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On the Performance of Alternate Conceptual Ecohydrological Models for Streamflow Prediction

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A merging of a lumped conceptual hydrological model with two conceptual dynamic vegetation models is presented to assess the performance of these models for simultaneous simulations of streamflow and leaf area index (LAI). Two conceptual dynamic vegetation models with differing representation of ecological processes are merged with a lumped conceptual hydrological model (HYMOD) to predict catchment scale streamflow and LAI. The merged RR-LAI-I model computes relative leaf biomass based on transpiration rates while the RR-LAI-II model computes above ground green and dead biomass based on net primary productivity and water use efficiency in response to soil moisture dynamics. To assess the performance of these models, daily discharge and 8-day MODIS LAI product for 27 catchments of 90 – 1600km2 in size located in the Murray – Darling Basin in Australia are used. Our results illustrate that when single-objective optimisation was focussed on maximizing the objective function for streamflow or LAI, the other un-calibrated predicted outcome (LAI if streamflow is the focus) was consistently compromised. Thus, single-objective optimization cannot take into account the essence of all processes in the conceptual ecohydrological models. However, multi-objective optimisation showed great strength for streamflow and LAI predictions. Both response outputs were better simulated by RR-LAI-II than RR-LAI-I due to better representation of physical processes such as net primary productivity (NPP) in RR-LAI-II. Our results highlight that simultaneous calibration of streamflow and LAI using a multi-objective algorithm proves to be an attractive tool for improved streamflow predictions.