Geophysical Research Abstracts
Vol. 17, EGU2015-12626, 2015
EGU General Assembly 2015

The variable value of stream level observations for model calibration in different geographic regions

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Simple runoff models with a low number of model parameters are often able to simulated catchment runoff reasonably well, but these models usually rely on model calibration, which makes their use in ungauged basins challenging. Here a dataset of 600+ gauged basins in the US was used to study how good model performances could be achieved when instead of stream flow data only stream level data would be available. The latter obviously is easier to observe and in practice several approaches could be used for such stream level observations: water level loggers have become less expensive and easier to install; stream levels will in the near future be increasingly available from satellite remote sensing resulting in evenly space time series; community-based approaches (e.g., crowdhydrology.org), finally, can offer level observations at irregular time intervals. Here we present a study where a runoff model (the HBV model) was calibrated for the 600+ gauged basins. Pretending that only stream level observations at different time intervals, representing the temporal resolution of the different observation approaches mentioned before, were available, the model was calibrated based on these data subsets. Afterwards the simulations were evaluated on the full observed stream flow record. The results indicate that stream level data alone already can provide surprisingly good model simulation results in humid catchments, whereas in arid catchments some form of quantitative information (stream flow observation or regional average value) is needed to obtain good results. These results are encouraging for hydrological observations in data scarce regions as level observations are much easier to obtain than stream flow observations. Based on runoff modeling it might be possible to derive stream flow series from level observations using loggers, satellites or community-based approaches. The approach presented here also allows comparing the value of different types of observations depending on climate and other catchment characteristics and, thus, to guide the monitoring of (previously) ungauged basins.