



The passive microwave imaging missions MWI and CIMR and their synergies with SCA

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EPS-SG Microwave Imager (MWI)

MWI mission in a nutshell

Synergies with SCA

Copernicus Imaging Microwave Radiometer (CIMR)

CIMR mission in a nutshell

Synergies with SCA

Conclusions

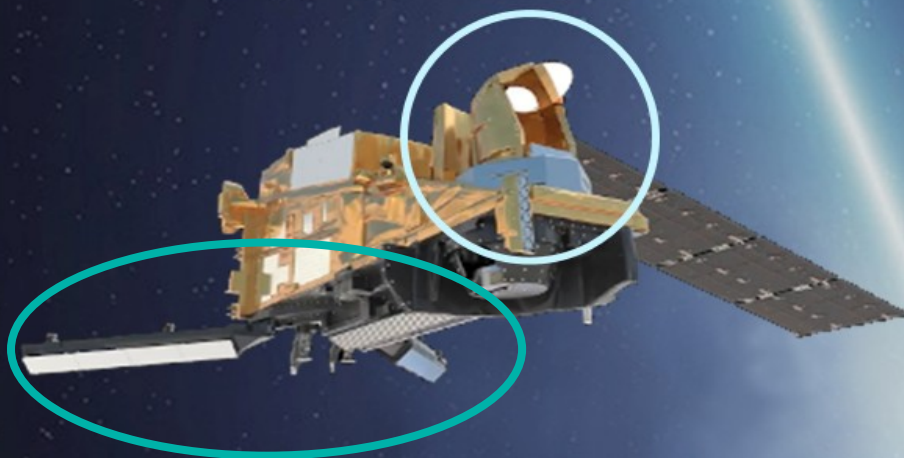


EPS-SG: EUMETSAT Polar System - Second Generation

Metop-SG B

Metop-SG A

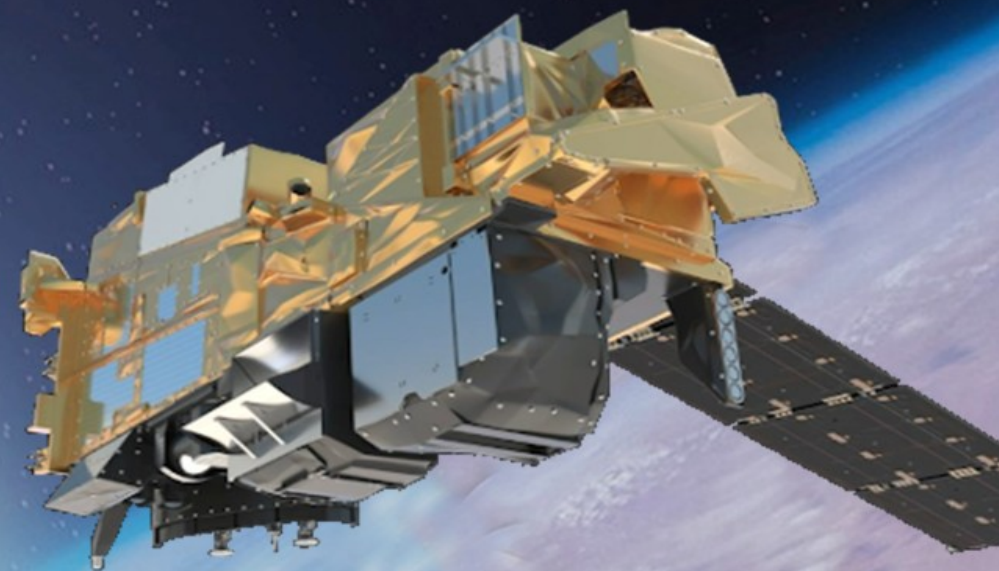
Microwave Imager (MWI)



Scatterometer
(SCA)

Nominal launches:

Metop-SG B1	Jun.- Aug. 2026
Metop-SG B2	2033
Metop-SG B3	2040



Orbit (Metop-like):

- Sun synchronous
- low earth orbit at 835 km mean altitude
- 09:30 local time of the descending node
- Metop-SG-A and -B on the same orbit, separated by

