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Adaptation to Climate Change in The Netherlands

Henk van Schaik

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- Situation of The Netherlands
- Impacts of CC in The Netherlands
- Priorities plans and costs to cope with CC in Dutch water management
  - Wetter conditions
  - Dryer conditions

- Climate change and water supply issues

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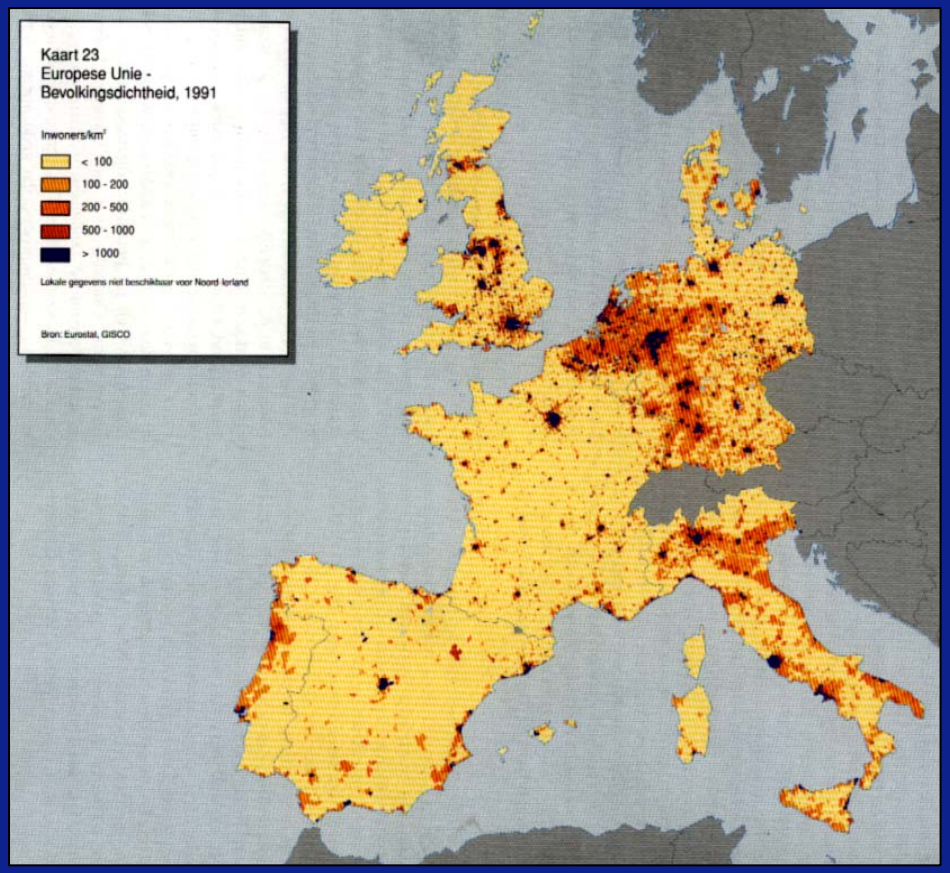
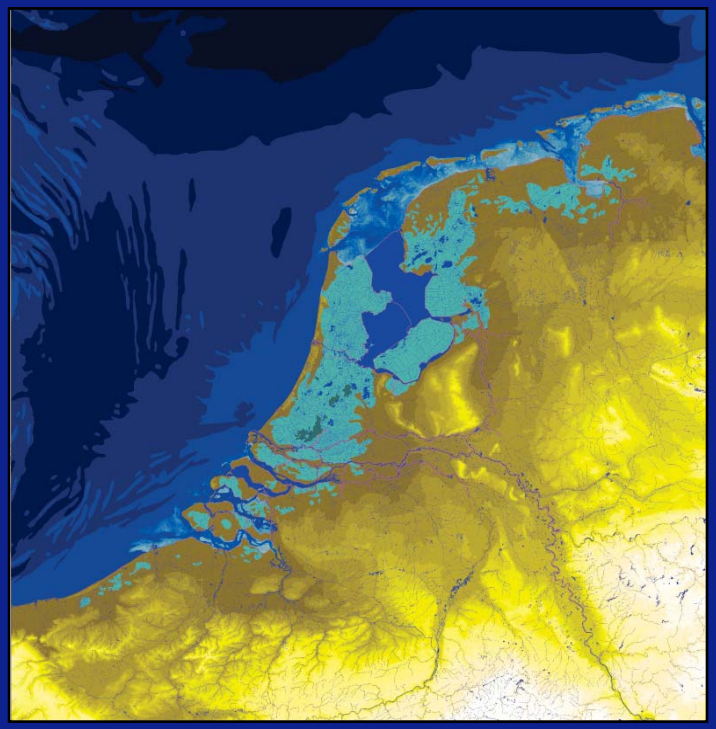
The Netherlands





Below sealevel
55% Land / 60% Population
65% National Gross Product

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Water management in the Netherlands is heavily dependent upon the Rhine River

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Our nightmare

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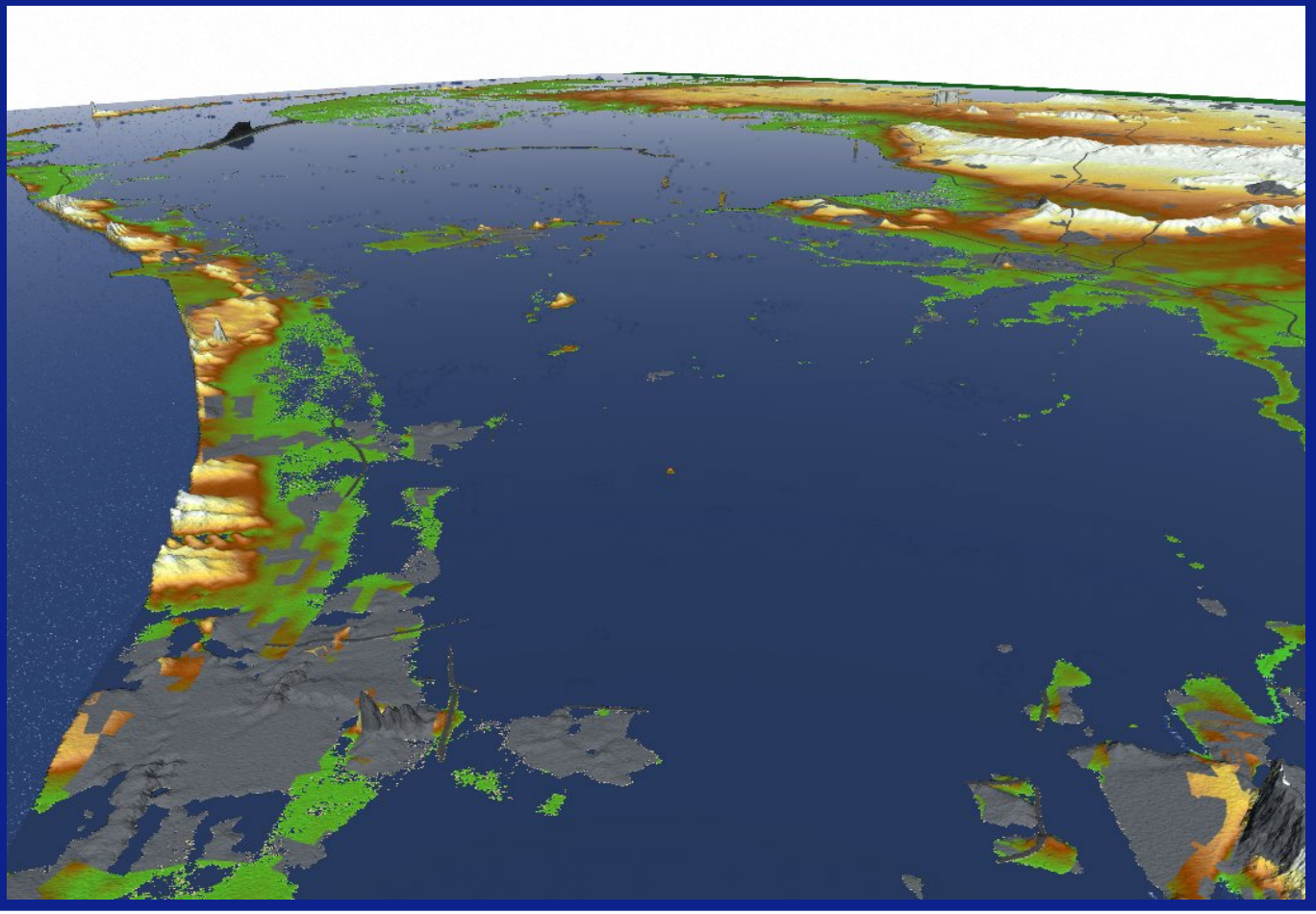
Where would the Dutch be without dikes?



