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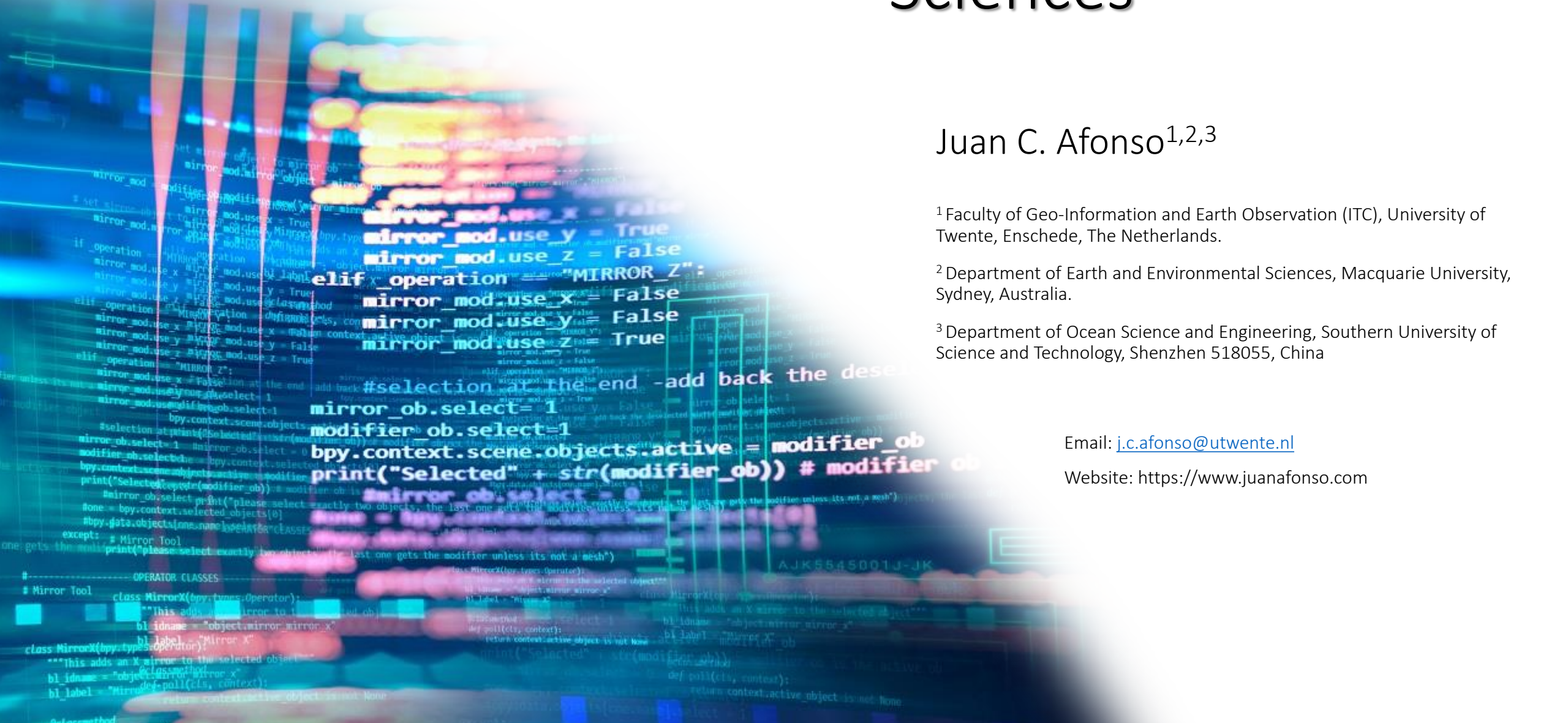
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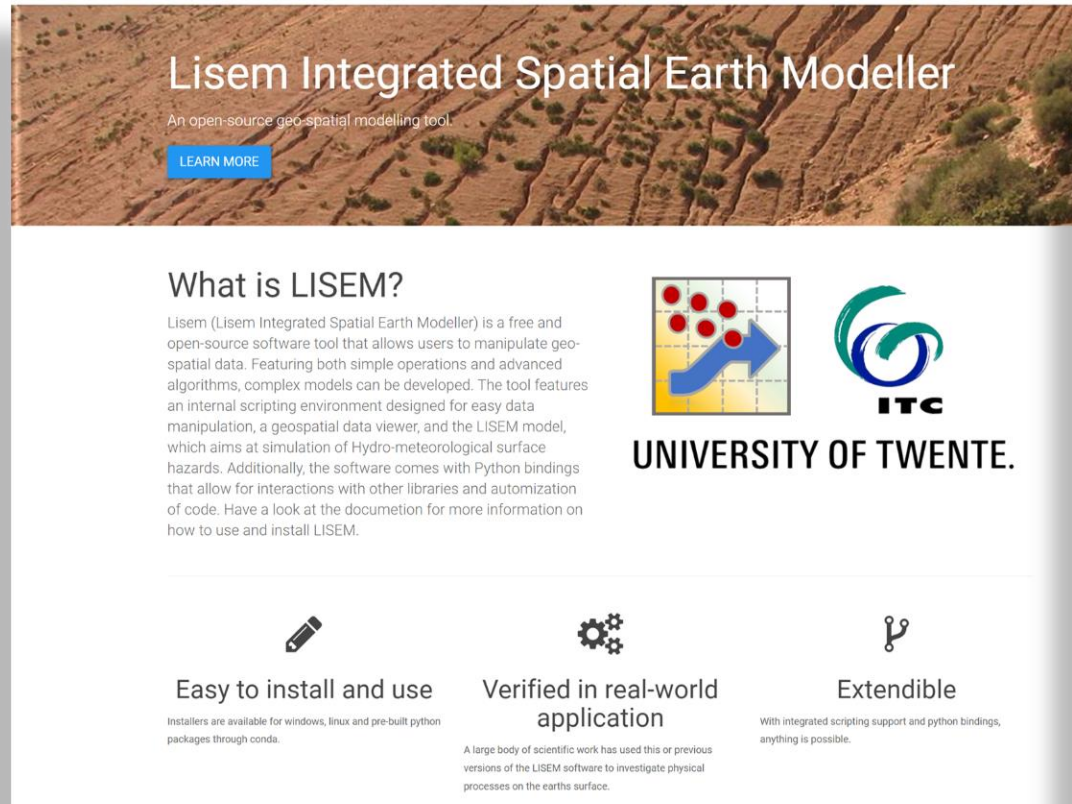


- Members of AES have a long tradition in the development of software packages for processing, modelling and manipulating geospatial and hyperspectral datasets for a number of applications (e.g. natural hazards, exploration)

LISEM

Victor Jetten

Bastian van den Bout





Lisem Integrated Spatial Earth Modeller
An open-source geo-spatial modelling tool.


