Global Distribution of aerosols as seen from the POLDER instruments

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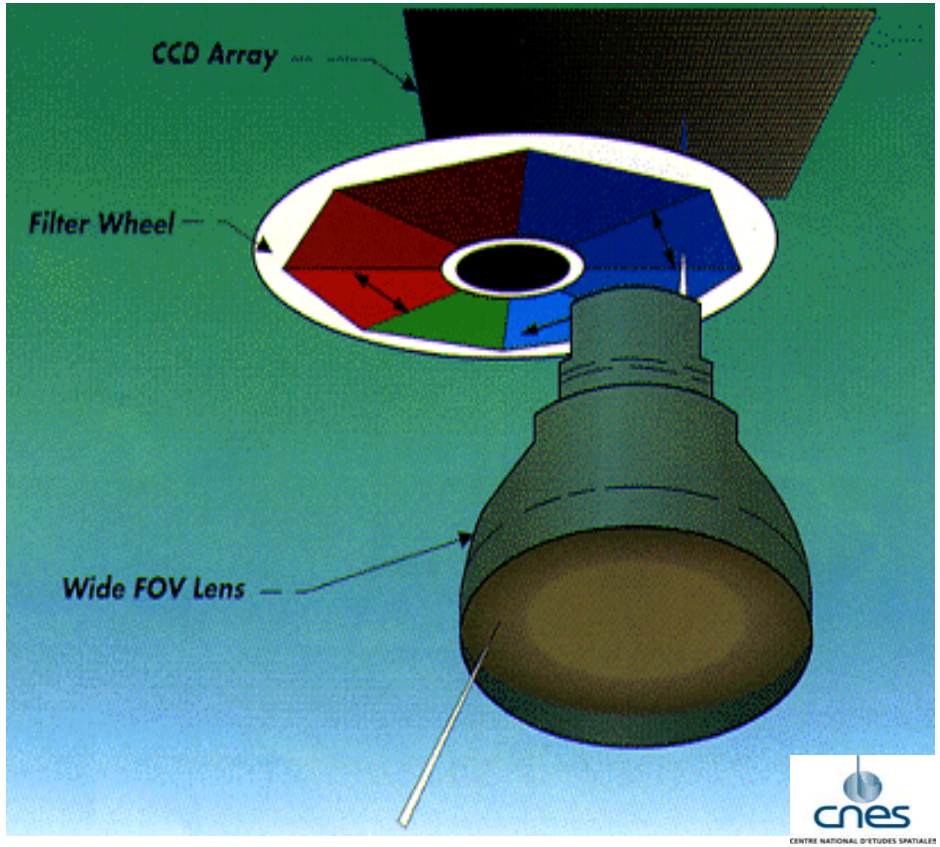
POLDER heritage

- POLDER : Polarization and Directionality of the Earth Reflectances

  Makes multidirectional Reflectance measurements, including the linear polarization component

- Flew onboard ADEOS-1. Eight months of measurements before the platform solar panel failure
- Another, similar, instrument onboard ADEOS-2, launched Dec. 2002
- A third instrument to fly onboard a micro-sat platform, part of the Aqua train
- Project managed by CNES. Scientific team mostly French, with international collaboration

INSTRUMENT

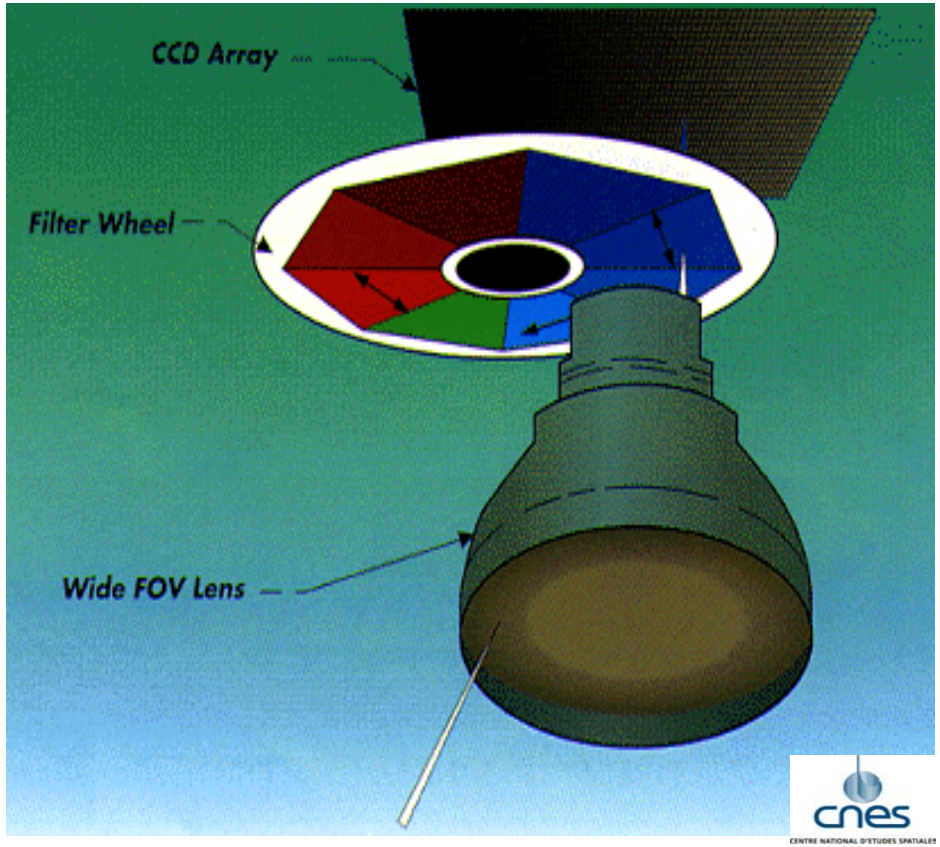


Simple instrument concept :

- CCD Array (0.4 to 1 µm)
- Filter/polarizer wheel
- Wide FOV lens

The CCD matrix images a bi-dimensional portion of the Earth. The rotating wheel allows successive multispectral measurements

