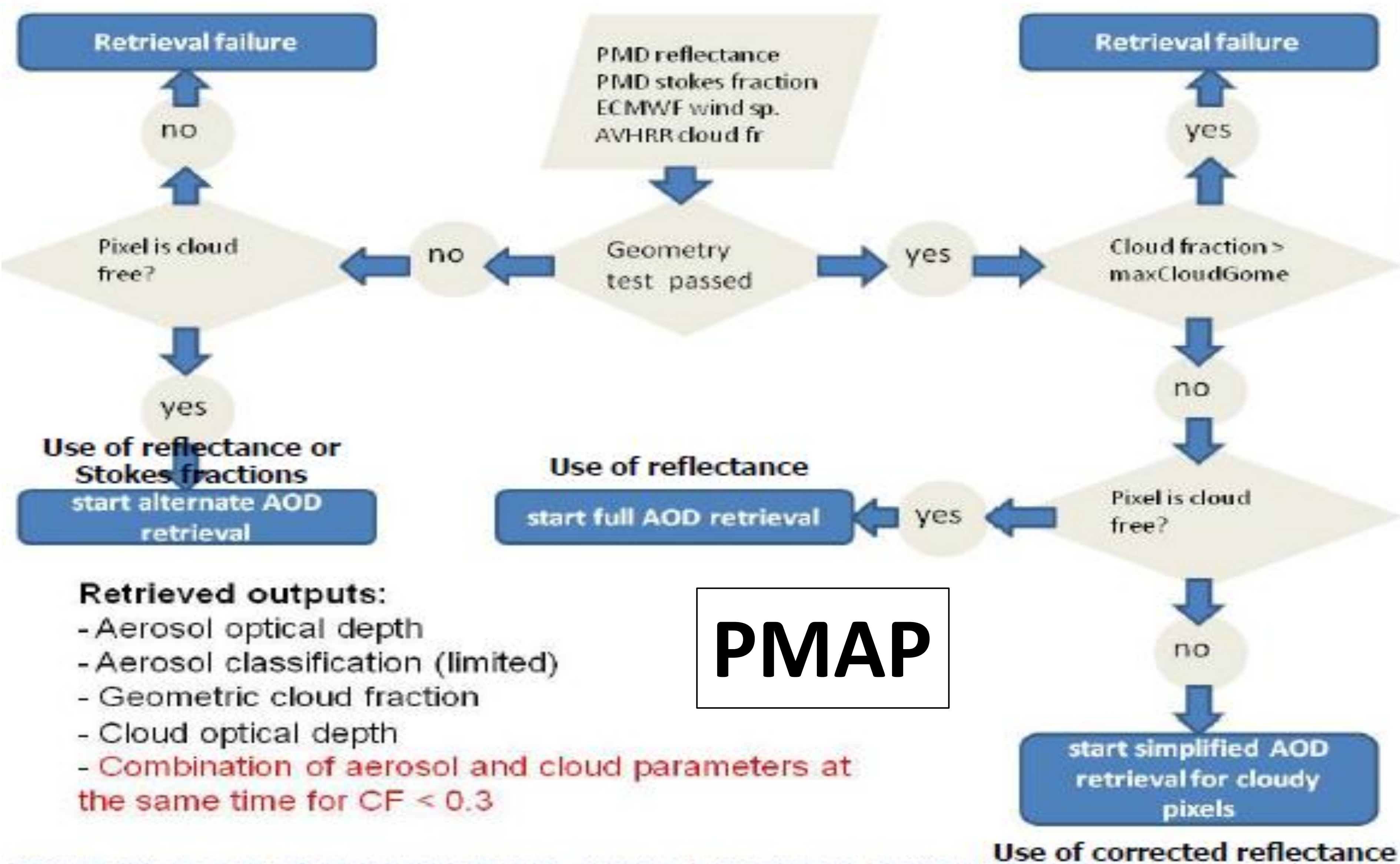
A brief recall

aerosol (satellite) **retrievals**

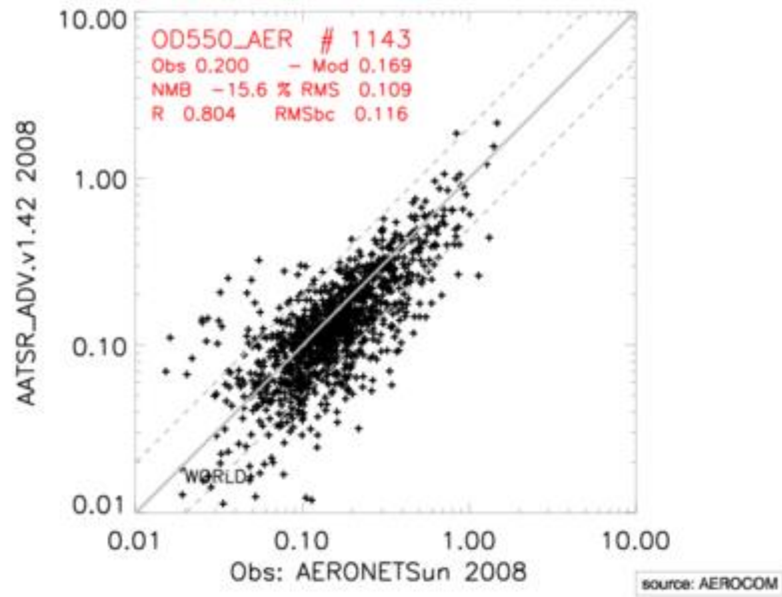
- Thomas, Kolmonen, Lang, Sayer, Xue, Wagner, Povey, Duan, Stap, deVries, Yoon, Fan, Mazolla, Sogocheva, Sano, Penning de Vries