[LEARN MORE](#)

What is LISEM?

Lisem (Lisem Integrated Spatial Earth Modeller) is a free and open-source software tool that allows users to manipulate geo-spatial data. Featuring both simple operations and advanced algorithms, complex models can be developed. The tool features an internal scripting environment designed for easy data manipulation, a geospatial data viewer, and the LISEM model, which aims at simulation of Hydro-meteorological surface hazards. Additionally, the software comes with Python bindings that allow for interactions with other libraries and automatization of code. Have a look at the documentation for more information on how to use and install LISEM.





UNIVERSITY OF TWENTE.




Easy to install and use

Installers are available for windows, linux and pre-built python packages through conda.



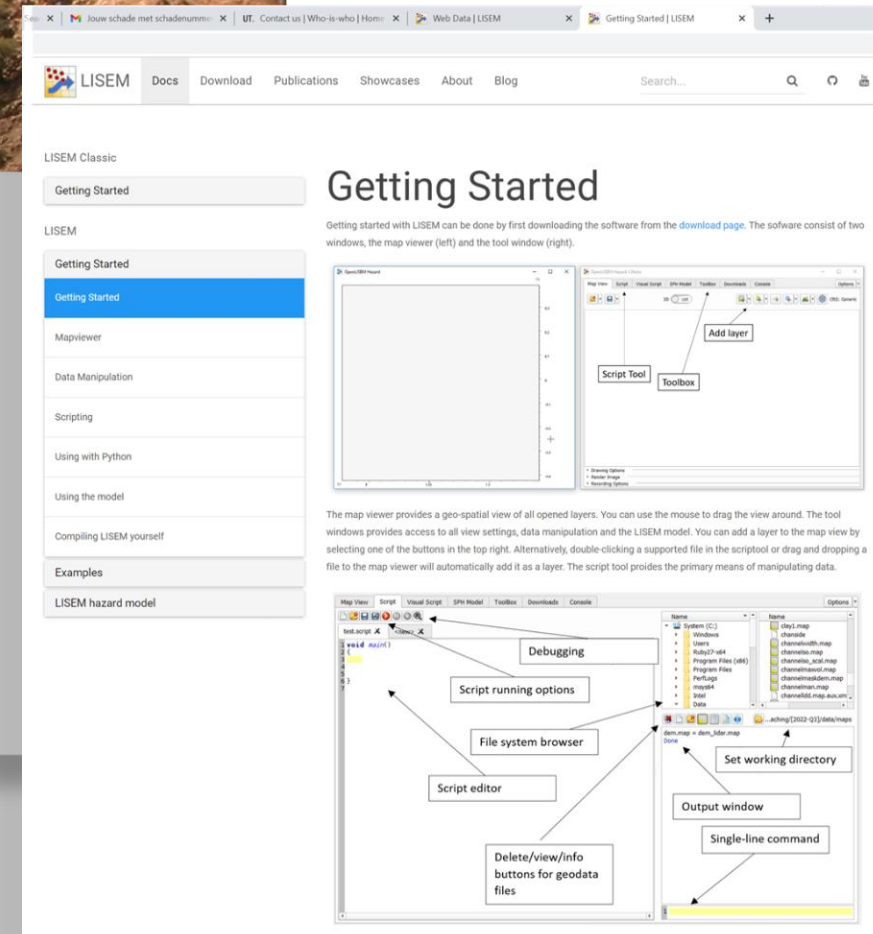
Verified in real-world application

A large body of scientific work has used this or previous versions of the LISEM software to investigate physical processes on the earth's surface.



Extendible

With integrated scripting support and python bindings, anything is possible.

