TOWARD A GLOBAL IONOSPHERIC ELECTRODYNAMICS MODEL

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PROBLEM

solve 2D potential equation (assumes equipotential field lines and $\nabla \cdot \mathbf{J} = 0$)

$$\nabla \cdot (\Sigma \cdot \nabla \Phi) = S(J_{\parallel}, V_n)$$

Φ: electrostatic potential

Σ: ionospheric conductance tensor (solar EUV and auroral)

S: source function for the electric potential

region 1 and 2 current systems $J_{\parallel}$ and thermospheric wind V_n are the primary drivers of the global electric field

SCHISM (IN GENERAL)

- high latitude

$$\nabla \cdot (\Sigma \cdot \nabla \Phi) = S(J_{\parallel})$$

  - spherical coordinates
  - problematic going to equator
  - $\Phi = 0$ in mid-latitude ($\sim 40°$)

- low- to mid-latitude

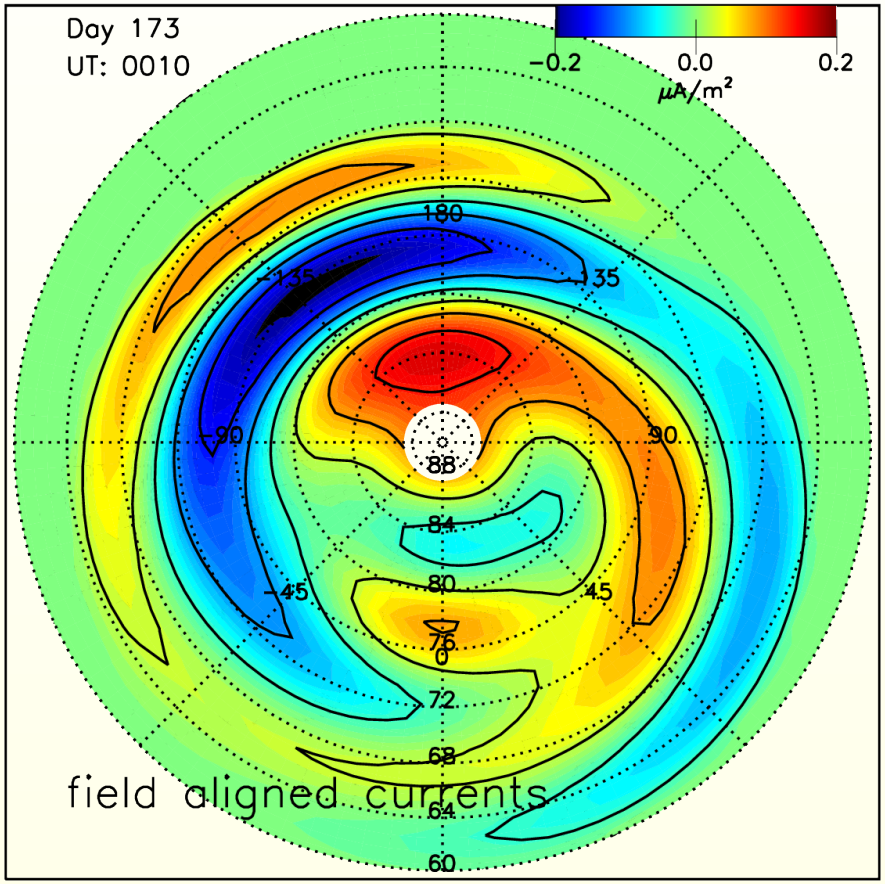
$$\nabla \cdot (\Sigma \cdot \nabla \Phi) = S(V_n)$$

  - dipole coordinates
  - $\Phi = 0$ in mid-latitude ($\sim 60°$)

- currently, low- to mid-latitude equation with $\Phi = 0$ at high latitude 90°
- developing global solution of Φ for both low latitude and high latitude
- some preliminary results

