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

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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 Basin Management (Geo4IRBM) is concentrated on the deformations which take place within two watersheds: Cimanuk-Cisangurung watershed (East Java) and Iratunseluna river watershed (Central Java). As one of the main goals of the project is to 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

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 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.

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.