

# Norwegian contributions to the ISWI program

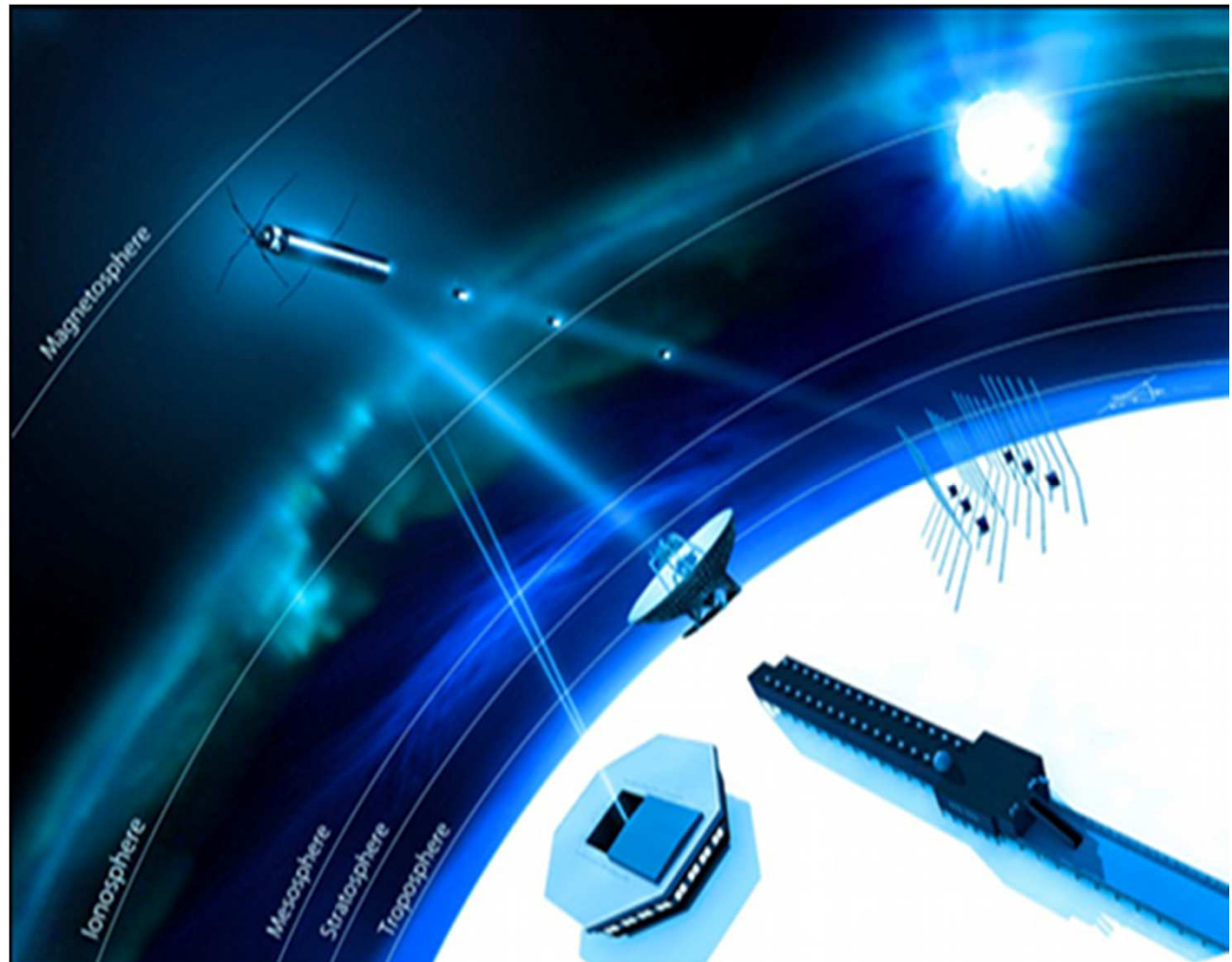
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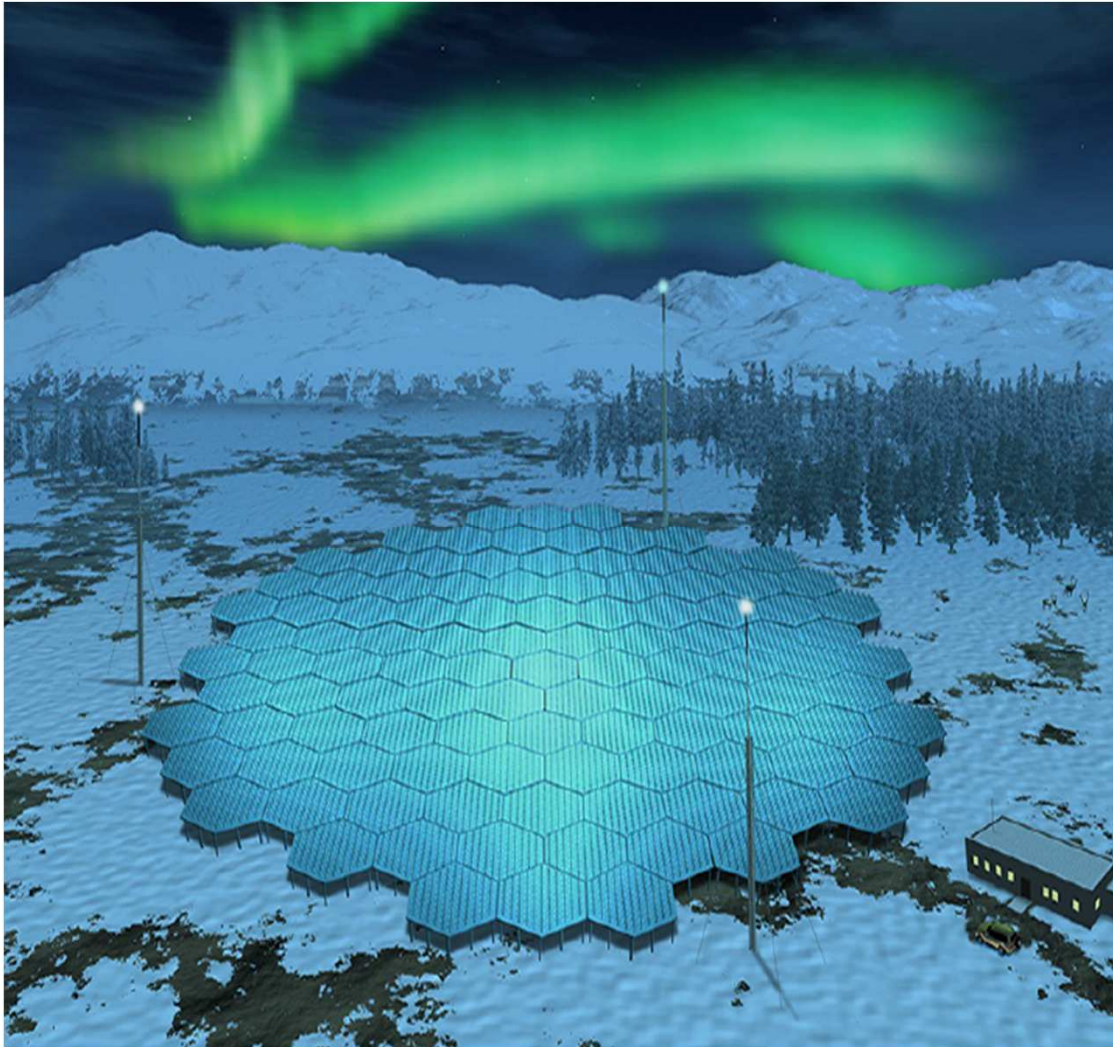
Instabilities and turbulence in polar ionosphere

