



Samuel Tolentino

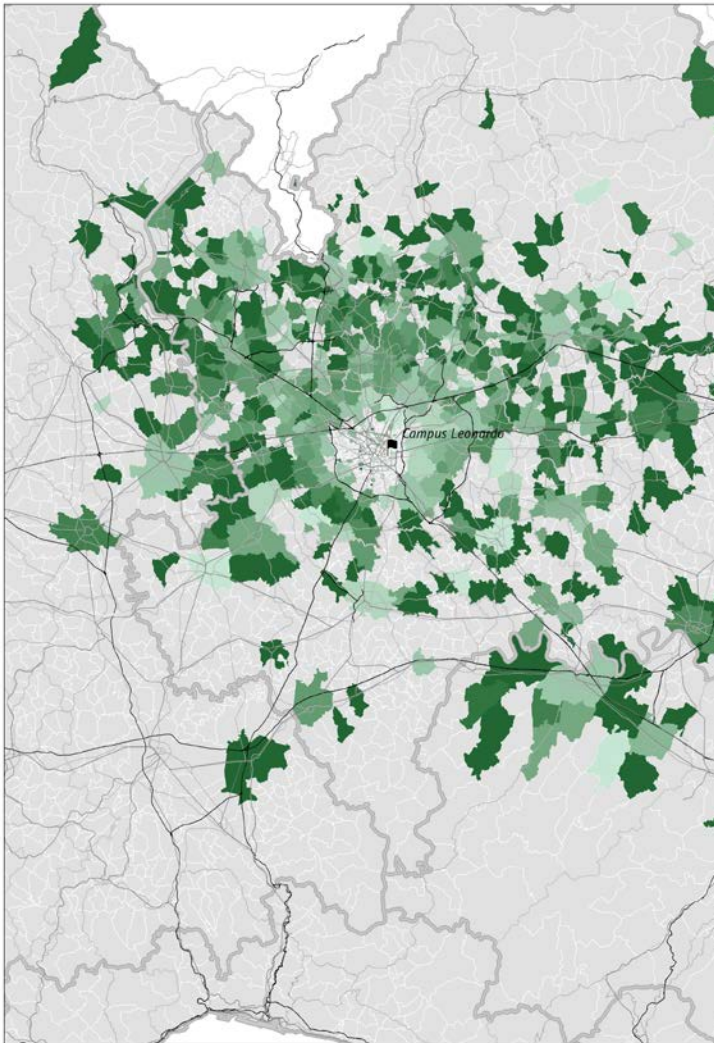
***Geography of modal choice
to access Politecnico di
Milano university campuses***

Geography of modal choice to access Politecnico di Milano university campuses

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CONTENTS

-  Introduction
-  The survey
-  Methodology
-  Modal share
-  Catchment area
-  Trips distribution
-  Conclusions and further research



The project

- "Città Studi Campus Sostenibile" project (CSCS) aims to turn the university district into an example for quality of life and environmental sustainability.
- Particular attention is devoted to understand students and staff commuting patterns, being CO₂ emission related to transport activities one of the most relevant impacts a university has on society and environment (Miralles-Guasch, C., & Domene, E., 2010).
- In this framework, in the last years the Sustainable Office of the University carried out two surveys on mobility and commuting, among students, professors and administrative staff. The most recent one took place in 2017.



Research question

- In (Bertolin et al., CSUM 2018) we focused on estimating the total km travelled yearly by the Politecnico population to access campuses, by each mean of transportation, in order to calculate the related CO₂ emissions.
- Now we want to analyse and represent:
 - Spatial distributions of trips related to each campus
 - Modal share focusing on origins to better understand territory-related modal choice.

Tools

- Origin-disaggregated data analysis.
- Automated GIS data representation.



The survey

- Survey specifically designed to analyse mobility behaviour in commuting to/from the university, considering the actual living place (not the administrative one).
- Sample questions: means of transport for the most frequent kind of trip (primary) and an eventual other kind (secondary), typology of engine for private vehicle, distance or minutes travelled and frequency on weekly working days base, etc...
- Distinction between course and exam periods (students).

2017 sample:

- 51,921 Politecnico Community.
- 13,034 responses (25.1%).



The survey



Leonardo:
53% of whole
community
27% responses

Bovisa:
37% of whole
community
26% responses

Others:
10% of whole
community
19% responses



Original Data

2017 Survey

13,034 responses (25.1%
of the whole
community)

Each record represents a
primary double way trip
and, eventually, a
secondary double way
trip.

Total means of transport:
11
car, motorbike, train,
metro, tram, bus (urban
or suburban), bike,
skate, on foot (whole
way or part)

Total used trip chains:
190



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Database consolidation

Data cleaning [Excel]

