

Supplementary Material

Characterising Brazilian biomass burning emissions using WRF-Chem with MOSAIC sectional aerosol.

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This document describes the supplementary material online available for the above paper, and includes further figures to support the analysis presented in the paper. For further information, please contact the authors.

S1. 3bem_emissions.f90

The 3BEM emissions code within PREP-CHEM-SRC v1.4 has been modified for this study to include estimates of active fire size and burned area from the 2012 fire season, prepared by Gabriel Periera. Please see the included 3bem_emissions.f90 file. To use, copy into the src/ directory of PREP-CHEM-SRC and recompile. Changes to code have been highlighted by comments by SAN.

The key change is the addition of the subroutine `get_fire_area_for_veg`, between lines 1706-1793. This sets the burned area and active fire size for all detected fires with missing fire area information. Fire size and burned area are each treated as separate variables, where burned area controls the emitted species mass while fire size is sent to the plume-rise parameterisation, to control injection height of emissions.

Values of burned area and fire size can be replaced in lines 1727-1752 to be suitable for other regions and studies.

S2. SAMBBA_WRFCHEM_CO_sept2012.mp4

This video shows a 3D visualization mixing ratios of carbon monoxide (CO) in ppmv over the campaign period, from 14 to 30 September 2012. Mixing ratios below 0.12ppmv are transparent. Fire emissions can be observed being emitted during the local afternoon at elevated heights. These are transported by advection and convection through the domain. The WRF-Chem model data is taken from the modified emissions scenario. Visualisations were generated using the Visualization and Analysis Platform for Ocean, Atmosphere and Solar Researches (VAPOR) <http://www.vapor.ucar.edu/>.

S3. SkewT_all.zip

This directory contains Skew-T plots from every dropsonde carried out during the SAMBBA flight campaign, compared with WRF-Chem model data extracted along the same vertical column and interpolated to the same time. Plots were generated using the skewT_PlotData function within the NCAR Command Language (NCL) <https://www.ncl.ucar.edu/Applications/skewt.shtml>.

S4. Addition model-measurement comparison figures

Due to limitations in length of paper and limited data coverage, some useful plots have not been included within the main document. These can be seen as extensions to figure 9 within the main paper, and have been included here for completeness.

This first set of figures compares vertical profiles of BC from the two model emissions scenarios with flight measurements, as done for CO, POM and b_{scat} within the main manuscript. These were not included in the main paper due to limited availability of BC measurements from the SP2 in flight B731.

The remaining figure comprise box-whisker plots, akin to those shown in Figures 9 and 10 in the main manuscript, which were not included in the main text due to limited data coverage or because the results were not considered significant for the main conclusions of the text.

