Climate change

KNMI'06 climate scenarios




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Structure presentation

- Climate change and the greenhouse effect
- Observed climate change in the Netherlands
- The KNMI'06 climate scenarios
- Scenarios in neighbouring countries
- Effects of climate change

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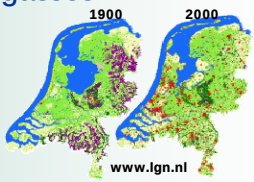
What is climate change?

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


www.fines.be



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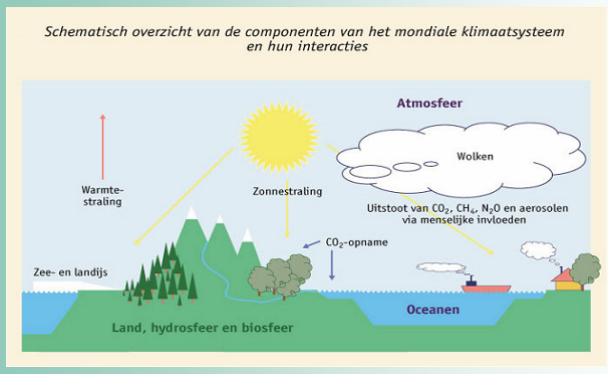
Greenhouse-effect



- 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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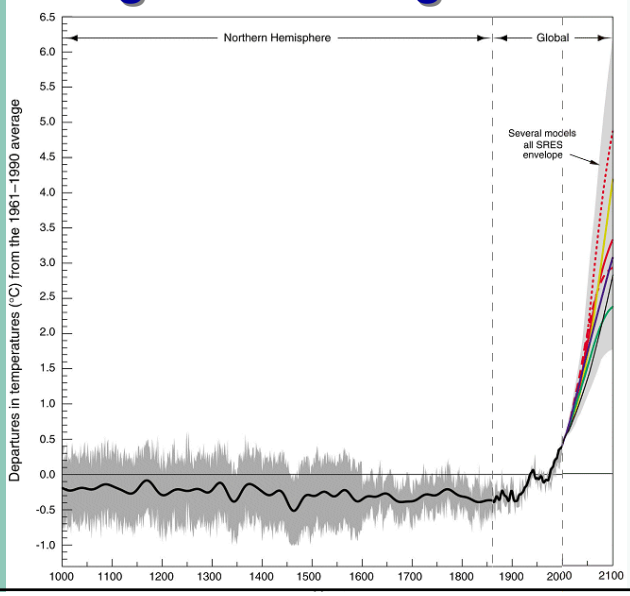
Consequences of increase of greenhouse gasses…



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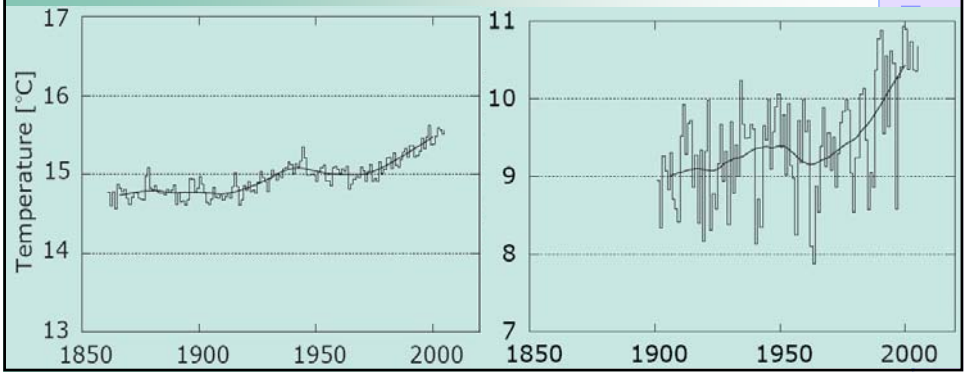
Average year temperature

- Significant increase in average temperature
- Larger year-to-year variation for regions than for the world as a whole

