Climate change

What can we expect in the Netherlands?




J. Bessembinder

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Set-up of presentation

- What is climate (change)?
- The climate system and the greenhouse effect
- Observed climate change
- Climate scenarios: IPCC and KNMI'06
- Interpretation climate data
- Effects of climate change

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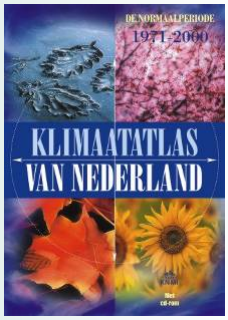
What is climate?

"The **average weather in a given region** over a longer period for among others temperature, precipitation, humidity, sunshine and wind. Also chance of **extremes** is part of the description of a climate"

Often a peiod of **30 years** used to describe a climate



Period 1971-2000

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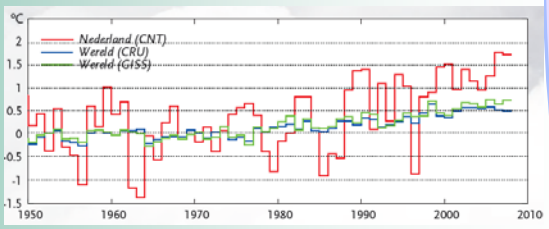
What determines the climate in the Netherlands?

- Position: latitude, along the coast and mainly westerly winds: **sea climate**
  - Westerly wind: mild and wet summers and winters
  - Easterly wind: relatively cold winters and warm, dry summers
- Average global temperature



- THC ("gulf stream"): about +3 °C

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What is climate change?

Climate change is nothing new:

Natural influences:

- Internal variations (El Niño)
- Variations in solar intensity and position of the earth (ice ages)
- Volcanic eruptions

Human influences

- Changes in land use
- Emissions of greenhouse gasses


www.netwerk.nl


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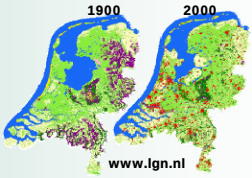

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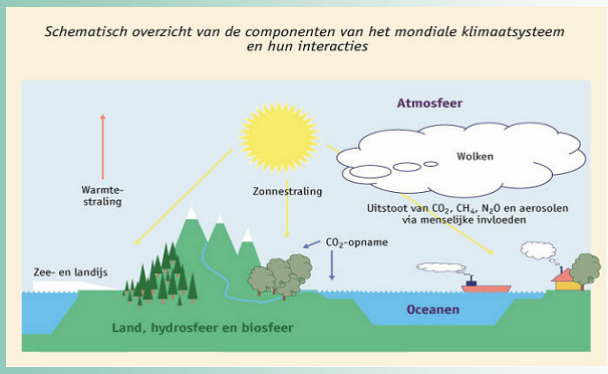
Greenhouse-effect



- The sun warms the earth
- The earth emits radiation (long wave)
- Greenhouse gasses, a.o. CO_2, retain this radiation
- This increases the temperature from -18°C to +15°C

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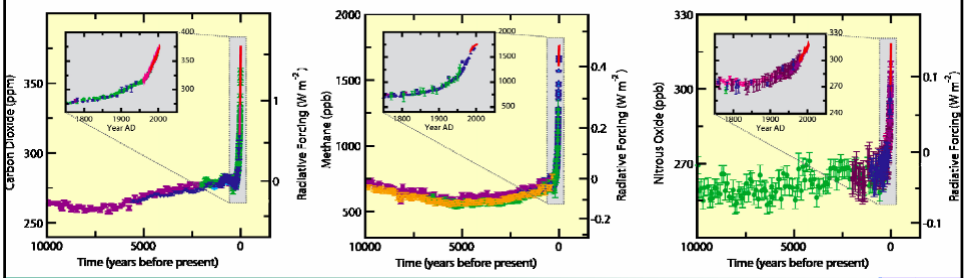
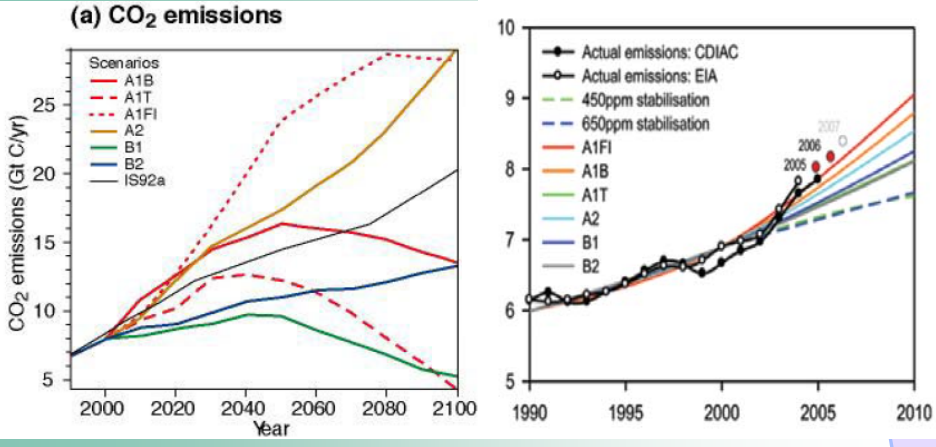
Increase of Green House Gasses



