# Semitransparent Cirrus in the Tropical Tropopause Layer: Cloud Genesis and their Optical Properties

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The association of semitransparent cirrus (STC) observed over the east coast of Peninsular India in different periods of the year with the prevailing structure and dynamics of the atmosphere is examined using ground based Lidar and MST Radar (from Gadanki, 13.5°N) along with satellite (KALPANA-1) borne measurements. Mean climatological features of the regional distribution of deep convection (clouds) and genesis of STC over the Indian subcontinent and the surrounding oceanic regions are examined using KALPANA data. A close examination of mean STC cover derived from satellite data along with mean tropospheric wind field around 100 hpa level obtained from NCEP reanalysis reveals that the STC observed during the monsoon period are usually associated with convective outflows originating from very deep convective regions over the Bay of Bengal. The region between the top of major convective outflow (in the troposphere) and the cold point tropopause, defined as the Tropical Tropopause Layer (TTL) is highly conducive for the formation of STC. For those thicker cirri forming within the TTL, the cloud top remains mostly steady and/or aligned with the top of TTL, while the cloud base varies significantly in accordance with TTL base (governed by the altitude extent of convective outflow). The cloud depolarization ratio (VDR) measured using lidar shows very large values (~0.5) during the monsoon period, which indicates that the associated particles are relatively large and highly non-spherical in nature. At times very thin cirrus clouds are observed near the top of the TTL with very small values of VDR (~ 0.2) which could be composed of tiny ice crystals. For those STCs, which form below the TTL the value of VDR is generally small, but optical depth is quite large. These clouds are relatively denser than those forming near the cold point and are composed of particles which could be more spherical in nature. Being associated with higher temperature, it is quite reasonable to presume that they could be super-cooled droplets similar to those observed in mid-latitude cirrus. A detailed analysis of this data also shows that the relatively dense TTL cirrus with high values of VDR observed during monsoon are associated with outflow from convective anvils from the adjacent deep convective regions while those thin clouds with low values of VDR observed during winter could mostly be of *insitu* origin.

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