Towards Reducing the Social-Technical Gap in Location-Aware Computing

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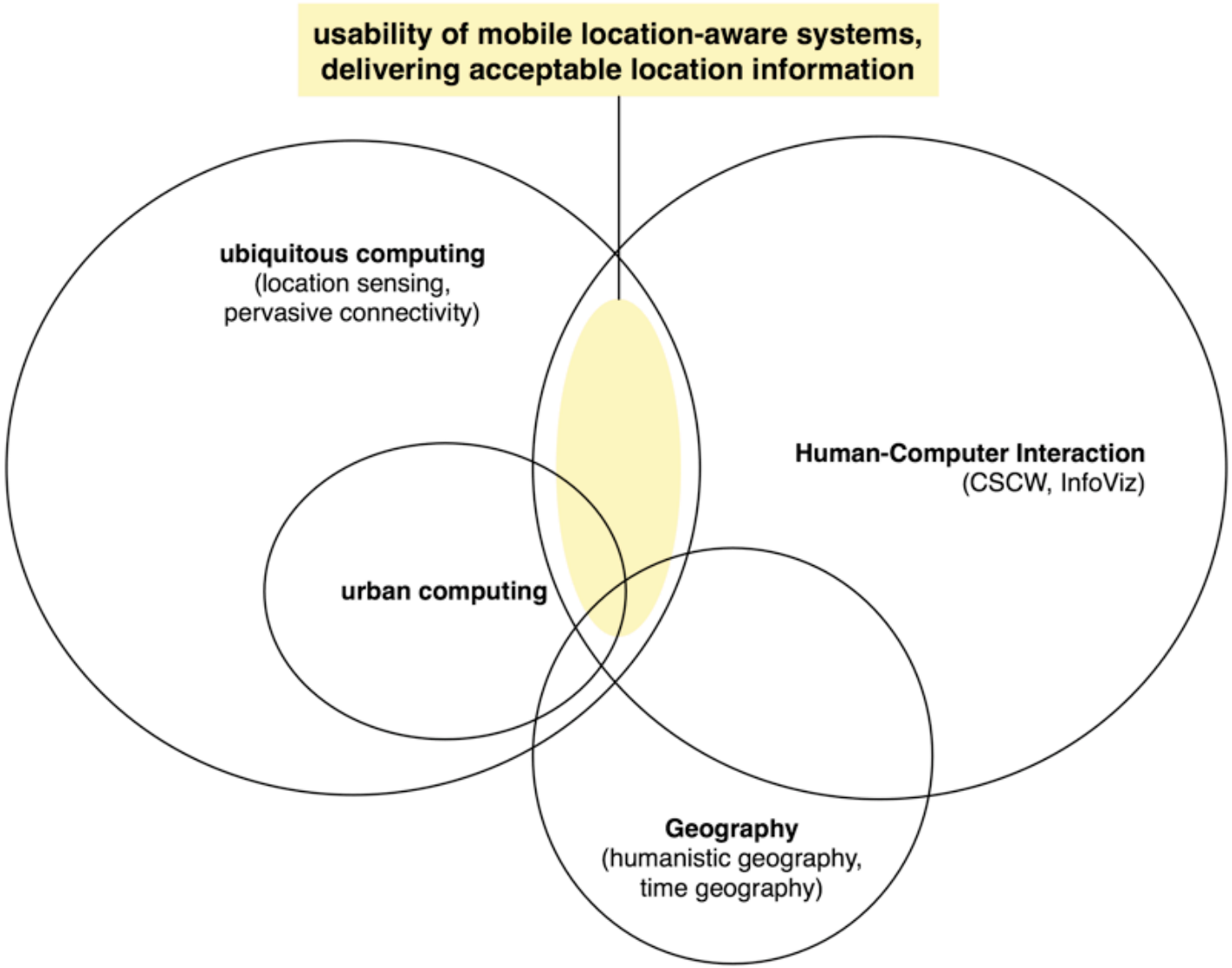
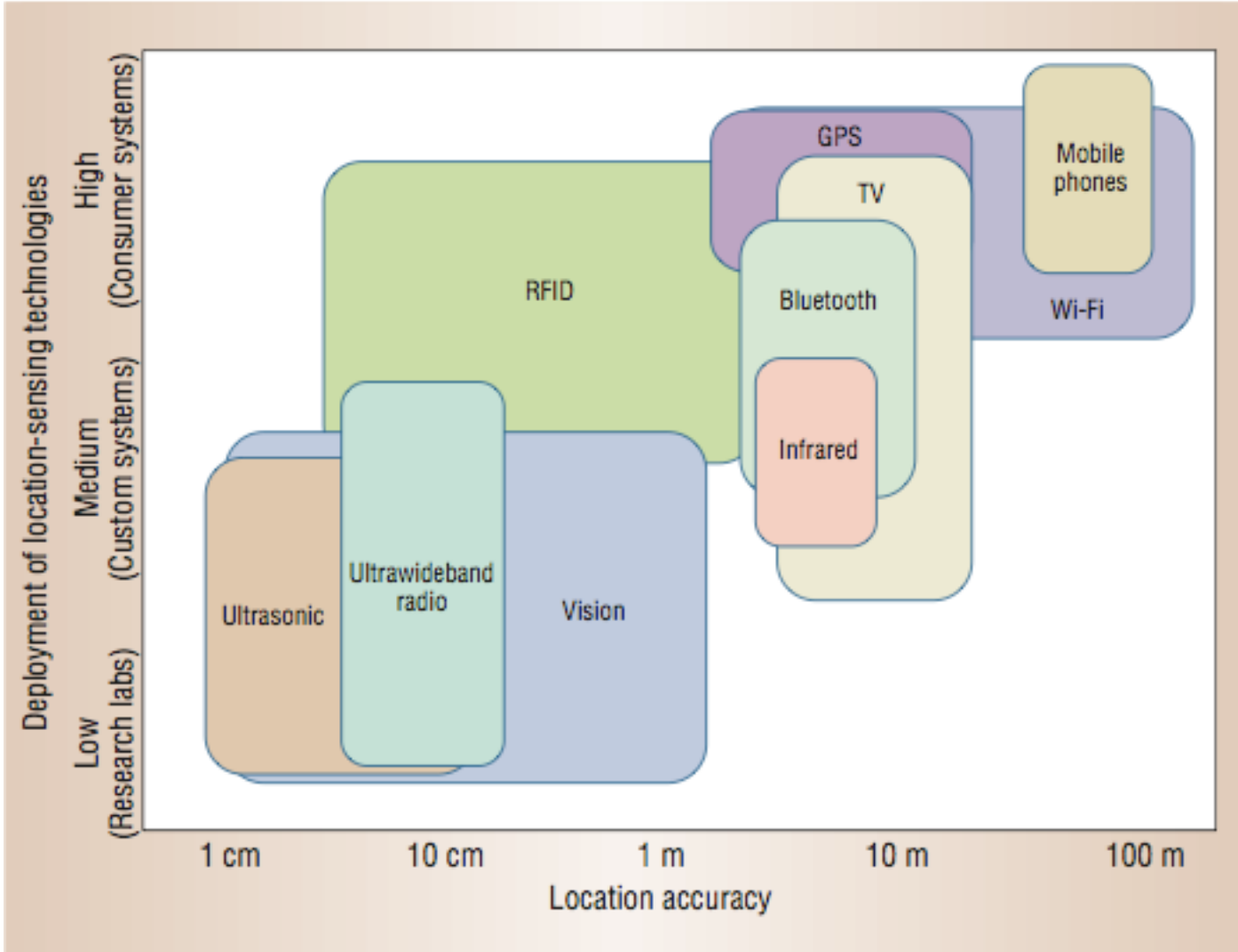
Scope


usability of mobile location-aware systems, delivering acceptable location information
ubiquitous computing
(location sensing, pervasive connectivity)
Human-Computer Interaction
(CSCW, InfoViz)
urban computing
Geography
(humanistic geography, time geography)

