Data fusion in conductivity specification

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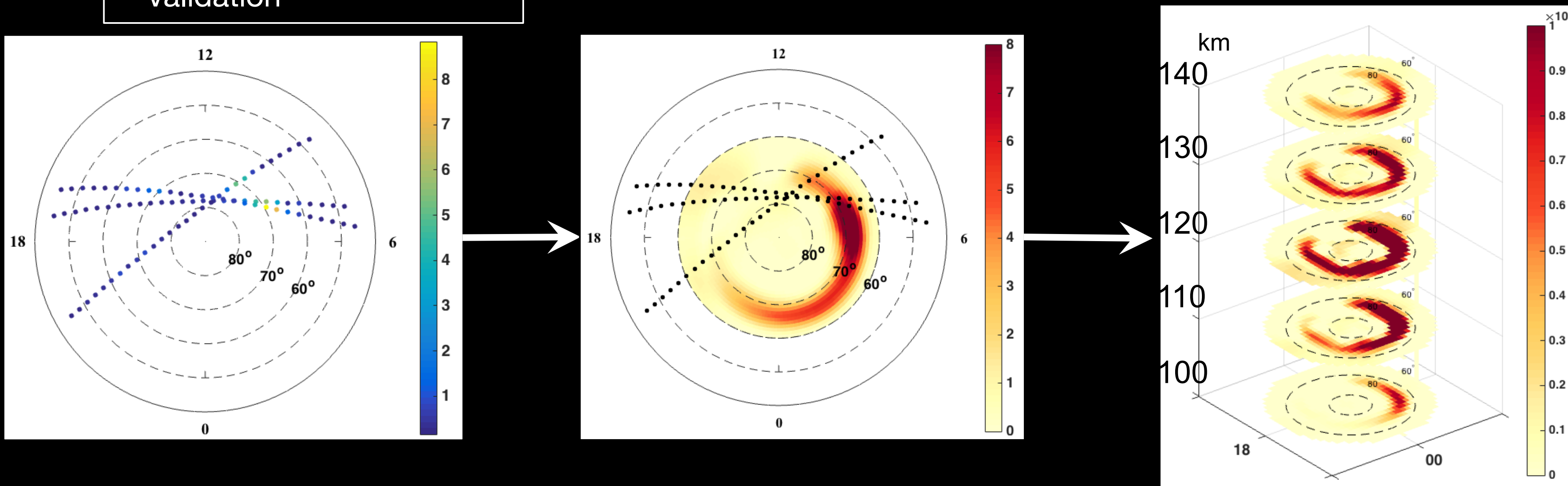
Challenges
- Uncertainty quantification
- Validation



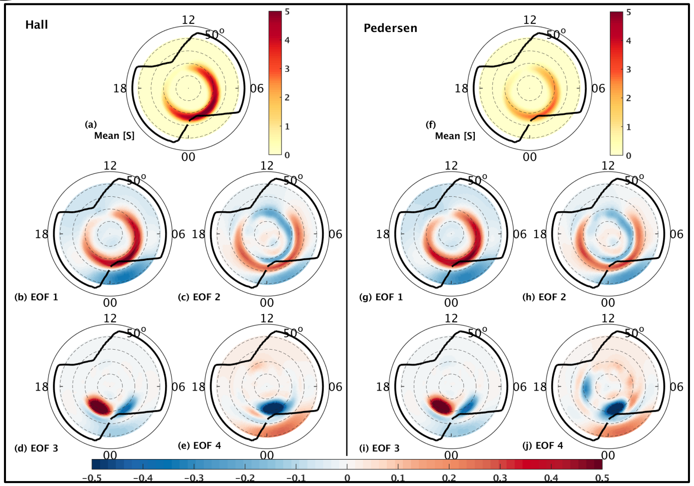
What does the community need from improved conductivity modeling?

Application of modeling improvement:

1. Studying local features in global analyses;
2. Facilitating closer agreement between diverse observations; and
3. Means to apply improvements

Optimal Interpolation (OI) technique: 3 Steps

1 Characterize the variability



McGranaghan, R. et al. (2015), Modes of high-latitude conductance variability derived from DMSP energetic electron precipitation observations: Empirical Orthogonal Function (EOF) analysis. J. Geophys. Res. Space Physics, 120, 11,013–11,031, doi: 10.1002/2015JA021828.

