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DSD INTERNATIONAL CONFERENCE 2014

Climate Change Impacts on Urban Flood Risks

by

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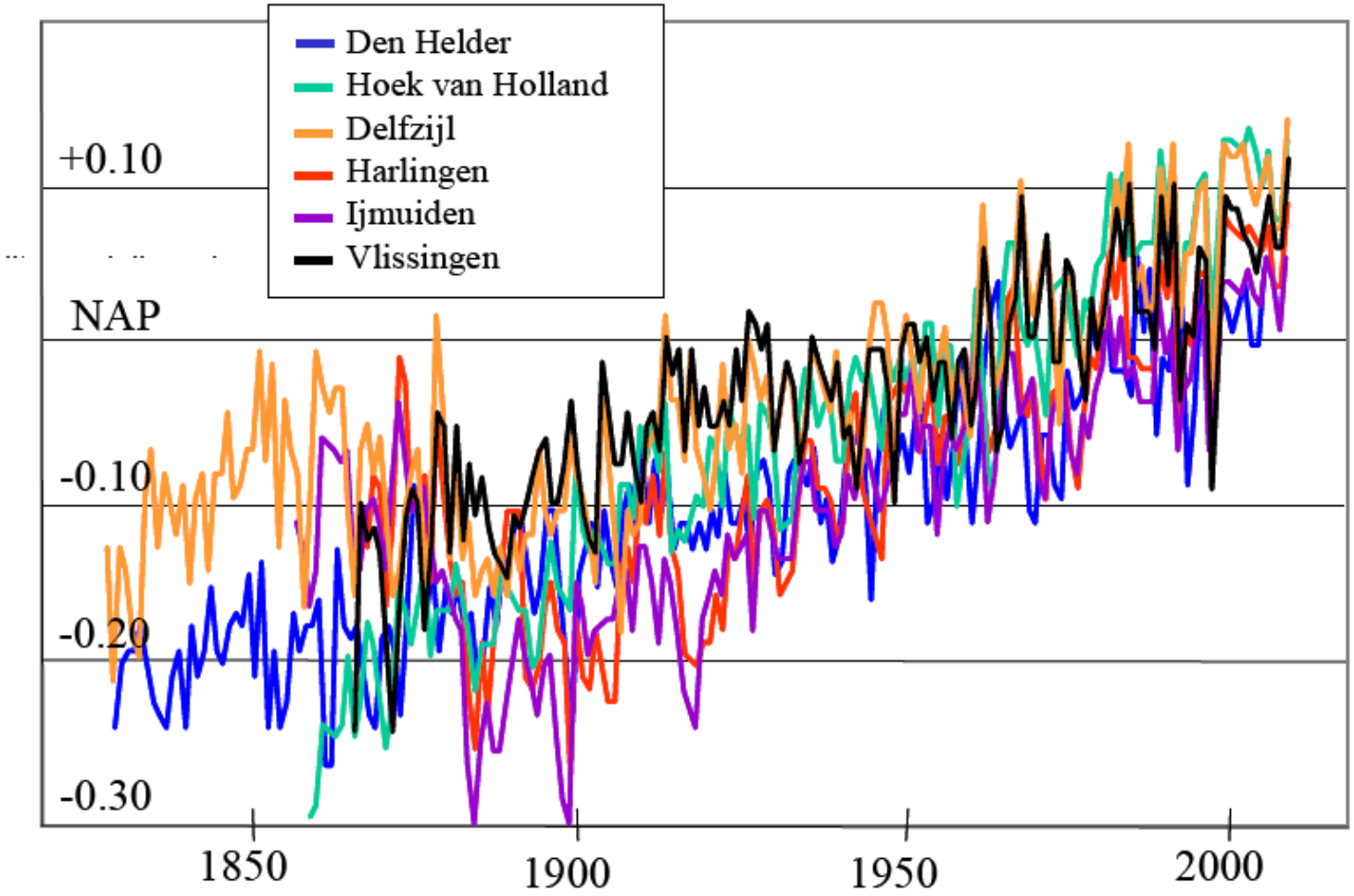
FloodConsult

Singapore / The Netherlands

Recorded sea level rise in The Netherlands

Recorded sea water levels – consistent trend up



Rising sea water levels

The question is not “will it happen”?
It is “when and how much”

Principal causes

- **Thermal expansion of the sea**
- **Land ice melt (glaciers, Greenland, Antarctica)**

Not the same all over the globe

Estimates for the Netherlands

- **IPCC 4th Report: 18 to 59 cm in 2100**
- **IPCC 5th Report: 40 to 100 cm in 2100**
- **Netherlands Delta Commission – 130 cm in 2100**

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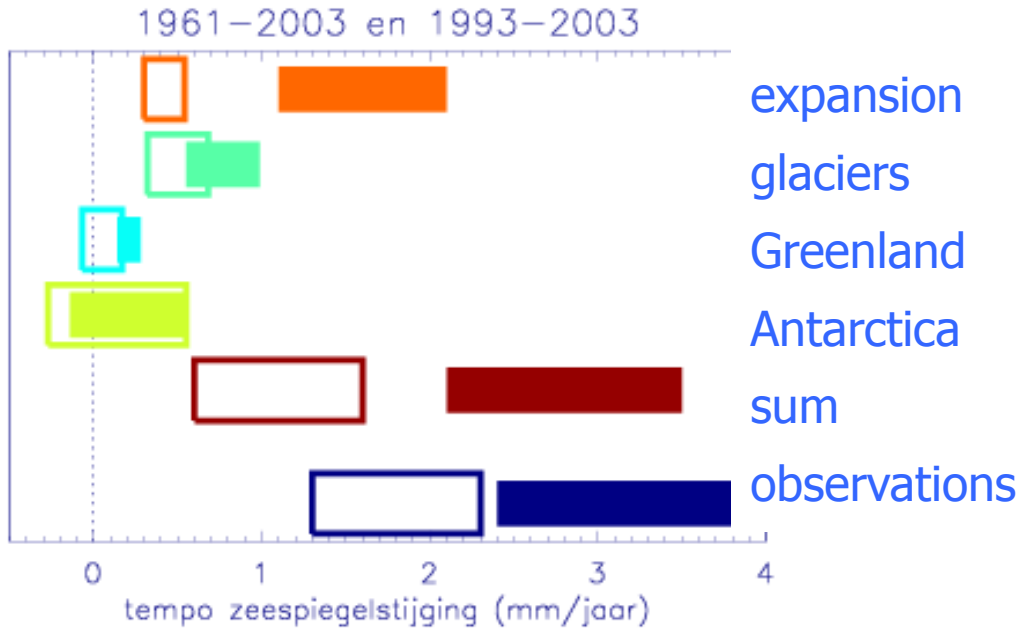
Rising sea water levels IPCC-5

