3.5.6 Global Geophysical Fluids Center (GGFC)

The Global Geophysical Fluids Center (GGFC) is a product center within the International Earth Rotation and Reference Systems Service. The GGFC supports, facilitates, and provides services and products to the worldwide research community in areas related to the variations in Earth's rotation, its shape, its gravitational field, and geocenter that are caused by mass transport of environmental fluids on its surface (atmosphere, oceans, continental water, etc.) and by the transport of internal fluids (mantle and core).

Eight Special Bureaus (SB) have been established to supply products to support community research. These include: Atmospheres, Oceans, Hydrology, Tides, Mantle, Core, Loading, and Gravity/ Geocenter.

The products provided by the SB's are based on global observational data and/or state-of-the-art model output. The products are available through the individual SB web sites that can be accessed via the GGFC portal(<http://www.ecgs.lu/ggfc/>), which is currently hosted at the European Center for Geodynamics and Seismology .

In some of the SB's, the yearly activity is high because new fluid models and data sets are constantly becoming available. The SB's take these new data sets and convert them into a product required by the research community. The annual activities of these SB's are included here. In other SB's, the fluid models or data sets are well established and upgrades occur only rarely. These SB's do not report annually. However, when a major change does occur, this WILL be documented in the Annual Report.

The importance of the products supporting the analysis of geodetic data is ever increasing. In fact, new products such as global models of tropospheric delays are required. In addition, some products are even being requested in real time. As a result of all these new user requirements, this year we began a process to reorganize the GGFC. The exact form the reorganization will take is still being discussed in the IERS Directing Board. An exact model will most likely be accepted in 2008.

As with every year, I would like to take this opportunity to thank all the volunteers who chair and maintain the respective SB's.

Tonie van Dam, Head GGFC

Special Bureau for the Atmosphere

In conjunction with the U.S. National Oceanic and Atmospheric Administration (NOAA) the SBAtmosphere has produced data from several different operational meteorological centres. We have also produced data from atmospheric reanalyses, spanning back to 1948. SBAtmosphere organized a system to operate in two modes. In the first, it supplies the data in near-real time through the services at NOAA, including analysis and forecast terms. That mode is under the direction of Craig Long of NOAA. In the second mode, it updates monthly archives of the data on the FTP server at Atmospheric and Environmental Research, Inc. (AER) in Lexington, MA. Access can be obtained through the AER website and by exchange of data through the ftp protocol.

The principal data prepared relate to atmospheric excitations of the Earth rotation vector, as forced by changes in the winds and surface pressure of the atmosphere, known respectively as the motion and mass terms of the atmospheric angular momentum AAM. For the axial component, related to length-of-day, the stronger term is the motion one, and for the equatorial term, related to polar motion, the mass term generally dominates. An “inverted barometer” correction is produced to the mass terms, designed to model an equilibrium condition of the oceans in which the ocean depresses in response to a higher atmospheric pressure and rises in response to a lower one.

SBAtmosphere also computes the AAM terms locally, in a number of equal-area sectors distributed around the globe, as well as globally. In addition, SBAtmosphere computes the mean atmospheric surface pressure over the globe, and various spherical harmonics, which are related to the Stokes coefficients of the Earth gravity field, of particular interest to recent space-gravity missions. SBAtmosphere archives torques from the NCEP-NCAR reanalyses that relate to the angular momentum transfer from atmosphere to solid Earth, including topographic (mountain), friction, and gravity wave drag torques. Users log in to our ftp sites to obtain the desired information.

Dr. Yonghong Zhou has been processing the atmospheric data from his position at Shanghai Astronomical Observatory to help update the SBA archives. He processes both the NCEP-NCAR reanalyses using the revised codes that were developed while he was a visitor at Atmospheric and Environmental Research. The revised procedure has improved on the treatment of the lower boundary and also updated a number of geophysical constants needed to calculate the atmospheric excitations.

During 2007 we continued investigations of using atmospheric models for more rapid subdiurnal scales. Fields from one of the NASA models can be extracted hourly, in between the six-hour analyses that are routinely used. We have been investigating the feasibility of calculations of the atmospheric excitation terms for the Earth orientation parameters. A test period was October 2002, during the special CONT’02 campaign in which measurements from Very Long Baseline Interferometry developed high temporal resolution data. Various issues involved the discontinuities at the 6-hour marks when analyses were made, and we established techniques to lessen these discontinuities. Also, we are now awaiting results from a new analysis in which a smoother signal, not subject to such discontinuities, is expected.

Dr. Katherine Quinn has been assisting in some analyses and the preparation of some new data sets, including Earth rotation/ polar motion excitations from the ECMWF 40-year reanalysis (ERA-10) and a new set of NCEP reanalyses (called the NCEP-2 reanalyses). We have also been making arrangements to receive the data from the ECMWF on a regular basis on regular temporal resolution and also on high resolution during an upcoming campaign, the CONT'08 campaign.

Results of the SBA were presented at the European Geosciences Union meeting, the American Geophysical Union meeting, meetings of the Journees de Reference Spatio Temporelles including sessions related to the campaign for prediction of Earth orientation parameters.

Acknowledgments

The U.S. National Science Foundation has supported activities, at AER of the SBA under Grant ATM-0429975.

David Salstein

Special Bureau for the Oceans

Introduction

The oceans have a major impact on global geophysical processes of the Earth. Nontidal changes in oceanic currents and ocean-bottom pressure have been shown to be a major source of polar motion excitation and also measurably change the length of the day. The changing mass distribution of the oceans causes the Earth's gravitational field to change and causes the center-of-mass of the oceans to change which in turn causes the center-of-mass of the solid Earth to change. The changing mass distribution of the oceans also changes the load on the oceanic crust, thereby affecting both the vertical and horizontal position of observing stations located near the oceans. As part of the IERS Global Geophysical Fluids Center, the Special Bureau for the Oceans (SBO) is responsible for collecting, calculating, analyzing, archiving, and distributing data relating to nontidal changes in oceanic processes affecting the Earth's rotation, deformation, gravitational field, and geocenter. The oceanic products available through the IERS SBO web site at <http://euler.jpl.nasa.gov/sbo> are produced primarily by general circulation models of the oceans that are operated by participating modeling groups and include oceanic angular momentum, center-of-mass, and bottom pressure.

