Response for Referee #2
We thank Referee #2 for the support given to this paper and for the comments to improve it. His comments and remarks are carefully taken into account in the revised version of this manuscript.

General remarks
RC1:
The present manuscript search to quantify the dust emission and deposition over North Africa and establish a climatology of optical properties over the region using a 5-year simulation (2006-2010) of the ALADIN model which is coupled to the surface me SURFEX. The model results are compared against MODIS, CALIPSO and AERONET observations showing the ability of the model to reproduce the main dust patterns observed over North Africa.

While the results of the study are interesting to be published, their presentation and discussion are not yet sufficient enough to be published at Atmospheric Chemistry and Physics in the current form. The present manuscript is focusing on the model evaluation more than in the analysis of the processes associated to dust cycle or differences along the simulated period that can be affect the model results as changes in the land surface properties, for example. Therefore, I would suggest to the authors to resubmit the manuscript to Geoscientific Model Development (GMD).

AC1:
Our paper indeed includes a validation of the ALADIN model which could have been part of a publication material for GMD for instance. However, we believe that original parts of the modelling development work for ALADIN-DUST actually already have been published precisely in GMD, and we refer to the discussion of the numerical parameterization in Mokhtari et al., (2012). The main purpose of this paper is to produce a climatology of desert aerosols in North Africa. In this sense, we believe that the paper is closer to the ACP scopes. The relevance of this paper for ACP was already confirmed by the Scientific Editor for the article, upon submission time.

General Comments
RC1:
The manuscript demonstrates the ability of the ALADIN model to reproduce the main dust patterns observed over North Africa for the period 2006-2010. The authors include a set of observational datasets that focus to provide a database of dust optical properties, however only the aerosol extinction (AOT and extinction) is discussed.
In the current form, the present work is showing a model evaluation results and it would need to include to answer a particular question. Any sensitivity analysis to differences on the refractive index, single scattering albedo or size distribution is considered. Furthermore, an analysis of the processes associated to dust cycle or differences along the simulated period that can be affect the model results as changes in the land surface properties should be included in the manuscript. Also, if there is any new model development included in the present model configuration should be emphasized in the manuscript or a discussion that emphasize the improvement that represents to use a dust climatology based on a regional model instead to a global model.

AC1:

Indeed, in this manuscript, only the optical thickness and the extinction coefficients are discussed and analyzed. We chose these two parameters to validate the optical properties simulated by ALADIN for three reasons: the first reason is the availability of observational data over a fairly long timescale for these two products, covering the total period of simulations, which highly facilitates a comparison. The second reason is the quality of these two products in the data, especially for optical thicknesses. The last reason is that only the extinction climatology is used in the radiative scheme of atmospheric models.
We agree that analyzing the SSA or g distribution and evolution would reinforce the paper particularly to see how these parameters are depending on size distribution (Mallet et al., 2009).
But in addition to that, we analyzed the dust source and deposition areas and the surface concentrations and we have given inter-comparisons with other previous studies.
The ALADIN model does simulate the single scattering albedo (SSA) and particle size distribution. But comparable observational products are not available for the period of simulation. The validation of these two products can be treated for specified case studies such as done in Mallet et al., 2009 or in Crumeyrolle et al., 2008, 2011. These studies use the same aerosol scheme and the same method to retrieve the aerosol optical properties (SSA, g, extinction). These references have been added in the revised paper: (i) to show that the aerosol distribution is correctly modeled over West Africa with the ORILAM aerosol scheme, and (ii) to add comments about the evolution of the two other aerosol optical parameters (SSA and asymetric factor) during their transport over West Africa.

According to the two last remarks, we propose to update the title of the article in order to clarify the subject:
"3D dust aerosol **distribution** and **extinction climatology** over North Africa simulated with the ALADIN numerical prediction model from 2006 to 2010."

