FLOODrisk
Lyon
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Extreme sea levels under present and future climate: a pan-European database

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Presentation plan

- Background
- Methodology
- Validation
- Results
- Further research

Background

- FP7 project "*Risk Analysis of Infrastructure Networks in response to extreme weather*" is aiming to provide an operational analysis framework that identifies critical infrastructure components impacted by extreme weather events and minimise the impact of these events on the EU infrastructure network.
- The project includes a "hazard identification" work package. Our group was analysing return periods and extents of river floods and coastal floods in EU countries under present and future climate.
- Project is led by Trinity College Dublin. A final dissemination event will be held in Dublin on 24th March 2017.

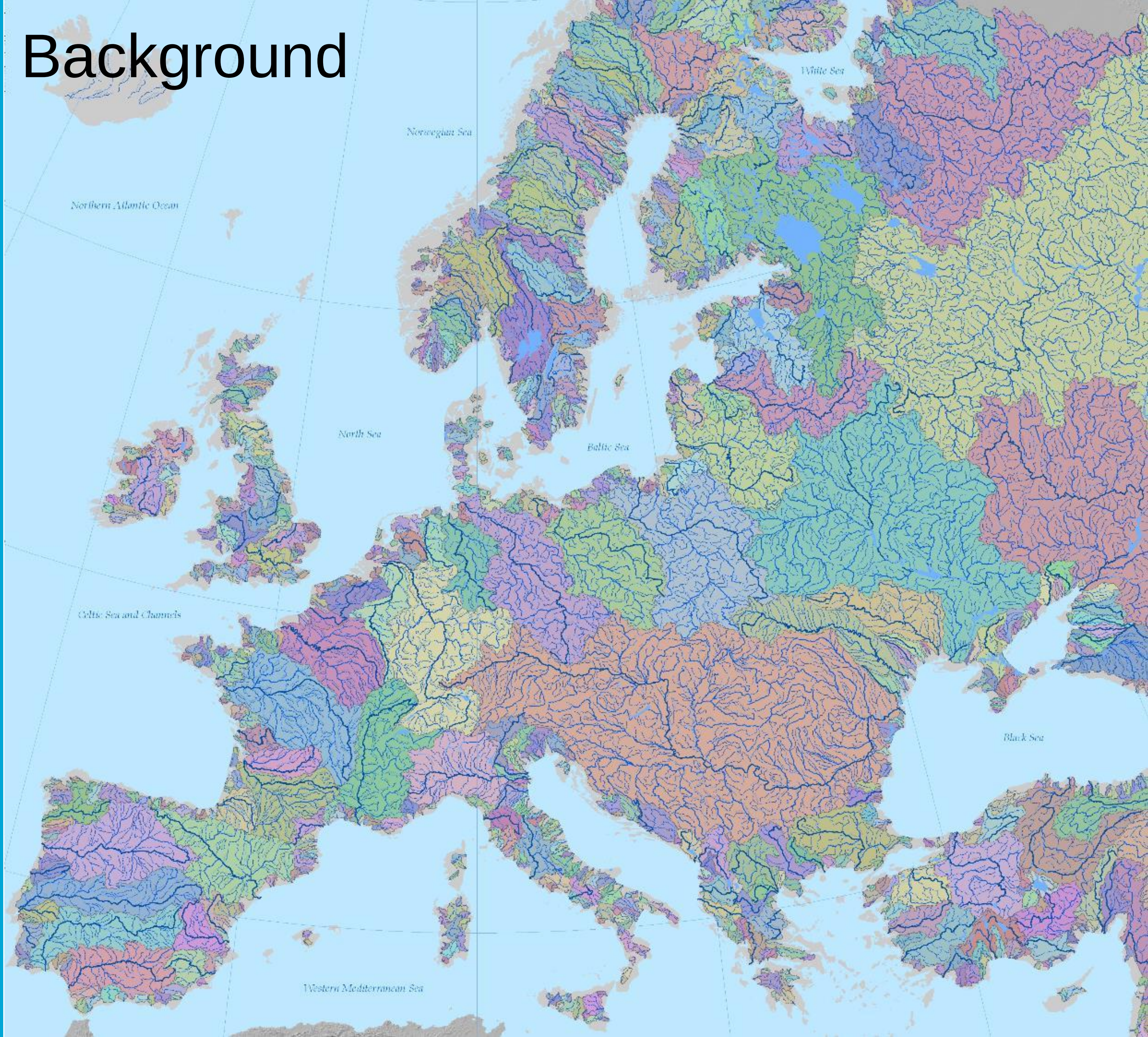
RAIN PROJECT

http://rain-project.eu/

This project has received funding from the European Union's Seventh Framework Programme for research. technological development and demonstration under grant agreement no 608166. The contents of this presentation are the author's views. The European Union is not liable for any use that may be made of the information contained therein.

This project is funded by the European Union

Background



Source: Vogt et al. (2010) “Main Rivers of Europe”. http://ccm.jrc.ec.europa.eu/

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Methodology

1) Use a hydraulic model to simulate extreme storm surges under present and future climate.

Deltares Delft3D model was used

2) Use external databases of tides, isostatic adjustment, sea level rise and ocean's dynamic topography to calculate extreme water levels.

Several global databases were used.

3) Use the water levels to derive flood zones in GIS.

