ANALOG AND DIGITAL IONOGRAM SCALING

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Abstract:

New digisonde measurements (DPS 4 equipment) started regular ionospheric soundings and ionospheric drift measurements at Pruhonice observatory (50.0N, 14.6E; central European midlatitude station) in January 2004, which replaced the older ionosonde IPS 42. This new sounding equipment operates like a Doppler radar system. The digisonde DPS 4 measures not only ionograms, but also other properties of the electromagnetic signals reflected from ionosphere (time of flight, wave polarization, amplitude, phase, angle of arrival etc.), provides automatic scaling of ionograms and other characteristics of the ionosphere. Additional information about the wave polarization enables us to determine and distinguish exactly between ordinary and extraordinary wave traces on the ionogram records. This new possibilities basically change scaling of the ionograms compare to the ionograms from classical ionosondes. Digisonde measurements show, that in some cases the interpretation of ionograms based on classical ionospheric soundings lead to the systematic errors, which affect classical ionograms interpretation.We have collected the representative data set to demonstrate the differences in scaling when some complicated ionospheric situations occur (triple splitting, spread F, irregularities on the ionospheric electron density profile shape etc.). We demonstrate possible significant misinterpretations of the ionograms of the measurements using the classical equipment (like Australian ionosonde IPS 42) that records only time of flight of the electromagnetic sounding pulse.Sources of the uncertainties in scaling are of several origins. 1. Uncertainty of the arrival directions of the reflected signals. In ionograms from DPS-4 we can eliminate signal from oblique reflections and pick up the vertical reflection information (corresponding to the URSI definition of critical frequencies of the ionospheric layers). 2.Uncertainty in sensing of the ordinary and extraordinary mode. In some cases (mostly spread F), it is hard to estimate boundary between ordinary and extraordinary mode from IPS 42 ionograms.Using the new equipment we are able to significantly distinguish between reflected waves that have origin in non-vertical transmission of the antenna, non-horizontal stratification of the ionosphere and non-parabolic ionospheric electron density profile.The aim of the contribution is to present comparison of the data sets measured by conventional ionosondes and by new digisondes (like DPS-4). Errors in scaling parameters could reach several tens of MHz in frequency and several tens of km in height. We show here that it is necessary to be careful in using the old ionospheric ionosonde measurements and scaled data.