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Global Hydrological Budget Derived from Atmospheric Circulation Model and Grace Time-Variable Gravity

BENJAMIN F. CHAO

College of Earth Sciences, National Central University, Taiwan

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.) We calculate these hydrological budget quantities, subject to the spatial and temporal resolutions afforded by the data. Although presently we only demonstrate the methodology, these results for R potentially provide insights for the hydrological budget especially for large basins and can be compared and contrasted with existing estimates or estimation algorithms. Future improvements, in both spatial and temporal resolutions, are expected to be substantial by way of new innovative processing methods of GRACE data, hence representing a new application of the GRACE observations in hydrology especially w. r. t. ungauged basins.