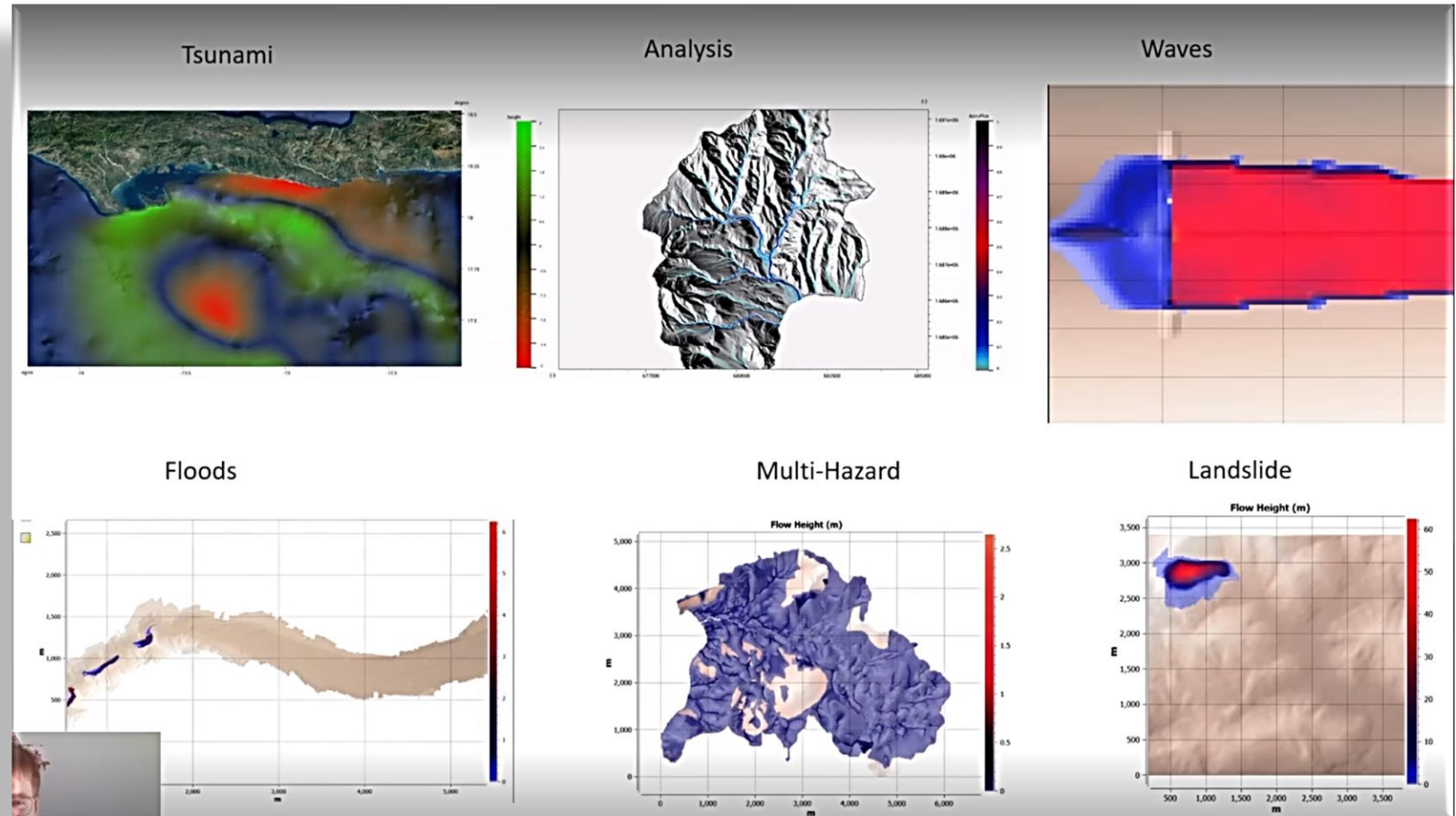


The screenshot shows the LISEM website's 'Getting Started' page and a screenshot of the software interface. The website page includes a navigation menu (Docs, Download, Publications, Showcases, About, Blog) and a sidebar with links to 'Getting Started', 'Mapviewer', 'Data Manipulation', 'Scripting', 'Using with Python', 'Using the model', 'Compiling LISEM yourself', 'Examples', and 'LISEM hazard model'. The main content area is titled 'Getting Started' and explains that the software consists of two windows: the map viewer (left) and the tool window (right). The software interface screenshot shows the 'Map Viewer' window on the left and the 'Tool Window' on the right. The tool window contains a 'Script Tool' and a 'Toolbox'. The 'Script Tool' window is open, showing a script editor with a 'Debugging' button, 'Script running options', a 'File system browser', and 'Delete/view/info buttons for geodata files'. The 'Toolbox' window shows a 'Set working directory' button, an 'Output window', and a 'Single-line command' field.

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Wim Bakker
Chris Hecker
Harald van der Werff
Freek van der Meer
Jelmer Oosthoek
Frank van Ruitenbeek

HypPy

Hyperspectral Python

HYPY OVERVIEW

Hyperspectral Python (HypPy) is a collection of tools developed at the University of Twente. HypPy has adopted the ENVI file format as the image format.

HYPY FEATURES

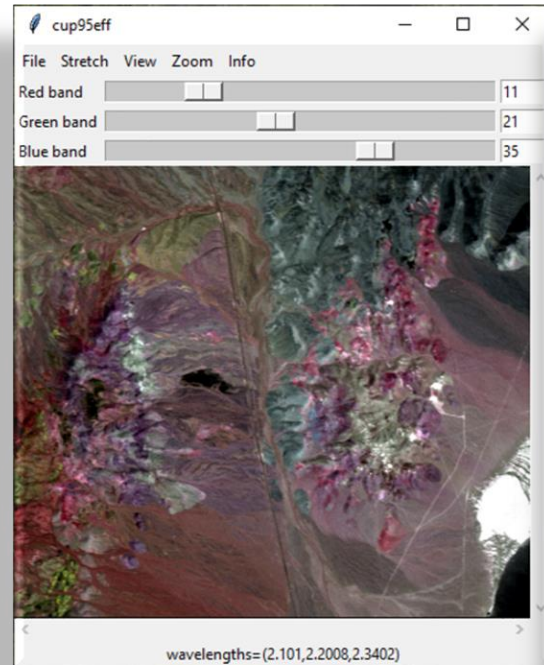
- Viewer for ENVI format hyperspectral images.
- Viewer for spectra and spectral libraries.
- Conversion programs.
- Simple spectral tools.
- Band Math.
- Spectral Math.
- Minimum Wavelength mapping.
- Destriping
- PCA and inverse PCA.
- Hyperspectral filters.
- Spectral Angle Mapper (SAM).
- Rule image classifier.
- Linear Unmixing (fully constrained).
- Tools for processing Omega images from the Mars Express.
- Command-line interface for scripting.
- Manuals:
 - graphical user-interface
 - scripting with HypPy
 - programming interface
 - spectral math

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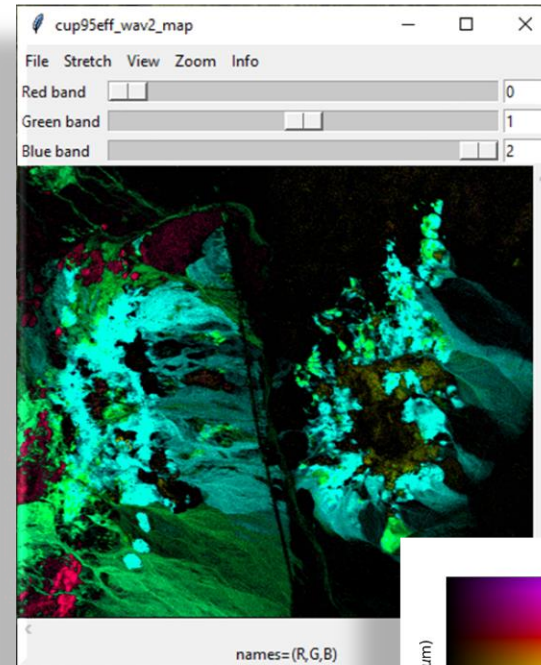
HypPy

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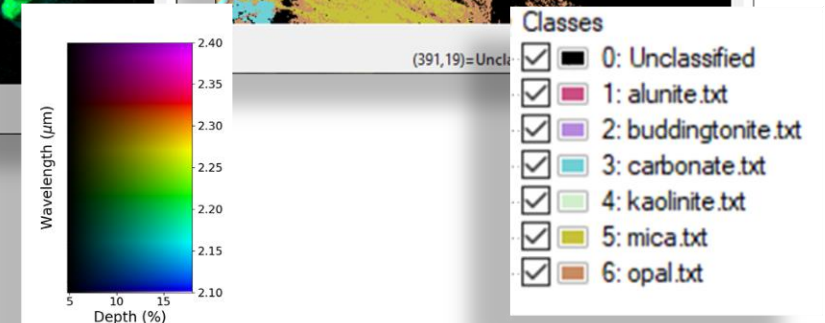
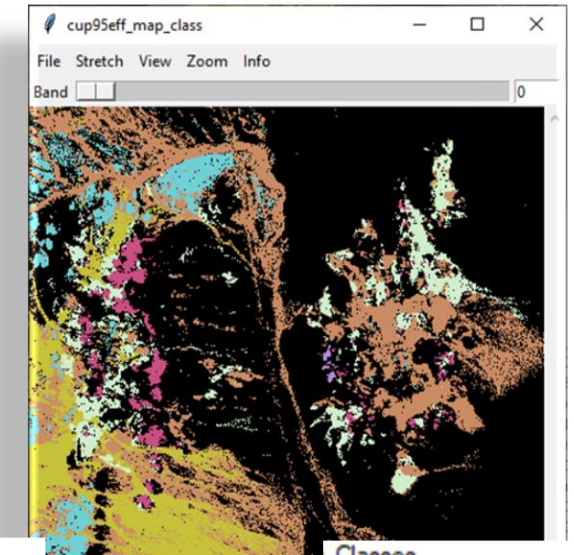
Hyperspectral Image



