GC8-Hydro-30, updated on 20 Apr 2024
https://doi.org/10.5194/egusphere-gc8-hydro-30
A European vision for hydrological observations and experimentation

Using multiple hydrological data sources to reduce uncertainty in soil drainage modeling

Yefang Jiang[1] and the Yefang Jiang[*]
[1]Agriculture and Agri-Food Canada (yefang.jiang@agr.gc.ca)
[*]A full list of authors appears at the end of the abstract

Soil drainage flux is crucial for determining agrochemical loading and groundwater recharge. Because soil drainage is difficult to measure, it is typically predicted using soil moisture models. However, different soil moisture models have been shown to produce different drainage values although they all respected the same soil measurements well, leading to a non-uniqueness problem. To address this issue, this study used groundwater level, stream flow, and tile drainage measurements along with soil moisture data to constraint soil drainage estimation through a coupled soil and groundwater modeling framework in the Cross River watershed in Prince Edward Island, Canada. A 1D Richards equation model, LEACHM, was developed to predict soil drainage and calibrated using soil moisture data. A 3D watershed-scale MODFLOW model was built and calibrated against groundwater level data. The two models were loosely coupled using the soil drainage predicted by LEACHM as recharge. Forward coupled LEACHM and MODFLOW simulations were performed until simulated daily soil moisture, groundwater level, baseflow, and tile drainage values simultaneously matched the 2011–2014 observed values within prescribed error ranges by fine tuning the hydraulic parameters in coupled models. The coupled models were then verified using 2015–2016 data. The resulting LEACHM simulations matched the soil moisture data with less than 15% error, and MODFLOW simulations matched the groundwater level and base flow data, except for a few short periods when LEACHM overestimated soil drainage under deep snow cover. Although the timing of simulated soil drainage corresponded with the occurrence of tile drainage, the simulated soil drainage was generally higher than the tile drainage, which is considered reasonable because tiles intercept only a portion of the overall soil drainage. This exercise demonstrates that the coupled modeling respected multiple hydrological data sources instead of soil moisture alone, and thus enhanced soil moisture estimation.

Yefang Jiang: Ana Kostic; Judith Nyiraneza