- new ideas
- evaluations
- uncertainties
- by association

new retrieval concepts

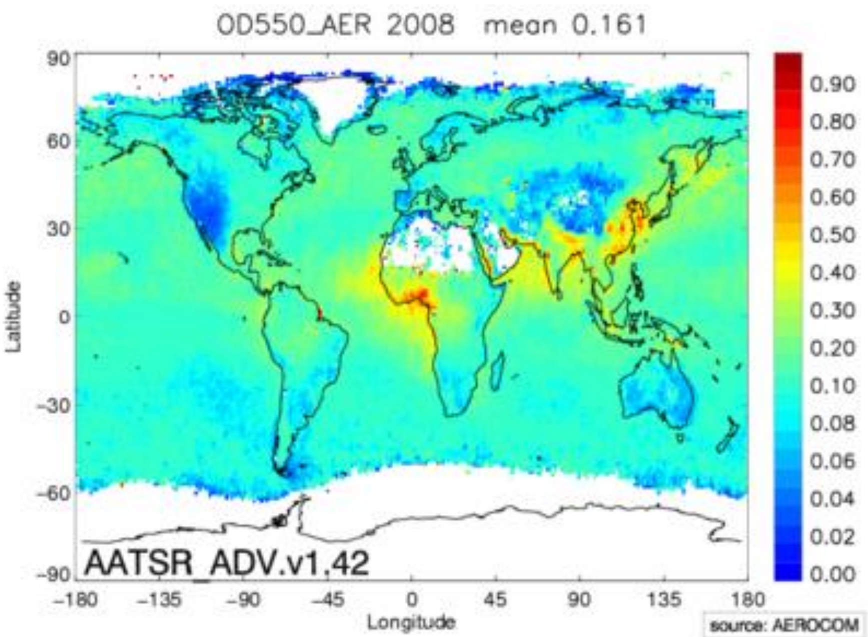


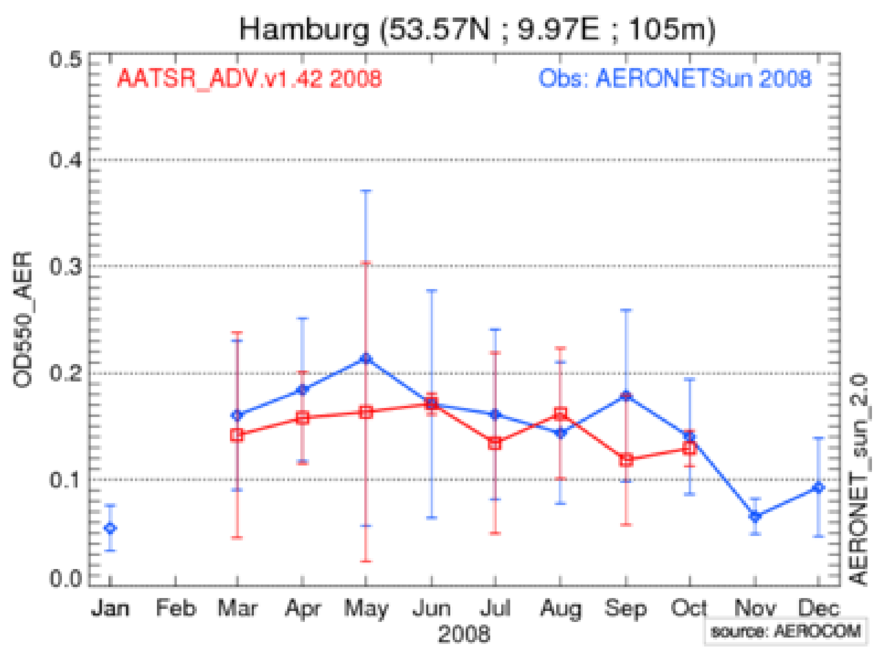
AOD evaluation



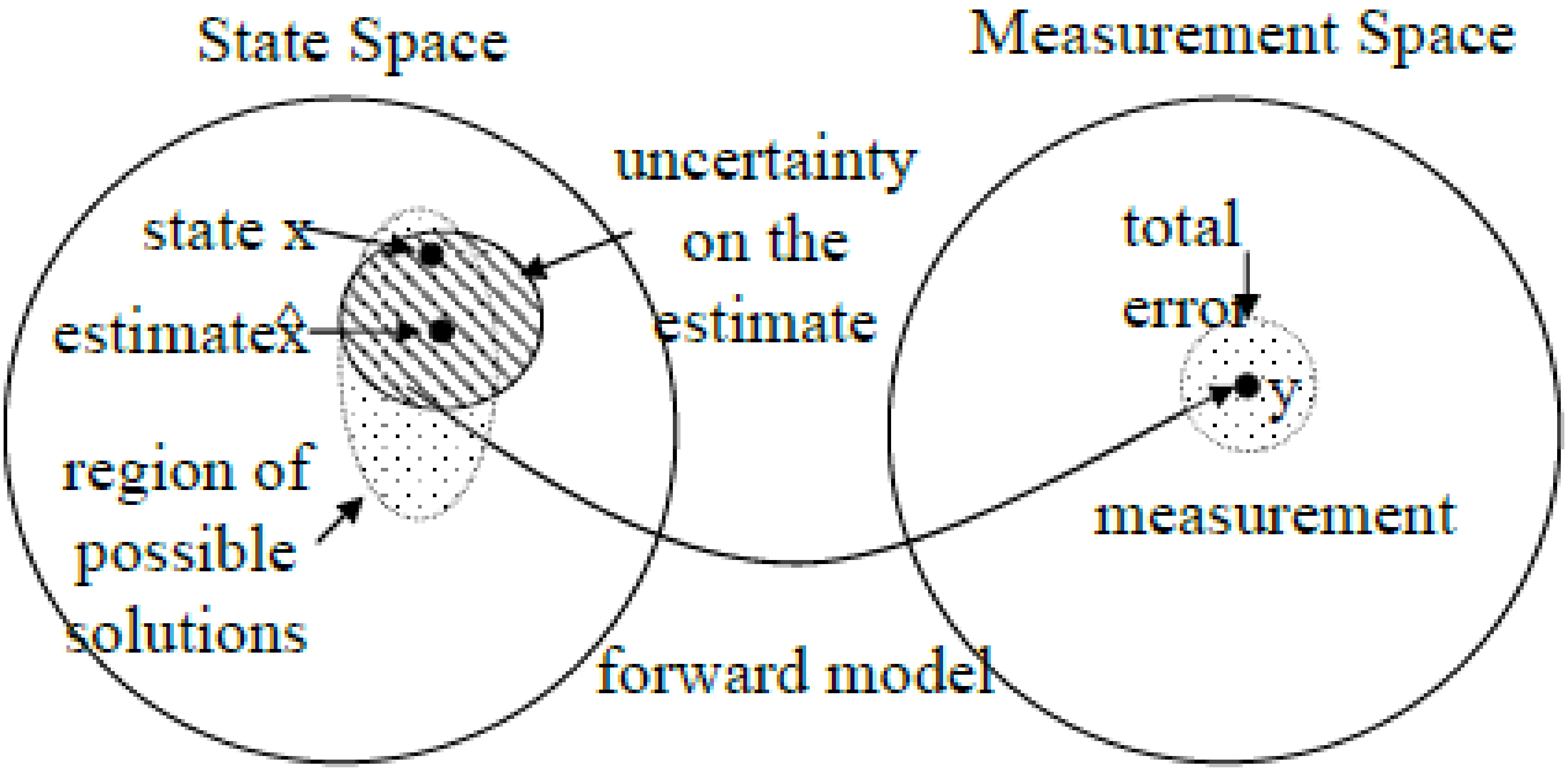
here for ...

AATSR-ADV Level 3 (1º x 1º grid) for 2008 against AERONET (using several AeroCom tools)

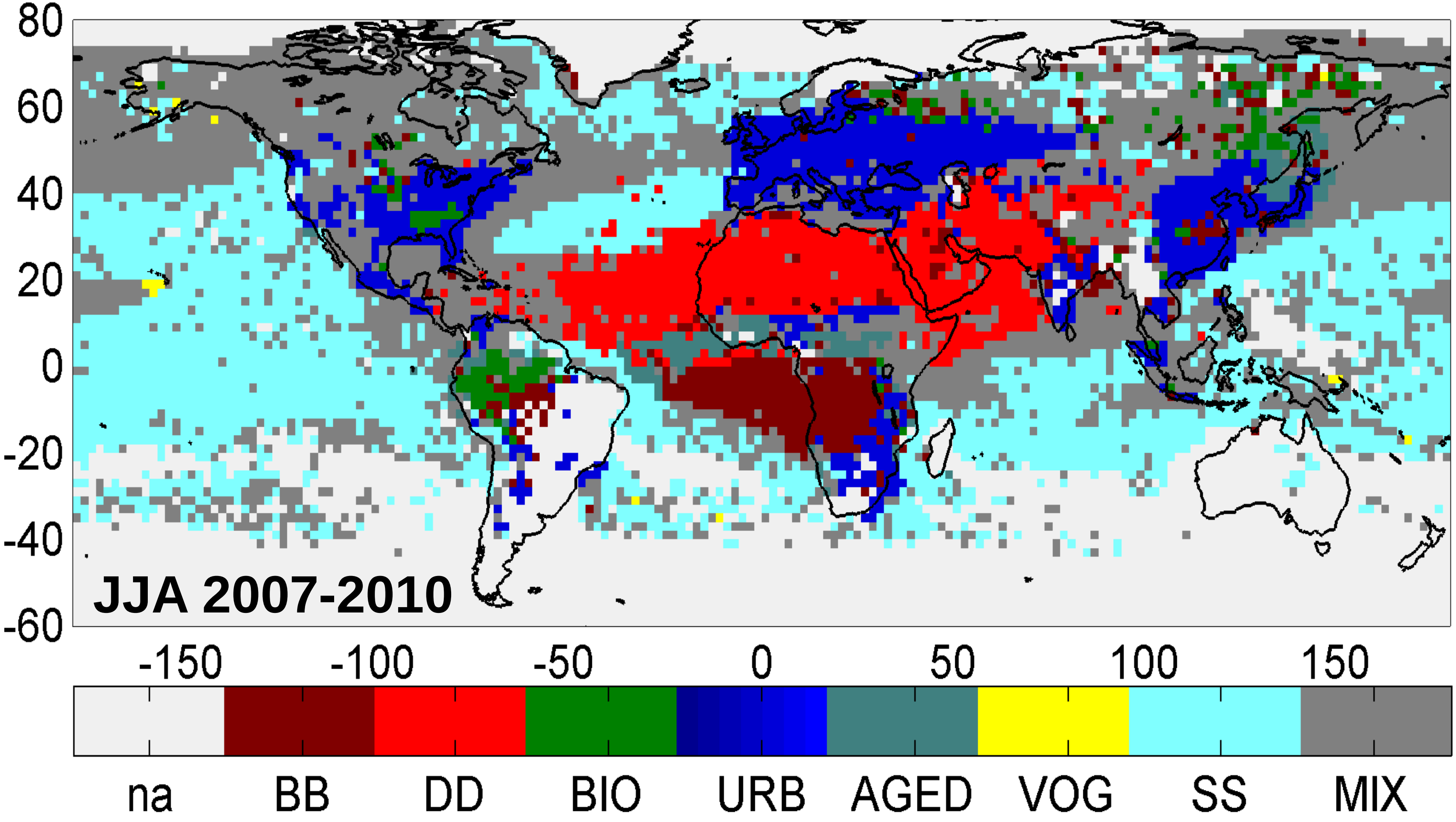




estimating pixel uncertainty



general typing by ‘association’

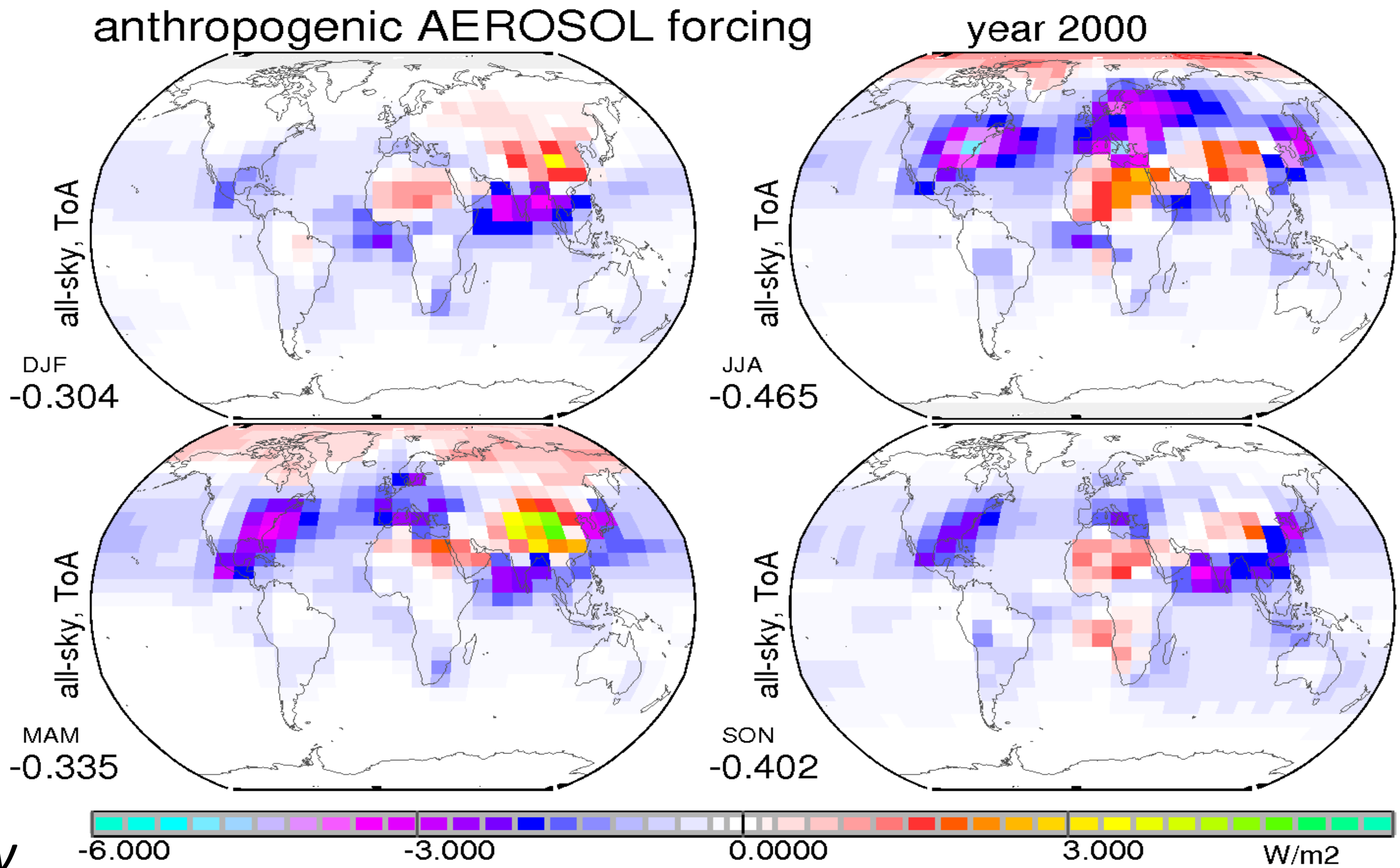


Aerosol types: BB – biomass burning, DD – desert dust, BIO – (sec.) biogenic, URB – (sec.) urban, VOG – volcanic sulfate, AGED – aged or transported, SS – sea salt (na – not assessed)

direct aerosol (rad. transfer) **impacts**

- Tomasi, Arola, Doppler, Kinne
  - global
  - regional
  - local
  - instantaneous