Wavelength Map



Classified Image



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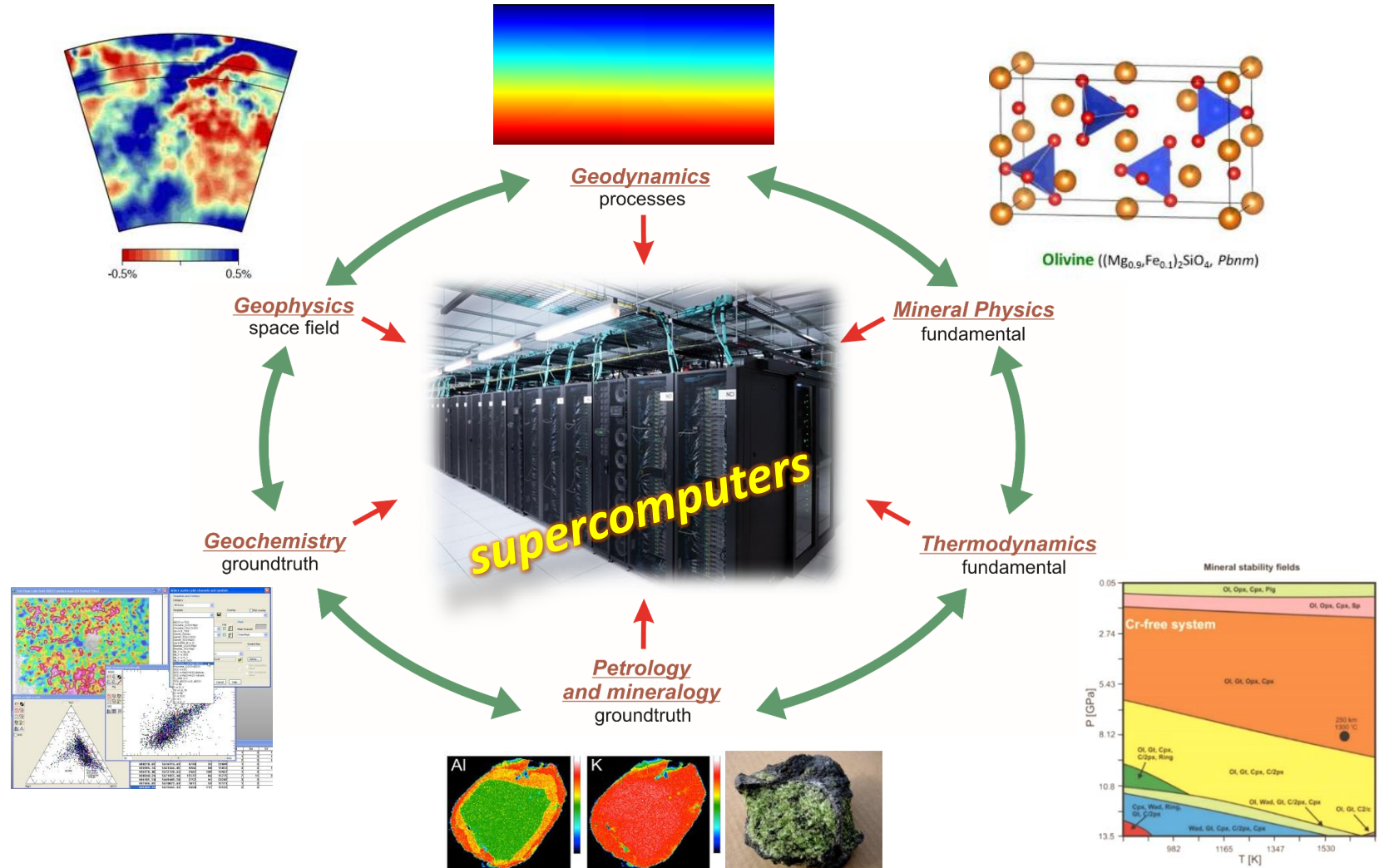
Open Source Portals for Risk Management

hosts risk management data and information accessible to stakeholders to facilitate analysis, research, greater awareness of risk management and climate change adaptation

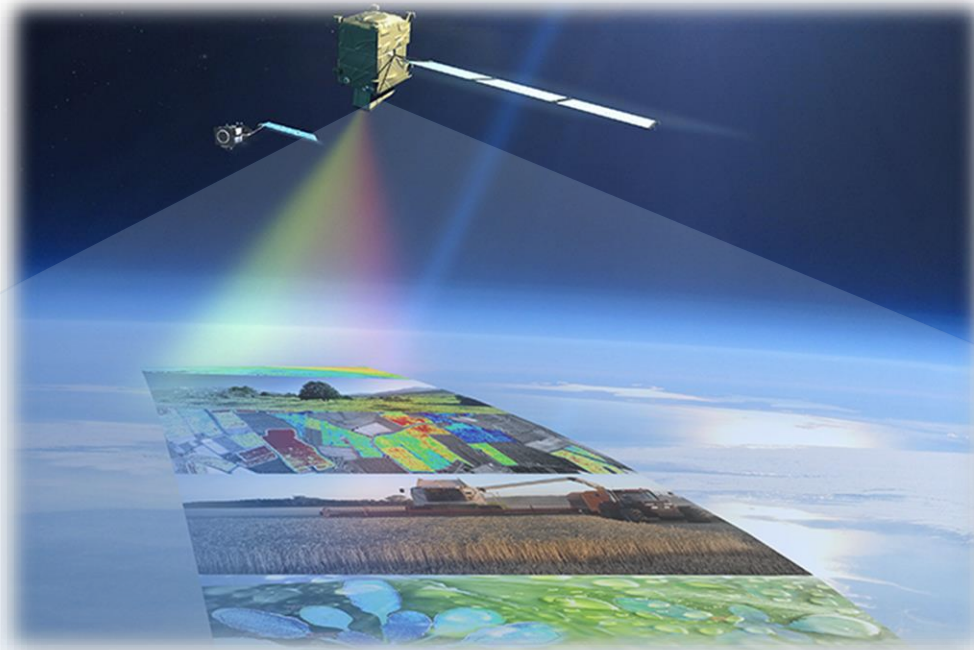
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LitMod suite

