

Overview of the EUMETSAT Polar System – Second Generation (EPS-SG) passive microwave missions

V. Mattioli¹, C. Accadia¹, R. Munro¹, J. Ackermann¹, F. De Angelis¹, S. Di Michele¹, I. Krizek¹, T. Hewison¹, M. Labriola¹, G. Bruni¹, L. Salghetti Drioli², D. Schobert², A. Graziani², C. Mas¹, R. Ekelund¹, V. Barlakas³, J. Lu³

¹EUMETSAT, Eumetsat-Allee 1, 64295 Darmstadt, Germany

²ESA-ESTEC, Keplerlaan 1, 2201 AZ Noordwijk, The Netherlands

³CS Group, Robert-Bosch-Straße 7, 64293 Darmstadt

25th INTERNATIONAL TOVS STUDY CONFERENCE /8 -14 May 2025/Goa, India



EPS-SG: EUMETSAT Polar System – Second Generation

The EUMETSAT Polar System - Second Generation (EPS-SG) in Low Earth Orbit (LEO): European contribution to the Joint Polar System – ensure continuity of essential operational meteorological observations from polar orbit

Two-satellite configuration Metop-SG-A and –B on the same orbit, separated by 90°

Metop-like orbit:

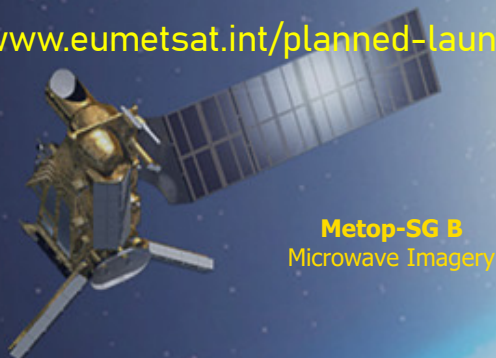
- Sun synchronous
- low earth orbit at 835 km mean altitude
- 09:30 local time of the descending node

Nominal lifetime of 7.5 years/spacecraft

Nominal launches:

Metop-SG A1 Aug. 2025	Metop-SG B1 Jun. – Aug. 2026
Metop-SG A2 2033	Metop-SG B2 2034
Metop-SG A3 2041	Metop-SG B3 2042

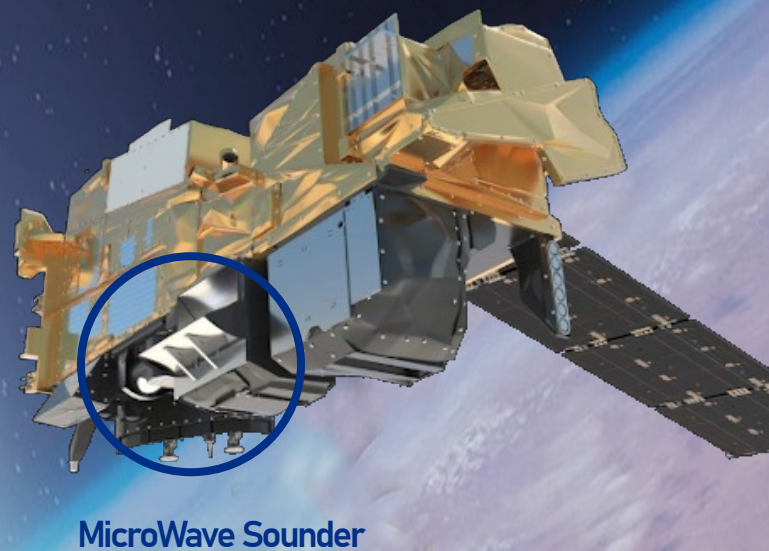
<https://www.eumetsat.int/planned-launches>



