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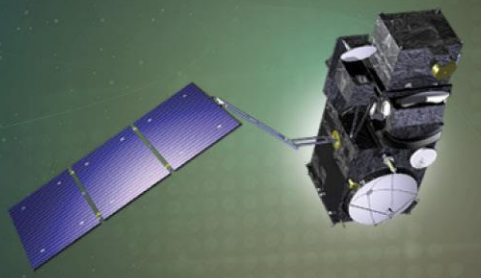

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FRM needs to support Cal/Val activities for EUMETSAT operated Copernicus missions: Example for Aerosol Products

Thierry Marbach, Bertrand Fougnie, Julien Chimot, Edouard Martins, Bojan Bojkov

EUMETSAT

Outline

- EUMETSAT Operational Needs
- Fiducial Reference Measurements (FRM) Characteristics
- EUMETSAT FRM Roadmap
- Gap Analysis: Example of the Aerosol Products
- Summary

Actual and Short-Term EUMETSAT Operational Missions

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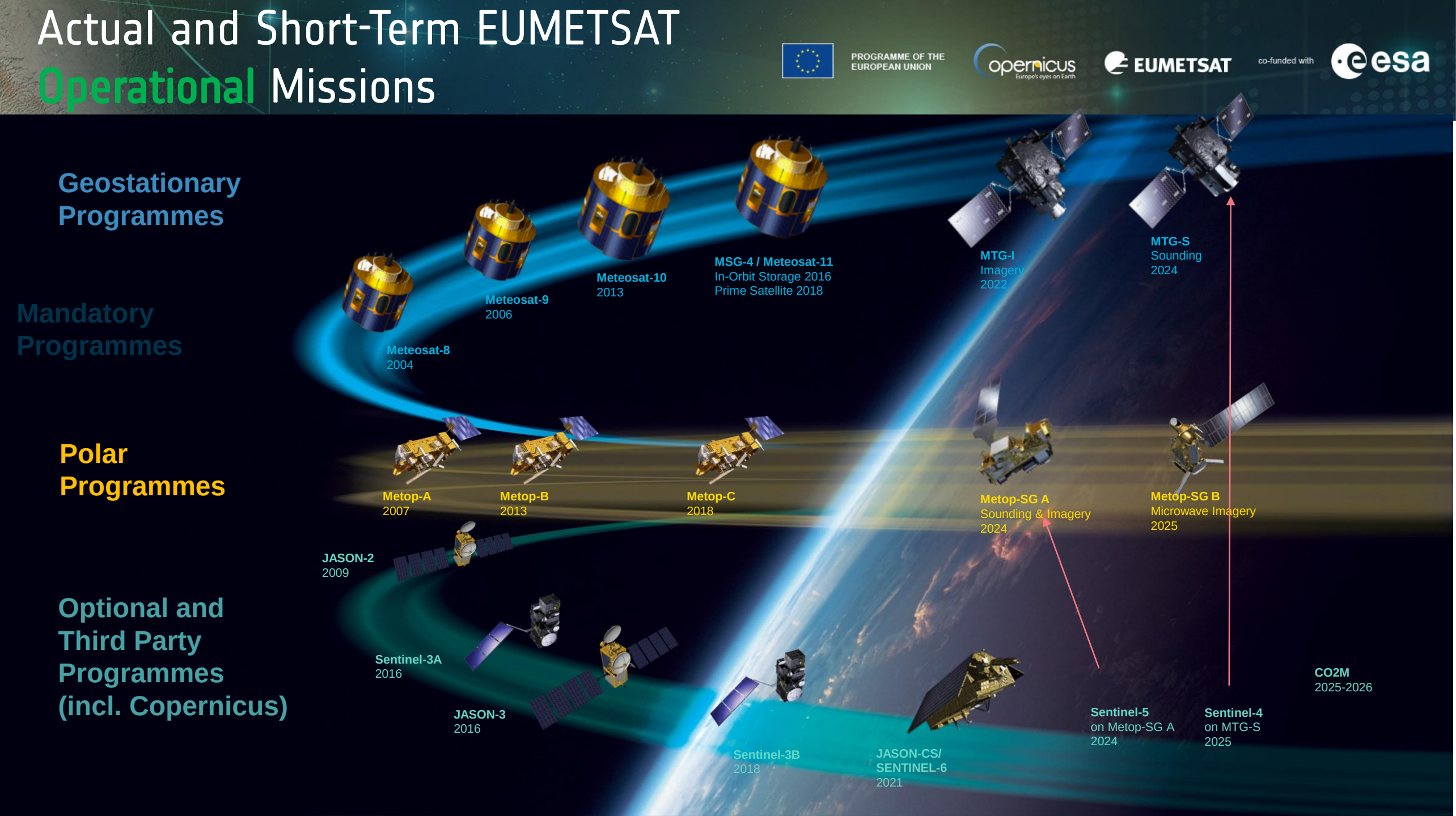
Geostationary Programmes

