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

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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 description

- **Difference plots**
  - Automatic generation for failures
  - Raster plots of underlying grid for quick comparison

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
- **Scaling plots**
  - Test case description and illustrations
  - Timing summary for multiple runs on each dycore
  - Comparison of test configurations
  - Automatic generation for multiple, relevant 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 enabling 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 starting point we create the initial data sets using a suite of scripts to interpolate the data to the model grid.

Methodology
- 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 spatial 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.

Easy deployment
- Internal dependency management
- Automatic website generation
- Command line options or saved configurations

User friendly
- Command line options or saved configurations

Open Source release on github 7/15/2015
- v1.0.0 https://github.com/LIVVkit/LIVVkit

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

Later
- Integrate into developer work flow
- NIGHTLY builds and tests of CISM

Support other ice-sheet models
- Greenland; Antarctica planned
- IceBridge
- SeaRise
- InSAR
- RACMO 2.0

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