Aerosol typing
(WG 5)

Introduction / seed questions

(with Lucia Mona / WG lead)

Aerosol type

- … is a categorial / qualitative variable

- … is input needed for (ill-posed) retrievals / affects accuracy (AOD …)
- … is estimated from ground-based data (sampling!) and model climatologies

- … is output from retrievals to some extent (AERONET, satellite)

- Different instruments
  - … need different definitions
  - … have different / limited information content for aerosol type

Aerosol typing

Aerosol typing procedures differ in many aspects:

- approach
- nomenclature (e.g. same name for different definitions)
- assumed number of components (e.g. TOMS: 3 – MISR: 74)

- parameters used for the classification
  - Particle size
  - Particle shape
  - Absorbing properties
  - Aerosol load
  - Location
  - Seasonal behavior

- approach
  - by source (e.g. dust, sulfates)
  - by optical properties (e.g. aspherical, absorbing)

Examples

MODIS

Fine (<1μm)

WEAKLY ABSORBING

MODERATLY ABSORBING

STRONGLY ABSORBING

Coarse (>1μm)

COARSE

CALIPSO

non-depolarizing

depolarizing

high aerosol content

small aerosol content

POLLUTED CONTINENTAL

SMOKE

CLEAN MARIN

CLEAN CONTINENTAL

more

less

DUST

POLLUTED

over the Sea

Questions?

What is needed?

- review of aerosol typing assumptions
- harmonization of the nomenclatures
- harmonization of the procedures

→ Long-term perspectives (WG2)
Validation (WG3)
Improved accuracy(WG4)

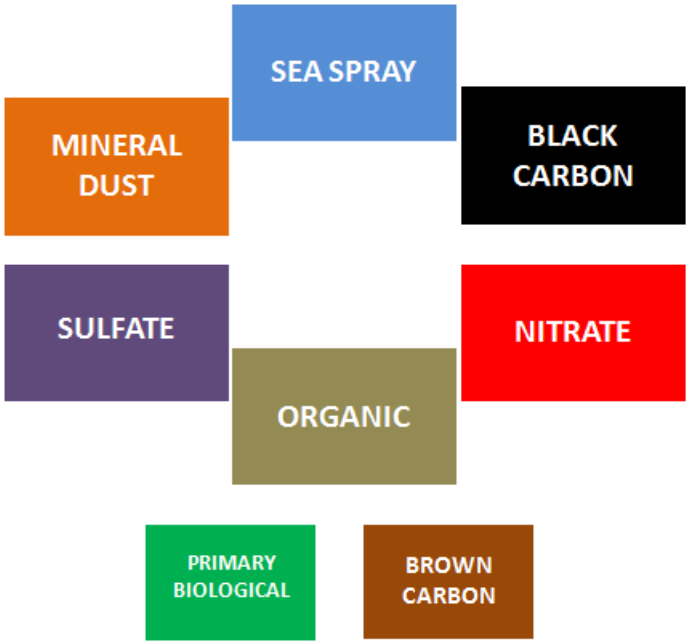
Can / we find one overarching nomenclature?
Do we see a need / benefit in it?

Critical points

- how realistic is an overarching common definition of aerosol types?

- GB communities (e.g. AERONET, EARLINET, in situ) also have different procedures for the typing, even in the same network

- the 2013 IPCC report classification mainly relies on near-surface typing



Simple aerosol typing in Aerosol_cci

Simple concept

- 4 basic components
- Reflects theoretical information content
- External mixtures with 3 mixing fractions
- Evaluation ongoing of information content

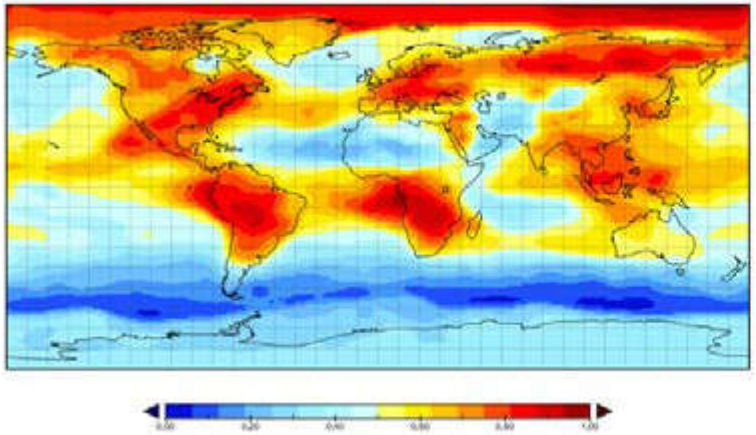
- Output (easier to validate / compare)
  - Fine mode AOD (fine mode / total mixing fraction)
  - Dust AOD (dust / total coarse mode mixing fraction)
  - [AAOD (absorption fraction in fine mode)]

