

QUAINT project and the Italian Atlas of Transport

**Paolo Beria, Alberto
Bertolin, Raffaele Grimaldi,
Antonio Laurino, Dario
Nistri, Samuel Tolentino**

**Andrea Debernardi,
Emanuele Ferrara,
Gabriele Filippini**

LABORATORIO DI POLITICA DEI TRASPORTI
TRASPOL
RESEARCH CENTER ON TRANSPORT POLICY



POLITECNICO
MILANO 1863

DIPARTIMENTO DI ARCHITETTURA
E STUDI URBANI

META
mobilità
economia
territorio
ambiente



CONTENTS

- QUAINT project aims
- Model and project structure
- Database contents and structure
- Preliminary results
- The Atlas of Italian Transport



QUAINT project aims

Aims

QUAINT project aims at:

- ✓ 1. creating a **unique database of all Italian long distance transport components** (infrastructure, services, market conditions, demand);
- ⌚ 2. developing a **quantitative and spatial tool** for the analysis of passenger long distance transport plans and policies at national level;
- ✓ 3. analysing the **existing situation**, through maps, simulations and complex accessibility indicators;
- ✓ 4. effectively visualise current transport trends and the effect of future policies, with the creation of an **Atlas of Italian transport**;
- ⌚ 5. **evaluating a broad range of projects, plans and policies**, included in current official planning or alternative.

→ this is also requested by the recent:





The innovations and impacts of the project are of different nature.

A. We built the most **comprehensive (and huge) geographical description of Italian transport sector**, before not existing even at governmental level.

- * national-scale
- * homogeneous (Milan is as detailed as Crotone)
- * multimodal

B. We are developing a **forefront tool for spatial analysis and assessment** of scenarios, plans and policies.

- * independent → **influence the debate on Italian transport policies**

C. **Methodological innovations:** the construction of a multimodal timetable based on hyper-graph; the direct connection between simulation model and economic assessment; the use of data mining techniques for market structure analysis; etc.



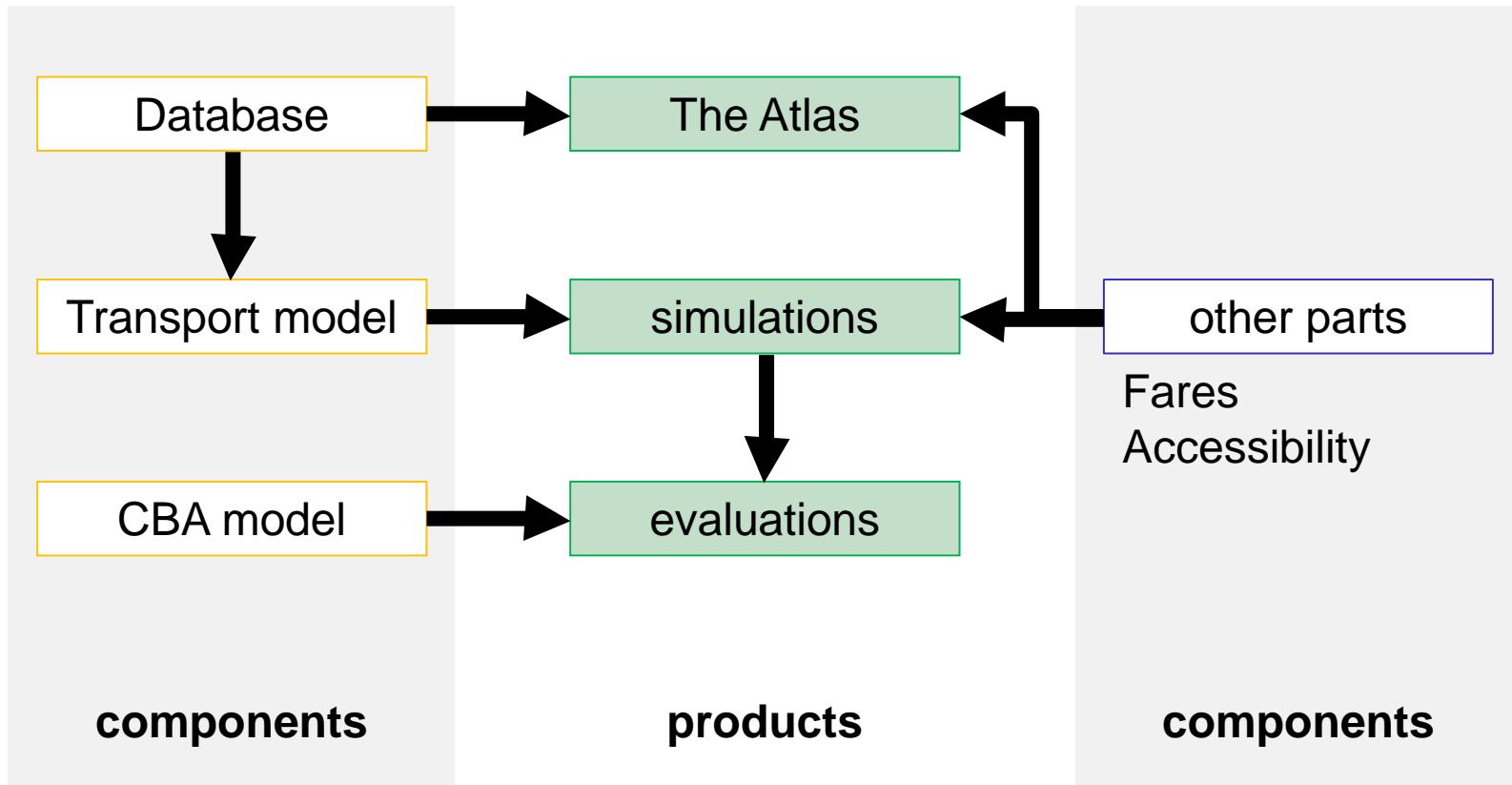
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Model & project structure

The components of QUAINT





Model & project structure

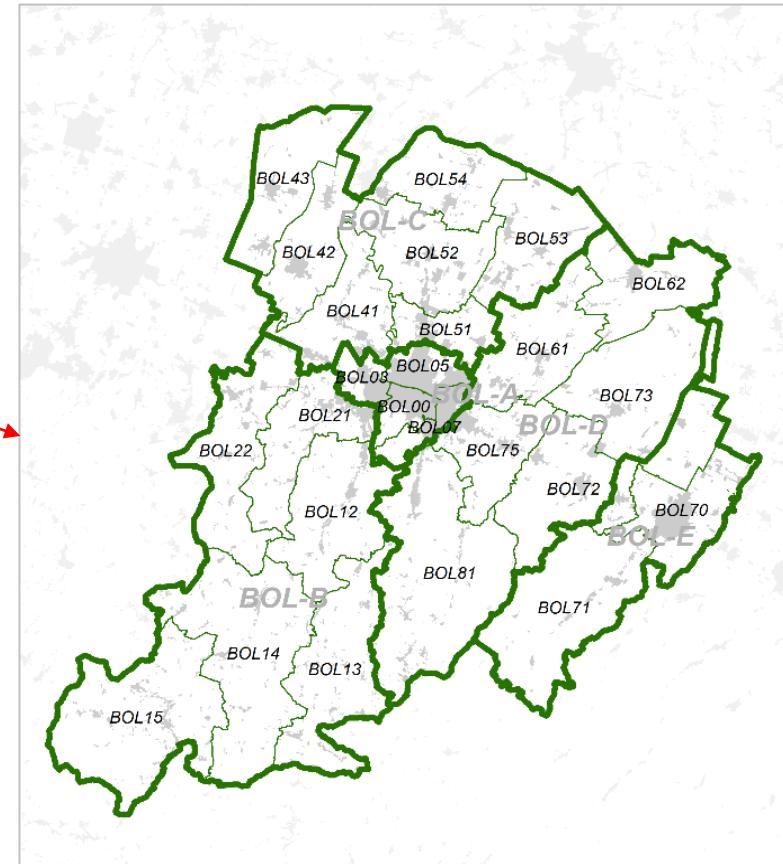
Zoning

The model is multi-level. Level “T-4” (*NUTS-4-like*): 371 zones. “T-5”: **1764 zones**

QUAINT base model (T-4: 371 zones)



QUAINT detailed model (T-5: 1764 zones)





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Database contents and structure

Database structure

The first *half* of QUAINT work consisted in a huge work of data collection and homogenisation, to feed the model database.

