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Impacts and costs of sea-level rise: A focus on Europe

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Drawing on work with: Robert Nicholls, Jochen Hinkel, Nassos Vafeidis, Paul Watkiss, Jason Lowe, Anne Pardaens, Susan Hanson, Abiy Kebede, Barbara Neumann, Colin Woodroffe

Examples of extreme events

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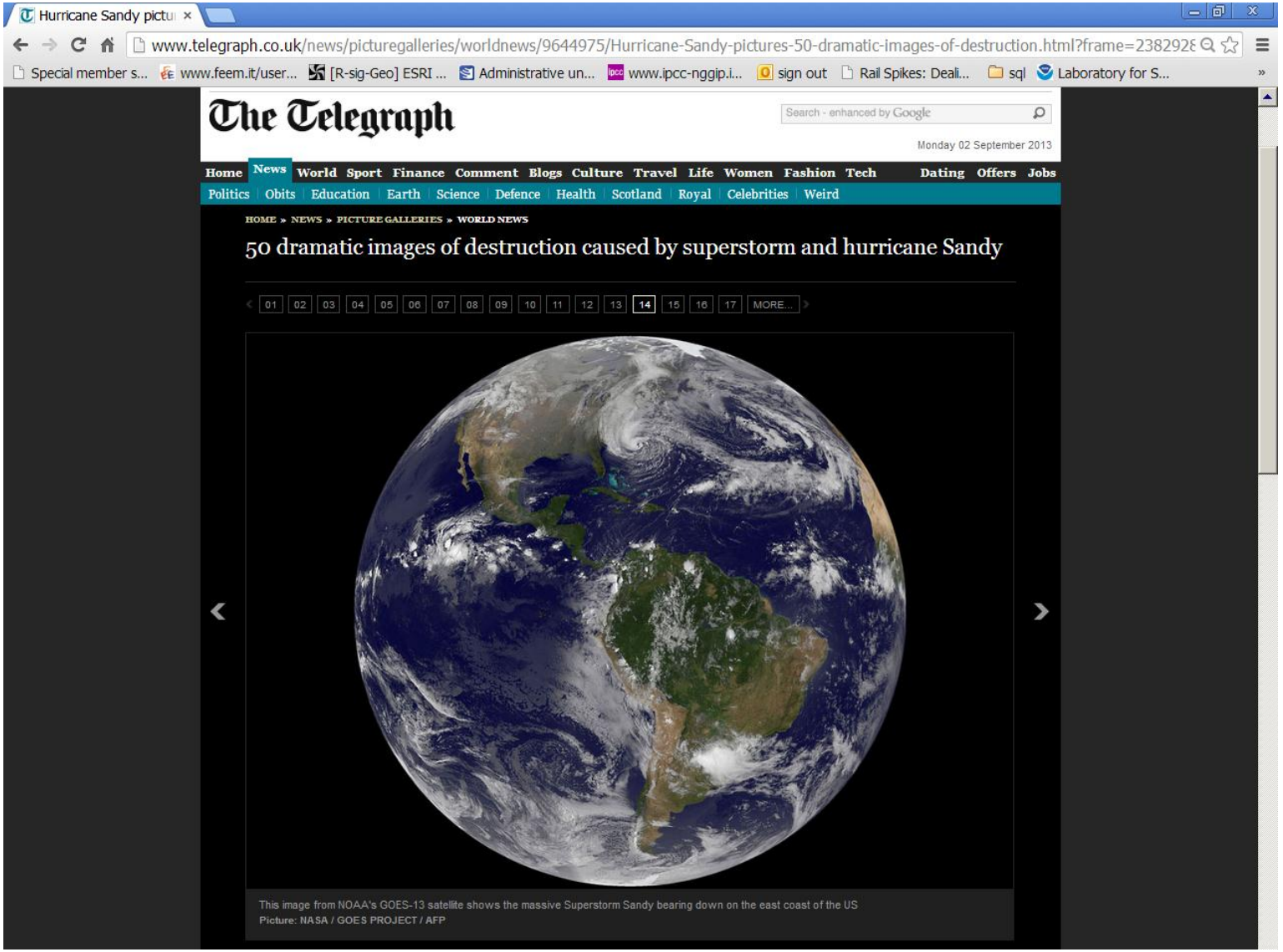

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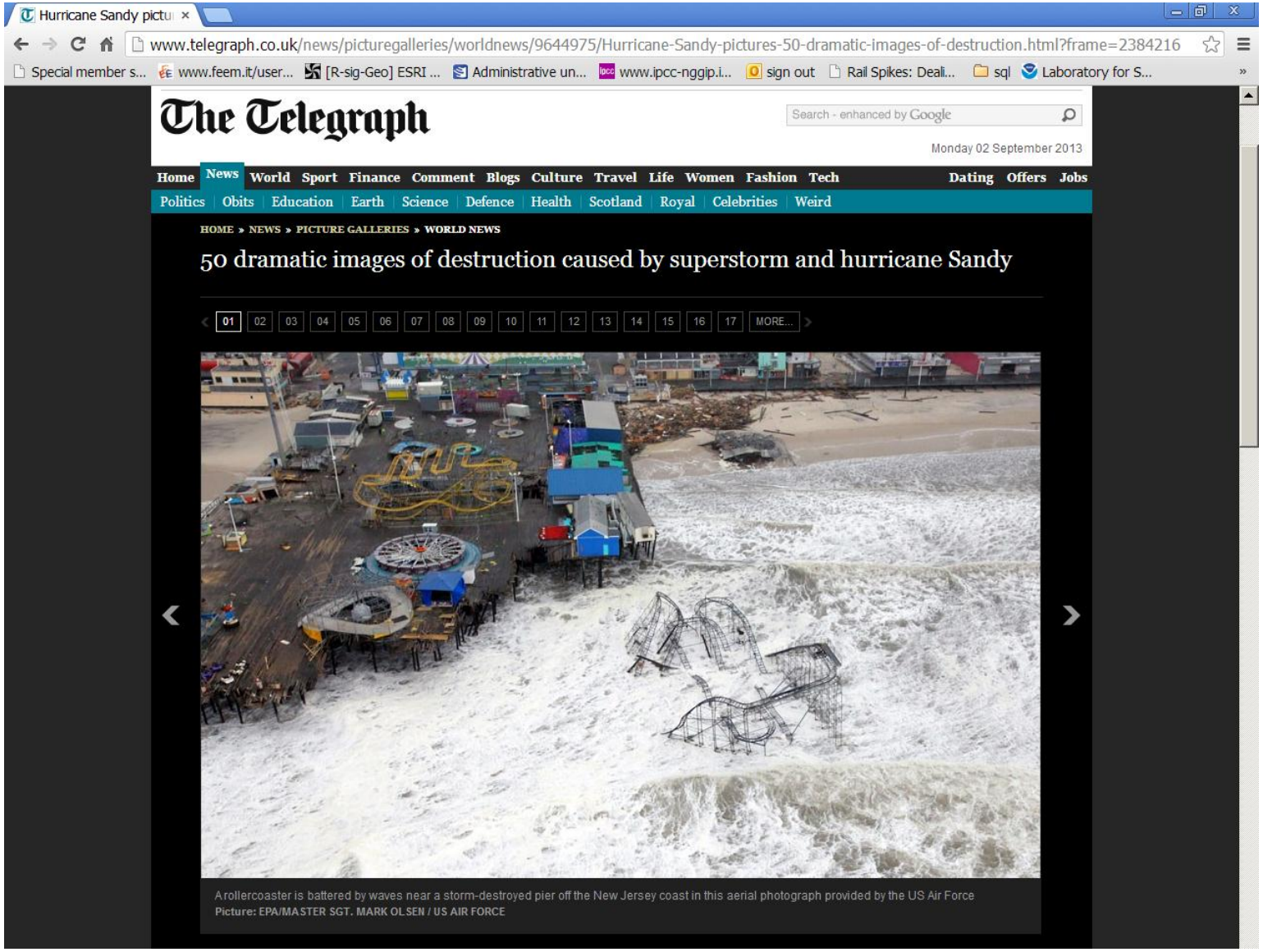

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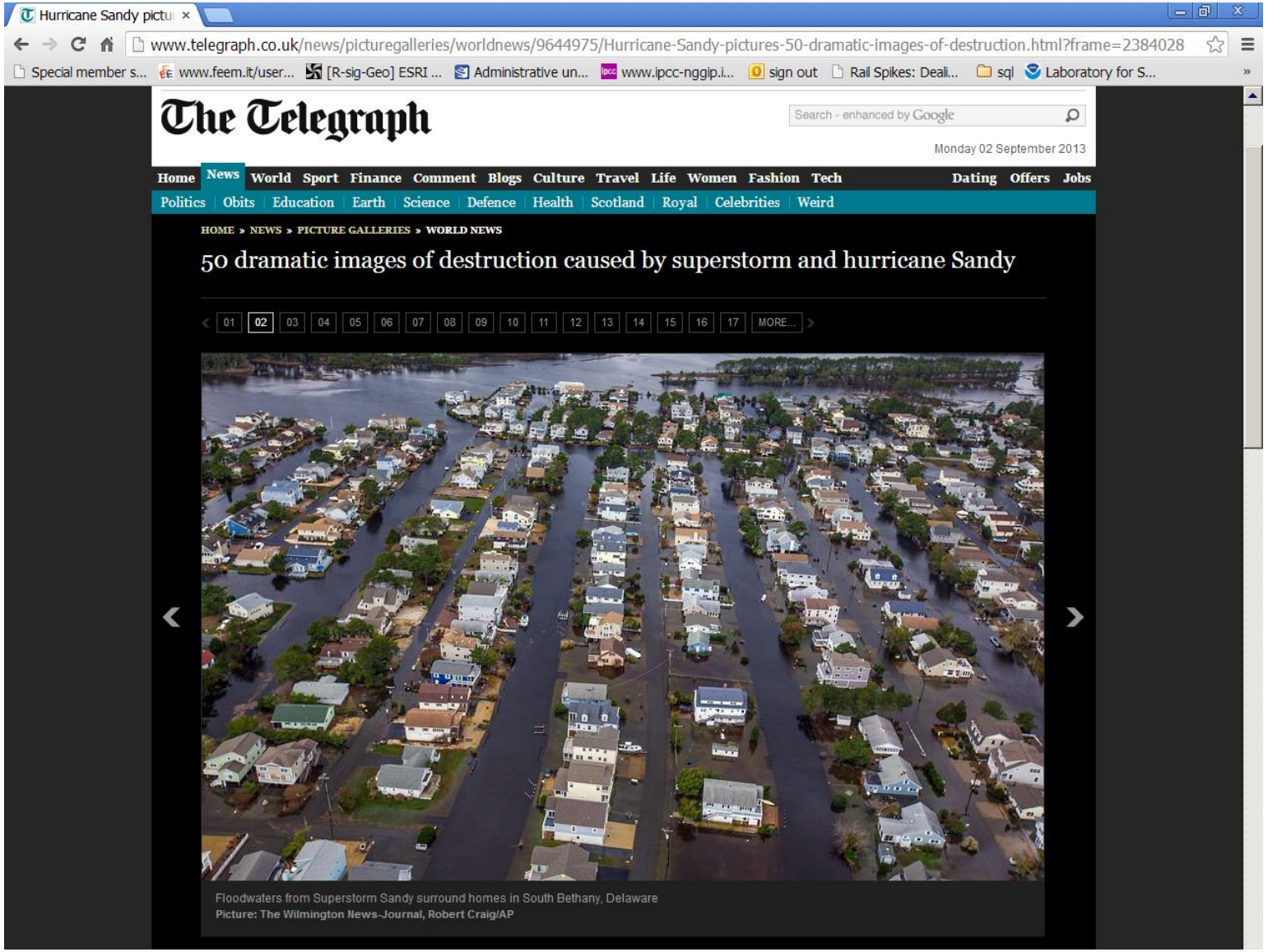

