ALTERNATIVES FOR ESTIMATING SEASONAL FACTORS ON RURAL AND URBAN ROADS IN FLORIDA (PHASE II)

Final Report
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Prepared for

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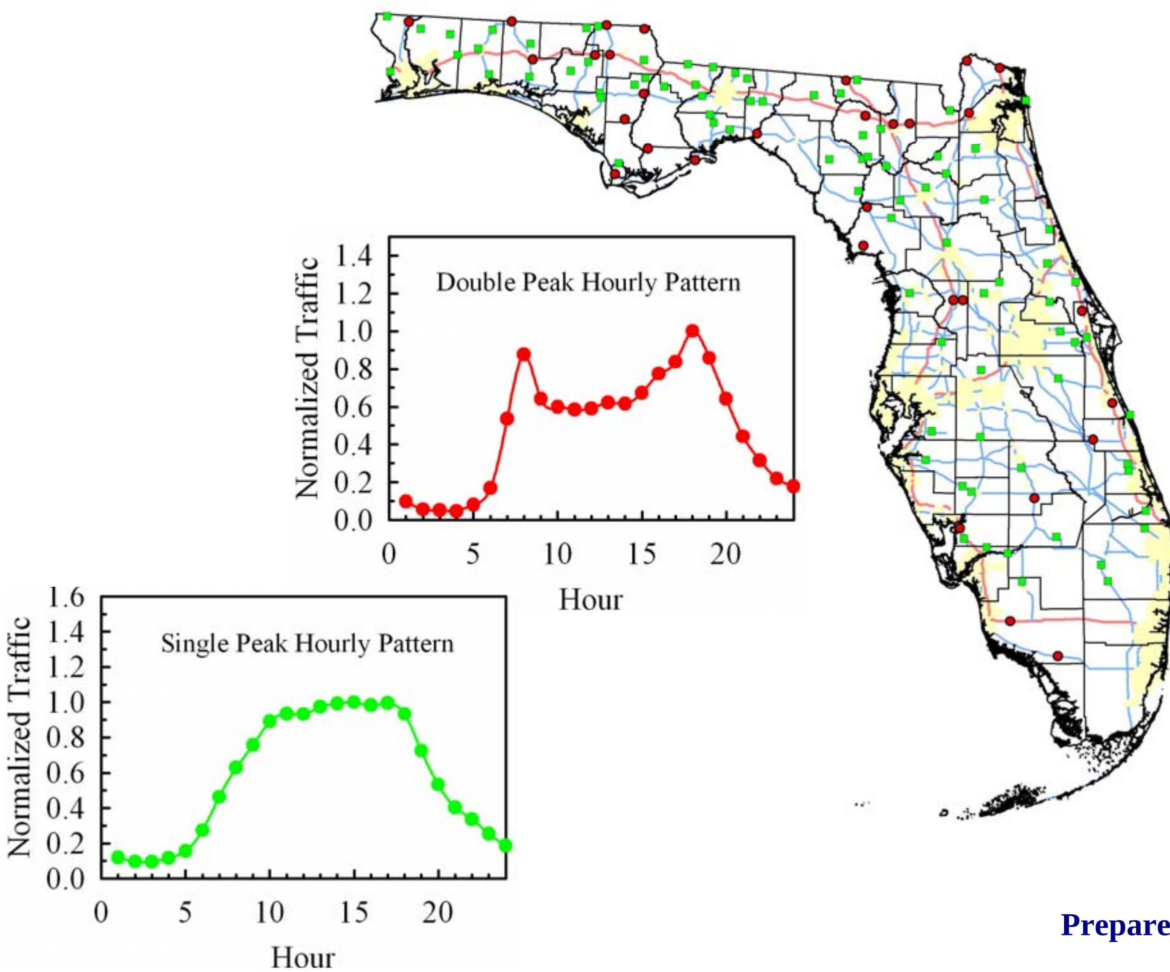

Prepared by

Lehman Center for Transportation Research
Department of Civil & Environmental Engineering
Florida International University

February 2008

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Submitted by

Fang Zhao, Ph.D., P.E.
Professor and Deputy Director

Shanshan Yang, M.S.
Research Assistant

and

Chenxi Lu, Ph.D.
Research Assistant

Lehman Center for Transportation Research
Department of Civil & Environmental Engineering
Florida International University
University Park Campus, EAS 3673
Miami, Florida 33199
Phone: 305-348-3821
Fax: 305-348-2802
E-mail: zhaof@fiu.edu

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16. Abstract

Current practice at the Florida Department of Transportation (FDOT) employs seasonal factors (SFs) in the calculation of annual average daily traffic (AADT) at portable traffic monitoring sites (PTMS). Permanent traffic monitoring sites (TTMSs) are first manually classified into different groups (known as seasonal categories). These groups are based on similarities in the traffic characteristics of roads and on engineering judgment. FDOT districts then assign a seasonal factor category to each PTMS according to the site's functional classification and geographical location. It is assumed that seasonal variability and traffic characteristics at the short-term and permanent count sites are similar in the same geographic area. A previous study investigated traffic and land use data in Southeast and North Florida, with the goal of making the seasonal factor assignment process more objective and data-driven, as this would improve the accuracy in AADT estimation for PTMSs. The results from that study demonstrated the possibility of identifying the link between land use variables and seasonal factors. In this follow-up study, a state-wide investigation is conducted, and multiple linear regression analyses are carried out. These are used to identify possible factors contributing to the seasonal fluctuations in traffic volumes for urban and rural locations with a TTMS in Florida. Based on these factors, a methodology is developed to determine which TTMSs are most likely to share similar seasonal factors with a PTMS in urban areas. This methodology may be improved and expanded for application to rural areas.

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EXECUTIVE SUMMARY

This research is a follow-up study to a previous project. The project entailed an investigation of the problems with seasonal factor grouping and assigning TTMS groups to coverage count sites. The previous study involved limited urban areas in Southeast Florida and rural areas in North Florida. The present study expands the investigation to all of the urban and rural areas in Florida. The goal of this expansion is to provide the necessary knowledge to implement a practical tool that can be used for estimating seasonal factors for coverage counts statewide.

The research involved the following: imputation of TTMS data, clustering of TTMSs to create seasonal factor groups, conducting regression analysis to identify influential land use variables that may affect seasonal factors, and a preliminary study of possible assignment methods.

Imputation refers to the replacement of missing data with a substitute. This substitute allows data analysis to be conducted without being misleading. This is important because there are less than 300 TTMSs in service, and 24.2% of them are missing data from the year 2000. The imputation method adopted in this study is easily understood and implemented.

Cluster analysis has been applied to statewide TTMSs to create seasonal factor groups. A model-based cluster technique using only the 12 MSFs proves to be more practical and produces reasonable results.

Regression models are developed to identify influential variables for the seasonal factors of TTMSs. It is found that influential variables for the seasonal factors of the TTMSs are different in urban and rural areas and in different climate zones. The state is divided into three climate zones. Separate models are developed for each zone. For North Florida, the most influential variables are as follows: whether a TTMS is close to a urban freeway; employment related to hotels and camps; employment related to museums, art galleries, and gardens; retired households; seasonal households; population ages 11-17; retired households with low income; residential university; etc. For Central Florida, important variables are agriculture workers; proximity of a TTMS to an urban collector, minor arterial, or principal arterial; median household income; retired households; seasonal households; population ages 11-17; low-income retired households; etc. For South Florida, hotels, museums, manufacturing employment, retired and seasonal households, and proximity to principal arterials are significant variables.

The approach for modeling the urban area TTMSs cannot be applied to rural TTMSs. This is because there is an insufficient number of TTMSs in which to divide the rural areas to model them separately. An alternative approach is developed to separately model those TTMSs for which the hourly traffic pattern on a typical weekday shows a single peak (i.e., recreational travel dominates) and those of which the weekday hourly traffic pattern has a double peak (i.e., commute travel dominates). Some variables are significant regardless of whether the TTMSs' hourly traffic patterns show a single or double peak. These include the distance to and population of a nearby urban area, seasonal households in South Florida, and retail employees in South Florida. For TTMSs with a single peak, manufacturing employment, a truck factor, and the population between ages 18 and 64 are also found to be important. Likewise, the distance from a TTMS to the closest public beach is found to be important for the double-peak TTMSs. Several variables describe the spatial proximity to nearby urban areas and the roadway function class. The significance of these variables suggests that the basis for some current practices, such as considering function class and roadway use, may be valid in rural areas.

For the purpose of assigning seasonal factors to a coverage count site, the influential variables obtained from the urban models are used in developing a method to identify a TTMS. This TTMS will be similar to a given count station in terms of land uses or roadway functions. A similarity score is developed to measure the similarity between two count sites. This score is based on the identified influential variables, which are weighted by their partial R^2 values in the models. This approach shows promising results: The average of standard errors in estimated seasonal factors is about 5% overall.

To further develop the results from this study for implementation, the following research efforts are recommended:

1) Conduct a more detailed analysis of the results of the assignment method to evaluate its accuracy. This is accomplished by determining the distribution of the errors. Note that this distribution includes the ranges, in addition to the currently used aggregate measure of mean errors. Understanding the locations or the characteristics of TTMSs where large errors occur will help identify variables that may be inappropriate. It can also indicate the need for additional variables.

2) Apply the proposed method to the assignment of seasonal factors in rural areas. Depending on the results, there may be a need to improve the regression models by identifying additional variables or to improve the definitions of existing variables.

3) Investigate the effect of inclusion or exclusion of different variables. For instance, if the exclusion of a variable does not change the assignment results, this variable may be left out to simplify the problem. Conversely, if a variable improves assignment results, it may be included even if its partial R^2 from regression analysis is somewhat low. The effectiveness of the weighting scheme and alternative weighting schemes may also be examined to improve the assignment results.

4) Explore the feasibility of estimating each of the monthly seasonal factors for a given PTMS based on the influential variables in the regression equation corresponding to the same month. This is done as opposed to matching a PTMS to a TTMS and borrowing all of the monthly seasonal factors from that TTMS.

5) Compare the assignment results from the proposed approach to those obtained using the existing method. Note that, in the existing method, the average of the seasonal factors of a TTMS group is assigned to a coverage count site.

6) Independently test the assignment methods by using data collected monthly from selected sites that are different from the existing TTMSs in terms of geographic location and land use and roadway characteristics. This testing serves two purposes. One is to validate the proposed assignment methods. The other is to investigate the distribution of existing

TTMSs to determine whether they provide adequate coverage by representing a wide range, commonly encountered combinations of land uses and roadway types. In the assignment process, redundant TTMSs may be identified if many in relative spatial proximity are found to be similar to nearby PTMSs in both their land use and roadway characteristics and in their seasonal factors. Conversely, an area may also be identified as needing additional TTMSs because of their unique land use and roadway functions. To remove redundant TTMSs will reduce the operating and maintenance costs. The saved resources may be reinvested by adding TTMSs to needed areas to improve the accuracy of AADT estimation.

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1. INTRODUCTION

1.1 Background and Problem Statement

State departments of transportation (DOTs) routinely collect traffic data. These data are used as inputs to numerous types of analyses, including planning, roadway design, pavement design, air quality, roadway maintenance, funding allocation, etc. One of the most important types of data is traffic volume. Annual Average Daily Traffic (AADT) is one of the most often used measures of traffic volume. AADT is defined for a roadway section as the total vehicle trips in one direction or both directions in one year, divided by the number of days in the year. Obtaining actual AADT information requires the collection of traffic data continuously throughout a year, which is expensive. In practice, DOTs usually collect continuous traffic data only at a limited number of sites. For many other sites where traffic data are required, 24- to 72-hour traffic data collection is usually conducted. Such traffic data are referred to as short-term counts or coverage counts. From these counts, average daily traffic (ADT) can be computed for the days when data are collected. ADT is then used to estimate AADT.

It is well known that traffic variations occur at different time scales. These may include time of day, day of week, and season (such as month) of the year, as stated in the Traffic Monitoring Guide (USDOT 2001) published by the Federal Highway Administration (FHWA). Of the known causes of temporal fluctuations in traffic streams, seasonal variation is probably the most important. It is a characteristic that must be accounted for in any traffic monitoring. Currently, the Florida Department of Transportation (FDOT) stores and reports traffic volume data collected from about 300 strategically located telemetry traffic monitoring sites (TTMS). These TTMSs record traffic data continuously and provide true AADT and seasonal factor information. This information is then utilized to convert ADT, obtained from short-term traffic counts collected at portable traffic monitoring sites (PTMSs), to AADT. To estimate AADT from ADT, the Florida DOT (FDOT) applies the following equation (FDOT 2002):

$$AADT = ADT \times SF \times Axle \tag{1-1}$$

where

- $AADT$ = an estimate of typical daily traffic on a road segment for all days of the week, Sunday though Saturday, over the period of one year;
- ADT = the average daily traffic, typically the average value of a 24- to 72-hour traffic count collected from Tuesday to Thursday;
- SF = a seasonal factor that reflects traffic seasonal fluctuation; and
- $Axle$ = an axle correlation factor that converts the counted number of axels to the number of vehicles.

Seasonal factors may be expressed as weekly and monthly factors. Weekly seasonal factors are used to account for traffic volume variations during a week. There are 12 monthly seasonal factors (MSFs), which are derived by dividing the monthly average daily traffic (MADT) at a given location with its AADT. In Florida, MSFs are obtained from the approximately 300 TTMSs. These TTMSs are grouped into clusters or factor groups based on similarities in their monthly variation patterns. The seasonal factors for a given group are the group averages. A coverage count site, or a portable traffic monitoring site (PTMS), is assigned to one of these factor groups. The AADT for a given coverage count location is then estimated using the seasonal factors of the assigned factor group.

Currently, in Florida, seasonal factor groups are assigned to coverage count sites according to subjective criteria. Furthermore, only the geographic location of a coverage count site and its functional classification are considered when an SF category is assigned. FDOT desires a data-driven, more objective approach to improve the estimation of seasonal factors and, thus, provide more accurate AADT estimates.

Constructing factor groups from TTMSs and estimating monthly factors with a given degree of precision has attracted a lot of attention over the years. Numerous studies have been conducted in the past to identify alternative approaches that reveal the truth-in-data and that reduce the subjective judgment involved in traffic data analysis. The major difficulty in developing factor groups lies not in the aggregation of the continuous counters applied to a given group. Instead, it is found in the specification of definable characteristics that allow the objective assignment of short counts to the seasonal factor groups. Seasonal traffic patterns may be affected by a roadway's functional classification (such as rural, urban, interstate, collector, and recreational), land use, etc. These factors, if understood and quantified, may potentially be exploited. They can aid in the assignment of seasonal factors from one or more TTMSs to a coverage count site or PTMS, which will reduce the data collection effort and improve the accuracy of AADT estimations.

With this being the goal, in 2004, the Lehman Center for Transportation Research, Florida International University, completed a research project on the development of seasonal factors. There are a number of conclusions that were drawn from the 2004 study (Zhao *et al*. 2004):

- A literature review confirmed the importance of geographic location in seasonal factor grouping and assignment.
- Model-based clustering incorporating coordinates of the TTMSs established practical numbers of factor groups.
- Linear regression analyses were conducted for selected urban and rural areas to identify possible explanatory variables for seasonal traffic fluctuations.
- For urban roads in southeast Florida, four variables were identified as significant indicators for seasonal fluctuations in traffic. They are seasonal residents, tourists, retired people between age 65 and 75 with high income, and retail employment.
- For rural roads, variables such as the functional classification for highways, percentage of seasonal households, agricultural employment, and the truck factor were identified as potential explanatory variables. The models, however, do not perform as well as those developed for the tri-county area in District 4. Further investigation is needed to improve the models for rural areas.
- No correlation was found between the seasonal factors and functional classification, traffic volumes per lane, or number of lanes.
- A fuzzy decision tree was constructed using the TTMS groups in the Southeast Florida tri-county area. The groups were obtained from the model-based cluster analysis for assigning seasonal factors to coverage counts.

- A geographic information system (GIS) based computer program was developed to demonstrate the usefulness of a GIS user interface for visualization of land use, demographic, socioeconomic, transportation systems, and traffic counts.

The 2004 study was limited in geographic coverage. Only data from the TTMSs in rural areas in District 2 and 3 and the urban areas in Districts 4 and 6 were analyzed. To make the research results useful, a seasonal factor assignment method applicable to the entire state of Florida is needed.

1.2 Research Goals and Objectives

Implementing a practical tool that is applicable statewide for both rural and urban area applications requires the following:

- An understanding of the factors underlying the seasonal traffic patterns. Because of the noticeable changes in climate from the north to the south and different types of local economies, these factors may be different depending on the area.
- Adequate TTMSs data to ensure valid statistical analyses.
- Identifying and quantifying the underlying factors as variables and statistically verifying the variables that have a link to seasonal factors.
- Successful development of a methodology for assigning a set of seasonal factors obtained from TTMSs to coverage count sites. This methodology must be applicable to all districts for both urban and rural areas. This depends on the success of identifying variables that adequately explain the seasonal variations in traffic.
- Validation of results from the developed methodologies to evaluate the accuracy of the methodology.
- Development of application software to provide easy-to-use tools to district data administrators to assist in their data collection and analysis tasks.

The need for a practical tool that will improve the seasonal factor assignment process to make it more consistent, objective, and accurate is fully recognized. However, there are still currently uncertainties regarding whether the methodology may be easily expanded to other districts. Some districts have limited number of TTMSs, which makes it difficult to draw reliable conclusions statistically. Models for rural areas also need to be improved before they can be applied to establish the fuzzy decision trees for short count seasonal factor assignment. Given these uncertainties and limitations, it is proposed that research proceed in two stages. The first stage will focus on identifying the variables that are effective in explaining the seasonal traffic patterns for all FDOT districts, including both urban and rural areas. The success of this research will ensure that a methodology for assigning seasonal factors to short term counts is successfully developed.

Therefore, this research is focused on investigating potential variables that may be used to develop a statewide approach for assigning short-term counts to seasonal factor groupings. This research builds upon the initial seasonal factor study completed for Southeast Florida. The goal is to develop a statewide approach based on readily available socioeconomic and traffic characteristics data. The following research tasks will be performed:

1. Identify, evaluate, and develop alternative approaches that have the potential to improve the current seasonal factor grouping process.
2. Identify possible explanatory variables that allow more accurate assignment of short-count sites to a given seasonal factor group.
3. Develop a methodology to assign established seasonal factor groups to short count sites based on the explanatory variables.

1.3 Report Organization

The remainder of this report is divided into six chapters. Chapter 2 describes the data imputation effort to maximize the number of TTMSs that may be used in this study. A large number of useful TTMSs will both allow a better coverage of the geographic area in the state and ensure the validity and reliability of the statistical analyses.

Chapter 3 presents the results of seasonal factor grouping. The grouping is performed for each analysis region and for urban and rural TTMSs separately. The cluster employs the model-based cluster analysis technique.

The identification of influential variables of traffic seasonality in urban areas is discussed in Chapter 4. That for rural areas is discussed in Chapter 5. The entire state is divided into three climate zones, or analysis regions, to account for the significant differences in climate across the state. Regression models are then developed for each of the three regions based on TTMSs in urban areas. The rural area TTMSs are divided into two groups based on their typical weekday hourly traffic patterns. TTMSs in each group are then modeled by regression analysis.

Chapter 6 gives a description of a preliminary investigation of a potential assignment procedure. Instead of assigning a seasonal group to a PTMS, a unique score is computed for a paired PTMS and TTMS to determine how similar they are to each other. Based on such similarity scores, TTMSs are ranked to identify the most likely match with a PTMS. The seasonal factors of the TTMS may be considered for use at the PTMS.

Chapter 7 provides conclusions from this study. Recommendations for future work necessary to bring the research results to implementation are also made.

There are four appendices. Appendices A and B describe the imputation results for TTMSs in urban and rural areas, respectively. Appendix C provides the name, definition, description, and SICS code of all of the employment categories that are selected to develop the employment variables used in this study. Appendix D gives the definition of the variables used in the regression analyses.

2. IMPUTATION OF TTMS DATA

The data used in this research are from the year 2000. The decision to use these data is based on census data being available for that year. Hence, the data on demographics are likely to be more accurate.

Traffic volume data were continuously collected from nearly 285 telemetry traffic monitoring sites (TTMSs) located in 68 counties in Florida in the year 2000. Due to the operational environment of the devices, missing and erroneous data are unavoidable. As a result, 60 TTMSs are missing some or all seasonal factors. These 60 TTMSs comprise more than 20% of all TTMSs. A common practice when treating incomplete data is the removal of records with missing values. However, because of the limited number of TTMSs and the large area they need to serve, it is important that as many TTMSs as possible be used for this analysis. This will ensure that 1) the largest possible geographic coverage is achieved and 2) statistical results are valid.

Historical data for the TTMSs with missing monthly seasonal factors (MSFs) are examined. Then, the missing data are estimated based on techniques in trend analysis and averaging. This procedure is described in this chapter.

2.1 Data Structure

Traffic data collected from the Florida TTMS sites are stored in four MS Access files on the Florida Traffic Information (FTI) CD. For urban areas, the monthly adjustment factors used in this study are stored in the DIRECTIONAL_VOLUME table in the Microsoft Access file Traffic_CD.mdb. There are 12 columns, with headings JANV, FEBV, MARV, APRV, MAYV, JUNV, JULV, AUGV, SEPV, OCTV, NOVV, and DECV, that store the MSFs for the 12 months. Monthly factors for each direction, as well as for both directions, are provided. The FTI CDs used in this research are from the year 1997 to the year 2005. A sample of the seasonal factor database used in this research is shown in Table 2.1. The highlighted cells indicate missing MSFs.

The databases also use four flags to describe each day when data were collected:

- "N" for Normal,
- "A" for an atypical day,
- "H" for an atypical holiday day, and
- "S" for an atypical day with special event.

Table 2.1 Sample Seasonal Factor Database on FTI CD

COUNTY	SITE	YEAR	DIR	JANV	FEBV	MARV	APRV	MAYV	JUNV	JULV	AUGV	SEPV	OCTV	NOVV	DECV
01	0014	2000	B	0.9300	0.8400	0.8300	0.9300	1.0300	1.0900	1.0900	1.0800	1.1000	1.0100	0.9500	0.9500
01	0014	2000	N	0.9400	0.8400	0.8300	0.9200	1.0300	1.0800	1.0900	1.0800	1.1000	1.0200	0.9600	0.9600
01	0014	2000	S	0.9100	0.8400	0.8300	0.9400	1.0400	1.0900	1.0800	1.0700	1.0900	1.0000	0.9400	0.9400
01	0228	2000	B	0.9500	0.8600	0.8600	0.9400	1.0200	1.1000	1.1300	1.1100	1.1300	1.0400	1.0000	0.9700
01	0228	2000	E	0.9500	0.8600	0.8600	0.9400	1.0200	1.1000	1.1200	1.1000	1.1300	1.0400	1.0000	0.9700
01	0228	2000	W	0.9500	0.8600	0.8600	0.9400	1.0200	1.1000	1.1300	1.1100	1.1300	1.0400	1.0000	0.9600
01	0350	2000	B	0.0000	0.0000	0.0000	0.8800	0.9900	1.0600	1.0400	1.0700	1.1200	1.0500	0.9300	0.9400
01	0350	2000	N	0.0000	0.0000	0.0000	0.8500	0.9600	1.0400	1.0400	1.0700	1.1200	1.0700	0.9400	0.9600
01	0350	2000	S	0.0000	0.0000	0.0000	0.9000	1.0100	1.0700	1.0400	1.0700	1.1100	1.0200	0.9200	0.9100
01	9917	2000	B	0.0000	0.9100	0.8800	0.9900	1.1100	1.1500	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
01	9917	2000	S	0.0000	0.9100	0.8800	0.9900	1.1100	1.1500	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
02	0044	2000	B	1.0000	0.9200	0.9100	0.9700	1.0200	1.0600	1.0300	1.0600	1.1300	0.9800	0.9300	1.0100
02	0044	2000	N	1.0200	0.9300	0.9100	0.9400	1.0200	1.0600	1.0400	1.0600	1.1100	0.9700	0.9400	1.0200
02	0044	2000	S	0.9900	0.9100	0.9100	0.9900	1.0300	1.0600	1.0200	1.0600	1.1500	0.9900	0.9200	1.0000
02	0324	2000	B	0.9800	0.9000	0.8900	0.9400	1.0200	1.1100	1.1700	1.0500	1.0100	0.9700	0.9700	1.0600
02	0324	2000	E	0.9900	0.9100	0.9000	0.9500	1.0000	1.0900	1.1700	1.0600	1.0200	0.9700	0.9800	1.0300
02	0324	2000	W	0.9700	0.8900	0.8900	0.9400	1.0500	1.1200	1.1700	1.0500	1.0000	0.9600	0.9600	1.0800
03	0094	2000	B	0.9500	0.8400	0.8700	0.9500	1.0700	1.1300	1.1500	1.1100	1.1500	1.0100	0.9500	0.9200
03	0094	2000	E	0.9400	0.8300	0.8600	0.9600	1.0700	1.1400	1.1600	1.1200	1.1700	1.0100	0.9500	0.9200
03	0094	2000	W	0.9600	0.8500	0.8800	0.9500	1.0600	1.1200	1.1400	1.1000	1.1400	1.0100	0.9500	0.9200
03	0143	2000	B	0.9600	0.9000	0.9100	0.8800	0.9300	1.1300	1.2000	1.1500	1.1200	1.0800	0.9700	0.9200
03	0143	2000	N	0.9700	0.9100	0.9100	0.8800	0.9200	1.1200	1.2000	1.1400	1.1100	1.0800	0.9800	0.9200
03	0143	2000	S	0.9500	0.9000	0.9100	0.8900	0.9300	1.1300	1.1900	1.1700	1.1200	1.0800	0.9600	0.9100
03	0191	2000	B	0.9600	0.8700	0.8500	0.9600	1.0500	1.1200	1.0900	1.1000	1.1300	1.0400	0.9400	1.0000
03	0191	2000	N	0.9600	0.8700	0.8500	0.9500	1.0400	1.1100	1.0900	1.1000	1.1400	1.0500	0.9500	1.0000
03	0191	2000	S	0.9600	0.8600	0.8500	0.9700	1.0600	1.1200	1.0900	1.0900	1.1300	1.0300	0.9400	1.0000

2.2 Statistics of TTMSs with Missing 2000 MSFs

For the year 2000, there are a total of 285 TTMSs statewide, and 69 of them are missing one or more MSFs. For those 69 TTMSs, 36 sites are located in urban areas and 33 in rural areas. Table 2.2 and 2.3 list the TTMSs with missing MSFs in urban and rural areas, respectively. These missing data result in a loss of 24.2% of the useable data for the year 2000.

Table 2.2 List of TTMSs with Missing Data in Urban Areas

Index	COSITE	Description
1	140013	US 41, 0.4 MI. NORTH OF DALE MABRY HIGHWAY
2	150086	US 92 1 MI EAST OF SAN MARTIN BLVD.
3	460305	US-98/SR-30, APPROX. 250' WEST OF HATHAWAY BRIDGE
4	480159	US 29,0.8 MI N OF US-90-A , WIM#16
5	509940	SR-267, 1 MI. NORTH OF I-10, QUINCY
6	530117	US 90,WEST OF RUSS STREET, MARIANNA
7	559908	US319, 0.3 MI E OF SR 61, TALLAHASSEE, WIM#8
8	589937	SR-87, 180 FEET NORTH OF BASS LN., MILTON
9	729923	I-95, 0.75MI S OF DUNN AVE, JACKSONVILLE, WIM#23
10	799929	US1, 0.25MI N OF RIO GRANDE RD, EDGEWATER, WIM#29
11	870187	SR-836,0.8 MI E OF NW 107TH AVE UNDERPASS,DADE CO.
12	930099	SR-7/US-441 ONE MI. N OF SR-806,(REF 0694) TTMS
13	930174	I-95, S.E. CORNER OF CONGRESS AVE. O.P.,W PALM BCH
14	930257	SR 715, .7 MILES SOUTH OF HOOKER HIGHWAY (TTMS)
15	970267	SR 821, APPROX. 0.5 MI. SOUTH OF NW 25TH ST.
16	970403	TPK, 0.2 MI N OF PEMBROKE RD (TTMS)
17	970410	TPK, 1500 FT N OF SR834/SAMPLE RD
18	970413	TPK, 2627 FT N OF SR806/ATLANTIC AVE TTMS
19	979913	FL TURNPIKE AT BECKER RD OP, SOUTH OF FT PIERCE
20	979934	HOMESTEAD EXTN., SOUTH OF I-75 INTERCHANGE
21	109922	I-275 TAMPA, 0.25MI N OF FLETCHER AVE., WIM#22
22	140199	US-19,1.4 MI. N. OF SR-54,NEW PORT RICHEY,PASCO CO
23	360317	I-75, SB SHOULDER, 0.35 MILES N OF WILLIAMS RD.
24	550207	MERIDIAN RD., NORTH OF BRADFORD RD., TALLAHASSEE
25	710189	US-17,0.6 MI SOUTH OF CR-220,CLAY CO.-- UC 6/94
26	729914	I-295, 3.0 MI N OF I-10
27	799906	I-4, 0.4 MI E ENTERPRISE RD OP -- REPL TTMS 0179
28	920303	I-4/SR-400, APPROX. 0.4 MI. SW OF ORANGE CTY. LINE
29	720157	I-295,3.0 MI N OF I-10,WIM#14 -- UC 9/94
30	100341	SR674-COLLEGE AV, 285 FT W CYPRESS V BLVD-HILLS#53
31	100338	SR583 (56TH ST), 1216 FT S OF SLIGH AVE - HILLS#03
32	100342	SR45/US41, 574 FT N OF TRENTON ST - HILLS#58
33	100339	SR60 (CC CSWY), 1996 FT W ROCKY PT DR - HILLS#18
34	860255	SR 834/SAMPLE RD. 0.14 MI.W OF NW 14TH AVE. TTMS
35	860256	SR 818/GRIFFIN RD, 112' WEST OF SW 70TH AVE. TTMS
36	550201	US-319(CAPITAL CIRCLE), 0.3 MI. EAST OF SR-61

Table 2.3 List of TTMSs with Missing Data in Rural Areas

Index	COSITE	Description
1	010014	US 41, 1.4 MI N OF OIL WELL ROAD (R-117,1000,9917)
2	130146	SR64, 1 MI W OF CR675, E OF DESOTO SPDWY @ PTMS 18
3	140079	US 98/301, 0.5 MI SOUTH OF US 301 & 98 JCT.
4	290269	I 10, 0.45 MI EAST OF US41, LAKE CITY
5	300234	SR 349, 0.1 MILES NORTH OF FOREST HILLS
6	479944	SR-69, 2.5 MILES S. OF CITY LINE, SELMAN
7	540245	SR 59, 1150' NORTH OF US 27
8	550211	SR-20, BTWN COES LANDING RD & WILLIAMS LANDING RD
9	550349	SR-61/US-319, MP-15.033, 300' N. OF CHEROKEE ROAD
10	700223	SR-407,0.7 MI. SOUTHWEST OF I-95,BREVARD CO.
11	740047	US 1, 7.0 MI N OF HILLIARD AT STATE LINE
12	750104	SR-50,0.19 MI. W. OF SR-520 NEAR BITHLO (TTMS)
13	799925	US92,0.25MI E OF CLARK'S BAY RD,E OF DELAND,WIM#25
14	890289	SR 76/KANNER HWY, 3 MILES WEST OF CR 711 - TTMS
15	920065	SR-500, 2.0 MI. W OF SR-15 (IN HOLOPAW) (TTMS-C)
16	939935	US-27/SR-25, 1.9 MI. N OF TALISMAN SUGARMILL RD.
17	560301	SR-12,1.7 MILES SOUTH OF GADSEN COUNTY LINE
18	010350	I-75, AIRPORT RD OVERPASS, PUNTA GORDA MP-13.480
19	040271	SR 72, 600' WEST OF CR661
20	090229	SR 66, 430' EAST OF SPARTA ROAD
21	120273	SR 31, 202' NORTH OF FOXHILL ROAD
22	299936	I-10, 50 FT. WEST OF CR-250 OVERPASS, LAKE CITY
23	480348	SR-95/US-29, MP-15.984, 450' N. OF CHURCH ROAD
24	580251	US 90, 0.9 MILES WEST OF OKALOOSA COUNTY
25	599946	SR-363, 1.1 MILES S. OF US-98, ST. MARKS
26	700134	SR-9/I-95,3.34 MI. S. OF SR-514
27	030351	COLLIER CO. I-75, GOLDEN GATE W OF EVERGLADES BLVD
28	609938	US-331/SR-83, APPROX. 3.2 MILES NORTH OF FREEPORT
29	019917	US41, 4.8 MI N OF LEE CO (NEAR R 14, 1000 & 117)
30	079918	SR 25/80, US 27 1.6 MI EAST OF SR 80 R-160
31	549901	I10 JEFFERSON CO, APPROX 1.0 MI E OF SR257, WIM#1
32	609928	I-10/SR-8, APPROX. 1.3 MI. WEST OF BOY SCOUT ROAD
33	269904	I-75/SR-93, 3 MILES NORTH OF MARION COUNTY LINE

2.3 Data Imputation Procedure

To impute the missing data for the urban areas, all of the available historical MSFs data from 1997 to 2005 are checked for each site with missing data in the year 2000. However, for rural areas, the MSFs are imputed based on the historical data from 1998 to 2005. This is because the data structure used for 1997 is different from that of the other years. Furthermore, for rural areas, only the weekday data are used in imputation. This is a decision made to reduce the problem complexity since the effect of atypical traffic data due to weekends, holidays, special events, and other non-recurring events may be more pronounced in rural areas than urban areas due to the relatively light traffic on rural roads.

The data imputation procedure follows the rules below:

(1) If only one or two MSFs are missing from the 2000 data, use the data from 1999 or another year only for the months with missing data.
(2) If more then two MSFs are missing, check the 1999 data. If no data are missing, and the seasonal pattern is consistent with those from the other years, use the 1999 data for 2000.
(3) If the data from 1999 have MSFs that are significantly different from those from the other years, use the average values from all years but excluding the 1999 MSF(s).
(4) If the data from 1999 are also missing, look for the next closest year that has complete MSFs.

The imputation results for urban and rural areas are presented in Appendix A and Appendix B, respectively. Three examples are presented below to illustrate the procedure for data imputation.

Example 1: The data from the year 2000 borrowed from the year 1999

For site #930099, the MSFs are missing for six months. Figure 2.1 plots the historical data. Note that the seasonal patterns from year to year are quite similar and that the 1999 pattern is consistent with those of other years. This means that the 1999 data can be borrowed for the year 2000. Table 2.4 shows that the 1999 MSF data are complete. Therefore, the 1999 data are adopted.

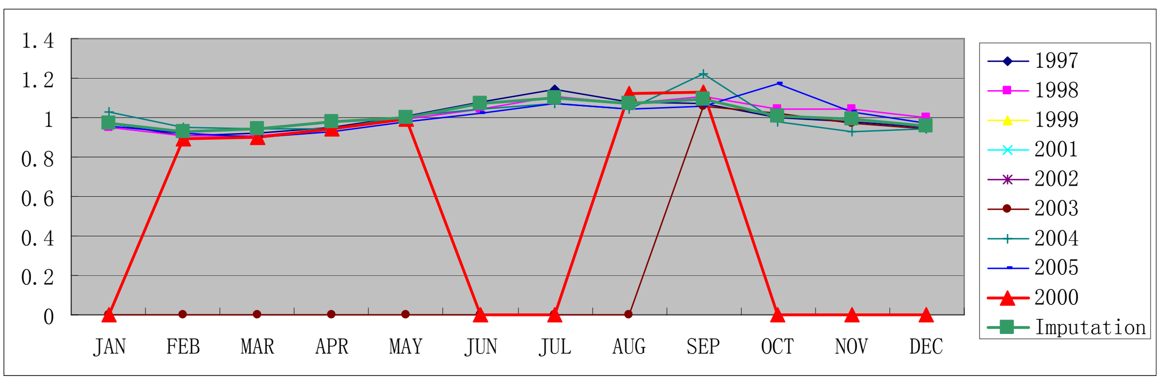


Figure 2.1 Historical Data Plot for Site 930099

Table 2.4 Imputation of Site 930099

YEAR	MSF											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	0.97	0.91	0.92	0.95	1.01	1.08	1.14	1.08	1.07	1	0.98	0.95
1998	0.95	0.91	0.91	0.94	0.99	1.04	1.11	1.07	1.11	1.04	1.04	1
1999	0.97	0.93	0.94	0.98	1	1.07	1.1	1.07	1.09	1.01	0.99	0.96
2001												
2002												
2003	0	0	0	0	0	0	0	0	1.06	1.02	0.97	0.94
2004	1.03	0.95	0.94	0.94	1.01	1.04	1.07	1.04	1.22	0.98	0.93	0.94
2005	0.96	0.92	0.9	0.93	0.98	1.02	1.07	1.04	1.06	1.17	1.03	0.97
2000	0	0.89	0.9	0.94	0.99	0	0	1.12	1.13	0	0	0
Imputed	0.97	0.93	0.94	0.98	1	1.07	1.1	1.07	1.09	1.01	0.99	0.96
Source year	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999

Example 2: The October MSF borrowed from the 1999 data based on the average

For site 930174, all of the 12 MSFs for 1999 are available. However, the MSF for October 1999 is different from those from all other years. Therefore, the average value of all other years is computed as the imputed value. Figure 2.2 shows the historical data plot. Table 2.5 provides the data used and the imputed values.

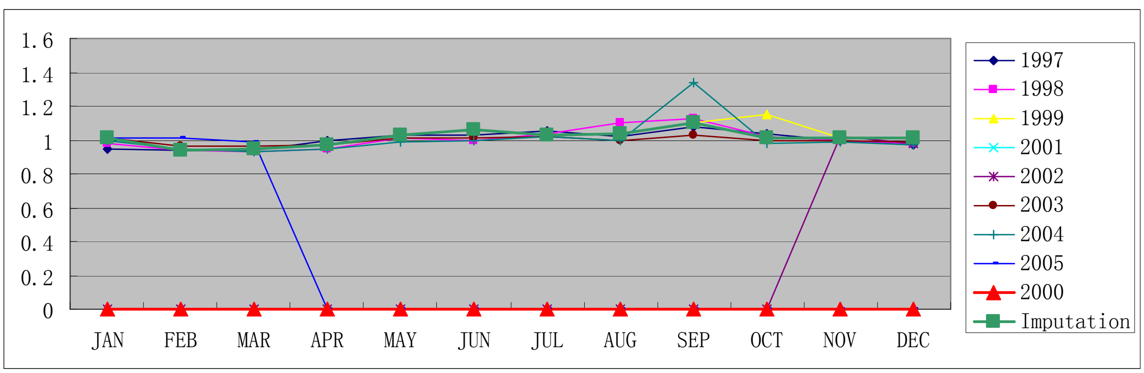


Figure 2.2 Historical Data plot of Site 930174

Table 2.5 Imputation of Site 930174

YEAR	MSF											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	0.95	0.94	0.94	1	1.03	1.03	1.05	1.02	1.08	1.04	1	0.97
1998	0.98	0.94	0.93	0.95	1.01	1	1.04	1.1	1.13	1.02	1	0.98
1999	1.01	0.94	0.95	0.97	1.03	1.06	1.03	1.04	1.1	1.15	1.01	1.01
2001												
2002	0	0	0	0	0	0	0	0	0	0	1.02	0.98
2003	1.01	0.96	0.96	0.97	1.01	1.01	1.02	1	1.03	1	1	0.99
2004	1	0.95	0.93	0.95	0.99	1	1.02	1	1.34	0.98	0.99	0.97
2005	1.01	1.01	0.99	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0	0	0
Imputed	1.01	0.94	0.95	0.97	1.03	1.06	1.03	1.04	1.1	1.01	1.01	1.01
Source year	1999	1999	1999	1999	1999	1999	1999	1999	1999	Avg.	1999	1999

Example 3: The entire year 2001 data borrowed

For site 740047, data for four months in 2000 are missing. The 1999 data are also missing for several months and cannot be used. As a result, the 2001 data are borrowed. Figure 2.3 shows that seasonal patterns are similar for the period between 1997 and 2005. Table 2.6 gives the imputation results.

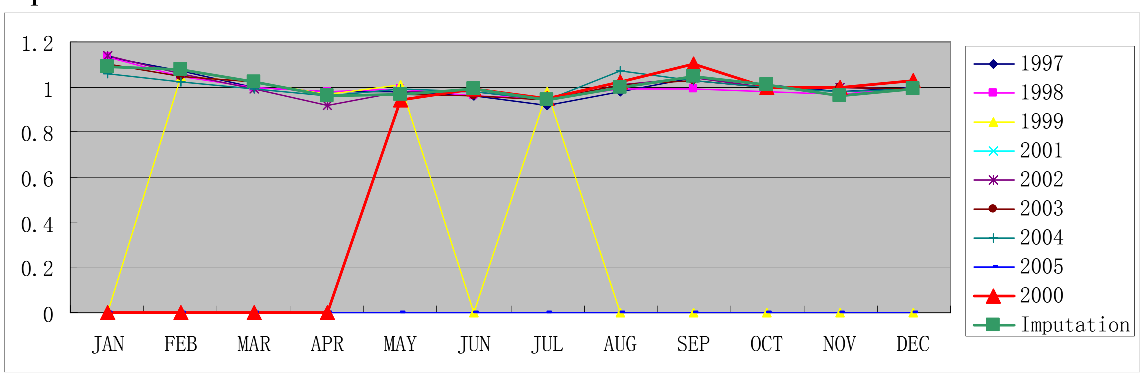


Figure 2.3 Historical Data Plot for Site 740047

Table 2.6 Imputation of Site 740047

YEAR	MSF											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.13	1.07	1	0.98	0.98	0.96	0.92	0.98	1.04	1.01	0.98	1
1998	1.13	1.05	1	0.98	0.99	0.96	0.95	0.99	0.99	0.98	0.97	1
1999	0	1.05	1.02	0.97	1.01	0	0.98	0	0	0	0	0
2001	1.09	1.08	1.02	0.96	0.97	0.99	0.94	1	1.05	1.01	0.96	0.99
2002	1.14	1.06	0.99	0.92	0.98	0.98	0.94	1.01	1.04	1	1	0.99
2003	1.1	1.05	1.02	0.96	0.97	0.96	0.94	1.01	1.03	1	1	0.99
2004	1.06	1.02	0.99	0.96	0.99	0.98	0.94	1.07	1.03	1	0.98	0.99
2005	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0.94	0.99	0.95	1.02	1.1	1	1	1.03
Imputed	1.09	1.08	1.02	0.96	0.97	0.99	0.94	1	1.05	1.01	0.96	0.99
Source year	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001

2.4 Data Imputation Results

For the 69 TTMSs with missing data in 2000, the MSFs for 54 sites are imputed successfully. The remaining 15 sites cannot be imputed for the following reasons:

(1) Three sites do not have reliable historical data.
(2) Three sites show inconsistent patterns in the historical data.
(3) Two sites are co-located with other sites.
(4) Seven sites have no MSF data for all of the years.

These 15 sites are excluded from the datasets used for analyses. Table 2.7 lists these sites and gives the reasons for unsuccessful imputation in the last column. "C" indicates that a TTMS is co-located with another TTMS. Therefore, it is not needed. "U" indicates unreliable historical data. "M" means no data are available. "V" means that there are large variations in the historical data.

Table 2.7 List of TTMS with Missing Data after Imputation

Index	SITE	Description	Reason
1	019917	US41, 4.8 MI N OF LEE CO (NEAR R 14, 1000 & 117)	C
2	100338	SR583 (56TH ST), 1216 FT S OF SLIGH AVE - HILLS#03	U
3	100339	SR60 (CC CSWY), 1996 FT W ROCKY PT DR - HILLS#18	U
4	100341	SR674-COLLEGE AV, 285 FT W CYPRESS V BLVD-HILLS#53	U
5	269904	I-75/SR-93, 3 MILES NORTH OF MARION COUNTY LINE	V
6	550201	US-319(CAPITAL CIRCLE), 0.3 MI. EAST OF SR-61	C
7	609928	I-10/SR-8, APPROX. 1.3 MI. WEST OF BOY SCOUT ROAD	V
8	799906	I-4, 0.4 MI E ENTERPRISE RD OP -- REPL TTMS 0179	V
9	079918	SR 25/80, US 27 1.6 MI EAST OF SR 80 R-160	M
10	100342	SR45/US41, 574 FT N OF TRENTON ST - HILLS#58	M
11	549901	I10 JEFFERSON CO, APPROX 1.0 MI E OF SR257, WIM#1	M
12	720157	I-295,3.0 MI N OF I-10,WIM#14 -- UC 9/94	M
13	860255	SR 834/SAMPLE RD. 0.14 MI.W OF NW 14TH AVE. TTMS	M
14	860256	SR 818/GRIFFIN RD, 112' WEST OF SW 70TH AVE. TTMS	M
15	920303	I-4/SR-400, APPROX. 0.4 MI. SW OF ORANGE CTY. LINE	M

“C”: Co-located with another site.
“U”: Historical data are unreliable.
“M”: Not included in MSF dataset.
“V”: Cannot be imputed as large variation in historical data.

3. SEASONAL FACTOR GROUPING

This chapter presents the seasonal factor grouping for urban and rural areas. The grouping can be used later for short-term count site assignment to seasonal factor groups. The groups may also provide clues as what geographic areas might share similar land use characteristics.

All of the TTMSs are classified as urban and rural sites according to the map provided on the FDOT 2000 Traffic Information CD. The map is shown in Figure 3.1. Grouping is performed for the urban and rural TTMSs separately.

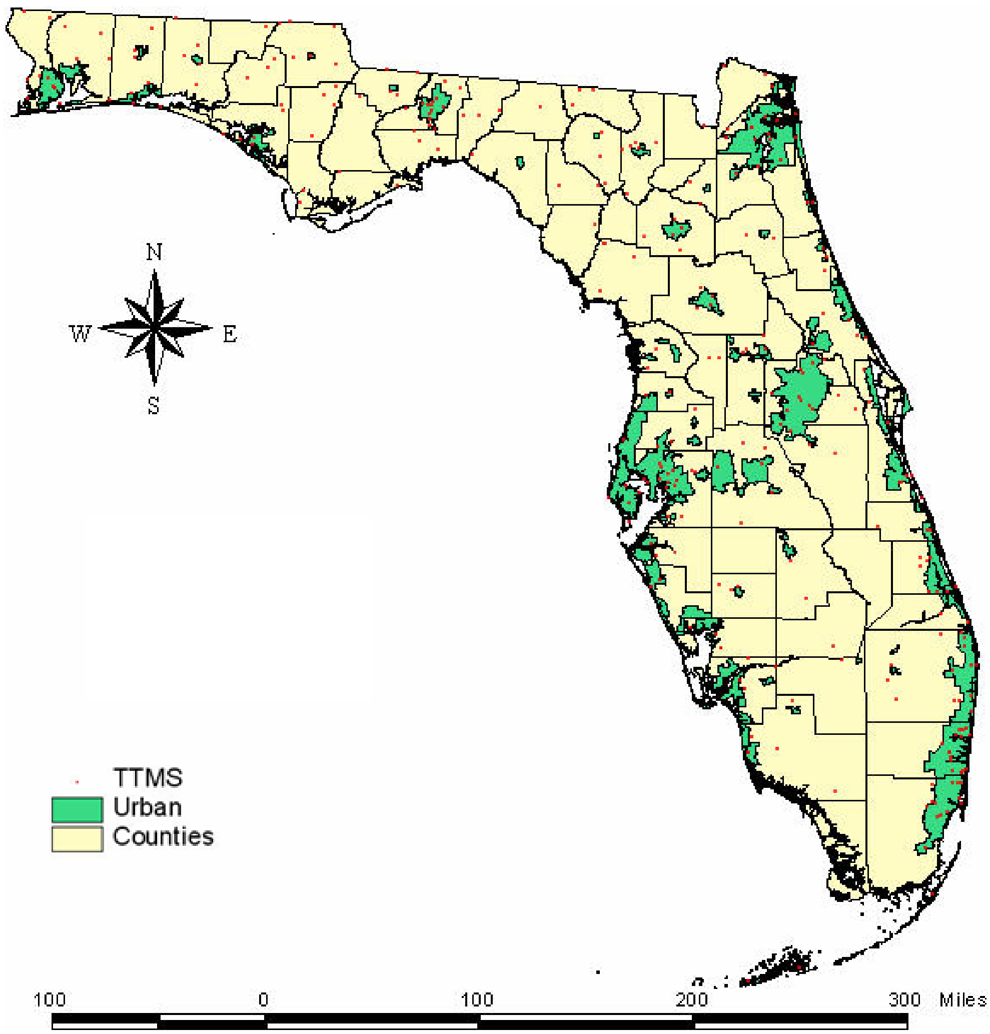


Figure 3.1 Urban and Rural Area Definition

The creation of seasonal factors groups involved both cluster analyses and manual adjustments. The statistical methods available include hierarchical cluster analysis and model-based cluster analysis methods. These methods group the TTMSs based on the similarity between their MSFs. Compared with the hierarchical cluster method, model-based cluster analysis gives the grouping result as well as the optimal number of groups. Thus, the model-based cluster analysis method is adopted to determine grouping.

Different sets of variables are also tested for model-based cluster analysis. These include:

- 12 MSFs only;
- 12 MSFs and 2 location variables (longitude and latitude);
- 12 MSFs and 11 slope variables (11 differences between two adjacent months' seasonal factor).

When the location variables, expressed as the longitude and latitude of the TTMSs, are included in the cluster analysis, the optimal group number grows significantly. A comparison of the results obtained by using the above sets of variables will be given in Sections 3.1.1 and 3.2.1.

The 11 slope variables represent the direction of change in MSF from one month to the next. The purpose is not only to group TTMSs that have similar MSFs, but also to make them similar in the direction of the changes. Therefore, 11 slope variables (difference between MSF of one month and that of the previous month) plus the 12 MSFs are used in the cluster analysis. However, the introduction of the slope variables only slightly improved the cluster results and only for urban TTMSs. The results obtained using the 12 MSFs as the variables and the results using the 23 variables are compared in Table 3.1 and Table 3.2, respectively, for urban and rural TTMSs. The comparison is made based on the following three measures of effectiveness:

- The average squared deviation of the 12 MSFs for all sites, which is the sum of the 12 squared distances between MSFs for each site, and the average MSFs for the group:

$$D = \frac{\sum_{j=1}^{N}\sum_{i=1}^{12}\left(MSF_{ji} - \overline{MSF}_i\right)^2}{N} \tag{3-1}$$

  where
  D = the average squared deviation of MSFs
  MSF_{ji} = the monthly seasonal factor for month i and TTMS j,
  $\overline{MSF_j}$ = the group average MSF for month i,
  N = the number of TTMSs in each group.
- The number of months for which the MSFs exceed the threshold of 5% of the group average.
- The number of TTMSs for which the MSFs exceed the threshold of 5% of the group average.

The smaller the values of these measurements are, the better the result is.

Table 3.1 Comparison of MOE for Urban Area

12 Variables				
Group	Group Size	D	# Months over 5%	# TTMSs over 5%
1	5	0.0257	15	5
2	10	0.0150	17	8
3	5	0.0168	14	5
4	32	0.0072	15	10
5	32	0.0062	15	10
6	19	0.0135	27	10
7	4	0.0172	8	3
8	1	NA	NA	NA
9	4	0.0104	5	2
10	11	0.0097	10	6
SUM	123	0.1217	126 (8.54%)	59 (47.97%)
23 Variables				
1	9	0.0247	26	8
2	12	0.0092	9	6
3	27	0.0077	13	8
4	6	0.0206	13	6
5	5	0.0201	10	3
6	1	NA	NA	NA
7	5	0.0136	9	3
8	17	0.0123	20	9
9	31	0.0057	13	10
10	10	0.0080	6	4
SUM	123	0.1220	119 (8.06%)	57 (46.34%)

Table 3.2 Comparison of MOE for Rural Area

12 Variables				
Group	Group Size	D	# Months over 5%	# TTMSs over 5%
1	28	0.0165	52	17
2	5	0.0164	9	4
3	2	0.0271	6	2
4	27	0.0126	38	20
5	13	0.0143	21	10
6	42	0.0123	47	23
7	12	0.0272	32	10
8	12	0.0205	29	7
9	6	0.0268	18	5
SUM	147	0.1736	252 (14.29%)	98 (66.67%)
23 Variables				
1	10	0.0190	16	6
2	26	0.0139	45	16
3	22	0.0195	50	17
4	2	0.0271	6	2
5	22	0.0140	31	14
6	36	0.0111	40	20
7	10	0.0154	18	8
8	7	0.0347	28	6
9	12	0.0282	32	10
SUM	147	0.1828	266 (15.08%)	99 (67.35%)

Based on the above discussion, model-based cluster analysis with only 12 MSFs as the variables is used for grouping the TTMSs. This is followed by manual adjustment of the seasonal factor groups. Note that the results from the model-based cluster analysis with the location variables are also used as a reference during the manual adjustment process. The adjustment is made based on the following general rules:

(1) Groups with TTMSs located in the same geographic area and sharing similar MSF patterns remain unchanged.
(2) A groups is subdivided in the following two cases:
    (a) The TTMSs within a group are geographically separated by a long distance, or there is a significant difference in their latitudes. The latter may mean a significant difference in climate. For instance, a TTMS located in South Florida will not be grouped together with one in Jacksonville.
    (b) The MSFs of some TTMSs have a different pattern from that of the others within the same group.

The grouping results are described in greater detail in the following sections.

3.1 Seasonal Factor Grouping for Urban Areas

Of the 270 TTMS, 128 are in urban areas. The model-based cluster analysis without considering the locations resulted in 10 groups.

Table 3.3 Comparison of Cluster Analyses for Urban TTMSs

Method	Number of Groups
Model based without X, Y	10
Model based with X, Y	33

3.1.1 Results from Cluster Analysis in Urban Areas

The grouping results from model-based clustering method for the TTMSs located in urban areas, without incorporating the X and Y coordinates, are shown in Figure 3.2. The model produces ten clusters that include TTMSs that are far apart when the location effect is not considered. While some TTMSs that are far away from each other may share similar seasonal traffic patterns, the underlying causes may be quite different due to differences in climate, population characteristics, economic structures, etc.

Table 3.4 gives the number of TTMSs in each group. Nine out of the ten groups consist of more than one TTMS.

Table 3.4 Number of TTMS Stations in the Optimal Ten Urban Groups

Group	Number of TTMS Stations
1	2
2	12
3	4
4	34
5	3
6	45
7	9
8	5
9	1
10	8

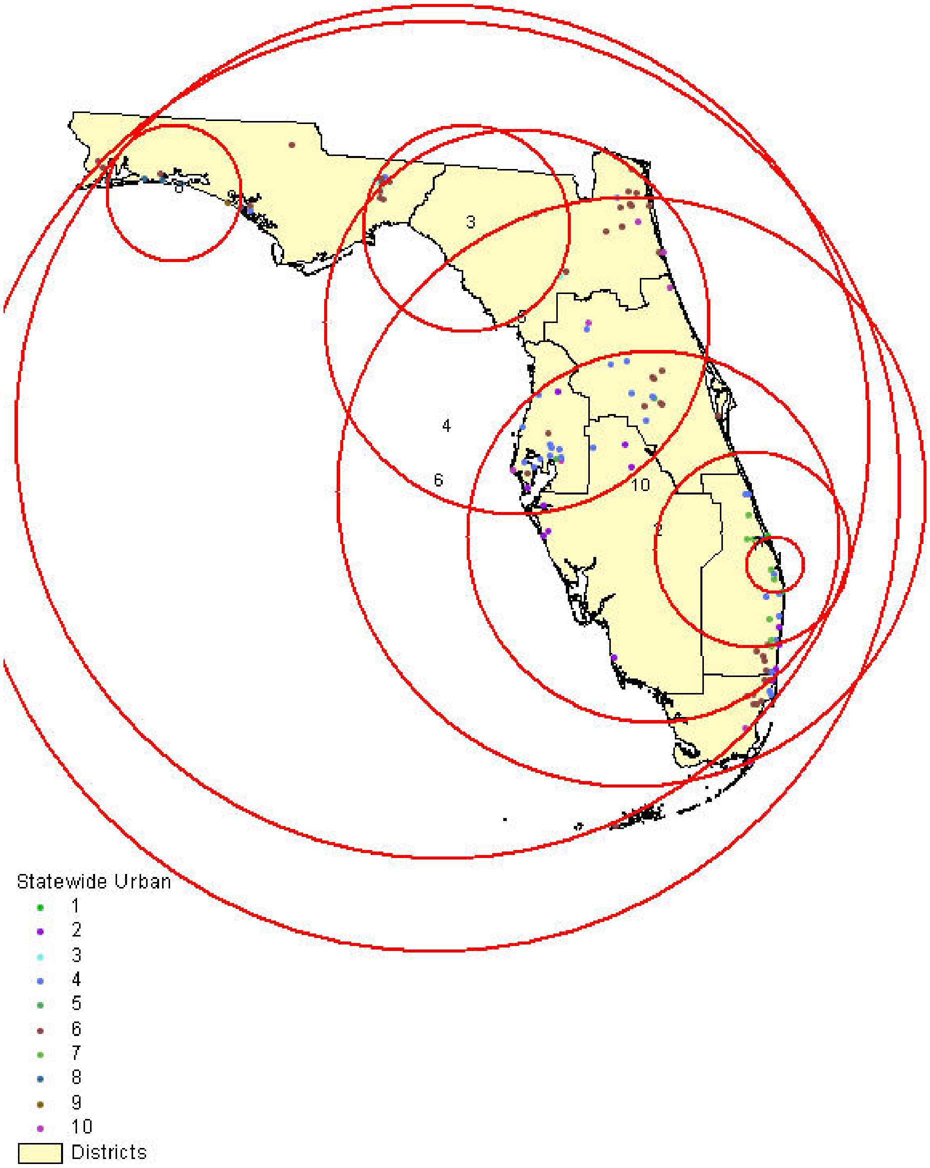


Figure 3.2 Optimal Ten Groups from Model-Based Method for Urban Areas

Model-based clustering is also performed with the location of the TTMSs considered. In other words, the clusters are produced by simultaneously considering the similarity in the monthly seasonal factors, as well as the proximity of the TTMSs. The spatial distribution of the groups is depicted in Figure 3.3. The figure reveals a more spatially clustered pattern of the TTMSs. However, as shown in Table 3.5, 33 groups are created, compared to 10 when location is not considered. Furthermore, many groups are made up by a single TTMS station, which is undesirable.

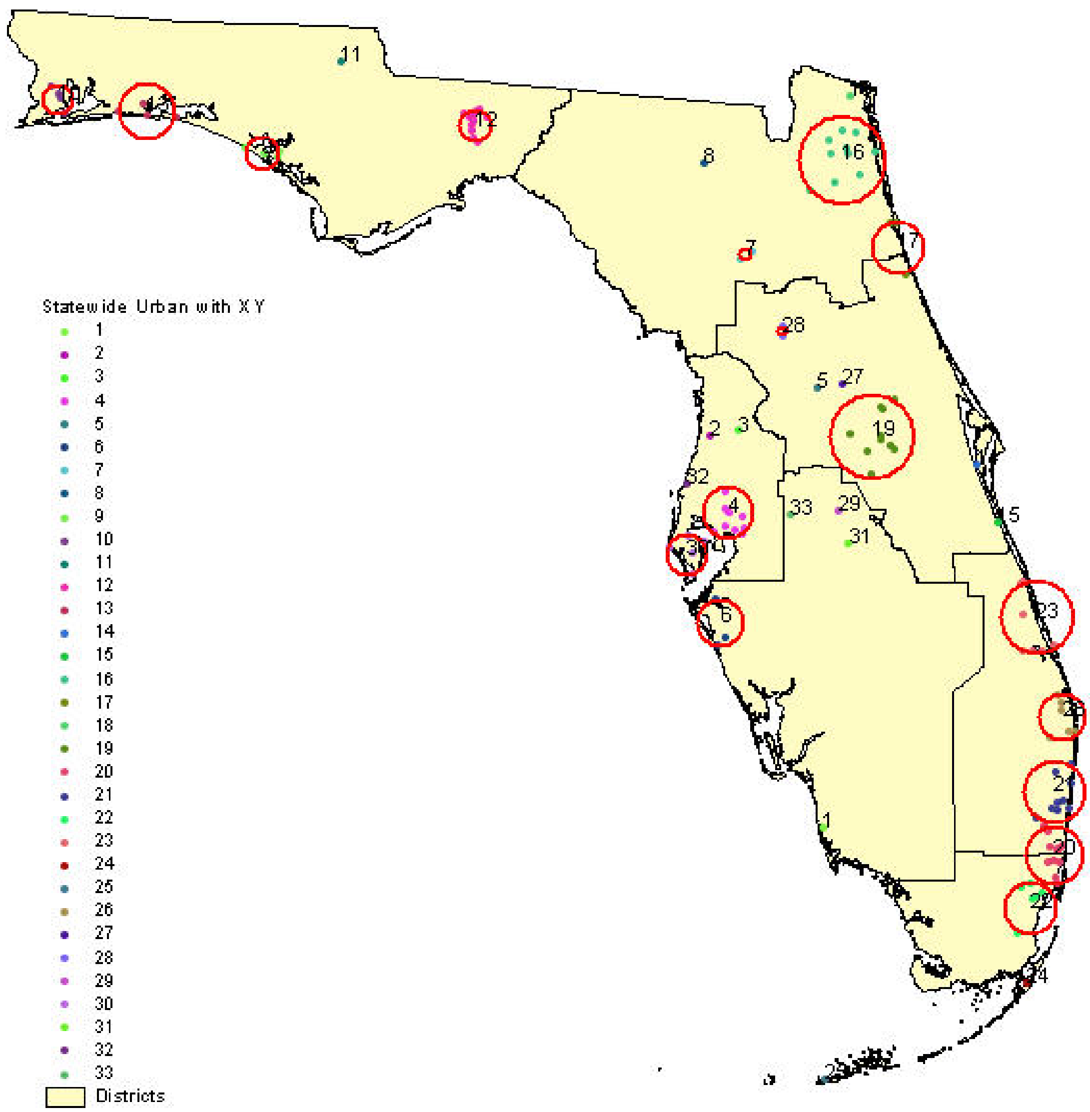


Figure 3.3 Optimal 33 Groups for Urban Areas from the Model-Based Method with Location Variables Included

Table 3.5 Number of TTMS Stations in the Optimal 33 Urban Groups from Model-Based Cluster Analysis with Location Variables

Group	Number of TTMSs
1	1
2	1
3	1
4	9
5	1
6	3
7	2
8	1
9	4
10	4
11	1
12	11
13	4
14	1
15	1
16	10
17	3
18	1
19	10
20	12
21	9
22	6
23	7
24	1
25	1
26	6
27	1
28	2
29	1
30	5
31	1
32	1
33	1

The results shown in Table 3.5 suggest that the model-based cluster method with x-y coordinates added may not be appropriate for clustering the urban TTMSs statewide. This is because location seems to be given too great a weight. For example, Palm Beach County may share some similarities with counties along the southwest Gulf Coast in terms of climate and population characteristics. However, they will not be grouped together, even if their MSF patterns are similar, simply because they are spatially separated. As one of the objectives of the research is to identify variables that potentially influence the seasonal patterns of traffic, a small number of

groups is more desirable than a large number of groups. This is because more groups mean greater complexity.
It is easier to divide fewer groups into more groups based on the similarity of MSF patterns within a group than it is to merge smaller groups into larger ones. Hence, the results from cluster analysis, without considering location (as shown in Figure 3.2 and Table 3.4), are used as the basis to refine the grouping. This process is manual and involves inspecting each group and identifying TTMSs that do not belong. Also note that, for practical applications, jurisdiction is also important when creating seasonal factor groups. The boundary of FDOT districts are also considered when refining the grouping. The results are described in the next section.

3.1.2 Refinement of Cluster Results for Urban Areas

The grouping results shown in Figure 3.2 are further investigated. Figures 3.4 through 3.8 show the spatial distribution patterns and MSF profiles for TTMS Groups 1, 3, 7, 8, and 9, respectively. The figures demonstrate that the TTMSs in the same group have similar monthly profiles and are located in close proximity. In the profiles, the red lines indicate the 5% thresholds above and below the group means.

The TTMSs in the above groups are identified in Table 3.6.

