Title: Future population exposure to flooding due to sea-level rise and storm surge in South Korea where the country's population is declining

Abstract:

South Korea has good reason to be concerned about climate change. The nation's mean temperature is getting hotter more rapidly than global and East Asian averages; over the last century (1912–2018) the average mean temperature in South Korea has increased by 1.9 ◦C which is 0.85 ◦C higher than the global average (National Institute of Meteorological Sciences, 2018). A hotter climate will inevitably warm up the ocean and elevate the sea level mainly because of thermal expansion. Hotter sea surface temperatures will trigger stronger storms and typhoons more frequently. Sea-level rise (SLR) will even let such storms and typhoons intrude inlands deeper because water will ease the friction of lands. Given its three-sided coastal geography, the Korean peninsula will become more vulnerable to SLR and the associated floods in the future. Thus, our research is to quantify how many people will be exposed to such future threats.

This study aims to quantify and compare population exposure to flood due to SLR and storm surge (SS) between 2010 and 2050. SLR refers to an average sea level, while SS indicates an additional layer of ocean water driven by storms and typhoons. That is, when SLR and SS are added up, this combination may result in flooding. First, population exposure to SS in 2010 is mapped and quantified, and compared with population exposure to SLR and SS in 2050. SLR and SS were modeled based on the moderate climate change scenario by averaging Representative Concentration Pathways (RCP) 4.5 and 8.5 to delineate 100-year floodplains for the coastal areas. Gridded population projection data were produced via dasymetric mapping that is based on state-of-the-art ensemble machine learning algorithms, e.g., eXtreme Gradient Boosting (XGBoost) at a 500m pixel level. By doing so, our work will portray how future SLR will impact people who live in coastal regions of South Korea.

Our results show that approximately 1.79 million residents of the capital region, Seoul and Incheon, will become affected in 2050. At the national level, 4.91 million people and 12,697 square kilometers of coastal lands will be affected by floods due to future SLR and SS in 2050. Some areas will be affected less in the future because their populations will become smaller.

Keywords: Sea-level rise, flood, typhoon, gridded population data, population projection, climate change

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Important results:

