@article{Kalashnikov2024,
abstract = {Lightning is a major source of wildfire ignition in the western United States (WUS). We build and train convolutional neural networks (CNNs) to predict the occurrence of cloud-to-ground (CG) lightning across the WUS during June–September from the spatial patterns of seven large-scale meteorological variables from reanalysis (1995–2022). Individually trained CNN models at each 1° × 1° grid cell (n= 285 CNNs) show high skill at predicting CG lightning days across the WUS (median AUC = 0.8) and perform best in parts of the interior Southwest where summertime CG lightning is most common. Further, interannual correlation between observed and predicted CG lightning days is high (median r = 0.87), demonstrating that locally trained CNNs realistically capture year-to-year variation in CG lightning activity across the WUS. We then use layer-wise relevance propagation (LRP) to investigate the relevance of predictor variables to successful CG lightning prediction in each grid cell. Using maximum LRP values, our results show that two thermodynamic variables—ratio of surface moist static energy to free-tropospheric saturation moist static energy, and the 700–500 hPa lapse rate—are the most relevant CG lightning predictors for 93–96 percent of CNNs depending on the LRP variant used. As lightning is not directly simulated by global climate models, these CNNs could be used to parameterize CG lightning in climate models to assess changes in future CG lightning occurrence with projected climate change. Understanding changes in CG lightning risk and consequently lightning-caused wildfire risk across the WUS could inform fire management, planning, and disaster preparedness.},
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