In the description of the ORILAM scheme:
Page 5757, line 20: after "…….(Binkowski and Roselle, 2003)." We add:
"The method of calculation of aerosol optical properties is described in Grini et al. (2006). The refraction indexes used have been calculated upon the AMMA data base (Tulet et al., 2008). ORILAM has been evaluated by several papers for the West Africa region. Crumeyrolle et al., (2008 and 2011), performed a good description of the size distribution during the AMMA campaign. Mallet et al. (2009) studied the evolution of the asymmetry factor (g) and the single scattering albedo (SSA) for the dust storm event which occurred on March 2006 and studied the radiative balance over West Africa. These studies however only were carried out only for specific situations."

Ref:
Mallet, M., Tulet, P., Serc, D.¸ Solmon, F., Dubovik, O., Pelon, J., Pont, V., and Thouron, O.: Impact of dust aerosols on the radiative budget, surface heat fluxes, heating rate profiles and convective activity overWest Africa during March 2006, Atmos. Chem. Phys., 9, 7143–7160, doi:10.5194/acp-9-7143-2009, 2009.

Crumeyrolle, S., Gomes, L., Tulet, P., Matsuki, A., Schwarzenboeck, A., and Crahan, K.: Increase of the aerosol hygroscopicity by cloud processing in a mesoscale convective system: a case study from the AMMA campaign, Atmos. Chem. Phys., 8, 6907–6924, doi:10.5194/acp-8-6907-2008, 2008.

Tulet, P., Mallet, M., Pont, V., Pelon, J., and Boone, A.: The 7–13 March, 2006, dust storm over West Africa: generation, transport and vertical stratification, J. Geophys. Res., 113, D00C08, doi:10.1029/2008JD009871, 2008.

In the sub-section (2.3) **2006-2010 simulations**:

Page 5759, Line 15: we add:
"In this paper, we restrict the analysis to the extinction coefficient and its vertical integration (AOT) for comparison with the observations available for the 2006-2010 period."

RC2:
Discussions of the results would be easier to follow if some statistics were included in the AERONET and MODIS comparison. Also, I would suggest to include a new sub-section in Sect. 2 with the description of the different observational datasets used in the model comparison. This new section will include a description of the different AERONET sites and satellite aerosol products used and their limitations in the dust model comparison as other possible aerosol species that can affect the discussion of the results or the temporal and spatial resolution of these products.

AC2:

In the paper, a qualitative comparison is made for concentrations (Fig. 12), a statistical comparison for optical thicknesses in order to evaluate the representativeness of our simulation (Fig. 11, and discussion on AOT correlation coefficient, section 4.2). Furthermore, we have used a Z_α factor for the case of extinction coefficients, which gives access to the average vertical profile of extinctions (Fig. 13 and 14). Another quantitative evaluation was for emissions, where we compared the estimated values with those given in previous studies.
We have also introduced in the manuscript the correlation coefficient for the dust surface concentration (see Fig. 1).

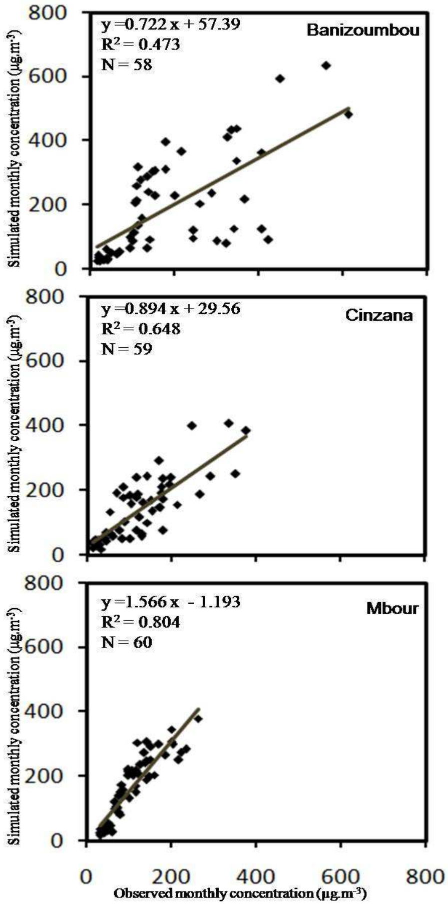

Fig.1: Scatter plot of monthly ALADIN dust surface concentration against observation over Banizoumbou, Cinzana and Mbour from 2006 to 2010. N is the number of averaged monthly surface concentration data available from 2006 to 2010. R is the correlation coefficient.

