Evaluation of the Impact of Statistical Models on Global SuperDARN Convection Maps

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abstract. The recent addition of two radars to the existing network of six Super Dual Auroral Radar Network (SuperDARN) HF radars in the northern hemisphere has extended the area in the high latitude where measurements of convecting ionospheric plasma are made. Periods are now common during which the electrostatic potential, Φ, due to the $\mathbf{E}\times\mathbf{B}$ drift of ionospheric plasma, is known to a high degree of confidence over nearly $\frac{3}{4}$ of the high latitude region. During such periods global convection maps derived using the APL fitting technique are well-defined by the measurements alone. The details of statistical model data, used only to constrain the solution in regions lacking observations, have little effect on the gross features of the large-scale convection patterns. The global solution of Φ and the total potential variation across the polar cap, Φ_{PC}, are virtually independent of the statistical model. The ability to accurately determine a global solution of Φ based on direct measurements represents an important acheivement in understanding solar wind-magnetosphere-ionosphere coupling.

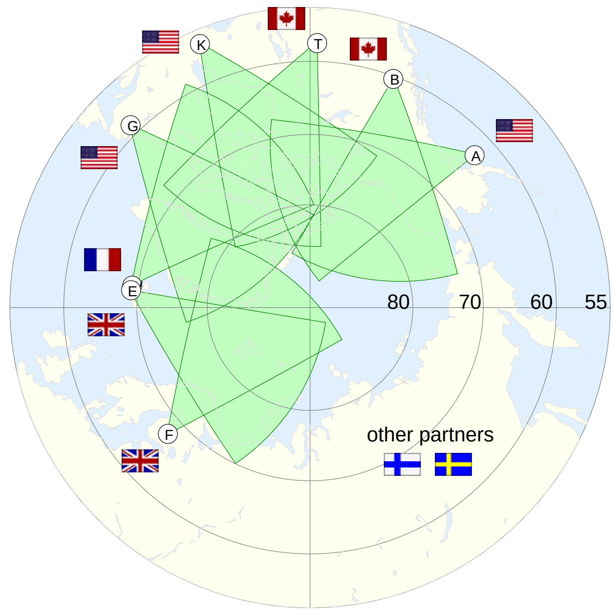

Figure 1: Location and coverage of the northern hemisphere SuperDARN component.

Discussion

The increased coverage of the northern hemisphere component of SuperDARN can be seen in Figure 1. An additional radar in Alaska will further extend the coverage to the west sometime in 2000. It is apparent from Figure 1 that periods must now exist when line of sight (LOS) velocity measurements are provided over ~3/4 of the high latitude ionosphere. During such periods the solution of the fitting technique described by *Ruohoniemi and Baker* [1998] is adequately constrained by the measurements alone and the resulting globabl electrostatic potential patterns are largely unaffected by the choice of statistical model.

Figure 2 illustrates an example when the coverage approaches nearly 3/4 in the northern hemisphere. LOS velocity vectors are present from ~6 MLT to ~24 MLT. Ionspheric convection in the dayside and dusk sectors is well-defined by the measurements. Unfortunately, this period occured before the radar in British Columbia was operational.

The LOS data from 2 can be used to construct a global map of the electrostatic potential, Φ, in the high-latitude ionosphere using the technique described by *Ruohoniemi and Baker* [1998]. The resulting potential pattern is shown in Figure 3. The fitting was performed to order 8 and the APL statistical model corresponding to IMF magnitude $6\leq B_T\leq 12$ nT and IMF orientation B_z-/B_y- [*Ruohoniemi and Greenwald*, 1996].

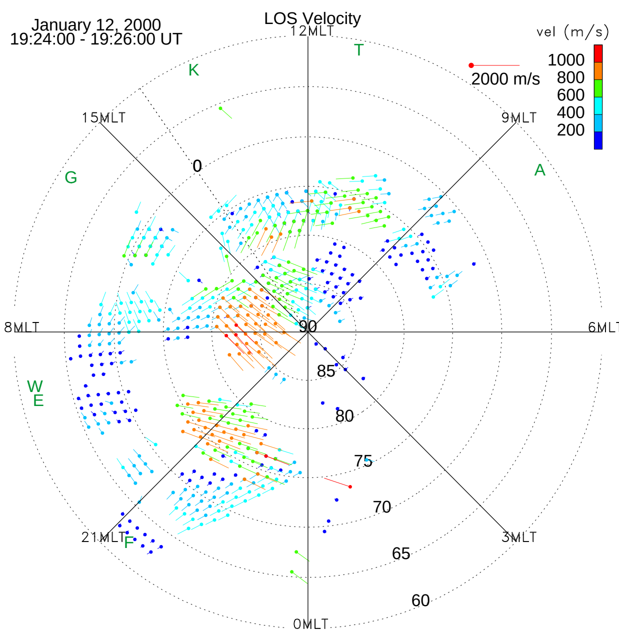

Figure 2: Line of sight (LOS) velocity data from the northern hemisphere SuperDARN component for the period of 1924–1926 UT on January 12, 2000.

