

Marc Loiselet, Ville Kangas, Ilias Manolis, Franco Fois, Salvatore d'Addio  
 European Space Agency, ESA/ESTEC, Keplerlaan 1, 2200 AG Noordwijk, The Netherlands  
 E-mail: [Firstname.Lastname@esa.int](mailto:Firstname.Lastname@esa.int)

## MetOp-Second Generation

The ESA MetOp Second Generation (MetOp-SG) Programme was approved at the ESA Council Meeting at Ministerial level in Naples in November 2012.

MetOp-SG is a follow-on to the current, first generation series of MetOp satellites, which is now established as a cornerstone of the global network of meteorological satellites.

The MetOp-SG programme is being implemented in collaboration with EUMETSAT.

ESA will develop the prototype MetOp-SG satellites (including associated instruments) and procure, on behalf of EUMETSAT, the recurrent satellites (and associated instruments). The overall MetOp-SG space segment architecture consists of two series of satellites (Sat-A, Sat-B), each carrying different suites of instruments and operating in LEO polar orbit. The planned launches of the first of each series of satellites are at the beginning of 2021 and at end 2022, respectively.

More information can be found in the "MetOp Second Generation – Overview" presentation from Graeme Mason, Hubert Barré, Maurizio Betto, ESA-ESTEC, The Netherlands.

Satellite	Instruments	Instrument Provider
Sat-A	METImage	DLR via EUMETSAT
	IASI-NG	CNES via EUMETSAT
	MWS	ESA – MetOp-SG
	RO	ESA – MetOp-SG
	3MI	ESA – MetOp-SG
Sentinel-5	ESA – GMES	
Sat-B	SCA	ESA – MetOp-SG
	MWI	ESA – MetOp-SG
	RO	ESA – MetOp-SG
	ICI	ESA – MetOp-SG
	Argos-4	CNES via EUMETSAT

## Payload

ESA is responsible for instrument design of six instruments, namely the MicroWave Sounder (MWS), Scatterometer (SCA), the Radio Occultation (RO), the MicroWave Imaging (MWI), the Ice Cloud Imager (ICI), and the Multi-viewing, Multi-channel, Multi-polarisation imager (3MI). Four other instruments (addressed in sessions of the ESA Living Planet Symposium) will complete the payload : METImage from DLR, the Infrared Atmospheric Sounding Instrument New Generation (IASI-NG) from CNES, Sentinel-5 from ESA via GMES Programme and Argos-4 from CNES.

**MetOp-SG is required to ensure the continuity of these essential meteorological observations. Its payload will bring improved accuracy / resolution of the measurements, and also add new measurements (frequencies, channels) and missions (MWI, ICI, 3MI).**

## MicroWave Sounder (MWS)

(Instrument Prime: Astrium Ltd. UK)

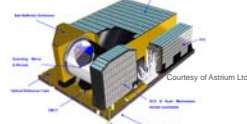


- Cross-Track Scanning Microwave Radiometer
- 24 channels, 23.8 GHz – 229 GHz, single polarisation

Channel	Frequency (GHz)	Utilisation
MWS-1	23.8	Water vapour column
MWS-2	31.4	Window water vapour column
MWS-3	50.3	Cloud-liquid surface emissivity
MWS-4	52.8	Temperature profile
MWS-5	53.2	Temperature profile
MWS-6	53.6	Temperature profile
MWS-7	54.1	Temperature profile
MWS-8	54.4	Temperature profile
MWS-9	54.9	Temperature profile
MWS-10	55.4	Temperature profile
MWS-11	55.9	Temperature profile
MWS-12	56.4	Temperature profile
MWS-13	57.0	Temperature profile
MWS-14	57.6	Temperature profile
MWS-15	58.2	Temperature profile
MWS-16	58.8	Temperature profile
MWS-17	59.4	Temperature profile
MWS-18	60.0	Temperature profile
MWS-19	60.6	Temperature profile
MWS-20	61.2	Temperature profile
MWS-21	61.8	Temperature profile
MWS-22	62.4	Temperature profile
MWS-23	63.0	Temperature profile
MWS-24	229	Quasi-window water vapour profile

