Two decades analysis of cirrus cloud radiative effects by lidar observations in the frame of NASA MPLNET lidar network

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Assessing the cirrus cloud radiative effect is crucial to establish their feedback on the Earth-atmosphere system. For this reason, cirrus clouds are of paramount importance in climate. Moreover, these tiny ice clouds are the most common cloud gene, continuously covering 30% of the Earth's surface, peaking to 70% in the tropical and equatorial regions. The same authors, in three different recent studies, assessed the yearly cirrus cloud radiative effects characteristics for different NASA MPLNET permanent observational sites, deployed at different latitudes, e. g. Goddard Space Flight Center, Singapore, and Fairbanks Alaska. The analysis put in evidence that the cirrus cloud can be both cooling or warming agents of the Earth-atmosphere system during the daytime, depending on their latitude. The cirrus clouds are warming agents in equatorial/tropical regions because of the higher averaged solar zenith angle, and become neutral at mid-latitudes. At polar latitudes instead, cirrus clouds become cooling agents because of the lower solar zenith angle. In this analysis instead, using the Fu-Liou-Gu radiative transfer model, we assess how the cirrus cloud radiative effects, both at the top-of-the atmosphere and surface, changed over twenty years. The analysis is extended also to evaluate also changes in cloud optical depth over the same period. This is unprecedented research, because to our knowledge, no other analysis has been carried out from ground-based measurement for such a long period. As a future perspective, the analysis will be repeated for the different observational sites of the MPLNET lidar network to evaluate cirrus cloud radiative effects at a global scale.