Efficiency of the South-Asian-monsoon energy pump into the Upper Troposphere, and its downstream effects on the Atlantic and the Arctic

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Each year the planetary-scale African–Asian monsoonal outflow near the tropopause carries a large anticyclonic gyre that has a longitudinal spread that occupies nearly half of the entire tropics. In recent years, the South Asian summer monsoon has experienced increased rainfall over the northwestern portion of the Indian subcontinent, and it has correspondingly contributed to more intense local anticyclonic outflows from this region. The western lobes of these intense upper-level high-pressure areas carry outflows with large heat fluxes from the monsoon belt West towards Africa as well as North towards central Asia and eventually all the way to the Arctic. These outflows have a direct impact on the African Easterly Waves (AEW) that often spawn hurricanes in the Atlantic, as well as a direct impact on the rapid ice melt in the Canadian Arctic.

The proposed suborbital mission is to collect and analyze observations to help improve our ability to model and forecast these crucial monsoonal transports and their downstream effects. The objectives are 1) to observe and relate convective-scale to meso-scale changes in the three-dimensional circulation with the efficiency of the resulting convective transports (of air mass and heat) and the build-up of the large-scale anomalies, as they are modulated by the three-dimensional structure of the aerosol loading; and 2) to observe how fluctuations in the monsoon large-scale upper-level outflow affect downstream convection, especially within AEWs. The observations will be tailor-made to help understand the controls of the northward march of the monsoon isochrones, the initiation and magnitude of heat towers over the subcontinent during the monsoon, and how the mostly zonal land-sea differential heating interacts with the meridional progress of the Intertropical Convergence Zone (ITCZ) to constrain the intensities of the northern and western outflows. Unique contributions will be made by two airborne instruments, operated in concert: NASA-LARC's Doppler Aerosol Wind Lidar (DAWN) coherent-detection wind lidar which uses a pulsed laser with a wavelength of about two microns to measure vertical profiles of the three dimensional components of the wind field, and JPL's Airborne Second Generation Precipitation Radar (APR-2) precipitation radar which measures the three-dimensional structure of rain within a swath that is about 10km wide (depending on the altitude of the plane) and extends from flight level down to the surface.