Modeling and Forecasting of Urban Heat Island using \( LST \) and \( CO_2 \)

One-page Extended Abstract

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Urban heat island (UHI) is an urban region which exhibits threateningly higher temperature than its surrounding city area. This environmental phenomenon is one of the major factors to cause global warming and other climatic degradations. In this research, we are modeling the spatio-temporal trend of UHI pattern with a novel data fusion approach to forecast them in future. We consider the hike of carbon dioxide (\( CO_2 \)) and land surface temperature (\( LST \)) to be the major contributing factors for the UHI occurrence.

The correlation analysis between \( LST \) and \( CO_2 \) have been carried out to check how they are causal to each other for different study regions. This analysis has been carried out for different zones having diverse terrestrial structure in three regions, such as, Kolkata, India, Berlin, Germany, and Dallas, USA. In Figure 1, it is observed that in Dallas, USA has higher positive correlation compared to the zones in Berlin, Germany and Kolkata, India (Data source: NASA OCO-2’s column averaged \( CO_2 \) data (\( XCO_2 \)) and temperature profile data, year: 2015). It has also been observed that for different wind properties (such as, wind directions) and land use/land cover (LULC) types, the correlation and the impact of both \( LST \) and \( CO_2 \) vary in a diverse manner.

![Figure 1: Correlation analysis between \( LST \) and \( CO_2 \)](image)

In this work, after identifying the high \( LST-CO_2 \) correlated zones, the impact of \( CO_2 \) on the warmth rising of the earth surface is modeled with the inter-annual time-series data of both the primary parameters (\( LST \) and \( CO_2 \)). For the past trend analysis of UHIs, and to predict and forecast the UHIs in future, we are applying the multivariate zonal semantic kriging (SemK) based spatial interpolation method. As a result we have found that the association between \( LST \) and \( CO_2 \) enhances the prediction accuracy of UHIs in general. Furthermore, the impact of different LULC types to the occurrence of UHIs is also being investigated further to mitigate the UHI’s effect with proper urbanization and city planning.