DRIVERS/CONDUCTANCE

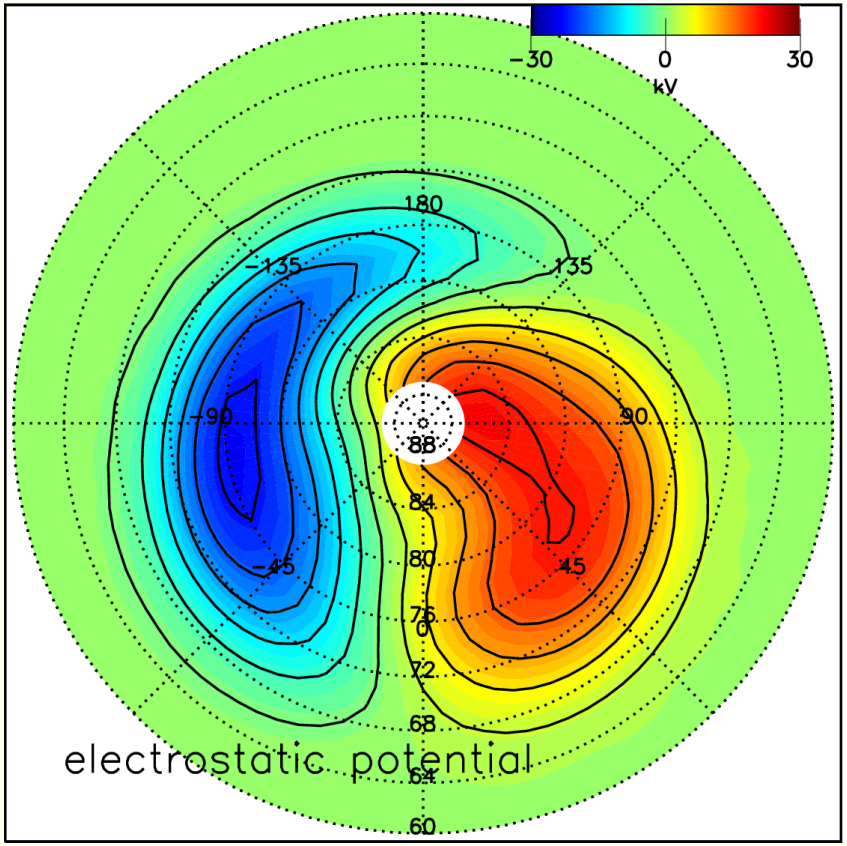
- use HWM14 for the neutral wind
- use Weimer for the region 1/2 currents
- use Hardy model for precipitation fluxes and Rees model to calculate enhanced ionization in auroral zone

