Multidisciplinary expertise of historical information for the characterization of water levels during storm and coastal flooding events

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& members of working group
« Historic Storms and Marine Flooding »

Context

Storms and their associated surges can dramatically impact coastal areas and infrastructures

Within the last decades in western Europe
- **"Lothar" and "Martin" storm (12/1999)**
- **"Xynthia" storm (02/2010)**: death of more than 47 people and over 1.5 billion euros of damage
- **Winter 2013 / 2014** : frequent marine floodings, coastal erosion

For a better coastal risk management, **highest values of extreme water levels have to be estimated as accurately as possible!**

Systematic sea level time series are directly analyzed (tide gauge measurements)

→ **Extreme Value Analysis (EVA) widely used to assess annual probabilities of exceedance or return periods**

Winter 2014 – Le Conquet (Brittany)

Context

Extreme Value Analysis → assess probability of high return periods (100 – 1000y RL)

Limitations:
- Short durations of observations (few decades/ one century at most)
- Gaps within observation period
- Presence of outliers (value that is very different from other values)
- → **Poor estimation of distribution parameters and large uncertainties**

Consideration of Historical Information
- Improve statistic modeling
- Reduce uncertainties for high return periods
- Add other extreme events

Extreme values theory
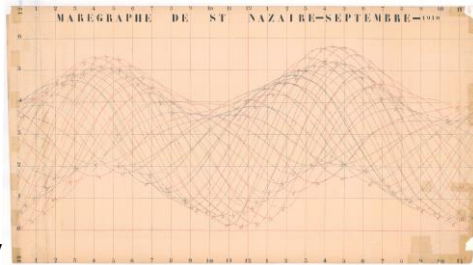*(GPD fitted to the POT surges)*
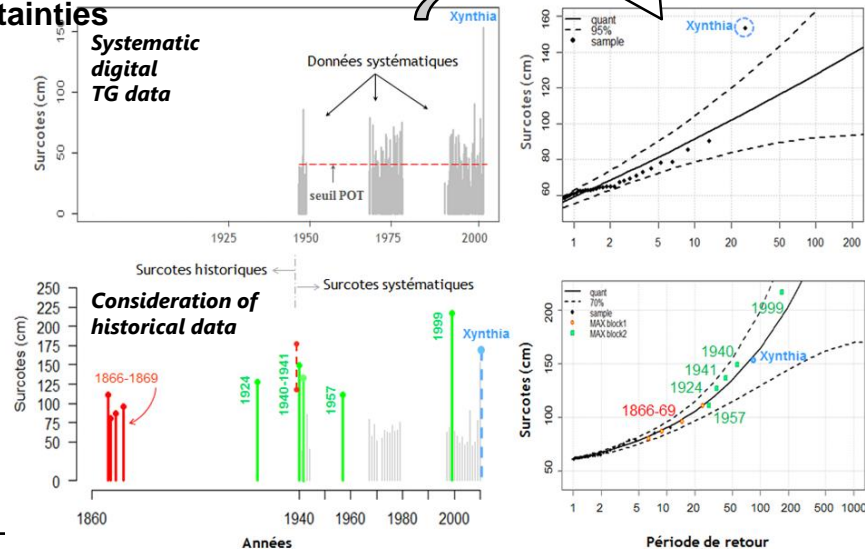
Recovery of historical information

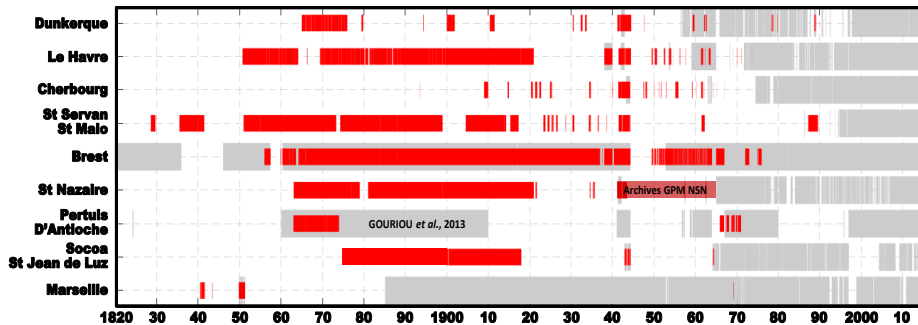## Tide Gauge Data – Data Rescue: Quantitative Data

Poster A. Latapy et al., 2021

Assessing long-term sea level evolution: the historical sea level data rescue approach

→ Quantified information but scarce and not always close to impacted areas

MAREGRAPHE DE ST NAZAIRE-SEPTEMBRE-1918

Numerical data Shom
Paper archives, Ongoing inventory

Dunkerque
Le Havre
Cherbourg
St Servan / St Malo
Brest
St Nazaire — Archives GPM NSN
Pertuis D'Antioche — GOURIOU *et al.*, 2013
Socoa / St Jean de Luz
Marseille

1820 30 40 50 60 70 80 90 1900 10 20 30 40 50 60 70 80 90 2000 10

Historical Archives

Engineer reports, Local Press, Scientific essays, Damage reports, Diaries, Maps, plans, Sketches of dikes, quays, Photographs, paintings ….

