KNMI

European Climate Change scenarios and the impact on agriculture

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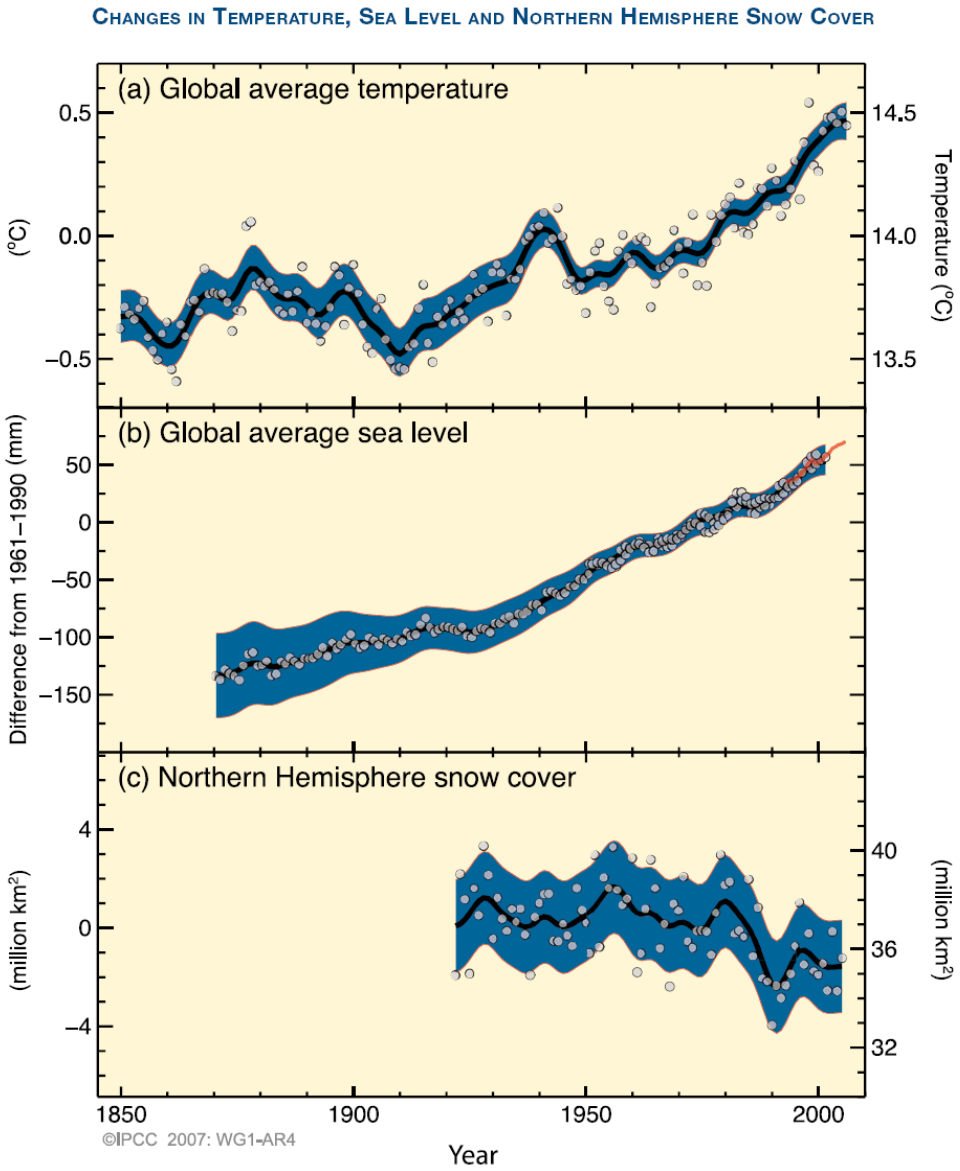
Climate change in observations