Optimal Interpolation (OI) technique: 3 Steps

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Boulder, Colorado

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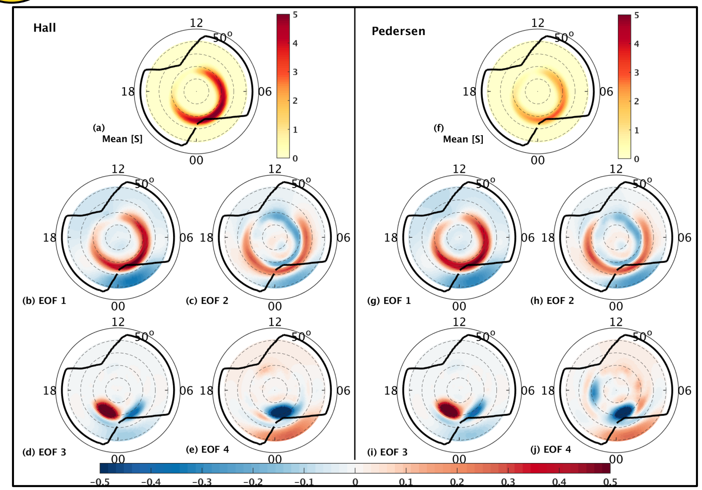
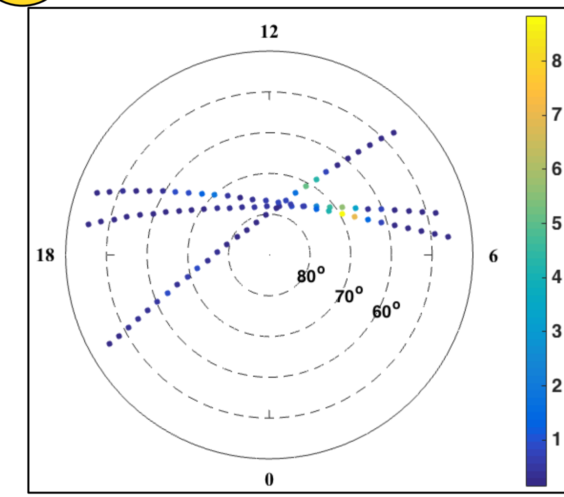


2 Accumulate observations



McGranaghan, R., D. J. Knipp, T. Matsuo, and E. Cousins (2016), Optimal interpolation analysis of high-latitude ionospheric Hall and Pedersen conductivities: Application to assimilative ionospheric electrodynamics reconstruction, J. Geophys. Res. Space Physics, 121, 4898–4923, doi:10.1002/2016JA022486.

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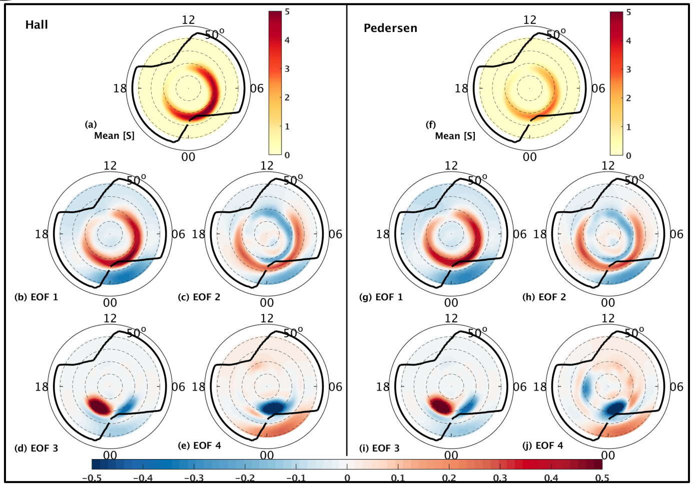

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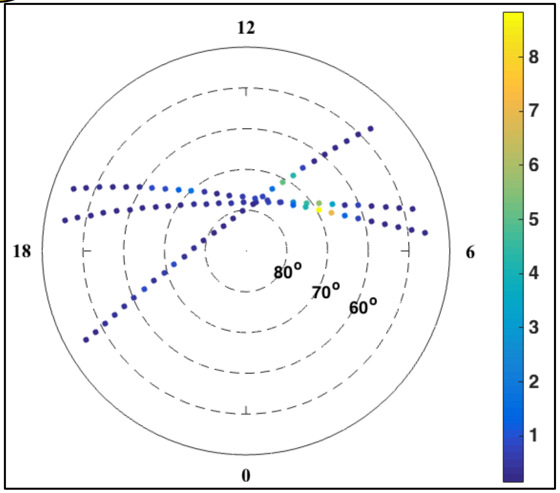
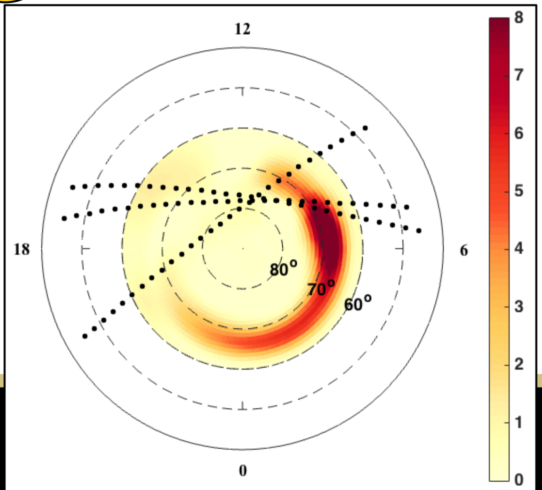


3 Optimal interpolation



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How can we qualitatively test the conductance models?

