ADM-Aeolus
ESA's Wind Lidar Mission and its Validation Needs

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European Space Agency

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Aeolus: Mission Objectives

Scientific objectives

- To improve the quality of weather forecasts;
- To advance our understanding of atmospheric dynamics and climate processes;

Explorer objectives

- Demonstrate space-based Doppler Wind LIDARs potential for operational use.

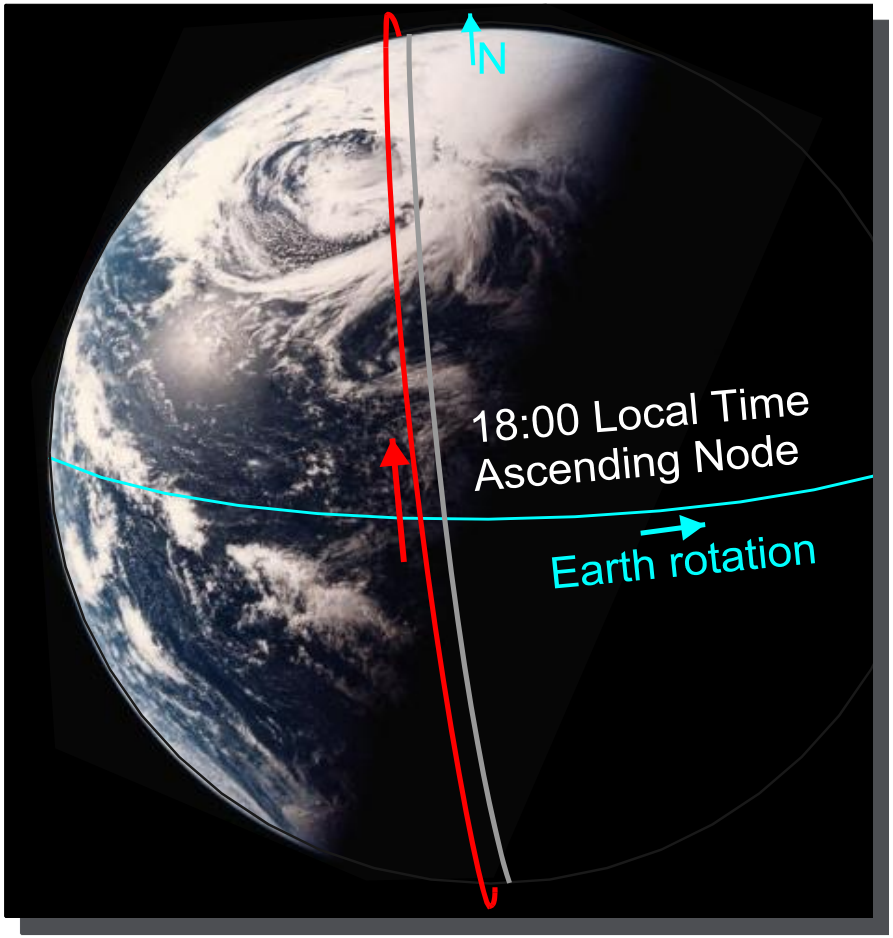
Observation means:

- Provide global measurements of horizontal wind profiles in the troposphere and lower stratosphere
- Spin-off products are (co-polar) atmospheric extinction and backscatter profiles