Nominal lifetime: 8.5 years/spacecraft, >21 years for the Program

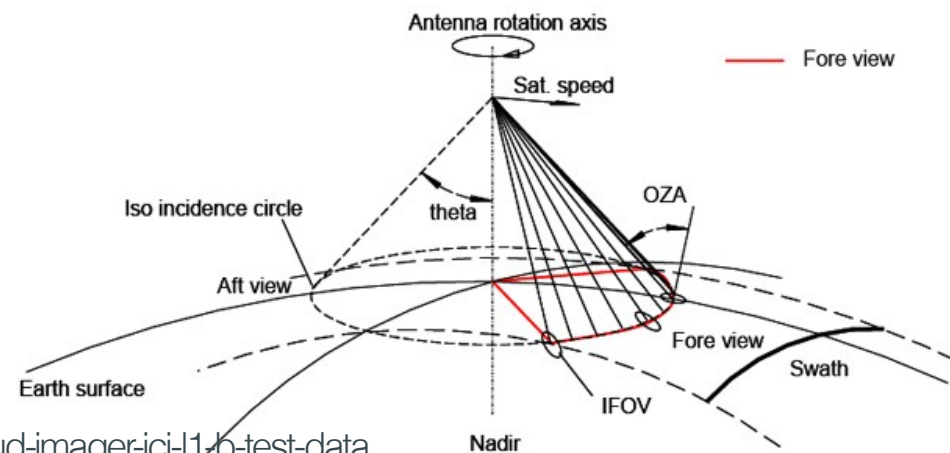


MicroWave Imager (MWI)

- Main applications:
 - Provision of cloud/precipitation products in support of regional/global NWP, Nowcasting and very short-range forecasting;
 - Continuity of measurements of key microwave imager channels as observed by SSM/I, TMI, SSMIS, AMSR-E, GMI in support of long-term climate records;
 - Observations of sea ice parameters and snow cover, snow water equivalent, sea surface wind (in synergy with SCA on the same platform).

- MWI Products (Test Data available on the EUM website*):