Metop-SG B



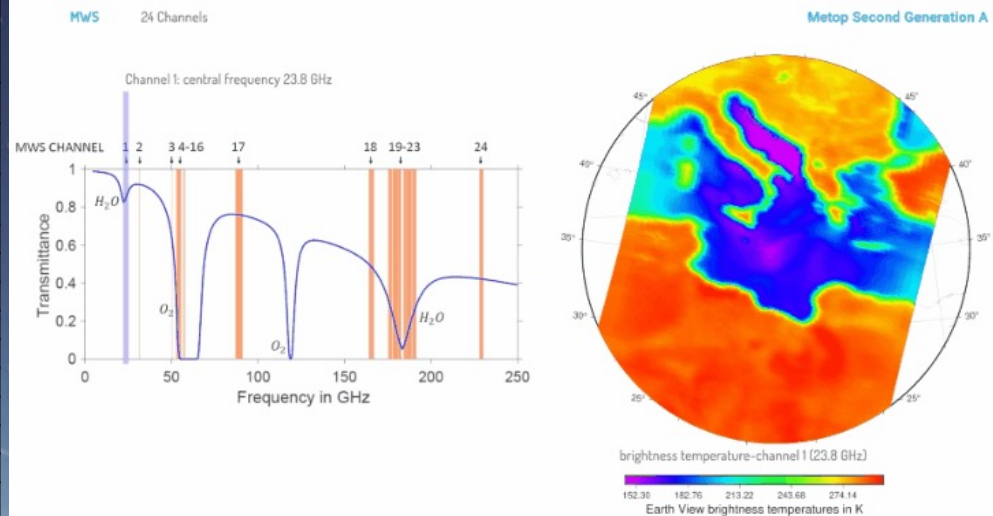
Metop-SG A



MicroWave Sounder		MicroWave Imager	Ice Cloud Imager
Main applications	Spectral radiance measurements on • Temperature • Water vapour profiles • Cloud liquid	Cloud and precipitation products	First operational radiometer for ice cloud monitoring • Non-precipitating ice – not covered either in the optical and thermal IR or in the mm-wave range
For Numerical Weather Prediction	Nowcasting and very short-range forecasting	• Nowcasting and very short-range forecasting at regional scales • Support NWP at regional and global scales	
For climate monitoring	Temperature and humidity sounding records	Continuity of key microwave channels as observed by SSM/I, TMI, SSMIS, AMSR-E, GMI	Ice cloud products
Supporting applications		Observations of sea ice parameters and snow cover, snow water equivalent, sea surface wind	• Validation of ice cloud models • Parameterisation of ice clouds in weather and climate models

MWS: Channel Performance Requirements

Channel	Frequency (GHz)	Bandwidth per passband (MHz)	NEAT Threshold (K)	Footprint (IFOV) Size at 3dB (km)	Centre frequency stability (MHz)
MWS-1	23.8	270	0.25	40	±5.0
MWS -2	31.4	180	0.35	40	±10.0
MWS -3	50.3	180	0.5	20	±5.0
MWS -4	52.8	400	0.35	20	±3.0
MWS-5	53.246 ± 0.08	2x140	0.4	20	±5.0
MWS -6	53.596±0.115	2x170	0.4	20	±2.0
MWS-7	53.948 ± 0.081	2x142	0.4	20	±1.0
MWS -8	54.40	400	0.35	20	±2.0
MWS -9	54.94	400	0.35	20	±2.0
MWS -10	55.50	330	0.4	20	±2.0
MWS -11	57.290344	330	0.4	20	±0.5
MWS-12	57.290344±0.217	2x78	0.55	20	±0.5
MWS-13	57.290344 ±0.3222±0.048	4x36	0.6	20	±1.2
MWS-14	57.290344±0.3222±0.022	4x16	0.9	20	±1.2
MWS-15	57.290344±0.3222±0.010	4x8	1.2	20	±0.5
MWS-16	57.290344±0.3222±0.004 5	4x3	2.0	20	±0.2
MWS-17	89.0	4000	0.25	17	±130
MWS-18	165.5±0.725	2x1350	0.5	17	±40
MWS-19	183.311±7.0	2x2000	0.4	17	±30
MWS-20	183.311±4.5	2x2000	0.4	17	±10
MWS-21	183.311±3.0	2x1000	0.6	17	± 30.0
MWS-22	183.311±1.8	2x1000	0.6	17	±10
MWS-23	183.311±1.0	2x500	0.75	17	±30.0
MWS-24	229 +/- 1 GHz	2x1000	0.70	17	±100.0



