Can local information impact in SWAT catchment scenario modelling?

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Abstract: Forests are seen as important for carbon sequestration; however, increased afforested area can decrease stream flow volumes. For policy development in relation to the expansion of forestry, clear scientific advice is needed. Field monitoring techniques, such as weather stations, flow meters, groundwater and online water quality monitoring, are crucial for collecting high-resolution data at catchment sites, but are expensive and therefore limited to point and small scales. In Uruguay, a consortium of private companies and research organisations has invested in long-term forest hydrology experiments. Data from long-term experiments in forestry experimental sites are costly in time, instrumentation and maintenance. Hydrological and landscape models are important tools to integrate knowledge, such as field data, and can provide valuable information to decision-makers about the quantity and quality of water, as well as the impact of management at the catchment level.

Calibrating a physical model, such as SWAT (Arnold et al. 2012), on a single output can be problematic, due to the complexity of the processes modeled, such as plant growth and land management. Calibrating on multiple output variables can improve the real world representation. More generally, a combination of local field data and statistical methods can improve model realism, capturing the natural variability and uncertainty. However, there is limited quantification of the value of the detailed information in the final output, such as in parameter uncertainty reduction or changes in final scenarios. The aim of this study was to develop an initial workflow to test the advantages of the inclusion of detailed local experiment data in model-based decision-making at the catchment scale with focus in land use change due to afforestation.

A SWAT 2012 model was calibrated using Sequential Uncertainty Fitting algorithm (SWATCUP) (Abbaspour et al. 2015) to flow and ET data using default parameters. Subsequently the model was updated to include detailed data from small catch-ment experiments comparing grassland and pine and this was compared with the original results and parameter distributions. Initial results indicate the expected clear reduction in parameter uncertainty after inclusion of detailed data (Figure 1). However, the model currently predicts increases in flow in a scenario of increased afforested area.

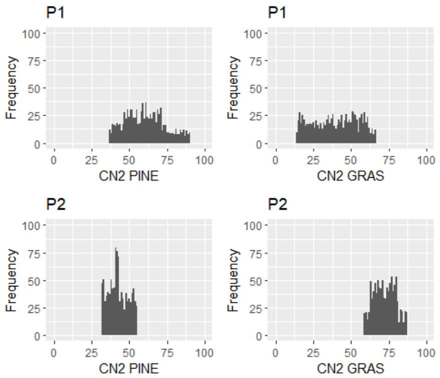

Figure 1. Distribution of estimated values for initial SCS runoff curve number for moisture condition II (CN2) for grass and pine. P1 non-updated model, P2 updated model from detailed data

As this is contradictory to field evidence and reported literature, current work concentrates on identifying the model structure limitations that creates this mismatch and additional local data and/or model structure adjustments that are needed to address this.

REFERENCES

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