Table 3.6 TTMSs in Urban Groups 1, 3, 7, 8, and 9

Group	Number of TTMSs	TTMSs
1	2	C890259, C930087
3	4	C260323, C550208, C550209, C550226
7	9	C700114, C860214, C940260, C940334, C970410, C970413, C970416, C970417, C979913
8	5	C460305, C570293, C580261, C570167, C600168
9	1	C460166

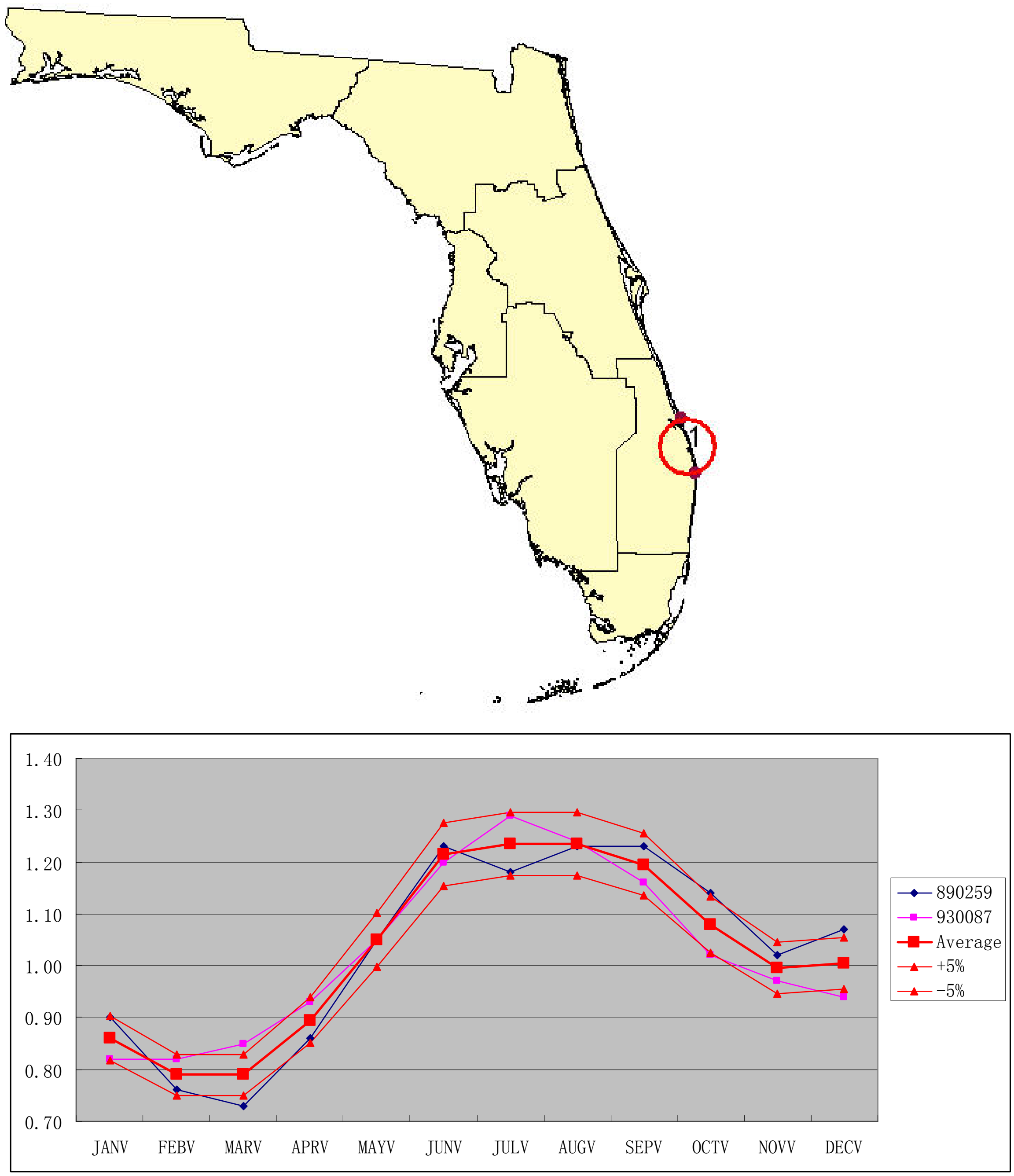
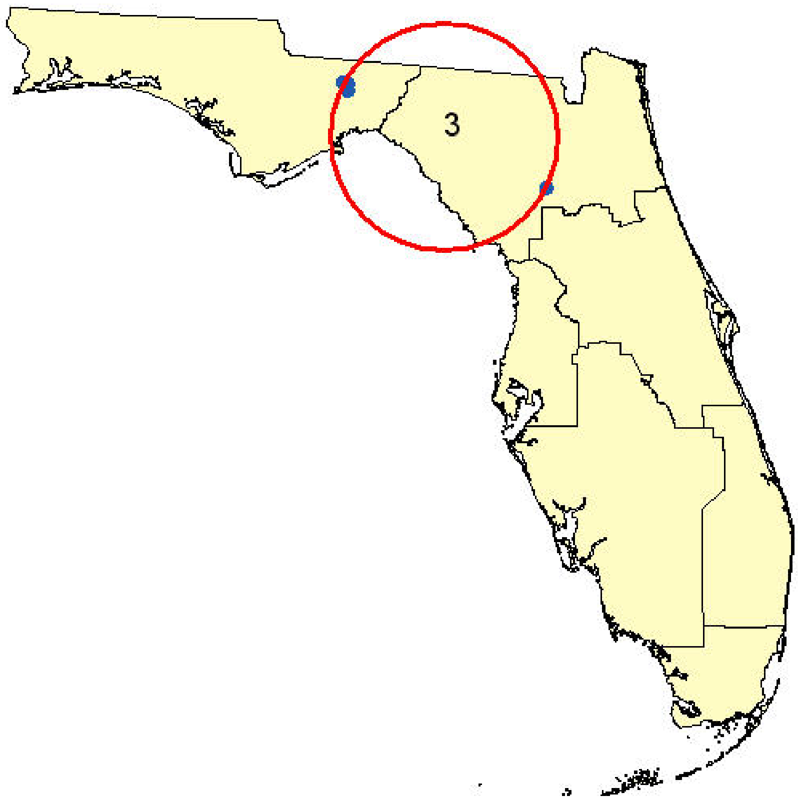


Figure 3.4 Spatial Distribution and Profiles of the TTMSs in Urban Group 1



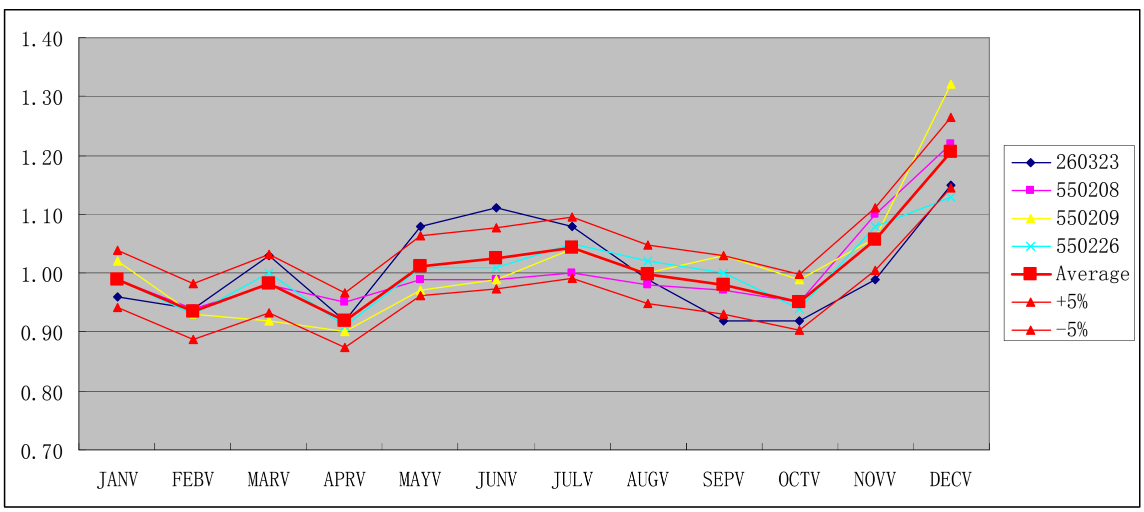
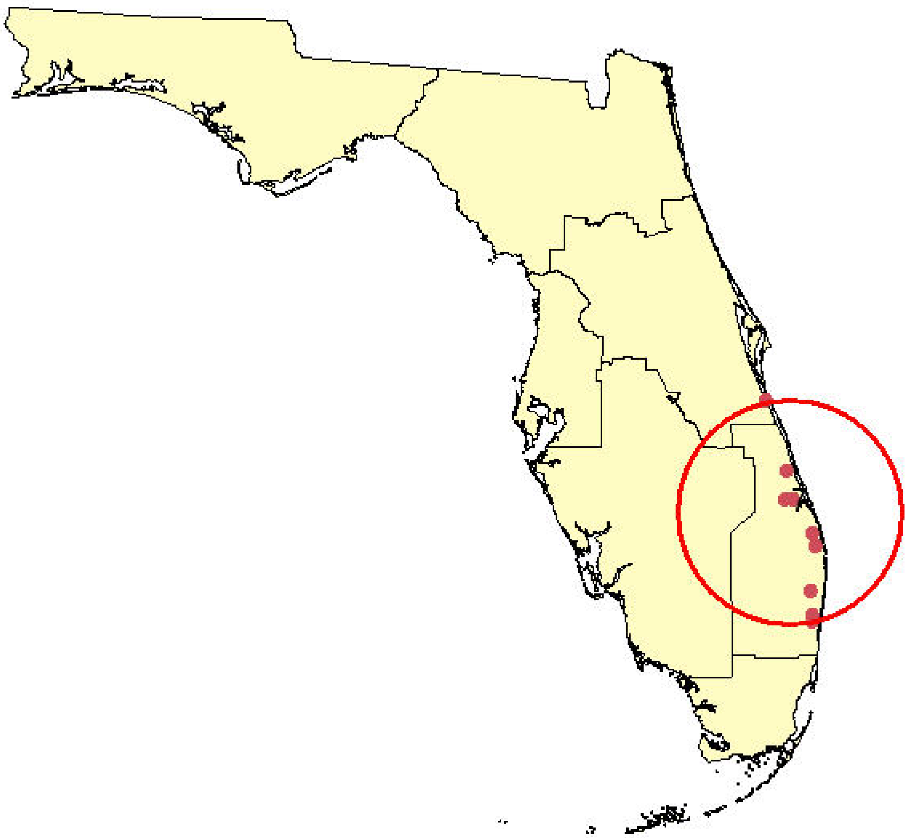


Figure 3.5 Spatial Distribution and Profiles of the TTMSs in Urban Group 3



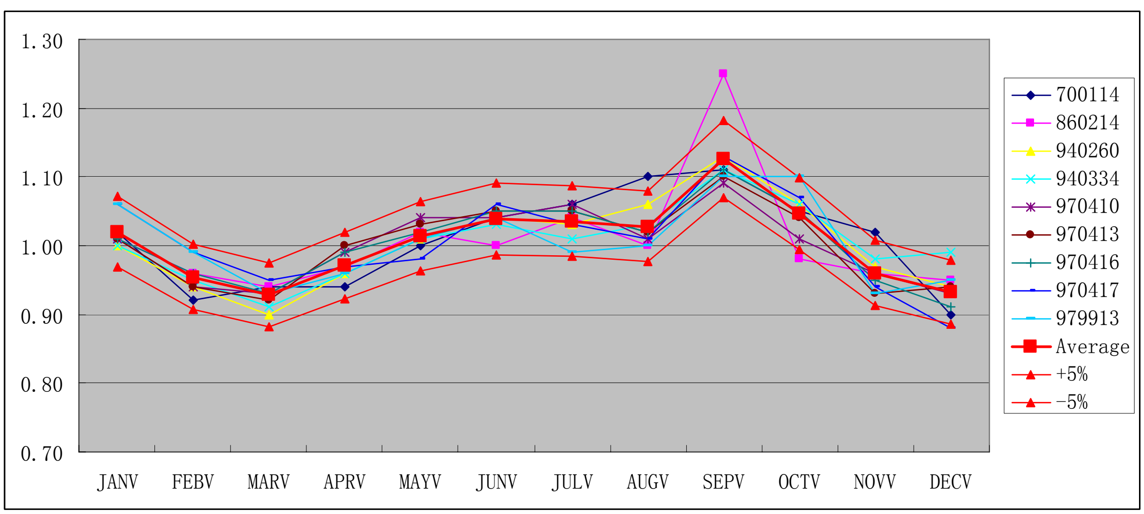
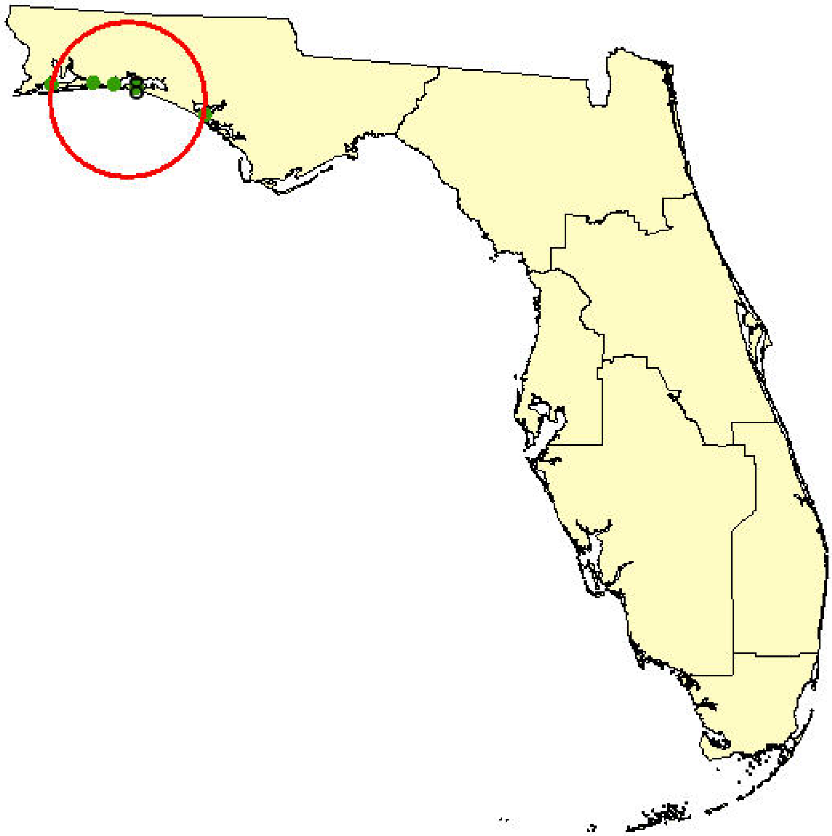


Figure 3.6 Spatial Distribution and Profiles of the TTMSs in Urban Group 7



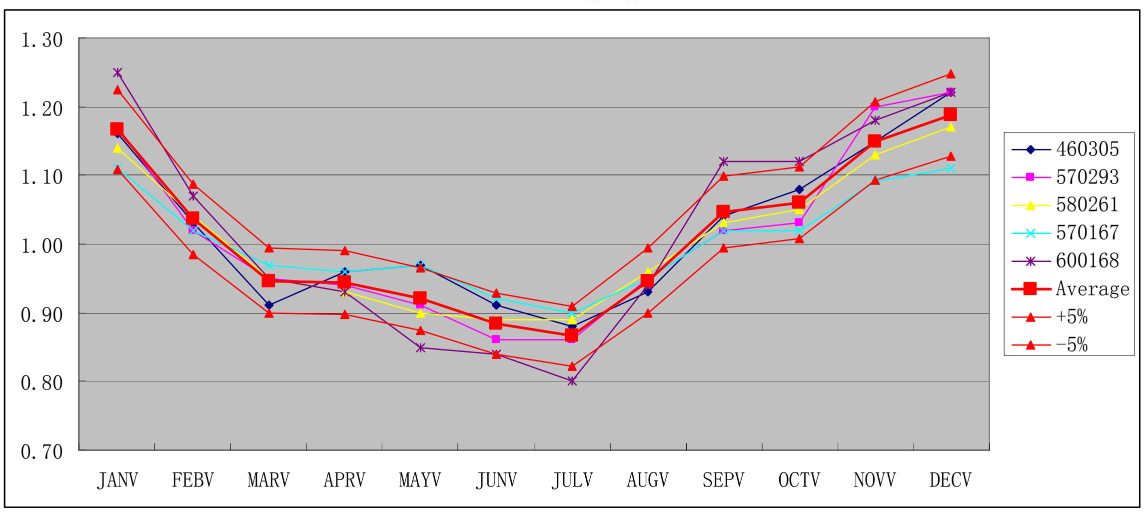
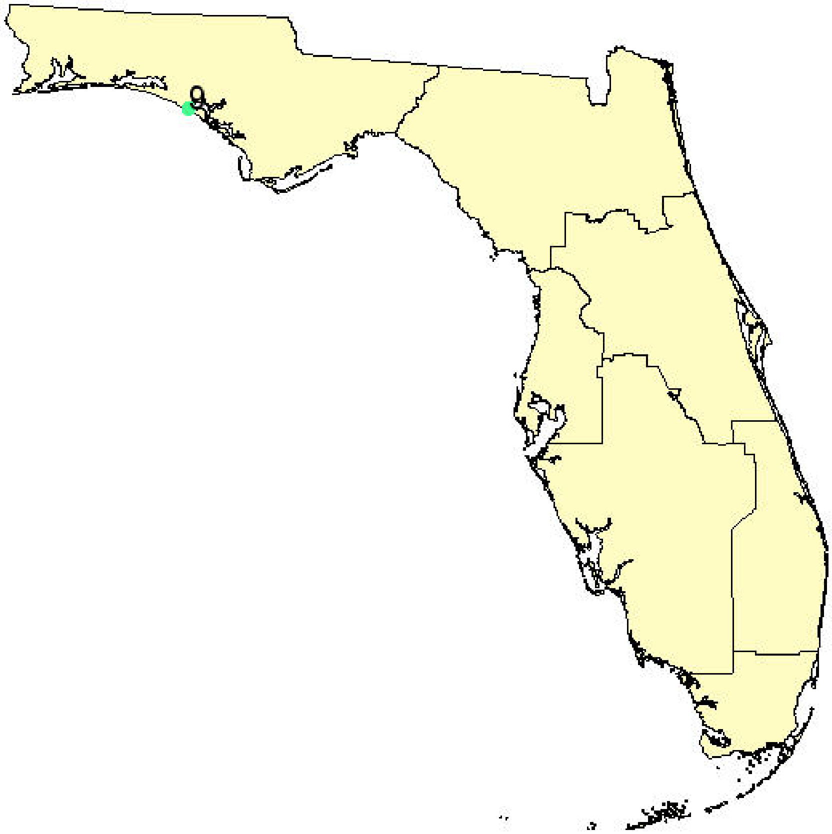


Figure 3.7 Spatial Distribution and Profiles of the TTMSs in Urban Group 8



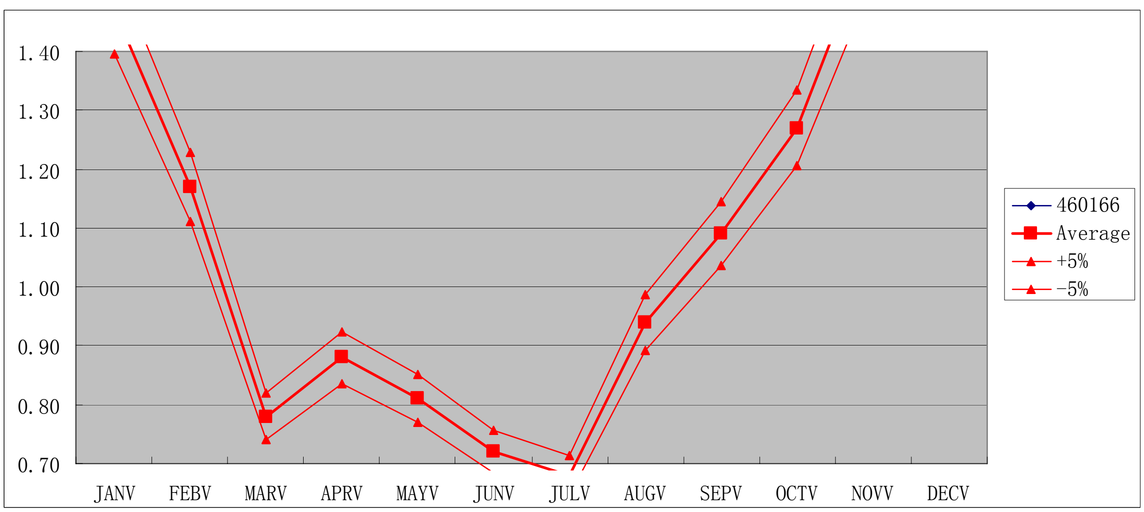
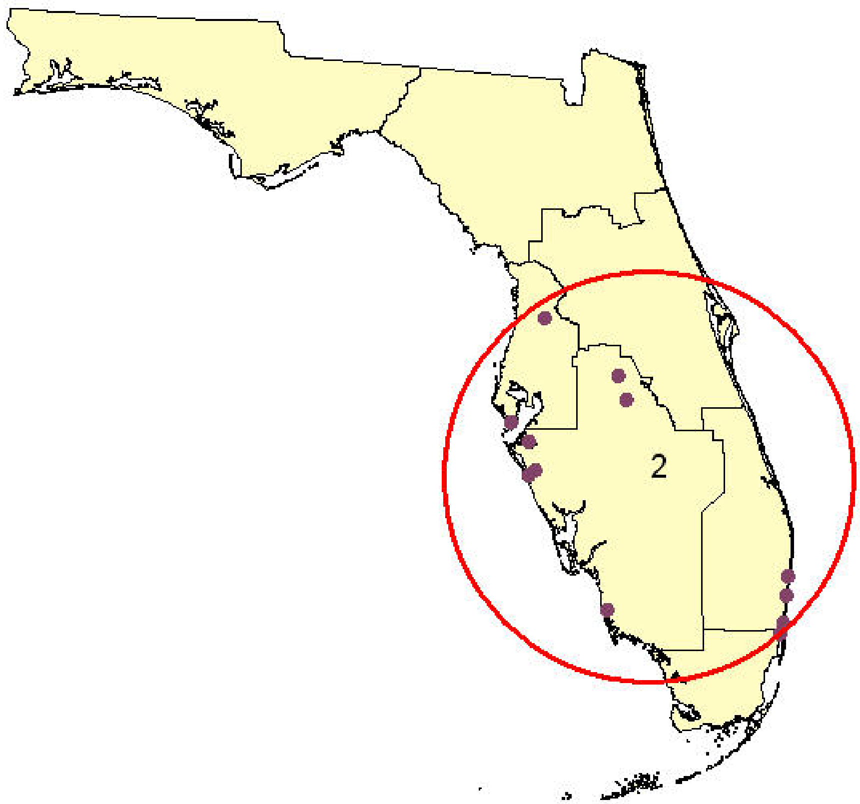


Figure 3.8 Spatial Distribution and Profile of the TTMS in Urban Group 9

For Groups 2, 4, 5, 6, and 10, the TTMSs in the same group are located far apart. For example, as shown in Figure 3.9, the TTMSs in Group 2 span over four FDOT districts. The TTMSs in this group are reassigned to three new groups (Groups 21, 22, and 23) as shown in Figure 3.10. The group profiles are depicted in Figures 3.11 through 3.13.



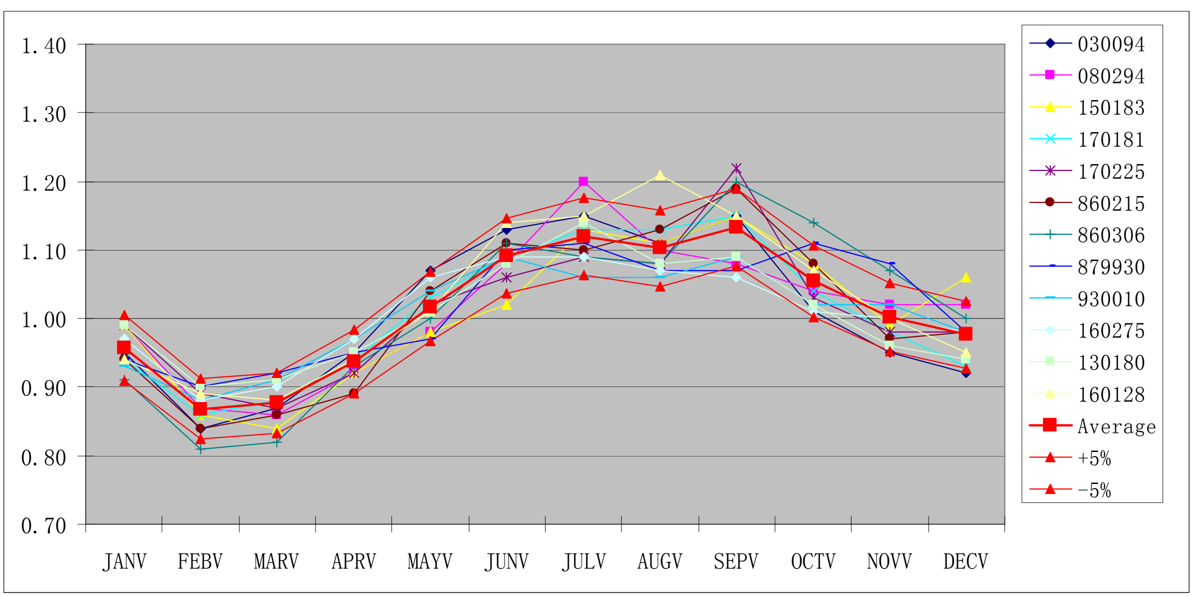


Figure 3.9 Spatial Distribution and Profiles of the TTMSs in Urban Group 2

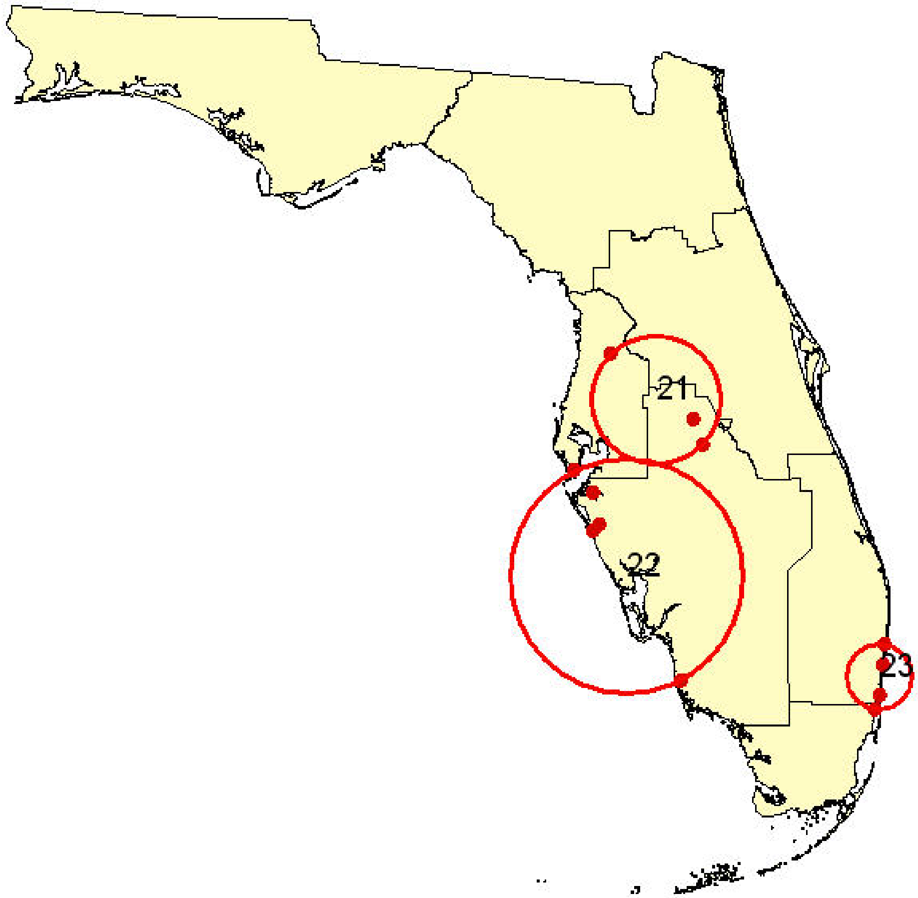


Figure 3.10 Spatial Distribution of the Three New Subgroups for the Urban Group 2

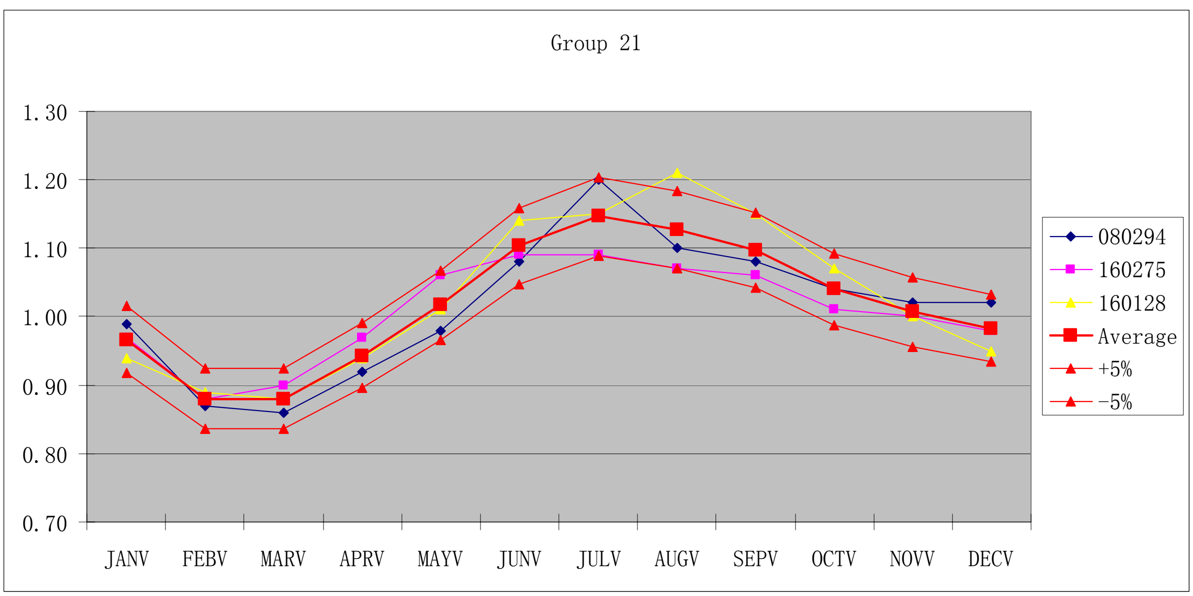


Figure 3.11 Profiles of the TTMSs in the New Urban Group 21

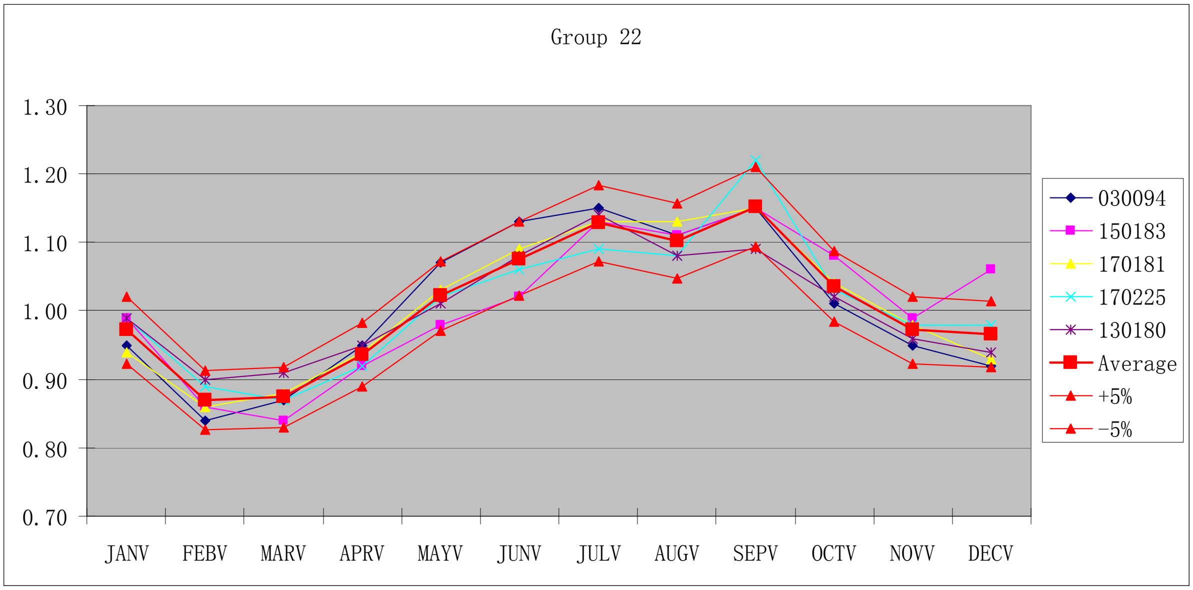


Figure 3.12 Profiles of the TTMSs in the New Urban Group 22

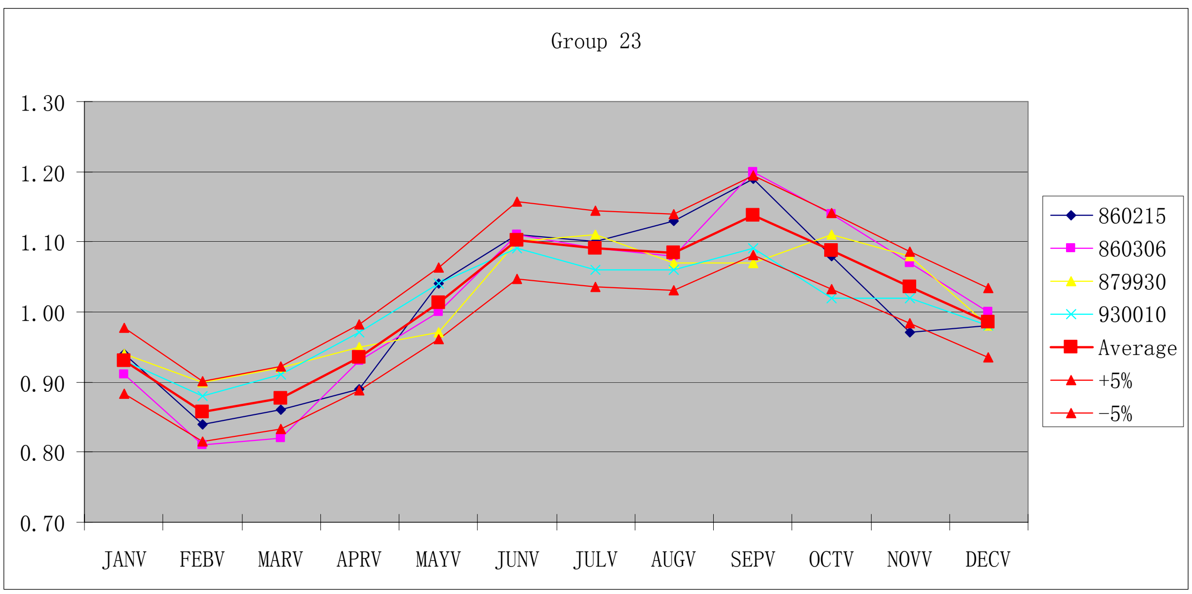


Figure 3.13 Profiles of the TTMSs in the New Urban Group 23

The TTMSs in Group 4, as illustrated in Figure 3.14, are spread over nearly the entire state. Similar to Group 2, the TTMSs in Group 4 are split into three new subgroups: 41, 42, and 43, as shown in Figure 3.15. The group profiles are plotted in Figures 3.16 through 3.18.

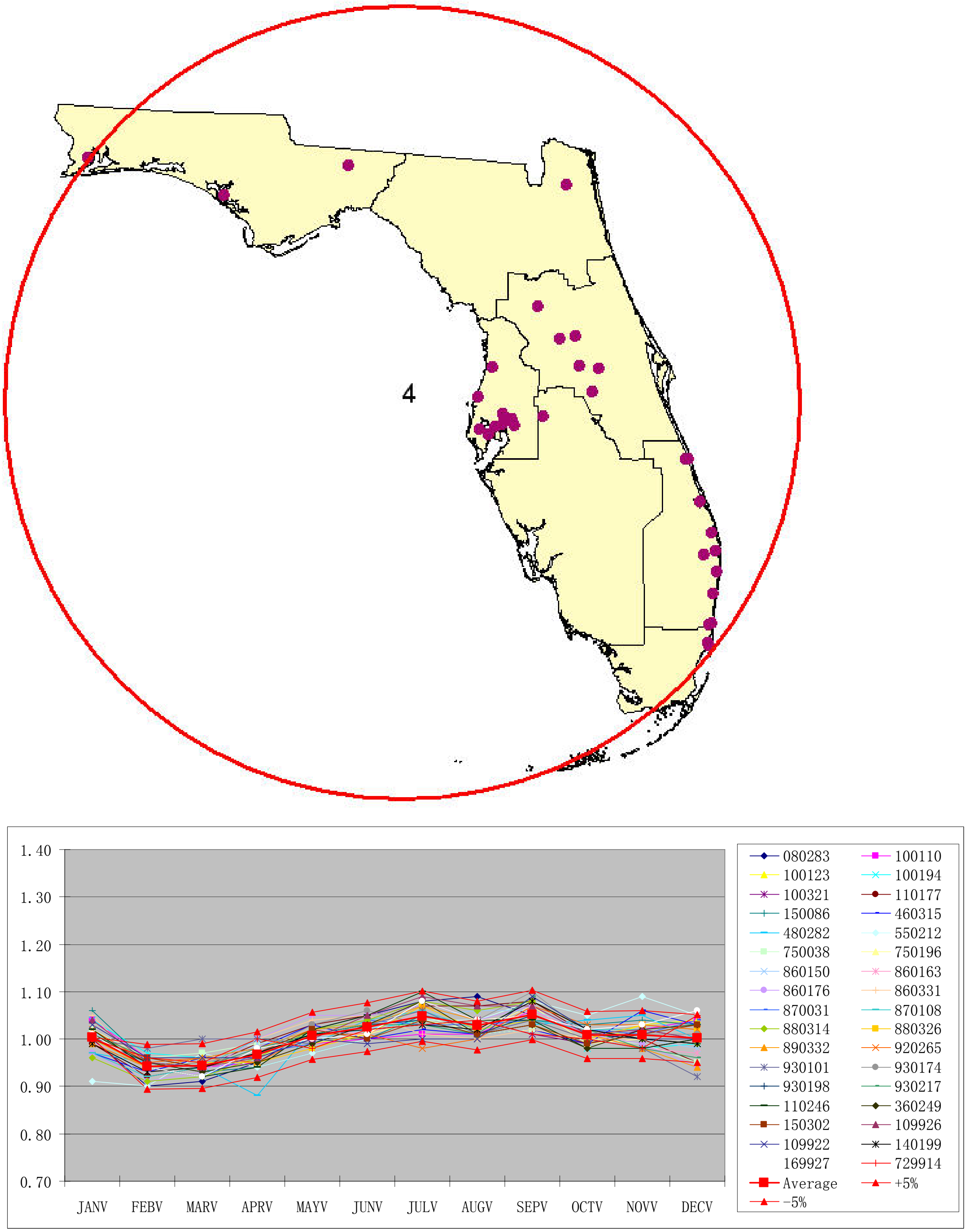


Figure 3.14 Spatial Distribution and Profiles of the TTMSs in the Original Urban Group 4

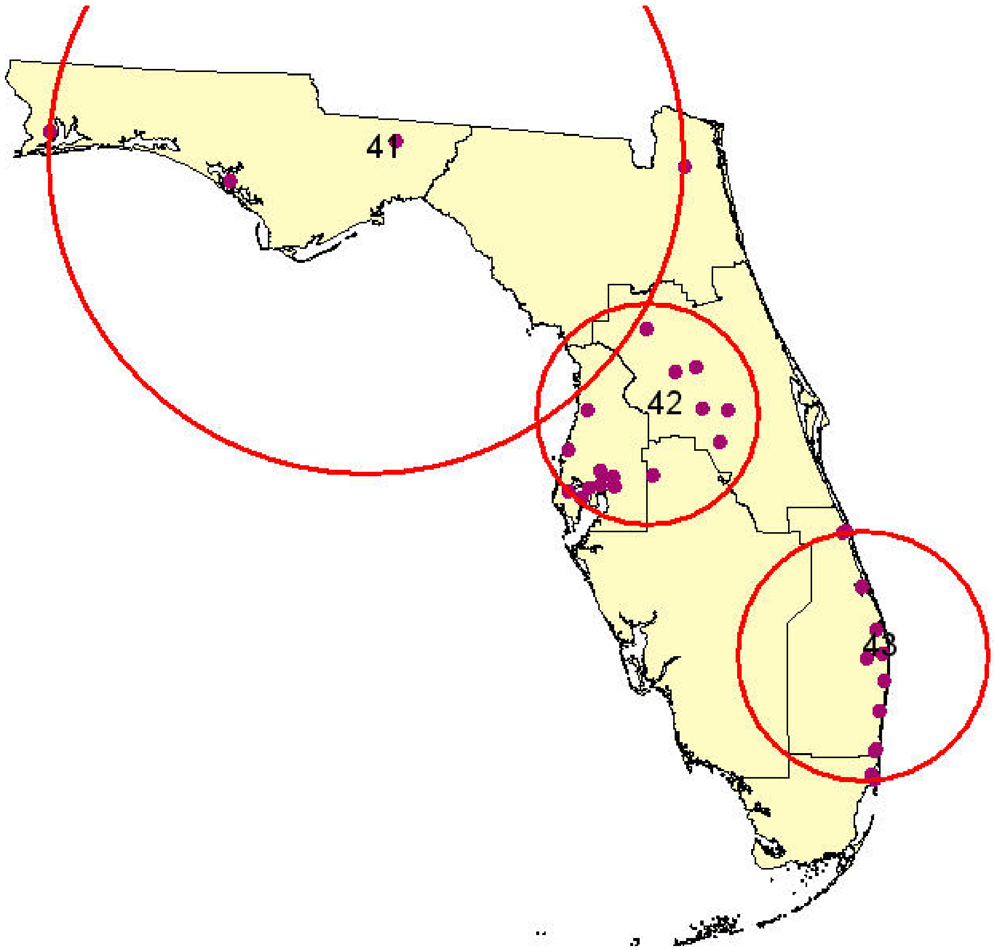


Figure 3.15 Spatial Distribution of the Three New Subgroups for the Original Urban Group 4

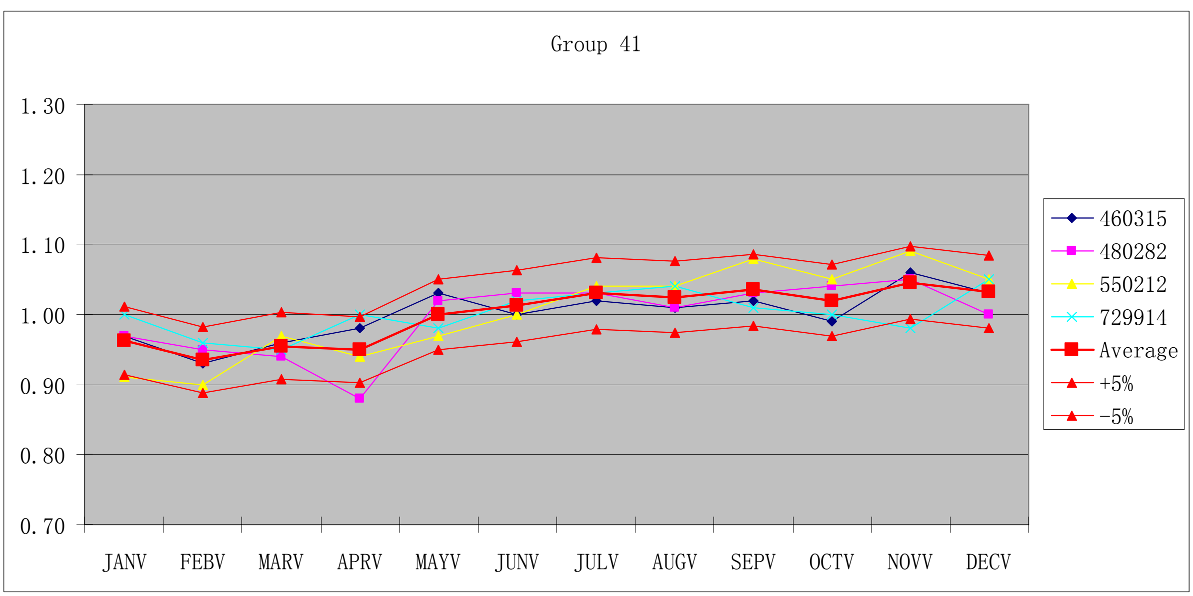


Figure 3.16 Profiles of the TTMSs in the New Urban Group 41

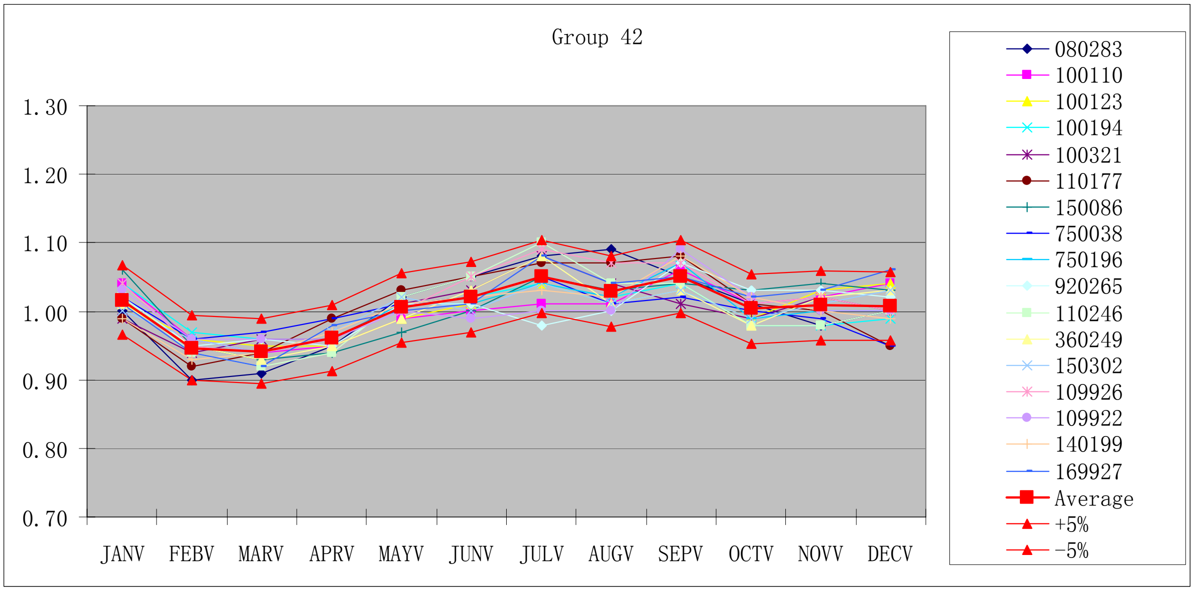


Figure 3.17 Profiles of the TTMSs in the New Urban Group 42

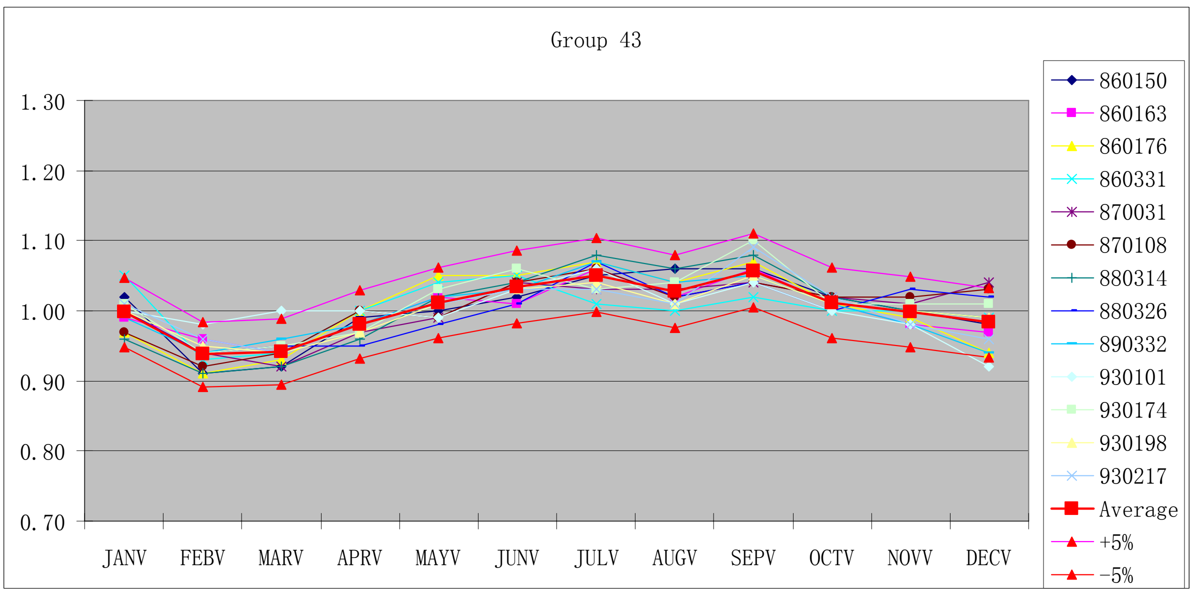


Figure 3.18 Profiles of the TTMSs in the New Urban Group 43

Figure 3.19 shows the spatial distribution of TTMSs in Group 5 and the profiles of their MSFs. Figure 3.20 illustrates the two new subgroups created from Group 5. The group profiles for the two new subgroups are shown in Figures 3.12 and 3.22.

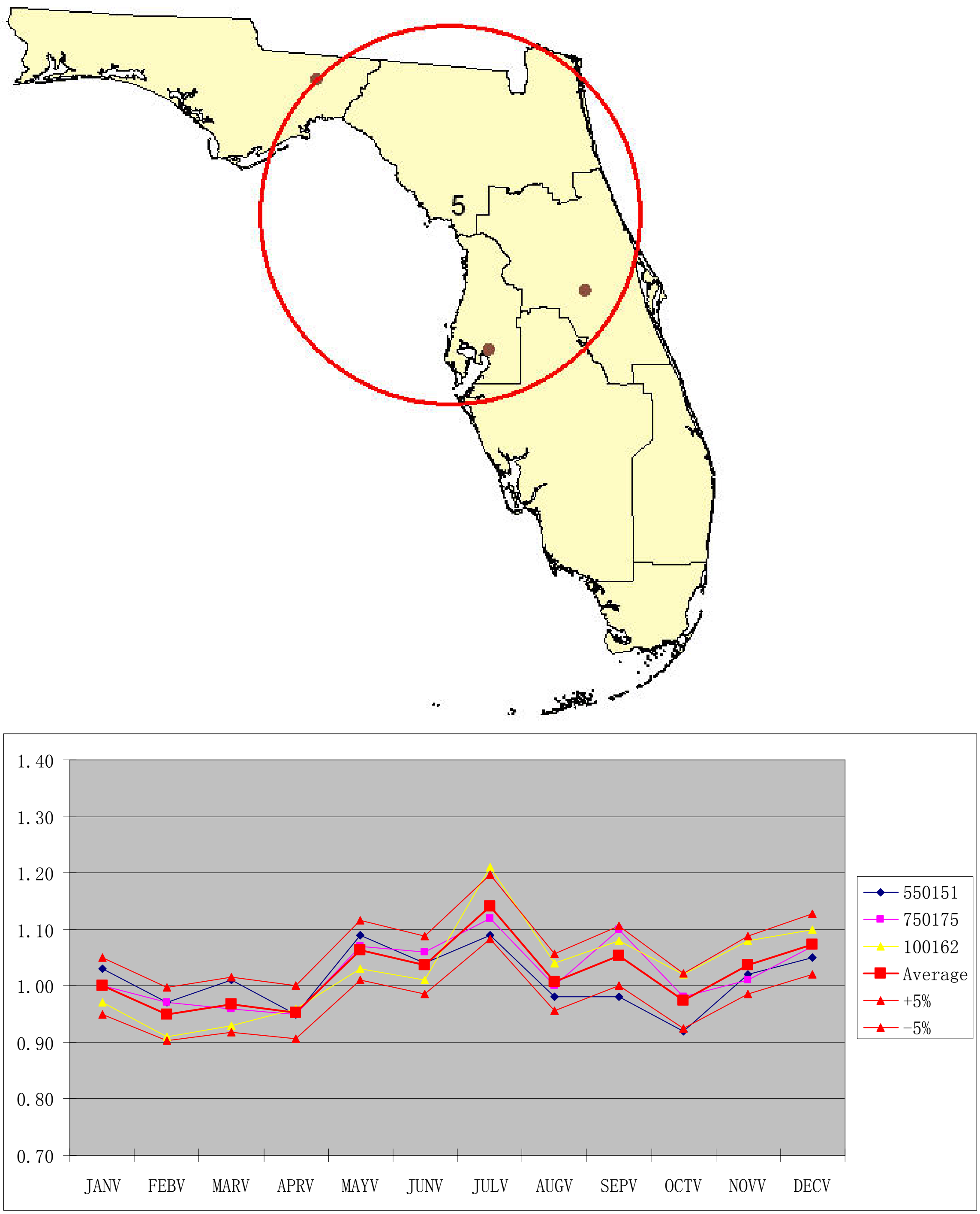


Figure 3.19 Spatial Distribution and Profiles of the TTMS in the Original Urban Group 5

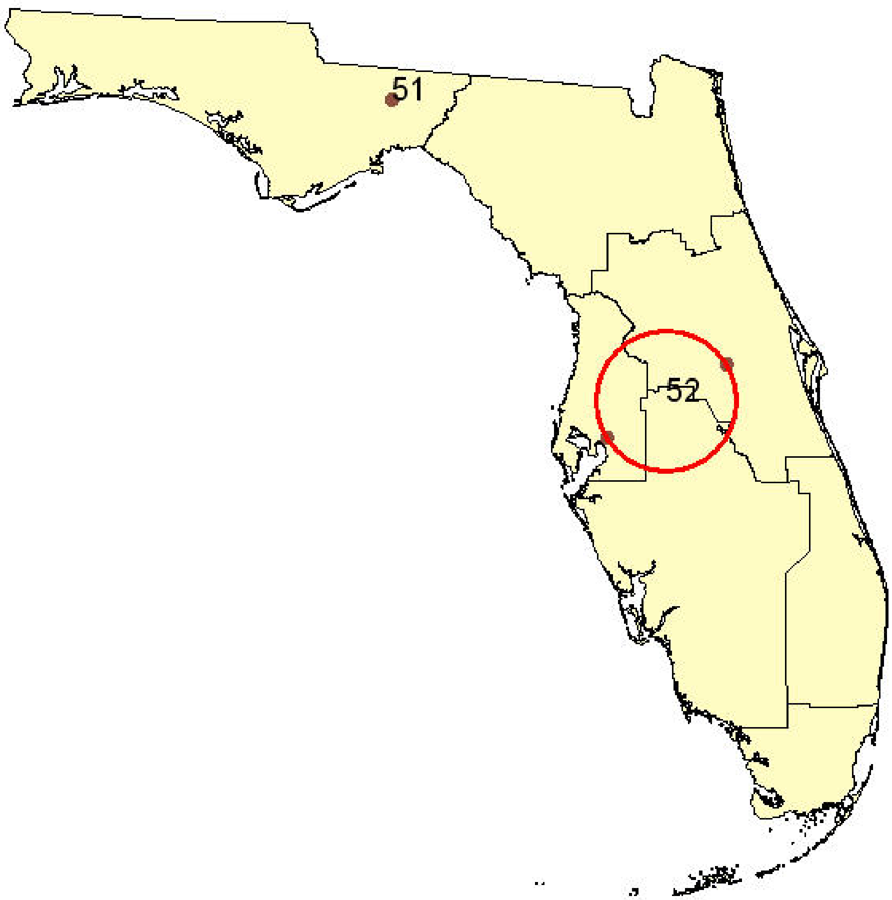


Figure 3.20 Spatial Distribution of the Two New Subgroups for the Original Urban Group 5

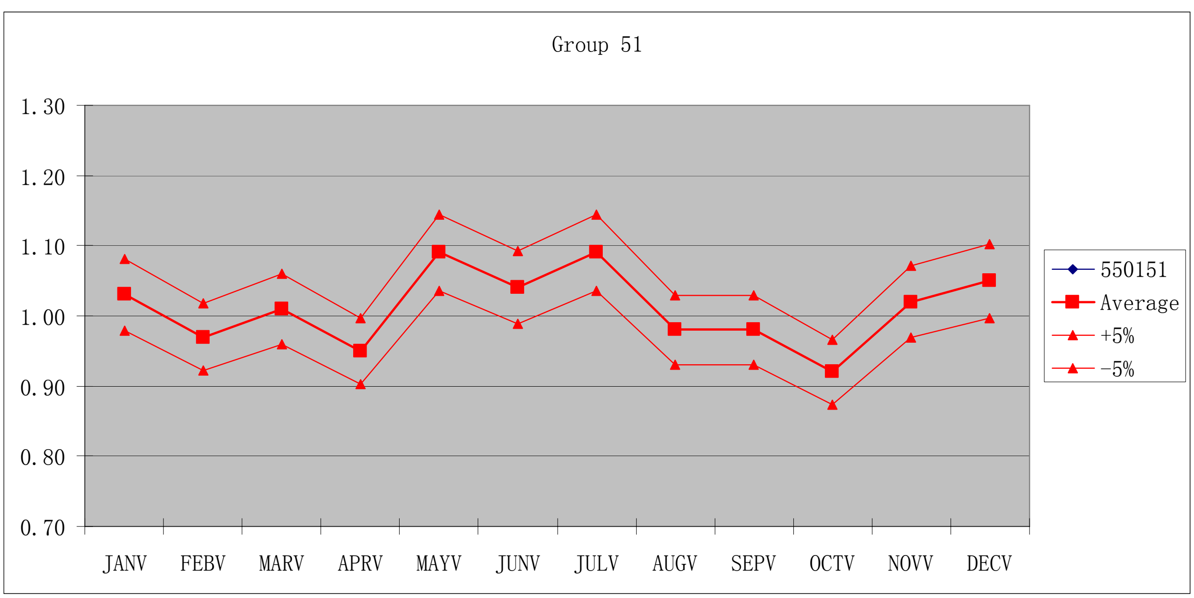


Figure 3.21 Profiles of the TTMSs in the New Urban Group 51

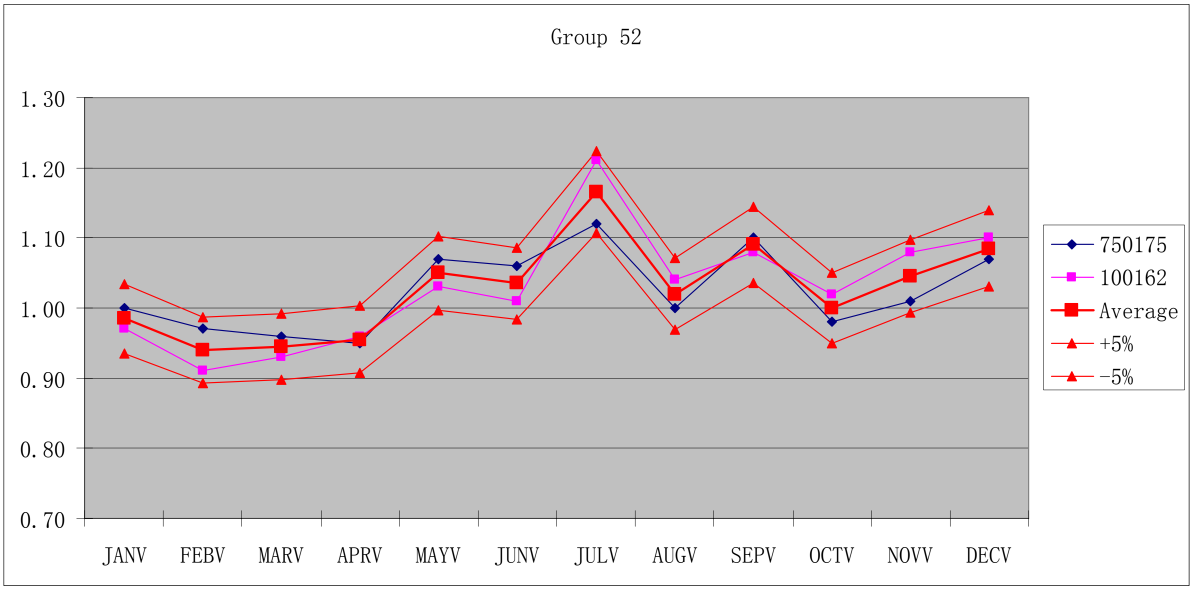
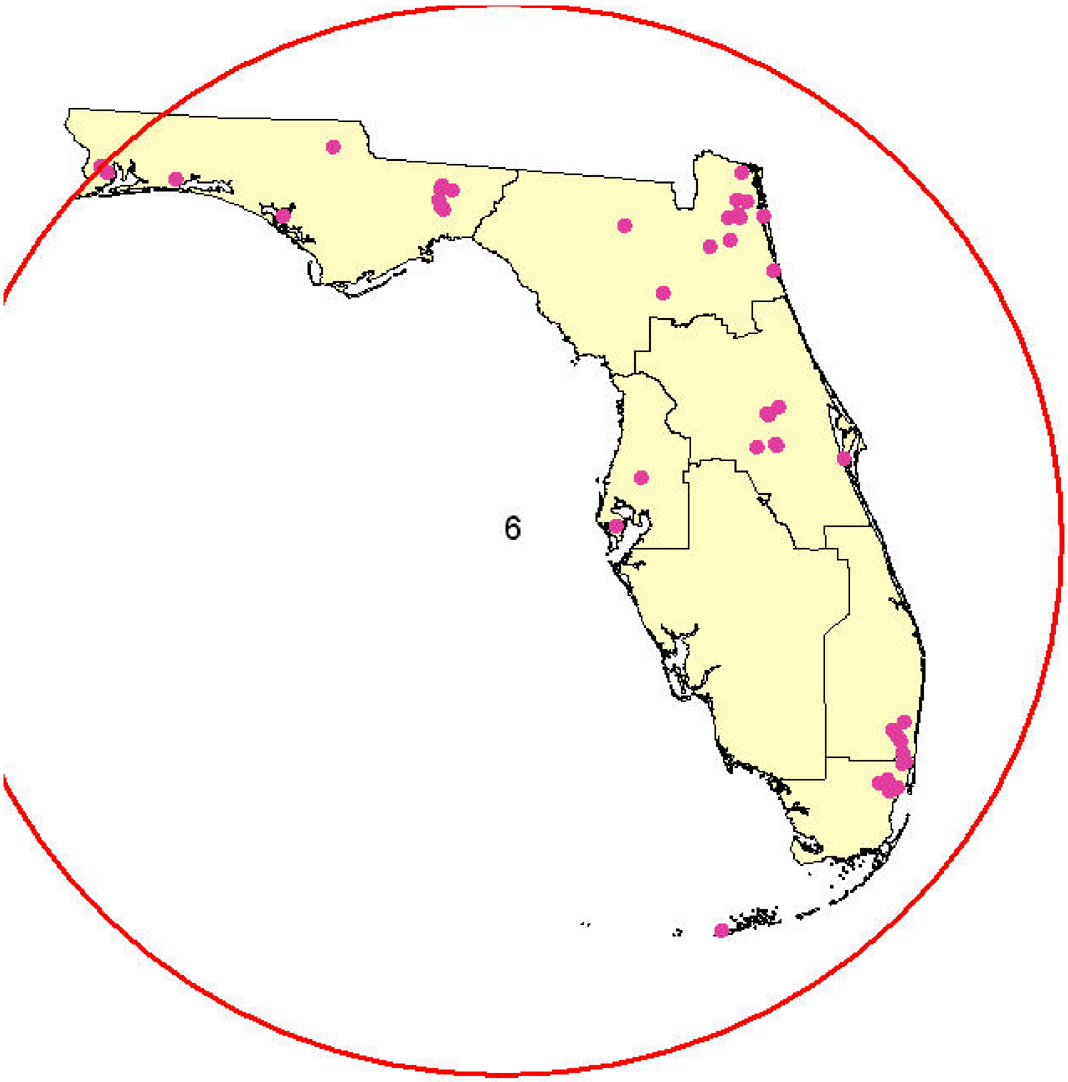


Figure 3.22 Profiles of the TTMSs in the New Urban Group 52

Figure 3.23 shows the spatial distribution of the TTMSs in Group 6 and their MSF profiles. Figure 3.24 shows the three new subgroups created from Group 6. The group profiles for the four new subgroups are depicted in Figures 3.25 through 3.28. There is a possibility that subgroups 61 and 62 may be combined.



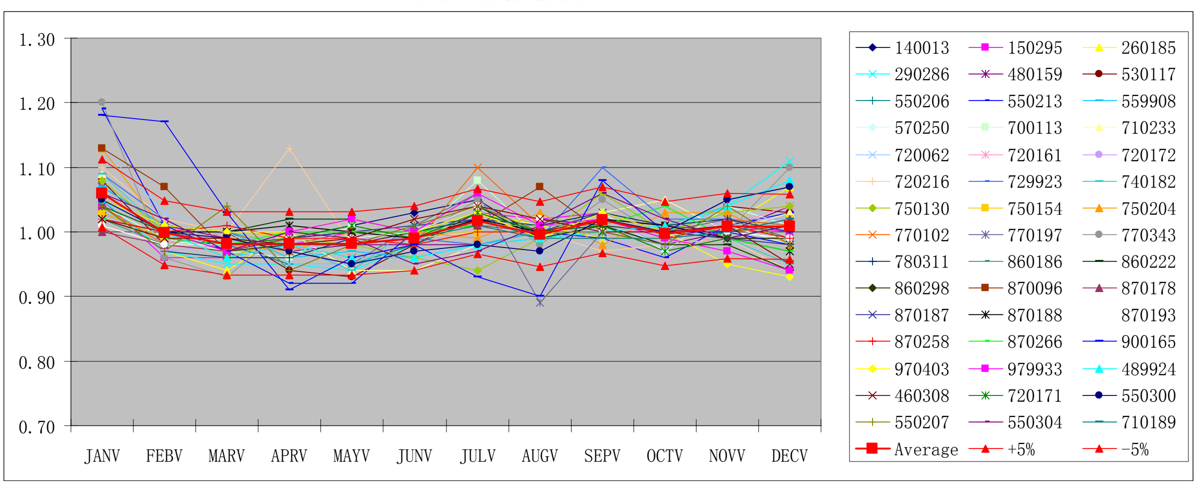


Figure 3.23 Spatial Distribution and Profiles of the TTMS in the Original Group Urban 6

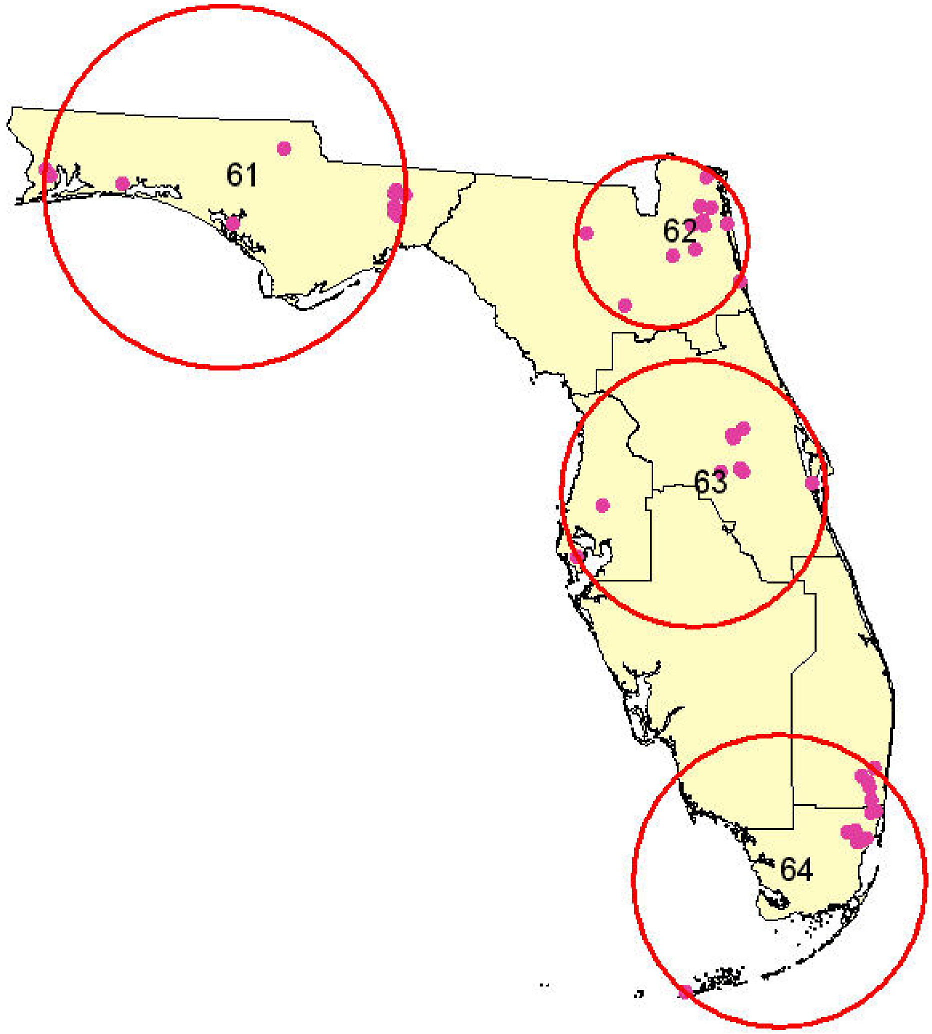


Figure 3.24 Spatial Distribution of the Four New Subgroups for the Original Urban Group 6

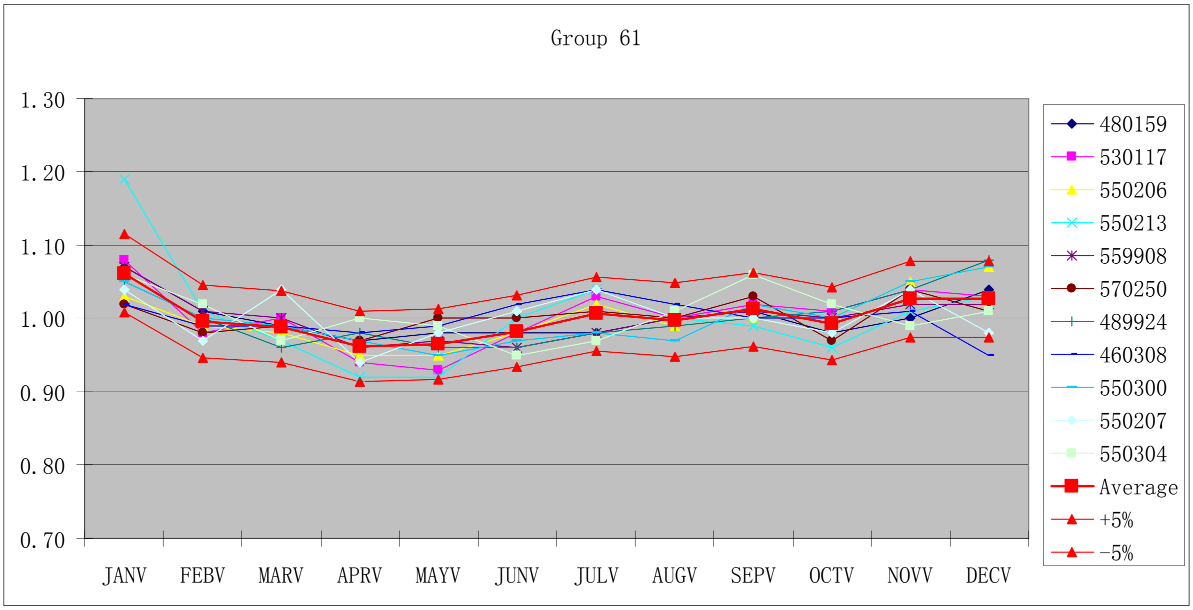


Figure 3.25 Profiles of the TTMSs in the New Urban Group 61

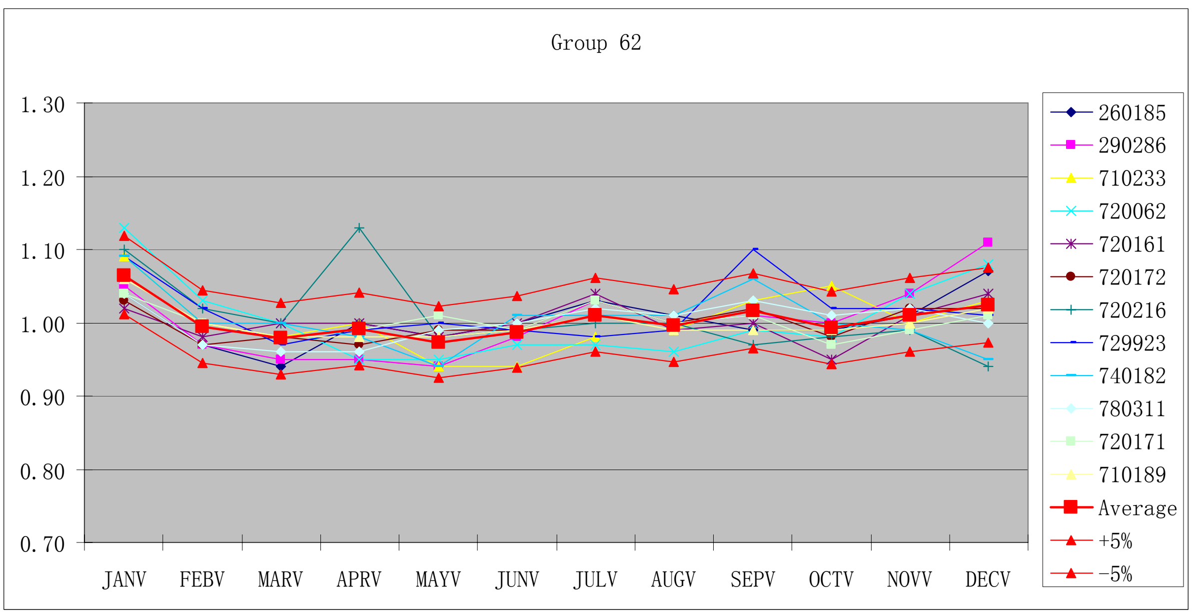


Figure 3.26 Profiles of the TTMSs in the New Urban Group 62

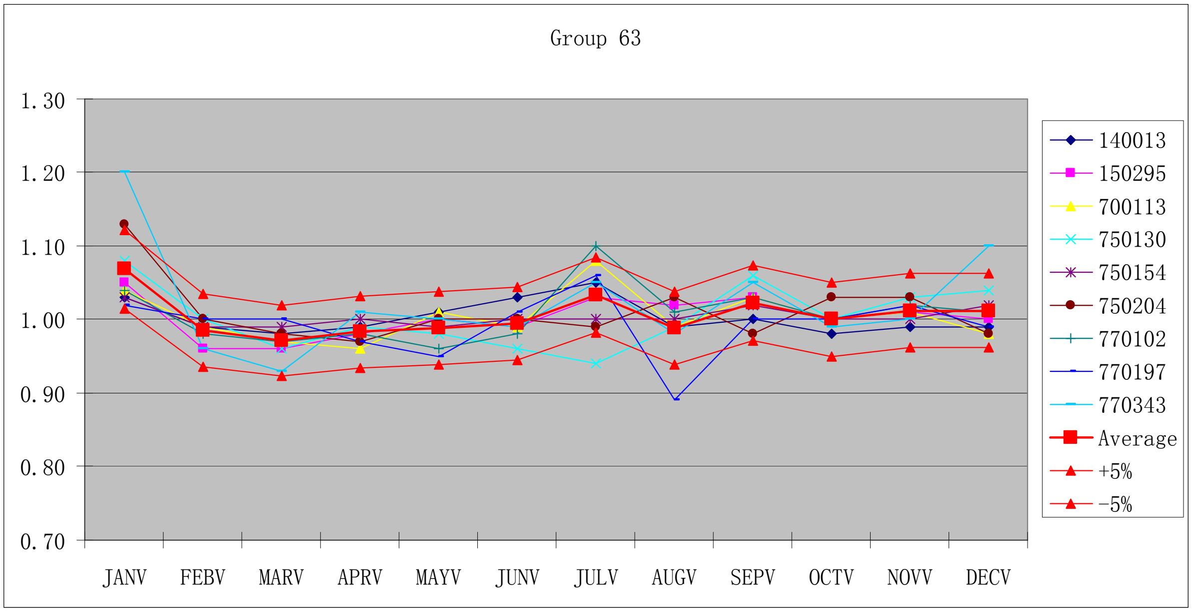


Figure 3.27 Profiles of the TTMSs in the New Urban Group 63

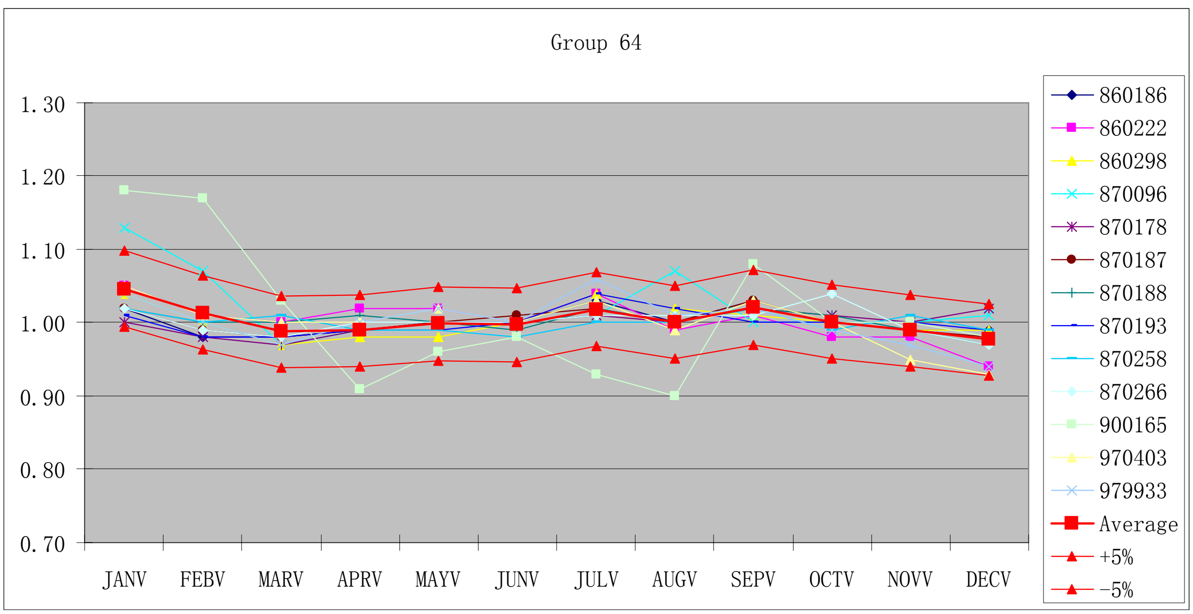


Figure 3.28 Profiles of the TTMSs in the New Urban Group 64

Finally, Group 10, as illustrated in Figure 3.29, is divided into three new subgroups. They are illustrated in Figure 3.30. The group profiles for the three new subgroups are given in Figures 3.31 through 3.33.

