WHY

Aerosol introduces one of the largest uncertainties in climate research. Aerosol originates from different sources and has short life-times on the order of a few days. Thus, aerosol properties (amount, size and absorption) and aerosol altitude vary strongly in space and time. Any estimates for the associated impact on the Earth's climate are further complicated, because underlying surface (solar albedo), co-located clouds and available sun-light also influence the eventual radiative forcing (which captures imposed changes to the radiative energy balance). As radiative forcing continuously changes not only in magnitude but also in sign, the overall impact (daily average, regional average or even global average) is made up by differences of larger numbers. Moreover, aerosol and environ-mental properties are usually poorly defined. Thus, the aerosol radiative forcing attributed to aerosol is highly uncertain – even when integrating over time. Here results from radiative transfer simulations are presented. These calculations only address the impact due to the presence of aerosol in the atmosphere (direct effect – no feedbacks). Monthly statistics of data for aerosol properties and for environmental properties were assembled. Based on these data-sets aerosol forcings are determined separately for solar and infra-red spectral regions, for total aerosol and its anthropogenic fraction and for clear-sky (no clouds) and all-sky (cloudy) conditions.

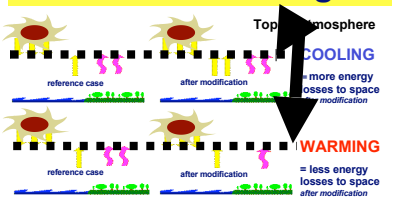
Aerosol (direct) Radiative Forcing

a measurement approach … with modeling support

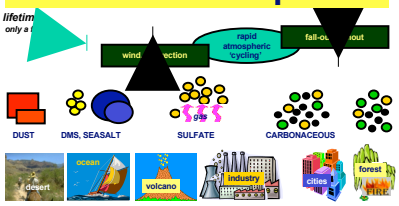
S. Kinne (1)
the AERONET-group (2)
and the AeroCom modeling community

(1) Max-Planck Institute for Meteorology, Hamburg
(2) NASA Goddard Space Flight Center, Greenbelt

'climate' forcing

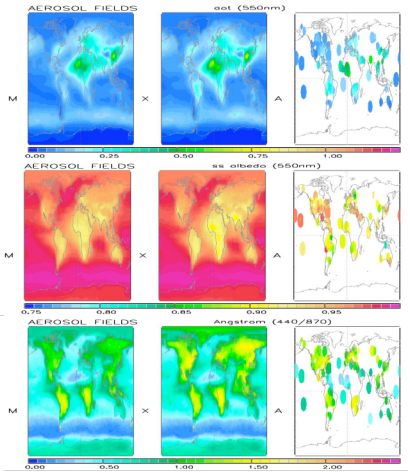


aerosol is complex !



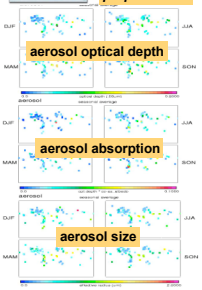
forcing approach

aerosol input data

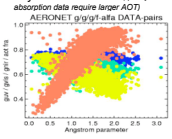


AERONET

'quasi'-global seasonal properties of

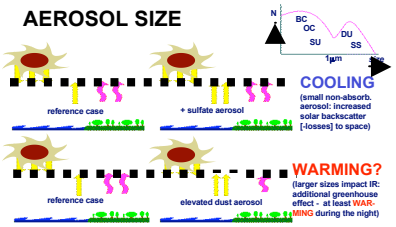


AERONET - data for size and absorption are based on inversions of sky-radiance data *(quality absorption data require larger AOT)*