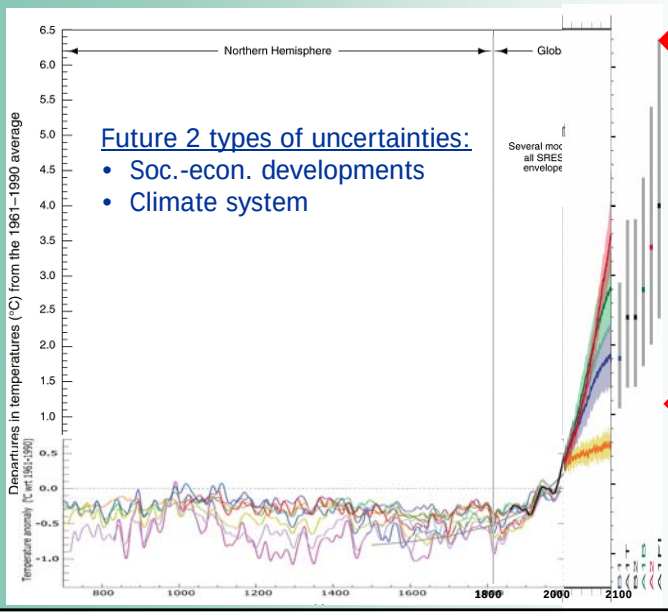
- Concentrations are higher than the pre-industrial concentrations in the past 10,000 years
- Increase of concentrations of CO_2, CH_4 en N_2O is mainly due to human activities

Emission scenarios

- Emission scenarios represent various socio-economic and technological developments



IPCC climate scenarios



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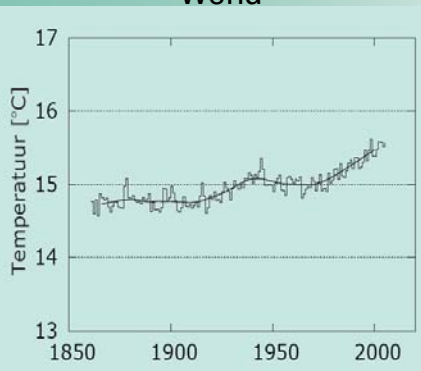
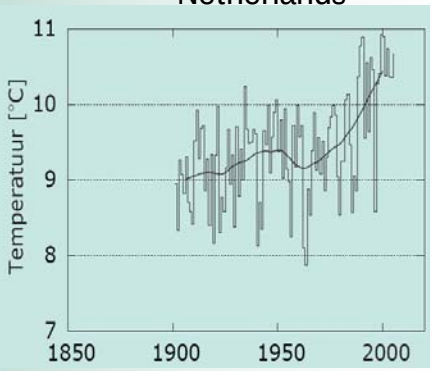
Yearly average temperature

- Significant increase of temperature on most of the European weather stations
- Larger year-to-year variation for region than globally

World



Netherlands



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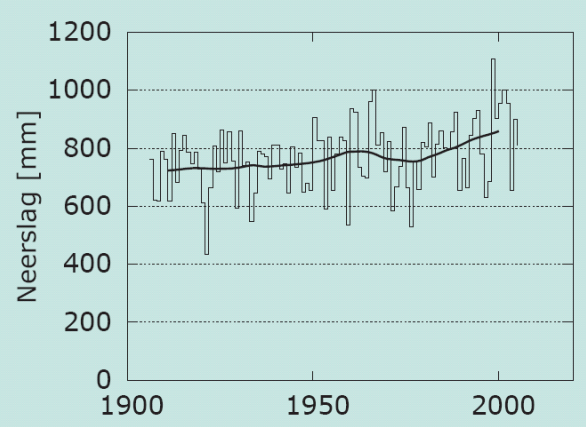
Precipitation in the Netherlands

- Increase yearly precipitation due to increase in autumn, winter and spring
- No change in summer precipitation



Average of 13 stations in the Netherlands

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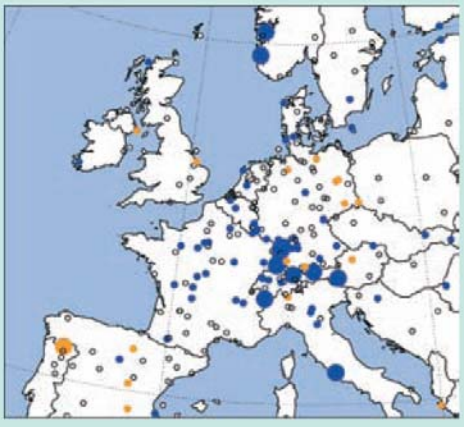
Precipitation in Europe

- Increase in yearly precipitation in temperate regions
- Increase in intensity of extreme precipitation



