



Be smart  
in a SNAP!



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

## *Understanding traffic flows to improve air quality*

IV° evento di disseminazione in Toscana del progetto TRAFAIR



<https://www.disit.org>

<https://www.snap4city.org>

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

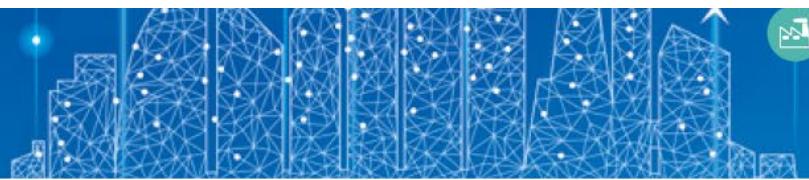


*Be smart in a SNAP!*

## L'importanza dei dati per la gestione della città sostenibile

<https://www.disit.org>

<https://www.snap4city.org>



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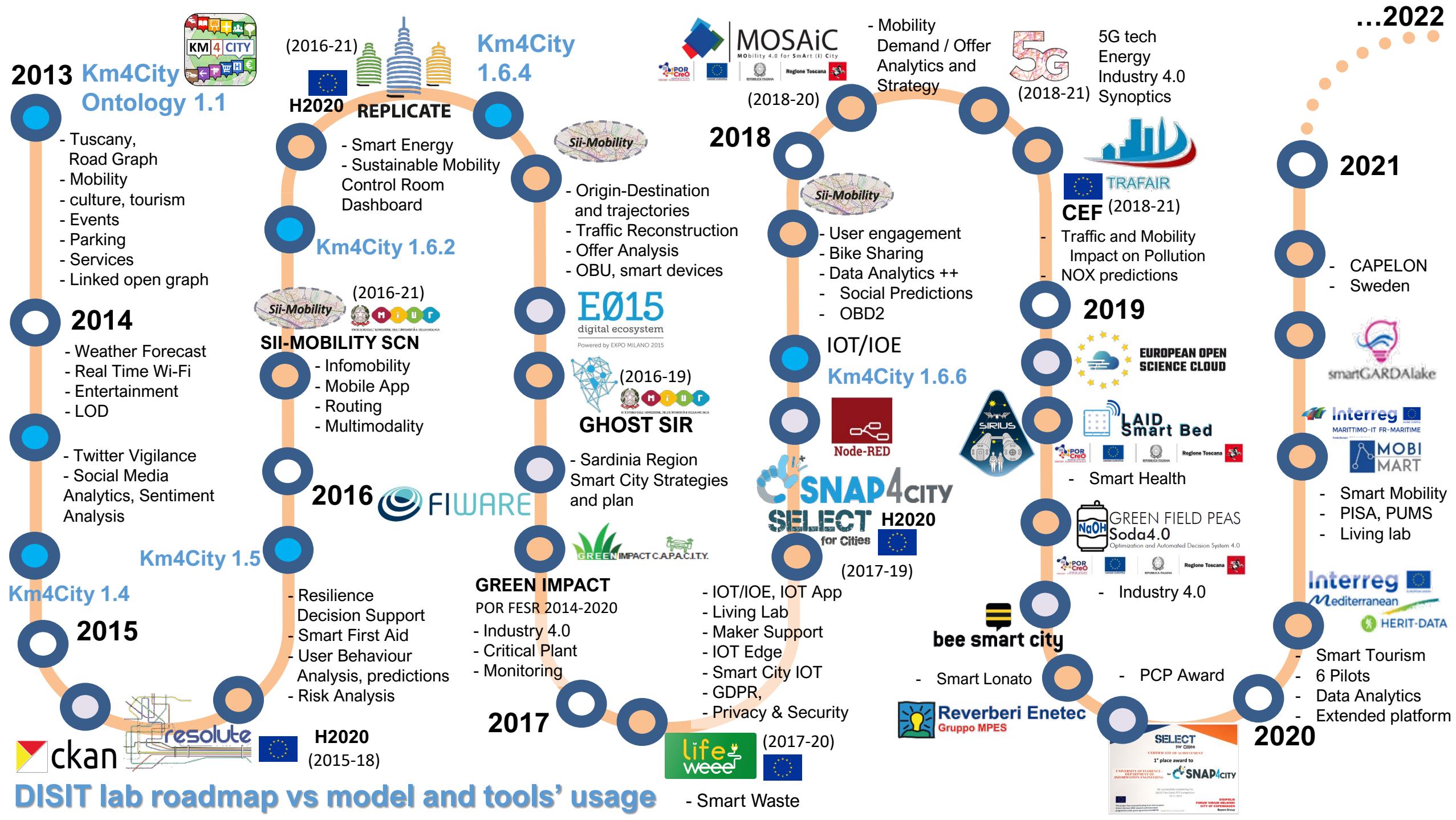
**SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES**



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

DINFO  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

DISIT  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB



# TRAFAIR: Relazione tra Inquinamento e Qualità dell'Aria

- <http://trafair.eu/> INEA CEF, TELECOM PROJECT

- Obiettivo principale:

- Comprendere quanto l'inquinamento incida sulla qualità dell'aria che i cittadini respirano per regolare correttamente la mobilità urbana e aumentare la consapevolezza di vivere in una città sempre più tecnologica e orientata alla salute dei cittadini stessi

- Metodologie / azioni adottate:

- Raccolta dati provenienti da sensori del traffico e dell'aria
  - Studio dell'inquinamento urbano, proveniente principalmente da eventi di traffico
  - Studio degli indici di qualità dell'aria, che in genere dipende dalle misure per l'inquinamento sugli inquinanti: NO, NO<sub>2</sub>, CO, O<sub>3</sub>
  - Utilizzo di metodi matematici per fare previsioni e deduzioni
  - Utilizzo delle risorse High Performance Computing (HPC) per gestire un problema Big Data
  - Divulgazione delle informazioni e dei risultati raggiunti a cittadini e pubblica amministrazione tramite strumenti personalizzati





**Snap4City**

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- [Dashboards \(Public\)](#)
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- [Data Set Manager: Data Gate](#)
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Home / Snap4City - scalable Smart aNalytic APplication builder for sentient Cities

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## Snap4City - scalable Smart aNalytic APplication builder for sentient Cities

 [CLICK for NEWS](#) Smart Cities need to set up a flexible Living Lab to cope with the city evolution in terms of services and city users' needs and sustainability. Snap4City solution (<https://www.snap4city.org>) provides a flexible method and solution to quickly create a large range of smart city applications exploiting heterogeneous data and enabling services for stakeholders by IOT/IOE, data analytics and big data technologies. Snap4City applications may exploit multiple paradigms as data driven, stream and batch processing, putting co-creation tools in the hands of: (i) Smart Living Lab users and developers a plethora of solutions to develop applications without vendor lock-in nor technology lock-in, (ii) final users customizable / flexible mobile Apps and tools, (iii) city operators and decision makers specialized / sophisticated city dashboards and IOT/IOE applications for city status monitoring, control and decision support. Snap4City satisfies all the expected requirements of Select4Cities challenge PCP and much more, and it is 100% open source, scalable, robust, respects user needs and privacy; provides MicroServices and easily replaceable tools; compliant with GDPR; provides a set of tools for knowledge and living lab management, and it is compliant with more than 60 protocols including end-to-end encrypted communication. Snap4City is an official platform of FI-WARE, an official library of JS Foundation Node-RED, registered on EOSC, present on EOSC marketplace, and BeeSmartCity MarketPlace, etc.

  
**Training Snap4City:**  
 Dal Dati alla Città Senziente, Smart City and IOT  
 - 25 Giugno 2019  
 - 9 Luglio 2019  
 - 23 Luglio 2019  
 Scuola di Ingegneria, Università di Firenze  
 Via Santa Maria 3, Firenze  
[PROGRAMMA](#)

  
**SNAP4APPLIANCE**  
 Virtual Machines ready to use for  
 Smart City and IOT Applications  
[DOWNLOAD](#)

  
**HELSINKI**      **ANTWERP**      **TOSCANA**  
[GET IT ON Google play](#)   [GET IT ON Google play](#)   [GET IT ON Google play](#)  
[Download on the App Store](#)   [Download on the App Store](#)   [Download on the App Store](#)

We expect you at Stand 120,  
 Hall P2, Level 0, Street A  
 Smart City Expo World  
 Congress 2018  
 13-15 November 2018,  
 Barcellona, Gran Via Venecia

  
**DECO**      **SMARTCITY EXPO WORLD CONGRESS**      **EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE**

### Registration

- [New Registration](#)
- [Request a new password](#)

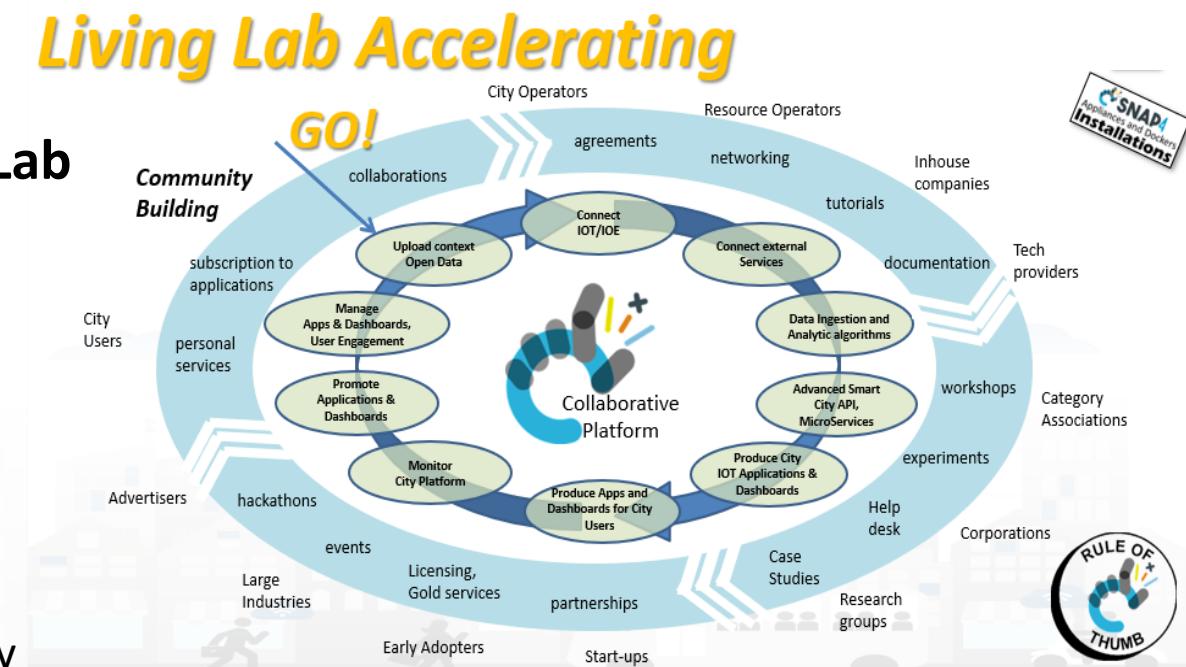
Powered by  
[www.km4city.org](http://www.km4city.org)

Snap4City improves city services, security and safety by offering a sustainable solution for smart city and **Living Lab**, thus attracting industries and stakeholders. Snap4City is capable to keep under control the real time city evolution, reading concord computing and controlling key performance indicators (KPI), detecting unexpected evolutions, performing

Trafair, Snap4City, 15 dicembre 2020

# Smart City e Workflow

- **Raccolta dei requisiti:**
  - Quali sono i servizi che si vogliono ottenere?
  - Per quale tipologia di utenti finali?
  - Quali dati si hanno a disposizione?
- **Coinvolgimento delle persone: il concetto di Living Lab**
  - Pubblica Amministrazione, Regione, etc.
  - Aziende pubbliche e private che forniscono servizi alla città
  - Centri di ricerca
  - Cittadini, studenti, pendolari, turisti, etc.
- **Pianificazione del lavoro:**
  - Costi, Tempi, nuove installazioni (se necessarie)
- **Raccolta e gestione Dati:**
  - Raccolta dati e relativa ingestione nella piattaforma Snap4City
  - Controllo dello stato dei dati in real time
- **Analisi Dati per il raggiungimento dei servizi finali**
- **Realizzazione dei Servizi finali:**
  - Mobile App, Totem, Dashboards, etc.



