REVIEW OF THE ICAP MULTI MODEL ENSEMBLE ANALYSIS

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ICAP 2014 Meeting

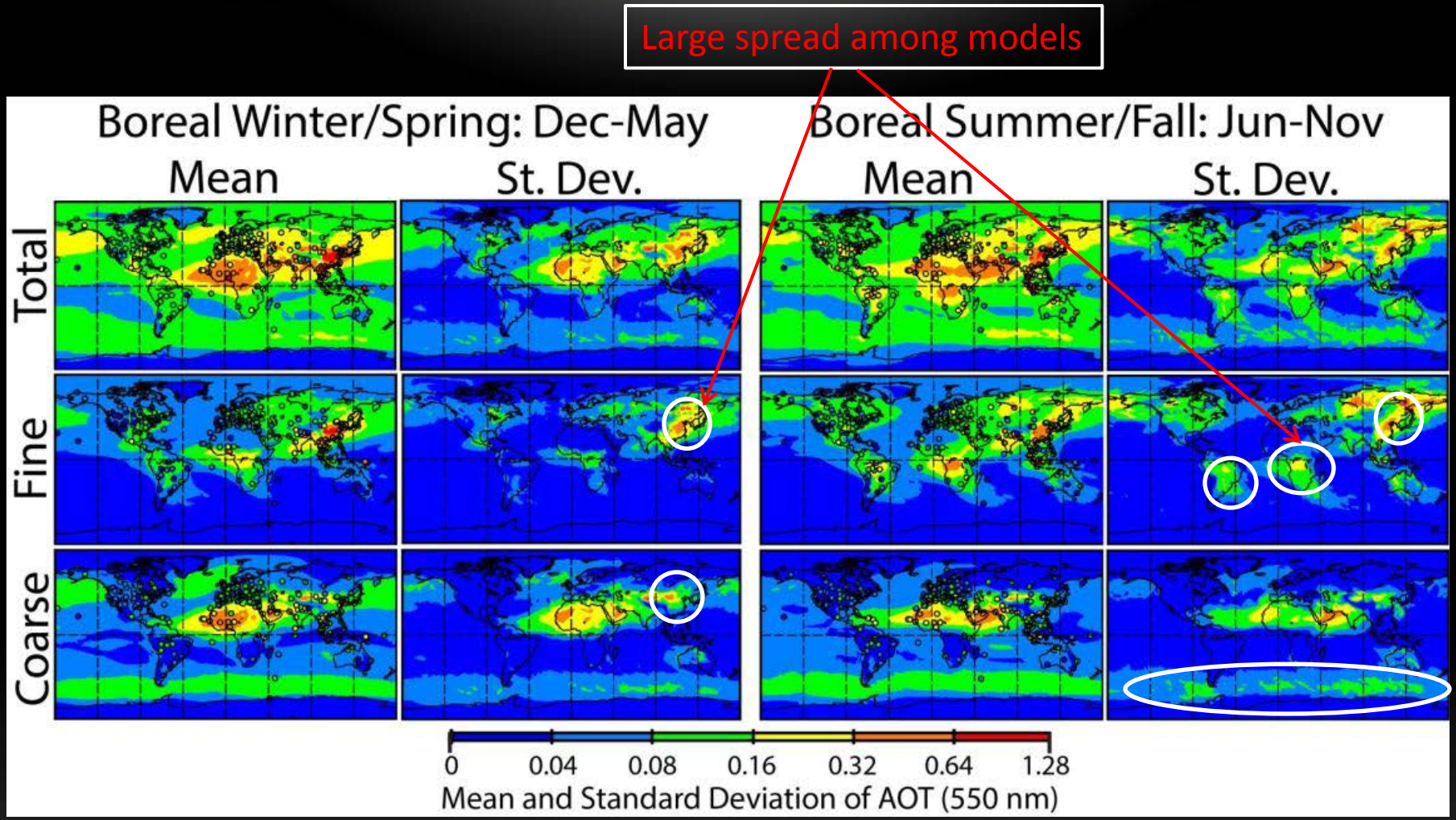
RATIONAL FOR ICAP MME

- 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., TC track and intensity, has proven to be beneficial. What about AOT?
- It helps to identify problem areas for aerosol modeling. The differences in aerosol processes (eg., sources, sinks, microphysics and chemistry) and their background meteorology in these mostly independent aerosol models would result in different AOT. On top of that, for models with AOT assimilations, the diversity in assimilation methods, the observed AOT data to be assimilated and their pre-assimilation treatments also leads to differences in the AOT analyses. Areas with the largest diversity requires attention for aerosol model improvement.
- Operational aerosol forecast becomes available at many NWP centers, which enables an exploration of aerosol MME.