Concerning the integration of a subchapter describing different observational dataset used in the model, we have followed the recommendation of the Reviewer as this indeed clarifies the descriptions in our paper.

Page 5759, after sect. 2.3: we added the sub-section 2.4

2.4 Dataset

2.4.1Ground-based measurement

In this study we use the AERONET AOT product (level 2) and the PM10 measured dust mass concentration (Particulate Matter concentration, particles with diameter of 10 µm or less) in order to evaluate the model-simulated AOT and the surface dust concentration, respectively, from 2006 to 2010.

AERONET (http://aeronet.gsfc.nasa.gov/) is a federation of ground-based remote sensing instruments measuring aerosol and its characteristics (Holben et al., 1998). The AERONET sunphotometers directly measure aerosol optical thickness at seven wavelengths (approximately 0.340, 0.380, 0.440, 0.500, 0.675, 0.870, and 1.02 µm) with an estimated uncertainty of 0.01 – 0.02 (Holben et al., 2001). In the model, the AOT is simulated at 0.55 µm, and it is therefore compared to the AOT measured at the nearest wavelength, 0.440 µm or 0.675 µm. Following Schmechtig et al., (2011) the AOT measured over Banizoumbou, Cinzana and Mbour, at wavelength 0.44 µm and 0.675 µm, are significantly correlated (r2 =0.99) with slopes ranging from 1.04 in Cinzana to 1.06 in MBour. Thus, in our study, we used the AOT measured at 0.44 µm over the five AERONET sites located in West Africa at:

Banizoumbou (Niger), Cinzana (Mali), DMN_Maine_Soroa (Niger), Mbour (Senegal) and Capo Verde (Fig. 2). We note that the AOT measurements onily are possible during the day since they are based on measuring the solar radiation attenuation. This characterstic may be affecting the results of the intercomparison if a dust storm event occured at nighttime.

The three stations composing the "Sahelian Dust Transect" (SDT) (Marticorena et al., 2010) located in the Sahelian region at Banizoumbou, Cinzana and MBour are used to validate the surface dust concentration simulated by ALADIN. The SDT provides a continuous monitoring of the atmospheric concentrations PM10 with a 5 minute time step, using a Tapered Element Oscillating Microbalance (TEOM 1400A from Thermo Scientific) equipped with a PM10 inlet. PM10 measurements refer to particulate matter which passes through a size-selective inlet with a 50% effciency cutoff at 10 μm aerodynamic diameter (Marticorena et al., 2010). In terms of sensitivity, the detection limit of the instrument is about 0.06 $\mu g.m^{-3}$ for a one hour sampling time.

2.4.2 Satellite data

The Aqua-MODIS product (Tanré et al., 1997; Levy et al., 2007) was used to evaluate the AOTs simulated by ALADIN. This instrument is a multi-spectral radiometer, designed to retrieve aerosol microphysical and optical properties over ocean and land. Two products of Aqua-MODIS are considered in this study: the MODIS Dark Target (DT) and the MODIS Deep Blue (DB) algorithms (Hsu et al., 2004). The MODIS DT algorithm over land is not designed to retrieve aerosol over bright surfaces, such as the Saharan deserts due to the large values of surface reflectivity (Remer et al., 2005; Shi et al., 2013). This problem leads to large spatial gaps in the aerosol optical thickness recorded in desert regions, although these regions are affected by some of the largest aerosol loadings worldwide. However, the DB algorithm takes advantage of this surface phenomenology by performing aerosol retrievals in the visible blue spectrum (such as the 0.47 μm spectral channel in MODIS) and by utilizing the selected aerosol model in the inversion to generate the AOT (Hsu et al., 2004, 2006; Shi et al., 2013). Thus, a combination between these two products is made to complete the AOT database for the whole of North Africa (ocean and land).

