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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling a typical winter-time dust event over the Arabian Peninsula and the Red Sea" *by* S. Kalenderski et al.

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Responses to the major comments

1) Yes, in winter season transport of dust from Arabian Peninsula over the Red Sea to North Africa happens frequently. The transport takes part mostly in the Northern part of the Red Sea. In summer season transport of African dust is observed more frequently.

2) 10m-wind field is crucial for dust emission scheme and the model results were validated against ECMWF analysis and reported in page 26615. The results of comparison of averaged and instantaneous fields were discussed but figures were not shown since we wanted to focus on the radiative impact of dust. The model and reanalysis

fields are well correlated (both averaged and instantaneous; see Fig. 1 and Fig. 2 in this response) with correlation coefficient of 0.81 and 0.62 respectively. The model (because of its higher spatial resolution, does better job than reanalysis (Fig.2) since it is able to reproduce westward-blowing wind jets along the coast of north part of Red Sea and thus depicts the Arabian dust transport observed in MODIS images (Fig.1 in the paper). Similar results we obtained for the other fields (e.g. T2, Fig. 3). The text in page 26615, line 7 is extended to include: with correlation coefficient of 0.82 on average and 0.62 at 12:00 UTC on 14 January 2009.

Following the reviewer recommendation we have included in the text a figure with a wind field comparison and a corresponding discussion.

The MODIS swaths cover only relatively small part of the modeled domain and this is the reason why the domain was restricted in Fig. 1. Presenting the data in this way helps to better compare two fields. In Fig. 5 we compared only instantaneous MODIS (when available) and WRF-CHEM fields since for the considered two-weeks MODIS observations are to sparse in time to make a meaningful time averaging.

The model and AERONET time series of the optical depth at Solar Village are well correlated with RMSE 0.11. The text is changed in p.26627 line 12 to include: and RMSE equal to 0.11.

3) During the winter season events of large African dust transport across Red Sea are very unlikely since the subtropical high increases south-north pressure gradient over North Africa and leads to strong harmattan northeasterly winds. Additionally, Khamsin/Sharav cyclones can contribute significantly to the dust load during the winter season, however they track along the Mediterranean coast or northward. The eastward dust transport from Africa is more likely to happen in summer season. There are many other smaller scale features that might be important for the dust transport from Africa over Red Sea which we plan to discuss in a forthcoming modeling study with more details.

4) Yes the original GOCART emission scheme is an 8 size bins model (0.1-0.18, 0.18-0.3, 0.3-0.6, 0.6-1, 1-1.8, 1.8-3, 3-6, and 6-10 um in radius) and do not directly provide lognormal size distribution parameters of emitted dust required by the aerosol model and the dust optical properties module. Therefore, the emission scheme is used only to calculate the total dust mass fluxes within the bins and the size distribution parameters of emitted dust is estimated as discussed in Zhao et al., 2010. We extend the discussion by the following text (p. 26612, line 17): The original GOCART scheme is 8 size bins model which do not provide directly lognormal size distribution parameters of emitted dust required by the aerosol model and the optical properties module. Therefore, the scheme is used only to calculate the total dust mass fluxes and the size distribution of the emitted dust is estimated. Responses to minor comments - Winter is selected since the dust transport over the Red Sea is mostly from the Arabian Peninsula as we discuss in the previous section. The summer season transport is also interesting and we plan to work on it as well.

- The 600 nm wavelength is the standard output from the radiative transfer model used in this study. Aeronet provides an Angstrom exponent so we choose to convert Aeronet optical depth to 600 nm for comparison. We believe it is unlikely it could cause any additional discrepancy. A comparison at 600 nm is not unusual and was performed in other studies, e.g. Pere et al., 2011 (doi:10.1029/2011JD016240)

- MENA is accepted term in UNEP and WMO terminology. We extended the text by including the MENA lon-lat boundaries p. 26609, l.8: 0-40N; 15W-60E

- Yes, it is correct to say in (p.26609, 26634) Zender et al., 2004.

- We are not aware of some other studies that treat this problem neither observational nor modeling, see the review by Knippertz and Todd, 2012.

- Only GOCART dust generation parameterization was used in this study. We used SOGRAM to calculate aerosol atmospheric transport and deposition. Despite dust is the dominant aerosol in this study the model is configured to take into account biomass

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burning and anthropogenic aerosols as well as the aerosol-gas and gas phase chemistry which represents the modeled phenomena more realistically.

- We now show the full names for AERONET and MODIS on p. 26610. GOCART is spelled in p.26612 (Global Ozone Chemistry Aerosol Radiation and Transport)

- Data assimilation/nudging option is not used in this study.