In order to show the choice of stastistical model has little effect on the solution of Φ for this period, the fitting was performed using all eight statistical patterns of [*Ruohoniemi and Greenwald*, 1996] corresponding to IMF magnitude $6\leq B_T\leq 12$ nT. Figure 4 shows residual

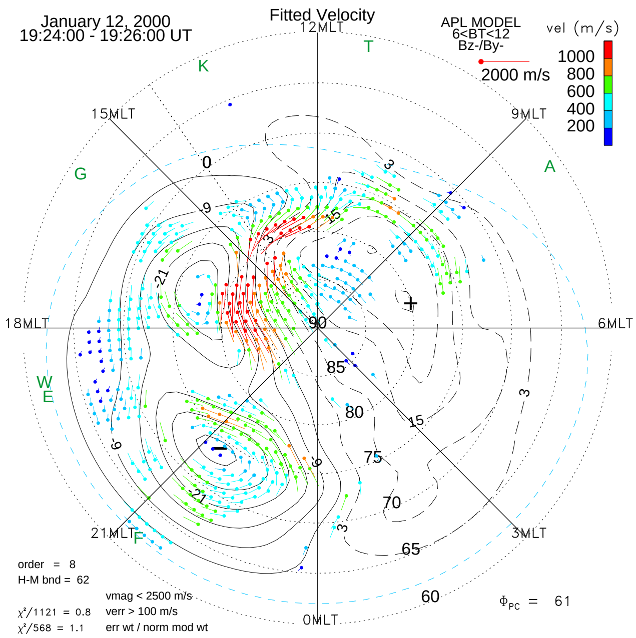

Figure 3: Fitted data using the LOS data from Figure 2 and the APL model with IMF

potential patterns which result from the difference between the solution of Φ using one of these statistical models and the solution of Φ shown in Figure 3.

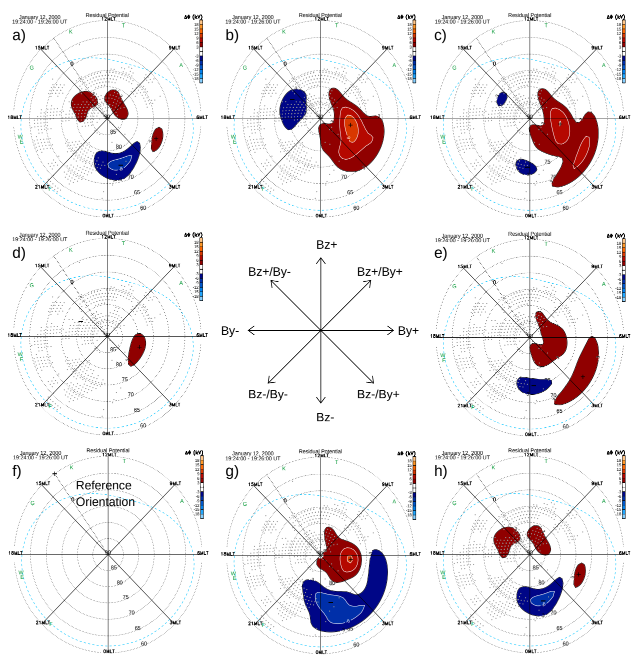

Figure 4: Residual potential contours resulting from the difference between the solution of Φ using one of the statistical pattern of *Ruohoniemi and Greenwald* [1996] corresponding to IMF magnitude $6 \leq B_T \leq 12$ nT and the solution of Φ shown in Figure 3.

The main differences can be seen in the residual contours corresponding to the fit using the APL statistical model of IMF orientation B_z-/B_y-. Residuals no greater than ∼10 kV are seen in this pattern and are confined to a region where no measurements exist. Differences in the solution are expected at such locations since the statistical models of the ionospheric flow differ drastically in magnitude and orientation for the two models chosen. However, the small residuals demonstrate that the global pattern remains largely determined soley by the LOS measurements. Further details are provided by *Shepherd and Ruohoniemi* [2000].

References

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