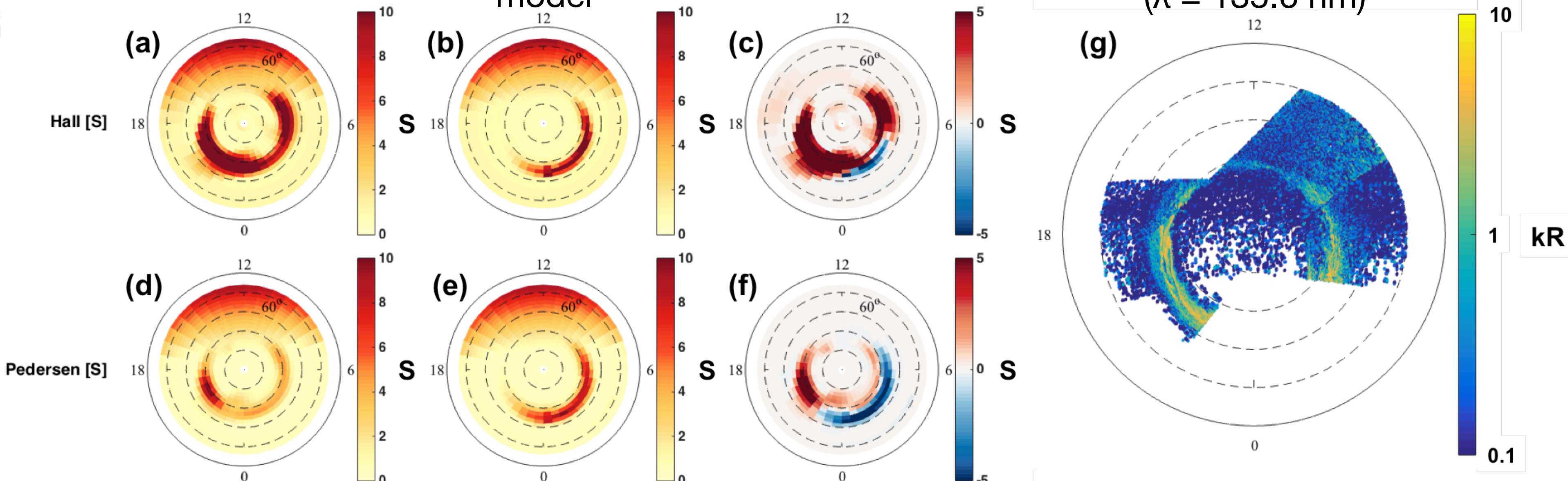
Qualitative metric – OI conductance model captures discrete precipitation

OI conductance model

Cousins et al. [2015] model

Difference ($\Sigma_{OI} - \Sigma_{C2015}$)

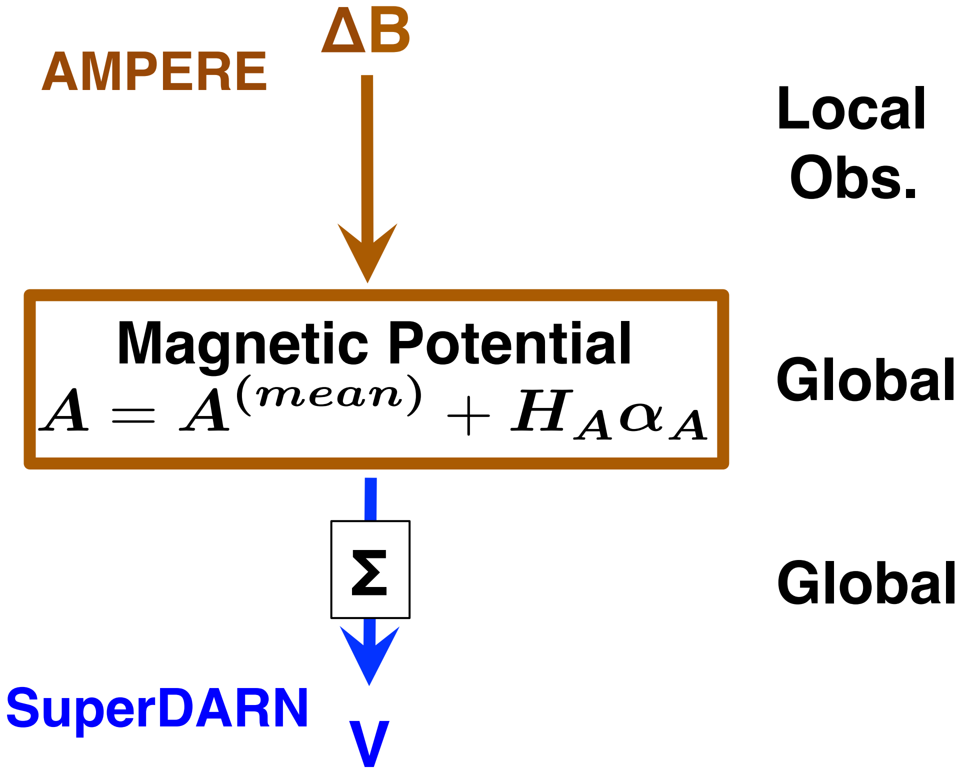
SSUSI auroral emission (λ = 135.6 nm)



Time (UT hr:min) =
11:55
to
12:05

Time (UT hr:mi) =
11:35
to
12:25

How can we quantitatively test the conductance models?