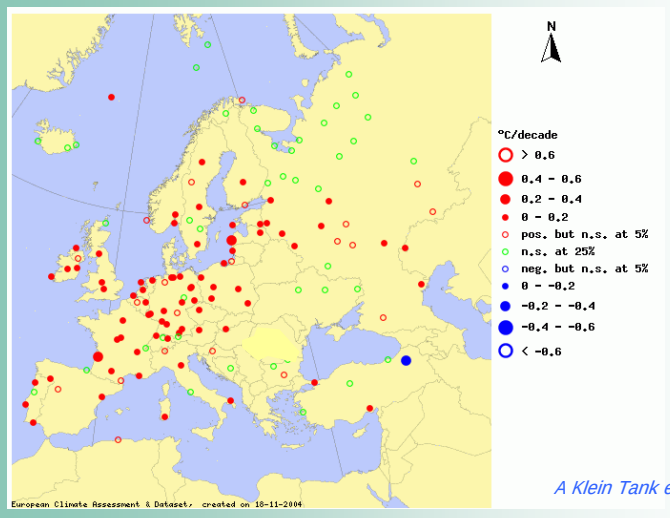
World

Netherlands



Can we see this in Europe?

- Trend in mean temperature 1946-2003



A Klein Tank ea

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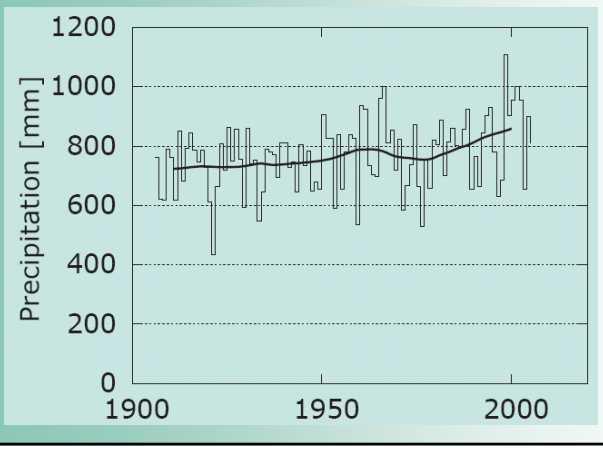
Precipitation in the Netherlands

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



Average of 13 stations in the Netherlands

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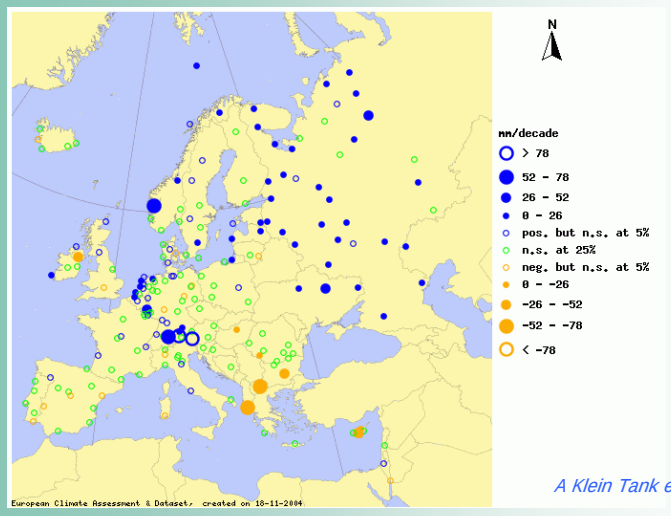
Can we see this in Europe?

- Trend in mean precipitation 1946-2003



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What are scenarios?

Suppose: you want to organise a party for your daughter in summer

- Weather in the Netherlands is variable: in July it can be warm and sunny, but it can also rain

- Prepare for both situations: “inside” and “outside” scenario

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What are climate scenarios?

