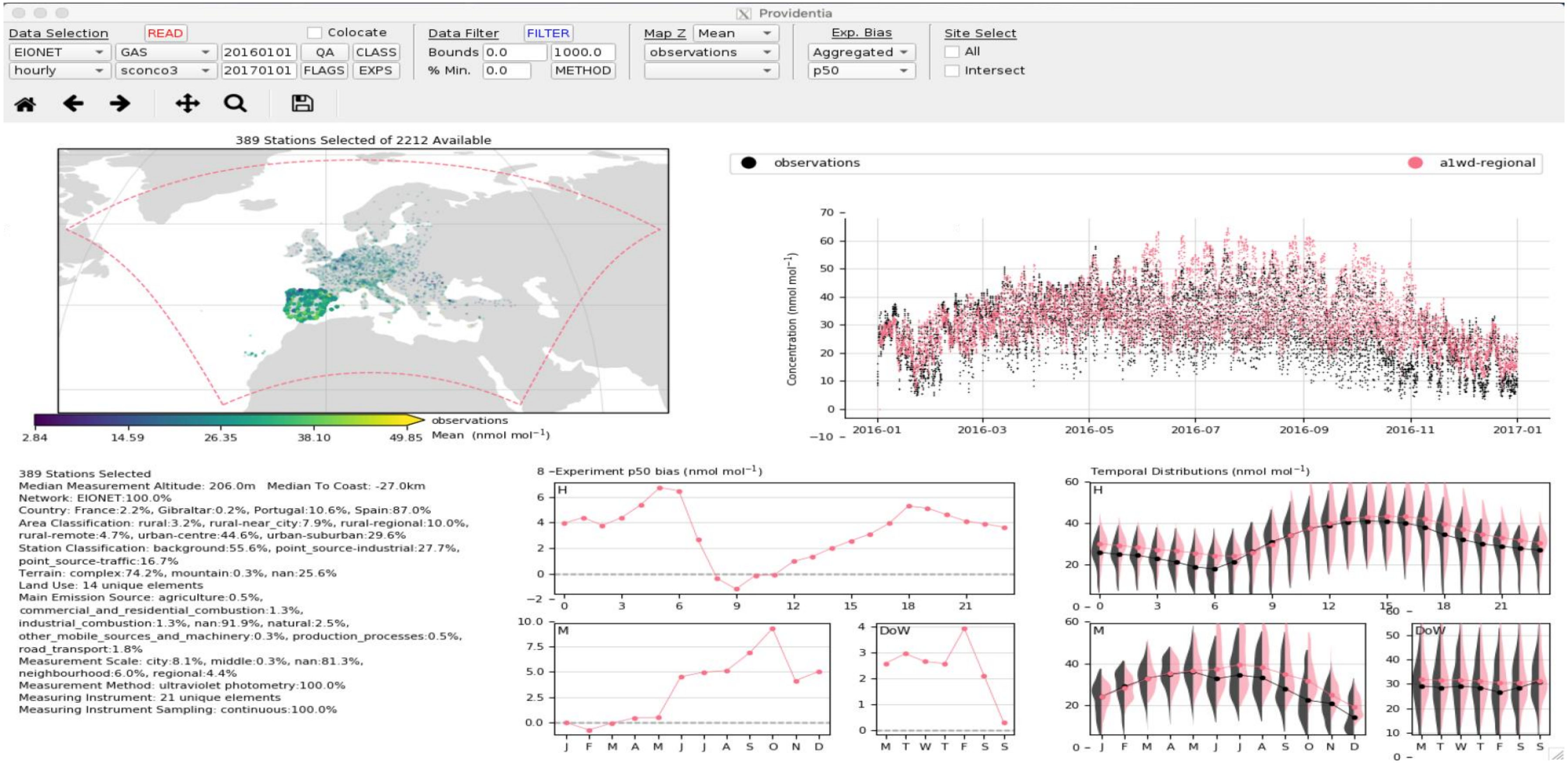
poster summary slides

AeroCom / AeroSAT 2019

- **Bowdalo, Dene**
- ***GHOST: A framework for the harmonization of global surface atmospheric observations***

GHOST:
Globally Harmonised Observational Surface Treatment

Dene Bowdalo, Amalia Vradi, Oriol Jorba
Barcelona Supercomputing Center, dene.bowdalo@bsc.es



Data Selection: EIONET, hourly, GAS, sconco3, 20160101, 20170101
Data Filter: Bounds 0.0 1000.0, % Min. 0.0
Map Z: Mean, observations
Exp. Bias: Aggregated, p50
Site Select: ☐ All ☐ Intersect

389 Stations Selected of 2212 Available

389 Stations Selected
Median Measurement Altitude: 206.0m   Median To Coast: -27.0km
Network: EIONET:100.0%
Country: France:2.2%, Gibraltar:0.2%, Portugal:10.6%, Spain:87.0%
Area Classification: rural:3.2%, rural-near_city:7.9%, rural-regional:10.0%, rural-remote:4.7%, urban-centre:44.6%, urban-suburban:29.6%
Station Classification: background:55.6%, point_source-industrial:27.7%, point_source-traffic:16.7%
Terrain: complex:74.2%, mountain:0.3%, nan:25.6%
Land Use: 14 unique elements
Main Emission Source: agriculture:0.5%, commercial_and_residential_combustion:1.3%, industrial_combustion:1.3%, nan:91.9%, natural:2.5%, other_mobile_sources_and_machinery:0.3%, production_processes:0.5%, road_transport:1.8%
Measurement Scale: city:8.1%, middle:0.3%, nan:81.3%, neighbourhood:6.0%, regional:4.4%
Measurement Method: ultraviolet photometry:100.0%
Measuring Instrument: 21 unique elements
Measuring Instrument Sampling: continuous:100.0%

- **Chin, Mian**
- ***Atmospheric Composition and Asian Monsoon: A coordinated modeling and analysis with ACAM, AeroCom, and CCMI communities***

Atmospheric Composition and Asian Monsoon: A modeling and analysis coordinated among ACAM, AeroCom, and CCMI

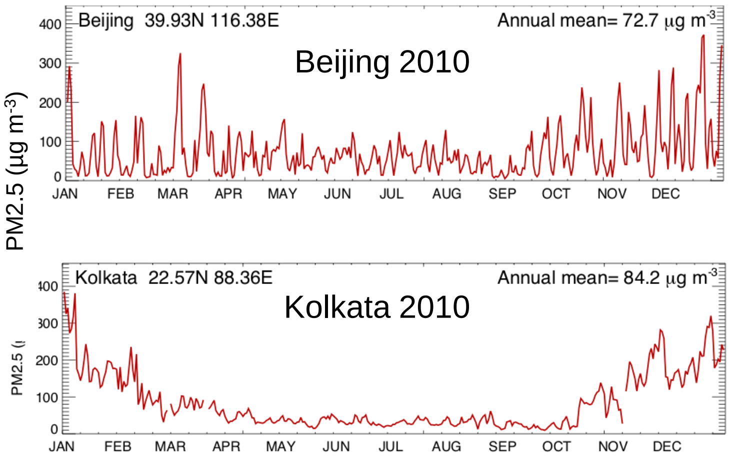
Mian Chin, James Crawford, Qing Liang, Xiaohua Pan, Huisheng Bian, Hans Schlager, Laura Pan, Michael Schulz

AeroCom
aerosol comparisons between observations and models

ccmi
chemistry-climate model initiative

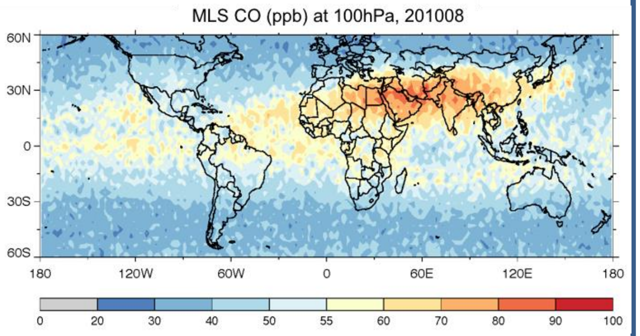
ACAM
ATMOSPHERIC COMPOSITION & THE ASIAN MONSOON

- Winter monsoon season features a severe air pollution problem
- The level of surface pollution is anti-correlated with the winter monsoon strength
- Aerosol-radiation-cloud interactions exacerbate the pollution problem

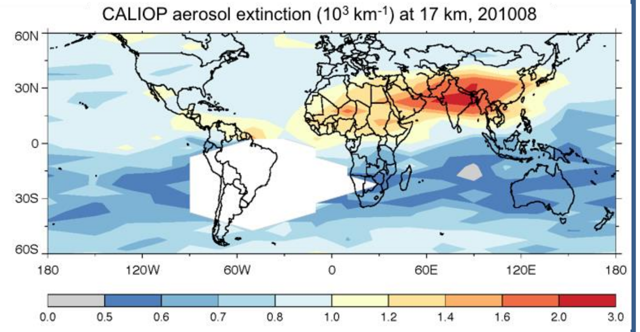


- Summer monsoon season features a strong convective transport lifting the surface pollutants to near the tropopause in the Asian monsoon anticyclone, where they further spread out to alter the atmospheric composition far beyond Asia

MLS CO 100 hPa Jul-Aug 2010



CALIOP aerosol extinction 17 km Aug 2010



COME TO SEE THE AYALYSIS PLAN AND JOIN US!

- **Cho, Nayeong**
- ***A global perspective on detecting aerosol-cloud interaction signals***

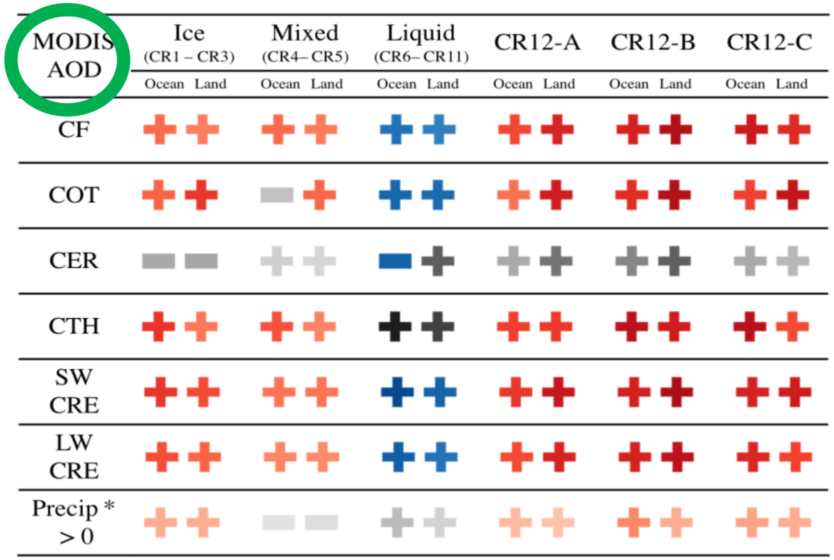
A Global view of Aerosol-Cloud interaction signals

Nayeong Cho[2,1], Lazaros Oreopoulos[1] (Lazaros.Oreopoulos@nasa.gov) Dongmin Lee[3,1]
[1]NASA Goddard Space Flight Center, [2]Universities Space Research Association, [3]Morgan State University

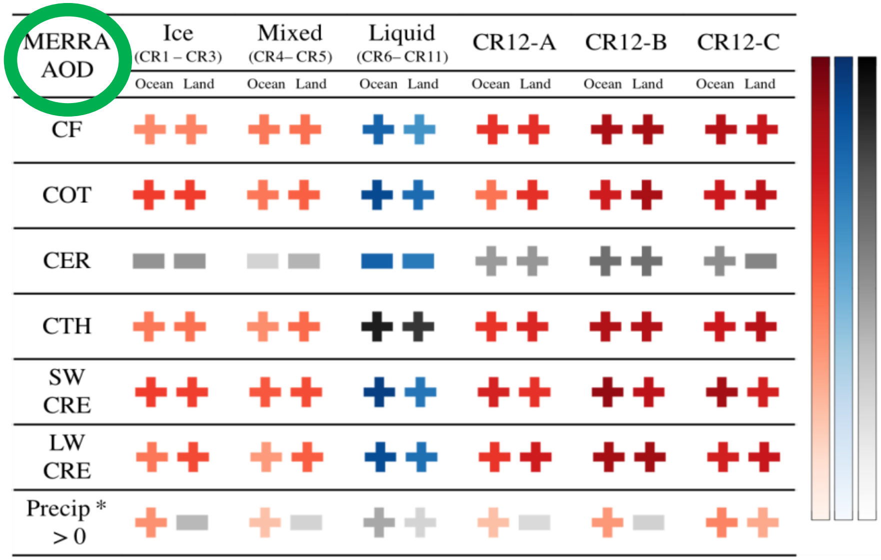
What the work is about

We provide a ***near-global*** picture of Aerosol-Cloud-Precipitation-Radiation interactions (ACPRI) apparent signals by employing MODIS Cloud Regimes (CRs) and Cloud Properties. We assess whether ACPRI can be diagnosed by investigating the variation with AM/morning (MODIS or MERRA-2) AOD of PM/afternoon cloud–affected quantities; the results are segregated by AM (Terra) CR.
This work convey the apparent responses to aerosol variations of the planet's cloud regimes by accounting for logarithmic cloud affected quantities sensitivity to logarithmic AOD perturbations. We concentrate on the prevailing ocean and continental sensitivity signs as extracted from statistic of the slops at global scales.

Aerosol-Cloud-Precipitation-Radiation signals



MODIS AOD	Ice (CR1 – CR3)		Mixed (CR4– CR5)		Liquid (CR6– CR11)		CR12-A		CR12-B		CR12-C	
	Ocean	Land	Ocean	Land	Ocean	Land	Ocean	Land	Ocean	Land	Ocean	Land
CF	+	+	+	+	+	+	+	+	+	+	+	+
COT	+	+	−	+	+	+	+	+	+	+	+	+
CER	−	−	+	+	−	+	+	+	+	+	+	+
CTH	+	+	+	+	+	+	+	+	+	+	+	+
SW CRE	+	+	+	+	+	+	+	+	+	+	+	+
LW CRE	+	+	+	+	+	+	+	+	+	+	+	+
Precip * > 0	+	+	−	−	+	+	+	+	+	+	+	+



MERRA AOD	Ice (CR1 – CR3)		Mixed (CR4– CR5)		Liquid (CR6– CR11)		CR12-A		CR12-B		CR12-C	
	Ocean	Land	Ocean	Land	Ocean	Land	Ocean	Land	Ocean	Land	Ocean	Land
CF	+	+	+	+	+	+	+	+	+	+	+	+
COT	+	+	+	+	+	+	+	+	+	+	+	+
CER	−	−	−	−	−	−	+	+	+	+	+	−
CTH	+	+	+	+	+	+	+	+	+	+	+	+
SW CRE	+	+	+	+	+	+	+	+	+	+	+	+
LW CRE	+	+	+	+	+	+	+	+	+	+	+	+
Precip * > 0	+	−	+	−	+	+	+	−	+	−	+	+

- **Chubarova, Natalia**
- ***Aerosol-cloud interaction and its influence on solar irradiance and cloud transmittance according to the INMCM5 climate model***

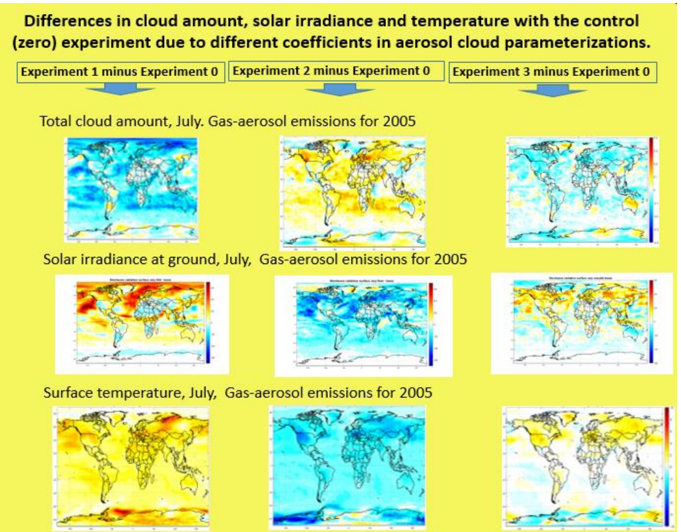
Aerosol-cloud interaction and its influence on solar irradiance and cloud transmittance according to the INMCM5 climate model

Chubarova N.E.[a], Poliukhov A.A.[a,b], Volodin E.M.[c]*
[a]Lomonosov Moscow State University, Moscow, Russia
[b]Hydrometcenter of Russia, Moscow
[c]Institute of Numerical Mathematics RAS, Moscow, Russia

The influence of various parametrizations of aerosol-cloud-interaction on the global solar irradiance and cloud transmittance at the earth's surface was analyzed according to the Russian INMCM5 model (Volodin et al., 2017) with the aerosol module described in (Volodin and Kostrykin, 2016).

First task was to estimate the cloud amount, radiation and temperature feedback to different aerosol-cloud parametrizations. The new (McCoy et al., 2017) coefficients in aerosol-cloud parameterization used in the model has shown the most appropriate results with reasonable increase in cloud amount and a decrease in the global irradiance by 25 W/m2 on average.

Second task was to estimate the changes in global solar irradiance and cloud transmittance due to different emissions of aerosol precursors for 1980 and for 2005. Numerical experiments revealed that at lower emissions rates a decrease in cloud transmittance was observed. We discussed the probable causes of the observed effect



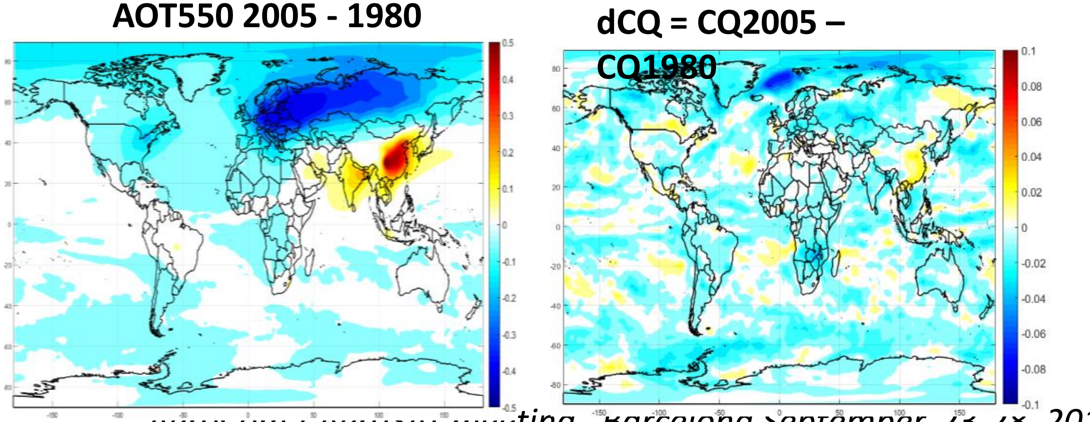
Differences in cloud amount, solar irradiance and temperature with the control (zero) experiment due to different coefficients in aerosol cloud parameterizations.

