

VOLUME 4 ISSUE 3

CIG NEWS ELEMENTS

COMPUTATIONAL INFRASTRUCTURE FOR GEODYNAMICS

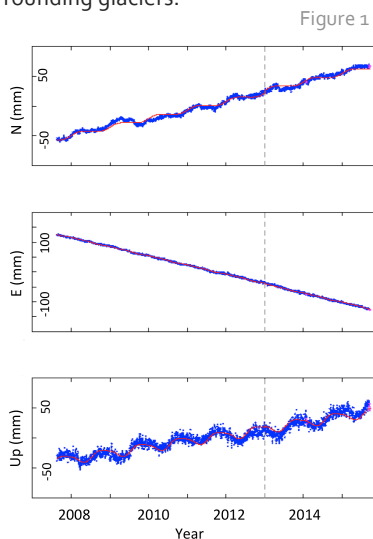
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Research Highlight - PyLith

Estimating Viscoelastic Deformation due to Seasonal Loading

Scientists have been making summer-time geodetic measurements in south central Alaska for decades to estimate the rate at which a continental-ocean terrane is accreting to the North American continent. Southern Alaska has big earthquakes every century and large, rapidly changing glaciers. In the last decade, primarily as part of the EarthScope Plate Boundary Observatory project, continuous GPS measurements have recorded the response of sites such as the near-coastal geodetic site, AB35 to competing processes: uplift and movement to the northwest due to tectonic forces and the response of the solid Earth to seasonal and longer-term changes in the cryosphere (snow and ice) surrounding the site. Which process causes the largest displacements of the site? Figure 1 (Blewitt, Nevada Geodetic Lab, 2015) shows the Northward, Eastward, and Upward motion of AB35 between 2007 and 2015. The site is moving rapidly to the north and west reflecting the tectonic convergence of site toward interior Alaska but there is small wiggle on the North component reflecting seasonal displacements of the site associated with snow loading and unloading. However, the Up component, shows a large seasonal signal due to snow loading in the winter (down) and ice and snow melting in the

warmer months (site goes up). Between 2007 and the present, the site position is slowly moving upward, due to tectonic forcing but probably associated with longer-term ice melting as well. We are using the CIG finite element modeling (FEM) program PyLith to estimate the surface displacements and stresses associated with seasonal loading changes (top figure and Figure 2 far right) for water year 2012, 2011.8 – 2012.8) and the longer-term retreat of the surrounding glaciers.



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ANNOUNCEMENTS

Elections: Deadline to Vote November 30
 CIG Business Meeting: Monday, December 14

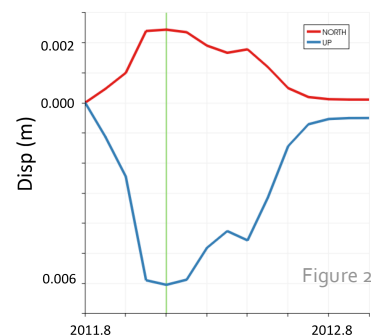


Figure 1 Displacement as a function of time (North, East, and Up in mm) for the near-coastal continuous GPS site AB35. (Top) Plan view of the finite element model (FEM) grid created using CUBIT with the maximum surface displacement (meters, in late winter/early spring) calculated using the CIG FEM code PyLith. The grid is centered near the GPS site AB35 (pink box) in southern Alaska. Figure 2. Predicted North (N, red) and Vertical (Z, blue) as a function of time at AB35 for 2011.8 to 2012.8 (WY2012). Most of the displacement is elastic but a purely elastic response would return to the zero after one year when the load is removed.

Jeanne Sauber, NASA Goddard Flight Center

Code Corner

NEW RELEASES

- ASPECT 1.3 2015-05-18
- deal.II v8.3 2015-08-08
- SPECFEM3D GLOBE 7.0.0 2015-07-10
- Virtual Quake 2.0.0 2015-09-13

ALLOCATIONS

Stampede	108,2796 / 1,886,789
Yellowstone	467,102 / 490,000

NEW RELEASES

ASPECT

We are pleased to announce the release of ASPECT 1.3. ASPECT is the Advanced Solver for Problems in Earth's ConvecTion. It uses modern numerical methods such as adaptive mesh refinement, multigrid, and a modular software design to provide a fast, flexible, and extensible mantle convection solver. ASPECT is available from:

<https://aspect.dealii.org/>

This release includes the following changes:

- New: Averaging of material properties between the quadrature points of a cell. This greatly increases the stability of solutions in simulations with spatially varying coefficients, and also greatly accelerates the solution, at times up to a factor of ten.
- Corrections to the entropy stabilization scheme for compositional fields.
- Fixed and extended: Removal of rigid body translations and rotations when the simulation has a nullspace.
- New: VTU visualization output can now be grouped into an arbitrary number of files per time step.
- Various fixes to the nonlinear solver residual computation.
- New visualization postprocessors that can output the shear stress and full stress tensors.

