

# **Space Weather: current activities and future directions**

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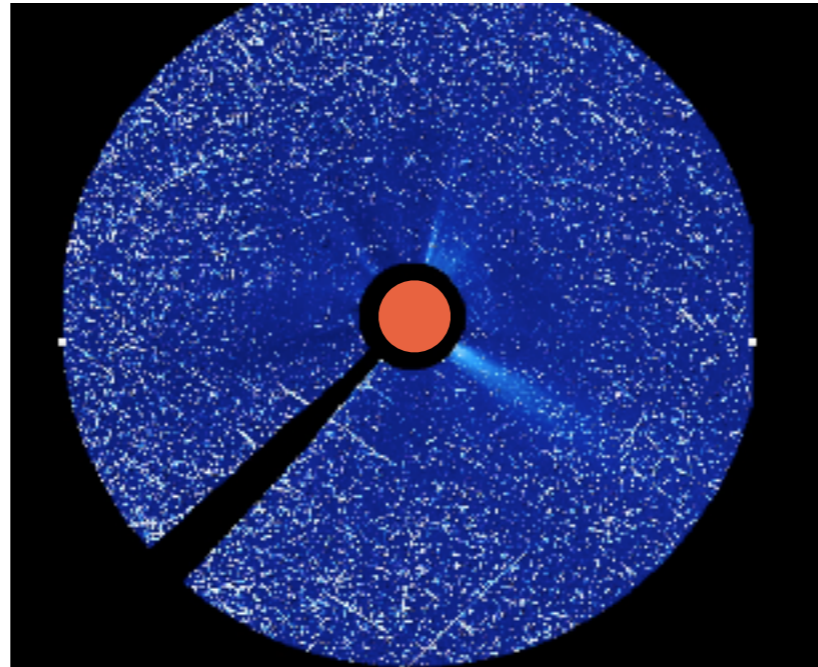
[Alexi Glover, ESA contact]

## Ejections



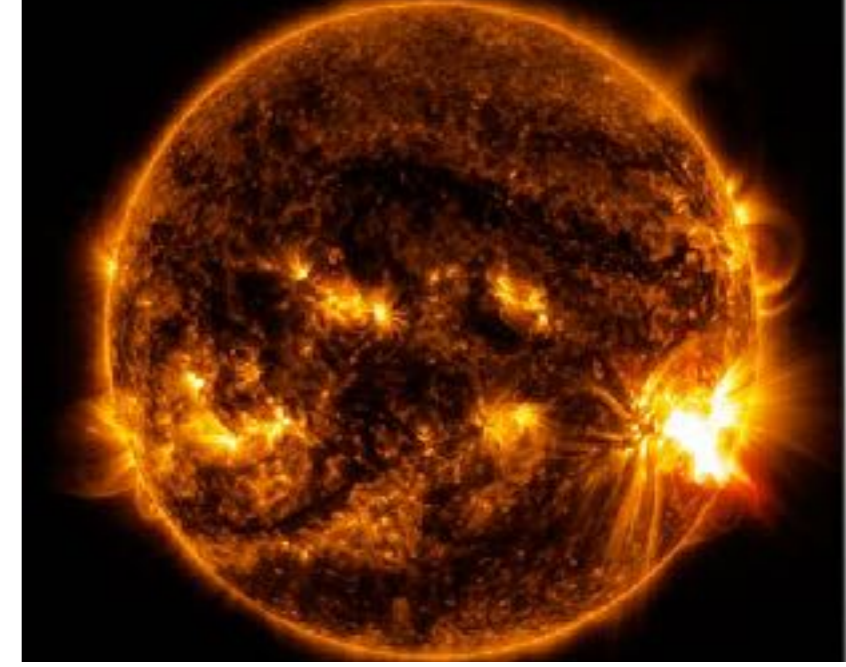
- satellite surface charging
- GNSS errors
- electricity network interruptions
- possibility of cascading failures

## Energetic particles



- ionising radiation at aircraft altitudes
- damage to spacecraft and aircraft electronics
- HF radio communication problems