Various filters to check
the internal coherence of
each record



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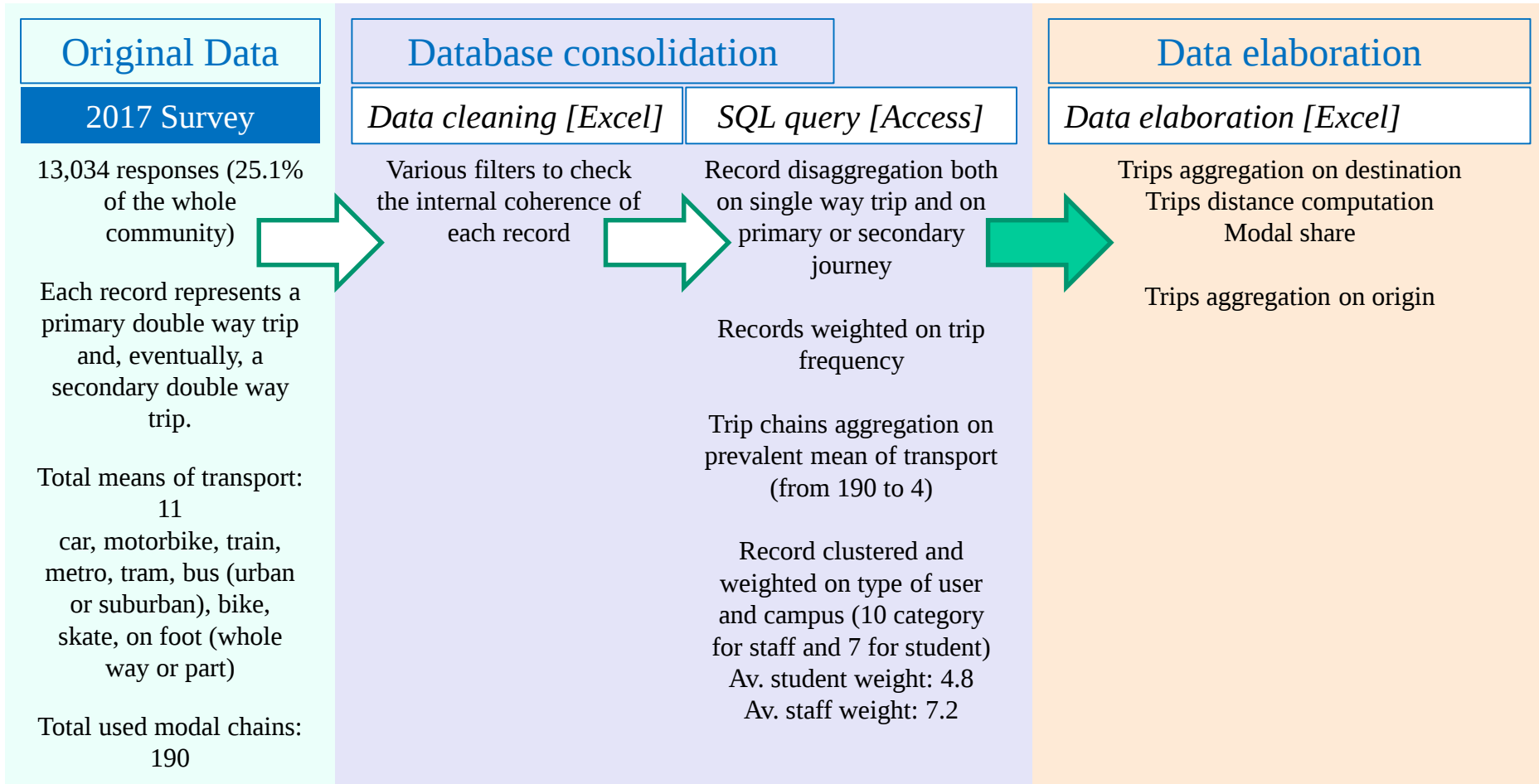
SQL query [Access]

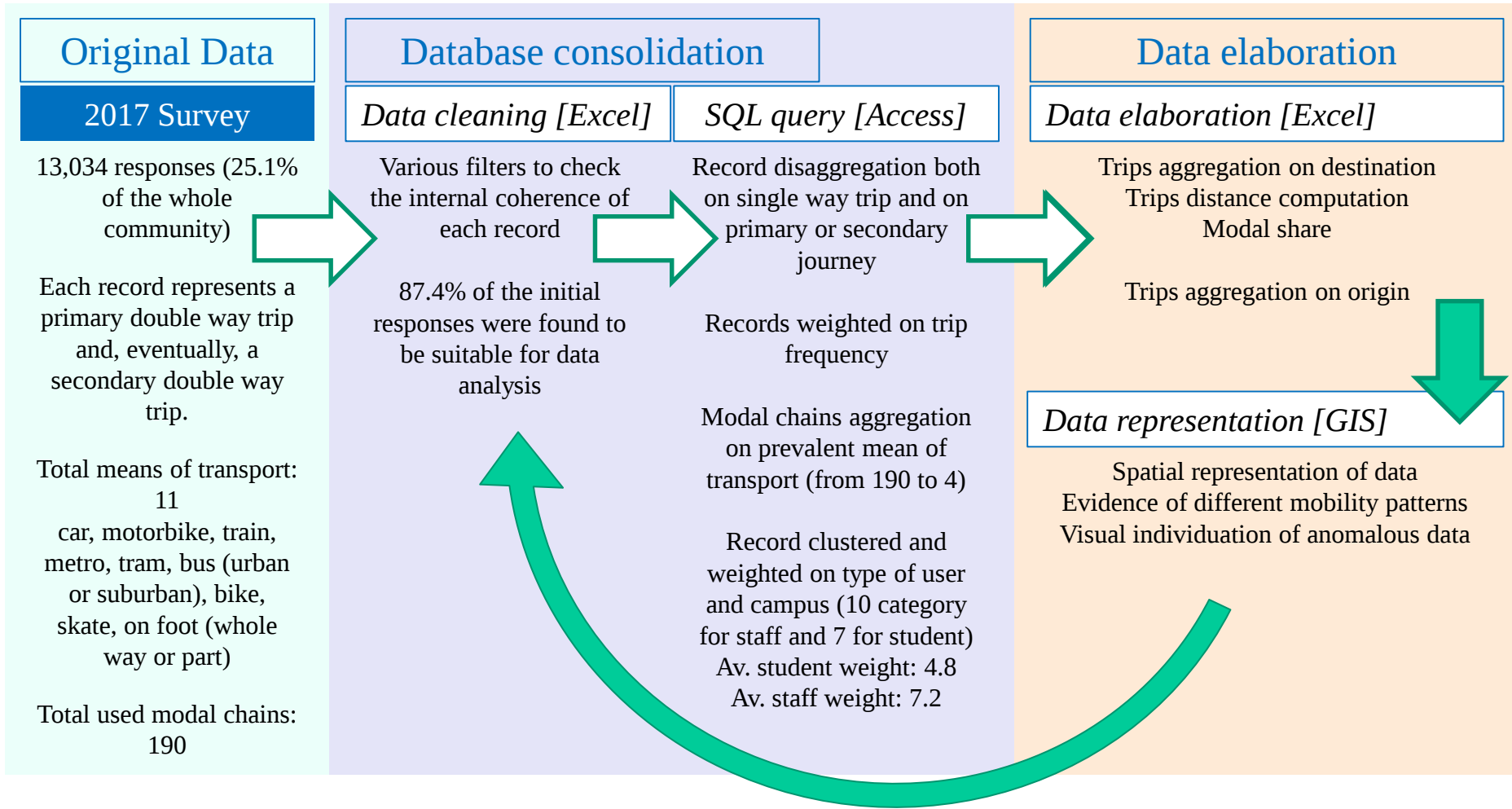
Record disaggregation both
on single way trip and on
primary or secondary
journey