# Punto di partenza

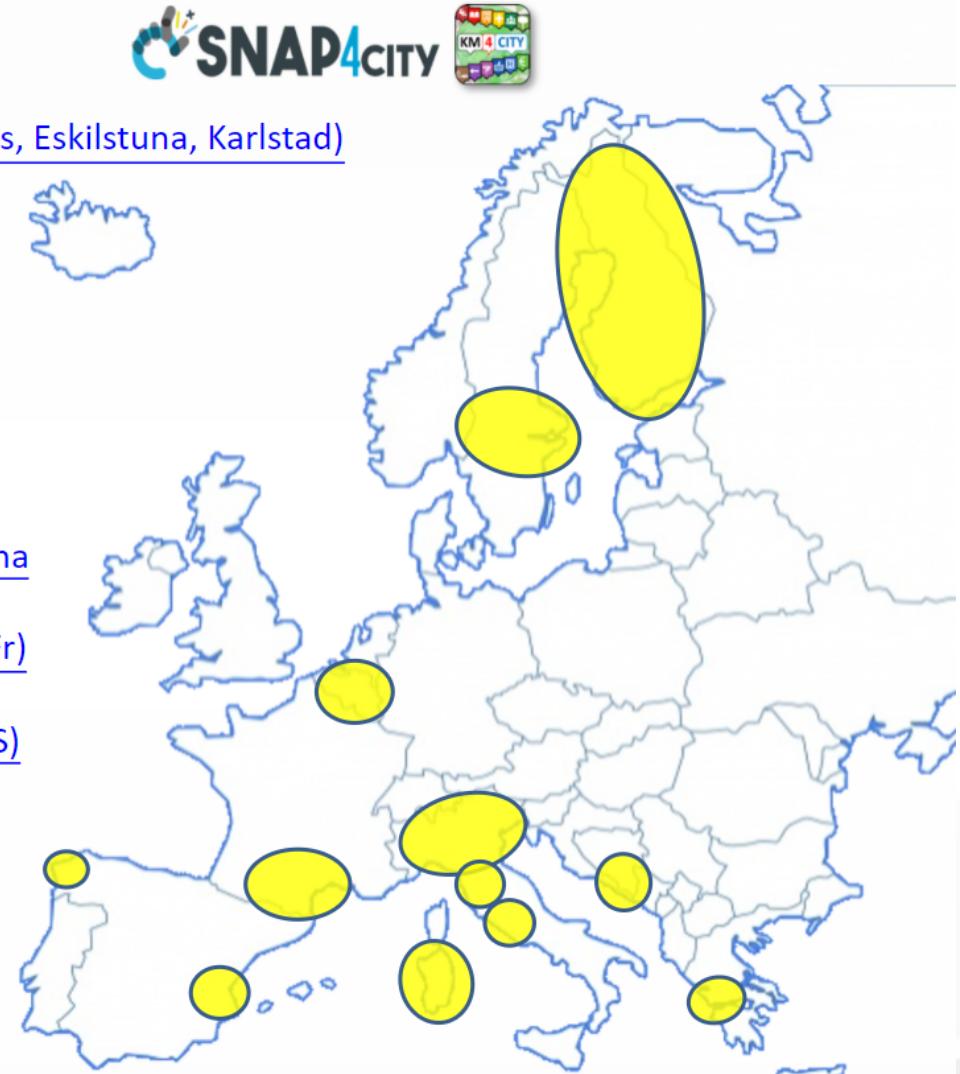


## per TRAFAIR a Livorno, Firenze, Pisa: SNAP4City

- Snap4City (<https://www.snap4city.org>)  
è una piattaforma Big Data, è GDPR compliant, è piattaforma ufficiale EOSC
- Snap4City è **presente** in svariate regioni italiane ed europee e in vari progetti nazionali ed europei
- Snap4City aggrega semanticamente i dati in conformità con la multi-ontologia KM4City

### Main Organizations/areas

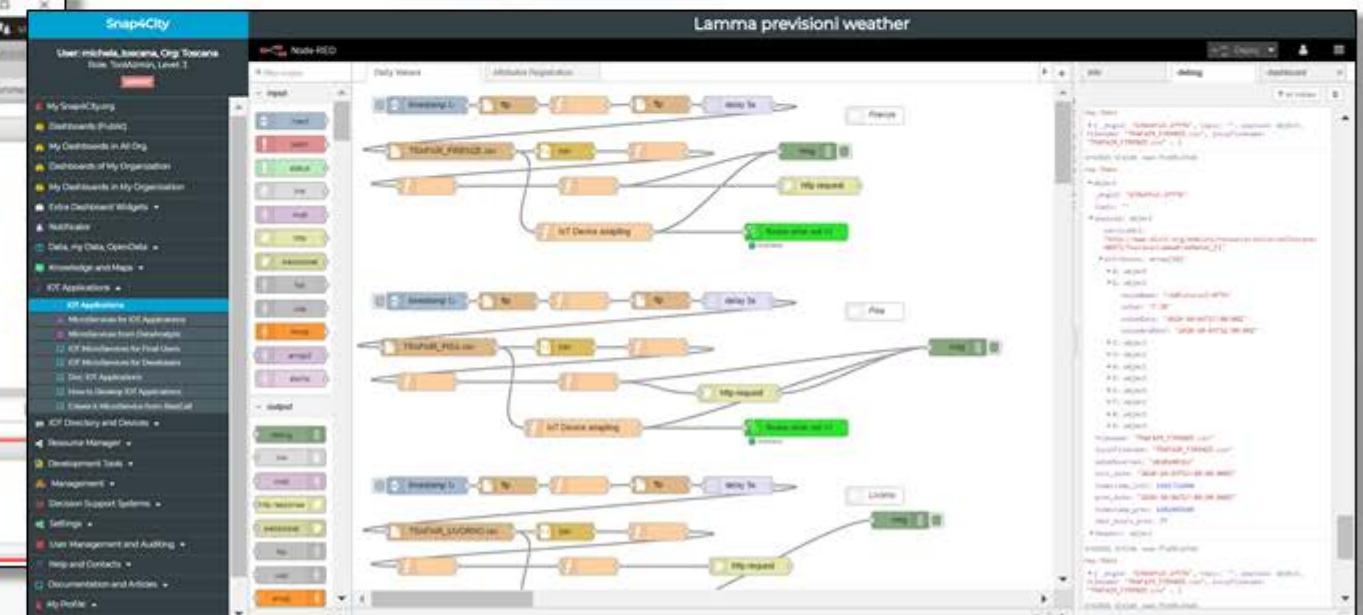
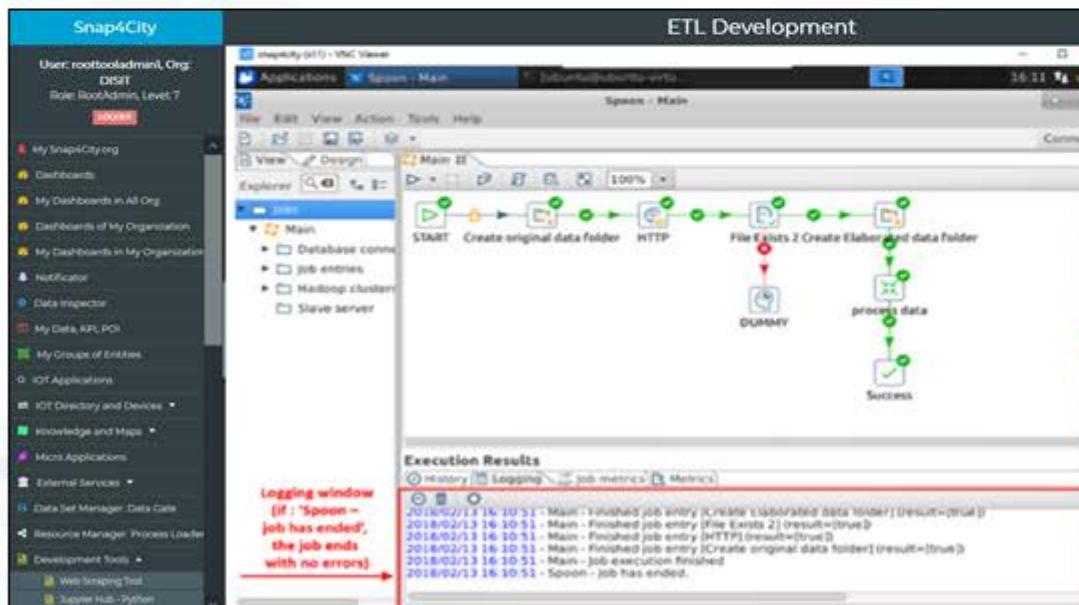
- [Antwerp area \(Be\)](#)
- [Capelon \(Sweden: Västerås, Eskilstuna, Karlstad\)](#)
- [DISIT demo \(multiple\)](#)
- [Dubrovnik, Croatia](#)
- [Firenze area \(I\)](#)
- [Garda Lake area \(I\)](#)
- [Helsinki area \(Fin\)](#)
- [Livorno area \(I\)](#)
- [Lonato del Garda \(I\)](#)
- [Modena \(I\)](#)
- [Mostar, Bosnia-Herzegovina](#)
- [Pisa area \(I\)](#)
- [Pont du Gard, Occitanie \(Fr\)](#)
- [Roma \(I\)](#)
- [Santiago de Compostela \(S\)](#)
- [Sardegna Region \(I\)](#)
- [SmartBed \(multiple\)](#)
- [Toscana Region \(I\), SM](#)
- [Valencia \(S\)](#)
- [Venezia area \(I\)](#)
- [WestGreece area \(Gr\)](#)



## Strumenti di Ingestion

- Strumenti per la raccolta dati disponibili su Snap4City:
  - IoT Applications (integrazione del tool NODE-RED)
    - Gestione dati statici, periodici, real time (Protocolli PULL e PUSH)
  - ETL processes (integrazione del tool Pentaho Kettle nella Piattaforma):
    - Gestione di dati che cambiano periodicamente nel tempo (Protocolli di tipo PULL)
  - Tramite Crawler, file, mobile, etc.

