Land Ice Verification and Validation Kit

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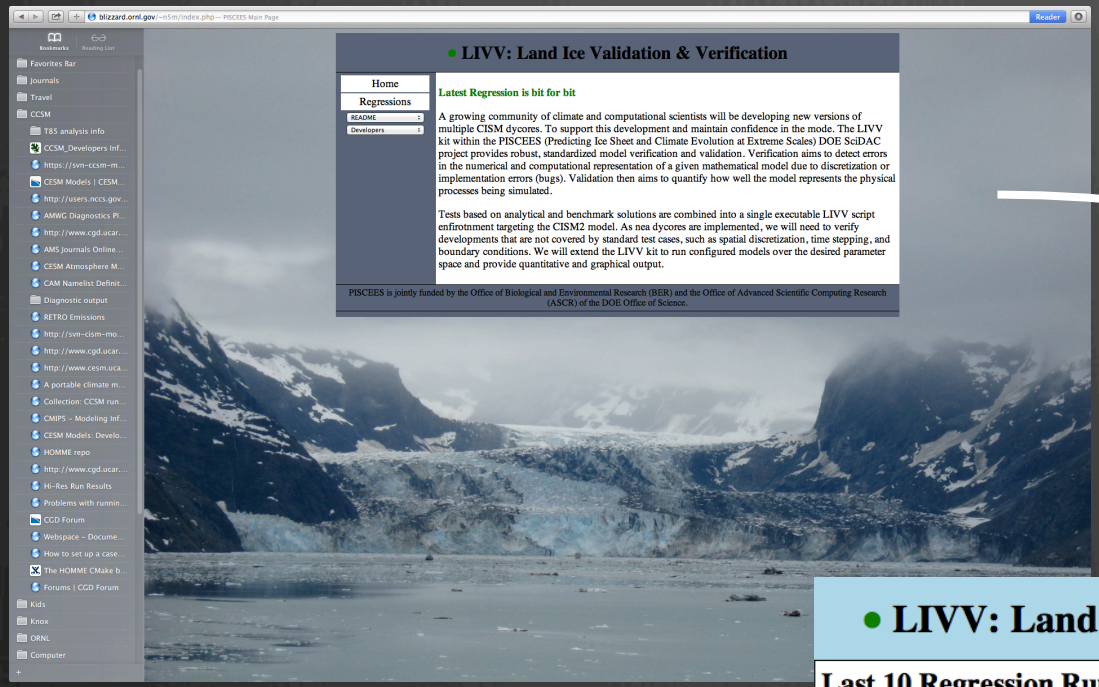
LIVV Kit 'Raison d'etre'

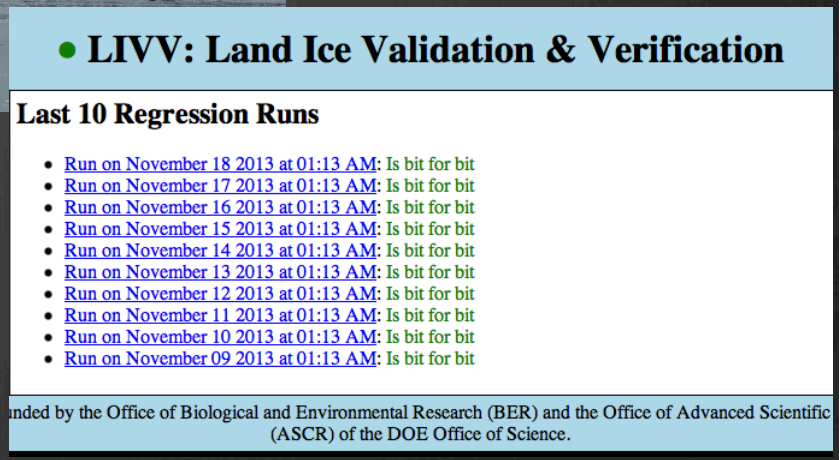
- Provide verification test suite for CISM testing as standalone and within CESM
- Nightly autotesting of the code for bit-4-bit reproducibility
- Python and NCL based code, points to baseline test results
- Operates on glide or glissade dycores, and will extend it to others as they are incoroprated into CISM
- Comes with submit scripts designed for OLCF, NERSC, MAC OSx and rel06 platforms
- Performance V&V operational on Titan and Hopper* (several punch list items)
- Validation has begun. LIVV can create some test plots given a data source.