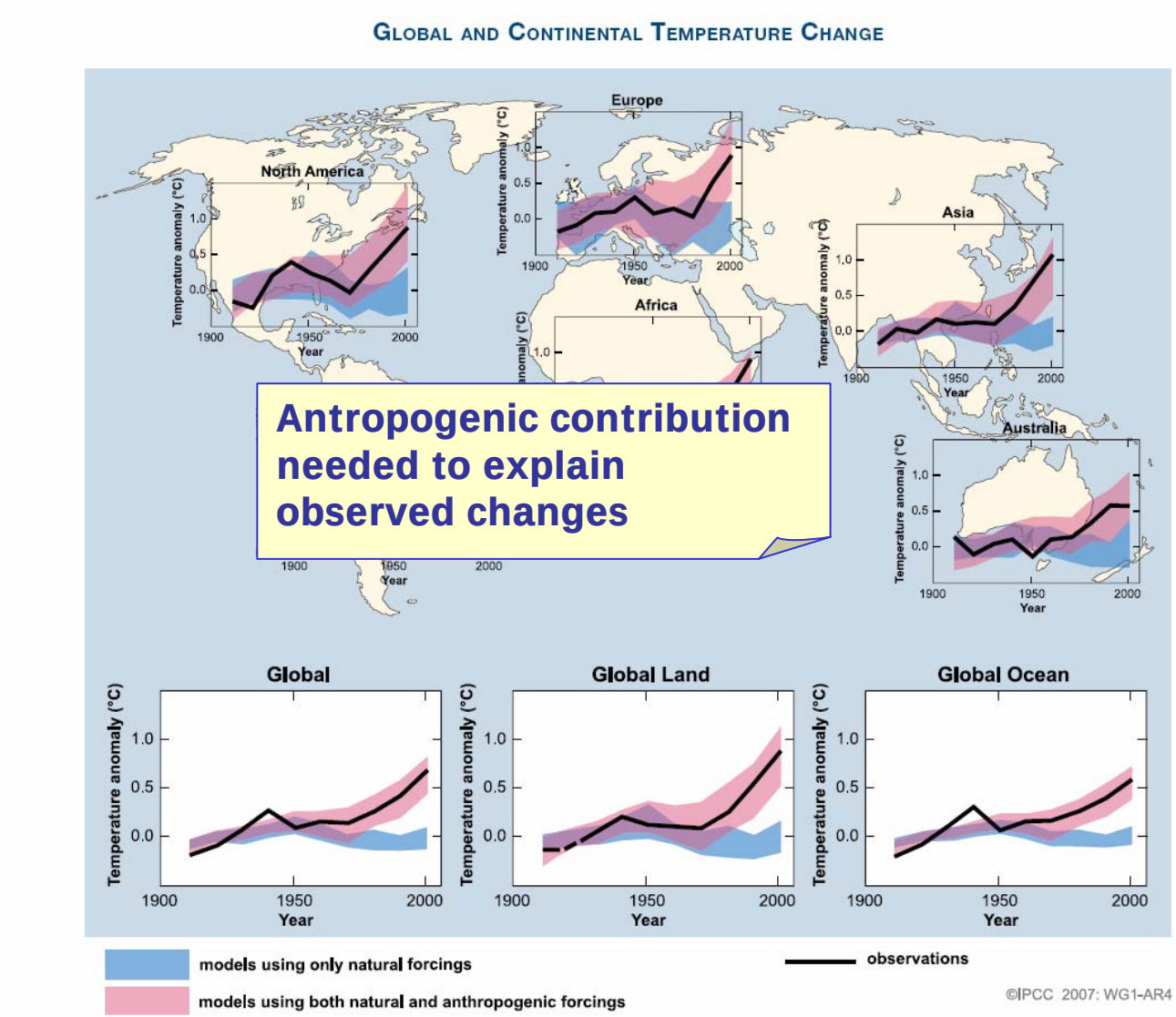
Temperature rise since 1956 accelerating to 0.13 ± 0.03 K/10yrs

Sea level rise since 1993 accelerating to 3.1 ± 0.7 mm/yr

Snow cover/glacier length decreasing

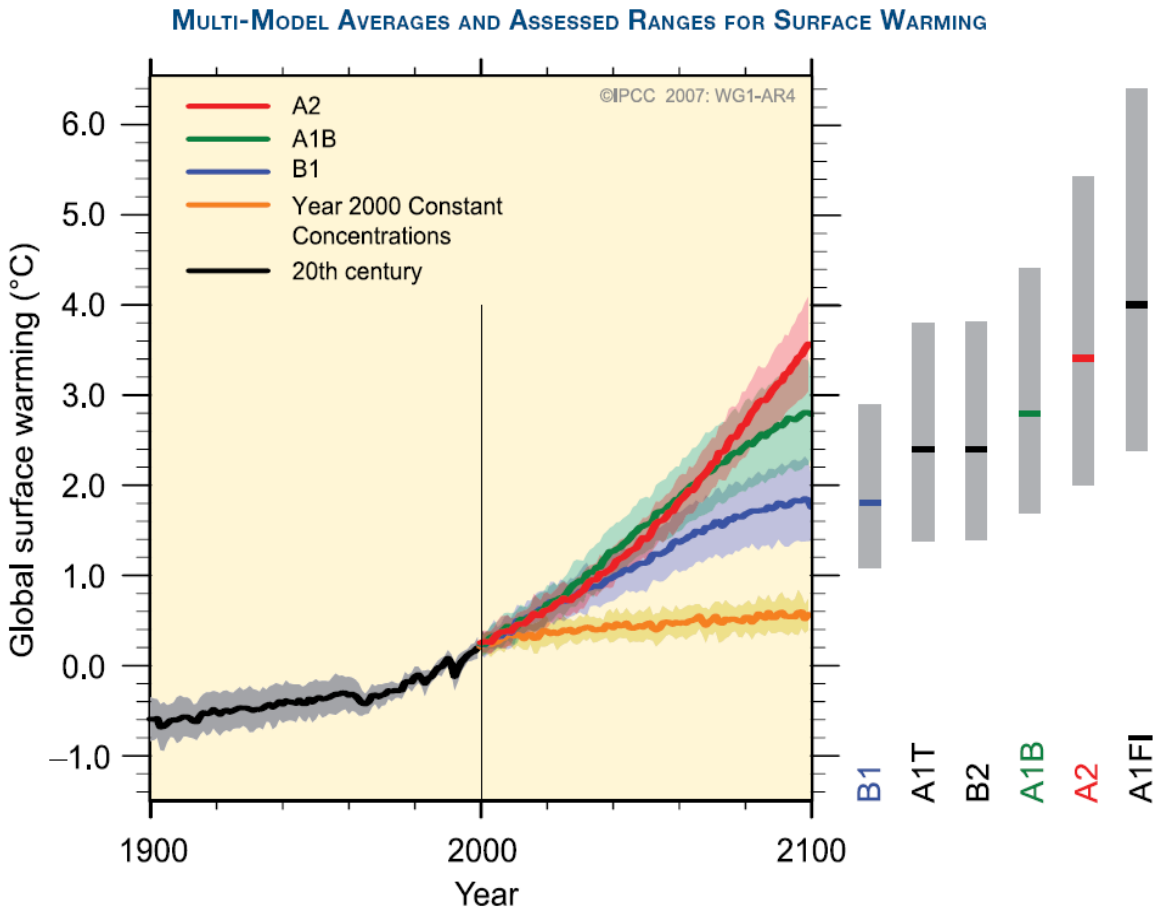
IPCC, 2007

Model reconstructions



IPCC, 2007

Model projections (global mean temperature)

