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Spatial variability of shortwave radiative fluxes in the context of snowmelt

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Snow-covered mountain ranges are a major source of water supply for run-off and groundwater recharge. Snowmelt supplies as much as 75% of surface water in basins of the western United States. Factors that affect the rate of snow melt include incoming shortwave and longwave radiation, surface albedo, snow emissivity, snow surface temperature, sensible and latent heat fluxes, ground heat flux, and energy transferred to the snowpack from deposited snow or rain. The net radiation generally makes up about 80% of the energy balance and is dominated by the shortwave radiation. Complex terrain poses a great challenge for obtaining the needed information on radiative fluxes from satellites due to elevation issues, spatially-variable cloud cover, rapidly changing surface conditions during snow fall and snow melt, lack of high quality ground truth for evaluation of the satellite based estimates, as well as scale issues between the ground observations and the satellite footprint. In this study we utilize observations of high spatial resolution (5-km) as available from the Moderate Resolution Imaging Spectro-radiometer (MODIS) to derive surface shortwave radiative fluxes in complex terrain, with attention to the impact of slopes on the amount of radiation received. The methodology developed has been applied to several water years (January to July during 2003, 2004, 2005 and 2009) over the western part of the United States, and the available information was used to derive metrics on spatial and temporal variability in the shortwave fluxes. It is planned to apply the findings from this study for testing improvements in Snow Water Equivalent (SWE) estimates.