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Water mass variations from Independent Component Analysis (ICA) of GRACE Level-2 monthly GRACE solutions

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Since the launch of the Gravity Recovery and Climate Experiment (GRACE) mission in March 2002, its measurements have been increasingly used for large-scale hydrological, oceanic and ice caps applications.
Because of the problem of north-south striping that limits geophysical interpretation, different post-processing approaches for filtering Level-2 GRACE geoid solutions have been applied to extract useful geophysical signals, in particular changes in continental water storage.
We propose a new post-processing method of the GRACE solutions from different providers (i.e. UTCSR, JPL, GFZ) by considering completely objective constraints, so that the contributors to the observed gravity field are forced to be uncorrelated numerically using an Independent Component Analysis (ICA) technique. This approach does not require a priori information except the assumption of statistical independence of the elementary sources that compose the total measured signals, i.e. geophysical and spurious noise. As the condition of non Gaussianity for input pre-filtered GRACE signals remains valid, this linear inverse approach ensures to separate components which are statistically independent. A previous study on one month of data showed that the most energetic component found by ICA corresponds mainly to continental water mass changes. Series of ICA-estimated global maps of continental, oceanic and ice caps changes have been computed over 08/2002-07/2010 and compared with classical global GRACE solutions, such as destriping and Gaussian filtering. We also analyzed ICA-based time-series of water mass averages and estimated groundwater storage variations for the major drainage basins of the world and the mass balance of Greenland.