Number of days with 20 mm or more

- > 0,1
- 0,01 - 0,1
- Not significant
- -0,01 - -0,1
- < -0,1

Source: ECA

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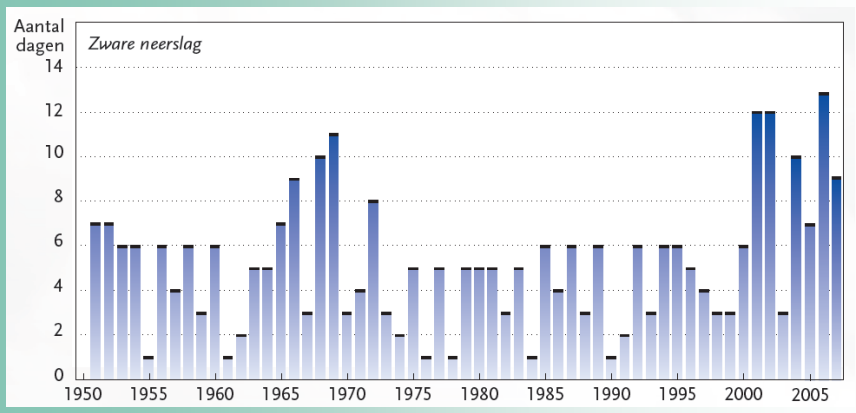
Extreme prcipitation



Number of days with 50 or more on 1 or more weather stations in the Netherlands

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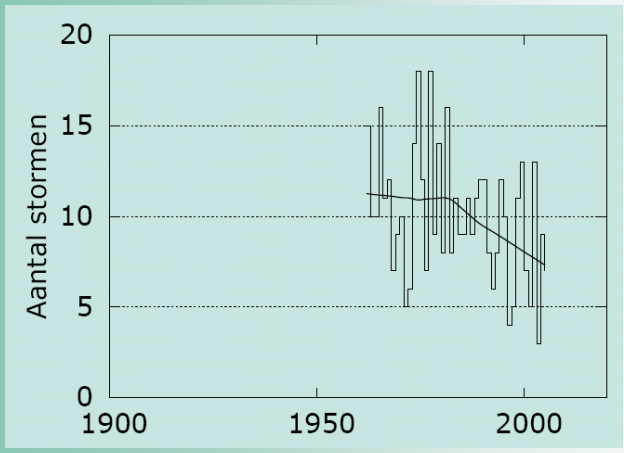
Storms in the Netherlands

- Decrease of “storm” frequency



>7 Bft along the coast and >6 Bft inland

Source: HYDRA

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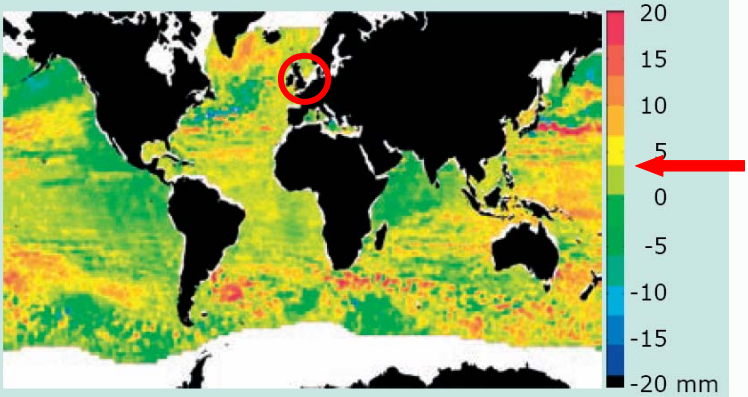
Sea level

- 20st century: 1.7 mm/jaar
- Between 1993-2004: about 3 mm/year



Source: Leuliette et al, 2004

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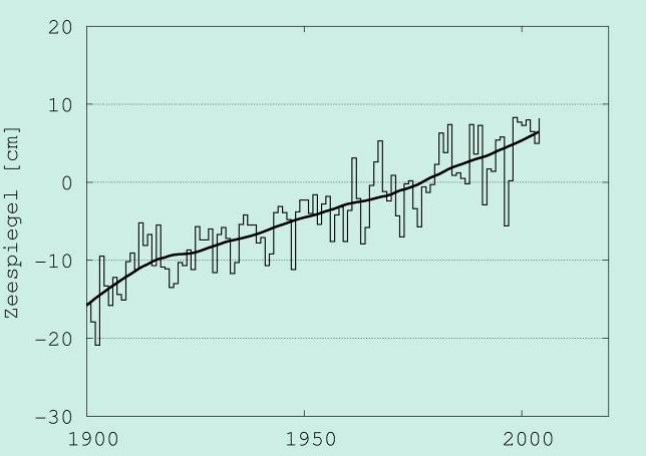
Sea level in the Netherlands

- 20st century: about 2 mm/year



Compared to NAP

Source: RIKZ/MNP

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What are climate scenarios?

Consistent pictures of a possible future climate

They indicate the magnitude of changes in e.g. temperature, precipitation, evaporation, wind and sea level

For adaptations in:

water management, coastal protection, agriculture, energy, environmental protection, tourism, etc.