### IoT Applications



### ETL

# TRAFAIR:

# dati provenienti da sensori del traffico

- Sensori del traffico:
  - Dati provenienti dall’Osservatorio Regionale  
<http://www501.regione.toscana.it/osservatoriotrasporti>
  - Tipologia di dato:
    - Posizione dei sensori (fissa)
    - Velocità veicoli equivalenti
  - Frequenza di osservazione:
    - 10 minuti

The screenshot shows a web page with a header featuring the logo of MARITTIMO - IT FR - MARITIME (TOSCANA - LIGURIA - SARDEGNA - CORSE) and the tagline "La Cooperazione al cuore del Mediterraneo". The main content area includes a red banner with the text "Sito di Supporto ai Lavori di Gestione e Aggiornamento delle Banche Dati dell’Osservatorio Regionale per la Mobilità ed i Trasporti". Below the banner are several navigation links: "Consultazione" (with sub-links "Dati, Metadati, Specifiche"), "Gestione certificati" (with sub-links "Richiesta certificato", "Rinnovo certificato", "Istruzioni installazione certificato:", "Internet Explorer", "Firefox"), "Comunicazioni TPL" (with sub-links "Upload Orari TPL", "Download Orari TPL", "Validità Orari TPL", "Upload altri Dati TPL", "Storico invii altri Dati TPL", "Validità altri Dati TPL", "Ricavi e Sussidi", "Atti d’obbligo"), and "Area riservata" (with sub-links "Gestione Grafi", "Documentazione di progetto", "Reportistica", "Amministrazione"). A large image of a modern blue and white regional train is positioned next to the "Consultazione" link.

# TRAFAIR: dati

## provenienti da sensori dell'aria (low-cost) e previsioni del tempo

- Sensori dell'aria:
  - Dati provenienti da Sensori CNR-IBE (Open Data)
  - Tipologia di dato:
    - Posizione dei sensori (fissa)
    - Dati: **CO, NO, NO<sub>2</sub>, O<sub>3</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>**, etc.
    - Frequenza di osservazione:
      - Circa 3 minuti
  - Dati relativi alle previsioni orarie Lamma:
  - Tipologia di dato:
    - Vento: velocità (m/s) e direzione
    - Radiazione solare (W/m<sup>2</sup>)
    - Temperatura (gradi Centigradi)
  - Previsioni per le prossime 84h, aggiornate con frequenza giornaliera



Consiglio Nazionale delle Ricerche  
Istituto di Biometeorologia - Sede di Firenze

CONSORZIO LaMMA Fondatore GIANPIERO MARACCI

Meteo&Mare Servizi e progetti Consorzio | ITA |

Codice Allerta meteo  
Domenica 4 Ottobre 2020

2 Allerte attive →

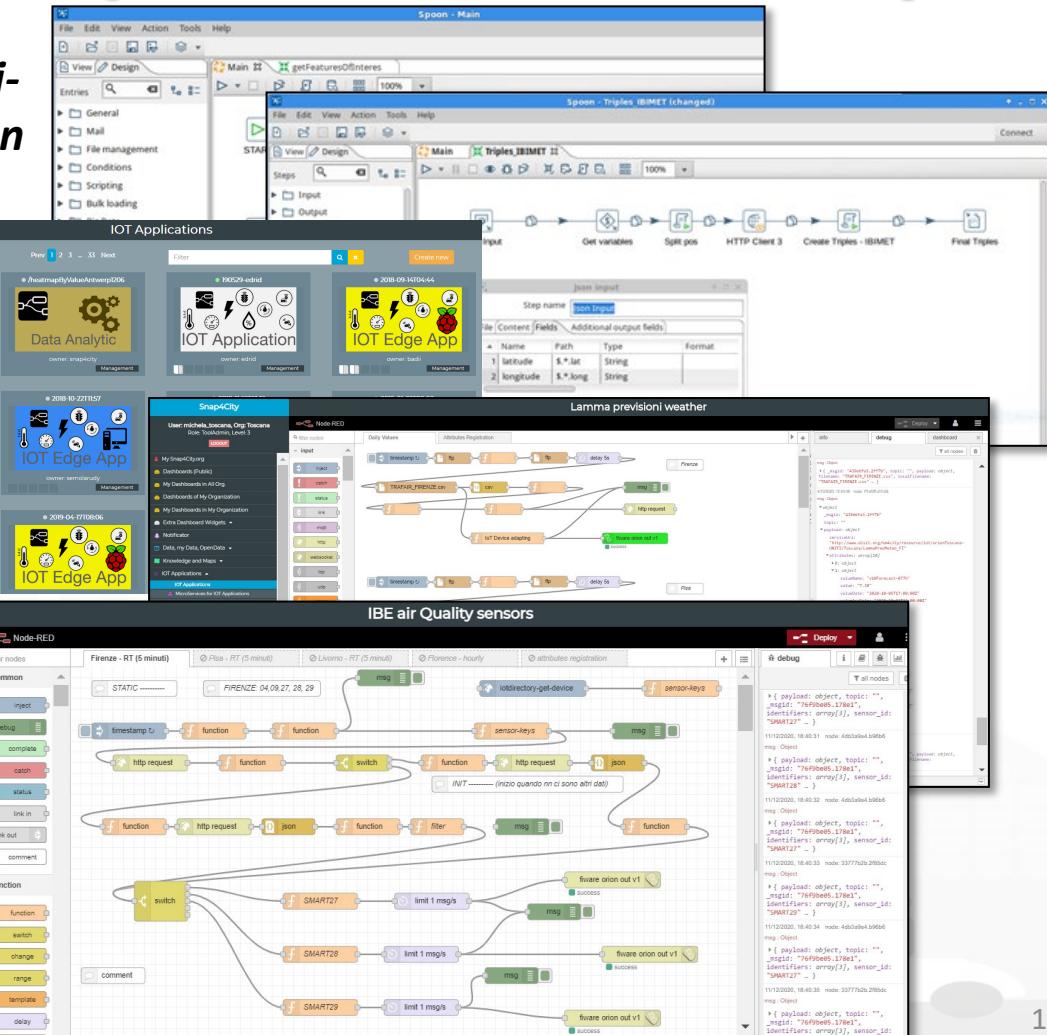
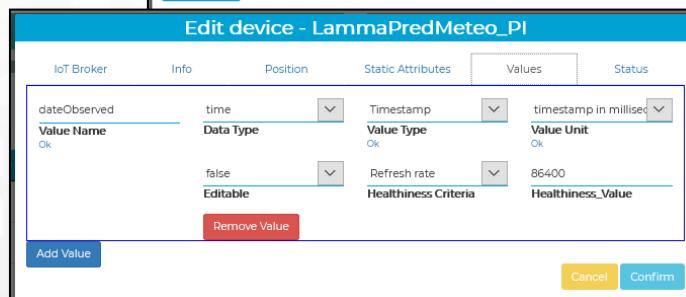
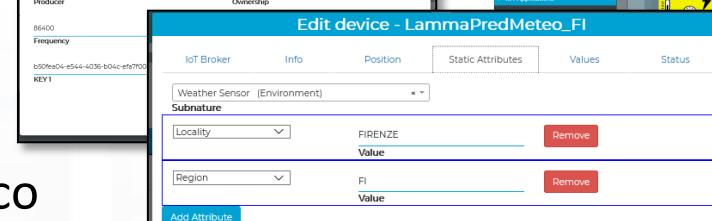
Bollettino Meteo PDF

Aggiornato domenica 4 ottobre 2020 07:31

# TRAFAIR: Raccolta dati provenienti da sensori del traffico, sensori aria e previsioni del tempo

- ETL/IoTApp per le informazioni 'statiche' (frequenza di cambiamento Bassa)
- ETL/IoT App per le informazioni periodiche:
  - Ogni 10 minuti per i dati dei sensori traffico
  - Giornaliera per i dati Lamma (previsioni meteo)

*Triples creation (KM4City multi-ontology) starting from the json data source file*



# O DI SIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

# Dati dai sensori qualità aria: ingestion e calibrazione





Snap4City
IOT Devices Management

1802 DEVICES
1791 ACTIVE
525 PUBLIC
1242 PRIVATE

Show 25 entries

	Device Identifier	IOT Broker	Device Type	Model	Ownership	Organization	Owner	Status	Edit	Delete	Location
<span style="color: blue;">+</span>	AQ_IBE_27	orionToscana-UNIFI	air_quality	IBE Air Quality	MYOWNPUBLIC	Toscana	michela_toscana	active	<span style="color: green;">EDIT</span>	<span style="color: red;">DELETE</span>	
<span style="color: blue;">+</span>	SMART04	orionToscana-UNIFI	air_quality	IBE Air Quality	MYOWNPUBLIC	Toscana					
<span style="color: blue;">+</span>	SMART09	orionToscana-UNIFI	air_quality	IBE Air Quality	MYOWNPUBLIC	Toscana					
<span style="color: blue;">-</span>	SMART28	orionToscana-UNIFI	air_quality	IBE Air Quality	MYOWNPUBLIC	Toscana					

Broker URI: 192.168.1.47

Kind: sensor

Device Type: air\_quality

Protocol: ngsi

Model: IBE Air Quality

Longitude: 11.2440

Device Uri: <http://www.dit.org/km4city/resource/iot/orionToscana-UNIFI/Toscana/SMART28>

