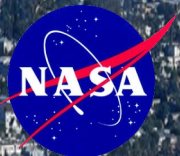


Creating a Digital Twin for Transportation and Air Quality

Jeanne Holm, Mohammad Pourhomayoun, Dawn Comer
Kabir Nagrecha, Pratyush Muthukumar

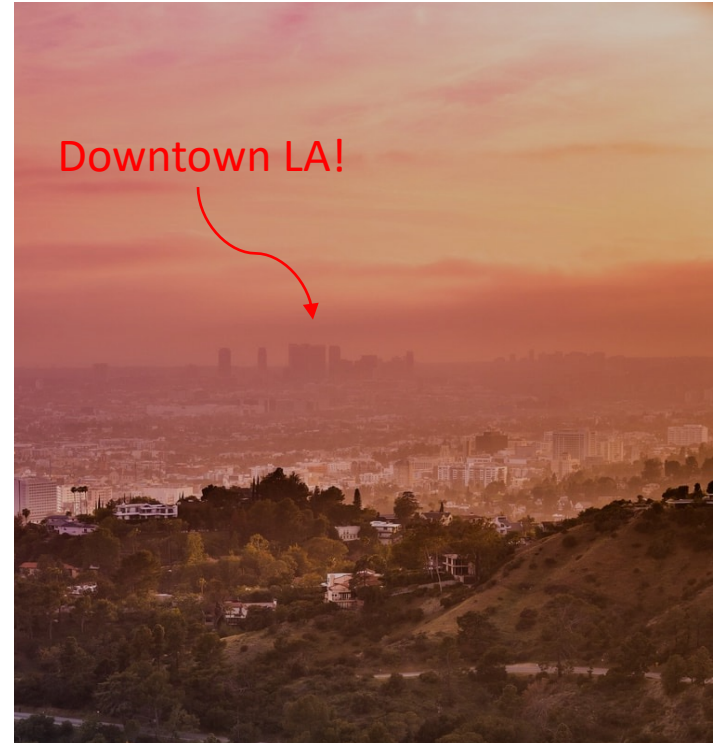
City of Los Angeles
California State University Los Angeles
AI Agora



AI Agora

Air Pollution

- Air pollution is called “**The Silent Killer**”. It is responsible for the early deaths of 7 million people every year. It means that every 5 seconds, somebody around the world dies prematurely from the effects of air pollution.
- Unfortunately, the minority and low-income communities tend to be exposed to higher levels of air pollution.



[1] UN Report 2019, UNICEF, <https://news.un.org/en/story/2019/06/1039661>

[2] The American Lung Association, “Disparities in the Impact of Air Pollution”

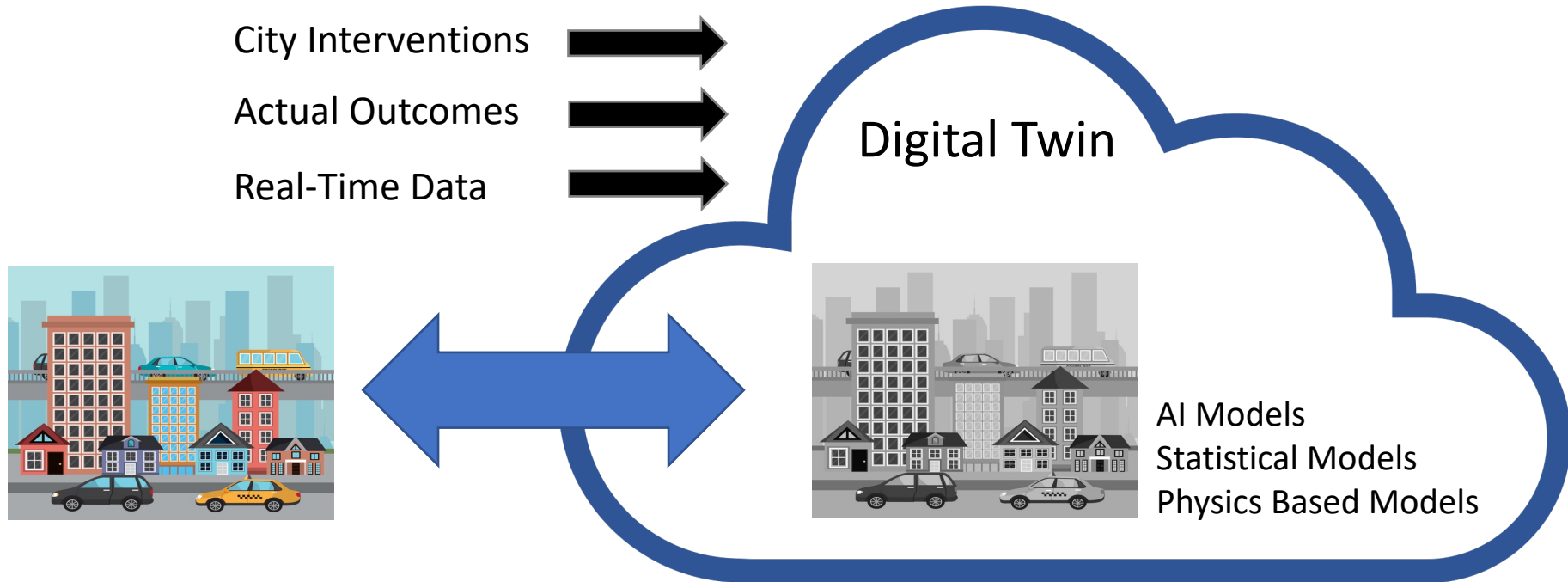
Air Pollution

- The first and the most important step in mitigating the air pollution risks is to understand the sources of it, discover the patterns, and predict it in advance.
- By enhancing human understanding and prediction of air quality, local governments, health providers, and others can help mitigate the effects of air pollution.



Digital Twin Model for Air Quality and Transportation

We have developed a digital twin including AI models, data analytics and ML algorithms, statistical models, and data visualization to replicate the real-world system and its behavior, and to understand and predict urban air pollution.



