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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud and aerosol radiative effects as key players for anthropogenic changes in atmospheric dynamics over southernWest Africa" *by* Konrad Deetz et al.

Anonymous Referee #1

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Overview: The authors analyze six simulations of the COSMO-ART regional model with an outer domain of roughly 40 x 40 degrees centered around the Bight of Benin and an inner domain of roughly 10 x 15 degrees aligned along the Gold Coast of Southern West Africa. A main strength of the study is that the authors conduct an extensive analysis of the simulations to suss out patterns of response to aerosol conditions, and to draw some conclusions about some mechanisms and hypotheses about others. A main weakness of the study is that almost no comparisons to observations are made nor are the realism of assumed meteorological or surface or aerosol properties discussed, leaving the reader necessarily uncertain as to the degree to which the simulations are basically realistic, either in the baseline state or in the dynamic

range of aerosol conditions investigated. Especially in today's satellite age, it should not be considered a sufficient evaluation of a regional model simulation to compare results only to droplet number concentration observations. Based on the simulations, the authors advance a schematic diagram of how near-coastal meteorological conditions could be impacted by increasing regional pollution during the monsoonal period when no land-sea breeze period occurs. Observational work, for instance using satellite observations, would be required to confirm the robustness of the proposed mechanism and its strength for a given dynamic range of aerosol relative to other regional-scale drivers that are held fixed in the current study, such as sea surface temperature.

Major comments

1. In the introduction the authors refer twice to "convective-cloud invigoration mechanism," the first time apparently referring to cold clouds and the second time to warm clouds (page 2, line 32). Is this the same mechanism? Please clarify in the text to what degree the mechanism being referred to operates in simulations and under what conditions, versus established in observations and under what conditions.

2. The six simulations vary only aerosol mass and number concentrations, but how this is done is not described. The authors state that the mass and number are scaled by factors of 0.1, 0.25, 0.5, 1, 2 and 4. Since there is "aerosol-chemistry spin up" the only way I can understand this is if the values are scaled only when some process rates are calculated, but which process rates? Please clarify in the text.

3. Please report aerosol properties that correspond to the simulations somehow in Table 1 or similar format. Did the aircraft campaign for this special issue make any aerosol measurements at all that are relevant for comparison? Can the simulated aerosol conditions be compared somehow and somewhere to measurements? I consider it mandatory to indicate in the manuscript in quantitative terms (beyond a multiplicative factor) what is the dynamic range considered in this study in terms of basic measurable units such as CN, CCN, AOD, PM1, PM2.5 or the like.

4. Owing to the leading role of direct effect, simulated single-scattering albedo should be somehow quantitatively reported from simulated values and compared to measurements or other at a minimum reported simulations somewhere relevant in Africa.

5. The authors seem to focus on sensible heat flux without considering the role of soil moisture and latent heat flux (e.g., in the abstract and conceptual diagram). Is latent heat flux irrelevant at this location? Also at locations of previous studies? I have to assume that precipitation within the inner domain is negligible during the monsoon season and the surface starts out very dry, but that is not stated (please clarify in the text).

6. Please clarify in the text how soil moisture is initialized in the simulations, whether results are sensitive to how that is done.

7. Please report whether simulations are sensitive to other factors, including inner or outer domain locations or sizes, grid mesh resolution, and boundary layer turbulence or cloud schemes.

Minor corrections

1. page 2, line 19: "react" –> "are" or other fix

2. page 3, line 1: "dependent" –> "dependence" or other fix

3. recommend to divide section 5 text up from one long paragraph currently

4. recommend to guide the reader more graphically in following the transition from figure 2 (schematic diurnal cycle) to later figures (all in UTC), such as by indicating UTC time range on the panels of figure 2

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