S4.1 Vertical profiles of BC

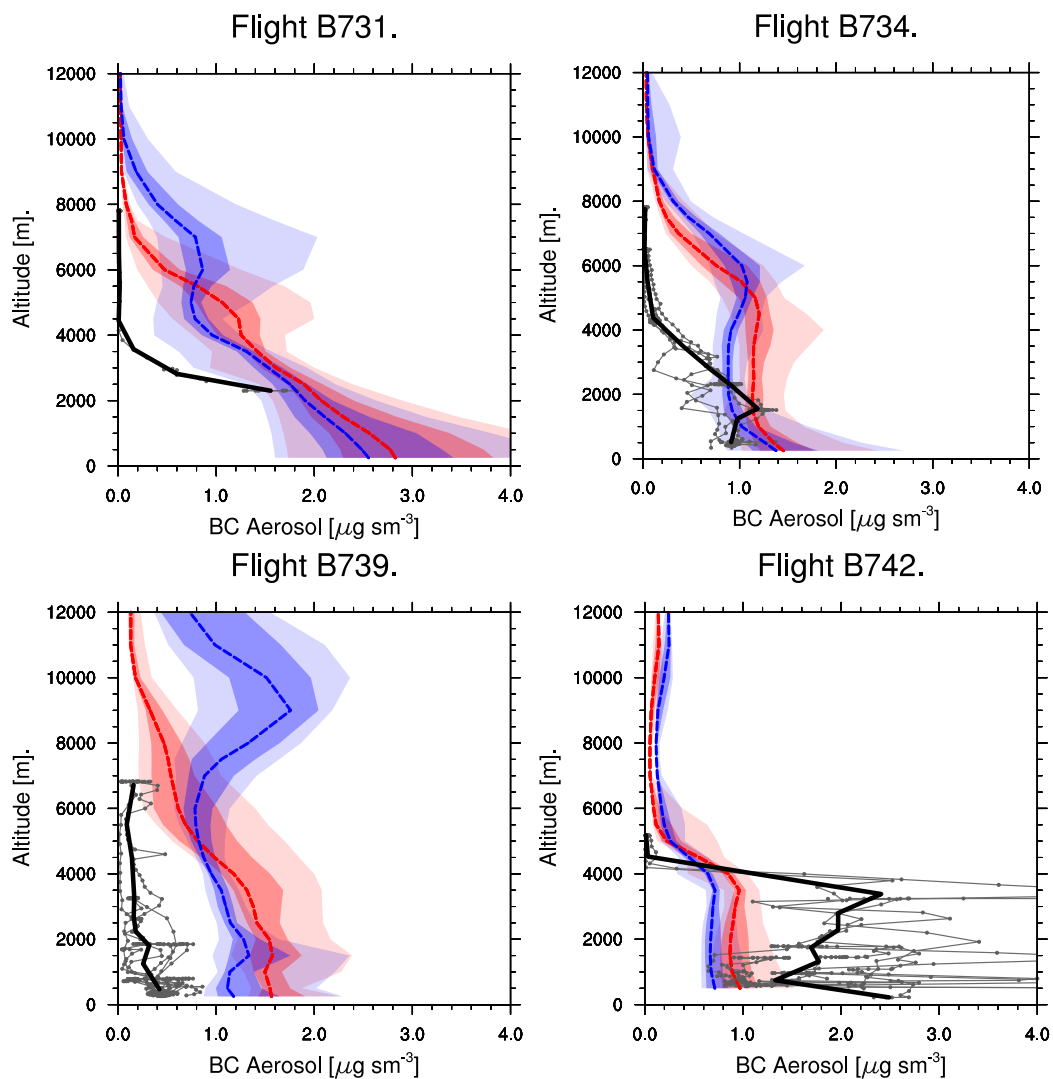


Figure 1. Vertical profile of Black Carbon (BC), showing WRF-Chem model results with modified emissions in red, and standard emissions in blue. Dark shaded regions show interquartile range and faded regions the 5th-95th range. Black line shows model median line from flight profiles, with faded grey lines actual model results averaged over every 3 minutes.

