Introduction

- A new algorithm and associated software (released with CAM5.2) to generate surface height and associated sub-grid-scale topographic variances is presented.
- Atmospheric models usually need the following topography related variables:
  - PHIS: geopotential height of surface
  - LANDFRAC: land fraction (0,1)
  - SGH: standard deviation of PHIS on scales approximately less than 6km (for turbulent mountain stress parameterization)
- The “raw” topographic data (USGS 30sec) is binned to an intermediate lat-lon grid for plotting. Label ‘FV 0’ refers to more smoothing (“16x”) and ‘4x’, ‘8x’, and ‘16x’, refer to different representations of surface elevation. Labels ‘4x’, ‘8x’, and ‘16x’, refer to different representations of surface elevation.

- PHIS is usually smoothed to avoid noise problems; after smoothing PHIS the SGH variable is incorporated to include the extra sub-grid-scale variance in SGH introduced by the smoothing of PHIS.

- The “raw” topographic data (USGS 30sec) is binned to an intermediate gnomonic cubed-sphere grid which, contrary to the older versions of CAM topography generation software, results in a quasi-isotropic separation of scales over the entire sphere for SGH30 and SGH (see center Figure).
- The cubed-sphere data is thereafter rigorously remapped using a volume conserving method (Lauritzen et al. 2010; Ulrich et al. 2009) to any target model grid. The algorithm supports structured and unstructured meshes; even with non-convex control volumes.

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Topography generation software: CAM5.2

New CAM (NSF-DOE Community Atmosphere Model)

Peter Hjort Lauritzen1, J. Bacmeister1, M.A. Taylor2, R.B. Neale1

1 National Center for Atmospheric Research (NCAR), Boulder, Colorado, USA 2Sandia National Laboratories, Albuquerque, New Mexico, USA

Figure: Cross sections of height through the Andes for different levels of PHIS smoothing in CAM-SE (spectral elements) as well as HOMME (High-Order Methods Modeling Environment) and CAM-4V (finite volume) height.

- Vertical velocities – level 10 (~323hPa): 10 year average over June-July-August
- Sea-level pressure (SLP): 10 year average over December-January-February

Summary

- Topography generation software that consistently separates scales for sub-grid-scale parameterizations and volume-conserving remaps variables directly to any spherical target grid has been released with CAM5.2.
- Different levels of smoothing of PHIS for the new dynamical core in CAM based on spectral elements (SE) have been tested in “AMIP”-like simulations and a balance between roughness of PHIS, level of additional divergence damping and simulation quality has been found: 16x, 2.5x div

References


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