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Surface water / groundwater interactions and their spatial variability, an example from the Avon River, South-East Australia

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Understanding the interaction between river water and regional groundwater has significant importance for water management and resource allocation. The dynamics of groundwater/surface water interactions also have implications for ecosystems, pollutant transport, and the quality and quantity of water supply for domestic, agriculture and recreational purposes.

After general assumptions and for management purposes rivers are classified in loosing or gaining rivers. However, many streams alternate between gaining and loosing conditions on a range of temporal and spatial scales due to factors including: 1) river water levels in relation to groundwater head; 2) the relative response of the groundwater and river system to rainfall; 3) heterogeneities in alluvial sediments that can lead to alternation of areas of exfiltration and infiltration along a river stretch; and 4) differences in near river reservoirs, such parafluvial flow and bank storage. Spatial variability of groundwater discharge to rivers is rarely accounted for as it is assumed that groundwater discharge is constant over river stretches and only changes with the seasonal river water levels. Riverbank storage and parafluvial flow are generally not taken in consideration. Bank storage has short-term cycles and can contribute significantly to the total discharge, especially after flood events.

In this study we used hydrogeochemistry to constrain spatial and temporal differences in gaining and loosing conditions in rivers and investigate potential sources. Environmental tracers, such as major ion chemistry, stables isotopes and Radon are useful tools to characterise these sources.

Surface water and ground water samples were taken in the Avon River in the Gippsland Basin, Southwest Australia. Increasing TDS along the flow path from 70 to 250 mg/l, show that the Avon is a net gaining stream. The radon concentration along the river is variable and does not show a general increase downstream, but isolated peaks in some areas instead. Radon concentrations are in general low (under 0.5 Bq/l), but rise significantly when groundwater discharges to the river (up to 3 Bq/l).

By using high resolution radon mapping with a water-air-gas-exchanger in combination with EC mapping on a boat we were able to show that groundwater discharge to the river is diffuse on river reaches of about 1 km length where it occurs. The discharge areas are along large alluvial riverbed deposits and are likely to be a mixture of local groundwater and parafluvial flow.

High resolution radon mapping has only been used in coastal areas and this is the first study where the method was applied to river systems.