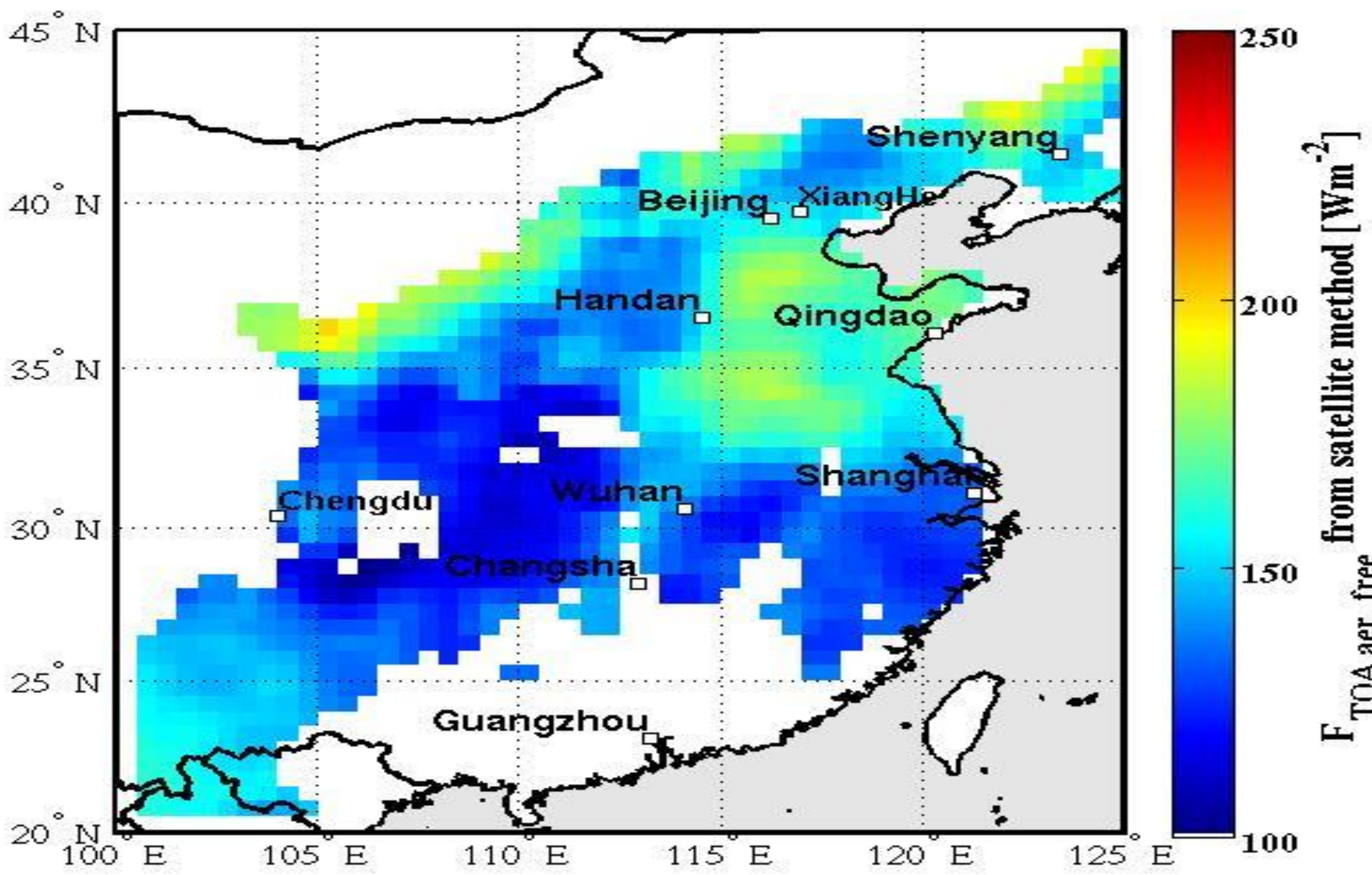
global distributions



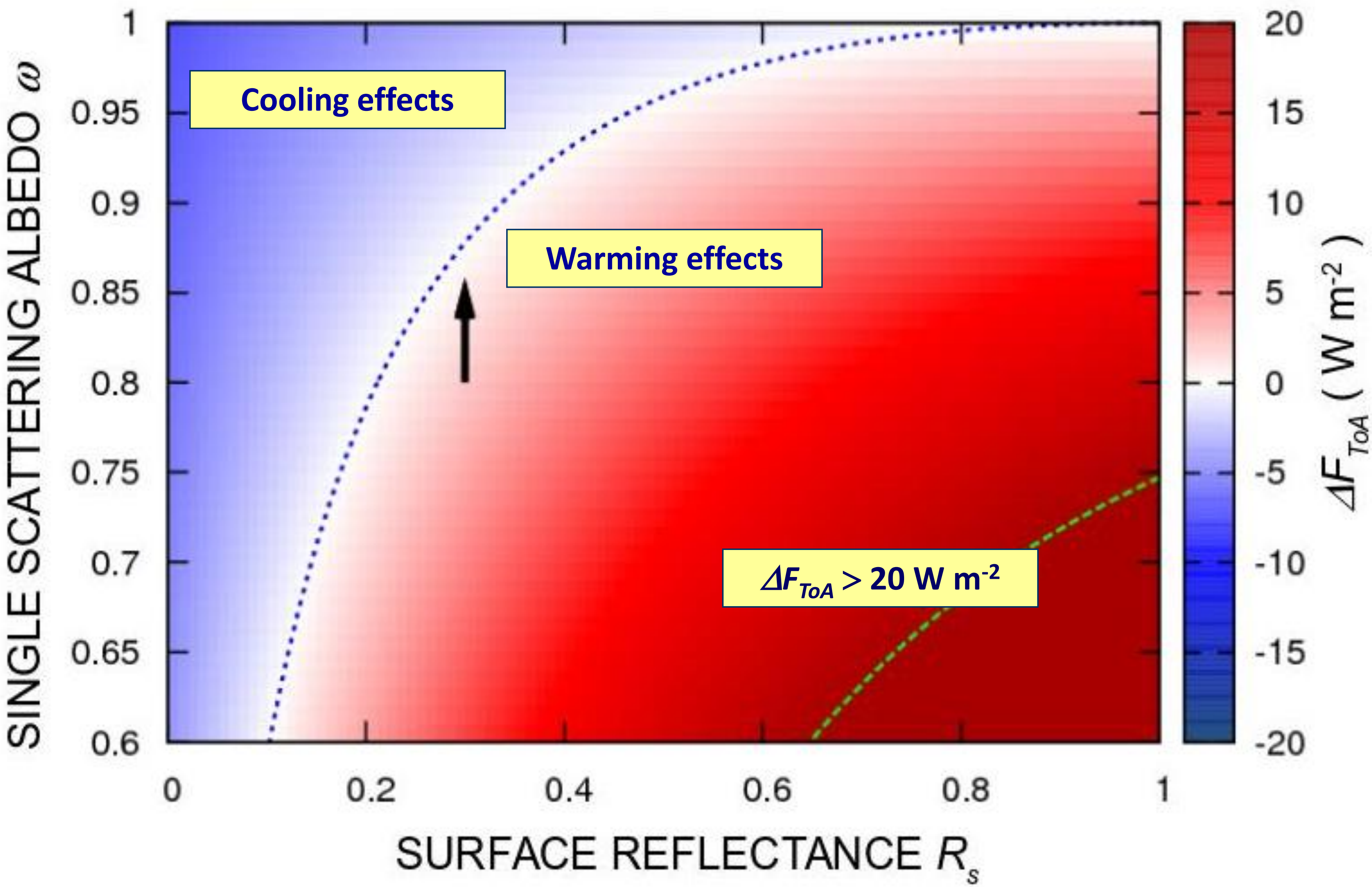
by season

← climate cooling climate warming →

MODIS +CERES → clear-sky forcing



forcing sensitivities



cloud (satellite retrievals)

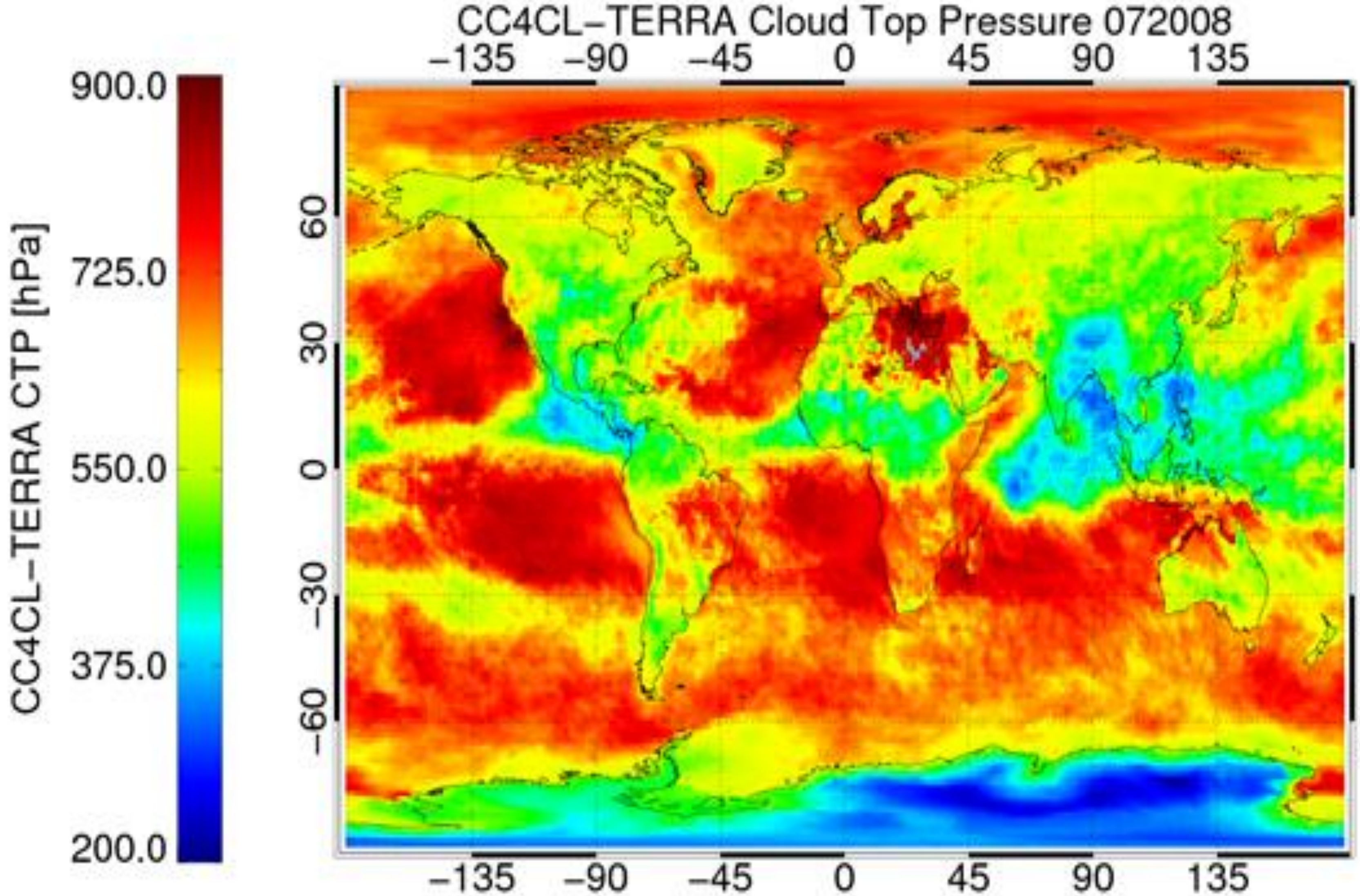
- Hollmann
- Devasthale
- Thomas
- Grosvenor