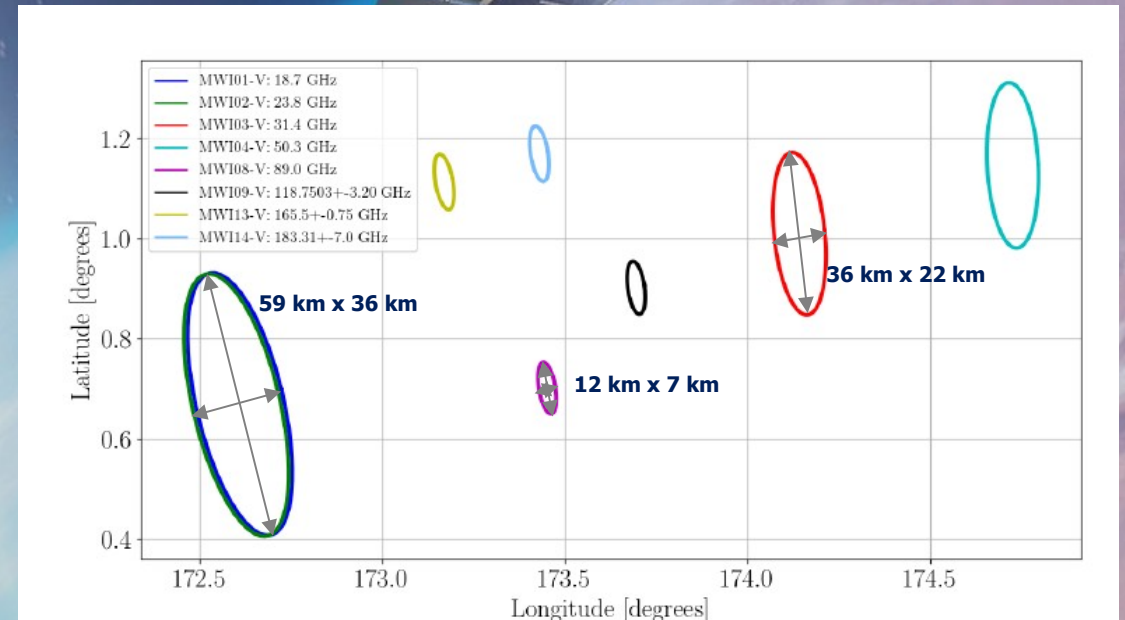
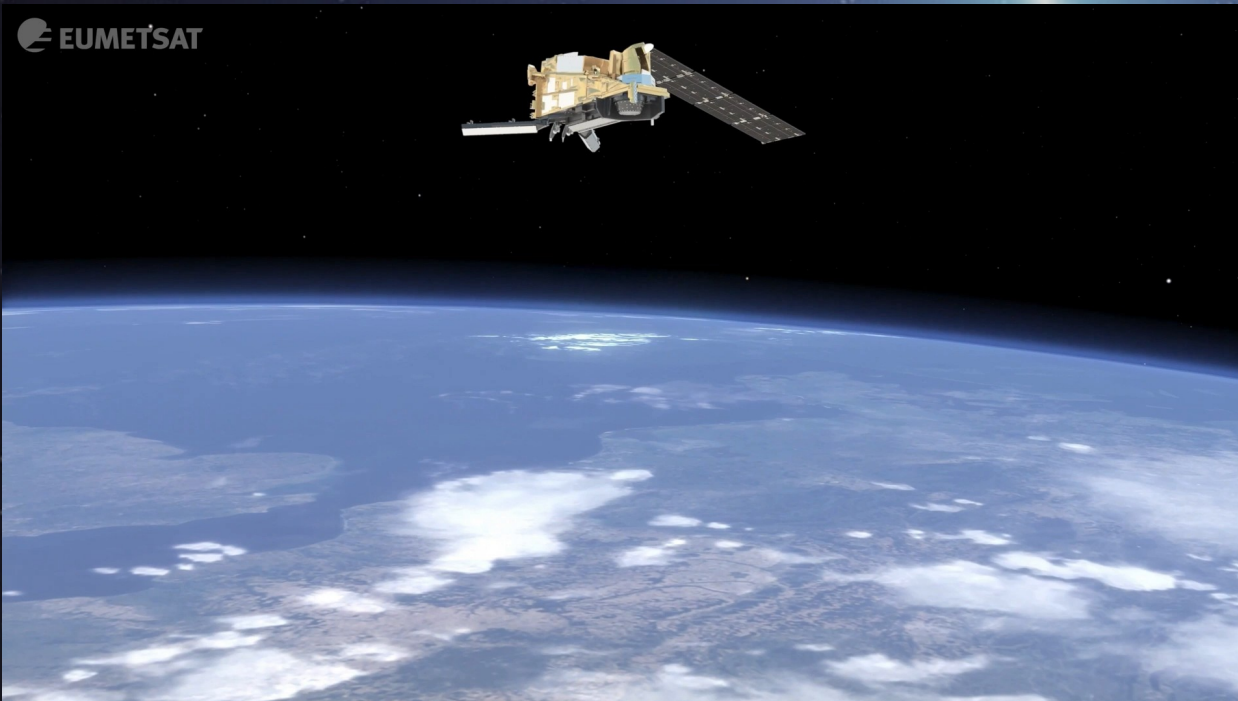
- L1B: calibrated radiances;
- L2: Liquid water path (together with IWP from ICI);
- Several L2 and L3 products are developed by the EUMETSAT SAFs.



MWI scanning characteristics

- **Conically scanning at 45 rpm (~ 1.3333 seconds)**
- **Incidence angles within $53^\circ \pm 2^\circ$**
- **Observations acquired $\pm 65^\circ$ in azimuth in the fore view (about 1700 km swath)**
- **MWI footprints: MWI-1/2 (18.7 / 23.8 GHz) 50 km; MWI-3/7 (31.4 / 50-54 GHz) 30 km; MWI-8/18 (89/118/165.5/183 GHz) 10km**
- **Across-track, oversampling factor is ~ 22 (MWI-1/2), ~ 10 (MWI-3/7), and 3-4 (MWI-8/18)**
- **Along-track, footprint overlap is at least 20%**