Rocket programs:  
ICI, CaNoRock

Cube STAR

Instrumentation  
development





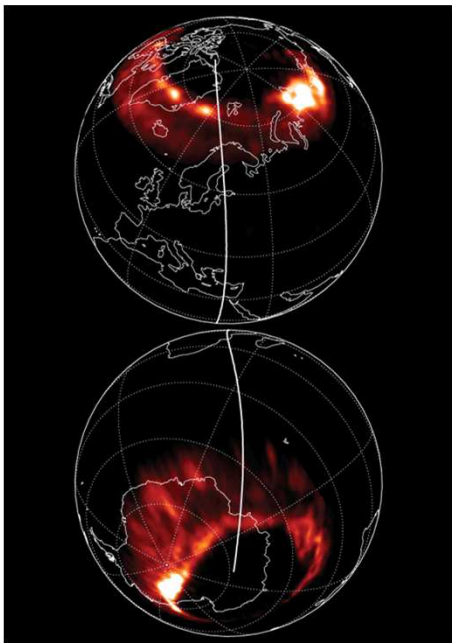
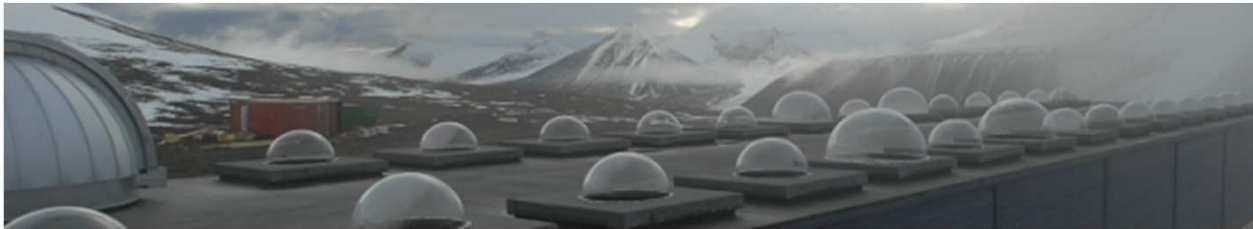
## **EISCAT\_3D**

