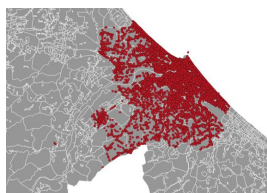


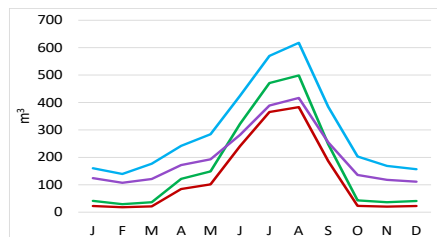
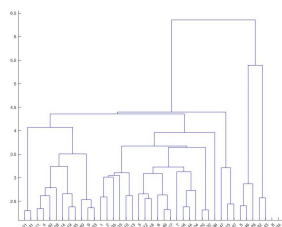


Mass beach resort: concentration of non-residents and specific water-demanding touristic activities, in the critical dry summer season.

Need to keep into account the touristic factor in urban water demand studies.



- Collection and geo-referencing of all the city water-meters
- Association of all hotels (>1000) and bathing establishments (>200) to single-users' water-meters (through tourist office info and addresses since tariff is not unique...)
- Characterisation of hotels (category, number of rooms, water-demanding services such as restaurant, pools, etc.) and bathing establishments (number of umbrellas, hot showers, jacuzzi)
- Hierarchical clustering of hotels in classes with similar characteristics
- Identification of water demand patterns in the classes



*PS: Water demand data validation: declining frequency of meter readings (still done traditionally) in the last years
⇒ smart-meters are sorely needed!*

Elena Toth, Mattia Neri and Cristiana Bragalli
University of Bologna, Bologna, Italy – elena.toth@unibo.it

WATER DEMAND IN TOURISTIC CITIES

In a densely touristed city, the concentration of non-residents and specific water-demanding touristic activities add considerable pressure on the available water supplies.

For coastal cities, often inherently affected by water scarcity conditions, such increase in demand is concentrated in the summer season, that is already the most critical period from the climatic point of view.

THE SIMTWIST JPI WATER PROJECT

The touristic factor has not been adequately addressed in the urban water demand studies, so far, and it is often neglected also by the water utilities and the consumers: the European JPI SIMTWIST (SIMulating Tourism Water consumption with STakeholders) project

<https://www.simtwist.eu/>

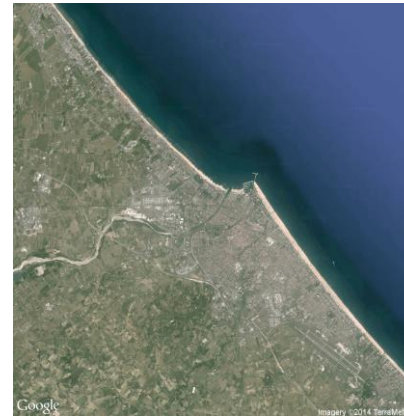
is addressing this issue with a “stakeholder-centred” approach, where the behavior, and the perceptions, of the different water and tourism stakeholders’, and their inter-relationships, are studied in their social and economic context.



The work presents an analysis of the features that characterise the hotels and bathing establishments in the city along with the corresponding water demand for the single users.

Case study: Rimini

Biggest beach resort on the Adriatic sea. Long history of tourism development (first bathing establishment opened in 1843). Profitable seaside tourist industry, attracting around **7 million tourists every year**.

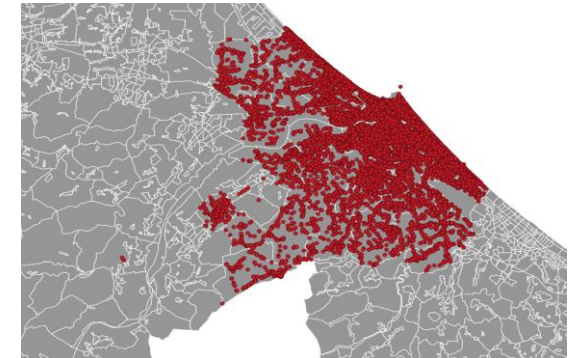


More than 2 millions night-stays each August. Over 1000 hotels, over 30000 bedrooms and one of the highest concentrations of hotels in Europe.

