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Airborne In-situ Measurements during JATAC/CAVA-AW 2021/2022 campaigns - First Climate-Relevant Results

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The JATAC campaign in September 2021 and September 2022 on and above Cape Verde Islands have resulted in a large dataset of in-situ and remote measurements. In addition to the calibration/validation of the ESA's Aeolus ALADIN during the campaign, the campaign also featured secondary scientific objectives related to climate change. The atmosphere above the Atlantic Ocean off the coast of West Africa is ideal for the study of the Saharan Aerosol layer (SAL), the long-range transport of dust, and the regional influence of SAL aerosols on the climate.

We have instrumented a light aircraft (Advantic WT-10) with instrumentation for the in-situ aerosol characterization. Ten flights were conducted over the Atlantic Ocean up to over 3000 m above sea level during two intense dust transport events. PollyXT, and EvE lidars were deployed at the Ocean Science Center, measuring the vertical optical properties of aerosols and were also used to plan the flights.

The particle light absorption coefficient was determined at three different wavelengths with Continuous Light Absorption Photometers (CLAP). They were calibrated with the dual wavelength photo-thermal interferometric measurement of the aerosol light-absorption coefficient in the laboratory. The particle size distributions above 0.3 μm diameter were measured with two Grimm 11-D Optical Particle Size Spectrometers (OPSS). These measurements were conducted separately for the fine aerosol fraction and the enriched coarse fraction using an isokinetic inlet and a pseudo-virtual impactor, respectively.

The aerosol light scattering and backscattering coefficients were measured with an Ecotech Aurora 4000 nephelometer. The instrument used a separate isokinetic inlet and was calibrated prior to

and its calibration validated after the campaign with CO_2. We have measured the total and diffuse solar irradiance with a DeltaT SPN1 pyranometer. CO_2 concentration, temperature, aircraft GPS position altitude, air and ground speed were also measured.

The in-situ single-scattering albedo Angstrom exponent and the lidar depolarization ratio will be compared as two independent parameters indicating the presence of Saharan dust. We will show differences between homogeneous Saharan dust layer in space (horizontally and vertically) and time and events featuring strong horizontal gradients in aerosol composition and concentration, and layering in the vertical direction. These layers often less than 100 m thick, separated by layers of air with no dust.

Complex mixtures of aerosols in the outflow of Saharan dust over the Atlantic Ocean in the tropics will be characterized. We will show the in-situ atmospheric heating/cooling rate and provide insight into the regional and local effects of this heating of the dust layers. These measurements will support of the research on evolution, dynamics, and predictability of tropical weather systems and provide input into and verification of the climate models.