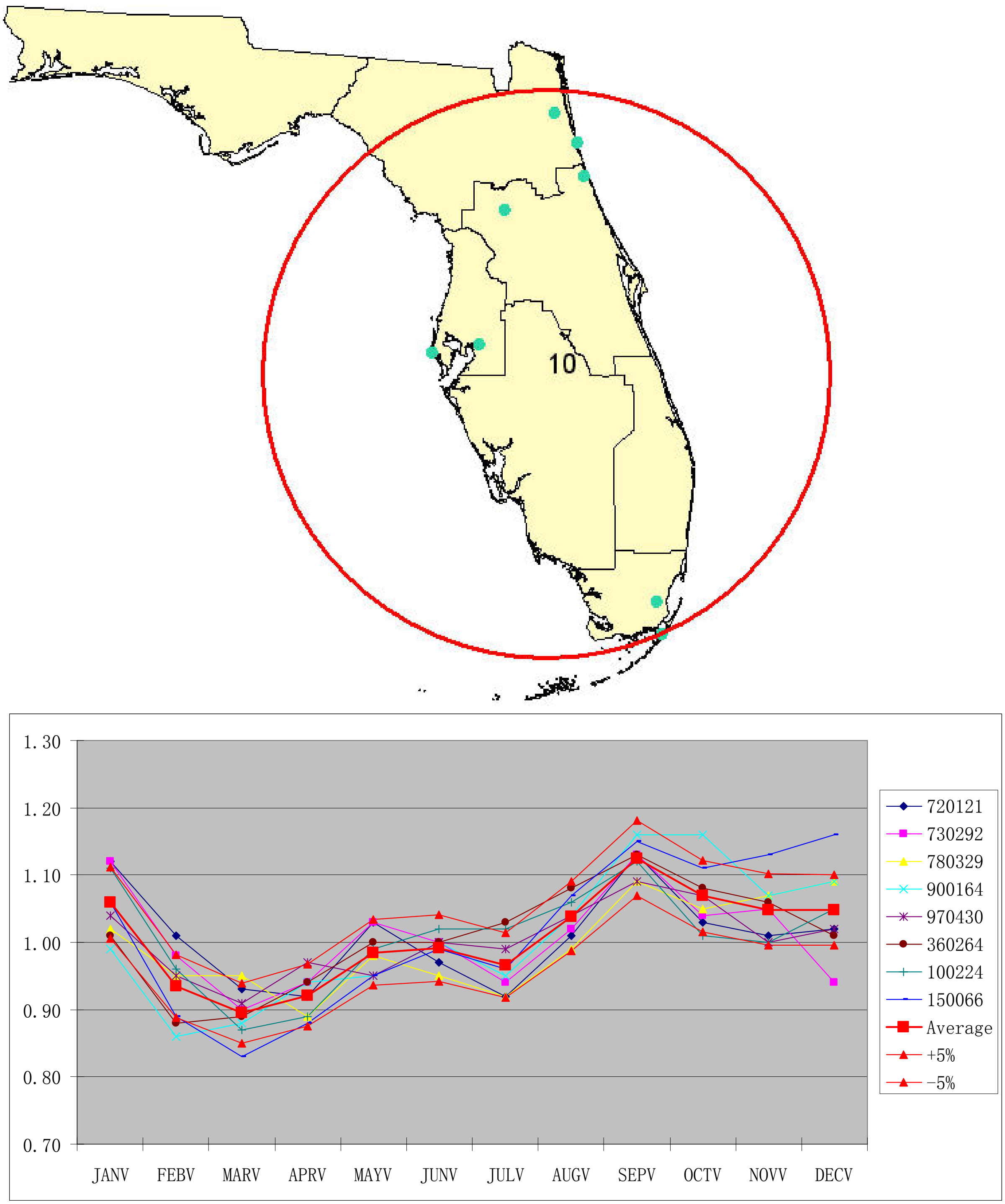


Figure 3.29 Spatial Distribution and Profiles of the TTMSs in the Original Urban Group 10

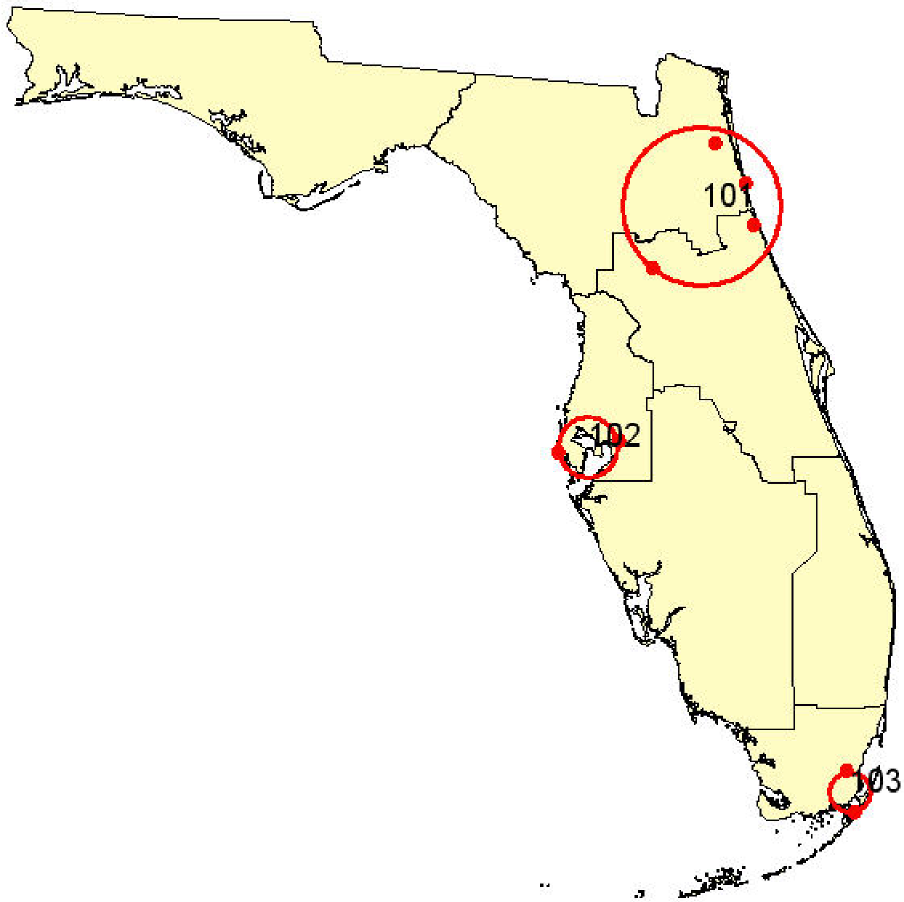


Figure 3.30 Spatial Distribution of the Three New Subgroups for the Original Urban Group 10

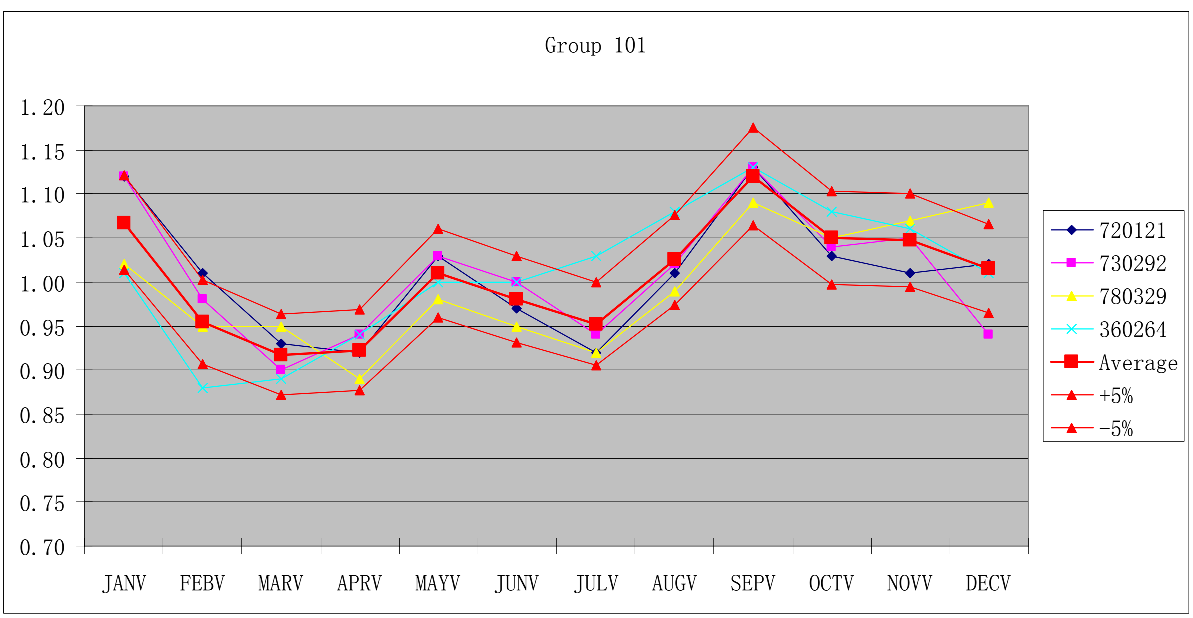


Figure 3.31 Profiles of the TTMSs in the New Urban Group 101

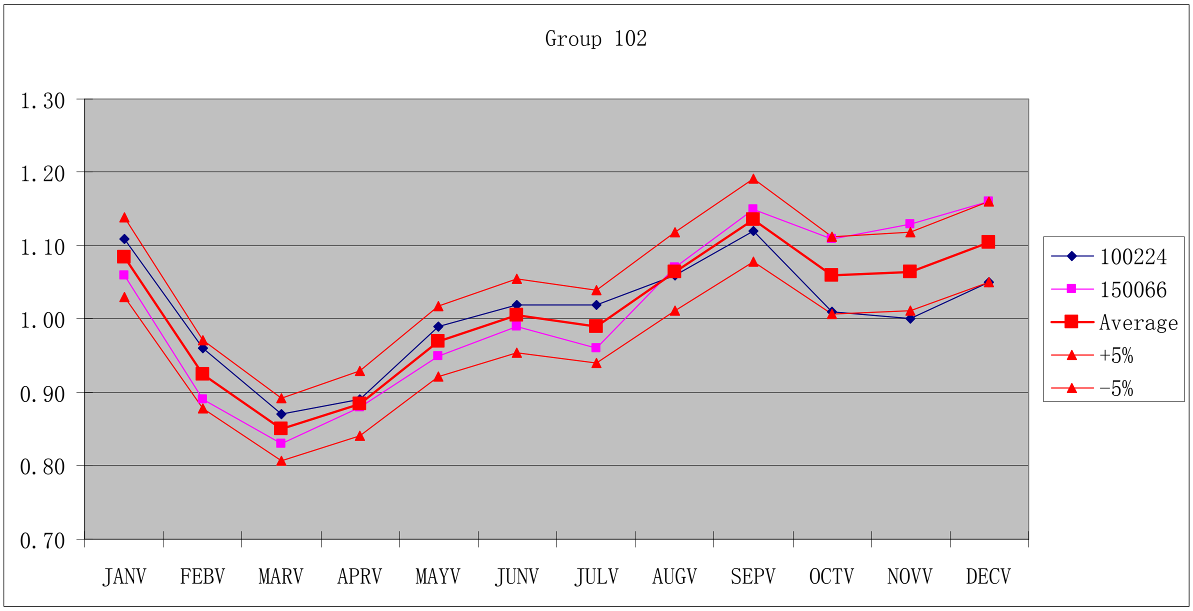


Figure 3.32 Profiles of the TTMSs in the New Urban Group 102

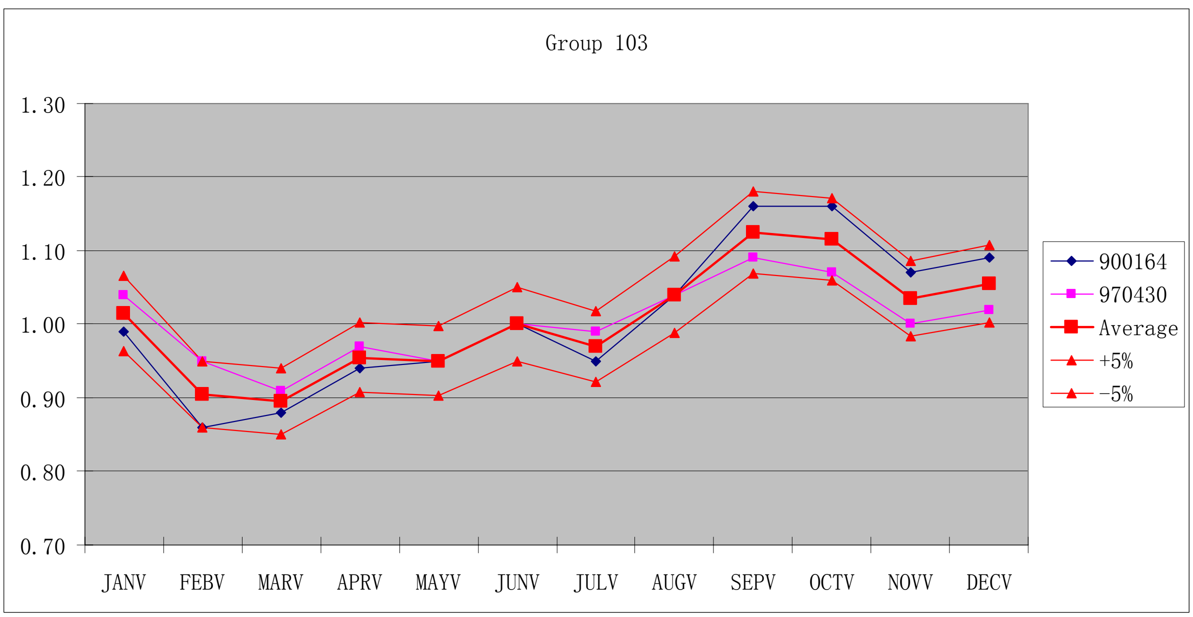


Figure 3.33 Profiles of the TTMSs in the New Urban Group 103

After the TTMSs in Groups 2, 4, 5, 6 and 10 are reassigned, a total of 20 seasonal groups are defined for the 123 TTMSs located in the urban area. Figure 3.34 shows the spatial patterns of the TTMSs in these 20 TTMS groups. The number of stations in each group is presented in Table 3.7.

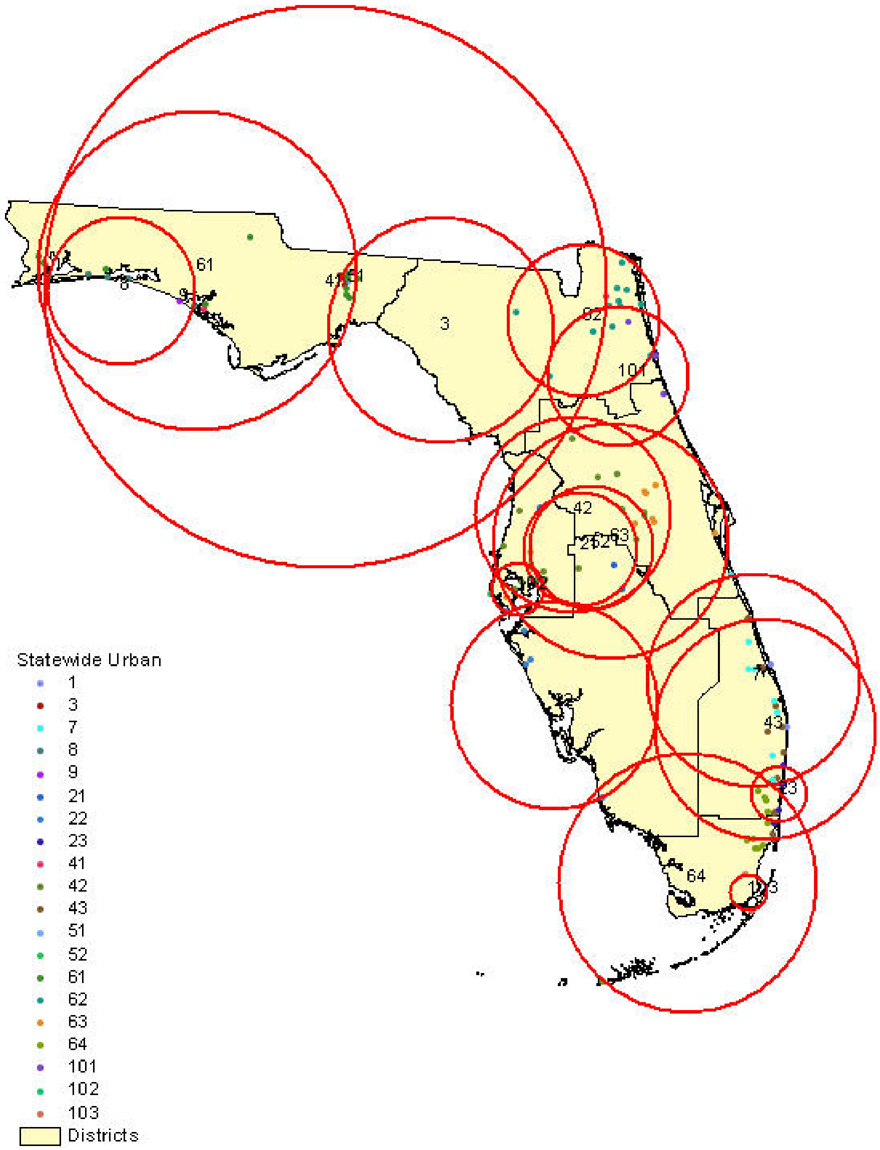


Figure 3.34 Modified Spatial Distribution of the TTMSs in Urban Areas

Table 3.7 Number of the TTMSs in the 20 Urban Groups

Group	Number of TTMSs
1	2
3	4
7	9
8	5
9	1
21	3
22	5
23	4
41	4
42	17
43	13
51	1
52	2
61	11
62	12
63	9
64	13
101	4
102	2
103	2

3.2 Seasonal Factor Grouping for Rural Areas

The procedure to develop the groups for the TTMSs in rural areas is the same as that for urban areas. Based on the rural area definition on the FDOT 2000 CD-ROM, there are 142 TTMSs in rural areas. The model-based cluster analysis without considering the locations resulted in nine groups. The results from the cluster analyses are first presented in Section 3.2.1. Section 3.2.2 discusses the refinement of the grouping based on the cluster analysis results.

Table 3.8 Comparison of Cluster Analyses for Rural TTMSs

Method	Number of Groups
Model based without X, Y	9
Model based with X, Y	44

3.2.1 Results from Cluster Analyses in Rural Areas

Figure 3.35 illustrates the spatial distribution based on the optimal grouping results produced by the model-based method for the TTMSs located in the rural area. This was done without incorporating the X and Y coordinates. The results show that the model produced clusters that include TTMSs far apart when the location effect is not considered. Table 3.9 gives the number of TTMSs that are assigned to each group.

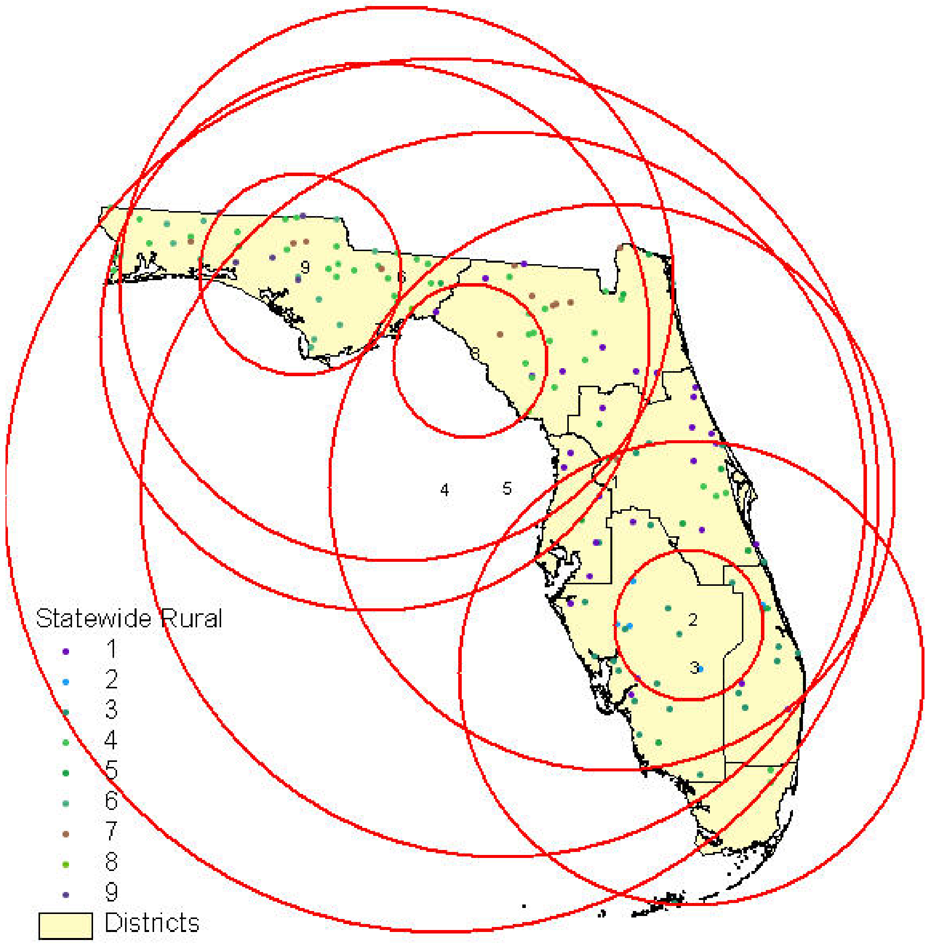


Figure 3.35 Optimal Nine Groups from Model-Based Clustering for TTMSs in Rural Areas

Table 3.9 Number of TTMSs in the Optimal Nine Groups

Group	Number of TTMSs
1	28
2	5
3	26
4	41
5	13
6	13
7	13
8	2
9	6

Figure 3.36 shows the optimal result when the coordinates of the TTMSs are included in the analysis. A more spatially clustered pattern of the TTMSs can be seen. However, as shown in Table 3.10, many groups have only one TTMS.

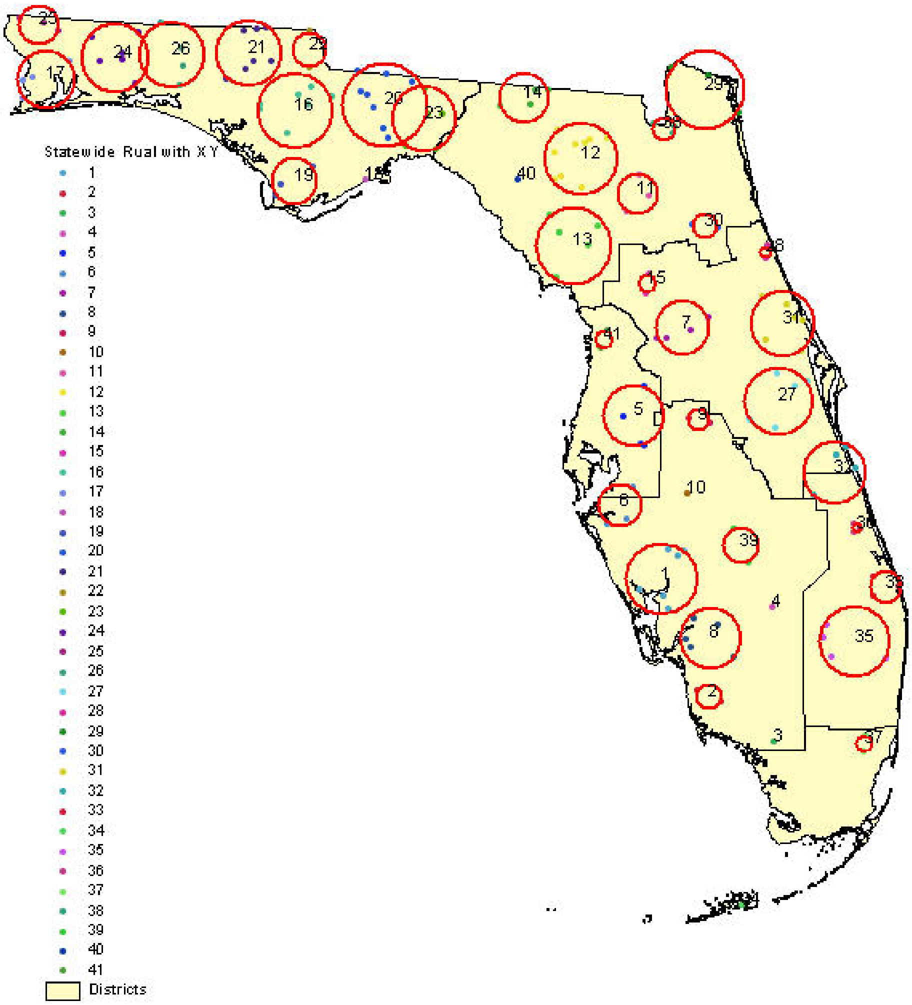


Figure 3.36 Optimal 44 Groups Based on Model-Based Clustering with X-Y for Rural Areas

Table 3.10 Number of TTMSs in the Optimal 44 Groups

Group	Number of TTMSs
1	6
2	2
3	1
4	1
5	4
6	3
7	4
8	5
9	2
10	1
11	3
12	9
13	5
14	4
15	1
16	2
17	7
18	4
19	1
20	3
21	8
22	7
23	2
24	5
25	6
26	3
27	4
28	5
29	2
30	2
31	2
32	6
33	5
34	3
35	1
36	1
37	3
38	3
39	2
40	3
41	2
42	1
43	1
44	2

3.2.2 Refinement of Cluster Results for Rural Areas

The grouping results, shown in Figure 3.35, are examined. Within the same group, the TTMSs in Groups 2, 8, and 9 are similar in their monthly profiles. They are also located in close proximity to each other. Their spatial distributions and MSF profiles are illustrated in Figures 3.37, 3.38, and 3.39, respectively.

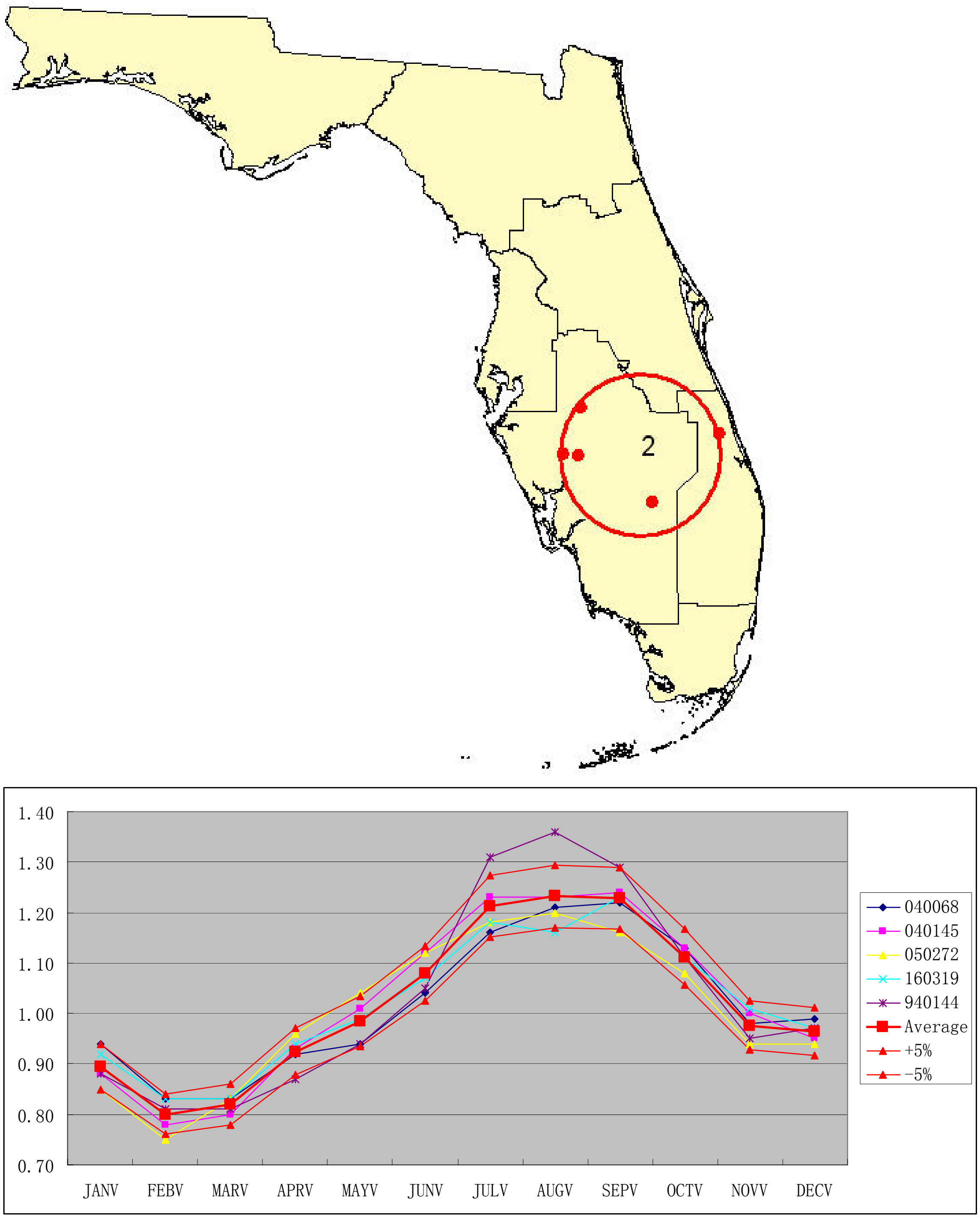
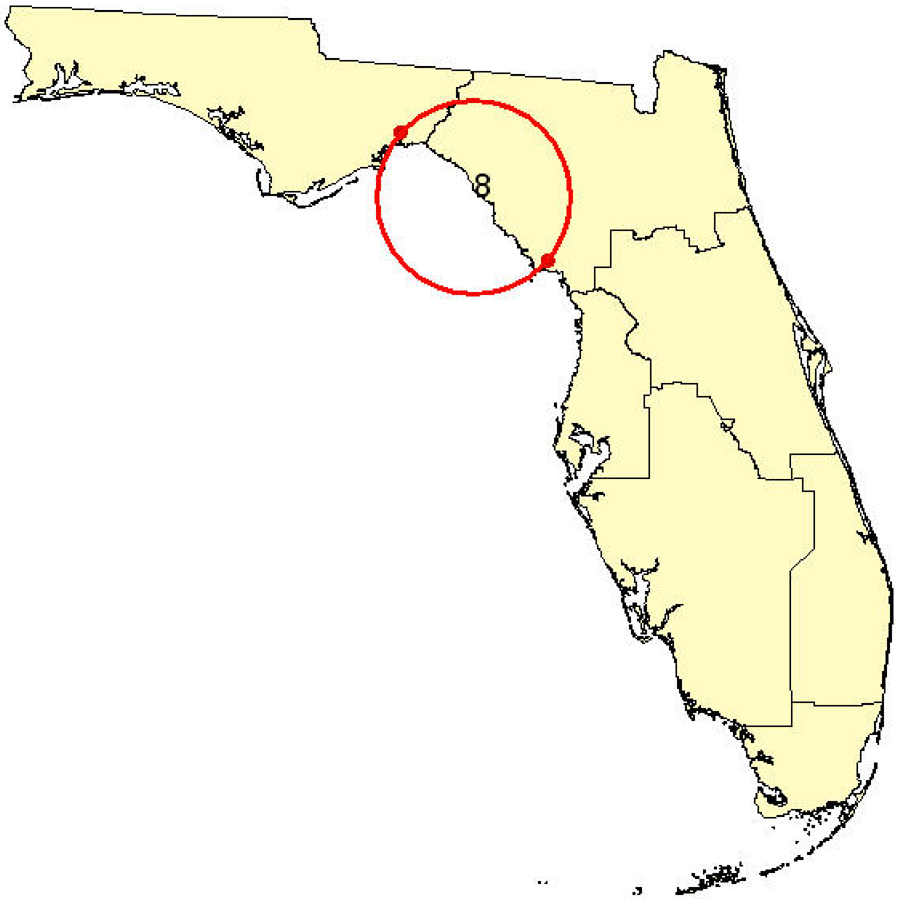


Figure 3.37 Spatial Distribution and Profiles of the TTMSs in Rural Group 2



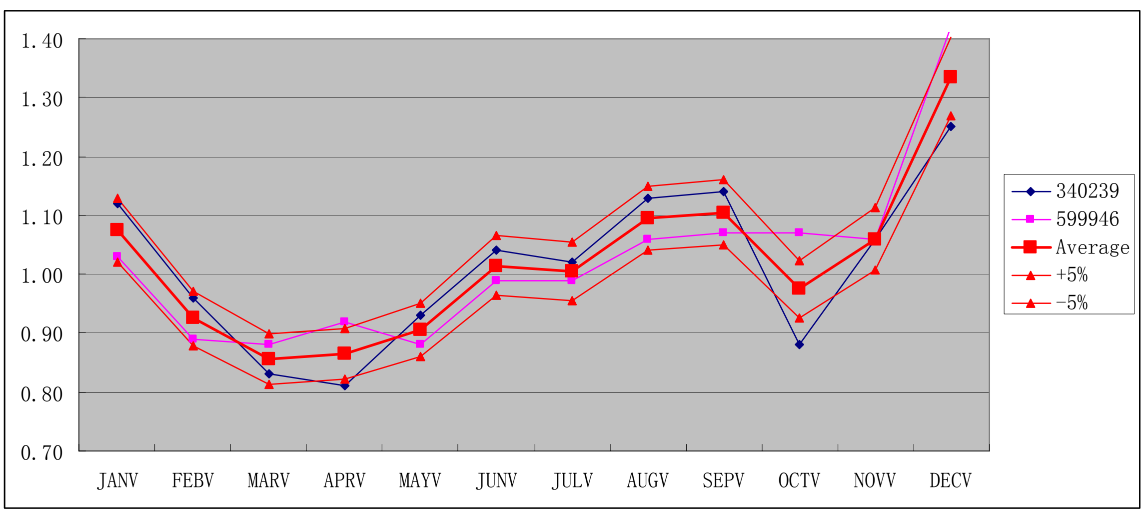
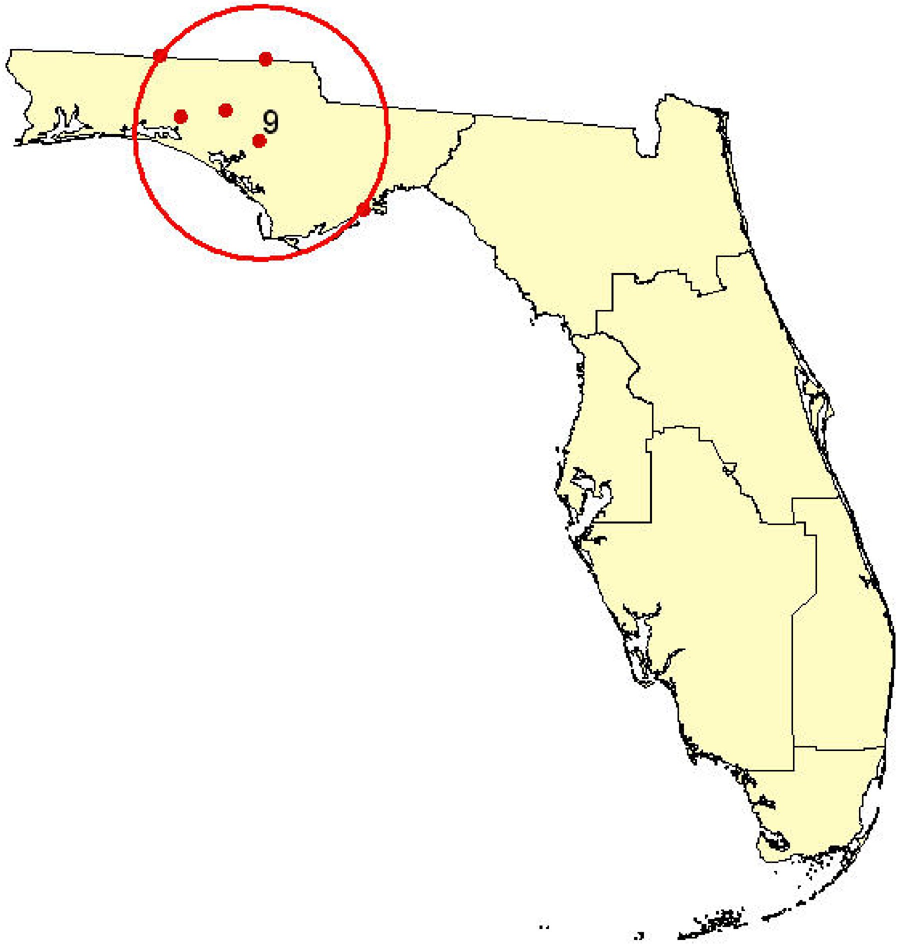


Figure 3.38 Spatial Distribution and Profiles of the TTMSs in Rural Group 8



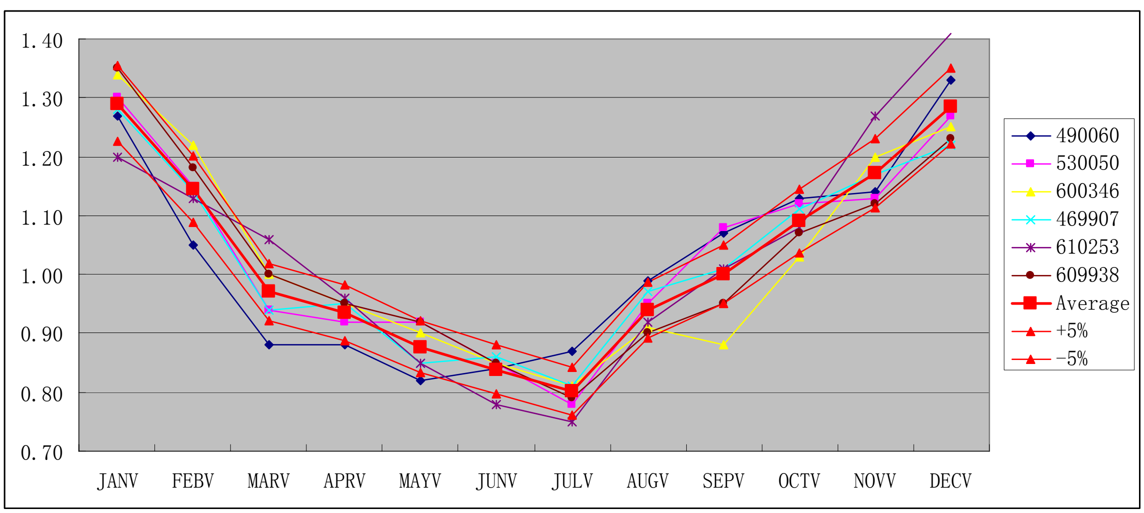


Figure 3.39 Spatial Distribution and Profiles of the TTMSs in Rural Group 9

For TTMS Groups 1, 3, 4, 5, 6, and 7, the TTMSs in the same groups are located far apart. For example, as shown in Figure 3.40, the TTMSs in Group 1 are from five FDOT districts, which are regrouped into the six new groups shown in Figure 3.41. Figures 3.42 through 3.46 illustrate the profiles for these six new subgroups.

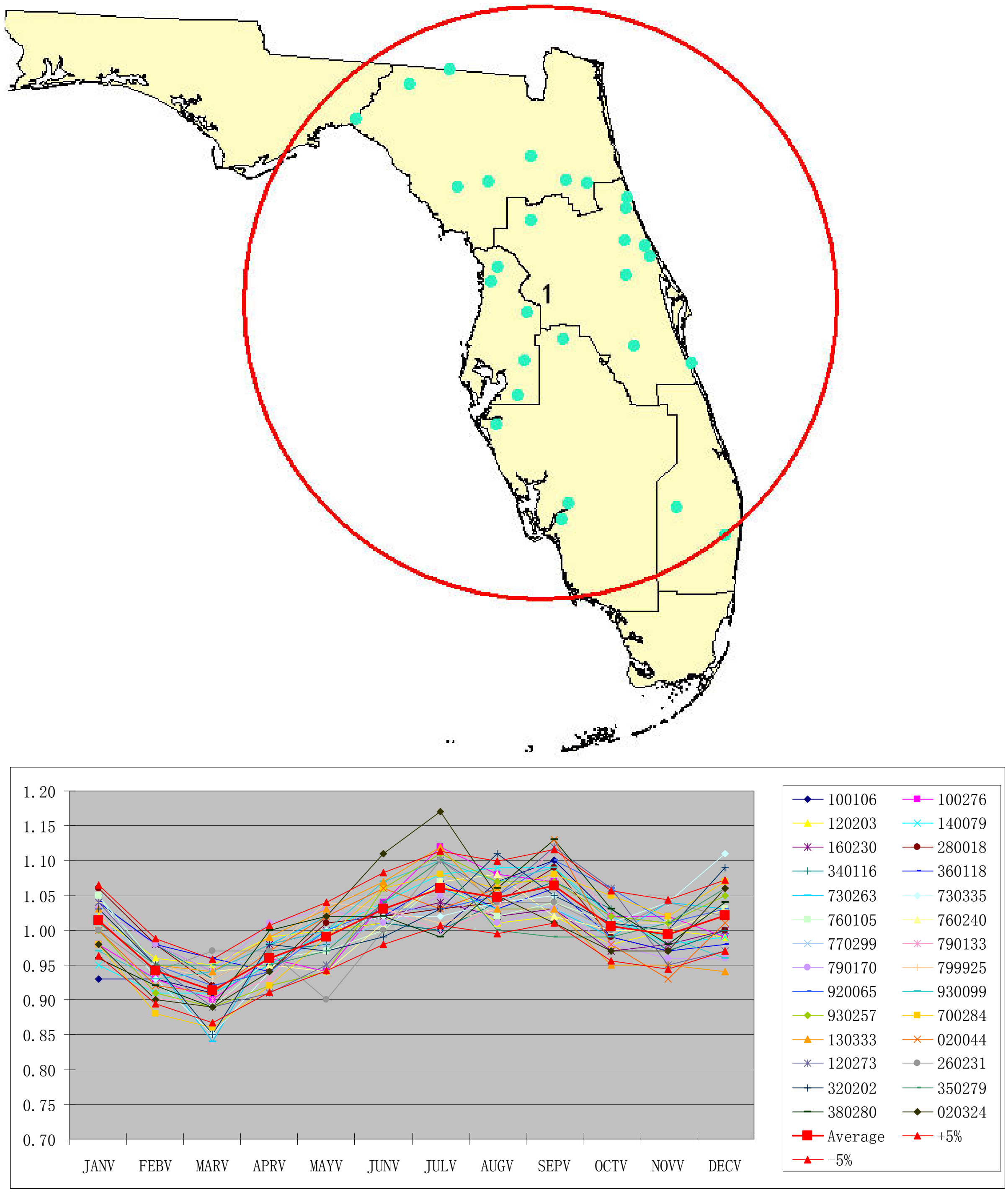


Figure 3.40 Spatial Distribution and Profiles of the TTMSs in Rural Group 1

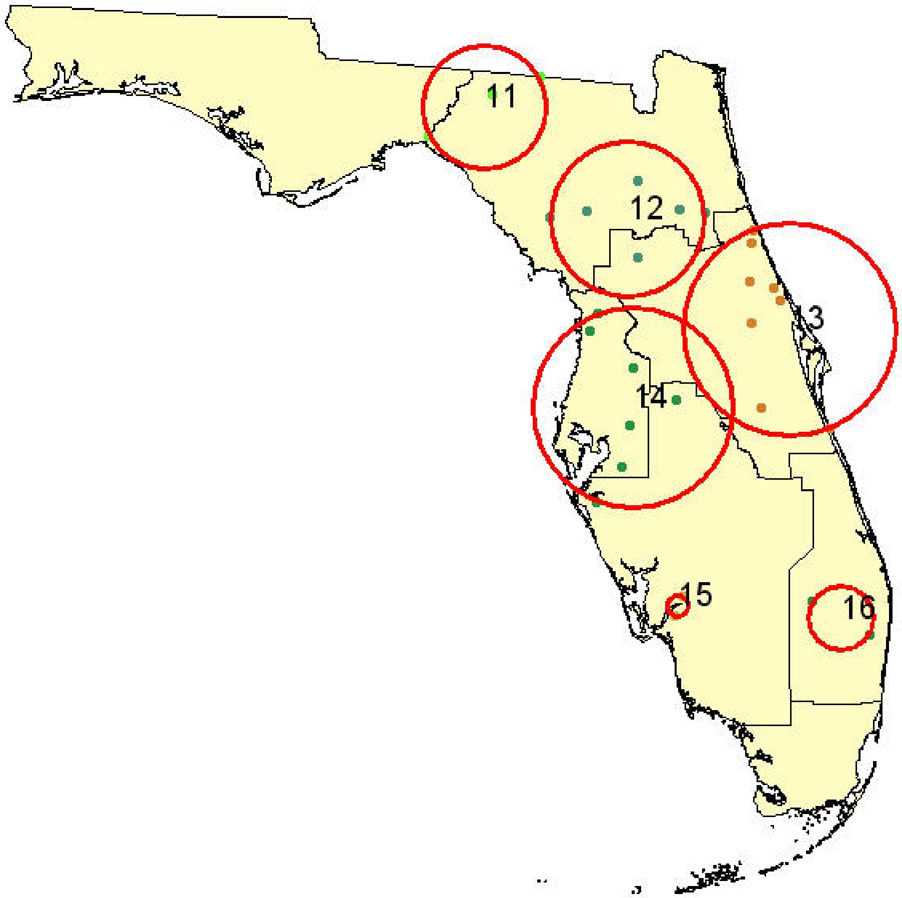


Figure 3.41 New Subgroups Based on Rural Group 1

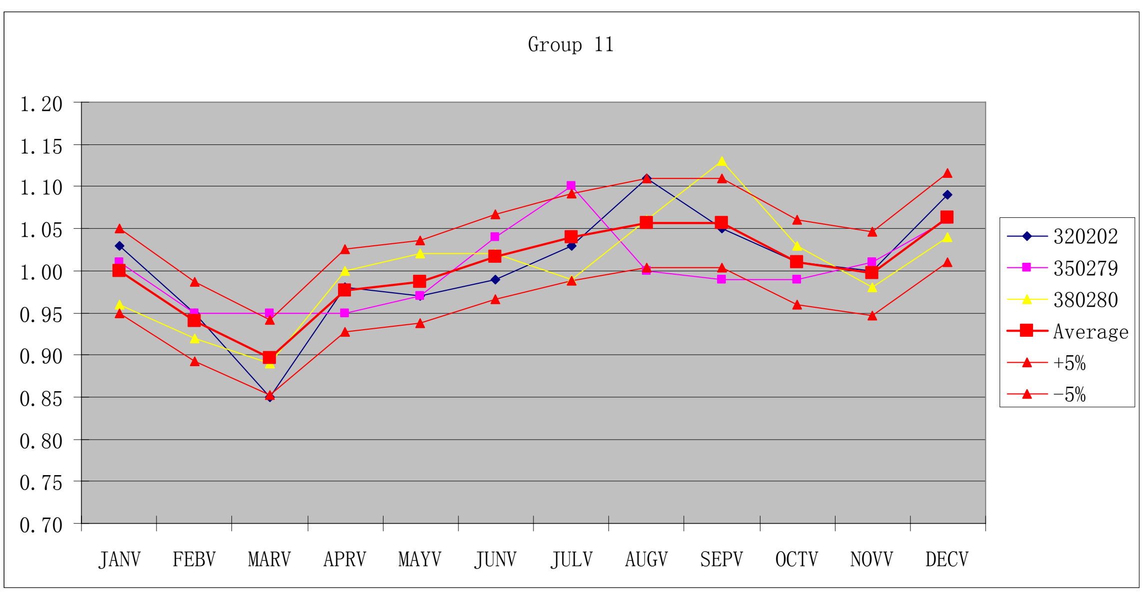


Figure 3.42 Profiles of TTMSs in the New Rural Group 11

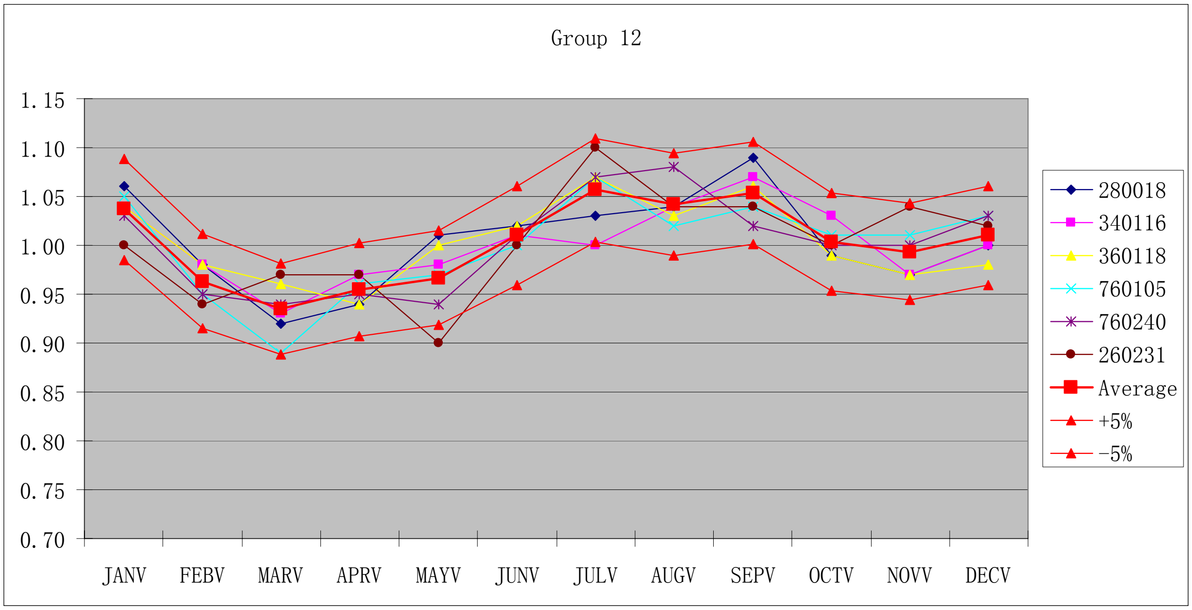


Figure 3.43 Profiles of TTMSs in the New Rural Group 12

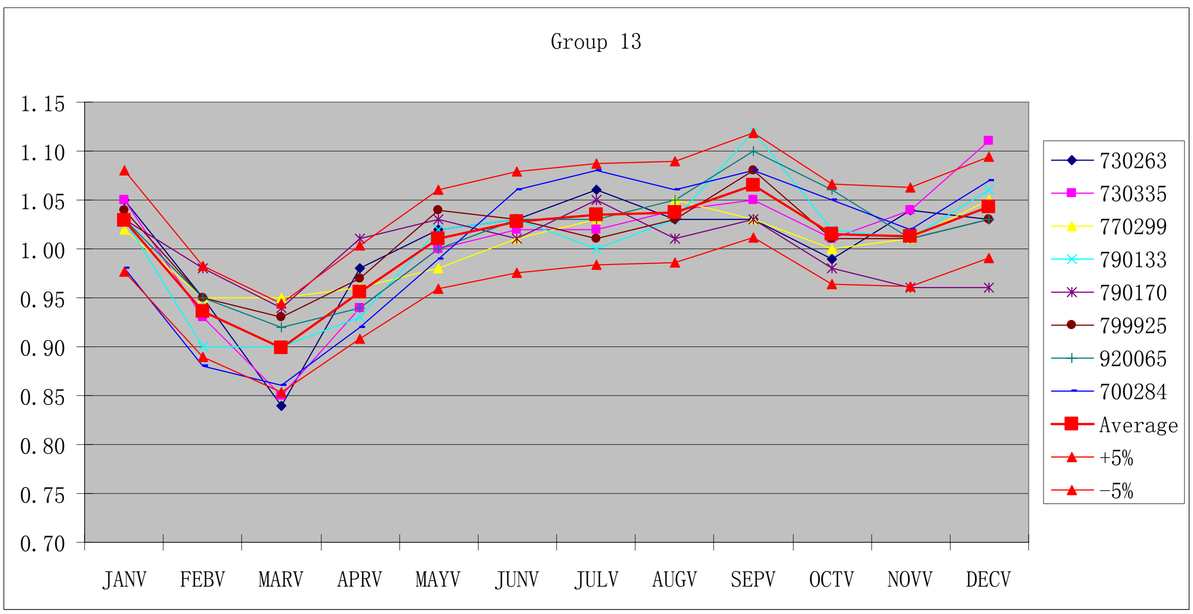


Figure 3.44 Profiles of TTMSs in the New Rural Group 13

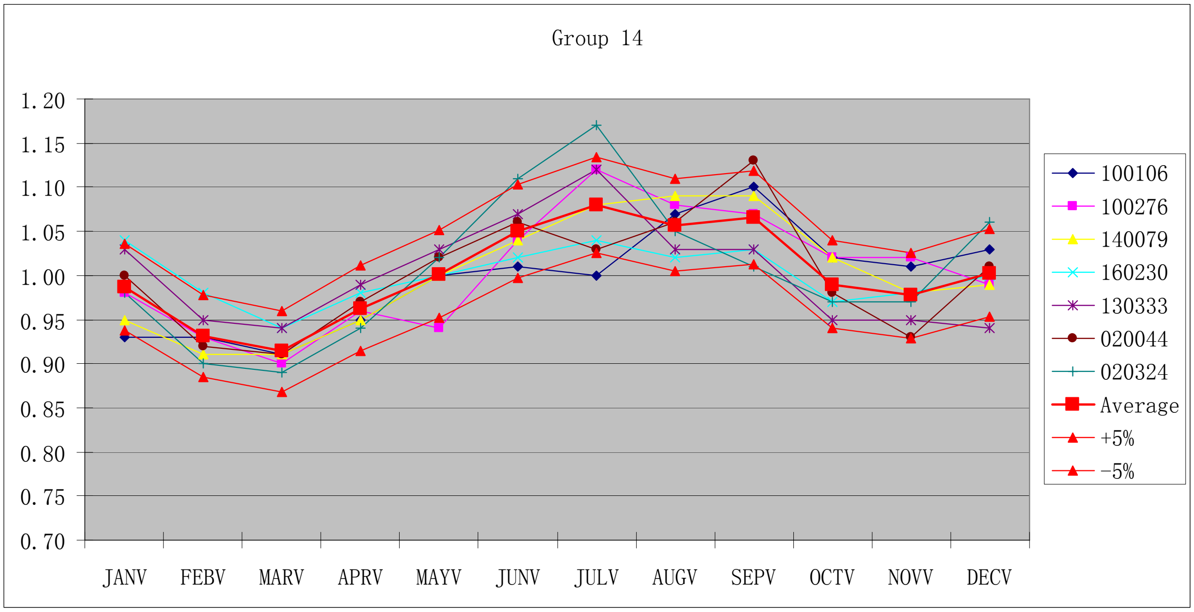


Figure 3.45 Profiles of TTMSs in the New Rural Group 14

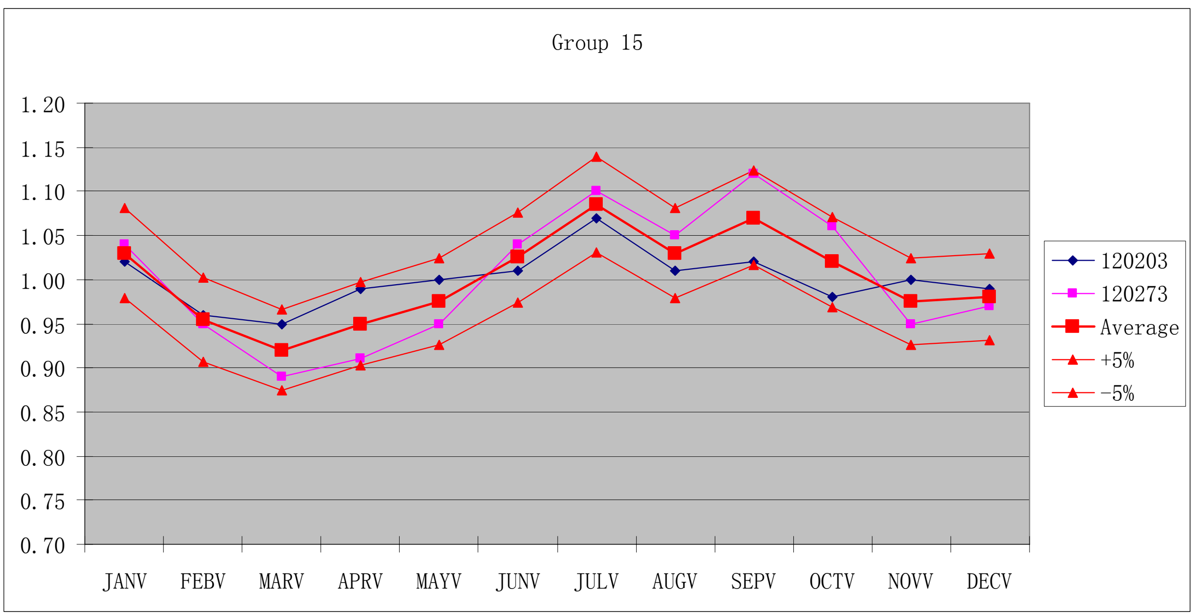


Figure 3.46 Profiles of TTMSs in the New Rural Group 15

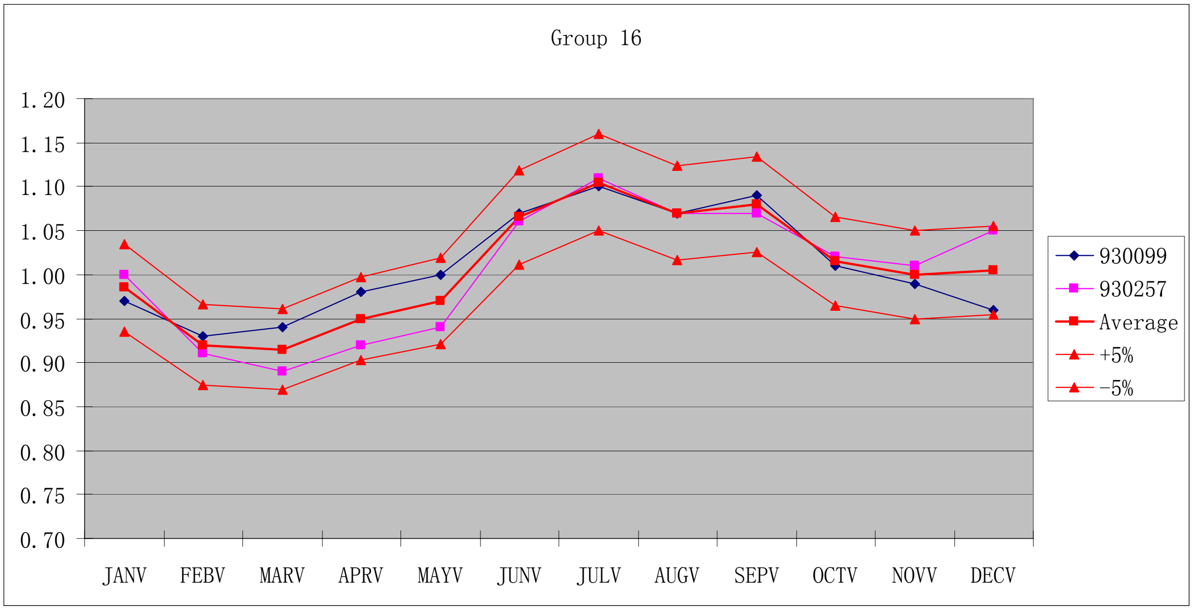


Figure 3.47 Profiles of TTMSs in the New Rural Group 16

Figure 3.48 shows the spatial distributions of TTMSs in Group 3. This group is subdivided into four new subgroups, as shown in Figure 3.49. Figures 3.50 through 3.53 show the profiles for the four new subgroups.

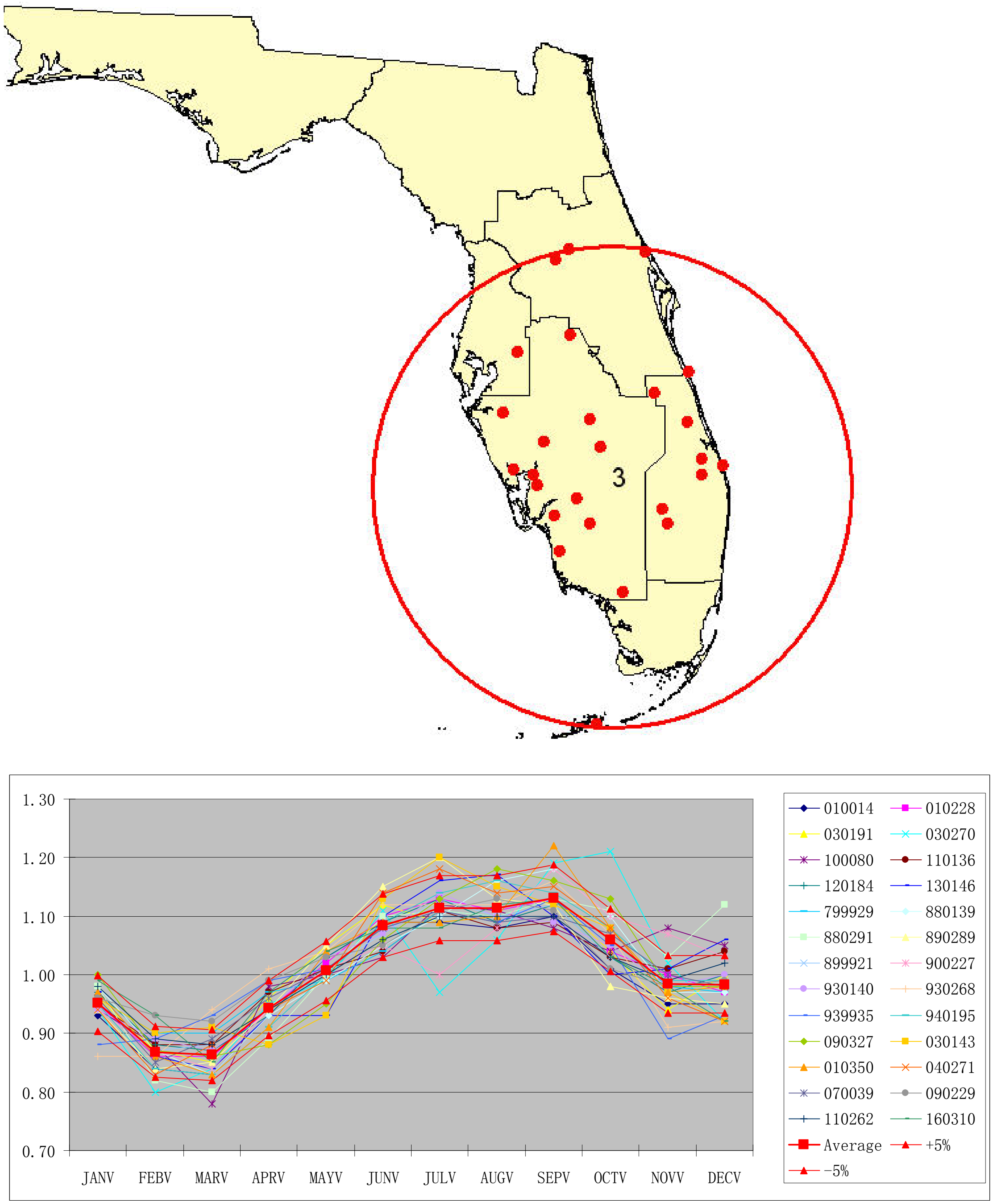


Figure 3.48 Spatial Distribution and Profiles of TTMSs in Rural Group 3

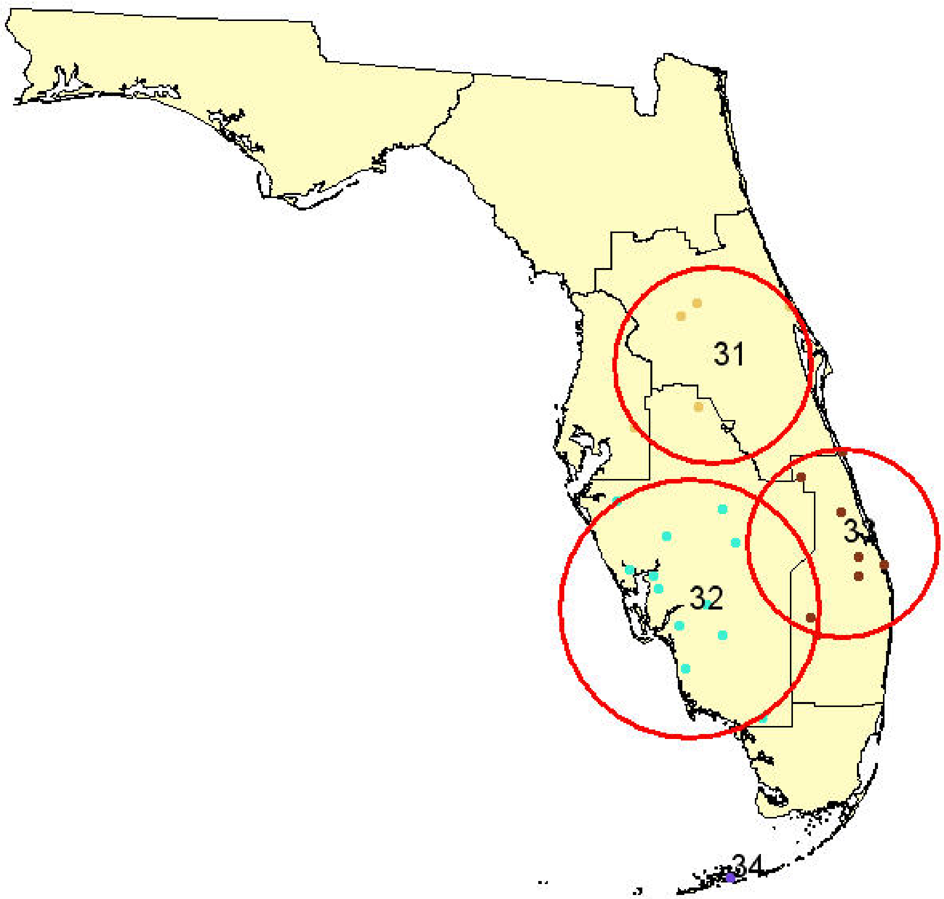


Figure 3.49 Four New Subgroups Created Based on Rural Group 3

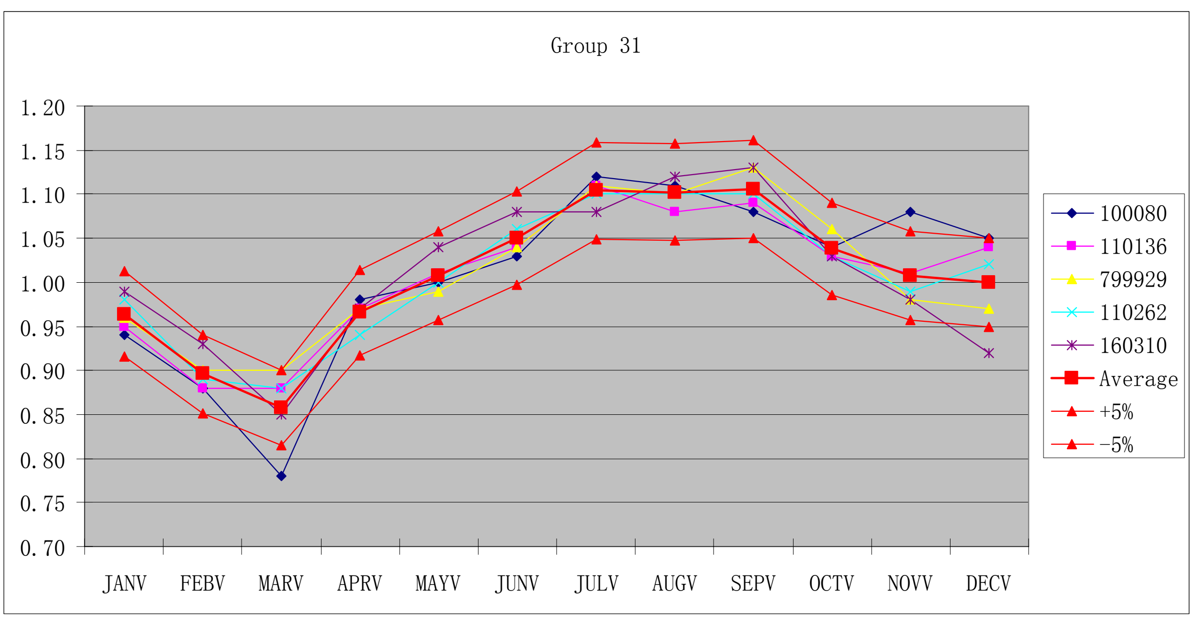


Figure 3.50 Profiles of TTMSs in the New Rural Group 31

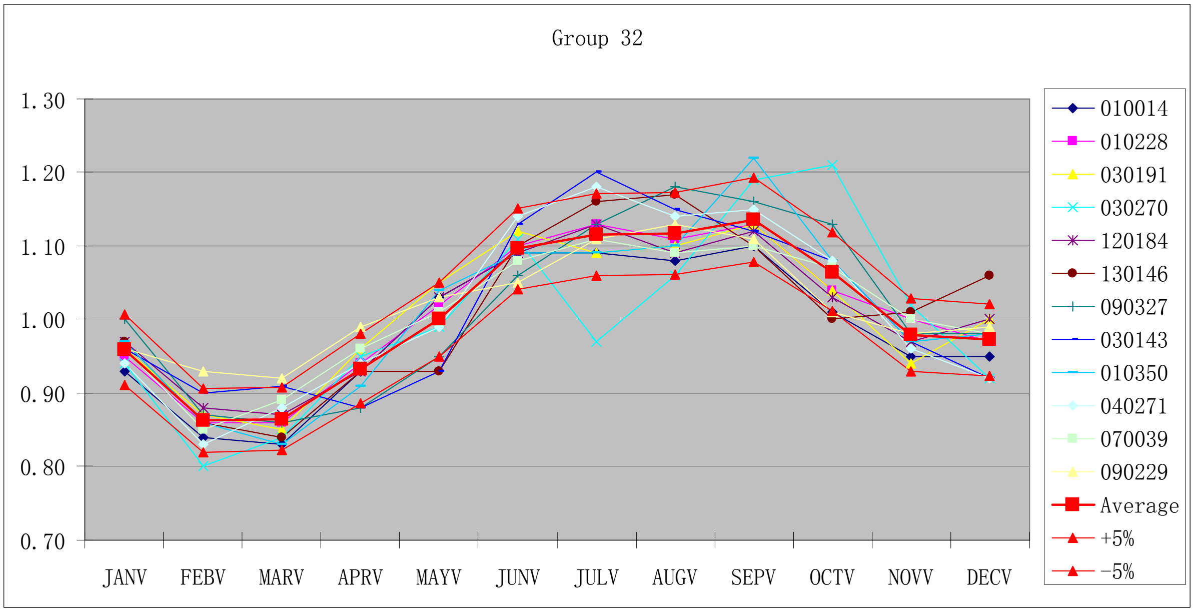


Figure 3.51 Profiles of TTMSs in the New Rural Group 32

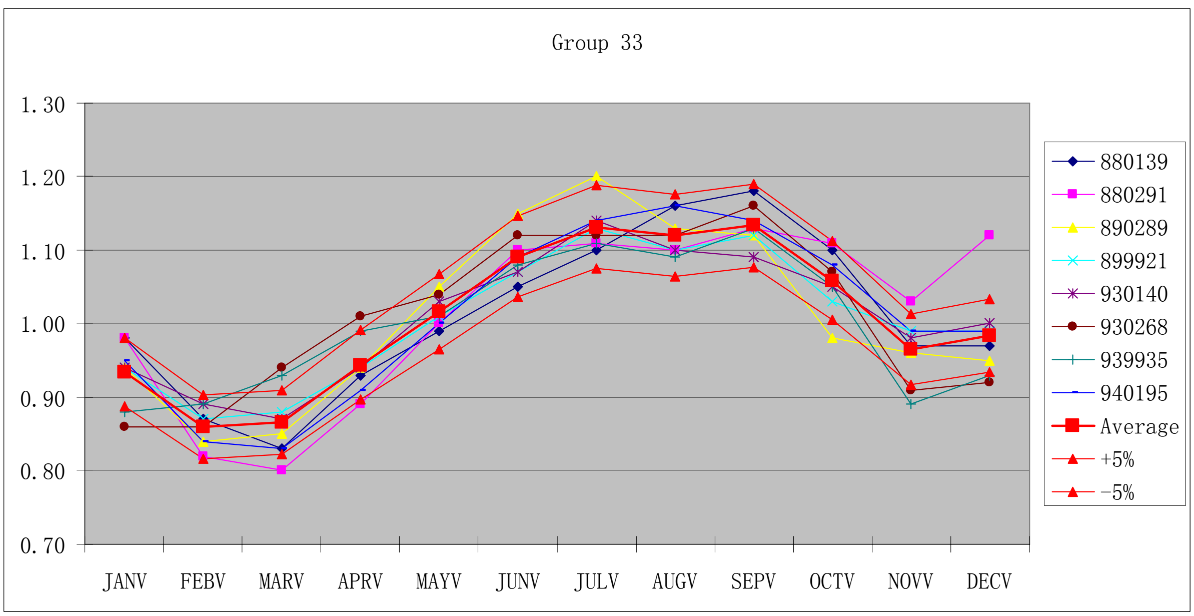


Figure 3.52 Profiles of TTMSs in the New Rural Group 33

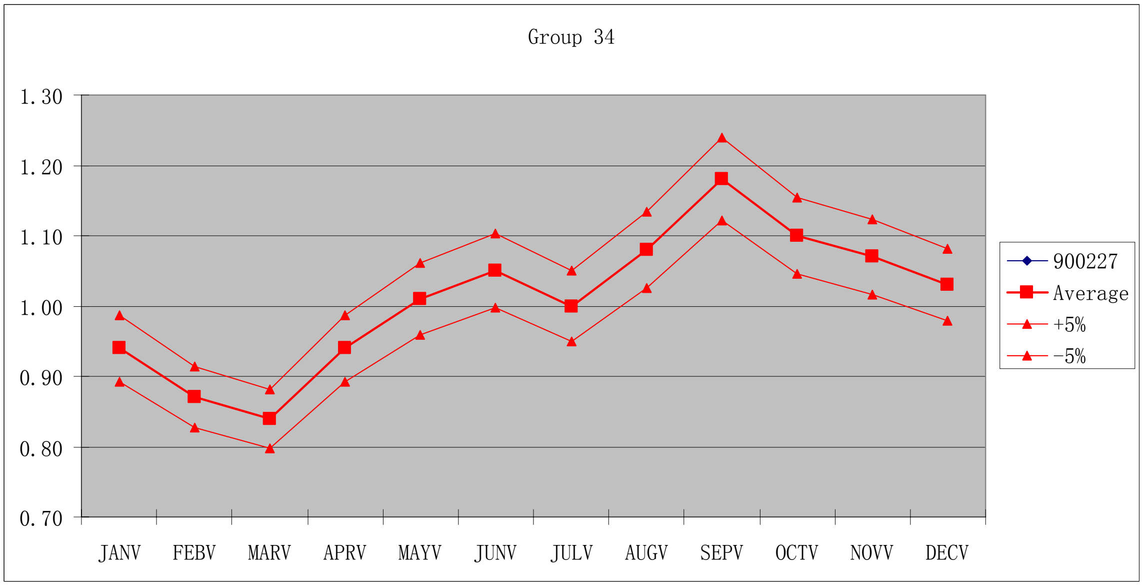


Figure 3.53 Profiles of TTMSs in the New Rural Group 34

The TTMSs in Group 4 are located across the entire state, as indicated in Figure 3.54. These TTMSs are regrouped into four new subgroups, which are shown in Figure 3.55. Figures 3.56 through 3.59 plot the profiles for these four new subgroups.