Basic Workflow on LCF Systems

- Download CISM code to hopper/titan/mac/linux box
- Use Doug Ranken's (LANL) new auto build/run/test script on a given platform
  - Copy over reg_test and perf_test from the project space location to access benchmark results for a given machine
  - Copy over the /higher_order directory from the CISM repo to the execution area (LCF only)
  - Build and run code in glide and glissade modes. If successful, it will run all the tests for b4b and performance within a predefined envelope
- Access to LIVV will be in carver/rhea/mac/blizzard in /higher-order
  - Select options of interest (evaluate performance or just output?)
  - Execute the script, view the website

Main Page: Auto-verification and Docs

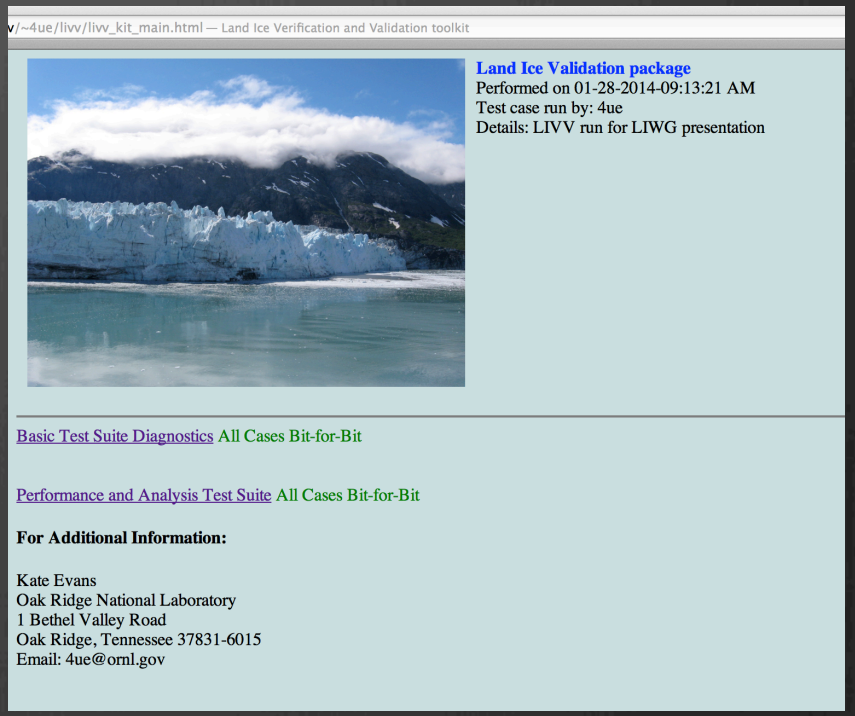




Blizzard.ornl.gov

Title Page for each LIVV run: Production or Test Suite Output

- User decides to run Verification, Performance, and/or Validation tests.
- LIVV runs all tests for which there is output for each type of run
- Top level assessment for verification, so no need to delve further



*Website location can be set as a subdirectory of a project
Example: http://users.nccs.gov/~4ue/livv/livv_kit_main.html

Test Page: 3 types of info and a hierarchy of information

- BFB check for each test
- Times of last simulation to check if new
- Velocity Solver Details
  - Nonlinear and Linear iteration count
  - Presented in plot or list form depending on whether it's a time dependent case
- Case Details
  - All runtime settings are listed as a reference and for reproducibility
- Output plots of the benchmark, new run, and difference are presented for comparison

Test case configuration

- Runtime settings for the code are presented for each case and highlighted in red if different from the benchmark values
- Settings within the code are not incorporated (should be moved to runtime if changed frequently)