4 aerosol components

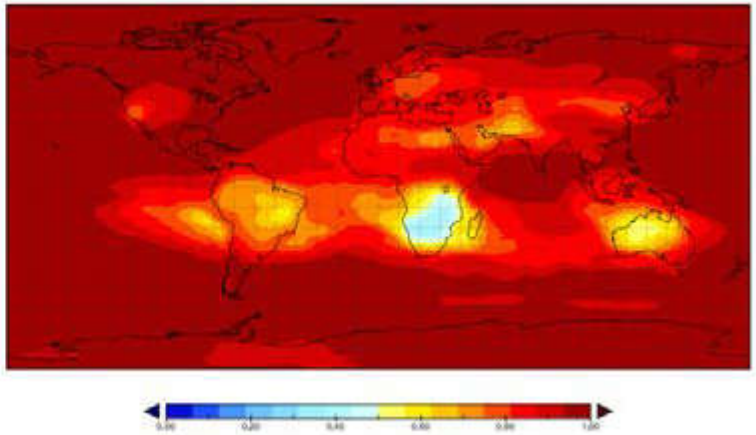
aerosol component	Refr. index, real part (55μm)	Refr. Index, imag part (.55μm)	reff (μm)	geom. st dev (σ_i)	variance (ln σ_i)	mode. radius (μm)	comments	aerosol layer height
Dust	1.56	0.0018	1.94	1.822	0.6	0.788	non-spherical	2-4km
sea salt	1.4	0	1.94	1.822	0.6	0.788	AOD threshold constraint	0-1 km
fine mode weak-abs	1.4	0.003	0.140	1.7	0.53	0.07	(ss-albedo at 0.55 μm: 0.98)	0-2 km
fine mode strong-abs	1.5	0.040	0.140	1.7	0.53	0.07	(ss-albedo at 0.55 μm: 0.802)	0-2 km

AOD mixing (fractions) from AEROCOM

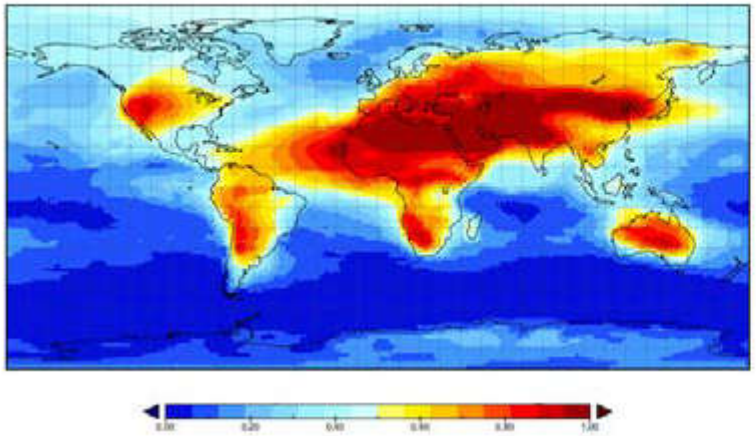
Fine mode fraction



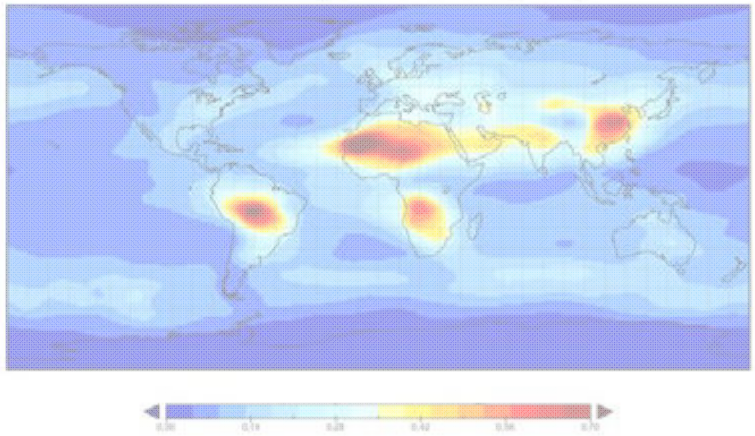
Fraction of the less absorbing component in the fine mode



