Deltares
Enabling Delta Life

Flood Management and Climate Change
Presentation at the First National Climate Conference Surinam
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by

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Courtesy Jaap Kwadijk, Deltares for his contribution to the slide set

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Deltares: joining forces

In 2008, the following Dutch institutions joined forces to form Deltares:

- **WL | Delft Hydraulics –** hydraulics, hydrology, water quality, ecology and integrated water management
- **GeoDelft –** geo-engineering
- A part of **TNO Built Environment and Geosciences** – soil and groundwater
- Sections of **Rijkswaterstaat** (RIKZ, RIZA and DWW) – integrated water management and hydraulic engineering

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Range of disciplines at Deltares

Measuring and monitoring
Mathematics and
 information technology

Hydrology
Hydrodynamics
Geohydrology
Soil mechanics
Chemistry and microbiology
Ecology
Spatial sciences
Sediment transport and morphology

Hydro-engineering
Geo-engineering
Eco-engineering

Risk management
Life and social sciences

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Why we need such institute in the Netherlands

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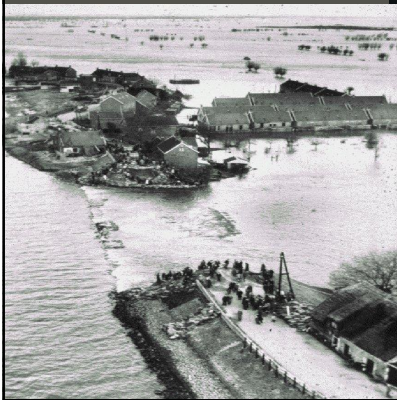

Historic water management

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Closure dam Zuiderzee, 1932
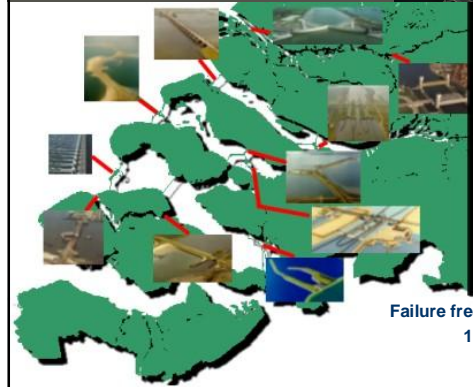
1953 flood Rhine Delta - Zeeland