Such data come from various sources:

- i. Official statistical data (e.g. census)
- ii. Other databases (e.g. land use maps, air timetable)
- iii. Ad-hoc surveys (e.g. fares)
- iv. Manual input (e.g. rail timetables, coach timetables)
- v. Manual redraw of existing sources (e.g. rail and road networks are redrawn on the basis of Openstreetmap).

It is worth remembering that all of this is collected at the **country-level and homogeneously** across the country: if one information is partial, it is excluded!



Database contents and structure

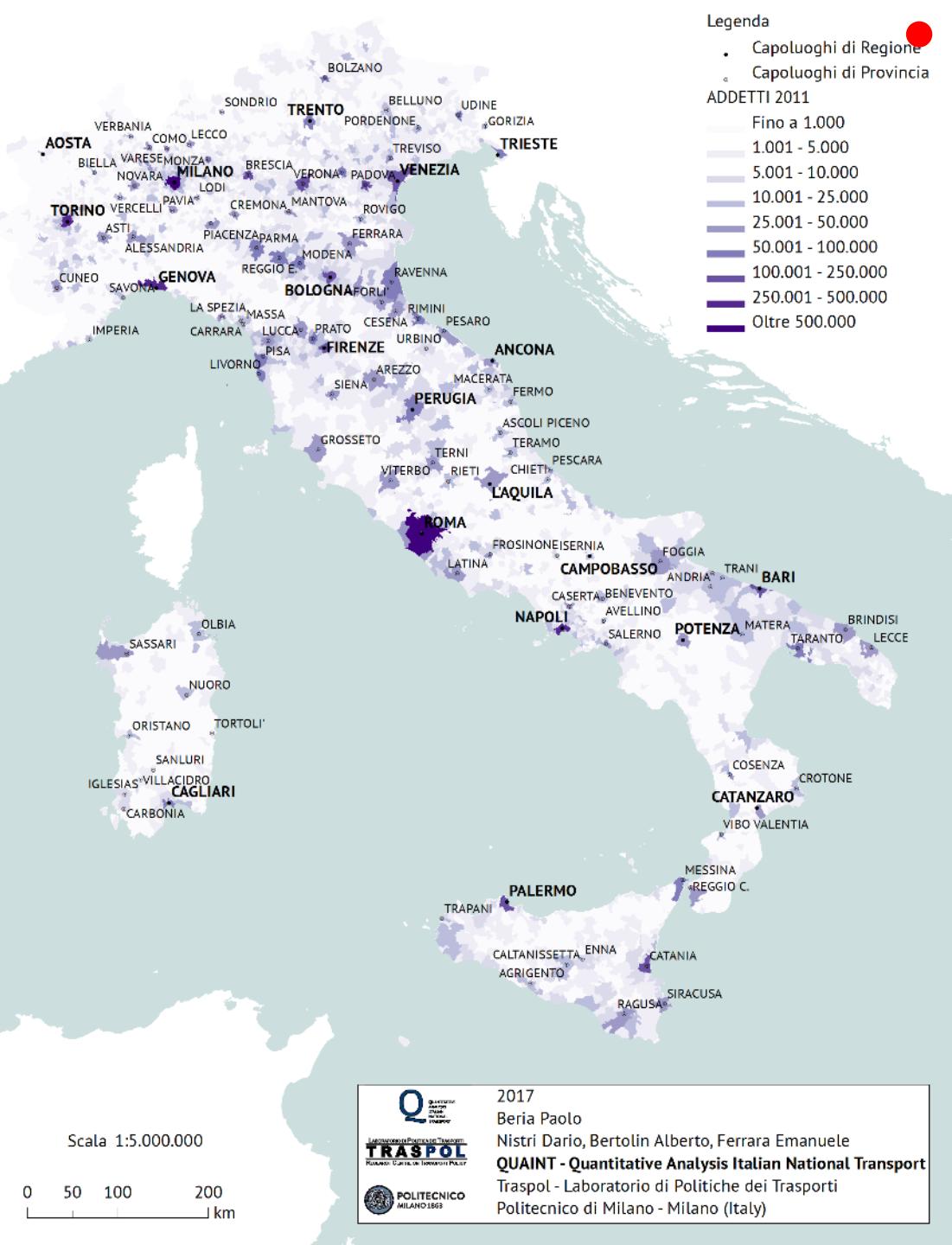
1. Demographics

Most of demographical data come from ISTAT, but all of them are spatialized

- ✓ Municipality level
- ✓ Census precinct level ("particelle censuarie")

Later, these information are aggregated at the model scales (zones T-4 or T-5)

municipality-level representation →





Database contents and structure

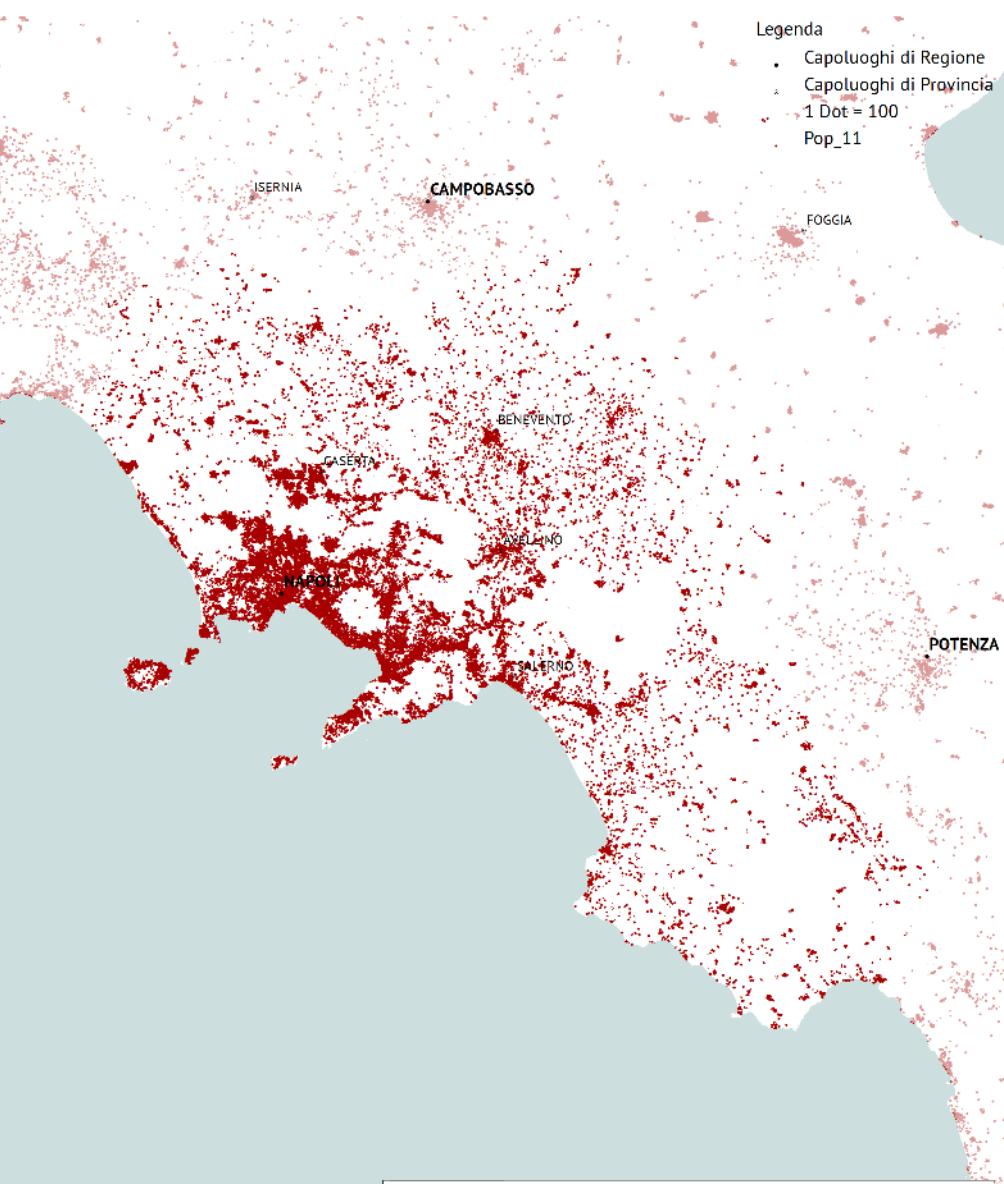
1. Demographics

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- ✓ Census precinct level (“particelle censuarie”)

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“particelle censuarie” representation →





Legenda

- Capoluoghi di Regione
- Capoluoghi di Provincia
- ZoneT5
- Grafo Stradale
- CLASSE
 - 2 : Autostrade
 - 3 : Rete primaria
 - 4 : Rete secondaria
 - 5 : Rete locale
- OSM Italia





