Geoinformational Support
Geo4IRBM
for Integrated River Basins Management

Deformation studies on Java (Indonesia) based on persistent and distributed scatters derived from Sentinel-1 data

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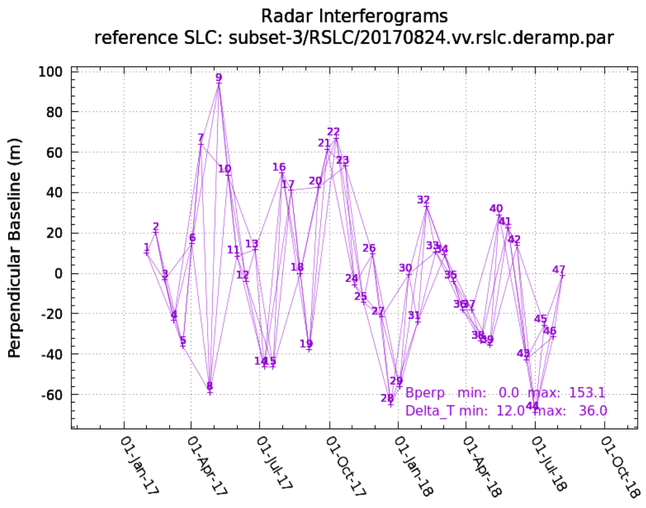
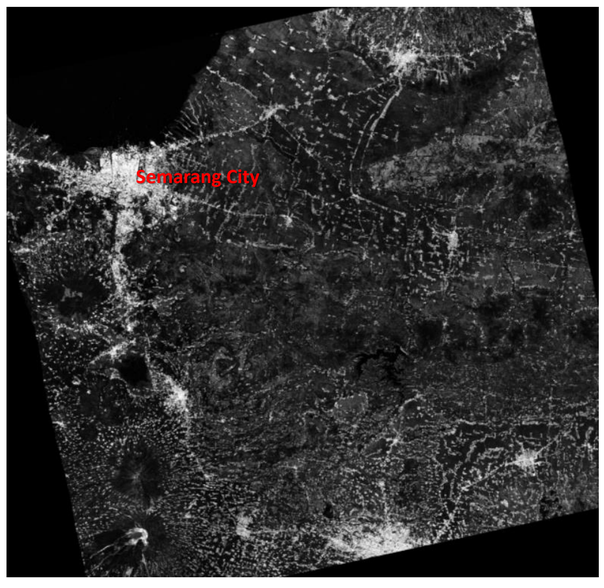
REMOTE SENSING CENTRE

The main goals of the project and study area

The Java Island (Indonesia) due to its location in tropical zone and within Pacific ring of fire is characterized by very dynamic environment. Its dynamics is manifested by numerous surface deformations of various genesis triggered e.g. by earthquakes, volcanoes, landslides or soil erosion. This study carried out within the ESA Project: Geoinformation Support for Integrated River Basins Management (Geo4IRBM) is concentrated on the deformations which take place within two watersheds: Cimanuk-Cisanggarung rivers watershed (East Java) and Jratunseluna river watershed (Central Java). As one of the main goals of the project is identify landslides and to assess the soil erosion within the watersheds. The deformation studies are performed using combined sets of both persistent and distributed scatters. The latter give the opportunity to measure deformation also outside of the built-up areas which is crucial for this project.

Data sets and methods



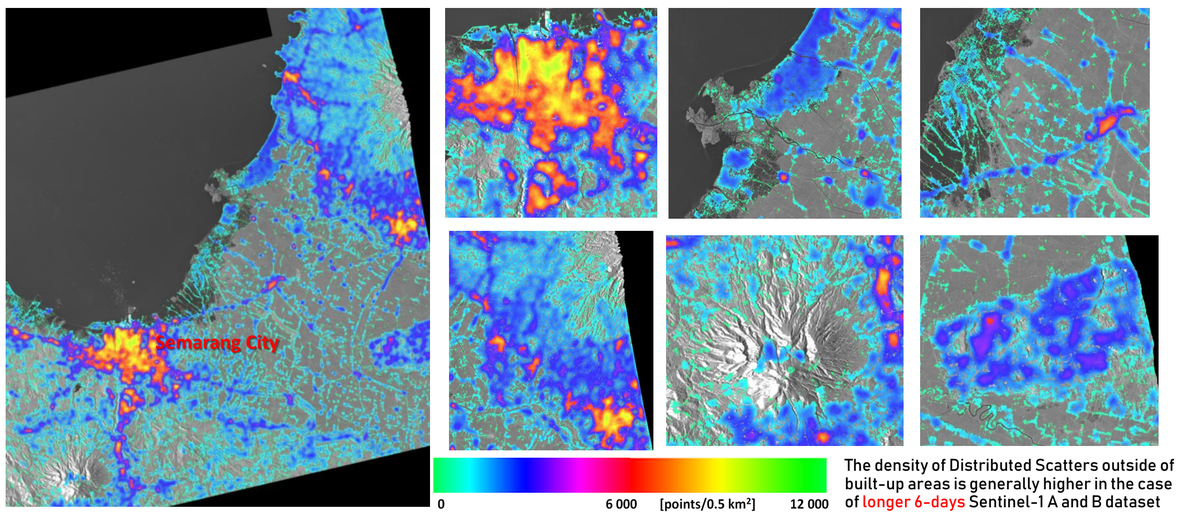


Average coherence for the part of the Jratunseluna catchment based on 6-days Sentinel-1A and B dataset (August 2017 – January 2018)

