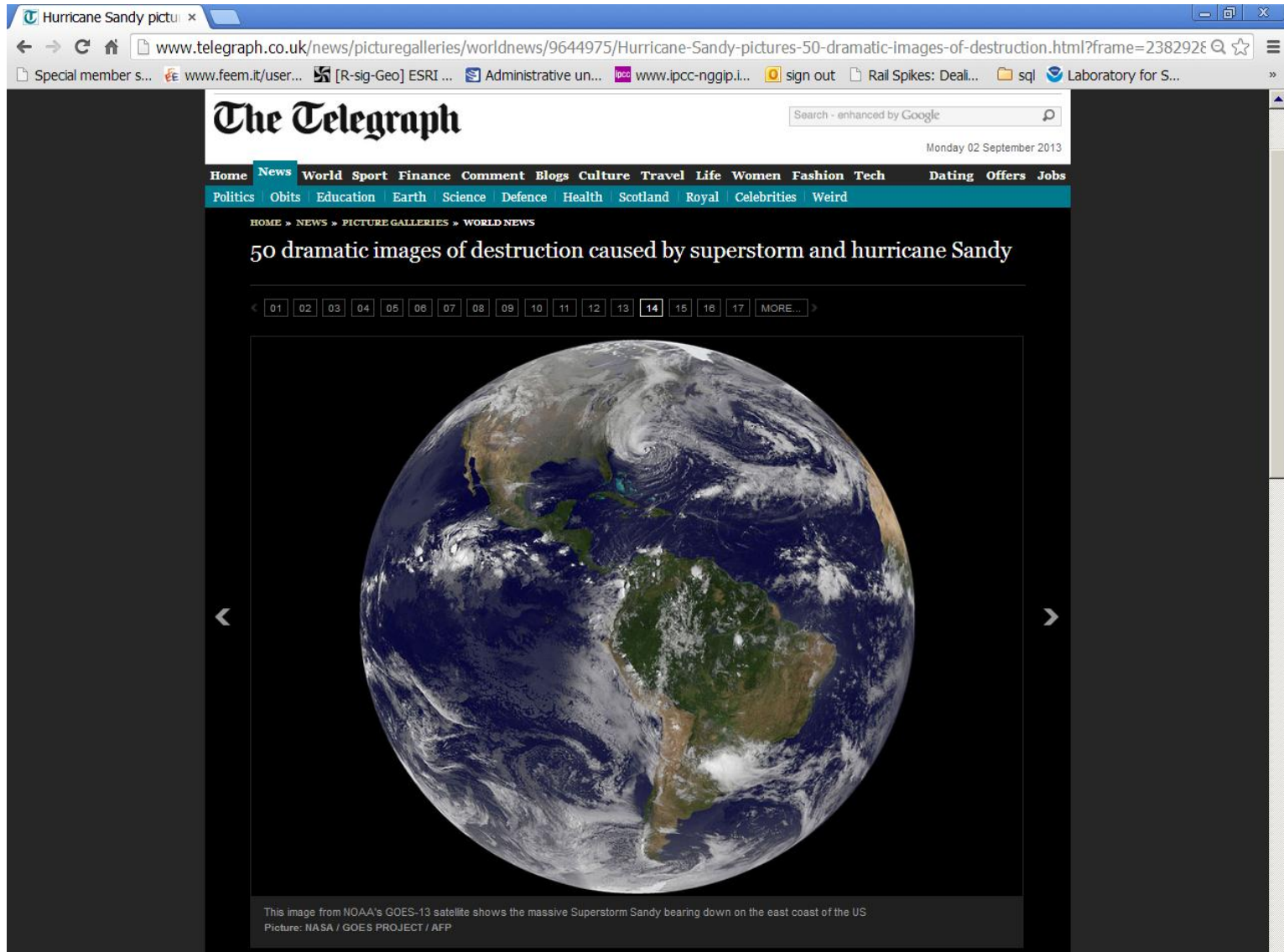


Impacts and costs of sea-level rise: A focus on Europe

Sally Brown,
University of Southampton, UK

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



Examples of extreme events

Hurricane Sandy pictu x

www.telegraph.co.uk/news/picturegalleries/worldnews/9644975/Hurricane-Sandy-pictures-50-dramatic-images-of-destruction.html?frame=2384216

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A rollercoaster is battered by waves near a storm-destroyed pier off the New Jersey coast in this aerial photograph provided by the US Air Force

Picture: EPA/MASTER SGT. MARK OLSEN / US AIR FORCE

Examples of extreme events

Hurricane Sandy pictu

www.telegraph.co.uk/news/picturegalleries/worldnews/9644975/Hurricane-Sandy-pictures-50-dramatic-images-of-destruction.html?frame=2384028

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Floodwaters from Superstorm Sandy surround homes in South Bethany, Delaware
Picture: The Wilmington News-Journal, Robert Craig/AP

Examples of extreme events

Hurricane Sandy pictu x

www.telegraph.co.uk/news/picturegalleries/worldnews/9644975/Hurricane-Sandy-pictures-50-dramatic-images-of-destruction.html?frame=2382796

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HMS Bounty, a 180-foot (54.86 meters) tall ship, sinks beneath the waves after being hit by Hurricane Sandy
Picture: EPA/USCG /Tim Kuhl

Examples of extreme events

Hurricane Sandy pictu x

www.telegraph.co.uk/news/picturegalleries/worldnews/9644975/Hurricane-Sandy-pictures-50-dramatic-images-of-destruction.html?frame=2382800

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A still taken from a surveillance camera capturing footage of water engulfing an underground station in Hoboken, N.J.
Picture: AP Photo/Port Authority of New York and New Jersey

Examples of extreme events

Hurricane Sandy pictu x

www.telegraph.co.uk/news/picturegalleries/worldnews/9644975/Hurricane-Sandy-pictures-50-dramatic-images-of-destruction.html?frame=2384032

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Cars are partially submerged on a flooded street in Hoboken in New Jersey, Picture: REUTERS/Eduardo Munoz

Examples of extreme events

Hurricane Sandy pictu x

www.telegraph.co.uk/news/picturegalleries/worldnews/9644975/Hurricane-Sandy-pictures-50-dramatic-images-of-destruction.html?frame=2381029

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People walk on a street littered with debris after Hurricane Sandy hit Santiago de Cuba
Picture: Desmond Boyland/REUTERS

Examples of extreme events

Hurricane Sandy pictu x

www.telegraph.co.uk/news/picturegalleries/worldnews/9644975/Hurricane-Sandy-pictures-50-dramatic-images-of-destruction.html?frame=2382795

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The storm surge engulfs the Inlet section of Atlantic City, N.J.
Picture: AP Photo/Sabc Action News, Dann Cuellar

Examples of extreme events

Hurricane Sandy pictu x

www.telegraph.co.uk/news/picturegalleries/worldnews/9644975/Hurricane-Sandy-pictures-50-dramatic-images-of-destruction.html?frame=2380276

