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# Global hydrological budget derived from atmospheric circulation model and GRACE time-variable gravity

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The continental hydrological budget has several components all varying as a result of geophysical and climatic processes; the variability is mainly seasonally but with considerable non-seasonal signals. The governing equation is S (water storage) = P-E-R, where the continents exchange water mass with the atmosphere in the form of precipitation minus evapo-transpiration P-E, and with the ocean by way of runoff R. The runoff R, including the surface as well as underground and cryospheric components, have traditionally been difficult to monitor or model; but now by combining the following two data sets one can in principle obtain a global estimate for R: (1) The space gravity mission GRACE yields monthly S estimate globally on a spatial resolution of ˜1000 km over the last 3 years. (2) The atmospheric circulation model output, such as from NCEP, provides proxy estimates for global P-E at ˜daily and ˜200 km resolutions (where the proxy P-E is calculated from the integrated water vapor flux within a given column of air.) This represents a new application of the GRACE observations. We calculate these hydrological budget quantities, subject to the spatial and temporal resolutions afforded by the data, for both seasonal and non-seasonal signals. These results can be compared and contrasted with existing estimates or estimation algorithms of R and provide insights for the validity of the latter.