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Impacts of Biomass burning aerosol-radiation interactions on the Amazon rainforest productivity

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Diffuse light conditions can increase the photosynthesis efficiency and carbon uptake by vegetation canopies. The diffuse fraction of photosynthetically active radiation (PAR) can be affected by either cloudiness or changes in the atmospheric aerosol burden. During the dry season, a hotspot of Biomass Burning (BB) on the edges of the Amazon rainforest emits a complex cocktail of aerosols/aerosol precursors and gases (CO_2, O_3, NO_x ...). This creates potential for very large interactions between chemistry, aerosol, cloud, radiation and the biosphere in the Amazon region. The combined effects of biomass burning on the terrestrial carbon cycle are poorly known yet the overall effect needs to be understood. Here, we use the Met Office Hadley Centre Earth System Model HadGEM2 which provides a fully coupled framework with fully interactive aerosol, radiative transfer, dynamic vegetation, atmospheric chemistry and biogenic volatile organic compound emission components. The present work focuses on the impacts of present day biomass burning aerosol emissions upon photosynthesis rate and net primary productivity (NPP) of the Amazon rainforest. We evaluate that the overall net impact of biomass burning aerosols on NPP is an increase of +103 to +124 TgC/a over the central amazon basin. This results from competing effects, namely an increase in diffuse light that stimulates photosynthetic activity of non-light-saturated shaded leaves (+65 to +110 TgC/a), a reduction in the total amount of PAR (-52 to -105 TgC/a) and climate feedbacks dominated to the first order by the reduction in surface air temperature that controls the rate of photosynthetic processes (+90 to +118 TgC/a).