Recovering electron density height profiles using forward oblique ionosondes

P.L. Martin, N. Jackson-Booth, R. Penney, R. Buckland
QinetiQ, Malvern Technology Centre, Great Malvern, WR14 3PS, UK
plmartin@qinetiq.com

The ionosphere is a temporally varying refractive medium located between 50 km and 1000 km above the Earth's surface that affects communications systems. A strong understanding of ionospheric electron density is therefore paramount for radio systems. The electron density profile can be determined using a range of measurement techniques, including incoherent scatter radar (operating in the VHF and UHF bands), total electron content (TEC) derived from global navigation satellite systems (GNSS, operating in the L-band) data and vertical electron density profiles from ionosondes (transmitter and receiver pairs that operate in the HF-band). Assimilative ionospheric models use these measurements to produce now casts of the ionosphere. One such model, EDAM (Electron Density Assimilation Model), produces full 3D global now casts through assimilation of ionospheric data via a Kalman filter approach.

The measurement techniques listed above prove difficult to utilize over areas such as oceans as data from vertical ionosondes and GNSS is sparse. Forward oblique ionosondes (FOIs) consist of a receiver and transmitter pair with a known separation distance and can therefore be used to enable measurements over previously under-observed regions. FOIs measure the time-of-flight of the radio signal at a range of frequencies to infer the total electron content along the ray path and thus the state of the ionosphere.

Here we present preliminary results for the assimilation of FOIs into EDAM, demonstrating that the background electron density can be successfully modified using FOIs to capture the bottomside structure of the ionosphere. Comparisons are made using simulated FOI data, showing good agreement between the original electron density model and that returned by EDAM after assimilation of the simulated FOI.