

Update on WGNE-Sponsored Activity: 2012 NCAR Summer School and Model Intercomparison Workshop on Non-hydrostatic Global Models



Christiane Jablonowski and Paul Ullrich (University of Michigan), Peter H. Lauritzen and Ram Nair (NCAR), Mark Taylor (Sandia National Lab)

27th WGNE, Oct/17-21/2011, NCAR, Boulder, CO

Background: Dynamical Core Summer Colloquium in 2008 at NCAR

Lauritzen, Jablonowski, Taylor, Nair

- Sponsored by NCAR Advanced Study Program (ASP), NASA and DOE.
- We invited modeling groups, lecturers and students to a hands-on dynamical core intercomparison project at NCAR, Boulder, USA



Modeling teams were: German Weather Service, Max-Planck Institute, NCAR (3 models), NASA GSFC (2 models), NASA GISS, Duke University, NCEP, Colorado State University, MIT

Impacts of the 2008 Colloquium

- Springer Book, April 2011 (556 pages)
- Dissemination of the dynamical core intercomparison data online through the *Earth System Grid* (2008 data currently in transfer to NOAA host server, 1.3 TB)
- Modeling mentors were provided with sometimes surprising feedback about their dynamical cores.
- Selected science results of the intercomparison project in peer-reviewed journals (Lauritzen et al. 2010; J. Adv. Model. Earth Syst.).
- Test cases have potential to become a community standard. They are easy to implement and run.
- The workshop ideally integrates science and education.

The image shows the front cover of a book. The top half of the cover has a background of a globe with a blue grid overlay. In the upper right corner, there are four smaller globe icons with different grid patterns: red, black and white, blue, and blue with red outlines. The title 'LECTURE NOTES IN COMPUTATIONAL SCIENCE AND ENGINEERING' is at the top left in white, and '80' is at the top right. The authors' names 'P. H. Lauritzen · C. Jablonowski' and 'M. A. Taylor · R. D. Nair Editors' are in the middle left. The main title 'Numerical Techniques for Global Atmospheric Models' is in large white font, with 'Tutorials' in red at the bottom right. The Springer logo is at the bottom right. The spine of the book is visible on the left, showing 'Lauritzen · Jablonowski Taylor · Nair (Eds.)' and 'LNCSE 80'. At the bottom left is a barcode and ISBN information: ISBN 978-3-642-11639-1, 9 783642 116391, 9 783642 038438, and a link to springer.com.

**LECTURE NOTES IN COMPUTATIONAL
SCIENCE AND ENGINEERING**

Lauritzen · Jablonowski
Taylor · Nair (Eds.)

LNCSE
80

P. H. Lauritzen · C. Jablonowski
M. A. Taylor · R. D. Nair Editors

**Numerical Techniques
for Global Atmospheric
Models**

Tutorials

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Springer

In Active Planning Status: Dynamical Core Workshop in 2012

NCAR, July 30 – August 10 (tentative)

Organizers (proposing team):

- Prof. Christiane Jablonowski (University of Michigan)
- Dr. Peter H. Lauritzen (NCAR)
- Dr. Mark Taylor (Sandia National Laboratories)
- Dr. Ram D. Nair (NCAR)
- Dr. Paul A. Ullrich (University of Michigan)

Goals of the 2012 Workshop

- Teach ~30 multi-disciplinary students/postdocs how today's and future atmospheric models are built and how they can be improved.
- Test, discuss & intercompare the newest numerical methods and modeling techniques for global climate and weather models; special attention given to emerging non-hydrostatic dynamical cores.
- Establish new non-hydrostatic dynamical core test cases for the community, provide online benchmark solutions along with their uncertainties. Some tests include moisture.
- Accelerate community-wide interactions and collaborations.
- Promote the successful, rational development of non-hydrostatic global models & shorten the development cycle.

2012 Workshop: Methods

- Invite an international group of dynamical core modelers from both the weather and climate community.
- Recruit about 10 dynamical core modeling groups that port their dynamical cores to NCAR's computing architecture and spend 2 weeks with us and the students.