Organization: Toscana

PAYOUT NOS v1

K1: 60be4e72-4371-4335-8258-6b0208443696

Created on: 2020-10-08 16:23:05

Broker Port: 8445

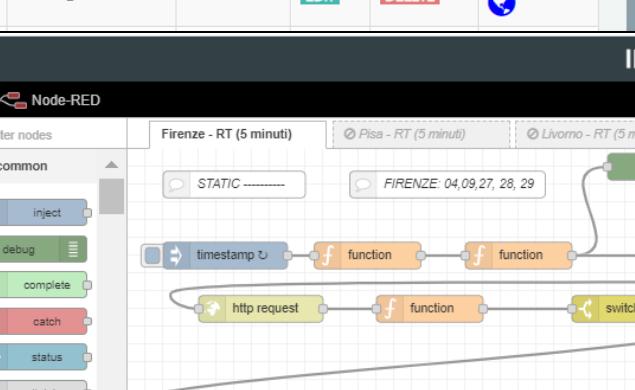
Visibility: MyOwnPublic

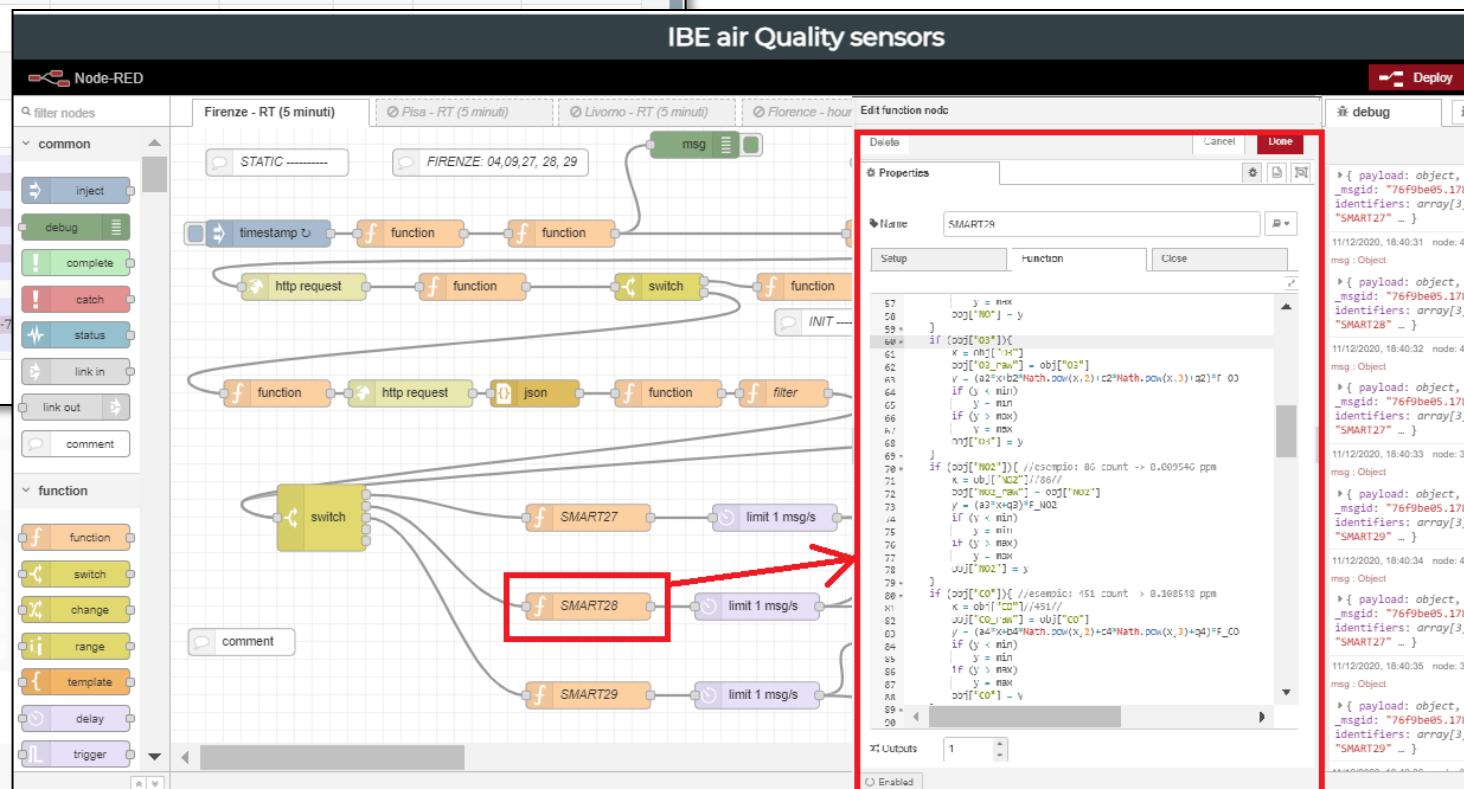
Format: json

MAC:

Producer: CNR IBE

Latitude: 43.7998





Ogni utente registrato alla piattaforma può:

1. creare i devices
2. realizzare la Propria IoTApp per ingerire i dati in tempo reale (o periodico)

# Snap4City: Gestione Dati

- Data Ingestion Tool:
  - Monitoraggio in tempo reale della qualità del dato
- Stanno arrivando correttamente i dati dai sensori del traffico?
- Nel caso di problemi chi posso avvertire?

**Snap4City**

User: michela\_toscana, Org: Toscana  
Role: ToolAdmin, Level: 3

Logout

My Snap4City.org

Dashboards (Public)

My Dashboards in All Org.

My Dashboards of My Organization

My Dashboards in My Organization

Extra Dashboard Widgets

Notifier

Data, my Data, OpenData ▾

Data Inspector

My Data, KPI, POI

My Groups of Entities

Data Set Manager - Data Gate

Add Data Sources into the Platform

High Level Types

Supported Protocols, How to add

Interoperability & Standards

Knowledge and Maps ▾

IOT Applications ▾

IOT Directory and Devices ▾

Resource Manager ▾

Development Tools ▾

Management ▾

Decision Support Systems ▾

Settings ▾

User Management and Auditing ▾

Help and Contacts ▾

Documentation and Articles ▾

My Profile ▾

Last Value

15.9

**Data Inspector**

Map

Now displaying in Standard Mode  
Switch to the Synoptic Mode to select MyKPIs and sensors that you need for your synoptic  
Switch now to the Synoptic Mode

Single data widgets

Multi data widgets

FilterMap GPSRaw GPSOn

Device Values Healthiness Process Image Licensing

GPS Coordinates: 43.79534912, 11.15452357

High-Level Type: Sensor

Nature: Mobility and Transport

Subnature: SensorSite

Last Date: 2020-10-04 09:20:00

Last Value: 120.423164

Value Type Healthy Delay (s) Reason Healthiness Criteria Refresh Rate (s) Data type Unit Value Time Trend

thresholdPerc	green	564	undefined	refresh_rate	600	float	%	Not Available	<a href="#">VIEW</a>
speedPercentile	green	564	undefined	refresh_rate	600	float	%	Not Available	<a href="#">VIEW</a>
occupancy	green	564	und						
concentration	green	564	und						
avgTime	green	564	und						
averageSpeed	green	564	und						
avgDistance	green	564	und						
vehicleFlow	green	564	und						

Time Trend

**Data sources Details**

Device Values Healthiness Process Image Licensing

Last Date: 2020-10-04 09:20:00

Last Value: 120.423164

Value Type: vehicleFlow

Healthiness Criteria: refresh\_rate

Delay: 661

Data Type: float

Period: 600

Last Update:

Healthiness Criteria 1: (2020-10-04 13:50:59) true

Healthiness Criteria 2: (2020-10-04 09:20:00) false

**Data sources Details**

Device Values Healthiness Process Image Licensing

Value Type: vehicleFlow

Healthiness Criteria: refresh\_rate

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**SNAP4CITY**

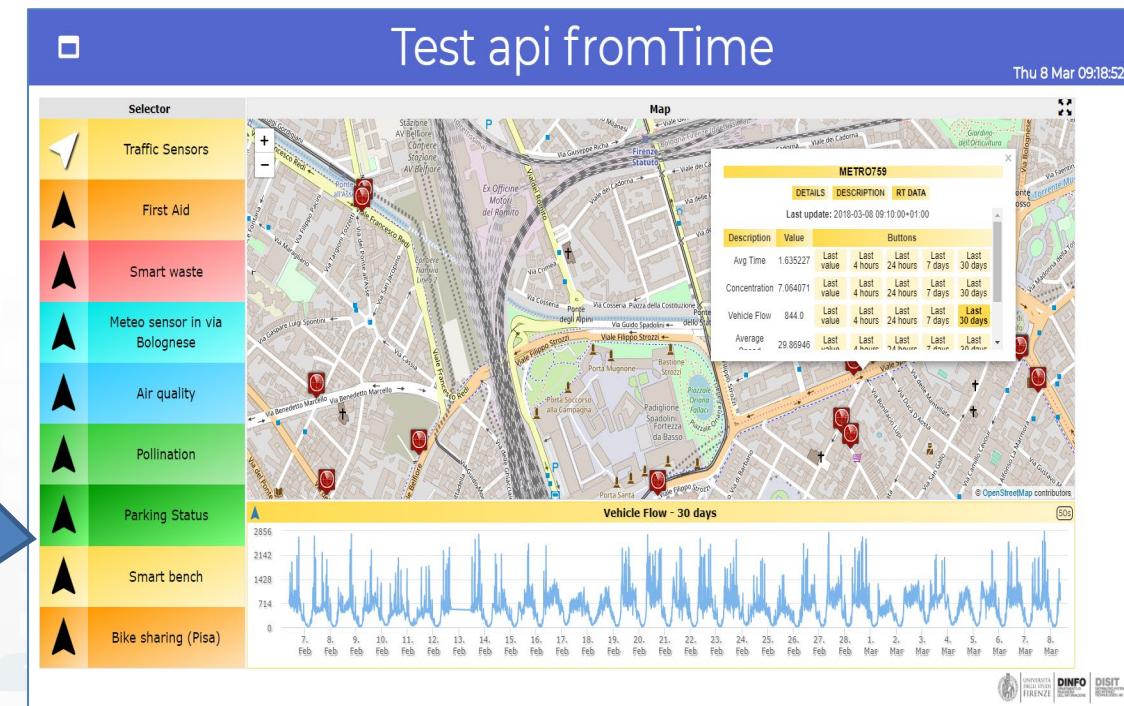
KM4CITY

Barcode

# Snap4City: Realizzazione Dashboards

The Wizard help you in selecting only possible combination of data vs graphic representation