Payload

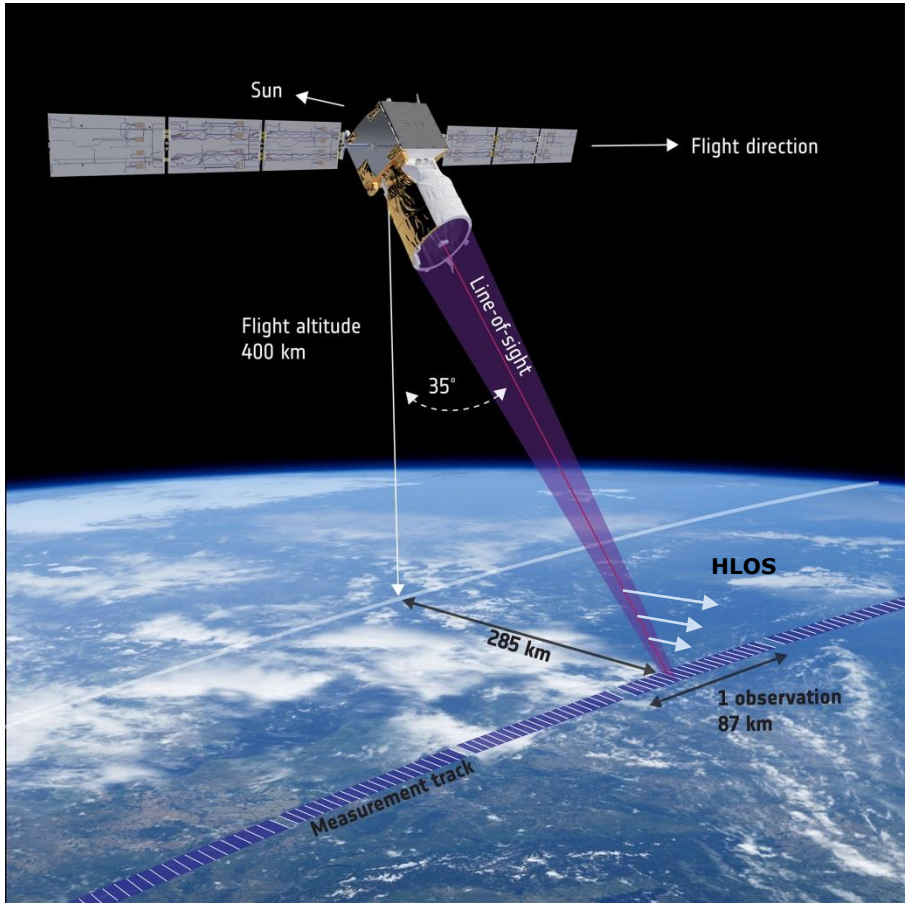
- ALADIN: Atmospheric LAser Doppler INstrument

Mission Parameters



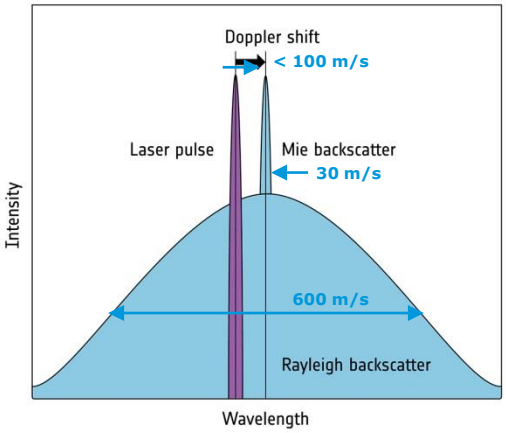
- Orbit: sun-synchronous
- Mean altitude: <400 km
- Local time: 18:00 ascending node
- Inclination: 96.97°
- Repeat cycle: 7 days / 109 orbits (111@320km)
- Orbits per day: ~16
- Mission lifetime: 3 years

Aeolus: Measurement Principle (1/2)



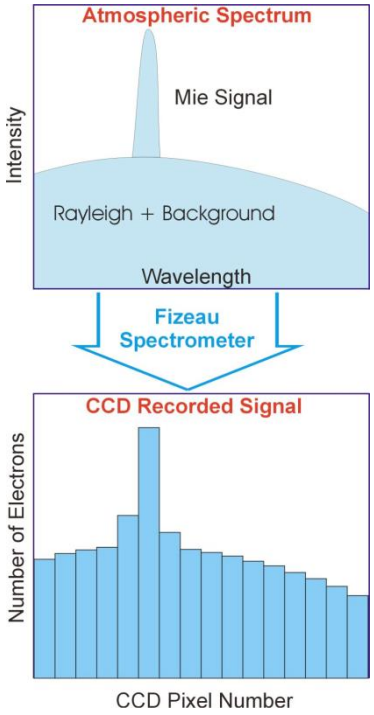
- Direct detection UV Doppler wind Lidar operating at 355 nm and 50 Hz PRF with 2 receiver channels
- Mie receiver to determine winds from aerosol & cloud backscatter
- Rayleigh receiver to determine winds from molecular backscatter
- The line-of-sight (LOS) is pointing 35° from Nadir to capture single component horizontal wind (LOS wind is projected to HLOS)
- The line-of-sight is pointing orthogonal to the ground track velocity vector to remove contribution from the satellite velocity