## Flares

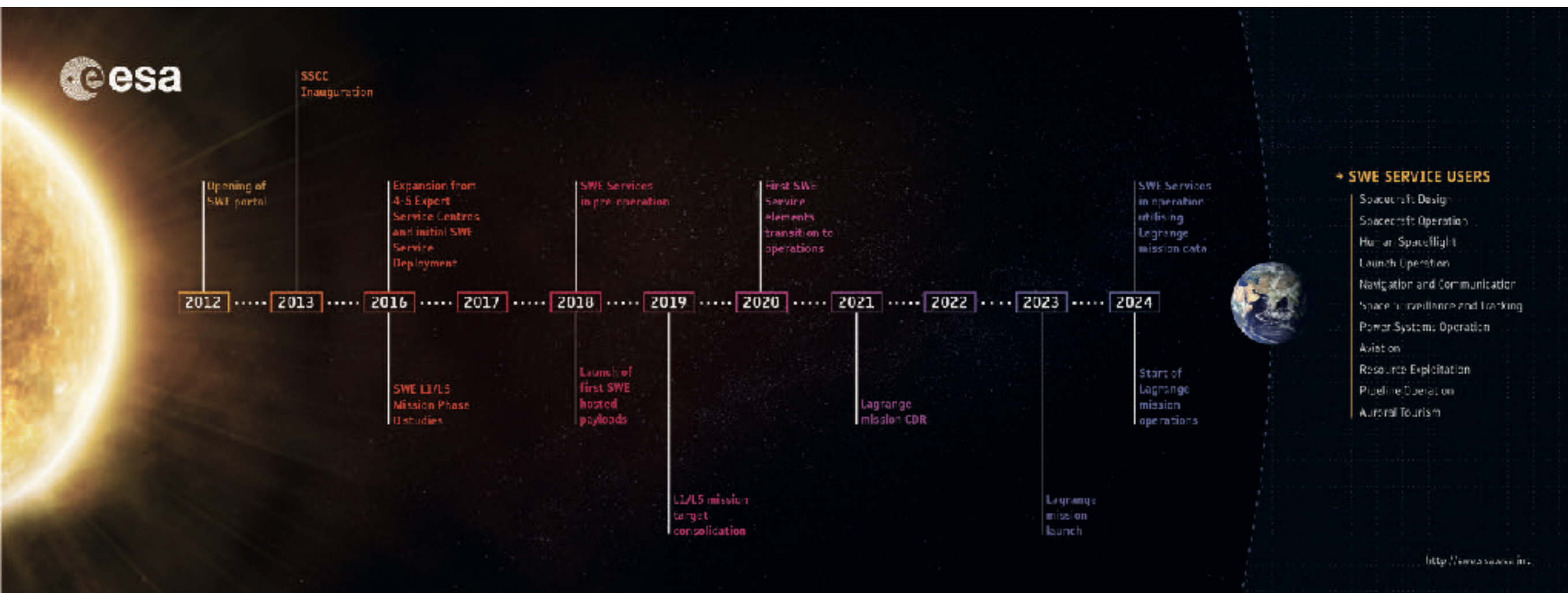


- atmospheric heating
- ionospheric changes
- HF communication problems
- Mobile phone network issues

# ESA's space weather programme

ESA has a strand of work that seeks to monitor and assess the associated risks under its **Space Safety programme**.

[https://www.esa.int/Safety\\_Security/Space\\_Weather\\_Office](https://www.esa.int/Safety_Security/Space_Weather_Office)



## ESA\_lab@UCL: The vision

*To build a closer and sustainable relationship between ESA and UCL that acts as a catalyst for creative and high-return activities to enhance ESA's ability to provide space weather services as part of the space safety programme, and that utilise UCL's multi-disciplinary scope and expertise. Working in partnership to build strands of alignment between UCL's research and ESA's Space Safety programme needs.*

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UCL capabilities:

**Research into  
fundamental science of  
the Sun-Earth system**

**Forecasting  
techniques and  
products**

**Mission concept  
development**

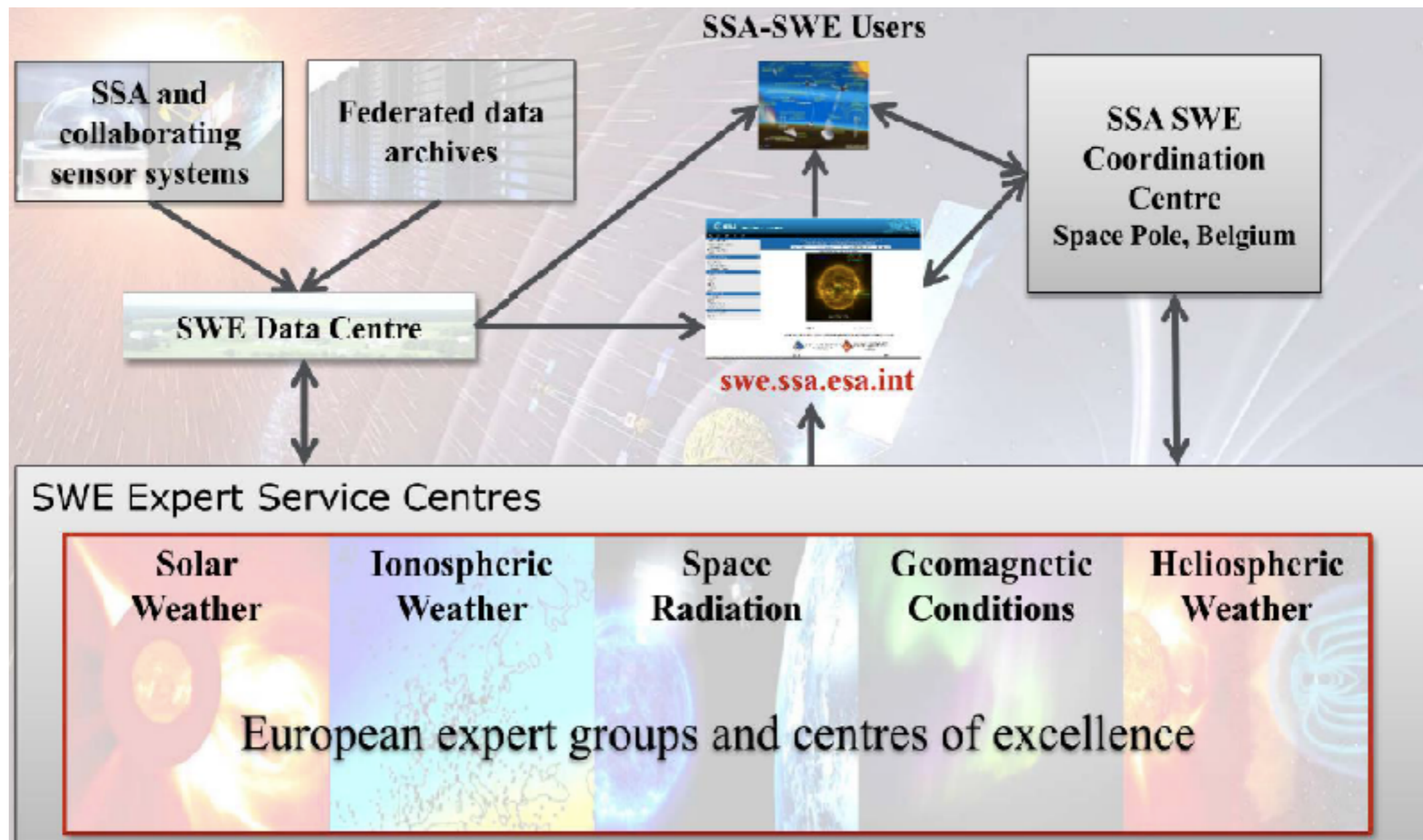
**Instrumentation design  
and build**

**Education and training**

*What would you like to  
develop?*

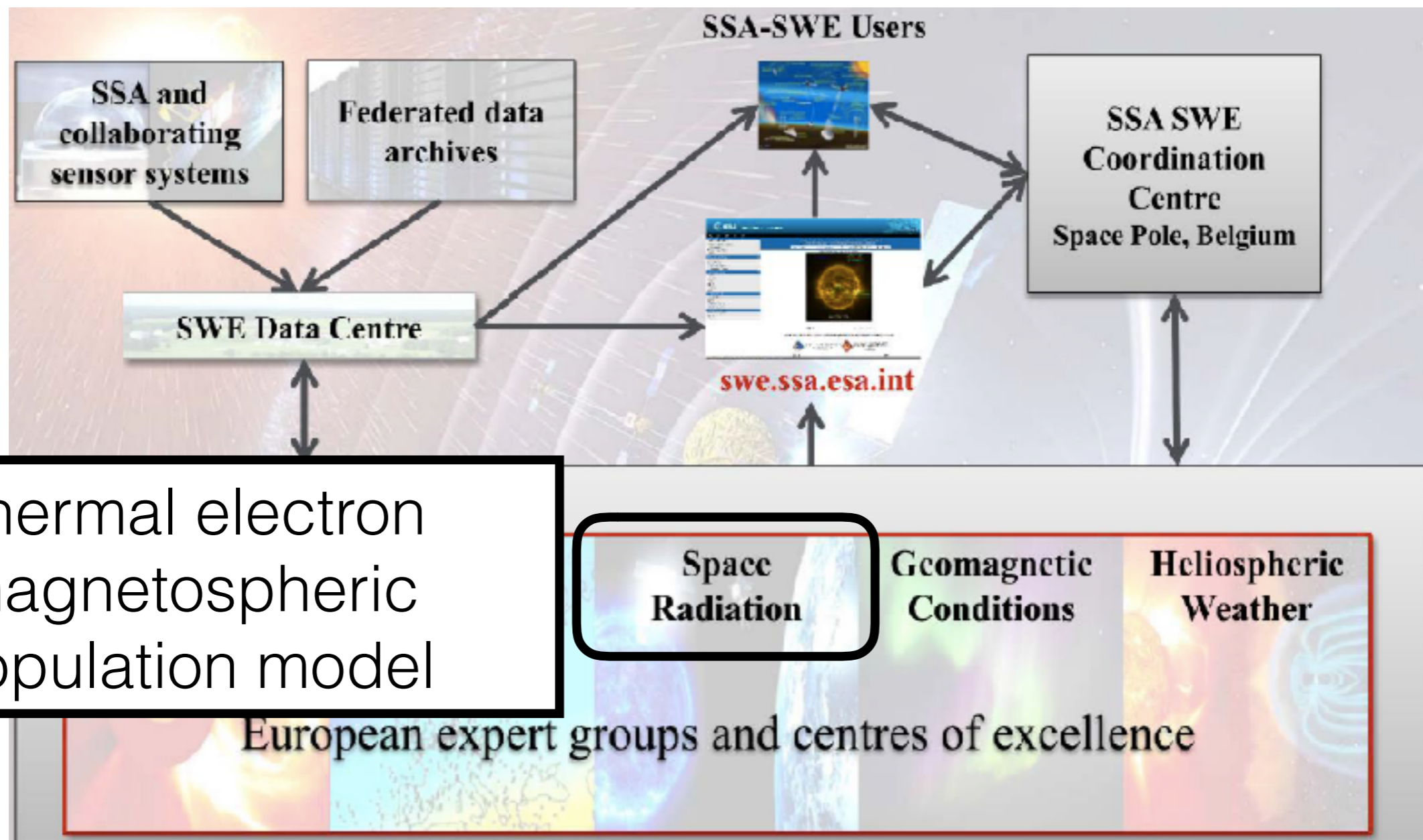