Over bright arid region, only DB data are available, offering no alternative choice. Conversely, in the areas with dense vegetation and ocean, only DT data are available and are therefore used in our study, in these regions. In addition, we have transition areas with low vegetation such as the Sahel (10°N-15°N). For these areas, both the DB and DT products are available. The DT product for the semi-arid regions tends however to be biased and underestimated (Levy et al., 2010). For example, the difference between DB and DT estimated for the transition regions can exceed 0.3. For this reason we chose the DB product for the transition regions. Recently, Levy et al., (2013) proposed another solution for the transition regions, namely to merge the two products and create a combined AOD product. Levy et al., (2013) used the Normalized Difference Vegetation Index (NDVI) to identify these regions. Unfortunately, this solution has not yet been validated.

The CALIOP Level 2 Layer 5 km product was used to evaluate the mean particle vertical distributions simulated by ALADIN over North Africa. The CALIOP instrument (Winker et al., 2007) was launched in 2006 on the Cloud–Aerosol Lidar and Pathfinder Satellite Observations (CALIPSO) spacecraft, and has now provided over 8 years of nearly continuous global measurements of aerosols and clouds with high vertical and spatial resolution at two-wavelength (532 nm and 1064 nm) (Rogers et al., 2014). As part of the "A-train" multisatellite constellation, CALIPSO follows a 705 km sun-synchronous polar orbit, with an equator-crossing time of about 1:30 P.M., local solar time (Stephens et al., 2002). The orbit repeats the same ground track every 16 days. The vertical distribution of aerosols, provided by lidar, is important for radiative forcing (e.g., Satheesh, 2002), air quality studies (e.g., Al-Saadi et al., 2005; Engel-Cox et al., 2006), and model validation (Dirksen et al., 2009; Koffi et al., 2012). The CALIOP instrument and its initial performance assessment are described in Winker et al. (2007) and Hunt et al. (2009).

Fig. 2: Location of the five AERONET sites used in this study to evaluate the ALADIN simulated AOT over West Africa Banizoumbou (Niger), Cinzana (Mali), DMN_Maine_Soroa (Niger), MBour (Senegal) and Capo verde.

Ref:

Levy, R. C., Remer, L. A., Kleidman, R. G., Mattoo, S., Ichoku, C., Kahn, R., and Eck, T. F.: Global evaluation of the Collection 5 MODIS dark-target aerosol products over land, Atmos. Chem. Phys., 10, 10399–10420, doi:10.5194/acp-10-10399-2010, 2010.

Levy, R. C., Mattoo, S., Munchak, L. A., Remer, L. A., Sayer, A. M., Patadia, F., and Hsu N. C.: The Collection 6 MODIS aerosol products over land and ocean, Atmos. Meas. Tech., 6, 2989–3034, doi:10.5194/amt-6-2989-2013, 2013

Winker, D. M., Hunt, W. H., and McGill, M. J.: Initial performance assessment of CALIOP, Geophys. Res. Lett., 34, L19803, doi:10.1029/2007GL030135, 2007.

Hunt,W. H.,Winker, D. M., Vaughan, M. A., Powell, K. A., Lucker, P. L., and Weimer, C.: CALIPSO lidar description and performance assessment, J. Atmos. Ocean. Tech., 26, 1214–1228, doi:10.1175/2009jtecha1223.1, 2009.

Rogers, R. R., Vaughan, M. A., Hostetler, C. A., Burton, S. P., Ferrare, R. A., Young, S. A., Hair, J.W., Obland, M. D., Harper, D. B., Cook, A. L., and Winker, D. M.: Looking through the haze: evaluating the CALIPSO level 2 aerosol optical depth using airborne high spectral resolution lidar data, Atmos. Meas. Tech., 7, 4317–4340, doi:10.5194/amt-7-4317-2014, 2014.

