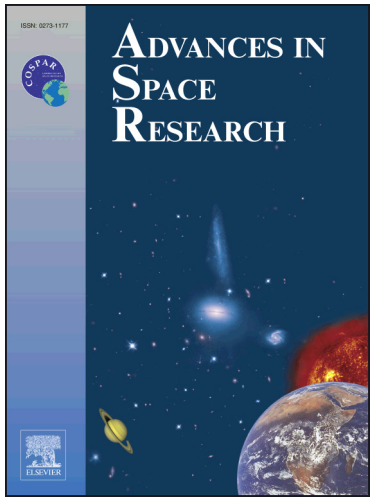

A review of results of the international ionospheric Doppler sounder network

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A review of results of the international ionospheric Doppler sounder network

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Abstract

This paper summarizes main recent results reached by the Czech-lead international network of ionospheric Doppler shift sounders. The network consists of Doppler sounders in the western half of Czechia (5 measuring paths, 3 frequencies with central receivers in Prague), northern Taiwan (3 transmitters, two separated receivers, 1 frequency), and two similar systems (3 measuring paths with 1 receiver and 1 frequency) in Tucuman (north-western Argentina) and Hermanus (the southernmost South Africa). Main areas of research have been: (1) propagation of gravity waves; (2) ionospheric effects of earthquakes; (3) low latitude/equatorial phenomena; (4) ionospheric response to strong meteorological phenomena; (5) effects of solar flares, geomagnetic activity and geomagnetic micropulsations. Main results: (1) Theoretically expected dominance of gravity wave propagation against wind has been confirmed. (2) Impact of a train of seismic waves (P, S, SS, Rayleigh) generated by the Tohoku 2011 M9.0 earthquake was registered in the ionosphere over the Czech Republic as long-period infrasound at the distance of about 9000 km from epicenter. (3) Analysis of ionospheric infrasound excited by the Nepal 2015 M7.8 earthquake observed by the Czech and Taiwan Doppler sounders showed that the intensity of ionospheric signal is significantly height and latitude dependent. Air/plasma compression has to be considered to compute air particle velocities from the observed Doppler shift. (4) Nonlinear effects result in formation of N-shaped pulse disturbance in the upper atmosphere /ionosphere above strong earthquakes as was documented by the example of the M8.3 Illapel 2016 earthquake. (5) Spread F structures observed by Doppler sounders in Tucuman and Taiwan (both under the crest of equatorial ionization anomaly) provide results consistent with S4 scintillation data and with previous optical, GPS and satellite measurements. (6) Short period gravity waves and rarely infrasound are observed in the ionosphere above large convective systems.

Keywords: Ionospheric Doppler shift sounding; gravity waves; infrasound; solar forcing

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1. Introduction

The vertical coupling in the atmosphere-ionosphere system is one of "hot" topics of current ionospheric research. Processes on the Earth's surface or in the lower-lying layers of