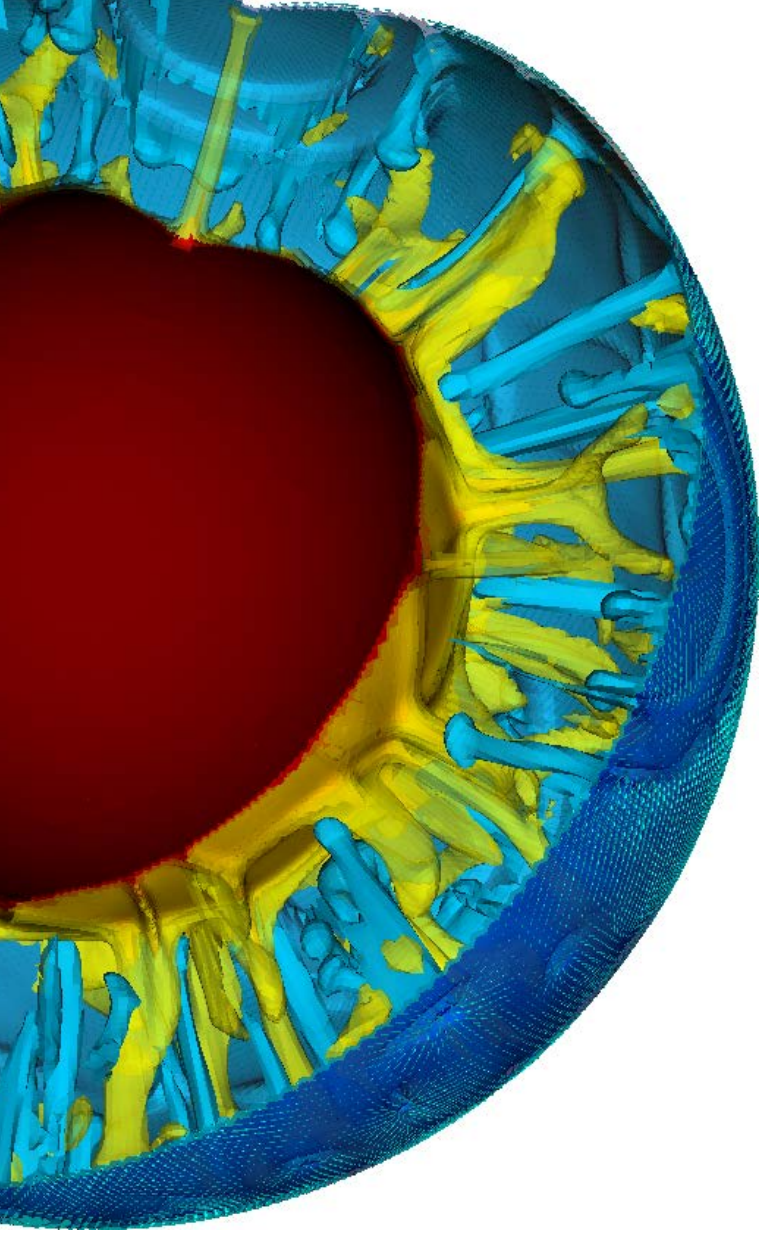

Computational Infrastructure for Geodynamics

CIG
COMPUTATIONAL INFRASTRUCTURE for GEODYNAMICS

2019 Business Meeting
11 December 2019
San Francisco, CA

CIG is funded by the NSF's Geoinformatics program (in GEO-EAR) with contributions from NSF's Office of Advanced Cyberinfrastructure

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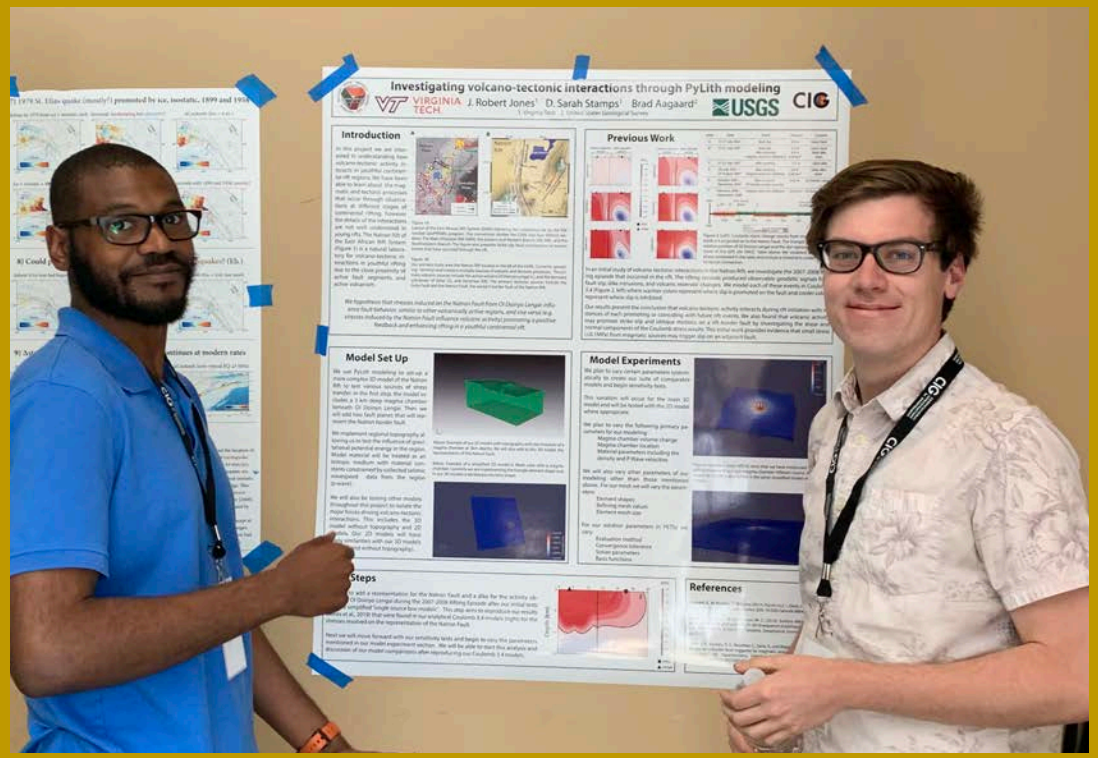
AGENDA



Volcanic-tectonic modeling with PyLith.
2019 CDM Workshop

Welcome

Governance

- EC Activities
- Elections

Activities

Discussion

- Survey

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LEADERSHIP

2019
EXECUTIVE COMMITTEE ACTIVITIES

Leadership Transition

CIG IV Planning

CIG Community Meeting Writing Committee

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CIG STAFF

Ask about the video …
~Tahoe, CA

DIRECTOR

Lorraine Hwang

RESEARCH SCIENTIST

Hiroaki Matsui

John Naliboff

Rene Gassmoeller

SYSTEM ADMINISTRATION

Bill Broadley

Timothy Thatcher*

*new

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GOVERNANCE

Thanks to:

Frederik Simons

Nominating Committee

Carolina Lithgow-Bertelloni

Frederik Simons

Jolante van Wijk

Executive Committee:

Bruce Buffet (UC Berkeley)*

Katie Cooper (WSU)

Claire Currie (U. Alberta)*

Louis Moresi (Melbourne U.)