Possible Modeling Partners in 2012

- Open invitation: operational centers, research & university community, including prototype dynamical cores
 - Goal: represent a broad spectrum of equation sets, modeling approaches, numerical methods and computational grids
- Possible providers of non-hydrostatic dynamical cores (**in contact**):
 - U.K. Met Office (model ENDGAME)
 - ECMWF (non-hydrostatic version of IFS)
 - NASA's GEOS-6, FV model on cubed-sphere grid (also GFDL)
 - Max-Planck Institute / German Weather Service: model ICON
 - Colorado State University (David Randall's group)
 - Frontier Research (FRCGC) & CCSR: model NICAM
 - NOAA/ESRL's NIM model (non-hydrostatic icosahedral model)
 - NCEP
 - Others models?: e.g. prototypes from NCAR, LMD (France)

Preparation by Modeling Partners

- Secure institutional support, free up resources and time (personnel)
- Model developers play an **active role and are key to success:**

Before the workshop (March – July 2012)

- Implement the suggested test cases and prepare the model simulations (e.g. run scripts)
- Port the model to NCAR supercomputers (with NCAR software engineering support)
- Be able to either output or convert the model data to a CF-compliant NetCDF data file

During the Workshop (July 30 – August 10, 2012)

- Spend two weeks at NCAR
- Give short introductory tutorial about the model
- Serve as modeling mentors, work with a group of 3-4 students
- Oversee evaluation of the simulation results

2012 Workshop: Methods

- Invite an international group of dynamical core modelers from both the weather and climate community.
- Recruit about 10 dynamical core modeling groups that port their dynamical cores to NCAR's computing architecture and spend 2 weeks with us and the students.
- Perform a student-run model intercomparison project.
- Document & archive results through peer-reviewed articles, open-access data sets via the Earth System Grid.
- Workshop will establish newly developed software tools for innovative online collaborations and community interactions (workspaces, data, visualization): <http://www.esrl.noaa.gov/cog/>
- Keynote speakers give lectures on modern numerical techniques and innovative computational tools.

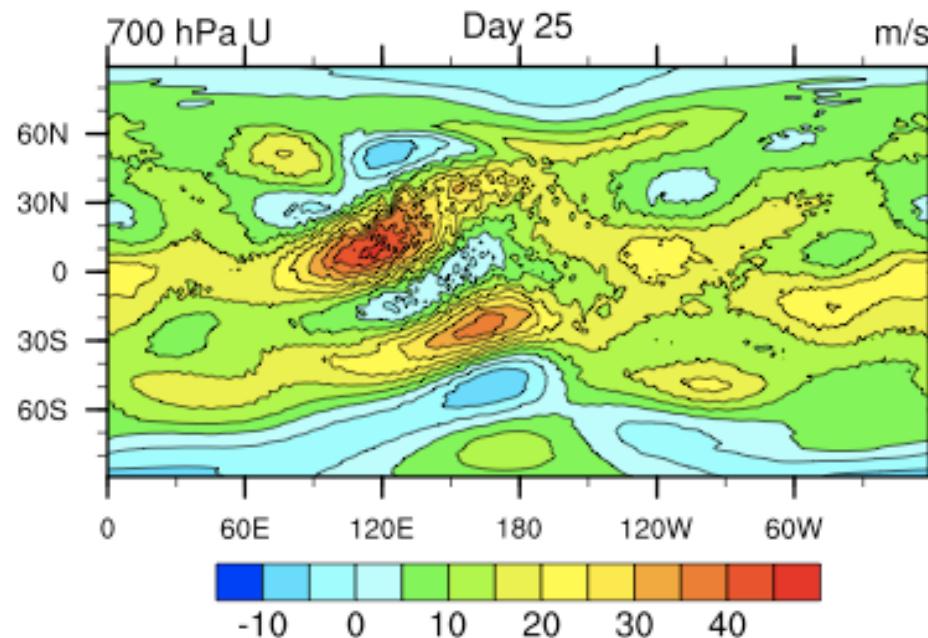
Workshop format

- Morning lectures
- Afternoon hands-on sessions in partnership with a modeling mentor.
 - direct scientific feedback and discussion about the model simulations, lively.



Why participate? Because ...