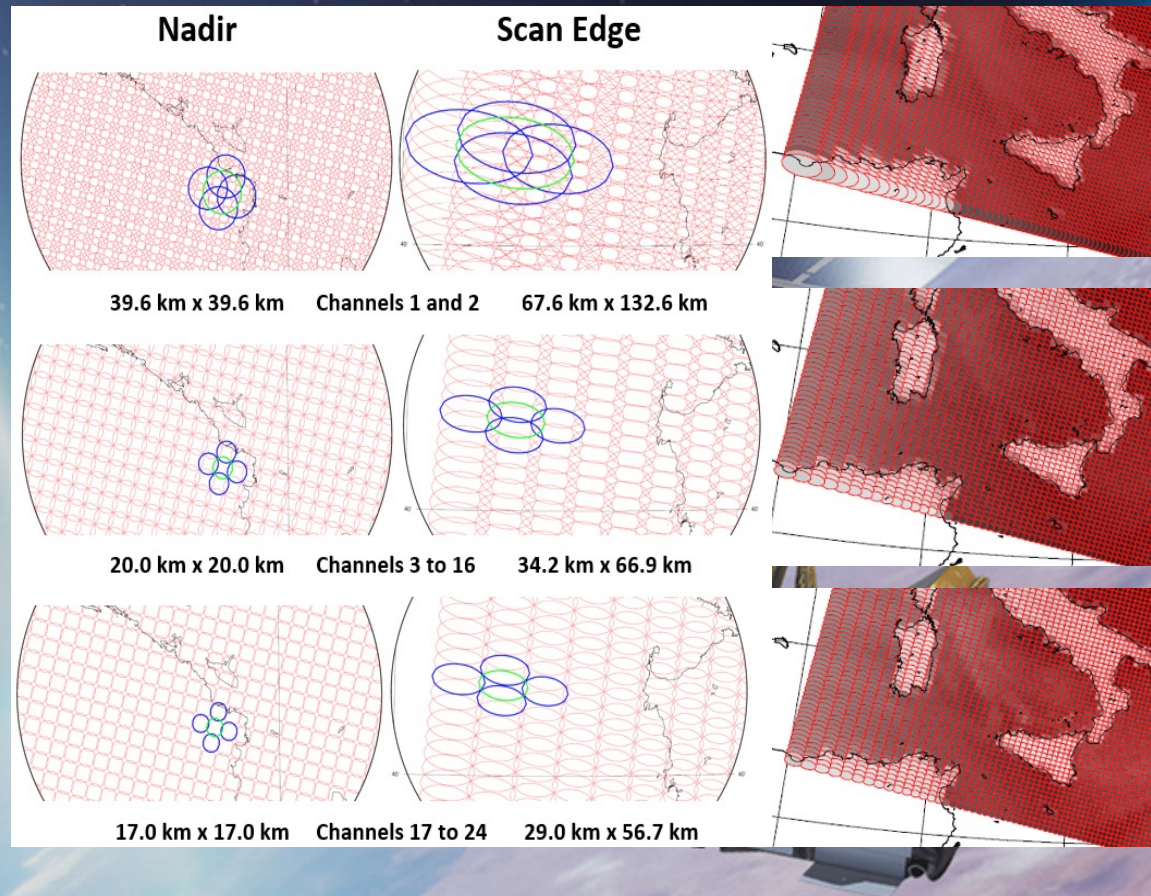
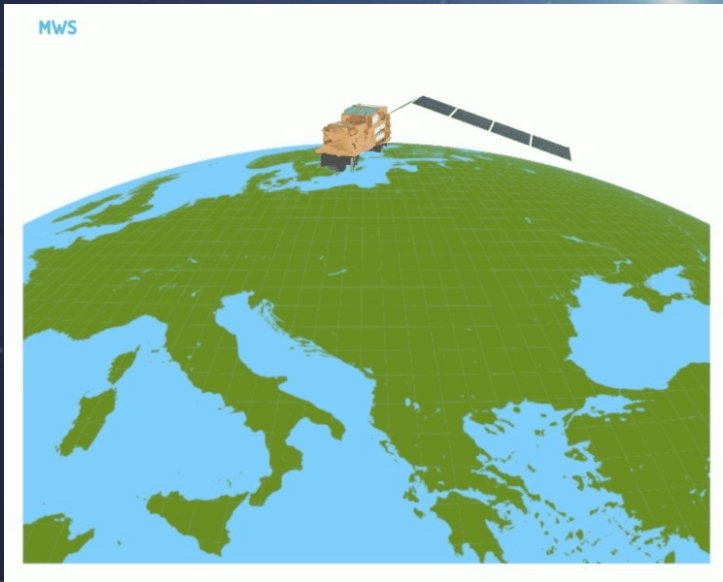
Several types of requirements:

- Acquisition requirements
- Spectral requirements
- Level 1 radiometric requirements
- Level 1 geometric requirements

In addition, timeliness requirements shall be met

MWS Scanning Characteristics

- Cross-track scanner
- 95 pixels per scan line for each channel
- 2.25 seconds scan duration
- 49.85° maximum scanning angle
- ~2250 km swath width



Main channels of EPS-SG MWI and ICI 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

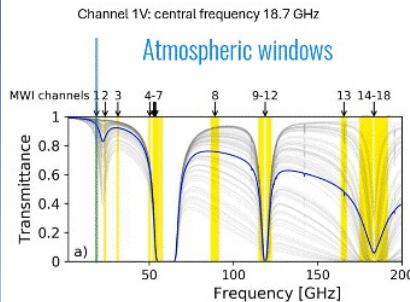
Humidity sounding in the 183 GHz line (some of bands in common)

