

EGU23-7035, updated on 30 Nov 2023

<https://doi.org/10.5194/egusphere-egu23-7035>

EGU General Assembly 2023

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Characterization of Tropical Tropopause Layer clouds combining balloon-borne and space-borne observations

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Tropical Tropopause Layer clouds have a significant impact on the Earth's radiative budget and regulate the amount of water vapor entering the stratosphere. They are a key component of the climate system but their observation is still challenging. The Strateole-2 project aims at a better understanding of dynamical, transport, and processes in the Tropical Tropopause Layer (TTL) using long-duration super-pressure balloons flying for several months in the lower stratosphere along the equator belt. From October 2021 to late January 2022, three microlidars flew onboard stratospheric balloons, slowly drifting just a few kilometers above the clouds. These observations have unprecedented sensitivity to thin cirrus and provide a fine scale description of cloudy structures both in time and space. Statistical comparisons with spaceborne lidar CALIOP are discussed, highlighting the unique ability of the microlidar to detect optically thin clouds. The modulation of outgoing longwave radiation by tropical clouds is also investigated using the balloon-borne observations.