Digital Twin Model for Air Quality and Transportation

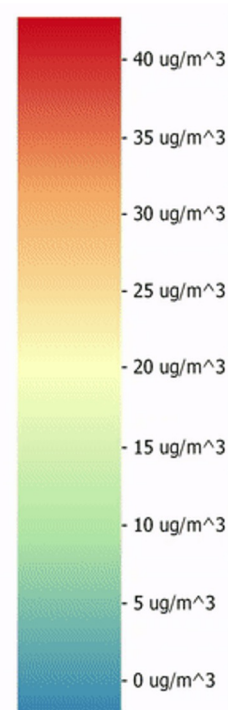
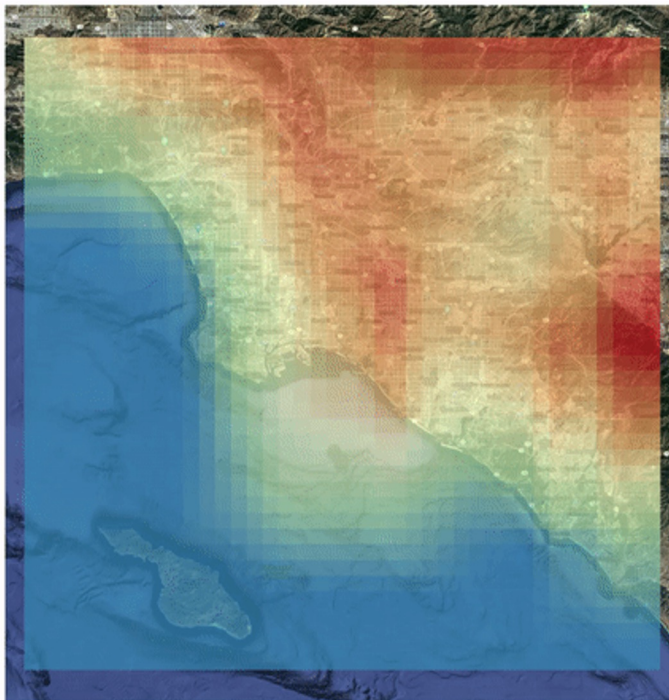
- The digital twin that visualizes AI-based AQ predictions for various types of air pollutants on various time scales
- The digital twin visualizes and connects real-time air quality to transportation.
- Through this work we will be able to visualize and model what-if scenarios showing the impact of changing modes of transportation or modifying public transportation on air quality.
- More importantly, to understand the impact of adding new modes of transportation such as urban air mobility on transportation and air quality.

AI-based Air Quality Prediction

The average accuracy for 24-hour prediction over all site locations in LA County is **94.56%**.