,CO

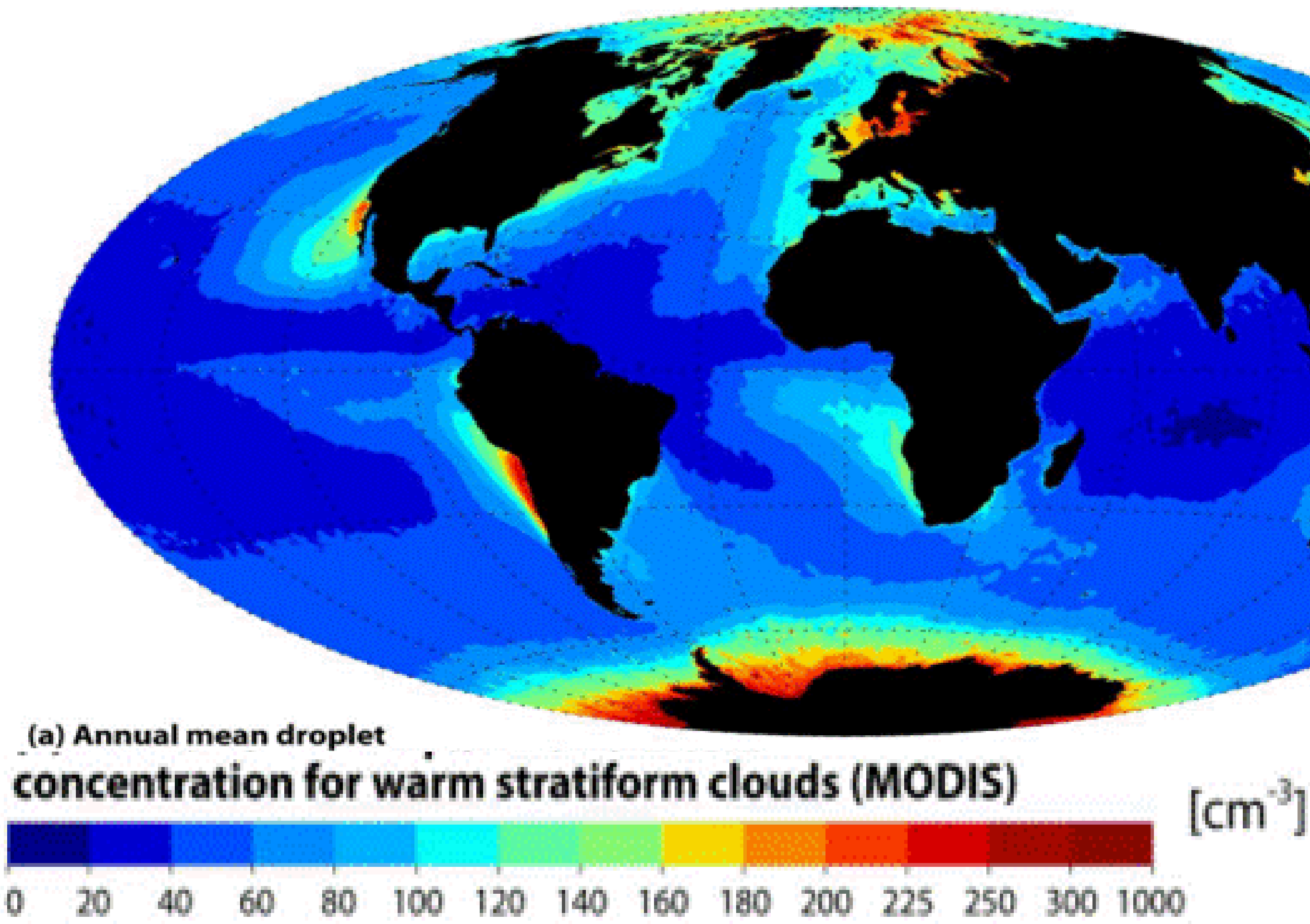
- MODIS (Aqua+Terra) [DWD]
- AVHRR (NOAA-15, 16, 17) [DWD]
- AATSR [RAL]

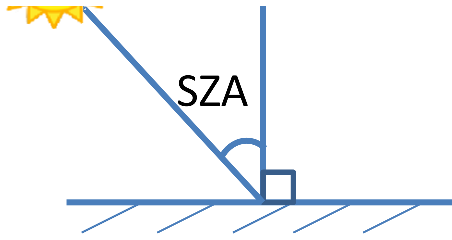
cloud cci

cloud top pressure



MODIS mean droplet concentration
for liquid water clouds >80% 1x1 cloud fractions



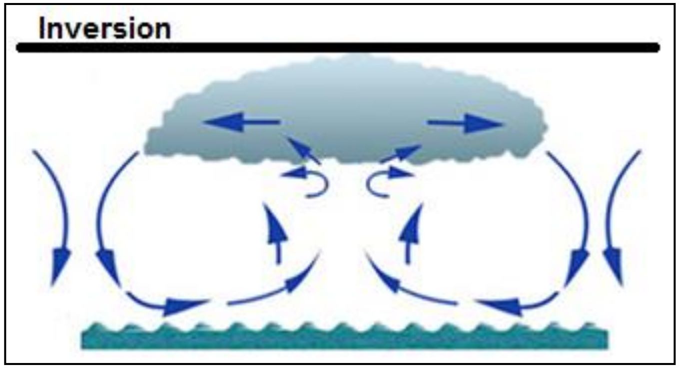


- **investigating high N_d values near Antarctica**

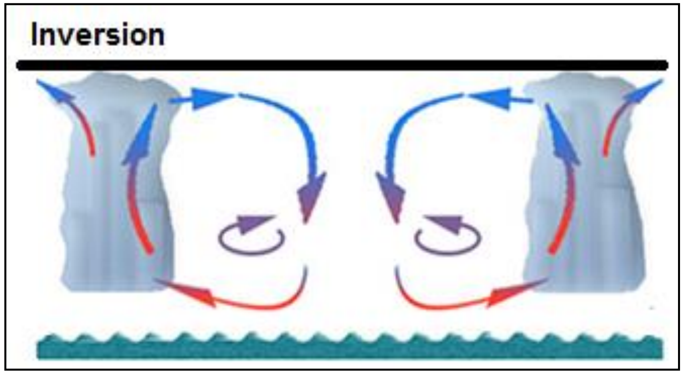
aerosol-clouds

- Modeling
  - Quaas
  - Rosenfeld
  - Chang
  - Neubauer
- Observations
  - Devasthale AVHRR / MODIS
  - Lelli GOME / SCIAMACHY
  - Costantino POLDER/ MODIS / CALIPSO