Examples of extreme events

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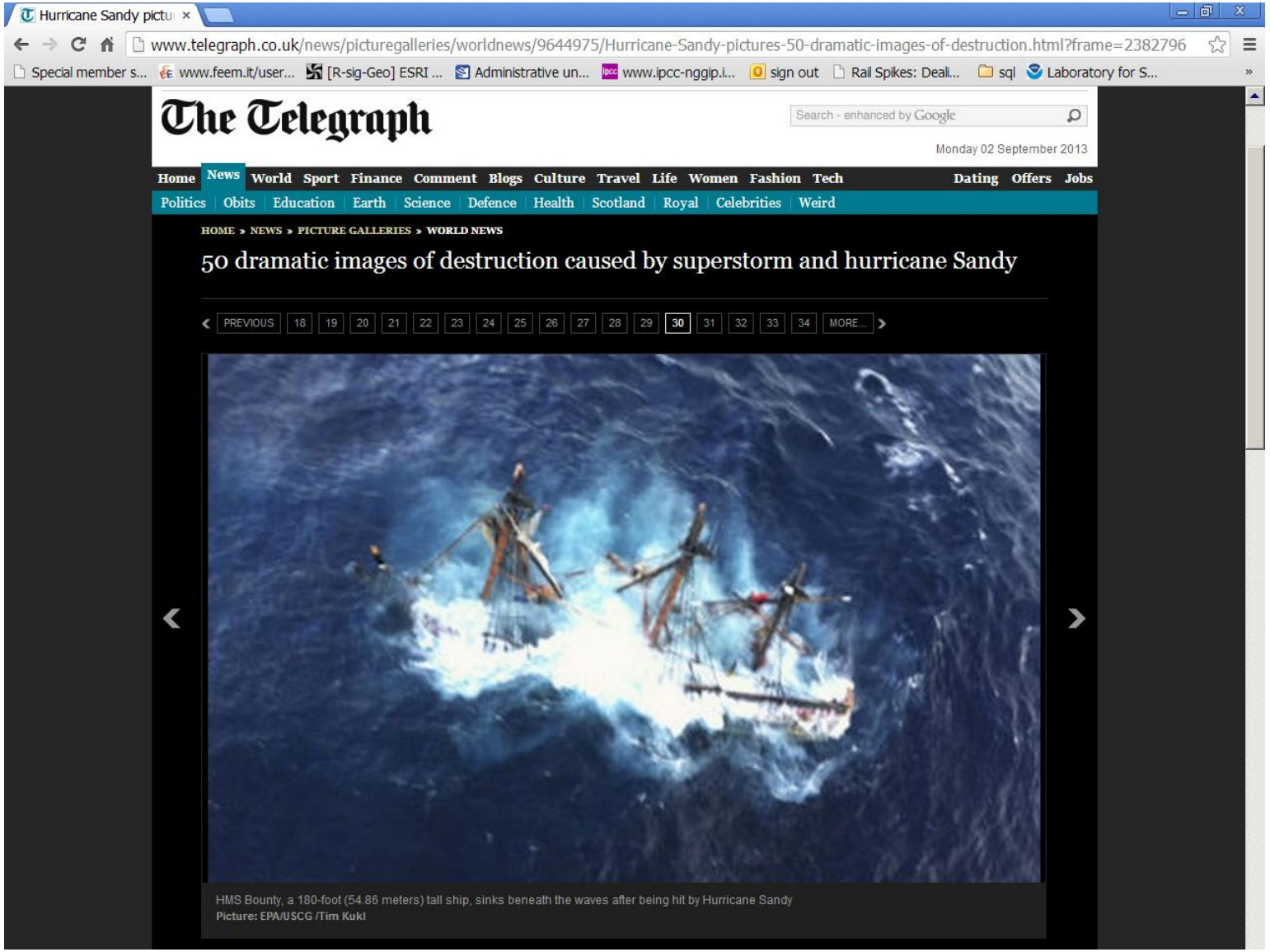

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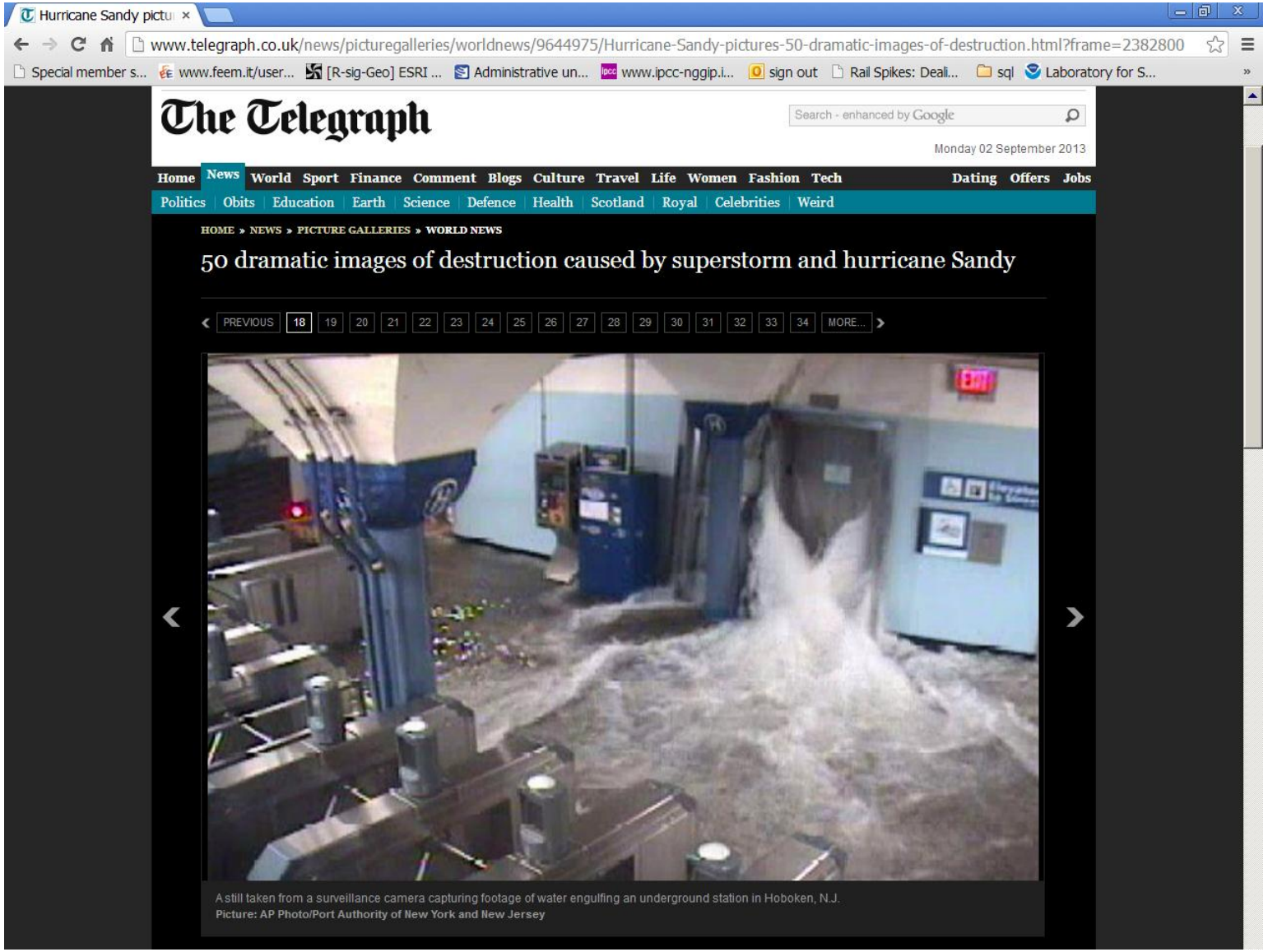

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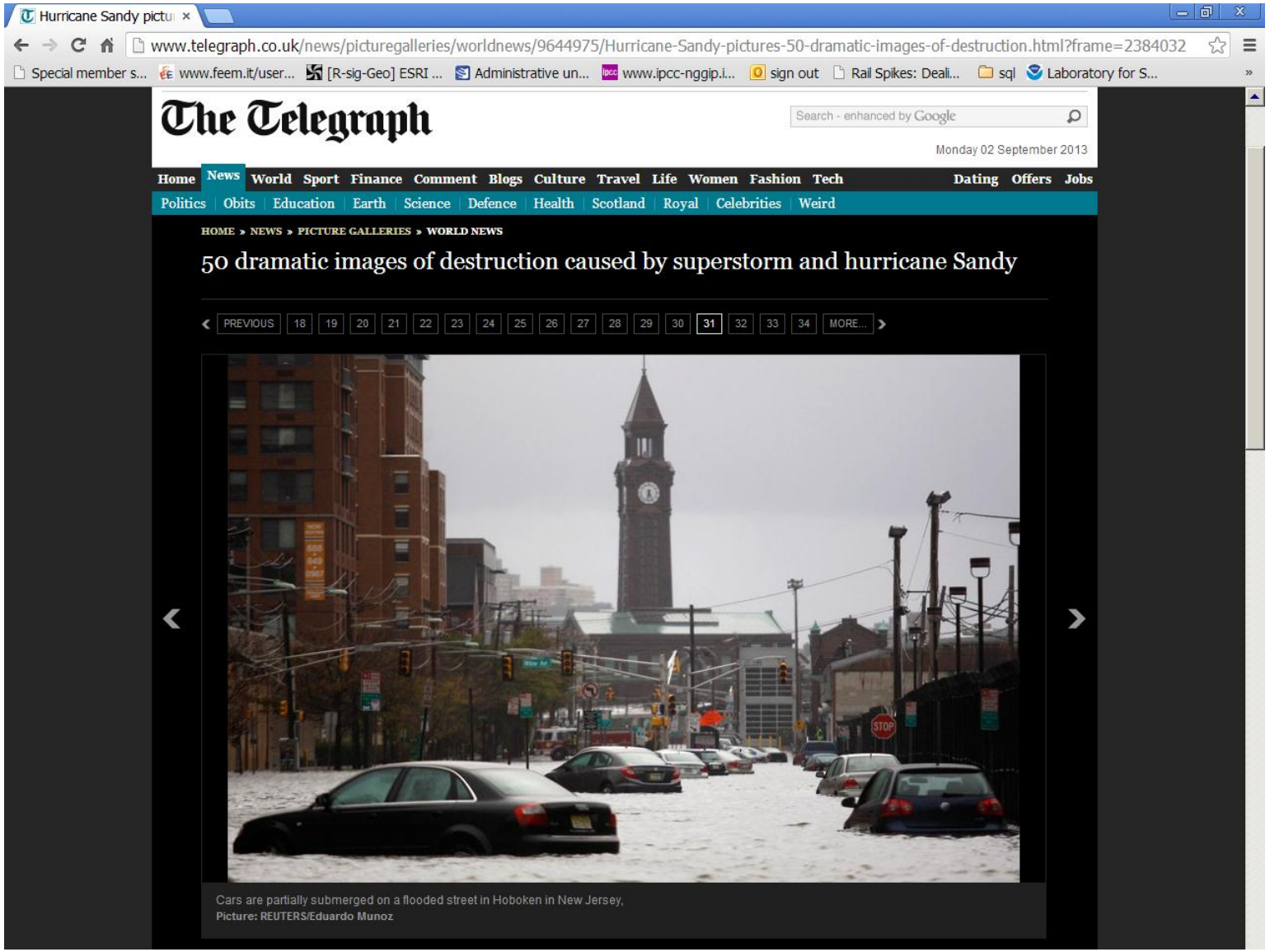