New generation of incoherent radar  
3D information of ionospheric parameters

## **Tromsø Geophysical Observatory**

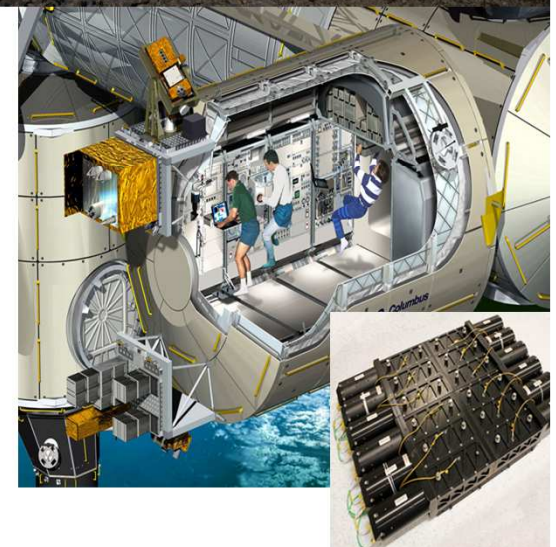
Part of European Space Situational Awareness - SSA network

# Birkeland Centre for Space Science



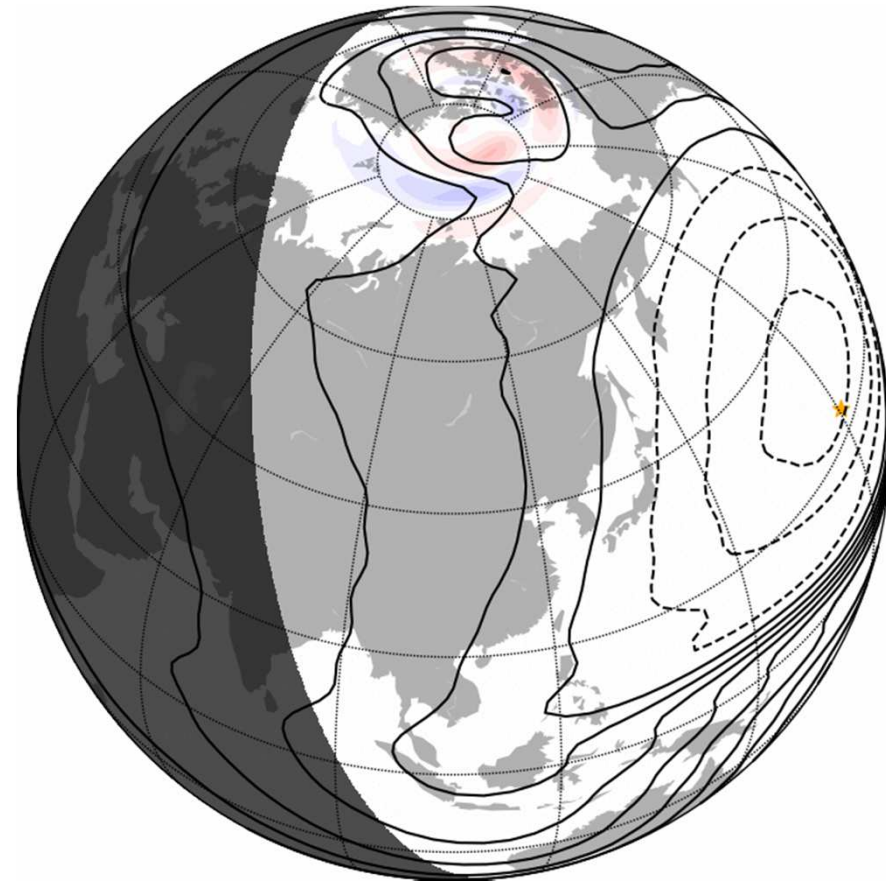
Norwegian centre of excellence  
Four core research topics:

- Asymmetric geospace
- Dynamic ionosphere
- Energetic particle precipitation
- Terrestrial gamma ray flashes



# A global model of ionospheric currents

- **Empirical model**, based on magnetic field measurements at low Earth orbit: *Swarm* and CHAMP.
- Includes **total** current, without any assumptions about conductivity
- No assumption of hemispheric symmetries
- Main field distortions accounted for
- Includes both polar and low latitude (Sq) currents
- Depends on solar wind coupling function, IMF orientation, dipole tilt angle, and F10.7 index