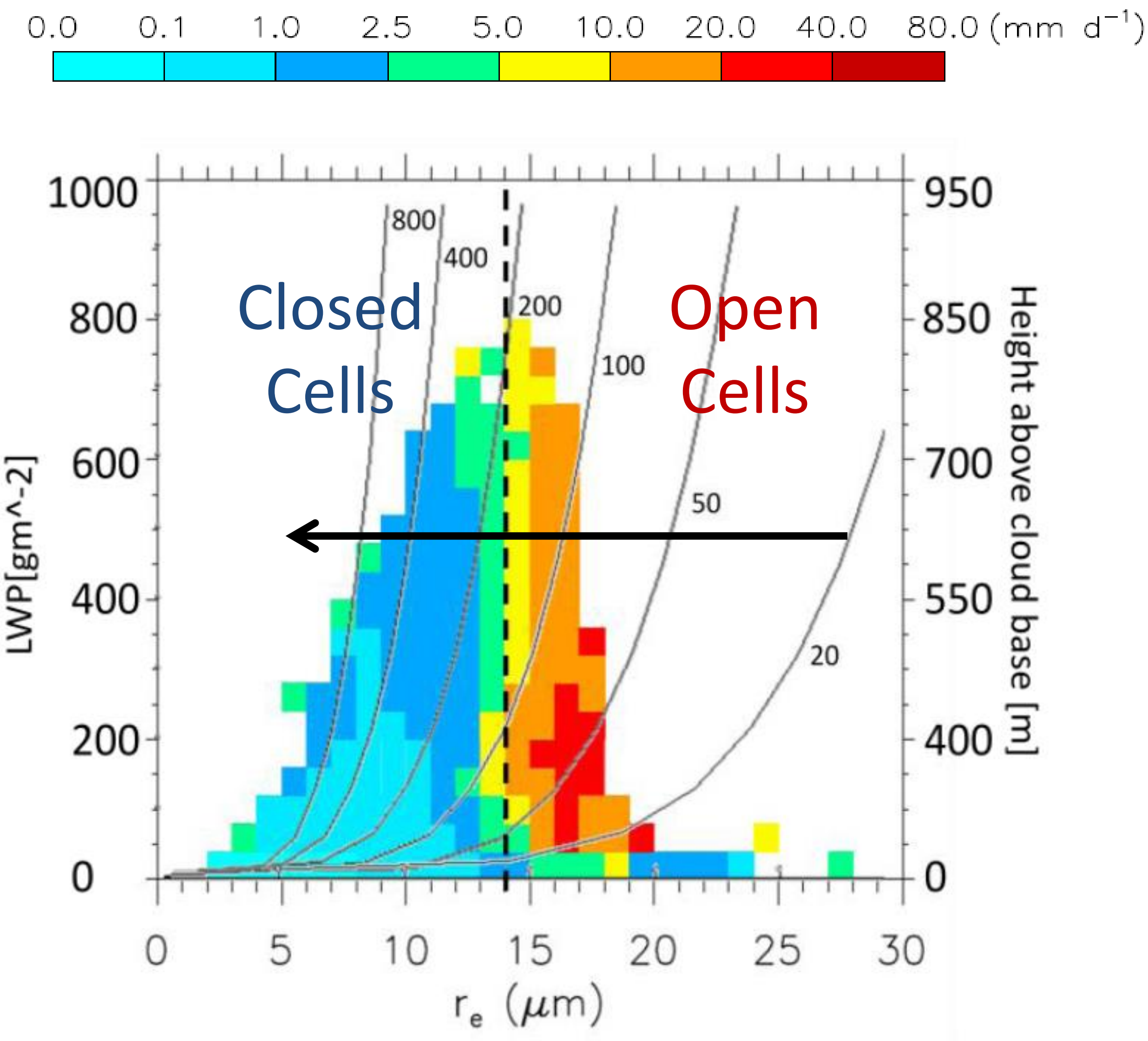
Closed cells



Open cells

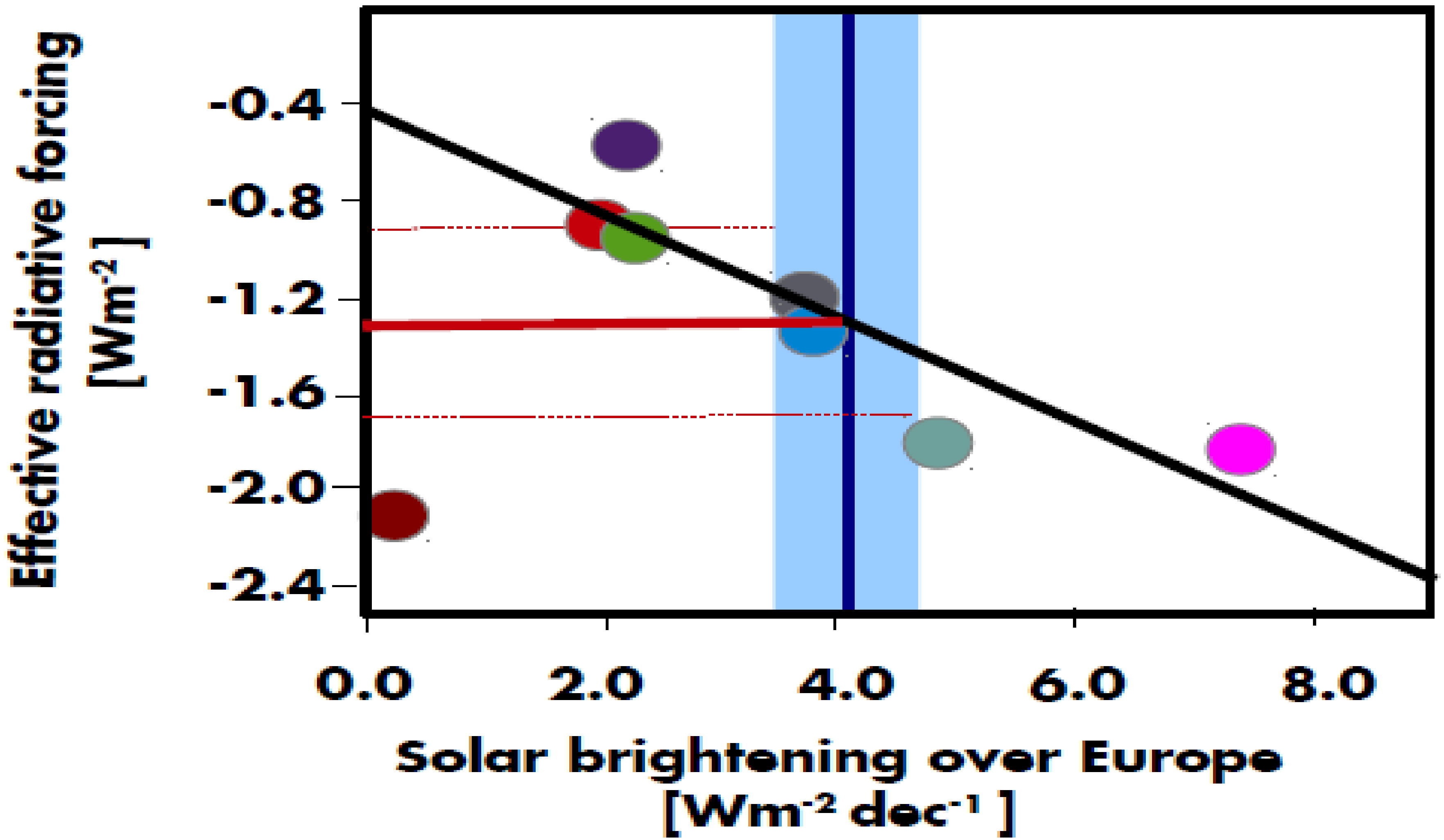


Can aerosols close open cells?



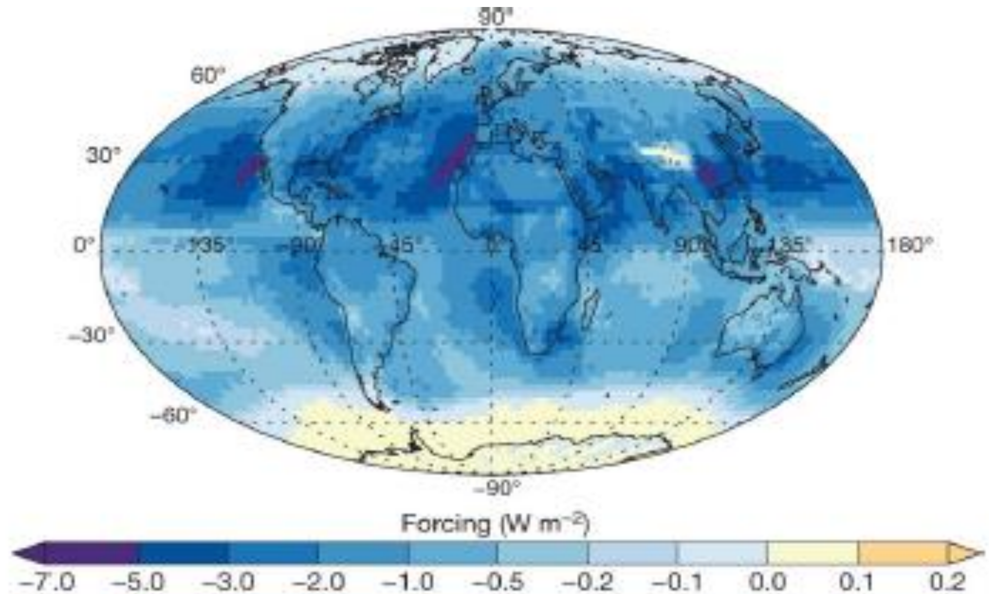
Rosenfeld et al., 2012

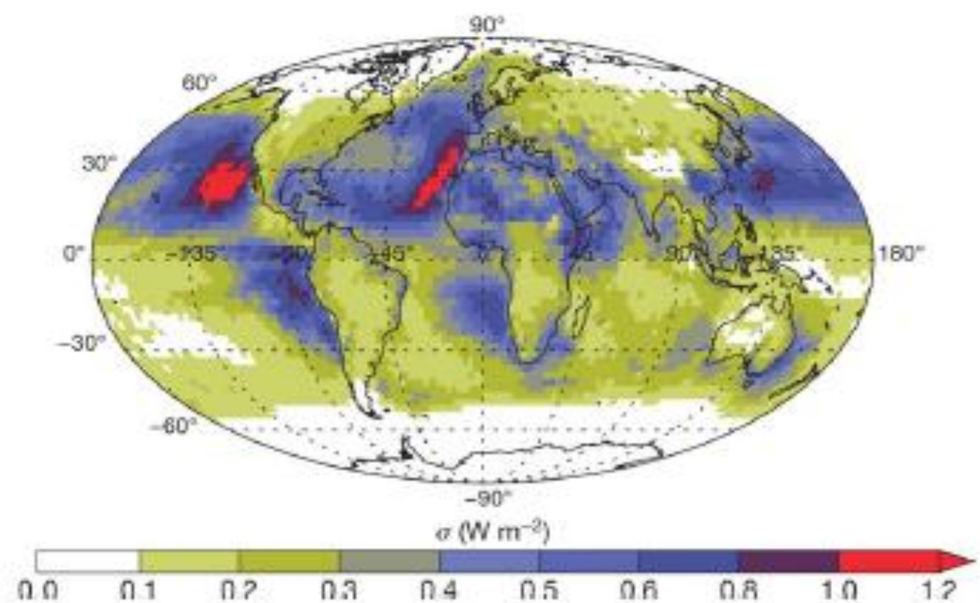
inferred … **-1.4** **W/m2** (+/- 0.3) **cooling**



-1.2W/m2 (+/- 0.4)