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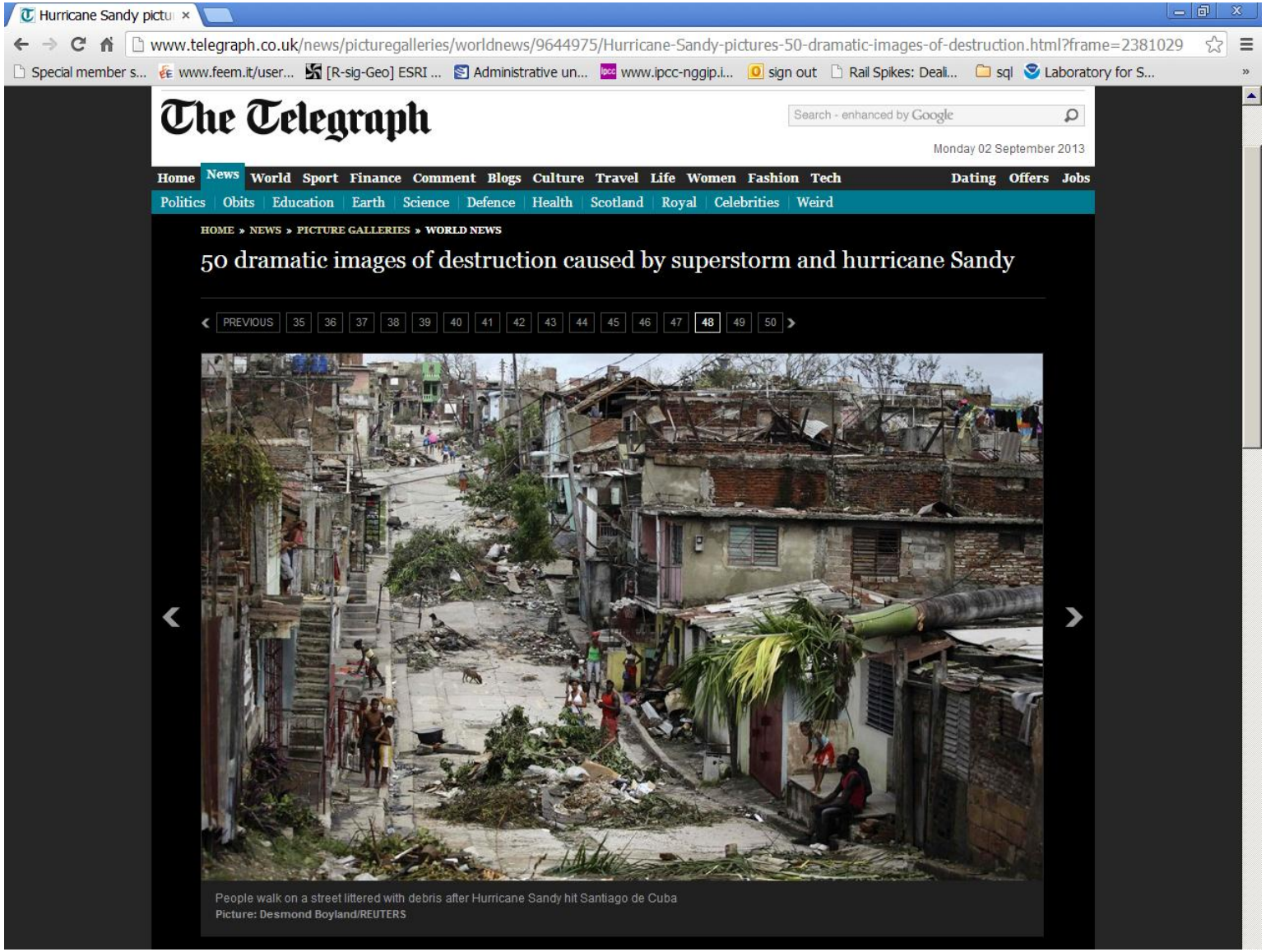

Examples of extreme events

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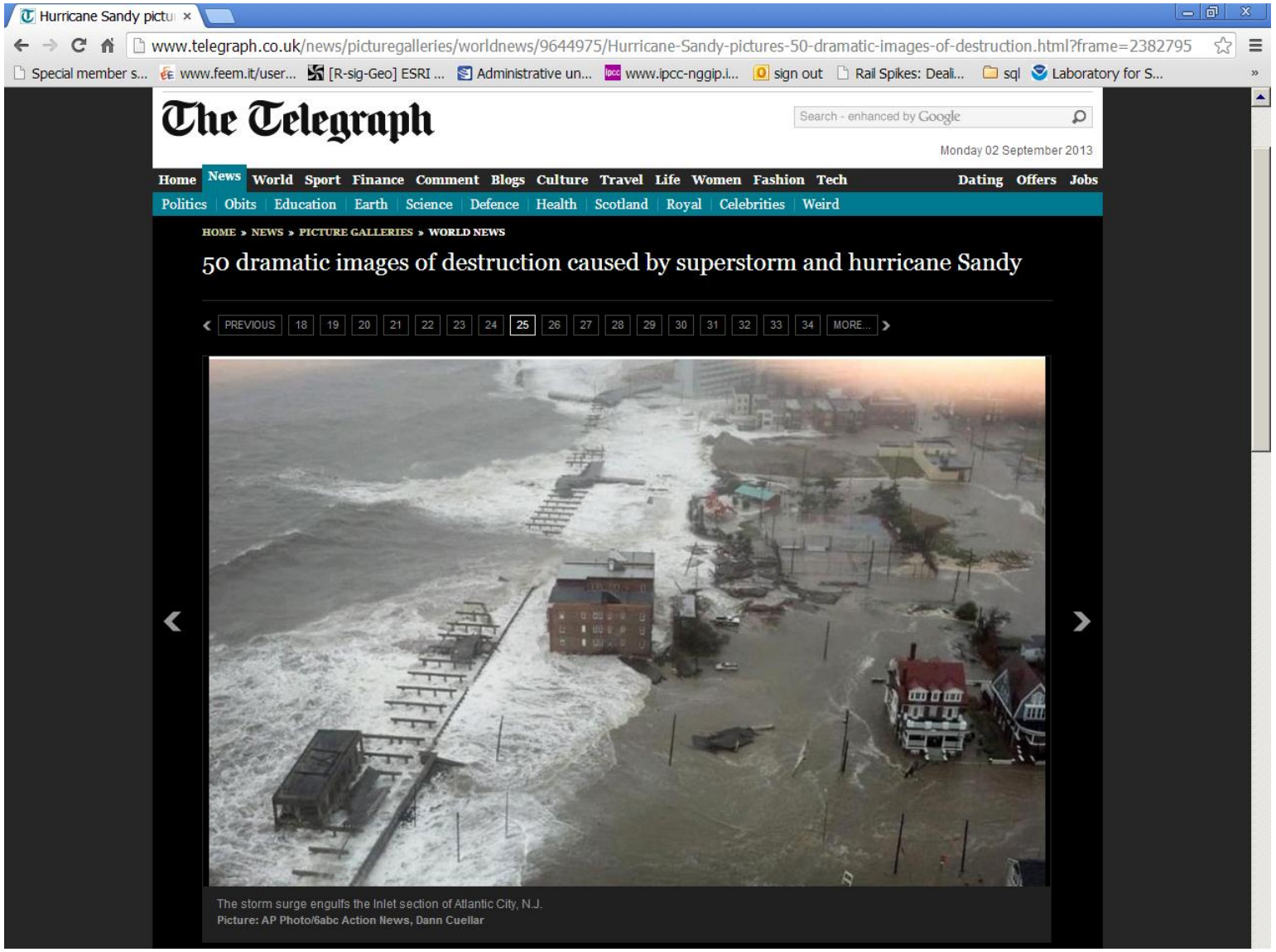

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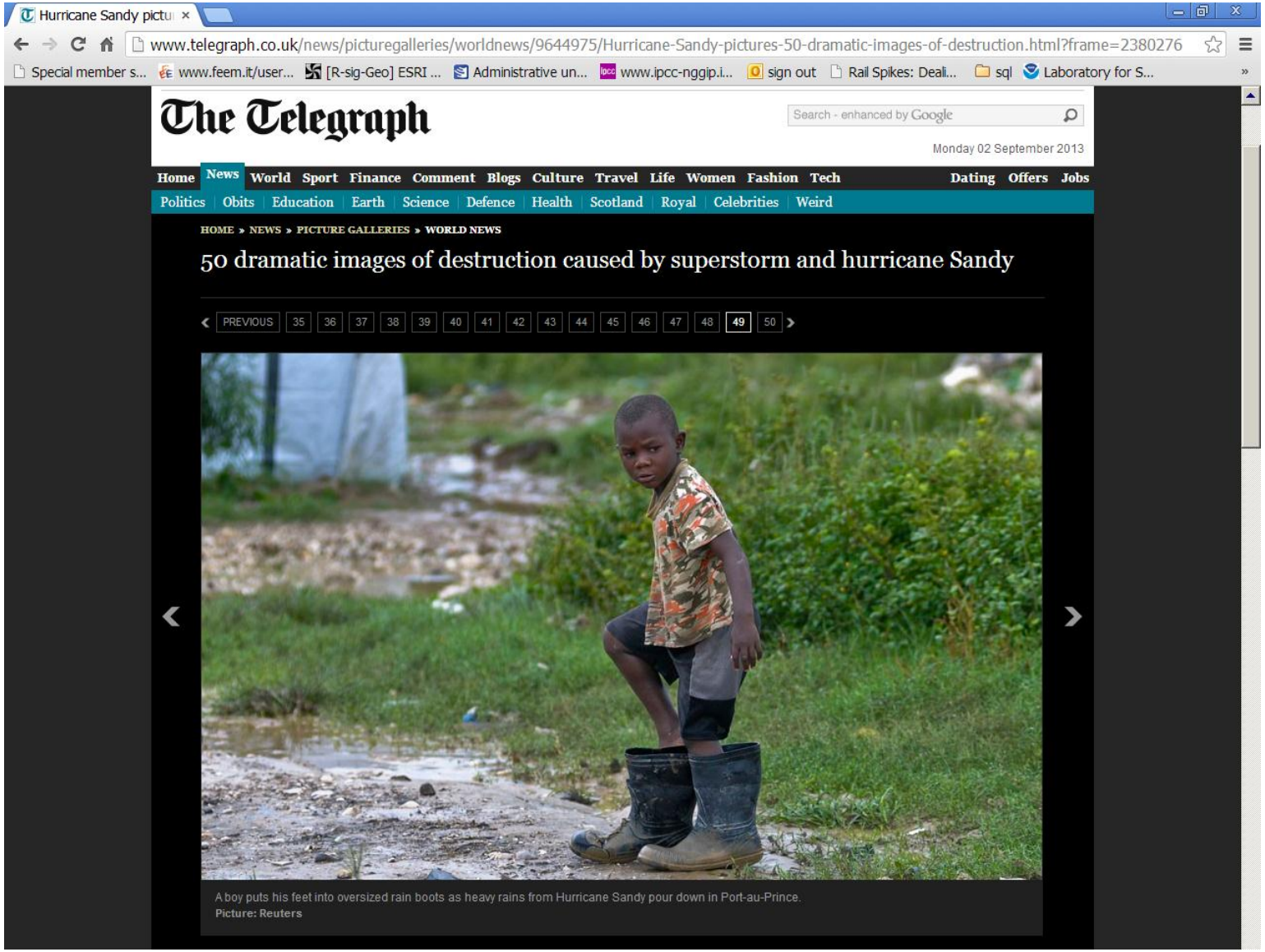

