

**GRAS SAF Open Loop Workshop**  
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## **Satellite and Space Research Activities at DMI**

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# Satellite research activities at DMI

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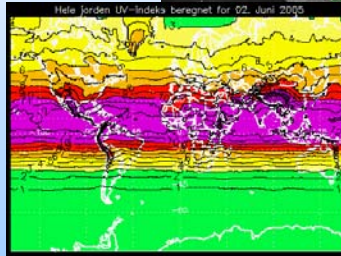
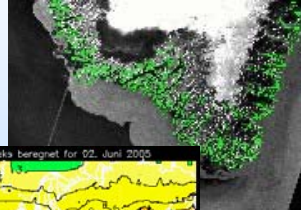
## Outline of presentation

- **Satellite Application Facilities, GRAS, OSI, and O3M**
- **Data assimilation, HIRLAM, NOAA satellites**
- **Occultation retrieval techniques**
- **ESA space weather projects**
- **The Ørsted satellite**
- **Summary and outlook**

## SAFs at DMI



- **GRAS SAF**
  - Hosted by DMI, with Met Office and IEEC as partners
- **OSI SAF**
  - Maps of sea ice and archiving
  - Hosted by Meteo France
- **O3M SAF**
  - UV index
  - Hosted by FMI
- **All these SAFs deliver operational products and will use data from Metop**



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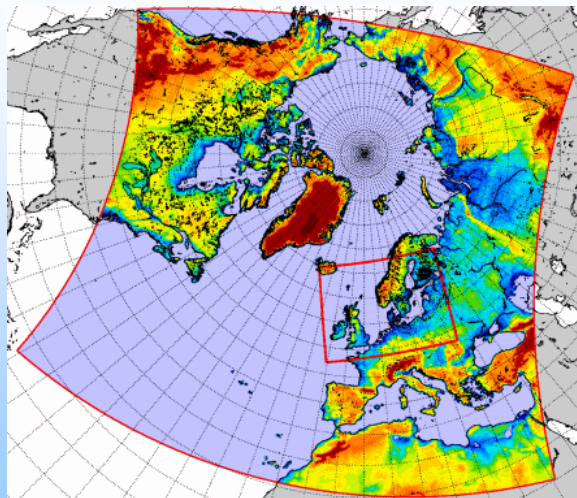
## Data assimilation, HIRLAM



The forecast model is a grid point model and the horizontal resolution is  $0.15^\circ$  for DMI-HIRLAM-T15, whereas the smaller domain model DMI-HIRLAM-S05 has a resolution of  $0.05^\circ$  about 5km. Both versions have 40 layers in the vertical.

3DVAR system using AMSU data

Impact trails by Met Office  
And ECMWF using CHAMP  
data show already promising  
results



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Slide 4

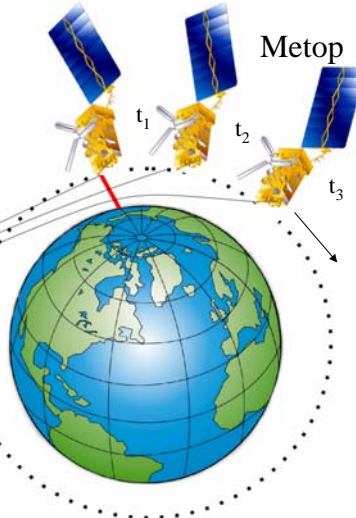
# Occultation retrieval techniques



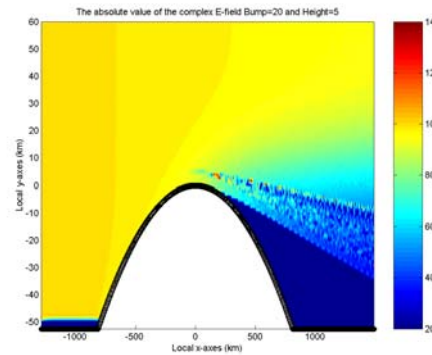
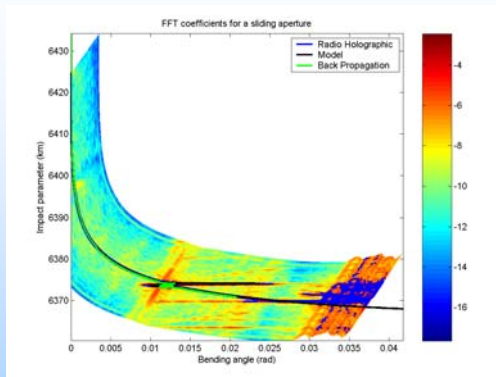
- The **basic observable** is the signal Doppler shift.
- Precise knowledge of the observational **geometry** results in the phase shift due to the medium along the ray path.
- The **ionosphere, stratosphere and troposphere** cause signal **phase** and **amplitude** changes.

$$\mu = 1 + C_0 P T^{-1} + C_1 P_w T^{-2} - C_2 N_e f^{-2}$$

Dry term    Wet term    Ionos. term

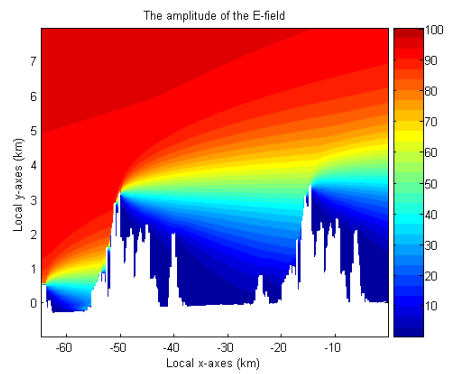
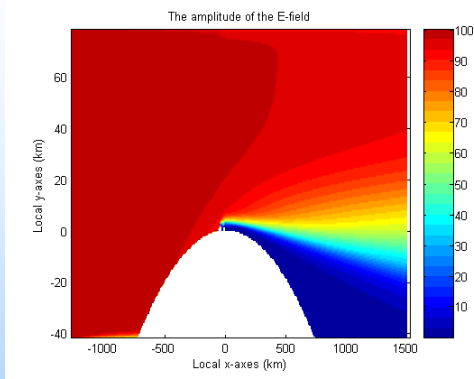


# Full Spectrum Inversion FSI / CT



The upper plot shows the bending angle profile calculated using 3 different algorithms. Also shown is the bending angle for the entire spectrum of the occultation signal. The right plot shows the electric field in the neutral atmosphere.

