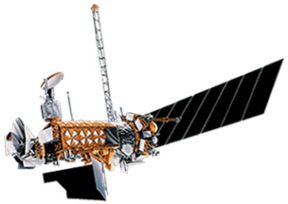
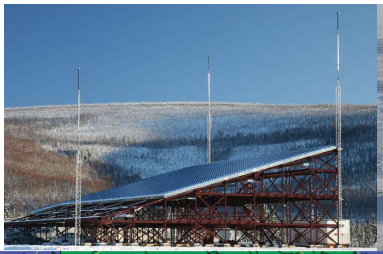
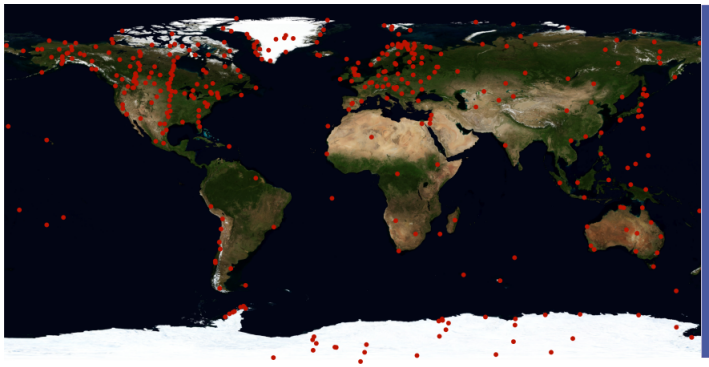
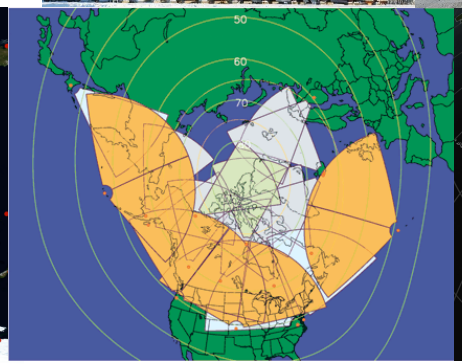
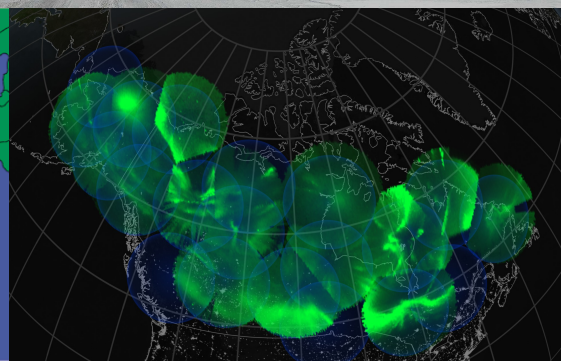
Making Sense of High-latitude Geospace Observations Modeling, Data Fusion and Assimilation











Conveners: Tomoko Matsuo, Jesper Gjerloev, Ryan Mcgranaghan William Lotko, Binzhen Zhang

4:00 - 4:10 **Tomoko Matsuo** Introduction

4:10 - 4:20 **Mike Ruohoniemi** SuperDARN

4:20 - 4:30 **Jesper Gjerloev** Global continuous magnetosphere-ionosphere coupling

4:30 - 4:40 **Ryan Mcgranaghan** Conductivity mapping

4:40 - 4:50 **Don Hampton** Ground based optical estimates of electron precipitation energetics in the auroral zone

4:50 - 5:00 **Russel Cosgrove** Conductance and conductivity

5:00 - 5:10 **Rob Gillies** Initial RISR-C results with REGO, SWARM, and SuperDARN

5:10 - 5:20 **Mark Conde** FPI neutral wind mapping

5:20 - 5:30 **Art Richmond** AMPERE-driven TIEGCM

5:30 - 5:40 **Binzheng Zhang** FPI wind and CMIT

5:40 - 6:00 **All** Open Discussion

High-latitude ionospheric electrodynamics

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

$$\nabla \times \mathbf{B} = \mu_o \mathbf{J}$$

$$\vec{J}_{\parallel} = -\nabla \cdot \vec{J}_{\perp}$$

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

Non-conservative electric fields?