CURRENT ICAP-MME OPERATIONS

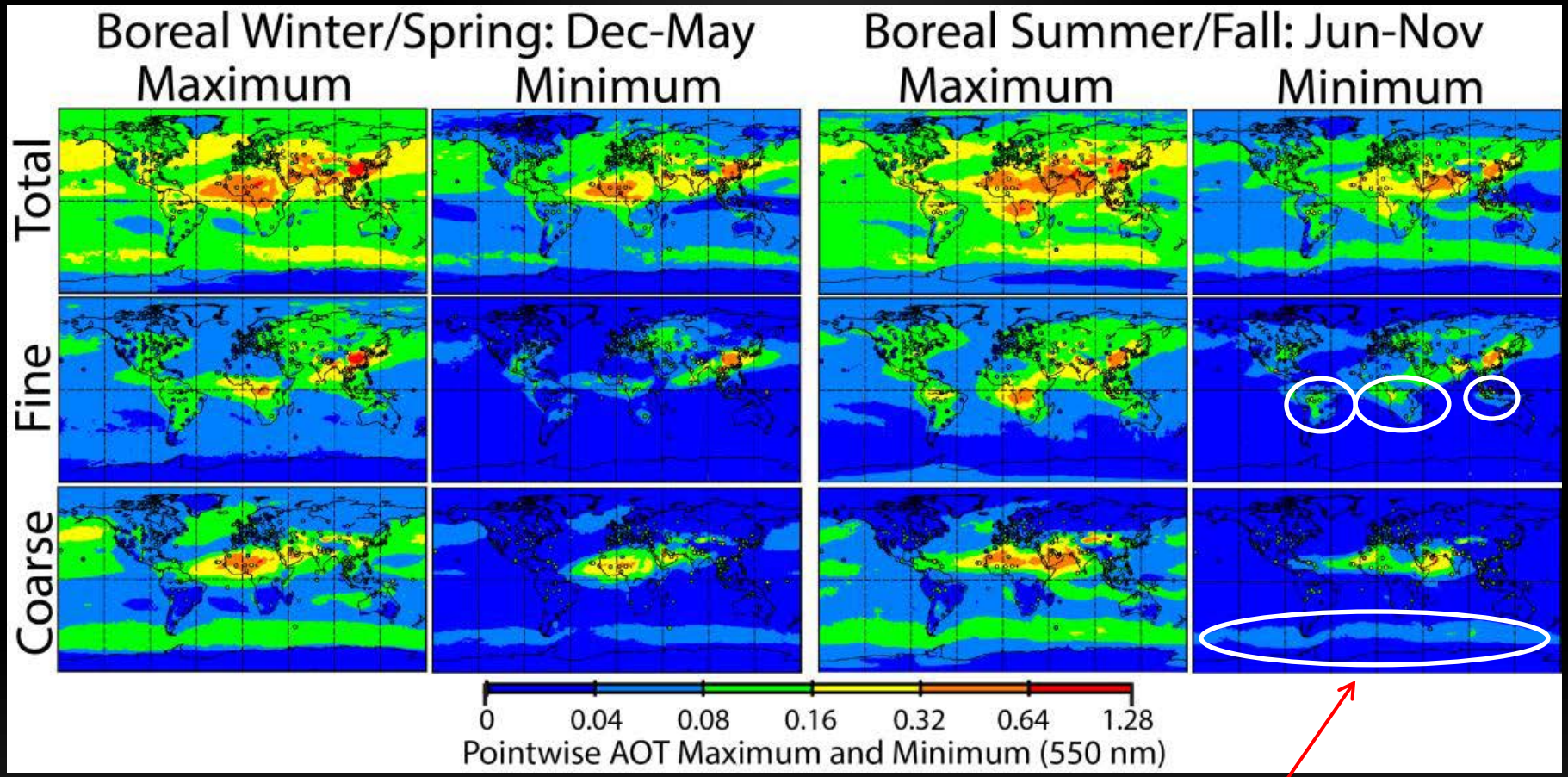
- 7 Participating Models:
  - BSC-CTM/NMMB (dust, seasalt, 6hrly, 1.4°x1°)
  - ECMWF MACC (all species, 3hrly, 1.125°x1.125°)
  - FNMOC/NRL NAAPS (all species, 6hrly, 1°x1°)
  - JMA MASINGAR (all species, 6hrly, 1°x1°)
  - NASA GSFC/GMAO (all species, 1hrly, 0.25°x0.3°)
  - NOAA NGAC (dust, 3hrly, 1°x1°)
  - UK Met office unified model (dust, 3hrly, 0.16°x0.25°)
- The ICAP-MME is run daily with 1x1 degree resolution at 00Z for 6 hourly forecasts out to 120 hours with a one-day latency.
- Currently data transfer is between centers. But we are moving towards distributing AOT forecast data and plots to the public.
- Data dissemination plan

