Study of air flow directions above Slovenia by lidar detection of aerosols

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Air masses carry various types and concentrations the aerosols, which can be monitored using lidar. Relating these measurements to the transport paths the air masses can help determine their origin and can serve as a cross-check for meteorological models. A study using January 2005 - September 2006 Mie scattering lidar data from Otlica observatory, Slovenia (43.93°N, 13.20°E, [945] m a.s.l.) was performed.

Typical flow directions of air masses arriving to Slovenia were determined by using the K-means clustering method. The method has been applied to air mass backward trajectories computed by the HYSPLIT model. The trajectories describe air flows at altitudes of 1.5 km, 3.0 km, 4.0 km, 5.5 km, 7.0 km and 9.0 km. As a result of cluster analysis, four typical classes were obtained: a Northern class (N), a Northwest-Western class (NW-W), a Southwest-Western class (SW-W), and a Central class (C) which gathers the short trajectories arriving from different directions. For all seasons the frequencies of occurrence showed that most of the air trajectories fall into the SW-W (from 47% to 30% for different altitudes) and C (from 35% to 25%) classes. Classes N and NW-W were found to have lower frequencies of occurrence at all altitudes (about 20%).

Using the lidar data, an estimate of the atmospheric optical properties in UV (355 nm) was performed using the Fernald method. For the air masses arriving from the SW-W direction bringing the Saharan dust, the maximum back-scattering and extinction coefficient values were found to be $\beta_a = (1.2 \pm 0.3) \times 10^{-6} m^{-1} sr^{-1}$ and $\alpha_a = (1.2 \pm 0.3) \times 10^{-5} m^{-1}$, with an estimated lidar ratio of 35. Maritime aerosols were brought by air masses arriving from NW-W direction. In this case, the maximum coefficient values were found to be $\beta_a = (1.0 \pm 0.3) \times 10^{-6} m^{-1} sr^{-1}$ and $\alpha_a = (1.1 \pm 0.3) \times 10^{-5} m^{-1}$ with an estimated lidar ratio of 15. Lidar data was not available for air masses from the N class, and was inconclusive for the C class, where the prevailing aerosol type was not possible to identify.