Case Details:

Configure File Settings

Output available from test run: acab artm beta topg thk usurf uvel vvel wvel flwa velnorm temp bheatflx bmlt bwat kinbcmask
Grid Size (vert by ew by ns): 11x150x280
Grid Spacing (ew by ns): 10000x10000
Start/End Time: 0.,10.0, Number of time steps = 10.0

Parameters
---
flow_factor = 1

Options
---
flow_law = 2 different than benchmark value: 0
evolution = 3
temperature = 1 different than benchmark value: 3

HO Options
---
which_ho_babc = 4
which_ho_efvs = 2 different than benchmark value: 0

Velocity Solver Settings:

XML File Settings

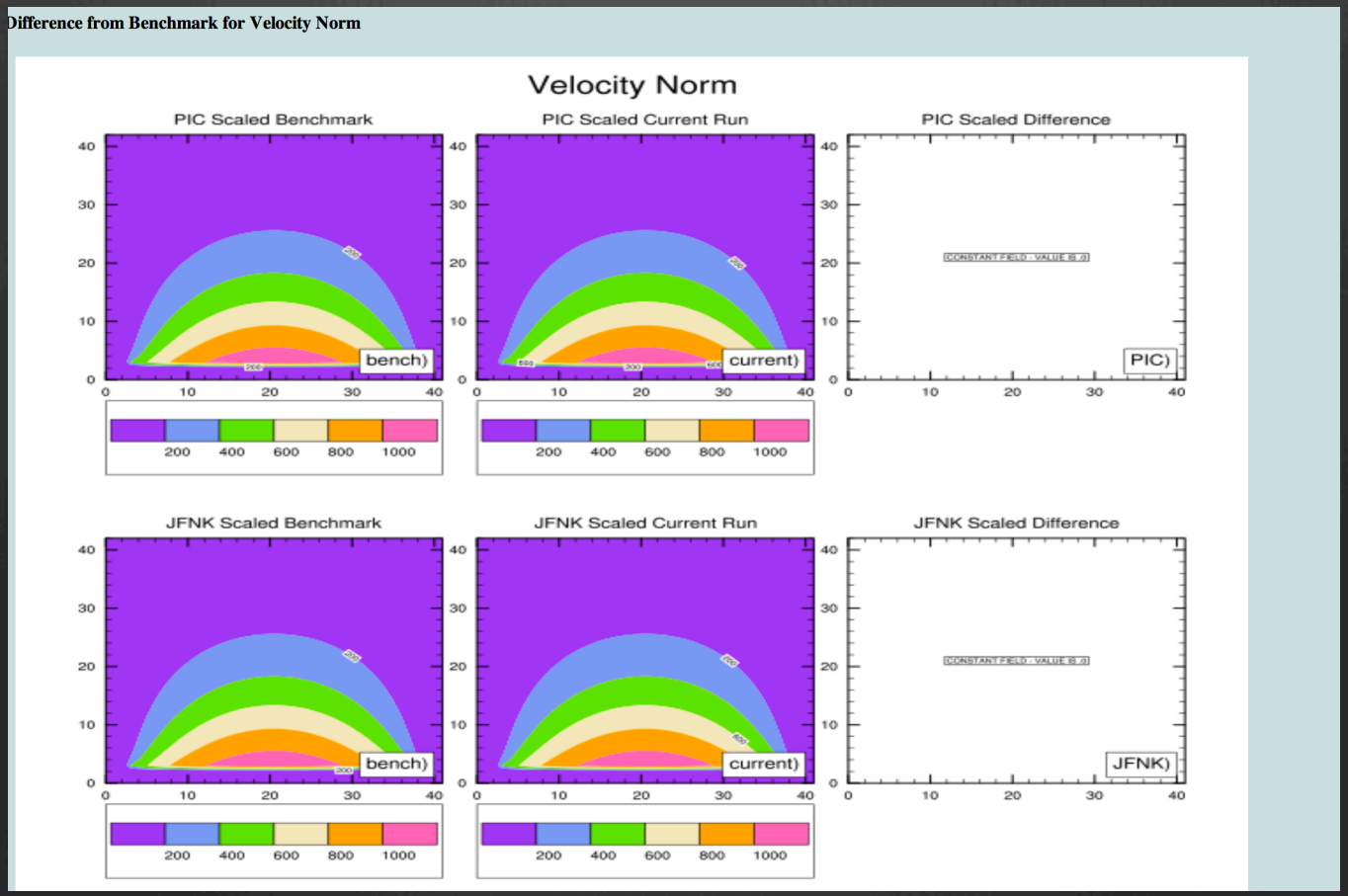
Preconditioner: Picard

Block GMRES: Convergence Tolerance = 1e-11
Block GMRES: Maximum Iterations = 100
Preconditioner Type = Ifpack
Prec Type = ILU
Overlap = 1
Fact: Level-of-Fill = 1

Solver: NK

Newton: Jacobian Operator = Matrix-Free
Newton: Forcing Term Method = Type 2
Newton: Forcing Term Alpha = 2.0
Newton: Forcing Term Gamma = 0.10

Tri-Plots (Test, Benchmark, and Difference Plots)



Performance V&V (pLIVV)

- Development of automated information and metrics to evaluate performance of code
  - Regression tests of performance changes
  - Quantify performance changes due to new code features or bugs
- Simple dome problem for a range of problem sizes(60,120,240,500) to exercise scaling and performance behavior is included
- perf_test benchmark directory structured like reg_test
- Run 10 benchmark simulations to gather min, max, average stats about run speed.

Test Runs for Performance

- Dome 60 through Dome 500 to enable problem size scaling info
- Contains similar verification checks with plots and configure settings as with test problems
- Case run times are compared to a suite of runs on LCF systems, which are variable.

Performance and Analysis Test Suite

Test Suite Descriptions

Diagnostic Dome 60 Test: Bit-for-Bit

Diagnostic Dome 60 Velocity Solver Details
Solver Parameter Settings: Diagnostic Dome 60 XML Details
Diagnostic Dome 60 Case Details
Time of Last Simulation: 11/04/2013 01:27 PM

Diagnostic Dome 120 Test: Bit-for-Bit

Diagnostic Dome 120 Velocity Solver Details
Solver Parameter Settings: Diagnostic Dome 120 XML Details
Diagnostic Dome 120 Case Details
Time of Last Simulation: 11/08/2013 05:20 PM