AMPERE to predict SuperDARN   ΔB → V

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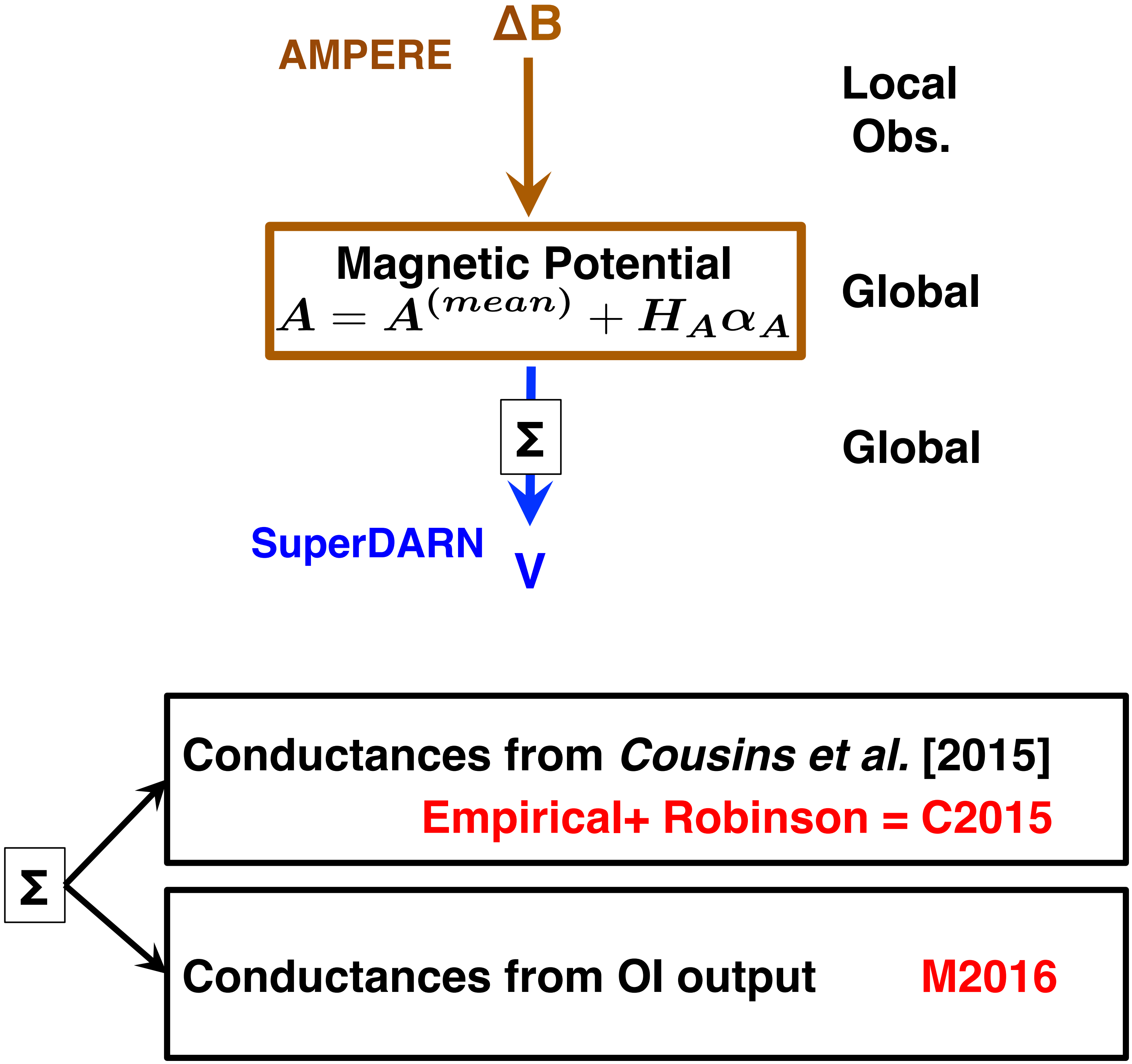
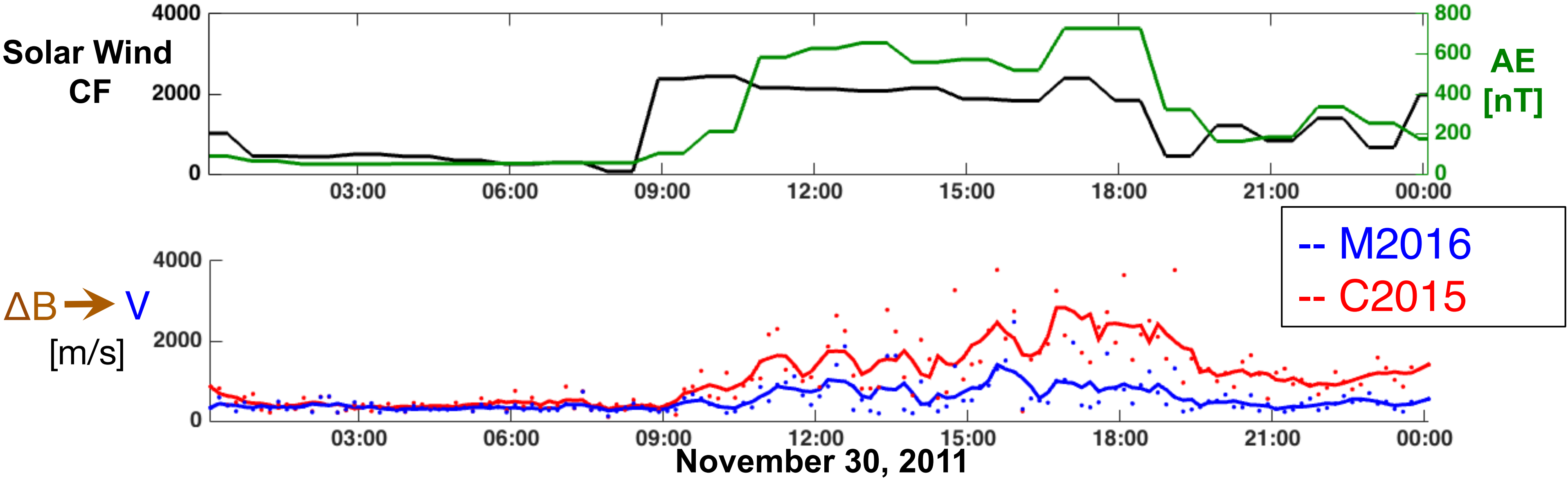
Cousins, E. D. P., T. Matsuo, and A. D. Richmond (2015), Mapping high-latitude ionospheric electrodynamics with SuperDARN and AMPERE, J. Geophys. Res. Space Physics, 120, doi:10.1002/2014JA020463.


