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A pre-calibration approach to selecting optimum inputs for hydrological models in data-scarce regions: a case study in Jordan

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This study reports a pre-calibration methodology to select optimum inputs to hydrological models in dryland environments, demonstrated on the semi-arid Wala catchment, Jordan (1743 km^2). The Soil and Water Assessment Tool (SWAT) is used to construct eighteen model scenarios combining three land-use, two soil and three weather datasets spanning 1979 - 2002. Weather datasets include locally-recorded precipitation and temperature data and global reanalysis data products. Soil data comprise a high-resolution map constructed from national soil survey data and a significantly lower-resolution global soil map. Landuse maps are obtained from global and local sources; with some modifications applied to the latter using available descriptive landuse information. Variability in model performance arising from using different dataset combinations is assessed by testing uncalibrated model outputs against discharge and sediment load data using r^2, Nash-Sutcliffe Efficiency (NSE), RSR and PBIAS. A ranking procedure identifies best-performing input data combinations and trends among the scenarios. In the case of Wala, Jordan, global weather inputs yield considerable improvements on discontinuous local datasets; conversely, local high-resolution soil mapping data perform considerably better than globally-available soil data. NSE values vary from 0.56 to -12 and 0.79 to -85 for best and worst-performing scenarios against observed discharge and sediment data respectively. Full calibration remains an essential step prior to model application. However, the methodology presented provides a transparent, transferable approach to selecting the most robust suite of input data and hence minimising structural biases in model performance arising when calibration proceeds from low-quality initial assumptions. In regions where data are scarce, their quality is unregulated and survey resources are limited, such methods are essential in improving confidence in models which underpin critical water and land resource management decisions.