The 2024 World Congress on
Advances in Civil, Environmental, & Materials Research (ACEM24)
19-22, August, 2024, The K hotel, Seoul, Korea

Analyzing Climate and Environmental Impacts on Seasonal Ground Deformation of Major Highway Overpasses in Beaumont, Texas Using PS-InSAR and SBAS

Md Saffiquzzaman Chowdhury[1)], *Yong Je Kim[2)], and Jinwoo An[3)]

[1),2)] *Department of Civil and Environmental Engineering, Lamar University, Beaumont, TX 77710, United States*
[3)] *Department of Civil Engineering, University of Texas Rio Grande Valley, Edinburg, TX 78539, United States*
[2)] ykim3@lamar.edu

ABSTRACT

In this research, insights are provided into the influence of climatic and environmental factors on seasonal ground deformation of major highway overpasses in Beaumont, Texas. The extent and timing of deformation are evaluated through the deformation concentration degree (DCD) and deformation concentration period (DCP) indices. A total of 28 Sentinel-1A images, captured between January 2023 and December 2023 and obtained from the Alaska Satellite Facility (ASF), were utilized in this study. The analysis was conducted using a combined approach of persistent scatterer interferometric synthetic aperture radar (PS-InSAR) and small baseline subset (SBAS) techniques. The seasonal deformation of three major highway overpasses in Beaumont, Texas was assessed using DCD and DCP indices. While the DCD index quantifies the annual distribution of deformation, the DCP index identifies specific periods of concentrated deformation throughout the year. The findings reveal that ground deformation across Beaumont and its adjacent areas ranged from +20.4 mm to -21.9 mm from January 2023 to December 2023, based on the combined PS-InSAR and SBAS analyses. A strong correlation was observed between these measurements and GNSS data, with a root mean square error (RMSE) of 0.595. The analysis indicated that overpasses number 1 and number 2 remained stable throughout 2023, whereas overpass number 3 experienced slow ground uplift. Consequently, DCD and DCP analyses, as well as correlation of ground deformation with climatic and environmental factors, were specifically focused on overpass number 3. For PS pixels on this overpass with a DCD ≥ 0.3, a clear seasonal pattern emerged, with certain months exhibiting higher deformation levels than others. To elucidate the response of ground conditions to various factors over time, climatic data, including temperature and

---

[1)] Graduate Student
[2)] Assistant Professor
[3)] Assistant Professor

precipitation from the PRISM Climate Group at Oregon State University, along with groundwater elevation data from the Texas Department of Transportation (TxDOT), were utilized to correlate with ground deformation patterns at overpass number 3 throughout 2023. Additionally, boring log data obtained through TxDOT from overpass number 3 were examined to assess the impact of high plasticity index soils on ground uplift in this area.