Co-financed by the Connecting Europe Facility of the European Union

SNAP4CITY

TRAFAIR

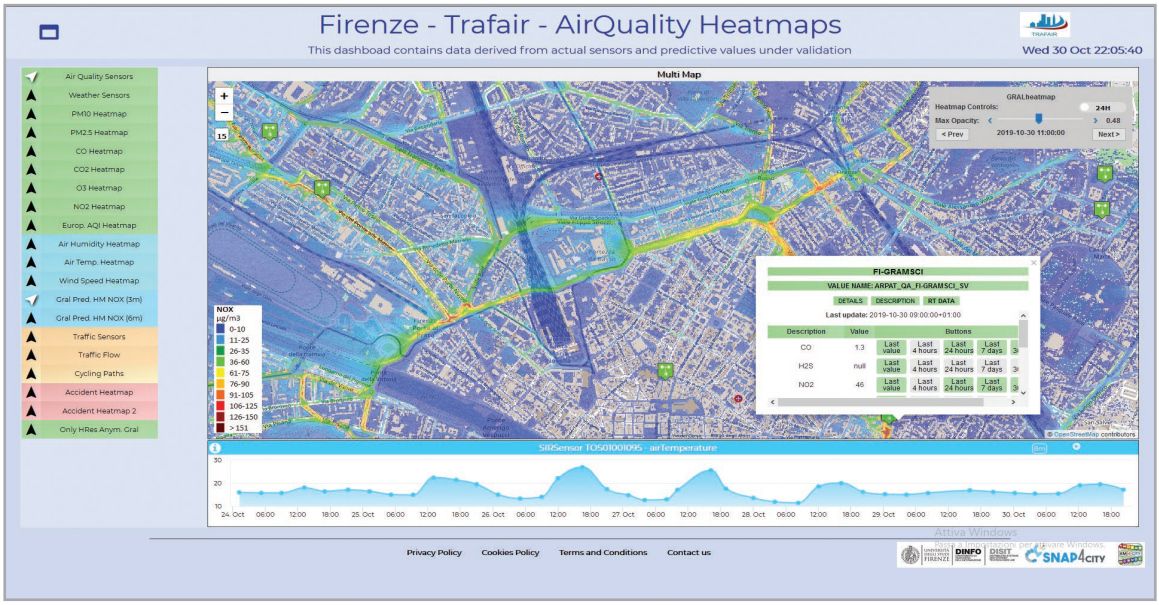
Understanding traffic flows to improve air quality

High Resolution Prediction of Environmental Data

Analysis of Pollutant dispersion in the city

Smart Cities need to understand how much pollution affects the quality of the air that citizens breath. The city operators may regulate urban mobility, thus providing the evidence at citizens that they are living in a city sensitive to the quality of life, predicting the overruns of law limits. To this end, specific sensors and solutions become fundamental, such as: traffic flow sensors for monitoring urban mobility, traffic flow reconstruction, sensors for assessing air quality parameters, parking, traffic and RTZ sensors, weather forecasts, etc., together with the knowledge of the city structure, prediction model for environmental variables.

In order to assess the air quality in each part of the city, the level of pollution aspects have to be measured, for example: SO2, NO, NO2, O3, CO, CO2, PM10, PM2.5, etc. and derived Air Quality Indexes. Most of the environmental pollutants are influenced by relevant traffic flows in different manners, while others are influenced by house heating, industries, boats, etc. Specific measures may depend on the sensor position and location context, on calibration, on the time of the measure, season, etc. A measure performed along a primary street in terms of traffic may strongly differ with respect to the actual values just in the garden of the house behind the primary street. To this end, mathematical methods have been set up to perform predictions of pollution diffusion and deductions.