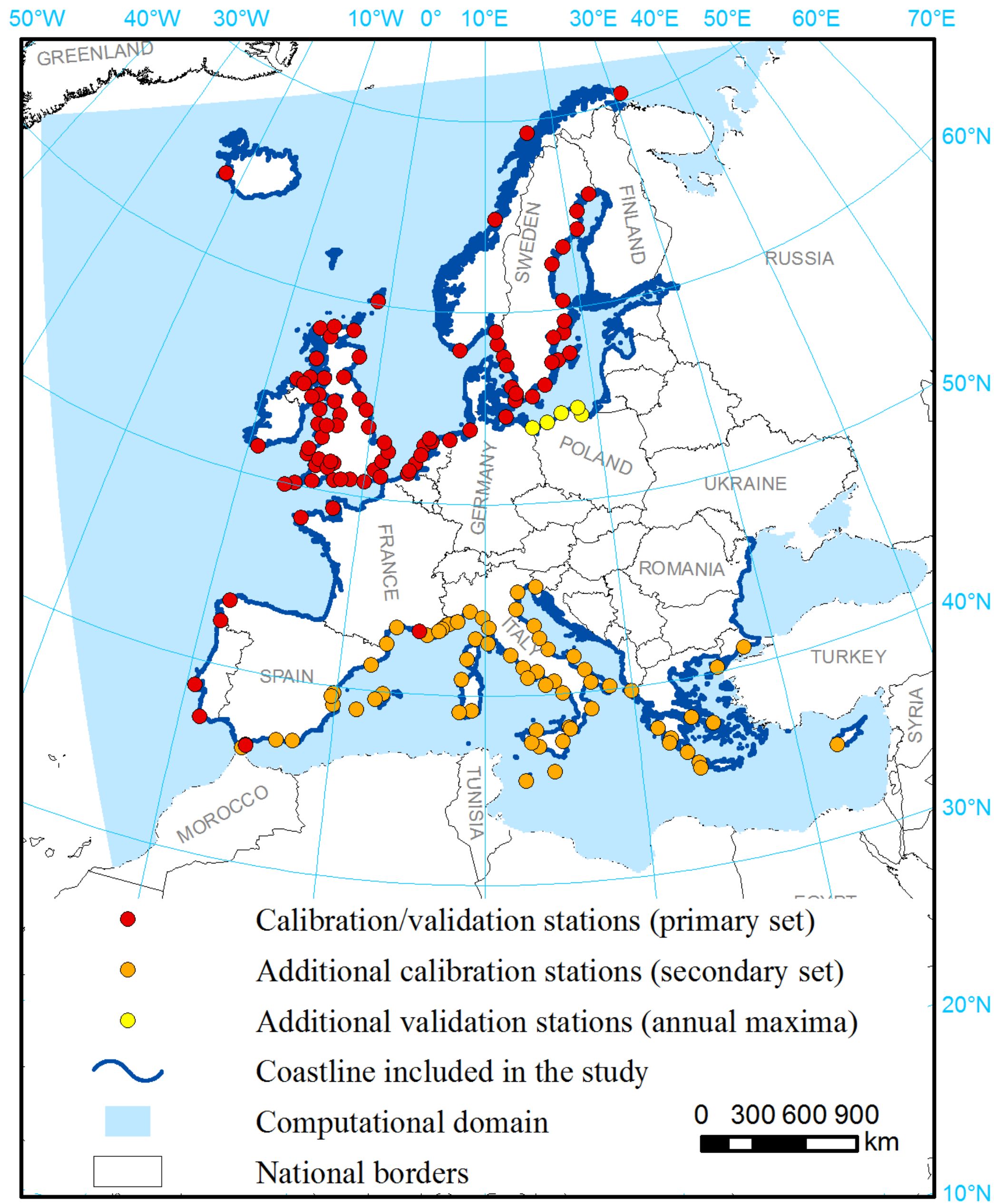
ArcGIS analysis using "bathtub fill approach"

Domain

Regular grid

0.11° resolution

30 min timestep



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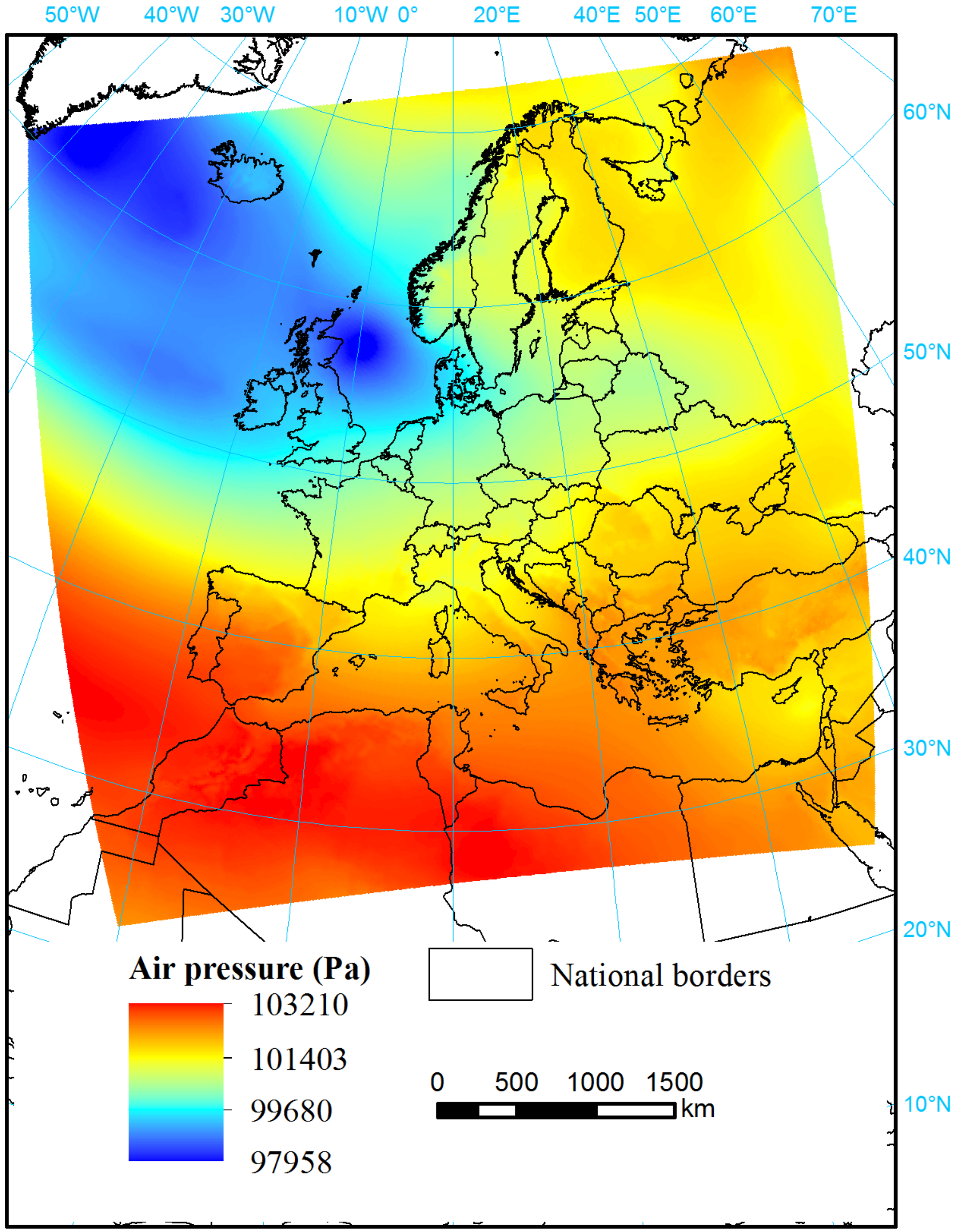
Meteorological input

