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Discussions

Distributive rainfall/runoff modelling to determine runoff to baseflow proportioning and its impact on the determination of the ecological reserve

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Abstract

River systems that support high biodiversity profiles are conservation priorities world-wide. Understanding river eco-system thresholds to low flow conditions is important for the conservation of these systems. While climatic variations are likely to impact the streamflow variability of many river courses into the future, understanding specific river flow dynamics with regard to streamflow variability and aquifer baseflow contributions are central to the implementation of protection strategies. While streamflow is a measurable quantity, baseflow has to be estimated or calculated through the incorporation of hydrogeological variables. In this study, the groundwater components within the J2000 rainfall/runoff model were distributed to provide daily baseflow and streamflow estimates needed for ecological reserve determination. The modelling approach was applied to the RAMSAR-listed Verlorenvlei

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estuarine lake system on the west coast of South Africa which is under threat due to agricultural expansion and climatic fluctuations. The sub-catchment consists of four main tributaries, the Krom Antonies, Hol, Bergvallei and Kruismans. Of these, the Krom Antonies tributary was initially presumed the largest baseflow contributor, but was shown to have significant streamflow variability, attributed to the highly conductive nature of the Table Mountain Group sandstones and quaternary sediments. The Bergvallei tributary was instead identified as the major contributor of baseflow. The Hol tributary was the least susceptible to streamflow fluctuations due to the higher baseflow proportion (56%), as well as the dominance of less conductive Malmesbury shales which underlie this tributary. The estimated flow exceedance probabilities indicated that during the wet cycle (2007-2017) the average inflow supported the evaporative demands if the lake was at 40 % capacity, while during the dry cycle (1997-2008), only 15 % of the lake's capacity would be met. The exceedance probabilities estimated in this study suggest that inflows from the four main tributaries are not enough to support the lake during dry cycles, with the evaporation demand of the entire lake being met only 38 % of the time. This study highlighted the importance of low occurrence events for filling up the lake, allowing for regeneration of lake supported ecosystems. While the increased length of dry cycles are likely to result in the lake drying up more frequently, it is important to ensure that water resources are not overallocated during wet cycles, hindering ecosystem regeneration and prolonging the length of these dry cycle conditions.