

UNCTAD National Workshop Jamaica

30 May – 1 June 2017, Kingston, Jamaica

“Climate Change Impacts and Adaptation for Coastal Transport Infrastructure in Caribbean SIDS”

LISCoAsT – Large Scale Integrated Sea- level and Coastal Assessment Tool: Application for the SIDS (II)

By

Michalis Vousdoukas

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Ispra, Italy

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LISCoAsT – Large scale Integrated Sea-level and Coastal Assessment Tool: Application for the SIDS

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"Climate change impacts and adaptation for coastal transport infrastructure in Caribbean SIDS"

Michalis Vousdoukas, Lorenzo Mentaschi, Evangelos Voukouvalas, Luc Feyen

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Disaster Risk Management Unit Directorate E, Joint Research Centre, EC

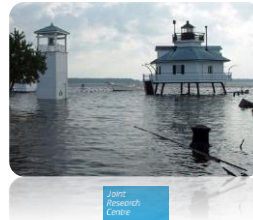
Activity on river floods:

European/Global Flood Awareness System (EFAS/GLOFAS)

Climate change projections (Alfieri L., Rojas R., Feyen L)

Coastal floods group:

Michalis Vousdoukas, Lorenzo Mentaschi, Evangelos Voukouvalas, Dimitrios Bouziotas, Tomas Montblanc, Georgia Kakoulaki, Francesco Dottori, Luc Feyen

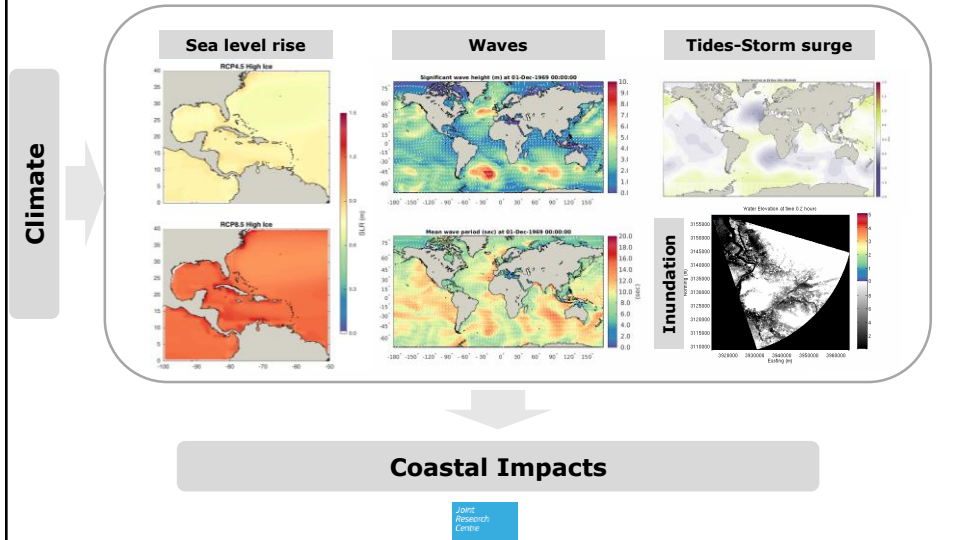


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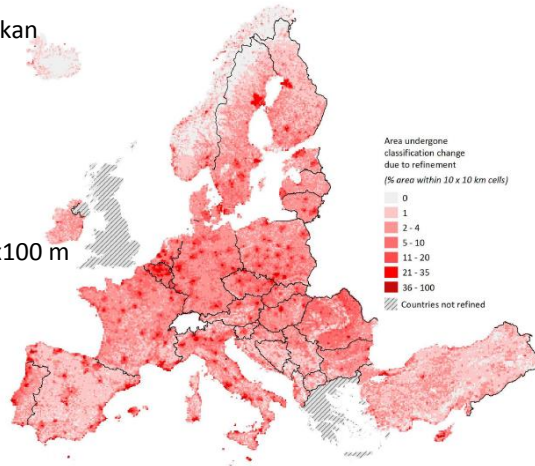
LISCOAST: Coastal Impact assessment



The LISCoAsT approach
EXPOSURE-VULNERABILITY

Exposure: current land use and population

- 2006 land use map, 100x100 m
- EU27 + EFTA + Turkey + Balkan
- 45 thematic classes
- Refined CORINE land use
 - Soil Sealing Layer
 - TeleAtlas®
 - Urban Atlas
- 2006 population map, 100x100 m
- EU27 + EFTA
- SSPs



Batista e Silva, F., Lavallo, C., Koomen, E., 2013. A procedure to obtain a refined European land use/cover map. *Journal of Land Use Science*, 8 (3), pp. 255-283.
 Batista e Silva, F., J. Gallego, C. Lavallo, 2013. A high-resolution population grid map for Europe. *Journal of Maps*, 9, 16-28.

