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Mid-latitude cirrus investigations at high-resolution through ground-based lidar measurements

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Although cirrus vertical distributions determine their local cooling or warming effects, one of the main missing information in Global Climate Models (GCMs) is the characterization of their vertical location and stratification. Lidar technique, in contrast, can detect cirrus with high spatial and temporal resolution, providing accurate information on their vertical distribution.

In this work, the recent and on going studies about the the characterization of mid-latitude cirrus through lidar systems located at the Observatory of Haute Provence (OHP, 43.9 ° N, 5.7 ° E) in France and at Rome Tor Vergata (RTV, 41.8 ° N, 12.6 ° E) in Italy are presented. Cirrus have been firstly studied in terms of quasi-stationary periods regarding statistical variability. A clustering approach has been then adopted to derive cirrus classification (and climatology) over the period 1996-2007 for OHP lidar measurements and over 2007-2010 for RTV dataset. Three independent cirrus classes have been identified: I thin middle tropospheric cirrus, II thick upper tropospheric cirrus, III thin tropopause cirrus. The temporal variability of the optical properties of these classes has been then analyzed at lidar raw temporal sampling (180 sec). While advection dominates, at the first order, variability on timescale of minutes can be related to space fluctuations of cloud properties on typical scale of few kilometers. Lognormal distributions of the optical depth have been used to model variability of the cirrus optical depth as observed by lidars.

Finally, the implementation of the OHP lidar system in terms of two analogic channels that collect the Rayleigh-Mie orthogonal and parallel component signals through an high-resolution acquisition chain (vertical and temporal sampling of 37.5 m and 1 sec, respectively) has been employed to investigate the high frequency cirrus variability in a recent campaign held at the OHP. The preliminary results of this campaign are also showed