Ionosonde measurements of dynamic characteristics and inhomogeneities of the ionosphere

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Advanced models of the ionosphere, including the well-known International Reference Ionosphere (IRI) model, make use of various ionospheric characteristics, such as the critical frequency (f_oF_2), peak density height (h_mF_2), and total electron content (TEC), on which to base the construction of the vertical distribution profile of the ion and electron density. These variables are often used to either build (climatological) models or their measurements are ingested in real-time for nowcasting applications. However, only static, local characteristics are currently being used. In order to improve the ionospheric plasma specification and to provide more accurate nowcasts and forecasts, an improved knowledge of dynamic parameters like plasma drift velocities, asymmetries and gradients in the ionosphere is needed. This is particularly important when modelling the disturbed ionosphere, as strong gradients and large plasma movements can be expected to occur during geomagnetic storms.

The talk will present our experience in exploring the capabilities of the digital ionospheric sounder (Lowell Digisonde-4D) installed at the RMI Geophysical Centre in Dourbes (50.1N, 4.6E), to measure the ionospheric tilts and gradients as well as the full, three-dimensional plasma drift vector. A preliminary analysis of these dynamic characteristics will be presented. In particular, diurnal and seasonal quiet-time patterns will be discussed together with case studies of some recent geomagnetic storms.

One example of the importance of dynamic measurements can be found in the problem of modelling the topside electron density distribution. The commonly used α-Chapman profile for the topside ionosphere is based on the assumption of local ionisation and recombination, driven directly by sollar radiation. However, even in quiet conditions, the diurnal pattern of plasma drift can cause deviations from the α-Chapman distribution at certain local times. This could explain the deviations recently seen in the analysis of topside ionograms.