RISES-AM- EU Research Project

Global Climate Forum

UNIVERSITY OF Southampton

Sea level rise impacts and adaptation in Europe

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Matthew Wadey, Ivan Haigh, Jochen Hinkel, Sally Brown, Nassos Vafeidis, and RISES-AM Consortium

Conference outcome

The conference will serve as a basis for a new assessment of the state-of-the-art on regional sea level research that will be an important input to the next IPCC assessment.

A major outcome from the conference will therefore be an evaluation of the current state of sea level science, an outline of future research requirements for improving our understanding of sea level rise and variability and a description of the observational requirements (both experimental and sustained systematic observations).

The outcomes will be published in multiple forms, including an agenda setting peer-reviewed paper specifying the information on coastal seal level change required by coastal communities for adaptation and decision making purposes.

In detail the conference will:

I. Identify the key factors contributing to past, present and future regional sea level rise and variability.
II. Organize a systematic attack on the error budget of these factors.
III. Identify stakeholder needs for sea-level information for coastal planning and management purposes.
IV. Define the requirements for new and augmented research, technical development and observations consistent with the above.

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INTERNATIONAL WCRP/IOC CONFERENCE 2017

Regional Sea Level Changes and Coastal Impacts

July 10-14, 2017

THE EARTH INSTITUTE
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New York, NY, USA

For full conference program see
www.sealevel2017.org

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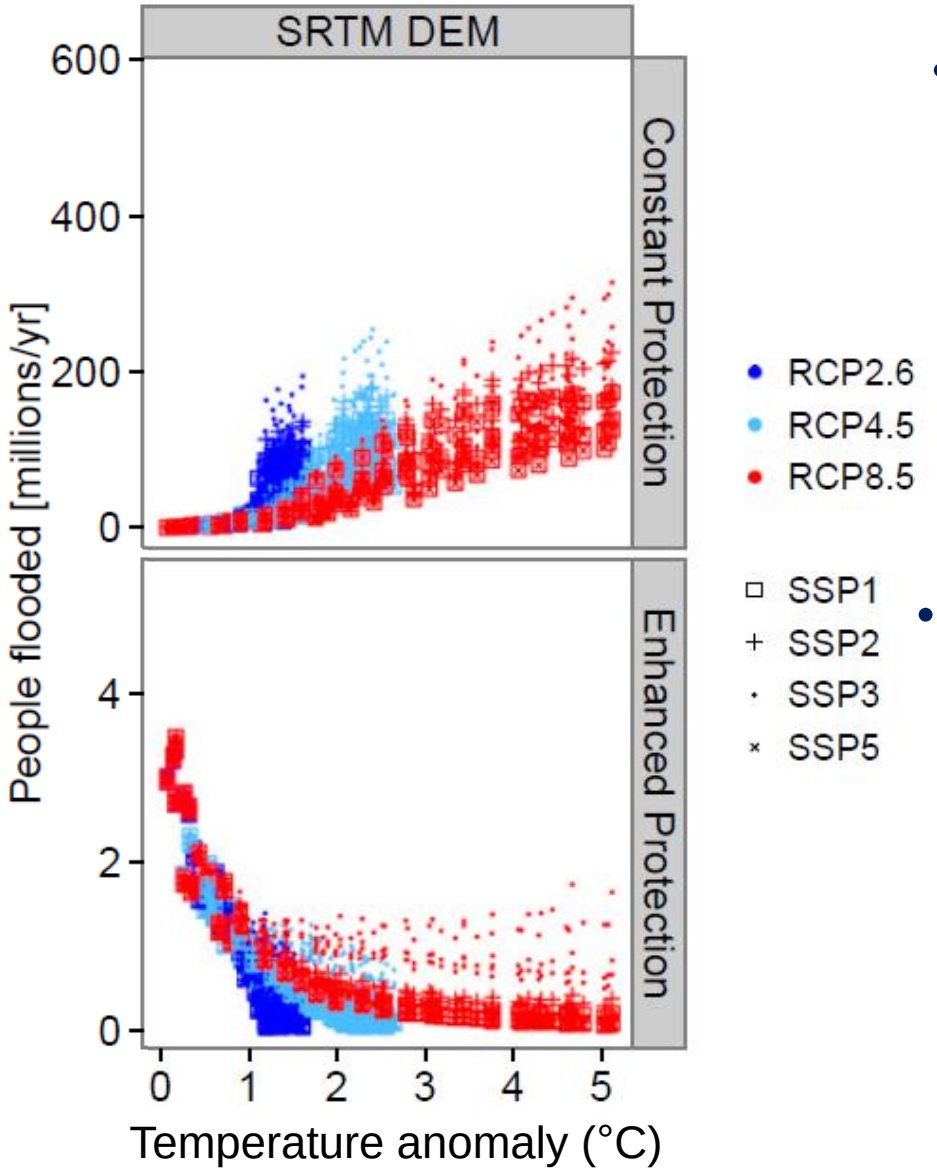
Benefits of adaptation (globally)