Data Products

Seven different oceanic angular momentum series are currently available from the IERS Special Bureau for the Oceans:

(1) ponte98.oam, a series computed by Ponte *et al.* (1998) and

Ponte and Stammer (1999, 2000) from the products of a simulation run of the MIT ocean general circulation model which spans January 1985 to April 1996 at 5-day intervals;

(2) johnson01.oam, a series computed by Johnson *et al.* (1999) from the products of version 4B of the Parallel Ocean Climate Model (POCM) which spans January 1988 to December 1997 at 3-day intervals;

(3) c20010701.oam & c20010701.chi, a series computed by Gross *et al.* (2003, 2004) from the products of a simulation of the oceans' general circulation run by the Estimating the Circulation and Climate of the Ocean (ECCO) group at JPL which spans January 1980 to March 2002 at daily intervals and which is available either as a series of angular momentum values (c20010701.oam) or as a series of effective excitation functions (c20010701.chi);

(4) ECCO_50yr.oam & ECCO_50yr.chi, a series computed by Gross *et al.* (2005) from the products of a simulation of the oceans' general circulation run by the ECCO group at JPL which spans January 1949 to December 2002 at 10-day intervals and which is available either as a series of angular momentum values (ECCO_50yr.oam) or as a series of effective excitation functions (ECCO_50yr.chi);

(5) ECCO_kf049f.oam, a series computed by Gross *et al.* (2005) from the products of a data assimilating model of the oceans' general circulation run by the ECCO group at JPL which spans January 1993 through March 2006 at daily intervals;

(6) ECCO_kf066a2.oam & ECCO_kf066a2.chi, a series computed by Gross (2008) from the products of a simulation of the oceans' general circulation run by the ECCO group at JPL which spans January 1993 through March 2008 at daily intervals and which is available either as a series of angular momentum values (ECCO_kf066a2.oam) or as a series of effective excitation functions (ECCO_kf066a2.chi); and

(7) ECCO_kf066b.oam & ECCO_kf066b.chi, a series computed by Gross (2008) from the products of a data assimilating model of the oceans' general circulation run by the ECCO group at JPL which spans January 1993 through March 2008 at daily intervals and which is available either as a series of angular momentum values (ECCO_kf066b.oam) or as a series of effective excitation functions (ECCO_kf066b.chi).

Seven different oceanic center-of-mass series are also currently available from the IERS Special Bureau for the Oceans:

(1) dong97_mom.cm, a series computed by Dong *et al.* (1997) from the results of a version of the Modular Ocean Model (MOM) run at JPL which spans February 1992 to December 1994 at 3-day intervals;

(2) dong97_micom.cm, a series also computed by Dong *et al*. (1997) from the results of running the Miami Isopycnal Coordinate Ocean Model (MICOM) at JPL which also spans February 1992 to December 1994 at 3-day intervals;
(3) c20010701.cm, a series computed by Gross (personal communication, 2003) from the results of a simulation run of the ECCO ocean model done at JPL which spans January 1980 to March 2002 at daily intervals;
(4) ECCO_50yr.cm, a series computed by Gross (personal communication, 2004) from the products of a simulation of the oceans' general circulation run by the ECCO group at JPL which spans January 1949 to December 2002 at 10-day intervals;
(5) ECCO_kf049f.cm, a series computed by Gross (personal communication, 2004) from the products of a data assimilating model of the oceans' general circulation run by the ECCO group at JPL which spans January 1993 through March 2006 at daily intervals;
(6) ECCO_kf066a2.cm, a series computed by Gross (personal communication, 2008) from the products of a simulation of the oceans' general circulation run by the ECCO group at JPL which spans January 1993 through March 2008 at daily intervals; and
(7) ECCO_kf066b.cm, a series computed by Gross (personal communication, 2008) from the products of a data assimilating model of the oceans' general circulation run by the ECCO group at JPL which spans January 1993 through March 2008 at daily intervals.

Time series of the ocean-bottom pressure are currently available from the IERS SBO through a link to the JPL ECCO web site at <http://ecco.jpl.nasa.gov/external> from which two dimensional ocean-bottom pressure fields can be obtained that have been produced from purely surface flux-forced ocean models as well as ocean models that additionally assimilate satellite and in situ data. A link is also provided to the GLObal Undersea Pressure (GLOUP) data bank of ocean-bottom pressure measurements at <http://www.pol.ac.uk/psmslh/gloup/gloup.html>.

In addition to these data sets, a subroutine to compute oceanic angular momentum, center-of-mass, and bottom pressure from the output of general circulation models can be downloaded from the IERS SBO web site along with a bibliography of related articles.

Acknowledgments

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Richard Gross

Special Bureau for Tides

No report submitted.

Special Bureau for Hydrology

The Special Bureau for Hydrology provides internet access to data sets of water storage load variations for major land areas of the world. The web site contains results from five numerical models, the NCEP (National Center for Environmental Prediction) reanalysis, the ECMWF (European Center for Medium Range Weather Forecasting) reanalysis, the CPC (Climate Prediction Center) Land Data Assimilation System (LDAS), the NASA's Global Land Data Assimilation System (GLDAS), and the NOAA LadWorld land dynamics model. Global terrestrial water storage changes estimated from GRACE (Gravity Recovery and Climate Experiment) time-variable gravity observations during the period April 2002 and February 2008 are also provided in our online data archive (at <http://www.csr.utexas.edu/research/ggfc/>). The NASA GLDAS, CPC LDAS, and GRACE data products are updated on a regular basis.