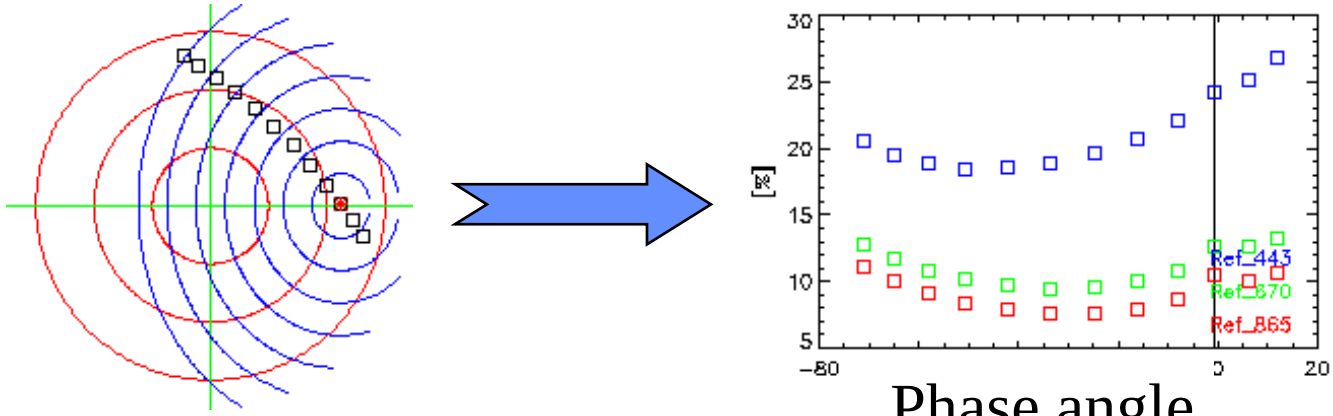
INSTRUMENT



- **Wide field of view lens : ± 51 ° along track, ± 43 ° cross track**
- **Swath* : 1800 km ; 2400km along track**
- **Spatial Resolution ≈ 6 km**
- **Up to 14 ≠ viewing angles per pixel for a single satellite pass**
- **16 positions of the filter wheel [3 slots needed for each polarized band]**

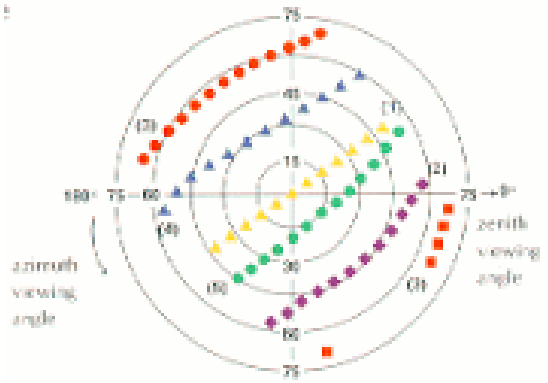
**For an Altitude of 800km*

MULTI-DIRECTIONAL OBS

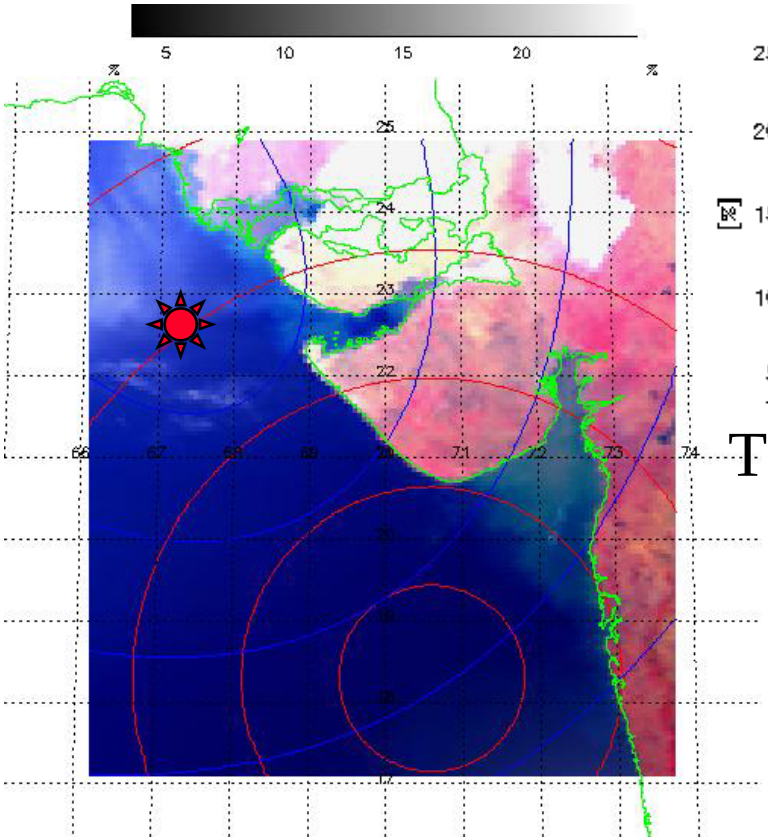


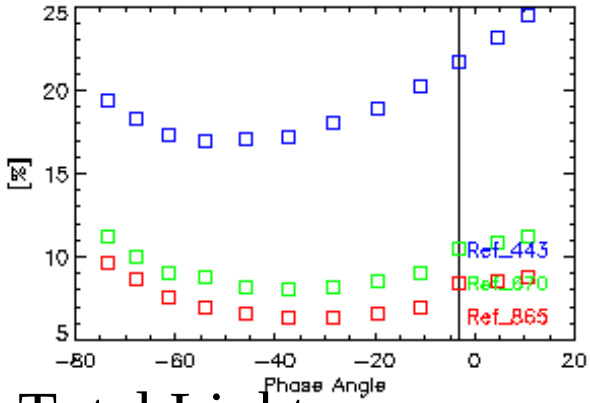
Up to 14 measurements for a given Earth target are acquired within 4 minutes

The viewing geometry of the successive measurements depends on the latitude and position in the swath

