LIVVkit: Advanced software and workflow for analysis of continental-scale ice-sheet modeling

Katherine Evans* Joseph Kennedy* Andrew Bennett* Patrick Worley* Stephen Price′ Matthew Hoffman′

CLIMATE CHANGE SCIENCE INSTITUTE
OAK RIDGE NATIONAL LABORATORY

SciDAC
Scientific Discovery through Advanced Computing

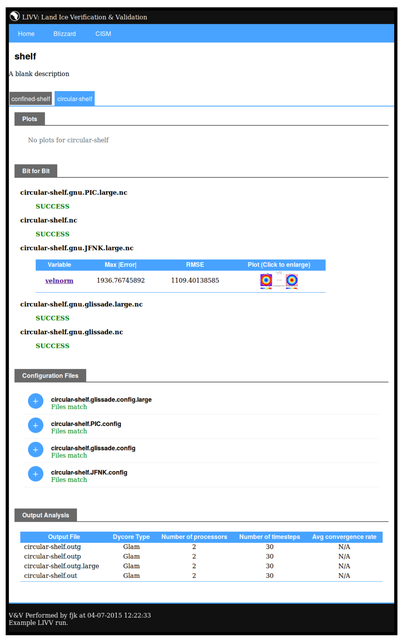
Verification

Does the model work?

Continent-scale, dynamical, ice-flow models are computationally expensive and have large, complex code bases. As developers add in new, cutting-edge, methods from researchers, there is a strong need to be able to determine the effects of changes on the model solution. By comparing new model output against a preserved model output, or benchmark, we can determine if, and how much a new feature or method effects the model solution. Because of the complexity of the code base, these evaluations need to happen for each and every change to the model.

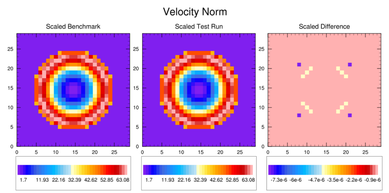
Automatic verification tests with LIVV

bit-for-bit tests



- Test case description and illustrations
- Bit-for-bit analysis of multiple, relevant variables
- Failure description with error details -- Max and RMSE
- Comparison of test configurations
- Machine performance descripton

Di ff erence plots



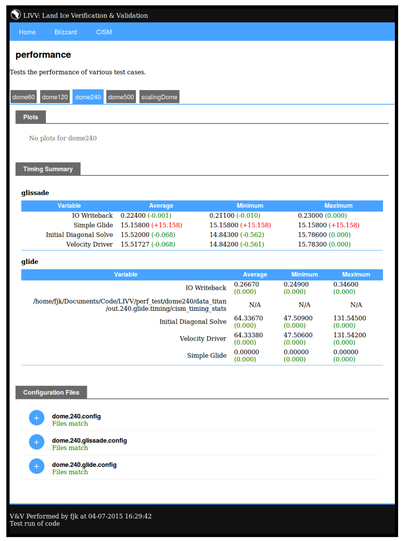
- Automatic generation for failures
- Raster plots of underlying grid for quick compairison

Performance

How well does it work?

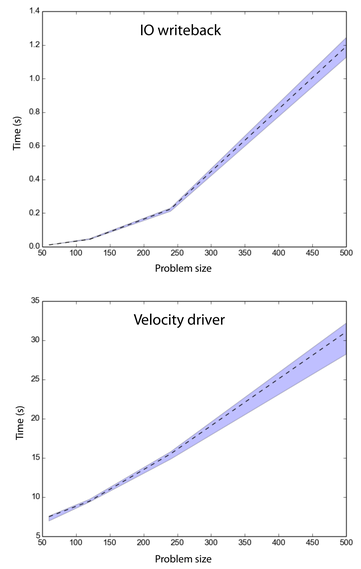
Continent-scale, dynamical, ice-flow models are computationally expensive and have large, complex code bases. As developers add in new, cutting-edge, methods from researchers, there is a strong need to be able to determine the effects of changes on the model solution. By comparing new model output against a preserved model output, or benchmark, we can determine if, and how much a new feature or method effects the model solution. Because of the complexity of the code base, these evaluations need to happen for each and every change to the model.

Automatic performance tests with LIVV



- Test case description and illustrations
- Timing summary for multiple runs on each dycore
- Comparison of test con figurations

Scaling plots



- Automatic generation for multiple, relvant metrics.

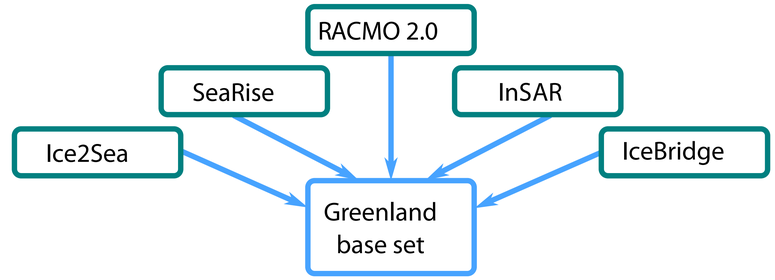
Validation

Present day initialization and comparison

To quantify how well continent-scale, dynamical, ice-flow models capture the true dynamics of polar ice sheets, a robust validation procedure is being developed as well. Recent advances in data collection tools and data analysis procedures are enalbing us to create a proper set of initial conditions for present-day simulations. The next step is to perform validation of these runs, often using similar techniques to prepare the data. As a statring point we creat the initial data sets using a suite of scripts to interpolate the data to the model grid.

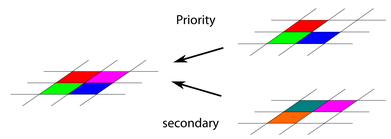
Methodology

- Modular design
  - reusable, general data classes and functions
  - data specific functions are isolated
  - Handles transformations between projections
- Python code base with NetCDF and proj4 support
- Greenland; Antarctica planned
- Automatic CISM configuration file generation
- Open source releases on Github with CISM



New priority interpolation method

Multiple datasets are needed to give a complete spacial or temporal coverage of the area. This data typically needs to be interpolated to a computational grid. We developed an interpolation method that allows a priority and secondary dataset to be combined and then interpolated to a grid. This method can handle datasets from different projections.



LIVV

Good Design = Good Tools

Easy deployment

- Internal dependency management
- Automatic website generation

User friendly

- Command line options or saved con figurations

Open Source release on github 7/15/2015

Extensible and maintainable

- Python code base
  - Modular for easy test and feature additions
  - Commonly used by scientists
- Jinja2 for website generation
  - Templated for easy changes
- v1.0.0 https://github.com/LIVVkit/LIVVkit

Planned development

Soon

- Support more CISM dycores
- More performance metrics and plots
- Initial validation tests
- Newer datasets

Later

- Integrate into developer work flow
- Nightly builds and tests of CISM
- Antarctica!
- Support other ice-sheet models

*Climate Change Science Institute, Oak Ridge National Laboratory, ′Los Alamos National Laboratory

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