Harmonised Cal/Val Strategy

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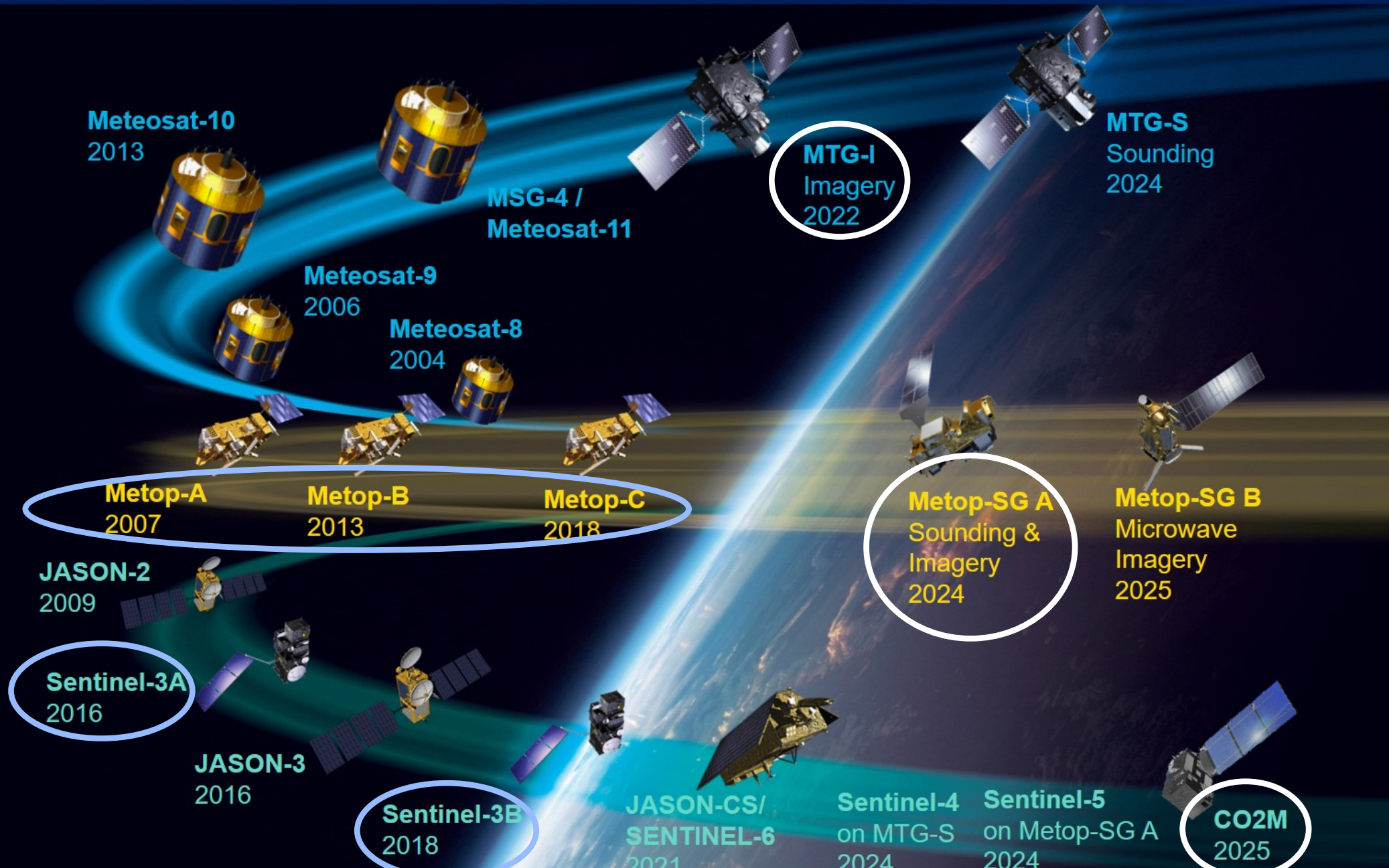
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- Aerosol products from a suite of satellites