Structure

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- Relative sea-level rise and other drivers
- Projections of sea-level rise and modelling impacts
- European costs
- Adaptation

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Relative sea-level rise

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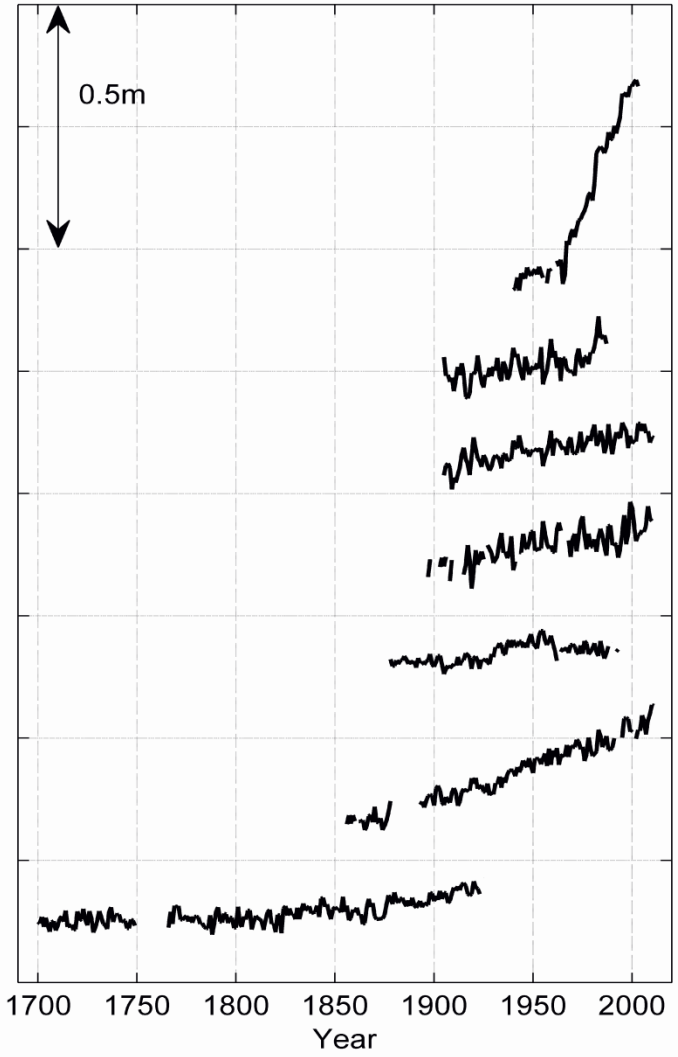
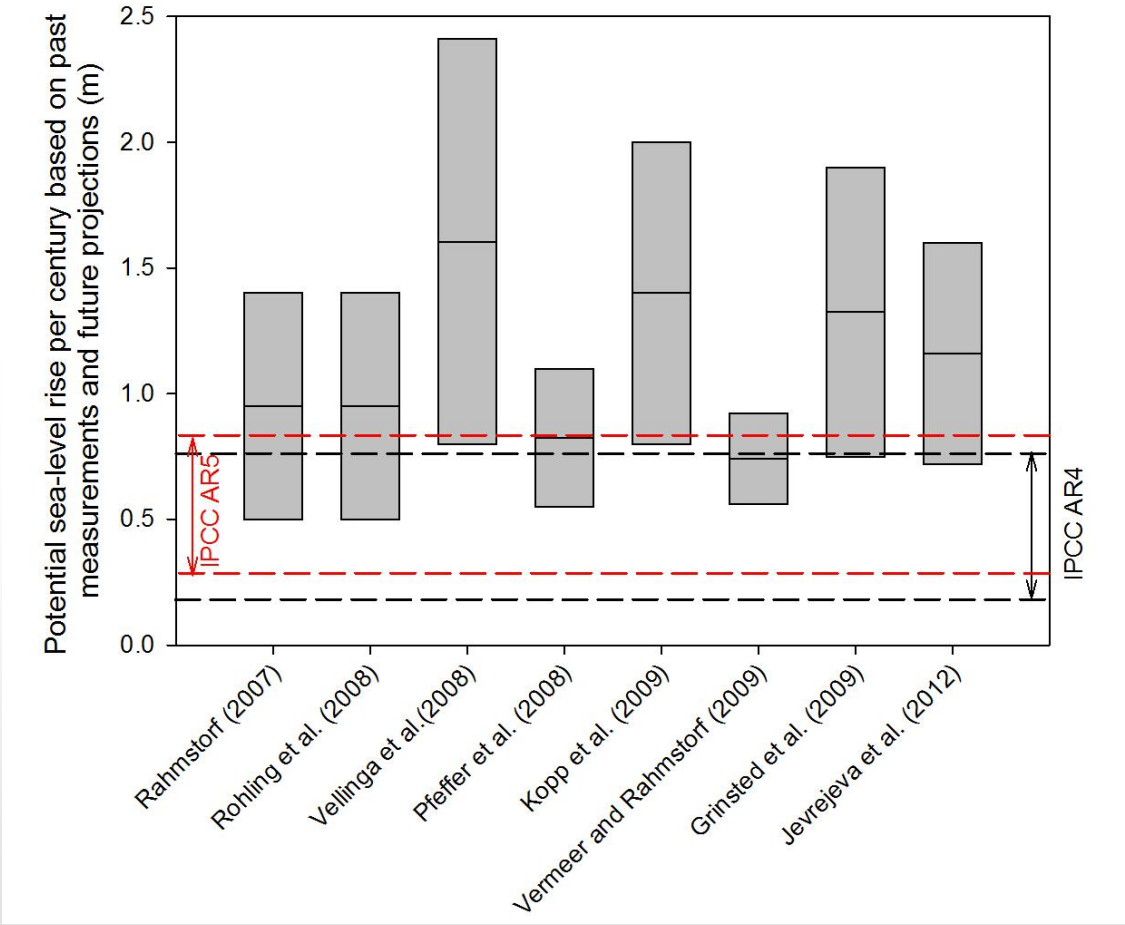


Bangkok, Thailand	**13.2 mm/yr**
Buenos Aires, Argentina	**0.7 mm/yr**
Honolulu, USA	**1.4 mm/yr**
Freemantle, Australia	**2.0 mm/yr**
Mumbai, India	**0.8 mm/yr**
New York, USA	**3.0 mm/yr**
Amsterdam, the Netherlands	**0.5 mm/yr**

Source: Brown et al. (2013) . Sea-level rise impacts and responses: A global perspective. In: C Finkl (ed) Coastal Hazards.

Projections of sea-level rise



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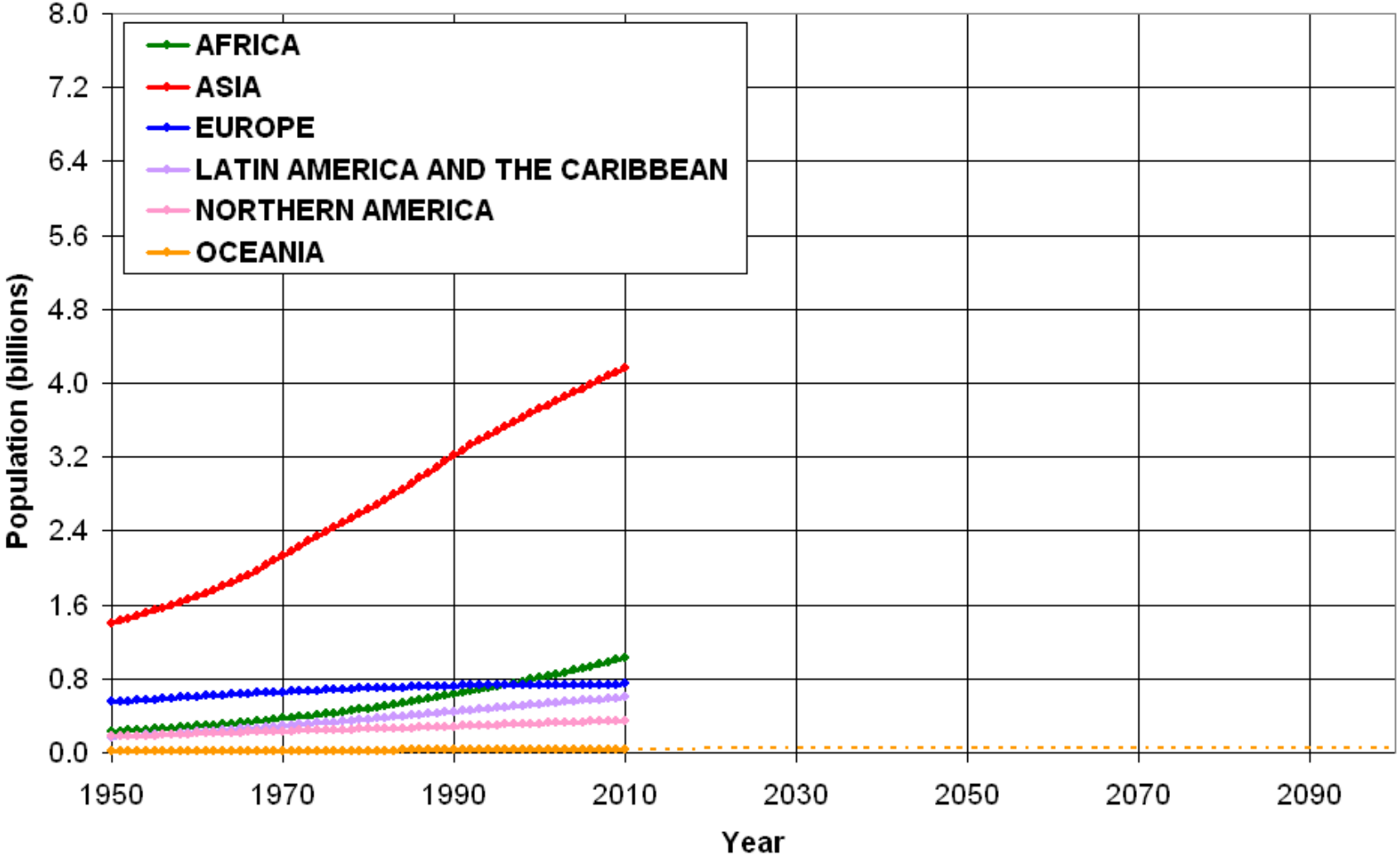
Population growth



