Monitoring Weather and Climate from Space

July 2017
EUMETSAT mission planning

- **Mandatory Programmes**
  - **EUMETSAT POLAR SYSTEM SECOND GENERATION (EPS-SG)**
  - **METOP-SG A: SOUNDING AND IMAGERY**
  - **METOP-SG B: MICROWAVE IMAGERY**

- **Optional Programmes**
  - **JASON (HIGH PRECISION OCEAN ALTIMETRY)**
    - **JASON-2**
    - **JASON-3**

- **Third Party Programmes**
  - **COPERNICUS**
  - **SENTINEL-4 ON MTG-S**
  - **SENTINEL-5 ON METOP-SG A**
  - **SENTINEL-6 (JASON-CS)**
  - **SENTINEL-3 A/B/C/D**
Current EUMETSAT satellites

**METOP-A & -B (98.7° incl.)**
- LOW EARTH, SUN-SYNCHRONOUS ORBIT
- EUMETSAT POLAR SYSTEM (EPS) / INITIAL JOINT POLAR SYSTEM

**SENTINEL-3 (98.65° incl.)**
- LOW EARTH, SUN-SYNCHRONOUS ORBIT
- COPERNICUS SATELLITES DELIVERING MARINE AND LAND OBSERVATIONS

**METEOSAT-8 (41.5° E)**
- GEOSTATIONARY ORBIT
- METEOSAT 2ND GENERATION PROVIDING IODC FROM FEBRUARY 2017 – MID-2020

**METEOSAT-9, -10, -11**
- GEOSTATIONARY ORBIT
- METEOSAT 2ND GENERATION
- TWO-SATELLITE SYSTEM
- FULL DISC IMAGERY MISSION (15 MINS) (METEOSAT-10 (0°))
- RAPID SCAN SERVICE OVER EUROPE (5 MINS) (METEOSAT-9 (9.5° E))
- METEOSAT-11 STORED IN ORBIT (UNTIL MID-2018)

**JASON-2 & -3 (63° incl.)**
- LOW EARTH, NON-SYNCHRONOUS ORBIT
- OCEAN SURFACE TOPOGRAPHY MISSION, SHARED WITH CNES/NOAA/EU
Current EUMETSAT satellites
Deploying the MSG and Metop satellites

- MSG-1 (Meteosat-8) launch 28 August 2002
- MSG-2 (Meteosat-9) launch 21 December 2005
- MSG-3 (Meteosat-10) launch 5 July 2012
- MSG-4 (Meteosat-11) launch 15 July 2015

**METEOSAT SECOND GENERATION**

- Metop-A launch 19 October 2006
- Metop-B launch 17 September 2012

**EUMETSAT POLAR SYSTEM (EPS)**

- Metop-A
- Metop-B
- Metop-C
Meteosat Second Generation: a two-satellite operational system
MSG for nowcasting of severe weather: thunderstorms
MSG for transport: aviation

Eyjafjallajökull ash cloud from 7 to 11 May 2010 (second eruption)
MSG for confirmation of forecasts
EUMETSAT Polar System: part of the Initial Joint Polar System shared with the US
Impact of EUMETSAT satellites on NWP
Five-day forecast of cyclone Sandy landfall on the US coast by the ECMWF global model, with (left) and without (right) ingestion of observations from polar orbiting satellites, compared to the operational analysis (best approximation of ground truth, centre)
Altimetry missions – past, present, future

- **GFO** 1998-2008
- **ERS-2** 1995-2011
- **TOPEX-POSEIDON** 1992-2006
- **ERS-1** 1991-2000
- **GEOSAT** 1985-1990
- **ENVISAT** 2002-2012
- **JASON-1** 2001-2013
- **JASON-2** 2008
- **CRYOSAT** 2010
- **HY-2A-G**
  - 2A 2011
  - 2B 2018
  - 2C 2018
  - 2D 2019
  - 2E 2021
  - 2F 2020
  - 2G 2022
- **SARAL** 2013
- **JASON-3** 2016
- **SENTINEL-3A-D**
  - 3A 2016
  - 3B 2017
  - 3C Before 2020
  - 3D 20??
- **CFOSAT** 2018
- **JASON-CS/SENTINEL-6**
  - A 2020
  - B 2026
- **SWOT** 2020
Jason contributing to mean sea level observations

Overall trend: 3.18 mm/yr
Global altimeter data
Corrected for GIA
Annual signal removed
Jason-3 contributing to El Nino observations
EUMETSAT ground systems across Europe

- EPS GROUND STATION
  - SVALBARD
- MTG TT&C GROUND STATION
  - FUCINO
- MSG BACKUP AND RANGING GROUND STATION
  - MASPALOMAS, GRAN CANARIA
- MTG GROUND STATIONS
  - LEUK, LARIO
- MTP PRIMARY GROUND STATION
  - EUMETCAST TURNAROUND STATION
    - MTG TT&C GROUND STATION
    - FUCINO
- EUMETCAST TURNAROUND STATION
  - MADRID
  - EUMETCAST AFRICAN TURNAROUND RECEPTION STATION AND EPS BACKUP CONTROL CENTRE
  - NEAR PARIS
- EUMETSAT HEADQUARTERS MISSION CONTROL CENTRE
  - DARMSTADT
- MTG TT&C GROUND STATION
  - CHEIA
- ASCAT TRANSPONDER 1
  - ANKARA PROVINCE
- ASCAT TRANSPONDER 2
  - ESKISEHIR PROVINCE
- ASCAT TRANSPONDER 3
  - YOZGAT PROVINCE
- MSG GROUND STATION AND EUMETCAST UPLINK
  - USINGEN
- EUMETCAST AFRICAN TURNAROUND UPLINK
  - NEAR PARIS
Delivering time-critical data to three continents

