AEROSOL ASSIMILATION UPDATES

In collaboration with: Antje Inness, Johannes Flemming, Sebastien Massart, Marijana Crepulja, Martin Suttie, Mohamed Daouhi and Luke Jones
Progress since last ICAP

- MODIS Deep Blue data are included passively in the NRT CAMS run – will be switched on to active in the next upgrade
- SEVIRI AOD assimilation test performed
- CALIPSO assimilation improvements (activated variational bias correction)
- Evaluation of CALIPSO assimilation with HSRL
- Development of TL for AOD assimilation with GLOMAP
Impact of MODIS Deep Blue AOD data

- Tested in the o-suite (g4e2) configuration of C-IFS for three months (Jun-Aug-Sept 2014)
- Impact on bias is slightly negative
- Impact on rms is neutral
- Correlations are improved, possibly due to better constraining the AOD close to the dust sources
Aerosol Optical Depth coverage from various sensors

AATSR: data over deserts but narrow swath & one instrument

PMAP: for now, only data over ocean were tested at ECMWF. Two platforms (more resilient), multi-sensor (more points of failure).

SEVIRI: geo-stationary, high data volume, partial coverage

MODIS: two platforms, global coverage. Data also over bright surfaces when Deep Blue is used.
SEVIRI Aerosol Optical Depth (ocean-only)

- Produced in NRT at ICARE (http://www.icare.univ-lille1.fr/msg/)
- Based on an algorithm by Thieuleux et al., 2005
- Small but detectable impact on global bias (negligible in RMS)
- European/African coverage
- Of interest for European regional data assimilation
- Huge data volume (thinning needed)
- Other products under consideration

Data coverage over 24h

- ECWMF is actively pursuing monitoring/assimilation of SEVIRI products
Produced pre-operationally by EUMETSAT based on GOME2, AVHRR and IASI data. Similarly to AATSR data:

- Adds value to forecast-only run as shown by comparison with AERONET data
- Comparable impact with MODIS due to global coverage
- Good back-up (as it will be NRT from METOPA and METOPB) if MODIS stops working

- Monitoring, and eventually assimilation, of PMAP data begin soon
Assimilation of lidar signal

CY40R2 (NRT cycle)

Data: all operational data plus MODIS AOD and CALIOP Level 1.5 backscatter
AERONET verification shows good performance of lidar assimilation locally or at least not worse than the MODIS Dark Target-only run.

...but globally the MODIS-only run is still on the lead.
More on evaluation of the impacts of CALIOP profile assimilation

Assimilation of CALIOP profiles slightly reduces extinction profiles in some locations; largest extinction values remain near surface.

Depending on location, these reductions can improve or worsen agreement with HSRL.
Comparison of Median Profiles with and without CALIOP assimilation

- Median profiles in good agreement with MODIS AOT assimilation
- Adding CALIOP:
  - produces relatively minor effects on median profiles
  - tends to lower the AOT with respect to runs that assimilate only MODIS AOT – slightly better agreement with HSRL
REANALYSIS RUNS

BAMS State of Climate 2014

Biomass burning AOD anomaly for JJA 2014

- Only anomalies in biomass burning aerosols could be plotted as the reanalysis for 2014 had to be run with a different cycle from that used for the MACC reanalysis.
- These were shown to be consistent with fire emissions and CO anomalies.

Carbonaceous Aerosol Optical Depth (2003-2012)

REANALYSIS RUNS

- New “interim” reanalysis from 2003-2014 has been run in parallel mode (literally) for fast turnaround
- Limited number of archived fields
- Reduced number of meteorological datasets
- Still under evaluation

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- Main differences in AOD are down to model changes as the “interim” reanalysis uses MODIS Dark Target as the MACC reanalysis
- Increase in dust (particularly close to the source areas)
- Perhaps now too much dust but this is being corrected for the next reanalysis

- Striking differences in sea salt are attributable to model changes (big impact)
- Bias correction for MODIS data includes also surface wind speed as predictor (smaller impact)
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CAMS DATA USAGE PERSPECTIVES

• CAMS is a data-hungry beast

• At the moment ~20 different datasets are used, mostly related to O3 and other chemical species

• Only two aerosol-related datasets are used in the NRT analysis and forecast suite (MODIS Terra and Aqua, including Deep Blue)

• More datasets are in the pipeline

• Radiance assimilation is still far into the future, products such as optical depth or lidar backscatter/extinction are still the main observation type

• Aerosol assimilation depends heavily on products from space agencies

• Assimilation of profiling data from lidars is on its way, but still requires a lot of R&D (on both sides: agencies, and developers)