Collection of information on the water meters for all the single users in Rimini (>70000)

Identification of water meters corresponding to hotels and bathing establishments

Detailed (and very time-consuming!) search of the water meters of all hotels (>1000) and bathing establishments (>200) in Rimini based on the official list of Rimini touristic activities, identified by the address.



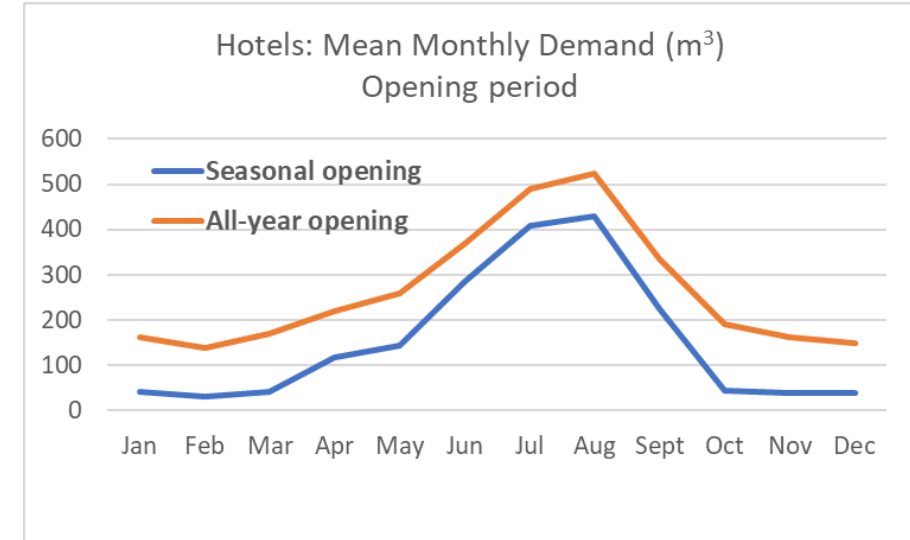
In some cases, more than one water meters are found to correspond to the same hotel: their water volumes are then aggregated.

We identified the large majority of the IDs of such meters and asked the water utility for the corresponding sub-annual information (**estimates** of monthly volumes) for the 13 years 2008-2020.

Characterisation of hotels (~ 1000 hotels in Rimini)

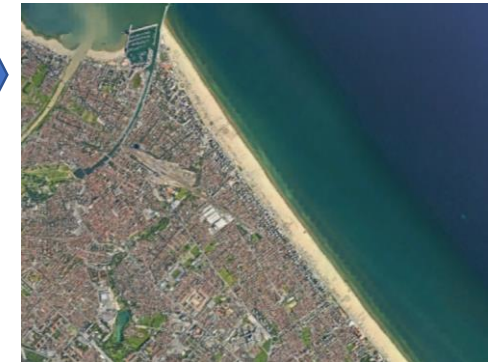
From tourism office and hotels websites:

- **Size (number of bedrooms)**
- **Category (number of stars)**
- **Opening period:** seasonal vs all-year opening (but many “seasonal” hotels actually are open all year, especially during holidays times (Easter, New Year, ...)).



Hotel services related to water use

- **Garden** (even if hotel gardens tend to be very small in Rimini, due to high urbanisation along the coast)
 - **Restaurant**
 - **Pools**
 - **Jacuzzi tubs**
 - **Air Conditioning** (that may decrease need for showering for cooling off)
 - **Bar**
 - **Laundry service** (but such feature identify the service offered to the clients $\Rightarrow$ its absence does not necessarily implies that the hotel linen is laundered outside the premises) - **NOT RELEVANT WITHOUT FURTHER INFORMATION**
- AVAILABLE IN ALMOST ALL HOTELS
NOT CONSIDERED**
- NOT RELEVANT WITHOUT FURTHER INFORMATION**