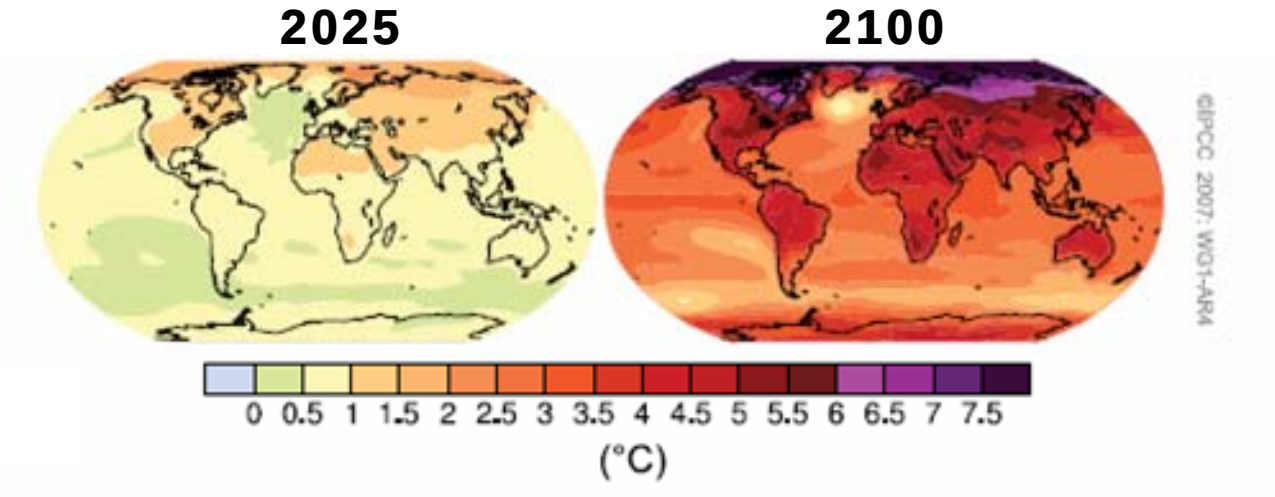


IPCC, 2007

Climate change involves many aspects

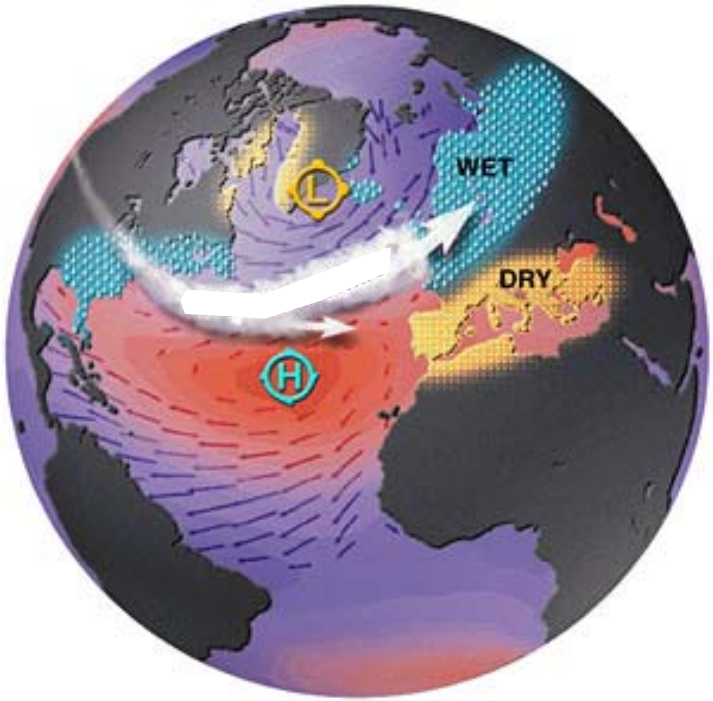
- Future temperature change varies between regions
- Mean wind patterns may also change!

