CIG-II: Futures

Louise Kellogg
UC Davis
Chair, Science Steering Committee
Ex officio member of the
Proposal Writing Committee

Timeline for CIG-II

- Sept. 1, 2008 Final Year of CIG starts
- Dec. 16, 2008 Announce Proposal Writing Committee (PWC) at Business Meeting
- Collect information for self-study
- EC & SSC nurture moderate collaborative (CDI, CMG, OCI) proposals
- **March 30-31 Future of CIG Workshop, Pasadena**
- April 1 Proposal Writing Committee (PWC) meets face to face
- May 15-30, Draft CIG-II proposal posted for public comment
- July 9 CIG-Geoinformatics proposal submitted to NSF
- Sept. 1, 2009, CIG Transition begins
  - CIG Carry forward
  - OCI-PetaApps Award
  - Small Supplemental from NSF Geoinformatics
- Jan 1, 2010 CIG-II Begins

Funding structure for CIG-II
Geoscience focus
+ collaboration with Computational Science

1. Aimed at **NSF GeoInformatics** program: Core computational infrastructure and community organization
   - Maintain computational infrastructure and support
   - Software development and enhancement
   - Open source application of known, established, and trusted methodologies (perhaps adapted from other fields).
   - Seek funding through the NSF-EAR-IF Geoinformatics competition
2. **Other funding sources**: Research in computational science and applied math targeting obstacles in geoscience
   - Focus on areas impeding progress in multiple working groups
   - Collaborative teams (Computational Scientists, applied mathematicians, and geoscientists).
     - Moderate sized projects funded through CDI (Type I & II), CMG, OCI-PetaApps, and others that emerge
     - Large Center proposal to CDI-Level III when available

Self-study

How self-study information was collected:

- One page abstracts collected from CIG participants
- Survey of CIG participants
- Self-assessment by management team
- Discussion among EC and SSC

Results of self-study (p. 1)
Accomplishments

- Established the infrastructure for development and support of robust, well-engineered codes for a wide range of geodynamics problems.
- New and existing supported codes.
- Supported geoscientists learning to use these methods through workshops - for both CIG and non-CIG codes.
- Strengthened interaction between sectors of the geodynamics and numerical methods communities.
- Enabled scientific progress (as shown in 1-pagers and talks).
- Generally raised the level of computational methods used in geodynamics (and the expectations of the community.)

Results of self-study (p. 2)
Lessons learned

- Geoscientists need to be involved in all stages of the code development (from design to implementation).
- Working groups are a good mechanism but have not always worked as well as CIG would like to see.
- Workflows are different for different communities.
- There are barriers, some poorly understood, to building the user community.
- How to run workshops and tutorials: the short-term tectonics workshops (held in Golden, CO) are a model.
- It is challenging to determine who the community is: (how many people use the codes and the impact of it on research).

Recommendations for CIG-II: Scientific priorities

Scientific areas represented:

- o Magma dynamics
- o Long-term tectonics
- o Short-term tectonics
- o Seismology
- o Mantle Convection

Categories of scientific development:

- o New physics and geometries
  - e.g. plates in mantle convection; mid-ocean ridges in magma dynamics; mineral physics in several codes.
- o New rheologies, faulting, etc.
- o Enhanced basic functionality
  - e.g. Equivalence of Tecton in PyLith
- o Coupling between codes or codes + observations
  - e.g. long-term tectonics and magma dynamics or mantle convection; seismology and mantle convection
- o New problems:
  - e.g. glaciology, climate coupling

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Recommendations for CIG-II: Computational sciences developments

- o Grids, meshes, etc.: Need for Unstructured Grids, Adaptive Mesh Refinement (AMR) and …
- o Multiphysics coupling: coupling between codes, or coupling of codes to observations, etc.
- o Access to computing resources ?
- o Codes designed to take advantage of developments in hardware (GPUs, petascale computing, scalability.)
- o Flexible formulations of governing equations and improved solvers (Deal II, FEniCS, St. Germaine), etc.
- o Data assimilation, inverse problems, adjoint methods
- o Visualization, imaging, data mining tools.

Recommendations for CIG-II: Community building

- Expand community use of methods and tools (GALE, PyLith, SpecFEM).
- Workshops: Successful for training and development. Suggestions include targeting multiple levels of expertise, variations in format and venue, online, etc.
- Educational programs: key to future of geodynamics.
- Exchange programs to bring geoscientists and computer scientists together for development.
- Improved methods for user engagement with input to codes.
- Stronger connections to other communities (mineral physics, rheology, etc.)
- Role of working groups?

