Testing Bottom-Side Ionospheric Profiles Generated Using Assimilative Models

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Testing Scenario

The analysis interval for the present study is the whole of September 2011, and the study concentrates on observations from the four Digisondes in the Republic of South Africa (RSA), situated at Grahamstown, Hermanus, Louisvale and Madimbo (Figure 1). Data from the Grahamstown Digisonde and GPS data from Sub-Saharan Africa was assimilated.

The remaining RSA Digisondes were then used to test the model results.

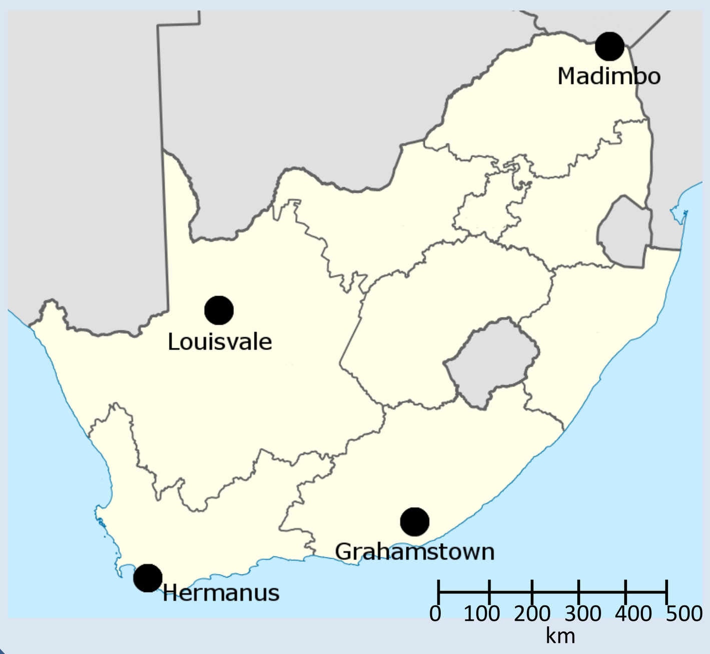

Figure 1: Locations of the four RSA Digisondes.

Models

The tested models were:

- **IRI-2007.** The international Reference Ionosphere is a monthly median model that provides ease and speed of use, and a generally acceptable level of validity. It uses either the URSI or CCIR world maps of foF2 and M(3000)F2 to define the F2 peak parameters foF2 and hmF2.[1]
- **EDAM.** The Electron Density Assimilative Model was developed to assimilate ionospheric measurements into a background ionospheric model. The assimilation is based on a weighted, damped least mean-squares estimation.[2]
- **GPSII.** The GPS Ionospheric Inversion model is a recursive data assimilation algorithm that provides an electron density model for a fixed geographical area. At each time step the electron density model matches all ionospheric data accumulated during the model update time interval to within the data measurement error.[3]

Results

The models have been assessed in terms of the F2 layer critical frequency (foF2), the height of the F2 peak (hmF2) and the height where the plamsa frequency is 80% of the foF2 (h(0.8foF2)). This latter parameter provides an indication of how well the models match the bottom-side profile of the F2 layer.

Figure 2 is a Taylor diagram[5] which has been modified to also show the bias of the models. The radial distance from the origin shows the normalised standard deviations of the models' and the azimuthal angle corresponds to the correlation between the model and the observation. The dotted semicircles, centred at the 'Observed' marker, represent the normalised standard deviation of the errors (model minus observation). A normalised parameter can be converted back to the absolute value by multiplying it by the corresponding factor (top right of diagram).

