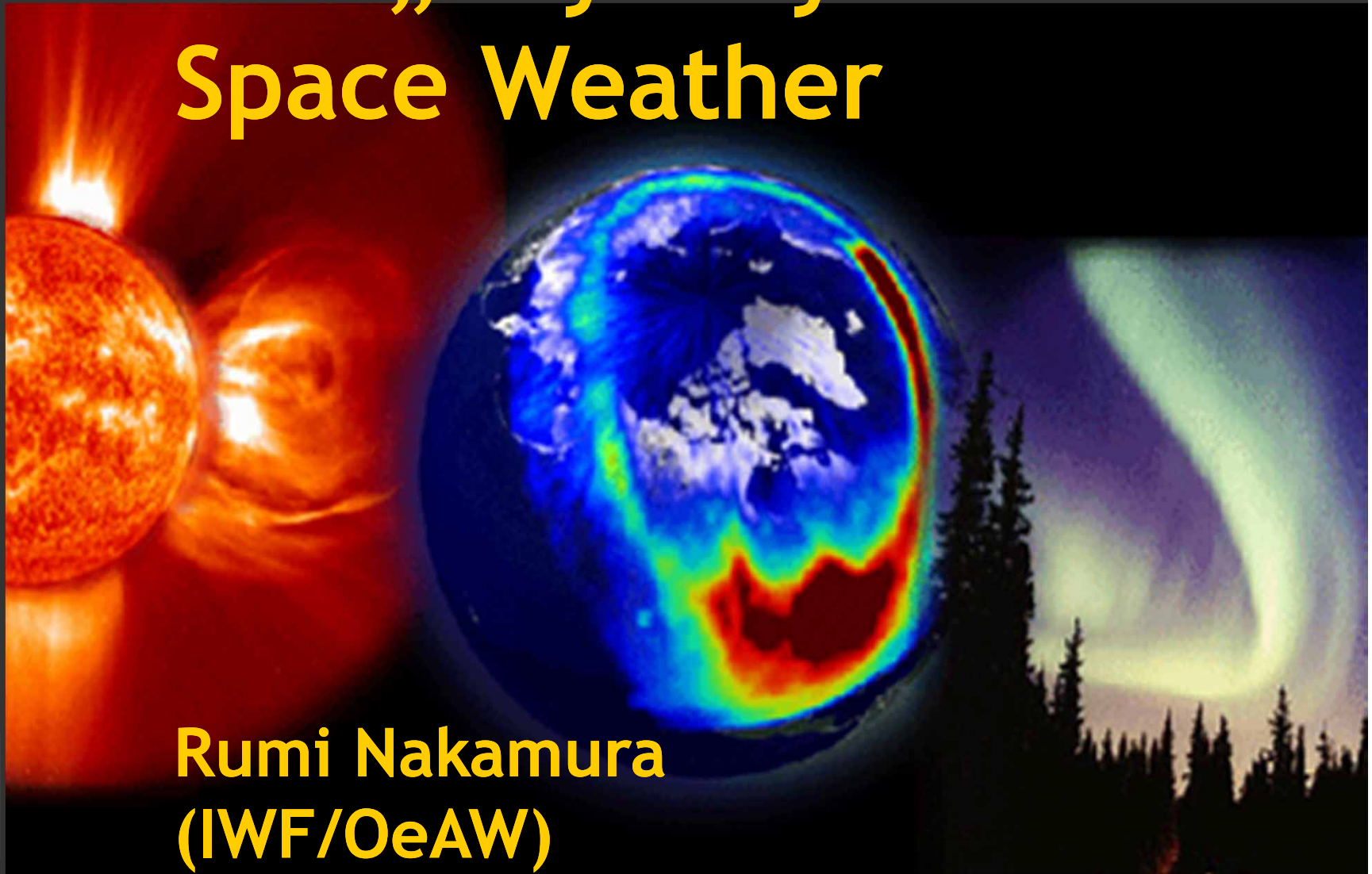
