MASTER Workshop – ESA's Distributed Space Weather Sensor System (D3S)

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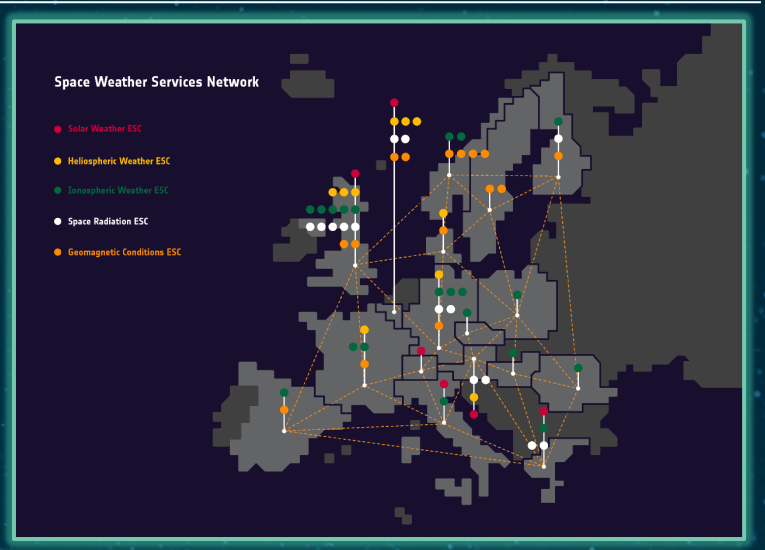
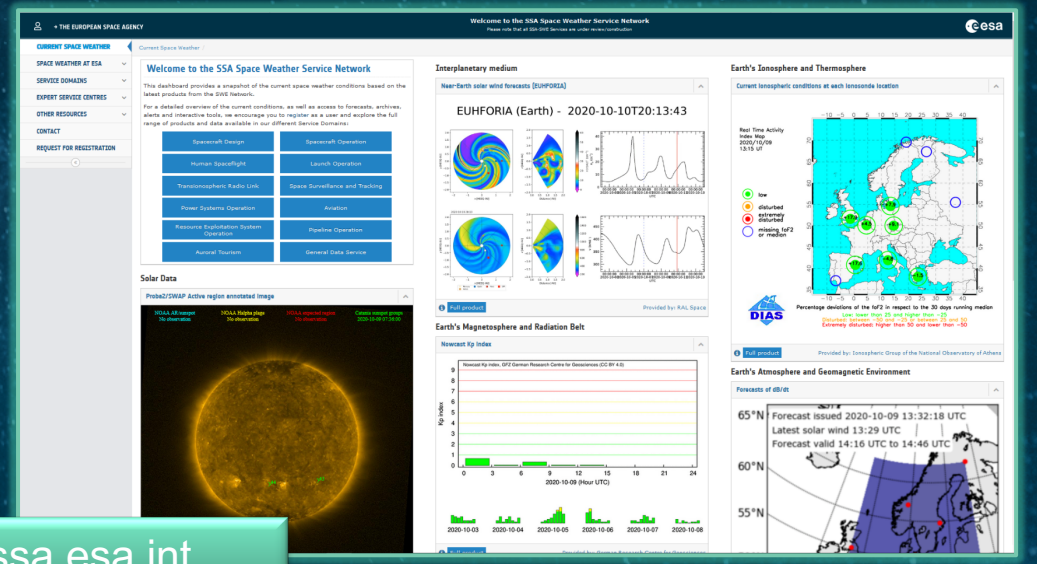
SWE Service Network in 2020

- 29 user driven services in demonstration & testing available via SWE Portal
- ~1500 registered users
- ~1M hits per month
- >40 Institutes/organisations involved in service development and provision
- Online service provision supported by SWE helpdesk (8/5) and second line support from Expert Groups
  - Tailored service campaigns for high priority users



- New modernised SWE Portal / Online Service Entry Point
  - User tailored dashboards
  - Simplified registration process

- Ongoing developments
  - Products, modelling, applications, underpinning R&D
  - Ground and space based measurement facilities