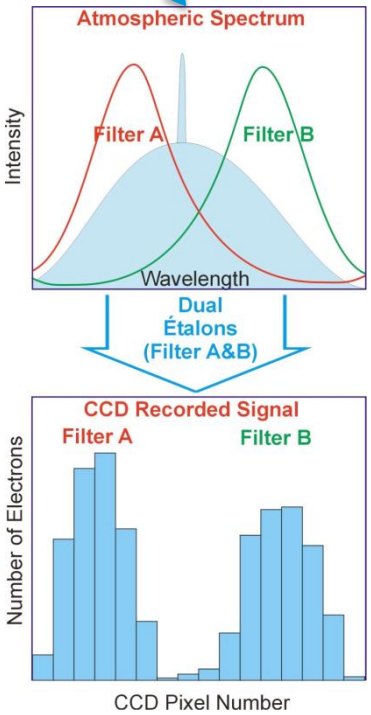
Aeolus: Measurement Principle (2/2)



Mie channel:
- Aerosol/cloud backscatter
- Imaging technique

Rayleigh channel:
- Molecular backscatter
- Double-edge technique



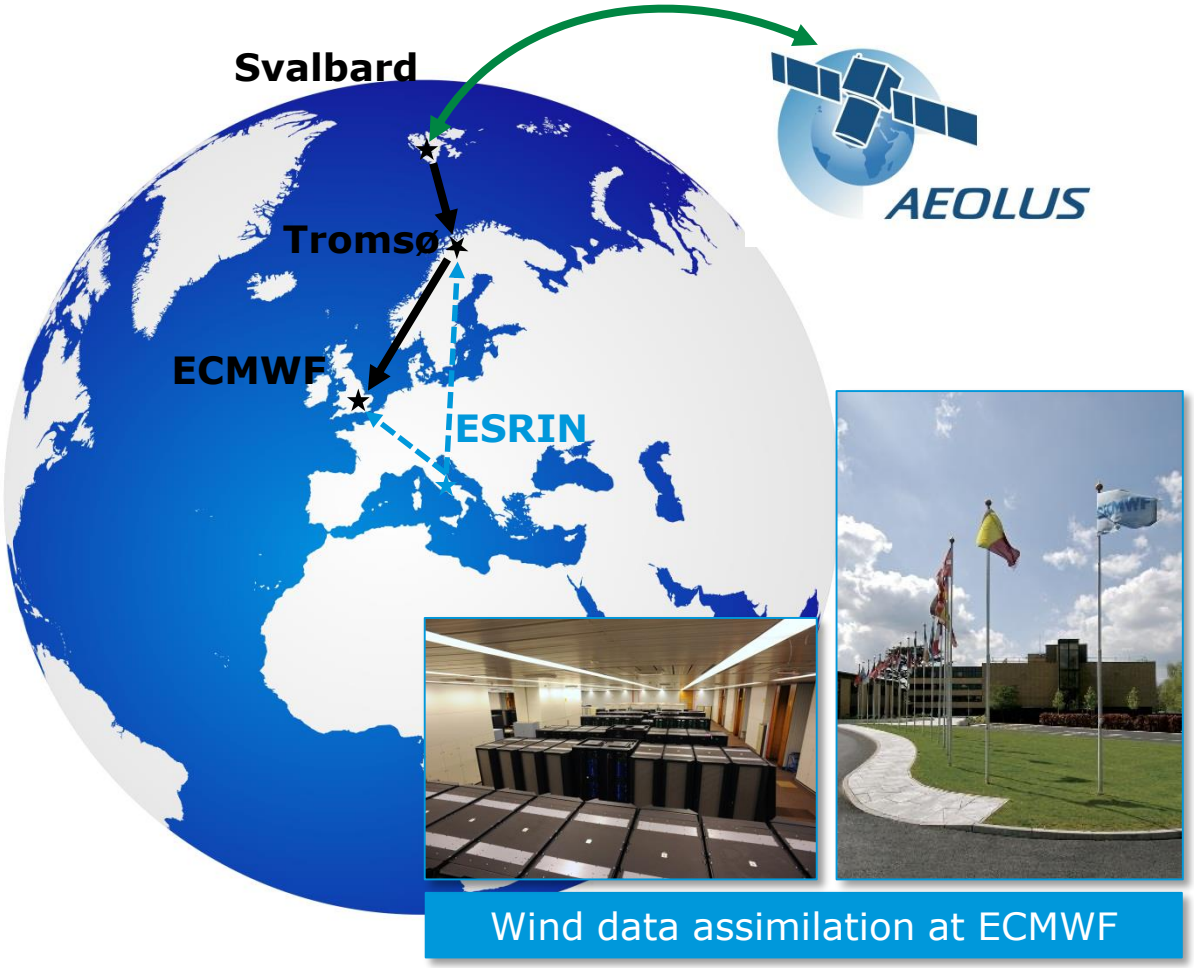


Wind information in the spectral shift of Mie and Rayleigh backscatter spectra wrt laser freq.