Records weighted on trip
frequency

Trip chains aggregation on
prevalent mean of transport
(from 190 to 4)

Record clustered and
weighted on type of user
and campus (10 category
for staff and 7 for student)
Av. student weight: 4.8
Av. staff weight: 7.2







Sampling weights

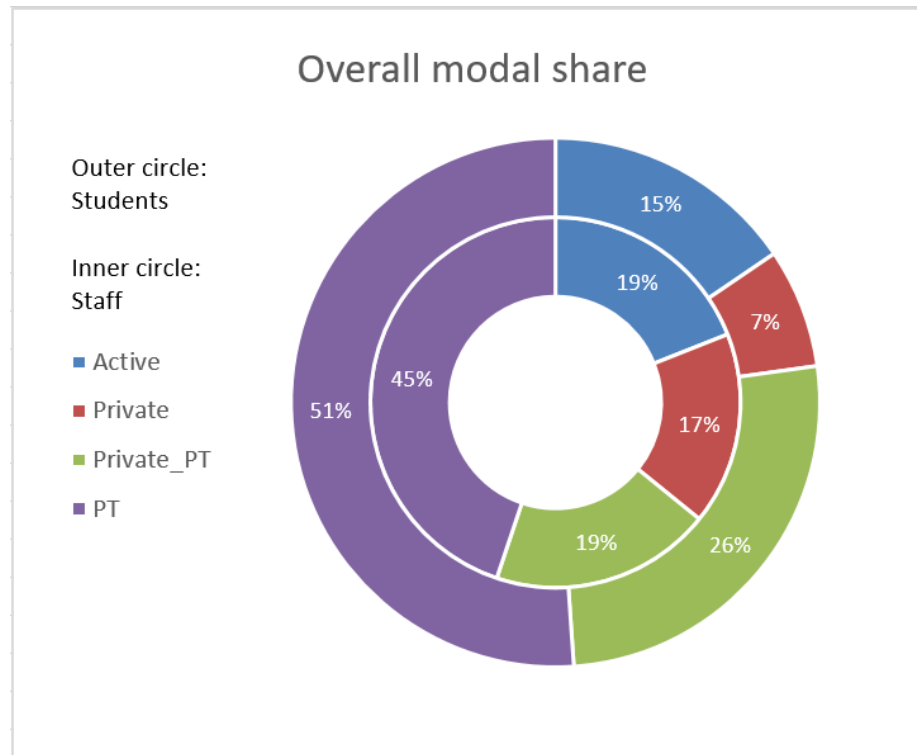
The number of respondents [r] was expanded to represent the entire Politecnico population [P].
Cluster on campus [c] and university career/job category [j]

$$Sw_{cj} = \frac{P_{cj}}{r_{cj}}$$

CAMPUS	STUDENT			STAFF			
	Bachelor	Master	Single Course	Administrative staff	Professor	R. fellow & PhD	Technical staff
Leonardo	3.1	4.8	-	7.3	-	8.8	1.6
Bovisa	3.3	4.6	-	4.7	-	23.6	2.2
Others	4.1	5.5	-	2.5	-	6.0	1.6
All	-	-	8.3	-	2.3	-	-



Modal share _ Overall

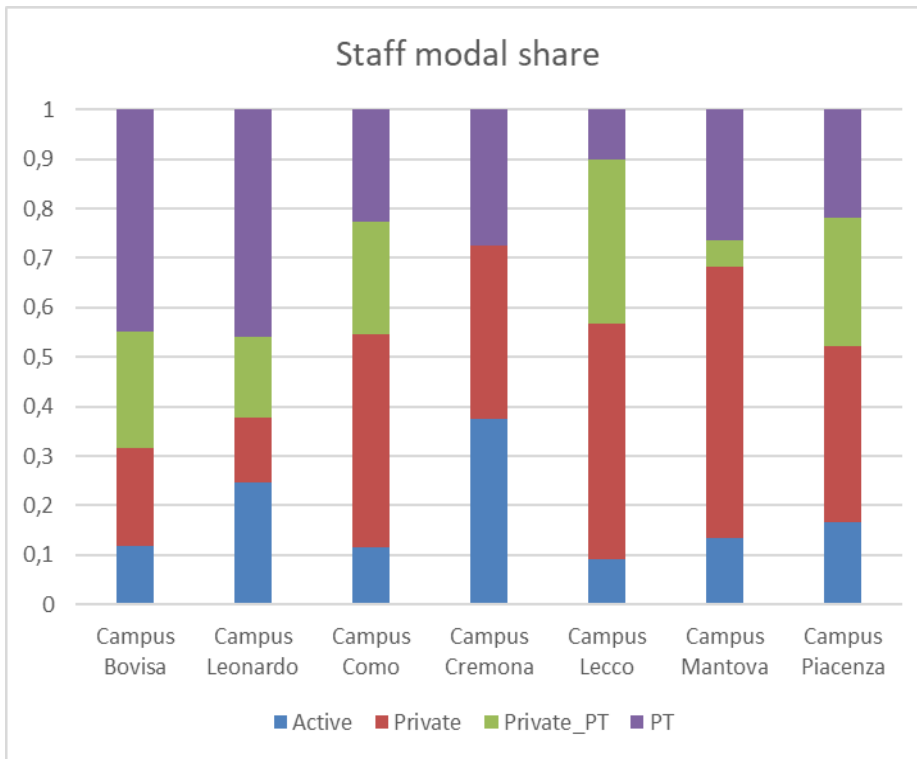


- Modal share is calculated for course period.
- Students account for the 79% of the total trips, while staff for the 21%.
- The share of trips by public transportation solely are around 50% of the total.
- Staff are more incline to direct trip by car than students, who instead are more prone to interchange with public transportation.