Input from 2 climate models:

- **ERA-Interim** reanalysis (0.75º resampled to 0.11º)
- **EURO-CORDEX** simulation prepared by SMHI specially for RAIN project with RCA4 model

- 6-hourly data

- Air pressure
- Wind speed (northward and eastward component)

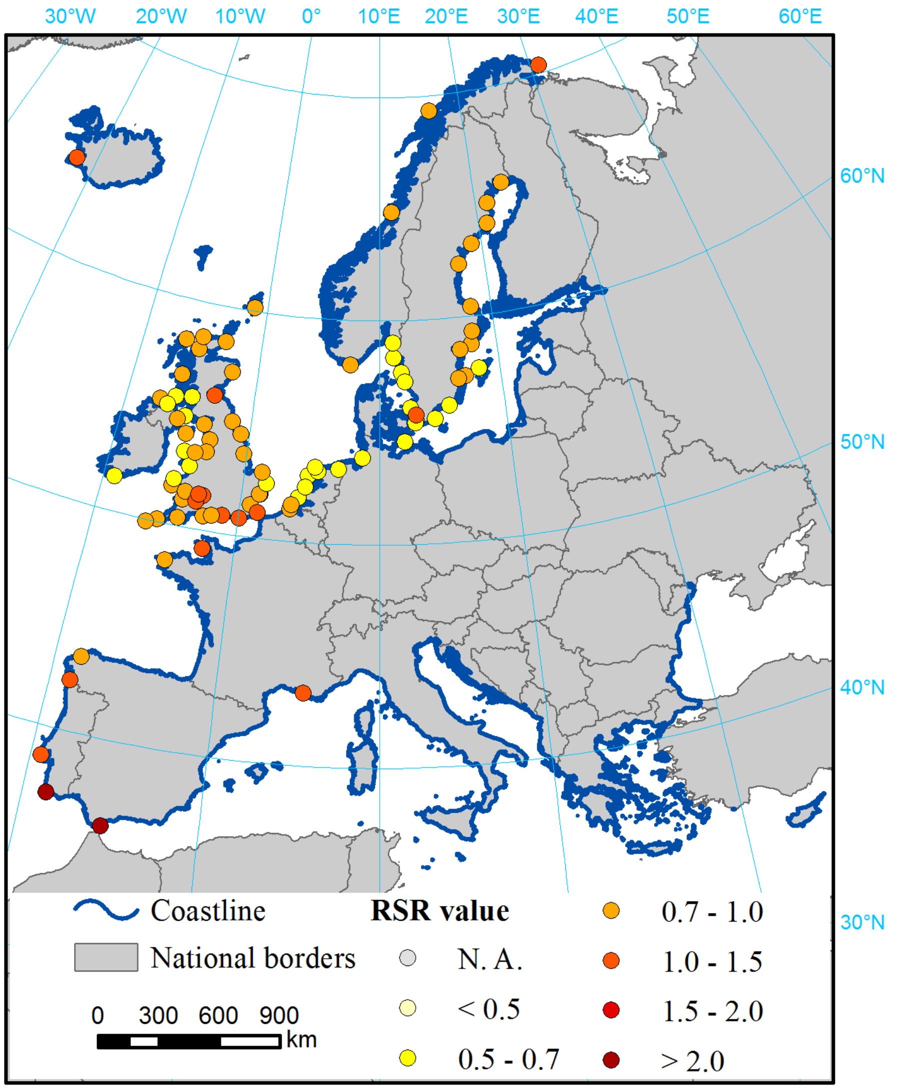


Calibration

Calibration was done running the model for 1997-2000 with ERA-Interim and
1) adjusting:
- wind drag coefficient (Charnock)
- ocean bed roughness

2) comparing with 90 gauges in 14 territories
- 6-hour timeseries
- daily maxima
- monthly maxima

Run	Series	R^2	NSE	RMSE	RSR
1997-2000 primary stations	Timeseries	0.52	0.42	0.15	0.78
	Daily max	0.61	0.52	0.15	0.72
	Monthly max	0.75	0.72	0.15	0.53



Timeseries, calibration

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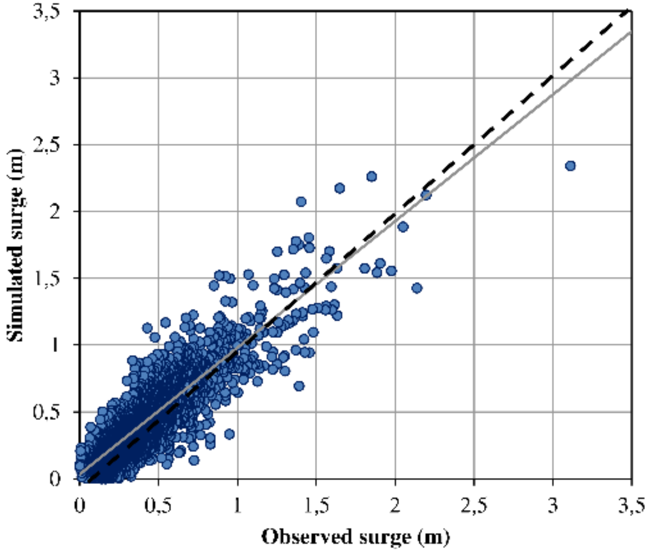
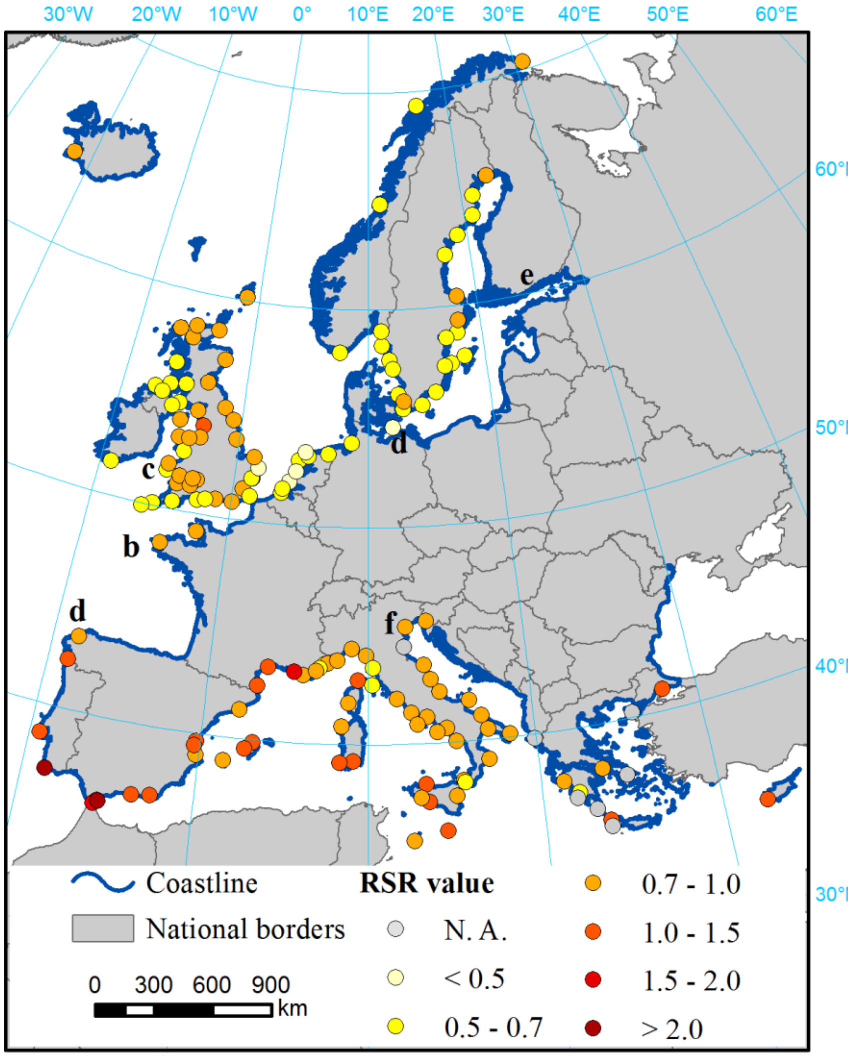
Calibration

