

Review Lu et al.: The implementation of NEMS GFS aerosol component (NGAC) version 1.0

General Comment:

The authors present describe the development and implementation of the NGAC aerosol module into the GFS modelling system. Their particular emphasis is on the dust module which they describe in more detail including a model validation exercise with regard to this newly implemented scheme. Satellite remote sensing and surface measurements are used to evaluate the model performance.

The paper is well and concisely written, perhaps sometimes too concise (see comments). The validation part is good, but the extent to which the model was tested against observational data is rather limited. While I would like to see more validation results to put the model performance in better context with other state-of-the-art models, particularly with NMMB/BSC-Dust as it is technically the same atmospheric model. Given that NMMB/BSC-Dust performs rather well in comparison with other dust models (see Perez et al 2011 and Haustein et al 2012), it would be to the benefit of the paper to showcase these - potentially above-average – result.

As the paper is highly topical and suitable for publication in GMD, I am willing to accept the manuscript in its current form after minor corrections have been made as outlined below.

Specific Comment:

The validation part is good, but I do recommend including more AERONET stations. In fact, what I wish the authors would have done is a validation effort similar in extent to what has been presented in Huneus et al 2011. As far as I know, they even developed a tool that is straight-forwardly applicable. In doing so, the authors could test the model performance in all regions of the globe rather than at just two AERONET stations next to the main Saharan desert dust sources (which, arguably, are the most important sources). In addition, as pointed out above, they can highlight the model skill in the context of other - presumably less performant - models. In any case, I would kindly ask the authors to defend their minimalistic choice and to justify why they did not use more or omit other AERONET stations. The same is true for the choice of satellite remote sensing products. MISR, MSG Seviri or OMI are other data set available for comparison.

Minor comments:

Section 2.1, p.7, line 4ff: Not sure it is relevant to mention the future development of WAM in this context. Unless it takes any bearing on the further development of the aerosol module, you may as well leave it out in order to avoid confusion.

Section 2.2, p.7/8: You are referring to the on-line capability of the model here. Later in section 2.3, p.9, line 19ff, you provide more details on how the on-line approach works. Are you talking about the same thing here? Please try to make the text more coherent and merge the bits that belong together.

Section 2.2, p.8, line 13ff: Which dust emission scheme you are using? Also, which moisture correction and surface roughness correction scheme you are using? Have you done any sensitivity experiments in order to tune the model, e.g. wrt soil moisture, or did you just tune the emission budget? As a side note: Ginoux's topographical dust source function happens to be very suitable for representing the major dust sources as they are linked to wind channelling effects due to said orography.

Section 3, p.10, line 8: NCEP begins → NCEP has begun

In the next line, you mention that dust forecasts are available online. On p.11, line 3, you do actually provide an online resource which appears to be linked to these forecasts. I recommend merging the two separated statements, which presumably, refer to the same thing.

Section 3, p.10, line 27: I don't quite understand this sentence: "This aerosol-radiation decoupled configuration that GOCART aerosols are not radiatively coupled to the AGCM is intended [...]". Please rephrase!

Section 4.2, p.12, line 16ff: Why did you only compare with MODIS? What about OMI, MISR, MSG Seviri? In Fig 5: Why only monthly AOD means rather than seasonal means? At least it has to be consistent! Text and Figure capture say different things.

Section 4.2, p.13, line 9ff: As highlighted in the specific comment, I would kindly ask you to either justify the choice of only two AERONET stations for comparison, or provide a more comprehensive analysis. While the performance at the two stations shown in Fig 6 is really good, it may well just be by chance. I'd rather know the model performing not so well in some regions as opposed to not knowing at all. Also, what about Lidar observations? How do you know the model is able to represent the vertical structure of the dust plume away from sources? EARLINET and CALIOP are the tools to go with. Again, please justify why you didn't use either of those.

Section 5.1, p.15, line 2ff: Fig 8 does not seem to add any extra value. Unless you compare NGAS with ICAP directly, rather than showing the average of all ICAP models (MME), I don't see any benefit of putting the Figure and suggest to take it out.

References:

Huneus et al 2011: Global dust model intercomparison in AeroCom phase I.

Perez et al. 2011: Atmospheric dust modeling from meso to global scales with the online NMMB/BSC-Dust model - Part 1.

Haustein et al. 2012: Atmospheric dust modeling from meso to global scales with the online NMMB/BSC-Dust model - Part 2.