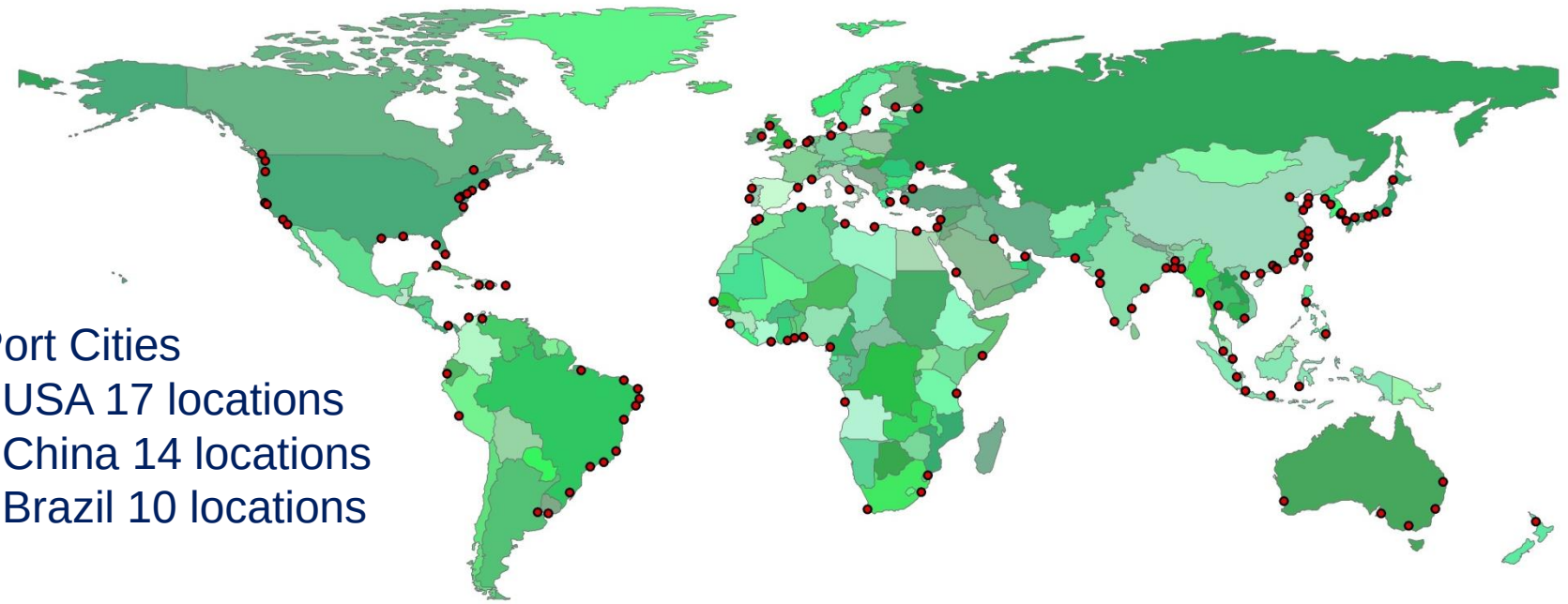


- **Without additional adaptation: The expected number of people flooded continues to grow.**
- **With additional adaptation: The number of people flooded decreases, despite, in some scenarios, a growing population.**

Hinkel et al. (2014): doi:10.1038/nclimate2505

Port City Locations

≥1 million population in 2005
136 locations



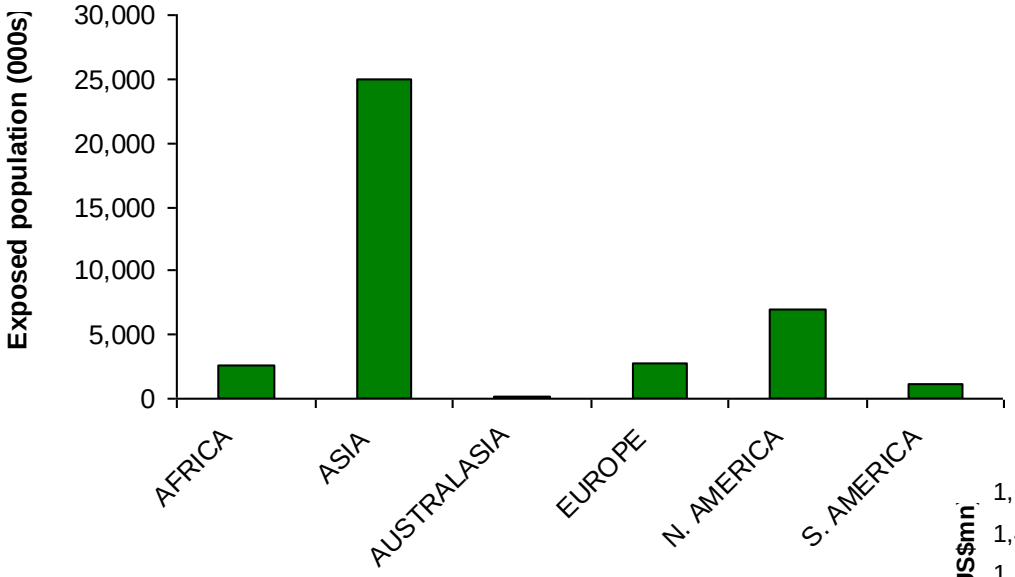
Port Cities
- USA 17 locations
- China 14 locations
- Brazil 10 locations

N 0 5,000 10,000 Kilometers

Key global results for the flood plain
- 40 million people
  - 0.6% of global population
  - (10% of port city population)
- US $3000 billion of assets
  - 5% of global GDP

