Retrieval of L2B HLOS winds using T3999 ECMWF and CALIPSO

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1 Goals
The ADM-Aeolus end-to-end simulator (E2S) along with the subsequent chain of processors (L1B, L2B) is employed to generate HLOS wind profiles and their error statistics in the Euro-Atlantic domain.

The input to E2S is a high resolution simulation using the ECMWF model with resolution around 4 km in midlatitudes. Atmospheric composition along the simulated ADM-Aeolus tracks is provided by real CALIPSO observations.

In addition to the up-to-date HLOS wind statistics, we present the sensitivity of the retrieval to the accumulation length and the L2B processor classification scheme.

2 ADM-Aeolus simulator
The wind retrieval procedure consists of the Aeolus simulator and several operational processors. L2B processor configuration:
- allows to adapt the representativeness scale of observations
- Classify clear and cloudy scenes

Since 2012 the ADM retrieval software has been in use at UL-FMF.

Presented results apply a "perfect calibration mode" [1].

3 Data set
High resolution nature run: T3999 ECMWF (HRNR)
- Outputs available on 137 model levels at near uniform ~5 km horizontal grid distance.
- Simulation period is 1-10 April 2007

A significant increase in mesoscale variability in T3999 compared to T1279

Example of HRNR and CALIPSO collocated over north Atlantic area.

Figure 2.1: The HLOS wind retrieval scheme.

Figure 3.2: Kinetic energy density multiplied by S/N at a single level in T3999 simulation and operational T1279 forecast at model level closest to 800 hPa.

CALIPSO observations
HRNR is combined with the cloud and aerosol measurements by CALIPSO for the same time period.

Figure 3.3: Backscatter coefficient estimated from HRNR (hour forecast) and CALIPSO single extinction coefficient.

4 Error statistics of the L2B wind
Statistics is based on differences between derived L2B HLOS winds and truth (HRNR). This provides errors (in form of standard deviation and MAD) that can be compared with the L2B estimated errors.

MAD stands for median absolute deviation and is a robust measure of dispersion similar to standard deviation. MAD0/647499 provides a measure that is not so susceptible to very large or very small error.

It was observed that MAD is very small and closer to 0.3 m/s, which is very similar to STD.

5 Sensitivity to the accumulation length
Representativeness scale of the L2B wind profiles is controlled by the accumulation length (ACC) which controls the scale over which individual measurements (~2.8 km scale) are averaged horizontally.

Regional differences in the Mie-cloud retrieval
- Significant amount of variability evident below 5 km altitude.
- Minimum of error shifts to smaller ACC over aerosol rich areas (e.g. North Africa).
- L2B estimated HLOS winds errors becomes less reliable over aerosol rich areas.

6 Classification into clear and cloudy scenes
Signal classification into clear or cloudy is controlled by the scattering ratio threshold (SR), ratio between the total backscatter and backscatter from molecules. The Rayleigh signal is contaminated by the Mie signal (so-called cross-talk). L1B SR (used by L2B) is biased for SR > 2. A large value of SR (typically 1.8) is needed to minimize these effects in Rayleigh signal.

We investigate sensitivity of the Mie retrieval to the fine tuning of SR.

3.7: Clear [left] and cloudy [right] L1B HLOS wind retrieval.

Aerosol signal: Each pixel represents a single observation. Colors represent derived L2B HLOS winds in truth (HRNR). The x-axis is along the orbit in the west direction.

7 Conclusions
- A high resolution nature run by the ECMWF model was combined with the observed optical properties of real CALIPSO observations as input to the E2S-L1B-L2B retrieval software.
- The up-to-date statistics of the ADM-Aeolus HLOS winds has been prepared for the midlatitude domain. It shows a small bias and errors STD of about 2-3 m/s for the Ray-clear and around 1 m/s for Mie-cloud channel.
- Sensitivity studies show that spatial-temporal variability of atmospheric composition significantly affects the Mie-cloud retrieval as a function of accumulation length.

Tuning of the SR threshold does not show a statistically significant improvement in the Mie-channel retrieval. Possibly, an additional class (mixed clear/cloud or aerosol) might be beneficial in the situation shown.

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