..and beyond: ICI channels in “quasi-windows” (243, 664 GHz) and WV bands (325, 448 GHz)

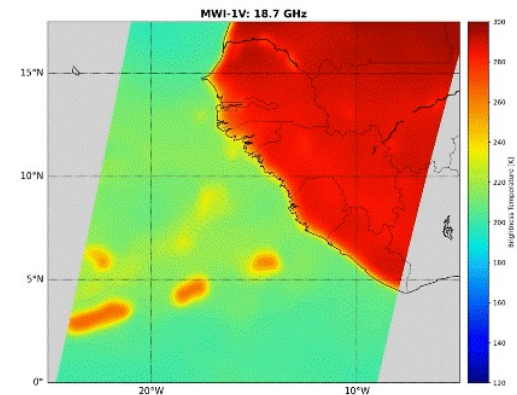
Channel	Frequency (GHz)	Pol.
MWI-1	18.7	V, H
MWI-2	23.8	V, H
MWI-3	31.4	V, H
MWI-4	50.3	V, H
MWI-5	52.7	V, H
MWI-6	53.24	V, H
MWI-7	53.75	V, H
MWI-8	89.0	V, H
MWI-9	118.7503±3.2	V
MWI-10	118.7503±2.1	V
MWI-11	118.7503±1.4	V
MWI-12	118.7503±1.2	V
MWI-13	165.5±0.75	V
MWI-14	183.31±7.0	V
MWI-15	183.31±6.1	V
MWI-16	183.31±4.9	V
MWI-17	183.31±3.4	V
MWI-18	183.31±2.0	V

Channel	Frequency (GHz)	Pol.
ICI-1	183.31±7.0	V
ICI-2	183.31±3.4	V
ICI-3	183.31±2.0	V
ICI-4	243.2±2.5	V, H
ICI-5	325.15±9.5	V
ICI-6	325.15±3.5	V
ICI-7	325.15±1.5	V
ICI-8	448±7.2	V
ICI-9	448±3.0	V
ICI-10	448±1.4	V
ICI-11	664±4.2	V, H

MWI CHANNELS



L1B product



MWI and ICI 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: scanning clockwise from zenith

ICI: scanning counterclockwise from zenith

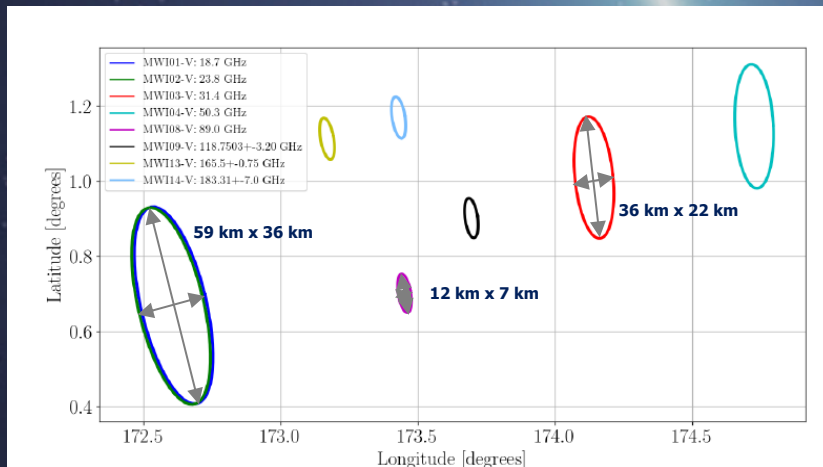


MWI and ICI Footprint sizes

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

1392 samples per scan line for all the channels

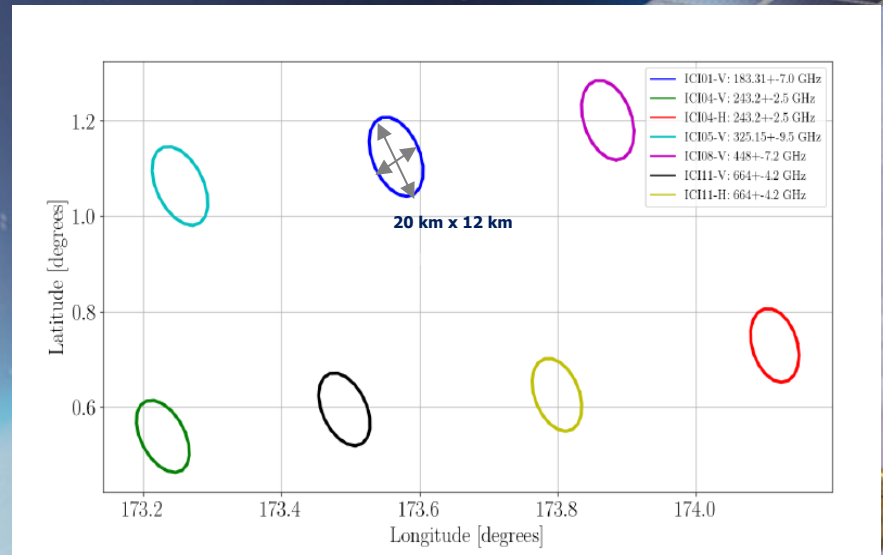
Across-track, oversampling factor is ~22 (MWI-1/2), ~10 (MWI-3/7), and 3-4 (MWI-8/18). Along-track, footprint overlap is at least 20%