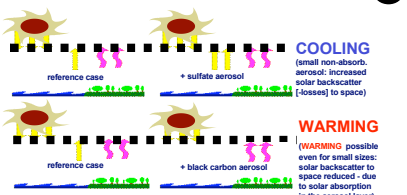


critical parameters

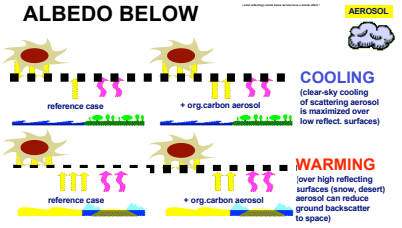
AEROSOL SIZE



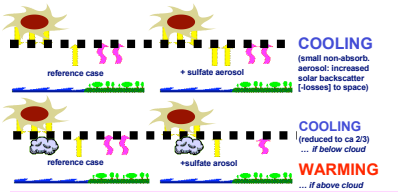
AERO. ABSORPTION



ALBEDO BELOW



CLOUD PRESENCE



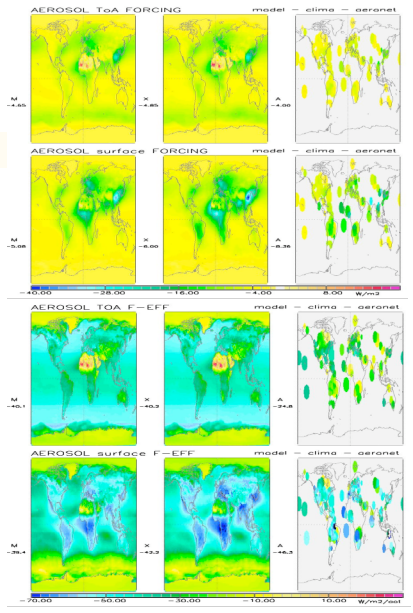
not only magnitude but … **even the sign of forcing is affected!**

forcing results

annual ***AEROSOL FORCING***

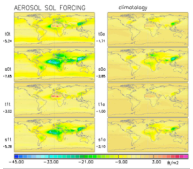
annual ***AEROSOL F. EFFICIENCY***

NEXT



label – explanation

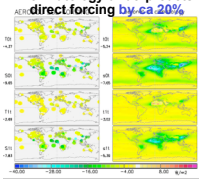
- **t0t** – ToA / clr / total
- **s0t** – surf / clr/ total
- **t0a** – ToA / clr / anthr
- **s0a** – surf / clr / anthr
- **t1t** – ToA / all / total
- **s1t** – surf / all / total
- **t1a** – ToA / all / anthr



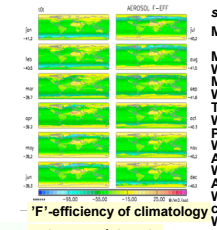
comparison at all sites

	Anet	clima	
t0t	- 6.7	- 4.5	W/m2
s0t	-11.5	- 9.5	W/m2
t1t	- 4.1	- 2.7	W/m2
s1t	- 9.1	- 7.8	W/m2

AERONET data suggest : climatology underpredcts direct forcing by ca 20%

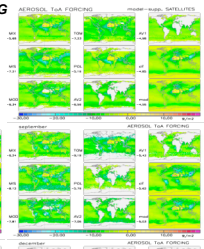


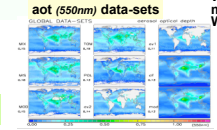
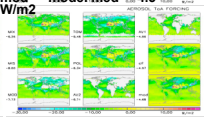
clear-sky ToA Forcing (based on simulated efficiencies, +satellite aot)



sample corrected ToA FORCING

MIX	– composite	5.6 W/m2
MOD	– MODIS	7.2 W/m2
MIS	– MISR	6.3 W/m2
TOM	– TOMS	7.8 W/m2
POL	– POLDER	5.7 W/m2
AV1	– AVHRR, 1ch	6.1 W/m2
AV2	– AVHRR, 2ch	5.1 W/m2
cli	– climatology	4.8 W/m2
mod	– model med	4.5 W/m2



'F'-efficiency of climatology

aot ***(550nm)*** **data-sets**