Holben, B. N., Tanre, D., Smirnov, A., Eck, T. F., Slutsker, I., Abuhassan, N., Newcomb, W. W., Schafer, J., Chatenet, B., Lavenu, F., Kaufman, Y., Van de Castle, J., Setzer, A., Markham, B., Clark, D., Frouin, R., Halthore, R., Karnieli, A., O'Neill, N. T., Pietras, C., Pinker, R. T., Voss, K., and Zibordi, G.: An emerging ground-based aerosol climatology: Aerosol Optical Depth from AERONET, J. Geophys. Res., 106, 12067–12098, 2001.

Stephens, G. L., Vane, D. G., Boain, R. J., Mace, G. G., Sassen, K., Wang, Z., Illingworth, A. J., O'Connor, E. J., Rossow, W. B., Durden, S. L., Miller, S. D., Austin, R. T., Benedetti, A., and Mitrescu, C.: The cloudsat mission and the A-Train: a new dimension of space-based observations of clouds and precipitation, B. Am. Meteorol. Soc., 83, 1771–1790+1742, 2002.

Al Saadi, J., Szykman, J., Pierce, R. B., Kittaka, C., Neil, D., Chu, D. A., Remer, L. A., Gumley, L., Prins, E., Weinstock, L., MacDonald, C., Wayland, R., Dimmick, F., and Fishman, J.: Improving national air quality forecasts with satellite aerosol observations, Bull. Am. Meteorol. Soc., 1249–1261, doi:10.1175/BAMS-86-9-1249, 2005.

Engel-Cox, J. A., Hoff, R. M., Rogers, R., Dimmick, F., Rush, A. C., Szykman, J. J., Al-Saadi, J., Chu, D. A., and Zell, E. R.: Integrating LIDAR and satellite optical depth with ambient monitoring for 3-D dimensional particulate characterization, Atmos. Environ., 40, 8056–8067, 2006.

Dirksen, R. J., Boersma, K. F., de Laat, J., Stammes, P., van der Werf, G. R., Val Martin, M., and Kelder, H. M.: An aerosol boomerang: rapid around-the-world transport of smoke from the December 2006 Australian forest fires observed from space, J. Geophys. Res., 114, D21201, doi:10.1029/2009JD012360, 2009.

Satheesh, S. K.: *Letter to the Editor* Aerosol radiative forcing over land: effect of surface and cloud reflection, Ann. Geophys., 20, 2105–2109, doi:10.5194/angeo-20-2105-2002, 2002.

Minor errors:

RC1:

Introduction Sect. should be updated with a more recent publications. For example, the latest IPCC report (IPCC, 2013) or the reference of the dust AEROCOM intercomparison (i.e. Huneeus et al., 2010) are missing.

AC1:

The reference is updated in the revised manuscript.

Page 5753 line 2-3: The sentence "Dust aerosol.....(IPCC,2007)." becomes:

"Mineral dust aerosol dominates the aerosol mass over some continental regions with relatively higher concentrations accounting for about 35% of the total aerosol mass (IPCC, 2013)".

Ref:

Intergovernmental Panel on Climate Change (IPCC): Climate Change 2013: The Physical Science Basis in: Clouds and Aerosols, Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)], Boucher, O., D. Randall, P. Artaxo, C. Bretherton, G. Feingold, P. Forster, V.-M. Kerminen, Y. Kondo, H. Liao, U. Lohmann, P. Rasch, S.K. Satheesh, S. Sherwood, B. Stevens and X.Y. Zhang, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi:10.1017/CBO9781107415324, 2013.

RC2:
Page 5755 Line 18-19: The reference to the SDS-WAS is not well justify in the text.