Mean temperature change SRES A2 scenario



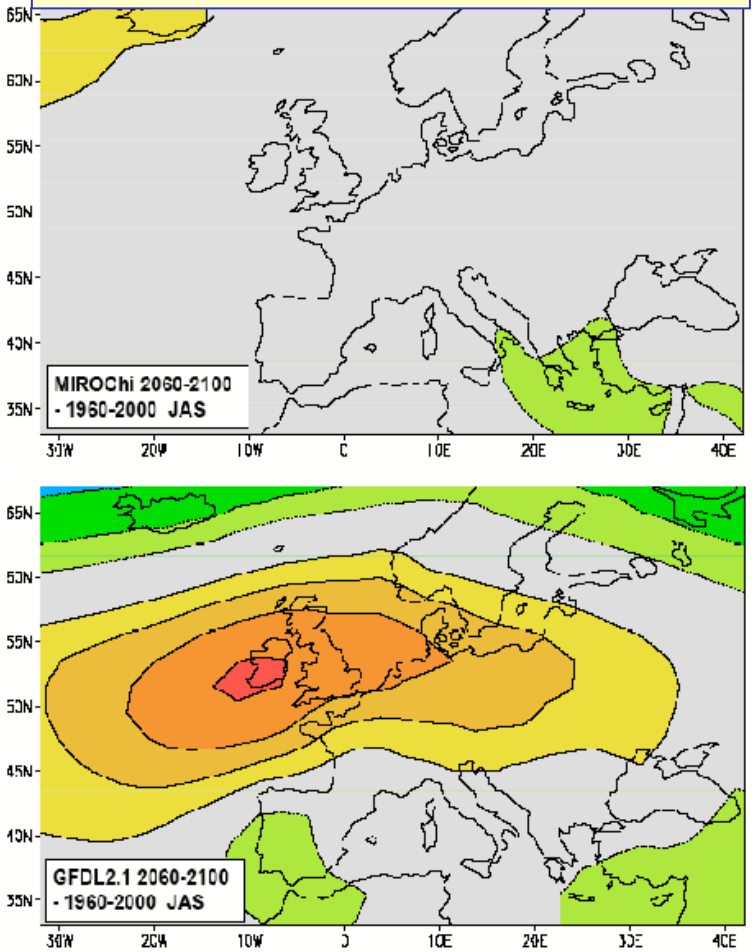
IPCC, 2007

Atmospheric circulation change



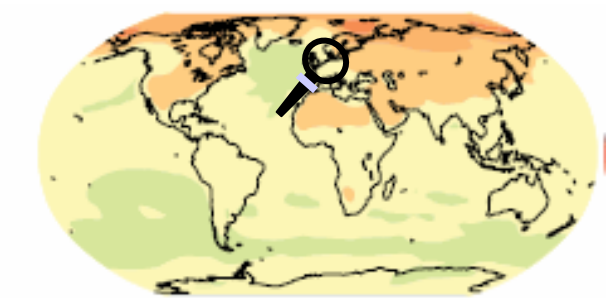
Van Ulden and Van Oldenborgh, 2006

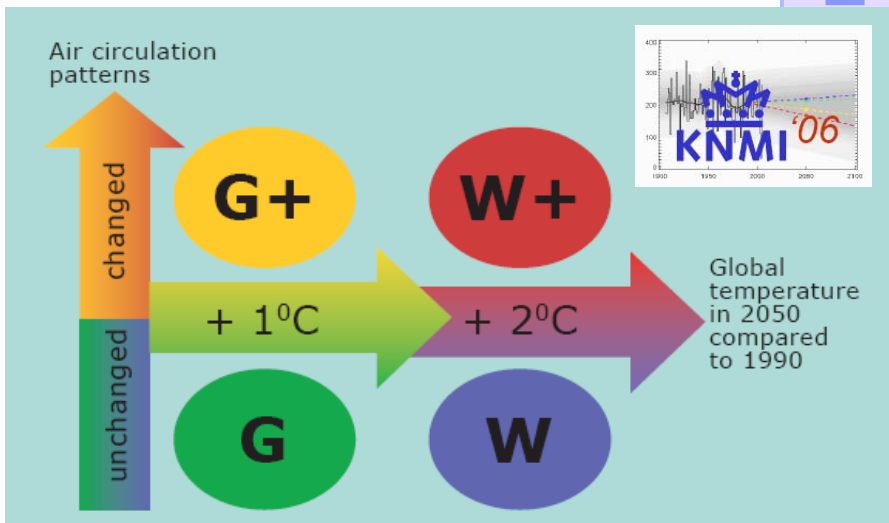
Sea level pressure difference from 2 different GCMs



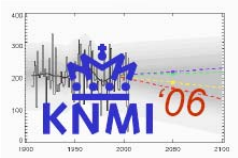
Climate change in the Netherlands

- Climate change in the Netherlands depends on
  - global temperature rise
  - change in local wind regime



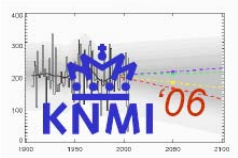


The KNMI'06 climate scenarios: change in 2050 relative to 1990



		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
	warmest summer day per year	+1.0°C	+1.9°C	+2.1°C	+3.8°C
	average precipitation amount	+3%	-10%	+6%	-19%
	number of wet days (≥ 0.1 mm)	-2%	-10%	-3%	-19%
	daily precipitation sum exceeded once in 10 years	+13%	+5%	+27%	+10%
	potential evaporation	+3%	+8%	+7%	+15%
Sea level	absolute increase	15-25 cm	15-25 cm	20-35 cm	20-35 cm

Some examples



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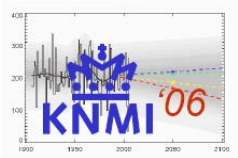
With circulation change the coldest and warmest temperature change more than mean

