

Supporting information for “Oscillations of the Ionosphere Caused by the 2022 Tonga Volcanic Eruption Observed with SuperDARN Radars”

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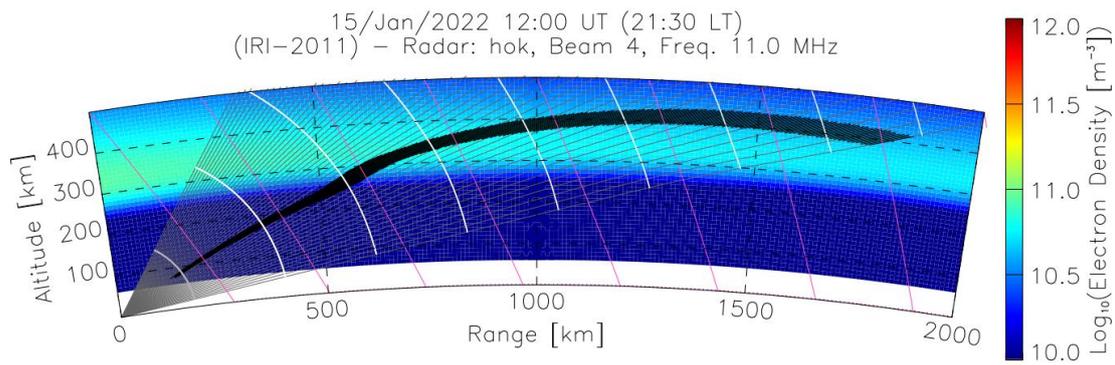


Figure S1. 1 Ray-tracing simulation. Propagation paths of HF rays in the ionosphere at 1200 UT for beam 4 of the HOK radar on 15 Jan 2022 obtained using ray-tracing simulator. Ionospheric electron densities from the International Reference Ionosphere (IRI) are plotted in the background. Each HF ray is plotted in gray and the length of a ray path to a scatter point is the slant range. The black segments indicate regions with good aspect conditions, i.e., regions where the rays are within 1° of orthogonality with the background geomagnetic field (magenta lines) and where the radar could observe ionospheric scatter. The solid white traces serve as range markers: the first trace from the transmitter is at 180 km, and all subsequent traces are 225 km apart.

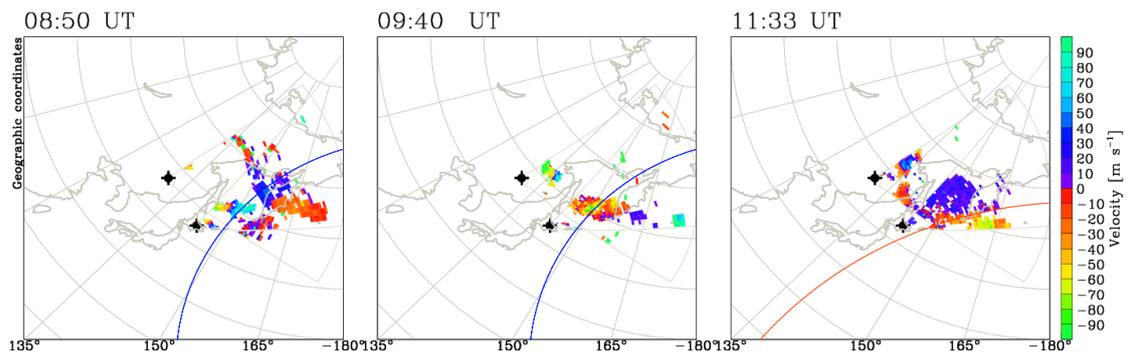


Figure S2. Wavefront observed by the SuperDARN radars. LOS velocity observations from the JME and HOK radars at 0850 UT, 0940 UT and 1133 UT in terms of geographic coordinates. The blue curve represents an arc on the great circle centered on the magnetic conjugate point of the Tonga volcano in the Northern Hemisphere, and the orange curve represents an arc on the great circle centered on the Tonga volcano.