Emission Scenario	Mean cm	Range cm
RCP2.6	44	28-61
RCP4.5	53	36-71
RCP6.0	55	38-73
RCP8.5	74	52-98

Global sea level rise

- **Thermal expansion**
- **More water (melting of land ice, change of terrestrial storage)**
- **Measurements show an increase somewhat larger than forecasted. Acceleration of ice melt??**



IPCC, 2007

Standard Scenario rainfall depth changes over 20 years

	% increase of rainfall depth in climate change scenario for various return periods						
	T2	*T5*	*T10*	*T20*	*T50*	*T100*	*T200*
-4.0	1.5	1.1	0.9	0.8	0.7	0.6	0.5
-3.5							
-3.0	1.9	1.4	1.2	1.0	0.9	0.8	0.7
-2.5							
-2.0	2.5	1.9	1.6	1.4	1.2	1.1	1.0
-1.5	3.4	2.6	2.3	2.0	1.8	1.6	1.5
-1.0	3.7	2.9	2.6	2.3	2.1	1.9	1.8
-0.5							
0.0							
0.5							
1.0							
1.5	3.4	2.6	2.3	2.0	1.8	1.6	1.5
2.0	2.5	1.9	1.6	1.4	1.2	1.1	1.0
2.5	1.9	1.4	1.2	1.0	0.9	0.8	0.7
3.0							
3.5	1.5	1.1	0.9	0.8	0.7	0.6	0.5
4.0							

Handling climate change impacts

Example recent study Hong Kong

Review of DMP for North and Yuen Long

Sensitivity analyses climate change impacts

- **Baseline Scenario: based upon 2010 system & HKO headquarters rainfall and sea level statistics**
- **Standard Scenario: x % rainfall increase and 6 cm sea level rise in 2030**
- **High Scenario: 2x % rainfall increase and 12 cm sea level rise in 2030**
- **Extreme Scenario: 4x % rainfall increase and 40 cm sea level rise in 2030**

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Climate Change Statements

Facts or Myths ?