Source: United Nations World Population Prospects (2012). Total population, plus projections based on high and low fertility rates. http://esa.un.org/wpp/Excel-Data/population.htm

Population projections

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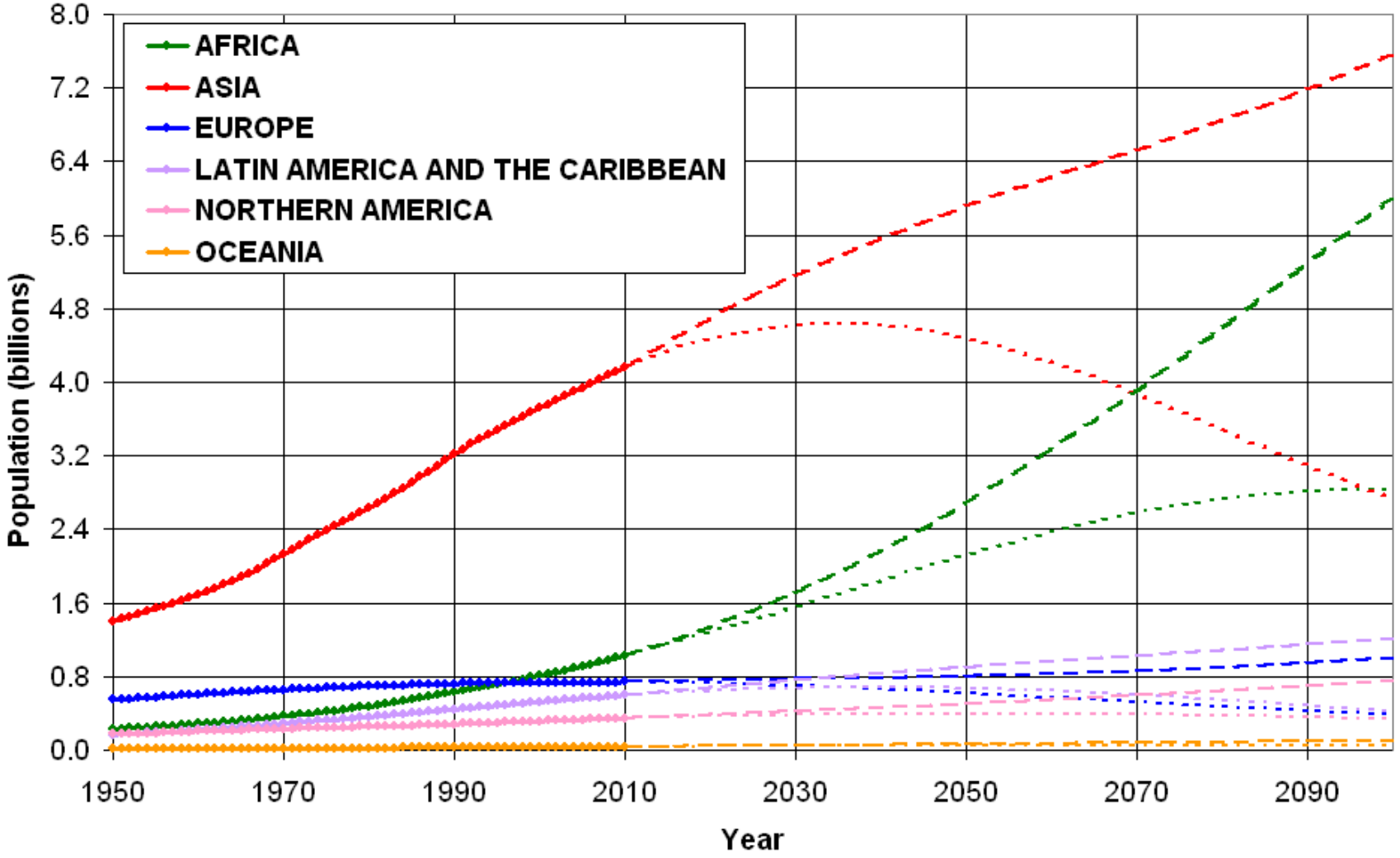

Source: United Nations World Population Prospects (2012). Total population, plus projections based on high and low fertility rates. http://esa.un.org/wpp/Excel-Data/population.htm

Coastal population

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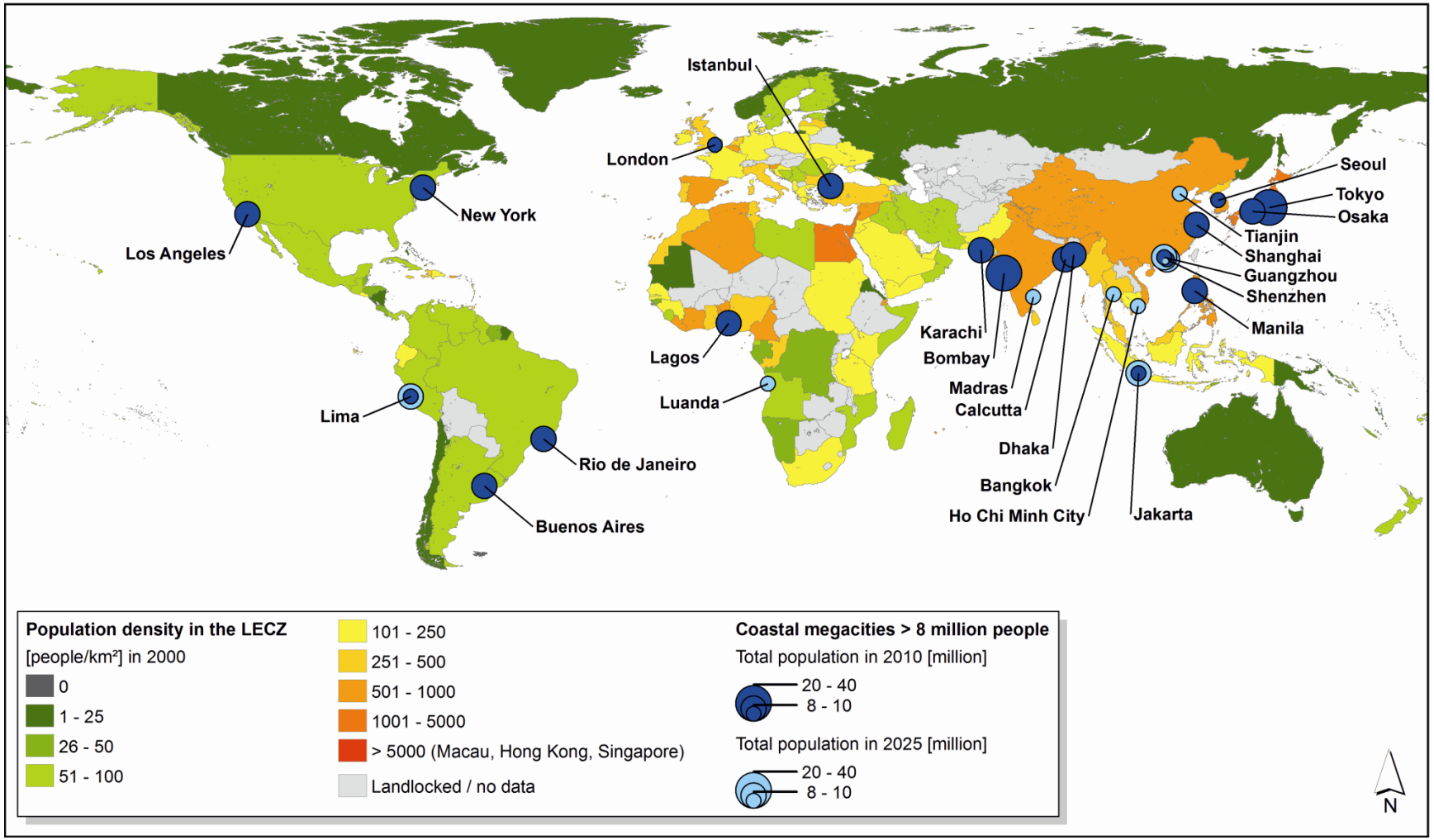

Source: Brown et al. (2013) . Sea-level rise impacts and responses: A global perspective. In: C Finkl (ed) Coastal Hazards.

Why Europe?

- Locally high population densities
- Important cities
- Important trade
- Improve understand costs from a strategic planning perspective
- Consider how to better protect the coast

Structure

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Potential sea-level rise

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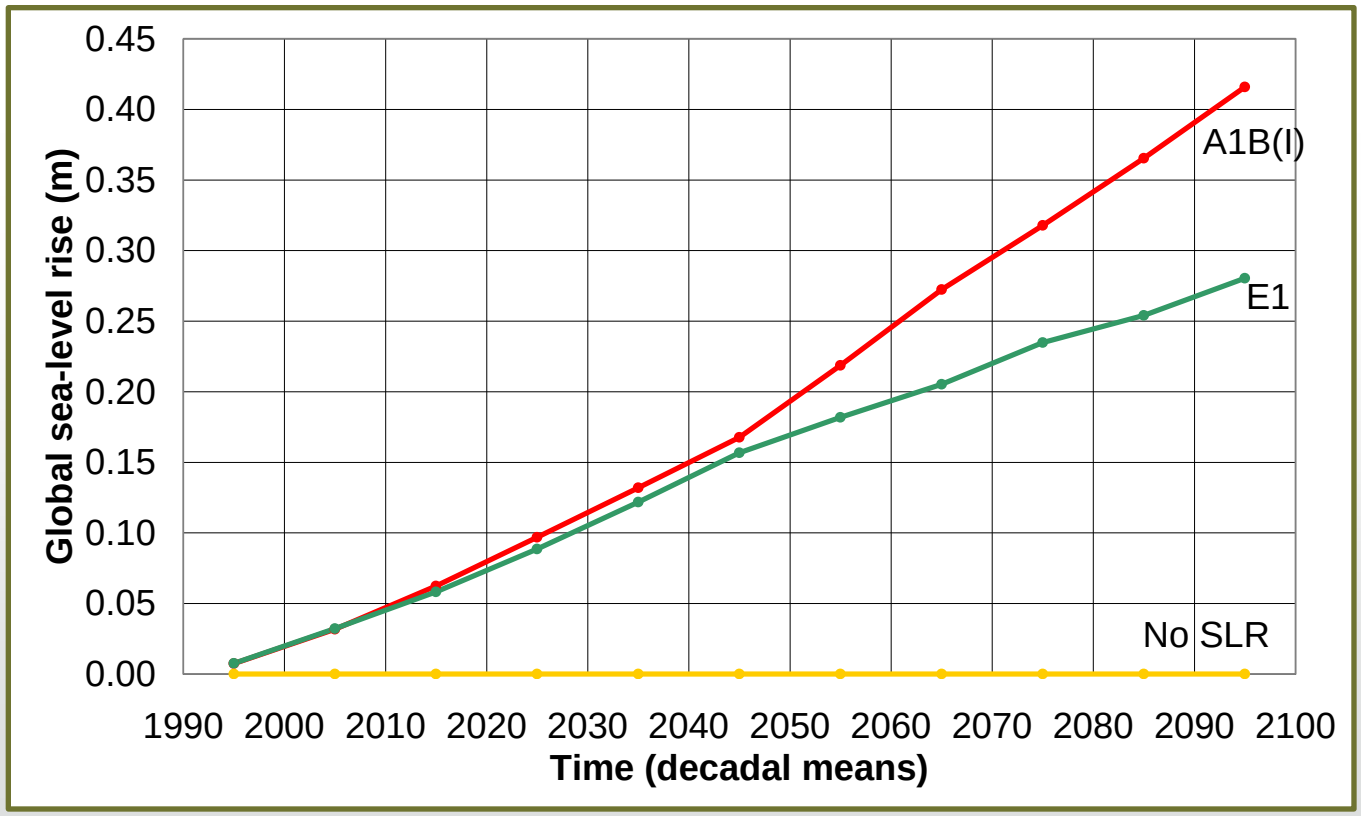
- A1B(IMAGE) scenario (3.5°C rise, 0.37m rise in 2080s)
- E1 mitigation scenario (1.5°C rise 0.27m rise in 2080s)
- No climate change scenario (0m rise in 2080s)



