Request for Research Funding for FY 2020-2021			
Requesting Office	Planning – Office of Policy Planning	**Priority**	5 of 8
Proposed Title	Development of a Methodology and Datasets for Assessing Compounding Effects on Flood Risk from Extreme Rainfall, Rising Sea Levels, Storm Surge and Waves, and Intensifying Storms for Planning and Design of Coastal Transportation Infrastructure in Florida		
Justification	Resiliency of future Transportation Infrastructure (TI) requires the development and implementation of planning and design guidelines for a changing environment characterized by extreme rainfall, rising sea levels, storm surge and waves, stronger storms and in some cases increasing groundwater levels. There is increasing evidence that many low-lying coastal communities in Florida are already experiencing unprecedented flooding from record setting rainfall, typically resulting from tropical storms and hurricanes, higher high tides (also known as King Tides), and in some cases slowing or even stalled storms over highly urbanized areas. When multiple factors such as rainfall, storm surge, waves, swollen rivers, sea level rise, and rising water tables act together they have a compounding effect on the nature of flooding experienced by TI and other civil infrastructure. This phenomenon known as Compound Flooding (CF) is emerging as a fundamental challenge for resiliency planning and design of civil infrastructure in coastal regions and yet the current standards and guidelines typically ignore the joint probability of these compounding stresses and shocks, leading to wrong assumptions in the design of TI in coastal regions. The flood hazards are becoming even more complex because future projections of these contributing factors indicate the need for incorporation of nonstationarity in climate and other drivers (HEC 17). Research is needed to develop specific guidelines for planning and design of TI accounting for compound flooding and develop data sets which in turn can be incorporated into the UF GeoPlan Sea Level Scenario Sketch Planning Tool and into resiliency indices that are under development.		
Impact	The proposed research seeks to investigate, model, and develop methods for addressing resiliency of future TI in coastal areas where compounding effects of climatic and hydrologic shocks and stresses are prominent. Current planning and design practices, if any, are deemed to be very conservative as they either assume the contributing factors to be complete independent or consider the unlikely scenario of simultaneous occurrence of worst case scenario for each factor (e.g. 100-year rainfall coupled with 100-year sea level) for planning and design of TI such as roads, buildings, bridges, and associated drainage facilities. The proposed research will focus on the nature of the compound flooding phenomenon including the joint probabilities of stresses (e.g. sea level rise) and shocks (e.g. tropical systems) in major coastal areas around the State of Florida and develop methods for incorporating compounding effects into innovative planning and design guidelines for both retrofitting existing and new TI. In the long run, implementation of such practices will provide more accurate information on the risk faced by coastal TI and provide data sets for FDOT, MPOs, and other local governments. It will also result in cost-effective investments for ensuring resiliency of the coastal infrastructure facing a changing environment. The methods developed in this research will be customized for spatially varying, local conditions around the State of Florida		
Affected Offices	This proposed project will potentially benefit a wide range of FDOT Offices and stakeholders, including: • FDOT Office of Policy Planning • FDOT Forecasting and Trends Office • FDOT Systems Implementation Office • FDOT Office of Environmental Management • FDOT Emergency Management Office • FDOT Office of Design • FDOT Maintenance Office • FDOT Districts • Florida's Metropolitan Planning Organizations • Various local city and county departments and regional planning councils throughout the State of Florida		
Existing Work	A review of the databases of Transportation Research International Documentation (TRID) and the Research in Progress (RIP) did not reveal any past or ongoing work on the topic of compounding effects.		
Keywords Used In Existing Work Search **(Cannot leave blank)**	Compound Flooding, Sea Level Rise, Climate Change, Planning and Design guidelines under Nonstationarity		
Related Contracts (Give contract numbers)			

Funding Request	$300,000	**Anticipated Duration**	24 months
Project Manager	Jennifer Carver	**Contracting Method**	Direct contract with Florida International University; FIU will provide subawards to UCF (for technical analysis) and UF GeoPlan Center (incorporation into the Sketch Planning Tool)
Urgency	Score 1	Many coastal regions of Florida are already experiencing compounding effects of sea level rise, storm surge, rainfall and elevating groundwater levels. The current planning and design guidance do not explicitly account for flooding due to compounding effects and there is an urgent need to improve the engineering methods to account for situations where the FDOT engineers face such situations in retrofitting and/or planning transportation infrastructure.	
Implementability	Score 1	The current research on compounding effects on flood risk are yielding methods that have the potential to be used in practice immediately. As in the case of HEC-17 which addressed climate change, there is confidence that the application of such methods and the supporting data sets can be incorporated into a guidance document. Both methods and data can be included in the UF GeoPlan toolbox.	

Project Benefits (Succinct, complete explanation)

1. The results and the outcomes of this research will elevate the current planning and design guidelines in FDOT to consider recent developments in considering compounding effects of flooding on coastal highways, roads, bridges and other infrastructure.
2. Incorporation of actionable, and peer-reviewed science into current planning and design practices
3. Further develop methodologies outlined in HEC-17 (2nd edition) and HEC-25 specifically for coastal regions of the State of Florida
4. Incorporation of the research outcomes and products into UF GeoPlan tools
5. Potentially incorporate the research into FDOT ongoing efforts in addressing the future resiliency of transportation infrastructure under conditions of changing stresses and shocks
6. Capacity building among FDOT engineers and professionals for incorporating more realistic factors contributing to floods risks
7. The outcomes of this project will supplement the current FDOT guidance documents for planning and design of transportation infrastructure in situations where compound factors affect flood risk. The methods will be tested for pilot areas first before being recommended and this incremental improvements to the current guidelines will facilitate phased implementation and continuous improvement via UF GeoPlan tools

Project Benefits **(Select all that apply and explain)**	**Quantifiable Benefits (units, dollars, etc…if applicable)**	**Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits**
o Materials Enhancement		
o Materials Savings		
o Time Savings		
o Lives Saved/Injuries Prevented		
o Other (Explain)	Savings in infrastructure due to implementation of more realistic planning and design assumptions	Project examples which will compare the costs using the proposed methodology with those associated with current guidelines

*Comments should explain and support urgency, financial benefit, and implementability scores