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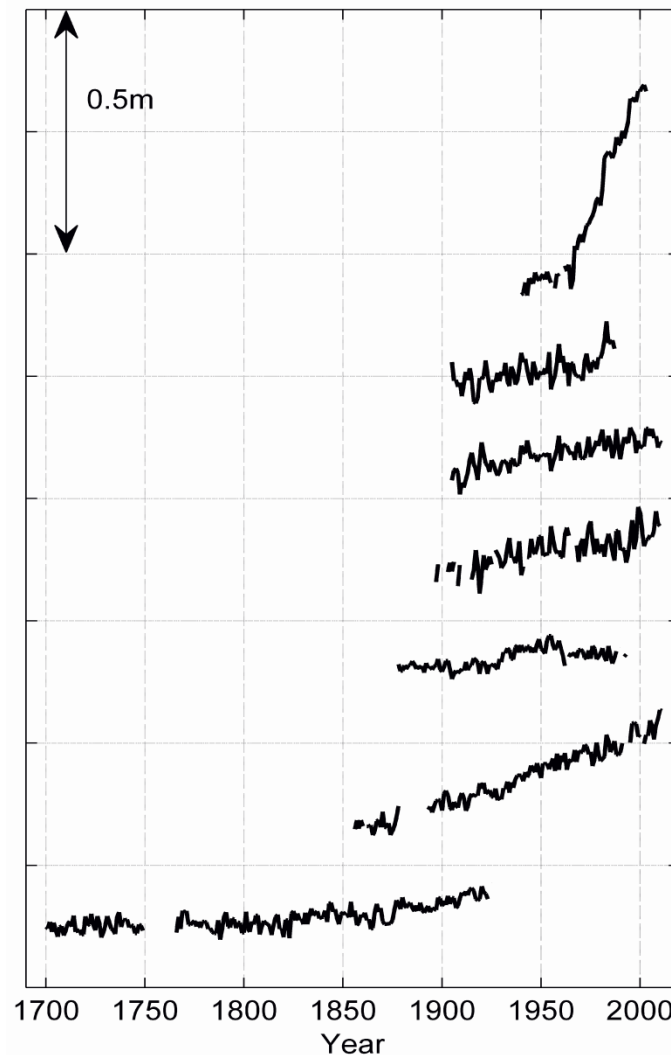


A boy puts his feet into oversized rain boots as heavy rains from Hurricane Sandy pour down in Port-au-Prince. Picture: Reuters

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

- Relative sea-level rise and other drivers
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Relative sea-level rise