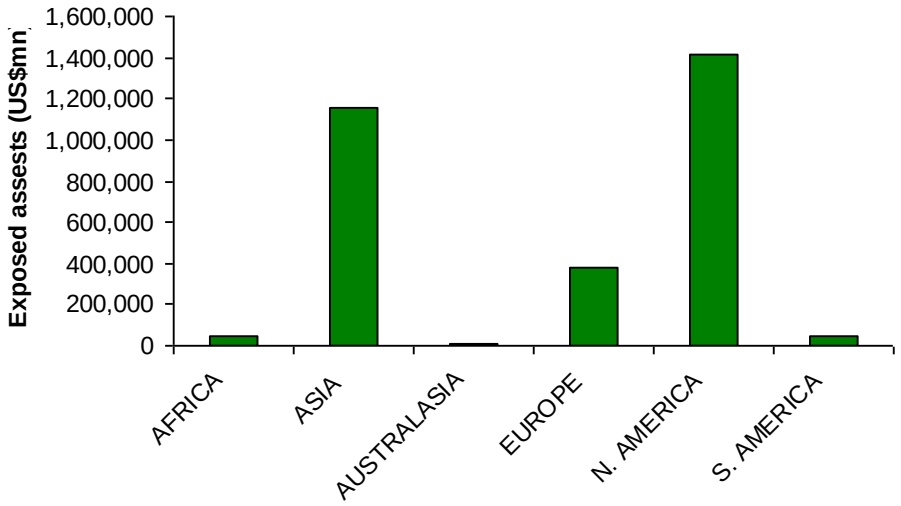
Nicholls et al., 2008

Port City Exposure by Continent in 2005



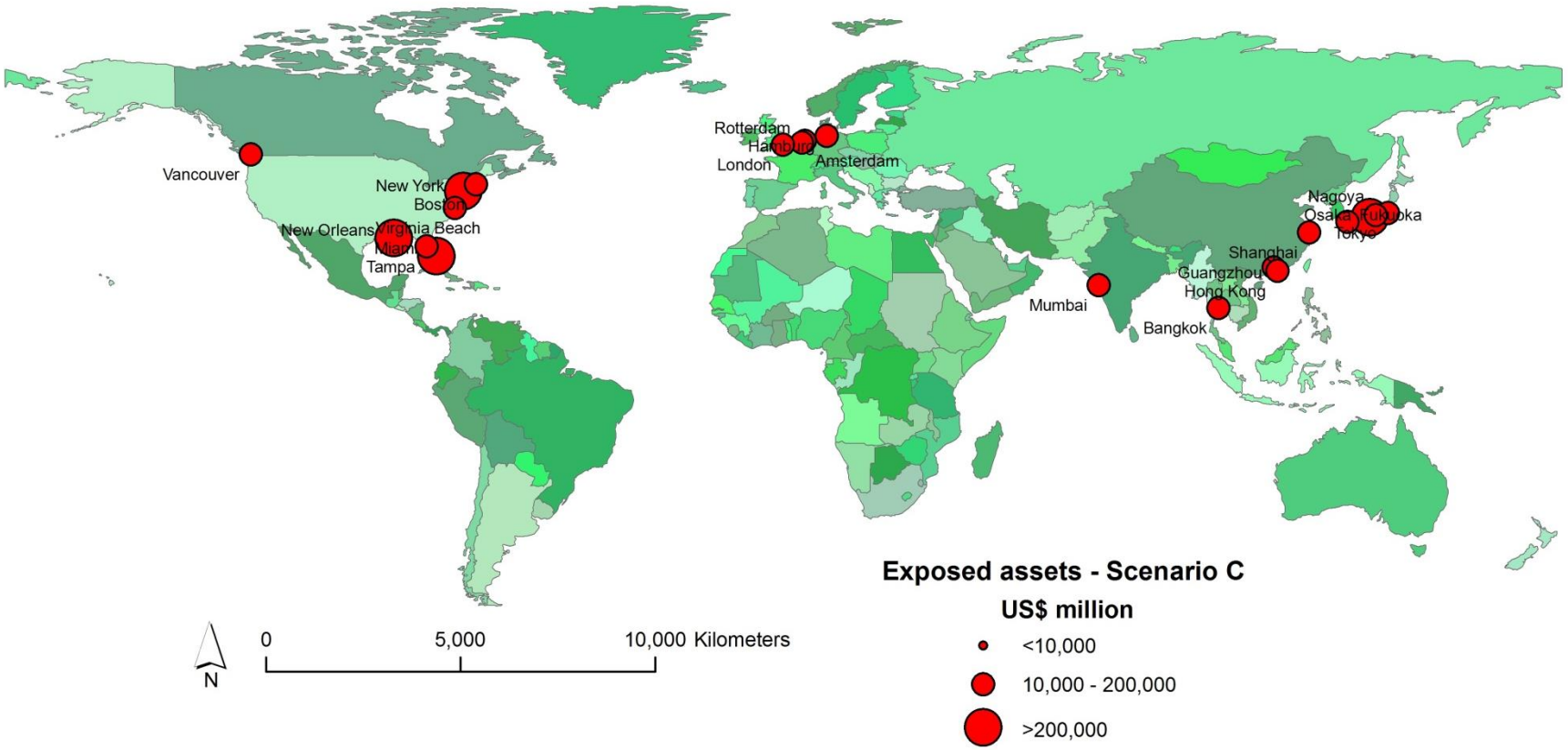
(a) Population

(b) Assets



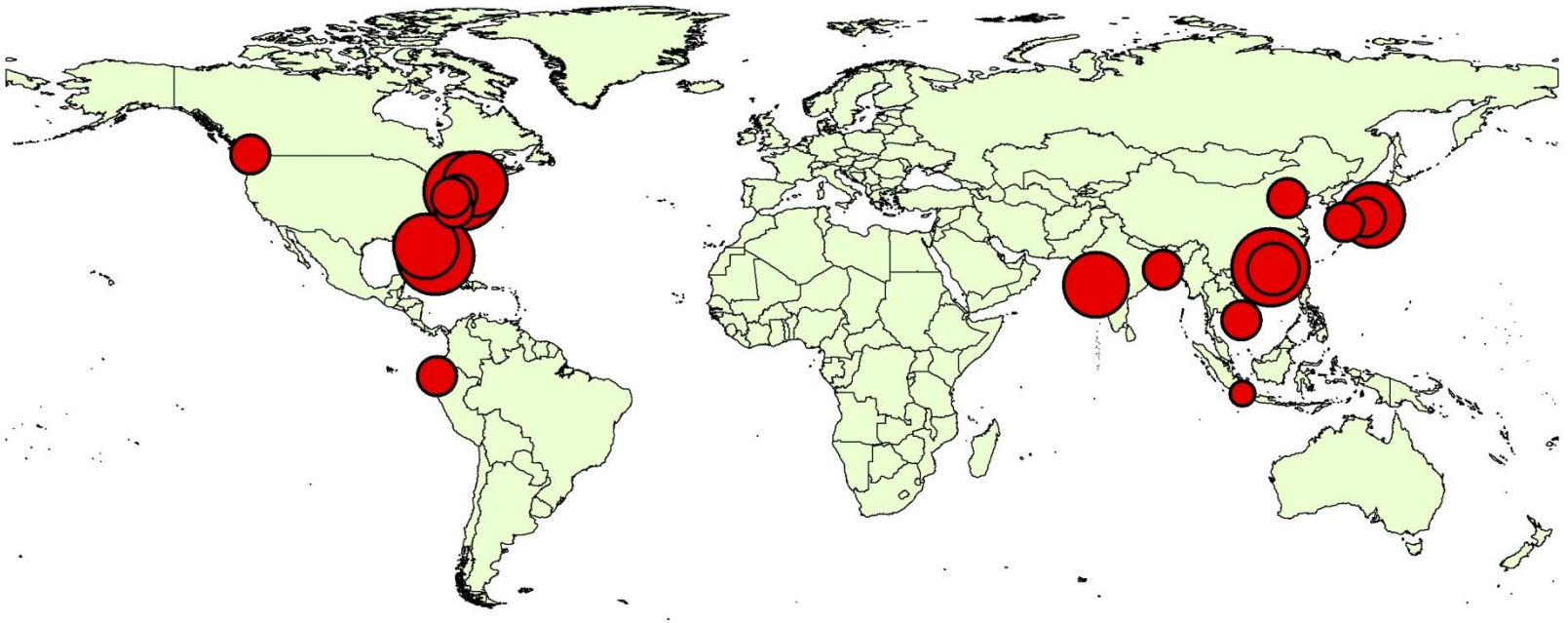
Nicholls et al., 2008

Exposed Assets 2005
Top 20 Coastal Cities Worldwide



Nicholls et al., 2008

Expected annual losses 2005
Top 20 Coastal Cities – Absolute Losses



Top 20 cities ranking by risk, with protection in 2005.
Average annual losses. Millions US dollars.