Characterisation of hotels



Category	Seasonal opening	Bar	Restaurant	Garden	Laundry service	Jacuzzi	Kids Pool	Indoor Pool	Outdoor Pool	Any kind of pool
1 or 2 stars	85%	83%	54%	46%	6%	1%	2%	0%	2%	4%
3 stars	78%	97%	74%	46%	16%	11%	5%	1%	17%	25%
4 or 5 stars	17%	97%	80%	58%	79%	54%	13%	6%	55%	79%
All hotels	76%	93%	69%	47%	17%	11%	5%	1%	15%	22%

Hotel Category: the large majority of both hotels and bedrooms belong to the intermediate 3 star category. The hotel size (number of rooms) tend to be greater for higher category

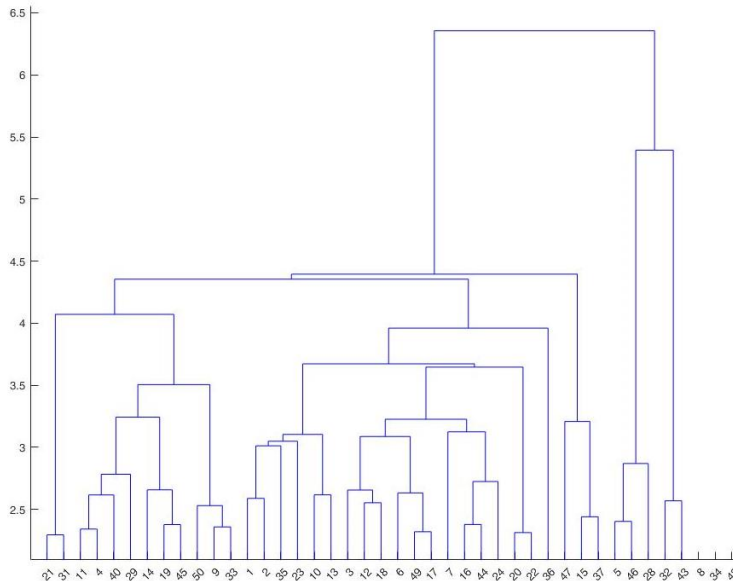
Category	% of city hotels	% of city bedrooms	Mean number of bedrooms per hotel
1 or 2 stars	32%	20%	23
3 stars	61%	68%	38
4 or 5 stars	7%	12%	57

But higher category hotels also generally offer a combination of water-demanding services and their influence cannot be easily disentangled.

Hierarchical Clustering based on main hotel features



- Category,
- Opening season,
- Number of Rooms,
- Restaurant,
- Garden,
- Pool or Jacuzzi



4 main clusters

Top category (3/4 stars),
larger size,
with restaurant,
often pool and/or spa,
annual opening

Majority:
Medium category (2/3 stars),
middle size,
with restaurant,
sometimes pool/spa,
seasonal opening

Medium category (2/3 stars),
middle size,
no restaurant,
sometimes pool/spa,
annual opening

Lowest category,
smaller size,
no restaurant,
rarely pool/spa,
seasonal opening

Hierarchical Clustering based on main hotel features



Cluster size	Stars	Seasonal Opening	Number of Rooms	Restaurant	Garden	Pool or jacuzzi
52%	2.68	100%	36	100%	48%	30%
7%	2.84	0%	30	0%	45%	29%
16%	3.16	0%	42	100%	42%	62%
25%	2.34	100%	28	0%	48%	16%