AMPERE
ΔB
Local
Obs.
Magnetic Potential
$A = A^{(mean)} + H_A \alpha_A$
Global
Σ
Global
SuperDARN
V
Σ
Conductances from *Cousins et al.* [2015]
Empirical+ Robinson = C2015
Conductances from OI output
M2016

ΔB → V

Median Absolute Deviations (MADs)



ΔB → V
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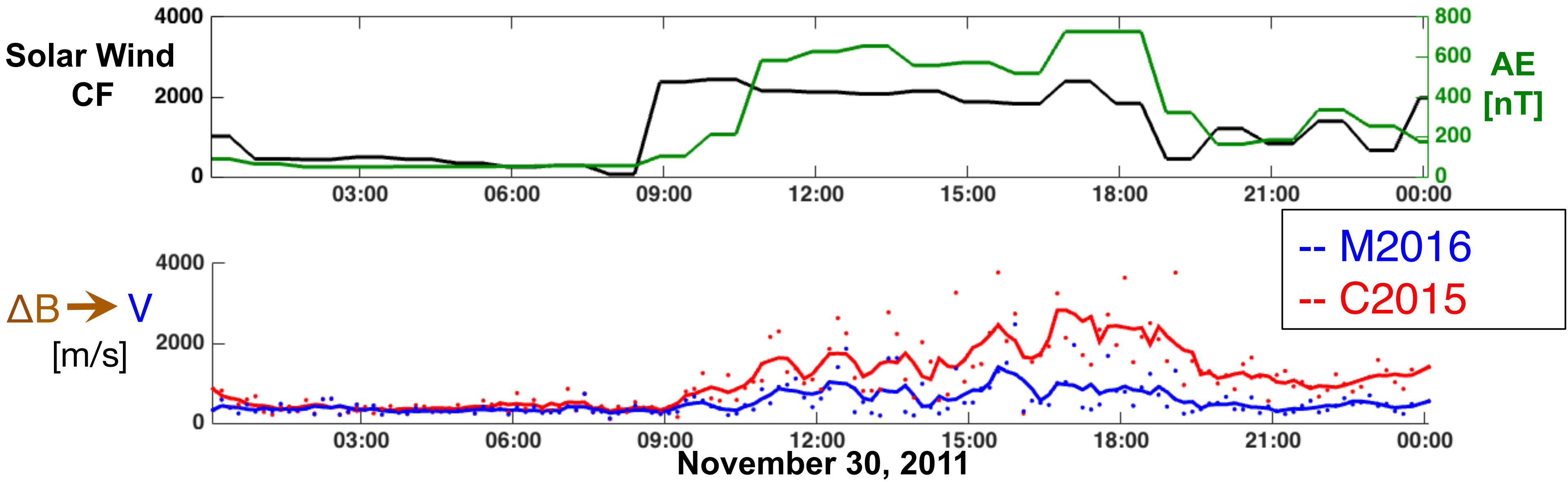

Total ΔB → V MADs [m/s]

C2015:	**684.2**
M2016:	**382.7**

ΔB → V

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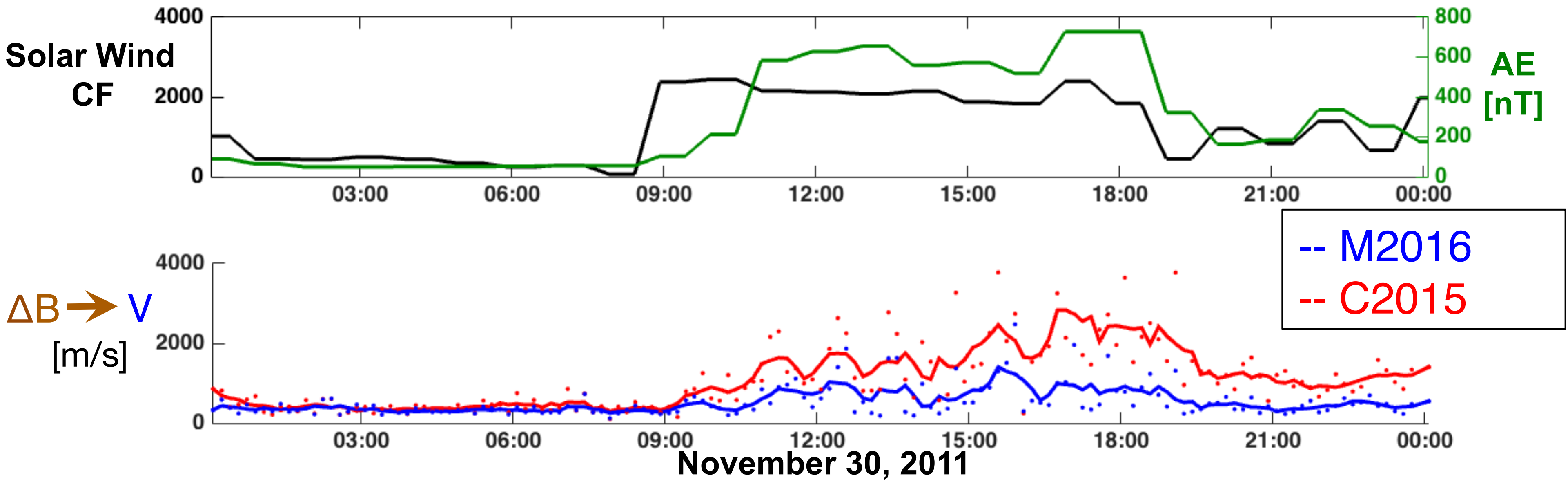

