

## Hydrology of the people, by the people, for the people: bringing together citizen science and hydrologic forecasting

Small streams often lack reliable hydrological data. Environmental agencies play a key role in providing such data; however, these agencies are often challenged by the growing monitoring needs and lack of funding. Given the spatial mismatch between observed data and small watersheds/headwaters, local volunteers can act as potentially valuable research partners. We examine how CrowdHydrology, a citizen science program that collects stream stage and stream temperature observations, improves a hydrologic model of the Boyne River, Michigan, USA. Volunteers provided observations at four calibration sites with different interarrival times of the observations. We tested whether stream stage and stream temperature observations (measured by volunteers) improved the performance of a Soil and Water Assessment Tool (SWAT) model of the Boyne River. Observations were integrated into the model using the ensemble Kalman filter. This framework allowed us to integrate observation error, track the variability of model parameters, and simulate daily streamflow and stream temperature across the watershed. Measures of daily model performance included the Nash-Sutcliffe efficiency, modified Nash-Sutcliffe efficiency ( $E_{f-mod}$ ), refined index of agreement ( $d_r$ ), and relative bias ( $Bias$ ). For all calibration sites, estimates of streamflow improved after data assimilation compared to simulations based on initial/default SWAT parameters. Different measures of model performance emerged based on the interarrival times of the observations. Results demonstrate that observations collected by local volunteers, with a certain temporal resolution, can improve SWAT hydrological models and capture central tendency.

Avellaneda, P. M., Ficklin, D. L., Lowry, C. S., Knouft, J. H., & Hall, D. M. (2020). Improving hydrological models with the assimilation of crowdsourced data. *Water Resources Research*, 56(5), e2019WR026325.

Bio: Darren Ficklin is an associate professor in the Department of Geography at Indiana University. He received his B.S. in geological sciences at Indiana University and then went on to get his M.S. in geology at Southern Illinois University and Ph.D. in hydrologic sciences at the University of California-Davis. After completing his Ph.D., he stayed in California and completed his postdoctoral work at Santa Clara University. His current research focuses on the intersection of hydrology and climate.