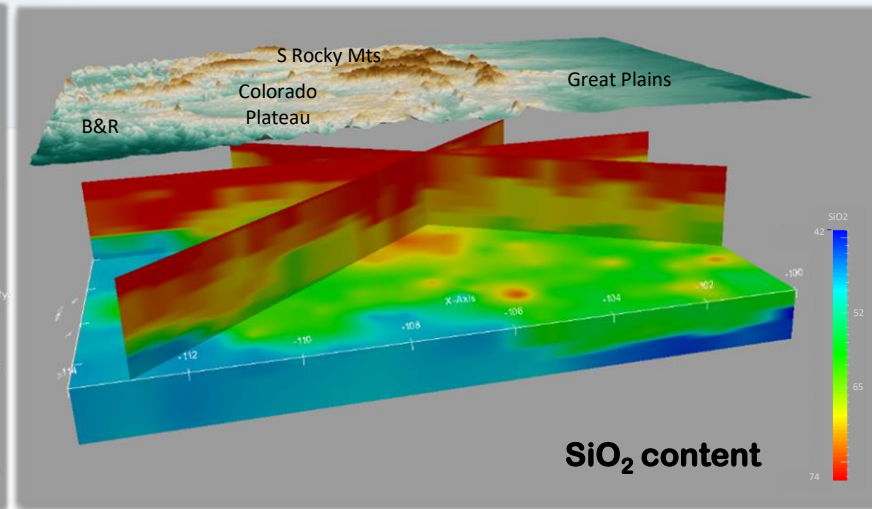
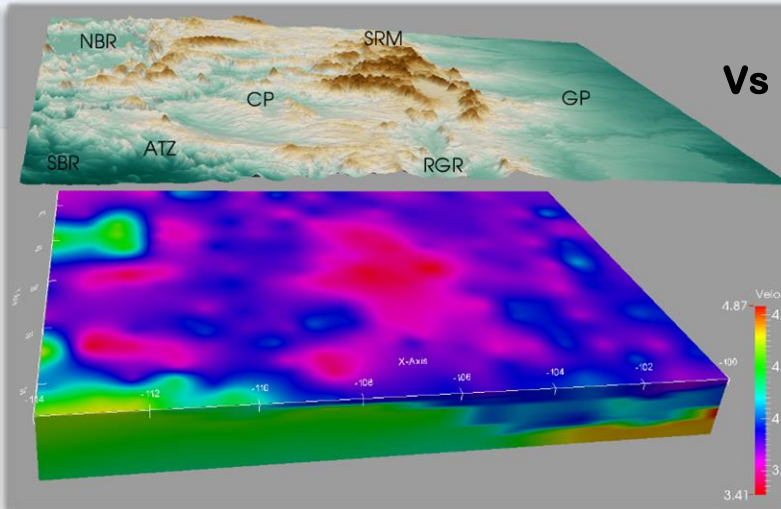
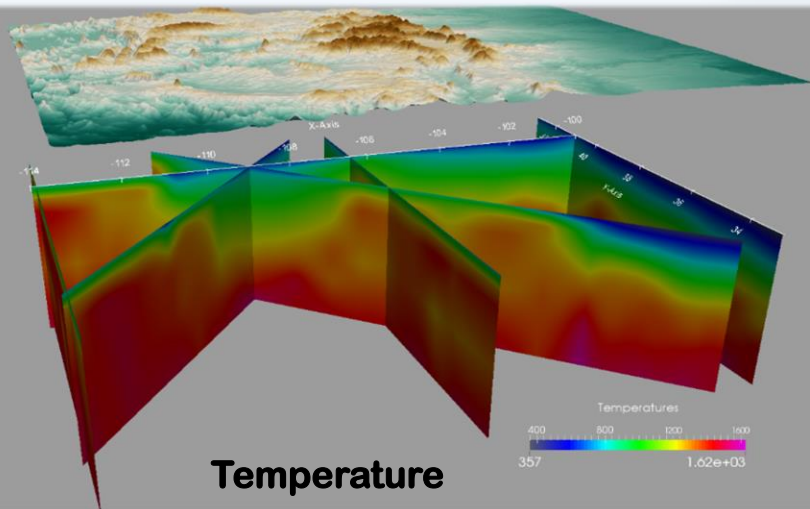
J.C. Afonso
M. Van der Meijde
I. Fadel



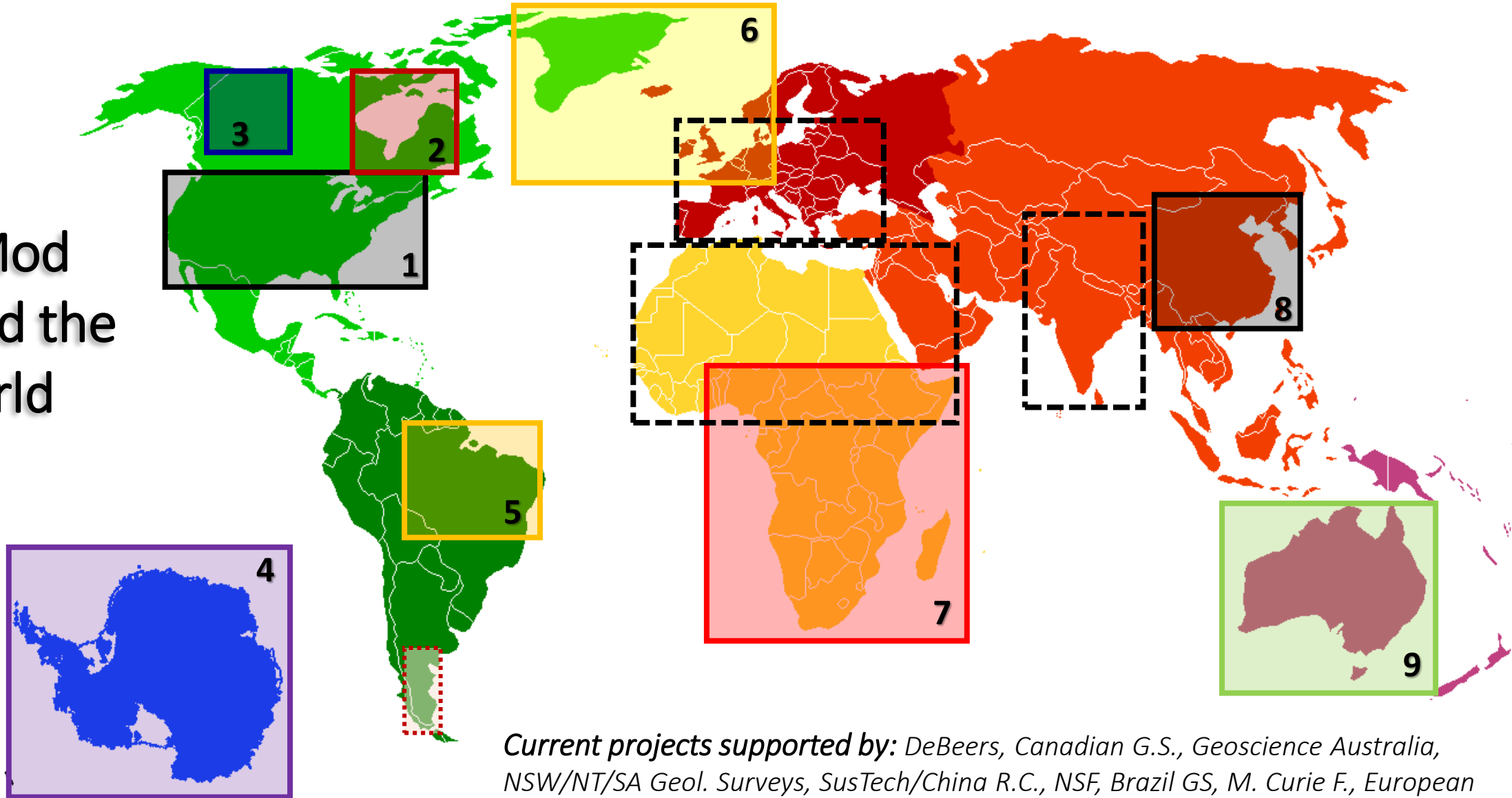
Multi-Observable Thermochemical Tomography (MTT)