Some examples



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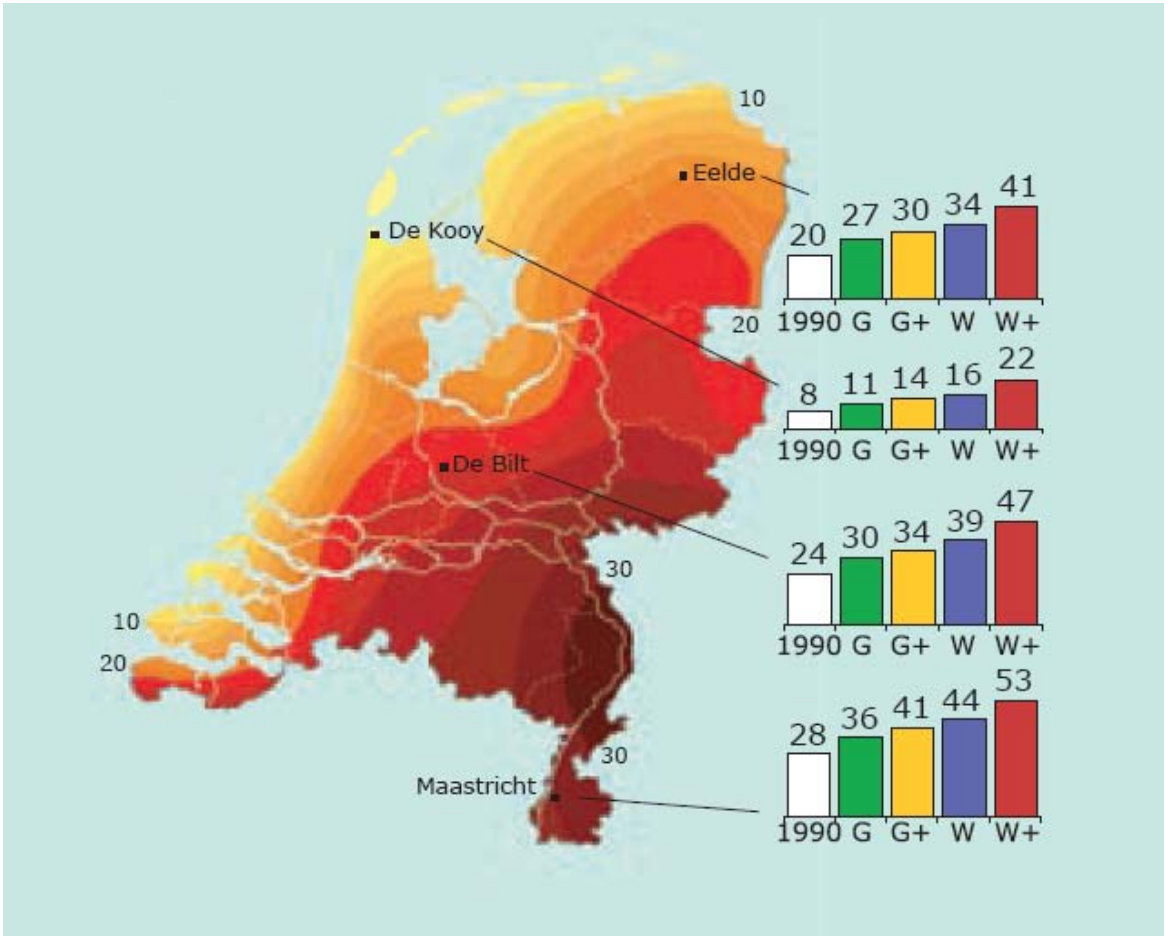
Nr of wet days strongly dependent on circulation change

Nr of summer days

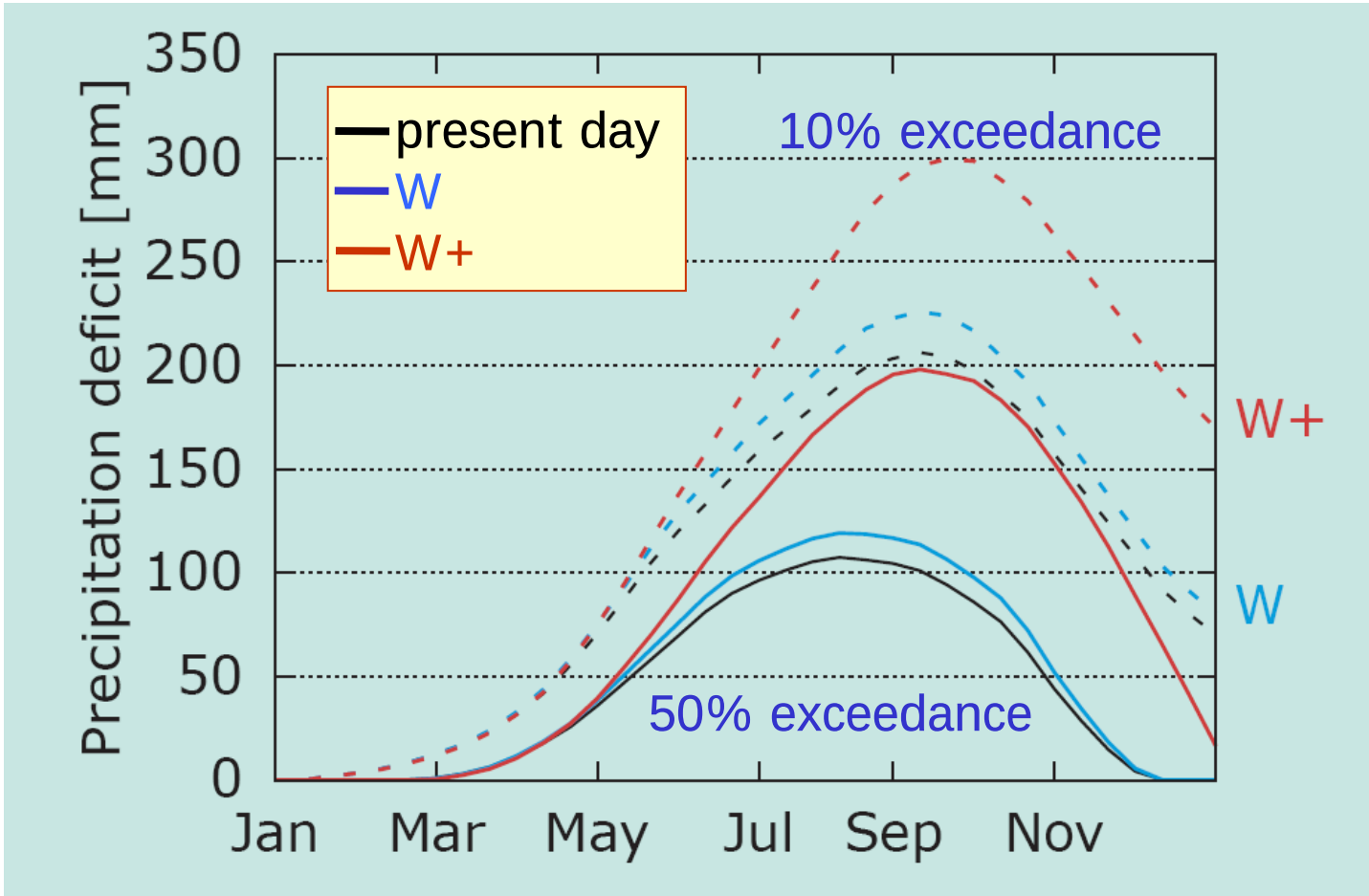


Calculated by transforming observed 1970 – 2000 observations consistent with KNMI'06 scenarios