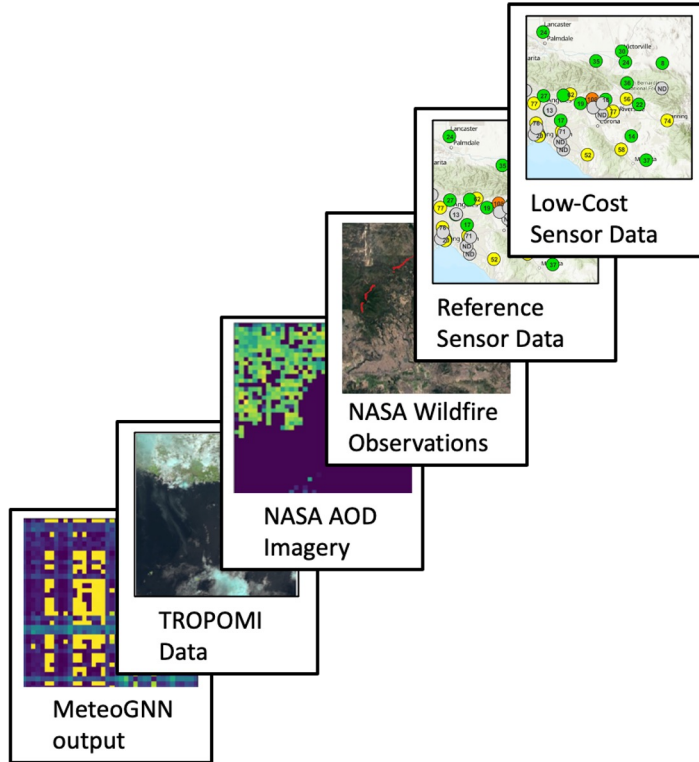
12 predictive models

PM2.5, NO2, O3, CO, CO2, SO2



- Temporal Resolution: hourly prediction
- Spatial Resolution: 250 m²

AI-based Air Quality Prediction



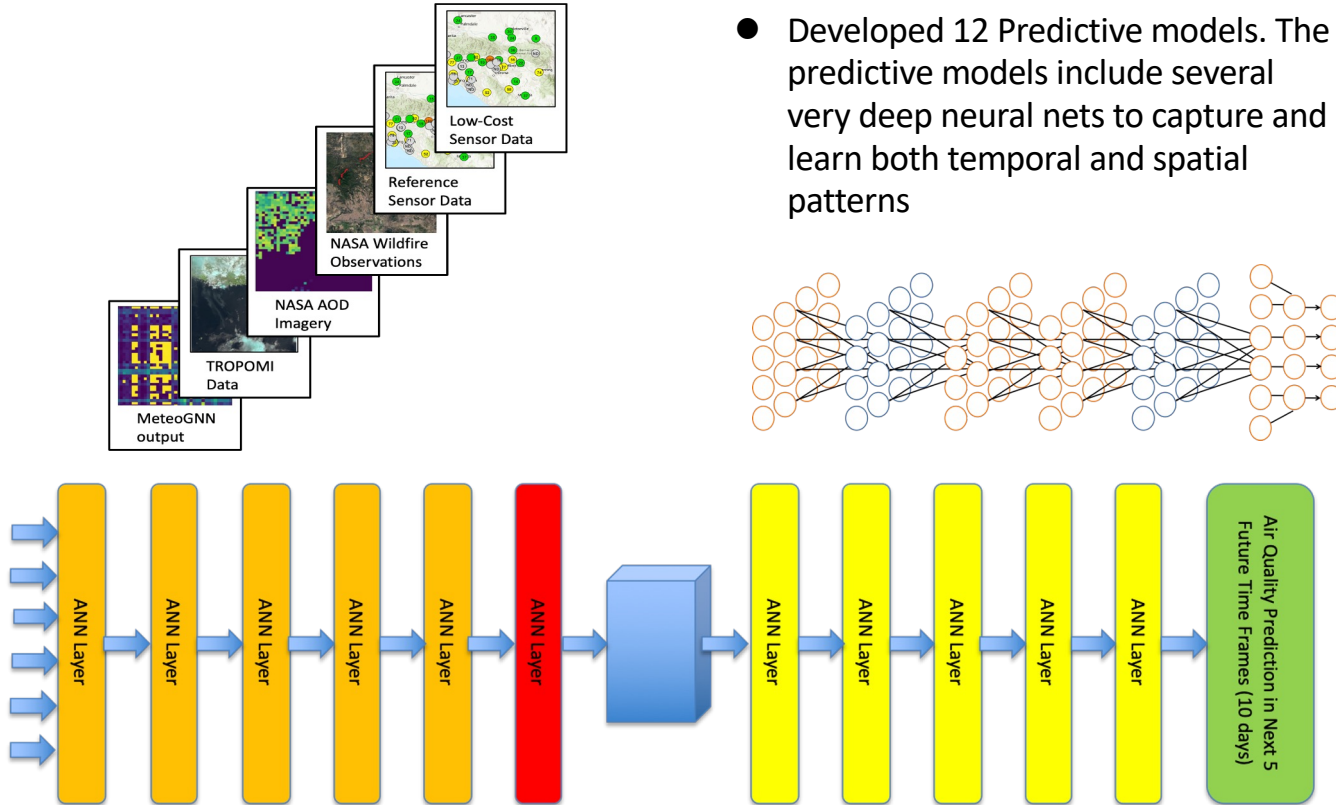
Data

- NASA Imagery
- ESA/NASA TROPOMI Data
- NASA Wildfire data
- Reference Sensors
- Low Cost Sensors
- Meteorological data

Data Processing and Data Fusion

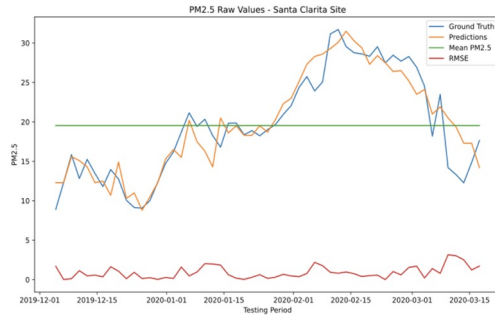
- Preprocessing and cleansing
- Outliers/trustworthiness and missing values
- Feature extraction and knowledge discovery
- Feature selection and dimensionality Reduction
- Format matching and alignments

AI-based Air Quality Prediction

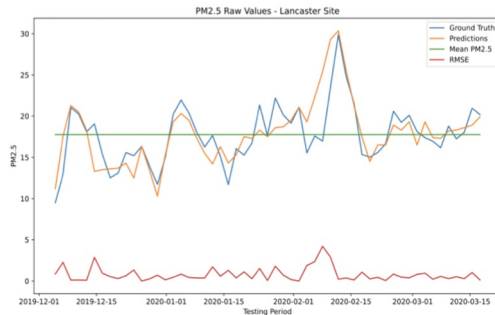


Predicting PM2.5 Based on Satellite Observations, Ground Sensors, Meteorological Data, and Wildfire/Smoke Data

Santa Clarita Site PM 2.5 Observed Sensor Data vs Predicted



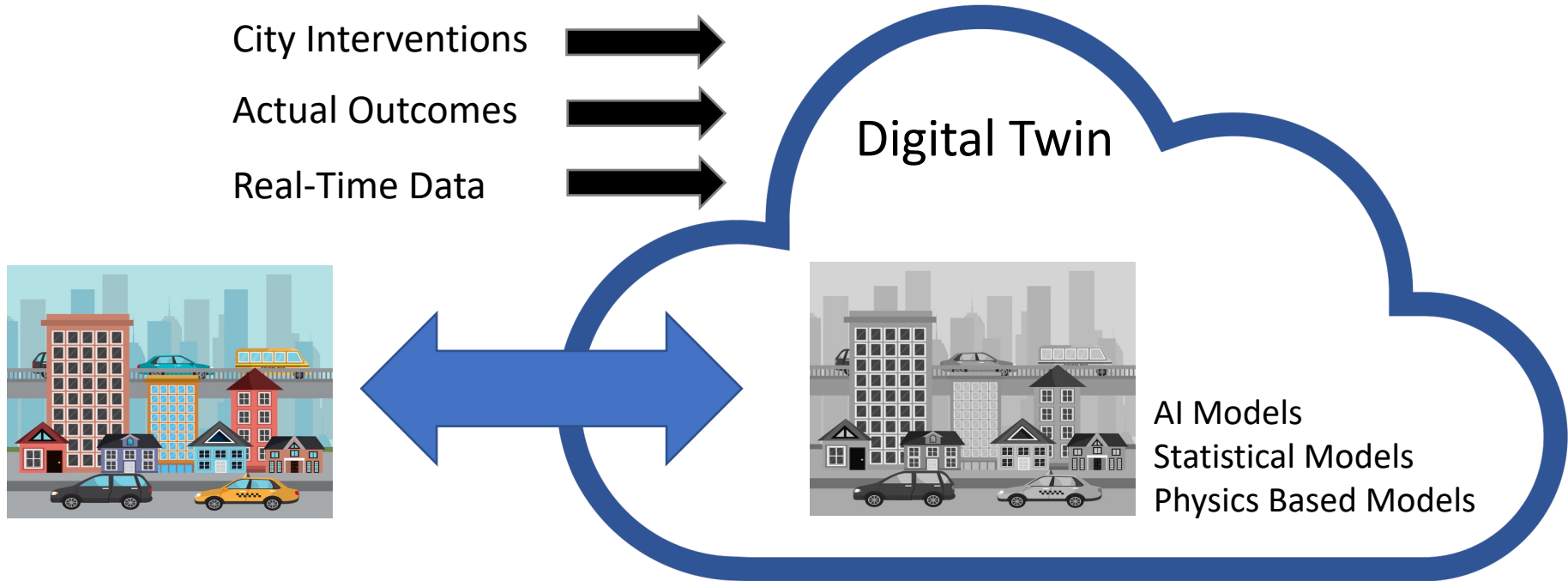
Lancaster Site PM 2.5 Observed Sensor Data vs Predicted