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

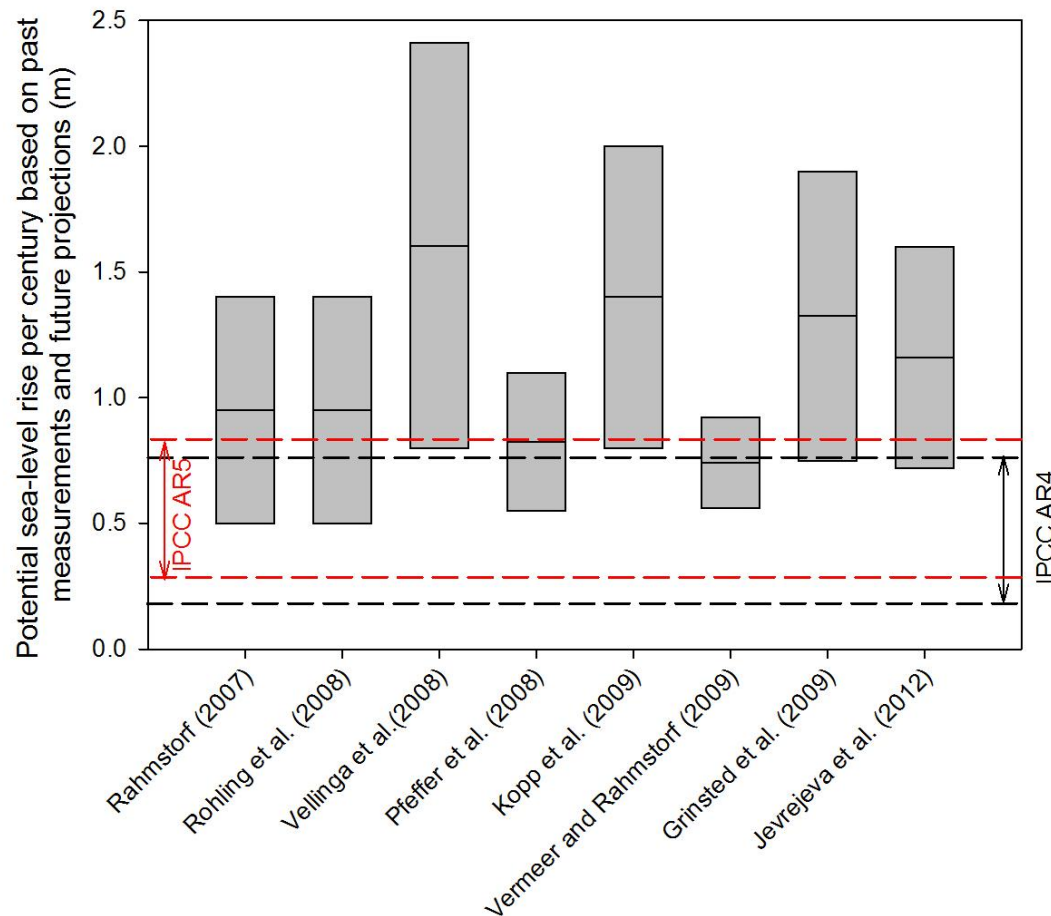
New York, USA

3.0 mm/yr

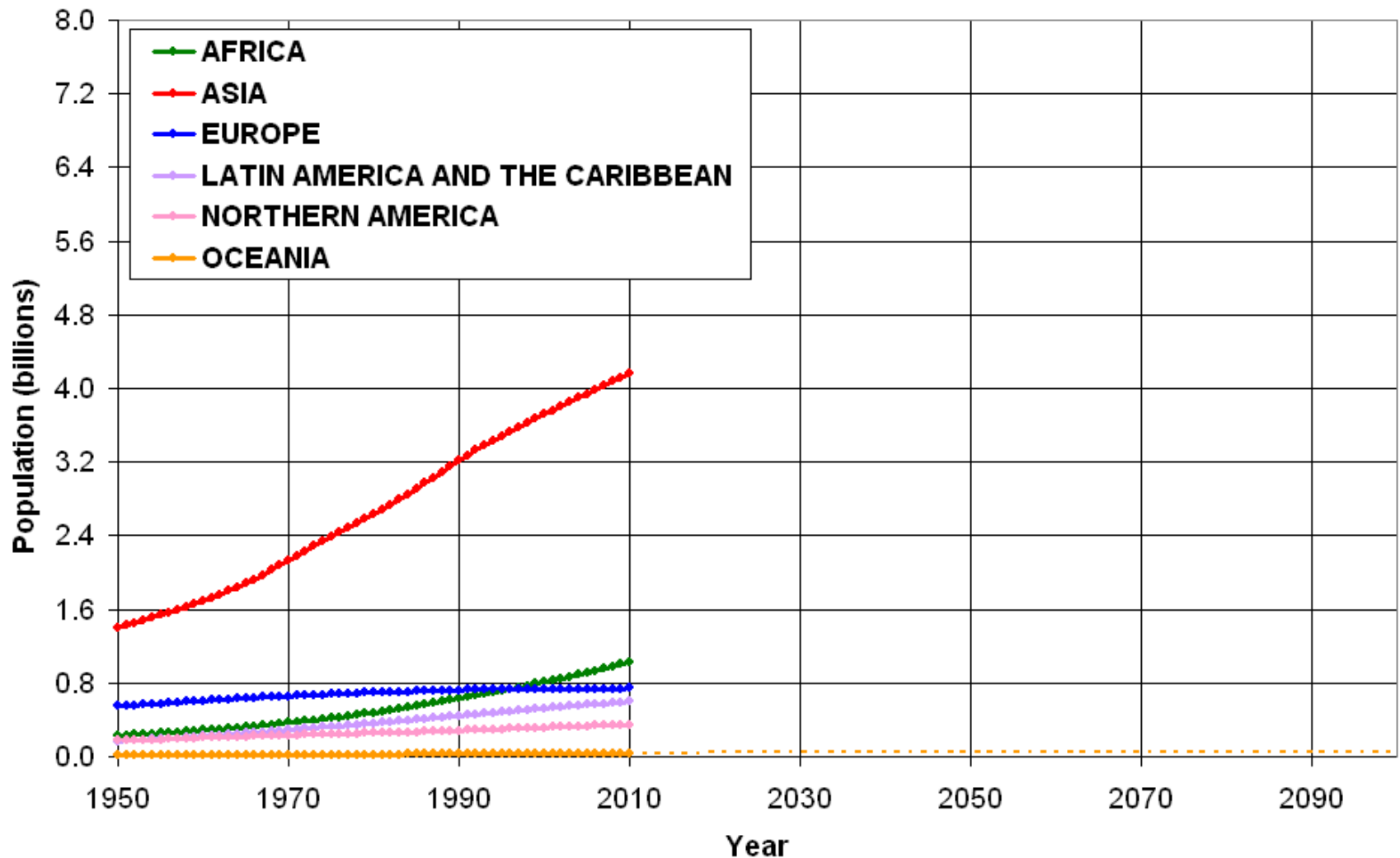
Amsterdam, the Netherlands

0.5 mm/yr

Projections of sea-level rise

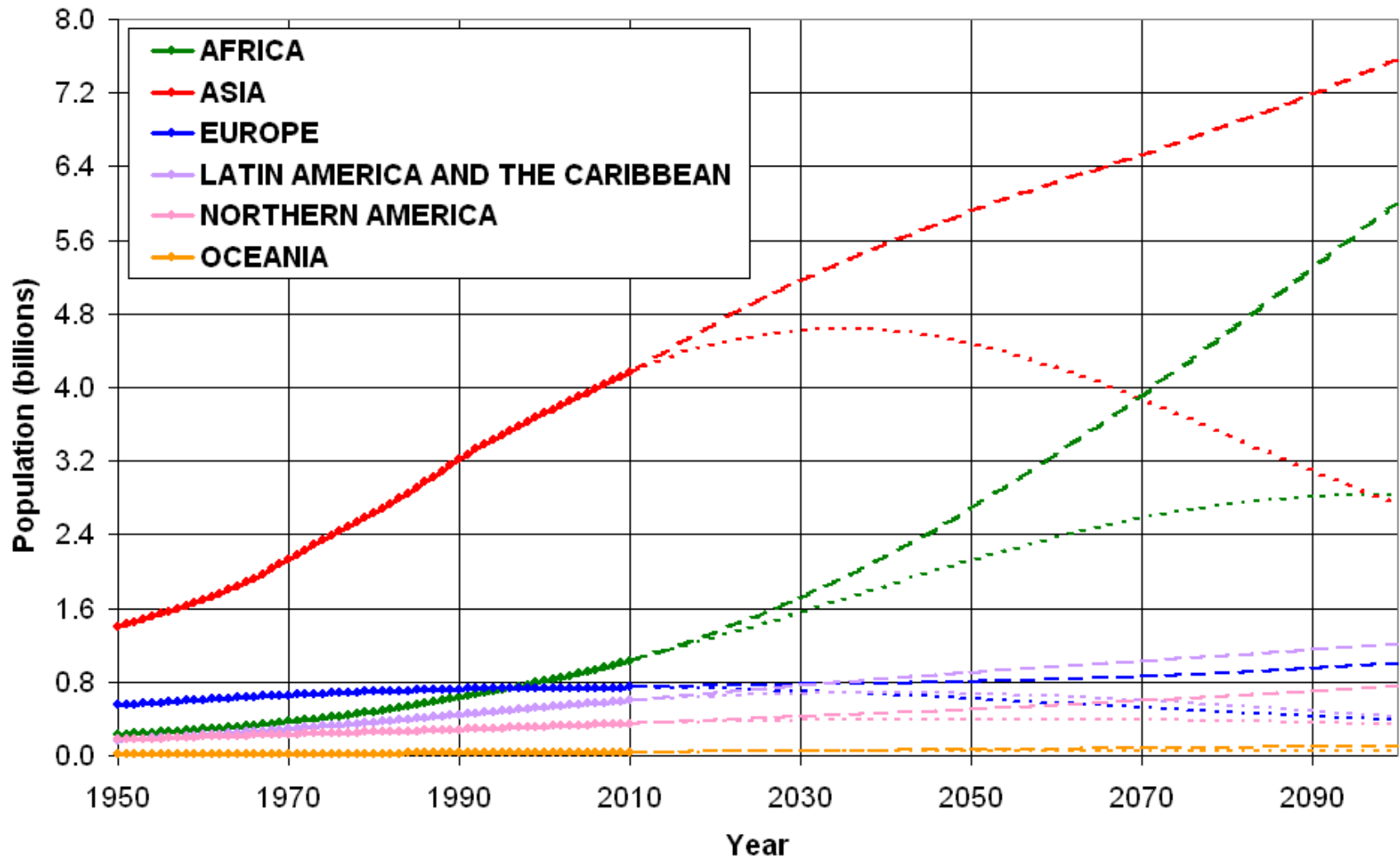


Population growth



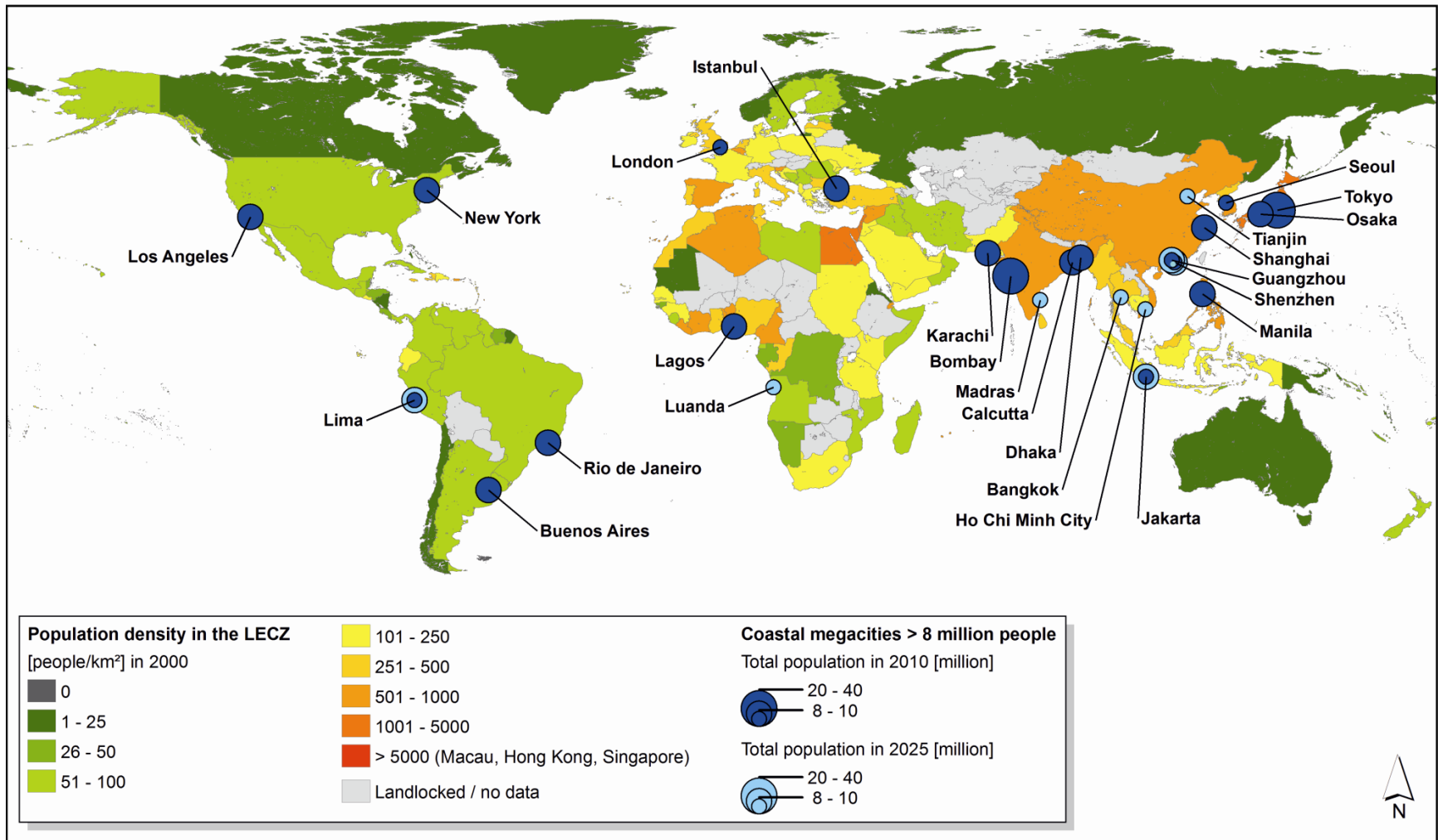
