Sea level rise scenario's

Presentation by Pier Vellinga
Wageningen University Research
and Vrije Universiteit Amsterdam

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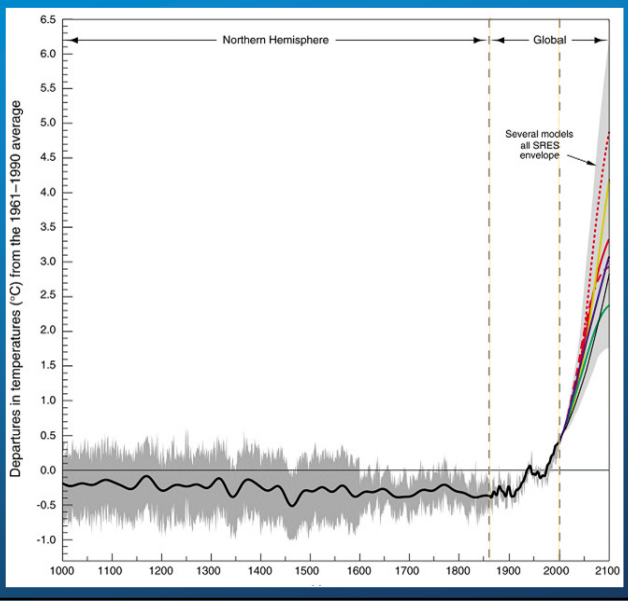
For quality of life

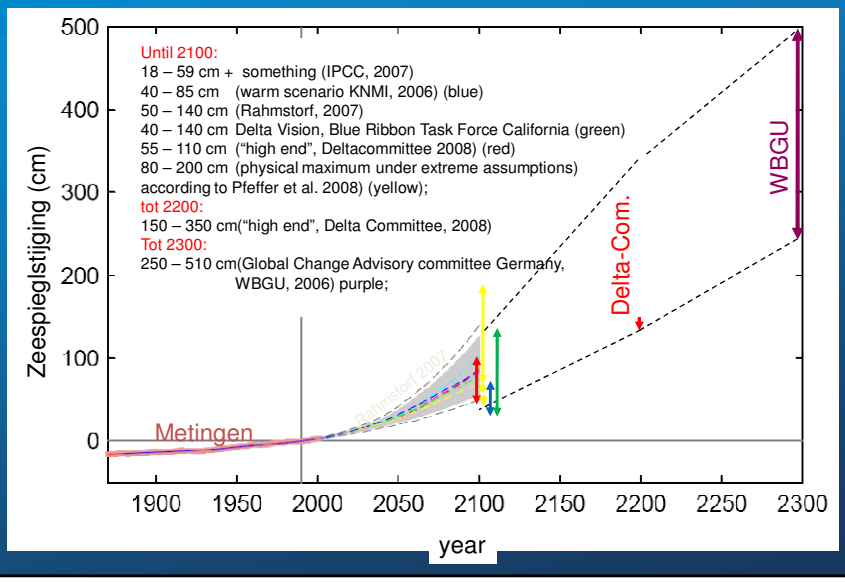
Kennis voor Klimaat

Global average temperature scenario's

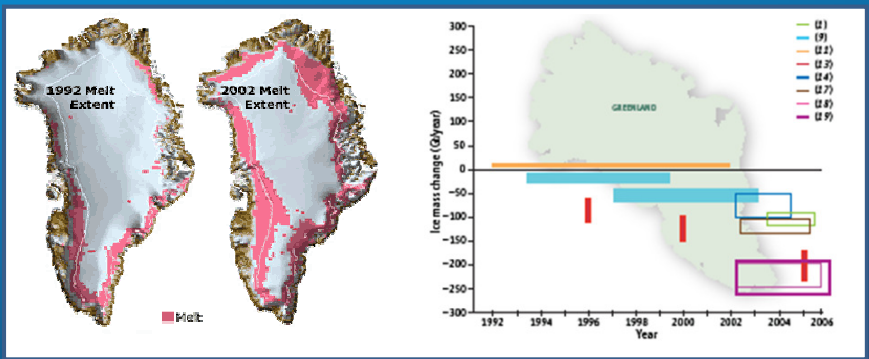


Summary of IPCC results (2007)

