Geosci. Model Dev. Discuss.,
doi:10.5194/gmd-2016-219-RC2, 2016

Geoscientific Model Development Discussions

Interactive comment on "OZO v.1.0: Software for solving a generalized omega equation and the Zwack-Okossi height tendency equation using WRF model output" *by* Mika Rantanen et al.

Anonymous Referee #2

Received and published: 28 October 2016

General comments The authors present OZO, a diagnostic tool for numerical atmospheric models that calculates the vertical motions associated with different physical forcings and the corresponding height tendencies with the help of the generalized omega and the Zwack-Okossi tendency equations. With OZO it is possible to calculate the vertical velocity and height forcing for each physical mechanism, including both the direct effect from the forcing itself and the indirect effects related to the vertical motion induced by each physical mechanism. Another interesting feature of the software is the possibility to infer the vertical velocity from pressure level data. For the diagnostics OZO uses the hydrostatic primitive omega, vorticity, and thermodynamic equations as well as the nonlinear balance equation. These equations can be solved using standard

output and makes OZO potentially useful for the diagnostic of any atmospheric model. The paper is well written, with a concise and complete abstract and the overall presentation well structured and clear. The description of the equations is complete, with correctly defined mathematical formulae and the methods and the assumptions made are valid and clearly outlined. The references seem appropriate. They give a correct overview of the field and their numbers are adequate. The authors state that the software could be useful for studying the dynamics of such important climate features as storms, low level jets, etc. As such, OZO could be very useful for understanding changes in the dynamics of these phenomena due to changes in the environment, say climate change or the transition of tropical cyclones to extratropical cyclones. However, that kind of studies could be more challenging from the numerical point of view than the case presents in the paper and could need a WRF setup with much higher resolution than the presented here. Therefore I would like to see the performance of OZO with a higher resolution, realistic application (i.e. in a 3-10 km grid and simulations for different seasons). If OZO is able to show good results in such applications, it would represent an important tool for the climate and weather prediction modeling community. Another shortcoming of the software is that it is tailored to use input from WRF, while other similar packages (for instance, DIONYSOS, RIP4) can run on other numerical models. Although I guess it would be not too difficult to extend OZO for the use with the output from other regional models. Although the authors describe similar packages and indicate clearly the differences between OZO and these tools, I miss a more direct comparison of their results.

Specific comments 1. In Räisänen (1995) the method is applied to the ERA reanalysis. Why this time you choose the idealized case and not the real case of Blazquez et al (2012)? Last generation reanalysis are considered significantly better than these available when Räisänen (1995) was published. Would the use of a state of the art reanalysis improve the correlations for the different regions obtained in that paper? 2. The use of the Coriolis parameter f would not cause numerical problems if you analyze a real case? 3. Is your software suited for the analysis of long term climate

simulations? 4. I wonder if the performance of OZO depends on resolution. 5. Model setup description is not clear, should be as in Blazquez et al (2012) 6. I am not sure that at 100 km resolution non-hydrostatic effects are relevant

Technical corrections Introduction, paragraph 5: change “to separate individual forcings contributions to vertical motion and height tendency” to “to separate the contributions of each forcing to the vertical motion and height tendency”. Line 8, page 2: “but the division of the ω to contributions of various atmospheric processes is not possible in RIP4” to “but the division of the ω tendency into contributions from various atmospheric processes is not possible in RIP4” I do not understand the phrase “OZO output explicitly includes ω and height tendency contributions of vorticity advection and temperature advection by the full wind field V and the corresponding contributions associated with the divergent wind Vχ” In line 3, page 7. May be it could be changed to “OZO output explicitly includes the vorticity advection and temperature advection terms of the ω and height tendency equations due to both the full wind field V and the the divergent wind Vχ”

Please also note the supplement to this comment:
http://www.geosci-model-dev-discuss.net/gmd-2016-219/gmd-2016-219-RC2-supplement.pdf

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