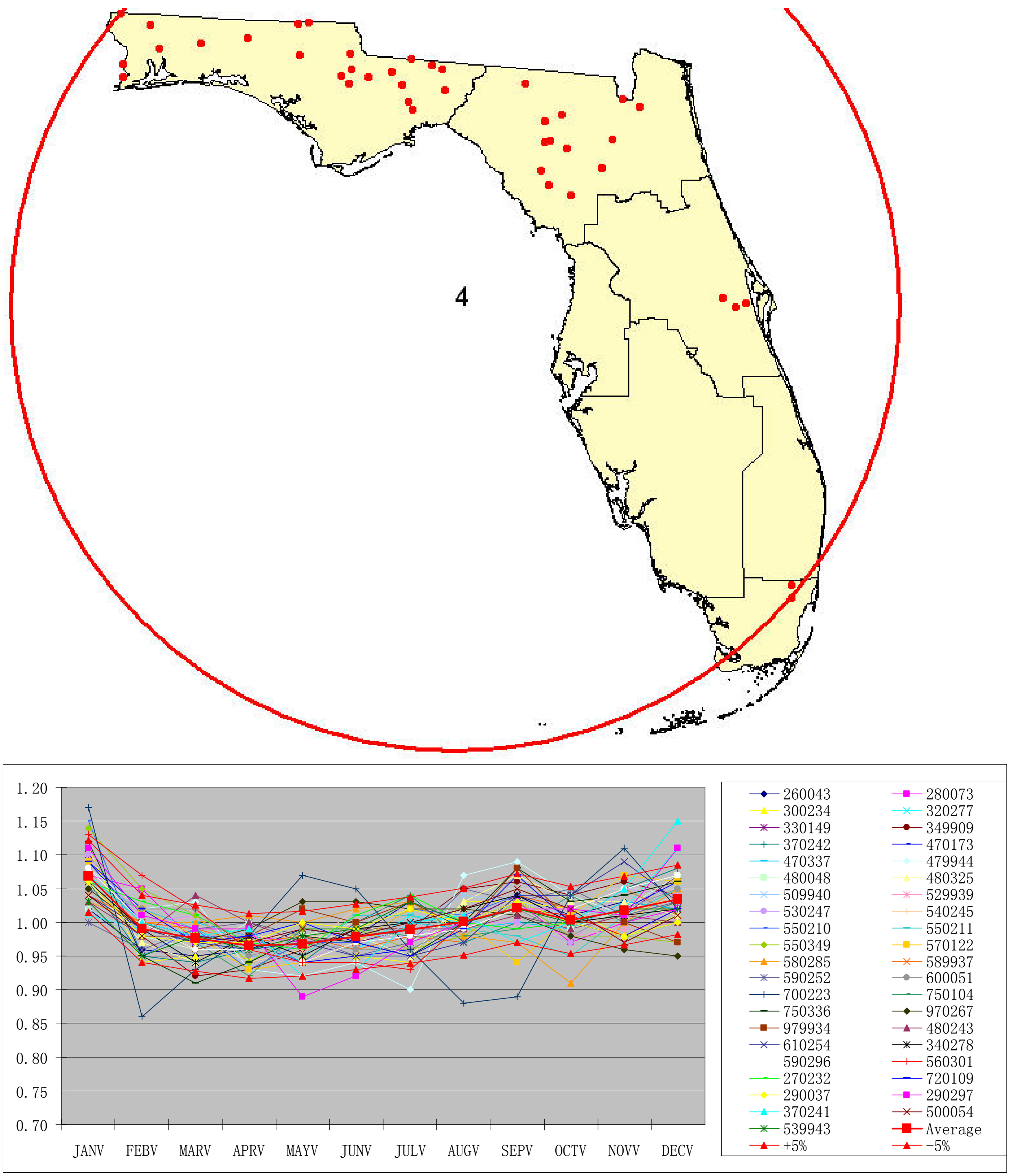


Figure 3.54 Spatial Distribution and Profiles of TTMSs in Rural Group 4

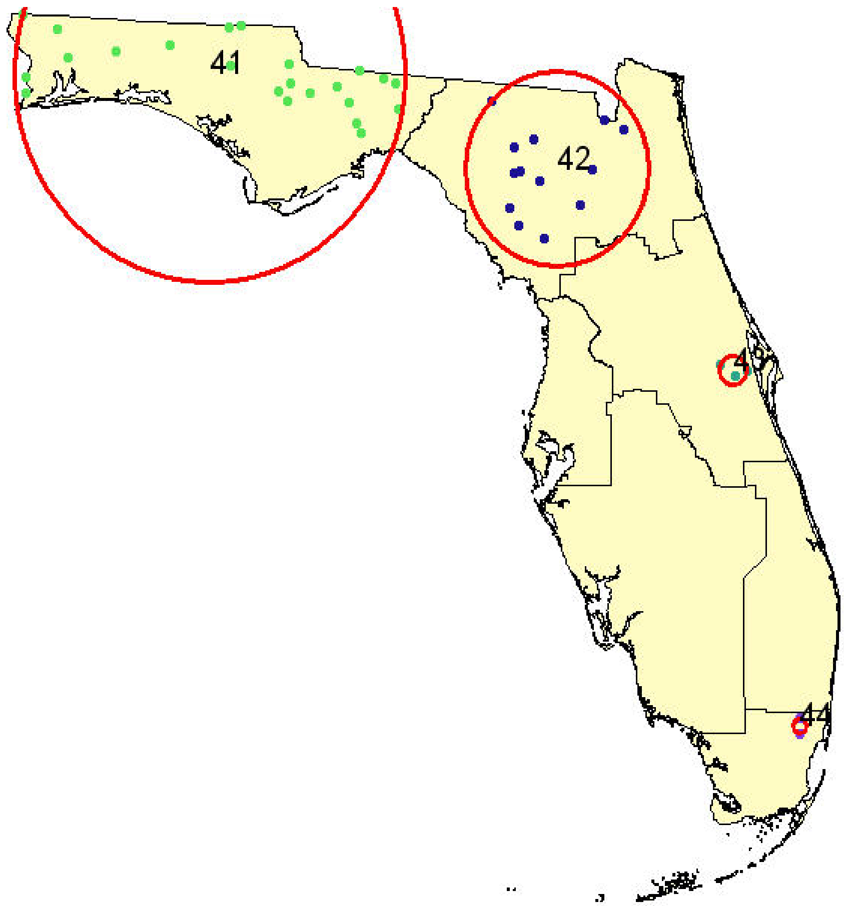


Figure 3.55 Four New Subgroups Created Based on Rural Group 4

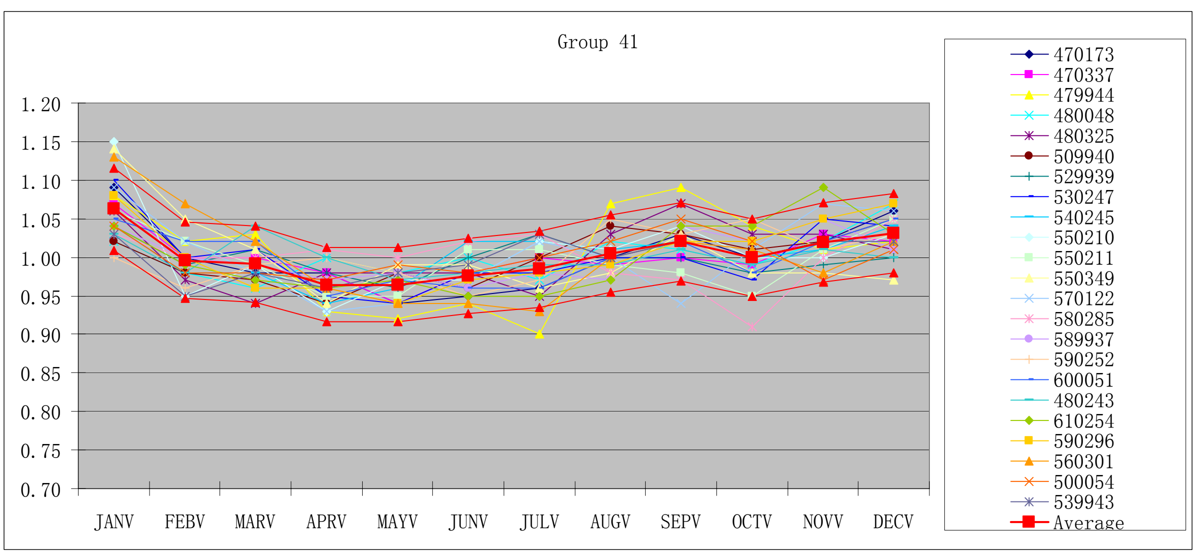


Figure 3.56 Profiles of TTMSs in the New Rural Group 41

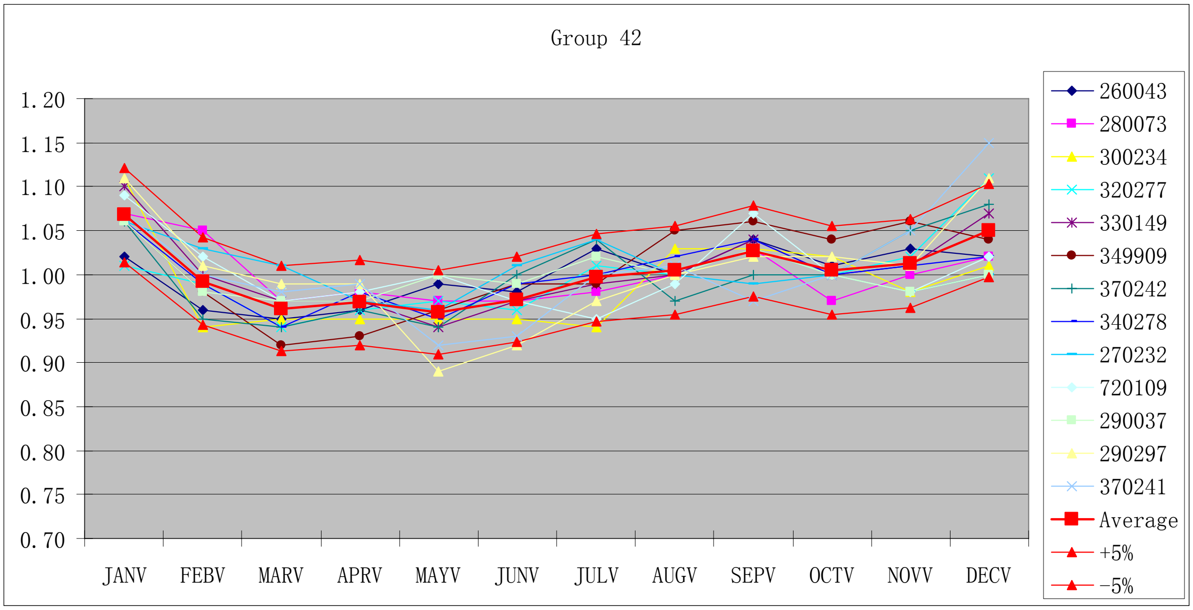


Figure 3.57 Profiles of TTMSs in the New Rural Group 42

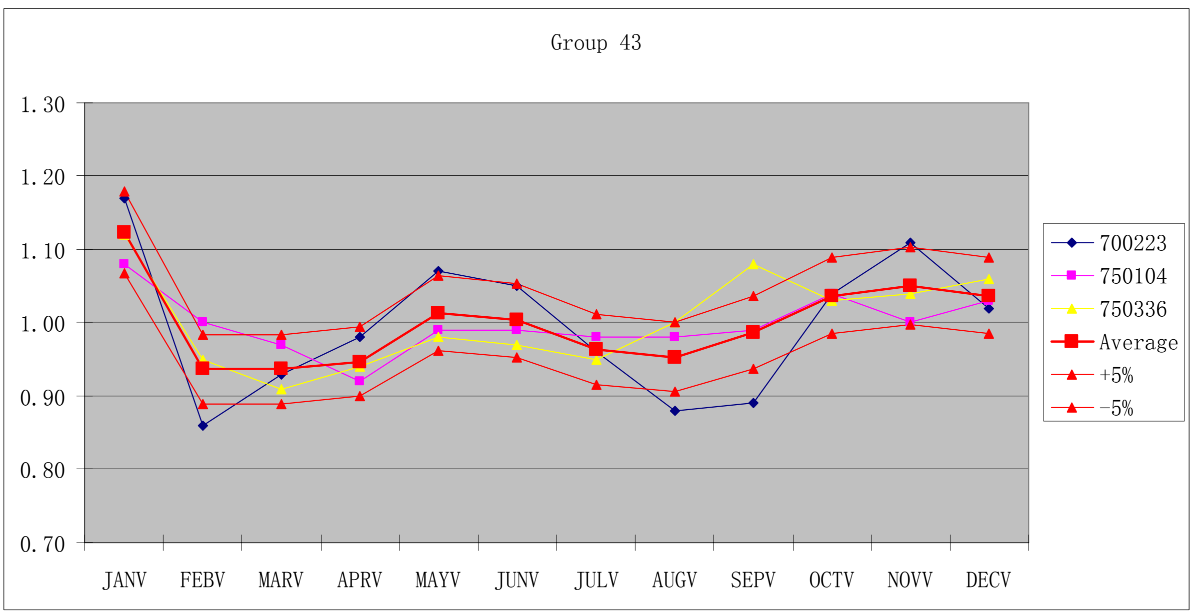


Figure 3.58 Profiles of TTMSs in the New Rural Group 43

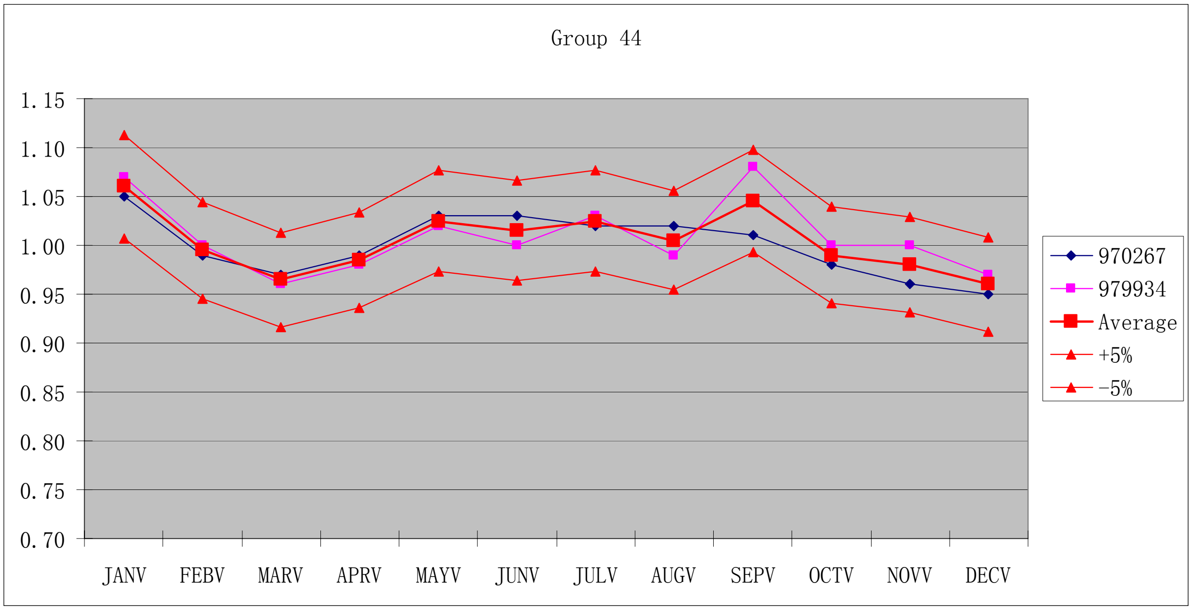
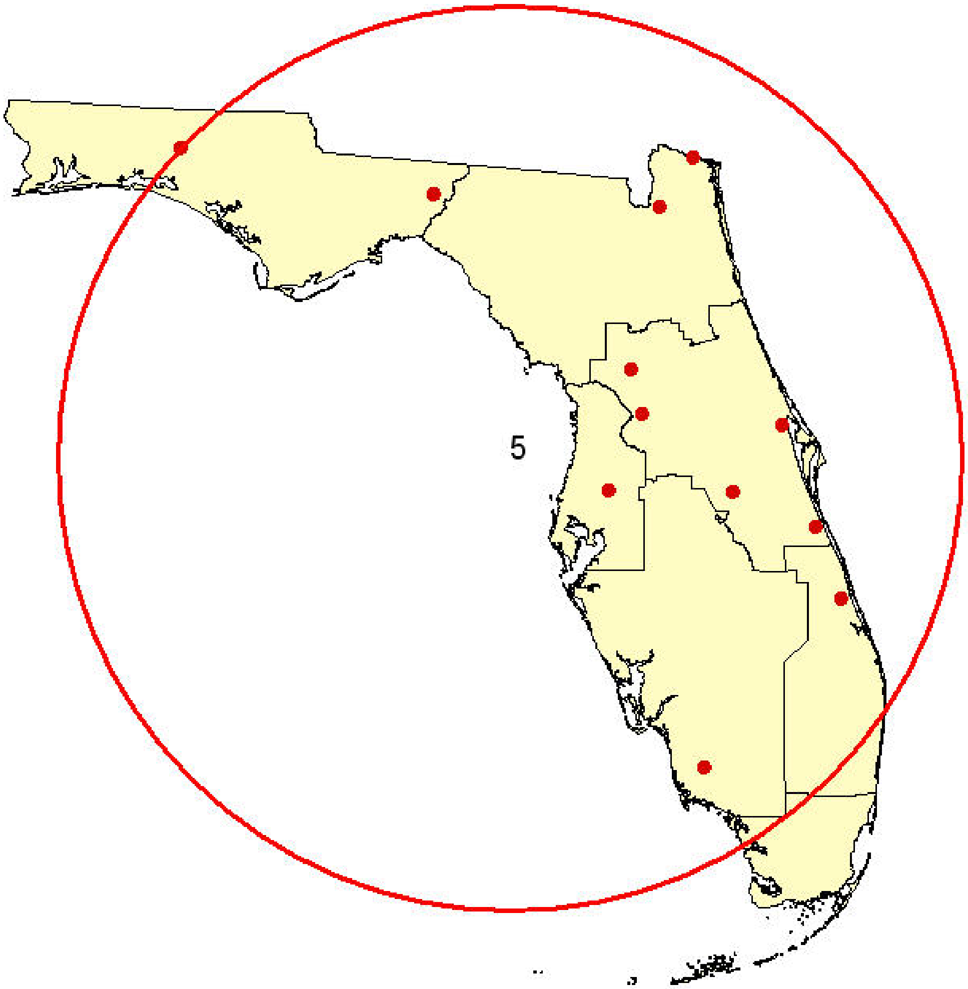


Figure 3.59 Profiles of TTMSs in the New Rural Group 44

Figure 3.60 shows the spatial distribution of the TTMSs in Group 5. Figure 3.61 shows the distributions after four subgroups are created from Group 5. The group profiles for the new subgroups are depicted in Figures 3.62 through 3.65.



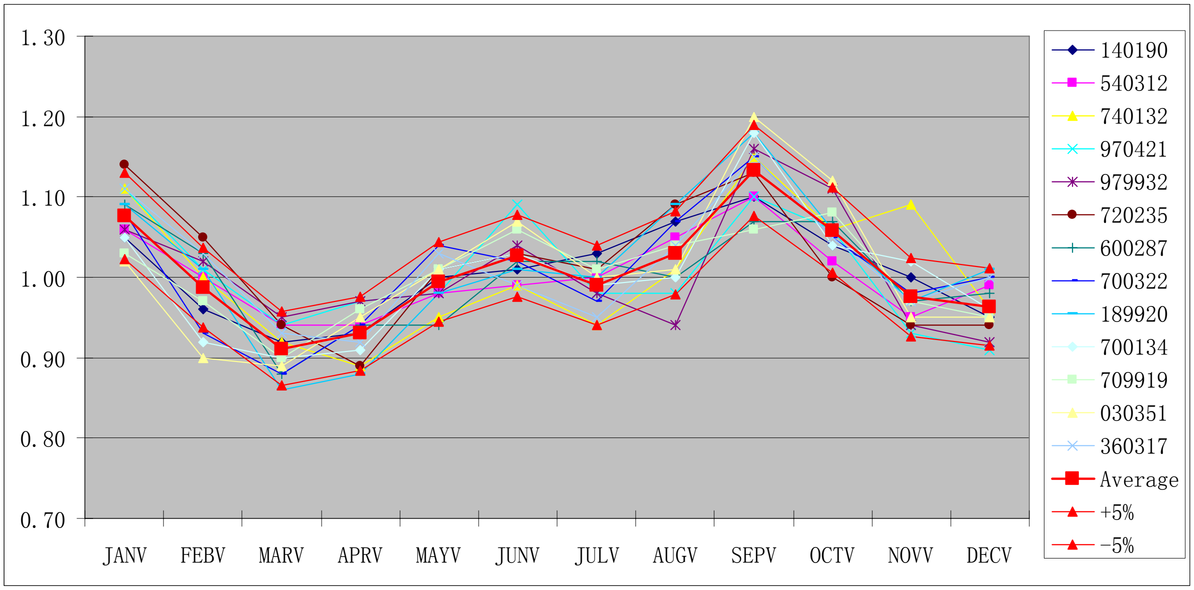


Figure 3.60 Spatial Distribution and Profiles of TTMSs in Rural Group 5

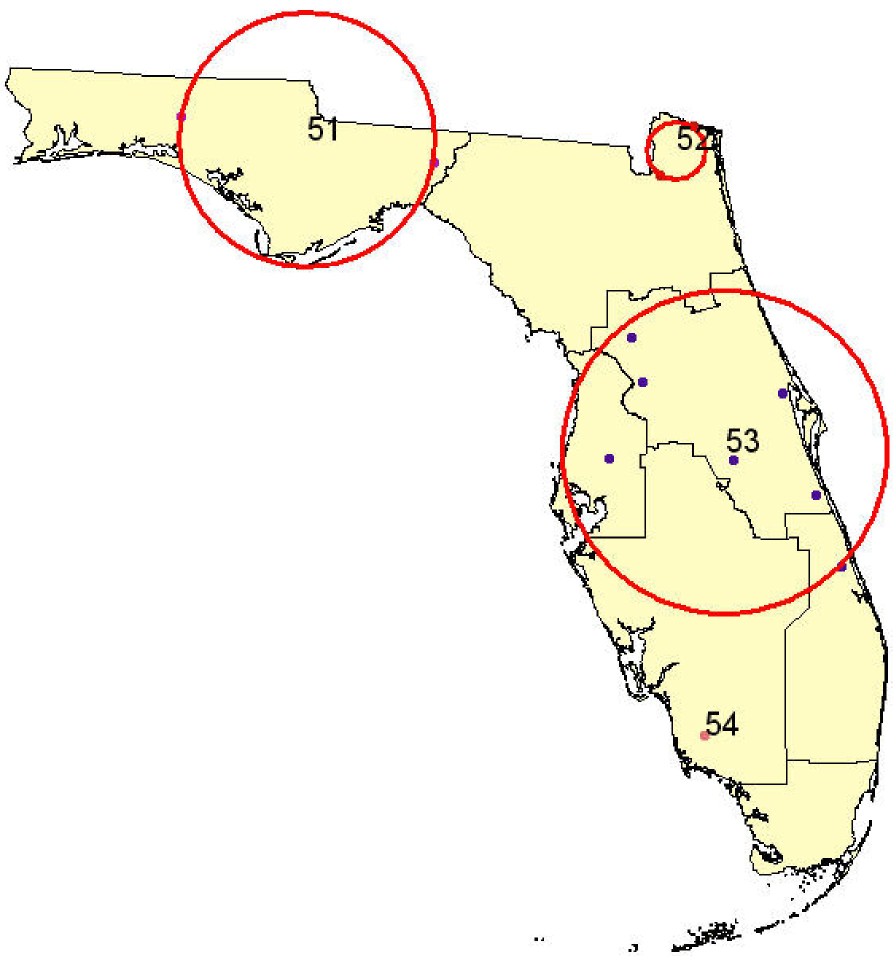


Figure 3.61 Four New Subgroups Created from Rural Group 5

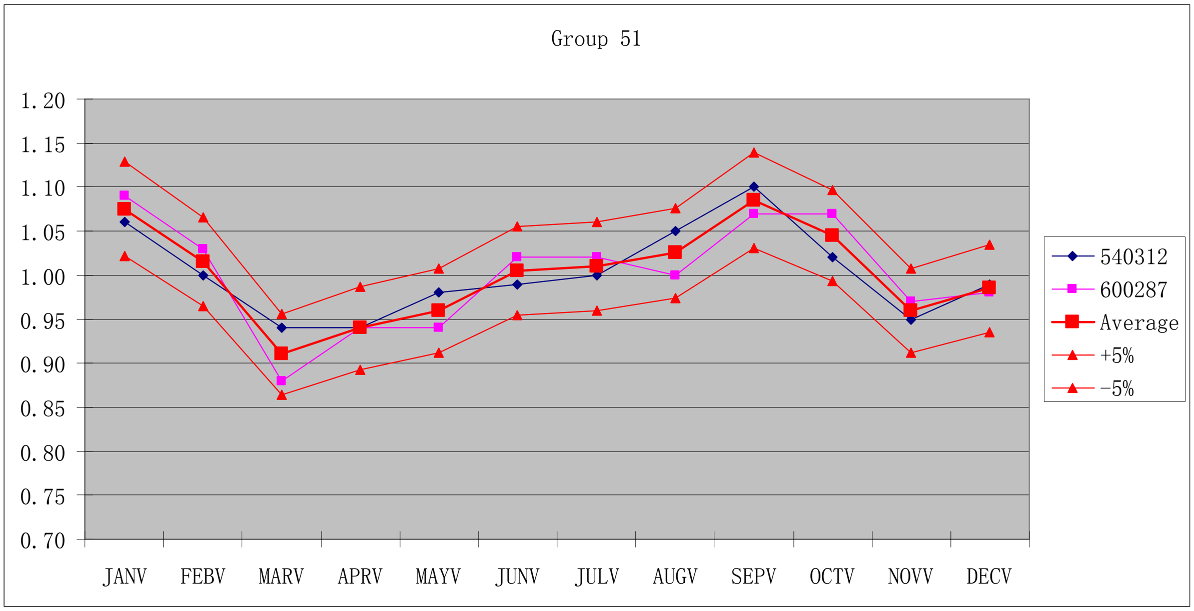


Figure 3.62 Profiles of TTMSs in the New Rural Group 51

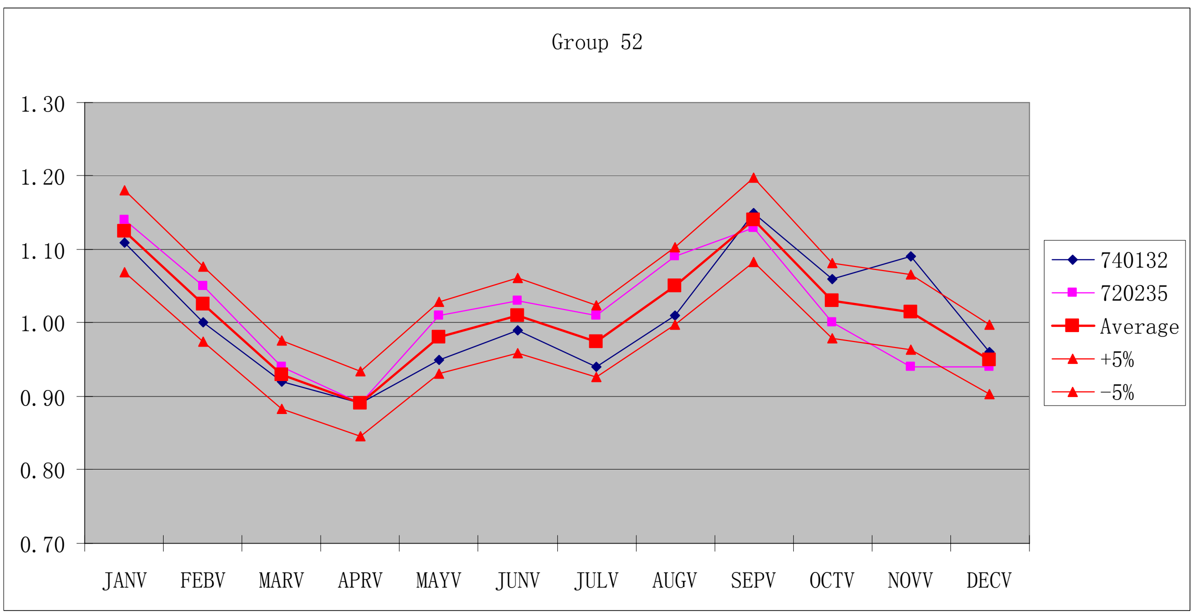


Figure 3.63 Profiles of TTMSs in the New Rural Group 52

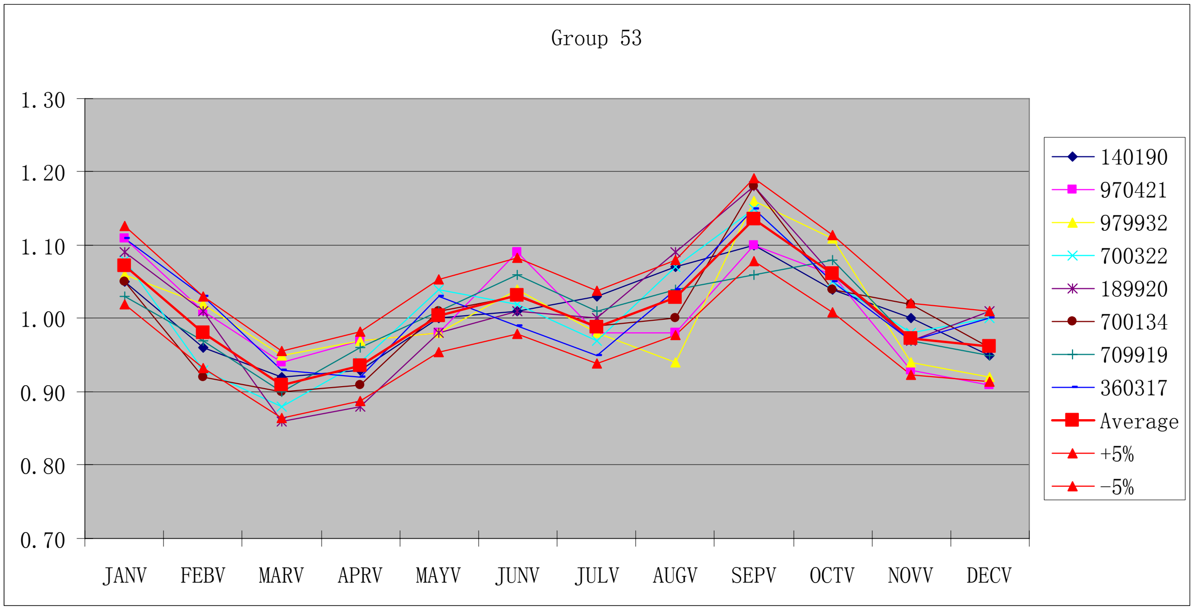


Figure 3.64 Profiles of TTMSs in the New Rural Group 53

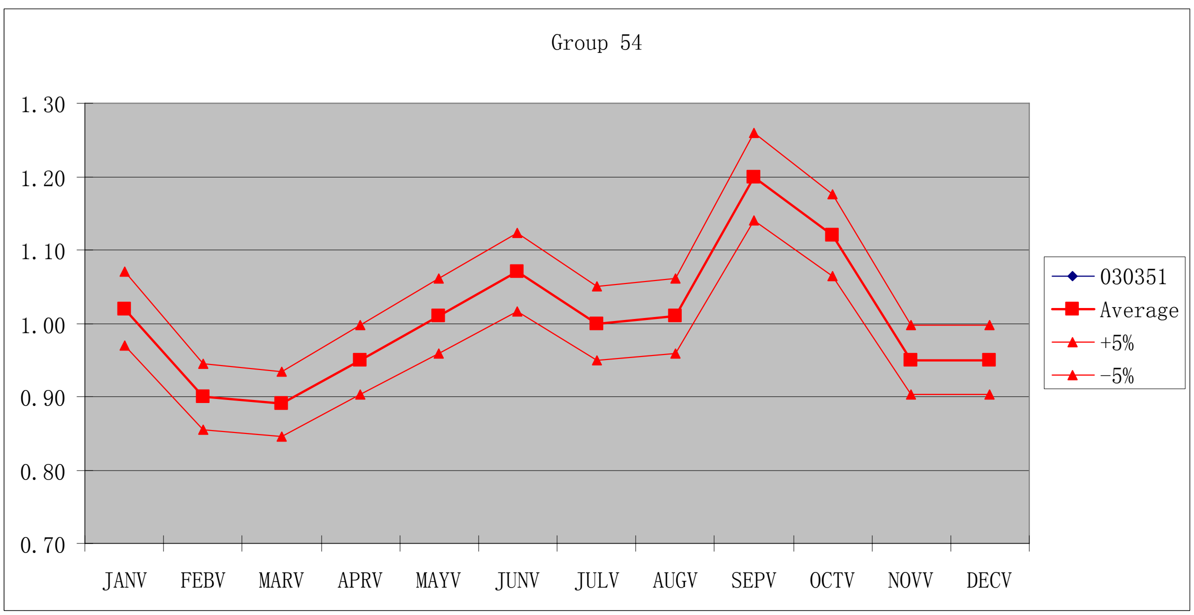
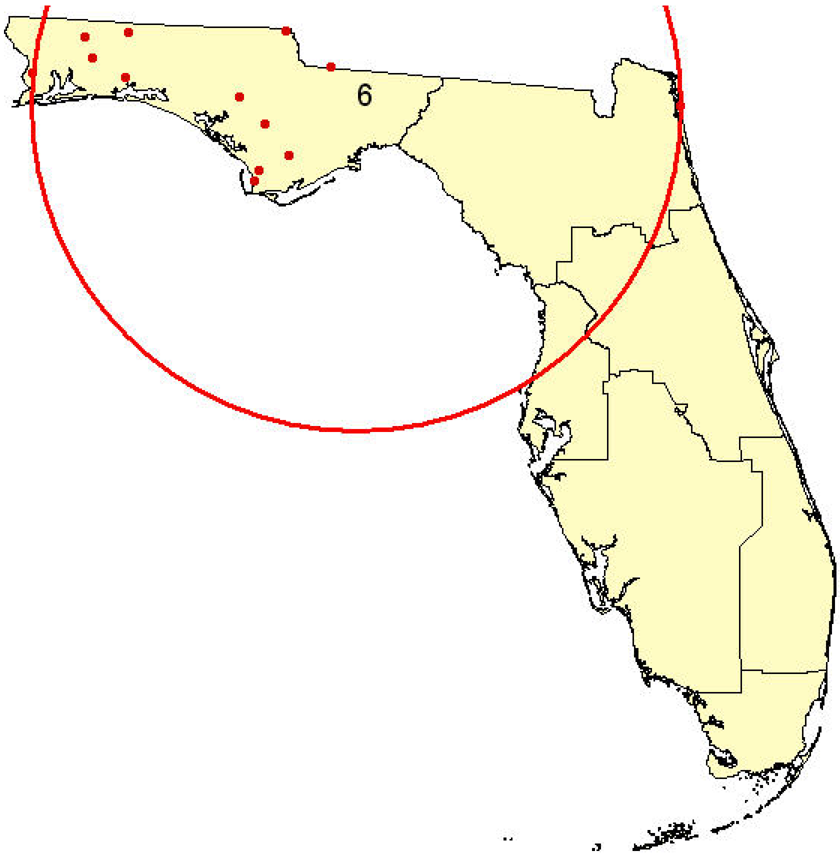


Figure 3.65 Profiles of TTMSs in the New Rural Group 54

The spatial distribution and profiles of the TTMSs in Group 6 are illustrated in Figure 3.66. Note that there are large variations in the MSFs in this group. The TTMSs in this group are divided into four subgroups as shown in Figure 3.67. The group profiles are plotted in Figures 3.68 through 3.71. Also note that the three groups with a single TTMS cannot be combined because they have significantly different patterns.



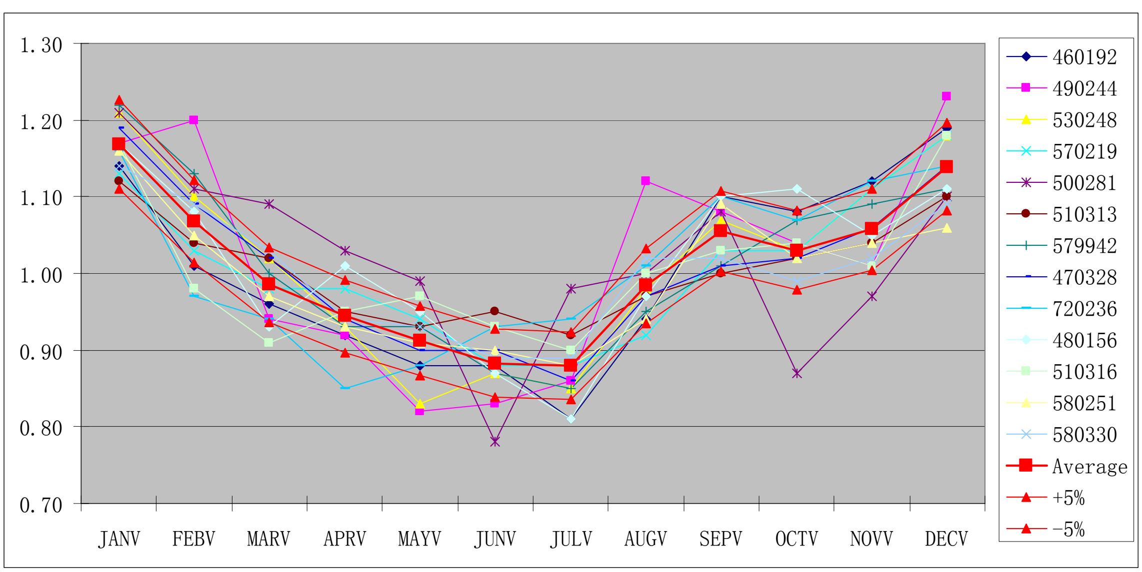


Figure 3.66 Spatial Distribution and Profile of TTMSs in Rural Group 6

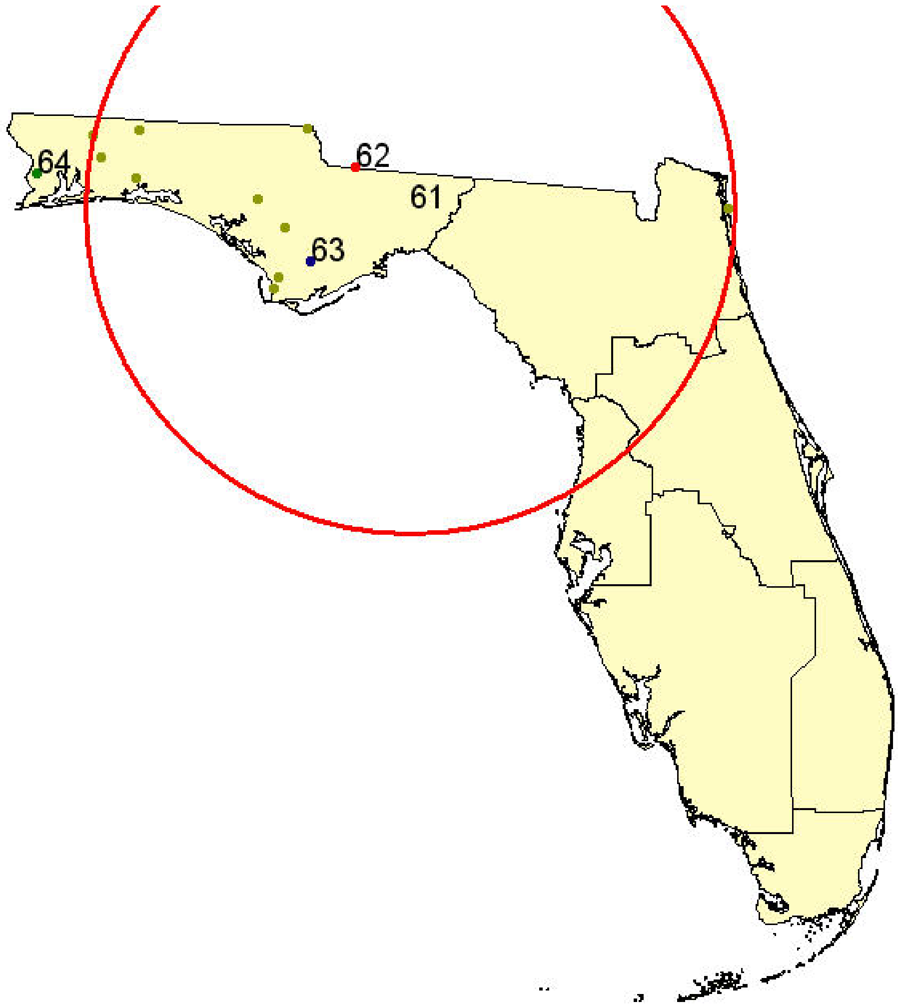


Figure 3.67 Four New Subgroups Created from Rural Group 6

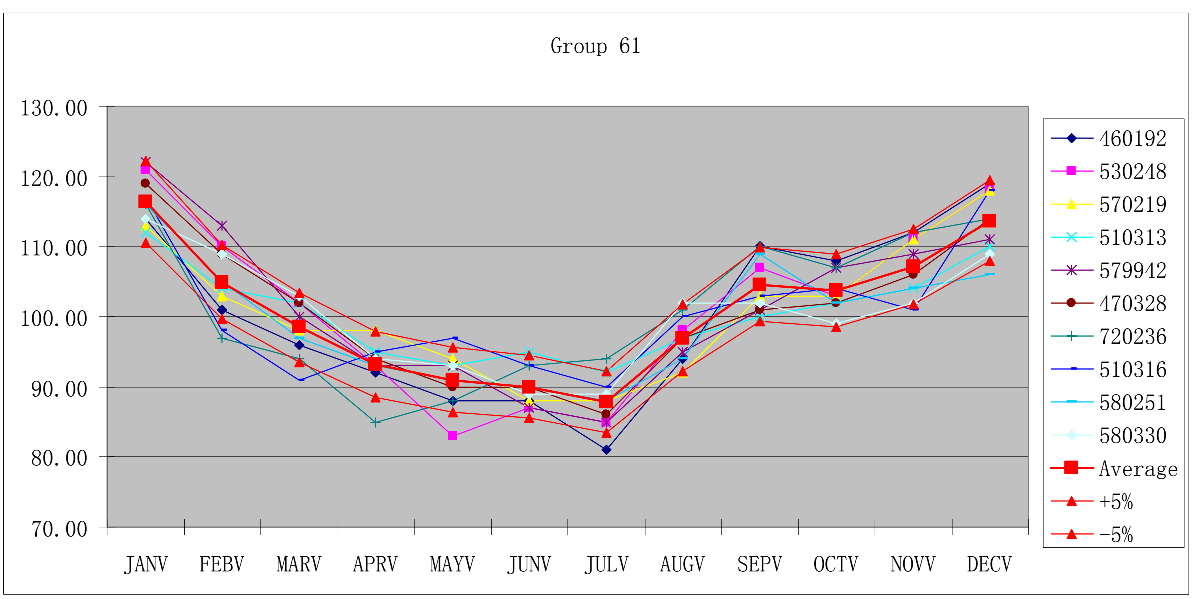


Figure 3.68 Profiles of TTMSs in the New Rural Group 61

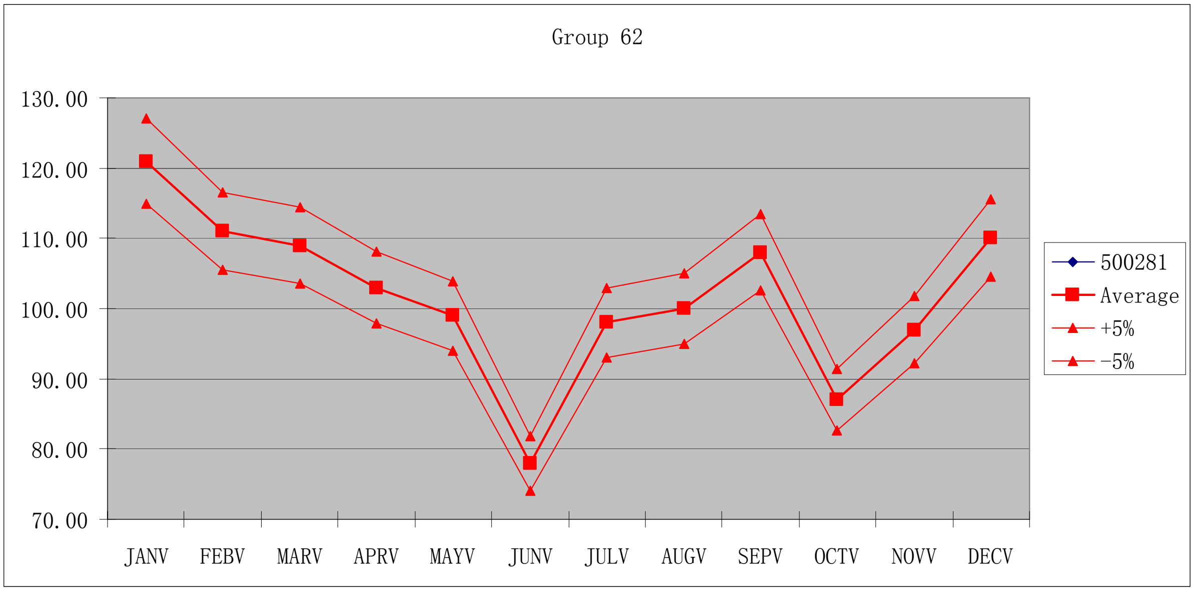


Figure 3.69 Profiles of TTMSs in the New Rural Group 62

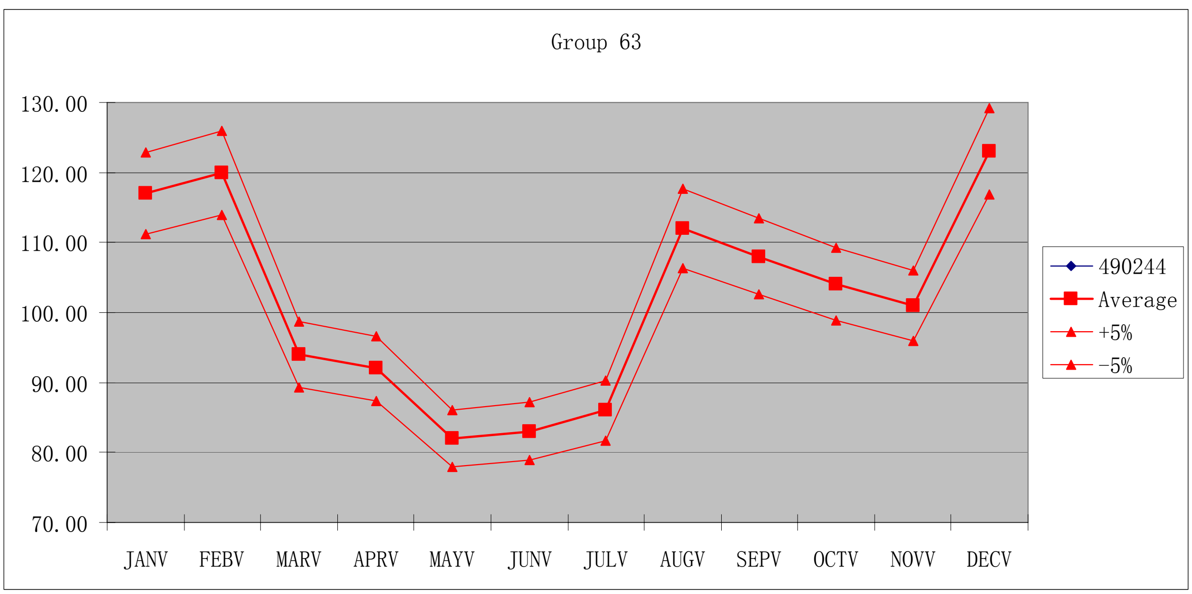


Figure 3.70 Profiles of TTMSs in the New Rural Group 63

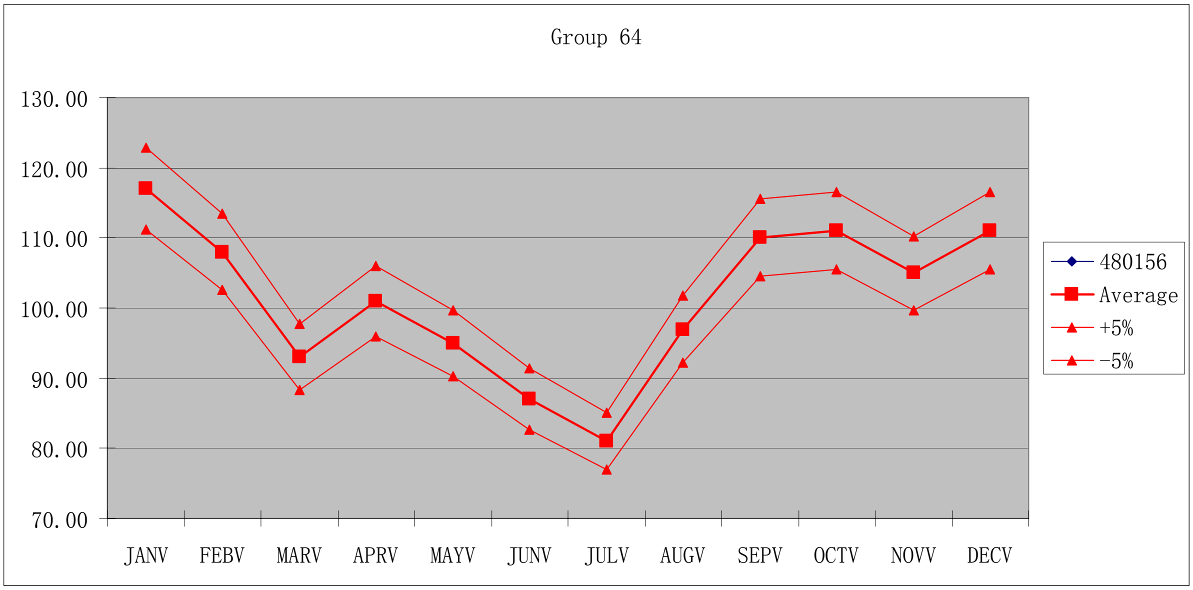


Figure 3.71 Profiles of TTMSs in the New Rural Group 64

Finally, Group 7, as illustrated in Figure 3.72, is split into three new subgroups. These are illustrated in Figure 3.73. The group profiles for the new subgroups are depicted in Figures 3.74 through 3.76.

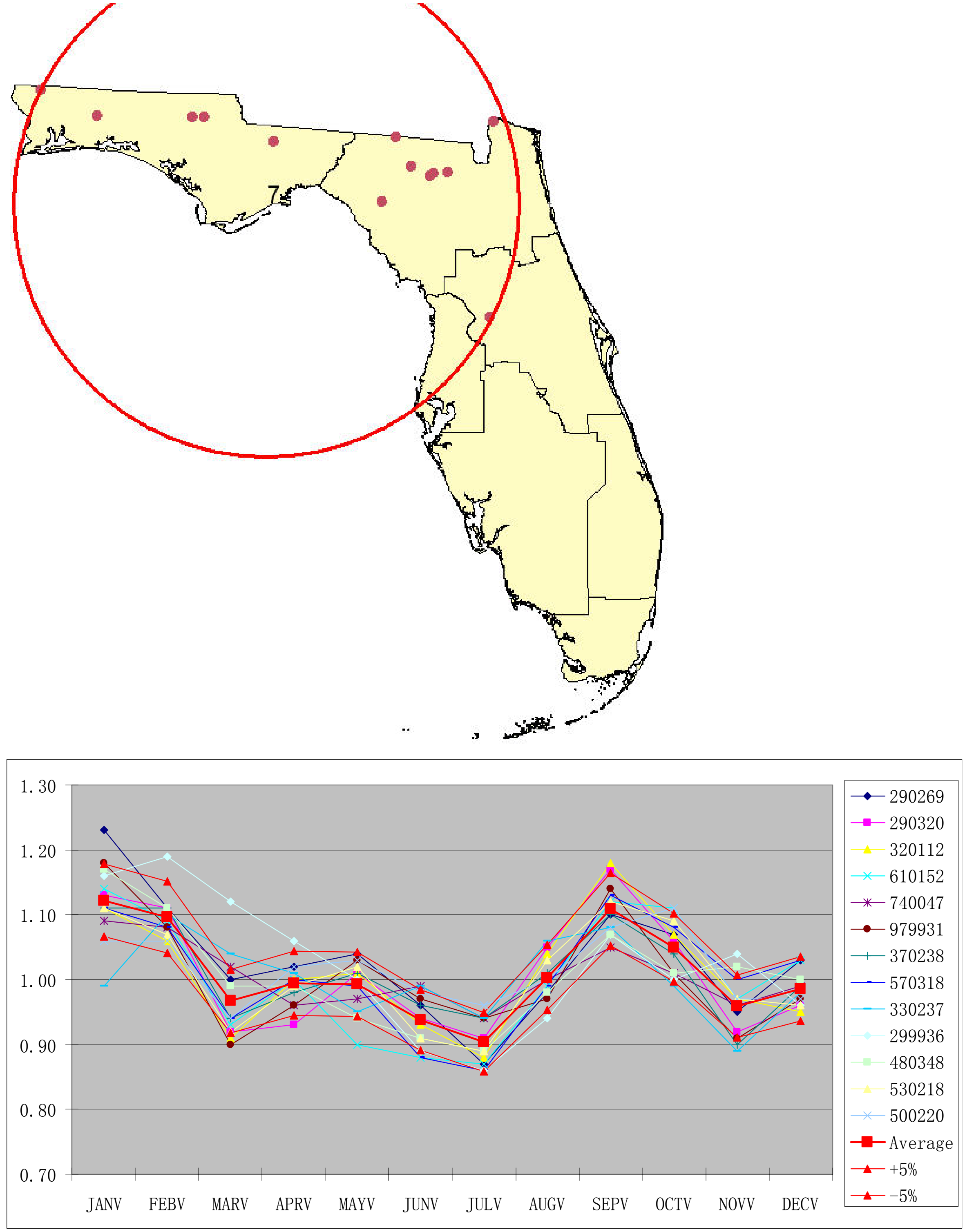


Figure 3.72 Spatial Distribution and Profiles of the TTMSs in Rural Group 7

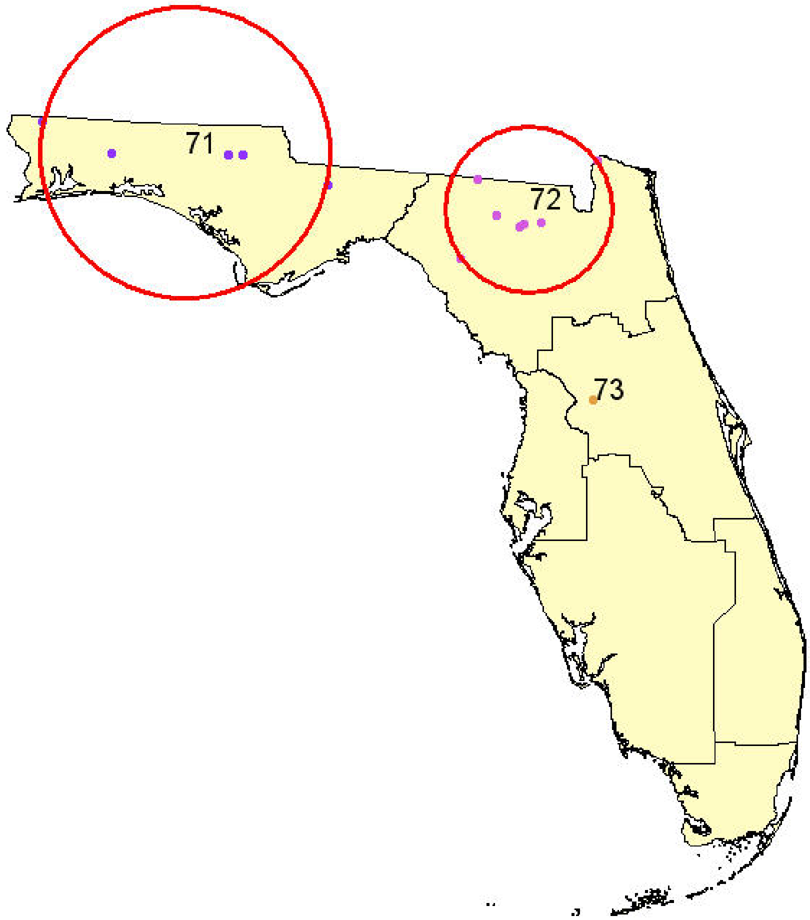


Figure 3.73 Three New Subgroups Created from Rural Group 7

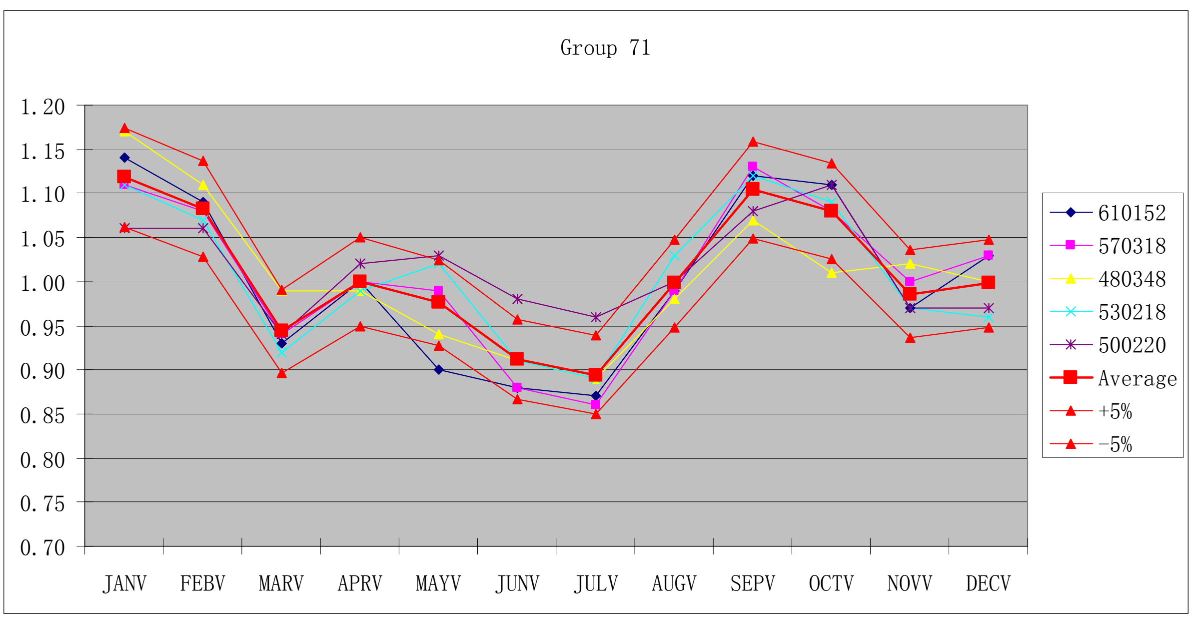


Figure 3.74 Profiles of TTMSs in the New Rural Group 71

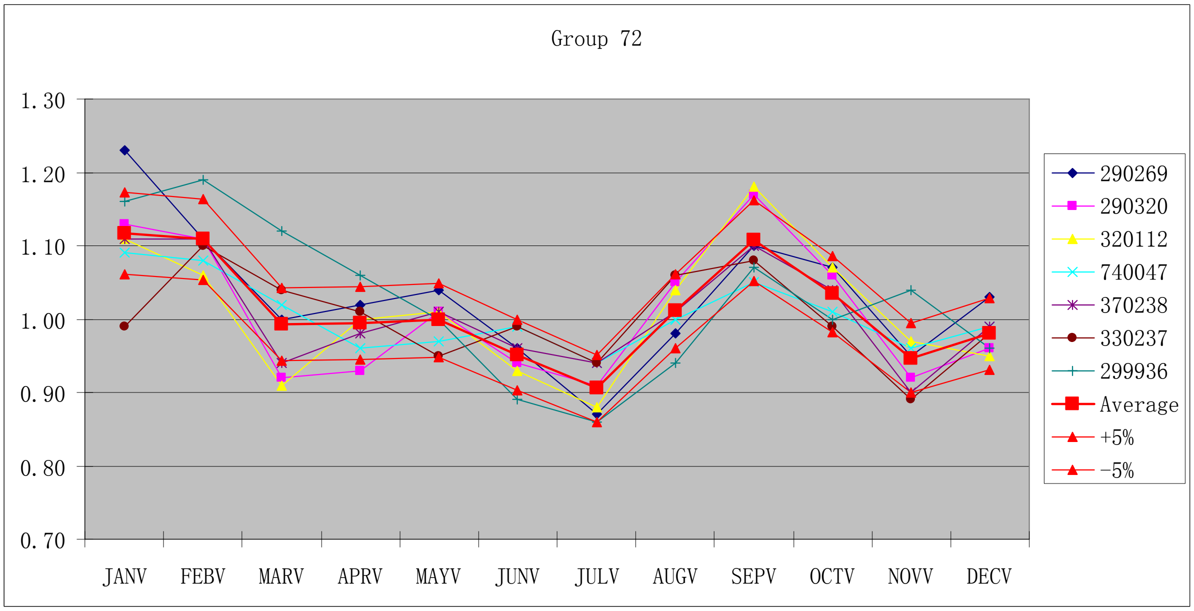


Figure 3.75 Profiles of TTMSs in the New Rural Group 72

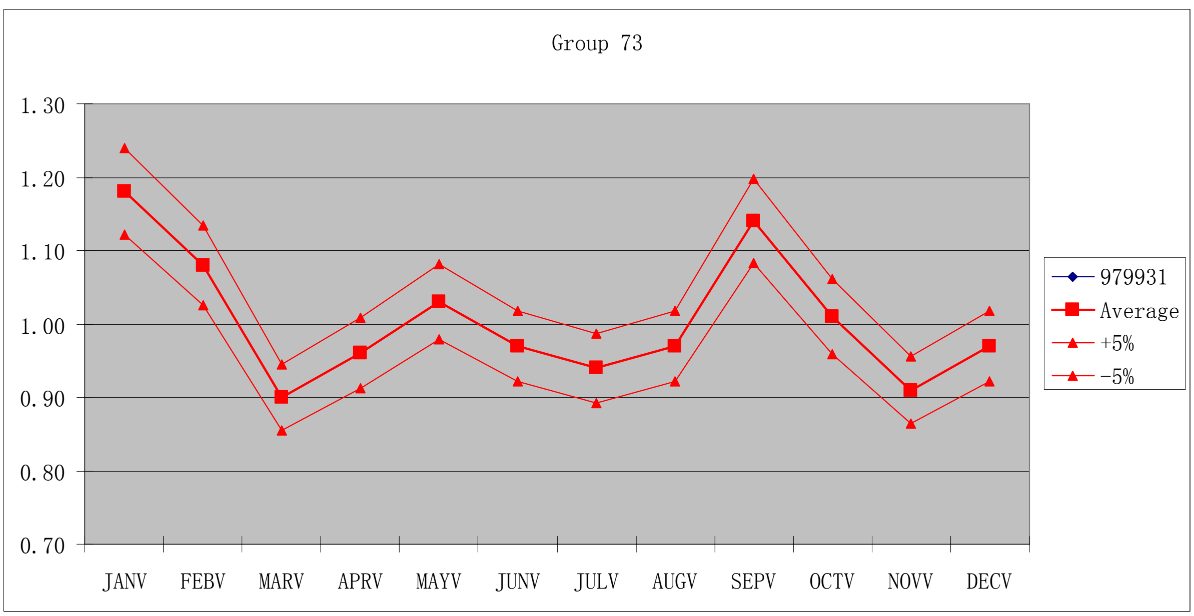


Figure 3.76 Profiles of TTMSs in the New Rural Group 73

After the TTMSs in Groups 1, 3, 4, 5, 6, and 7 are reassigned, a total of 28 TTMS groups are defined for the 147 TTMSs located in rural areas. Figure 3.77 shows the spatial patterns for these 28 TTMS groups. The number of stations allocated to each group is presented in Table 3.9.

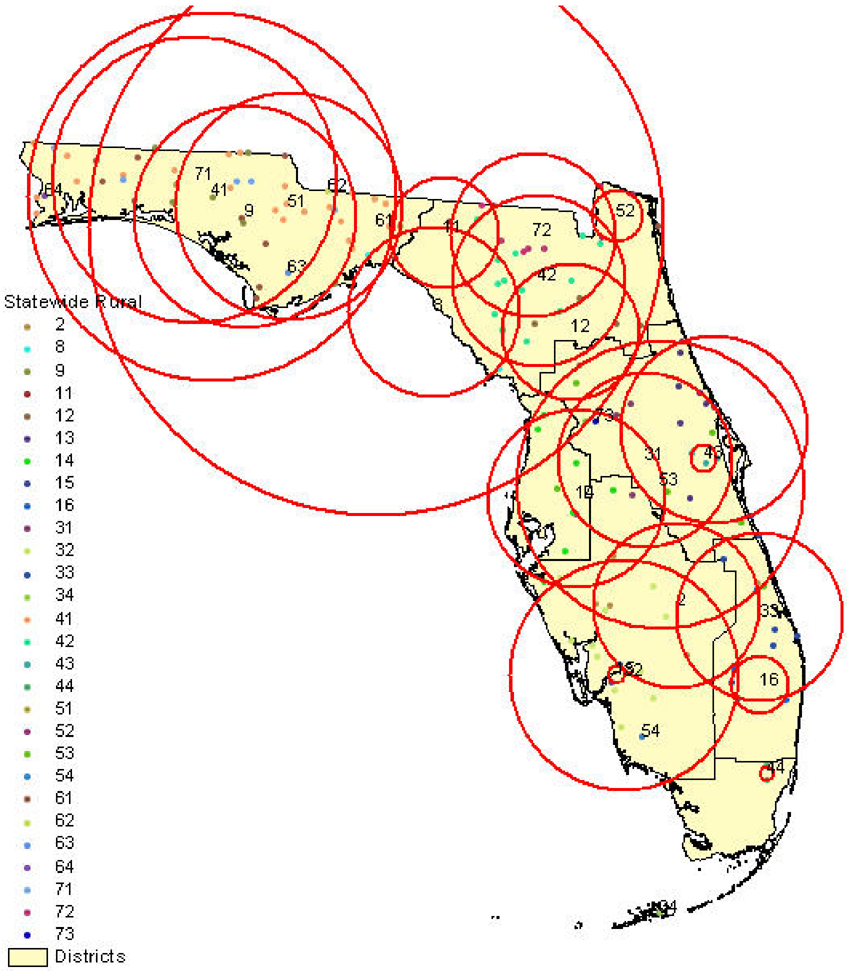


Figure 3.77 Spatial Distribution of Modified TTMS Groups in Rural Areas

Table 3.11 Number of TTMSs in the 28 Rural Groups

Group	Number of TTMSs
2	5
8	2
9	6
11	3
12	6
13	8
14	7
15	2
16	2
31	5
32	12
33	8
34	1
41	23
42	13
43	3
44	2
51	2
52	2
53	8
54	1
61	10
62	1
63	1
64	1
71	5
72	7
73	1

4. MODELING INFLUENTIAL VARIABLES OF SEASONAL FACTORS IN URBAN AREAS OF FLORIDA

This chapter describes the regression analyses for identifying variables that potentially influence monthly seasonal factors. The dependent variables are the 12 monthly seasonal factors (MSFs). The regression analyses attempt to establish the relationships between the MSFs and potentially influential variables as linear equations. These equations have the following format:

$$MSF_k = \beta_{0k} + \beta_{1k}\, x_1 + \ldots + \beta_{ik}\, x_i + \ldots + \beta_{pk}\, x_p \qquad (4\text{-}1)$$

where

MSF_k = a monthly seasonal factor for month k,

β_{ik} = the regression coefficient for the ith independent variable for month k, and

x_i = the ith independent variable.

In this chapter, Section 4.1 describes the data used to compile values of the independent variables and defines the variables used in the analyses. The regression analysis results are described in Sections 4.3, 4.4, and 4.5 for TTMSs in North, Central, and South Florida, respectively.

4.1 Definition of Variables for Urban Areas

Potential independent variables used in regression analysis are those likely to have a causal relationship with seasonal factors. They describe the demographic and socioeconomic characteristics of an area where a TTMS is located. They are selected based on two major considerations: (1) whether the source data are readily available or can be collected easily and economically for both base and forecast years and (2) whether variables can be quantified. The independent variables can be classified generally into the following categories:

- Roadway characteristics,
- Aggregate demographic and socioeconomic variables in the surrounding area of count stations, and
- Geographic spatial location dummy variables from the cluster analysis.

The data used to compile these variables included the following:

- Population and number of occupied hotel/motel rooms at the TAZ level. This population and number are those estimated by county planning departments or metropolitan planning organizations (MPOs) for their 1999 or 2000 transportation models.
- Population, number of retired households by different income groups, number of seasonal households, number of total households, and number of total housing units from the 2000 census at census tract level.
- Employment data for the year 2000 from the InfoUSA database purchased by FDOT. The data include, for each business establishment, the business name, address, location, business type (identified by a SIC code), number of employees, etc.
- Street network with federal functional classification.

The independent variables are described in the following subsections.

4.1.1 Roadway Characteristic Variables

Variables in this category are summarized in Table 4.1. The data are from the 2000 FDOT Traffic Information CD and the Roadway Characteristics Inventory (RCI) database. Four variables, *FR*, *PA*, *MA*, and *CO*, are dummy variables that take a value of 0 or 1 and indicate the type of road where a TTMS is located.

Table 4.1 Roadway Characteristic Variables for Urban Roads

Variable	Description
FR	Equals 0 if TTMS not located on urban freeway; 1 otherwise
PA	Equals 0 if TTMS not located on urban principal arterial; 1 otherwise
MA	Equals 0 if TTMS not located on urban minor arterial; 1 otherwise
CO	Equals 0 if TTMS not located on urban collector; 1 otherwise

4.1.2 Demographic and Socioeconomic Variables

It is well known that socioeconomic conditions affect the travel behavior of trip makers. The variables in this category are designed to reflect the socioeconomic characteristics of the population in the area surrounding a count station. The use of buffer methods is based on the assumption that traffic at a count station is affected by trips generated in or attracted to the area within a certain distance of that count station. Traffic may be made up of local and regional (through) traffic. Buffer methods will not be able to account for the characteristics of all of the traffic generators in the region. This is a limitation of the buffer methods. However, in the absence of more accurate yet simple and practical methods, buffer methods appear to be a reasonable tool for this application.

The variables are compiled using the buffer analysis method. A circular buffer around each count station is created, based on which the variable values are estimated. The buffer radii vary according to the functional classification of the roadway segment where a TTMS is located (Zhao and Chung, 2001). This variation reflects the size of the service area for different types of roads. The buffer radii are five miles for freeway and principal arterials, 0.5 mile for minor arterials, and 0.25 mile for collectors. These radii are based on the common spacing of roads of different function classes. A larger buffer zone implies that the MSFs for a count station are impacted by the characteristics of a larger surrounding area.

<u>Percentage of student populations by different age groups</u>

Four variables are defined to represent student population groups. They are described in Table 4.2. Their values are computed based on the assumed buffer area for a TTMS. The population of a given age group and the total population in the buffer area are estimated first. The percentage is then computed.

Table 4.2 Student Population Age Group Variables

Variable	Description
ST1	Population percentage of Age 0-4
ST2	Population percentage of Age 5-17
STU21	Population percentage of Age 5-10
STU22	Population percentage of Age 11-13
STU23	Population percentage of Age 14-17

Percentage of retired households by different income levels

Retired households are defined as households with a retired householder. Retired households are further divided into two subgroups by the state median income level. The percentages of these households out of all retired households are calculated and defined as *Rt_Low* as *Rt_High*. The state median income was $38,500 in 2000. For convenience, the household income levels are divided into $0 - $39,999 and $40,000 and above. The definition of the three retired household related variables is given in Table 4.3.

Table 4.3 Retired Household Variables Based on State-Wide Median Income

Variable	Description
RETIRE	Percentage of retired households out of total households
Rt_Low	Percentage of retired households with low income ($0 – $39,999)
Rt_High	Percentage of retired households with high income ($40,000 and above)

Seasonal Household Percentage

Variable *SHP* represents the seasonal households as a percentage of permanent households in a buffer zone around a count station.

Median Household Income

Variable *MInc* represents the median household income in a buffer zone around a count station.

Employment Variables

Fourteen variables describing employment in a buffer area surrounding a count station are listed in Table 4.4. InfoUSA employment data are used to compute the values of the variables to reflect the seasonality of economic activities. The InfoUSA database is purchased by FDOT annually and has statewide coverage. For detailed information on each variable and its corresponding SIC codes, please refer to Appendix C.

Table 4.4 Employment Variables for Urban Roads

Variable	Description
AgriP	Agriculture workers as a percentage of total workers
FishP	Fishing & Hunting workers as a percentage of total workers
TranP	Transportation workers as a percentage of total workers
WholP	Wholesale workers as a percentage of total workers
RtlP	Retail workers as a percentage of total workers
ResaP	Restaurant workers as a percentage of total workers
HotlP	Hotel & Camp workers as a percentage of total workers
EduP	Education workers as a percentage of total workers
RecServP	Amusement & Recreation Services workers as a percentage of total workers
MseumP	Museums art galleries & gardens workers as a percentage of total workers
MineP	Mining workers as a percentage of total workers
ManuP	Manufacturing workers as a percentage of total workers
ServP	Services workers as a percentage of total workers
OffP	Office workers as a percentage of total workers

4.1.3 Special Land Use Variables for Urban Models

Variables in this category are designed to account for the effects of special land use types, including universities, tourist attractions, and recreational sites.

<u>University Variables</u>

Variables in this category are summarized in Table 4.5. *DLEG* is the variable that represents the impact of legislative sessions for the TTMSs located in Leon County. Because community colleges typically operate year round, they may have less seasonal variation in travel related to their activities. The 13 state universities have large enrollments and can potentially affect the seasonality of travel. Two dummy variables, *SU* and *FU,* are created to distinguish mostly residential universities (University of Florida, Florida State University, Florida A&M University, and University of Miami) from universities that have a significant commuting student body. Because Gainesville and Tallahassee are college towns, the universities' impacts are considered to be county wide. For the University of Miami, which is located in a large urban area, the impact area is assumed to be three miles.

Table 4.5 Location Characteristic Variables for Urban Roads

Variable	Description
DLEG	Equals 1 if TTMS is located in Leon County; 0 otherwise
SU	Equals 1 if TTMS is in the county of UF, FSU, and FAMU; or within three miles of UM or FIT; 0 otherwise
FU	Equals 1 if TTMS is located within three miles of other state universities; 0 otherwise

Tourist Attraction and Recreational Site Variables

The Disney parks and other amusement parks, located in Osceola County, attract a significant number of tourists. These tourists may generate seasonal traffic. Therefore, the variable *DISNEY* is created to represent the tourist effect in Osceola County. The variable assumes a value of 1 if a TTMS is located in Osceola County and 0 otherwise.

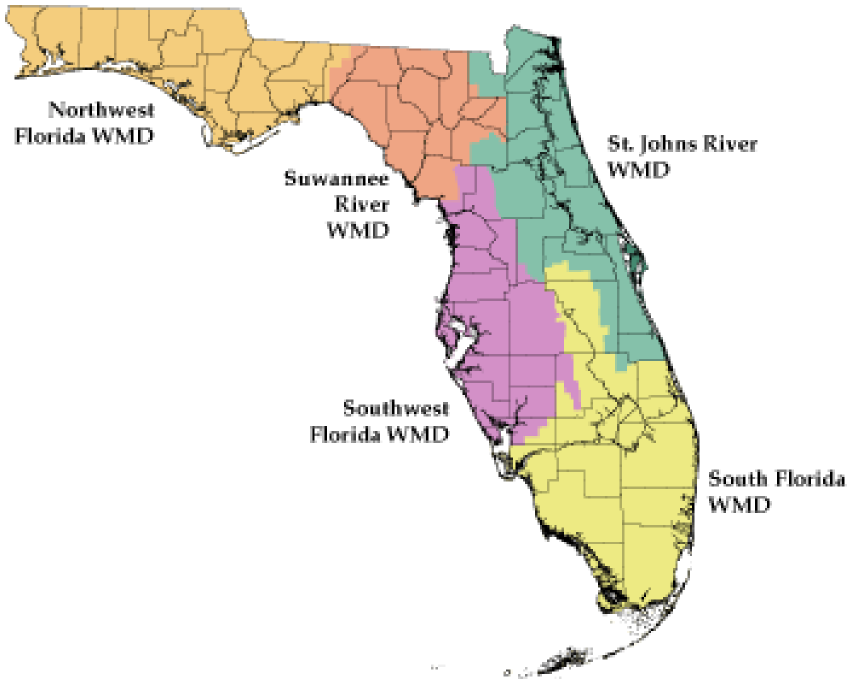


Figure 4.1 Water Management Districts in Florida (Source: Florida Department of Environmental Protection)

In addition to amusement parks, other land uses may also attract visitors, perhaps in larger numbers in some months than others. Such land uses include public beaches, golf courses, marinas, finishing camps, parks, and zoos. They are identified from the land use data that are created by the water management districts in Florida. There are five water management districts in Florida, as shown in Figure 4.1. However, only three have year 2000 land use data, with land use categorized according to the Florida Land Use and Cover Classification System (FLUCCS). Because there are no data from the Suwannee River Water Management District (SRWMD) or the Northwest Florida Water Management District (NWFWMD), the land use variables are only tested in the models for South and Central Florida. Land use is depicted in Figure 4.2.

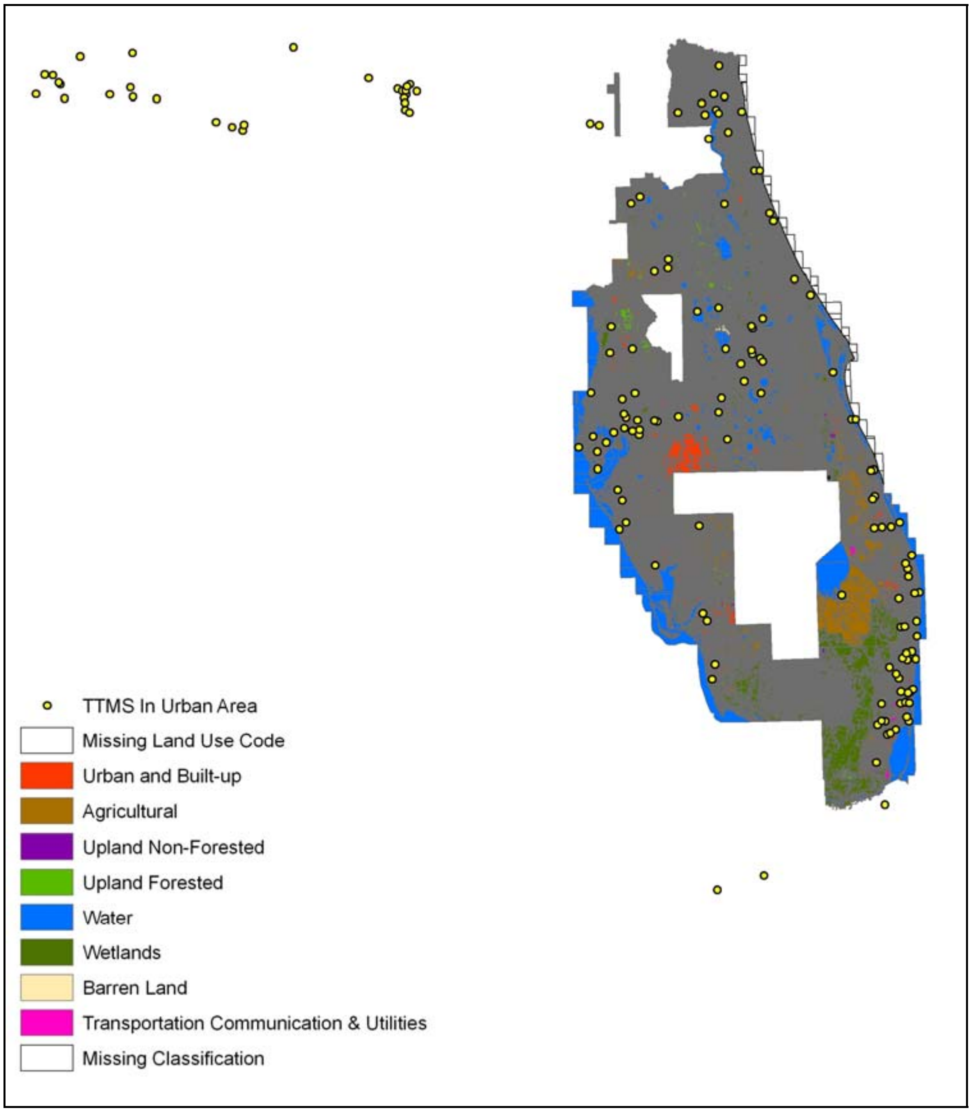


Figure 4.2 Land Use and TTMSs in Urban Areas

Four land use dummy variables are created. The variables and the land use type they represent are summarized in Table 4.6. The values of these variables for a given TTMS are determined based on whether any portion of the buffer area of the TTMS is of one of the four land use types. If a part of the buffer area is of one of the four land uses, the corresponding variable assumes a value of 1. Otherwise, the variable for that TTMS is 0.

