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Record-setting forest stress in the Rocky Mountains caused by low snowfall and high potential evapotranspiration, consistent with expected future conditions

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Projections of future climate for the Southwestern U.S. and other semi-arid regions globally include reductions in mountain snow accumulation and increased summer potential evapotranspiration. These changes may significantly alter runoff production, evapotranspiration, and gross primary productivity in mountain forests. Analysis of remotely sensed vegetation greenness data indicate strong forest and understory growth dependencies associated with snow accumulation and snowmelt with peak snow water equivalent explaining 40-50% of inter-annual variability in forest greenness in the Sierra Nevada and Rocky Mountains. Examples of these dependencies will be presented based on the 2012 drought in the Southwestern US whereby near record low snow accumulation and record high potential evapotranspiration have resulted in record low forest greening as evident in the 30+ year satellite record. Forest response to aridity in 2012 was exacerbated by forest disturbance with greenness anomalies 90% greater in magnitude in Bark Beetle and Spruce Budworm affected areas versus undisturbed areas and 182% greater in magnitude in areas impacted by fire. Given potential future changes in the hydroclimatology of mountainous regions, the results of these measurements may identify tipping points regarding ecosystem responses to water availability across gradients in physiography.