

## ***Interactive comment on “FVM 1.0: A nonhydrostatic finite-volume dynamical core formulation for IFS” by Christian Kühnlein et al.***

**Anonymous Referee #1**

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FVM1.0: A nonhydrostatic finite-volume dynamical core formulation for IFS gmd-2018-237

By C. Kuehnlein et al.

General comments

The manuscript documents some recent advances made in the development of a new finite-volume dynamical core within the Integrated Forecasting System at ECMWF. These include the introduction of a horizontal-vertical split transport scheme, variable timestepping, coupling to the physical parameterization suite through a flexible interface, and optional subcycling of dynamical steps between physics steps. Some of these developments, in combination with recoding, have led to significant improve-

C1

ments in computational performance. At the same time, test case results are reassuringly similar to those produced using the operational spectral dynamical core. The paper is generally well written, and provides a valuable documentation of the state of development of what is potentially a future operational dynamical core. I would be happy to recommend publication subject to minor amendments to clarify a few points.

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Specific comments

Section 2.1.2. There seem to be several levels of iteration: equations (11a) and (11b); the weakly nonlinear (19); and the line Jacobi preconditioner (appendix B), with various corresponding lagged terms (p11 line28, p30 line 8). Could the relation of these to each other be clarified, for example with a section of pseudocode?

P7: Could the authors say something about whether the perturbation form of the equations still works for more complex flows and in the presence of significant orography? Is a more complex ‘ambient’ state needed?

P7: Do the metric terms (caligraphic M) blow up at the poles, and, if so, does this cause any difficulty? Check for consistent font ((5) and (C3)).

P9 Table 2: Since there is no prognostic equation for Exner pressure in (1a)-(1e), could you explain why there is an off-centring parameter for the Exner perturbation?

P16 line 15: Could a reference be given for the IFS documentation?

P19 line 16: It is a shame that the baroclinic instability was not triggered in just one hemisphere, as grid imprinting can be revealed in the quiescent hemisphere. In the present case ‘no signs of any significant grid imprinting’ (P19 line 31) is rather a weak statement because the fully developed wave could be hiding any grid imprinting.

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Minor points, typos, etc

C2

P2 line 22: advancements -> advances

P2: I think footnote 1 could be omitted; this is a different kind of 'spectral' and readers are not likely to get confused.

P8, lines 25 and 27: there is some repetition here.

P9 line 1: there two -> there are two

P10 line 22: gather -> gathering

P11 line 4: More idiomatic would be 'still requires the Exner pressure perturbation to be specified'

P11 line 24: 'respectively (7)' ??

P19 line 29: 30 ??

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