Total ΔB → V MADs [m/s]

C2015:	**684.2**
M2016:	**382.7**
M2016+SSUSI:	**359.1**

ΔB → V

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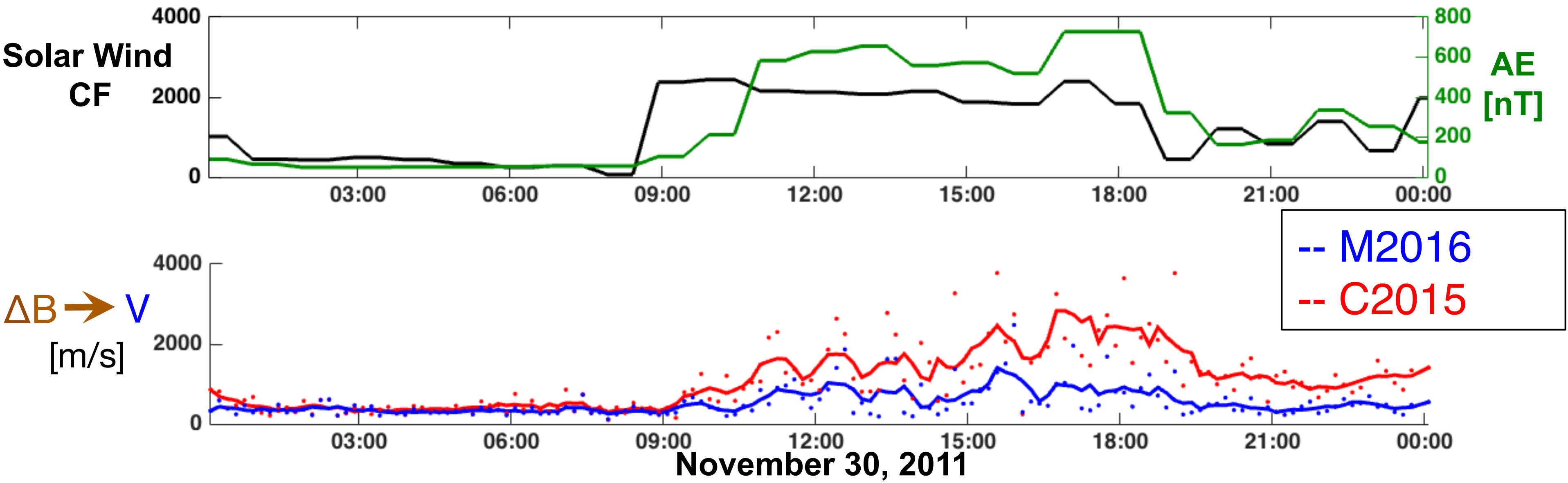

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Reconciling observations

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Challenges

- Uncertainty quantification
- Validation
- Allowing community to use these improvements

Summary

- Accurate ionospheric specification during storm time precluded by inaccurate conductivity modeling
- New modeling better capable of reconciling ground- and space-based observations

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- New modeling better capable of reconciling ground- and space-based observations

Spoke about extensively on Monday and Tuesday (2D and 3D)