### Mission Objectives

- Temperature and water vapor profiles in clear and cloudy air
- Cloud liquid water columns
- Continuation of AMSU/MHS/ATMS

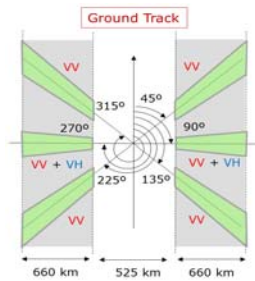


### Main Performances

- Small footprint (40km/20km/17km)
- Very good NEDT
- Extremely comprehensive characterisation of radiometric, spectral and spatial performance
- More Channels compared to previous microwave sounding instruments

## Scatterometer (SCA)

(Instrument Prime: to be selected in 2014)



### Mission Objectives

- Ocean surface wind vectors
- Soil moisture
- Snow equivalent water
- Sea-ice extent and type

### Main Performances

- Horizontal resolution: Nominal: (25km)<sup>2</sup>, High: (17-22 km)<sup>2</sup>
- Nominal Radiometric resolution:  $\leq 3\%$  for  $\theta_i \leq 25^\circ$  at 4 m/s cross-wind (VV),  $\leq (0.175 \times \theta_i - 1.375)\%$  for  $\theta_i > 25^\circ$  at 4 m/s cross-wind (VV)
- Horizontal sampling: Nominal: (12.5km)<sup>2</sup>, High: (12.5km)<sup>2</sup>
- 99% coverage in 48 hours
- Minimum incidence angle : 20 degrees

- Wind scatterometer, C-band
- Six antennas (3 on both sides of the satellite ground-track), VV polarisation
- Observation of extreme winds with VH polarisation

## MicroWave Imager (MWI)

(Instrument Prime: Compagnia Generale per lo Spazio CGS S.p.A. IT)

- Conically Scanning Microwave Radiometer
- 26 Channels, 18.7 GHz – 183 GHz
- Channels up to 89 GHz have dual polarisation
- Channels 118 GHz – 183 GHz have V polarisation only

Channel name	Frequency (GHz)	Utilisation
MWI-1	18.7	Precipitation over sea
MWI-2	23.8	Total column water vapour over sea
MWI-3	31.4	Precipitation over sea and (marginally) land
MWI-4	50.3	Precipitation over sea and land including drizzle, snowfall, height and depth of the melting layer
MWI-5	52.8	Precipitation over sea and land
MWI-6	53.2	Precipitation over sea and land
MWI-7	53.6	Precipitation over sea and land
MWI-8	54.1	Precipitation over sea and land
MWI-9	54.4	Precipitation over sea and land
MWI-10	54.9	Precipitation over sea and land
MWI-11	55.4	Precipitation over sea and land
MWI-12	55.9	Precipitation over sea and land
MWI-13	56.4	Precipitation over sea and land
MWI-14	57.0	Precipitation over sea and land
MWI-15	57.6	Precipitation over sea and land
MWI-16	58.2	Precipitation over sea and land
MWI-17	58.8	Precipitation over sea and land
MWI-18	59.4	Precipitation over sea and land
MWI-19	60.0	Precipitation over sea and land
MWI-20	60.6	Precipitation over sea and land
MWI-21	61.2	Precipitation over sea and land
MWI-22	61.8	Precipitation over sea and land
MWI-23	62.4	Precipitation over sea and land
MWI-24	63.0	Precipitation over sea and land
MWI-25	63.6	Precipitation over sea and land
MWI-26	64.2	Precipitation over sea and land



### Mission Objectives

- Cloud and Precipitation Products
- Water Vapour and Temperature Gross Profiles
- All weather surface imagery including:
  - Sea surface wind
  - Sea ice coverage (and type)
  - Snow coverage, depth and water equivalent
- Continuation of SSMI/TMI/SSMIS

