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Thursday PM, December 19, 2019

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Organized by Wei E. I. Sha, Zhi-Xiang Huang

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13:10 Invited Particle Simulation of Plasmons
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13:30 Invited Multiphysics Modeling and Simulation of Carrier Transport in Nanoscale Device: Combination of Classical Electromagnetics and Quantum Mechanics
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Land Deformation of Surabaya City, Indonesia Based on DInSAR and Multiple Images Interferometric SAR

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Introduction

Land deformation in Indonesia has been widely studied, and some of them occur in several cities and places such as Jakarta, Bekasi, Bandung, Semarang, Pekalongan, Lhokseumawe, including Surabaya (1).

Many things are the cause of land deformation events in Indonesia including the development of the city itself, excessive exploitation of groundwater, exploitation of natural gas, and the Sidoarjo mud disaster (LUSI) as happened in East Java, near Surabaya.

In this research, we focus on monitoring land deformation that occurred in Surabaya based on the analysis of Differential Interferometric Synthetic Aperture Radar (DiNSAR) and Multi-Images InSAR using Sentinel 1A C-Band frequency data.

Method

Differential Interferometric Synthetic Aperture Radar (DiNSAR) method and InSAR Multi-Images using Sentinel 1A C-Band frequency data have been applied in this research.

This research also uses ten Sentinel 1 A data with vertical-vertical polarization, which is the result of recording on: July 13, 2017, September 11, 2017, November 10, 2018, March 10, 2018, May 9, 2018, July 8, 2018 , 6 September 2018, 4 January 2019, and 5 March 2019.

For the analysis of DiNSAR, the pair of data recorded on 10 March 2018 and 5 March 2019 were used. The acquisition geometry for interferogram generation is illustrated in Figure 1.

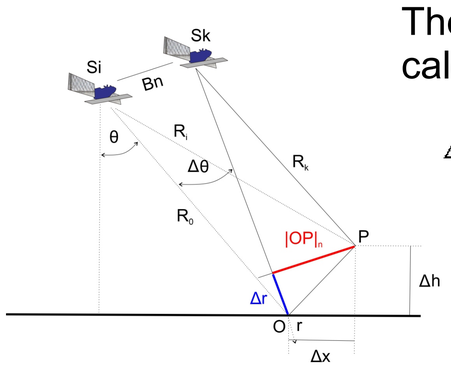

Figure 1. Acquisition Geometry for Interferogram Generation

The relative of interferometric is thus calculate using Equation:

$$\Delta\phi_{ik} = \phi_{ik}(P) - \phi_{ik}(O) = \frac{4\pi}{\lambda}[R_{ik}(P) - R_{ik}(O)]$$

Atmospheric Phase Scattering (APS) has also been corrected by the Multi-Images InSAR method

Location

Figure 2. Footprint of Sentinel 1A data (Research Location)

The research location is the Surabaya City area, and is in the northern part of the Sentinel 1A Satellite recording footprint area, as shown in Figure 2

Result

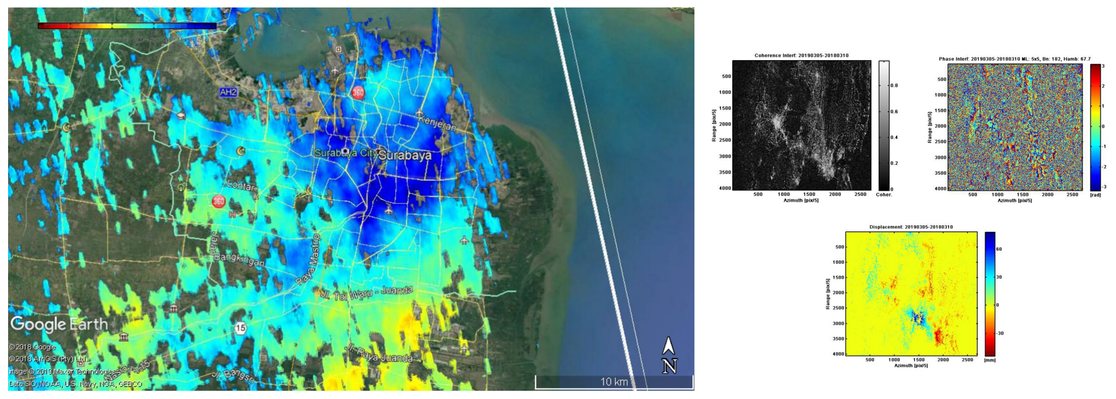

Figure 3.The result of DiNSAR analysis, Coherence Image, and Phase Interferogram

Based on data analysis using the DiNSAR method, the condition of land deformation in Surabaya is relatively stable. Only found a subsidence rate of 1 cm per year in the south, and an increase in groundwater level in the north of 2 cm per year. The rate of subsidence in the south is likely related to land erosion or groundwater use, and land subsidence in the north due to sedimentation due to accumulation of alluvial material.

Figure 4. The result of Multi-Images InSAR of Surabaya City, normal baseline graph, and Interferograms

In the analysis using the Multi-Image Interferometric SAR method, it also shows that land deformation in Surabaya City is not very clearly detected, as shown in Figure 4. There are some areas experiencing subsidence but only small spots.

In this analysis also carried out removal of Atmospheric Phase Scattering (APS) with, with the APS conditions as shown in Figure 5

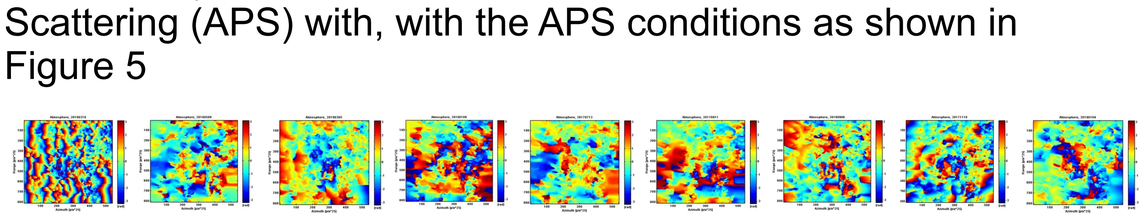

Figure 5. Atmospheric Phase Scattering of Multi-Images InSAR

Conclussion

Based on the analysis based on the DiNSAR method and Multi-Images InSAR using Senstinel 1A data, land deformation in Surabaya is relatively small, only in the form of subsidence of about 1 cm per year in the south, and 2 cm in the rise in the north. This land deformation condition is likely related to groundwater use and sedimentation processes that have occurred.

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[1] Chaussard, Estelle & Amelung, Falk & Abidin, Hasanuddin Z. & Hong, Sang-Hoon. (2013). Sinking cities in Indonesia: ALOS PALSAR detects rapid subsidence due to groundwater and gas extraction. Remote Sensing of Environment. 128. 150–161. 10.1016/j.rse.2012.10.015.