# ESA's Expert Service Centres

- ESA established a space weather information network through its Expert Service Centres



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Thermal electron magnetospheric population model

Space Radiation

Geomagnetic Conditions

Heliospheric Weather

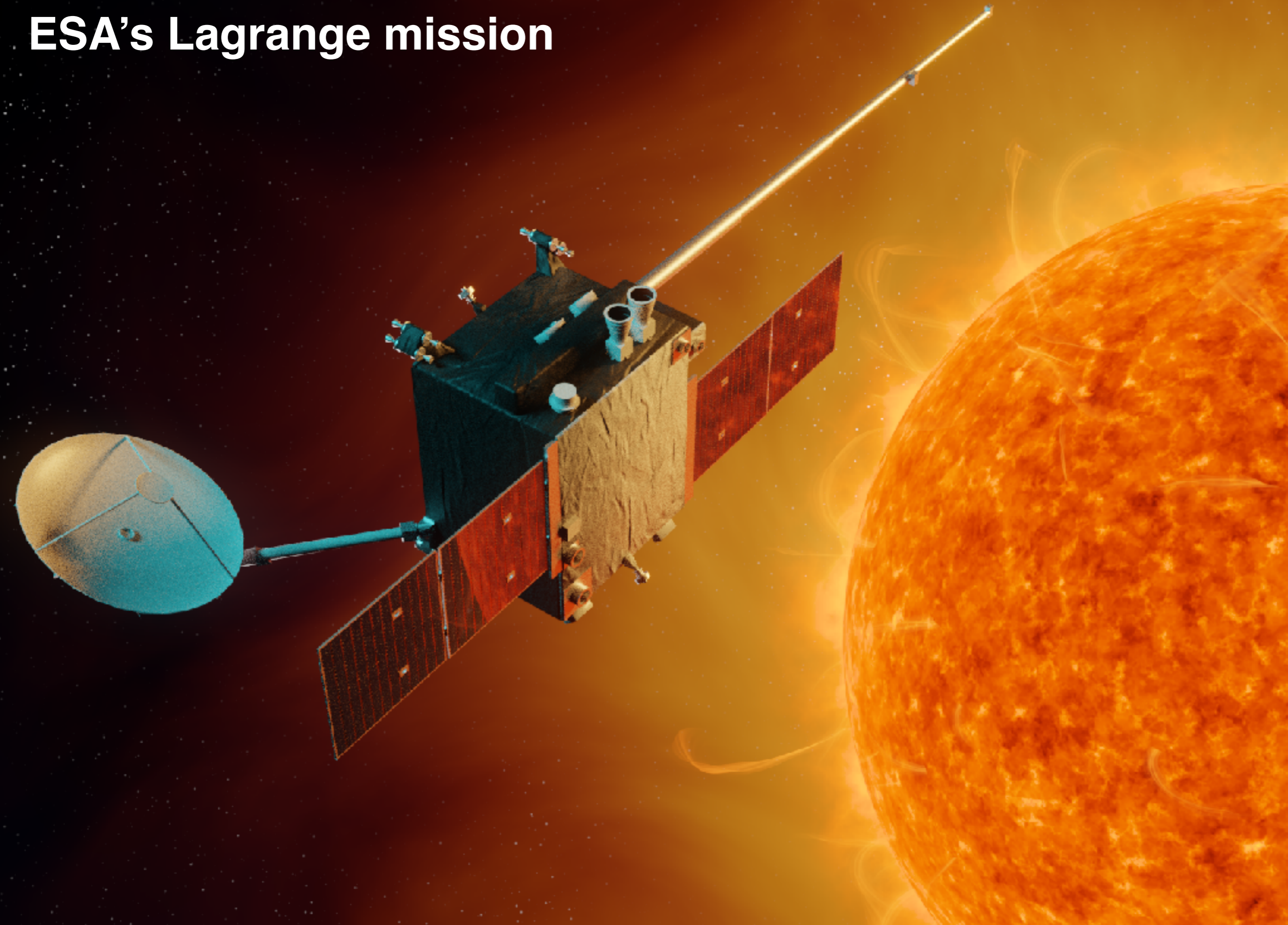
European expert groups and centres of excellence

