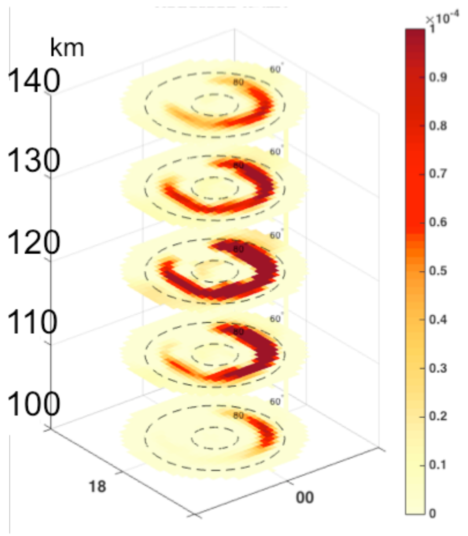
AMIE NextGen - extending capabilities for the assimilative mapping of ionospheric electrodynamics (AMIE) procedure

- Optimization with respect to both magnetic potential and electrostatic potential
- Realistic prior model error covariance derived large data bases
- Improved assimilative conductivity mapping
  (*See Mcgranaghan's poster DATA-04 on Tuesday*)
- EarthCube: Distributable AMIE Py software
- New multi-resolution needlet basis functions
  and non-Gaussian inferential framework



High-latitude Geospace Data Fusion and Assimilation at 4pm on Thursday

References: *Richmond and Kamide, JGR,1988; Matsuo et al., JGR, 2005; Cousins et al., JGR, 2013a,2013b; Knipp et al., SW, 2014; Matsuo et al., JGR, 2015; Cousins et al., JGR, 2015a, 2015b; Mcgranaghan et al., JGR, 2015, 2016; Fan et al., JASA, 2016.*
Supports: *NSF-Aeronomy AGS1025089, NSF-Polar PLR1443703, NSF-ICER1541010.*

AMIE NextGen

[Cousins et al., 2013, 2015; Matsuo et al., 2015; Mcgranaghan et al., 2016]

States

$$\vec{E},\ \Phi,\ \underline{\underline{\Sigma}},\ \vec{J}_{\|},\ \vec{J}_{\perp},\ \Delta\vec{B}$$

Observations

SuperDARN plasma drifts
Iridium/AMPERE magnetic fields
Ground-based magnetic fields
DMSP auroral particle precipitations

Forward Model $\mathbf{H}$

$$\vec{E} = -\nabla\Phi$$

$$\vec{J}_{\perp} = \underline{\underline{\Sigma}} \cdot \vec{E}$$

$$\vec{J}_{\|} = \nabla \cdot \vec{J}_{\perp}$$

$$\nabla \times \Delta\vec{B} = \mu_o \vec{J}$$

Solve for polar-cap SH coefficients with Bayesian estimator for Gaussian processes

