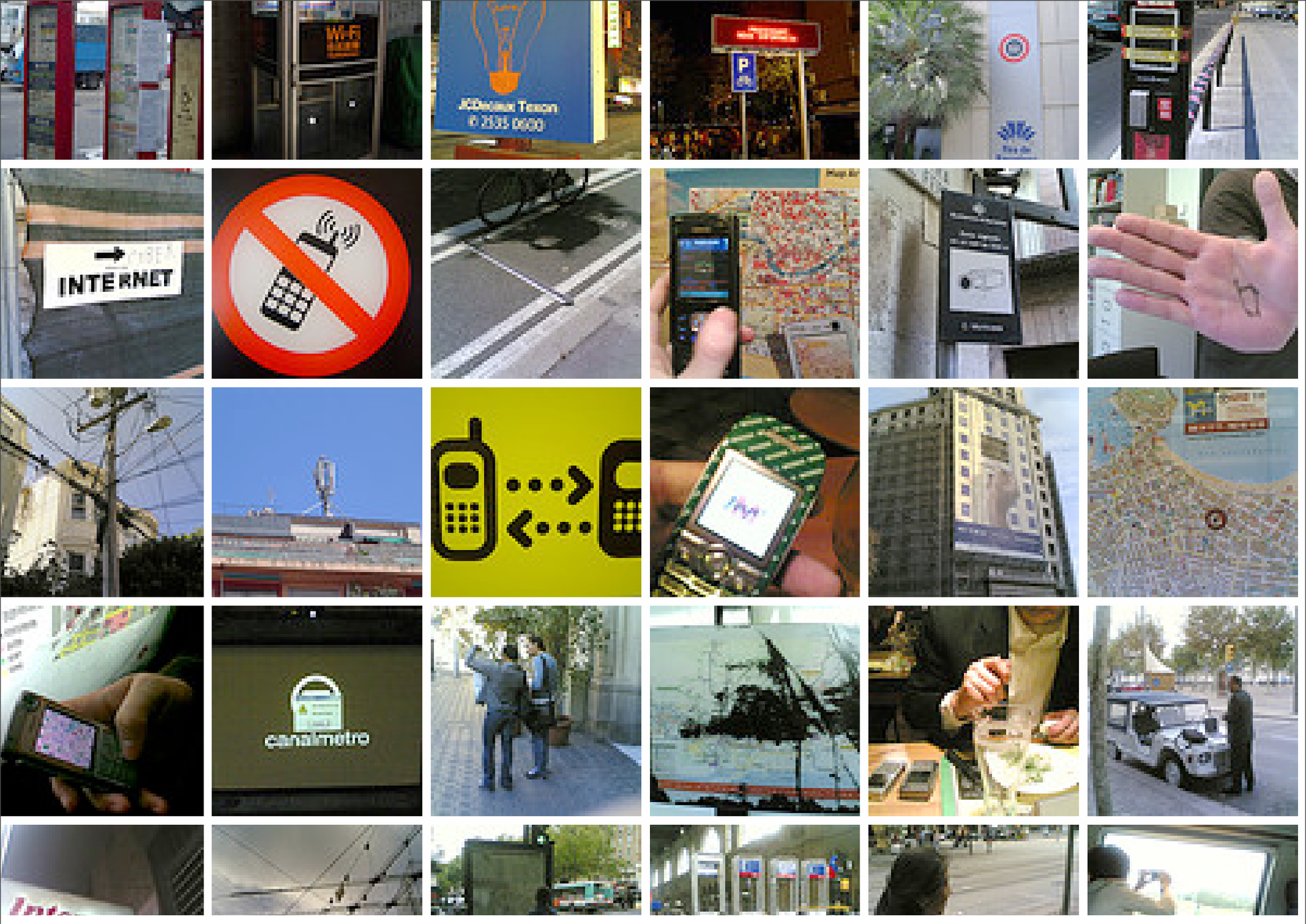


Fabien Girardin - Universitat Pompeu Fabra
Visualizar'08 Database City, Madrid, November 3, 2008

My name is Fabien Girardin, I am a PhD canditate at Universitat Pompeu Fabra, affiliated to MIT SENSEable City Lab. My background in engineering, my research in human-computer interaction and the context of my work at the Department and Urban Studies and Planning at MIT led me to investigate the integration of ubiquitous technologies in cities with a particular focus on their interaction with humans. This kind of context implies cross-disciplinary research with people comming from: urban studies and architecture, information and computer science, software engineering, interaction design, social and communication studies. It also forces the development of a peculiar process based on three steps: urban demos (to stretch the mind and collect data), data exploration and analysis (to build theories), interventions and observations in urban contexts (to test or augment the analysis). This presentation will follow this process.

From Sentient to Responsive Cities

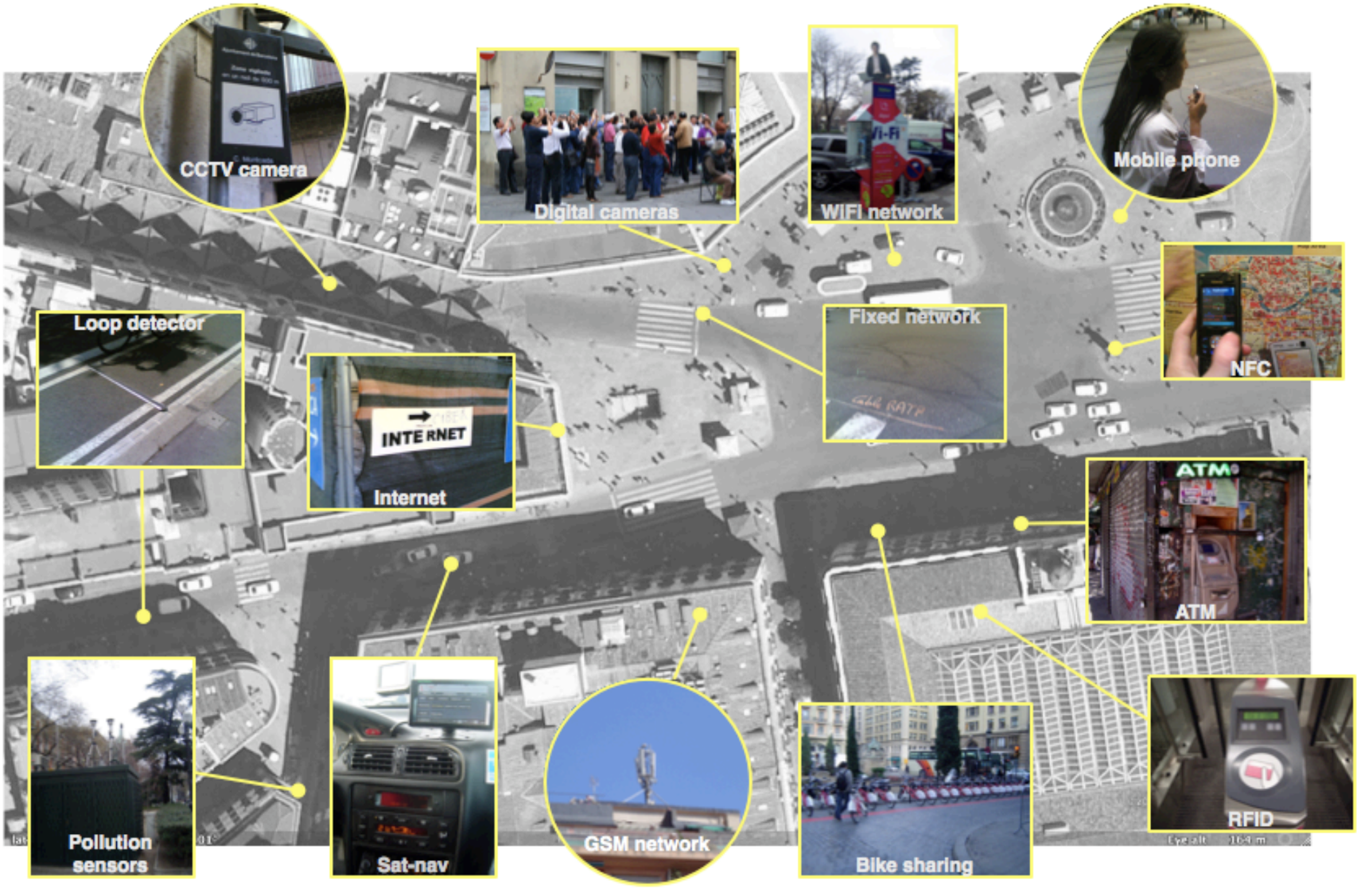
Microscopes and telescopes

Evidences and loops

Taxi drivers

I seperated this presentation in three main themes. In, Microscopes and telescopes I will discuss the emergence of new types of urban data that sentient cities generate. Evidence and loops describes the potentials to create valuable information from these data and feed them back to authorities and people (Responsive cities). Finally, in taxi drivers I will discuss, based on a study of the co-evolution of taxi drivers and their satnav system, why the design of this process to feedback urban information to people should be carrefully thought off.

New urban actors



New urban actors have emerged in the life of the city, all connected to a network. Some of these urban actors take the form of CCTV cameras, loop detectors, wireless networks, fixed communication networks, digitally mediated consumption system, RFID and NFC-based interactive systems, and pollutions sensors that transform the landscape of the contemporary city into a “militarized scanscape”.

