UPDATES ON THE INTERNATIONAL COOPERATIVE FOR AEROSOL RESEARCH MULTI-MODEL ENSEMBLE (ICAP-MME)

Peng Lynch[1], Jeffrey S. Reid[1], Laaziz Amraoui[2], Nicole Asencio[2], Sara Basart[3], Angela Benedetti[4], Malcolm Brooks[5], Peter Colarco[6], Arlindo da Silva[6], Oriol Jorba[3], Sarah Lu[7], Edward Hyer[1], Yaswant Pradhan[5], Thomas Sekiyama[8], Taichu Y. Tanaka[8], Jun Wang[7]

[1] Marine Meteorology Division, Naval Research Laboratory, Monterey CA; [2] Meteo France [3] Earth Sciences Department, Barcelona Supercomputing Center, Barcelona, Spain; [4] ECMWF, Reading, UK; [5] UK Met Office, Reading, UK; [6] NASA GSFC, Greenbelt, MD; [7] NOAA NCEP, College Park, MD ; [8] Meteorological Research Institute, Japan Meteorological Agency, Tsukuba, Japan

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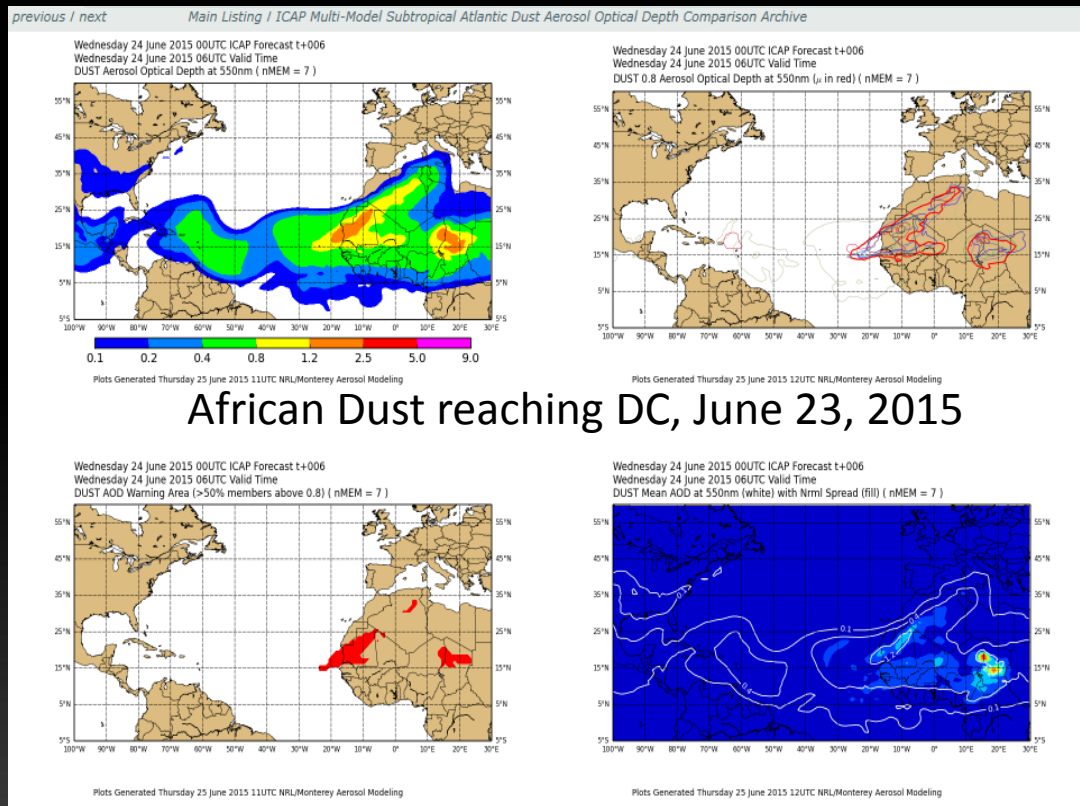
MOTIVATION FOR ICAP MME

- It provides a testbed of probabilistic aerosol forecast. Systematic errors arising from the imperfect nature of the models and sensitivity of models to initial conditions are two main sources of forecast errors. Ensemble-based predictions are shown to be able to help control for these errors. Further, multi-model ensemble forecasting for other atmospheric features, e.g., tropical cyclone track and intensity, has proven to be beneficial. We will show AOT ensemble is similar.

- It helps to identify problem areas for aerosol modeling. Areas with the largest diversity requires attention for aerosol model improvement and/or investigation on the driving meteorology.

- Operational aerosol forecast becomes available at many NWP centers, which enables an exploration of aerosol MME.



CURRENT ICAP MODELS

Organization	BSC	Copernicus / ECMWF	JMA	Meteo France	NASA	US Navy	NOAA	UK Met Office
Model	NMMB/BSC-CTM	CAMS	MASINGAR	MOCAGE	GEOS-5	NAAPS	NGAC	UKMO
Status	QO	O-24 hrs	QO	O	QO	O	O	O
Meteorology	Offline NMMB	Inline IFS	inline AGCM	Offline ARPEGE	Inline GEOS-5	Offline NAVGEM	Inline GFS	Inline UM
Resolution	1.4x1	0.4x0.4	0.56x0.56	2x2	0.25x0.31	0.33x0.33	1x1	0.35x0.23
levels	24	60	40	47	72	60	64	70
DA	LETKF^p	4DVar	EnKF^p	2018	2DVar +LDE	2DVar 3DVar, EnKF^p	NA	4DVar
Assimilated Obs	DAQ MODIS+DB	DAQ MODIS+DB	CALIOP, MODIS, Himawari-8	NA	Neural Net MODIS	DAQ MODIS, CALIOP	NA	MODIS Dust AOT
Species	Dust Sea Salt BC, OC (POA,SOA) Sulfate	BC Dust OC Sea Salt Sulfate	BC Dust OC Sea Salt Sulfate	BC Dust OC Sea Salt Sulfate	BC Dust OC Sea Salt Sulfate	Anthro+bio B. Burn Dust Sea Salt	Dust BC OC Sea Salt Sulfate	Dust
Size Bins	8 (dust, salt) Bulk (BC, OC, Su)	3	10	6	5	1	5	2
Bio. Burn. Emissions	NA	GFAS	GFAS	GFAS	QFED	FLAMBE	GBBEPx	NA

New Member

- The ICAP-MME is run daily w/ 1x1 deg res at 00Z for 6 hrly fcasts out to 120 hrs w/ a 1-day latency.
- Modal AOT (550nm) and dust AOT (550nm) data in NetCDF is available at http://usgodae.org/cgi-bin/datalist.pl?dset=nrl_icap_mme&summary=Go

