

EGU2020-10956

<https://doi.org/10.5194/egusphere-egu2020-10956>

EGU General Assembly 2020

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## The NASA ORACLES airborne flight projects – lessons learned for future multi-platform missions to study aerosol-cloud-climate interactions

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Three deployments involving the NASA P-3 and ER-2 aircraft in the ORACLES (ObseRvations of Aerosols above CLouds and their intEractionS) project in September 2016, August 2017 and October 2018 were designed to study the seasonal interactions of biomass burning (BB) aerosols emanating from Southern Africa with the semi-permanent subtropical stratocumulus (Sc) cloud deck over the South-East (SE) Atlantic. We provide a science overview of all deployments, describing novel approaches for coordinating the NASA aircraft with each other, with the Bae-146 aircraft during flights near Ascension Island in 2017, and with satellite overpasses. Based on various examples, we describe the requirements for spatiotemporal coordination and the scientific benefits gleaned from successful synergy of datasets thus obtained. We provide the current status of integrative work that addresses the overarching science questions regarding aerosol-radiation-climate interactions in the region. We conclude by linking the suborbital observations with overarching observational efforts, in particular NASA's ACCP (Aerosols, Clouds, Convection, and Precipitation) Designated Observable study, which aims to define combinations of orbital and suborbital observing system concepts for addressing integrated aerosol-cloud-climate objectives as defined in the 2017 US Decadal Survey.

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