We thank the reviewers for their supportive and thoughtful comments. Our responses to the comments are provided below, with the reviewers' comments italicized.

Review 2:

The manuscript "Modeling investigation of light absorbing aerosols in the central Amazon during the wet season" focuses on the modelling tool GEOS-Chem to assess the variability and nature of aerosol particles in the Central Amazon (CA) during the wet season of 2014, with particular emphasis on the light absorbing aerosols (LAA). To evaluate and support the model results in respect to the main remote sources of aerosol particles found in CA during the wet season, i.e. Sahara (dust) and sub-Saharan biomass burning regions (smoke), the authors used observational data from ground-based (AERONET) and orbital (MODIS, CALIOP) remote sensing platforms. These data are also used to discuss and assess the model performance as regard to the transatlantic transport of aerosols (dust/smoke) toward CA during the analysed period (Jan-Apr 2014). Considering the modelling of LAA in CA, observational data used to evaluate model simulations and support the manuscript conclusions are measurements performed at the ATTO site of aerosol light absorption, mass concentrations of refractory Black carbon (rBC), total aerosol and coarse mode.

The manuscript is well written, the scientific goal is of significant relevance and consistently addressed. Therefore, I recommend its publication after minor revisions. Comments: I would suggest more caution regarding the spatial representativity of the conclusions derived combining model results with observations at ATTO. While conclusions in the context of the region defined in the manuscript title (i.e., Central Amazon) are ok, often in the manuscript the conclusions are provided interchanging Amazon basin (ex. Page 7, Line 01) and Central Amazon. Certainly, even during the wet season, other regions inside the Amazon basin, for example the southern/southwest portions, are likely to present aerosols properties characteristics distinct from those found in CA based on measurements at ATTO. As done for the North of Africa, it would be elucidative to see the evaluation of the model performance against AERONET and MODIS over north and northeast of South America as regard to the AOD time and spatial variability. Along with ATTO data, I think it would reinforce the model capability to simulate aerosol particles loading across Amazon basin and borders, in special given the role of regional open fire contribution to the aerosols in CA.

We are now more careful with the use of "Amazon Basin" and "Central Amazon" and use "**Amazon basin**" in most of the places in the text, including the title: "Modeling investigation of light absorbing aerosols in the **Amazon basin** during the wet season". We also added the following sentences at the end of the first paragraph of Section 5.3 to explain the model performance over northern South America: "**Due to the high cloud fraction in the wet season, there is little AERONET Level 2.0 data available for the model evaluation in the Amazon basin. On the other hand, we compared the distribution of simulated AOD averaged over Jan-Apr 2014 with MODIS AOD data. We find that the model is able to reproduce the observed spatial variation with an *r* of 0.76, but has a negative bias of -32%. The background and mean AOD is 0.033 and 0.082 in the model and 0.059 and 0.12 in MODIS data, respectively. Keep in mind that high cloud fractions in the Amazon basin in the wet season combined with coarse model resolution could also introduce significant sample bias in the comparison, which presents a challenge for the model evaluation**."

Since the manuscript analyses a specific wet season, conclusions must be carefully *contextualized. I would suggest caution when general conclusions are made (Ex. subtopic 4.1: the discussion concerning the main Saharan source area of the dust deposited in CA). In this context, the meteorological scenarios have to be taken in to account: was the 2014 wet season meteorological scenario consistent with climatological features? That may have important impact on the Saharan origin of dust deposited in CA. The role of meteorological processes on the resultant aerosol optical properties observed at ATTO and CA are barely discussed, in particular, precipitation (wet removal) and wind circulation fields.*

We rewrote the last paragraph of Section 4.1 and provide supporting material to discuss the effect of meteorological scenarios (including wind and precipitation fields) on the origin of dust deposited in the Amazon basin: "However, there is also intra-seasonal variability for the sources of dust arriving **over the Amazon basin. We find that the trans-Atlantic transport of Bodélé dust becomes the largest contributor over the Amazon Basin in January (see Fig. S1 in the supporting material). This difference is not introduced by the variation in dust emissions, as the relative contributions of the four dust source regions are quite similar in January (35%, 10%, 7.4%, and 19% for northwest Sahara, northeast Sahara, West Sahel, and Bodélé) compared with February-April. The bottom panel in Fig. S1 also shows more sensitivity of the Amazon basin to Bodélé emissions in January. A detailed analysis of the meteorological fields (wind fields and precipitation, see Fig. S2 in the supporting material) suggests that the difference is mainly due to the changes in precipitation fields, which removes more northwest Sahara and West Sahel dust but less northeast Sahara and Bodélé dust along the transport towards South America. We also analyzed the interannual variability in wind fields and precipitation for the year of 2013-2015 and find that the difference between 2014 and the average of 2013-2015 along the dust transport path (see Fig. S3) is relatively smaller than the intra-seasonal variability (Fig. S2).** This wide spatiotemporal variability in sources to some extent explains the divergence in the literature."