Carl Tape (UA Fairbanks)

5 elected members

2 ex-officio

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GOVERNANCE

Thanks to:

Brad Aagaard

John Rudge

Science Steering Committee:

Ebru Bozdag (CSM)

Juliane Dannberg (U. Florida)*

David Ham (Imperial C.)

Jessica Irving (Princeton)

Scott King (VaTech)*

Gabriele Morra (UL Lafayette)

Krista Soderlund (UT Austin)

Cian Wilson (Carnegie DTM)

8 elected members

2 ex-officio

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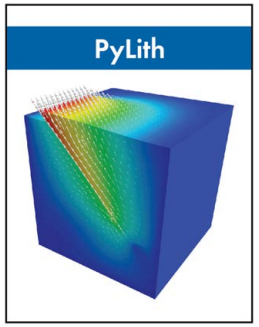
GOVERNANCE

New Institutional Member

University of Florida

Short Term Crustal Deformation 2019 Activities

Brad Aagaard
Charles Williams
Eric Hetland
Eric Lindsey



PyLith Development

Parallel, 2-D and 3-D finite-element code for modeling crustal deformation associated with earthquake faulting and elastic and/or viscoelastic rheologies -*Aagaard, Knepley, Williams*

Version 2.2.2 (July 2, 2019) *Fixes a few small bugs*

Version 3.0.0 beta (June 2019)

- New multiphysics formulation and PETSc time-stepping algorithms
- New examples

Version 3.0.0 (Jan/Feb 2020)

- Numerous delays due to other commitments and new bugs (e.g., changes to PETSc DMPlex finite-element data structures)
- Still adding more tests (and finding more bugs)

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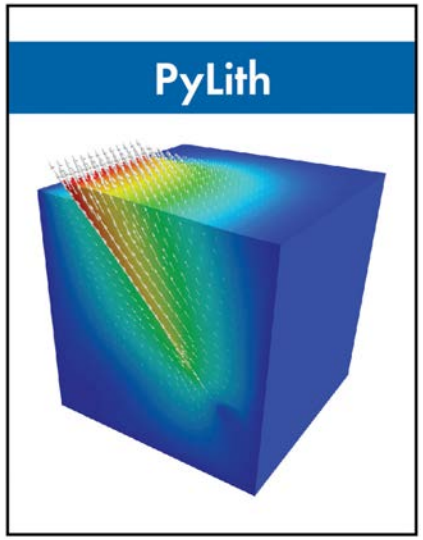
Workshop 2019

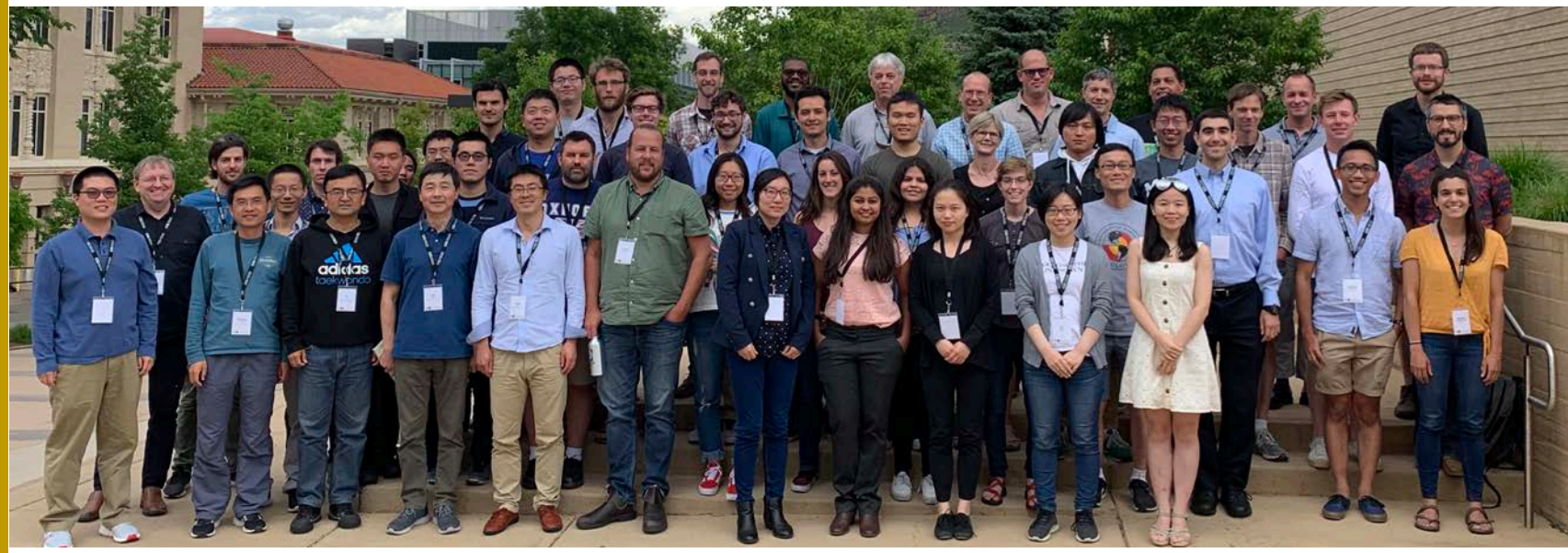
June 10-14
Crustal Deformation Modeling Workshop
Colorado



2.0 days PyLith tutorials

+

2.5 days science talks & discussions



SCEC

58 participants

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Short Term Crustal Deformation

2020 Activities

Brad Aagaard
Charles Williams
Eric Hetland
Eric Lindsey

PyLith Hackathon

June 7–14, 2020,
Colorado School of Mines

- Looking for about 12 interested hackers
- Expectation: 3–4 projects with 3–4 people working together. LIST OF POTENTIAL PROJECTS Pending
- Application process will open in late January