1953 flooding disaster
SW - Netherlands

Resulting in:
- the Delta-law
- the Delta-plan

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Delta Plan, the Netherlands

**Failure frequency of up to
1 in 10,000 years**

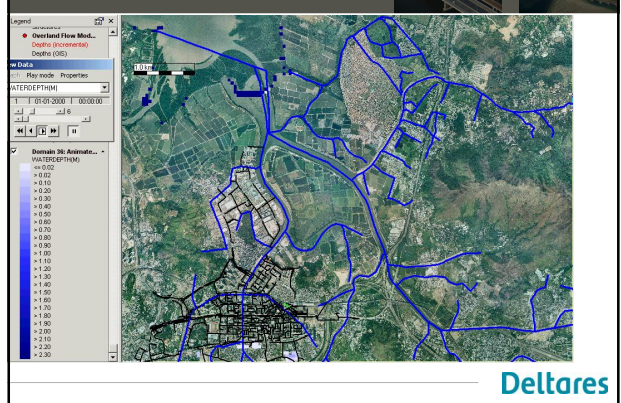**Deltares**

Storm surge barrier Eastern Scheldt

Room for
the Rhine branches
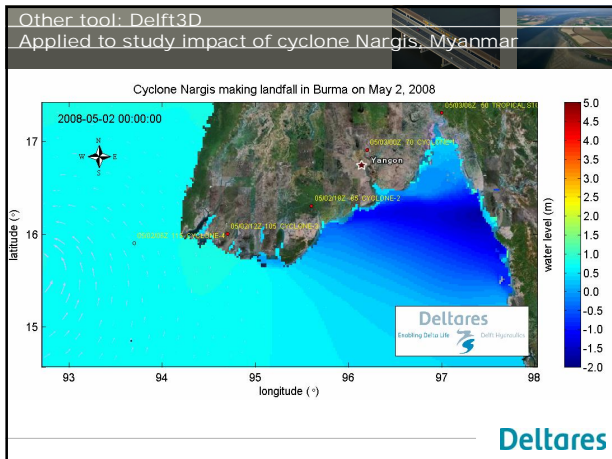

SOBEK simulation of Beveland flooding 1953

View Data
WATERDEPTH(M)
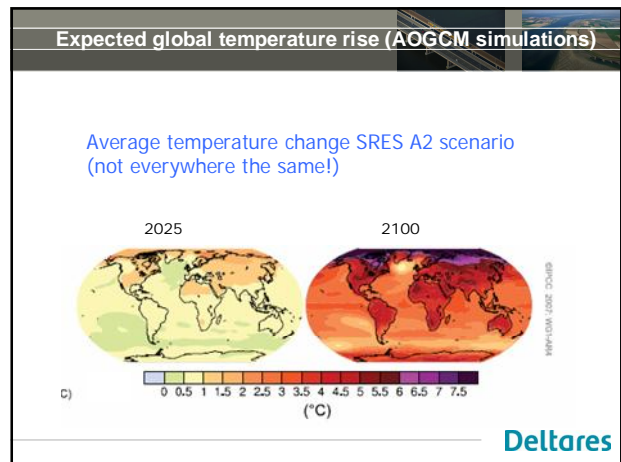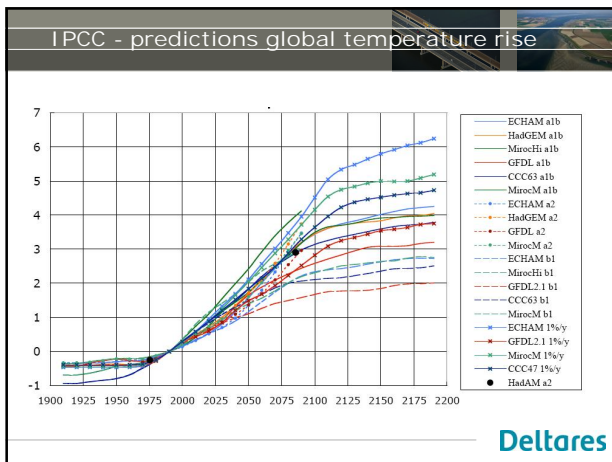01-02-1953   00 00.00
28

SOBEK model Yuen Long, Hong Kong

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Slide 1

Cyclone Nargis making landfall in Burma on May 2, 2008

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Slide 2

- **Impacts of changing sea water levels**
  - **coastal flooding**
  - **salt intrusion**
- **Impacts of changing rainfall**
  - **yearly water balace (reservoirs, incl. spillways)**
  - **droughts**
  - **flooding caused by individual storms**
- **Impacts of changing winds**
  - **wind set-up in coastal zones**
- **Impacts of changing temperatures**
  - **water quality and ecology**

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Slide 3

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Slide 4

Average temperature change SRES A2 scenario
(not everywhere the same!)

2025   2100

0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5
(°C)

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Slide 5

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

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

Not the same all over the globe

Estimates for the Netherlands
- **IPCC – 18 to 59 cm in 2100**
- **Netherlands Delta Commission – 130 cm in 2100**

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Slide 6

temperature change varies across the globe
(change in) wind pattern
(change in) ocean currents
(change in) the gravity field of the earth

Ocean Dynamic Topography (cm)   Oct 3-12, 1992

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Series for all stations along the Dutch coast

Legend:
- Den Helder
- Hoek van Holland
- Delfzijl
- Harlingen
- Ijmuiden
- Vlissingen

+0.10
NAP
-0.10
-0.20
-0.30

1850   1900   1950   2000

Global sea level rise

Thermal expansion
More water (melting of land ice, change of terrestrial storage)