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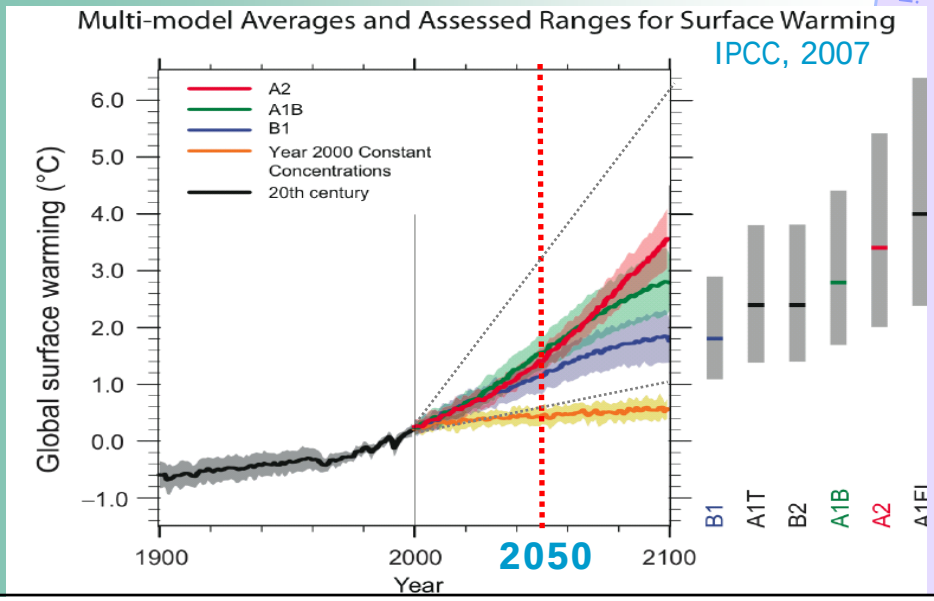
Global climate scenarios

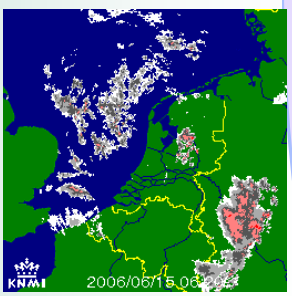


Shortcommings GCM's

- GCM's coarse resolution (200-500 km)
- Poor representation spatial detail
  - Land-sea
  - Topography
- Poor representation small scale events
  - Rainfall extremes, wet day frequency
  - Land-atmosphere interaction

GCM

RCM



Use of RCM's
Regional Climate Models

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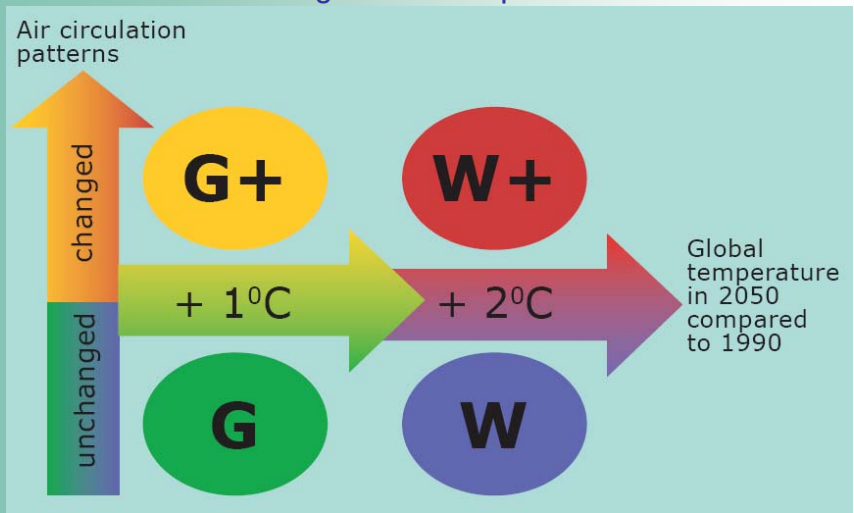
KNMI'06 scenarios

No climate change scenarios per emission scenario!



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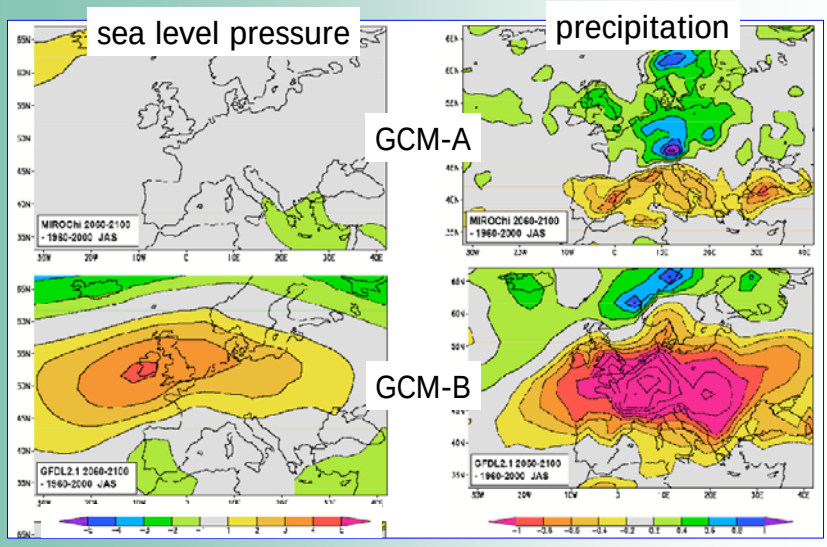
Circulation change (e.g. summer)