Consistent pictures of 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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Methodology

Step 1: What are main factors for climate change in the Netherlands

Step 2: What is the possible global range for these factors until 2100 (use GCM's)

Stap 3: Selection steering variables: structure scenarios

Step 4: Translation of global changes to changes in the Netherlands (use RCM's and observations)

Stap 5: Kwantify relevant climate parameters

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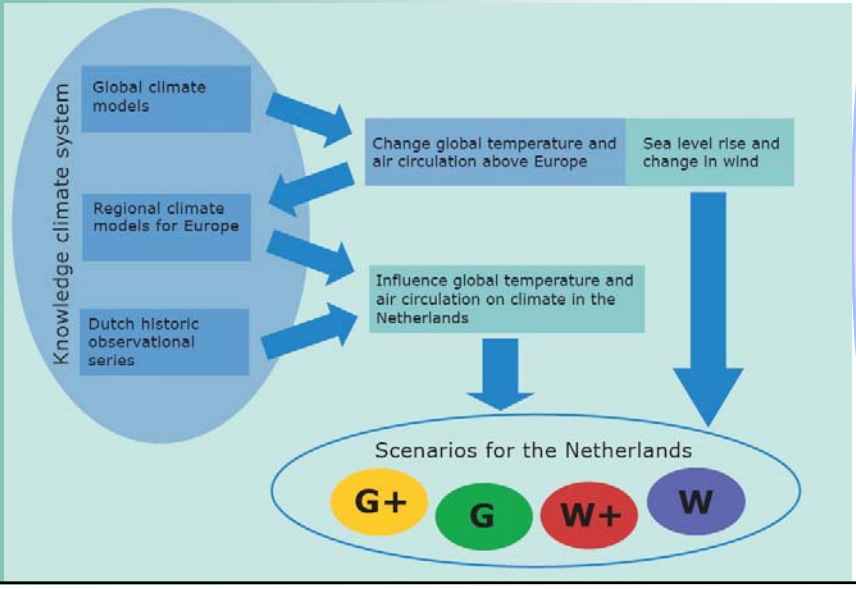
Methodology KNMI'06 scenarios



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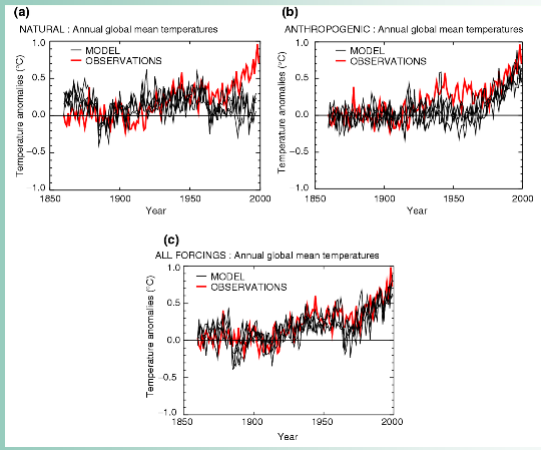
Can we trust climate models?

Only natural variability



Only antropogenic contributions

Natural + antropogenic effects

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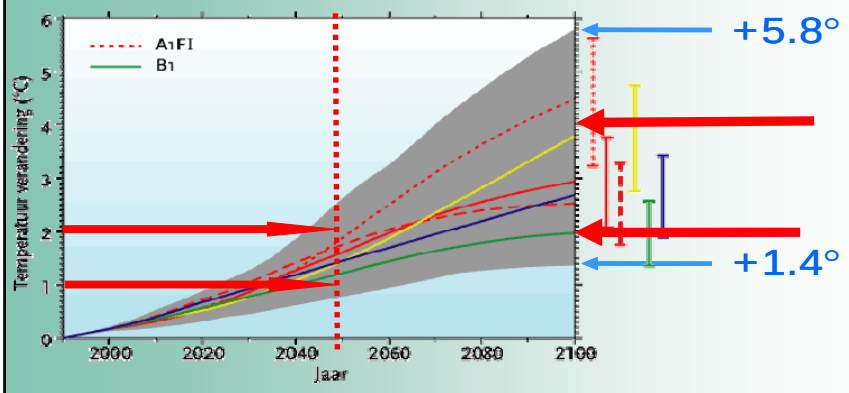
IPCC 2001: global temperatuur

Start with projections with Global Circulation Models :

- Multiple emission scenarios
- Multiple models



Tijdshorizon 2050 en 2100

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Quality GCM's

Available:

- Results 23 GCM's (for 4th report IPCC)

Result:

- 7 poor, 8 moderate, 3 reasonable, 5 good

5 models with best representation of current atmospheric circulation used.