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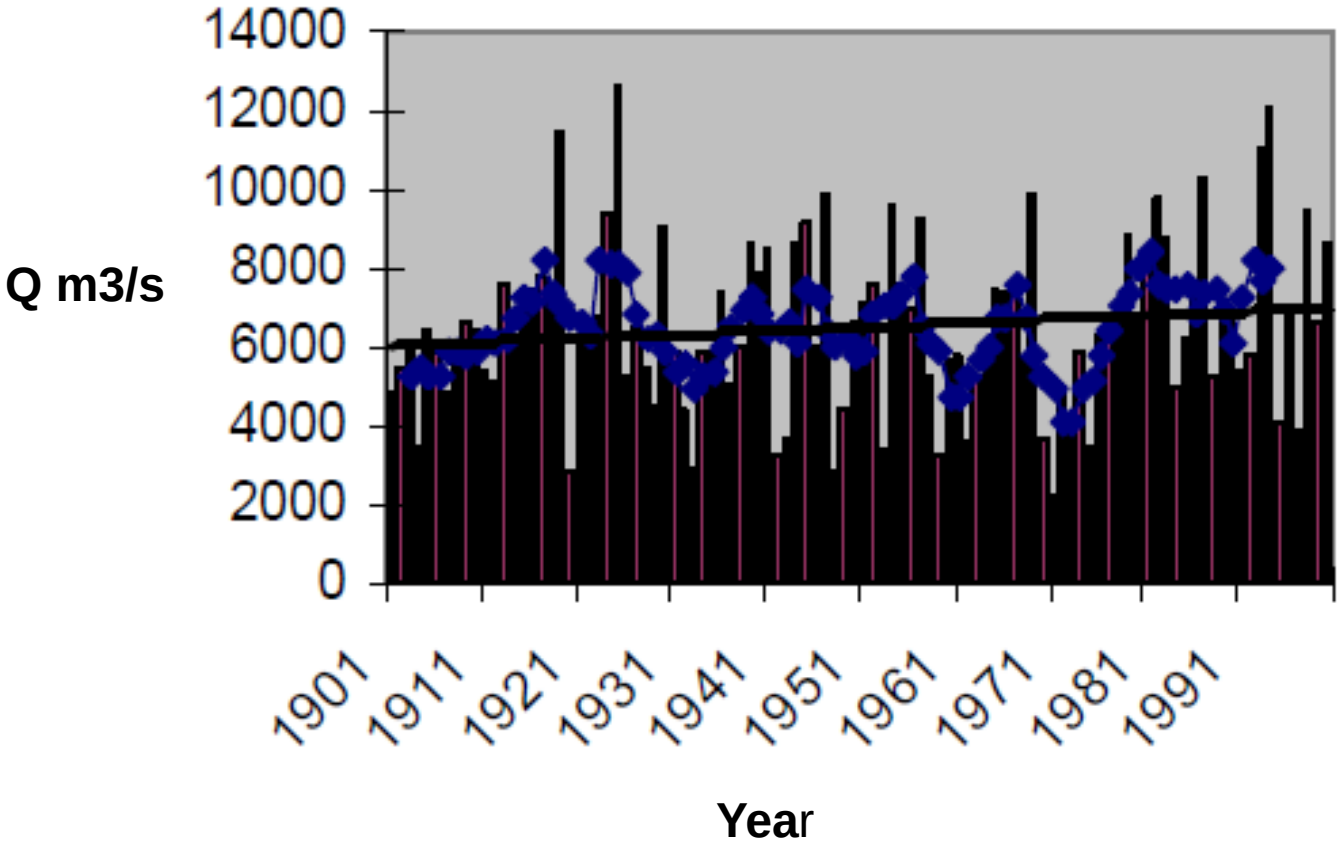