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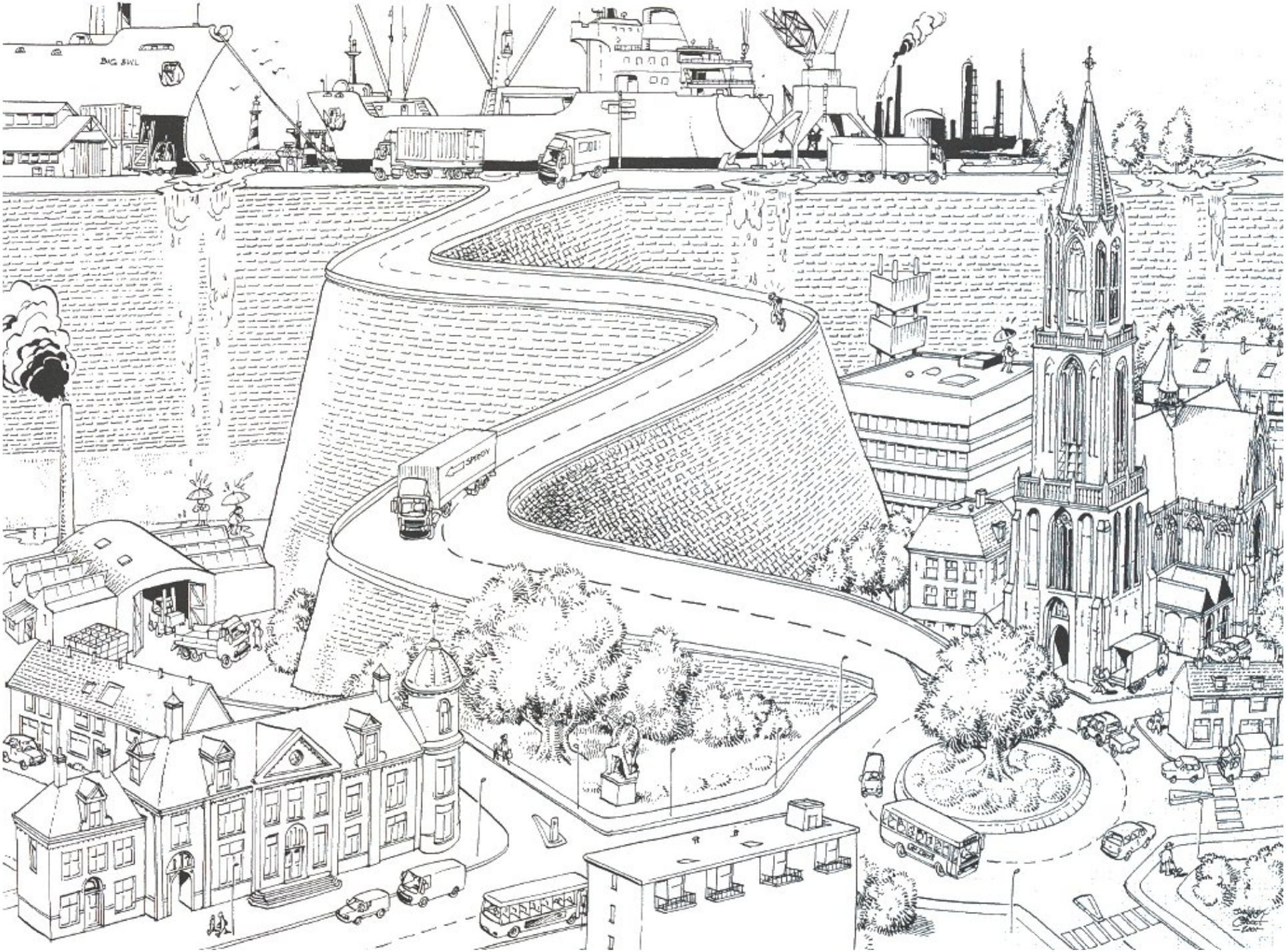
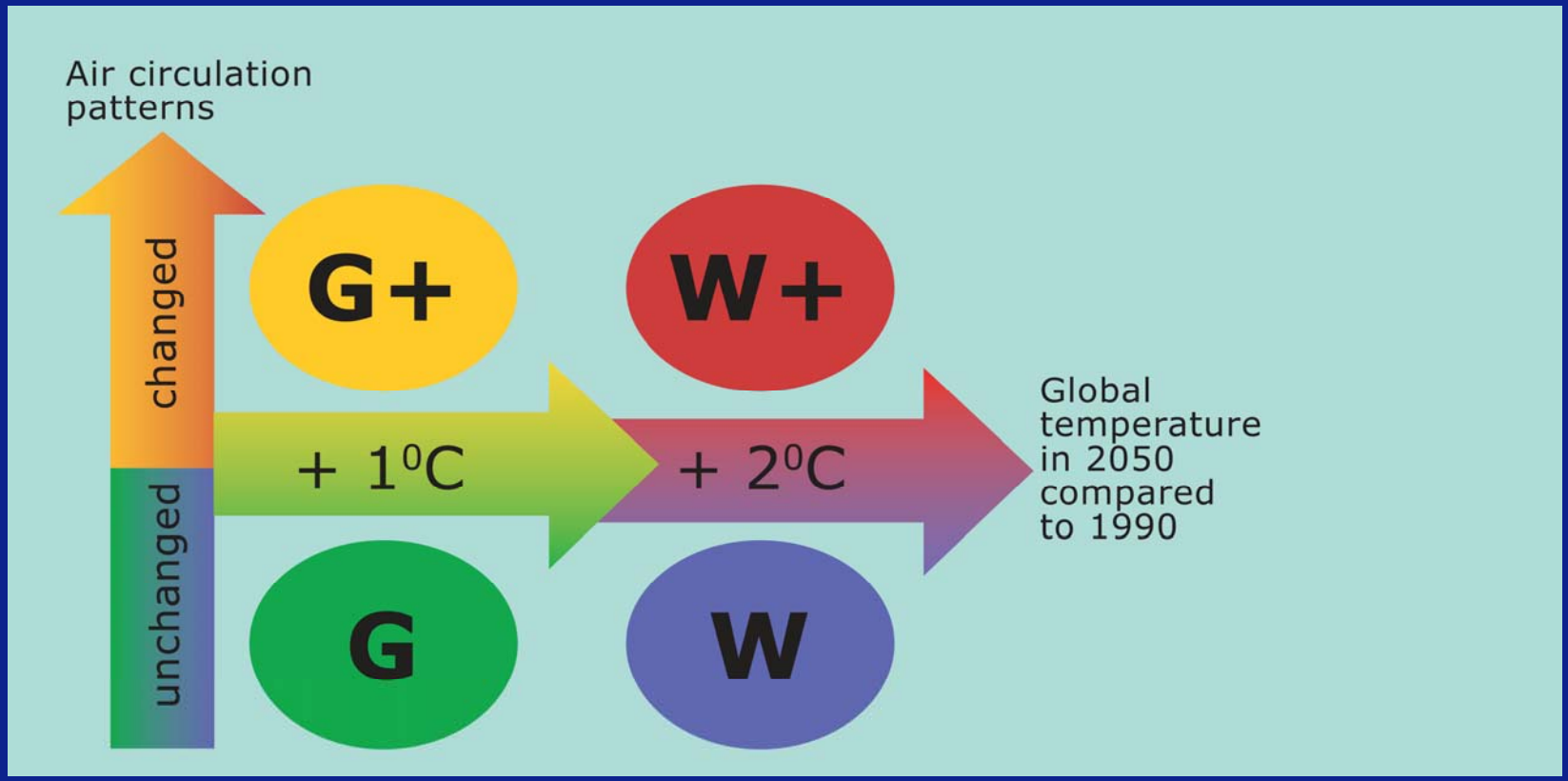