Return time of 2003 drought

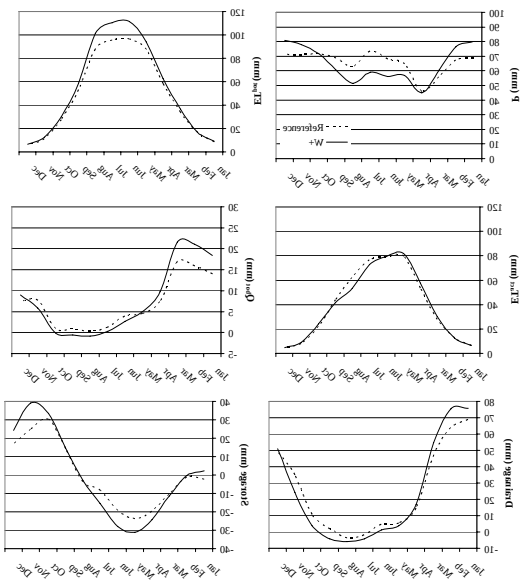
	1906-2000	G	G+	W	W+
Precipitation deficit (mm)	144	151	179	158	220
Return time of 2003-drought (yrs)	9,7	7,9	4,1	6,5	2,0

Potential precipitation deficit

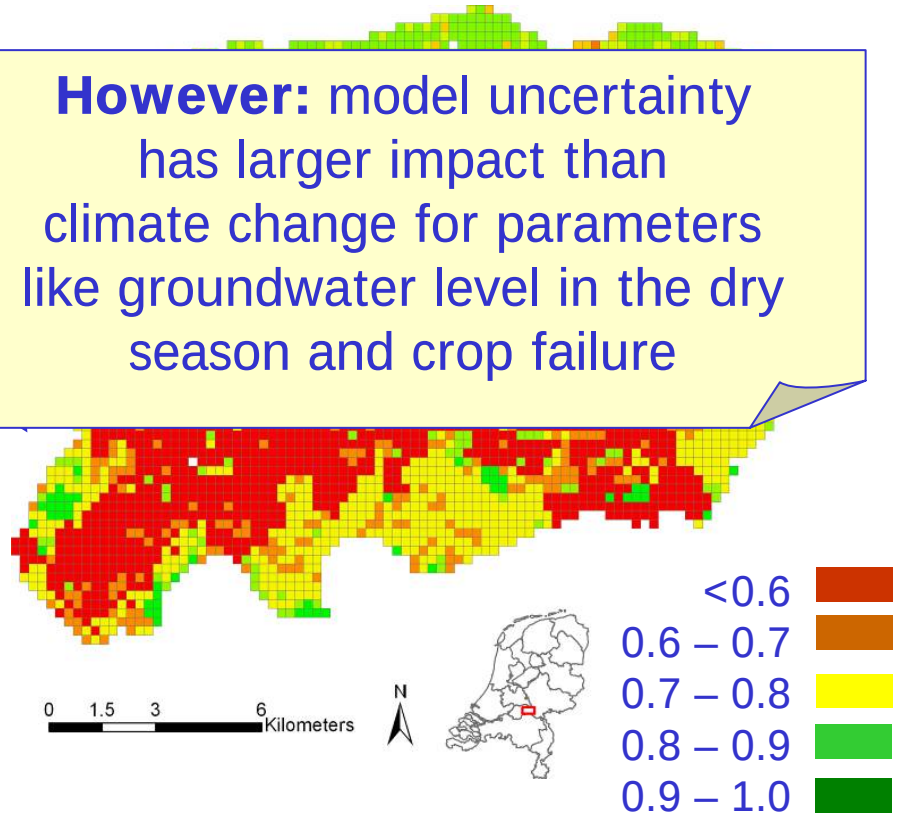


Tailoring studies (1): Impact on crop yield

- Hydrological + crop yield model
- Relative yield
  - reference
  - W+ scenario

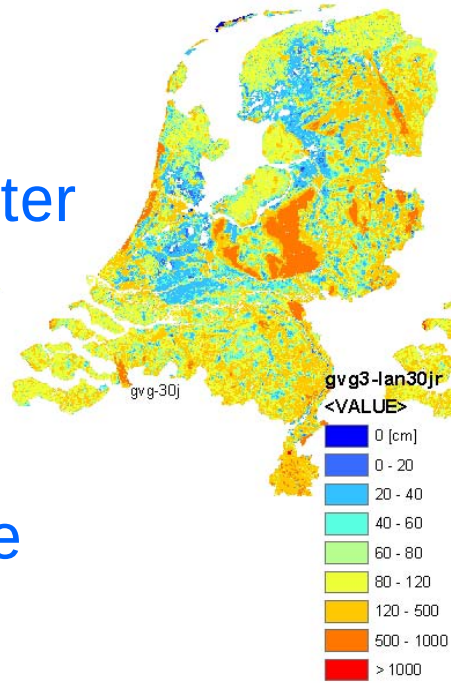


However: model uncertainty has larger impact than climate change for parameters like groundwater level in the dry season and crop failure



