Comment on “Soil Moisture Response to Snowmelt and Rainfall in a Sierra Nevada Mixed-Conifer Forest”

Bales et al. (2011) advance the understanding of soil moisture dynamics in response to water input, especially snowmelt, in the mixed conifer zone of the Sierra Nevada, California. In particular, we appreciate the authors’ conclusion that regolith deeper than 1 m is important in supporting base flow and evapotranspiration during the summer months. It is important to recognize, however, that a considerable body of knowledge relevant to these processes already exists, much of it produced by research in the Sierra Nevada.

The occurrence, distribution, and formation of soft, deeply weathered granitic rock in the Sierra Nevada was described by Wahrhaftig (1965), and the importance of this kind of regolith to forest ecosystems was addressed directly by R.J. Arkley 30 yr ago. He concluded that, “The productivity and indeed survival of the forest trees in this summer-dry climate appear to depend on moisture stored at considerable depth in fractured or decomposed rock” (Arkley, 1981). This observation has been elaborated on and refined by research conducted on granitic terrain in the Sierra Nevada and southern California mountains during the last 20 yr. Weathered granitic bedrock holds appreciable plant-available water (Jones and Graham, 1993) that is recharged by meteoric water flowing preferentially through fractures and more slowly through the matrix (Johnson-Maynard et al., 1994; Graham et al., 1997; Frazier et al., 2002). The water is extracted during the summer months by roots that are confined to joint fractures but extend several meters deep (Sternberg et al., 1996). This water stored deep within the soft bedrock is indeed crucial for the survival of forest trees during the dry summers and often supplies more total water to transpiration than does the overlying soil (Anderson et al., 1995; Hubbert et al., 2001a, 2001b; Rose et al., 2003). Reliance on bedrock-stored water can begin when the trees are 2- or 3-yr-old seedlings (Witty et al., 2003). The crucial role of mycorrhizae in transporting water from the weathered bedrock matrix to the joint-bound roots has also been documented (Egerton-Warburton et al., 2003; Bornyasz et al., 2005). An overview perspective was presented by Graham et al. (2010).

New attention to deep regolith processes from critical zone researchers of various backgrounds is exciting, promising better understanding of how rock weathers, develops porosity, transmits and stores water, and is accessed by organisms. As this exploration advances, it will be most effective if it recognizes and builds on prior research, including the abundant relevant literature in soil science journals.

References