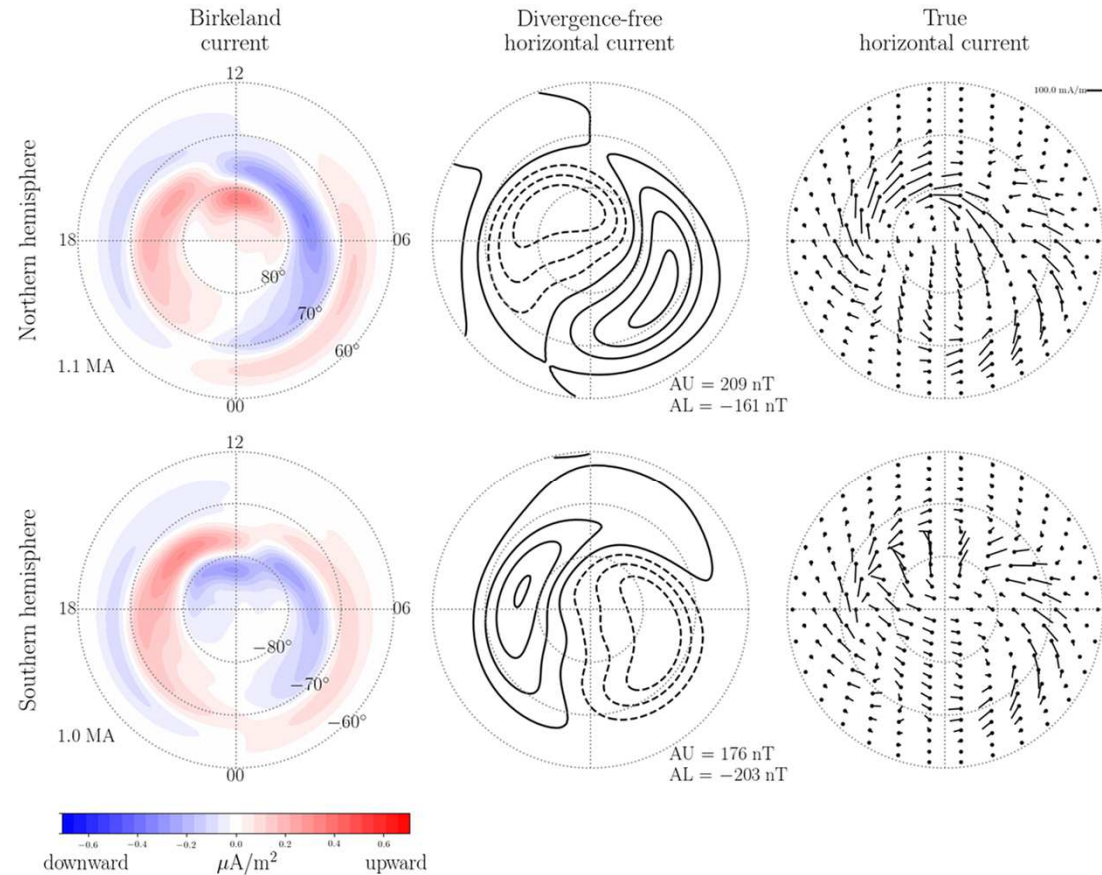
# Potential space weather applications

## Total current predictions

Total current obtained by combining Birkeland current and “equivalent” current. Critical quantity for Joule heating calculations.

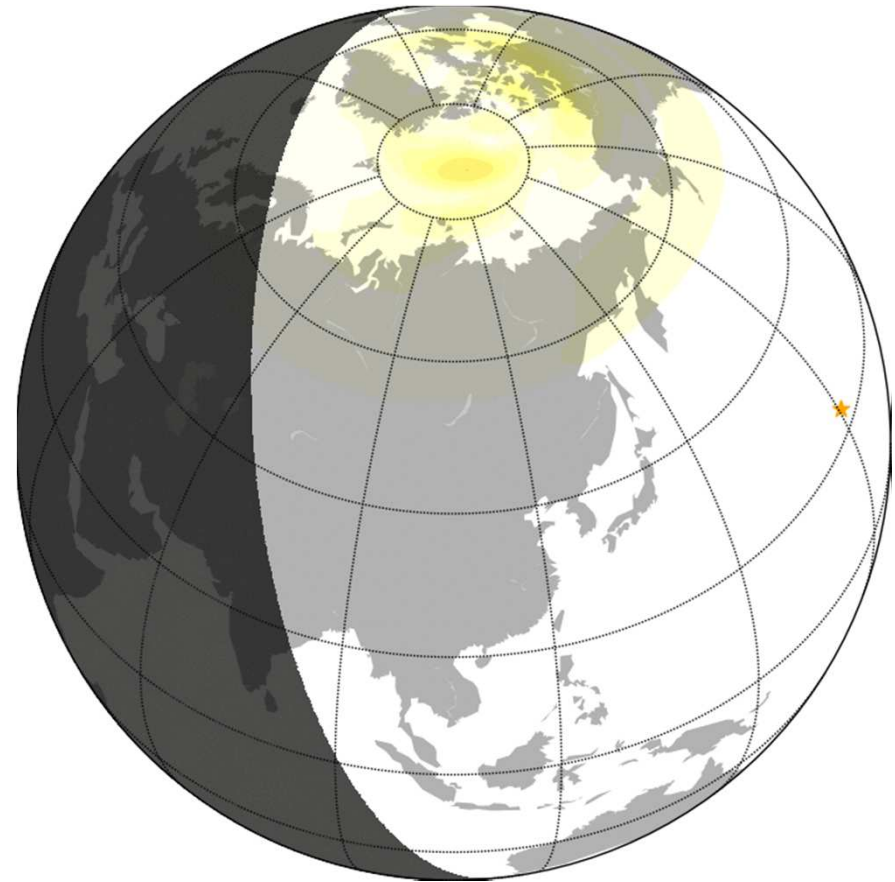
## Prediction of ground magnetic perturbations