Diagnostic Dome 240 Test: Bit-for-Bit

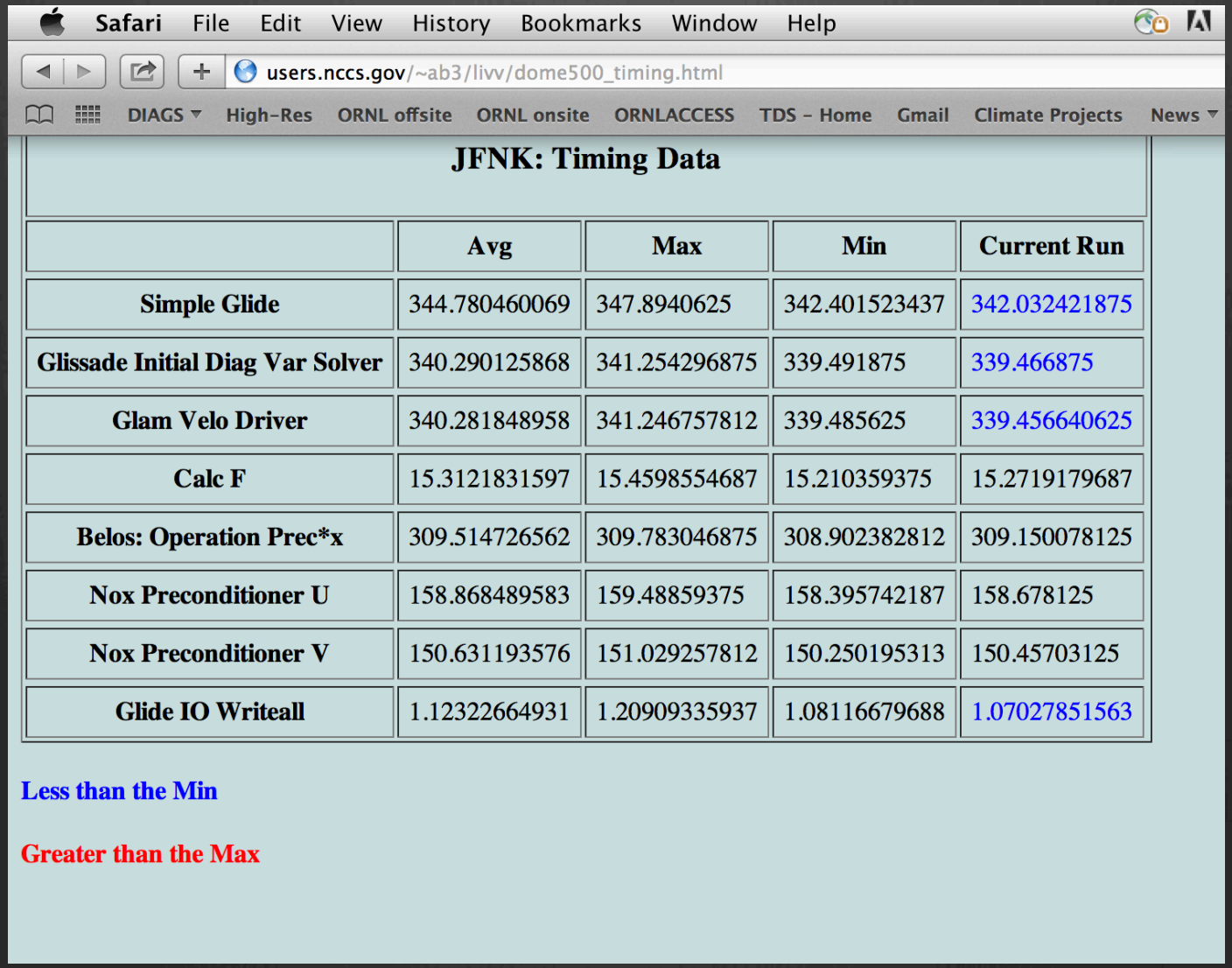
Diagnostic Dome 240 Velocity Solver Details
Solver Parameter Settings: Diagnostic Dome 240 XML Details
Diagnostic Dome 240 Case Details
Time of Last Simulation: 11/08/2013 05:05 PM

Diagnostic Dome 500 Test: Bit-for-Bit

Diagnostic Dome 500 Velocity Solver Details
Solver Parameter Settings: Diagnostic Dome 500 XML Details
Diagnostic Dome 500 Case Details
Time of Last Simulation: 11/08/2013 05:15 PM

Home

pLIVV on LCF systems



JFNK: Timing Data

	Avg	Max	Min	Current Run
Simple Glide	344.780460069	347.8940625	342.401523437	342.032421875
Glissade Initial Diag Var Solver	340.290125868	341.254296875	339.491875	339.466875
Glam Velo Driver	340.281848958	341.246757812	339.485625	339.456640625
Calc F	15.3121831597	15.4598554687	15.210359375	15.2719179687
Belos: Operation Prec*x	309.514726562	309.783046875	308.902382812	309.150078125
Nox Preconditioner U	158.868489583	159.48859375	158.395742187	158.678125
Nox Preconditioner V	150.631193576	151.029257812	150.250195313	150.45703125
Glide IO Writeall	1.12322664931	1.20909335937	1.08116679688	1.07027851563

