A Solid Earth Research and Teaching Environment

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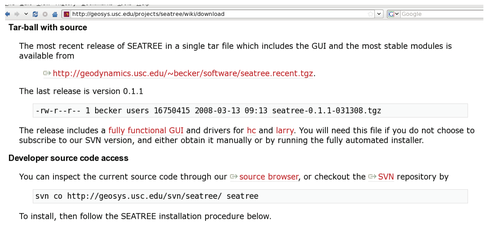
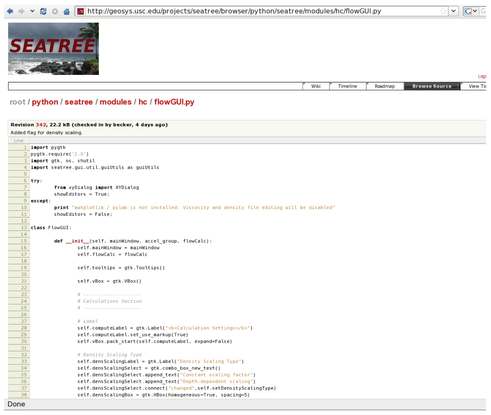
Design goals

SEATREE provides a modular, robust, and user-friendly software framework to facilitate using solid Earth research tools in the classroom and for interdisciplinary, scientific collaboration. We use python wrappers and a "soft" object-oriented programming approach to make use of modern software design, while remaining compatible with traditional scientific coding. Our goals are to provide a fully contained, yet transparent package that allows users to operate in an easy, graphically supported "black box" mode, while allowing to look under the hood. In the long run, we envision SEATREE to contribute to new ways of sharing scientific research, and making (numerical) experiments truly reproducible again.

Open-source implementation

Low level: C, Fortran modules
Wrappers: Python, module objects
GUI: PyGtk GNOME toolkit
Development: SVN, Trac
Documentation: Wiki





Screenshots from currently implemented modules

Global mantle flow

hc module

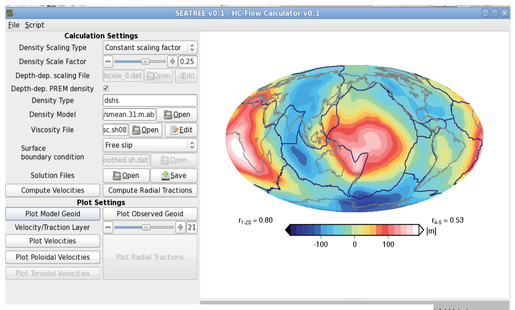
hc is a C-language implementation of a Hager & O'Connell (1981), semi-analytical, propagator matrix approach to solving for velocities and tractions in spherical shell Stokes flow in the presence of only radially varying viscosity.

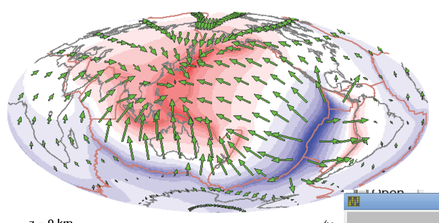
This code is based on work by Bernhard Steinberger who modified the original source from Brad Hager and Rick O'Connell.

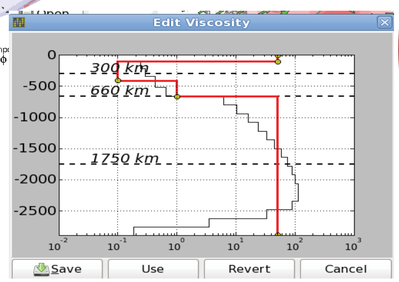
Bernhard's F77 was rewritten in C by Thorsten Becker and Craig O'Neill in 2006 during the CIG mantle flow benchmarking effort.

References

- Hager, B. H. and O'Connell, R. J. (1981). A simple global model of plate dynamics and mantle convection J. Geophys. Res. 86, 4843
- Steinberger, B. (2000). Slabs in the lower mantle - results of dynamic modelling compared with tomographic images and the geoid, Phys. Earth Planet. Inter., 118, 241.
- Steinberger, B. and A. Calderwood (2006). Models of large-scale viscous flow in the Earth's mantle with constraints from mineral physics and surface observations, Geophys. J. Int., 167, 1461.
- Becker et al. (2006) Global flow code benchmark plan.







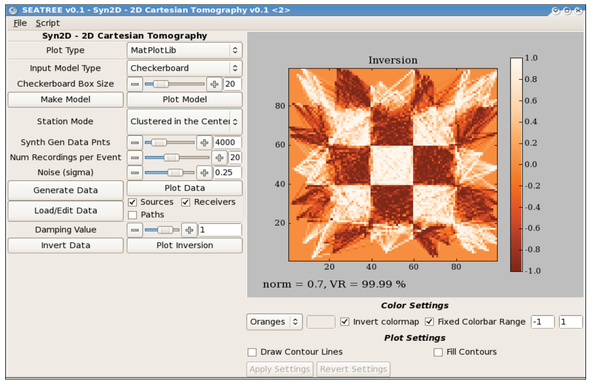
2D tomography

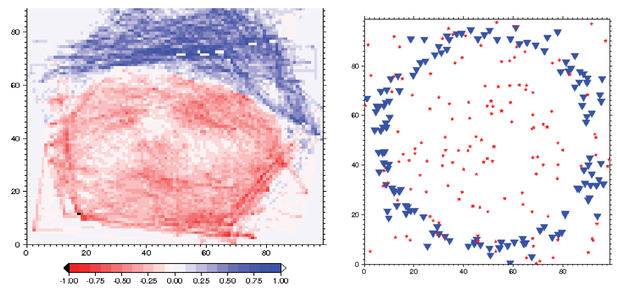
syn2D module

Syn2D is a 2-D Cartesian tomography teaching tool contributed originally by Lapo Boschi and slightly modified by Thorsten Becker. The user can choose between

- a checkerboard or PGM grayscale image "Earth" structure,
- different, random station/receiver distributions,
- different synthetic noise levels

The code will then trace rays through the input medium, and create synthetic datasets. The latter can then be inverted using LSQR least squares for different parameterizations and normal damping choices. The code creates map-view plots of the inverted structure and output for L-curve tradeoff analysis.





Non-Linear Earthquake Relocation

NonLinLoc Module

Nonlinloc is a python-wrapped GUI for Anthony Lomax' NonLinLoc nonlinear earthquake location routines, visualization by means of Matplotlib calls. Ideally users will be able to change the veolcity models of the surrounding ground, and the take of angles and the travel times of the P & S waves and then visually be able to see the effects of these paremters on earthquake locations, as well as wave propogation. It also allows one to gain an understanding of the structure and patterns of the seismicity of an area.