Combined storm and meteotsunami hazards

Through data analysis and numerical simulation

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Meteotsunamis in Portugal

- **Meteorological tsunamis or Meteotsunamis** are hazardous tsunami-like waves (1 min - 2 hr) with atmospheric origin [1].
- Different from storm surges and wind waves.
- Sudden atmospheric pressure jump is the main origin of meteotsunamis.
- How many meteotsunamis are in Portugal?
  - Two confirmed cases: July 6-7, 2010[2] and June 25-26, 2011[3]
- Using thresholds from previous study[4], we identified **31 meteotsunamis** associated to a sudden pressure jump 2010-2019
- **11** cases are related to extratropical/tropical storms (ex-Hurricanes) or European winter storms.

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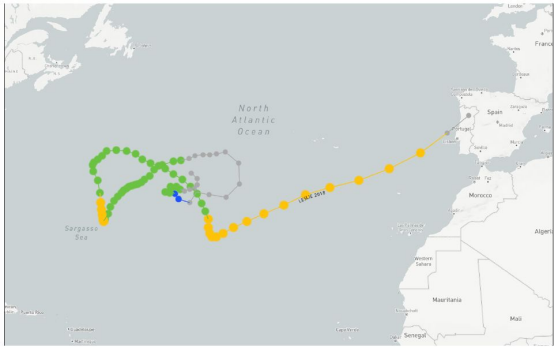
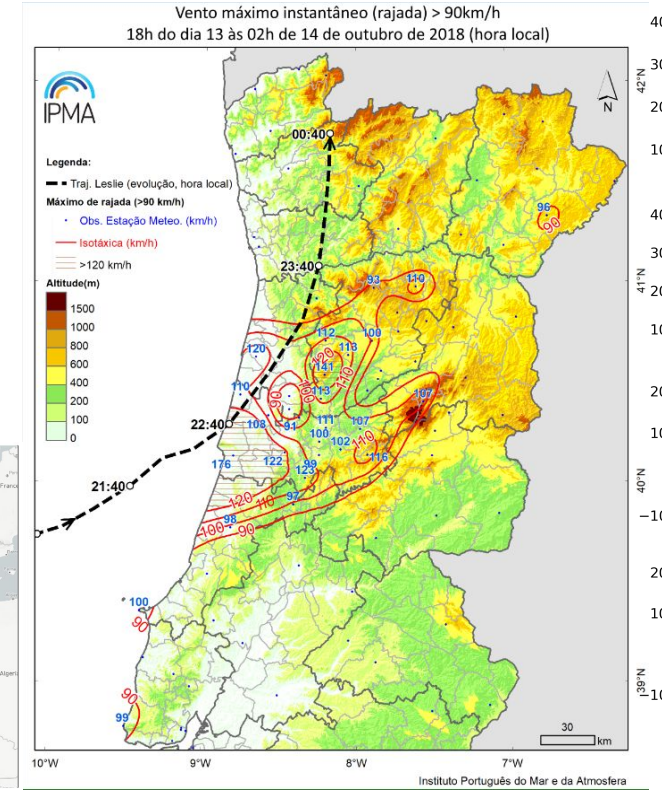
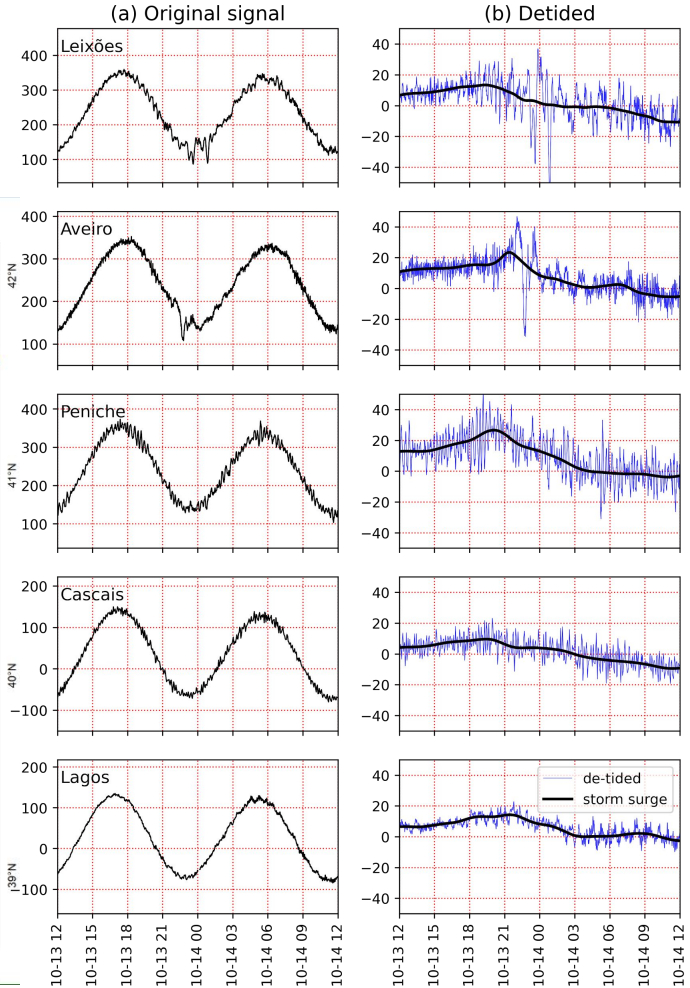
Hurricane Leslie (2018)

