AuScope

AN ORGANISATION FOR A NATIONAL
EARTH SCIENCE INFRASTRUCTURE PROGRAM

SAM (Simulation, analysis, modelling)

The AuScope Simulator is a toolkit of simulation, modelling, inversion and data mining tools, underpinned by parameters provided through the AuScope 'Earth Composition and Evolution' component. The AuScope simulator makes extensive use of software, techniques and expertise developed through the Australian Computational Earth Systems Simulator (ACcESS) Major National Research Facility.

The NCRIS funds will be used principally for deployment, maintenance and enhancement of software previously developed in the participating institutions of the ACcESS MNRF and Predictive Mineral Discovery (*pmd*CRC) activities and will include the following.

Principal software packages and descriptions

The software packages which make up the S.A.M. infrastructure are available individually for download to expert users whose needs are met by direct access to specialized software. The packages are also available to other researchers through workflows mapped for individual application areas. The workflows, package downloads and contact details are available from the S.A.M. area of the AuScope website.

Escript - is a highly innovative, interactive, object-oriented language for multi-physical modelling. Through its high level of abstraction users can quickly implement and test new mathematical models without concern for the underlying numerical schemes and their implementation. Validated models can be easily linked to build complex simulations. Escript has successfully been applied to Mantle convection with complex rheologies, subduction zones, geothermal reservoirs, reactive transport modelling, volcano lava dome modelling, earthquake simulations and tsunamis.

Reactive Transport Model - A code developed within CSIRO Exploration & Mining and the Minerals Down Under Flagship and was started during the pmd*CRC using Fastflo and more recently the UQ Escript solver. The code models coupled fluid-flow, heat and mass transport and chemical reactions (using the HCh/WinGibbs solver) within the earth, and will be of widespread interest in the minerals and energy industries.

ESyS-Particle - is a high performance, object-oriented platform for the modelling of geophysical phenomena involving large deformations and fragmentation, with particular emphasis on rock breakage and large-scale granular flow. ESyS-Particle implements the Discrete Element Method (DEM), which has found broad application in scientific computing across numerous disciplines including geomechanics, mining engineering, minerals processing, civil and mechanical engineering, the pharmaceuticals industry, and geohazards.

Underworld/StGermain - have been developed to produce a suite of tools that can be used by researchers to simulate large scale Earth processes, such as plate/mantle interaction and basin development. The latter is of particular interest to energy exploration companies. The coupling of Underworld and SPModel was funded by an ARC linkage grant with the support from a petroleum company.

SPModel - A tool for studying the erosion, sediment transport and basin fill associated with tectonic deformation of the basement rocks. SPModel can be run by itself to study the manner in which surface processes modify topography from a library of deformation models. It can also be run as a module for Underworld to study the coupling between tectonics and surface processes.

Pplates - is a tectonic reconstruction tool for linking plate motion histories with geodynamic, tectonic and surface elevation outcomes. The "what if" approach encapsulated in the Pplates software is designed to provide the structural geologist with quantitative feedback on the validity of postulated scenarios.

gPlates - This investment is designed to facilitate the publishing of map data across the group in a consistent way. The investment will leverage the extensive capabilities of the Open Source GMT mapping software with custom links designed to present structural geological model map outputs for time based evolutionary models.