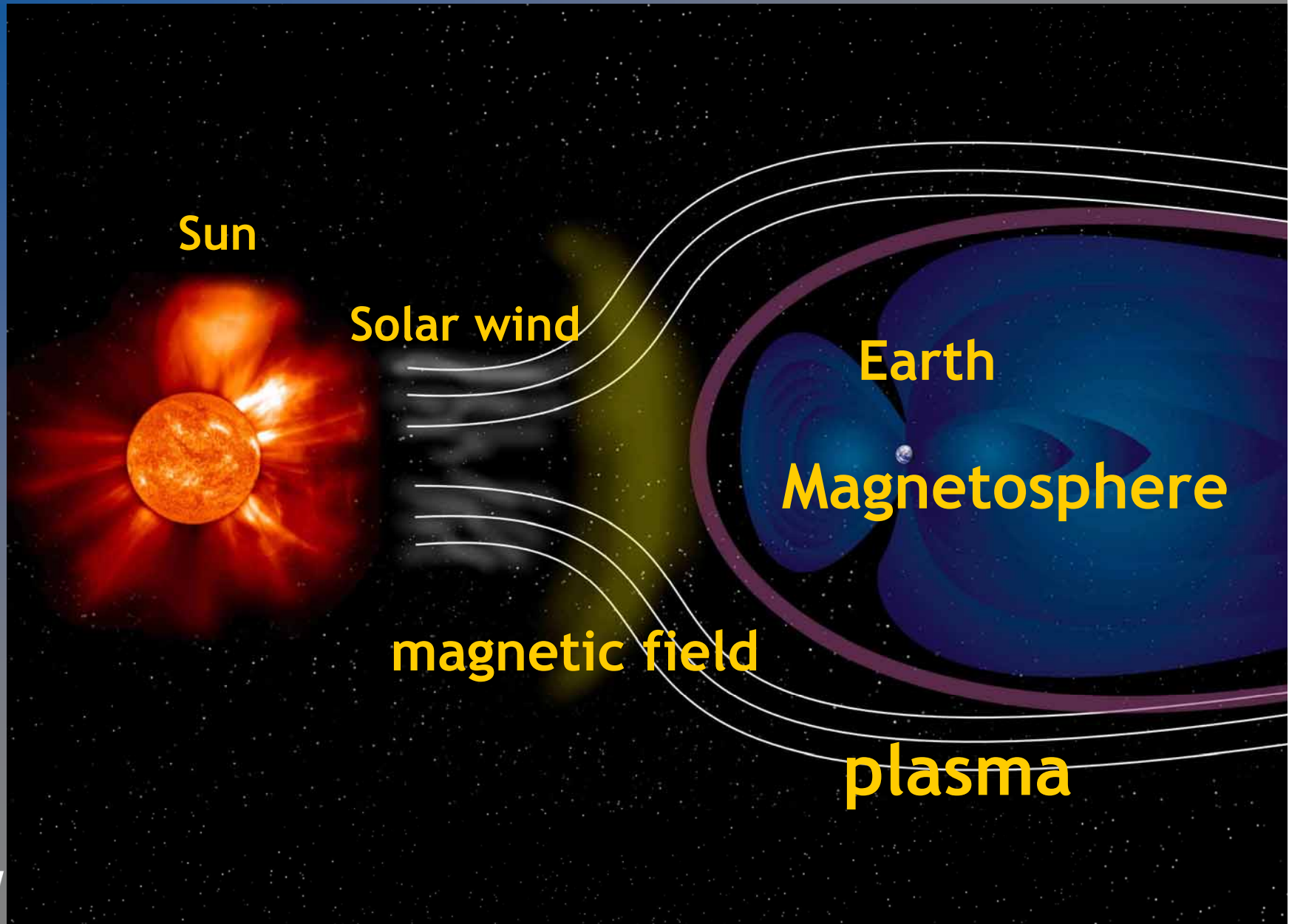