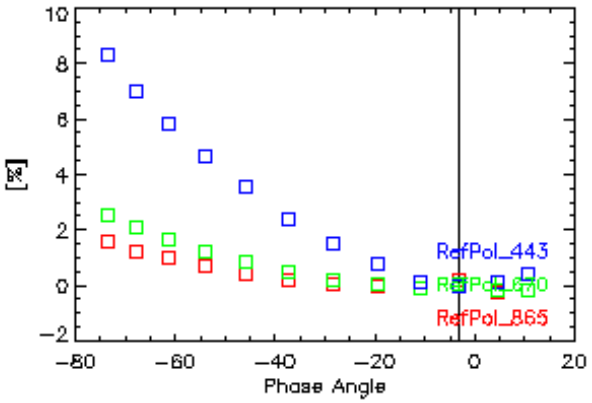


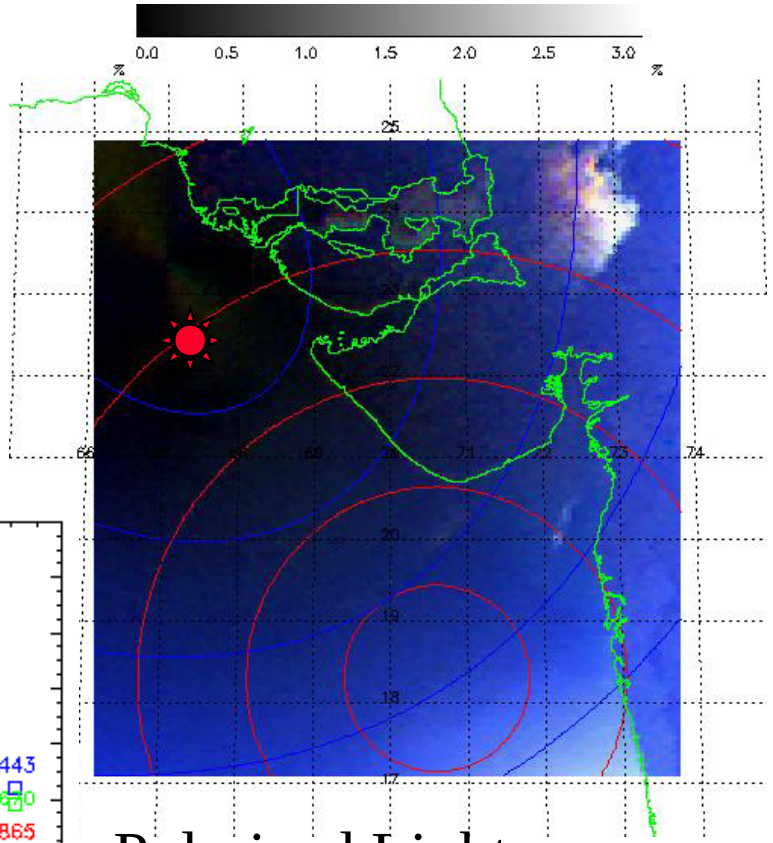
POLARIZED MEASUREMENTS





Total Light





Polarized Light

Same area (West of India) seen in total light (440-670-870 nm composite) and polarized light.

Lines show phase angle and view zenith angle

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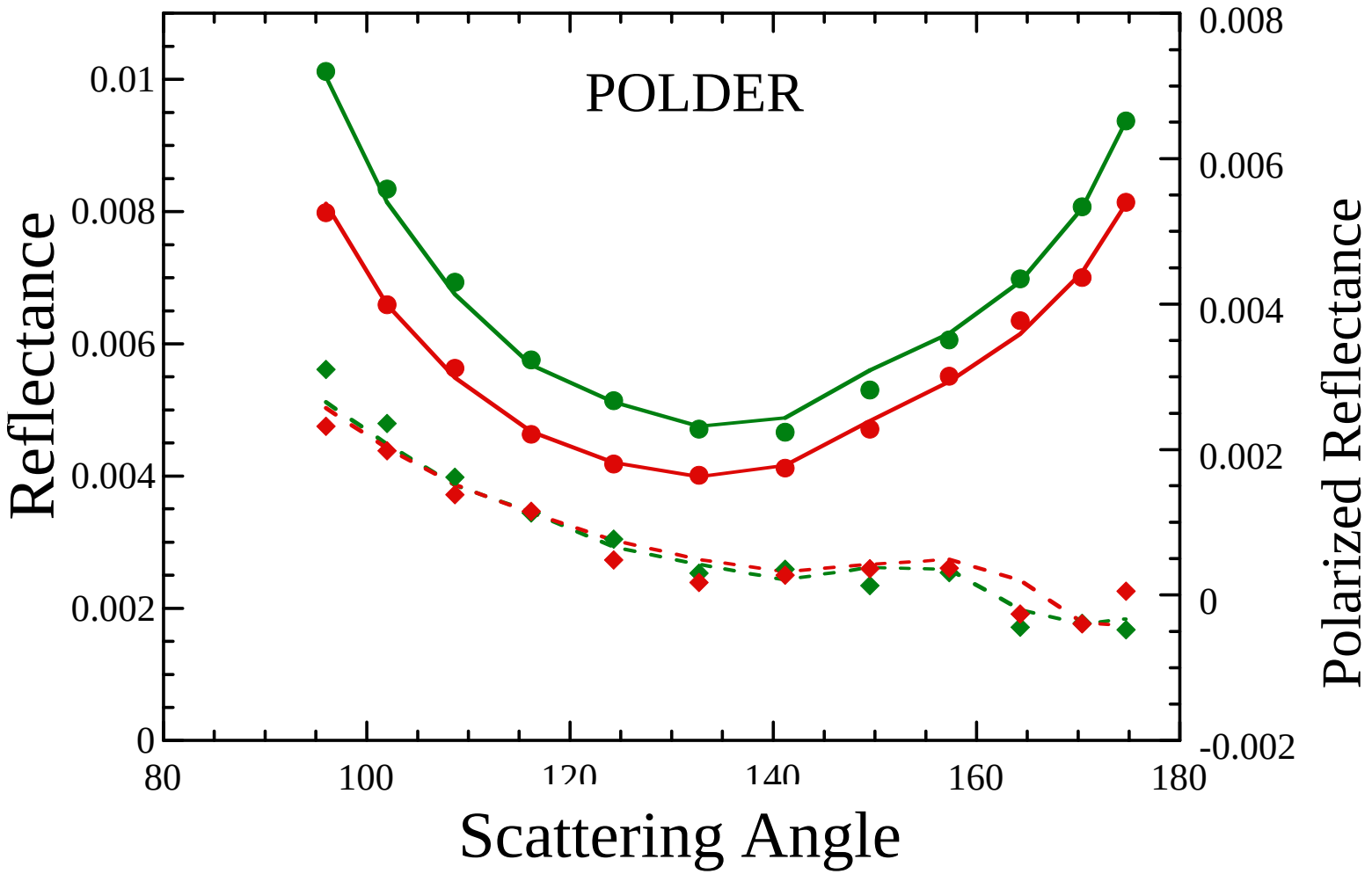
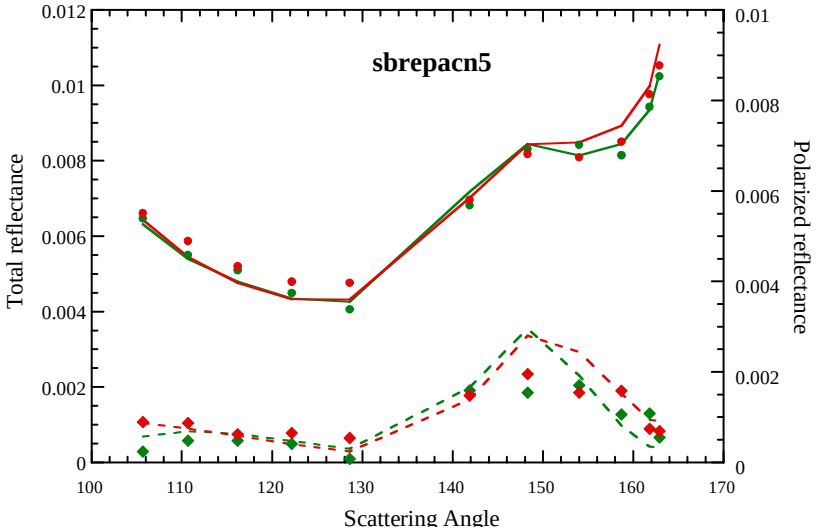
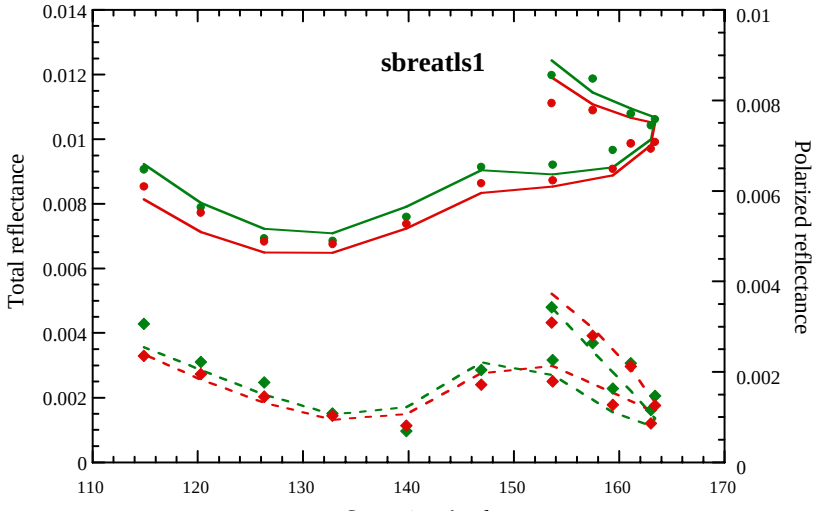
Information content



