

Eruptive trends and dynamics of remote volcanoes detected from space-based thermal data and SO₂ emissions: a comparative analysis of Stromboli, Batu Tara and Tinakula volcanoes

*Corrado CIGOLINI¹, Marco Laiolo¹, Francesco Massimetti^{1,2}, Maurizio Ripepe², Diego Coppola¹

1. Department of Earth Sciences, University of Torino, Italy, 2. Department of Earth Sciences, University of Firenze, Italy

South-Eastern Pacific has a large number of unmonitored volcanoes that may potentially produce large-scale eruptive events capable to affect highly-populated areas. Therefore, forecasting changes in volcanic activity in the light of historical time-series is a rather intriguing challenge for the space-based earth observations.

Batu Tara (Indonesia) and Tinakula (Solomon Island) are two poorly known volcanic islands with morphologies and reported short-term activities rather similar to the ones observed at Stromboli volcano (Italy). However, thanks to over a decade-long satellite data we are able to effectively compare the activity occurring at Stromboli (a unique natural laboratory and “open-vent” system) with those taking place at the above volcanoes.

We process and analyse the radiant flux (thermal activity) coupled with SO₂ emissions (degassing activity) at these three volcanoes for over a decade. The combined analysis of Volcanic Radiant Power (from MODIS data) and SO₂ burden (from OMI data) reveals different long-term eruptive trends, and contrasting ratio of gas vs. thermal emissions. In fact, the persistent open-vent explosive activity of Stromboli volcano is interrupted by flank effusions that periodically drain the degassed magma stored at shallow levels. On the other hand, the long-lasting exponential decay of both thermal and gas emissions observed at Batu Tara is consistent with the eruption of an “undegassed magma” from a deep, and likely a “closed” magma chamber. Finally, Tinakula volcano exhibits multiple year-long eruptive phases, characterised by evolving gas vs. thermal ratio correlated with an increasing eruptive intensity: thus suggesting the involvement of a volatile-zoned magma chamber with periodic phases of gas/magma accumulations. Our results suggest that the combined analysis of satellite thermal/gas data is a useful tool for better understanding long-term volcanic dynamics and interpreting volcanic processes occurring at a shorter time-scale. We also stress that large satellite datasets on active volcanoes, available from different platforms, greatly enhance the opportunity to efficiently monitor remote volcanic targets in the attempt to mitigate volcanic risk.

Keywords: Remote volcanoes, satellite datasets, Volcanic Radiative Power, SO₂ emissions, volcanic risk