NEW MODEL DATA PUT ON EVALUATION

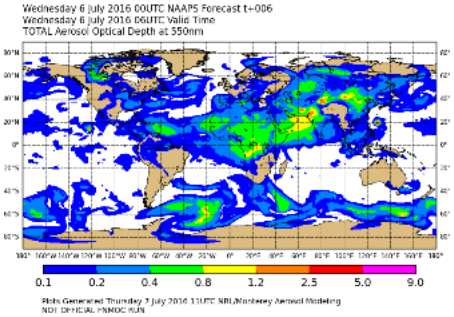
previous / next

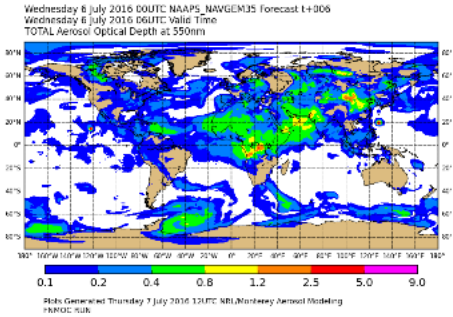
Main Listing / ICAP Multi-Model Global Total Aerosol Optical Depth Archive

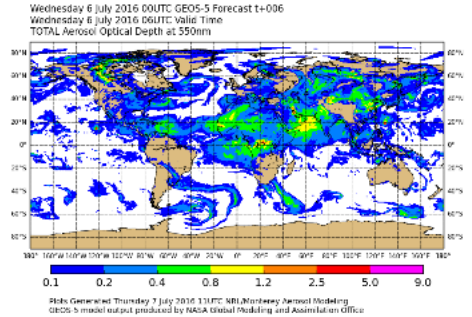
t+hour
006
012
018
024
030
036
042
048
054
060
066
072
078
084
090
096
102
108
114
120

sulfate
dust
smoke
seasalt
total

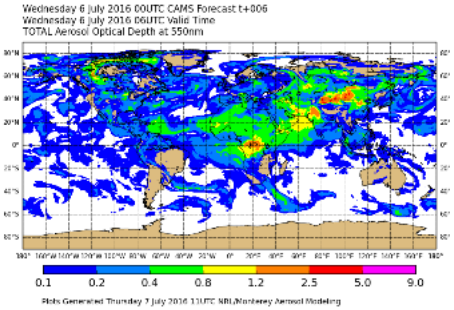
global
niosea
byzantium
eastasia
subtropatl
pacific
conus
satlantic
sioaus
npolar