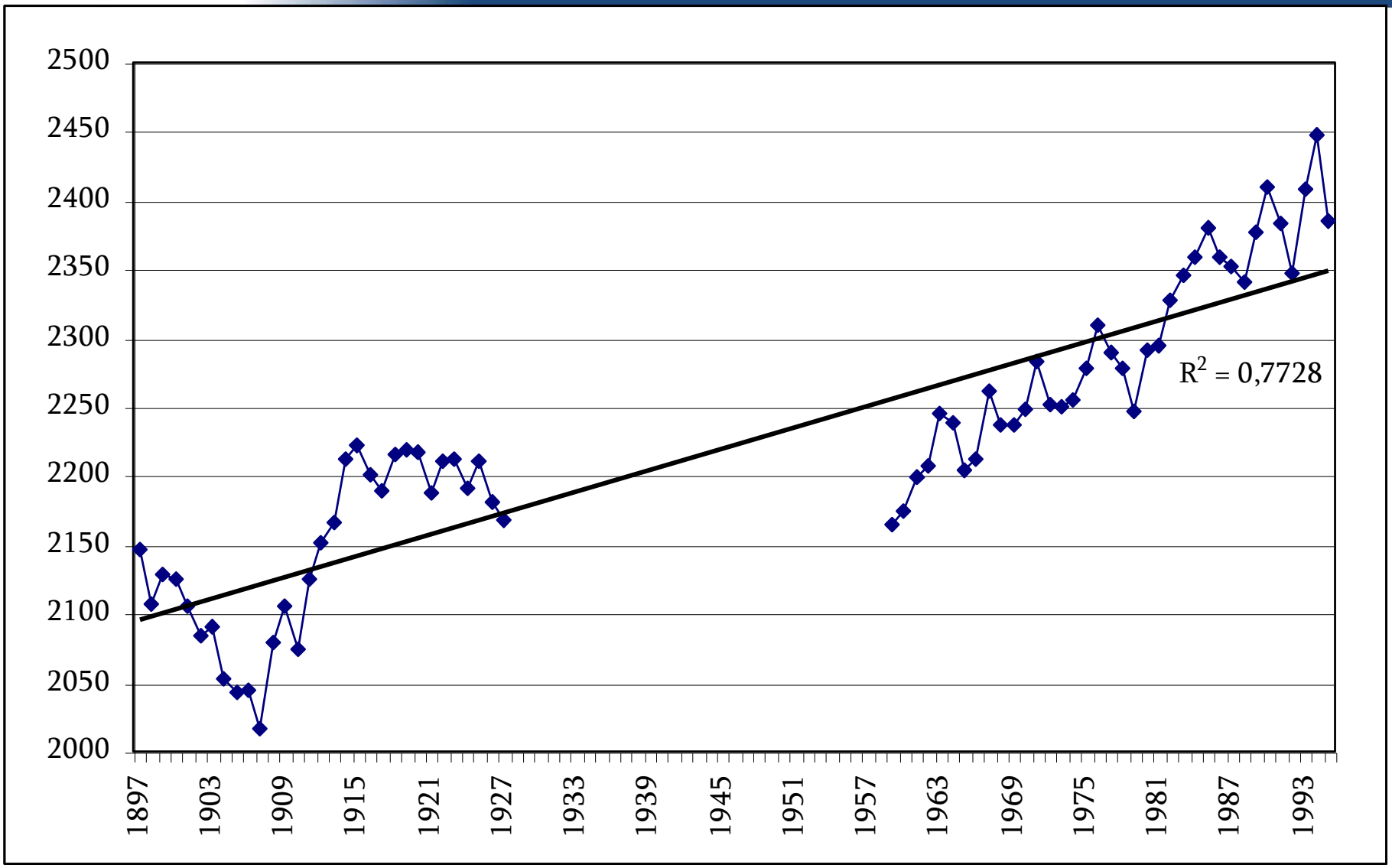
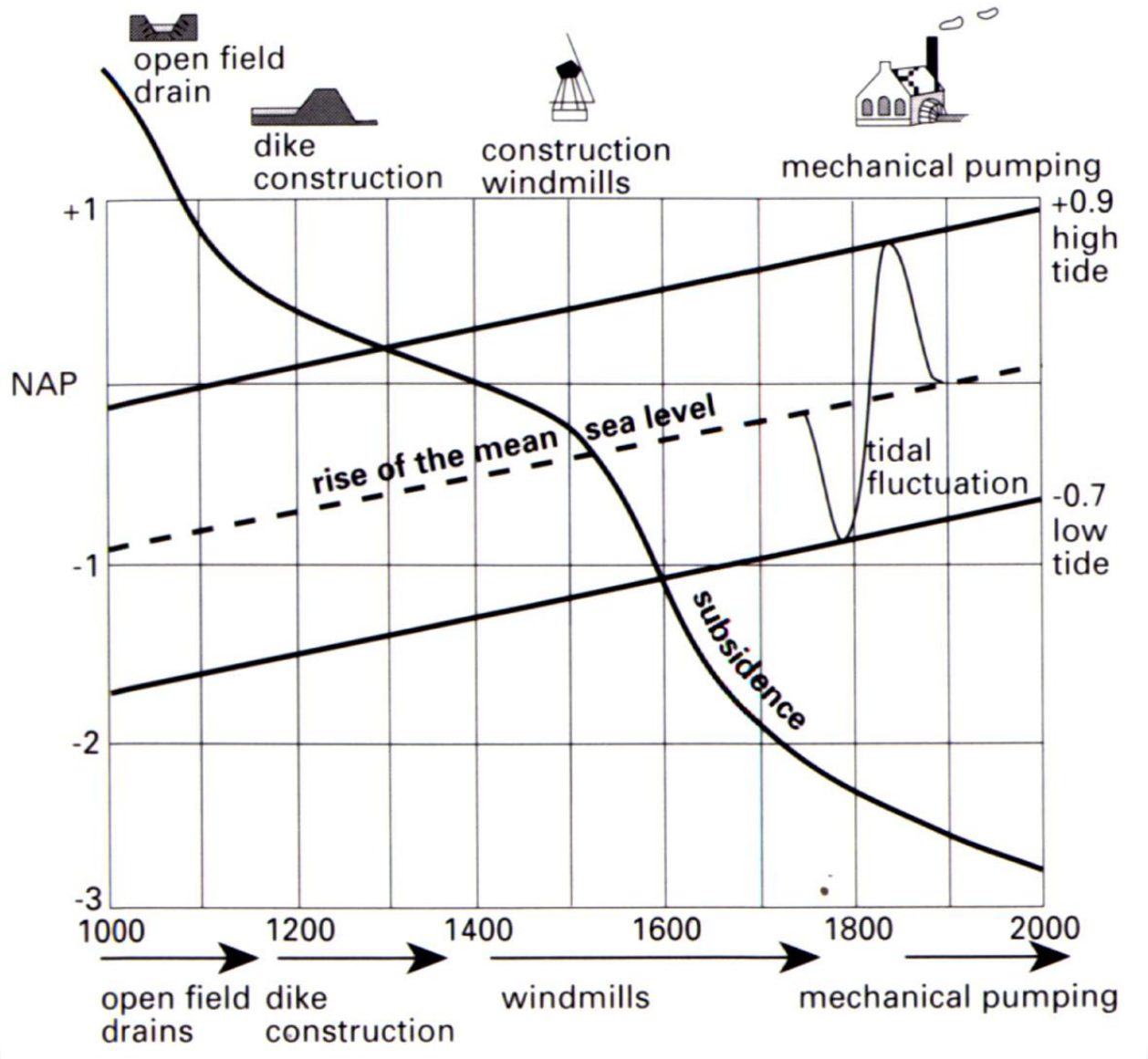
Rhine discharge entering The Netherlands



