Land Ice Verification and Validation Kit

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Steve Price and Matt Hoffman, LANL

LIVV kit strategy

- Provide verification test suite for CISM testing as standalone and within CESM
- Validation of production GIS, ANT runs to follow
- Python and NCL based code sits within CISM repo
- Based on glide dycore, but extensible to others with access to output format to parse/process
- Comes with build, submit, and LIVV set-up script designed for NERSC and OLCF platforms
- Mac and other platforms to follow

Basic Workflow on LCF systems

- Access to code on hopper/titan
  - Load the software environment specified in the script heading
  - Run the master build script. If successful, it will launch the submit scripts to the machines
  - Check for successful job completion
- Access to LIVV carver/lens
  - Load the software environment specified in the script heading
  - Copy the /higher-order directory from CISM to the scratch space
  - Specify several options in the script, such as website location, comment, whether to run tests or production evaluation
  - Execute the script, view the website

Title Page: Access Production or Test Suite output

Land Ice Validation package
Performed on 12-31-2012-12:12:07 PM
Test case comment: evaluating code and test suite for CISM2.0 release

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Basic Test Suite Diagnostics

Production Configure Diagnostics

Production Output Diagnostics

Ice Thickness

For Additional Information:

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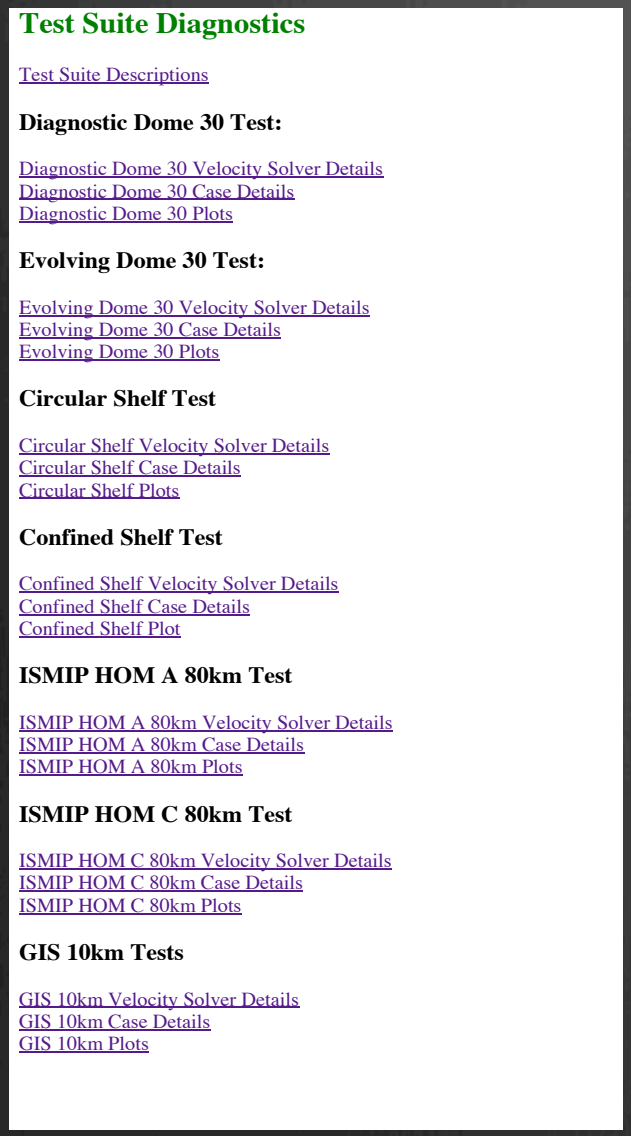
*Website location can be set as a subdirectory of a project

Test Page: 3 options



Test Suite Diagnostics

Test Suite Descriptions

Diagnostic Dome 30 Test:

Diagnostic Dome 30 Velocity Solver Details
Diagnostic Dome 30 Case Details
Diagnostic Dome 30 Plots

Evolving Dome 30 Test:

Evolving Dome 30 Velocity Solver Details
Evolving Dome 30 Case Details
Evolving Dome 30 Plots

Circular Shelf Test

Circular Shelf Velocity Solver Details
Circular Shelf Case Details
Circular Shelf Plots

Confined Shelf Test

Confined Shelf Velocity Solver Details
Confined Shelf Case Details
Confined Shelf Plot

