Accessing remote data using a URL in ASPECT: the EarthCube BALTO-ASPECT URL Reader

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Brokered Alignment of Long-tail Observations
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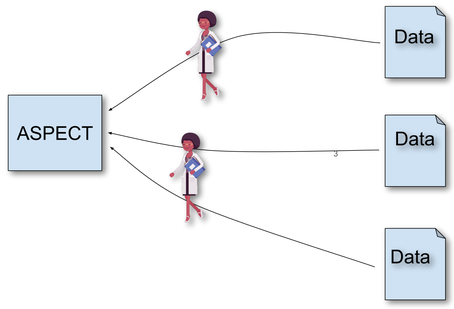
Motivation

Numerous ASPECT (Advanced Solver for Problems in Earth's Convection; i.e. Kronbichler et al., 2012; Heister et al., 2017; Bangerth et al., 2020) capabilities utilize user-defined input files such as seismic tomography, surface velocities, and lithospheric structure. The current version of ASPECT requires the input files be located on the computer where computations are run. We have developed a broker called the BALTO-ASPECT URL Reader that makes it possible to read remote data by simply defining a URL in the ASPECT parameter file.

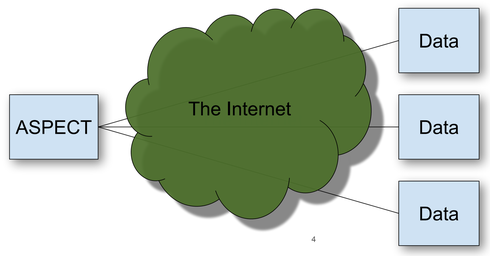
Without remote access

Data must be gathered and reformatted by hand. Data must also be stored locally.



Using remote access

Data can remain remote and format conversions are handled by the broker/server



Setting up a parameter file to read remote data

ASPECT parameter files require the user to specify the Data directory and Data file name when an input file is utilized. When the BALTO-ASPECT URL Reader is invoked, the user defines the URL of the remote data file they want to use. The only requirement is that the host of the data file must use the widely accepted Data Access Protocol (Gallagher et al., 2007). ASPECT will read the file as if it were located on the user's computer.

Local file is stored on user's machine

```
subsection Initial temperature model
   set Model name = adiabatic boundary
 subsection Adiabatic boundary
    set Data directory    = $ASPECT_SOURCE_DIR/contrib/opendap/input_files/
    set Data file name    = lithospheric_thickness.txt
 end
 end
```

Remote file is stored in a remote location that uses DAP

```
subsection Initial temperature model
   set Model name = adiabatic boundary
 subsection Adiabatic boundary
    set Data directory    =
    set Data file name       = http://balto.opendap.org/opendap/lithosphere_thickness/lithospheric_thickness.csv
end
end
```

How to compile ASPECT with URL capability on MacOS Catalina using the deal.ii app

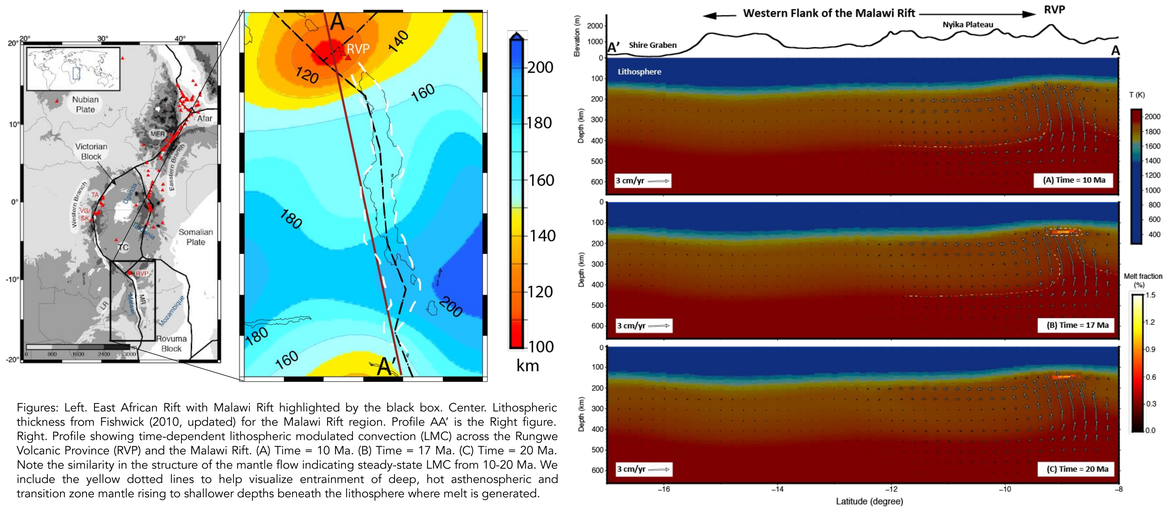
1. Get Xcode from the App Store
2. Install libdap with homebrew from the terminal
   `brew install libdap`
3. Install the latest deal.ii app and open the dealii app terminal
   `load module dealii`
4. Clone ASPECT from GitHub from within the dealii app terminal
   `git clone https://github.com/geodynamics/aspect`
5. Compile ASPECT with appropriate libdap options
   `cd aspect`

   `cmake -DLIBDAP_LIB=/usr/local/lib -DLIBDAP_DIR=/usr/local -DASPECT_WITH_LIBDAP=ON`

   `make`

Melt Generation Beneath the Rungwe Volcanic Province Use-Case

Using the ASPECT Adiabatic Boundary plugin, we calculated lithospheric modulated convection and associated melt generation in the asthenosphere using the Fishwick (2010, updated) lithospheric thickness model, which is located at http://balto.opendap.org/opendap/lithosphere_thickness/ along with several other models. We found melt can be generated beneath the Rungwe Volcanic Province without the need for a plume source (Njinju et al., under review, JGR).



Figures: Left. East African Rift with Malawi Rift highlighted by the black box. Center. Lithospheric thickness from Fishwick (2010, updated) for the Malawi Rift region. Profile AA' is the Right figure. Right. Profile showing time-dependent lithospheric modulated convection (LMC) across the Rungwe Volcanic Province (RVP) and the Malawi Rift. (A) Time = 10 Ma. (B) Time = 17 Ma. (C) Time = 20 Ma. Note the similarity in the structure of the mantle flow indicating steady-state LMC from 10-20 Ma. We include the yellow dotted lines to help visualize entrainment of deep, hot asthenospheric and transition zone mantle rising to shallower depths beneath the lithosphere where melt is generated.

References

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