Source: United Nations World Population Prospects (2012). Total population, plus projections based on high and low fertility rates. <http://esa.un.org/wpp/Excel-Data/population.htm>

Population projections



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



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

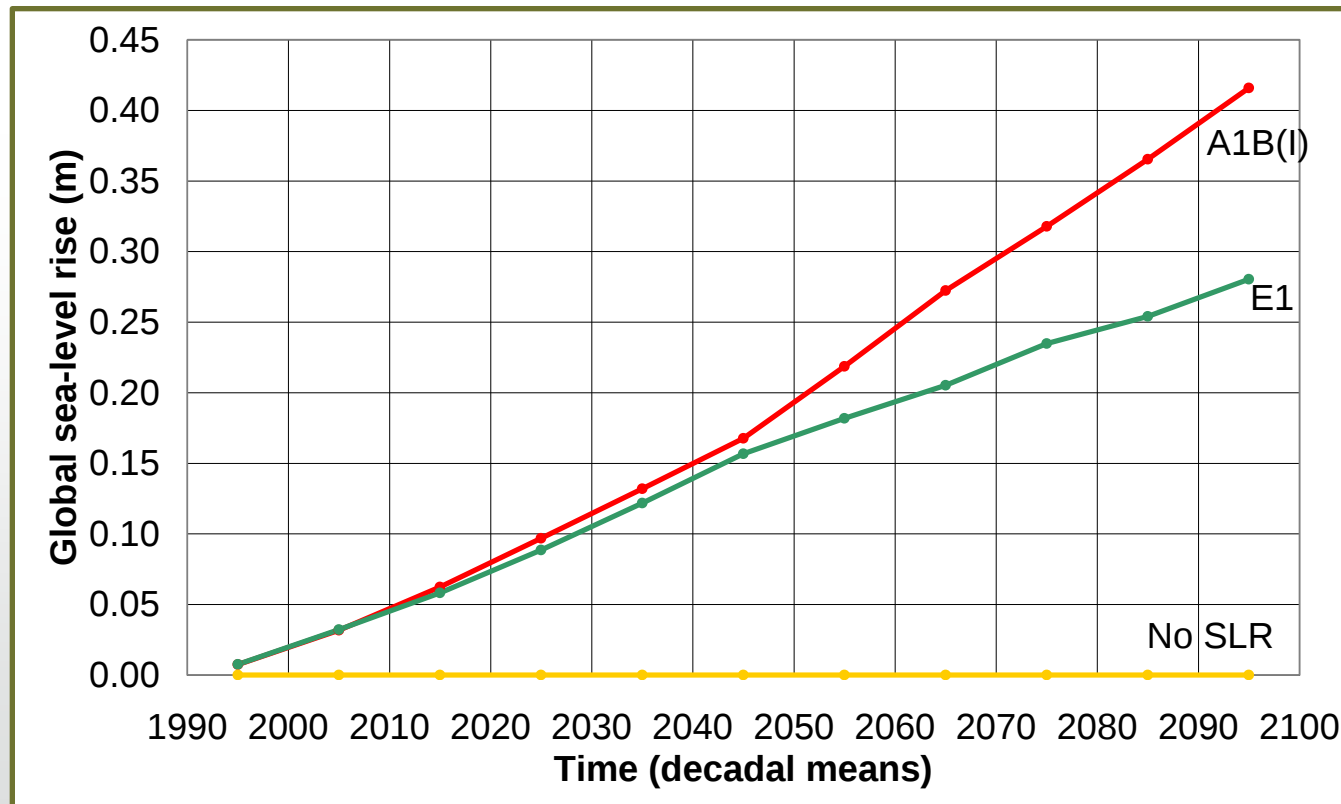
Why Europe?