Mapping of large infrastructures and key economic assets

- Non renewable Power Plants (MW)
- Electricity distribution lines (km)
- Unesco cultural sites (number)
- Social infrastructure (number)
- Ports/Airports (No People Served)
- Transport networks (No People Served)
- Urban transport (No People Served)

Transmission lines



Below 220kV
 220kV - 299kV
 300kV - 379kV
 380kV - 499kV
 500kV - 999kV
 DC

Ports



Railway network

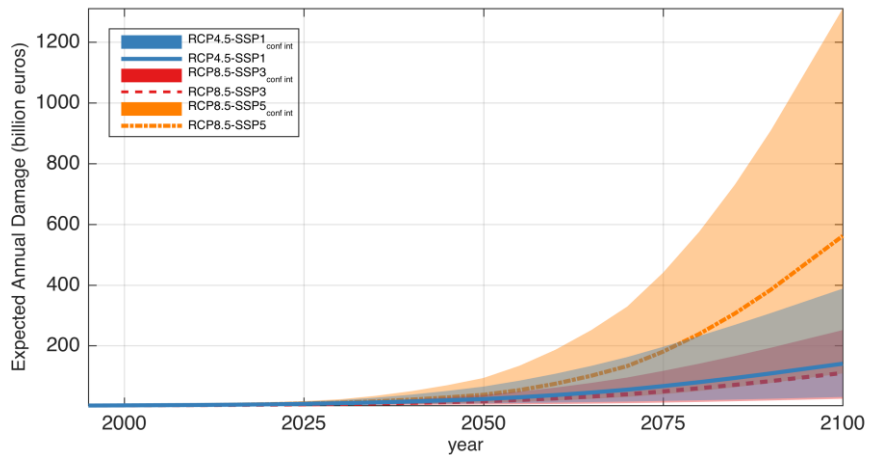




Results

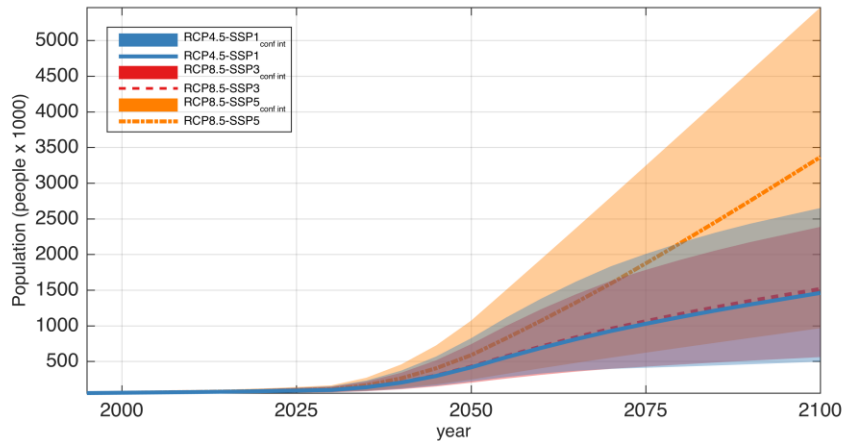
PROJECTIONS OF COASTAL IMPACTS FOR EUROPE

Projections of EAD for RCP4.5 and 8.5



Only direct impacts!

Projections of EA number of people affected

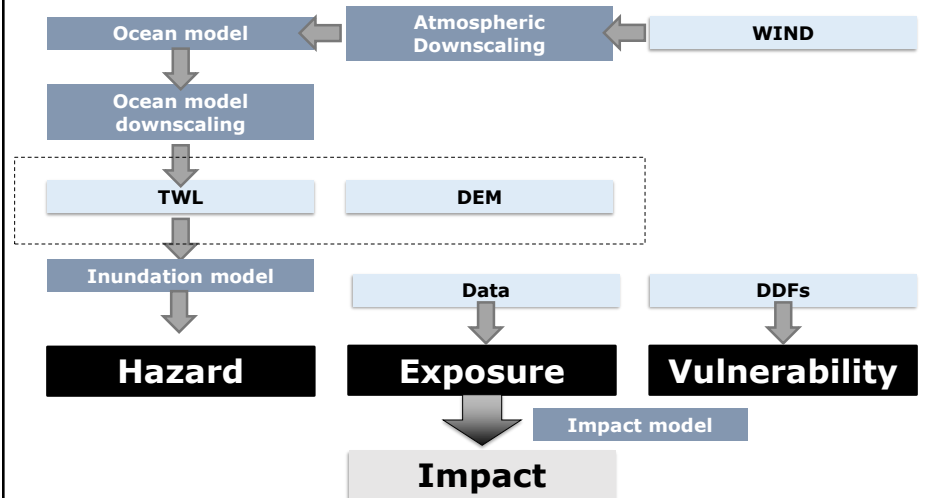


Only direct impacts!

Critical aspects

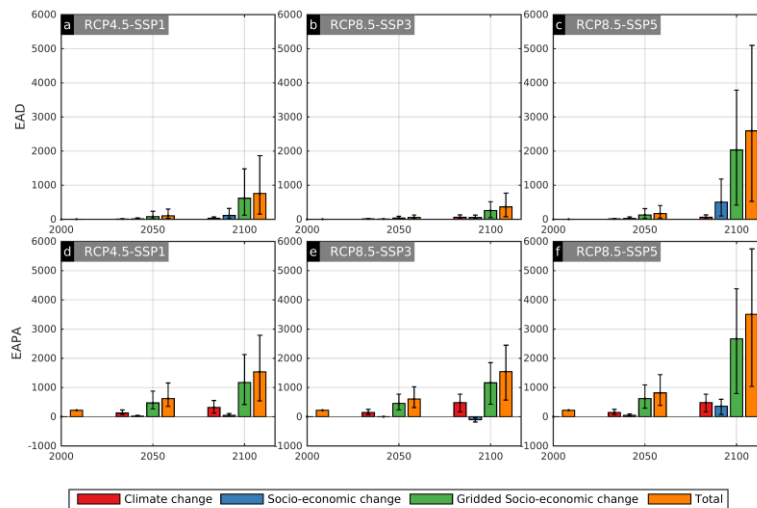
- Temporal and spatial scales
- Consider all processes (tides, waves, storm surge, erosion, protection failure, etc), or exclude the right ones ☺
- Data quality
- Find the right inundation model for the scale and data quality
- Exposure maps, stationary or dynamic
- Find the right impact assessment methodology
- Adaptation pathways

