Review of acp-2011-742, “Long-term simulations (2001–2006) of biomass burning and mineral dust optical properties over West Africa: comparisons with new satellite retrievals”, by Malavell et al.

GENERAL:

This paper presents 2001-2006 RegCM simulations of aerosol over North Africa and evaluate the simulated optical properties, including AOT, SSA, AE, and AAE with AERONET data at four sites and the MODIS Deep Blue, MISR, and OMI remote sensing data over the region. Although the comparisons of these parameters between three satellite retrieval are interesting and informative, the paper itself is pretty much showing that a lot of problems with RegCM without fixing the most basic one among them, and a lot of difference between satellite data without offering much of the insight of data quality, retrieval limitations, and the proper use of them. My major comments are listed below.

1. RegCM: The major problem with the model evaluation presented in this paper is that it seems the evaluation is at the “initial stage” that reveals several outstanding shortcomings of the model. Although no one should expect a perfect model, these major issues should be resolved before writing a manuscript. For example, it is very clear and has been acknowledged several times by the authors in the paper that the wavelength-dependence of mass extinction efficiency Kext is not “realistic” (at least for dust). If the Kext is wrong, can you convince the readers and yourself that the AOT calculated at those wavelengths (440, 500, 675 nm) are correct? There are many published wavelength-dependent Kext values in the literature, why not use the more realistic ones? In addition, the AAE does not look right either – there is no composition, seasonal, and regional differences in the AAE simulated by the model. Furthermore, there is no description on how the optical properties were obtained. Such initial model evaluation provides little scientific value to the community and is not appropriate for publications on ACP.

2. Model evaluation: The model evaluation needs to be a lot more quantitative than just saying subjective phrases such as “good agreement”, “well”, etc. There are many more AERONET sites in the study region; why pick just 4 of them? Also, the title says “long-term simulations…” but there is no presentations on interannual variability or any other values related to the “long-term” simulations.

3. Data: AERONET and satellite data has different accuracy for different products. For example, AOT and AE are directly measured in AERONET but SSA and AAOT are retrieved with much larger uncertainties; MISR AOT is far more accurate than SSA, which should be used under specific conditions; etc. All the products used in this paper and their associated uncertainties/limitations should be described. Currently, only AOT was presented in the data description sections (2.2 – 2.3).

SPECIFICS:

Page 28588, line 14: “comparable values…”. How comparable? Be quantitative.

Page 28588, line 20-21: I agree that the optical properties should be examined at multiple wavelengths, but I don't see the value from this paper – the authors let the spectral dependent optical properties be wrong without showing effort of improvements.

Page 28593, line 11-12: "in a similar wayto AEAOT we can define an AE for SSA)…". This is wrong. You cannot use equation (1) to derive AESSA at all. You should use AAOT and AOT to compute SSA at each wavelengths.

Page 28594, line 3-4: Why is 6.35 m2/g "consistent" with 5.8 m2/g? How is 5.8 "slightly differ: from 5.0?

Page 28593, line 8: How do those optical properties obtained? Need some description. How do they compare with the values in the literature?

Page 28597, line 5-6: Aerosol index is not a radiative property and is not retrieved but measured.

Page 28597, line 10-11: The statement of OMI near-UV algorithm sensitivity is wrong. While AI is less sensitive below 2 km, AOT and AAOT can be retrieved even if the aerosol is near the surface. The accuracy depends on the right prescription of the aerosol height in the retrieval. The loss of sensitivity to aerosol near the ground applies only to the AI, not AOT and AAOT.

Page 28598, line 4-5: What is the evidence of the problem in the upper layers? How can you tell if the problem is in the upper or lower layers?

Page 28599, line 3: How did you "assign" those values? Based on what?

Page 28599, line 5-6: If you knew the Kext values are not realistic, why not use more realistic values? This is puzzling.

Page 28599, line 24: Is the averaged AERONET/PHOTON SSA obtained by averaging the 4 sites? How about other AERONET sites in that region?

Page 28599-28600, SSA: You did not say much about RegCM SSA - are the wavelength dependence of Kabs realistic? If Kext is not realistic, would you expect realistic SSA at those wavelengths?

Page 28600, line 25 to page 28611, line 18: The discussion only limited for DJF. How about JJA? The differences in different panels are larger in JJA but there is no discussion about JJA.

Page 28601, line 21-22: "Kext of smoke aerosol in RegCM is higher…" How much higher? Can it explain the differences if the "literature" values of Kext were used?

Page 28601, line 22: "satellite underestimation" - Why do you think satellite underestimated the AOT? Is there any AERONET site in this region to confirm that satellite AOT is underestimated?

Page 28601, line 24: Max fire intensity does not always occur between 3-5 pm. Literature reported max time varies greatly.

Page 28602, line 28: Aerosol models used for aerosol retrieval over Africa are pretty accurate - dust and smoke are very obvious and seasonal. Other aerosol types are almost negligible in this region.

Page 28604, line 5-6: How can you be sure it is the optical properties, not the emission or mass concentrations, in the model? How inadequate it is - please provide some evidence and estimates!

Page 28604, line 22: The first obvious thing anyone would notice right away from Fig 2 is that the model is very different from all the satellite sensors.

Page 28606, line 25-26: Too strong emission should not affect SSA, because absorbing and non-absorbing components should be both too strong. SSA is an intensive property that does not change with the amount as far as the relative fractions stay the same.

Page 28607, line 13-14: “MISR…exhibits the lowerst values in Saharan” compared to what? To other satellites, or to other regions? How can one tell from the bar chart the MISR highlights the Bodele source?

Page 28607, line 14-15: “OMI AEAOT…does not display any regional contrast” – but OMI AE over Sahel is much higher than over Sahara!

Page 28607, line 17-23: Nothing in Figure 4 shows those regional features. Why not display a map to make these points? Are you expecting the readers to take your words for it?

Page 28608, line 6: What kind of error from surface reflectance? How does it cause summer AE being higher than winter? On the other hand, two out of three AERONET sites over land Table 2 also show higher AE in summer. How do you explain?

Page 28608, discussion of Figure 4: Why didn't you say a word about AEAAOT from RegCM? The value of <1 is way below all the satellites. This is like pure BC! Very unrealistic. Also, you showed SSA panel in Figure 4 but did not mention anything about this panel either. Should this panel show AEAOT instead of SSA?

Page 28609, first paragraph: Some physical explanation of Figure 5 is needed. What quantities AE and AAE represent? Should we expect a positive or negative correlation between AAE and AE? How does this relationship change with composition? Why not include the RegCM points in Figure 5?

Page 28609, second paragraph: The RegCM optical properties are not only unrealistic for Kext, but mostly likely Kabs as well. The RegCM AAE has no regional and no seasonal differences even though dust, BC, and OC should have quite different AAE values. It makes no point to use the model for anything related to aerosol optical or radiative properties. What is the direction you are going to take to make the RegCM useful other than a generic “improvement”?

Table 2: not legible. The fonts are way too small.