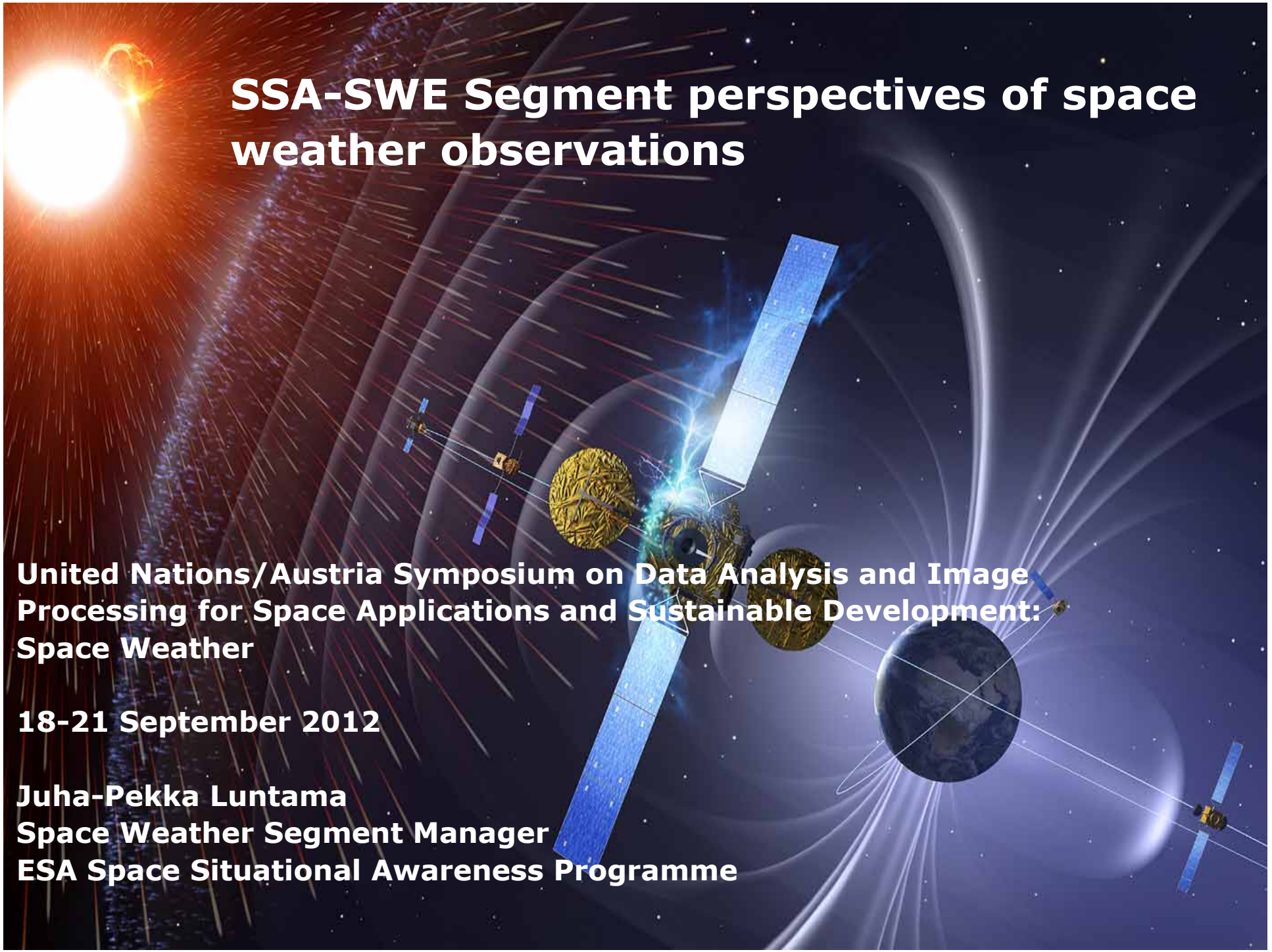
SSA-SWE Segment perspectives of space weather observations