MWI: scanning clockwise from zenith



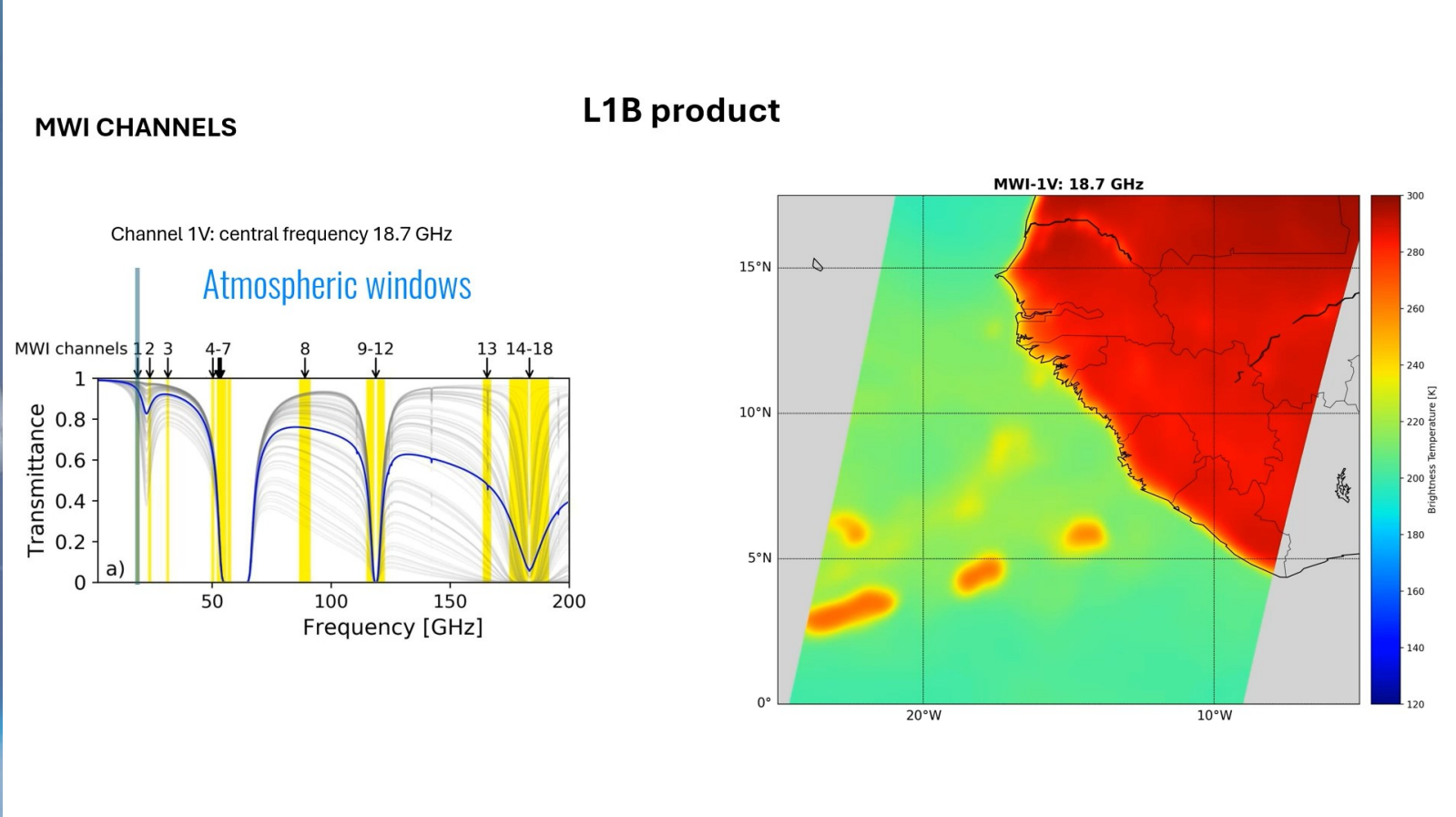
Main channels of EPS-SG MWI in spectrum

MWI Imaging channels in the “windows” (18.7, 31.4, 89.0, 165.5 GHz) and low water vapour absorption (23.8 GHz)

MWI Temperature sounding in the O₂ 50/60 complex - 118 GHz line

Humidity sounding in the 183 GHz line (some of bands in common with ICI)

Channel	Frequency (GHz)	Pol.
MWI-1	18.7	V, H
MWI-2	23.8	V, H
MWI-3	31.4	V, H
MWI-4	50.3	V, H
MWI-5	52.7	V, H
MWI-6	53.24	V, H
MWI-7	53.75	V, H
MWI-8	89.0	V, H
MWI-9	118.7503±3.2	V
MWI-10	118.7503±2.1	V
MWI-11	118.7503±1.4	V
MWI-12	118.7503±1.2	V





