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Hydrology and Earth System Sciences Discussions

Interactive comment on "Confirmation of *ACRU* model results for applications in land use and climate change studies" *by* M. L. Warburton et al.

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We thank Dr Kienzle for his valid and constructive comments. References to the recent applications of ACRU outside of the South Africa, as highlighted by Dr Kienzle in his review, have been included in Section 2, the discussion on the application of the ACRU model. The specific comments made by Dr Kienzle's are addressed under the headings given in his review.

On calibration

The ACRU model has been conceptualized and structured as an operational model to be run on catchments where streamflow data are not generally available, and for use

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with national databases of climate, soils, and land use as sources of information, in order to give acceptable results across a range of hydroclimatic regimes. Calibration is a refinement which can be undertaken on catchments with high quality streamflow data; however, few such catchments exist in the developing world or where decisions need to be taken.

For these very reasons no calibration was undertaken as this would have distorted the general applicability of the model for decision-making on ungauged catchments. The purpose of this study was to demonstrate the ability of the ACRU model to simulate under a wide range of climatic regimes and land uses using a robust method of configuration where national level datasets, and not detailed data from field visits, and widely documented experience-based default parameters were used, and thereby to demonstrate that the model would be suitable to use in extrapolation situations such as climate and land use change impact studies where observed data for calibration would not be available. Furthermore, to simply adjust model parameters, the values of which can be justified and substantiated through experience, to obtain a better simulation appears flawed to the authors when it is considered that the quality of the observed streamflow data imperfect and that the length of the observed streamflow data used was relatively short (Addressed in attached revised manuscript – Section 1).

With reference to selecting another option to calculate the potential evapotranspiration, the Hargreaves and Samani (1985) daily A-pan equivalent reference evaporation equation was the option selected because it had been shown in a comparative study by Bezuidenhout (2005) to mimic the daily values of Penman-Monteith reference evaporation better in South Africa than other methods. Additionally, this equation requires only daily maximum and minimum temperatures as inputs. As the purpose of the study was to demonstrate that the model could be used in different climatic regimes, and ultimately in climate change impact studies where most commonly only daily maximum and minimum temperatures are available, the choice of Hargreaves and Samani's (1985) daily A-pan equivalent reference evaporation equation is believed to be justified.

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The reported difference between the means is negative when the simulation is higher than the observed because the calculation was done as

((Mean observed flow - mean of simulated flow)/ (Mean observed flow))

Thus, if the simulated flows are greater the difference is a negative.

On Enhanced Evaporation Associated with Forests

Under the enhanced evaporation from forest canopies option in ACRU energy available from the potential evaporation is used to first evaporate water stored on plant's canopy from the previous day's rainfall. The amount of water stored is driven by the vegetation interception and water use coefficient values, both of which are governed crop biomass. Thus, if your subcatchment was not 100% afforested the vegetation interception and water use coefficient values would reflect this. For the purposes of this study, those land use units assigned to commercial forestry were assumed to be 100% afforested with the ACRU vegetation values input accordingly.

On Crop Coefficients

The term crop coefficient in the attached revised manuscript has been changed to "water use coefficient", which makes the term more applicable to the range of vegetation types present within the catchments under consideration in the study.

On Reported Numerical Values

Reported numerical values decimal places have been revised according to the reviewer's suggestions in the attached revised manuscript.

On Land Cover Information

The authors agree with the reviewer that a large component of the ease of use in South Africa of the ACRU model lies in the databases that have been developed to support it, not only in terms of values for vegetation variables, but also South African soils information, rainfall and temperature databases. This does not detract, however, from

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using ACRU elsewhere in the world – it only means that users might have to search for the relevant climate, soils and land cover data and “translate” it into ACRU compatible input.

On Delineating Modelling Units

The cascading flow routing is necessary for the dams/reservoirs within each subcatchment. If no cascading flow routing had been used, the areas contributing to the reservoir inflows would be incorrect and would affect the catchment water balance as well as any irrigation taking place from the reservoirs.

On Simulation Results

The statement made by the authors on the Nash Sutcliffe coefficient has been strengthened according to the suggestions made by the reviewer (attached revised manuscript).

Technical Corrections

The technical corrections given by Dr Kienzle are included in the attached revised manuscript.

References

Bezuidenhout, C. N.: Development and Evaluation of Model-Based Operational Yield Forecasts in the South African Sugar Industry, Ph.D. thesis, School of Bioresources Engineering and Environmental Hydrology, University of KwaZulu-Natal, South Africa, 137 pp, 2005. Hargreaves, G. H. and Samani, Z. A.: Reference crop evapotranspiration from temperature, TASAE, 1, 96–99, 1985.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/7/C3027/2010/hessd-7-C3027-2010-supplement.pdf

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