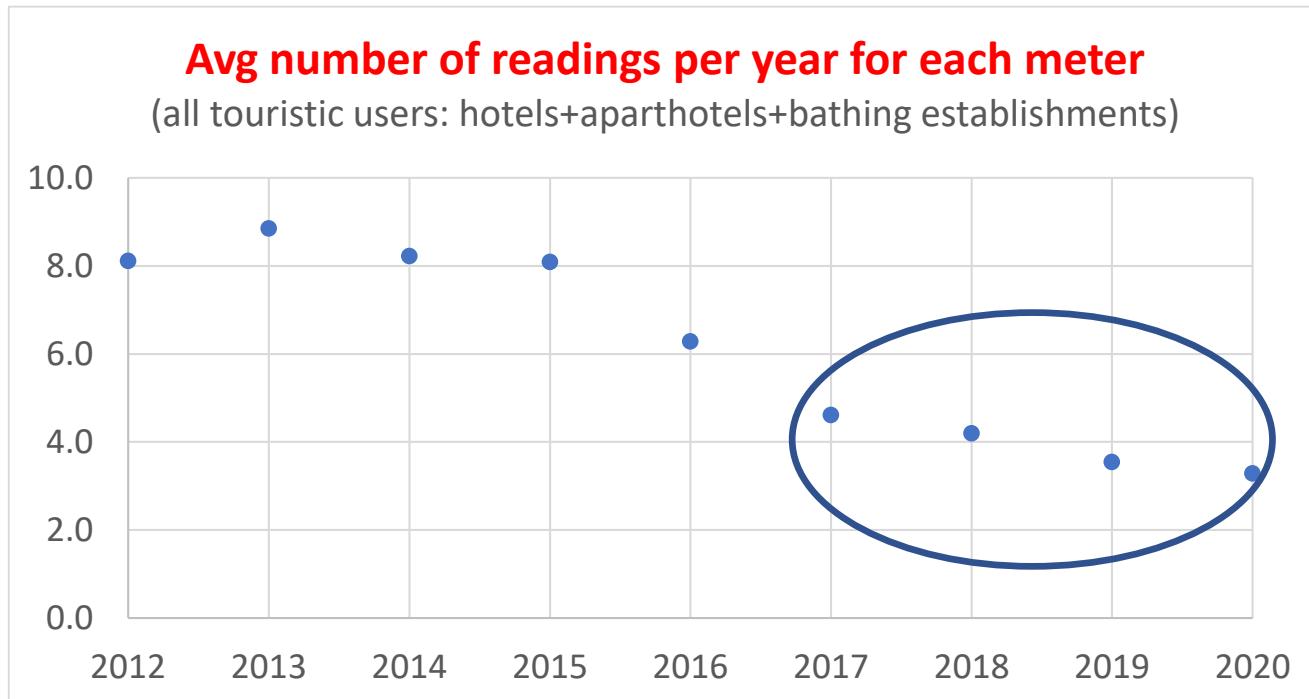
Gardens: evenly distributed

- 1) Majority: Medium category (2/3 stars), middle size, with restaurant, sometimes pool/spa, seasonal opening
- 2) Medium category (2/3 stars), middle size, no restaurant, sometimes pool/spa, annual opening
- 3) Higher category (3/4 stars), larger size, with restaurant, often pool and/or spa, annual opening
- 4) Lower category, smaller size, no restaurant, rarely pool/spa, seasonal opening

Monthly water volumes: decreasing number of readings in the last years

The monthly volumes were inferred from meter readings that should be collected every month for the larger consumers and bimonthly for the others.

But, when validating the data and investigating suspicious values, we found out that actually the number of readings substantially declined in the last years (the recent decline in data availability is not a prerogative of meteo-hydrological networks...).