- Fixes to the latent heat formulation.
- New 'ascii data' plugins for boundary and initial conditions.
- New mass flux statistics postprocessor.
- Many other fixes and small improvements.

Wolfgang Bangerth, Timo Heister, and many other contributors.

SPECFEM3D GLOBE

New in SPECFEM3D_GLOBE 7.0.0:

- supports CUDA and OpenCL GPU accelerators
- ADIOS file I/O support
- ASDF seismograms
- simultaneous MPI runs
- tomography tools
- Comprehensive Earth Model (CEM) model support
- git versioning system (here on github) to support user contributions
- enhanced performance in both mesher and solver

Changes:

- new seismogram name formats (changes from station.network.. to network.station.. following IRIS convention)
- uses binary topography files
- updates ellipticity and gravity factors
- updates AK135 model
- bug fixes geocentric/geographic conversions

Virtual Quake

This update includes major bug fixes to the rupture model and the multiprocessing mode. The rupture model matrix solver has been stabilized. New features have been added to the data analysis script PyVQ, including event KML (Google Earth) output to visualize co-seismic slips. Improved physically derived stress drop algorithm that uses known scaling relations.

Code Attribution @CIG

One of the barriers to proper attribution of software codes for credit, discoverability, and reproducibility is the lack of knowledge of how to cite. Through the SAGA project, CIG is developing language to make this easier for users to support these goals. A strawman proposal can be found at: <https://geodynamics.org/cig/projects/saga/draft-attribution/>

Join the conversation and add your thoughts and suggestions to improve software citation.

Frontiers in Planetary and Stellar Magnetism Through High Performance Computing

Congratulations to the CIG Geodynamo Working Group for receiving an additional 150 million core-hours on the IBM Blue Gene/Q "Mira" through the INCITE program at the Argonne Leadership Computing Facility (ALCF). Led by Jon Aurnou and Nick Featherstone, the team has been working with the ALCF experts to improve the performance of the CIG developed code *Rayleigh*. During the 2nd year of the project, simulations will push the frontiers of our understanding of the Earth's, Jupiter's and the Sun's dynamo. The massive datasets generated will be open to the community for analysis. For the latest information see the project's webpage:

<http://geodynamics.org/cig/projects/dynamo-frontiers>

KUDOS

Congratulations to all of our AGU award winners:

- [Inge Lehman Medal](#). Peter Olson, *John Hopkins University*
- [Flinn Award](#). Robin Reichlin, *NSF*
- [Keiti Aki Young Scientist Award](#), *Sanne Cottar, University of Cambridge*

Peter and Robin will be honored at the Honors Ceremony and Banquet to be held on 16 December 2015 at the 2015 AGU Fall Meeting.

WANTED

AGU Abstracts Wanted

Help other researchers find your presentation at the 2015 Fall AGU meeting by submitting your abstract information to CIG. Use the [SUBMIT](#) link from the home page or mail to events@geodynamis.org. Visit our website to find a listing of [abstracts](#) and [sessions](#) of interest.

Governance



Elections

2015 Elections

CIG Member Representatives are voting for 2 new Executive Committee and 3 new Science Steering Committee Members. EC candidates **Omar Ghattas** or **Carl Gable** will join returning members Bruce Buffet, David Bercovici and Omar Ghattas. SSC candidates **Jon Arnou, Tom Clune, Carl Tape, Artie Rogers, Jed Brown, Timo Heister, Dave May, and/or Eunseo Choi** will join returning members Brad Aagaard, Tim Ahern, Jed Brown, David May and Carl Tape.

Candidate statements can be viewed at:

<http://geodynamics.org/cig/about/governance/elections/>

Please contact your member representative and vote. Elections close on **November 30, 2015**.

Many thanks to outgoing EC members Claire Currie and Scott King and SSC Members Jon Arnou, Magali Billen and Jolante vanWijk; and to our Nominating Committee – Laurent Montesj, Bruce Buffett and Matt Knepley.

New EC and SC members will be announced at the CIG Business Meeting during 2015 AGU Fall Meeting.

ELECTIONS

Events

CIG Webinars

CIG webinars draw from a pool of experts from mathematicians, to computer scientists, and to geoscientists, among others to bring together a crosscutting community of faculty, students and researchers to both inform and disseminate knowledge on the tools and methodologies employed to further the study of problems in geodynamics.

The one-hour webinars will be held the 2nd Thursday of each month October through May @2pm PT unless otherwise noted. Webinars will be recorded for later viewing.

Reminders and details are sent through the cig-all mailing list.

