HISTORICAL DIMENSION OF MEDITERRANEAN CLIMATE: CLIMATIC HAZARDS AND WATER RESOURCES. The example of Barcelona city, 12th to 19th Centuries





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5) Urban evolution of Barcelona

6) Itinerary

Section 1: Water management and water uses in historical time. Section 2: Commercial activity. Ribera Quarter: trading and seamen. Section 3: Institutions into a little medieval kingdom.

1) Climatic conditions: Temperature. Monthly regime (Mean values. Period 1901-1990)



1) Climatic conditions: Temperature. Yearly Mean Values 1901-1990



1) Climatic conditions: Precipitation. Monthly Mean, Max. and Min. Period 1901-1990



(mm) Santiago Mean: 583 mm. Desv. est.: 150 mm. Max.: 1006 mm. Min.: 355 mm Madrid Barcelona (mm) Mean: 286 mm. Desv. est.: 101 mm. Mean: 1642 mm. Desv. est.: 456 mm. Max.: 574 mm. Min.: 90 mm. Max.: 3163 mm. Min.: 610 mm. Murcia Sevilla (mm (mm) Mean: 436 mm. Desv. est.: 103 mm. Max.: 746 mm. Min.: 240 mm. Only with 1000 km. (Santiago-Murcia) we find mean values between 1642 and 286 mm. Desv. est.: 165 mm. Mean: 577 mm. Max.: 1054 mm. Min.: 264 mm The absolute **minimum** of Santiago is 610 mm. meanwhile the absolute maximum in Murcia is 574 mm.

1) Climatic conditions: Precipitation. Yearly Total Values. 1901-1990

2) Climatic Hazards: rainfall extremes are the first climatic variable producing hazardous situations... in both directions:





Temporal Dimension

With so frequent occurrence of droughts and floods into mediterranean rainfall pattern, it's obvious water resources management is: no easy, expensive, and limiting factor for social and economic development.



3) Data Sources: Early Meteorological Observations. Daily instrumental series Scientific activity of physicians. Example of Barcelona since January 1780.





Holy Cross General Hospital	Ι.
14-19th centuries.	
Workplace of Dr. Salvá	

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Data series. Or	iginal manuscripts



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May, Sefler mis de mi estimacios : Yo soy pa Patricio lleno de autori, a esta, Ciudada, que ane la dado, la cuma, y quistera tester, estem mano todos los arbitrios que pudieten remedint la solicicion que padecem muchos de mis Compariosas, por la fonesta guerra qui mos afige. Si no puedo lograr tan bues éfecto por la cesarez de mis dige. Si no puedo lograr tan bues éfecto por la cesarez de mis dige. Si no puedo lograr tan bues éfecto por la cesarez de mis digeras en puedos a les necesidades conservir e con auxillos pécniarios prárs est teórer de las necesidades de tes Parlecular partos en mis manos, para que enredando de tes Parlos ha puesto en mis manos, para que enredando á Va., la publique en su su feriodico y in merces su atenetos.

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Dissemination of results. Local press

3) Data Sources: Early Meteorological Observations. Firsts results: Identification of strongest drought in Barcelona, 1817, "The Year of Famine"



3) Data Sources: Proxy-Data from documentary sources. Information to be obtained

80%: Rogation Ceremonies (Cultural indirect answer to environmental anomalies) by environmental elements produ

by environmental elements producing hazardous situations and impacts: droughts, rainy periods, storms, epidemics, locusts.

20%: Direct F

Direct Descriptions of climatic impacts: floods, sea-storms, strong wind events, strong snowfalls cold and hot waves.





3) Data Sources: Quantification of Rogation Ceremonies by drought.

Prevention Level (I) Mental Prayer into parish churches Intra Ecclesiam Intra Civitatem



Low Level (II) Relics Showing into Cathedrals Intra Ecclesiam Intra Civitatem



Medium Level (III) Public Processions with Relics by streets *Extra Ecclesiam* Intra Civitatem



Strong Level (IV) Water Contact of Relics Extra Ecclesiam Intra Civitatem Substitution by other ceremonies in 1619



Critical Level (V) Pilgrimages Extra Ecclesiam Extra Civitatem

Rogations were suggested by Guildic Authorities, ordered by Municipal Authorities and developped by Ecclesiastical Authorities, generating in all moment documentary records of deliberations and decisions. Liturgical procedures were defined and preserved by Vatican regulations

3) Data Sources: Description of Flood Events from municipal documentary sources.



First testimony of catastrophic flood in Barcelona

Biblioteca Nacional de Catalunya, Ms. 485, 27 d'agost de 1389, fol. 293: "Anno domini m ccc lxxx ix dies xxvii mensis augusti circa horam vespro fuit tot et tanta multitudo et tempestas aquas pluvialis in civitate barchinona et in eio territorio et duravit per tres horas et plo ita qui postravit ad terram murum ditem Civitatis quod erat retro monasterius sancti damiani barchinone et pte dormitori dicti monasteri et per maiori pt ora hospitia q erant in vico dls Orbs et in vico den jucglar et in alys diversis locus barchinona et multas vineas destruxit et eraditavit/ Et inplevit regum comdale lapidibus et cementis in tum qp per xii dies stetit qp no potuit intrar aquam moledinos in civitate barchn."

1866: Flood in Barcelona recovering the old bed river of "Ramblas" after the destruction of walled perimeter.