Fraction of dust in the coarse mode

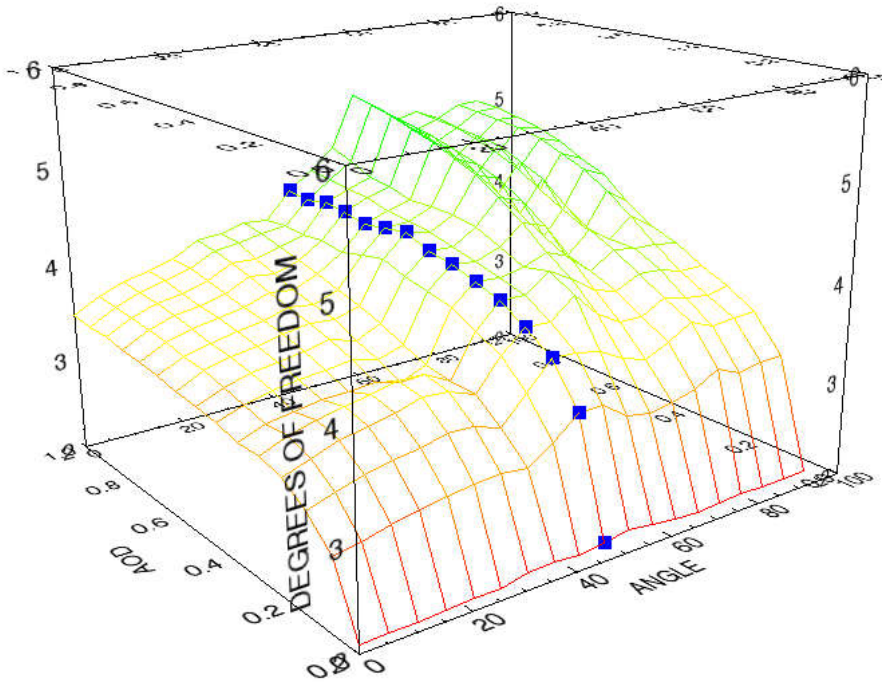


AOD550 (not used as a priori)

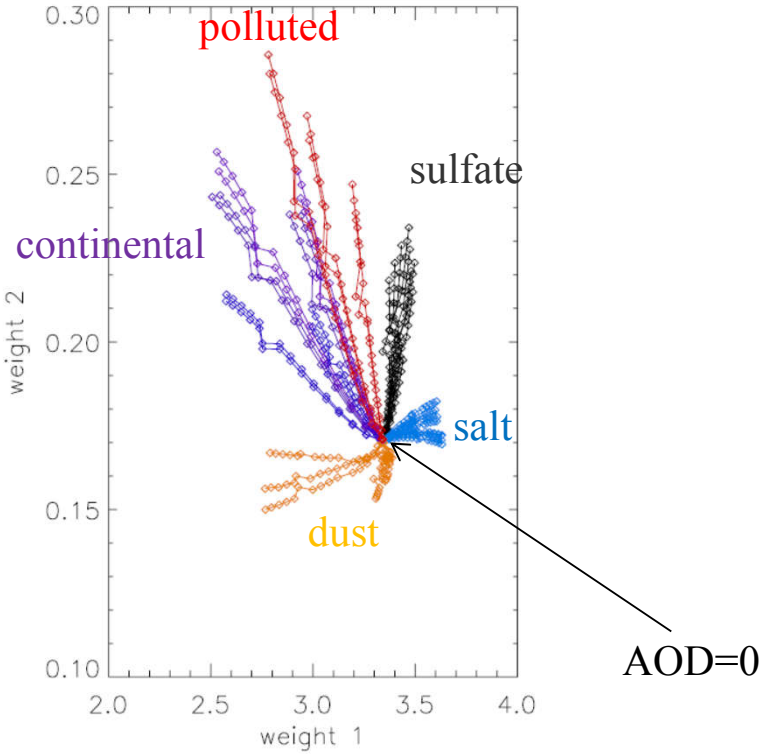


Information content analysis (SYNAER/SCIA)

A tool to identify systematically strengths and limitations



DOF as f(AOD, θ_0)



PCA weights a and 2