Table 4.6 Land Use Dummy Variables for Urban Road

Variable	FLUCCS Code	Definition
LU1	1810	Swimming Beach
LU2	1820	Golf Course
LU3	1840	Marinas and Fishing Camps
LU4	1850	Parks and Zoos

4.2 Delineation of Model Areas for Urban Areas

Florida stretches over in the north-south direction over several the climate zones, from temperate in the north to subtropical in the south. South Florida, for example, attracts many visitors and welcomes the return of large numbers of seasonal residents in the winter months because of its warm temperatures. In contrast, summer is the season in North Florida for tourists and for outdoor recreation. Therefore, the same variables may impact traffic in a similar manner, but during different seasons, in North and South Florida. For this reason and for modeling purposes, the state is divided roughly into three regions that represent three climate zones: North Florida, Central Florida, and South Florida. Separate models are developed for each region.

Counties in each region are divided into groups to investigate whether counties within the same region may differ in climate, land use, and demographics. If the counties do differ with regard to these variables, the result may be different seasonal traffic patterns. Regression models are estimated first for one group, then for an expanded group with one more group of counties added. This is repeated until all groups within the same region are included in the models. In this process, model results after each step are carefully examined. This ensures that models do not change significantly in terms of R-squared values, variables included, and coefficients. When such a change is observed, it may indicate that the newly added group of counties may not belong to the region.

As an example, North Florida was originally divided into four groups of counties roughly based on latitude and urban boundaries. Three groups are described in Table 4.7. The fourth group (N3) is Volusia County. Modeling results achieved a higher R-square for both North and Central Florida models by combining the N3 area into the Central Florida region instead of the North Florida region. As a result, Volusia County was removed from the North Florida region and became part of the Central Florida region.

The boundaries of the three regions and the TTMS locations are shown in Figure 4.3. The final models for the three regions are presented in Sections 4.3, 4.4., and 4.5, respectively.

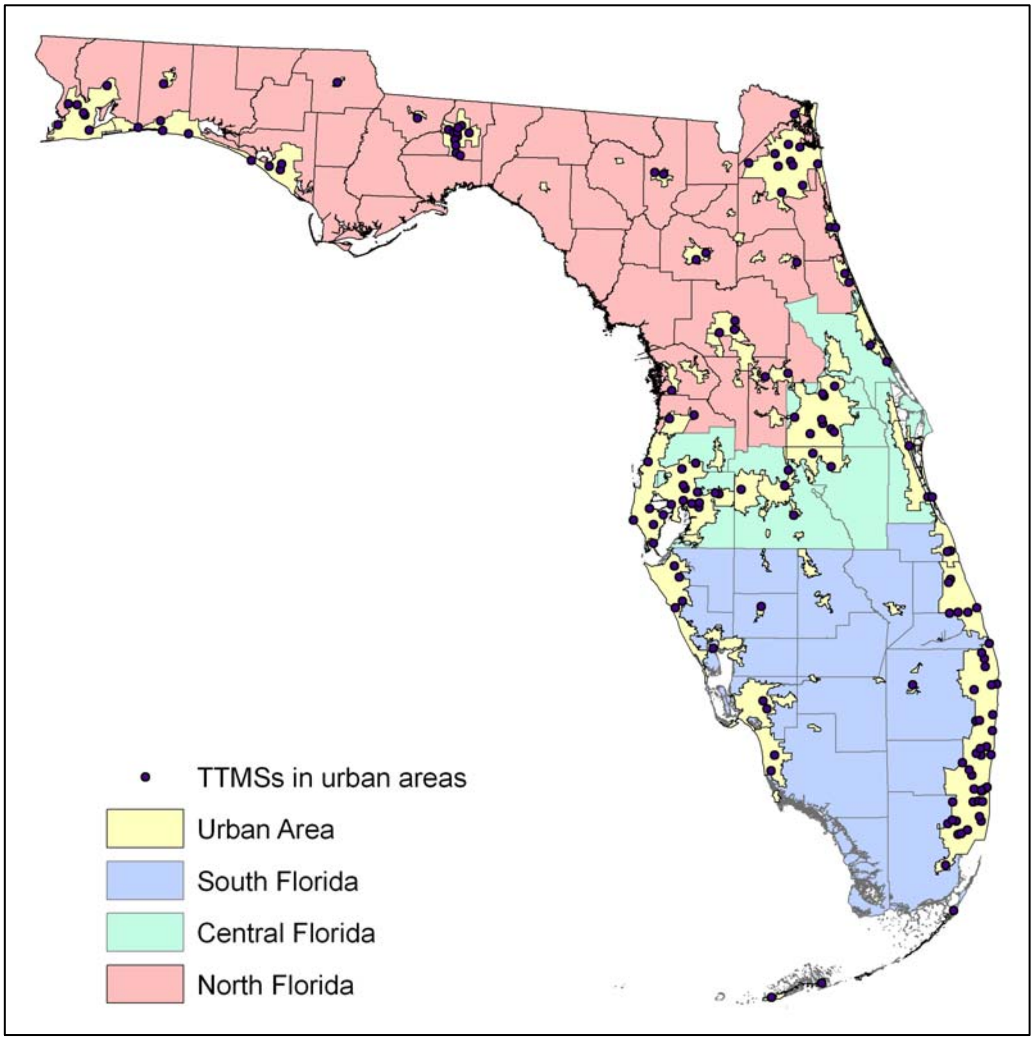


Figure 4.3 Boundaries of Study Areas

The three study areas and the groups of counties within each study area are defined in Tables 4.7, 4.8, and 4.9. These groups of TTMSs in each region are shown in Figures 4.4, 4.5, and 4.6.

Table 4.7 List of Counties within the North Florida Analysis Area

Area	County	Number of TTMSs
N1	Escambia, Santa Rosa, Okaloosa, Walton, Bay, Jackson, Gadsden, Leon, Columbia, Nassau, Duval, St Johns	44
N2	Alachua, Putnam, Flagler	5
N4	Lake, Marion, Citrus, Hernando	8

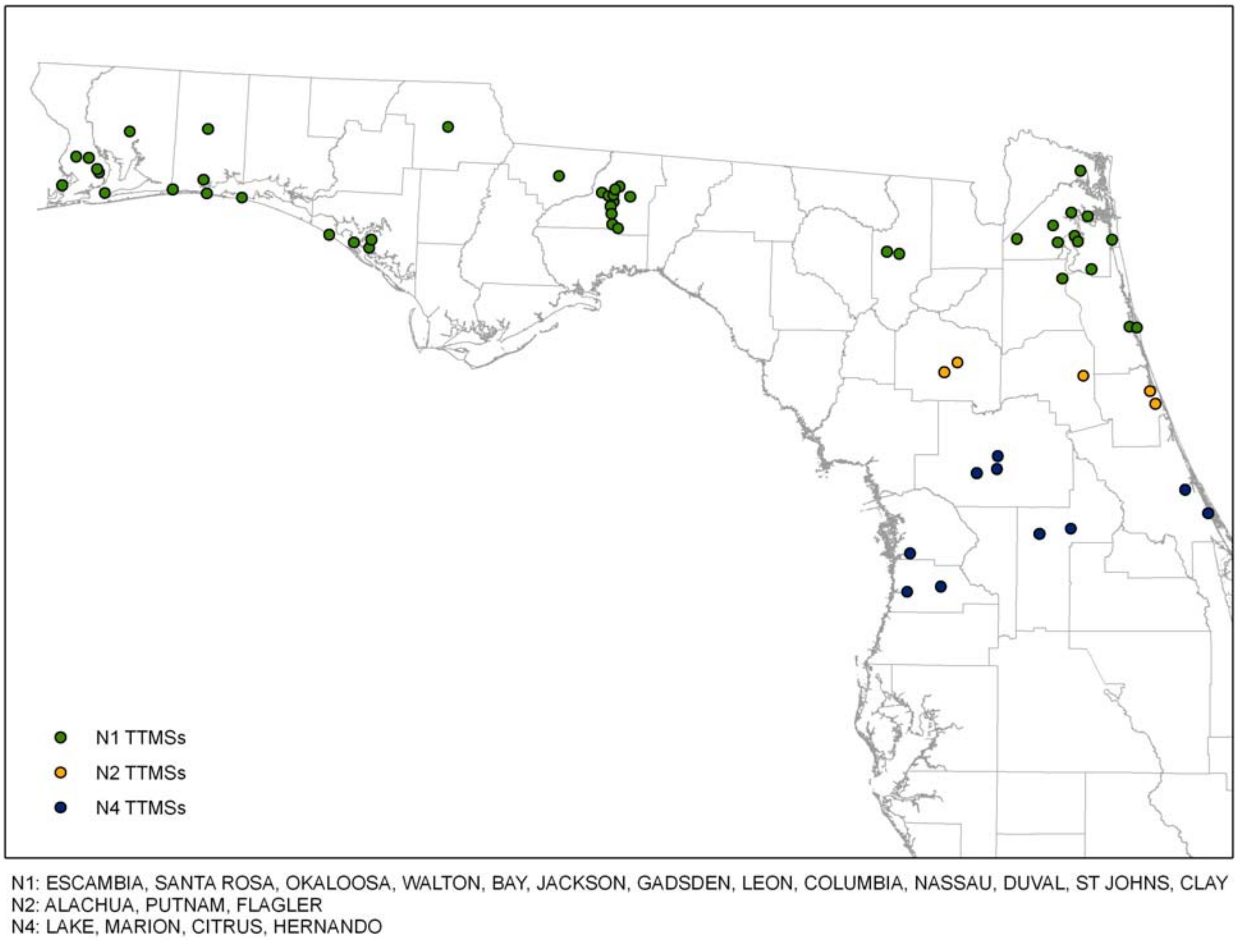


Figure 4.4 TTMSs in Three Urban Study Areas in North Florida

Table 4.8 Study Areas in Central Florida

Area	County	Number of TTMSs
N3	Volusia	2
C1 (*S5*)	Pasco, Hillsborough, Pinellas	18
C2 (*S6*)	Polk	4
C3 (*S7*)	Brevard	3
C4 (*S8*)	Orange, Seminole, Osceola	11

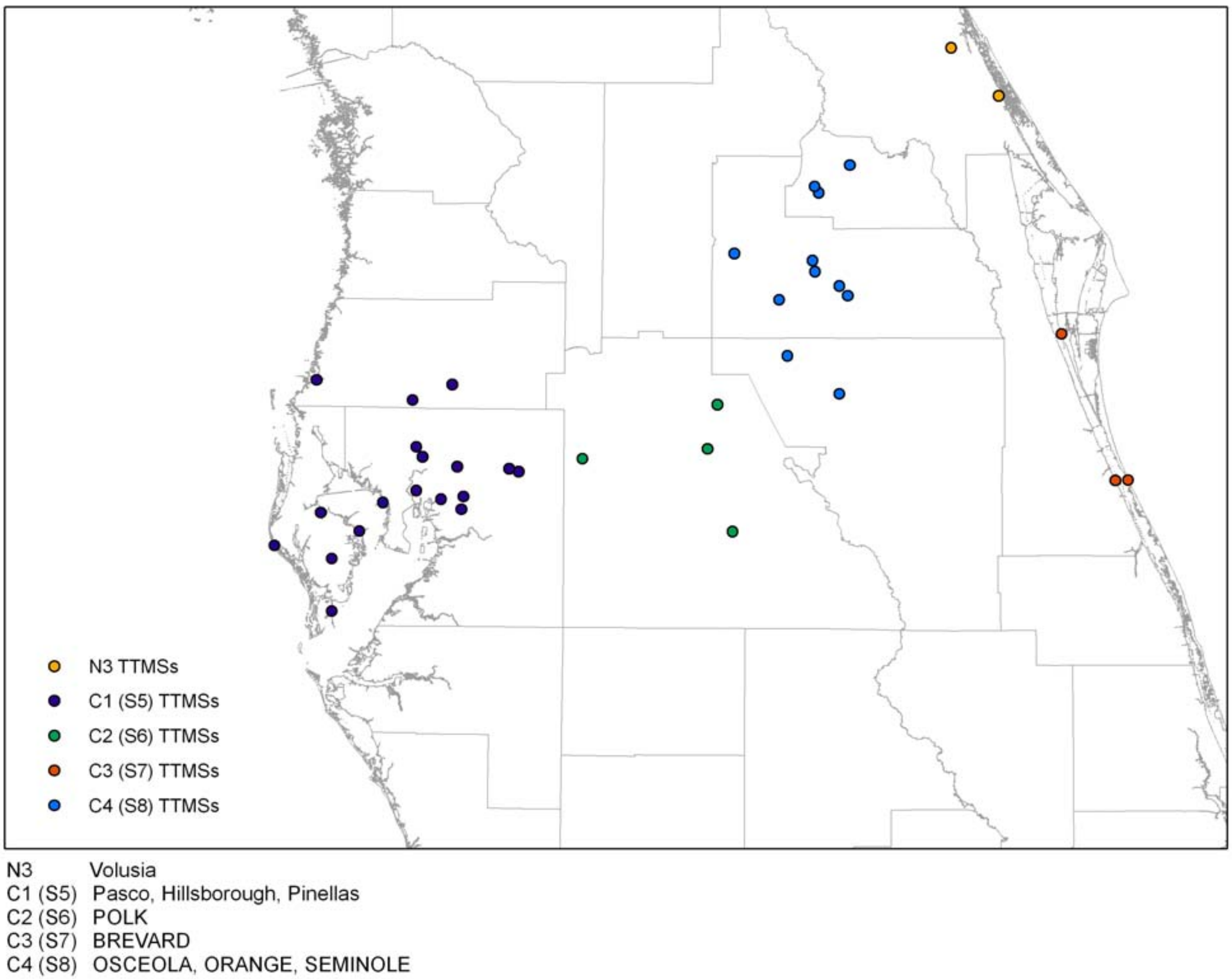
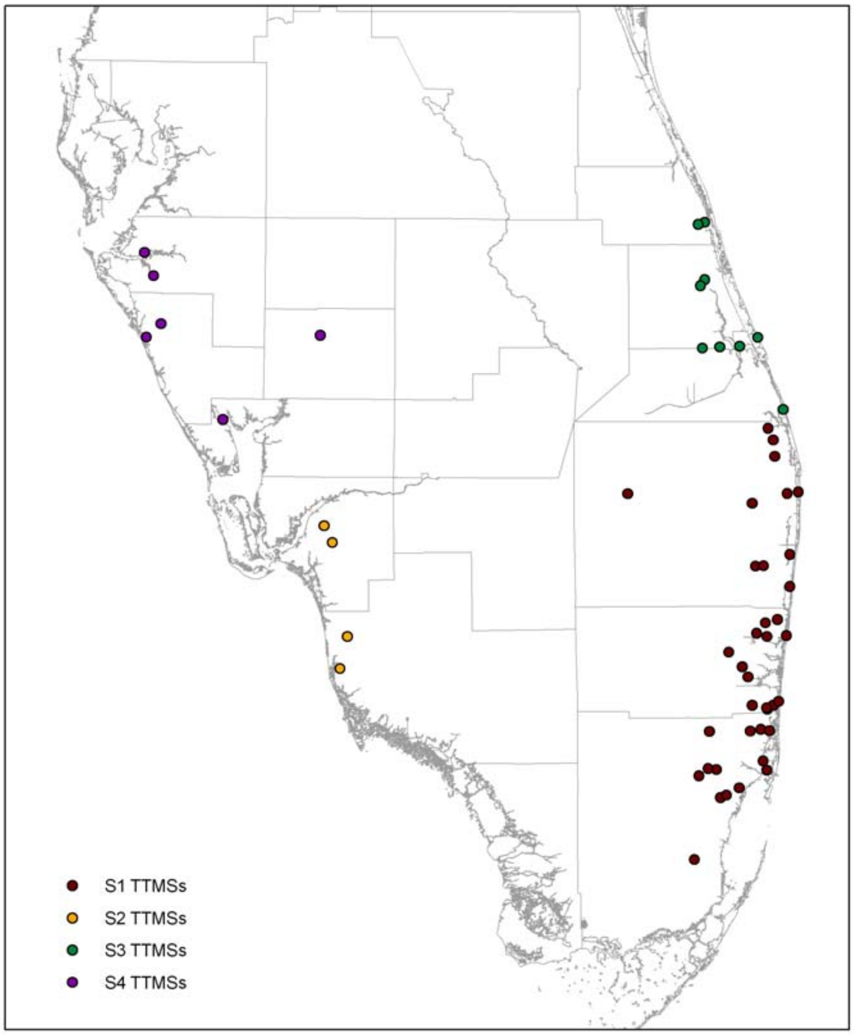


Figure 4.5 TTMSs in Five Urban Study Areas in Central Florida

Table 4.9 List of Counties within the South Florida Analysis Area

Area	County	Number of TTMSs
S1	Broward, Miami-Dade, Palm Beach	37
S2	Lee, Collier	4
S3	Martin, St Lucie, Indian River	9
S4	Charlotte, Sarasota, Manatee, Desoto	6



S1 BROWARD, MIAMI-DADE, PALM BEACH
S2 LEE, COLLIER
S3 MARTIN, ST LUCIE, INDIAN RIVER
S4 CHARLOTTE, SARASOTA, MANATEE, DESOTO

Figure 4.6 TTMSs in Four Urban Study Areas in South Florida

4.3 North Florida Model Results

The regression models of the 12 MSFs for North Florida are given in Table 4.10. A total of 57 TTMSs are included in the model.

Table 4.10 Regression Models for North Florida (NFL)

Month	Seasonal Factor Equation	R^2	Adj. R^2	RMSE
JAN	JAN_SF=0.94385+1.99490×$ST22$+0.00307×SHP+1.12005×$FishP$+0.01004×HotlP+0.84707×$MseumP$	0.6581	0.6246	0.0512
FEB	FEB_SF=0.99449-0.03588×SU-0.00221×$RETIRE$ +0.76741×$ST23$+0.00154×SHP +0.46882×$MseumP$	0.5477	0.5034	0.0386
MAR	MAR_SF=1.00727-0.00260×Rt_Low-0.00083117×SHP-0.00550×$HotlP$	0.5227	0.4957	0.0324
APR	APR_SF=0.96401+0.04544×FR-0.02808×MA-0.00463×$HotlP$	0.4087	0.3752	0.0306
MAY	MAY_SF=1.04120-0.02183×LEG-0.92003×$ST23$-0.00230×SHP-0.85560×$FishP$ +0.00130×$RestP$-0.00544×$HotlP$-0.42097×$MseumP$+0.00191×$OffP$	0.6934	0.6423	0.0274
JUN	JUN_SF=1.08684-2.00258×$ST22$-0.00207×SHP-1.00131×$FishP$-0.00522×$HotlP$-0.73832×$MseumP$	0.6506	0.6163	0.0383
JUL	JUL_SF=1.00827+0.05153×SU+0.00322×Rt_Low-1.65684×$ST22$-0.00226×SHP-0.00911×$HotlP$+0.00134×EdP-0.67131×$MseumP$	0.6269	0.5736	0.0548
AUG	AUG_SF=0.97445+0.01612×LEG+0.00275×Rt_Low-0.47684×$ST1$-0.00073571×SHP +0.00327×$WholP$+0.00161×$RcServP$-0.27203×$MseumP$	0.7776	0.7458	0.0180
SEP	SEP_SF=1.01290-0.03285×SU+0.00150×$RETIRE$	0.2879	0.2615	0.0445
OCT	OCT_SF=0.96692-0.02716×SU+0.85153×$ST23$+0.00201×SHP+0.00781×$HotlP$-0.00108×EdP	0.5776	0.5362	0.0365
NOV	NOV_SF=1.00212+0.00276×SHP+0.00916×$HotlP$+1.00144×$MseumP$	0.6020	0.5795	0.0591
DEC	DEC_SF=0.99280+0.00348×SHP+0.00544×$TranP$+0.01648×$HotlP$+1.37402×$MseumP$	0.6164	0.5869	0.0851

The variables included in the above models are listed in Table 4.11, along with their partial R^2 values and the months for which they are significant. Table 4.12 and 4.13 list only those variables that have a partial R^2 greater than 0.05. Table 4.12 lists the variables by name, while Table 4.13 lists them by partial R^2 value.

The models show that *SHP* (percentage of seasonal households), *MseumP* (percentage of museums/art/galleries/gardens workers), and *HotlP* (percentage of hotel & camp workers) appear in most of the models with relatively large partial R^2 values. *Rt_Low* (percentage of retired households with low income), *RETIRE* (percentage of retired households), *FR* (freeway), *ST22* (percentage of population ages 11-13), and *ST23* (percentage of population ages 14-17) are some of the variables that appear infrequently. However, these variables have noticeable partial R^2 values when they do appear in the models.

In general, variables representing tourist related activities, such as fishing, museum, and hotel related employment, tend to have a positive coefficient in the winter months and a negative sign in the summer months. This suggests that the tourist season is summer in North Florida.

The variable that represents residential universities, *SU*, appears in the February, September, and October models with a negative coefficient. In contrast, it appears in the July model with a positive coefficient. This is possibly due to an increase in traffic related to the beginning of the academic year and a decrease in traffic caused by holidays during summer.

Variable *SHP* appears in all models except for April and September. Note that there is a positive coefficient during the colder months (from October to February) and a negative coefficient during the warm months (March, and May to August). This shows that there may be more seasonal households in North Florida during the warm months than the cold months.

Variables representing the student population ages 11-17 (*ST22* and *ST23*) tend to be associated with more traffic during the summer vacation season (May, June, and July) but less traffic during January and February.

The variable that represents low income retired households, *Rt_Low*, is included in the March model with a negative coefficient and the August model with a positive coefficient. Similarly, the variable *RETIRE* appears with a negative coefficient in the February model while a positive coefficient in the October model. This suggests that low-income retired households tend to have greater activity during February and March than August and September.

Table 4.11 Variables from Model NFL Sorted by Month and Partial R^2 Value

Variable	Partial R^2	Month
SHP	0.2964	JAN
MseumP	0.1659	JAN
ST22	0.0775	JAN
HotlP	0.0709	JAN
FishP	0.0473	JAN
MseumP	0.1572	FEB
RETIRE	0.144	FEB
SU	0.1046	FEB
SHP	0.0851	FEB
ST23	0.0569	FEB
Rt_Low	0.3359	MAR
HotlP	0.1367	MAR
SHP	0.0501	MAR
FR	0.1973	APR
HotlP	0.1291	APR
MA	0.0822	APR
SHP	0.2662	MAY
ST23	0.1439	MAY
MseumP	0.0745	MAY
HotlP	0.0395	MAY
RestP	0.0407	MAY
FishP	0.0368	MAY
OffP	0.0617	MAY
LEG	0.0301	MAY
MseumP	0.2701	JUN
SHP	0.1298	JUN
ST22	0.1487	JUN
FishP	0.0642	JUN
HotlP	0.0377	JUN
MseumP	0.1851	JUL
SHP	0.1178	JUL
ST22	0.1102	JUL
Rt_Low	0.073	JUL
SU	0.0678	JUL
HotlP	0.0404	JUL
EdP	0.0325	JUL
Rt_Low	0.3854	AUG
MseumP	0.1438	AUG
SHP	0.0619	AUG
RcServP	0.0647	AUG
WholP	0.0344	AUG
ST1	0.0603	AUG
LEG	0.0271	AUG
RETIRE	0.2256	SEP
SU	0.0623	SEP
SHP	0.3353	OCT
HotlP	0.0767	OCT
SU	0.0673	OCT
ST23	0.046	OCT
EdP	0.0522	OCT
MseumP	0.3448	NOV
SHP	0.2035	NOV
HotlP	0.0537	NOV
MseumP	0.2973	DEC
SHP	0.1648	DEC
HotlP	0.0742	DEC
TranP	0.08	DEC

Table 4.12 Variables from Model NFL Sorted by Name and Partial R^2 Value

Variable	Partial R^2	Month
EdP	0.0522	OCT
FishP	0.0642	JUN
FR	0.1973	APR
HotlP	0.1367	MAR
HotlP	0.1291	APR
HotlP	0.0767	OCT
HotlP	0.0742	DEC
HotlP	0.0709	JAN
HotlP	0.0537	NOV
MA	0.0822	APR
MseumP	0.3448	NOV
MseumP	0.2973	DEC
MseumP	0.2701	JUN
MseumP	0.1851	JUL
MseumP	0.1659	JAN
MseumP	0.1572	FEB
MseumP	0.1438	AUG
MseumP	0.0745	MAY
OffP	0.0617	MAY
RcServP	0.0647	AUG
RETIRE	0.2256	SEP
RETIRE	0.144	FEB
SHP	0.3353	OCT
SHP	0.2964	JAN
SHP	0.2662	MAY
SHP	0.2035	NOV
SHP	0.1648	DEC
SHP	0.1298	JUN
SHP	0.1178	JUL
SHP	0.0851	FEB
SHP	0.0619	AUG
SHP	0.0501	MAR
ST1	0.0603	AUG
ST22	0.1487	JUN
ST22	0.1102	JUL
ST22	0.0775	JAN
ST23	0.1439	MAY
ST23	0.0569	FEB
Rt_Low	0.3854	AUG
Rt_Low	0.3359	MAR
Rt_Low	0.073	JUL
SU	0.1046	FEB
SU	0.0678	JUL
SU	0.0673	OCT
SU	0.0623	SEP
TranP	0.08	DEC
WholP	0.0344	AUG

Table 4.13 Variables from Model NFL Sorted by Partial R^2 Value

Variable	Partial R^2	Month	Variable	Partial R^2	Month	Variable	Partial R^2	Month
Rt_Low	0.3854	AUG	*RETIRE*	0.144	FEB	*Rt_Low*	0.073	JUL
MseumP	0.3448	NOV	*ST23*	0.1439	MAY	*HotlP*	0.0709	JAN
Rt_Low	0.3359	MAR	*MseumP*	0.1438	AUG	*SU*	0.0678	JUL
SHP	0.3353	OCT	*HotlP*	0.1367	MAR	*SU*	0.0673	OCT
MseumP	0.2973	DEC	*SHP*	0.1298	JUN	*RcServP*	0.0647	AUG
SHP	0.2964	JAN	*HotlP*	0.1291	APR	*FishP*	0.0642	JUN
MseumP	0.2701	JUN	*SHP*	0.1178	JUL	*SU*	0.0623	SEP
SHP	0.2662	MAY	*ST22*	0.1102	JUL	*SHP*	0.0619	AUG
RETIRE	0.2256	SEP	*SU*	0.1046	FEB	*OffP*	0.0617	MAY
SHP	0.2035	NOV	*SHP*	0.0851	FEB	*ST1*	0.0603	AUG
FR	0.1973	APR	*MA*	0.0822	APR	*ST23*	0.0569	FEB
MseumP	0.1851	JUL	*TranP*	0.08	DEC	*HotlP*	0.0537	NOV
MseumP	0.1659	JAN	*ST22*	0.0775	JAN	*EdP*	0.0522	OCT
SHP	0.1648	DEC	*HotlP*	0.0767	OCT	*SHP*	0.0501	MAR
MseumP	0.1572	FEB	*MseumP*	0.0745	MAY			
ST22	0.1487	JUN	*HotlP*	0.0742	DEC			

4.4 Central Florida Model Results

The regression models of the MSFs in Central Florida (CFL) are given in Table 4.14. A total of 38 TTMSs are included in the model.

Table 4.14 Regression Models for Central Florida (CFL)

Month	Seasonal Factor Equation	R^2	Adj. R^2	RMSE
JAN	JAN_SF=1.05296+0.04354×$LU2$+0.08528×$LU3$-0.00253×Rt_Low	0.4966	0.4522	0.0386
FEB	FEB_SF=0.99220-0.00192×$RETIRE$	0.3266	0.3079	0.0329
MAR	MAR_SF=0.95455+0.04189×PA-0.00197×SHP-0.03780×$AgriP$-0.00106×$RtlP$	0.5923	0.5429	0.0328
APR	APR_SF=0.96193-0.03752×$MineP$	0.1130	0.0884	0.0258
MAY	MAY_SF=1.04696+0.05252×CO-9.35253E-7×$MInc$-0.00052936×$ServP$	0.3670	0.3111	0.0202
JUN	JUN_SF=0.98370+0.00130×$RETIRE$+0.05039×$AgriP$	0.5481	0.5223	0.0230
JUL	JUL_SF=1.14257-0.08904×$DISN$-0.05963×$LU4$-0.00000203×$MInc$	0.3377	0.2793	0.0470
AUG	AUG_SF=1.03812-0.02298×PA-0.06810×$DISN$-0.03790×$LU2$+0.00111×SHP +0.09428×$AgriP$-0.02329×$OffP$	0.7671	0.7220	0.0292
SEP	SEP_SF=1.14004-0.04809×PA-1.59261×$ST22$+0.06048×$AgriP$	0.5357	0.4947	0.0335
OCT	OCT_SF=1.04013-0.09017×CO+0.00326×Rt_High-1.05551×$ST23$+0.04152×$AgriP$	0.5600	0.5066	0.0229
NOV	NOV_SF=1.01727+0.06101×MA+0.00409×$TranP$-0.00308×EdP	0.4189	0.3676	0.0251
DEC	DEC_SF=1.00861+0.08639×MA	0.1336	0.1096	0.0505

For the Central Florida models, significant variables are *AgriP* (percentage of agriculture employment) and *RETIRE* (percentage of retired households). *AgriP* appears most often and contributes a large portion of partial R^2 to the June, August, September, and October models with a positive sign.

Of the variables that describe tourist attractions and recreational sites, *LU2* (the golf course variable) and *LU3* (the marinas/fishing camp variable) are included in the January model with a positive coefficient, indicating a decreased level of travel related to these activities. *LU4* (the parks and zoos variable) is selected by the July model with a negative sign, pointing to an increase in travel to parks and zoos. The variable *DISNEY* shows up in models for July and August with a negative sign. This means traffic around Disney parks tends to increase during these two months, which coincide with school summer vacation time.

Roadway characteristic variables (*PA*, *MA*, and *CO*) are selected by two models. *PA* (principal arterial) enters the March model with a positive coefficient and the September model with a negative coefficient. This suggests that principal arterials tend to have more traffic in September but lower traffic in March in rural areas. The *MA* (minor arterial) variable is selected by the November and December models. Their coefficients are both positive, suggesting that minor arterials carry less traffic during the last two months of a year. *CO* (collector) appears in the May model with a positive coefficient and in the October model with a negative coefficient. This indicates that traffic on collectors tends to increase during October and decrease during May. The model results also show that retired households seem to contribute to the increase in traffic during February and the decrease during June. *MInc* (median household income) appears in the May and July models with a negative sign. This suggests that, during these two months in Central Florida, the higher the median income is, the more traffic is generated.

Table 4.15 lists all of the variables included in the above models, along with their partial R^2 values and the months for which they significant. Table 4.16 and 4.17 list all of the variables that have a partial R^2 larger than 0.05. Table 4.16 sorts the variables by name, while Table 4.17 sorts them by partial R^2 value.

Table 4.15 Variables from Model CFL Sorted by Month and Partial R^2 Value

Variable	Partial R^2	Month
Rt_Low	0.2177	JAN
LU3	0.1914	JAN
LU2	0.0875	JAN
RETIRE	0.3266	FEB
SHP	0.2821	MAR
PA	0.1863	MAR
AgriP	0.0639	MAR
RtlP	0.0601	MAR
MineP	0.113	APR
CO	0.1625	MAY
MInc	0.1198	MAY
ServP	0.0846	MAY

Variable	Partial R^2	Month
AgriP	0.3462	JUN
RETIRE	0.2019	JUN
MInc	0.1334	JUL
DISN	0.1193	JUL
LU4	0.0851	JUL
AgriP	0.4459	AUG
SHP	0.1321	AUG
DISN	0.0584	AUG
OffP	0.0572	AUG
LU2	0.0367	AUG
PA	0.0369	AUG
PA	0.2403	SEP

Variable	Partial R^2	Month
ST22	0.1238	SEP
AgriP	0.1716	SEP
ST23	0.1912	OCT
AgriP	0.1494	OCT
Rt_High	0.0832	OCT
CO	0.1363	OCT
MA	0.1797	NOV
EdP	0.1144	NOV
TranP	0.1248	NOV
MA	0.1336	DEC

Table 4.16 Variables from Model CFL Sorted by Name and Partial R^2 Value

Variable	Partial R^2	Month
TranP	0.1248	NOV
Rt_Low	0.2177	JAN
Rt_High	0.0832	OCT
ST23	0.1912	OCT
ST22	0.1238	SEP
SHP	0.2821	MAR
SHP	0.1321	AUG
ServP	0.0846	MAY
RtlP	0.0601	MAR
RETIRE	0.3266	FEB
RETIRE	0.2019	JUN
PA	0.2403	SEP

Variable	Partial R^2	Month
PA	0.1863	MAR
OffP	0.0572	AUG
MineP	0.113	APR
MInc	0.1334	JUL
MInc	0.1198	MAY
MA	0.1797	NOV
MA	0.1336	DEC
LU4	0.0851	JUL
LU3	0.1914	JAN
LU2	0.0875	JAN
EdP	0.1144	NOV
DISN	0.1193	JUL

Variable	Partial R^2	Month
DISN	0.0584	AUG
CO	0.1625	MAY
CO	0.1363	OCT
AgriP	0.4459	AUG
AgriP	0.3462	JUN
AgriP	0.1716	SEP
AgriP	0.1494	OCT
AgriP	0.0639	MAR
TranP	0.1248	NOV
Rt_Low	0.2177	JAN

Table 4.17 Variables from Model CFL Sorted by Partial R^2 Value

Variable	Partial R^2	Month
AgriP	0.4459	AUG
AgriP	0.3462	JUN
RETIRE	0.3266	FEB
SHP	0.2821	MAR
PA	0.2403	SEP
Rt_Low	0.2177	JAN
RETIRE	0.2019	JUN
LU3	0.1914	JAN
ST23	0.1912	OCT
PA	0.1863	MAR
MA	0.1797	NOV

Variable	Partial R^2	Month
AgriP	0.1716	SEP
CO	0.1625	MAY
AgriP	0.1494	OCT
CO	0.1363	OCT
MA	0.1336	DEC
MInc	0.1334	JUL
SHP	0.1321	AUG
TranP	0.1248	NOV
ST22	0.1238	SEP
MInc	0.1198	MAY
DISN	0.1193	JUL

Variable	Partial R^2	Month
EdP	0.1144	NOV
MineP	0.113	APR
LU2	0.0875	JAN
LU4	0.0851	JUL
ServP	0.0846	MAY
Rt_High	0.0832	OCT
AgriP	0.0639	MAR
RtlP	0.0601	MAR
DISN	0.0584	AUG
OffP	0.0572	AUG

4.5 South Florida Model Results

Regression models for the MSFs in South Florida (SFL) are given in Table 4.18. A total of 56 TTMSs are included in the model. The variables in the models are listed by month and sorted by their partial R^2 value in Table 4.19. The variables with a partial R^2 larger than 0.05 are sorted by name in Table 4.20 and by partial R^2 value in Table 4.21.

The most significant variable for South Florida is *SHP* (percentage of seasonal households). This appears in eight models and also contributes the largest portion of R^2. Variable *SHP* appears in the first four models (from January to April) with a negative coefficient and in the next four models (from May to August) with a positive coefficient. This indicates that the seasonal households tend to take up residence during the winter months in South Florida and leave in the summer months. *RETIRE* (Percentage of retired households) is included in only the May and November models, but the partial R^2 contributed by this variable is noticeable. The negative coefficient for this variable in the November model and the positive coefficient in the May model suggest that retired households are inclined to increase activities during winter and decrease activities in May.

Table 4.18 Regression Models for South Florida (SFL)

Month	Seasonal Factor Equation (S1234 Area)	R^2	Adj. R^2	RMSE
JAN	JAN_SF=0.99986-0.00174×SHP+0.00311×$ManuP$	0.4451	0.4242	0.0405
FEB	FEB_SF=0.95036-0.00260×SHP+0.00271×$ManuP$	0.5490	0.5319	0.0431
MAR	MAR_SF=0.95697-0.00246×SHP	0.5224	0.5135	0.0375
APR	APR_SF=0.98516-0.00126×SHP	0.4226	0.4119	0.0234
MAY	MAY_SF=0.97891+0.00114×$RETIRE$-0.00931×$AgriP$	0.3284	0.3030	0.0207
JUN	JUN_SF=1.01870+0.00242×SHP	0.5719	0.5640	0.0334
JUL	JUL_SF=1.06287+0.00271×SHP-0.00624×$HotlP$-0.00284×$ManuP$	0.4763	0.4460	0.0438
AUG	AUG_SF=1.01573+0.00253×SHP	0.4649	0.4550	0.0433
SEP	SEP_SF=1.04084+0.00226×SHP+0.00730×$RcServP$	0.4448	0.4238	0.0489
OCT	OCT_SF=1.01530+0.00530×$HotlP$	0.2247	0.2103	0.0355
NOV	NOV_SF=1.02076+0.05257×MA-0.00106×$RETIRE$+0.73320×$ST1$-1.09422×$ST23$	0.3956	0.3482	0.0241
DEC	DEC_SF=0.96605+0.06337×SU+0.07313×$MseumP$	0.2483	0.2199	0.0332

Table 4.19 Variables from Model SFL Sorted by Month and Partial R^2 Value

Variable	Partial R^2	Month
SHP	0.3394	JAN
ManuP	0.1057	JAN
SHP	0.4916	FEB
ManuP	0.0573	FEB
SHP	0.5224	MAR
SHP	0.4226	APR
RETIRE	0.2599	MAY
AgriP	0.0685	MAY

Variable	Partial R^2	Month
SHP	0.5719	JUN
SHP	0.3305	JUL
HotlP	0.0751	JUL
ManuP	0.0707	JUL
SHP	0.4649	AUG
SHP	0.3681	SEP
RcServP	0.0766	SEP
HotlP	0.2247	OCT

Variable	Partial R^2	Month
MA	0.1637	NOV
RETIRE	0.1102	NOV
ST23	0.0659	NOV
ST1	0.0558	NOV
MseumP	0.1488	DEC
SU	0.0995	DEC

Table 4.20 Variables from Model SFL Sorted by Name and Partial R^2 Value

Variable	Partial R^2	Month
AgriP	0.0685	MAY
HotlP	0.2247	OCT
HotlP	0.0751	JUL
MA	0.1637	NOV
ManuP	0.1057	JAN
ManuP	0.0707	JUL
ManuP	0.0573	FEB
MseumP	0.1488	DEC

Variable	Partial R^2	Month
RcServP	0.0766	SEP
RETIRE	0.2599	MAY
RETIRE	0.1102	NOV
SHP	0.5719	JUN
SHP	0.5224	MAR
SHP	0.4916	FEB
SHP	0.4649	AUG
SHP	0.4226	APR

Variable	Partial R^2	Month
SHP	0.3681	SEP
SHP	0.3394	JAN
SHP	0.3305	JUL
ST1	0.0558	NOV
ST23	0.0659	NOV
SU	0.0995	DEC

Table 4.21 Variables from Model SFL Sorted by Partial R^2 Value

Variable	Partial R^2	Month
SHP	0.5719	JUN
SHP	0.5224	MAR
SHP	0.4916	FEB
SHP	0.4649	AUG
SHP	0.4226	APR
SHP	0.3681	SEP
SHP	0.3394	JAN
SHP	0.3305	JUL

Variable	Partial R^2	Month
RETIRE	0.2599	MAY
HotlP	0.2247	OCT
MA	0.1637	NOV
MseumP	0.1488	DEC
RETIRE	0.1102	NOV
ManuP	0.1057	JAN
SU	0.0995	DEC
RcServP	0.0766	SEP

Variable	Partial R^2	Month
HotlP	0.0751	JUL
ManuP	0.0707	JUL
AgriP	0.0685	MAY
ST23	0.0659	NOV
ManuP	0.0573	FEB
ST1	0.0558	NOV

5. MODELING INFLUENTIAL VARIABLES OF SEASONAL FACTORS IN RURAL AREAS OF FLORIDA

This chapter presents the modeling of seasonal factors for the Florida rural areas. Variables that are thought to be potentially influential are defined in Section 5.1. Experiences from a previous study (Zhao *et al*. 2004), as well as additional regression analyses, show that modeling seasonal factors for the Florida rural areas is challenging. The model results are much worse than they are for urban areas. To improve the model results, a strategy is developed that involves separately modeling TTMSs based on their daily traffic patterns. Section 5.2 describes the method used to classify the rural TTMSs into two groups: one with daily traffic patterns characterized by a single peak and the other with double peaks. Regression analyses are performed based on the single- and double-peak classification. These analyses identify which potential influential variables are statistically significant in determining the seasonal traffic patterns at the TTMSs. The regression analysis results are described in Sections 5.3 and 5.4 for the single- and double-peak TTMSs, respectively.

5.1 Definition of Variables for Rural Areas

The independent variables prepared to calibrate the multiple regression models for the rural TTMSs include roadway characteristics, demographic and socioeconomic variables, and other variables that describe the location and accessibility of the TTMSs.

5.1.1 Roadway Characteristic Variables

Variables in this category are given in Table 5.1, where variables *PA*, *MA,* and *CO* are dummy variables. These variables indicate the type of road where a TTMS is located. The data are retrieved from the 2000 FDOT Traffic Information CD and the FDOT's Roadway Characteristics Inventory (RCI) database.

Table 5.1 Roadway Characteristic Variables for Rural Roads

Variable	Description
PA	Equals 0 if TTMS not located on rural principal, 1 otherwise
MA	Equals 0 if TTMS not located on rural minor arterial; 1 otherwise
CO	Equals 0 if TTMS not located on rural collector; 1 otherwise
TF	Truck factor

5.1.2 Demographic and Socioeconomic Variables

Most of the demographic and socioeconomic data for rural areas are from the 2000 Census, with the exception of the employment data, which are from a proprietary database purchased by FDOT annually. The data are available to all FDOT districts without the need for special data collection.

The variable values are also computed based on a buffer method. However, because roadway spacing in rural areas is irregular, a uniform buffer size is inappropriate even for TTMSs on roads of the same functional classification. Therefore, a variable buffer method is used. Using this method, the distance between the road where a TTMS is located and the closest road that has the same functional classification is first computed using GIS. A fixed percentage is then applied to this distance to determine the buffer size. Three percentages are tested with regression analysis: 25%, 50%, and 75%. Because 50% gives the best regression models, it is selected as the percentage used to compute the buffer size. For instance, if the distance between a TTMS and the next road with the same functional classification is eight miles, applying the 50% will give a buffer size of four miles. However, if this distance exceeds ten miles, an upper limit of the buffer size of five miles applies. In addition to the buffer size limit, the buffer area may also be modified if it overlaps with any urban areas. The overlapping urban areas are removed from a buffer area to arrive at the final impact area. This is then used to compile independent variables.

Rural area models share many of the variables used in urban area models. They include:

- Percentage of student population by different age groups,
- Percentage of retired households by different income levels,
- Seasonal household percentage,
- Median household income, and
- Employment variables.

Descriptions of the above variables may be found in Tables 4.2, 4.3, and 4.4. Additional age group variables, given in Table 5.2, are also tested.

Table 5.2 Age Group Variables for Rural Roads

Variable	Description
PPA5	Population aged 5 and under as a percentage of total population
PPA6_17	Population aged between 6 and 17 as a percentage of total population
PPA22_64	Population aged between 22 and 64 as a percentage of total population
PPA18_64	Population aged between 18 and 64 as a percentage of total population
PPA6_21	Population aged between 6 and 21 as a percentage of total population
PPA18_21	Population aged between 18 and 21 as a percentage of total population
PPA65up	Population aged 65 and over as a percentage of total population
PDA5	Population density aged 5 and under
PDA6_17	Population density aged between 6 and 17
PDA22_64	Population density aged between 22 and 64
PDA18_64	Population density aged between 18 and 64
PDA6_21	Population density aged between 6 and 21
PDA18_21	Population density aged between 18 and 21
PDA65up	Population density aged 65 and over

5.1.3 Location Variables for Rural Models

Relative Locations to Urban Areas, Beaches, or Interstate Highways

Rural areas typically have low land use intensity and a higher portion of through traffic. This traffic is not generated locally and cannot be captured by the buffer method. Because the amount of through traffic may be affected by the location of a road in relation to a nearby urban area, beach, or interstate highway, special dummy variables are created to account for such impacts. The distance between a TTMS and an urban area, beach, or interstate highway is measured. The population size of the urban area is also taken into consideration as a larger urban area may have a greater impact on a nearby TTMS. These variables are defined in Table 5.3.

Table 5.3 Special Location Variables

Variable	Description
Dist1	Max of ratio of population of a metropolitan area to the distance from the TTMS to the metropolitan area (person/mile)
Indexdist2	$(\sum \frac{\text{Metropolitan population}}{\text{Distance from the TTMS to the metropolitan area}})^{-1}$ (10^{-5} mile/person)
Interdist	Distance from a TTMS to the closest highway interchange (meter)
Beachdist	Distance from a TTMS to the closest beach site (mile)

<u>Climate Factors</u>

For the urban models, the TTMSs are divided into three groups that reflect the climate differences of different regions in the state. Each region is modeled separately. This is not feasible for the rural area TTMSs because their number is not large enough to ensure the statistical validity of the models. Therefore, some of the socioeconomic and demographic variables previously used in urban models are modified to reflect the climate zone in which a TTMS is located. The climate zones are the same as the three regions (North, Central, and South Florida) defined in Section 4.2. The socioeconomic and demographic variables are separated into three, each representing a particular socioeconomic or demographic factor in a given climate zone. These variables include seasonal households, hotel employment, retail employment, and museum employment. Table 5.4 gives the definition of these new variables.

Table 5.4 Socioeconomic and Demographic Variables for Different Climate Zones

Variable	Description
NSHP	Percentage of seasonal households in North Florida
CSHP	Percentage of seasonal households in Central Florida
SSHP	Percentage of seasonal households in South Florida
NHotlP	Hotel & Camp workers as a percentage of total workers in North Florida
CHotlP	Hotel & Camp workers as a percentage of total workers in Central Florida
SHotlP	Hotel & Camp workers as a percentage of total workers in South Florida
NRtlP	Retail workers as a percentage of total workers in North Florida
CRtlP	Retail workers as a percentage of total workers in Central Florida
SRtlP	Retail workers as a percentage of total workers in South Florida
NMsemP	Museums art galleries & gardens workers as a percentage of total workers in North Florida
CMsemP	Museums art galleries & gardens workers as a percentage of total workers in Central Florida
SMsemP	Museums art galleries & gardens workers as a percentage of total workers in South Florida

5.2 Classification of Single- and Double-Peak TTMS Groups

Preliminary regression analyses of the seasonal factors for rural TTMSs indicate that employing similar variables results in poor regression models. The link between the monthly seasonal factors (MSFs) and the independent variables describing demographic, socioeconomic, and roadway characteristics is weak. One reason may be that the monthly variation in traffic is more significant on rural roads than urban and commuter routes (HCM 2000). Another reason thought to have contributed to the poor model results is that urban traffic is dominated by commuting. In rural areas there is often a lack of commuters, and most traffic may be generated form other activities such as agriculture, mining, fishing, recreational travel, etc. Due to the low land use intensity, irregular road networks, and longer travel distances, the generators of such activities are difficult to capture for a given TTMS.

Sharma (1983) and Sharma *et al*. (1986) proposed a method to classify rural roads based on trip purpose and trip length information. This information is gleaned from origin-destination (OD) surveys conducted by Alberta Transportation. Based on daily traffic patterns, five predominant road uses were identified (Sharma 1983): commuter, commuter-recreational, commuter-recreational-tourist, tourist, and highly recreational. Three typical hourly traffic patterns were also identified: commuter, partially commuter, and non-commuter. Cumulative trip length distribution information was used to classify roads serving mainly regional, interregional, or long-distance travel. These road classifications based on trip purposes are helpful because they provide insight into the potential land use patterns that contribute to seasonal traffic patterns. However, such data are often unavailable for rural areas, as is the case in Florida.

In this section, a method is proposed to classify roads according to their daily traffic patterns. This will distinguish between those roads that have a significant portion of traffic related to commuting and those that do not. The rural TTMSs are then classified into two groups based on the roads they are on. Each group is modeled separately. The purpose is to reduce the variability in the data within the same group and to improve model results. This will also helps identify independent variables that are most relevant to each group of TTMSs.

Classification of TTMSs based on whether commuting traffic is noticeable or not is achieved by examining the hourly traffic pattern at a TTMS. A traffic pattern dominated by commuter travel usually shows two peaks, one in the morning and one in the afternoon. The traffic pattern on a road that is used by few commuters but more people for recreational purposes typically exhibits a single peak around mid-day. Therefore, a method is used to determine whether a given hourly traffic is a single-peak (SP) or a double-peak (DP) pattern.

There are 116 TTMSs in the rural areas of Florida. Their hourly traffic patterns are determined based on the data on a typical weekday. The representative weekday is chosen as Wednesday in the year 2000. The hourly traffic volumes for all Wednesdays are extracted for each TTMS. They are then averaged to arrive at their annual average weekday hourly volumes.

To determine if a TTMS belongs to a SP or a DP group, the maximum and minimum hourly volumes are examined. Figures 5.1 and 5.2 show a single-peak and a double-peak traffic pattern, respectively. For both SP and DP patterns, Max_1 is defined as the maximum hourly traffic volume in the morning from hour 0 (0:00) to hour 10 (10:00). Max_2 is the maximum hourly traffic volume in the afternoon from hour 15 (15:00) to hour 24 (24:00). *Min_midday* is the minimum hourly volume between the hour 10 (10:00) and hour 15 (15:00).

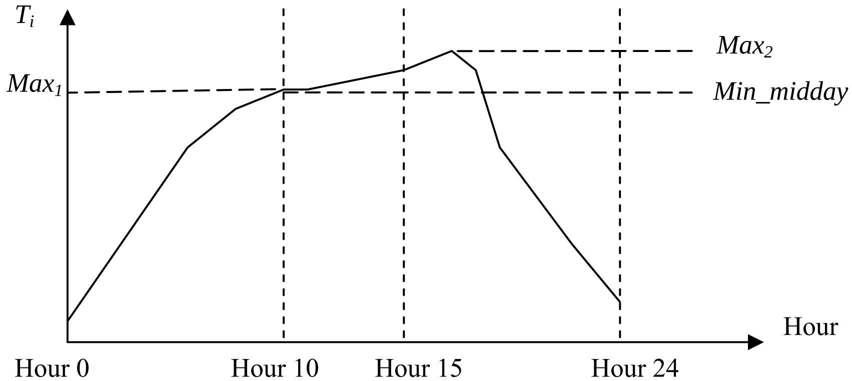


Figure 5.1 Single-Peak Pattern and Variables Describing Peaking Characteristics

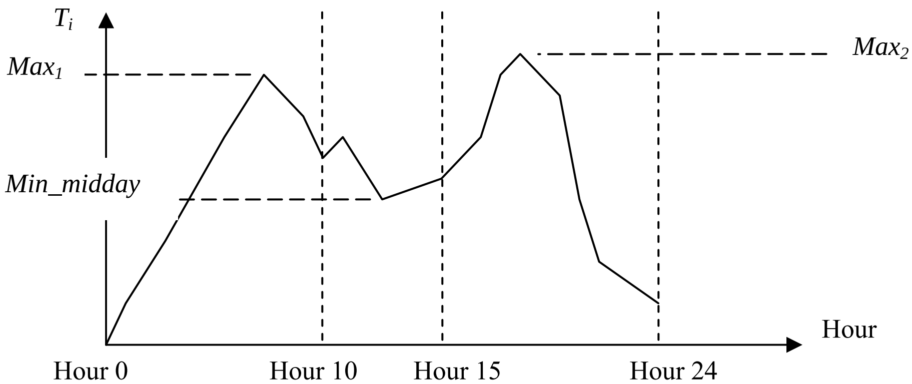


Figure 5.2 Double-Peak Pattern and Variables Describing Peaking Characteristics

Determining the presence of double peaks involves checking if both the morning peak traffic volume Max_1 and afternoon peak traffic volume Max_2 are larger than the minimum traffic volume between hour 10 and hour 15 (i.e., *Min_midday*). Without losing generality, the smaller of the morning peak volume and afternoon peak volume is defined as

$$Min\_peak = \min\{Max_1, Max_2\} \quad (5\text{-}1)$$

The difference between *Min_peak* and *Min_midday* indicates the magnitude of the variation in midday traffic, which is defined as follows:

$$D\_MinMax\_MinMD = Min\_peak - Min\_midday \quad (5\text{-}2)$$

Max is defined as the maximum hourly traffic volume for an entire day:

$$Max = \max\{T_i\} \quad (5\text{-}3)$$

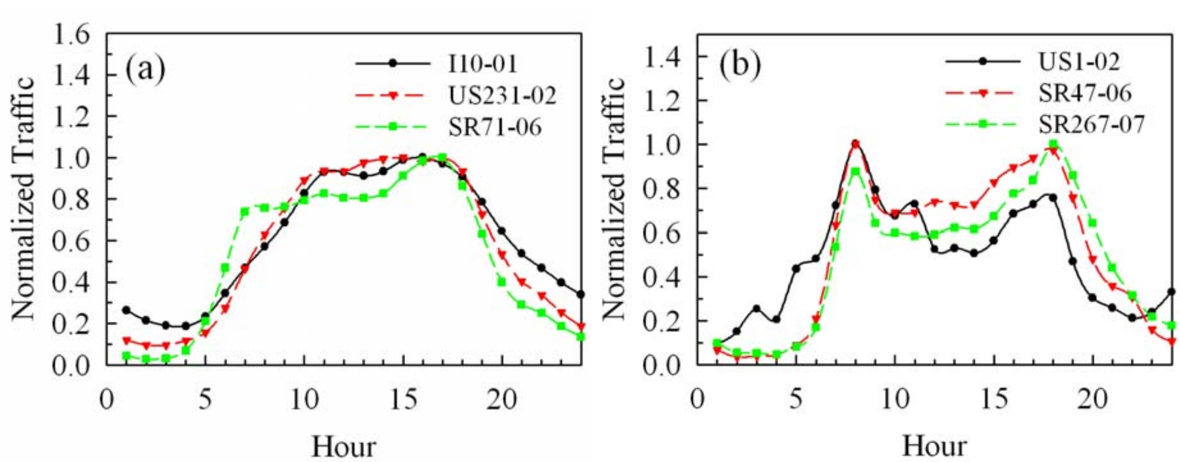
where T_i is the traffic for hour i (i = 1, 2, …, 24). *D_MinMax_MinMD* can be normalized by dividing it by *Max*. This determines the difference between the smaller of the peak traffic volumes and the minimum midday traffic volume as a percentage of the maximum daily hourly traffic:

$$PD\_MinMax\_MinMD = \frac{D\_MinMax\_MinMD}{Max} \tag{5-4}$$

An hourly traffic pattern is classified based on the value of *PD_MinMax_MinMD*. If *Min_peak* is no larger than the *Min_midday*, it means at least one of Max_1 and Max_2 is equal to the minimum hourly traffic between hours 10 and 15 (see Figure 5.1). In this case, *PD_MinMax_MinMD* is 0, which suggests that the traffic pattern has a single peak either at noon or in the early afternoon (seldom in the morning). Theoretically, it is possible to have two peaks, one morning or afternoon peak and one that may appear between hours 10 and 15. This will result in a TTMS being wrongly classified as having a single peak. This was not observed within the data from the 116 TTMSs, however.

If *PD_MinMax_MinMD* is larger than 0, at least two peaks exist. The value of *PD_MinMax_MinMD* indicates how large the difference is between the minimum peak traffic volume and the minimum midday traffic volume. If *PD_MinMax_MinMD* is small enough, the pattern is considered single-peaked. Four different scenarios are tested for cases of *PD_MinMax_MinMD* = 0.00, 0.10, 0.15, and 0.20 to investigate which one results in better models. It is possible that there may be a third peak during the midday period, but this happens rarely. Only two cases of a third peak have been observed, and they are still considered to share similarity with the double-peak TTMSs.

The hourly traffic patterns of three TTMSs with a single peak are plotted in Figure 5.3(a) for illustration purposes. The criterion applied to classify these TTMSs into the SP group is *PD_MinMax_MinMD* = 0. The traffic patterns of three other TTMSs with double peaks are shown in Figure 5.3(b). It may be seen this criterion has worked reasonably well.

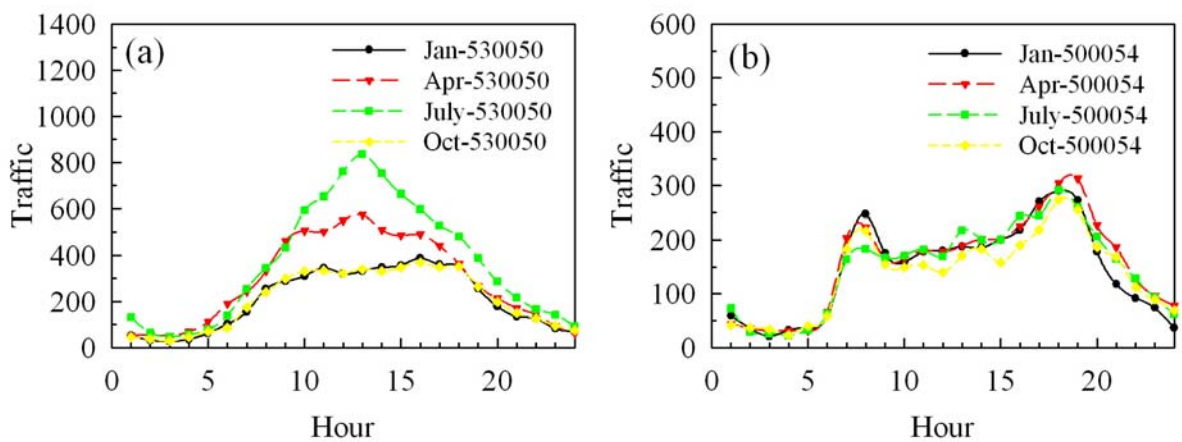


(a) single-peak pattern (b) double-peak pattern

Figure 5.3 Hourly Traffic Variations for Selected TTMSs

Note that the hourly data used to classify traffic patterns are averaged from the full year data for all Wednesdays. It is assumed that the traffic patterns on Wednesdays are representative of those of the two other typical weekdays (Tuesdays and Thursdays). This has been confirmed by checking the traffic patterns of these two weekdays. The use of the average of full year data guarantees the smoothness of the data. It also reflects the overall traffic pattern on an annual basis.

From the application point of view, the short-term count data from PTMSs only cover a few days, such as a 72-hour period. The traffic variation over a short period may not be same as the pattern obtained from the averaged data for the whole year. This may cause difficulty in the application of this method. To verify that the SP or DP pattern based on annual average hourly traffic is similar to that of a short period count of 48 or 72 hours, the traffic patterns of selected TTMSs for selected weekdays are examined. It is found that most of the SP or DP traffic patterns remain unchanged, although some seasonal variations are observed. Figure 5.4(a) shows the hourly traffic patterns at site 530050 in the months of January, April, July, and October. This site exhibits single-peak traffic patterns that are generally consistent, even though the hourly traffic patterns within each month vary. Figure 5.4(b) shows the hourly traffic patterns at site 500054 during different seasons, also in the months of January, April, July, and October. These patterns are consistent with the double peak pattern.



(a) 530050 on US 231 in different seasons (b) 500054 in different seasons

Figure 5.4 Hourly Traffic Pattern for TTMSs

Recognizing that individual hourly traffic patterns for the same location may not always be consistent, the classification results based on the cutoff criterion *PD_MinMax_MinMD* = 0 are determined for all of the TTMSs. There are a total of 1,472 hourly traffic patterns in the SP group and 10,564 in the DP group. For the TTMSs in the SP group, 53% of all of the individual day hourly traffic patterns are also single-peaked, while 89% in the DP group are also double-peaked. One reason why averaged hourly traffic patterns may be different from everyday hourly traffic patterns is that traffic patterns also change with seasons. There is also the possibility that there is small randomness in the data. When the cutoff criterion is *PD_MinMax_MinMD* = 0.05, 74% of the SP group and 80% of the DP group agree with their classifications based on annual average hourly patterns.

After the TTMSs are classified into the SP and DP groups, regression models are developed to relate the seasonal factors with variables that describe land use, accessibility, and roadway characteristics. The modeling results are presented in the next two sections.

5.3 Single-Peak Models

There are 33 TTMSs belonging to the SP group. The regression models for the SP group are given in Table 5.5.

For the SP group models, the R^2 values are between 0.5529 and 0.9468. The only exception is the model for October, which is 0.4093. Overall, these R^2 values are much higher than those of the models when the TTMSs are not separated into SP and DP groups.

The most significant variables are location variable *Dist1* and *SrtlP* and *SSHP*. Variables *SrtlP* and *SSHP* indicate that climate is an important factor. Moreover, they indicate that the same types of employment do not necessarily affect traffic seasonality during the same months in different climate zones.

Variable *Dist1* contributes an approximately 0.3 partial R^2 to the March, April, June, and December models. Of the models for March, April, and December, the coefficient is negative. This suggests that the closer a count station is to an urban area, the more traffic it may experience during these months.

Variable *SRtlP* appears in seven models and contributes high partial R^2 values to the January, July, August, and October models. For the January model, the coefficient of this variable is negative. For the other three models, the coefficient is positive. This indicates that retail-related employment in South Florida tends to increase traffic during January. In contrast, decreased traffic occurs during July, August, and October.

The *SSHP* variable is selected by four models. These are January, February, September, and October. The coefficients for January and February are negative, while those for September and October are positive. This indicates that the seasonal households in South Florida are active during the first two months of a year but not in September and October.

The variables *PPA18_64* (age group 18-64) and *PPA22_64* (age group 22-64) also appear frequently, with relatively high partial R^2 in the January, February, June, and July models. They are correlated with an increase in traffic during winter time and contribute to a decrease in traffic during summer time.

Table 5.6 lists all of the variables included in the above models, along with their partial R^2 values and the months for which they are significant. Tables 5.7 and 5.8 list all of the variables that have a partial R^2 larger than 0.05. Table 5.7 sorts the variables by name and Table 5.8 by partial R^2 value.

Table 5.5 Regression Models for the Single-Peak Group for Rural Areas

Month	Seasonal Factor Equation (Single Peak Group)	R^2	Adj. R^2	RMSE
JAN	*JAN_SF*=0.85572+0.00039208×*Indexdist2*-1.16530×*ST23*+0.48158×*PPA18_64*-0.00268×*SSHP*-0.00623×*SRtlP*+0.01111×*SHotlP*-0.41836×*CMseumP*-0.00392×*Tran*P-0.00269×*WholP*+0.00153×*EdP*+0.00159×*ManuP*	0.9468	0.9189	0.0244
FEB	*FEB_SF*=0.76702+0.45899×*PPA18_64*-0.00092932×*NSHP*-0.00263×*SSHP*-0.00698×*SRtlP*-0.00240×*WholP*	0.8480	0.8198	0.0367
MAR	*MAR_SF*=0.81821-0.00204×*TF*-0.00000214×*Dist1*+0.35360×*PPA22_64*-0.00120×*NSHP*-0.00446×*SRtlP*-0.19837×*NMseumP*-0.06868×*SMseumP*	0.8299	0.7823	0.0310
APR	*APR_SF*=1.00503-0.00000112×*Dist1*-4.77704E-7×*Interdist*+0.00077162×*NRtlP*+0.41417×*CMseumP*-0.00166×*RestP*-0.00130×*ManuP*	0.7035	0.6351	0.0253
MAY	*MAY_SF*=0.98524+9.210628E-7×*Dist1*-6.25641E-7×*Interdist*+0.00479×*TranP*-0.00124×*ManuP*	0.5529	0.4890	0.0295
JUN	*JUN_SF*=1.22743+0.00281×*TF*+0.00000168×*Dist1*-1.41281×ST21+0.92899×*ST23*-0.51406×*PPA22_64*	0.6805	0.6213	0.0406
JUL	*JUL_SF*=1.12175+0.00212×*TF*-0.00039189×*Indexdist2*+8.1128E-7×*Interdist*-0.39404×*PPA18_64*+0.00589×*SRtlP*+0.00147×*ManuP*	0.7872	0.7381	0.0371
AUG	*AUG_SF*=1.07595+0.00304×*TF*+7.357061E-7×*Interdist*-0.23121×*PPA18_64*+0.00600×*SRtl*P+0.05256×*FishP*	0.6967	0.6405	0.0345
SEP	*SEP_SF*=1.00854+0.47485×*ST21*+0.00895×*CSHP*+0.00121×*SSHP*+0.00541×*SRtlP*+0.00826×*NHotlP*+0.03512×*FishP*+0.00336×*TranP*	0.8530	0.8119	0.0225
OCT	*OCT_SF*=1.02075+0.00080427×*SSHP*+0.00326×*SRtlP*	0.4093	0.3699	0.0300
NOV	*NOV_SF*=1.06294+0.05240×*MA*+0.00051468×*Indexdist2*-1.20256×*ST23*+0.00101×*ServP*	0.7330	0.6948	0.0271
DEC	*DEC_SF*=0.98965-0.00000303×*Dist1*+0.22647×*PPA18_64*+0.01098×*NHotlP*+0.01003×*RcServP*	0.6560	0.6069	0.0383

Table 5.6 Model Variables for Rural SP Group Sorted by Month and Partial R^2 Value

Variable	Partial R^2	Month
SRtlP	0.3413	JAN
PPA18_64	0.2069	JAN
SSHP	0.1173	JAN
WholP	0.0907	JAN
Indexdist2	0.0409	JAN
TranP	0.0313	JAN
ST23	0.0297	JAN
EdP	0.0275	JAN
ManuP	0.0181	JAN
SHotlP	0.0221	JAN
CMseumP	0.0208	JAN
SSHP	0.4765	FEB
WholP	0.1594	FEB
PPA18_64	0.1022	FEB
SRtlP	0.0624	FEB
NSHP	0.0474	FEB
Dist1	0.3867	MAR
NMseumP	0.1638	MAR
SRtlP	0.0781	MAR
NSHP	0.0625	MAR
PPA22_64	0.0717	MAR
TF	0.0345	MAR
SMseumP	0.0326	MAR
Dist1	0.2743	APR
Interdist	0.1279	APR
ManuP	0.0769	APR
RestP	0.0992	APR
CMseumP	0.0733	APR
NRtlP	0.052	APR
TranP	0.1901	MAY
Interdist	0.1924	MAY
ManuP	0.0909	MAY
Dist1	0.0795	MAY
Dist1	0.2853	JUN
PPA22_64	0.1752	JUN
ST21	0.0886	JUN
TF	0.0769	JUN
ST23	0.0544	JUN
ManuP	0.2628	JUL
SRtlP	0.1595	JUL
PPA18_64	0.1402	JUL
Indexdist2	0.0935	JUL
Interdist	0.08	JUL
TF	0.0511	JUL
SRtlP	0.2331	AUG
Interdist	0.1622	AUG
TF	0.1278	AUG
FishP	0.0889	AUG
PPA18_64	0.0847	AUG
SSHP	0.3317	SEP
CSHP	0.2332	SEP
SRtlP	0.083	SEP
NHotlP	0.0809	SEP
FishP	0.0571	SEP
ST21	0.0362	SEP
TranP	0.031	SEP
SSHP	0.2954	OCT
SRtlP	0.1139	OCT
Indexdist2	0.277	NOV
ServP	0.199	NOV
ST23	0.1645	NOV
MA	0.0924	NOV
Dist1	0.3387	DEC
NHotlP	0.1597	DEC
RcServP	0.0879	DEC
PPA18_64	0.0698	DEC

Table 5.7 Model Variables for Rural SP Group Sorted by Name and Partial R^2 Value

Variable	Partial R^2	Month
CMseumP	0.0733	APR
CSHP	0.2332	SEP
Dist1	0.3867	MAR
Dist1	0.3387	DEC
Dist1	0.2853	JUN
Dist1	0.2743	APR
Dist1	0.0795	MAY
FishP	0.0889	AUG
FishP	0.0571	SEP
Indexdist2	0.277	NOV
Indexdist2	0.0935	JUL
Interdist	0.1924	MAY
Interdist	0.1622	AUG
Interdist	0.1279	APR
Interdist	0.08	JUL
MA	0.0924	NOV
ManuP	0.2628	JUL
ManuP	0.0909	MAY
ManuP	0.0769	APR
NHotlP	0.1597	DEC
NHotlP	0.0809	SEP
NMseumP	0.1638	MAR
NRtlP	0.052	APR
NSHP	0.0625	MAR
PPA18_64	0.2069	JAN
PPA18_64	0.1402	JUL
PPA18_64	0.1022	FEB
PPA18_64	0.0847	AUG
PPA18_64	0.0698	DEC
PPA22_64	0.1752	JUN
PPA22_64	0.0717	MAR
RcServP	0.0879	DEC
RestP	0.0992	APR
ServP	0.199	NOV
SRtlP	0.3413	JAN
SRtlP	0.2331	AUG
SRtlP	0.1595	JUL
SRtlP	0.1139	OCT
SRtlP	0.083	SEP
SRtlP	0.0781	MAR
SRtlP	0.0624	FEB
SSHP	0.4765	FEB
SSHP	0.3317	SEP
SSHP	0.2954	OCT
SSHP	0.1173	JAN
ST21	0.0886	JUN
ST23	0.1645	NOV
ST23	0.0544	JUN
TF	0.1278	AUG
TF	0.0769	JUN
TF	0.0511	JUL
TranP	0.1901	MAY
WholP	0.1594	FEB
WholP	0.0907	JAN

Table 5.8 Model Variables for Rural SP Group Sorted by Partial R^2 Value

Variable	Partial R^2	Month
SSHP	0.4765	FEB
Dist1	0.3867	MAR
SRtlP	0.3413	JAN
Dist1	0.3387	DEC
SSHP	0.3317	SEP
SSHP	0.2954	OCT
Dist1	0.2853	JUN
Indexdist2	0.277	NOV
Dist1	0.2743	APR
ManuP	0.2628	JUL
CSHP	0.2332	SEP
SRtlP	0.2331	AUG
PPA18_64	0.2069	JAN
ServP	0.199	NOV
Interdist	0.1924	MAY
TranP	0.1901	MAY
PPA22_64	0.1752	JUN
ST23	0.1645	NOV

Variable	Partial R^2	Month
NMseumP	0.1638	MAR
Interdist	0.1622	AUG
NHotlP	0.1597	DEC
SRtlP	0.1595	JUL
WholP	0.1594	FEB
PPA18_64	0.1402	JUL
Interdist	0.1279	APR
TF	0.1278	AUG
SSHP	0.1173	JAN
SRtlP	0.1139	OCT
PPA18_64	0.1022	FEB
RestP	0.0992	APR
Indexdist2	0.0935	JUL
MA	0.0924	NOV
ManuP	0.0909	MAY
WholP	0.0907	JAN
FishP	0.0889	AUG
ST21	0.0886	JUN

Variable	Partial R^2	Month
RcServP	0.0879	DEC
PPA18_64	0.0847	AUG
SRtlP	0.083	SEP
NHotlP	0.0809	SEP
Interdist	0.08	JUL
Dist1	0.0795	MAY
SRtlP	0.0781	MAR
ManuP	0.0769	APR
TF	0.0769	JUN
CMseumP	0.0733	APR
PPA22_64	0.0717	MAR
PPA18_64	0.0698	DEC
NSHP	0.0625	MAR
SRtlP	0.0624	FEB
FishP	0.0571	SEP
ST23	0.0544	JUN
NRtlP	0.052	APR
TF	0.0511	JUL

5.4 Double-Peak Models

There are 83 TTMSs in the DP group. The regression models for the 12 MSFs are given in Table 5.9.

For the DP group models, the most significant variables are *Dist1*, *SRtlP*, and *SSHP*. The *SRtlP* variable contributes the largest partial R^2 value to the January, February, August, and September models. The coefficients in the January and February models are negative. Those for August and September are positive. This indicates that retail-related employment in South Florida tends to generate more traffic in January and February and does the opposite in August and September.

The variable *SSHP* is present in the March model with a negative coefficient and in the May and October models with a positive coefficient. This indicates that the traffic generated by seasonal households in South Florida is more noticeable in March, whereas these households have less of an impact on traffic in May and October.

The variable *Dist1* appears in eight models: January, February, March, May, June, July, November, and December. The coefficients in the June and July models are positive. They are negative for the other six models. This suggests that, for a count station near an urban area, traffic tends to decrease in June and July, but increases for the other six months.

Table 5.10 lists all of the variables included in the above models, along with their partial R2 value and the months for which they significant. Table 5.11 and 5.12 list all of the variables that have a partial R^2 larger than 0.05. Table 5.11 sorts the variables by name and Table 5.12 by partial R^2 value.

