

Intensity Variations of Subtropical Potential Vorticity Streamers: Impact on the Environment of the Subtropical Atlantic and Tropical Cyclone Activity

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Subtropical potential vorticity (PV) streamers are elongated filaments of high PV air that can serve as channels for tropical-extratropical air mass exchange. These PV streamers often originate from anticyclonic Rossby wave breaking (AWB), where upstream low PV air is advected poleward over downstream high PV air in the upper troposphere. This flow evolution results in an elongated, positively tilted upper-tropospheric trough (i.e., PV streamer) downstream of the AWB axis. Subtropical PV streamers modify the tropospheric environment, by enhancing vertical wind shear (VWS) and moisture anomalies in their vicinity. These environmental changes in VWS and moisture play an important role in enhancing or suppressing different tropical cyclogenesis (TCG) pathways in the Atlantic basin. Despite this knowledge, prior PV streamer climatologies have not investigated how these environmental variables change as PV streamers fluctuate in size, intensity, or tilt during the tropical cyclone (TC) season. This proposal is motivated by the lack of prior research of these PV streamer changes in size, intensity, and tilt, where these changes are hypothesized to significantly alter environmental variables important to TC activity in the Atlantic basin.

This study investigates PV streamers in the Atlantic basin using the Climate Forecast System Reanalysis from 1979–2015. PV streamers are identified using an algorithm from June–November on the 350-K isentropic surface bounded by the 2-PVU contour. This algorithm identifies PV streamers as the high PV trough that occurs downstream of the AWB axis. Unique to this climatology is its assessment of the size, intensity, and tilt of each PV streamer. These characteristics are used to investigate how different intensity PV streamers modify the tropospheric environment in the NATL, and how different intensity PV streamers impact TCG pathways in the NATL basin. PV streamers are first sorted into strong and weak intensity categories using area average total standardized PV anomaly within the PV streamer. These categories are then composited to illustrate differences in environmental VWS (850–200-hPa), upper-tropospheric thickness (500–200-hPa), and precipitable water in proximity to PV streamers. Preliminary results show that strong PV streamers are associated with a greater magnitude and wider extent of VWS, and decreased precipitable water upstream of their trough axis relative to weak PV streamers. A seasonal PV streamer activity metric (combining size, intensity, and duration) is also computed during the tropical cyclone season to assess the relationship between PV streamer activity and TC activity. Preliminary results show that seasons with larger and stronger PV streamers are negatively correlated with TC activity, while seasons with weaker PV streamers are positively correlated with TC activity in the Atlantic basin.