Total cloud amount, July. Gas-aerosol emissions for 2005

Solar irradiance at ground, July, Gas-aerosol emissions for 2005

Surface temperature, July, Gas-aerosol emissions for 2005

The difference in AOT and CQ due to various gas-aerosol emissions for 2005 and 1980 years



AOT550 2005 - 1980

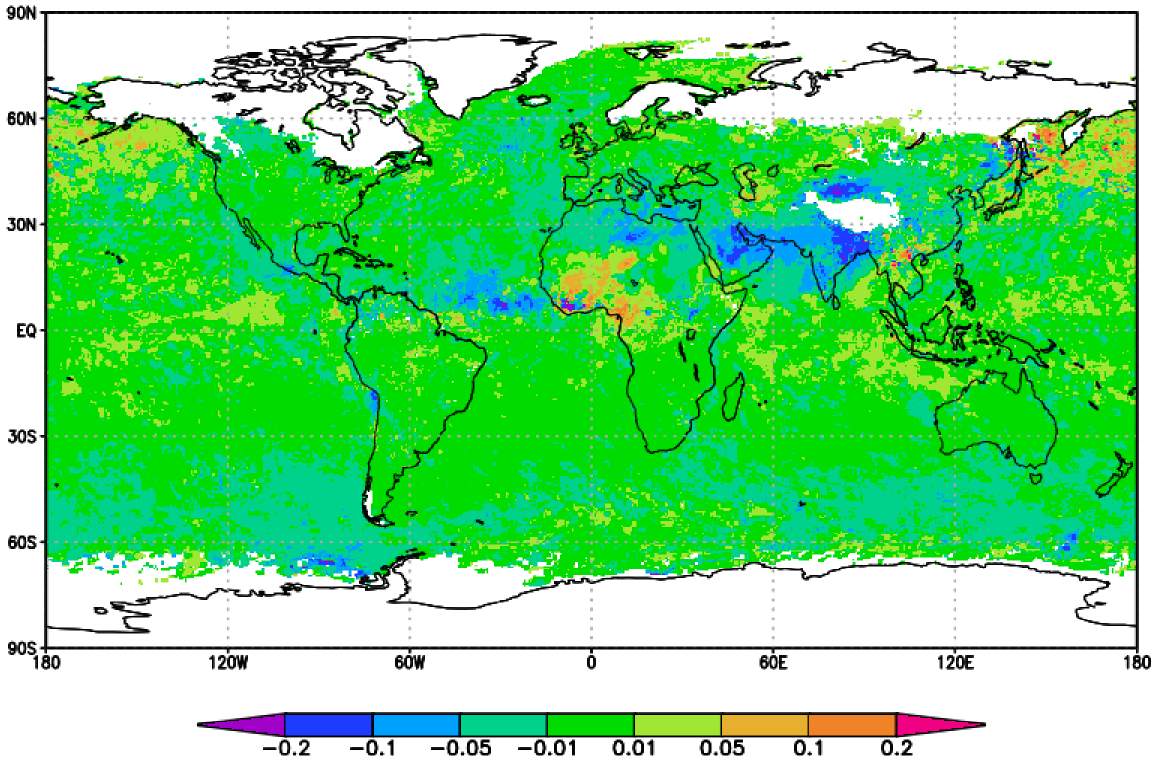
dCQ = CQ2005 – CQ1980

- **Colarco, Peter**
- ***Development of the NASA GEOS Chemical Transport Model (CTM) Capability for Evaluating and Deconvolving Aerosol Simulation Sensitivity to Meteorology and Core Aerosol Physics***

Development of the NASA GEOS Chemical Transport Model (CTM) Capability for Evaluating and Deconvolving Aerosol Simulation Sensitivity to Meteorology and Core Aerosol Physics

Peter Colarco (NASA GSFC), *Megan Damon (NASA GSFC/SSAI), Lawrence Takacs (NASA GSFC/SSAI), Peng Xian (NRL), Jeffrey Reid (NRL), Juli Rubin (NRL), Arlindo da Silva (NASA GSFC)*

Δ AOD ($\text{NAVGEM}_{\text{ctm}}$-$\text{MERRA-2}_{\text{ctm}}$)



To investigate variability in the aerosol simulation due to meteorology, we perform our own mini-AeroCom by running the US Navy NAVGEM and NASA MERRA-2 meteorological fields through the same GOCART code in the NASA GEOS CTM

- **Dawson, Matthew**
- ***Chemistry Across Multiple Phases (CAMP): A novel flexible treatment for multiphase chemistry in atmospheric models***

CAMP
chemistry across multiple phases

CAMP solves multiphase chemistry in atmospheric models and is designed for:

- **portability** across models
- **flexibility** of chemical mechanisms
- **self-containment** in a standalone library

CAMP accepts a set of **JSON** input data to build an **object-oriented** description of a multiphase chemical mechanism and then solve the gas- and condensed-phase chemistry and partitioning as a **single kinetic system**.

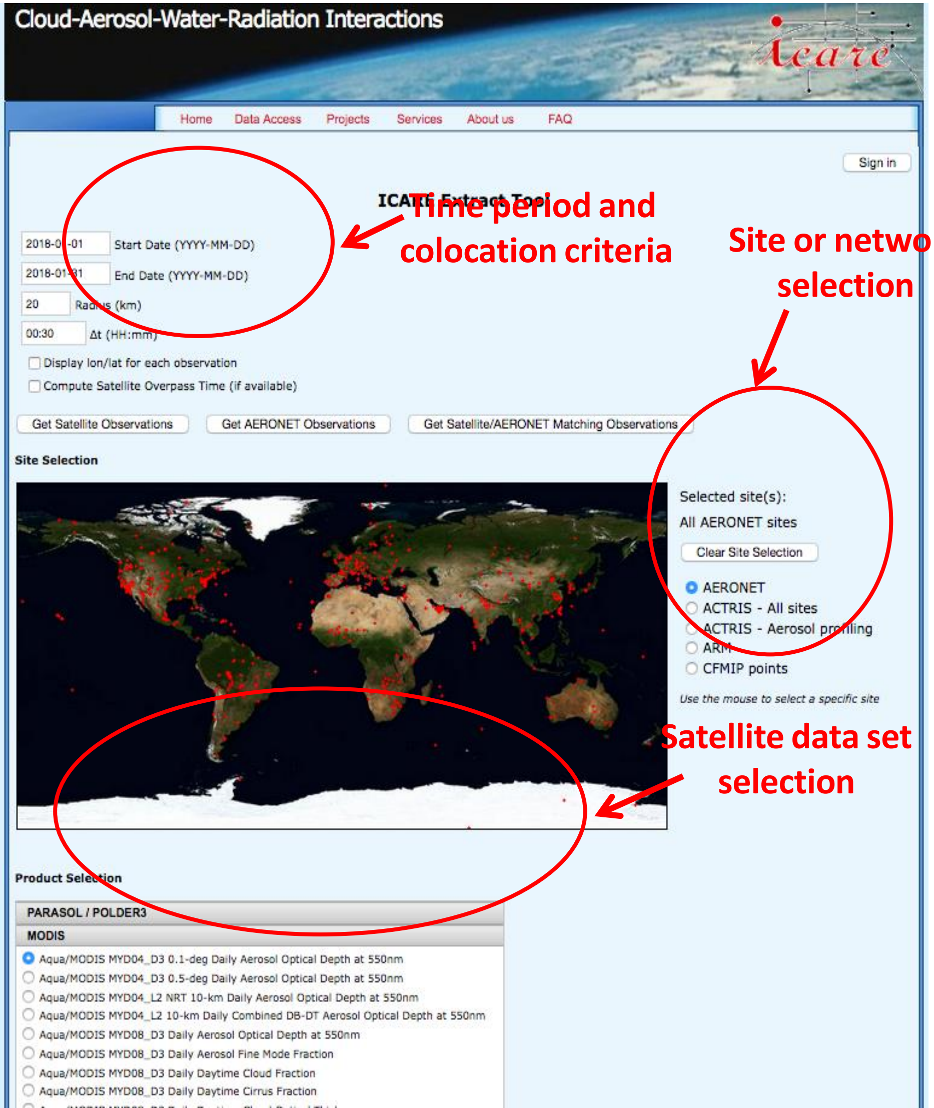
*Coming soon with **GPUs!***

- **Descloitres, Jacques**
- ***A validation tool for satellite aerosol data sets***

A validation tool for satellite aerosol data sets

ICARE Data and Services Center

Jacques Descloitres and Anne Vermeulen
Univ. Lille, CNRS, CNES, UMS 2877 - ICARE Data and Services Center, F-59000 Lille, France
http://www.icare.univ-lille1.fr
contact@icare.univ-lille1.fr



ICARE Extract Tool

2018-0 -01 Start Date (YYYY-MM-DD)
2018-01-31 End Date (YYYY-MM-DD)
20 Radius (km)
00:30 Δt (HH:mm)
☐ Display lon/lat for each observation
☐ Compute Satellite Overpass Time (if available)

Site Selection

Selected site(s):
All AERONET sites

● AERONET
○ ACTRIS - All sites
○ ACTRIS - Aerosol profiling
○ ARM
○ CFMIP points

Use the mouse to select a specific site

Product Selection

PARASOL / POLDER3
MODIS
● Aqua/MODIS MYD04_D3 0.1-deg Daily Aerosol Optical Depth at 550nm
○ Aqua/MODIS MYD04_D3 0.5-deg Daily Aerosol Optical Depth at 550nm
○ Aqua/MODIS MYD04_L2 NRT 10-km Daily Aerosol Optical Depth at 550nm
○ Aqua/MODIS MYD04_L2 10-km Daily Combined DB-DT Aerosol Optical Depth at 550nm
○ Aqua/MODIS MYD08_D3 Daily Aerosol Optical Depth at 550nm
○ Aqua/MODIS MYD08_D3 Daily Aerosol Fine Mode Fraction
○ Aqua/MODIS MYD08_D3 Daily Daytime Cloud Fraction
○ Aqua/MODIS MYD08_D3 Daily Daytime Cirrus Fraction

Time period and colocation criteria

Site or network selection

Satellite data set selection

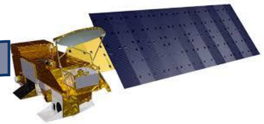
- Web service available for interactive use: http://www.icare.univ-lille1.fr/extract
- Several validation studies conducted at ICARE Data and Services Center in the past
- ICARE archives many commonly-used satellite and ground-based data sets on the same system
- Increasing need for repeatable and traceable evaluations using massive data sets extensively
- We are in the process of consolidating a validation bench open to external users
- Off-line scripting is possible to retrieve massive satellite-ground colocation data sets automatically

- **DiTomaso, Enza**
- ***Towards the production of a high-resolution regional dust reanalysis for Northern Africa, the Middle East and Europe***

Towards the production of a high-resolution regional dust reanalysis for Northern Africa, the Middle East and Europe

Enza Di Tomaso, Sara Basart, Jerónimo Escribano, Paul Ginoux, Oriol Jorba, Francesca Macchia, Carlos Pérez García-Pando

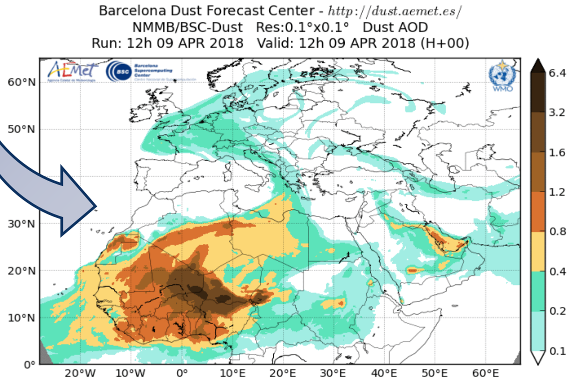
A **high resolution dust reanalysis** for Northern Africa, Middle East and Europe is currently in production at BSC in the framework of the ERA4CS DuctClim project (2017-2020). It covers the satellite era of quantitative aerosol information, and will be linked to development of **dust-related services** tailored to key socio-economic sectors (**transport, energy, health**)



MODIS Deep Blue Coarse AOD

GFDL Geophysical Fluid Dynamics Laboratory

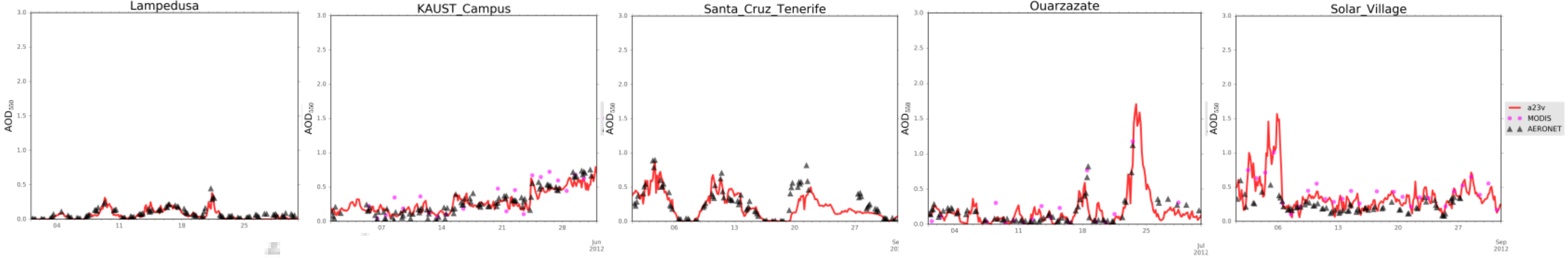
- *AE, ω filter, coarse AOD retrieval*
- *highest quality flag* (Ginoux et al., 2012; Pu & Ginoux 2016)
- *uncertainty model based on Sayer et al., 2014*



Dust ensemble forecasts are used to estimate **flow-dependent forecast uncertainty,** which is used by our data assimilation scheme to optimally combine model prior information with satellite observations

NMMB-MONARCH ensemble forecast is based on:
- *multi-parameter source perturbations*
- *multi-physics source perturbations*
- *multi-meteorological initial and boundary conditions*

Dust analysis at AERONET sites



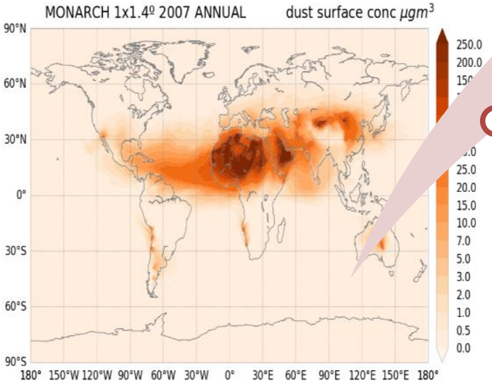
Barcelona Supercomputing Center Centro Nacional de Supercomputación
PRACE
STARS
GOBIERNO DE ESPAÑA MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA
AEMet Agencia Estatal de Meteorología
AXA Research Fund
inDust
DustClim
ERA4CS European Research Area for Climate Services

- **Goncalves, Maria**
- ***Modeling dust mineralogy with MONARCH***

Modelling dust mineralogy with MONARCH

M. Gonçalves Ageitos, M. Dawson, A. Bou, O. Jorba, M. Klose, C. Pérez García-Pando.

- *Direct and indirect effect*
- *Atmospheric chemistry*
- *Biogeochemical cycles*

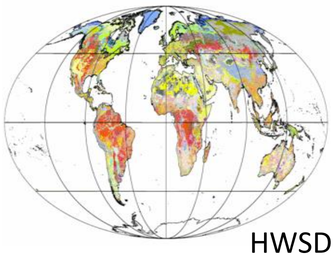


Soil mineralogy atlas

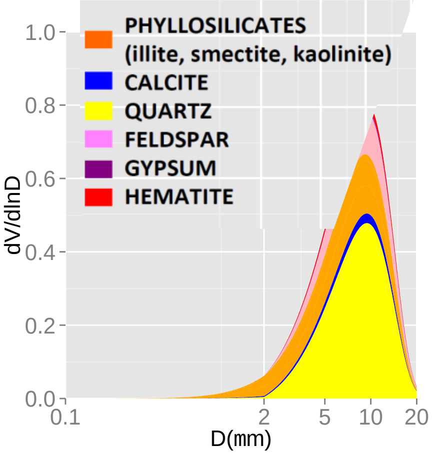
(Claquin et al. 1999)

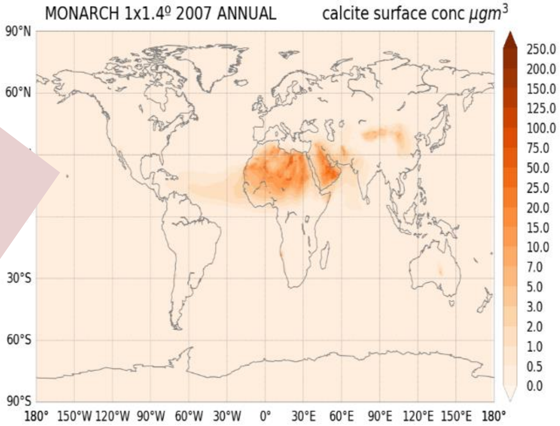
Size resolved mineral fraction at emission

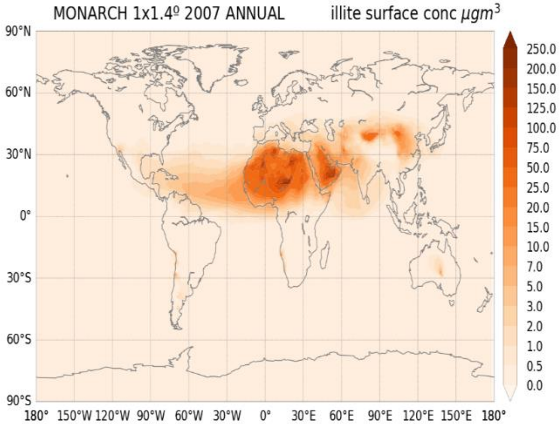
Flexible implementation into MONARCH dust module



HWSD







Annual mean surface concentration (µgm^{-3})
Year 2007

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Department of Project and Construction Engineering

GOBIERNO DE ESPANA
MINISTERIO DE ECONOMIA Y COMPETITIVIDAD

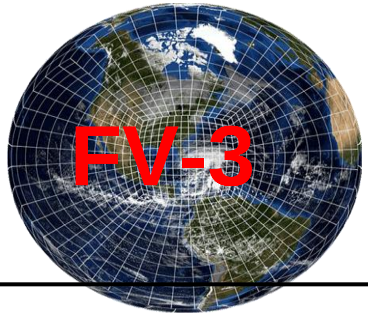
18th AeroCOM workshop. Barcelona, 23th-28th September, 2019

- **Grell, Georg**
- ***Development and Application of Global Aerosol Forecasts using NCEP’s Online Coupled Model GEFS-Aerosol***

Development and Application of Aerosol Forecasts using NCEP's Online Coupled Modeling Systems

The Unified Forecast System (UFS) is a community based Earth modeling system designed as both, a research tool and as basis for NOAA's operational forecasts

UFS
UNIFIED FORECAST SYSTEM



Two coupled chemistry components available

WRF-Chem chem_driver component for regional/global FV3GFS

only water friendly and ice friendly aerosols

Storm-scale, with **feedback to NWP**

Simplified chemistry and aerosols

EMC-GOCART
19 variab

More sophisticated chemistry and aerosol modules including secondary organic aerosols (SOA) will be available

CMAQ component for AQ forecasting

Operational CMAQ EPA modules in progress (CB06, AERO)
228 variables

NASA and NCAR-MICM in future ?

