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Water quantity and quality impacts in a tropical basin, Côte d'Ivoire linked to climatic variability

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Under climate change scenarios, it is clear that systematic changes in temperature and precipitation will be superimposed upon both existing climatic variability but also changing climatic variability. Whilst possible climate futures and their hydrological impacts are becoming better-established, this is much less the case in tropical environments and over large spatial scales. Further, much less work has considered how such changes might propagate into processes that are known to be hydrologically-driven, such as the transfer of sediments and solutes from hillslopes to rivers and lakes. This paper has used the SWAT model to determine water quantity and quality impacts, for both current and possible climate futures for the tropic river basin "N'Zo". This is a large drainage basin (7350 km2) that feeds into the Buyo lake in the Côte d'Ivoire. At this spatial scale, effective model application has to be sensitive to the serious difficulty of assimilating large amounts of spatial data in a region that is historically data sparse. This requires close attention to be given to the uncertainities in model predictions. Here we use SWAT-CUP (the SWAT Calibration and Uncertainty Procedure) to assess, given data concerns, what is the magnitude of the change in model predictions necessary to separate climate driven signals in water quantity and quality from the uncertainty associated with model application. Given the spatial scale of the basin, the hydrological response considered is the monthly mean river flow and the water quality response, using the upon point samples of inorganic nitrate and phosphate concentrations. Model predictions are evaluated using a series of four Objective Functions. Initial sensitivity analysis was used to identify important parameters. These were then used in SWAT-CUP to automatically identifiy model parameters and their uncertainty. Prediction uncertainty was then established using a range of sampling methods as applied to these parameters. The model was also validated by comparison with data not used in the calibration. The results showed that whilst there was substantial uncertainty in both necessary data and derived model parameters, because the response time of the system was relatively low at this larger spatial scale of application, model uncertainties at shorter time and finer spatial scales tended to be smoothed and hence less signifcant at longer time and larger spatial scales. The result is that the signal of the change necessary as compared with model uncertainties was smaller than might be imagined given the uncertainties of model application at this spatial scale.