Van Ulden and Van Oldenborgh, 2006

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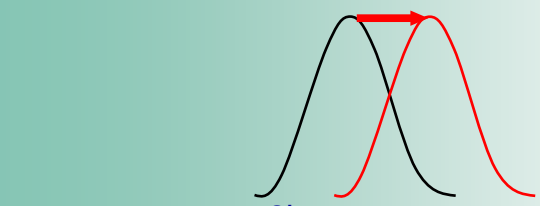
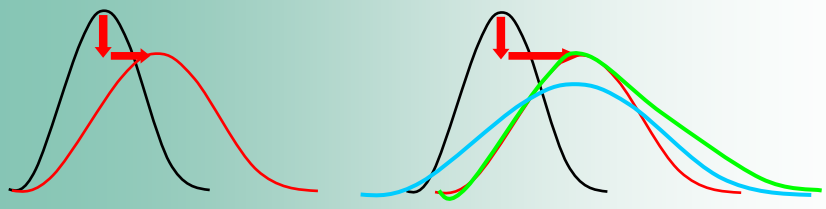
KNMI'06 scenarios: 2050 relative to 1990

		G	G+	W	W+
Global temperature rise		+1°C	+1°C	+2°C	+2°C
Change in air circulation patterns		no	yes	no	yes
Winter [3]	average temperature	+0.9°C	+1.1°C	+1.8°C	+2.3°C
	coldest winter day per year	+1.0°C	+1.5°C	+2.1°C	+2.9°C
	average precipitation amount	+4%	+7%	+7%	+14%
	number of wet days (≥ 0.1 mm)	0%	+1%	0%	+2%
	10-day precipitation sum exceeded once in 10 years	+4%	+6%	+8%	+12%
	maximum average daily wind speed per year	0%	+2%	-1%	+4%
Summer [3]	average temperature	+0.9°C	+1.4°C	+1.7°C	+2.8°C
	average precipitation amount		+6%		-19%
	daily precipitation sum exceeded once in 10 years		+27%		+10%
	potential evaporation	+3%	+8%	+7%	+15%
Sea level	absolute increase	15-25 cm	15-25 cm	20-35 cm	20-35 cm

Change in climate variables



Change average



Change average and distribution

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General picture

Characteristics of all KNMI'06 scenarios:

- Temperature continues to rise
- Winters on average wetter
- Intensity of extreme rainfall increases
- Changes in wind climate small
- Sea level continues to rise

Together the scenarios represent a "forecast" for the future climate

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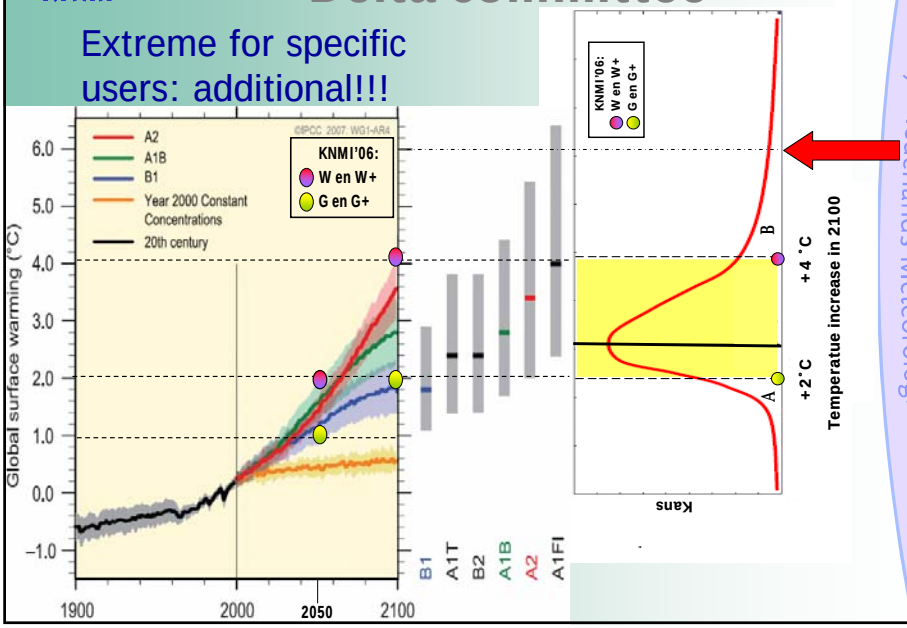
Delta committee

Extreme for specific users: additional!!!



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Delta committee versus KNMI'06

Delta committee scenarios	KNMI'06 scenarios
'Plausible upper limit' of possibilities	Range of most likely outcomes
Specifically for the objective of this committee: long-term safety against flooding	General for everyone: wide range of applications
Targeted at 2100 and later	Targeted at 2050 and 2100
Basis is IPCC 'likely' upper estimate of global temperature rise (+6°C in 2100 w.r.t. 1990)	Basis is IPCC 'best estimates' for global temperature rise (+2°C or +4° in 2100 w.r.t. 1990)
Extreme extrapolation of uncertainty ice sheet dynamics	Less extreme extrapolation of uncertainty ice sheet dynamics
⇓	⇓
Maximum sea level rise in 2100 of 120 cm (excl. 10 cm subsidence)	Highest scenario for sea level rise in 2100 is 85 cm (excl. subsidence)

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Scenarios other countries

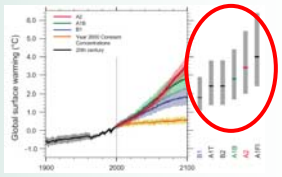
1. Regional scenarios per emission scenarios
2. Scenarios made with a limited number of GCM's en RCM's

