

# A PROPOSAL FOR EVOLUTION OF AEROSOL ECV PRODUCTS

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# Essential Climate Variables

- ◆ An ECV is a physical, chemical or biological variable or a group of linked variables that critically contributes to the characterization of Earth's climate.
- ◆ Criteria for ECVs
  - **Relevance:** The variable is critical for characterizing the climate system and its changes.
  - **Feasibility:** Observing or deriving the variable on a global scale is technically feasible using proven, scientifically understood methods.
  - **Cost effectiveness:** Generating and archiving data on the variable is affordable, mainly relying on coordinated observing systems using proven technology, taking advantage where possible of historical datasets.

# ECVs for GCOS

- ◆ Selected for the specific application area of Climate Monitoring
  - (other application areas are dealt by other programs)
- ◆ GCOS currently specifies 54 ECVs.

## Atmosphere

### Atmospheric Composition

- Aerosol and ozone precursors
- Aerosols properties
- Carbon dioxide, methane and other greenhouse gases
- Ozone

### Surface

- Precipitation
- Pressure
- Radiation budget
- Temperature
- Water vapour
- Wind speed and direction

### Upper-air

- Cloud properties
- Earth radiation budget
- Lightning
- Temperature
- Water vapour
- Wind speed and direction

# Current GCOS Aerosol ECVs products (4 ECV Products)

- ◆ Spectral Aerosol Optical Depth
- ◆ Single Scattering Albedo
- ◆ Aerosol light Extinction profile
- ◆ Aerosol Layer Height

Note that ECVs are not connected to a single measurement technique and can be measured or derived from other measurements

# Previous GCOS variables

variable	resolution			accuracy	stability <i>per decade</i>
	horiz. (km)	vertical (km)	temporal		
AOD (column)	5-10	N / A	4 h	max (0.03, 10%)	0.01
SSA (column)	5-10	N / A	4 h	0.03	0.01
layer height	5-10	N / A	4 h	1 km	0.5 km
extinction (profile)	200-500	1 (at ~10km) 2 (at ~30km)	1 week	10%	20%

Table 2: GCOS requirements for aerosol properties (2016 implementation plan)

# For each ECV product

- Fill in a requirement table (for Climate applications)

Item needed		Definition				
Definition	ECV	Atmospheric Aerosol				
	ECV Product	Aerosol Chemical Composition				
	Product definition	The mass and the nature of the chemical constituents in aerosol particles influence their optical properties. Knowledge of the main aerosol components classified into 4 categories (inorganic, organic, black carbon and dust) provides very useful constraints on aerosol forcing estimates.				
	Additional information	Aerosol chemical composition can be approximated by other indicators related to aerosol type, and estimated using column integrated information				
		Threshold (1)	Breakthrough (1)	Goal (1)	Metric (2)	Units (3)
Resolution	Spatial Resolution: Horizontal					
	Spatial Resolution: Vertical					
	Temporal Resolution					
	Timeliness					
Uncertainty	Required measurement uncertainty					
	Stability for users					
Background information	References and Standards					
	Deviation					
Data Source	In-situ	<a href="https://aeronet.gsfc.nasa.gov">https://aeronet.gsfc.nasa.gov</a>				
	Reanalysis					
	Space-borne					

- Add data sources: in-situ, satellite, re-analysis
- To be concluded end of October
- Will go through public review

# For each requirement, define

- **Threshold:** The minimum requirement: the value that has to be met to ensure that data are useful.
- **Breakthrough:** One or more values that enable additional uses within climate monitoring.
- **Goal:** The ideal requirement above which further improvements are not necessary.

# How to address horizontal resolution ?

- Observations seem to agree that very little correlation can be detected when sampling at more than a few hundred km (range 250-500 km)
  - → **this can be defined as threshold**
- Climate models are running typically with horizontal resolution of a few tens of km (50 km ?)
  - → **this can be defined as a breakthrough**
- High frequency variations in aerosol parameters are not necessarily relevant for GCOS application
  - → **goal = breakthrough in this case**

Is this suited to climate modelling applications (reanalysis for example ?)



# How to address vertical resolution ?

- Measurements can be single-point, column-integrated or column resolved
- **Cannot be different ECV products at the ground, in the column.**
- **Threshold**
- **Breakthrough**
- **Goal**

Is this suited to climate modelling applications (reanalysis for example ?

# How to address Temporal resolution

- **threshold is to provide monthly variations**
- **breakthrough is to provide daily variation**
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- **goal is to provide hourly variation  
(reanalysis, fluxes ?)**

Is this suited to climate modelling applications  
(reanalysis for example ?)

# Revision of GCOS EVCs products

- To be proposed within the next GCOS implementation plan (2020-2024)
- Given complexity of aerosol role on climate, additional Aerosol ECV products are needed
- They must remain « Essential », and will not exceed 6 ECVs in total
- As much as possible, they must be independent from each others

# Strategy for Aerosol EVCs revision

- Maintain AOD, SSA and  $F_z(\sigma_{ep})$  as ECVs
- Add notes insisting upon the importance of AAOD, Fine/Coarse AOD.

# Strategy for Aerosol EVCs revision

- **Questions related to ALH**
  - Important to locate aerosol layers for RF calculation
  - But, ALH is not well-defined, nor unambiguously measured.
  - Calibration of ALH is most generally performed by comparison with  $F_z(\sigma_{ep})$
- **Suggestion**: to move ALH to a supporting parameter for  $F_z(\sigma_{ep})$  ECV in case full profile retrieval is not available (ground-based or space-borne)

# Proposal for new Aerosol ECVs

## 1. Aerosol size-related ECV

- Particle Number (Volume) Size Distribution. In-situ and column integrated. Note indicating that Extinction Angström Exponent can be used as proxy.

## 1. Aerosol cloud forming potential-related ECV

- Number of Cloud Condensation Nuclei at a given supersaturation is key to first-order (twomey effect) indirect effect

## 1. Aerosol chemical composition-related ECV

- Mass-fraction of inorganic/organic/Black-Carbon and dust aerosol. Note saying Absorption Angström exponent can be used under some assumption. Also complex refractive index under known RH

# Agenda

- End of September
  - Feedbacks on ECVs after AERO-SAT and AEROCOM meetings
- Mid-Oct Final Decision on new ECV list
- Tables to be finalized end of October
  - Please inform if you will not be able to meet deadlines