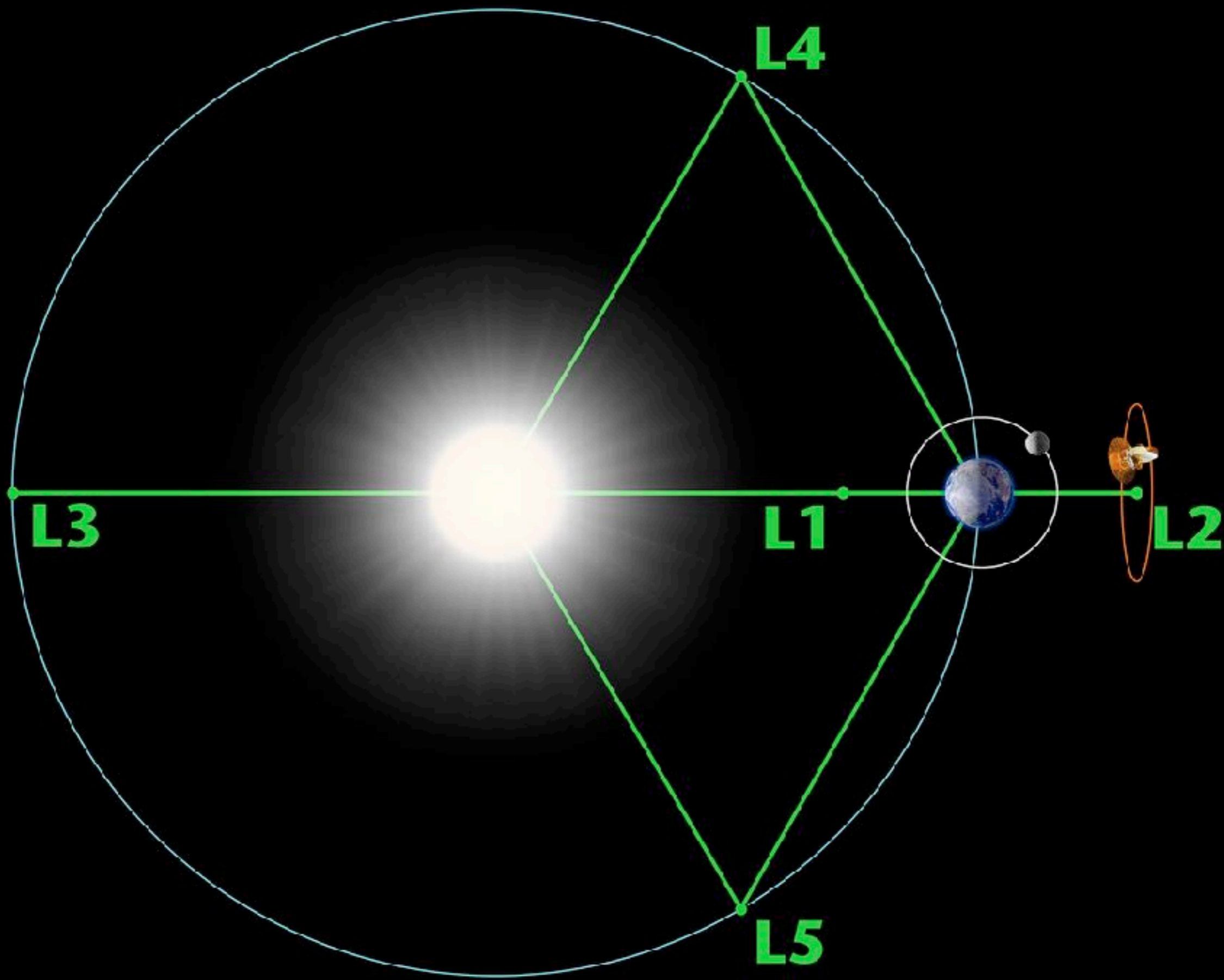
# ESA's space weather programme

- BUT - providing timely and accurate space weather information is possible only if sufficient observation data are continuously available, requiring ground-based and space-based instrumentation