Data Reception & Processing

Data reception at Svalbard

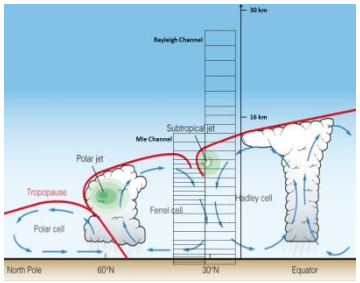
Data processing at Tromsø



Wind data assimilation at ECMWF

Aeolus atmospheric products

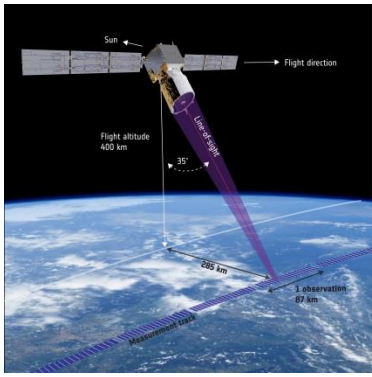
1. **Primary (L2b) product:**
   a. Horizontally projected LOS (HLOS) wind profiles
      - Approximately zonal at dawn/dusk (6 am/pm)
      - ~85 km observation from 3 km subsamples
      - From surface to ~30 km in 24 vertical layers
      - Random errors: 1-2(PBL), 2(Trop), 3-5 (Strat) m/s
      - Bias requirements: 0.5 m/s

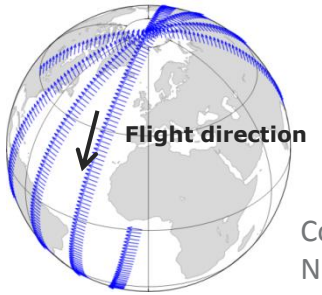


2. **Spin-off (L2a) products :**
   a. Optical properties profiles
      - co-polar β, σ, lidar ratio (circular polarised source)
      - ~85 km observation averages from 3 km subsamples

   From this one can deduce:
      - Cloud/aerosol cover/stratification
      - Cloud/aerosol top heights
      - Cloud/aerosol base height (optically thin)
      - Aerosol typing (limited)