PyLith v3.x *Development Plan, April 2019*

- Significant progress on poroelasticity implementation
  Robert Walker, Josimar Alves da Silva
- Update spontaneous rupture formulation and explicit time stepping
- More under-the-hood changes (e.g., Python 2 → Python 3)

Still waiting for champion(s) to lead other community code development efforts

Geodetic inversions

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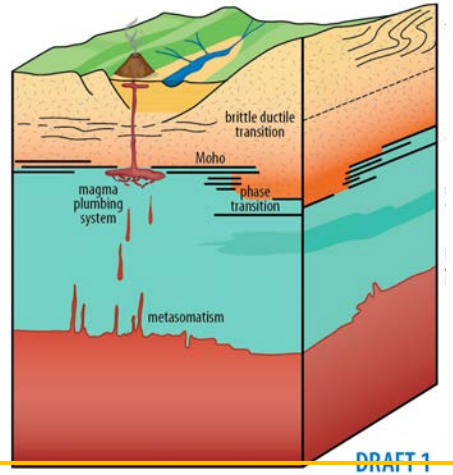
Long Term Tectonics

Jolante van Wijk
Cedric Thieulot
Mark Behn
Susanne Buiter
Claire Currie
Lijun Liu
Eric Mittelstaedt
John Naliboff

White Paper



Transitional Domains of the Lithosphere: the Future of Lithospheric Geodynamics

observational and computational

Canadian Geophysical U.

The Lithosphere

Workshop

LTT Crustal Deformation Modeling

! volunteers needed !

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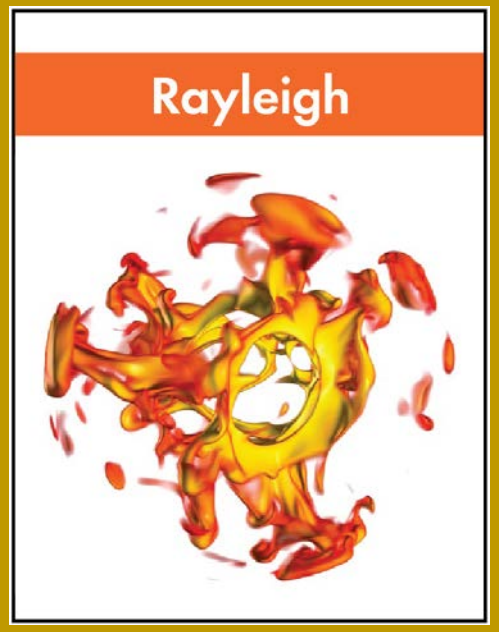
Rayleigh



Nick Featherstone

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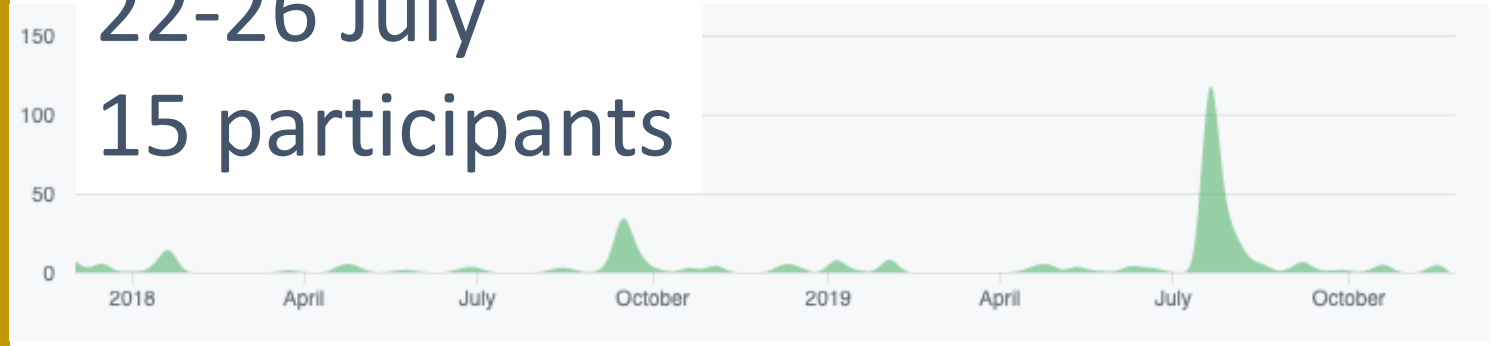
2019 Rayleigh Hackathon

- Online documentation that auto-updates
- Jupyter notebook examples:
  - modifying the code's equation sets
  - volumetric rendering using YT and Vapor.
- Custom-reference states and custom nondimensionalizations
- Generic inputs

22-26 July

15 participants



SPECFEM-X

Hom Nath Gharti
&
Jeroen Tromp

Major Development Milestones

- Coseismic and postearthquake deformation
- Gravity anomalies
- Magnetic anomalies
- GPU implementation: Phase I

Significant Future Plans

- Frequency Domain solver and Normal Modes
- Glacial Isostatic Adjustments
- True Polar Wander and Wobbles
- GPU implementation: Phase II

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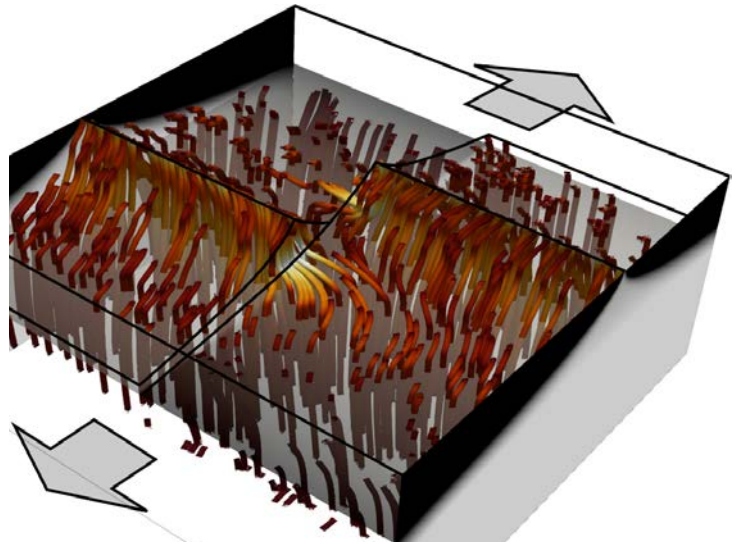
ASPECT

Jacky Austermann
Wolfgang Bangerth
Juliane Dannberg
Menno Fraters
Rene Gassmoeller
Anne Glerum
Timo Heister
John Naliboff