- **Guevara, Marc**
- ***HERMESv3: a stand-alone multiscale atmospheric emission modelling framework***

HERMESv3: a stand-alone multiscale atmospheric emission modelling framework

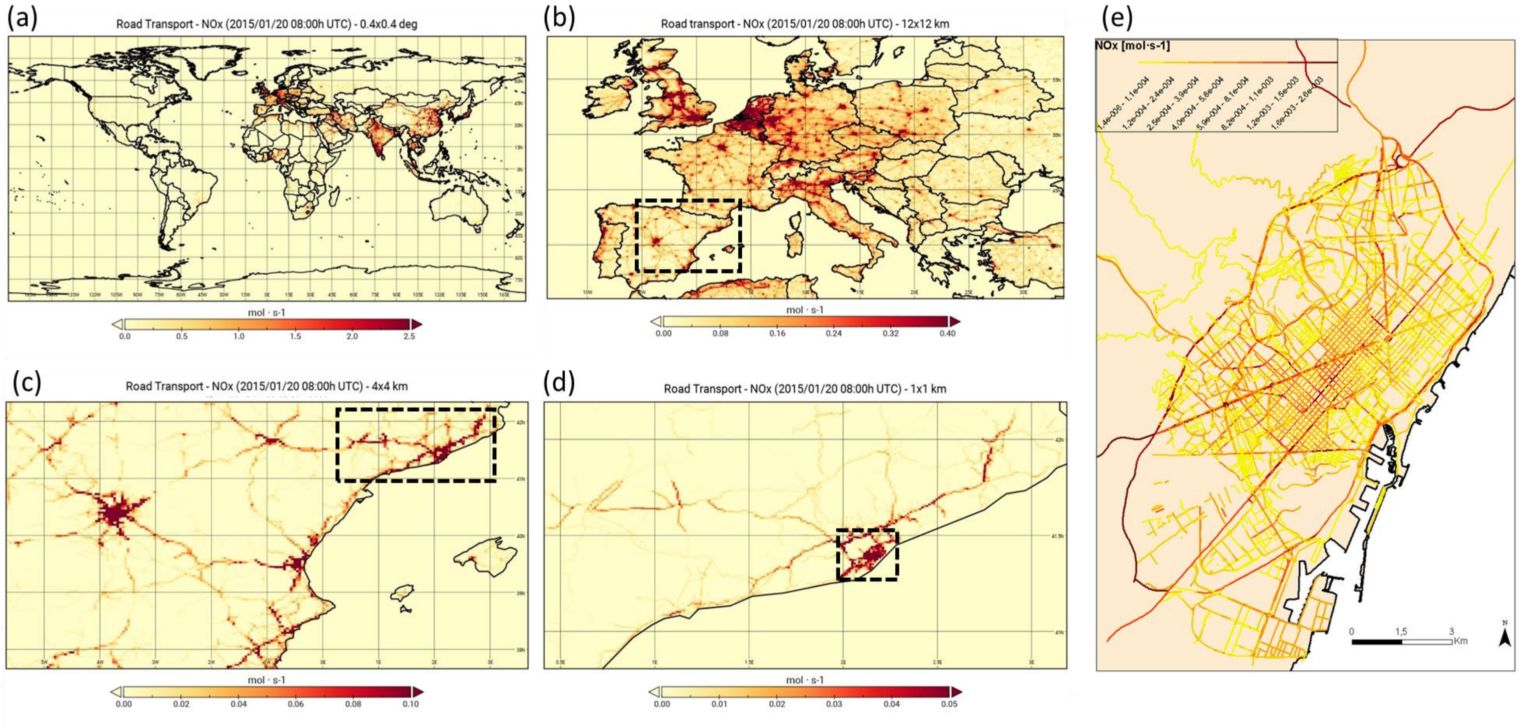
A **python-based, open source and multiscale** emission modelling framework that **estimates gas and aerosol emissions** for use in atmospheric chemistry models.

global-regional module
(HERMESv3_GR)

https://earth.bsc.es/gitlab/es/hermesv3_gr

bottom-up module
(HERMESv3_BU)

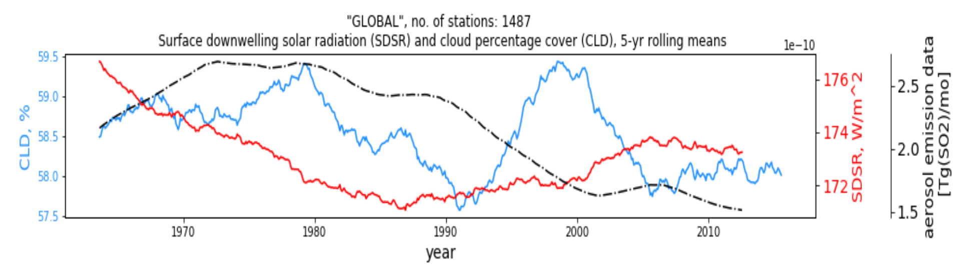
https://earth.bsc.es/gitlab/es/hermesv3_bu

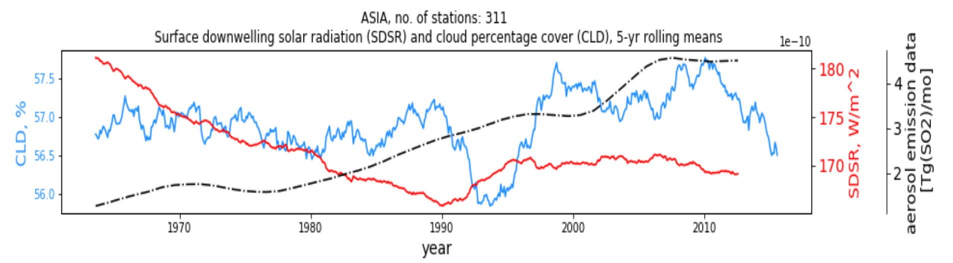


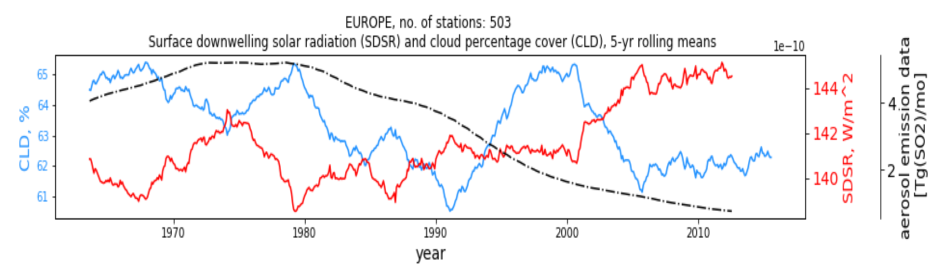
- **Julsrud, Ingeborg**
- ***Analysis of historical variations in surface solar radiation, cloud cover and aerosol emissions***

ANALYSIS OF HISTORICAL VARIATIONS IN SURFACE SOLAR RADIATION, CLOUD COVER AND AEROSOL EMISSIONS

GEBA *CRU TS v4.02* ***input4MIPs/SO2_em_anthro***


"GLOBAL", no. of stations: 1487
Surface downwelling solar radiation (SDSR) and cloud percentage cover (CLD), 5-yr rolling means


ASIA, no. of stations: 311
Surface downwelling solar radiation (SDSR) and cloud percentage cover (CLD), 5-yr rolling means


EUROPE, no. of stations: 503
Surface downwelling solar radiation (SDSR) and cloud percentage cover (CLD), 5-yr rolling means

Seek to examine role of cloud cover changes during global dimming/brightening periods.

Datasets averaged over GEBA station locations.

Results:

- SSR vs. cloud cover:
  - Strong anticorrelation on shorter timescales.
  - Weak anticorrelation between trends.
- SSR vs. SO_2 emissions:
  - Strong anticorrelation between trends on most continents.

Ingeborg Rian Julsrud

September 2019

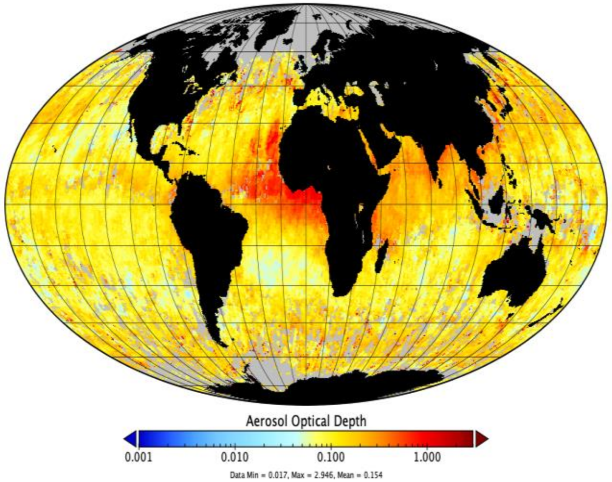
UiO : Universitetet i Oslo

- **Kalashnikova, Olga**
- ***Analysis of L3 MISR V23 aerosol products over the ocean, and comparison with MODIS***

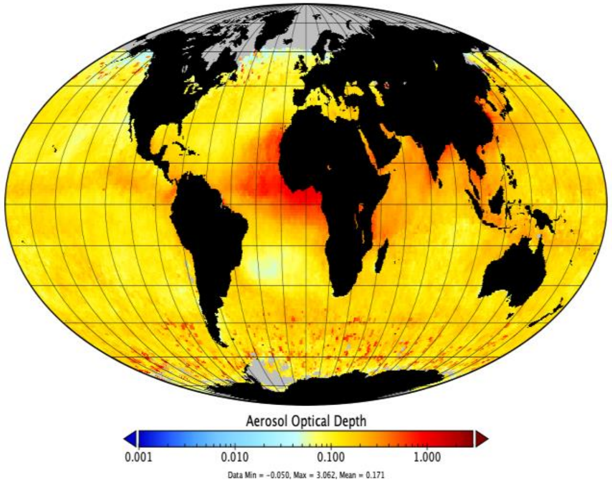
Analysis of L3 MISR V23 aerosol products over the ocean, and comparison with MODIS

Olga V. Kalashnikova (olga.kalashnikova@jpl.nasa.gov), M. J. Garay, M. Witek, H. Lee, and the MISR team
Jet Propulsion Laboratory, California Institute of Technology

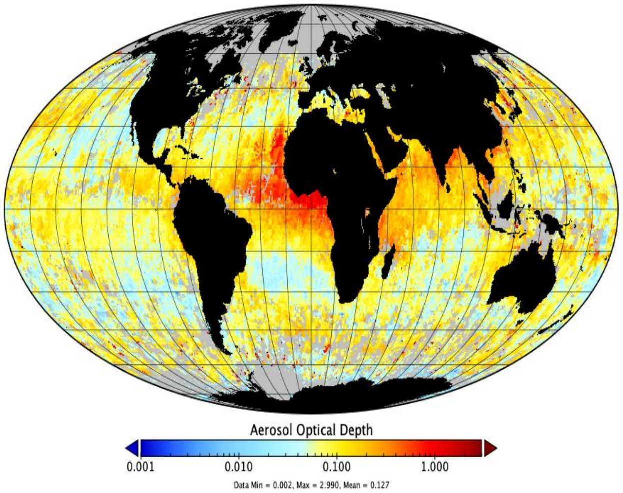
MISR V22 January 2015



MODIS C6.1 January 2015



MISR V23 January 2015



The MISR team recently released the 4.4 km V23 aerosol product (vs V22 at only 17.6 km)

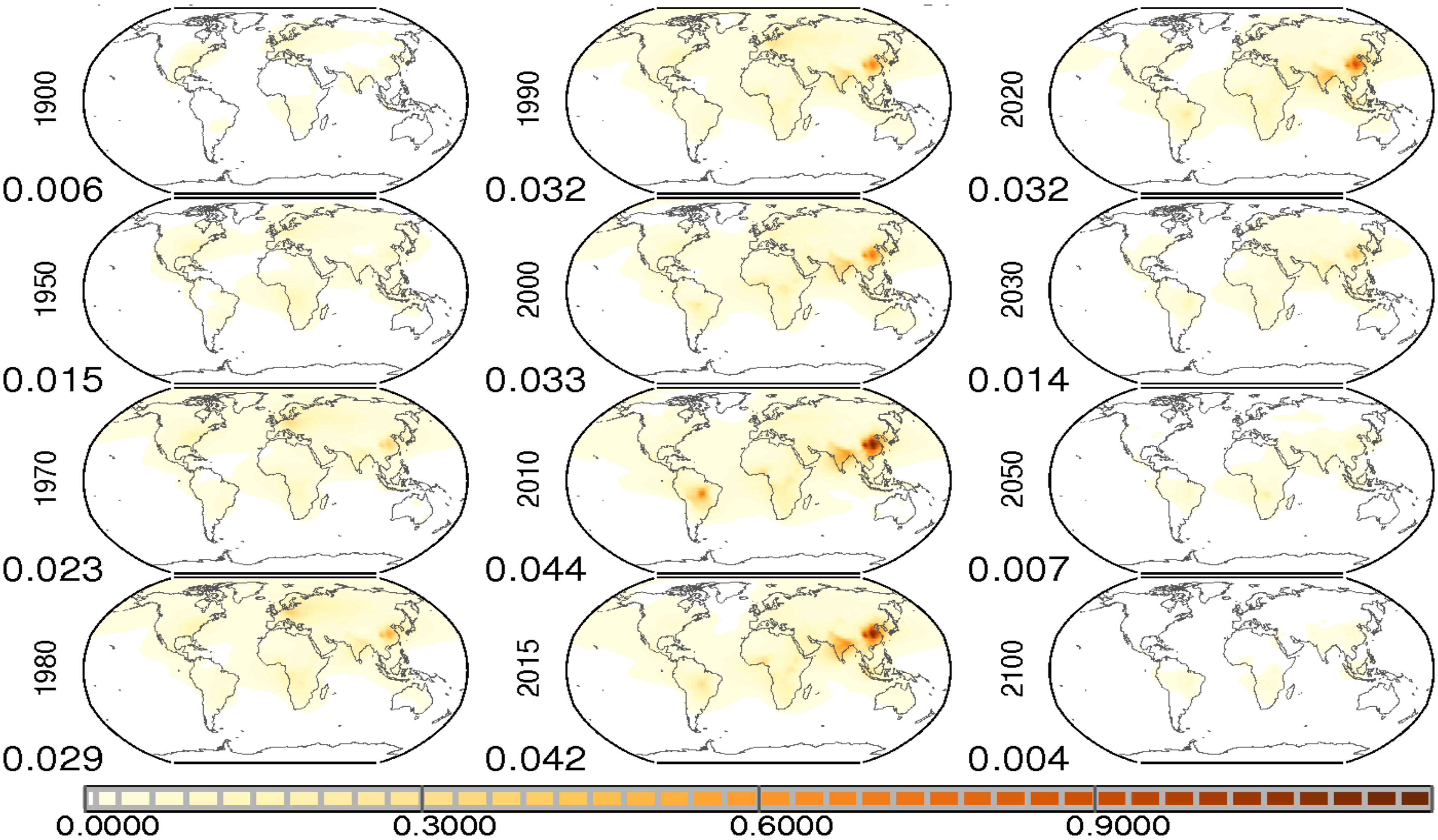
V23 AOD – Shows significant reduction over the global oceans as compared to V22 due to corrections for veiling light and the introduction of a term to account for the effects of chlorophyll

Is the new MISR L3 V23 AOD too low over the global oceans?

