

EOF and SSA analyses of hydrological time series to assess climatic variability and land-use effects: a case study in the Kabini River basin of South India

Y. JAVEED¹, M. SEKHAR¹, S. BANDYOPADHYAY² & S. MANGIAROTTI³

¹ *Department of Civil Engineering, Indian Institute of Science, Bangalore 560 012, India*
muddu@civil.iisc.ernet.in

² *EOS, Indian Space Research Organisation, Bangalore, India*

³ *LMTG, Univ. Toulouse, CNRS IRD OMP, 14 avenue E. Belin, F-31400 Toulouse, France*

Abstract In the last two decades, significant changes have taken place in the semi-arid areas of the Kabini River basin (an area of 10 000 km² and a sub-basin of Cauvery River basin) in the south of India on the use of groundwater for irrigation. Depletion of water tables due to over-extraction of groundwater has become a critical issue in some parts of these areas. However, the impacts are found to be non-uniform across the region due to the heterogeneity in terms of aquifer characteristics of the hard-rock system, spatio-temporal pumping patterns of micro-scale land parcels, variations in the soil types and in addition the spatial variability of the recharge. Empirical orthogonal functions (EOF) have been applied to analyse the spatial and temporal signatures of the behaviour of the rainfall and the groundwater in 66 piezometers monitored during the last three decades in the semi-arid zone of the Kabini River basin. The approach helped in delineating the non-uniform spatial clusters in the groundwater system resulting due to the various factors discussed above. Singular spectrum analysis was applied to study the rainfall, streamflows and groundwater levels in the system to comprehensively analyse the climatic and anthropogenic effects on the regional system. The respective roles of climatic and land use changes on the groundwater recharge and discharge components are simulated using the CRD model, which illustrates its utility for the sustainable development of the groundwater system under a changing hydro-climatic scenario.

Key words time series; EOF; SSA; groundwater; CRD model; climatic variability; land use changes