The „Key Players“ of Space Weather

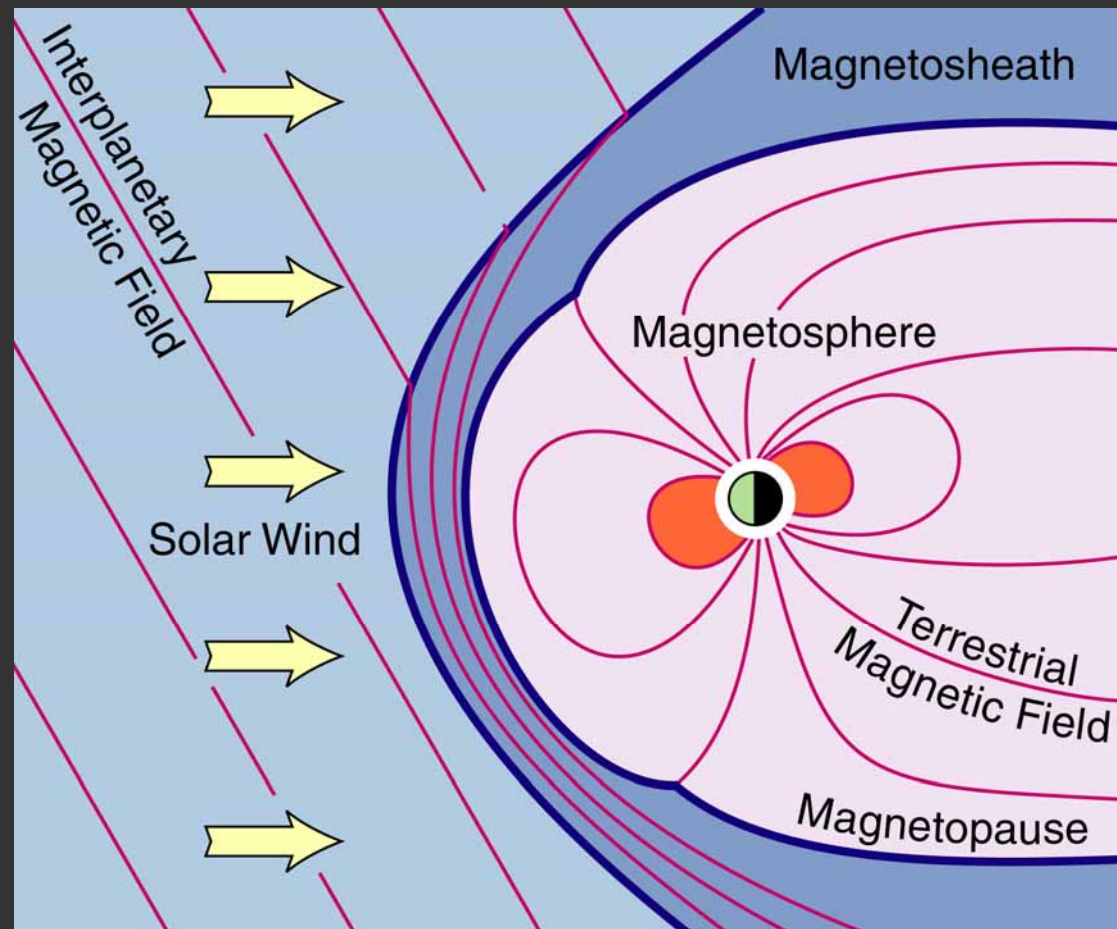


Rumi Nakamura
(IWF/OeAW)



Magnetosphere: terrestrial magnetic field populated with plasma

- Solar wind/IMF cannot enter magnetosphere
- Supersonic stream decelerated at bow shock
- Magnetopause is boundary between two plasmas
- Pressure equilibrium: dipolar magnetic field is deformed