Digital shadows

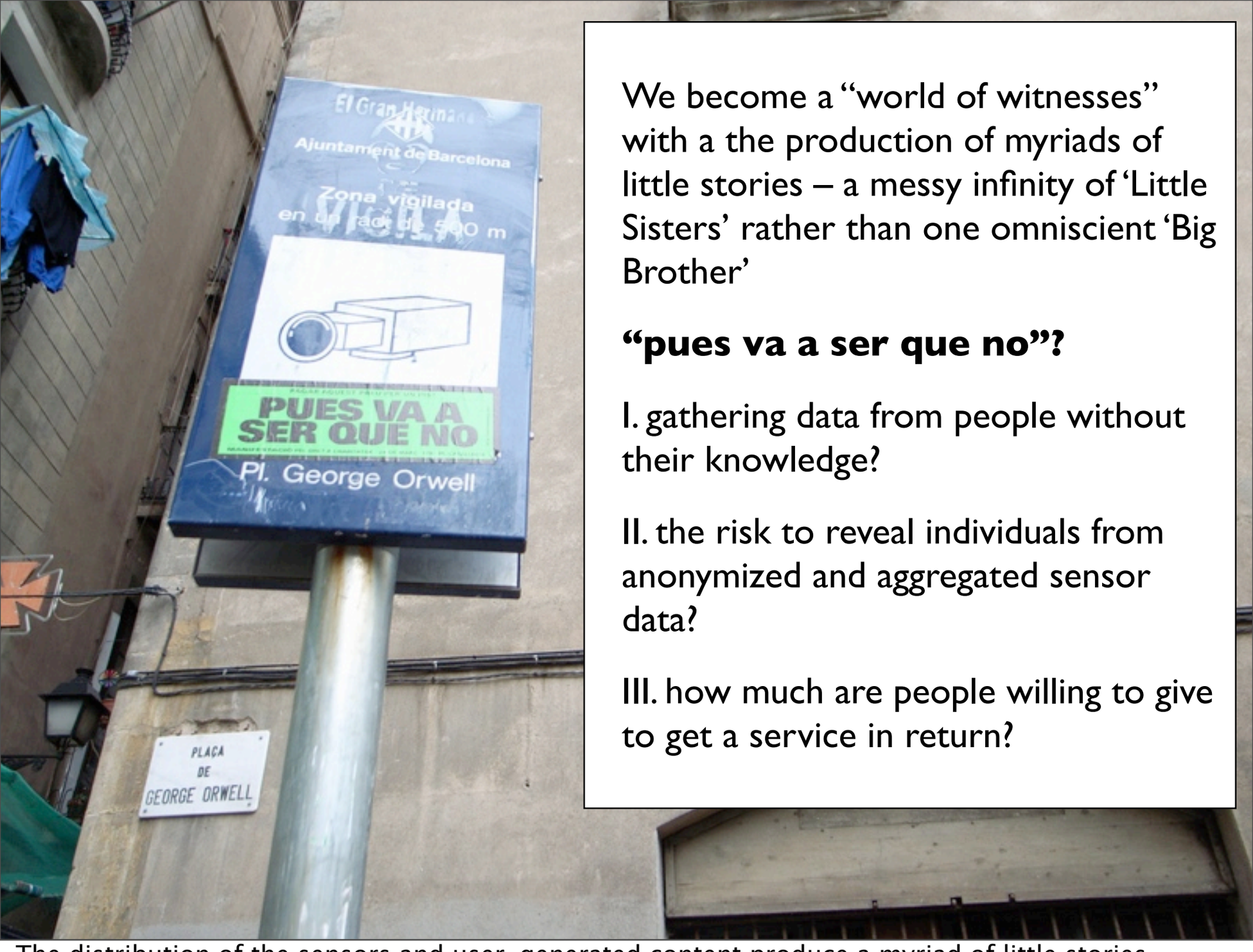
- Records of implicit interactions with these new urban actors in the physical space with digital means
- Examples: RFID card (bike sharing, metro), tangible sensors, wireless networks (GSM, Wi-Fi), fidelity cards, credit cards, etc

Our implicit interaction with these new actors create logs or “digital shadows” of our actions in time and space

Digital footprints

- Explicit user-generated content with geographic anchor: "*from shoeboxes to digital footprints*"
- Fall of prices to store data
- Raise of online social networks and 'new cartography' as ways to map and visualize the city through images and narrative descriptions

Another type of records comes from georeference content people explicitly and publicaly disclose online (digital footprints). The phenomenon of sharing content previously kepts in "shoeboxes" to the Internet has been drivent by the fall of prices to store data (to massively collect), the raise of online social networks (to share) and geospacial web or new cartographry (to georeference and map)



We become a "world of witnesses" with a the production of myriads of little stories – a messy infinity of 'Little Sisters' rather than one omniscient 'Big Brother'

"pues va a ser que no"?

I. gathering data from people without their knowledge?

II. the risk to reveal individuals from anonymized and aggregated sensor data?

III. how much are people willing to give to get a service in return?

The distribution of the sensors and user-generated content produce a myriad of little stories moving from the vision of the omniscient "Big Brother" to a "world of witness" where everybody plays the role of "Little Sister". The collection, access, analysis and disclosure of these data do not come without creating social and ethical issues. My research participates to the debat in creating positive value to these data. As a society, we will need to chose how much we are willing to give to get a service in return? The success of fidelity cards in chains of supermarkets is an example of the trade-off privacy vs. value.

Bruno Latour

"The consequences for the social sciences will be enormous: they can finally have access to masses of data that are of the same order of magnitude as that of their older sisters, the natural sciences"

More specifically, the access to these massive amounts of spatio-temporal data have a consequence on social sciences (including urban studies)

Urban informatics

1. Urban data gathering (What can be sensed?)
2. Urban data analysis (What can we do with what is quantitativly sensed and qualitativly observed?)
3. Information visualization (What can we communicate?)
4. Designing technologies and services for the city (How to design to improve?)

The research in that domain is often called “urban informatics”. It deals about 3 main themes: understanding urban dynamics, understanding the integration of ubiquitous technologies in urban life and designing technologies for people in the city. The research is stratified in 4 layers: data gathering, data analysis, information visualization and design of urban services. This presentation will cover each of this stratum.

Sentient cities

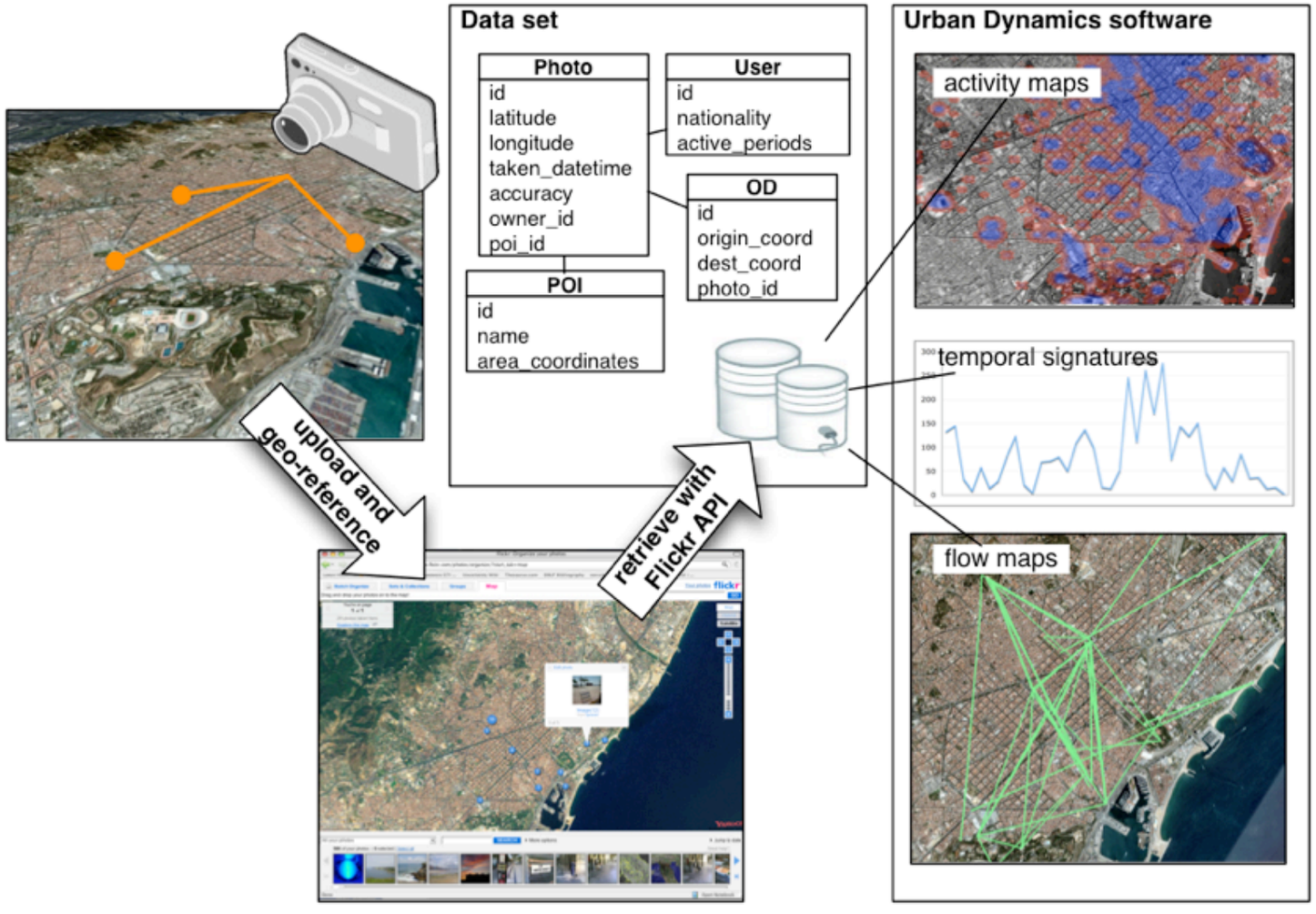
- Technologies that gets embedded in the fabric of our lives and giving us the ability to show previously invisible urban processes
- Literature: *pulsing cloud of data, reveal the city as we experience it, instantaneous information, enhancement of our perception*

The collection and visualization of dynamic urban data has enabled researchers to show previously invisible urban processes leading to a type of cities that I call “Sentient cities”. These cities are often painted in the litterature with the terms: pulsing cloud of data, reveal the city as we experience it, instantaneous information, enhancement of our perception. I will now give a few examples.

Nowadays tourists leave digital footprints behind them that reveal their presence

In this project, we worked with the Province of Florence in Italy. Florence has difficulties in understanding the tourist dynamics that takes place in the region, because tourist mainly come to the Province for the day and do not stay. They prefer to sleep in the nearby cities. In consequence tourists leave very little traces of their presence and activities. Surveys are very expensive to perform and only provide a snapshot. We collected and analysis georeferenced photos publicaly available on the photo-sharing web platform Flickr.

Digital footprinting



Girardin, F., Fiore, F. D., Ratti, C., and Blat, J. (2008). Leveraging explicitly disclosed location information to understand tourist dynamics: A case study. Journal of Location-Based Services 2, 1, 41–54.

In the process we call “digital footprinting”, tourists take photos and upload them to Flickr with georeferences. Our system collects these data and with data-mining techniques extract the photo and user information and infers the types of tourists from their behaviors. The visualization of this basic analysis generates activity and flow maps as well as temporal signatures.