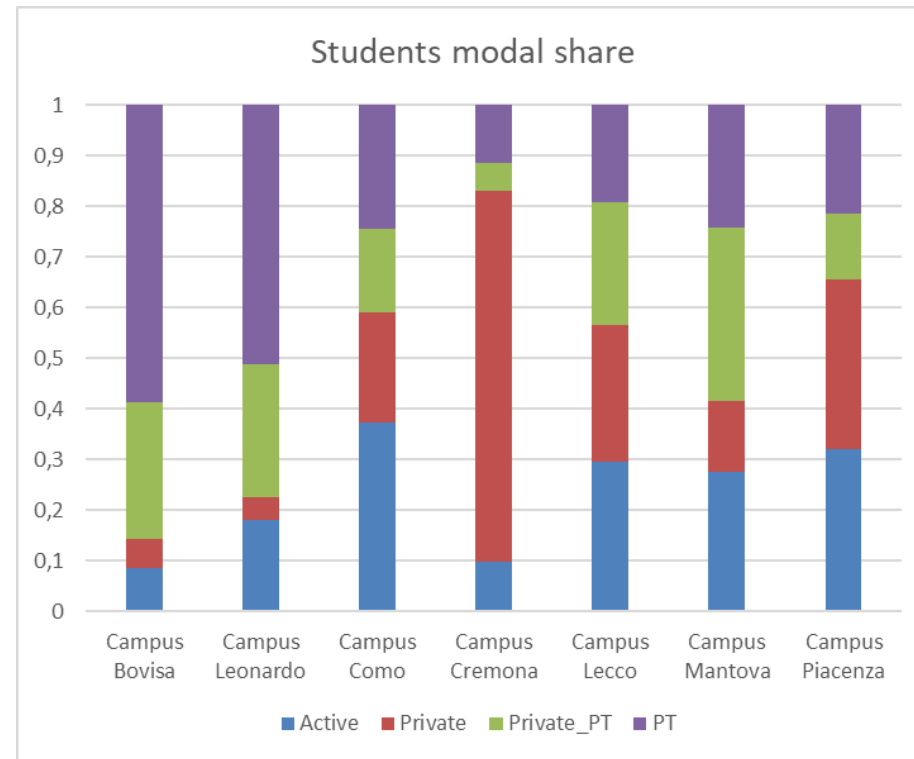


Modal share _ Campuses

Staff modal share



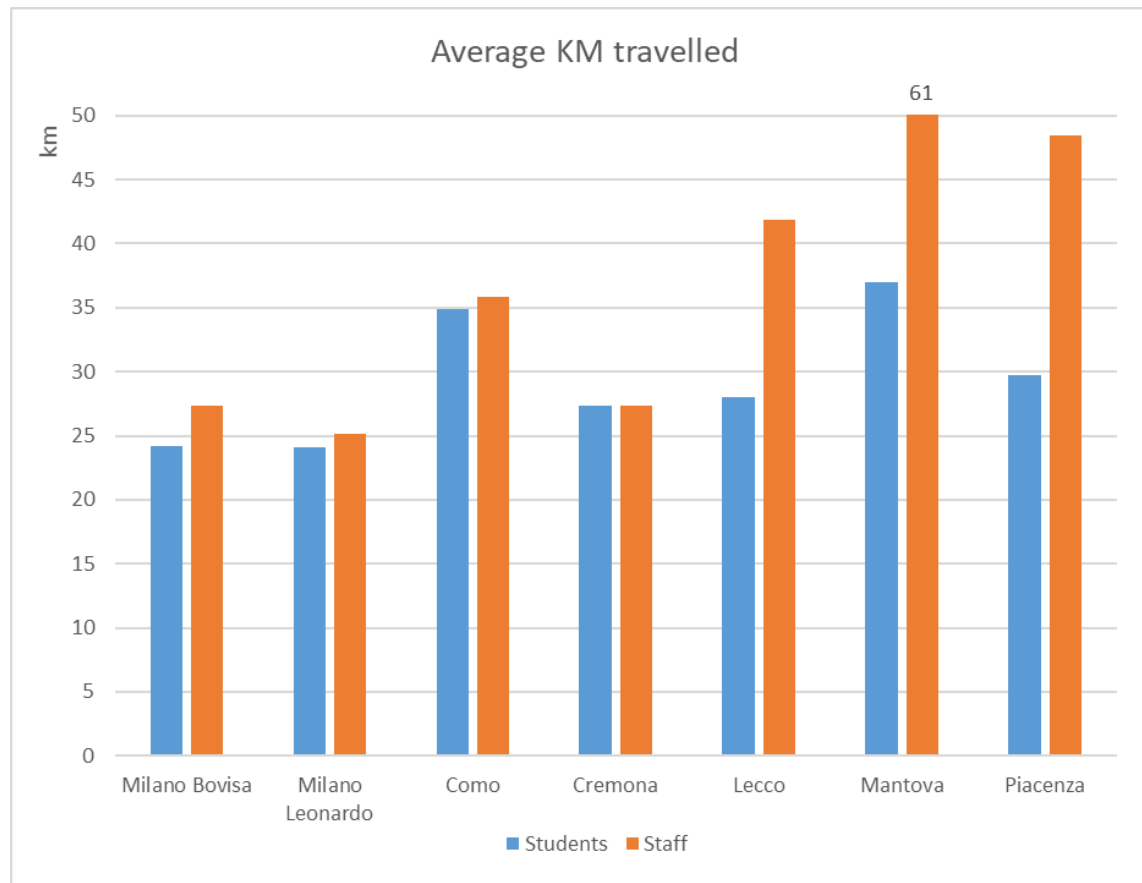
Students modal share



- Modal share may differ considerably between campuses (e. g. Cremona)