Additional calibration was done for 2011-2014 and 1979-2014



Monthly maxima, 2011-2014



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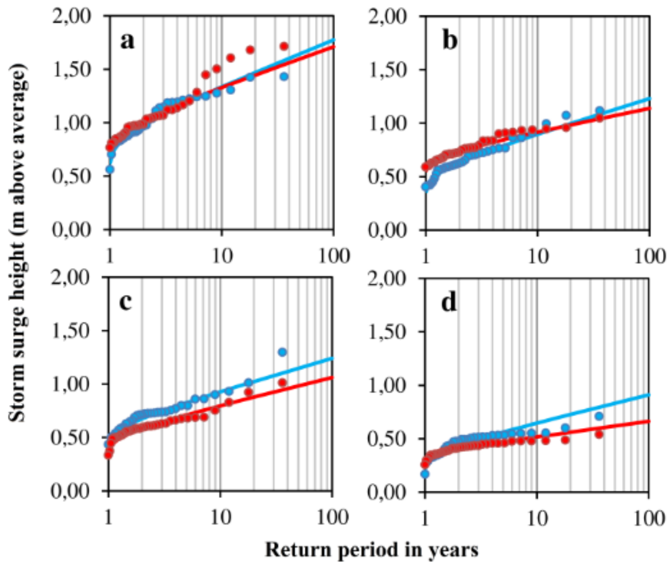
Validation



Annual maxima, 1970-2005 with EURO-CORDEX

(a) Gedser, Denmark,
(b) Milford Haven, UK,
(c) Brest, France,
(d) La Coruña, Spain

Return period (years)	ERA-Interim (1979–2014)			EURO-CORDEX (1970–2005)		
	R^2	NSE	RSR	R^2	NSE	RSR
1000	0.87	0.76	0.52	0.86	0.83	0.40
100	0.86	0.81	0.45	0.87	0.84	0.40
10	0.84	0.83	0.41	0.86	0.81	0.44
2	0.76	0.71	0.55	0.80	0.69	0.58

Return periods for stations with ≥ 20 years of data

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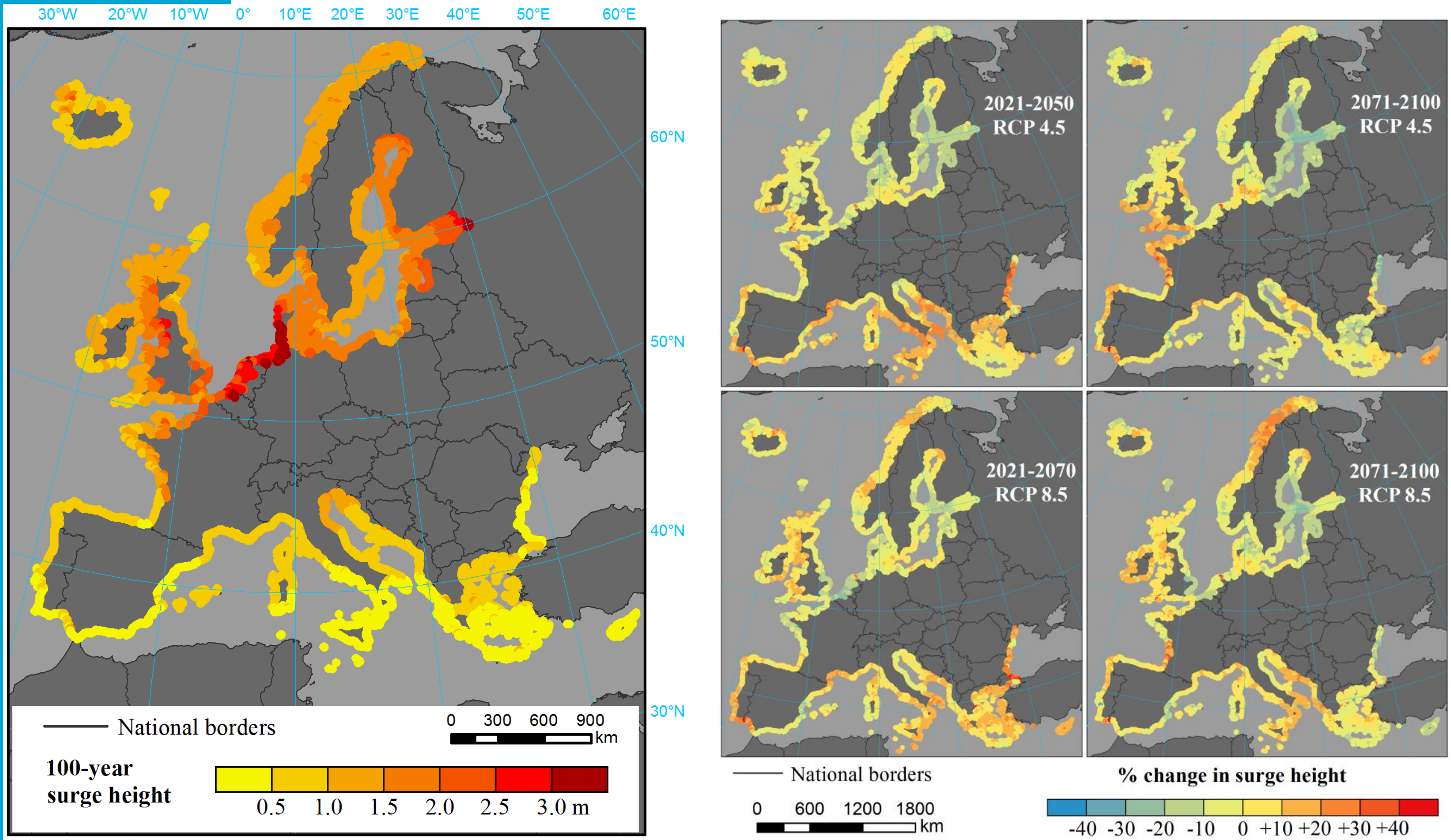
Results – storm surge (100-year)