State-of-the-art technique to map the entire thermochemical architecture of the crust and lithosphere using *multiple satellite and land-based datasets, probabilistic inverse theory and machine learning.*

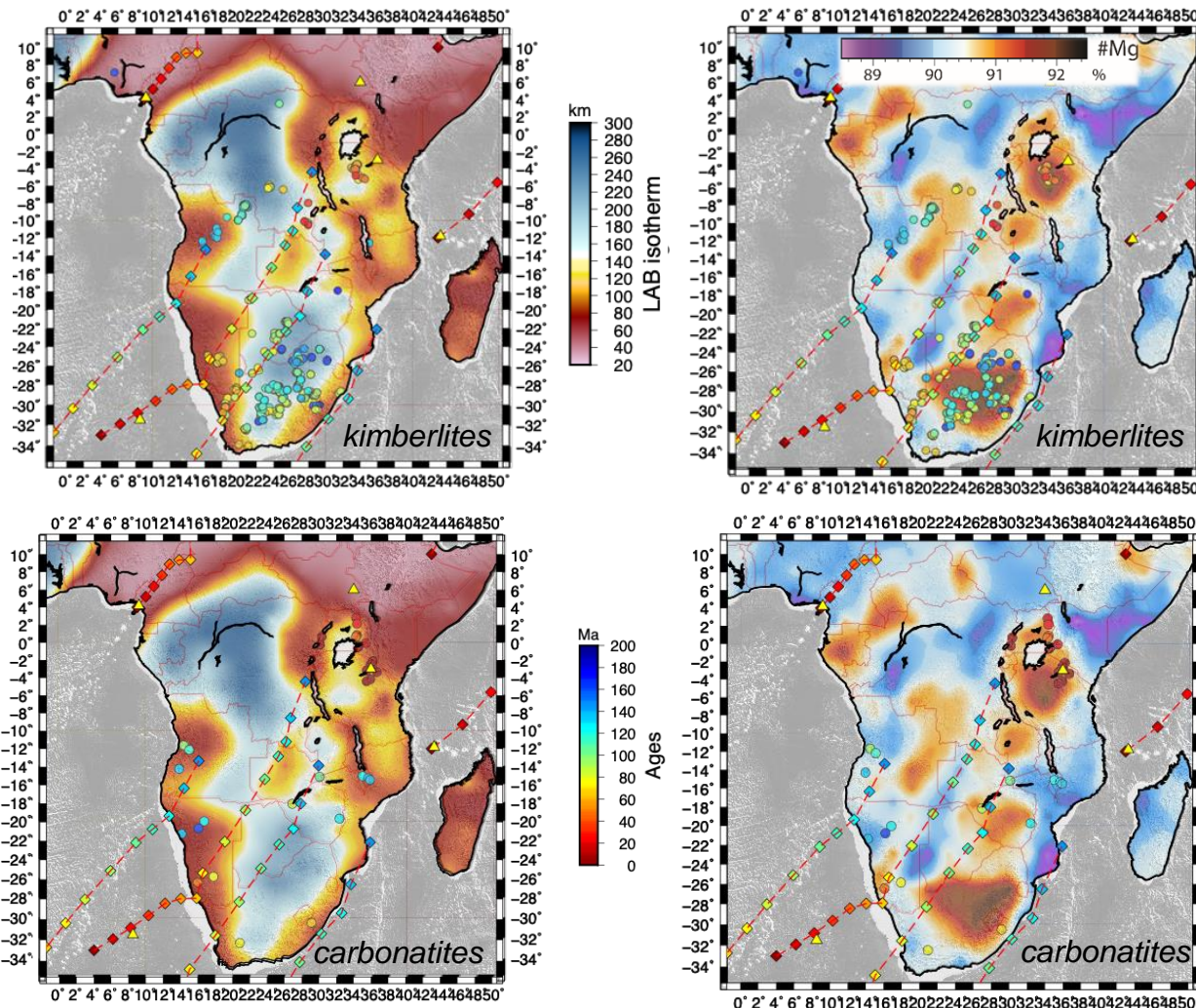


LitMod
around the
world

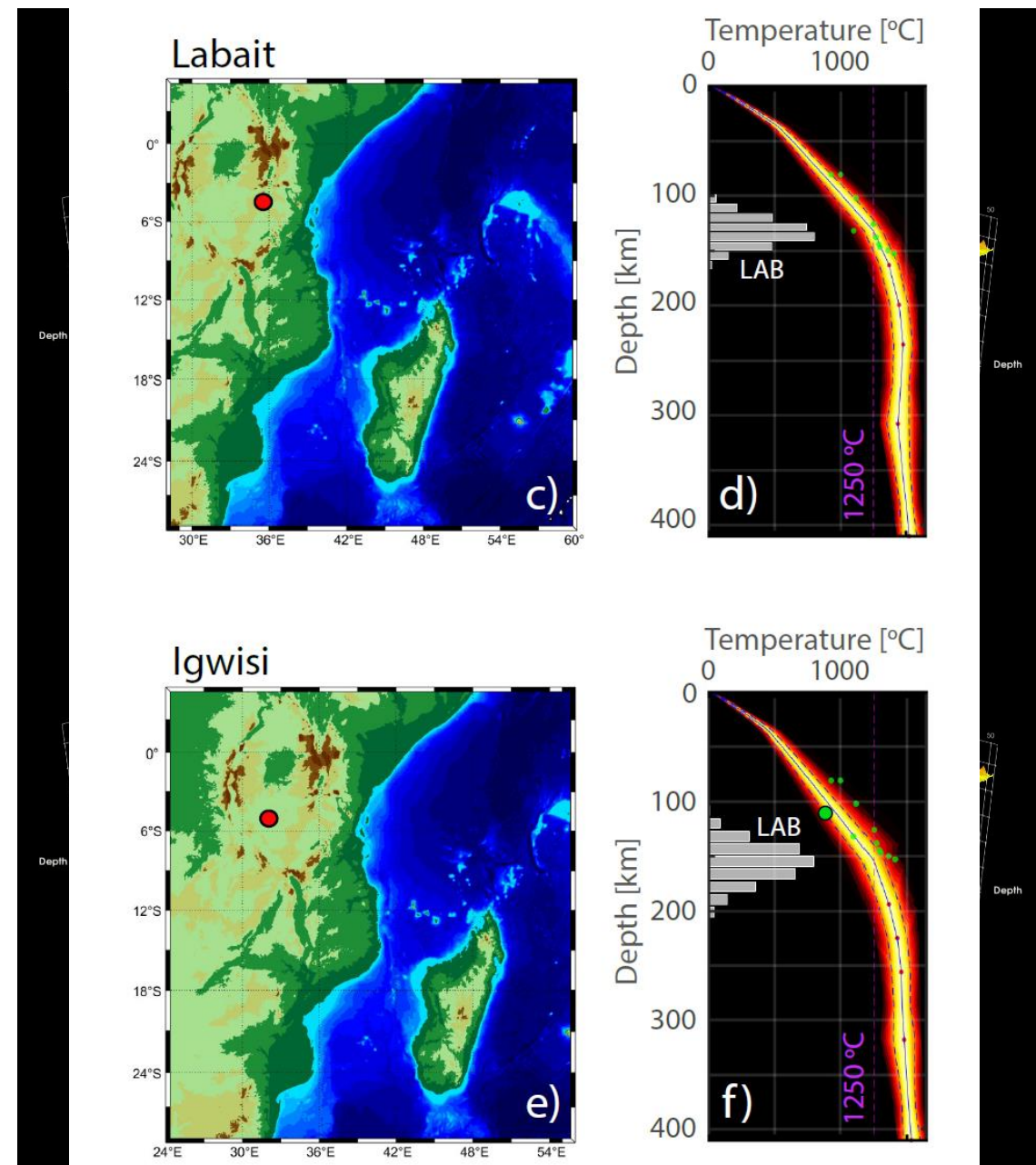


Current projects supported by: DeBeers, Canadian G.S., Geoscience Australia, NSW/NT/SA Geol. Surveys, SusTech/China R.C., NSF, Brazil GS, M. Curie F., European Space Agency, Clean Air Task Force, ARC, Canadian R.C. and others...

Central/southern Africa as an example...



