

# Challenges for impact modelling – experiences with coastal safety/DIVA

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International Workshop Adaptation Decision Support Methods and Tools  
Amsterdam, 3 October 2012



## Plan



- Introduction
- DIVA Model
- Preliminary ISI-MIP Results
- Concluding Remarks

## Introduction

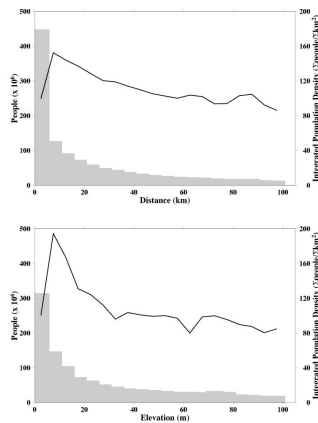
### Coastal Trends

Rising local and global risks

- Population
  - Large and growing coastal population (double global trends)
  - Urbanising coastal zone (new residents are urban)
  - Tourism, recreation and retirement
- Subsiding cities in susceptible locations, especially in deltas
- Climate change and sea-level rise
- A reactive approach to adaptation

## Coasts and People

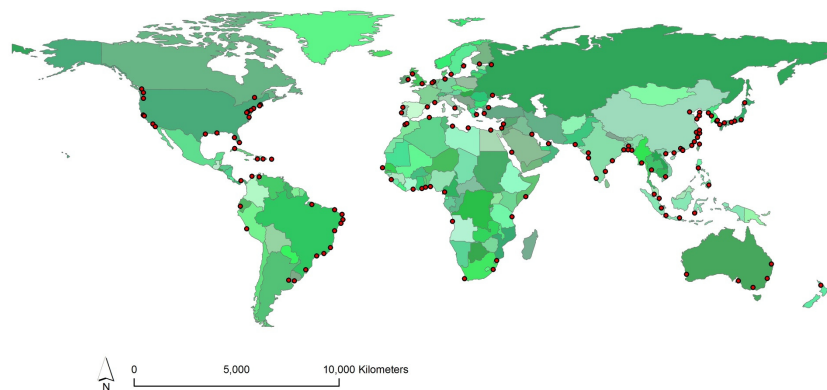
Population and economic density in the coastal zone is greater than other areas of the earth's surface.



Source: Nicholls and Small, 1993, Journal of Coastal Research

## Port City Locations

$\geq 1$  million population in 2005  
136 cities globally and 24 cities in the study area (18%)



Source: Nicholls et al., 2008, OECD Report

# DIVA (Dynamic Interactive Vulnerability Assessment) Model

## DIVA

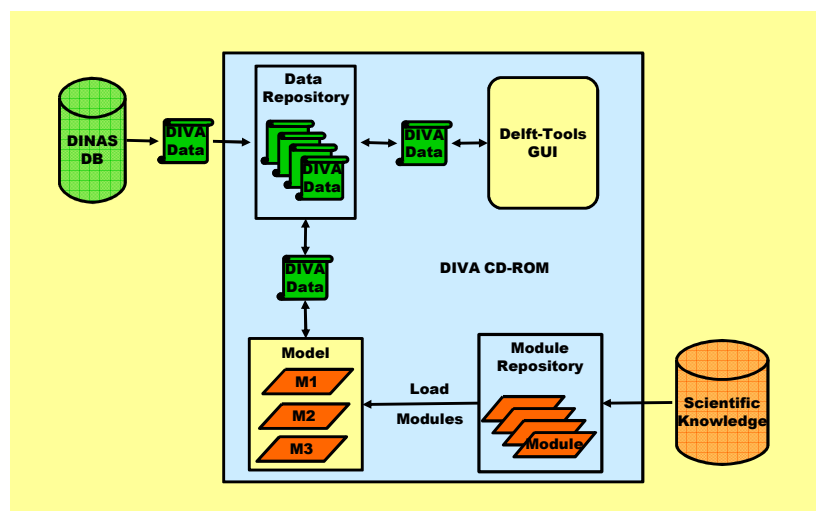
Developed by EU-funded DINAS-COAST Project:

- Potsdam Institute for Climate Change Research (PIK),
  - University of Southampton (was Middlesex University),
  - Sussex University (was Hamburg University),
  - Delft Hydraulics (now Deltares),
  - Vrije Universiteit, Amsterdam.
- An integrated tool to explore sea-level rise
  - Comprises data and algorithms
  - Considers national, regional and global scales
  - Adaptation is an integral component

## Impacts/Responses to Sea-level Rise in DIVA

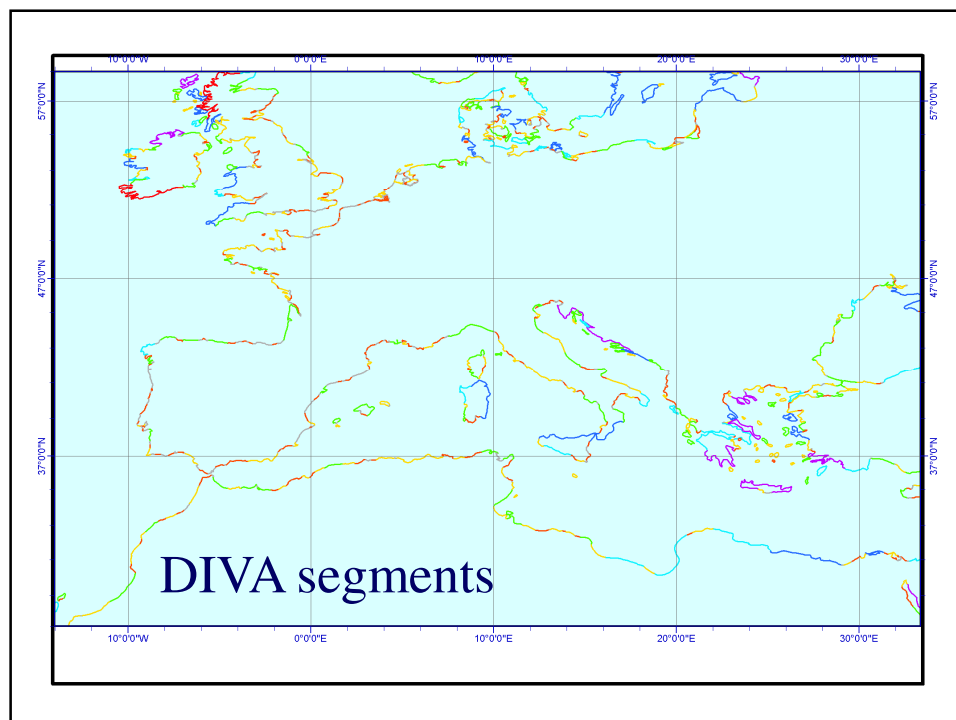
NATURAL SYSTEM EFFECTS		SELECTED ADAPTATIONS
1. Inundation, flood and storm damage	a. Surge (sea)	<ul style="list-style-type: none"> <li>Dikes</li> </ul>
	b. Backwater effect (river)	
2. Wetland loss (and change)		<ul style="list-style-type: none"> <li>Forbid hard defences</li> <li>Sediment nourishment</li> </ul>
3. Erosion (direct and indirect morphological change)		<ul style="list-style-type: none"> <li>Beach nourishment</li> </ul>
4. Saltwater Intrusion	a. Surface Waters	
	b. Groundwater	
5. Rising water tables/ impeded drainage		

