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Evaporation over fresh and saline water surfaces

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Evaporation over large water bodies has a crucial role in the global hydrological cycle. Evaporation occurs whenever there is a vapor pressure deficit between a water surface and the atmosphere, and the available energy is sufficient. Salinity affects the density and latent heat of vaporization of the water body, which reflects on the evaporation rate. Different models have been developed to estimate the evaporation process over water surfaces using earth observation data. Most of these models are concerned with the atmospheric parameters. However these models do not take into account the influence of salinity on the evaporation rate; they do not consider the difference in the energy needed for vaporization. For this purpose an energy balance model is required.
Several energy balance models that calculate daily evapotranspiration exist, such as the surface energy balance system (SEBS). They estimate the heat fluxes by integration of satellite data and hydro-meteorological field data. SEBS has the advantage that it can be applied over a large scale because it incorporates the physical state of the surface and the aerodynamic resistances in the daily evapotranspiration estimation. Nevertheless this model has not used over water surfaces.
The goal of this research is to adapt SEBS to estimate the daily evaporation over fresh and saline water bodies. In particular, 1) water heat flux and roughness of momentum and heat transfer estimation need to be updated, 2) upscaling to daily evaporation needs to be investigated and finally 3) integration of the salinity factor to estimate the evaporation over saline water needs to be performed.
Eddy covariance measurements over the Ijsselmeer Lake (The Netherlands) were used to estimate the roughness of momentum and heat transfer at respectively 0.0002 and 0.0001 m. Application of these values over Tana Lake (freshwater), in Ethiopia showed latent heat to be in a good agreement with the measurements, with RMSE of 35.5 Wm-2and rRMSE of 4.7 %. Afterwards the validity of salinity adapted model was tested over different study areas using ECMWF data. It was found that for the original SEBS model and salinity-adapted model over Great Salt Lake, the RMSE were 0.62 and 0.24 mm respectively and the rRMSE 19% and 24%. The evaporation reduction of the Great Salt Lake and the oceans are 27% and 1 %, respectively. In conclusion, SEBS model is adapted to calculate the daily evaporation over fresh water and salt water by integration the salinity factor in the model.