Page 05: Line 01: I would think better about the sentence "We use the region NSA to represent the Amazon Basin". Along Amazon basin, NSA include several other regions with characteristics, in many aspects, distinct from Amazon basin. Therefore, rigorously, I would not indicate NSA as representative of Amazon basin.

We deleted this sentence.

The aerosol loading distribution (as seen in AOD) nearby remote emission sources (Sahara and Sub-Saharan biomass burning region) predicted by the model presented significant differences when compared with MODIS. One can see that in the amount of dust/smoke leaving the west coast of Africa. I wonder how good is the MODIS retrieval compared with AERONET across Sahara and sub-Saharan region? Model seems to compare better with AERONET (Figure 2) than with MODIS. Nevertheless, there are two large AOD spots (in Serra Leoa and in Congo) in the model that appear in the MODIS field with much lower values. At least, the one in Serra Leoa seems to have important impact on the plume transported toward South America. This is not quite discussed in the manuscript.

We modified the text in Section 2.3 and also Fig.3 to discuss the comparison between MODIS and AERONET as well as the comparison between the model and MODIS over the outflow region: "The major underestimation in the model is over the Bodélé region, which may be due to insufficiently high resolution to represent the high wind speeds encountered between the mountain ranges in this relatively small region (Ridley et al., 2012). **However, the NMB is generally in the range of 20–50 % over the outflow region. The model also shows two large AOD spots (in Sierra Leone and Congo) with significant contribution from open fires (20–**

80 %), while MODIS only shows slight enhancement in AOD compared to the surrounding areas.

We also sampled the MODIS data at the four AERONET sites to check the consistence between the MODIS and AERONET AOD. The results are given in Fig. 3. The time series plot shows that the MODIS retrieval underestimates AOD at most sites with NMB of -12 % to -36 %, except at the Banizoumbou site, with NMB of 7 %. The negative bias in MODIS AOD in the outflow region (at the Ilorin site in particular) explains partly the large difference between the model and MODIS AOD discussed above."

The combination of the lack of emission in the Bodélé region with the overestimation of AOD downwind of Bodélé in the model is still not clear to me. In the manuscript it is suggested that the model tendency to overestimate AOD downwind of Bodélé is mainly driven by differences in the optical properties. How about the role of removal processes? Also one would wonder about the impact once the emission in Bodélé region is properly simulated.

As mentioned above, we added the comparison between MODIS and AERONET, and explained better in the text: "**The negative bias in MODIS AOD in the outflow region (at the Ilorin site in particular) explains partly the large difference between the model and MODIS AOD discussed above.**" We also modified the text in Section 4.1 to address the impact once the Bodélé emission is doubled: "Therefore, even with doubled emissions, Bodélé would not dominate dust over the Amazon **basin. The dust burden over most of the Amazon basin would be increased by less than 20%, except over eastern Brazil, where the burden would be increased by 20–50 %**."

Minor technical corrections: Page 06: It seems that references for MODIS and AERONET products have been missed.

fixed

Page 2, Line 02: Replace "...as strong absorber..." to "...as strong absorbers..."

done

Page 4, Line 03: Replace "...is calculated online..." to "...are calculated online..."

done

Page 4, Line 20: Replace "...OA..." to "...organic aerosol (OA)...". The term "OA" appears in the text before its definition, which is done afterward (Page 4, Line 29).

fixed

Page 4, Line 24: It seems that where is "...refractive index and the AAE at 550 nm..." it should be "...refractive index and the MAE at 550 nm..."

fixed

Page 7, Line 10: Replace "...February 2104..." to "...February 2014...".

done

Page 13, Line 14: "Figure 14 shows... . . .AAOD at 550 nm. . ." in the Figure 14 legend (Page 40) its mentioned ". . .AAOD at 500 nm. . .", which is correct?