## DIVA Concept

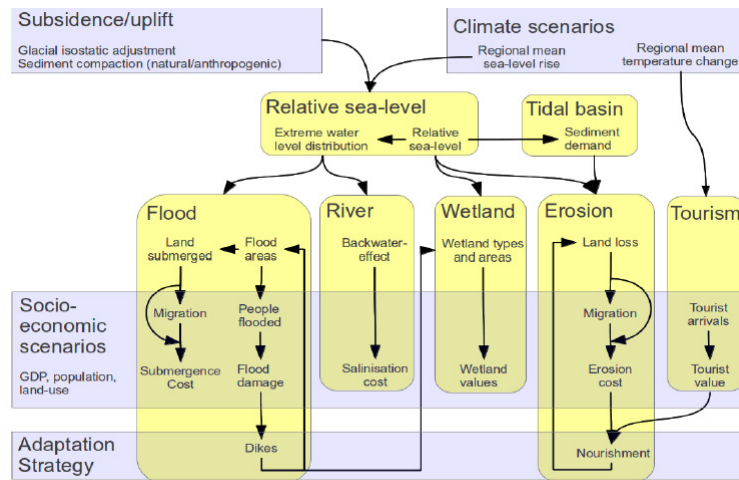


## DIVA Database

- Derived from existing and new global data stored in a geodatabase;
- Mapped to 12,148 linear segments of 'similar' vulnerability (1-D structure);
- Comprises about 100 natural, ecological and socio-economic factors;
- Deltas have subsequently been added as a geographic feature.



## DIVA Structure



Source: Hinkel et al., A global assessment of coastal vulnerability with the DIVA model, in prep.

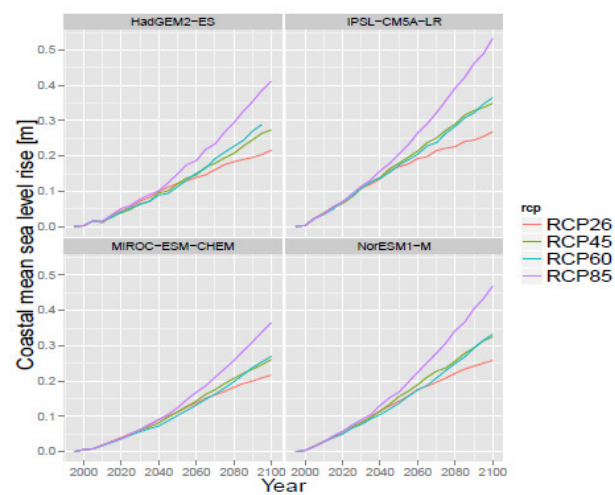
## DIVA Applications

- Peseta
- CIRCE
- ClimateCost
- IMPACT2C
- ISI-MIP
- Adaptation cost estimates by UNFCCC, World Bank and ADB

## Preliminary ISI-MIP results

### Sea-level rise scenarios

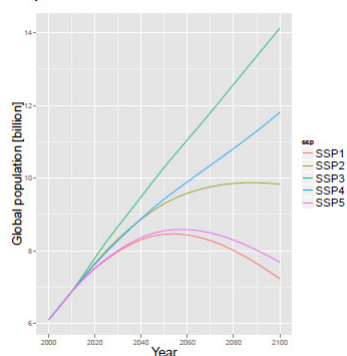
(only steric sea level rise and mountain glacier/icecap melting)





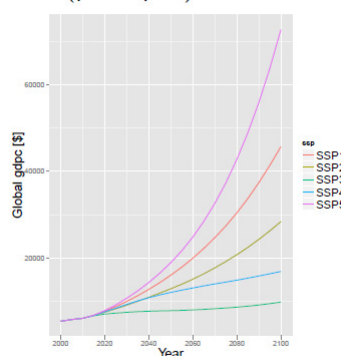
## Socio-economic scenarios (SSPs)

Population:



Source: OECD, IIASA

GDP (per capita):



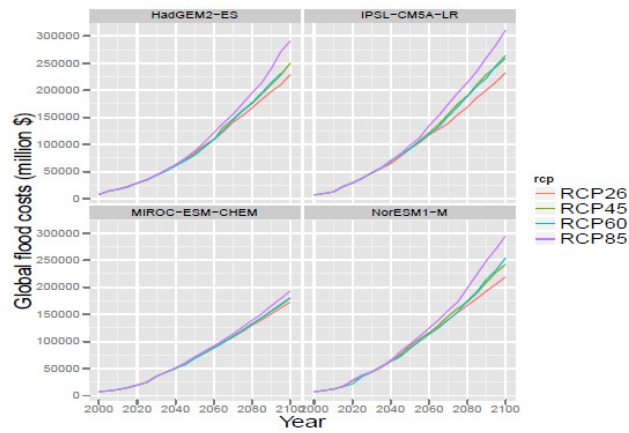
## Adaptation Options

- Beach Nourishment Costs – for beach erosion
- Dike Upgrade (Capital Costs) – for flooding
- Dike Maintenance Costs – for flooding
- Port Upgrade Costs



