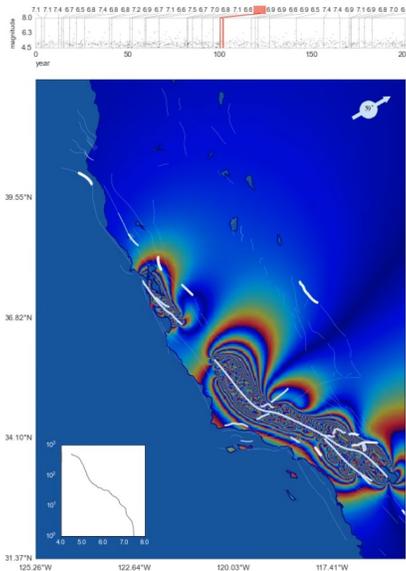


Research Highlight

GALE Applied to Study Metamorphic Core Complexes

Le Pourhiet, et al.'s (2012) recent paper on the *Kinematic Interpretation of the 3D Shapes of Metamorphic Core Complexes* compared 3D numerical experiments performed with GALE, a CIG maintained code, to finite strain observed in the field within the ductile crust, which is exhumed within dome shaped structures called metamorphic core complexes. Their study focuses on the impact of 3D kinematic extensional boundary conditions on the 3D shape of these domes. They show for the first time, that domes formed in transtensional step over; or at the tip of propagating strike-slip faults, display a finite strain field which can be interpreted as characteristic of a transpressive domes, although on their model no shortening was applied in the far field.

Their study used Q1Q1 elements and each run consisting of 200-300 time steps, required 72 hr of computation using a parallel geometric multigrid solver on 16 CPUs. A full description of the multigrid method used in GALE is provided in Appendix B of their paper. Supplementary materials are also included so readers may reproduce the results and, post-process the finite strain field and export it to VTK format out of any GALE model.



Calculated INSAR interferogram for simulated earthquakes on the San Andreas fault from the Virtual California earthquake simulation program (Heien and Sachs, 2012)

Announcements

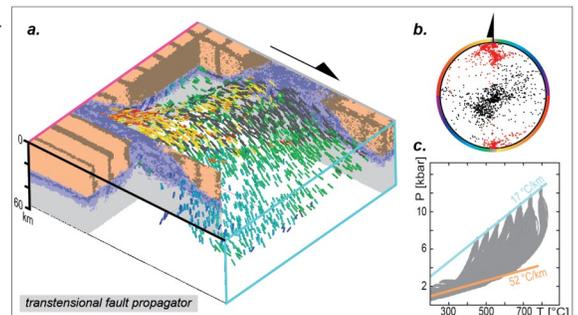
- ◆ Next Webinar Thursday November 15
- ◆ XSEDE Allocation Renewal
- ◆ December 4, CIG Business Meeting @ 2012 AGU Fall Meeting

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Results for transtensional fault propagator. (a) Internal deformation of the model outlined by cross-sections across the material points and by tubes representing the stretching lineation (maximum stretching axis of the finite strain tensor). The tubes are colored by their strike with color scale represented in b. where gray indicates when the lineation is aligned with the direction of stretching imposed at the boundary of the model.

(b) Stereo-plot representation of the lineation (red) and the foliation (black) for all the tracers located at less than 8 km depth after 12 Myr of simulation. (c) Synthetic P-T path for the same tracers as those represented in the stereo-plot. Initial and final thermal gradient in blue and yellow, respectively. The final thermal gradient is constrained assuming the line goes through 0° at the surface.



CIG on YouTube™

Check out CIG's newest YouTube videos at: <https://www.youtube.com/user/CIGeodynamics>. View Wolfgang Bangerth's webinar from October 11, 2012 on *Using Existing Libraries to Improve and Solve Computational Problems*. Or navigate to Playlists and view Timo Heister's videos generated from the mantle convection program Aspect. If you have videos you wish to share with the community, contact lorraine@geodynamics.org



NEW RELEASES

- ⇒ Pylith 1.8.0 [2012 October 24]
- ⇒ Specfem3D_V5.1.5 [2012 August 27]
- ⇒ Gale 2.0.1 [frozen]
- ⇒ Flexwin-1.0.1 [2012 August 18]
- ⇒ Pythia-0.8.1.15 [2012 October 9]

Computing

XSEDE Allocation Renewal. The CIG XSEDE allocation was accepted for renewal and is now available through 2013 on the TACC Ranger cluster. This will ensure the seismology portal (<http://geodynamics.org/portals/seismo/>) can continue to operate and further assist CIG developers and other researchers in their work. CIG is looking into adding portals for other codes to

allow researchers access to supercomputing resources for their work.

Computing Summary.

CIG currently has computing resources on XSEDE and NCAR systems. If you are interested in using a small amount of these resources for feasibility testing of your research before submitting a large resource request, please contact Eric Heien (emheien@geodynamics.org).

