

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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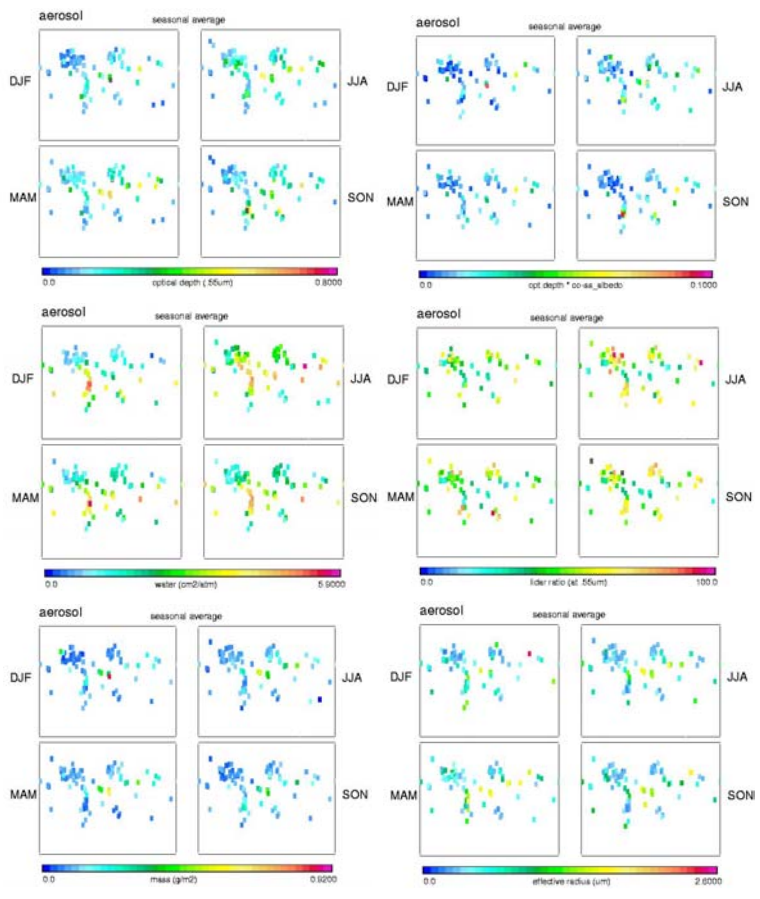
AERONET

- 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) \leftrightarrow single scattering albedo
 - aerosol size-distribution (22 size-bins) \leftrightarrow effective radius (vol/sur)
 - water vapor column (from direct attenuations at 0.94 μ m 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

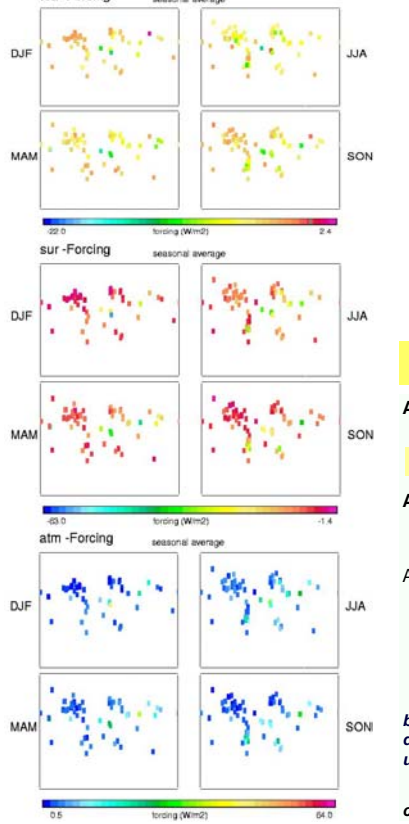
The Earth's View - results are displayed in identical sized frames



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 .94 μ m water band
 - Lidar ratio (extinction / backscatter) (middle right) based on retrieved aerosol size / ref.index (at 0.55 μ m)
 - 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 with ISCCP clouds



Forcing

What is aerosol forcing?
 The resulting difference to the atmospheric energy balance from [simulations with aerosol] minus [simulations without aerosol]

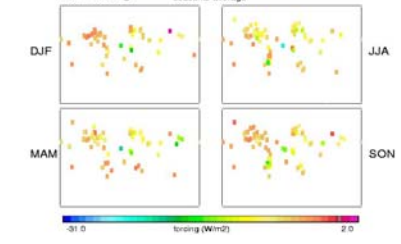
What data were used?

- 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 (\leftrightarrow surface processes)
- net-flux changes (W/m2) in the atmosphere (\leftrightarrow atm. dynamics)

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) \leftrightarrow

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...

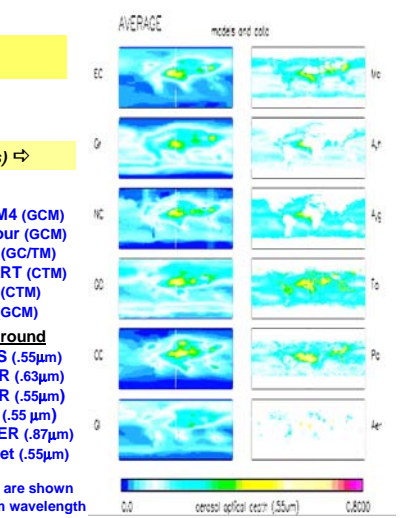
biomass: less likely to cool (ToA), strong atmos. heating

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/CM)
 - GO - GOCART (CTM)
 - CC - CCSR (CTM)
 - GI - GISS (GCM)
- Satellites/Ground**
- Mo - MODIS (.55 μ m)
 - A,n - AVHRR (.63 μ m)
 - A,g - AVHRR (.55 μ m)
 - To - TOMS (.55 μ m)
 - Po - POLDER (.87 μ m)
 - Aer - Aeronet (.55 μ m)
- note:** all data are shown refer to .55 μ m wavelength