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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Analysis of the ozone profile specifications in the WRF-ARW model and their impact on the simulation of direct solar radiation" *by* A. Montornès et al.

Anonymous Referee #2

Received and published: 29 August 2014

General Comments:

This paper describes the specification of ozone profiles used within most of the WRF-ARW radiation options, compares these to the MSR total ozone dataset, and reviews the impact of the differing ozone amounts on the calculation of the direct solar radiation in two of the WRF radiation options. The first part of the analysis, which compares the various WRF ozone specifications to the MSR data, is a very useful demonstration of the degree to which the ozone concentrations vary spatially and temporally among the radiation codes. While the worthwhile goal of the second part of the analysis is to illustrate the isolated impact of the ozone differences using a consistent, if simplified,

radiative transfer method, this result does not relate directly to how the ozone variations contribute to actual radiation calculations within WRF. The paper would be more useful to the WRF user community if the authors added an analysis using one or more of the WRF radiation codes so that the full complexity of the radiative processes involved were represented. For example, the two models applied in the second part could be run within WRF for a single time step for some region or globally. In different experiments, each radiation code could be run with its own ozone specification and then run again with the ozone concentration from the other radiation code. This might be an insightful way to demonstrate the impact of the ozone changes within the context of actual WRF calculations. Furthermore, from this reviewer's perspective, the differing specification of trace gas amounts within each radiation option is a fundamental flaw in the design of WRF-ARW itself rather than the radiation codes. These quantities should be provided to each radiation option in a consistent and sufficiently detailed manner from the host model, rather than be defined haphazardly as presently done. In some cases the radiation codes were extracted from other global models, which define their own ozone specification, while in other cases the radiation codes were provided for WRF independently of any existing dynamical model and without a pre-defined ozone specification. The authors are encouraged to consider addressing this perspective by using this paper not simply to compare the various ozone approaches but to provide guidance to the community on a better way forward; that is, to provide evidence for the advantages of improving WRF by adopting a unified and accurate approach to atmospheric specification for all of the radiation options. From a technical writing standpoint, the manuscript contains numerous grammatical difficulties and unclear sentences that are specified in the detailed comments along with suggested improvements. It is also suggested that the current three figures be separated into five figures. It is recommended that publication of the paper be reconsidered after major revisions to the manuscript are completed.

Detailed Comments:

Abstract

Page 20232, Line 12: The phrase “ozone modeling” suggests a more sophisticated approach than what is described in the paper; the phrase “ozone profile” is recommended.

1 Introduction

Page 20232, Line 23: The first sentence of the Introduction uses a somewhat awkward analogy. The shortwave absorption is more the “fuel” than the “engine”. A better start may be “The absorption of shortwave radiation by the surface and atmosphere is the primary source of energy that drives the atmospheric system.”

Page 20233, Line 2: Specify the peak level of ozone heating in the stratosphere. The authors might also specify here the top pressure level required to simulate the stratospheric ozone heating effectively.

Page 20233, Line 24: The phrase “defining a region denoted by ozone layer” is unclear and should be reworded.

Page 20234, Line 1: Replace “These results. . .” with “This results. . .”

Page 20234, Line 6: If the intended meaning of this phrase is “. . .an analysis of the uncertainties associated with the computation of the direct solar radiation” then reword accordingly, otherwise clarify.

Page 20234, Line 14: Replace “error over the direct” with “error on the direct”

Page 20234, Line 15: Replace “composed only by ozone” with “composed only of ozone”

Page 20234, Line 16: Replace “is centered in” with “focuses on”

Page 20234, Line 20: The footnote on this page might be more appropriately added to the acknowledgments, but this is a point to take up with the editor.

2 Methodology

Page 20235, Line 15: It might be clearer to reword this sentences as “. . .neglect the pressure and temperature (i.e. height) dependence of the ozone absorption. . .”

Page 20236, Line 8-9: Excluding the GFDL shortwave code from the analysis deprives the readers, especially those who may be using this parameterization in WRF, from the opportunity to understand its accuracy relative to the other methods. It is arguable that the community would be better served by including results from all of the available SW options.

Page 20236, Line 10: The WRF-ARW user’s guide lists the reference for the original Goddard scheme as Chou and Suarez (NASA, 1994), for the GFDL SW model as Fels and Schwarzkopf (JGR, 1981), and for RRTMG_SW as Iacono et al. (JGR, 2008).

Page 20236, Line 12: This reviewer’s understanding of the RRTMG_SW code is that the number of sub-intervals (i.e. quadrature points) used to integrate the k-distributions in each spectral band is variable among the fourteen bands, not fixed at 16, and totals 112. This is a time saving feature of this code relative to the RRTM_SW model, which does use a fixed set of 16 quadrature points in each spectral band for a total of 224.

Page 20237, Line 4: Replace “81th” with “81st”

Page 20237, Line 6: The phrase “In the first part” is vague. Please clarify.

Page 20237, Line 10: Replace “composed by 37 levels” with “defined at 37 levels”

Page 20237, Line 20: Replace “cover” with “covers”

Page 20237, Line 25: A better word than “assigned” in this sentence would be “distributed”

Page 20238, Line 3: Add “with” before “respect”

Page 20238, Line 12: This sentence has to be reworded. The phrase “. . .individual

gas species loss progressively the hydrostatic equilibrium. . .” doesn’t communicate the intended meaning.