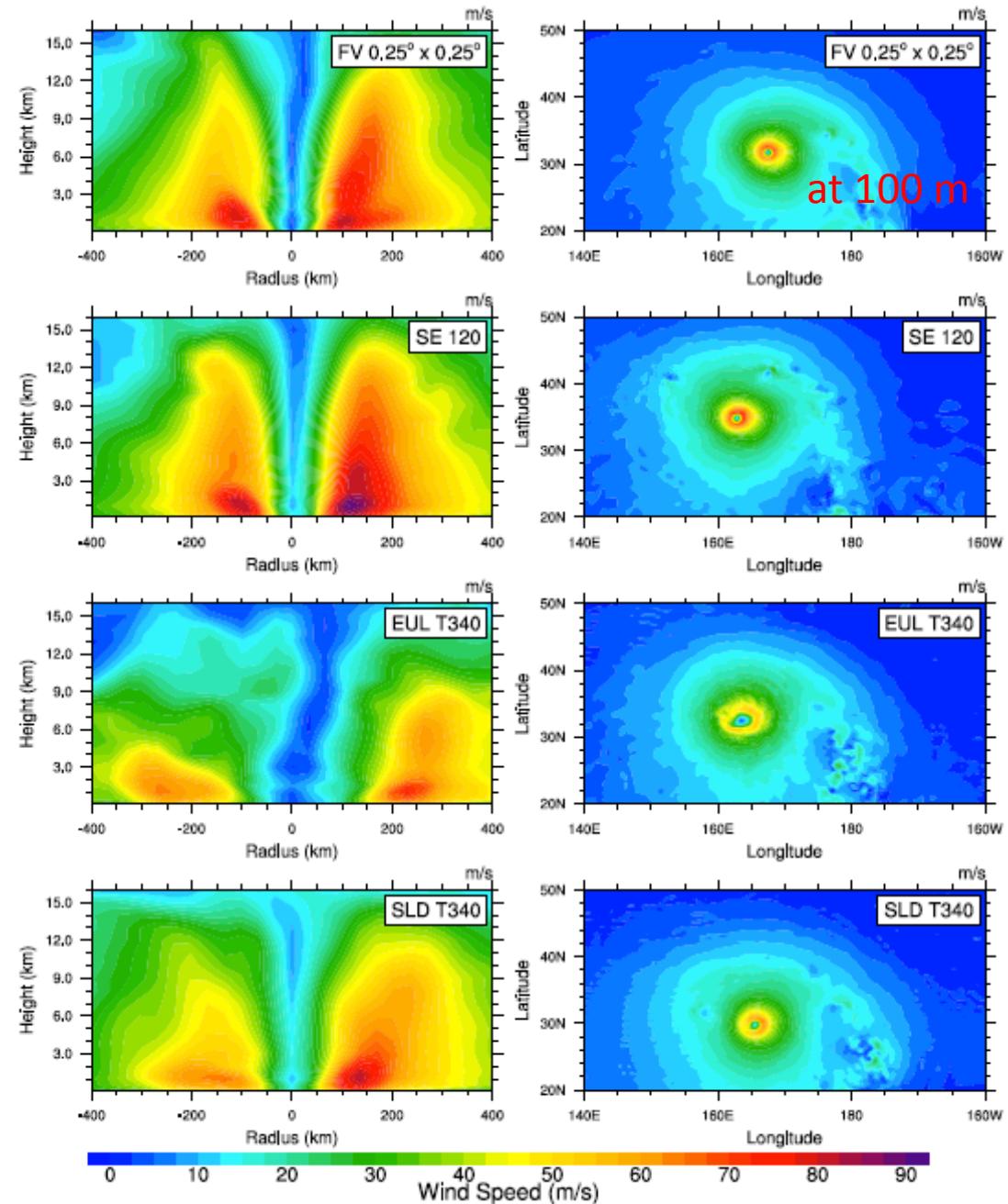
- Modelers are curious and strive to improve the simulations.
- It matters, it is fun and highly interactive.
- We all learn new aspects, even about unanticipated model instabilities, and accelerate the model development.