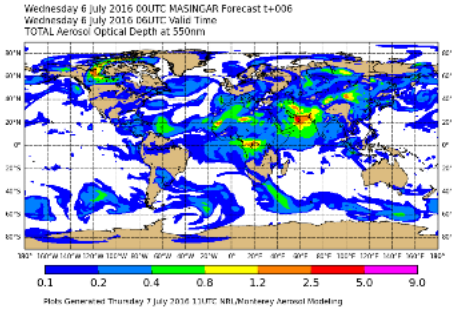


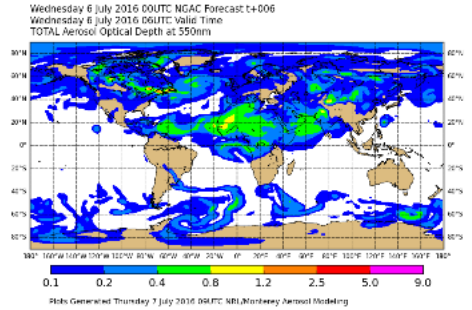




NGAC with full species



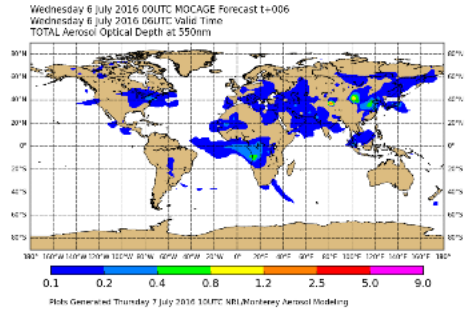




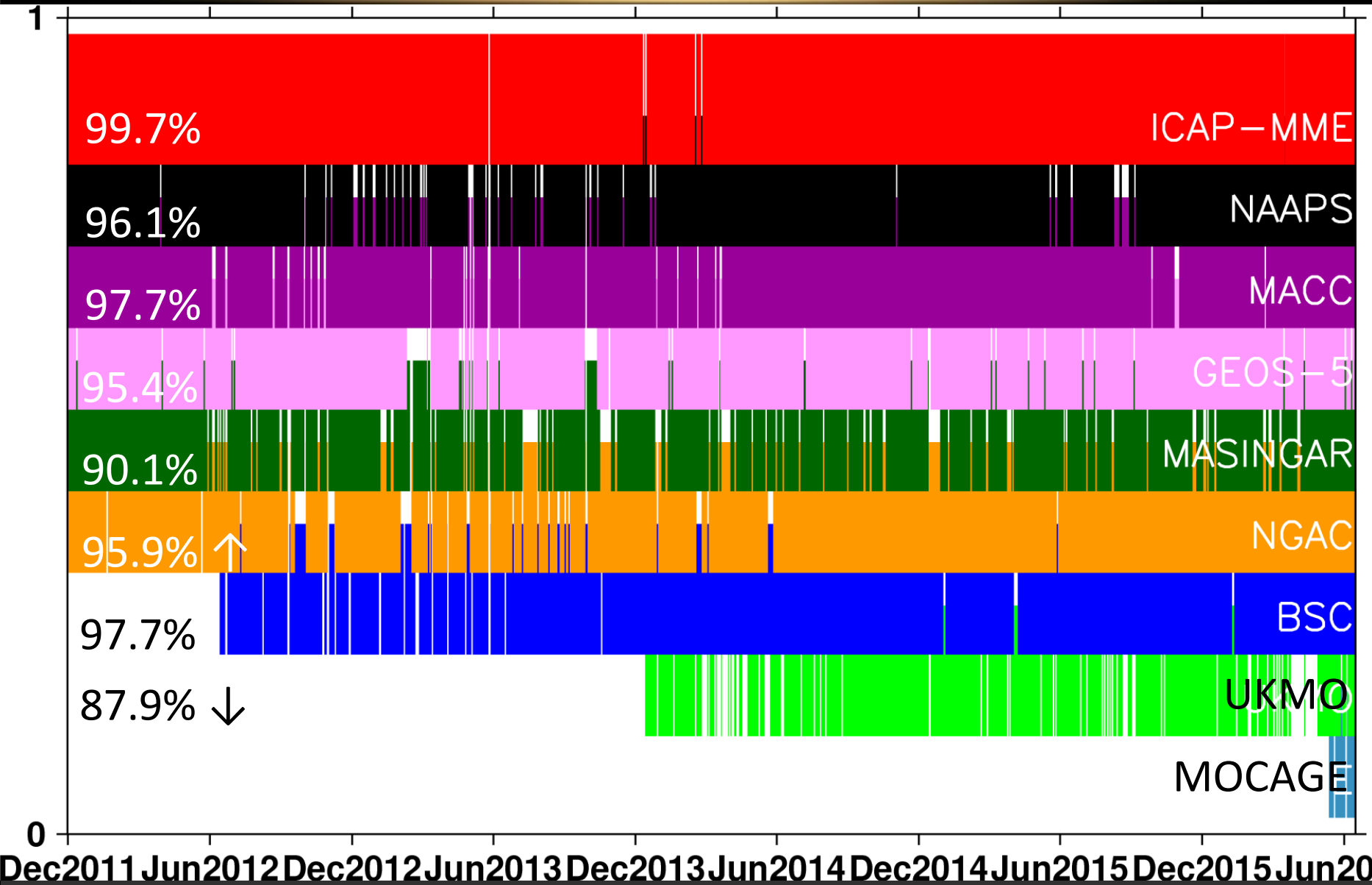
UKMO/Unified Model Imagery Unavailable

BSC Imagery Unavailable

New model MOCAGE

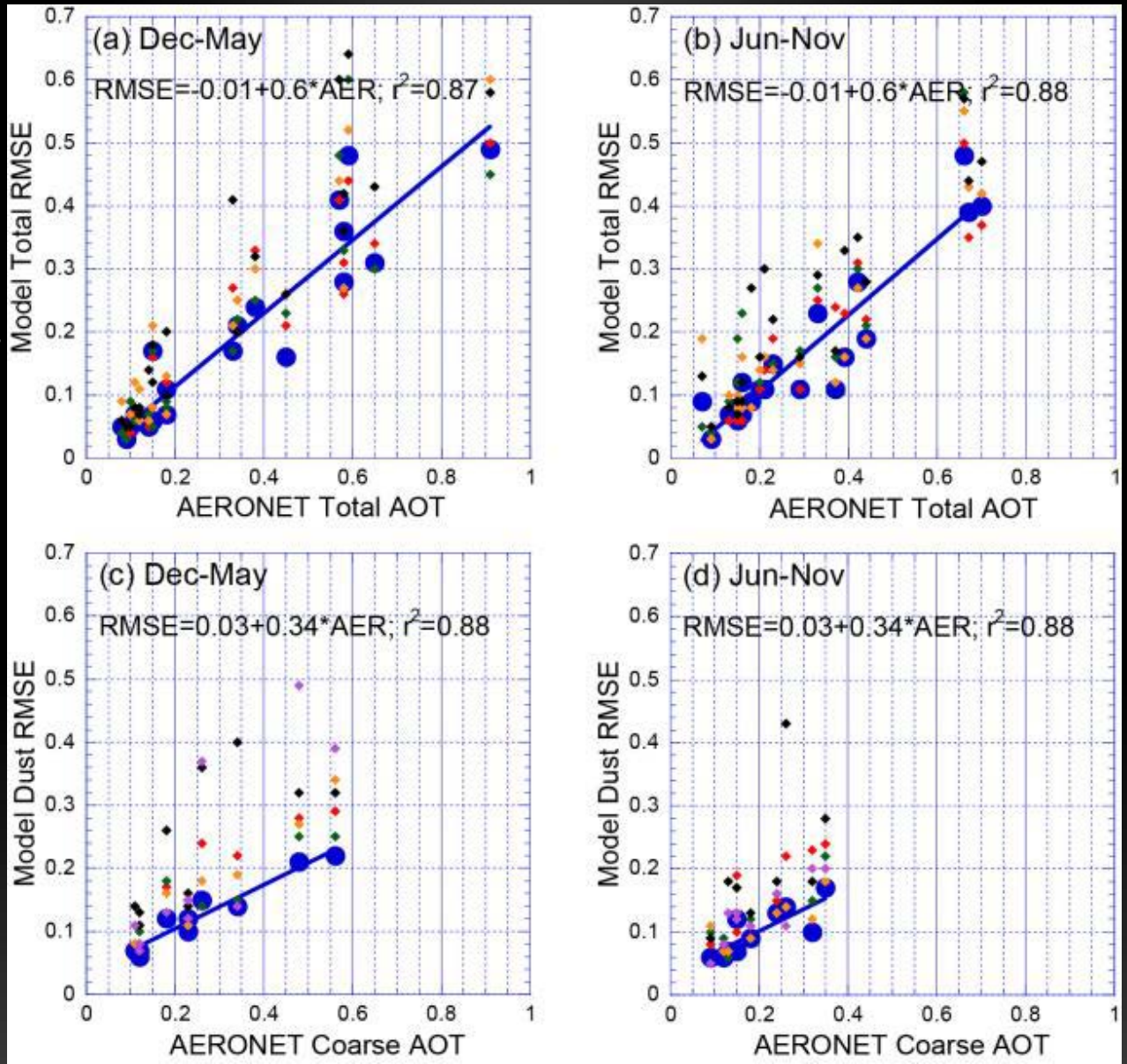