BIG SWL

Climate change: scenarios for the Netherlands

based on IPCC scenarios



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Consequences for the Netherlands

	Probability
▪ Rising sea level (35-85 cm)	>90%
▪ Increasing average temperature (1-2.5 ºC)	>90%
▪ Increasing drought summer	>90%
▪ Increasing intensity rainfall summer	66-90%
▪ Increasing intensity rainfall winter	66-90%
▪ Increasing wind velocity, storm	33-66%

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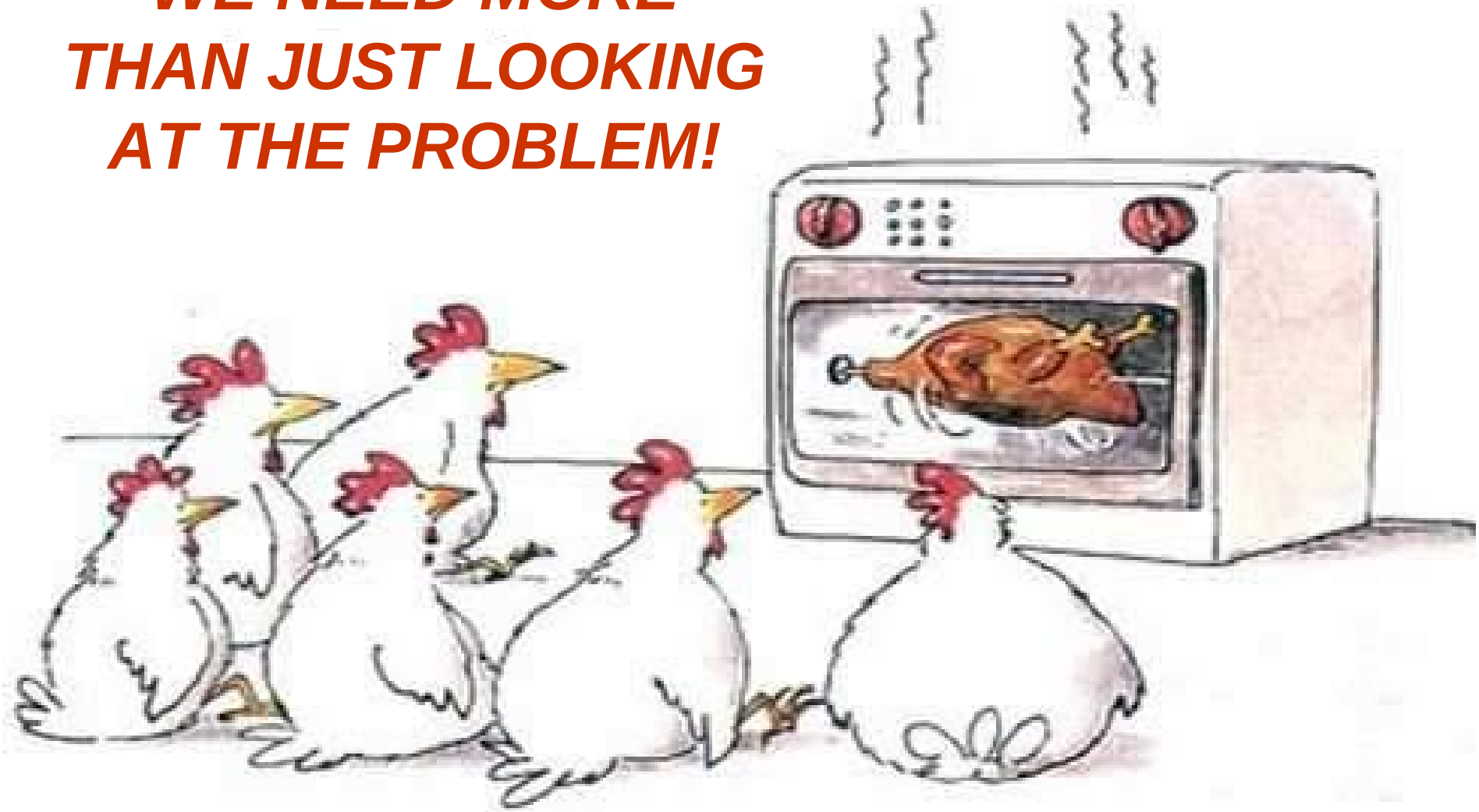
WE NEED MORE THAN JUST LOOKING AT THE PROBLEM!



Prime Minister perspective….

"The climate is changing and we should make our country climate proof. The national government together with science, policy and other stakeholders"

Jan-Peter Balkenende - Dutch Prime Minister, november 2005"

Vol. 438| 17 November 2005 nature

COMMENTARY

Climate proofing the Netherlands

Regional climate change should not be seen only as a threat; changes to weather patterns could generate opportunities for large-scale innovations, say **Pavel Kabat**, **Pier Vellinga** and their colleagues.

