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Characterising Groundwater Hydrology of Krishna-Godavari Basins

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Hydrological prediction models measure changes in **T**otal **W**ater **S**torage(TWS) comprising surface and ground water storage changes over time. Until now it is not a directly measured quantity, rather than calculated from a host of other variables such as rainfall, runoff , soil moisture, infiltration indices, groundwater drawdown etc. TWS is also effected among others, by interaction between stream and aquifer, leakages to surrounding geological formations, artificial recharge from manmade structures, which are currently very rarely being included into models and are uncertain at best. In the Indian context soil moisture is also an uncertain variable, which is usually taken as a percentage of rainfall uniformly over India, not accounting for local soil conditions. All these uncertainties make Hydrological modeling quiet tricky. Uniform spatio-temporal coverage of the above said hydrological variables extending well into the past is also necessary to understand the response of TWS to climatic changes such as temperature rainfall etc. In developing countries like India such records are lacking and are fragmented at best. Direct measurement of TWS has become a reality ever since the advent of **s**atellite **t**ime **v**ariable **g**ravity(STVG) i.e. **G**ravity **R**ecovery **A**nd **C**limate **E**xperiment satellite (Wahr et.al [1], [2]), as a major part variation in time variable gravity is contributed by hydrological changes within upper layers of the crust (Wahr et.al [2]). As such direct measurement of TWS would regularize measurements and reduce the error bar resulting from these uncertainties by a big margin. Becker et.al [3] have utilized insitu hydrological measurements and STVG demonstrate such possibility using predominantly sedimentary Amazon basin as an example.

Krishna-Godavari basin in India, is an arid, rain fed, hard rock terrain basin drained by two perennial rivers Krishna and Godavari. Being hard rock terrain, groundwater recharge through secondary porosities is low and dependence on surface resources is high. There could be very little or no lag in response to climate change for this basin. Artificial surface water storage is well developed in this region and groundwater dependence is moderate. Also this basin consist of sub-basins which are facing prolonged drought for over 10 years. These factors make Krishna-Godavari basin a prime case for hydrological basin characterization, in repose to climate change. Here we explore a method based on signal separation to achieve the twin objectives of regularization of hydrological data using STVG in this basin and its characterization with reference to past changes, focusing on TWS. STVG from GRACE is subjected to EOF analysis and part of the signal perturbation caused by TWS is identified using statistical techniques such as correlograms and causality. Insitu TWS is regularized through cost function analysis using insitu stream gauge data, groundwater levels and TWS from STVG. Establishing hydrological characteristics of the basin is established from the regularized data. These characteristics can be utilized for future prediction.

References:

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[2] Wahr et.al(1998) J. Geophys. Res., 1998, 103(12),30205–30229

[3] Becker et.al (2011) Hydrology and Earth system science 15,533-546.