Database contents and structure

2. Infrastructure

Road networks are classified:

- In **classes** according to the role in the model
- In **types** according to the geometrical characteristics

Class 2+3 roads →





Database contents and structure

2. Infrastructure

Road networks are classified:

- In **classes** according to the role in the model
- In **types** according to the geometrical characteristics

Class 4 roads →





Database contents and structure

2. Infrastructure

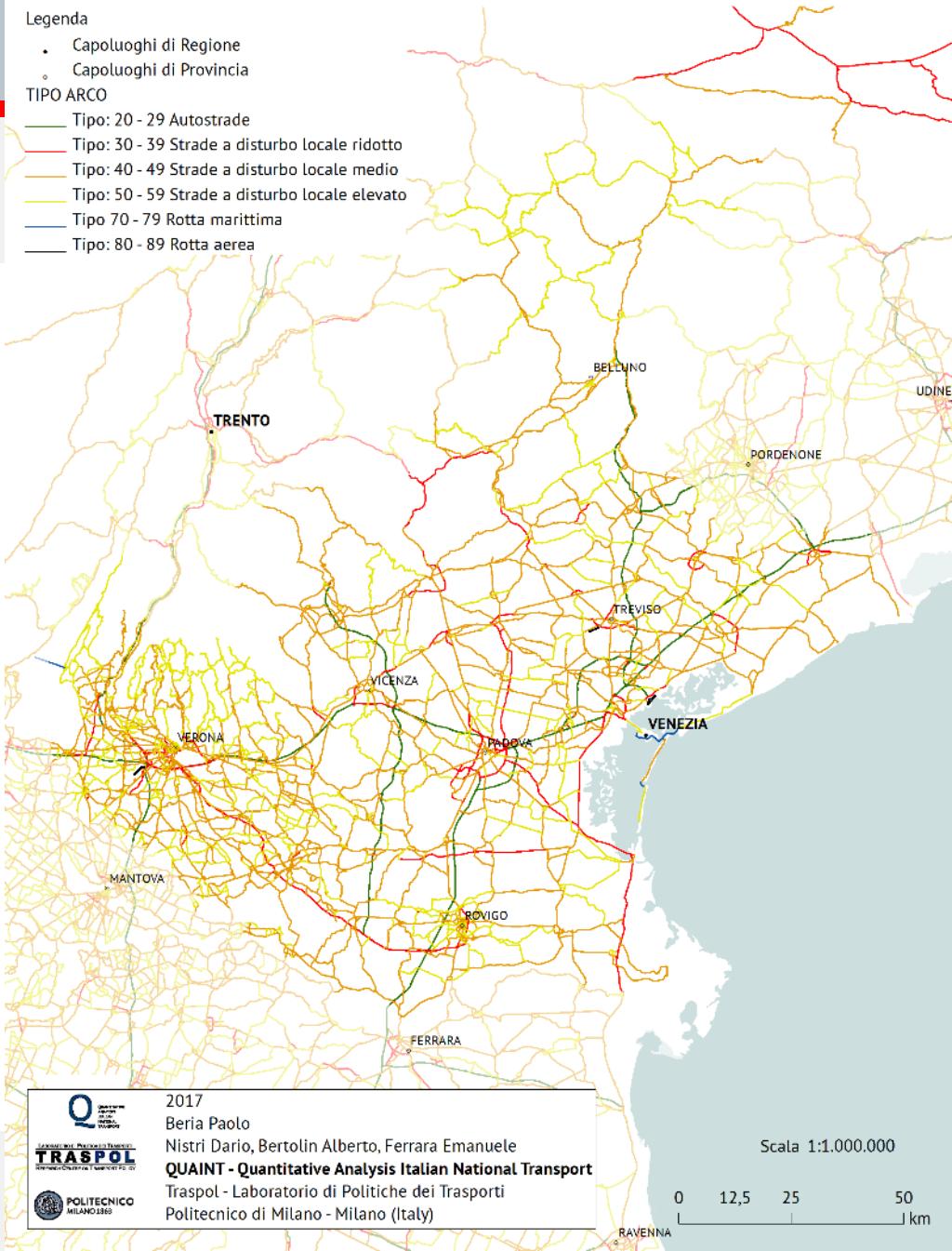
Road networks are classified:

- In **classes** according to the role in the model
- In **types** according to the geometrical characteristics

Example of road network modelled →

Legenda

- Capoluoghi di Regione
 - Capoluoghi di Provincia
- TIPO ARCO
- Tipo: 20 - 29 Autostrade
 - Tipo: 30 - 39 Strade a disturbo locale ridotto
 - Tipo: 40 - 49 Strade a disturbo locale medio
 - Tipo: 50 - 59 Strade a disturbo locale elevato
 - Tipo 70 - 79 Rotta marittima
 - Tipo: 80 - 89 Rotta aerea





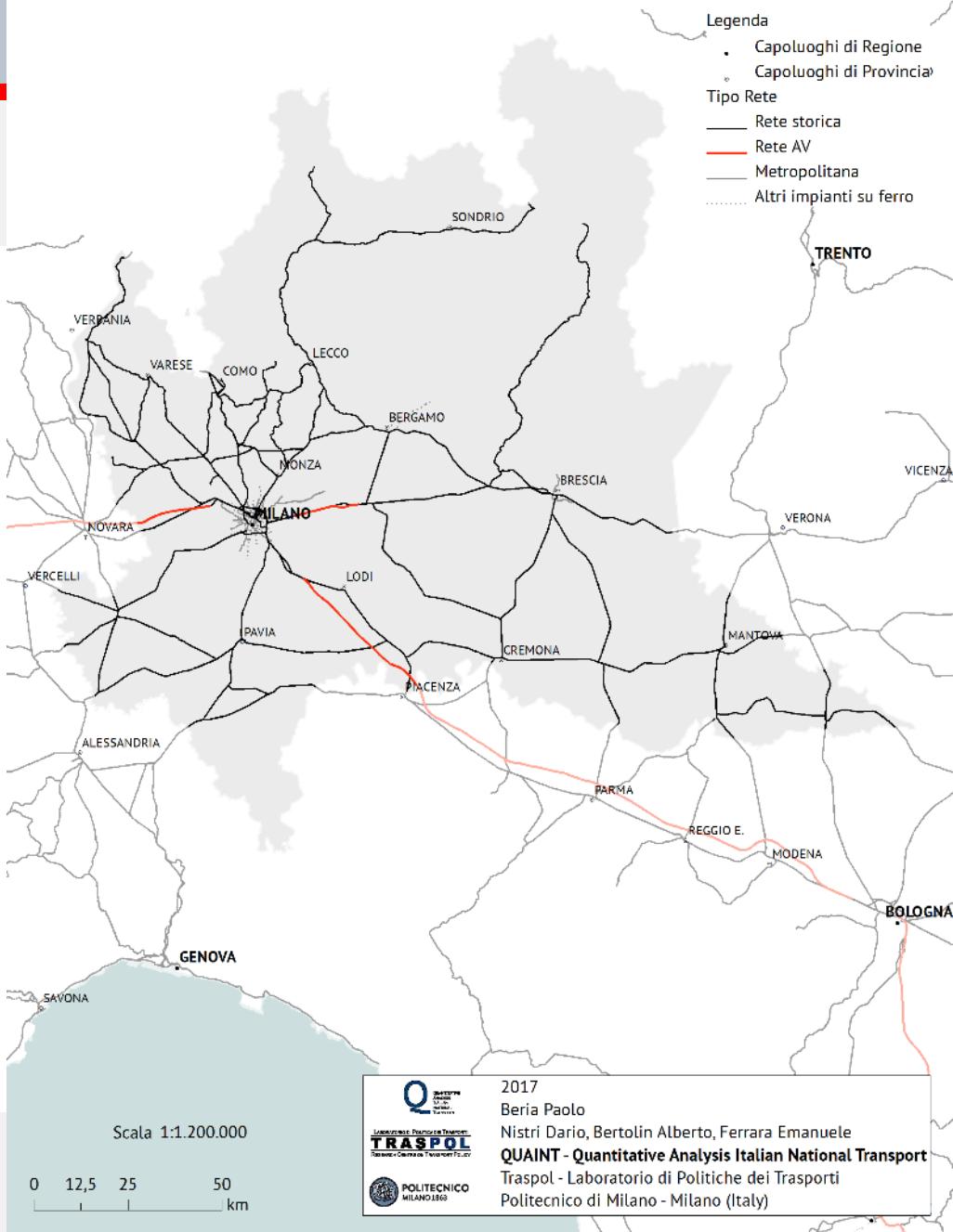
Database contents and structure

2. Infrastructure

Rail network has been totally redrawn.