Science - Policy interaction

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Climate change: opportunities for innovation

Kabat et al. (2005):

“Climate change should not only be considered as a threath, but could also create opportunities for large-scale innovations”

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COMMENTARY

Climate proofing the Netherlands

Regional climate change should not be seen only as a threat; changes to weather patterns could generate opportunities for large-scale innovations, say **Pavel Kabat**, **Pier Vellinga** and colleagues.

Throughout human history, people in regions all over the world have learnt, mostly by trial and error, to cope with extreme-climate events. Based on limited climatic and hydrological data on past events, countries have developed infrastructure and legislation to protect people from floods and droughts. Protective measures differ widely between regions, countries and continents — as do the risks. In economically important and densely populated parts of the Netherlands the standards of flood defence are the highest in the world; dykes protect delta regions from a flood event expected to occur once every 10,000 years.

But global climate change caused by greenhouse-gas emissions means that key climate and hydrological variables will change. We can no longer assume that the future climate can be predicted on the basis of past patterns[1]. Climate change and sea-level rise present major challenges to each of the world's delta regions, which together harbour about 70% of the world's population and economic resources. We think the international science and policy communities should develop plans for achieving future sustainability in these vital areas of our planet, using a 'climate proofing' approach.

Climate proofing does not mean reducing climate-based risks to zero — an unrealistic goal for any country. The idea is to use hard infrastructure to reduce risks to a quantified level, accepted by the society or economy. This risk can be further combated by 'softer' measures, such as insurance schemes or, as a last resort, evacuation plans. Such climate proofing should be driven by opportunities for technological, institutional and societal innovations, rather than purely by fear of the negative effects of climate change.

Too little too late

The high impacts of the recent US hurricanes (economic losses associated with Hurricane Katrina were in excess of $125 billion[2]), exposed the consequences of not taking enough precautionary measures to address low-probability but high-magnitude climate events. Most levees in New Orleans, breached by storm waters following hurricane Katrina, were built to deal with floods that occur once every 30 years. Since Hurricane Katrina hit New Orleans last summer, many have advocated increasing levee protections for New Orleans and even for the entire Louisiana coast. However, a broader climate-proofing approach may be a better long-term solution than simply reinforcing and raising the levees.

Globally, evidence is mounting for more frequent and intense climate extremes in the future, as a consequence of anthropogenic climate change[3,4]. But these predictions, and those for specific regional impacts, remain uncertain, and deciding on the right strategy to prepare for these events is not an easy task. In the Netherlands, the government is already investing in climate proofing. In addition to the ongoing Climate Changes Spatial Planning Research programme (KvR) scheduled for 2005–2009, which is costing €100 million (US $118 million), the government will soon launch a new initiative called ARK (Adaptation Programme for Spatial Planning and Climate). ARK will be several times larger than KvR, in both size and scope. It will develop, through partnership between policy makers, researchers and other stakeholders, a comprehensive agenda that deals with climate change across several sectors of the society and economy.

Lost at sea

In the Netherlands, many key decisions about future developments are being taken now, and incorporating climate-change risks and opportunities into these decisions, as was recently called for by the senate of the Dutch parliament, is essential. For the Dutch government, climate change is accepted as an issue to address in many sectors and policies. But why is it politically acceptable to spend millions of euros on climate proofing in the Netherlands, but not in most other countries?

Sixty percent of the Netherlands territory is located below sea level and 70% of the gross national product is earned in these flood-prone areas. So it is quite likely that the Netherlands will be confronted with several effects of climate change, including increased risk of flooding and more frequent summer droughts. The predictions for the Netherlands'

Vision of the future: a hydrometropole

Today the Netherlands is divided into several dyke-protected regions which have different flooding risks. A future floating city, or hydrometropole, could be further divided so that different risk thresholds are matched to suitable property insurance levels. Finding extra land to store surplus floodwater will require creative solutions.

for example, greenhouse horticulture businesses place a high demand on water for irrigating their crops, and are sensitive to both wet and dry climate extremes. Greenhouses and their water reservoirs also cover large surface areas. So integrating water reservoirs into the foundations of greenhouses could both save space and serve as emergency floodwater storage[5]. These ideas are already moving from research ideas to pilot projects in the Dutch city of Naaldwijk (see above).

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Dutch Climate proofing
“we will stay”

- Research for knowledge to
  - Inform the public
  - Build political support: first Chamber motion on climate proofing
  - Develop adaptation plans

Innovations: Hydrometropole

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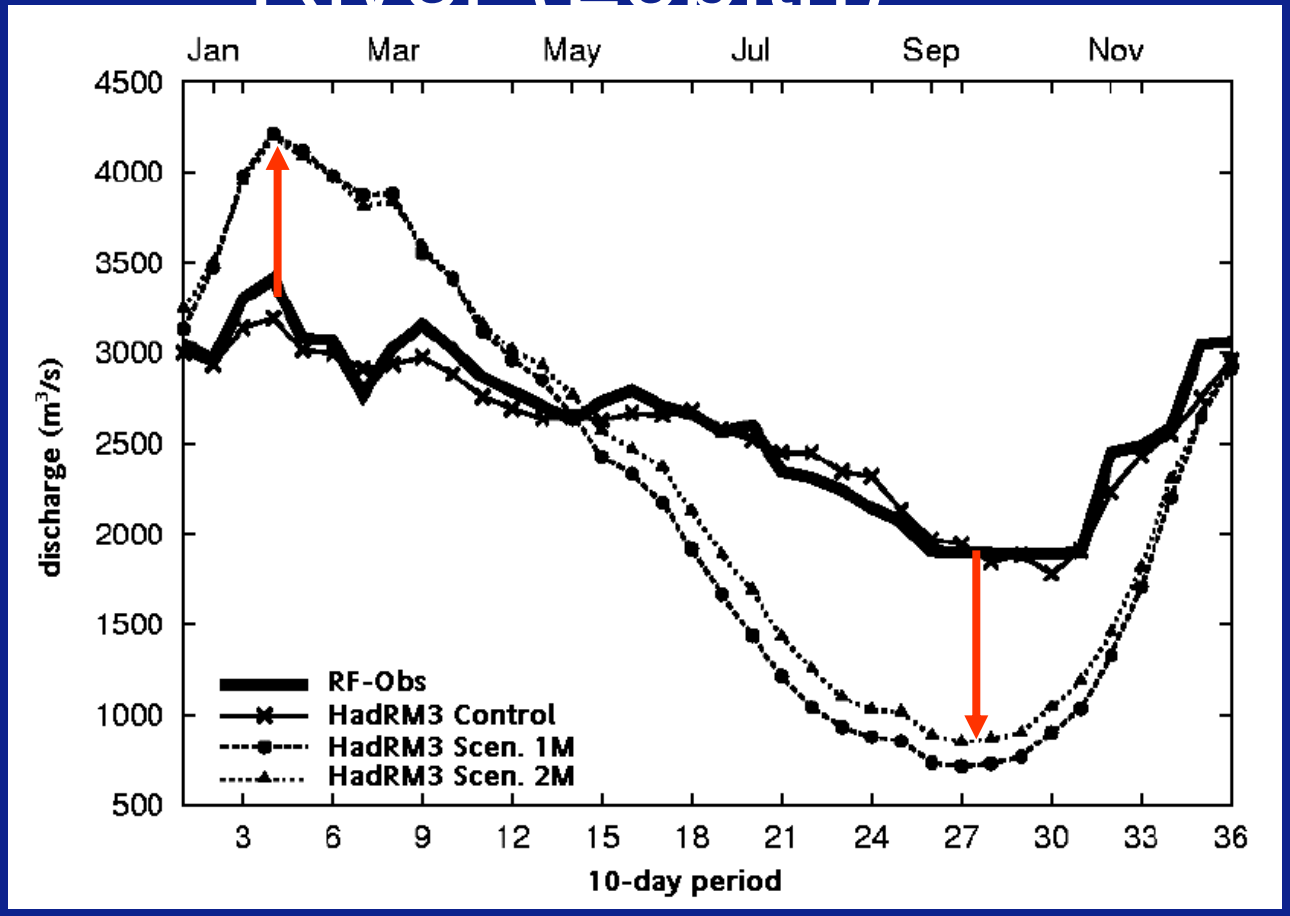
Possible impact of climate change on average discharge of the Rhine River (Lobith)



