

Ad Hoc Expert Meeting on

**Climate Change Adaptation for
International Transport:
Preparing for the Future**

16 to 17 April 2019

Climate change and international transport

Presentation by

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Climate change and international transport

Michalis Vousdoukas

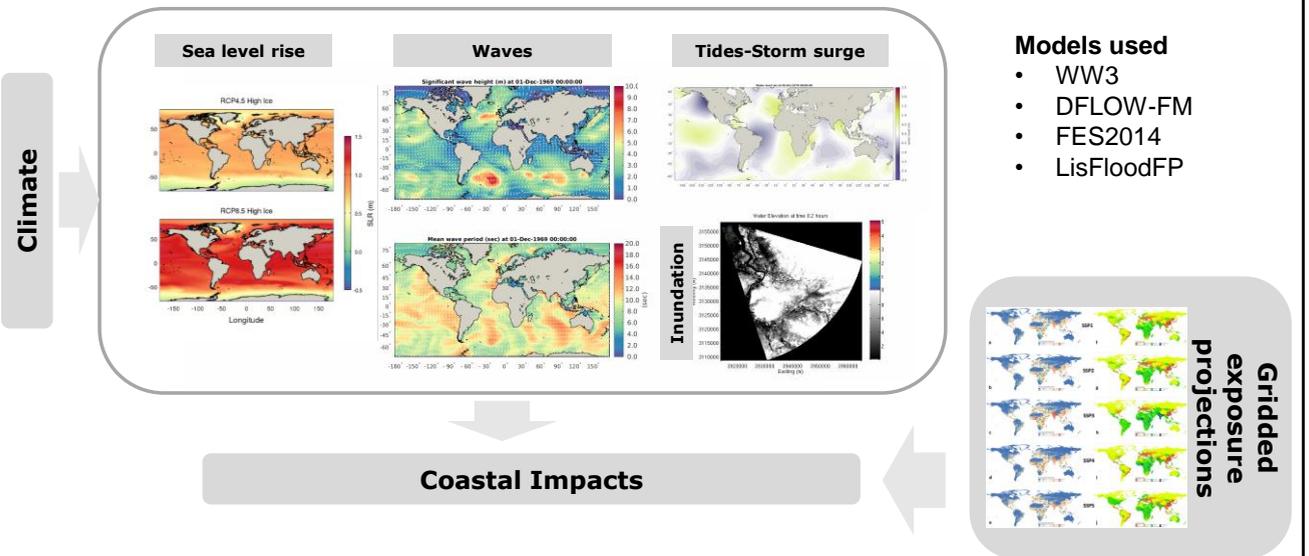
Disaster Risk Management
Directorate for Space, Security and Migration
Joint Research Centre



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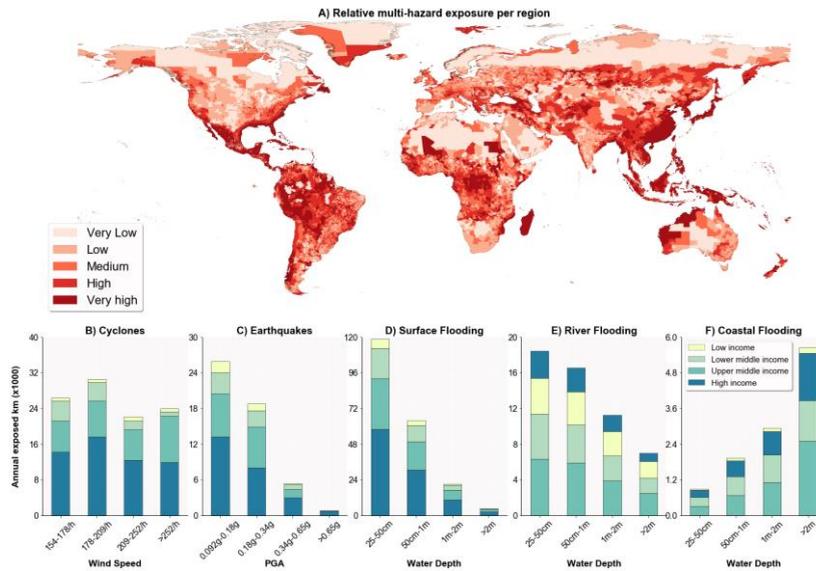
LISCoAsT – Large-scale Coastal Assessment Tool