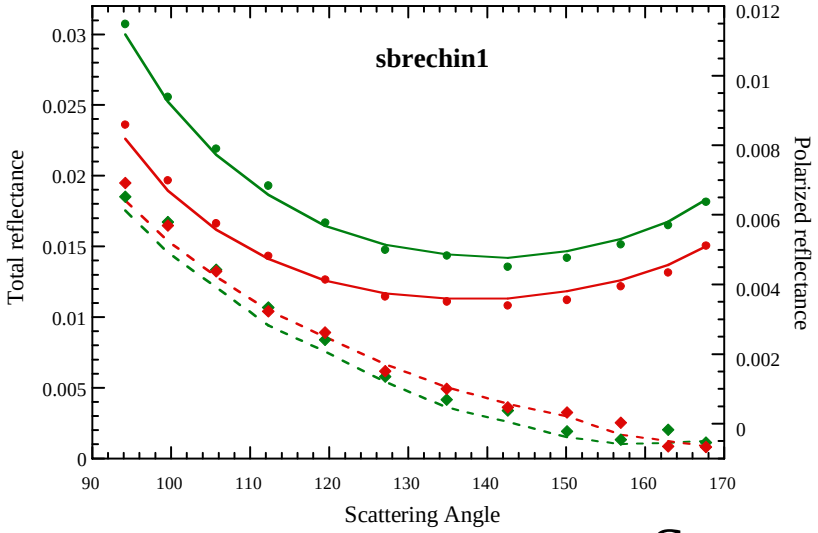
Aerosol Inversion

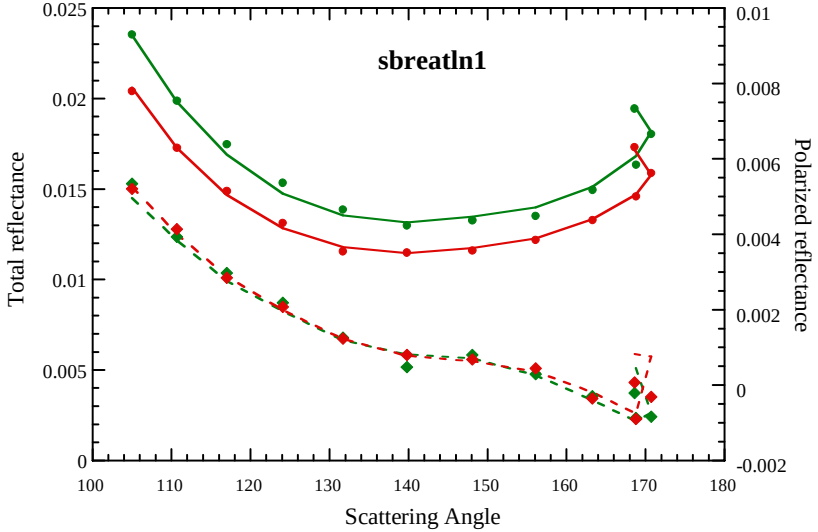
Herman et al. 2003





Large to small particles



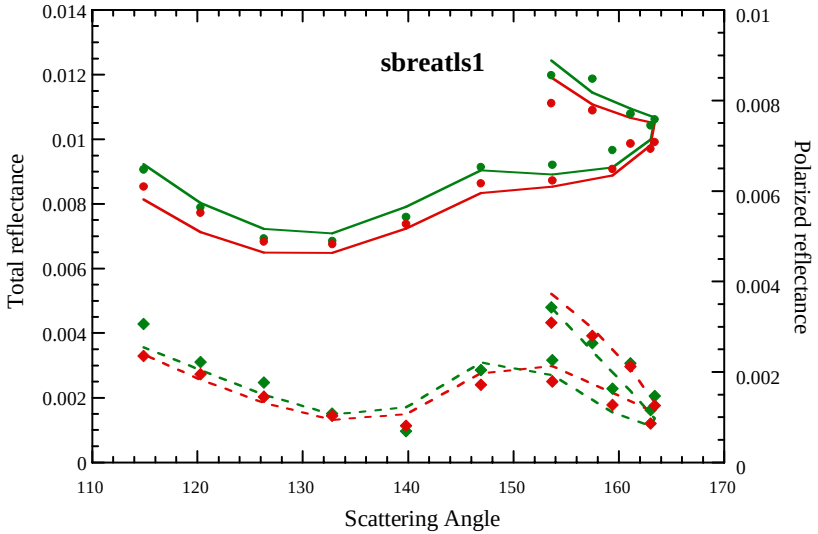


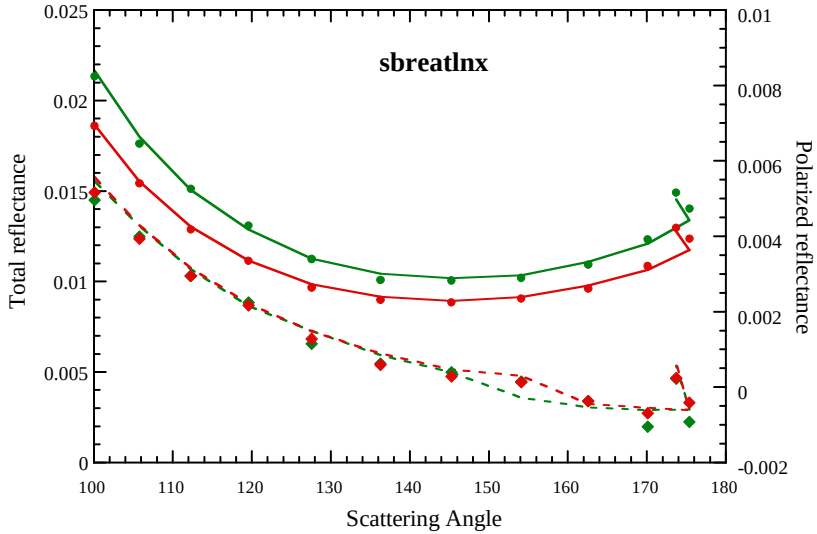
Spectral effect increases

150° arc decreases

Aerosol Inversion

Herman et al. 2003