Assuming a current height, we calculate ground magnetic perturbations and synthetic AE indices



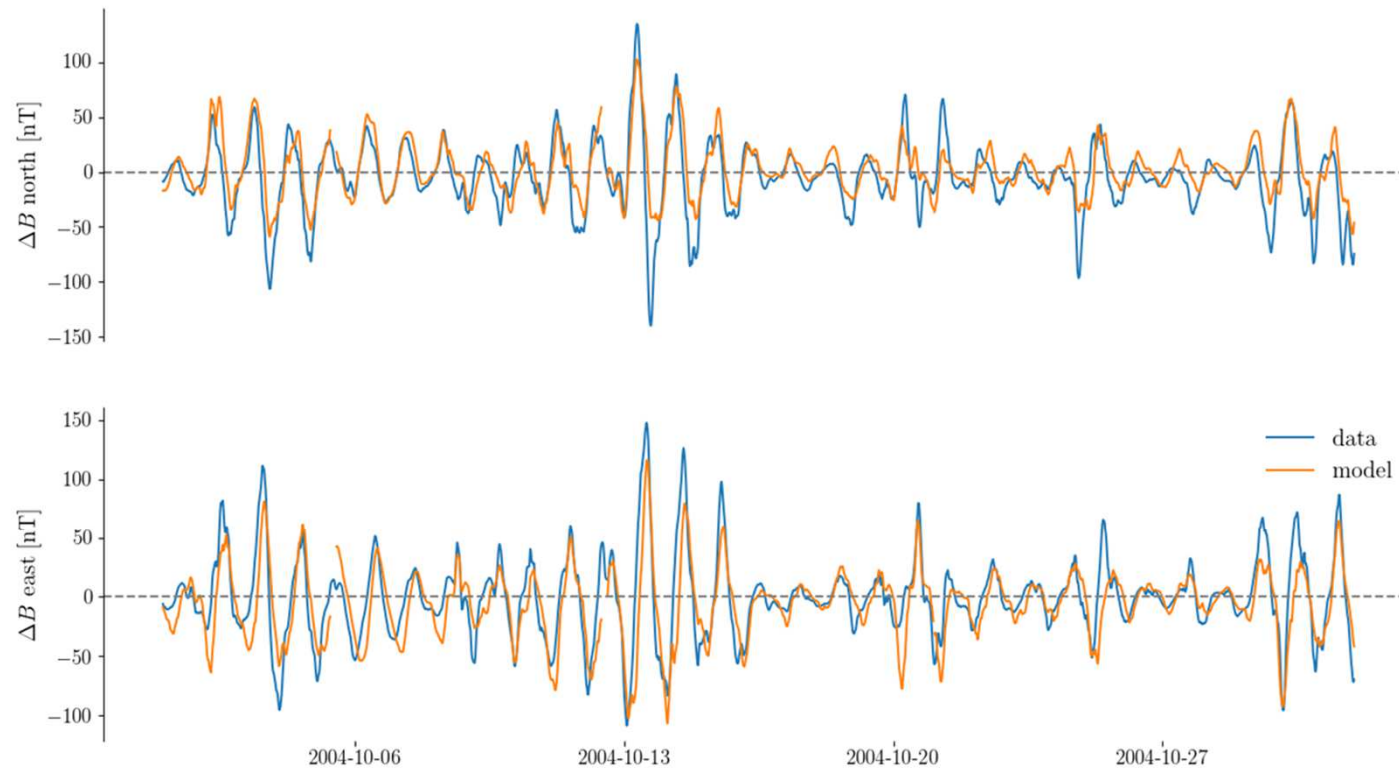
# Total current

- Can be used to estimate Joule heating  $\mathbf{j} \cdot \mathbf{E}$ , relevant for satellite drag predictions
- No assumption about conductivity
- Only possible with precise satellite measurements (Swarm + CHAMP)