2 years (2005-2007)

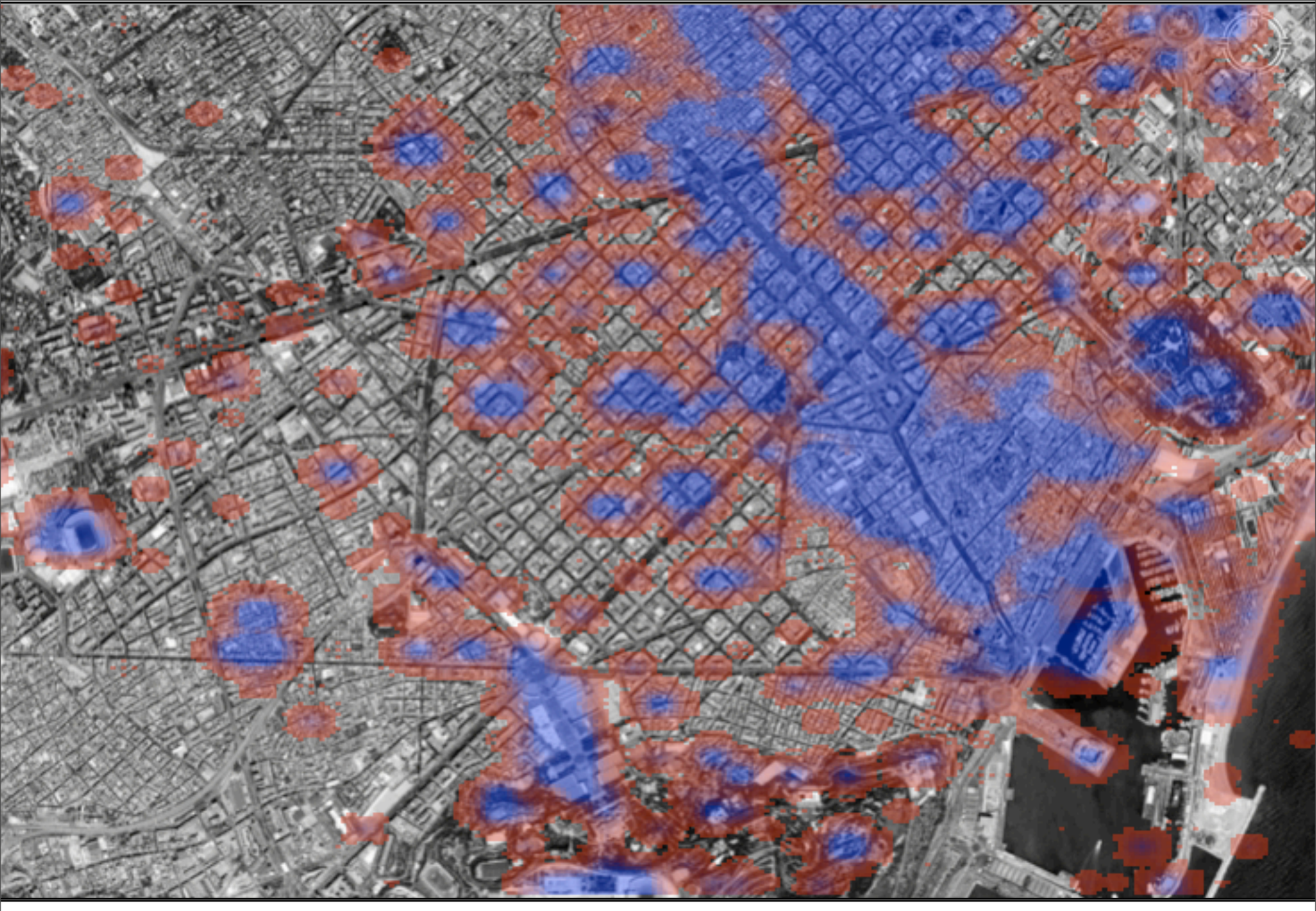
Region	Photos	Photographers
Barcelona	154,106	5818
Province of Florence	81,017	4280
Rome	144,501	6018

We collected Flickr data for multiple cities. For the province of Florence, we analyzed 81,000 photos shared by 4280 photographers.

Scale

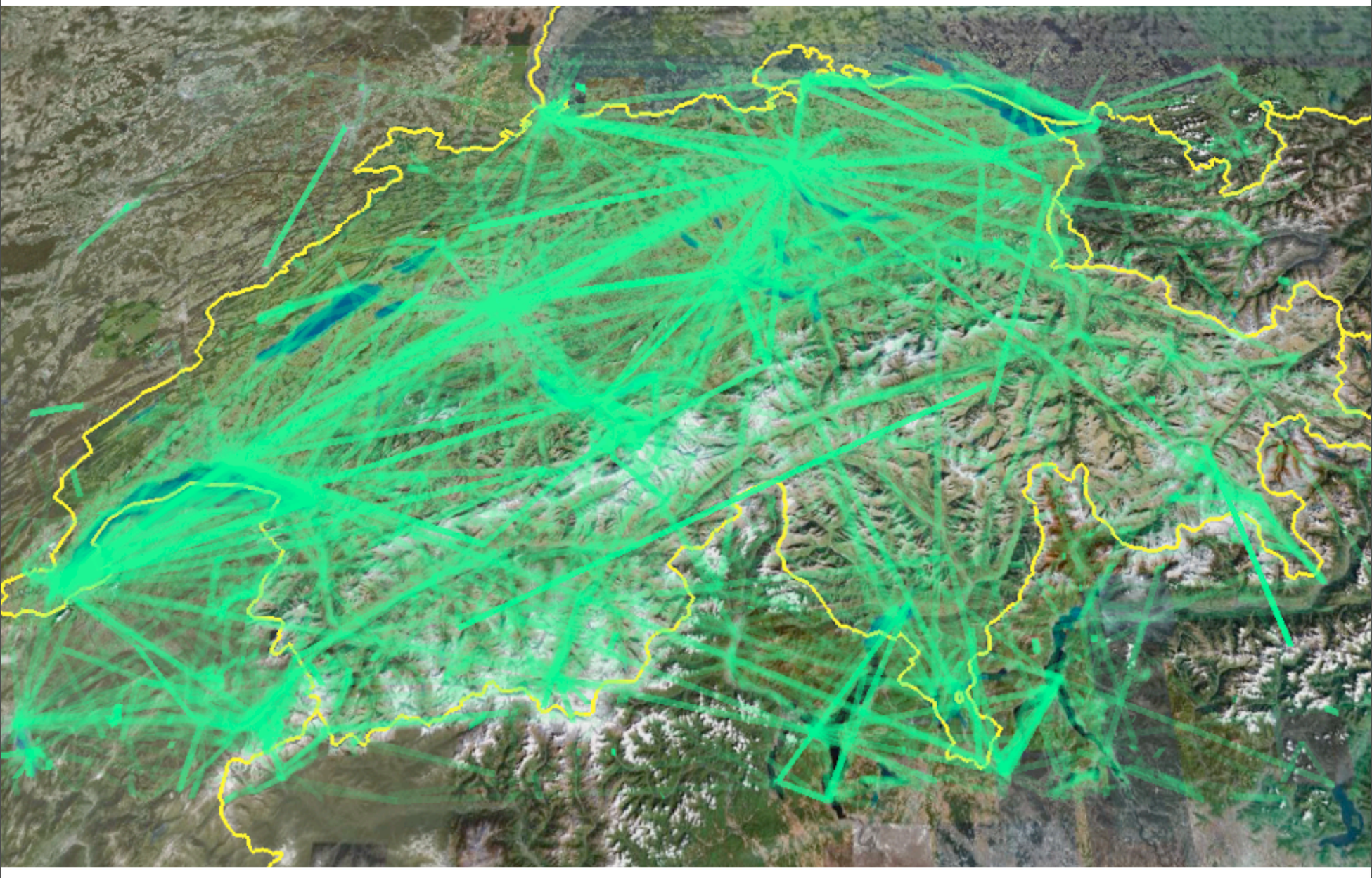
Density of photographers in Tuscany in 2007 at region, city and monument scales. Fabien Girardin, UPF

The basic mapping of this data enables to uncovers the density of tourists at very different scales, such as region, citiy and point of interest. While cities are interested in understanding tourist dynamics within their boundaries, we found out that they were equaly interested in understand how the “competitive” cities perform. This type of data allows comparaisons.



Density of photographers in Barcelona 2007. Fabien Girardin, UPF
http://www.flickr.com/photos/drremulac/1286627123/in/set-72157600018368138/

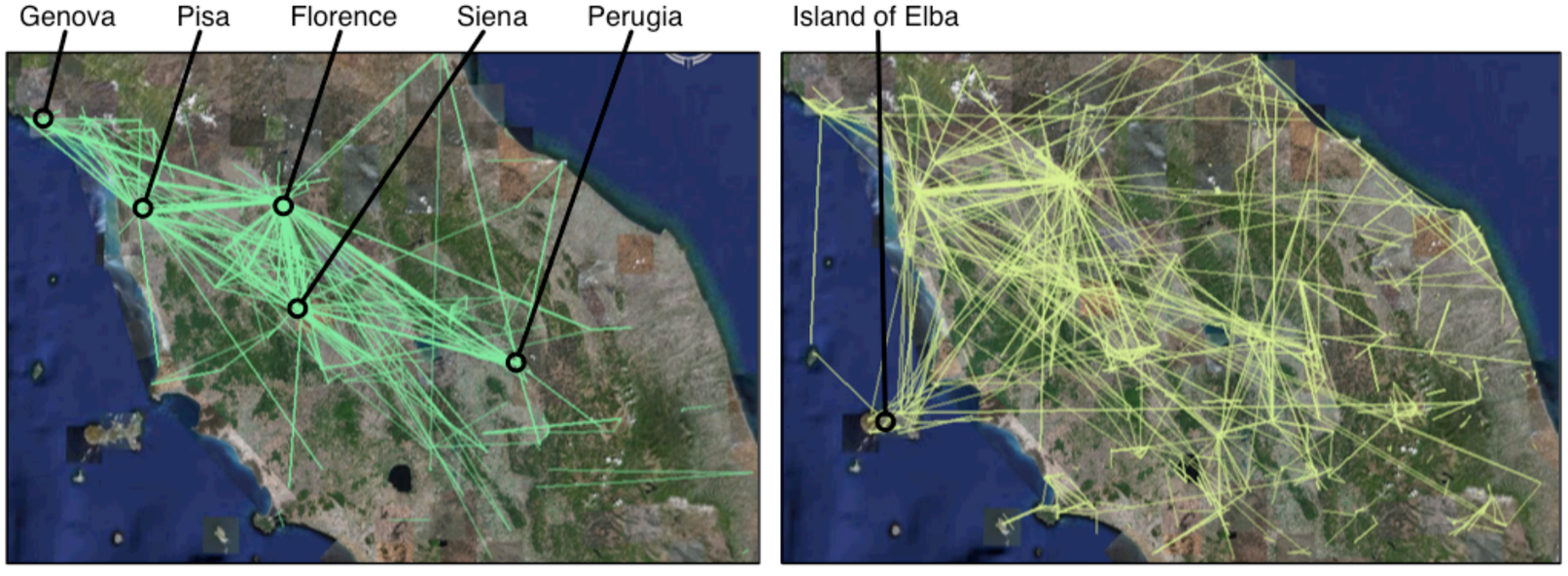
For instance, if I would ask a barcelonia to draw me the map of presence of tourists, he/she would probably draw this map (generated with Flickr data for 2007). This map confirms the many assumptions the city has on the presence of tourists and it is actually the first time that it can be mapped.



