Spatiotemporal Climate Forecasting with ConvLSTM

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Recent years, climate forecasting techniques with machine learning have been developing to get high accuracy result, unlike physical simulation that uses the techniques of ensemble mean and has already been employed by JMA (Japan Meteorological Agency) which cannot perform well for long term prediction because climate data is a very high non-linear relationship. Machine learning techniques can build a forecasting model by learning patterns from prior data while maintaining the spatial correlation that very important for climate data because the variable from one area could affect other areas. In this paper, we studied the spatial-temporal pattern of machine learning techniques can improve the forecasting result. The experiment compares 3 forecasting models. Linear regression model is a simple forecasting linear model that try to produce linear formula from the training dataset, we use this model with non-spatial correlation setup. CNN (Convolutional Neural Network) is a class of deep learning, the key idea is convolutional layer that is able to maintain spatial correlation through the network. ConvLSTM (Convolutional Long Short-Term Memory) is the improvement version of Fully Connected Long Short-Term Memory that combines convolution operator inside every gate (the control unit that measures how much information will pass through) in the memory cell; therefore, spatial correlation is preferably maintained on the arbitrary of times. We run the experiment to forecast temperature at 2 meter height of the Japan area, we used the monthly mean data of ERA-Interim dataset that started from 1979 to the present. The result has shown that ConvLSTM performs the best accuracy compares to CNN and non-spatial correlation setup linear regression model.

Keywords: Climate Forecasting, ConvLSTM, Spatial Correlation

