A multi-diagnostic intercomparison of tropical width time series using models, reanalyses, and satellite observations

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Poleward migration of the latitudinal edge of the tropics of ~0.25 – 3º decade^{-1} has been reported in several recent studies based on satellite and radiosonde data, and reanalysis output covering the past ~30 years. To date, it has been unclear to what extent this large range of trends can be explained by the use of different data sources, time periods, and edge definitions. In this presentation, we address these issues by applying a suite of tropical edge latitude diagnostics based on tropopause height, winds, precipitation/evaporation, and outgoing longwave radiation (OLR) to six reanalyses and four satellite data sets. These diagnostics include both previously used definitions and new definitions designed for more robust detection. The wide range of widening trends is shown to be primarily due to the use of different data sets and edge definitions, and only secondarily due to varying start/end dates. We also show that the large trends (> ~ 1º decade^{-1}) previously reported in tropopause and OLR diagnostics are partially due to the use of subjective definitions based on absolute thresholds. Statistically significant Hadley cell expansion based on the mean meridional streamfunction of 1.0 – 1.5º decade^{-1} is present in three of four reanalyses that cover the full time period (1979-present), whereas other diagnostics yield trends of -0.5 – 0.8° decade^{-1} that are mostly insignificant. These results are compared to model trends calculated over both the 20th and 21st century in the CMIP3 output.