DATA FLOW OF THE ICAP MODELS

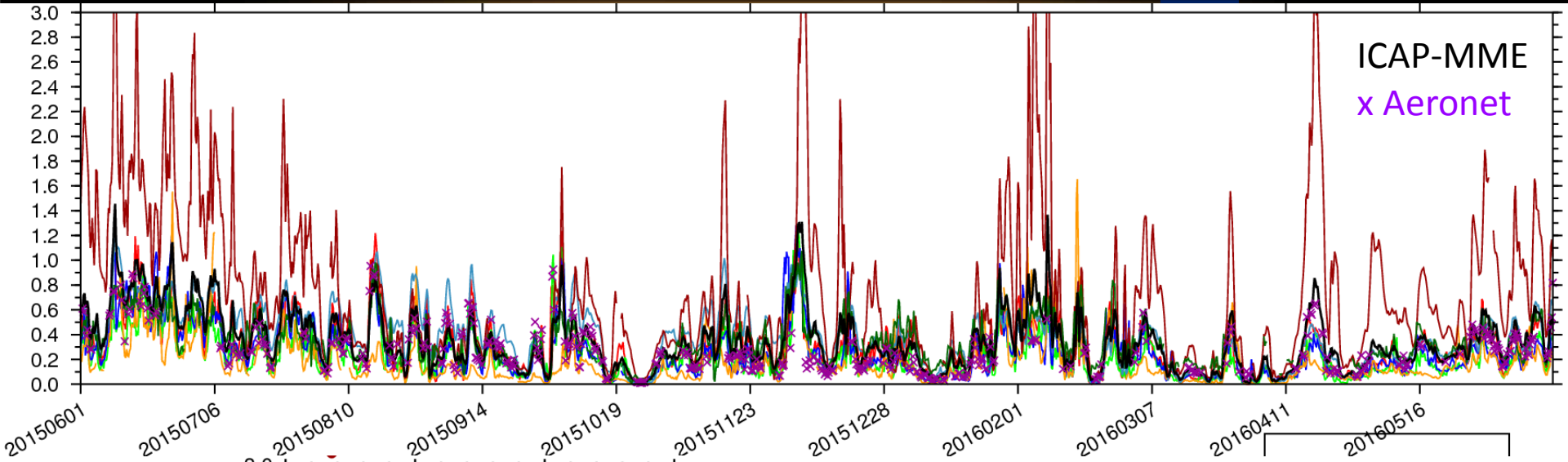


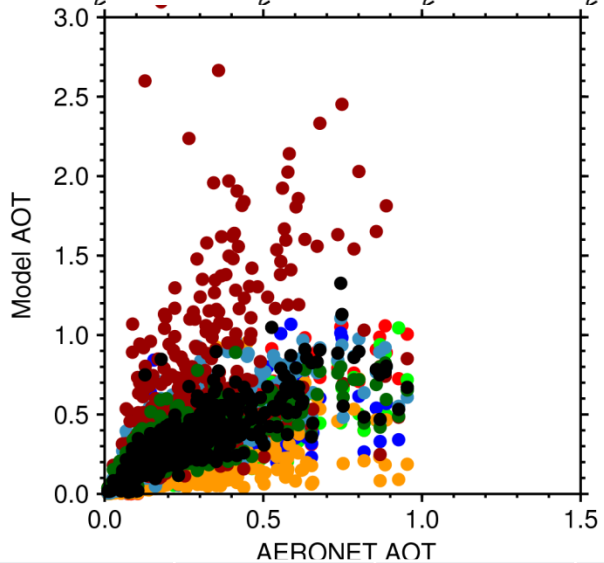
72 HOUR FORECAST RMSE: (2012)
THE ICAP-MME IS THE TOP PERFORMER

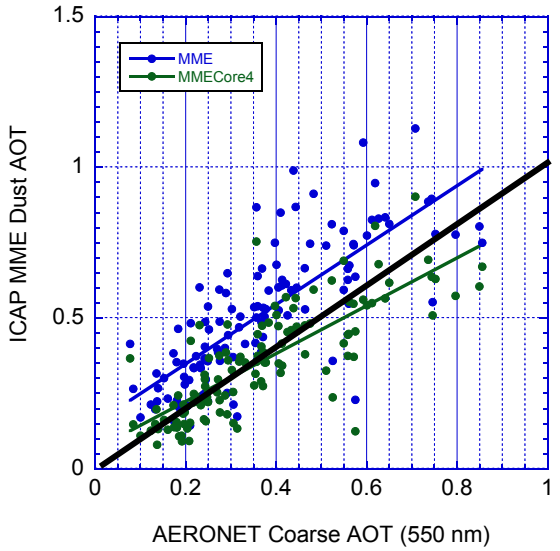
(Sessions, et al, ACP, 2015)



ICAP MODELS DUST AOT AT CAPE VERDE (2015)