## Dashboard Wizard



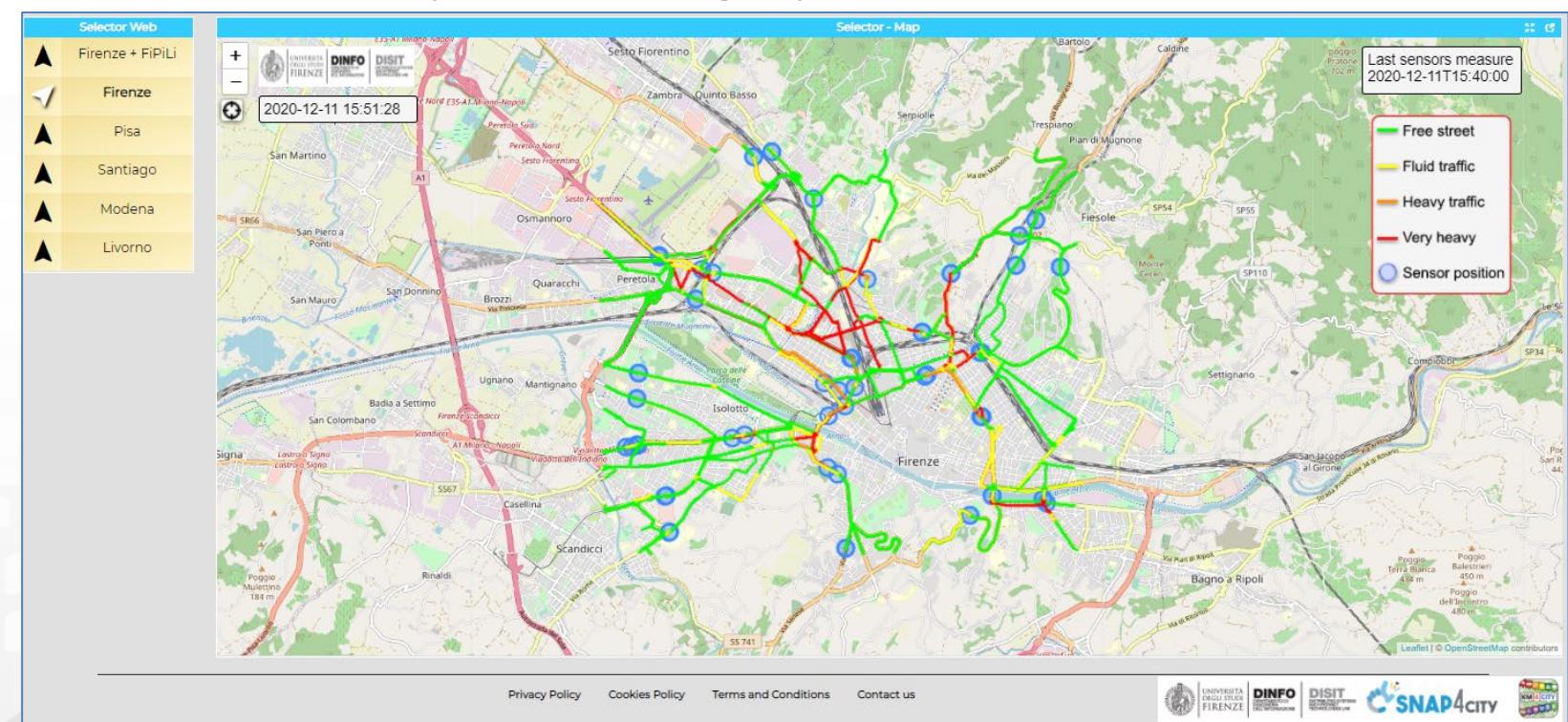
# TRAFAIR Data Dashboard: Pisa, Firenze, Livorno

<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjY4MQ==>



# Disit Traffic Model Dashboard - Firenze

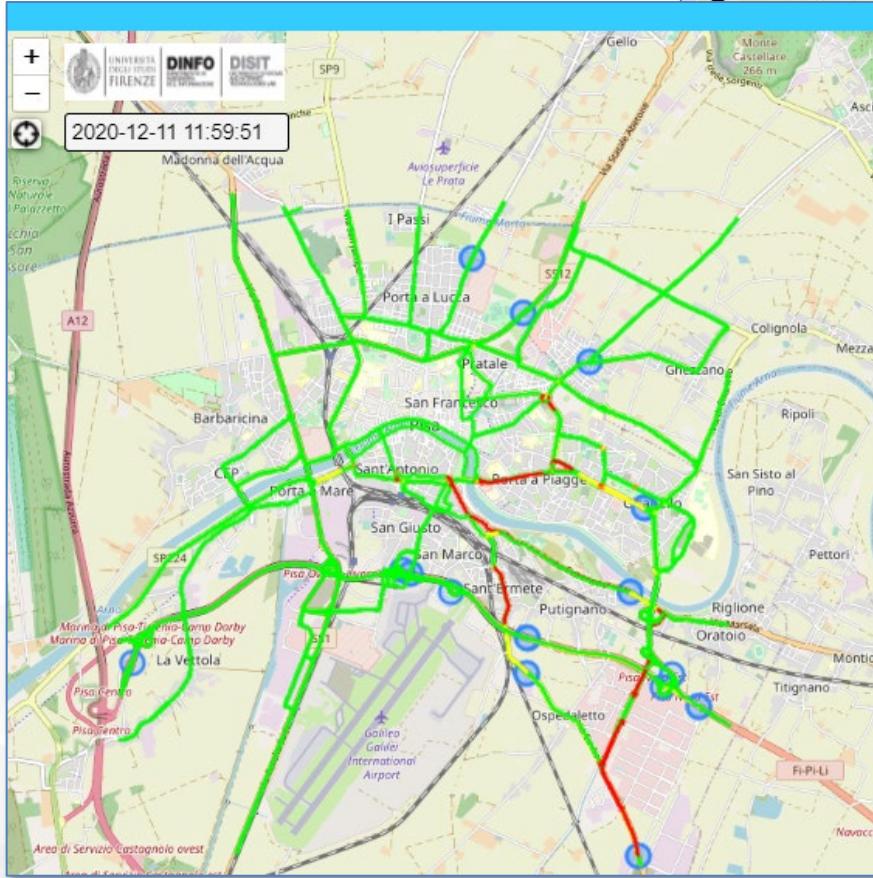
- Scopo del modello:
  - Migliorare la mobilità urbana attraverso un modello generale e auto-adattivo per una ricostruzione del traffico a basso costo in tempo reale in ogni posizione della città
- Il modello si basa su dati provenienti da:
  - Reti stradali per ottenere le infrastrutture stradali e le restrizioni al traffico (Open Street Map, Open Data delle città)
  - Sensori di traffico (Regione Toscana e Comuni)