Critical aspects



7 June 2017

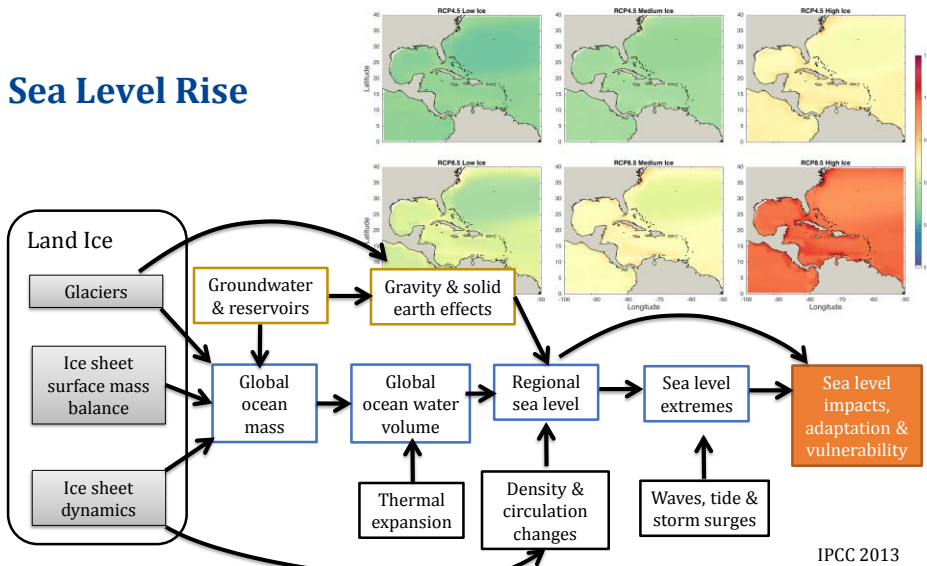
Coastal impacts- Socio-economic vs Physical





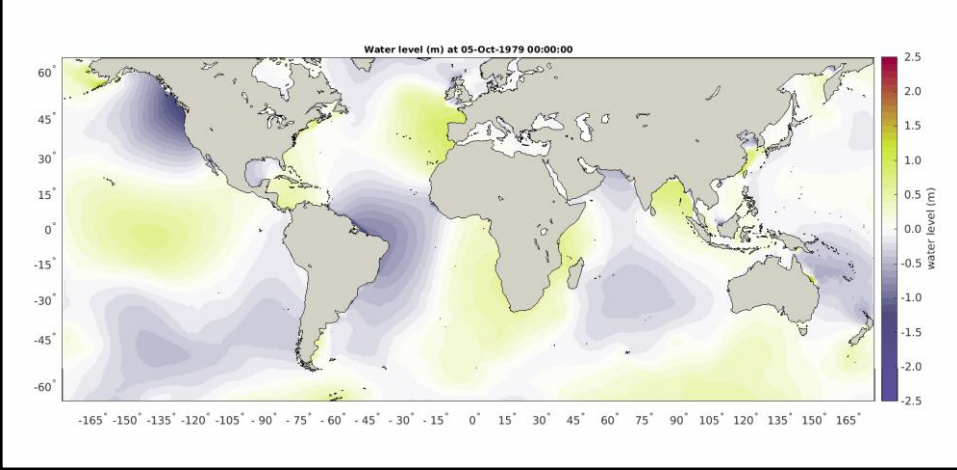
The LISCoAsT approach
HAZARD PROJECTIONS

Sea Level Rise

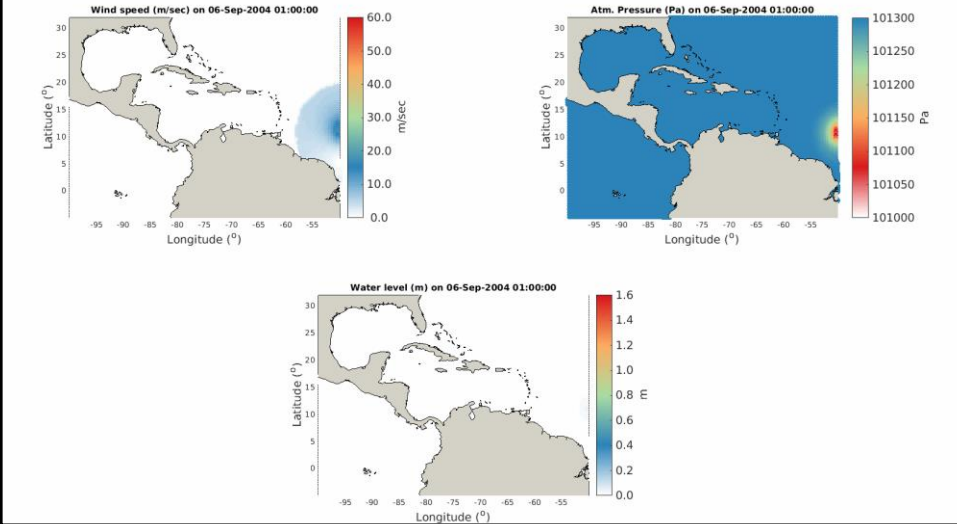


Sea level extremes: Global Storm Surge Model

Model used: DFLOW
 Simulated tidal, wind and pressure driven ocean circulation
 Flexible mesh
 Nearshore resolution 0.11° x 0.05°
 Offshore resolution 0.94° x 0.42°