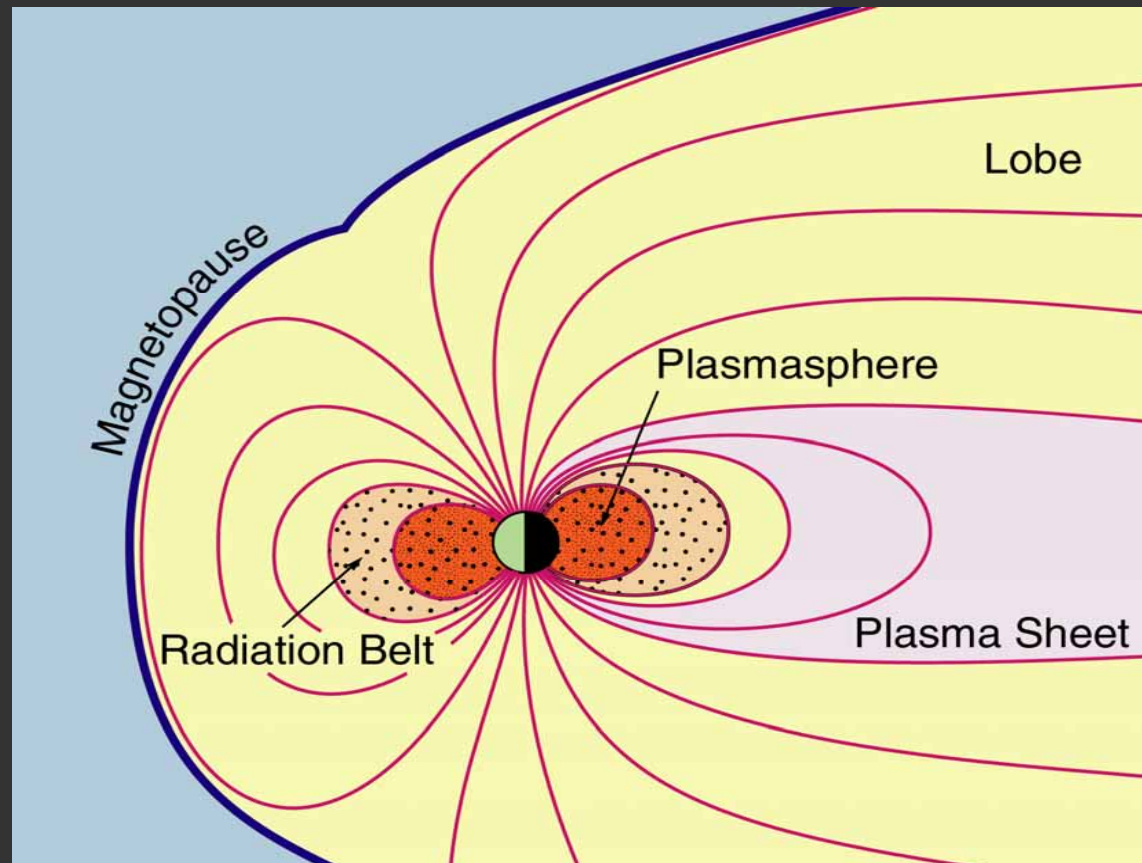
SW – Magnetosphere Interaction

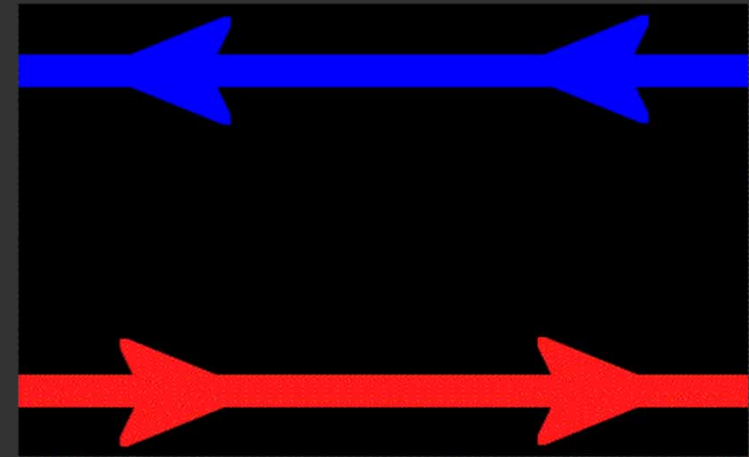
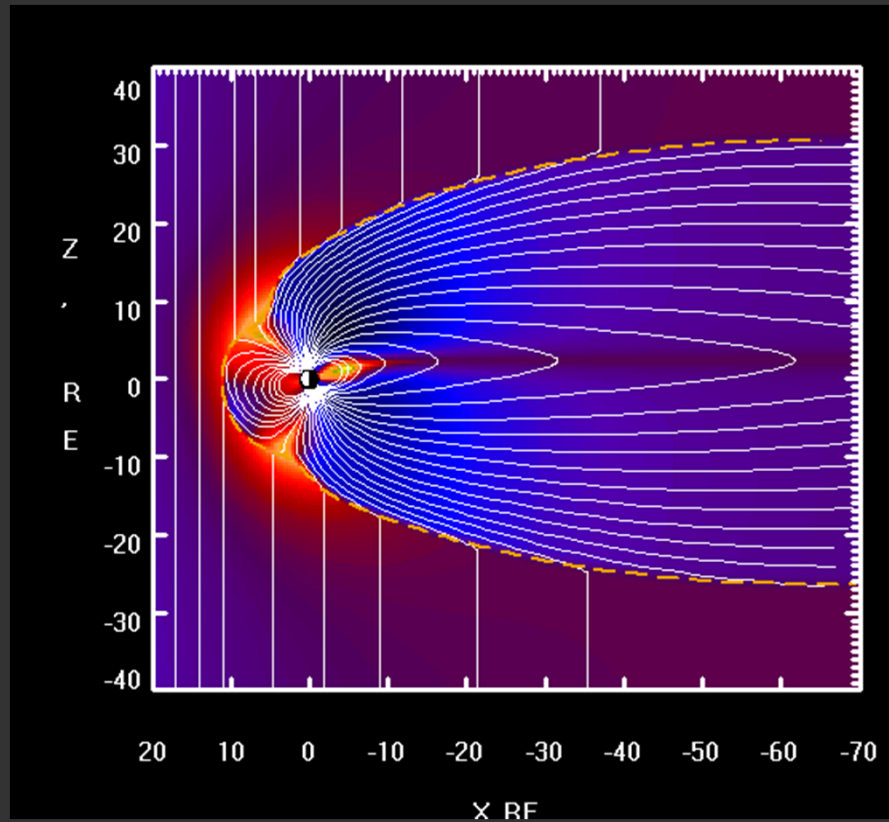
Input: 10^4 GW of solar wind hit magnetopause