25 year averaged yearly rainfall at HKO



Soil subsidence and climate change



The impact of soil subsidence may be much larger than that of climate change

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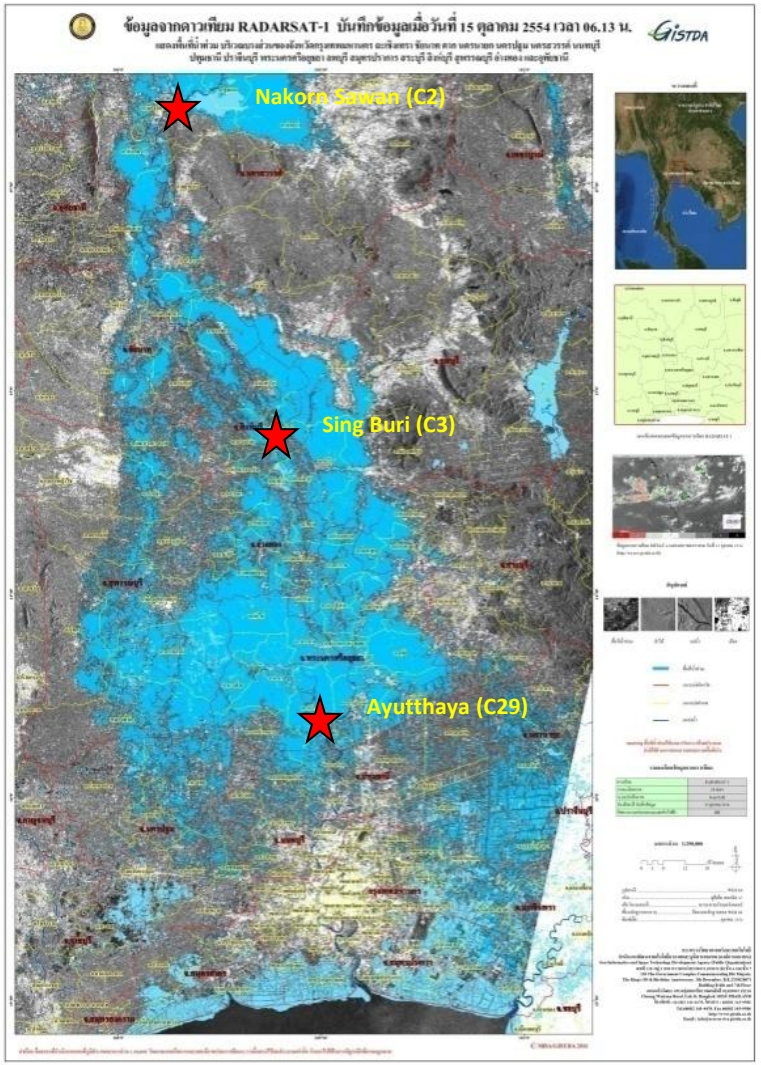
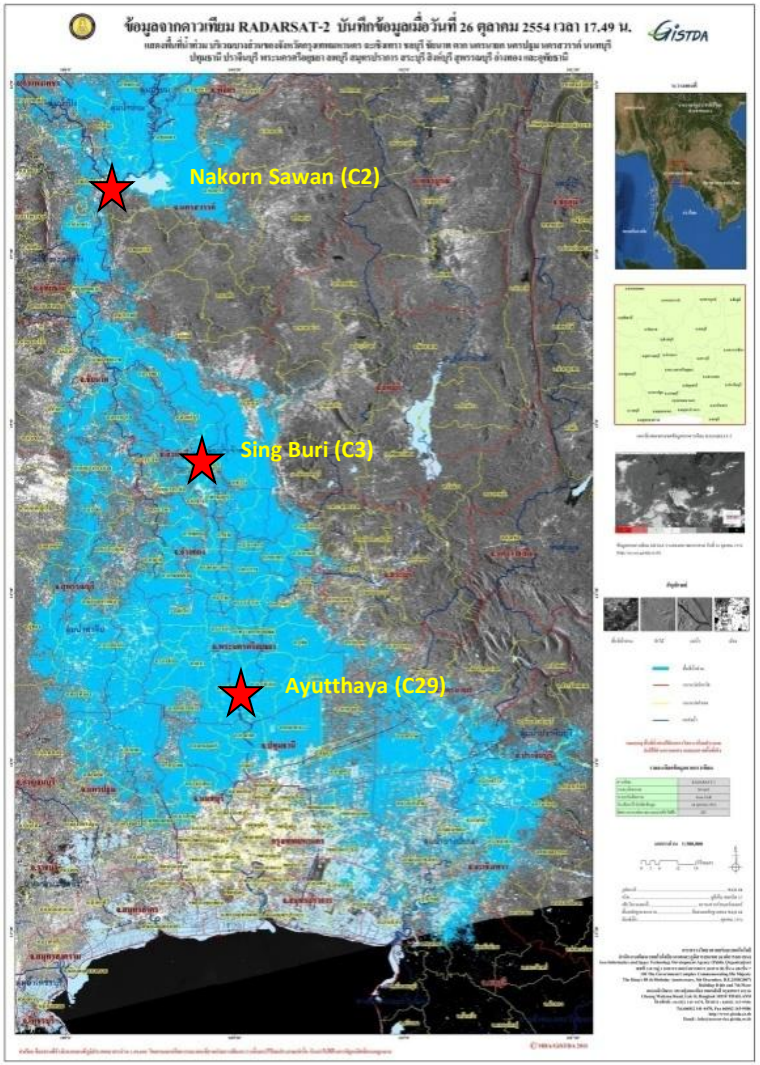
Silted drainage channel in Khulna, Bangladesh