# Model ground perturbations

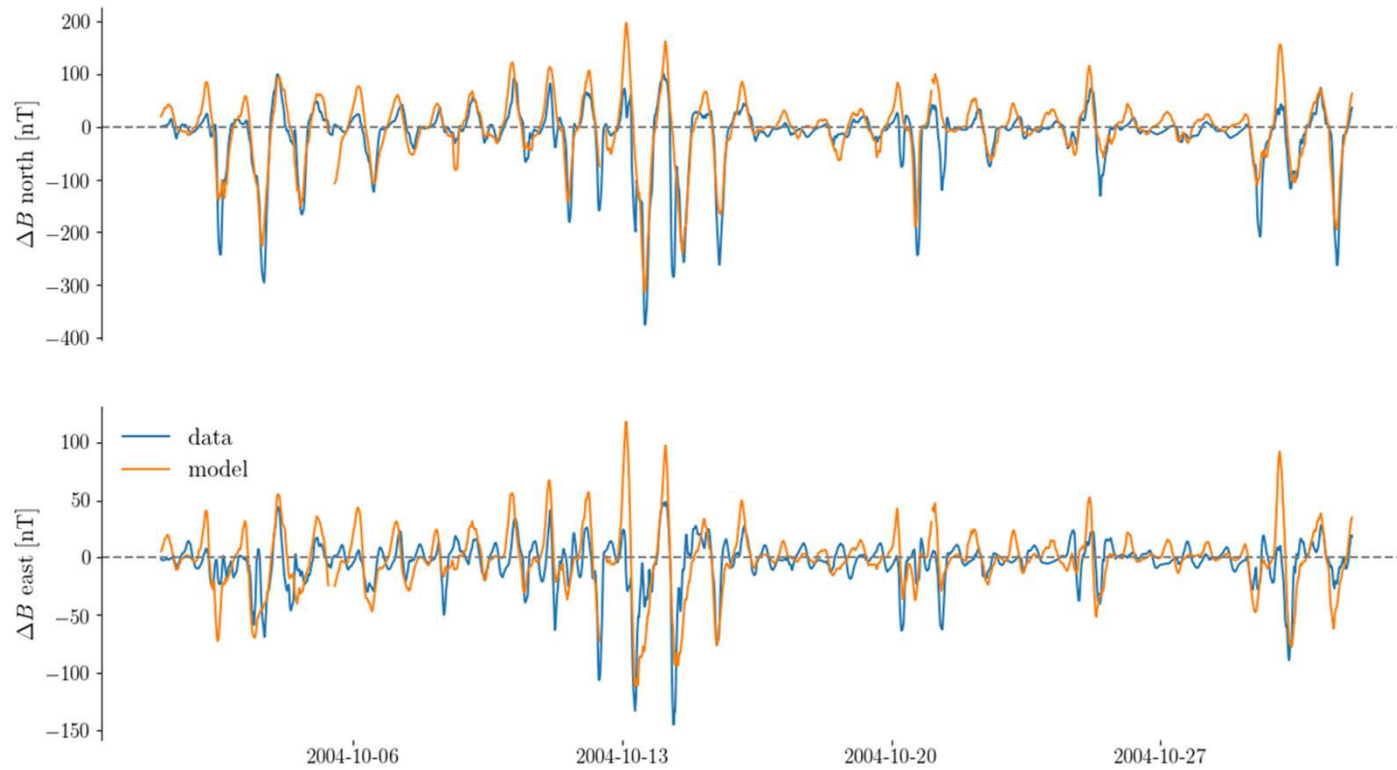
Thule (85°)