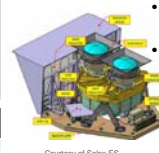
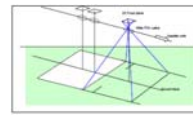
### Main Performances

- Good NEDT
- Internal calibration targets
- Extremely comprehensive characterisation of radiometric, spectral and spatial performance
- Large number of channels (118 and 183 GHz)

## Multi-viewing, Multi-channel, Multi-polarisation Imaging mission (3MI)

(Instrument Prime: Selex ES IT)

- 2D pushbroom imager
- Filter wheel (33 filter slots)
- Detectors: CCD for VNIR, HgCdTe for SWIR



### Mission Objectives

- Aerosol characterisation for NWP, climate monitoring, atmospheric chemistry and air quality
- Cloud detection/phase/optical thickness
- Aerosol effective radius/height/optical depth/type
- New instrument with heritage from Polder

### Main Performances

- High polarisation sensitivity
- Very stringent straylight requirements
- SSD: 4km
- Swath: 2200 km
- 14 views for VNIR, 12 views for SWIR

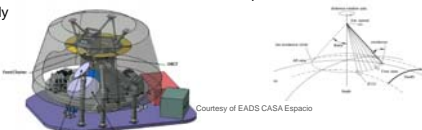
(\*) N (resp. Y) stands for unpolarised (resp. polarised) channels  
 (\*\*) Reduced performances

## Ice Cloud Imager (ICI)

(Instrument Prime: EADS CASA Espacio ES)

- Conically Scanning mm/sub-mm Radiometer
- 13 Channels, 183 GHz – 664 GHz
- Dual polarisation for channels 243 GHz and 664 GHz, others V polarisation only

Channel name	Frequency (GHz)	Utilisation
ICI-1	183.3147.0	Water vapour profile and snowfall
ICI-2	183.3143.4	Water vapour profile and snowfall
ICI-3	183.3142.0	Water vapour profile and snowfall
ICI-4	243.2x2.0	Quasi-window, cloud ice emissivity, cirrus clouds
ICI-5	225.15x5.5	Cloud ice effective radius
ICI-6	225.15x5.5	Cloud ice effective radius
ICI-7	225.15x5.5	Cloud ice effective radius
ICI-8	448x1.2	Cloud ice water path and other
ICI-9	448x1.2	Cloud ice water path and other
ICI-10	448x1.4	Cloud ice water path and other
ICI-11	664x1.2	Cloud ice water path and other



### Mission Objectives

- Cloud Ice Retrieval
- Cloud Ice Water Path
- Cirrus Clouds
- Water Vapour

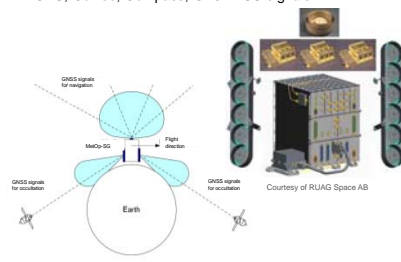
### Main Performances

- New spectral range (all channels at/above 243GHz are new)
- Footprints of 15km for all channels
- Good NEDT
- Extremely comprehensive characterisation of radiometric, spectral and spatial performance

## Radio Occultation (RO)

(Instrument Prime: RUAG Space SW)

- Atmospheric limb sounder for NWP and climate monitoring
- Two occultation antennas
- One zenith antenna
- GPS, Galileo, Compass, GLONASS signals



### Mission Objectives

- Temperature Profile
- Water Vapour Profile
- Tropopause height
- Height of planetary boundary layers
- Surface Pressure

### Main Performances

- Bending angle accuracy: 0.5µrad at 35km altitude
- 1100 occultations per day (GPS+Galileo)
- Closed loop and Open loop on L1 and L5
- Minimum SLTA: -300km
- Use of Pilot signals
- Ionospheric information