- **Kinne, Stefan**
- ***Aerosol radiative effects over time with IPCC6 aerosol emissions***

anthropogenic AOD 1900 – 2100

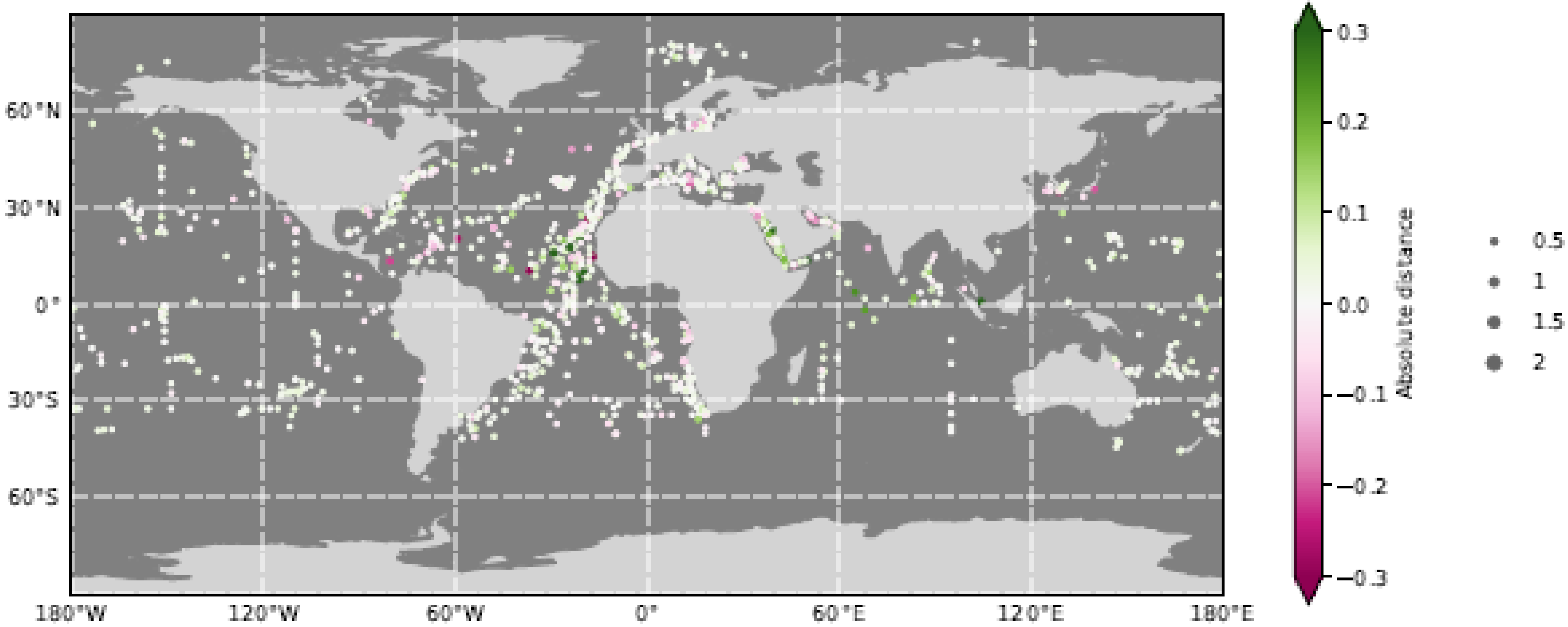
MACv2 (2005) scaled with OSLO CTM AOD changes



- **Kinne, Stefan**
- ***MPI-M/NASA collaborations to provide aerosol properties of oceans***

satellite AOD vs MAN

vs MODIS, MISR and VIIRS



overestimates and **underestimates** of **MODIS** AOD

- **Kirkevag, Alf**
- ***How do clear-sky vs. all-sky assumptions affect aerosol hygroscopic swelling, optical properties and subsequent effective radiative forcing estimates in NorESM2?***

How do clear-sky vs. all-sky assumptions affect aerosol hygroscopic swelling, optical properties and subsequent effective radiative forcing estimates in NorESM2 ?

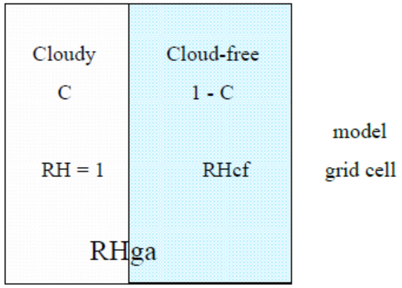
Alf Kirkevåg, Jonas Gliss, Jan Griesfeller, Augustin Mortier,
Dirk Olivié, Øyvind Seland, and Michael Schulz

AeroCom

This poster presents

results from two versions of NorESM2 / CAM6-Oslo run with IPCC AR6 emissions for year 2014 (PD) and 1850 (PI). The standard CMIP6 version uses cloud-free RH (RHcf) for hygroscopic swelling, while the test version makes use of grid-averaged RH (RHga) for hygroscopic swelling. This affects optical properties used for radiative transfer as well as their validation against observations.

$$RHga = 1 * C + RHcf * (1 - C)$$

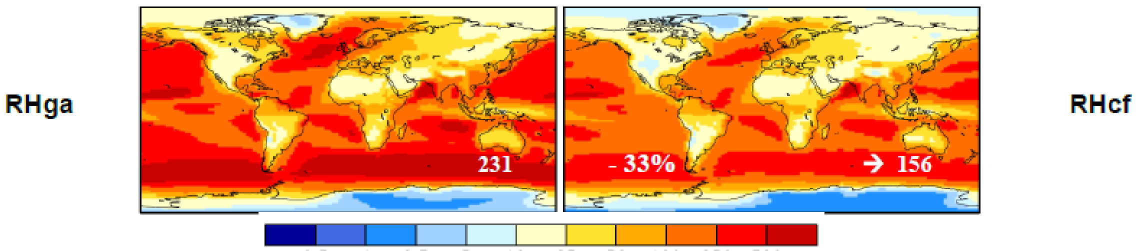


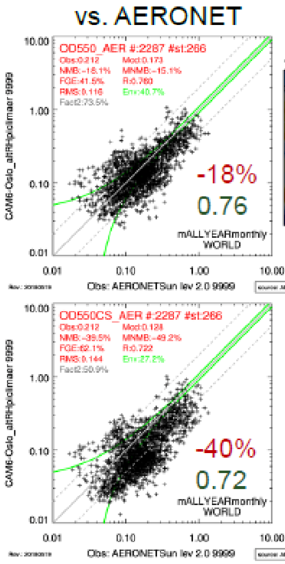
Both model versions diagnose both all-sky and clear-sky optics, which we define as all-sky optics weighted by the cloud-free fraction (1 - "total cloud cover"). All this gives rise to four different measures of aerosol optical properties, e.g. for column integrated optical depth, AOD:

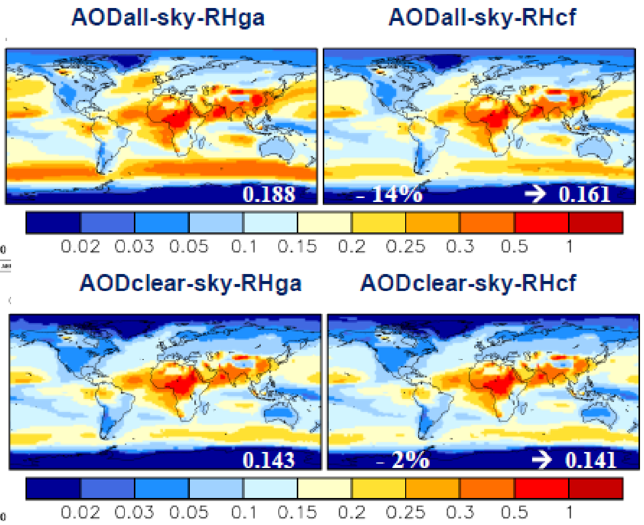
- AODall-sky-RHga
- AODall-sky-RHcf
- AODclear-sky-Rgha
- AODclear-sky-RHcf

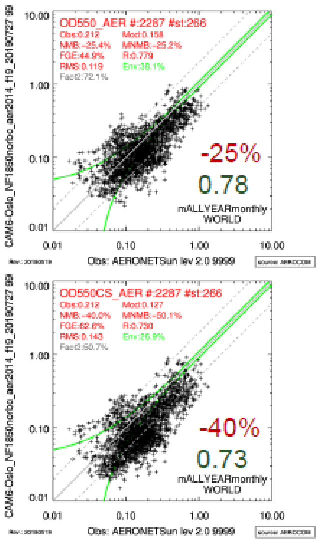
Note that only all-sky optics are used for radiative transfer

Condensed aerosol water column burden (mg m^{-3})

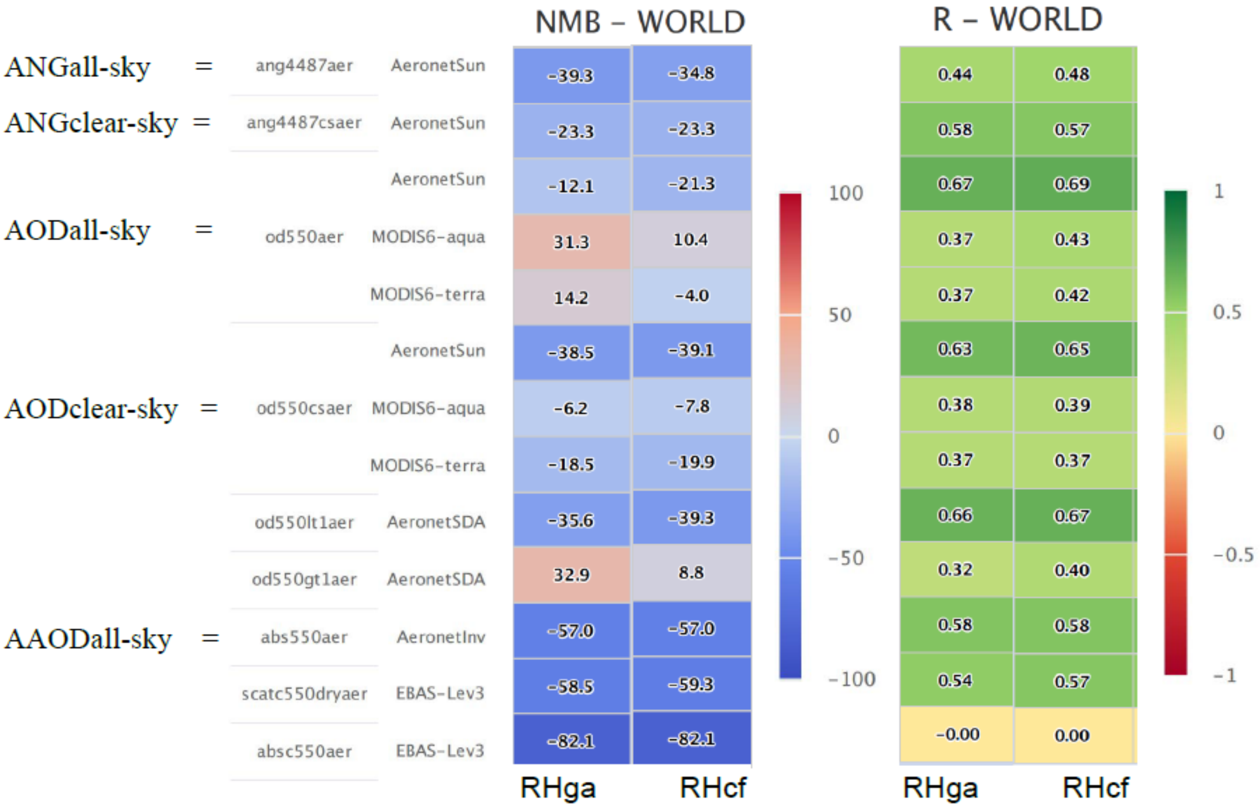








How do clear-sky vs. all-sky assumptions affect aerosol hygroscopic swelling, optical properties and subsequent effective radiative forcing estimates in NorESM2 ?



			NMB – WORLD RHga	NMB – WORLD RHcf	R – WORLD RHga	R – WORLD RHcf
ANGall-sky =	ang4487aer	AeronetSun	-39.3	-34.8	0.44	0.48
ANGclear-sky =	ang4487csaer	AeronetSun	-23.3	-23.3	0.58	0.57
AODall-sky =	od550aer	AeronetSun	-12.1	-21.3	0.67	0.69
		MODIS6-aqua	31.3	10.4	0.37	0.43
		MODIS6-terra	14.2	-4.0	0.37	0.42
AODclear-sky =	od550csaer	AeronetSun	-38.5	-39.1	0.63	0.65
		MODIS6-aqua	-6.2	-7.8	0.38	0.39
		MODIS6-terra	-18.5	-19.9	0.37	0.37
	od550lt1aer	AeronetSDA	-35.6	-39.3	0.66	0.67
	od550gt1aer	AeronetSDA	32.9	8.8	0.32	0.40
AAODall-sky =	abs550aer	AeronetInv	-57.0	-57.0	0.58	0.58
	scatc550dryaer	EBAS-Lev3	-58.5	-59.3	0.54	0.57
	absc550aer	EBAS-Lev3	-82.1	-82.1	-0.00	0.00

Normalized mean bias (NMB) and correlation coefficient (R) for various modelled optical parameters - column integrated and near surface values - compared to remote retrieved and in-situ observations. For interactive maps, statistics and more detailed explanations, see

⬇

aerocom-evaluation.met.no

Globally averaged column integrated PD aerosol water content, optical depth (AOD at 550nm), absorption AOD (AAOD at 550 nm) and Ångstrøm parameter (ANG between 440 and 870 nm), as well as the (PD - PI) SW Effective Radiative Forcing for Aerosol Radiation Interactions, ERFari (direct + semi-direct effect following Ghan, 2013) from the two sets of experiments.

Modeled PD values (PD-PI for ERFari)	**All-sky-RHga**	**All-sky-RHcf**	**Clear-sky-RHga**	**Clear-sky-RHcf**
Aerosol water (mg/m^3)	231	156	–	–
AOD at 550 nm	0.188	0.161	0.143	0,141
AAOD at 550 nm	0.0037	0.0037	0.0039	0.0038
ANG 440-870 nm	0.390	0.426	0.500	0.505
TOA SW ERFari (W m^{-2})	-0.031	-0,012	–	–

- **Klose, Martina**
- ***Soil mineral dust: Natural and anthropogenic aerosol***

Soil mineral dust: Natural and anthropogenic aerosol

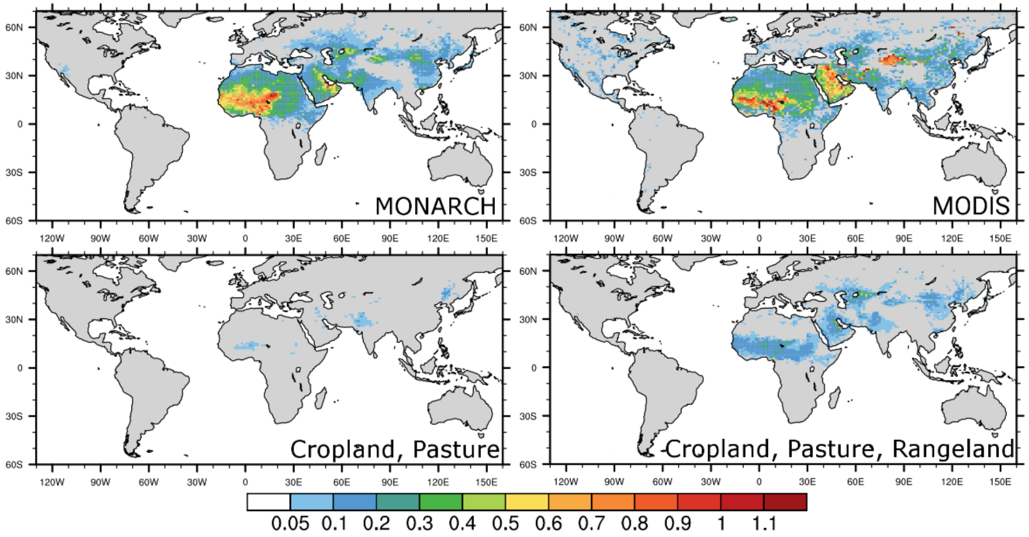
martina.klose@bsc.es
Martina Klose, Carlos Pérez García-Pando, Paul Ginoux, Ron Miller

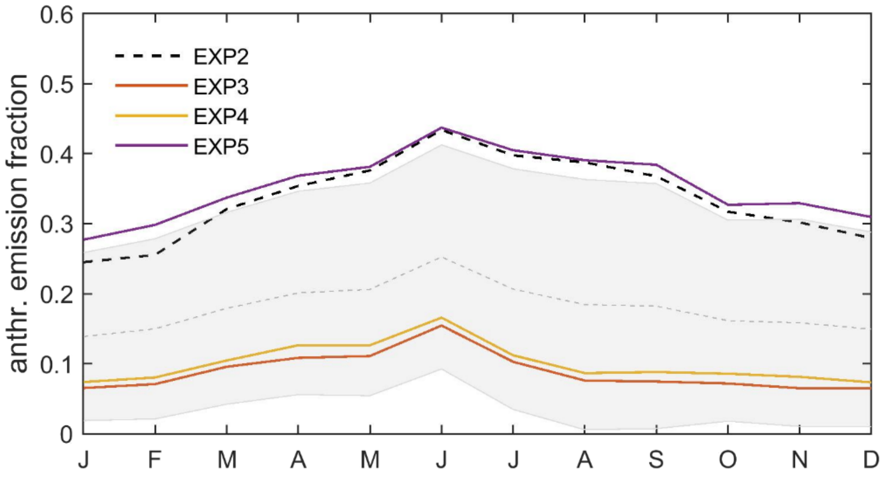
Objective: better quantify the contributions of anthropogenic (agricultural) and natural sources to global dust emission and their uncertainty

Method: Combine improved land-surface representations with advanced dust models and observational constraints

Model: MONARCH (Multiscale Online Non-hydrostatic AtmospheRe CHemistry model)

Average dust optical depth (March-April-May)





- **Global anthropogenic emission fraction on average**
  - ○ **8%** → cropland, pasture (EXP3)
  - ○ **35%** → cropland, pasture, rangeland (EXP5)

⇨ Considerable uncertainty related to the definition of "anthropogenic sources"

- **North America, Southwest Asia, and Europe** show largest anthropogenic emission fractions, but the emitted dust mass from these areas is small.

