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Aircraft Observations into the Characteristics of Biomass Burning Instigated 'Regional Haze' Over the Amazon during the SAMBBA Campaign

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Aerosols associated with large scale Biomass Burning (BB) impact upon weather and climate at global and regional scales. However, quantitative evaluation of these effects is impeded by i) a limited understanding of BB processes and ii) a lack of quantitative knowledge of precise BB aerosol physiochemical characteristics, thus resulting in large model uncertainties.

One region where these uncertainties are especially manifest is the Amazon Basin (AzB). Intense and widespread burning results in high atmospheric loadings of BB aerosol, which over the course of the dry season develops into a so-called 'regional haze'. This cloaks the AzB in a complex and inhomogeneous mix of BB emissions, characterized by large Aerosol Optical Depths (>1), low visibility and poor air quality. This haze has a substantial impact on the radiation budget over the AzB through direct scattering/absorption and indirect cloud microphysics effects.

In order to best constrain the model uncertainties, and given the scale of the AzB earth-atmosphere system, an intensive observation campaign by multiple international institutions was instigated in the South American Biomass Burning Analyses (SAMBBA) project. The findings reported here are from the SAMBBA aircraft campaign, conducted during the 2012 dry season using the large UK research aircraft (FAAM BAe-146).

The dense (high AOD), persistent haze expected throughout the campaign was only present for the first five or so days, due to removal via washout/transportation associated with large storms. For the remaining period, a haze was present but much reduced in area and intensity (mostly AOD's <0.6) and far more localized and spatially heterogeneous. Across the three weeks, multiple burns with differing characteristics, origins and processes were sampled, giving rise to haze from various sources, such as rainforest in Rhondonia and Cerrado agricultural fires in Mato Grosso. Thus, the ten (of twenty) SAMMBA flights that encountered haze, sampled from a diversity of haze types.

The haze was sampled using the standard instrumentation suite available onboard FAAM, a C-ToF-AMS (Compact Time-of-flight Aerosol Mass Spectrometer) and a SP2 (Single Particle Soot Photometer), thereby allowing a detailed physiochemical analysis: results from the AMS yielded size resolved chemical composition of organic and inorganic (e.g. nitrate, sulphate) components, whilst the SP2 yielded size resolved black carbon mass on a single particle basis. SAMBBA also represented the first utilization of the C-ToF-AMS in sampling BB in Amazonia.

This data allows the preliminary presentation of the chemical and physical characteristics of regional haze during SAMBBA including the structure, in terms of vertical profiles and spatial distribution, and composition, in terms of mass loadings, size distributions, number concentrations and chemical processing. For instance, vertical profiles displayed significant structures, with layering from differing sources; typically a local shallow boundary layer would be covered by the extensive regional haze and above this, in the free troposphere, multiple detached layers were observed.

This work complements the other, exhaustive, work of SAMBBA participants, helping to provide the most detailed characterization of Amazonian BB to date, aiding understanding of weather, climate and, more tangibly

in an expanding Brazil, air quality issues.