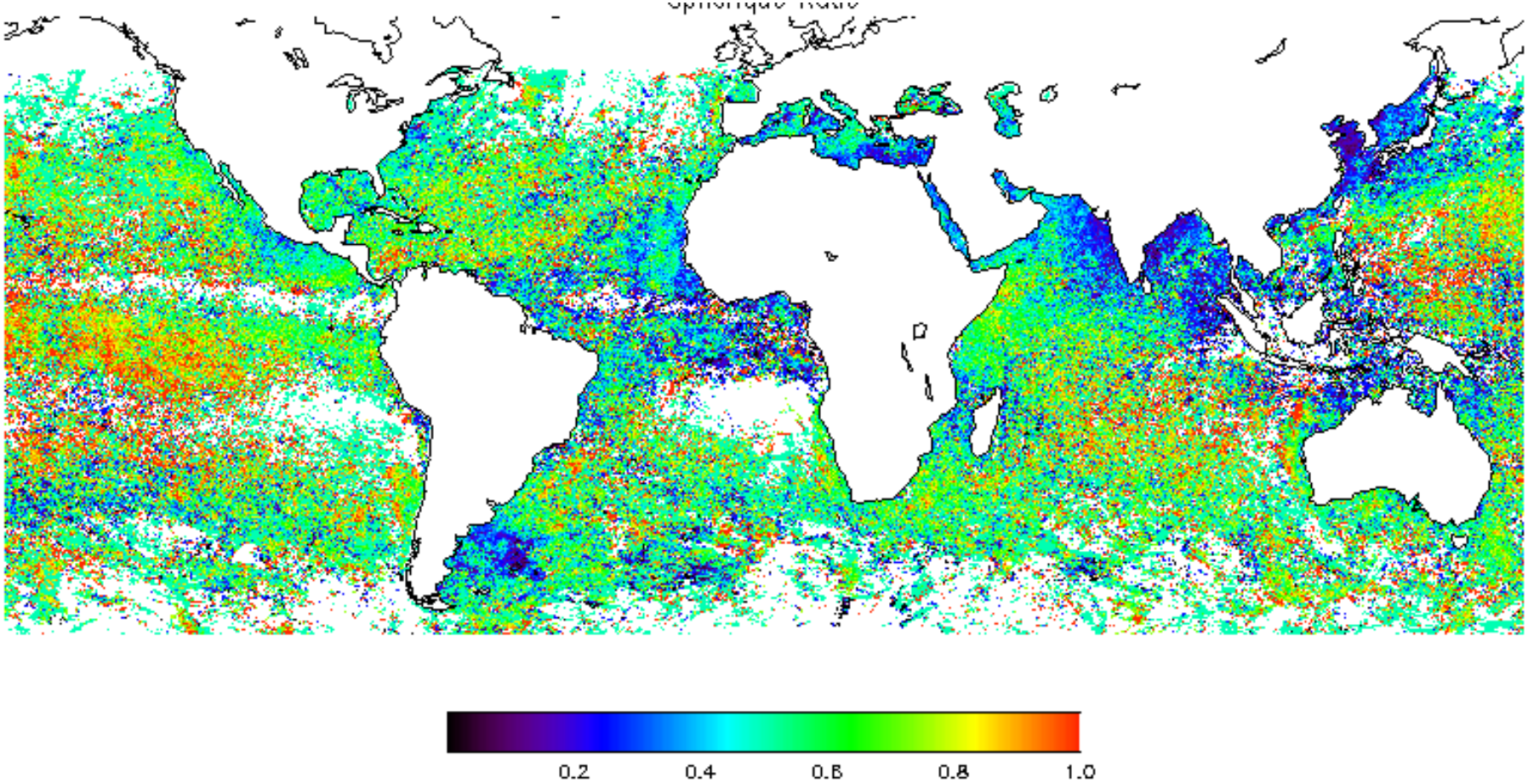




150° arc indicates the presence of large, spherical particles

Small spectral effect but no Arc. Non spherical particles.

Global Results

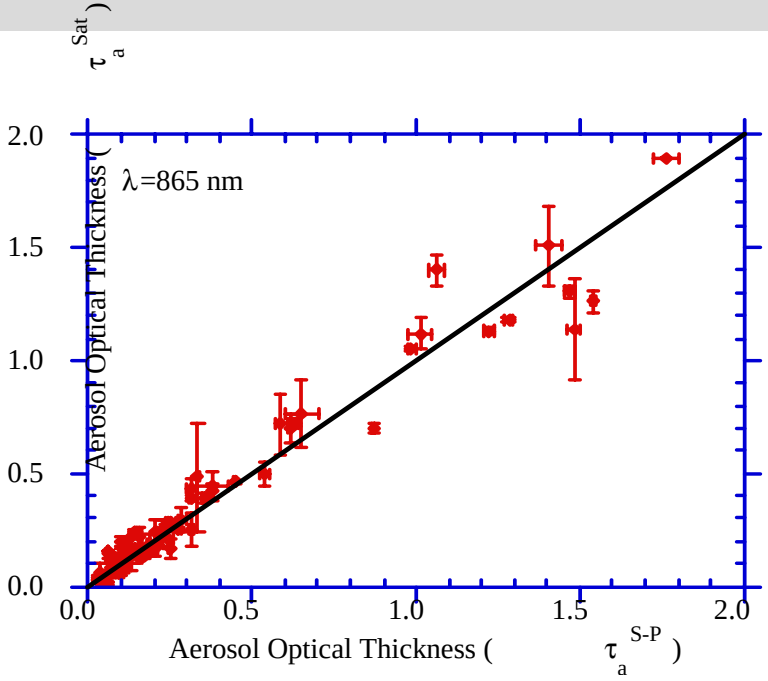


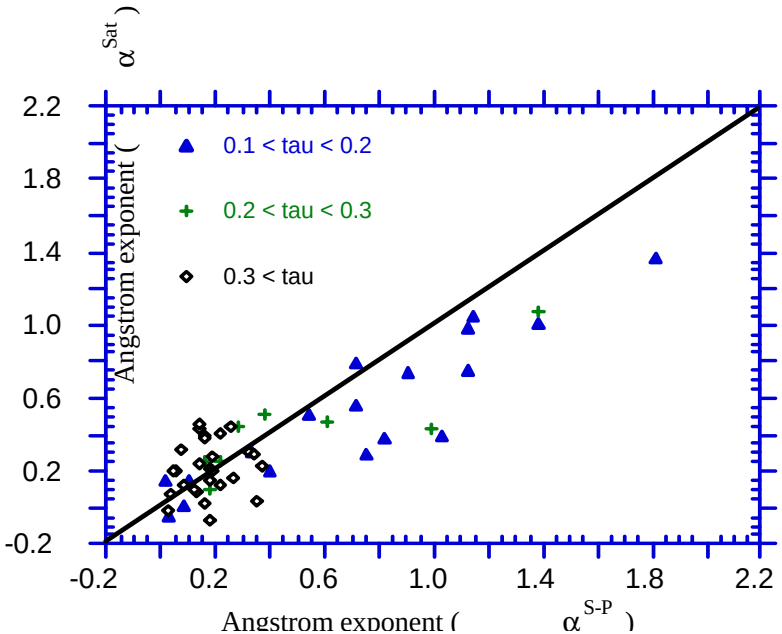
Large particles : Ratio of Spherical to the total