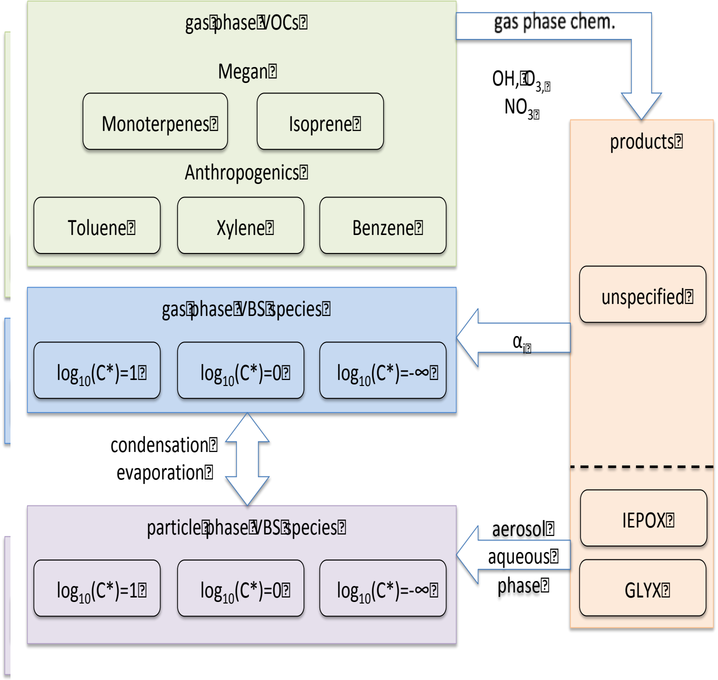
- **Kühn, Thomas**
- ***The volatility basis set in ECHAM-HAM-SALSA***

The volatility basis set in ECHAM-HAM-SALSA

T. Kühn[1,2] // T. Yli-Juuti[1] // J. Merikanto[2] // A. Hienola[2] // A. Arola[3] // T. Mielonen[3] // K.E.J. Lehtinen[1,2] // H. Korhonen[2] // A. Virtanen[1] // H. Kokkola[2]

[1]Aerosol Research group, Department of Applied Physics, University of Eastern Finland, Kuopio, Finland
[2]Finnish Meteorological Institute, Helsinki, Finland
[3]Finnish Meteorological Institute, Kuopio, Finland

contact: thomas.h.kuhn@uef.fi



gas phase VOCs

Megan

Monoterpenes

Isoprene

Anthropogenics

Toluene

Xylene

Benzene

gas phase chem.

OH, O_3, NO_3

products

unspecified

IEPOX

GLYX

gas phase VBS species

$log_{10}(C^*)=1$

$log_{10}(C^*)=0$

$log_{10}(C^*)=-\infty$

α_i

condensation
evaporation

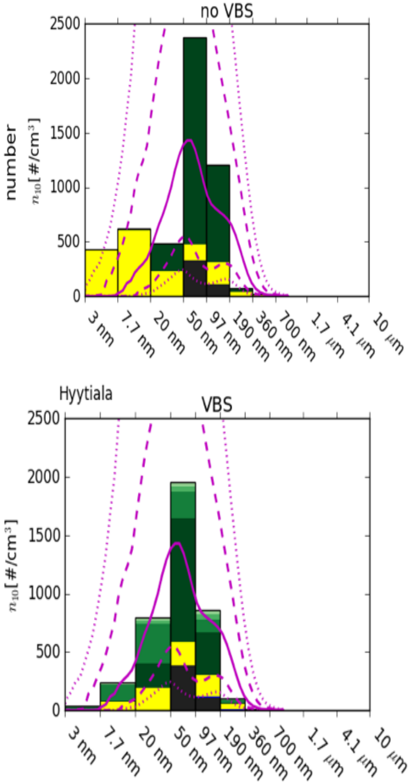
particle phase VBS species

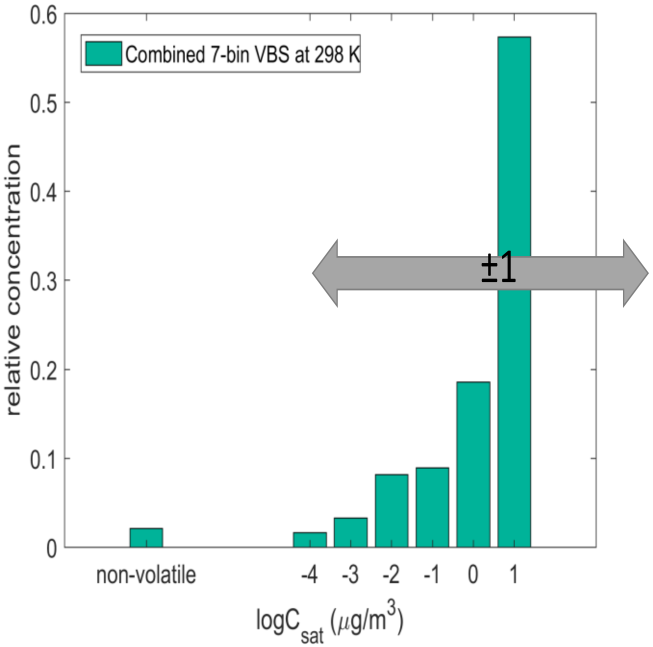
$log_{10}(C^*)=1$

$log_{10}(C^*)=0$

$log_{10}(C^*)=-\infty$

aerosol
aqueous
phase



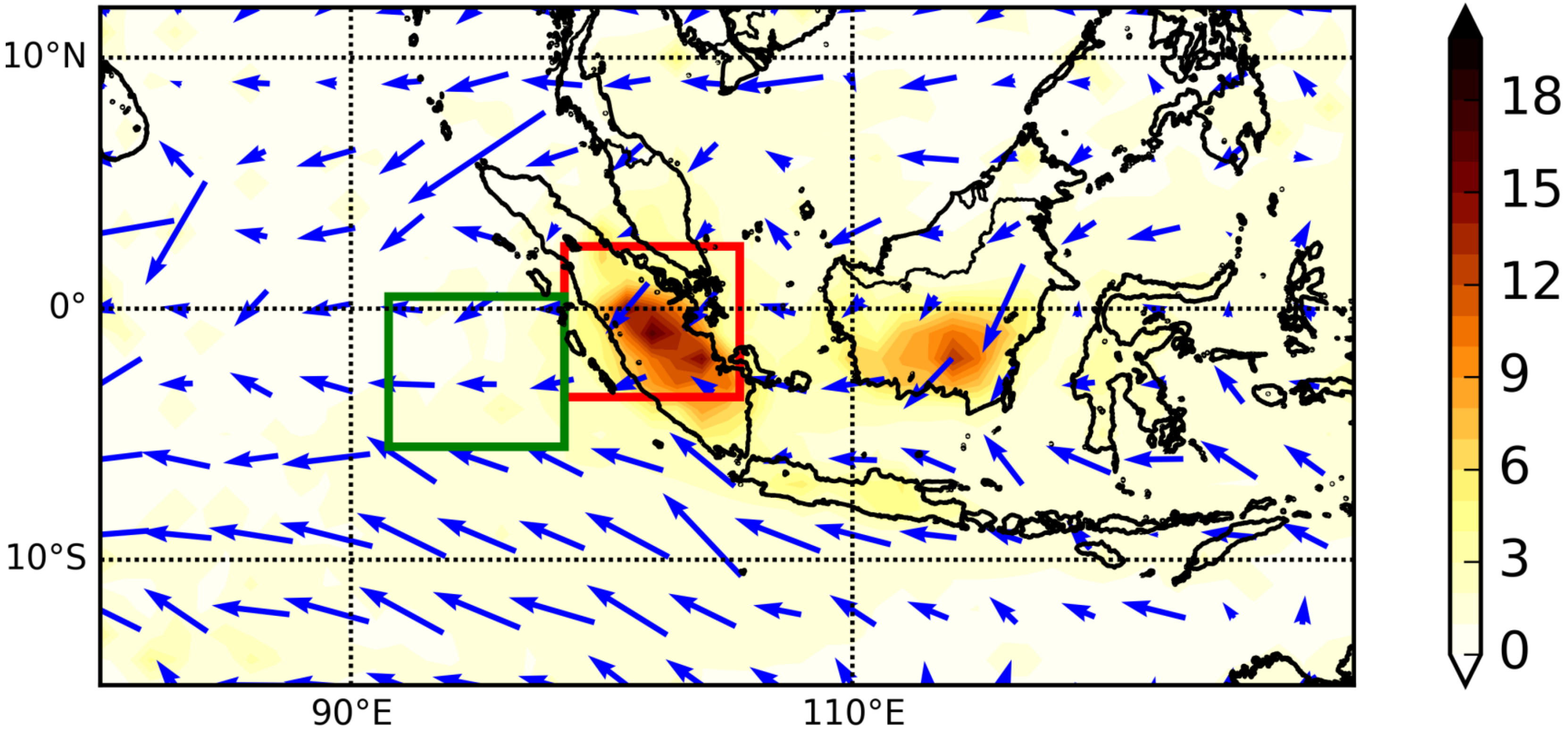


- **Lee, Huikyo**
- ***Satellite observations of ammonia and aerosol optical properties during the 2015 Southeast Asian haze***

Satellite observations of ammonia and aerosol optical properties during the 2015 Indonesian fire

Olga V. Kalashnikova (Jet Propulsion Laboratory)

CrIS column NH_3 [10^{16} molecules cm^{-2}] and MISR cloud motion vectors (CMVs)



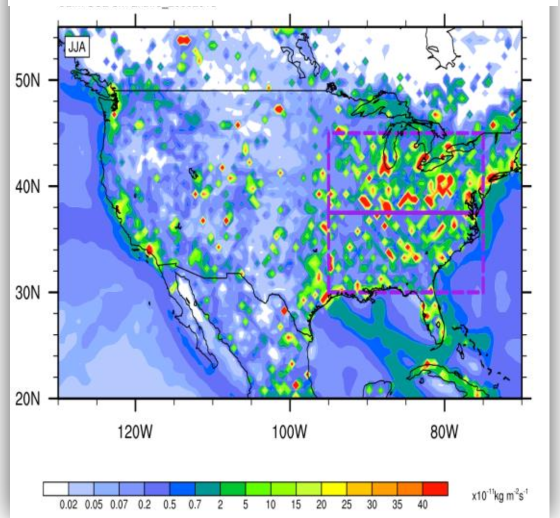
- Ammonia emissions from wildfires could influence optical properties of smoke plumes: the more ammonia emissions, the more scattering.

- **Liu, Yawen**
- ***Seasonal difference of the long-term trend of aerosols over the Eastern U.S.***

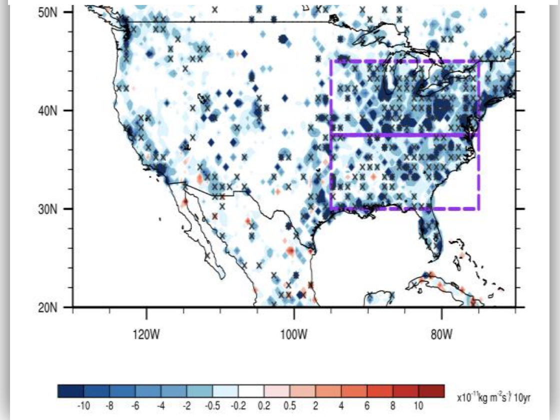
Seasonal difference of the long-term trend of aerosols over the Eastern U.S.

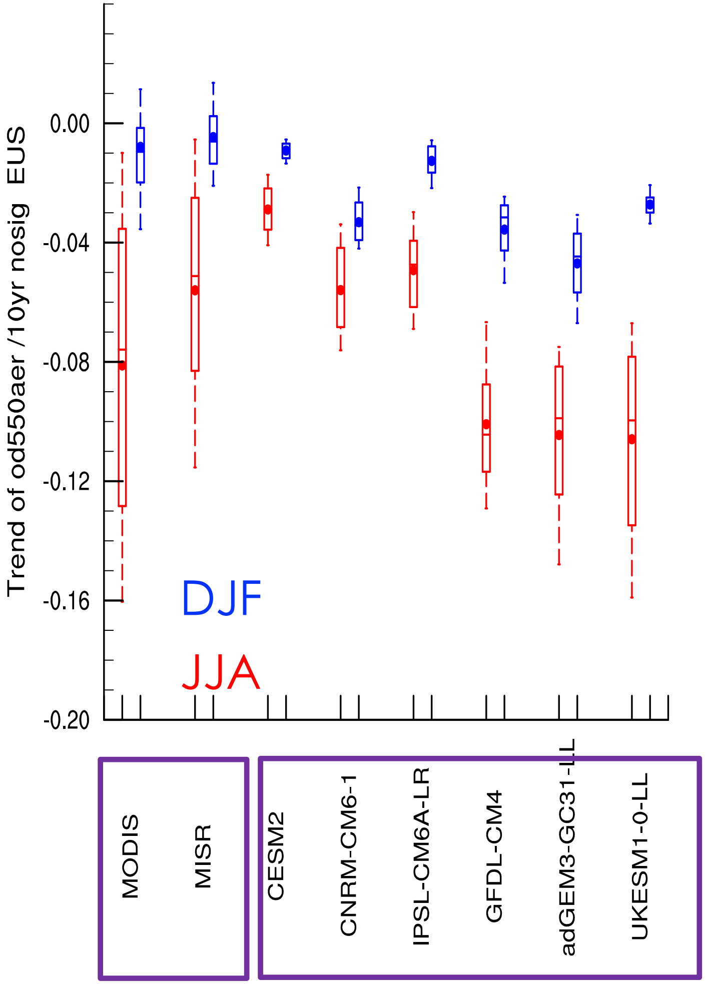
Yawen Liu

Anthro-SO2 emission



Trend of Anthro-SO2 emission





Ob

CMIP6 Model

Find out more…

Aerosol concentration

Radiation

Seasonality

Spatial pattern

Understanding model performance

- **Lufarelli, Marta**
- ***Towards a consistent retrieval of cloud/aerosol single scattering properties and surface reflectance***

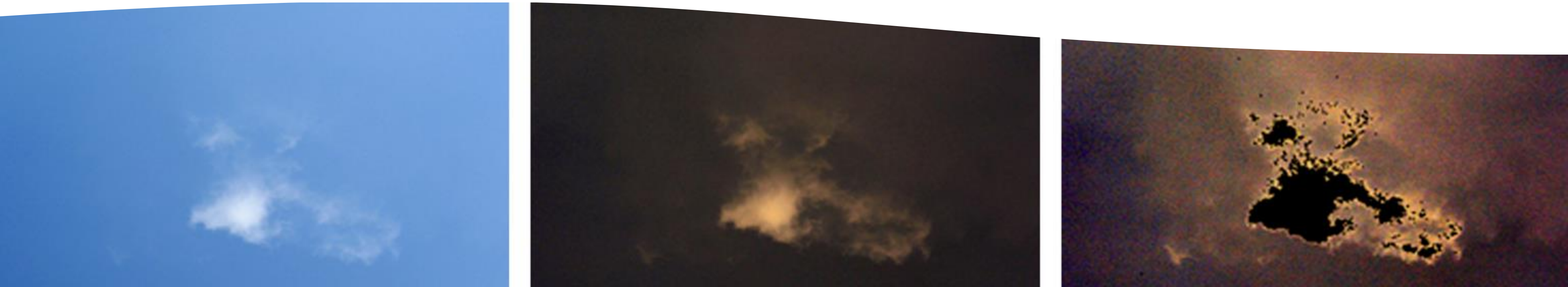
Towards a consistent retrieval of cloud/aerosol single scattering properties and surface reflectance

Aerosol retrieval strongly depend on the quality of the considered cloud mask:

- Cloud contamination often leads to an overestimation of the aerosol optical thickness
- Pixel surrounding clouds are often not processed by neither cloud or aerosol algorithms

We aim at developing an algorithm capable of simultaneously retrieve aerosol and cloud single scattering properties, overcoming the need of an external cloud mask.

Come see me or Yves Govaerts at our poster!

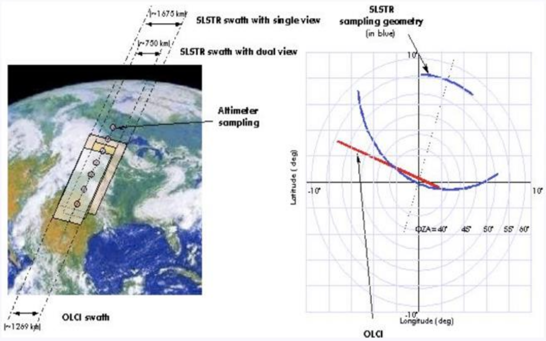


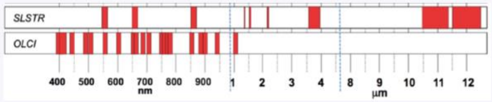
- **North, Peter**
- ***New Products of Global Atmospheric Aerosol for Sentinel-3***

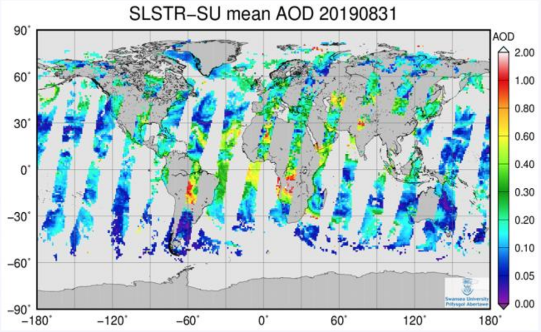
New aerosol products for Sentinel-3 & (A)ATSR missions

Peter North, Andreas Heckel, Claire Henocq, Stephane Ferron, Frederic Rouffi, Steffen Dransfeld, Julien Chimot and the
Aerosol CCI Team (Simon Pnnock & Thomas Popp leads)

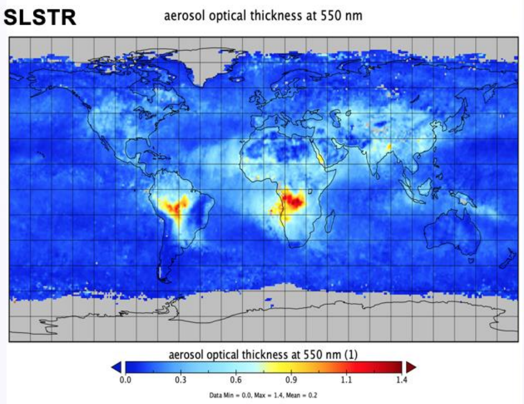
(A) SLSTR/OLCI sampling





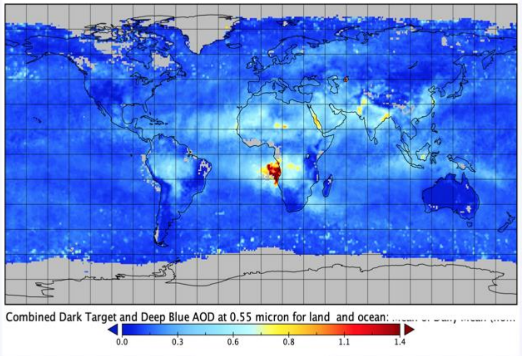


(B) SLSTR AOD & MODIS

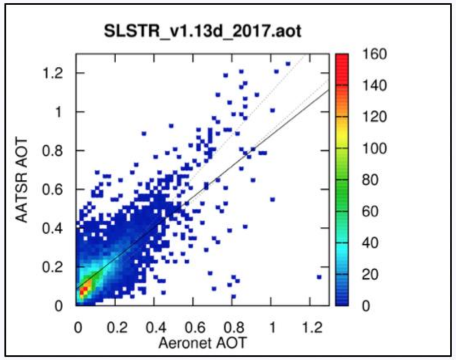


MODIS

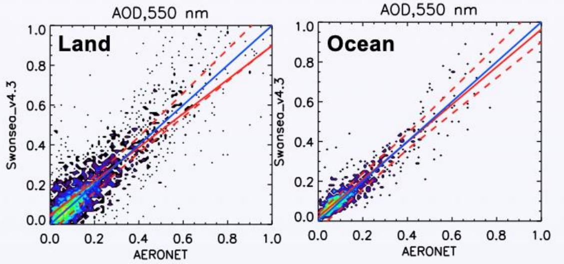
Combined Dark Target and Deep Blue AOD at 0.55 micron for land and ocean