Table 5.9 Regression Models for Rural DP Group

Month	Seasonal Factor Equation (Double Peak Group)	R^2	Adj. R^2	RMSE
JAN	*JAN_SF*=1.14688-0.00000164×*Dist1*-0.00075402×*Beachdist*-0.00487×*Rt_High*+0.00233×*NSHP*-0.00530×*SRtlP*+0.01445×*CHotlP*-0.00052938×*ServP*	0.6095	0.5730	0.0464
FEB	*FEB_SF*=1.12776-0.00000111×*Dist1*-0.00310×*RETIRE*-1.28081×*ST22*+0.00275×*NSHP*-0.00655×*SRtlP*	0.6298	0.6057	0.0453
MAR	*MAR_SF*=1.01308-0.02003×*PA*-8.86801E-7×*Dist1*-0.00050155×*Indexdist2*-0.00376×*Rt_High*-0.00265×*SSHP*-0.00688×*SHotlP*	0.5847	0.5519	0.0359
APR	*APR_SF*=0.98908-0.01506×*PA*-0.00304×*Rt_High*+0.00043424×*EdP*	0.2581	0.2299	0.0269
MAY	*MAY_SF*=0.96930+3.997491E-7×*Dist1*+0.00213×*SSHP*+0.00910×*CHotlP*	0.2830	0.2558	0.0306
JUN	*JUN_SF*=0.88950-0.04795×*CO*+0.00000154×*Dist1*+0.00057774×*Beachdist* +0.00528×*RETIRE*-0.00404×*Rt_Low*-0.00248×*NSHP*	0.5278	0.4906	0.0464
JUL	*JUL_SF*=0.78991+0.00000188×*Dist1*+0.00108×*Beachdist*+0.00750×*RETIRE*-0.00487×*Rt_Low*+0.71992×*PPA18_21*-0.00377×*NSHP*-0.01512×*CHotlP*+0.00220×*AgriP* +0.00646×*RcServP*+0.00251×*MineP*	0.7122	0.6722	0.0478
AUG	*AUG_SF*=0.96453+8.381719E-7×*Dist1*+0.24575×*PPA65up*+0.00816×*SRtlP* +0.00456×*RcServP*+0.00259×*MineP*	0.5686	0.5406	0.0460
SEP	*SEP_SF*=0.99057+0.00220×*TF*+0.00394×*Rt_High*+0.00511×*SRtlP*+0.00343×*RcServP*	0.4717	0.4446	0.0405
OCT	*OCT_SF*=1.01007+0.01853×*PA*+0.00234×*SSHP*+0.00755×*SHotlP*	0.2690	0.2412	0.0356
NOV	*NOV_SF*=1.05748-0.00000149×*Dist1*-0.00066973×*Beachdist*+0.54413×*ST23*	0.3476	0.3229	0.0432
DEC	*DEC_SF*=1.07997-0.00000149×*Dist1*-0.00071958×*Beachdist*+0.00294×*NSHP*	0.3813	0.3578	0.0517

Table 5.10 Model Variables for Rural DP Group Sorted by Month and Partial R^2 value

Variable	Partial R^2	Month
SRtlP	0.3306	JAN
Dist1	0.0994	JAN
Beachdist	0.0499	JAN
Rt_High	0.0512	JAN
NSHP	0.0258	JAN
ServP	0.024	JAN
CHotlP	0.0286	JAN
SRtlP	0.3832	FEB
Dist1	0.0857	FEB
RETIRE	0.069	FEB
NSHP	0.052	FEB
ST22	0.0399	FEB
SSHP	0.3411	MAR
Dist1	0.1216	MAR
Rt_High	0.0409	MAR
PA	0.0337	MAR
SHotlP	0.0249	MAR
Indexdist2	0.0225	MAR

Variable	Partial R^2	Month
Rt_High	0.1602	APR
PA	0.0598	APR
EdP	0.0381	APR
SSHP	0.1688	MAY
Dist1	0.0664	MAY
CHotlP	0.0479	MAY
Dist1	0.3032	JUN
RETIRE	0.0952	JUN
NSHP	0.0309	JUN
CO	0.0349	JUN
Beachdist	0.0315	JUN
Rt_Low	0.0322	JUN
Dist1	0.2465	JUL
NSHP	0.0691	JUL
Beachdist	0.086	JUL
AgriP	0.0478	JUL
RcServP	0.0358	JUL
MineP	0.0291	JUL

Variable	Partial R^2	Month
SRtlP	0.4058	AUG
MineP	0.0423	AUG
PPA65up	0.0393	AUG
Dist1	0.0476	AUG
RcServP	0.0337	AUG
SRtlP	0.354	SEP
Rt_High	0.0451	SEP
TF	0.0429	SEP
RcServP	0.0296	SEP
SSHP	0.1435	OCT
SHotlP	0.0763	OCT
PA	0.0492	OCT
Dist1	0.1976	NOV
Beachdist	0.1137	NOV
ST23	0.0364	NOV
Dist1	0.2414	DEC
Beachdist	0.0656	DEC
NSHP	0.0742	DEC

Table 5.11 Model Variables for Rural DP Group Sorted by Name and Partial R^2 Value

Variable	Partial R^2	Month
Beachdist	0.1137	NOV
Beachdist	0.086	JUL
Beachdist	0.0656	DEC
Dist1	0.3032	JUN
Dist1	0.2465	JUL
Dist1	0.2414	DEC
Dist1	0.1976	NOV
Dist1	0.1216	MAR
Dist1	0.0994	JAN

Variable	Partial R^2	Month
Dist1	0.0857	FEB
Dist1	0.0664	MAY
PA	0.0598	APR
NSHP	0.0742	DEC
NSHP	0.0691	JUL
NSHP	0.052	FEB
RETIRE	0.0952	JUN
RETIRE	0.069	FEB
SHotlP	0.0763	OCT

Variable	Partial R^2	Month
SRtlP	0.4058	AUG
SRtlP	0.3832	FEB
SRtlP	0.354	SEP
SRtlP	0.3306	JAN
SSHP	0.3411	MAR
SSHP	0.1688	MAY
SSHP	0.1435	OCT
Rt_High	0.1602	APR
Rt_High	0.0512	JAN

Table 5.12 Model Variables for Rural DP Group Sorted by Partial R^2 Value

Variable	Partial R^2	Month
SRtlP	0.4058	AUG
SRtlP	0.3832	FEB
SRtlP	0.354	SEP
SSHP	0.3411	MAR
SRtlP	0.3306	JAN
Dist1	0.3032	JUN
Dist1	0.2465	JUL
Dist1	0.2414	DEC
Dist1	0.1976	NOV

Variable	Partial R^2	Month
SSHP	0.1688	MAY
Rt_High	0.1602	APR
SSHP	0.1435	OCT
Dist1	0.1216	MAR
Beachdist	0.1137	NOV
Dist1	0.0994	JAN
RETIRE	0.0952	JUN
Beachdist	0.086	JUL
Dist1	0.0857	FEB

Variable	Partial R^2	Month
SHotlP	0.0763	OCT
NSHP	0.0742	DEC
NSHP	0.0691	JUL
RETIRE	0.069	FEB
Dist1	0.0664	MAY
Beachdist	0.0656	DEC
PA	0.0598	APR
NSHP	0.052	FEB
Rt_High	0.0512	JAN

6. PRELIMINARY INVESTIGATION OF SEASON FACTOR ASSIGNMENT

The models described in Chapters 4 and 5 indicate that there is a relationship between the monthly seasonal factors and land use variables. Even though the models cannot be used to directly predict the monthly seasonal factors, they provide likely connections between the seasonal factors and the various variables modeled. These variables may be used to develop a metric to determine which TTMS(s) may be used for the assignment of seasonal factors to a coverage count site. This metric is based on the similarity between land use and other characteristics. This chapter describes a preliminary investigation to explore a simple and practical assignment method. Results from the application of this method are also described. Section 6.1 explains the methodology used for assignment. Sections 6.2 through 6.4 present assignment results in urban areas from three different assignment strategies.

6.1 Methodology for Measuring Similarity between Two Count Sites

In Florida, the current practice for assigning seasonal factors to coverage counts is to create seasonal factor groups and to use the group averages as the seasonal factors. Next, these seasonal groups are assigned to coverage count sites. Their averaged seasonal factors are then applied to convert ADT to AADT. During the first phase of this project, a fuzzy decision tree was developed (Zhao 2004, Li *et al*. 2006). It was used for classifying a count site based on the value of selected variables (or decision variables) that were identified in regression analysis. In constructing the fuzzy decision tree, those TTMSs that have already been grouped are used. The group they belong to is considered a class that the fuzzy decision tree should be able to correctly define. This definition is based on the values of a set of decision variables. The values of these decision variables are computed for each TTMS. One variable is selected at a time. Based on the values of a given variable of all of the TTMSs, a dividing point is then determined to classify the TTMSs into two groups: One group's variable values are smaller than the value defining the dividing point, and the other group's are larger. Next, a new variable is selected and each of the two groups is further divided into two new groups. This process repeats until all of the TTMSs are classified. That is, each group only has TTMSs that belong to the same seasonal factor group. A perfectly built tree should result in all of the TTMSs of the same seasonal factor group also being classified into the same group by the decision tree. The decision tree, therefore, is defined by the sequence of the variables applied at each step of classification and the variable values at the dividing points. Furthermore, a fuzzy decision tree allows a fuzzy range around the dividing point. If the value of a decision variable is outside this fuzzy range, a TTMS is classified with 100% probability into one of the two subgroups. Otherwise, a TTMS is classified as a member of both subgroups with a probability of less than 100%.

In the Phase 1 study, such a tree was constructed successfully, meaning that TTMSs belonging to the same seasonal factor group were also classified by the decision tree into the same group. However, the tree was not tested for application. This is because testing required MSFs data that were not already used in constructing the fuzzy decision tree, and there were no additional TTMSs that could be used for that purpose. This continues to be a problem because the number of available TTMSs is limited. The geographic area that must be covered is very large, and there are many seasonal factor groups. This creates a demand for even more test data with which to test the entire decision tree.

In addition to the lack of TTMS data for testing a fuzzy decision tree, this method also had a few other limitations. One was that there could be too much fuzziness in the classification. Although all of the TTMSs were classified into their correct groups, their membership in the group they belong to may have been incomplete. This means that the probability of their belonging was less than 100%. Additionally, because TTMSs may be classified multiple times by different variables, their membership in a group may have been low. This is because the TTMSs in different groups were not completely distinct in either their seasonal factors or land use characteristics. Another limitation was that the tree structure highly depends on seasonal factor grouping. Any changes in seasonal factor grouping will lead to changes in the tree structure. This would not be a concern if there were no uncertainty in the seasonal factor grouping process. However, the SF grouping process involves much judgment. Furthermore, there is no guarantee that the TTMSs in the same SF group will actually share the same characteristics represented by the decision variables.

In this study, a different approach is developed. This approach is based on the idea that if the variables identified in the regression analysis are the underlying causes for the seasonal traffic variations, they may be used to directly link one count station to a TTMS based on the similarity between their variable values. This is determined by a similarity score, *S*. This score is calculated based on a selected set of variables that are identified during regression analyses. To measure the similarity, the differences between the values of each of the variables are first computed for the two count stations. These differences are then weighted by the regression partial R^2 values corresponding to the variables, normalized by the maximum value of the variables, and summarized. *S* for two count stations *i* and *j* may be expressed as follows:

$$S_{ij} = \sum_{k=1}^{p} \frac{\left|V_{ki} - V_{kj}\right| \times PR_k}{\max_k \{V_k\}} \tag{6-1}$$

where

S_{ij} = the similarity score defined for count stations *i* and *j* ($i \neq j$),
V_{ki} = the value of the *k*th variable in the 12-month models for count station *i*,
V_{kj} = the value of the *k*th variable in the 12-month models for count station *j*,
PR_k = the partial R^2 for the *k*th variable, and
$max(V_k)$ = the maximum value for the variable V_k among all TTMSs.

Recall that there are 12 regression equations in each model set. Any variables may appear repeatedly in different equations and, therefore, may be associated with different R^2 values. Hence, the similarity score for the whole year is summed from the 12 month scores.

Using the above definition, similarity scores can be computed for each pair of count stations. The goal of the assignment here is to identify one or more best matched TTMSs for any given short-term count site. If multiple TTMSs are matched to a given count site, they may be ranked based on their similarity scores as the first best match, second best match, and so on.

To test this methodology, TTMSs in the urban areas are used to find matches. Because the MSFs for these TTMSs are already known, it is possible to evaluate whether this method provides satisfactory assignment results. A particular assignment result that matches a TTMS *j* to a count site i is evaluated based on the square root of the sum of the mean square of the 12 month seasonal factor differences. That is,

$$e_{ij} = \sqrt{\frac{1}{12}\sum_{m=1}^{12}\left(\frac{MSF_{mi} - MSF_{mj}}{MSF_{mi}}\right)^2} \tag{6-2}$$

where

e_{ij} = a measure of difference between the monthly seasonal factors of count site i and j being compared,

MSF_{mi} = the monthly seasonal factor for count site i for month m, and

MSF_{mj} = the monthly seasonal factor for count site j for month m.

A good match should have a small error.

In the next section, the above method is applied to TTMSs in urban areas.

6.2 Urban TTMS Assignment within Model Regions

The urban area TTMSs are modeled for three different regions: North, Central, and South Florida. There is one set of models for each of the three regions. The assignment is conducted within each region for TTMSs in all three regions. In other words, only TTMSs within the same region are considered as the candidates for any given count site. For any TTMS within a region, which is tested here as a short-count site, all of the TTMSs in the same region are treated as potential candidates. Their similarity scores are then computed.

The variables used to calculate the similarity scores for TTMSs are summarized in Table 6.1. These variables are thought to be significant for each of the model regions based on the regression analyses described in Chapter 4. The definition of the variables can be found in Section 4.1.

Table 6.1 Variable Sets Used for Assignment for Model Regions

Model Region	Variables
North	*EdP, FishP, FR, HotlP, LEG, MA, MseumP, OffP, RcServP, RestP, RETIRE, SHP, ST1, ST22, ST23, Rt_Low, SU, TranP*, and *WholP*
Central	*AgriP, CO, DISN, EdP, MA, MInc, MineP, MseumP, OffP, PA, RETIRE, RtlP, ServP, SHP, ST22, ST23, Rt_High, Rt_Low*, and *TranP*
South	*AgriP, HotlP, MA, ManuP, MseumP,RcServP, RETIRE, SHP, ST1, ST23*, and *SU*

The first five best matching TTMSs are presented. Table 6.2 shows the assignment results for each TTMS in North Florida, Table 6.3 for those in Central Florida, and Table 6.4 for those in South Florida. The column *Test Sites* gives the identification number of a TTMS. This TTMS is treated as a short-term count site. The next five columns list the first five best matching sites based on their similarity scores.

Table 6.2 Assignment Results for TTMSs in North Florida

Test Sites	Bets Matching Sites				
	1st	2nd	3rd	4th	5th
260323	550208	550207	550226	550300	550206
290286	729923	290320	480156	720161	509940
550206	550300	550208	550212	559908	550207
559908	550212	550206	260185	550300	550226
720161	729923	720172	290320	720171	480159
780329	480282	720172	570250	480159	110246
550207	550226	550300	550208	550206	550209
460315	360317	509940	530117	720172	360264
530117	460315	360317	110246	509940	480282
460308	720121	570318	720062	480159	740182
080283	360317	730335	460315	730292	760105
360264	460315	730335	360317	020044	080283
110246	480282	780311	360317	570250	720172
580261	570318	729923	460308	780311	720109
729923	720161	780311	570318	729914	720172
550212	550206	559908	260185	550300	550226
730335	080283	360264	020044	360317	730292
260185	550212	559908	550206	720109	780311
730292	360317	730335	080283	489924	760105
760105	360317	730335	080283	460315	730292
290320	720161	729923	290286	720171	570318
509940	780311	460315	720172	360317	480159
550151	550304	550300	550207	550226	550208
550208	550300	550206	550207	550226	550212
550209	550226	550207	550300	260185	480282
550213	550206	550300	550208	559908	550212
550226	550207	550300	550209	550208	550206
720062	720121	460308	570167	480159	720172
720121	570167	720062	460308	480159	480325
720172	480159	780311	480282	570250	460308
720216	489924	460308	480159	729914	720121
740182	360249	460308	720109	570318	589937
780311	720172	480159	509940	360249	720109
720109	589937	460308	740182	360249	480159
720171	720161	489924	729914	720216	290320
550300	550206	550208	550207	550226	550212
550304	720171	550300	550151	550208	550207
729914	489924	729923	720216	780311	720171
460166	570293	460305	780329	760105	600168
460305	720161	290320	720171	580261	729923
480159	720172	360249	460308	780311	720109
480282	720172	570250	110246	480159	360249
480325	570167	720121	589937	720109	720062

Test Sites	Bets Matching Sites				
	1st	2nd	3rd	4th	5th
570250	720172	480282	360249	740182	110246
570293	290320	720161	550151	720171	460305
589937	720109	570167	720121	460308	480325
570318	460308	480159	720109	360249	780311
489924	720216	729914	720172	480159	780311
480156	460308	480159	570318	360249	720172
570167	720121	460308	720062	480325	589937
600168	760105	460308	720062	720172	480159
710189	720121	720062	570167	480156	480159
080294	110177	760105	360264	730335	020044
110177	080294	020044	360264	730335	760105
360249	740182	480159	780311	720109	570250
020044	730335	360317	360264	080283	730292
360317	460315	080283	509940	110246	530117

Table 6.3 Assignment Results for TTMSs in Central Florida

Test Sites	Bets Matching Sites				
	1st	2nd	3rd	4th	5^{th}
100106	109926	100224	100194	109922	750196
100321	770102	100162	750154	750038	150295
150302	109922	100194	100224	750130	109926
109922	100194	109926	750196	100224	770343
169927	140199	150295	700113	750038	100162
750038	700113	770102	150295	100321	770197
750175	100110	109922	750196	100194	109926
770197	700113	750038	150295	140013	770102
790133	100110	750196	750175	109922	100123
799929	790133	700284	750175	100110	160275
100080	750175	750196	100194	109922	100110
100110	750196	750175	100123	100194	109922
100123	750196	100110	100194	109922	109926
100194	109922	109926	100224	750196	770343
140013	770102	100321	150295	750038	770197
140190	750130	100224	109922	770343	109926
150086	750154	100162	770102	100321	150295
150183	790133	100080	160310	750196	100110
150295	700113	750038	100321	750154	140013
100224	109926	100194	109922	750130	770343
109926	100224	100194	109922	770343	750130
150066	160310	150302	100110	750175	700284
100162	100321	750154	770102	150086	750038
140199	150295	700113	169927	750038	100321
160275	799929	160310	790133	169927	700284

Test Sites	Bets Matching Sites				
	1st	2nd	3rd	4th	5th
160128	100106	150183	790133	100080	100123
160310	150183	100080	790133	150066	750175
700113	750038	150295	770102	100321	770197
700114	750154	150295	150086	750038	100162
700284	790133	750130	140190	770343	100080
750130	140190	100224	770343	109922	109926
750154	770102	100321	100162	150086	150295
750196	109922	100194	100110	770343	100123
750204	109922	100194	750196	109926	100224
770102	100321	750154	750038	100162	140013
770343	109922	750130	109926	100224	100194
920265	150086	750154	100321	770102	100162
979932	750175	100110	750196	109922	790133

Table 6.4 Assignment Results for TTMSs in South Florida

Test Sites	Bets Matching Sites				
	1st	2nd	3rd	4th	5th
170181	130180	979913	880314	890332	170225
030094	899921	860214	130333	030191	860176
860150	010228	030094	860306	899921	860214
860214	899921	030094	130333	030191	010228
860306	030094	860214	899921	860150	930010
870178	870266	870188	870193	930257	860222
870266	870188	970267	979934	930257	870178
930099	930101	940260	970403	860186	120203
970267	870266	979934	870188	970430	930257
970416	930174	970417	890332	970410	880314
979934	970267	870266	870188	970430	930257
890332	970417	880314	930174	979913	970416
970421	860163	880314	890332	930198	970416
930198	860331	930217	120184	970421	880314
870193	870188	870178	870266	930257	970267
120184	860176	860331	930217	930198	030191
010228	030094	860214	899921	860150	130333
040145	930217	860331	120184	970417	930198
170225	979913	940260	979933	970410	860186
130333	030191	860176	899921	030094	120184
130180	170181	979913	170225	880314	890332
030191	130333	860176	120184	930217	860331
120203	879930	860186	970403	870187	940260
860163	970421	970410	880314	860331	890332
860176	120184	030191	130333	930217	860331
860186	970403	940260	940334	860298	930101

Test Sites	Bets Matching Sites				
	1st	2nd	3rd	4th	5th
860215	930087	010228	860214	030094	899921
860222	870187	979933	860298	860186	970403
860298	979933	860222	860186	970403	930101
860331	930217	040145	120184	930198	970416
870031	870108	930174	970416	970417	979913
870096	870187	970267	979934	860222	979933
870108	940260	940334	170225	970416	870031
870187	860222	979933	860298	860186	120203
870188	870266	970267	930257	870193	870178
870258	860186	120203	970403	940334	879930
879930	120203	860186	970403	940260	979933
930010	860176	120184	930198	930217	860331
930087	860215	010228	860150	030094	899921
930101	940260	970403	860186	930099	860298
930174	970416	970417	890332	880314	970410
930217	860331	040145	120184	930198	970417
930257	870266	870188	970267	870178	870193
970403	860186	940260	940334	930101	860298
970410	930174	860163	979913	970416	170225
970413	930198	120184	860176	930217	130333
970417	890332	930174	970416	880314	979913
970430	970267	870266	979934	870188	870187
979933	860298	860222	870187	860186	970403
880314	890332	970417	970421	930174	979913
880326	870193	870178	870188	860222	860298
890259	860215	930087	010228	860150	860306
899921	030094	860214	130333	030191	860176
940260	970403	860186	930101	940334	860298
940334	970403	860186	940260	979933	860298
979913	170181	170225	890332	130180	930174

To verify whether the similarity scores are good indicators of matches, the monthly seasonal factors of the TTMS assumed to be a short-count site and those of its best matches are compared. As an example, the seasonal factors for TTMS 899921 and its first five best matches are listed in Table 6.5. This table also lists the percentage differences between the MSFs of each matched pair of sites. The seasonal factors for all of the TTMS sites are plotted in Figure 6.1. Note that the first and fourth best matches have seasonal factors closest to those of site 899921.

However, after carefully checking the seasonal factor patterns of all TTMSs and their matching sites, it is found that the first two matches often have a seasonal factor pattern that is similar to that of the site of interest. Furthermore, their MSF values are also a close match to those of the site of interest. This suggests that the average value of the first two matched sites may be used as an estimate of the MSFs for a site of interest. In the last two rows of Table 6.5, the average MSFs of the first two matched sites and the corresponding percentage differences are provided. The average values in this example, as well as from tests conducted for all TTMSs in North Florida, suggest that they are acceptable in most cases. An advantage of using average values is reliance on more TTMSs and avoiding occasional exceptions.

Table 6.5 Seasonal Factors for the Sample Site 899921 and the First Five Best Matched Sites

	Site	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Test Site	899921	0.94	0.87	0.88	0.94	1.01	1.07	1.13	1.10	1.12	1.03	0.99	0.99
Best	030094	0.95	0.84	0.87	0.95	1.07	1.13	1.15	1.11	1.15	1.01	0.95	0.92
		1%	-3%	-1%	1%	6%	6%	2%	1%	3%	-2%	-4%	-7%
2nd best	860214	1.01	0.96	0.94	0.97	1.02	1.00	1.04	1.00	1.25	0.98	0.96	0.95
		7 %	10%	7%	3%	1%	-7%	-8%	-9%	12%	-5%	-3%	-4%
3rd best	130333	1.03	0.95	0.94	0.99	1.03	1.07	1.12	1.03	1.03	0.95	0.95	0.94
		10%	9%	7%	5%	2%	0%	-1%	-6%	-8%	-8%	-4%	-5%
4th_best	030191	0.96	0.87	0.85	0.96	1.05	1.12	1.09	1.10	1.13	1.04	0.94	1.00
		2%	0%	-3%	2%	4%	5%	4%	0%	1%	1%	5%	1%
5th_best	860176	0.97	0.91	0.93	1.00	1.05	1.05	1.07	1.04	1.07	1.01	0.99	0.94
		3%	5%	6%	6%	4%	-2%	-5%	-5%	-4%	-2%	0%	-5%
Average		0.98	0.90	0.91	0.96	1.05	1.07	1.10	1.06	1.20	1.00	0.96	0.94
		4%	3%	3%	2%	3%	0%	-3%	-4%	7%	-3%	-4%	-6%

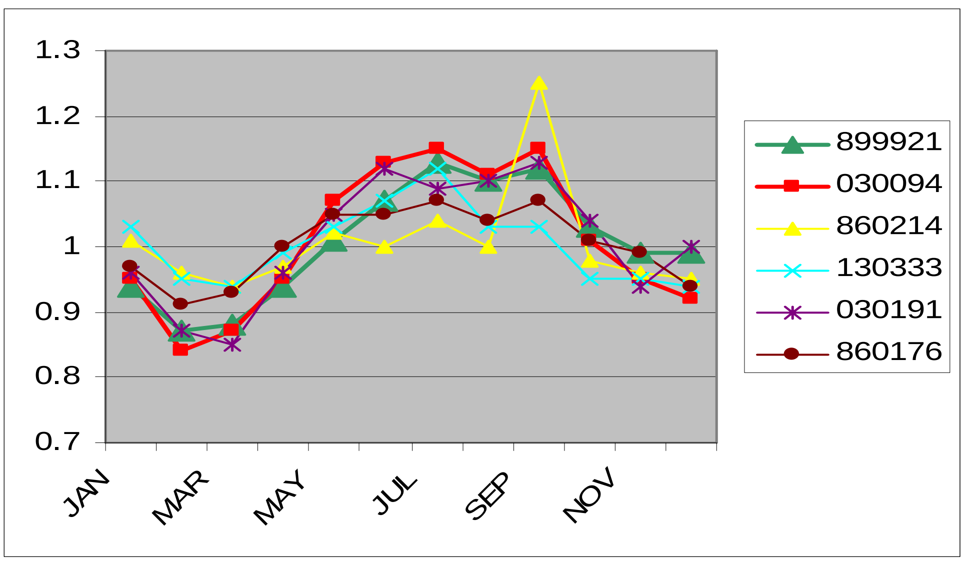


Figure 6.1 Seasonal Factors for the Test Site 899921 and the First Five Closest Matching Sites

Figure 6.2 plots the percentage differences in the MSFs of site 899921 and its matching sites. The curve labeled the average is based on the average MSFs of the first two best matching sites. Except for the second and third best matching sites, note good matches with site 899921. The percentage differences in MSFs for the first, third, and fifth sites are limited to a range of about -5% to +5%. The averages of the 12 month percentage differences for each of the matching sites are 0.036901, 0.070285, 0.062111, 0.028722, 0.043845, and 0.039484 for the first, second, third, fourth, fifth, and average, respectively. The fourth site is most similar to the test site. The first site and the average are also rather close.

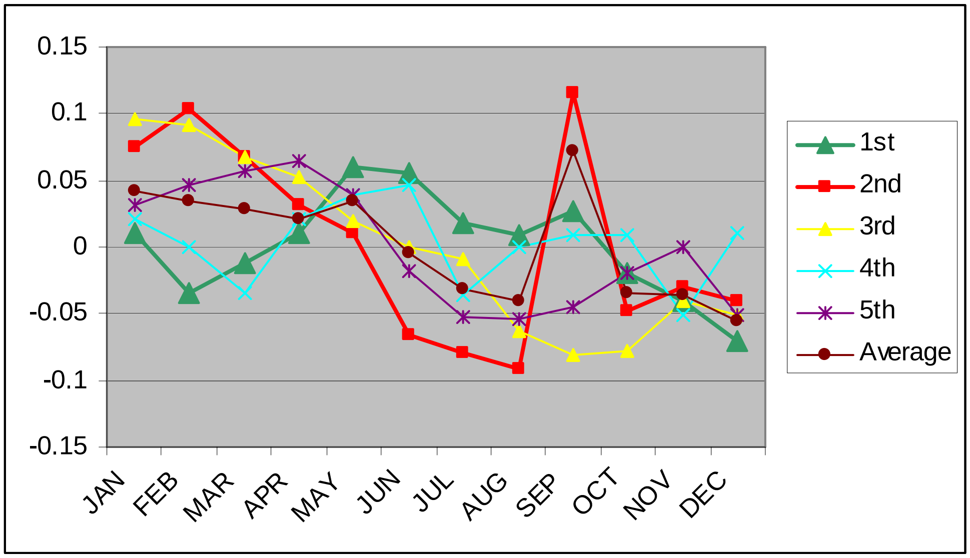


Figure 6.2 Percentage Difference in the MSFs for Site 899921 and the First Five Best Matches

6.3 MSF Assignment within Model Regions and Based on a Reduced Variable Set

One concern regarding the above assignment method is that it involves too many variables. Some of these have relatively low R^2 values. It is desirable that the number of variables be as small as possible. Because variables with low R^2 values have small weighting factors, it may be possible to exclude them entirely from the assignment process. In the experiment described in this section, a reduced variable set is tested. For each of the three regions, the partial R^2 values for each of the variables from the 12 regression models are summed. If a variable appears four times in the models for one region, for instance, the sum will contain four partial R^2 values. If this sum of partial R^2 is less than a certain value, the variable is not used for assignment purposes. For North and Central Florida, the variables are both reduced from 19 to 9 with a cutoff value of 0.2 for the sum of partial R^2 values. For South Florida, the size of the variable set is reduced to 6 from 11 using a cutoff value of 0.15. Tables 6.7, 6.8, and 6.9 show the assignment results for the three regions, respectively.

The reduced variables used to calculate the similarity scores for sites in three model regions are summarized in Table 6.6.

Table 6.6 Reduced Variable Sets Used for Assignment for Three Model Regions

District	Variables
North	*FR*, *HotlP*, *MseumP*, *RETIRE*, *SHP*, *ST22*, *ST23*, *Rt_Low*, and *SU*
Central	*AgriP*, *CO*, *MA*, *MInc*, *PA*, *RETIRE*, *SHP*, *ST23*, and *Rt_Low*
South	*HotlP*, *MA*, *ManuP*, *MseumP*, *RETIRE*, and *SHP*

Table 6.7 Assignment for North Florida with Reduced Variables

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
260323	550208	550207	550300	710189	550226
290286	729923	720161	509940	290320	720172
550206	550300	550207	550208	550226	550212
559908	260185	550212	550206	550300	550226
720161	729923	290320	720172	290286	720171
780329	720172	480282	480159	480156	570250
550207	550226	550300	550208	550206	550209
460315	530117	509940	360317	110246	570250
530117	460315	360317	509940	110246	080283
460308	740182	480156	360249	720121	570318
080283	360317	730335	460315	530117	110246
360264	460315	730335	360317	020044	530117
110246	360317	780311	720172	509940	480282
580261	570318	729923	480156	740182	360249
729923	720161	290286	480156	780311	570318
550212	559908	260185	550206	550226	550207
730335	080283	020044	360264	360317	730292
260185	559908	550212	550206	550226	550209
730292	360317	080283	730335	489924	760105
760105	360317	080283	730335	110246	509940
290320	720161	729923	290286	720171	570318
509940	780311	110246	460315	360249	480156
550151	550304	550207	550226	550300	550208
550208	550300	550207	550226	550206	550209
550209	550226	550300	550207	260185	550208
550213	550206	550300	550208	550207	550212
550226	550207	550209	550300	550208	550206
720062	720121	460308	570167	740182	480159
720121	570167	720062	460308	480325	589937
720172	570250	480282	480159	480156	360249
720216	489924	460308	729914	480159	360249
740182	460308	720109	360249	480156	570318
780311	360249	480156	720172	480282	509940
720109	740182	360249	589937	460308	480156
720171	720161	729914	489924	290320	720216

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
550300	550206	550207	550208	550226	550209
550304	720171	550207	550300	550208	550151
729914	489924	729923	720216	780311	480156
460166	570293	460305	760105	780329	290320
460305	290320	720161	720171	580261	729923
480159	360249	480156	720172	480282	570250
480282	720172	480159	570250	780311	110246
480325	570167	720121	589937	720109	360249
570250	720172	480282	480159	360249	480156
570293	290320	550151	720161	460305	720171
589937	720109	740182	480325	360249	720121
570318	480156	740182	360249	460308	480159
489924	720216	729914	720172	480156	570250
480156	360249	460308	480159	740182	570318
570167	720121	480325	460308	720062	480156
600168	760105	480282	570250	460308	480159
710189	720121	720062	480325	570167	260323
080294	110177	760105	360264	730335	020044
110177	080294	020044	360264	760105	730335
360249	480156	480159	780311	740182	720109
020044	730335	360317	080283	360264	760105
360317	110246	080283	460315	530117	509940

The variables used to calculate the similarity scores in Central Florida are *AgriP, CO, MA, MInc, PA, RETIRE, SHP, ST23*, and *Rt_Low*. Four of these are the same as those for North Florida.

Table 6.8 TTMSs Assignment for Central Florida with Reduced Parameters

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
100106	100080	150183	750204	750196	109926
100321	100162	770102	750154	750038	140013
150302	750204	109922	100194	100224	109926
109922	100194	750204	109926	750196	100224
169927	140199	150295	700113	750038	100162
750038	700113	770102	150295	100162	750154
750175	100110	750196	109922	100123	100194
770197	140013	750038	700113	150295	750154
790133	100110	700284	100123	750175	750196
799929	790133	700284	979932	100123	100110
100080	150183	100123	750196	100110	100194
100110	750175	750196	100123	750204	109922
100123	750196	100110	109922	750175	100194
100194	109922	109926	750196	750204	100224

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
140013	770102	770197	750154	100162	750038
140190	750130	750204	100224	770343	109926
150086	750154	770102	140013	100162	920265
150183	100080	790133	160310	700284	100110
150295	700113	750038	750154	770197	100162
100224	109926	770343	109922	100194	750204
109926	100224	100194	109922	770343	750204
150066	150302	160310	700284	750175	100110
100162	100321	770102	750154	750038	140013
140199	150295	700113	169927	750038	770197
160275	799929	160310	790133	979932	169927
160128	100106	150183	100080	790133	100123
160310	150183	100080	150066	790133	979932
700113	750038	150295	100162	770102	770197
700114	150295	750038	140013	750154	770197
700284	790133	100110	770343	140190	750130
750130	140190	100224	770343	750204	109926
750154	770102	100162	100321	150086	750038
750196	100194	109922	100123	750175	100110
750204	109922	100194	109926	100224	750196
770102	100162	750154	100321	750038	140013
770343	109926	100224	750130	750204	109922
920265	150086	750154	100162	770102	100321
979932	100110	750175	790133	100123	750196

The variables used to calculate the similarity scores for the TTMSs in South Florida are *HotlP, MA, ManuP, MseumP, RETIRE,* and *SHP*. Four variables are the same as those for North Florida and three are the same as those for Central Florida. The *RETIRE* and *SHP* variables are common to all three regions.

Table 6.9 Assignment Results for South Florida with a Reduced Variable Set

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
170181	130180	979913	880314	890332	170225
030094	899921	860214	130333	030191	860176
860150	010228	030094	860306	899921	860214
860214	030094	899921	130333	010228	030191
860306	860214	030094	899921	860150	930010
870178	870266	870188	930257	870193	970267
870266	930257	870188	970267	979934	870178
930099	930101	940260	120203	970403	860186
970267	870266	979934	930257	970430	870188
970416	930174	970417	870108	890332	970410

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
979934	970267	870266	930257	870188	970430
890332	970417	880314	930174	979913	970416
970421	860163	880314	930198	970416	970410
930198	860331	930217	120184	040145	970421
870193	870188	870266	970430	870178	930257
120184	860176	930217	860331	930198	040145
010228	860214	030094	899921	860150	130333
040145	930217	860331	970417	930198	120184
170225	870108	940260	979913	979933	970403
130333	030191	860176	899921	120184	030094
130180	170181	979913	170225	870108	880314
030191	130333	860176	120184	930217	860331
120203	879930	860186	970403	940260	870187
860163	970421	970410	880314	860331	890332
860176	120184	030191	930217	130333	860331
860186	970403	940260	940334	860298	860222
860215	930087	010228	860214	030094	899921
860222	870187	979933	860298	860186	970403
860298	860222	979933	860186	970403	930101
860331	930217	040145	930198	120184	970416
870031	870108	930174	970416	970417	979913
870096	870187	860222	970267	979933	979934
870108	940334	170225	940260	970416	970403
870187	860222	979933	970430	860186	860298
870188	870266	930257	970267	870178	870193
870258	120203	940334	860186	970403	879930
879930	120203	860186	970403	870187	940260
930010	860176	120184	930217	930198	860331
930087	860215	010228	899921	860150	030094
930101	940260	930099	970403	860186	860298
930174	970416	970417	890332	880314	979913
930217	860331	040145	120184	930198	970417
930257	870266	870188	970267	979934	870178
970403	860186	940260	940334	930101	120203
970410	930174	979913	860163	970416	170225
970413	930198	120184	930217	860176	130333
970417	890332	930174	880314	970416	979913
970430	970267	870266	870193	870188	860222
979933	860222	860298	860186	870187	970403
880314	890332	970417	930174	970421	979913
880326	870188	870193	870178	870266	860222
890259	860215	930087	010228	860150	860306
899921	030094	860214	130333	030191	860176

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
940260	970403	860186	940334	930101	870108
940334	970403	860186	940260	870108	860298
979913	170181	890332	170225	130180	930174

Compared to the assignment results obtained based on the full set of variables, 40 of 57 sites see the first best matching sites remain unchanged for North Florida. For Central Florida, the number of sites remaining unchanged is 25 out of 38. There are 46 of 56 sites remaining unchanged for South Florida. Coincidently, the assignment results for TTMS 899921, discussed in the preceding section, are exactly the same as before.

6.4 Assignment in Urban Areas within FDOT Districts and Based on a Reduced Variable Set

In the SF assignment process, jurisdiction sometimes can be a consideration. In fact, in current practice, only nearby TTMSs within the same county or an FDOT district are used when determining the seasonal factors for a short-term count site. In this section, a geographic constraint is applied to test how such restrictions affect the assignment results. The geographic constraint is that the assignment is carried out with TTMSs within an FDOT district. County is not selected as the geographic unit for this purpose. This is because some counties have too few TTMSs to reflect a variety of land use conditions.

There are seven FDOT districts in Florida. The district boundaries and urban TTMS locations are illustrated in Figure 6.3. Note that the boundaries of the three model regions (see Figure 4.3) do not align with the district boundaries exactly.

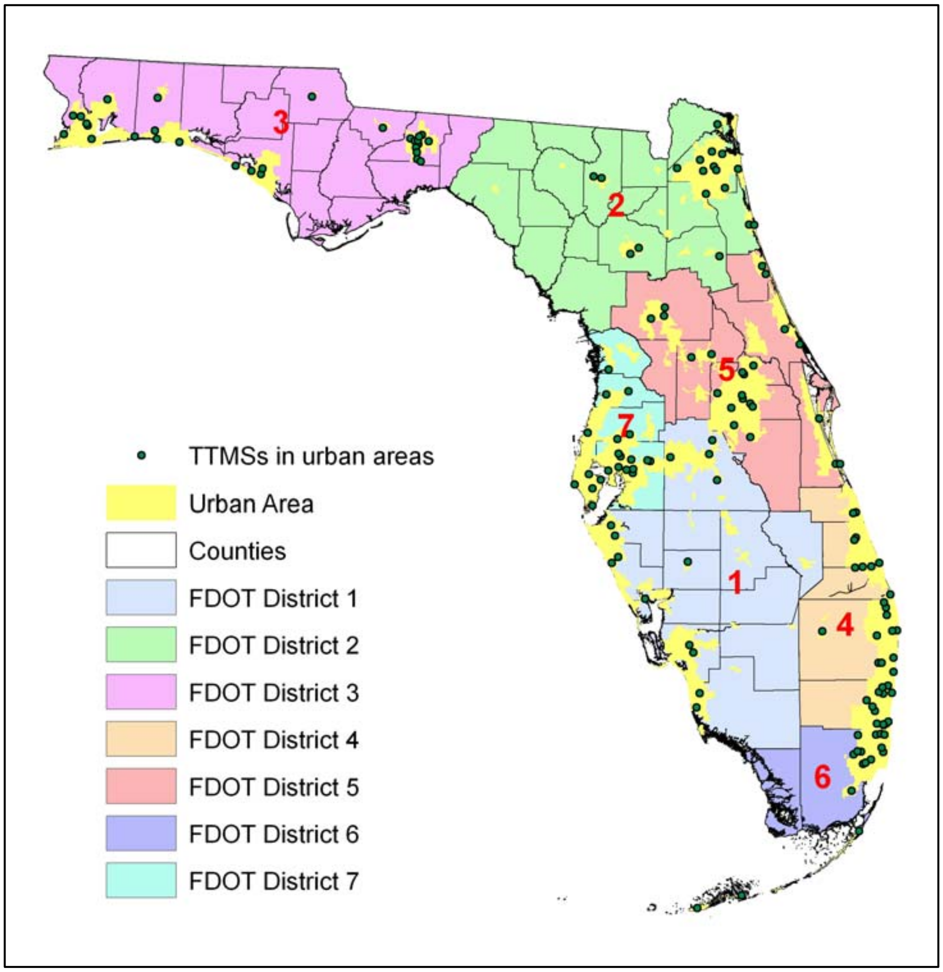


Figure 6.3 Boundaries of FDOT Districts

The variables used for assignment in each district are taken from the models of a region that has the most overlap with the district. For Districts 2 and 3, the variables are from the North Florida models. For Districts 5 and 7, the variables from the Central Florida models are applied. For Districts 1, 4, and 6, the variables from the South Florida models are adopted. Table 6.10 lists the variables used for each district. The assignment results are shown in Tables 6.11 through 6.17.

Table 6.10 Variable Sets Used for Assignment for Seven FDOT Districts

District	Variables
1, 4, 6	*HotlP*, *MA*, *ManuP*, *MseumP*, *RETIRE*, and *SHP*
2, 3	*FR*, *HotlP*, *MseumP*, *RETIRE*, *SHP*, *ST22*, *ST23*, *Rt_Low*, and *SU*
5, 7	*AgriP*, *CO*, *MA*, *MInc*, *PA*, *RETIRE*, *SHP*, *ST23*, and *Rt_Low*

Table 6.11 Assignment Results for District 1 with a Reduced Variable Set

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
010228	169927	160275	030094	160310	130333
030094	130333	030191	010228	120184	040145
030191	130333	120184	040145	030094	170181
040145	120184	030191	170181	130333	130180
120184	040145	030191	130333	170181	170225
120203	170225	160128	130180	170181	040145
170181	130180	170225	160128	040145	120203
170225	130180	170181	160128	120203	040145
160275	169927	010228	160310	030094	130333
130333	030191	120184	030094	040145	170181
130180	170181	170225	160128	040145	120203
160128	170225	130180	120203	170181	040145
160310	160275	010228	169927	030094	030191
169927	160275	010228	030094	160310	130333

Table 6.12 Assignment Results for District 2 with a Reduced Variable Set

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
260185	720172	720109	740182	780311	720062
260323	710189	720121	720062	740182	720109
290286	729923	720161	290320	720172	729914
290320	720161	729923	290286	720171	780311
720062	720121	740182	720109	720172	710189
720121	720062	720109	740182	710189	720172
720161	729923	290286	290320	720172	720171
720172	780311	720109	740182	260185	720062
720216	720109	729914	740182	720172	720062
729923	720161	290286	720172	780311	290320
740182	720109	720062	720172	720121	260185
760105	780311	720172	290286	740182	720109
780311	720172	720109	740182	260185	729923
780329	780311	720172	740182	720109	720062
720109	740182	720172	720121	720062	780311
720171	720161	729914	290320	729923	720216
710189	720121	720062	260323	720109	740182
729914	720216	729923	720171	290286	720172

Table 6.13 Assignment Results for District 3 with a Reduced Variable Set

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
460166	460305	570293	600168	580261	480282
460305	580261	570318	480156	460308	480159
460315	530117	509940	480282	570250	480159
480159	480156	570250	480282	460308	589937
480282	480159	570250	480156	509940	550209
480325	570167	589937	550208	480159	460308
509940	460315	530117	480282	570250	480156
530117	460315	509940	480282	570250	480159
550151	550207	550300	550226	559908	550206
550206	550300	550207	550208	559908	550226
550208	550300	550206	550207	550226	480325
550209	550226	550207	480282	550300	559908
550212	550207	550226	559908	550206	550300
550213	550206	550208	550300	550207	570167
550226	550207	550300	550209	559908	550206
559908	550206	550226	550300	550212	550207
570250	480159	480156	480282	460308	589937
570293	480282	550151	480156	480159	570250
580261	570318	480156	460308	570250	480159
589937	460308	570167	480159	480325	480156
570318	480156	460308	480159	580261	570250
489924	480156	480282	570250	480159	570318
460308	480156	570318	480159	589937	570167
480156	480159	570318	460308	570250	480282
550300	550206	550207	550208	550226	559908
570167	480325	589937	460308	480156	480159
600168	460308	570318	480156	460305	570250
550207	550226	550300	550206	550208	550212
550304	550300	550151	489924	550207	550206

Table 6.14 Assignment Results for District 4 with a Reduced Variable Set

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
860150	860306	899921	860214	930010	860176
860163	970421	970410	880314	860331	970416
860176	930217	860331	930198	930010	970413
860186	970403	940260	940334	860222	860298
860214	899921	860176	860306	930198	970413
860215	930087	860214	899921	860306	860150
860222	979933	860298	860186	970403	940334
860298	860222	979933	860186	970403	930101
860306	860214	899921	860150	930010	860176
860331	930217	930198	970416	860163	930174
880314	890332	970417	930174	970421	979913
880326	930257	860298	860222	979933	930101
890259	860215	930087	860306	860150	860214
890332	970417	880314	930174	979913	970416
899921	860214	860176	930198	970413	930217
930010	860176	930217	930198	860331	970413
930087	860215	899921	860150	860214	860306
930099	930101	940260	970403	860186	860298
930101	930099	940260	970403	860186	860298
930174	970416	970417	890332	880314	979913
930198	860331	930217	970421	880314	970413
930217	860331	930198	970417	860176	890332
930257	880326	860222	860298	930101	930099
940260	970403	860186	940334	930101	979933
940334	970403	860186	940260	860298	860222
970403	860186	940260	940334	930101	860222
970410	860163	930174	979913	970416	890332
970413	930198	930217	860176	860331	970421
970416	930174	970417	890332	970410	880314
970417	890332	930174	880314	970416	979913
970421	860163	880314	930198	970416	970410
979913	890332	930174	880314	970417	970410
979933	860222	860298	860186	970403	940334

Table 6.15 Assignment Results for District 5 with a Reduced Variable Set

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
110177	799929	360264	920265	700113	730335
700113	750038	770102	770197	750154	360264
700114	750038	750154	700113	360317	770197
730292	360317	730335	790133	700284	799929
730335	790133	799929	700284	979932	730292
750038	700113	770102	750154	770197	360264
750130	750204	770343	750196	750175	790133
750154	770102	750038	770197	700113	920265
750175	750196	750204	770343	750130	979932
750196	750175	750204	770343	750130	790133
750204	750130	750196	770343	750175	790133
770102	750154	750038	700113	770197	750196
770197	750038	770102	750154	700113	360264
770343	750196	750204	750130	750175	790133
790133	730335	979932	700284	750204	750196
799929	730335	790133	700284	110177	979932
920265	750154	770102	750038	700113	770197
979932	790133	750175	750196	750204	750130
110246	360249	790133	770343	360317	750204
360249	750196	750204	750175	110246	770343
360264	700113	750038	770197	770102	750154
700284	790133	730335	750130	750204	770343
360317	730292	790133	730335	110246	750196

Table 6.16 Assignment Results for District 6 with a Reduced Variable Set

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
870031	870108	870258	879930	970430	870187
870096	870193	970267	870266	870187	870188
870108	870031	870258	879930	870187	970430
870178	870266	870188	979934	970267	900164
870187	970430	870193	870096	970267	870266
870188	870266	979934	970267	870178	900164
870193	970267	870188	970430	870096	870266
870258	879930	970430	870187	870193	870108
870266	870188	979934	970267	870178	900164
879930	870258	870187	970430	970267	870193
900164	900165	900227	979934	870266	870188
900165	900164	900227	979934	870266	870188
900227	900164	900165	979934	870266	870188
970267	870266	870188	979934	870193	870178
970430	870187	870193	970267	870188	870266
979934	870266	870188	970267	900164	900165

Table 6.17 Assignment Results for District 7 with a Reduced Variable Set

Test Sites	Best Matching Sites				
	1st	2nd	3rd	4th	5th
080283	140199	150295	100162	100321	140013
080294	140199	080283	150295	020044	150086
100080	150183	100123	100110	100194	109922
100106	150183	100080	109926	100224	100194
100110	100123	109922	100194	109926	100224
100123	100110	109922	100194	109926	100224
100194	109922	109926	100224	100123	100110
100321	100162	140013	150086	150295	080283
140013	100162	150086	100321	150295	080283
140190	100224	109922	109926	100194	100110
150086	140013	100162	100321	150295	140199
150183	100080	100110	100123	100194	109922
150295	080283	100162	140013	140199	100321
150302	109922	100194	100224	109926	100123
020044	100110	100123	109922	140190	100224
100224	109926	100194	109922	140190	100110
109926	100224	100194	109922	100110	140190
150066	150302	100110	140190	100123	109922
100162	100321	140013	150086	150295	080283
109922	100194	109926	100224	100123	100110
140199	080283	150295	080294	100162	100321

The assignment results are examined to determine if they are reasonable. As an example, the assignment results for site 899921 are given below in Table 6.18. This table shows the effect of assignment based on district boundaries. It also shows the monthly seasonal factors of site 899921 and the matching TTMSs. The percentage difference between the MSFs of the test site and the matching TTMSs are also calculated. The MSFs and the percentage differences in the MSFs are averaged for the first two best matches and are shown in the last two rows of the table. The monthly seasonal factors of the matching TTMSs are plotted in Figure 6.4. The percentage differences between the MSFs of site 899921 and the matching TTMSs are also calculated and plotted in Figure 6.5.

Table 6.18 MSFs for Test Site 899921 and the First Five Best Matching Sites in District 4

	Site	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Test Site	899921	0.94	0.87	0.88	0.94	1.01	1.07	1.13	1.10	1.12	1.03	0.99	0.99
1st best	860214	1.01	0.96	0.94	0.97	1.02	1.00	1.04	1.00	1.25	0.98	0.96	0.95
		7%	10%	7%	3%	1%	-7%	-8%	-9%	12%	-5%	-3%	-4%
2nd best	860176	0.97	0.91	0.93	1.00	1.05	1.05	1.07	1.04	1.07	1.01	0.99	0.94
		3%	5%	6%	6%	4%	-2%	-5%	-5%	-4%	-2%	0%	-5%
3rd best	930198	1.00	0.95	0.94	0.97	1.01	1.03	1.04	1.01	1.05	1.01	1.00	0.99
		6%	9%	7%	3%	0%	-4%	-8%	-8%	-6%	-2%	1%	0%
4th best	970413	1.01	0.94	0.92	1.00	1.03	1.05	1.05	1.02	1.10	1.04	0.93	0.94
		7%	8%	5%	6%	2%	-2%	-7%	-7%	-2%	1%	-6%	-5%
5th best	930217	1.01	0.96	0.94	0.98	1.01	1.03	1.03	1.01	1.09	1.02	0.98	0.96
		7%	10%	7%	4%	0%	-4%	-9%	-8%	-3%	-1%	-1%	-3%
Average		0.99	0.94	0.94	0.99	1.04	1.03	1.06	1.02	1.16	1.00	0.98	0.95
		5%	7%	6%	5%	2%	-4%	-7%	-7%	4%	-3%	-2%	-5%

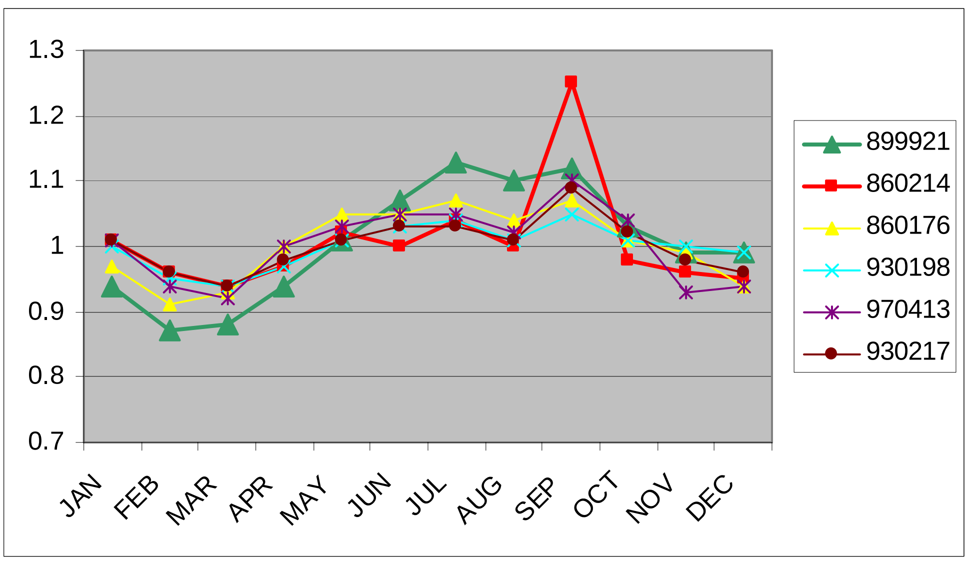


Figure 6.4 MSFs for the TTMS 899921 and the First Five Best Matching Sites within District 4

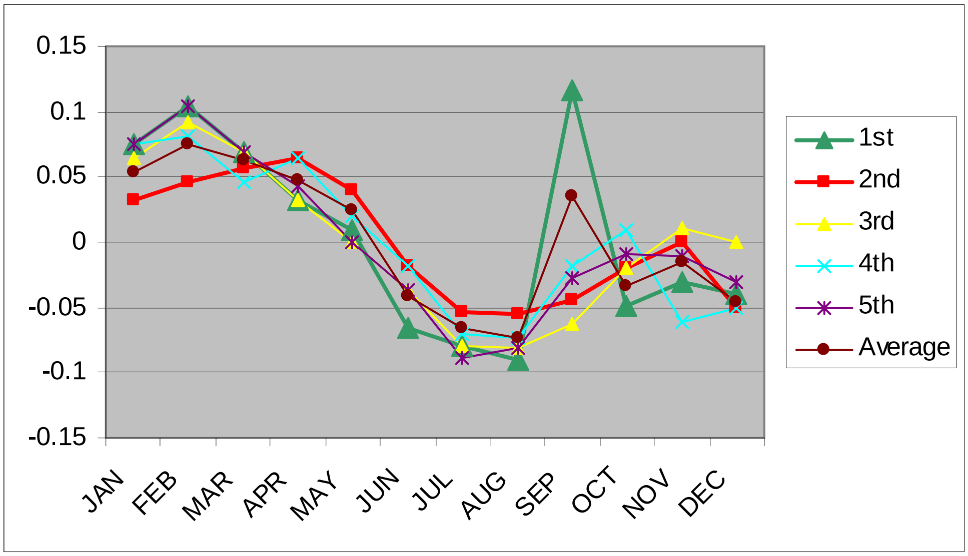


Figure 6.5 Percentage Differences between MSFs for Site 899921 and the First Five Best Matches within District 4

In this particular example, the three previous best matches (TTMSs 030094, 130333, and 030191) are not in the same district. As a result, the previous second and fifth best matches become the first and the second best within District 4. The average of the 12 month percentage differences for each of the matches becomes 0.070285, 0.043845, 0.055541, 0.05465, and 0.058067 for the first, second, third, fourth, and fifth best matches, respectively. The average of the scores of these matches is 0.051162. The differences have increased, indicating less accurate assignment results.

6.5 Evaluation of the Three Assignment Strategies

The preceding sections described three assignment strategies. The question then naturally arises: Which strategy works best? This question cannot be answered based on the analysis of the lone test case shown here. To give an overall assessment of all of the test TTMSs, the average error is computed as follows for each assignment strategy:

These average errors reflect the average difference between the estimated MSFs and true MSFs for all tested sites within the same region.

Table 6.19 Average Errors of the Assignment Results Based on Full Variable Set

Best Match	North	Central	South
1st	0.058453	0.053952	0.043630
2nd	0.058136	0.042621	0.050254
3rd	0.060341	0.045074	0.047321
4th	0.058639	0.045981	0.046396
5th	0.055406	0.049464	0.045786
Average	0.052953	0.042357	0.041964

It is clear from the above table that it is not necessarily true that the first best match is always better than others. However, the first best matches in South Florida appear to perform better than the second through the fifth. The second best matches in Central Florida are better than the other four. Note that the average of the first two best matches is always better overall than all of the others, as indicated by the last row in Table 6.19.

Table 6.20 shows the average errors in MSFs that are computed based on the reduced variable sets. They are not necessarily worse than those obtained using the full variable sets. Some errors, such as those for the first best matches in North and Central Florida, are even smaller than those derived using the full variable sets. This suggests that the reduced variable sets may potentially be used for assignment purposes.

Table 6.20 Average Errors of the Assignment Results Based on a Reduced Variable Set

Best Match	North	Central	South
1st	0.057524	0.04345	0.046393
2nd	0.063766	0.044593	0.050264
3rd	0.058141	0.048900	0.04757
4th	0.061914	0.053314	0.048486
5th	0.064822	0.05012	0.046241
Average	0.053392	0.038877	0.043145

Table 6.21 gives the errors computed based on the results of assignment restricted to FDOT districts and using a reduced variable set. The first two best matches always give better overall performance. Compared with the errors associated with the strategy of region-wide assignment with a reduced variable set, it appears that the overall performance of the district based assignment method is slightly better for District 2 (North Florida) and District 4 (South Florida). That for other districts, however, has become worse. Still, the absolute values are not significantly different from those derived using the previous strategy.

Table 6.21 Average Errors of the Assignment Results Based on a Reduced Variable Set within a District

Best Match	District1	District2	District3	District4	District5	District6	District7
1st	0.055805	0.047023	0.063454	0.045211	0.039331	0.04792	0.044181
2nd	0.045057	0.048264	0.064206	0.044534	0.051907	0.049549	0.046537
3rd	0.056179	0.058785	0.063131	0.045999	0.051234	0.047518	0.049129
4th	0.062670	0.045114	0.059959	0.043438	0.057104	0.048628	0.045162
5th	0.064921	0.049712	0.074597	0.046234	0.062475	0.059978	0.045482
Average	0.045502	0.043080	0.056779	0.039321	0.039919	0.044181	0.039135

7. CONCLUSIONS AND RECOMMENDATIONS

In this research, a statewide study was conducted involving imputation of TTMS data, clustering of TTMSs to create seasonal factor groups, conducting regression analysis to identify influential land use variables that may affect seasonal factors, and a preliminary study of possible assignment methods.

Imputation refers to the replacement of missing data with a substitute that allows data analysis to be conducted without being misleading. Because less than 300 TTMSs are in service and 24.2% of them have missing data in 2000, imputation is necessary. The advantage of the imputation method adopted in this study is that it is easily understood and implemented. The disadvantage of this method is that it is time-consuming because manual adjustments have to be made for each site. This process, however, may be made more efficient through automation.

Cluster analysis has been applied to statewide TTMSs to create seasonal factor groups. A model-based cluster technique using only the 12 MSFs has proven to be more practical in this regard. It also produced reasonable results. Variables that represent locations of TTMSs were also tested. However, they resulted in a large number of groups, with many groups consisting of a single TTMS.

Regression models were developed to identify influential variables for the seasonal factors of TTMSs. It was found that influential variables for the seasonal factors of the TTMSs are different in urban and rural areas and in different climate zones. To account for differences in climate, the urban areas are divided into three regions: North, Central, and South Florida. For North Florida, the most influential variables are found to be proximity of a TTMS to an urban freeway; employment related to hotels, camps, museums, art galleries, and gardens; retired households; seasonal households; population ages 11-13 and 14-17; retired households with low income; residential university; etc. For Central Florida, important variables are agriculture workers; proximity of a TTMS to an urban collector, minor arterial, or principal arterial; median household income; retired households; seasonal households; population ages 14-17; low-income retired households; proximity to a large residential university; etc. For South Florida, hotels, museums, manufacturing-related employment, retired and seasonal households, and proximity to principal arterials are significant variables.

The approach for modeling urban area TTMSs cannot be applied to rural TTMSs. This is because there is an insufficient number of TTMSs in which to divide rural areas to model them separately. An alternative approach was developed to separately model those TTMSs for which the hourly traffic pattern on a typical weekday shows a single peak (i.e., recreational travel dominates) and those for which the weekday hourly traffic pattern has a double peak (i.e., commute travel dominates). The models were improved as a result, particularly for the single-peak TTMSs. These are more difficult to model due to the low land use intensity and through traffic. Hence, this improvement may be attributed to the intrinsic connection between daily traffic patterns and land use variables. These, in turn, are connected to the seasonal traffic variations. The more noticeable improvement in the models for the single-peak group may be because recreational roadways (single-peak pattern) have more seasonal variations, while the traffic on commuting roadways (double-peak pattern) varies less seasonally.

Some variables are significant regardless whether the TTMSs' hourly traffic patterns show a single or double peak. These include the distance to and population of a nearby urban area, seasonal households in South Florida, and retail employees in South Florida. For TTMSs with a single peak, manufacturing employment, a truck factor, population ages 18-64, and proximity to a freeway interchange were also found to be important. For the double-peak TTMSs, the distance from a TTMS to the closest public beach is found to be important. Several variables describe the spatial proximity to nearby urban areas and roadway function classes. The significance of these variables suggests that the basis for current practices considering the function class and roadway use may be valid in rural areas.

The influential variables obtained from the urban models were used in developing a method to identify a TTMS that is similar to a given count station in terms of its land uses or functions. A similarity score was developed to measure the similarity between two count sites. This score was based on the identified influential variables, which were weighted by their partial R^2 values in the models. This approach showed promising results: The average of standard errors among estimated seasonal factors was about 5% overall.

The assignment method developed in this study offers at least three advantages. First, no additional TTMSs are required to validate the assignment results. This makes this approach more practical and less expensive when compared to, for example, a fuzzy decision tree. Second, a count site may be linked to multiple TTMSs. This provides the analyst with alternative TTMSs in case there is a sufficient basis to reject the best matching TTMS based on the selected variables. Third, this method can be tested with the same TTMSs that are used in the regression analysis. Although this is not to say that there is no need for independent testing using an entirely different set of data, this method allows the development of some understanding of how well the method works. Finally, this method has the potential to eliminate the need to conduct seasonal factor grouping.

To further develop the results from this study for implementation, the following research efforts are recommended.

1) Conduct more detailed analysis of the results of the assignment method to evaluate its accuracy. This involves determining the distribution of the errors, including the ranges, in addition to the currently used aggregate measure of mean errors. Understanding the locations or the characteristics of TTMSs where large errors occur will help identify variables that may be inappropriate. It will also indicate the need for additional variables, if any.

2) Apply the proposed assignment method to the assignment of seasonal factors in rural areas. Depending on the results, there may be a need to improve the regression models by identifying additional variables or to revise the definitions of existing variables.

3) Investigate the effect of inclusion or exclusion of different variables. This is especially true for some of the variables that are correlated with others, even though they are not included in the same equations. For instance, if the exclusion of a variable does not

change the assignment results, this variable may be left out to simplify the problem. Conversely, if a variable improves assignment results, it may be included even if its partial R^2 from regression analysis may be low. The effectiveness of the weighting scheme and alternative weighting schemes may also be examined to improve the assignment results.

4) Explore the feasibility of estimating the seasonal factor for a given PTMS for each month based on those of one or more TTMSs that share similarities on a monthly basis, as opposed to matching a PTMS to a TTMS and borrowing all of the monthly seasonal factors from that TTMS.

5) Compare the assignment results from the proposed approach to those obtained using the existing method. In the existing method the average of seasonal factors of a TTMS group is assigned to a coverage count site.

6) Independently test the assignment methods by using data collected monthly from selected sites that are different from the existing TTMSs in terms of geographic location and land use and roadway characteristics. This testing serves two purposes. One is to validate the proposed assignment methods. The other is to investigate the distribution of existing TTMSs to determine whether they provide adequate coverage by representing a wide range, commonly encountered combinations of land uses and roadway types. In the assignment process, redundant TTMSs may be identified if many in relative spatial proximity are found to be similar to nearby PTMSs in both their land use and roadway characteristics and in their seasonal factors. Conversely, an area may also be identified as needing additional TTMSs because of their unique land use and roadway functions. To remove redundant TTMSs will reduce the operating and maintenance costs. The saved resources may be reinvested by adding TTMSs to needed areas to improve the accuracy of AADT estimation.

There are many opportunities to improve the efficiency of the entire process. Tasks that may be made highly automated include TTMS data imputation, investigation of abnormal data, variable compilation, regression analysis, and seasonal factor assignment. Finally, to benefit from the research results, a computer application needs to be created. This application should be GIS based, with a user-friendly interface.

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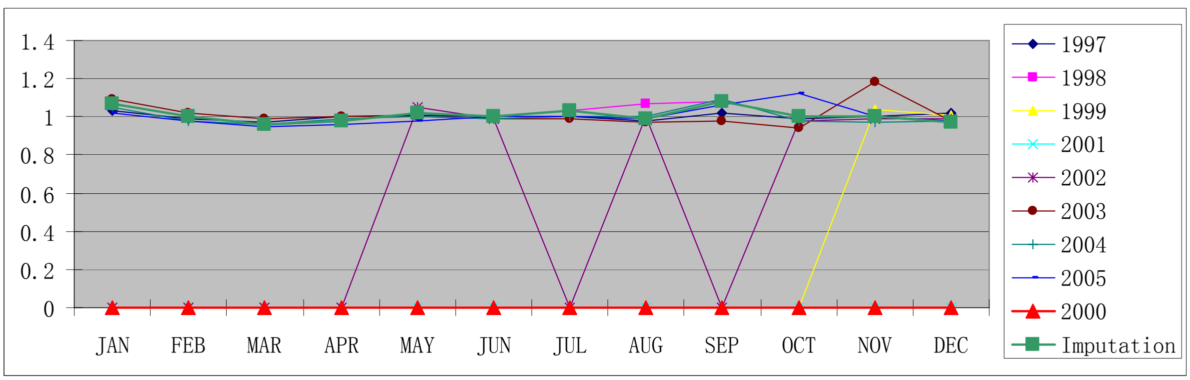
APPENDIX A. IMPUTATION OF MSFS FOR URBAN AREA

In this appendix, the data used for imputation and imputation results for the 26 TTMSs are presented. The content of the table and the profiles have been explained in Section 2.2.

