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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Fennec dust forecast intercomparison over the Sahara in June 2011" *by* J.-P. Chaboureau et al.

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We thank the Referee for his/her time and his/her constructive comments. We have complied with most of the proposed changes. In the revised version of the manuscript, we now thank the referees explicitly in the Acknowledgment section. In the following, our point by point replies to the Referee's comments are in blue.

This manuscript tries to look for any potential systematic error in the forecasts through evaluating the ability of three models to reproduce the key processes for mobilization and transport. The dust evaluation was made using satellite and ground-based observations.

General comments:

This study describes the first ever intercomparison of dust forecasts over the western Sahara by using the airborne and ground-based data sets. The result presents that, at monthly scale, large AODs were forecast over the Sahara, a feature observed by some satellite retrievals but mislocated by others over the Sahel. The AOD was correctly predicted by the high-resolution models while underestimated by the low-resolution models. The results are reasonable. However, there are ambiguous descriptions in the paper. I recommend publication after the revisions.

Specific comments:

1. P4, L109, 'variables at the end of a given 24 h forecast are were passed on as initial conditions at the start of', 'were' or 'are'? Were. Thanks

2. P4, L101-109, The initial and boundary conditions of ALADIN and AROME were taken from operational large-scale ARPEGE forecasts at 18:00 UTC, while two models with different resolution of Meso-NH were initialized by the ECMWF analysis at 00:00UTC. Why don't use the same initial and boundary conditions? The forecasts were done on two different computer centers, one at Météo-France, the other at Laboratoire d'Aérologie. The centers had different avalaibility to computing ressources and to access to either ARPEGE forecasts or ECMWF analyses.

3. To discrepancy of different models' result, what is the main reason? How about the contributions of initial and boundary condition and the DEAD version? Indeed, the initial and boundary conditions and the different DEAD version are a source of discrepancy between the forecasts. This is discussed in the section dedicated to the AOD comparison.

4. P18, Lin595: What is the reason of the AOD difference between MODIS and MISR? Just because of the number of observations? How about the contribution of retrieval algorithm? In addition to the sampling issue, the way the AOD was retrieved is another reason of the AOD difference. MODIS Deep blue algorithm is based on observations in the blue wavelengths of the visible spectrum (412 and 470 nm) while MISR uses

four narrow spectral bands centered at 446, 558, 672, and 866 nm and nine distinct zenith angles). AOD products are then referenced to 550 and 558 nm for MODIS and MISR, respectively. Banks et al. (RSE 2013) have also shown that, over North Africa and during the Fennec campaign, AODs retrievals from these sensors were sensitive to meteorological conditions as well as to the emissivity of underlying surfaces. This information is now included in the revised version of the manuscript.

5. The aerosol emission field is not needed to input for models? It is calculated by model itself? The emission field is a diagnostic computed from the wind field and the surface characteristics at every time step and for every model mesh over land. This field was saved in the course of the ARPEGE and Meso-NH runs. Unfortunately, it was computed but not saved as an output field in the AROME simulations.

6. What is the height of wind filed used to calculate the dust emission? Same or not in three models? The wind field used for calculating the dust emission is the one at the lowest level. The lowest level differs between each model. Note that ARPEGE and AROME used a terrain-following vertical grid in pressure coordinates while it is in altitude coordinates for Meso-NH.

7. As shown in the paper, the simulation abilities of three models are different even over same area. How about the land surface situation in each model? Same or different? For all three models, the topography is derived from the GTOPO30 database, the soil characteristics are obtained from the FAO database and the vegetation is from the ECOCLIMAP database. So the land surface characteristics of each model are derived from the same databases. However they differ between the models as a result of the interpolation of these gridded databases at the horizontal resolution of the models.

8. As shown in L68 on P3, 'The objectives of this intercomparison were to look for any potential systematic error in the forecasts...', How to ensure the error is systematic and how to eliminate such error in forecasts reasonably? We did not find any systematic errors, except the low bias in the model-derived AOD over Tamanrasset. In that case,

we hypothesize that a process is not included/reproduced in the DEAD scheme, i.e. the remobilization of dust transported from remote sources, which is frequently observed in this region. We believe that improving this aspect of the DEAD scheme could improve dust forecasts, not only in northern Africa.

9. On the research of dust, there are many studies on the dust property and transport basing on the observation and simulation over the world, such as:

Kaufman, Y. J., Tanré, D., Dobocik, O., Karnieli, A., and Remer, L. A.: Absorption of sunlight by dust as inferred from satellite and groundbased remote sensing, Geophys. Res. Lett., 28, 1479–1482, 2001.

Takemura, T., Uno, I., Nakajima, T., Higurashi, A., and Sano, I.: Modeling study of long-range transport of Asian dust and anthropogenic aerosols from East Asia, Geophys. Res. Lett., 29, 2158, doi:10.1029/2002GL016251, 2002.

Chen, S., J. Huang, C. Zhao, Y. Qian, R. Leung, and B. Yang, 2013: Modeling the transport and radiative forcing of Taklimakan dust over the Tibetan Plateau: A case study in the summer of 2006, Journal of Geophysical Research: Atmospheres, 118, doi:10.1002/jgrd.50122.

Bi, J., J. Huang, Q. Fu, X. Wang, J. Shi, W. Zhang, Z. Huang, and B. Zhang, Toward characterization of the aerosol optical properties over Loess Plateau of Northwestern China, Journal of Quantitative Spectroscopy & Radiative Transfer, 112 (2) (2011), 346-360.

Liu, Y., J. Huang, G. Shi, T. Takamura, P. Khatri, J. Bi, J. Shi, T. Wang, X. Wang, and B. Zhang, Aerosol optical properties and radiative effect determined from sky-radiometer over Loess Plateau of Northwest China, Atmospheric Chemistry and Physics, 11 (22) (2011), 11455-11463, doi:10.5194/acp-11-11455-2011.

Huang, J., W. Zhang, J. Zuo, J. Bi, J. Shi, X. Wang, Z. Chang, Z. Huang, S. Yang, B. Zhang, G. Wang, G. Feng, J. Yuan, L. Zhang, H. Zuo, S. Wang, C. Fu and

J. Chou, An overviewthe semi-arid climate and environment research observatory over the Loess Plateau, Advances in Atmospheric Sciences, 25 (6) (2008), 906-921, doi:10.1007/s00376-008-0906-7.

Huang, J., J. Ge, and F. Weng, 2007: Detection of Asia dust storms using multisensor satellite measurements, Remote Sensing of Environment, 110, 186-191.

Huang, J., P. Minnis, Y.Yi, Q.Tang, X. Wang, Y. Hu, Z. Liu, K. Ayers, C. Trepte, and D. Winker, 2007: Summer dust aerosols detected from CALIPSO over the Tibetan Plateau, Geophys. Res. Lett., 34, L18805, doi:10.1029/2007GL029938.

Please cite above researches and inter-compare with your study.

We thank the reviewer for the interesting references. However, we find it difficult to include references to inter-comparison studies that took place in areas other than Northern Africa. Since the above mention studies relate to China, exception made of the Kaufman et al. paper, we have not included them as well as the Kaufman et al. paper that discussed aerosol optical properties over Dakar and Cape Verde, that is outside the area under scrutiny.

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