

# SEMINAR

## What is cooling the tropopause above tropical cyclones?

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Cold anomalies have been observed in the tropical tropopause layer (TTL) above deep convective systems. Above tropical cyclones (TCs), this tropopause layer cooling (affectionately referred to as TLC) extends on scales  $\sim 1000$  km and is estimated to be of order 1 K/day using GPS radio occultation temperature retrievals from COSMIC. Even though TCs account for a small fraction of deep convection globally, they produce the deepest convection and with the highest frequency. TCs may therefore modulate the water content of the stratosphere, both by cooling it and by injecting ice into it. Understanding these processes leads us to the question of how TLC is produced.

Several mechanisms have been proposed:

- 1) Diabatic cooling from cloud top radiative cooling.
- 2) Adiabatic cooling in cloud tops that overshoot their level of neutral buoyancy.
- 3) Adiabatic cooling from convectively generated gravity waves or large-scale ascent associated with the TC secondary circulation.

The relative contribution and spatial partition of these mechanisms remain uncertain, perhaps due to the scarcity of in situ data, uncertainty in remote sensing data, and lack of vertical resolution in models near the tropopause.

We quantify the contribution of cloud radiative processes using radar and lidar data from the A-train satellites, and find that cloud top cooling can explain up to 50% of TLC. The contribution of overshooting tops is difficult to evaluate due to the challenges inherent to the observation of these short-lived, small-scale features. However, we expect overshooting to be largely compensated by subsidence and adiabatic warming. We propose a numerical simulation framework to quantify the relative contributions of gravity waves and the TC secondary circulation.

**Monday, November 4, 2019, 3:30 p.m**

Refreshments 3:15 p.m

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FL2-1022, large seminar room

Live webcast: <http://ucarconnect.ucar.edu/live>

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