Tourists traces in Switzerland in 2007. Fabien Girardin, UPF
http://www.flickr.com/photos/drremulac/464000368/in/set-72157600018368138/

Each photo contains a timestamp the digital cameras embeds when the photo is taken. So not only can we analyse the location of the photo but also its temporal context. With both location and time data we build a sequence of photos that forms the trails the tourists follow. The mapping these traces reveals main flows. In the case of Switzerland, it touristic areas such as Interlakend and Zermatt have an equal importance as the main cities.

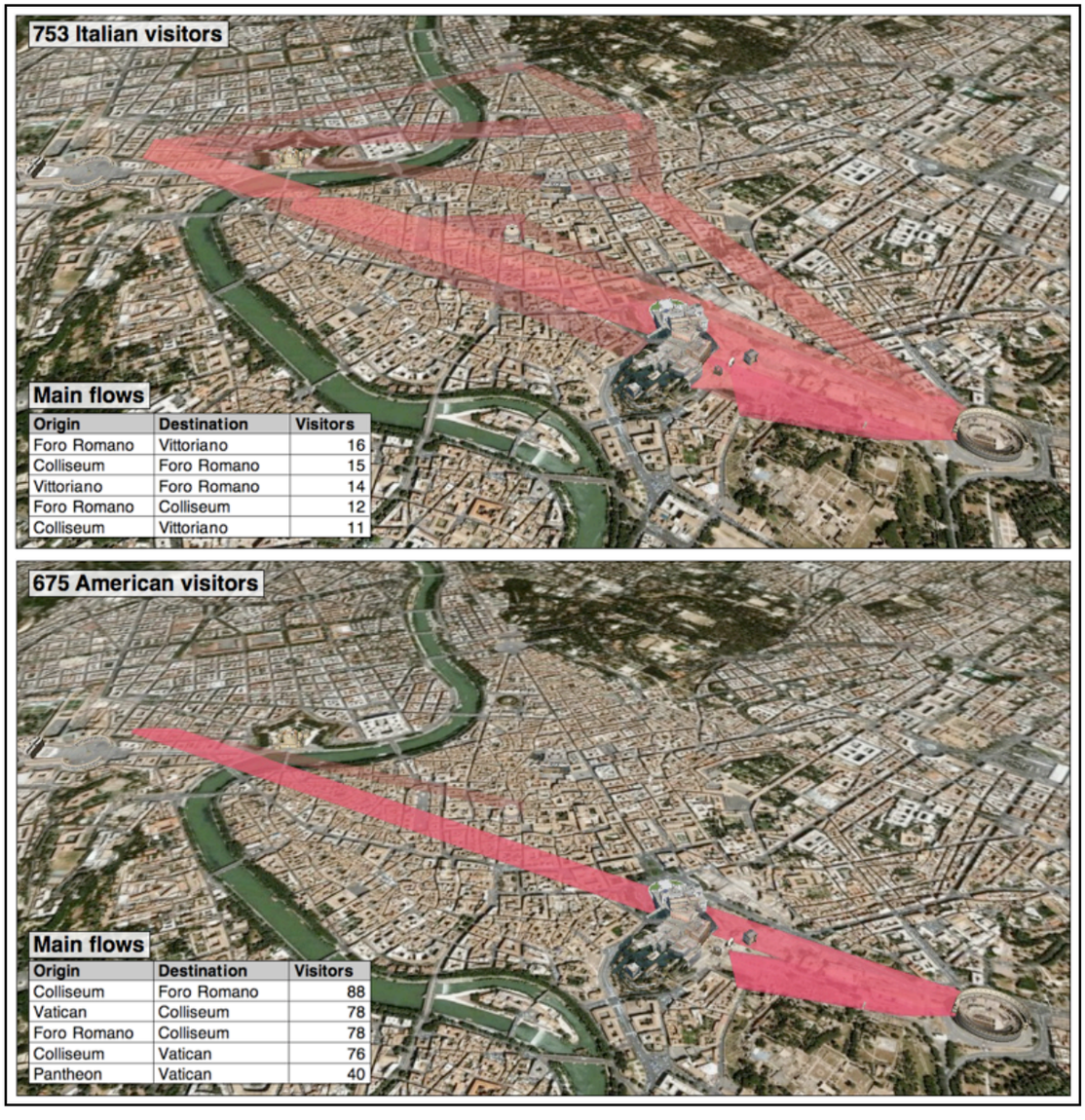
Types of tourists



Tourists and locals can be recognized from their practice
60% of users disclose their home country

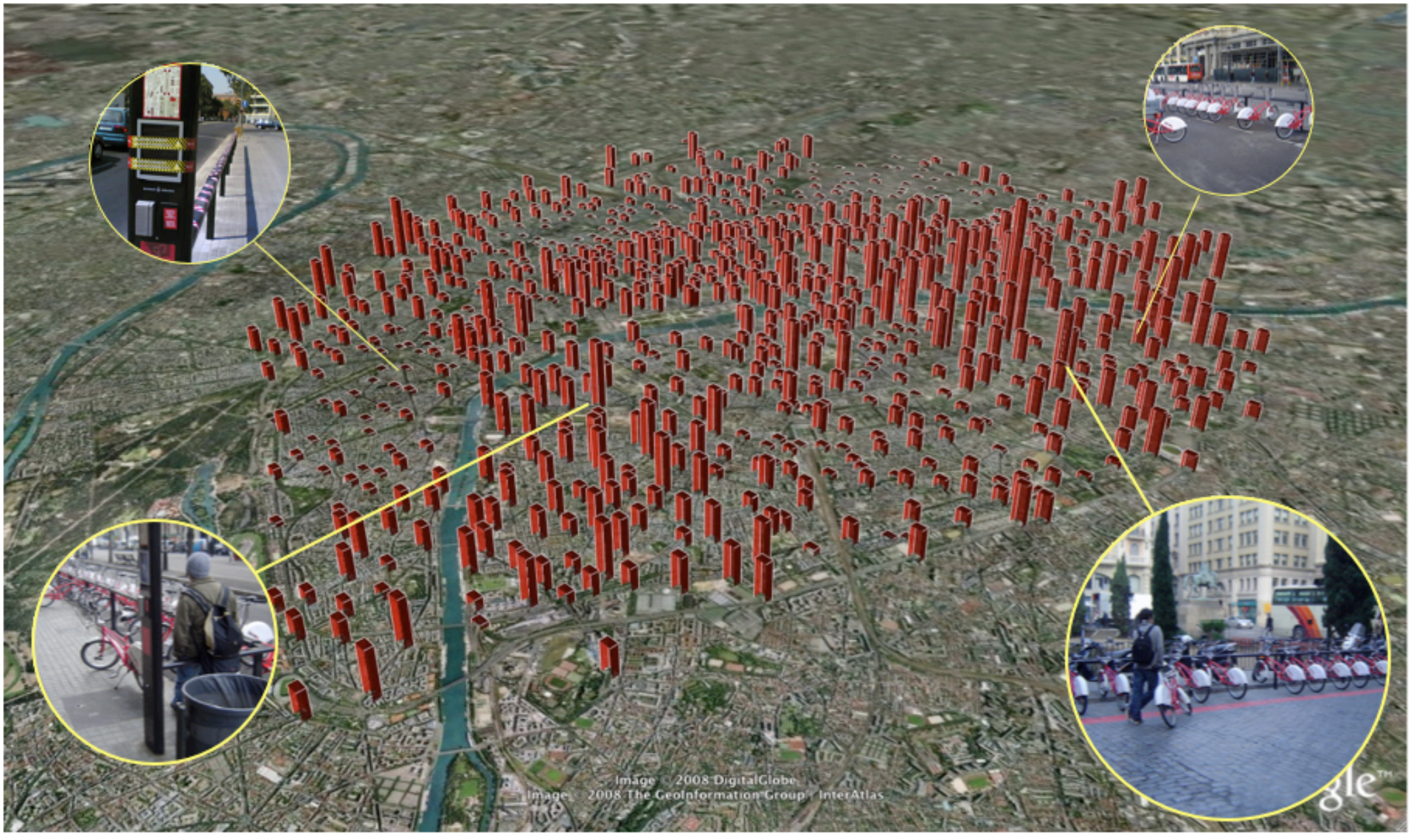
Flickr lets the opportunity to its users to set their home city or country. We found out that 60% of the users discolsed their home coutry. Taking advantage of this information, we were able to map the traces of american (left) and italian (right) visitors in Tuscany and its proximity

Flows



Girardin, F., Calabrese, F., Dal Fiore, F. , Ratti, C., and Blat, J. (2008). Digital footprinting: Uncovering tourists with user-generated content. IEEE Pervasive Computing, 7(4):36–43.

With the data revealing the main points of interested, it is possible to aggregated this traces into flows. Once again the difference between italian (top) and american (bottom) visitors in Rome.



Bike sharing systems as proxies of city dynamics

Another project aimed at extracting public information on the real-time state of bike sharing system to use as proxmy to reveal city dynamics.