Open Oceans : Spherical

Non Spherical exports from India and China

Validation of aerosol ocean products





- Comparison of POLDER retrievals to sunphotometer measurements
- Excellent agreement on the optical thicknesses
- Some bias on the Angstrom coefficient
- Large optical thickness are limited to dust events due to the position of the sunphotometers during POLDER lifetime

Over Land Surfaces…

Total Reflectance channels cannot be used (lack mid-IR channels)

Makes use of polarized reflectance measurements

Surface contribution modeled by empirical functions

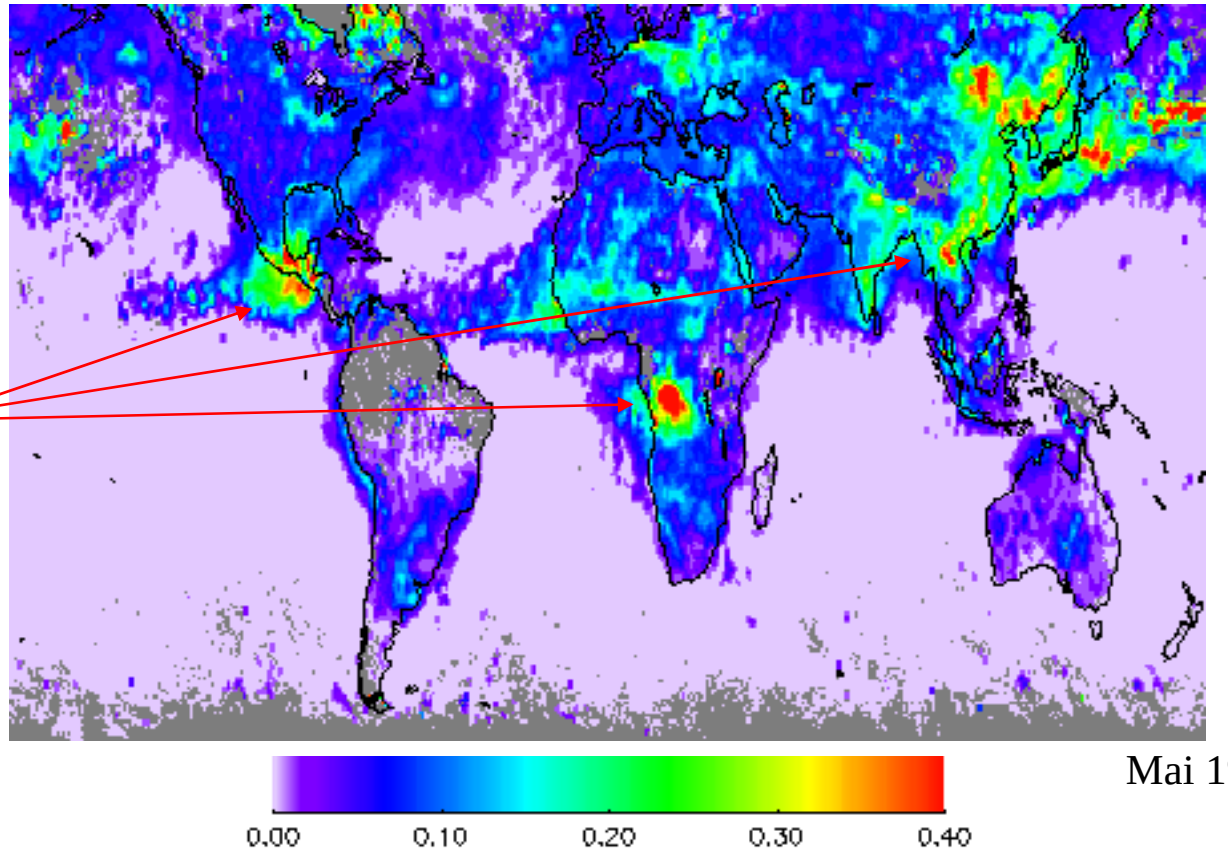
F(surface_type , scattering angle)

Sensitive to small [polarizing] particles

==> Aerosol Index

Aerosol Index

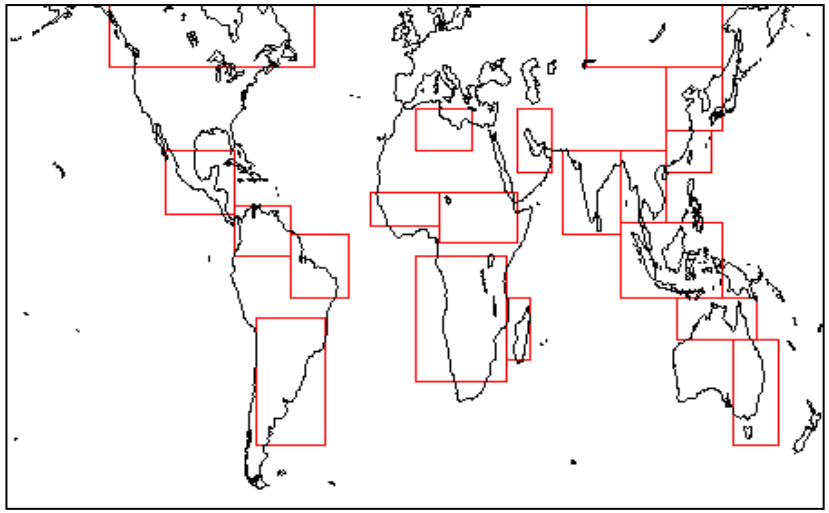
Biomass burning

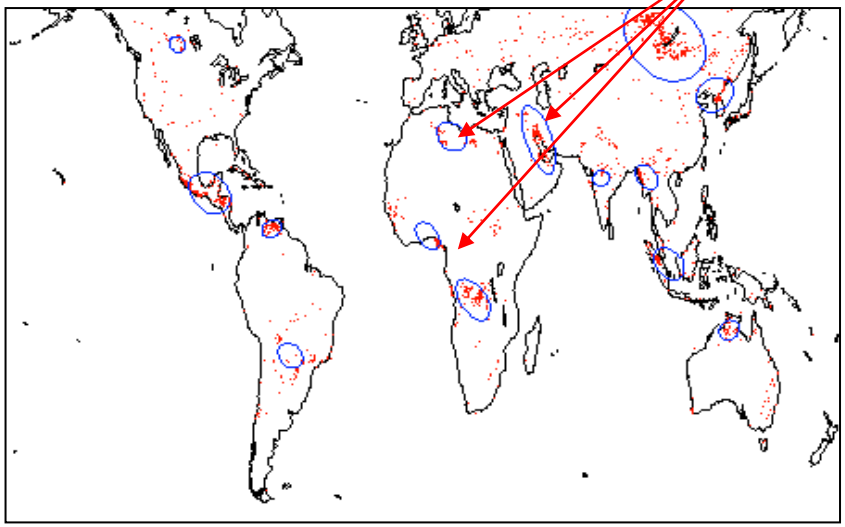


Mai 1997

- Over the oceans, product of optical thickness and Angstrom coefficient
- Over land, sensitive to “small” aerosols since large particles do not polarise
- Insensitive to dust and/or clouds.
- Roughly proportional to number of particles

