Title:-

Performance of the Cut-cell Method of Representing Orography in Idealised Simulations

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Abstract:-

Several tests of a model with a cut-cell representation of orography are presented: a resting atmosphere test, advection across a hill and a warm rising bubble over hills with different gradients. The tests are compared with results from terrain-following models.

Results indicate that errors associated with terrain-following coordinates are reduced, in some cases greatly reduced, with the cut-cell approach. In a resting atmosphere the cut-cell approach does not generate flow around an isolated hill however steep the terrain.

Relative errors in a rising bubble test are an order of magnitude smaller than terrain-following simulations. These rising bubble tests demonstrate that the Cut-cell model is better at handling steep gradients than the basic terrain-following method. Differences due to the effect of the underlying terrain do not erroneously increase as the aspect ratio increases in contrast to a terrain-following model.

All these tests demonstrate that by avoiding any distortion of the computational grid away from the terrain, the cut-cell method reduces errors in the flow aloft compared to terrain-following methods. Furthermore, results from the rising bubble test with very steep orography (aspect ratio of 10) demonstrate that the Cut-cell model is stable, without compromising accuracy.