10 Prediction Accuracy	Days
93%	2 days in future
90%	4 days in future
88%	6 days in future
83%	8 days in future
80%	10 days in future

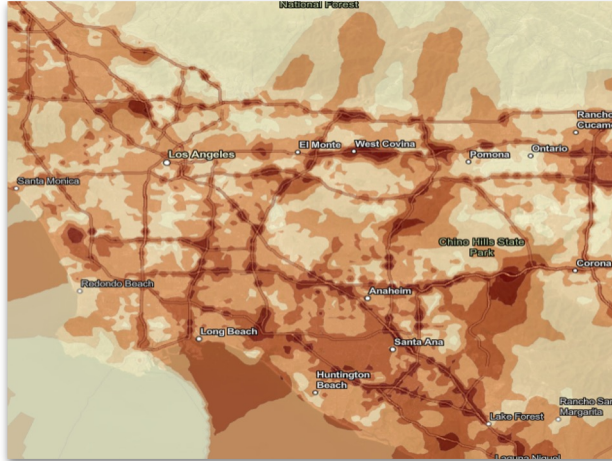
48-hour prediction Accuracy	Sensor Location
94%	Downtown LA
95%	Long Beach
91%	Lancaster
91%	Glendora
93%	Santa Clarita
93%	Reseda
95%	Long Beach – Rt 710

Digital Twin Model for Air Quality and Transportation to replicate the real-world system and its behavior.

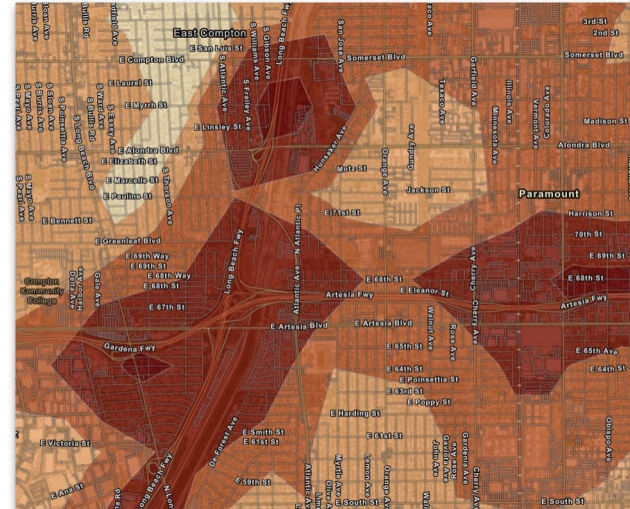


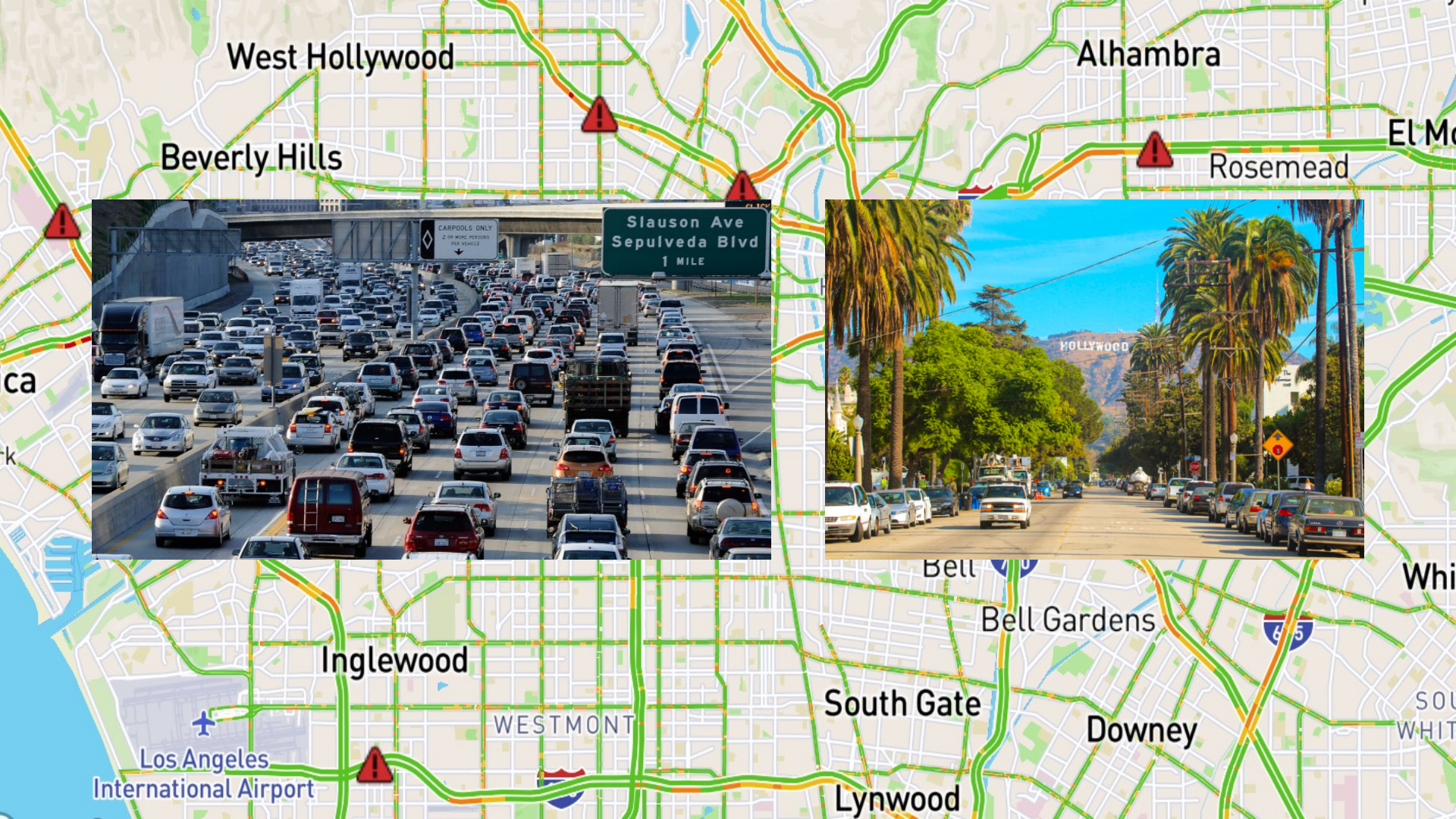
Digital Twin Model for Air Quality and Transportation

