Surface Deformations from Glacial Isostatic Adjustment Models with Laterally Homogeneous, Compressible Earth Structure

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The zipped file contains global 1-degree grid files of four different surface deformation parameters:

- Horizontal velocity, North component (vnorth)
- Horizontal velocity, East component (veast)
- Vertical velocity (vup)
- Geoid change (dgeoid)

calculated from a set of 26 different glacial isostatic adjustment models applying 10 different radially varying (=layered) earth structures and 3 different global ice models.

The different earth structures and the available combinations with ice models are as follows

Layer/Model	Value	Naming	Ice model
Lithosphere (km)	60 90 120 150	f i l o	ANU-ICE ICE-6G_C ICE-7G_NA
Upper Mantle (E20 Pa s)	4	7	
Lower Mantle (E21 Pa s)	2 20	2 6	
VM5a	See Roy & Peltier (2017)	vm5a	ICE-6G_C
VM7	See Roy & Peltier (2017)	vm7	ICE-7G_NA

File naming is simply {ice model}_{earth model}_{parameter}.grd. For example, anu-ice_f72_vup.grd is the global vertical velocity grid file calculated with a GIA model with ANU-ICE ice history and 60 km lithospheric thickness, 4E20 Pa s upper mantle viscosity and 2E21 Pa s lower mantle viscosity. Grid files (NetCDF format) were generated with GMT6 (Wessel et al., 2019), thus can be directly used.

Ice thickness histories of ICE-6G_C (Argus et al., 20214; Peltier et al., 2015) and ICE-7G_NA (Roy & Peltier, 2017) were downloaded from W. R. Peltier's data website at the University of Toronto, Canada: https://www.atmosp.physics.utoronto.ca/~peltier/data.php

Note that the velocity field of ICE-6G_C(VM5a) can be compared to the one available from W. R. Peltier's data website. The files provided here are <u>not</u> a substitute for the ones by W. R. Peltier and colleagues! Analyzing the difference between the files from this work and the ones available on the data website can help getting an error estimate from the two GIA model implementations (see further below). The user will find minor differences in the uplift component but larger ones in far field areas of the horizontal components.

ICE-7G_NA(VM7) results are added as complement for interested users. However, note that ICE-7G_NA contains ice thickness history modifications in North America only and a fully global re-optimization of the ice thickness is warranted. Hence, excessive use and interpretation of these grid files, especially on global scale, should be avoided.

ANU-ICE is a global 1-degree ice thickness model merged from several regional models (Lambeck, 1995; Fleming & Lambeck, 2004; Lambeck et al., 2010; 2014; 2017) kindly provided by Anthony Lambert and Kurt Lambeck, ANU, Canberra, Australia. The regional models contain differing spatial and temporal resolutions that were unified to fit the global 1-degree spatial resolution at mainly common time steps (500–1000 years). The Antarctic Ice Sheet part contains changes in the last time steps, thus some larger changes in the velocities can be found there.

The software ICEAGE (Kaufmann, 2004) is used for calculating the grids, which applies the viscoelastic normal-mode method (Peltier, 1974; Wu, 1978). The sea-level equation is solved in a pseudo-spectral approach (Mitrovica et al., 1994; Mitrovica & Milne, 1998) in an iterative procedure in the spectral domain. See further details in Kaufmann and Lambeck (2000; 2002). The spherical harmonic expansion in the spectral domain is truncated at degree 192, which corresponds to ~1° spatial resolution. The models are spherically symmetric (1D), compressible, with Maxwell-viscoelasticity, rotational feedback, and time-dependent coastlines. The Earth's core is, as assumed to be inviscid, incorporated as lower boundary condition. Rheological parameters such as depth-dependent density, Young's modulus, etc., are taken from PREM (Preliminary Reference Earth Model; Dziewonski & Anderson, 1981).

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