ECHAM5 (Duitsland), HadGEM1 (Engeland)
MIROC Hi (Japan), GFDL 2.1 (USA), CCC63 (Canada)

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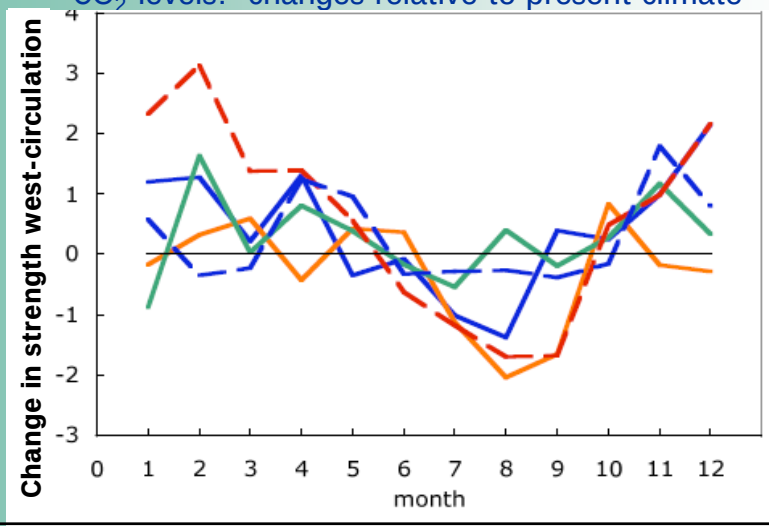
Global projections: circulation

- G-west NW-Europe end of 21st century with doubled CO_2-levels: changes relative to present climate



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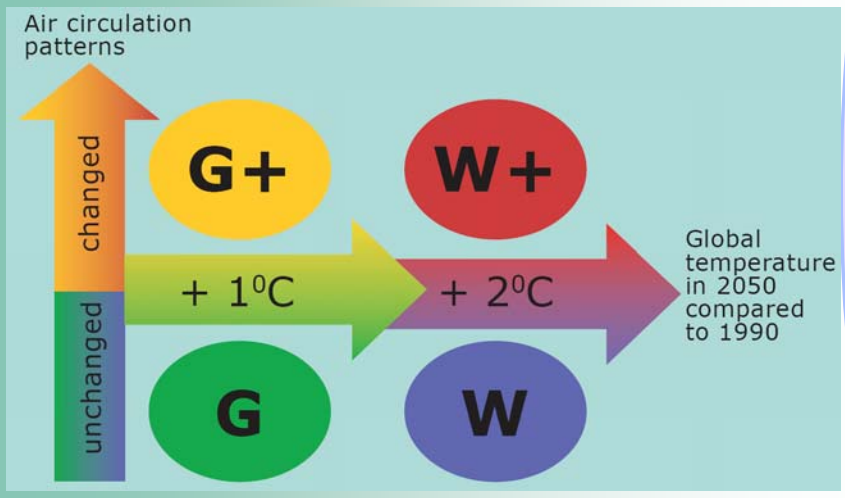
Structure of the scenarios



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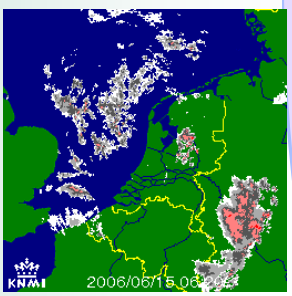
Limitations GCM's

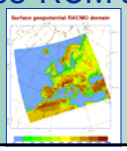
- GCM's coarse resolution (200-500 km)
- Poor representation spatial detail
  - land-sea
  - topography
- Poor representation small scale events
  - Extreme precipitation, Wet day frequency)
  - Land-atmosphere interaction