Mandatory Programmes

Polar Programmes

Optional and Third Party Programmes (incl. Copernicus)



EUMETSAT Operational Needs

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EUMETSAT provides operational products, which implies :

- Reliability : more than 99% - 24/7
- Timeliness : Near Real Time dissemination from sensing time:
  - 100 to 180min for LEO
  - 20min for GEO
- Quality control
- Continuity over the mission lifetime : maintenance of timeliness, quality standards, etc.
- Consistency between the different systems

EUMETSAT Cal/Val Needs

EUMETSAT Cal/Val needs are related to its operational missions:

- **Ground-based product quality better and/or similar to satellite mission accuracy:**
  - Measurements traceable to standard and/or community recognised best practices / standard operating procedures;
  - Consistent and traceable processing.
- **Gapless ground-based products**
  - Long-term data availability in order to cover mission lifetimes;
  - Timeliness of ideally less than 48h (for satellite/product performance monitoring purposes).
- **Data access & format of the ground-based products:**
  - Easy access to data, central facility when dealing with networks;
  - Widely used NetCDF format is preferred.
- **Documentation:**
  - Product lists that can be supported/provided;
  - Detailed products descriptions, including description of measurements, retrievals/processing, uncertainties limitations, etc.
  - Description of data access & policy for use.
- **Fiducial Reference Measurements – FRM:** tailoring of algorithms to meet specific needs, modification of measurement schedules to better match satellite overpasses time.

FRMs Characteristics (i)

- Fiducial Reference Measurements (FRM) themselves are tailored and fully characterized measurements made to support specific EO mission Cal/Val needs.

- FRM may be a subset dataset of the so-called “in-situ measurements”, and may be multi-purpose in application (i.e. also for model validation).

FRMs Characteristics (ii)

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The defining characteristics for FRM are:

- FRM should ideally have documented SI traceability (e.g. via round-robin characterisation and regular pre-and post deployment calibration of instruments) using metrology standards and/or community recognised best practices;
- FRM are independent from the satellite geophysical retrieval;
- An uncertainty budget for all FRM instruments, and derived measurements, is available and maintained;
- FRM protocols, procedures and community-wide management practices (measurement, processing, archive, documents, etc.) are defined, published and adhered to;
- FRM are accessible to other researchers/satellite teams allowing independent verification of processing systems.

EUMETSAT FRM Roadmap (i)

- The calibration and validation (Cal/Val) activities are a key component of the EUMETSAT operated Copernicus missions and all EUMETSAT missions in general;
- The availability of in-situ/fiducial reference measurements (FRMs) is monitored through a dedicated roadmap;
- The goal of this roadmap is to identify FRMs needs for the EUMETSAT Cal/Val activities (i.e. product-wise gap analysis) and propose a way forward to cover for future needs and related possible support to FRMs;
- Through the roadmap, the FRMs needs are centralised and therefore highlight commonalities and synergies between the instruments.
- The gaps analysis will cover:
  - Sources of key ground-based measurements;
  - Gaps in parameters (based on the EUMETSAT mission requirements and Cal/Val plans);
  - Gaps in algorithms for ground based measurements (e.g. accurate RT model);
  - Gaps in auxiliary data;
  - Gaps in location of station.

EUMETSAT FRM Roadmap (...)