- $D \approx 15 R_E$, $\rho \approx 5 \text{ cm}^{-3}$, $v \approx 400 \text{ km/s} \Rightarrow \frac{\pi}{2} \rho v^3 D^2 \approx 10^4 \text{ GW}$

Output: ~500 GW are dissipated in magnetosphere (5%):

- Polar ionosphere (Joule heating)
- Radiation belt (charge exchange)

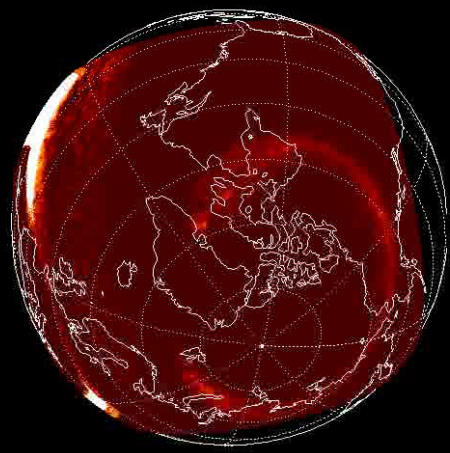




- Solar wind momentum, energy, & plasma can enter magnetosphere
- Magnetic energy converted to particle energy (acceleration)

Players of Space Weather Research

2001-01-03-10:36:30

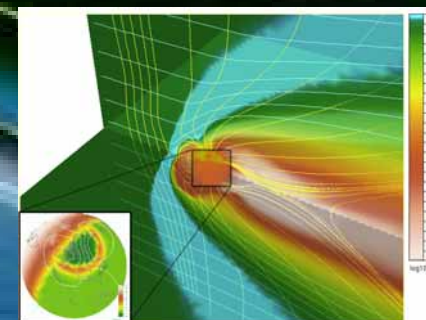


Spacecraft observation

Ground-based observation



Model & Theory



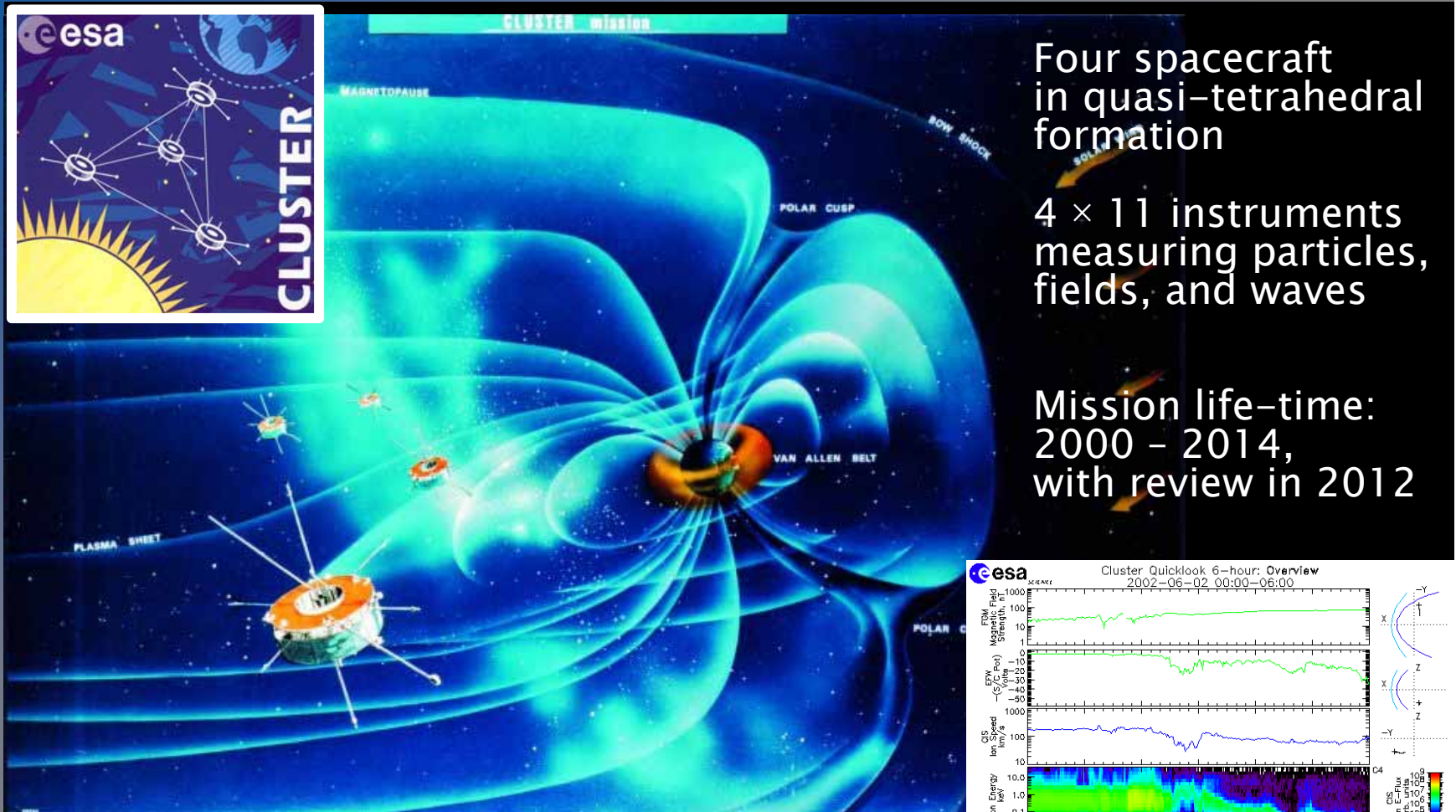
European Cluster Assimilation Technology

E L A T