- ④ Locally high population densities
- ④ Important cities
- ④ Important trade
- ④ Improve understand costs from a strategic planning perspective
- ④ Consider how to better protect the coast

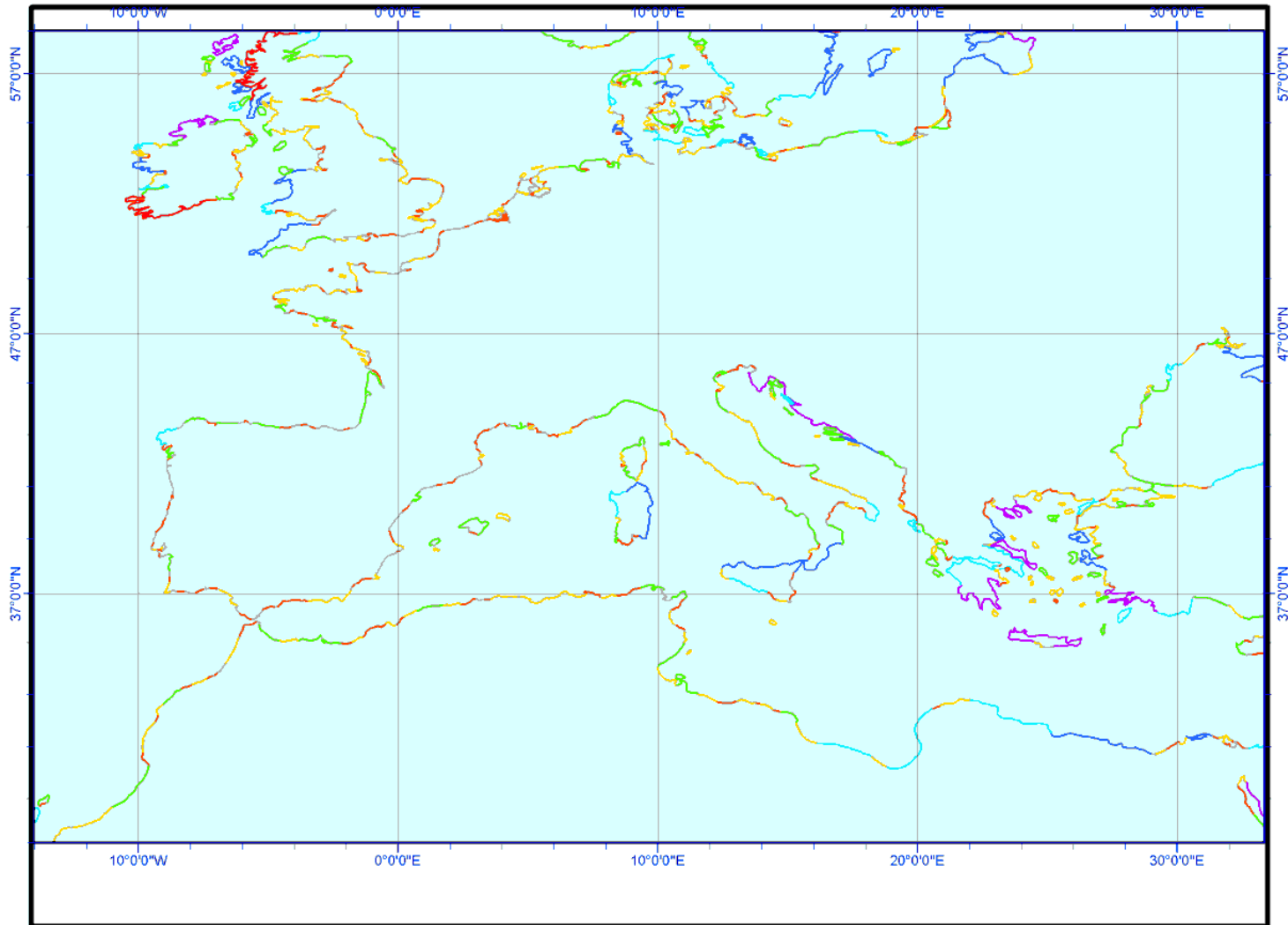
- Relative sea-level rise and other drivers
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Potential sea-level rise

- ⌚ 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)

