

LIVVkit: Now and into the future

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CESM LIWG

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Acknowledgements

Collaborators

- Kate Evans (ORNL), Mary M. Forrester (at CO Mines), Andrew R. Bennett (now at UW)
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- LANL: Stephen Price, Matthew Hoffman
- ORNL: Pat Worley (now retired), Matthew Norman, Adrianna Boghozian



A cautionary tale...

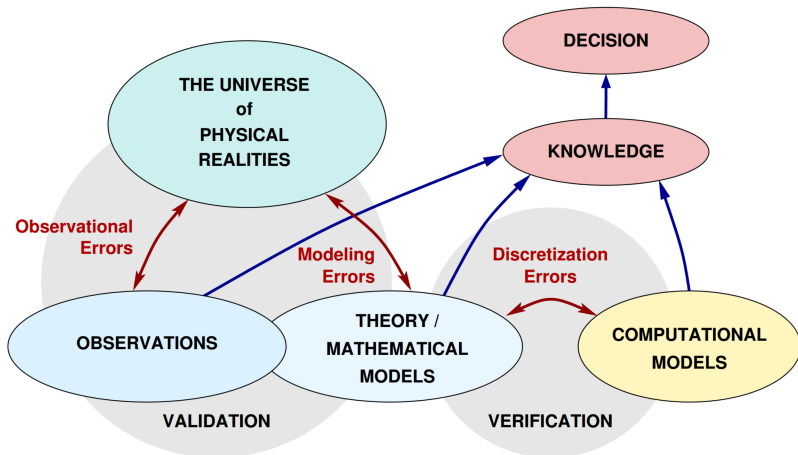
The war over supercooled water

How a hidden coding error fueled a seven-year dispute between two of condensed matters top theorists.

Physics Today, 22 August 2018

[DOI:10.1063/PT.6.1.20180822a](https://doi.org/10.1063/PT.6.1.20180822a)

Even more important for Earth science!



[From Oden et al., 2010] Imperfect computational modeling: Imperfections in the mathematical models, incomplete observational data, observations delivered by imperfect instruments, and corruption of the model itself in the discretization needed for computation all lead to imperfect paths to knowledge.

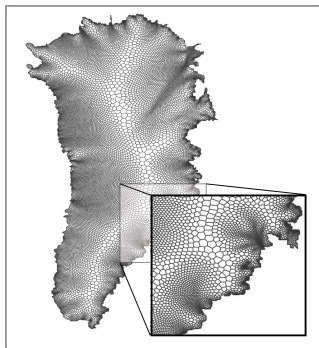


LIVVkit



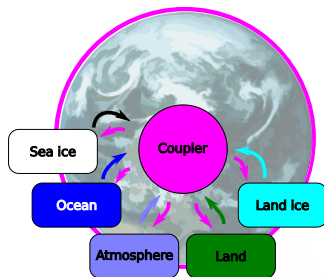
What are we testing?

Ice sheet models



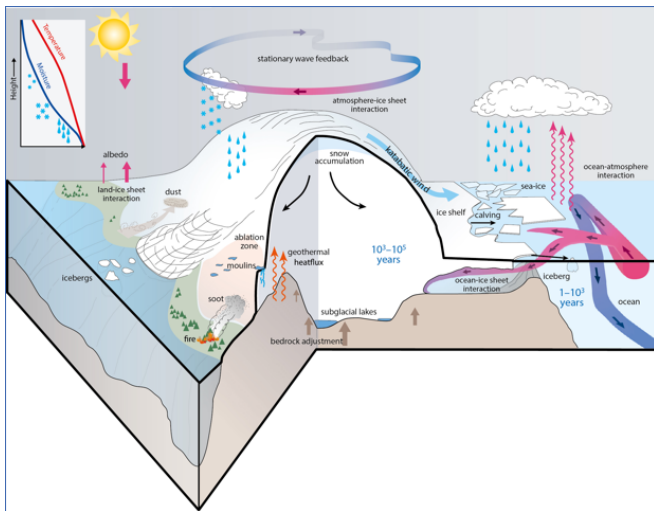
CISM, MALI, BISICLES, PISM

Coupled Models



CESM, E3SM

What are we testing?

