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Modelling of the Effect of Biomass Burning Aerosol in South America

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Modelling of biomass burning aerosol over S. America was undertaken using the HADGEM3 model in order to investigate the impact of absorbing aerosols on climate, particularly in the S. American region, as part of the SAMBBA project. The model was run for a 30 year period with a resolution of N96 (1.25 x 1.875 degrees) and 85 vertical levels, using a bulk aerosol scheme (CLASSIC).

In order to examine the impacts of biomass burning aerosol on radiative fluxes and climate, we performed two 30-year climate model runs with high and low emissions over South America (based on the years 2010 and 2000 respectively). Emissions outside of S. America are taken as the 1997-2000 mean for both runs. The emissions are taken from GFED 3.1, and scaled by a factor of 2 in the model. Other aerosol emissions, sea-surface temperatures and sea-ice are based on monthly climatological means.

The results for September (the month of greatest emissions) show a reduction in the clear-sky surface SW radiation of 11.5 Wm^{-2} for the high emissions case over the area of the highest AOD compared to the low emissions case, with a corresponding reduction in the surface temperature of the order of 1 K and surface sensible heat flux of 4.3 Wm^{-2}; the differences in the latent heat flux are less clearly correlated with the differences in the AOD spatially, with a smaller reduction of 1.8 Wm^{-2}in the biomass burning area.

The total cloud fraction also shows a reduction for the high emissions case, as expected from cloud 'burn-off' due to the semi-direct effect, with the greatest effect on the cloud layer in and just above the aerosol. We also see changes to the low-level (850mb) circulation, with a strengthening of the low-level jet to the east of the Andes, together with changes in the positioning of the S. Atlantic high pressure system.

The results show the predicted effects on the radiation budgets and the semi-direct effect on the cloud cover; we are continuing to study the detailed effects on cloud cover at different heights, and effects on the general climate for changes in the biomass burning aerosol burden for S. America.

This modelling work was undertaken as part of the SAMBBA project, which was a consortium of several UK and Brazilian universities, and included field measurements, aircraft observations and climate modelling.