
AA & JHJ
Hiro
Celal
Scott
Ross
John

Summary and further comments

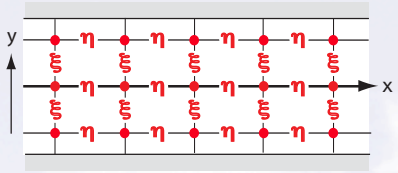
- Our effort in this research objective has been concentrated on the development of a Q3D algorithm based on a "gappy" grid.
- The formulation of lateral boundary condition is central to the development of the Q3D algorithm.
- The application of the cyclic Q3D (CQ3D) CRM to an idealized small domain is highly successful. It reproduces most of the important statistics of the benchmark 3D solutions.
- Comparisons with the results of a 2D CRM and a coarse-resolution 3D CRM indicate that an MMF based on the CQ3D CRM will be a useful framework for climate modeling.
- Various attempts to further improve the Q3D CRM were not successful, indicating that we have almost reached a plateau in the approach without using an interactive GCM.

Future plans

Short-term (by July 2011)

- Restructure the Q3D grid

  Within each channel, currently there are three grid-point arrays for η and scalar prognostic variables while there are only two grid-point arrays for ξ. To avoid the imbalance in the degrees of freedom between them at its origin, we will eliminate the third array. This will make the model more efficient roughly by the factor of 2/3.



ξ : x component of vorticity
η : y component of vorticity
• : scalar variables

- Fully document the Q3D algorithm and clean up the code.
- Parallelize the code and start working with a larger domain.
- Develop a Q3D MMF through coupling the Q3D CRM with an idealized GCM.
- Start implementing the Q3D CRM into the geodesic global model.

Long-term (after July 2011)

- Complete implementing the Q3D CRM into the geodesic global model.
- Evaluate the global Q3D MMF in view of climate simulation.

Future plans (Longer term) - continued

Implementation of the Q3D CRM into global models

- The global model can be either a vorticity-equation or a momentum-equation model.

  The latter case:

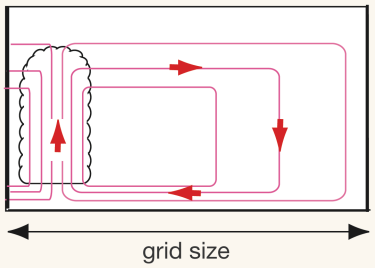
  The dynamical input to the Q3D CRM is through diagnosed vorticity.
  The dynamical output from the Q3D CRM is through diagnosed momentum.

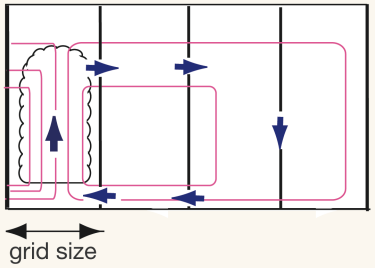
- The horizontal coordinate of the Q3D can be a square grid even though the geodesic grid is used by the GCM.

  Reason:

  - The Q3D algorithm is more or less established for square grid.
  - In the MMF approach, the output from the Q3D CRM is only through netsize averages.

ILLUSTRATION OF GRID-SCALE AND SUBGRID-SCALE MASS CIRCULATION

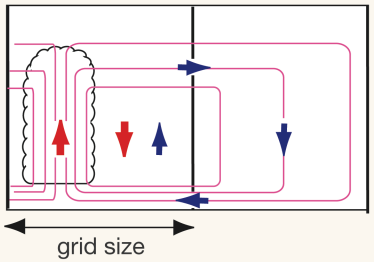




Subgrid-scale mass circulation

Grid-scale mass circulation

Existing schemes do a reasonable job for this transition.



" As the grid size deceases, the cloud fraction tends towards a bimodal, 0 or 1, distribution . . " – Krueger (2002)

Existing schemes do not cover this transition.

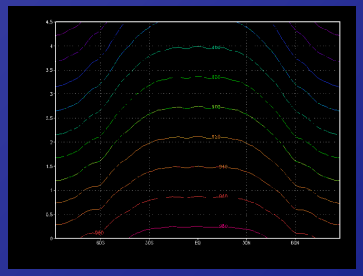
Hiro

Surface fluxes + -2 K forcing

- SAM's surface flux parameterization
- -2 K forcing for the prognostic equation of potential temperature

