First Results from the Layered Atlantic Smoke Interactions with Clouds' (LASIC) AMF1 Deployment in the Remote Southeast Atlantic

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Motivation

Southern Africa emits one-third of the world's biomass burning aerosols (BBA), seasonally transported westward over the least examined of the large planetary subtropical stratocumulus decks. Satellite datasets cannot characterize the aerosol-cloud vertical structure with confidence. The aerosol direct radiative effect is still poorly known, as are the processes by which the clouds adjust to the presence of the smoke. Most surface-based insitu and remote sensing LASIC aerosol and cloud measurements on Ascension Island (8S, 14W, halfway between Africa and south America) began June 1, 2016, providing an unprecedented characterization of a BBA aerosol seasons. Instrument health has been good.

Guiding questions include:

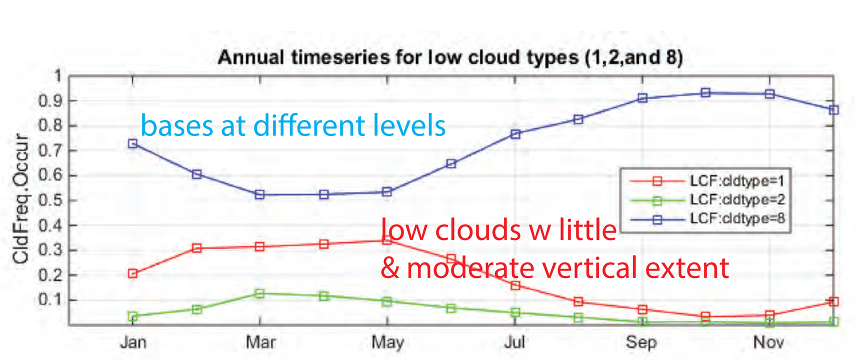
• Does BBA reach the surface? This is not only crucial for surface-based aerosol characterization, but also for understanding the low cloud response.

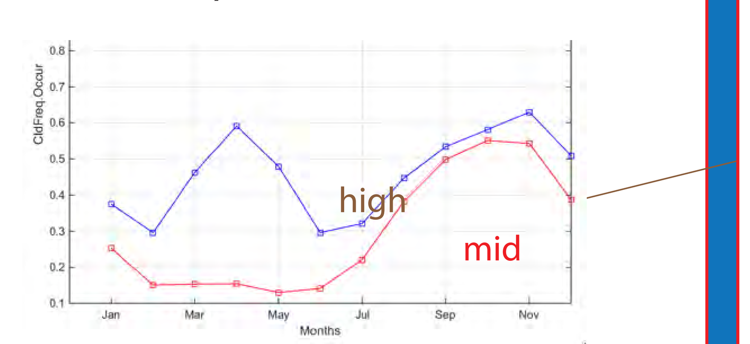
• If so, how does the single-scattering albedo (SSA) of the BBA evolve over the BBA season? This is important for the direct radiative effect and for the atmospheric radiative heating rate profiles.

• How do the low cloud properties change when BBA is present, either in the free troposphere or within the boundary layer or both?