Measurements show an increase somewhat larger than forecasted

1961–2003
- expansion
- glaciers
- Greenland
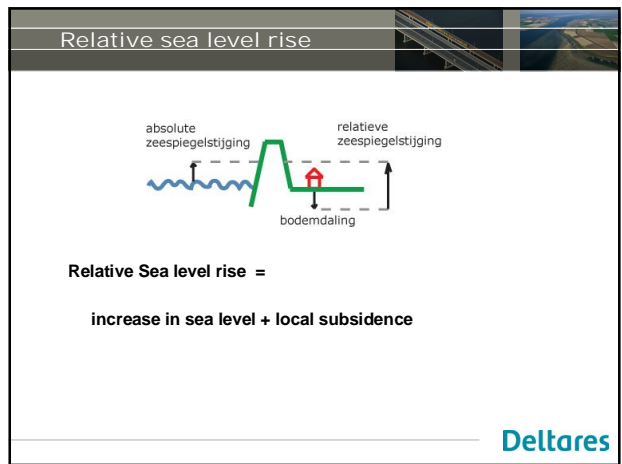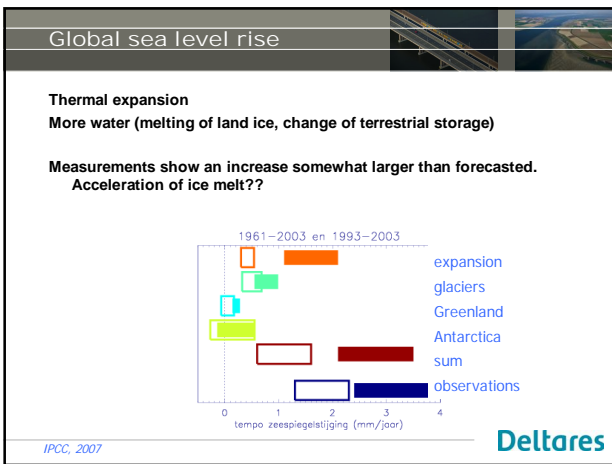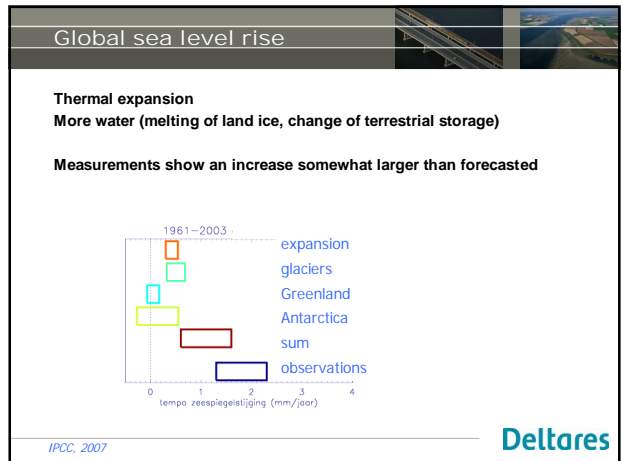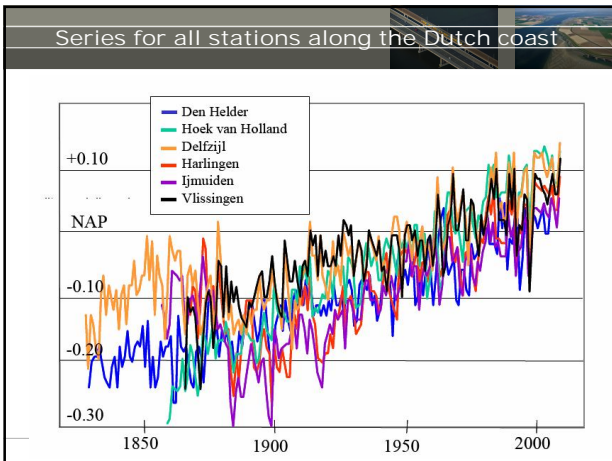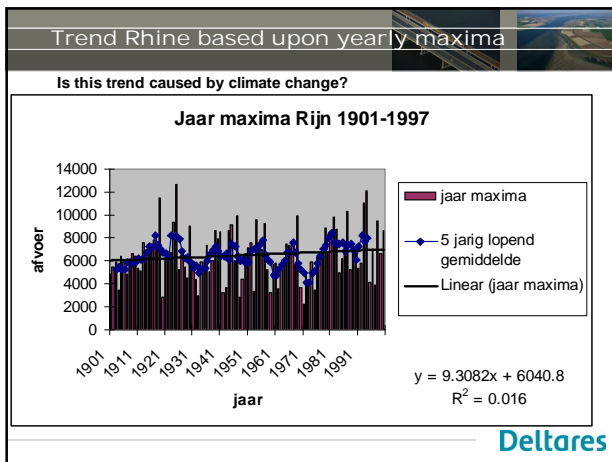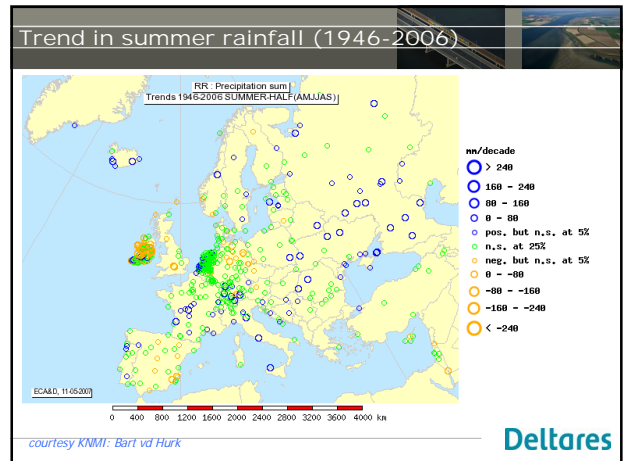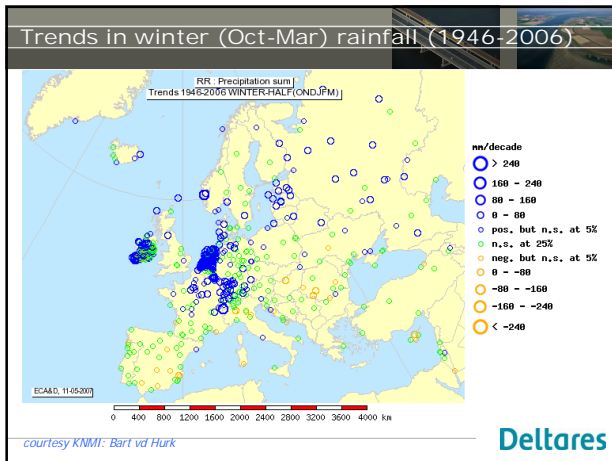- Antarctica
- sum
- observations

