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Prediction of Urban Heat Islands by Modeling Environmental Variables including CO_2

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Urban heat island (*UHI*) is a patch of region in the urban area where the temperature is threateningly warmer than its surrounding city area. In today's world, the increasing growth of this environmental phenomenon is one of the major threats that are causal to global warming and other climatic degradations. In our research work, we are aiming to predict and forecast the *UHI* pattern in future by modeling their past trend with a novel data fusion approach. We consider the *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 for different continents, considering zones having diverse terrestrial structure. For example, the zones in Berlin, Germany have higher positive correlations compared to the zones in 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 in-between correlation and the impact of both *LST* and CO_2 vary in a diverse manner.

In this work, after identifying the high *LST*-CO_2 correlated zones worldwide, 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 of our analysis (*LST*and CO_2). For the past trend analysis of *UHI*s, and to predict and forecast the *UHI*s in future time instances, we are applying the multivariate zonal *semantic kriging* (*SemK*) based spatial interpolation method. The *SemK* is very initial attempts in the literature of geostatistical interpolation methods which can model any significant semantic knowledge of the atmosphere/ terrain for the betterment of the prediction/ forecasting method. For example, it has inherent capability to model underlying terrain (*LULC*) properties which is another contributing factor to the *UHI*s. It can also accommodate and model any other knowledge/ influencing parameters for the prediction of the primary parameter (e.g., *UHI* in terms of *LST*).

We have found that, association between *LST* and CO_2 enhances the prediction and forecasting accuracy of *UHI*s in general. Furthermore, the impact of different *LULC* types to the occurrence of *UHI*s is also identified for diverse zones, aiming to mitigate its effect with proper urbanization and city planning in sub-city scales.