AC2:
Some details have been added in the revised version of the manuscript and the paragraph now reads:
Page 5755 line 17-23: The paragraph: "Initiatives have ....capabilities" becomes:
"Initiatives have already been taken to use operational Numerical Weather Prediction (NWP) and regional models at high resolution and short timescales. These efforts include the WMO Sand and Dust Storm Warning Advisory and Assessment (SDS-WAS, http://sds-was.aemet.es) program, whose mission is to achieve comprehensive, coordinated and sustained observations and modeling of sand and dust storms in order to improve the monitoring of such storms, increase understanding of the dust processes and enhance dust prediction capabilities. SDS-WAS is established as a federation of partners organized around regional nodes (Northern Africa-Middle East-Europe Node and Asian Node). About 16 dust prediction models have been used in SDS-WAS as BSC-DREAM8b, MACC-ECMWF, INCA-LMDZT, CHIMERE, SKIRON, ETA, NGAC, NAAPS…."

RC3
Page 5757 Line 18-23: The calculation of aerosol optical properties should be described in more details because the optical properties are the focus of the present study.

AC3:
The method of calculation of aerosol optical properties is described in more detail in Grini et al., (2006). The refraction indexes used in our work have been calculated following a table of interpolation proposed by Grini et al., (2006). The dust optical properties are calculated from these new indexes in function of lognormal parameter upon the AMMA size distribution (Tulet et al., 2008). These references have been added in the revised version of the manuscript. (See general comments, AC1)

RC4:
Page 5759 Sect. 2.3: The model simulation begins 1 January 2006, or is there a spin-up period for dust concentration?

AC4:
Thank you for this remark. Indeed, the model simulation do have a spin-up period. This is the reason why our numerical simulation period actually starts on 25 December 2005, in order to build up a more realistic initial state for the dust concentrations. This information was added in the revised version of the manuscript.
Page 5759 line 3-6: The sentence "To simulate ..... next simulation." becomes:
"To simulate the 2006–2010 period, successive forecasts of two consecutive days (48 h) are performed. The final term of each simulation is used as the initial condition for the dust concentration of the next simulation. The model simulation has a spin-up period and in order to start our study with a realistic initial state for dust concentrations, the start date of the numerical simulations is 25 December 2005. However, for the evaluations described in this article, only data from 1 January 2006 through 31 December 2010 are considered."

RC5:
Page 5759 Line 14: Indicate the coordinate of the vertical layer (sigma?).

AC5:
Thank you for this remark, it is hybrid vertical coordinate.
Page 5759 line 13-14: The sentence: "The horizontal ..... 67 km." becomes in the revised manuscript:
"The horizontal resolution is 20 km x 20 km with 60 hybrid vertical levels; from the surface to 67 km."

RC6:
Page 5760 Line 13: In the comparison of ALADIN with the rest of the model results (global and regional), ALADIN is the model that provides highest emissions between the regional models meanwhile it is lower with the global. This should be better discussed in the text.

AC6:
This is correct; the global models give large dust emission. This aspect is now discussed in the revised text.

Page 5760 line 5-13: the paragraph "Table 2 compares..........Zender et al. (2003)" becomes:
"Table 2 compares the annual mean dust flux obtained in this work with other recent global and regional dust model studies. Important differences in the annual mean dust flux can be observed. The largest value of the annual mean dust flux is simulated by Ginoux et al. (2004) and is equal to 1430 $Tgyear^{-1}$, which is twice as large as the value simulated by Marticorena and Bergametti (1996) (665–586 $Tgyear^{-1}$). Our estimation lies between those obtained by Ginoux et al. (2004) and by Marticorena and Bergametti (1996), and is in good agreement with the value obtained by d'Almeida (1986), Callot et al. (2000), Laurent et al. (2008) and Zender et al. (2003).
Dust emissions depend on both surface features and soil types, but they also depend on the meteorological conditions (wind and precipitation). These elements are defined differently from one model to another. Global models have a relatively low resolution, and thus misrepresent the surface characteristics (roughness) and the soil types (% of clay and % of sand). As a consequence, these models tend to overestimate the spread of dust emission areas. For example, at 1 ° x 1 ° resolution (medium resolution of global models), an entire area can become a dust emission source when in reality it is not. Eventually, dust emission is overestimated as well. Regional models, due to their higher resolution, provide more details on the emission source areas compared with global models, which then in turn enables to diminish this positive bias.
It is also interesting to mention that the three values of dust emission estimated by Zender et al., (2003), Laurent et al., (2008), Marticorena et al., (1995) and the one of our study are all based on the same dust mobilization scheme of Marticorena et al. (1995). Therefore, a correlation between the estimates of these four studies can be expected."