<http://data.jrc.ec.europa.eu/collection/LISCOAST>



Global multi-hazard road and railway infrastructure exposure



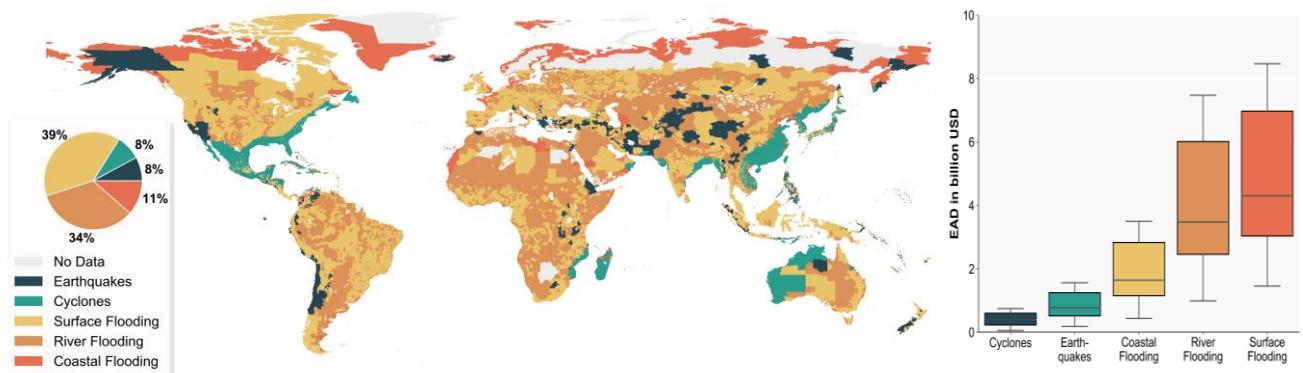
Global Expected Annual Damages (EAD) range from 3.1 to 22 billion US dollars, of which approximately 73% is caused by surface and river flooding.

Many coastal areas show high exposure to risk

Koks et al., Nature Communications (2019)



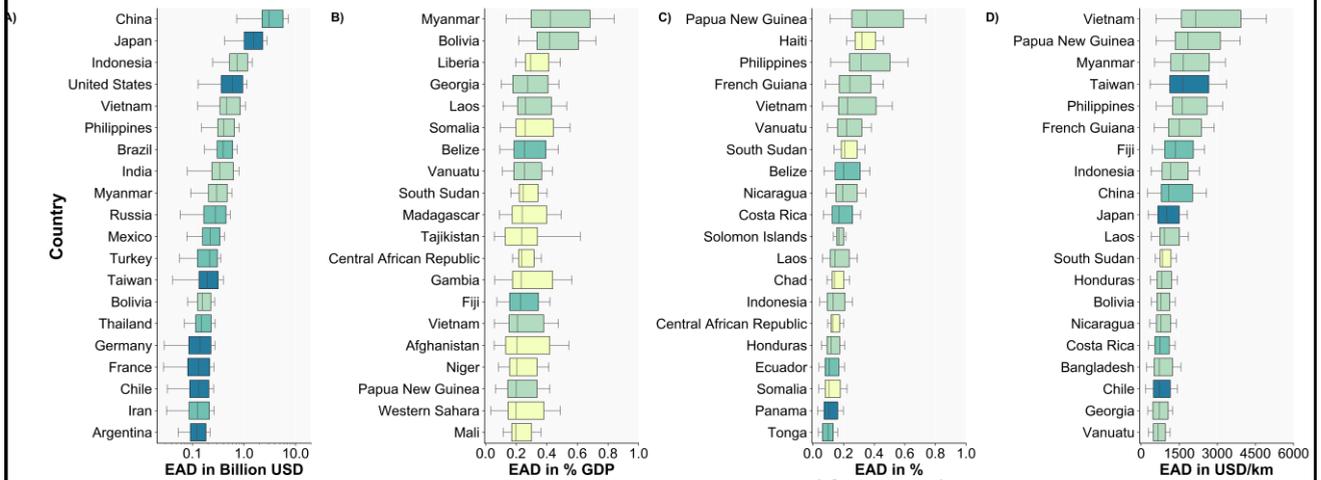
Global multi-hazard road and railway infrastructure exposure: Dominant hazard per region