Translation from latin:

In the year 1389, 7th September, by evening, strong thunderstorm occurred in Barcelona and sorroundings during 3 hours. One sector of walled perimeter collapsed close to St. Damian monastery. Different buildings collapsed in Orbs Street and Jucglar Street and other sites. Flood also destroyed a lot of vineyards. Flood covered the "Comtal" Channel with stones and sand. Consequently, water mills of the city were closed during 12 days because water didn't arrive enoughly to them". **3**) Climatic Variability from proxy-data: Drought frequency in catalan coast (Data series from Girona, Barcelona, Tarragona and Tortosa).



3) Climatic Variability from proxy-data: Flood frequency in Catalonia. Averaged frequency indices from 12 data series.



... and variations in lenght of Unterer Grindelwalgletscher (Pfister, 1988)



4) Water Management in the mediterranean cities of "Ancient Regime"

Two basic factors were important for the cities:

Military defense by means of walled perimeters Water supplying in continuous flow for: Direct Human Use Hydraulic Energy Industrial Activities Agricultural Activities

Mediterranean Climate generated singular water management because of irregular water flows available on rivers:

Irrigation channels for agriculture Urban channels for human consume and industry Singular water mills to obtain energy Forced water sources in mountains by mines

But also walled perimeters were necessaries to stop and derive the flood events in close rivers, maintaining the overflow out of the cities.

4) Water Management in the cities of "Ancient Regime". Negative effects of population increasing: human pressure into the walled city, water quality decreasing, epidemics...



If water infrastructures and management don't go in parallel development, life quality is decreasing. Example: Yellow Fever Event 1821 provoked the death of 6% inhabitants of Barcelona in 2 months.

Barcelona population increasing by "Industrial Revolution"



Roman city (Colonia Barcino)



Water channels only for direct consume and leisure (baths)



Water channels

Non-permanent rivers

Litoral lagoon



Walled perimeter



12

Walled perimeter open to the sea (12-14th)

Catalan Kingdom was confident with dynamic coastal defense (different types of galley, rowing vessels)



Non-permanent rivers





Walled perimeter



Increased walled perimeter open to the sea (14-16th)

Barcelona increased the population and a new perimeter was necessary.

Plague epidemics of mid 14th century stopped this process.

The soil available was used like agricole reserve during sieges.

Water channels

Non-permanent rivers



Litoral lagoon



Walled perimeter

2.....



Closed walled perimeter (16-18th)

Turkey and muslim pirates obligued the authorities to take static defenses.

The Sea Wall generated problems to access to harbour and sanitary disturbances because it stopped sea breezes.

Water channels

Non-permanent rivers





Walled perimeter



Militarized city (18-19th)

After the Succession War, Borbon dinasty Stablished a new Administration and Institutions.

Military control of the city is evident by presence of thousands of soldiers but also with the second citadele or large fortress to control the city.

Water channels

Non-permanent rivers



Walled perimeter

Geographical distribution of activities into the walled perimeter of Barcelona city (14-19th centuries)

Po In ar



Industrial activity. Manufacturing quarter



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Trading activity. Burgeoise quarter



Maritime activity. Fishermen and seamen quarter

Professional activity. Lawyers, physicians, functionaries, teachers



Financial power. Walled jewish quarter "Call"



Agricultural activity. Urbanization in progress during 18th century

6) Itinerary. General overview



6) Itinerary. Section 1.



SECTION 1: WATER MANAGEMENT AND WATER USES IN HISTORICAL TIME

- Departure. St. Pere Sq.

- Basses St. Pere Sq. Energy production by hydraulic mills.

- Old water mill structures

- St. Agusti Square. Catalan Army Academy. Industrial use of water: Textil quarter.

- Assaonadors Street. Leather quarter.

- Connection with section 2: Marcús Square Montcada Street

6) Itinerary. Section 2.



SECTION 2: COMMERCIAL ACTIVITY: RIBERA QUARTER. TRADING, AND SEAMEN - Departure. Montcada Street. - Visit to any trade "palace".

- Mosques Street: the money flow.

- Olles Square. Seamen hazards: floods in land, storms in sea.

- Canvis Vells Street.

Financial aspects.

- Caputxes Street.

Human pressure in walled cities.

- Argenteria Street.

Medieval Shoping Center

- Carassa Street.

Prostitution like economic activity.

- Cotoners Street.

18th Century Industrial Take-Off.

- Connection with section 3: Angel Square/Swiss Hotel/City Jail

6) Itinerary. Section 3.



SECTION 3: INSTITUTIONS INTO A LITTLE MEDIEVAL KINGDOM - Departure. Angel Square. Prison. Justice system. - Rei Square. Religious Court.

- Rel Square. Religious Court. Kingdom Palace Buildings.
- Sant Iu Square. Kingdom Palace. Private residence
- Cathedral. Local Ecclesiastical Authority. Poors Hospital.
- Ardiaca Palace. Economic
- Chapter Authority. City Archive.
- Bishop Palace. Territorial Ecclesiastical Authority.
- Marlet Street. Jewish ghetto.
- Financial power
- St. Miquel Square. High Court
- Ciutat Street. Municipal authority
- Bisbe Street. Territorial authority.
- (Permanent Representation of Medieval Parliament)
- Paradis Street. Roman Temple. End of itinerary.