Univ. of Leicester, UK Steve Milan (coordinator), Mark Lester
OeAW, Austria Rumi Nakamura
FMI, Finland Kirsti Kauristie, Minna Palmroth
IRF, Sweden Hermann Opgenoorth
SPb Univ., Russia Victor Sergeev
European Commission Stefano D'Orilia
European Space Agency Matt Taylor, Harri Laakso

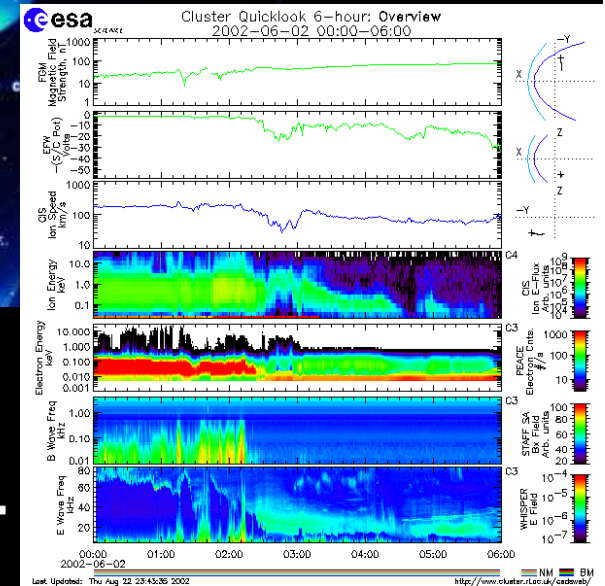
IWF ESA Cluster mission



Four spacecraft
in quasi-tetrahedral
formation

4 × 11 instruments
measuring particles,
fields, and waves

Mission life-time:
2000 - 2014,
with review in 2012



IWF Cluster Active Archive

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CLUSTER ACTIVE ARCHIVE

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WELCOME TO THE CLUSTER ACTIVE ARCHIVE