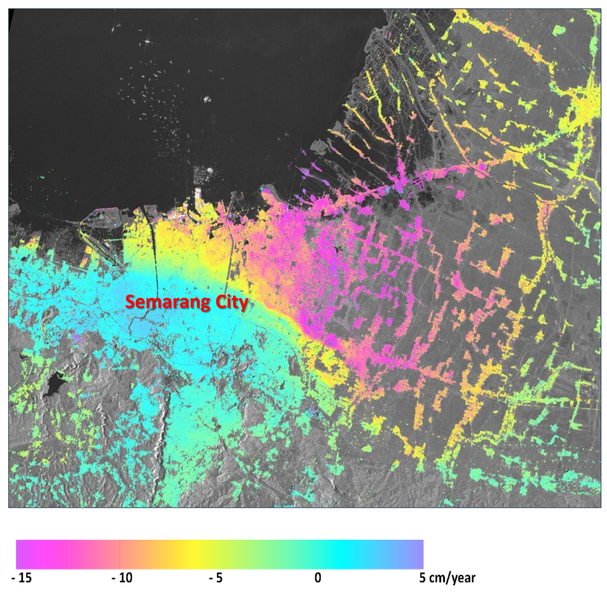
The studies are carried out on the basis of sets of Sentinel-1 A and B images derived from 5 different ascending and descending orbits. The data starting from the beginning of 2017 were taken into account. Before this period the Sentinel-1 data from Java Island were acquired with relatively low frequency (every 24 days or often less) which was not enough to obtain sufficient number of distributed scatters outside the built-up areas in this tropical, very humid and vegetated environment. Starting from January 2017 the data have been registered by Sentinel-1 A every 12 days. Unfortunately the images acquired with full potential temporal resolution using Sentinel-1 A and B have been available only for one descending orbit starting from the end of July 2017. The spatial distribution and density of persistent and distributed scatters obtained, based on the 6-days and 12-days sets of the images of the same region, were compared. The results show that frequency of data acquisition is crucial for obtaining the deformation signal from distributed scatters located outside the built-up areas in tropical zone.

RESULTS

The spatial distribution of Persistent and Distributed Scatters – results based on the data acquired from January 2017 till the end of September 2018



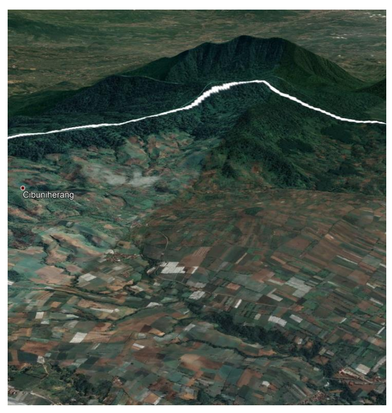
The density of Distributed Scatters outside of built-up areas is generally higher in the case of longer 6-days Sentinel-1 A and B dataset

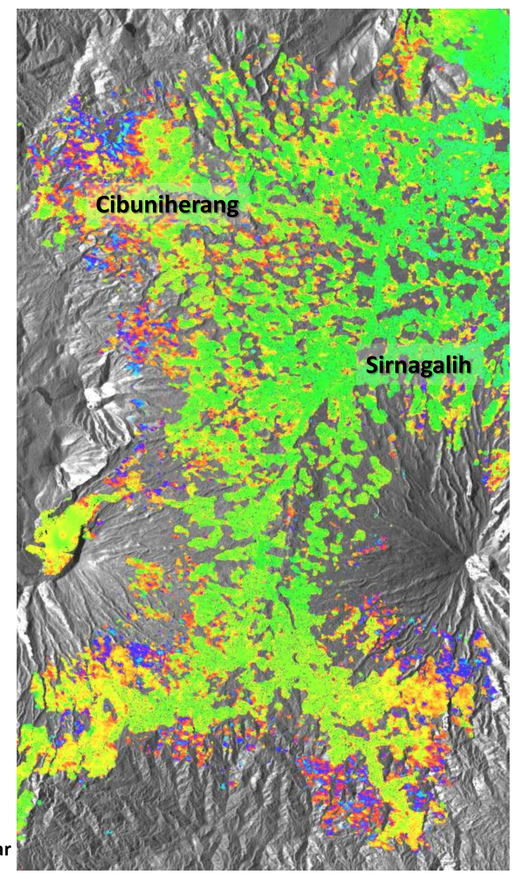


First results obtained for the Jratunseluna river watershed show very large deformations, which take place in different parts of the study area. The biggest one is observed in Semarang City especially close to the fault located there. The relative deformations between various parts of the city observed using multitemoral interferometric techniques exceed 15 cm per year, which is in agreement with the information obtained directly from Indonesia, from the people working for the Asian Development Bank – the main end-user of this study.

