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Chloride deposition in rainfall to estimate regional groundwater recharge in Africa

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Determining groundwater recharge is critical, particular in arid and semi-arid environments where water resources are seasonal and groundwater is heavily relied upon. An effective method for determining groundwater recharge is the chloride mass balance (CMB) method. Globally, numerous studies have applied the technique to determine long-term recharge estimates to groundwater aquifer systems and to evaluate the resources potential for development. The application of the method is not without a list of assumptions and it is therefore necessary to understand and constrain the input variables, in particular, the value used for chloride fallout. In the African sub-continent large variations in rainfall amount and seasonal rainfall patterns can have a considerable impact on the chloride atmospheric deposition and therefore the use of short-term records of only a few values can result in significant recharge error estimates. A large component of chloride may also be lost via surface runoff, which ultimately impacts the calculated recharge value as well. As part of the UpGro Consortium Project- Hidden Crisis: unravelling current failures for future success in rural groundwater supply, we have developed and installed simple rainfall collectors at sites across Malawi, Uganda and Ethiopia, to provide input data for recharge estimation. We have also undertaken a detailed review of all of the available published literature where chloride concentrations in rainfall has been measured for a period for at least one or more year's duration across the African sub-continent to develop a regional map of chloride deposition in rainfall. Datasets with less than one year's record were excluded as the measurement is unlikely to represent the annual average. Rivers and streams will also be sampled to estimate chloride loss in runoff. Fieldwork for this project is being conducted by in-country researchers from the local universities in conjunction with a number of 'community researchers' who regularly monitor the rainfall collectors. The information gathered from these collectors together with groundwater data from over 550 hand pump boreholes that were sampled in field survey 1 of the project will be used to estimate groundwater recharge and compared to other studies that have been conducted in Africa. Improving our knowledge and understanding of the spatial and temporal variability in the chloride atmospheric deposition that is used to estimate recharge can contribute to the evaluation of groundwater aquifer systems which are heavily relied upon for water supply and their resilience to changing climatic conditions and resource development.