GCM

RCM



Use RCM's



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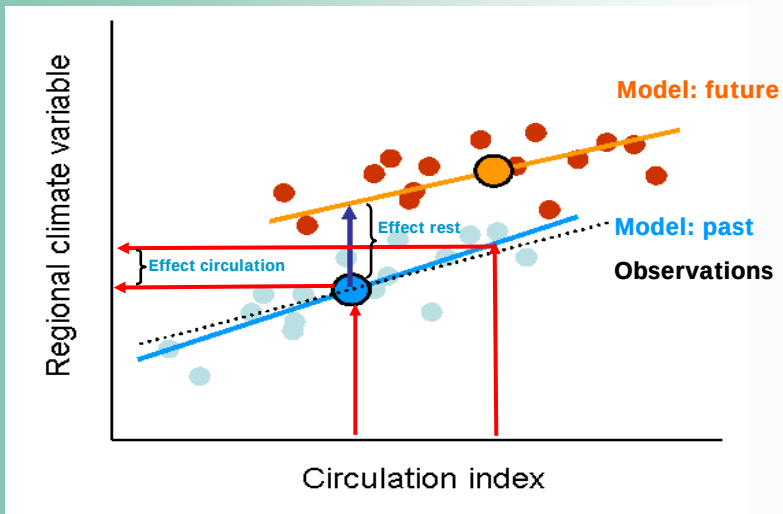
Seperate influence circulation and temperature



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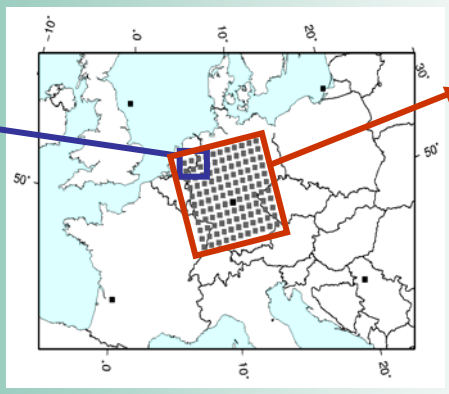
RCM data usage



Temperature (spatial detail)

Precipitation (small scale events)

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KNMI'06 scenarios: 2050 t.o.v. 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

General picture

Characteristics of all KNMI'06 scenarios

- Temperature will continue to increase
- Winters will become wetter
- Increase intensity extreme summer showers
- Changes in wind climate small
- Sea level will continue to increase

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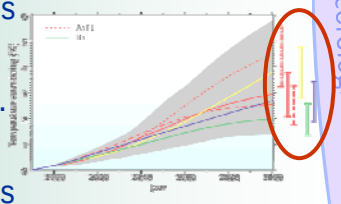
Scenarios in other countries

1. Regional scenarios for various emission scenarios
2. Scenarios made with a limited number of GCM's and RCM's

Advantage KNMI'06:

- most recent GCM and RCM-runs
- range of emission scenarios (uncertainty due to socio-econ. developments)
- large range of GCM's and RCM's (uncertainty due to limited knowledge of climate)



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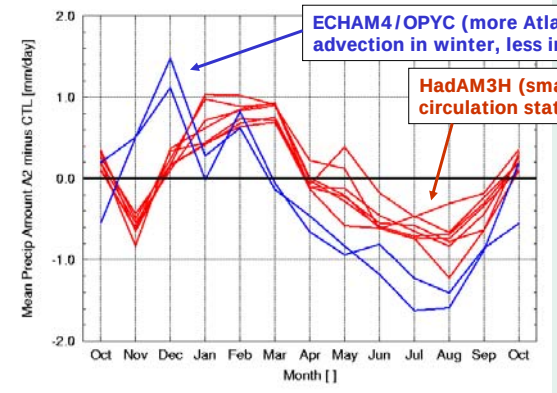
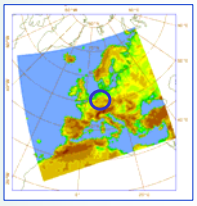
The influence from the driving GCM

- Change of precipitation annual cycle in Rhine area from multiple regional climate model simulations
- Two different GCM's