ICI footprints: avg. 16 km (ICI-1 to ICI-11): ~20 km along-track and ~12 km across-track for the footprints (at -3 dB)

810 samples per scan line for all the channels

Across-track, oversampling factor is about 3-4. Along-track, footprint overlap is at least 40%



MWS, MWI and ICI Test Data

- MWS L1B, MWI/ICI L1B test data V3 (final versions) and MWI-ICI Level 2 test data V2 have been published on the EUMETSAT website for format familiarization and system testing (also Product Format Specifications available). MWI and ICI Level 1B test data are available also in BUFR format

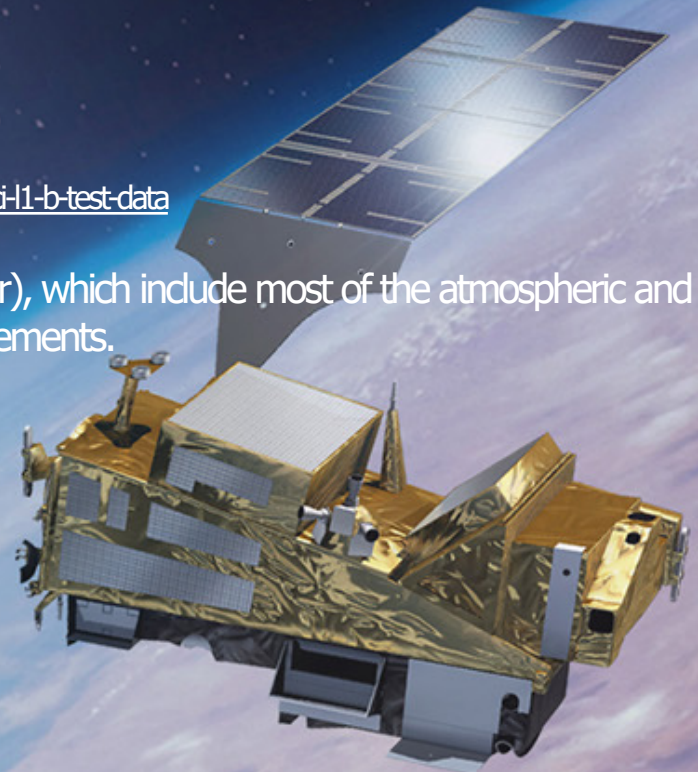
MWS L1B v3, MWI-ICI L2 v2:

<https://user.eumetsat.int/resources/user-guides/metop-sg-test-data>

MWI/ICI L1B v3:

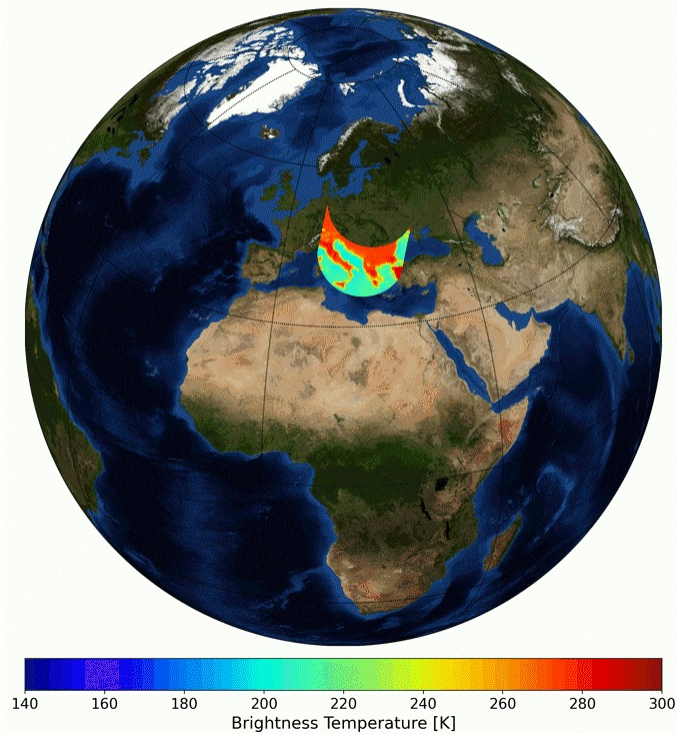
<https://user.eumetsat.int/news-events/news/eps-sg-microwave-imager-mwi-and-ice-cloud-imager-ici-l1-b-test-data>