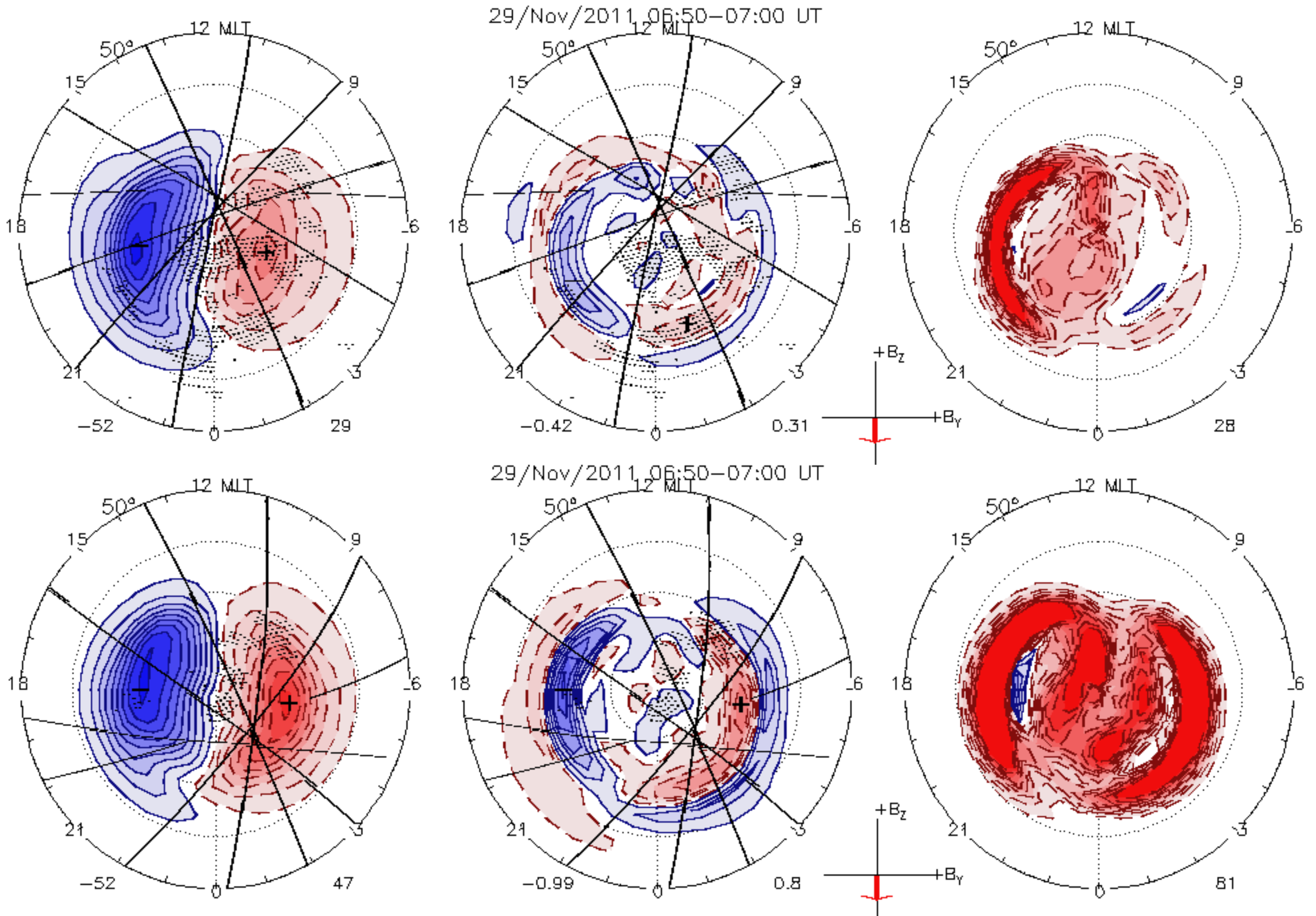
Bayesian analysis

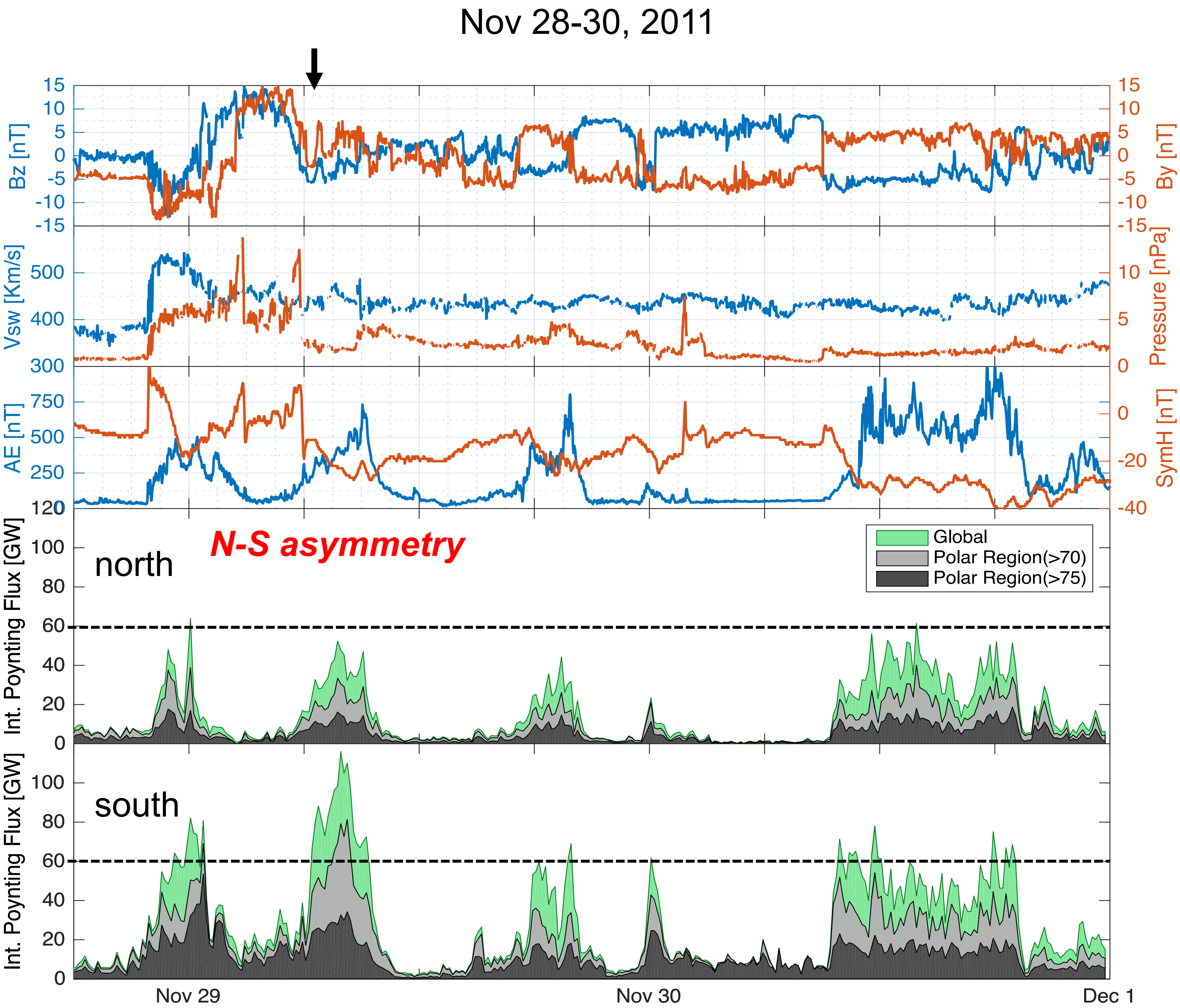
$$[\mathbf{x}|\mathbf{y}] \propto [\mathbf{y}|\mathbf{x}][\mathbf{x}]$$

$$\mathbf{x}_a = \mathbf{x}_b + \mathbf{K}(\mathbf{y} - \mathbf{H}\mathbf{x}_b)$$

$$\mathbf{C}_a = (\mathbf{I} - \mathbf{K}\mathbf{H})\mathbf{C}_b$$