(C) Aeronet comparison

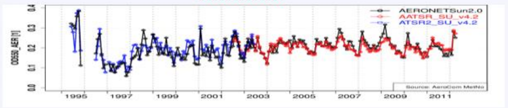


AATSR



K=0.807 a= 0.85 b= 0.05 RMSE= 0.143 K=0.925 a= 0.94 b= 0.02 RMSE= 0.058

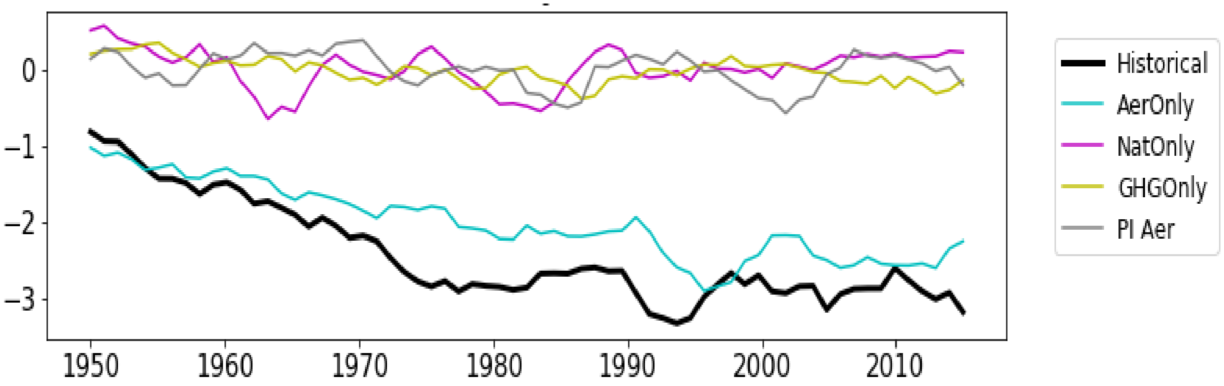
ATSR-2/AATSR vs Aeronet



- **Onsum Moseid, Kristine**
- ***Using global dimming to disentangle the aerosol forcing history***

Kristine Onsum Moseid

Using global dimming to disentangle
The aerosol forcing history



CMIP6 experiments
AerChemMip, DAMIP, DECK

Model
NorESM2

Background

Downwelling shortwave radiation at the surface decreased 1960-1990 – called global dimming

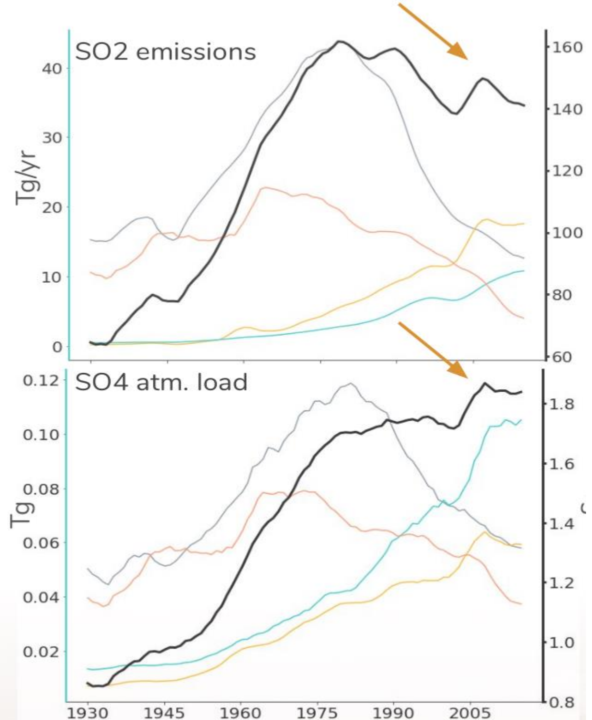
CMIP5 models did not recreate global dimming, how will NorESM2 perform?

Results

Global dimming is apparent in NorESM2 historical and AerOnly DAMIP experiments – but no global brightening

Sulfate burden increase at the same time as emissions decrease

Global lifetime of sulfate increases in NorESM2



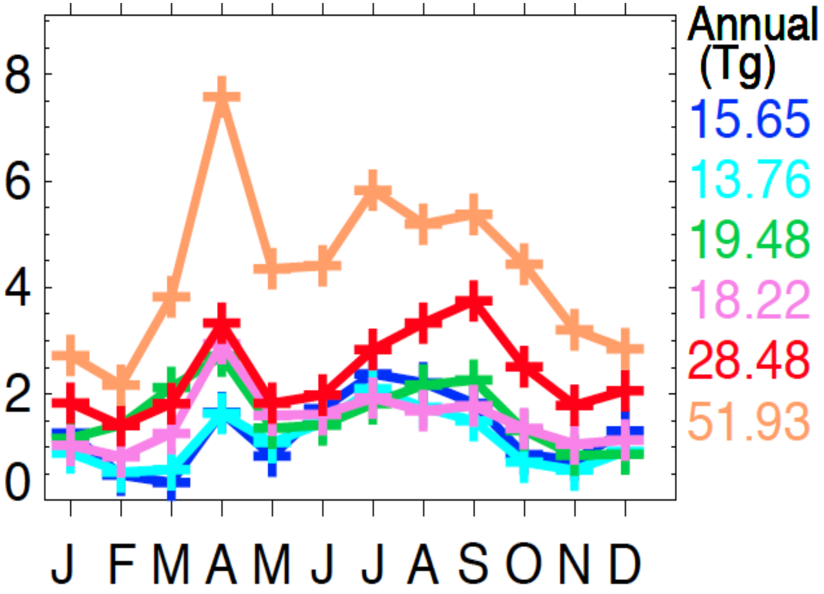
- **Pan, Xiaohua**
- ***Six Global Biomass Burning Emission Datasets: Inter-comparison and Application in one Global Aerosol Model***

6 Global Biomass Burning Emission Datasets: comparison and application in one global aerosol model

now in ACPD

Xiaohua Pan [*,1,2], Charles Ichoku [2], Mian Chin [2], Huisheng Bian [3,2], Anton Darmenov [2,] , Luke Ellison [4,2],
Tom Kucsera [5,2], Arlindo da Silva [2], Mariya Petrenko [1, 2], Jun Wang [6], Christine Wiedinmyer [7] , Tomohiro Oda[5], Ge Cui[6]

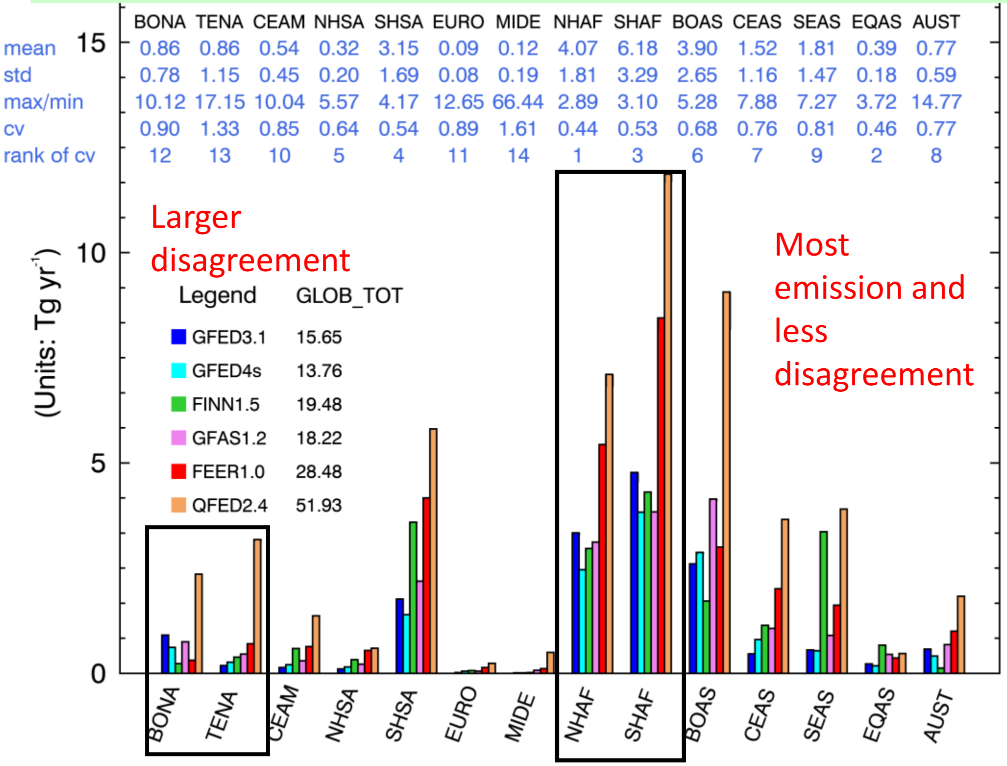
Global OC BB Emission 2008 – monthly
(unit: Tg/month)



NOTE:

1. GLOB_TOT: QFED/GFED4s=3.8
2. Disagreement: largest in less burning regions MIDE, TENA, BONA, EURO, least in NHAF, SHAF

Regional OC BB Emission 2008 – annual
(unit: Tg/year)



	BONA	TENA	CEAM	NHSA	SHSA	EURO	MIDE	NHAF	SHAF	BOAS	CEAS	SEAS	EQAS	AUST
mean	0.86	0.86	0.54	0.32	3.15	0.09	0.12	4.07	6.18	3.90	1.52	1.81	0.39	0.77
std	0.78	1.15	0.45	0.20	1.69	0.08	0.19	1.81	3.29	2.65	1.16	1.47	0.18	0.59
max/min	10.12	17.15	10.04	5.57	4.17	12.65	66.44	2.89	3.10	5.28	7.88	7.27	3.72	14.77
cv	0.90	1.33	0.85	0.64	0.54	0.89	1.61	0.44	0.53	0.68	0.76	0.81	0.46	0.77
rank of cv	12	13	10	5	4	11	14	1	3	6	7	9	2	8

Larger disagreement

Most emission and less disagreement

North America

Africa

- **Peng, Yiran**
- ***Key processes responsible for uncertainties in aerosol simulation with two aerosol modules in the Community Atmosphere Model version 5.3***

Key process(es) responsible for discrepancies in aerosol simulation with two aerosol modules in the Community Atmosphere Model version 5.3

M. Wang, Y. Peng*, K. von Salzen, J. Li, R. Mahmood and X. Liu

- AeroCom I and II indicated that **large diversities** still exist in the **aerosol life cycles** and **particle sizes** simulated with different models;
- We try to investigate the problem by using **two aerosol modules** (PAM and MAM7) driven with the same atmospheric GCM CAM5.3;
- **sensitivity experiments** are conducted to identify the key processes responsible for the discrepancies in simulated aerosol mass, number and size.

Highlights:

- PAM simulates much more ultra-fine particles (around 10-100 nm) than MAM7;
- Both **condensation** and **coagulation** are the major processes responsible for the large discrepancy in aerosol number distribution.

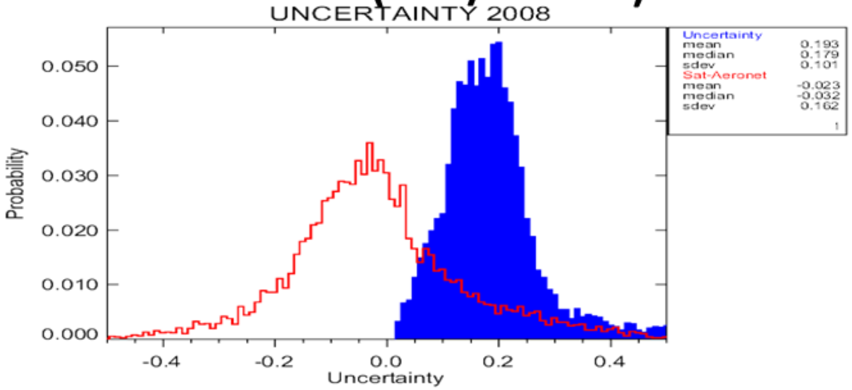
- **Popp, Thomas**
- ***Propagating sophisticated FCDR uncertainties for AVHRR to Aerosol Optical Depth CDRs***

FIDUCEO has received funding from the European Union's Horizon 2020 Programme for Research and Innovation, under Grant Agreement no. 638822

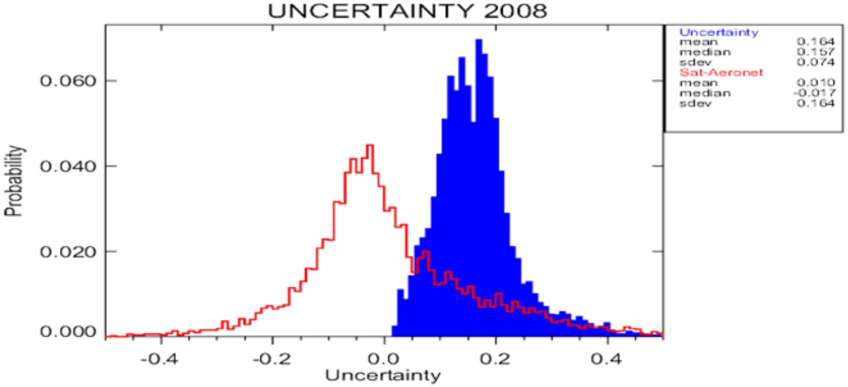
Propagating sophisticated FCDR uncertainties for AVHRR to Aerosol Optical Depth CDRs

Thomas Popp / DLR
EU H2020 FIDUCEO project

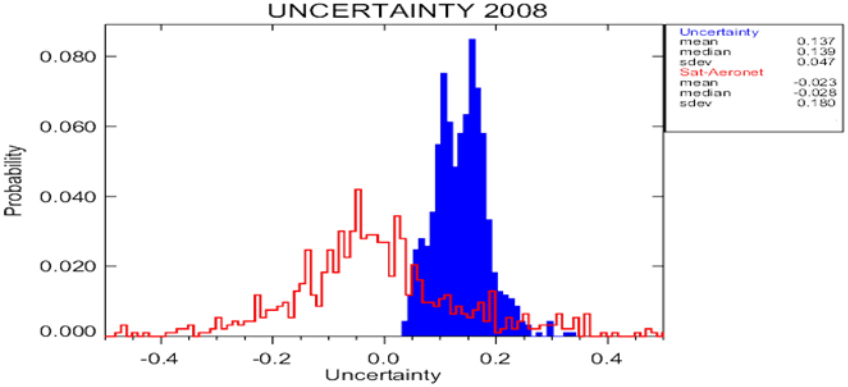
L2A (1x1 / 4x4km)


UNCERTAINTY 2008

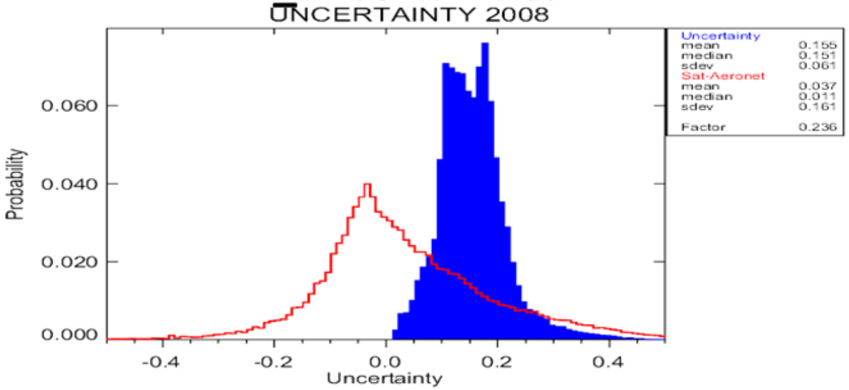
L2B (3x3 / 12x12km)


UNCERTAINTY 2008

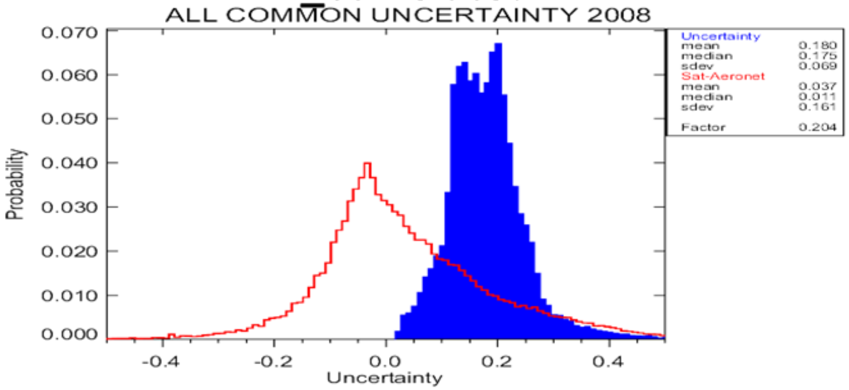
L3_daily (1° x 1°)