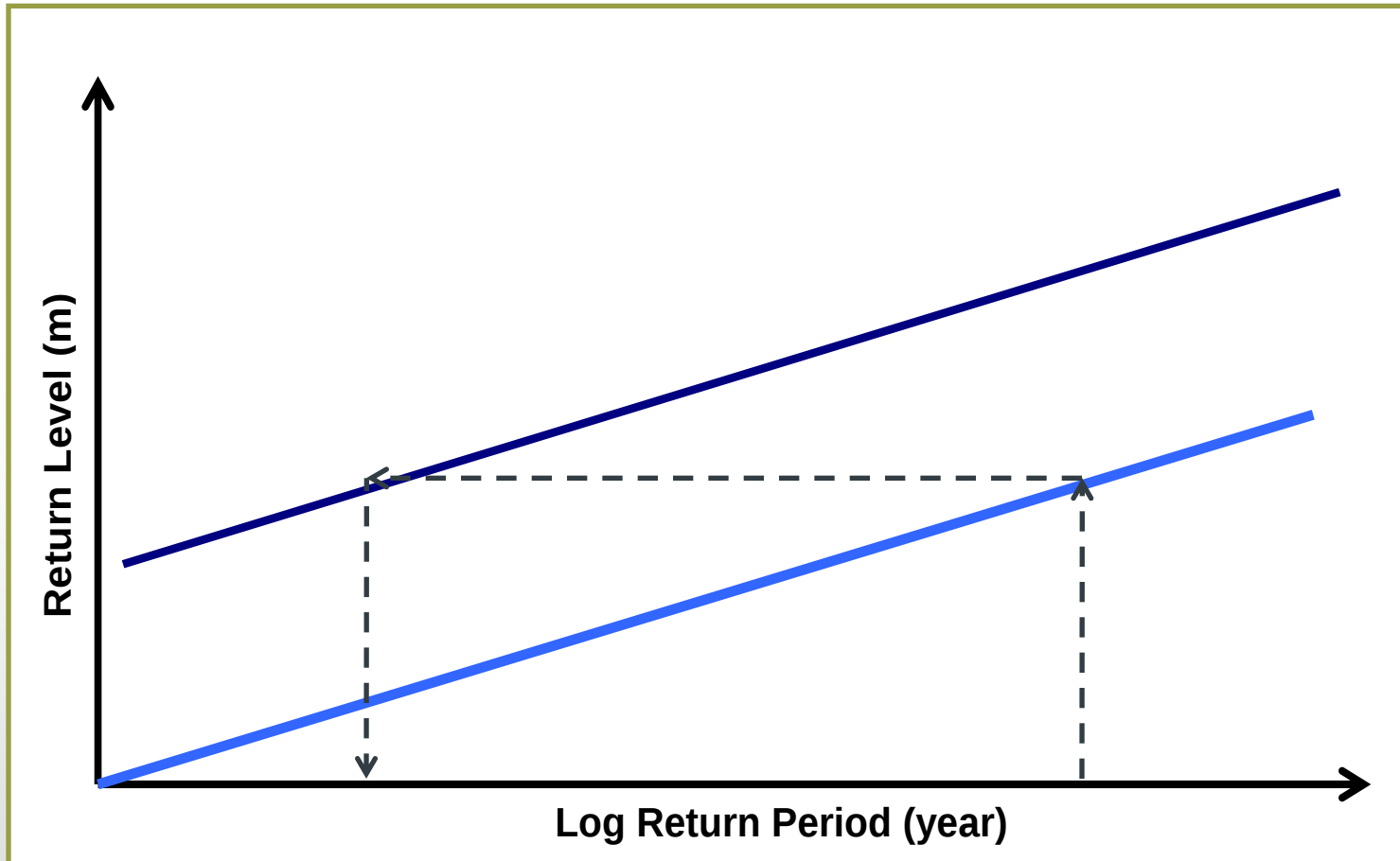


DIVA: Coastal Segments



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

DIVA: Return Period



UNIVERSITY OF
Southampton



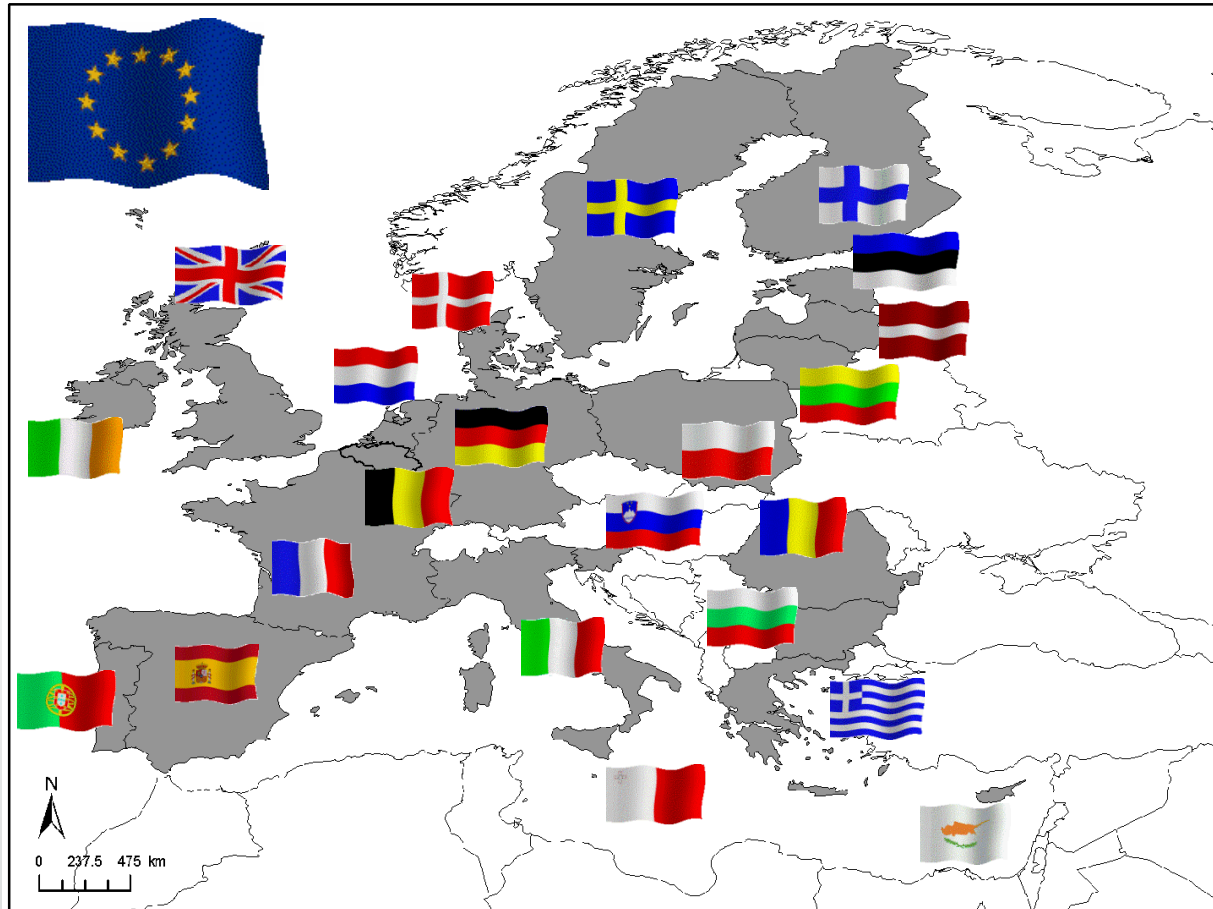
Parameters investigated

- ② Damage costs (2005 Euros, not discounted or uplifted): Sea floods, river floods, land loss, salinisation, people to migrate.
- ② 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

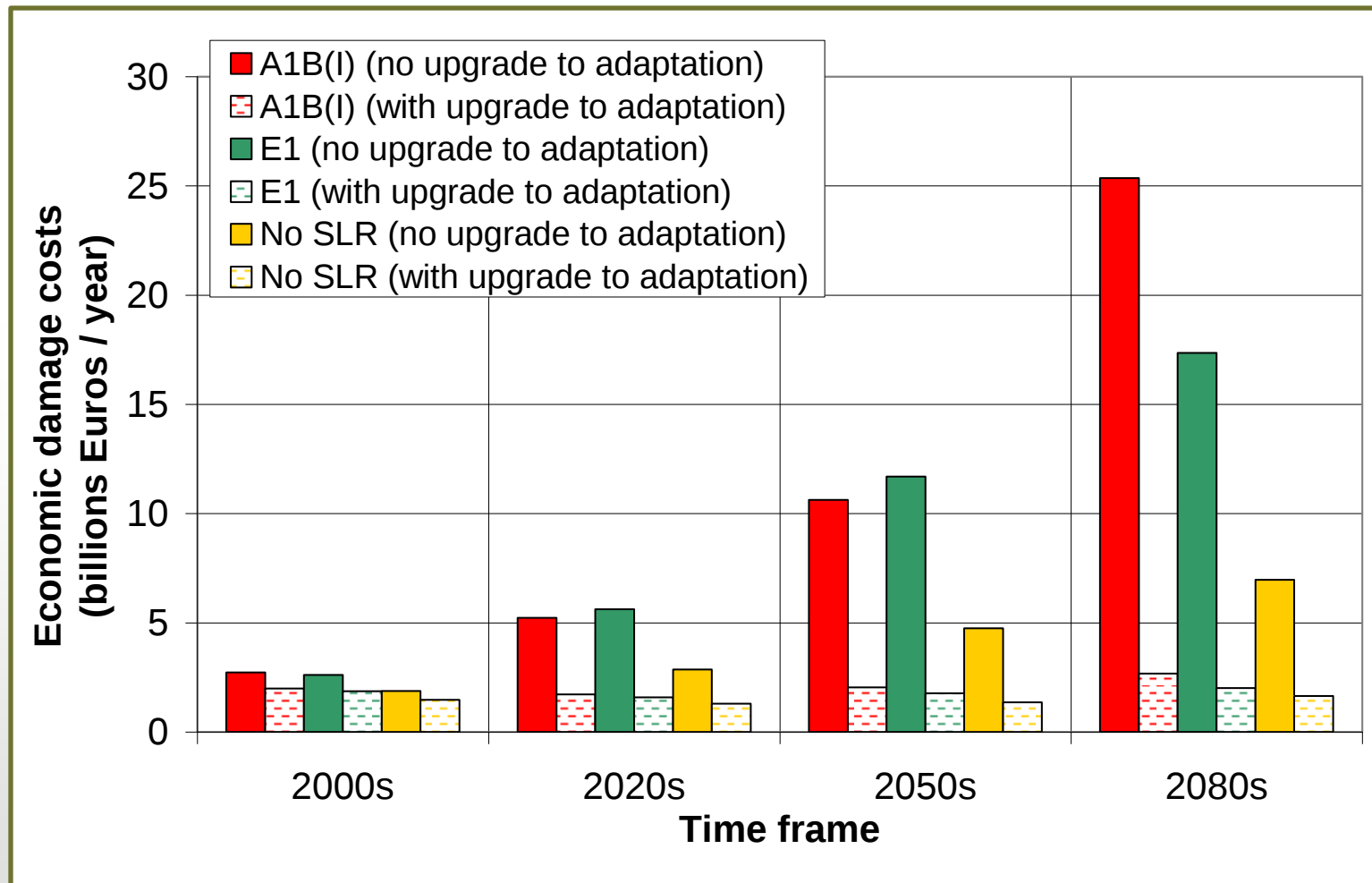
- Relative sea-level rise and other drivers
- Projections of sea-level rise and modelling impacts
- European costs
- Adaptation