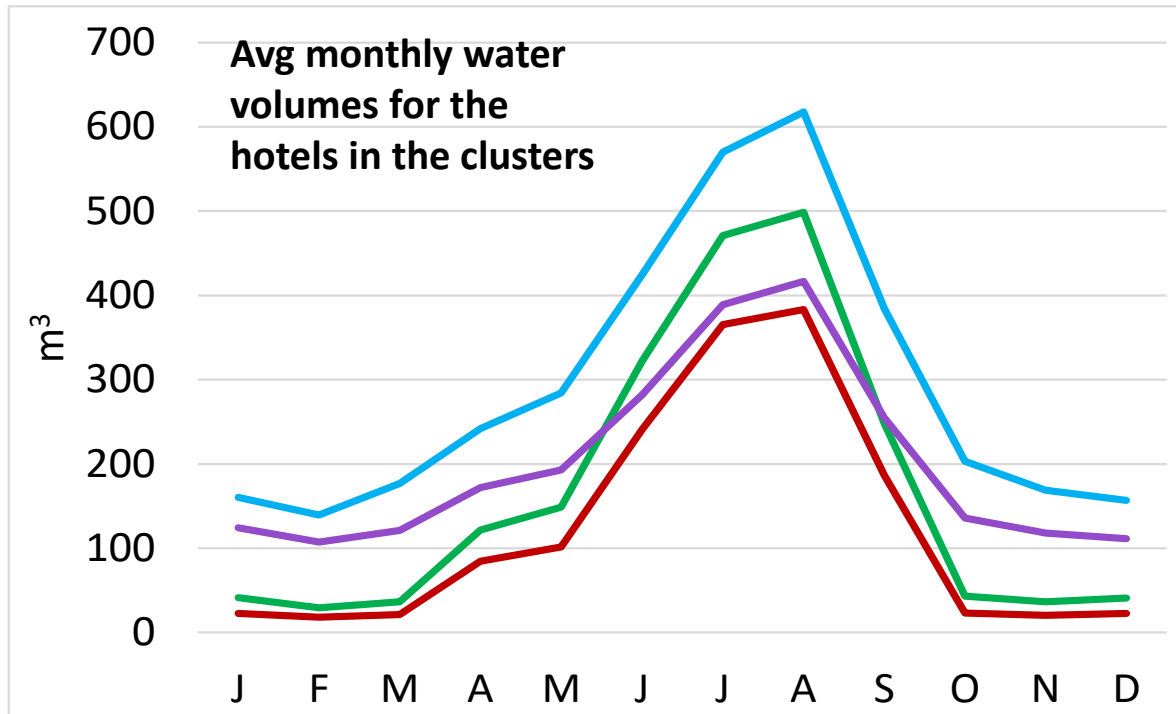
Due to the scarce frequency of the readings in the last years, the monthly data stored in the water utility database are not reliable

⇒ discarded the estimates for the last 4 years (2017, 2018, 2019, 2020) when <6 readings per year were available

Analysis of water use in the 4 clusters



- 1) Medium category (2/3 stars), middle size, with restaurant, sometimes pool/spa, seasonal opening
- 2) Medium category (2/3 stars), middle size, no restaurant, sometimes pool/spa, annual opening
- 3) Higher category (3/4 stars), larger size, with restaurant, often pool and/or spa, annual opening
- 4) Lower category, smaller size, no restaurant, rarely pool/spa, seasonal opening



Influence of size

Annual opening (clusters 2 and 3)

⇒ higher volumes in non-summer months

Medium category with seasonal opening and restaurant (cluster 1)

⇒ higher summer volumes than similar category but without restaurant (cluster 2)

Characterisation of Rimini bathing establishments

~ 200 bathing establishments in the set.

The water-demanding services available in the touristic websites are:

- **Hot showers**
- **Jacuzzi tubs (recent additions)**
- Nebulisers for air-cooling – very few establishments and small consumption - **NOT RELEVANT**