The real-time impact of Fossil Fuel Combustion by Cars, Trucks, and Busses

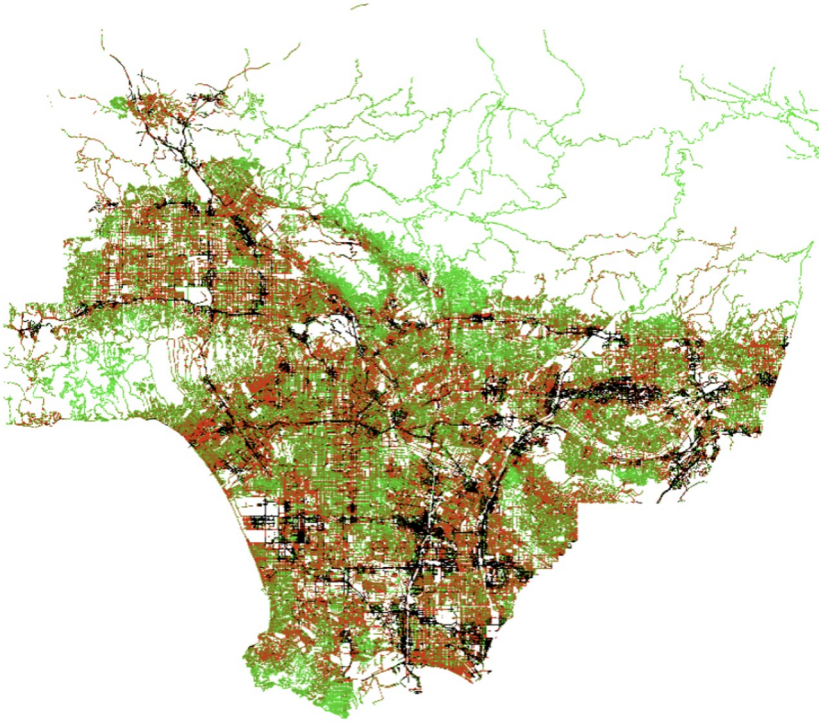


The projected air pollution created by Fossil Fuel Combustion by Cars, Trucks, and Busses



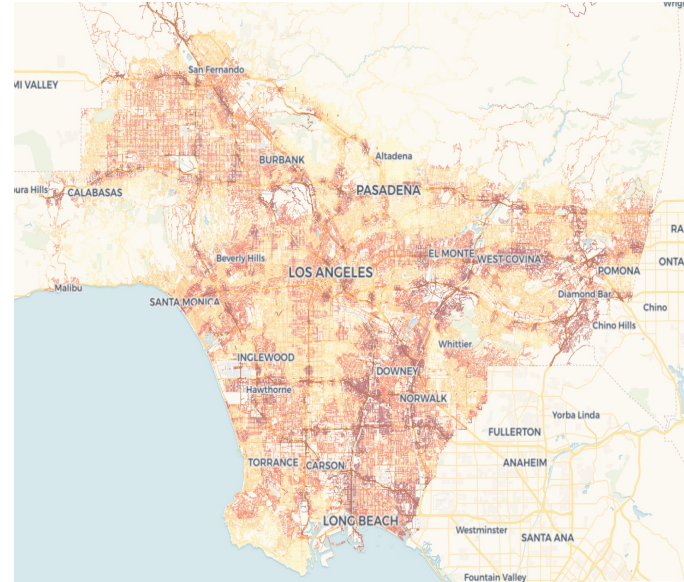
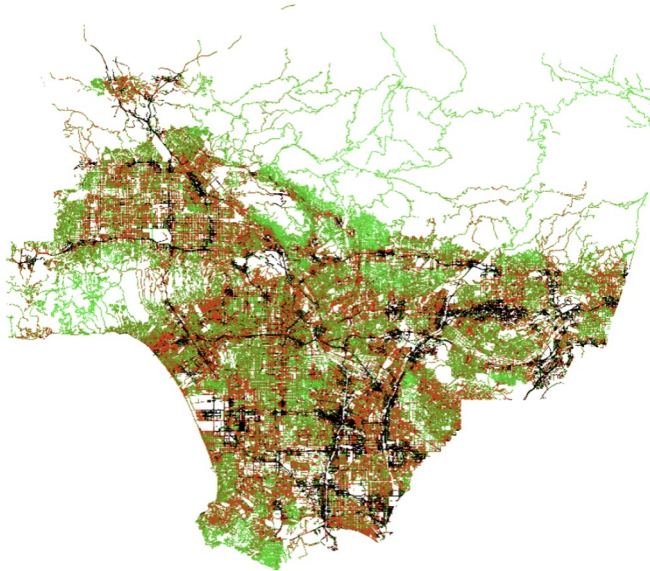


