

First Validation of Aeolus Wind Products with Radiosondes and Doppler Lidar at the ACTRIS Granada Station

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The Aeolus satellite was set up in a Sun-synchronous orbit at 320 km from the surface on August 22nd 2018. Since then, Aeolus has retrieved wind products almost continuously with a single meteorological instrument onboard: ALADIN, the first Doppler lidar in space. This instrument works with a set of two interferometers that allow for retrieving the Doppler shift of the backscattered radiation in the horizontal line-of-sight (HLOS) caused by the movement of molecules (Rayleigh channel) and particles (Mie channel), leading to two independent HLOS wind estimates known as Rayleigh and Mie winds. Furthermore, the processor chain provides a scene classification of the atmospheric conditions, which distinguishes between regions with significant particle backscatter (classified as *cloudy*) and regions with little particle backscatter (classified as *clear*). From the four resultant combinations, only the Rayleigh clear and Mie cloudy configurations are considered of enough scientific quality.

Aeolus provides a full coverage of the Earth every week. In the case of the ACTRIS Granada station (AGORA), Aeolus overpasses the site twice every Thursday, at around 24 km before the orbit shift (ANX 4.5), and at around 70 km after the orbit shift (ANX 2.0) that occurred in June 2021. At this location we have developed an intensive validation campaign of Aeolus wind products with a ground-based Doppler lidar system (Halo Photonics, StreamLine model) running continuously. 107 satellite overpasses spatially and temporally coincident with Doppler lidar measurements were found from July 2019, the beginning of Aeolus reprocessed data, to June 2021, when the orbit shift changed the comparison setting. For this database, 4518 (1114) Aeolus HLOS wind estimates were available and the mean Rayleigh clear (Mie cloudy) HLOS wind were 1.4 ± 17.7 m/s (1.2 ± 17.5 m/s). However, the ground-based Doppler mainly provides wind measurements roughly inside the atmospheric boundary layer (a few kilometers above the surface). Thus, only 80 (110) pairs of values are available for the Rayleigh clear (Mie cloudy) configuration. From these points, the mean difference between the systems is 0.1 ± 8.9 m/s (-1.3 ± 9.2 m/s) for the Rayleigh clear (Mie cloudy) configuration.

Due to the vertical range limitation of the ground-based Doppler lidar, an alternative validation was performed using radiosondes. In this case, the database is much more modest but the results can extend to significantly higher altitudes (up to approximately 20 km). The preliminary results yield a mean difference of 1.4 ± 7.3 m/s (7.8 ± 12.1 m/s) from 141 (48) pairs of values for the Rayleigh clear (Mie cloudy) configuration. In addition, a slope, intercept and linear correlation coefficient of 0.98 ± 0.05 m/s (0.81 ± 0.11 m/s), 1.4 ± 0.6 m/s (1.8 ± 0.9 m/s) and 0.87 (0.73) is obtained from the correlation of Aeolus Rayleigh clear (Mie cloudy) and radiosonde winds.