Strong N-S asymmetry and large polar cap energy deposition

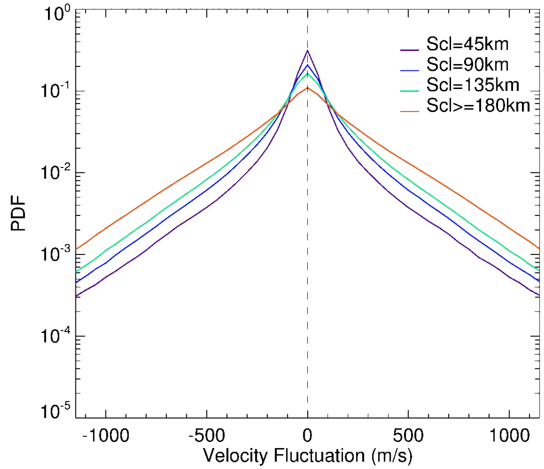


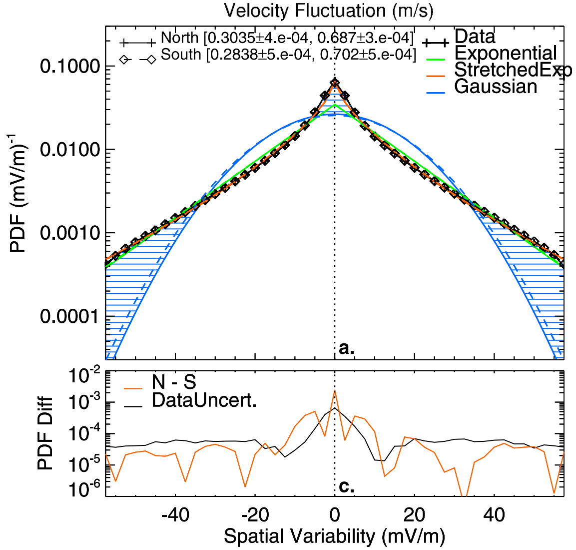


Nov 28-30, 2011
Bz [nT]
By [nT]
Vsw [Km/s]
Pressure [nPa]
AE [nT]
SymH [nT]
N-S asymmetry
north
south
Global
Polar Region(>70)
Polar Region(>75)
Int. Poynting Flux [GW]
Nov 29
Nov 30
Dec 1