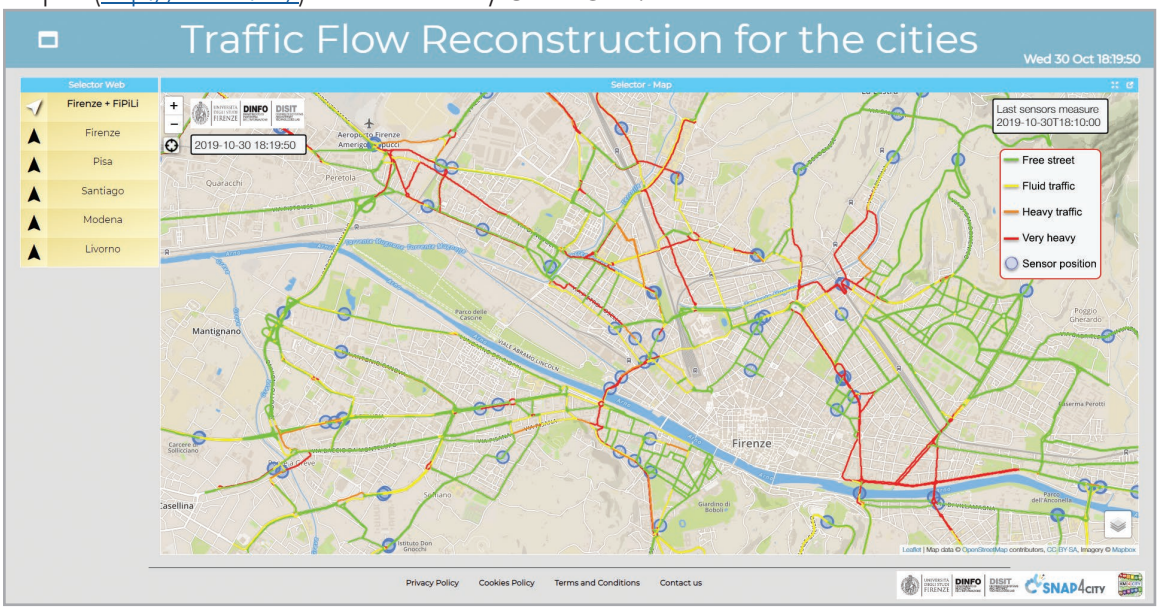


https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTUzMg==

Dashboards with predictions of environmental parameters in cities such as of Florence, Livorno, Pisa, etc., includes predictions performed for each hour in the next 48 hours, with a spatial resolution up to 4x4m.

The air quality regarding NOX (NO and NO2) is primarily related to the production of pollution from the vehicles running in the city. The computation of the traffic flow in all primary and secondary streets of the city is used to estimate the number of vehicles passing and producing pollutant in each road segment of the urban graph. The production of pollution is an input data for the predictive model to determine the air quality state in a given city using the GRAL model.

Other sources can be taken into account. The GRAL model is based on modelling the flow of particles in the 3D shape of the city, taking into account wind, vegetation, etc. The approach can be also used for computing prediction on other kind of particles, such as PM10, PM2.5 as performed in Helsinki. The methodology and the mathematical models adopted and used to make the environmental parameters predictions have been developed in the context of TRAFAIR Project (http://trafair.eu/) coordinated by UNIMORE.



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The Snap4City has made possible the development of the predictive model and tools, providing data at the basis of the algorithms and the infrastructure for real time computation.

Snap4City is providing a Big Data infrastructure for smart city in terms of the services provided and for the data necessary for the predictions. Snap4City semantically aggregates any kind of data coming from any sources and semantically aggregates them in compliance with the smart city ontology Km4City (https://www.km4city.org). DISIT Lab has developed the parallel implementations of Traffic Flow reconstruction and of GRAL simulation, making possible the computations of predictions 48 hours in advance for several cities.

Snap4City computed traffic flow reconstruction starting from traffic flow data, for Firenze, Livorno, Pisa, Santiago di Compostela, Modena, etc. Thus, a real-time solution of traffic flow reconstruction with high precision has been created and computed thus leveraging the detections from a few fixed traffic sensors deployed within the area of interest. A such solution has several advantages with respect to the solutions available in the state of the art, since it provides at the same time the following features: supporting complex and real-world road structure; wide applicability; no needs of third-party engagement on providing data from installed devices on vehicles; robust with respect to discontinuous data; declared precision rate; real-time production of data; visual rendering of results. The traffic flow reconstruction tool of Snap4City is based on a machine learning solution to Partial Differential Equation (PDE) modelling of traffic and of the city.

The figure above presents a dashboard on Snap4City reporting the predicted NOx concentration map in the city of Florence, Livorno and Pisa. A similar computation has been performed also on Helsinki for predicting the PM10 24 hours in advance. On the dashboard, you can navigate on several predictions, in past and future and you can see the 24H animation of the next and past days.

Extended version accessible from: https://www.snap4city.org/530
Contact: https://www.snap4city.org
Partners: UNIMORE, DISIT lab, Regione Toscana, USC, Santiago de Compostela, CESGA, Saragoza, Univ. of Zaragoza, Modena, LEPIDA.

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Predictions of Pollutants Dispersion in the city: Every hour, 48hours in advance