ADM-Aeolus – Science and Cal/Val Workshop Summary, February 2015

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Introduction:

ADM-Aeolus, carrying a Doppler wind lidar instrument (ALADIN), is part of ESA's Earth Explorer Programme with a current launch readiness expected at the end of 2016 and an estimated nominal life-time of 3 years. The project is now entering the regular instrument assembly, integration and testing phase - time for the user community to get ready for launch, CAL/VAL and the mission exploitation. Therefore in February 2015 ESA organised the second Aeolus workshop, after the first workshop in 2006, which was focusing on Aeolus Science. This time, besides scientists also Cal/Val Principle Investigators were meeting in order to present and discuss the Aeolus mission and products, science applications and Calibration and Validation aspects.

Objectives of the workshop:

- Scientific community to present their plans for the use of the Aeolus data and start getting familiar with the expected products and product quality
- Cal/Val Principle Investigators to present their Cal/Val projects and to coordinate their contribution to the mission validation (Cal/Val implementation Plan)

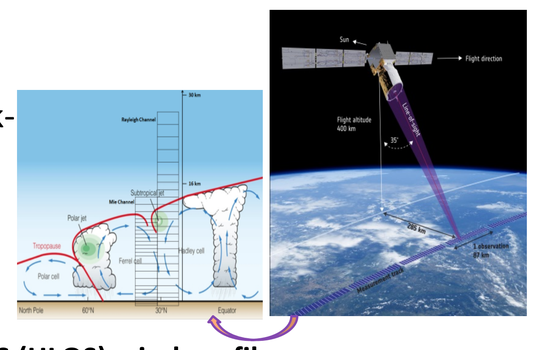
The Aeolus workshop programme, presentations and posters are available on the workshop web site:
http://www.aeolus-science-calval-2015.org/

Workshop Conclusions:

The workshop was attended by about 100 participants, representing the European NWP community as well as worldwide groups and scientists dealing with observing systems for wind and aerosols. The need for operational global wind profile information for further progress in NWP and climate modeling has been underlined as well as the need for future satellite missions continuing these measurements after Aeolus.

Aeolus products

Aeolus will measure Doppler shifts of the frequencies of back-scattered laser pulses.



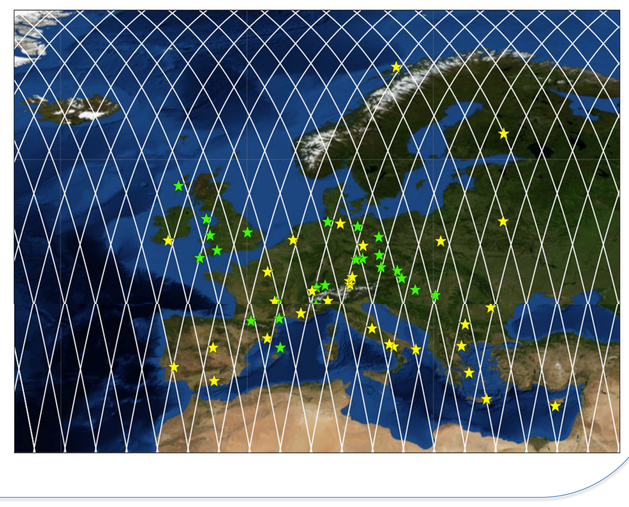
Horizontally projected LOS (HLOS) wind profiles

- Approximately zonal at dawn/dusk (6 am/pm)
- ~85 km observation from 3 km subsamples – scene classified
- From surface to ~30 km in 24 vertical layers
- Random errors: 1-2(PBL), 2(Trop), 3-5 (Strat) m/s
- Bias requirement: 0.5 m/s

Product	Description
L0	Time ordered raw data
L1A	- Geo-located, unprocessed observational data - Fully processed housekeeping data
L1B As NRT data from ESA	- Preliminary HLOS Horizontal Line of Sight winds - Mie & Rayleigh useful signal profiles
L2B Processor available from ECMWF	- Temperature and pressure corrected HLOS winds, separated for cloudy and clear measurements
L2A	Spin-off: co-polar extinction and backscatter profiles

Aeolus products coverage

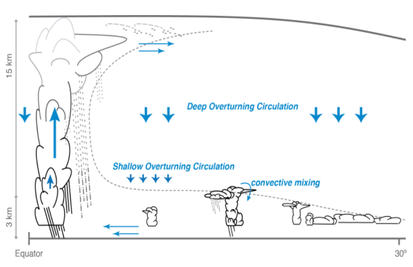
repeat cycle: 109 orbits, 7 days;
orbit to orbit < 380km



Wind session example

Most significant impact of wind observations is expected to be in the UTLS regions and in the tropics. As the tropical UTLS also is effected by the presence of cirrus clouds from deep tropical convection, the vertical sampling of Mie channels deserves special attention. In addition Ozone variations are strongly effected by wind dynamics.

Importance for winds for climate applications



Courtesy: S. Bony, CNRS

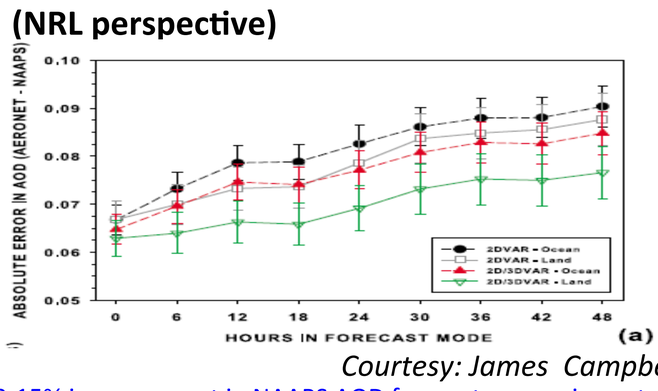
Wind information essential for climate predictions:

Grand Challenges of WCRP underline role of cloud circulation interactions for climate sensitivity

Aerosol & Cloud session example

Assimilation of aerosol is still challenging. So far mostly total optical depth observations from satellites are used. Vertical position and structure of aerosol layers are determined by circulation model dynamics and the specification of sources and sinks.

