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ADM-Aeolus: wind profiles from space

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ADM-Aeolus is primarily a research and demonstration mission, flying the first Doppler wind lidar in space, scheduled to be launched end of 2017 by ESA. The lidar is operated in the UV at 355 nm wavelength. Part of the emitted signal is scattered back by molecules (Rayleigh scattering) and detected by the instrument Rayleigh channel. Another part of the emitted signal is scattered back by aerosol and cloud particles (Mie scattering), and detected by the Mie channel.

The light received is Doppler shifted due to the movement of the scatterers along the laser Line- Of- Sight (LOS) and a horizontal LOS (HLOS) wind component profile is infered which extends from the surface up to a height of about 30 km.

The number of rangebins is limited to 24 per channel. The vertical resolution is adjustable and will typically be 250 m close to the surface, 1 km in the free troposphere and 2 km in the stratosphere.
The horizontal resolution is adjustable as well, with a raw resolution of around 3 km, but signals will be accumulated into observations of typically 84 km length to improve the signal-to-noise ratio before processing.

ADM-Aeolus aims to measure wind component profiles with a quality comparable to radiosonde soundings to expect substantial impact on NWP models. To achieve this, signals measured in clear air will be separated from signals measured in scenes containing clouds or aerosols, before accumulation over 84 km. This requires a feature detection algorithm, which is part of the level-2B (L2B) processing, and based on detection of cross-talk, i.e. detection of Mie signal in the Rayleigh channel signal. This allows the flexibility to position the Rayleigh range bins in the stratosphere, without the need of a co-located Mie range bin. Cross-talk detection is based on comparing the measured and expected signal. The latter is calculated from auxiliary meteorological information obtained from NWP input, typically temperature and pressure, and instrument calibration parameters. All this information is available at L2B stage.

The position and size of Mie and Rayleigh bins in the profile may be changed eight times per orbit. Mie range bins may be positioned at altitudes where clouds are expected, based on climatology, e.g., tropical cirrus. Using small sizes for Mie channel bins in these regions allows for accurate localization of cloud layers. In addition the Mie channel signal appears best for ground echo detection.

Finally, the available NWP model inputs (pressure and temperature) are used to correct for line broadening (Rayleigh-Brillouin effect) of the backscattered molecular signal. This is also done at L2B stage.

KNMI and ECMWF are responsible for building and maintenance of the L2B software stage as part of the ground segment, and for testing the combined chain of software (instrument simulation, level-1B, Level-2B) that will be run in the ground segment.