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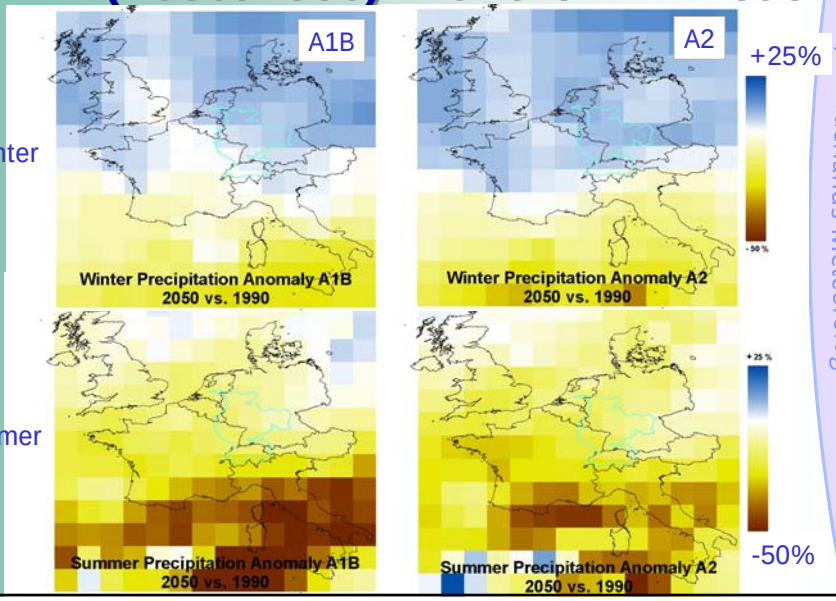
Projections mean precipitation (2050/1990) with the MPI model



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Projections mean precipitation (2050/1990) with the MPI model

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A1B

A2

+25%

Winter

Mean change
Winter change ± +5 – +10%
Summer change ± -10 – -15%

Gradient
N-S gradient in winter
SE-NW gradient in summer

Difference scenarios
A2 a bit stronger in winter
A1B a bit stronger in summer

Resolution
Resolution very coarse (>150 km)

Extremes
Only seasonal mean!
No info on extremes or nr of wet days.

Summer

-50%

Scenarios neighbouring countries

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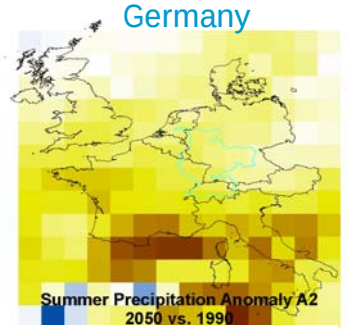
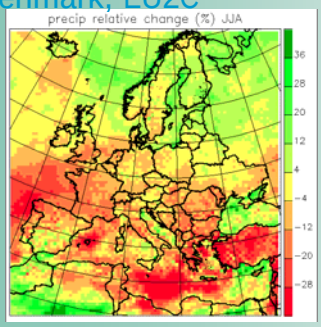
- Summer precipitation