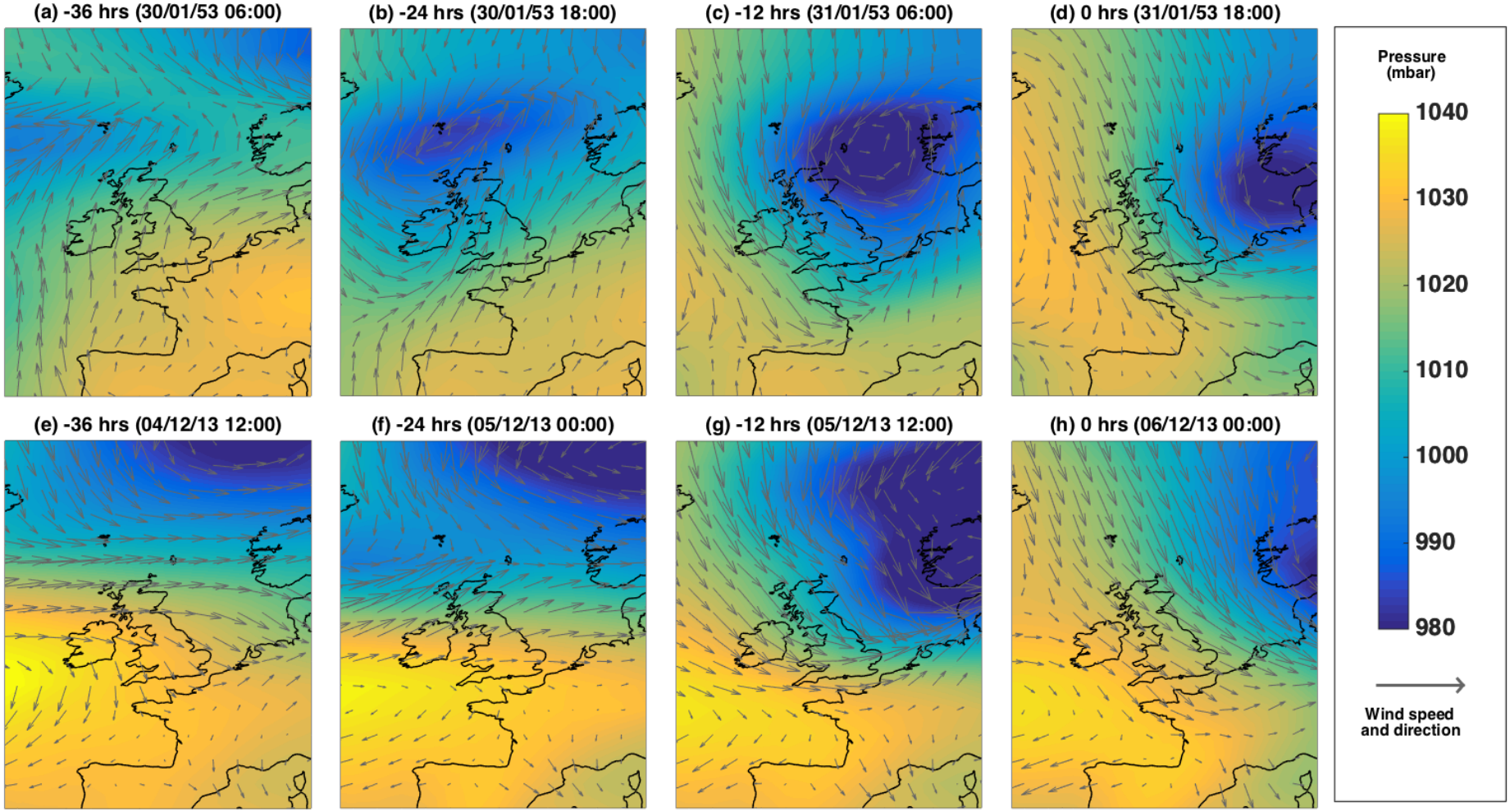
< 75 | 76 - 150 | 151 - 225 | 226 - 300 | > 300