Paris Through Velib'

Fabien Girardin, Universitat Pompeu Fabra
Revealing Paris Through Velib' Data: http://www.girardin.org/fabien/tracing/velib/

The resulting animation give a glimpse at the spatio-temporal state of the system (and city) and the mobility patterns of its users (movements from empty areas to peak areas)

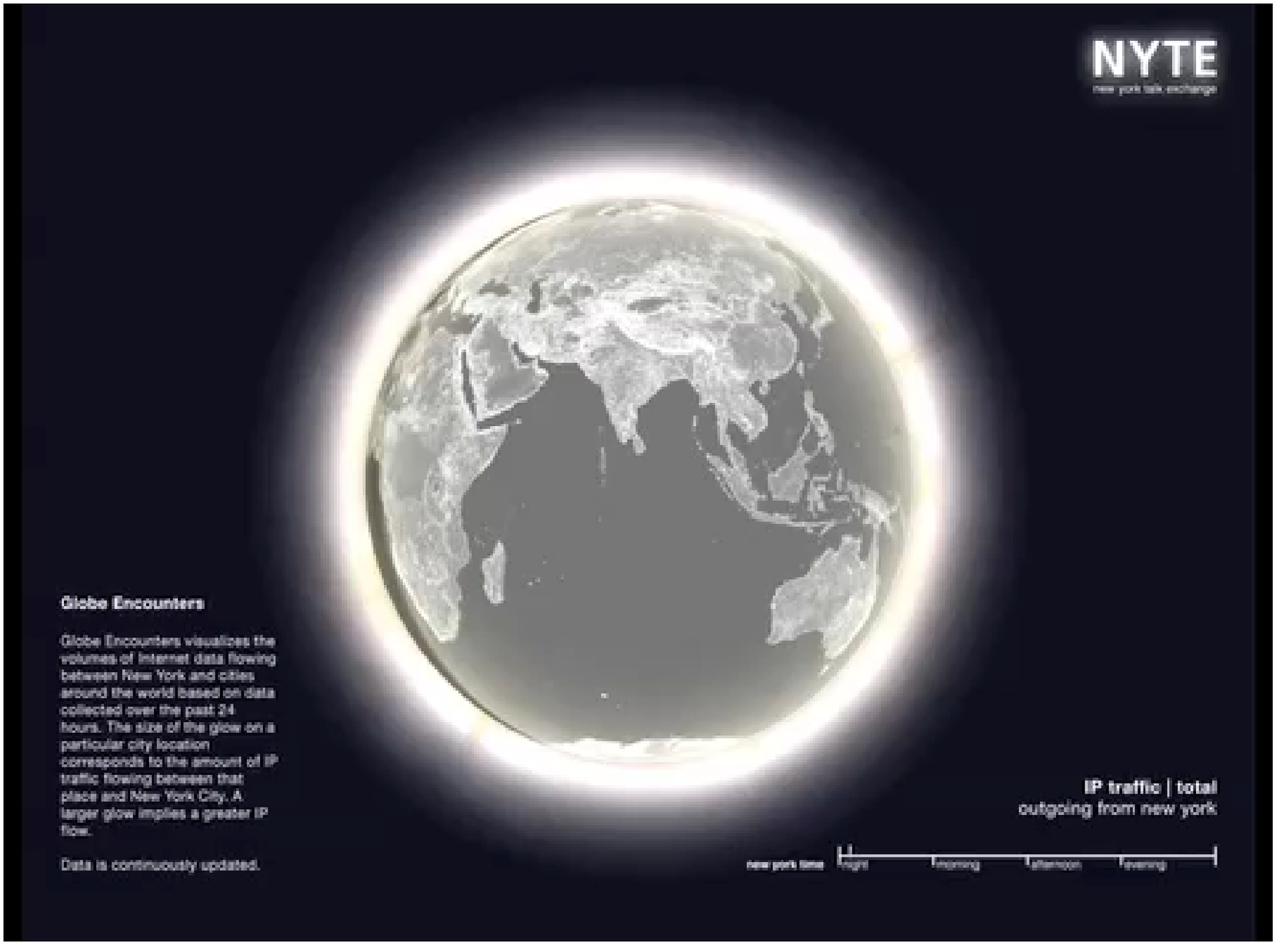
Bicing appropriation

Fabien Girardin, Universitat Pompeu Fabra
Bicing on a sunny sunday Data: http://www.girardin.org/fabien/tracing/bicing/

One intention behing these visualization is to explore how accumulated data can help people to grasp the availability and quality of the system over space and time (e.g. do not expect to encounter available bikes the different neighborhoods at certain hours). Here is the example of Barcelona on a sunny Sunday, that show the movement of the city to the beach and back. At certain times it is incovenient to bike to the beach (because all the stations are full) and leave the beach with a bike (because all the stations are empty)

Cellular network traffic as proxy of city dynamics

Real-time Rome aggregated data from cell phones to better understand urban dynamics in real time. By revealing the pulse of the city, the project aims to show how technology can help individuals make more informed decisions about their environment. In the visualizations of Real Time Rome we synthesize data from various real-time networks to understand patterns of daily life and special events in Rome. MIT SENSEable City Lab, Real-Time Rome: http://senseable.mit.edu/realtimerome/



Telephone and IP traffic as proxy of city global connectivity

New York Talk Exchange illustrates the global exchange of information in real time by visualizing volumes of long distance telephone and IP (Internet Protocol) data flowing between New York and cities around the world. MIT SENSEable City Lab, New York Talk Exchange, http://senseable.mit.edu/nyte/

Stretching the imagination

Local authorities and their public opinion

The public in general

Besides collected data for futher analysis, the projects aim at stretching the imagination of local authories and their public opinion (left: press conference in Florence that provided feedback from the media and citizens on our early work on tourism) and the public in general (right: Design and Elastic Mind exhibit at MoMA in New York)

Limitations

- Provide a glimpse to reality. Sense what is cheap to sense, plus lack of data interoperability
- Reveal phenomena. But does not explain them.
- Need to prove that these data bring at least the same amount of knowledge than their "manual" data (e.g. surveys).
- Need of new skills and techniques to analyze and grasp the significance of these data

However, these work have two main limitations: First they only provide a glimpse to reality, because they rely on data that are "cheap" to collect and access. Therefore, they only reveal phenomena without explaining them. In consequence, further efforts are needed to assess the part of reality that these data provide and prove that the information produced bring at least the same amout or higher value of knowledge as the traditional techniques. This implies the develop of new skills and techniques to analyse and grasp the significance of these data.

Sentient cities: so what?

- We have been developing microscopes and telescopes
- Still no science on “what we see”

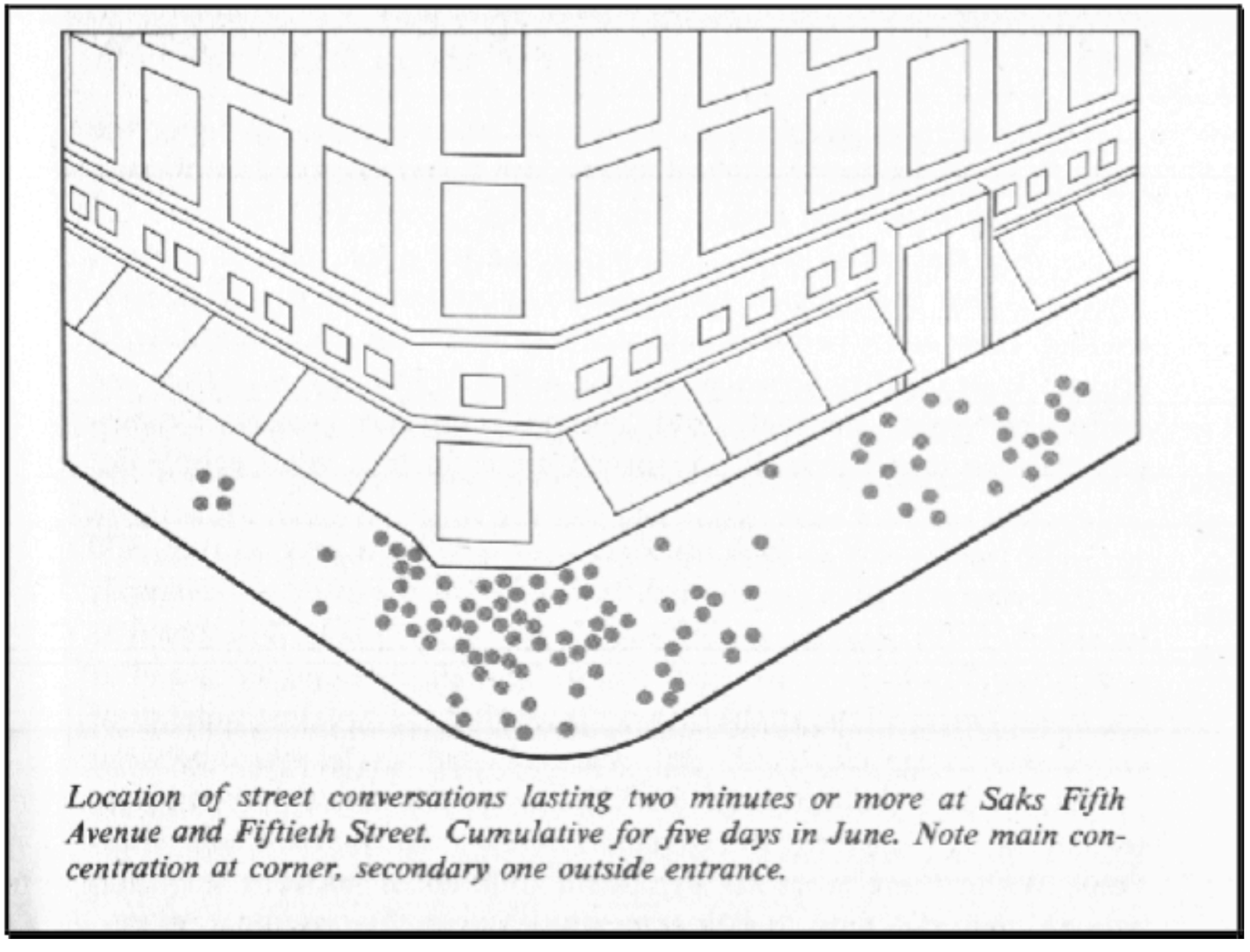
In other words, so far we have been developing microscopes and telescopes that uncover the sentient cities. But we still have not developed the science on “what we see”. I will address this issue in the second part of this presentation.

Responsive city

- Evidence-based urbanism (planning was about predict and accommodate and it becomes more observe and improve)
- Feedback loop (provide immediate information that can be acted upon)
- Citizen empowerment (pervasive tools and services)

The development of techniques to analys digital shadows and digital footprints can change the way we understand and plan cities. As planning was about predict and accommodate and it will become more observe and improve, leading to decision-making based on evidences (Evidence-based urbanism). The processing of data and distribution of information uncovers the possibility to create feedback loop mechanisms in which the information can be acted upon in real-time. Such mechanism can lead to a new generation of pervasive tools and service to empower authorities, citizens and visitors cities (Responsive cities).

Evidence-based urbanism



Location of street conversations lasting two minutes or more at Saks Fifth Avenue and Fiftieth Street. Cumulative for five days in June. Note main concentration at corner, secondary one outside entrance.