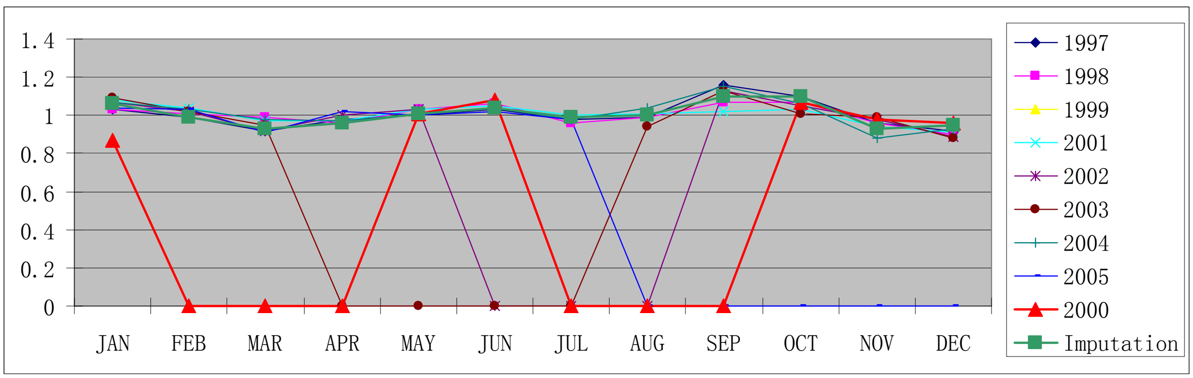
A.1 Imputation for Site 979934

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.03	0.99	0.97	1	1.01	1	1	0.98	1.02	0.99	1	1.02
1998	1.07	1	0.96	0.98	1.02	1	1.03	1.07	1.08	1	1	0.97
1999	0	0	0	0	0	0	0	0	0	0	1.04	1.01
2000												
2001	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	1.05	0.99	0	1	0	0.98	0.99	0.99
2003	1.09	1.02	0.99	1	1	0.99	0.99	0.97	0.98	0.94	1.18	0.98
2004	1.05	0.98	0.96	0.99	1	0.99	1	1	1.09	0.98	0.97	0.98
2005	1.02	0.98	0.95	0.96	0.98	1	1	0.99	1.06	1.12	1	0.98
2000	0	0	0	0	0	0	0	0	0	0	0	0
Imputation	1.07	1	0.96	0.98	1.02	1	1.03	0.99	1.08	1	1	0.97
Source	1998	1998	1998	1998	1998	1998	1998	Avg-98	1998	1998	1998	1998



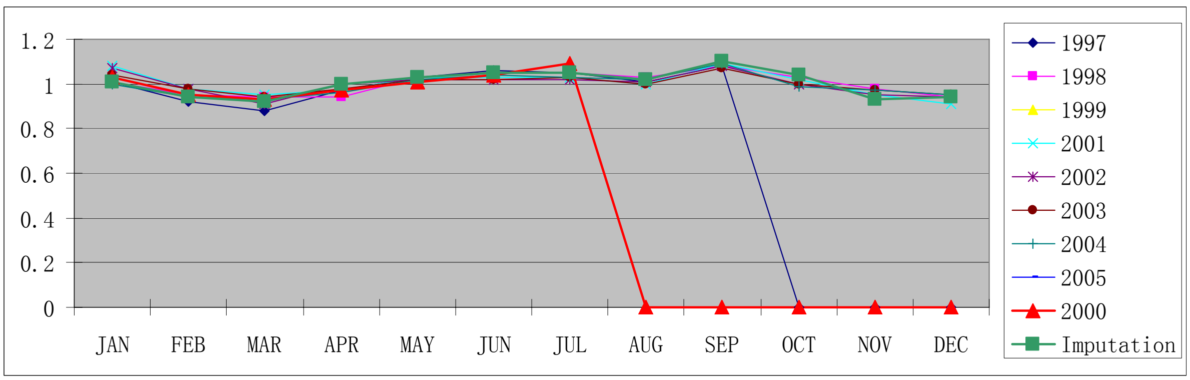
A.2 Imputation for Site 979913

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.03	0.99	0.92	0.98	1	1.03	0.98	0.99	1.16	1.1	0.96	0.92
1998	1.03	1.01	0.99	0.96	1.03	1.06	0.96	0.99	1.07	1.07	0.96	0.9
1999	1.06	0.99	0.93	0.96	1.01	1.04	0.99	1	1.1	1.1	0.93	0.95
2000	0.87	0	0	0	1.01	1.08	0	0	0	1.07	0.98	0.96
2001	1.08	1.04	0.97	0.97	1.03	1.05	1	1.01	1.02	1.03	0.94	0.91
2002	1.07	1.02	0.92	1	1.03	0	0	0	1.13	1.05	0.98	0.89
2003	1.09	1.02	0.95	0	0	0	0	0.94	1.13	1.01	0.99	0.88
2004	1.07	1.03	0.98	0.97	1.01	1.04	0.98	1.04	1.15	1.06	0.88	0.93
2005	1.04	1.03	0.91	1.02	1	1.02	0.98	0	0	0	0	0
2000	0.87	0	0	0	1.01	1.08	0	0	0	1.07	0.98	0.96
Imputation	1.06	0.99	0.93	0.96	1.01	1.04	0.99	1	1.1	1.1	0.93	0.95
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



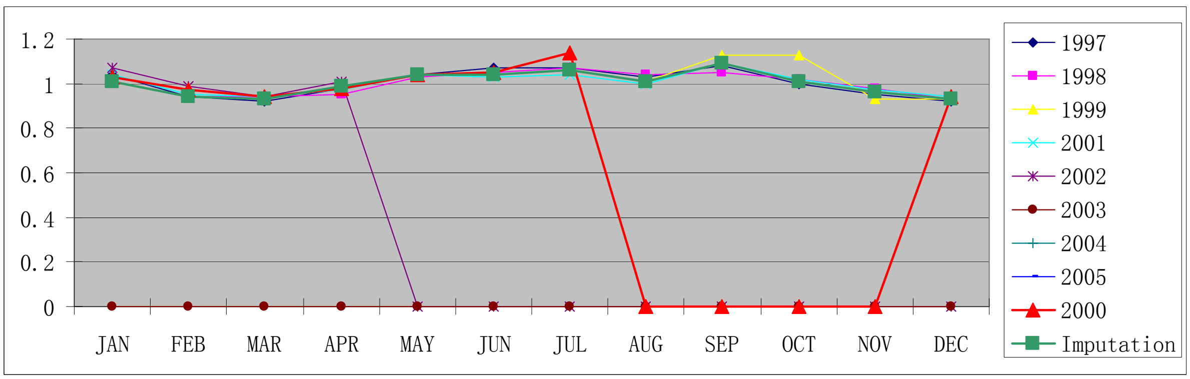
A.3 Imputation for Site 970413

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.01	0.92	0.88	0.97	1.03	1.06	1.05	1.01	1.08	0	0	0
1998	1.01	0.95	0.94	0.94	1.03	1.05	1.05	1.03	1.08	1.03	0.98	0.94
1999	1.01	0.94	0.92	1	1.03	1.05	1.05	1.02	1.1	1.04	0.93	0.94
2000	1.03	0.95	0.93	0.97	1.01	1.04	1.09	0	0	0	0	0
2001	1.08	0.98	0.95	0.97	1.03	1.03	1.03	1	1.09	1.02	0.95	0.91
2002	1.07	0.98	0.91	1	1.02	1.02	1.02	1.01	1.08	1	0.95	0.94
2003	1.04	0.98	0.94	0.98	1.02	1.02	1.03	1	1.07	1	0.97	0.95
2004	1	0.94	0.93	0.96	1.02	1.04	1.03	1.02	1.09	0.99	0.97	0.95
2005												
2000	1.03	0.95	0.93	0.97	1.01	1.04	1.09	0	0	0	0	0
Imputation	1.01	0.94	0.92	1	1.03	1.05	1.05	1.02	1.1	1.04	0.93	0.94
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



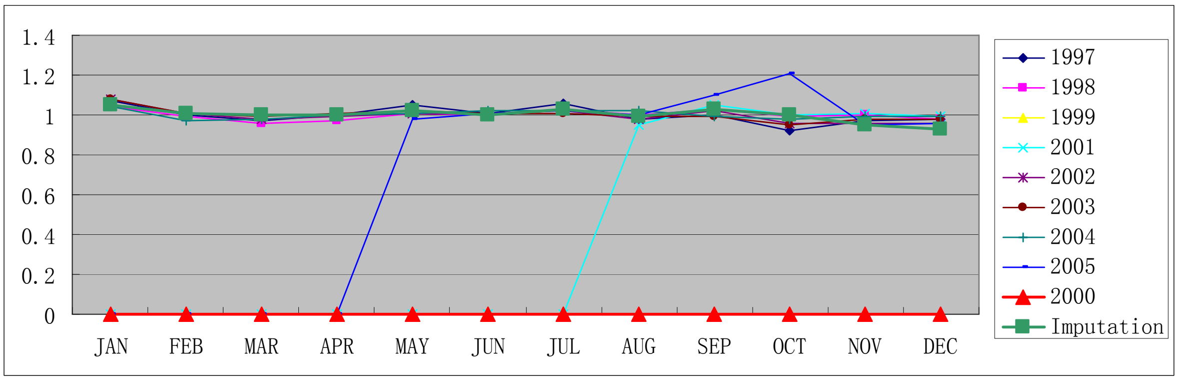
A.4 Imputation for Site 970410

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.04	0.94	0.92	0.98	1.04	1.07	1.07	1.03	1.08	1	0.95	0.92
1998	1.01	0.94	0.94	0.95	1.03	1.05	1.07	1.04	1.05	1.02	0.98	0.93
1999	1.01	0.94	0.93	0.99	1.04	1.04	1.06	1.01	1.13	1.13	0.93	0.93
2000	1.03	0.97	0.94	0.98	1.04	1.05	1.14	0	0	0	0	0.94
2001	1.04	0.95	0.94	0.97	1.04	1.03	1.04	1	1.09	1.02	0.97	0.94
2002	1.07	0.99	0.94	1.01	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0
2004												
2005												
2000	1.03	0.97	0.94	0.98	1.04	1.05	1.14	0	0	0	0	0.94
Imputation	1.01	0.94	0.93	0.99	1.04	1.04	1.06	1.01	1.09	1.01	0.96	0.93
Source	1999	1999	1999	1999	1999	1999	1999	1999	Avg - 99	Avg - 99	Avg all	1999



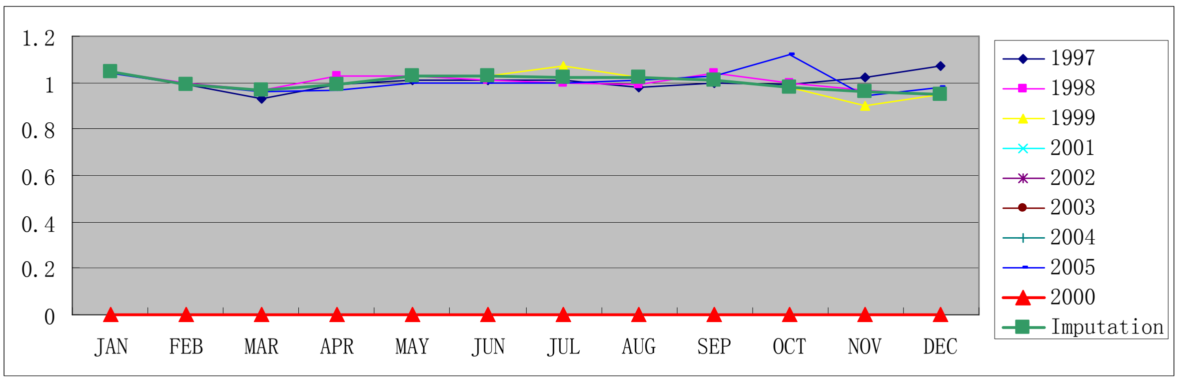
A.5 Imputation for Site 970403

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.07	1	0.97	1	1.05	1.01	1.06	0.98	1	0.92	0.97	0.98
1998	1.04	0.99	0.96	0.97	1.01	1	1.03	1	1.03	0.99	1	0.98
1999	1.05	1.01	1	1	1.02	1	1.03	0.99	1.03	1	0.95	0.93
2000	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0.95	1.05	1	1.01	0.99
2002	1.08	1.01	0.98	0.99	1.01	1.01	1.02	0.98	1.02	0.96	0.96	0.96
2003	1.08	1.01	0.99	1.01	1.02	1.01	1.01	0.99	0.99	0.95	0.98	0.98
2004	1.04	0.97	0.98	1	1.01	1.02	1.02	1.02	0.99	0.98	0.99	0.99
2005	0	0	0	0	0.98	1.01	1.02	1	1.1	1.21	0.95	0.96
2000	0	0	0	0	0	0	0	0	0	0	0	0
Imputation	1.05	1.01	1	1	1.02	1	1.03	0.99	1.03	1	0.95	0.93
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



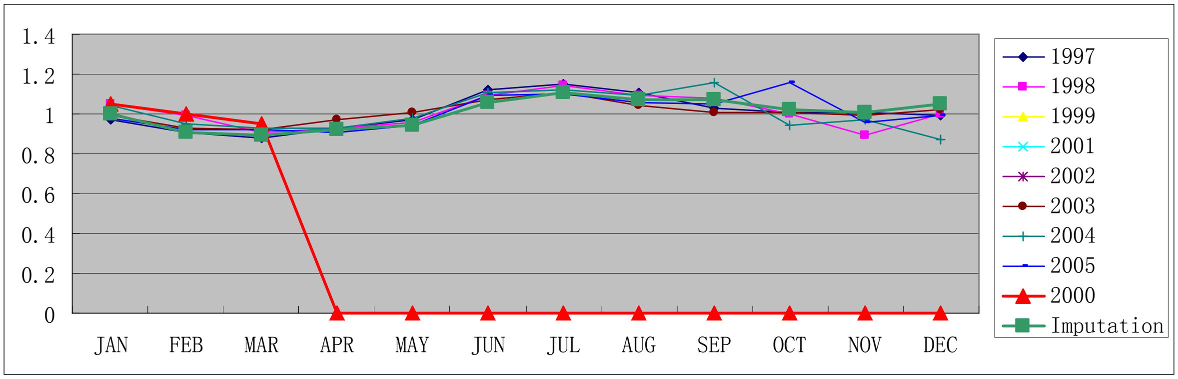
A.6 Imputation for Site 970267

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.05	0.99	0.93	0.99	1.01	1.01	1.01	0.98	1	0.99	1.02	1.07
1998	1.05	1	0.97	1.03	1.03	1.01	1	0.99	1.04	1	0.97	0.94
1999	1.05	0.99	0.97	0.99	1.03	1.03	1.07	1.02	1.01	0.98	0.9	0.95
2000	0	0	0	0	0	0	0	0	0	0	0	0
2001												
2002												
2003												
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005	1.04	0.99	0.96	0.97	1	1	1	1.01	1.03	1.12	0.94	0.98
2000	0	0	0	0	0	0	0	0	0	0	0	0
Imputation	1.05	0.99	0.97	0.99	1.03	1.03	1.02	1.02	1.01	0.98	0.96	0.95
Source	1999	1999	1999	1999	1999	1999	Avg all	1999	1999	1999	Avg all	1999



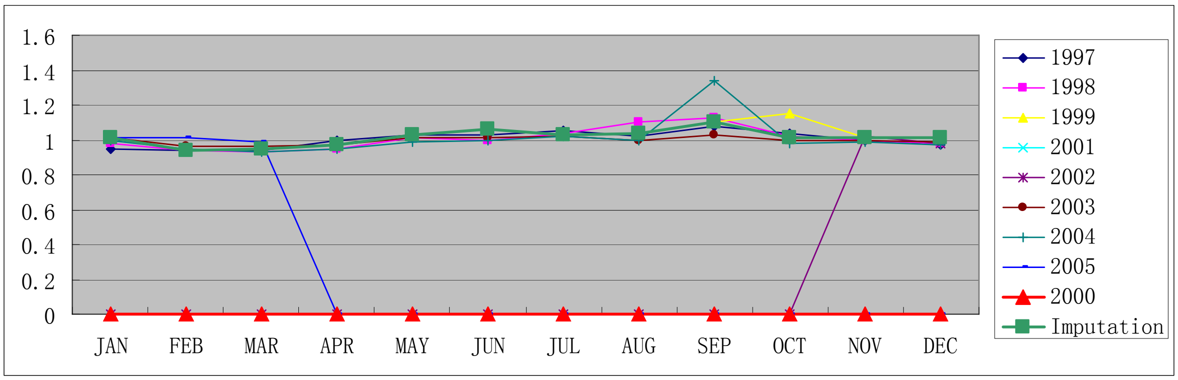
A.7 Imputation for Site 930257

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	0.97	0.91	0.88	0.93	0.97	1.12	1.15	1.11	1.03	1.01	1.01	0.99
1998	1.05	0.99	0.91	0.93	0.96	1.09	1.14	1.09	1.08	1	0.89	1
1999	1	0.91	0.89	0.92	0.94	1.06	1.11	1.07	1.07	1.02	1.01	1.05
2000	1.05	1	0.95	0	0	0	0	0	0	0	0	0
2001												
2002												
2003	0.99	0.93	0.92	0.97	1.01	1.07	1.11	1.04	1.01	1.01	0.99	1.02
2004	1.04	0.95	0.93	0.93	0.98	1.11	1.12	1.09	1.16	0.94	0.97	0.87
2005	0.98	0.92	0.92	0.91	0.94	1.09	1.1	1.06	1.05	1.16	0.96	0.99
2000	1.05	1	0.95	0	0	0	0	0	0	0	0	0
Imputation	1	0.91	0.89	0.92	0.94	1.06	1.11	1.07	1.07	1.02	1.01	1.05
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



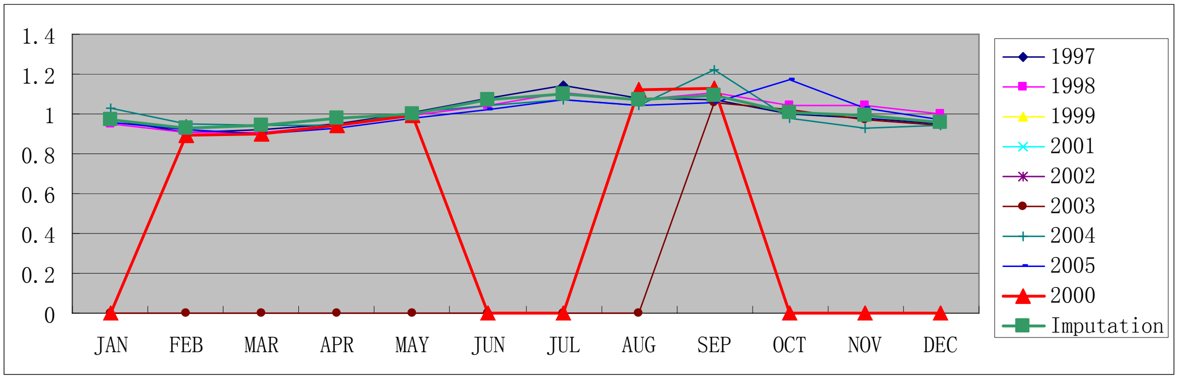
A.8 Imputation for Site 930174

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	0.95	0.94	0.94	1	1.03	1.03	1.05	1.02	1.08	1.04	1	0.97
1998	0.98	0.94	0.93	0.95	1.01	1	1.04	1.1	1.13	1.02	1	0.98
1999	1.01	0.94	0.95	0.97	1.03	1.06	1.03	1.04	1.1	1.15	1.01	1.01
2000	0	0	0	0	0	0	0	0	0	0	0	0
2001												
2002	0	0	0	0	0	0	0	0	0	0	1.02	0.98
2003	1.01	0.96	0.96	0.97	1.01	1.01	1.02	1	1.03	1	1	0.99
2004	1	0.95	0.93	0.95	0.99	1	1.02	1	1.34	0.98	0.99	0.97
2005	1.01	1.01	0.99	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0	0	0
Imputation	1.01	0.94	0.95	0.97	1.03	1.06	1.03	1.04	1.1	1.01	1.01	1.01
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	Avg-99	1999	1999



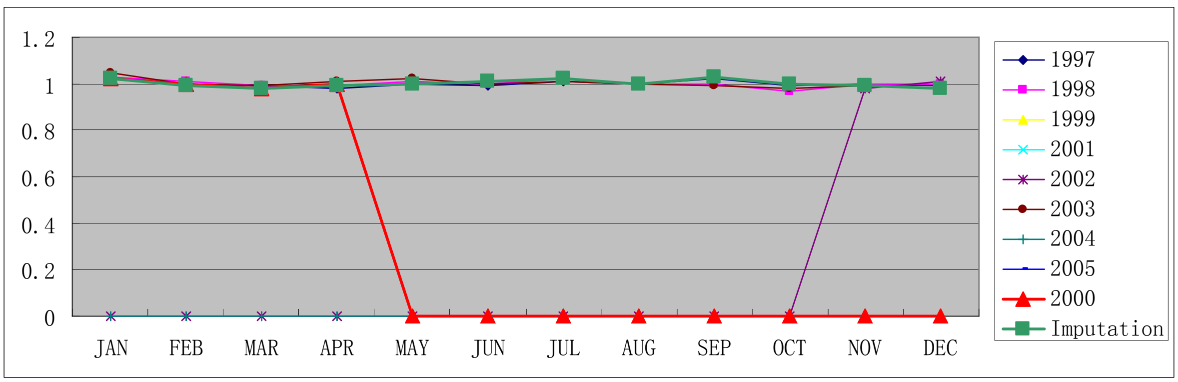
A.9 Imputation for Site 930099

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	0.97	0.91	0.92	0.95	1.01	1.08	1.14	1.08	1.07	1	0.98	0.95
1998	0.95	0.91	0.91	0.94	0.99	1.04	1.11	1.07	1.11	1.04	1.04	1
1999	0.97	0.93	0.94	0.98	1	1.07	1.1	1.07	1.09	1.01	0.99	0.96
2000	0	0.89	0.9	0.94	0.99	0	0	1.12	1.13	0	0	0
2001												
2002												
2003	0	0	0	0	0	0	0	0	1.06	1.02	0.97	0.94
2004	1.03	0.95	0.94	0.94	1.01	1.04	1.07	1.04	1.22	0.98	0.93	0.94
2005	0.96	0.92	0.9	0.93	0.98	1.02	1.07	1.04	1.06	1.17	1.03	0.97
2000	0	0.89	0.9	0.94	0.99	0	0	1.12	1.13	0	0	0
Imputation	0.97	0.93	0.94	0.98	1	1.07	1.1	1.07	1.09	1.01	0.99	0.96
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



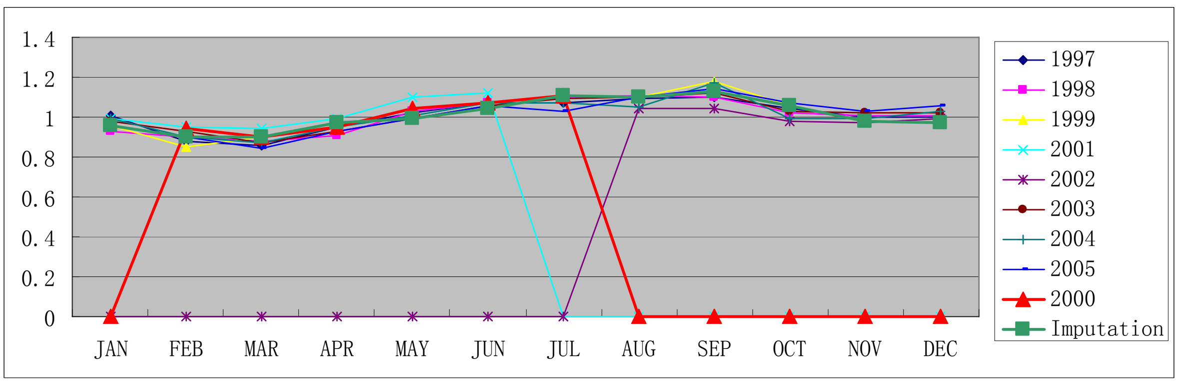
A.10 Imputation for Site 870187

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.03	1	0.99	0.98	1	0.99	1.01	1	1.02	0.99	1	0.99
1998	1.03	1.01	0.99	0.99	1.01	1	1.02	1	1	0.97	1	1
1999	1.02	0.99	0.98	0.99	1	1.01	1.02	1	1.03	1	0.99	0.98
2000	1.02	1	0.98	1	0	0	0	0	0	0	0	0
2001												
2002	0	0	0	0	0	0	0	0	0	0	0.98	1.01
2003	1.05	1	0.99	1.01	1.02	1	1.01	1	0.99	0.98	0.99	0.98
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005												
2000	1.02	1	0.98	1	0	0	0	0	0	0	0	0
Imputation	1.02	0.99	0.98	0.99	1	1.01	1.02	1	1.03	1	0.99	0.98
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



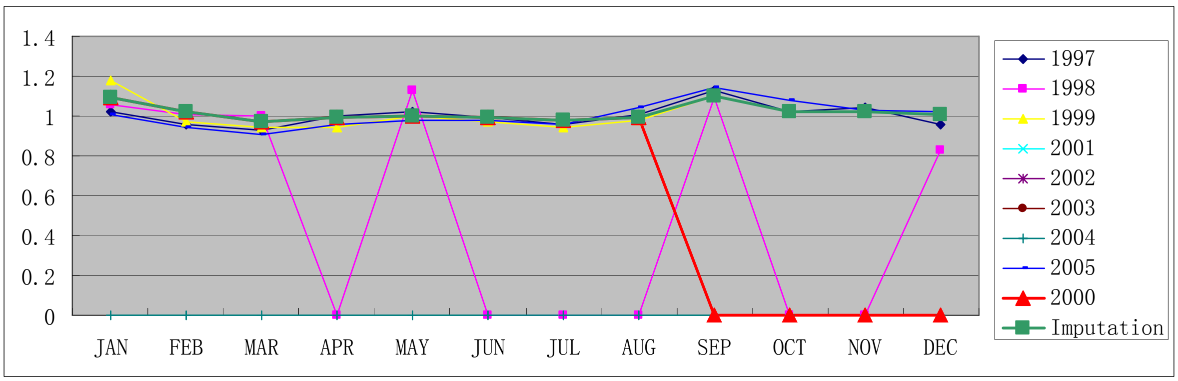
A.11 Imputation for Site 799929

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.01	0.88	0.86	0.95	1.02	1.07	1.07	1.09	1.1	1.04	1	1
1998	0.93	0.9	0.88	0.91	1.03	1.07	1.1	1.11	1.1	1.02	1.01	1.01
1999	0.96	0.85	0.9	0.97	0.99	1.04	1.11	1.1	1.18	1.06	0.98	0.97
2000	0	0.94	0.9	0.95	1.04	1.07	1.11	0	0	0	0	0
2001	0.99	0.95	0.94	0.99	1.1	1.12	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	1.04	1.04	0.98	0.97	0.99
2003	0.98	0.93	0.87	0.93	0.99	1.06	1.09	1.1	1.12	1.03	1.02	1.02
2004	0.99	0.9	0.87	0.95	1.01	1.07	1.07	1.05	1.17	0.99	0.99	1.03
2005	0.96	0.9	0.84	0.93	0.99	1.06	1.03	1.1	1.14	1.07	1.03	1.06
2000	0	0.94	0.9	0.95	1.04	1.07	1.11	0	0	0	0	0
Imputation	0.96	0.9	0.9	0.97	0.99	1.04	1.11	1.1	1.13	1.06	0.98	0.97
Source	1999	Avg all	1999	1999	1999	1999	1999	1999	Avg-2002	1999	1999	1999



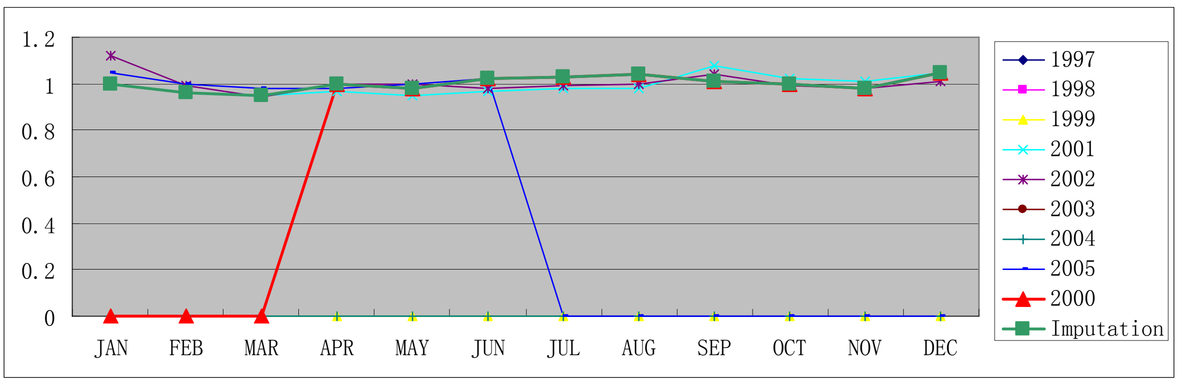
A.12 Imputation for Site 729923

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.02	0.96	0.93	1	1.02	0.99	0.96	1.01	1.13	1.02	1.04	0.96
1998	1.06	1.01	1	0	1.13	0	0	0	1.09	0	0	0.83
1999	1.18	0.97	0.94	0.94	1	0.97	0.94	0.98	1.1	1.02	1.02	1.01
2000	1.09	1.02	0.97	0.99	1	0.99	0.98	0.99	0	0	0	0
2001												
2002												
2003												
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005	1.01	0.94	0.91	0.96	0.98	0.98	0.96	1.04	1.14	1.08	1.03	1.02
2000	1.09	1.02	0.97	0.99	1	0.99	0.98	0.99	0	0	0	0
Imputation	1.09	1.02	0.97	0.99	1	0.99	0.98	0.99	1.1	1.02	1.02	1.01
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



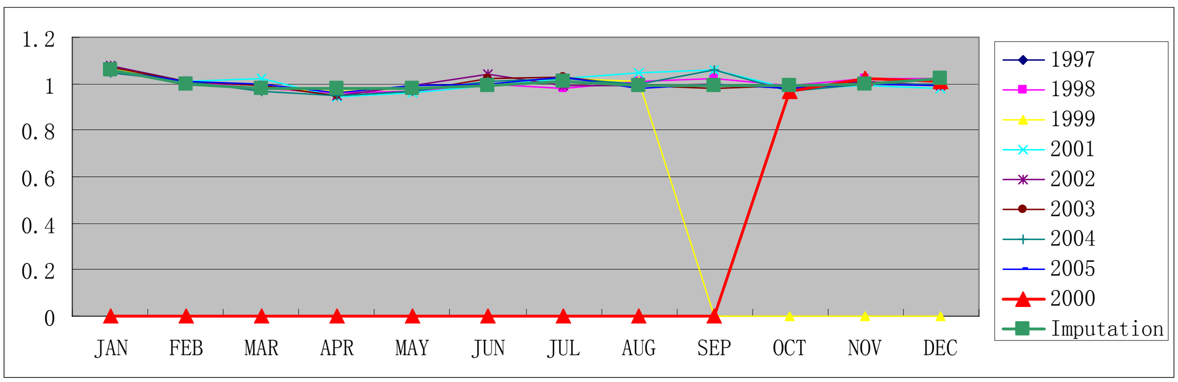
A.13 Imputation for Site 729914

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997												
1998												
1999	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	1	0.98	1.02	1.03	1.04	1.01	1	0.98	1.05
2001	1	0.96	0.95	0.97	0.95	0.97	0.98	0.98	1.08	1.02	1.01	1.05
2002	1.12	0.99	0.94	1	1	0.98	0.99	1	1.04	0.99	0.98	1.01
2003												
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005	1.05	1	0.98	0.98	1	1.02	0	0	0	0	0	0
2000	0	0	0	1	0.98	1.02	1.03	1.04	1.01	1	0.98	1.05
Imputation	1	0.96	0.95	1	0.98	1.02	1.03	1.04	1.01	1	0.98	1.05
Source	2001	2001	2001	2000	2000	2000	2000	2000	2000	2000	2000	2000



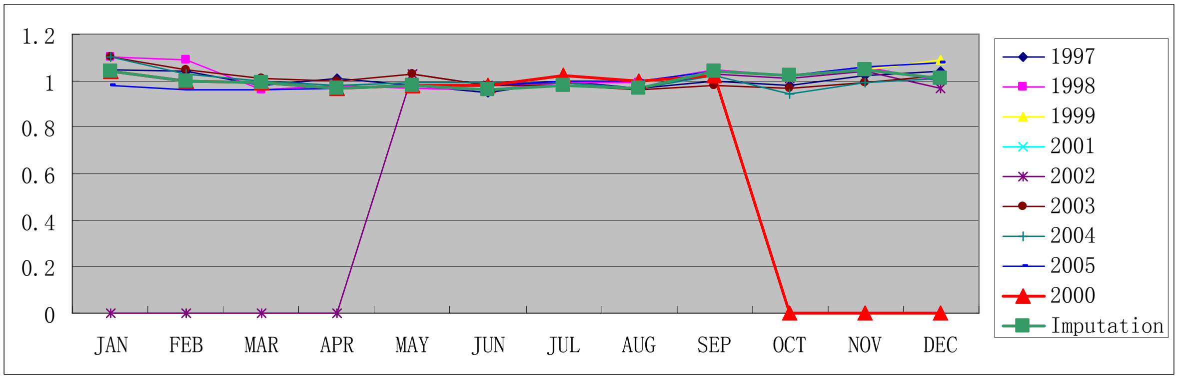
A.14 Imputation for Site 710189

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.06	1	0.98	0.98	0.98	0.99	1.01	0.99	0.99	0.99	1	1.02
1998	1.05	1.01	0.98	0.96	0.97	1	0.98	1.01	1.02	0.99	1.02	1.02
1999	1.07	1	0.98	0.97	0.98	1	1.02	1.01	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0.97	1.02	1.01
2001	1.08	1.01	1.02	0.94	0.96	0.99	1.02	1.05	1.06	0.98	0.99	0.98
2002	1.08	1.01	0.99	0.95	0.99	1.04	0.99	0.99	1	0.98	1.01	0.99
2003	1.07	1.01	0.99	0.95	0.97	1.02	1.03	0.99	0.98	0.99	1	1
2004	1.05	1.01	0.97	0.95	0.97	1.01	1.02	1	1.06	0.97	1	1
2005	1.06	1.01	1	0.96	0.99	1	1.03	0.98	1	0.98	1	0.99
2000	0	0	0	0	0	0	0	0	0	0.97	1.02	1.01
Imputation	1.06	1	0.98	0.98	0.98	0.99	1.01	0.99	0.99	0.99	1	1.02
Source	1997	1997	1997	1997	1997	1997	1997	1997	1997	1997	1997	1997



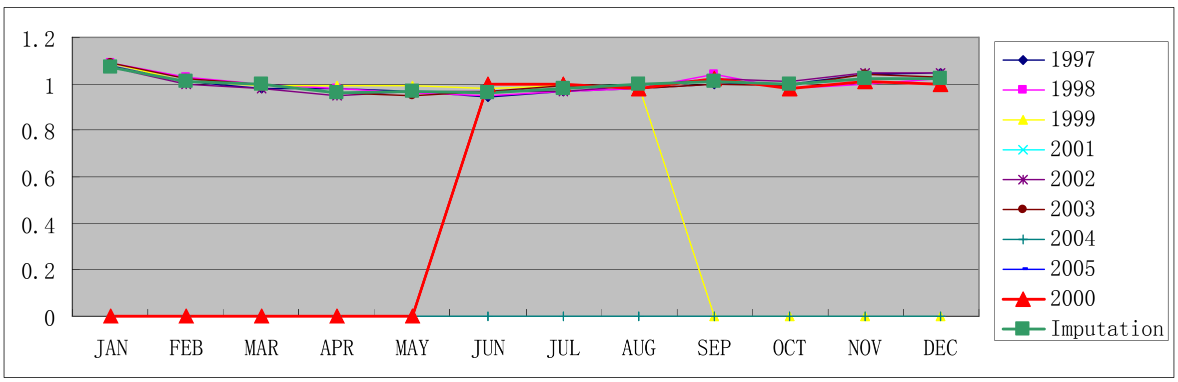
A.15 Imputation for Site 589937

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.05	1.04	0.98	1.01	0.98	0.95	1	0.97	1	0.98	1.02	1.04
1998	1.1	1.09	0.96	0.98	0.97	0.96	0.99	0.99	1.05	1.02	1.06	1
1999	1.04	1	0.99	0.97	0.98	0.96	0.98	0.97	1.04	1.02	1.05	1.09
2000	1.04	1	0.99	0.97	0.98	0.98	1.02	1	1.02	0	0	0
2001												
2002	0	0	0	0	1.03	0.98	0.99	0.97	1.03	1.01	1.04	0.97
2003	1.1	1.05	1.01	1	1.03	0.98	0.98	0.96	0.98	0.97	0.99	1.02
2004	1.1	1.03	1	0.98	0.99	0.99	0.99	0.97	1.02	0.94	0.99	1.01
2005	0.98	0.96	0.96	0.97	0.98	0.98	1	1	1.04	1.02	1.06	1.08
2000	1.04	1	0.99	0.97	0.98	0.98	1.02	1	1.02	0	0	0
Imputation	1.04	1	0.99	0.97	0.98	0.96	0.98	0.97	1.04	1.02	1.05	1.01
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



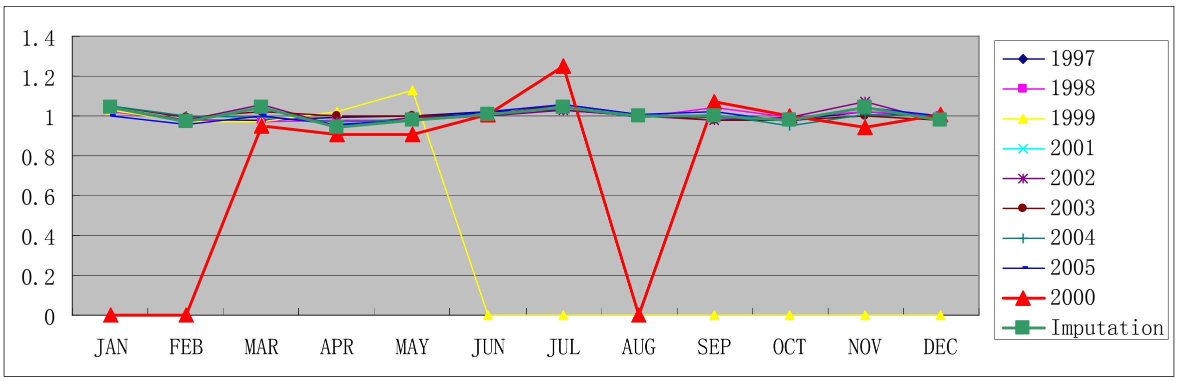
A.16 Imputation for Site 559908

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.08	1.01	0.98	0.98	0.97	0.94	0.97	0.98	1	1	1.04	1.05
1998	1.09	1.03	1	0.98	0.96	0.95	0.97	0.98	1.04	0.98	1	1.02
1999	1.09	1.01	0.99	0.99	0.99	0.98	0.99	0.99	0	0	0	0
2000	0	0	0	0	0	1	1	0.98	1.02	0.98	1.01	1
2001	1.07	1.01	1	0.96	0.97	0.96	0.98	1	1.01	1	1.02	1.02
2002	1.07	1	0.98	0.95	0.97	0.97	0.97	0.99	1.02	1.01	1.05	1.05
2003	1.09	1.02	1	0.96	0.95	0.97	0.99	0.98	1	0.99	1.04	1.03
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005												
2000	0	0	0	0	0	1	1	0.98	1.02	0.98	1.01	1
Imputation	1.07	1.01	1	0.96	0.97	0.96	0.98	1	1.01	1	1.02	1.02
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



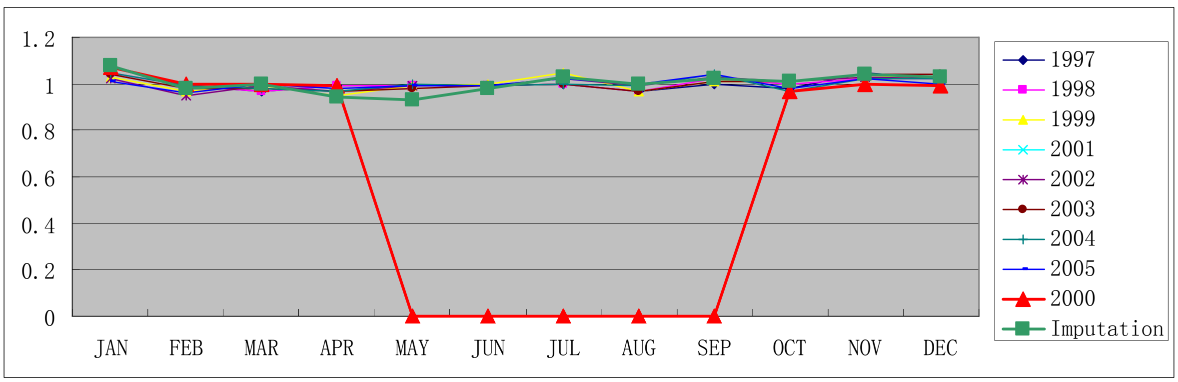
A.17 Imputation for Site 550207

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.04	0.98	0.98	0.99	1	1.02	1.03	1	0.99	0.98	1.02	0.99
1998	1.02	0.98	0.97	0.98	0.98	1	1.04	0.99	1.04	0.99	1.02	1
1999	1.03	0.97	0.97	1.02	1.13	0	0	0	0	0	0	0
2000	0	0	0.95	0.91	0.91	1.01	1.25	0	1.07	1	0.94	1.01
2001	1.04	0.97	1.04	0.94	0.98	1.01	1.04	1	1	0.98	1.04	0.98
2002	1.04	0.98	1.06	0.95	0.99	1	1.03	1	0.98	0.99	1.07	0.97
2003	1.05	0.99	1.02	1	1	1.01	1.06	1.01	0.98	0.98	1	0.98
2004	1.05	1	0.99	0.97	0.98	1.01	1.04	0.99	1.01	0.95	1.01	1
2005	1	0.96	1	0.96	0.98	1.02	1.06	1.01	1.02	0.97	1.04	1
2000	0	0	0.95	0.91	0.91	1.01	1.25	0	1.07	1	0.94	1.01
Imputation	1.04	0.97	1.04	0.94	0.98	1.01	1.04	1	1	0.98	1.04	0.98
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



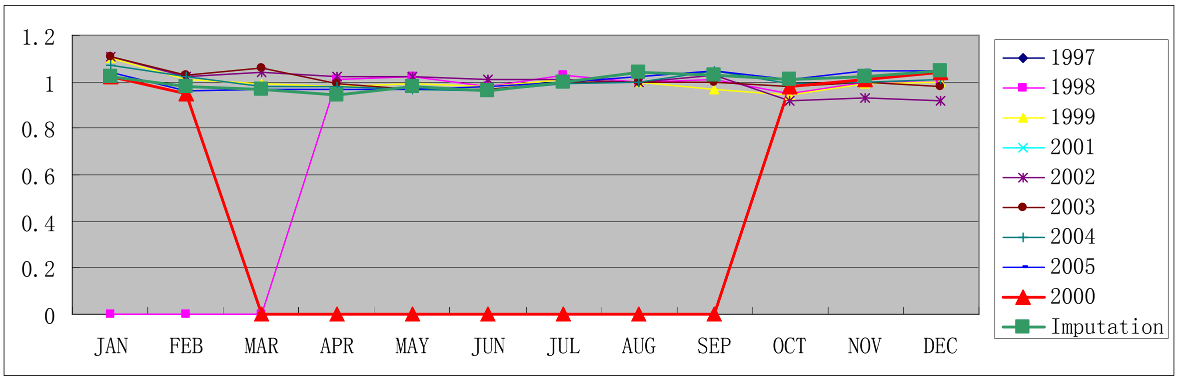
A.18 Imputation for Site 530117

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.07	0.99	0.97	0.99	0.99	0.99	1	0.97	1	0.98	1.05	1.02
1998	1.05	0.99	0.97	0.99	0.99	0.99	1	0.97	1.02	1	1.02	1.02
1999	1.03	0.97	0.99	0.95	0.99	1	1.05	0.97	1.01	1.01	1.03	1.03
2000	1.07	1	1	0.99	0	0	0	0	0	0.97	1	0.99
2001	1.08	0.98	1	0.94	0.93	0.98	1.03	1	1.02	1.01	1.04	1.03
2002	1.02	0.95	0.99	0.97	0.99	0.99	1.02	0.99	1.03	1.01	1.03	1.02
2003	1.04	0.98	0.98	0.97	0.98	0.99	1	0.97	1.01	1.01	1.04	1.04
2004	1.05	0.99	0.98	0.97	1	0.99	1	0.99	1.04	0.97	1.02	1.02
2005	1.01	0.96	1	0.98	0.99	0.99	1.02	1	1.04	0.98	1.02	1
2000	1.07	1	1	0.99	0	0	0	0	0	0.97	1	0.99
Imputation	1.08	0.98	1	0.94	0.93	0.98	1.03	1	1.02	1.01	1.04	1.03
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



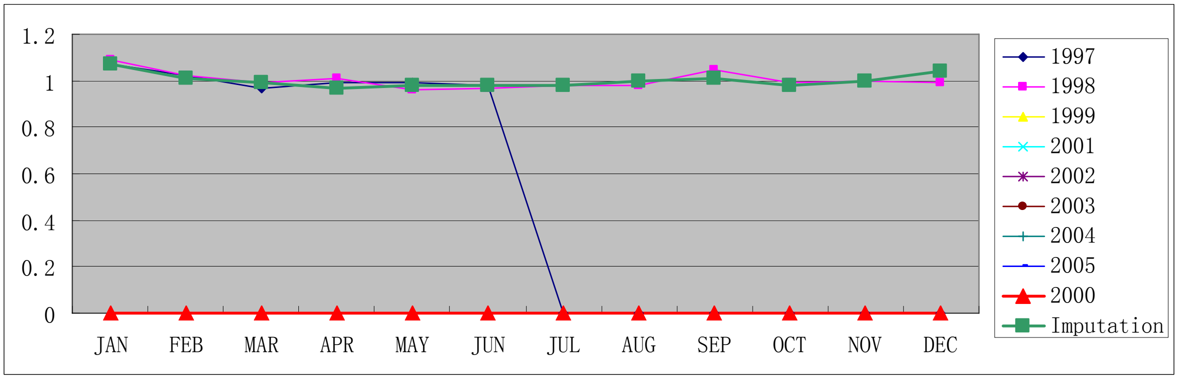
A.19 Imputation for Site 509904

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997												
1998	0	0	0	1.01	1.02	0.98	1.03	1	1.01	0.95	1	1
1999	1.1	1.01	0.99	0.98	0.99	0.98	1.01	1	0.97	0.94	0.99	1
2000	1.02	0.95	0	0	0	0	0	0	0	0.98	1.01	1.04
2001	1.02	0.98	0.97	0.94	0.98	0.96	1	1.04	1.03	1.01	1.02	1.05
2002	1.11	1.02	1.04	1.02	1.02	1.01	1.01	1	1.03	0.92	0.93	0.92
2003	1.11	1.03	1.06	0.99	0.97	0.97	1	1	1	0.98	1	0.98
2004	1.07	1.02	0.98	0.98	0.97	0.96	0.99	1	1.05	0.99	1	1.01
2005	1.04	0.96	0.97	0.97	0.97	0.98	1	1.02	1.05	1.01	1.05	1.05
2000	1.02	0.95	0	0	0	0	0	0	0	0.98	1.01	1.04
Imputation	1.02	0.98	0.97	0.94	0.98	0.96	1	1.04	1.03	1.01	1.02	1.05
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



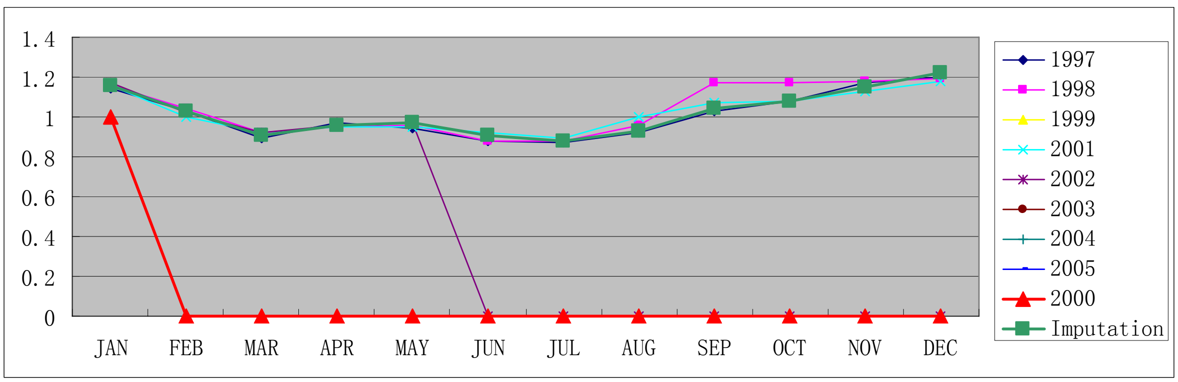
A.20 Imputation for Site 480159

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.07	1.02	0.97	0.99	0.99	0.98	0	0	0	0	0	0
1998	1.09	1.02	0.99	1.01	0.96	0.97	0.98	0.98	1.05	0.99	1	0.99
1999	1.07	1.01	0.99	0.97	0.98	0.98	0.98	1	1.01	0.98	1	1.04
2000	0	0	0	0	0	0	0	0	0	0	0	0
2001												
2002												
2003												
2004												
2005												
2000	0	0	0	0	0	0	0	0	0	0	0	0
Imputation	1.07	1.01	0.99	0.97	0.98	0.98	0.98	1	1.01	0.98	1	1.04
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



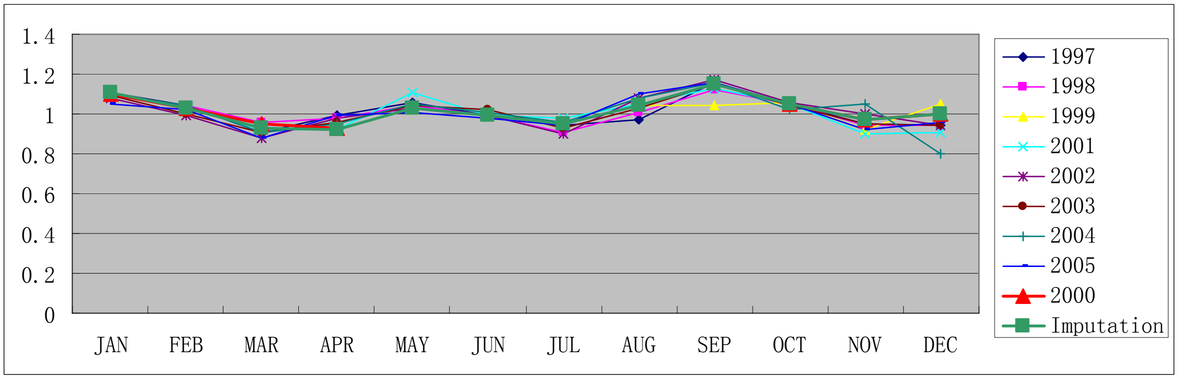
A.21 Imputation for Site 460305

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.14	1.03	0.89	0.97	0.94	0.88	0.87	0.92	1.03	1.08	1.17	1.2
1998	1.16	1.04	0.92	0.95	0.96	0.88	0.88	0.96	1.17	1.17	1.18	1.19
1999	1.16	1.03	0.91	0.96	0.97	0.91	0.88	0.93	1.04	1.08	1.15	1.22
2000	1	0	0	0	0	0	0	0	0	0	0	0
2001	1.16	1	0.92	0.95	0.95	0.92	0.89	1	1.07	1.08	1.13	1.18
2002	1.17	1.02	0.92	0.96	0.97	0	0	0	0	0	0	0
2003												
2004												
2005												
2000	1	0	0	0	0	0	0	0	0	0	0	0
Imputation	1.16	1.03	0.91	0.96	0.97	0.91	0.88	0.93	1.04	1.08	1.15	1.22
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



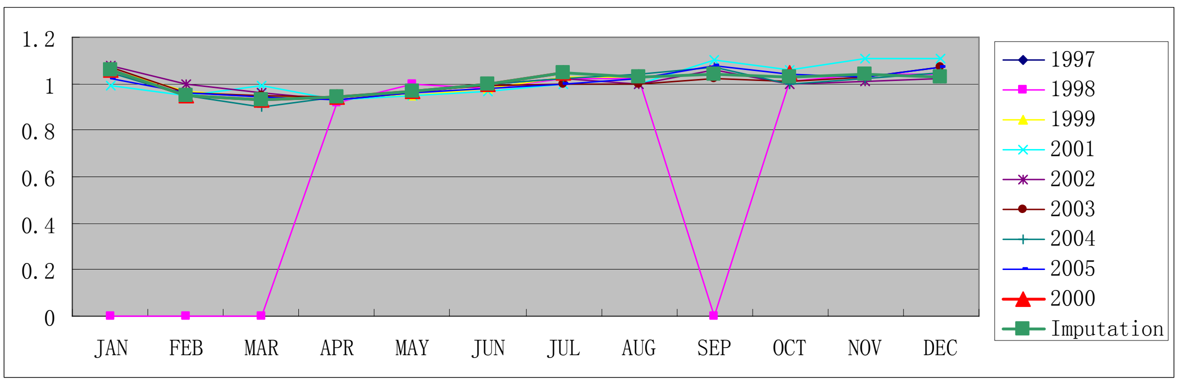
A.22 Imputation for Site 360317

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.11	1.04	0.91	0.99	1.06	0.99	0.94	0.97	1.16	1.05	0.95	0.94
1998	1.09	1.04	0.96	0.98	1.04	0.99	0.91	1.01	1.12	1.05	0.94	0.94
1999	1.11	1.03	0.93	0.92	1.03	0.99	0.95	1.04	1.04	1.06	0.92	1.05
2000	1.1	1.03	0.95	0.93						1.05	0.97	1
2001	1.11	1.03	0.92	0.92	1.11	0.99	0.98	1.05	1.13	1.05	0.9	0.91
2002	1.08	0.99	0.88	0.98	1.03	0.99	0.9	1.08	1.17	1.06	1	0.94
2003	1.09	1	0.91	0.96	1.04	1.02	0.93	1.03	1.15	1.04	0.95	0.94
2004	1.1	1.04	0.91	0.95	1.05	1.01	0.96	1.08	1.16	1.02	1.05	0.8
2005	1.05	1.02	0.88	0.99	1.01	0.98	0.94	1.1	1.16	1.05	0.92	0.96
2000	1.1	1.03	0.95	0.93						1.05	0.97	1
Imputation	1.11	1.03	0.93	0.92	1.03	0.99	0.95	1.04	1.15	1.05	0.97	1
Source	1999	1999	1999	1999	1999	1999	1999	1999	Avg-99	2000	2000	2000



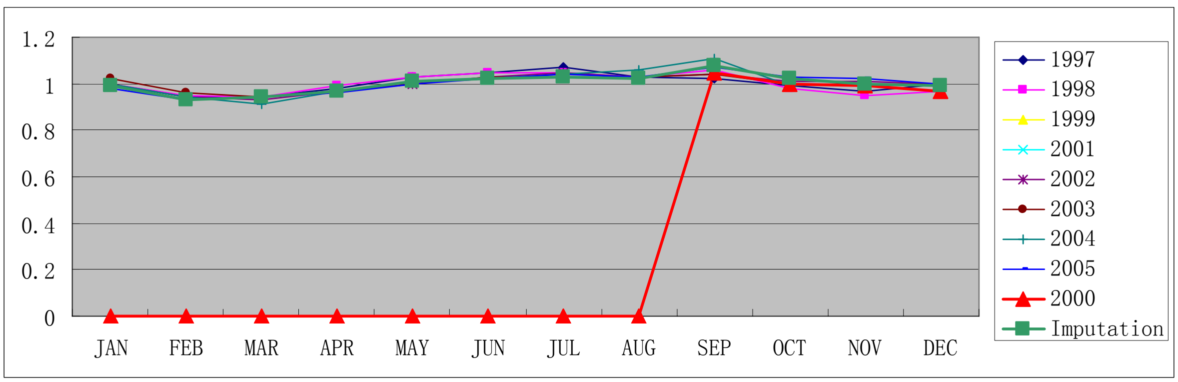
A.23 Imputation for Site 150086

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997												
1998	0	0	0	0.92	1	0.98	1.02	1.02	0	1.01	1.04	1.04
1999	1.06	0.97	0.94	0.94	0.95	0.98	1.03	1.03	1.04	1.03	1.04	1.03
2000	1.06	0.95	0.93	0.94	0.97	1	1.05			1.05		
2001	0.99	0.95	0.99	0.93	0.95	0.97	1	1	1.1	1.06	1.11	1.11
2002	1.08	1	0.96	0.93	0.96	1	1.02	1	1.06	1	1.01	1.02
2003	1.07	0.96	0.95	0.94	0.97	0.99	1	1	1.02	1.01	1.03	1.07
2004	1.05	0.95	0.9	0.94	0.97	1	1.02	1.04	1.07	1	1.02	1.05
2005	1.02	0.96	0.94	0.93	0.96	0.98	1	1.02	1.08	1.04	1.03	1.07
2000	1.06	0.95	0.93	0.94	0.97	1	1.05			1.05		
Imputation	1.06	0.95	0.93	0.94	0.97	1	1.05	1.03	1.04	1.03	1.04	1.03
Source	2000	2000	2000	2000	2000	2000	2000	1999	1999	1999	1999	1999



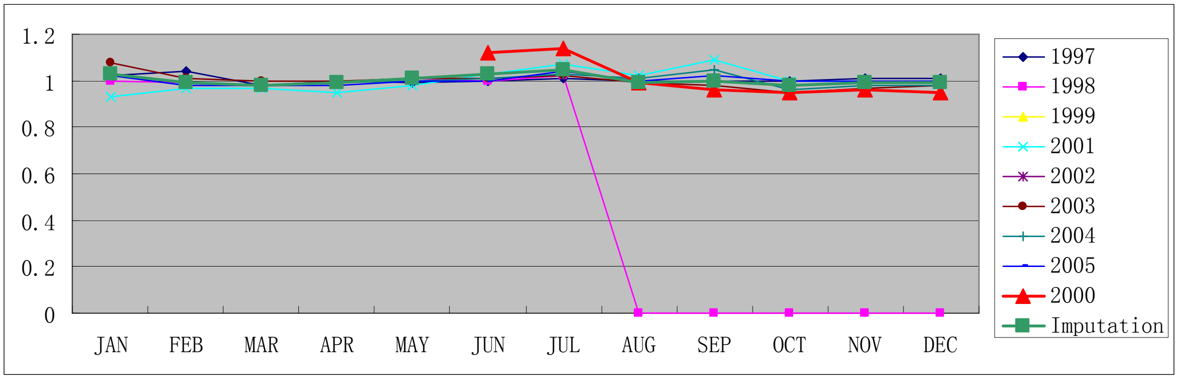
A.24 Imputation for Site 140199

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1	0.94	0.94	0.98	1.03	1.05	1.07	1.03	1.02	0.99	0.97	1
1998	1	0.95	0.94	0.99	1.03	1.05	1.05	1.03	1.06	0.98	0.95	0.97
1999												
2000									1.05	1	0.99	0.97
2001	0.99	0.93	0.94	0.97	1.01	1.02	1.03	1.02	1.08	1.02	1	0.99
2002	1	0.94	0.93	0.97	1	1.03	1.05	1.03	1.04	1.01	1.01	1
2003	1.02	0.96	0.94	0.97	1	1.03	1.03	1.03	1.04	1	1	1
2004	1	0.94	0.91	0.97	1.01	1.02	1.04	1.06	1.11	0.99	1	0.99
2005	0.98	0.93	0.94	0.96	1	1.02	1.04	1.03	1.07	1.03	1.02	1
2000	0	0	0	0	0	0	0	0	1.05	1	0.99	0.97
Imputation	0.99	0.93	0.94	0.97	1.01	1.02	1.03	1.02	1.08	1.02	1	0.99
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



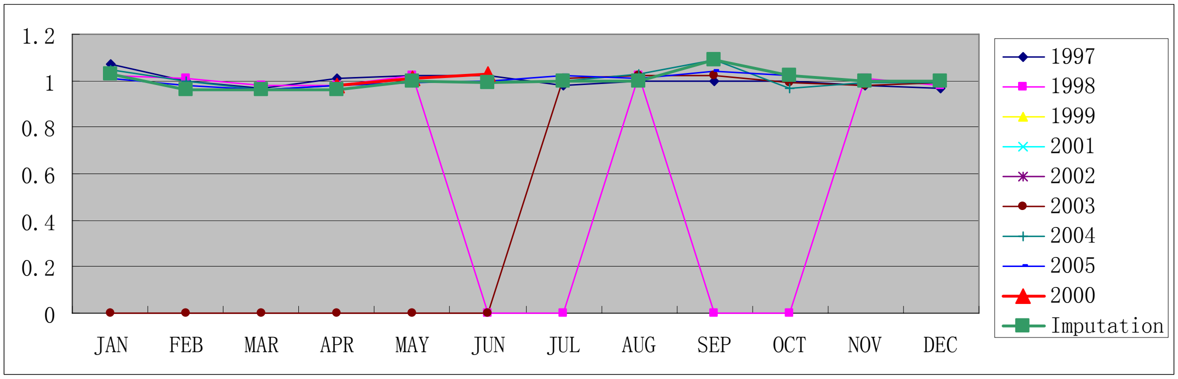
A.25 Imputation for Site 140013

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.02	1.04	0.98	1	0.99	1	1.01	1	1	1	1.01	1.01
1998	1	0.99	0.98	0.99	1.01	1	1.02	0	0	0	0	0
1999												
2000						1.12	1.14	0.99	0.96	0.95	0.96	0.95
2001	0.93	0.97	0.97	0.95	0.98	1.03	1.07	1.02	1.09	1	1	0.99
2002	1.03	0.99	0.98	0.99	1.01	1.03	1.05	0.99	1	0.98	0.99	0.99
2003	1.08	1.01	1	1	1.01	1.01	1.02	0.99	0.98	0.95	0.97	0.98
2004	1.03	0.99	0.98	0.99	1	1.01	1.03	1.01	1.05	0.96	0.98	0.98
2005	1.02	0.98	0.98	0.98	1	1	1.04	1	1.02	1	1	1
2000						1.12	1.14	0.99	0.96	0.95	0.96	0.95
Imputation	1.03	0.99	0.98	0.99	1.01	1.03	1.05	0.99	1	0.98	0.99	0.99
Source	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002



A.26 Imputation for Site 109922

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	1.07	1	0.97	1.01	1.02	1.02	0.98	1	1	1	0.98	0.97
1998	1.02	1.01	0.98	0.98	1.02	0	0	1.02	0	0	1.01	0.98
1999	1.03	0.96	0.96	0.96	1	0.99	1	1	1.09	1.02	1	1
2000				0.98	1.01	1.03						
2001												
2002												
2003	0	0	0	0	0	0	1.01	1.02	1.02	0.99	0.98	0.99
2004	1.05	1	0.96	0.98	0.99	1	1	1.03	1.09	0.97	0.99	0.99
2005	1.01	0.98	0.96	0.98	0.99	1	1.02	1.01	1.04	1.02	1	1
2000				0.98	1.01	1.03						
Imputation	1.03	0.96	0.96	0.96	1	0.99	1	1	1.09	1.02	1	1
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999

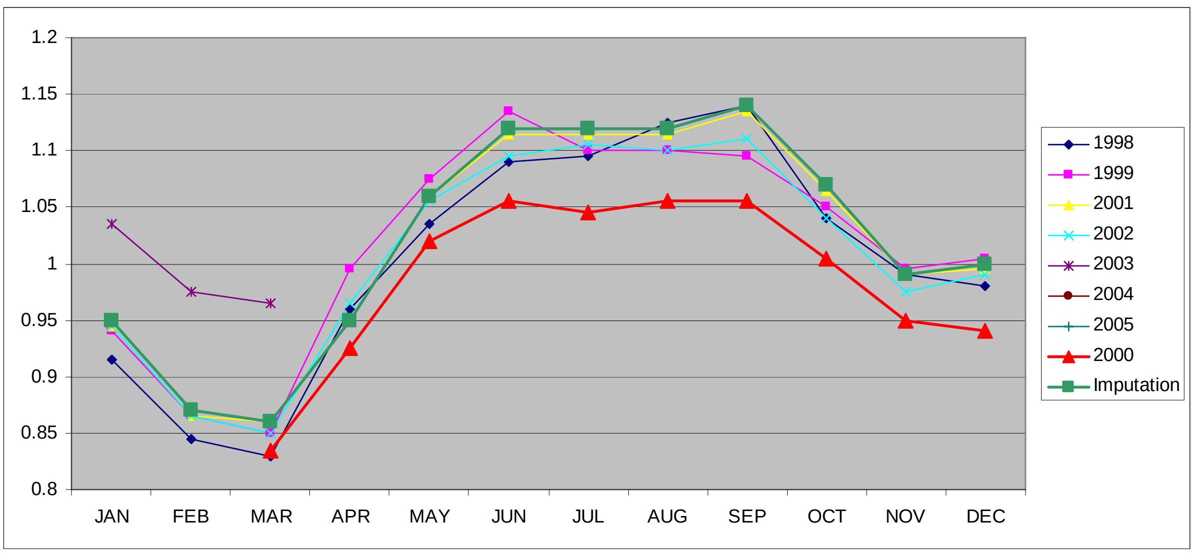


APPENDIX B. IMPUTATION OF MSFS FOR RURAL AREA

B.1 Imputation for Site 010014

For site 010014, data of year 2000 are borrowed from 2001.

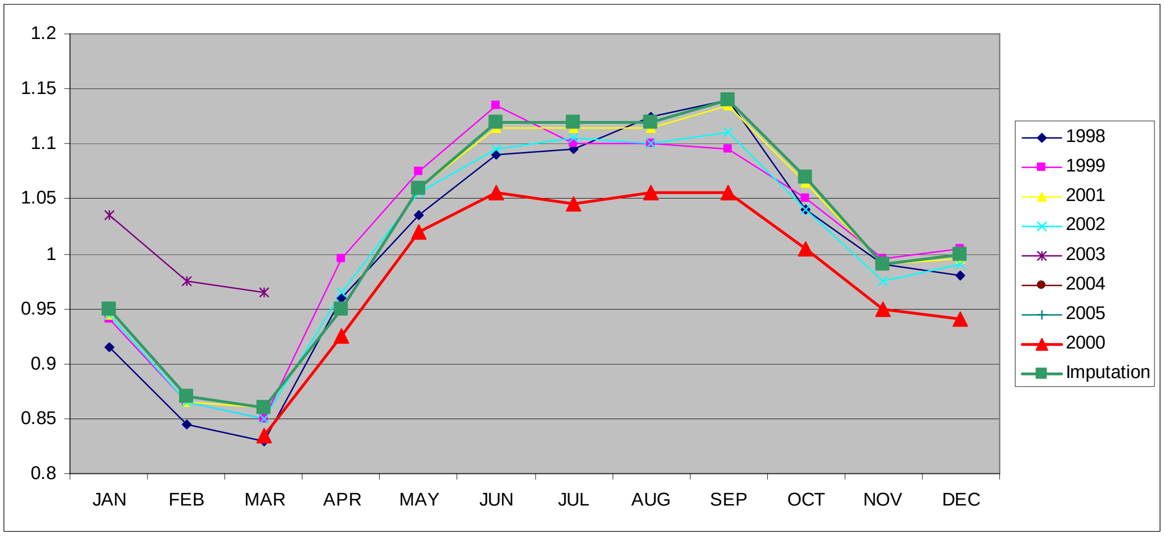
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	0.915	0.845	0.83	0.96	1.035	1.09	1.095	1.125	1.14	1.04	0.99	0.98
1999	0.94	0.865	0.85	0.995	1.075	1.135	1.1	1.1	1.095	1.05	0.995	1.005
2001	0.945	0.865	0.86	0.95	1.06	1.115	1.115	1.115	1.135	1.065	0.99	0.995
2002	0.945	0.865	0.85	0.965	1.055	1.095	1.105	1.1	1.11	1.04	0.975	0.99
2003	1.035	0.975	0.965									
2004												
2005												
2000			0.835	0.925	1.02	1.055	1.045	1.055	1.055	1.005	0.95	0.94
Imputation	0.95	0.87	0.86	0.95	1.06	1.12	1.12	1.12	1.14	1.07	0.99	1
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



B.2 Imputation for Site 010350

For site 010350, data for year 2000 are borrowed from 2001.

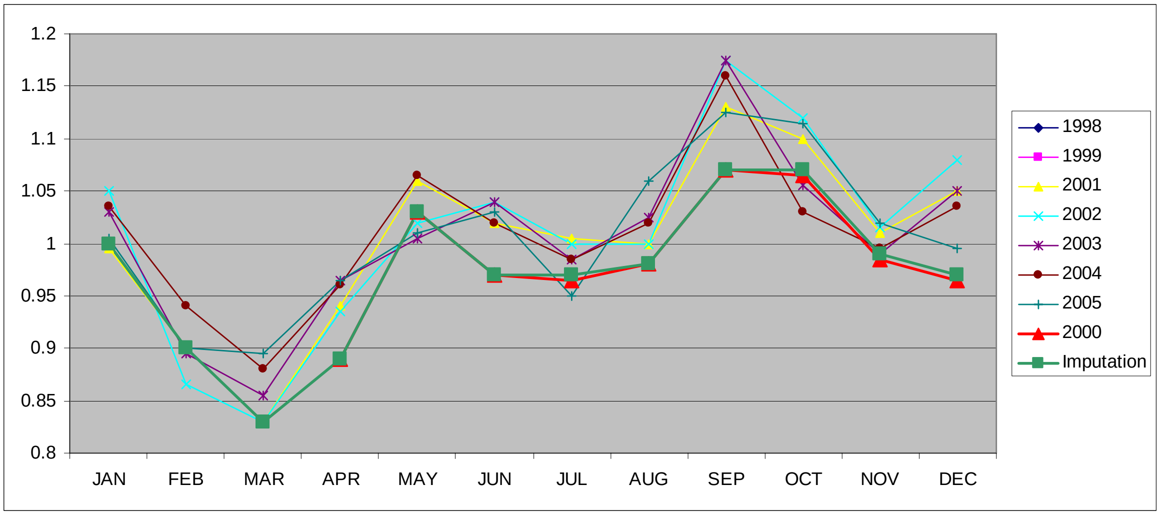
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998												
1999												
2001	0.94	0.865	0.82	0.925	1.04	1.045	1.05	1.08	1.145	1.07	0.995	1.045
2002	1.04	0.915	0.86	0.97	1.09	1.13	1.17					
2003			0.83	0.93		1.045	1.035	1.07	1.15	1.03	0.96	0.99
2004	1.07	0.96	0.9	0.98	1.09	1.095	1.08	1.15	1.08	0.99	0.95	0.975
2005	1.065	0.985	0.935	1.07								
2000				0.875	0.99	1.005	1.015	1.045	1.05	1.04	0.98	0.975
Imputation	0.94	0.87	0.82	0.93	1.04	1.05	1.05	1.08	1.15	1.07	1	1.05
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



B.3 Imputation for Site 030351

For site 030351, MSFs for April to December are from 2000, MSFs for January to March are borrowed from 2001.

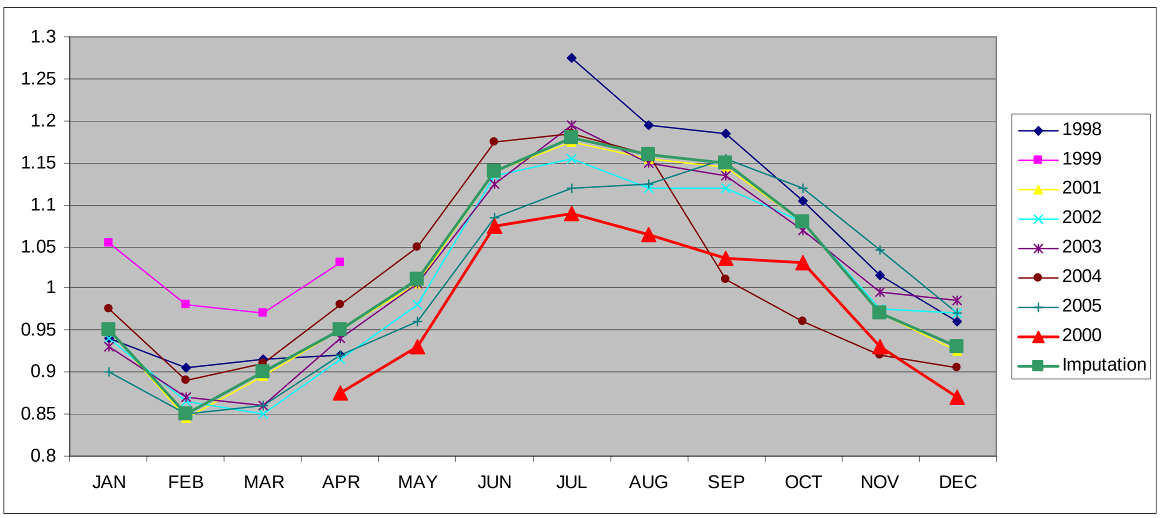
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998												
1999												
2001	0.995	0.9	0.83	0.94	1.06	1.02	1.005	1	1.13	1.1	1.01	1.05
2002	1.05	0.865	0.83	0.935	1.02	1.04	1	1	1.175	1.12	1.015	1.08
2003	1.03	0.895	0.855	0.965	1.005	1.04	0.985	1.025	1.175	1.055	0.99	1.05
2004	1.035	0.94	0.88	0.96	1.065	1.02	0.985	1.02	1.16	1.03	0.995	1.035
2005	1.005	0.9	0.895	0.965	1.01	1.03	0.95	1.06	1.125	1.115	1.02	0.995
2000				0.89	1.03	0.97	0.965	0.98	1.07	1.065	0.985	0.965
Imputation	1	0.9	0.83	0.89	1.03	0.97	0.97	0.98	1.07	1.07	0.99	0.97
Source	2001	2001	2001	2000	2000	2000	2000	2000	2000	2000	2000	2000



B.4 Imputation for Site 040271

For site 040271, MSFs for all months are borrowed from 2001.

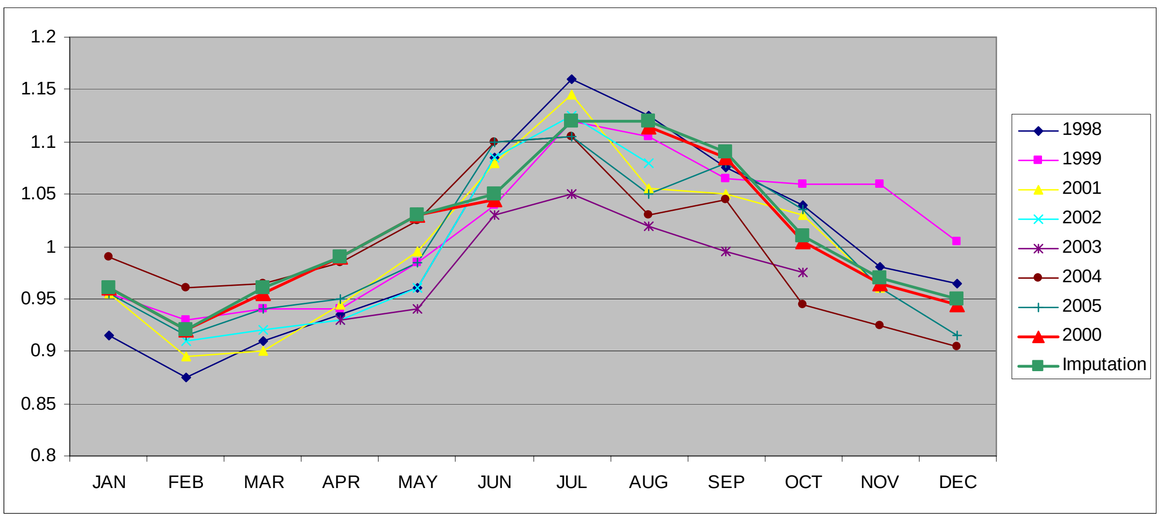
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	0.94	0.905	0.915	0.92			1.275	1.195	1.185	1.105	1.015	0.96
1999	1.055	0.98	0.97	1.03								
2001	0.95	0.845	0.895	0.95	1.005	1.14	1.175	1.155	1.145	1.08	0.97	0.925
2002	0.94	0.865	0.85	0.915	0.98	1.135	1.155	1.12	1.12	1.08	0.975	0.97
2003	0.93	0.87	0.86	0.94	1.005	1.125	1.195	1.15	1.135	1.07	0.995	0.985
2004	0.975	0.89	0.91	0.98	1.05	1.175	1.185	1.16	1.01	0.96	0.92	0.905
2005	0.9	0.85	0.86	0.92	0.96	1.085	1.12	1.125	1.155	1.12	1.045	0.97
2000				0.875	0.93	1.075	1.09	1.065	1.035	1.03	0.93	0.87
Imputation	0.95	0.85	0.9	0.95	1.01	1.14	1.18	1.16	1.15	1.08	0.97	0.93
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



B.5 Imputation for Site 090229

For site 090229, MSFs for all months except July are from 2000. For July, MSF is borrowed from 1999.

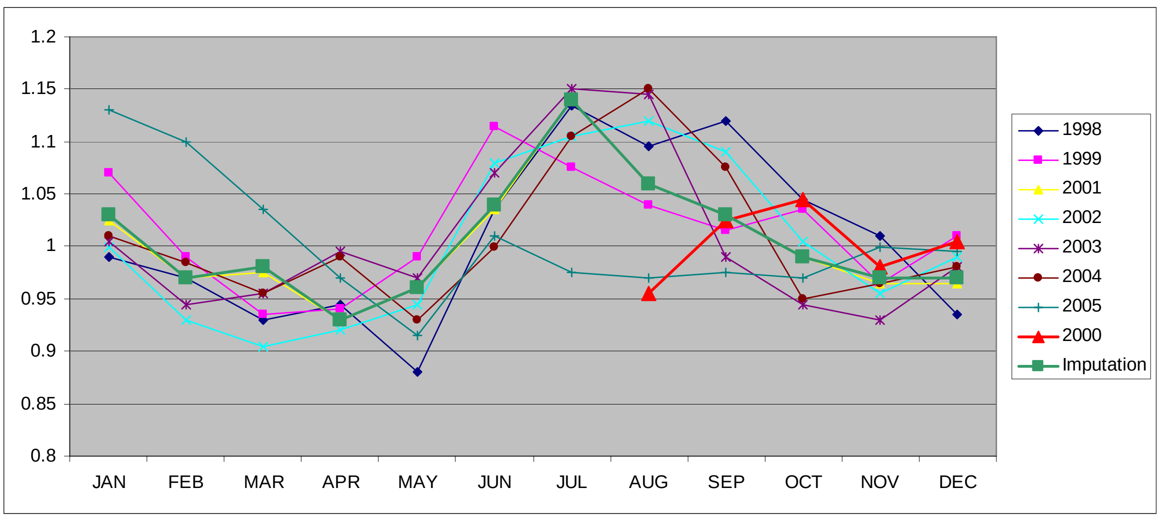
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	0.915	0.875	0.91	0.935	0.96	1.085	1.16	1.125	1.075	1.04	0.98	0.965
1999	0.955	0.93	0.94	0.94	0.985	1.04	1.12	1.105	1.065	1.06	1.06	1.005
2001	0.955	0.895	0.9	0.945	0.995	1.08	1.145	1.055	1.05	1.03	0.96	
2002		0.91	0.92	0.93	0.96	1.085	1.125	1.08				
2003				0.93	0.94	1.03	1.05	1.02	0.995	0.975		
2004	0.99	0.96	0.965	0.985	1.025	1.1	1.105	1.03	1.045	0.945	0.925	0.905
2005	0.955	0.915	0.94	0.95	0.985	1.1	1.105	1.05	1.08	1.035	0.96	0.915
2000	0.96	0.92	0.955	0.99	1.03	1.045		1.115	1.085	1.005	0.965	0.945
Imputation	0.96	0.92	0.96	0.99	1.03	1.05	1.12	1.12	1.09	1.01	0.97	0.95
Source	2000	2000	2000	2000	2000	2000	1999	2000	2000	2000	2000	2000



B.6 Imputation for Site 120273

For site 120273, MSFs for all months are borrowed from 2001.

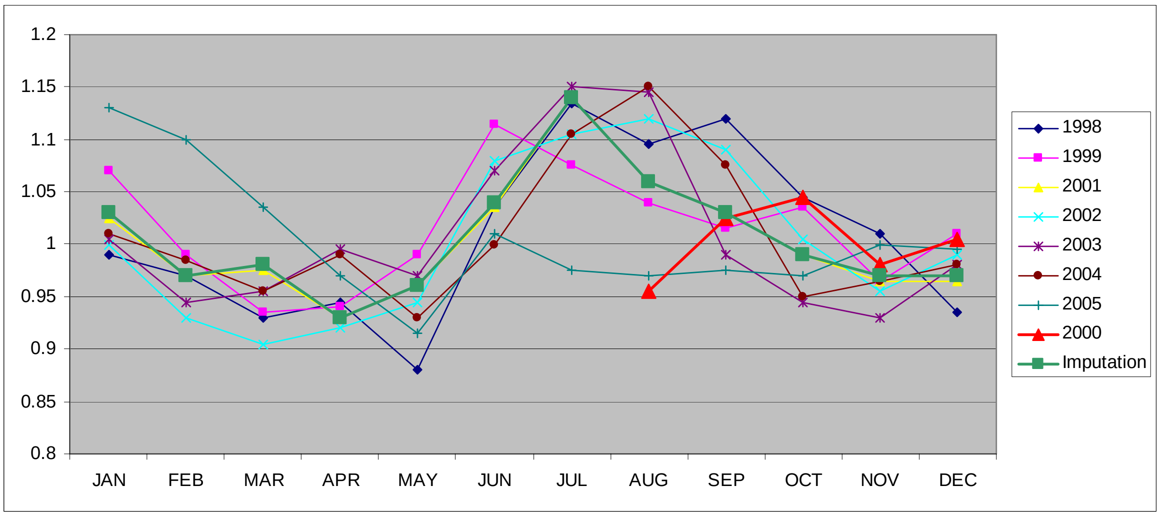
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	0.99	0.97	0.93	0.945	0.88	1.035	1.135	1.095	1.12	1.045	1.01	0.935
1999	1.07	0.99	0.935	0.94	0.99	1.115	1.075	1.04	1.015	1.035	0.965	1.01
2001	1.025	0.97	0.975	0.93	0.96	1.035	1.14	1.06	1.03	0.99	0.965	0.965
2002	1	0.93	0.905	0.92	0.945	1.08	1.105	1.12	1.09	1.005	0.955	0.99
2003	1.005	0.945	0.955	0.995	0.97	1.07	1.15	1.145	0.99	0.945	0.93	0.98
2004	1.01	0.985	0.955	0.99	0.93	1	1.105	1.15	1.075	0.95	0.965	0.98
2005	1.13	1.1	1.035	0.97	0.915	1.01	0.975	0.97	0.975	0.97	1	0.995
2000								0.955	1.025	1.045	0.98	1.005
Imputation	1.03	0.97	0.98	0.93	0.96	1.04	1.14	1.06	1.03	0.99	0.97	0.97
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



B.7 Imputation for Site 130146

For site 130146, MSFs for all months except June are borrowed from 1999. For June, MSF is estimated as the average of year 1998 to 2005.

