

Generation of trans-equatorial field-aligned current by the 2022 Hunga Tonga Hunga Ha'apai volcanic eruption

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Just after the 2022 Hunga Tonga Hunga Ha'apai volcanic eruption, geomagnetic oscillations with periods near the vertical acoustic resonance around 4 minutes are observed at Apia and Honolulu geomagnetic observatories with amplitude about 2 nT and 0.2 nT, respectively. The volcanic eruption started around 04:14 UT on January 15, 2022 and the oscillations appeared at 04:21 UT at Apia, Samoa, only about 7 minutes after the start of eruption. Because the distance between the volcano and Apia is about 841 km, it takes about 40 minutes for a sound wave to propagate from the volcano to Apia. Therefore, it is more plausible to assume that the magnetic oscillation observed at Apia about 7 minutes after the eruption is caused by the sound waves propagated vertically upward to the ionosphere and generated an electric current. The oscillations in the east-west component of geomagnetic fields are anti-phase with zero time lag between the two geomagnetic stations. The Honolulu locates near the geomagnetic conjugate point of the Apia. The coherent appearance of geomagnetic oscillation at Honolulu strongly support the idea that the ionospheric current generated over the volcano diverted as a field-aligned current which flew to the opposite hemisphere and caused the geomagnetic oscillation at Honolulu. The GPS TEC oscillations with period similar to geomagnetic field oscillations are observed at the GPS stations both in Samoa and Hawaii. The generation mechanism of the TEC oscillations over Hawaii area is also discussed.

Keywords: Acoustic resonance, Field-aligned currents, Geomagnetic field oscillation, GPS-TEC oscillation