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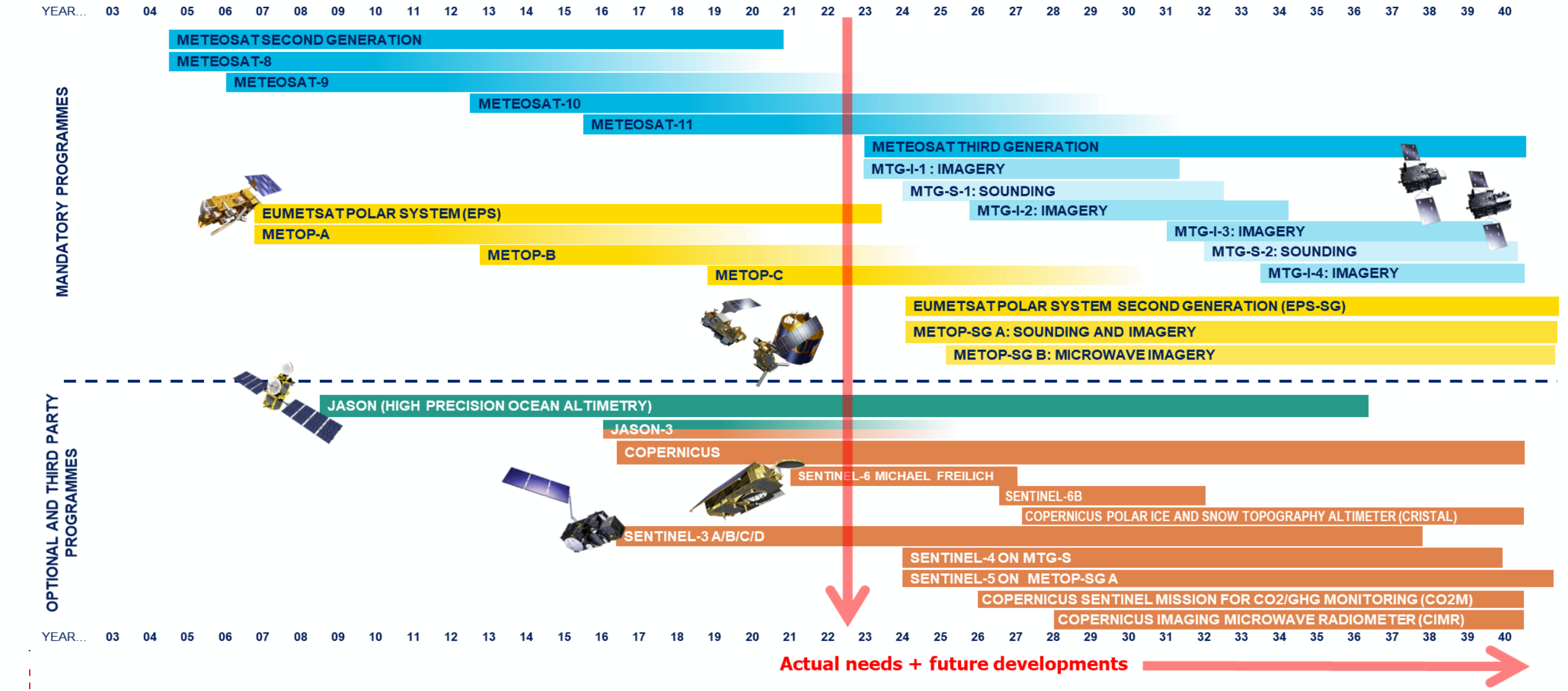

Gap Analysis: Example of the Aerosol Products (i)

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The product-wise gap analysis highlights the synergies between:

- Copernicus and EUMETSAT missions
- Copernicus missions onboard EUMETSAT mandatory program
- Assimilated products by CAMS: AOD from the EPS PMAp (1st operational synergy aerosol product in NRT) and soon from S3 SLSTR

