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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol-induced changes in summer rainfall and circulation in the Australasian region: a study using single-forcing climate simulations" *by* L. D. Rotstayn et al.

Anonymous Referee #2

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This paper discusses how anthropogenic aerosols may alter the Australian summer monsoon based on a set of coupled climate model simulations, and concludes that aerosols have contributed to the observed multi-decadal rainfall increase over north-western Australia (NWA). The authors present a host of analyses on the model-simulated circulation changes and reanalysis products, and offer a physical mechanism through which aerosol forcing may give rise to the anomalous cyclonic flow off the coast of NWA, which plays a central role in enhancing the regional rainfall. I, however, find that explanation unconvincing (see below). Also, the model's aerosol/cloud-related schemes are described in almost painstaking detail, which makes the paper too long. In light of the primary focus on circulation changes, I do not think that this level of detail

is necessary for interpreting the results. Thus, major revisions are needed before the paper is suitable for publication.

Specific comments:

Abstract L10-17 and Section 4.4: The argument that the anomalous cyclonic circulation is initiated by the aerosol-induced rainfall increase south of the equator is problematic. The DJFM rainfall and circulation changes in response to aerosols and greenhouse gases (GHG) (Figs. 9 and 16) closely mirror each other. This suggests that the simulated responses are driven mainly by model feedbacks, as opposed to the spatial structure of a particular forcing. In this sense, the true explanation cannot be aerosol-specific.

P5110 L6-8: Why is the hydrological sensitivity of aerosols larger than of GHG? See P5127 of Ming and Ramaswamy (2011) for an explanation.

P5119 and 5120: The term A is the sum of sulfate, sea salt and hydrophilic OC. This implies that the different aerosol species have the same CCN efficiency, which is not the case. In particular, OC is much less soluble than inorganic salts (sulfate and sea salt). Please justify this choice, or at least acknowledge the issue.

P5123 L11-21: Is there any upper limit on RH when calculating hygroscopic growth?

P5124 L24-26 and Fig. 2d: Statistical testing is need for RFP.

P5126 L7-11: Given the emphasis put on aerosols and the nonlinearity issue, it is logical to run the aerosol-only case. If the computer time is limited, one can drop the no_aerosol case. Please explain.

P5134 L16-L17: In response to aerosols alone, land cools more than oceans, regardless of precipitation changes. Increased rainfall merely contributes to the cooling.

P5136 L7-L27: The assertion that these mechanisms discussed in the literature hold for this particular set of model simulations is not supported.

P5318 L18: The right hand side of Eq. 2 can be thought of as a source of absolute vorticity by "stretching" an air column (see P16 of Ian James' Introduction to Circulating Atmospheres). The equation is based on the conservation of potential vorticity, not absolute vorticity.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 5107, 2012.