Sensitivities of subgrid-scale physics schemes, meteorological forcing, and topographic radiation in atmosphere-through-bedrock integrated process models: A case study in the Upper Colorado River Basin

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Supplementary Material:

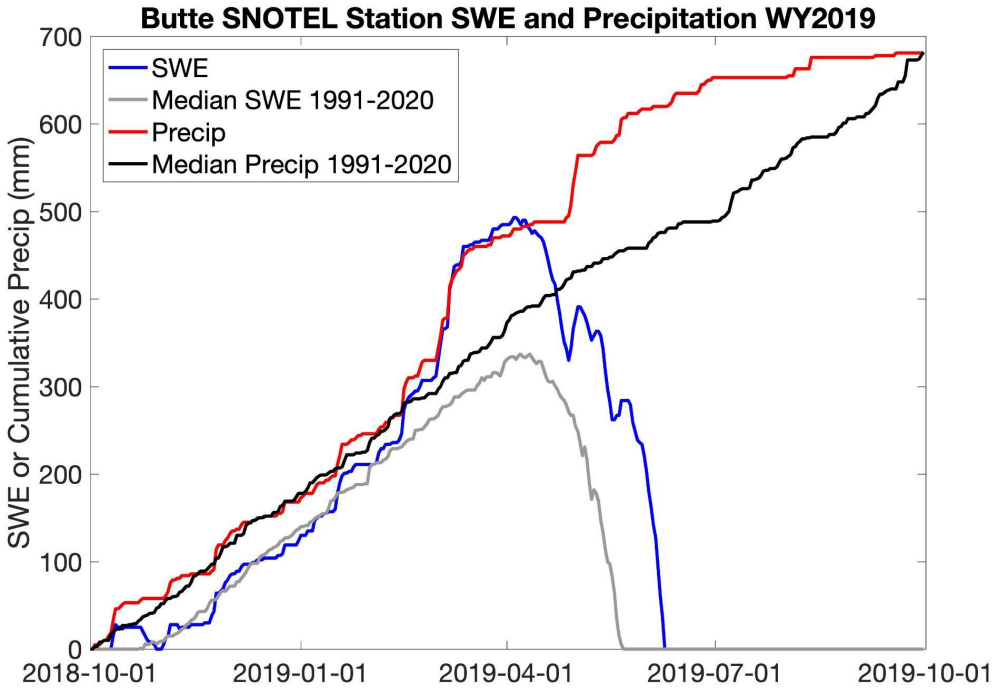

Figure S-1: Water Year 2019 precipitation and SWE measurements at the Butte SNOTEL station (38.89N, 106.95W) relative to the 1991-2020 climate normal.