2012 BI-SEASONAL MEANS AND SPREADS



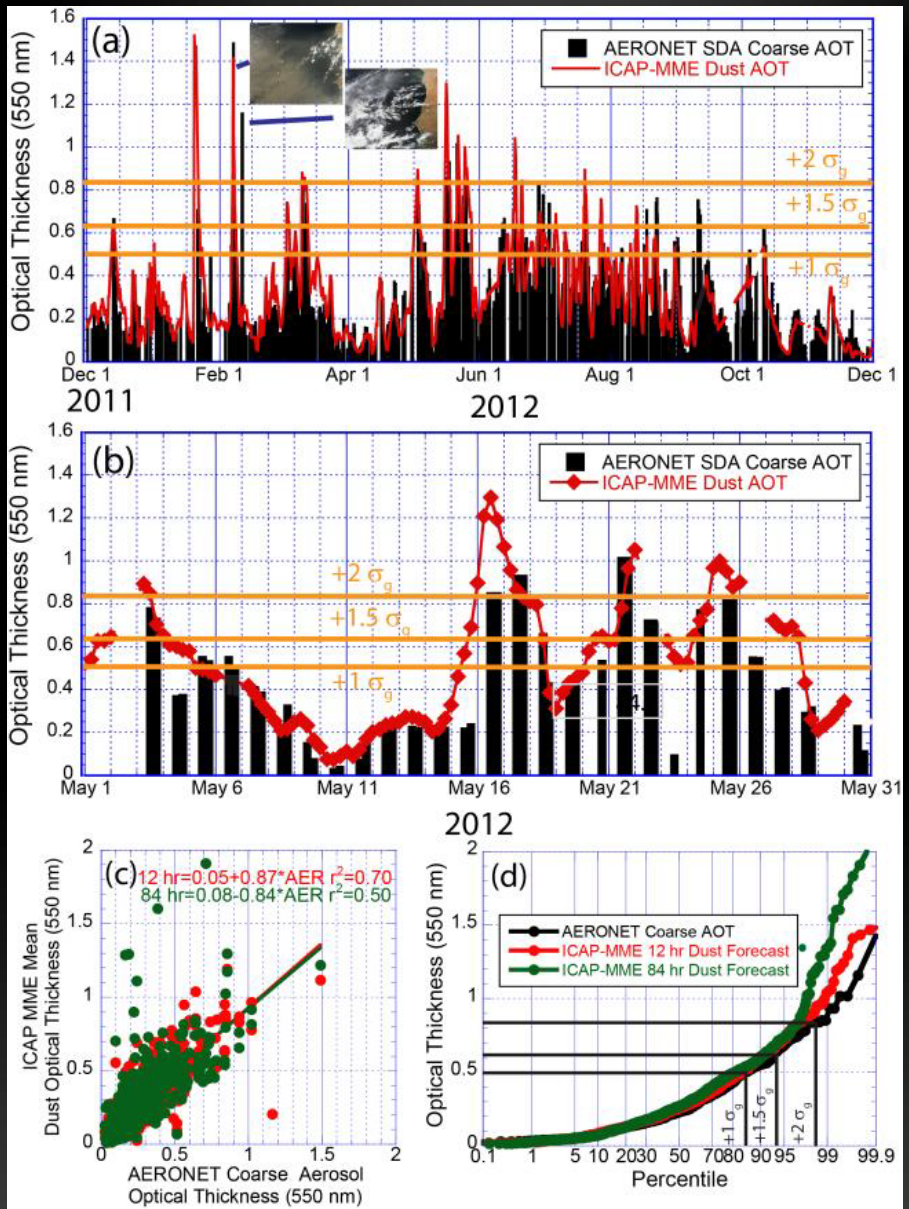
Sessions, W. R. et al., 2014. Development towards a global operational aerosol consensus: Basic climatological characteristics of the International Cooperative for Aerosol Prediction Multi-Model Ensemble (ICAP-MME). ACP.