We corrected the legend in Fig. 14 to "AAOD at **550** nm"

Page 36, Legend: Replace ". . .BC-CO analysis in Fig. 12. . ." to ". . .BC-CO analysis in Fig. 11. . .".

done

Page 41, Legend: The wavelengths correspondent to the calculated AAE?

We modified the legend to: "Model Absorption Ångström exponent (AAE) **based on AAOD at 400 nm and 550 nm** over the Amazon basin averaged over Jan-Apr 2014"

Special attention to the figures captions, some of them, to be fully understood, required text revision. They should be self-sufficient. I think there is need to improve the description provided by some captions (ex. From Figure 14).

We modified the figure captions to improve the description

Captions: It would help if the author identify the AERONET site used in Figure 3 in the map presented in Figure 2.

We added this sentence at the end of the caption: "**The purple dots are the AERONET sites used in Fig. 3.**"

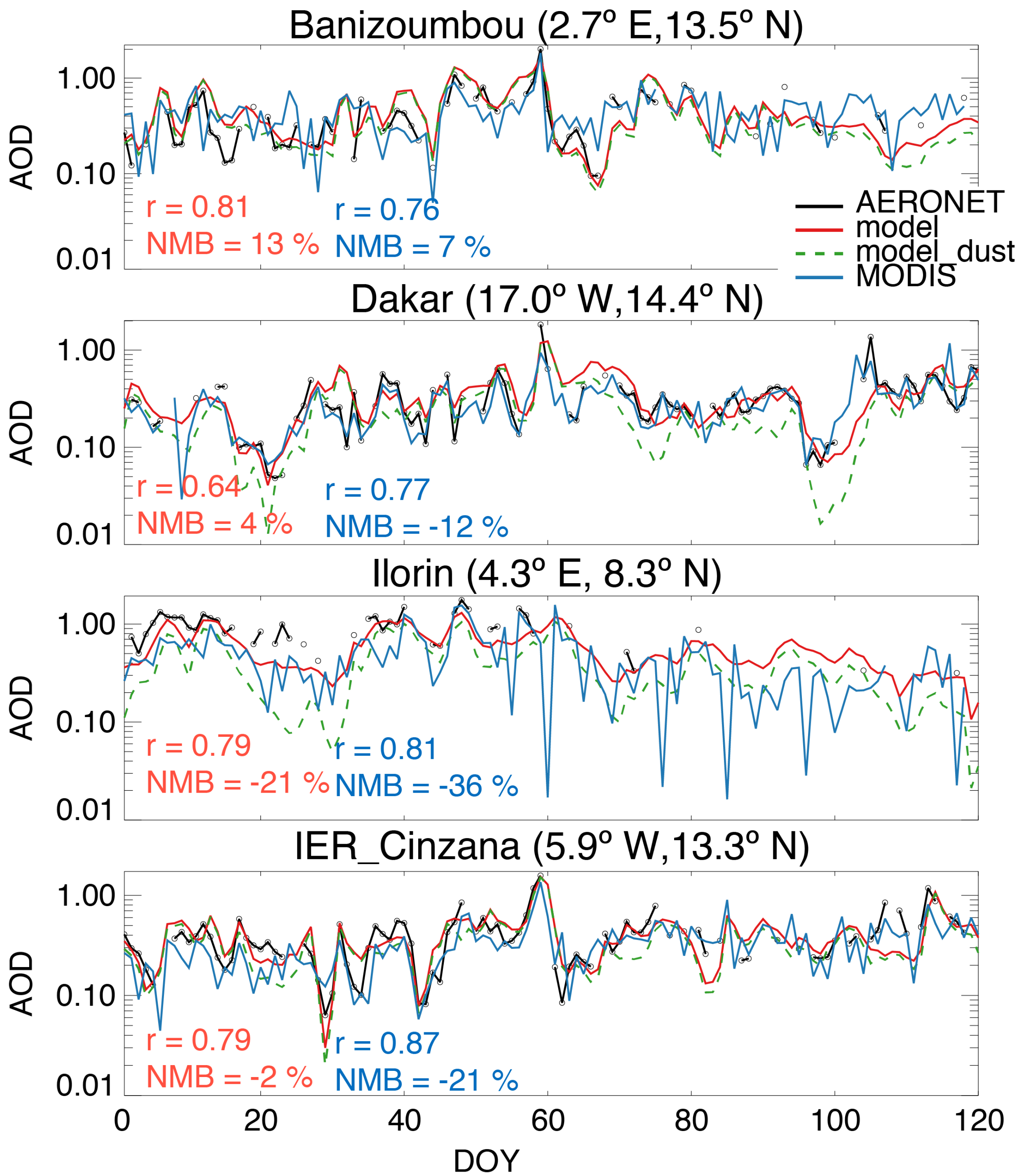

Figure 3: Time series of observed (black lines for AERONET and blue lines for MODIS)) and simulated (red lines) AOD at 550 nm during Jan-Apr 2014. Model results of dust AOD are also shown as green dashed lines. Normalized mean bias (NMB) and correlation (r) statistics between the model and AERONET (red) and between the MODIS and AERONET (blue) are shown as inset.