A particular attention has been placed on the coherency of graphical objects and stations, as the “map” must dialogue with the timetable!!

Example of rail network →





Legenda

• Capoluoghi di Regione

» Capoluoghi di Provincia

Tessuto Urbano Industriale

Tessuto Urbano Terziario

Residenti e Addetti / kmq

1.000 - 2.000

2.001 - 5.000

5.001 - 10.000

10.001 - 20.000

20.001 - 50.000

50.001 - 100.000

100.001 - 200.000

oltre 200.000

Tessuto Urbano Residenziale

Residenti e Addetti / kmq

1.000 - 2.000

2.001 - 5.000

5.001 - 10.000

10.001 - 20.000

20.001 - 50.000

50.001 - 100.000

100.001 - 200.000

oltre 200.000

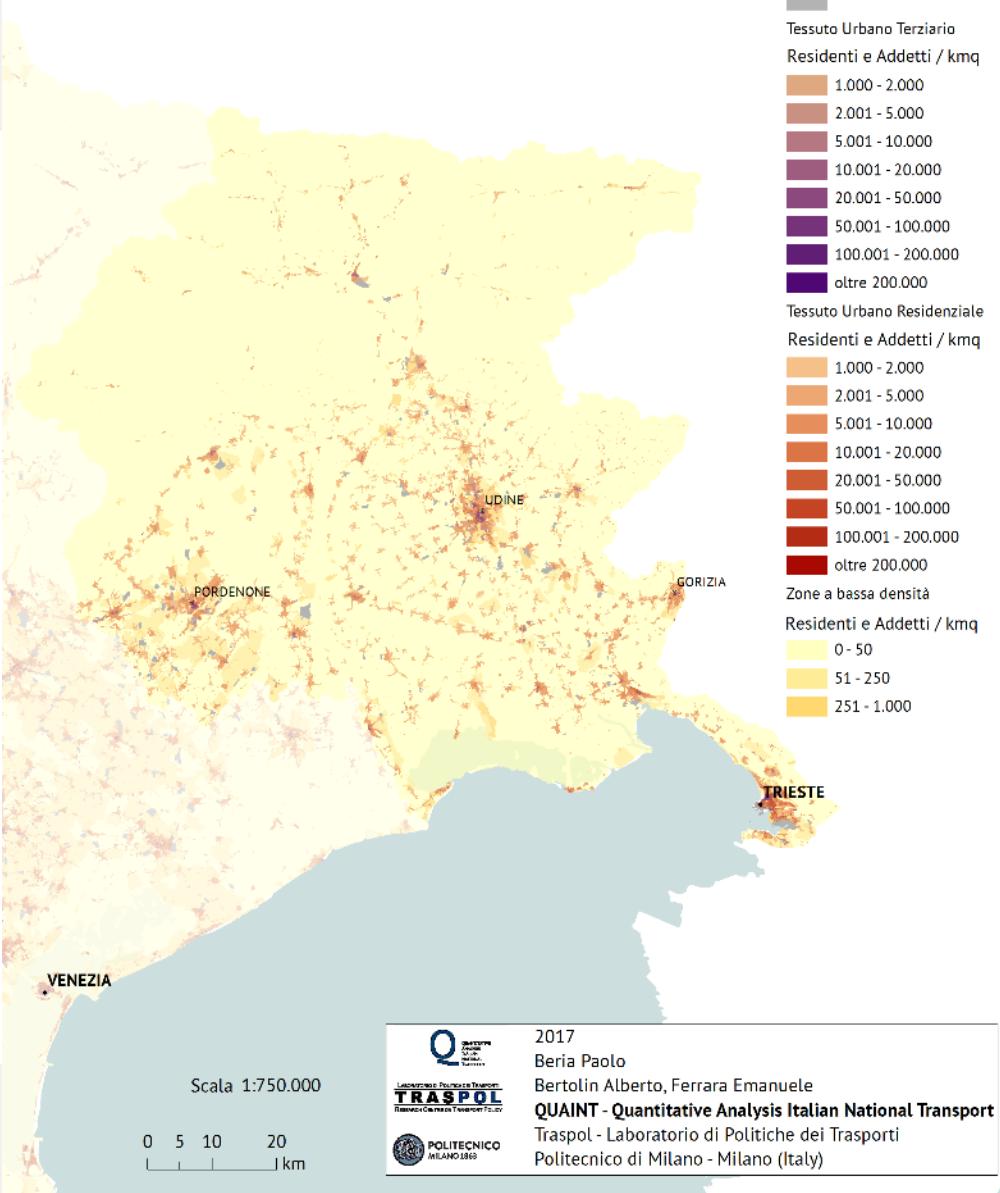
Zone a bassa densità

Residenti e Addetti / kmq

0 - 50

51 - 250

251 - 1.000



Database contents and structure

3. Land use

Two sources for land use:

- i. ISTAT census precincts:
(population, population density,
main function).
- ii. SDI4Apps project.

*Example of land use: density of census
zones →*

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PASSEGGERI: MERCATO, PIANIFICAZIONE,
INNOVAZIONE ||| 28-29 SETTEMBRE 2017



Database contents and structure

4. BDO ("Base Dati Orari")

The BDO (*Base Dati Orari*, or Timetables Database) is the heart of the modelling and of Quaint project.

The BDO has been built in a number of ways:

- a. **Manual input of timetables** (used for most of coach companies)
- b. **Semi-automated input of timetables** (used for rail timetables);
- c. **Automated input from existing databases** (used for air transport, from OAG database);
- d. **Automated input from GTFS** (used for some companies, such as Trenord, GTT, Flixbus).

All data is “coherent”: any “ride”, associated to a “timetable”, is assigned to a “line” and each line to a “company”.

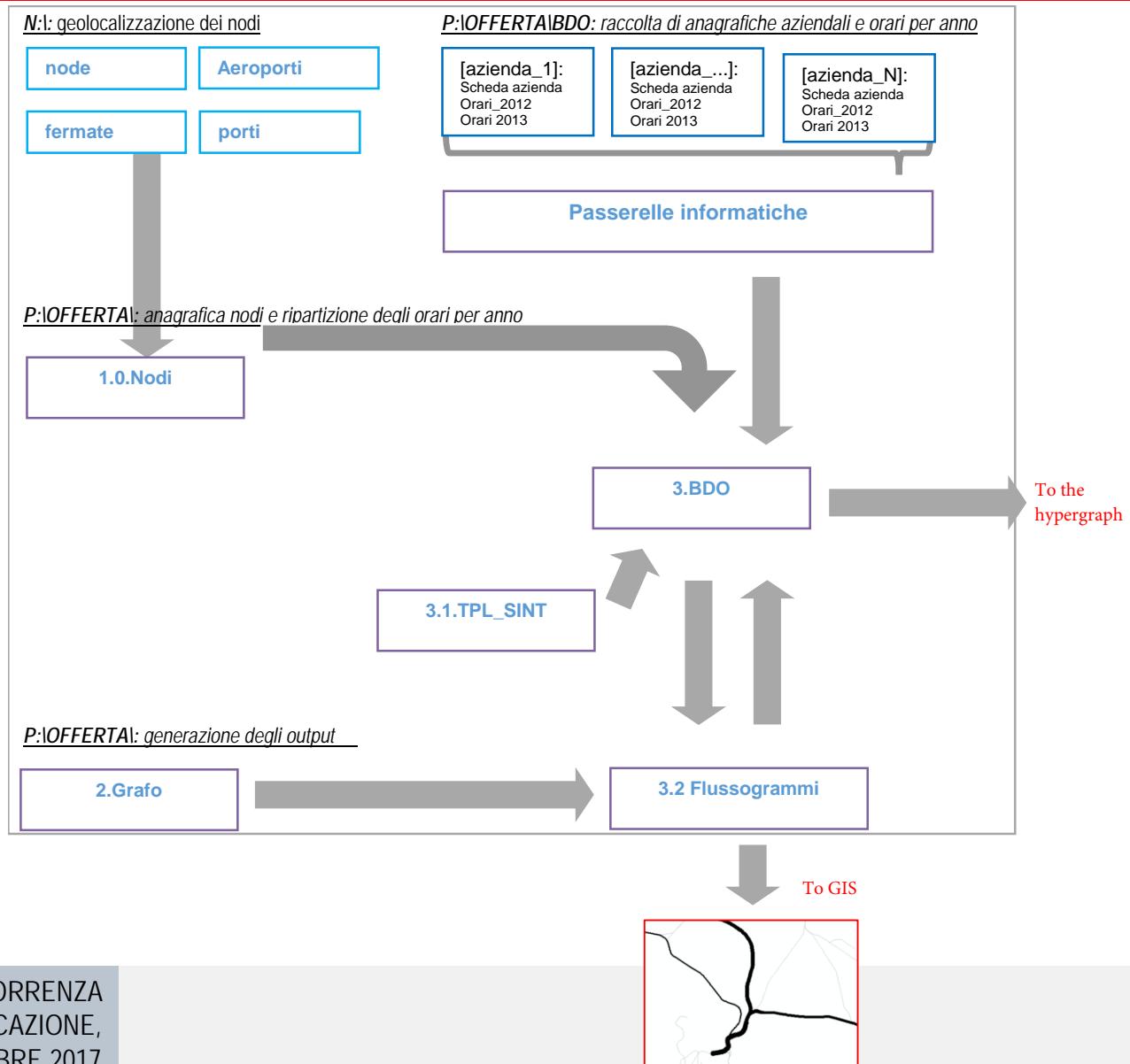
<i>Average rides/day</i>	
High speed trains	285
Eurocity and Intercity trains	178
Regional trains	10.256
Flights	2.686
Coaches	943