2012 BI-SEASONAL MIN/MAXS

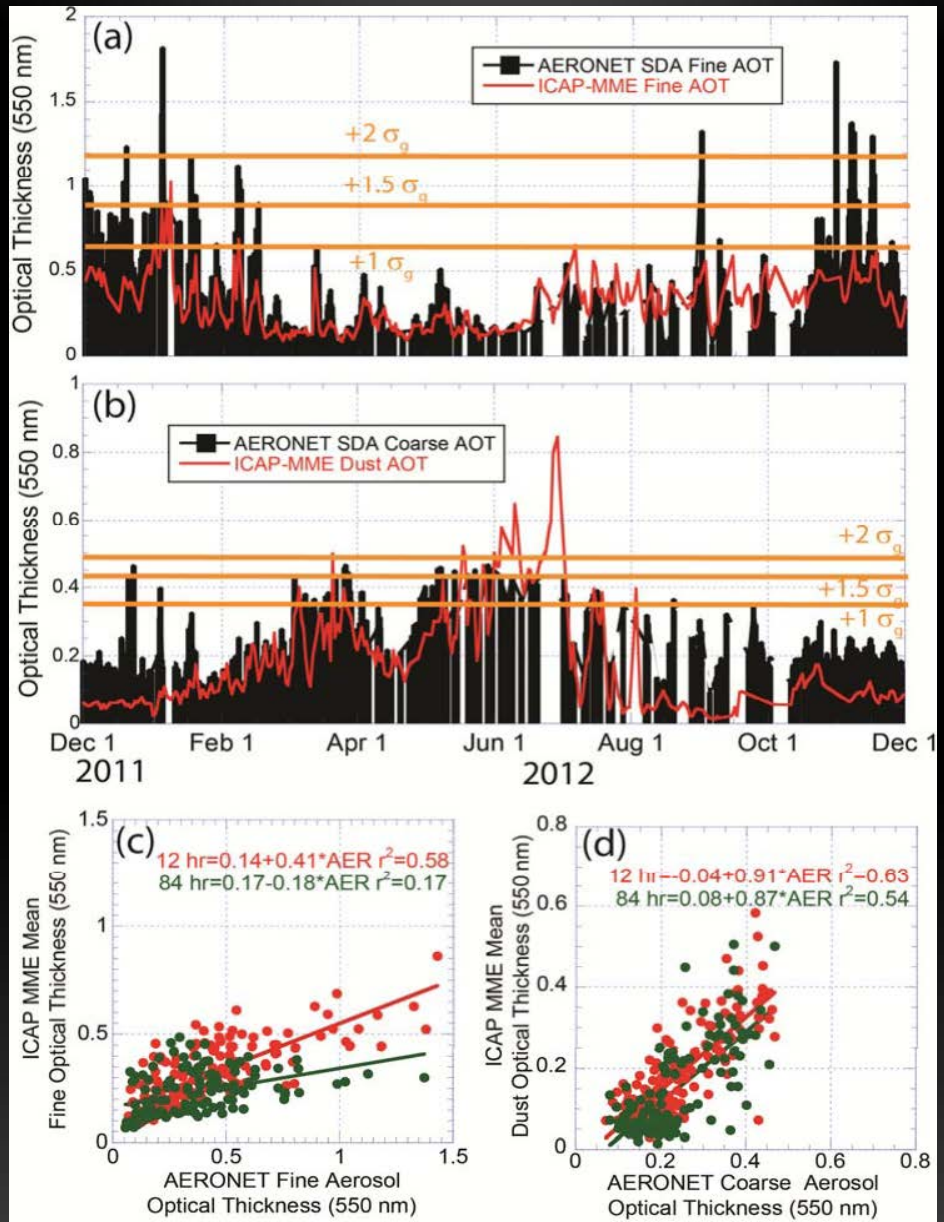


Large spread among models

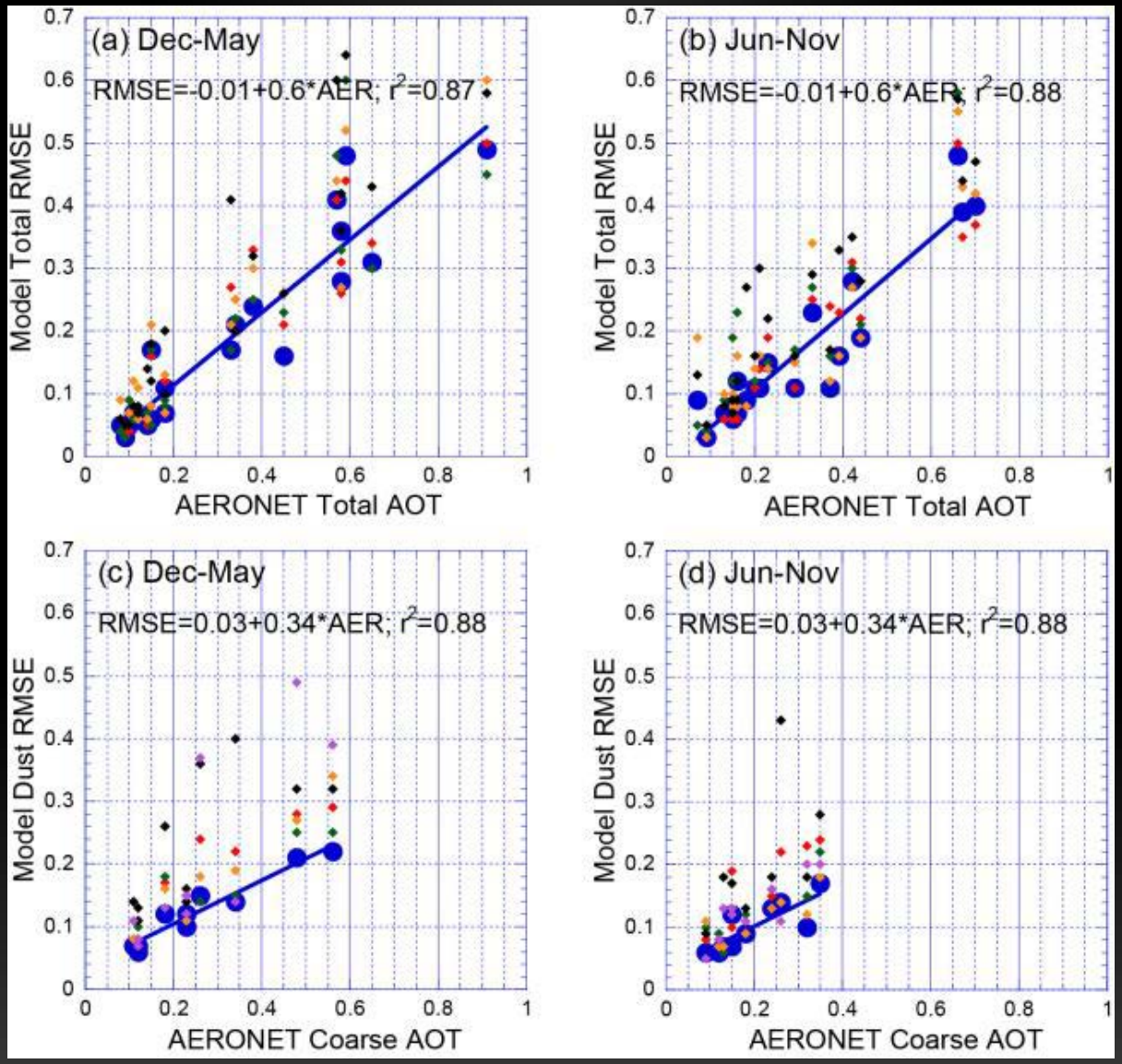
ICAP-MME EVALUATION AT CAPO_VERDE



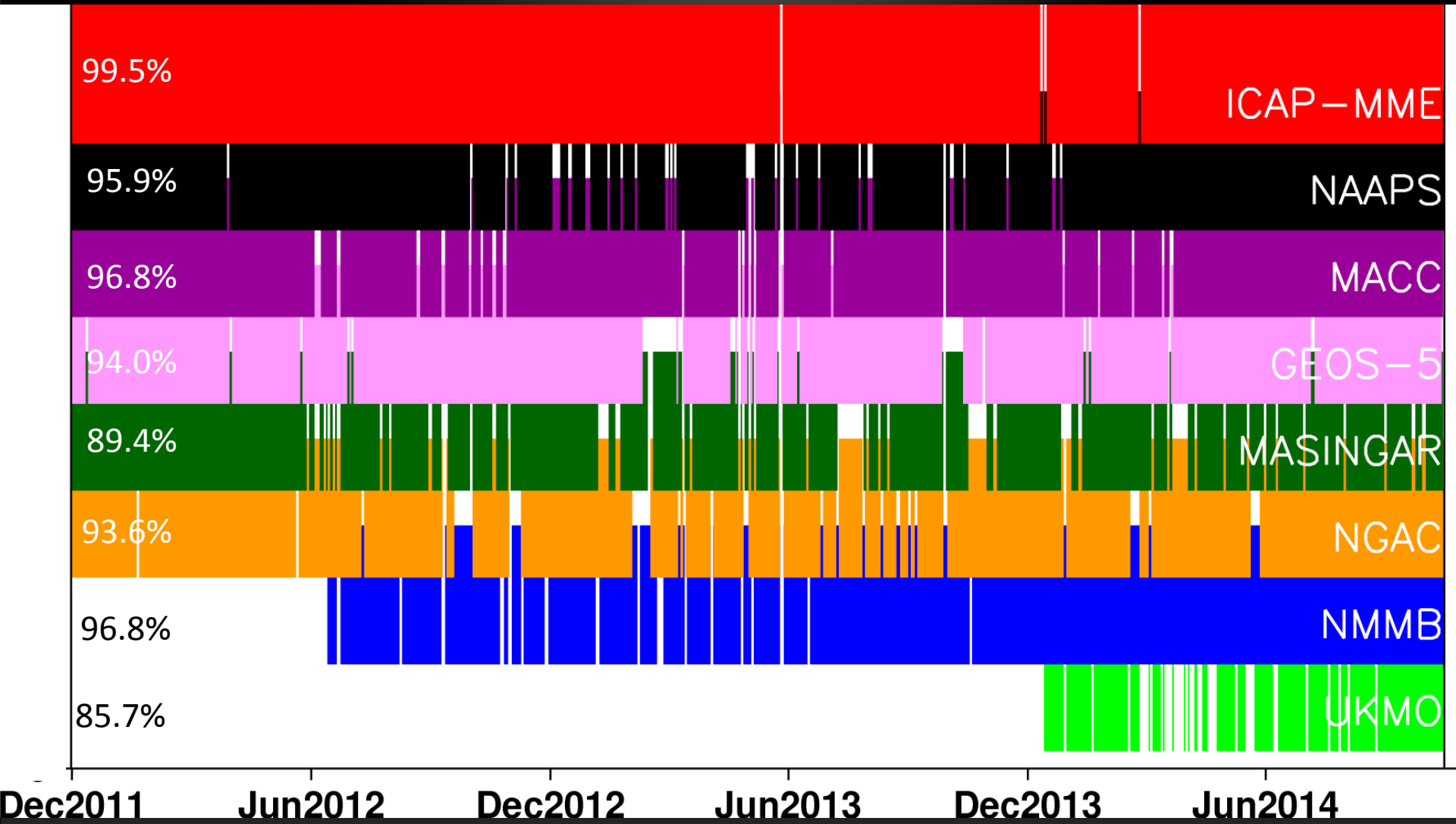
EVALUATION AT KANPUR



72 HOUR FORECAST RMSE: THE ICAP-MME IS THE TOP PERFORMER-BUT PART OF THIS IS THE "SMOOTHING EFFECT" INHERENT IN CONSENSUS ENSEMBLES



STATISTICS OF DATA DELIVERY



DATA DISTRIBUTION

- Post data to http://www.usgodae.org
- To the public
  - Coarse, Fine and Total AOTs , MME consensus mean and spread
  - Total Dust AOT, consensus mean and spread
- To the ICAP community
  - Speciated and total AOTs, MME consensus mean and spread without revealing model names.
- Data file property
  - Format: CF-compliant NetCDF format.
  - Name convention:
    - icap_yyyymmdd00_MME_modeaod.nc
    - icap_yyyymmdd00_MME_totaldustaod.nc
    - Icap_yyyymmdd00_MME_aod.nc
  - Size: mode (32M), dust file (11M), speciated file (182M)
  - Frequency: one per day

CF VARIABLE NAME STANDARD NEEDS TO INCLUDE MORE AEROSOL SPECIFICS

- http://cfconventions.org
- Currently available CF standard names for aerosol optical properties are limited. Some examples are
  - atmosphere_optical_thickness_due_to_aerosol
  - atmosphere_absorption_optical_thickness_due_to_ambient_aerosol
  - atmosphere_optical_thickness_due_to_dust_dry_aerosol
- Needs to include more aerosol specific, e.g., wavelength, size info etc. Maybe we can contribute.

