

Characteristics of ionospheric convection derived by the Map Potential Algorithm and contribution of mid-latitude SuperDARN data

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Introduction

What is the Map Potential Algorithm?

-> It is the method of deriving large-scale convection maps based on radar data complemented by a statistical model

Processing of the Map Potential Algorithm

1. Groundscatter is excluded.
2. Perform a boxcar filtering.
3. Assign uncertainties to the filtered velocity values.
4. Define a global grid for spatial averaging (by the spatial scale of 1 degree of latitude).
5. Plot of the averaged line-of-sight velocity values.
6. Determine a solution for the distribution of electrostatic potential expressed as a series expansion in spherical harmonics.

Image of the Large-Scale Convection

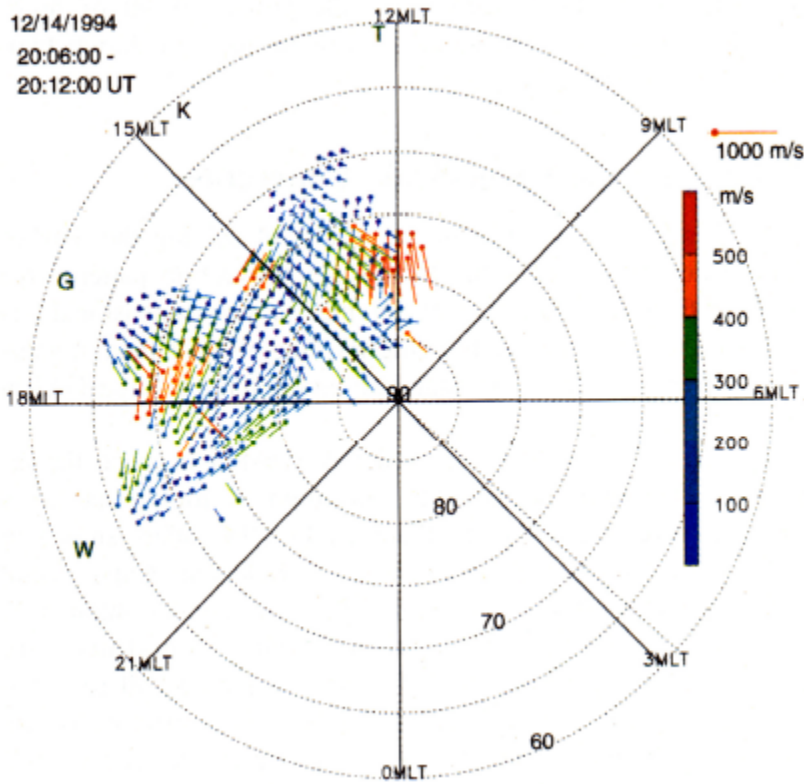


Plate 1. Plot of the averaged line-of-sight velocity values

Reference :

Ruhoniemi, J. M., and K. B. Baker, Large-scale imaging of high-latitude convection with Super Dual Auroral Radar Network HF radar observations, *J. Geophys. Res.*, 103, A9, 20,797-20,811, 1998.

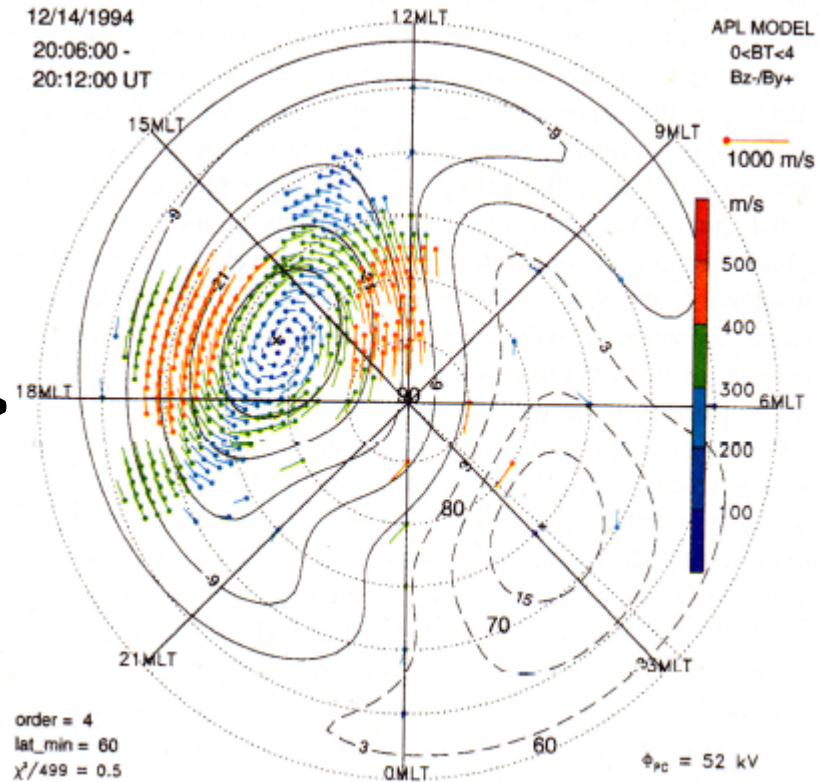


Plate 2. Solution for the global convection pattern obtained by fitting the data of Plate 1 and data from a statistical model

Current situation and issues

現状における問題点

We don't know the degree of the reliability of the data from a statistical model (based only on the high latitude radar data).
統計モデル(高緯度データのみを元にして作り上げた統計モデル)からのデータの信頼性がわからない。

How could I approach the issue?