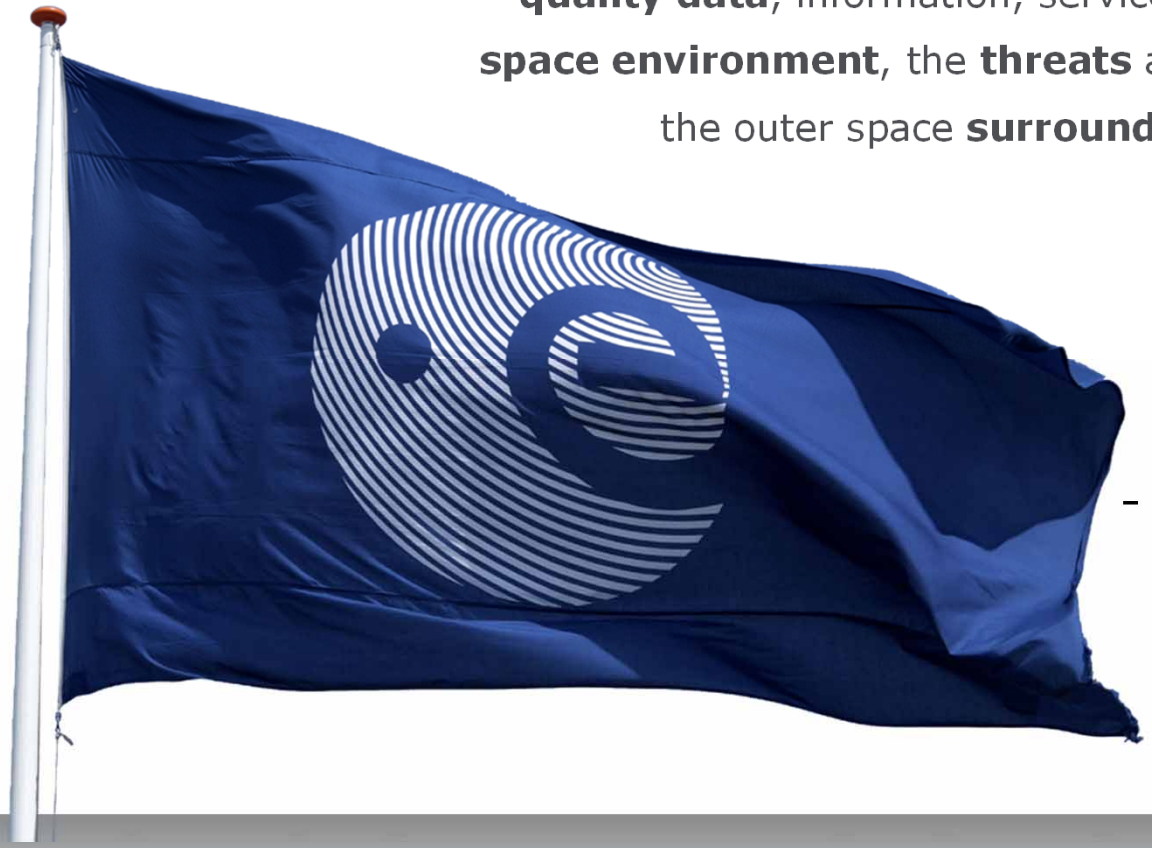
United Nations/Austria Symposium on Data Analysis and Image Processing for Space Applications and Sustainable Development: Space Weather

18-21 September 2012

Juha-Pekka Luntama
Space Weather Segment Manager
ESA Space Situational Awareness Programme

PURPOSE OF THE SSA PROGRAMME

"The objective of the Space Situational Awareness (SSA) programme is to support the **European independent utilisation** of, and **access to, space** for research or services, through the **provision of timely and quality data**, information, services and knowledge regarding the **space environment**, the **threats** and the sustainable exploitation of the outer space **surrounding our planet Earth."**