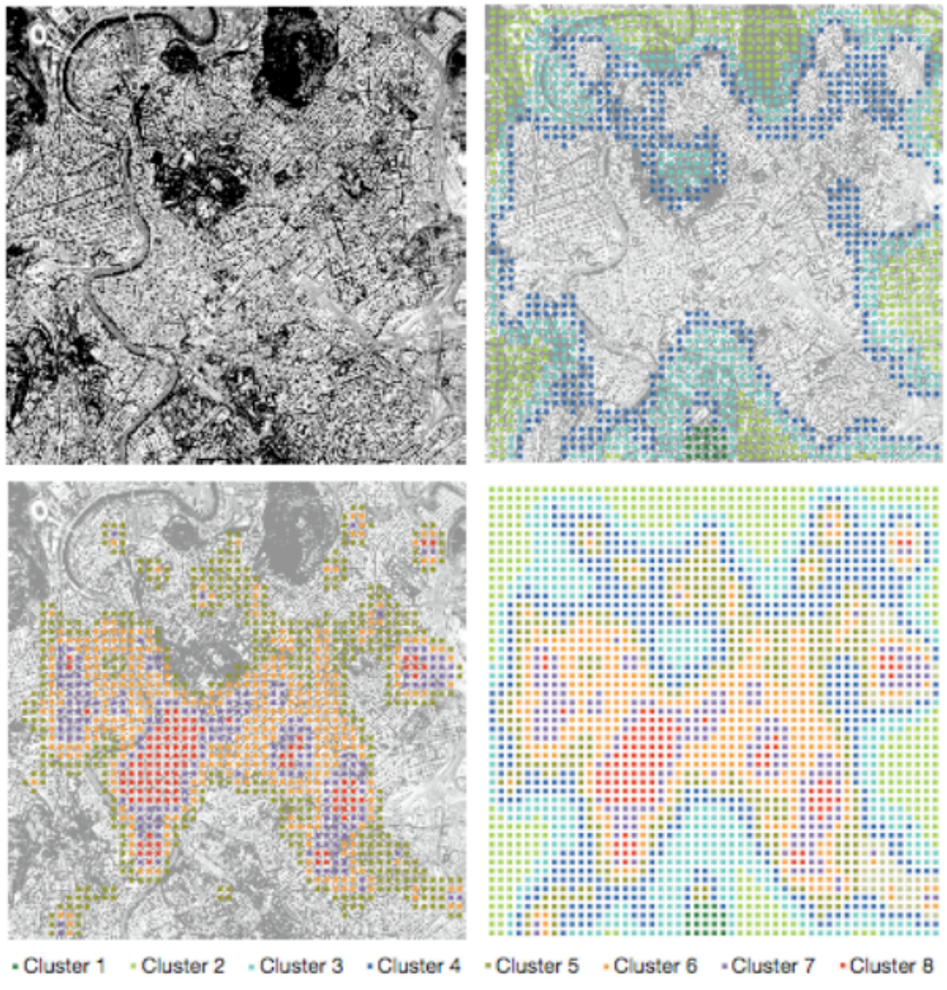
Whyte, William H. 1971. City: Rediscovering the Center. New York: Anchor Books.

Evidences have always been hard to produce.

Evidence-based urbanism

and since William Whyte's drawings in 1971, things have not evolved much as these photos taken a few weeks ago in New York count can testify. The city regularly sends employees to perform manual counts of traffic. As a matter of fact, this type of ground truth data are absolutly to callibrate the development of more pervasive and automatic tools to describe urban dynamics.

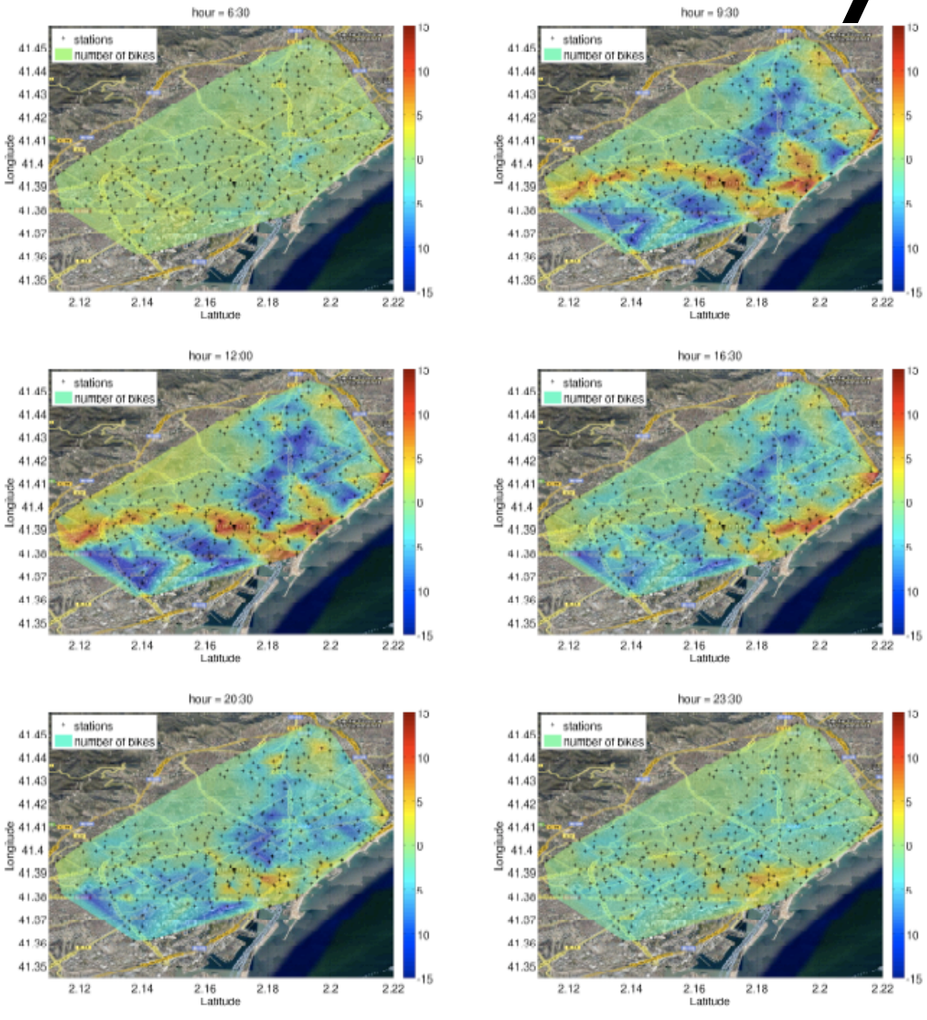
Cellular census

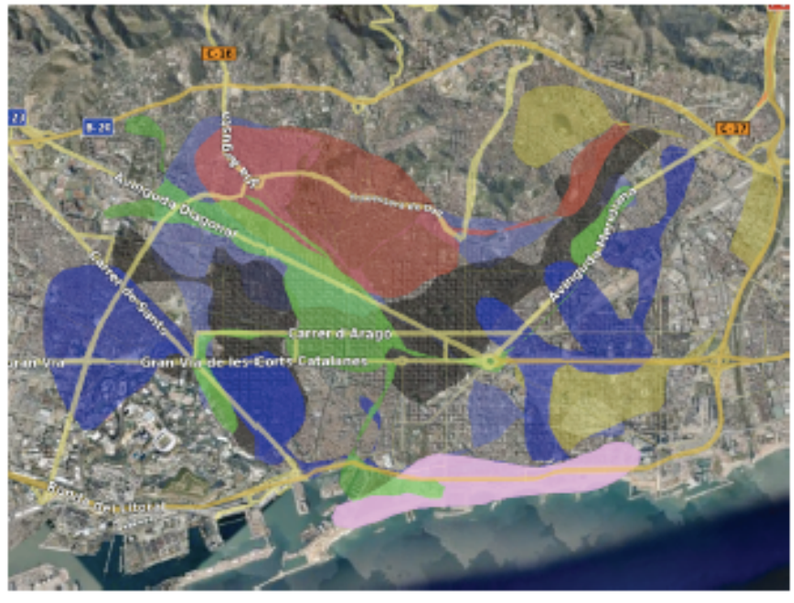


Reades, J., Calabrese, F., Sevtsuk, A. & Ratti, C. (2007) Cellular Census: Explorations in Urban Data Collection. IEEE Pervasive Computing, 6, 3, pp. 30-38.

A first example of the development of evidence-based urbanism. Colleagues at MIT SENSEable City Lab have analysed cell phone use to show new ways of looking at the city as a holistic, dynamic system. The analysis of the spatio-temporal signature of cellular network traffic characterize areas on the basis of flows and dynamics rather than on the basis of comparatively static physical or demographic features.

Spatial clustering from mobility patterns

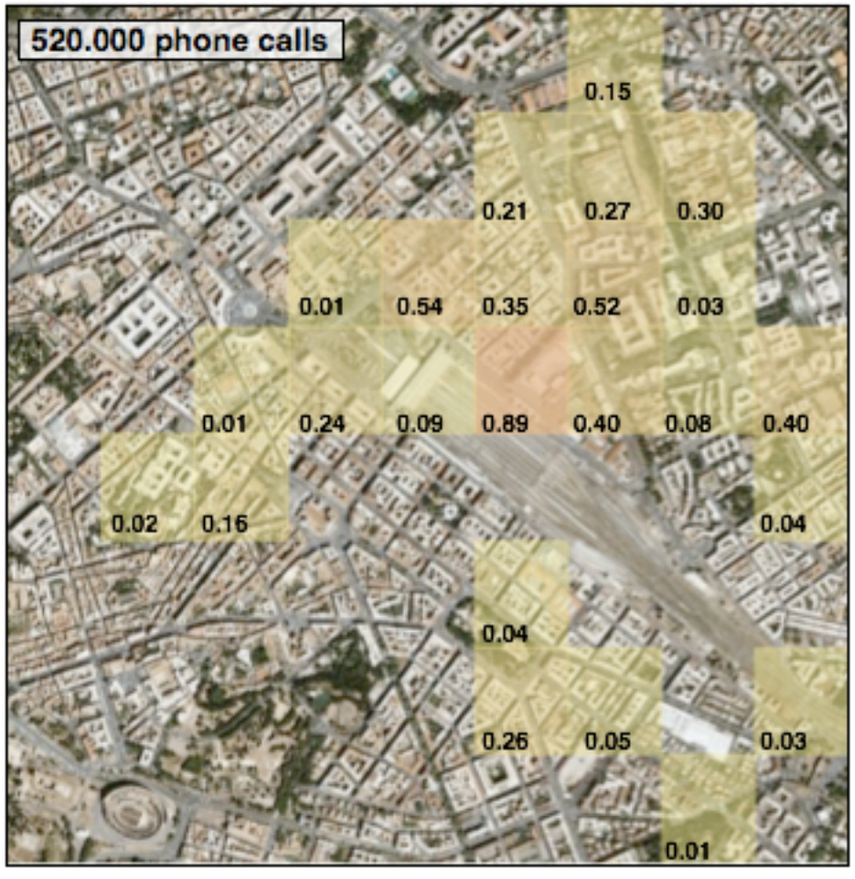




Kaltenbrunner et al. (2008) Bicycle cycles and mobility patterns (in submission)

Colleague at the Universitat Pompeu Fabra have performed similar clustering of space (right), but with public data of a bike-sharing system. With these data, they can infer the activity cycles of Barcelona's population as well as the spatio-temporal distribution of their displacements (left).

