Monitoring of the Geo-Plasma Environment

MOPLE

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MOPLE submitted as EoI for FP6 by:

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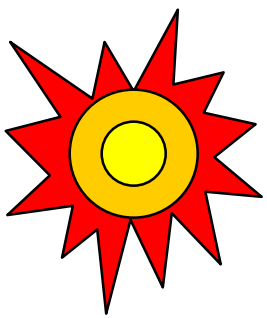
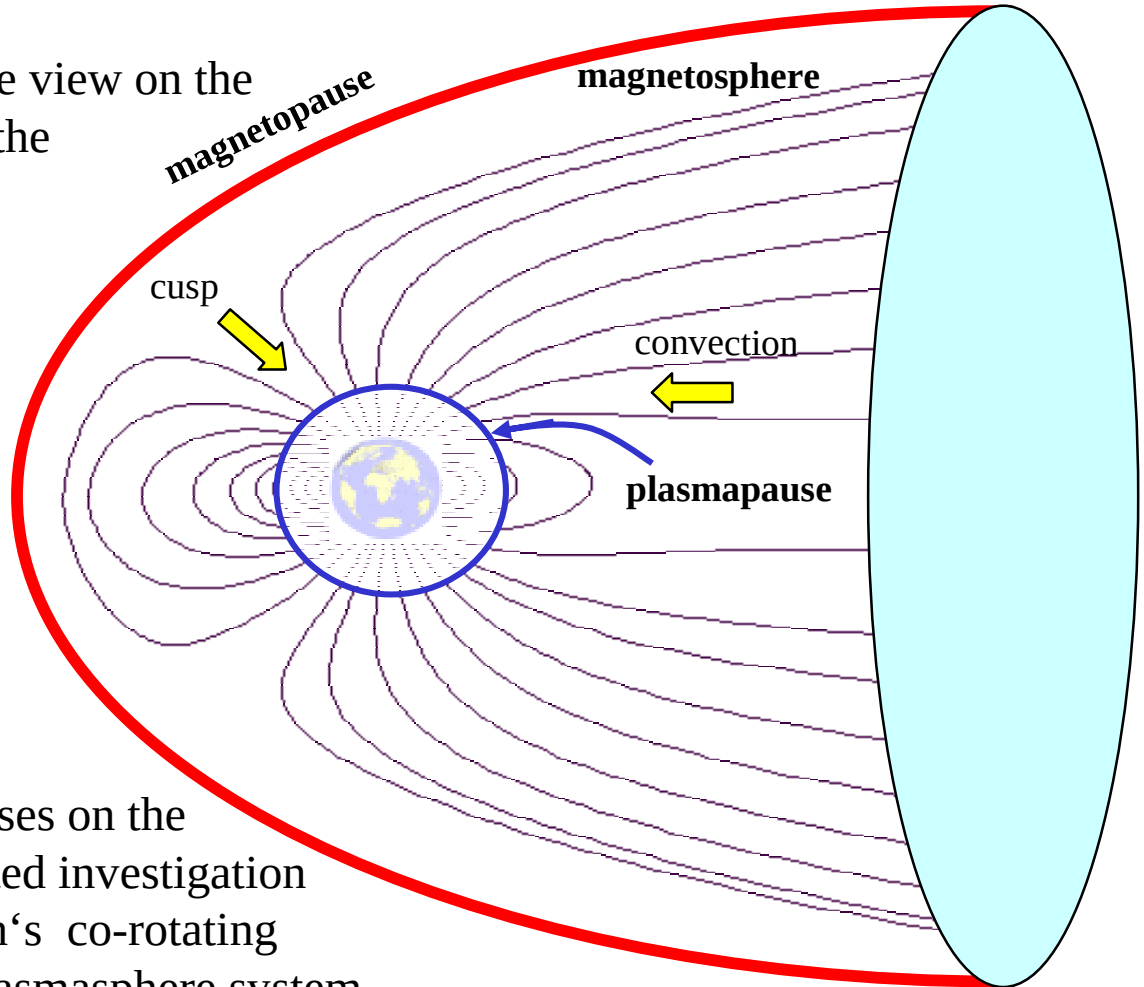
- Global Monitoring of the Geo-plasma
- Reliability and Accuracy of Radio Systems
- Outcome for Europe
- Conclusions