ISMIP HOM A 80km Test

ISMIP HOM A 80km Velocity Solver Details
ISMIP HOM A 80km Case Details
ISMIP HOM A 80km Plots

ISMIP HOM C 80km Test

ISMIP HOM C 80km Velocity Solver Details
ISMIP HOM C 80km Case Details
ISMIP HOM C 80km Plots

GIS 10km Tests

GIS 10km Velocity Solver Details
GIS 10km Case Details
GIS 10km Plots

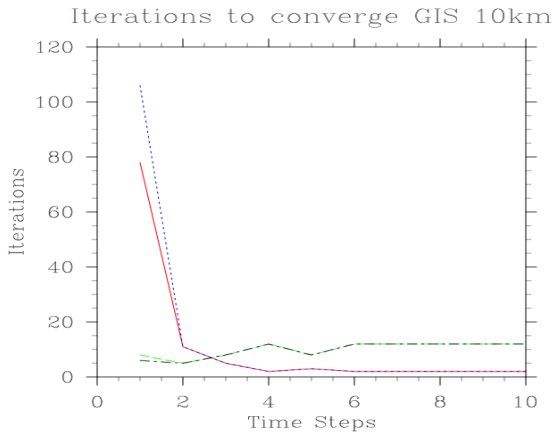
- Velocity Solver Details
  - Iteration count
  - Nonlinear and Linear information in plot or list form
- Case Details
  - Relevant settings provided as a reference and comparison to the benchmark
  - Changes from benchmark are highlighted in red with both values
- Output plots for comparison to the benchmarks
- Coming soon! Solver settings

Velocity Solver Information

GIS 10km Iteration Count Details:

Eventually published in plot form

Iteration Count for Nonlinear and Linear Solver



New Run:

Number of Processors = 128
Number of Nonlinear Iterations = 78, 11, 5, 2, 3, 2, 2, 2, 2, 2, 2,
Average Number of Linear Iterations per Time-Step = 8.397, 5.727, 8.8, 12.5, 8.333, 12.0, 12.0, 12.0, 12.0, 12.0, 12.0,

Benchmark Run:

Number of Processors = 128
Number of Nonlinear Iterations = 106, 11, 5, 2, 3, 2, 2, 2, 2, 2, 2,
Average Number of Linear Iterations per Time-Step = 6.217, 5.727, 8.8, 12.5, 8.333, 12.0, 12.0, 12.0, 12.0, 12.0, 12.0,

- Nonlinear and average linear iteration count for each time step are presented
- Coming soon! Separate plot showing the characteristics of the linear solver and preconditioner linear solver breakdown etc.

Test Configurations

- Presented for each case and highlighted if different from the benchmark
- Settings within the code are not incorporated
- Settings to investigate in the code should be moved to runtime options

Dome 30 Case Details:

Configure file Settings

Output available from test run: thk usurf uvel vvel wvel velnorm temp
Grid Size (vert by ew by ns): 10x30x30
Grid Spacing (ew by ns): 2000x2000
Start/End Time: 0.,10., Number of time steps = 10.0