Release 2.1.0 (April 2019)

Geodynamic World Builder
Volume of Fluid method
New compressible formulations
→ DI33C-0049



Future:

Visco-elastic-plastic deformation with phase changes, compressibility

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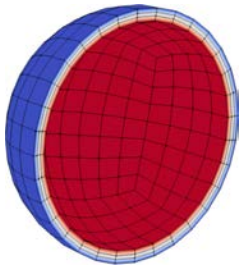
2019 ASPECT Hackathon

- Temperature stabilization: new SUPG, improved EV

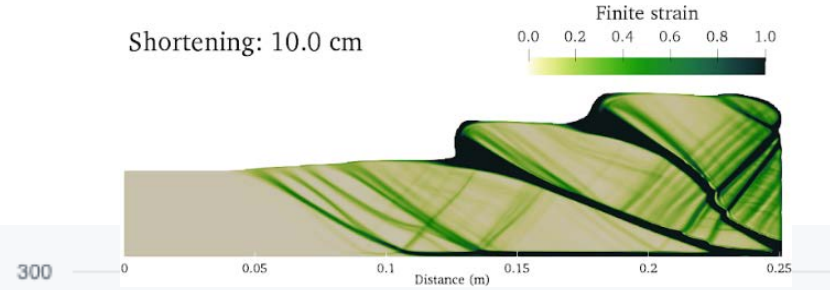
- Robust shear band angles

for visco-plastic → *T51C-16*

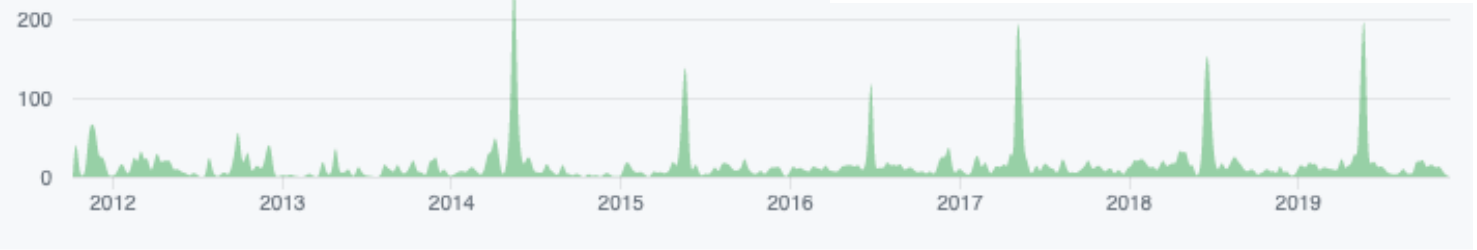
- Visco-elasto-plastic models



- Mesh deformation framework
- *various cookbooks and benchmarks*



21 May – 1 June
24 participants



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HPC

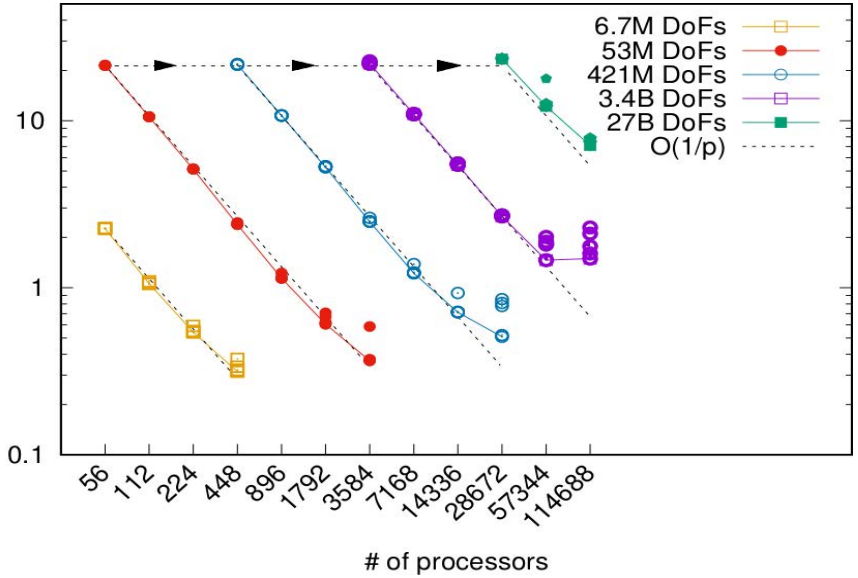
Spike was 66 million years to early to become a dinosaur of computing.
Albuquerque, NM

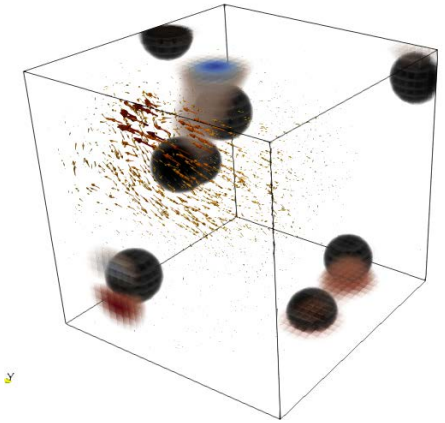
XSEDE

- allocation available for community use

Frontera Early Access (ranked #5)

- ASPECT: implemented multigrid solver. Excellent scaling.
- Future: I/O at scale, realistic problems, high-resolution grain-size models





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Webinar Series

November 14

February 13

March 12

April 9

May 7

more in 2020 !

2019-2020 Observations and Data that Drive Geodynamics

Richard Styron, *GEM Foundation & Earth Analysis, LLC.*

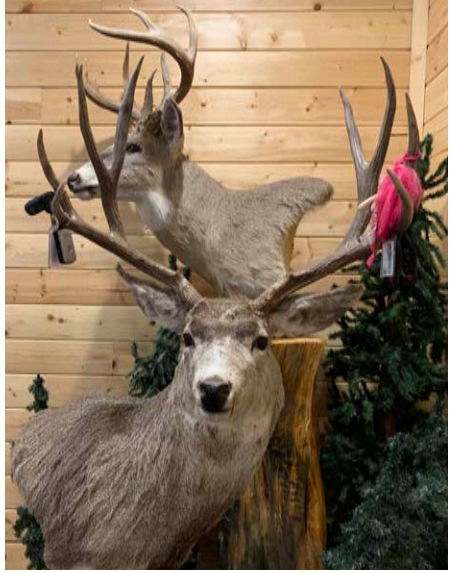
Christy Till, *Arizona State U.*

Nicole Gasparini, *Tulane U.*

Jane Willenbring, *Scripps Inst. of Oceanography*

Ved Lekic, *U. Maryland*

Brandon Schmandt, *U. New Mexico*



Finding creative ways to track car keys.
2019 ASPECT Hack

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2019-2020 Speaker Series

Katie Cooper Gabriele Morra Carl Tape Sarah Stamps Frederik Simons

FROM GRAINS TO TECTONIC PLATE BOUNDARIES

Sylvain Barbot, USC

U. Louisiana, Lafayette ◆ Louisiana State U.

CLUES ABOUT THE BREAK-UP OF THE AFRICAN CONTINENT

Sarah Stamps, Virginia Tech

Michigan State U. ◆ Grand Valley S.U. ◆ U.A. Fairbanks

WHAT CREATES THE UNIQUE TOPOGRAPHY OF EAST AFRICA?