Database contents and structure

4. BDO ("Base Dati Orari")

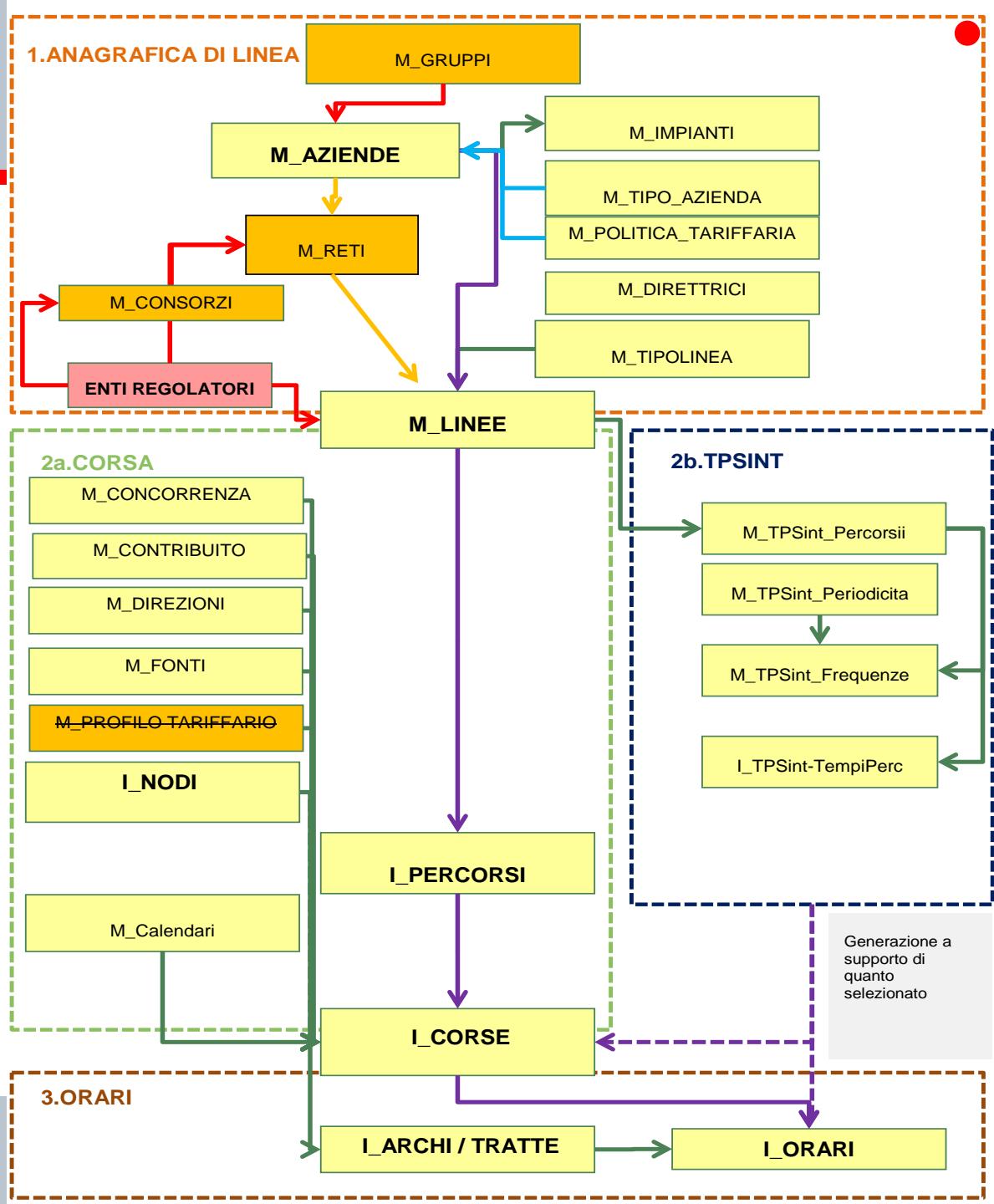
The BDO is part of the supply module:





The BDO is structured in layers and made of four main parts:

- a. Companies database
- b. Lines database
- c. Rides database
- d. Timetable database





Database contents and structure

4. BDO ("Base Dati Orari")

An example of the ORARI database: how one ride is described in space and time.

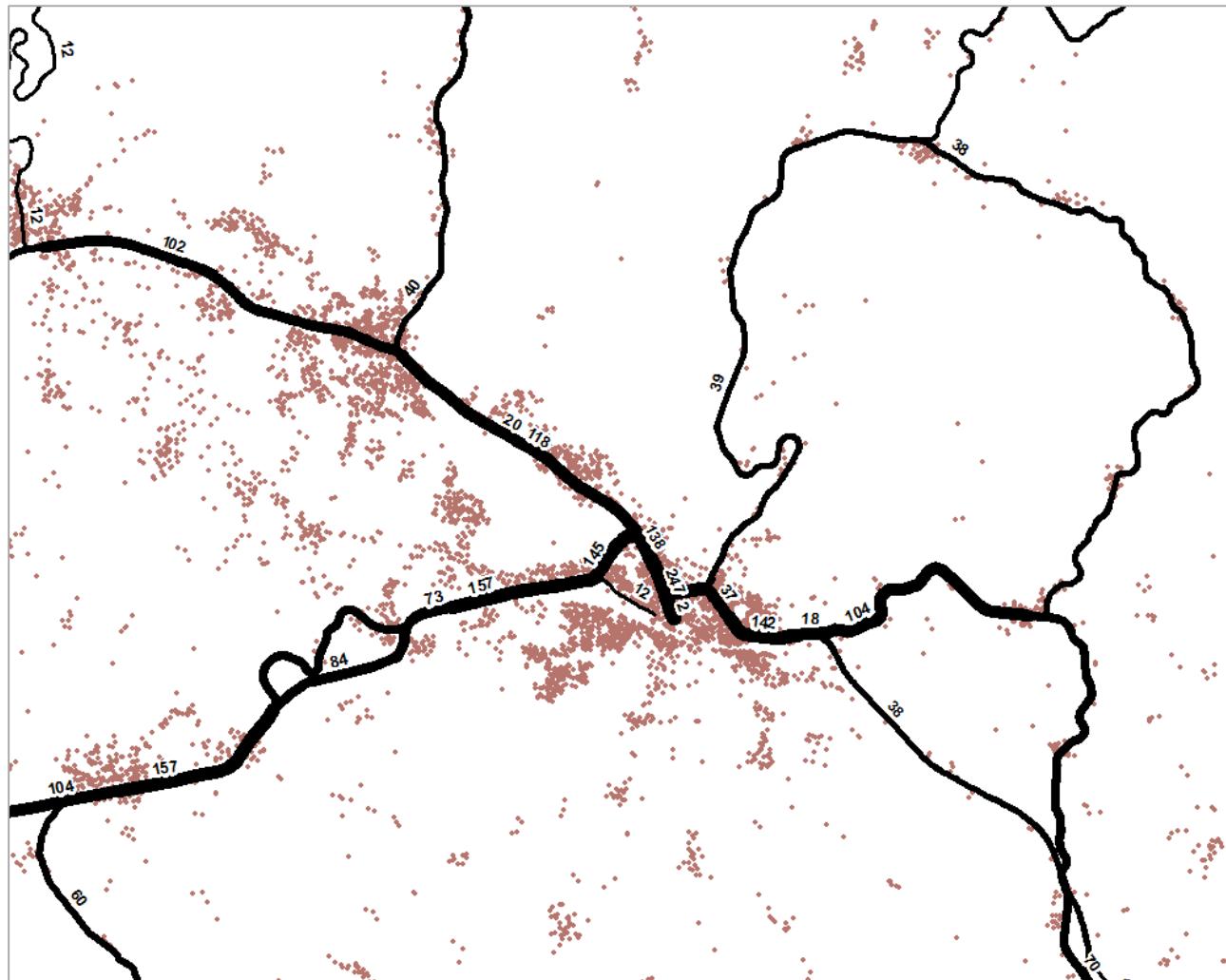
ID_CORSA	PROG	ID_NODO_A	ID_NODO_B	ID_TIPOTR_ATTA	ORA_INI	ORA_FIN	TEMPO	LUNGHEZZA	SALITA	DISCESA
773557	1	100283	100270	1	21:08	21:13	0,08	7,049	1	0
773557	2	100270	100063	1	21:13	21:18	0,08	9,08	0	0
773557	3	100063	100005	1	21:18	21:23	0,08	8,35	0	0
773557	4	100005	100071	1	21:23	21:27	0,07	7,019	0	0
773557	5	100071	100073	1	21:27	21:31	0,07	5,02	0	0
773557	6	100073	100113	1	21:31	21:33	0,03	1,144	0	0
773557	7	100113	100105	1	21:33	21:36	0,05	2,2	0	0
773557	8	100105	100076	1	21:36	21:39	0,05	0,348	0	0
773557	9	100076	100077	1	21:39	21:45	0,10	4,318	0	0