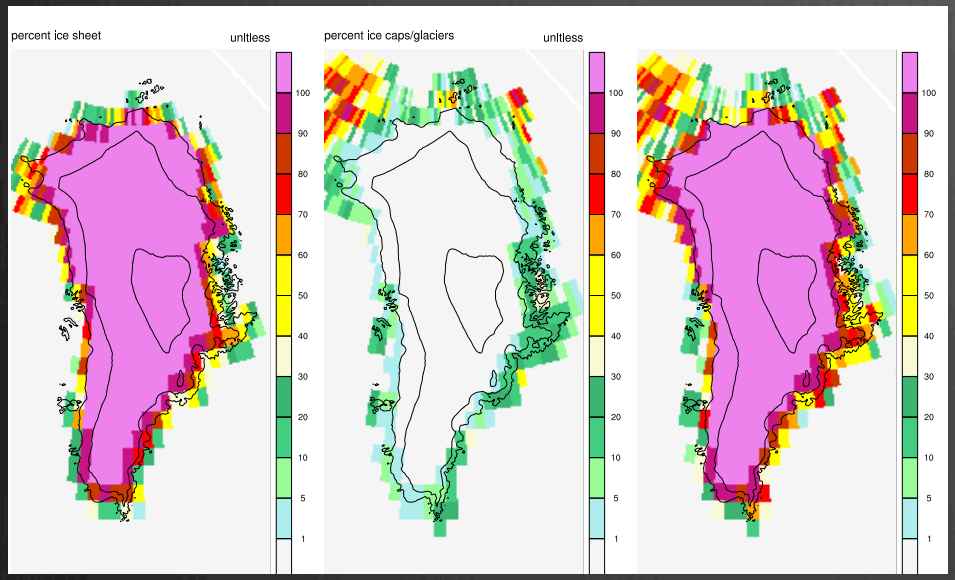
Less than the Min

Greater than the Max

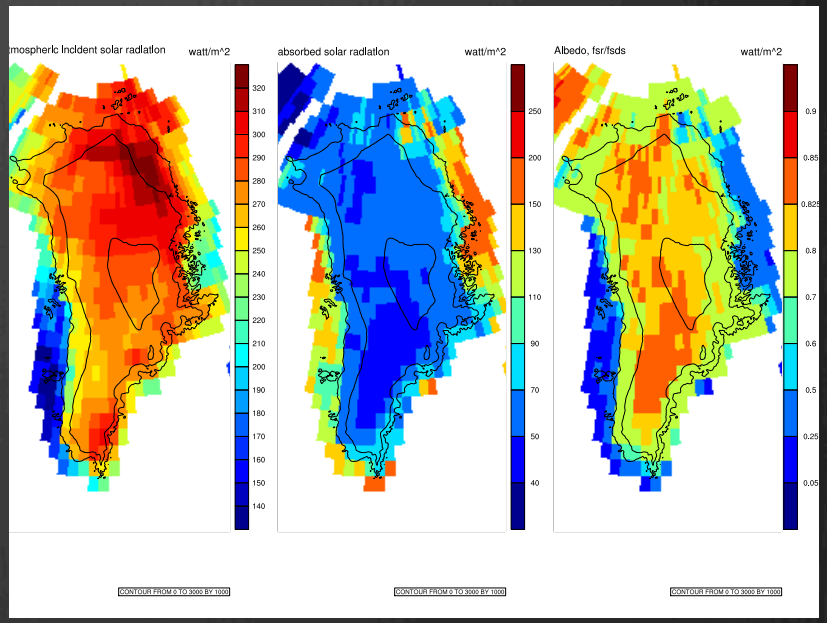
CISM Validation Plans

- Based on Vizcaino et al. (2013) analysis of CESM with an active CISM1 model from 1960-2005.
- Settings within LIVV for local model data location and years to analyze
- Present mean values in tabular form for a range of ice sheet, atmosphere, and land variables
- Present 2D plots for a range of variables in CESM-CISM relevant for ice sheet simulation
- Compare to RACMO, reanalysis, and observational data where possible

CISM Validation Plots



Percent ice sheet, percent glaciers, sum of both



Atmospheric incident, absorbed solar radiation, albedo