Tailoring studies (2): Groundwater tables

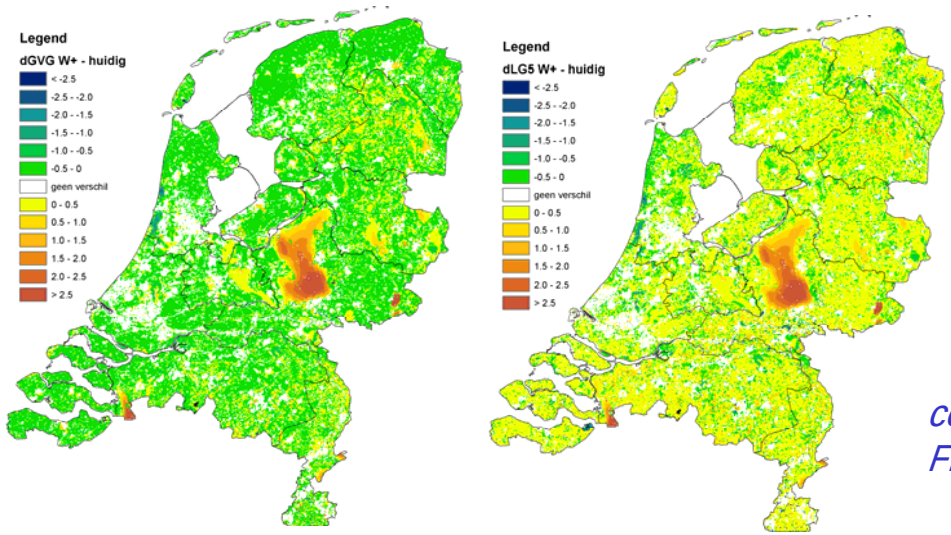
- Current practice: **detailed hydrological model** is used to calculate high resolution ground water balance
- Climate change assessment needs long records: **expensive**!
- To enable affordable climate change assessment: can one construct a **single reference year** that reproduces proper reference climatological ground water product?



Change in ground water table the Netherlands

- Aim: first assessment of effect of W+ scenario on ground water table in various stages of the growing season
- Tailoring:
  - production of location specific meteo (applied linearly in this example)
  - running high resolution ground water model

Start of growing season: **generally wetter**

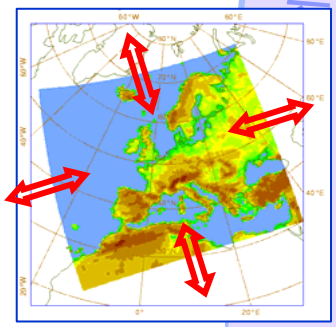


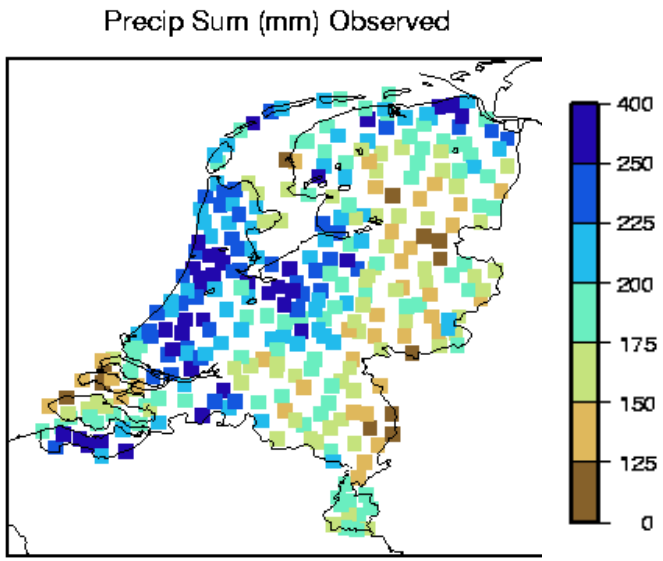
Lowest water table during growing season: **generally drier**

courtesy Timo Kroon, Franziska Keller ea

The real world: summer of 2006

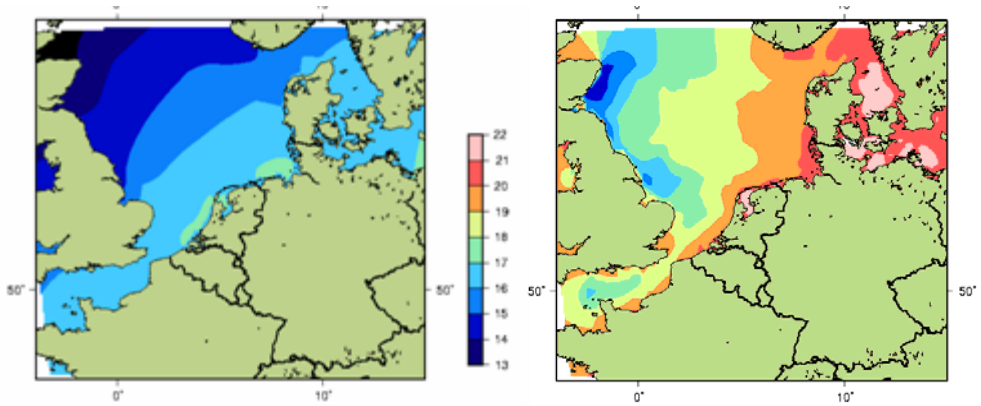
- July was anomalously warm and dry
- Precipitation August 2006