4.2 Box-whisker plots of POM for flights B734, B739 and B742

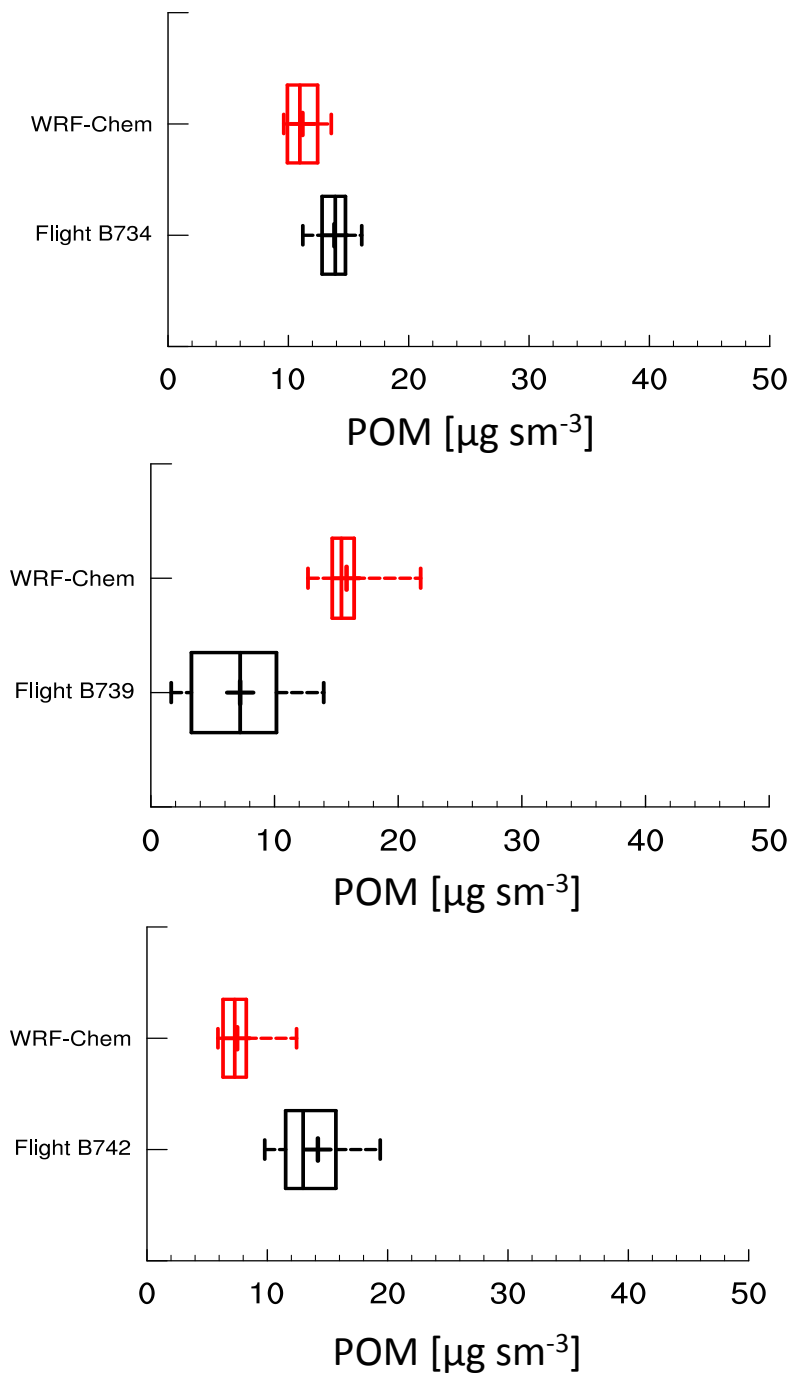


Figure 2. Box-whisker plots for particulate organic matter (POM) for flights B734, B739 and B742. Data for straight-level runs below 3.25km a.s.l.

