Abstract – E. Jensen

Title: A42F-03: Small-scale Variability in Tropical Tropopause Layer Humidity

Recent advances in statistical parameterizations of cirrus cloud processes for use in global models are highlighting the need for information about small-scale fluctuations in upper tropospheric humidity and the physical processes that control the humidity variability. To address these issues, we have analyzed high-resolution airborne water vapor measurements obtained in the Airborne Tropical TRopopause EXperiment over the tropical Pacific between 14 and 20 km. Using accurate and precise 1-Hz water vapor measurements along approximately-level aircraft flight legs, we calculate structure functions spanning horizontal scales ranging from about 0.2 to 50 km, and we compare the water vapor variability in the lower (about 14 km) and upper (16-19 km) Tropical Tropopause Layer (TTL). We also compare the magnitudes and scales of variability inside TTL cirrus versus in clear-sky regions. The measurements show that in the upper TTL, water vapor concentration variance is stronger inside cirrus than in clear-sky regions. Using simulations of TTL cirrus formation, we show that small variability in clear-sky humidity is amplified by the strong sensitivity of ice nucleation rate to supersaturation, which results in highly-structured clouds that subsequently drive variability in the water vapor field. In the lower TTL, humidity variability is correlated with recent detrainment from deep convection. The structure functions indicate approximately power-law scaling with spectral slopes ranging from about -5/3 to -2.