   Important to fill gap between Calipso/EarthCARE observations





Courtesy N. Žagar

Dusk/dawn orbit

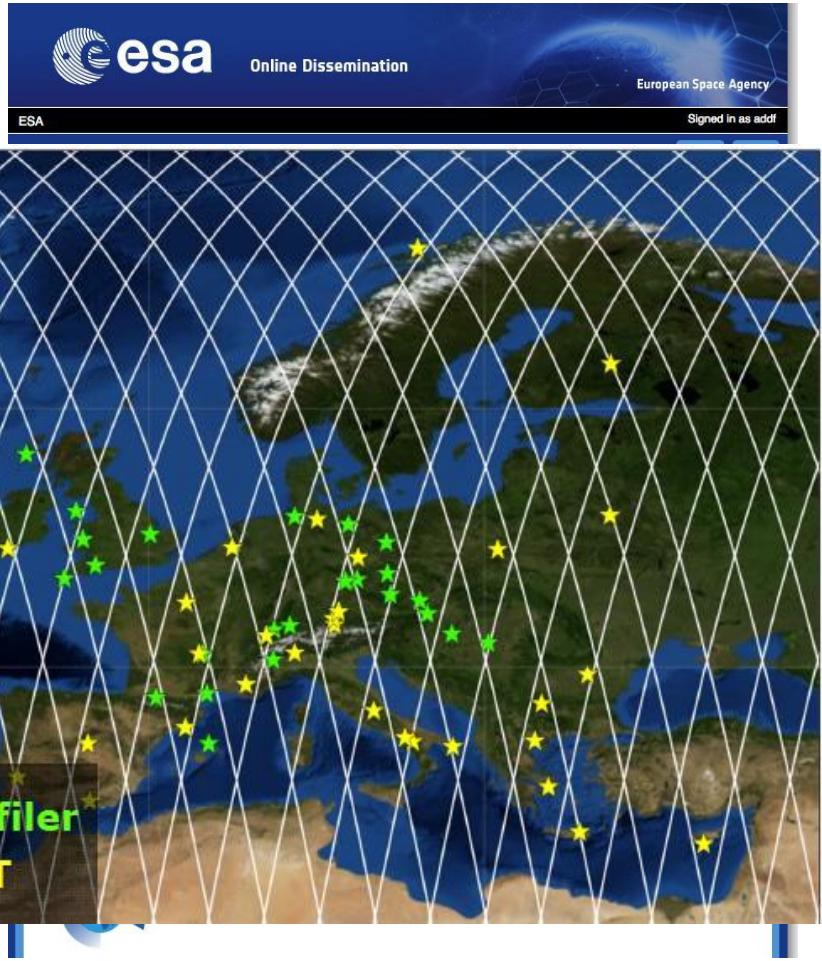
Data Dissemination, Tools and Download

- Products available from ADDF server (simple SSO registration):
  - via website: http://aeolus-ds.eo.esa.int/addf/
  - scripted via HTTPS

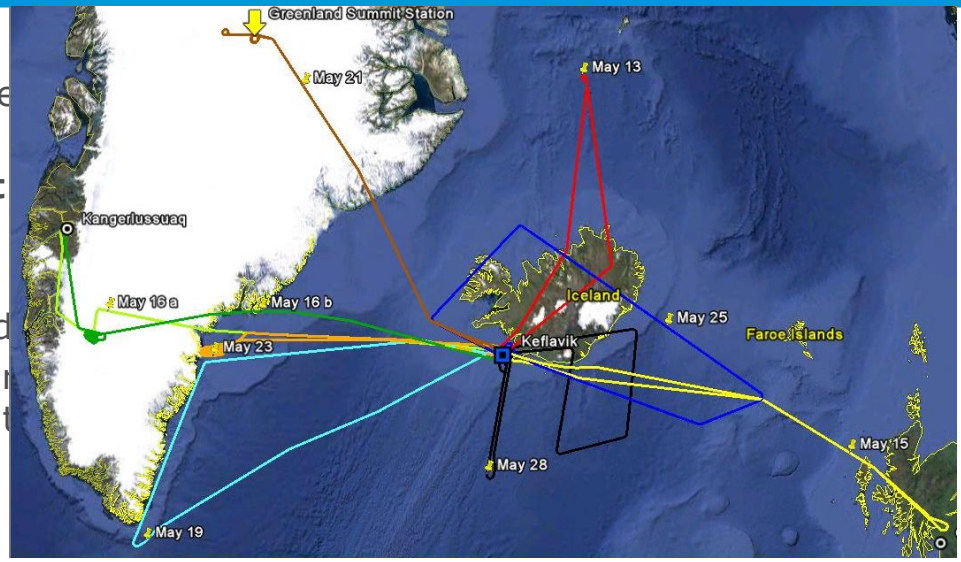
- Storing/Archiving of standardized Cal/Val data at EVDC (Skytek/ICHEC/NILU).

- Cal/Val tools (e.g. overpass Predictor, co-location tools) in development.

- First products available ~L+3-5m



Aeolus A2D preparation campaigns

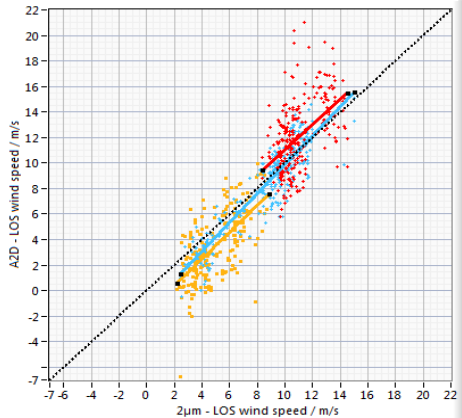


3. **Further successful pre-launch campaign in May 2015 (WindVal):**
   - extend observations in highly heterogeneous conditions (vert./hor.)
   - extend dataset on nadir response calibrations
   - rehearsal and preparation for CAL/VAL activities (DLR, NASA, Summit Station)