DIVA: Coastal Segments

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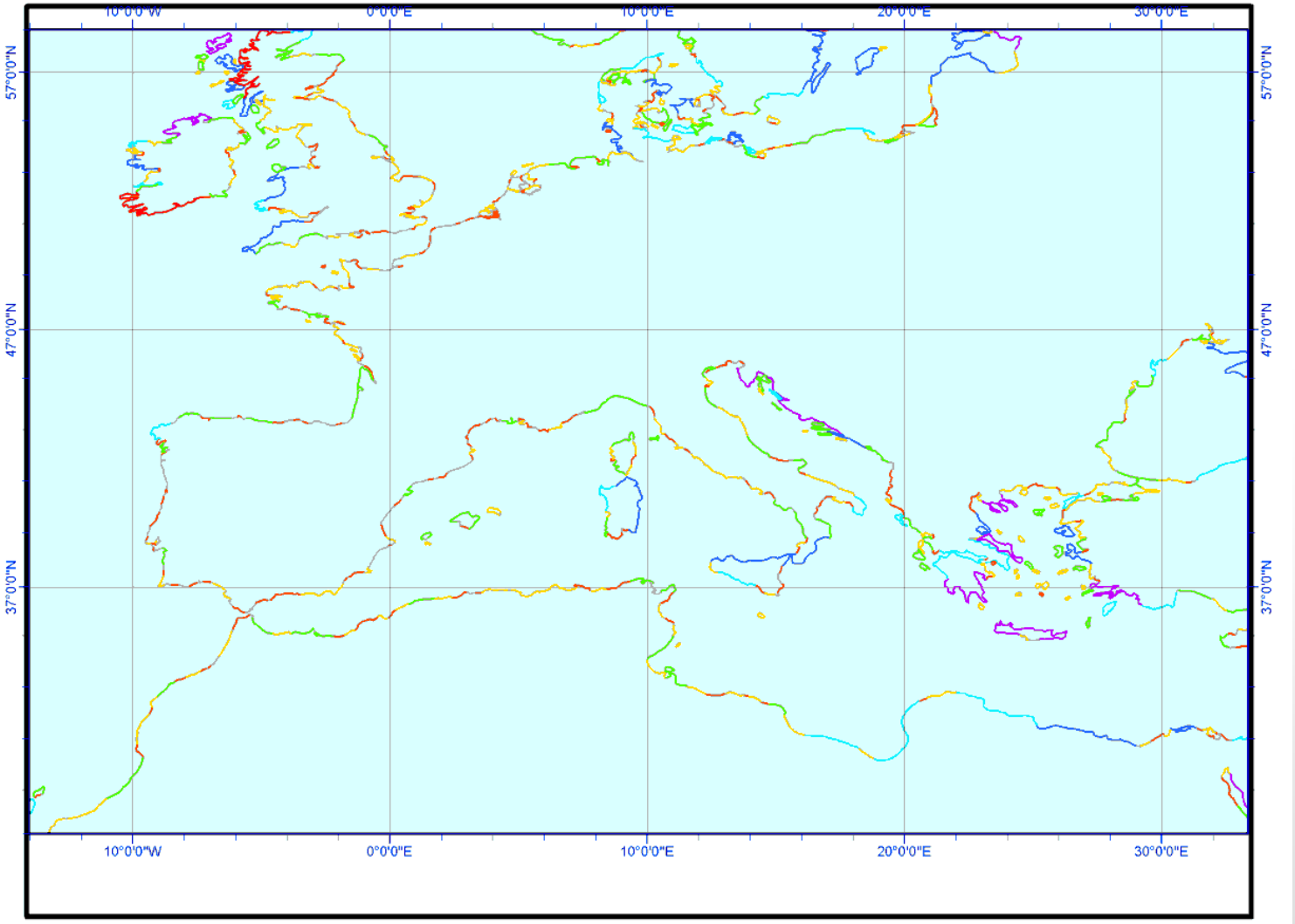
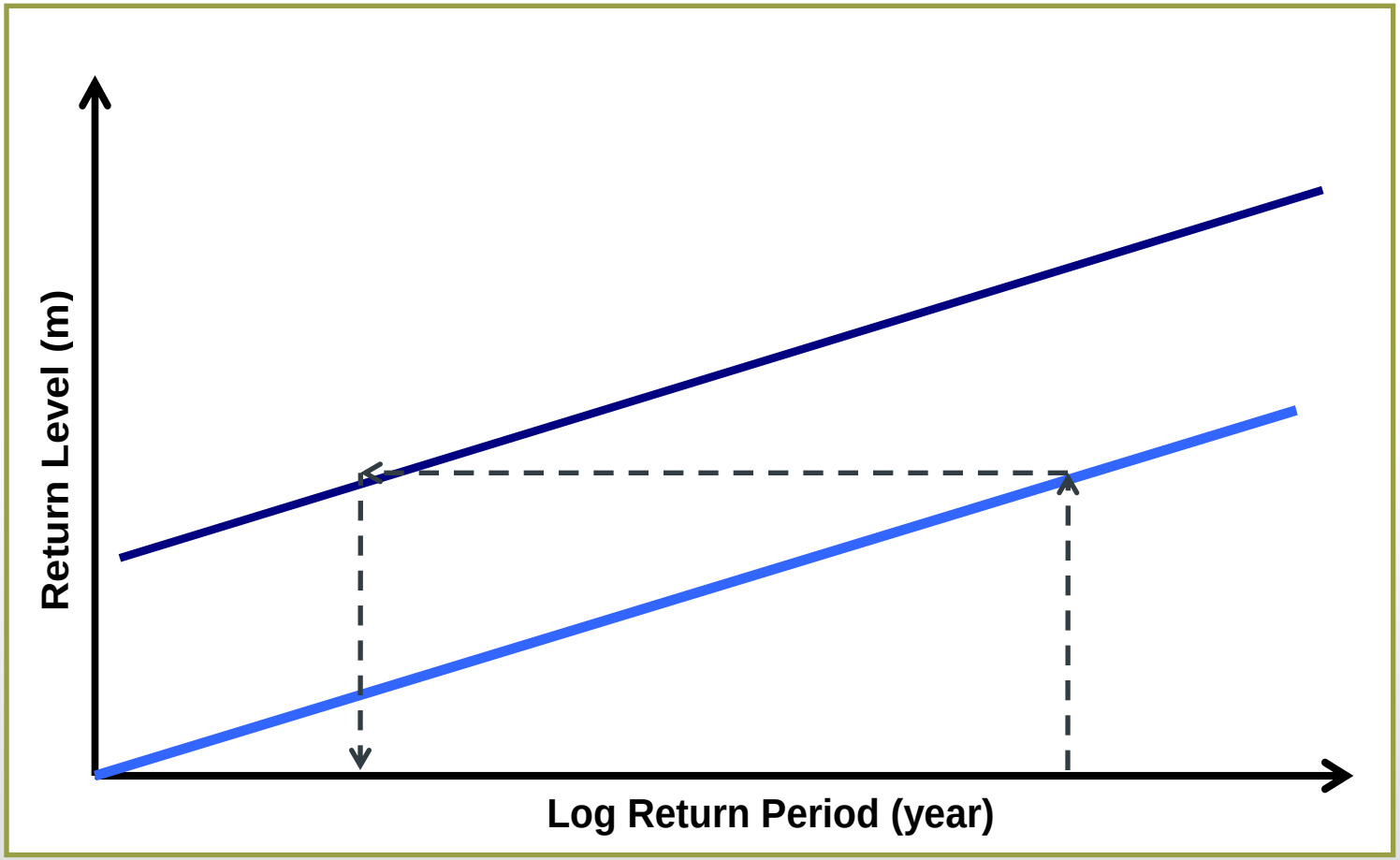


12,000 segments globally, with 1,606 in the EU, average length 45km.

DIVA: Return Period



DIVA: Module methodology

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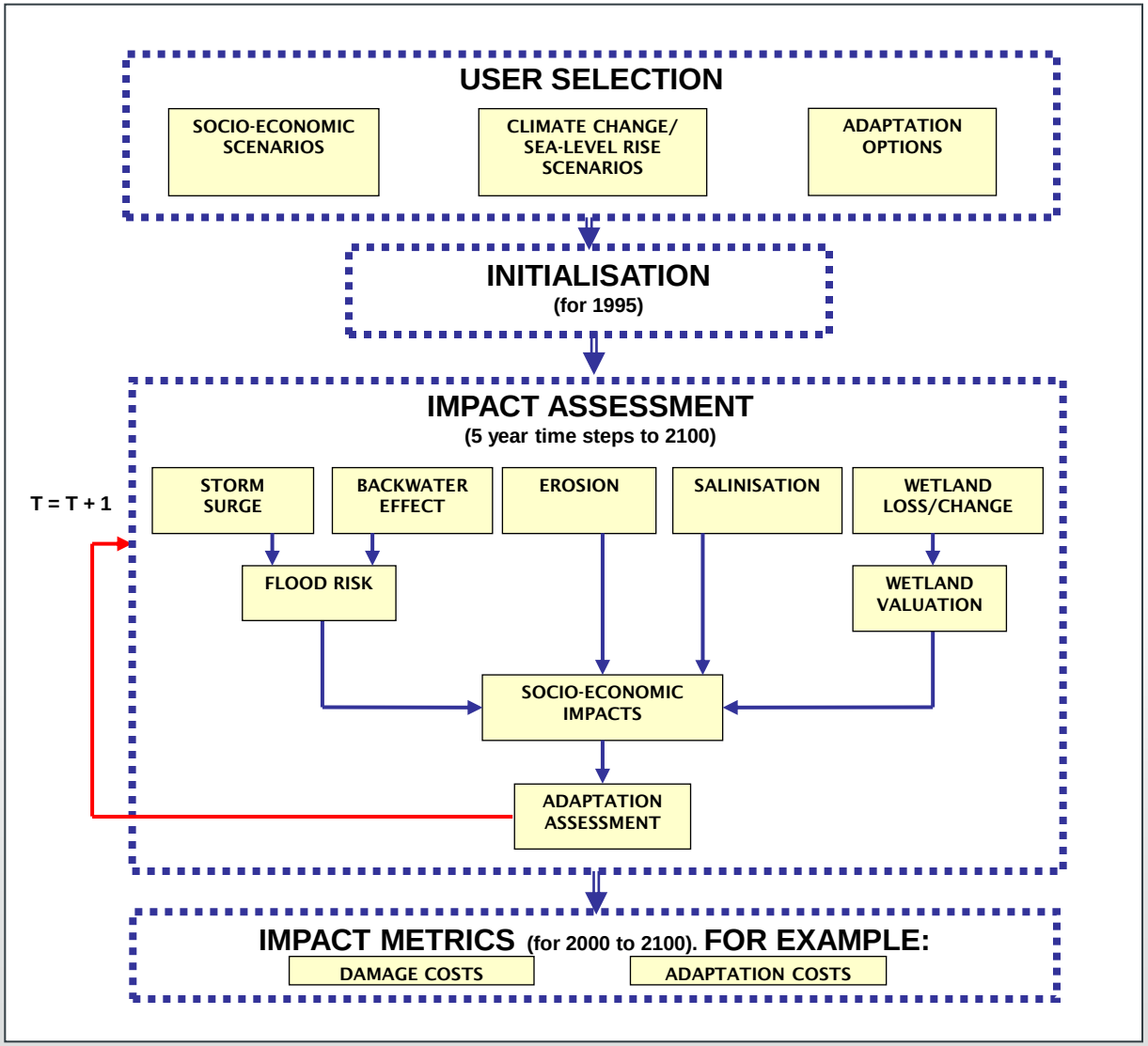

Parameters investigated

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- Damage costs (2005 Euros, not discounted or uplifted): Sea floods, river floods, land loss, salinisation, people to migrate.
- Adaptation costs (2005 Euros, not discounted or uplifted): Sea dike, river dike, beach nourishment.