- Aerosol processor in the operational context

- Processors currently in operation + under preparation & development

- Cal/Val: Standardised Approaches and methodologies

- Need for FRM, Roadmap, and activities

		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	550nm	spectral	spectral			550nm		spectral
Model or Type				class								type		
Fine mode fraction	FMF						AOD							
Single Scattering Albedo	SSA													
Refractive index														
Effective radius	AER													
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			AOD		AOD			AOD		

(green)	Existing operational product
(blue)	Under implementation
(pink)	Under development
(grey)	Feasibility study

Indicative list:
not fully exhaustive and
subject to modification

Toward a standardisation of methodology and harmonisation of processes

- Information Content Analysis (ICA) for each sensor/system
  - Should identify what can be realistically retrieved

    The larger the IC, the large the number of parameter to be retrieve AND/OR the better the performance
- Simultaneous Surface Aerosol Retrieval (SSAR)
  - Must be adapted & tuned considering the ICA
- Tailor the products to user needs – may impact the algorithm
- Physical description
  - Adopt a common aerosol model definition, vertical distribution definition…
- RTM
- Validation: adopt a consistent 6-step approach
  - Qualitative analysis
  - Matchups with ground measurements (e.g. Aeronet…)
  - Inter-satellite/sensor comparison
  - Consistency with aerosol sources
  - Comparison with alternative algorithms
  - Model-based comparison

Aerosol algorithm/processor in EUMETSAT

Operational products:

- **O1: EPS/PMAp** : Synergistic combination of instruments

- **O2: S3/SLSTR** : Dual–view radiometer

Under preparation:

- **P1: EPS-SG/3MI**: Multidirectional polarimeter

- **P2: EPS-SG/MAP**: Synergistic use of 4 instruments (inc. 3MI)

- **P3: CO2M/MAP**: Multiview polarimeter

- **P4: S3/SYN and S3-NG**: Synergy with Multispectral Pushbroom

- **P5: MTG/FCI** : Geostationary imagers

- "Operational product" ?
  - Dissemination to operational users
  - Near real time delivery (<3:00h from sensing time)
  - Robustness (availability)
  - Documented performance (validation report)
  - Stability of the performance
  - Monitoring of the performance
  - In general continuous improvements
  - Product tailored to user needs

- Scientific developments are needed to support these definitions and improvements
  - Some adaptation from the scientific development are needed to convert into an operational processor
  - Tailor the products to user needs (core parameters, performance, additional information…)

- A proper Cal/Val is needed for
  - The development of the product: assess performance, identify and fix limitations, improvements…
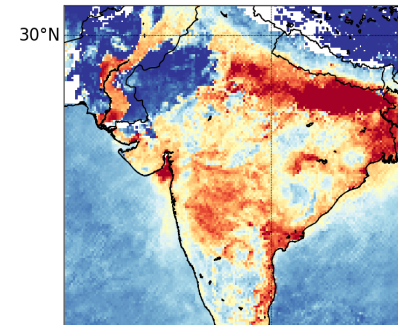 - The monitoring of the performance

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AOD @ 550 nm METOP Metop (A+B+C)
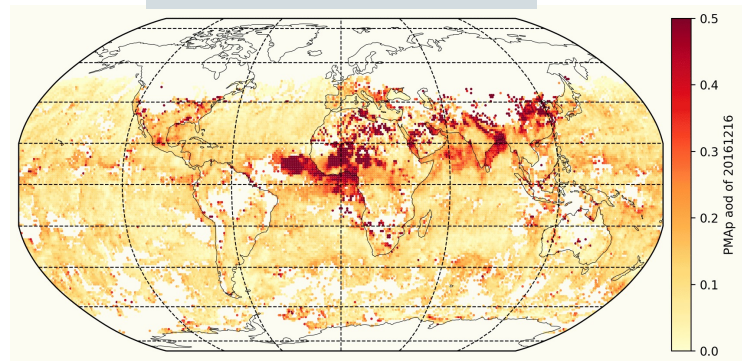
Matchups In-situ