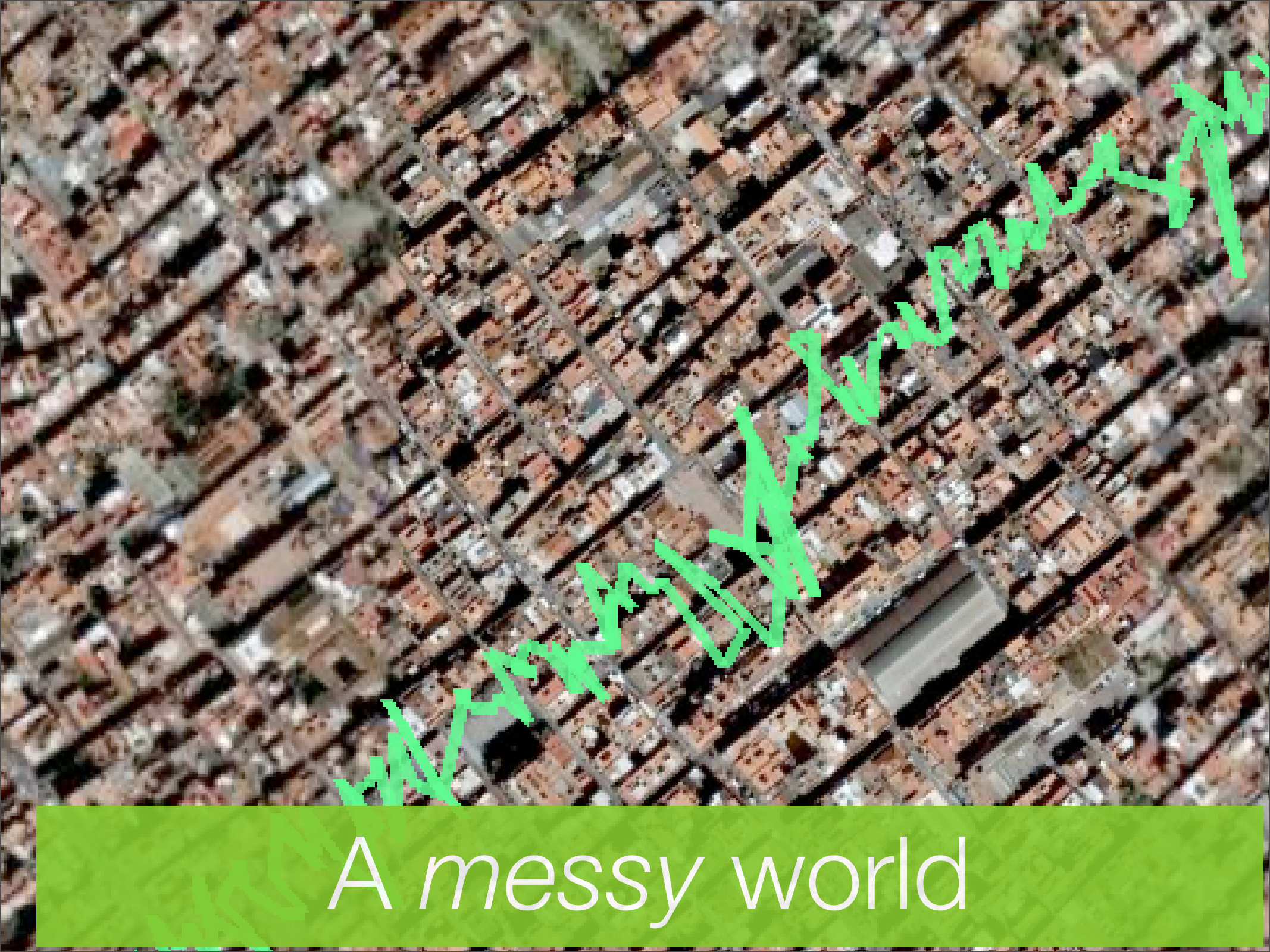
Location-aware computing

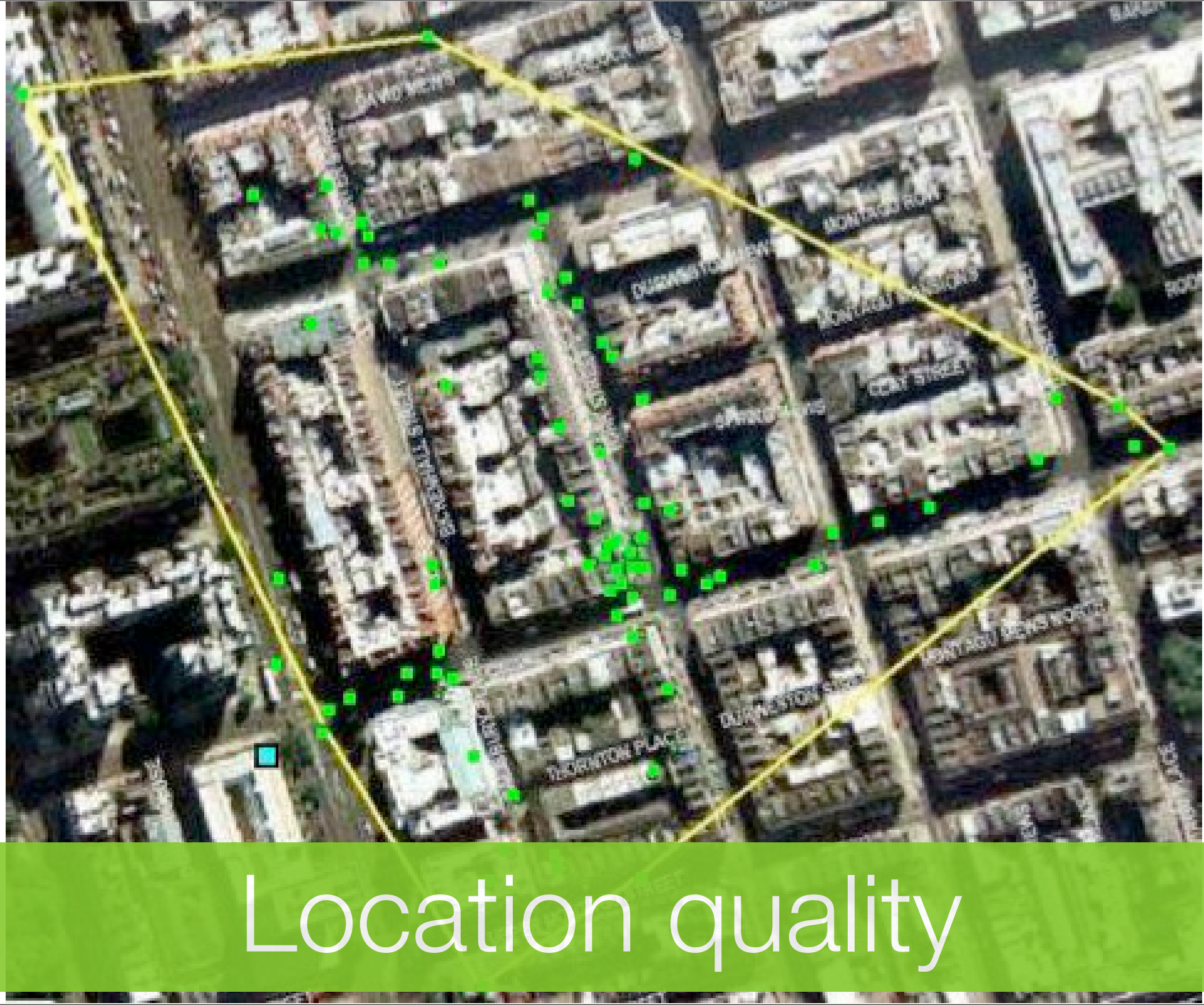
Enabling technologies



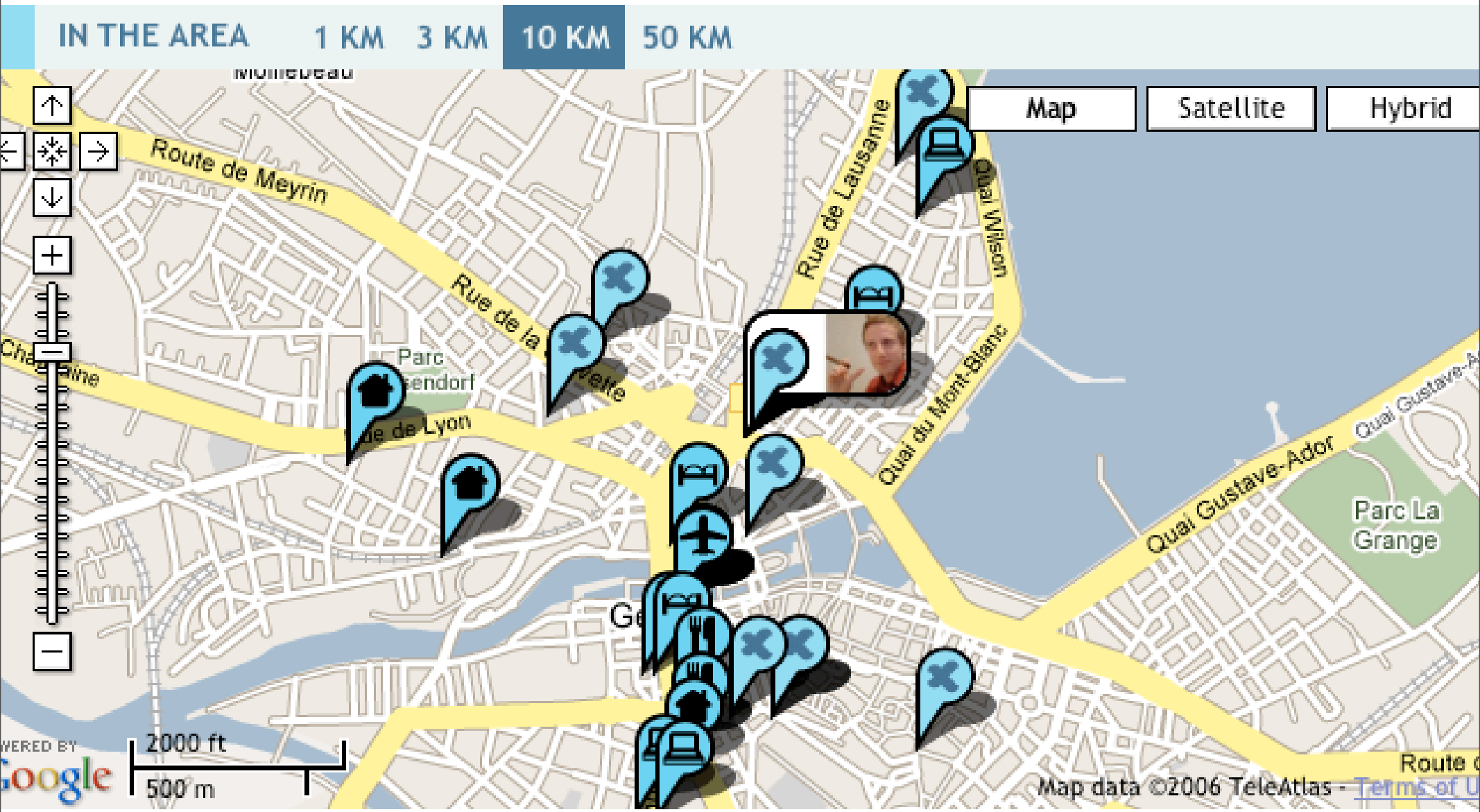
Source: Hazas, M., Scott, J., and Krumm, J. Location-aware computing comes of age. IEEE Computer 37, 2 (2004), 95–97.