UNCERTAINTY 2008

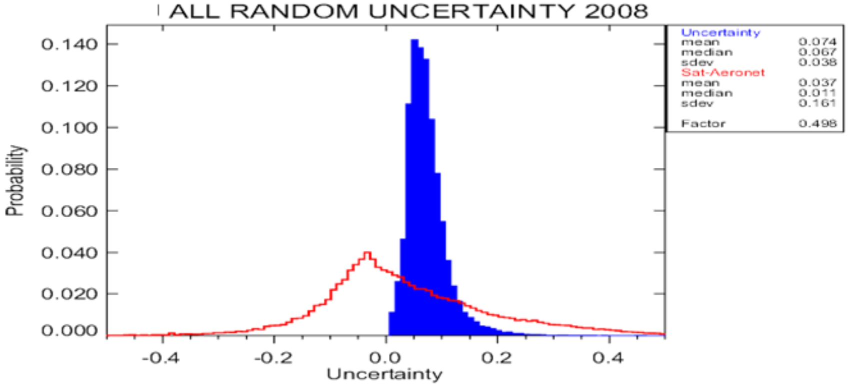
L2B_uncertainties


UNCERTAINTY 2008

L2B_correlated


ALL COMMON UNCERTAINTY 2008

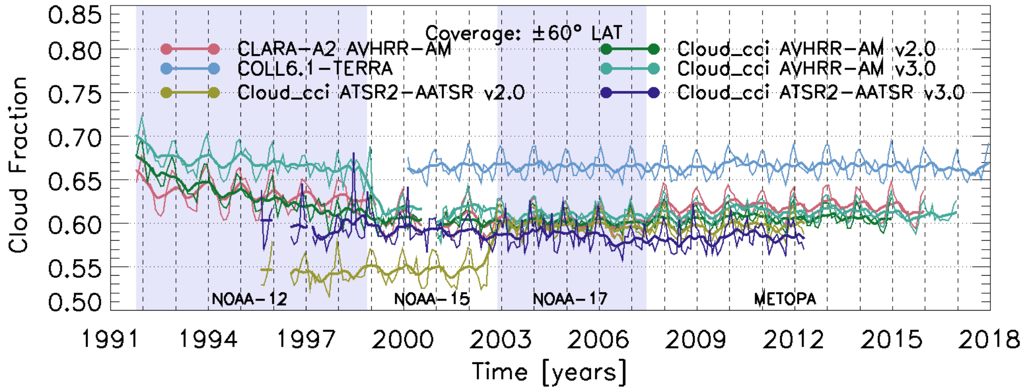
L2B_random

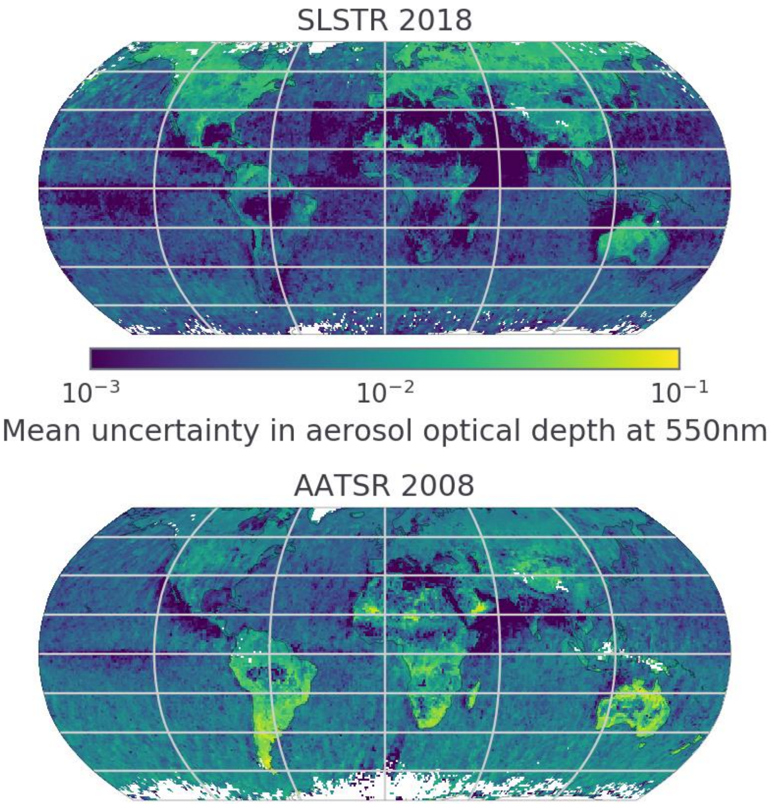

ALL RANDOM UNCERTAINTY 2008

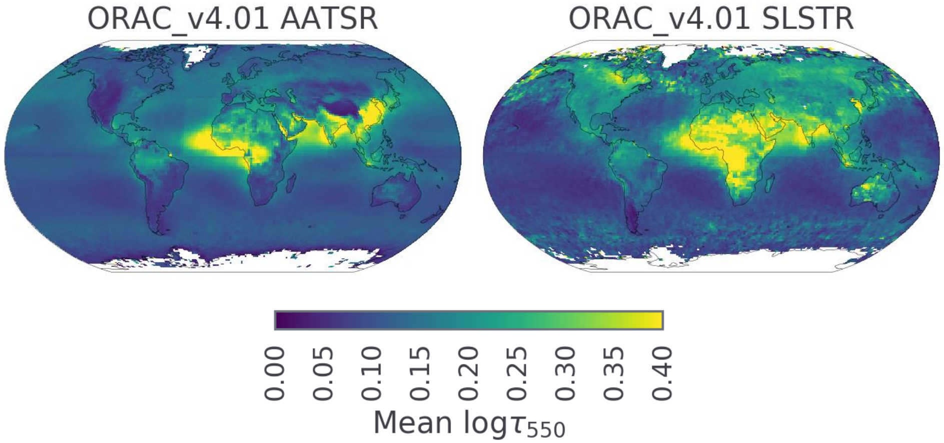
- **Povey, Adam**
- ***Aerosol and cloud products from SLSTR with ORAC***

Aerosol and Cloud Products from SLSTR and AATSR with ORAC

- The Optimal Retrieval of Aerosol and Cloud provides exactly what it says it does in the name
- Change in distribution of uncertainty between instruments







- **Tsay, Si-Chee**
- ***A satellite-surface-modeling perspective of light-absorbing aerosols over Himalaya-Nepal: Results from the RAJO-MEGHA project***

A satellite-surface-modeling perspective of light-absorbing aerosols over Himalaya-Nepal: *Results from the RAJO-MEGHA project*

(Radiation, Aerosol Joint Observation-Modeling Exploration over Glaciers in Himalayan Asia: Sanskrit: Dust-Cloud; **梵文: 沙塵煙雲***)*

***Si-Chee Tsay**, B. N. Holben, N. C. Hsu, K.-M. Kim, A. M. da Silva, Jr.,*
W. K.-M. Lau (UMd), A. K. Panday (ICIMOD), and MANY Others

A-Train tracks:
Daytime ascending &
Nighttime descending

GEOS-5 Model Simulation

Si-Chee Tsay, Deputy
EOS/Terra Project Scientist

- **Thanos Tsikerdekis**
- ***Assimilating aerosol optical properties related to size (ANG) and species (SSA) from POLDER/PARASOL with an ensemble data assimilation system***

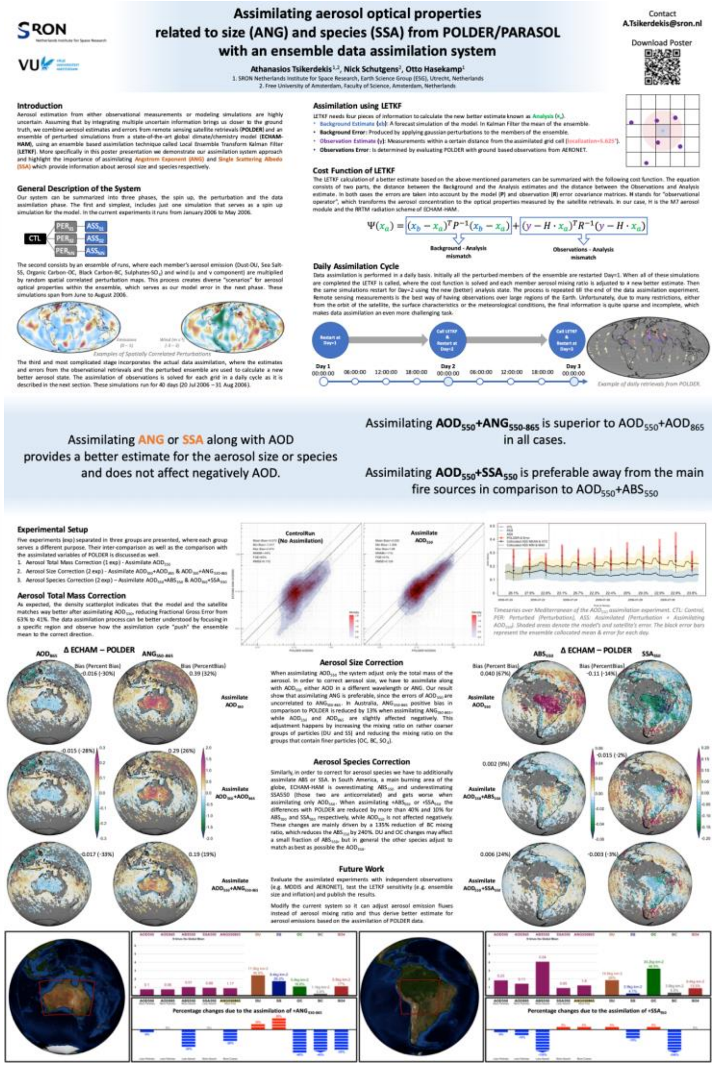
Assimilating aerosol optical properties related to size (ANG) and species (SSA) from POLDER/PARASOL with an ensemble data assimilation system

Athanasios Tsikerdekis[1,2], **Nick Schutgens**[2], **Otto Hasekamp**[1]
1. SRON Netherlands Institute for Space Research, Earth Science Group (ESG), Utrecht, Netherlands
2. Free University of Amsterdam, Faculty of Science, Amsterdam, Netherlands

Interested to see our aerosol assimilation approach?

Wondering how **aerosol size and species** information from satellites can improve an aerosol simulation?

Can we account for the total mass, size and species correction in one experiment?



Assimilating aerosol optical properties
related to size (ANG) and species (SSA) from POLDER/PARASOL
with an ensemble data assimilation system

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Introduction

Aerosol estimation from either observational measurements or modeling simulations are highly uncertain. Assuming that by integrating multiple uncertain information brings us closer to the ground truth, we combine aerosol estimates and errors from remote sensing satellite retrievals (**POLDER**) and an ensemble of perturbed simulations from a state-of-the-art global climate/chemistry model (**ECHAM-HAM**), using an ensemble based assimilation technique called Local Ensemble Transform Kalman Filter (**LETKF**). More specifically in this poster presentation we demonstrate our assimilation system approach and highlight the importance of assimilating Angstrom Exponent (ANG) and Single Scattering Albedo (SSA) which provide information about aerosol size and species respectively.

General Description of the System

Our system can be summarized into three phases, the spin up, the perturbation and the data assimilation phase. The first and simplest, includes just one simulation that serves as a spin up simulation for the model. In the current experiments it runs from January 2006 to May 2006.

The second consists by an ensemble of runs, where each member's aerosol emission (Dust-DU, Sea Salt-SS, Organic Carbon-OC, Black Carbon-BC, Sulphates-SO_4) and wind (u and v component) are multiplied by random spatial correlated perturbation maps. This process creates diverse "scenarios" for aerosol optical properties within the ensemble, which serves as our model error in the next phase. These simulations span from June to August 2006.

Examples of Spatially Correlated Perturbations

The third and most complicated stage incorporates the actual data assimilation, where the estimates and errors from the observational retrievals and the perturbed ensemble are used to calculate a new better aerosol state. The assimilation of observations is solved for each grid in a daily cycle as it is described in the next section. These simulations run for 40 days (20 Jul 2006 – 31 Aug 2006).

Assimilation using LETKF

LETKF needs four pieces of information to calculate the new better estimate known as Analysis (x_a).

- Background Estimate (xb): A forecast simulation of the model. In Kalman Filter the mean of the ensemble.
- **Background Error**: Produced by applying gaussian perturbations to the members of the ensemble.
- Observation Estimate (y): Measurements within a certain distance from the assimilated grid cell (localization=5.625°).
- **Observations Error**: Is determined by evaluating POLDER with ground based observations from AERONET.

Cost Function of LETKF

The LETKF calculation of a better estimate based on the above mentioned parameters can be summarized with the following cost function. The equation consists of two parts, the distance between the Background and the Analysis estimates and the distance between the Observations and Analysis estimate. In both cases the errors are taken into account by the model (**P**) and observation (**R**) error covariance matrices. **H** stands for "observational operator", which transforms the aerosol concentration to the optical properties measured by the satellite retrievals. In our case, H is the M7 aerosol module and the RRTM radiation scheme of ECHAM-HAM.

$$\Psi(x_a) = \underbrace{\boxed{(x_b - x_a)^T P^{-1} (x_b - x_a)}}_{\text{Background - Analysis mismatch}} + \underbrace{\boxed{(y - H \cdot x_a)^T R^{-1} (y - H \cdot x_a)}}_{\text{Observations - Analysis mismatch}}$$

Daily Assimilation Cycle

Data assimilation is performed in a daily basis. Initially all the perturbed members of the ensemble are restarted Day=1. When all of these simulations are completed the LETKF is called, where the cost function is solved and each member aerosol mixing ratio is adjusted to a new better estimate. Then the same simulations restart for Day=2 using the new (better) analysis state. The process is repeated till the end of the data assimilation experiment. Remote sensing measurements is the best way of having observations over large regions of the Earth. Unfortunately, due to many restrictions, either from the orbit of the satellite, the surface characteristics or the meteorological conditions, the final information is quite sparse and incomplete, which makes data assimilation an even more challenging task.

Example of daily retrievals from POLDER

Assimilating ANG or SSA along with AOD provides a better estimate for the aerosol size or species and does not affect negatively AOD.

Assimilating **AOD_{550}+$ANG_{550\text{-}865}$** is superior to AOD_{550}+AOD_{865} in all cases.

Assimilating **AOD_{550}+SSA_{550}** is preferable away from the main fire sources in comparison to AOD_{550}+ABS_{550}

Experimental Setup

Five experiments (exp) separated in three groups are presented, where each group serves a different purpose. Their inter-comparison as well as the comparison with the assimilated variables of POLDER is discussed as well.

1. Aerosol Total Mass Correction (1 exp) - Assimilate AOD_{550}
2. Aerosol Size Correction (2 exp) - Assimilate AOD_{550}+AOD_{865} & AOD_{550}+$ANG_{550\text{-}865}$
3. Aerosol Species Correction (2 exp) – Assimilate AOD_{550}+ABS_{550} & AOD_{550}+SSA_{550}

Aerosol Total Mass Correction

As expected, the density scatterplot indicates that the model and the satellite matches way better after assimilating AOD_{550}, reducing Fractional Gross Error from 63% to 41%. The data assimilation process can be better understood by focusing in a specific region and observe how the assimilation cycle "push" the ensemble mean to the correct direction.

Timeseries over Mediterranean of the AOD_{550} assimilation experiment. CTL: Control, PER: Perturbed (Perturbation), ASS: Assimilated (Perturbation + Assimilating AOD_{550}). Shaded areas denote the model's and satellite's error. The black error bars represent the ensemble collocated mean & error for each day.

Aerosol Size Correction

When assimilating AOD_{550} the system adjust only the total mass of the aerosol. In order to correct aerosol size, we have to assimilate along with AOD_{550} either AOD in a different wavelength or ANG. Our result show that assimilating ANG is preferable, since the errors of AOD_{550} are uncorrelated to $ANG_{550\text{-}865}$. In Australia, $ANG_{550\text{-}865}$ positive bias in comparison to POLDER is reduced by 13% when assimilating $ANG_{550\text{-}865}$, while AOD_{550} and AOD_{865} are slightly affected negatively. This adjustment happens by increasing the mixing ratio on rather coarser groups of particles (DU and SS) and reducing the mixing ratio on the groups that contain finer particles (OC, BC, SO_4).

Aerosol Species Correction

Similarly, in order to correct for aerosol species we have to additionally assimilate ABS or SSA. In South America, a main burning area of the globe, ECHAM-HAM is overestimating ABS_{550} and underestimating SSA550 (those two are anticorrelated) and gets worse when assimilating only AOD_{550}. When assimilating +ABS_{550} or +SSA_{550} the differences with POLDER are reduced by more than 40% and 10% for ABS_{550} and SSA_{550} respectively, while AOD_{550} is not affected negatively. These changes are mainly driven by a 135% reduction of BC mixing ratio, which reduces the ABS_{550} by 240%. DU and OC changes may affect a small fraction of ABS_{550}, but in general the other species adjust to match as best as possible the AOD_{550}.