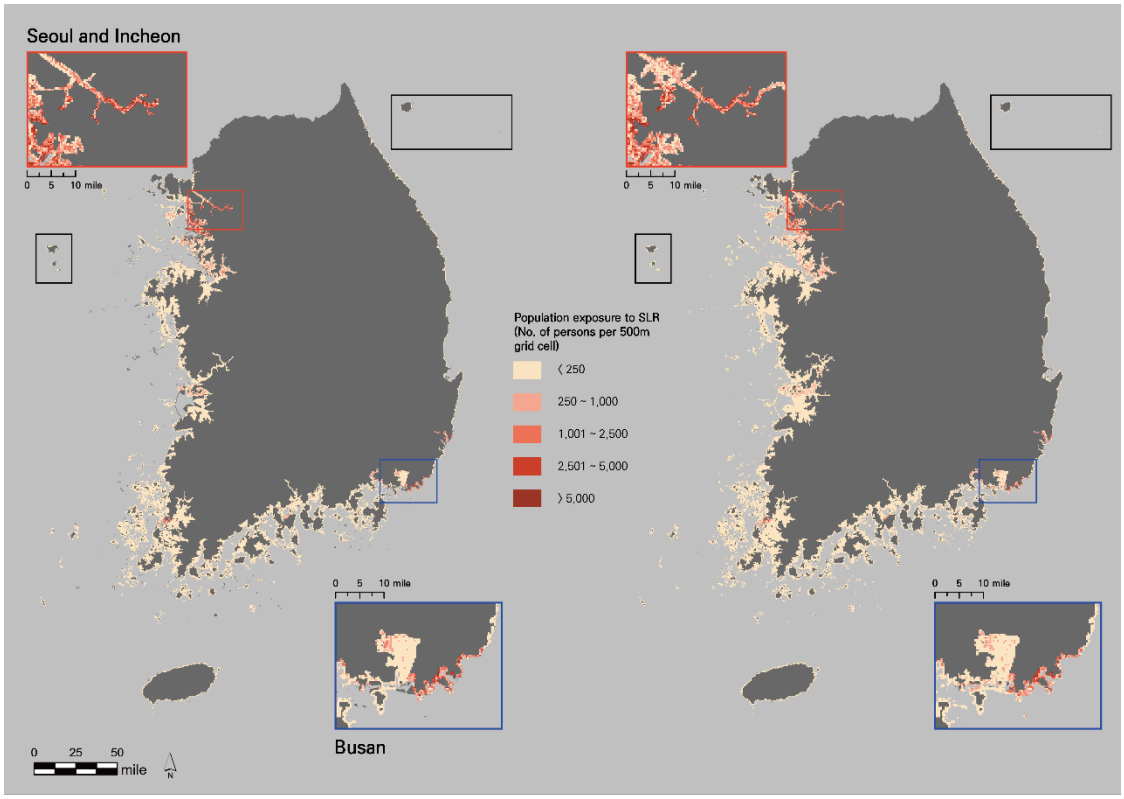

Figure 1. Population exposure to (a) storm surge in 2010 and (b) storm surge and sea-level rise in 2050.

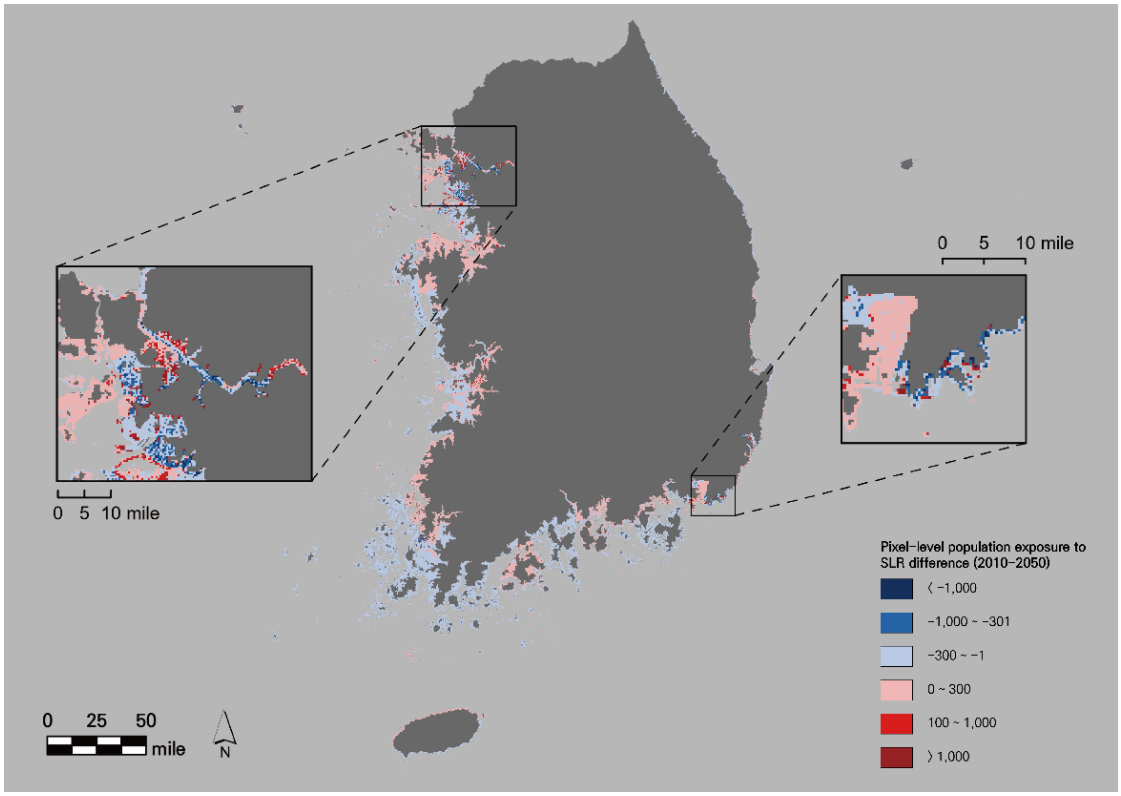

Figure 2. Future differences in population exposure to storm surge and sea-level rise between 2010 and 2050 (the negative values are due to population decline).