Hallegatte et al., 2013

Hallegatte et al (2013)
Conclusions for Global Coastal Cities by 2050

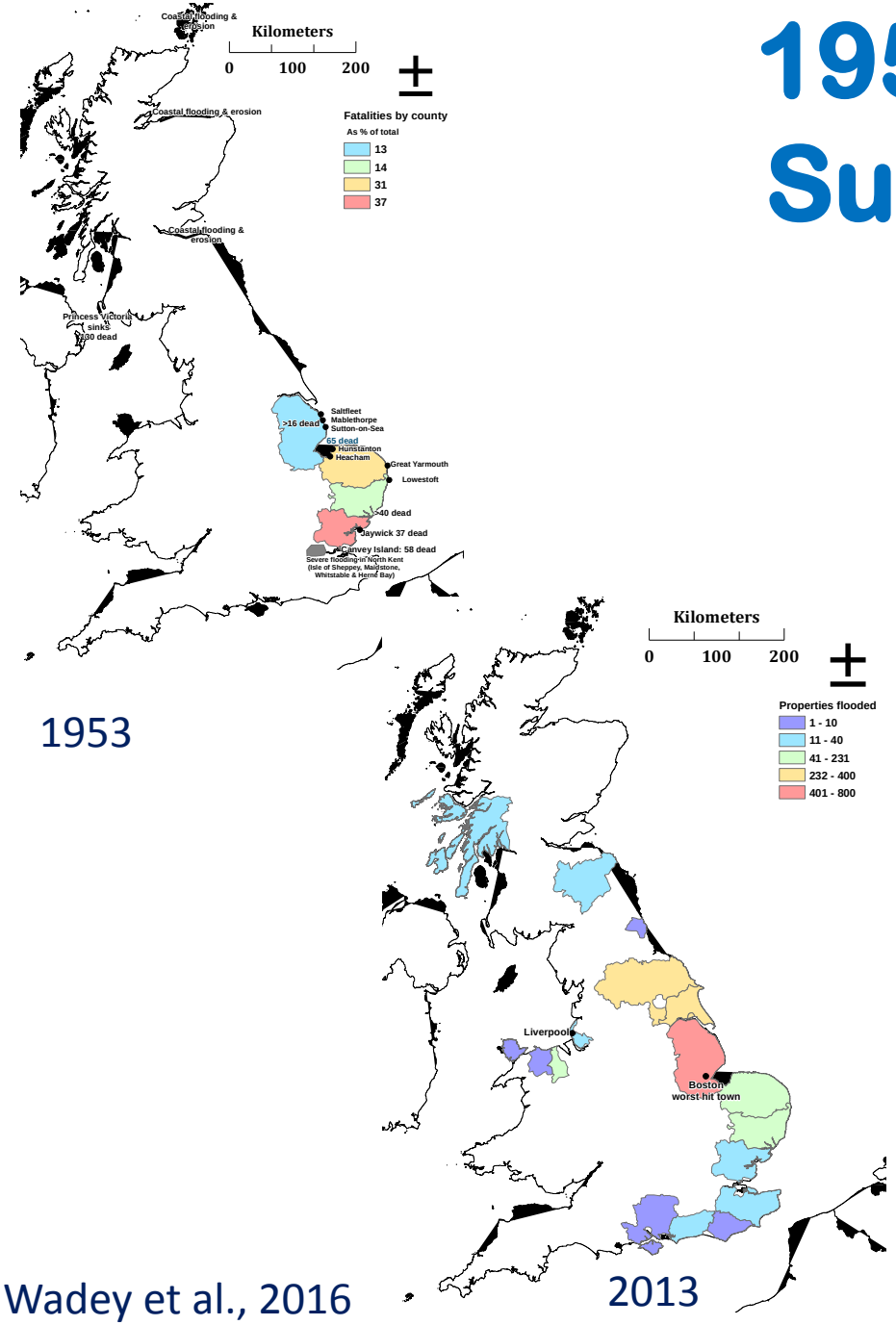
- With climate change and subsidence, present protection will need to be upgraded to avoid unacceptable losses (of US$1 trillion or more per year).
- Even if adaptation investments maintain constant flood probability, subsidence and sea-level rise will increase global flood losses substantially (to US$60–63 billion per year). To maintain present flood risk, adaptation will need to reduce flood probabilities below present values.
- In this case, the magnitude of losses when floods do occur would increase, often by more than 50%, making it critical to also prepare for larger disasters than we experience today. This is an expression of residual risk.