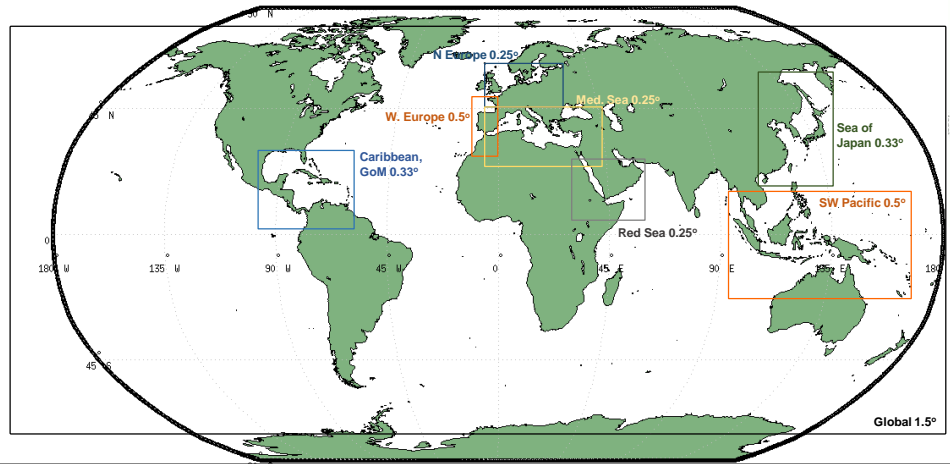
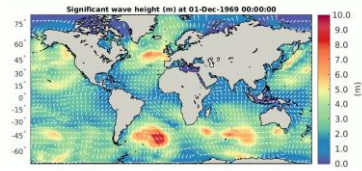
Sea level extremes: Tropical cyclones





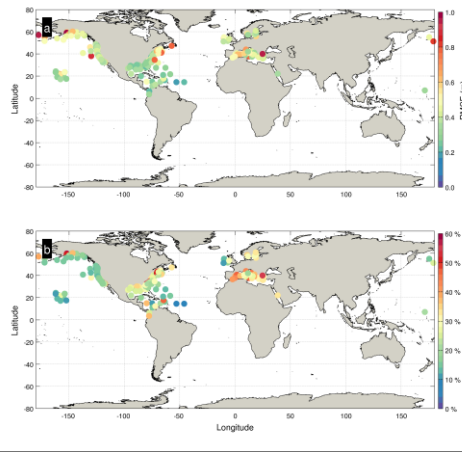
Global wave model

- Multi-grid runs
- Arduin setup
- Forced by ERA INTERIM (validation) and CMIP5 winds (projections)
- 6-member climate model ensemble

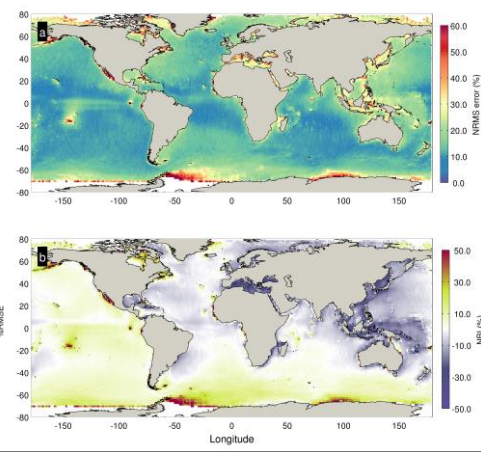


Ongoing activities - Global wave model

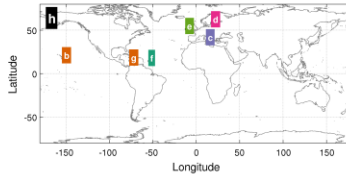
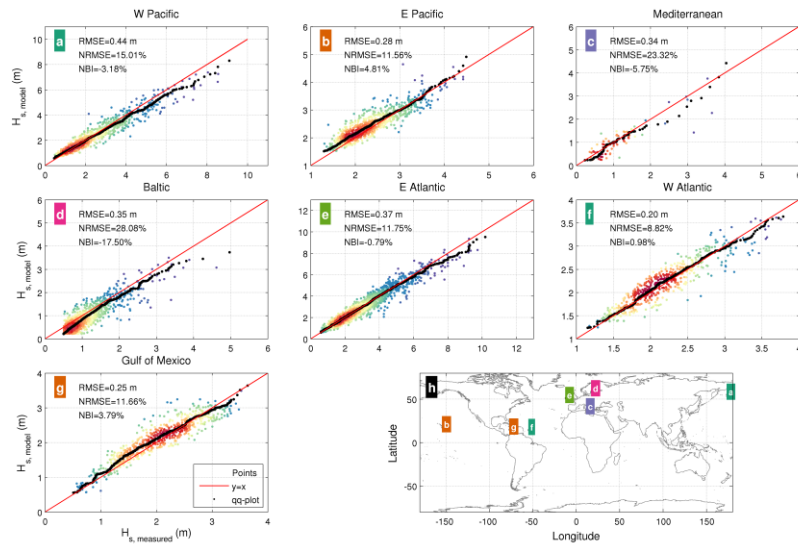
Validation against buoy data