Koks et al., Nature Communications (2019)



Global multi-hazard road and railway infrastructure exposure: Country level



Koks et al., Nature Communications (2019)



The right time to talk climate change is now

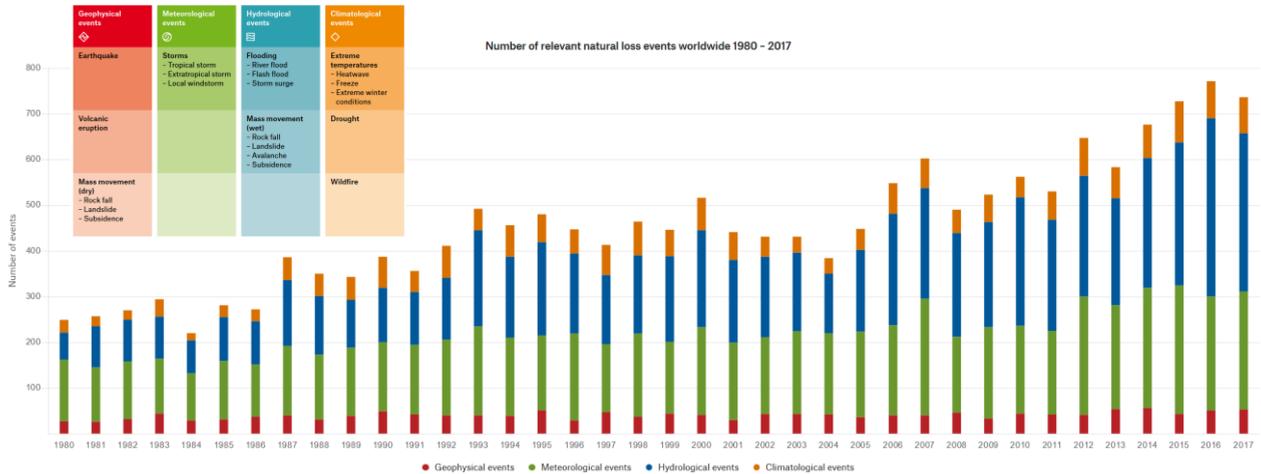
The Independent, August 2017
 Extreme weather could kill 150,000 people each year in Europe by the end of the century, say (JRC) scientists.

The Guardian, today
 Huge risk if global warming exceeds 1.5C, warns landmark UN report. Urgent changes needed to cut risk of extreme heat, drought, floods and poverty, says IPCC

CNN, August 2018
 Hot deadly summer
 Fires in Greece, Sweden and California, heat records across the world (China, Japan, South-Korea, Europe, North America, Middle-East, Africa), drought in northern Europe, Australia, flooding in Japan, India, ...

Flood Havocs Kerala

Number of natural loss events worldwide 1980 - 2017

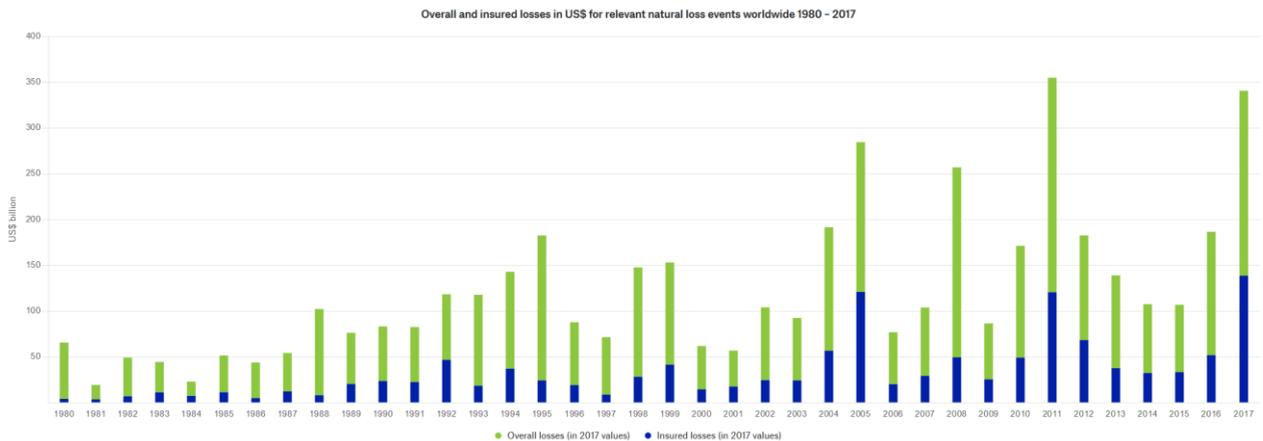


(NatCatSERVICE, MunichRE)