- We include the lat-lon in the text now: North, 40°-45°E, 27°-29°N ; Middle, 45°-48°E, 25°-28°N;South, 44°-56°E, 16°-23°N

- The font size in Figures is increased by 15%.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 26607, 2012.

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Interactive Comment

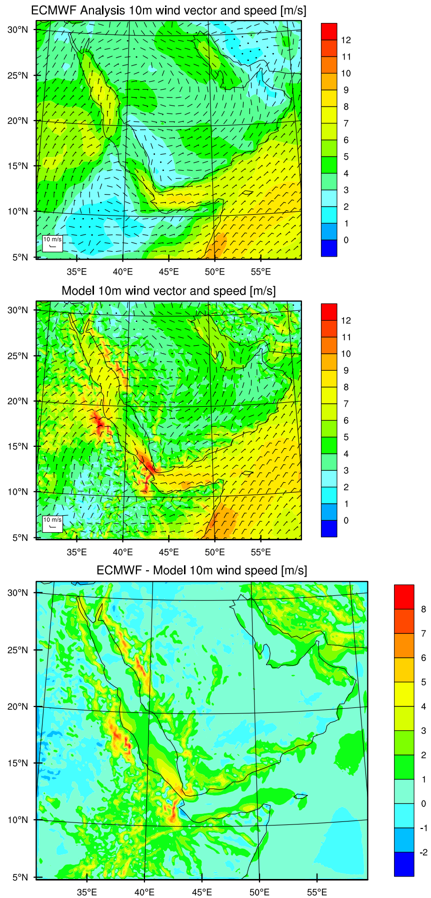

Fig. 1. Comparison between ECMWF and modeled 10m wind fields averaged for the simulation period. Correlation coefficient 0.82.

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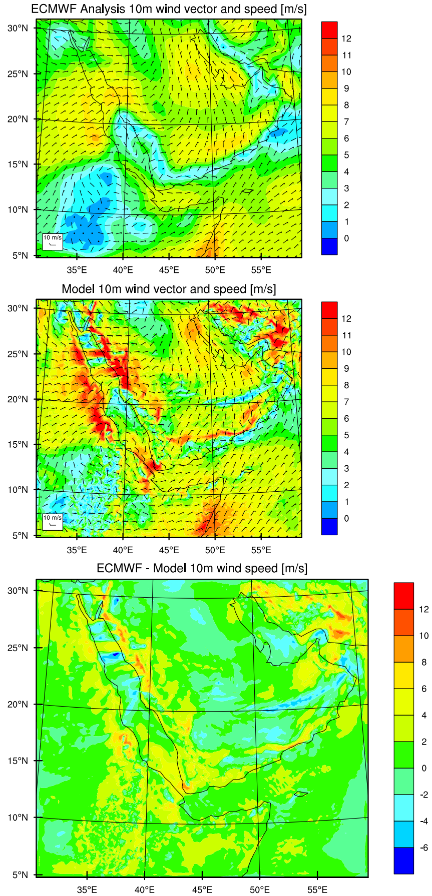

Fig. 2. Comparison between ECMWF and modeled 10m instantaneous wind fields at 12:00 UTC on 14 Jan 2009. . Correlation coefficient 0.62.

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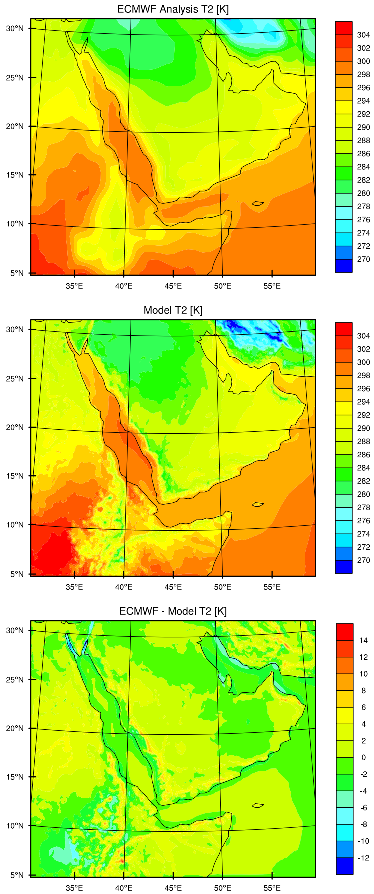

Fig. 3. Comparison between ECMWF and modeled T2 fields averaged for the simulation period. Correlation coefficient 0.95.

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