Geosci. Model Dev. Discuss., 6, C1–C3, 2013
www.geosci-model-dev-discuss.net/6/C1/2013/

Interactive comment on "The ICON-1.2 hydrostatic atmospheric dynamical core on triangular grids – Part 1: Formulation and performance of the baseline version" *by* H. Wan et al.

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Received and published: 4 February 2013

I appreciate the documentation fo the ICON dynamical core. This is a great achievement for the development group.

I want to stress some points that could be discussed in more detail in the Paper:

1) Equivalent resolution (Table 2 and discussion on page 83)

The 'by eye comparison' to ECHAM is not an objective scientific method. It is very easy to give the effective degrees of freedom or in other words the total number of effective number of mass points for ICON in comparison to ECHAM.

In the triangular C-grid one has 3 normal velocity components where a comparable quadrilateral mesh has 2 normal velocity components. The work by Thuburn (2008) showed how the third degree of freedom is slaved to account for a linear dependence among the three velocity compontents on a hexagonal grid. Whatever on is doing – either go to the hexgonal C-grid where the overspecification can be treated without disrupting wave propagation – or stay with the triangular C-grid and apply some unphysical filtering as it is done in the present model description – eventually the third degree of freedom does not provide any new dynamical information. Therefore we have to conclude that a hexagon – which contains 3 normal components => effectively 2 normal components – is comparable to a quadrilateral grid box. Hence we have to count the number of hexagons (=half of the number of triangles) to find the effective number of mass points. Interestingly, comparing the n_m for ICON and ECHAM in table 2, we find approximately that n_m for ECHAM is about half the number of triangles (the n_m for ICON). The reason why the ratio is not exactly met and there are less n_m for ICON than expected from this consideration is related to the fact that in a triangular C-grid model, the tracer advection (in this case the temperature advection) is performed a bit more precisely. This increases the overall accuracy as can be observed by similar examples that are known from Skamarock and Gassmann (2011) when they are increasing the order of accuracy of the tracer advection in the baroclinic wave test.

For the same dynamical resolution than a comparable quadrilateral mesh one needs thus approximately twice the number of mass points. One has to discuss what this means for the efficency of an operational model where the computing time spent in physical parameterizations is dominating the overall timings. One could half the number of parameterization calls when using a hexagonal mesh.

2) Motivation for ICON

I know that the main motivation for keeping the triangular C-grid mesh is the fact that grid refinement is based on the philosophy of dividing triangles in contrast to the grid streching philosophy advocated in MPAS. The grid refinement issue is not discussed in this paper, but it needs at least to be mentioned as a motivation in the introduction. Why the MPAS approach is ruled out for ICON?

3) Aqua planet experiments

I do not understand why two different vertical resolutions and two different time steps are used for ECHAM and ICON. One could learn more if using the same settings for the two models, especially as they employ exactly the same parameterizations. It is not clear why ICON is showing less high frequency activity than ECHAM in Figures 15 and C1.

4) Kinetic energy spectra

Since the paper discusses some unusual and unphysical momentum diffusion terms and we know that the diffusion is the main driver for the shape of a kinetic energy spectrum it would be interesting to discuss kinetic energy spectra for ECHAM and for ICON for either the Held-Suarez test or the aqua planet experiments.

Interactive comment on Geosci. Model Dev. Discuss., 6, 59, 2013.

GMDD

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