The Cluster Active Archive is a depository of processed and validated high-resolution Cluster data, raw data, processing software, calibration data, documentation and other value added products.



- ESA initiative to store all Cluster data
- Efforts are made to ensure the data are “final”
- Extensive validation and cross-calibration effort
- Online data portal, including quick-look plots



IWF The Role of ECLAT

- ECLAT provides context for the Cluster observations
- How do Cluster observations relate to other observations of the magnetosphere, made from the ground or other space-borne observatories?
- The Cluster Ground-based Working Group has provided contextual information for the duration of the Cluster mission to date on an ad hoc basis
- This will be formalized, improved, and combined with a data-serving functionality within ECLAT



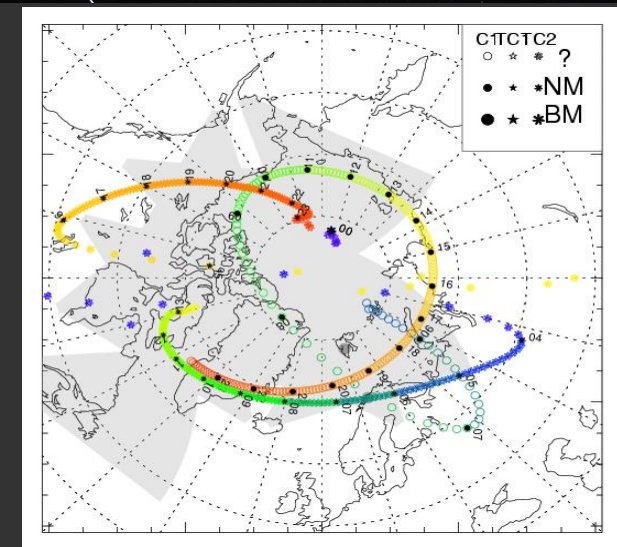
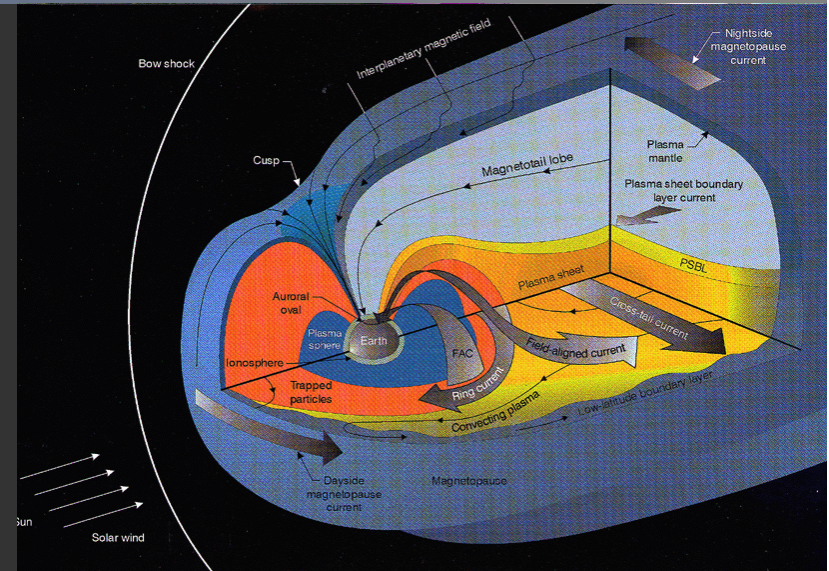
IWF What is needed?

