

(43-220415-A) Injection of Unprecedented Amounts of Water Vapor Into the Stratosphere by the Eruption of Hunga Tonga-Hunga Ha'apai

H. Vömel¹, S. Evan², and M. Tully³

¹National Center for Atmospheric Research (NCAR), Earth Observing Laboratory, Boulder, CO 80307; 303-497-8837, E-mail: voemel@ucar.edu

²Laboratoire de l'Atmosphère et Cyclones LACy / UMR8105, Université de La Réunion, 97744 Saint-Denis Cedex 09, France

³Australian Bureau of Meteorology, Smithton, Tasmania, Australia

Large volcanic eruptions, although rare events, can influence the chemistry and the dynamics of the stratosphere for several years following the eruption. The eruption of the submarine volcano Hunga Tonga-Hunga Ha'apai on 15 January of 2022, injected at least 50 Tg of water vapor directly into the stratosphere. This event raised the amount of water vapor in the developing stratospheric plume by several orders of magnitude and possibly increased the amount of global stratospheric water vapor by more than 5%. The amount of water vapor transported into the stratosphere was sufficiently large that during the days following the eruption relative humidity over liquid water in the stratosphere reached several tens of percent and became detectable by parts of the operational network using Vaisala RS41 radiosondes. Several soundings using the Cryogenic Frostpoint Hygrometer (CFH) confirmed the extreme amounts of water vapor within the plume. The operational radiosoundings allowed tracking the dispersion of the volcanic plume during the first two months after the eruption and characterizing its vertical distribution. This extraordinary eruption may have initiated an atmospheric response different from that of previous well-studied large volcanic eruptions.

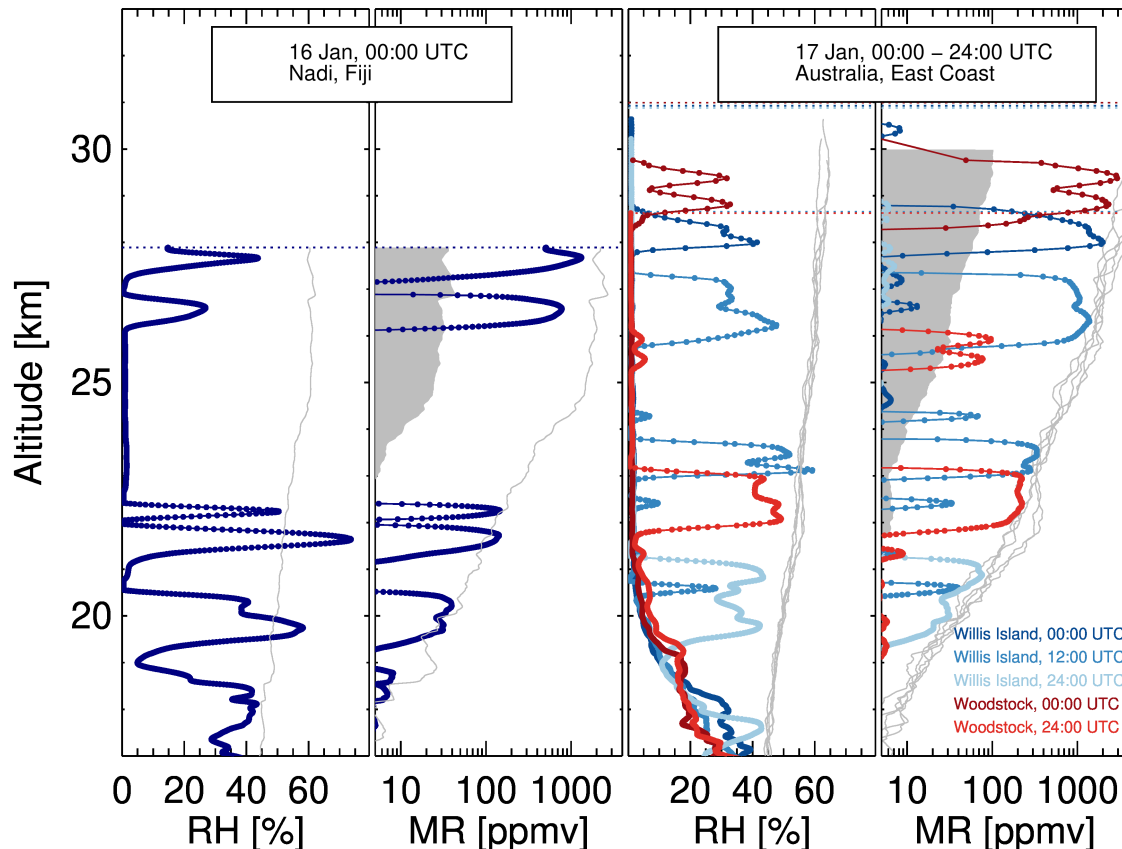


Figure 1. Vaisala RS41 radio soundings within 48 hours after the eruption. Left panels: Sounding at Nadi, Fiji, 16 January, 00:00 UTC, 19 hours after the eruption started. Right panels: Five soundings at two Australian east coast stations on 17 January. Ice saturation is shown as thin grey lines. Balloon burst altitudes are indicated by dotted horizontal lines. The mixing ratio was calculated by first subtracting a 1% relative humidity baseline. The grey shaded area indicates the estimated detection limit.