XSEDE Science Gateways, Dec 21. Eric Heien will be giving an XSEDE Science Gateways talk on December 21. This talk will cover the CIG Seismology Portal (<https://geodynamics.org/portals/seismo/>), including the rationale behind it, the science of the application running on it and the technology used to interface the portal with the XSEDE supercomputers.

Comings and Goings

New CIG Staff. CIG welcomes Rajesh Kommu and Shuqiang Wang to its Staff at UC Davis both are developers responsible for supporting and developing CIG code. Rajesh received his Ph.D. in Physics from UC Davis. He completed an undergraduate degree in chemical engineering and has software development experience in the healthcare industry. Rajesh's thesis utilized a computational approach

to quantum gravity in which a 3+1 dimensional spacetime emerges as the preferred spacetime geometry. He is proficient in several programming languages, various parallel programming platforms, and various numerical linear algebra techniques. Shuqiang received his Ph.D. in Applied Mathematics from Stony Brook University where he continued as a postdoctoral research associate. He brings a strong background in computational mathe-

matics and code development in high performance computing. His research experience includes developing numerical methods for solving elastic wave equations and fluid dynamics including methods for hydrodynamic-type PDE's describing free surface and multiphase flows.

Elections. Congratulations to new Executive Committee (EC) Member Scott King, new Science Steering Committee (SSC) Member Jolante van Wijk

(University of Houston) and returning SSC Member Magali Billen (UC Davis). Committee members will serve 3 years. We would like to thank departing EC Chair, Marc Parmentier and SSC member, Garrett Ito for their service and guidance to the CIG community.

CIG at Fall AGU

NSF Street Booth Fair. Come visit us at the NSF Street Booth Fair in the exhibit hall. Look left down the row of booths against the wall as you enter the exhibit hall for Booth 5340. CIG developers will be on hand answering questions and providing support.

Booth scheduling will be posted on our website at a later date. In addition, UC Davis Keck Caves will again have exciting visuals on their large 3D TV screen.

CIG Annual Business Meeting.

The CIG Annual Business Meeting will be held on Tuesday, December 4 during Fall AGU.

Please join us and meet our new Executive Committee, Science Steering Committee and CIG HQ Staff members at a reception with light hors d'oeuvres beginning at 6pm followed by the Business Meeting at 6:30 pm at the Parc55. Bring your ideas and suggestions for future

code development direction and activities for CIG. We hope to see many of you there!

AGU Abstracts. Remember to send us your CIG related abstracts and session information. As last year, these will be highlighted on geodynamics.org.

Events

California Academy of Sciences, San Francisco, CA. Don't forget to visit the *Earthquake* exhibit at the California Academy of Sciences in Golden Gate Park during AGU. Ask for tickets to *Evidence of a Restless Planet* at the Morrison Planetarium. The show explores the forces that transform the surface of our planet including accurate, data-driven visualizations contributed by CIG scientists in a dramatic immersive video format on the 75-foot "full-dome" digital screen.

Recent Meetings

8-9 October 2012. CIG Dynamo Development Workshop, Boulder, CO. 29 scientists participated in this international workshop. The workshop focused on existing methodologies of studying the solar and geodynamo. A team has been formed to define community benchmarks. Plans for a

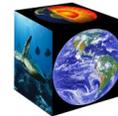
WANTED!

WANTED—AGU POSTERS. Have a poster you do not want to schlep home? Leave it at the CIG Booth 5340 and have it become part of the display at CIG HQ of active research being conducted using CIG resources.

next workshop are being developed to continue discussing benchmarking, the state of the art and long-term requirements.

October 2012. **EarthCube Workshops.** The CIG community participated in workshops to help shape the direction of the new NSF EarthCube effort by evaluating and articulating the cyberinfrastructure needs of the Structural Geology and Tectonics community held on October 20-21 in Chicago and the EarthScope community held on October 29-30 in Phoenix. EarthCube's scientific objective is to develop a framework over the next decade to understand

and predict the Earth system from the Sun to the center of the Earth. Domain workshops strove to identify science drivers, challenges, and use case scenarios; the needed data, tools and visualizations; and necessary interactions with different data systems. Recurring themes included the need for visualization in data discovery and fusion coupled with simple tools in multi-dataset analysis, access to datasets from other domains, interchange formats, provenance and characterizing uncertainty.



Webinar

Thursday, November 15 @ 2pm PT *** NEW TIME & DATE ***

Modern Numerical Methods for Modeling Convection in the Earth's Mantle

Timo Heister, Ph.D.

Visiting Assistant Professor, Department of Mathematics, Texas A&M University

We present the new open source code ASPECT for modeling convection in the earth's mantle (see <http://www.dealii.org/aspect/>). ASPECT uses modern numerical methods and provides very good parallel scalability; this is achieved by building on the open source finite element library deal.II (see <http://www.dealii.org/> and the first CIG webinar talk by Wolfgang Bangerth).



