



VLF Observations of the 2021-2022 Hunga Tonga-Hunga Ha'apai Eruption

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From December of 2021 through January of 2022, the Hunga Tonga-Hunga Ha'apai submarine volcano experienced eruptive activity a couple miles off the coast of the Hunga Tonga Island. On January 15th of 2022 at approximately 04:15 UTC, this previous activity culminated in a large eruption with effects prominent enough to create atmospheric gravity waves on a global scale. The University of Florida maintains a network of very low frequency (VLF) radio receivers across the US and in Antarctica that detected significant perturbations to VLF signals Earth's ionospheric waveguide as a result of the explosion. These observations are accompanied by observations of strong auroral hiss-like structures observed in the Antarctic.

Atmospheric gravity waves are suspected to have caused unique signals in VLF transmissions collected at sites in Arrival Heights, Antarctica. A sharp increase in amplitude in both the East-West and North-South receiver channels from signals transmitted from three North American VLF transmitters as well as an increase in broadband VLF signal strength measured from Arrival Heights can be seen starting at approximately 04:30 UTC and increasing in magnitude of effect until approximately 05:00UTC. Due to the timing of these signal events less than 15 minutes after the main eruption and the strong shock wave this eruption produced, we suspect that the events are related. It seems possible that the shock wave this eruption produced may have stimulated the precipitation of charged particles from the Earth's radiation belts, creating emissions that emulate auroral hiss and in turn increasing signal amplitudes at selected narrowband wavelengths.

This paper presents a complete analysis of UF's VLF observations during the Hunga Tonga eruption.