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Water Balance Modelling in a Semi-Arid Environment Using Remote Sensing, Lake Manyara, East African Rift, Tanzania

Dorothea Deus (1,3), Richard Gloaguen (1), and Peter Krause (2)

(1) TU Bergakademie Freiberg, Geology, Remote Sensing Group, Freiberg(Sach), Germany (dorothd@gmail.com, +493731393599), (2) TLUG, Abteilung 5 – Wasserwirtschaft–Referat 51. Gewässerkundlicher Landesdienst, Hochwassernachrichtenzentrale. Göschwitzer Str. 41, 07745 Jena, (3) Department of Geomatics, School of Geospatial Sciences and Technology (SGST), Ardhi University, Dar es Salaam, Tanzania

We estimate the water balance in a semi-arid environment with limited in situ data by using a remote sensing approach. We use a semi-distributed hydrological model fed with remote sensing data to study the spatial and temporal variability of water balance parameters within the catchment. Satellite gravimetry GRACE data is used to verify the trends of the inferred lake level changes. The results show that the lake undergoes high spatial and temporal variations, characteristic of a semi-arid climate with high evaporation and low rainfall. We observe that the Lake Manyara water balance and GRACE equivalent water depth show comparable trends; a decrease after 2002 followed by a sharp increase in 2006-2007. Our modelling confirms the importance of the 2006-2007 Indian Ocean Dipole fluctuation in replenishing the groundwater reservoirs of East Africa. We therefore demonstrate that water balance modelling can be performed accurately using remote sensing data even in complex climatic settings. Despite the small size of Lake Manyara, GRACE data are useful and thus show great potential for hydrological research on smaller un-gauged lakes and catchments in semi-arid environments.