Space and tourist activities

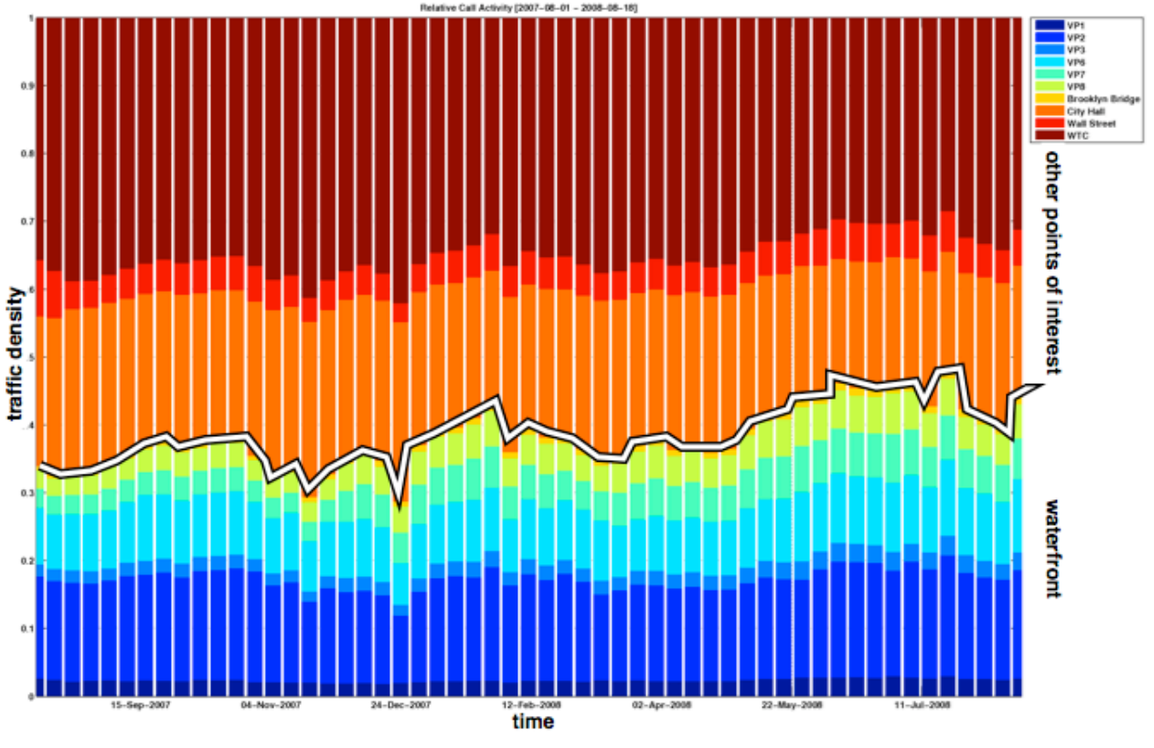


Girardin, F., Blat, J., Calabrese, F., Dal Fiore, F. & Ratti, C. (2008) Digital Footprinting: Uncovering Tourists with User-Generated Content. IEEE Pervasive Computing, October/November 2008, pp. 36-43.

In Rome, we were able to compare the density of tourists from their digital footprints (i.e. georeference photos) and digital shadows (i.e. aggregated cellular network traffic) they generate when visiting Rome. The spatio-temporal analysis revealed that georeference photo were a good proxy to capture the presence of tourists in their sightseeing activites. On the other hand cellular network traffic data were good indicators of space where tourists are on the move or in their accomodations.

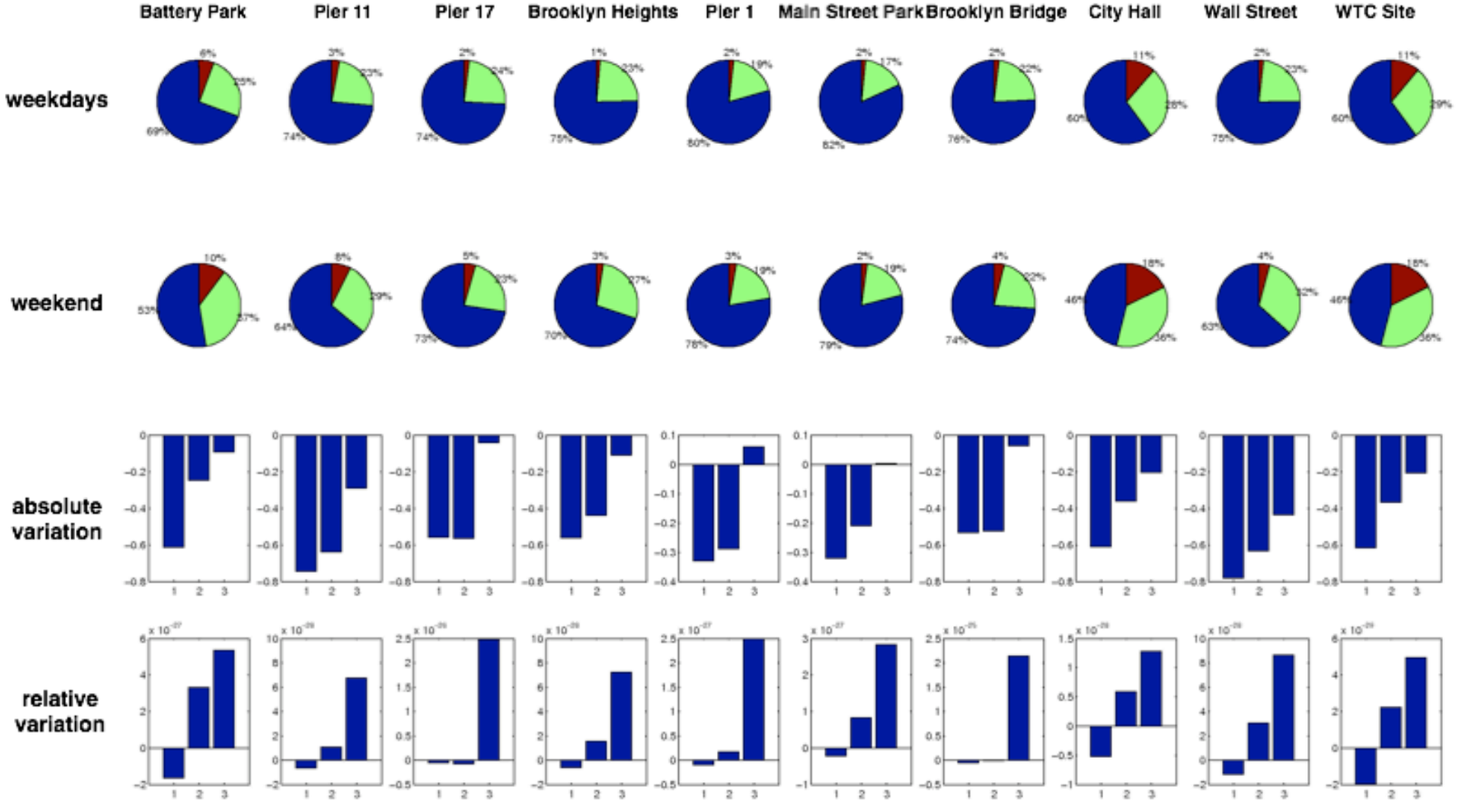
Quantify urban attractiveness

1. Vantage Point 1
2. World Trade Center
3. Wall Street
4. City Hall
5. Vantage Point 2
6. Vantage Point 3
7. Brooklyn Bridge
8. Vantage Point 6
9. Vantage Point 7
10. Vantage Point 8



New York City has dedicated resources to improve the access and quality of its waterfront over the past years. The improvement of the attractiveness of this space is hardly quantifyable. In this project we developed techniques to compare the evolution of the attractiveness of different points of interests in Lower Manhattan. Based on aggregated cellular network activity as indicators of attractivity, we could show the increasing “strenght” over 1 year of the waterfront compare to inland points of interested.

Quantify urban attractiveness



Plotting the relative presence of visitors and locals for the weekdays and weekends reveals that both the waterfront and inland points of interest attract relativly more visitors on the weekend than the weekdays (which might be accepted). Digging deeper the statistics show that inland points of interest attracts relativly more US visitors and the waterfront outperform the inland to attract foreigners.