ESyS-Crustal - provides the software infrastructure needed for a deeper understanding and better description of interacting fault systems with potential applications in natural hazard forecasting and risk evaluation (e.g. earthquakes and tsunami generation forecasting), green energy exploitation (e.g. geothermal reservoir modelling), deep geological disposal (e.g. radioactive waste treatment and CO_2 geological storage), groundwater modelling, minerals exploration, and related environmental problems.
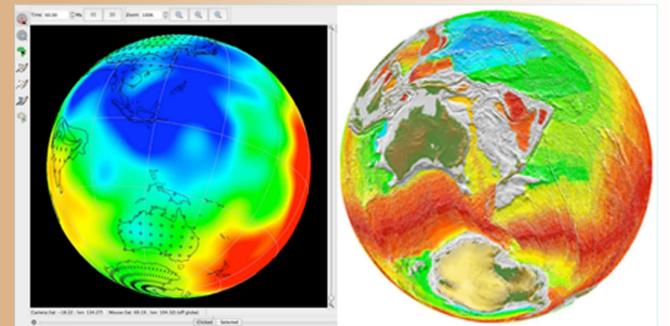
Left: An example of visualizing mantle convection output in a plate tectonic framework. Dynamic surface topography, caused by mantle upwellings (red) and downwellings (blue), imported into GPlates with continents overlain. Both dynamic surface topography and continents are reconstructed at 60 m.y. ago.
Right: oceanic crustal age, illuminated with seafloor fabric, and topography on land.
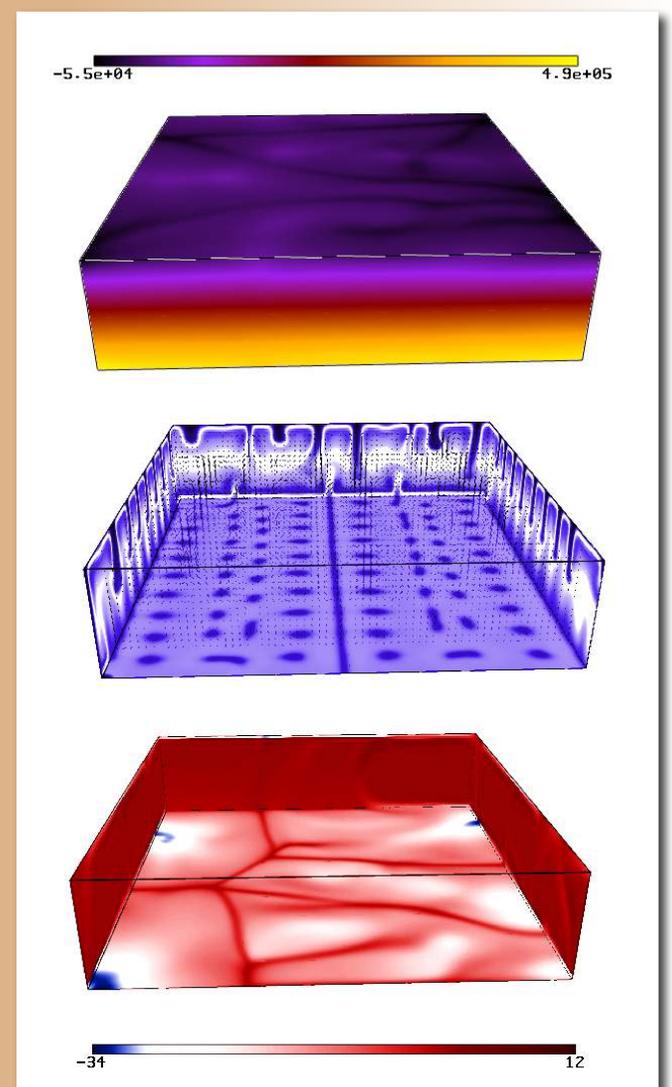
A parallel mantle convection simulation using Underworld running on 500 CPUs. Here we show the dynamic pressure, initial temperature field, and vertical heat flux after 25000 timesteps
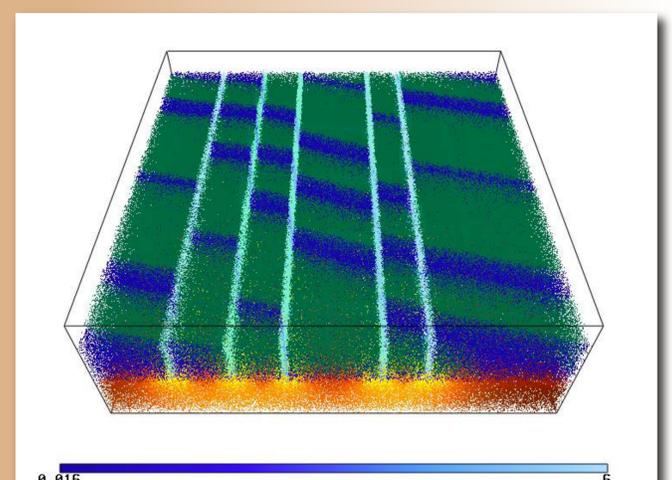
Simulation of strike-slip deformation in a layer of brittle material floating on a viscous substrate. The shear band spacing is controlled by the thickness and relative strength of the two layers.