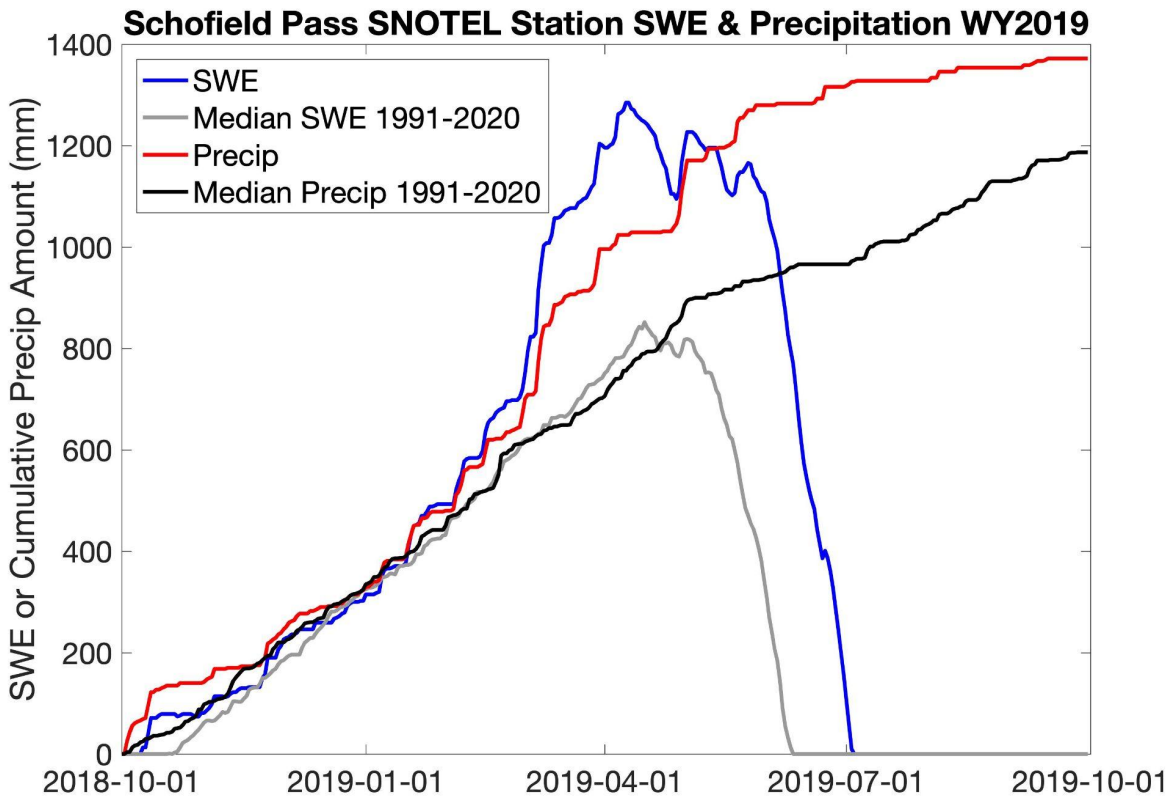

Figure S-2: Water Year 2019 precipitation and SWE measurements at the Schofield Pass SNOTEL station (39.02N, 107.05W) relative to the 1991-2020 climate normal.