2011 flood disaster Bangkok

Large volume of water overflowing from Chao Phraya River



October 15, 2011

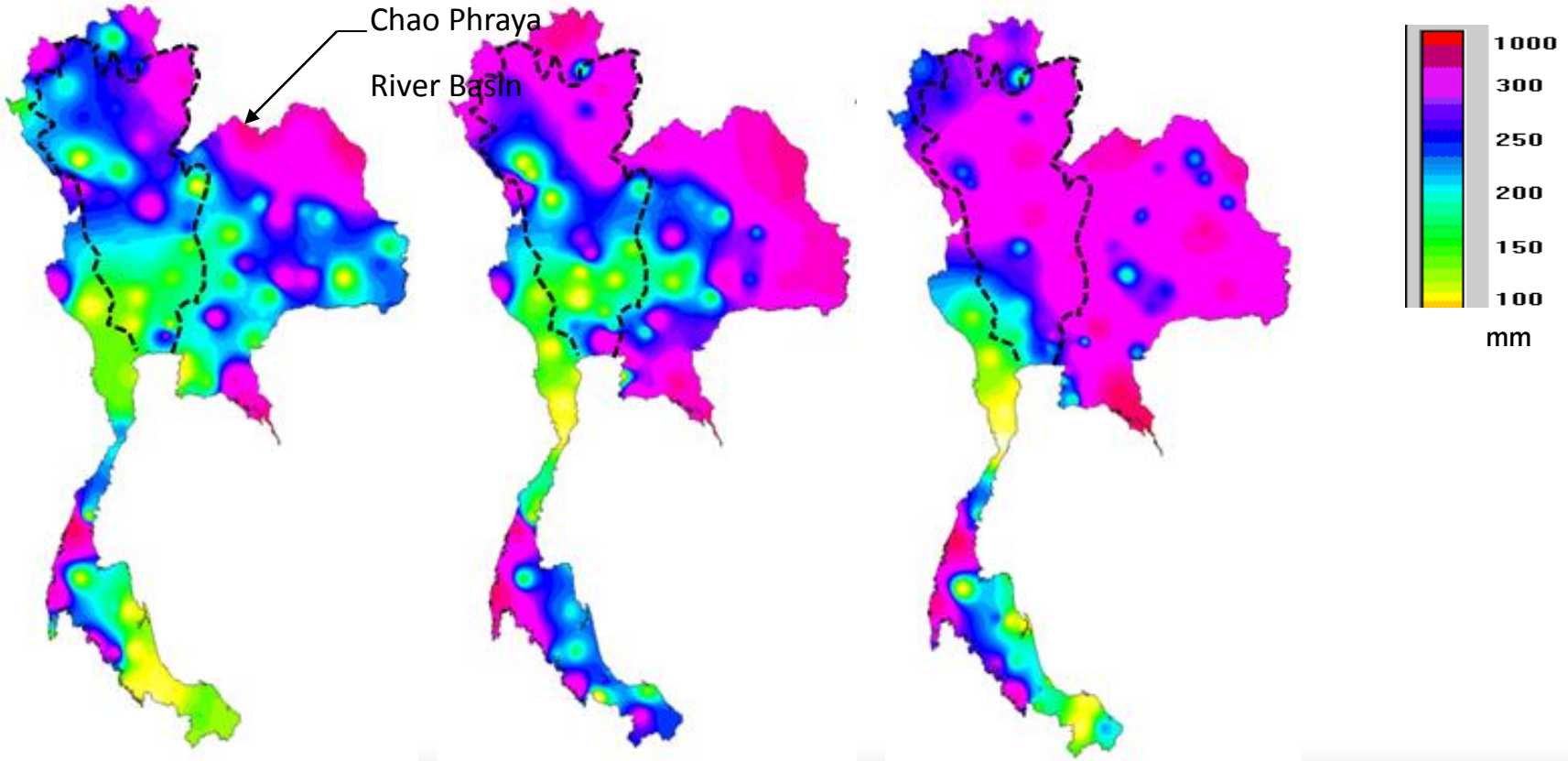


October 26, 2011

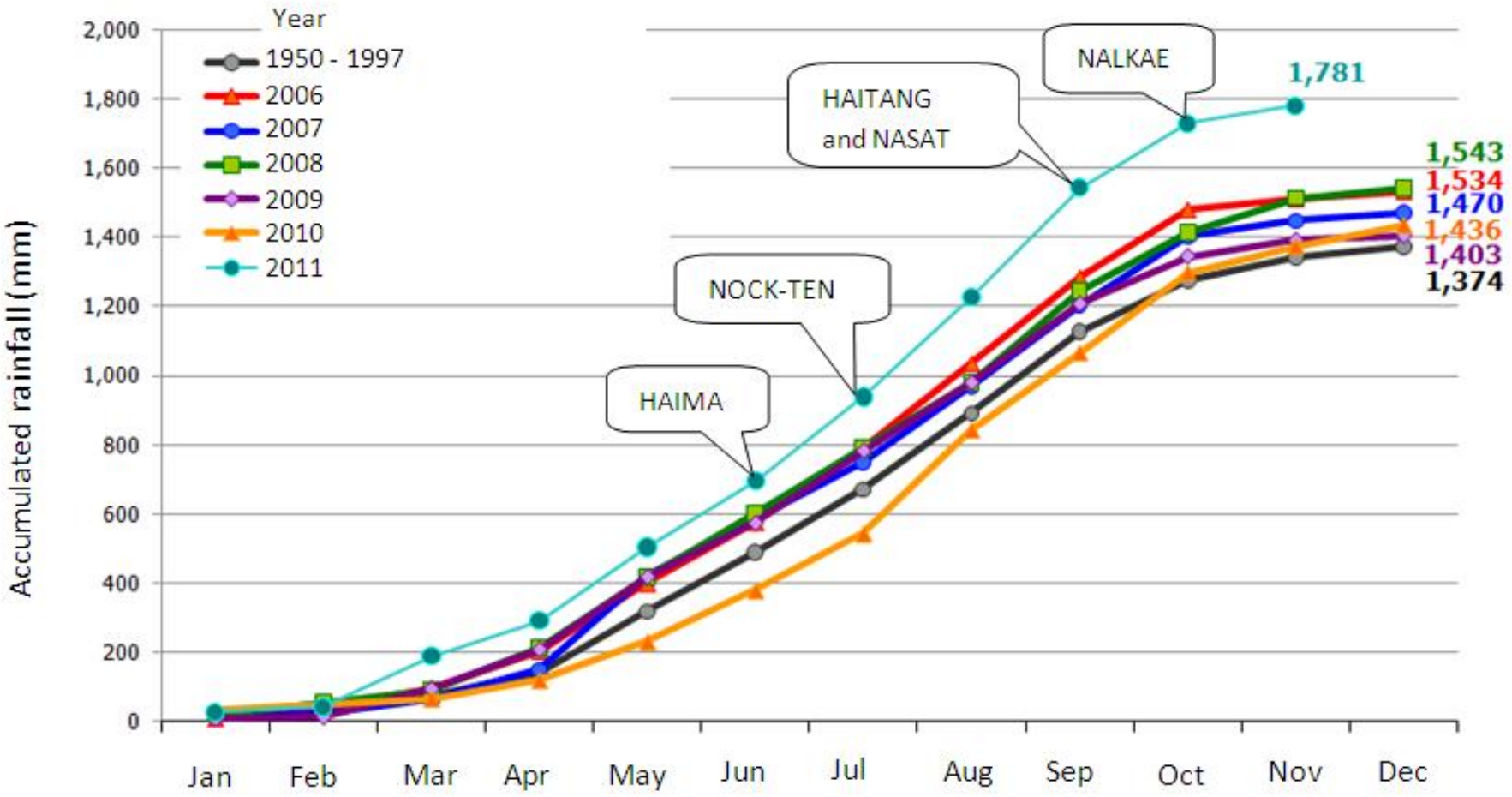
Rainfall 2011 Bangkok flood disaster

Heavy rainfall on Chao Phraya River Basin

During the monsoon season from May to October 2011 there was a large amount of rainfall on the Chao Phraya River Basin with main contributions from 4 major tropical storms: HAIMA, NOCK-TEN, HAITANG and NESAT



Yearly accumulated rain depths Chao Phraya Basin, Thailand



The 2011 flood was caused by a rain depth exceeding average by only 23 %

Flood risk management

Modifying hazard	Modifying exposure	Modifying vulnerability
• Dikes • Polders with pumps • Reservoirs • Retention basins • Diversion canals • Sediment management • Increasing channel conveyance • Sustainable urban drainage systems (SUDS) • Interfering in the phase of flood waves	• Land use planning • Building codes • Elevating terrains • Floating houses • Choice construction material • Resettlements (e.g. PROSAMIM project in Manaus)	• Good planning and design, based upon flood risk analysis → raising awareness • Flood forecasting • Flood warning • Evacuation exercises • Information systems • Resilient construction • Resilient use of living space • Post-flood recovery services • Flood insurance

