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The benefits of temporally and spatially distributed information on the fidelity of a physically-based hydrological model

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Distributed, process-based hydrological models seek to achieve realistic representations of model states and fluxes. This requires information on the spatial distribution of meteorological forcings and soil information. To accomplish this, hydrologists need to make several decisions regarding the spatial and temporal model configurations. In this study, we explore the marginal benefits of distributing such information - in space and time - on hydrologic model fidelity. We address this issue in the context of water resources in Chile, within a multi-institutional project focused on characterizing the water balance across the country under historical and future climatic conditions.

We implement the Variable Infiltration Capacity (VIC) hydrological model in 85 near-natural catchments across continental Chile (18°-43° S), spanning a myriad of physiographic characteristics and hydroclimatic regimes. We test several model configurations that include different spatial – gridded versus lumped, with or without elevation bands – and temporal – 3h or daily-step – resolutions. The models are calibrated by maximizing the Kling-Gupta efficiency (KGE) criterion - computed with daily streamflow - through the adjustment of 14 parameters using the Shuffled Complex Evolution (SCE-UA) algorithm. We assess the different model configurations by, verifying daily streamflow simulations along with other relevant state variables such as snow water equivalent (SWE) and soil moisture. Preliminary results suggest that spatially lumped model configurations provide better streamflow simulations (i.e. KGE values), but inconsistent catchment-scale time series of SWE. Ongoing work is oriented to explore potential links between benefits in model configurations and catchment similarities.