- **ESA Ministerial Council November 2008**

CUSTOMERS FOR SSA SERVICES

European Governments
- EU, EC
- National
- Regional

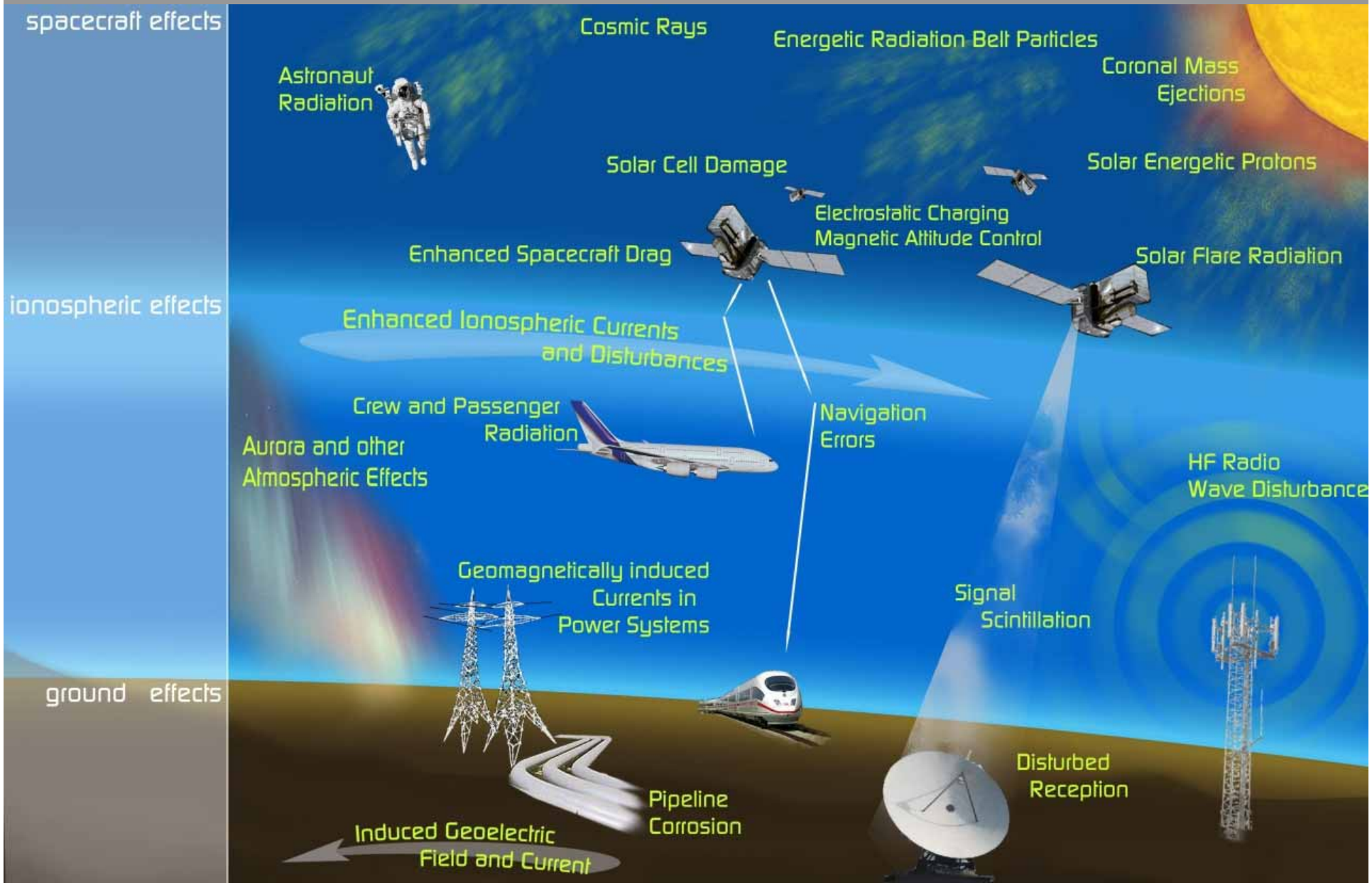
European Space Agencies
- ESA
- National