A near 30 years record (January 1979 to February 2008) of monthly terrestrial water storage (TWS) change derived from GLDAS is newly added to our online data archive. GLDAS is an advanced land surface modeling system jointly developed by scientists at the NASA Goddard Space Flight Center (GSFC) and the NOAA NCEP. GLDAS parameterizes, forces, and constrains sophisticated land surface models with ground and satellite products with the goal of estimating land surface states (e.g., soil moisture and temperature) and fluxes (e.g., evapotranspiration). In this particular simulation, GLDAS drove the Noah land surface model version 2.7.1, with observed precipitation and solar radiation included as inputs. GLDAS estimates are the sum of soil moisture (2 m column depth) and snow water equivalent. Greenland and Antarctica are excluded because the Noah model does not include ice sheet physics. The GLDAS data are provided on 1° x 1° grids and at 3-hourly and monthly intervals (0.25° x 0.25° grids are also available at both 3-hourly and monthly intervals, but are not provided here limited by disk space). Daily average TWS changes is computed from the 3-hourly model estimates. Antarctica is not included in the model and estimates over Greenland are not recommended to use, because of the lack of ice dynamics in the model.

LadWorld is a global land dynamics model developed by scientists at the NOAA Geophysical Fluid Dynamics Laboratory. Simulated variables include snow water equivalent, soil water, shallow ground water, soil temperature, evapotranspiration, runoff and stream flow, radiation, and sensible and latent heat fluxes. This particular simulation (named Fraser and released in March 2007), differs from previous runs in the temporal extent of the simulation, which runs through November 2006. Additionally, the initial condition is one that is better equilibrated with climatic forcing. The improved initial condition removed a minor spin-up issue that had affected earlier LaDWorlds. Monthly TWS changes, representing the sum of soil water, snow, and ground water are provided for the period January 1980 to November 2006. Details of the LadWorld models are available at <http://www.gfdl.noaa.gov/~pcm/project/ladworld.htm>.

CPC LDAS is forced by observed precipitation, derived from CPC daily and hourly precipitation analyses, downward solar and long-wave radiation, surface pressure, humidity, 2-m temperature and horizontal wind speed from NCEP reanalysis. The output consists of soil temperature and soil moisture in four layers below the ground. At the surface, it includes all components affecting energy and water mass balance, including snow cover, depth, and albedo. Monthly averaged soil water storage changes are provided on a 1 x 1 degree grid. These data are averaged from the original 0.5 x 0.5 degree grid and converted into NetCDF and standard ASCII format. The data cover the period Jan. 1980 through Dec. 2007. No estimate is provided over Antarctica. A README file and a few Matlab scripts used for doing the conversion are provided as a reference to the data format.

The NCEP reanalysis model is a fixed data-assimilating global numerical model, designed mainly for atmospheric studies. It has been run for a period starting in 1948, up to the present. NCEP results are valuable for their global coverage and long duration. The hydrologic part of this model is mainly employed as a lower boundary condition in the model, and reflects a combination of an imposed (non data-assimilating) hydrologic cycle, and interaction with the atmosphere. The NCEP reanalysis variations are probably representative of the real Earth, but not accurate in detail. They lack the level of inter-annual variability expected in the real hydrologic cycle, and observed in some more sophisticated data-assimilating land surface model results. In addition, there are evident flaws over Antarctica and Greenland, which probably result from locating highly variable sea ice at land grid points. Therefore Antarctica and Greenland are excluded from geodetic calculations. The web site includes daily NCEP water storage in Gaussian grid (T62) form for Jan. 1979 – Dec. 2004, and polar motion and length of day excitation time series for Jan. 1948 – Dec. 2004, as well.

The ECMWF data-assimilating reanalysis model, similar to NCEP, also with a surface hydrologic cycle. We find that it appears more realistic than NCEP, showing greater interannual variability. In addition, its seasonal cycle resembles long-term average results based on local budget (Precipitation-Evaporation-Runoff) calculations. The web site includes 2.5-degree gridded values at daily intervals for the period 1979–1993.

The README file with the NCEP and ECMWF data also includes details on the way in which actual loads are calculated from the soil moisture model field. Data are available in both ascii and NetCDF (.nc) formats. In addition, there are helpful sample Matlab com-

Table 1: GGFC SBH Online Data Archive

Parameters	Sources	Information
Water Storage Change From GRACE (New!)	GRACE Release 4 (CSR)	Time Span: Apr. 2002 - Feb. 2008 Sampling Rate: Monthly, 67 Solutions GSM only (GAC not restored) Grid: 1 x 1 Degree Grid Decorrelation + 500 km Gaussian Smoothing Truncation at degree 60
Water Storage Change From GRACE	GRACE Release 1 (CSR)	Time Span: Apr/May 2002 - Jul 2004 Sampling Rate: Monthly, 22 Solutions Grid: 1 x 1 Degree Grid Gaussian Smoothing: 600, 800, 1000 km Truncation at degree 60, No C20
GLDAS Monthly Water Storage (New!)	NASA Global Land Data Assimilation System	Time Span: January 1979 – February 2008 Sampling Rate: Monthly Grid: 1 x 1 Degree Units: mm of water height
GLDAS Daily Water Storage	NASA Global Land Data Assimilation System	Time Span: Jan. 1, 2002 - May 31, 2007 Sampling Rate: Daily Grid: 1 x 1 Degree Units: mm of water height
NOAA LadWorld Monthly Water Storage	NOAA LadWorld (Fraser)	Time Span: Jan., 1980 - Nov., 2006 Sampling Rate: Monthly Grid: 1 x 1 Degree Units: mm of water height
CPC Monthly Water Storage	CPC Land Data Assimilation System	Time Span: Jan. 1948 - Dec. 2007 Sampling Rate: Monthly Grid: 1 x 1 Degree
NCEP Daily Water Storage	NCEP/NCAR Reanalysis-I Soil Moisture and Snow	Time Span: Jan. 1979 - Dec. 2004 Sampling Rate: Daily Grid: Gaussian (T62), ~1.904 x 1.875 Degree
ECMWF Daily Water Storage	ECMWF Reanalysis Soil Moisture and Snow	Time Span: 1979 - 1993 Sampling Rate: Daily Grid: 2.5 x 2.5 Degree
Water Storage	NCEP/NCAR Climate Data Assimilation System I (CDAS-1) soil moisture and snow	Time Span: 1993 - 1998 Sampling Rate: Monthly Grid: 1 x 1 degree
Water Flux	NCEP/NCAR Climate Data Assimilation System I (CDAS-1) soil moisture and snow	Time Span: 1993 - 1998 Sampling Rate: Monthly Grid: 1 x 1 degree