First Results off 2µm DWL vs. A2D, image credits U. Marksteiner DLR

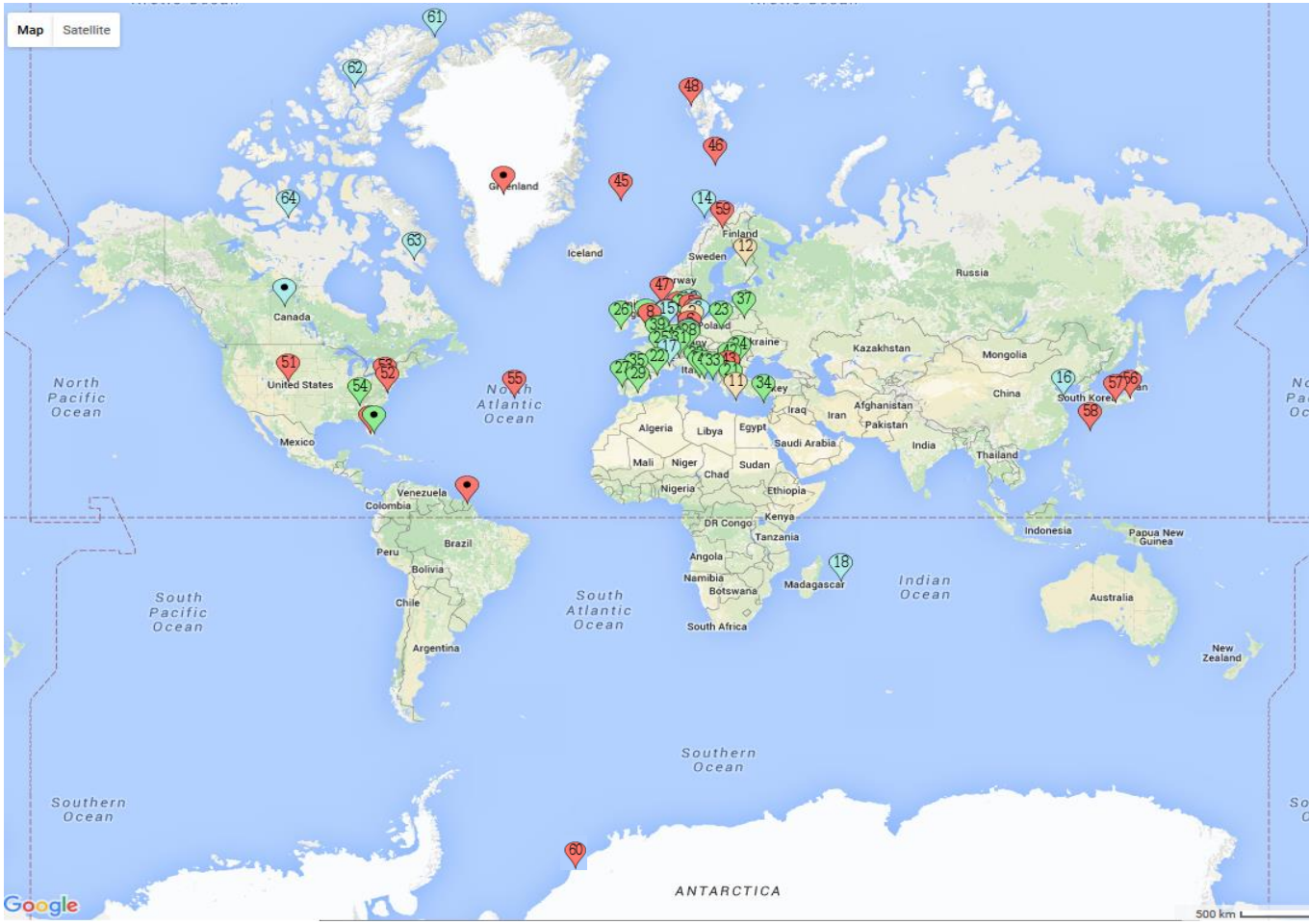
Statistical Results

corr. coeff.	r = 0.89
N points	= 765
slope	= 1.28
std. dev.	= 2.2 m/s
avg. bias	= -0.17 m/s



ADM Aeolus Cal/Val Preparations

- (Delta) Cal/Val AO Call in 2014, 17 proposals, including 4 joint national efforts.
- Groups targeting both wind and aerosol, or one of them.
- Proposed infrastructure use includes: EARLINET, wind profilers, radiosondes, strat. Balloons, NWP monitoring,…



ADM-Aeolus (Cal/Val) Schedule

1. Science and Cal/Val Workshop Feb. 2015, Instrument, processing, science and Cal/Val Plans presented

1. Draft Cal/Val Implementation Plan review (February to April 2016)

1. Cal/Val Coordination & Rehearsal Workshop planned for winter 2016/17

2. ADM-Aeolus launch readiness expected April 2017

3. Phase E1 Cal/Val Workshop at ~L+3 months

1. Regular *Validation & Evolution* workshops throughout phase E2

Thank you!