Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01592, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01592
EGU General Assembly 2008

GRACE Secular Trends and Periodic Variations at Global and Regional Scales

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Datasets of global-distributed monthly water equivalent thickness, i.e. hydrologic mass balance, from the Gravity Recovery and Climate Experiment (GRACE) are investigated. The datasets examined are the Level-3 Release 4, 400 km half-width smoothed, de-striped version from the University of Texas Center for Space Research over the period of August 2002 through December 2006. A glacial isostatic adjustment grid (Paulson et al., 2007; ICE-5G/VM2) is applied to the GRACE monthly grids. Globally, spatially-averaged land and ocean time series are anti-correlated with a near 180-degree phase with maxima (ocean) / minima (land) occurring around September / May. Least squares-derived secular trends indicate increasing monthly water equivalent thickness on land areas and decreasing water equivalent thickness on ocean areas, on average, with spatially non-uniform patterns. These secular trends are in near-balance to within uncertainty, over the period of GRACE observations. However, a reduction of water equivalent thickness occurred from September through December 2004. This reduction, while seen in the regionally-averaged time series in the high-northern latitudes has not yet been identified in other regions. The ΔC_{20} geopotential coefficient is not modeled at this time. Regionally-averaged time series derived on the Arctic Ocean and Khatanga – Lena – Yana River regions are anti-correlated with a near 180-degree phase, and opposing secular trends of water equivalent thickness change. Least-squares regression on the Arctic Ocean region time series indicates a secular trend of water equivalent thickness reduction of 0.072 ± 0.031 cm/month, equivalent to a water volume loss of 91.1 ± 39.2 km^3/yr. Least-squares regression on the region of the Khatanga – Lena – Yana River region time series indicates a water equivalent

thickness gain of 0.098 ± 0.031 cm/month, equivalent to a water volume increase of 74.8 ± 23.7 km^3/yr. Empirical orthogonal function analysis will be needed to resolve periodic and near-periodic components, to better resolve the secular trends in the time series. Comparisons of the regional-averaged GRACE monthly trends and variations with other geophysical time series will be needed to separate source components and assess uncertainty.