3 CLUSTERS:

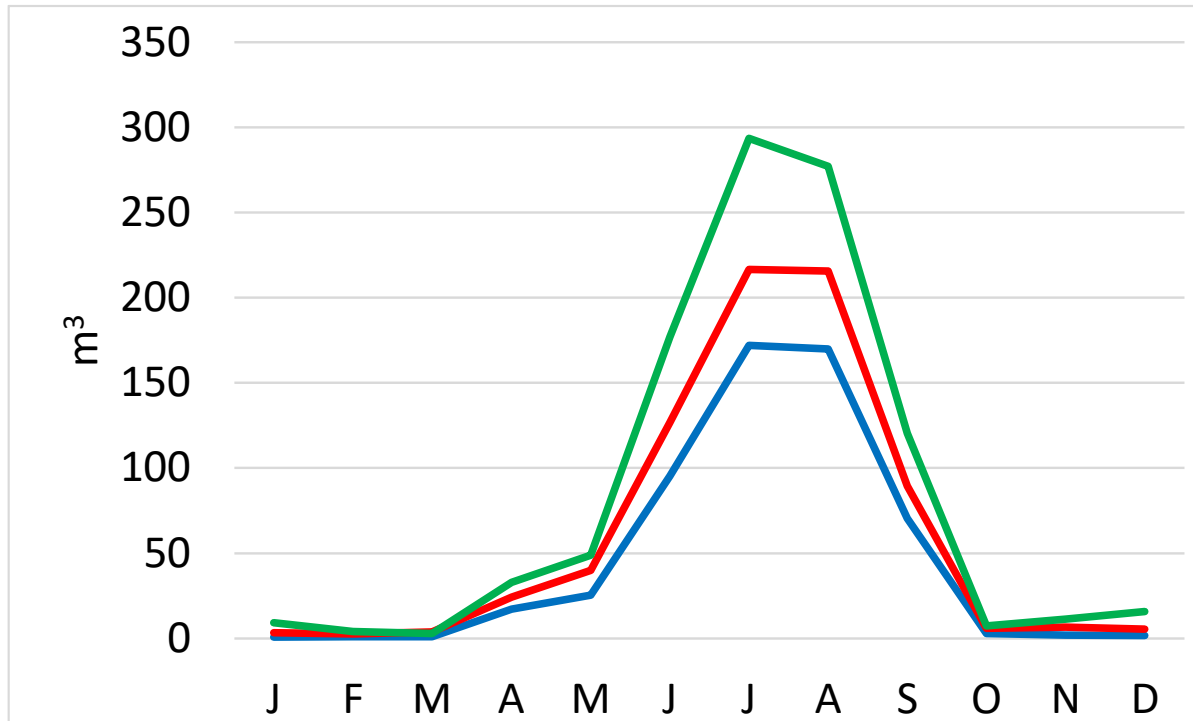
1. Without hot showers: 20%
2. With hot showers (but no jacuzzi): 71%
3. With both hot showers and jacuzzi: 9%



Analysis of water demand in the Rimini bathing establishments



1. Without hot showers: 20%
2. With hot showers (but no jacuzzi): 71%
3. With both hot showers and jacuzzi: 9%



Role of size (number of beach umbrellas) is not clear: many establishments have merged in the recent years, to provide 'joint' services (baby club, beach tennis, etc) to their clients and the resulting «size» is varying every year.

Water volumes are larger in establishments with hot showers and even more where jacuzzi tubs are available, due to the larger average size, but mainly to the water demanding services.

Limitations and future analyses: decreasing number of readings in the last years

Such **decline is counterintuitive, given the technological progress of the water metering approaches**, but there is no smart-metering in Rimini, yet: the water meters are of the traditional type, aging and manually read by staff that is evidently more and more busy.

Smart-metering is still sporadic in Italy, implemented only for experimental studies, and an overall, expensive replacement of the existing meters is not possible until the national water (and energy and waste) authority ARERA will not issue clear (and definitive) guidelines on the technical specifics of such monitoring system (especially problematic is the definition of the transmission system).

As said above, the utility's validation and data filling procedures are extremely simplified, given that their main objective is a reliable annual volume (for billing purposes) and they are not focussed on the monthly detail.

We have therefore asked the utility for the **raw readings** (from 2012 to 2020) and we are working on those (with more refined data mining approaches) in order to get a more faithful reproduction of the monthly values.

Limitations and future analyses:

Need for further information (surveys with hotel and bathing establishment managers)

Some of the features used in the characterization are insufficient or not reliable: touristic activities are always changing (see merging bathing establishments)

Information on

- linen laundry management
- served meals in the restaurant
- garden watering
- pool size

is not available

Data on actual room/umbrella occupation is missing (large “size” does not mean fully booked!)

Conclusions

The touristic factor has not been adequately addressed in urban water demand studies, so far, and it is often neglected also by the water utilities.

The present study attempts to contributing to quantifying the water consumption in touristic activities, analysing the hotel and bathing establishment) features that have the largest influence on the water consumption patterns, in order to quantify and forecast water uses for similar users and anticipating the expected peaks in the summer seasons. Such analyses are necessary in order to better manage water supply and demand in a touristic city.

Many additional information would be needed, from both the water utility and the hotel and bathing establishment managers, and detailed surveys are needed (foreseen inside the SIMTWIST JPI EU Project in progress),

The number of water meter readings (still traditional) are insufficient and declining: need for smart-water metering!!!