Advantage KNMI'06:

- Insight in range for the future: uncertainty due to socio-econ. developements and due to incomplete knowledge climate system included

Disadvantage KNMI'06:

- No model runs that can be linked directly to the scenarios



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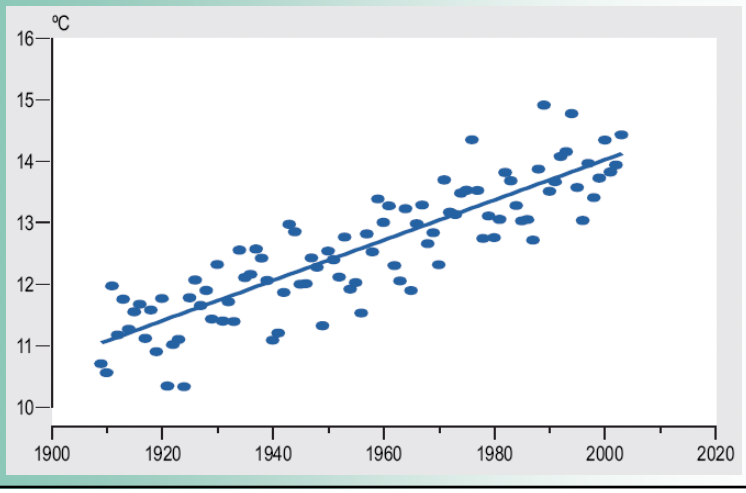
Interpretation climate data (1)

- Average temperature water of the river Rhine at Lobith
- *About 1/3 of increase due to climate change*



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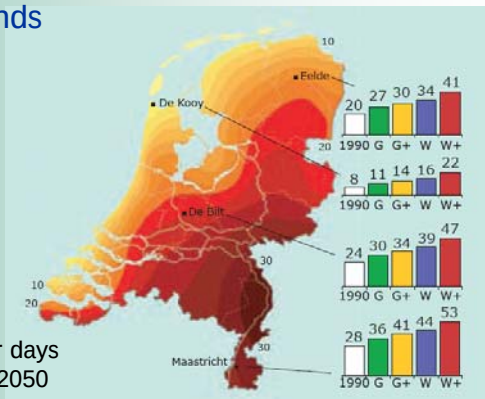
Interpretation climate data (2)

- Spatial variation due to current climate

- No spatial differentation in climate change within the Netherlands



Summer days
around 2050

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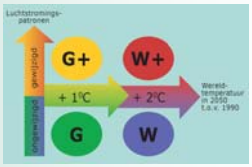
Interpretation climate data (3)

Scenarios are not climate predictions: range probable development



Increase uncertainty

temperature > sea level > precipitation > wind
winter precipitation > summer precipitation
averages > extremes

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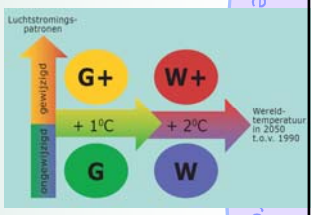
How to use climate scenarios?

- For what purpose are scenarios used?
  - Inventarisation impacts
  - Inventarisation adaptation options
  - Policy
- Which scenario and which time horizon is most relevant?



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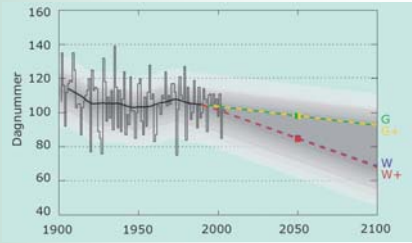
Warmer climate and nature

- Average temperature increases



- Growing season can start earlier: around 2050 6 (G) up to 19 days (W+) earlier
- "Agenda"problems for animals, region can become to warm, etc.

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Summer days around 2050

• Largest increase in W+ due to changes in air circulation

	De Bilt 1976-2005	G	G+	W	W+	Parijs 1976-2005
Max. temp. summer (°C)	21,7	22,6	23,1	23,5	24,6	23,9
Summer days	24	31	36	38	49	45
Tropical days	4	7	9	9	15	9

• More outdoor recreation

• Problem: more blue algae, more heat stress

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Water excess

• Increase intensity extreme precipitation in winter and summer

	G	G+	W	W+
Winter: 10-day sum once per 10 y	+4%	+6%	+8%	+12%
Summer: 24-hour sum once per 10 y	+13%	+5%	+27%	+10%

• Increase local water excess

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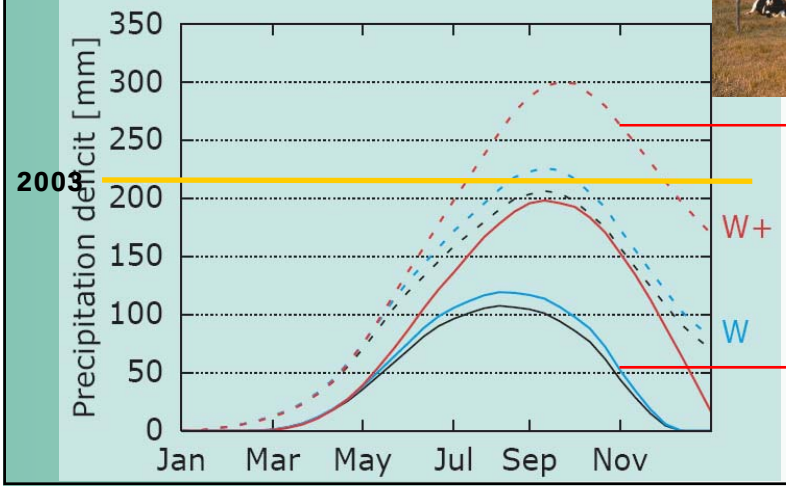
Drought