A perfect world


A *messy* world

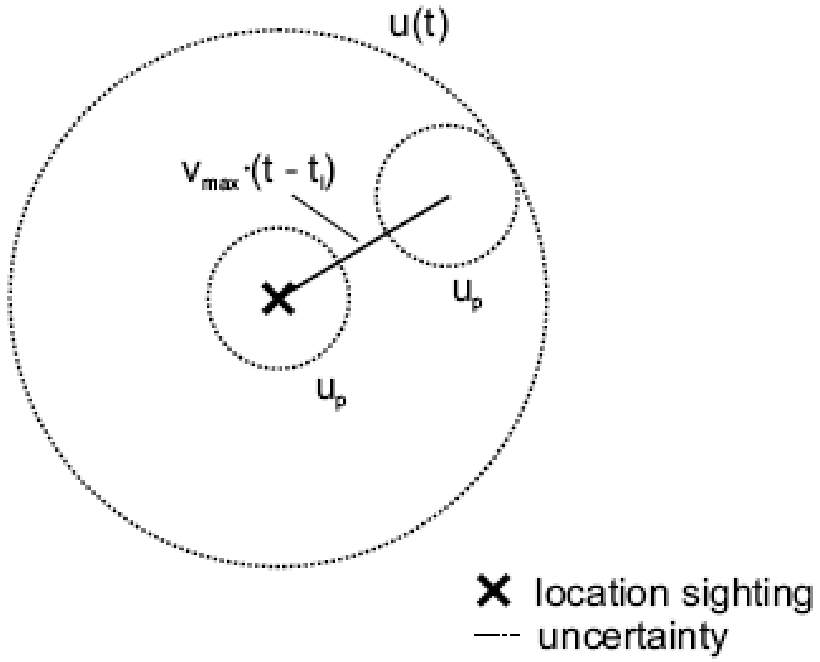


Location quality



Location timeliness

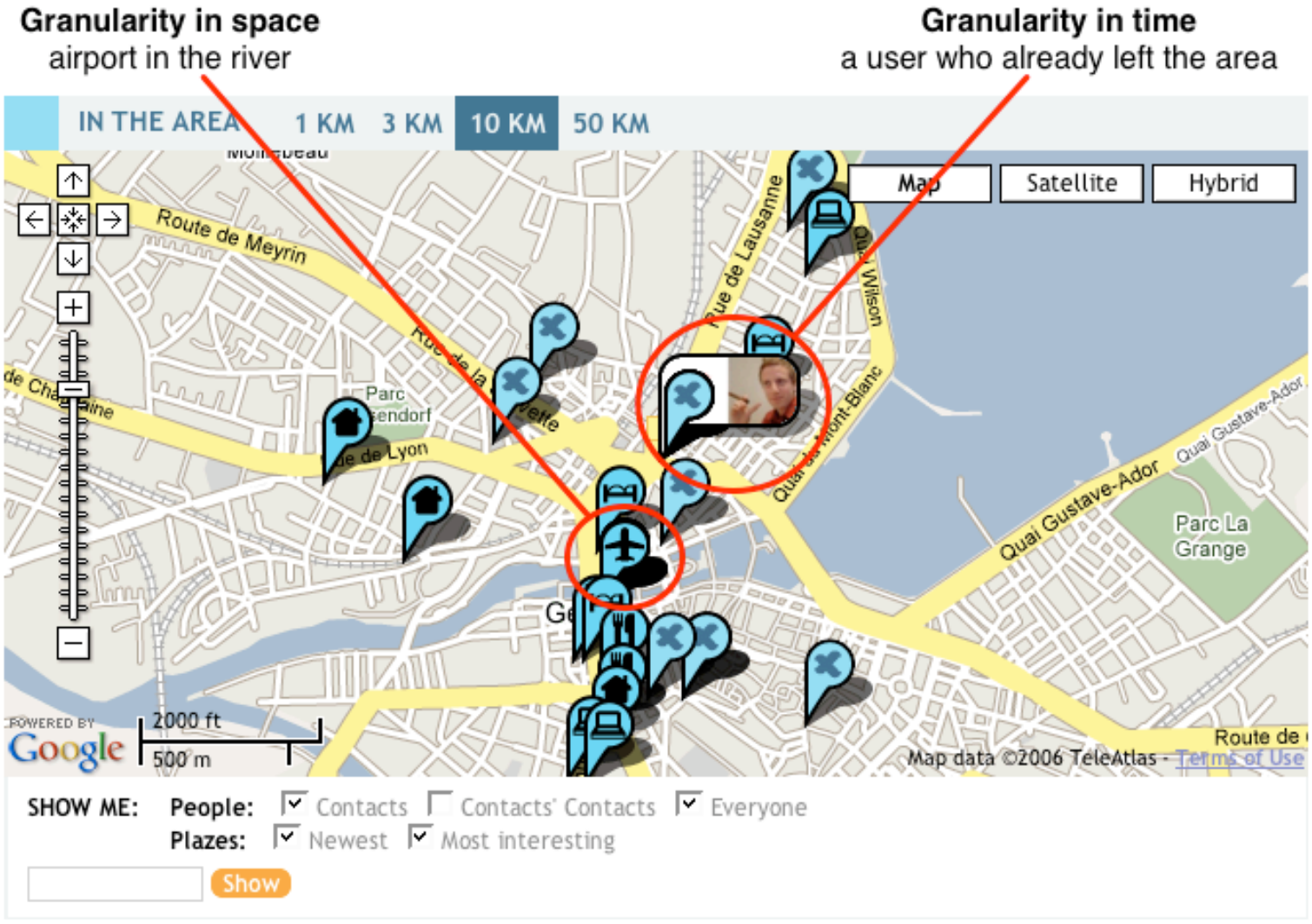
Location uncertainty



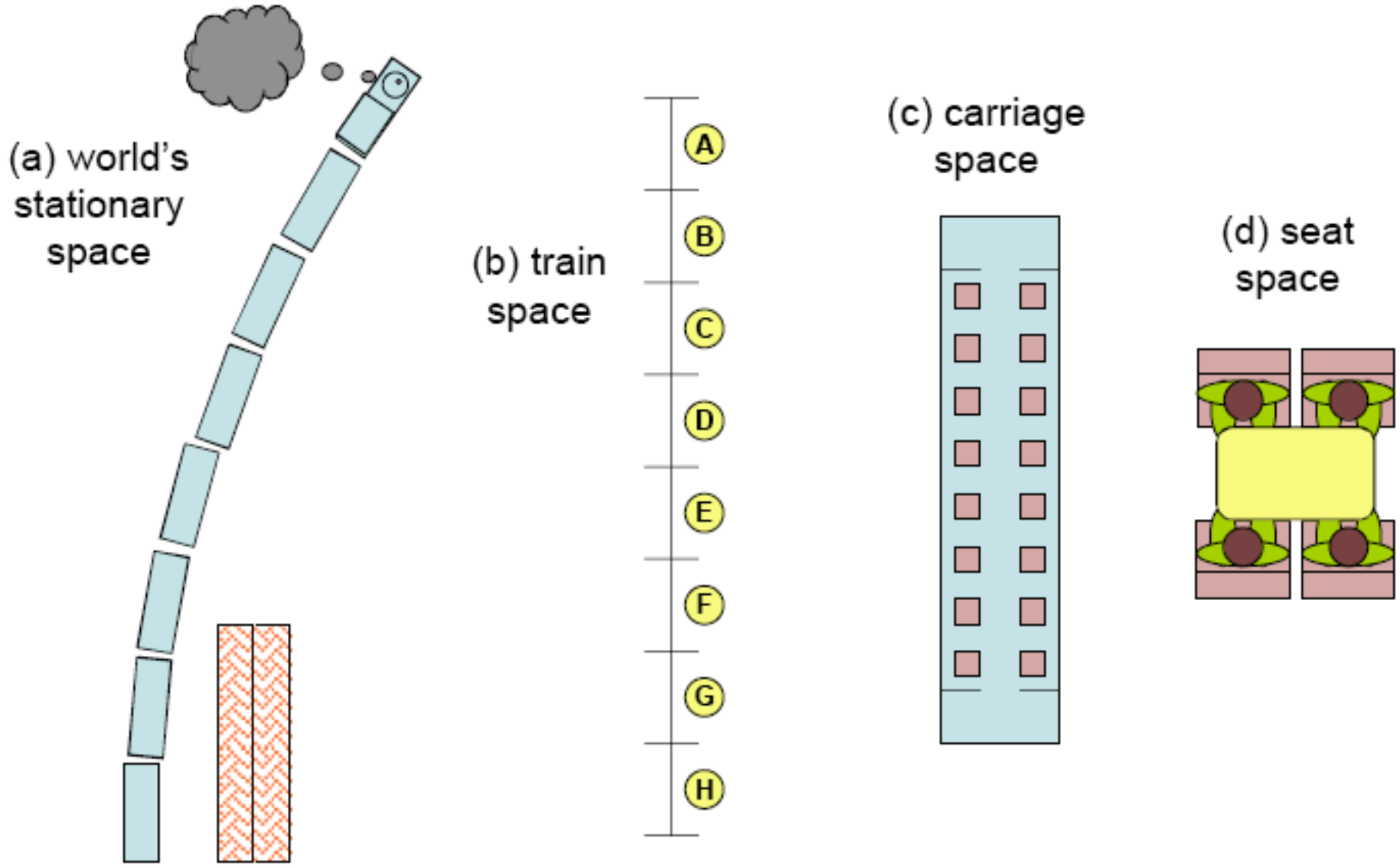
Source: Leonhardi, A. and Rothermel, K. 2001. A Comparison of Protocols for Updating Location Information. Cluster Computing 4, 4 (Oct. 2001), 355-367