Recent projections of global avarage sea level rise

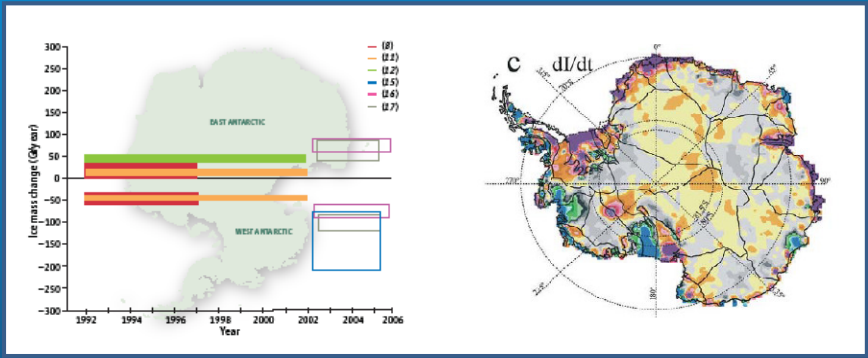


Melting of Greenland glaciers

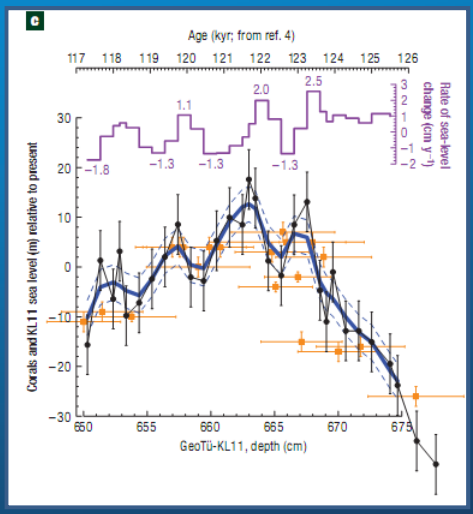


Source: Steffen et al. (2004) / Cazenave (2006)

Melting of antarctic glaciers



Source: Cazenave (2006)



source: Rohling et al (2007)

Greenland ice sheet disintegration

Beyond 2 degrees global average temperature rise the probability of Greenland ice sheet disintergration is 50 precent or more.

The Greenland ice sheet disintegration will result in a global average sea level rise of about 7 meters in about 300 to about 1000 years.

- beware of gravity effects, resulting into less than average rise in the Northern Hemisphere and more than average rise in the southern hemisphere-

Based on sources such as IPCC, Gregory and Huybrechts, Lenton and Hansen and others

West Antarctic ice sheet disintegration

Beyond 2 to 3 degrees global average temperature rise the WAIS is expected to start disintegrating

Leading to a global average rise in sea level up to 5 m. in a period 300 to 1000 years.

Beware of gravitational effects leading to less than average rise in the southern hemisphere and more than average rise in the northern hemishere

Based on sources such as Oppenheimer and Alley, Lenton, Kriegler, Vaughan and others...

An estimate of contributions to global average sea level rise in 2100 in case of 4 degrees global av. temp. rise

- Global mean thermal expansion....0.1 to 0.5 m;
- Small glaciers.....0.1 to 0.2 m;
- Antarctic ice sheet.....0.0 to 0.4 m;
- Greenland ice sheet.....0.1 to 0.2 m;
- Terestrial water storage.....0.0 to 0.04 m

  – Total, if independent variables: 0.6 to 1.1 m
  – Source: Vellinga et al/Katsman et al, for the Netherlands Delta Committee (2008)

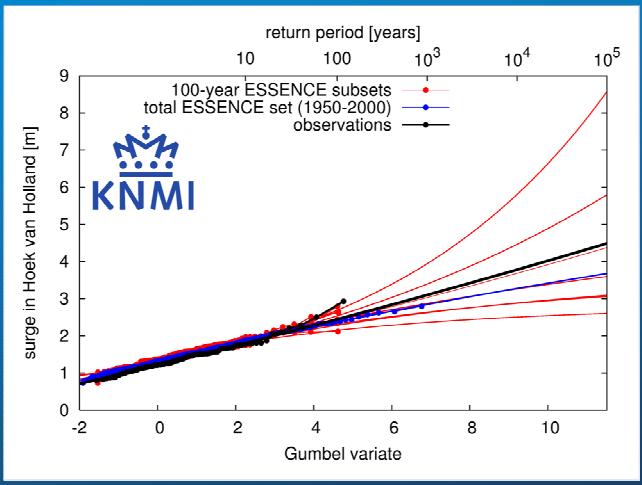
An estimate of contributions to global average sea level rise in 2200 in case of a global av. temp. rise of 4 degrees in 2100

- Global mean thermal expansion 0.4 to 1.5 m;
- Small glaciers.....0.1 to 0.3 m;
- Antarctic ice sheet .....0.2 to 1.4 m;
- Greenland ice sheet.....0.5 to 0.8 m;

- Total, considered independent var. 1.5 to 3.5 m.

- Source: Vellinga et al/Katsman et al for the Netherlands Delta Committee (2008).

Storm surge statistics



Bron: H.W. van den Brink (KNMI)

Peak river discharge Rhine in cubic meter per second

Peak discharge at Lobith (border between Germany and Netherlands) assuming Germany will build embankements

	Referentie afvoer	**2050**	**2100**	**2200**
Piekafvoer (m^3/s)	16.000	16.500 – 19.000	17.000 – 22.000	n.b.
Verandering piekafvoer %		3 – 19	6 – 38	n.b.