Sea surface temperature

normal Aug 2006

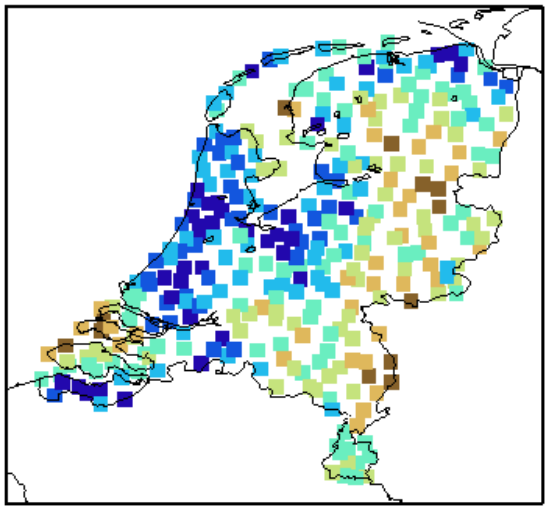


courtesy Geert Lenderink
Erik van Meijgaard

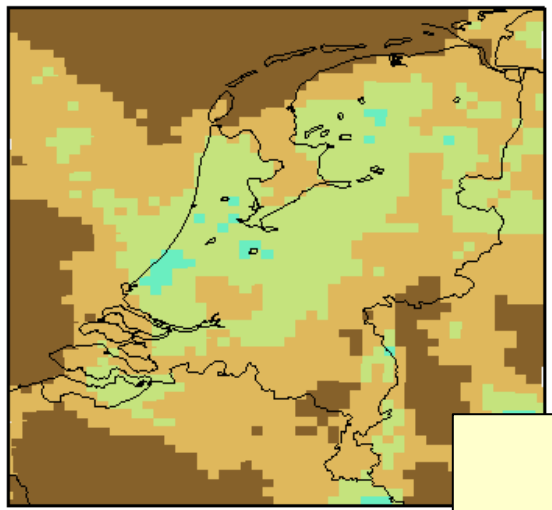
Precipitation gradient

- Heavy precipitation limited to coastal zone

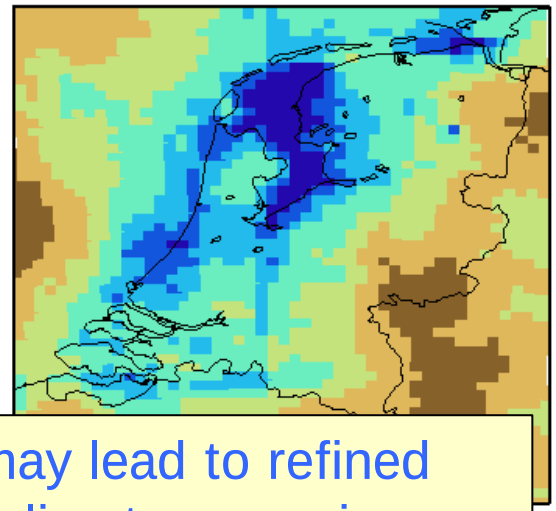
Precip Sum (mm) Observed



run with normal SST



run with true Aug'06 SST



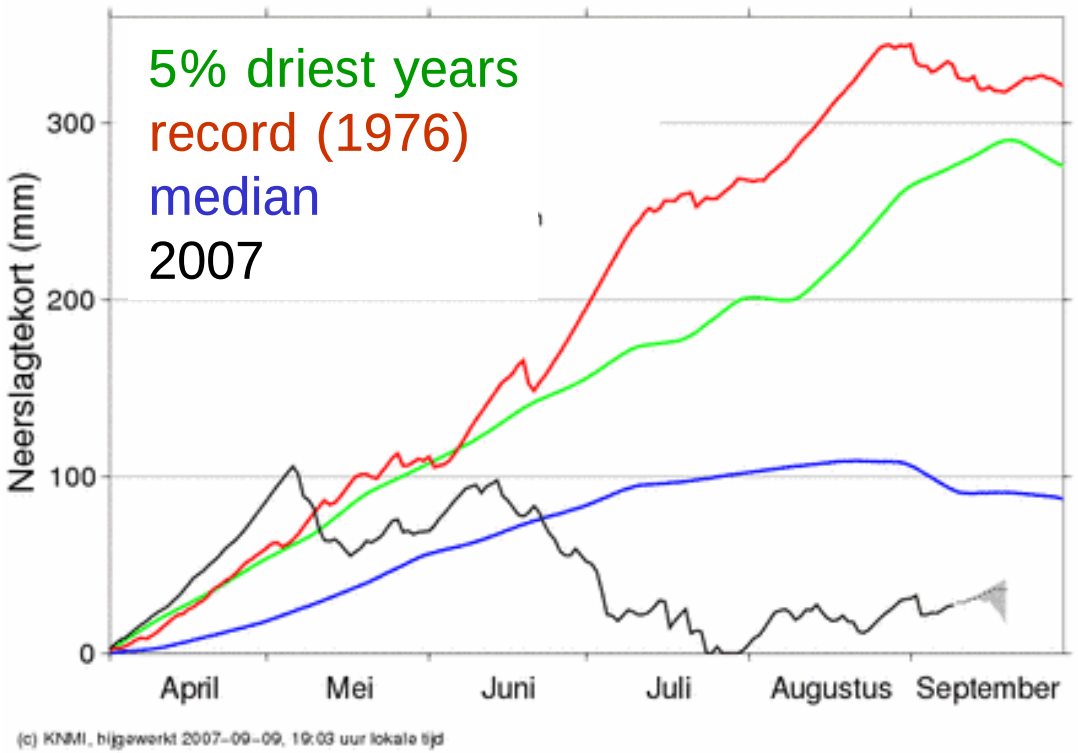
may lead to refined climate scenarios

courtesy Geert Lenderink
Erik van Meijgaard

Spring and summer 2007

- April was extremely dry and warm
- Summer (June-July-August) very wet and cool

Potential evaporation minus precipitation



Conclusions

- Regional variability increases
  - at daily time scale (changes of extremes are stronger than changes of means)
  - within a season (nr of wet days changes, evidence for rapid transition of persistent anomalous episodes)
  - between years (scenarios differ widely but none can be excluded)
- Climate change scenarios will continue to develop
  - present state of the art is different from yesterday's
- Future tailoring studies will include European crop production (ALTERRA WAGENINGEN UR + KNMI)