Spacecraft Operators
- Commercial
- Academic
- Governmental

- Space Insurance
- Space Industry
- Energy
  - Surveying
  - Electrical Grid
  - Power Supply
- Network Operations
- Telecommunications
- Air Traffic Control
- Search and Rescue Entities

- United Nations
- Defence
- Civil Protection

Space Weather Impacts on Infrastructure



SSA Space Weather System Objectives

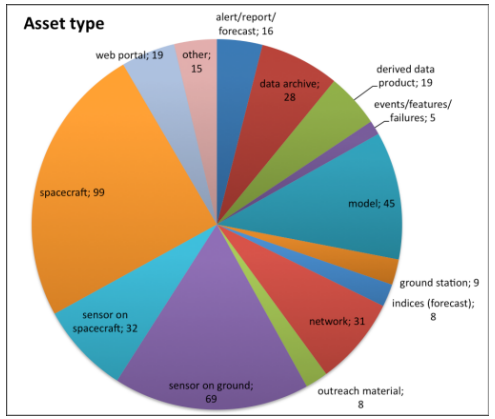
Detection and **forecasting** of the Space Weather events and the **effects** it has on European space assets and ground based infrastructure:

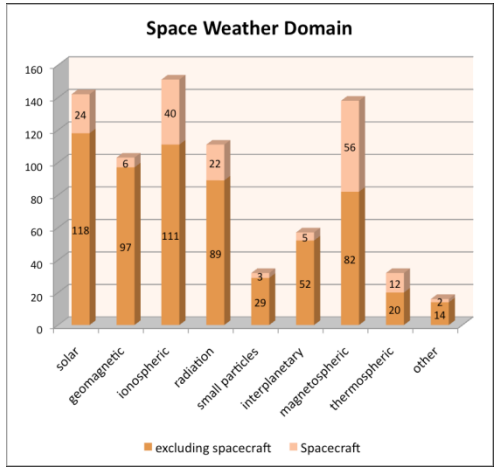
- Provision of comprehensive knowledge, understanding and maintained awareness of the natural space environment
- Detection and forecasting of SWE and its effects
- Detection and understanding of interferences due to SWE
- Prediction and/or detection of permanent or temporary disruption of mission and/or service capabilities
- Monitoring of the Sun, the solar wind, the radiation belts, the magnetosphere and ionosphere to the extent that it supports SSA SWE services
- Provision of predicted local spacecraft and launcher radiation, plasma and electromagnetic environment data

images: (ESA & NASA)

Starting point: Utilisation of Existing Assets

- ESA SSA-SWE system is based on existing European SSA assets: Over 400 existing assets identified*
  - 200 observation systems on ground or in space
  - 45 SWE models
  - 31 ground based observation networks
  - 28 data archives
  - Expertise, products, ground stations, ...
- Many coverage gaps in global, ground based observations
  - Magnetosphere
  - Ionosphere
  - Solar observations





* Includes some non-European assets with open data access

SSA-SWE Perspectives on SWE Data

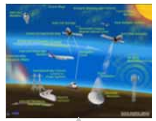
- Operational services require reliable and well characterised observation data
  - Standardised data formats
  - All data well characterised with known error characteristics
  - Verfication and validation
  - Metadata
  - Metrics for data quality
- Nowcasting and forecasting services require Near Real-Time (NRT) data and product dissemination
- Off-line data can be used e.g. for research, validation of nowcasts and forecasts, post-event analysis, forcast challenges, ...