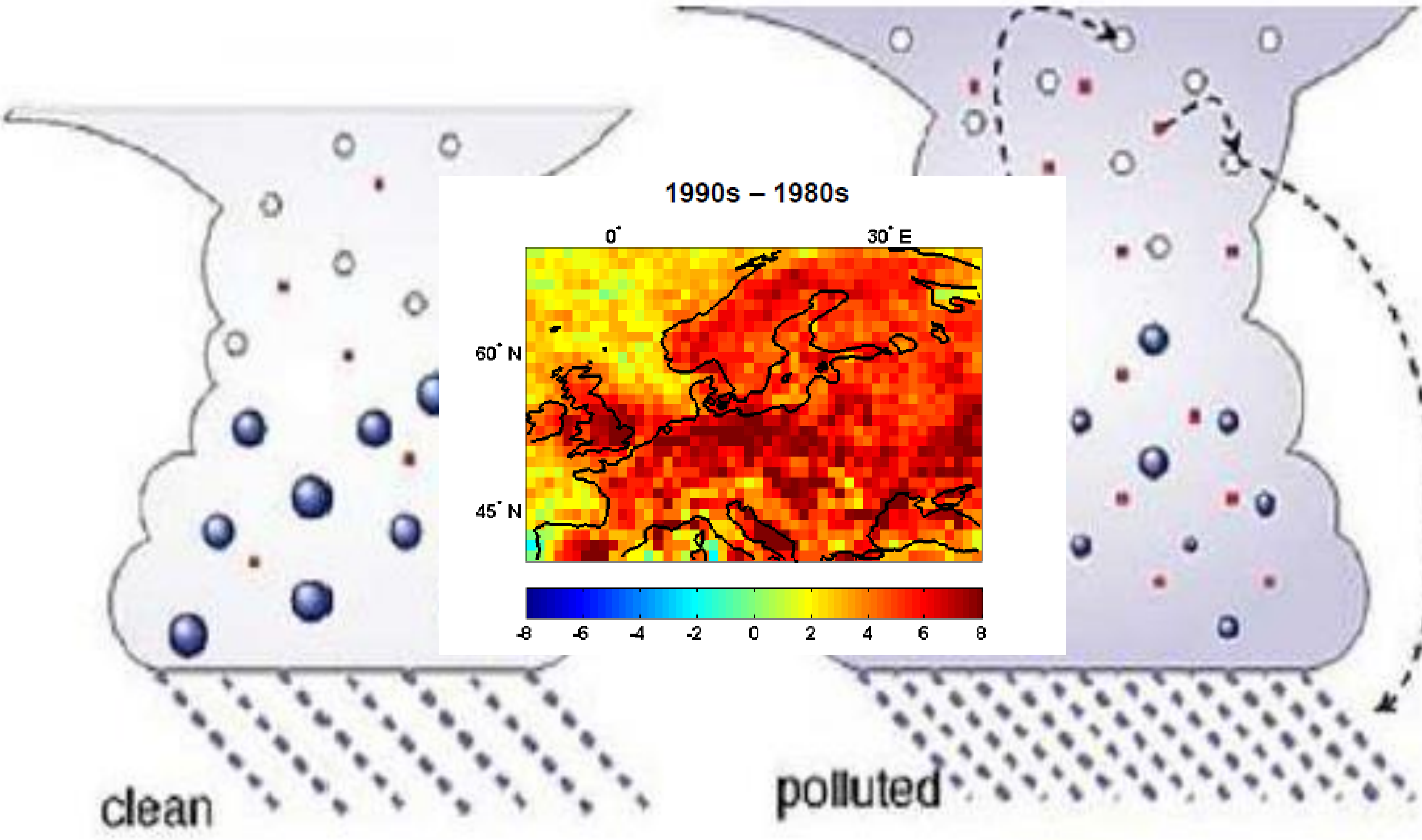
- Uncertainty sources of anthropogenic aerosol effect
- Natural/anthropogenic emissions most important
- Aerosol processes cause 14% of variance
- Low-level stratified clouds from ISCCP data



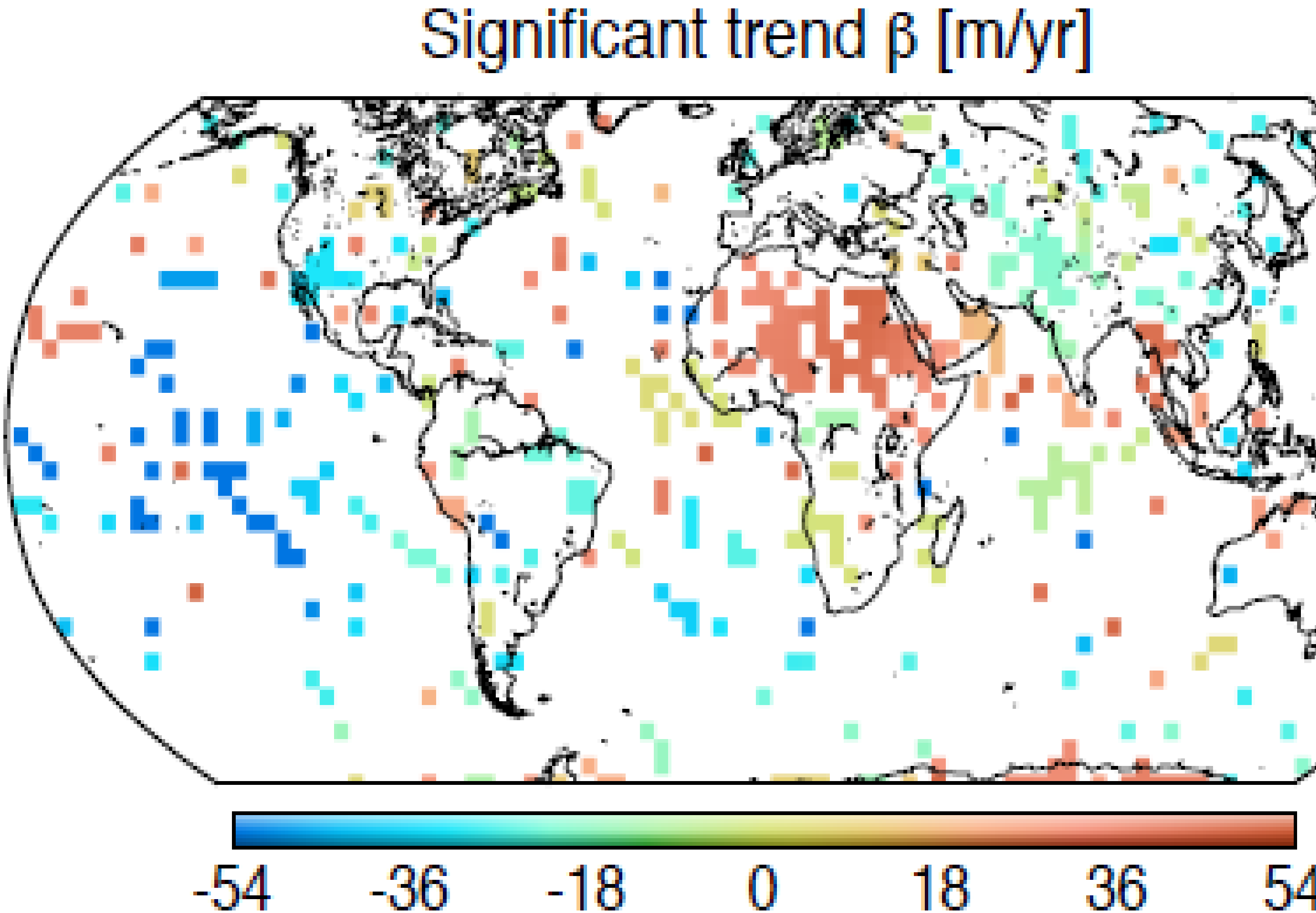


anthropogenic aerosol indirect effect (top) and uncertainty (bottom)

pollution ~ cloud-top height

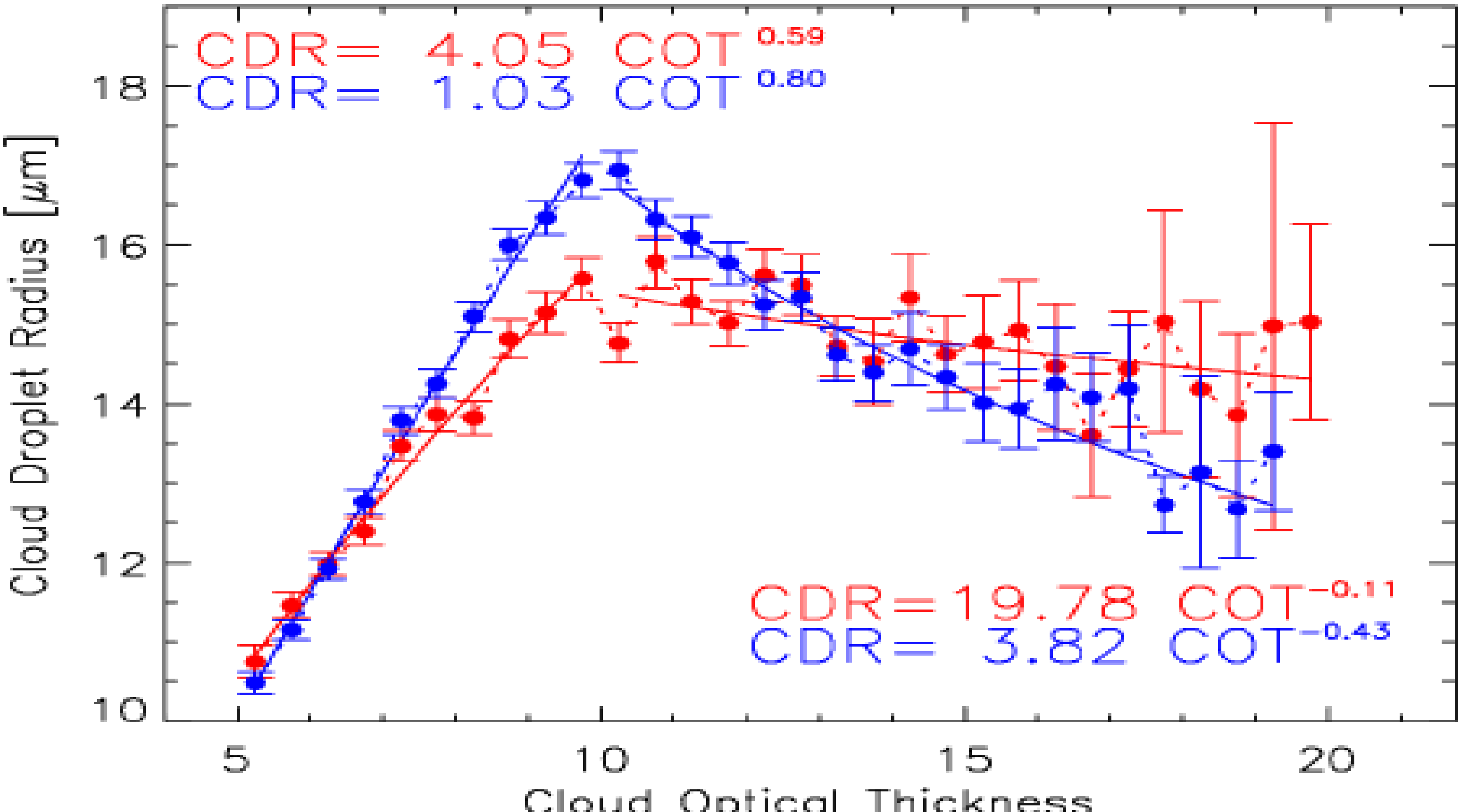


cloud-top height trends (O2-band)