Recovery of historical information

Tide Gauge Data - Data Rescue: Quantitative Data **Historical Archives**

Recovery of historical data is necessary but
- Time consuming activity
- Needs management of different type of information coming from various scientific contexts and practice
- Archives are geographically scattered

2016: **Creation of Working Group (WG) « Historic Storms and Floodings »**
Mutualize informations concerning extreme events and performe a multidisciplinary expertise of historical archives
engineers, oceanographers, statisticians, historians …

→ Presentation of two tools used:
  → Data Base
  → Methodology: Quantification of historic water levels

IRSN Data Base « Historic Storms and Marine Flooding »
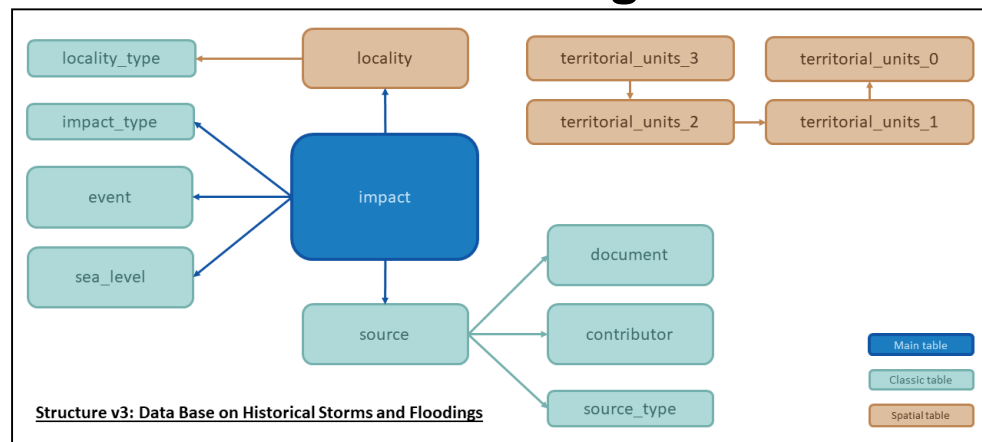
Recovery of historical Information

Find information on an extreme event
→ Store information in database

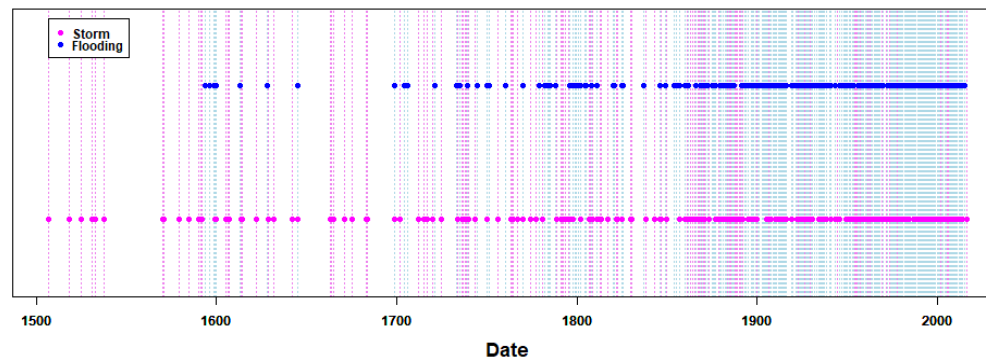→ PostgreSQL + PostGIS
→ Development since 2015

Website: https://gforge.irsn.fr/gf/project/bdts/

→ Spring 2021: more than 800 events
    → 382 Events with Flooding
    → 427 Storms