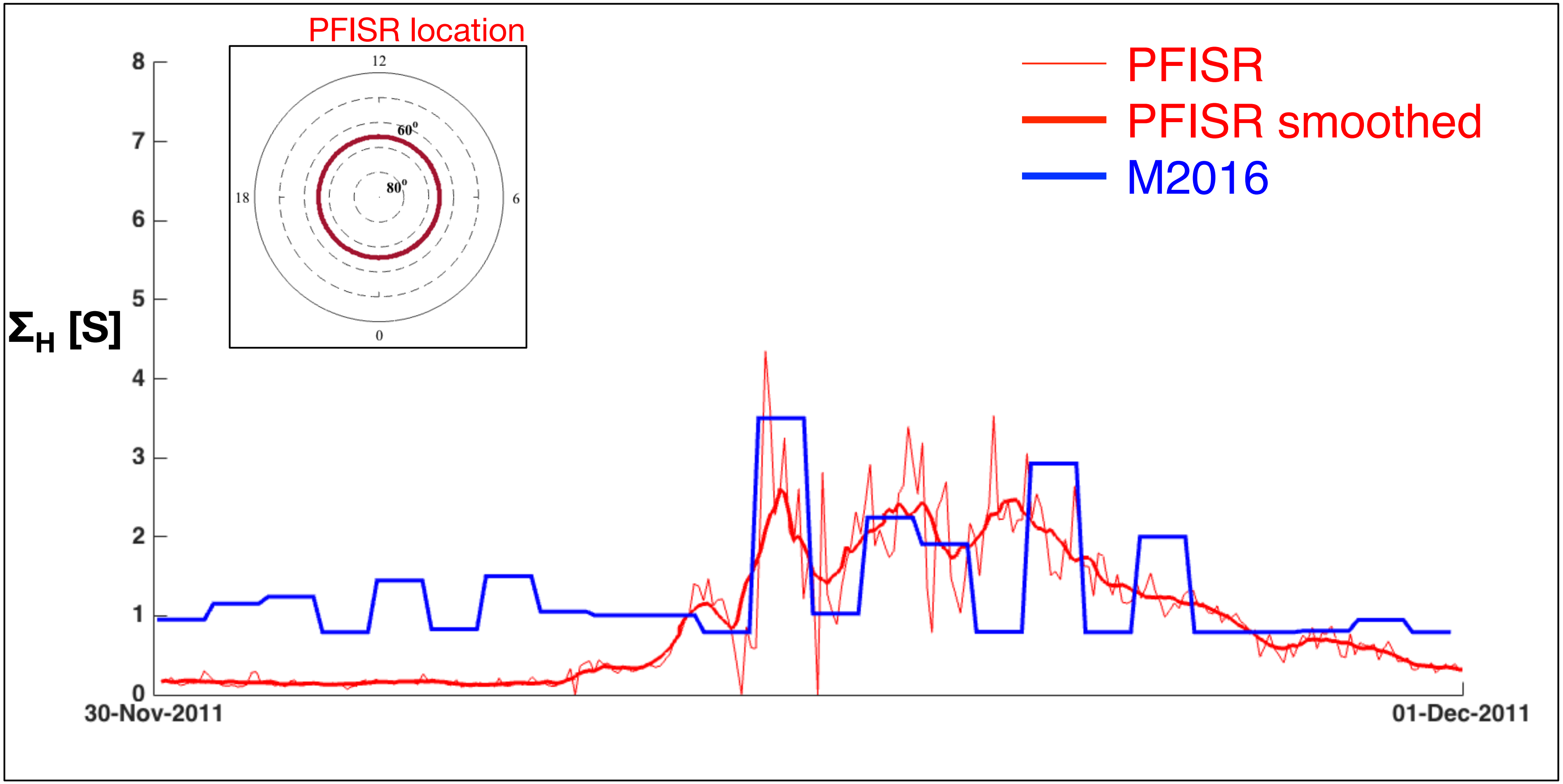
Community needs modeling capable of assimilating growing geospace observational system

Challenges:

- Uncertainty quantification
- Validation of 3D estimates
- Ease of use and availability