Synergies between MWI and SCA

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Metop-SG B

Microwave Imager (MWI)



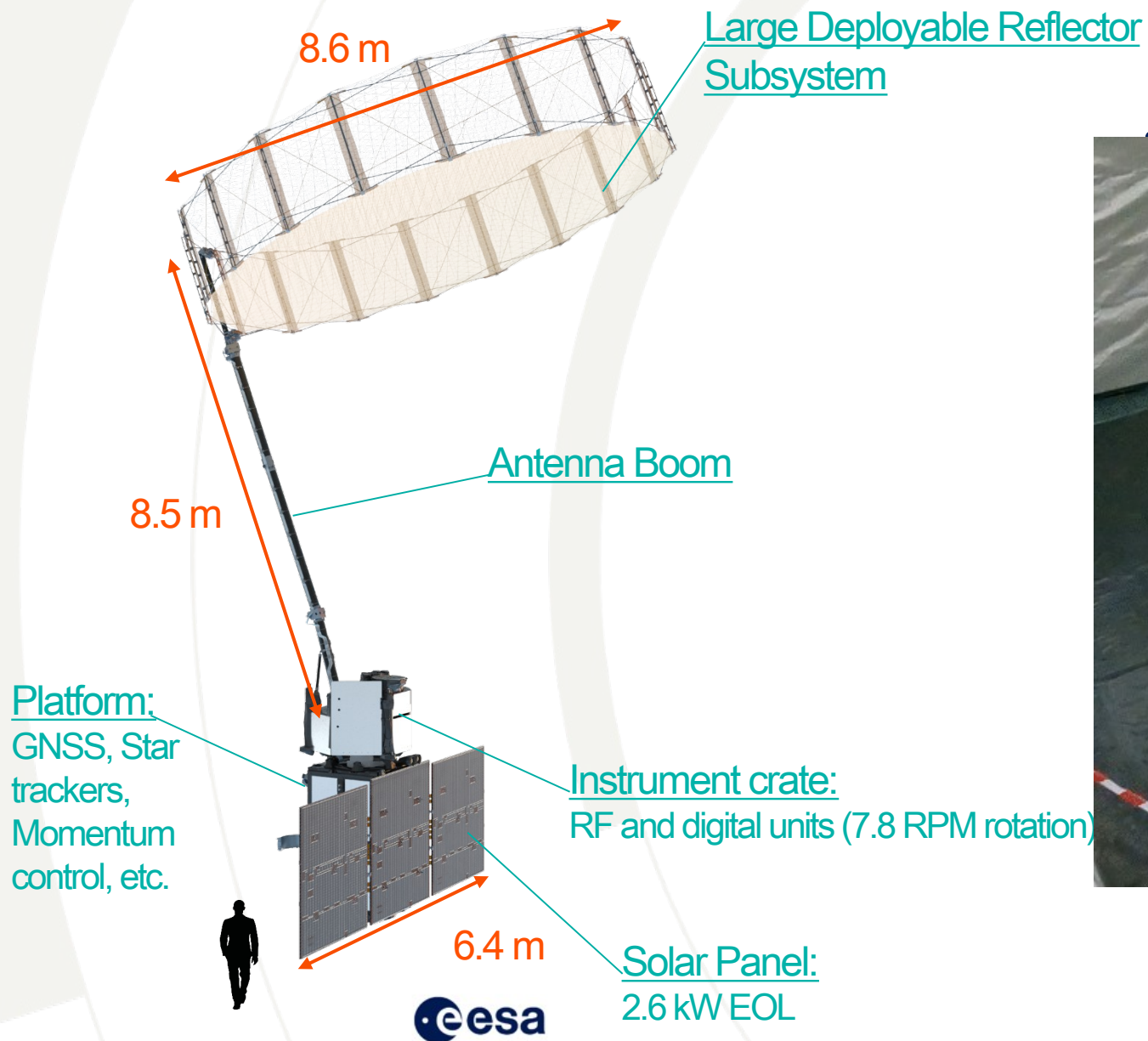
Scatterometer
(SCA)