Parameters
---
flow_factor = 1
ice_limit = 0

Options
---
dycore = 1
flow_law = 2
evolution = 3
temperature = 3

HO Options
---
diagnostic_scheme = 1
which_ho_babc = 4
which_ho_efvs = 0

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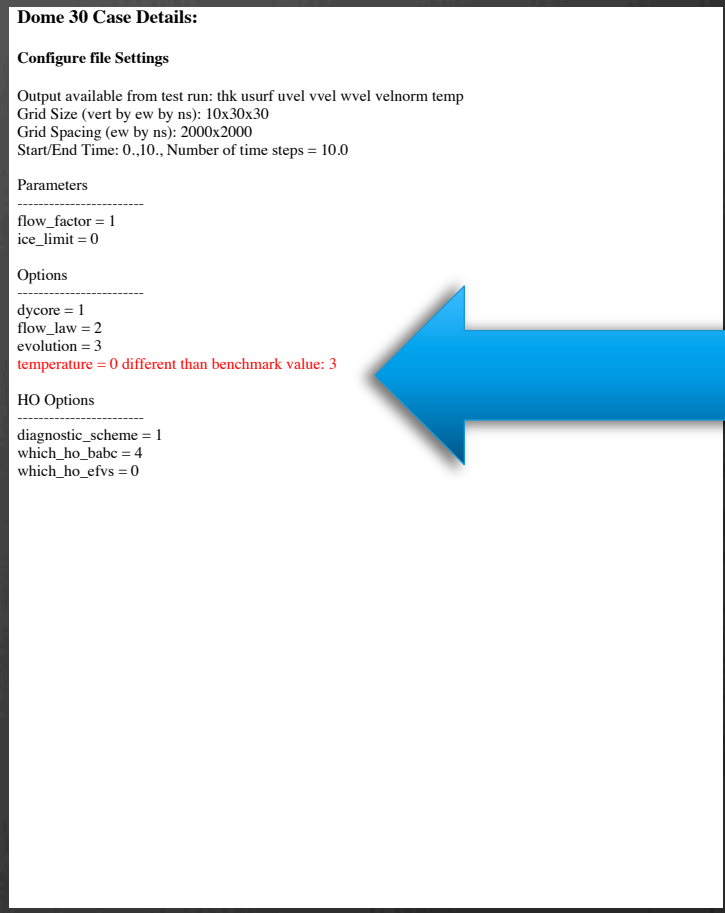

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Options
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evolution = 3
temperature = 0 different than benchmark value: 3

HO Options
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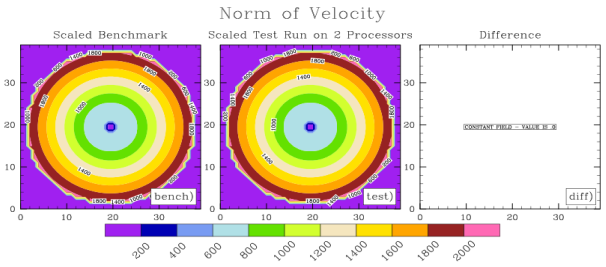
Plots of Test Results: Designed to catch differences

Circular Shelf Plot Details:

Difference from benchmark for a range of processor counts for a range of variables



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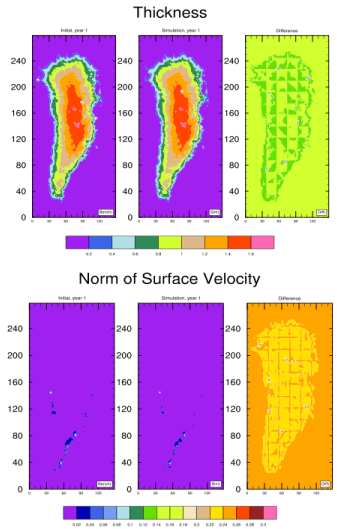


Key to successful model long term development

- Tests that
  - exercises as much of the code as possible (more relevant tests)
  - Is easy to use (we are busy and will cheat in running the tests if its hard or takes a long time)
  - Provides information about the results and the model performance (solver data and scaling)
  - What else?

Coming soon: Automated Regression testing

- We should have tests that run automatically to catch issues quickly
- HOMME developers are also setting this up as we speak (and they have been around for 10 years)
- Should we have some thing hooked up to CESM as well?

Next steps: Validation

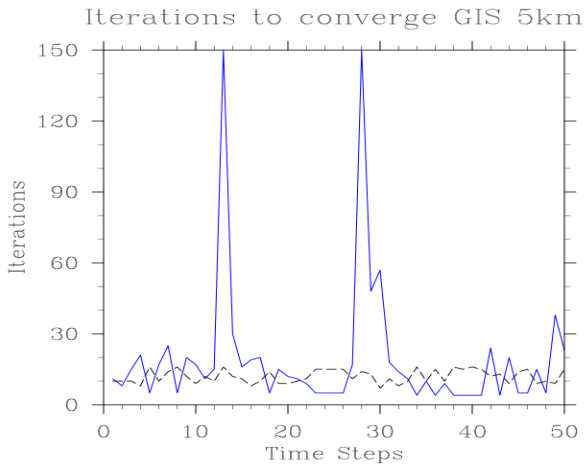
or, "putting the V in V&V"

- Production runs of GIS (ANT is stubbed out) can be evaluated like a test case
- Variables, time steps, need to be added
- Plots of performance: scaling, solver behavior, parameter choices
- Large datasets require parallel performance, link to S-DAV, ESG, Visit, Paraview