- Prec. deficit = rainfall - pot. evaporation
- 1906-2000 and climate scenarios for 2050



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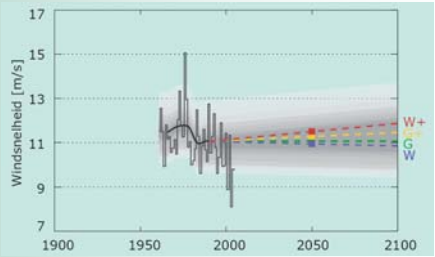
Wind energy

- Hardly any change in wind speed compared to the year-to-year variation



- Little change expected in maximum long-term wind energy yields

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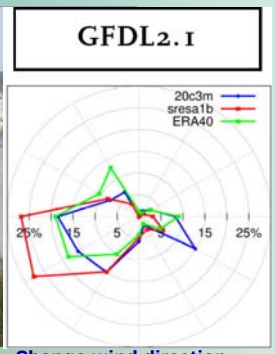
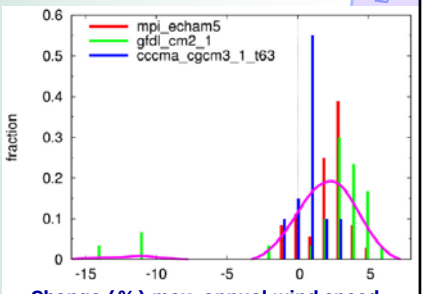
Storm surge along coast

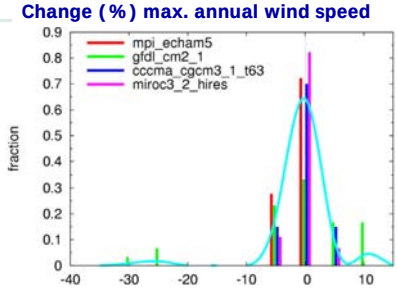
- Storm surge also depends on wind direction
- No change in average max. annual storm surge



Change wind direction



Change (%) max. annual wind speed



Change (%) max. annual storm surge

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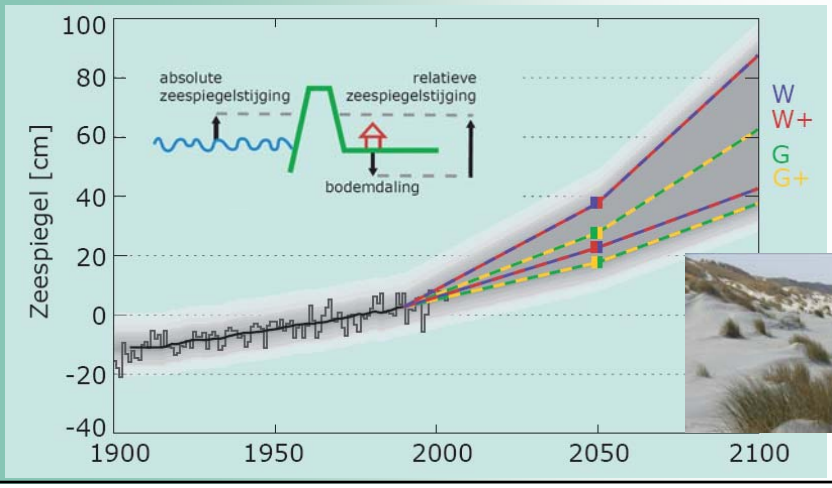
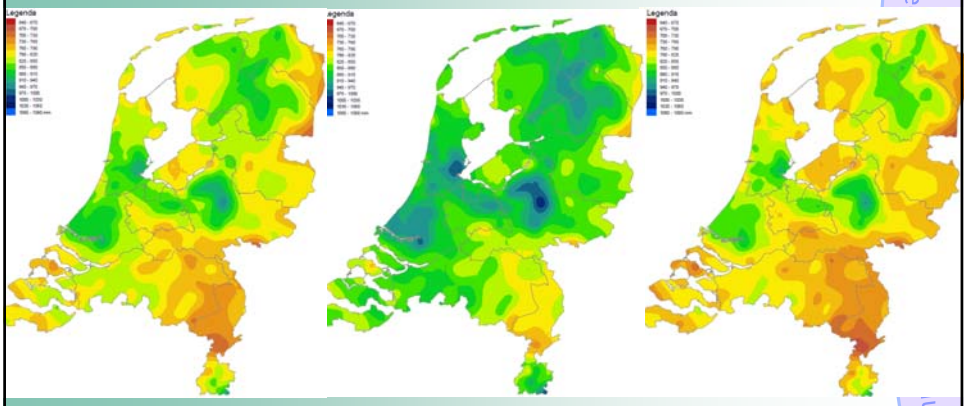
Sea level rise

