Spatially distributed modeling of the Colorado River basin: Calibration of the variable infiltration capacity (VIC) model using a Genetic Algorithm

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Abstract. The variable infiltration capacity (VIC) model is a spatially semi-distributed macro-scale hydrologic model that solves full water and energy balances between the land surface and the atmosphere and includes algorithms for shallow subsurface (frozen and unfrozen) moisture in three soil layers, separate surface runoff and baseflow responses, snow accumulation and melt, spatially and temporally varying leaf area indices, lake and wetland dynamics. Additionally, the model accounts in a probabilistic manner for sub-grid variability in land cover and topography, moisture and energy fluxes, land surface vegetation classes, and soil moisture storage capacity. With tremendous flexibility in parameterizing each cell of the model is the difficulty in efficient model calibration. Each soil layer includes 42 parameters, and each vegetation tile includes 55 parameters. This discussion includes the development of the spatially distributed model in GIS and delineating basins with large cell sizes in the Colorado River Basin. This is followed by the determination of three fitness functions used to assess model performance, selection of the parameters used to optimize the fitness function, and a brief discussion of the real-coded NSGAII genetic algorithm. Fitness functions are used to create non-dominated sets of solutions leading to increased fitness (*i.e.,* improved calibration to observed hydrographs). Finally, the results of the model and interpretation of the pareto-optimal front will be discussed while considering implications of certain limiting assumptions.