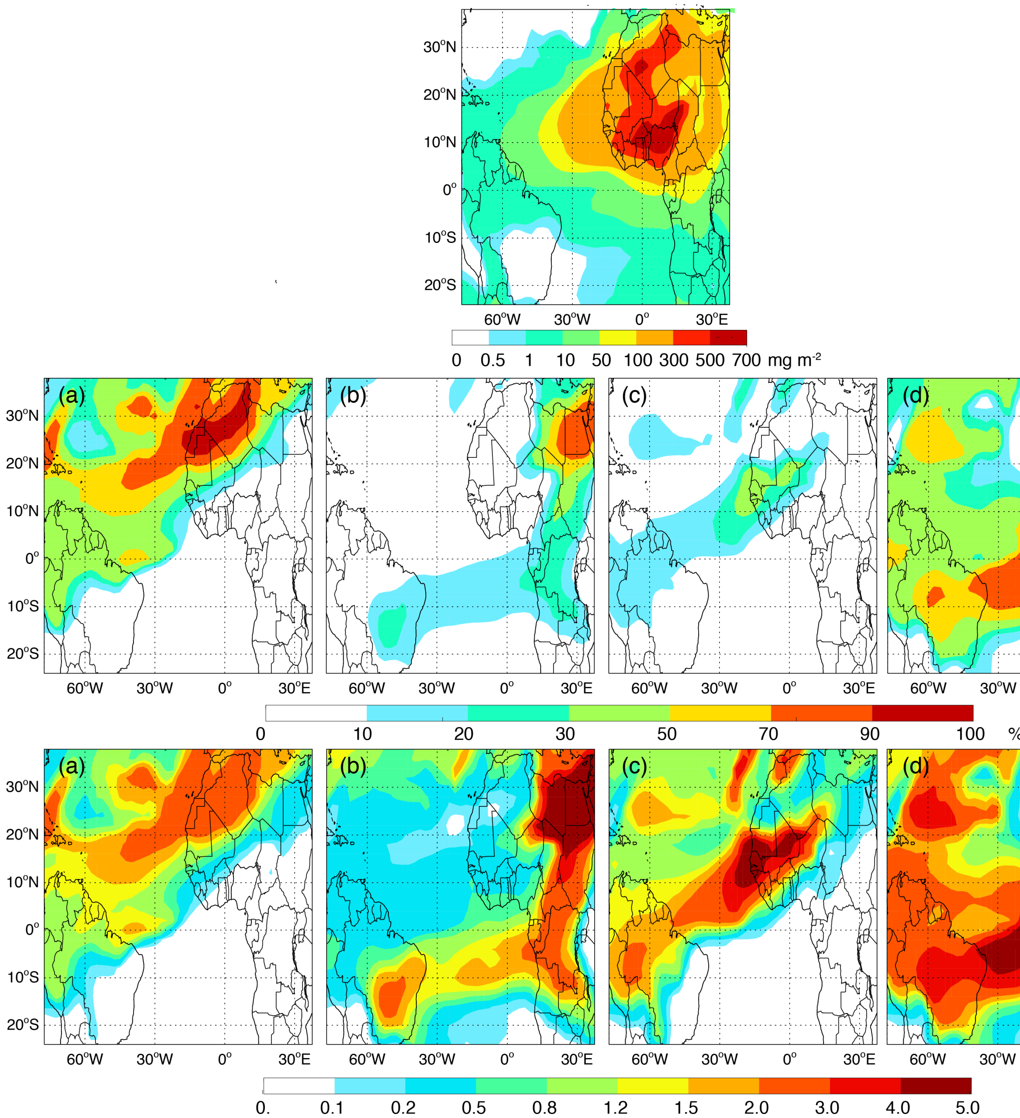

Figure S1: Column burden of total dust (top panel) and the contribution to total dust burden from four defined source regions (a: northwest Sahara; b: northeast Sahara; c: West Sahel; d: Bodélé) (middle panels) over the rectangle region between 80° W–40° E and 25° S–40° N in Jan 2014. The bottom panels are sensitivity of dust burden to the emission from four source regions with high value indicating high sensitivity (see text).

