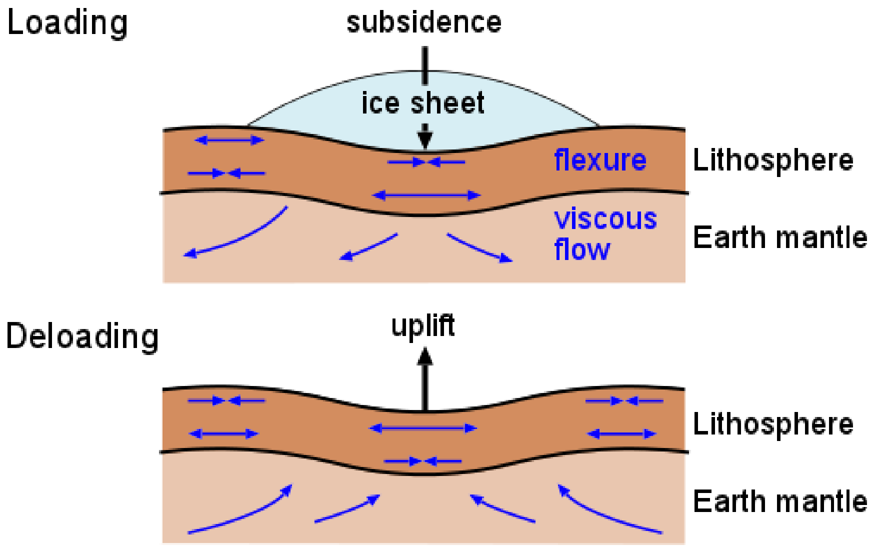
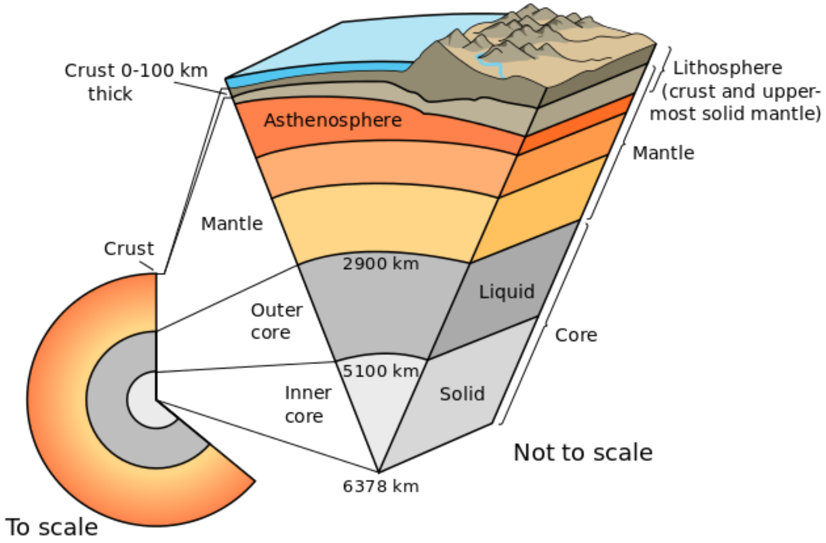
Glacial Isostatic Adjustment in Elmer/Ice

Glacial Isostatic Adjustment





- Evidence that West Antarctica has thin lithosphere and low viscosity, resulting in faster uplift on timescales fast enough to affect MISI.
- Layers with different material properties (eg from PREM)
- Modified Linear Elastic solver
- Need to handle viscoelastic materials for the mantle.
- Solve for sea level
- Most GIA codes work on a spectral domain, not easily compatible with finite element code

Approaches:

- **LLRA**
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- local lithosphere (elastic) and relaxing asthenosphere (viscous affects with constant time lag)
- Very simple to implement
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- **Wu et al (2004)**
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- Non-self-gravitating incompressible flat earth
- Modified linear elastic solver for lithosphere. (But need viscoelastic for mantle deformation)

Equations non-self gravitating incompressible flat Earth

- Wu et all do a transformation of the effective stress to include "background stress", where *w* is the deformation vector
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- Values for density and gravity are averaged over the different layers
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- In Elmer, use the Navier equations, and include and an extra term to include contribution of the the displacement
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$$\nabla \cdot \boldsymbol{\tau} - \rho_0 g_0 \nabla w = \mathbf{0}$$

$$\rho_0 = \frac{1}{z^+ - z^-} \int_{z^-}^{z^+} \rho(z)\, dz,$$

$$g_0 = \frac{1}{z^+ - z^-} \int_{z^-}^{z^+} ||\boldsymbol{g}(z)||\, dz$$

$$\rho \frac{\partial^2 \boldsymbol{u}}{\partial t^2} - \nabla \cdot \boldsymbol{\tau} = \boldsymbol{f}$$

$$\int_{\Omega_i} \rho_0 g_0 \nabla w \varphi \, dV.$$