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The challenges of predicting drought-induced forest mortality using plant hydraulic models

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Modeling forest drought-induced mortality is critical for predicting the impacts of climate change on ecosystems, natural resources, and global carbon- and water-cycles. The incorporation of mechanistic representations of how water moves through plants (i.e., plant hydraulics) in vegetation, land surface, and Earth system models has enabled estimating the degree of vascular damage that plants experience due to drought stress, with the possibility of mechanistically relating vascular stress to plant mortality. We used forest inventory data and a plant hydraulics model for predicting forest mortality across Western United States. We found that incorporating plant hydraulic model outputs of vascular damage and photosynthetic assimilation in generalized linear models and random forest models improved forest mortality predictions. Nevertheless, the variance explained by these models was relatively low. We use this study to highlight which are the challenges for predicting forest drought-induced mortality at landscape scales. We also propose future research lines that will help close existing knowledge gaps and improve mortality predictions.