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Interaction between riparian phreatophytes, alluvial aquifers and channel processes

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The interplay of vegetation patterns, alluvial aquifer water balances and channel processes during floods was investigated in a large-scale semi-arid basin with crystaline basement (Buffelsrivier/SA). The evaporation from phreatophytic vegetation in alluvial aquifers was desribed using an adaptive individual-based model of tree proliferation coupled to numerical surface flow and groundwater models. The application of this individual-based model approach revealed the adaptive behaviour of the ecohydrological system and allowed a determination of regional actual evaporation. Only specific patterns of tree distribution and density, resulting from an adaptive process of proliferation and dying, stabilized the groundwater flow system close to the range of observed groundwater levels. While groundwater depth and lateral flow control the distribution of tamarisk and acacia vegetation, the phreatophytes regulate water levels and the flow system. Indirect recharge from floods responds to the available storage resulting from such interaction. The opposition of these processes constitutes an adaptive ecohydrological system that could not be modelled adequately in previous investigation steps using non-adaptive approaches.