POP2 Development: z-star

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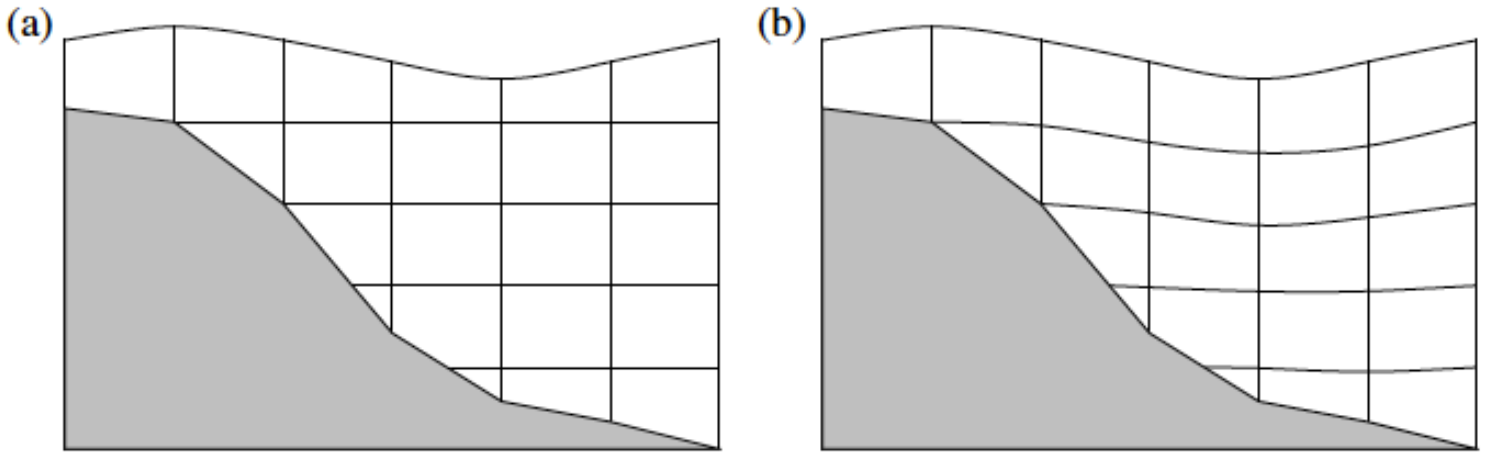
z-star: allow all levels to respond in a proportional way to external mode

A. Adcroft, J.-M. Campin / Ocean Modelling 7 (2004) 269–284



How CESM-POP does it now

Z-star

Z-star implementation

- Summary:
  - Basic implementation is done.
  - Initial tests have been performed

Z-star implementation

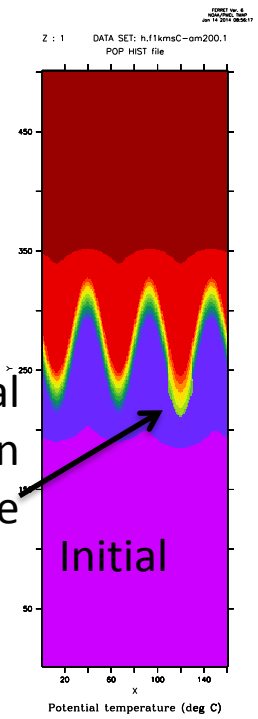
- Notes on implementation:
  - Fluxes pass through time-independent DZT
    - Preserves linear form of barotropic solver
    - Cell volumes, however, always based on time-dependent thickness (THICKT)
  - Pressure gradient correction for z-star happens to be same as what Rick and WooYoung did for PBCs
    - Allows for simplification of code
    - Under “varthick”, new code differs beyond roundoff
      - More accurate in uppermost level#

z-star tests

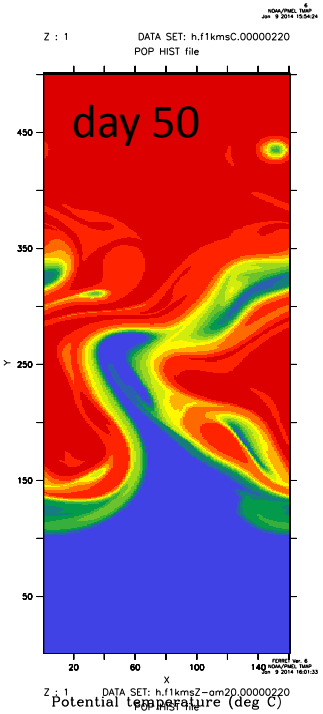
- Baroclinically unstable channel test problem, from Ilicak et al. 2010
  - Being used by Petersen et al. to evaluate vertical coordinate schemes in MPAS.
- Similarly unforced “gx1” global config, to verify that real bathymetry not problematic.