SUDS (1)

Sustainable urban drainage systems

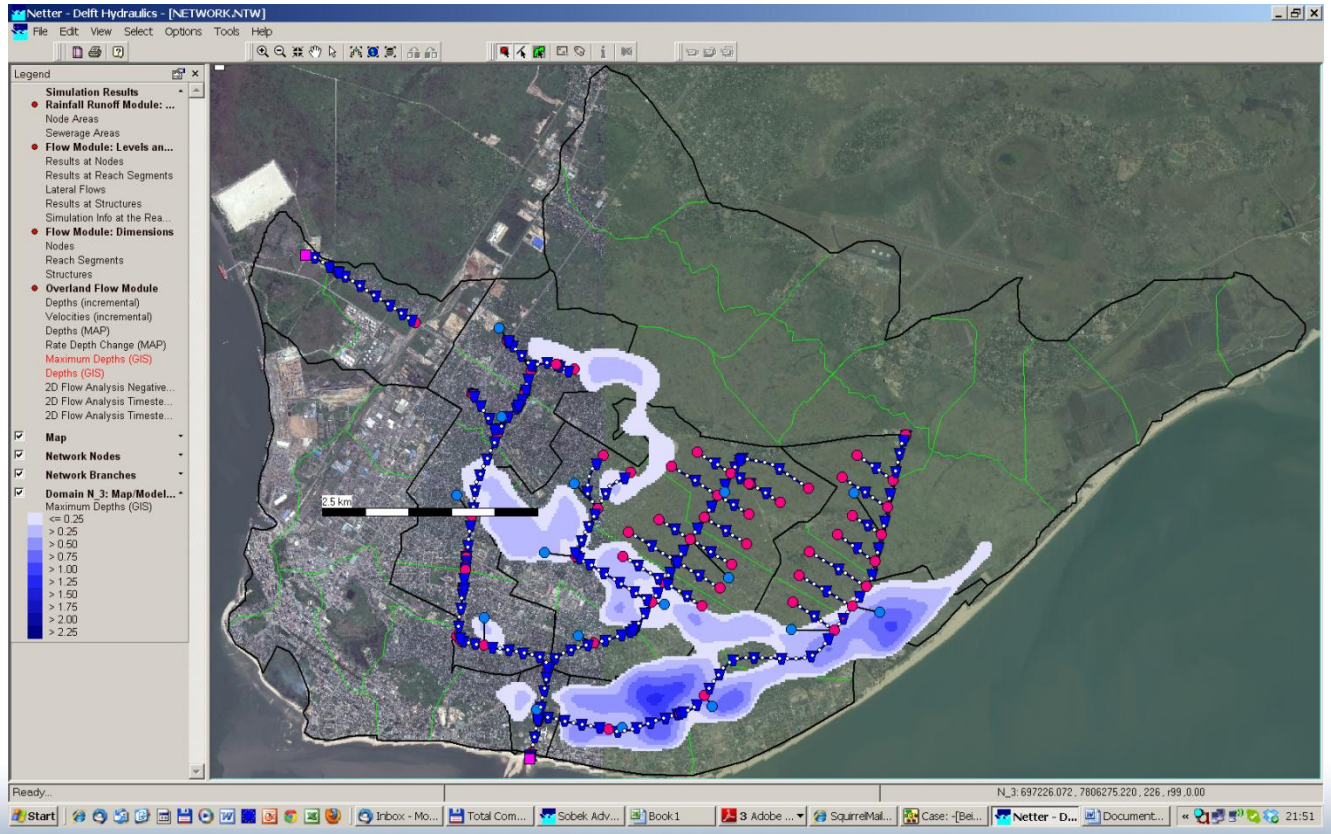
- Green roofs
- Retention basins or ponds
- Infiltration trenches and filter drains
- Infiltration pits and basins
- Permeable surfaces
- Constructed wetlands

Applied in upstream parts of catchments with the function of reducing volume and speed of runoff

Drainage problems in Beira, Mozambique

Example of flood map

Produced for Beira, Mozambique for a 1 in 2 year rain storm combined with the average between neap and spring tide



Produced with SOBEK

Courtesy Deltares, The Netherlands

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Temporary water filled flood barrier

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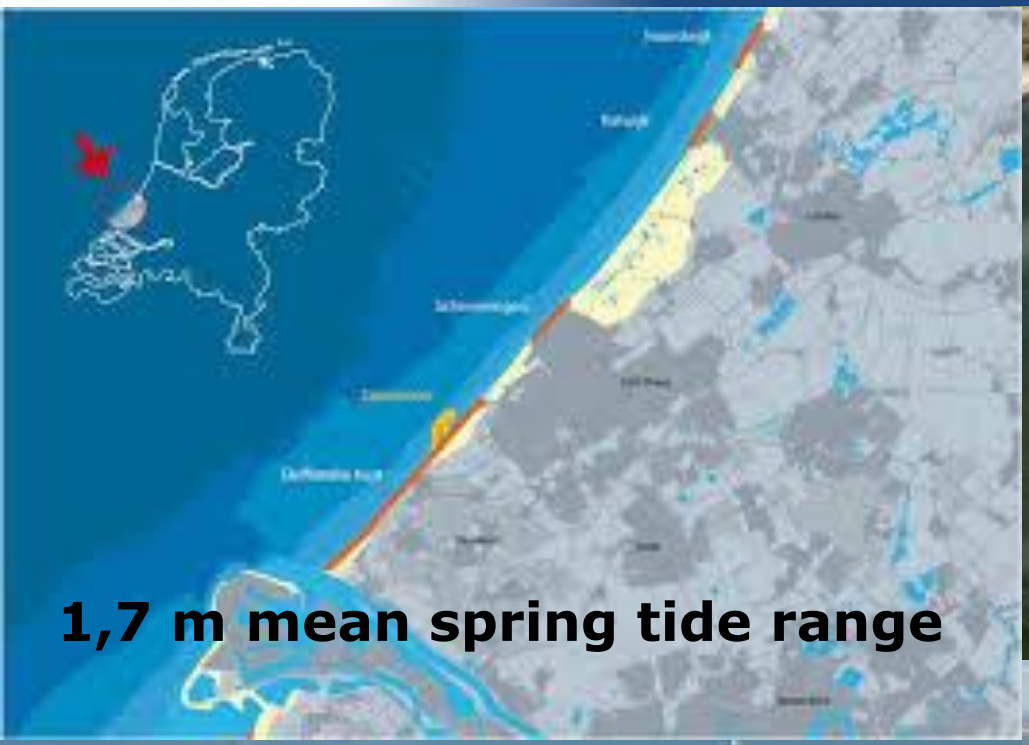
Building with Nature concept



