



Midlatitude cirrus clouds and multiple tropopauses from a 4-year climatology over the SIRTA observatory

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A comparison of 4 years of lidar observations of midlatitude cirrus clouds over the SIRTA observatory with multiple tropopauses (MT), retrieved from radiosounding temperature profiles, will be presented. The temporal variability of MT properties (frequency, thickness) will be discussed. Results show a marked annual cycle, with MT frequency reaching its lowest point in May (~18% occurrence of MT) and slowly rising to more than 40% in DJF. The average thickness of the MT also follows an annual cycle, going from less than 1 km in spring to 1.5 km in late autumn. Comparison with lidar observations show that cirrus clouds show a preference for being located close below the 1st tropopause. When the cloud top is above the 1st tropopause (7% of observations), in 20% of cases the cloud base is above it as well, resulting in a cirrus cloud “sandwiched” between the two tropopauses. Statistics of distances between cloud bases and tops show that inter-tropopause clouds most likely originate from the same area, while cross-tropopause clouds originate from the free troposphere, leading to different formation processes and microphysical properties. Compared to the general distribution of cirrus, cross-tropopause cirrus show a higher frequency of large optical depths, while inter-tropopause cirrus show almost exclusively low optical depths typical of subvisible clouds. Results suggest the occurrence of inter-tropopause cirrus clouds is correlated with the frequency of multiple tropopauses.