Database contents and structure

4. BDO ("Base Dati Orari")

The interface between
BDO and GRAPH,
allows to map any
timetable!



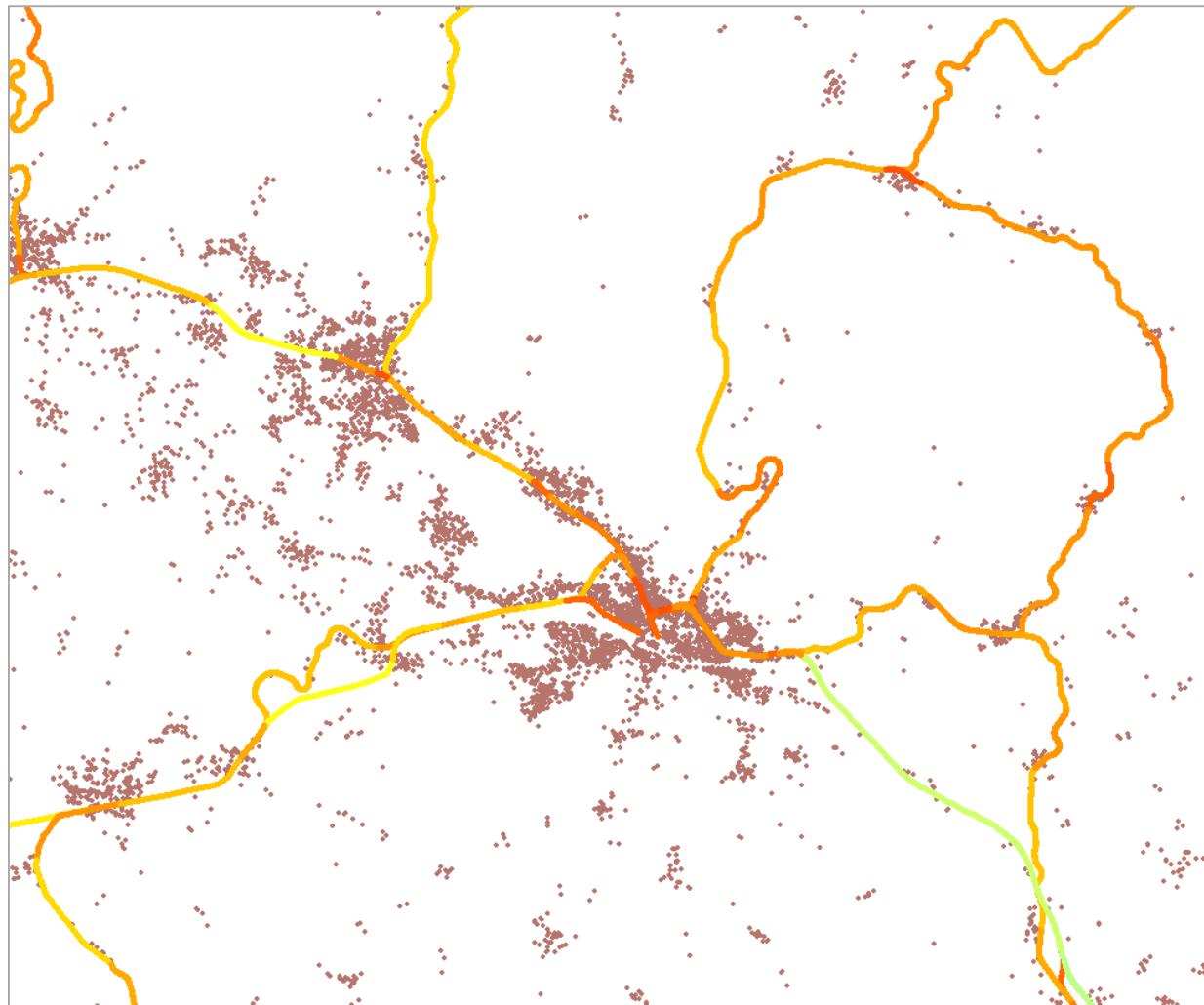


Database contents and structure

4. BDO ("Base Dati Orari")

The interface between
BDO and GRAPH,
allows to map any
timetable!

*Example of average
speed flowchart →*





5. Fares

QUAINT describes the supply not only in terms of infrastructure and services, but also in terms of fares.

- Market structure matters!
- Important for long-distance transport!

We model **real fare strategies**, depending from:

- a. mode
- b. level of competition (intermodal and intramodal)
- c. market context
- d. characteristics of the alternatives.



Database contents and structure

6. Alternative mobility

Alternative forms of mobility are **gaining a larger role**, also for long-distance transport. Moreover, they are a **potential source of data**, due to their strict link with mobile applications.

In QUAINT we focused on the main long-distance alternative transport mode, namely **carpooling via BlaBlaCar**.

We analysed the available trips on across 81 days during 2015. Overall we collected more than **400.000** trips and 71.000 individual users.

The interest for this data is twofold:

1. To map the phenomenon of long-distance carpooling in Italy
2. To provide potential calibration data for trip distribution and for modal share





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Preliminary results

Seven picks, until now...

- 1. The web-Atlas**
- 2. Measuring the long-distance accessibility of Italian cities**
- 3. Carpooling in Italy, an analysis of supply**
- 4. Italian Long-Distance Coach Transport Market Report**
- 5. Accessibility to Italian remote regions: comparison among different transport alternatives**
- 6. Analysis of coach fares in Italy: a market not yet in equilibrium**
- 7. A preliminary assignment of OD matrix**



Preliminary results

1. The web-Atlas

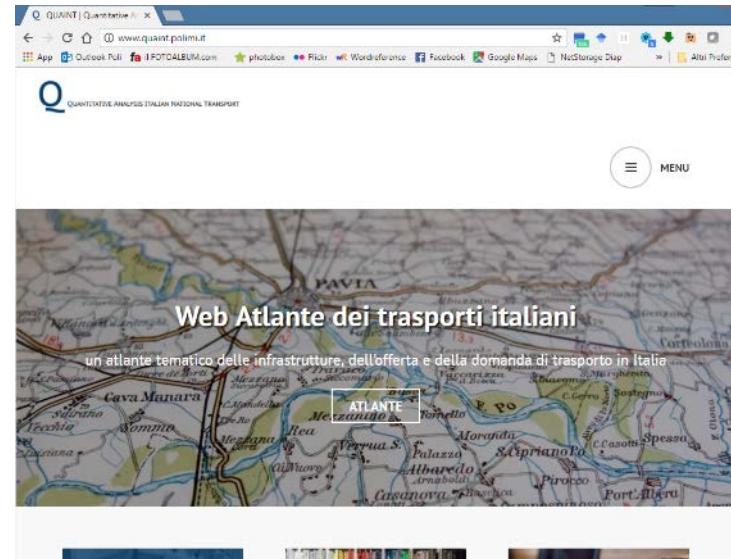
Our main output for the general public will be the **Atlas of Italian Transport**.