1,7 m mean spring tide range

Sand engine – Hook of Holland

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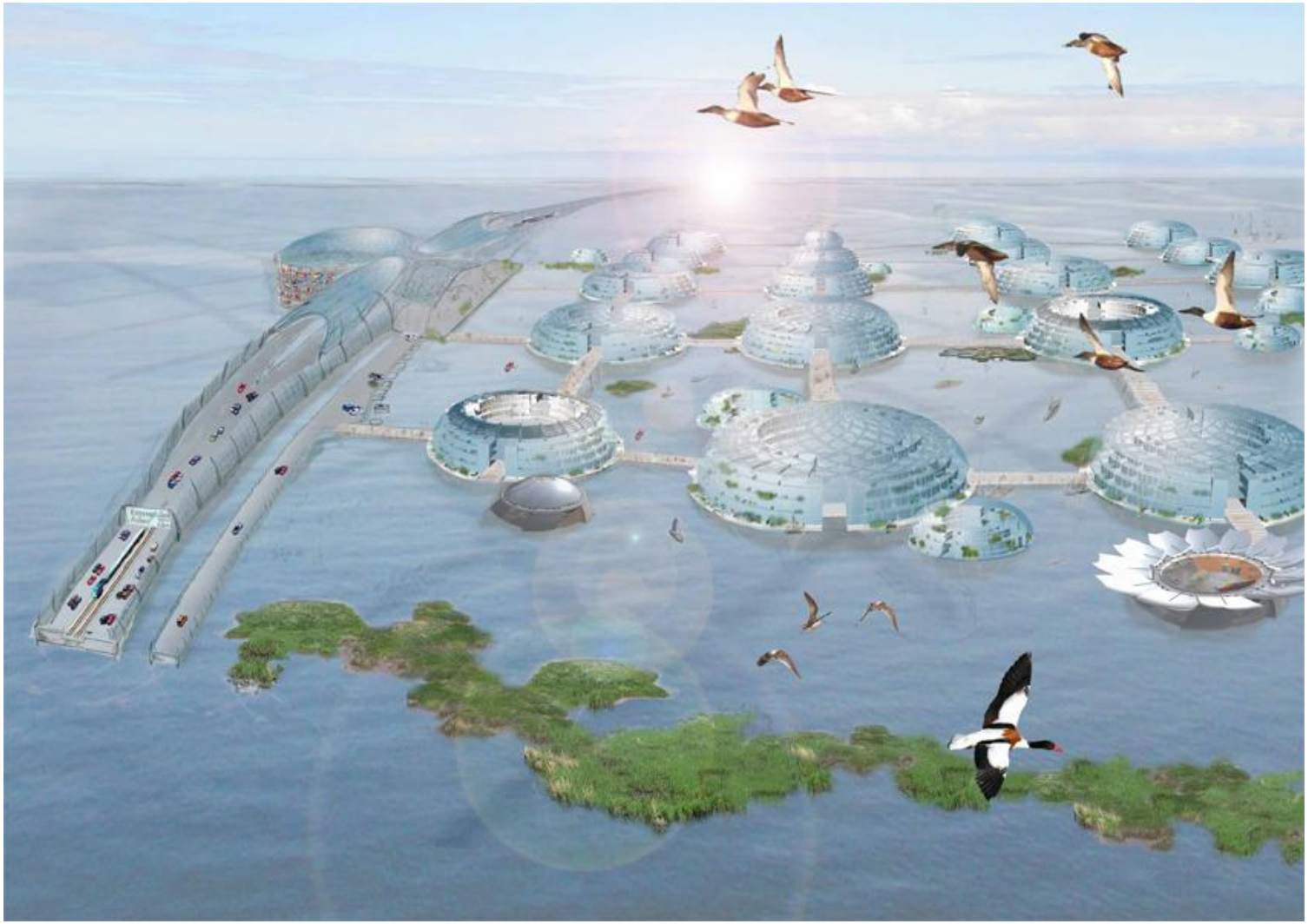
Floating buildings (vision Rotterdam)



Concluding remarks

- Sea levels are expected to rise in the range of 40 – 100 cm this century
- Rainfall increases in many parts of the world, primarily increasing the intensity of short duration storms
- Not all extreme flood events can be attributed to climate change
- There are tipping points in urban systems above which a relatively small change in driving forces can cause (extreme) flooding
- Fighting floods must be based upon insight into the source of the problems and interventions focussing on diminishing these sources (e.g. SUDS)
- New concepts such as “building with nature” and “living with floods” provide creative ways of reducing the impacts of climate changes
- Non-structural flood management measures become even more important under climate change

Thank you for your attention