New Test Cases

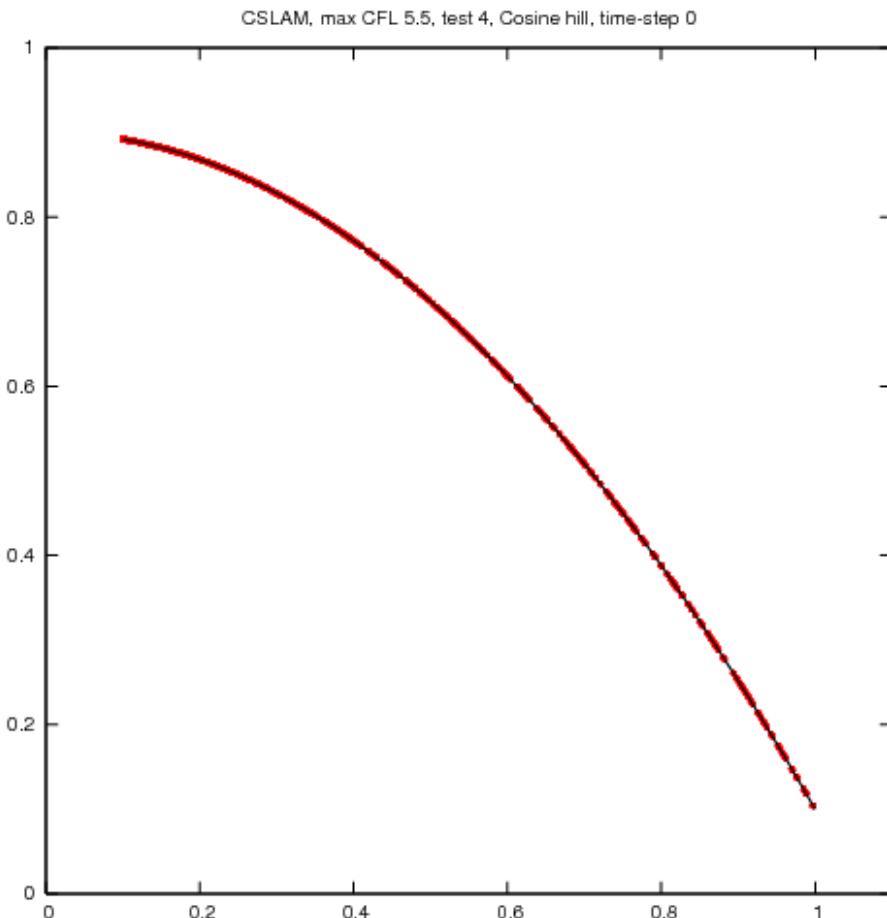
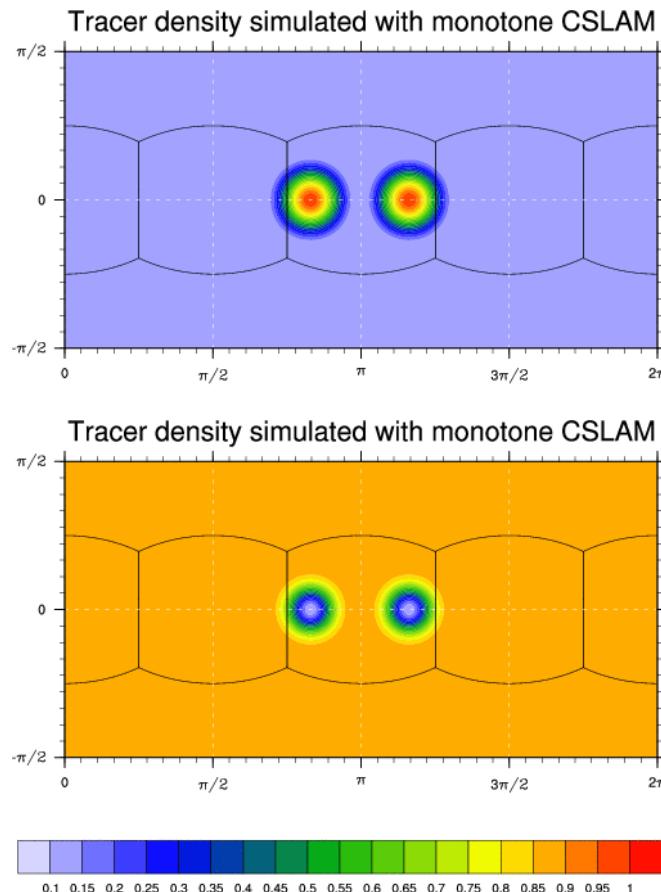
- In progress: new suite of idealized test cases that will be suitable for non-hydrostatic models.
Collaborators are welcome.
- We suggest dry dynamical core tests; and tests with simple moist physics parameterizations.
- Example: Idealized Tropical Cyclone
(Reed and Jablonowski, MWR, 2011)

Tropical Cyclone Test Case (moist)
Wind speed (day 10): 4 NCAR CAM5 results



Preserving pre-existing functional relation between tracers under challenging flow conditions

(important for online chemistry)