Jolante Van Wijk, NMT

Florida State U. ◆ U. Montana ◆ Montana Tech

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Future Activities

2020

January *21-23*	ASPECT User Workshop *Virtual*
May 3-6	CGU *Banff LTT*
June 7-14	PyLith Hackathon *Colorado*
July 25-31	LTT Deformation Modeling Workshop *Colorado*
Aug 4-15	ASPECT Hackathon *Wyoming*
Summer	Rayleigh Hackathon *tbd*
October *6-8*	SPECFEM Developers Workshop
October *23-25*	CIG Community Workshop *Davis, CA*

Cultivating analog skills.
2019 ASPECT Hack

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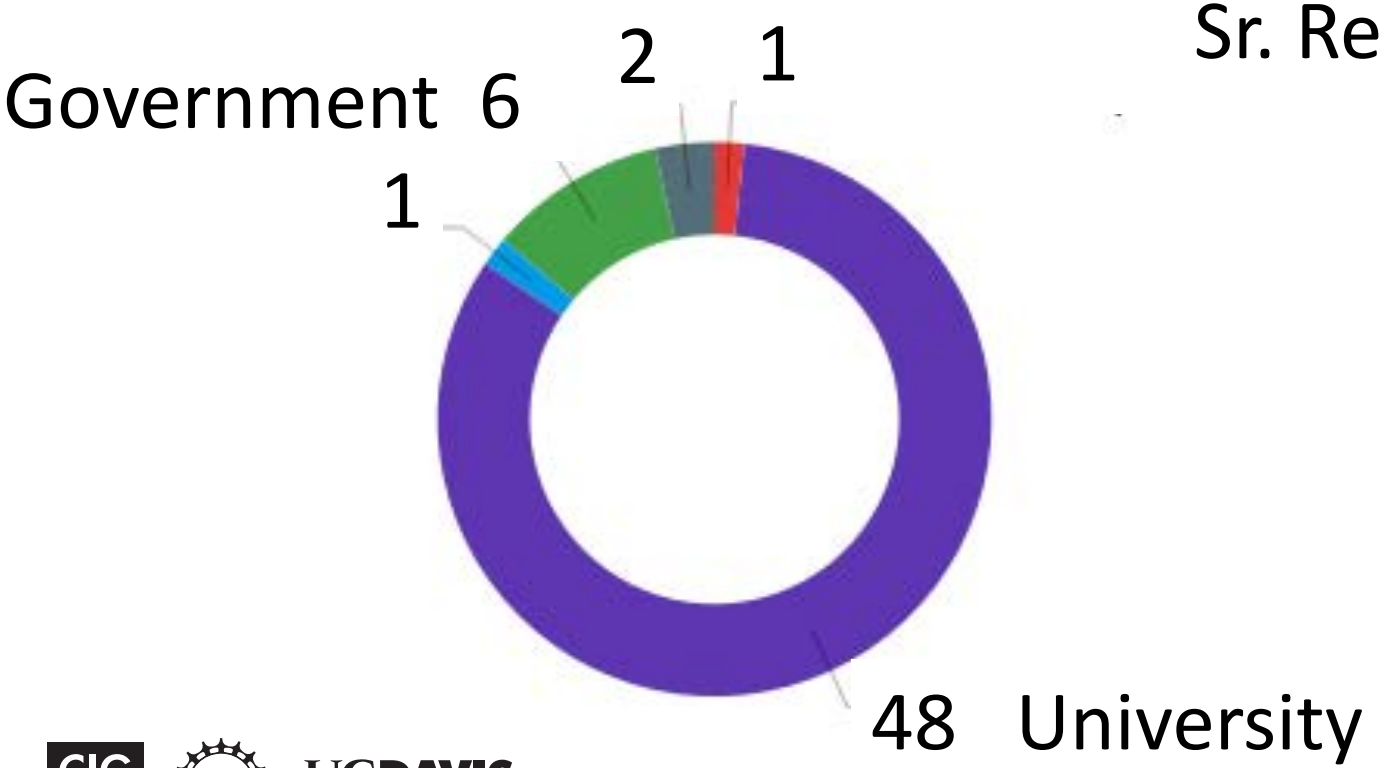
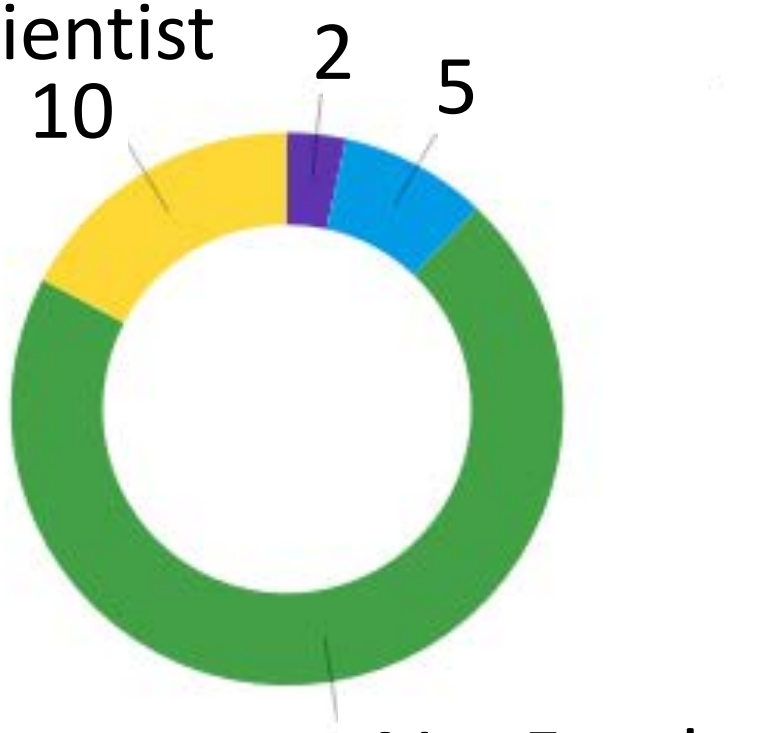
Survey - Demographics