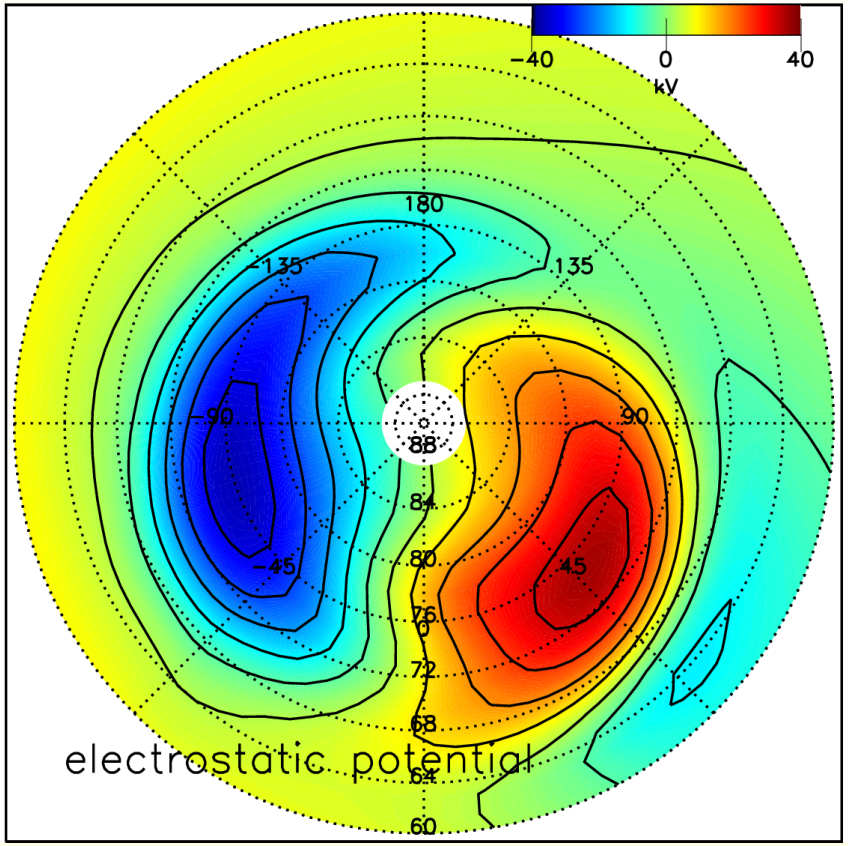


- use dipole coordinate system for potential equation
- solve potential equation with just neutral wind (Φ_V)
- solve potential equation with just region 1/2 currents using Φ_V at lower boundary (Φ_J)
- $\Phi = \Phi_V + \Phi_J$

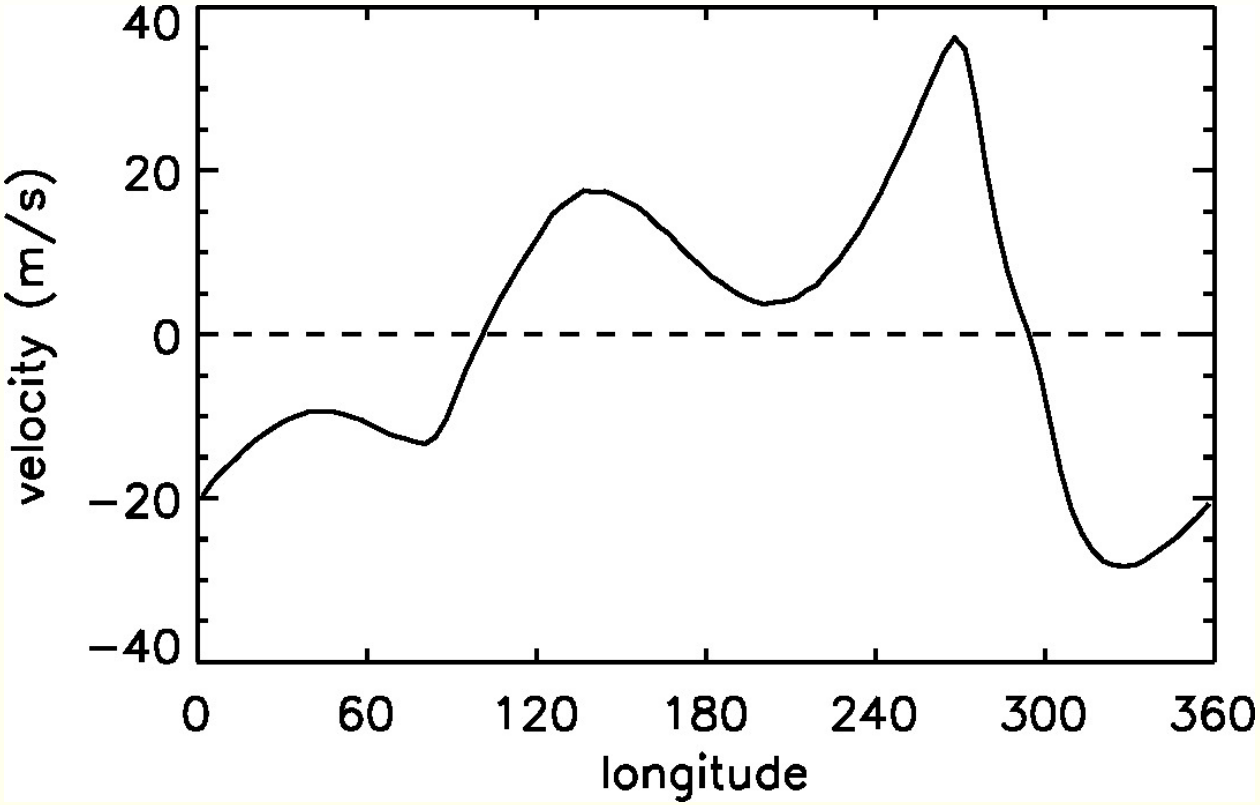
HIGH LATITUDE POTENTIAL

weimer (left) vs sami3 (right)