PMAp - Aeronet
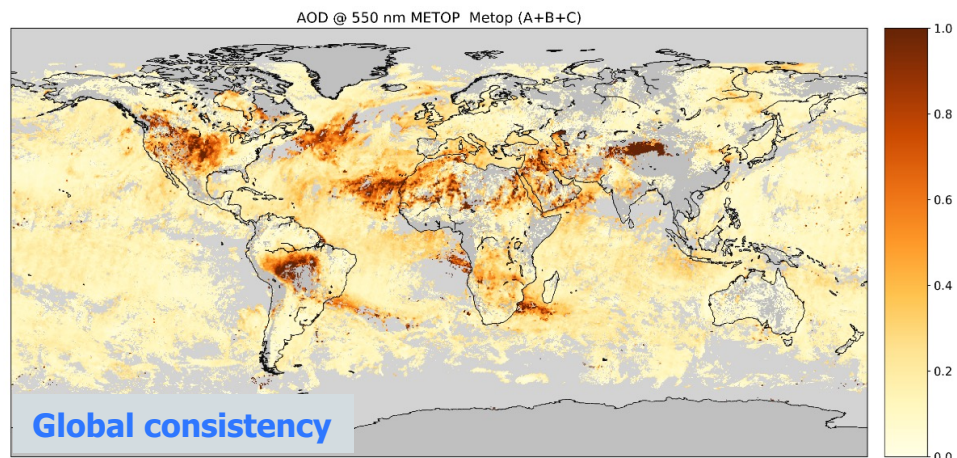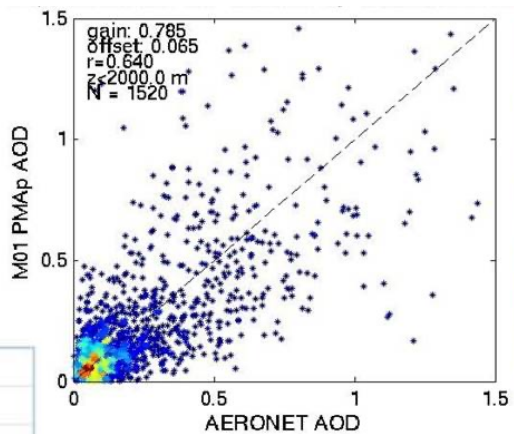
Global consistency

Consistency with other sensors

Timeseries
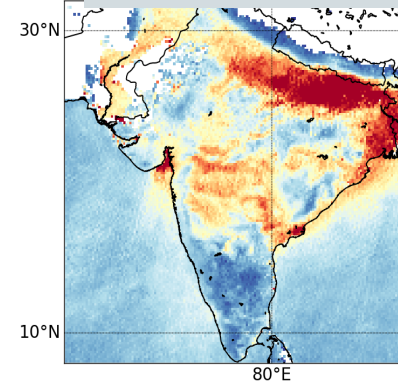
Consistency VS parameters
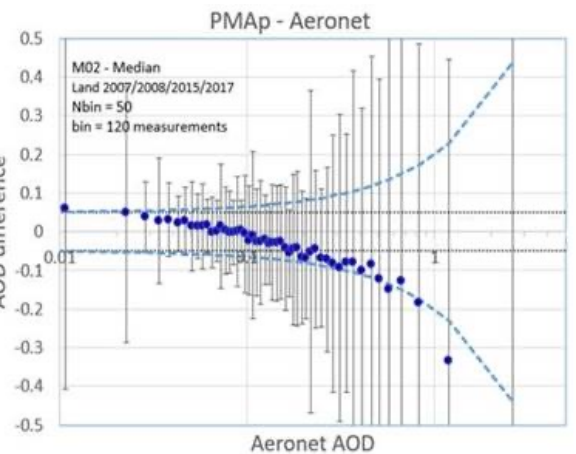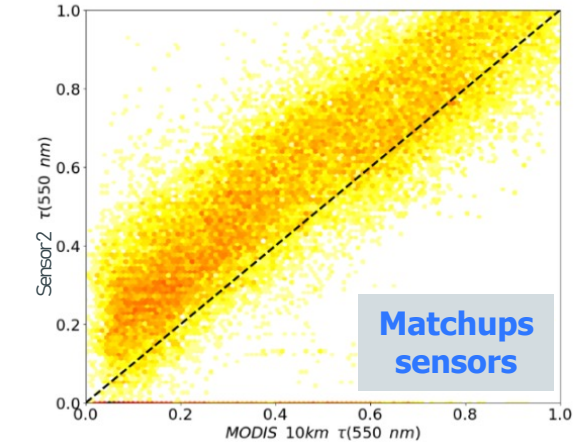
Temporal consistency
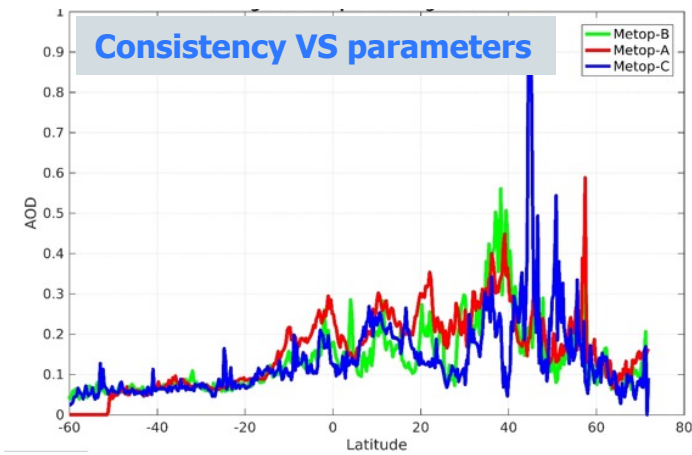
Matchups sensors