PlaceRank

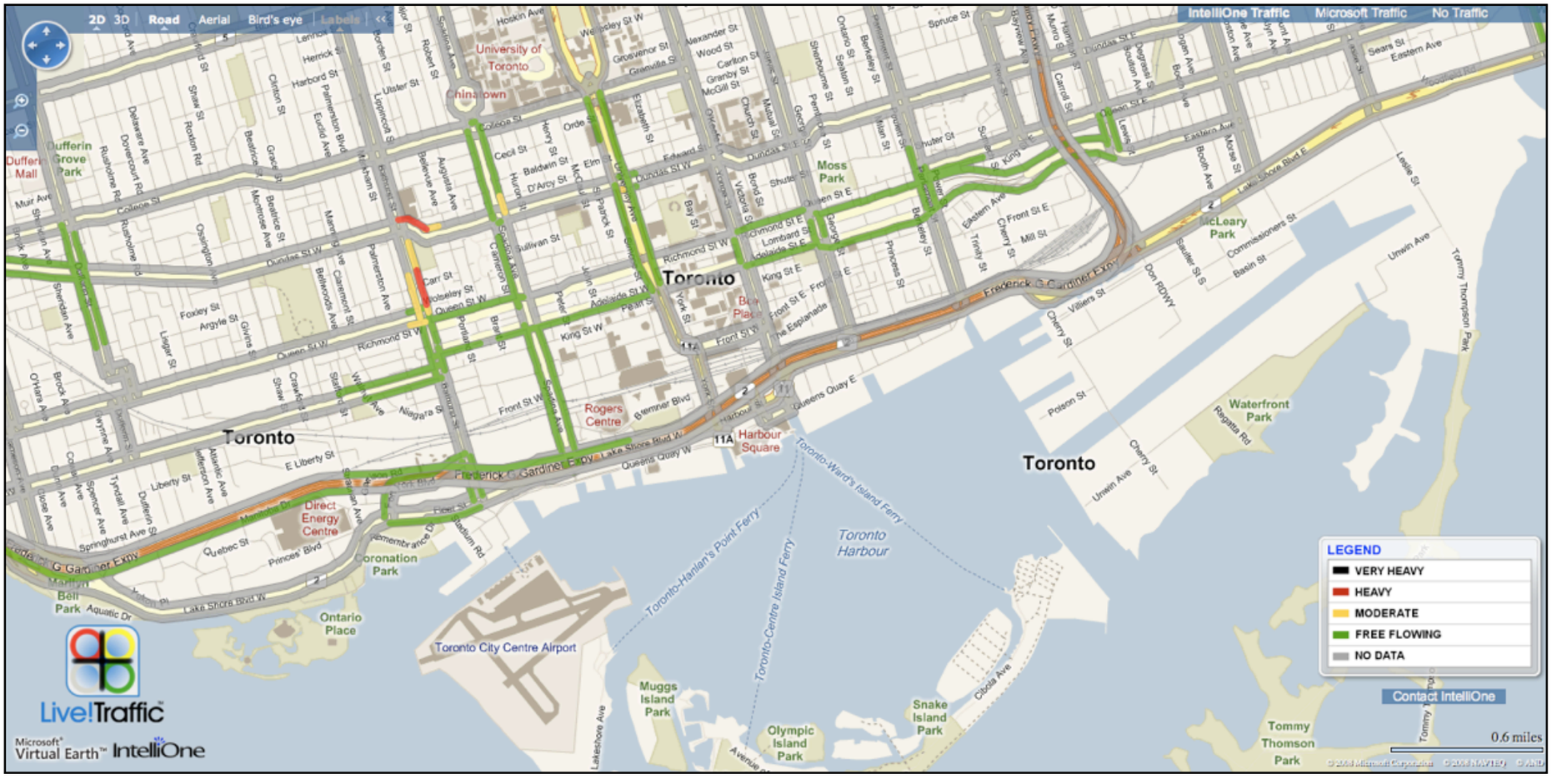
The PlaceRank indicator, inspired by the PageRank indicator used by Google to rank the importance of webpages on the Internet, determines the centrality of a location among a set of points of interests based on the amount of digital footprints and how they flowing between them. Applying this algorithm to the flow of photographers shows the evolution of the centrality of the waterfront: In 2008 the vantage points at the waterfront appear as central as the other points of interest, meaning that they are part of tourist trips around the city as much as the other points of interest.

Post-occupency evaluation

- Inspired from HCI and software engineering. Not in the current practice of architects and urban designers
- Evaluate the the built space and urban digital services with urban informatics
- Study how people adapt to urban informatics and adapt urban informatics to their needs
- Mixed methods quantitative and qualitative to reveal and explain phenomena

These works that cluster the space from its use and “measure” the attractiveness of the build could very well be applied to new types of study to inform the design of the space and its services. These post-occupency evaluation, overlooked in the practice of architecture and urban design are part of the methods in HCI (e.g. user-centered design) and software engineering (e.g. quality assurance) with mixed quantitative and qualitatie methods. As urban informatics is getting intimate with people, the analysis of the data they generate should help improve their integration.

Feedback loop



Information generated from the analysis of dyanamic urban data can be communicated to people, forming a feedback loop. A classic example is are the Live Traffic systems that used cellular network data to estimate the quality of the traffic at specific parts of a city and feed the warnings of traffic jams back to drivers.

Feedback loop

MIT SENSEable City Lab
WikiCity Rome: http://senseable.mit.edu/wikicity/rome/

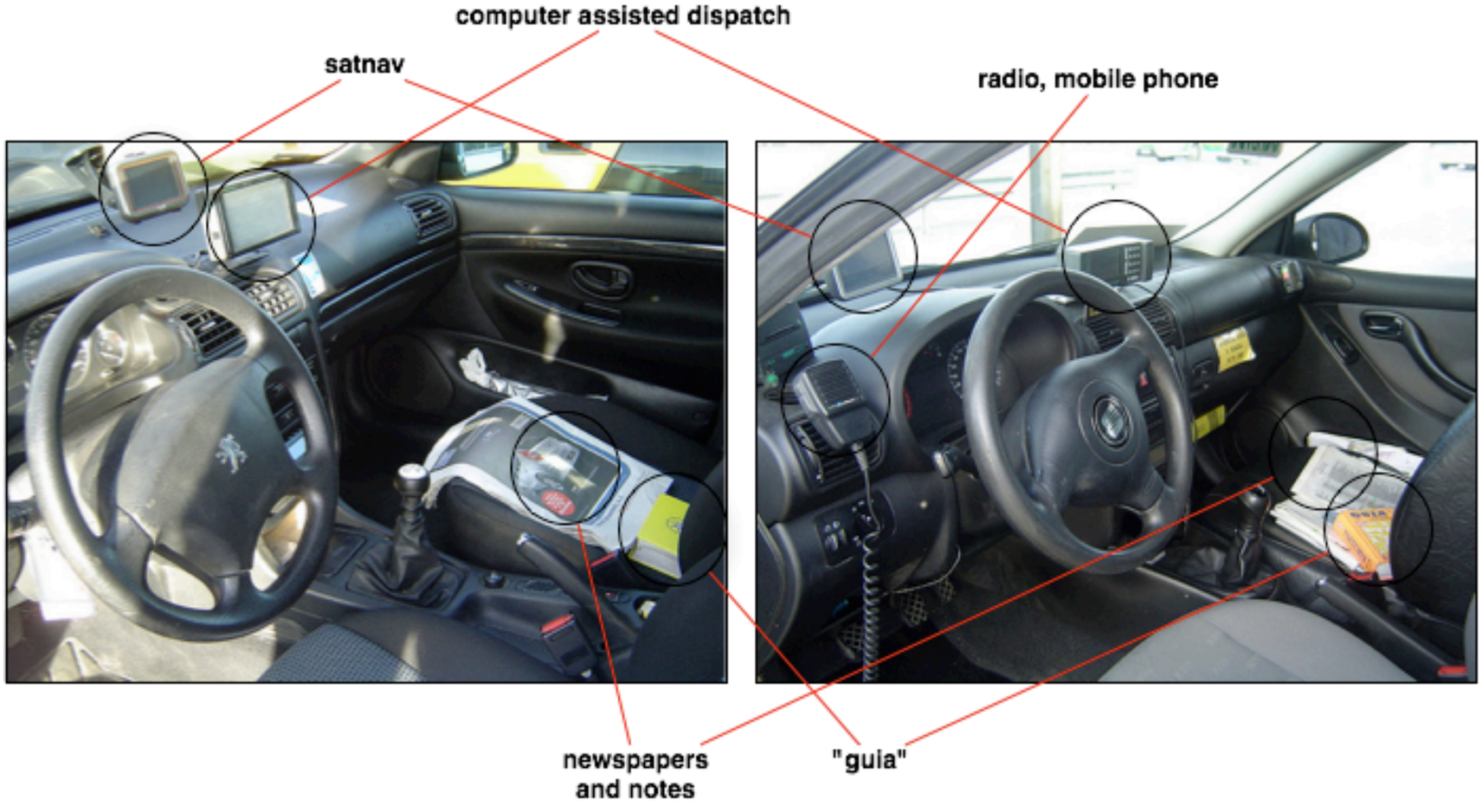
The MIT SENSEable City Lab developed an system WikiCity that gathers dynamic real time data (aggregated cellular network traffic data, buses, events, ...) and feeds back the information on the activity (here example of WikiCity in Rome during the Notte Bianca Festival). A major questions these type of system open is: How are the people moving within their city in response to this pulse of activities and events happening and how to design for it?

New technologies and the city

- Driver: techno-determinism and utilitarian approach that talks of new technologies in hyperbolic terms
- The difference between solving a problem and contributing to the health of society
- Technologies are not drivers of urban change, but are rather caught up in complex networks (or 'socio-technical assemblages')
- For instance, the success of the Internet did not lead to the end of space, neither the end the city

To adress the question on the integration of such system as part of a Responsive city, we need to step back and understand how technologies and cities evolve. Many current project still use a techno-determinist approach and rethoric. For instance, they show poor consideration on the between solving a problem (and potentially create another one) and contributing to the health of society. Similarly, they develop the assumption that technologies are drivers of urban change, overlooling the socio-technical assemblage that is a city.

Integration into practices



Girardin, F. and Blat, J. (2008). The co-evolution of taxi drivers and their in-car navigation systems. Situating Sat Nav session at the 2008 Association of American Geographers Annual Meeting, April 2008.

In response to a techno-determinist approach, I propose to study the first instances of massive use of ubiquitous technologies in the city. The study of the integration of satellite navigation system into the practice of taxi drivers describes the co-evolution people have with technologies: how they adapt to it and how they adapt it to their practice. For instance, it is important to understand how a new technologies complements an ecosystem of existing artifacts (newspaper, notes, guides). Results of this type of study should inform the design of future urban digital services and also design the space that hosts these services.

I followed 12 taxi drivers in Barcelona. This community forms a massive population of early adopters of in-car navigation systems with a strong past practice of relying on mobile technologies and maps to support their work. My work describes the use of their satnav system (the acquisition, its relation with the echosystem of artifacs, the evolution of the use (which service, where, when), the learning process of the system and the city, etc...

Co-evolution

- Wayfinding, tendency to be used less over time
- Not necessarly deskilling of navigation and orientation
- Maybe deskilling in social. Transfer of the trust from social interacting to machine-supported. May lose interaction with the client, important in the learning process.

This study shows that wayfinding feature was used less over time. More importantly it describes the different approaches experienced and novice taxi drivers have to use the system. The automation of wayfinding was perceived as deskilling. Novice drivers would not need navigation and orientation skills. In fact the many uncertainties of a sat-nav system are badly handled by drivers with little knowledge of the city. In fact, I observed they have a tendency to use the street directory and paper maps for the dense urban area (or areas where they have points of reference). However the sat-nav systems might have an impact on reducing social interactions, very important to novice taxi driver to learn the “tricks” of the city for his/her client; a type of knowledge that an automated system does not communicate.

Take-Aways

- Use of digital footprints and digital shadows to reveal the invisible (with still many obscurities)
- New techniques to transform these data into evidences to inform the design of built space
- Integration is part of a complex co-evolution that require new methods to inform the design of urban services

There are a couple of take-aways I would like to communicate in this presentation. First, our implicit and explicit interaction of new urban actors generate data that reveal the invisible (with still many obscurities). Beyond mapping, there is new techniques to transform these data into evidence. These evidence can be used to inform the design of built space. When fed back to people, the urban information generated from these evidences should be looked under socio-technical lenses.

Thank you

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Thank you