

Interactive comment on “Large simulated radiative effects of smoke in the south-east Atlantic” by Hamish Gordon et al.

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Overall

This well written study of the impacts of biomass-burning aerosol (BBA) on low-level clouds over the SE Atlantic covers a lot of ground without over reaching. The simulations are clearly described, the analysis solid, and results fairly put in the context of previous studies. It is publishable after addressing a few minor points detailed below, in order of appearance.

Specific comments

1. Page 5: if winds are being nudged, would that not diminish any dynamic response of large-scale vertical motion to a heating perturbation?

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2. Surprising that changing σ_w from eqn. 1 to just fixing it at 0.12 m/s would have much of an effect in increasing CDNC, given that eqn. 1 already includes a floor of 0.10 m/s. Also, why not just increase the floor to 0.12 m/s in the original expression?
3. The κ value for sulphate seems quite large. Typical values for ammonium bisulphate are more like 0.6, maybe 0.7 at the extreme (cf. Petters and Kreidenweiss 2007). Using a value of effectively unity seems worth an explanation.
4. What is basis for fraction of each grid box that is raining being 0.3 on the 65 km mesh?
5. Interquartile range is a scalar, and what is shaded in fig. 3 is the inner half of the distribution.
6. Might point out in the last paragraph of section 6.1 that while the moisture aloft is indeed associated with BBA aloft over the region, they are associated with a common factor, namely outflow from the deep continental boundary layer, and surely the moisture would be there even in the absence of aerosol sources.
7. The generally good agreement between aerosol index AI and aerosol optical depth AOD described in the first full paragraph of page 19 does not get so much support from fig. 8, which instead shows that 2 of the 5 so-called clean days have quite large values of AI but not AOD. Not sure I'd characterize the relationship as generally good and wonder how robustly they are correlated.
8. MODIS platforms pass overhead not far from local noon. Do the comparisons with model result in fig. 10 use the same, quite limited sampling of the diurnal cycle?
9. The positive LW semi-direct forcing is confusing, given that lower cloud tops for polluted clouds should emit more LW. Less emission from even warmer surface through more overcast deck, perhaps?
10. The entrainment rates discussed on page 33 seem higher than expected, with values of around 2 to 5 cm/s. Not hard to find literature reporting typical rates for

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nocturnal stratocumulus 5 if not 10 times smaller, even smaller during the day. Is mean entrainment rate computed from the mean of column-wise $d(z_i)/dt - w(z_i)$? The plausible simulation of PBL depth does not obviously square with the reported rates.

Typesetting issues

1. Line 6 of page 3 should use `\citet` instead of `\citep`.
2. Year for Gunnar et al. citation is missing on line 12 of page 6.
6. The citation D. Holdridge...2016a appears in multiple places but is missing from the references.

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