Surface cloud observations provide clues

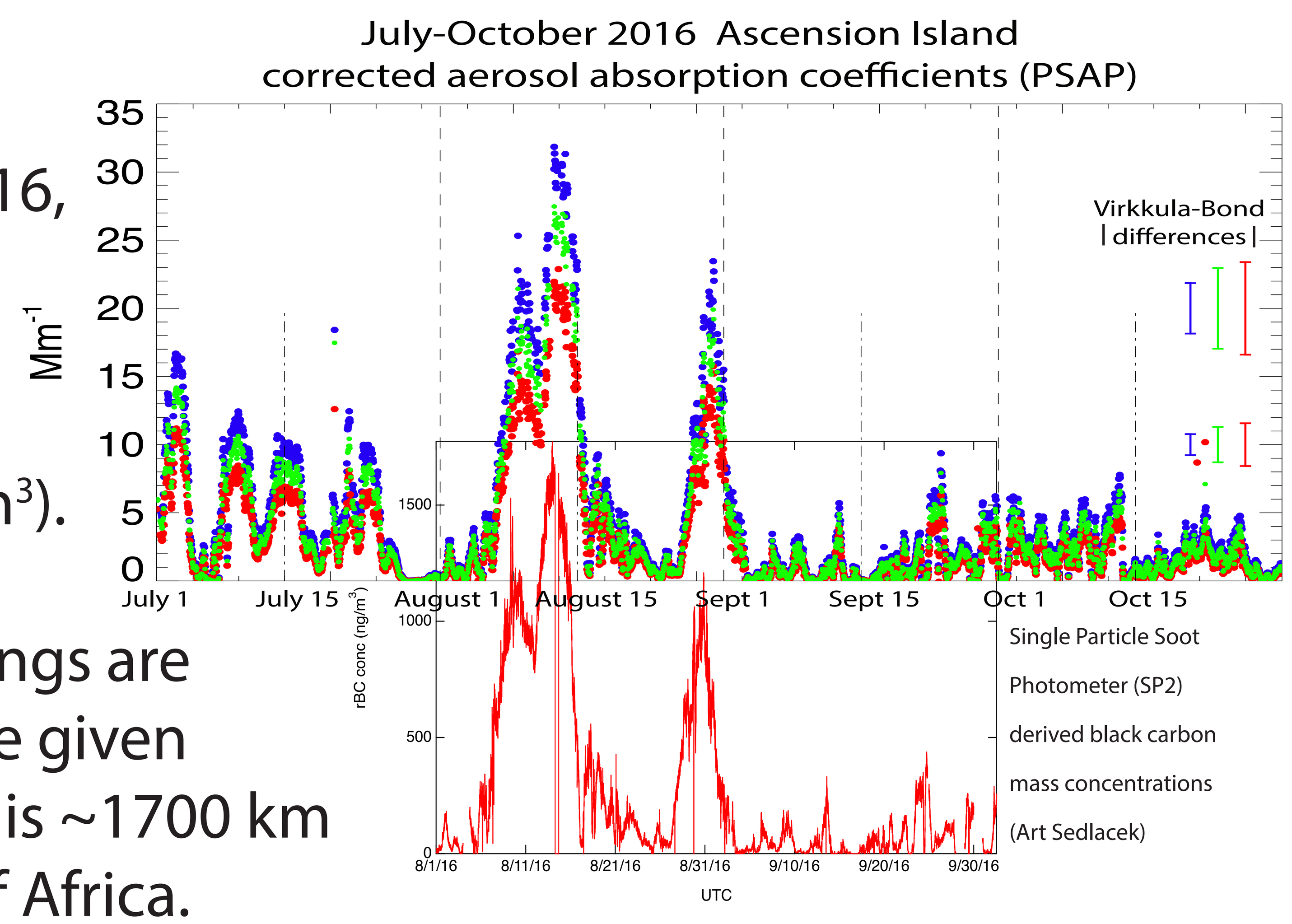
two-layer low cloud structure more prevalent in BBA months when inversion is stronger (IGRA radiosondes not shown)





Does biomass-burning aerosol reach the surface? *YES*

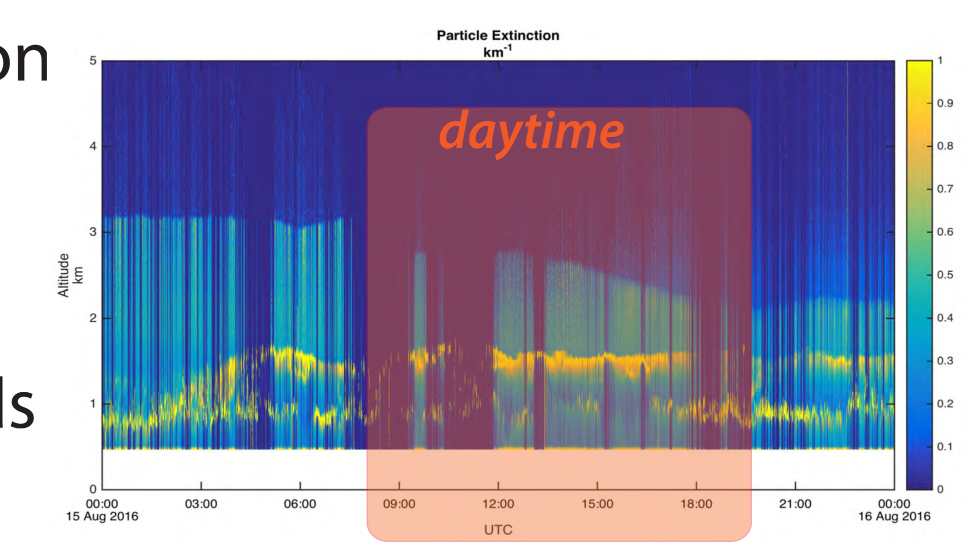
some absorbing aerosol almost always reached the surface between July 1 - Oct 30, 2016, in at times significant amounts (>1.5 µg/m³).



