COLLEGE of CHARLESTON
SCHOOL OF SCIENCES AND MATHEMATICS

COLLEGE of CHARLESTON
DEPARTMENT OF GEOLOGY AND ENVIRONMENTAL GEOSCIENCES

Linder, N., Harris, M.S., “Coastal Displacement Using InSAR and GPS.”

Nathan Linder Research Statement:

As a geology undergraduate living on the Charleston peninsula, much emphasis has been placed on studying the effects of climate change on sea-level rise and the rates of that rise into the City. Similarly, the entirety of coastal South Carolina has prominent flooding problems from North Carolina to Georgia, increasing in frequency and severity over the last decade. To understand the changes, sea-level rise is a combination of multiple components that can be reduced to two terms: changes in the level of the ocean, which includes the climate variable, and changes due to land displacement (subsidence or rebound1). The goal of this study is to understand the rate of relative sea-level rise due to land displacement in Coastal South Carolina. To carry out this goal, I will be using lnSAR (Interferometric Synthetic Aperture Radar) satellite images to obtain precise elevations from different dates and GPS/GNSS data to identify changes of less than 2mm per year over one to two decades, well within the capability of the methods2. These data will be combined with pre-existing research on flooding, coastal hazards, and their effects on urban community planning. I will be learning the specific techniques of lnSAR processing with Dr. Harris this spring for only the Charleston area, expanding analysis with lnSAR and GNSS data into the other coastal regions of the Southeast from Wilmington to Savannah under this proposal. The current timeline and methods for this project include training during the spring by analyzing the localized Charleston INSAR satellite data, then researching land displacement in other southeastern coastal regions in the summer. In the first two weeks, INSAR satellite pairs will be downloaded for analysis. In weeks three through five, the data will be processed using processing workflows within the Sentinel Application Platform (SNAP) to calculate land displacement. In weeks six and seven, comparisons will be made between existing GNSS occupations by the State Geodetic Survey that have occurred within the area between different satellite pair dates and new data we will collect in the summer with the help of UNAVCO's equipment pool. In week eight, we will compare our data to sea level data from earlier geologic research.3 Starting with week three, a scientific paper will be started, focusing on background and methods, with weeks nine and ten focusing on the paper's discussion section and the presentation of the summer's research at the SSM symposium. Using remote sensing data is especially important because it allows us to research large-scale regional changes that would otherwise be difficult and costly to research. I have always had an interest in remote sensing, beginning with using sonar and backscatter data to map and interpret the seafloor. lnSAR satellite data is collected via different methods, but we can also use it to create informative maps and interpret changes happening on Earth's surface which influence local and regional planning. These types of research and experiential learning will help me realize these goals in graduate school and my career in remote sensing of the earth. Combined with remote sensing, I am also interested in the environmental aspects of geological research. Sea-level rise due to climate change is perhaps the most pressing issue in modern environmental studies for coastal communities. The rise in sea level has many effects, with most, if not all, being detrimental to coastal communities in which we live. 1. Gehrels, R. Sea-level change since the Last Glacial Maximum : an appraisal of the I PCC 4th Asses. Rpt. J. Quat. Sci. 25, 26-38 (2010). 2. Lazecky, M., Hlavacova, I., Martinovic, J. & Ruiz-Armenteros, A. M. Accuracy of Sentinel-1 Interferometry Monitoring System based on Topography-free Phase Images. Procedia Comput. Sci. 138, 310-317 (2018). 3. Kemp, A. C. et al. Late Holocene sea- and land-level change on the U.S. SE Atlantic coast. Mar. Geol. 357, 90-1 (2014).

In June 2019, I sailed on the R/V Savannah for 4 days, conducting seafloor mapping off the Savannah coast and learning how to acquire and process multibeam sonar data. In Spring 2020, I worked with Dr. Chadwick to analyze Mesozoic dike samples in the lab, learning about magmatic dike processes as well as geochemistry methods. In Fall 2020, I worked with Dr. Sautter in her seafloor research class to conduct my own study on potential deep-sea coral locations and geomorphological measurements in the New England Seamounts using Caris HI PS and SIPS 11.3.