RC7:
Page 5761 Line 14: Again, the authors are compared the results of the regional ALADIN model with a global model results from Tanaka and Chiba (2005). I would be desirable to include a discussion about the possible improvement that represents to use a regional model at 20km x 20km in comparison with a global model.

AC7:
We have mentioned Tanaka and Chiba (2005) for the comparison of our results because this study shows the seasonal variation on dust emissions over North Africa. A discussion will be added in the text.

Page 5761 line 14-19: The paragraph: "This seasonality is consistent ......Tanaka and Chiba (2005)." becomes:

"This seasonality reproduces the general pattern of the seasonality simulated by Tanaka and Chiba (2005) for the period 1979–2003 over North Africa with the global CTM model (MASINGAR) at a resolution of 1.8 x 1.8°. In contrast, in terms of intensity, the dust emission flux simulated by MASINGAR in spring accounts for almost half of the total emissions in North Africa (500 Tg). These estimates are higher than those simulated by ALADIN.

In summer, the dust emission flux simulated by MASINGAR is much underestimated compared with the flux estimated by ALADIN. Indeed, the summer season is characterized by significant dust uprising over the Sahel in connection with large convective systems. These systems generate strong gust winds at the leading edge of their cold pools which can lead to "walls of dust" known as "haboob", a sometimes fast moving and extremely hazardous phenomenon (Knippertz et al. 2012). However, even regional models at resolution of about 10 km do not adequately represent these processes, neither in climatological terms nor for weather forecasting (Knippertz et al. 2012)."

Ref:

Knippertz P., and Todd, M. C., Mineral dust aerosols over the Sahara: Meteorological controls on emission and transport and implications for modeling, Rev. Geophys., 50, RG1007, doi:10.1029/2011RG000362, 2012.

RC8:

Page 5762 Line 21-22: the authors indicates "we show that the use of a three dimensional NWP model such as ALADIN significantly improves the climatology of wet deposition of dust aerosols". This sentence needs to be better justified with the comparison with other model studies.

AC8:

We added in the revised manuscript the intercomparison with other models studies.

Page 5763 line 17: we add after dry deposition. The paragraph below:

"The inter-comparison of dust wet deposition simulated by ALADIN for the year 2006 with models used in the AEROCOM and SDS-WAS programs (BSC-DREAM8b, GOCART-v4Ed.A2.CTRL, GISS-modelE.A2.CTRL and TM5-V3.A2.CTRL, http://aerocom.met.no/cgi-bin/aerocom/surfobs_annualrs.pl) for the same period is given by the Table 1. The results show that the mean wet deposition estimated by ALADIN is much higher than those estimated by AERCOM Model's. As discussed for the seasonal wet deposition, the major part of the wet deposition takes place during the wet season of the African Monsoon.

In terms of spatial distribution, the ALADIN model performs better for the estimation of the dust wet deposition associated with convective systems in the Sahelian regions. For example, the estimates of the BSC-DREAM8b model do not exceed 0.2 $g.m^{-2}.year^{-1}$ for the Sahel and the West African region. Those simulated by TM5-V3.A2.CTRL are less than 5 $g.m^{-2}.year^{-1}$ and those obtained by GOCART-v4Ed.A2.CTRL and GISS-modelE.A2.CTRL varied in the range 20-50 $g.m^{-2}.year^{-1}$. The fact that some part of the total precipitation of ALADIN is resolved can explain that the wet deposition processes in ALADIN are found to be more efficient than in some global models. "

Table 1: Mean dust wet deposition

Models	Wet deposition for 2006 in (g.m^{-2}.year^{-1})
BSC-DREAM8b	0.46
GOCART-v4Ed.A2.CTRL	9.653
GISS-modelE.A2.CTRL	8.301
TM5-V3.A2.CTRL	4.673
This study	21,36

RC9:
Page 5762 Line 3: In Fig. 5, Bodélé is not the region with the maximum deposition, only in winter we find maximum deposition in this region. This is consequence to low level dust transport during this period. This should be emphasized in the text.