Themo-chemical model from surface down to 400 km depth.



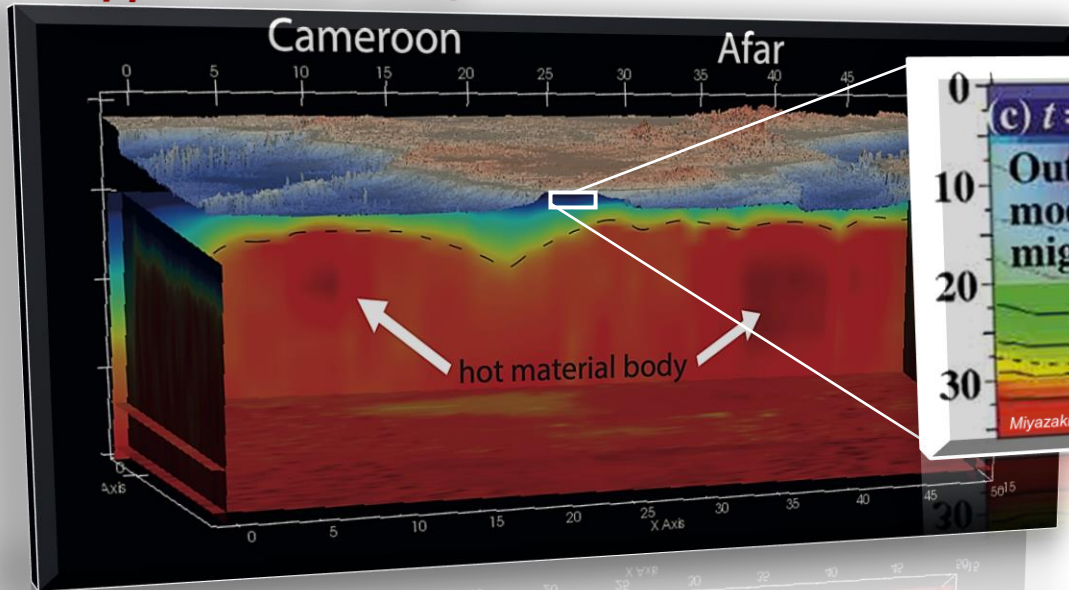
What can we do then for exploration and assessment of geothermal resources at global, regional and local scales?

“ Reconstruction of the geologic history of a long-lived magma-hydrothermal system ... requires integration of rock-preserved evidencewith an ensemble of **increasingly complex computations** based on geochemical transport theory...

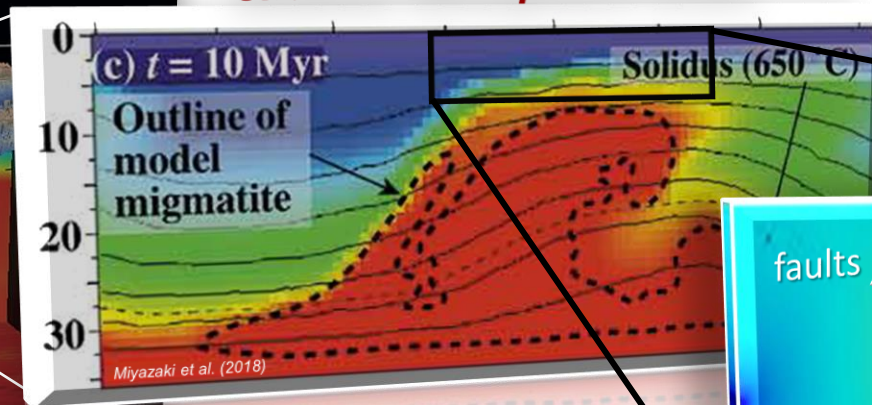
...The first step is the construction of a **reference state** model for pure conductive cooling...”