- Landfall at 22:40 on 13 October 2018
- 998 hPa, max. gust of 49 m/s at landfall
- Max. air pressure change: 6.1 hPa/10 min at Aveiro







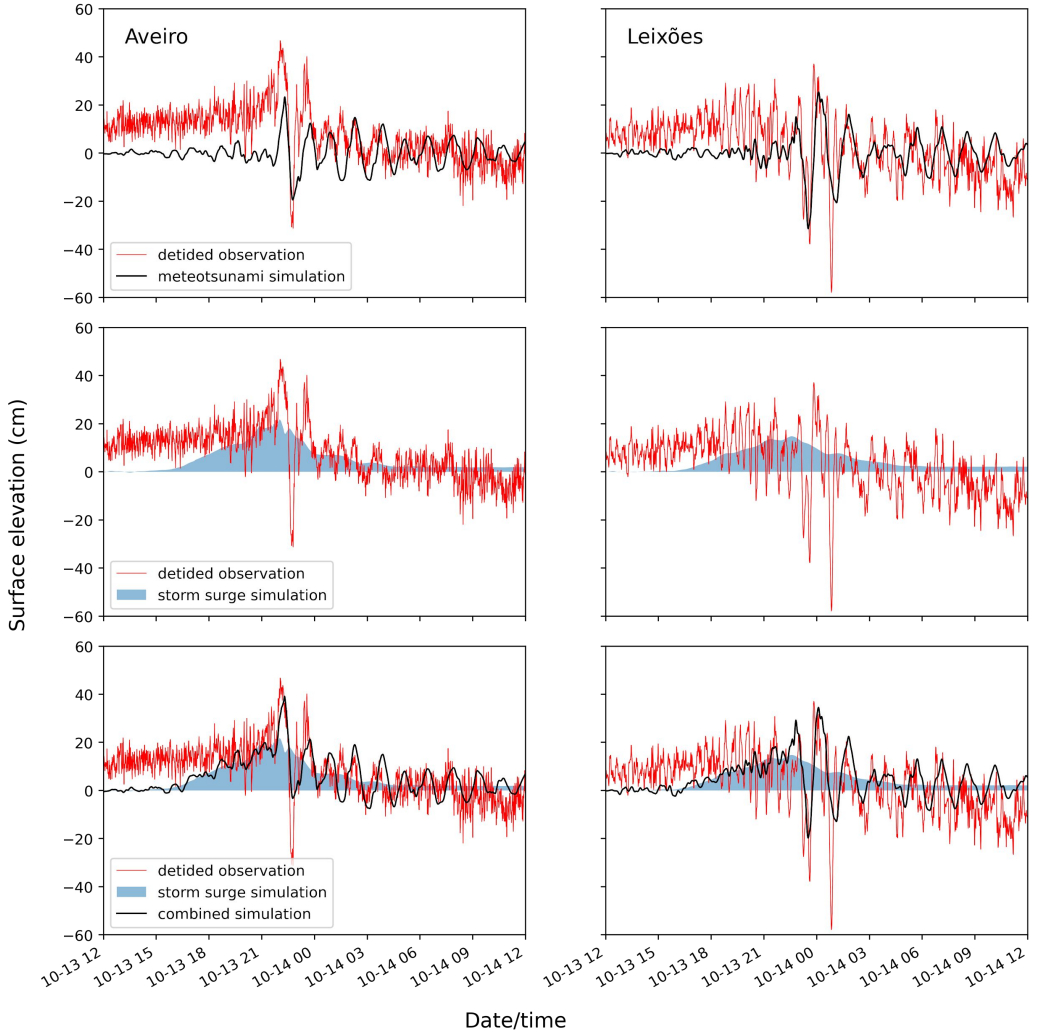
Numerical results and summary

Storms may accompany a sudden air pressure change which may induce meteotsunamis.

Coast of Portugal is vulnerable to storms and meteotsunamis.

Combining storm surge and meteotsunami simulations can improve to reproduce the observed waves.

Thank you!