- Deploying MWI and SCA on the same Metop-SGB platform offers a unique opportunity to leverage the synergy between their capabilities;
- MWI-SCA synergy is not limited to the retrieval of surface ocean wind vectors (OWV) but involves also soil moisture, a large set of sea-ice information (including sea-ice concentration, thickness, type, age and displacement) and storm monitoring.
- This synergies will bring:
 - Improved Retrieval Accuracy: e.g. MWI can be used to correct atmospheric effects in the SCA data;
 - Enhanced Data Consistency operating both instruments on the same platform;
 - Complementary Observational Strengths;
 - All-Weather Capability;
 - Support for Climate Applications;
 - Severe weather monitoring: more comprehensive understanding of storm systems in terms of structure, moisture, precipitation, surface conditions.



CIMR System overview

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PRIMARY OBJECTIVES



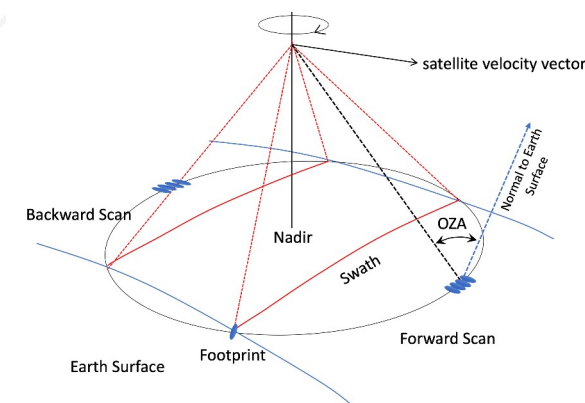
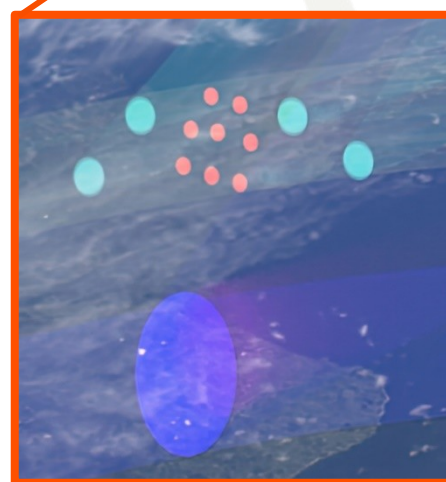
and on land (soil moisture, surface temperature, etc.).



CIMR: The Copernicus Imaging Microwave Radiometer

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Frequency band	L	C	X	K	Ka
Relevant ECVs	Salinity	Sea surface winds & temp.		Water vapour, cloud & rain	
Allocated band [GHz]	1.4 – 1.427	6.425– 7.250	10.6– 10.7	18.6– 18.8	36–37
Centre frequency [GHz]	1.4135	6.925	10.65	18.7	36.5
Footprint size [km]	<60	≤15	≤15	≤5.5	<5 (goal=4)
L1b Radiometric resolution [K] NEAT	≤0.3	≤0.2	≤0.3	≤0.4 (goal: ≤0.3)	≤0.7
Polarisation	Full Stokes				
Swath width	>1900 km				
Observation Zenith Angle [deg]	52.0 ±1.0	55.0 ±2.0			





- Retrieval algorithm currently developed in external study:
 - Multi-parameter, multi-frequency, multi-scale algorithm, using a physically-based optimal estimation (OE) method;
 - Realistic test-data (5 scenes).
- Retrieval of wind direction possible due:
 - Full polarization measurements (all Stokes parameters);
 - Combined forward and aft views.
- In addition, rainy wind retrievals possible thanks to L-band channel.