The 2015-16 series features an exciting line-up on software, science, and emerging issues in numerical analysis. Beginning in the fall, we will be introduced to several codes newly available in the CIG repository. Winter begins a series on uncertainty, verification and validation, and applications to earth sciences.

October 8 - Sanne Cottaar, Timo Heister, Bob Myhill, Ian Rose, and Cayman Unterborn, *An introduction to BurnMan - a mineral physics toolkit*

November 12 - Anders Petersson, Lawrence Livermore National Laboratories, *Simulating seismic wave propagation with SW4*

December 3 - Kasey Schultz & Mark Yoder, UC Davis, *Virtual California*

January 14 - William Oberkampf, Oberkampf Consulting

February 11 - Habib Najm, Sandia National Laboratory

March 10 - Anna Michalak, Carnegie Institution for Science

April 14 - Noemi Petra, UC Merced

May 12 - Andreas Fichtner, ETH, *Resolution analysis by random probing*

Next Webinar

November 12 @ 2pm PT - Anders Petersson, LLNL

Simulating seismic wave propagation with SW4

This webinar describes how to use the SW4 code to simulate ground motion due to earthquakes. After a brief overview of the numerical method, we describe how to set up a simulation in terms of seismic sources, the material model, visco-elastic attenuation, and topography. We also present some of the available output options, describe how to run SW4 on parallel machines, and make some suggestions on the workflow with SW4.

For more details on this and all CIG webinars see:

<http://geodynamics.org/cig/events/webinars>

XIV'th International Workshop on Modeling of Mantle and Lithosphere Dynamics

The XIV'th International Workshop on Modeling of Mantle and Lithosphere Dynamics was held at the CNRS conference facility on Ol'eron's Island, France.

Approximately 111 scientists from 11 countries gathered to present and discuss

the state of the art of mantle dynamics, lithospheric deformation, Earth's evolution, and numerical methods. CIG for the first time co-sponsored the meeting by supporting a US delegation of 15 predominantly early career scientists (graduate students, post docs, and assistant professors) to attend the meeting. Attendees engaged in scientific conversations with their European Geosciences Union (EGU) colleagues that would have been otherwise impossible. Many thanks go to the organizing committee who put together an excellent program, and especially to Laetitia Le Pourhiet who chaired the meeting. This international workshop is held every other year as part of the Thematic Meeting Series of the EGU, other co-sponsors included the International Lithosphere Program (ILP), the Institut des sciences de la Terre Paris (ISTeP, UPMC). The 2017 meeting will be hosted by The Netherlands.

ASPECT Hackathon



The 2nd ASPECT Hackathon was held May 19-30, 2015 at the Bodega Marine Laboratory, Bodega, CA. 23 participants coded for 9 days adding 6,706 lines of code. New users worked along side experience users forming new collaborations and making progress on existing projects. The group increased its efficiency by combining multiple commits that formed a new feature into one before submitting a pull request.

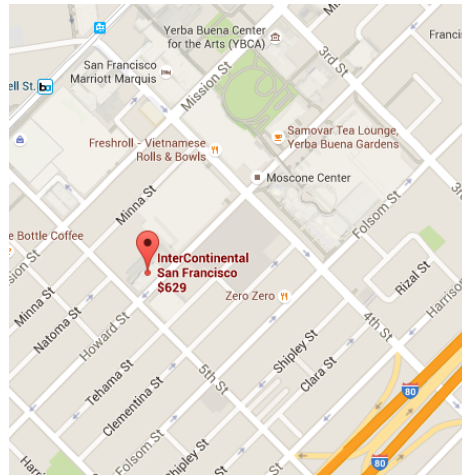


ASPECT github commits from 2014-current. The peaks correspond to the 2 hackathons.

2015 CIG Annual Business Meeting

*** NEW LOCATION

CIG will hold its Annual Business Meeting on **Monday, December 14** at the **Intercontinental San Francisco**. The Intercontinental is just around the corner from Moscone Center West. The reception begins at 6pm followed by the business meeting at 7pm. Light hors d'oeuvres will be served. Discussions will include planning for the **JUNE 2015 ALL HANDS MEETING**, an update on the CIG Phase III proposal and results from the 2015 EC and SSC elections. See our website for more information and directions.