Location information granularity

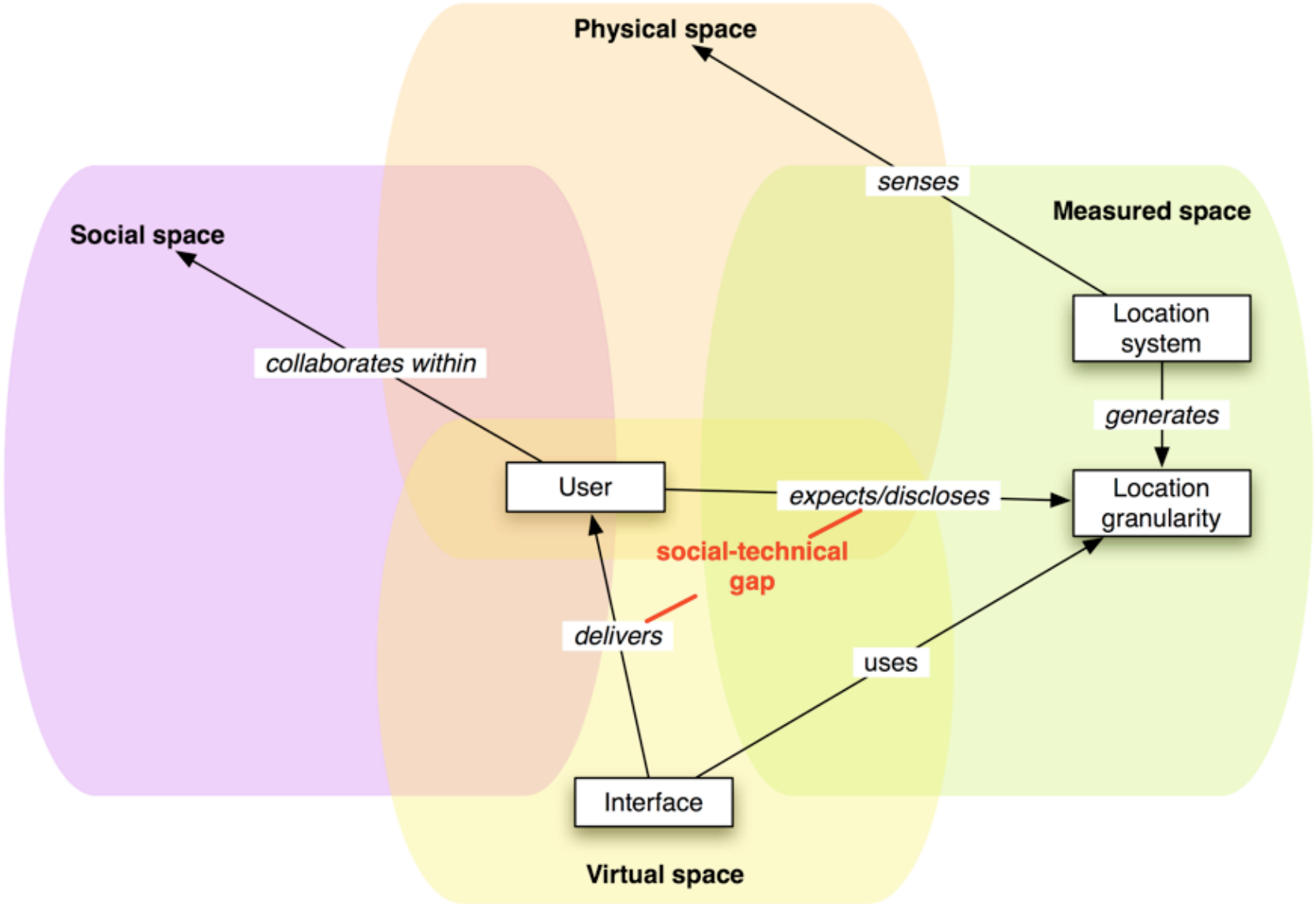
- space and place
- privacy



Location information granularity



Social-technical gap



Half-time *take-aways...*

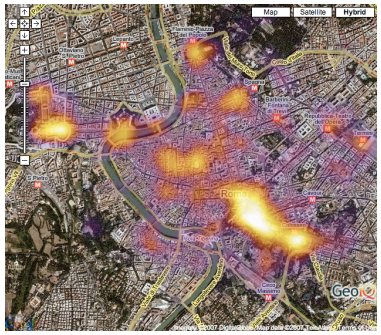
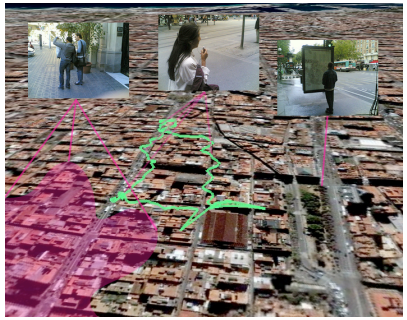
- Infrastructure and systems issues
- People have their own perception of the space that often does not match with technologically set ties between information a place.
- Difficulty in interpreting the uncertain information conveyed by location-awareness tools
- How the deliver the appropriate granularity of location information
- Context of access to location information

Research questions

How to build a location-aware system that takes into account the spatial uncertainty inherent to ubiquitous technologies?

- what level of location information quality and timeliness must be delivered in order to be useful and relevant?
- what parameters influence successful spatial uncertainty visualization?
- what is the balance between implicit and explicit forms of human interaction with a location-aware system that communicates the inherent uncertainty of its location information?

Approach

social-technical gap in location-aware computing

location information granularity & spatial uncertainty → **informed suggestions**

mixed, exploratory (CatchBob!)
descriptive, exploratory (flickr)
ethnographic, exploratory (taxi drivers)

→ **design strategies**

seamful design
uncertainty visualization
middleware design
spatio-temporal traces

→ **data collection and evalutation**

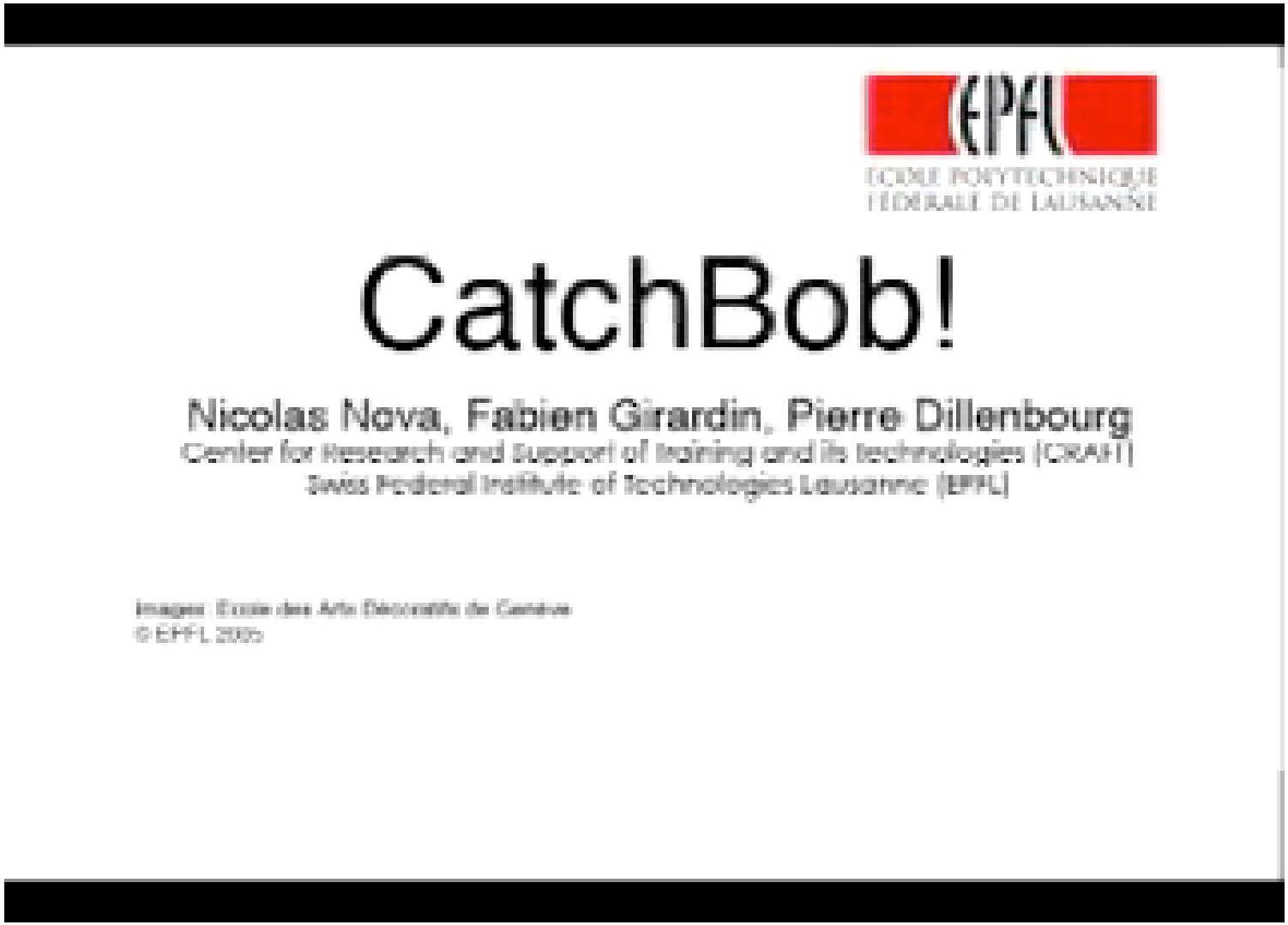
mixed approach, field study
ethnography supported by spatio-temporal data analysis tool
usability: does it work, where does it work? when and compared to what does it work?

