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Lidar cirrus cloud retrieval – methodology and applications

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In the last decades numerical modeling has experimented sensitive improvements on accuracy and capability for climate predictions. In the same time it has demanded the reduction of uncertainties related with the respective input parameters. In this context, high altitude clouds (cirrus) have attracted special attention for their role as radiative forcing. Also such clouds are associated with the vertical transport of water vapor from the surface to upper troposphere/lower stratosphere (URLS) in form of ice crystals with variability of concentration and morphology. Still cirrus formation can occur spatially and temporally in great part of the globe due to horizontal motion of air masses and circulations. Determining accurately the physical properties of cirrus clouds still represents a challenge. Especially the so-called subvisible cirrus clouds (optical depth inferior to 0.03) are invisible for space-based passive observations. On the other hand, ground based active remote sensing as lidar can be used to suppress such deficiency. Lidar signal can provide spatial and temporal high resolution to characterize physically (height, geometric thickness, mean temperature) and optically (optical depth, extinction-to-scattering ratio or lidar ratio, depolarization ratio) the cirrus clouds. This report describes the evolution of the methodology initially adopted to retrieval systematically the lidar ratio and the subsequent application on case studies and climatology on the tropical sites of the globe – São Paulo, Brazil (23.33 S, 46.44 W) and OPAR observatory at Ille de La Réunion (21.07 S, 55.38 W). Also is attempting a synergy between different instrumentations and lidar measurements: a infrared radiometer to estimate the kind of ice crystals compounding the clouds; CALIPSO satellite observations and trajectory model (HYSPLIT) for tracking air masses potentially responsible for the horizontal displacement of cirrus. This last approach is particularly interesting to understand the history of the cirrus clouds - time of residence in different altitudes, ageing process and possible phase changes. Finally the radiative transfer code FASDOM fed by ancillary meteorological and surface data is used to simulate brightness temperatures as measured by the infrared radiometer locate at the ground level in the OPAR laboratory.