References

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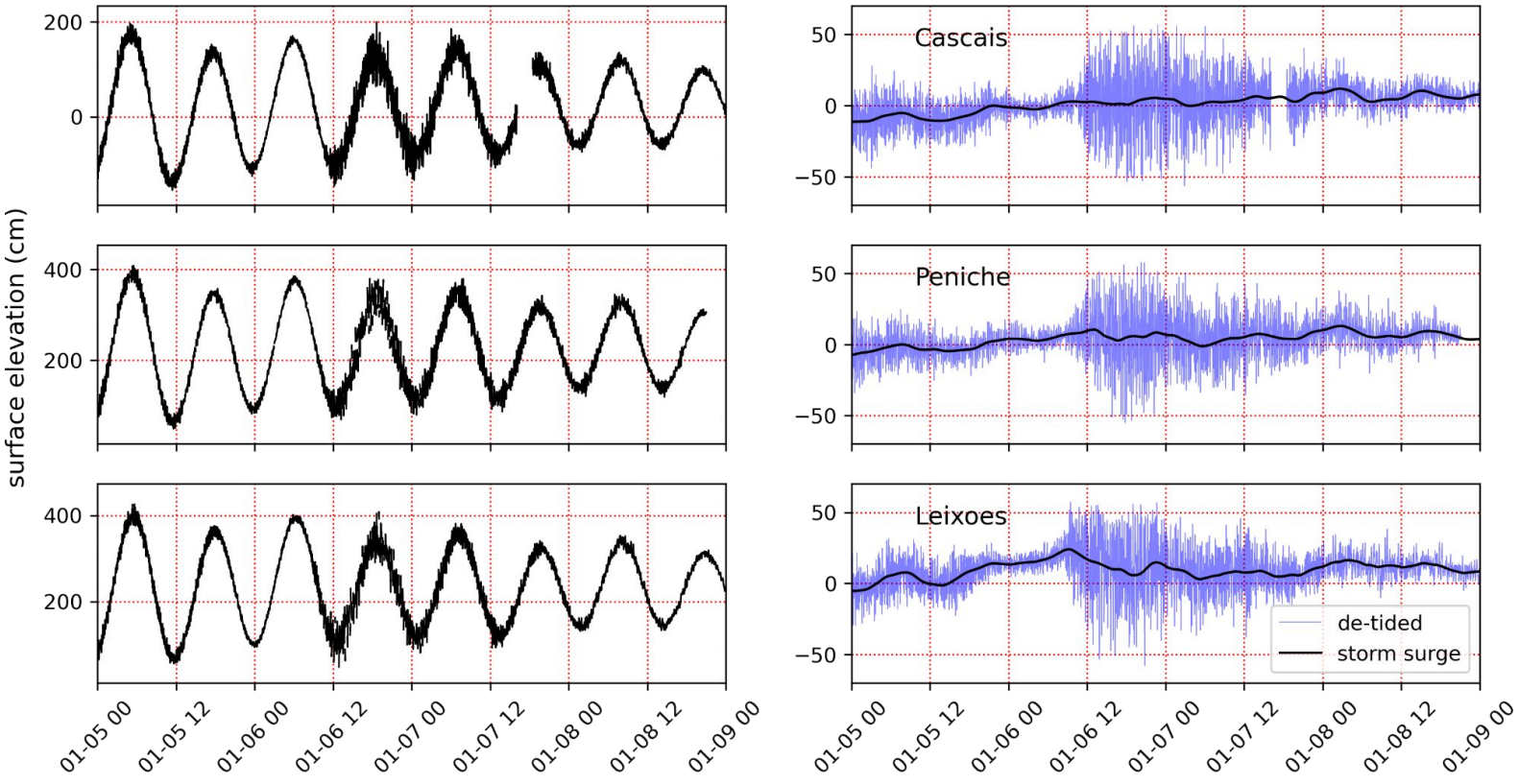
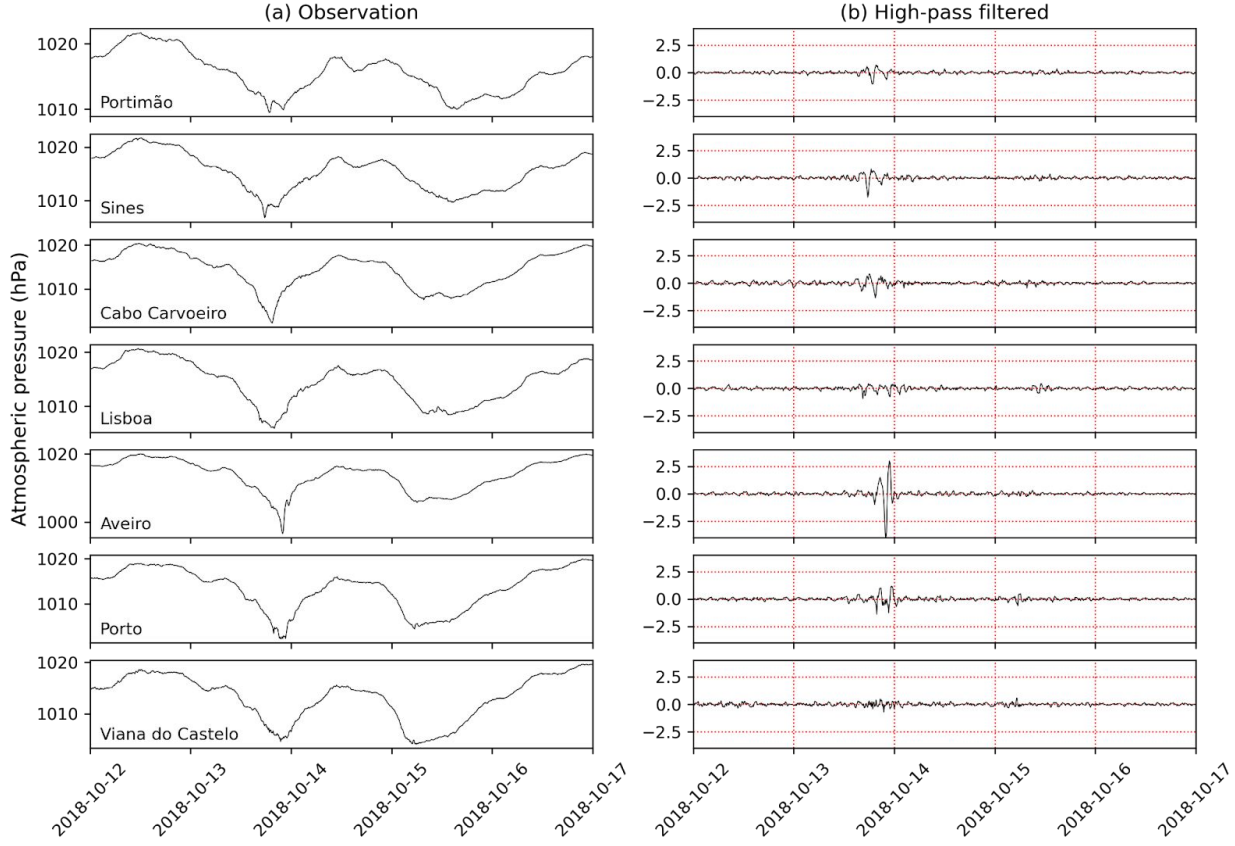
Details