Girardin, F. (2007). Bridging the social-technical gap in location-aware computing, Doctoral Colloquium at Pervasive 2007, Toronto, Canada.

Girardin, F. (2007). Bridging the social-technical gap in location-aware computing. In CHI '07: CHI '07 extended abstracts on Human factors in computing systems, pages 1653–1656, New York, NY, USA. ACM Press.

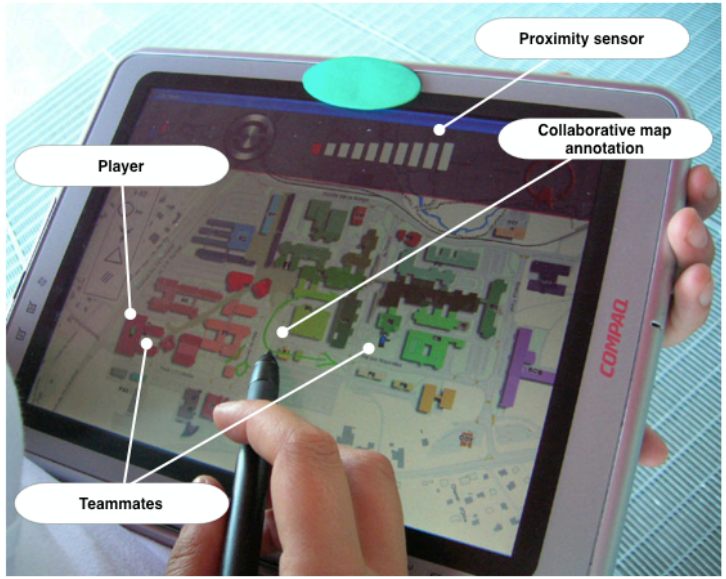
Phase 1: Exploratory

Field experiment: CatchBob!



Field experiment: CatchBob!

- Various players reactions to uncertainty: Believing, not understanding, overcoming
- Various sources of spatial uncertainty
- Players without a location awareness tool took better advantage of the annotation feature: picking up the relevant fact



- Automatic location-awareness ≠ Giving a location (act of communication carrying intentions)

Girardin, F. and Nova, N. (2006). Getting real with ubiquitous computing: the impact of discrepancies on collaboration. e-Minds International Journal on Human-Computer Interaction, 1(1):60–64.

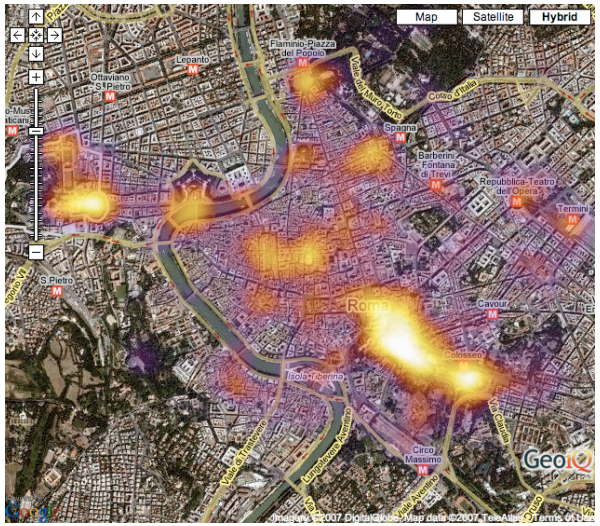
Girardin, F., Nova, N., Blat, J. (2006). Towards Design Strategies to Deal with Spatial Uncertainty in Location-Aware Systems, Poster at Ubicomp 2006, Orange County, CA. USA.

Case study: Granularity in geo-referencing

- **Context**: evaluate people use of granularity when referencing information geographically.

- **Aim 1**: identify users behaviors when explicitly disclosing location information (where, what, when, history of use).

- **Aim 2**: analyze how Flickr users take advantage of the accuracy feature to georeference their images



Girardin, F. and Blat, J. (2007). Place this photo on a map: A study of explicit disclosure of location information. Late Breaking Result at Ubicomp 2007.

Case study: Taxi drivers use of GPS

- **Context**: Barcelona taxi drivers who use GPS navigation systems. Ethnographic study

- **Aim**: identify the main issues embedded in the interaction of mobile workers with location information that fails to match a relevant granularity

- **Aim**: Where and when is it used?

- **How**: focused ethnography, semi-structured interview

Girardin, F. and Blat, J. (2008). The co-evolution of taxi drivers and their in-car navigation systems. Session on Situating Sat Nav: Questioning the TomTom Effect, 2008 Association of American Geographers Annual Conference. 15-19 April 2008, Boston, USA.

Articulation

Type	Context	Objective	Method
Field experiment 1	collaborative pervasive game	Explore the sources of spatial uncertainty and analyze players' behaviors towards spatial uncertainty	mixed, exploratory
Case study 1	sharing and geotagging photos	Identify the uses of location information granularity	descriptive, exploratory
Case study 2	taxi drivers use of GPS	Identify the main issues when a location-aware system does not match expectations (co-evolution)	ethnographic, exploratory
Field experiment 2	collaborative urban-scale environment	Analyze the integration of location information granularity in the design of the application. to evaluate strategies to manage spatial uncertainty.	mixed

Phase 2: Field studies

Context: Enhancing urban tourism experience

- **Context**: Give an awareness to citizens and/or tourists on their behaviors and surroundings in a urban space.

- **Aim 1**: Evaluate design strategies to manage spatial uncertainty based on what has been learned in the first 3 studies

- **How**: Compare approaches (Does it work?)

- **How**: Study the contextual impact of the approach (Where and when?)

Girardin, F., Blat, J., and Nova, N. (2007). Tracing the visitor's eye: Using explicitly disclosed location information for urban analysis. IEEE Pervasive Computing, 6(3):55.

Girardin, F., Fiore, F. D., Blat, J., and Ratti, C. (2007). Understanding of tourist dynamics from explicitly disclosed location information. In 4th International Symposium on LBS and Telecartography, Hong-Kong, China.

Project: Tracing the visitor's eye

- in our every day activities we leave behind **"digital" footprints** from our interaction with the urban environment and its digital infrastructures.

- these records of where people have been and when they were produced by these services, have led to the **understanding of different aspects of mobility and travel**.

- we collect and analyze the history of physical presence of tourists from **the photos publicly made available** on the world-wide web

- taking and uploading a photos is an **act of communication** of physical presence in time (i.e. "I was here").

- based on the time and location of the photos, we design **geovisualizations** to reveal the tourist activity and flows in space and time.

Targeted audiences

- provide **urban planners**, local authorities, tourism authorities and traffic engineers with useful information on how a city gets used by different groups.

- visualizations can nonetheless be helpful to raise awareness among **city residents and visitors**, as for the current ways in which they populate the city as well as for possible better alternatives.

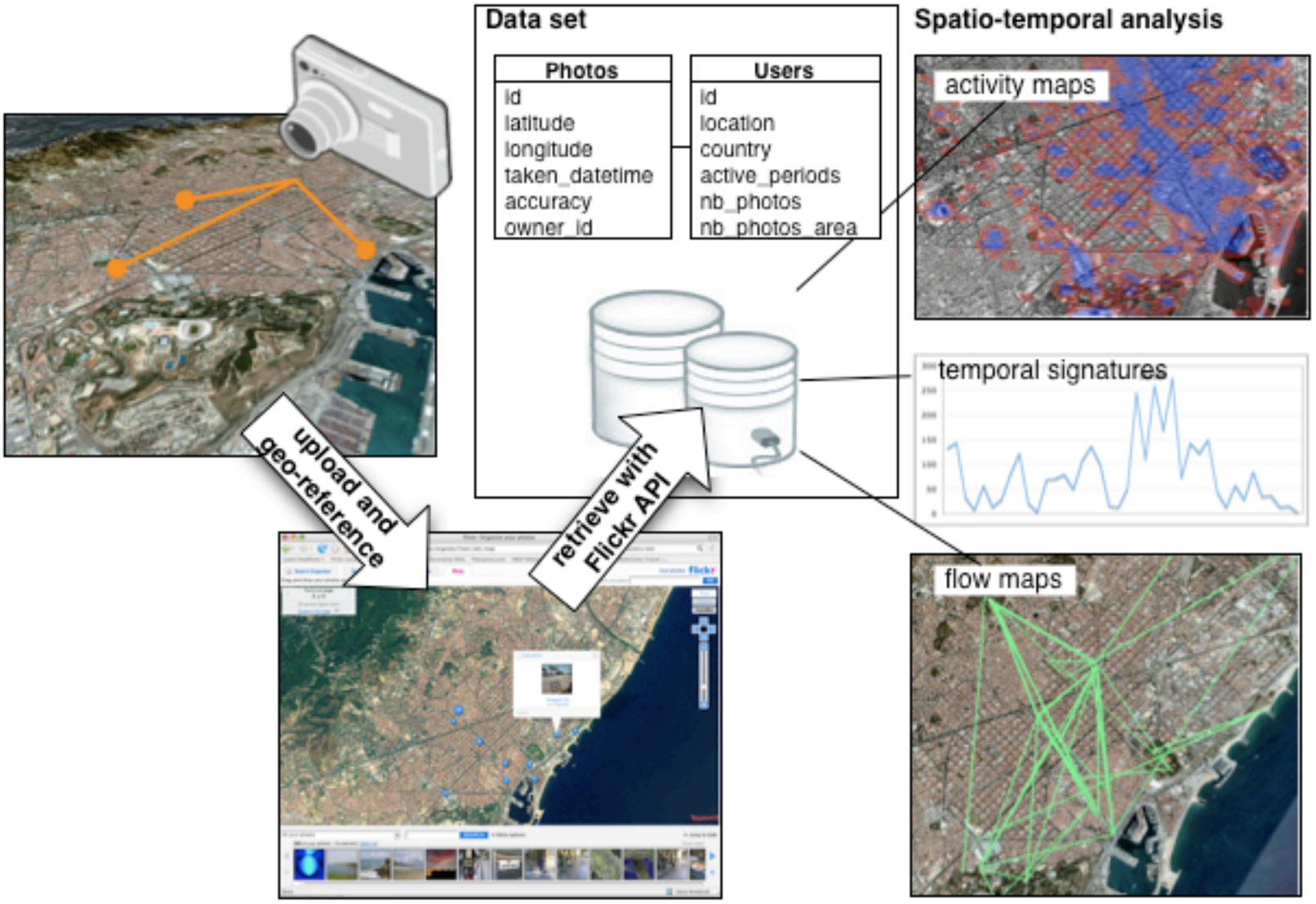
- **designers of location-based services** can tailor their services based on the history of past movements in space.