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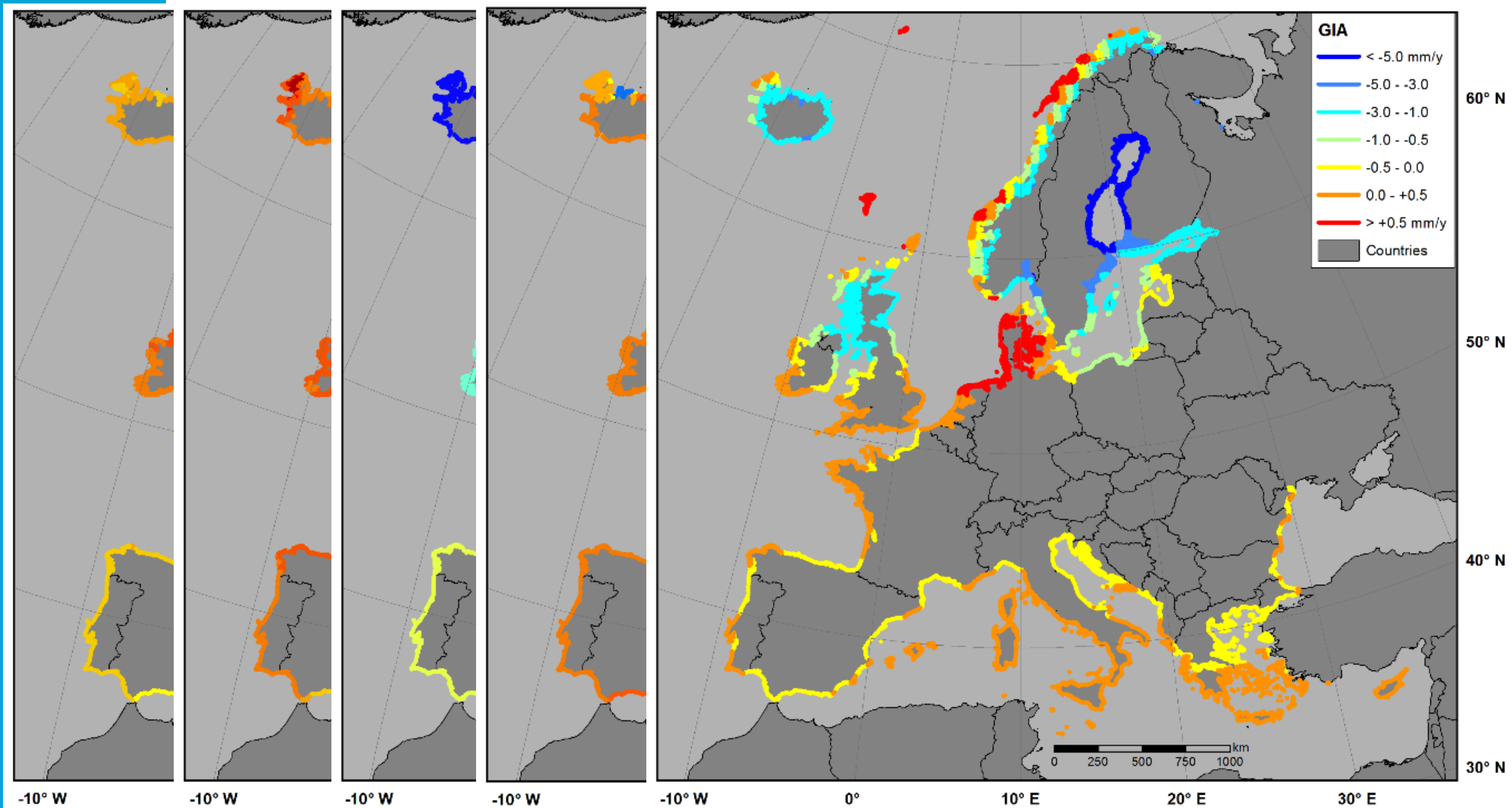
Extreme water levels

Extreme water level *WL* probability of occurrence *p* at time period *T*:

$$WL_{p,T} = Surge_{p,T} + Tide + MSL_{base} + SLR_T + GIA_T$$



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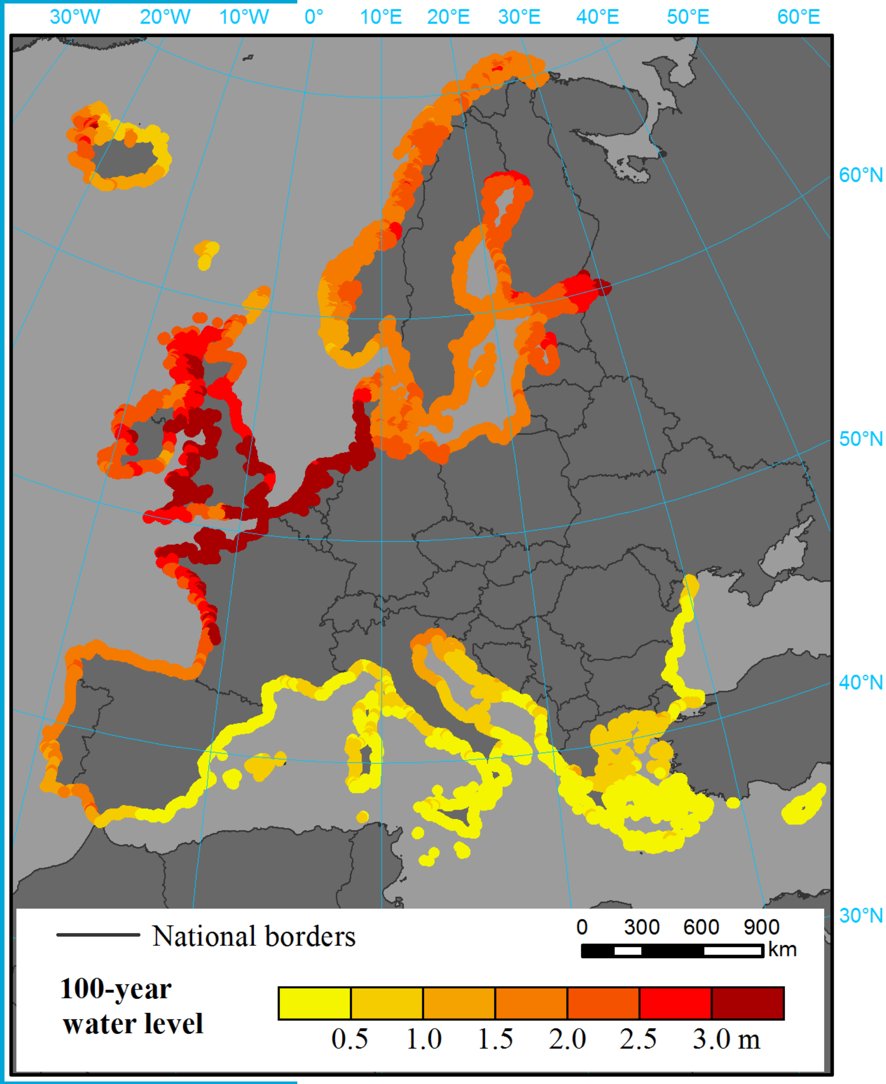
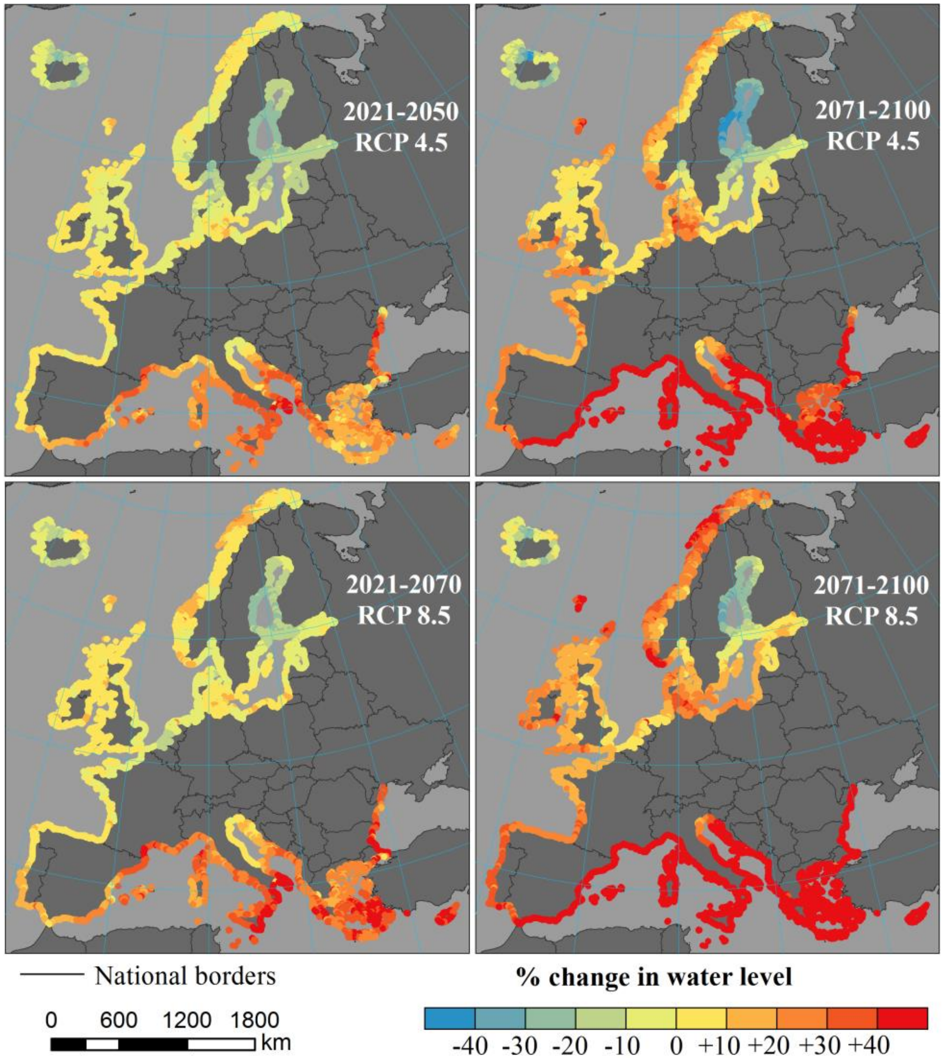
Results – extreme water level (100-year)