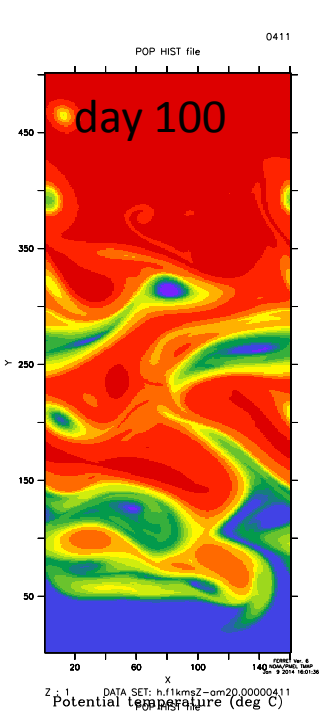
In both cases, we’ve needed to reduce time step by order(25%) when switching from varthick to z-star.

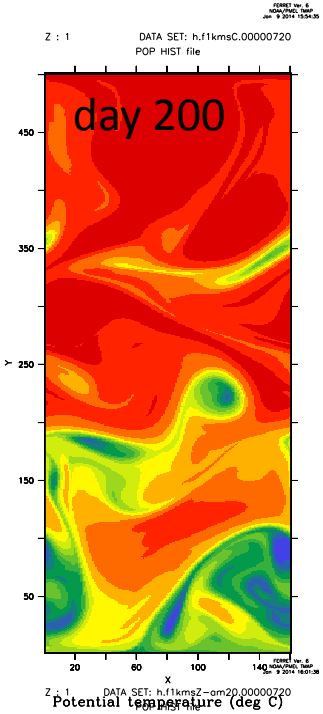
Testing under the baroclinically unstable channel used in Ilicak et al (2012):

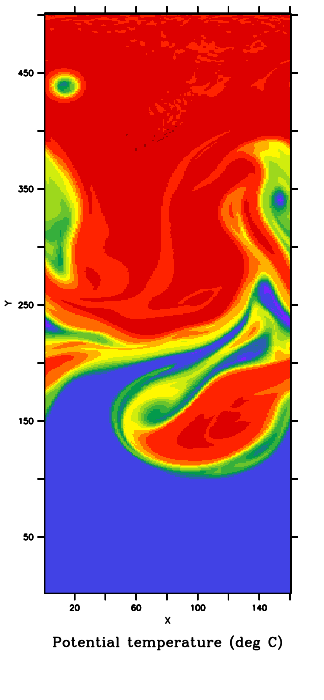


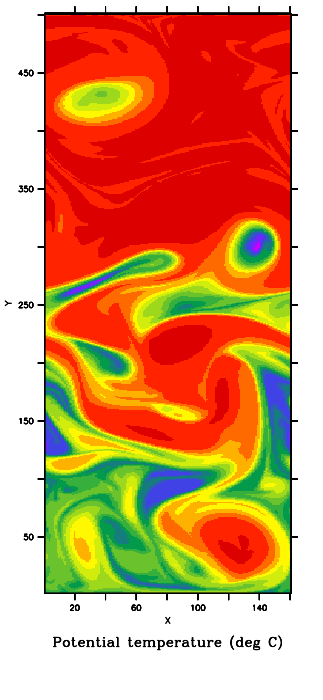
Shown here at highest of three horizontal resolutions (1 km)

