The Effect of Atmospheric Conditions on Flash Flood Prediction Using Deep Learning

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The objective of this experiment was to determine the extent to which atmospheric conditions contribute to the onset of flash flooding. By utilizing structured deep learning, we can gain a better understanding of the complex systems that develop natural disasters by uncovering hidden dependencies. To begin this experiment, I gathered data from the GFS through the NOAA data repository. The data used was dated from January 2013 to October 2018. The .grb files which hold the GFS data were converted to geoTIFF files and then to csv files for data analysis. The data variables used were taken from multiple standard constant atmospheric pressure layers. In addition to this, data regarding flash flood occurrences for the same years were taken from the NOAA Storm Data repository and mapped to their corresponding times and approximate coordinates. To analyze the data, I utilized the fast.ai deep learning library after creating a training and testing data set in Pandas dataframes. A learner object was created and an optimal learning rate to minimize the loss function was found using gradient descent. Finally, the network's accuracy and performance were recorded after an increasing number of epochs did not add meaningful performance. To visualize the results, the mean Brier scores of 10 trials for the testing data was calculated. This model achieved a mean Brier score of 0.112. In this project, I was able to create a simple deep learning model that was able to nearly match the results of industry grade flash flood predictors. This experiment shows that the deep learning approach to rare event prediction is developing and becoming more effective as time goes on. With additional variables and data optimization, this approach could revolutionize the way we fight natural disasters.