Catchment area _ Total average km

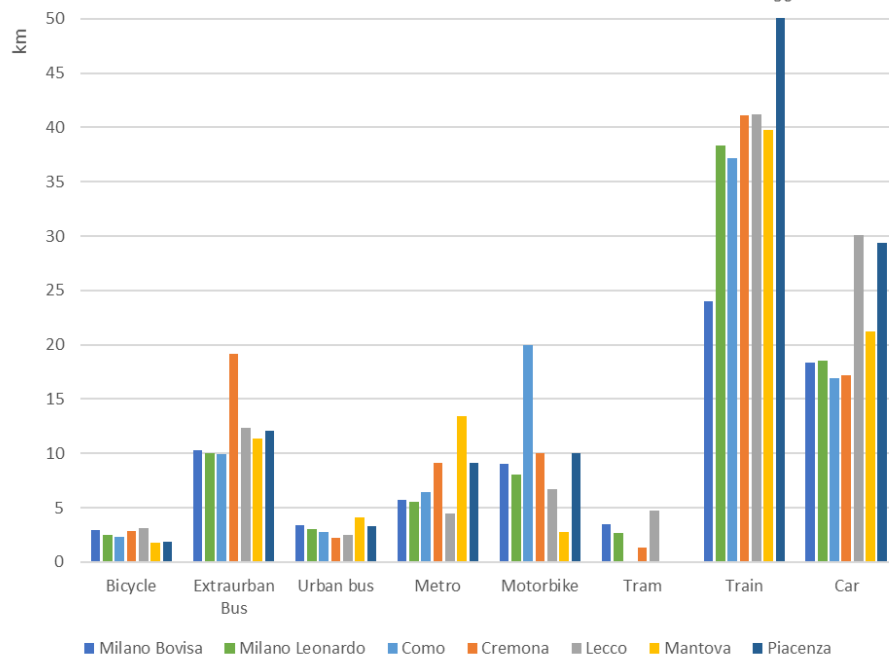


- Average km travelled for each trip (sum of km associated to each mean of transport in the modal chain).
- Students' trip length is only slightly higher toward territorial campuses.
- Staff's trip length to reach specific campuses is remarkably higher (commuting from Milan).