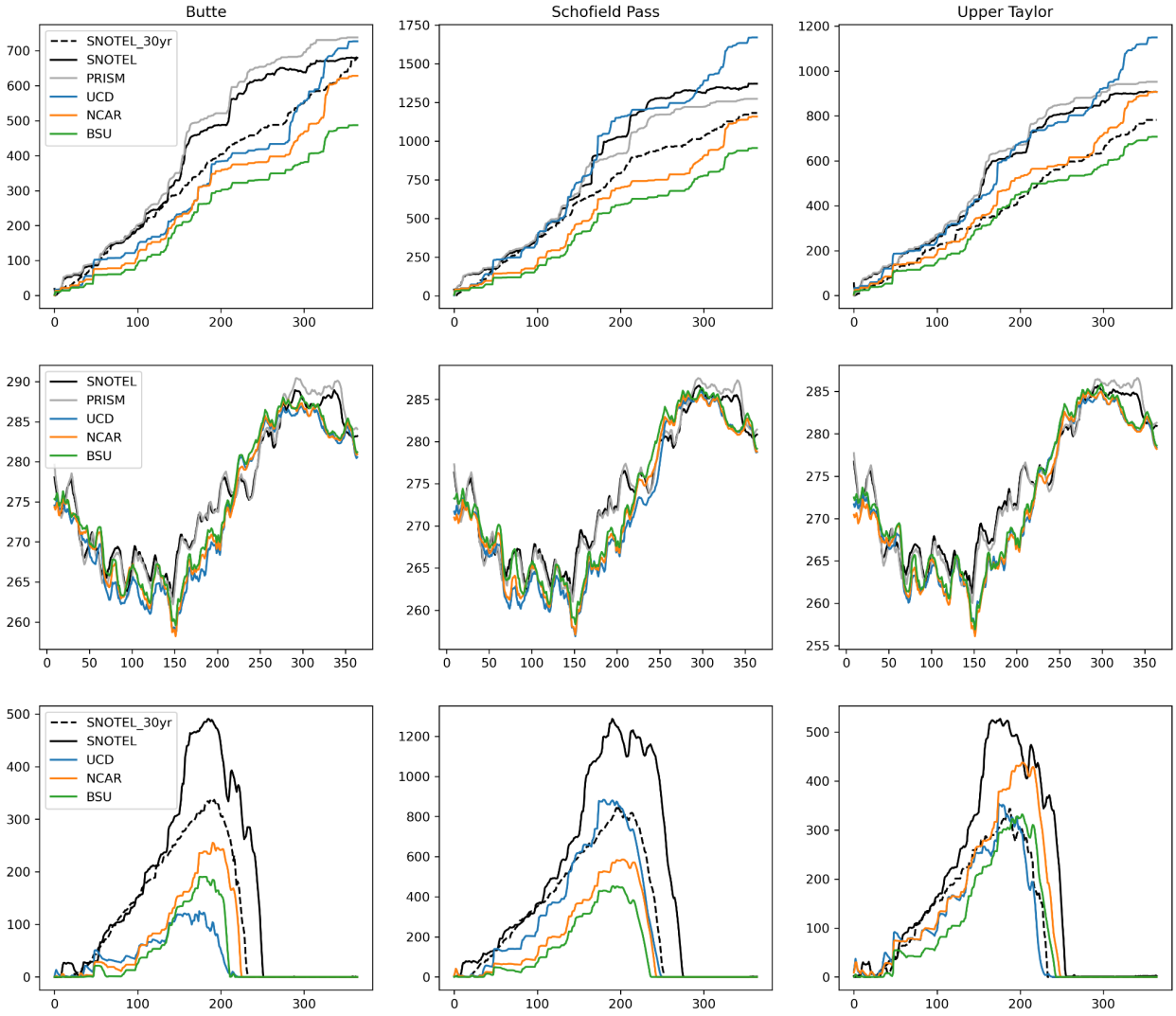

Figure S-3: Water Year 2019 precipitation, two-meter surface air temperature, and snow water equivalent (SWE) of WRF simulations across different subgrid-scale physics schemes against SNOTEL station measurements at Butte, Schofield Pass, and Upper Taylor. SNOTEL_30yr is the median accumulated precipitation and snow water equivalent (1990-2020). X-axis are days after Oct 1, 2018 (beginning of WY2019).