pollution ~ 1/precipitation

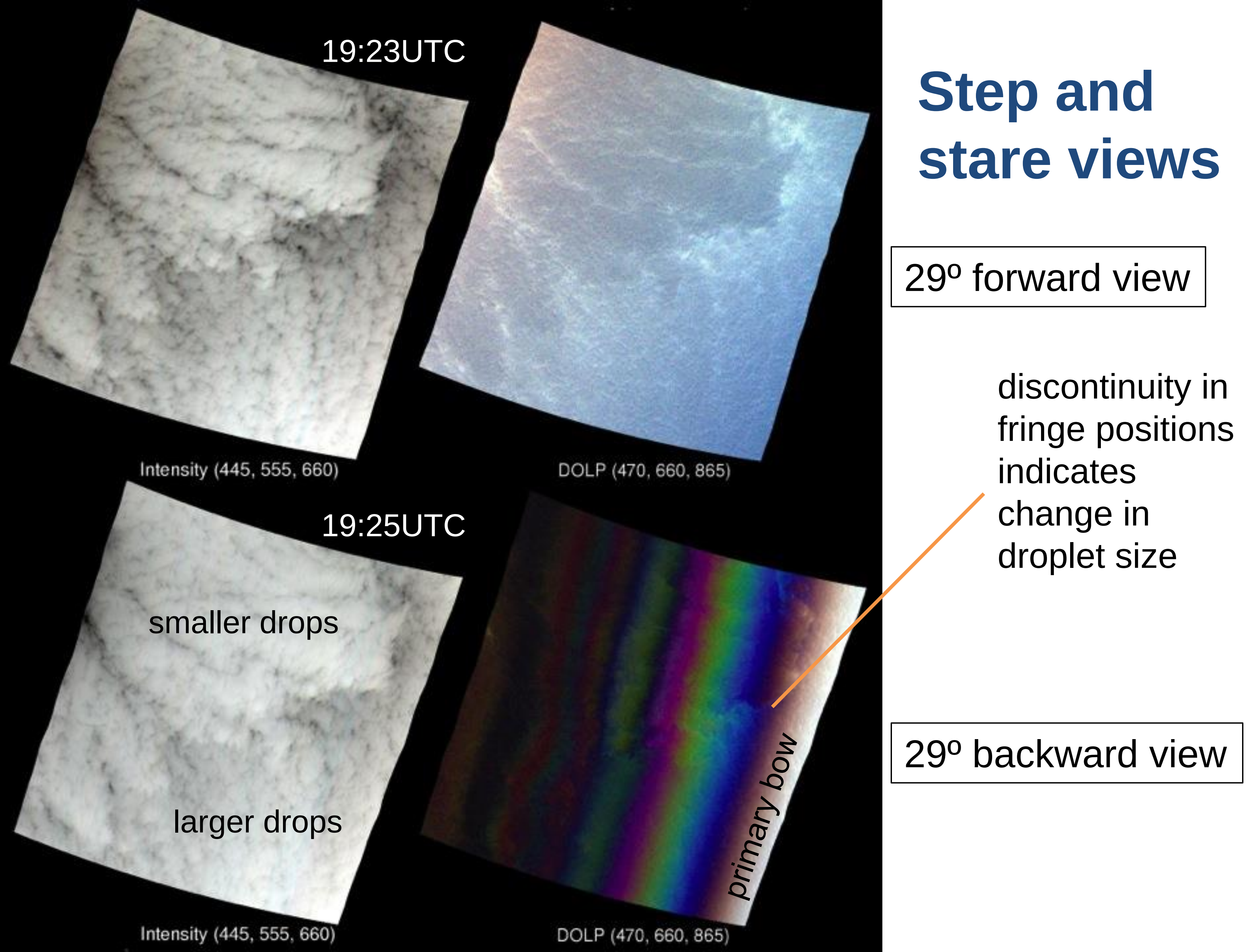
MODIS/CALIPSO



looking ahead

- the power of polarization
  - Breon
  - Hasekamp
- new retrievals
  - Litvinov
  - Di Nioa
- new sensors / opportunities
  - Sano
  - Davis
  - Marbach
  - Sayer
  - Hasekamp

Step and stare views



GRASP approach (Dubovik et al, 2011)

simultaneous inversion of a large group of pixels within one or several images

spatially smooth, spectrally dependent AOD

size distribution (shape-independent):

- d*V*/dln*r* - volume size distribution in total atmospheric column;

- size distribution is modeled using 22 size bins (0.05 ≤ *r*≤ 15 μm);

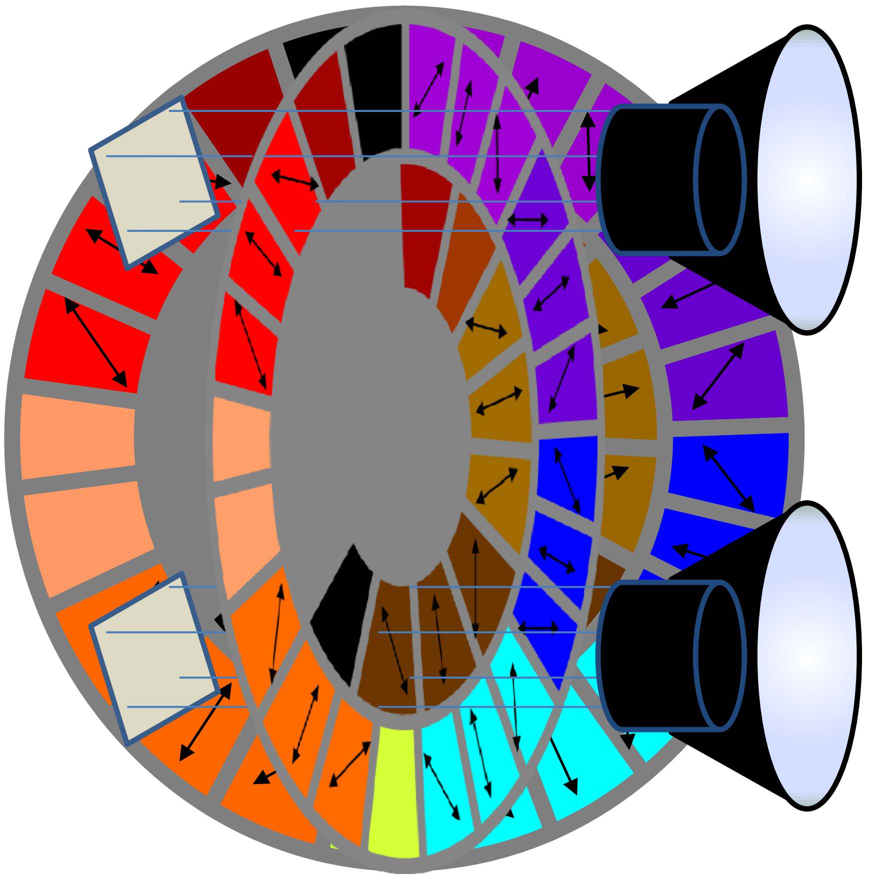
- size distribution is <u>**smooth**</u>

AEROSOL shape and composition (in the total atmospheric column):

- <u>randomly oriented homogeneous spheroids;</u>
- aspect ratio distribution *N*(ε) is fixed to that retrieved by Dubovik et al. 2006
- $1.33 \le n \le 1.6$; $0.0005 \le k \le 0.5$
- *n* and *k* <u>**smooth, spectrally dependent**</u>

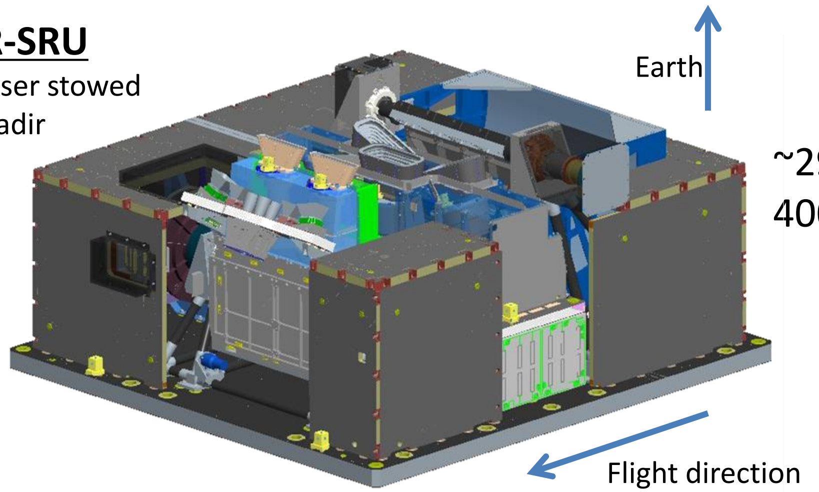
3MI Channels

Channel centre and width	Polarisation	Optical head
410 nm 20 nm	**Yes**	**VNIR Optical head**
443 nm 20 nm	**Yes**	
490 nm 20 nm	**Yes**	
555 nm 20 nm	**Yes**	
670 nm 20 nm	**Yes**	
763 nm 10 nm	**No**	
754 nm 20 nm	**No**	
865 nm 40 nm	**Yes**	
910 nm VNIR 20 nm	**No**	
910 nm SWIR 20 nm	**No**	**SWIR Optical head**
1370 nm 40 nm	**Yes**	
1650 nm 40 nm	**Yes**	
2130 nm 40 nm	**Yes**	



SGLI VIS and near-IR

VNR-SRU
- Diffuser stowed
- PL Nadir

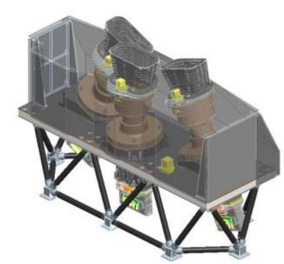


~290kg
400 W max

October 2011 Post Acoustics Alignment

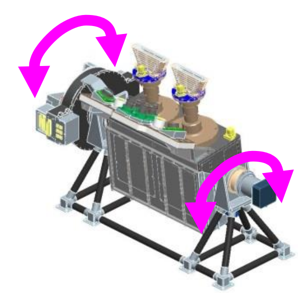
■ VNR non Polarized Obs. (NP)

– 3 telescopes with 24deg FOV realize the total 70 deg FOV Observation (1,150km)
– Wide wavelength range Observation from **380** to 869 nm.