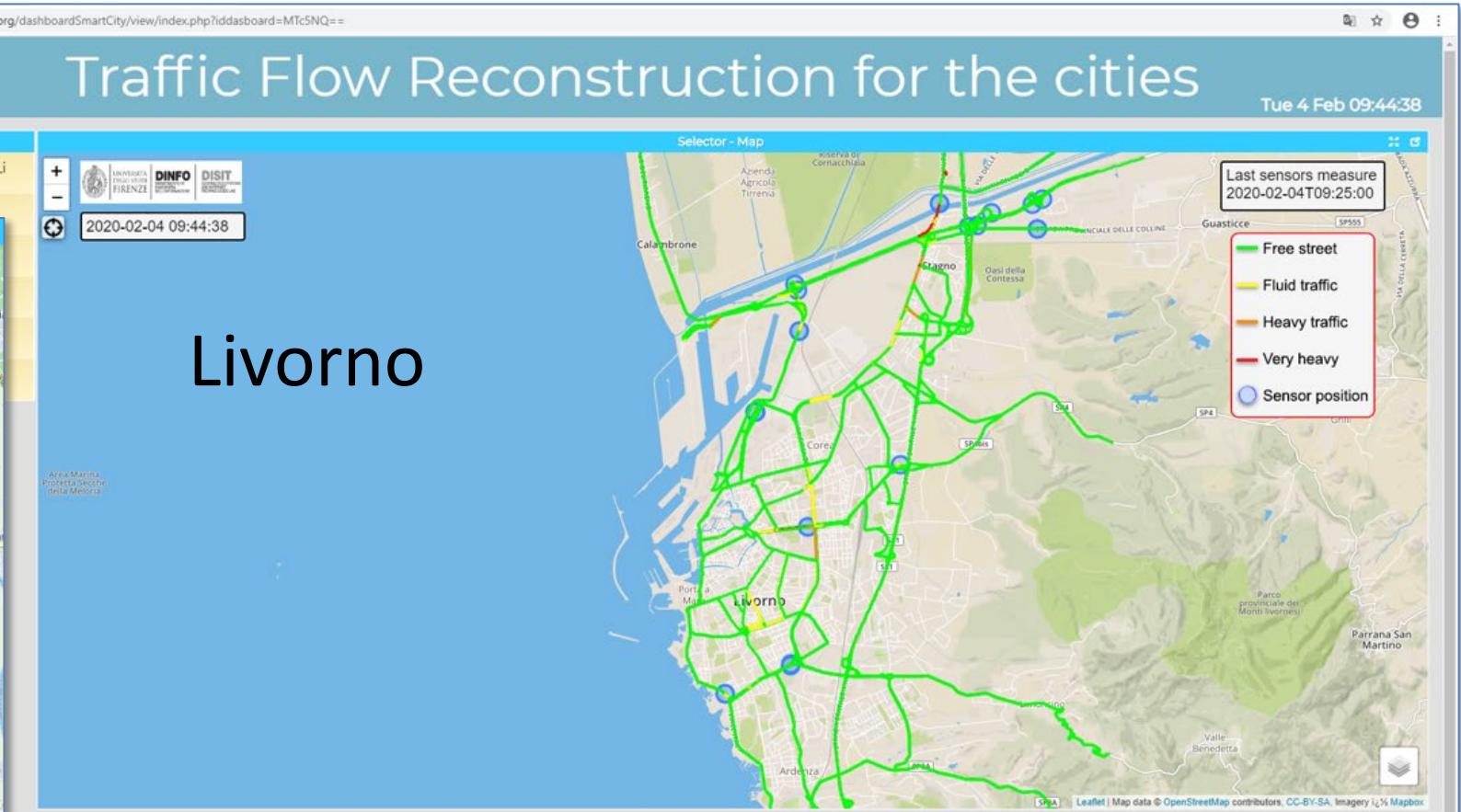
# Disit RT Traffic Model SNAP4CITY

## Dashboards: Pisa, Livorno

Pisa



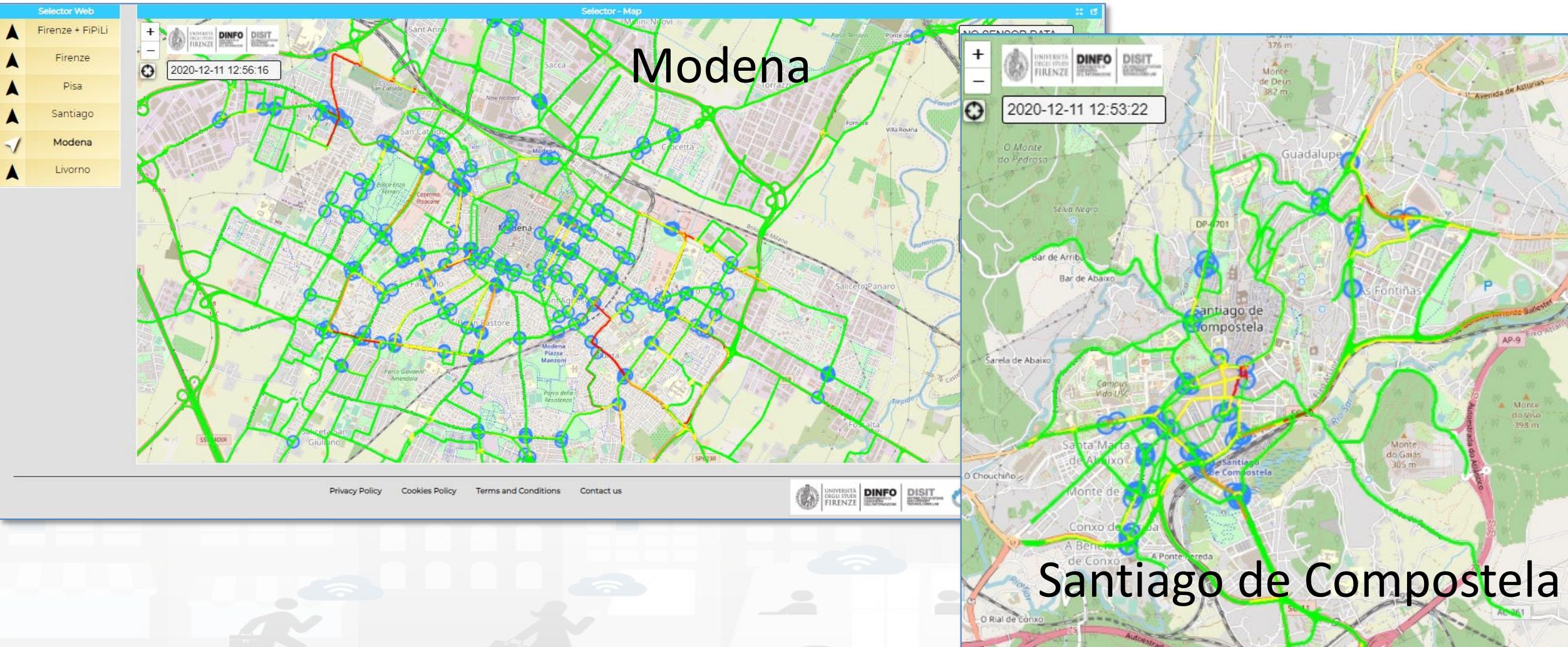
Livorno



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTc5NQ==>

# Dashboards: Modena, Santiago de Compostela

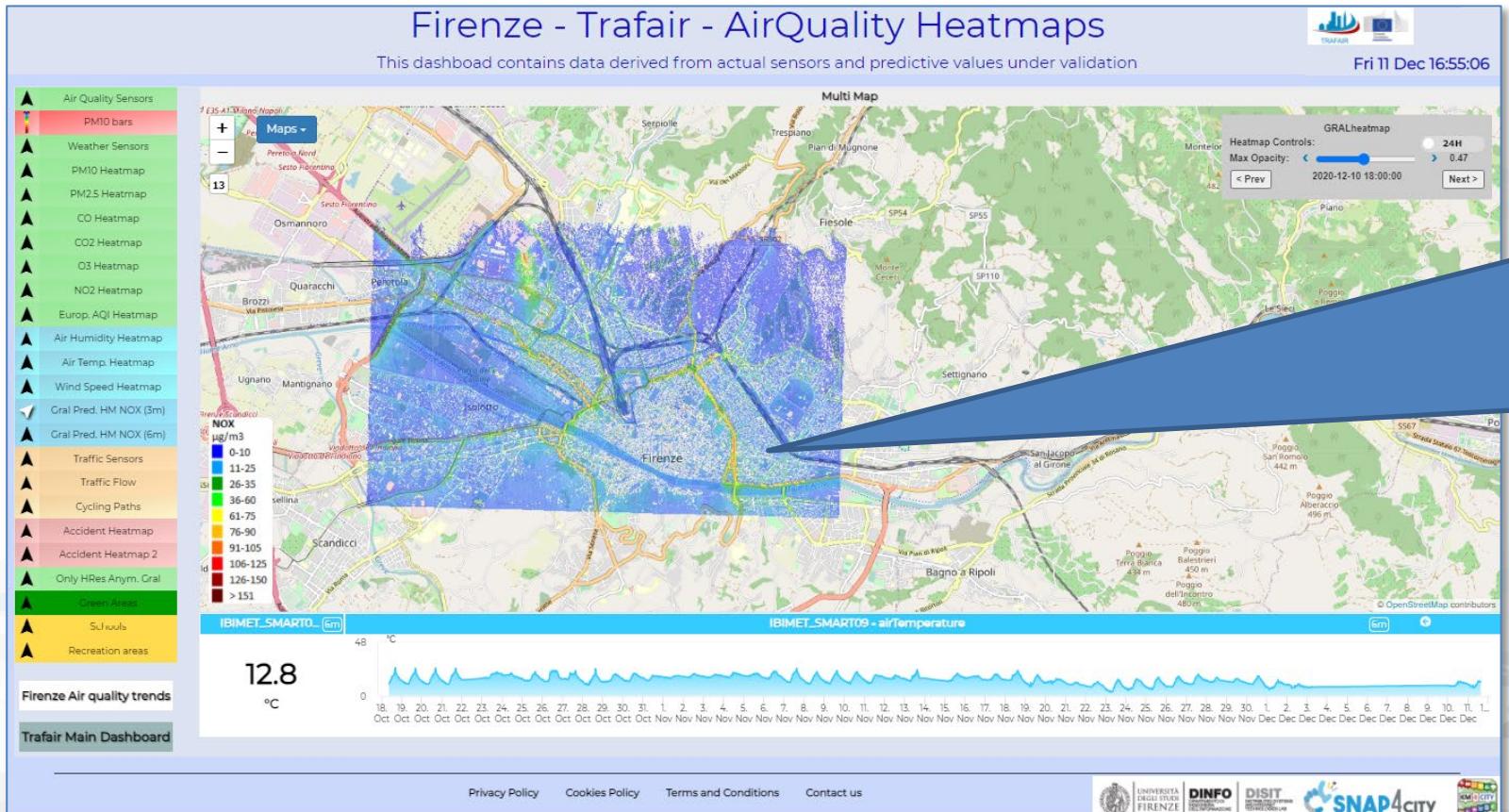
<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc5NQ==>



# Dashboard: Firenze

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

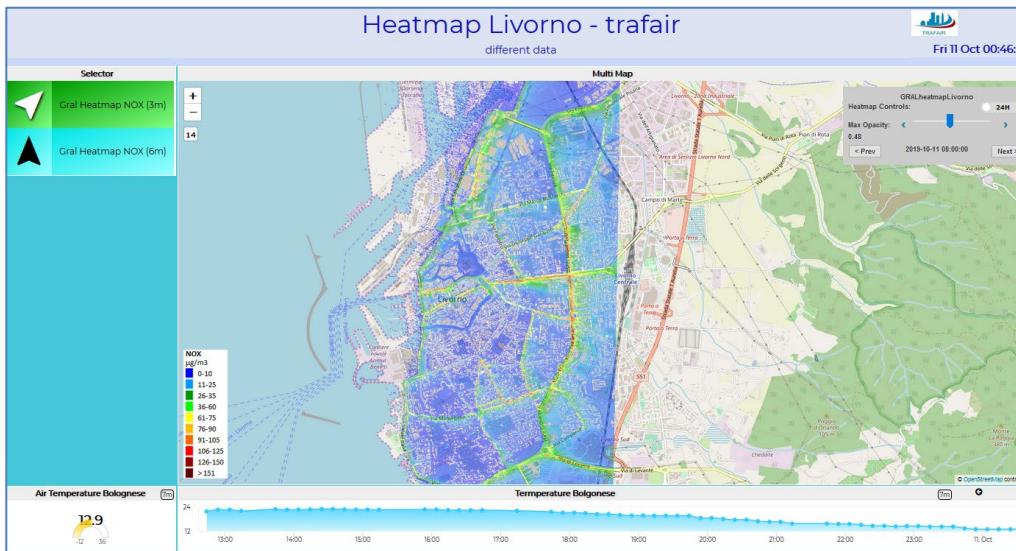
- La Dashboard descrive la mappa della concentrazione di NOx previsto nella città di Firenze sia a 3 che a 6 metri (risoluzione 4x4 metri)
  - Dalla dashboard è possibile vedere animazioni 24 ore su 24 e relative ai due giorni successivi (48 ore)



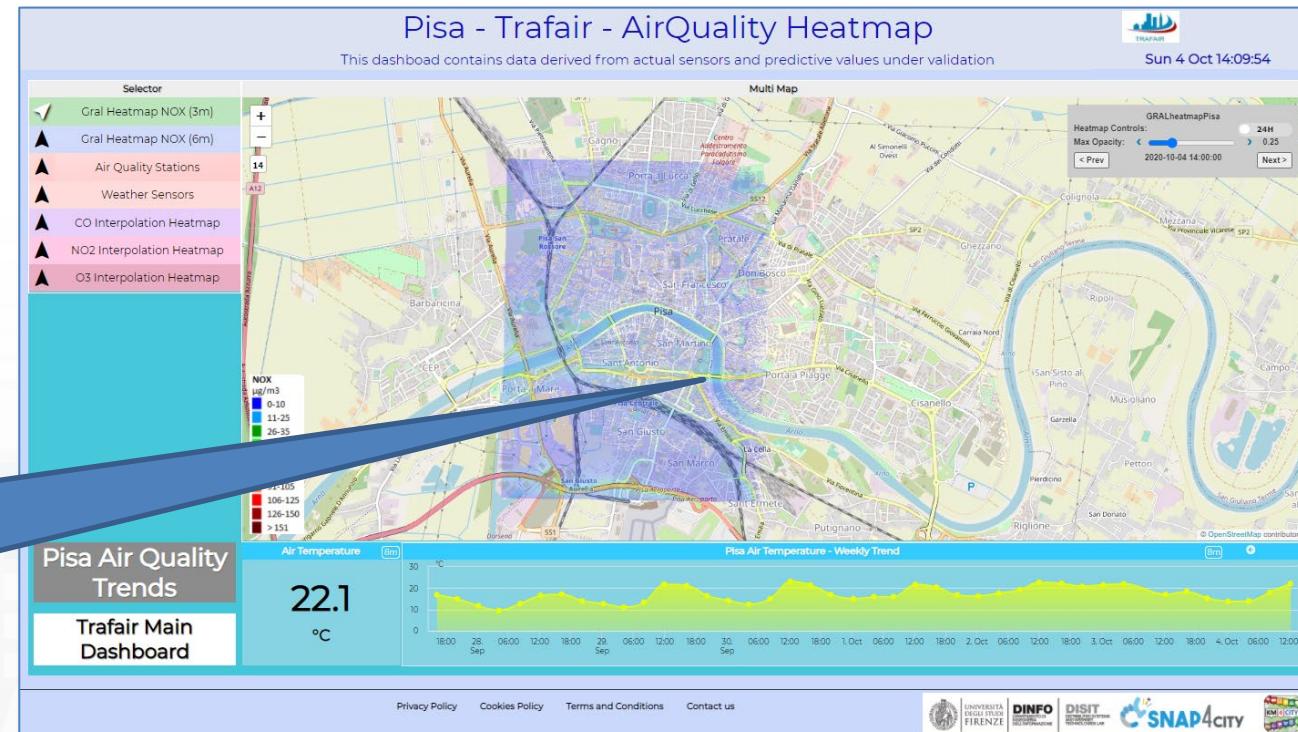
# prediction Dashboards: Firenze e Livorno