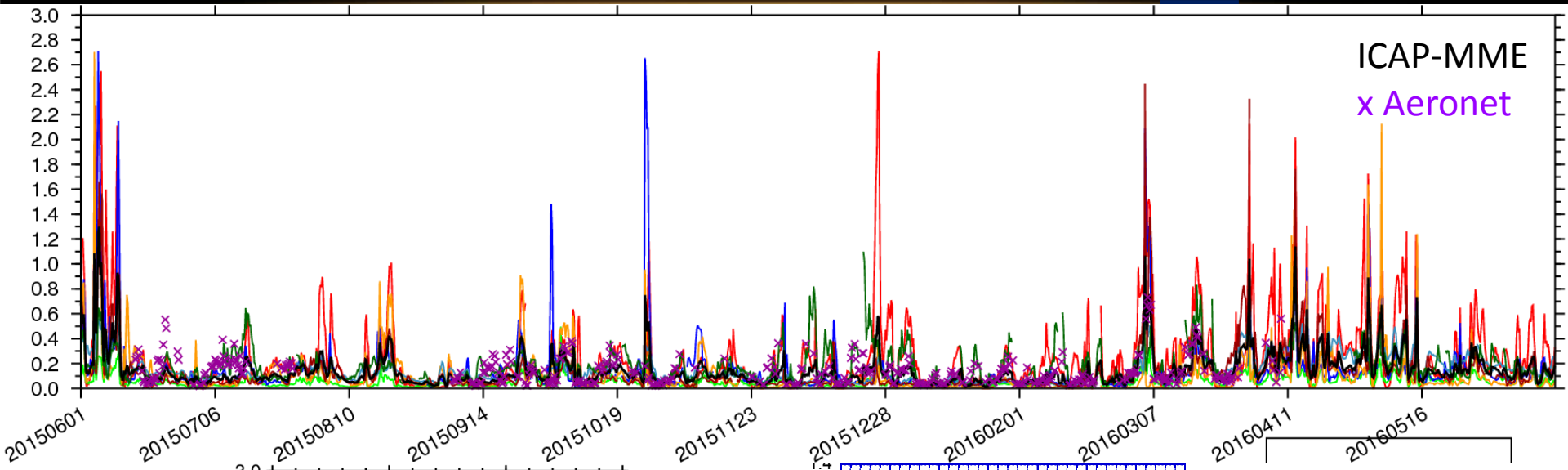


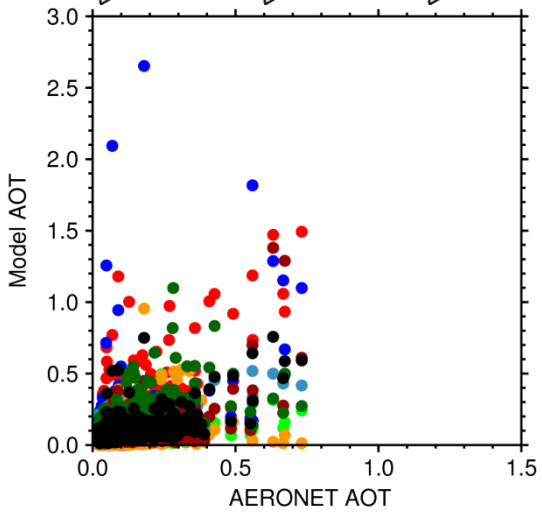


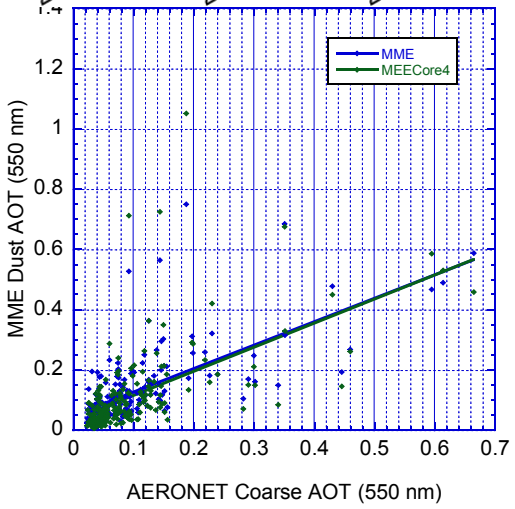


Dust-RMSEs	Model1	Model2	Model3	Model4	Model5	Model6	Model7	MME	MMECore4
Cape verde	0.16	0.15	0.23	0.24	0.21	1.03	0.19	0.20	0.13

ICAP MODELS DUST AOT AT BEIJING (2015)

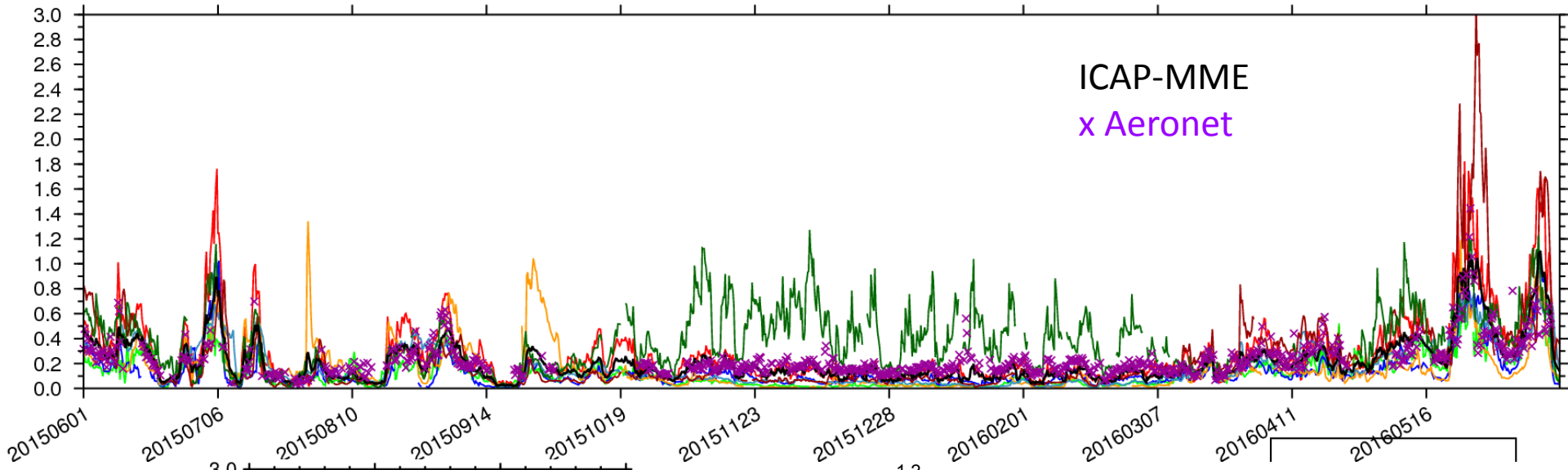


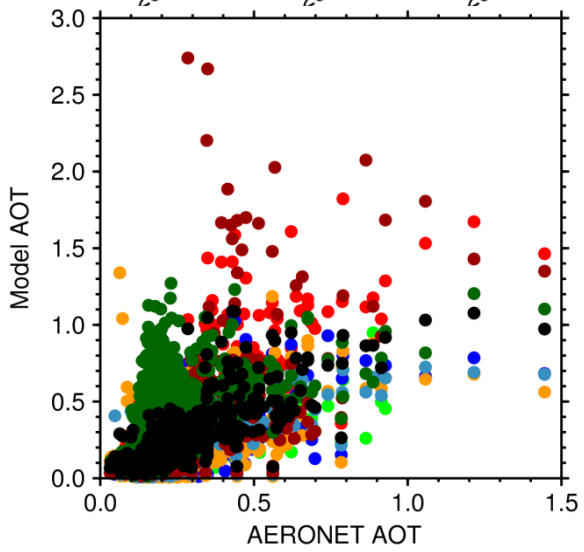


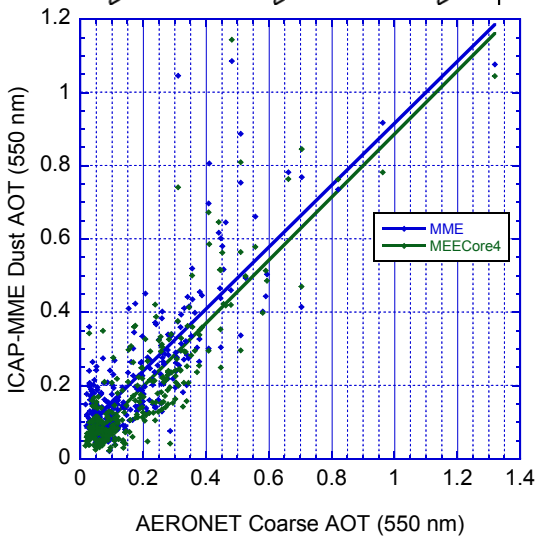


Dust-RMSEs	Model1	Model2	Model3	Model4	Model5	Model6	Model7	MME	MMECore4
Beijing	0.22	0.10	0.22	0.14	0.08	0.11	0.18	0.09	0.12

ICAP MODELS DUST AOT AT KANPUR (2015)