In the meantime, we released a **web-version of the Atlas**. It contains **different maps**, typically gathering more information than the paper ones, **navigable at high-resolution**.

To date, **three maps** are available:

- Flows of long-distance carpooling in 2016
- Highway flows and type of tolls
- Potential accessibility index 2013/14

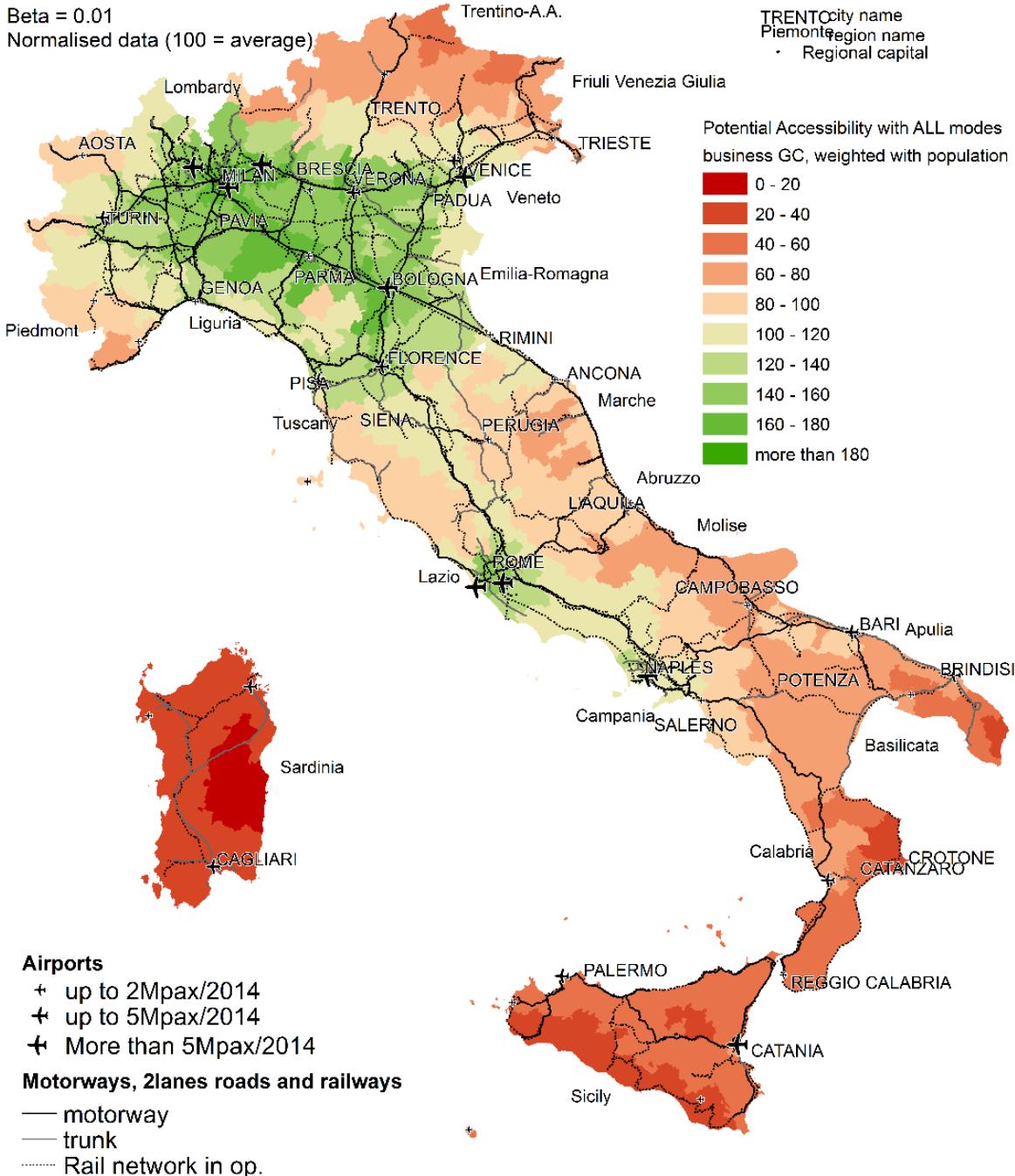
www.quaint.polimi.it





Beta = 0.01
Normalised data (100 = average)

TRENT city name
Piemonte region name
• Regional capital



Preliminary results

2. Accessibility (JTrGeo)

As we have completed a full description of Italian long-distance transport supply, we were able to calculate a **detailed OD matrix of generalized cost**, per mode (air, road, rail, coach) and per trip purpose (business, economy, family).

Generalised cost, in such a disaggregate form, can be used to compute an **accessibility indicator at the national-scale**.



Preliminary results

3. Carpooling in Italy

Data collected provide an incredibly rich **insight on long-distance mobility in Italy**.

For example, the penetration of the service is definitely different across Italian areas.

Viaggi medi giornalieri in carpooling da/verso Roma



*Example of trips to/from Rome
and distance classes →*

2016

Paolo Beria

Antonio Laurino, Alberto Bertolin

TRASPOL - Laboratorio di Politica dei Trasporti
Politecnico di Milano - Milano (Italy)



In collaborazione con:

Andrea Debernardi
Gabriele Filippini
Studio META - Monza (Italy)

Viaggi medi giornalieri
periodo analizzato: 83 giorni



Comune di partenza/arrivo

• Solo 1 viaggio in tre mesi

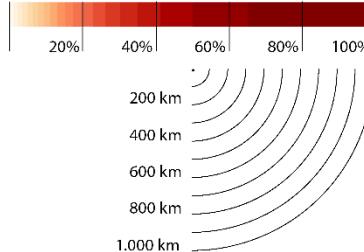
• 3 viaggi al mese

• 1 viaggio ogni due giorni

• 1 viaggio al giorno

• 10 viaggi al giorno

Viaggi medi giornalieri per classi di distanza [%]





Preliminary results

7. A preliminary assignment

We tried a preliminary assignment of the road network at the highest detail possible (1764-zones).

The OD matrix is not yet definitive, but the preliminary results look consistent.



