Dear Reviewer, thank you for finding time to read our article and present your comments that helped to improve the manuscript. Please find our responses below.

Author responses to Reviewer 1 comments

Major Comments:

(1) Sections 2, 5: The reduced latitude-longitude grid system can alleviate some major issues with the "pole problems." However, it is not clear whether your reduced grid system includes the singular pole points in the computations. The spherical operators in Eqn.2-5, involves terms with the cosine of the latitude in the denominator, which may lead to instability at the vicinity of the poles when using FD discretization. How do you address this issue? Please provide some description on this in the revised manuscript.

Answer: Our reduced grid does include the pole points and this was indicated in Sect. 5.1. We recognize two problems with $cos\varphi$ denominator: (1) how to approximate the operators at pole points, (2) the denominator is small in the vicinity of poles that can lead to instability. Our approach to the first problem was completely explained in Sect. 5.2. Additionally, we corrected a mistake in the denominator of Eq. 36 and added Eqs. 37, 38 that extend 36 to the pole points. As for the second problem, we believe that it is really dangerous only if short zonal waves are present in the polar regions. The reduced grid does help to avoid the instability, because it does not support the most of short zonal waves in the polar regions. On the full grid, fortunately, the ∇^4 diffusion with the implicit time-stepping effectively dumps short zonal waves in the vicinity of poles (as shown by ref. Li & Bates 1994). The following sentence is added in Sect. 7.1 ("Fourth order hyper-diffusion") in the paragraph after Eq. (56). So we never noticed any instability that we can attribute to $cos\varphi$ denominator.

(2) Section 3.2: The SL computational efficiency is obtained with the dimension-splitting conservative cascade scheme (CCS). This scheme uses an efficient sequence of 1D operations for multi-dimensional problems. Authors should briefly outline the CCS for the sake of clarity, which would help the readers. Moreover, the basic paper on CCS algorithm (Nair et al. (2002), MWR, vol.130, pp 2059-2073) should be cited in the revision.

Answer: The requested information is included at the end of Sect. 3.2.

(3) Section 9: The performance of the model is validated with a couple of experiments. The J-W baroclinic instability test is a relatively simple test for SL models, both reduced and full grid models produce very similar results. The Held-Suarez test shows the time-space averaged results over 1000 days, it is not a challenging test for comparing the numerical schemes or grid systems. What it shows is the model's overall ability to maintain an equilibrium for long-term integrations. Authors should consider performing a short-term integration experiment, based on flow over an isolated mountain, similar to the SW test-case 5 proposed by Williamson et al. (1992). The mountains/topography pose problems particularly for the SL models, and such a

test would be far more interesting. See the “mountain-induced Rossby wave test” in Simmaro et al. (2013), Tellus A 2013, 65, 20270, http://dx.doi.org/10.3402/tellusa.v65i0.20270). Also the reference: Jablonowski, C., Lauritzen, P. H., Taylor, M. A. and Nair, R. D. 2008. Idealized test cases for the dynamical cores of atmospheric general circulation models: a proposal for the NCAR ASP 2008 summer colloquium. http://esse.engin.umich.edu/admg/publications.php

Answer: The results of mountain induced Rossby wave test case are now included in the revised manuscript, please see Sect. 9.3.

Minor Comments:

(1) In the Abstract please indicate that your model is hydrostatic, these days dynamical cores mostly imply non-hydrostatic model development. (2) Reference: On Page 26, lines 25-28: The two references for baroclinic instability tests by Jablonowski, C. and Williamson, D. . . refer to same test, keep any one of them. (3) It would be nice to include your future extensions plans (if any) with this hydrostatic dynamical core, in the Conclusions.

Answer: All comments are accepted, the corresponding changes are made, except (2): we decided to keep both references since JW2006b is the "main" reference for this test case in high-impact journal and JW2006a contains some information (pictures for high resolution reference solutions) not present in JW2006b.