Buishand, T. A. and G. Lenderink (2004). ***Estimation of future discharges of the river Rhine in the SWURVE project***, KNMI, De Bilt, Technical Report TR -273.

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Priorities in Dutch water management

- Safety from flooding (sea, rivers)
  - Storm surge February 1953 (1800 dead)
  - River floods of December 1993, January 1995
- Maintenance of fixed water levels in polders
  - Ensure dike stability and infrastructure foundation
  - Facilitate agriculture
- Water allocation issues (droughts)
- Water quality improvement (WFD)
  - Chemical water quality
  - Ecological water quality

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The National Adaptation Strategy
Choices made in the process...

1. **Open debate**

   Not: ‘for and by governments’ or a technocratic problem

2. **Ongoing, planned, future investments, plans, policies**

   Not: *just new* investments and programmes

3. **Innovation parallel to practice**

   Not: sequential; first research, than policy frames, laws, implementation

4. **Adaptation mainly by ‘combining work with work’**

   Not (yet): megaprojects *just* for adaptation

5. **Mainstream in 10 year**

   Not: blueprint or series of projects for the coming 50 years

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Too much water

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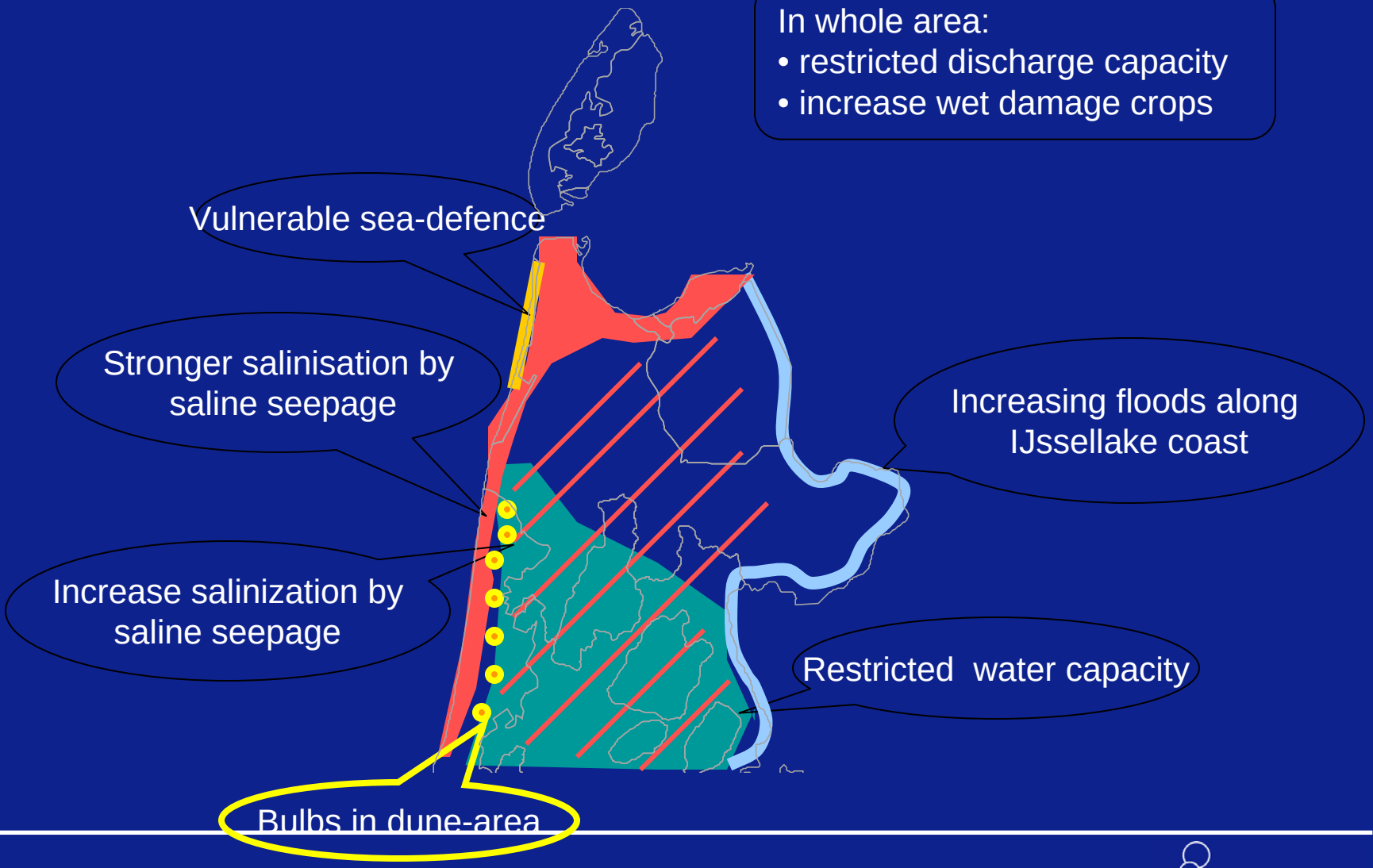
Vulnerabilities

