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Convective Processes Experiment – Aerosol and Winds (CPEX-AW): Virtual and Field Campaigns

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Tropical convection is a key player in the global weather and climate. Observing and predicting convective initiation, growth, dissipation, and interactions with the environment over the tropical ocean remain a grand challenge. The science objectives of CPEX-AW are: 1) better understanding interactions of convective cloud systems and tropospheric winds as part of the joint NASA-ESA Aeolus Cal/Val - Joint Aeolus Tropical Atlantic Campaign (JATAC), 2) observing the vertical structure and variability of the marine boundary layer in relation to initiation and lifecycle of the convective cloud systems, convective processes (e.g., cold pools), and environmental conditions within and across the ITCZ, 3) investigating how the African easterly waves and dry air and dust associated with Sahara Air Layer control the convectively suppressed and active periods of the ITCZ, and 4) investigating interactions of wind, aerosol, clouds, and precipitation and effects on long range dust transport and air quality over the western Atlantic. The CPEX-AW science team and the NASA DC-8 aircraft were deployed to St. Croix, the US Virgin Islands, from 18 August–10 September 2021, to address the science objectives. DC-8 is equipped with the Doppler Aerosol Wind Lidar (DAWN), Airborne Precipitation and Cloud Radar 3rd Generation (APR-3), High Altitude Lidar Observatory (HALO) Water Vapor DIAL and HSRL, High Altitude Microwave Sounding Radiometer (HAMSR), and GPS dropsondes. This article provides a summary of CPEX-AW scientific discoveries with highlights from some key aspects: a unique virtual campaign during the COVID pandemic and outstanding airborne observations from the field campaign.

- More than 120 researchers including graduate students and postdocs participated in CPEX-AW in St. Croix, Puerto Rico, and remotely.
- We have flown seven research missions that collected unprecedented data from DAWN, HALO, APR-3, HAMSR, and dropsondes, in a wide arrange of conditions from strong dust outbreak events to tropical storms.
- Underflown six Aeolus overpasses for a total of 5,836 km, which provide valuable data sets for Aeolus Cal/Val and studies of impact on weather forecasting.
- Complex wind and convection in pre-Tropical Storm (TS) Ida and Ida over the Gulf of Mexico

before the major Hurricane Ida made landfall, long lasting TS Kate and its interaction with dust and dry air over the central Atlantic, and dry air intrusion in Hurricane Larry.
- Co-located boundary layer observations over saildrones that measure air-sea fluxes and ocean current data in collaboration with the NOAA field campaign.