1) A knowledge of the magnetospheric regions and boundaries Cluster is encountering

- Region and boundary identification (OEAW)

2) An ability to know where Cluster is relative to other observatories in space or on the ground

- Magnetic field tracing (SPSU)



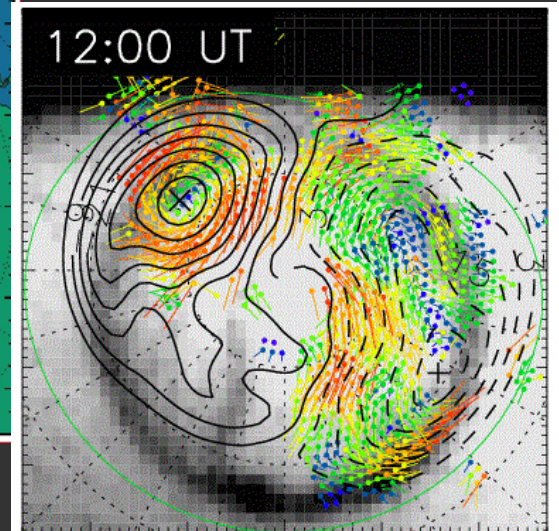
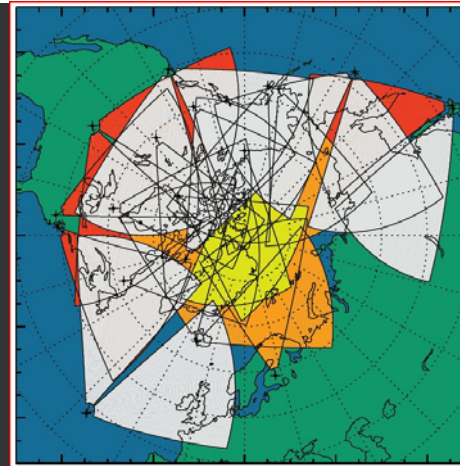
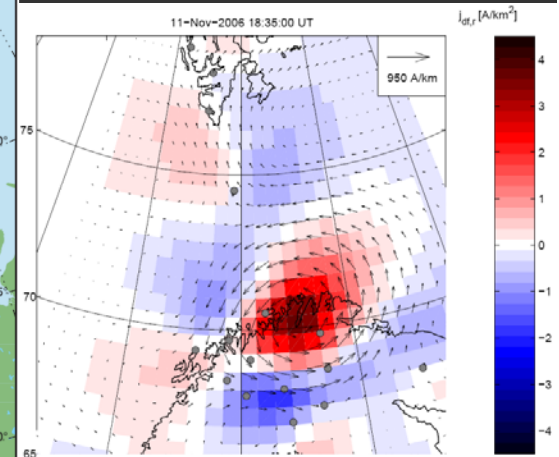
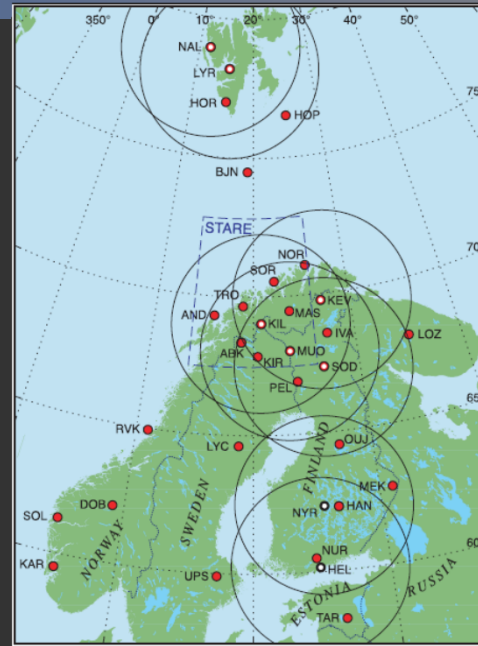
IWF What is needed?

3) The ionospheric conditions at the mapped footprint of the Cluster spacecraft

- Miracle equivalent current mapping (FMI)

4) Knowledge of the large-scale magnetospheric state and behaviour

- SuperDARN ionospheric flow patterns and global auroral imagery (ULEIC)



IWF What is needed?

5) Physics-based modelling of the magnetosphere as context and as re-analysis

- GUMICs long runs and re-analysis development (FMI)

6) Archive validation, science exploitation, and out-reach

- Science and validation workshops, networking with science community, public out-reach (IRF)

→ Workshop planned in April 2013 in IWF, Graz