Constraints of mobility data capture for travel surveys

Table 1. Mobility data capture with the constraints of travel surveys

Mobility data capture	Scalability	Longitude	Individual	Privacy
GPS	Low	Low	High	High
GSM (device-based)	Low	Medium	High	High
GSM (aggregated network-based)	High	High	Low	Medium
Bluetooth	Low	High	High	Medium

System


Data set
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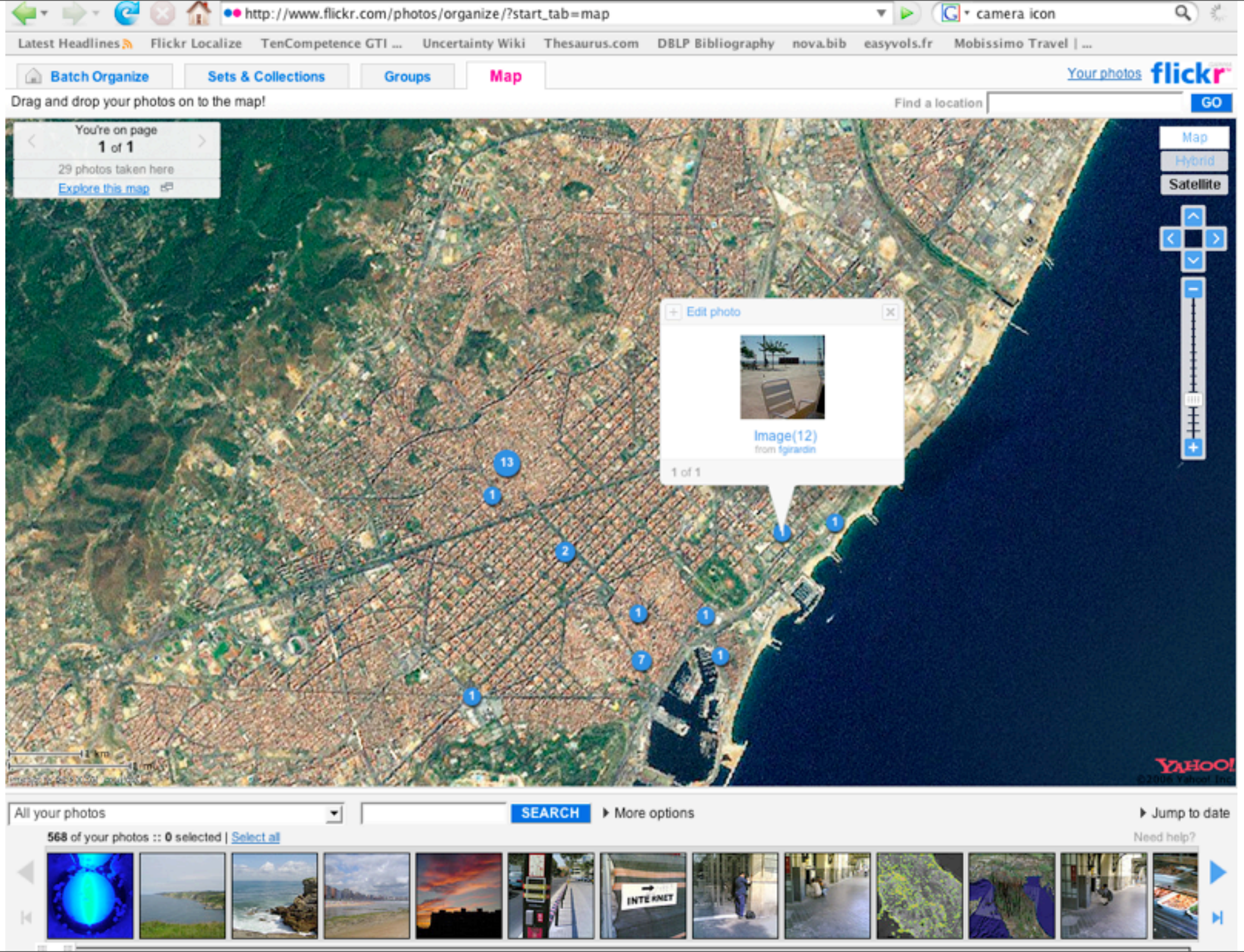
temporal signatures
flow maps
upload and geo-reference
retrieve with Flickr API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Drag and drop your photos on to the map!
Find a location
GO
You're on page
1 of 1
29 photos taken here
Explore this map
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Satellite
Edit photo
Image(12)
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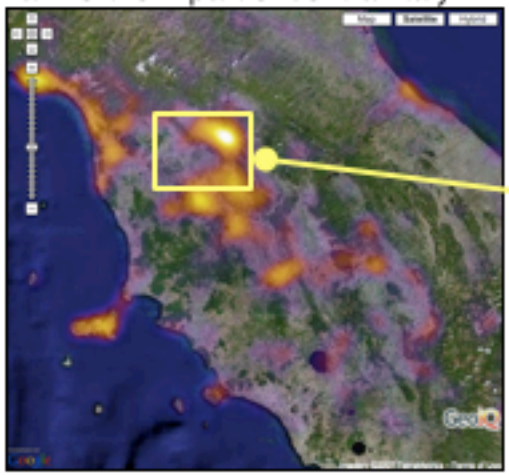
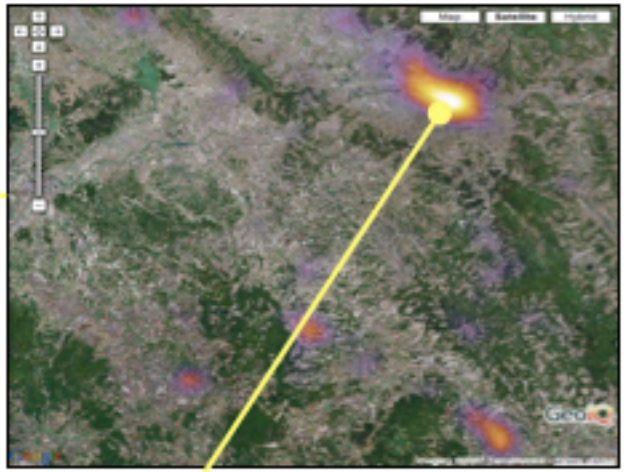
Need help?