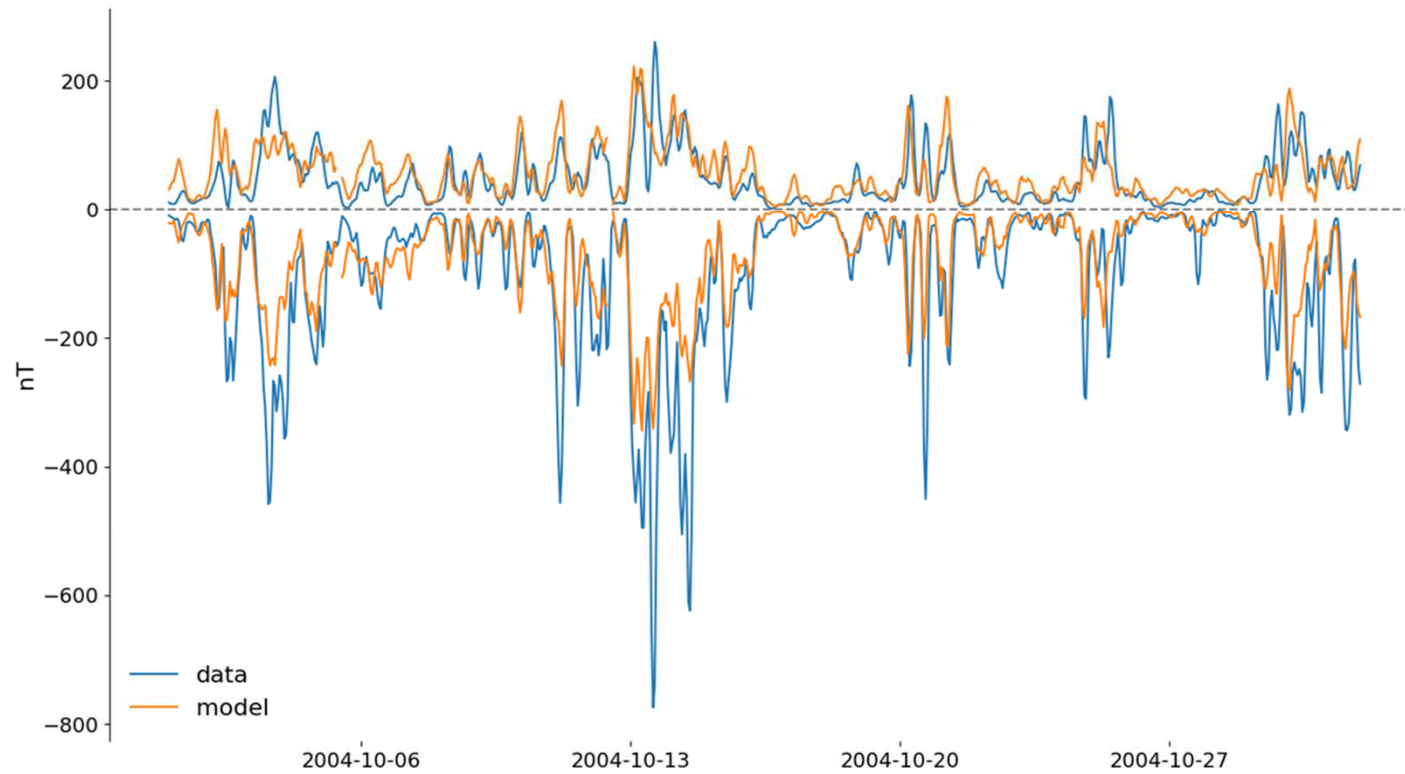
# Model ground perturbations

Yellowknife (69°)