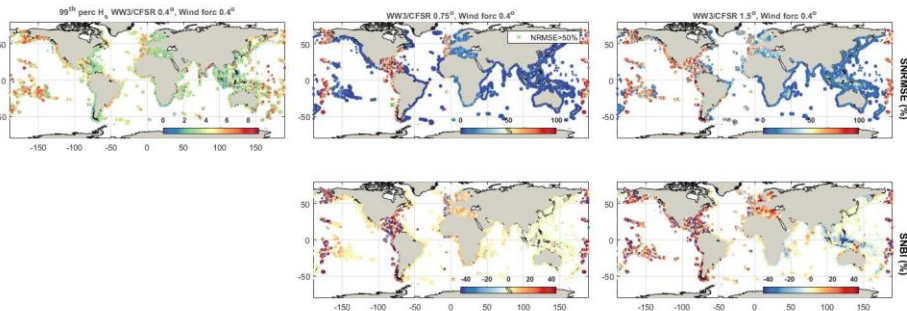
Validation against satellite data



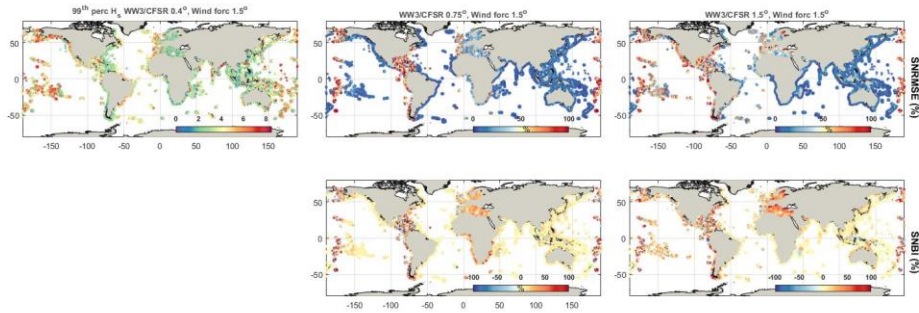
Ongoing activities - Global wave model



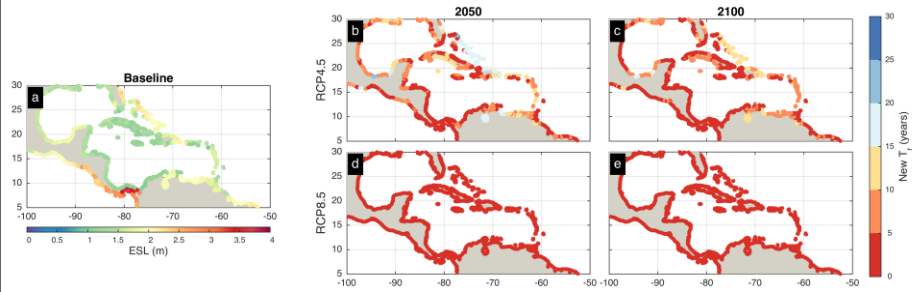
Sea level extremes: Grid resolution effects