- Coastal impact of Leslie was minimal. One reason may be the low tide at the time of the landfall.
- Data collected internally from IPMA
- Threshold for identifying Meteotsunamis
  - Larger than 4-sigma waves from two tidal gauges
  - 1.5hPa/30 min of atmospheric pressure change
- Numerical simulation using GeoClaw (www.clawpack.org)
  - Storm surge: Holland 1980 model, https://ftp.nhc.noaa.gov/atcf/
- Storm Christina (2014): This was an European storm, and generated large waves but the pressure jump was small (0.7hPa/10min). Storm surge modeling was not possible since the storm data was not available. We performed meteotsunami simulations, and numerical results suggested that Christina may have generated infragravity waves.
- At Peniche, there is a local resonance due to the harbor and wide continental shelf area.

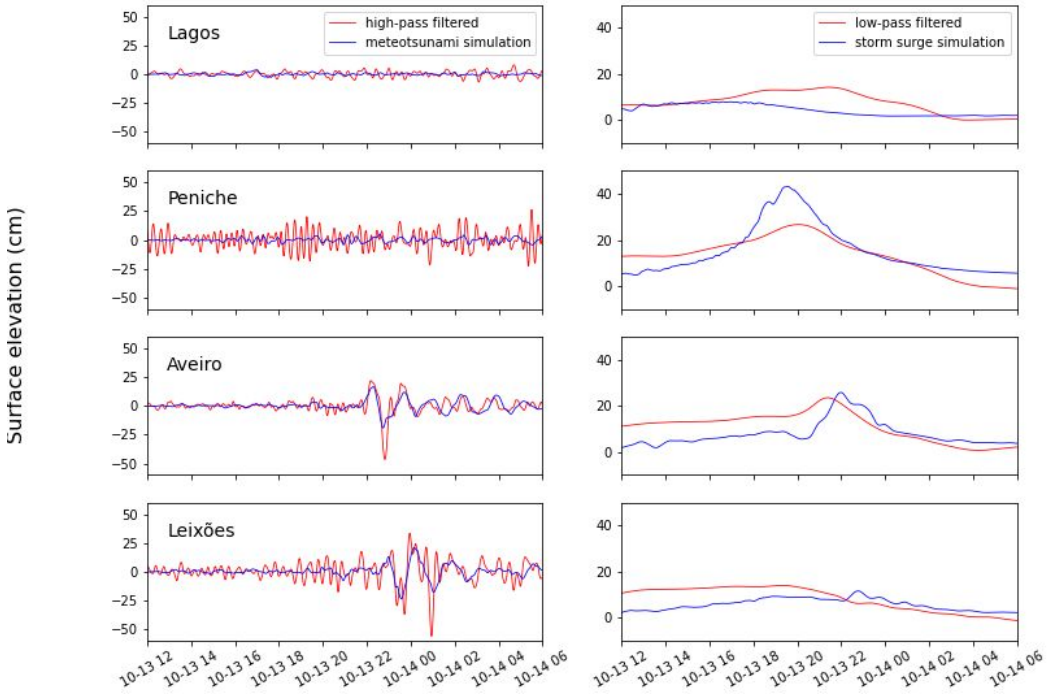
Christina (2014) - Tide stations



Leslie - Atmospheric pressure



Leslie - Numerical simulation



Leslie - Numerical simulation