tempo zeespiegelstijging (mm/jaar)
0   1   2   3   4

IPCC, 2007

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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??

1961–2003 en 1993–2003
- expansion
- glaciers
- Greenland
- Antarctica
- sum
- observations

tempo zeespiegelstijging (mm/jaar)
0   1   2   3   4

IPCC, 2007

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Relative sea level rise

absolute zeespiegelstijging   relatieve zeespiegelstijging

bodemdaling

Relative Sea level rise =

   increase in sea level + local subsidence

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Impact of land subsidence

open field drain
dike construction
construction windmills
mechanical pumping

+1
NAP
-1
-2
-3

+0.9 high tide
-0.7 low tide

rise of the mean sea level
tidal fluctuation
subsidence

1000 1200 1400 1600 1800 2000

open field drains
dike construction
windmills
mechanical pumping

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Trends in annual rainfall (1946-2006)

RR : Precipitation sum
Trends 1946-2006 ANNUAL

mm/decade
- \> 240
- 160 - 240
- 80 - 160
- 0 - 80
- pos. but n.s. at 5%
- n.s. at 25%
- neg. but n.s. at 5%
- 0 - -80
- -80 - -160
- -160 - -240
- < -240

ECA&D, 11-05-2007

0 400 800 1200 1600 2000 2400 2800 3200 3600 4000 km

courtesy KNMI: Bart vd Hurk

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Trends in winter (Oct-Mar) rainfall (1946-2006)

courtesy KNMI: Bart vd Hurk

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Trend in summer rainfall (1946-2006)

courtesy KNMI: Bart vd Hurk

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Trend Rhine based upon yearly maxima

Is this trend caused by climate change?

$y = 9.3082x + 6040.8$
$R^2 = 0.016$

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How to handle climate change impacts

Establish reference or baseline situation

Alternative approaches to study climate change impacts:

1. **Check on resilience – define "tipping points"**
2. **Study climate change impacts on the basis of scenarios and process this in design**

Example current study Hong Kong
Baseline Scenario: based upon 2010 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