# ESA's Lagrange mission





# Lagrange mission roadmap

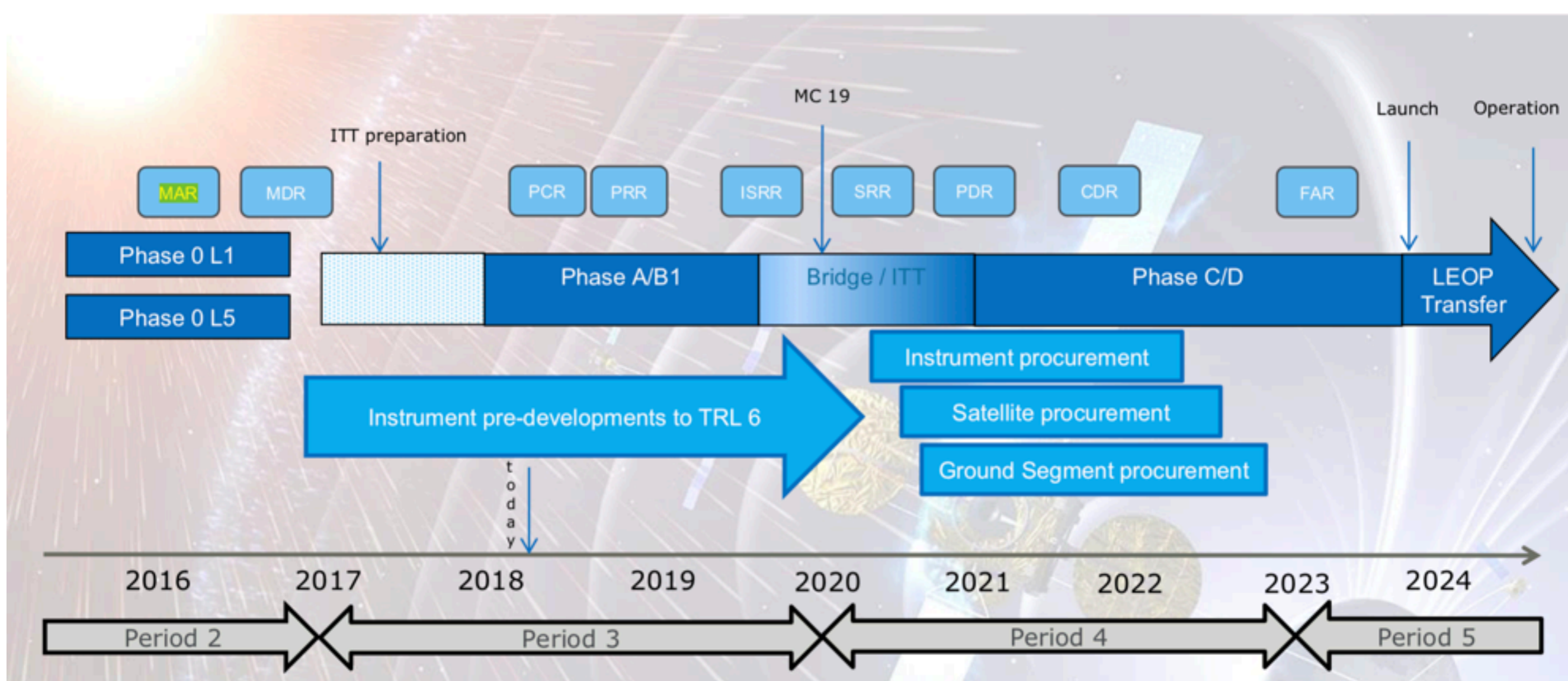


Image courtesy of Juha-Pekka Luntama and taken from:  
[https://cpaess.ucar.edu/sites/default/files/documents/sww-2018-presentations/Luntama\\_Juha-Pekka\\_06.pdf](https://cpaess.ucar.edu/sites/default/files/documents/sww-2018-presentations/Luntama_Juha-Pekka_06.pdf)

# The D3S programme

- D3S forms part of the overall ESA instrumentation programme
- Whilst instruments at L1 and L5 are part of the forecasting & event detection, the D3S system monitors the space weather impact
- D3S mission concept development