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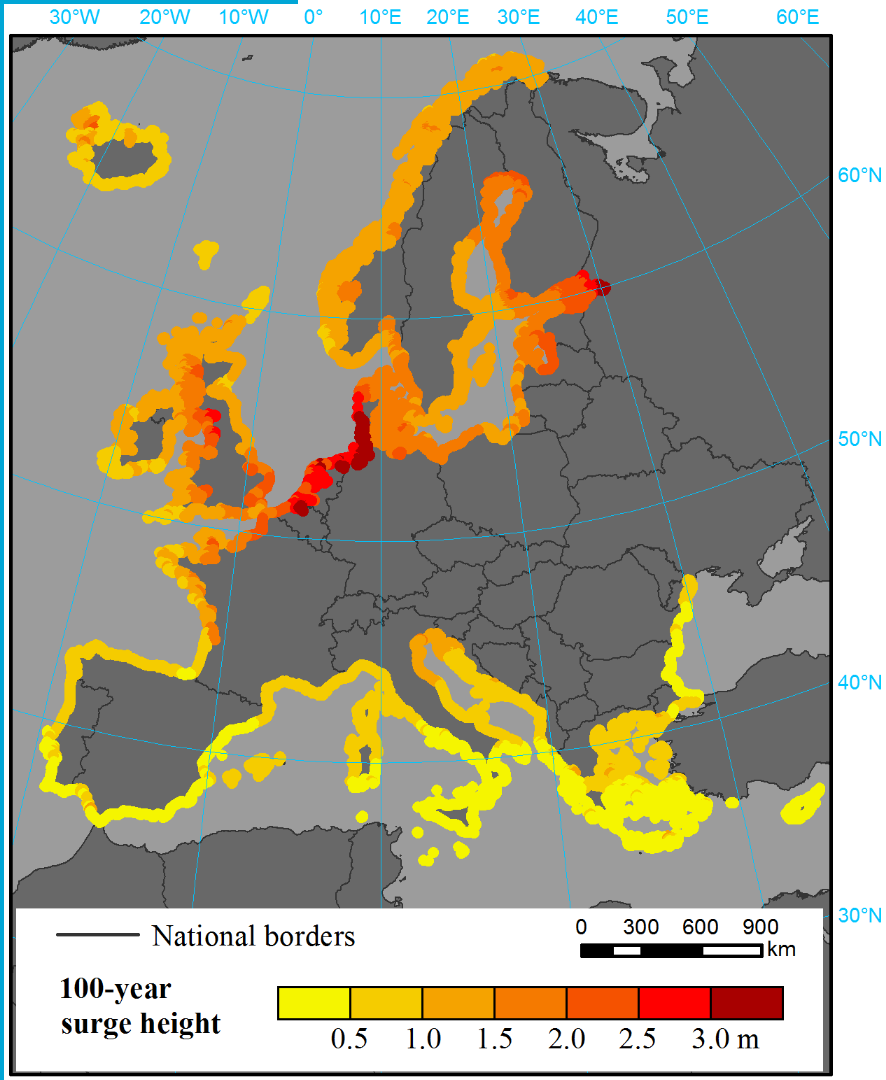

