A SMaRK Way to Map: Applications of the Statistical Modelling and Residual Kriging for High-Resolution Geospatial Data

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Abstract

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Atmospheric Chemistry is a complex precursor to evolution on Earth. Continued abundance of air pollution is a natural enemy to humankind, threatening all stages of life with increased risk to prepubescent and elderly populations. Ozone, a triatomic molecule, can vary significantly over minimal changes to both time and space, making it complex to model. Modeling surface ozone concentrations at high spatial resolutions is essential for informed decision-making surrounding air pollution regulation, healthy ecologies, and biological cycles within the world’s unique micro- and macro- biomes. Geospatial datasets that combine complex statistical methods (Deep Learning, Artificial Intelligence, GEOS-Chem, DOAS, etc.) are not as strong as they could be due to a lack of proper geospatial connection to the surface they represent. This thesis investigates various statistical models and their implementation into the residual kriging technique to better incorporate geographic error into complex modeling systems. A sample of daily predictions for maximum concentrations of surface O3 (DAMO3) in parts per million (ppm) at a 100m resolution combined with census tract demographic data in Maricopa, Pima, and Pinal Counties, AZ shows the necessity of this approach. Via statistical model and residual kriging (SMaRK) of geospatial residuals, a high-resolution approach to O3 suitable for urban analysis is proposed. This methodology is readily available and reproducible for states which have the data.

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