Biomass burning detection

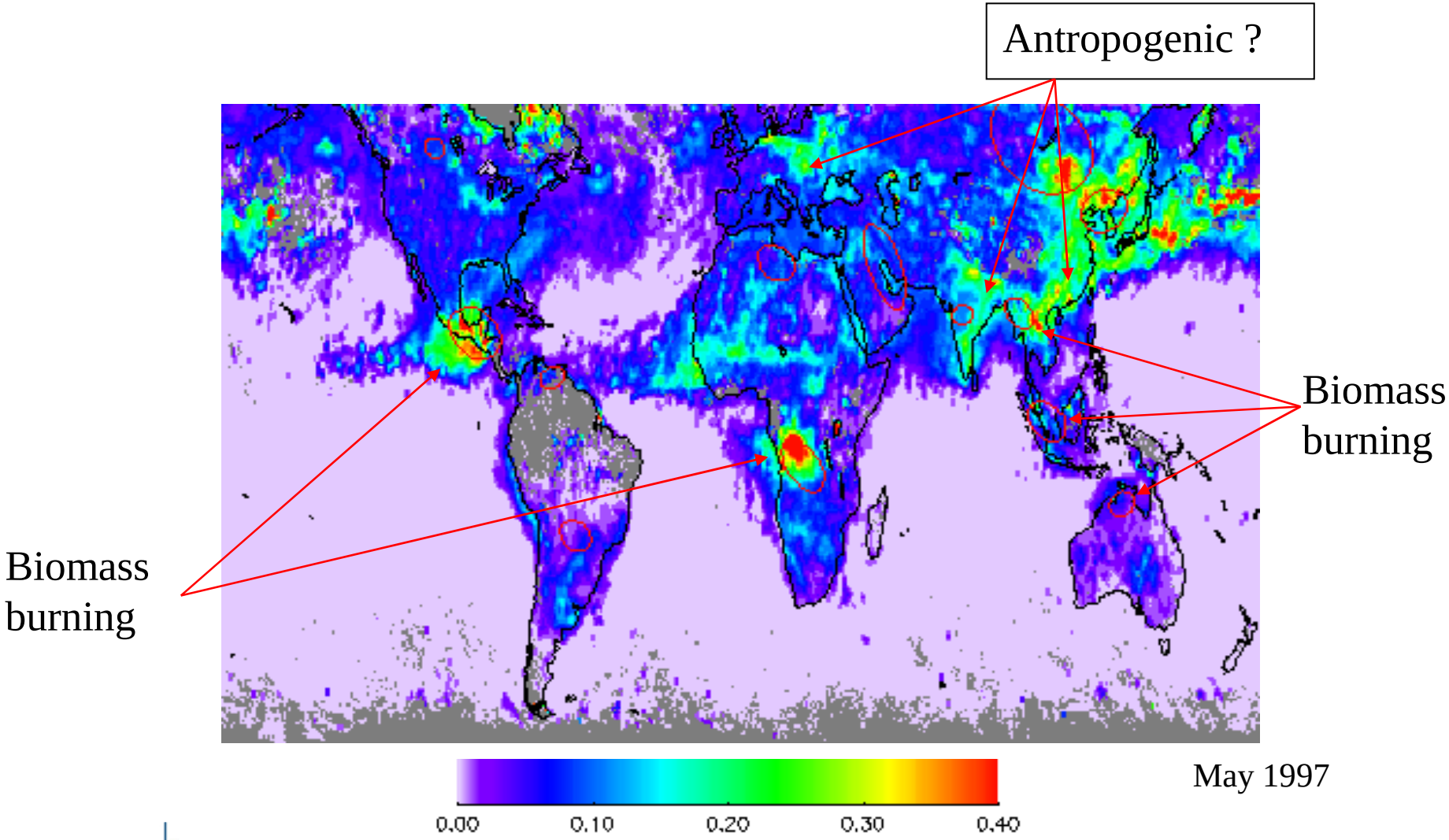




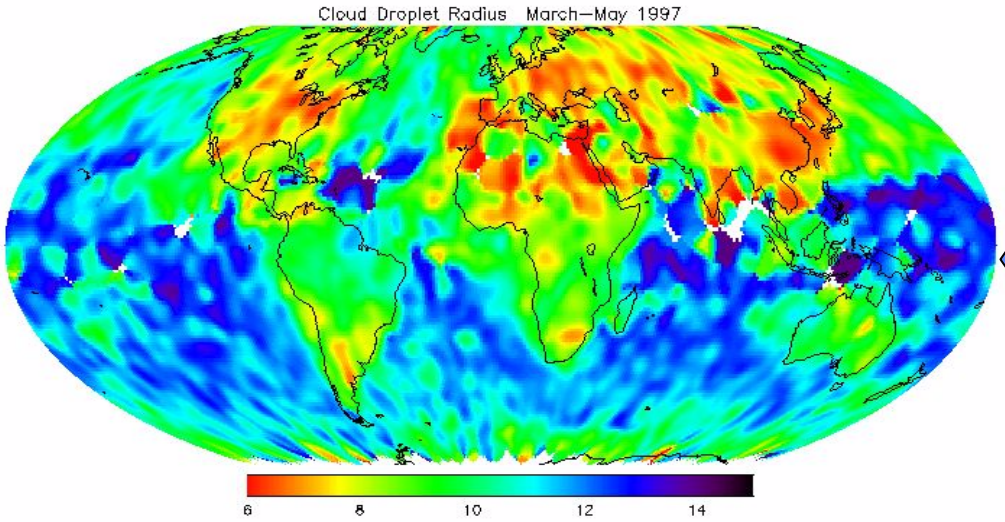
Oil / Gas industry

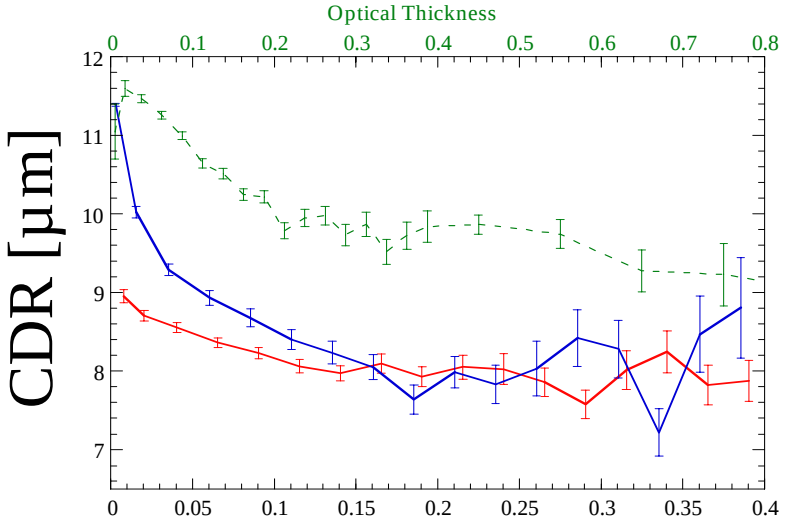
- Based on the observation of “hot spot” by the ERS/ATSR instrument
- Data processing at ESA-Frascati (Olivier Arino)
- Each red dot indicates one observation
- A-priori regions have been defined
- Ellipsis indicate the position and number of fires for each region