Potential for aerosol assimilation (NRL perspective)

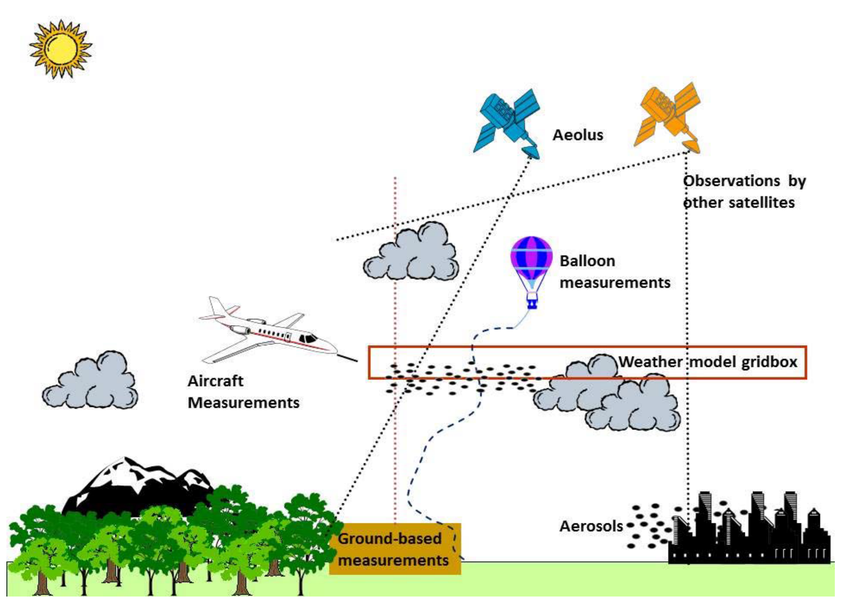


Courtesy: James Campbell, NRL

- 10-15% improvement in NAAPS AOD forecast accuracies out to 48 hr using CALIOP (*Zhang et al., GRL, 2012*)
- Assimilating satellite lidar data causes redistribution of aerosol particle extinction within NAAPS. This *directly* impacts:
  - Visibility assessment, Forecasts downwind, depiction of boundary layer, Diabatic heating rates/radiative transfer calculations, Radiance assimilation/atmospheric correction

Cal/Val session

Comparison with collocated instrumentation



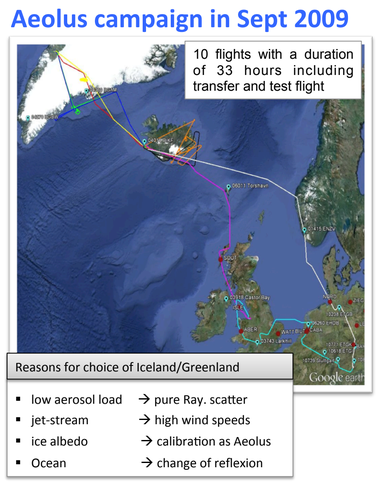
ADM-Aeolus Cal/Val proposals

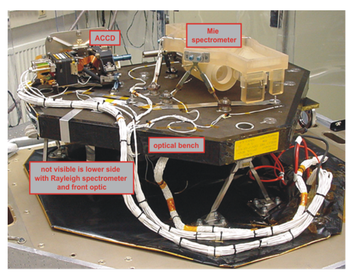
- 17 proposals, all accepted
- Target product:
  - Wind only: 6
  - Aerosols only: 3
  - Wind and aerosol: 8
- Airborne instrumentation: 5
- Lidar network: EARLINET
- Wind profilers: Norway, Sweden, UK, NL, Germany, Canada, Japan, South Pole
- Co-located radiosondes: Norway (70N)
- Stratospheric balloons: (Tropics)
- Models (Europe, US, Japan)

Cal/Val Implementation Plan

Example: ALADIN airborne demonstrator

Aeolus campaign in Sept 2009





Performs representative observations wrt ALADIN, but much higher spatial resolution (7.2km / 200 m/s =36)

Its instrumental performance (radiometric, noise, wind, calibration is well characterised

Can be used as a test-bed for ALADIN from ground and airborne platforms

Can be used to validate the calibration of ALADIN

Courtesy: DLR

Workshop recommendations

- Further promote ADM-Aeolus within the WIGOS (WMO Integrated Global Observing System), GCOS (Global Climate Observing System), GRUAN (GCOS reference network for upper-air climate observations), and WCRP (World Climate Research Programme) working groups.
- To further promote Aeolus within the stratospheric and ocean communities such as SPARC (WCRP core project on stratosphere) and CLIVAR (WCRP core project on climate and ocean).
- To contact South American and Alaskan lidar station networks and ask for their interest in participating in Aeolus CAL/VAL.
- To contact the Australian lidar network and ask for their interest in participating in Aeolus CAL/VAL.
- To organize an Aeolus Science Workshop in collaboration with WCRP at ECMWF
- To coordinate polar CAL/VAL efforts for Aeolus