CIMR L2 Global Ocean and Atmosphere products

L2 Variable ID	Description	Spatial resolution	Total standard uncertainty
SST-O	Sea Surface Temperature	≤ 15 km	≤ 0.2 K
SSS-O	Sea Surface Salinity	< 60 km	≤ 0.3 pss
OWV-O	Ocean Surface Wind Vector	≤ 40 km (g=15km)	2 ms^{-1} and $\leq 20^\circ$ in direction at wind speeds 6 ms^{-1}
PCP-A	Precipitation rate	≤ 15 km (g=5 km)	$\leq 80\%$ at 1 mm h^{-1} or $\leq 50\%$ above 10 mmh^{-1} .
LWP-A	Liquid Water Path	≤ 15 km (g=5 km)	$\leq 50\%$
TCWV-A	Total Column Water Vapour	≤ 15 km (g=5 km)	$\leq 10\%$

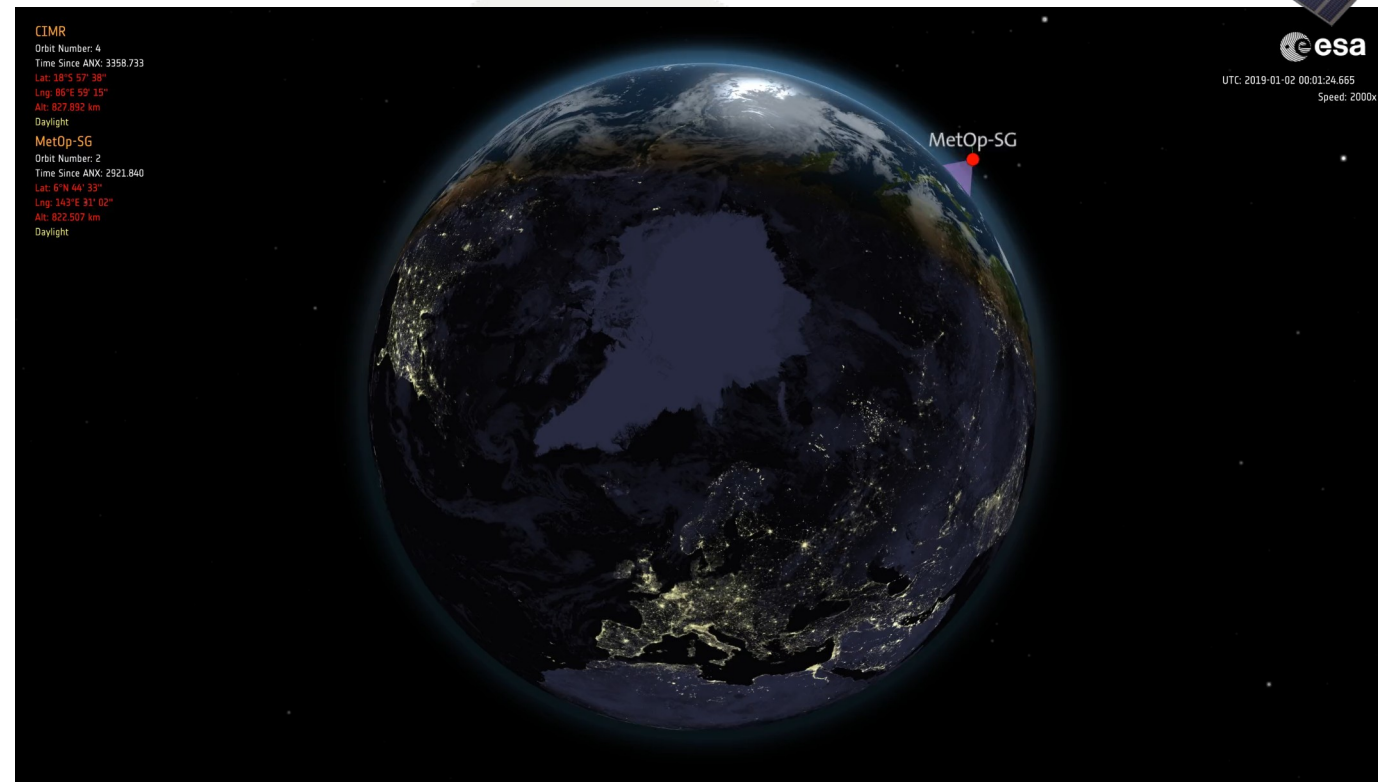
SCA L2 winds (End User Requirements) by EUM OSI SAF

Sensor	Description	Spatial resolution	Total standard uncertainty
SCA	Sea surface wind vector / Level 2	≤ 25 km	Std. Dev.: 2 m/s in wind components, Bias: 1 m/s in wind speed
SCA	Coastal sea surface wind vector / Level 2	≤ 12.5 km	Std. Dev.: 2 m/s in wind components, Bias: 1 m/s in wind speed

