Topological and geometric methods for COVID-19 tracking

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SARS-CoV2, the virus that causes COVID-19, differs from other viruses such as influenza, SARS, and MERS, in a number of important ways; in particular, in its response to weather conditions including temperature and humidity. Furthermore, since mortality due to COVID-19 may be closely linked to a prior history of lung and other respiratory diseases, ambient air quality might shed an important light on the expected severity of COVID-19 and associated survival rates. Hence, understanding the impact of atmospheric conditions and air quality on COVID-19 progression and associated mortality is urgent and critical, not only in terms of efficiently responding to the current pandemic (e.g., preparing an adequate health care response in areas with expected higher clinical coronavirus severity), but also in terms of forecasting impending hotspots and potential next-wave occurrences. We propose a new approach to investigate potential relationships between atmospheric conditions and air quality and COVID19 dynamics using deep learning models coupled with topological information on weather factors. We discuss utility and limitations of the proposed methodology and highlight a particular role of uncertainty quantification in these biosurveillance tasks. This research is a joint effort of UTDallas and NASA Jet Propulsion Laboratory Caltech.