Digital Twin Model for Air Quality and Transportation

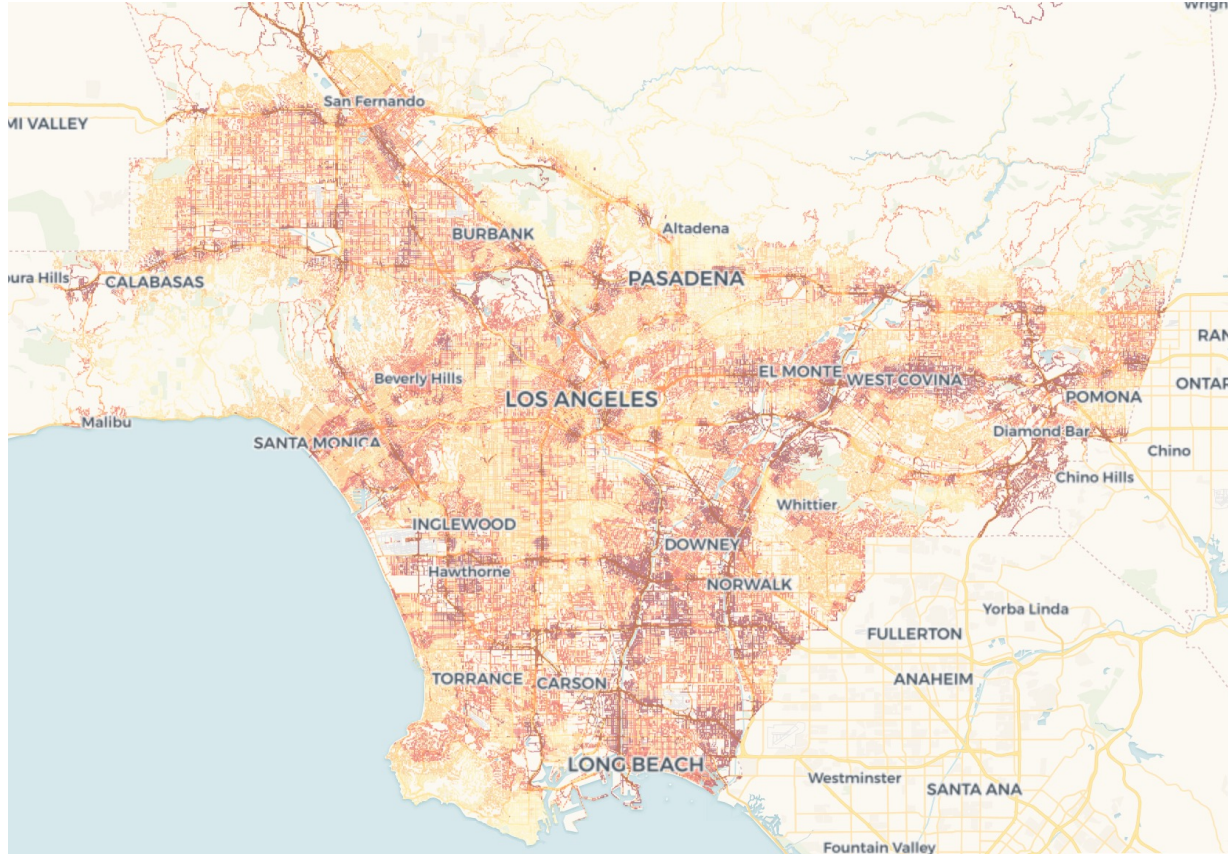


- Compute live traffic counts in real-time for every location.
- Convert traffic counts into live traffic-driven air pollution.
- Real-time Traffic Flow
- Real-time Traffic Count

Digital Twin Model for Air Quality and Transportation



Digital Twin Model for Air Quality and Transportation



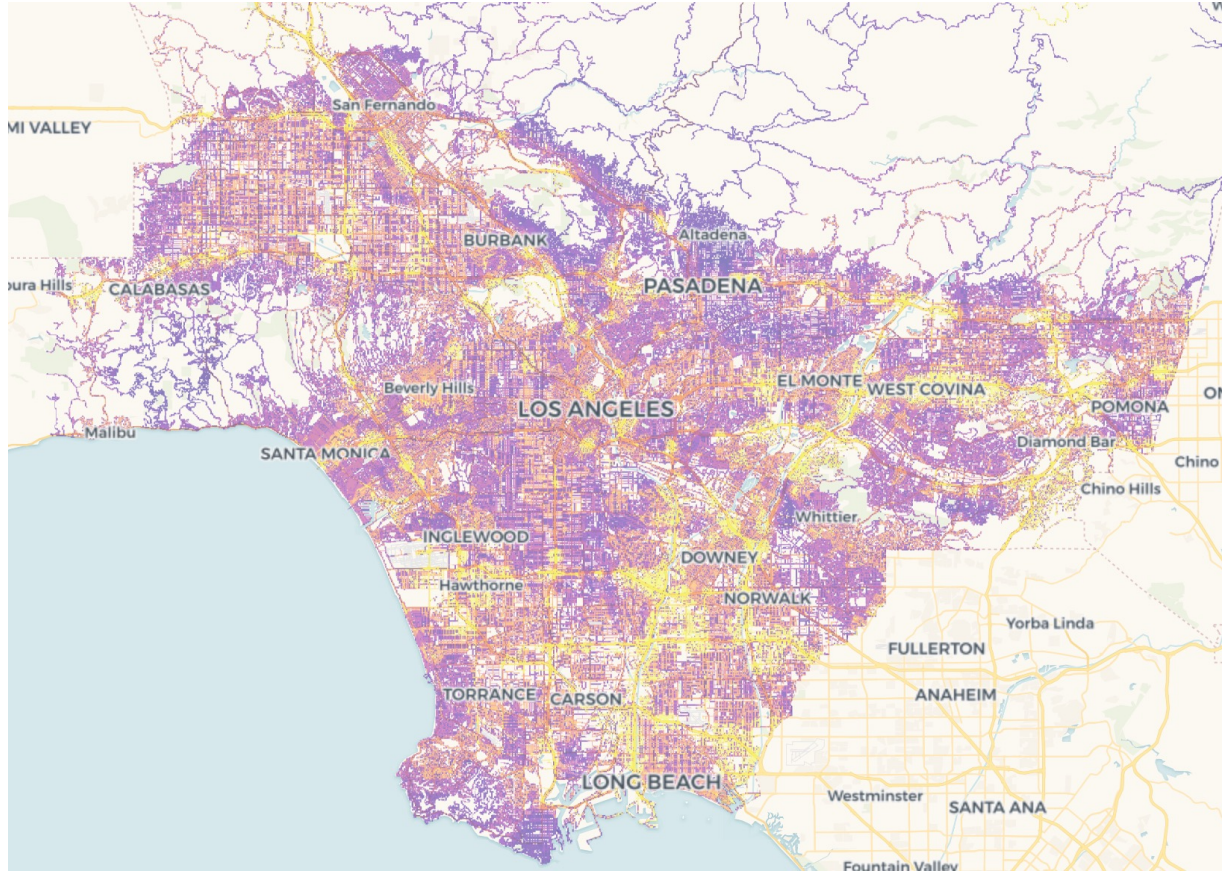
Real-time PM2.5
created by vehicles
per second