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

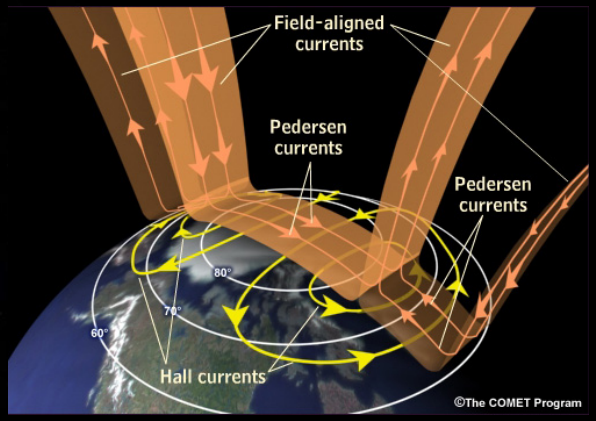
3D Conductivity?

$$\sigma_P(\mathrm{h}, \theta, \phi) \quad \sigma_H(\mathrm{h}, \theta, \phi)$$

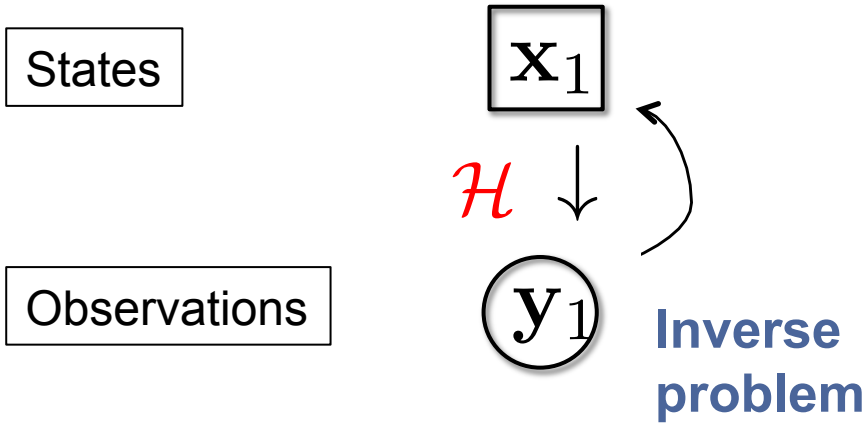
Effects of neutral winds?