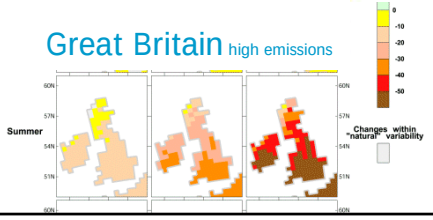
Germany



Denmark, EU2C



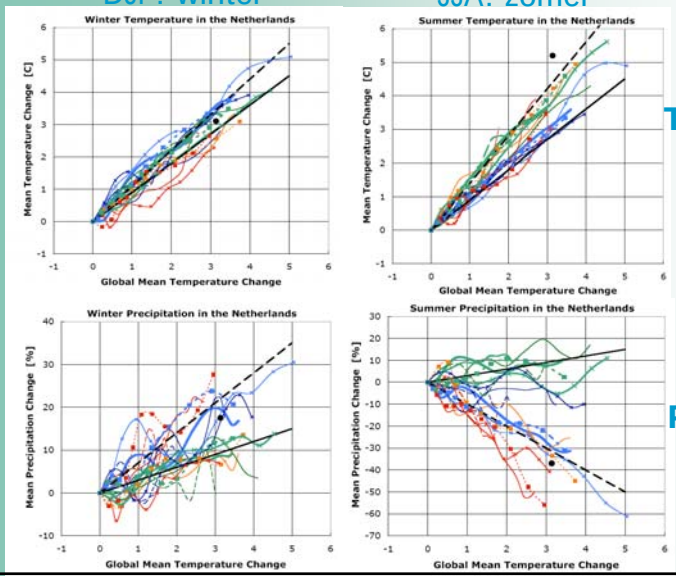
Great Britain high emissions



Cross-check met GCM's

DJF: winter

JJA: zomer



Temperature

Precipitation

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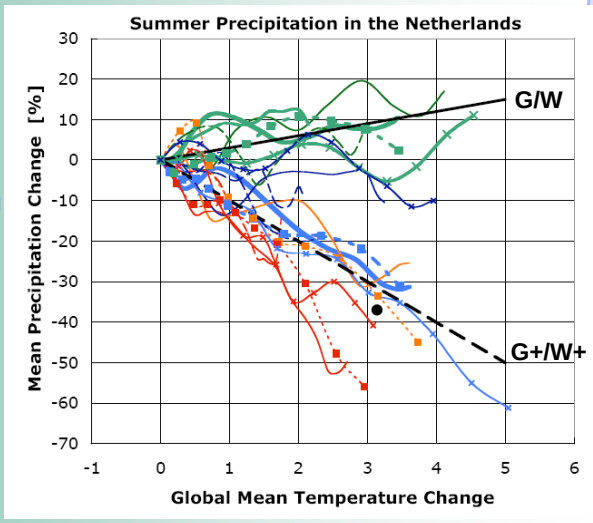
GCM's: range precipitation

- Range summer precipitation change in best 5 models



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Summer days around 2050

- Summer day: maximum temperature ≥ 25 °C
- Largest increase in W+ due to change in circulation

	1976-2005	G	G+	W	W+
De Kooy	8	11	14	16	22
De Bilt	24	30	34	39	47
Eelde	20	27	30	34	41
Maastricht	28	37	41	45	53

- Spatial differences due to current climate

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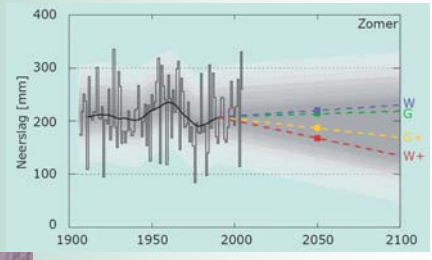
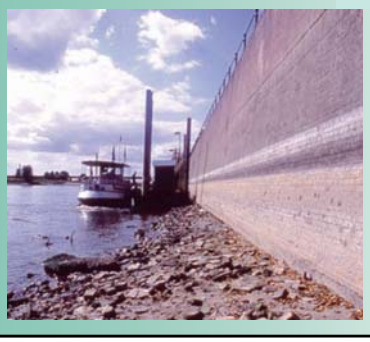
Summer discharge Rhine and Meuse

- Slight increase **or** decrease in summer precipitation
- Increase in evaporation





- Decrease summer discharge
- Hampered transport per ship
- Further penetration of salty seawater
- Decrease cooling water

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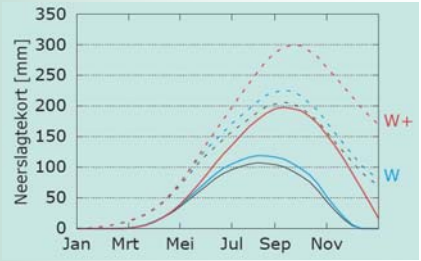
Drought in summer

- Neerslagtekort = prec. - evaporation
- Increase shortage in summer



- More often water shortage for agriculture and protected (wet) areas

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Water excess

- Increase precipitation intensity

	G	G+	W	W+
Winter: 10-day prec. sum, exceeded 1/10 y	+4 %	+6 %	+8 %	+12 %
Summer: daily prec. sum exceeded 1/10 y	+13 %	+5 %	+27 %	+10 %

- Increase local water excess

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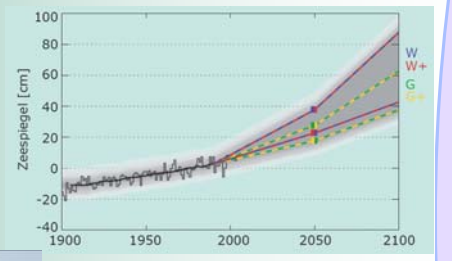
Sea level rise

- Sea level continues to rise



- Increased coastal erosion
- Increased salt intrusion
- Need for “updating” coastal protection

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