- KNMI'06: absolute SLR
- Sea level will contue to rise after 2100



Avg. Annual precipitation

1976-2005 W 2050 W+ 2050



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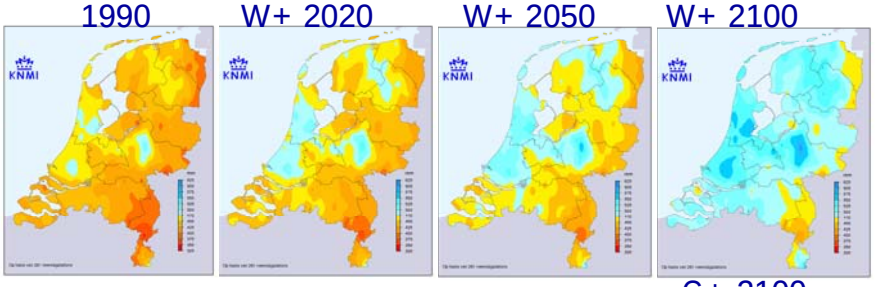
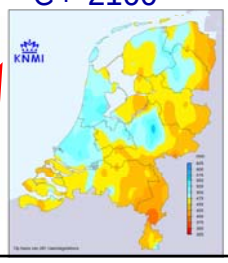
Avg. Precipitation winter half-yaer

1990 W+ 2020 W+ 2050 W+ 2100



G+ 2100



Change twice as vast in W and W+

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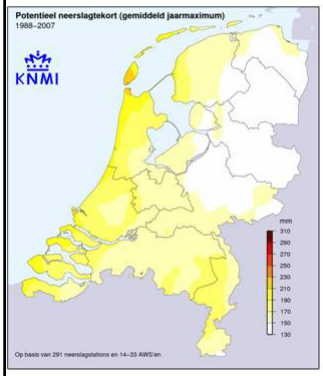
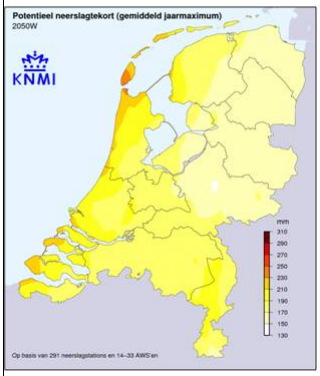
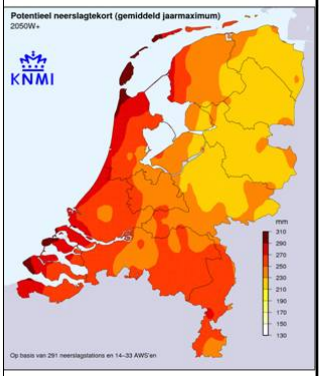
Maximum precipitation deficit

1988-2007	W 2050	W+ 2050
		

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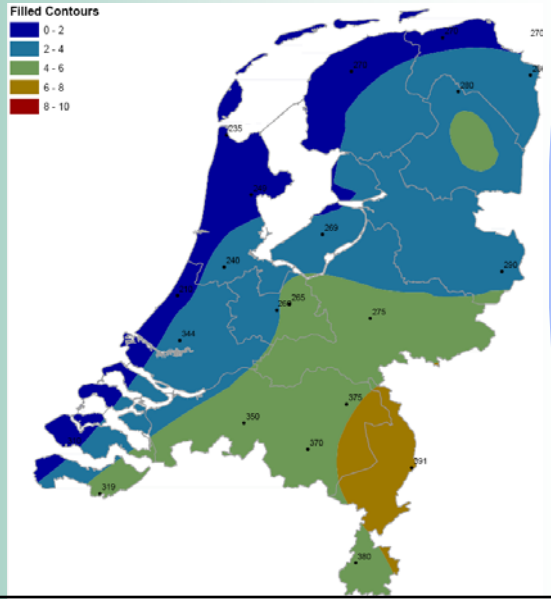
"Climate atlas"

Frost days in the period 1976-2005



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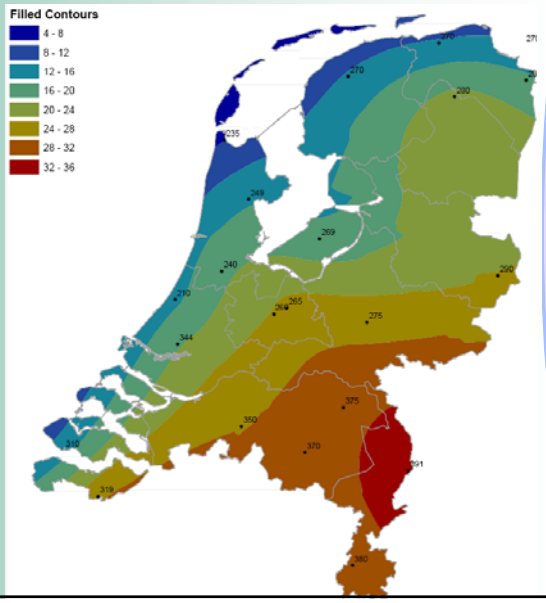
“Climate atlas”

Summer days
In the period
1976-2005



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