

Is the linear-shaped TEC anomaly the trace of a small comet impact?

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An ascending liquid-fuel rocket is known to make a hole in the ionosphere, or localized electron depletion, by leaving behind large amounts of neutral molecules (e.g. water) in the exhaust plume. Such holes made by the launches of H-IIA rockets from Tanegashima, Southwestern Japan, have been observed by Furuya and Heki (2008) with GEONET, a dense array of GPS (Global Positioning System) receivers in Japan, as a sudden and temporary decrease of TEC (total electron content). The observed disturbances are well explained with a simple numerical model incorporating the water diffusion and chemical reactions (dissociative recombination between electrons and water molecule ions) in the ionosphere. The substantial vanishing of the ionosphere generally lasts more than one hour, suggesting its application as a window for ground-based radio astronomical observations at low frequencies.

Frank et al. (1986a,b) interpreted atmospheric holes seen in the Earth's ultraviolet dayglow observed by the DE-1 satellite, as the obscuration of the dayglow by water clouds from the disruption and subsequent vaporization of small comets. They suggested that ~20 small comets as large as ~20 ton flow into the Earth's atmosphere, which led to a long-lasting controversy (e.g. Dessler, 1991; Frank and Sigwarth, 1993). Weight of the water vapor by a comet is comparable to the 10 second burn of the H-IIA engine, and an observable size of ionospheric holes are expected to occur.

A linear-shaped TEC depression was found on 19 January, 2006, in southeastern part of North America by the CORS (Continuously Operating Reference Stations) GPS network. TEC decrease of ~1 TEC unit or less extended more than 2,000 km, a pattern different from any known ionospheric disturbance, e.g. large- and medium-scale traveling ionospheric disturbances, earthquakes, volcanic eruptions, solar flares, plasma bubbles, and positive/negative storms. Here we address the possibility that an entry of a small comet into the Earth's atmosphere may have caused the linear TEC depression by emitting large amount of water molecules into ionosphere in the same way as the ascending H-IIA rocket.

References

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