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Topography and Vegetation Controls of the Hydrological Responses in a Semi-Arid Forested Headwater Catchment

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Solar radiation is the driving force for terrestrial ecohydrological processes. In mountainous regions, solar radiation reaching the land surface is strongly affected by topographic conditions (e.g., terrain slope and aspect) resulting in unevenly distributed solar radiation. This further affects ecohydrological processes including evapotranspiration, snowmelt, and runoff. However, most distributed hydrological models directly use measured or directly interpolated (e.g. IDW) solar radiation as inputs, not accounting for the topographic effects on solar radiation distribution. In this study, we first implemented a solar radiation spatial interpolation scheme to a fully integrated catchment-scale ecohydrological model by taking into account the topographic effects on direct (shading), diffuse (scattering) and reflected solar radiation. The resulting spatial distribution is more realistic than the direct interpolation. We applied the scheme to Gordon Gulch in Colorado, U.S, a mountainous catchment at different spatial resolutions. We will present some modeling results to show the topographic effects on solar radiation distribution, snow mass, vegetation growth, and runoff production, as well as the model sensitivity to modeling resolutions.