ANALYSIS OF EWT MAPS FROM GRACE MISSION AND LAND HYDYDROLOGY DATA

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EXTENDED ABSTRACT.

Using the Stokes coefficients from the Gravity Recovery and Climate Experiment (GRACE) gravimetric mission we can assess the Equivalent Water Thickness (EWT) maps showing the heterogeneity of the gravitational field. To obtain these maps we used the formula (1). Nevertheless the maps of EWT delivered from unfiltered data, present the well known characteristic stripes. To cut out the perturbation and to enhance the signal to noise ratio we need to use a filter to the raw data. Then we show the impact of the smoothing of the Stokes coefficients on the resulting EWT map distribution we used the Stokes coefficients made accessible and filtered by the International Centre for Global Earth Models (ICGEM) imported from three research centers GeoForschungsZentrum Potsdam (GFZ), Jet Propulsion Laboratory - NASA (JPL) and Center for Space Research (CSR) with the aid of an anisotropic method of smoothing of the geopotential coefficients from GRACE with three degrees of smoothing DDK3, DDK2 and DDK1 (Kusche 2009). The result of filtering may be seen on Figures 1b, 1c and 1d. Additionally we made some researches with NOAA Climate Prediction Center (CPC) land hydrosphere geophysical model. We obtained the Stokes coefficients from EWT map from January 2007, computing with formula (2). The resulting coefficients were subjected to filtration in the same way as the GRACE data. Next the EWT maps from the filtered coefficients were computed by formula (1). The result of filtered geophysical EWT maps can be seen in Figures 2b and 2c and compared to the unfiltered map seen in Figure 2a. Dividing the filtered by the original geophysical maps we got a scaling factor for the DDK filters. In Figures 3a to 3c we can see the scalling factor maps for DDK3, DDK2 and DDK1 filter respectively. After investigating scaling factor maps we came to some conclusions. Scaling factor reaches values close to unity for DDK3 filter, about 1.3 to 1.7 for DDK2 and up to 3 for DDK1, outside several areas in North Africa, Australia and some parts of Asia, where values exceed significantly value of 3.

COMPUTATIONAL PROCEDURE

D.P.Chambers 2006

$$\triangle q(\phi,\lambda,t) = \frac{R_{\oplus}\rho_{\oplus}}{3\rho_W}\sum_{n=0}^{40}\sum_{m=0}^{n}\frac{(2n+1)}{(1+k_n)}P_{nm}(\sin\phi)[\triangle C_{nm}(t)\cos m\lambda + \triangle S_{nm}(t)\sin m\lambda] \qquad (1)$$

Wahr and Molenaar 1998

$$\begin{bmatrix}\triangle C_{nm}\\ \triangle S_{nm}\end{bmatrix} = \frac{3\rho_W}{4\pi\rho_E R_E}\frac{1+k_n}{2n+1}\int_0^{2\pi}\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}\triangle q(\phi,\lambda,t)P_{nm}(\sin(\phi))\begin{bmatrix}x\cos(m\lambda)\\ \sin(m\lambda)\end{bmatrix}\cos(\phi)d\phi d\lambda \qquad (2)$$

$\triangle q(\phi,\lambda,t)$ – change in water storage in a unit area
$\triangle C_{nm}, S_{nm}$ – Stokes coefficients
ρ_W – density of fresh water$(1000kg/m^3)$
ρ_E – mean density of the Earth$(5517kg/m^3)$
R_E – mean equatorial radius of the Earth$(6371km)$
ϕ – geographic latitude
λ – geographic longitude
$P_{nm}(\sin(\phi)))$ – fully normalized Associated Legendre Polynomials of degree n and order m
k_n – are Love number of degree n

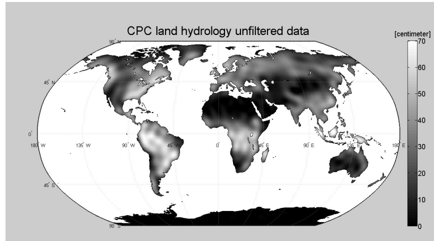

Figure 1: EWT map from CPC model from January 2007 without any filter

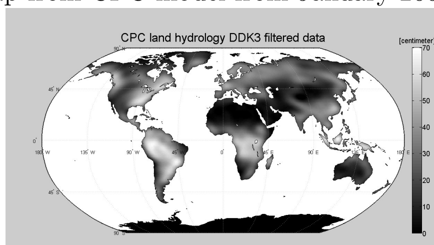

Figure 2: EWT map from CPC model from January 2007 with usage of DDK3 filter

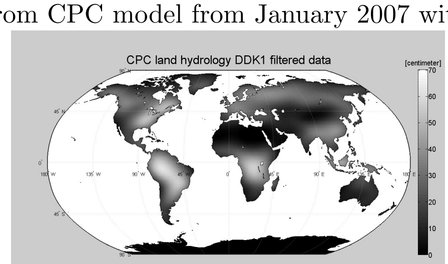

Figure 3: EWT map from CPC model from January 2007 with usage of DDK1 filter

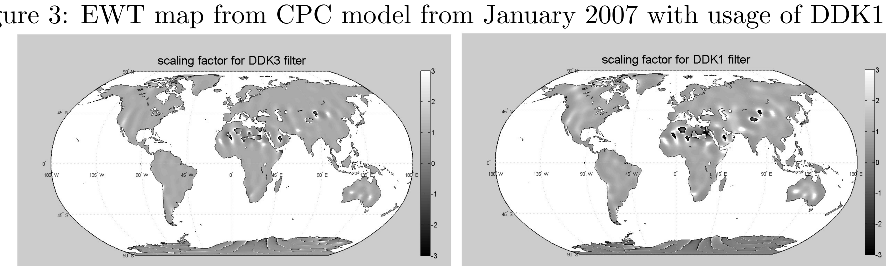

Figure 4: Map of scaling factor for the DDK3 (left) and DDK1(right) filter for January 2007

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