Aerosol Missions&Products		EPS	EPS	EPS	MSG	S3	S3	EPSSG	EPSSG	EPSSG	EPSSG	MTG	MTG	CO2M
Parameter	**Acronym**	*GOME2*	*IASI*	*PMAp*	*SEVIRI*	*OLCI*	*SLSTR*	*3MI*	*MAP*	*S5*	*IASI-NG*	*FCI*	*S4*	*MAP*
Total Optical Thickness	AOD			550nm	550nm	spectral	spectral	spectral	spectral	550nm		550nm	550nm	spectral
Model or Type				class								type		
Fine mode fraction	FMF													
Single Scattering Albedo	SSA						spectral							
Refractive index														
Effective radius	AER													
Angstrom coefficient														
Absorbing index	AAI													
Layer Height	ALH	absorb.	ash/dust		ash					absorb.	ash/dust	ash	absorb.	
Volcanic Ash			AOD	flag	AOD				AOD		AOD	flag		
Desert dust			AOD	flag			flag		AOD		AOD			

	Existing operational product
	Under implementation
	Under development
	Feasibility study

In orbit

Development

Gap Analysis:
Example of the Aerosol Products (ii)

Regarding the S3 AOD (550nm), CAMS has expressed for S3 SLTR AOD (550nm) through communication e.g. with EUMETSAT and the EC in the context of S3 & the future S3-New Generation, S3-NG, the following requirements:

- A threshold precision better than 15% or 0.05, whichever is larger (target 10% or 0.03);
- A threshold accuracy better than 15% or 0.05, whichever is larger (target 10% or 0.03).

This is similar to EUMETSAT mission requirements

Gap Analysis:
Example of the Aerosol Products (iii)

- As example, EPS-SG 3MI, which is the instrument driving the aerosol parameter needs;
- The existing aerosol in-situ measurements like AERONET are mature enough to cover almost all the EUMETSAT Cal/Val needs;
- Gap were identified (e.g. aerosol layer height, also needed for S3, S4/S5);
- AERONET data (e.g. Level1.5) are available <48h;
- Minimum effort to meet EUMETSAT's needs.

Parameter	Horizontal resolution	Mission	Vertical resolution	Accuracy
Cloud detection	Pixel@4km Pixel@500 m	3MI VII	N/A	5%
Aerosol Optical Depth	Clear pixel	3MI	N/A	0.05
Aerosol Type	Clear pixel	3MI	N/A	4 classes
Aerosol height	Clear pixel	3MI/UVNS	N/A	1km
Aerosol Effective Radius	Clear pixel	3MI	N/A	0.6 µm
Aerosol single scattering albedo	Clear pixel	3MI	N/A	0.2
Aerosol refractive index	Clear pixel	3MI	N/A	N/A
Volcanic ash	Clear pixel	VII	N/A	detection
UV Aerosol index	Clear pixel	UVNS	N/A	0.1

Support to Improvement of Ground based Aerosol Measurements

Targeted effort through interactions with entrusted (e.g. EEA, CAMS) entities will help EUMETSAT consolidate the monitored aerosol parameters, especially for Copernicus missions;

The EUMETSAT requirements for aerosol products were presented at the ACTRIS final meeting (held at EUMETSAT premise in April 2019) and propose consolidation of the ACTRIS operational phase (2025 timeframe).

EUMETSAT has published an invitation to tender for a Scientific Service for FRMs for Copernicus Aerosol Product Cal/Val Activities (closed on 13 October)

→ consolidate ground-based aerosol inter-calibration and algorithm improvement for Copernicus missions (starting with S3);

→ Taking into account results from other ongoing studies e.g. Sentinel-3 OLCI Aerosol Layer Height Prototype

EUMETSAT submitted a concept note to ATMO-ACCESS to support the TNA (Trans National Access) development and consolidation of aerosol (and cloud) ground based measurements.

Summary

- The Fiducial Reference Measurements (FRM) are well covering the needs in term of characterised measurements;
- The access, long term availability and special FRM needs (e.g. global coverage, better overpass time match) should be considered for the Network consolidation;
- Therefore, EUMETSAT is performing a product-wise gap analysis, highlighting commonalities and synergies between the actual and future instruments (well illustrated with the ALH example).
  → Recommendation provided by EUMETSAT for the Copernicus Cal/Val Solution (CCVS)
- The FRMs needs for the EUMETSAT Cal/Val activities are kept in a dedicated roadmap in order to identify future needs and related possible support to FRMs;
- Furthermore, targeted effort through interactions with entrusted entities (e.g. EEA, CAMS) will help EUMETSAT consolidate the monitored in-situ/FRMs.

Thank you for your attention