Scenario	Adaptation
A1B(I)	With upgrade
E1	With upgrade
No climate change	With upgrade
A1B(I)	No upgrade
E1	No upgrade
No climate change	No upgrade

Structure

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Geographical and time scales

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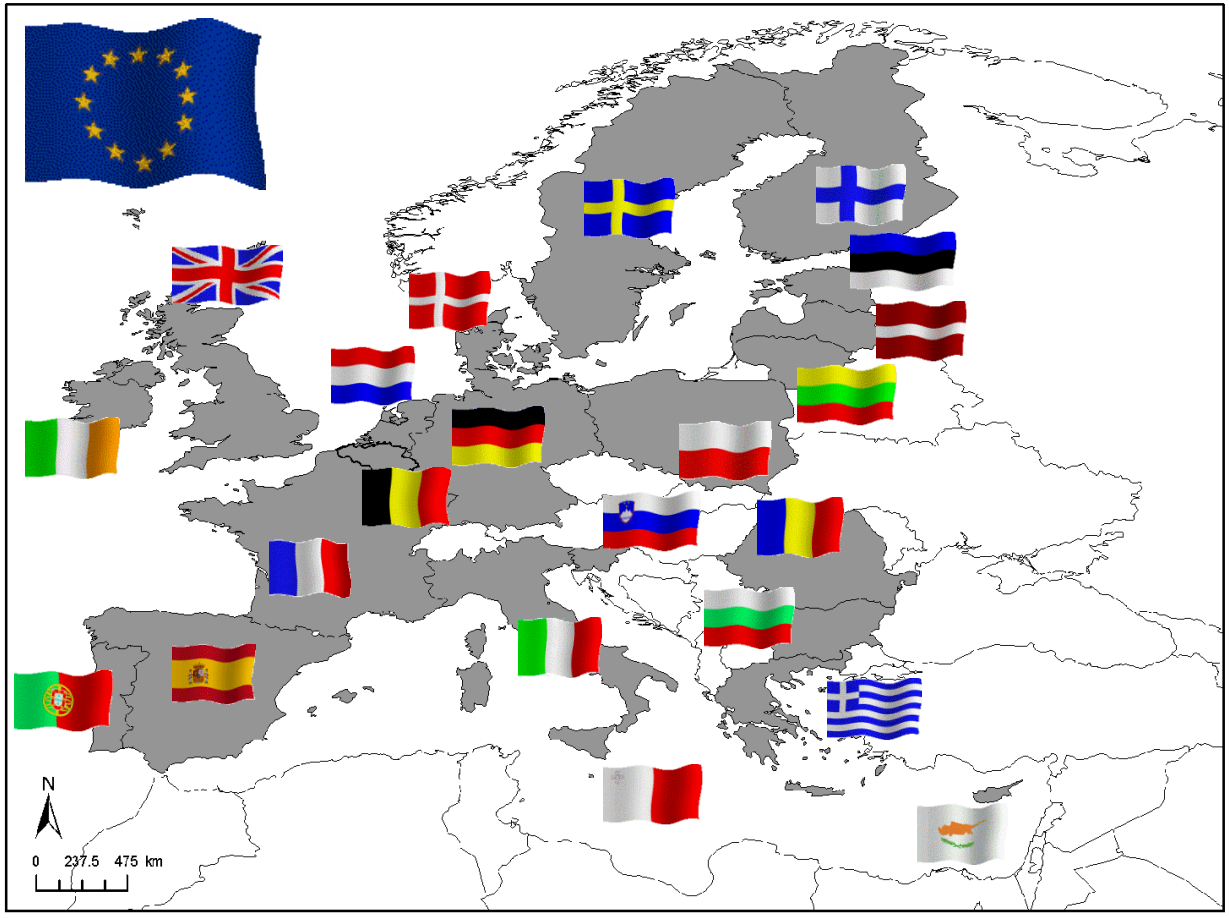
- 22 EU countries with a coastline (in 2010)



- Data reported as thirty year means (2020s, 2050s, 2080s)

EU damage costs

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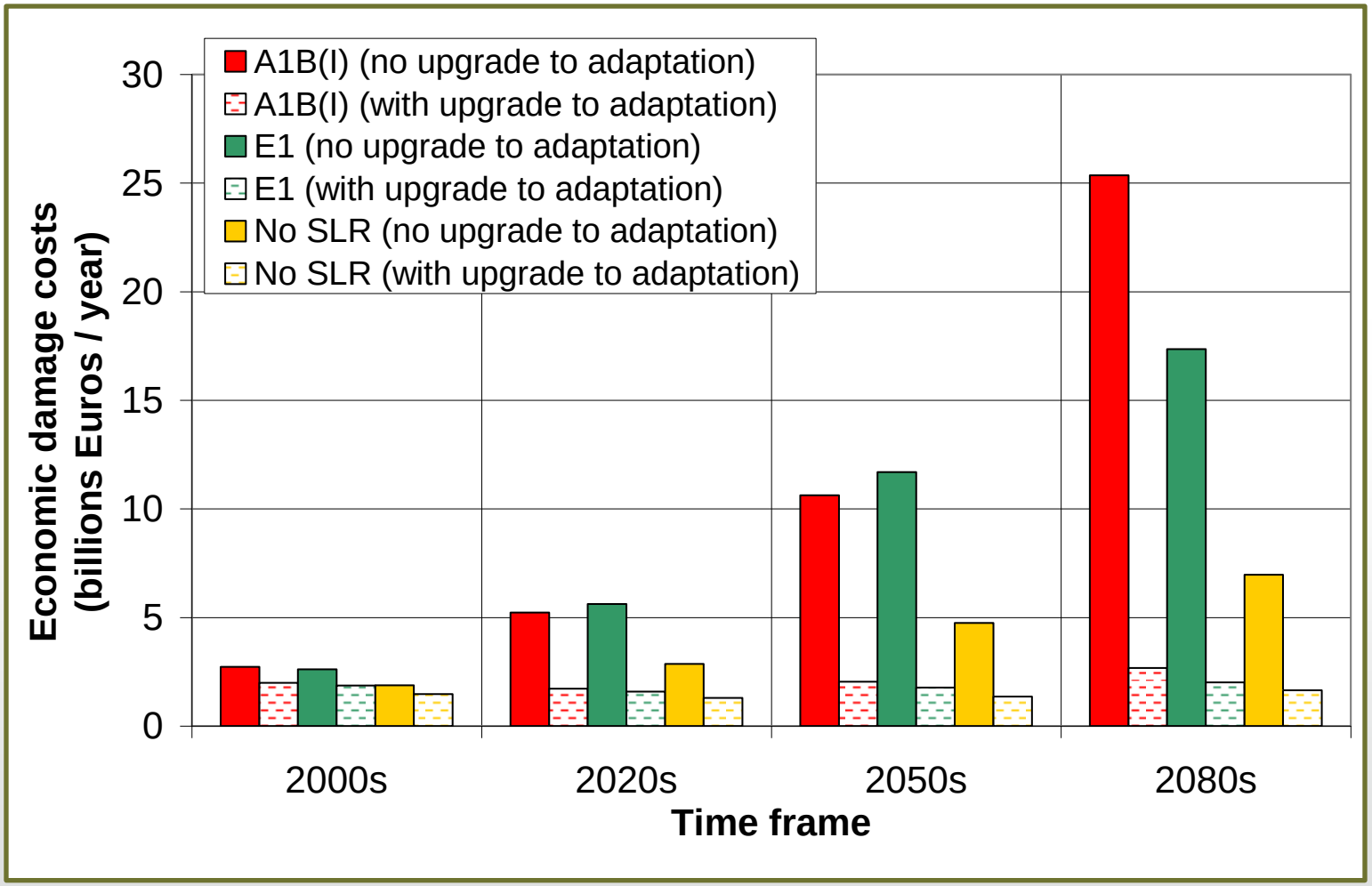
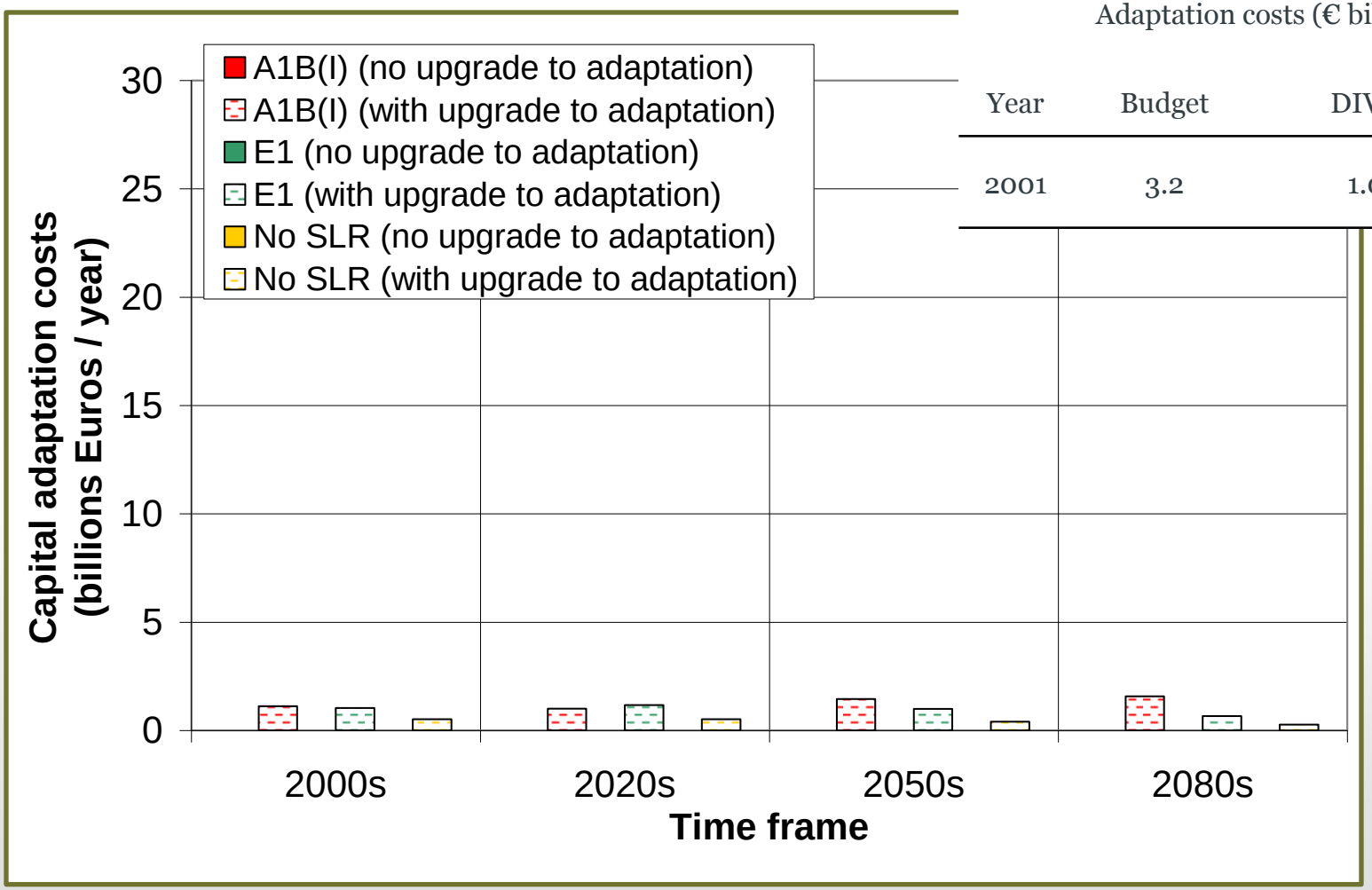


