



A multi-parametric and multi-platform approach to study the effects in atmosphere and ionosphere of the 2022 Hunga Tonga-Hunga Ha'apai larger eruptions

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The Hunga Tonga-Hunga Ha'apai volcano has been active since its first historical eruption in 1912 characterised by underwater explosions. During the explosive eruption of late December 2014, a tuff cone of ~1.9 km² connected the islands Hunga Tonga to the northeast and Hunga Ha'apai to the southwest [1]. After six quiet years, on 20 December 2021, the Hunga Tonga-Hunga Ha'apai volcano erupted abruptly. After about a week the eruptive activity started to decrease, but on 14 and 15 January 2022 large explosive eruptions were produced with plumes that reached the stratosphere with wide emissions of SO₂ and the corresponding pressure wave propagated all over the planet. In particular, on 15 January 2022 the largest eruption produced a plume well registered from satellites and destroyed the volcanic island previously formed in 2015 by the same volcano. We applied a multi-parametric and multi-platform study to investigate all the possible effects of the volcanic eruption in the atmosphere and ionosphere. In particular, we focused our attention on: a) seismological features on the occasion of the event; b) meteorological aspects, such as atmospheric pressure and air temperature, revealed by ISPRA's National Tidegauge Network in Italy and by a worldwide network; c) varying magnetic field observed by ground magnetometers and satellites, and other changing ionospheric parameters, such as the electron density, from satellites even if the event was preceded by an intense geomagnetic storm. All these parameters and their detailed investigation allow us to confirm the Lithosphere-Atmosphere-Ionosphere Coupling (LAIC) models introduced in the last ten-fifteen years to explain the possible effects in atmosphere and ionosphere by natural hazards such as volcanic eruptions and earthquakes.

1. Garvin, J.B., Slayback, D.A., Ferrini, V., Frawley, J., Giguere, C., Asrar, G.R., Andersen, K., 2018. "Monitoring and Modelling the Rapid Evolution of Earth's Newest Volcanic Island: Hunga Tonga Hunga Ha'apai (Tonga) Using High Spatial Resolution Satellite Observations". *Geophysical Research Letters* **45**, 3445-3452. <https://doi.org/10.1002/2017GL076621>.