Recent Extreme Events in Europe Jan/Feb 1953 vs. Dec 2013 Surges



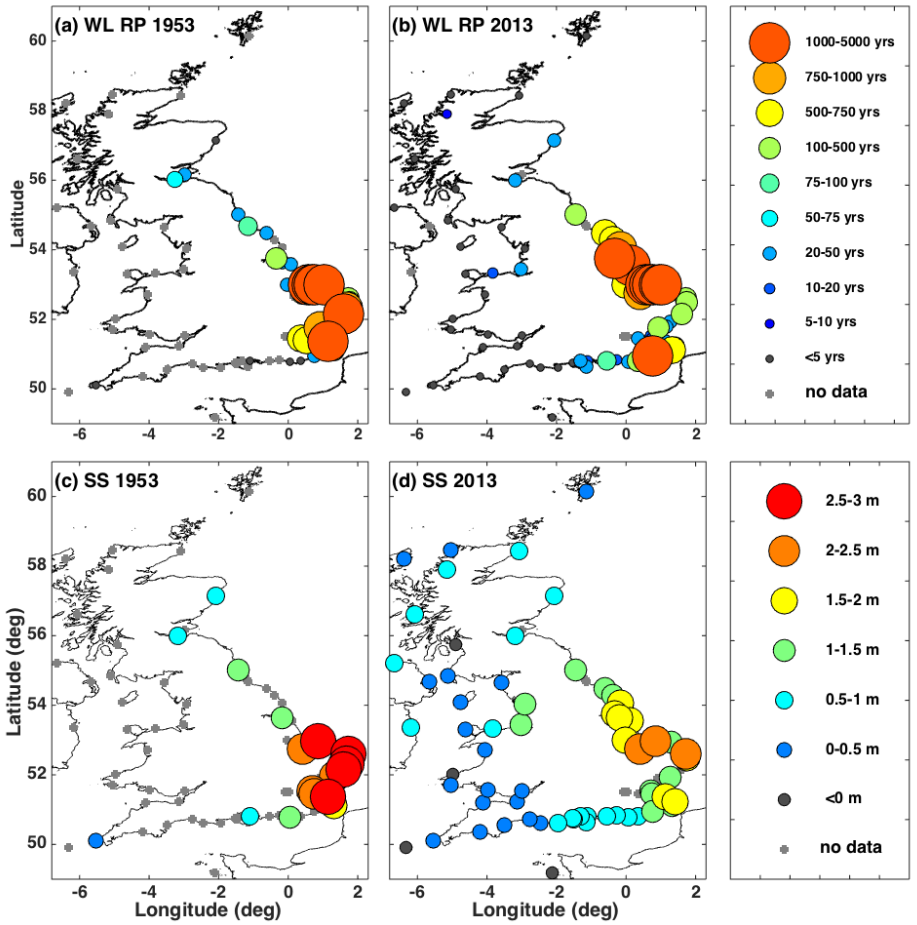
Wadey et al., 2016

1953 vs. 2013 Surge Events



1953

2013



WL – Water Level; SS – Storm Surge

Wadey et al., 2016

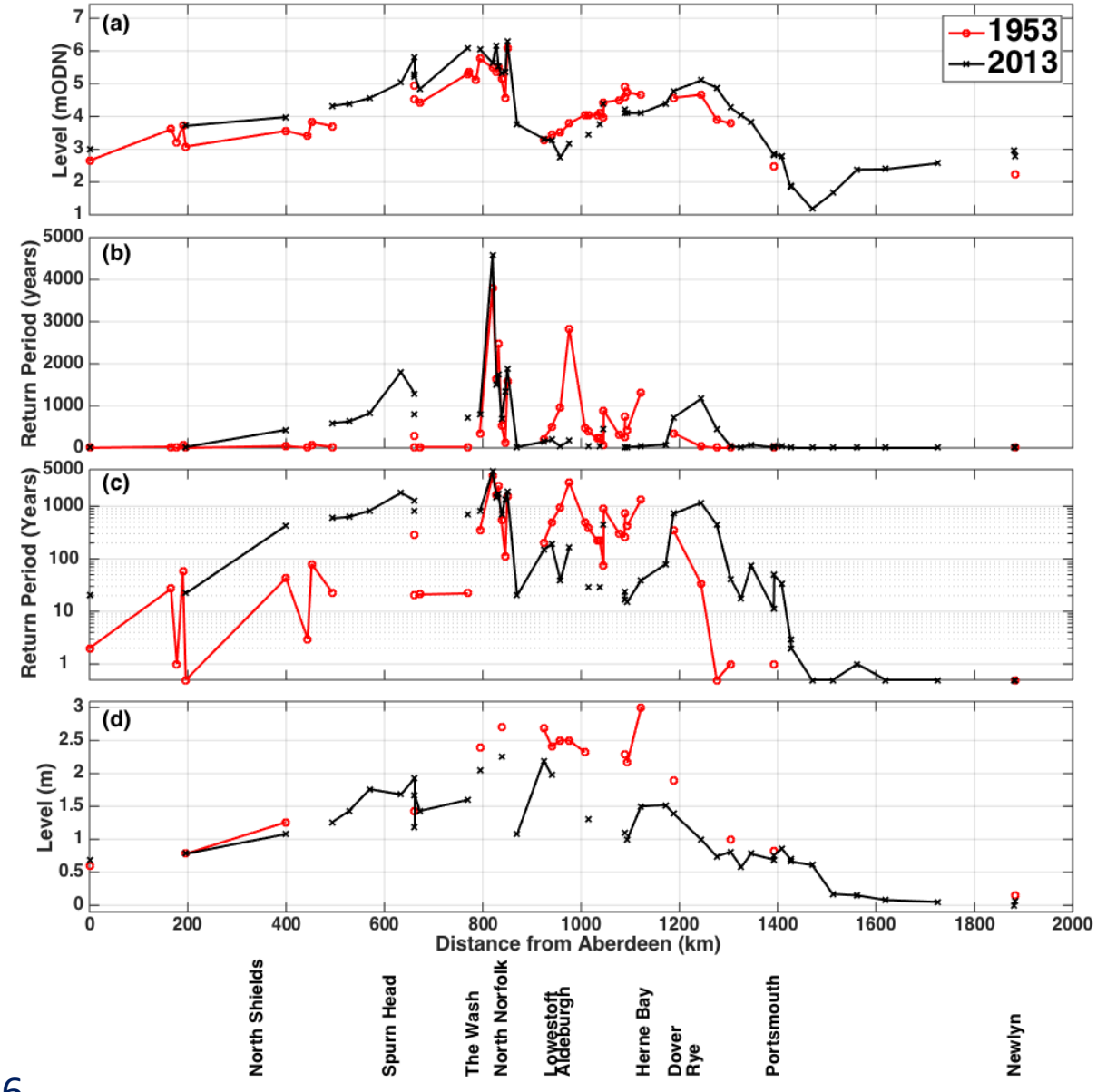
1953 vs. 2013 Surge Events

Water Level

Return Period

Return Period

Skew Surge



Wadey et al., 2016

1953 vs. 2013 Surge Impacts

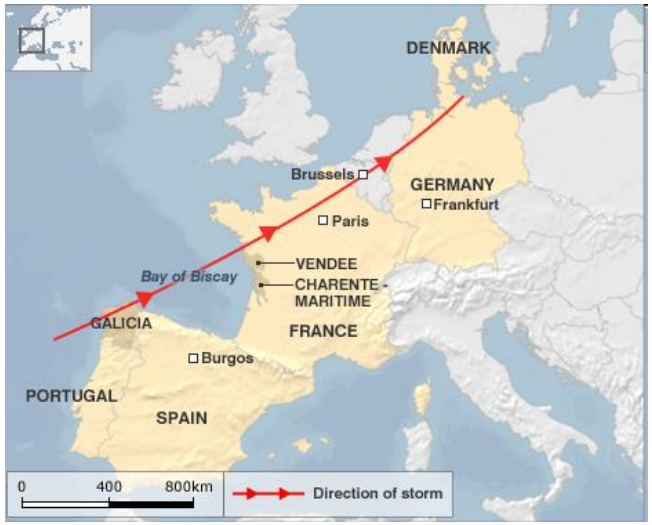
(UK only)

Wadey et al., 2016

IMPACT CATEGORY	1953	2013
DEATHS (FLOOD RELATED)	307	0
PEOPLE EVACUATED	32,000	18,000
PROPERTIES FLOODED	24,000	2,800
DEFENCE BREACHES	1200	< 50
LAND INUNDATED (KM^2)		
AGRICULTURE	650	68
TOTAL	834	N/A
INDUSTRIAL SITES INUNDATED	200	N/A
LIVESTOCK	47,000 cattle 140,000 poultry	<100 cattle 700,000 poultry
ENERGY SUPPLY	2 power stations, 12 gas works	1 electricity sub-station
PORTS IMPACTED	Tilbury, Felixstowe	Immingham
TRANSPORT IMPACTS (KM)		
ROADS	160	160
RAILWAYS	320	200
COST (£ BILLIONS)	1.2	0.25