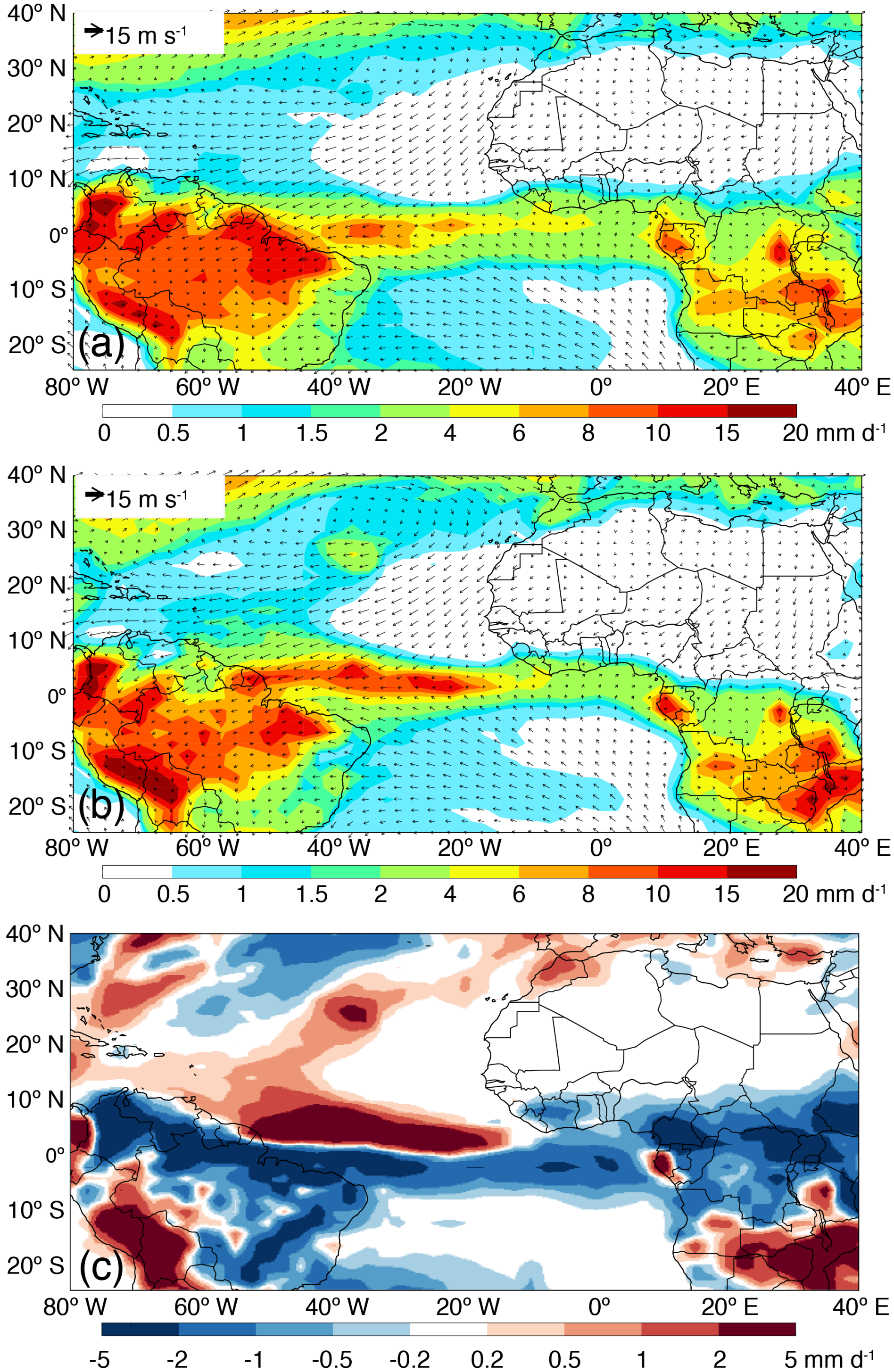

Fig S2. Precipitation (contours) in January-April (a) and January (b) for the year of 2014 over the rectangle region between 80° W–40° E and 25° S–40° N. Mean 0-1 km wind vectors are shown as arrows in both (a) and (b). The difference in precipitation between January and January-April is shown in (c).

