



# MONTHLY LAND WATERS SOLUTIONS BY LEAST SQUARES INVERSION OF GRACE GEOID DATA (2002-2006)

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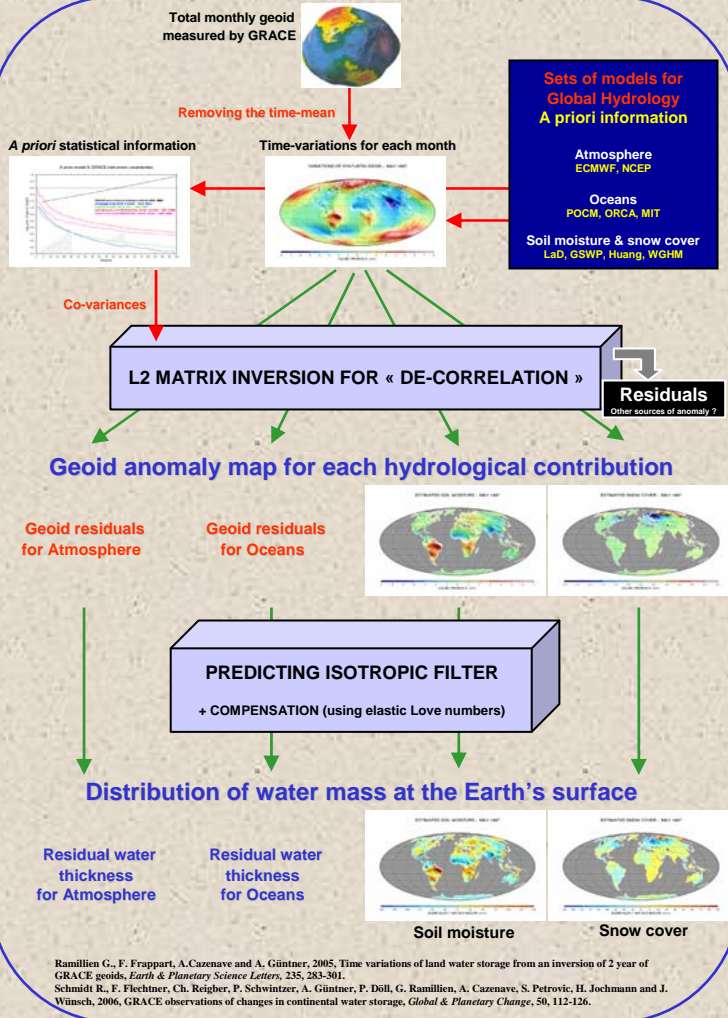
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**SUMMARY.** A least-square inversion procedure is used to derive the Land Waters (LW) variations at the resolution of ~400 km by combining: (1) monthly GRACE solutions from August 2002 to February 2007 recently made available by GFZ; and (2) a priori information from hydrology models. This approach proves to be an efficient strategy to separate different hydrological components (i.e., continental water storage included snow) from other geophysical phenomena, residual errors and high-frequency noise. Time-series of continental water storage for large drainage basin can be derived from these monthly LW solutions, and proved to be consistent in comparison with sparse in situ measurements of water levels and global hydrology models. A posteriori uncertainties on the estimated LW coefficients and errors from spectrum truncation and leakage can be also computed.

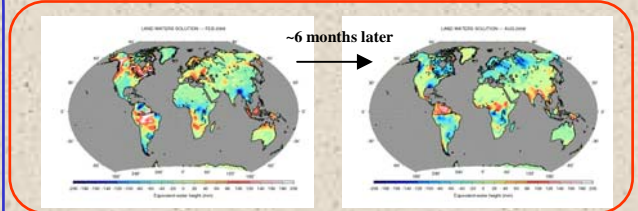
## Principle of time series inversion of GRACE Stokes coefficients



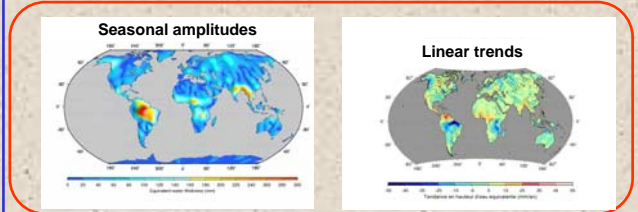
## Starting dataset: RL04 GSM solutions from GFZ

50 monthly GSM solutions (Stokes coefficients) from August 2002 to February 2007 provided by GFZ (« improved » RL04 release, 2006) developed up to deg. N=50 (Flechtner & Schmidt, 2007, personal communication). Corrected from atmosphere mass and oceanic tides, thus should represent mainly the **continental water storage** + un-modelled geophysical phenomena + residuals errors

## Two examples of LW solutions

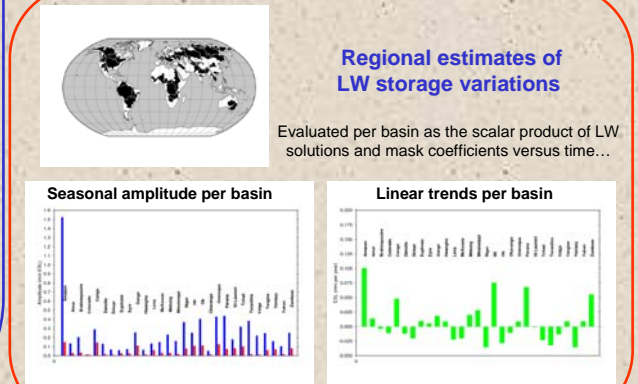


## Analysis of the LW solutions



## Regional estimates of LW storage variations

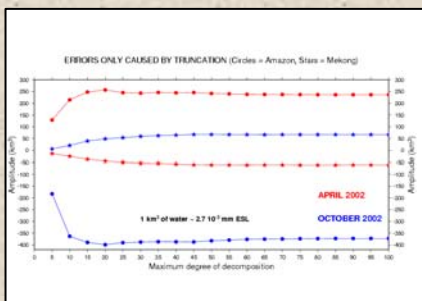
Evaluated per basin as the scalar product of LW solutions and mask coefficients versus time...



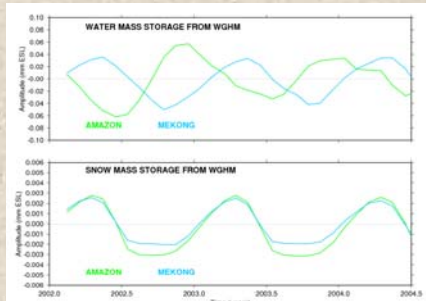
Ramillien G., F. Frappart, A.Cazenave and A. Güntner, 2005, Time variations of land water storage from an inversion of 2 year of GRACE geoids, *Earth & Planetary Science Letters*, 235, 283-301.  
Schmidt R., F. Flechtner, Ch. Reigber, P. Schwintzer, A. Güntner, P. Döll, G. Ramillien, A. Cazenave, S. Petrovic, H. Jochmann and J. Wunsch, 2006, GRACE observations of changes in continental water storage, *Global & Planetary Change*, 50, 112-126.

## Sources of non-formal errors on regional estimates

Error of truncation of spectrum around 1 km<sup>2</sup> at degree 50



Error of leakage from hydrology of other regions can reach 10% of the inner signal amplitude



Error of using an averaging radius (method under-estimation of the amplitude by factor 2)

