Aerosol-radiation-cloud interactions in the South-East Atlantic: future suborbital activities to address knowledge gaps in satellite and model assessments

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Southern Africa produces almost a third of the Earth's biomass burning (BB) aerosol particles. Particles lofted into the mid-troposphere are transported westward over the South-East (SE) Atlantic, home to one of the three permanent subtropical stratocumulus (Sc) cloud decks in the world. The SE Atlantic stratocumulus deck interacts with the dense layers of BB aerosols that initially overlay the cloud deck, but later subside and may mix into the clouds. These interactions include adjustments to aerosol-induced solar heating and microphysical effects, and their global representation in climate models remains one of the largest uncertainties in estimates of future climate. Hence, new observations over the SE Atlantic have significant implications for global climate change scenarios.

Our understanding of aerosol-cloud interactions in the SE Atlantic is hindered both by the lack of knowledge on aerosol and cloud properties, as well as the lack of knowledge about detailed physical processes involved. Most notably, we are missing knowledge on the absorptive and cloud nucleating properties of aerosols, including their vertical distribution relative to clouds, on the locations and degree of aerosol mixing into clouds, on the processes that govern cloud property adjustments, and on the importance of aerosol effects on clouds relative to co-varying synoptic scale meteorology.

We discuss the current knowledge of aerosol and cloud property distributions based on satellite observations and sparse suborbital sampling. Recent efforts to make full use of A-Train aerosol sensor synergies will be highlighted. We describe planned field campaigns in the region to address the existing knowledge gaps. Specifically, we describe the scientific objectives and implementation of the five synergistic, international research activities aimed at providing some of the key aerosol and cloud properties and a process-level understanding of aerosol-cloud interactions over the SE Atlantic: NASA's ORACLES, the UK Met Office's CLARIFY-2016, the DoE's LASIC, NSF's ONFIRE, and CNRS' AEROCLO-SA.