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Losses of natural events worldwide 1980 - 2017



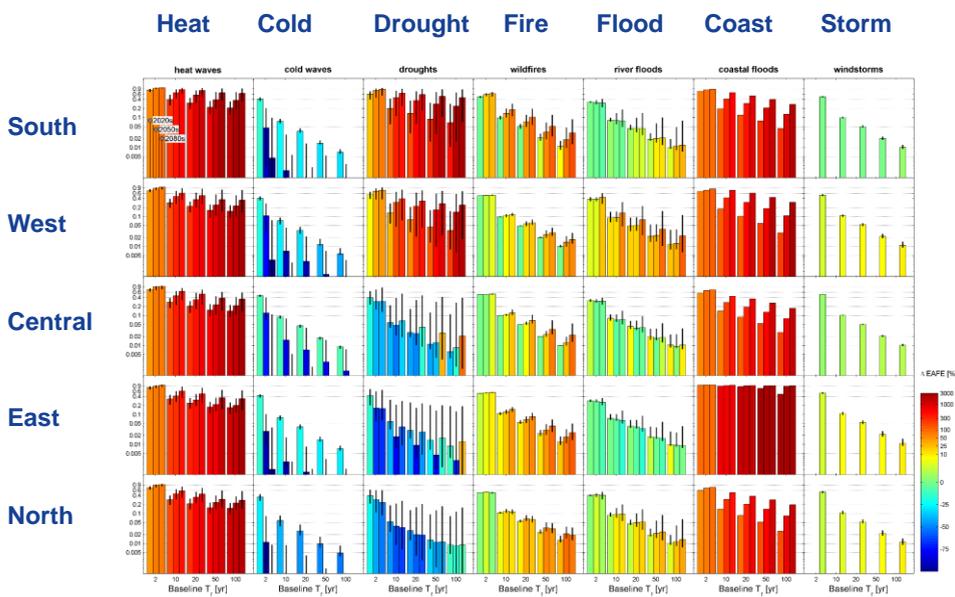
(NatCatSERVICE, MunichRE)

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Projections of multiple hazards in Europe

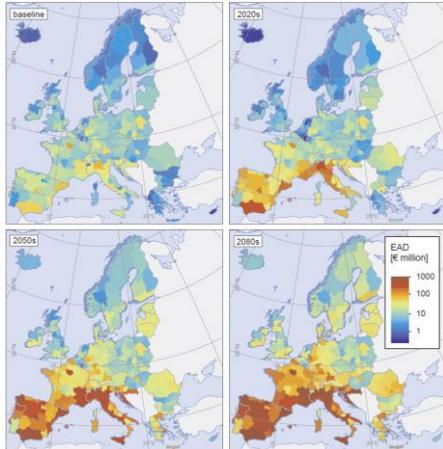


Strongest rise projected in heat and coastal hazard, for droughts in Southern Europe. Cold waves will become less important.

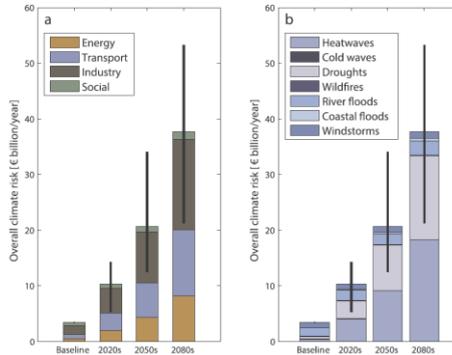
Forzieri et al.,
Climatic Change,
2016



Impact on Europe's critical infrastructures



Spatial pattern of overall climate hazard risk to critical infrastructures in the different time periods



Evolution in the 21st century of climate hazard damages to critical infrastructures in Europe

Escalating climate hazard damages to critical infrastructures in Europe with global warming.