mands lists and m-files for reading the data in NetCDF format with Matlab, and for interpolating from the original model grid to a uniform (for example 1 x 1 degree) grid.

In addition to the above numerical models' estimates, we also provide estimates of equivalent surface water storage using GRACE release 4 time-variable gravity observations provided by the GRACE team at the Center for Space Research (CSR), University of Texas at Austin. 67 monthly RL04 GRACE solutions, covering the period April 2002 and February 2008 are used to estimate global surface mass change on a 1 x 1 degree grid. The GRACE spherical harmonics are truncated at degree and order 60, and a decorrelation filter and 500 km Gaussian smoothing are applied.

Table 1 summarizes the current datasets in our online data archive (<http://www.csr.utexas.edu/research/ggfc/>).

Jianli Chen

Special Bureau for Mantle

The Special Bureau for Mantle provides internet access to contemporary forward model output for glacial isostatic adjustment (GIA). It is possible that internal buoyant instabilities in the mantle can drive an observable time-variation in the external gravitational field, quantifying such internal material transport with truly reliable data constraints remains highly elusive. GIA models, in contrast, are supported by a plethora of global and regional geological data. The models have widespread acceptance in the geologic, paleoenvironmental and geodetic sciences. At the one cm/yr level, global plate tectonic motions are known to be stable on a 4 million year timescale (DeMets and Wilson, 2008), and therefore, negligibly contribute to the observed secular trends in terrestrial gravity. GIA is the only known source for time-varying global crust-mantle motion involving long wavelength deep-seated mass transport, having both vertical displacement rates at the level of cm/yr, and changing with time scales of 100,000 to 1,000 years. Hence, it is this readily modeled phenomenon that has been the main focus of the GGFC Special Bureau for Mantle.

This update to the forward models include two new developments in GIA modeling: (1) A more refined Southern Hemispheric model, due primarily to the larger number of regional constraints can now be brought to bear (e.g., Ivins and James, 2004; 2005; Makintosh et al., 2007; Glasser et al. 2008) and that are now incorporated into an updated Antarctic plus Patagonia/Tierra del Fuego loading/unloading history; (2) The emergence of a new more sophisticated load/unloading ICE-5G history from the regional geochronologic constraints, such as those of Dyke et al. (2003), and incorporated into a global model by Peltier (2004) and a regional model by Tarasov and Peltier (2004). When these two advancements are then combined with GRACE analyses for secular trends in gravity over North America (Tamisiea et al., 2007; Rangelova and Sideris, 2008; Ivins and Wolf, 2008) and Antarctica (Velicogna and Wahr, 2006; Ramillien et al., 2006) a more virulent package of predictive GIA models for geoid trend emerges. The main new step forward achieved in this new suite of predictive models, now submitted to the GGFC portal, is that they make full advantage of these two improvements in load history, and utilize models of mantle radial structure that are compliant with the most recent: (i) crustal motion data from continuous

GPS observations, (ii) tide-gauge records, (iii) relative sea level data, (iv) absolute gravity observations and (v) GRACE time series. The laterally homogeneous, radially stratified, Maxwell viscoelastic modeling of Wolf et al. (2006) (accounting for constraints i – iv); Kaufmann and Lambeck (2002) (accounting for constraints i – iv, and true polar wander, using an alternative, but well-refined global load history, RSES); Paulson et al. (2007) (accounting for constraints iii and v and using ICE5G); Tamisiea et al. (2007) (accounting for constraints from iv – v, using ICE5G and additionally modeling the spatial form of the free air gravity anomaly field proximal to Hudson Bay and environs). Hereafter, the models are referred to as: WKWZ, KL02, PZW and TMD, respectively. The user may explore three variants of the first model, and two of the 2nd and 4th, thus, allowing for 8 model predictions in all. It is assumed that the user of these model output data are capable geodesists with an interest in using the GIA models for either model-corrective or purely exploratory science goals. Consequently, the time-rate of change of normalized real Stokes coefficients are supplied, beginning with the degree 2 term, up to and including l, m = 256. Although this is much higher than for GRACE analysis, where in truncation for secularly varying field should truncate well below degree and order 90. The models are run in a manner that forces mass conservation between continent and oceans throughout.