4.3 Box-Whisker plots for flight B731

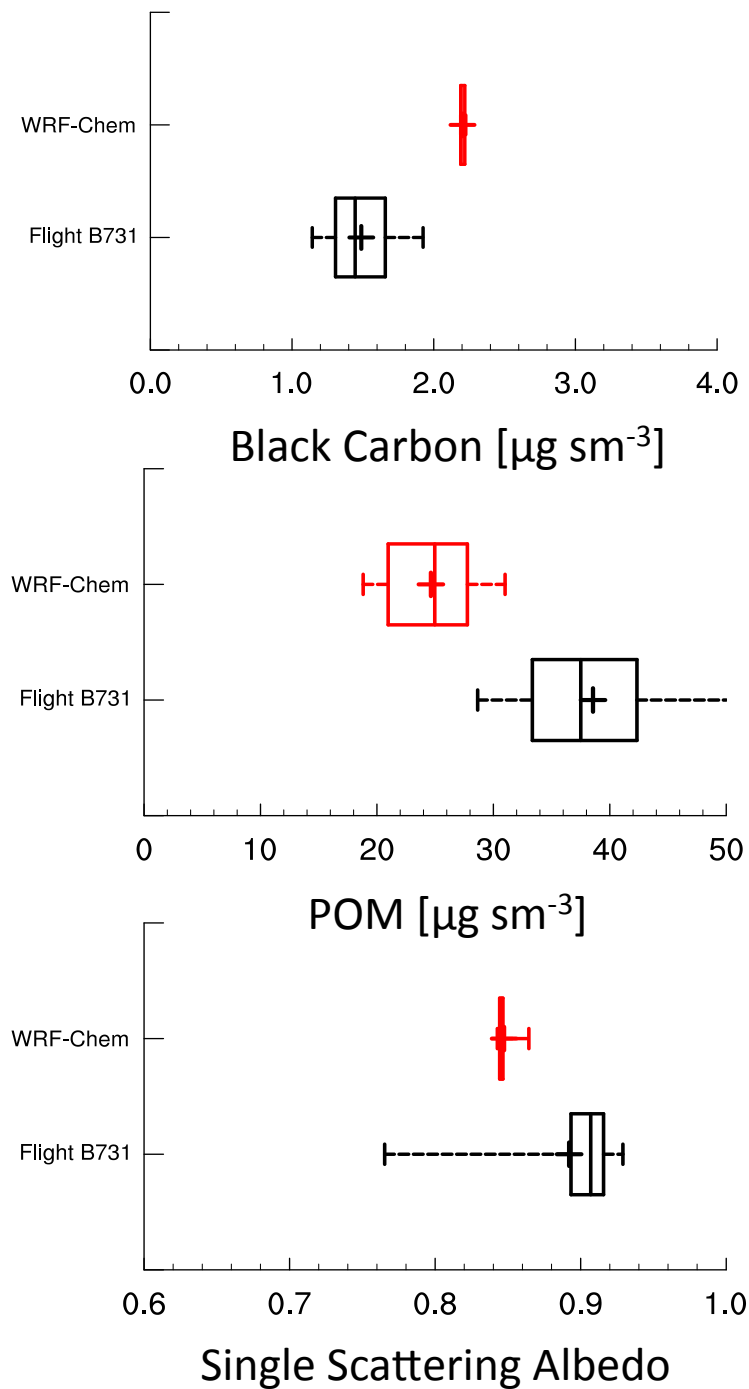


Figure 3. Box whisker plots for POM, BC and single scattering albedo for flight B731. Data for straight-level runs below 3.25km a.s.l. Not included in main paper because of limited coverage of BC measurements, with little crossover between POM and BC measurements, compromised calculation of POM:BC ratio.

4.3 CCN in flight B731

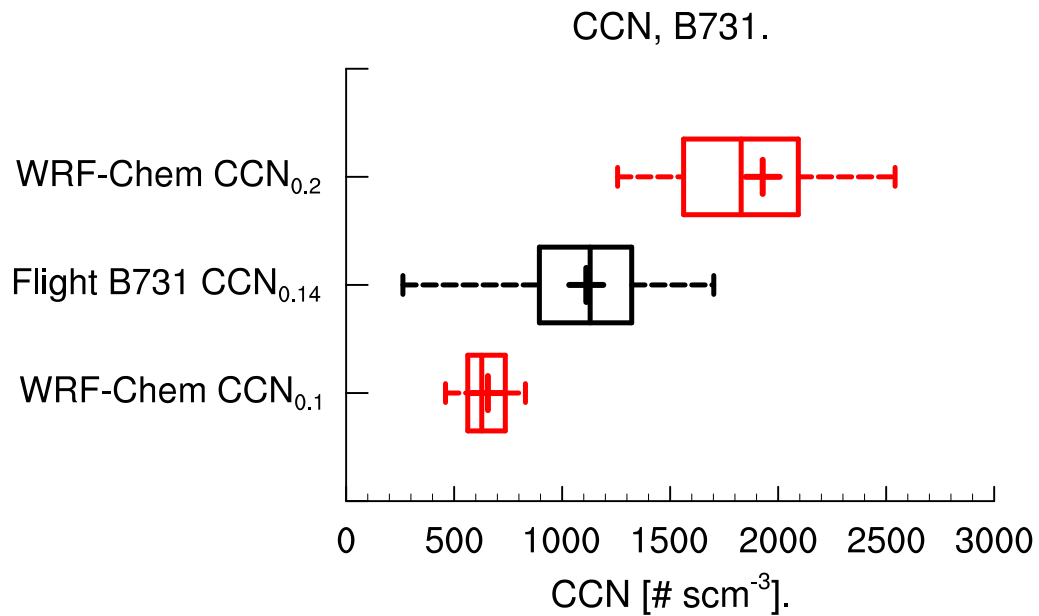


Figure 4. CCN concentration (scm^{-3}) with boundary layer (straight and level runs below 3.25km a.s.l), comparing data from flight B731 with model results. Shows good agreement between model and measurement. Note significantly higher CCN concentrations in model and measurements compared to flights B734 and B742 presented in main paper, reflecting higher aerosol loadings during this period. Not included in paper due to limited SMPS data over the same flight, making size distribution comparison difficult.