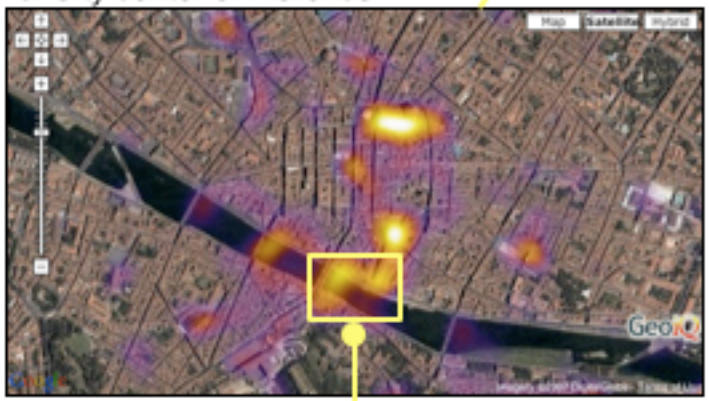
a. Northern part of central Italy



b. Province of Florence

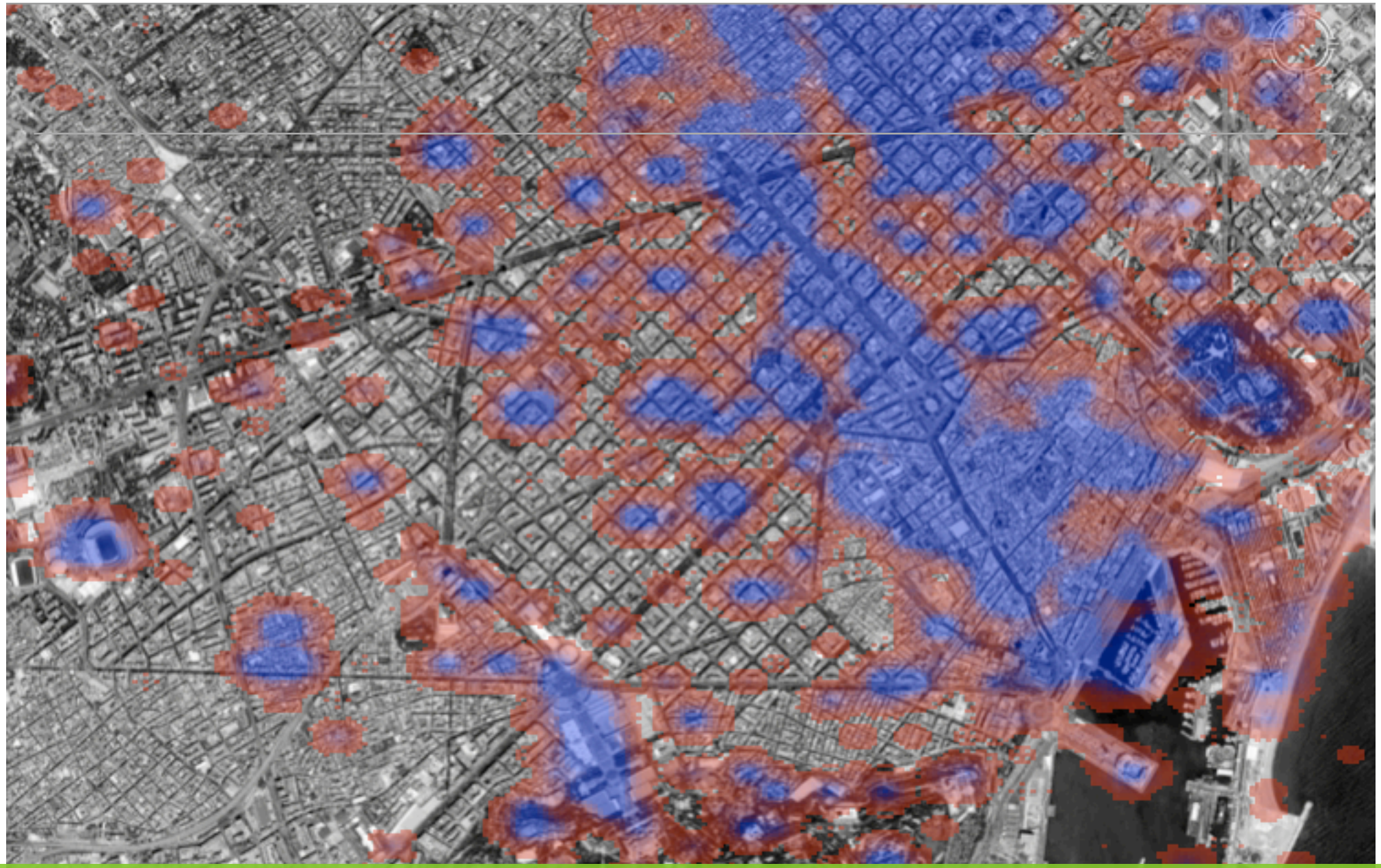


c. City center of Florence



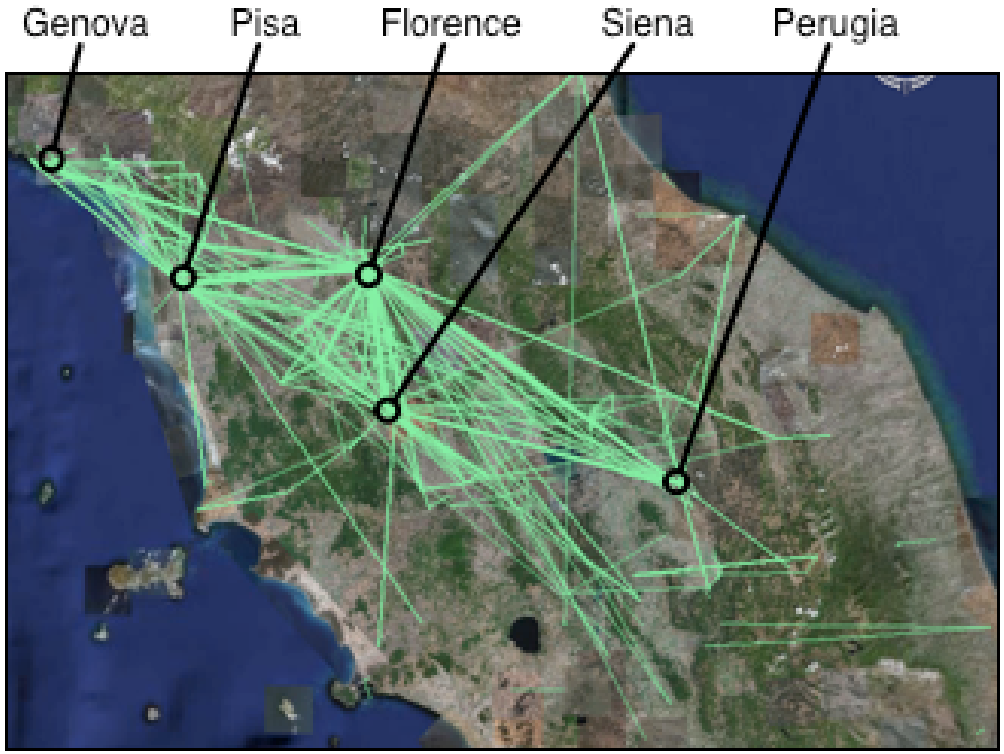
d. Ponte Vecchio bridge

Where are the tourists concentrated?

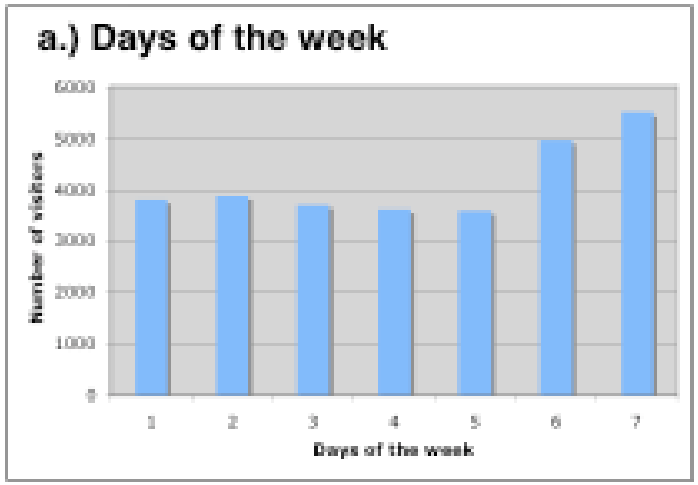


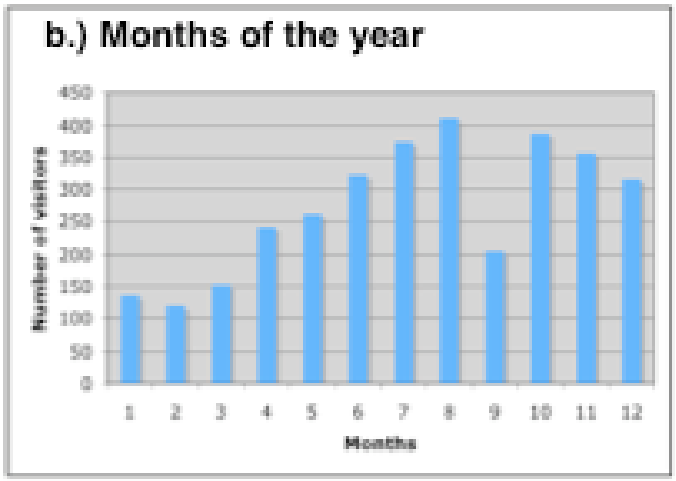
Where are the tourists concentrated?