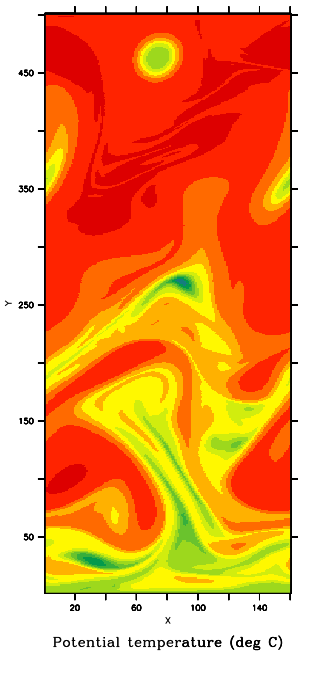












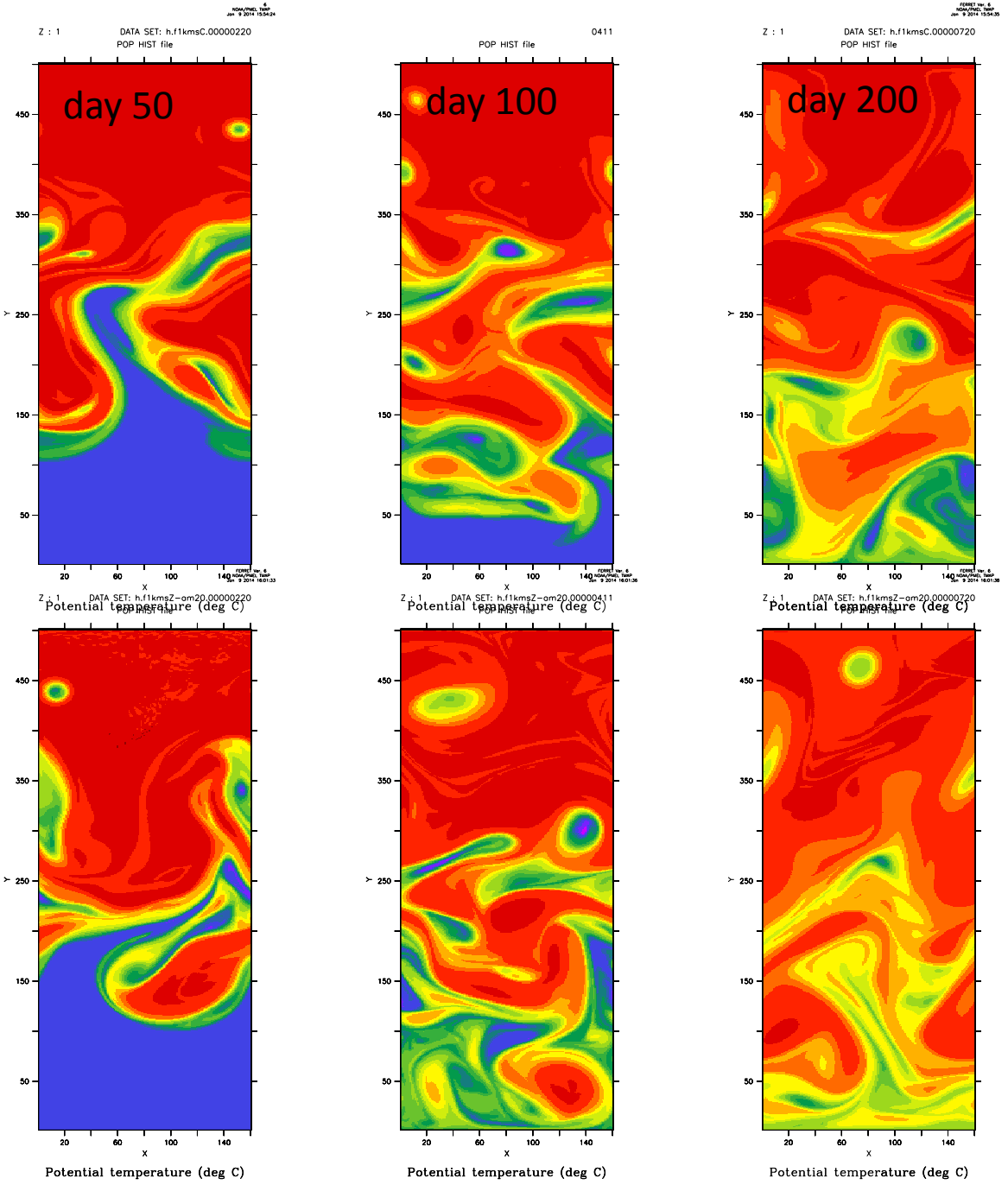
Testing under the baroclinically unstable channel used in Ilicak et al (2012):

(Mark will show statistics)