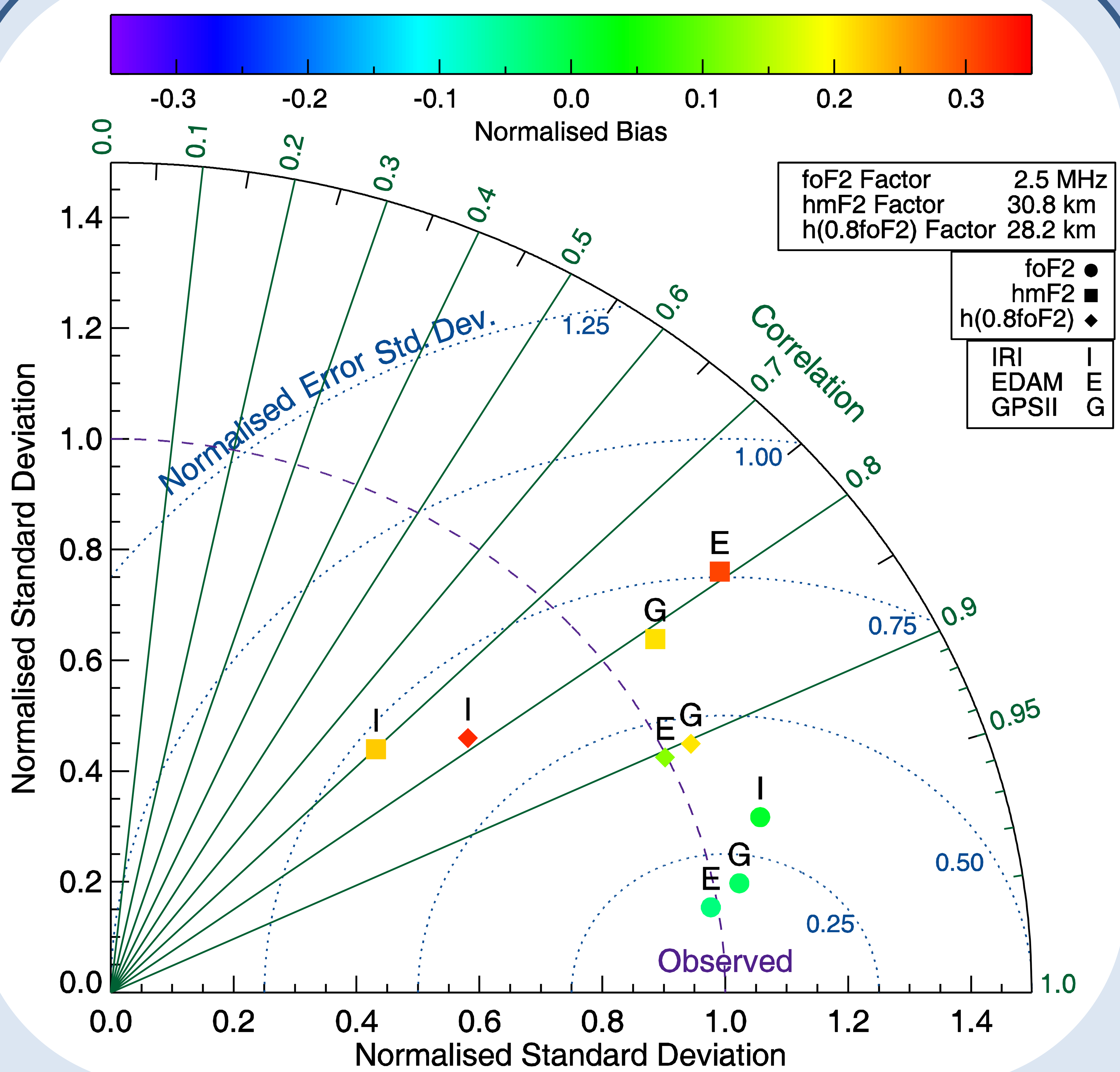

Figure 2: Taylor diagram showing model bias at Hermanus.

Discussion

Figure 2 shows that, at Hermanus, EDAM was slightly better than GPSII at specifying the values of foF2, showing a stronger correlation and a standard deviation closer to the observation. However EDAM has a negative foF2 bias which GPSII does not have and both show improvement, in standard deviation and correlation, over IRI. The situation is reversed at Louisvale where the GPSII estimate of foF2 outperforms EDAM.

GPSII gives the best estimates of hmF2 at all stations. EDAM tends to overestimate the range of hmF2 values which is evident from the normalised standard deviation being larger than 1, and shows a large positive bias.

The quality of the EDAM and GPSII h(0.8foF2) estimates are comparable and both provide improvement over IRI.

Acknowledgments & References

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