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Parametric Data-Assimilative Ionospheric Specification and Validation

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We present validation studies using a parametric data-assimilative ionospheric model, the Regional Ionospheric Profile Estimator (RIPE), focused on robust regional specification of bottom-side electron density profiles. The model functions by filtering, weighting, and interpolating individual vertical electron density profile parameters measured by ionosondes, here following the parameterization of the International Reference Ionosphere (IRI). RIPE operates on the *ratios* of scaled parameters to climatological model predictions for *fo*F2 (URSI model), *hm*F2 (Shubin), and B_0 and B_1 (Altadill, Torta, and Blanch). This allows the dominant spatial and temporal structure in the ionosphere to be handled by well-validated climatological models, while the statistical data assimilation routines handle only the normally-distributed deviations from climatology. Examination of spatial correlations for filtered measurement ratios demonstrate typical correlation length scales on the order of 2000 km. We demonstrate significant improvement over pure climatological model runs, and show that the model accuracy is insensitive to the precise selection of correlation length and other interpolation parameters.

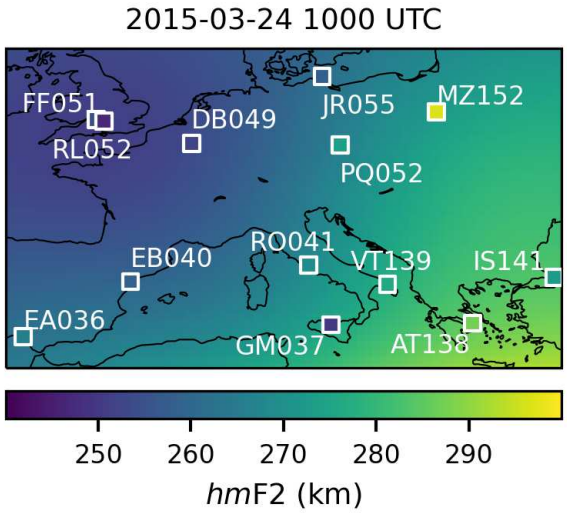

Figure 1. Example RIPE-generated map of hmF2 over the European sector, demonstrating the ability to handle outliers (e.g. values at GM037 and MZ152 ionosondes) and nearly-overlapping measurements (FF051 and RL052 stations).

We present validation data from several 30-day periods over the North American, European (with example shown here), and South American sectors. Accuracy improvements over pure climatological specification are observed in *fo*F2, *hm*F2, and B_0; no improvement is observed for B_1. Mean accuracy improvements are similar in magnitude when comparing to auto-scaled ionosonde data or a more limited set of hand-scaled data. Which profile parameters are most improved by the data assimilation process varies strongly with region and time period. We discuss possible reasons for this variability along with the advantages and limitations of our data assimilation approach.

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