- 2262 users in Member States
- 5 users in Cooperating State
- 2779 users world-wide

23 May 2017
Online access to data

- EUMETView: visualisation service to view EUMETSAT (Meteosat & Metop) and Copernicus Sentinel-3 marine imagery in an interactive way using an online map viewer.
## Online access to data

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<thead>
<tr>
<th>Link</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>eoportal.eumetsat.int</td>
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<td>archive.eumetsat.int</td>
<td>order past data</td>
</tr>
<tr>
<td>eumetview.eumetsat.int</td>
<td>visualise and explore, create layers in GIS applications</td>
</tr>
</tbody>
</table>
EUMETSAT Data Centre

- Archive dating back to 1981
- 1.0 Petabytes stored
- 1.5 Petabytes retrieved annually
- Raw and reprocessed data, centrally and decentrally produced
- Networked with Satellite Application Facilities (SAFs)
- Access online via Product Navigator
MTG full operational configuration

MTG-I
Rapid Scan Service

MTG-S
Sounding Service

MTG-I
Full Scan Service
MTG-I imaging mission

- Imagery mission implemented by two MTG-I satellites
- Full disc imagery every 10 minutes in 16 bands
- Fast imagery of Europe every 2.5 minutes
- New Lightning Imager (LI)
- Start of operations in 2021
- Operational exploitation: 2021-2042
MTG-S sounding mission

- Hyperspectral infrared sounding mission
- 3D weather cube: temperature, water vapour, O3, every 30 minutes over Europe
- Air quality monitoring and atmospheric chemistry in synergy with Copernicus Sentinel-4 instrument
- Start of operations in 2023
- Operational exploitation: 2023-2042
4D weather cube with MTG-I and MTG-S

- Lightning
- Convection
- Winds
- Atmosphere
MTG – higher resolution imagery

Example of ash detection, SEVIRI Natural Colour RGB, 12:15 UTC, 26 November 2006 (left), MODIS True Colour RGB, 12:20 UTC, 26 November 2006
EPS-SG full operational configuration

Metop-SG A
Sounding & Imagery

Metop-SG B
Microwave Imagery
EPS-SG A sounding and imagery mission

1. IASI-NG
   Infrared Atmospheric Sounding
2. MWS
   Microwave Sounding
3. METImage
   Visible-Infrared Imaging
4. RO
   Radio Occultation
5. 3MI
   Multi-viewing, -channel, -polarisation Imaging
6. Copernicus Sentinel-5
   UN/VIS/NIR/SWIR Sounding
EPS-SG B microwave imagery mission

1. **SCA**
   Scatterometer

2. **RO**
   Radio Occultation

3. **MWI**
   Microwave Imaging for Precipitation

4. **ICI**
   Ice Cloud Imager

5. **ARGOS-4**
   Advanced Data Collection System
EPS-SG mission capabilities

- Major improvements to all EPS observation missions
  - Infrared and microwave sounding
  - Optical imagery (METImage, developed by DLR)
  - Scatterometer
  - Radio occultation

- New imagery missions:
  - 3MI: first operational imaging polarimeter
  - MWI: microwave imagery of precipitation
  - ICI: Ice Cloud imagery
Jason-CS

1. Poseidon-4
   Dual Frequency Altimeter
2. AMR-C
   Advanced Microwave Radiometer
3. DORIS
   Doppler Orbitography and Radiopositioning Integrated by Satellite
4. GNSS RO
   GNSS Radio Occultation
5. LRA
   Laser Retroreflector Array
6. GNSS POD
   GNSS Precise Orbit Determination
   (unseen on top of the satellite)
From weather to environmental forecasting

16 July 2010

Meteosat 9 IR10.8 20080525 0 UTC

ECMWF Fc 20080525 00 UTC+0h:
Third party programmes in support of Copernicus

Monitoring Atmospheric Composition

- METEOSAT THIRD GENERATION
  - MTG-S-1: SOUNDING
  - MTG-S-2: SOUNDING
  - SENTINEL-4 ON MTG-S

- EUMETSAT POLAR SYSTEM SECOND GENERATION (EPS-SG)
  - METOP-SG A: SOUNDING AND IMAGERY
  - SENTINEL-5 ON METOP-SG A

Monitoring the ocean

- JASON (HIGH PRECISION OCEAN ALTIMETRY)
  - JASON-2
  - JASON-3
  - SENTINEL-6 (JASON-CS)

- SENTINEL-3 A/B/C/D

YEAR... 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
1. **OLCI**  
   Ocean and Land Colour Instrument

2. **SLSTR**  
   Sea and Land Surface Temperature Radiometer

3. **SRAL**  
   SAR Radar Altimeter

4. **MWR**  
   Microwave Radiometer
EUM↔NOAA Cooperation (1)

• Cooperation in satellite meteorology, oceanography and climate monitoring

• Focus on operational data exchange, data redistribution, production of climate-relevant datasets, scientific exchange, user training, coordination through multilateral partnerships (CGMS, CEOS, GEO)
EUM ↔ NOAA Cooperation (2)

• Joint programmes:
  • Joint Polar System – EPS-SG and JPSS
  • Altimetry - Jason-CS/Sentinel-6

• Data Exchange & Distribution:
  • MSG at 0deg & IODC
  • GOES-R
  • GEONETCast

• Science:
  • Many joint science activities
That’s it ....