Sea level extremes: Forcing resolution effects



Caribbean TWL projections: Changes in frequency



Data to be available



<https://global-surface-water.appspot.com>

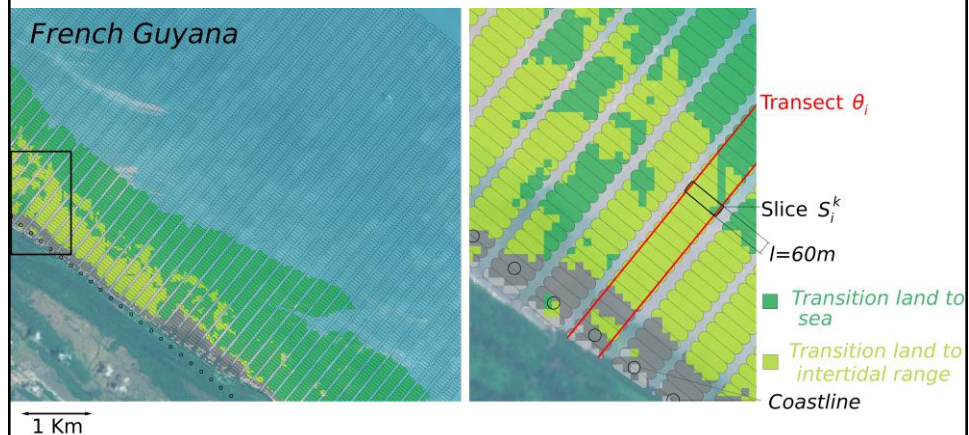
Current Global Erosion Trends



Joint Research Centre

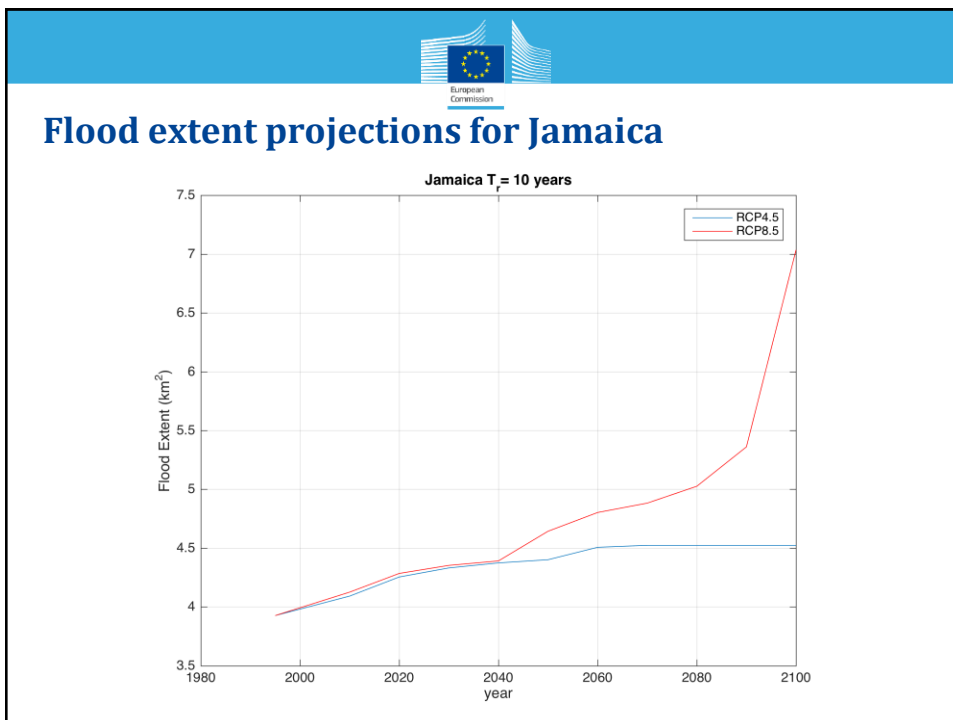
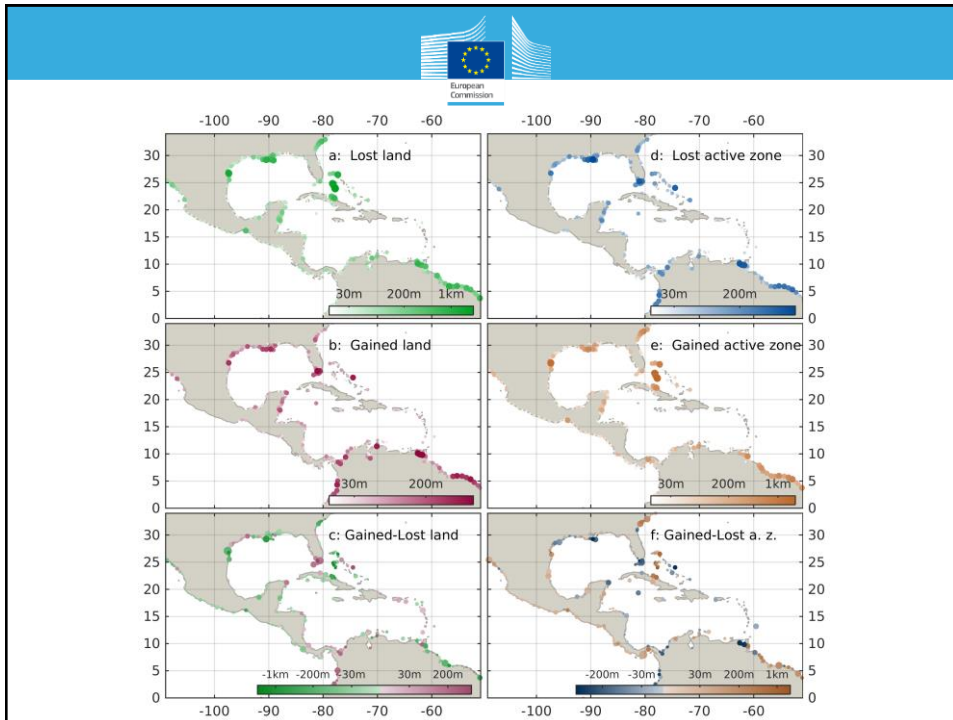


Long-term shoreline dynamics

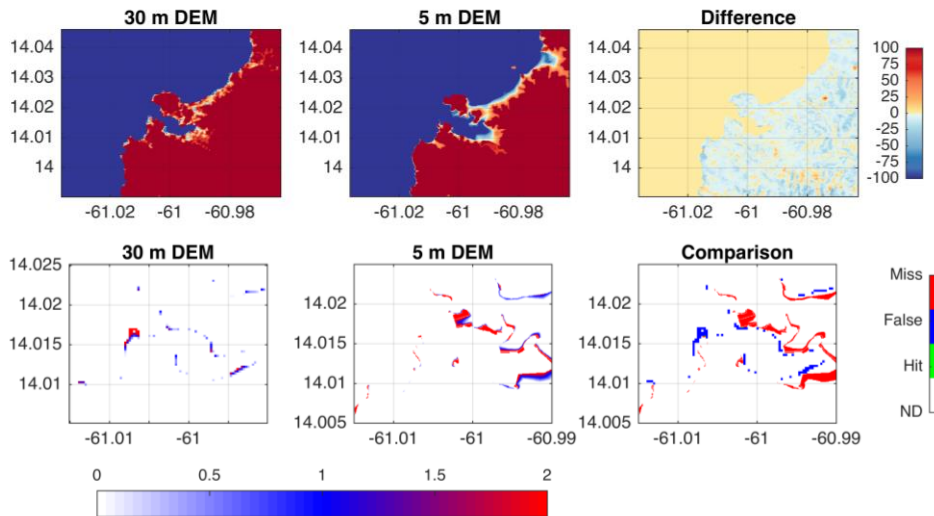


Based on Pekel et al 2016, Nature
3000000 Landsat satellite images
Past 32 years
30 m resolution

Joint Research Centre



Digital Elevation data



2D vs 3D inundation simulations




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doi:10.5194/nhess-2016-124
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Research article

Developments in large-scale coastal flood hazard mapping

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Received: 04 Apr 2016 – Accepted: 08 Apr 2016 – Published: 11 Apr 2016

Abstract. Coastal flooding related to marine extreme events has severe socio-economic impacts, and even though the latter are projected to increase under the changing climate, there is a clear deficit of information and predictive capacity related to coastal flood mapping. The present contribution reports on efforts towards a new methodology for mapping coastal flood hazard at European scale, combining (i) the contribution of waves to the total water level; (ii) improved inundation modelling; and (iii) an open, physics-based framework which can be constantly upgraded, whenever new and more accurate data become available. Four inundation approaches of gradually increasing complexity and computational costs were evaluated in terms of their applicability for large-scale coastal flooding mapping: static inundation (SM); a semi-dynamic method, considering the water volume discharge over the dykes (VD); the Flood Intensity Index approach (IW); and the model LISFLOOD-FP (LFP). A validation test performed against observed flood extents during the Xynthia storm event showed that SM and VD can lead to an overestimation of flood extents by 33% and 20% while IW and LFP

Discussion papers

Abstract Discussion Metrics

11 Apr 2016

Review status
This discussion paper is under review for the Journal Natural Hazards and Earth System Sciences (NHES).