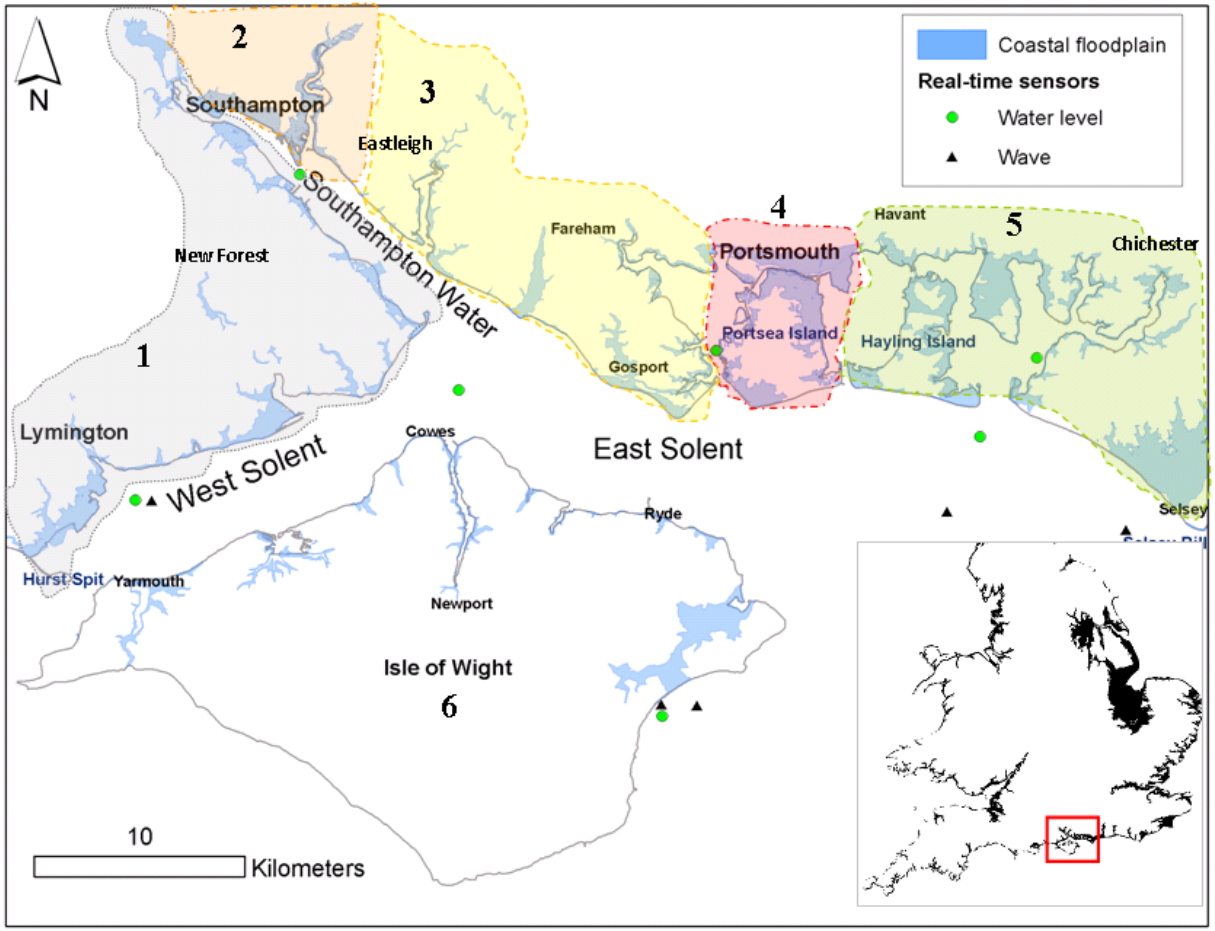
Cyclone Xynthia, France, 2010

Atlantic Storm ‘Xynthia’: 1.5m surge and large waves
~60 dead, lack of emergency planning & warning



Case Study: The Solent, UK

- Historically prone to flooding (Ruocco et al, 2011)
- 25,000 properties exposed to a 1 in 200 year coastal flood event
- Approx. half exposure in Portsmouth



Wadey et al., 2012

Solent Floods: 10 March 2008


Warsash (Fareham)


Hythe


Woodmill Outdoor Centre


Beaulieu

Priory Road, St Denys

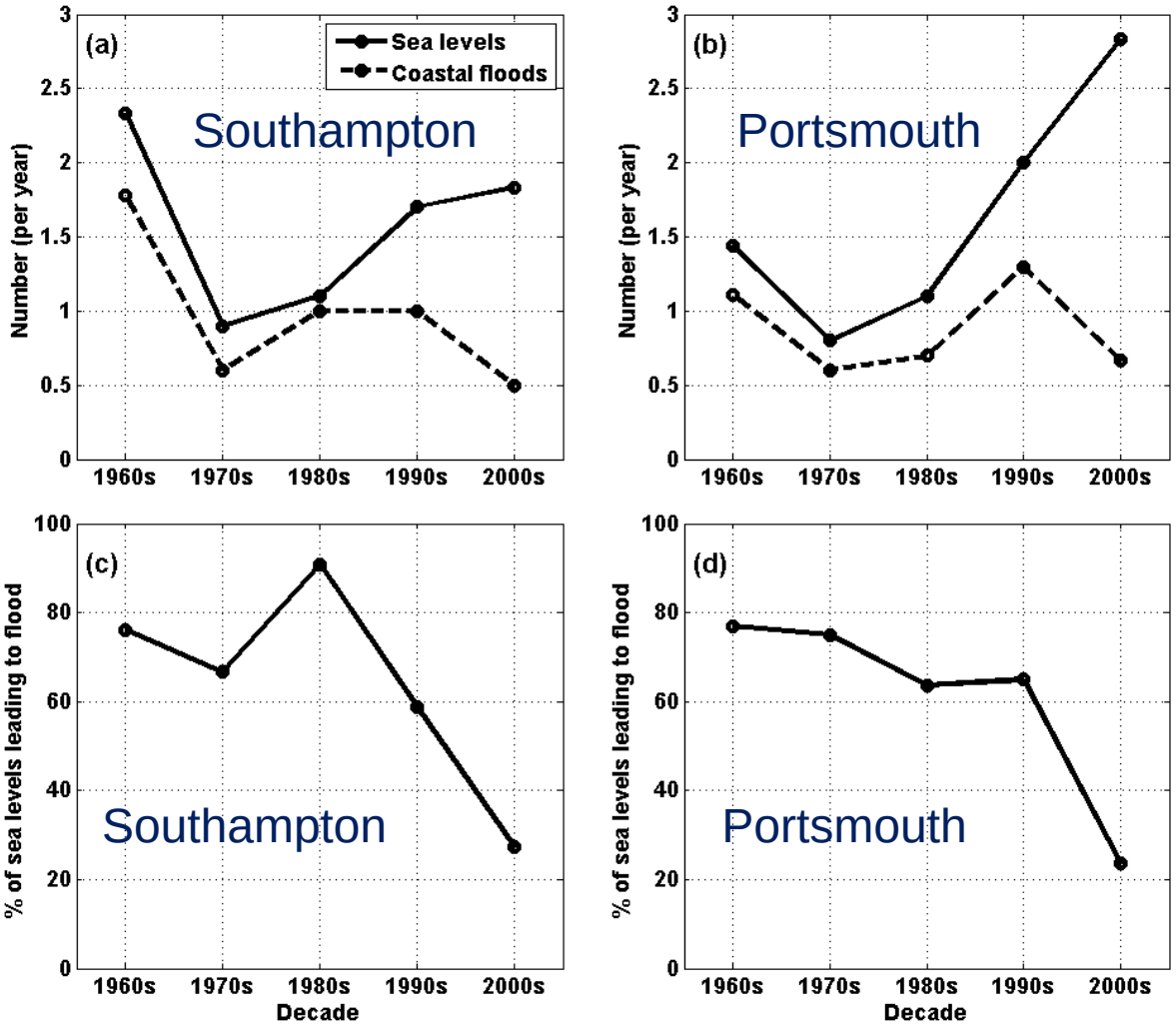
Photos from EA, (2010)