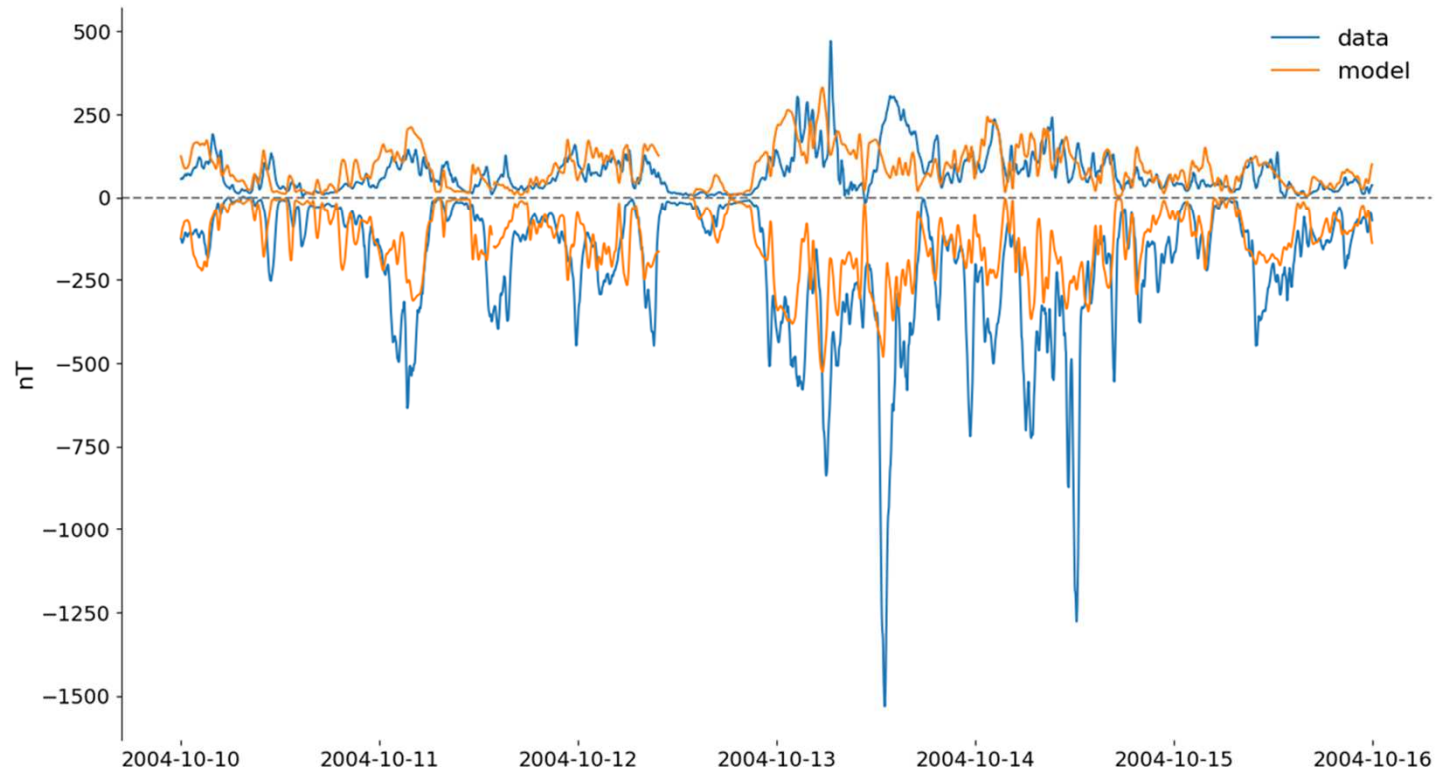
# Model ground perturbations

AE indices



# Model ground perturbations

AE indices



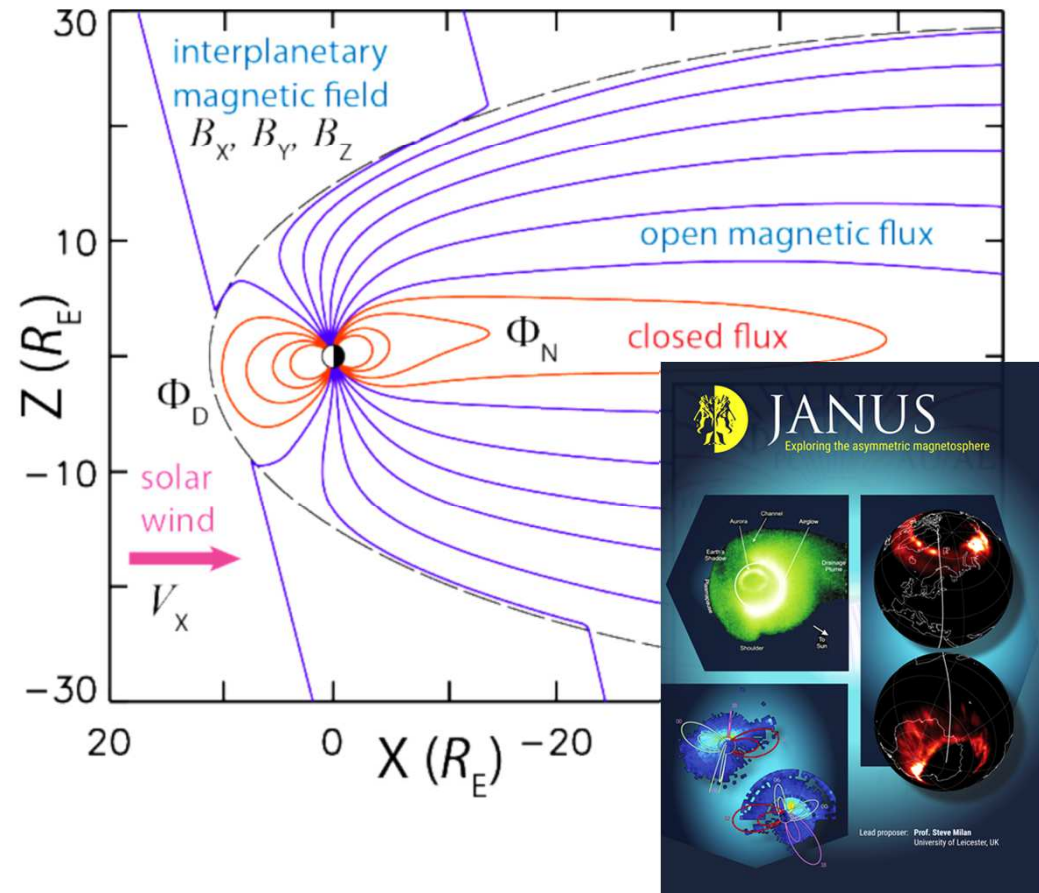
# A missing piece of information

Dayside reconnection rate can be estimated by solar wind measurements

Nightside reconnection rates are unknown

On short time scales, they are uncorrelated, but on long time scales they are identical

=> We can only model slow variations

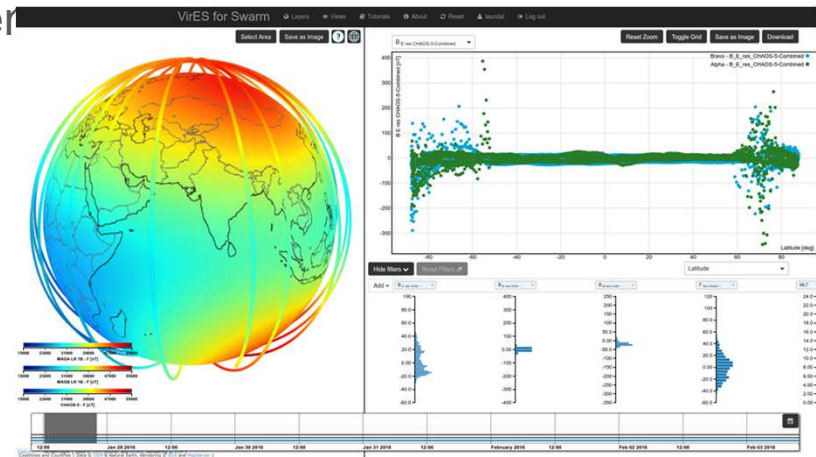


# Summary - magnetic field/current model

- Unique features:
  - Includes the total/true horizontal current
  - Distortions by main magnetic field taken into account
  - Includes hemispheric asymmetries

- Potential space weather applications:

- Improved satellite drag predictions
- Predictions of low-frequency ground disturbances



Screenshot from <https://vires.services/>

- Model will be released for public use in ~1 year
  - Model coefficients