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Building a hybrid drought monitor model based on U.S. Drought Monitor

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Drought is one of the costliest natural disasters, capable of causing significant losses in agriculture, economy, and ecosystems. Different definitions of drought from multiple perspectives made drought research complicate. Exploring droughts from a comprehensive perspective improves our understanding of the evolution and drivers of drought, while there are few such comprehensive studies. The establishment of the United States Drought Monitor (USDM) marks a significant milestone in the development of composite drought indices, amalgamating objective inputs with subjective evaluations from local experts. Its uniqueness lies in integrating subjective assessments from climate and water resource experts across the United States. However, due to the human subjectivity involved in creating USDM maps, its algorithms are challenging to apply beyond the United States. In this study, a Hybrid Drought Monitor Model (HDMM) was built using the random forest algorithm to predict drought categories based on USDM drought categories, input drought indices, and 10 static variables. The results indicate that during the testing phase, the overall accuracy of the 0.04° resolution HDMM reached 95%, surpassing the 91% overall accuracy at 1° resolution. Among the categories, D-1 (Normal or wet conditions) drought accuracy was the highest, while D0 (Abnormally Dry) drought accuracy was the lowest. During the validation phase, the HDMM exhibited good overall prediction of drought levels, yet spatial discrepancies existed across the continent. It performed poorly in the southwestern and northern regions, with overestimation of drought severity in many areas. Case studies of the 2017 Northern Plains Drought and the 2021 Southwestern Drought demonstrate that HDMM provided reliable drought classification and possessed good predictive capability. The HDMM can be adapted to other regions worldwide, offering a promising tool for land managers and local governments to prepare for and mitigate the impacts of drought.