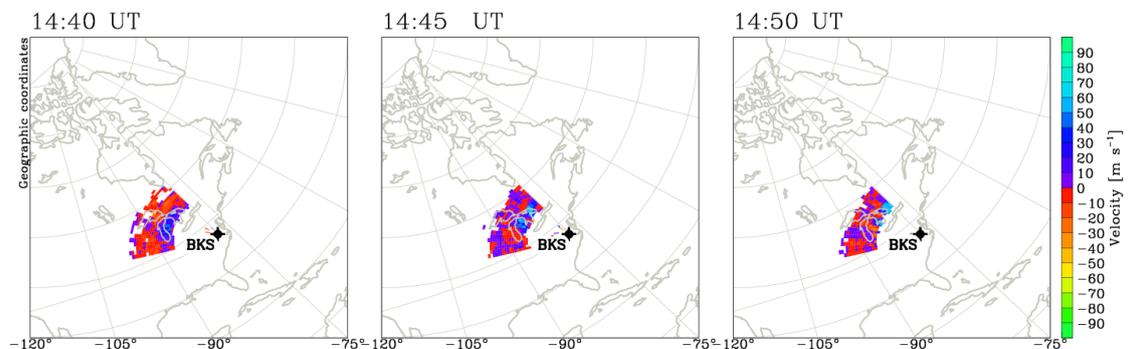


Figure S3. LOS velocity observations from the BKS radar at 1440 UT, 1445 UT and 1450 UT in terms of the geographic coordinates.