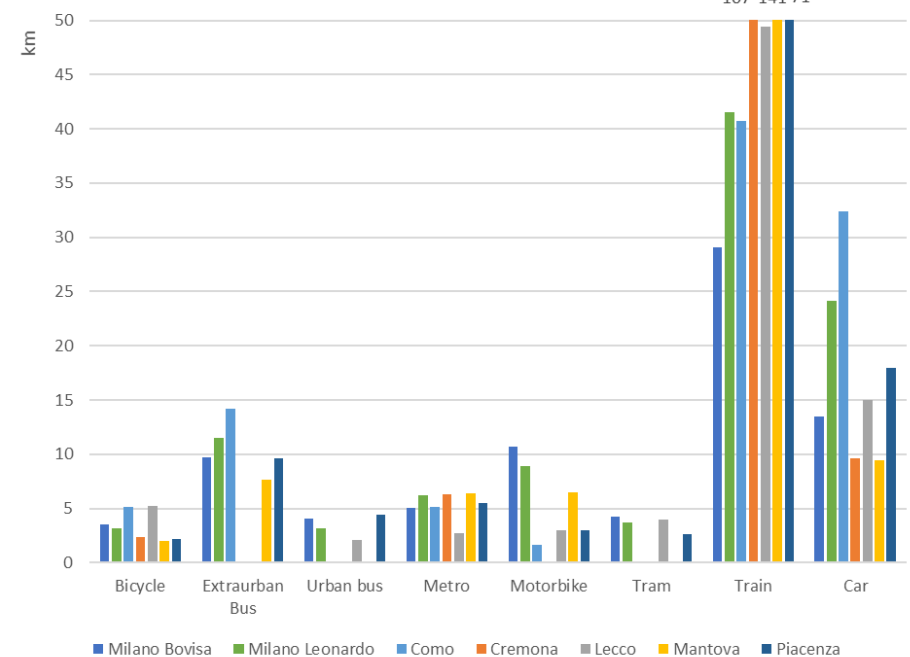


Catchment area _ Average km by mean of transport

Average KM travelled - Students



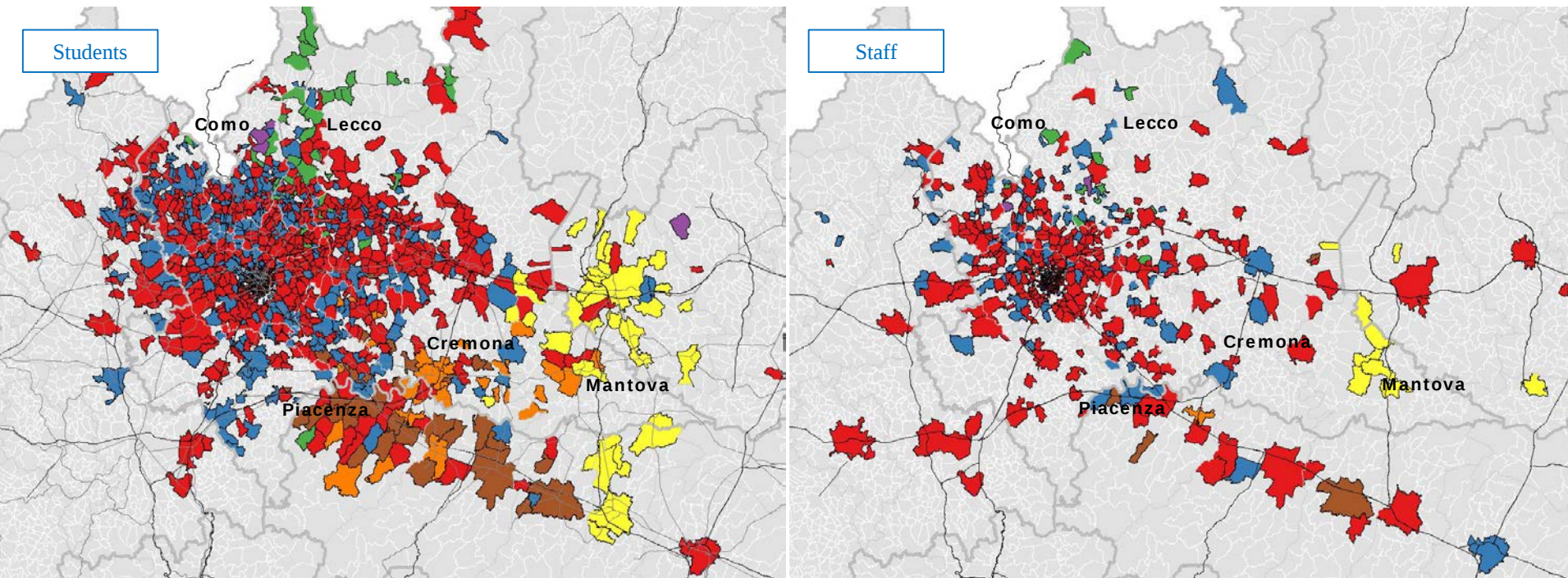
Average KM travelled - Staff



- Interestingly, average km travelled by bike are similar to the amount by bus, or even higher.
- Km travelled by staff by train are considerably higher for various campuses, differently than by car.



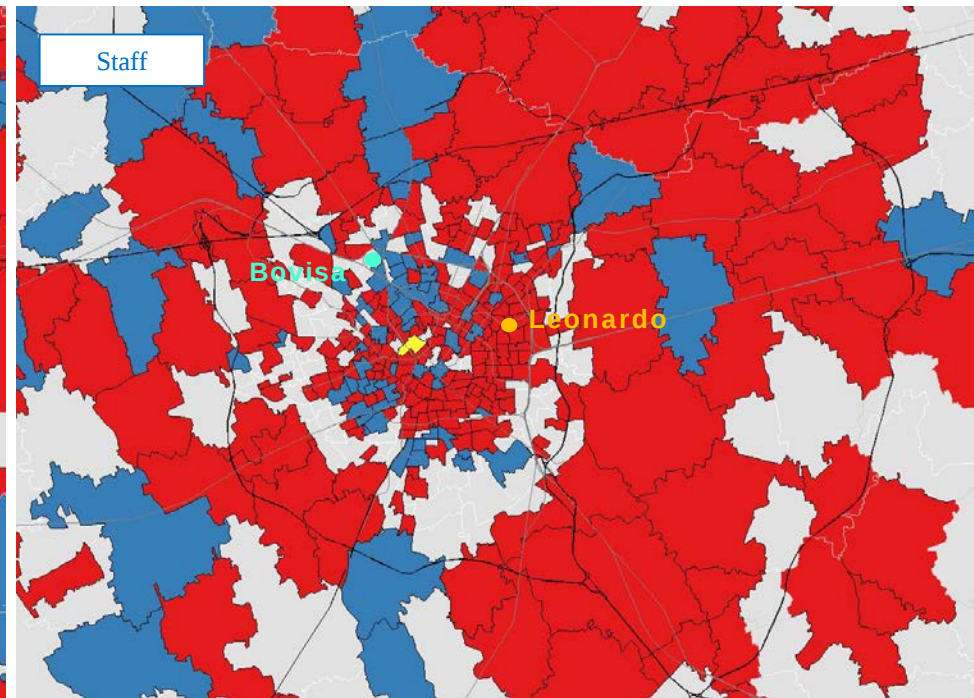
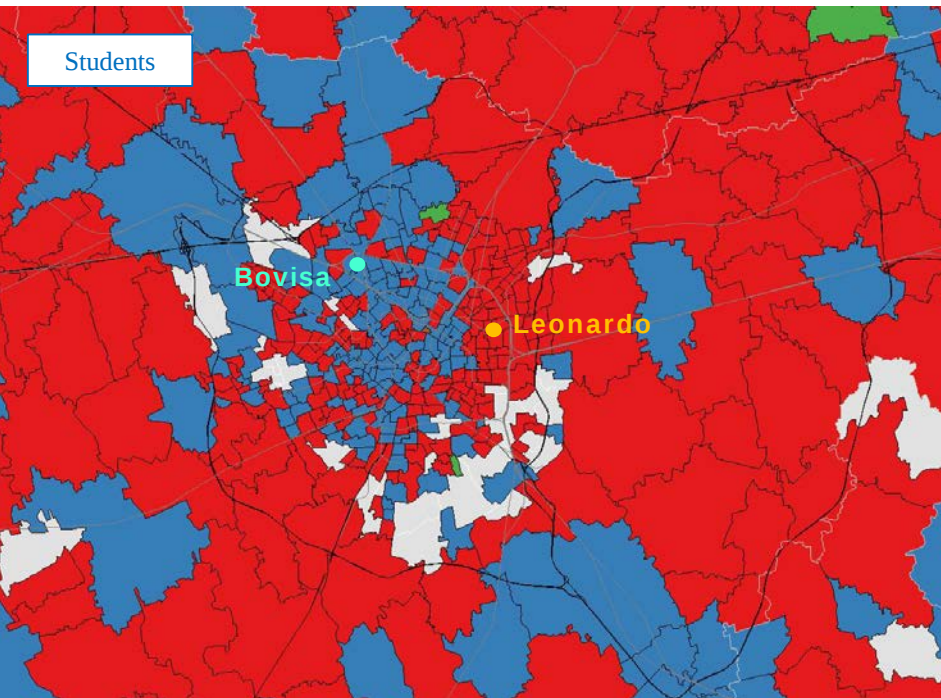
Trips distribution _ General view



- Catchment area of the secondary campuses is generally limited to the nearby areas / corridors (Como campus is definitely local, whilst Piacenza and Mantova attract along transport supply)
- Milanese campuses attract both students and staff from all over the region (and beyond)



