

Interactive comment on “Sensitivity of tracer transport to model resolution, forcing data and tracer lifetime in the general circulation model ECHAM5” by A. Aghedo et al.

Anonymous Referee #1

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This paper describes the transport of tracers in a widely used climate model, ECHAM5. It relies on a set of idealized numerical experiments, with tracer sources in different regions. Loss is constant globally. There are several experiments with the model using different horizontal and vertical resolution. There is one experiment using ECMWF winds, and the model is nudged towards these winds. It is well written, and the presentation is clear.

As a paper documenting the performance of a model, it is interesting and useful. Since the model is widely used and widely cited, having access to this model documentation

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is useful. In order for the paper to be useful to more than those with direct knowledge of the model details, some of the items listed below must be addressed.

As a paper that investigates transport in the model from a scientific perspective, there are deficiencies. There is little hope of determining cause and effect from the experiments that have been performed. The analysis is short, and the reliance on global diagnostics only supports characterizing the model in a qualitative, but useful, way. There are no real comparisons to many studies that focus, in more detail, on transport.

The publication of the paper depends on the publication policy of the journal. If a clear and useful description of a widely cited climate model is consistent with ACP guidelines, then with revision publication is warranted.

More specific comments:

1) In order to be useful to more than the people directly involved with ECHAM5 the following is needed.

1.1) Where is the top of the model and what is the configuration of the vertical levels? This is essential information for the reader to evaluate the performance of the model.

1.2) Please explicitly state the mechanisms of sub-scale mixing in the model. What sort of diffusion is used in the spectral dynamics? What sort of filters? What are the diffusive characteristics of the tracer advection algorithm? Since the formulation of sub-scale mixing strongly influences, perhaps dominates, the transport on these space and time scales, the reader needs to know this.

1.3) As I understand the experiment, all of the experiments are on-line versus off-line. This is true even for the ECMWF experiment. The data is used as a forcing, and there is a characteristic time scale of this relaxation. This relaxation is a dissipative process, and it strongly influences the transport on large spatial and temporal scales. We need to know the value of this parameter.

2) The experiment design is solid to investigate model performance. However, for sci-

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entific investigation of transport processes it is not adequate. The design mixes the influence on the resolution of dynamical features and the influence of resolution on parameterized and numerical dissipative processes. Further, the tracers are placed with out consideration of natural dynamical barriers: e.g. the tropopause, the subtropical jet stream, etc. There could be significant change in the results if, say, the tropopause tracer was placed 1 grid box higher or lower. Similarly, if north was defined as north of the subtropical jet stream.

Again, the experiment design is robust for characterizing model performance, but attribution of cross equatorial transport to behavior of the ITCZ is not convincing. The same comment is relevant with attribution of differences to the QBO in the ECMWF experiments. There are other substantive differences, including perhaps the interactions of planetary waves with the upper boundary.

3) I need more description of, for example in Figure 2, than the curves have different values. I have little intuitive link to R and M, your variables, and it would help me to use terms of magnitude, larger and smaller, and what it means in terms of transport, for example, faster and slower.

4) I disagree with your statement that the impact of horizontal resolution is limited to the experiments with surface sources. Note the role of high resolution in the stratT experiment. There is also something interesting in the surfT experiments. These figures have more richness than described.

5) Are not the interhemispheric transport times in this model very fast? That would seem to be consequential to the model performance in general. This perhaps demands more discussion.

6) In general, more mention of the ability of the model to stimulate transport mechanisms would be nice. For example, does the Madden Julian Oscillation change with resolution?

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There are oddnesses which I think are due to software translation of embedded characters. What is citepsimbur81 ?

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 137, 2008.

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