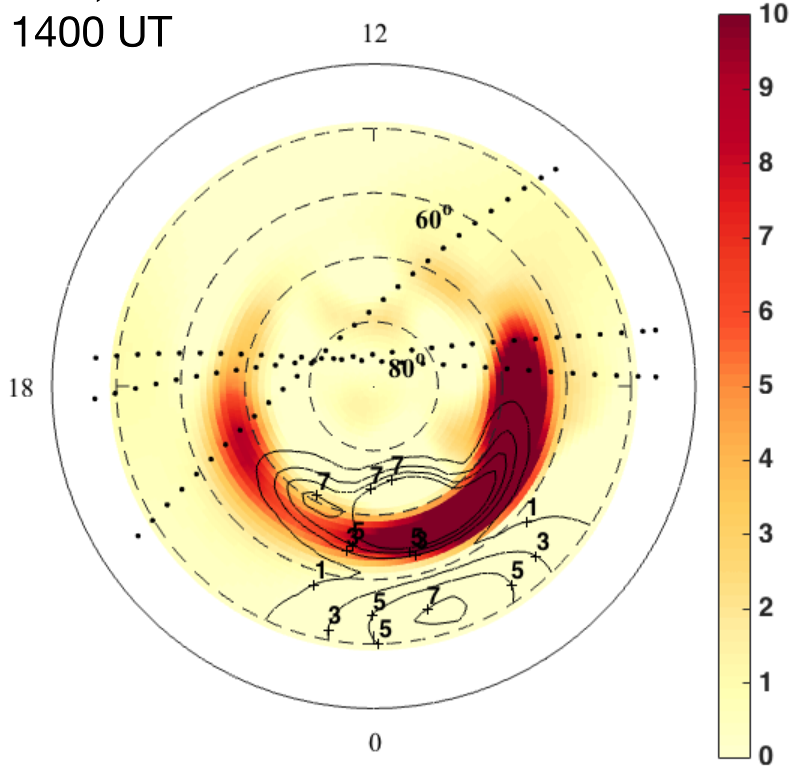
Backup Slides

PFISR-M2016 comparison

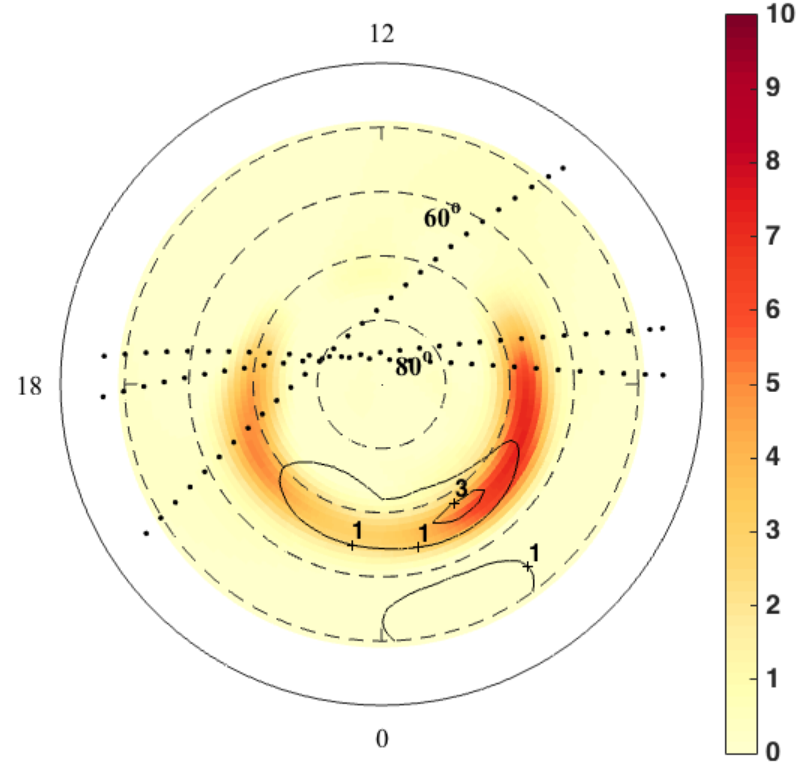


At times, uncertainty on estimates can be large…

November 30, 2011
1300 – 1400 UT



Hall [S]



Pedersen [S]

Contours = uncertainties
Color Map = estimates

At times, uncertainty on estimates can be large… But ISR data provide opportunity to supplement observations

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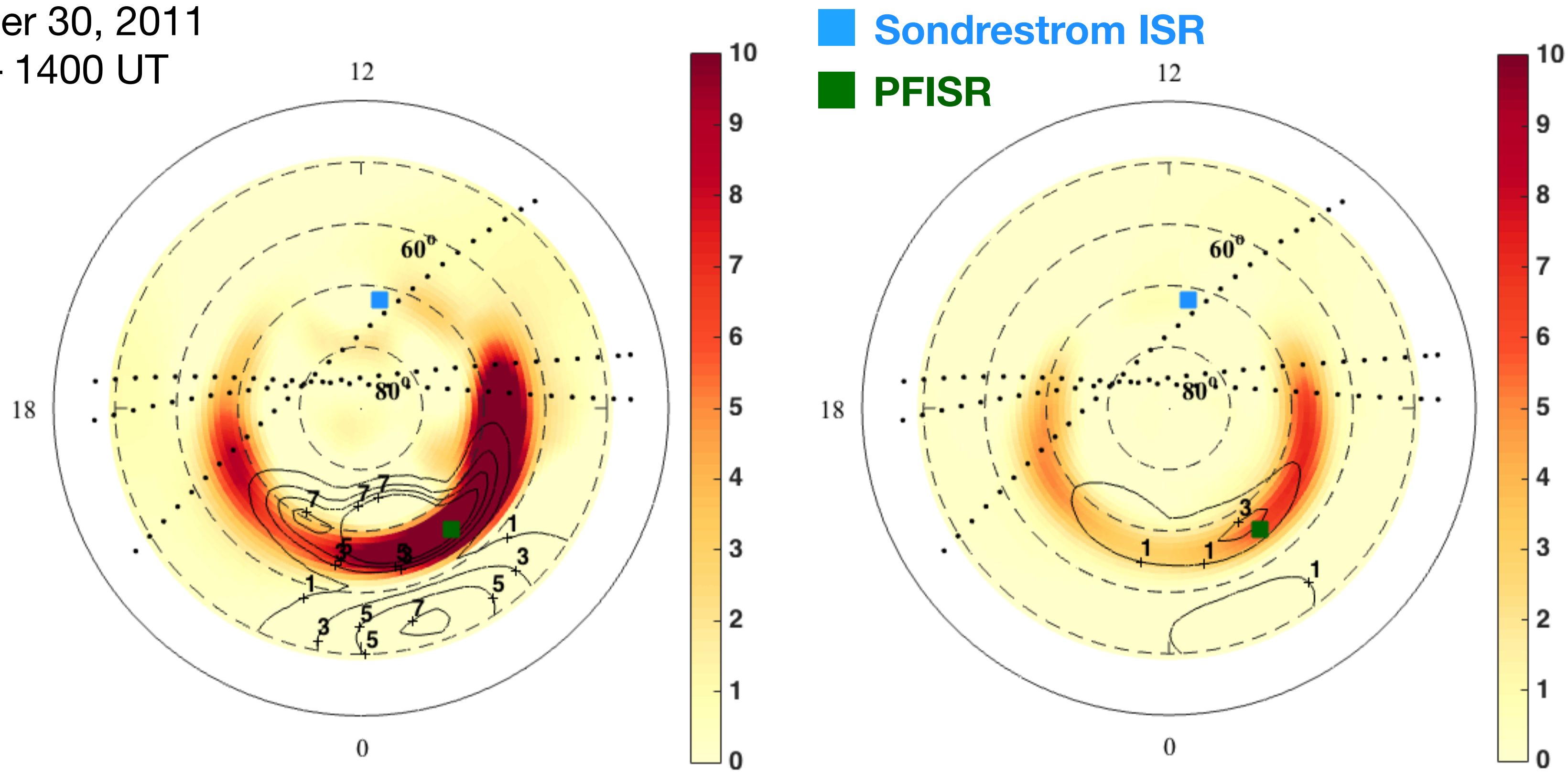

Hall [S]

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