- Based on three EPS orbits (two consecutive in late summer, one in winter), which include most of the atmospheric and surface conditions relevant to the microwave and sub-millimetre measurements.
- End-to-End L0-to-L2 consistency.
- MWI-ICI Level 2 test data V3 are currently under preparation.

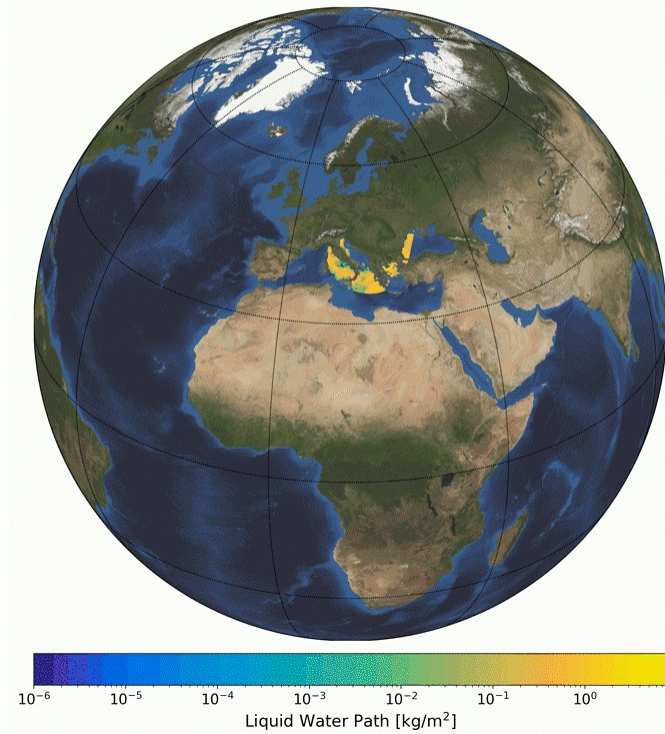


MWI Test Data: Level 1B and Level 2

MWI L1B - 3V Brightness Temperature (TB) [K]
31.4 GHz
1392 samples per scan