My primary affiliation is with a:



Career level:



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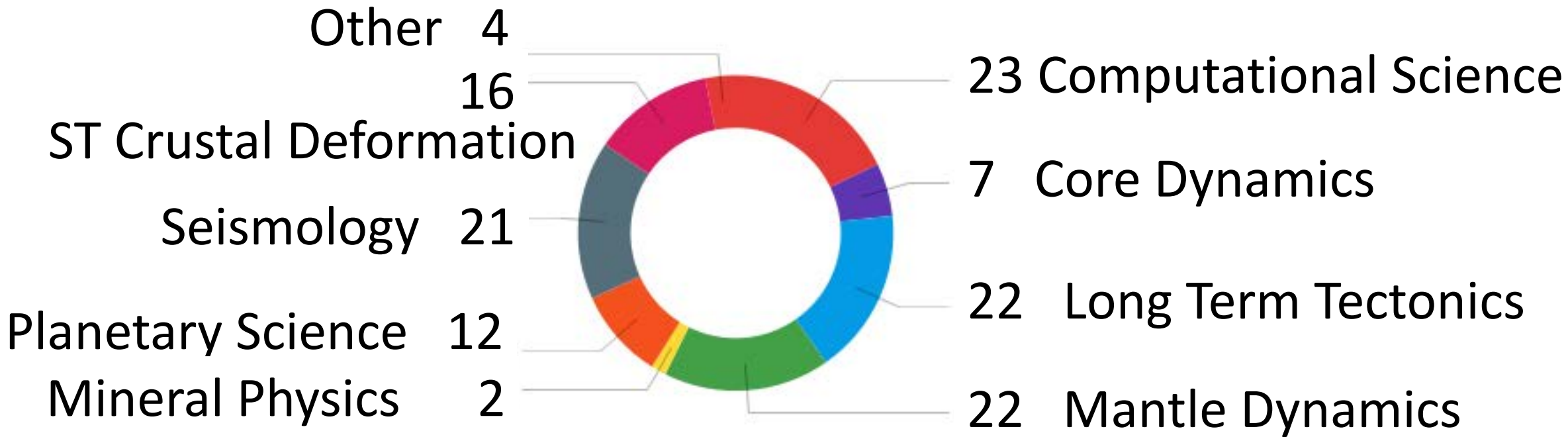
Survey - Demographics

My domain area(s) of expertise is:

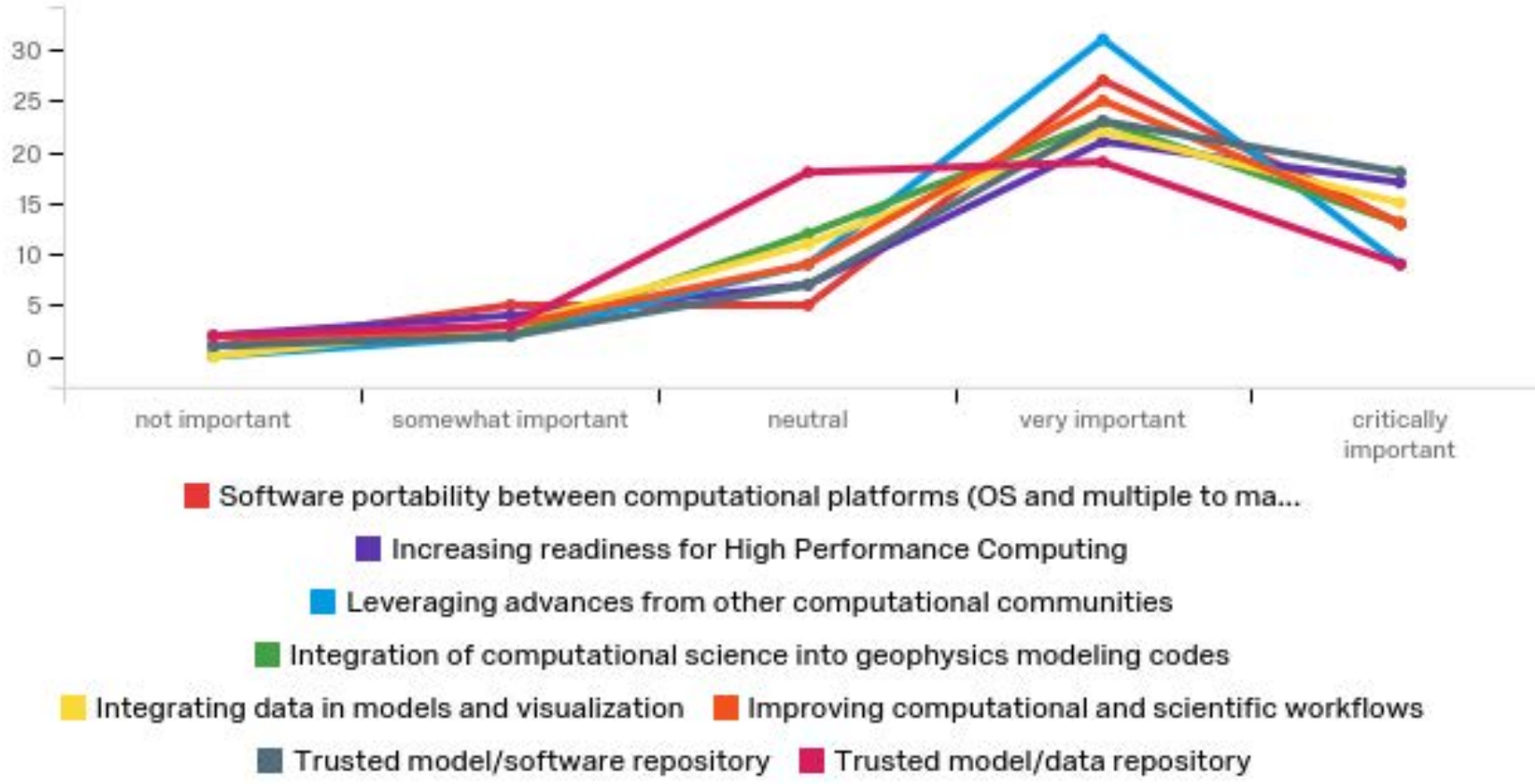
choose all that apply



Survey – Software

GPU implementation
inclusive communities
onboarding
fluid flow
multiphysics
data assimilation
workflow
AI
portability
usability
reproducibility

