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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impacts of increasing the aerosol complexity in the Met Office global NWP model" *by* J. P. Mulcahy et al.

J.-J. Morcrette (Referee)

JEAN-JACQUES.MORCRETTE@ECMWF.INT

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Review of

Impacts of increasing the aerosol complexity in the Met Office global NWP model

by J.P. Mulcahy, D.N. Walters, N. Bellouin, and S.F. Milton

General comments: ———— This paper describes the impacts of various descriptions of the effects of aerosols on the state of the atmosphere represented by the Met Office model in its numerical weather forecast configuration. The aerosol description is varied from a very simple surface-based (land vs. ocean), to a monthly mean multi-aerosol type climatology derived from previous 20/10-year climate-type integrations

with a prognostic aerosol model, to the same 12-prognostic aerosol variables configuration, or to this latter one initialised from aerosols analyzed as part of the GEMS program (Global Earth system Monitoring using Satellite data).

This study is extremely timely, as the introduction of a more sophisticated representation of aerosols and their potential effects for numerical weather prediction is a question being presently addressed by several operational NWP centres (ECMWF, Naval Research Laboratory, Japan Meteorological Agency, Meteo-France, NASA-GEOS5, , ...) as part of ICAP, the International Cooperative for Aerosol Prediction. One of the most pressing questions is related to the level of sophistication required from the aerosol model, and in terms of cost-benefit analysis whether a more involved aerosol model actually brings any sizeable benefit to the weather forecasts.

The study is rather extensive in terms of variables tested for a potential impact of aerosol processes, as well as the number of different observational datasets used for evaluation. My only concern is the length of period over which this study has been conducted. Whereas I don't doubt that the results would likely stand over longer periods of time, the five weeks considered (17 June-24 July) in this study seem quite short, as only Northern Hemisphere summer is actually studied. However, given the high horizontal and vertical resolutions of the model used ($\sim$40 km, 70 levels), I can accept the argument about the additional computational expense in the experiments using prognostic aerosols. Anyway, this study could benefit in the future from more consideration being given to the Saharan dust plumes (often happening in April-June), South American biomass burning events (occurring generally in September-October), or large pollution episodes over South-East Asia and China during the Northern hemisphere winter.

Being aware of the constraints that such an experimentation at (almost) operational NWP resolution usually meet, I would consider this very interesting paper to be suitable for publication in Atmos. Chem. Phys. after the typos and questions detailed in the following have been addressed.

More detailed comments and typos: ——————————— l.20: propagate

l.113: 50 or 30 Wm-2 as quoted in l.1094? l.120: (Allan et al., 2011)

l.214-216: the comments about tropospheric and stratospheric levels should be revised.

l.229: which is persisted

l.263: hydrophilic

l.297: FFBC or BCFF (cf. l.384)

l.357 June/July 2009 is quoted here, whereas June/July 2010is quoted in l.218

l.362: was necessary

l.367: tropospheric

l.384: see l.297

l.439: Angstrom (with some marks on A and o?)

l.442: Sentence starting "AOD measurements from MODIS" is likely to be wrong. I would think the Giovanni server allows to get much more than that.

l.462: Same comment as above also applies to MISR data. http://disc.sci.gsfc.nasa.gov/giovanni has daily servings of MODIS and MISR. As of 20131129, the following data appear to be available for download: MODIS Terra between 20000301 and 20131127 including DeepBlue MODIS Aqua between 20020704 and 20131126 including DeepBlue MISR between 20000225 and 20130831

l.484: it's? its?

l.504: Strictly speaking the areas covered by observations and model simulations are not the same, making a comparison of "global means" difficult.

l.553: Caribbean

l.611 and l.618: Sentences starting on these lines are long and could be cut into smaller chunks.

l.657: Figures 7 are rather tough to read!

l.771 and Figures 12: Top figure is somewhat difficult to read. What about the ARM curve, and the differences to the ARM curve below? Bottom figure does not reference the UM model in the same way as the figures above.

l.820: Each set of experiments has its own analysis. Would it be possible to get a comment on how these analyses differ (not much, I imagine)? The main improvements described in 6.1 therefore come from the forecasts, not from a potential change in analysis. I suspect that in Figure 13, there is a "story" hidden in the better results for T and RH obtained by AER_DIR and AER_CLIM wrt the other four around 700 hPa for the Northern hemisphere. Have you seen any change in convective precipitation, convective clouds? In discussion of Figure 14., I would point specifically to the areas where an improvement is to be seen or provide a figure showing DIR+INDIR-Analysis.

l.864: The increase in Sc by 20% in AER_DIR_INDIR and INIT_DIR_INDIR off-coast Chile and Namibia is not so obvious from Figure 15d and f?

l.921L over across?

l.951: sentence improperly linked

l.956: CNTRL

l.959: negligible

l.982: Could you put explicitly where previously it has been addressed.

l.1062: Here or in the conclusions, might be a place to stress that not all dusts have the same optical properties with for example various imaginary part of their refractive indices. In this respect, modelling aerosols for NWP will continue to be tough given the constraints of computer costs.

l.1070: This is what

l.1094: 30 or 50 Wm-2 as quoted in l.113?

l.1122: Apart from this (?)

l.1128: The potential of using = the potential use of the global NWP ...

l.1212: from NWP to climate, an objective in the development ... (?)

l.1216-1221: This paragraph sounds a bit too much as "Ten-year plan gobbledygook". Any possibly to say the same thing with more than one sentence?

l.1227: was?

l.1301: upper level tropical ...

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 30453, 2013.