ABSTRACT

Satellite-based precipitation estimates (SPEs) provide real-time and fine spatio-temporal precipitation data at the global level. SPEs, however, might differ from ground-based gauge observations since they are indirect estimates of precipitation. When passed through a hydrological model, the error in SPEs may propagate into the streamflow, and thereby limit its utility for hydrological applications. This thesis aims to quantify the sources of error, examine its hydrological utility and explore the dynamics of propagation of error from SPEs to streamflow simulations through the hydrological model. SPEs are evaluated with reference to gauge-based precipitation measurements which often are considered as ground-truth. Given there are multiple gauge-based precipitation datasets over India, we first examined the differences in their development algorithms and investigated their variability in representing monsoon spell characteristics. Next, we developed an improved error decomposition approach to detect the sources of error in SPEs introduced at different stages of the satellite precipitation retrieval process. We proposed an improved Split-Hit Error Decomposition Scheme (SHEDS) for SPEs that disintegrates total bias into over-hit (*OH*), under-hit (–*UH*), missed (–*M*), and false components (*F*). Furthermore, we expanded the conventional contingency table by categorising hit events as over-hit, true-hit, and under-hit based on observed and satellite rainfall event detection and magnitude. Next, we proposed two bias correction methods, one correcting the SPEs conjointly in frequency and time domains, and the other an extremely fast machine learning approach. We evaluated the hydrological utility of SPEs by feeding them (raw as well as bias corrected) into a hydrological model and thereafter, compared the simulated streamflow with the observed streamflow. Lastly, we focused on understanding the dynamics of error propagation of SPEs when processed through a hydrological model. We proposed a novel CONceptual DUal-STaged (CONDUST) framework to isolate the impact of SPEs error and hydrological model errors propagating into the streamflow. SPE-to-model and model-to-streamflow error propagation factors were defined using a conceptual framework. This thesis advances the era of satellite-based precipitation measurement by enhancing its accuracy and dependability for hydrologic applications. This thesis adds to the continued validation effort of satellite-based precipitation databases across the globe. The methods proposed in this thesis are generic and can be applied over any region or any simulated/observed precipitation datasets.