Structure v3: Data Base on Historical Storms and Floodings

Quantification of historic water levels
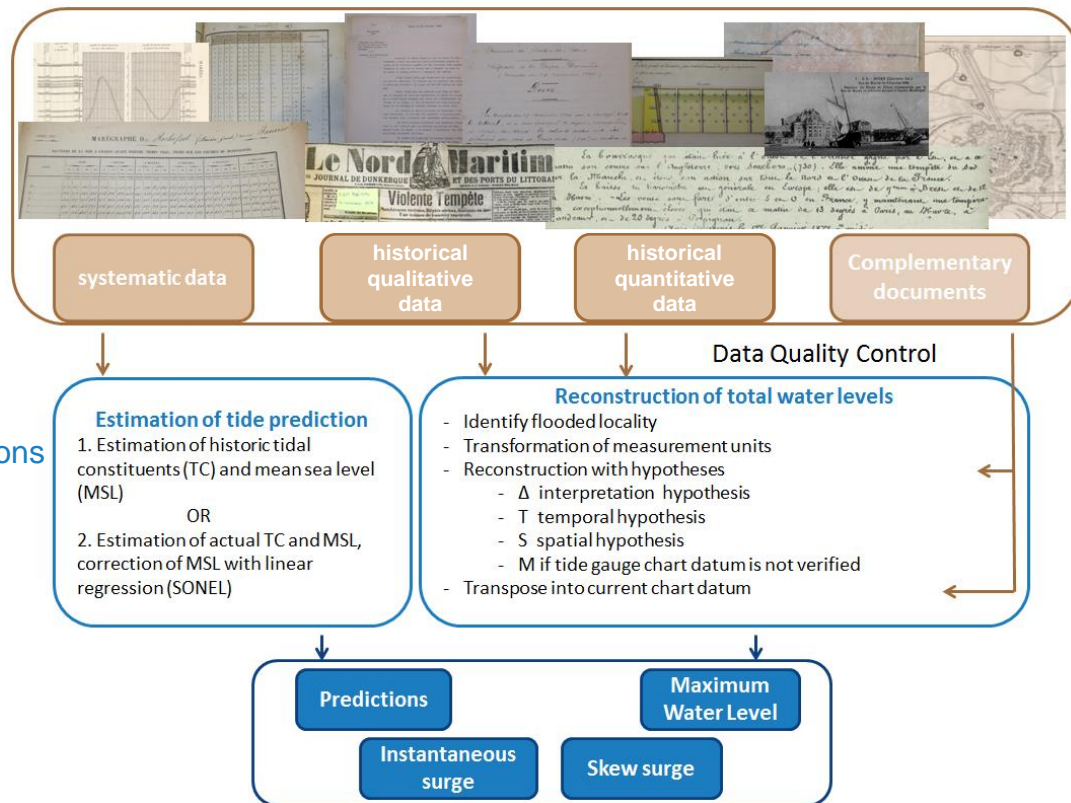
Recovery of historical Information

Analyze information on an extreme event
Adapted from *Giloy et al., 2019*

→ Data Quality Control

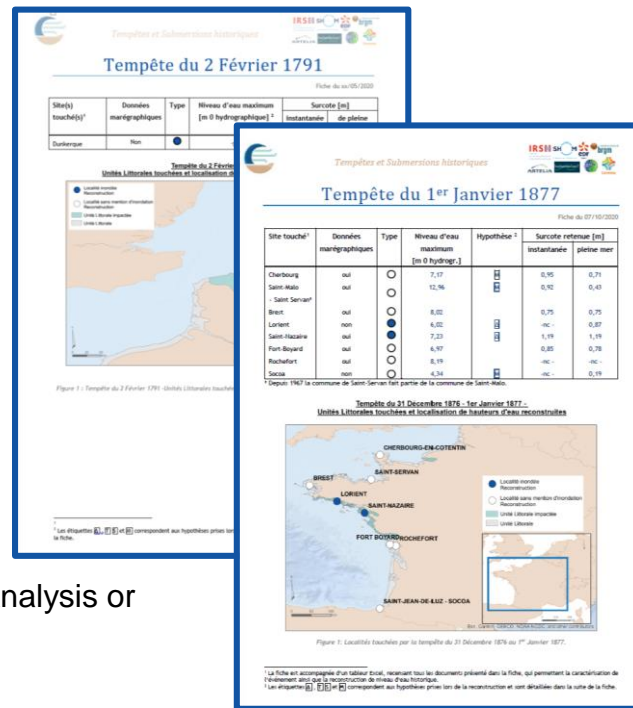→ Reconstruction of Water Levels and Tidal Predictions

→ Estimate surges and skew surges

Quantification of historic water levels

Recovery of historical Information

Trace information and reconstruction in storm sheets

→ Reconstructed values can be integrated in Extreme Value Analysis or used for risk management

Conclusion & Perspectives

2016-2020: Initiation of different multidisciplinary projects

- Creation of DB
- Methodology to quantify historic water levels and surge levels
    - including enhanced data quality control and prediction of tides for past events

Perspectives

- Enlarge study area to France and overseas
- Set up a case study on cyclones
- Continue to be a platform for exchange on topics regarding historic storms and floodings

Thank you for your attention

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