Future Work

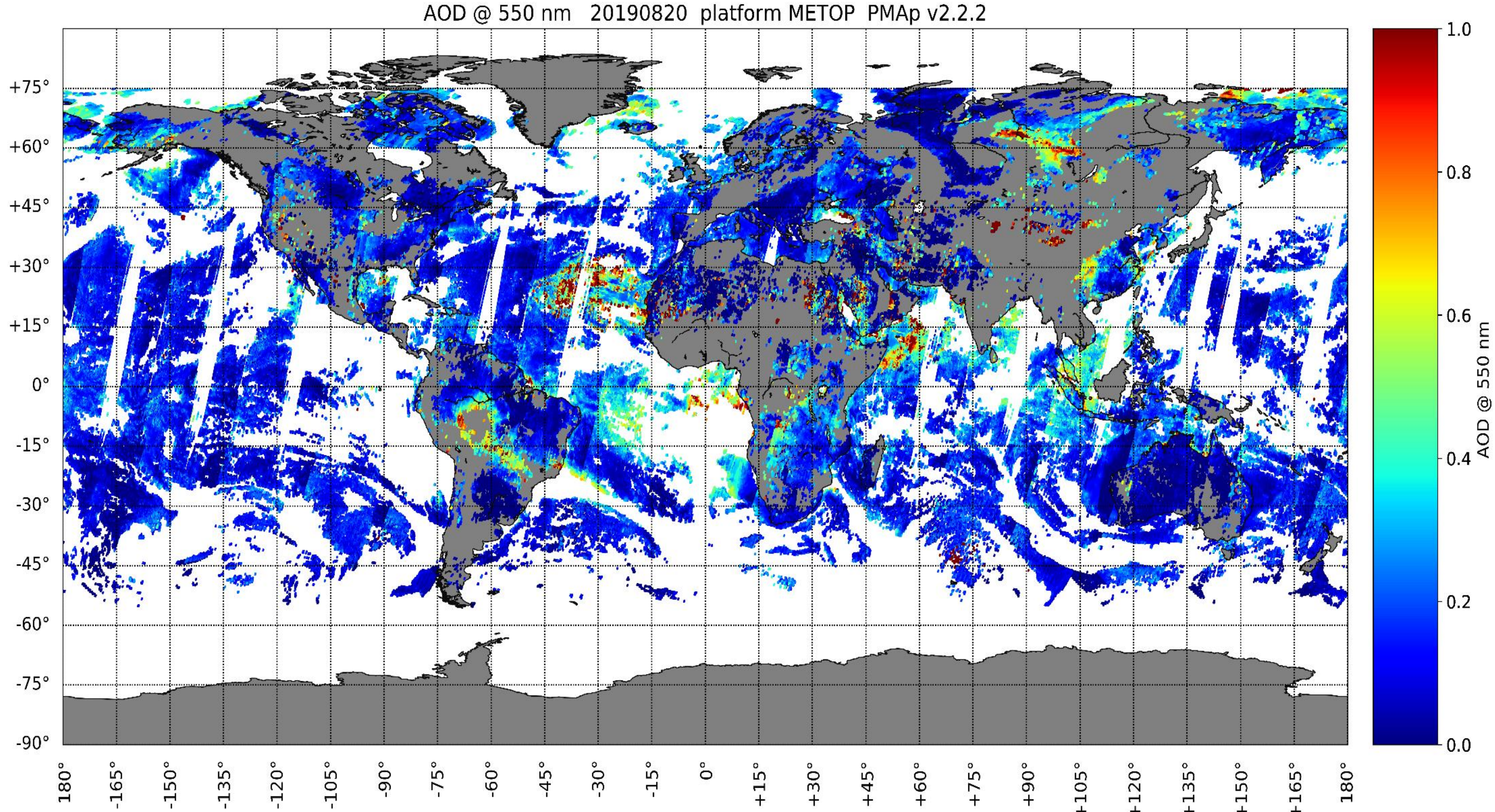
Evaluate the assimilated experiments with independent observations (e.g. MODIS and AERONET), test the LETKF sensitivity (e.g. ensemble size and inflation) and publish the results.

Modify the current system so it can adjust aerosol emission fluxes instead of aerosol mixing ratio and thus derive better estimate for aerosol emissions based on the assimilation of POLDER data.

- **Vazquez-Navarro, Margarita**
- ***PMAp version 2: synergistic global Aerosol Optical Depth retrieval over land and ocean from Metop.***

PMAp v2 global operational AOD retrieval from all 3 Metop

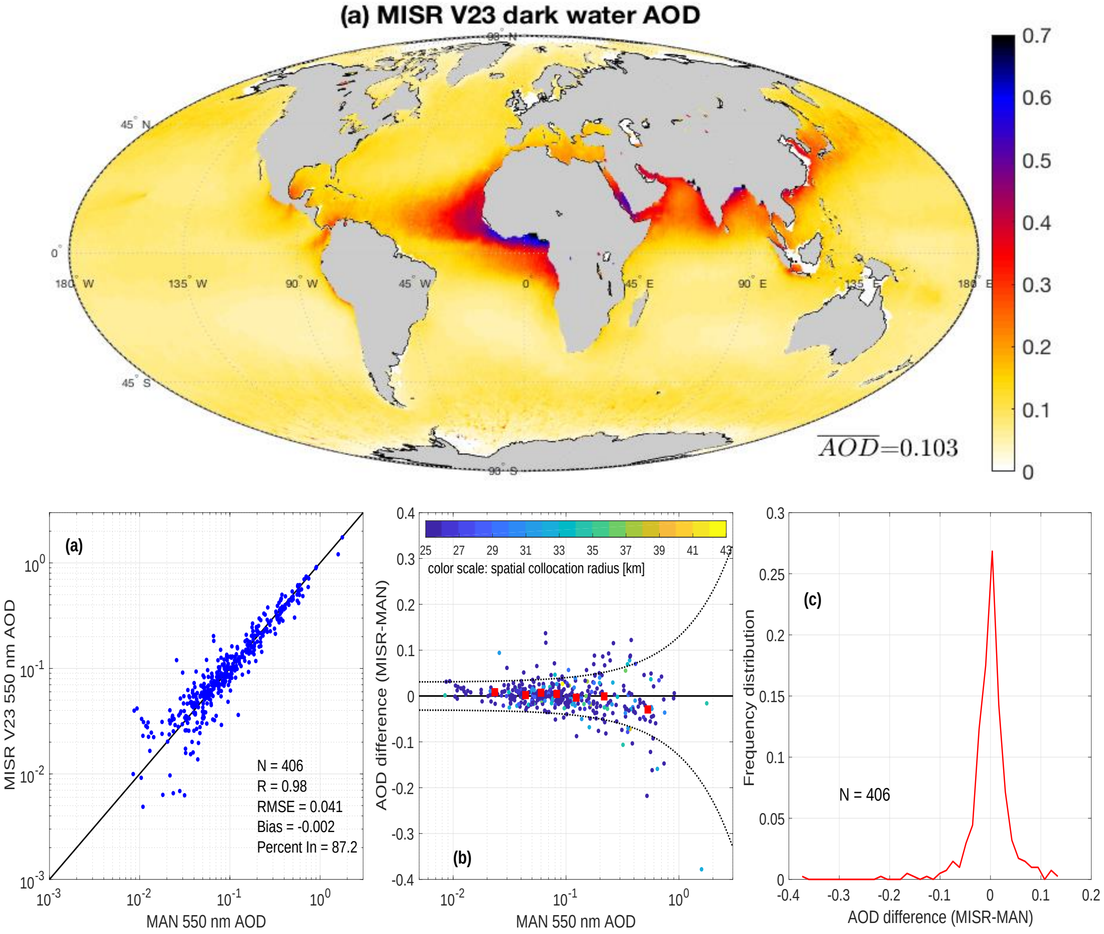
AOD (550nm) over land & ocean and aerosol type at GOME-2 PMD spatial resolution based on a combination of GOME-2 PMD + IASI + AVHRR.



- **Wittek, Marcin**
- ***Oceanic aerosol loading derived from MISR’s 4.4 km (V23) Aerosol Product***

Marcin L. Witek

Oceanic aerosols from MISR 4.4 km retrievals



A new version (V23) of the MISR aerosol product, publicly released in mid-2018, is analyzed. We assess the quality of retrievals over dark water using surface-based MAN and AERONET observations. We also examine aerosol climatology over oceans and assess reported AOD retrieval uncertainties.

External validation shows unparalleled accuracy of the V23 dark water AOD retrievals. The reported pixel-level AOD uncertainties realistically represent retrieval errors.

(top) Average MISR V23 AOD, mission composite; (bottom, three panels) validation results against MAN observations along with comparison statistics

Witek L. M, M. J. Garay, D. J. Diner, and A. Sminov (2019): Oceanic aerosol loading derived from MISR's 4.4 km (V23) Aerosol Product. *J. Geophys. Res.*, doi:10.1029/2019JD031065

- **Yu, Yan**
- ***Disproving the Bodélé depression as the primary source of dust fertilizing the Amazon Rainforest***

Disproving the Bodélé depression as the primary source of dust fertilizing the Amazon Rainforest

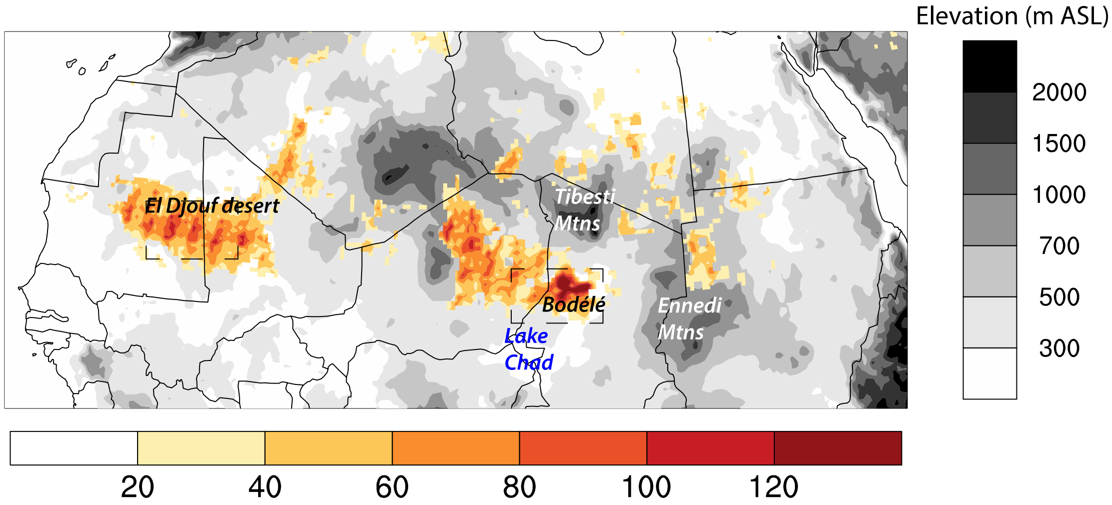
Yan Yu (yuyan06@gmail.com), Olga V. Kalashnikova, Michael J. Garay, Huikyo Lee, Michael Notaro, James R. Campbell, Jared Marquis, and Gregory S. Okin

Background: African dust provides key nutrients to fertilize the Amazon Rainforest. Previous AOD-based dust flux calculations indicated that the Bodélé depression is the main contributor to this trans-Atlantic dust transport, but have been challenged by geochemical analysis.

Current study integrates a suite of satellite observations into a novel trajectory analysis framework to investigate dust transport from the leading two North African dust sources, namely the Bodélé depression and El Djouf.

Methodology highlights:

- Initiate millions of trajectories with MISR-observed dust plume height.
- Quantify dust dry and wet deposition based on multiple satellite observations.



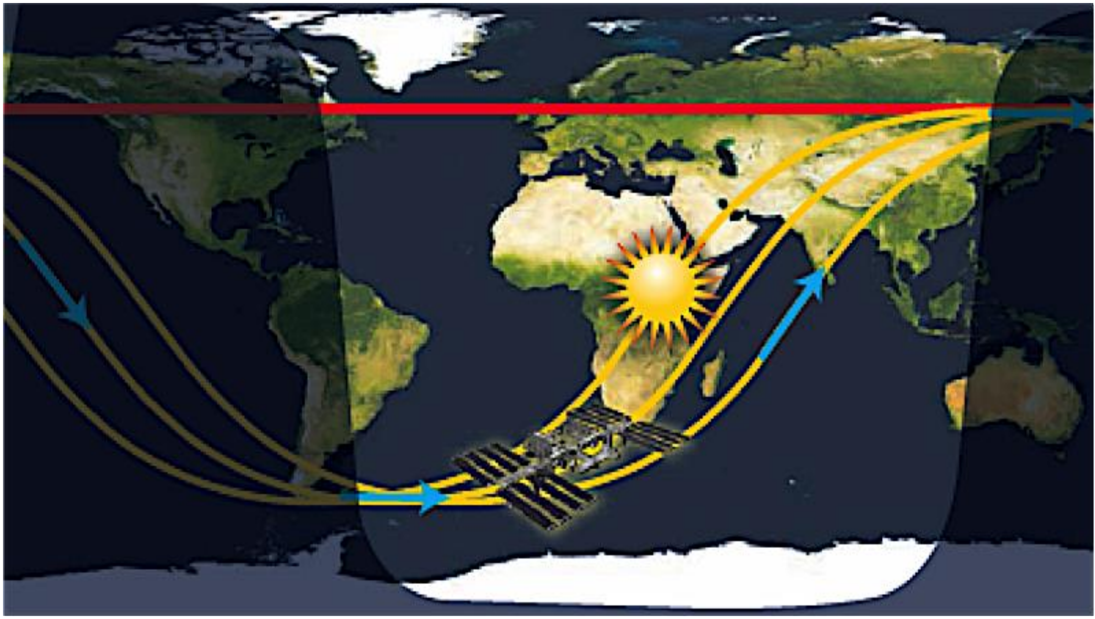
Yu et al. (2018) *GRL*

- **Yu, Yan**
- ***A Global Analysis of Dust Diurnal Variability Using CATS Observations***

A Global Analysis of Dust Diurnal Variability Using CATS Observations

Yan Yu (yuyan06@gmail.com), Olga V. Kalashnikova, Michael J. Garay, Huikyo Lee, Myungje Choi, Gregory S. Okin, John E. Yorks, and James R. Campbell

Scientific questions: What is the observed diurnal variability in dust loadings over global dust source regions? What key processes are responsible for these dust diurnal cycles?



Satellite observation: The Cloud-Aerosol Transport System (CATS) is an elastic backscatter lidar that operated on the International Space Station (ISS) for 33 months during 2015-2017. The ISS 51° inclination orbit enables CATS measurements at different local time every overpass, with full diurnal coverage for a given location within a 60-day period.

Analysis: evaluate the quality of CATS-based AOD and dust AOD, identify statistically significant diurnal cycle over key regions, link with specific processes.

- **Xue, Young**
- ***Hourly Remote Sensing Monitoring of Global Aerosol Optical Depth over Land Using Data from Three Geostationary Satellites: GOES-16, MSG-1, Himawari-8***

Global Hourly Aerosol Retrieval over Land from Geostationary Satellite Data

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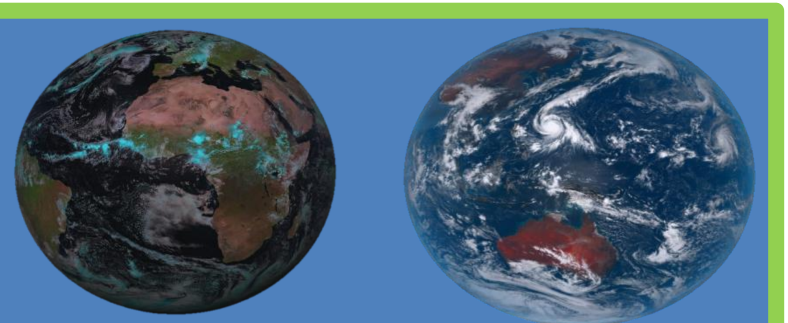
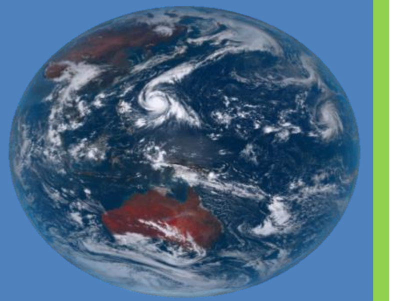
[5]College of Resources and Environmental Science, Ningxia University, Ningxia 750021, Ningxia Province, China.

Due to the limitations of satellite numbers and orbital width, it is almost impossible to monitor global aerosol distribution using polar orbiting satellites at high frequency. This greatly limits the application of Aerosol Optical Depth (AOD) datasets in many fields, such as atmospheric pollutant monitoring and climate change research. Although geostationary satellites have a very high temporal resolution and very large observation range, three or more satellites are still needed to achieve rapid monitoring of global aerosols. In this work, we obtain hourly global aerosol optical depth dataset by integrating AOD datasets retrieved from four geostationary weather satellites (GOES-16, MSG-1, MSG-4 and Himawari-8), which will greatly expand the application range of AOD datasets. The integrated geostationary satellite AOD datasets from April to August 2018 are validated using AERONET data. The validation results are follows: the Mean Absolute Error (MAE), Mean Bias Error (MBE), Relative Mean Bias (RMB), and Root Mean Square Error (RMSE) are 0.07, 0.01, 1.08 and 0.11, respectively. The ratio of the error of satellite retrieval within $\pm(\mathbf{0.05+0.2}\boldsymbol{AOD_{AERONET}})$ is 0.69. As a representative of polar orbit satellites, the spatial coverage and accuracy of MODIS C61 AOD product released by NASA are also analysed. The analysis results show that the integrated AOD dataset has similar accuracy to that of the MODIS AOD dataset and has higher temporal resolution and spatial coverage than the MODIS AOD dataset.

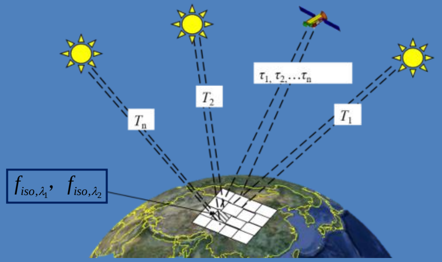


MSG4 SEVIRI (0) and MSG1 SEVIRI (41.5E)

GOES-16 ABI (75W)



Himawari-8 (140.E)

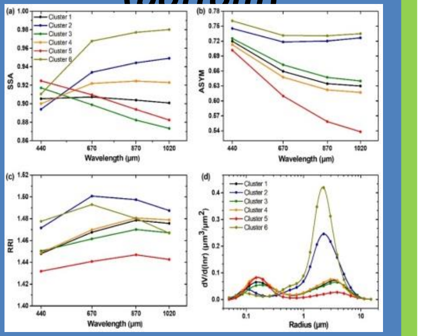


- **Joint Retrieval-Optimal** (*left*)
- **Aerosol Parameters** (*bottom*)

Two fundamental assumption :

➢the surface reflective property changes little during the observation period

➢assume one aerosol type for a grid of 1º×1º (g and SSA do not vary over the region of 1º×1º)



AeroSAT Experiment task groups (2018)

- **Aerosol Retrieval Comparison** [**Kinne**, **Schutgens**]
- **Characterizing retrieval uncertainties** [**Sayer**, **Povey, Govaerts, Levy, Patadia, Witek, Kahn, Dubovik, Mei, Rozanov, Thomas, Kolmonen, Stebel, Limbacher, Lyapustin, Popp**]
- **Joint Remote-Sensing AOD and Type** [**Kinne**, **others**]
- Connecting **model – satellite aerosol type** [**Mona**, **Kahn, Tsigaridis**]
- Constraining **Aerosol Vertical Distribution** [**Winker, Kahn, Nowotnick, Colarco**]
- **Consistent multi-sensor trends** [**Sogachewa, Schulz, Popp**]
- **CCN new approaches** [**Rosenfeld, Christensen, Bauer, Shanzuka, Stier**]