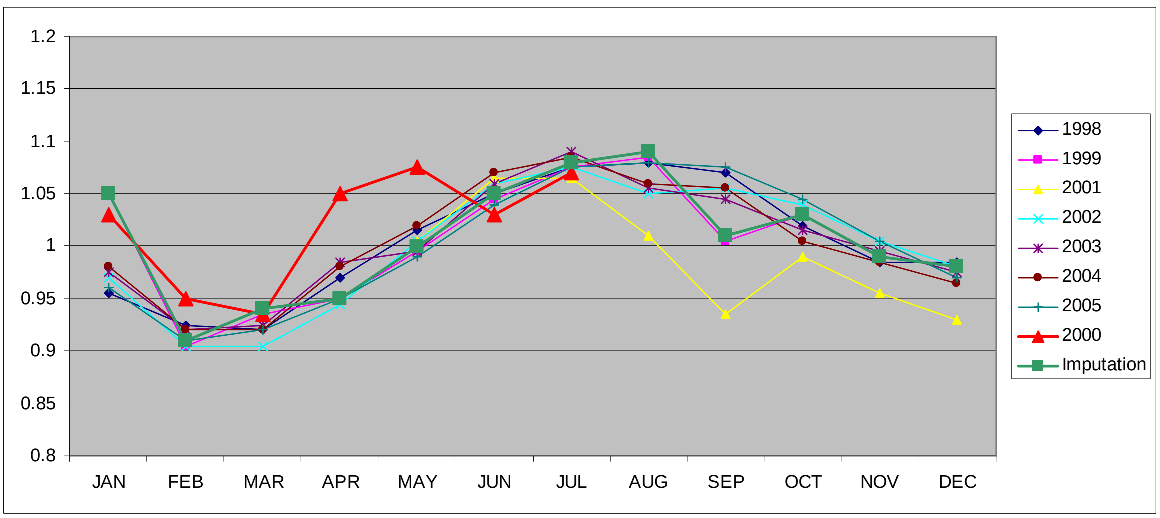
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.055	0.945	0.9	0.945	0.935	0.975	1.18	1.18	1.14	1.045	0.98	0.96
1999	0.965	0.885	0.895	0.95	0.945	1.12	1.145	1.195	1.145	1.095	1.045	1.04
2001	1.005	0.9	0.905	0.935	0.96	1.055	1.175	1.14	1.16	1.03	0.96	0.935
2002	1.02	0.945	0.91	0.955	0.975	1.055	1.155	1.15	1.085	1.04	0.97	1.01
2003	0.98	0.925	0.925	0.955	0.945	1.065	1.14	1.125	1.085	1.03	0.97	0.97
2004	1	0.925	0.905	0.96	0.97	1.04	1.135	1.17	1.105	1.035	1.015	0.99
2005	0.965	0.905	0.905	0.94	0.965	1.055	1.1	1.145	1.1	1.03	1.005	0.955
2000	0.98	0.88	0.875				1.15	1.14	1.08	1.01	0.95	0.93
Imputation	0.97	0.89	0.9	0.95	0.95	1.05	1.15	1.2	1.15	1.1	1.05	1.04
Source	1999	1999	1999	1999	1999	AVG	1999	1999	1999	1999	1999	1999



B.8 Imputation for Site 140079

For site 140079, MSFs for all months are borrowed from 1999.

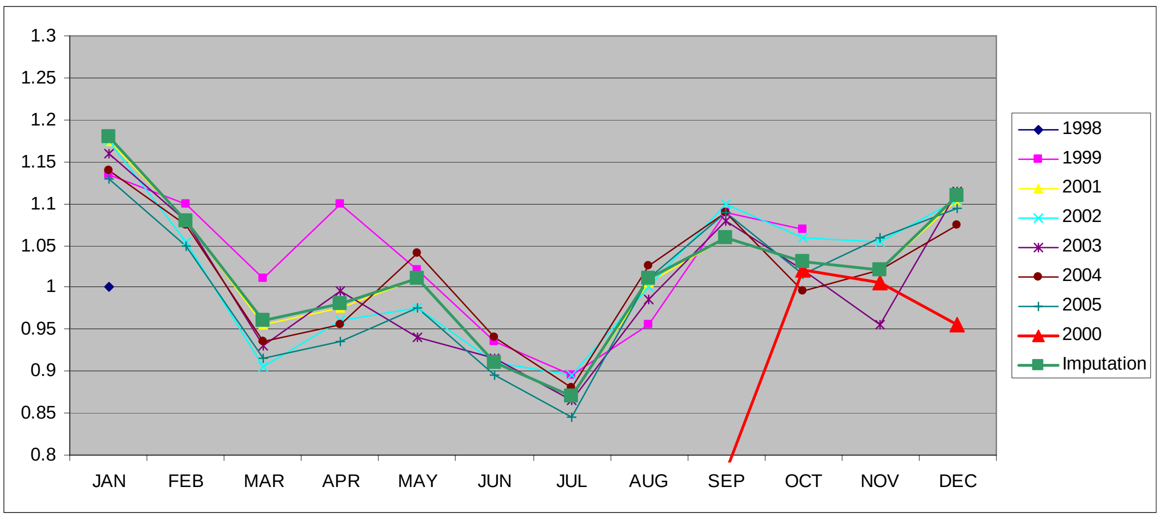
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	0.955	0.925	0.92	0.97	1.015	1.05	1.075	1.08	1.07	1.02	0.985	0.985
1999	1.05	0.905	0.935	0.95	0.995	1.045	1.075	1.085	1.005	1.03	0.99	0.98
2001					1.005	1.065	1.065	1.01	0.935	0.99	0.955	0.93
2002	0.97	0.905	0.905	0.945	1.005	1.06	1.075	1.05	1.055	1.04	1.005	0.98
2003	0.975	0.92	0.925	0.985	0.995	1.06	1.09	1.055	1.045	1.015	0.995	0.975
2004	0.98	0.92	0.92	0.98	1.02	1.07	1.085	1.06	1.055	1.005	0.985	0.965
2005	0.96	0.91	0.92	0.95	0.99	1.04	1.075	1.08	1.075	1.045	1.005	0.97
2000	1.03	0.95	0.935	1.05	1.075	1.03	1.07					
Imputation	1.05	0.91	0.94	0.95	1	1.05	1.08	1.09	1.01	1.03	0.99	0.98
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



B.9 Imputation for Site 290269

For site 269904, MSFs for all months are borrowed from 2001

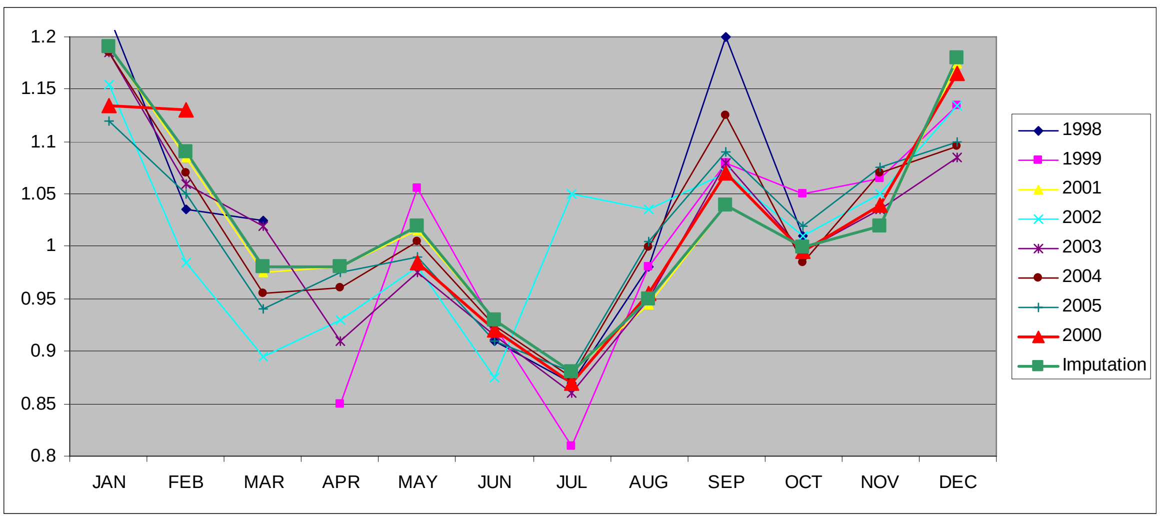
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1											
1999	1.135	1.1	1.01	1.1	1.02	0.935	0.895	0.955	1.09	1.07		
2001	1.175	1.08	0.955	0.975	1.01	0.91	0.87	1.005	1.06	1.03	1.020	1.105
2002	1.175	1.055	0.905	0.960	0.975	0.91	0.895	1	1.1	1.06	1.055	1.105
2003	1.16	1.08	0.93	0.995	0.94	0.915	0.865	0.985	1.08	1.02	0.955	1.115
2004	1.14	1.075	0.935	0.955	1.04	0.94	0.88	1.025	1.09	0.995	1.02	1.075
2005	1.13	1.05	0.915	0.935	0.975	0.895	0.845	1.01	1.09	1.015	1.06	1.095
2000									0.78	1.02	1.005	0.955
Imputation	1.18	1.08	0.96	0.98	1.01	0.91	0.87	1.01	1.06	1.03	1.02	1.11
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



B.10 Imputation for Site 299936

For site 299936, MSFs for all months are borrowed from 2001

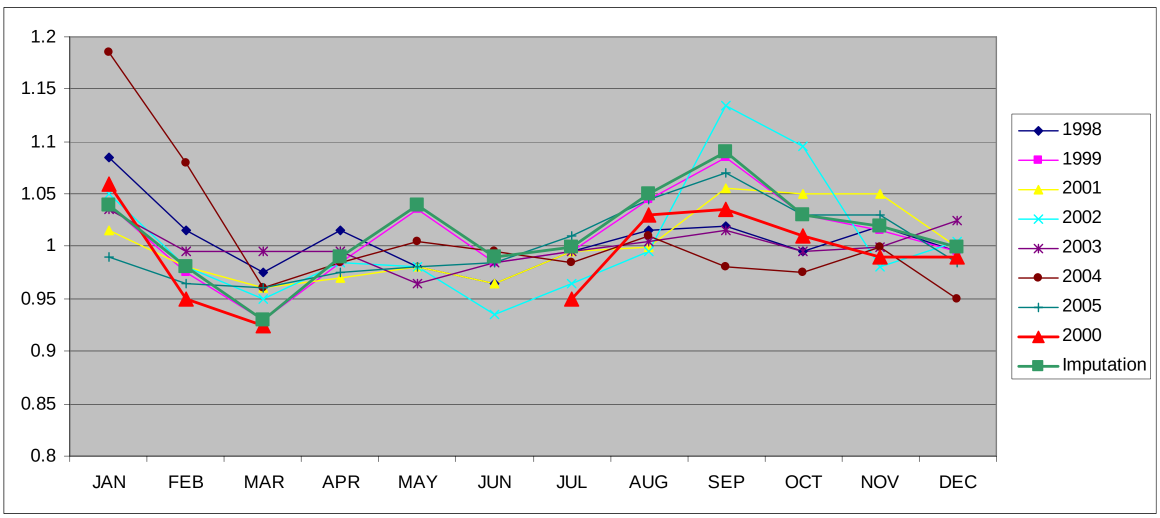
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.22	1.035	1.025			0.91	0.87	0.98	1.2	1.01		
1999				0.85	1.055	0.925	0.81	0.98	1.08	1.05	1.065	1.135
2001	1.19	1.085	0.975	0.98	1.015	0.93	0.88	0.945	1.04	1	1.02	1.175
2002	1.155	0.985	0.895	0.93	0.98	0.875	1.05	1.035	1.07	1.01	1.05	1.135
2003	1.185	1.06	1.02	0.91	0.975	0.915	0.86	0.95	1.08	0.995	1.035	1.085
2004	1.185	1.07	0.955	0.96	1.005	0.925	0.875	1	1.125	0.985	1.07	1.095
2005	1.12	1.05	0.94	0.975	0.99	0.91	0.88	1.005	1.09	1.02	1.075	1.1
2000	1.135	1.13			0.985	0.92	0.87	0.955	1.07	0.995	1.04	1.165
Imputation	1.19	1.09	0.98	0.98	1.02	0.93	0.88	0.95	1.04	1	1.02	1.18
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



B.11 Imputation for Site 300234

For site 300234, MSFs for all months are borrowed from 1999

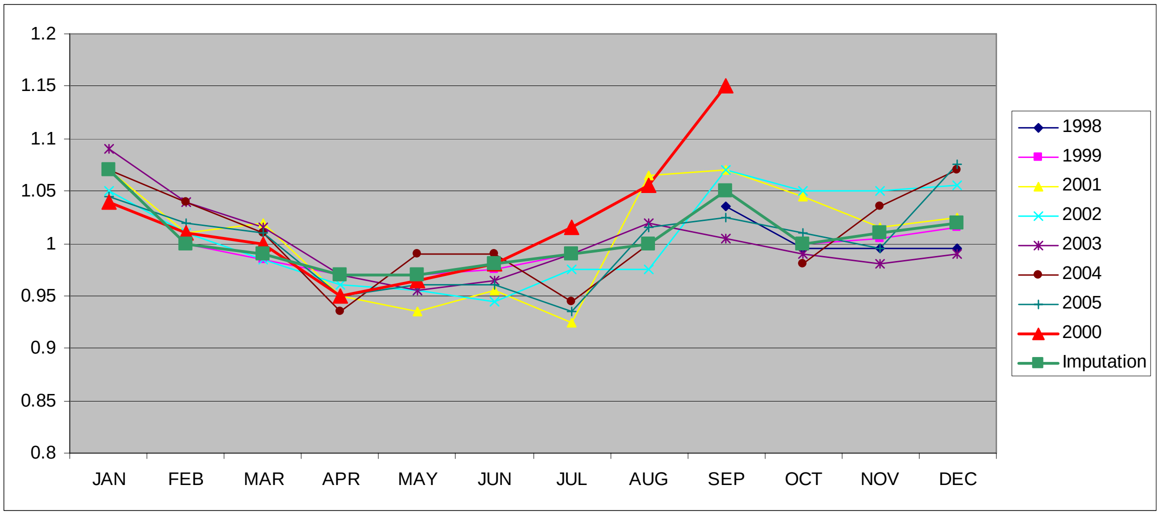
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.085	1.015	0.975	1.015	0.98	0.965	0.995	1.015	1.02	0.995	1.02	0.995
1999	1.04	0.975	0.93	0.985	1.035	0.985	0.995	1.045	1.085	1.03	1.015	0.995
2001	1.015	0.98	0.96	0.97	0.98	0.965	0.995	1	1.055	1.05	1.05	1
2002	1.05	0.98	0.95	0.985	0.98	0.935	0.965	0.995	1.135	1.095	0.98	1.005
2003	1.035	0.995	0.995	0.995	0.965	0.985	0.995	1.005	1.015	0.995	1	1.025
2004	1.185	1.08	0.96	0.985	1.005	0.995	0.985	1.01	0.98	0.975	1	0.95
2005	0.99	0.965	0.96	0.975	0.98	0.985	1.01	1.045	1.07	1.03	1.03	0.985
2000	1.06	0.95	0.925				0.95	1.03	1.035	1.01	0.99	0.99
Imputation	1.04	0.98	0.93	0.99	1.04	0.99	1	1.05	1.09	1.03	1.02	1
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



B.12 Imputation for Site 479944

For site 479944, MSFs for all months are borrowed from 1999

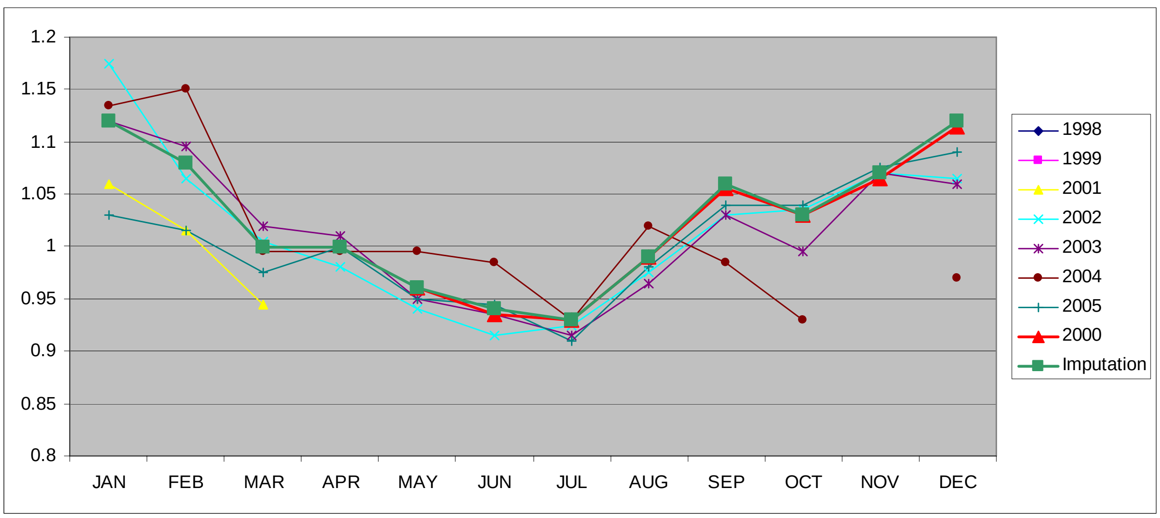
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998									1.035	0.995	0.995	0.995
1999	1.07	1	0.985	0.97	0.97	0.975	0.99	1	1.05	1	1.005	1.015
2001	1.07	1.01	1.02	0.95	0.935	0.955	0.925	1.065	1.07	1.045	1.015	1.025
2002	1.05	1.01	0.985	0.96	0.955	0.945	0.975	0.975	1.07	1.05	1.05	1.055
2003	1.09	1.04	1.015	0.97	0.955	0.965	0.99	1.02	1.005	0.99	0.98	0.99
2004	1.07	1.04	1.01	0.935	0.99	0.99	0.945	1		0.98	1.035	1.07
2005	1.045	1.02	1.01	0.95	0.96	0.96	0.935	1.015	1.025	1.01	0.995	1.075
2000	1.04	1.01	1	0.95	0.965	0.98	1.015	1.055	1.15			
Imputation	1.07	1	0.99	0.97	0.97	0.98	0.99	1	1.05	1	1.01	1.02
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



B.13 Imputation for Site 480348

For site 480348, MSFs for May to December are from 2000. For January to April, MSFs are estimated as the average of year 2002 to 2005.

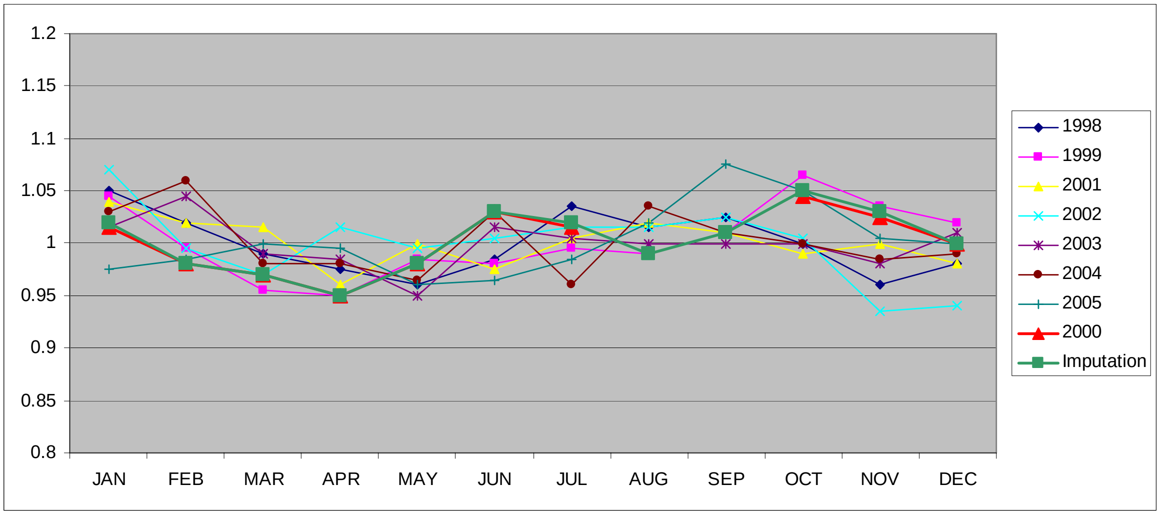
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998												
1999												
2001	1.06	1.015	0.945									
2002	1.175	1.065	1.005	0.98	0.94	0.915	0.925	0.975	1.03	1.035	1.07	1.065
2003	1.12	1.095	1.02	1.01	0.95	0.935	0.915	0.965	1.03	0.995	1.07	1.06
2004	1.135	1.15	0.995	0.995	0.995	0.985	0.93	1.02	0.985	0.93		0.97
2005	1.03	1.015	0.975	1	0.95	0.945	0.91	0.98	1.04	1.04	1.075	1.09
2000					0.96	0.935	0.93	0.99	1.055	1.03	1.065	1.115
Imputation	1.12	1.08	1	1	0.96	0.94	0.93	0.99	1.06	1.03	1.07	1.12
Source	AVG	AVG	AVG	AVG	2000	2000	2000	2000	2000	2000	2000	2000



B.14 Imputation for Site 540245

For site 540245, MSFs for all months except August and September are from 2000. For August and September, MSFs are borrowed from 1999.

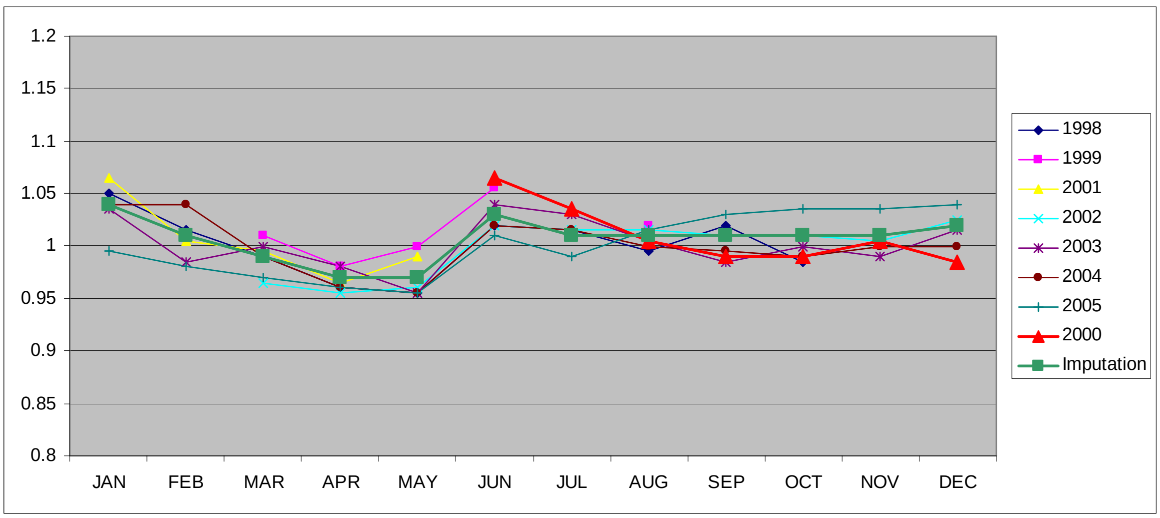
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.05	1.02	0.99	0.975	0.96	0.985	1.035	1.015	1.025	1	0.96	0.98
1999	1.045	0.995	0.955	0.95	0.985	0.98	0.995	0.99	1.01	1.065	1.035	1.02
2001	1.04	1.02	1.015	0.96	1	0.975	1.005	1.02	1.01	0.99	1	0.98
2002	1.07	0.995	0.97	1.015	0.995	1.005	1.015	1.015	1.025	1.005	0.935	0.94
2003	1.015	1.045	0.99	0.985	0.95	1.015	1.005	1	1	1	0.98	1.01
2004	1.03	1.06	0.98	0.98	0.965	1.03	0.96	1.035	1.01	1	0.985	0.99
2005	0.975	0.985	1	0.995	0.96	0.965	0.985	1.02	1.075	1.05	1.005	1
2000	1.015	0.98	0.97	0.95	0.98	1.03	1.015			1.045	1.025	1
Imputation	1.02	0.98	0.97	0.95	0.98	1.03	1.02	0.99	1.01	1.05	1.03	1
Source	2000	2000	2000	2000	2000	2000	2000	1999	1999	2000	2000	2000



B.15 Imputation for Site 550211

For site 550211, MSFs for all months are estimated as the average of all the available data from year 1998 to 2005.

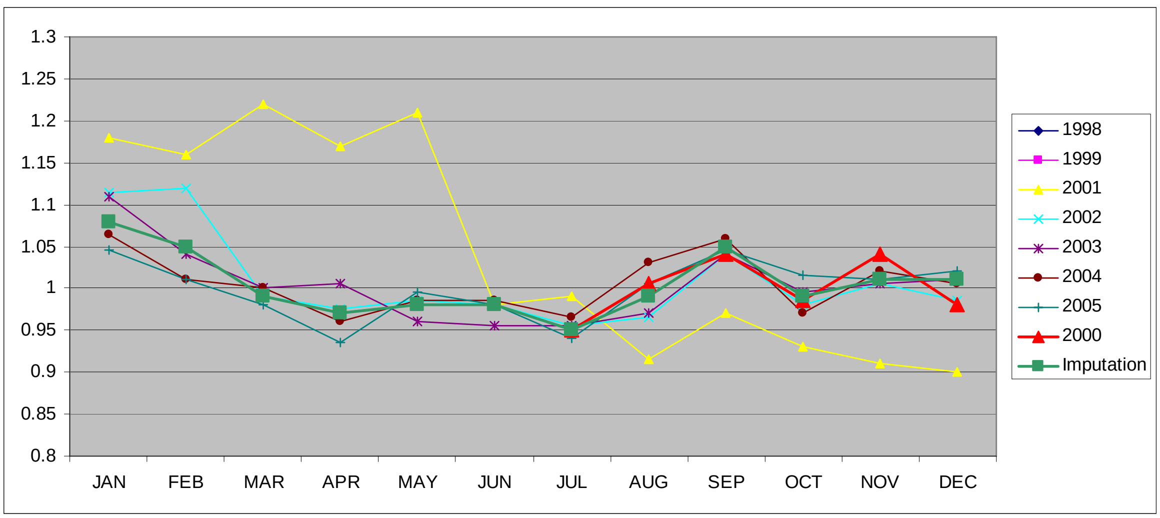
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.05	1.015	0.99	0.96	0.955	1.02	1.015	0.995	1.02	0.985		
1999			1.01	0.98	1	1.055		1.02		1.01		
2001	1.065	1.005	0.995	0.965	0.99							
2002			0.965	0.955	0.96	1.02	1.015	1.015	1.01	1.01	1.005	1.025
2003	1.035	0.985	1	0.98	0.955	1.04	1.03	1.005	0.985	1	0.99	1.015
2004	1.04	1.04	0.99	0.96	0.955	1.02	1.015	1	0.995	0.99	1	1
2005	0.995	0.98	0.97	0.96	0.955	1.01	0.99	1.015	1.03	1.035	1.035	1.04
2000						1.065	1.035	1.005	0.99	0.99	1.005	0.985
Imputation	1.04	1.01	0.99	0.97	0.97	1.03	1.01	1.01	1.01	1.01	1.01	1.02
Source	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG



B.16 Imputation for Site 550349

For site 550349, MSFs for all months are estimated as the average of year 2002 to 2005.

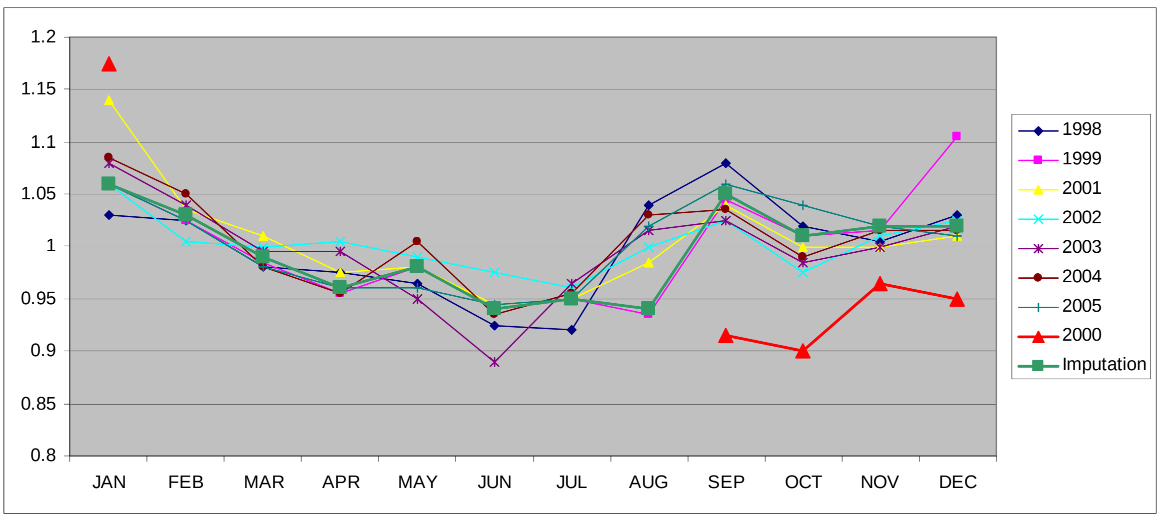
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998												
1999												
2001	1.18	1.16	1.22	1.17	1.21	0.98	0.99	0.915	0.97	0.93	0.91	0.9
2002	1.115	1.12	0.99	0.975	0.985	0.98	0.955	0.965	1.04	0.98	1.005	0.985
2003	1.11	1.04	1	1.005	0.96	0.955	0.955	0.97	1.04	0.995	1.005	1.01
2004	1.065	1.01	1	0.96	0.985	0.985	0.965	1.03	1.06	0.97	1.02	1.005
2005	1.045	1.01	0.98	0.935	0.995	0.98	0.94	1.005	1.045	1.015	1.01	1.02
2000							0.95	1.005	1.04	0.985	1.04	0.98
Imputation	1.08	1.05	0.99	0.97	0.98	0.98	0.95	0.99	1.05	0.99	1.01	1.01
Source	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG



B.17 Imputation for Site 560301

For site 560301, MSFs for all months except December are borrowed from 1999. For December, MSF is estimated as the average of year 1998, 2001 to 2005.

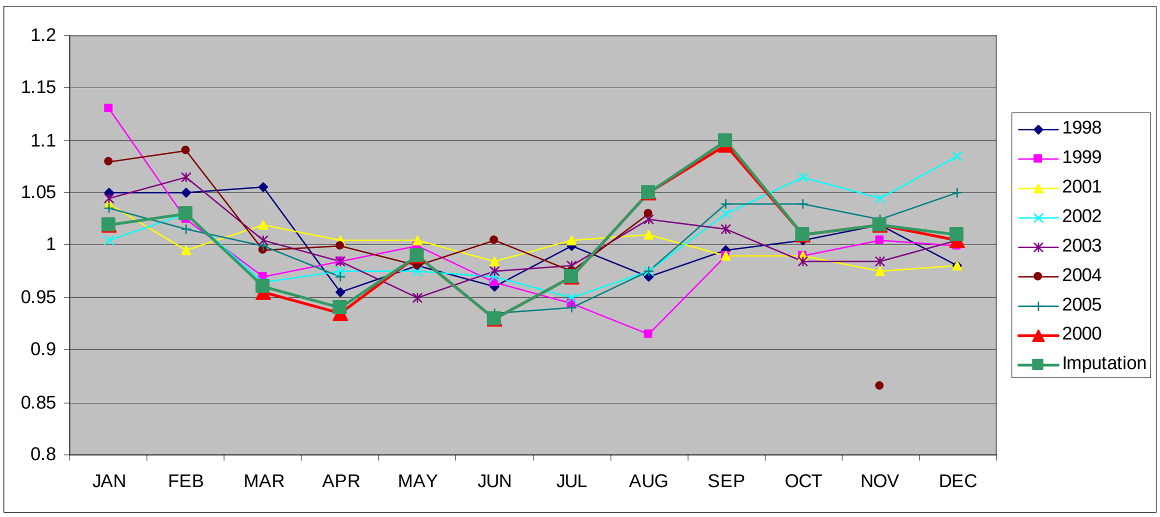
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.03	1.025	0.98	0.975	0.965	0.925	0.92	1.04	1.08	1.02	1.005	1.03
1999	1.06	1.025	0.985	0.955	0.98	0.94	0.95	0.935	1.045	1.01	1.015	1.105
2001	1.14	1.035	1.01	0.975	0.98	0.945	0.95	0.985	1.04	1	1	1.01
2002	1.06	1.005	1	1.005	0.99	0.975	0.96	1	1.025	0.975	1.01	1.025
2003	1.08	1.04	0.995	0.995	0.95	0.89	0.965	1.015	1.025	0.985	1	1.02
2004	1.085	1.05	0.98	0.955	1.005	0.935	0.955	1.03	1.035	0.99	1.015	1.015
2005	1.06	1.025	0.98	0.96	0.96	0.945	0.95	1.02	1.06	1.04	1.02	1.01
2000	1.175								0.915	0.9	0.965	0.95
Imputation	1.06	1.03	0.99	0.96	0.98	0.94	0.95	0.94	1.05	1.01	1.02	1.02
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	AVG



B.18 Imputation for Site 580251

For site 580251, MSFs for all months except February are from 2000. For February, MSF is borrowed from 1999.

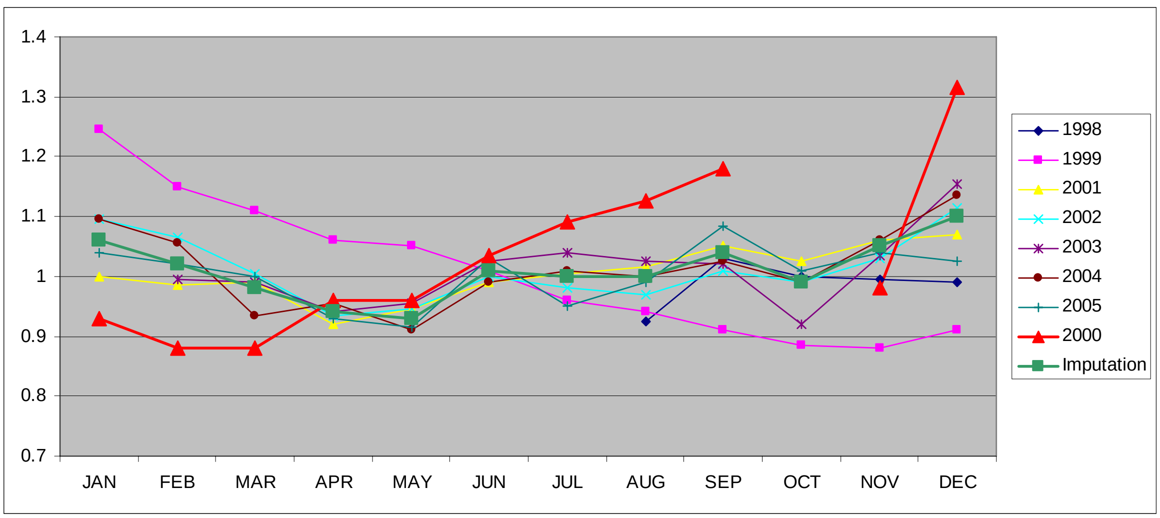
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.05	1.05	1.055	0.955	0.98	0.96	1	0.97	0.995	1.005	1.02	0.98
1999	1.13	1.025	0.97	0.985	1	0.965	0.945	0.915	0.99	0.99	1.005	1
2001	1.04	0.995	1.02	1.005	1.005	0.985	1.005	1.01	0.99	0.99	0.975	0.98
2002	1.005	1.03	0.965	0.975	0.975	0.97	0.95	0.975	1.03	1.065	1.045	1.085
2003	1.045	1.065	1.005	0.985	0.95	0.975	0.98	1.025	1.015	0.985	0.985	1.005
2004	1.08	1.09	0.995	1	0.98	1.005	0.975	1.03			0.865	
2005	1.035	1.015	1	0.97		0.935	0.94	0.975	1.04	1.04	1.025	1.05
2000	1.02		0.955	0.935	0.99	0.93	0.97	1.05	1.095	1.01	1.02	1.005
Imputation	1.02	1.03	0.96	0.94	0.99	0.93	0.97	1.05	1.1	1.01	1.02	1.01
Source	2000	1999	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000



B.19 Imputation for Site 599946

For site 599946, MSFs for all months are estimated as the average of year from 2001 to 2005.

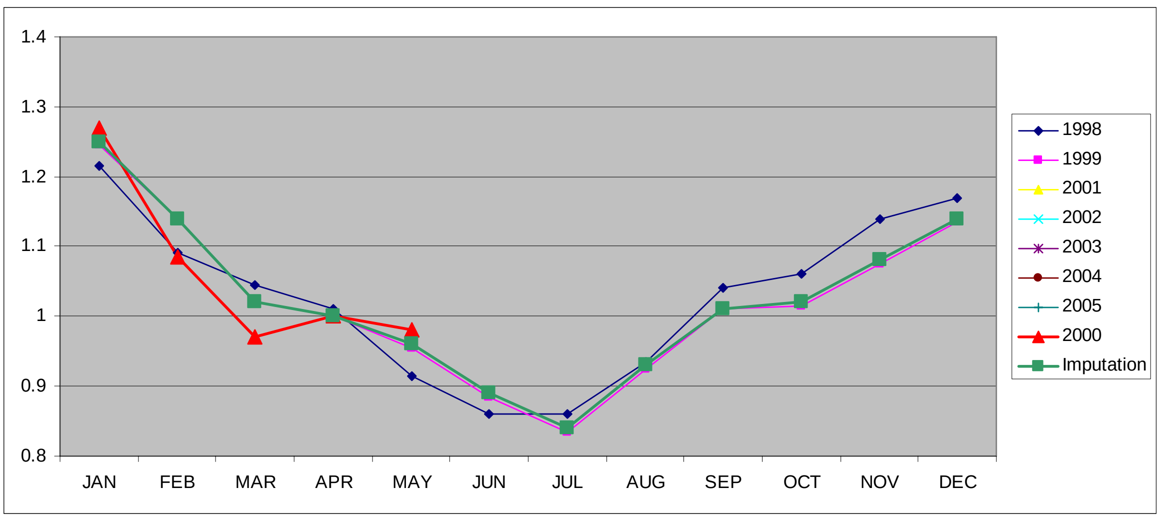
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998								0.925	1.03	1	0.995	0.99
1999	1.245	1.15	1.11	1.06	1.05	1.01	0.96	0.94	0.91	0.885	0.88	0.91
2001	1	0.985	0.99	0.92	0.945	0.99	1.005	1.015	1.05	1.025	1.06	1.07
2002	1.095	1.065	1.005	0.935	0.945	1	0.98	0.97	1.01	0.99	1.03	1.115
2003		0.995	0.99	0.94	0.955	1.025	1.04	1.025	1.02	0.92	1.035	1.155
2004	1.095	1.055	0.935	0.955	0.91	0.99	1.01	1	1.025	0.99	1.06	1.135
2005	1.04	1.02	1	0.93	0.915	1.03	0.95	0.99	1.085	1.01	1.04	1.025
2000	0.93	0.88	0.88	0.96	0.96	1.035	1.09	1.125	1.18		0.98	1.315
Imputation	1.06	1.02	0.98	0.94	0.93	1.01	1	1	1.04	0.99	1.05	1.1
Source	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG



B.20 Imputation for Site 609938

For site 609938, MSFs for all months are borrowed from 1999.

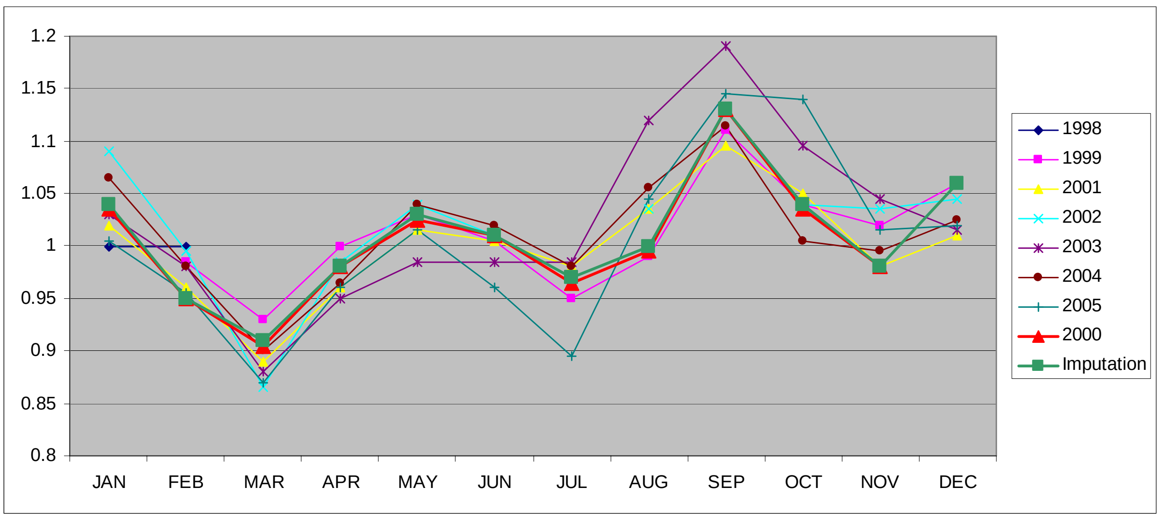
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.215	1.09	1.045	1.01	0.915	0.86	0.86	0.935	1.04	1.06	1.14	1.17
1999	1.245	1.14	1.02	1	0.955	0.885	0.835	0.925	1.01	1.015	1.075	1.135
2001												
2002												
2003												
2004												
2005												
2000	1.27	1.085	0.97	1	0.98							
Imputation	1.25	1.14	1.02	1	0.96	0.89	0.84	0.93	1.01	1.02	1.08	1.14
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



B.21 Imputation for Site 700134

For site 700134, MSFs for all months except December are from 2000. For December, MSF is borrowed from 1999.

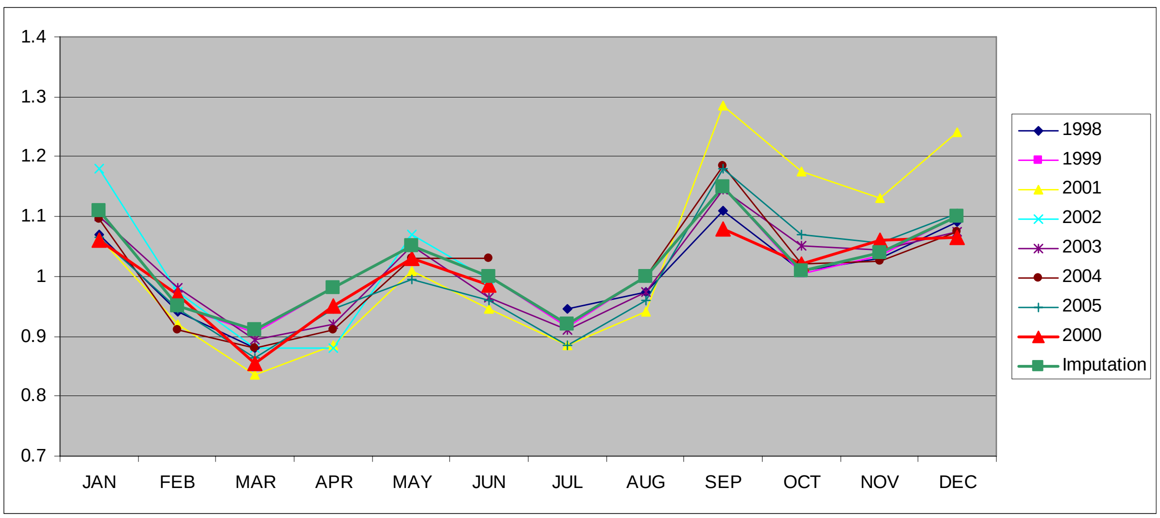
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1	1										
1999		0.985	0.93	1	1.03	1.005	0.95	0.99	1.11	1.04	1.02	1.06
2001	1.02	0.96	0.89	0.96	1.015	1.005	0.98	1.035	1.095	1.05	0.98	1.01
2002	1.09	0.995	0.865	0.985	1.04	1.01		1.035		1.04	1.035	1.045
2003	1.03	0.98	0.88	0.95	0.985	0.985	0.985	1.12	1.19	1.095	1.045	1.015
2004	1.065	0.98	0.9	0.965	1.04	1.02	0.98	1.055	1.115	1.005	0.995	1.025
2005	1.005	0.955	0.87	0.96	1.015	0.96	0.895	1.045	1.145	1.14	1.015	1.02
2000	1.035	0.95	0.905	0.98	1.025	1.01	0.965	0.995	1.13	1.035	0.98	
Imputation	1.04	0.95	0.91	0.98	1.03	1.01	0.97	1	1.13	1.04	0.98	1.06
Source	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999



B.22 Imputation for Site 700223

For site 700234, MSFs for all months are borrowed from 1999.

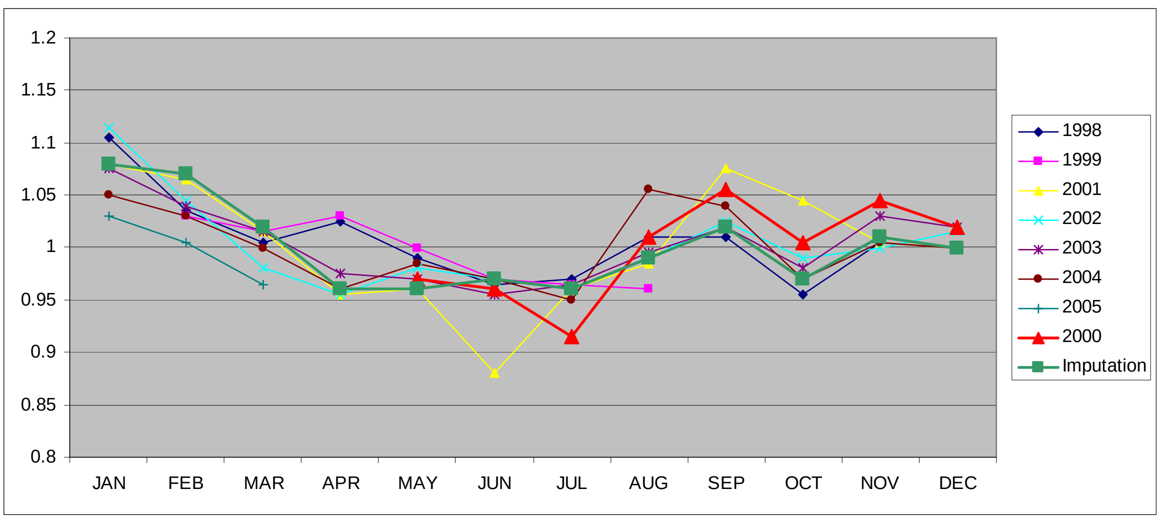
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.07	0.94	0.88				0.945	0.975	1.11	1.01	1.03	1.09
1999	1.11	0.95	0.905	0.98	1.05	1	0.915	1	1.15	1.005	1.035	1.1
2001	1.065	0.92	0.835	0.885	1.01	0.945	0.885	0.94	1.285	1.175	1.13	1.24
2002	1.18	0.975	0.88	0.88	1.07	0.995						
2003	1.1	0.98	0.895	0.92	1.05	0.965	0.91	0.975	1.145	1.05	1.045	1.075
2004	1.095	0.91	0.88	0.91	1.03	1.03		1	1.185	1.02	1.025	1.075
2005	1.065	0.945	0.865	0.945	0.995	0.96	0.885	0.96	1.18	1.07	1.055	1.105
2000	1.06	0.97	0.855	0.95	1.03	0.985			1.08	1.02	1.06	1.065
Imputation	1.11	0.95	0.91	0.98	1.05	1	0.92	1	1.15	1.01	1.04	1.1
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999



B.23 Imputation for Site 740047

For site 740047, MSFs for all months except June, September, and October, are borrowed from 2001. For June, September, and October, MSFs are estimated as the average of all available data from year 1998 to 2004.

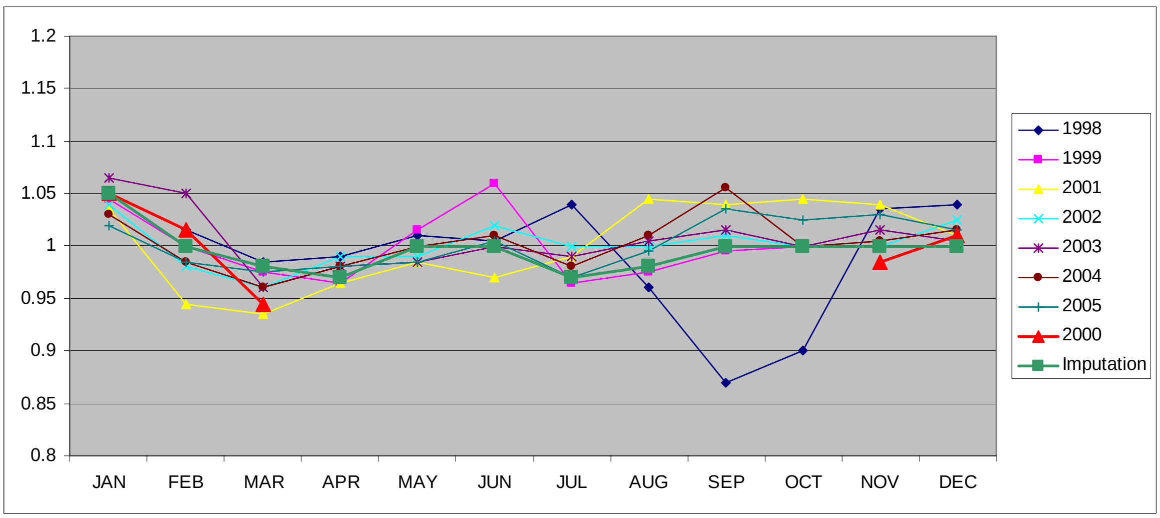
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.105	1.035	1.005	1.025	0.99	0.965	0.97	1.01	1.01	0.955	1.005	1
1999		1.03	1.015	1.03	1	0.97	0.965	0.96				
2001	1.08	1.065	1.015	0.955	0.96	0.88	0.96	0.985	1.075	1.045	1.005	1
2002	1.115	1.045	0.98	0.955	0.98	0.97	0.96	0.99	1.025	0.99	1	1.015
2003	1.075	1.04	1.015	0.975	0.97	0.955	0.965	0.995	1.02	0.98	1.03	1.02
2004	1.05	1.03	1	0.96	0.985	0.97	0.95	1.055	1.04	0.97	1.005	1
2005	1.03	1.005	0.965									
2000					0.97	0.96	0.915	1.01	1.055	1.005	1.045	1.02
Imputation	1.08	1.07	1.02	0.96	0.96	0.97	0.96	0.99	1.02	0.97	1.01	1
Source	2001	2001	2001	2001	2001	AVG	2001	2001	AVG	AVG	2001	2001



B.24 Imputation for Site 750104

For site 750104, MSFs for all months except May, and June are borrowed from 1999. For May, and June, MSFs are estimated as the average of all available data from year 1998 to 2005.

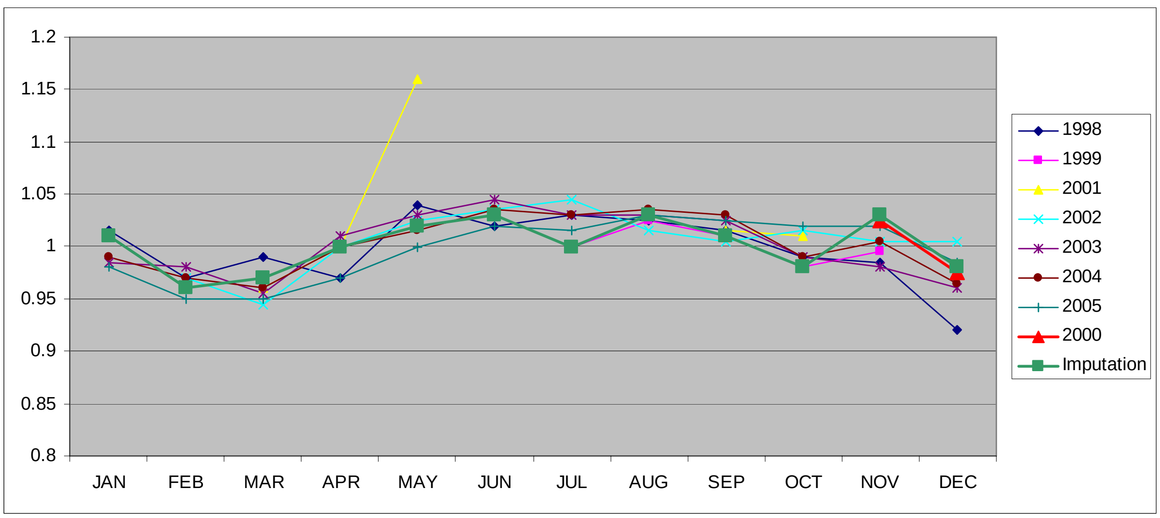
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.05	1.015	0.985	0.99	1.01	1.005	1.04	0.96	0.87	0.9	1.035	1.04
1999	1.045	1	0.975	0.965	1.015	1.06	0.965	0.975	0.995	1	1	1
2001	1.035	0.945	0.935	0.965	0.985	0.97	0.99	1.045	1.04	1.045	1.04	1.01
2002	1.04	0.98	0.96	0.99	0.99	1.02	1	1	1.01	1	1	1.025
2003	1.065	1.05	0.96	0.98	0.985	1	0.99	1.005	1.015	1	1.015	1.005
2004	1.03	0.985	0.96	0.98	1	1.01	0.98	1.01	1.055	1	1.005	1.015
2005	1.02	0.985	0.975	0.98	0.985	1.005	0.97	0.995	1.035	1.025	1.03	1.015
2000	1.05	1.015	0.945								0.985	1.01
Imputation	1.05	1	0.98	0.97	1	1	0.97	0.98	1	1	1	1
Source	1999	1999	1999	1999	AVG	AVG	1999	1999	1999	1999	1999	1999



B.25 Imputation for Site 799925

For site 799925, MSFs for all months except November and December are borrowed from 1999. For November and December, MSFs are from 2000.

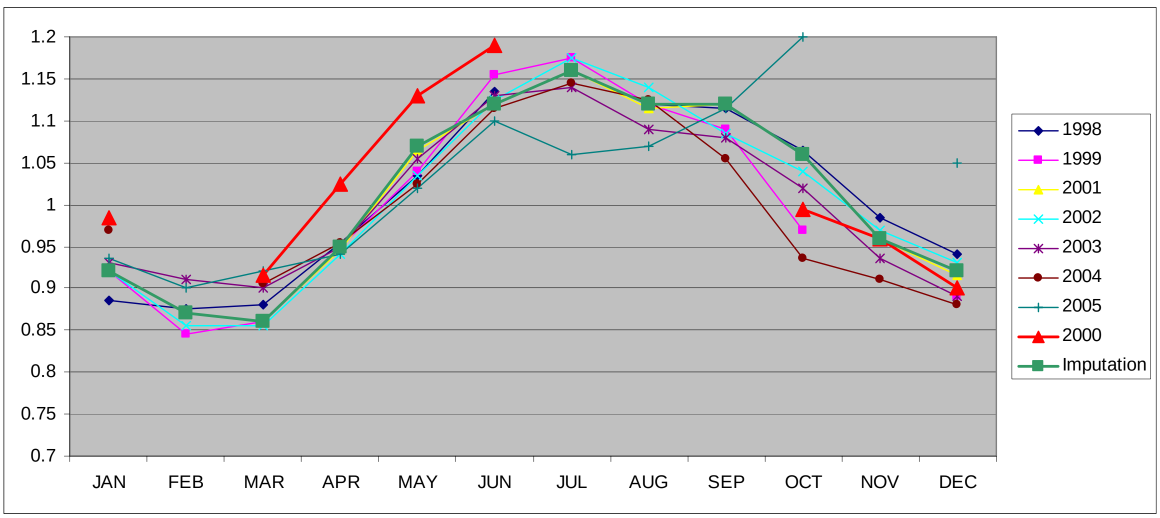
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	1.015	0.97	0.99	0.97	1.04	1.02	1.03	1.025	1.015	0.99	0.985	0.92
1999	1.01	0.96	0.97	1	1.02	1.03	1	1.025	1.01	0.98	0.995	
2001	1.01		0.96	1	1.16				1.015	1.01		
2002		0.97	0.945	1	1.025	1.035	1.045	1.015	1.005	1.015	1.005	1.005
2003	0.985	0.98	0.955	1.01	1.03	1.045	1.03	1.03	1.025	0.99	0.98	0.96
2004	0.99	0.97	0.96	1	1.015	1.035	1.03	1.035	1.03	0.99	1.005	0.965
2005	0.98	0.95	0.95	0.97	1	1.02	1.015	1.03	1.025	1.02	1.02	0.985
2000											1.025	0.975
Imputation	1.01	0.96	0.97	1	1.02	1.03	1	1.03	1.01	0.98	1.03	0.98
Source	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	2000	2000



B.26 Imputation for Site 890289

For site 890289, MSFs for all months are borrowed from 2001.

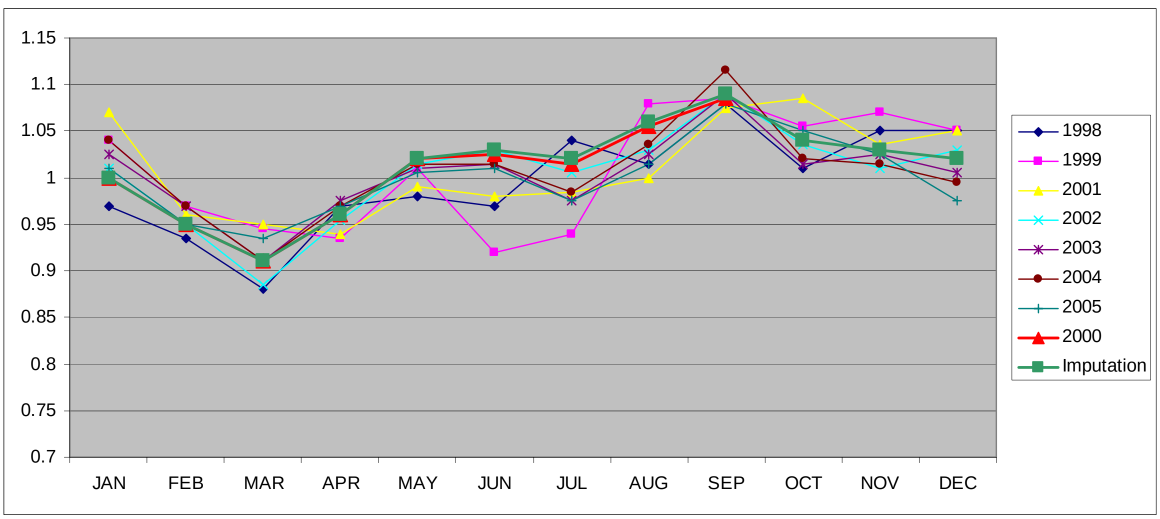
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	0.885	0.875	0.88	0.955	1.035	1.135		1.12	1.115	1.065	0.985	0.94
1999	0.92	0.845	0.86	0.95	1.04	1.155	1.175	1.12	1.09	0.97		0.89
2001	0.92	0.87	0.86	0.945	1.065	1.12	1.16	1.115	1.12	1.06	0.96	0.915
2002	0.92	0.855	0.855	0.94	1.035	1.125	1.175	1.14	1.085	1.04	0.97	0.93
2003	0.93	0.91	0.9	0.95	1.055	1.13	1.14	1.09	1.08	1.02	0.935	0.89
2004	0.97		0.905	0.955	1.025	1.115	1.145	1.125	1.055	0.935	0.91	0.88
2005	0.935	0.9	0.92	0.94	1.02	1.1	1.06	1.07	1.115	1.2		1.05
2000	0.985		0.915	1.025	1.13	1.19				0.995	0.96	0.9
Imputation	0.92	0.87	0.86	0.95	1.07	1.12	1.16	1.12	1.12	1.06	0.96	0.92
Source	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001



B.27 Imputation for Site 920065

For site 920065, MSFs for all months except October, November, and December are from 2000. For the last three months, MSFs are estimated as the average of year 1998 to 1999, and 2001 to 2005.

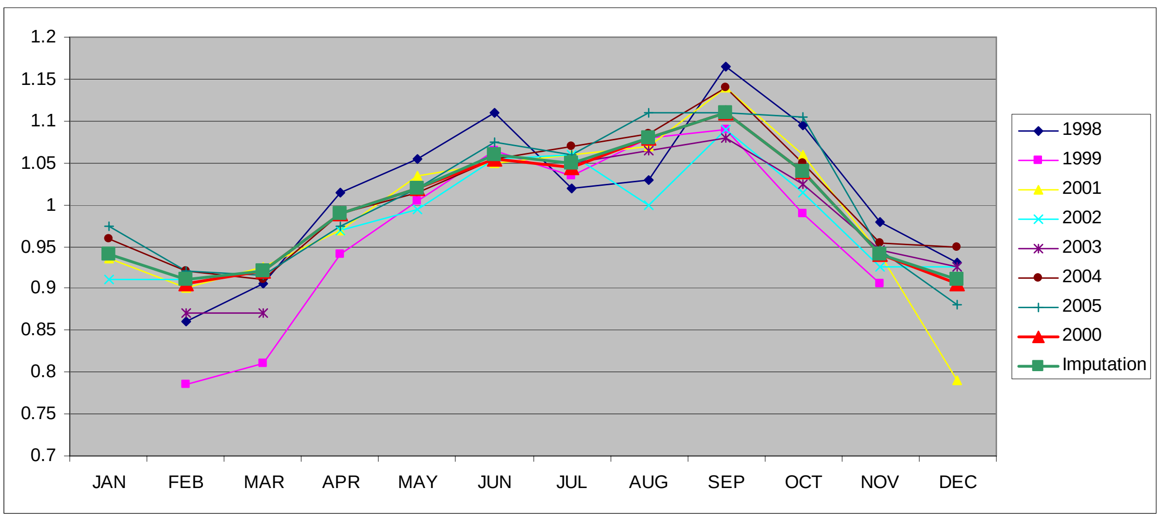
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998	0.97	0.935	0.88	0.97	0.98	0.97	1.04	1.015	1.08	1.01	1.05	1.05
1999	1.04	0.97	0.945	0.935	1.01	0.92	0.94	1.08	1.085	1.055	1.07	1.05
2001	1.07	0.96	0.95	0.94	0.99	0.98	0.985	1	1.075	1.085	1.035	1.05
2002	1.01	0.95	0.885	0.955	1.015	1.03	1.005	1.03	1.09	1.035	1.01	1.03
2003	1.025	0.97	0.91	0.975	1.01	1.015	0.975	1.025	1.09	1.015	1.025	1.005
2004	1.04	0.97	0.91	0.97	1.015	1.015	0.985	1.035	1.115	1.02	1.015	0.995
2005	1.01	0.95	0.935	0.97	1.005	1.01	0.975	1.015	1.08	1.05	1.025	0.975
2000	1	0.95	0.91	0.96	1.02	1.025	1.015	1.055	1.085			
Imputation	1	0.95	0.91	0.96	1.02	1.03	1.02	1.06	1.09	1.04	1.03	1.02
Source	2000	2000	2000	2000	2000	2000	2000	2000	2000	AVG	AVG	AVG



B.28 Imputation for Site 939935

For site 939935, MSFs for all months except January are from 2000. For January, MSF is borrowed from 2001.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1998		0.86	0.905	1.015	1.055	1.11	1.02	1.03	1.165	1.095	0.98	0.93
1999		0.785	0.81	0.94	1.005	1.065	1.035	1.08	1.09	0.99	0.905	
2001	0.935	0.9	0.925	0.97	1.035	1.05	1.06	1.07	1.14	1.06	0.94	0.79
2002	0.91	0.91		0.97	0.995	1.055	1.06	1	1.09	1.015	0.925	0.925
2003		0.87	0.87			1.06	1.05	1.065	1.08	1.025	0.945	0.925
2004	0.96	0.92	0.91	0.99	1.015	1.055	1.07	1.085	1.14	1.05	0.955	0.95
2005	0.975	0.92	0.915	0.975	1.02	1.075	1.06	1.11	1.11	1.105	0.945	0.88
2000		0.905	0.92	0.99	1.02	1.055	1.045	1.08	1.11	1.04	0.94	0.905
Imputation	0.94	0.91	0.92	0.99	1.02	1.06	1.05	1.08	1.11	1.04	0.94	0.91
Source	2001	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000



APPENDIX C. EMPLOYMENT VARIABLES

Table gives the name, definition, and a description of each of the employment categories in columns 2, 3, and 4. The first column provides the correspondence SIC code.

SIC	*Variable*	*Definition*	*Description*
1	*AgriP*	Agricultural Production-Crops	Agriculture workers as a percentage of total workers
9	*FishP*	Fishing & Hunting workers as a percentage of total workers	Fishing, hunting, trapping
42	*TranP*	Motor Freight Transportation/Warehouse	Transportation workers as a percentage of total workers
43		United States Postal Service	
44		Water Transportation	
45		Transportation by Air	
50	*WholP*	Wholesale Trade-Durable Goods	Wholesale workers as a percentage of total workers
51		Wholesale Trade-Nondurable Goods	
52	*RetailP*	Building Materials & Hardware	Retail workers as a percentage of total workers
53		General Merchandise Stores	
54		Food Stores	
55		Automotive Dealers & Service Station	
56		Apparel & Accessory Stores	
57		Home Furniture & Furnishings Stores	
59		Miscellaneous Retail	
58	*RestaP*	Eating & Drinking Places	Restaurant workers as a percentage of total workers
70	*HotelP*	Hotels Rooming Houses & Camps	Hotel & Camp workers as a percentage of total workers
82	*EduP*	Educational Services	Education workers as a percentage of total workers
79	*RecServP*	Amusement & Recreation Services	Amusement & Recreation Services workers as a percentage of total workers
84	*MuseumP*	Museums Art Galleries & Gardens	Museums Art Galleries & Gardens workers as a percentage of total workers
10	*MineP*	Metal Mining	Mining workers as a percentage of total workers
12		Coal Mining	
13		Oil & Gas Extraction	
14		Mining & Quarrying-Nonmetallic Miner	
20	*ManuP*	Food & Kindred Products Manufacture	Manufacturing workers as a percentage of total workers
21		Tobacco Products Manufacturing	
22		Textile Mill Products Manufacturing	
23		Apparel & Other Finished Products Manufacturing	
24		Lumber & Wood Prods Except Furniture Manufacturing	
25		Furniture & Fixtures Manufacturing	
26		Paper & Allied Products Manufacturing	
27		Printing Publishing & Allied Industry	

28		Chemicals & Allied Products Manufacturing	
29		Petroleum Refining & Related Industry Manufacturing	
30		Rubber & Miscellaneous Plastics Manufacturing	
31		Leather & Leather Products Manufacturing	
32		Stone Clay Glass & Concrete Products Manufacturing	
33		Primary Metal Industries Manufacturing	
34		Fabricated Metal Products Manufacturing	
35		Industrial & Commercial Machinery Manufacturing	
36		Electronic & Other Electrical Equipment	
37		Transportation Equipment Manufacturing	
38		Measuring & Analyzing Instruments Manufacturing	
39		Miscellaneous Industries Manufacturing	
60	*ServP*	Depository Institutions	Service workers as a percentage of total workers
61		Non-depository Credit Institutions	
62		Security & Commodity Brokers	
63		Insurance Carriers	
64		Insurance Agents Brokers & Service	
65		Real Estate	
67		Holding & Other Investment Offices	
72		Personal Services	
73		Business Services	
75		Auto Repair Services & Parking	
81		Legal Services	
83		Social Services	
87		Engineering & Accounting & management Services	
86		Membership Organizations	
91	*ServP*	Executive Legislative & General Government	Office workers s a percentage of total workers
92		Justice Public Order & Safety	
93		Public Finance & Taxation Policy	
94		Administration-Human Resource Programs	
95		Admin-Environmental Quality Programs	
96		Administration of Economic Programs	
97		National Security & International Affair	

APPENDIX D. LIST OF MODEL VARIABLES

Variables for Urban Area and Rural Area

Variable	Description	Range	Source	Update Frequency
Rt_Low	Percentage of retired HHs with low income out of total households	0-48.9618	Census	10 years
Rt_High	Percentage of retired HHs with high income out of total households	0-38.7589	Census	10 years
RETIRE	Percentage of retired HHs out of total households	1.5672-65.7629	Census	10 years
AgriP	Agriculture workers as a percentage of total workers	0-56.7071	INFO USA	every year
FishP	Fishing & Hunting workers as a percentage of total workers	0-2.25	INFO USA	every year
TranP	Transportation workers as a percentage of total workers	0-52.1255	INFO USA	every year
WholP	Wholesale workers as a percentage of total workers	0-73.2546	INFO USA	every year
RestP	Restaurant workers as a percentage of total workers	0-59.5177	INFO USA	every year
EdP	Education workers as a percentage of total workers	0-76.0180	INFO USA	every year
RecServP	Amusement & Recreation Services workers as a percentage of total workers	0-53.9735	INFO USA	every year
MineP	Mining workers as a percentage of total workers	0-47.5	INFO USA	every year
ManuP	Manufacturing workers as a percentage of total workers	0-95.7	INFO USA	every year
ServP	Services workers as a percentage of total workers	0-104	INFO USA	every year
OffP	Office workers as a percentage of total workers	0-23.67	INFO USA	every year
ST1	Population percentage under 4 years old	0.0001-0.0497	Census	10 years
ST2	Population percentage of Age 5-17	0.0005-0.2327	Census	10 years
STU21	Population percentage of Age 5-10	0.0002-0.0874	Census	10 years
STU22	Population percentage of Age 11-13	0.0001-0.0529	Census	10 years
STU23	Population percentage of Age 14-17	0.0001-0.0925	Census	10 years
MInc	Median household income	19235-70939	Census	10 years

Variables for Urban Area Only

Variable	Description	Range	Source	Update Frequency
FR	Equals 1 if TTMS is located on a urban freeway; 0 otherwise	0 or 1	FTI	every year

Variable	Description	Range	Source	Update Frequency
PA	Equals 1 if TTMS is located on a urban principle arterial; 0 otherwise	0 or 1	FTI	every year
MA	Equals 1 if TTMS is located on a urban minor arterial; 0 otherwise	0 or 1	FTI	every year
CO	Equals 1 if TTMS is located on a urban collector; 0 otherwise	0 or 1	FTI	every year
LEG	Equals 1 if TTMS is located in Leon County; 0 otherwise	0 or 1		N/A
SU	Equals 1 if TTMS is in the county of UF, FSU, and FAMU; or within three miles of UM or FIT; 0 otherwise	0 or 1		N/A
FU	Equals 1 if TTMS is located within three miles of other state universities; 0 otherwise	0 or 1		N/A
DISN	Equals 1 if TTMS is located in Osceola County; 0 otherwise	0 or 1		N/A
LU1	Equals 1 if TTMS buffer is covering swimming beach land use area; 0 otherwise	0 or 1	FGDL	N/A
LU2	Equals 1 if TTMS buffer is covering golf course land use area; 0 otherwise	0 or 1	FGDL	N/A
LU3	Equals 1 if TTMS buffer is covering marinas and fish camps land use area; 0 otherwise	0 or 1	FGDL	N/A
LU4	Equals 1 if TTMS buffer is covering parks and zoos land use area; 0 otherwise	0 or 1	FGDL	N/A
SHP	Percentage of Seasonal households	0-89.1927	Census	10 years
RtlP	Retail workers as a percentage of total workers	1.3953-64.7342	INFO USA	every year
HotlP	Hotel & Camp workers as a percentage of total workers	0-20.3017	INFO USA	every year
MseumP	Museums art galleries & gardens workers as a percentage of total workers	0.-1.4320	INFO USA	every year

Variables for Rural Area Only

Variable	Description	Range	Source	Update Frequency
PA	Equals 1 if TTMS is located on a rural principle arterial; 0 otherwise	0 or 1	FTI	every year
MA	Equals 1 if TTMS is located on a rural minor arterial; 0 otherwise	0 or 1	FTI	every year

Variable	Description	Range	Source	Update Frequency
CO	Equals 1 if TTMS is located on a rural collector; 0 otherwise	0 or 1	FTI	every year
TF	Truck factor	1.60-41.08	FTI	every year
PPA5	Population aged 5 and under as a percentage of total population	0.0209-0.1462	Census	10 years
PPA6_17	Population aged between 6 and 17 as a percentage of total population	0.0260-0.3508	Census	10 years
PPA22_64	Population aged between 22 and 64 as a percentage of total population	0.4003-0.7964	Census	10 years
PPA18_64	Population aged between 18 and 64 as a percentage of total population	0.4356-0.8439	Census	10 years
PPA6_21	Population aged between 6 and 21 as a percentage of total population	0.0399-0.4022	Census	10 years
PPA18_21	Population aged between 18 and 21 as a percentage of total population	0.0103-0.1710	Census	10 years
PPA65up	Population aged 65 and over as a percentage of total population	0.0261-0.4082	Census	10 years
PDA5	Population density aged 5 and under	0.0001-0.0623	Census	10 years
PDA6_17	Population density aged between 6 and 17	0.0005-0.2202	Census	10 years
PDA22_64	Population density aged between 22 and 64	0.0015-0.5303	Census	10 years
PDA18_64	Population density aged between 18 and 64	0.0016-0.5662	Census	10 years
PDA6_21	Population density aged between 6 and 21	0.0005-0.2561	Census	10 years
PDA18_21	Population density aged between 18 and 21	0.0001-0.0359	Census	10 years
PDA65up	Population density aged 65 and over	0.0002-0.1282	Census	10 years
Dist1	Max of ratio of Population of a metropolitan area to the distance from the TTMS to the Metropolitan area(person/mile)	8210-118356	Census	10 years
Indexdist2	$\left(\sum \frac{\text{Metropolitan population}}{\text{Distance from theTTMS to the metropolitan area}}\right)^{-1}$ (10^{-5} mile/person)	0.59553-2.68335	Census	10 years
Interdist	Distance from a TTMS to the closest highway interchange (mile)	465-112386		
Beachdist	Distance from a TTMS to the closest beach site (meter)	0.61-120.67		
NSHP	Percentage of seasonal households in northern Florida	0-96.4321	Census	10 years
CSHP	Percentage of seasonal households in central Florida	0-24.6406	Census	10 years
SSHP	Percentage of seasonal households in southern Florida	0-92.8253	Census	10 years
NHotlP	Hotel & Camp workers as a percentage of total workers in northern Florida	0-42.6966	INFO USA	every year
CHotlP	Hotel & Camp workers as a percentage of total workers in central Florida	0-6.6473	INFO USA	every year

Variable	Description	Range	Source	Update Frequency
SHotlP	Hotel & Camp workers as a percentage of total workers in southern Florida	0-13.0357	INFO USA	every year
NRtlP	Retail workers as a percentage of total workers in northern Florida	0-71.2273	INFO USA	every year
CRtlP	Retail workers as a percentage of total workers in central Florida	0-21.1563	INFO USA	every year
SRtlP	Retail workers as a percentage of total workers in southern Florida	0-19.5017	INFO USA	every year
NMsemP	Museums art galleries & gardens workers as a percentage of total workers in northern Florida	0-0.6986	INFO USA	every year
CMsemP	Museums art galleries & gardens workers as a percentage of total workers in central Florida	0-0.2462	INFO USA	every year
SMsemP	Museums art galleries & gardens workers as a percentage of total workers in southern Florida	0-1.25	INFO USA	every year