

Interactive comment on “Mid-latitude cirrus classification at Rome Tor Vergata through a multi-channel Raman–Mie–Rayleigh lidar” by D. Dionisi et al.

Anonymous Referee #2

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This manuscript report an interest cirrus classification. The preparation of lidar dataset is rigid and the analysis result is important and should be appreciated. The result is quiet useful for researchers to have sight of view of cirrus in midlatitude. However, since this is not first paper using cluster analysis to classify cirrus, so more new features should be revealed in this analysis. My general comment and suggestion list below.

Minor:

1. That is surprise to see 167 cirrus were derived only from 43 lidar sessions (47% of 93 days). Which means, in average, 4 independent cirrus clouds were selected in

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every single cirrus day. It make me think more than one samples were chosen from one independent cirrus. The author should report their cirrus selection strategy more clearly, otherwise, the dataset used for analysis is quiet questionable.

2. In the manuscript, only optically thick cirrus were analyzed. I think the occurrence of optically thin cirrus should also be included.

Major:

1. As pointed out by Fortuin et al. (2007) and Sunilkumar et al. (2010), the seasonality of cirrus occurrence frequency and height distribution might related with formation or transportation of cirrus. So the seasonality of cirrus should be reported and might be considered to be included in cluster analysis. I'd like to suggest the author try to give a more clear picture of seasonal distribution of cloud top, base, mid-cloud height, optical depth. Moreover, the occurrence frequency of each classification in each season might be interest.

2. Although meteorological parameters were in discussed in manuscript. I just wonder can meteorological parameters (e.g. temperature, wind) or meteorological conditions (e.g. wind shear, jet stream) be directly included in the cluster analysis? For example, few papers reported the relationship between easterly jet and cirrus formation (e.g. Das et al., 2011). So it might be interest to know is there any feature or class of cirrus related with meteorological parameters or condition.

3. The result of cluster analysis is very impressive. However, it seems cluster analysis did not distinguish some certain types of cirrus, e.g. laminar cirrus, contrail, or cirrus near or crossed tropopause. Luo and Rossow (2004) reported cirrus that crossed tropopause might directly related with water vapor transportation in upper-troposphere. So I just suggest the author manually collected certain types of cirrus and compare the statistics with results of cluster analysis.

Das, S.K., Chiang, C.-W. & Nee, J.-B., 2011. Influence of tropical easterly jet on upper

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tropical cirrus: An observational study from CALIPSO, Aura-MLS, and NCEP/NCAR data. *JOURNAL OF GEOPHYSICAL RESEARCH*, 116(D12), p.D12204.

Fortuin, J.P.F. et al., 2007. Origin and transport of tropical cirrus clouds observed over Paramaribo, Suriname (5.8 N, 55.2 W). *Journal of Geophysical Research: Atmospheres* (1984–2012), 112(D9).

Sunilkumar, S.V. et al., 2010. Semitransparent cirrus clouds in the tropical tropopause layer during two contrasting seasons. *Journal of Atmospheric and Solar-Terrestrial Physics*, 72(9), pp.745–762.

Luo, Z. & Rossow, W.B., 2004. Characterizing tropical cirrus life cycle, evolution, and interaction with upper-tropospheric water vapor using Lagrangian trajectory analysis of satellite observations. *Journal of Climate*, 17(23), pp.4541–4563.

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