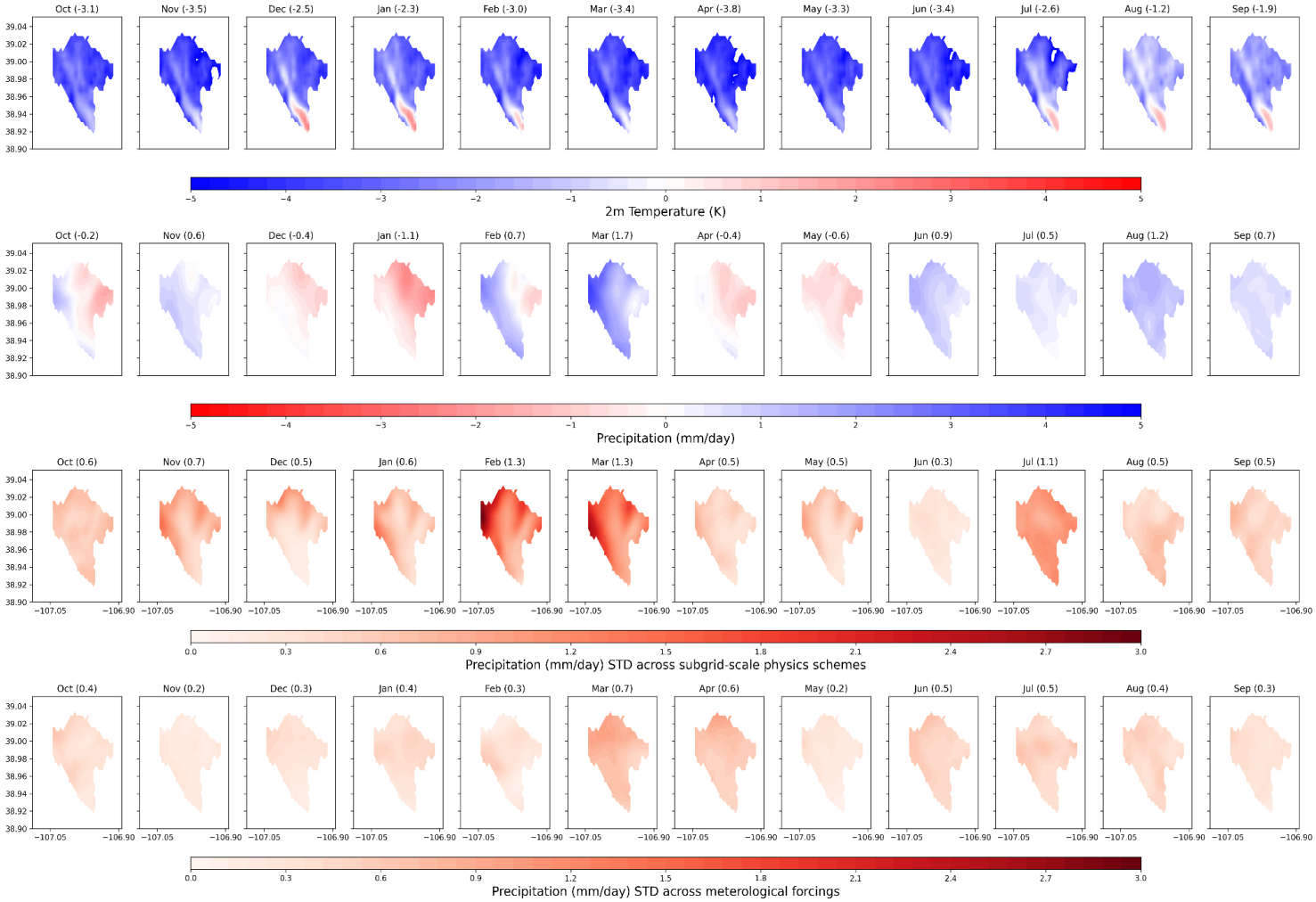

Fig S-4: Spatial distributions of monthly precipitation and average two-meter surface air temperature over the ERW across WRF simulations conducted with different subgrid-scale physics schemes and meteorological forcings. Differences between BSU-CFSR2 and PRISM (BSU-CFSR2 minus PRISM) are shown on the top two rows.

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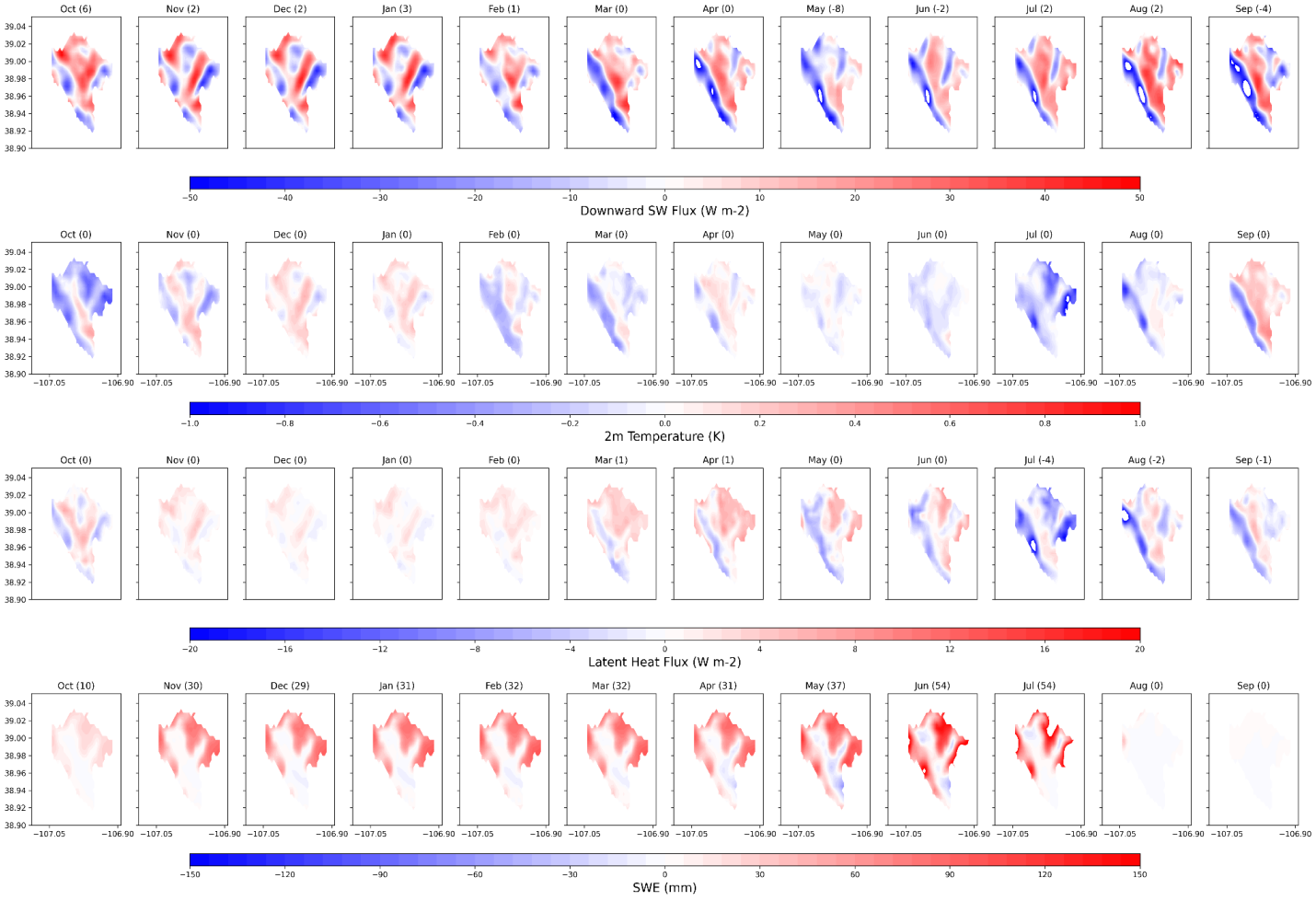