AC9:
Thank you for this remark.
The sentence: page 5762 line 5: "In winter ....200g/m^{-2}" becomes :
"In winter, the maximum of the seasonal dust deposition flux is located in the Bodélé Depression, with a value reaching 200 g.m^{-2}. This maximum is a consequence of low level dust transport during this period."

RC10:
Page 5764 Line 2: the climatology shown in Nabat et al. (2013), does it include the years analysed in the present study? It would be interesting that the authors would include it.

AC10:
The climatology of Nabat et al. (2013) covers the 1979-2009 period and has 50 km of resolution.
This information is included in the revised version of the manuscript.
Page 5755, line 14-16: The sentence "Based on both ......Sea" becomes
"Based on both satellite-derived monthly AOTs and a regional/chemistry model, Nabat et al. (2013) proposed a three-dimensional (3-D) monthly climatology of aerosol distribution over the Mediterranean Sea for the 1979-2009 period and at 50 km of resolution"

RC11:
Page 5767 Line 16: There isn't any Soroa AERONET site in the AERONET website (http://aeronet.gsfc.nasa.gov/cgi-bin/type_piece_of_map_opera_v2_new). Could the authors check it?
AC11:
Thank you for this remark, the Soroa AERONET site refers to the DMN_Maine_Soroa AERONET site. This is precision is added in the revised text
Page 5756 line 3: "Soroa" will be "DMN_Maine_Soroa (hereafter Soroa)"

RC12:
Page 5769 Line 22: The model underestimations observed during summer are associated to convective dust storms (haboobs) that the models are not capable to reproduce (see Knippertz and Todd, 2012).

AC12:
Thank you for this remark; this is corrected in the revised text.

Page 5769 line 22-25: Sentence "In summer,.....remains high" now reads:

"In summer, the simulated and observed surface concentrations are low for these two stations. In contrast, noticeable differences are seen from April to June at Banizoumbou. For this site, the simulated surface concentration decreases while the PM10 concentration remains high. The model underestimations observed during April to June are probably related to local dust uprisings that are not well simulated by ALADIN model. This underestimation is strong in June, which marks the transition between the dry and the wet season monsoon in West Africa. Recently, a study realized by Kocha et al., (2013) shows the existence of two important processes responsible for dust uprising in West Africa, namely: (1) the diurnal variation of surface wind speed modulated by the low level jet occurred after sunrise due to turbulent mixing (Washington et al., 2006), especially in Bodélé depression; (2) the gust wind associated with the density currents emanating from convective systems occurred at the afternoon. This second phenomenon generate a strong gust winds can lead to the "dust wall" known "haboob" (Tulet et al., (2010) ; Knippertz et al. (2012)).

We also noted a bias for the values of AOT in the same period but with a less pronounced intensity than for surface concentration."

RC13:

Page 5770 Line 6: "March" instead "Mars"

AC13:

Thanks, it will be been rectified in the revised manuscript.

Page 5770 line 5-7: Sentence "The maximum simulated.......for PM10). Will be:

"The maximum simulated surface concentration and observation is obtained in March (278 $\mu g.m^{-3}$ for ALADIN and 257 $\mu g.m^{-3}$ for PM10)."

RC14:

Page 5770 Line 10: There is also a model overestimation during July

AC14:

Thanks, it was a mistake. Rather, "there is also a model underestimation during July". This is corrected in the revised version of the manuscript.

Page 5770 line 9-10: Sentence "Over Mbour.........in August." now reads "Over Mbour, the monthly simulated surface concentrations are larger than the observations over all months except in July and August."