# Wave optics propagator



The plot on the right zooms in on a small section of the occultation where we have salt water (different impedance) and a mountain terrain.

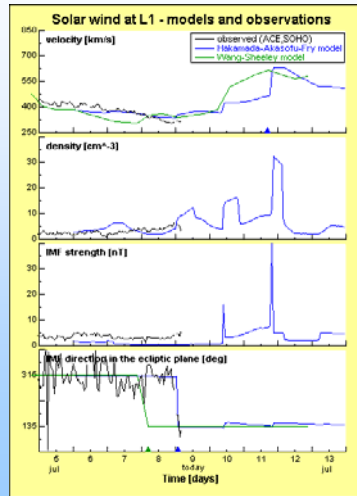
# LEO – LEO simulation and retrieval tool



# ESA space weather projects – geomagnetic activity



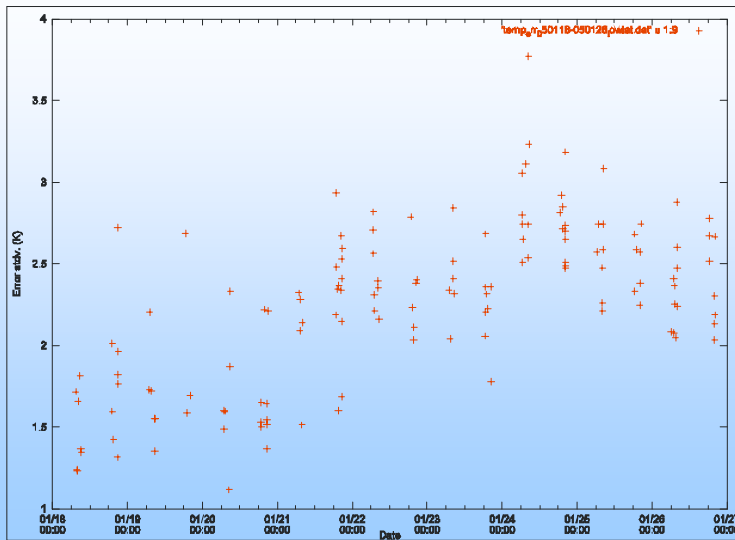
Magnetic sector boundary right on the HAF prediction. Increased geomagnetic activity expected at auroral latitudes on July 11<sup>th</sup> and 12<sup>th</sup>



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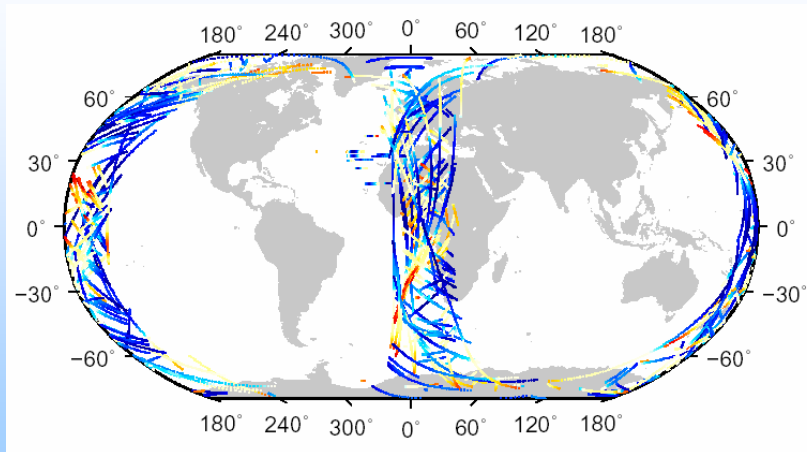
# ESA Space weather – GPS validation



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## GPS validation - Scintillations



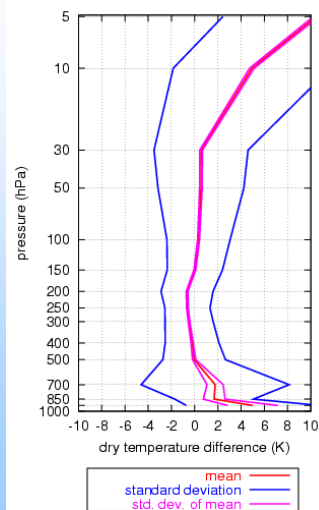
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## The Ørsted satellite



6 years in space  
(1999 – 2005)



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## Summary and outlook



- **Satellite data will increase in availability and use**
- **Use of GPS radio occultation data will move from science towards operational applications.**
  - **COSMIC from December 2005**
  - **Metop/GRAS from April 2006**
- **Space weather in starting phase for operational prediction models**
- **Proposals for next ESA - Earth Explorer mission**
- **NWP users: High number of profiles vs. accuracy vs. timeliness?**
- **Open loop data will increase the use of RO in the lower troposphere**