Geophysical Research Abstracts
Vol. 17, EGU2015-7755, 2015
EGU General Assembly 2015

Decomposing very rapid crustal displacements observed in the Amundsen Embayment into their instantaneous elastic and short (10-100 yr) time-scale viscoelastic components

Valentina Barletta (1), Michael Bevis (1), Ben Smith (2), Terry J Wilson (1), Abel Brown (3), Andrea Bordoni (4), Michael Willis (5), Bob Smalley (6), Eric Kendrick (1), Stephanie Konfal (1), Dana Caccamise (1,7), Richard Aster (8), Julien Chaput (9), David Heeszel (10), Andrew Lloyd (11), and Doug Wiens (11)

(1) Ohio State University, OH, USA, (2) University of Washington, WA, USA, (3) NASA-Goddard, MD, USA, (4) DTU, Denmark, (5) Cornell University, NY, USA, (6) University of Memphis, TN, USA, (7) National Geodetic Survey, USA, (8) Colorado State University, CO, USA, (9) Joseph Fourier University, Grenoble, FR, (10) Nuclear Regulatory Commission, USA, (11) Washington University, MO, USA

The Amundsen Embayment sector of West Antarctica is experiencing some of the fastest sustained bedrock uplift rates in the world. These motions, recorded by the Antarctic GPS Network (ANET) are far too rapid to be explained using traditional GIA models, but they cannot be explained purely in terms of the Earth's elastic response to contemporary ice loss. We use 13 years of very high resolution DEM-derived ice mass change fields over the Amundsen sector to compute the elastic signal and remove that from the observed geodetic time series. We obtain a very large residual - up to 5 times larger than the computed elastic response. We hypothesize that this residual signal manifests a short-time-scale viscoelastic response to post- Little Ice Age ice mass changes, including ice losses developed in the last decade or so. Short time-scale, high-rate viscoelastic deformation is plausible in areas underlain by very low mantle viscosities. Low or very low mantle viscosities are expected in this area based on existing heat flow estimates, seismic velocity anomalies, thin crust, and active volcanism, all of which are associated with geologically recent rifting. We estimated a plausible ice history for the last hundred years. We used the actual measurements from 2002 to 2014, and before 2002 we use 25% of present day melting rate, as suggested by published studies. We then simulated the bedrock displacement – both vertical and horizontal - with a spherical compressible viscoelastic Earth model having a low viscosity shallow upper mantle. We show that we can explain most of the signal (amplitude and direction) by using a 50-60 km elastic lithosphere and 1-2 x10̂18 Pa s viscosity in the shallow upper mantle.