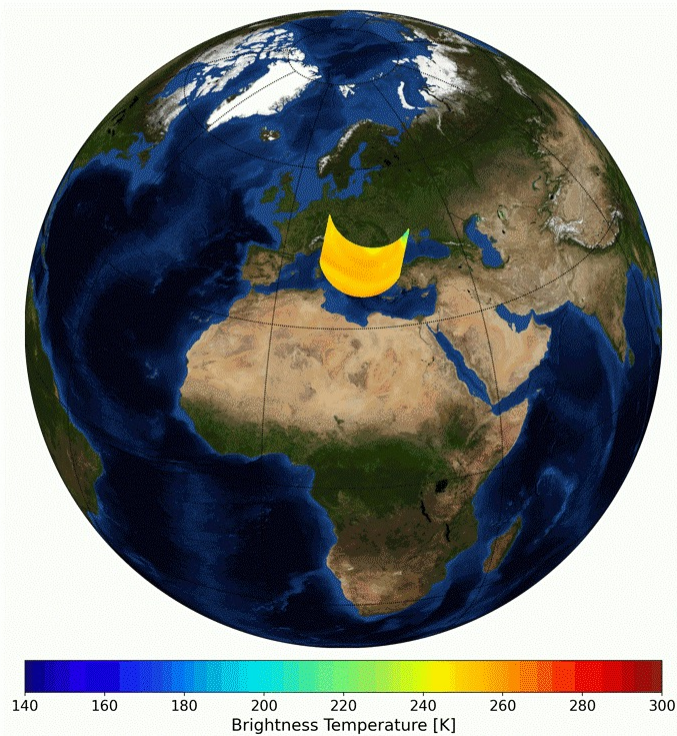


MWI L2 - Liquid Water Path (LWP) [kg/m²]
156 samples per scan

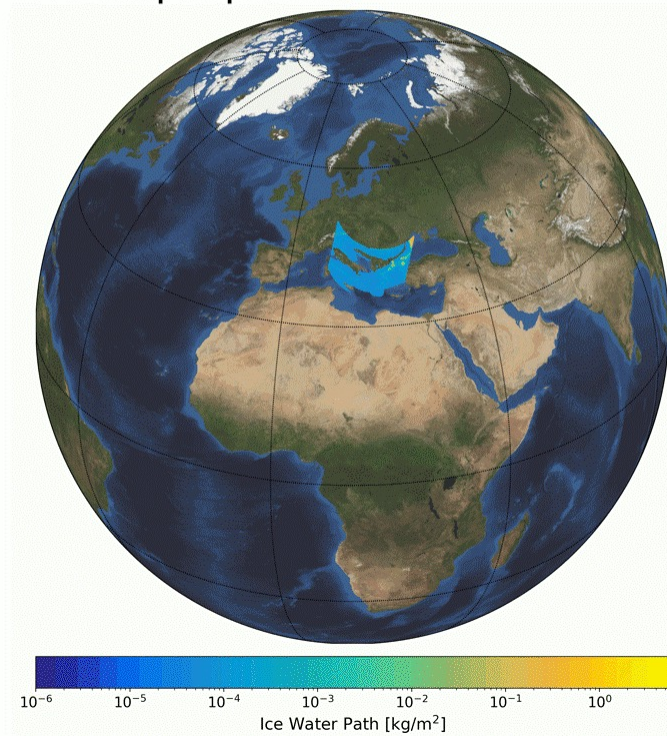


ICI Level 2 Test Data

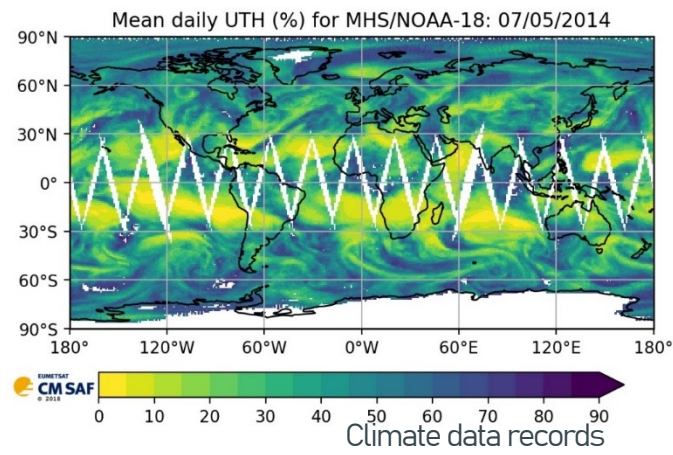
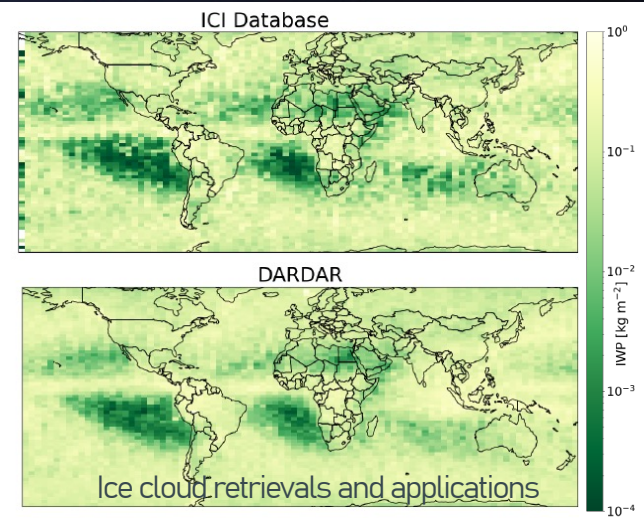
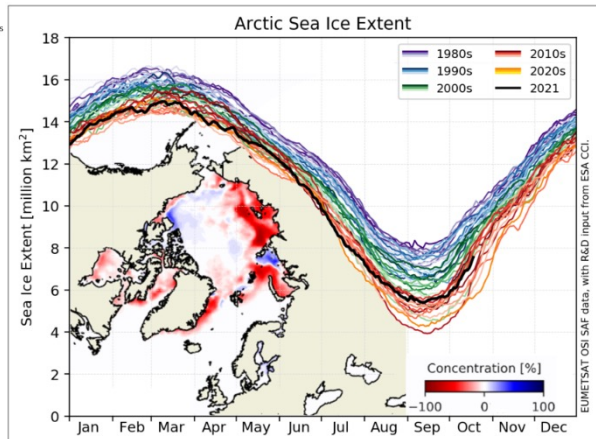
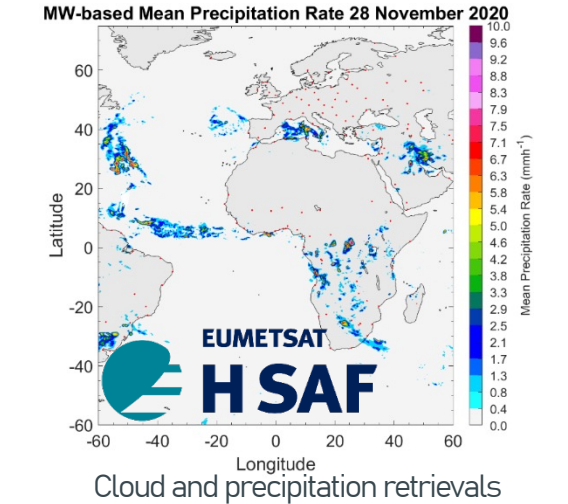
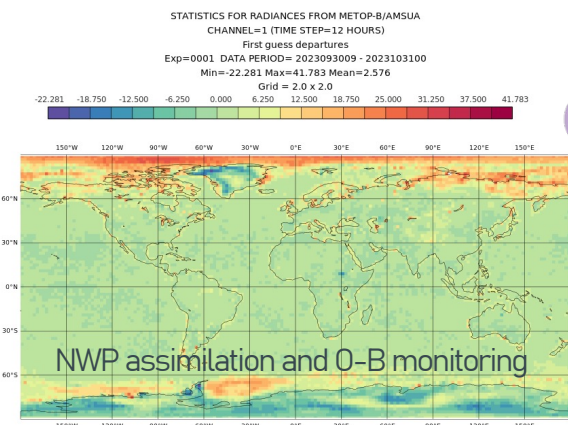
ICI L1B – 11V Brightness Temperature (TB) [K]
664 GHz
810 samples per scan