@ 22 EU countries with a coastline (in 2010)



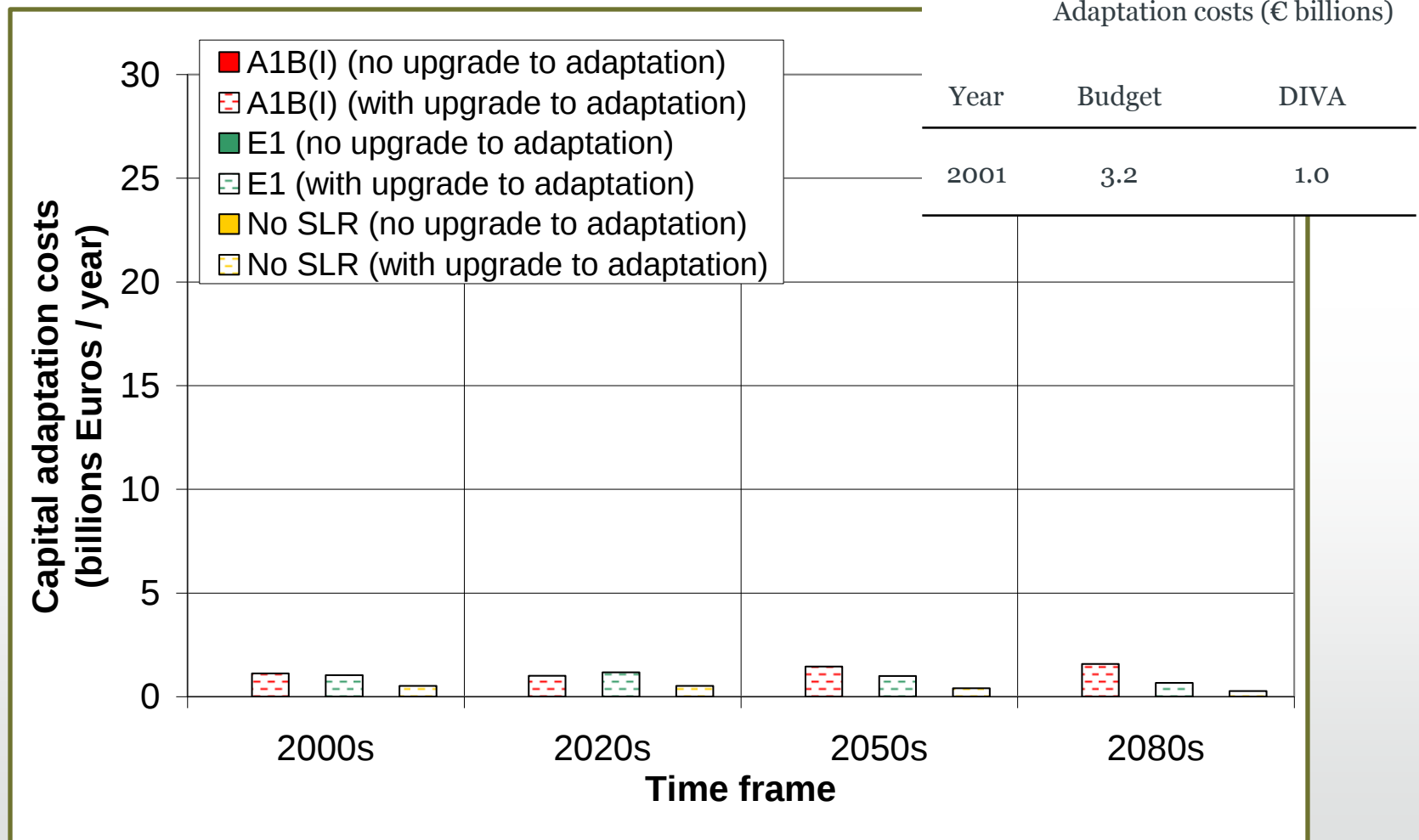
@ Data reported as thirty year means (2020s, 2050s, 2080s) ²⁶

