Real Time 3D Ionospheric Modelling with Ray Tracing Application over Mediterranean Area

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Abstract

This paper reviews the concept and some practical examples of instantaneous 3D modelling of regional ionosphere, based on ionosonde data from the INGV continuously operating stations at Roma and Gibilmanna. The 3D model was built considering characteristic anchor points for each of the different ionospheric regions and joining these points by an adaptive ionospheric profiler derived from the one used in Autoscala. The model produces as an output a 3D matrix which can be profitably used as an input for a Matlab/Fortran based ray tracing program recently developed at INGV.

This paper deals about some practical examples of instantaneous 3D modelling of regional ionosphere, based on ionosonde data from the Istituto Nazionale di Geofisica e Vulcanologia, INGV. Characteristic anchor points have been chosen for each ionospheric regions. These points are joint by an adaptive ionospheric profiler derived from the one used in Autoscala. For the F2 region the anchor point is given by the real height *hmF2* of the layer and its critical frequency *foF2*. These values are obtained basing on the observed heights ($hmF2_{ROMA}$[OBS] and $hmF2_{GIBILMANNA}$[OBS]) and critical frequencies ($foF2_{ROMA}$[OBS] and $foF2_{GIBILMANNA}$[OBS]) of the F2 layer, which are compared with the corresponding monthly median given by CCIR maps using Shimazaki's formulation. The differences $\delta hmF2_{ROMA} = hmF2_{ROMA}$[OBS] - $hmF2_{ROMA}$[CCIR] and $\delta hmF2_{GIBILMANNA} = hmF2_{GIBILMANNA}$ [OBS] - $hmF2_{GIBILMANNA}$ [CCIR] are thus computed and used in Kriging method to update the values given by CCIR maps. For the F1 region the critical frequency is derived form a solar zenith angle dependent model adjusted to match the values of *foF1* measured in Roma and Gibilmanna. For the E region the height is set to 110 km, while the critical frequency is estimated by a standard solar zenith angle and dependent model. The model provides as an output a regional estimation of the electron density over the Mediterranean area in form of a 3D matrix. Such a matrix can be profitably used as an input for a 3D ray tracing program used at INGV. In order to test the performance of 3D model represented as output (matrix in figure 1) a 3D ray tracing in some special cases.

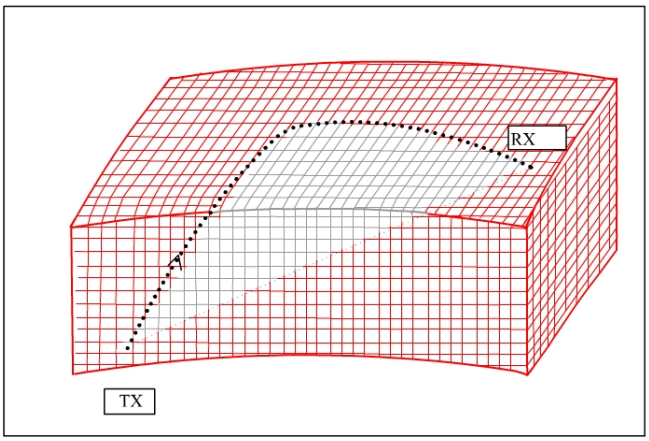

Fig.1. 3D adaptive model with a ray tracing program used at INGV

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