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On the Formation and Seasonal Properties of Topical Cirrus Clouds over Amazon Basin (2.89°S, 59.97°W): Observations from Lidar, Radiosonde and Satellite instruments.

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Abstract Text:

Formed mainly by anvil outflow and the remaining part of deep convective clouds after rainfall or in situ in the upper troposphere by synoptic events, high clouds are constantly found in the tropical region. The global cirrus cover has been estimated to be about 20-25% and their occurrence can be more than 70% over the tropics. These clouds have lifetime that can go from hours to a few days, large coverage area and have been recognized as important agents of the climate system as they can significantly alter the radiation balance of the atmosphere. Despite being relatively transparent to solar radiation (optical depth < 3.0), they trap the infrared radiation that would be lost to space, and thus may have a positive radiative forcing. In this paper, we report on tropical cirrus clouds characteristics as measured by a Lidar station operational in the central Amazon (2.89° S 59.97° W) since 2011. An automated algorithm for the detection of cirrus clouds was developed to determine the clouds geometrical properties. The transmittance of the lidar signal was used to derive the cirrus optical depth. The Klett method was used to derive the backscattering coefficient and to estimate the lidar ratio of the cirrus clouds. Precipitation information by TRMM satellite and wind field by ERA Interim reanalysis from ECMWF were used. As the results from the first two years of measurements (2011-2012), we found that the occurrence of high clouds with base altitude higher than 8 km (temperatures below -20°C) was approximately 71.0% of the total time of observation, varying between about 50% in the dry season (JJA) and about 80% in the wet season (DJF). These all cirrus clouds were classified as subvisual ($\tau < 0.03$) approximately 24.2% of times, 40.7% were thin cirrus ($0.03 < \tau < 0.3$) and 35.1% were cirrus stratus ($\tau > 0.3$). The average values of the cirrus base and top altitudes were $12.4 \pm 2.4 \text{ km}$ and $14.3 \pm 2.2 \text{ km}$, respectively. They were found at temperatures down to -90°C they reside most frequently near the tropopause. The mean diurnal cycle of the frequency and altitude, during both summer and winter, indicate anvil outflow to be the most important generation mechanism. The mean lidar ratio was $20.0 \pm 6.8 \text{ sr}$, indicating a mixed composition of thick plate and long column ice crystals. The behavior of these quantities with respect to temperature was analyzed.

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Session Selection: Cloud Observations and Uncertainties

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