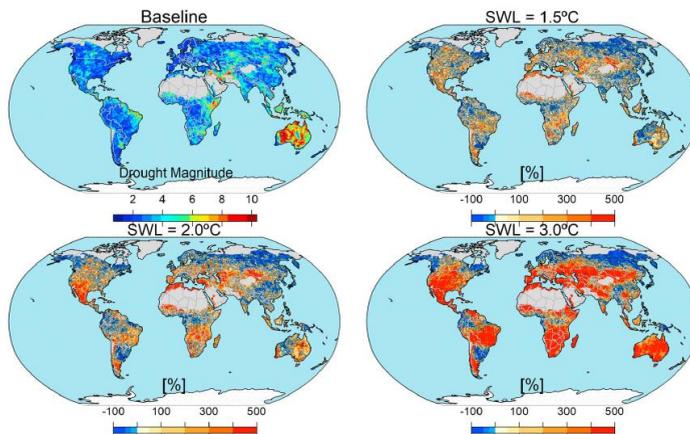
Uneven regional and sectorial distribution of future losses, adaptation requirements and capacity.

Forzieri et al., *Global Environmental Change*, 2018

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Global projections of drought hazard



Drought magnitude and relative changes (%) in drought magnitude with respect to the baseline for the three specific warming levels (1.5, 2.0, and 3.0° C).

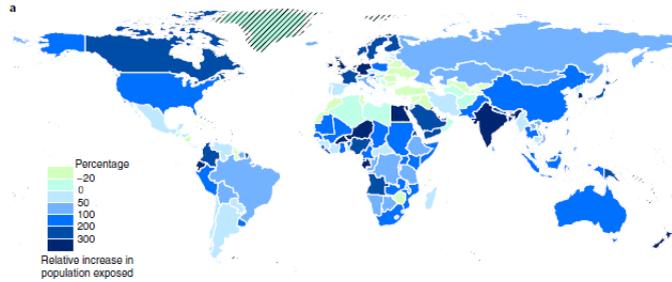
Two thirds of global population will experience a progressive increase in drought conditions with warming.

Naumann et al., *Geophysical Research Letters* (2017)

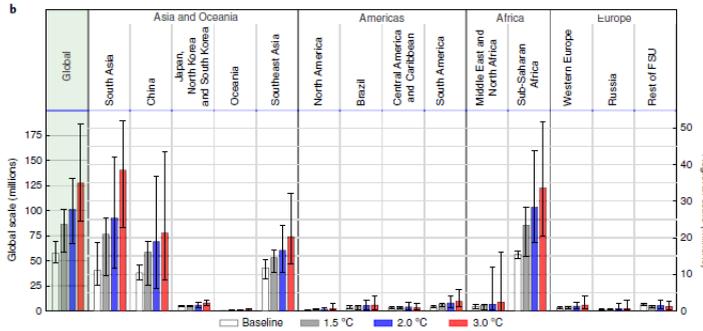
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Global projections of flood risk



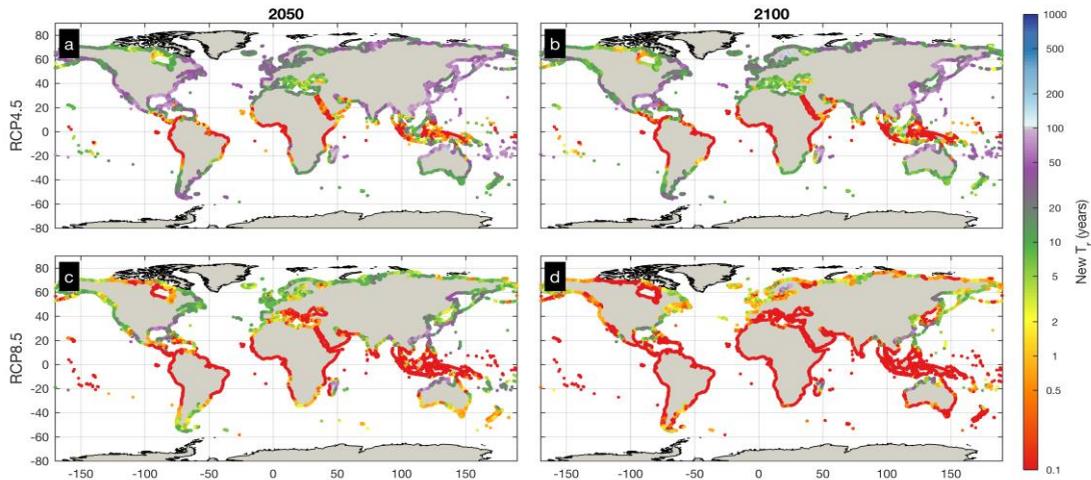
Flood risk is projected to rise in most parts of the world, with impacts increasing with the level of warming. Flood impacts are further shown to have an uneven regional distribution, with the greatest losses observed in the Asian continent at all analyzed warming levels.