	Referentie afvoer	**2050**	**2100**	**2200**
Piekafvoer (m^3/s)	16.000	15.500 – 17.000	16.000 – 17.500	n.b.

Source Neterlands delta committee, 2008

Cost of maintaining adequate flood safety levels

Present cost of water management, including coastal protection, in the Netherlands is about 1000 milion euro per year is about 0,2 % of GDP;

Additional cost for 1 meter sea level rise in 100 years is about 1000 milion per year, is 100.000 million euros over a 100 years, is an addtional annual investment of 0.2 % of GDP

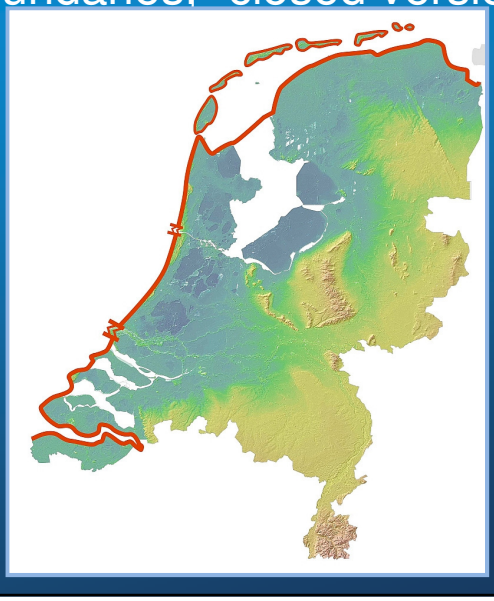
First order estimate of global cost of maintaining present flood safety levels in case of 1 meter rise in sea level

Cost for the Netherlands are about 1000 milion euro per year protecting about 10 milion people.

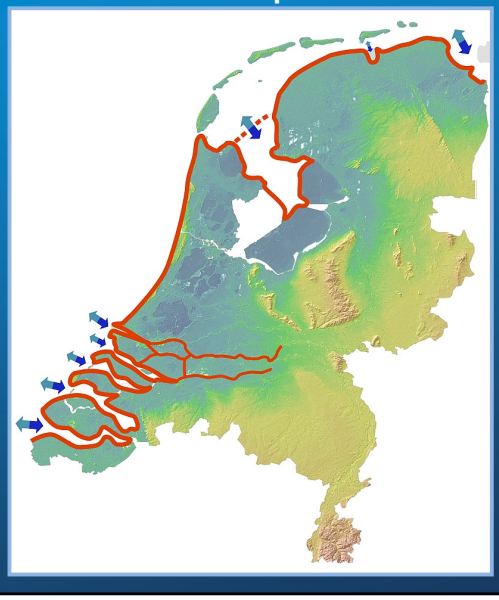
A reasonable assumption is that at global level some 500 milion additional people will be exposed to flooding in case of 1 meter sea level rise, accordingly the total global annual cost would be in the order of 50.000 milion euros per year.

Option 1: offensive strategy

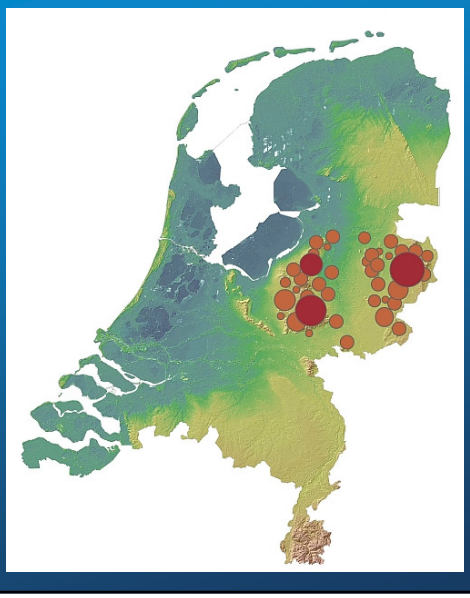
Option 2 protecting within existing boundaries, “closed version”



Option 2: protecting within existing boundaries, “open version”