Digital Twin Model for Air Quality and Transportation



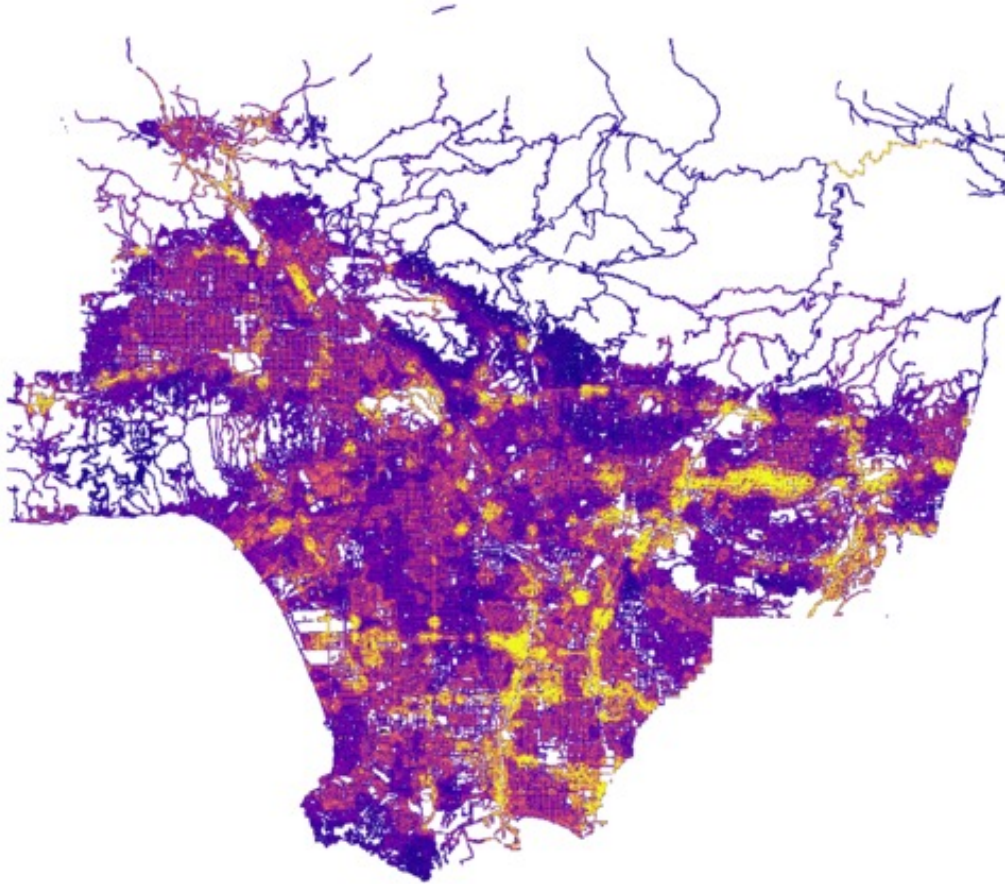
Real-time PM2.5
created by vehicles
per second

Digital Twin Model for Air Quality and Transportation



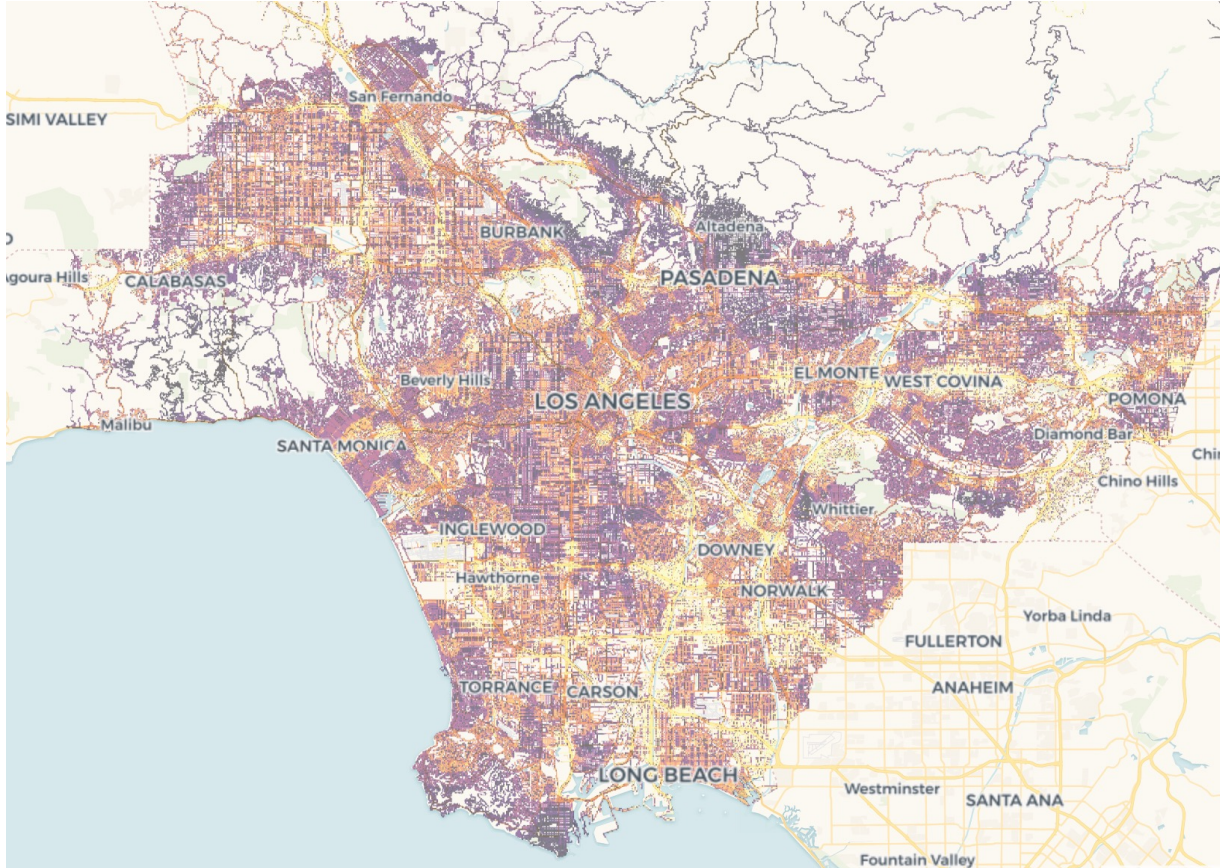
Real-time NO2
created by vehicles
per second

