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NESL's Atmospheric Chemistry Division Seminar

Midlatitude Tropopause and Low-level Moisture

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Abstract

A new relationship between the surface distribution of equivalent potential temperature and the potential temperature at the tropopause is proposed. Using a Gaussian approximation for the distribution of equivalent potential temperature, we argue that the tropopause potential temperature is approximately given by the mean equivalent potential temperature at the surface plus twice its standard derivation. This relationship is motivated by the comparison of the meridional circulation on dry and moist isentropes. It is further tested using four reanalysis datasets: the Interim ECMWF Re-Analysis (ERA-Interim); the NCEP–Department of Energy (DOE) Reanalysis II; the NCEP Climate Forecast System Reanalysis; and the Twentieth-Century Reanalysis (20CR), version 2. The proposed relationship successfully captures the annual cycle of the tropopause for both hemispheres. The results are robust among different reanalysis datasets, albeit the 20CR tends to overestimate the tropopause potential temperature. Furthermore, the proposed mechanism also works well in obtaining the inter-annual variability (with climatological annual cycle removed) for Northern Hemisphere summer with an above 0.6 correlation across different reanalyses. On the contrary, this mechanism is rather weak in explaining the interannual variability in the Southern Hemisphere and no longer works for Northern Hemisphere wintertime. This work suggests the important role of the moist dynamics in determining the midlatitude tropopause. In order to better understand the dynamical mechanisms, we make use of an idealized aquaplanet model simulation with a prescribed subtropical planetary-scale wave sea surface temperature perturbation, which mimics the land-ocean heating asymmetry. A similar dynamical connection is also found in this idealized model experiment, which reveals possible mechanisms related to the Asian monsoon and subtropical anticyclones. Finally, the representation of the dynamical relationship in CMIP5 models will also be discussed.

Monday, August 18th

3:15 p.m. Refreshments

3:30 p.m. – Seminar

FL2-1022, Large Auditorium