EU damage costs



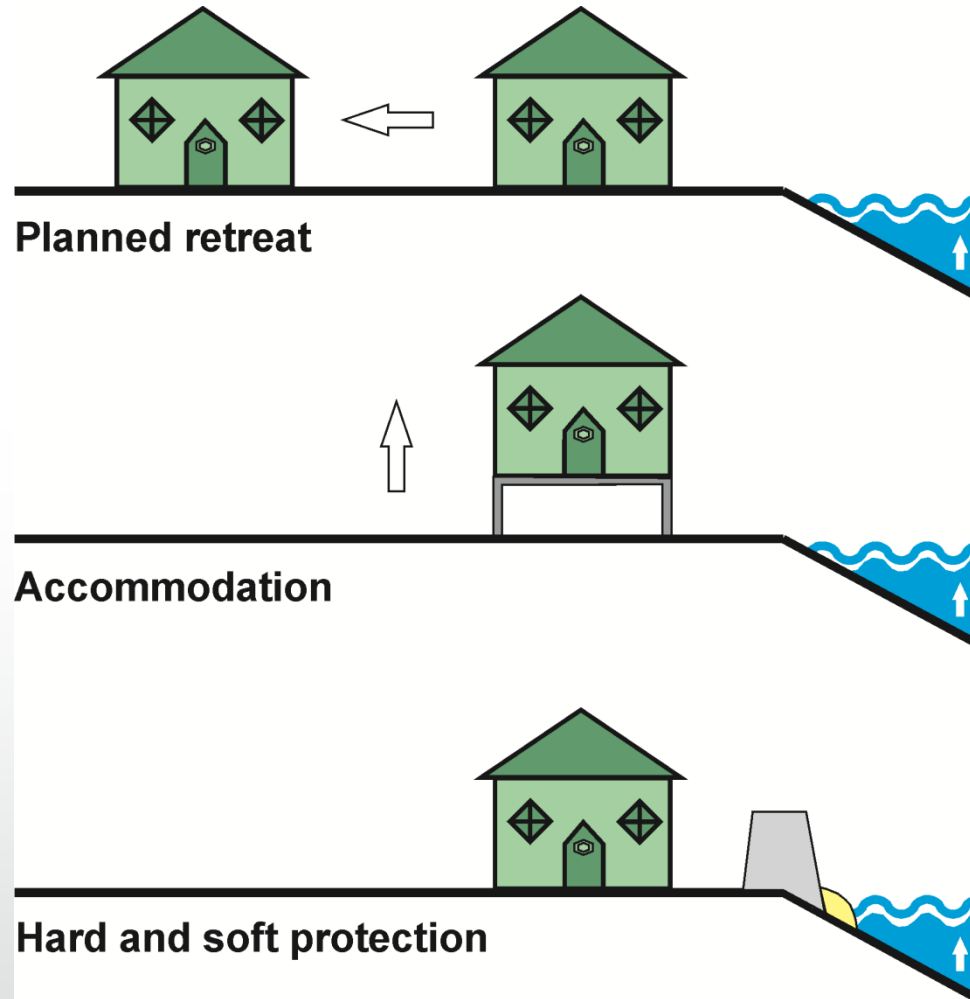
EU adaptation costs

Source: EuroSION (2004)



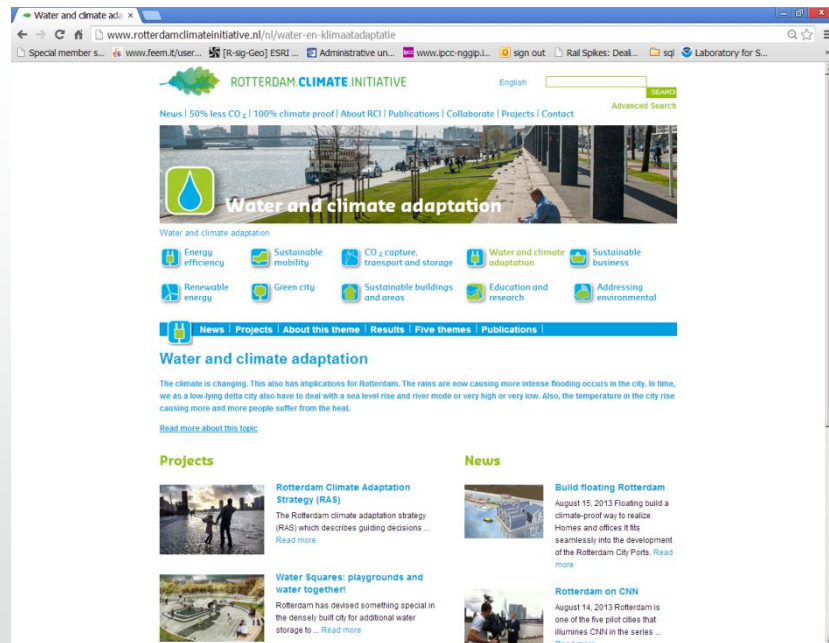
- Relative sea-level rise and other drivers
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Adaptation to sea-level rise

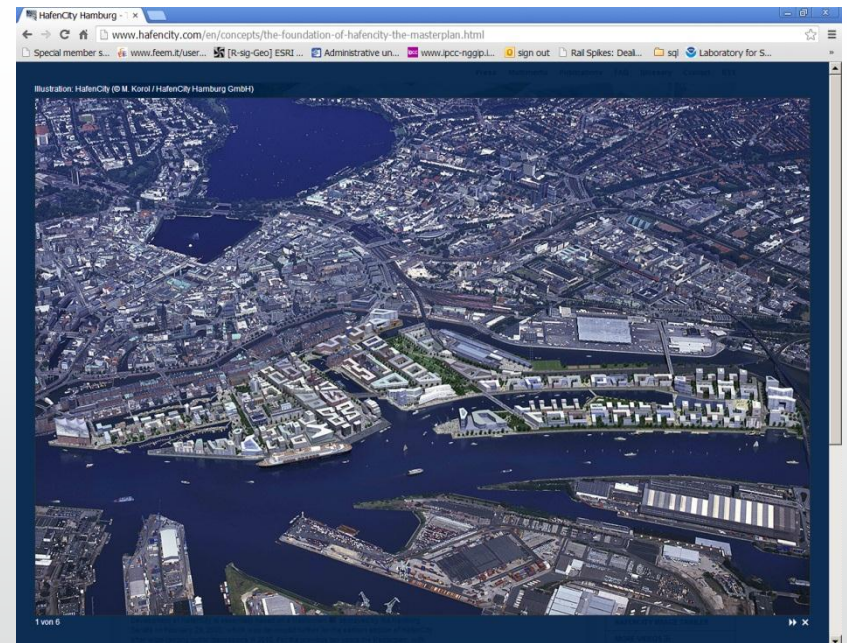


Adaptation to sea-level rise

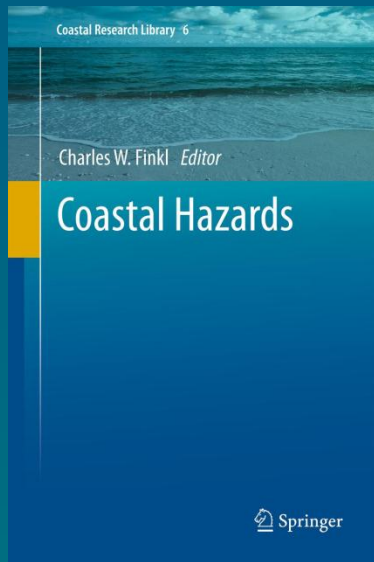
- Rotterdam:
Climate-proofing,
sustainability and energy
efficiency.



- HafenCity, Hamburg:
Redesigning the
waterfront to create a new
low flood risk area of the
city.



- ④ Climate mitigation does not stop sea-level rise, but will slow the rate of rise. Need to improve understanding the potential magnitude of sea-level -> Further monitoring.
- ④ Socio-economic change is important and will influence the magnitude of impacts and costs.
- ④ Adaptation remains essential and seems a wise and worthwhile investment -> Flexible about long-term adaptation: Promote awareness, broader range of options, more detailed assessments.
- ④ Put in context of the broader issues of integrated coastal zone management, considering other drivers of change.
- ④ 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>

