# Aeolus L2B/C wind product processing, quality control and NWP monitoring at ECMWF

ADM-Aeolus CAL/VAL Rehearsal Workshop, Toulouse, 28 March 2017

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European Space Agency

## Outline

- 1. Overview of Level-2B processing
- 2. ECMWF NRT processing
- 3. Data assimilation of L2B; L2C product and monitoring at ECMWF
- 4. Example of L2B winds from CAL/VAL dataset

#### Aeolus sampling terminology

Laser pulses (pulse rate 50 Hz, energy per pulse 80-120 mJ)



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Level-2B wind processing

- Line-of-sight (LOS) or Horizontal LOS wind components suitable for use in NWP/research
  - Using measurement-level L1B data and calibration products
- Additional features compared to L1B observations:
  - Grouping of measurements: control of horizontal resolution and noise
  - Classification of measurements: into different types using optical properties; to avoid significant Mie contamination of Rayleigh
  - Accumulation: of L1B signal of grouped and classified measurements
  - Wind retrieval for different observation types:
    - Rayleigh-clear; Mie-cloudy; Rayleigh-cloudy; Mie-clear
  - Rayleigh corrections:
    - Temperature, pressure sensitivity (Rayleigh-Brillouin Correction) using a priori (AUX\_MET) information

       without this correction 10 m/s HLOS wind biases occur
    - Mie cross-talk in Rayleigh signal using L1B scattering ratio values

#### ... continued

- Uncertainty estimates and quality flags for each wind result
- Wind observations are essentially independent however profile also provided pointing to observation index
- Processing settings controlled with AUX\_PAR\_2B file
- Software freely available and highly portable: <u>https://software.ecmwf.int/wiki/display/AEOL/ADM-Aeolus+Level-</u> <u>2B+Processor+Package</u>
- Additional tools in software package:
  - L2B EE to BUFR converter for NWP users
  - Various tools to write products to ASCII

### Inputs to L2B processor; as run at ECMWF (L2/Met PF)

#### NWP model



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## Classification of measurements into clear/cloudy

Default method: threshold on Mie channel L1B scattering ratio:  $\rho = \frac{\beta_p + \beta_m}{\beta_m}$ 



#### Example of effect of grouping algorithm: 100 km group size

L2B Mie Cloudy results from file:

ts/test case grouping/run id 100/AE TEST ALD U N 2B 20151001T010306 20151001T092306 0001.TXT



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#### 10 km group size

L2B Mie Cloudy results from file: sts/test\_case\_grouping/run\_id\_10/AE\_TEST\_ALD\_U\_N\_2B\_20151001T010306\_20151001T092306\_0001.TXT



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#### 400 km group size

L2B Mie Cloudy results from file: ts/test\_case\_grouping/run\_id\_400/AE\_TEST\_ALD\_U\_N\_2B\_20151001T010306\_20151001T092306\_0001.TXT



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#### Quality Control of L2B winds

- Recommended methods:
  - Threshold on 1- $\sigma$  error estimates provided for each L2B wind



- Use Product Confidence Data flags e.g. overall validity flag
- Warning:
  - L2B Rayleigh-cloudy and Mie-clear winds are significantly poorer quality than Rayleigh-clear and Mie-cloudy

#### L2B winds accuracy:

#### Verification of L2B winds against realistic simulator input "truth"

With "classic" grouping size (BRC) and QC using  $1\sigma$  esimates



## Operational L2B wind processing at ECMWF (L2/Met PF)

- ECMWF will operationally process L2B winds during mission
- L2B processing run as part of observation pre-processing:
  - Data driven: process each L1B product as provided by ESA's PDGS
  - Means ECMWF will perform <u>Near-Real-Time L2B processing</u>
  - Send our products to the PDGS
- Will convert in house from L2B EE to BUFR for our data assimilation
  - Considering options to send to PDGS

#### What is Level-2C product?

- Superset of L2B product
- L2C = L2B + results of data assimilation of L2B winds at ECMWF
  - Background and analysis wind vectors at L2B geolocations after data assimilation of L2B winds
  - Plus observation error, background error, 4D-Var QC results
- Only sensible if ECMWF actually assimilate L2B winds operationally

#### Monitoring of L1B/L2B data at ECMWF

Bespoke monitoring tools for Aeolus – using NWP model as reference:

- Want to understand Aeolus data problems soon after launch
- Focus on wind bias detection
- Be aware of conditions where NWP model is unreliable



#### Detailed look at assimilation:

### Example L2B product from CAL/VAL rehearsal dataset – realistic simulations

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#### Example, CAL/VAL rehearsal dataset, 320 km orbit 1

L2B Rayleigh Clear results positions, from file: /working/CAL\_VAL\_dataset\_orbit\_1/AE\_OPER\_ALD\_U\_N\_2B\_20151001T001124\_20151001T014212\_0001.TXT





#### Simulator input "truth" HLOS wind (m/s) from ECMWF model



# L2B Rayleigh-clear HLOS wind (m/s) L2B Rayleigh Clear results from file: /working/CAL\_VAL\_dataset\_orbit\_1/AE\_OPER\_ALD\_U\_N\_2B\_20151001T001124\_20151001T014212\_0001.TXT



L2B Mie-cloudy HLOS wind (m/s) L2B Mie Cloudy results from file: /working/CAL\_VAL\_dataset\_orbit\_1/AE\_OPER\_ALD\_U\_N\_2B\_20151001T001124\_20151001T014212\_0001.TXT



#### Any questions?