Fig S-5. Topographic radiation differences (3dRad minus 3dRad_off) in monthly average two-meter surface air temperature, downward shortwave (SW) flux, latent heat flux and snow water equivalent (SWE) over the ERW across the BSU-CFSR2 simulations with topo_shading on/off.

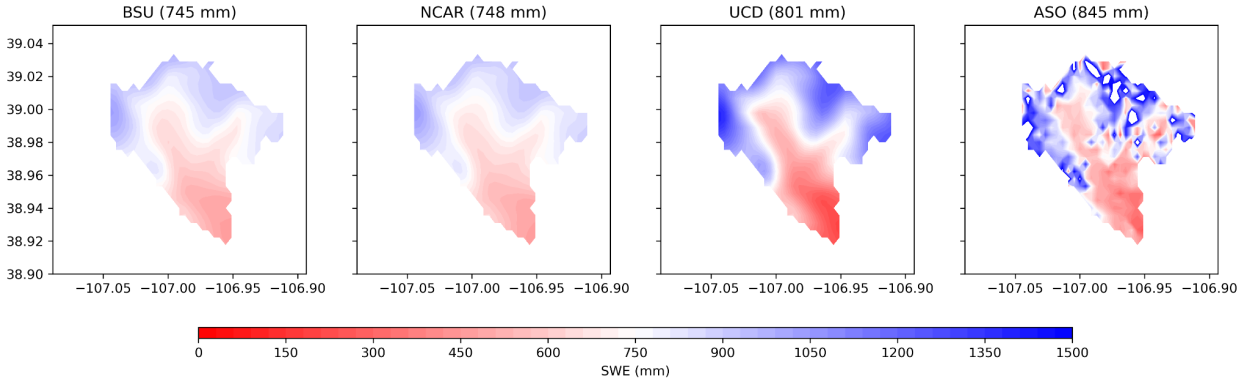

Fig. S-6 Snow water equivalent (SWE) estimates across different subgrid-scale physics schemes using the CFSR2 as the meteorological forcing and their comparison with ASO LiDar measurements on April 07, 2019. The white regions in the ASO plots represent regions that are greater than 1500 mm and may be associated with data quality issues around the ridgelines of mountains (Deems et al., 2013).