Interesting features of the dynamical core of CCAM

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Abstract

The Conformal Cubic Atmospheric Model (CCAM) has been used for over 20 years at CSIRO in Australia. It was the first global primitive-equations model to be developed on a cubed-sphere grid. It has a number of unique features.
The model was originally formulated on the conformal-cubic grid devised by Rancic et al. (1996). The formulation now permits the more-common equi-angular cube grid, as well as the uniform-Jacobian cube grid. CCAM can be run on stretched versions of all those grids by utilizing the Schmidt (1977) transformation, which just requires the inclusion of a map factor.

A family of reversible staggering schemes was proposed by McGregor (2005), well-suited to models utilizing cubed-sphere grids. The schemes have excellent dispersion properties for geostrophic adjustment and are a fundamental feature of the model. CCAM is a semi-implicit and semi-Lagrangian model, holding all variables on the non-staggered A grid. The wind components are reversibly transformed to staggered C positions for the semi-implicit calculations.

For fine resolution runs, the Miller-White (1984) non-hydrostatic scheme is employed. This scheme is exceptionally efficient and imposes no time-step penalty.

Over the years, CCAM has taken part in many model intercomparisons. Its main applications are for specialized very-fine-resolution NWP. CCAM is also used extensively for high-resolution dynamic downscaling of CMIP climate simulations over many domains, including Australia, Africa. New Zealand and several countries of Southeast Asia.

Keywords: cubed, sphere, semi, Lagrangian, reversible staggering

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