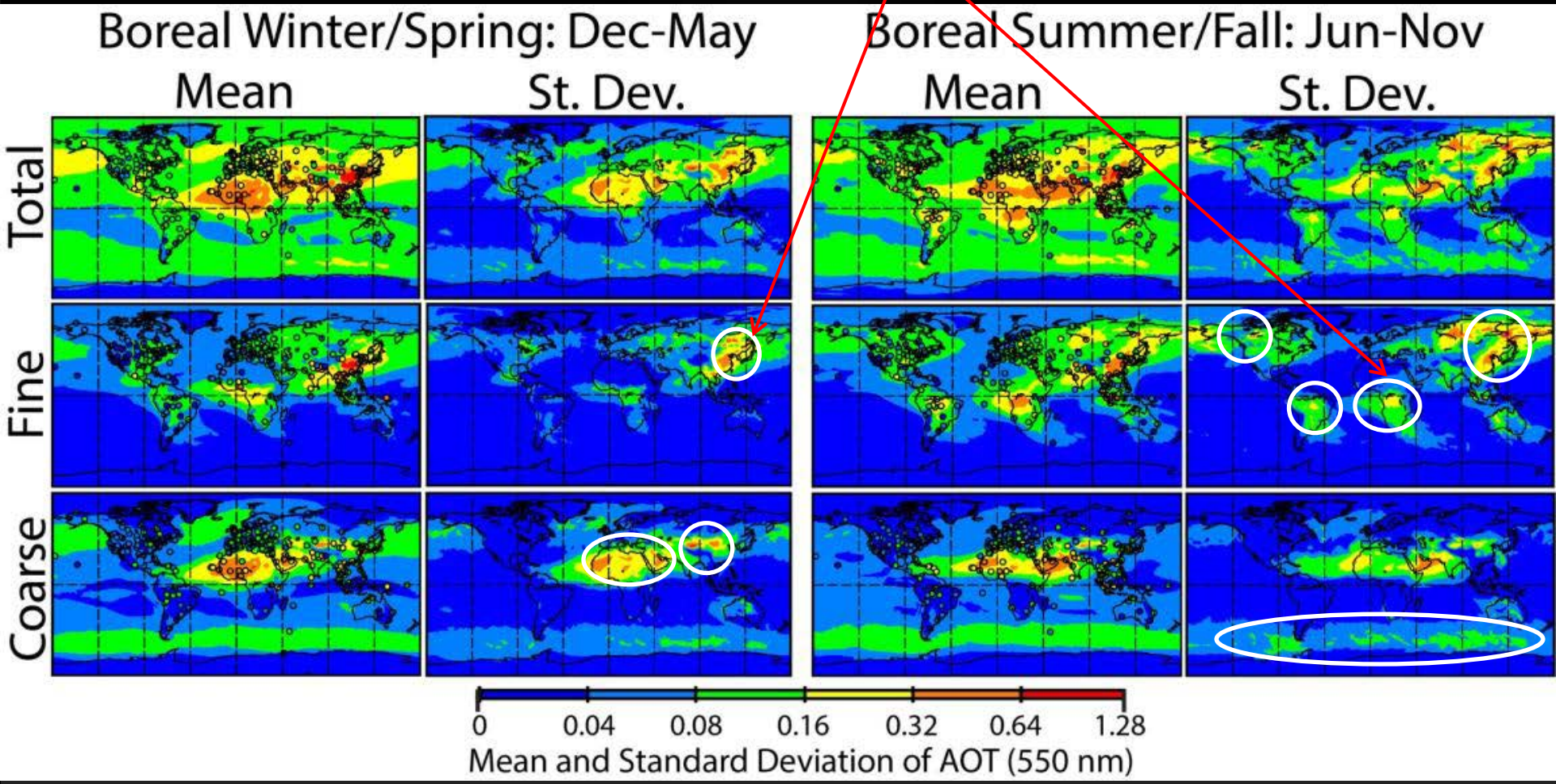






Dust-RMSEs	Model1	Model2	Model3	Model4	Model5	Model6	Model7	MME	MMECore4
Kanpur	0.20	0.10	0.12	0.16	0.10	0.26	0.40	0.12	0.10