In whole area:
- restricted discharge capacity
- increase wet damage crops



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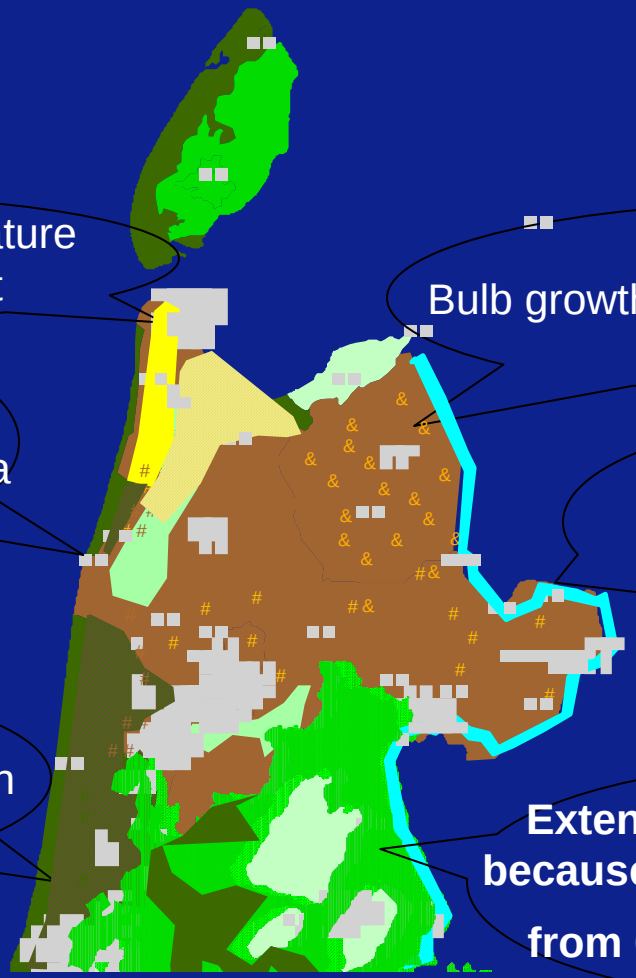
Spatial consequences



Reservation space for nature on a dynamical coast

Bulb growth not anymore possible in inner dune area

New dynamic nature and more emphasis on recreation

Bulb growth in theWieringermeer polder

Inner space area used as extensive grassland and as resting place for geese

Extensivation peat grassland because of increasing water level

from 60 up to 20 cm - surface

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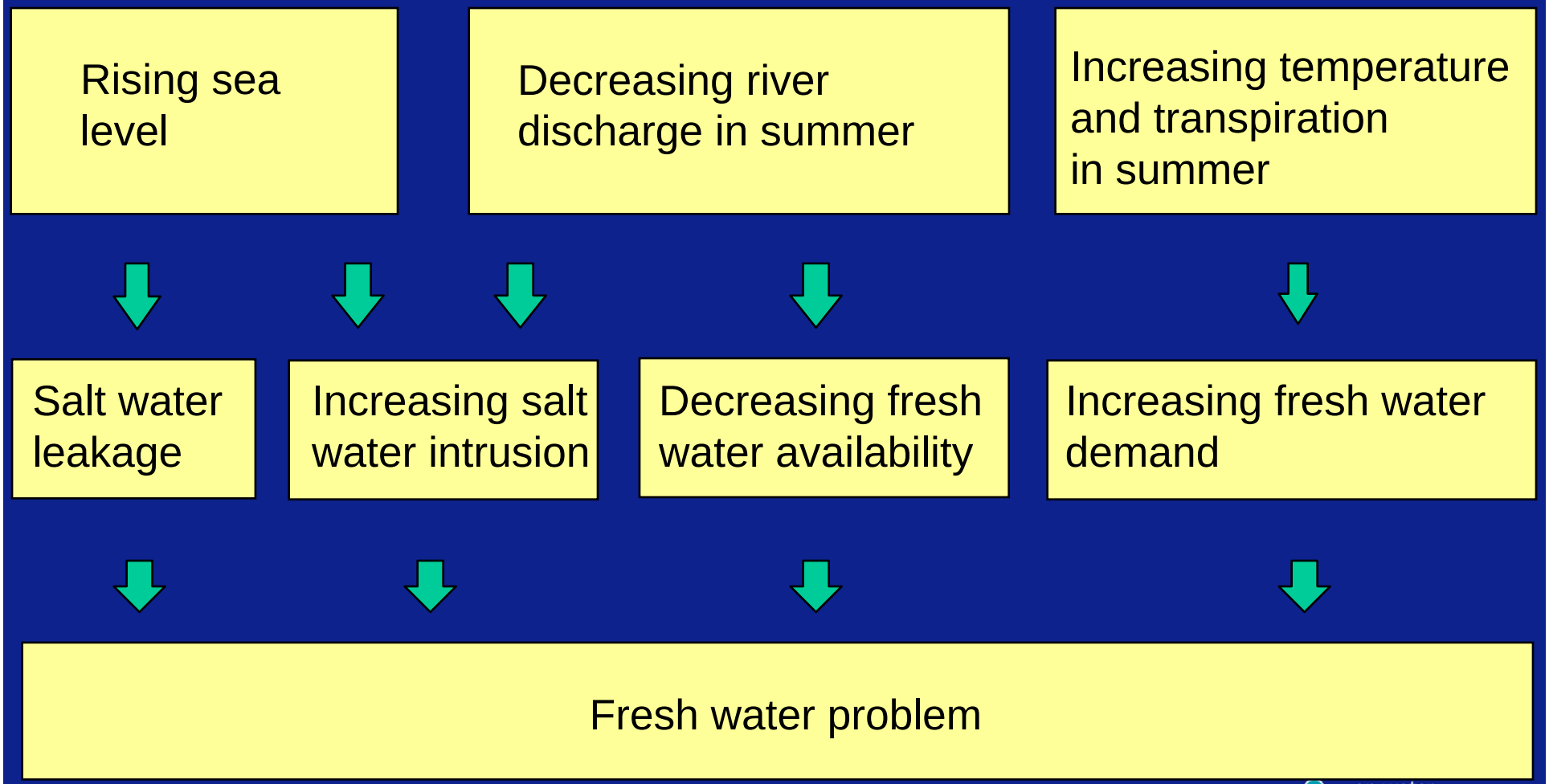
Costs of adaptation Netherlands

- Cost of water safety now 0.1 to 0.2% of GDP
  - currently below norm
- Commission advise:
  - raise with 1 billion per year, that is 0.2% of GDP
- Over time costs are declining as % of GDP
  - productivity growth

Not enough water

Climate change and water scarcity



on water and climate

Climate change: Economic effects

	G	G+	W	W+
Increase of the Mean yearly damage*	16	232	48	534
Net value**	286	4222	868	9701

In millions of euros

* Nowadayas mean yearly damage = 250 million euros

** Interest rate = 5,5%; period = infinite

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Climate change and Amsterdam utility/water board

- Climate change will affect the frequency and intensity of extreme events (floods, rainstorms, and droughts)

- This has strong consequences for all aspects of water supply (from source to tap)
  - Changes in demand, e.g. increasing peak factors
  - Changes in water resources availability (quantity and quality)
  - Risks to aquatic and terrestrial ecosystems (biodiversity issues)
  - Risks to infrastructure (floods, rainstorms, hurricanes)
  - Risks to drinking water quality (microbiology)

Watermanagement in Amsterdam and surroundings

City of Amsterdam:

-Sewerage

-Ground water

-Drinking water

Waterboard Amstel, Gooi en Vecht:

-Surface water management

-Waste water treatment

Waternet:

- operational/administrative organisation

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Waternet – Care for water

- Drinking water
- Waste water
- Surface water
- Safety behind the dykes

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Some key figures

- Annual budget € 450 million
- Organization 1650 employees
- Serving 1.2 million inhabitants
- 90 million $m^{3/}$year drinking water
- 130 million m^3/year waste water