Alfieri et al., *Earth's Future* (2017)
Dottori et al., *Nature Climate Change* (2018)

Rising seas and extreme weather

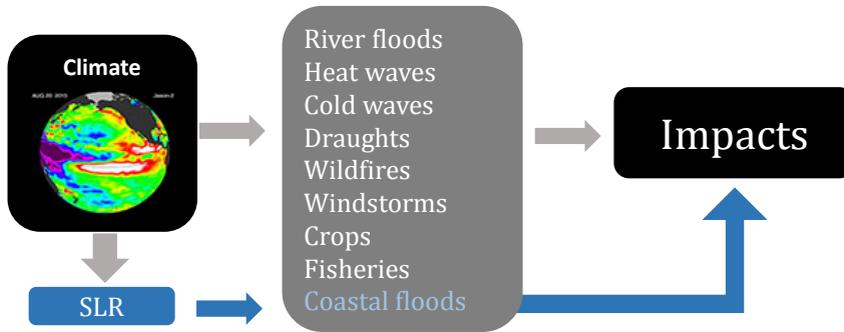
Vousdoukas et al. 2018 *Nature Communications*



Storm of the century occurs every year by 2050 along most of the tropics

By the end of the century along most of the global coastline

Rising seas and extreme weather



Coastal risk becoming one of the most threatening natural hazard

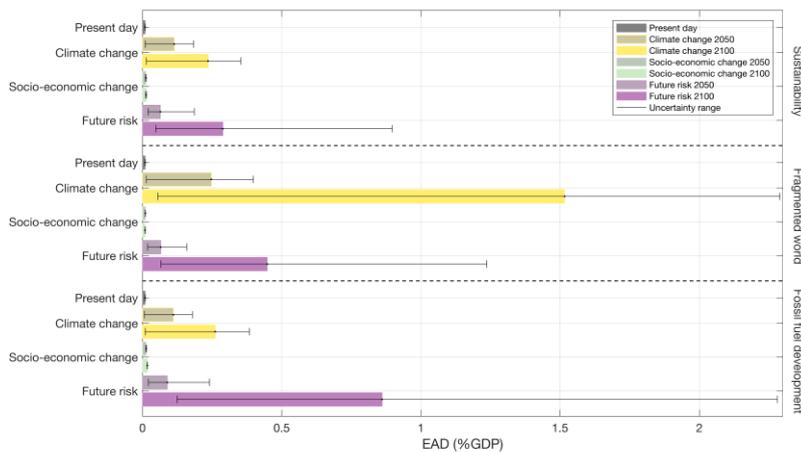
River floods: 0.04% Europe's GDP (present) ⇒ 0.1% GDP (future)

Coastal floods: 0.01% GDP ⇒ 0.29-0.86% GDP

(in absolute values increasing by 100 or even 1000 times)



Socio-economic vs Physical drivers



Vousdoukas et al. 2018 Nature Climate Change

Climate becomes the main driver of rising losses in contrast to historical trends which were dominated by socioeconomic development