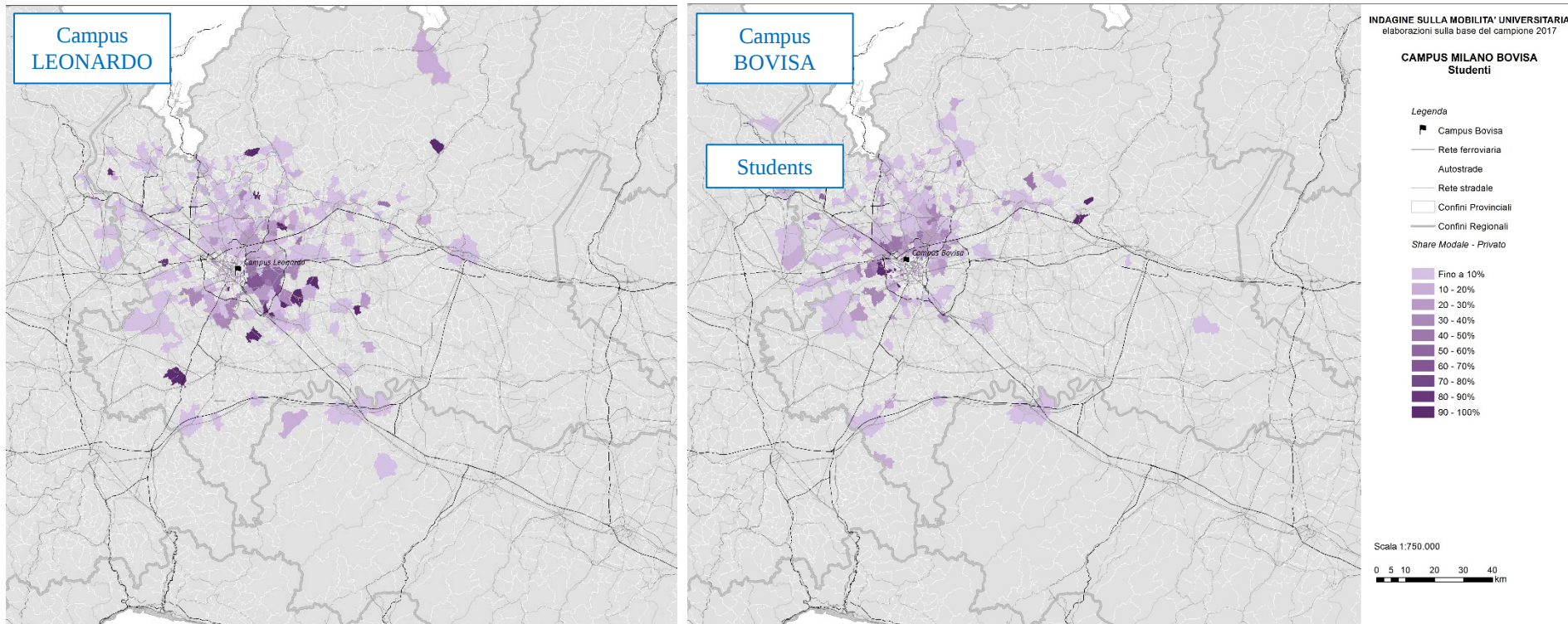
Trips distribution _ Milano and hinterland



- Catchment area of the secondary campuses is generally limited to the nearby areas / corridors (Como campus is definitely local, whilst Piacenza and Mantova attract along transport supply)
- Milanese campuses attract both students and staff from all over the region (and beyond)



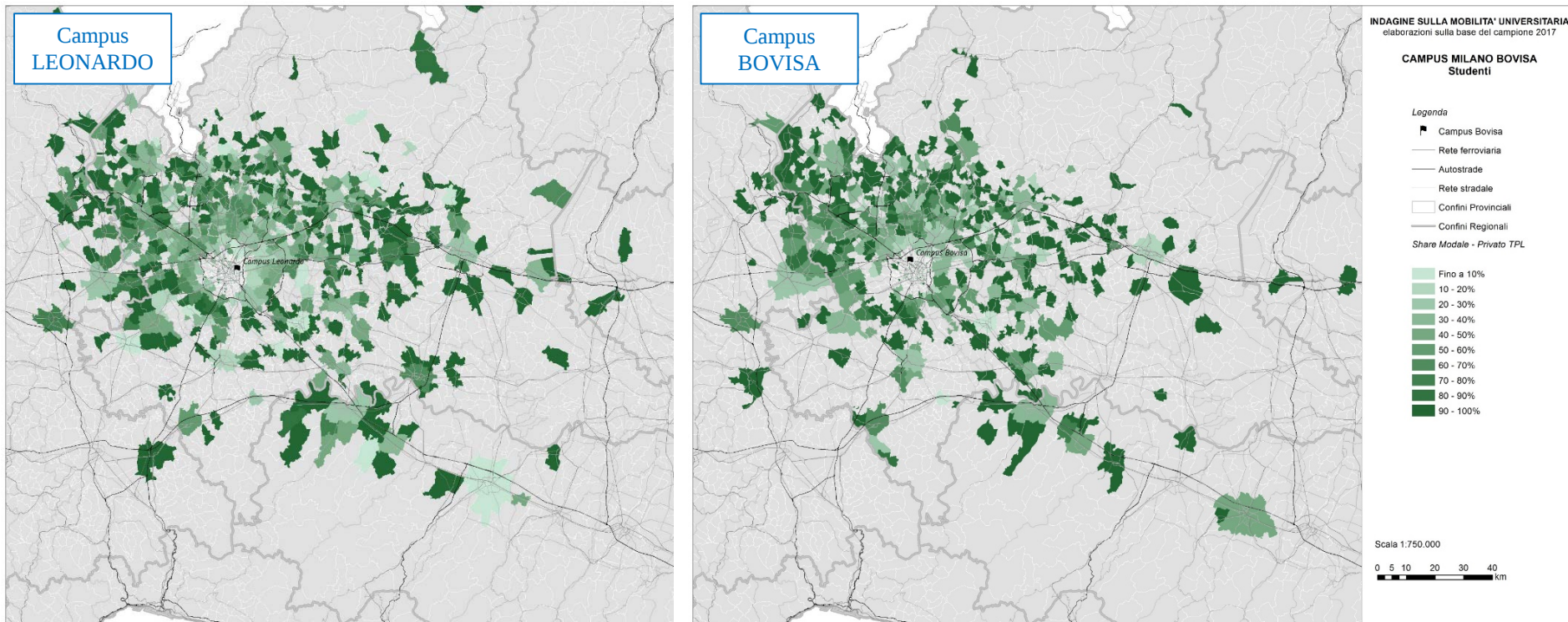
Trips distribution _ Milanese campuses (Students, by car)



