Geophysical Research Abstracts
Vol. 15, EGU2013-3669-1, 2013
EGU General Assembly 2013

Ionospheric Doppler shift observation, a powerful tool in the study of coupling of ionosphere with lower atmosphere

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The ionosphere is dynamically forced from lower atmosphere as well as from above. Traveling ionospheric disturbances (TIDs) are frequently observed in the ionosphere. It is well known that the sources of TIDs are mostly from acoustic gravity waves generated in the lower atmosphere. A number of surface sources such as severe weather, volcanic eruption and great earthquakes are some of such sources. In this presentation, we discuss application of the HF Doppler observation to study such couplings. Based on observational examples, the advantages and limitations of this measure are analyzed: first, the records of HF Doppler shift is temporally continues so the complete process of evolution of TIDs, from their starting to the end with the characteristics clearly shown; secondly, the record of HF Doppler shift is very sensitive to ionospheric structures such as waves and irregularities. It is mostly effective in investigation of the role of acoustic gravity waves in seeding small scale irregularities. However, the availability of HF Doppler observations is limited since its spatial resolution is poor, particularly in resolution along altitude. But, for some sudden explosive events such as co-seismic effects of great earthquake, combined with GPS TEC and infrasonic monitoring, Doppler observation is a very useful tool.