

## ***Interactive comment on “A 4D-Var inversion system based on the icosahedral grid model (NICAM-TM 4D-Var v1.0): 1. Off-line forward and adjoint transport models” by Yosuke Niwa et al.***

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This is a well-prepared manuscript with a good focus. It is ideally suited for GMD, since it describes the development of an off-line model suitable for inversions of GHG emissions. The focus is on errors due to the time resolution of the meteorological driver data, and on the general validation of the adjoint code. The validation sites are well chosen. There is only one major comment that I would like to make. The numerical errors due to the use of a flux-limiter and due to low temporal resolution of the driver meteo are typically in the order of  $\sim 1$  ppm for CO<sub>2</sub> (and mostly smaller). It is difficult to place these numbers in a proper context. I advise the authors to provide this context by (i) report typical RMSD differences between different models, e.g. the TRANSCOM

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ensemble (ii) provide a typical “error” in the NICAM-TM that can be obtained by running in a different temporal or spatial resolution, or by other means (e.g. sampling error) A more minor issue is the use of the word “underestimation” in several places. It should be absolutely clear that the “truth” is defined as the online model simulation. In fact, it turns out that the A6V6C6 version performs “better” over Russia. I have added some further textual suggestions in the attached pdf file.

Other minor issues:

Page 2, line 13: 20 years is hardly feasible, also because model transport errors start to play a role on longer timescales. More attention to model errors would improve the manuscript further.

Page 3, line 6: “The discrete adjoint is linear but reduces the accuracy of the numerical scheme, while the continuous adjoint is non-linear but maintains the numerical accuracy.” The fact that numerical wiggles as “fixed” does not necessarily mean that the numerical accuracy is higher, because it implies also numerical diffusion. See also page 6, lines 14-15.

Page 7, line 18: 7 minutes: please specify which configuration (frequency of meteo input, I assume A6V6C6)

Please also note the supplement to this comment:

<http://www.geosci-model-dev-discuss.net/gmd-2016-231/gmd-2016-231-RC1-supplement.pdf>

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