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Groundwater recharge quantification from historical rainfall records and salinity profiling in the RAMSAR listed Verlorenvlei catchment

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The Verlorenvlei RAMSAR listed wetlands are a fresh water estuarine system thought to be fed from the Verlorenvlei River. The Verlorenvlei River however has its source in the semi-arid hinterland and salinisation of groundwater in this region is a concern for the long term health of the wetlands. Analysis of drainage patterns indicate that the main input sources to the wetlands are the Krom Antonies, Hol, Bergvallei, and Kruismans rivers which are all tributaries of the Verlorenvlei River. However, given the very low rainfall in the catchment (less than 300 mm/yr) and the lack of surface water throughout much of the year, the possibility exists that the Verlorenvlei wetlands are fed by deeper groundwater. In this study, stable isotopes and hydrochemistry are used to evaluate the recharge to these groundwater systems and to assess the interaction with surface water that is known to be saline (average EC 472 µS/m). These results can be compared to longer-term rainfall records (since the 1960's) to predict future fluctuations in groundwater availability.

Analysis of historical rainfall records suggests that the Krom Antonies River which sits in the Moutonshoek catchment is the primary recharge location for the Verlorenvlei [1]. Groundwater hydrochemistry in this catchment indicates that it is the least saline groundwater feeding into the Verlorenvlei, with EC levels averaging 127 µS/m, comparable to shallow water in the tributary itself. Whilst deep groundwater in the Hol and the Kruismans sub-catchments are still relatively fresh (EC average 248 µS/m and 94 µS/m respectively), the equivalent shallow water in the individual tributaries is significantly more saline. This is consistent with stable isotopes which show a strong evaporation trend in surface water but much less of an evaporation effect in the deeper groundwater. The Hol River is an exception where evaporation trends are seen in both deep ground and surface water. These evaporation trends correlate with the higher EC values in the deep groundwater (average 248 µS/m) as well as surface water (average 761 µS/m).

In order to estimate recharge, eight rainfall collection points have been established in the Verlorenvlei catchment, and four sampling trips have been completed. The main recharge estimation techniques utilised are chloride mass balance (CMB) and stable isotopes in rain and ground water, with time constraints provided by Tritium and radiocarbon. The use of CMB to determine annual groundwater recharge for a particular catchment requires a minimum of one year of data, with rainfall and groundwater sampling commencing in June 2015. Consideration also needs to be given to the input of chloride derived from the dissolution of salts in the soil and rock mass. Stable isotope displacement (as a comparative study between rain and groundwater) will prove to be a powerful recharge estimation tool along with CMB, although care will be taken to note the sensitivities of the method to moisture fluxes of

less than 10 mm/y [2]. Continued monitoring will take place on a monthly basis, with the installation of rainfall collectors on the Moutonshoek mountain range for isotope collection, as well as the installation of pressure transducers in open boreholes.

References:

[1] CSIR (2009) Report prepared for the C.A.P.E. Estuaries Programme
[2] Xu Y and Beekman H (2003) In: *Groundwater Recharge in Southern Africa*: UNESCO Paris, 33-49