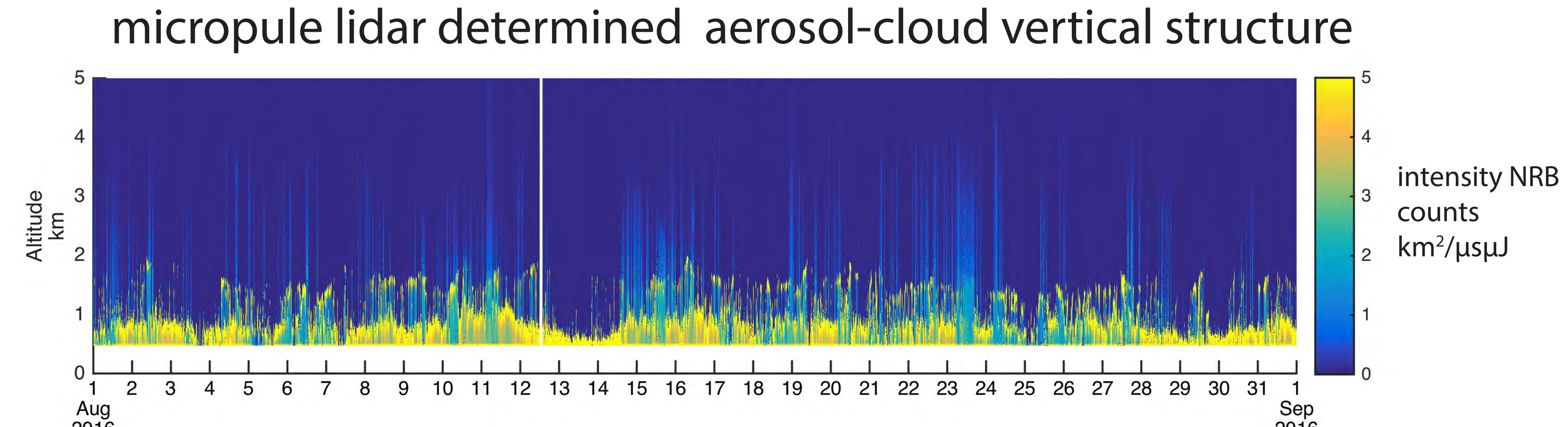
High loadings are remarkable given Ascension is ~1700 km offshore of Africa.

How do the low clouds respond to the presence of BBA? *WE DON'T YET KNOW*

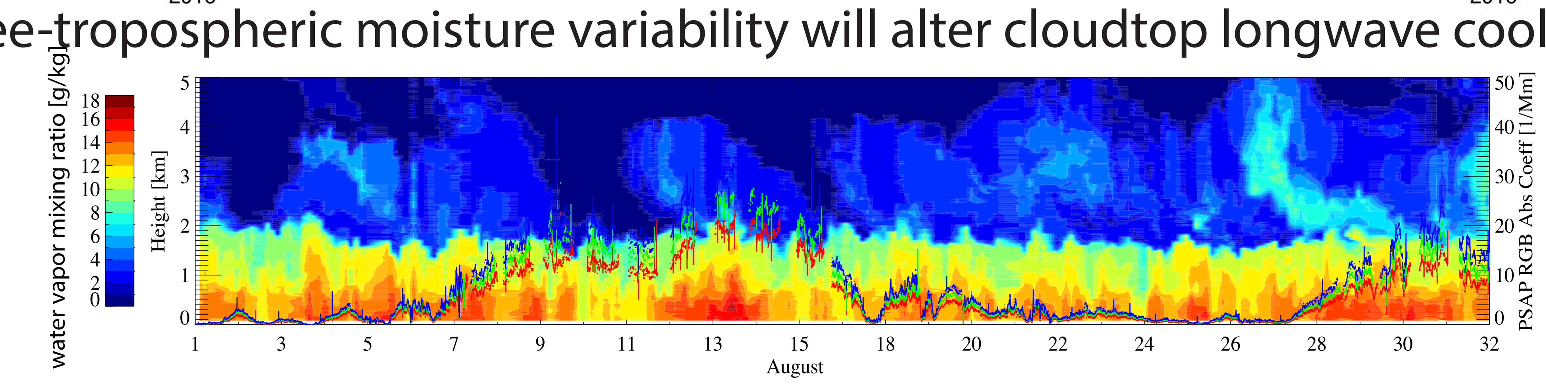
Does daytime solar absorption strengthen inversion and upper cloud layer, while increased boundary layer temperatures dissipate clouds at lifting condensation level?



