MET Norway use of Aeolus winds and aerosol, contribution to calibration-validation

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Project goals, frameworks

- To develop application of Aeolus observations to improve regional weather and aerosol monitoring and forecasting
- To contribute to the calibration and validation of the ADM-Aeolus LIDAR

NWP and weather forecasting:
- Shared NWP code: HARMONIE-AROME NWP model, HIRLAM-ALADIN consortium
- Operational systems: AROME-Arctic and AROME-MetCoOp cooperation with SMHI+FMI (future DMI, IMO)

Aerosols:
- EMEP (European Monitoring and Evaluation Programme) of the Convention on Long-Range Transboundary Air Pollutants (LRTAP) - EMEP chemical transport model
- European CAMS (Copernicus Atmospherig Monitoring Service) programme: regional air quality forecasting, including aerosol
- The institute also contributes to CMIP6 (Coupled Model Intercomparison Project) via coordination of international model intercomparisons (AerChemMIP/AeroCom)
CalVal of ADM-Aeolus aerosol products:

- Performing a NRT quick-check of ADM-Aeolus data using the EMEP MSC-W model in an operational Chemical Weather Prediction (CWP) regime
- Evaluation of ADM-Aeolus performance and consistency with other satellite data for analysis of long-term changes in atmospheric aerosol loads

ADM-Aeolus aerosol backscatter and extinction profiles and AOD are to be compared with:

- Calculation results from the EMEP/MSC-W model
- Observations from AERONET and EARLINET networks
- CALIPSO (and other satellites)
- This comparison will be facilitated by the use of the AeroCom validation/visualisation tool (Schulz et al., 2009).

Colocations with model simulations will be examined on a global scale focusing on geographic regions influenced with:

- different aerosol types
- different seasons
- facilitated by the additional model information on aerosol physical and chemical characteristics.
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**EMEP model**
- backscatter/extinction profiles, AOD

**NRT observations**
- AERONET
- EARLINET??

**ADM-Aeolus**
- ALADIN

- CWP (Chemical Weather Prediction) setup for model runs
- co-location with ADM observations
- Cross-check with available NRT observations

**AeroCom**
- visualisation & validation tool

**Data exchange with Andøya Space Sentre:**
- information about aerosol types from the model for ALOMAR lidar retrievals
- comparison of ALOMAR measured $\beta/\sigma$ profiles with model results

**NRT data check:**
- First characterization of Aeolus aerosol products
CalVal of ADM Aeolus aerosol products

Checking ADM Aeolus data consistency with other observations (essential for constructing long-term time-series)

**EMEP model**
- Backscatter/Extinction profiles, AOD
- 3D aerosols (concentration profiles, types)

**Independent observations:**
- AERONET
- EARLINET
- Satellites

ADM-Aeolus ALADIN

**AeroCom validation tool & database**

Comparison statistics

- CALIPSO 2007 Obs: AERONET 2007
- Only Stations WORLD
- # of valid observations: 1150
- OBS mean: 0.234
- MODEL mean: 0.222
- Spearman Rank Correlation: 0.563
- Pearson Correlation Coefficient: 0.611
- Spatial yearly mean Corr Coef: 0.800
- Seasonal Anomaly Corr Coef: 0.890
- RMS error: 0.206
- Slope fit forced through zero: 0.785
- Regression coefficient, Slope: 0.558
- Regression Constant, Offset: 0.111
- STDDEV(Model)/STDDEV(Obs): 1.096
- Score (mean relative bias): 5.6%
- Taylor Score: 0.841

Analysis of geographical differences due to dominating aerosol types using auxiliary model information

Reporting on validation results, analysis and interpretation, recommendations for data use
Assimilation and cal/val in HARMONIE-AROME system

AROME-MetCoOp:
- Operational cooperation between SMHI, MET Norway, and soon FMI
- Using Norwegian and Swedish HPC facilities
- Base for official forecast on yr.no
- Ensemble forecasts with 10 members.

AROME-Arctic:
- Operational at MET Norway
- Using Norwegian HPC facilities
- Domain covering Norwegian sea and partly arctic
- No radar reflectivity assimilation
- Deterministic forecasts (no ensemble system)
Assimilation and cal/val in HARMONIE-AROME system

Domains: 750x960 grid points
Horizonal resolution: 2.5 km
Model level definition: 65 level
Non-hydrostatic dynamic
Physical parametrisation: HARMONIE-AROME
Assimilation strategy: 3-hourly cycling
Surface modeling: SURFEX
Lateral boundary conditions: hourly ECMWF
Surface data assimilation: Optimum interpolation
Upper-air data assimilation: 3D-VAR
Observations: Surface (SYNOP, DRIBU), Radiosondes, Aircraft, ATOVS (AMSU-A, AMSU-B/MHS), IASI, Radar reflectivity, GNSS ZTD
Assimilation and cal/val in HARMONIE-AROME system

**Cal/val:**

**Assimilation:**
- Handling: obs. operator, quality control etc. (IFS implementation is starting point)
- Processing for shorter HLOS averaging lengths than standard desirable, but plans TBD
- With real ADM data: “data denial” experiments
- (Hopefully) operational assimilation

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Additional colocations for cal/val: radiosondes and AMVs

- Develop colocation tools for radiosonde winds and AMVs from polar orbiting satellites with ADM-Aeolus
- Focus on high-latitude sondes within the two model domains
- Year of Polar Prediction (YOPP, mid 2017- mid 2019) campaign periods of interest

Sondes: yellow dots
Manpower, tools and funding

- Aerosol data: Svetlana Tsyro, Jan Griesfeller, Michael Schulz
- Wind/NWP data: Roohollah Azad, Roger Randriamampianina, Harald Schyberg

- Tools for assimilation, colocation with independent data and analysis to be built
- Funding through ESA PRODEX programme (return of national fees). Relatively tight budget
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