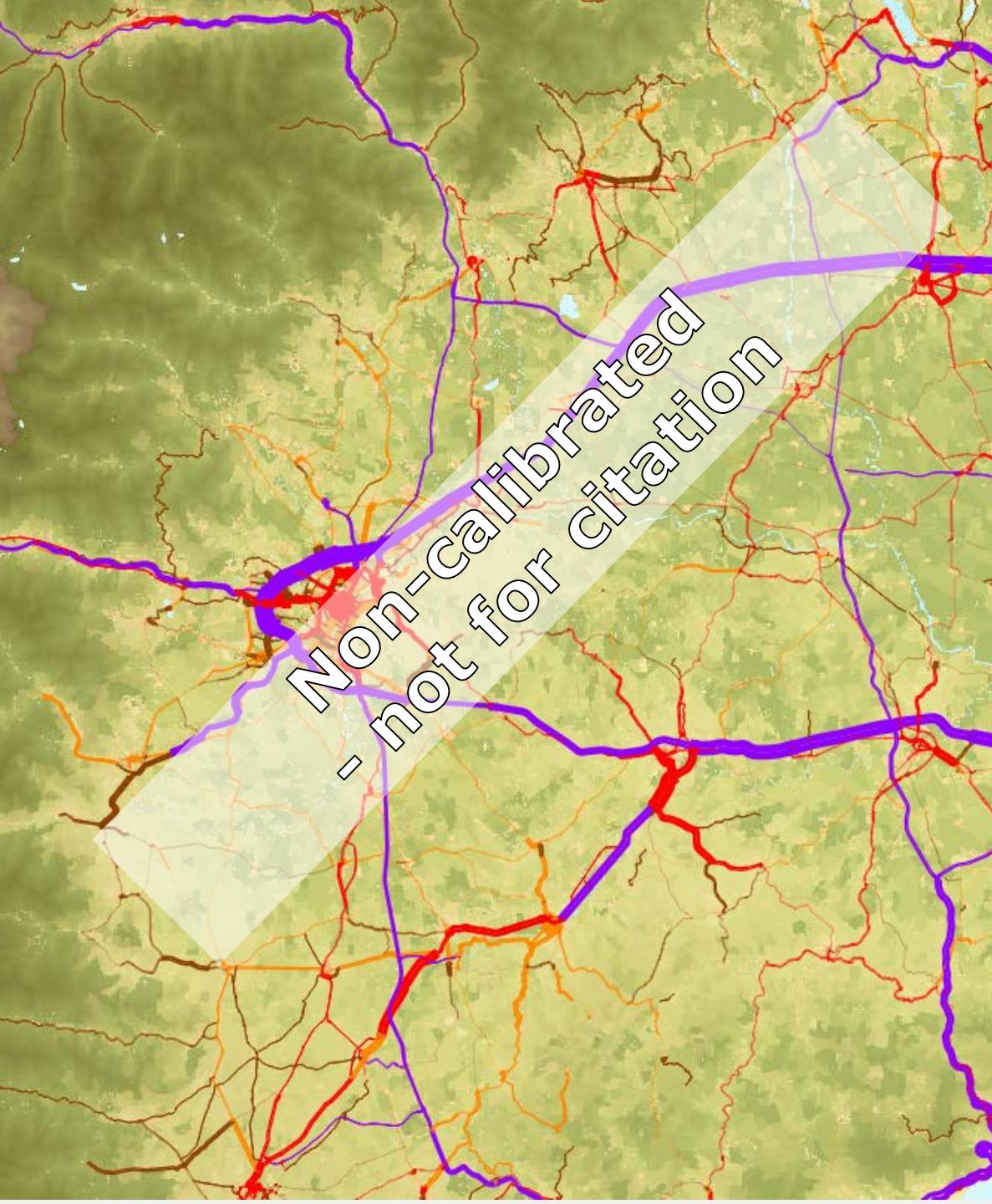


Preliminary results

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The Italian Transport Atlas

The project

It is an *ambitious* project.

Thanks to the huge spatial database collected, we are able to make a complete (and country-wide) **representation of Italian transport system** in its main supply components (and something also about demand...)

- 70-80 double-page tables
- a dozen of essays
- detailed land-use maps of main metropolitan areas
- transport and tourism





The Italian Transport Atlas

Tentative contents

ROAD TRANSPORT

Main road networks, toll systems
Long-distance coach supply
BlaBlaCar supply 2015

RAIL TRANSPORT

Rail networks (RFI + others), undertaking, signalling, power, etc.
Train timetable maps (long-distance, regional, operators, stations, change 2008-16, real line speed....)
Accessibility to rail infrastructure

AIR TRANSPORT

Italian airports, capacity, ownership
Supply and concentration indexes
Routes



The Italian Transport Atlas

Tentative contents

SEA TRANSPORT

Italian ports and piers extension

Supply of ferry services

Traffic in ports

URBAN AREAS (1:150.000)

Land use and density, mass transport systems, rail services, road network in Torino, Bologna, Milano, Brescia-Bergamo, Padova-Venezia-Treviso, Genova, Firenze-Prato-Pistoia, Trieste, Perugia, Cagliari, Sassari, Roma, Napoli-Caserta, Bari, Stretto di Messina, Catania, Palermo.

MOBILITY DEMAND

Car ownership

Highways flows

Air transport passengers and routes

Rail station passengers

ISTAT OD matrix, modal shares

TRANSPORT, TOURISM AND LAND USE



Beria Paolo et al.

QUAIANT project and the Italian Atlas of Transport

SIR 2014

The Italian Transport Atlas

Highway flows and toll types



FLUSSI AUTOSTRADALI E PEDAGGIAMENTO PER TRATTA



CONVEGNO: LA LUNGA PERCORRENZA
PASSEGGERI: MERCATO, PIANIFICAZIONE,
INNOVAZIONE ||| 28-29 SETTEMBRE 2017

In Italia sono presenti due macro sistemi di pedaggio autostradale:
sistema chiuso, la tariffa viene calcolata sulla base dei chilometri percorsi;
sistema aperto, la tariffa è fissa e viene riscossa solo al transito in determinati punti.

In alcune autostrade il pagamento avviene solo per via telematica - **free flow**.

In cartografia vengono inoltre riportati i **veicoli teorici medi giornalieri** al 2015 - dati AISCAT. Per veicoli teorici si intendono le unità veicolari che idealmente, percorrendo l'intera tratta autostradale, danno luogo a percorrenze pari a quelle ottenute realmente (veicoli chilometrici); il numero di tali veicoli è definito dal rapporto tra i veicoli-chilometro e la lunghezza della tratta autostradale.



Beria Paolo et al.

QUAINT project and the Italian Atlas of Transport

SIR 2014

The Italian Transport Atlas

Highway flows and toll types



FLUSSI STRADALI E ADDUZIONE AGLI AEROPORTI IN BLABLACAR

LEGENDA

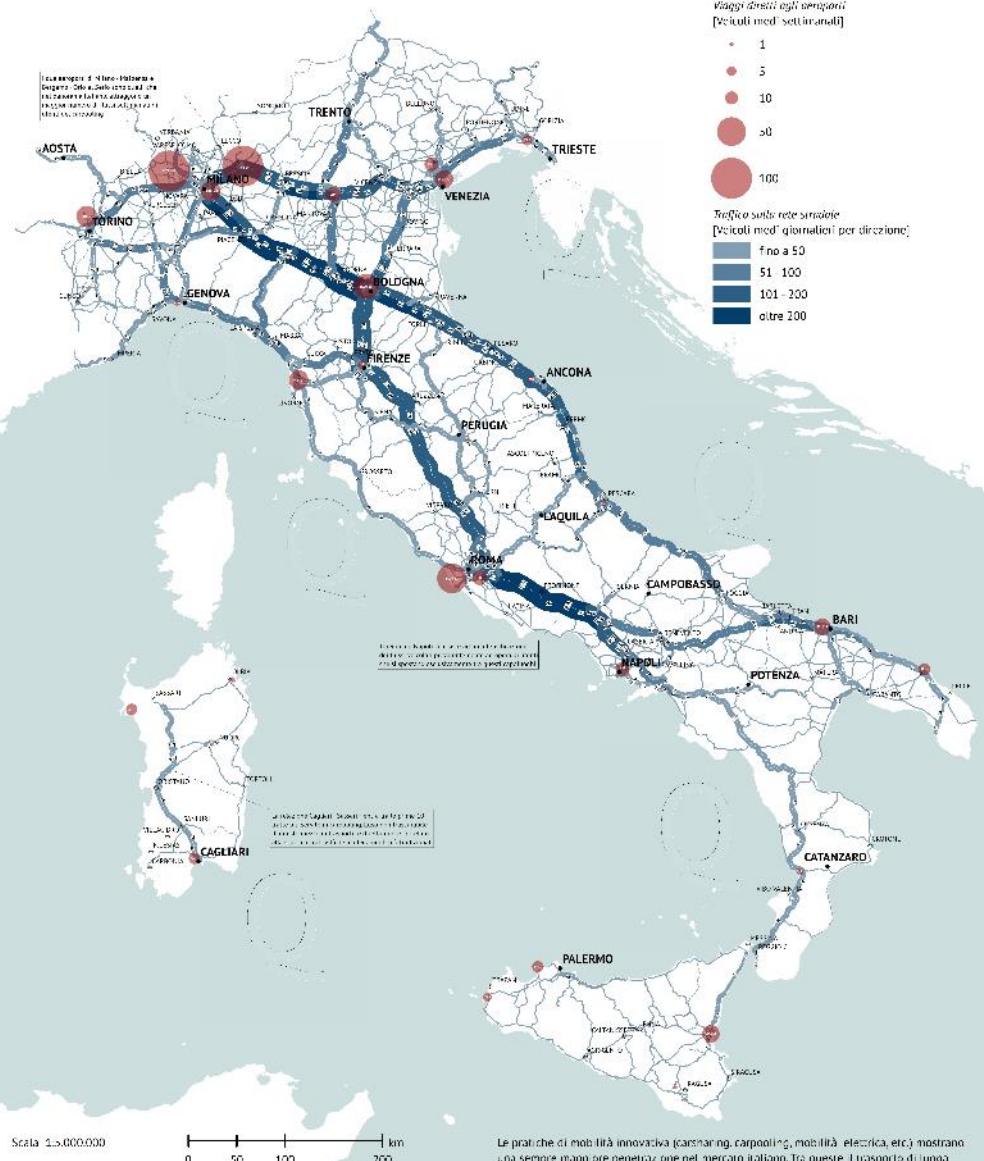
- Capoluoghi di Regione
- Capoluoghi di Provincia

Viaggi diretti agli aeroporti
[Veicoli medi settimanali]

- 1
- 5
- 10
- 50
- 100

Traffico sulla rete stradale
[Veicoli medi giornalieri per direzione]

- fino a 50
- 51-100
- 101-200
- oltre 200



Scala 1:5.000.000

0 50 100 200 km



Grazie per l'attenzione!!!

paoberia@polimi.it