→ Extract signatures
→ "Morphological" description of the performance
→ Try to understand origin

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3 phases with potentially different needs:

- Commissioning
- Pre-operational,
- Operational/routine

6 different but complementary approaches:

- Qualitative analysis
  - General behaviour wrt orbit, geometry, time, geophysical parameters…
- Ground-based references
  - FRM: Aeronet, Earlinet, Cloudnet, ACTRIS
- Space-based references :
  - VIIRS, Earthcare, MTG/FCI, H9/AHI, Sentinel-3/SLSTR
  - Other EUMETSAT aerosol products
- Model-based references :
  - CAMS, EMAC
- Consistency with other type of data
  - Fire, Bulletin, Trace gases…
- Comparison with alternative algorithms
  - Each algorithm having its own advantages and limitations

FRMs in Support to Operational Aerosol Mission

Fiducial Reference Measurements (FRM) support specific EO mission Cal/Val needs and shall cover the following key requirements for EUMETSAT and EUMETSAT operated Copernicus 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...
  - Description of data access & policy for use.

- **Tailoring** of algorithms to better meet specific needs
  - Adjust measurement schedules or protocol to better match satellite overpasses time

FRM activities

- EUMETSAT is maintaining a Fiducial Reference Measurement Roadmap "FRM-RM" describing the current and future needs in FRM, and proposing a way forward support FRMs for the next 5 to 10 years.
  - Covers aerosol, but more generally Atmospheric Composition and Air Quality needs

- The gaps analysis will cover gaps in:
  - parameters, timeliness, geographical location, auxiliary data, algorithms for ground based remote sensing measurements (e.g. accurate RT model)

- The RM monitors and provides an overview of cooperative activities on FRM
  ➔ Avoid duplication and minimise costs by centralising FRMs needs and highlighting commonalities and synergies (i.e. product-wise gap analysis)
  - Established "in-situ" networks: ACTRIS,
  - Working groups and organisations: WMO, CEOS...
  - Member States,
  - Other Space agencies: ESA, CNES, NASA...

- Two recent examples for aerosol:
  - FRM4AER: Service for FRMs for Copernicus Aerosol Product Cal/Val Activities started in 2023
  - Support in-situ campaign of opportunity:
    - Jan-Feb 2023: South Atlantic Ocean (KNMI, MPI) with AOD measurements (+ other parameters)

Conclusion

- Cal/Val activities are key-elements to support aerosol processors

- The operational context implies specific needs for Cal/Val

- Methodologies and approaches shall be harmonised and standardised

  ➜ Aerosol Roadmap

- Fiducial Reference Measurements are one of the needed references but a very important one

- Strategy to optimise the effort and improve the value of FRM

  ➜ FRM Roadmap

- This relies on collaborations and interactions with many partners

Thank you for your contribution !