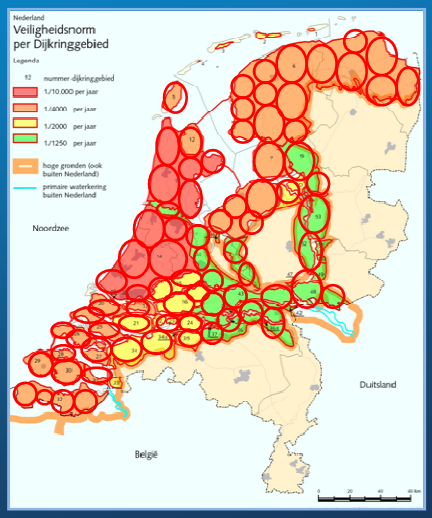
Option 3 retreat to higher grounds



Heightening existing dikes

Bron: DWW Rijkswaterstaat

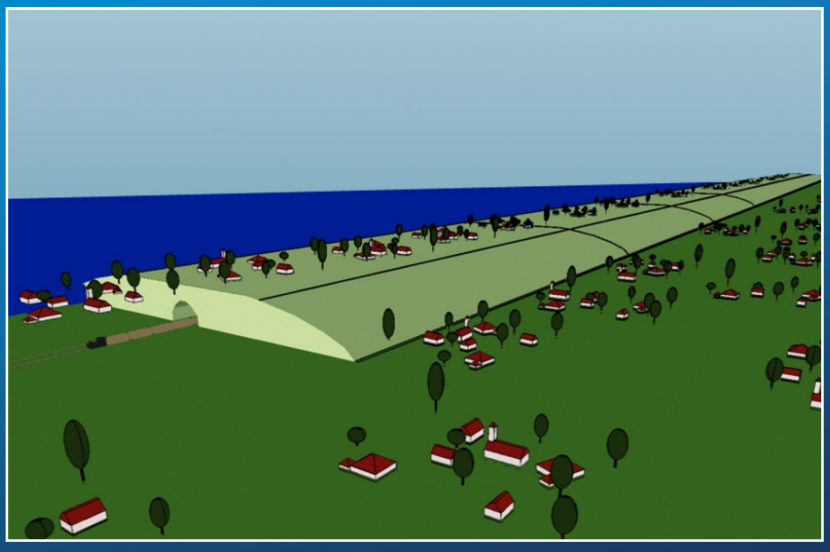
Increase the number of compartments / dike rings



Heightening the (entire) land

Bron: Deltares, VU

Breakproof dikes



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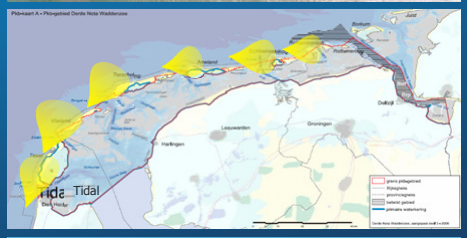
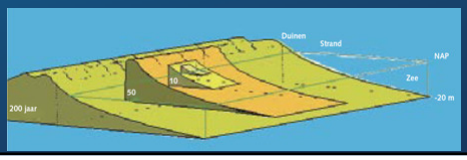
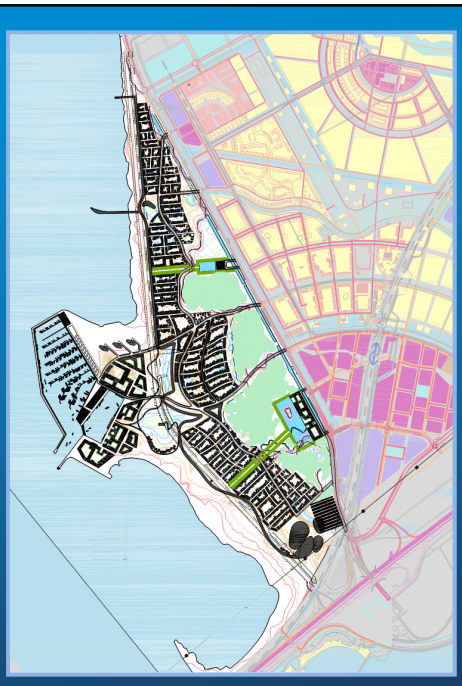
Nourishment of the coastal sand-river

Images Courtesy RIKZ





Klimaatbuffer/brede dijk, waarbij de kwelder meegroeit met de zee



Plannen brede dijk Almere

Bron: West 8 urban design & landscape architecture B.V.

Ellewoutsdijk

Zoutwater en brak water landbouw




Images courtesy Arjen de Vos

Floating cities and greenhouses


Image courtesy Dura Vermeer


Image courtesy www.drijvende kas.nl

conclusions

- Beyond 1 to 2 degrees C global temperature rise: increasing risk of disintegration of Greenland and Antarctic ice sheets
- Leading to a global rise in sea level of about 1 to 2 m in 2100; 2 to 4 m in 2200 and beyond 4 m in 2300;
- Interaction of slr with increased river peak discharge and and changes in storm surges and hurricanes/typhoons determines the risk of flooding in Delta's
- Subsidence is a major factor influencing the vulnerability of delta areas

Conclusions 2

- Rough estimate of global average annual cost which moreorless equals economically justified annual average investment in adaptation is about 50 bilion euro per year, starting in .....2020?

- Global initiatives in cooperation:

- Delta Alliance
- Estuary Alliance
- Connecting Delta Cities
- Alliance of Small Island Nations