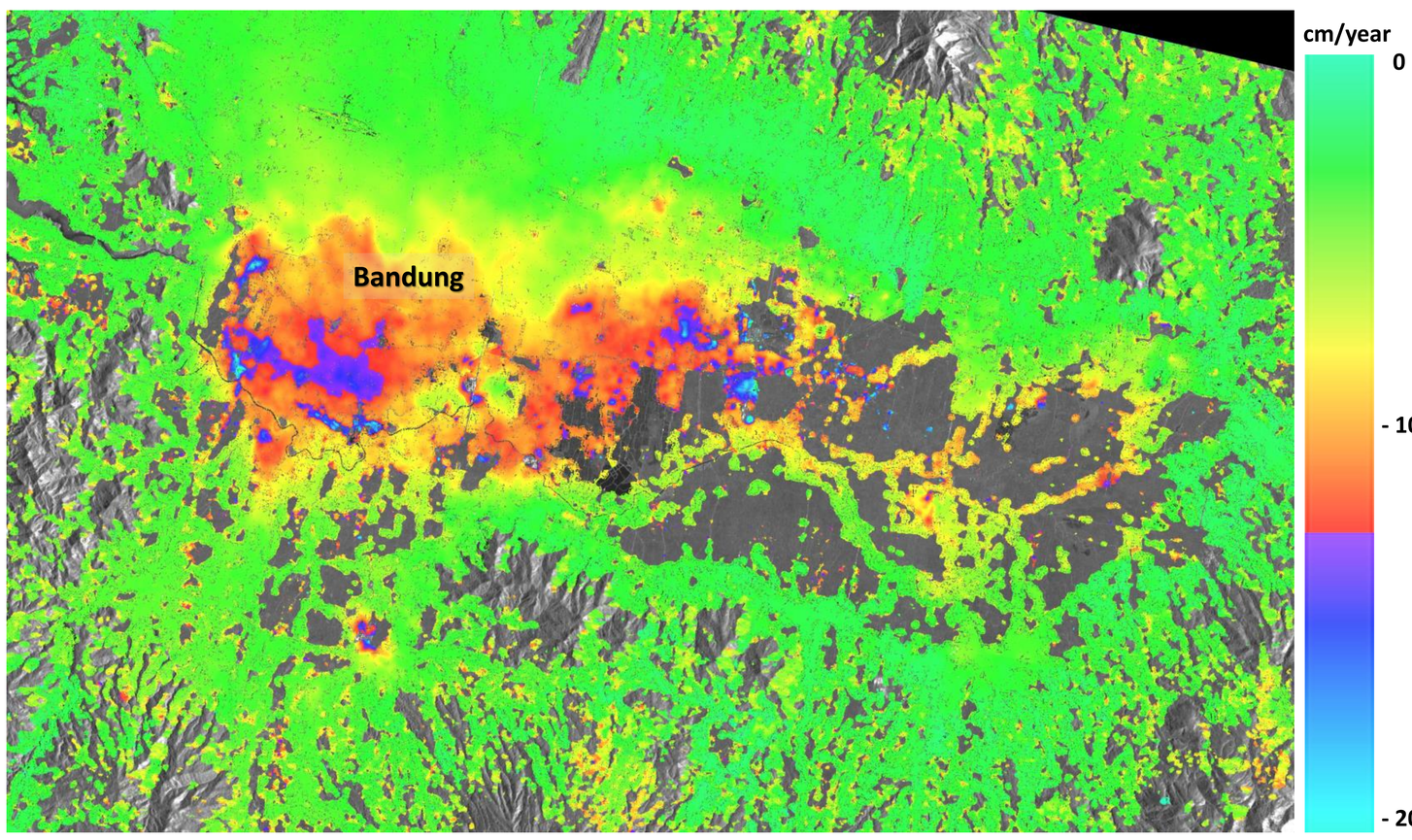
The deformation map of the part of Jratunseluna watershed (Semarang City and surroundings) based on the Sentinel-1 data registered from January 2017 to January 2018 from descending orbit D76.

The processing of the data was performed using the Gamma software. One of the biggest problems which have to be overcome is the correct phase unwrapping over the large areas, which is very difficult in this region due to the unfavorable combination of various factors: the spatial discontinuity of high quality persistent scatters, large deformations and very dynamic atmosphere, especially during the wet season.





- 12 - 6 0 cm/year



Many other deformations connected among others to landslides and soil erosion was also identified. The Sentinel-1 multi-temporal interferometry shows great potential for monitoring landslides and for assessment of soil erosion in tropical zone, especially when 6-day's datasets and distributed scatters are used for the study.