@article{Labe2024a,
  abstract = {To better understand the regional changes in summertime temperatures across the conterminous United States (CONUS), we adopt a recently developed machine learning framework that can be used to reveal the timing of emergence of forced climate signals from the noise of internal climate variability. Specifically, we train an artificial neural network (ANN) on seasonally averaged temperatures across the CONUS and then task the ANN to output the year associated with an individual map. In order to correctly identify the year, the ANN must therefore learn time-evolving patterns of climate change amidst the noise of internal climate variability. The ANNs are first trained and tested on data from large ensembles and then evaluated using observations from a station-based data set. To understand how the ANN is making its predictions, we leverage a collection of ad hoc feature attribution methods from explainable artificial intelligence (XAI). We find that anthropogenic signals in seasonal mean minimum temperature have emerged by the early 2000s for the CONUS, which occurred earliest in the Eastern United States. While our observational timing of emergence estimates are not as sensitive to the spatial resolution of the training data, we find a notable improvement in ANN skill using a higher resolution climate model, especially for its early twentieth century predictions. Composites of XAI maps reveal that this improvement is linked to temperatures around higher topography. We find that increases in spatial resolution of the ANN training data may yield benefits for machine learning applications in climate science.},
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