EXAMPLE DATA FILE

```
[heck] (xian pts/28)>ncdump -h icap_2014093000_MME_totaldustaod.nc
netcdf icap_2014093000_MME_totaldustaod {
dimensions:
        lat = 180 ;
        lon = 360 ;
        time = 21 ;
variables:
        float lat(lat) ;
                lat:units = "degrees_north" ;
                lat:long_name = "latitude" ;
        float lon(lon) ;
                lon:units = "degrees_east" ;
                lon:long_name = "longitude" ;
        double time(time) ;
                time:units = "seconds since 2014-09-30 00:00:00" ;
                time:long_name = "time" ;
        char dtg_vald(time) ;
                dtg_vald:units = "1" ;
                dtg_vald:long_name = "valid time in yyyymmddhh for reference" ;
        float dust_aod_mean(time, lat, lon) ;
                dust_aod_mean:_FillValue = -9999.f ;
                dust_aod_mean:model = "ICAP" ;
                dust_aod_mean:dtg_init = "2014-09-30 00:00:00" ;
                dust_aod_mean:long_name = "MME mean dust aerosol optical depth at 550nm" ;
                dust_aod_mean:units = "1" ;
        float dust_aod_stdv(time, lat, lon) ;
                dust_aod_stdv:_FillValue = -9999.f ;
                dust_aod_stdv:model = "ICAP" ;
                dust_aod_stdv:dtg_init = "2014-09-30 00:00:00" ;
                dust_aod_stdv:long_name = "MME standard deviation dust aerosol optical depth at 550nm" ;
                dust_aod_stdv:units = "1" ;

// global attributes:
                :Conventions = "CF-1.0" ;
                :model = "ICAP" ;
                :icap_members = 6 ;
                :member_names = "GEOS5,MACC,NAAPS,NGAC,NMMB,UKMO" ;
                :dtg_init = "2014-09-30 00:00:00" ;
                :history = "generated on 2014-10-01 12:08:09" ;
                :contact = "peng.lynch.ctr@nrlmry.navy.mil" ;
}
```

```
[heck] (xian pts/12)>ncdump -h icap_2014101200_MME_modeaod.nc
netcdf icap_2014101200_MME_modeaod {
dimensions:
        lat = 180 ;
        lon = 360 ;
        time = 21 ;
variables:
        float lat(lat) ;
                lat:units = "degrees_north" ;
                lat:long_name = "latitude" ;
        float lon(lon) ;
                lon:units = "degrees_east" ;
                lon:long_name = "longitude" ;
        double time(time) ;
                time:units = "seconds since 2014-10-12 00:00:00" ;
                time:long_name = "time" ;
        char dtg_vald(time) ;
                dtg_vald:units = "1" ;
                dtg_vald:long_name = "valid time in yyyymmddhh for reference" ;
        float coarse_aod_mean(time, lat, lon) ;
                coarse_aod_mean:_FillValue = -9999.f ;
                coarse_aod_mean:model = "ICAP" ;
                coarse_aod_mean:dtg_init = "2014-10-12 00:00:00" ;
                coarse_aod_mean:long_name = "MME mean coarse mode aerosol optical depth at 550nm" ;
                coarse_aod_mean:units = "1" ;
        float coarse_aod_stdv(time, lat, lon) ;
                coarse_aod_stdv:_FillValue = -9999.f ;
                coarse_aod_stdv:model = "ICAP" ;
                coarse_aod_stdv:dtg_init = "2014-10-12 00:00:00" ;
                coarse_aod_stdv:long_name = "MME standard deviation coarse mode aerosol optical depth at 550nm" ;
                coarse_aod_stdv:units = "1" ;
        float fine_aod_mean(time, lat, lon) ;
                fine_aod_mean:_FillValue = -9999.f ;
                fine_aod_mean:model = "ICAP" ;
                fine_aod_mean:dtg_init = "2014-10-12 00:00:00" ;
                fine_aod_mean:long_name = "MME mean fine mode aerosol optical depth at 550nm" ;
                fine_aod_mean:units = "1" ;
        float fine_aod_stdv(time, lat, lon) ;
                fine_aod_stdv:_FillValue = -9999.f ;
                fine_aod_stdv:model = "ICAP" ;
                fine_aod_stdv:dtg_init = "2014-10-12 00:00:00" ;
                fine_aod_stdv:long_name = "MME standard deviation fine mode aerosol optical depth at 550nm" ;
                fine_aod_stdv:units = "1" ;
        float total_aod_mean(time, lat, lon) ;
                total_aod_mean:_FillValue = -9999.f ;
                total_aod_mean:model = "ICAP" ;
                total_aod_mean:dtg_init = "2014-10-12 00:00:00" ;
                total_aod_mean:long_name = "MME mean total aerosol optical depth at 550nm" ;
                total_aod_mean:units = "1" ;
        float total_aod_stdv(time, lat, lon) ;
                total_aod_stdv:_FillValue = -9999.f ;
                total_aod_stdv:model = "ICAP" ;
                total_aod_stdv:dtg_init = "2014-10-12 00:00:00" ;
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                total_aod_stdv:units = "1" ;

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                :model = "ICAP" ;
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                :member_names = "GEOS5,MACC,NAAPS,MASINGAR" ;
                :dtg_init = "2014-10-12 00:00:00" ;
                :history = "generated on 2014-10-13 12:01:42" ;
                :contact = "peng.lynch.ctr@nrlmry.navy.mil" ;
}
```

