Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Dynamic stability of a jet near a transition in static stability JOHN MCHUGH, The University of New Hampshire — The vertical profile of the Earth's atmosphere contains a sharp transition region at the tropopause between two roughly constant stability layers, and also jet streams at nearly the same altitude, with the jet stream core possible above or below the tropopause, depending on location. This proximity of the jet to the tropopause would be expected to greatly affect the dynamic stability of the jet, treated here with the jet modeled with the Bickley $sech^2$ profile and the tropopause modeled as a smooth transition region with a tanh profile. Stability results are obtained numerically using a Chebyshev collocation spectral method. The results show that the jet becomes more unstable as it is moved further beneath the tropopause. Corresponding two-dimensional direct numerical simulations of the flow confirm the initial growth rate, but then show that the most unstable mode achieves more kinetic energy when the jet is just above the tropopause. Overall, the results indicate that when a jet is above the tropopause, the configuration is more stable and more likely to produce a strong single unstable mode. Conversely, when a jet is below the tropopause, the jet is more likely to form a broad spectrum of motion.

John McHugh
The University of New Hampshire

Date submitted: 30 Jul 2019 Electronic form version 1.4