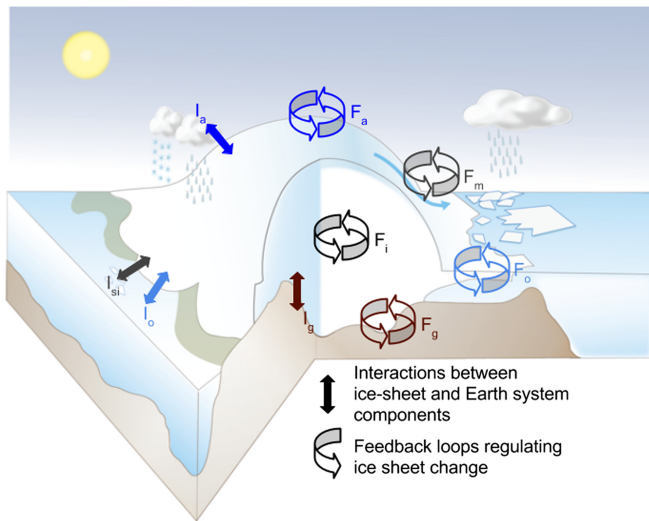


Main processes of ice sheet-climate-solid Earth interaction
From Masson-Delmotte et al. (2013),
in IPCC report AR5



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OAK RIDGE NATIONAL LABORATORY

What are we testing?



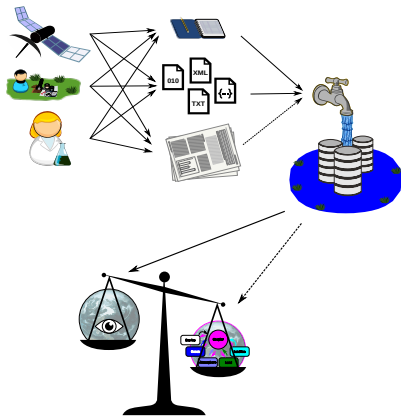
Summary of interactions (I) and feedback loops (F)

From Fyke et al. (2018),

DOI:10.1029/2018RG000600



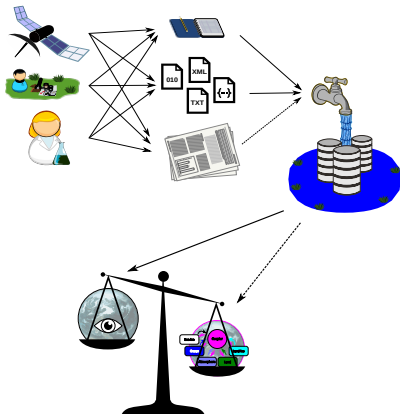
Challenges: Data



- Obs come from many sources
 - remote sensing
 - field campaigns
 - laboratory experiments
- Obs reporting is complicated
 - Key details in journal articles
 - Many different formats
 - Personal communication sometimes required
- Massive “swamp” of data
 - NASA EOSDIS > 9PB



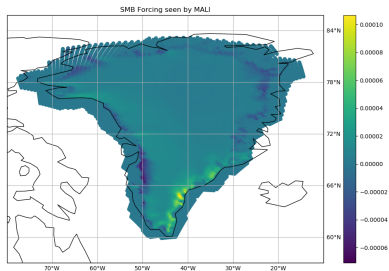
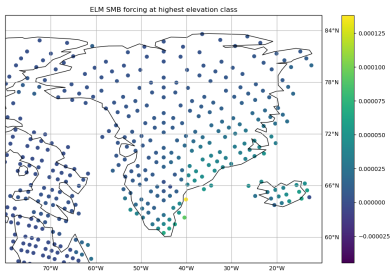
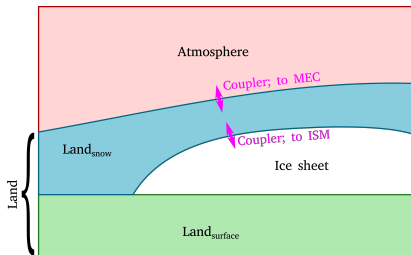
Challenges: Data and models



- Data needs to be comparable; sync:
 - Time
 - Grids
 - Projections
 - Available variables
 - This often requires expertise!
- Simulations requires similar setup efforts
 - Input datasets
 - Configuration
 - Spin-up
 - Execution
 - Postprocessing