EU adaptation costs

Source: Eurosion (2004)

Adaptation costs (€ billions)

Year	Budget	DIVA
2001	3.2	1.0



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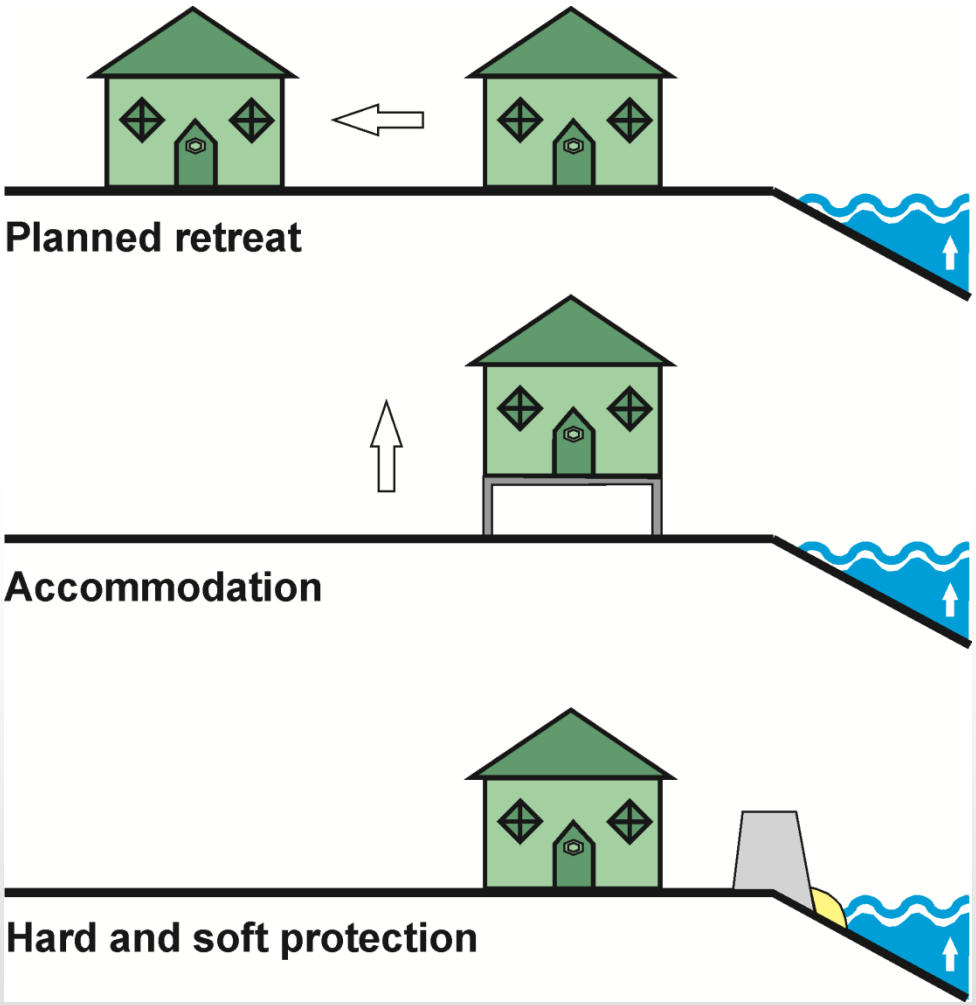
Adaptation to sea-level rise



Source: Brown et al. (2013) . Sea-level rise impacts and responses: A global perspective. In: C Finkl (ed) Coastal Hazards.

Adaptation to sea-level rise

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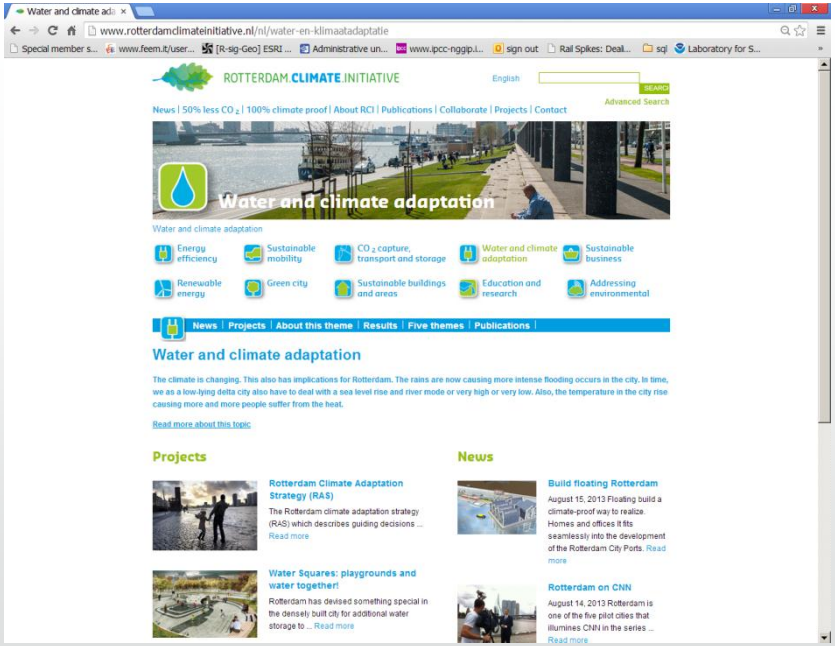
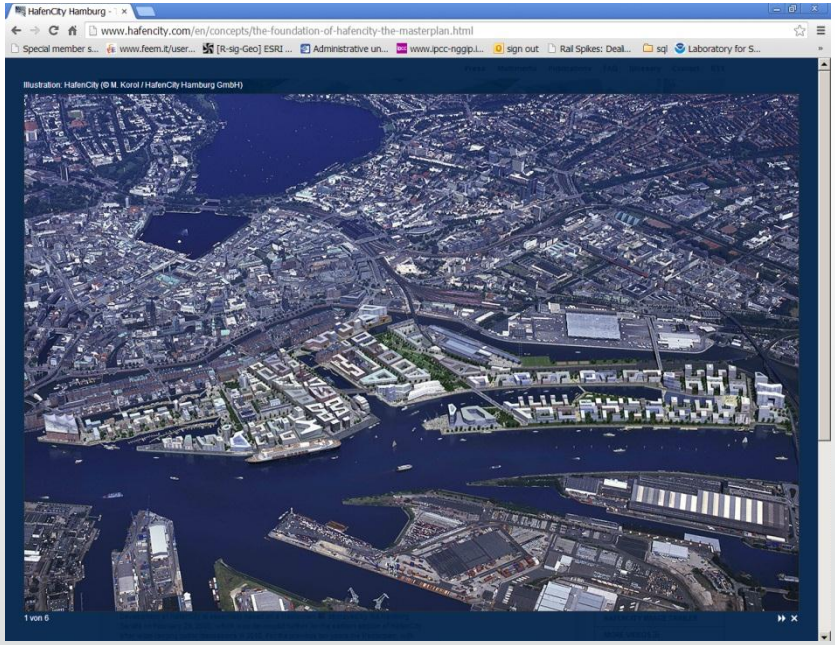
- Rotterdam: Climate-proofing, sustainability and energy efficiency.
- HafenCity, Hamburg: Redesigning the waterfront to create a new low flood risk area of the city.





Conclusion

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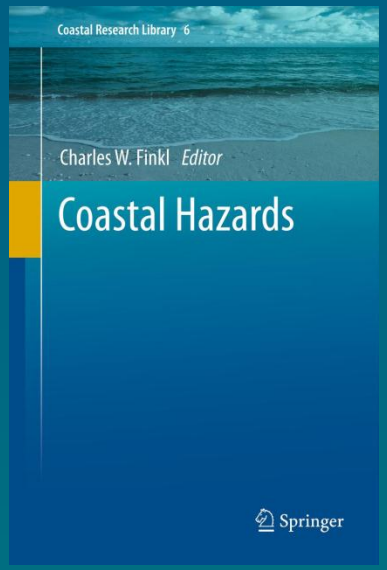
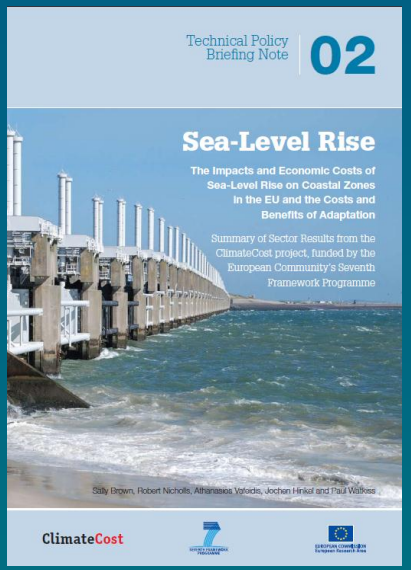
- Climate mitigation does not stop sea-level rise, but will slow the rate of rise. Need to improve understand the potential magnitude of sea-level -> Further monitoring.
- Socio-economic change is important and will influence the magnitude of impacts and costs.
- Adaptation remains essential and seems a wise and worthwhile investment -> Flexible about long-term adaptation: Promote awareness, broader range of options, more detailed assessments.
- Put in context of the broader issues of integrated coastal zone management, considering other drivers of change.
- A combination of adaptation and mitigation is advisable to reduce long-term sea-level rise and to keep risks at an acceptable level.





- Brown et al. (2013) Sea-level rise impacts and responses: a global perspective. In, Finkl, Charles W. (ed.)Coastal Hazards.
- Pardaens et al (2011. Sea-level rise and impacts projections under a future scenario with large greenhouse gas emission reductions. Geophysical Research Letters, 38, (12), L12604
- Brown et al. (2011) The Impacts and Economic Costs of Sea-Level Rise on Coastal Zones. Briefing note: http://www.climatecost.cc/reportsandpublications.html