The models are simple, in that the Earth is assumed incompressible, has creep specified by linear viscoelasticity of relaxing type and the mantle-crust consists of only 4 layers; a lithosphere of thickness, h_e, rigidities μ_i, densities, ρ_i, and a density stratified inviscid core lacking solid inner core, wherein the values are set to averages from PREM, with the constraint that density jump at the core mantle boundary (CMB), the gravitational acceleration at the CMB are identical to that specified in PREM, along with the mean surface gravity of the Earth. Four main parameters are varied among the 8 models: h_e, the mantle viscosity below the lithosphere, η_{UM}, and the viscosity of two additional layers: one above the CMB, $\eta^{(1)}_{LM}$, possibly characterizing the creep strength of the post-perovskite phase of the deepest mantle (when the zone has a relatively moderate thickness of 650 km), and one additional viscosity value, $\eta^{(2)}_{LM}$, characterizing the creep strength at mid mantle depths, the top part of the lower mantle, a zone just above which slabs often are seen to lie horizontally in tomographic imaging (e.g., Huang and Zhao, 2006).

Maps of Secular Time-Rate of Change in Geoid

The 8 model predictions are shown in pairs to highlight some of the salient differences in the predictions. In Figure 1 two variants of the KL02 models are shown. (At the top of the figure Earth rheological parameters of the models are given, with red and green lettering representing values for the top and bottom maps, respectively. All maps are geoid rate in mm/yr.) A noteworthy feature is shown in the lower frame of Figure 1; the smallest prediction of geoid variability over the continents in the Northern Hemisphere, this due to the small value of the upper and deepest mantle viscosity that is assumed. Note the lack of suppressed prediction in the Southern Hemisphere, this due to the younger history of Antarctic deglaciation in IJ05. Also note in the lower frame of Figure 1, that the model resolves youthful peculiarities of the load history in southwest Greenland, with the prediction here of negative rate of surface geoid change: a feature that could mimic ice mass loss. It appears in no other Earth structure models in the suite. The effect of the most radical variability in viscosity (confined to the deepest mantle) is shown in Figure 2 for the WKWZ series of models, which relied on the ICE-3G load model (not assumed here) and used data especially sensitive to the upper half of the mantle.

Also of notable contrast is when acceptable Earth structure is derived from different data, and different starting ice load histories; giving, in the end, remarkably similar present-day geoid rate predictions. Such is the case for contrasting WKWZ and PZW models shown in Figure 3. In Figure 4 two predictions for two Earth rheological structures are shown. The two structures assumed are both found acceptable using GRACE trends in North America in the TMD series. The dual (or 'degenerate') solutions are classic in GIA studies. The 'harder' deep mantle viscosity case (TMD2 at the top frame) shows muted amplitudes interior to the continent of Antarctica relative to TMD1 (bottom frame), while more robust responses occur in the oceanic Southern Hemisphere in TMD2, due to the longer relaxation times and lower wave number responses of the lower mantle in the later model. Note in Figure 4, in contrast however, how similar the predictions are within continental Canada.

Additional Notes on the Hybrid Load Model Assumed

The main advantage of using these GIA predictions offered at the GGFC Special Bureau for Mantle web site is that there exists a more appropriate balance of glacial loading/unloading between Southern and Northern Hemispheres in the models, accounting for ICE5G and IJ05, and Patagonian loads simultaneously.

The load assumes an Antarctic, Antarctic Peninsula + Patagonian load from the Southern Hemisphere that contribute a total of 10.36 meters of equivalent eustatic sea level rise since 21 kyr BP. With the exception of additional mass that correspond to small and distributed ice masses in the far eastern parts of Siberia and Kamchatka, which amount to less than 0.3 meters of equivalent eustatic sea level rise since last glacial maximum (LGM), the Northern Hemispheric part of the ice load history relies on the chronology and mass distribution of the ICE5G model. However, in order to