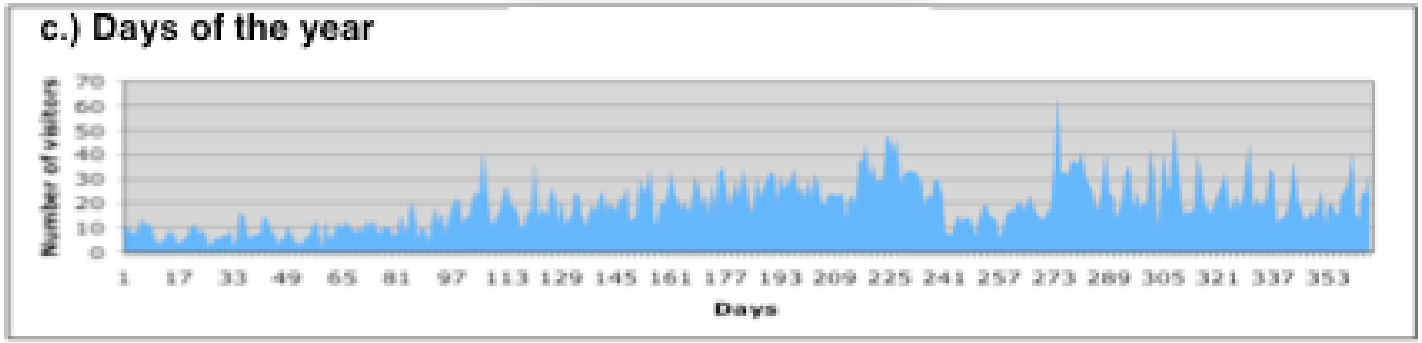
Patterns of flow

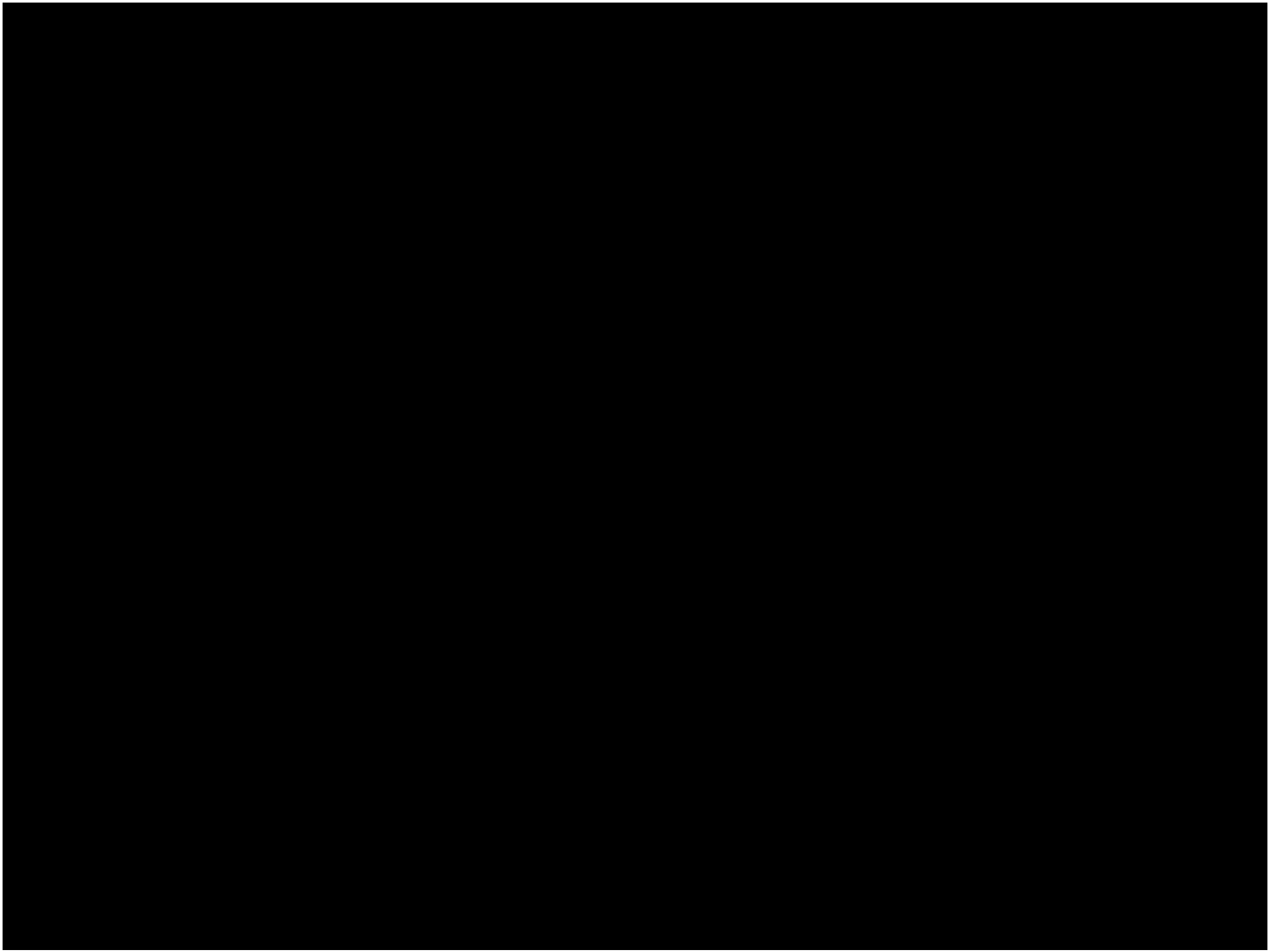


Spatio-temporal signatures

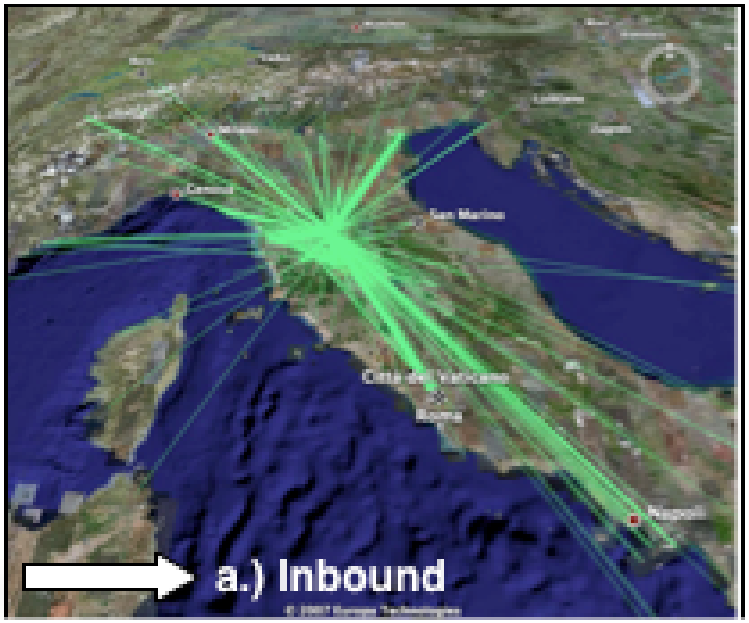


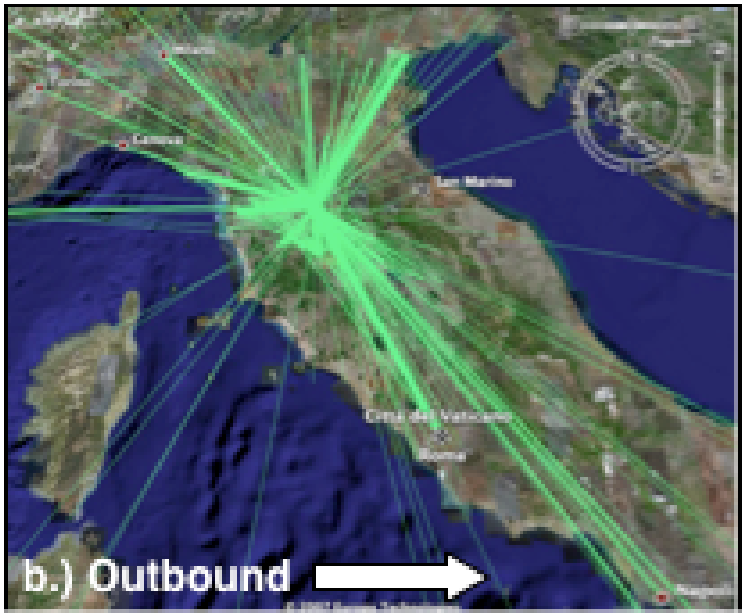






Flow into and out of the province





Hmm okay nice... but so what?

Feedback loop

Feedback loop

- when you give this information to the community, the community can change its behavior.
- aggregated various types data and visually mapped the density and movement of people, buses, taxis.
- Support all types of “mobilities”.

Social navigation

photo courtesy of Nicolas Nova

Social navigation

- humans as social beings often rely on other's implicit or explicit **recommendations to solve their problem.**
- "social navigation" that refers to the **navigation towards a cluster of people** or navigation because other people have looked at something
- Use **position history to tailor results** from requests for information further
- **people's past interactions** with the urban environment and infrastructure **become recommendations** and impact the perception of the space
- revealing the traces relevant to geographic location of specific socio-cultural groups and matching behaviors could **help create an informed decision on what and when to visit**.

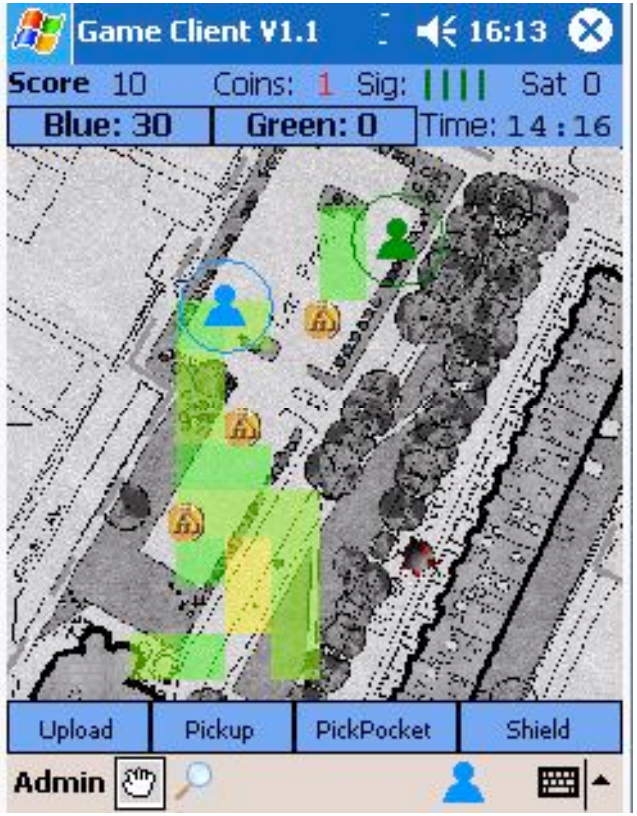
Seamful design

- delivering a clear mirror of the reality from sensed and explicitly disclosed data might be **hard to reach** (location information quality and timeliness).

- instead of hiding the imperfection of the data and mislead the user, a proper design would be to **reveal the limits of the technology**.
  (i.e. seamful design)

- **reveal to improve the appropriation**

- exploit the activity of other people as indicator of the **nuances of the granularity employed to communicate or retrieve location information** (e.g. definition of a neighborhood)



Take aways

- Socio-technological gap form by the discrepancies between what people expect (flexible, nuanced, and contextualized social world) and what positioning system can deliver.
- People have their own perception of the space that often does not match with technologically set ties between information a place.
- Location information is treated at different levels of granularity.
- Studying how people manage this granularity “should” help reduce the socio-technological gap and inform the design of location-aware systems.
- Explicit digital footprints present new opportunities to reveal how people act upon location information.
- Social navigation and seamful design can be approaches to reveal location information granularity and uncertainty to improve the appropriation.

Conclusion

“Let’s do smart things with stupid technology today, rather than wait and do stupid things with smart technology tomorrow?”

William Buxton