ICI L2 – Ice Water Path (LWP) [kg/m²]
Mean particle diameter [m]
Mean ice mass height [m]
226 samples per scan



Satellite Application Facilities – Contributions



EUMETSAT Data Access

<https://user.eumetsat.int/data-access>

 **EUMETSAT**
USER PORTAL

Dashboard

Data catalogue

Using data

Data access

News & events

Search user portal



Data Store



Data centre



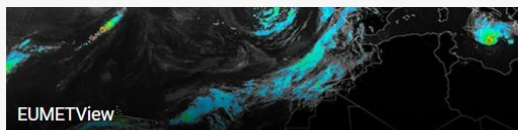
EUMETCast Africa



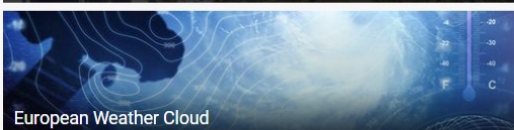
EUMETCast Europe



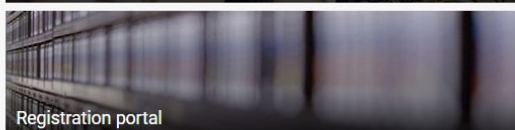
EUMETCast Terrestrial



EUMETView



European Weather Cloud



Registration portal



WEkEO

We offer a portfolio of data access options that allows users to view imagery and download data. Users can access our data in either near real-time (NRT) or historical mode.

Access data via:

- EUMETCast — multicast service transports a stream of near real-time data to user reception stations.
- Data store — download near real-time and historical data.
- EUMETView — View, animate and interact with satellite imagery on our Web Map Service.
- Data centre — long-term archive of all EUMETSAT data, which can be ordered online.

*If you need further help accessing data, click on the **Getting started using data** guide on the right.*



V2, 8 Feb 2024

User guide

Getting started using data

How to find, view, download and use our satellite data.

EPS-SG microwave missions

Will :

- Support Numerical Weather Prediction at regional and global scales
- Support the retrieval of cloud and precipitation products
- Support Nowcasting and very short-range forecasting at regional scales
- Support observations of sea ice parameters and snow cover, snow water equivalent, sea surface wind
- Continuity of measurements of key microwave channels in support of long-term climate records
- MWS, MWI and ICI L1B and L2 Test data available at [EUMETSAT Web page](#)
- TODAY - poster Session 3 - New microwave capabilities: *EUMETSAT microwave sounder constellation: the EPS-Sterna Programme*
- Monday 12th - poster Session 11 - Calibration of sensors: *EUMETSAT Polar System - Second Generation: pre-launch characterization of the microwave sounder (MWS) onboard Metop-SGA1*



Thank you!
Questions are welcome.