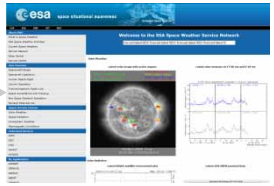
Scientific Observations and SSA-SWE

- Scientific knowledge is underpinning all operational services
- Most existing SWE assets are based on scientific requirements
- SSA Programme supports scientific research
  - Access to archived SWE data and products
  - Development of new models, tools and products based on scientific results
  - Testing and validation of SSA-SWE products and services against scientific prototypes
- Utilisation of all available and relevant SWE data will be considered
- Requirements for science and operational services are in many cases complementing each other

SSA-SWE Precursor Service System in 2012

SSA-SWE Users





SSA-SWE Service Portal:
swe.ssa.esa.int

SWE Data Centre
Redu, Belgium

SWE Service Coordination Centre,
Space Pole, Belgium

SWE Expert Service Centre
Solar Weather

ROB, Belgium (coord.)
Uni. Graz, Austria

SWE Expert Service Centre
Ionospheric Weather

DLR, Germany (coord.)
NMA, Norway
NOA, Greece

SWE Expert Service Centre
Space Radiation

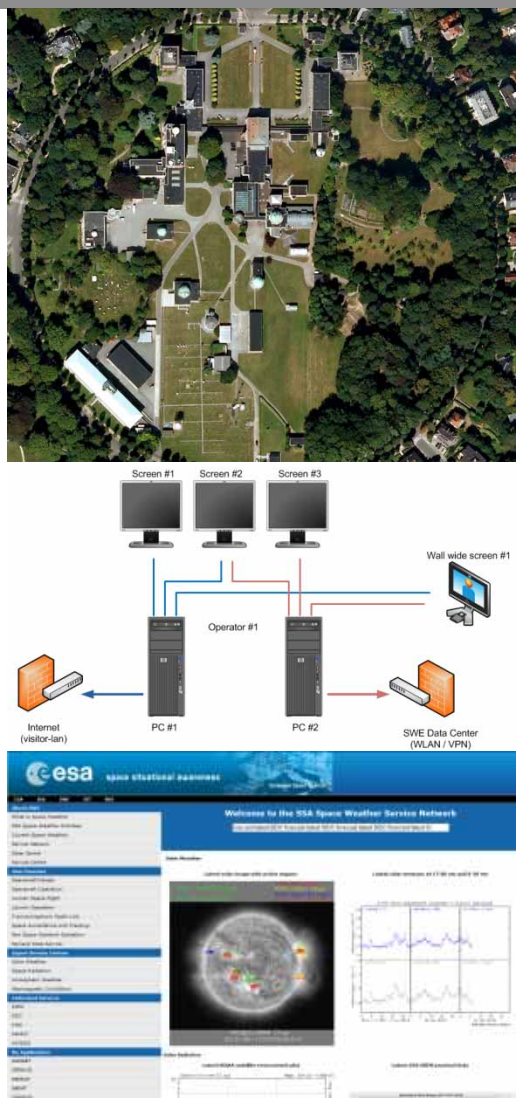
BIRA, Belgium (coord.)
AIT, Austria
UOA, Greece

SWE Expert Service Centre
Geomagnetic Conditions

TGO, Norway (coord.)

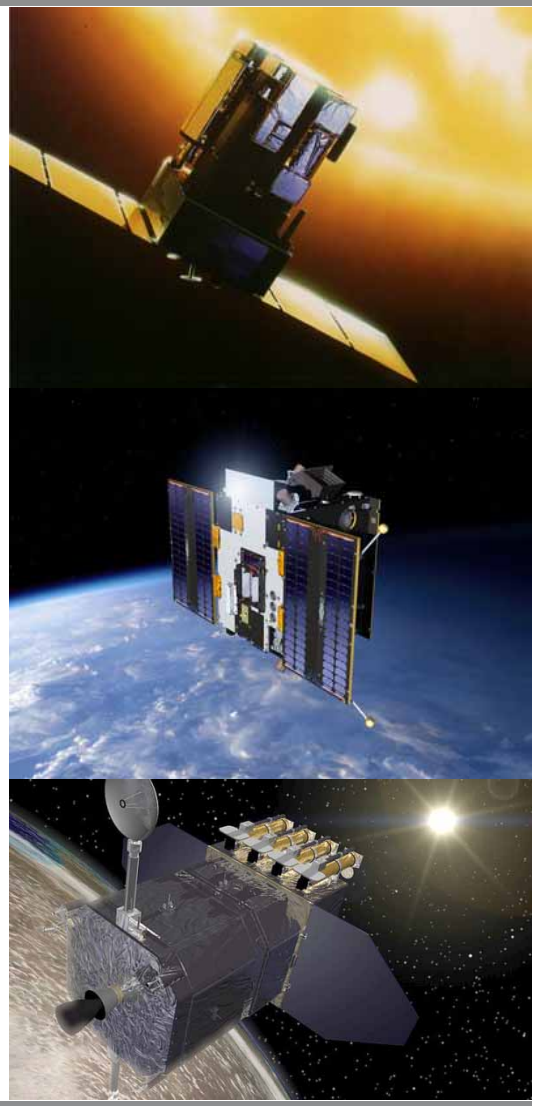
SWE Service Coordination Centre (SSCC)