Background

GMES requires a comprehensive view on the Geo-sphere system that includes the Earth‘s lithosphere, hydrosphere, atmosphere and biosphere



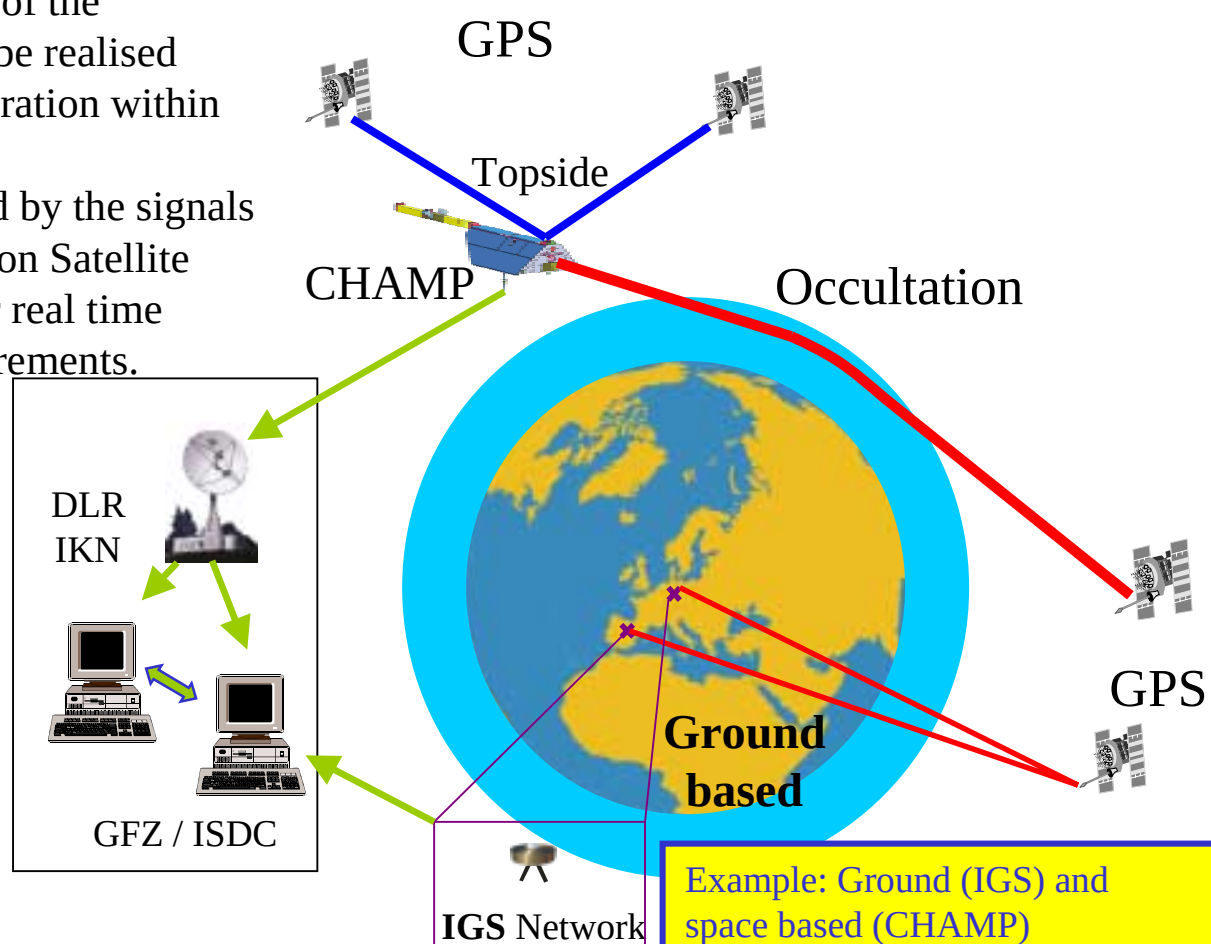
Solar wind



The FP6 **MOPLE proposal** focuses on the monitoring and application oriented investigation of the uppermost part of the Earth‘s co-rotating atmosphere, called ionosphere-plasmasphere system.