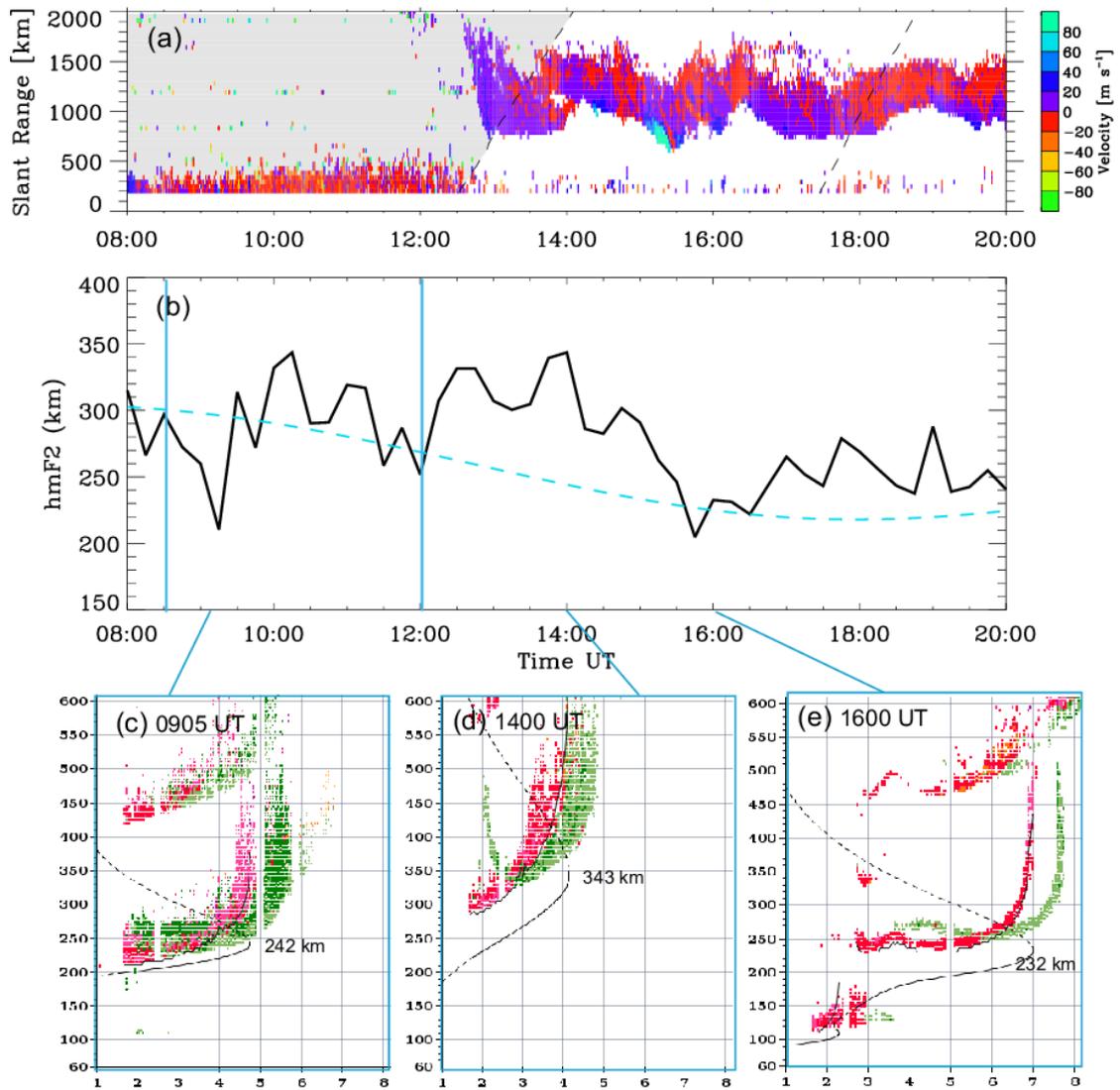


Figure S4. Vertical variation in the ionosphere in North America. (a) RTI plot of the LOS Doppler velocities observed from beam 4 of the BKS radar, (b) peak height of the F layer of the ionosphere as a function of time obtained from the Boulder digisonde, and three representative ionograms at (c) 0905 UT, (d) 1400 UT and (e) 1600 UT. The two vertical blue lines in panel (b) indicate the arrival time of the disturbance to the Boulder digisonde from the magnetic conjugate point of the volcanic eruption in Tonga and from the volcanic eruption itself. The cyan dashed curve in panel (b) indicates the variation in the peak height of the F layer of the ionosphere during quiet time.

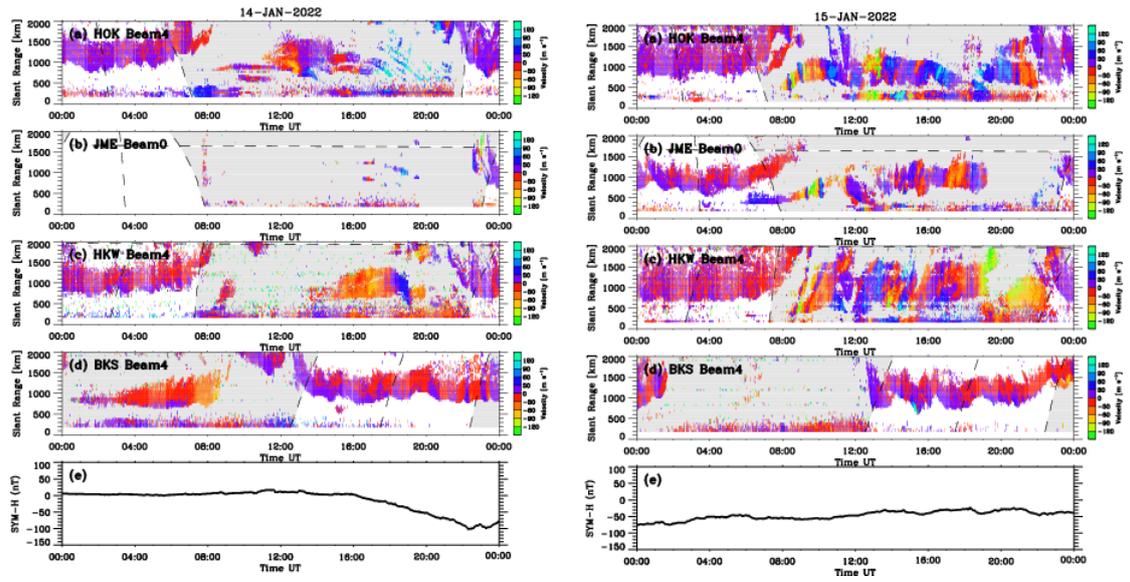


Figure S5. The RTI plots of the LOS Doppler velocities observed by the four SuperDARN radars on 14 January 2022 and 15 January 2022 with the SYM-H index.