WISH LIST AND FUTURE PLANS (USER-NEED BASED)

- Wish list:
  - AOD Analysis field (00Z) from each center.

- Future plans:
  - ? Longer forecast period, e.g., 7-days for slow moving SAL events.
  - ? 3-hourly
  - ? 0.5x0.5 degree
  - ? Surface Concentrations
  - ? cosmetic make up for the website, threshold value changes

http://www.nrlmry.navy.mil/aerosol/icap_date.1100.php?da

Aerosol analysis and fo... | Naval Research Lab...

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NRL Monterey ICAP Multi-Model Ensemble

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U. S. Navy Navy Recruiting Navy FOIA ONR

previous / next *Main Listing / ICAP Multi-Model Global Dust Aerosol Optical Depth Comparison Archive*

T+HOUR
006
012
018
024
030
036
042
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114
120

sulfate
dust
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eastasia
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pacific
conus
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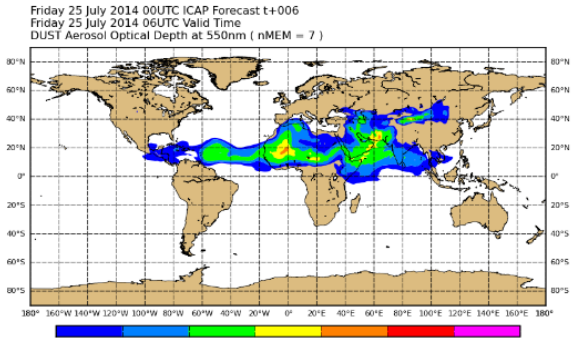

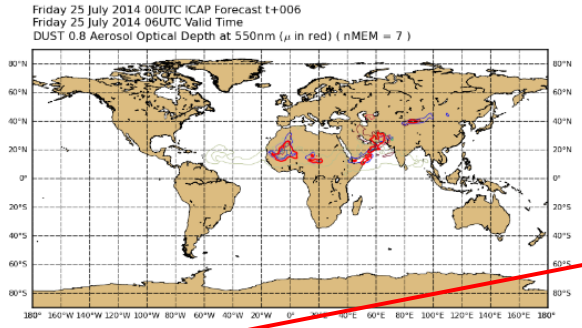

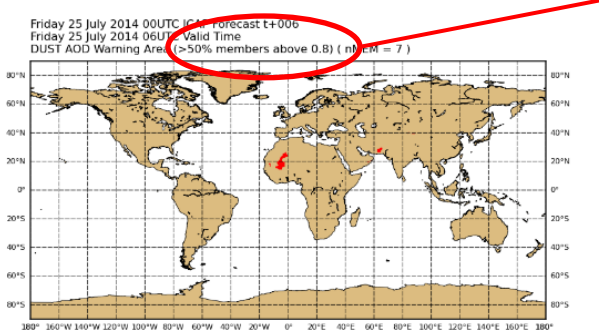

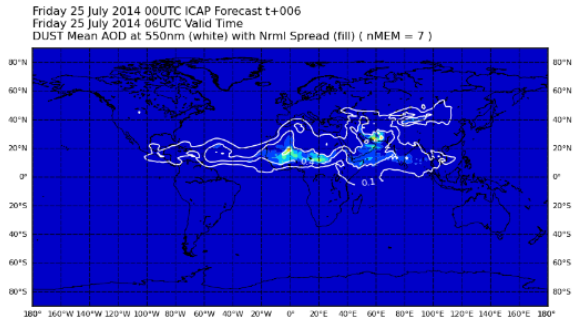

Plots Generated Monday 28 July 2014 13UTC NRL/Monterey Aerosol Modeling

Plots Generated Monday 28 July 2014 13UTC NRL/Monterey Aerosol Modeling

Current dust warning threshold is 0.8. Should we drop it to 0.4?