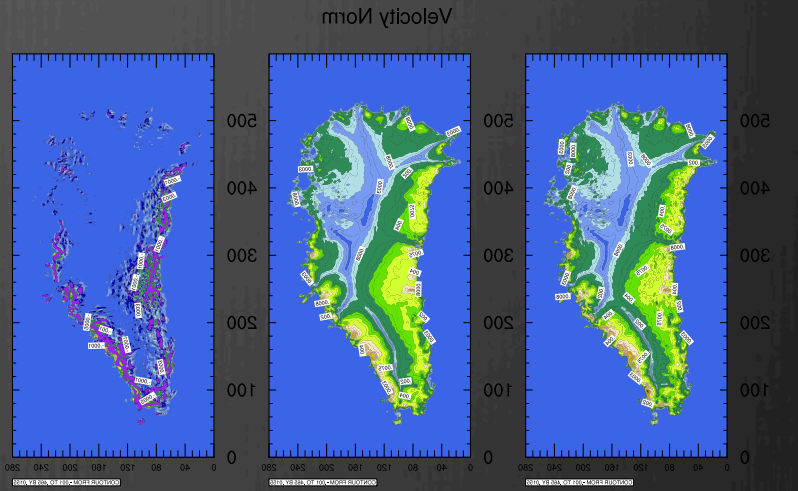
50 year GIS Test SS Run

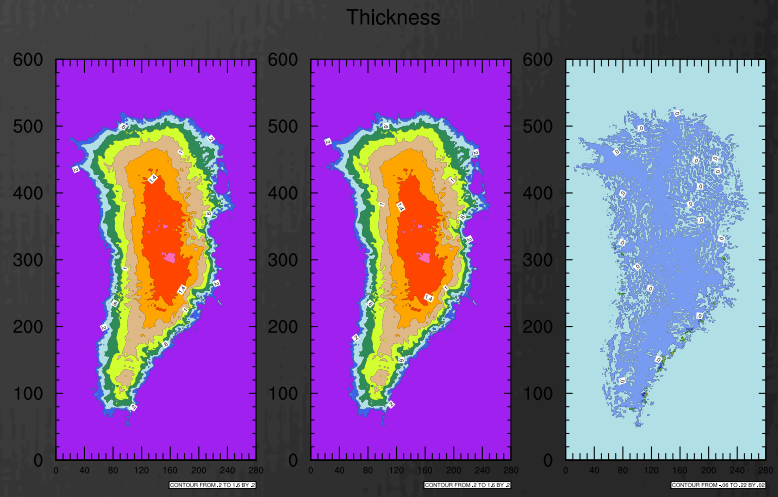
Job Output Diagnostics

Iteration Count for Nonlinear and Linear Solver

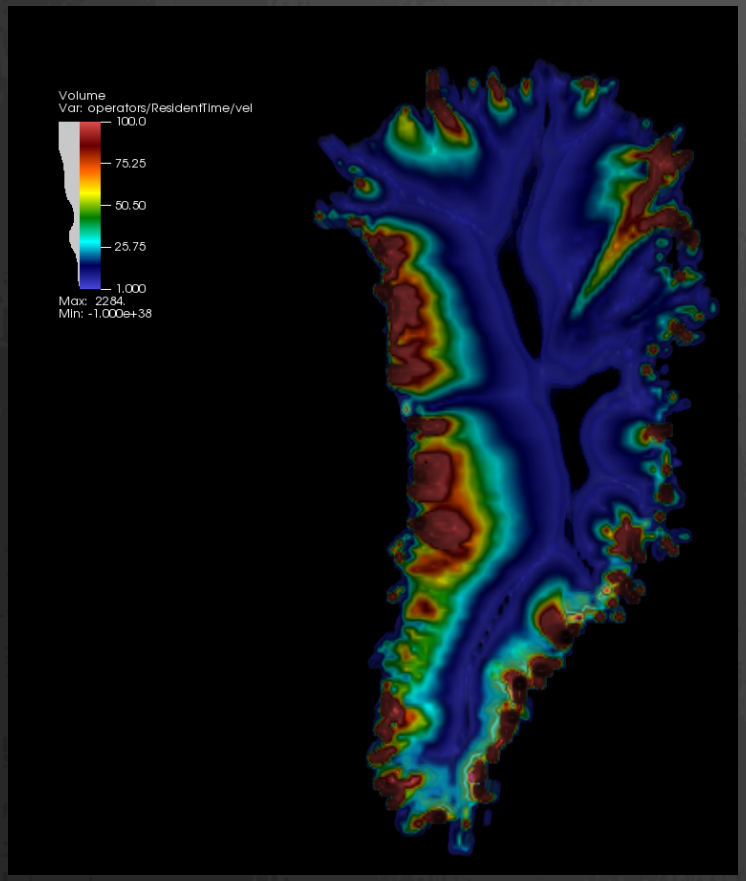


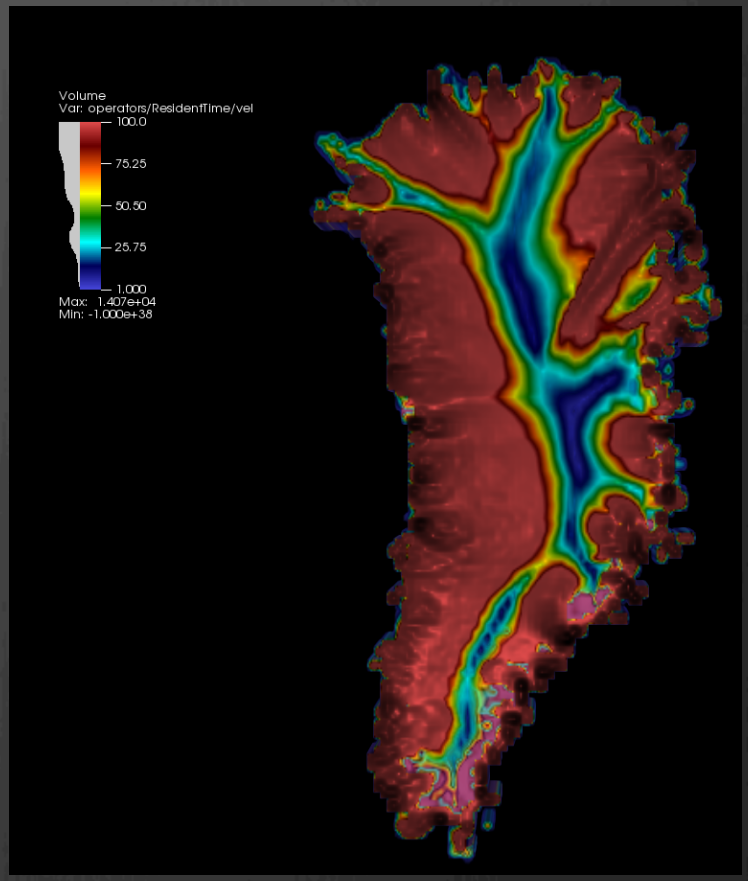
Number of Processors = 1500
Number of Nonlinear Iterations = 11, 8, 15, 21, 5, 17, 25, 5, 20, 17, 11, 15, 150, 30, 16, 19, 20, 5, 15, 12, 11, 9, 5, 5, 5, 5, 17, 150, 48, 57, 18, 14, 11, 4, 10, 4, 9, 4, 4, 4, 4, 24, 4, 20, 5, 5, 15, 5, 38, 23,
***TIME STEP(S) WHICH FAILED TO CONVERGE
Average Number of Linear Iterations per Time-Step = 10.455, 10.875, 10.067, 8.048, 16.4, 10.471, 14.08, 16.6, 12.4, 9.882, 12.0, 10.8, 16.607, 12.133, 11.438, 8.737, 10.75, 14.8, 9.533, 9.833, 10.273, 11.667, 15.2, 15.8, 15.0, 15.0, 11.588, 14.06, 13.938, 7.018, 11.944, 8.929, 10.455, 16.0, 10.1, 15.5, 10.0, 16.25, 15.75, 16.75, 15.75, 12.375, 13.0, 9.45, 14.8, 15.4, 9.133, 10.4, 9.921, 15.13,





Working with SDAV to analyze ice2sea CISM runs





Residence time: a record of how far an ice particle travels

isualizations created by Dave Pugmire, ORNL, SciDAC SDAV project

Connecting to CESM

(the model and the scientists)

- We want CESM users to measure the impact on CISM of changes made to the CESM, or SMB
- Making connections to AMWG, PCWG, LMWG
- How will CESM folks decide what options of CISM are best to use for their configurations?
  - Dycore choice
  - Resolution
  - Parameter settings
  - Processor layout

Segue to ice sheet movies. meantime …

Happy Birthday, Andy!