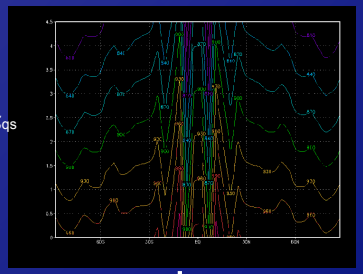
Model blows up…

π



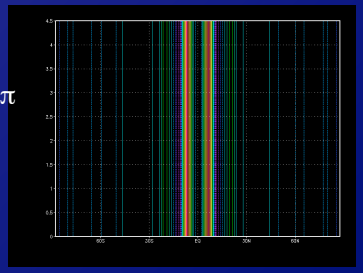
=

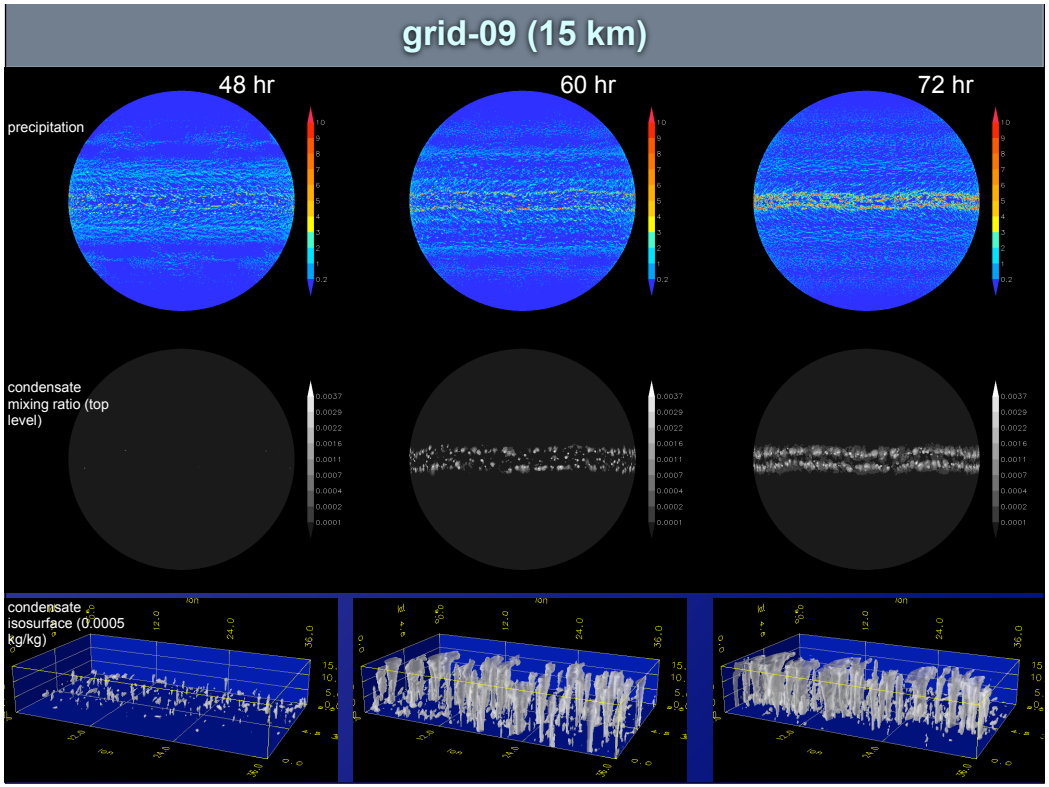
π_{qs}



+

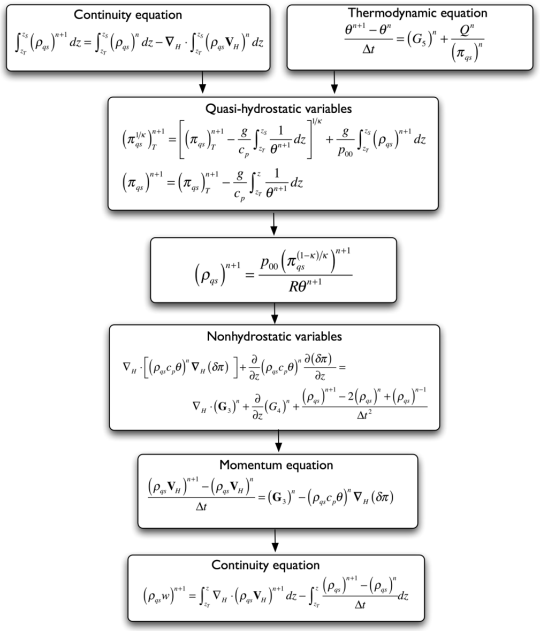
$\delta\pi$

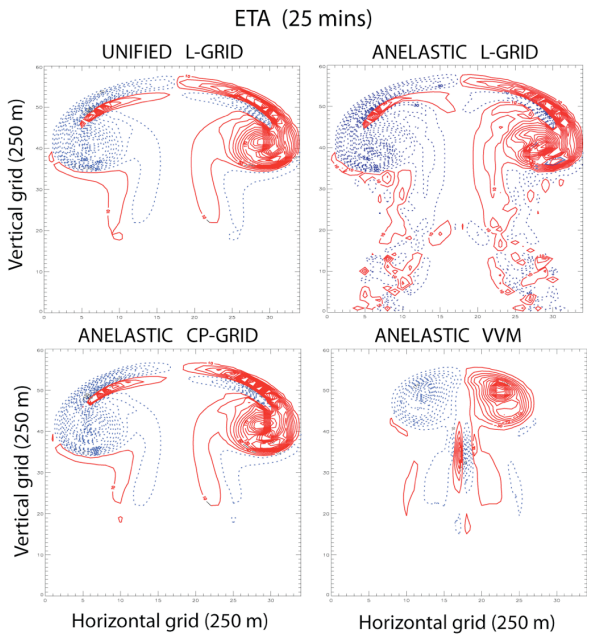



grid-09 (15 km)
48 hr
60 hr
72 hr
precipitation
condensate mixing ratio (top level)
condensate isosurface (0.0005 kg/kg)

Celal

INTEGRATION PROCEDURE FOR THE UNIFIED SYSTEM OF EQUATIONS



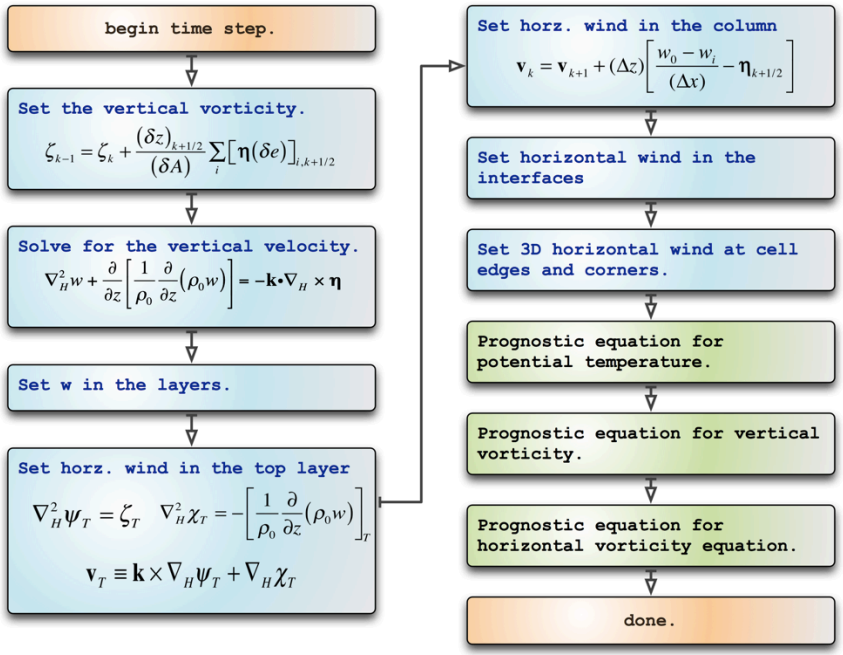

ETA (25 mins)
UNIFIED L-GRID
ANELASTIC L-GRID
ANELASTIC CP-GRID
ANELASTIC VVM
Vertical grid (250 m)
Vertical grid (250 m)
Horizontal grid (250 m)
Horizontal grid (250 m)

BUOYANT BUBBLE SIMULATIONS
WITH THE UNIFIED, ANELASTIC AND VVM MODELS

- Improve the potential temperature advection in the VVM.
- Construct an US-VVM.
- Construct the versions of the US and VVM with the CP-grid.
- Try to explain the differences between the simulations obtained by directly predicting momentum and vorticity.
- Construct an experimental fully-compressible model for comparison purposes.

Ross

Outline of a time step



Scaling test of GCRM on Jaguar XT5

- The **NCCS Cray XT5** with 244,256 cores.
  Each compute node contains two hex-core AMD Opteron processors, 16GB memory, and a SeaStar 2+ router.
- 128 layers
- Time required to do **1 time step**

Time (s)		Number of cores		
		10240	20480	40960
Grid resolution	10,485,762 **(10)** (7.819km)	3.29	2.27	
	41,943,042 **(11)** (3.909km)	11.6	6.15	3.32
	167,772,162 **(12)** (1.955km)	insufficient memory	insufficient memory	11.8

Next...

- Simple numeric tests. e.g. Jablonowski


Questions?

Thanks

John, Richard, Cindy