WHY

This poster is a powerful demonstration as to the value of global monitoring - from surface sites.

Well calibrated robots (under the umbrella of AERONET) measure atmospheric radiation under cloud free conditions. This permits a complete definition of all aerosol (column) properties: optical depth, size-distribution and absorption. Applications include evaluations of a-priori assumptions in satellite retrievals or ways to link surface and column data. Here, AERONET data in conjunction with satellite patterns set constraints to simulated aerosol properties and forcing.

Seasonal Aerosol Properties and Forcing

A global view based on AERONET statistics

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AERONET

a worldwide network of robotic **sun/sky photometers**

- supervised at NASA-Goddard [Holben, Eck, Smirnov, Tanre, Dubovik]
- **retrieved visible properties** up to 1/hour (sky-scanning mode) :
  - aerosol optical depth (regionally corrected with MODIS data)
  - aerosol absorption (refractive indices) ⇨ single scattering albedo
  - aerosol size-distribution (22 size-bins) ⇨ effective radius (vol/sur)
  - water vapor column (from direct attenuations at 0.94um wavelength)

Seasonal Averages

Statistics of 100 AERONET sites are displayed as seasonal averages

DJF:	December, January, February
MAM:	March, April, May
JJA:	June,July, August
SON:	September, October, November

The Earth's View – results are displayed in identical sized frames

Retrieved Properties

Aerosol optical depth *(upper left)*
regionally adjusted with MODIS retrievals

Aerosol absorption *(upper right)*
product of optical depth and co- single scattering albedo

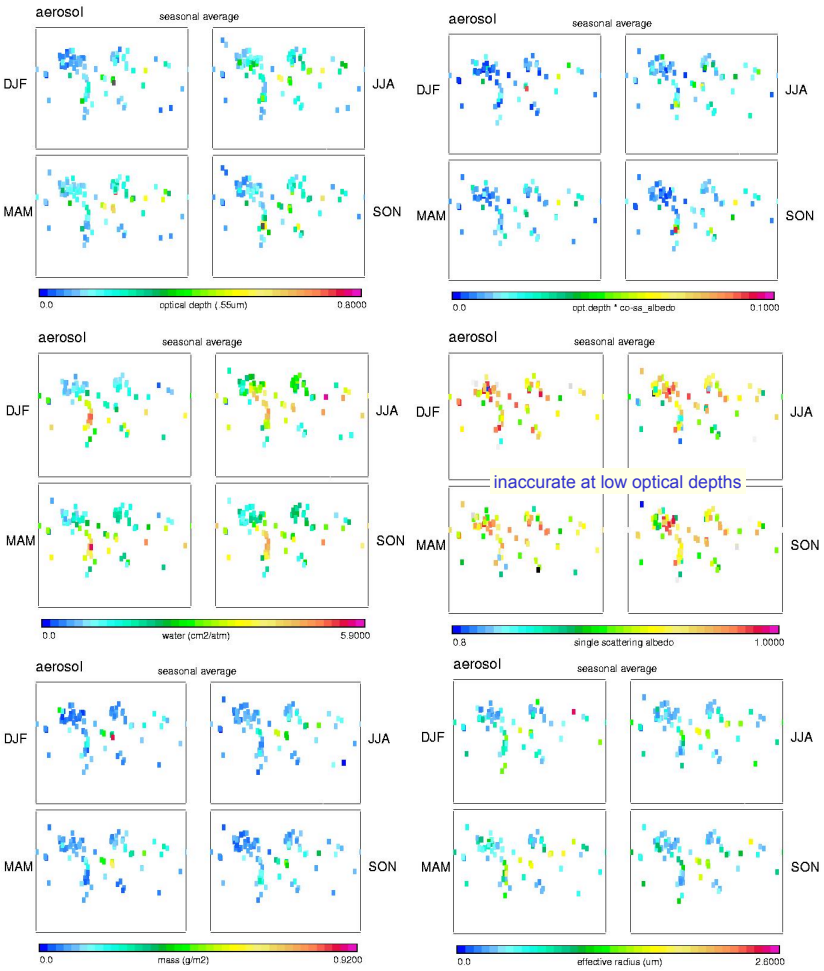
Atmospheric water vapor *(middle left)*
based on direct attenuation in the .94µm water band

Aerosol single scattering albedo *(middle right)*
low values at low opt.depth (<0.3) cloud be misleading

Aerosol mass *(lower right)*
'wet' aerosol mass based on retrieved size-distribution

Aerosol effective radius *(lower right)*
volume to surface area ratio of retrieved size-distributions

(note: black squares in figure exceed the maximum on the given [linear] scale)



Forcing

What is aerosol forcing?