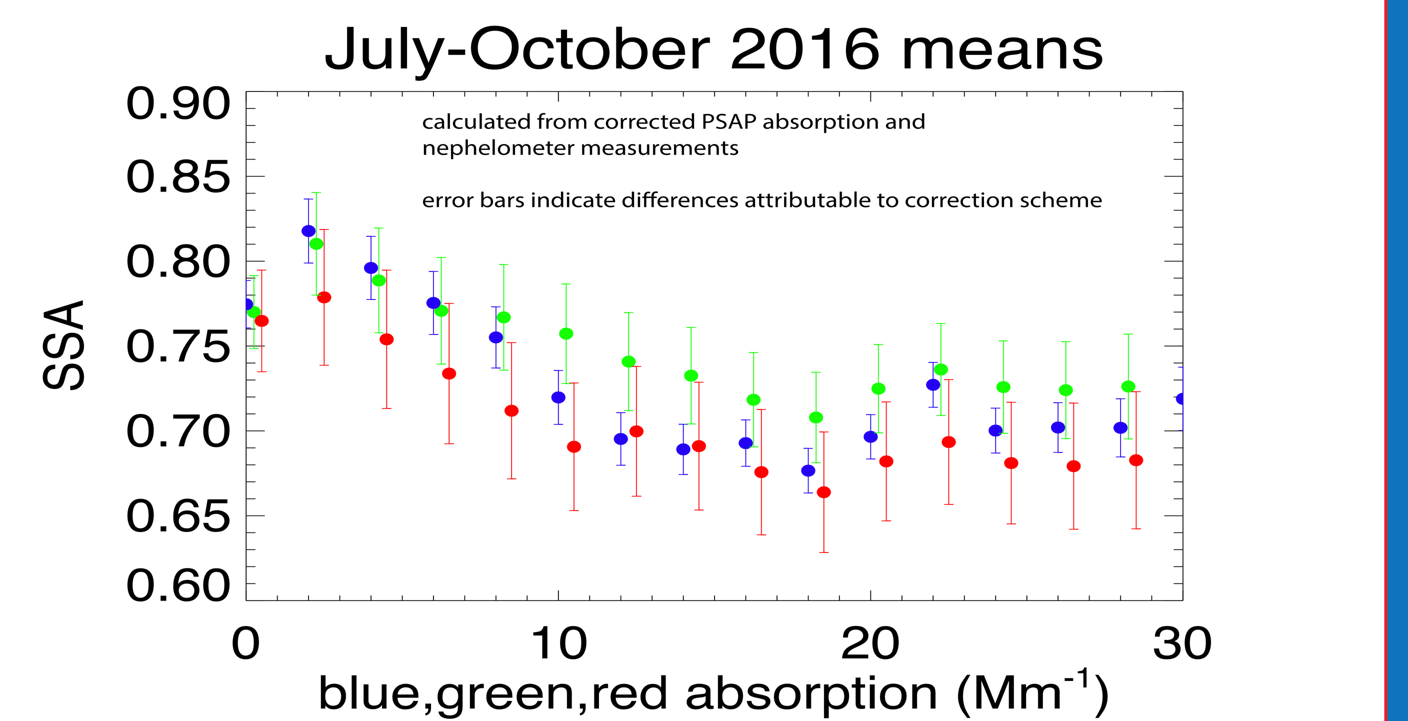
micropule lidar determined aerosol-cloud vertical structure



free-tropospheric moisture variability will alter cloudtop longwave cooling rates



How much sunlight does the BBA absorb? *A LOT*



Estimated SSA values span 0.70-0.75 at high aerosol loadings differing by > 0.5 depending on correction scheme. The absorbing angstrom exponent is ~ 1.3 for much of July-Oct (not shown). These values indicate more absorption and a higher black carbon fraction than documented for US wildfires (Liu, Aiken et al., 2014,GRL). **Why??**

Complementary aircraft deployments characterize local in-situ vertical structure

NASA EVS-2 ORACLES 2016, 2017 P-3 & ER-2 aircraft PI J. Redemann, Deputy PI R. Wood deploys from Namibia. UK CLARIFY 2017 FAAM BAe-146 aircraft. PI J. Haywood, will deploy from Ascension Aug-Sept 2017

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Complementary campaigns discussed in Zuidema, P,, J. Redemann, J. Haywood, R. Wood, S. Piketh, M. Hipondoka, and P. Formenti, 2016:Smoke and clouds above the southeast Atlantic: Upcoming field campaigns probe absorbing aerosol's impact on climate. Bull. Am. Meteor. Soc., 97, doi:10.1175/bams-d-15-00082.1 For further background see Adebiyi A. and P. Zuidema, 2016: The role of the southern African easterly jet in modifying the southeast Atlantic aerosol and cloud environments. Q. J. R. Meteorol. Soc., DOI: 10.1002/qj.2765 and referenes therein.