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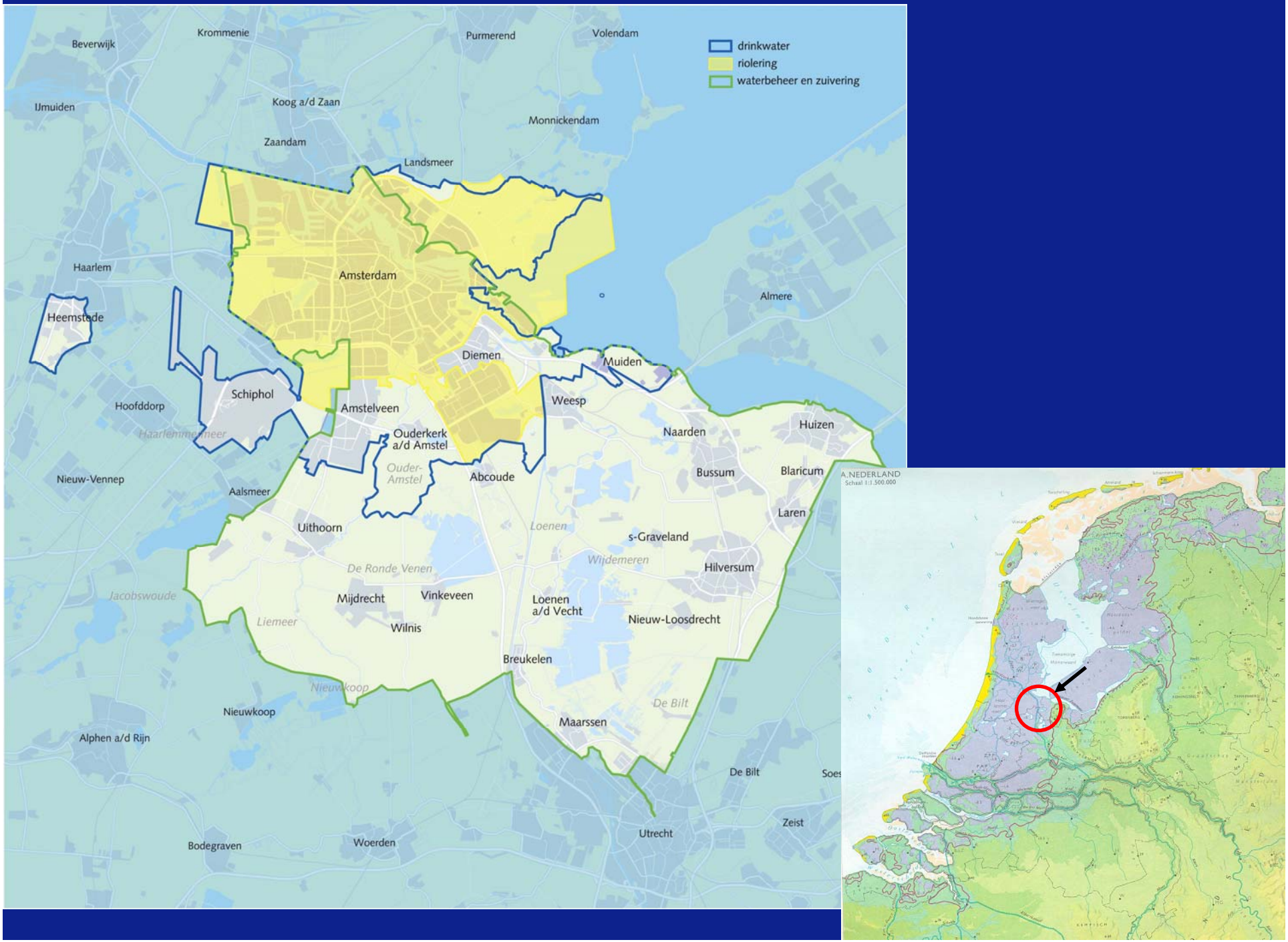
drinkwater
riolering
waterbeheer en zuivering
Beverwijk
Krommenie
Purmerend
Volendam
IJmuiden
Koog a/d Zaan
Monnickendam
Zaandam
Landsmeer
Haarlem
Amsterdam
Almere
Heemstede
Diemen
Muiden
Schiphol
Hoofddorp
Amstelveen
Weesp
Haarlemmermeer
Ouderkerk a/d Amstel
Naarden
Huizen
Nieuw-Vennep
Ouder-Amstel
Abcoude
Bussum
Blaricum
Aalsmeer
Laren
Uithoorn
Loenen
s-Graveland
De Ronde Venen
Wijdemeren
Hilversum
Jacobswoude
Mijdrecht
Vinkeveen
Loenen a/d Vecht
Liemeer
Wilnis
Nieuw-Loosdrecht
Breukelen
Nieuwkoop
De Bilt
Nieuwkoop
Maarssen
Alphen a/d Rijn
De Bilt
Zeist
Utrecht
Bodegraven
Woerden
A. NEDERLAND
Schaal 1:1.500.000

Strategy Waternet

- Adaptation
  - adapting to a changed climate
  - short term effect
  - local effect
- Mitigation
  - reducing greenhouse gas emissions
  - long term effect
  - global effect

Strategy Waternet - Adaptation

- Safety
- Discharge of rainwater
- Ecological healthy water
- Drinking water
- Waste water treatment

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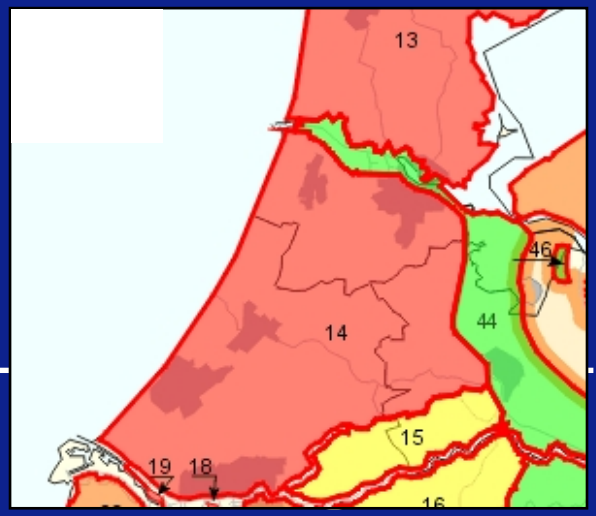
Strategy Waternet - Adaptation

- Safety (resistance)
  - Dikes (primary) content to the current standards (1:10.000)
  - Discussion on future standards around Amsterdam in relation to climate change and economical development
  - Protection level in relation to the economical value

→ Main measure: more capacity/space for rivers (overflow areas) and dikes (compartments)



Strategy Waternet - Adaptation

- Discharge rainwater (resistance and resilience)
  - Climate change causes more intense rainfall (50% in 2100)
  - Solving the problems according the principle: 1) retaining, 2) storing and 3) discharging
  - Water in development plans (multiple land use and groundwater care)
  - Surface water and sewer system meet the current national standard

  → Main measure: alternative water storage (i.e. vegetation roofs, infiltration)

Strategy Waternet - Adaptation

- Ecological healthy water (resistance and resilience)
  - European Water Framework Directive with realistic aims as an outcome
  - Improving quality, structural measures to improve the ecological flexibility and connecting waters
  - Report to Europe (Brussels) in 2009 about the ecological situation