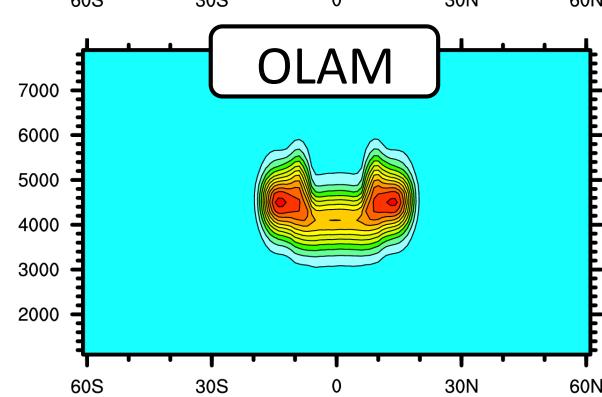
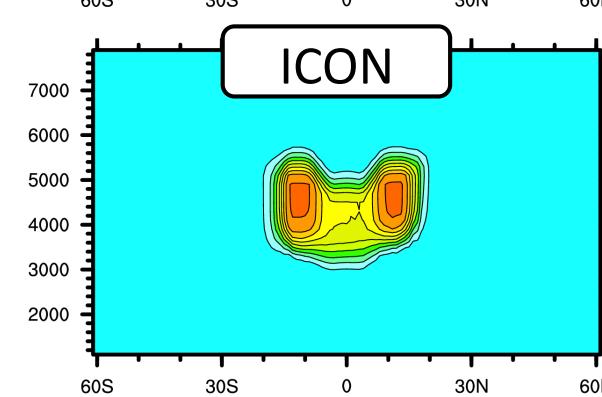
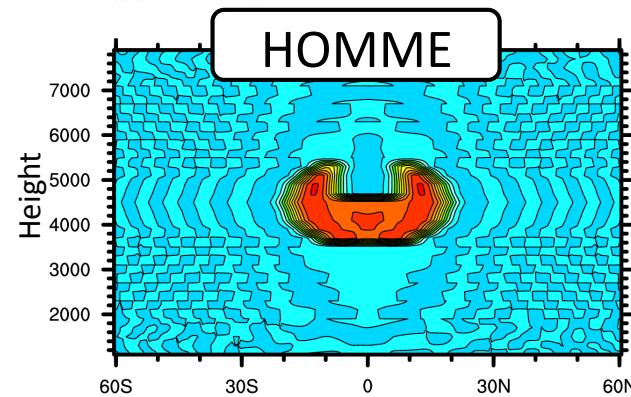
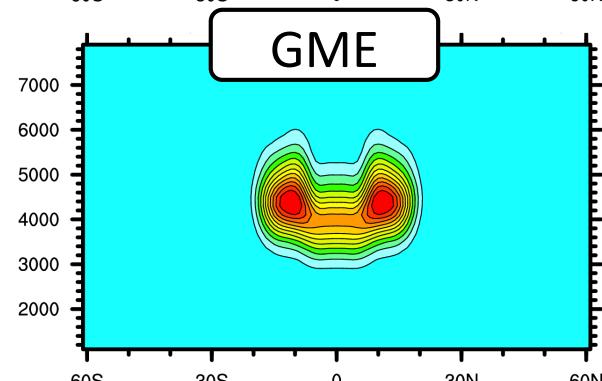
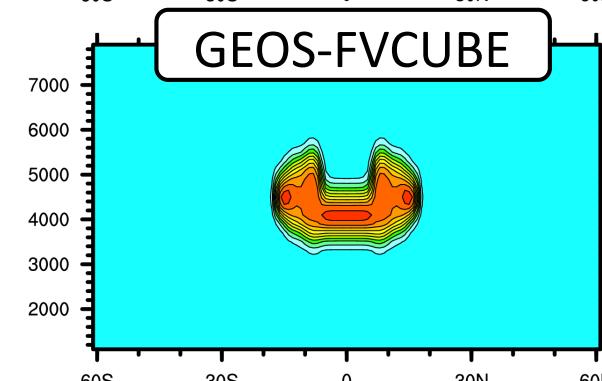
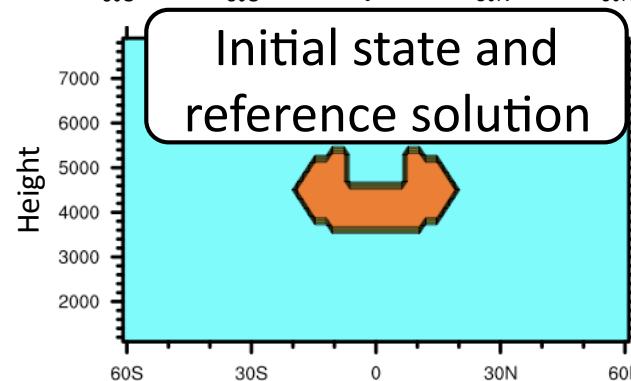
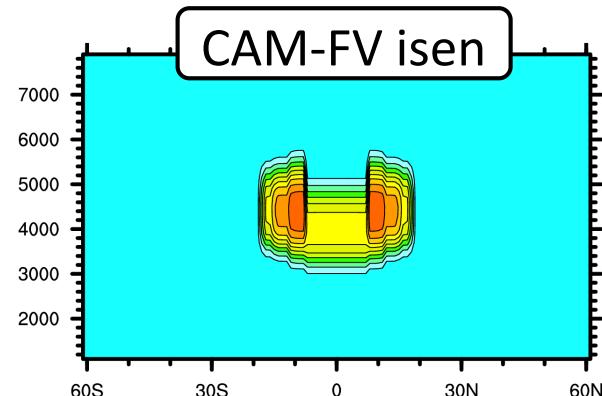
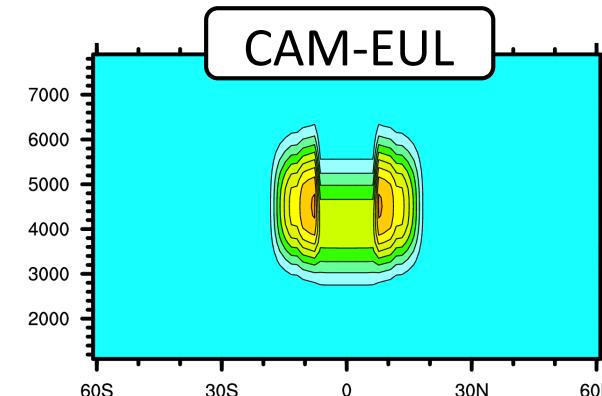
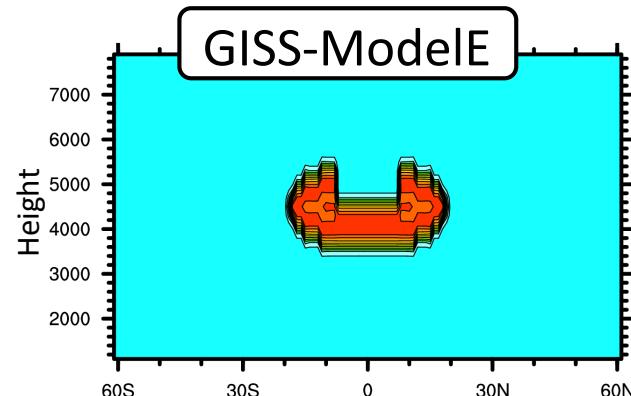
Financial and Logistical Support (10/2011)

