MAGIC Geodynamic Modeling

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The Mid-Atlantic Geophysical Integrative Collaboration (MAGIC) seismic deployment extends from the Atlantic coast of Virginia to the western boarder of Ohio. MAGIC is also using seismic data from the TA stations along with geomorphic observations. Prior to the arrival of the Transportable Array (TA), analysis of broadband seismic stations in the southeastern US detected a distinct pattern of shear-wave splitting (Long et al., 2010). Near the coast, stations exhibit well-resolved null (no splitting) behavior for SKS phases over a range of back azimuths, consistent with either isotropic upper mantle or with a vertical axis of anisotropic symmetry. Farther inland, Long et al. (2010) identify splitting with mainly NE–SW fast directions, consistent with asthenospheric shear due to absolute plate motion (APM), lithospheric anisotropy aligned with Appalachian tectonic structure, or some combination of these. To test hypotheses regarding mantle flow and aid the interpretation of the observations, we are building a new geodynamic model based on ASPECT (*Advanced Solver for Problems in Earth ConvecTion*)(Kronbichler et al. 2012) that uses buoyancy derived from seismic tomography along with realistic lithosphere and sub-lithosphere structure. At present our geodynamic model uses S40RTS (Ritsema et al., 2011) however we plan to compare these preliminary results with many of the seismic models available through the IRIS Earth Model Collaboration website (ds.iris.edu/ds/products/emc-earthmodels) to understand the sensitivity of the flow pattern to the seismic model. In addition we plan to incorporate crust and lithosphere-asthenosphere boundary models as these observations become available for the eastern US.

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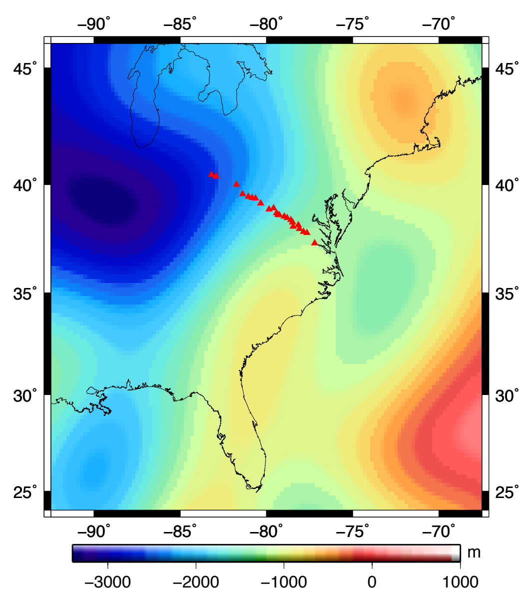

The figure at the left is the dynamic topography from a geodynamic calculation with a uniform mantle viscosity and a uniform scaling of seismic velocity to density. The S40RTS seismic model is converted to buoyancy to drive mantle flow and has a minimum wavelength of 1,000 km. The red triangles denote the stations from the MAGIC temporary deployment. Dynamic topography is the surface deformation that is induced by viscous stresses resulting from convective flow within the mantle. Dynamic topography varies as mantle flow changes and generally is small in amplitude and long in wavelength. Thus, dynamic topography can be difficult to remove from topographic anomalies resulting from tectonics (Braun, 2010).