Challenges: Models



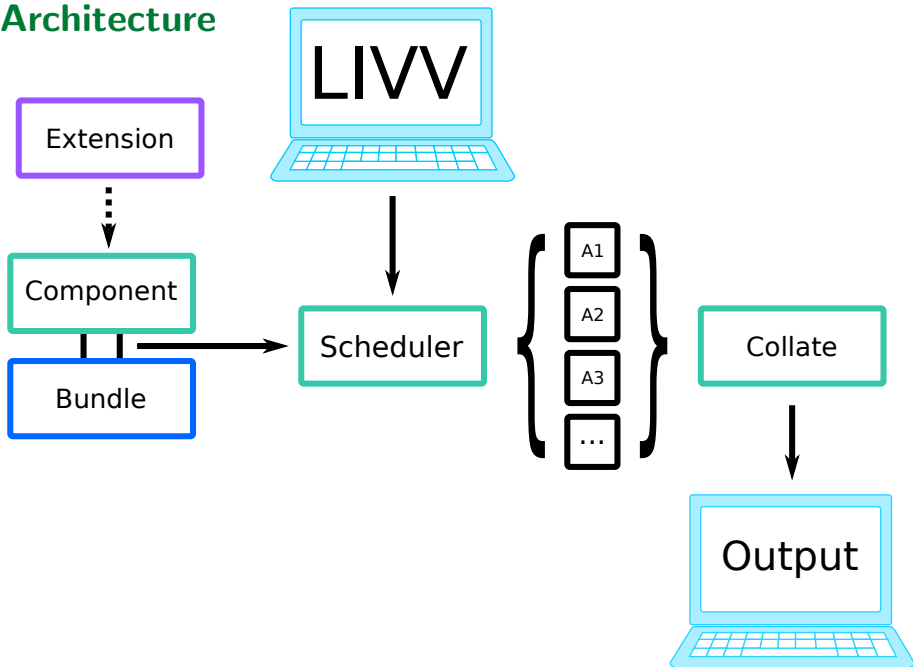




- Open source, open development package for ice sheets
 - Publicly developed at github.com/livvkit/livvkit
 - Distributed on conda-forge and PyPI
 - v2.1.6 released July 27, 2018; v2.2 coming soon!
- Validation challenge approached through LIVVkit Extensions (LEX)
 - Public development (primary) at code.ornl.gov/LIVVkit/lex
 - Closed development (alt) at code.ornl.gov/LIVVkit/lex-dev
 - Utilizes Git Large File Support (`git-lfs`) for distributing **obs** and **example model** data



Architecture



Let's have a look-see



Evans, K. J., et al. (2019). LIVVkit 2.1: Automated and extensible ice sheet model validation, *Geosci. Model Dev. Discuss.*, In Review. DOI:10.5194/gmd-2018-70



What's next?

LIVVkit v2.2

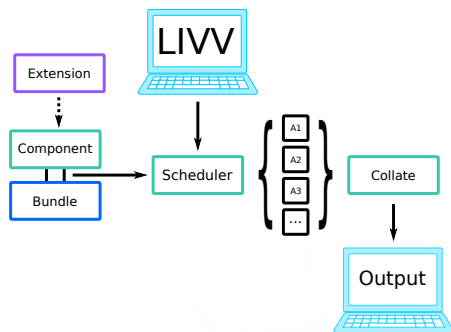
- Reworking the bundles
- More flexible web elements
- Full Bibtex support
- Combine output websites

LIVVkit v3.0

- Drop python 2 (finally)

LEX v0.2

- Moar data! E.g.,
 - RACMO > v2.3
 - Antarctic firn/ice cores
- Full SMB, SEB downscaling analysis
 - Greenland
 - Antarctica



What's next?

Whatever you want!



What's next?

I'm sorry if I'm slow to respond – this happened:



What's next?

- Climate reproducibility testing
 - EVE, powered by LIVVkit
 - <http://jhkennedy.org/sites/default/files/ClimateReproducibility/index.html>
- Verification of ISMIP6 submissions
 - ISMIP6 Atlas extension to LIVVkit
 - <http://jhkennedy.org/sites/default/files/Atlas/index.html>