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Measures

Important to take pro-active approach

Hard measures
- **Dikes and polders**
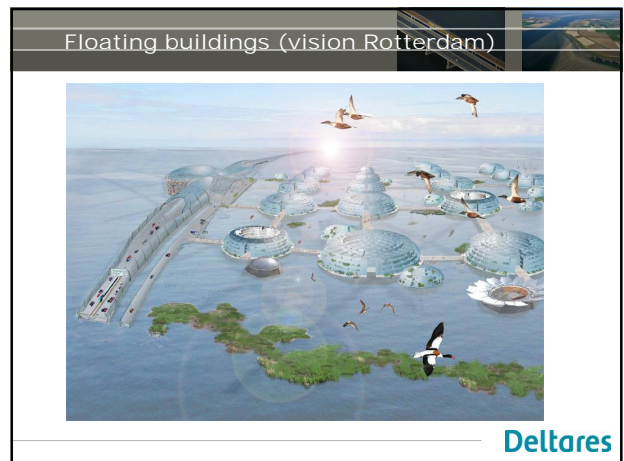- **Dams (including buffer zones, e.g. IJssellake)**
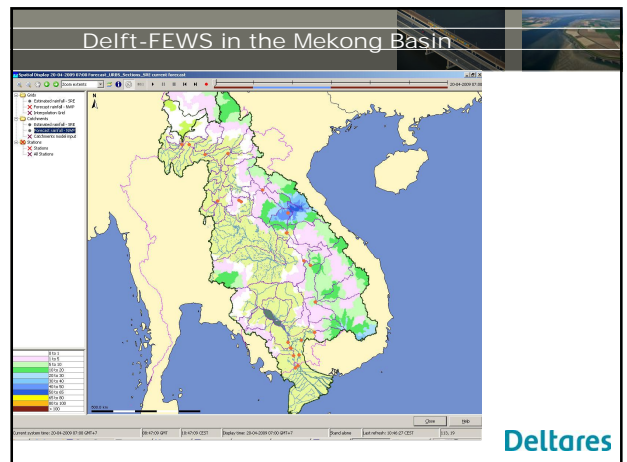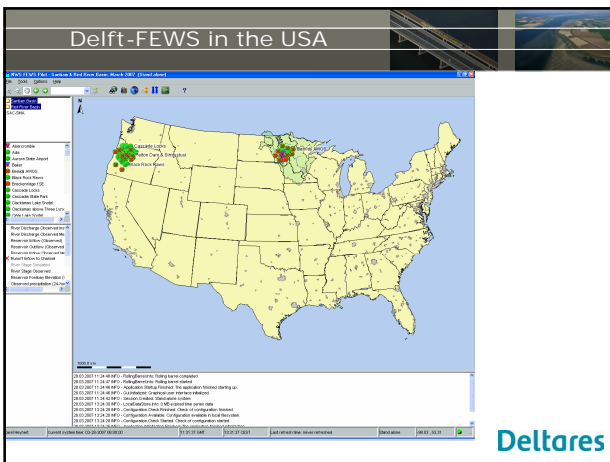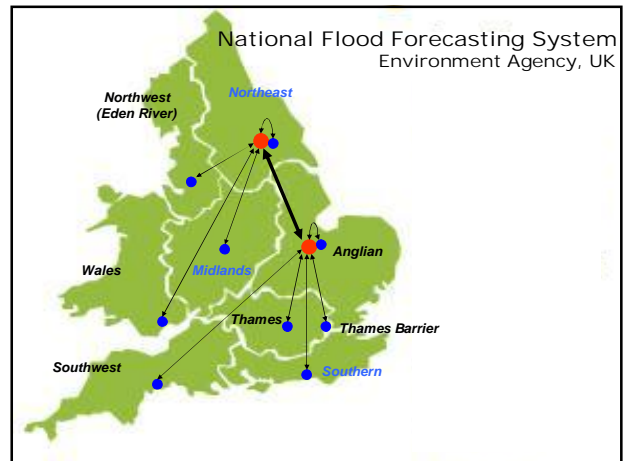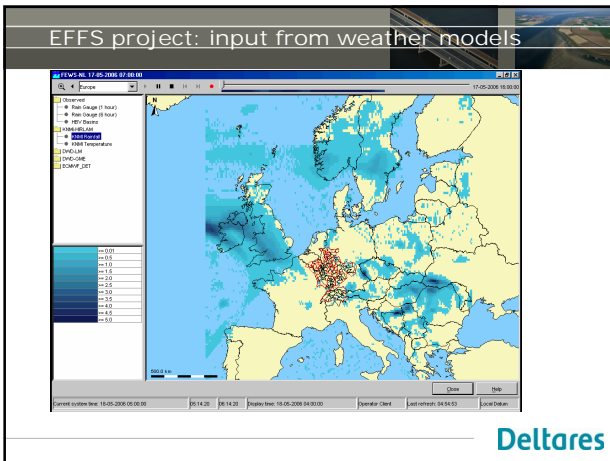
Less hard measures
- **Storm surge barriers**

Environmental friendly measures
- **Room for rivers**
- **SUDS (space for water, green roofs)**
- **Vegetation along dikes (reed, mangroves)**
- **Living with water**
  - **use of vertical space**
  - **floating houses**

Soft measures (e.g. flood forecasting)

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Floating buildings (vision Rotterdam)

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EFFS project: input from weather models

National Flood Forecasting System
Environment Agency, UK

Delft-FEWS in the USA

Delft-FEWS in the Mekong Basin

Climate Conference Rotterdam 2010

www.climatedeltaconference.org

International conference

Deltas in Times of
Climate Change

29 September to 2 October 2010
Rotterdam, The Netherlands

Concluding remarks

- **Is Surinam prepared for climate change impacts?**
- **The climate change impact issue requires a pro-active approach, in particular to serve as guide line for land use developments**
- **Climate change flood impact studies require a good set of toolkits to quantify these impacts**
- **The Netherlands has developed a suite of products to address the study of climate change impacts**
- **These products are in use in many countries world wide, including Surinam**