  → Main measure: ecological banks to improve the ecological flexibility

Strategy Waternet - Adaptation

- Drinking water
  - Planning new resource development to meet changing quantity and quantity (salt water intrusion, temperature)

→ Main measures: new technologies and new resources

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Strategy Waternet - Adaptation

- Waste water treatment
  - European Water Framework Directive with strict aims for N and P
  - Seperation of ‘grey’ and ‘black’ waste water flows

  → Main measure: better technologies (membrane) and better spatial planning

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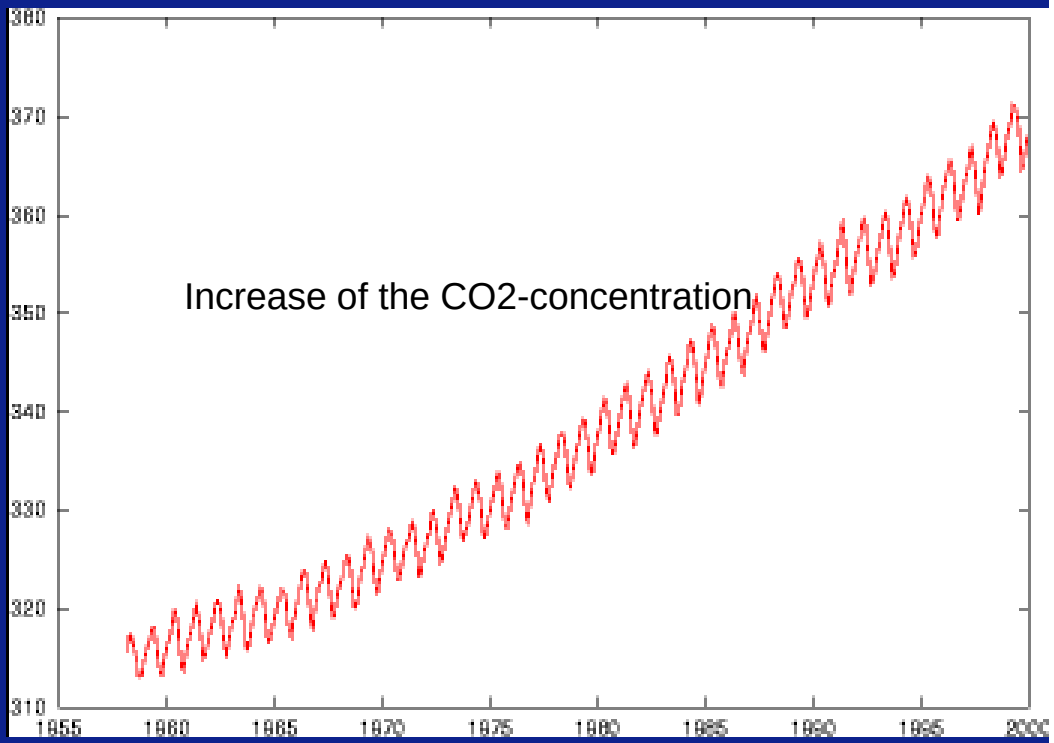
Strategy Waternet - Mitigation



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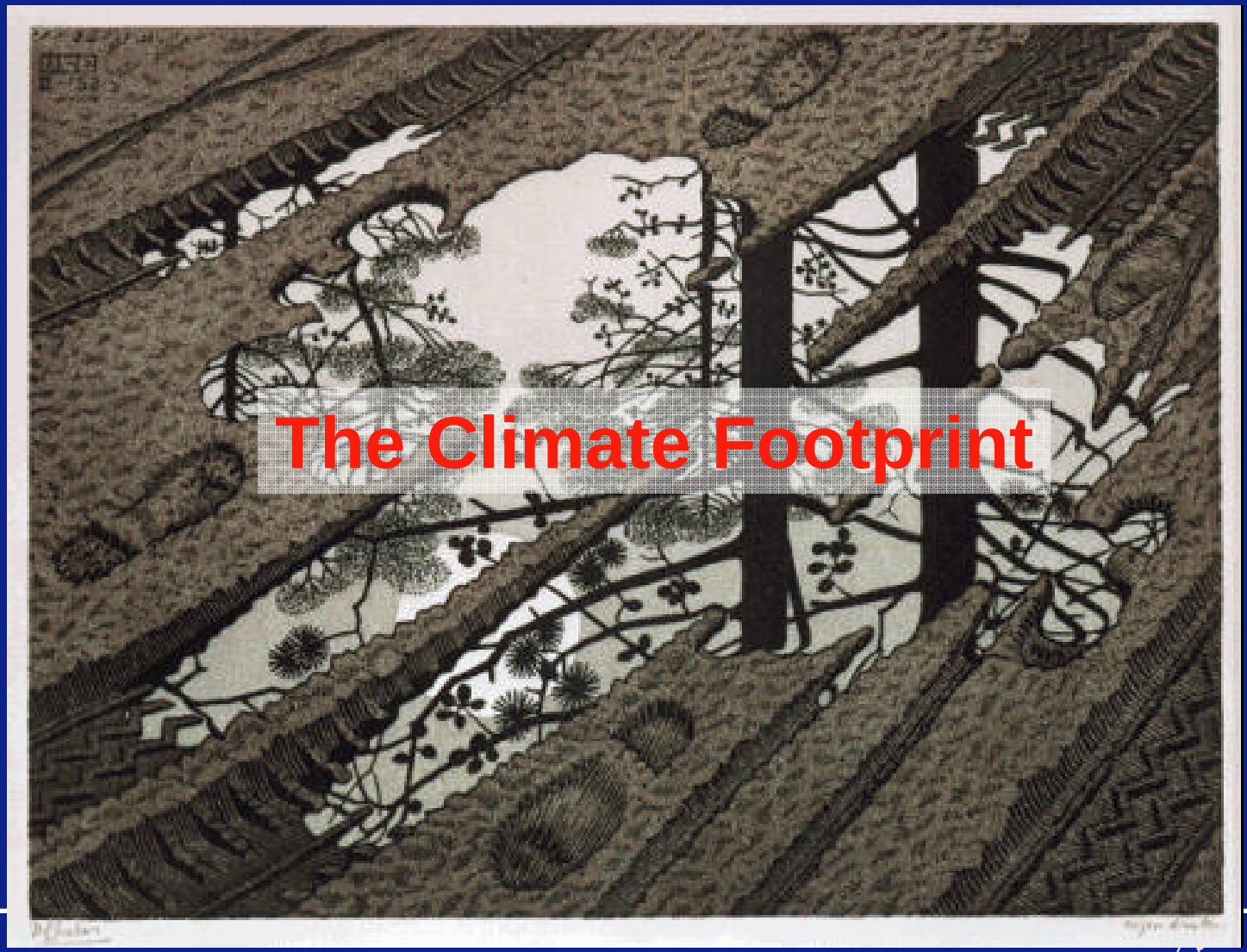

The Climate Footprint

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and climate


Amsterdam
today and in 2050!!!

Adaptation to Climate change

Prevent **mitigate...** **.. <u>and</u> adapt!**

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Thank you !

www.waterandclimate.org

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