Rank the importance of each of the following themes for CIG IV:



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Survey – Science

EQ cycle modeling

computational seismology

model-based data fusion

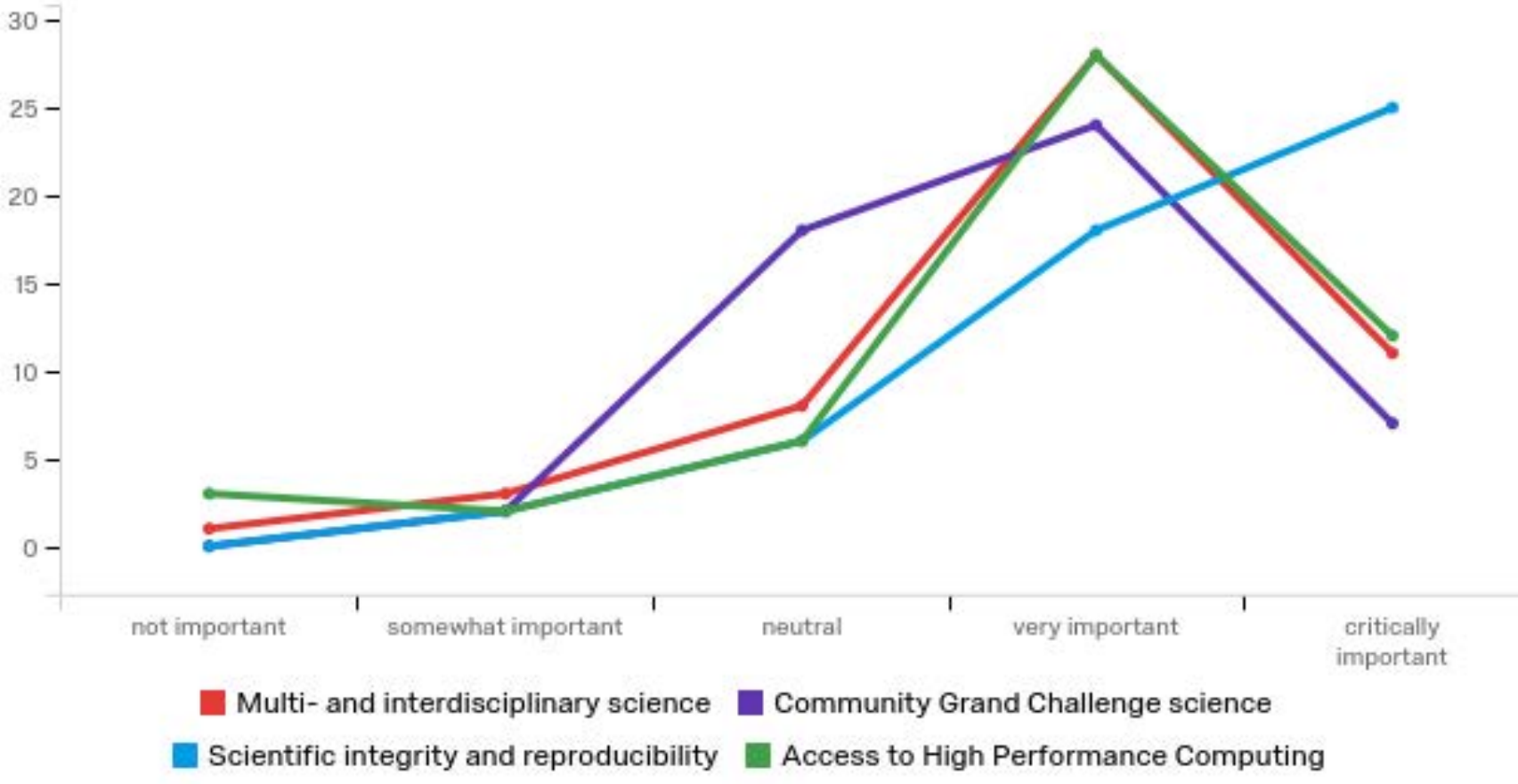
education

energy and mineral security

hpc facility

next generation training

Rank the importance of each of the following themes for CIG IV:



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Survey – Outreach

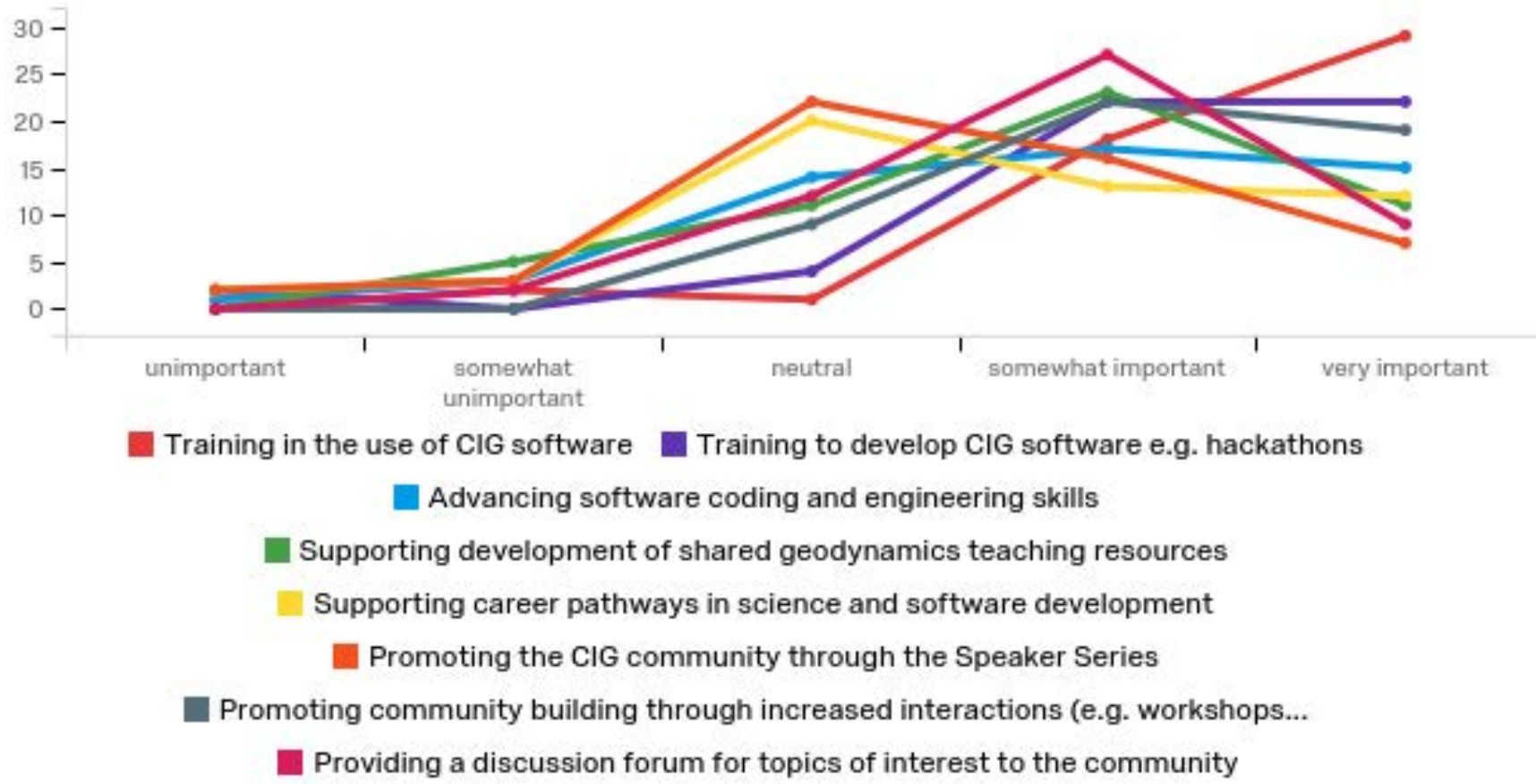
CIG "CIDER"

