Evaluation of Flash Drought Identifications with Machine Learning Techniques, Part 2: Deep Learning Learning Algorithms

Drought is a climatological dry extreme that can have a number of impacts on water resources and agriculture. To mitigate impacts, many studies have focused on identifying and predicting drought events. In recent decades, machine learning (ML) has emerged as a useful tool for drought identification and prediction, and ML applications using long-term metrics can successfully identify seasonal scale droughts and have shown some skill at drought prediction. However, recent attention has demonstrated that long-term drought metrics, such as the Palmer drought severity index (PDSI) and standardized precipitation index (SPI), cannot adequately identify the rapidly developing conditions (~1 month) that characterize flash drought. Thus, studies focused on flash drought have yielded a number of indices to represent rapidly evolving conditions using precipitation, soil moisture, evapotranspiration (ET), and potential ET (PET). Further, while much work has been conducted to investigate and identify flash drought events, limited work has been completed using ML techniques. Thus, this study uses to use several datasets including the NARR, NLDAS, ERA5, and MERRA2 to identify flash drought using deep learning techniques such as artificial neural networks (NNs), convolutional NNs, and recurrent NNs with U-shaped networks favored to maintain spatial and temporal resolutions. The NNs were trained on a set of flash drought variables (soil moisture, ET, PET, and so on) and additional analyses were performed to determine how much each variable contributes toward rapid intensification and flash drought identification.