Solent Floods: 10 March 2008

Yarmouth

Floating Bridge, West Cowes

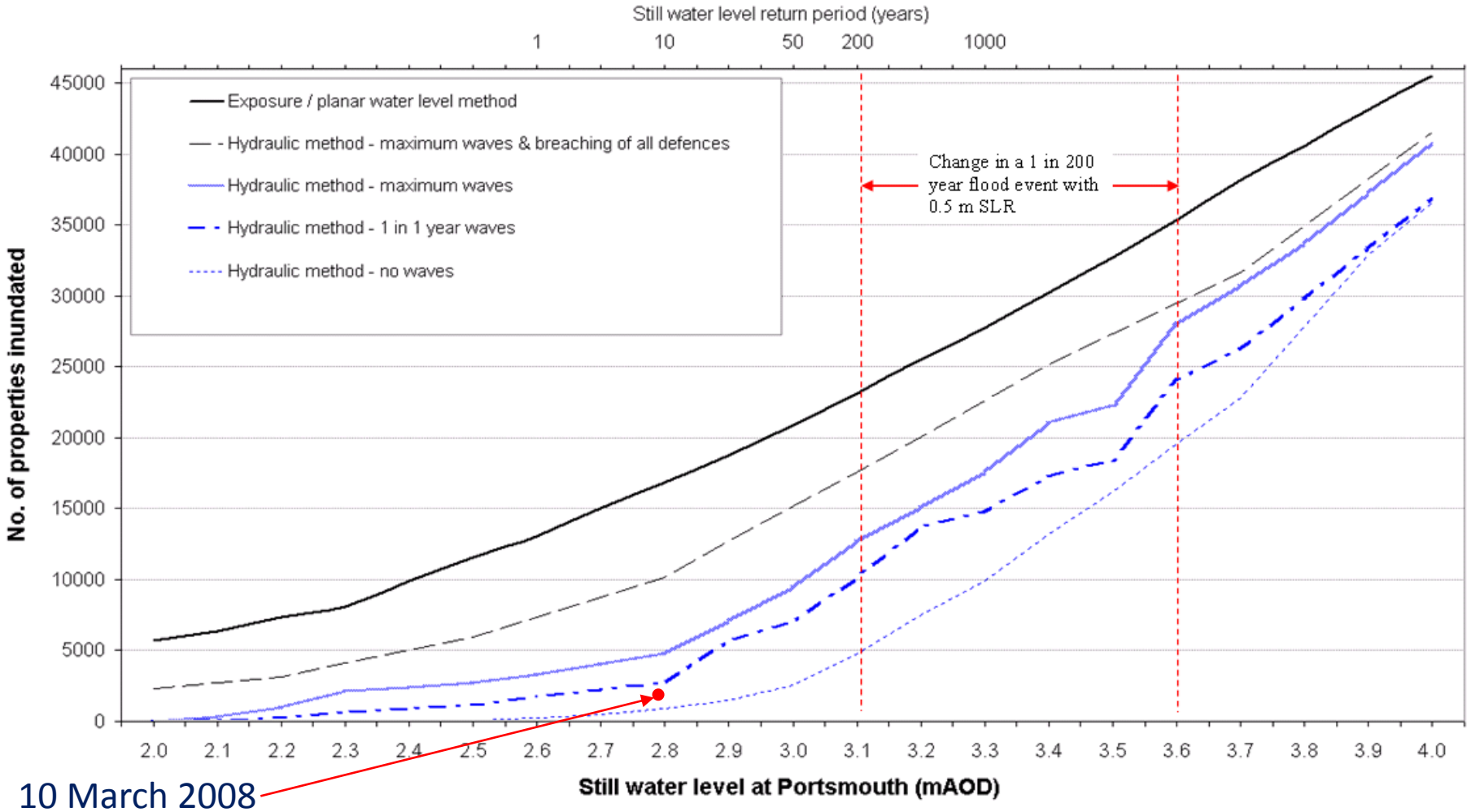
Extreme Sea Levels and Floods in the Solent



Ruocco et al., 2011

Modelled Flood Events in the Solent

Loads & failure mechanisms vs. number of properties flooded to positive depth (> 0 metres)



Wadey et al., 2012

Conclusions

- Europe has relatively high exposure globally, especially in north-west Europe.
- Risk (expected annual damages, risk to life, etc.) is globally low and we seem to be coping with current challenges.
- However, residual risk remains a challenge and “surprises” such as Xynthia are inevitable without a strongly proactive approach to adaptation.
- This will be true even with strong mitigation – but the rates of change will be slower and give more time to prepare.
- The challenge is to consider:
  (1) How to move from reactive to proactive management making full use of our simulation capabilities to explore future states;
  (2) Residual risk in meaningful ways;
  (3) The range of potential change beyond 2100 – the notion of coastal adaptation being a multi-step process.

Key Sources

- RISES-AM Briefing Note European (EU28) Policy For Coastal Adaptation Under Extreme Climate Scenarios. http://www.risesam.eu/
- SurgeWatch -- A Database Of UK Coastal Flood Events https://www.surgewatch.org/

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