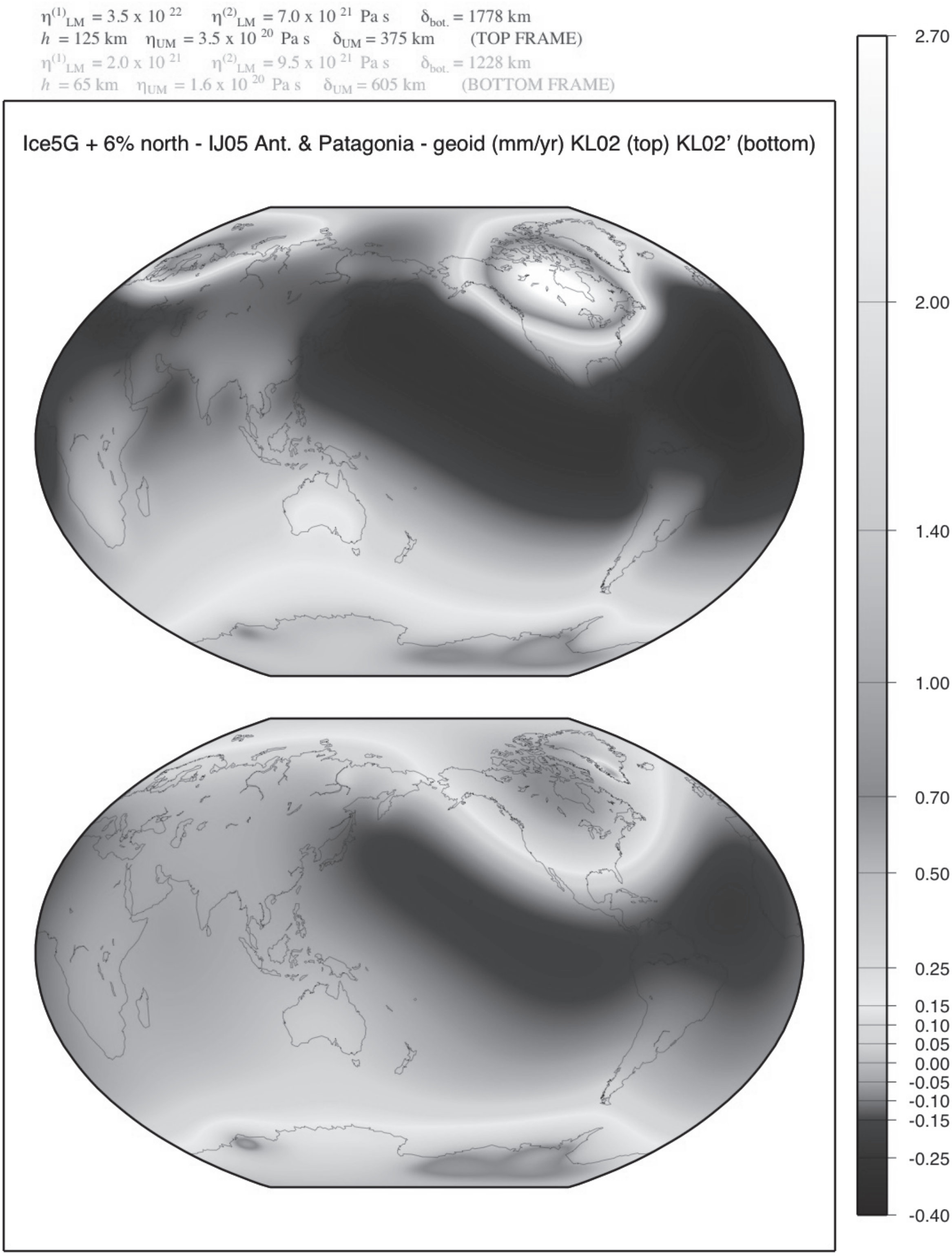

Fig. 1: Variants of the KL02 series, with the lower frame representing a case with the lowest value of upper mantle viscosity represented in the suite of models. It is of interest that Kaufmann and Lambeck (2002) selected the later set (green) parameters when accounting for present-day melting of Antarctica in their modeling scheme.

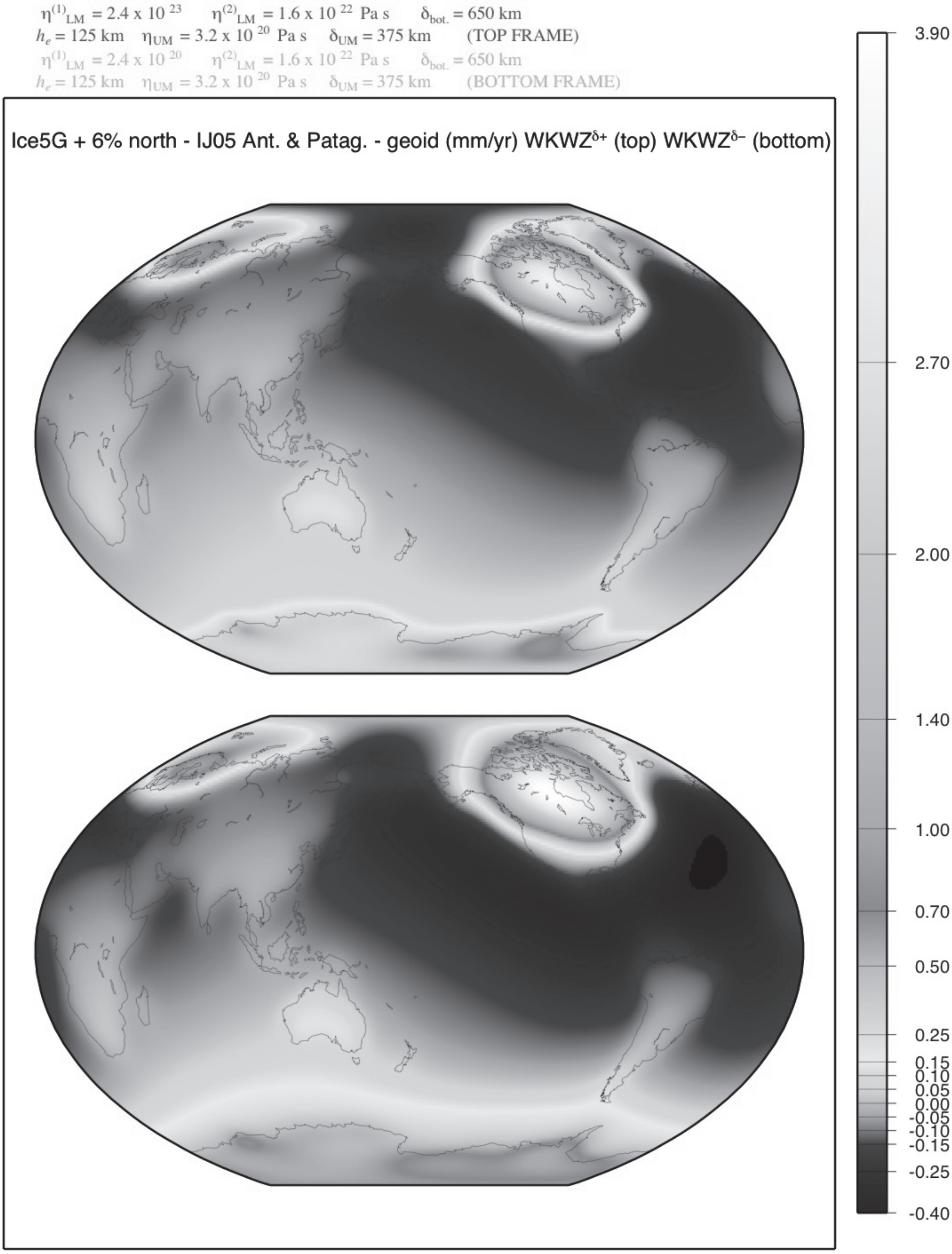

Fig. 2: Variants of the WKWZ series, with only the bottom viscosity of the mantle 650 km above the CMB being varied between top ('hard' post-perovskite) and lower ('soft' post-perovskite) frames. Three orders of magnitude difference in viscosity is assumed between the two predictions. Note, again, the larger prediction for Southern Hemisphere with the lower viscosity, now confined to a 'CMB asthenosphere'. The values of the upper and mid mantle viscosity keep rebounding geoids large in the Northern Hemisphere in both models.