- Inter-satellite wind comparison and model improvement possible thanks to synced orbits at poles
- Potentially improved CIMR L2 retrieval accuracy
 - Utilize SCA winds as first-guess data (primarily at high latitudes)
- Enhanced multi-satellite wind products



Collocation ± 10 min at poles



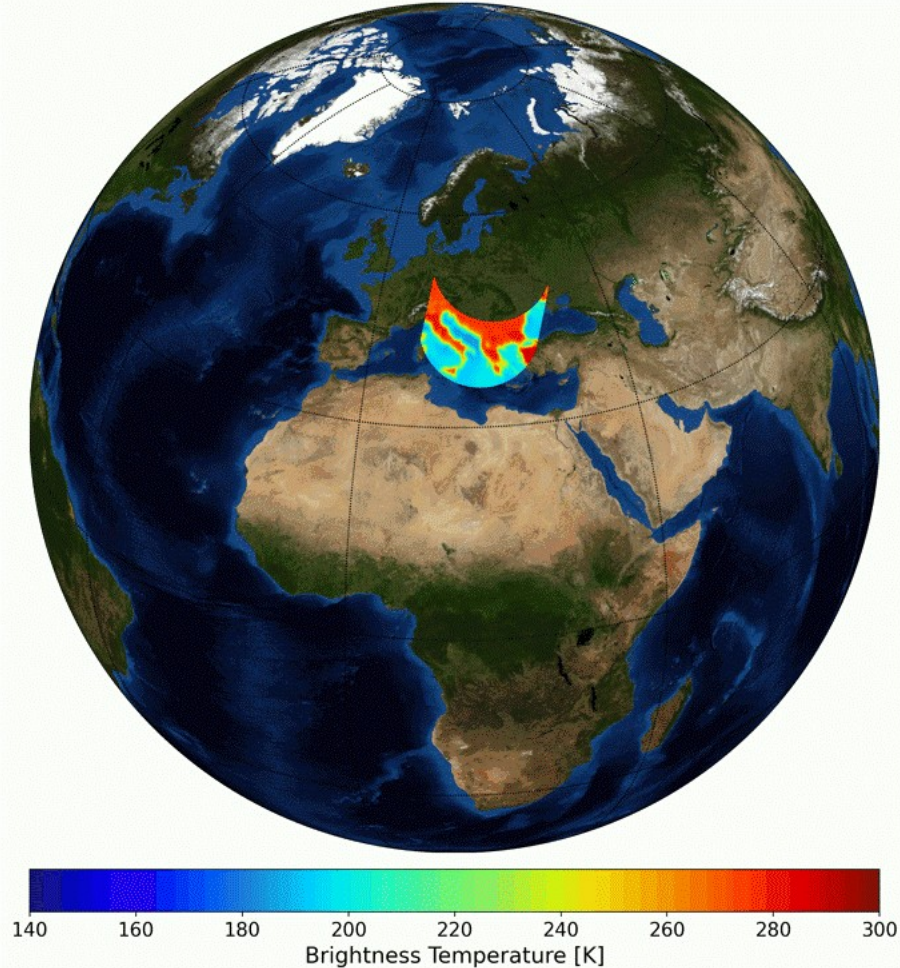
- MWI and CIMR next-generation polar-orbiting passive microwave radiometers provide enhanced spectral and sampling characteristics with respect to their heritage instruments.
- The synergetic use of SCA and MWI/CIMR offers a highly complementary observational strategy by combining the high-resolution wind vector retrieval and surface roughness sensitivity of SCA with the multi-frequency, multi-polarization thermodynamic measurements of MWI/CIMR.
- These synergies bring benefit in several applications, including OVV, sea-ice and storm monitoring;
- Deploying MWI and SCA on the same Metop-SGB platform offers a unique opportunity to leverage this synergy between their capabilities;
- The validation activity of the CIMR mission will significantly exploit the OVV cross-verification against SCA Products.



Thank you!
Questions are welcome.

MWI Test Data: Level 1B and Level 2

MWI L1B - 1V Brightness Temperature (TB) [K]
1392 samples per scan



MWI L2 - Liquid Water Path (LWP) [kg/m²]
156 samples per scan

