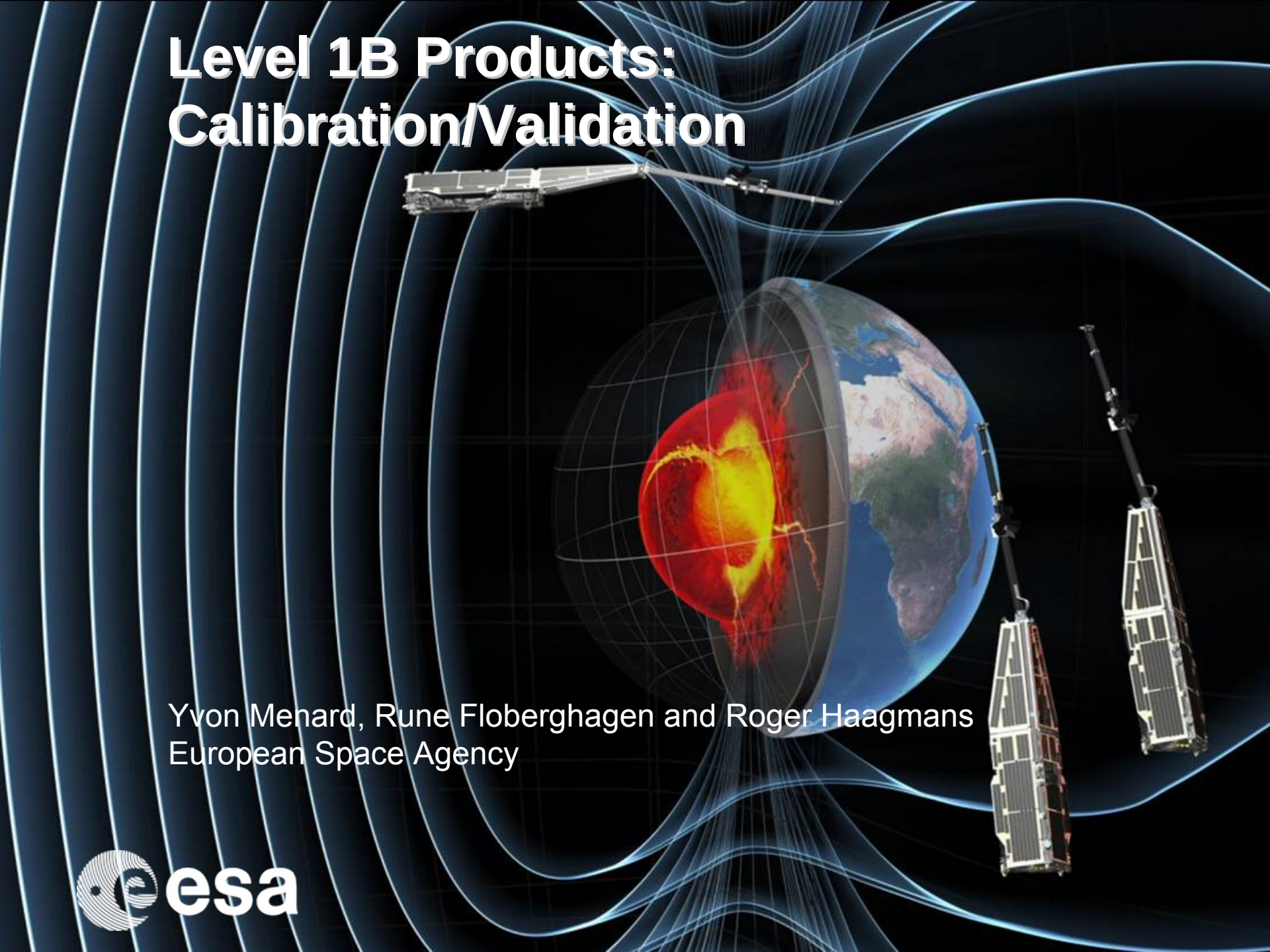
# Level 1B Products: Calibration/Validation



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# Swarm payload

**Absolute Scalar Magnetometer**

The ASM provides the ability of performing an in-flight calibration of the vector magnetometer, to maintain absolute accuracy in a multi-year geomagnetic field mission the ability of performing an in-flight calibration of the vector magnetometer is needed. For this purpose and for obtaining the magnitude of the field with high accuracy an ASM is included in the payload.

**Vector Field Magnetometer**

The Vector Field Magnetometer (VFM) accomplishes high precision, ultra-high linearity and low noise measurements of the Earth's magnetic field vector components.

# Swarm payload

**Electrical Field Instrument**

The EFI makes in-situ measurements of the ion distribution and its moments. Key parameters that can be determined by this instrument are ion arrival angle, drift velocity, ion density, ion and electron temperature and spacecraft potential. These parameters are used to calculate the local electric field.

**Star Tracker System**

The STR delivers 3 axis highly accurate attitude data. The STR is mounted together with the VFM on a rigid mechanical interface to get the knowledge of the VFM axis orientation. This mechanical interface between STR and VFM is called optical bench.

# Swarm payload

**GNSS Receiver**

The dual-frequency GNSS receiver will provide autonomous and real time satellite positioning and timing information. Precise orbit determination will be computed during post processing at Level 2.

**Accelerometer**

An ACC takes measurements of the non-gravitational accelerations acting on the spacecraft caused by air density, solar wind, Earth albedo, attitude and orbit control actuators etc.

**Laser Retro Reflector**

The LRR allows precise range measurements from ground based satellite laser ranging stations.

# Swarm Level 1B Products Files

- Magnetic vector data, 50 Hz
- Magnetic data, 1 Hz
- Magnetic Calibration data, 0.25 Hz
- Euler angle estimation of the CRF ← VFM transformation
- Plasma data, 2 Hz
- Position and velocity of S/C, 1 Hz
- Attitude of S/C, 1 Hz
- On-board GPSR navigational solution, 1 Hz
- GPS RINEX Observation data, 0.1 Hz
- GPS RINEX Navigation data, 2 hours
- Pre-processed ACC data, 1 Hz
- ASM and VFM auxiliary data, 50 Hz

# Definition calibration / validation

- **Calibration:** The process of quantitatively defining the system responses to known, controlled signal inputs.

- **Validation:** The process of assessing, by independent means, the quality of the data products derived from the system outputs.

These definitions correspond exactly to the definitions of the Working Group on Calibration and Validation Definitions of the Committee on Earth Observation Satellites.

# Dedicated Working Meetings

Three working meetings for cal/val of Level 1B products in parallel:

- ✓ CAL/VAL Magnetic field products
  - Chair: Stefan Maus
  - Co-chair: Nils Olsen
- ✓ CAL/VAL Electric field products
  - Chair: Hermann Lühr
  - Co-chair: David Knudsen
- ✓ CAL/VAL Accelerometer related product
  - Chair: Sean Bruinsma
  - Co-chair: Pieter Visser

# Dedicated Working Meetings

Three working meetings for cal/val of Level 1B products in parallel:

- To stimulate discussions and gather (new) ideas
- To be able to categorise between “fast response” and “longer duration” activities and calibration vs. validation
- Complexity of approach: fits automated approach or not
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- To get feedback for the Agency to support decision making on how to proceed
- Summary in plenary session afterwards