Digital Twin Model for Air Quality and Transportation



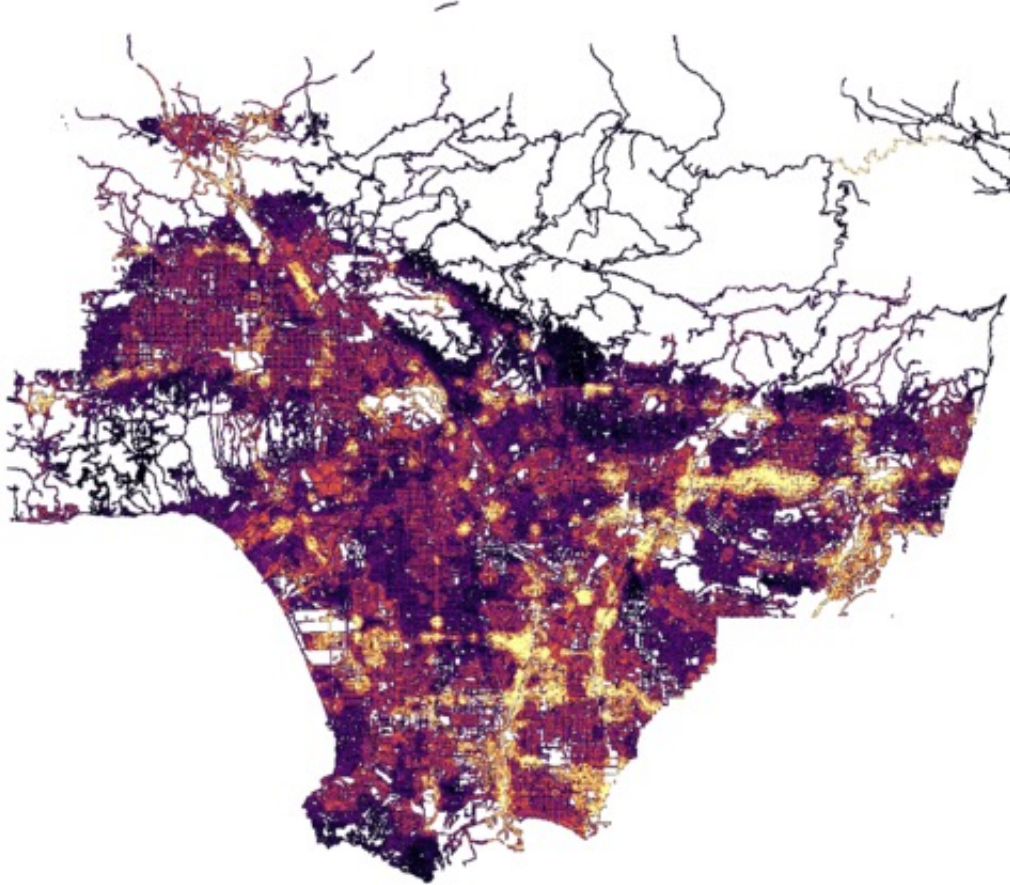
Real-time NO2
created by vehicles
per second

Digital Twin Model for Air Quality and Transportation



Real-time CO2
created by vehicles
per second

Digital Twin Model for Air Quality and Transportation



Real-time CO2
created by vehicles
per second

Digital Twin to Improve Decision Making

Improve city planning, health outcomes, and enforcement while managing dynamic changes in the environment and ecosystem

- Create predictive models
- Create visualizations to improve understanding
- Identify and integrate local data (health, polluters, traffic, roads, ports) from IOT and in-situ sensors
- Identify gaps in coverage
- Improve Environmental Justice
- model the impact of changing modes of transportation or modifying public transportation on air quality.

Thank you!

More info:

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airquality.lacity.org

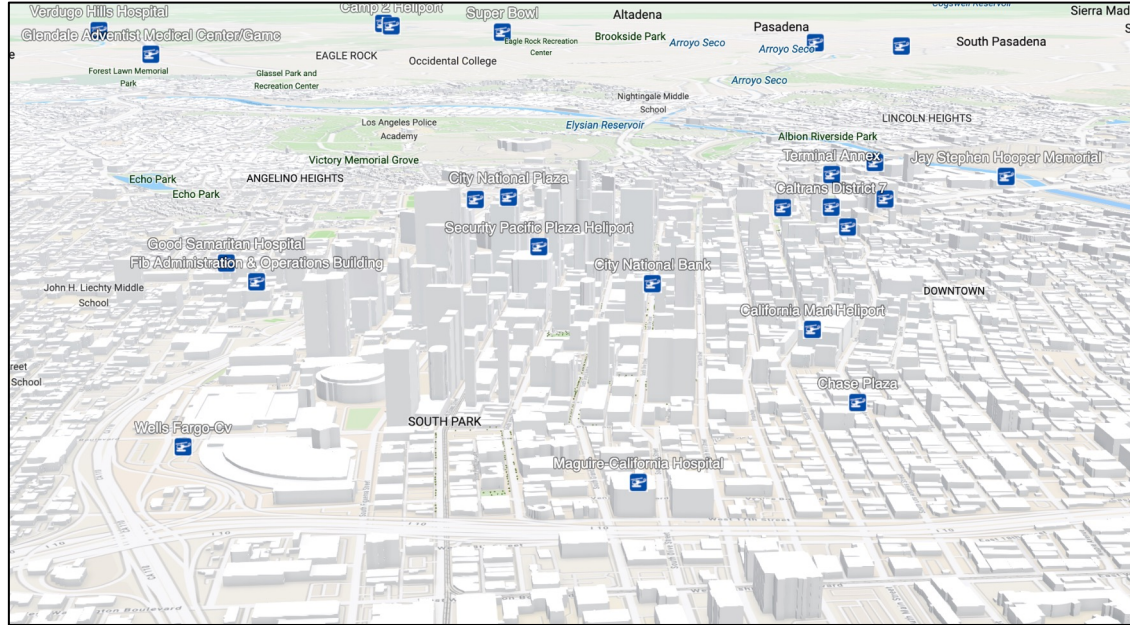
www.ai-agora.com



Appendix

Digital Twin for Air Pollution and Transportation

- Understand the impact of adding urban air mobility on transportation and AQ
- Locations of Heliports in Los Angeles County



Digital Twin for Air Pollution and Transportation

- Locations of Heliports in Los Angeles County