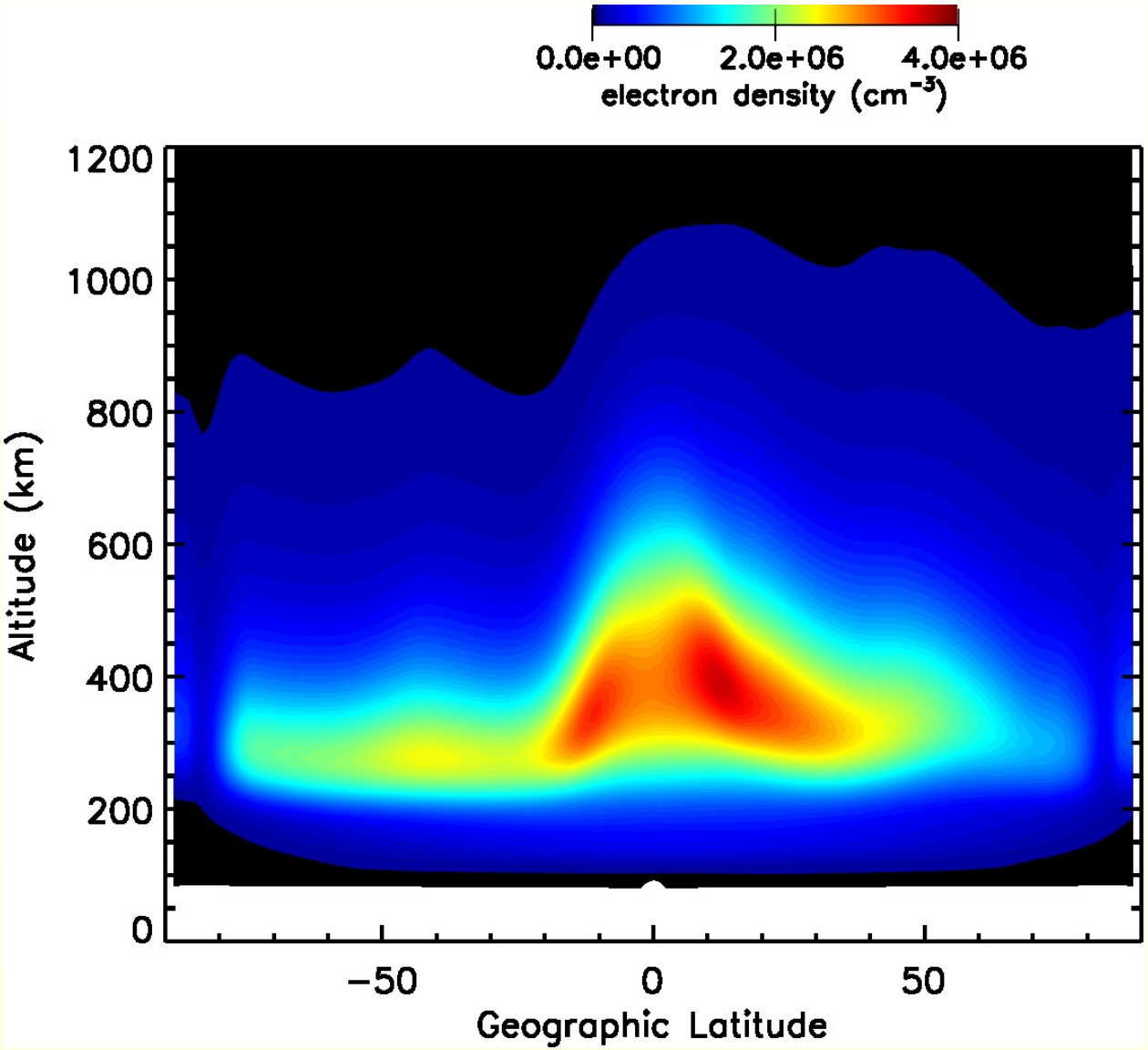


EQUATORIAL E $\times$ B VELOCITY



ELECTRON DENSITY

latitude vs altitude



SUMMARY

- reasonable first step
- yet challenges remain
  - north/south current systems different
  - open/closed field line boundary
  - matching potential across these boundaries

EVOLUTION OF DEVELOPMENT

- results not awful (9/12/16)
- results ok-ish (9/13/16)
- results bad (10/5/16)
- aargh! low-latitude dynamics suck (11/12/16)
- seems to work (11/13/16)
- results are reasonable (11/14/16)

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