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Machine Learning Methods with the Standardized VPD Drought Index to Identify and Assess Drought in the United States

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Extreme drought has a strong socio-economic impact on the human environment, especially where surface and ground water supplies are significantly reduced due to reduced stream flow, reduced hydroelectric generation, and increased ground water pumping for agricultural and human consumption. This reduction will likely increase in the future as drought is expected to increase in the United States due to global warming and climate change. However, identifying drought is problematic due to the lack of standardized classification or reliable methods for drought prediction. Recently, machine learning techniques have been applied to drought indices to identify drought features and for risk assessment. For this work, we utilize unsupervised machine learning (ML) computational algorithms to identify drought characteristics with a new drought index based on vapor pressure deficit (VPD). The Standardized VPD Drought Index (SVDI) is used to cluster points with common features to characterize spatial and temporal drought characteristics. The SVDI is calculated with the NASA's Land Surface Assimilation System (NLDAS) data from 1990-2010. Several ML cluster techniques (e.g. HMM, k_means, BIRCH, DBSCAN) are applied to the SVDI to identify known short and long term drought events. Optimized techniques will be applied to downscaled global climate models (e.g. CCSM4, GFDL-ESM2G, and HadGEM2-ES) based on the 8.5 Representative Concentration Pathway (RCP8.5). From the space-time clustering algorithm, we will extract the spatiotemporal information for each identified event as a means of determining the probability of each type of event under global warming in the future.