training in computational skills

more developers

summer undergraduate research

Rank the importance of each of the following themes for CIG IV:



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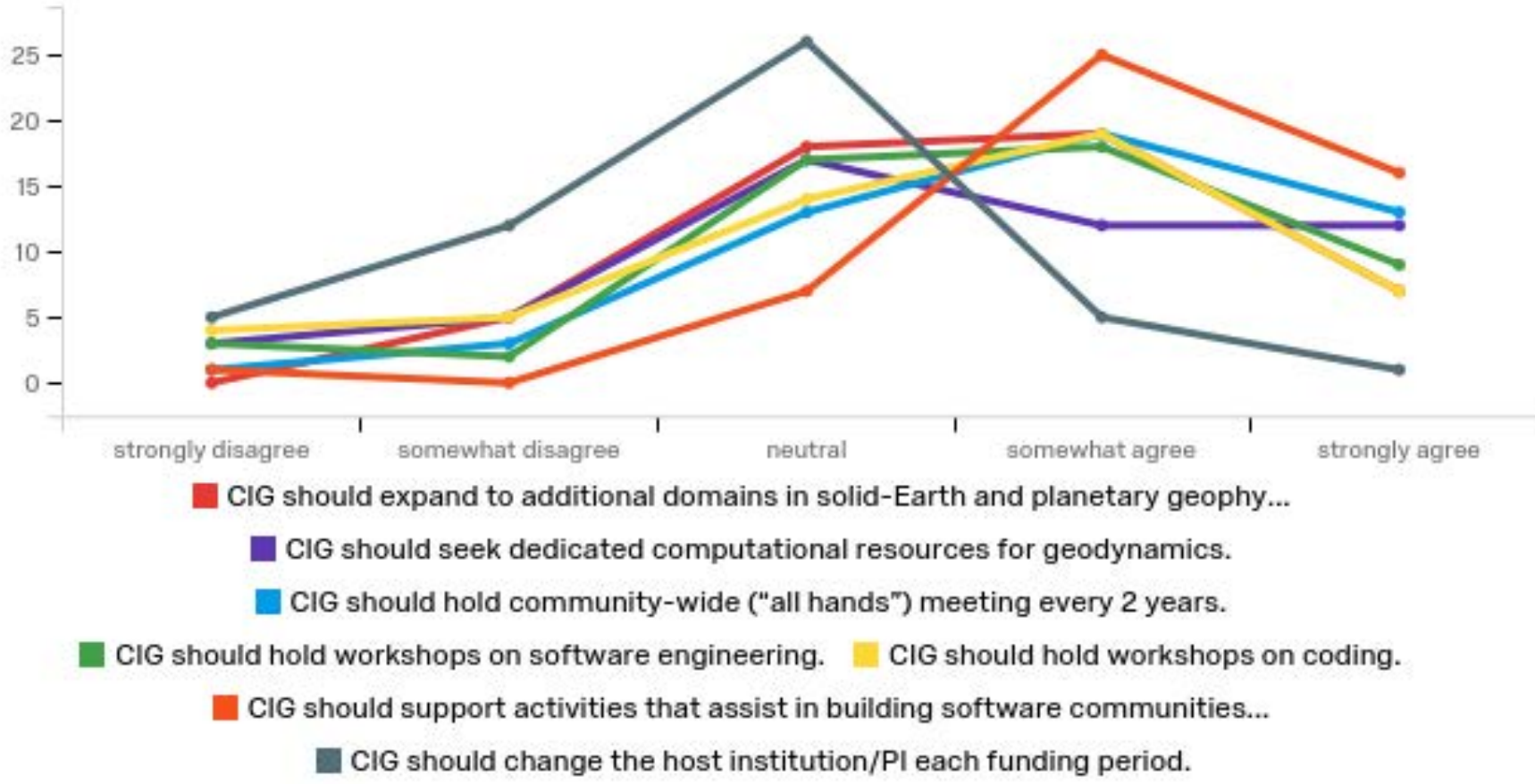
Survey - Activities

Indicate how strongly you agree or disagree with the following statements:



Survey - Comments

Frontier capabilities needed and opportunities:

- Machine learning in geodynamics
- Multi-scale physics and coupled problems across all scales e.g. LTT, MHD
- Supporting model and data collaboration and colocation

Partnering with science entities

Diversity and inclusivity:

- Demographics
- Participation in leading edge computing
- Small and large research groups
- International participation
- Funding
  - NASA for planetary geodynamics
  - NERC-NSF *United Kingdom*

Education:

- Pooling teaching resources
- Summer undergraduate researchers

Social responsibility:

- Decreasing our carbon footprint

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Postdoctoral Researchers @CIG UC Davis

2 Postdoctoral Researchers – RSE software development and engineering

- The positions are expected to contribute to the development and support of numerical modeling codes in geodynamics and towards conducting independent research.

Applications:

- < 5 page project proposal
- Letter of Collaboration

Deadline January 26, 2020

https://recruit.ucdavis.edu/JPF03269

For more information contact Lorraine Hwang:

ljhwang@ucdavis.edu

Wishing you a New Year filled with
Peace and Happiness