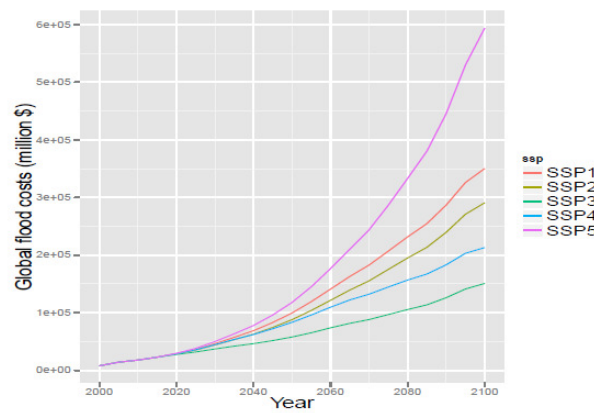
## Global Coastal Flood Impacts vs. SLR

SSP2, no adaptation  
flood costs – sea flood costs and river flood (backwater effect) costs

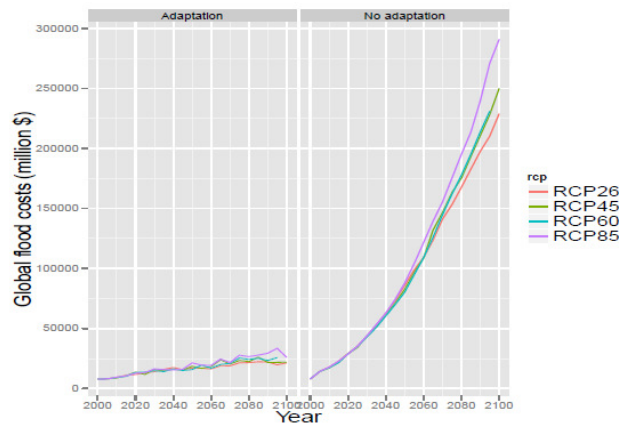


## Global Coastal Flood Impacts vs. SSP

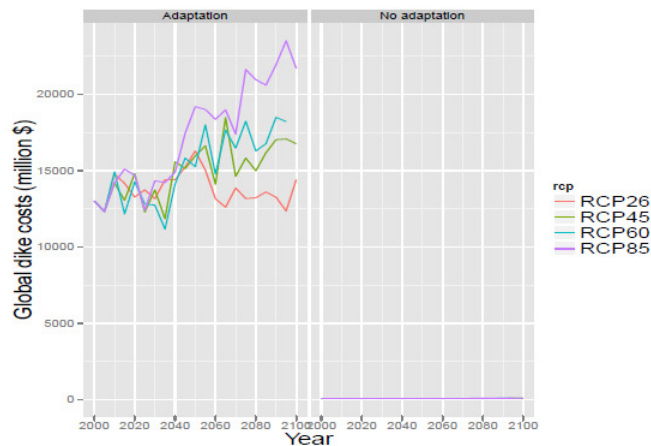
HadGEM2, RCP85, no adaptation



## Global Coastal Flood Impacts With and Without Adaptation HadGEM2, SSP2



## Global Coastal Flood Adaptation Costs With and Without Adaptation HadGEM2, SSP2



## Concluding Remarks

### Issues 1

- Sampling the future – appropriate scenarios (e.g. ice sheet decline; delta subsidence)
- The scale of analysis – regional (or global) versions of DIVA at higher resolution – nested analysis
- More processes – groundwater intrusion

## Issues 2

- Capturing adaptation – protect, accommodate and retreat (in stylised form)
- Real-world adaptation
- Adaptation deficit

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