Title: Integrated Temporal-Spatial Analysis Approach to Heat-Health Dynamics in Johannesburg, South Africa and Abidjan, Cote d’Ivoire

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**Introduction**:

The HE2AT Center Research Project 2 undertakes innovative analyses of urban environments of Johannesburg and Abidjan. Intersecting health, climate, and socioeconomic data, this study aims to harmoniously blend varied data types to navigate the intricacies of these two distinct cities.

**Methods:**

Our refined approach consists of the following steps:

**1. Data Integration:**

**- Harmonization**: Consolidating data from health, climate, and socioeconomic sources to craft a multi-dimensional dataset.

**- Temporal-Spatial Dynamics**: Emphasizing the intertwining of temporal patterns with spatial factors, especially accounting for location-dependent variables like housing type.

**2. Modeling Techniques:**

- **Tree-based & Neural Methods**: Employing decision trees, random forests, Extreme Gradient Boosting, Recurrent Neural Networks, and Long Short-Term Memory Networks.

**- Statistical Models**: Engaging Generalized Additive Models and Distributed Lag Nonlinear Models.

**3. Evaluation & Validation**:

**- Advanced Validation:** Implementing k-fold cross-validation, supplemented by traditional metrics like R-squared and RMSE.

**- Heatwave Case Studies:** Harnessing historical heatwave occurrences in both cities as specific validation benchmarks.

**Limitations:**

While the project analyzes include 25-40 longitudinal study datasets, the relatively small sample size may remain challenging for some algorithms. Techniques like data augmentation and transfer learning may address this limitation, at least in part.

**Discussion:**

With its integrated approach, the project offers comprehensive insights into heat exposure and health outcomes in Johannesburg and Abidjan, emphasizing the delicate interplay of time and space.

**Conclusion:**

HE2AT Project 2 showcases methodological innovations, pioneering interdisciplinary research in African urban contexts. By synergizing diverse datasets with innovative/novel analytics, the study aims to drive knowledge advances in the field and craft transformative public health solutions.

**Title:** Proposed Methodological Framework for Temporo-Spatial Prediction of Vulnerability to Heat-Health Dynamics in Johannesburg, South Africa, and Abidjan, Côte d'Ivoire

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**Introduction:** The HEAT Center Research Project 2 outlines a methodological framework tailored for the urban landscapes of Johannesburg and Abidjan. This multidimensional approach synthesizes temporal and spatial elements of health, climate, and socioeconomic data, aiming to pinpoint areas and populations at heightened risk of heat exposures.

**Methods:** Merging health, climate, and socioeconomic data, our framework sets the stage for predictive modeling that melds temporal intricacies with spatial nuances. Convolutional Neural Networks (CNNs) serve as complementary tools for segmentation prediction, refining the spatial granularity of identified vulnerable zones.

The temporal dimension is reinforced through Gradient Boosting, Recurrent Neural Networks, and Long Short-Term Memory Networks, capturing the ebb and flow of time-dependent patterns. Generalized Additive Models and Distributed Lag Nonlinear Models add depth to the temporal analyses.

For evaluation, the framework embraces k-fold cross-validation and metrics like R-squared, RMSE, and notably, AUC ROC, ensuring that the model's ability to discern vulnerabilities is both robust and sensitive. To contextualize the framework's potential, it's insightful to juxtapose the predictions against historical heatwave events in the two cities.

**Limitations:** While the framework spans a rich array of data, algorithm-specific challenges related to sample size can emerge. Data augmentation and transfer learning serve as remedies, aiming to optimize the predictive spectrum.

**Discussion:** Integrating spatial granularity with a temporal backbone, the framework aims to provide comprehensive insights into heat exposure vulnerabilities. The integration of AUC ROC ensures that predictions are balanced in terms of sensitivity and specificity, a pivotal aspect for actionable health insights.

**Conclusion:** HEAT Project 2 epitomizes interdisciplinary synergy, fusing Public Health, Climate Science, AI, and detailed temporo-spatial methodologies. With a focus on prediction, the objective is to proactively navigate the complexities of heat-related vulnerabilities in urban African settings