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

Anonymous Referee #2

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In this study, Kalenderski et al. used WRM-Chem to study winter time dust transport over the Arabian Peninsula and the Red Sea. They find that the presence of dust causes a significant reduction in the amount of solar radiation reaching the surface during this dust event. In addition, they hypothesize that the dust aerosols might have a significant impact on the nutrient transport into the Red Sea. Unfortunately this interesting section (4.4) is quite speculative and should be further elaborated. The study presented by Kalenderski et al. is an interesting contribution which I recommend for publication after the following comments are addressed:

General comments:

The authors claim that their event is a "typical winter time dust event", however no proofs are shown for this. Are there multi-annual data from an AERONET station avail-

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able to prove this claim? How often do such dust events occur annually in winter? What is the average AOD and dust emission of such winter time dust events?

Specific comments:

p.26615, l.13-14: “The emitted total dust amount was 18.3 Tg for the entire domain and simulation period.” To put the number of 18.3 Tg into context and to understand whether this is a large or low amount of dust emission, it would be interesting to compare this value with typical emission values for Saharan dust.

p. 26616: The particle size distribution is critical for the simulation of dust radiative effects, but so far the authors rely only on model assumptions. I am aware that in-situ measurements of dust size distributions for the Arabian Peninsula are rare, but a number of airborne measurements are available in the literature for the Saharan dust such as Ryder et al. (2012) or Weinzierl et al. (2009; 2011). These data should be used for intercomparison with the model size distributions.

p. 26619, l. 25: typo: “wave-dependent” –> change to “wavelength-dependent”

p. 26619. l.26ff: “(. . .) imaginary part of the dust refractive index (. . .) set to 0.006 (. . .), which gives comparable results with some other studies (. . .)” –> Please indicate the studies which show comparable results of the imaginary part of the refractive index. In contrast, literature values for Saharan dust show lower refractive indices.

p. 26623, l. 20 ff: The authors only talk about an overall decrease in T2, but if I understand Fig. 9 correctly, an increase in T2 of about 0.1 K is observed over the Red Sea. Please clarify.

Section 4.4. Dust deposition: Please add a figure showing the change in size distribution due to deposition of large mineral dust particles as the dust crosses the Red Sea. What is the largest particle size present in the air after depositing the dust into the Red Sea?

Section 4.5 is quite speculative. If this section is kept, more detail should be given,

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and the discussion should be put into context with already existing literature. The title implies that the dust impact on the Red Sea is investigated therefore one would expect to see numbers for example for the change in sea surface temperature or the nutrient transport into the Red Sea. Instead the authors only discuss the radiative forcing and state "This should have a profound effect on the energy balance at the sea surface." Please give references for this statement.

p. 26626, l. 9ff: "A complete understanding of the Red Sea's evolution and variability is impossible without a detailed quantification of the radiative effects of aerosols." I do not understand this statement. What do the authors mean with "the Red Sea's evolution and variability"?

p.26626, l.17: How much nutrients correspond to 0.65 Tg of dust? Is this a large or a small number compared to the nutrients present in the Red Sea?

p. 26626, l. 23: skip "most"

p. 26627, l. 8: add "satellite" between "temporal" and "coverage"

References:

Ryder et al. (2012), Atmos. Chem. Phys. Discuss., 12, 26783-26842.

Weinzierl et al. (2011), Tellus 63B, 589-618, doi: 10.1111/j.1600-0889.2011.00566.x.

Weinzierl et al. (2009), Tellus 61B, 96-117 doi: 10.1111/j.1600-0889.2008.00392.x.

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