EGU22-12079
https://doi.org/10.5194/egusphere-egu22-12079
EGU General Assembly 2022


# How sensitive are Aeolus Lidar Surface Returns (LSR) to the types of surface? Insights for LSR-based retrieval of AOD over ocean by using Aeolus.

**Lev Labzovskii**[1], Gerd-Jan van Zadelhoff[1], David Donovan[1], Jos De Kloe[1], and Damien Josset[2]
[1]R&D Satellite and Observations Group, Royal Netherlands Meteorological Institute (KNMI)
[2]Ocean Sciences Division, U. S. Naval Research Laboratory

The Aeolus mission offers unique opportunities for lidar surface returns (LSR) applications considering its incidence angle (~37.5$^{o}$) and the operated wavelength (~355 nm). Previous Aeolus-oriented studies have indicated that the contrast between LSR over dark and bright surfaces is expected to be particularly pronounced at 355 nm. We evaluated this surmise by comparing new LSR estimates from novel Aeolus prototype processor (using an optimal estimation approach) with various types of land for the Intensive Observation Period of Aeolus (September 2019) and an additional period during the same year. We discerned a very clear LSR gradient between the signal from water (mostly weak, but variable) and the signal from land (mostly strong), whereas the strongest LSR was found over white surfaces (ice or snow). Moreover, the sensitivity of LSR to the type of surface was also identified as the gradient between the brightest surfaces (snow/ice, sparse vegetation) and the dark surfaces (herbaceous forest, mangrove, wetland) was significant. Specifically, besides Antarctica and Greenland, the strongest returns over land were reported over the snow-covered areas of Tibet and Andes, followed by the arid areas of Northern America, Northern Africa and Middle East. Notably, the LSR from water was not always low as the average LSR estimate over water exhibited the strongest variability (~0.001 – 0.042 sr$^{-1}$) and yielded most statistical outliers. The application of sea ice mask from MERRA-2 model revealed that most strong LSR cases over water were associated with the undetected ice. The masking of detected ice has resulted in the dramatic reduction of the average LSR over water. As a result, the related LSR variability over water was dwindled by the factor of ~10 down to ~0.001 – 0.004 sr$^{-1}$ and >95% of outliers disappeared. Our findings about the sensitivity of Aeolus surface returns to the type of surface are beneficial because statistically robust LSR estimates over ocean lay the foundation for the Aeolus LSR-based Aerosol Optical Depth (AOD) retrieval over ocean. This retrieval can be established based on the fundamental link between LSR, near-surface wind speed and AOD over sea surface.