Denis L. Norton & J. Hulen (2001)

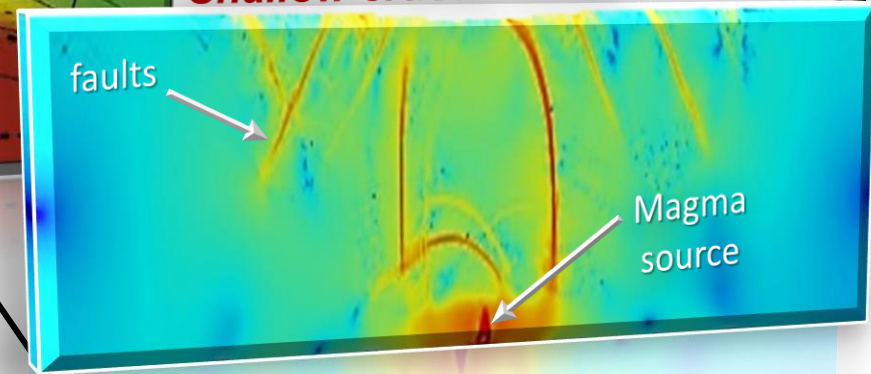
Upper mantle scale



Shallow lithosphere scale



Shallow crustal scale



- **Multi-method approach** (Multiple-Try-Metropolis, Parallel interacting chains, Tempering, Block Sampling, Adaptation, domain splitting, DE, among others)

Manual (man pages)

```

-misfitmod [STRING]
  Procedure to compute misfit computation. Example: -misfitmod xi2
  . Available options:

L2      - L2 norm with sigmas equal to data uncertainty: (obs-calc)^2/sigma.

xi2     - [default] Chi-squared normalised to the observations:
         (obs-calc)^2/|obs|.

-misfitrscl [NUMBER]
  Set number of MCMC steps after which individual weights of misfit
  components will be rescaled. Default is -1 (values <= 0 mean
  never rescale).

OPTIONS: PARALLEL TEMPERING
-ptadaptive [NUMBER]
  Adjust PT temperatures dynamically using Voudsen et al. (2002)
  approach. Use -ptadaptive 1 to switch it on and -ptadaptive 0 to
  turn it off [default].

-ptmixdelay [NUMBER]
  Delay (in MCMC steps) before PT swapping (mixing of states
  between individual chains) begins. Default value is -1 (start
  mixing immediately).

-pttladder [STRING]
  Initial PT temperature distribution. Example: -pttladder power10
  . Available options:

```

```

*****
* >>>> LitMod)4INV v2.0 <<<< *
*                               *
*   Written by:                 *
*   Juan C. Afonso              *
*                               *
*   Contributors:              *
*   I. Fomin, F. Salajegheh,    *
*   N. Rawlinson, J.A.D. Connolly *
*                               *
*   Macquarie University, Australia *
*   Copyright J.C. Afonso (GNU)  *
*   Build from Feb 25 2019 14:48:45 *
*                               *
*****

-----
LitMod checks the runtime environment before starting...
MPI hydra started without OpenMP directives.
MPI datatypes: real is 64-bit (gravity uses 64-bits) and integer is 32-bit

-----
LitMod is parsing command line arguments...
Started with the following command:
./LITMOD.i -i input_inversion -o output -w 2 -misfit 100 -nswap 4 -ptlchains 4
-nmcmc 6 -mtmis 1 -pttmhmtm 1.5
HDF5 output will be written.
Looking for model input files in folder: input_inversion
Writing outputs in folder: output

-----
LitMod started on 8 core(s)
Parallel Tempering environment is setting...
Core #0 (PID3717) with PT-temperature 1.0 (Metropolis-Hastings)
Core #1 (PID3718) with PT-temperature 1.0 (Metropolis-Hastings)
Core #2 (PID3719) with PT-temperature 1.0 (Metropolis-Hastings)
Core #3 (PID3720) with PT-temperature 1.0 (Metropolis-Hastings)
Core #4 (PID3721) with PT-temperature 3.2 (Multiple-Trial Metropolized
Independence Sampler) holds 2 computational samplers
Core #5 (PID3722) with PT-temperature 3.2 is sampler #1 of chain 5
Core #6 (PID3723) with PT-temperature 10.0 (Multiple-Trial Metropolized
Independence Sampler) holds 2 computational samplers
Core #7 (PID3724) with PT-temperature 10.0 is sampler #1 of chain 6
Ordered Tmax value is 10.00 without adaptive tempering
Obtained Tmax value is 10.00 ; Tmin value is 1.00
Geometric sequence used to set PTT
Performing 2 swaps (4 MCMC) per step with probability 100%
Swapping randomly selected chains despite their PT Temperatures
Multiple-Trial Metropolized Independence Sampler tries 10 proposals
OpenMP parallelism for Multiple-Try Metropolis switched OFF

-----
LitMod reads input files...
  reading input_inversion/header.dat ... successfully
  reading input_inversion/structure.dat ... successfully
-----
WARNING CRITICAL: Crustal densities are less than 2.16 (halite) or more than
5.0 g/cm3!
-----
WARNING: LAYER 1 IS THINNER THAN 20 m
-----
  reading input_inversion/observations.dat ... successfully
  reading TZ and lower mantle data from input_inversion/startmod.dat ...
successfully
Perple_X reads input files...
  opening ./perplex/inversion.dat
  opening ./perplex/stx08ver.dat
  opening ./perplex/solution_model.dat
  opening ./perplex/perplex_option.dat
All the model inputs were read!

-----
LitMod tries to share domain with size 14 by 10 between 8 CPUs each holding at
least 1 column(s)
- 4 independent blocks with size 7 by 5 found during Common Divider Grid
Reductions
- 2 independent blocks in each CDCR subgrid found during Coprime Grid Reduction
- All the available CPUs will be used to initialize the domain

-----
Simulation mode: solving inversion with MCMC
Performing 1e6 MCMC steps using uniformly distributed proposals

-----
Grid parameters:
Longitude: 14 nodes from -10.0 to 3.0
Latitude: 10 nodes from -10.0 to -1.0
Grid spacing dx, dy (degree): 1.000 1.000
approx dx1, dx2, dy, dz (km): 110.9 111.3 110.6 2.0
Thermodynamic nodes: 16
Computation nodes: 194
Compositional layers: 6
Total number of nodes: 18432
Total number of property layers: 4

-----
DOMAIN INITIALIZATION
max, min, average

Crustal properties
Density, kg/m3: 3125.00 2100.00 2697.64

```


- **Multi-method approach** (Multiple-Try-Metropolis, Parallel interacting chains, Tempering, Block Sampling, Adaptation, domain splitting, DE, among others)
- **Portability, outputs and data mining**
- **Library of benchmarks/examples**

HDF5 output formats for robust and easy visualization and data mining. Direct output for 3D printing and movies

