

Tropical tropopause layer variability associated with the Madden-Julian Oscillation during DYNAMO

Thomas Birner¹, Erin L. Dagg¹, Richard H. Johnson¹

¹*Department of Atmospheric Science, Colorado State University, Fort Collins, USA*

Observations show time variations in the TTL across multiple scales, including the intraseasonal variability of the Madden-Julian oscillation (MJO). In this study, we investigate the evolution of TTL properties and their vertical structure during the Dynamics of the Madden-Julian Oscillation (DYNAMO) field campaign from October-December 2011. This time period is particularly interesting in that two prominent MJO passages were seen over the tropical Indian Ocean. High vertical resolution radiosonde observations from the MJO initiation region (Gan Island; 0.7 S, 73.2 E) are contrasted with those from the decay region (Manus Island; 2.1 S, 147.4 E). CALIPSO satellite data is additionally used in determining the presence of thin cirrus clouds. Characteristics of the broad-scale structure of the MJO are analyzed, as well as higher-frequency variations. Spectral filtering is used to isolate low-frequency variability, Kelvin wave activity, and higher-frequency gravity wave perturbations. In particular, a 7-20 day bandpass of the temperature and zonal wind fields reveals strong TTL Kelvin wave signals in late October and early December. Its descending cold phase between 100-150 hPa coincides with a lowering of the cold point tropopause and an increase in cirrus cloud frequency preceding the active phase of the MJO. Another strong Kelvin wave signal appears in the lowermost stratosphere during the October MJO event, but which seems unrelated to the MJO below. Our analysis also shows that lower stratospheric gravity wave activity does not appear to be modulated by the MJO, but is generally stronger at Manus Island due to its proximity to the west Pacific warm pool.