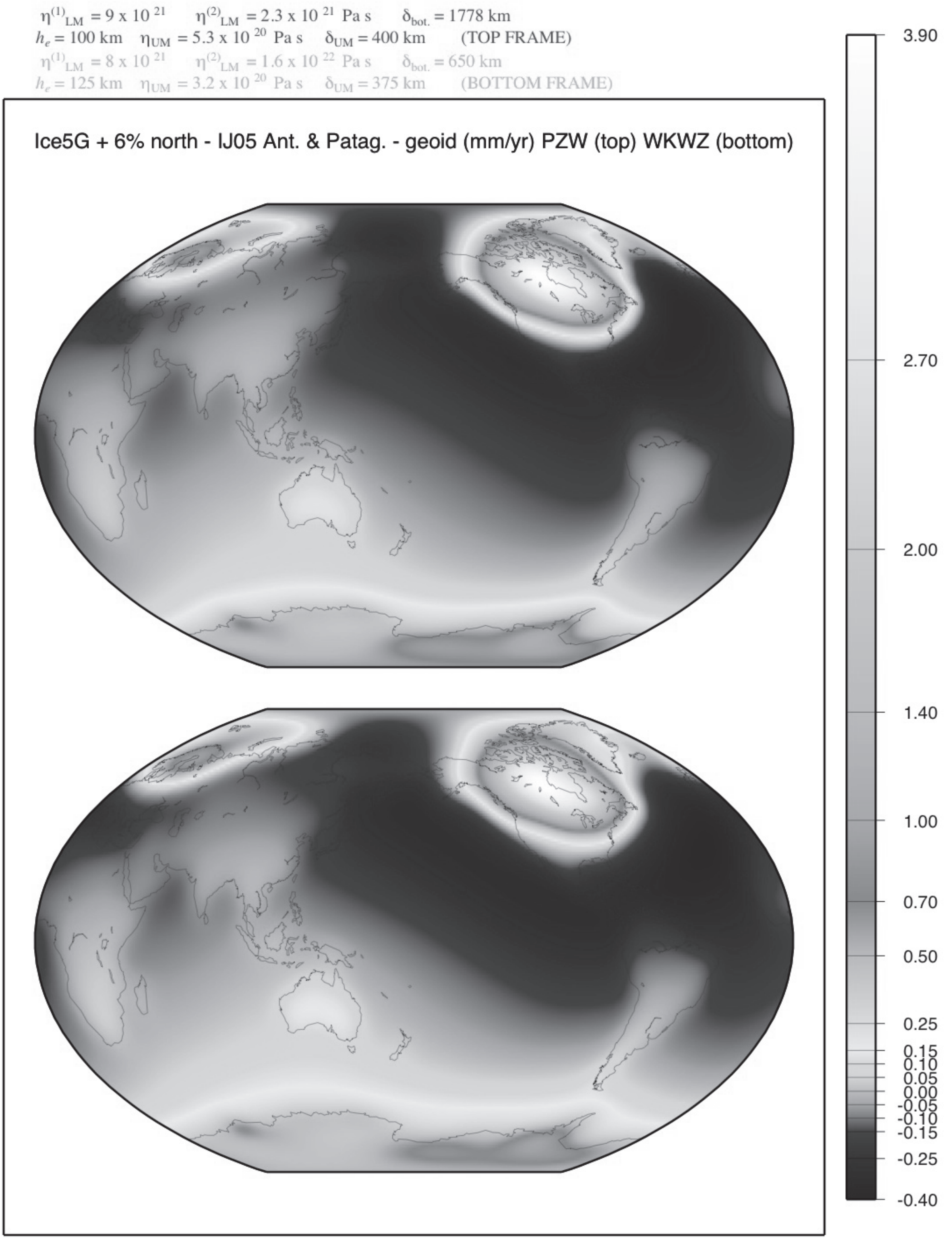

Fig. 3: Contrast between one representative stratified rheologies from the WKWZ series, with one from the PZW series. Note that there is relatively little difference between the model predictions and that the upper and deepest mantle viscosity values are similar. WKWZ and PZW used ICE3G and 5G, respectively. WKWZ used ICE3G plus Hudson Bay proximal constraints, and PZW used ICE5G with GRACE and RSL constraints.