- SSCC is the first point of contact for SSA-SWE services
  - operates and maintains the applications and databases in the SSA-SWE Data Centre
  - monitors the availability of the SSA-SWE services including the federated services
  - monitors the accessibility SSA-SWE Service Portal
  - appoints the second level user support by appropriate ESCs
- The operators of the SSA-SWE SSCC are
  - Belgium Institute of Space Aeronomie
  - Royal Observatory of Belgium
  - Space Application Services
  - Spacebel S.A.



Gaps in global SWE Infrastructure

- Operational SWE monitoring system for long term needs to be established
- Critical space borne observations have to be ensured
  - CMEs, solar wind, IMF, solar EM radiation, charged particles, Earth radiation environment, ...
- Data availability from all observation systems needs to be improved
  - Enhancement of ground based observation networks for coverage and timeliness
  - Ensured NRT dissemination, exchange, archiving
  - Collection of SWE impact data on space borne and ground based infrastructure
  - Enhanced data search and quick look tools

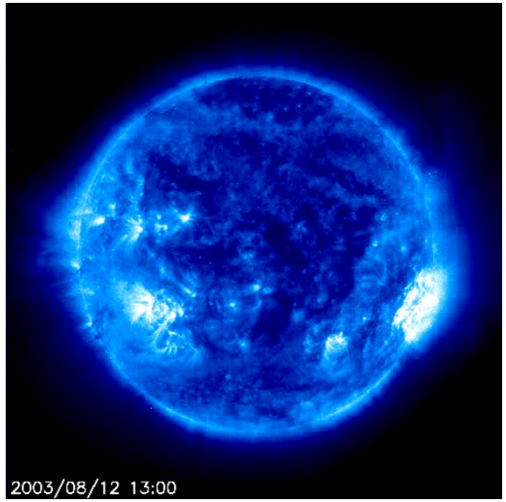


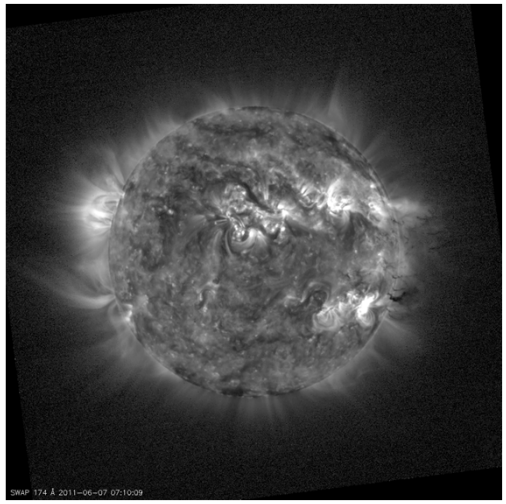
images: (ESA & NASA)

Gaps in Scientific Knowledge

- We still have many unknowns in solar physics
  - When will active regions flare, produce SPEs or eject CMEs
  - How big will the flare, SPE or CME be?
- Models of Sun-Earth interaction
- Fast MHD models
- Physics based forecasting models
- Fast upper atmosphere models for SWE impacts on atmospheric drag
- Space weather forecasting challenge?
- Analysis and understanding of the SWE impact on specific elements of our infrastructure

=> tailored services for various user domains





European SSA System