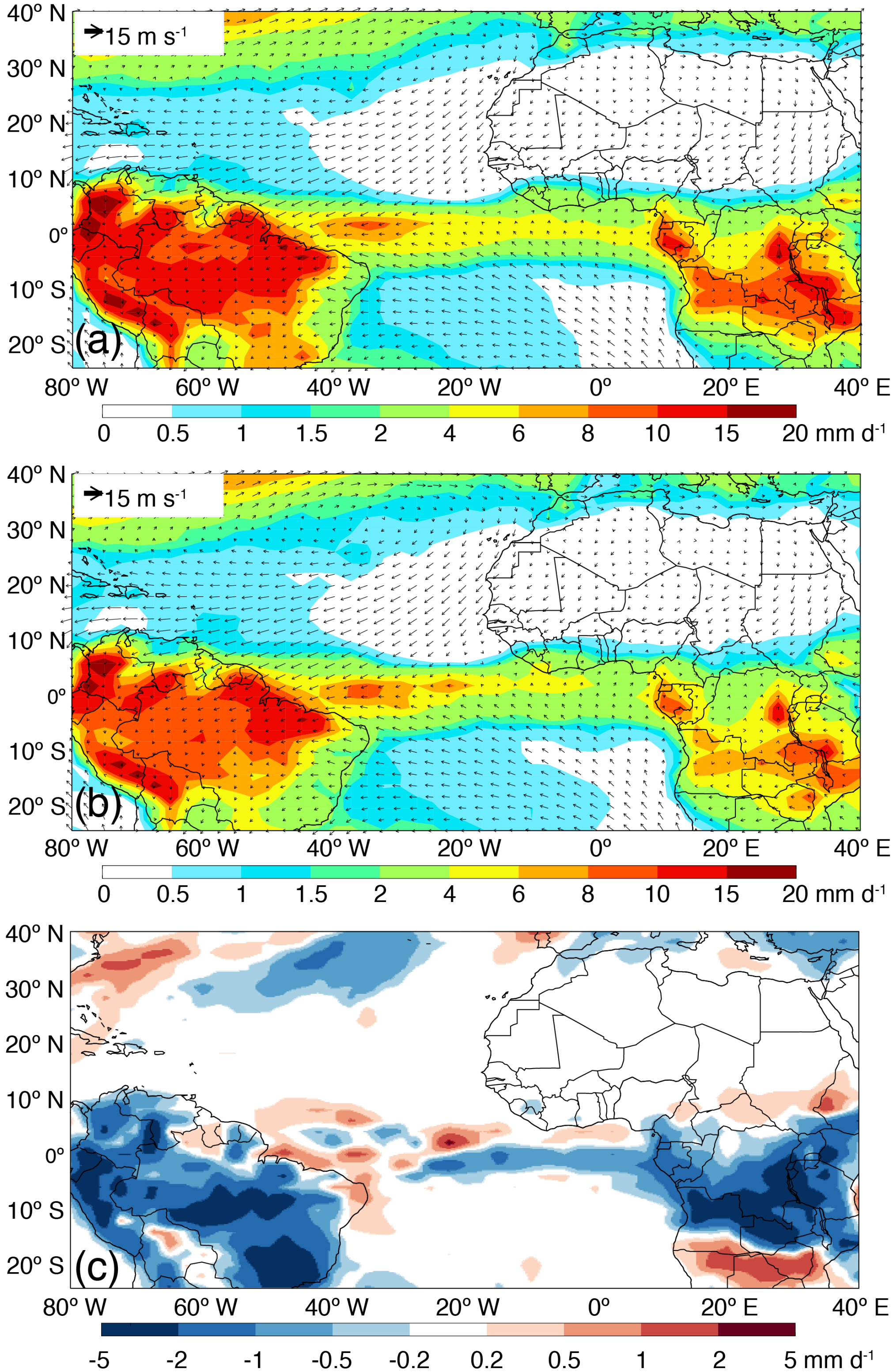

Fig S3. Precipitation (contours) in the year of 2013-2015 (a) and 2014(b) during January-April over the rectangle region between 80° W–40° E and 25° S–40° N. Mean 0-1 km wind vectors are shown as arrows in both (a) and (b). The difference in precipitation between the year of 2014 and 2013-2015 is shown in (c).