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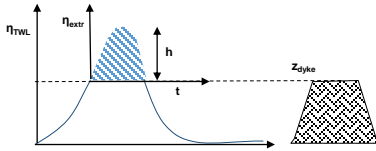
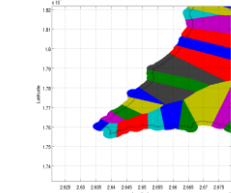
Journal metrics
IF 1.735


European Commission

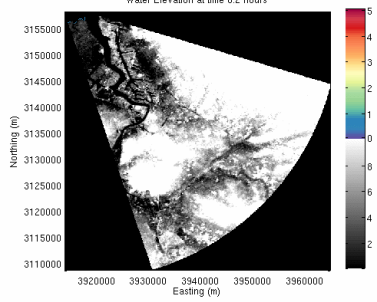
Coastal Inundation on EU scale

Several approaches initially tested:

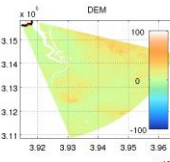
- Maximum potential impact
- Areas below with $z < TWL$
- Areas below with $z < TWL$ that are hydrologically connected to the s
- Overflow volume approach

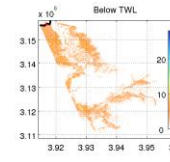
Water Elevation at time 0.2 hours



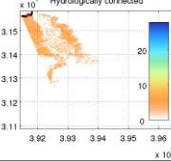
DEM



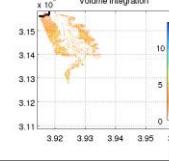
Below TWL



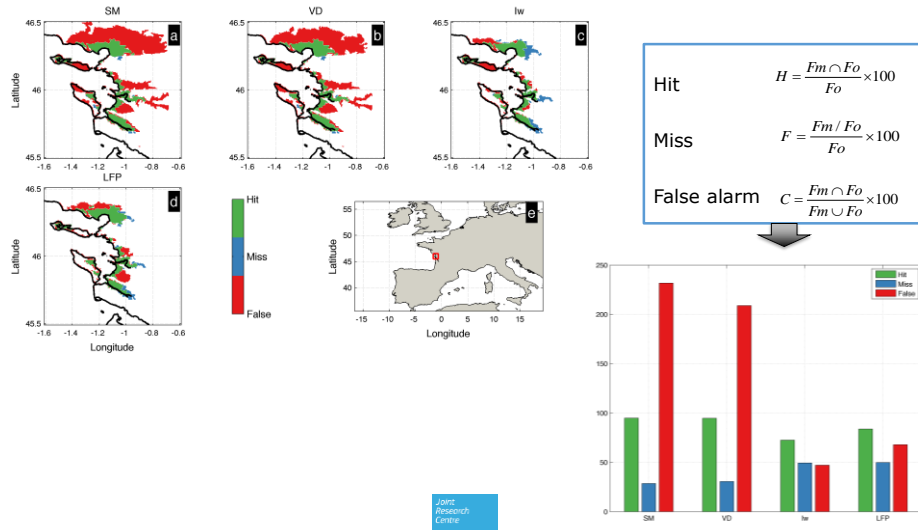
Hydrologically connected



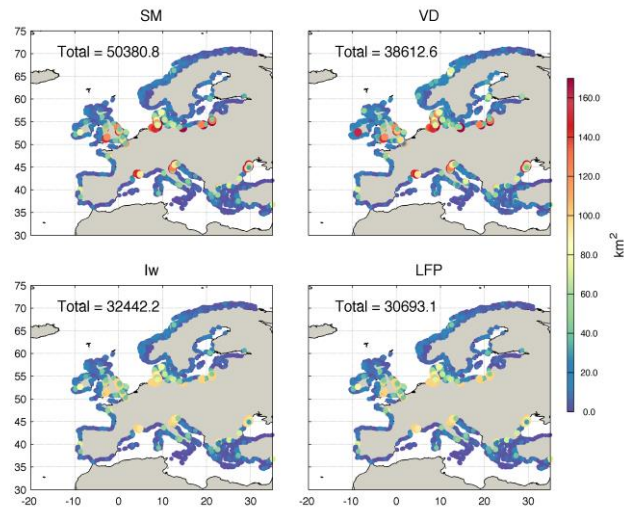
Volume integration



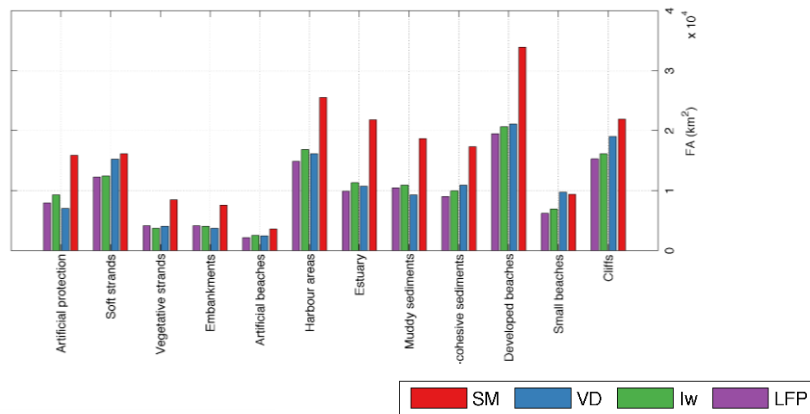
Validation for the Xynthia storm



European scale application for the present-day 100-year event