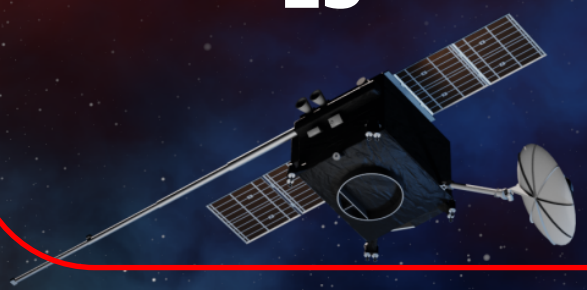


https://swe.ssa.esa.int

ESA's Enhanced Space Weather Monitoring System

Missions to solar wind

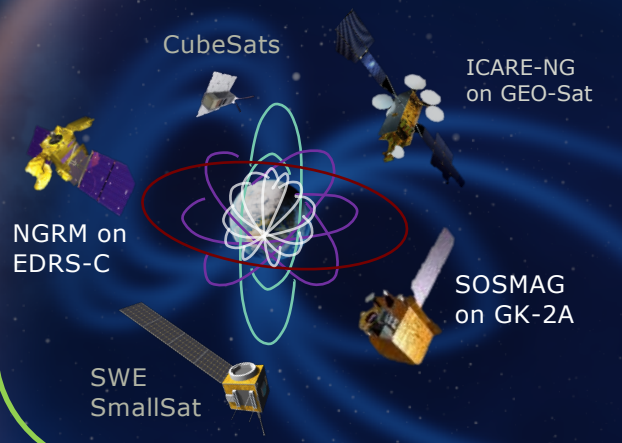
L5



L1

Forecasting
&
Event
detection

Impact & State Monitoring



Ground based measurements

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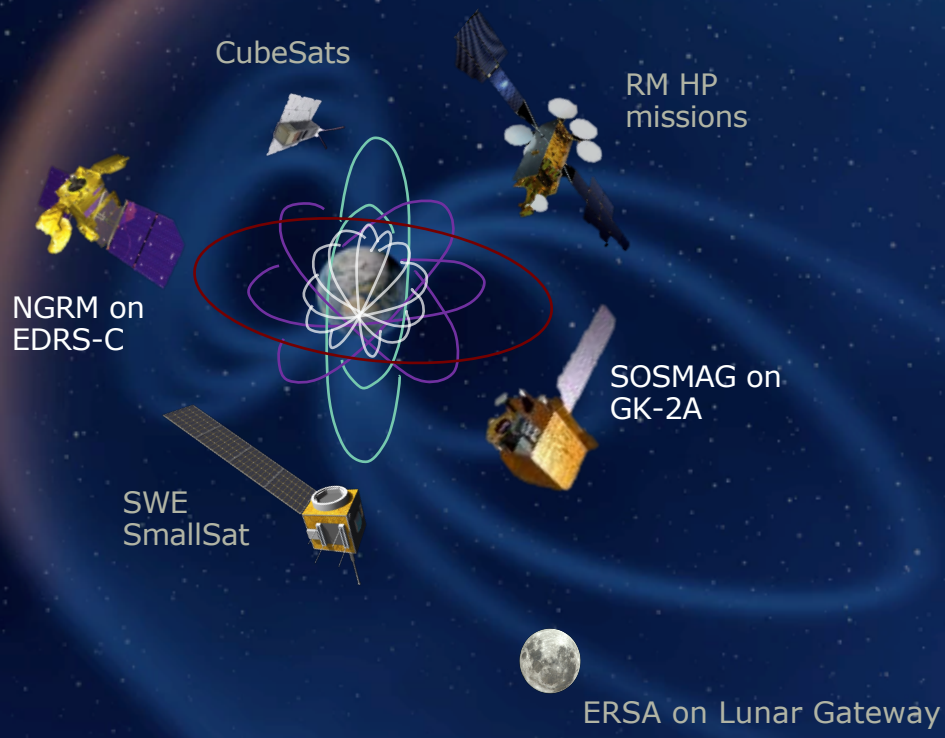
D3S:

- Hosted Payloads
- SmallSat mission

Distributed Space Weather Sensor System

Monitoring of SWE impact (within Earth's magnetosphere):

- Utilising hosted payload opportunities and dedicated small satellites
- Coverage: LEO, MEO, GEO, HEO
- Instrument development in ESA Technology Programmes, SSA/S2P Programme and existing European instrumentation
- Precursors: NGRM/EDRS-C, SOSMAG/GK2A