2012 BI-SEASONAL MEANS AND SPREADS

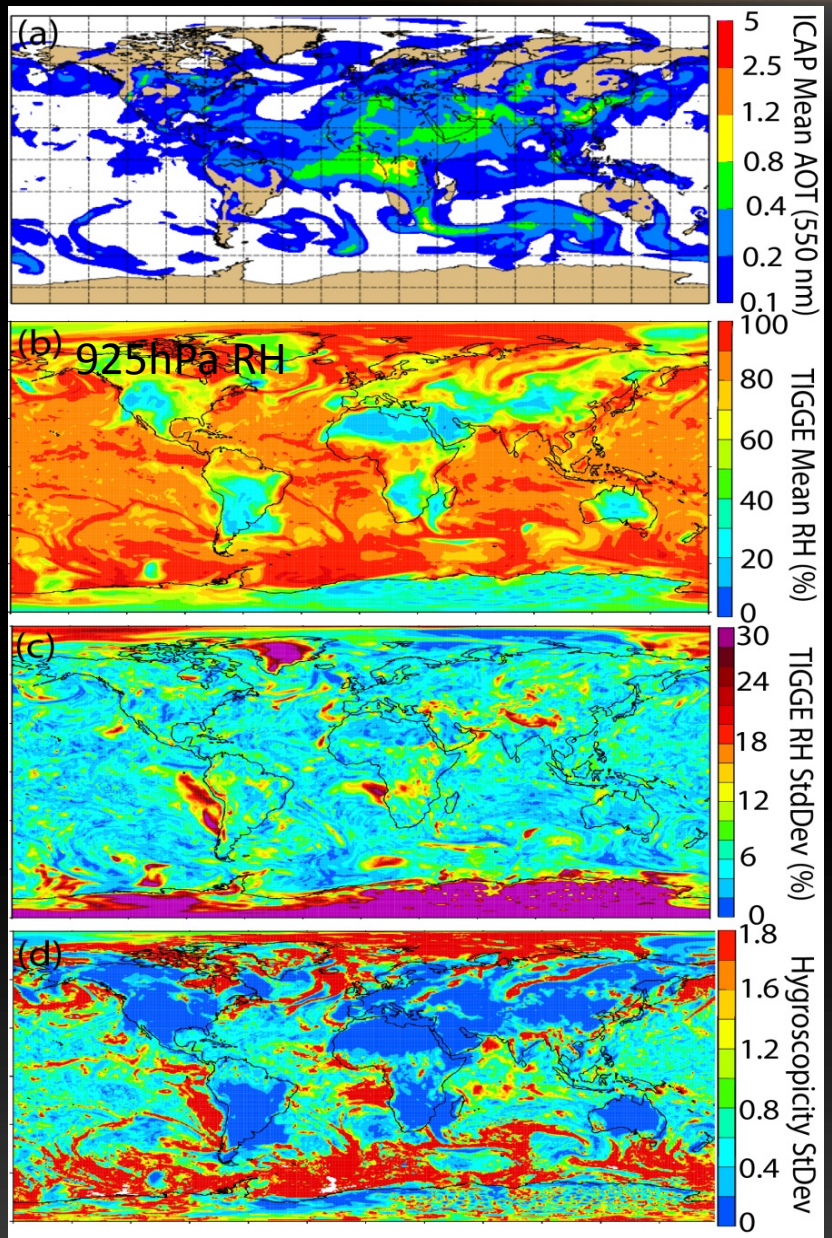


Sessions, et al., ACP 2015

SOURCES FOR AOT DIVERSITY

- Aerosol sources: anthropogenic and biogenic emissions, and biomass burning emissions from different inventories, dynamically-driven dust and sea salt emissions based on different model meteorologies.
- Aerosol removals, e.g., parameters for dry deposition, model precipitation.
- Aerosol transport, especially in the vertical (PBL height, mixing scheme)
- Aerosol chemistry (SO2->SO4, SOA etc)
- Aerosol optical properties, e.g., absorbing/scattering efficiencies.
- Aerosol microphysics, e.g., speciation definition, size bins.
- Hygroscopic growth with relative humidity.
- For models with data assimilations
  - the diversity in assimilation methods
  - the observed AOT data to be assimilated and
  - their pre-assimilation treatments.

DIVERSITY OF AOT RESULTED FROM POSSIBLE DIVERSITY OF METEOROLOGY



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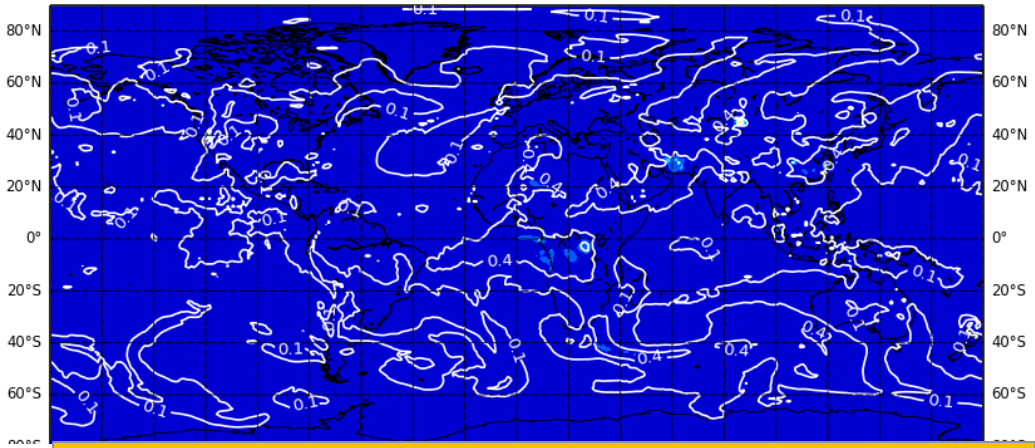
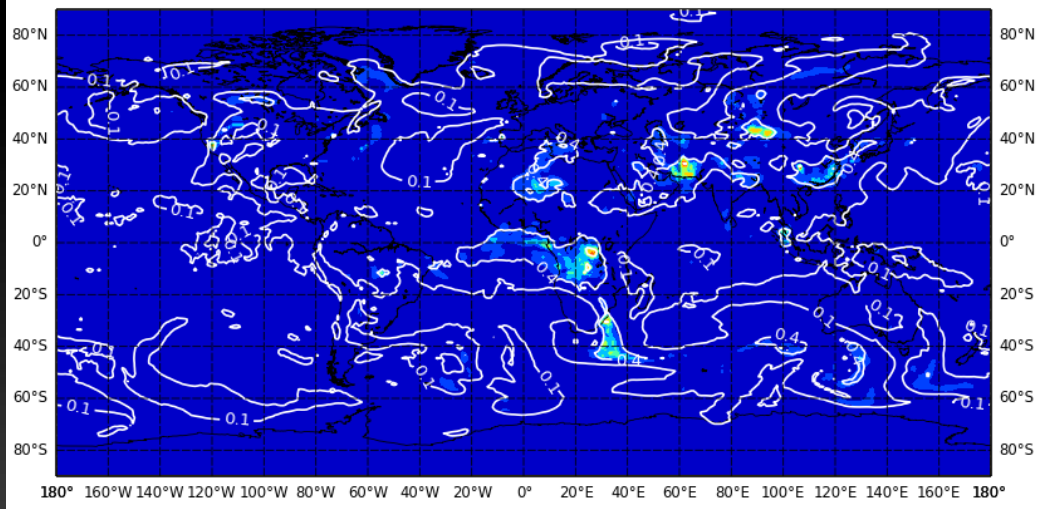
Total AOT spread among ICAP models (t+6hr)



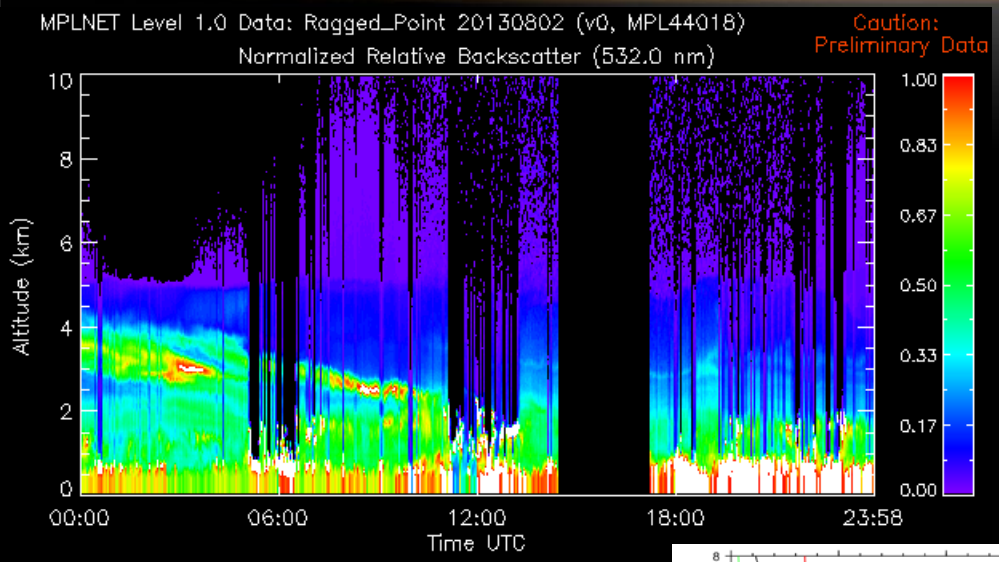
Total AOT spread among ICAP models (t+18hr)