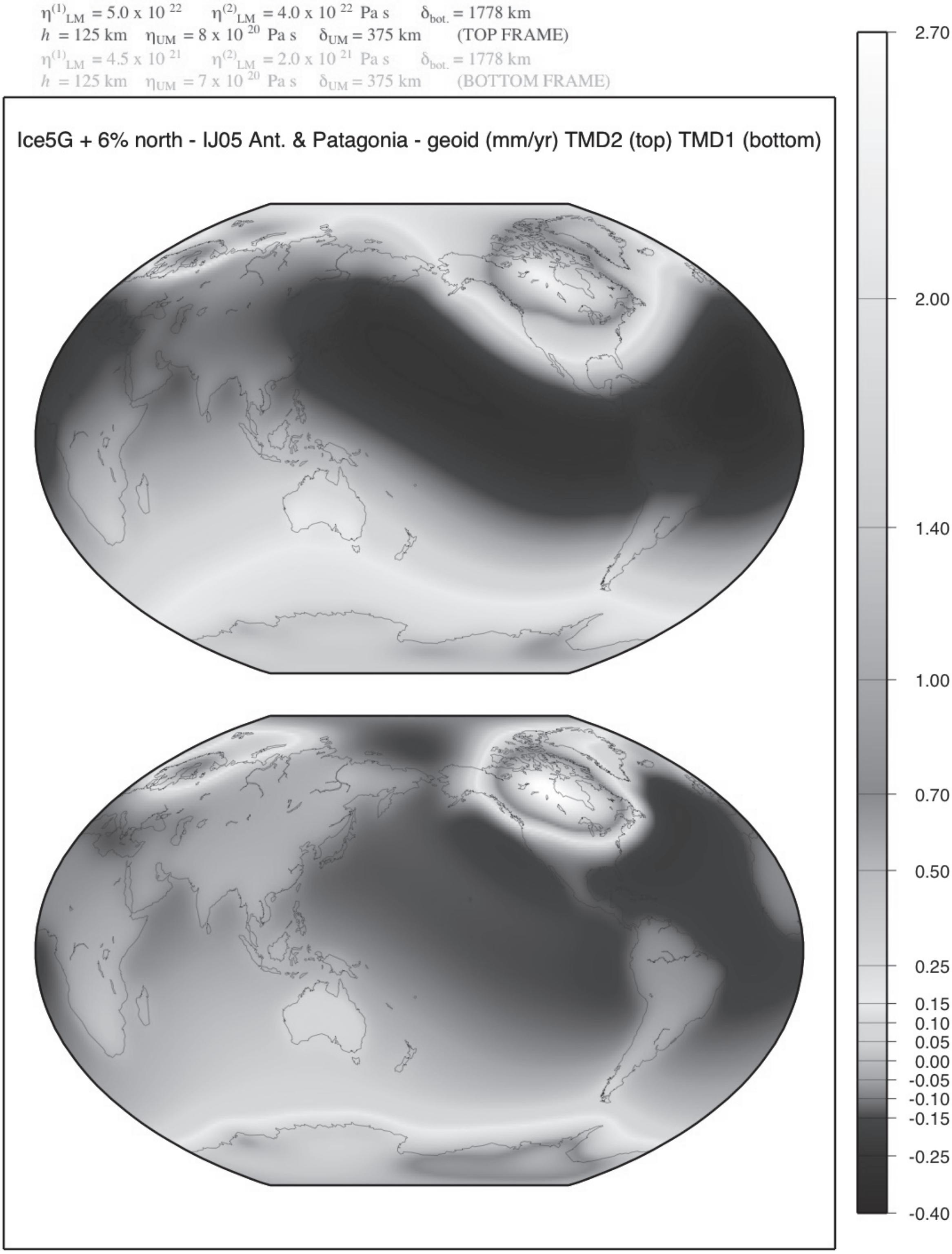

Fig. 4: Contrast between two acceptable solutions determined with the aid of GRACE trend for the Laurentide (TDM series). Note that there are relatively large differences outside of Canada.

merge the IJ05-Patagonian (PAT) models of Ivins and James (2004, 2005) with that of Peltier (2004), and still respect the data constraining the timing of sea-level rise since LGM far from the sites of the deglaciating ice sheets, along with approximate relative amplitudes of ice thicknesses at different geographic locations in the Northern Hemisphere, a simple mass-based scheme was used for merging. The modification to northern components of ICE5G required that they be increased in mass by 6% throughout the ice loading and unloading. This increase compensated for the decrease of the Southern Hemisphere in the IJ05-PAT models, with the total mean LGM sea-level rise amounting to 122.12 meters in the merged global modified IJ05-ICE5G model assumed in all calculations presented here and for those Stokes rate coefficients that are downloadable from the web site. All computations are performed using code developed by Erik R. Ivins at the Jet Propulsion Laboratory, with the exception of an associated Legendre polynomial Clenshaw summation routine kindly provided by Dr. Simon Holmes (Holmes and Featherstone, 2002).

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Erik R. Ivins

Special Bureau for the Core

Introduction

Flow in the fluid outer core and motion of the inner core with respect to the outer core can result in various geodetic phenomena observable from the Earth's surface or space. These phenomena include variations in the Earth's rotation and orientation, surface gravity changes, geocenter variations, and surface deformations. Although small, these variations can or could be observed by very precise space geodetic techniques. Observation of these effects yields unique insight into the core, which cannot be observed directly, and the resulting better understanding of the core will lead to improved models and predictions for the geodetic quantities.

Activities

The Special Bureau for the Core is responsible for collecting, archiving, and distributing data related to the core and plays a role in promoting and coordinating research on this topic. In particular, the SBC focuses on theoretical modelling and observations related to core structure and dynamics (including the geodynamo), and on inner core – outer core – mantle interactions. The SBC has about twenty members from the fields of geomagnetism, Earth rotation, geodynamo modelling (numerical and experimental), and gravimetry. The SBC has set up a web site (<www.astro.oma.be/SBC/main.html>) as the central mechanism for providing services to the geophysical community. Since one of the goals of the SBC is to distribute general information on the core, to make the geophysical community aware of the various geodetic effects that could be linked with the core, and to stimulate, support and facilitate core research, we present on our website concise explanations on topics as core convection, core flow, geomagnetism, core-mantle boundary torques, inner core differential rotation, Earth's rotation changes due to the core, and core composition. Additionally, we have built and continuously update a bibliography of articles relevant to the core that at present contains more than a thousand references.

Data products

The web site presently contains model data on core flow and core angular momentum. Most data are based on the observed surface geomagnetism field, and various hypotheses and physical assumptions are used to determine the flow and the angular momentum of the core. Moreover, a high-resolution time series is given that is determined by subtracting computed atmospheric angular momentum series from a time series for length-of-day variations. In addition to the data, a description is given of the relevant theories and of the dynamical assumptions used for constructing the flows.

Tim Van Hoolst

Special Bureau for Gravity/Geocenter

No report submitted.

Special Bureau for Loading

No report submitted.