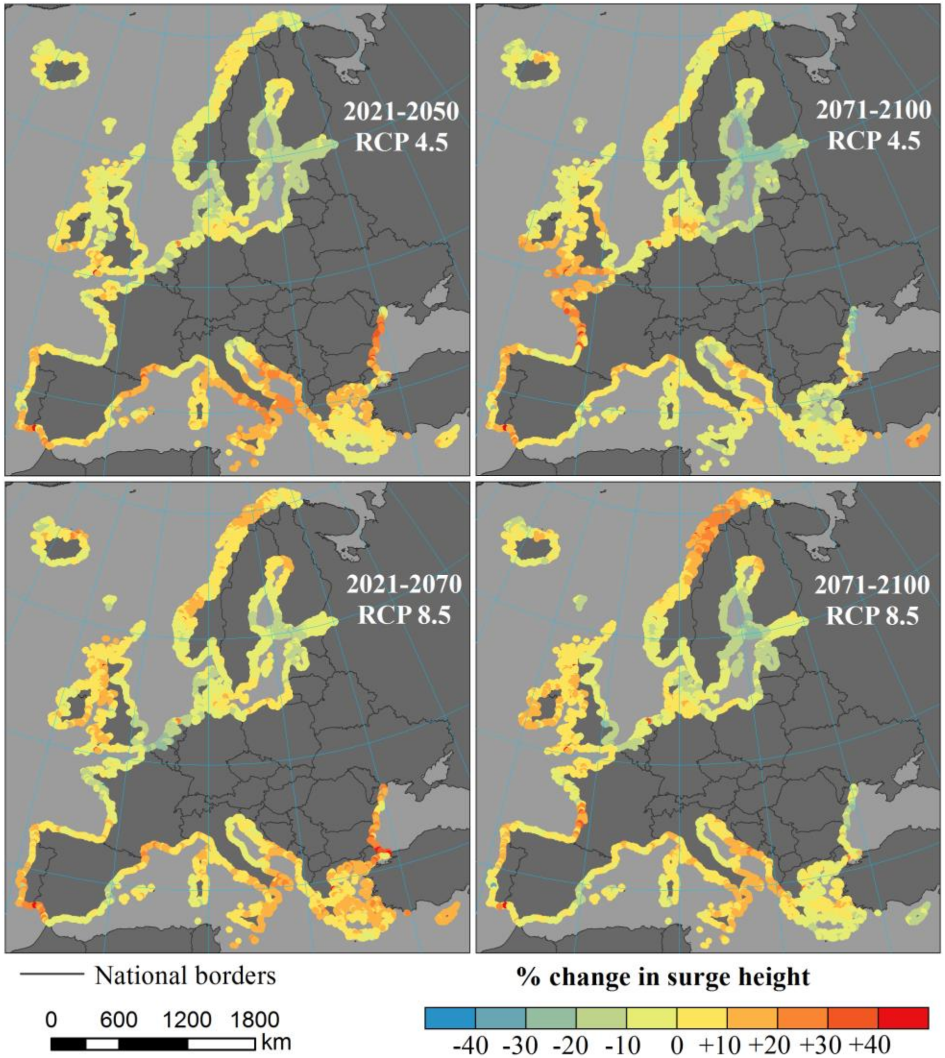

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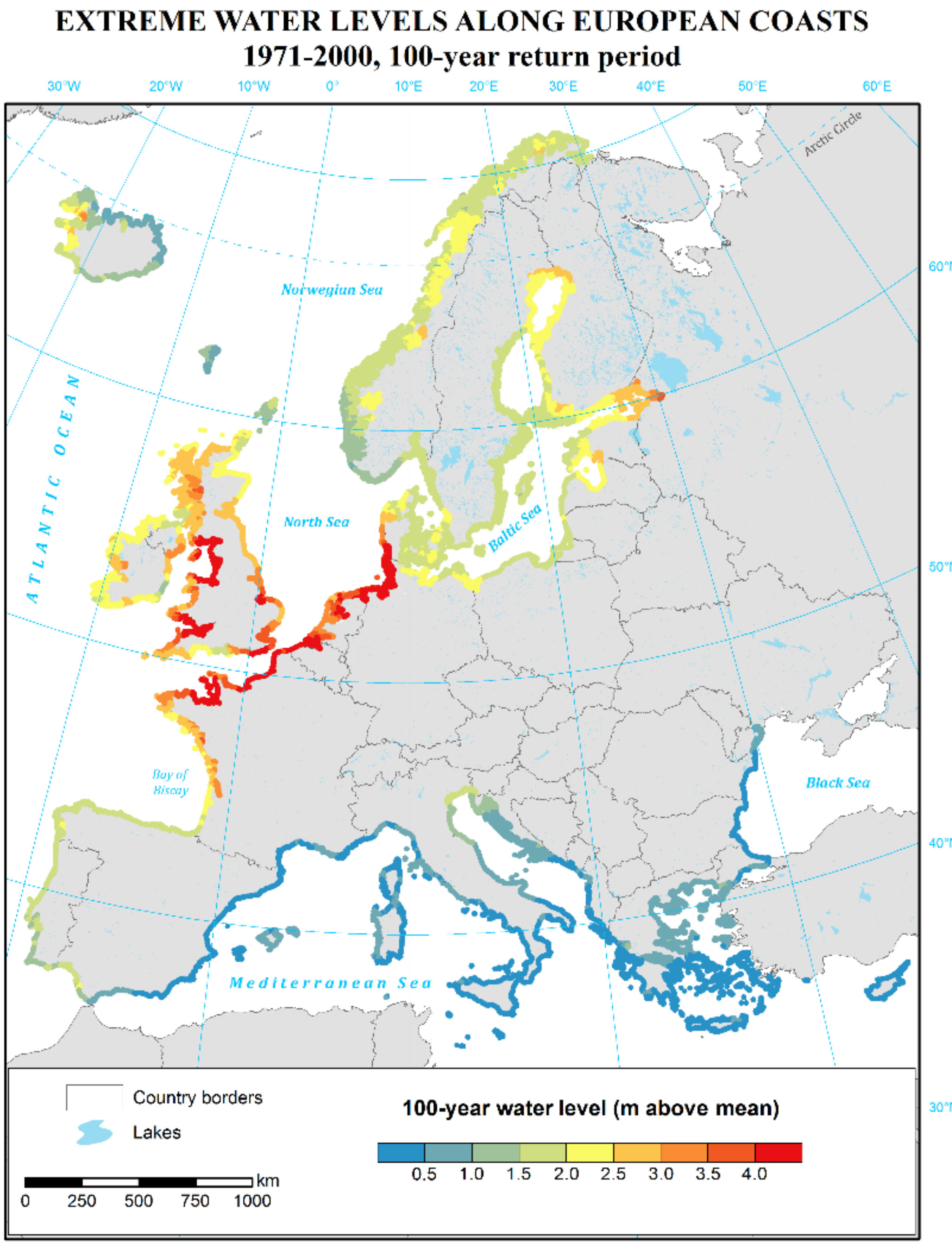
Database

Full database for 70,297 coastal segments
- 1971-2000
- 2021-2050
- 2071-2100
- RCP4.5
- RCP8.5

Data available from 4TU Data Centre

Report available at http://rain-project.eu/



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Further research

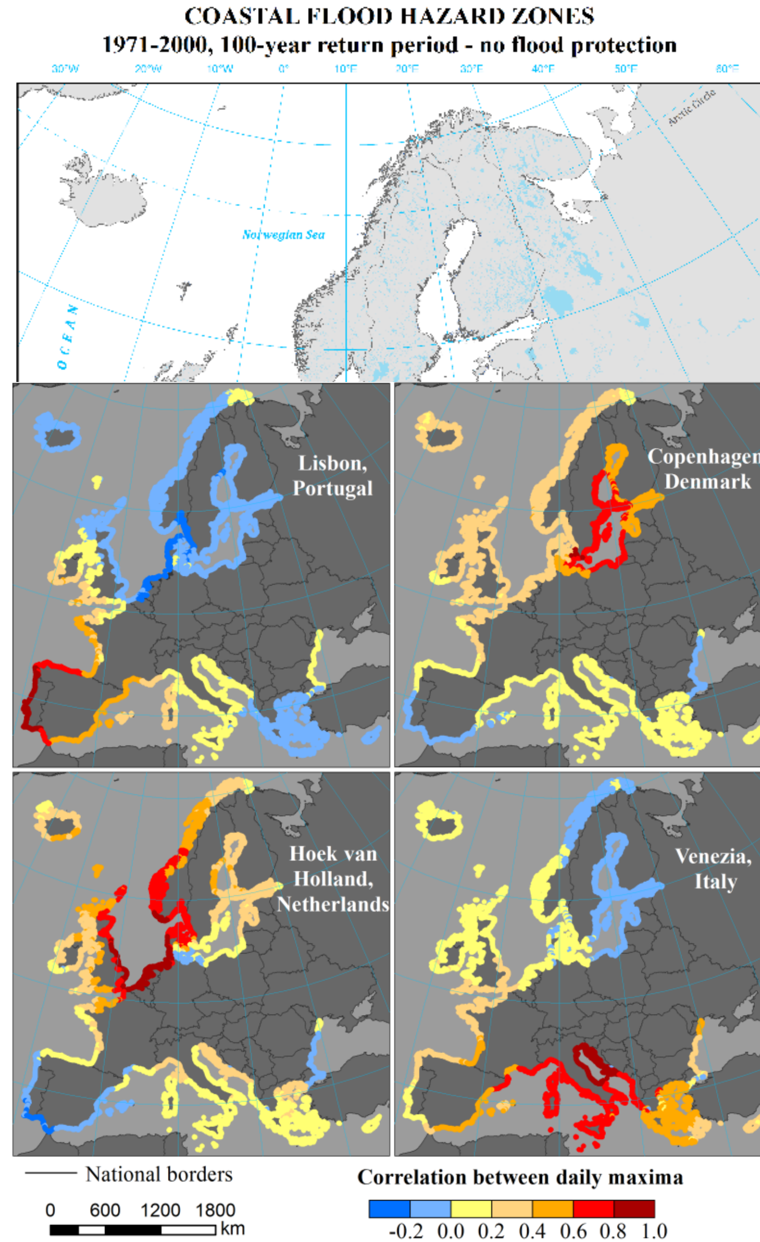
- Coastal flood analysis
- Comparison with JRC's work

Return period (years)	Joint Research Centre			This work		
	R^2	NSE	RSR	R^2	NSE	RSR
1000	0.65	0.19	1.62	0.35	0.30	0.87
100	0.71	0.21	1.62	0.74	0.69	0.56
10	0.73	0.21	1.64	0.89	0.89	0.33

- Analysis of dependencies between surges in different locations
- Application of maps in BRIGAID project

BRIGAID

BRIDGING THE GAP FOR INNOVATIONS IN DISASTER RESILIENCE



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Thank you!

Questions?

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