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Groundwater-vegetation interactions in mountain meadows

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Meadows of the Sierra Nevada of California,USA, and elsewhere are groundwater dependent ecosystems. Most of the precipitation in this environment falls in the form of snow during the winter months, and almost negligible quantities of rain fall during the summer growing season. Evapotranspiration (ET) of wet meadow vegetation is typically 5-8 mm/day during this growing season; therefore, the vegetation community must rely on a shallow watertable to meet the high water demand. This direct use of groundwater by vegetation can be verified and quantified with measurements of ET-induced diel water-table fluctuations. The water requirement of a specific vegetation community can be expressed as a vegetation threshold hydrograph, which depicts the maximum water table depth as it varies over the growing season. Variably-saturated groundwater modeling is a useful tool for predicting watertable depth and when used in concert with the vegetation threshold hydrograph, can be used to predict vegetation patterning in meadow environments. However, an iterative link must be employed between the vegetation model and the groundwater flow model. For the initial run of the groundwater model, a spatial distribution of ET must be assumed. The resulting predictions of water table depth are used to predict vegetation patterning. However, once a specific spatial distribution of vegetation is predicted, the associated spatial distribution of ET must be updated and the groundwater model rerun. This iterative procedure is continued until it converges on stable groundwater flow and vegetation patterns in successive iterations. Results show that modeled vegetation patterning is consistent with observations in meadow systems.