Geophysical Research Abstracts
Vol. 20, EGU2018-8488-1, 2018
EGU General Assembly 2018

Investigating ground instability in Indonesia by using multi temporal SAR interferometry

Fabio Bovenga (1), Athanassis Ganas (2), Alberto Refice (1), Antonella Belmonte (1), Raffaele Nutricato (3), Davide Oscar Nitti (3), Maria Teresa Chiaradia (3), Sotirios Valkaniotis (2), Sofia Gkioni (2), Chrysanthi Kosma (2), Paolo Manunta (4), Elizar Elizar (5), Darusman Darusman (5), and Philippe Bally (6)

(1) CNR - ISSIA, Bari, Italy (bovenga@ba.issia.cnr.it), (2) National Observatory of Athens, NOA, Athens, Greece, (3) Department of Physics “M. Merlin”, University of Bari, Bari, Italy, (4) Collaborative Space Ltd, Dundrum, Ireland, (5) Syiah Kuala University, Banda Aceh, Indonesia, (6) European Space Agency, ESA-ESRIN, Frascati, Italy

Indonesia is periodically affected by severe volcanic eruptions and earthquakes, which are geologically coupled to the convergence of the Australian tectonic plate beneath the Sunda Plate. This work is aimed at performing an analysis of ground displacements over Indonesian sites through Multi-temporal SAR interferometry (MTI). Two test sites, in Sumatra and Java, have been selected according to the following requirements: presence of ground instabilities, possibly related to onshore active faults or volcanoes; good expected interferometric coherence, availability of reliable archived interferometric SAR datasets, availability of ancillary geophysical data.
Displacement maps have been obtained by processing COSMO-SkyMed and Sentinel-1 datasets available on the area, through SPINUA algorithm, which performs Persistent Scattering (PS) analysis. The use of datasets coming from two datasets, allows cross-validating final results. The processing of Sentinel-1 data has been more complex w.r.t. that of COSMO-SkyMed data, as standard MTI displacement maps showed strong artifacts, likely due to residual atmospheric contributions and orbital errors. In order to overcome this problem, an alternative processing scheme has been experimented.
The tectonic analysis in Indonesia is difficult because the vegetation cover in the area causes lack of PS along and across the faults. Our MTI results provided useful information about the ground stability/instability within the selected test sites. In particular, concerning the tectonic activity in Sumatra, the MTI displacement analysis seems to confirm the inactivity of the Aceh fault segment, as foreseen by geodetic studies. Also, in the Java test site no displacement signal was detected related to possible activity of the faults present in the area.
Besides the tectonic activity, ground displacements were also identified basically reflecting local effects. The causes of these displacements were investigated by using ancillary geological data, and in situ inspections. The subsidence phenomena are mainly related to the presence of unconsolidated coastal/alluvial sediments and groundwater pumping.
An interesting example concerns a coastal area in Banda Aceh, which was overrun and completely destroyed by the 2004 tsunami. Most subsiding PS targets are positioned on port facilities structures and embankments. Extensive rebuilding and new constructions in the area add weight to the unconsolidated sediments. There is also an extensive presence of seasonally flooded crops and salt production flats. This suggests that the subsidence occurring in the area is probably related to compaction of sediments and/or recent artificial fill.
A subsidence has been also revealed in Java over the Yogyakarta urban area. This local displacement is induced by groundwater exploitation and soft sediment compaction, a result of major urban expansion and human activity during the last years. The high resolution of COSMO-SkyMed data allows catching interesting details over urban structures.
Finally, interesting localised subsidence rates are observed upon recent (2010) volcanic deposits at the flanks of Mt Merapi in Java, a result of compaction of the soft explosive products (pyroclastic density currents and pumice).

ACKNOWLEDGMENTS
Work supported by ESA project “Integrating SAR interferometry and GNSS for studying tectonic processes in Indonesia” (contract 4000114611/15/F/MOS), under Alcantara Study “Enhanced Tectonic Characterization for Indonesia” (Ref. 14-P16).