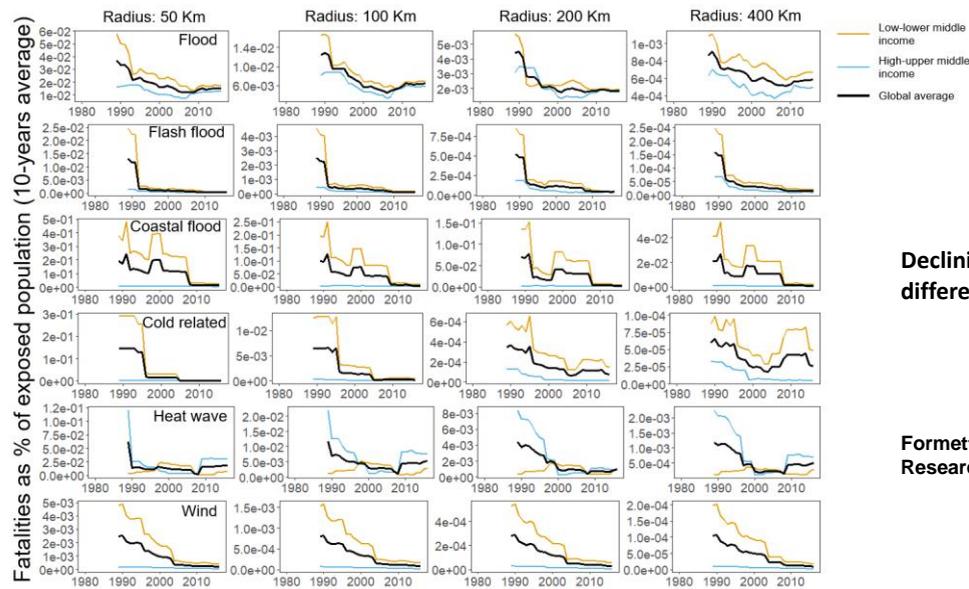




THE NEED TO TAKE MEASURES



Decline in vulnerability

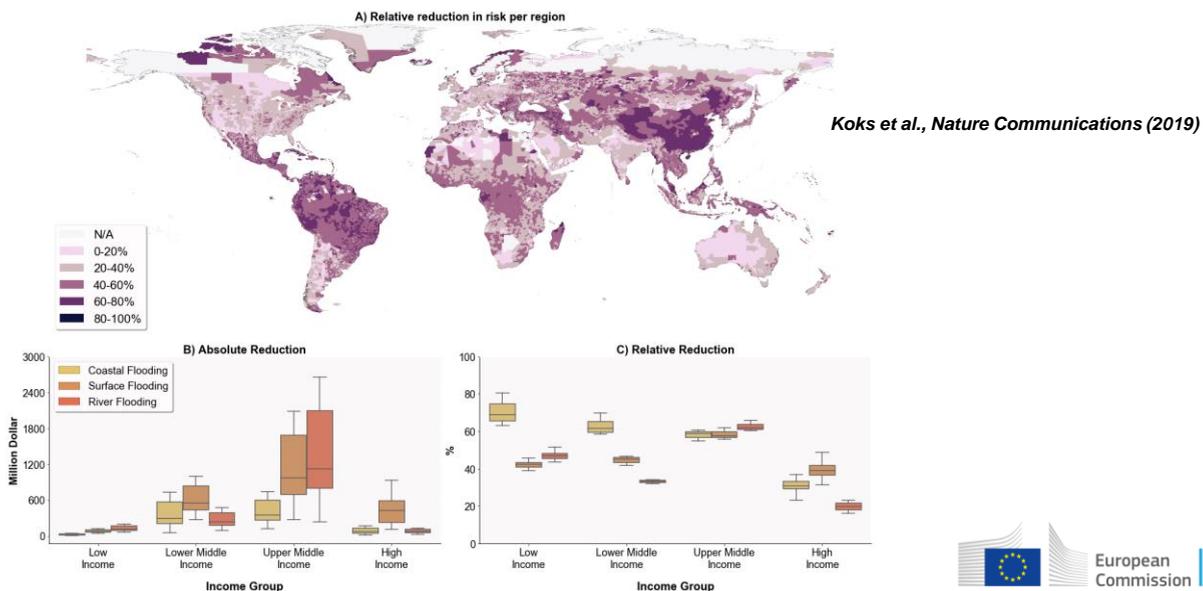


Declining global vulnerability to different climate hazards

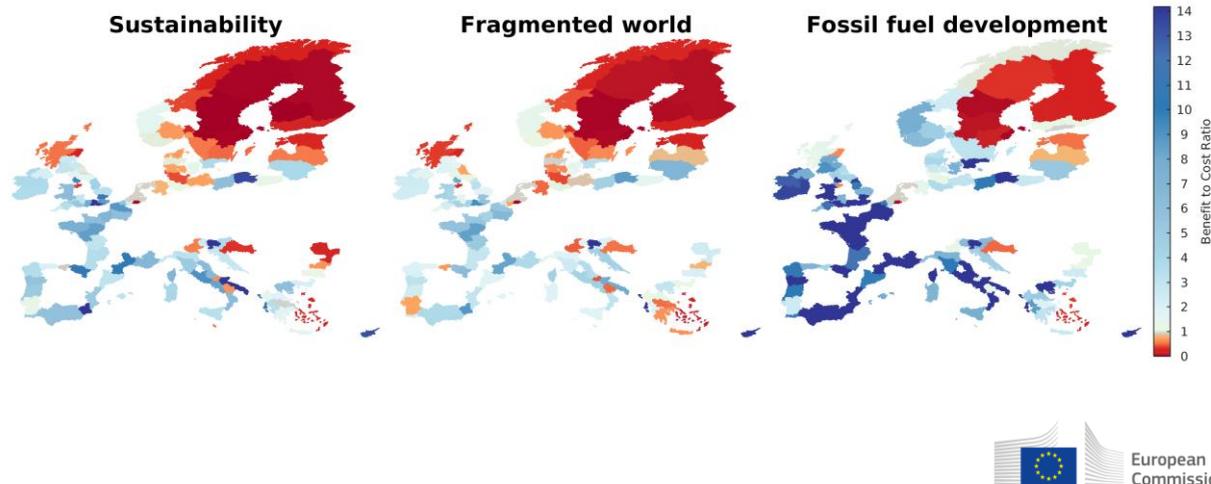
Formetta et al., Environmental Research Letters (2019)



Global multi-hazard road and railway infrastructure exposure: Benefits of adaptation

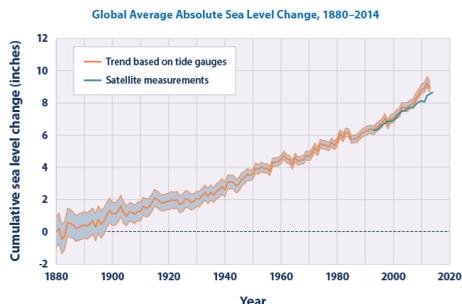


Benefits of adaptation: Results for Europe



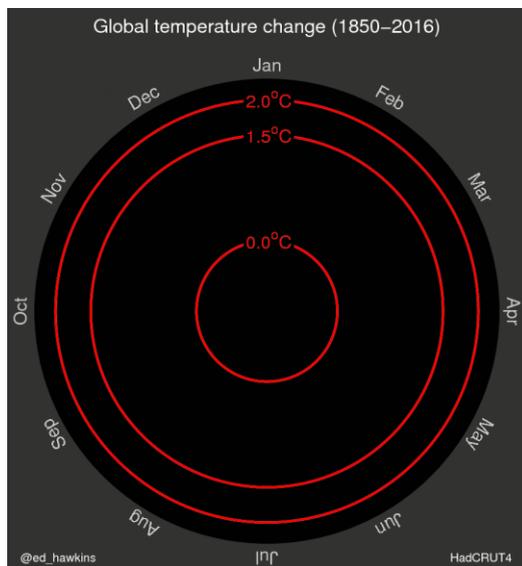
What is really at stake?

- The ocean absorbs >90% of the increase in energy
- Past sea levels under +1.5-2°C were 6-10 m higher than present
- Expansion of sea water per °C of warming is greater at higher temperature and higher pressure



Data sources:
 • CSIRO (Commonwealth Scientific and Industrial Research Organisation). 2015 update to data originally published in: Church, J.A., and N.J. White. 2011. Sea-level rise from the late 19th to the early 21st century. *Surv. Geophys.* 32:585-602. www.cmar.csiro.au/sea/level/SLR_data_cmar.html
 • NOAA (National Oceanic and Atmospheric Administration). 2015. Laboratory for Satellite Altimetry: Sea level rise. Accessed June 2015. http://fbis.gfdl.noaa.gov/SAT/SeaLevelRise/LSA_SLR_timeseries_global.php.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climatechange/indicators.



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HadCRUT4



A challenging path ahead...

- 100-1000 times increase in losses due to climate change
- Substantial risk for transport infrastructure
- Coastal hazard to overshadow river flooding
- Adaptation could already mitigate most of baseline losses
- It is inevitable in view of climate change
- Technically feasible but...
- Implementation at global scale can be challenging
- With substantial political, economic, and environmental costs, as well as social justice issues



Photos by www.wikipedia.org





Thank you very much...

<http://data.jrc.ec.europa.eu/collection/LISCOAST>

www.vousdoukas.com