Livorno

<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTgzMw==>



Pisa



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTc2Nw==>



# Heatmap Pisa - trafair

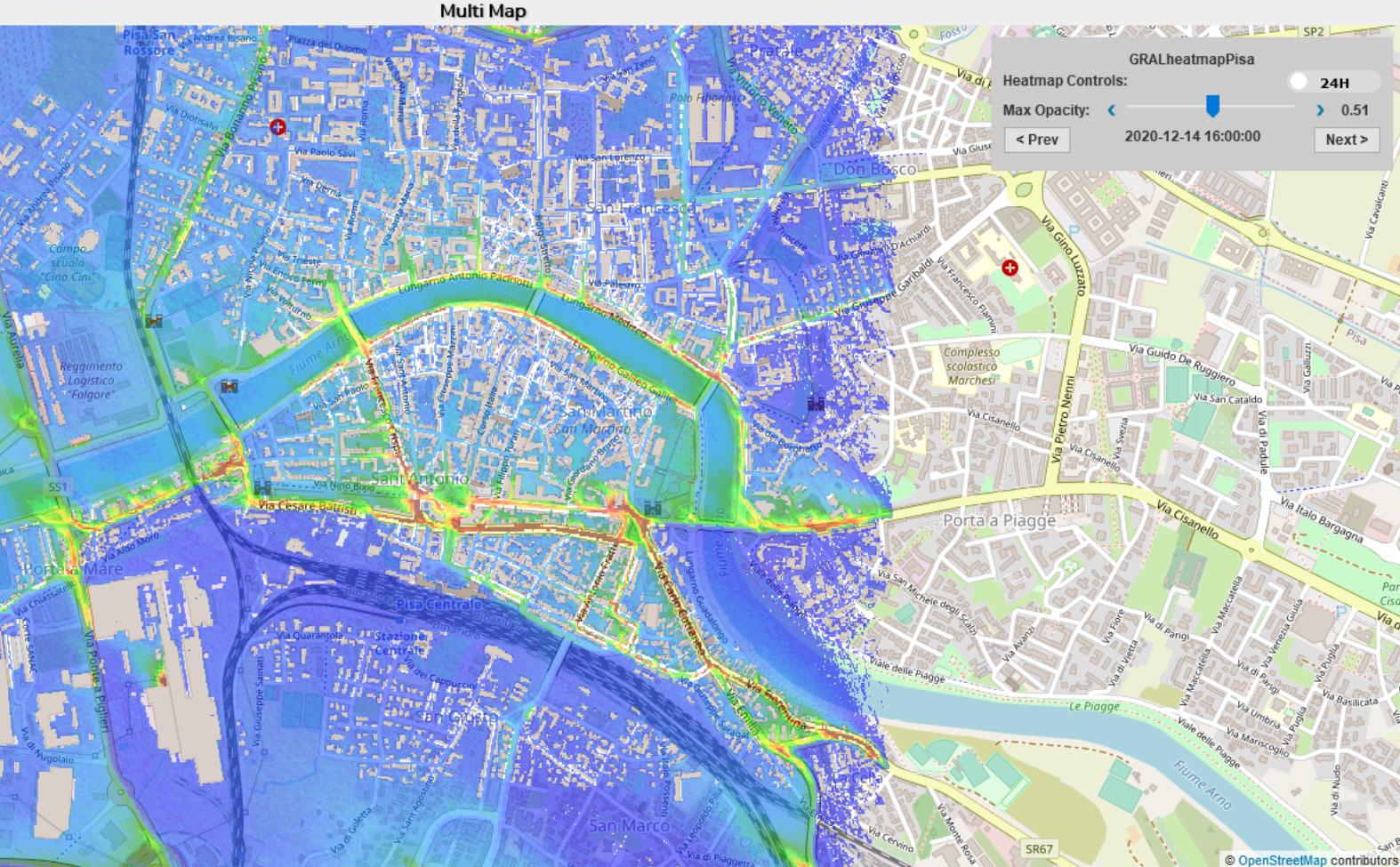
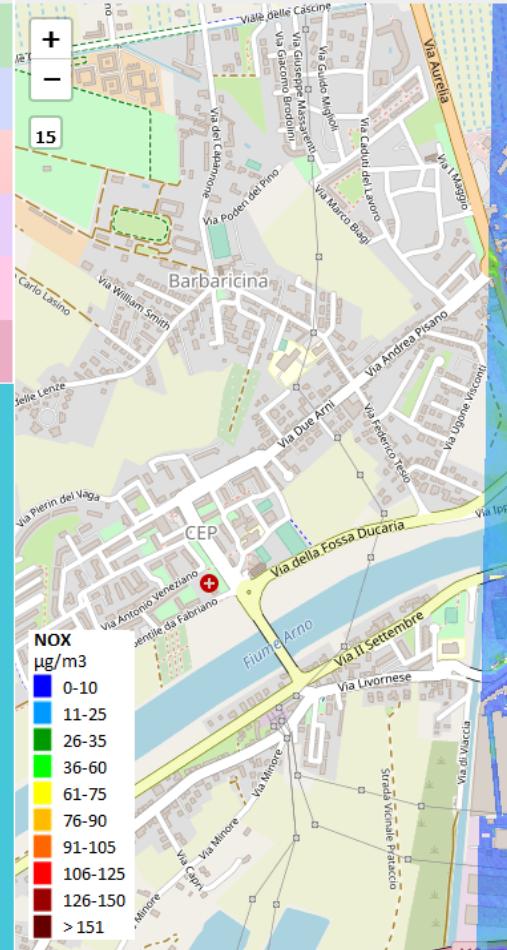


This dashboard contains data derived from actual sensors and predictive values under validation

Mon 14 Dec 16:54:29

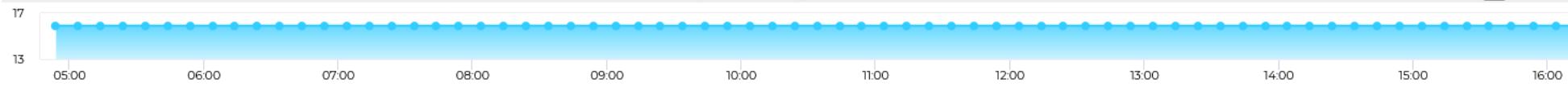
## Selector

- Gral Heatmap NOX (3m)
- Gral Heatmap NOX (6m)
- Air Quality Stations
- CO Interpolation Heatmap
- NO<sub>2</sub> Interpolation Heatmap
- O<sub>3</sub> Interpolation Heatmap



## Air Temperature Bolognese

9m



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SNAP4CITY

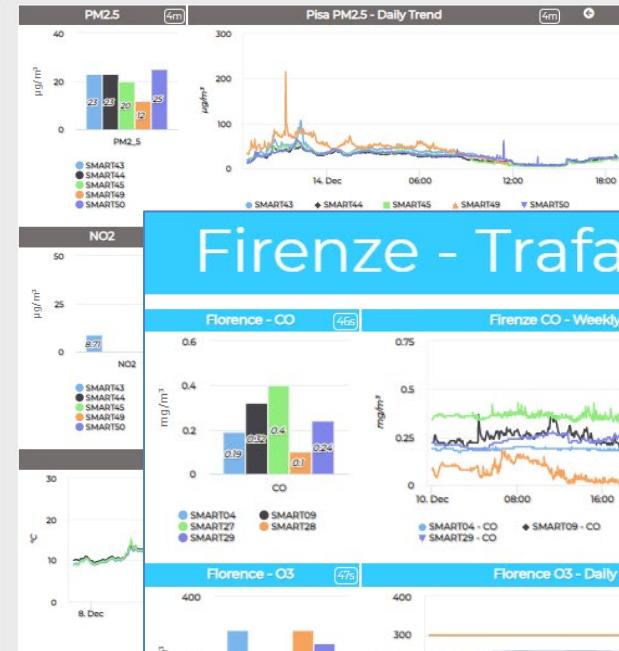
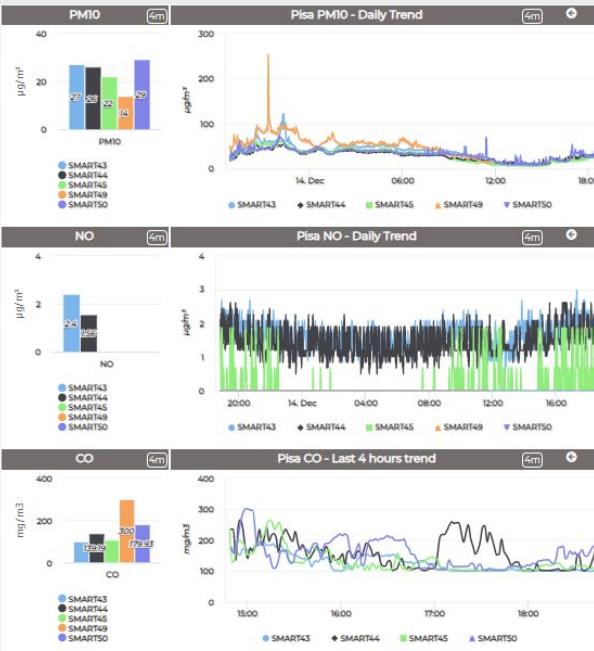
# Air Quality Trend: Firenze e Pisa

## Pisa - Trafair - AirQuality Trends



Pisa Main Dashboard

Trafair Main Dashboard



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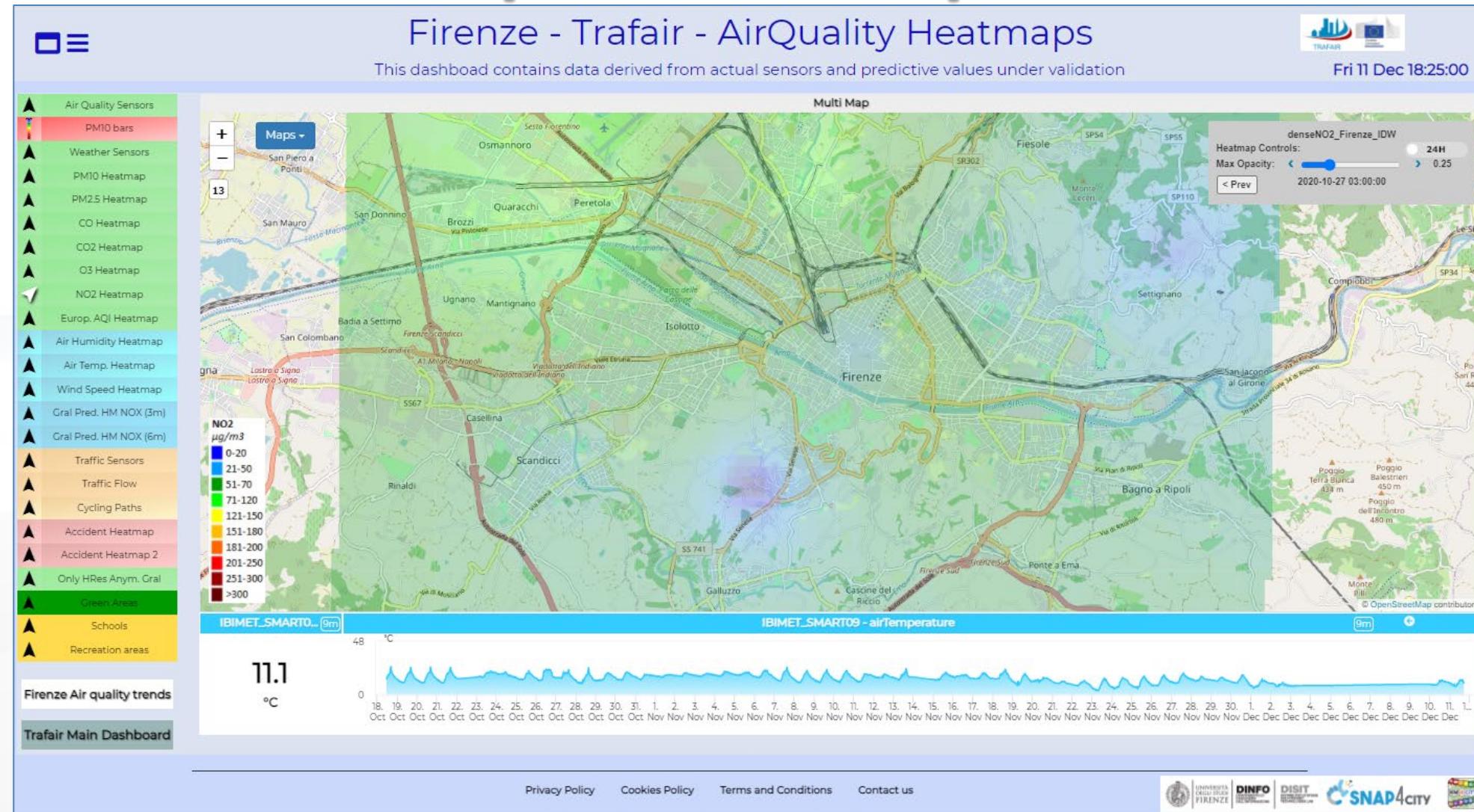
## Firenze - Trafair - AirQuality Trends