<http://www.trinitysem.edu/images/webinar.jpg>

In this webinar talk we will step through the many ingredients necessary for a modern simulation code: time discretization, nonlinear methods, linear solvers, stabilization, adaptivity, and parallelization. Finally, the effectiveness is shown in several numerical examples.

Submitted by Timo Heister, TAMU

2012-2013 Schedule

| | |
|--------------------|---|
| November 15 | Timo Heister. <i>Modern Numerical Methods for Modeling Convection in the Earth's Mantle</i> ** 2pm PT |
| December | NONE (AGU) |
| January 10 | Jed Brown. <i>High Performance Implicit Solvers for Geodynamics</i> ** 2pm PT |
| February 14 | Sarah Minson. <i>Bayesian Earthquake Modeling</i> |
| March 14 | Sylvain Barbot. <i>Using Relax to Probe the Rheology of the Lithosphere</i> *** 4pm PT |
| April 11 | Oliver Kreylos. TBD |
| May 9 | TBD |

Do you have a suggestion for or have heard a talk recently you think may interest the CIG community? Let us know by contacting lorraine@geodynamics.org

Recent Publications

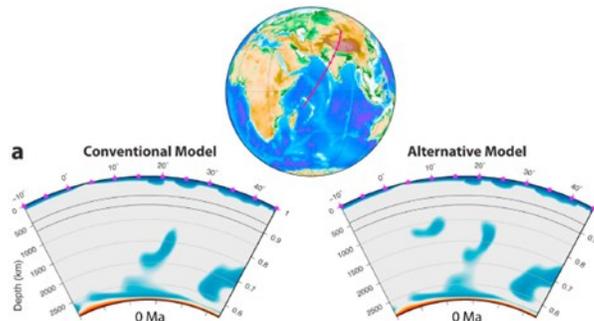
Heien, E., and M. Sachs (2012), Understanding long term earthquake behavior through simulation, *Computing in Science and Engineering*, 14 (5), 10-20, Sept.-Oct. 2012, doi:10.1109/MCSE.2012.39

Kronbichler, M., T. Heister, W. Bangerth (2012), High accuracy mantle convection simulation through modern numerical methods, *Geophys. J. Int.*, 191, 12-29, DOI: 10.1111/j.1365-246X.2012.05609.x

Le Pourhiet, L., B. Huet, D. A. May, L. Labrousse, and L. Jolivet (2012), Kinematic interpretation of the 3D shapes of metamorphic core complexes, *Geochem. Geophys. Geosyst.*, 13, Q09002, doi:10.1029/2012GC004271.

Shephard, G.E., L. Liu, R. D. Müller, and M. Gurnis (2012), Dynamic topography and anomalously negative residual depth of the Argentine Basin, *Gondwana Research*, 767, 6, doi:10.1016/j.gr.2011.12.00

Zahirovic, S., R. D. Müller, M. Seton, N. Flament, M. Gurnis, and J. Whittaker (2012), Insights on the kinematics of the India-Eurasia collision from global geodynamic models, *Geochem. Geophys. Geosyst.*, 13, Q04W1, 25, doi:10.1029/2011GC003883



Present-day temperature field predicted by numerical models along a vertical profile with slabs defined as thermal anomalies colder than 10% of the ambient mantle temperature as modeled by CitcomS (Zahirovic, et al., 2012).

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.

Upcoming Meetings

December 3-7, 2012, Fall AGU Meeting

Join more than 20,000 Earth and space scientists, educators, students, and other leaders in San Francisco, California December 3-7 as they gather to present groundbreaking research and connect with colleagues. <http://fallmeeting.agu.org/2012/>

December 4, 2012, CIG Annual Business Meeting

The CIG Annual Business Meeting will be held on Tuesday, December 4 during Fall AGU. Please join us and meet our new staff members at a reception with light hors d'oeuvres beginning at 6 pm followed by the Business Meeting at 6:30 pm.

Agenda items can be sent to: ariel@geodynamics.org to be forwarded to the meeting committee.

December 16-20, 2012, 1st International Conference on Frontiers in Computational Physics: Modeling the Earth System, Boulder, Colorado

Computational science complements the classical paradigm of theory and observation, and leads where neither is available. In particular, computational models play an essential role in diagnosis and prognosis of all elements of the Earth System, from solar variability through space weather, geomechanics, terrestrial climate and weather, down to ground water flow. This inaugural four-day Conference on Frontiers in Computational Physics will provide a forum for exchanging and sharing experiences, knowledge and on advanced computational techniques, methods, and models for simulation of the Earth System. With computational aspects in focus, the physical emphasis is on natural problems that are complex, coupled and multiscale. <http://www.frontiersincomputationalphysics.com/>

July 15-17, 2013, Seismic Imaging of Structure and Source, University of Alaska, Fairbanks



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*Computational Infrastructure for Geodynamics (CIG) is a
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