■ VNR Polarized Obs. (PL)

– 2 telescopes with 55 deg FOV each for **674** and **869** nm Observation.
– **AT tilting** mechanism for **+ / - 45deg**
– 55 deg FOV with 45 deg tilting

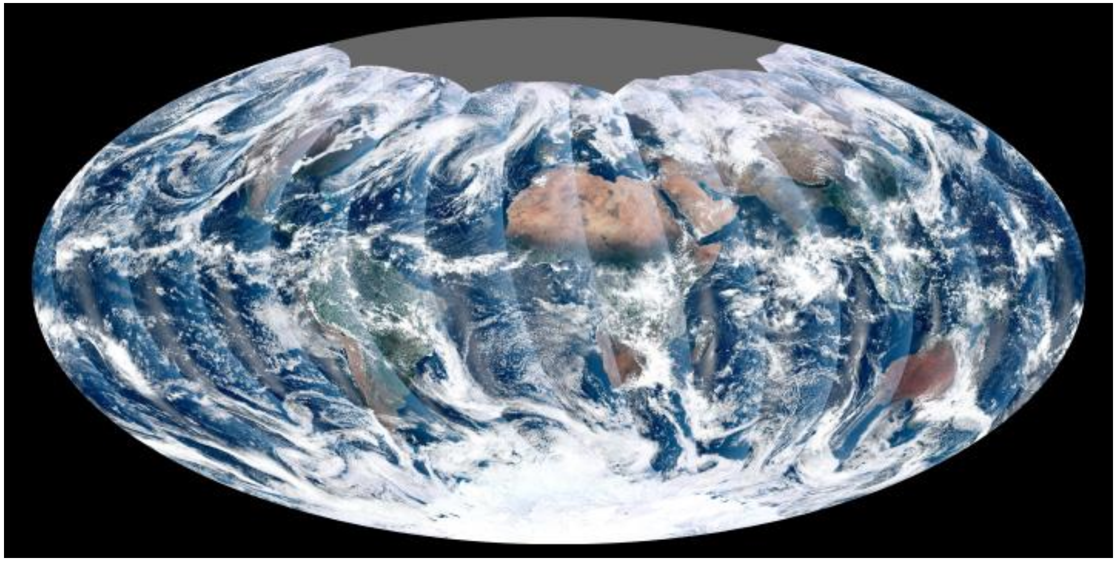


674 & 869 nm telescopes

±45deg tilting

Courtesy of Dr. Tanaka (JAXA/EORC)

The (near) future: **VIIRS**



First VIIRS global image: 24th November 2011, courtesy of NASA NPP team

- Visible Infrared Imaging Radiometer Suite (VIIRS) launched on Suomi-NPP in late 2011
- Similar to MODIS (for aerosol purposes), but:
  - 3,000 km swath width (no gap between orbits)
  - ‘Bowtie effect’ (pixel size increase across swath) much smaller than in MODIS
  - 750 m pixel size
- Current available products are distributed by NOAA, for operational purposes
  - NASA has recently put out a call for proposals to ‘continue the EOS heritage’

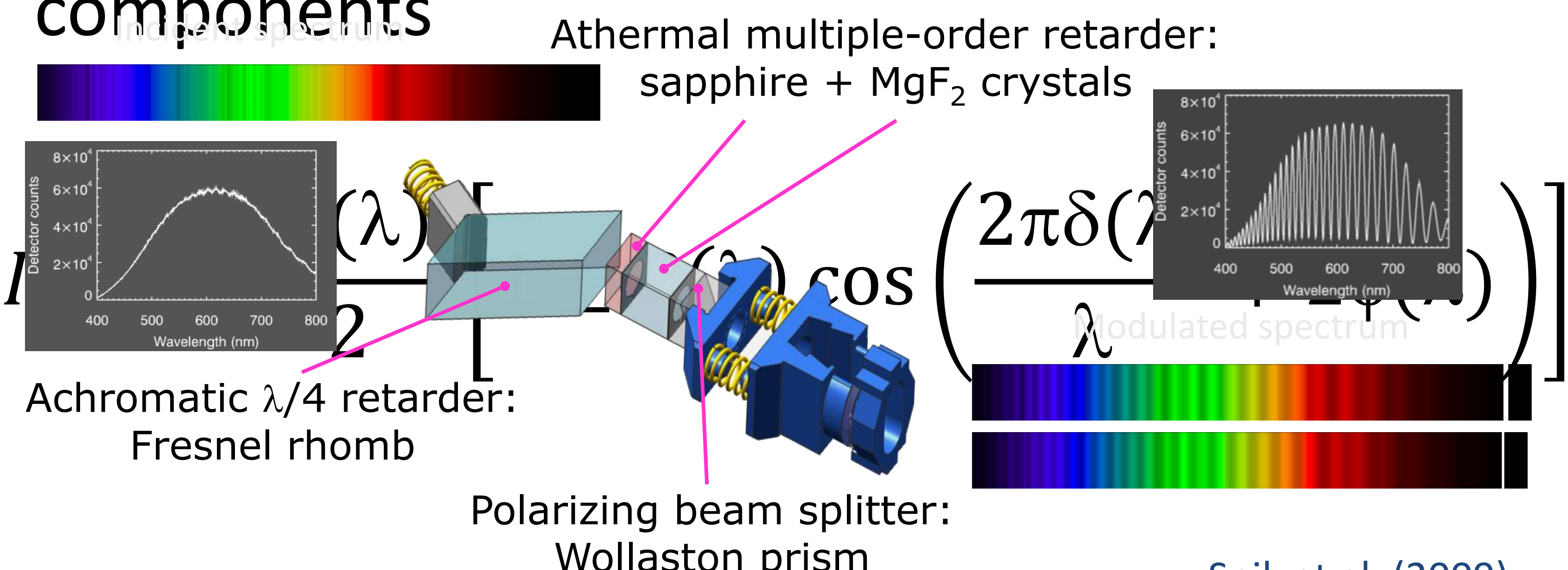
Flight Units 1 and 2 Instrument Specifications

Orbit:	833 km polar sun-synchronous
Swath:	>3,000 km (±56 degrees about nadir)
Scanning:	Rotating telescope with dual-sided, half-angle mirror
Size:	135 x 148 x 89 cm^3
Spectral Coverage:	0.4 to 12.5 μm
Number of Bands:	
Visible/Near Infrared:	9, plus day/night band
Mid-wave Infrared:	8
Long-wave Infrared:	4
Resolution:	
Radiometric (16 bands):	0.742 km nadir, 1.6 km EOS
Imaging (5 bands):	0.371 km nadir, 0.8 km EOS
Day/Night Band:	0.742 km constant across scan
Mass:	270 kg
Power:	170 W
Data Rate:	8 Mbps (avg.) / 10.5 Mbps (max.)

Figure 1. High level VIIRS Flight Unit 1 and Flight Unit 2 instrument characteristics with photo of FU1 being integrated onto the NPP spacecraft at Ball Aerospace. Photo courtesy Ball Aerospace.

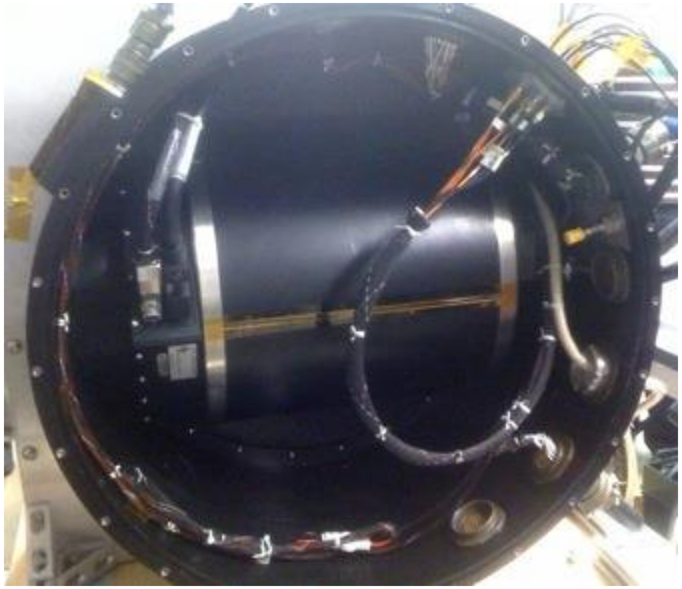
SPEX Spectro-polarimeter

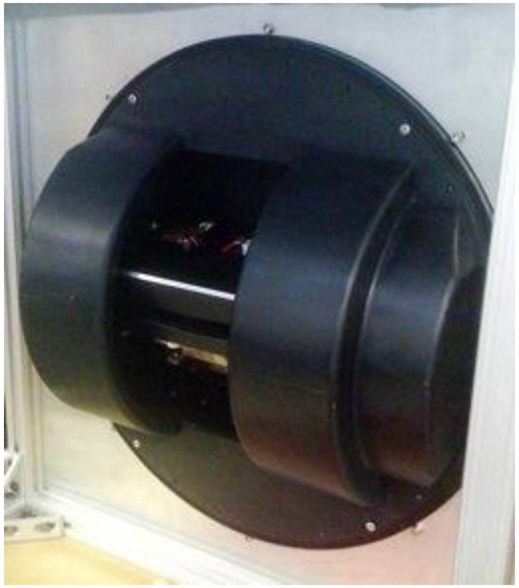
- Innovative measurement concept: spectral modulation
- Linear polarization parameters encoded in radiance spectrum by passive optical components



Snik et al. (2009)

Air MSPI





Spectral bands:

355, 380, 445,
470*,555, 660*,
865*, 935 nm
(*polarimetric)

The AirMSPI camera flies in the nose of NASA's ER-2 aircraft (20 km flight altitude)

AirMSPI is mounted in a gimbal for multi-angle viewing between ±67º

what I liked

- actual discussions
  - aerosol absorption (there ARE ideas to follow)
  - (level2) pixel accuracy is becoming a standard!

- overall set-up
  - long breaks
  - time to talk, to exchange ideas

finally

- **BIG** thanks to the organizers
  - Alexander
  - Johannes
  - Gerrit