Fri 11 Dec 17:45:36



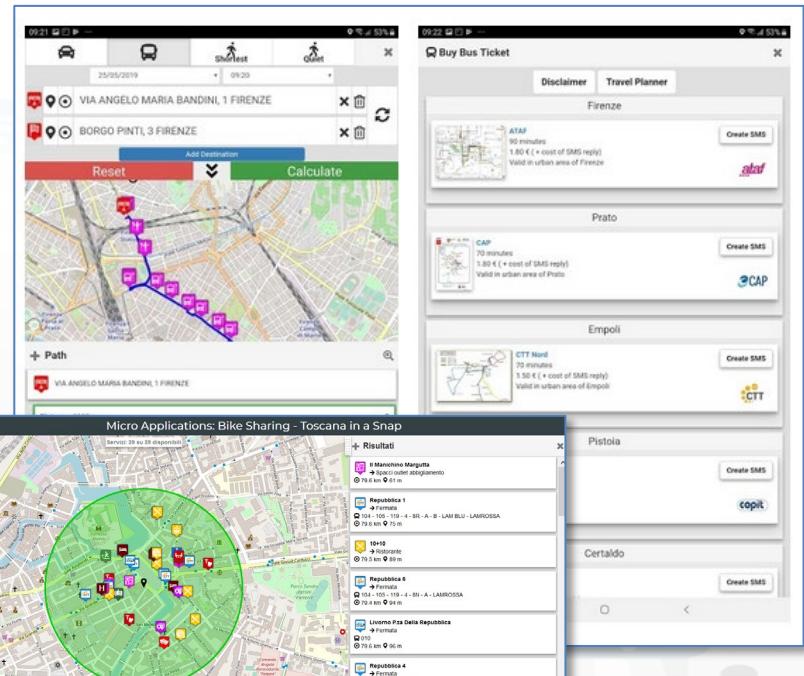
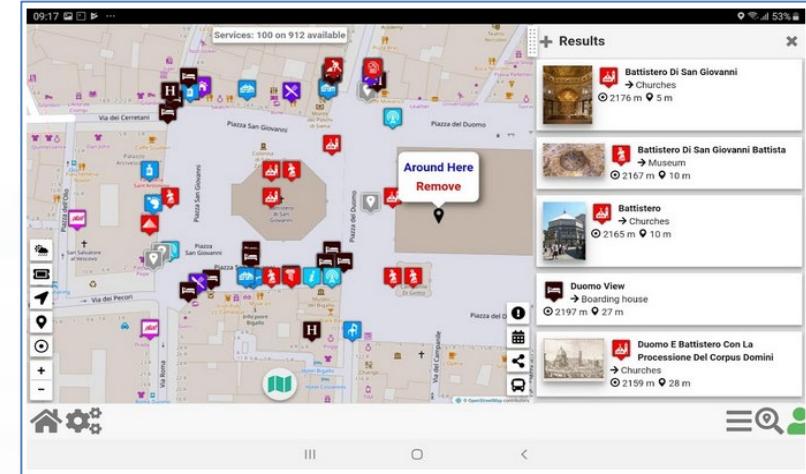
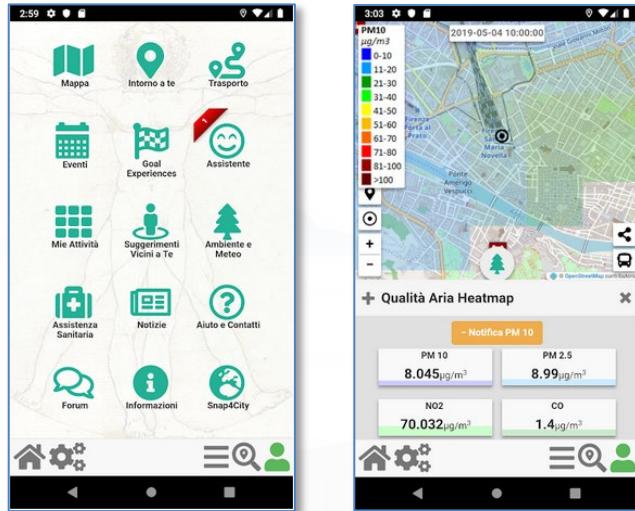
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## Interpolation Maps: NO<sub>2</sub>



# Mobile App Per cittadini/studenti/turisti e pendolari

<https://play.google.com/store/apps/details?id=org.disit.snap4city.mobileApp.tuscany&hl=it>



- Snap4City è un assistente personale su tutte le città e le aree della Toscana:
  - ambiente, mobilità e trasporti, cultura e turismo, intrattenimento, ma anche ospedali, meteo, orari del trasporto pubblico (13 operatori), pianificazione viaggi, qualità dell'aria, previsioni del tempo, percorsi multimodali, parcheggi, predizione sui posti liberi nei parcheggi, car sharing, piste ciclabili, notizie ed eventi, biglietterie, stazioni di rifornimento, noleggio, stato della pollinazione, etc.

## Mobile App: *Toscana in a Snap4*

<https://play.google.com/store/apps/details?id=org.disit.snap4city.mobileApp.tuscany&hl=it>



- I dati disponibili sono elencati sul portale Snap4city (<https://www.snap4city.org>)
- La maggior parte dei dati sono dati aperti (Open Data), altri possono essere privati e accessibili solo per un periodo di tempo limitato in base alle sperimentazioni in atto
- La registrazione sulla Mobile App *Toscana in a Snap4*, è valida anche per il portale Snap4City, su cui è possibile:
  - Gestire il proprio profilo in base al regolamento GDPR della Commissione europea
  - Avere accesso a molti altri servizi dal tuo portatile e da altri dispositivi
  - Connettere i propri dispositivi (e.s. sensori qualità aria, temperature, etc.) e creare le proprie IoTApp o Dashboards

# Snap4City



## Mobile App: Non solo Toscana...

<https://play.google.com/store/apps/details?id=org.disit.snap4city.mobileApp.helsinki&hl=it>

HELSINKI

Antwerp in a Snap  
DISIT Lab, paolo nesi

★★★★★



Helsinki air quality index

Notification Helsinki AQI

PM 10: 10.962 µg/m<sup>3</sup>, PM 2.5: 4.648 µg/m<sup>3</sup>

NO2: 15.941 µg/m<sup>3</sup>, Helsinki AQI: 1.048

Helsinki Multi Data H2

Helsinki vs Antwerp comparison

Temperature: 5.311 °C, Humidity: 86.593 %

Around Here

PM10: 8 ppm, PM2.5: 2 ppm, dateObserved: 2019-05-13T17:59:01.589000+02:00, reliability: 0.5, source: https://fh.vihilmanni.tu2

airQualityPM2\_5AverageLastHour: 1.3, airQualityPM2\_5RealTimeDelta: -3.6, airQualityM10RealTimeDelta: -8.45, airQualityPM10AverageLastHour: 3.75, realTimeAQI: 1, EnfuserAQI: 1.7, realTimeDeltaAQI: -0.7, airQualityPM10Enfuser: 12.2, airQualityPM2\_5Enfuser: 4.9

Upload Photo Take Photo

Helsinki

Air Quality

Notification PM 10

PM 10: 15.502 µg/m<sup>3</sup>, PM 2.5: 4.976 µg/m<sup>3</sup>

NO2: 20.285 µg/m<sup>3</sup>, SO2: 0.856 µg/m<sup>3</sup>

Services: 26

Map, Around you, Transport, Assistant, Goal Experiences, Suggestions Near You, Weather Forecast, Air Quality, Weather, Help and Contacts, My Activity, Forum, Information, Snap4City

Results

Antwerpen Kasteelplein: BusStop, 10-10-13-13-14-8-8, 1230 m

Antwerpen Groenplaats Metro: BusStop, 15-15-3-3-5-5-9-9

Tunnel

Closer

St. Anna Pedestrian Tunnel Right Side: Underpass, Escalators Status, Tunnel Status

St. Anna Ferry Right Stop: Ferry stop

Monday: Sun, 16.25 °C, 18.33 °C, 13.89 °C, 53.6 m/s

Tuesday: Sun, 14.45 °C, 11.95 °C, 29 °C, 53.5 m/s

Wednesday: Sun, 15.42 °C, 20.65 °C, 41 °C, 53.4 m/s

Thursday: Sun, 15.89 °C, 18.4 °C, 31 °C, 53.3 m/s

Friday: Cloudy, 11.95 °C, 18.4 °C, 29 °C, 53.2 m/s

Saturday: Sun, 20.65 °C, 26.4 °C, 54 °C, 44.6 m/s

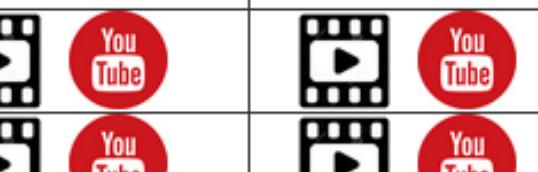
S4cantwerptrackerlocation

Cancel, Edit, Delegate

Show 10 entries, Values, DataTime, Latitude, Longitude

Antwerp

## On Line Training Material (free of charge)

	1st part (*)	2nd part (*)	3rd part (*)	4th part (*)	5th part (*)	6th part (*)	7th part (*)	
what	General	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	
PDF	 	 	 	 	 	 	 	 
Interactive	 	 	 	 	 	 	 	 
Video1	 	 	 	 	 	 	 	
Video2	 	 	 	 	 	 	 	
Video3	 	 	 	 	 	 	 	
Video4	 	 	 	none	 	none	none	
duration	2:55	3:16	3:41	2:00	2:48	2:35	1:47	