- The majority of trips by car to Milanese campuses are generated from areas located between 5 and 20 km of distance



Trips distribution _ Milanese campuses (Students, by PT or Private-PT)



- Trips by public mode (or with an interchange between private and public) cover the entire region



Trips distribution _ Como Campus (by car)

Students

Staff

INDAGINE SULLA MOBILITA' UNIVERSITARIA
elaborazioni sulla base del campione 2017

CAMPUS DI COMO
Personale Docente e
Tecnico Amministrativo

Legenda

- Campus Como
- Rete ferroviaria
- Autostrade
- Rete stradale
- Confini Provinciali
- Confini Regionali
- Share Modale - Privato

- Fino a 10%
- 10 - 20%
- 20 - 30%
- 30 - 40%
- 40 - 50%
- 50 - 60%
- 60 - 70%
- 70 - 80%
- 80 - 90%
- 90 - 100%

Totale viaggi medi giornalieri

10
0,1

Scala 1:500.000

0 5 10 20 30 40 km

Nota: Share modale relativo agli spostamenti eseguiti nella loro interezza con il solo mezzo privato.



Trips distribution _ Cremona Campus (by car)

Students

Staff

INDAGINE SULLA MOBILITA' UNIVERSITARIA
elaborazioni sulla base del campione 2017

CAMPUS DI CREMONA
Personale Docente e
Tecnico Amministrativo

Legenda

- Campus Cremona
- Rete ferroviaria
- Autostrade
- Rete stradale
- Confini Provinciali
- Confini Regionali
- Share Modale - Privato

- Fino a 10%
- 10 - 20%
- 20 - 30%
- 30 - 40%
- 40 - 50%
- 50 - 60%
- 60 - 70%
- 70 - 80%
- 80 - 90%
- 90 - 100%

Totale viaggi medi giornalieri

0,1

Scala 1:500.000

0 5 10 20 30 40 km

Nota: Share modale relativo agli spostamenti eseguiti nella loro interezza con il solo mezzo privato.



Trips distribution _ Lecco Campus (by car)

Students

Staff

INDAGINE SULLA MOBILITA' UNIVERSITARIA
elaborazioni sulla base del campione 2017

CAMPUS DI LECCO
Personale Docente e
Tecnico Amministrativo

Legenda

- Campus Lecco
- Rete ferroviaria
- Autostrade
- Rete stradale
- Confini Provinciali
- Confini Regionali
- Share Modale - Privato

- Fino a 10%
- 10 - 20%
- 20 - 30%
- 30 - 40%
- 40 - 50%
- 50 - 60%
- 60 - 70%
- 70 - 80%
- 80 - 90%
- 90 - 100%

Totale viaggi medi giornalieri
10
0,1

Scala 1:500.000

0 5 10 20 30 40
km

Nota: Share modale relativo agli spostamenti eseguiti nella loro interezza con il solo mezzo privato.



Trips distribution _ Mantova Campus (by car)

Students

Staff

INDAGINE SULLA MOBILITA' UNIVERSITARIA
elaborazioni sulla base del campione 2017

CAMPUS DI MANTOVA
Personale Docente e
Tecnico Amministrativo

Legenda

- Campus Mantova
- Rete ferroviaria
- Autostrade
- Rete stradale
- Confini Provinciali
- Confini Regionali
- Share Modale - Privato

- Fino a 10%
- 10 - 20%
- 20 - 30%
- 30 - 40%
- 40 - 50%
- 50 - 60%
- 60 - 70%
- 70 - 80%
- 80 - 90%
- 90 - 100%

Totale viaggi medi giornalieri

0,1

Scala 1:500.000

0 5 10 20 30 40 km

Nota: Share modale relativo agli spostamenti eseguiti nella loro interezza con il solo mezzo privato.



Trips distribution _ Piacenza Campus (by car)

Students

Staff

INDAGINE SULLA MOBILITA' UNIVERSITARIA
elaborazioni sulla base del campione 2017

CAMPUS DI PIACENZA
Personale Docente e
Tecnico Amministrativo

Legenda

- Campus Piacenza
- Rete ferroviaria
- Autostrade
- Rete stradale
- Confini Provinciali
- Confini Regionali
- Share Modale - Privato

- Fino a 10%
- 10 - 20%
- 20 - 30%
- 30 - 40%
- 40 - 50%
- 50 - 60%
- 60 - 70%
- 70 - 80%
- 80 - 90%
- 90 - 100%

Totale viaggi medi giornalieri

10
0,1

Scala 1:500.000

0 5 10 20 30 40
km

Nota: Share modale relativo agli spostamenti eseguiti nella
loro interezza con il solo mezzo privato.



Conclusions

Through the analysis of the modal share and the GIS representation we can make a few points. Among the mains:

- Public transportation (eventually in combination with private vehicle) accounts for about 65% of the total trips towards the two Milanese campuses for the staff and 81% for students, while towards the territorial campus it accounts for just the 39% and 30% respectively.
- Private vehicle is used most on middle-length trips, while the train is the mode associated with the most average trip length (especially for territorial campuses).
- In the first circle of municipalities around Milan there is a peculiar raise in car modal share (border effect of fare system?).
- Territorial campuses have mainly a local catchment area, despite (or because!) presenting a far higher car modal share.

Furthermore, GIS representation allowed a visual debug of the data set.



Further research

Cluster analysis of the data set may be used to link specific respondents' characteristics to mobility behaviour.

A discrete modal choice model (logit) is under development to investigate the determinants of modal choice related to transport characteristics and regulation (travel time, fares, availability of interchange facilities, etc.).

We are cooperating with the Sustainable Office of the University in planning a new survey, featuring a revised structure to:

- Avoid user misinterpretation of questions (thus obtaining less anomalous responses).
- Collect more effective information on modal chain (in order to be able to analyse attractiveness of modal interchanges).



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