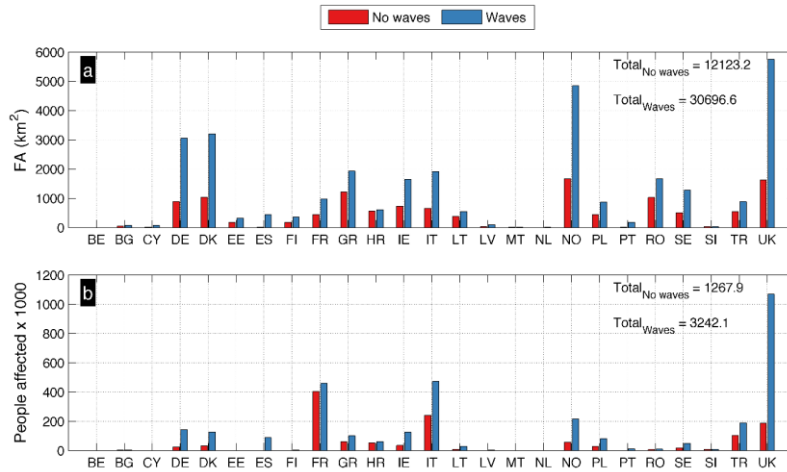
European scale application for the present-day 100-year event



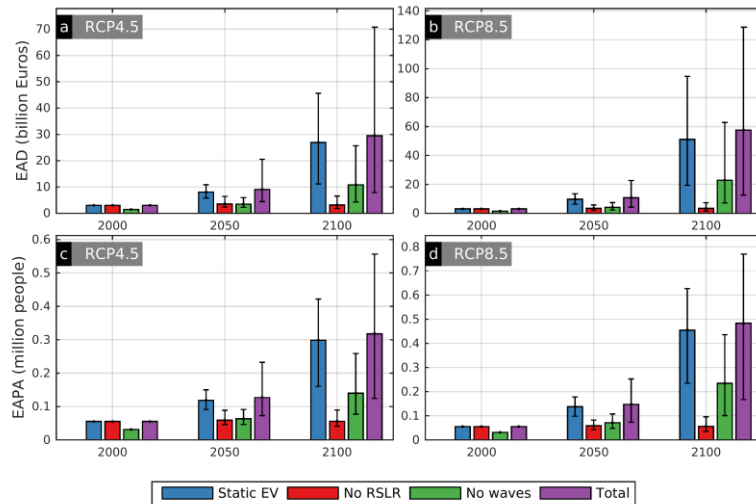
Coastal Inundation: considering waves



European scale application for the present-day 100-year event



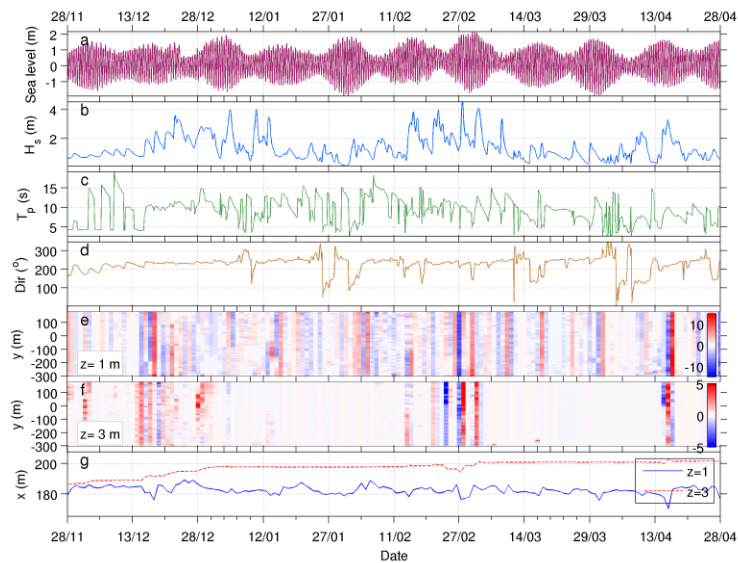
Coastal impacts- Physical contributions



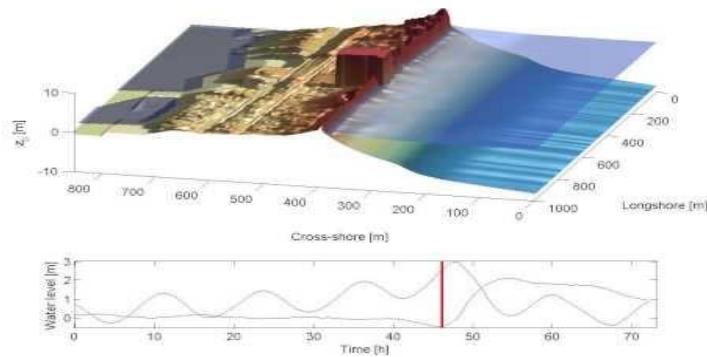
Coastal erosion and inundation



Shoreline dynamics and storms



Monitoring and Modelling morphology



There are simple solutions

- Understand the coastal systems and vulnerabilities
- Identify available information sources
- Combine with local knowledge
- Design Disaster Risk Reduction procedures
- Schedule inspections/monitoring
- Preparedness when there are anticipated impacts (protecting critical/sensitive points, issuing warnings, evacuating in extreme cases)

www.vousdoukas.com

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



Thank you very much...