Recommendations for CIG-II

Organizational structure

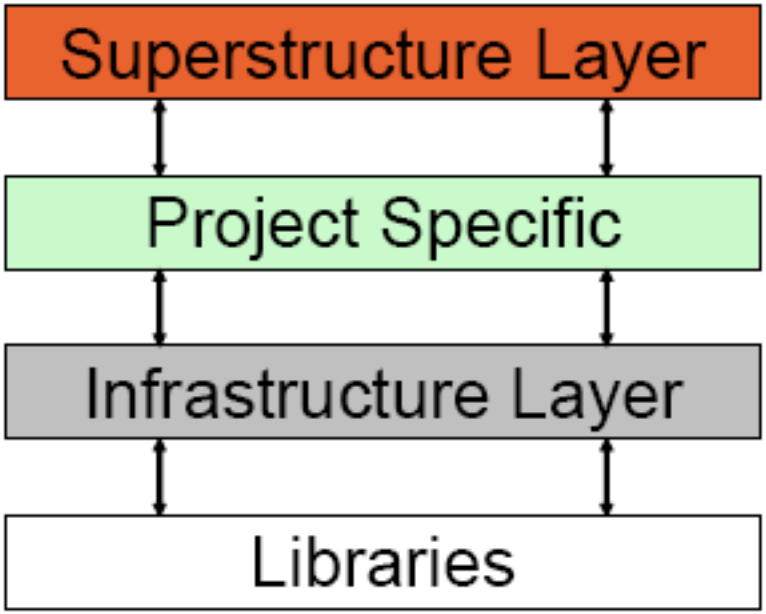
- Involve a project manager (full-time?) to manage projects.
- Develop and use milestones and benchmarks
- Combine SSC and EC into one Steering Committee.
- Steering Committee would have a mix of elected an appointed membership (to ensure balance).
- Establish an External Advisory Committee (with membership from several different disciplines).
- A greater involvement (including co-location) with a computational organization such as CACR.
- Engage more scientists through subcontracts with clear milestones and outcomes.

Recommendations for CIG-II

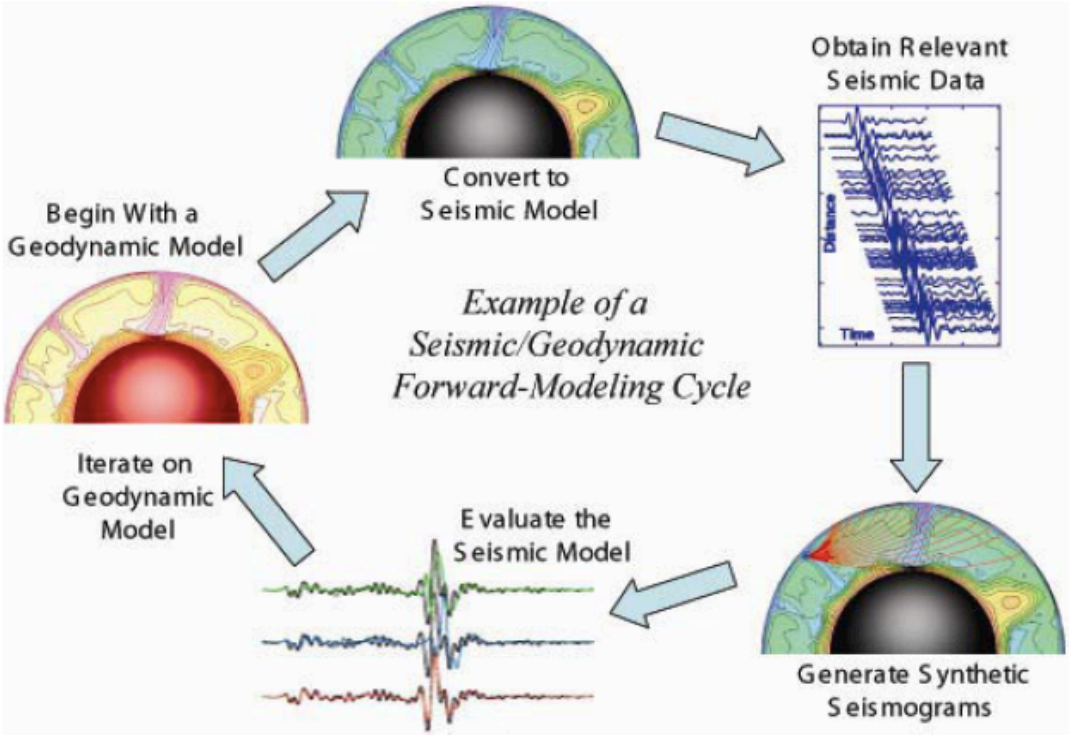
Miscellaneous

- Benchmarks: Developed by community, run by developers
- Encourage use of established / developed methods.

One view of CIG
(from original proposal)



Software layers making up the computational infrastructure for geodynamics



Workflow for integrating mantle dynamics and observational seismology accomplished through a superstructure modeling framework:

- Scientific development results in different packages that do different things.
- The goal for integrated physics: These packages need to talk to each other.
- Facilitating this is a goal of CIG and CIG-II.
- Development driven by science.

CIG-II Proposal Writing Committee

Bruce Buffett (UC Berkeley), Chair

Brad Aagaard (USGS)
Wolfgang Bangerth (TAMU)
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Peter Van Keken (U. of Michigan)
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Marc Spiegelman (Columbia), ex-officio, EC Chair