Non-Gaussian small-scale random electric fields result in considerably more Joule heating than Gaussian fields

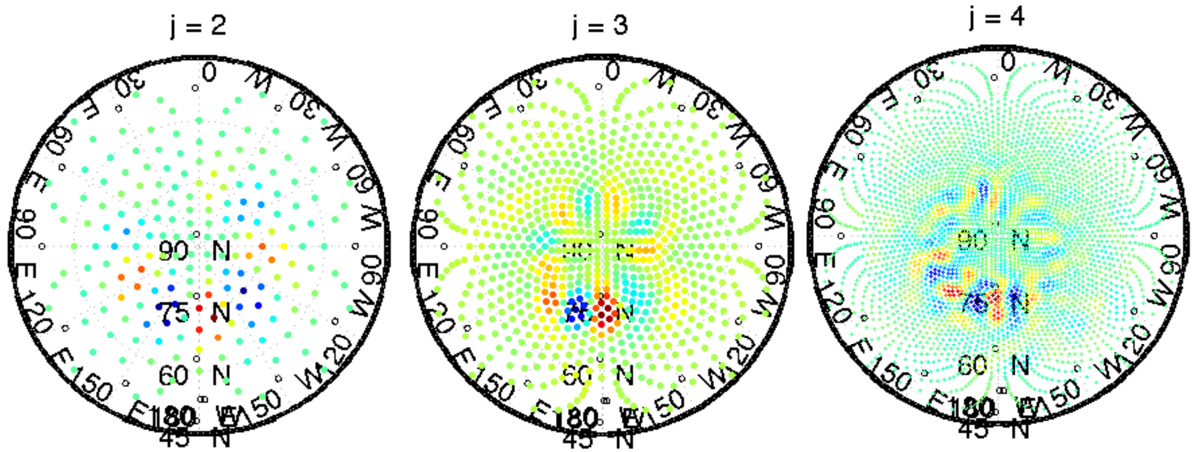
SuperDARN
Small-scale E fields

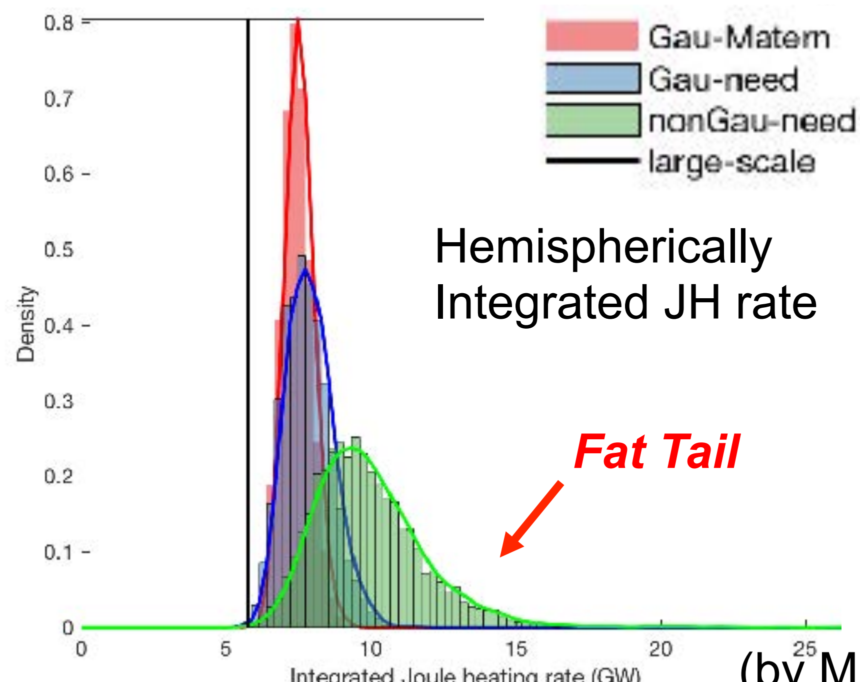




[Cousins and Shepherd, 2012]

Needlets (spherical multi-resolution frames)





(by Minjie Fan)