D3S Measurement requirements

Measurements target different environmental effects

- Earth Magnetosphere & Radiation Belt
  → Radiation environment of satellites

- Earth Ionosphere / Thermosphere
  → Propagation of communication signals between satellites and ground stations or radars / satellite drag

- Earth Atmosphere and Geomagnetic Environment
  → Potential impact on geomagnetically induced currents

- Micro-particle Environment
  → Satellite environment

Measurement products to be provided by D3S

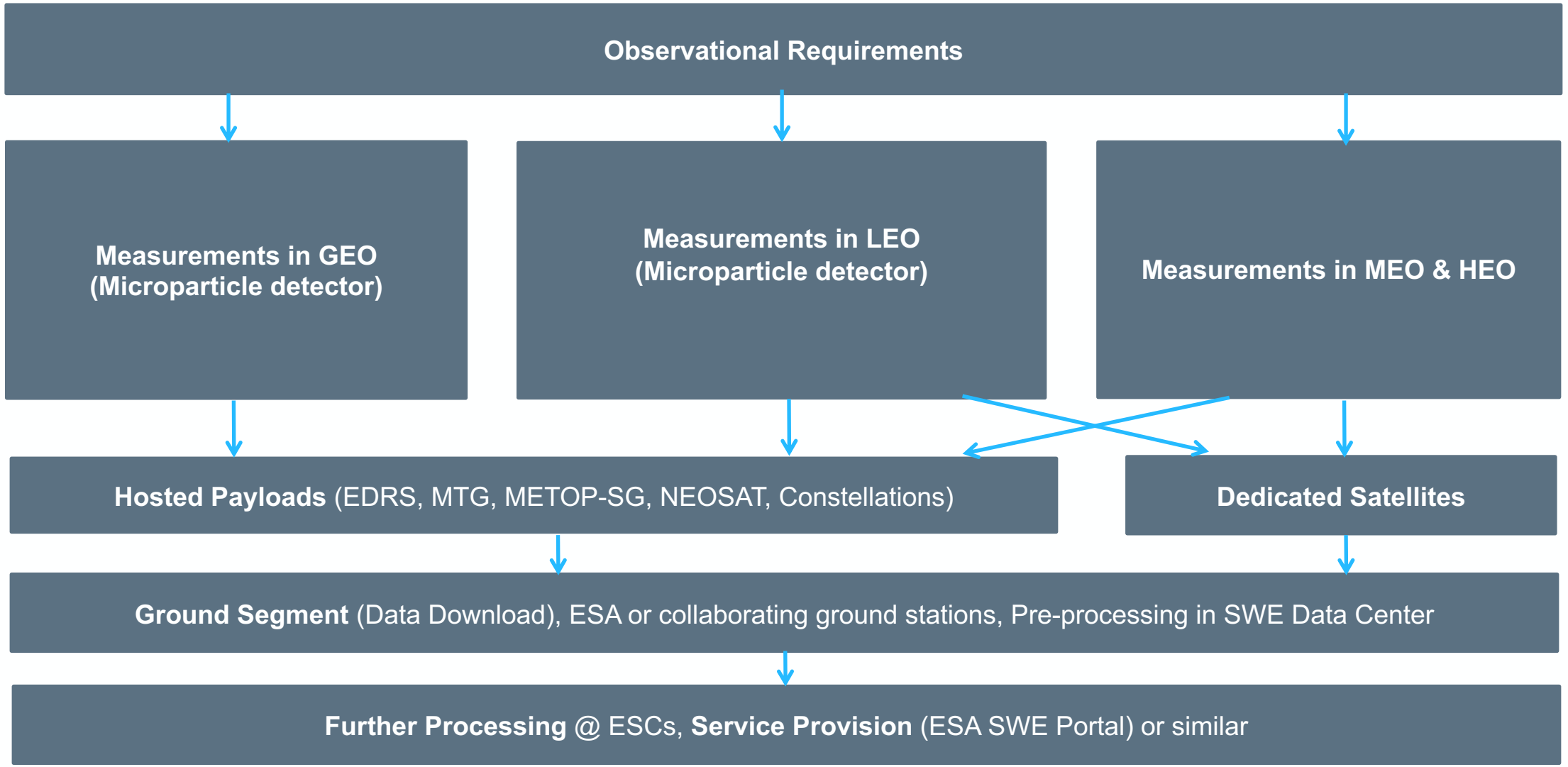
Micro-particle Environment:

Data on Microparticle Environment	Range	Altitude
Micro-particle impact detection and characterisation	Flux of sub-mm particles as a function of Size, Velocity, Angular Distribution	GEO, polar LEO and ISS altitude

Earth Ionosphere / Thermosphere:

Data on Earth Ionosphere / Thermosphere	Range	Altitude
3D Electron density	10^{9} m^{-3} to 10^{14} m^{-3}	100 km – 1000 km
Neutral Wind Velocity in Thermosphere	0 m/s to 300 m/s	100 km – 600 km
Neutral Density in Thermosphere	10^{10} m^{-3} to 10^{20} m^{-3}	100 km – 600 km
Atomic Oxygen Density	10^{8} m^{-3} to 10^{16} m^{-3}	400 km – 1000 km

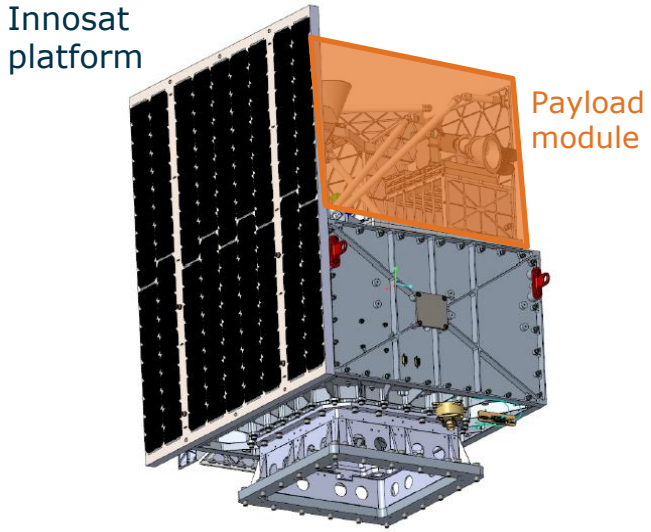
Preliminary architecture of D3S



D3S missions studies

SWE SmallSat Phase A/B:

- Constellation of 3-6 small satellites in elliptical LEO (400 km – 2500/4000 km, TBC)
- Continuous auroral oval monitoring and multi-point in-situ measurements of Earth's magnetosphere, ionosphere and thermosphere
- Mission implementation to be proposed at Ministerial 2022
- Instruments:
  - WFAI (optical & FUV)
  - Magnetometer
  - Radiation Monitor
  - Multi-Needle Langmuir Probe
  - Plasma Analyser
  - GNSS receiver
  - **Microparticle Detector**
  - Oxygen Sensor



Total payload allocation:

- *20 kg*
- *50 W*
- *500 kbps*
- *60 x 60 x 60 cm*

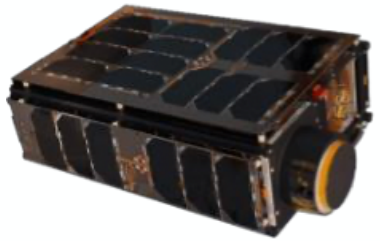
For microparticle instrument:

- *1.5 kg*
- *3 W*
- *2 kbps*
- *150 x 150x 50 mm³ (x 2)*

D3S mission studies

SWE Nanosatellites:

Phase 0/A study ongoing



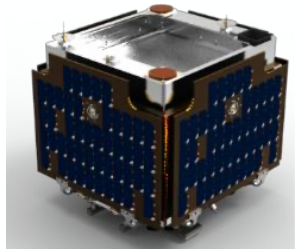
Scope:

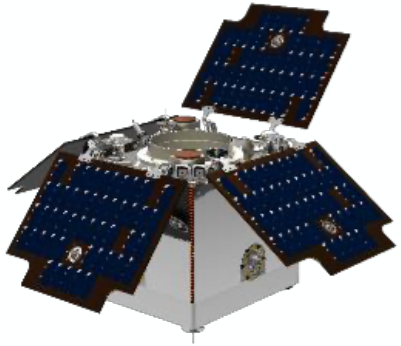
Initial mission concept study to assess the feasability (latency, lifetime, reliability) to use nanosatellites for operational space weather monitoring in near-Earth space.

Objective:

Analysis of measurement requirements and available technology to propose first nanosatellite mission concept followed by initial design

Compact ideas for microparticle monitoring?





The End – Thank you!