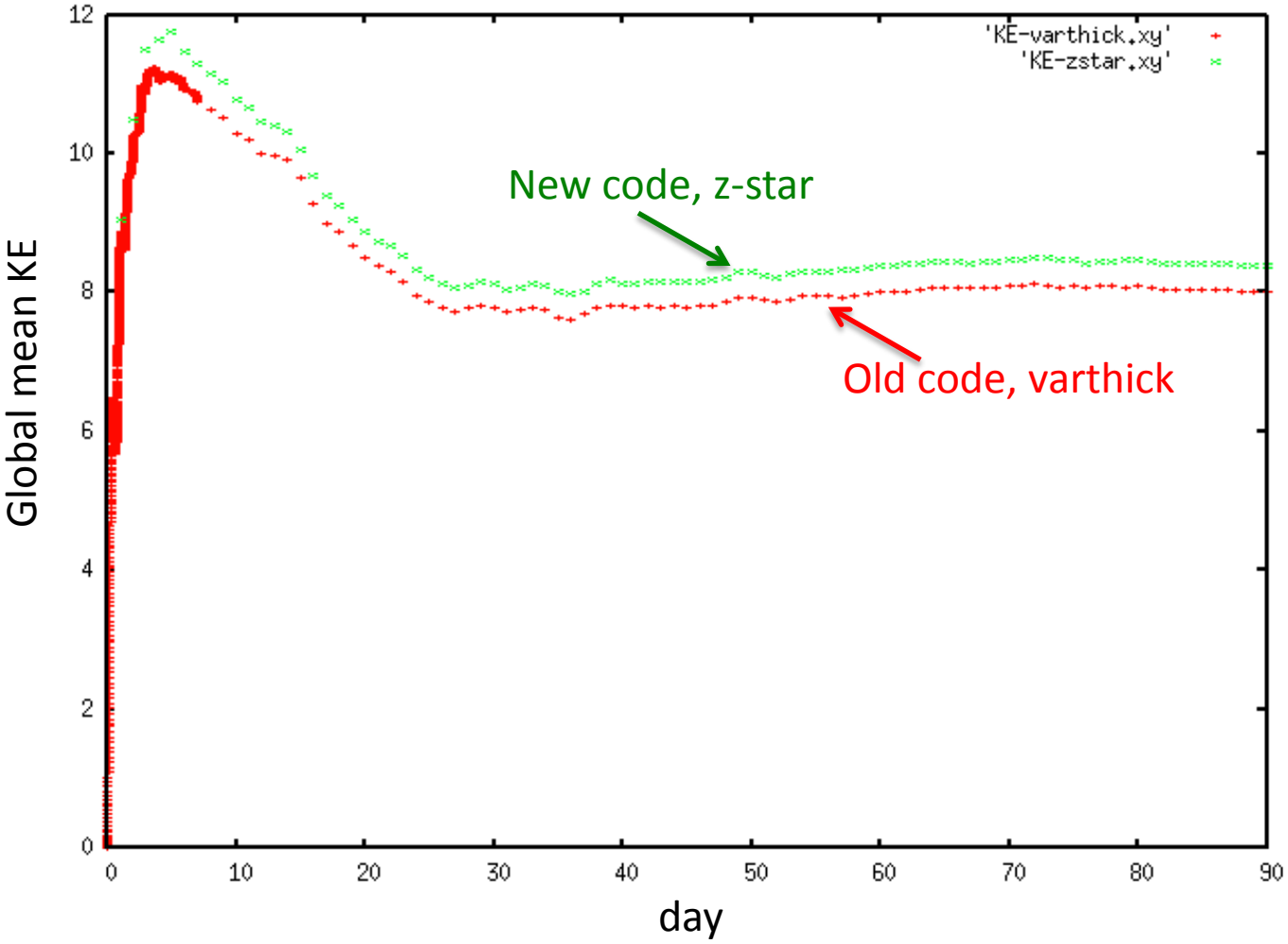
Control code (varthick):

New code (z-star):

Shown here at highest of three horizontal resolutions (1 km)



Results from an unforced test case using realistic "gx1" bathymetry:



Remaining issues

- Can pressure averaging be turned on?
- We have a simple prescription for GM
  - Should also apply to GM with partial bottom cells
  - but, yet to be done.
- Merge with Robert filter
  - and clean up of new sections of code
  - (Tony has put Mat's Robert implementation into RASM)

Path Forward

- We will merge Robert filter and z-star
  - To be done and tested in gx1 and tx0.1 by Breckenridge workshop
- The Working Group will work through (mostly minor) issues of making parameterizations compatible with z-star.