-> We will evaluate its reliability by comparing the cases where using the data from a statistical model (based only on the high latitude radar data) with the case where using mid-latitude SuperDARN data.

今までの統計モデルを用いた場合と、中緯度データを用いた場合とを比較して、統計モデルの信頼性を評価する。

What I have done so far 今までしてきたこと

- Studying the Map Potential Algorithm.
 - Making Map files.
- > From January 2009 to October 2014.
- Plotting potential maps for selected events

Examples of potential maps

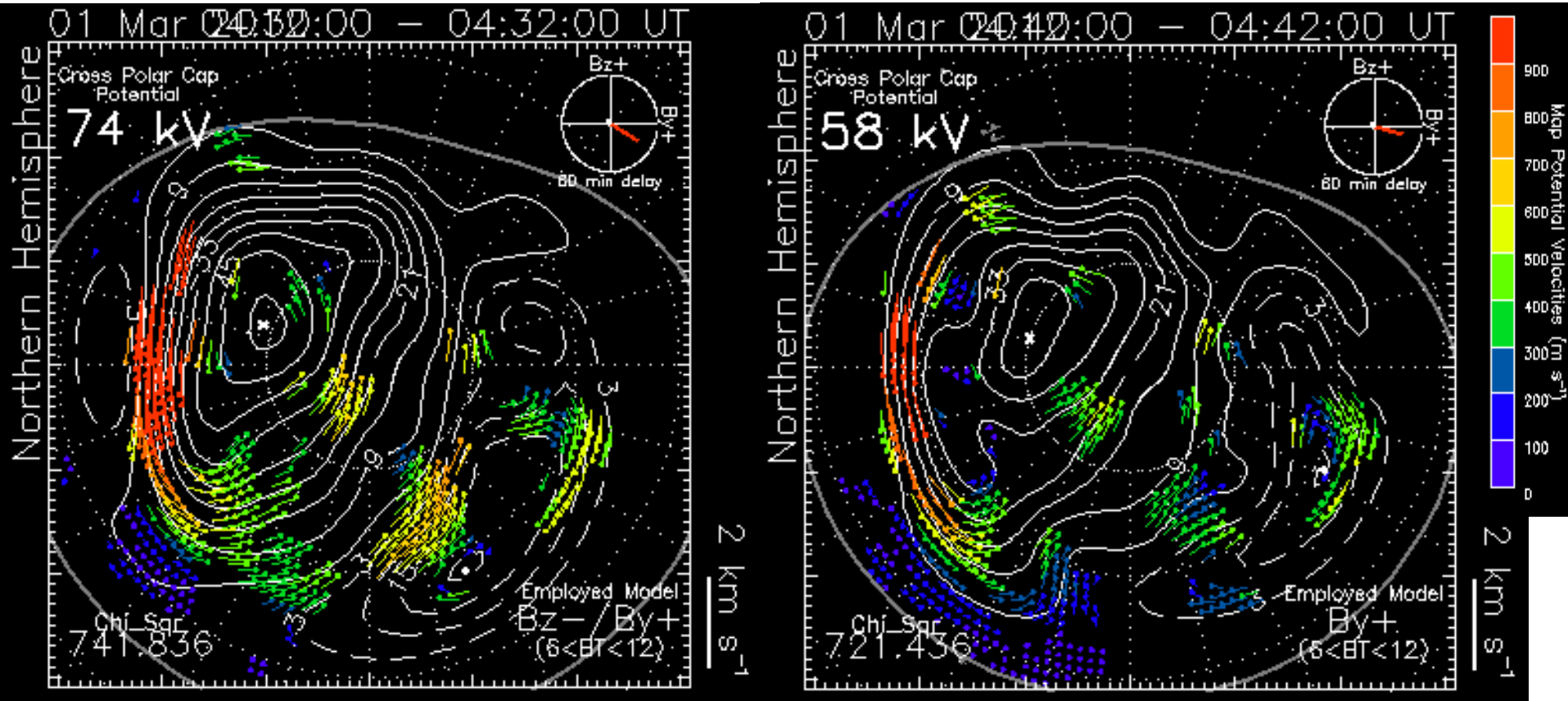


Plate 3. 01 Mar 2012 04:30:00-04:32:00 UT

Plate 4. 01 Mar 2012 04:40:00-04:42:00 UT

Things to do これからやること

- Compare the fitting results with and without mid-latitude radar data
- See the effects on map potential of changing HM boundary.
- Compare potential maps based on RG05 and CS10.

Summary

- The Map Potential Algorithm is the method of deriving convection maps based on radar data complemented by a statistical model.
- We're going to compare the fitting results with and without mid-latitude radar data.

Imaging the Large-Scale Convection

$$\Phi(\theta, \varphi) = \sum_{l=0}^L \sum_{m=-M}^M A_{lm} Y_{lm}(\theta, \varphi)$$

$$= \sum_{l=0}^L [A_{l0} P_l^0(\cos \theta) + \sum_{m=1}^l (A_{lm} \cos m\varphi + B_{lm} \sin m\varphi) P_l^m(\cos \theta)]$$

$$\vec{E} = -\text{grad}\Phi; \vec{V} = \vec{E} \times \vec{B}/B^2$$

$$\chi^2 = \sum_{i=1}^N \frac{1}{\sigma_i^2} [\vec{V}[i] \cdot \vec{k}[i] - W_i]^2$$

σ_i : 不定性、 $\vec{V}[i]$: 仮定した Φ から求めた対流速度
 $\vec{k}[i]$: 視線方向の単位ベクトル、 W_i : 観測値