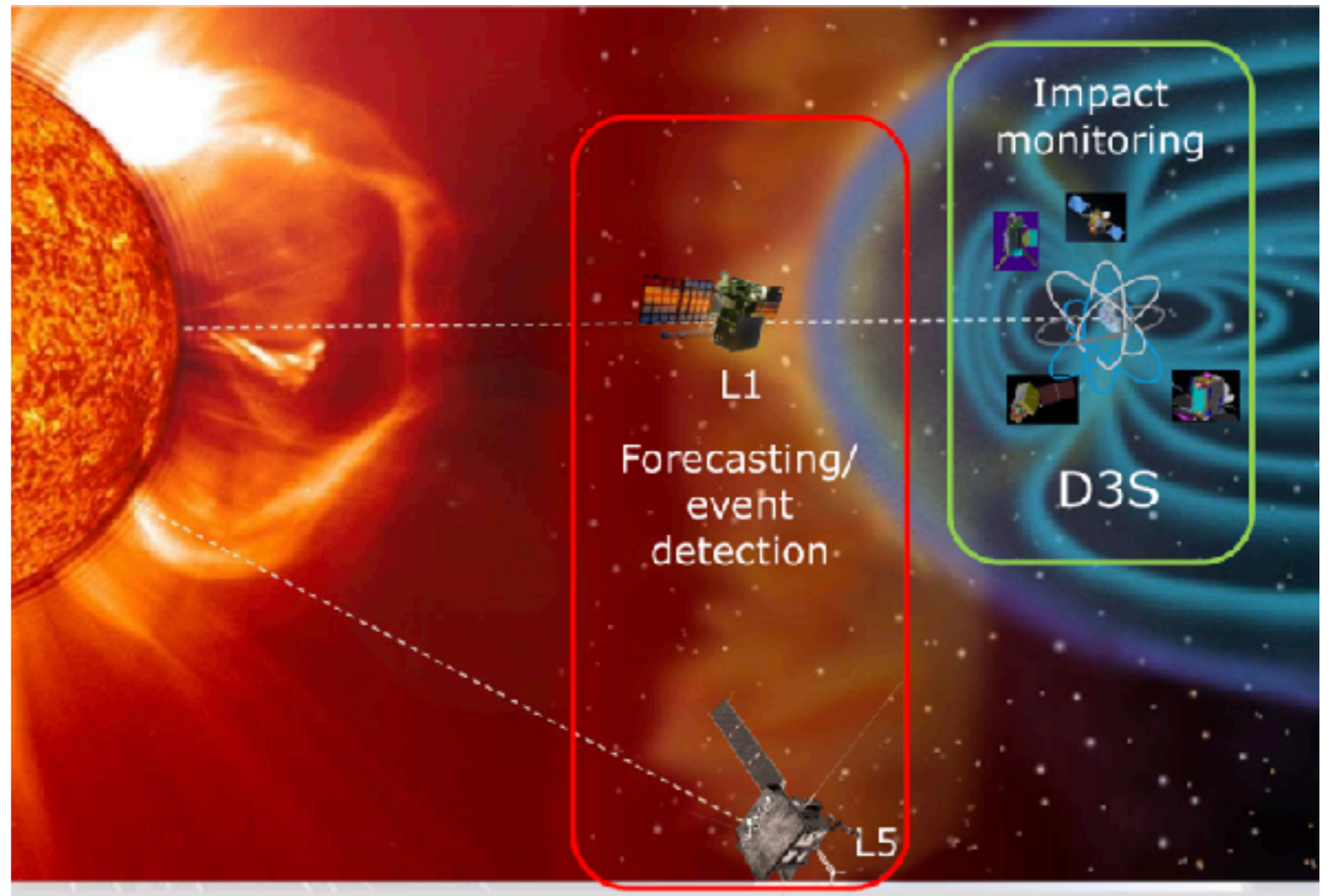


Image courtesy of Juha-Pekka Luntama and taken from:  
<https://tinyurl.com/y657rfjy>