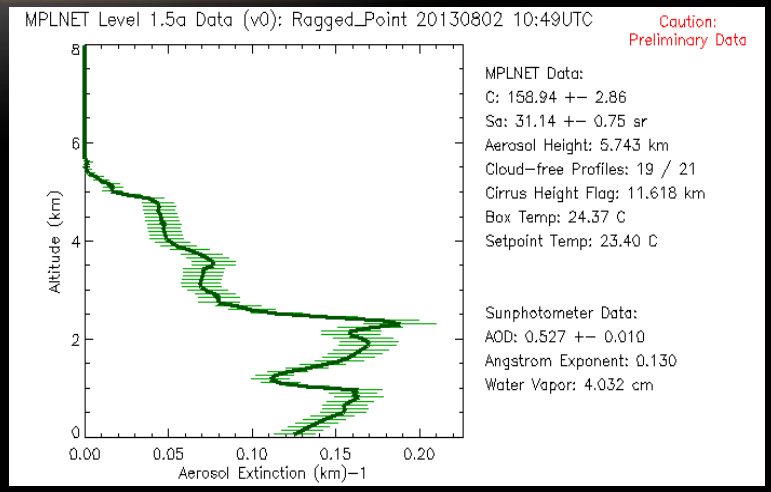


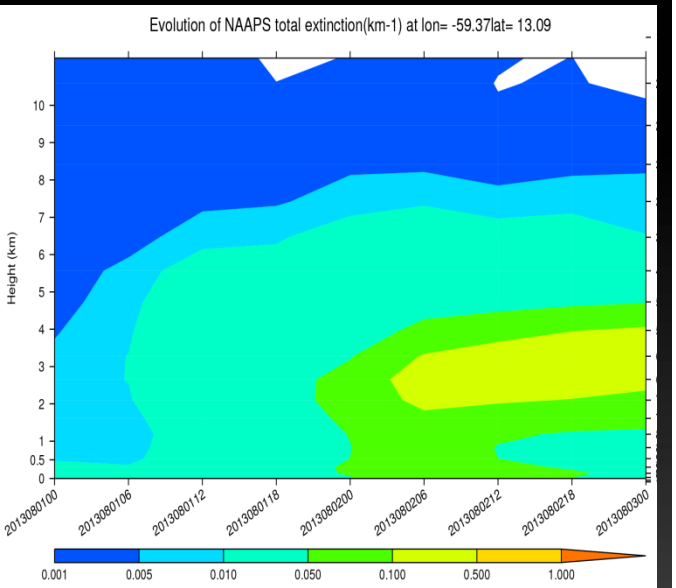
POSSIBILITIES FOR NEXT ICAP UPDATE

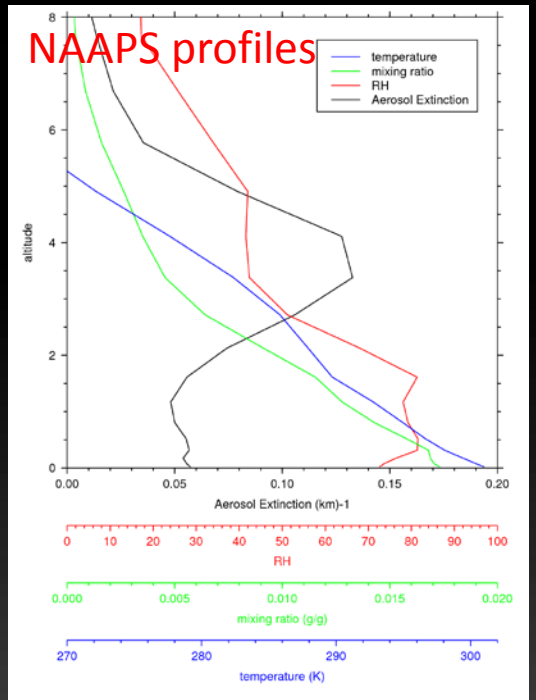
- Add global speciated (or fine/coarse) surface concentration fields.
- Add vertical component. Start with the MPLNET sites.
- Pressing meteorological variables that impact aerosol processes:
  - 1) boundary layer related parameters, e.g., surface wind, PBL height, t, q.
  - 2) precipitation, which is key for scavenging
  - 3) RH, which is important for relating aerosol mass to extinction and AOT.
- All these involve data requests to all centers.

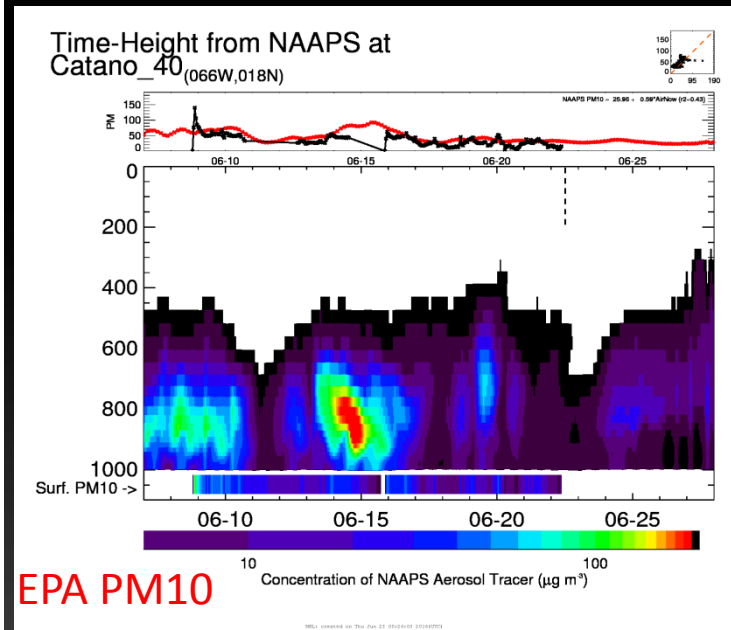
NAAPS VERTICAL PROFILES AS AN EXAMPLE











THANK YOU