Air Quality monitoring and forecasting

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Motivation

- **Air pollution is one of the major issues affecting human health, plants, animals, agricultural crops, and ecosystem.**
- **Certain concentrations of substances like Particulate matter (PM 10 and PM 2.5), Gases(Nitrogen oxides, Sulphur oxides and Carbon monoxide), Radioactive materials etc. can cause adverse effects on human beings, animals and environment.**
- **Future air quality can be analyzed in terms of air pollutants and air quality index by using timeseries models. Air quality model is a significant tool in monitoring and controlling air pollutants like Carbon monoxide (CO), Particulate matter(PM 10 andPM 2.5), Sulphur dioxide (SO 2), Nitrogendioxide (NO 2), Ozone (O 3) etc. Also, some meteorological parameters (Wind,Temp etc) greatly influence the air quality.**

Data and Visualization

- I used the Air Quality Data of the year 2018 across various counties of USA for the experiment which were available at epa.gov.
- Pollutants: SO2,NO2,CO,O3,PM10 and PM2.5 . Average daily concentration of each pollutant was considered
- Meteorological factors: Wind and Temperature. Average daily wind speed and temperature were taken into consideration.
- Correlation between each and every factor has been plotted and analyzed.
- The trends of each feature were plotted with respect to time.
- Also, for a given date and given pollutant (as user input) we can visualize the concentrations across all the counties in a heat map.

Prediction Methodology

- **The prediction problem was formulated as multivariate regression problem where the target variable is one of the pollutant or meteorological factor and the feature parameters are the last 10 days' average daily data of each parameter (so a total of 8*10 parameters forecast the next day's target variable's average concentration).**
- **Due to the sequence dependencies associated with large-scale and longer time series datasets, RNNs, and in particular LSTM models, are well suited.**

Resources Used

- Python 2.7
- Jupyter notebook
- Google Map
- Keras Library for Deep model LSTM
- Bokeh plot for visualization

Conclusion and Future Work

Predicting air quality, therefore, not only involves the difficulties of weather forecasting, it also requires data on and knowledge of

- Local pollutant concentrations and emissions
- Pollutant concentrations and emissions from distant locations
- Movements and possible transformations of pollutants
- Prevailing winds

Three dimensional model:

- Three-dimensional models mathematically represent all the important processes that have an impact on outdoor air pollution levels. Three-dimensional models simulate the emission, transport, and transformation of air pollution by making use of several submodels, including:
- Emission model: Simulates the spatial distribution of emissions from both natural and human sources.
- Meteorological model: Creates a trajectory model to predict the ambient levels of pollution using the 3-D meteorological model and emissions data.
- Chemical model: Looks at the transformation of primary (emitted) pollution into secondary pollution to determine the outcome of the pollutant.15
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