Page 20238, Line 16: Reword the end of this sentence to read “. . .and are monotonically decreasing”

Page 20238, Line 19: Reword “Because of available ozone profiles. . .” as “Because the available ozone profiles. . .”

Page 20239, Line 6: Change “pressure at surface” to “surface pressure”

Page 20239, Line 7: Change “pressure at surface” to “surface pressure”

Page 20239, Line 8: Suggest rewording “. . .shows a dependence on the location and the season” as “varies by location and season”

Page 20239, Line 10: Change “since” to ‘from”, and change “has been consistent” to “is consistent”

Page 20239, Line 15: Suggest rewording “To discuss about the geographical. . .” to “To quantify the geographical. . .”

Page 20239, Line 17: Suggest rewording “For the discussion about the seasonal. . .” to “In order to examine the seasonal. . .”

Page 20239, Line 20: Replace “situations” with “situation”

Page 20239, Line 20: Suggest replacing “summarized” with “identified”

Page 20240, Line 16: The phrase “leading a quantification about the error” is unclear and should be rewritten.

Page 20240, Line 18: Equation (5) suggests that the resulting error term on the left hand side is a function of ozone method in addition to the spatial dimensions.

Page 20240, Line 23: Replace “previous” with “previously”

Page 20240, Line 25: While it’s insightful to examine the ozone method of each radiation model using a similar, simplified radiative method as described in Section 2.3, it isn’t clear how this result relates to the effectiveness of each model to simulate the radiative effects of ozone within WRF. For example, are the differences in the ozone absorption related to the radiative transfer method used by each model larger, smaller or comparable to the differences caused by the ozone specification? Perhaps global calculations for a single time step with each radiation model (or at least New-Goddard and CAM) using its own ozone specification and the ozone specification of the other model would also be insightful.

Page 20241, Line 3: Replace “we” with “be”

Page 20241, Line 6: Reword the phrase “discussed by many literature such as”

Page 20242, Line 3: The provided definition of W(λ) is unclear. Is this the ratio of the energy in a band dλ to the total integrated energy?

Page 20242, Line 9: Suggest replacing “with the wavelength throughout the interval” with “on wavelength in the interval”

Page 20244, Line 17: Reword the phrase “the minimum slant respect the normal. . .”

Page 20244, Line 22: Suggest rewording “using as TO3, the original and MSR datasets” as “using TO3 from the model and the MSR datasets”

Page 20245, Line 4: Clarify and reword the phrase “due to total absorptions are normalized respect. . .”

3 Results

Page 20245, Line 12: Move the first comma so that the sentence reads “In the RRTMG scheme, shown in Fig. 1, the lowest. . .)

Page 20246, Line 2: Replace “. . .due to the ozone profiles are limited to winter. . .” with “. . .due to the ozone profiles being limited to winter. . .”

Page 20246, Line 4: Suggest replacing "...larger in the Southern during the Southern Hemisphere fall..." with "larger in the Southern Hemisphere from March to May..."

Page 20246, Line 5: Suggest replacing "...lower in the Northern Hemisphere during the Northern Hemisphere winter..." with "lower in the Northern Hemisphere from December to February..."

Page 20246, Line 7: Remove "the" after "around"

Page 20246, Line 9: Does this sentence refer to boreal spring and summer?

Page 20246, Line 20: Suggest replacing "emulated" with "simulated"

Page 20246, Line 27: Replace "...around the Greenwich's meridian..." with "...around 0°E..."

Page 20247, Line 5: Regarding the statement "...while the largest errors are observed in the RRTMG", are the authors referring to a globally weighted RMS error, or to the extreme errors? The prior text refers to larger extreme biases in the G-NG-FGL ozone method. In addition, it is recommended that this sentence be revised to refer to the biases of the ozone method used with RRTMG rather than the model itself, since the ozone specification defined in the interfacing is not strictly part of the RRTMG code itself.

Page 20247, Line 9: Clarify the phrase "...during the ending Southern Hemisphere winter and the near Southern Hemisphere spring due to the ozone hole is smoothed..."

Page 20247, Line 14: Replace "...it is observed an underestimated region..." with "...an underestimated region is observed..."

Page 20247, Line 24: Suggest replacing "determination" with "specification"

Page 20248, Line 6: Replace "Mid-latitudes" with "Mid-latitude"

Page 20248, Line 10: Add "a" before "bias"

Page 20248, Line 22: Remove "the" after "around", and replace "maximum" with "maxima"

Page 20248, Line 27: Clarify the phrase "...seasonal ozone depletion occurred since winter until near spring..."

4 Conclusions

Page 20250, Line 5: Figures 1 and 2 suggest that this sentence should refer to the Northern Hemisphere winter.

Page 20250, Line 9: Replace "...in front of the climatology" with "...relative to the climatology"

Page 20250, Line 10: The sentence that beings "Only the northern..." is unclear and should be reworded

Page 20250, Line 26: Replace "composed by" with "composed of"

Page 20251, Line 3: Replace "address" with "addresses"

Page 20251, Line 17: Add "the" before "underestimated"

Page 20251, Line 22: Add "As conclusion" with "In conclusion"

Page 20251, Line 25: The phrase "shortwave radiation at surface becoming as a relevant point due to..." is unclear and should be reworded

Tables and Figures

Figure 1: It is recommended that this be separated into two different figures and enlarged

Figure 3: It is recommended that this be separated into two different figures and enlarged

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 20231, 2014.