

Ionospheric disturbances in Europe caused by the 2022 Hunga-Tonga volcanic eruption

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Abstract:

On 15 January 2022 the Hunga volcano in Tonga in the Pacific Ocean produced a major explosive eruption. This event provides a rare opportunity to study the reaction of the ionosphere to such strong, impulsive events. Because volcanic eruptions of this magnitude are rare, this is the first event of this size for which the current generation of high temporal resolution ionospheric measurements are available. In addition, over the past decade ionosondes in Europe have started systematic synchronised operations, improving the spatial coverage of observations over the region. We exploit this improved observation network to study over a wide area the medium scale travelling ionospheric disturbances (TIDs) resulting from the eruption.

Europe is close to the antipode of this eruption. It is therefore expected that any effects detected in the ionosphere are due to the pressure waves travelling through the lower atmosphere, which in turn cause disturbances travelling upwards. For this reason, we combine the observations of the ionosphere through ionosondes and GNSS receivers with data from co-located pressure sensors. This allows us to identify the TIDs caused by the eruption, even though the period under investigation also exhibited some geomagnetically induced disturbances. These disturbances can then be tracked during their progression over the area by the different networks of ionospheric sensors. For this purpose, we use various independent methods: MUF obtained from vertical and oblique ionogram traces, de-trended density contours, GNSS derived TEC, and in-situ electron density measurements.