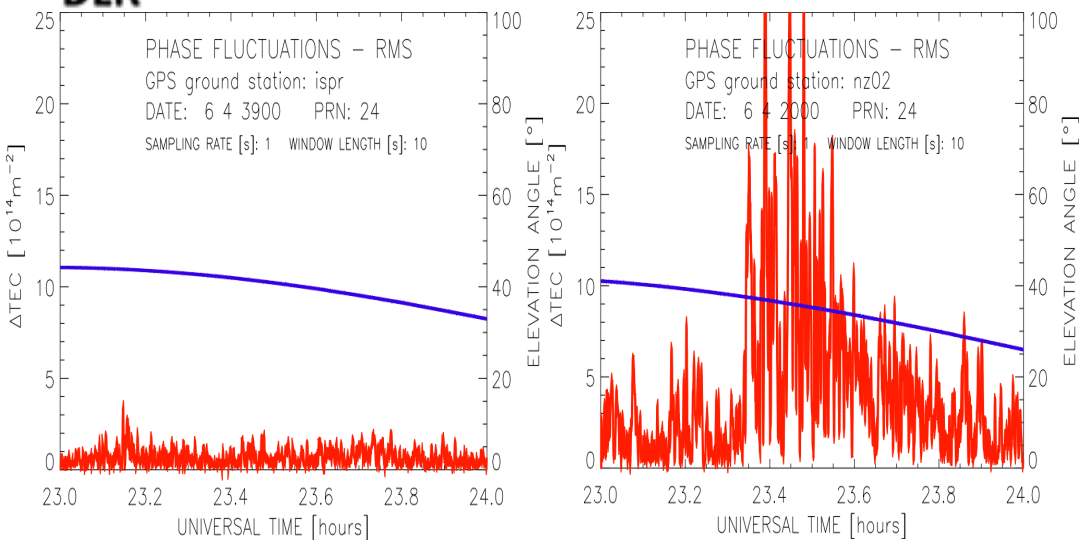
Global Monitoring of the Geo-Plasma

The environmental monitoring of the geo-plasma within GMES can be realised by a broad international co-operation within Europe.
The main data basis is provided by the signals of the existing Global Navigation Satellite Systems (GNSS) allowing near real time ground and space based measurements.
Emphasis is put on the future use of GALILEO whose signals on the one hand will be the most important data source for this monitoring.
On the other hand, GALILEO system customers will be interested in warnings, nowcast and forecast of the ionosphere state to guarantee a precise and secure navigation and positioning service.



Example: Ground (IGS) and space based (CHAMP) monitoring of the ionosphere/plasmasphere in DLR

Reliability and Accuracy of Radio Systems



Variability of GPS phases during the ionospheric storm on 6 April 2000

Ionospheric disturbances cause degradation of the system performance and reduce their security.

Nowcast and forecast of signal perturbations require global near-real-time monitoring of the geo-plasma.

Therefore, a permanent system for global monitoring of the key ionosphere parameters is much needed and should be established.

Affected radio systems:

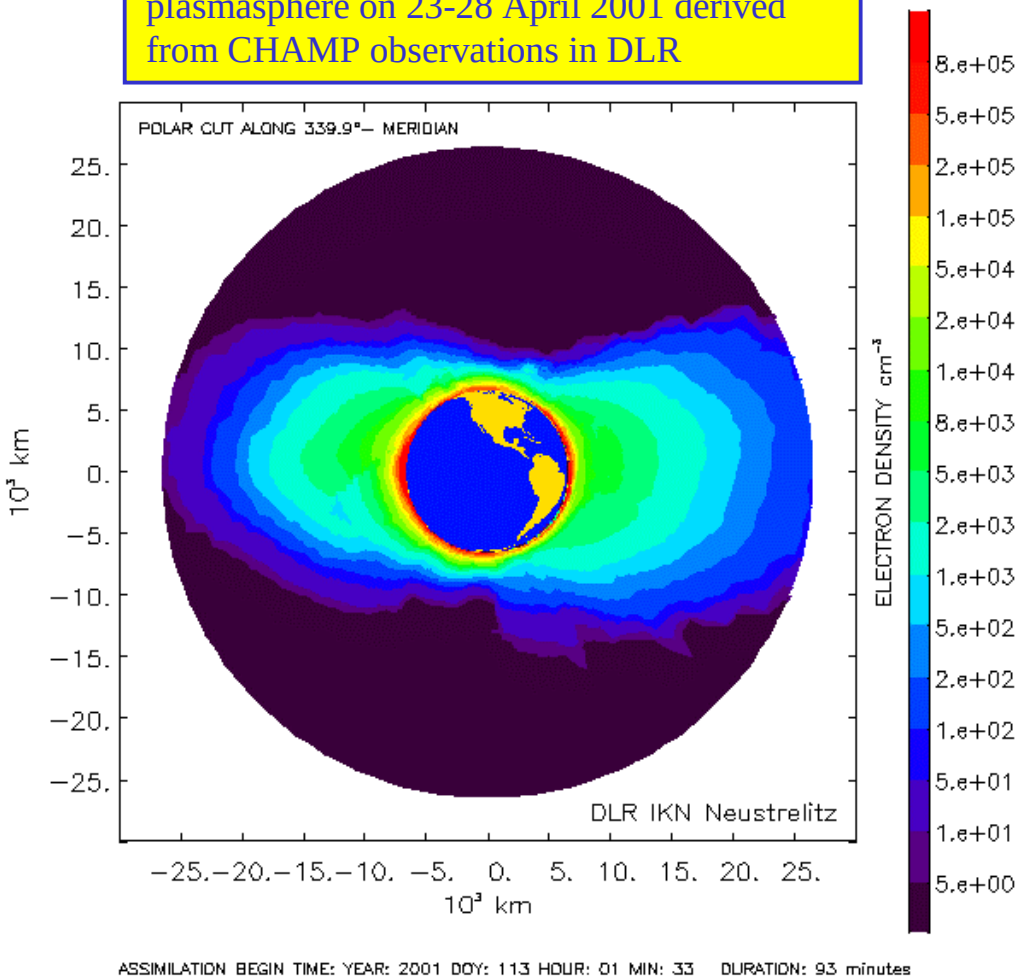
- Global Navigation Satellite Systems
- Ground Based Navigation Systems
- Radio Astronomy (VLBI)
- Satellite Altimetry
- Synthetic Arperture Radar (SAR)
- Ground-based and space-based communications (from the HF-band and up to the C- band range)
- Over the Horizon Radar (OHR)

Customers:

- Aerospace, airline and railway agencies
- Electrical and electronics companies
- Telecommunications companies
- Research institutes
- Public authorities
- etc.

Outcome for Europe

Geo-plasma environment: Electron density distribution in the topsside ionosphere and plasmasphere on 23-28 April 2001 derived from CHAMP observations in DLR



MOPLE contributes to:

- **European high-level research** by improving our understanding of the Earth's plasma environment, its response to the Sun, its coupling with other geo-spheres, and its impact on the radio-wave propagation;

- **European science and technology** by developing new techniques (data assimilation, forecast) and defining international standards (e.g. ITU);

- **European network** of integrated activities related to the geo-plasma monitoring and high-level data services including public authorities, system operators and small-scale companies;

- **European GALILEO system** by enhancing the accuracy and reliability;

- **European Space Weather Program**.

Conclusions

• The geo-plasma affects radio wave propagation in all radio systems using frequencies < 10 GHz (e.g. telecommunication and navigation satellite systems)

• Space Weather events and related global and local perturbation induced processes within the ionosphere-plasmasphere system can cause serious problems in communication and satellite navigation systems

• Ground and space based GNSS (GPS,GLONASS, GALILEO) measurements and future satellite missions (e.g. SWARM) provide a powerful tool for a permanent monitoring of the geo-plasma

• Global monitoring of the geo-plasma should belongs to the GMES program, as:
- the geo-plasma is part of the atmosphere co-rotating with the Earth
- the geo-plasma impacts accuracy and security of radio systems

• To efficiently exploit all European ressources, required is coordination of R&D activity and establishment of monitoring and data dissemination services for both scientific and technological applications.