



Tracking the evolution of the Merapi volcano crater area by high-resolution satellite imagery

Virginie Pinel¹, Raditya Putra², Akhmad Solikhin², François Beauducel^{2,3}, Agus Budi Santoso², and Hanik Humaida²

¹IRD, ISTerre, Le Bourget du Lac, France (virginie.pinel@univ-smb.fr)

²BPPTKG, PVMBG, Geological Agency, Indonesia

³IPGP, Paris

Located about 30 km north of the city of Yogyakarta, Merapi is considered as one of the most dangerous volcano of Indonesia with 3000 to 5000 fatalities since 1672 and about two million people living at less than 30 km from the crater. The recent eruptive history of Merapi is characterized by two eruptive styles: 1) recurrent effusive growth of viscous lava domes, with gravitational collapses producing pyroclastic flows known as « Merapi-type nuées ardentes » (VEI 2); 2) more exceptional explosive eruptions of relatively large size (VEI 3-4), associated with column collapse pyroclastic flows reaching distances larger than 15 km from the summit. The eruptive periodicity is 4 to 5 years for the effusive events and 50 to 100 years for the explosive ones. The last explosive events (VEI 3-4) occurred in November 2010 and opened a 500m wide and 250m deep crater. After the 2010 eruption, the activity has been reduced. We used TerraSAR-X data to characterize eruptive deposits emplaced during the 2010 event as well as sudden destabilization of crater walls. The activity increased significantly during the spring of 2018 when several phreatic eruptions were recorded with ash emission reaching an elevation of more than 5 kilometers. The 11th of August 2018 a new dome was observed inside the summit crater, thus marking the start of a new phase of effusive activity. It is essential to be able to quantitatively follow the temporal evolution of the dome shape and volume through time as its potential destabilisation would produce pyroclastic flow on the volcano flank. A time series of five tri-stereo Pleiades optical images, acquired between February and September 2019, is used to produce High Resolution DEMs of Merapi summit area with a spatial resolution of 3 m and a vertical precision of 1 m. By using a DEM derived from Pleiades stereo images acquired in April 2013 as a reference, the dome volume evolution through time is estimated. We show that the dome had already reached a volume around 0.5 Mm³ (+/- 0.02Mm³) end of February 2019 corresponding to a mean effusive rate of 3000 m³/day during 6 months and that its size remained constant after February 2019. These results are consistent with volume estimations derived from drone measurements. However DEMs derived from Pleiades images enable to monitor a larger area and reveal accumulation of eruptive deposits due to dome destabilization a few hundreds of meters below the dome. The magma effusive rate thus remained significant but was reduced to 250 m³/day from February to September 2019.