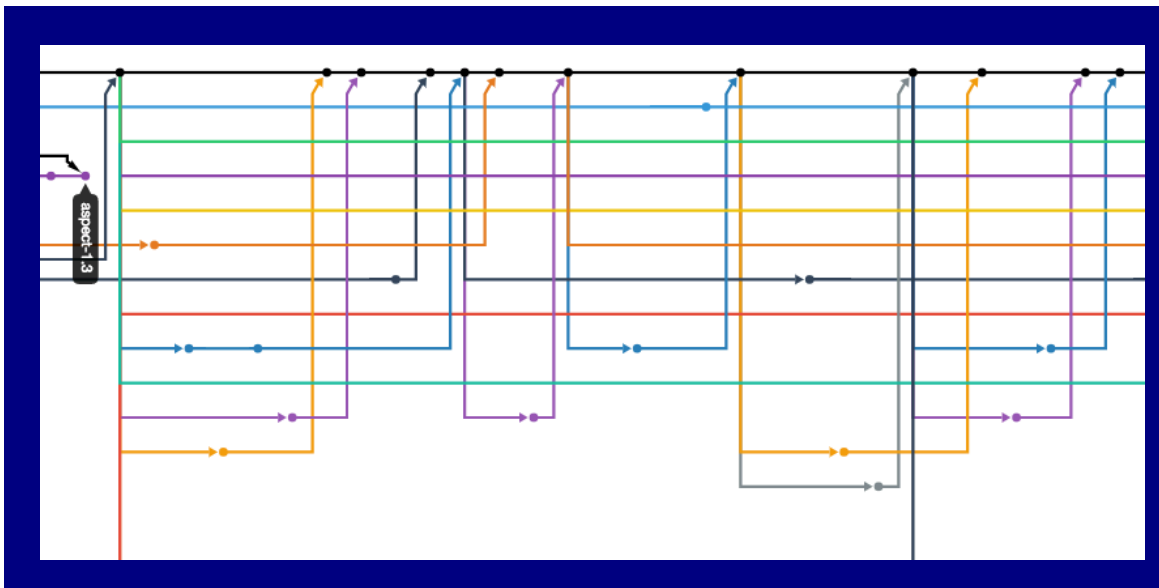
The Intercontinental is conveniently located behind Moscone Center West.

Upcoming Meetings

December 14, 2015. CIG Business Meeting, San Francisco, CA
 *** NEW LOCATION TBD

June 2016. CIG All Hands Meeting, Davis, California
 TBD

For more information on CIG hosted events, please go to geodynamics.org



ASPECT github network at the beginning of the May 2015 hackathon.

Recently Published

- Adam, J.M.-C. and Romanowicz, B. (2015) "Global scale observations of scattered energy near the inner-core boundary: seismic constraints on the base of the outer-core", *Physics Of The Earth And Planetary Interiors* DOI: 10.1016/j.pepi.2015.06.005
- de Wit, R.W.L. and Trampert, J. (2015) "Robust constraints on average radial lower mantle anisotropy and consequences for composition and texture", *Earth And Planetary Science Letters* Volume 429 DOI: 10.1016/j.epsl.2015.07.057
- Jadamec, MA (2015) "Slab-driven Mantle Weakening and Rapid Mantle Flow", *Subduction Dynamics: From Mantle Flow To Mega Disasters* *Geophys. J. Int.* (August, 2015) 202 (2): 811-827.doi: 10.1093/gji/ggv189
- Lim, Chungwan and Lee, Changyeol (2015) "Effects of temporal plume-slab interaction on the partial melting of the subducted oceanic crust", *Journal Of Asian Earth Sciences* DOI: 10.1016/j.jseaes.2015.09.016
- Mitsui, Y. and Heki, K. (2015) "Report on a characteristic oscillation about 38 mHz (26 s) in northeastern Japan following surface wave of the 2011 Tohoku megathrust earthquake", *Geophysical Journal International* Volume 202 (1) DOI: 10.1093/gji/ggv147
- Yang, Hsin-Ying and Tromp, Jeroen (2015) "Synthetic free-oscillation spectra: an appraisal of various mode-coupling methods", *Geophysical Journal International* Volume 203 (2) DOI: 10.1093/gji/ggv349
- Li, Shaoyang and Moreno, Marcos and Bedford, Jonathan and Rosenau, Matthias and Oncken, Onno (2015) "Revisiting visco-elastic effects on interseismic deformation and locking degree: a case study of the Peru - North Chile subduction zone", *Journal Of Geophysical Research: Solid Earth* DOI: 10.1002/2015jb011903
- Hosseini, Kasra and Sigloch, Karin (2015) "Multifrequency measurements of core-diffracted P waves (Pdiff) for global waveform tomography", *Geophysical Journal International* Volume 203 (1) DOI: 10.1093/gji/ggv298

Please send us your recent publications as well as research highlights so we may continue to keep the geosciences community informed of all the current research being conducted in geodynamics with CIG codes.

Submit publications at: <http://geodynamics.org/cig/news/publications/submit/>



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The Computational Infrastructure for Geodynamics (CIG) is a community-driven organization that advances Earth science by developing and disseminating software for geophysics and related fields.

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