Aerosol index vs Biomass burning



Impact of Aerosol on Cloud Droplet Radius



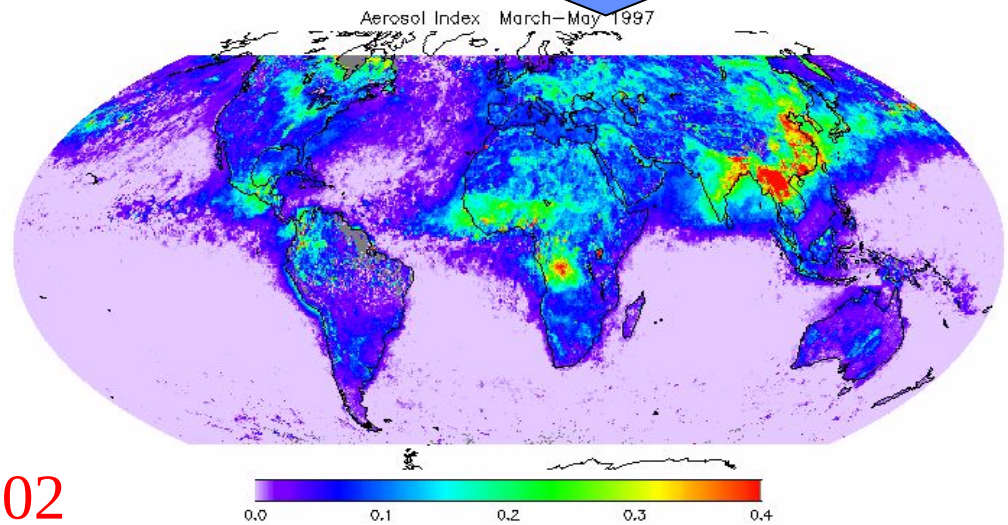


Aerosol Load

Measurements derived from POLDER/ADEOS

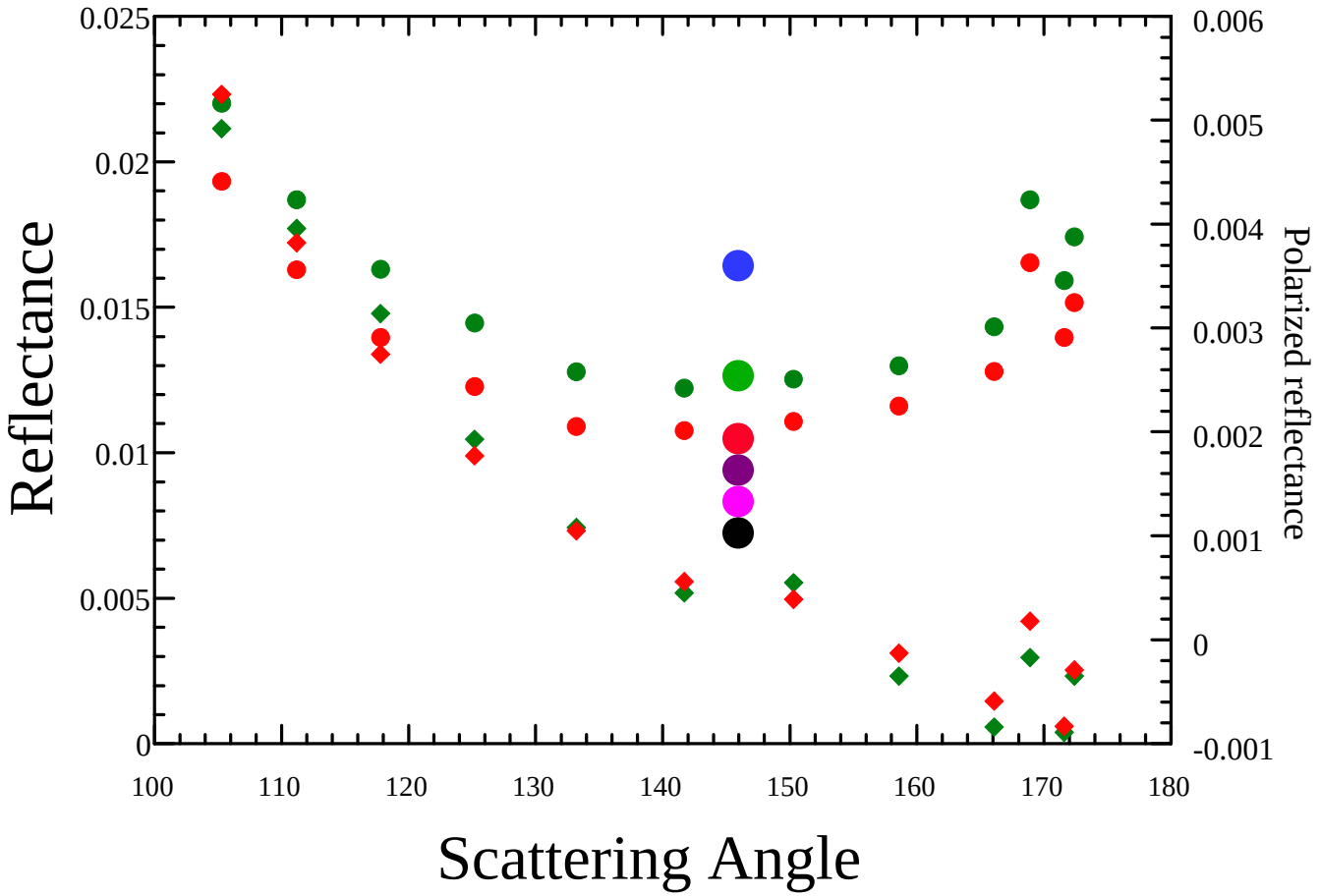
+ Aerosol => Smaller droplets

Very sensitive over the oceans, in particular for “clean” atmosphere



Bréon et al., *Science*, 2002

Perspective: POLDER-MODIS synergy



Further constrains on the aerosol model…