$$\mathbf{E}' = \mathbf{E} + \mathbf{U} \times \mathbf{B}$$

Credit: NASA



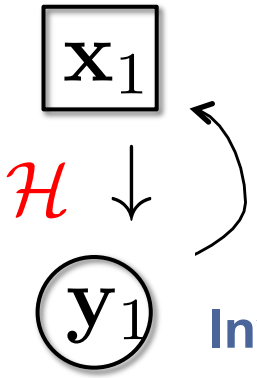
Inverse and data assimilation problem



Inverse and data assimilation problem

States

Observations



Inverse problem

Data assimilation problem

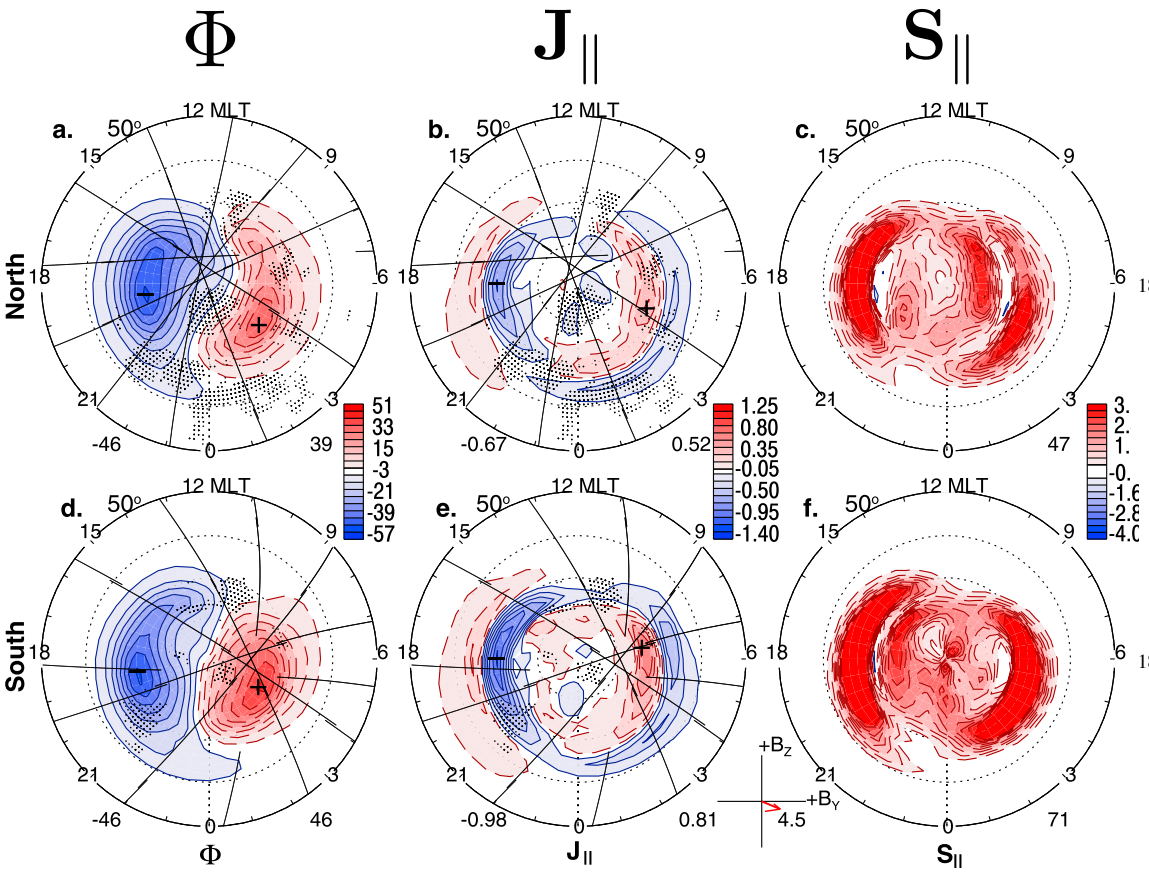
$$[\mathbf{x}|\mathbf{y}] \propto [\mathbf{y}|\mathbf{x}][\mathbf{x}]$$

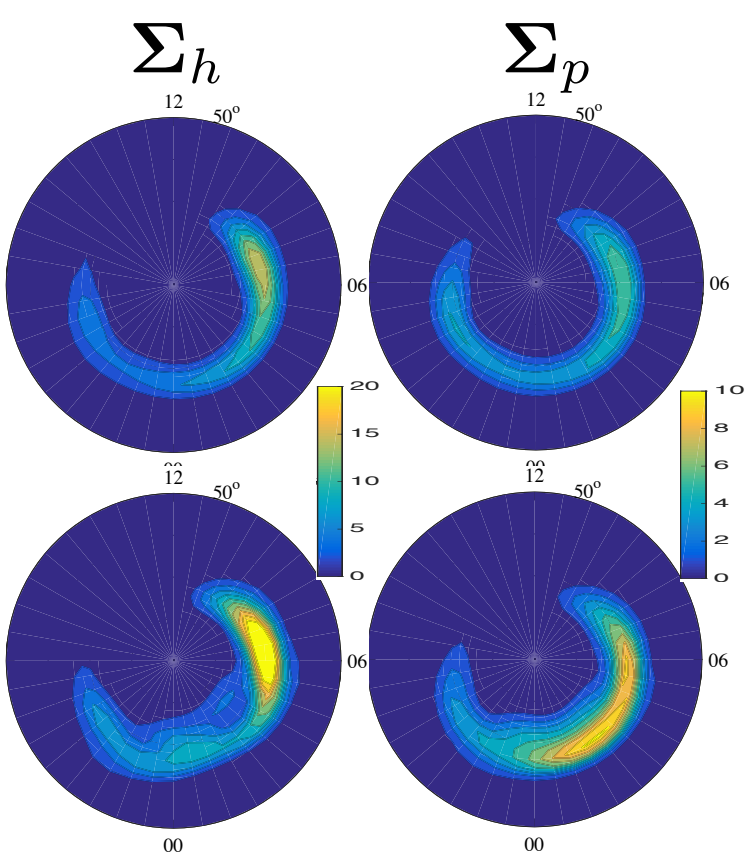
$$\mathbf{x}_a = \mathbf{x}_b + \mathbf{K}(\mathbf{y} - \mathbf{H}\mathbf{x}_b)$$

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

Uncertainty information

AMIE Nextgen maps derived from SuperDARN, Iridium/AMPERE and DMSP data





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

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