- Estimated US \$120,000 needed, depending on the number of participating modeling groups
 - \$33,000, Cyber-enabled Discovery and Innovation (CDI) grant, National Science Foundation (NSF)
 - \$25,000 - \$30,000, Department of Energy (DoE)
 - ≈ \$35,000, Global Interoperability Program (GIP), NOAA
 - \$25,000 still needed: Unexplored sources
 - NASA Workshop support grant
 - NSF Workshop support grant
 - NCAR, Director's Office (in contact with Deputy Director Maura Hagan)
- Logistical, computer infrastructure support for the 2012 summer workshop from NCAR's Computational and Informational Systems Laboratory (CISL)
- 540,000 NCAR Computing Units (GAUs) awarded on NCAR's supercomputers (including new Wyoming Center)

Suggested WGNE's Role

- 2012 Summer School and Model Intercomparison Workshop was endorsed by WGNE in October 2010
- Encourage WGNE members to participate in the 2012 summer school and dynamical core model intercomparison
 - Remote participation will also be possible through new Cyberinfrastructure tool
- Promote the scientific importance of standard test cases and the dynamical core intercomparison project
- Promote the long-term online visibility and open-access to the science results, e.g. through a partnership with PCMDI
 - NOAA will provide storage/cyberinfrastructure on the Earth System Grid.
- Your suggestions and feedback are greatly appreciated

8 Model Results (2008): Advection along the Equator



Resolutions $\approx 1^\circ \times 1^\circ L60$, $dz=250$ m