# The D3S programme

- D3S masters student project

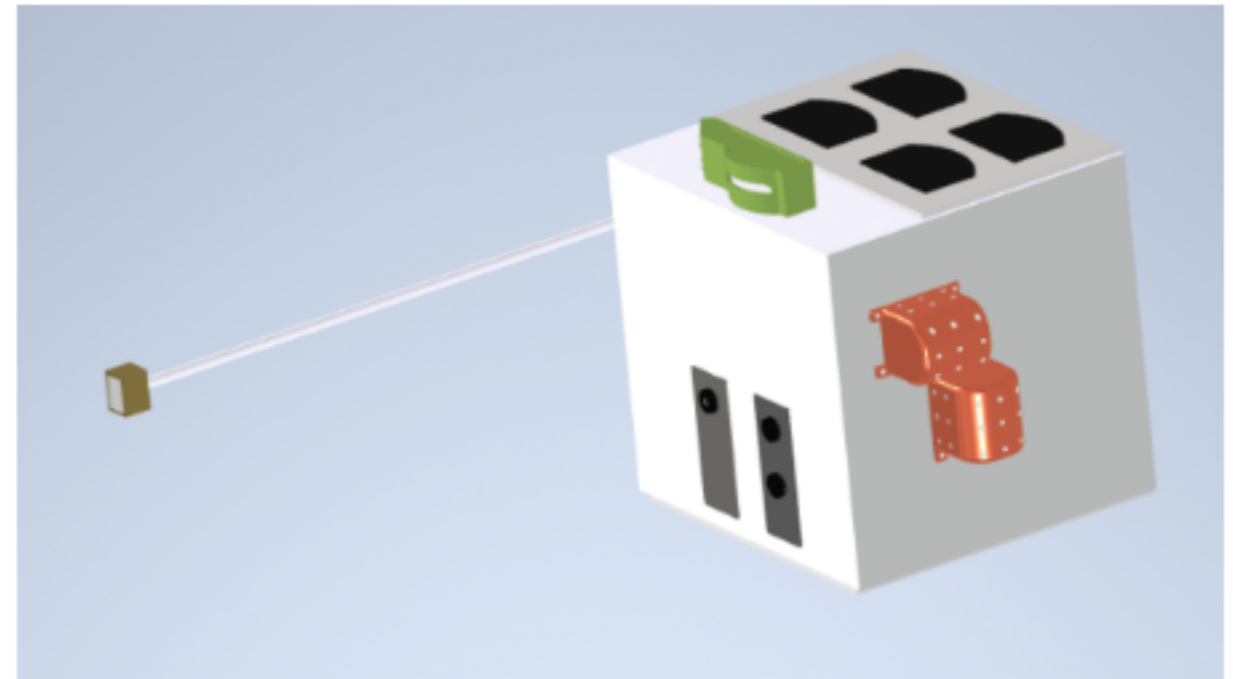


Figure 9.26: 3D model of the Frigg platform

The primary mission objectives are:

1. REQ-01: The mission shall monitor space weather effects in all or part of the Earth's atmosphere (i.e. aurora), ionosphere and magnetosphere.
2. REQ-02: The nominal mission lifetime shall be 3 (goal 5) years.
3. REQ-03: The total lifecycle cost of the mission shall not exceed 250 MEuro.
4. REQ-04: Revisit time of the northern (goal also southern) polar region should be no longer than 30 minutes.

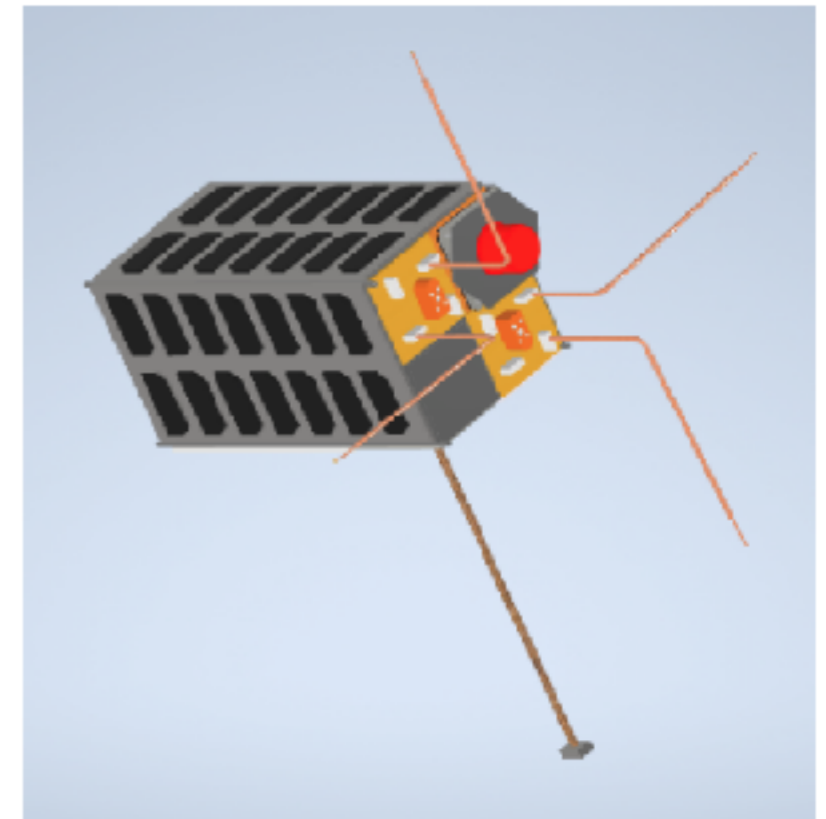


Figure 9.13: 3D model of the Milgaard platform

# Future opportunities

- Better mapping of capability and gaps
- UK-funded SWIMMR programme: we are involved with 3 projects. Impact to be finalised and translated.
- Preparation for Lagrange
- Training and policy work
- Focus on a theme: e.g. lunar exploration and space weather
- Wider UCL activities...