The resulting difference to the atmospheric energy balance from [simulations with aerosol] ***minus*** [simulations without aerosol]

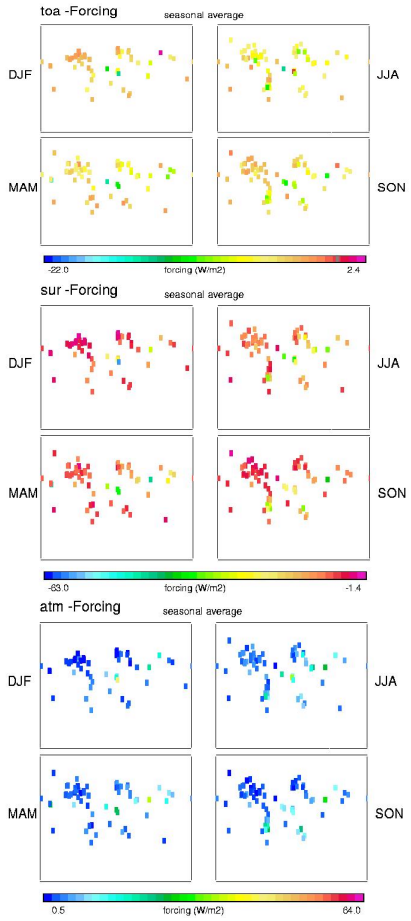
What data were used?

- apply AERONET data to prescribe the aerosol properties
- apply MODIS retrievals (at diff. scales) to remove local character
- apply MODIS based solar surface albedos (visible and near-IR)
- apply cloud statistics (ISCCP) high/mid/low cloud-cover (optional)

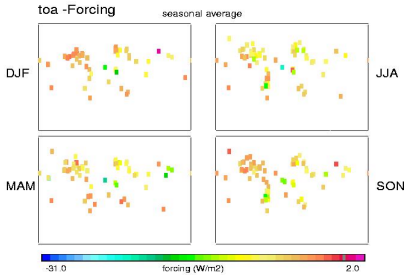
What quantities were calculated?

- net-flux changes (W/m2) at top of atmosphere ('climate' effect)
- net-flux changes (W/m2) at the surface (⇨ surface processes)
- net-flux changes (W/m2) in the atmosphere (⇨ atm. dynamics)

Forcing with ISCCP clouds



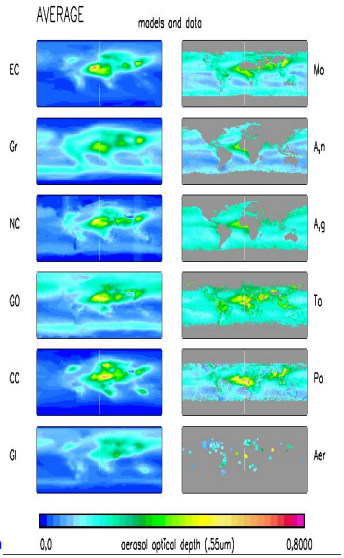
Forcing without clouds



Take Home Message

AERONET inversions define all aerosol properties
- many comparisons to other methods possible !

for example aerosol optical depth *(yearly averages)* ⇨



AERONET statistics combined with satellite data
- can extend local statistics to regional averages
- can permit regional forcing estimates (surf.albedo)

Aerosol Direct **FORCING** is influenced by
- location *(length of day / sun-elevation)*
- underlying surface *(e.g. water vs. clouds or ice)*
- aerosol concentration and
- aerosol type *(size and composition)*

with these particular aerosol type tendencies…

biomass: less likely to cool (ToA), strong atmos. heating
dust: more likely to cool (ToA), weak atmos. heating
urban: atmospheric heating increases with pollution

… many detected forcing results are better understood

clouds: reduce forcing (to about 2/3 of clear-sky value)

Models
EC - ECHAM4 (GCM)
GR - Grantour (GCM)
NC - NCAR (GC/TM)
GO - GOCART (CTM)
CC - CCSR (CTM)
GI - GISS (GCM)

Satellites/Ground
Mo - MODIS (.55µm)
A,n - AVHRR (.63µm)
A,g - AVHRR (.55µm)
To - TOMS (.55 µm)
Po - POLDER (.87µm)
Aer - Aeronet (.55µm)

note: all data are shown refer to .55µm wavelength