



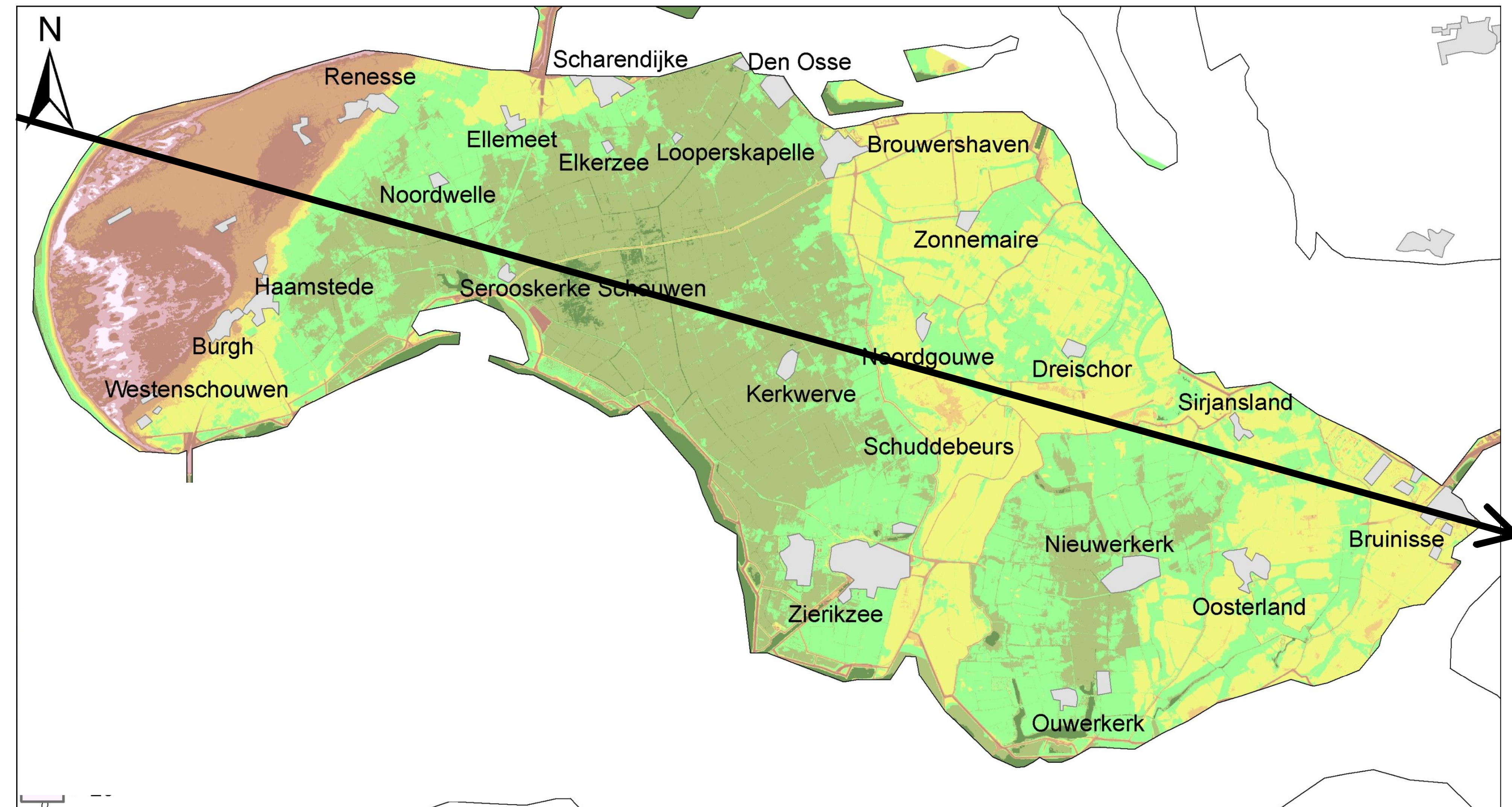
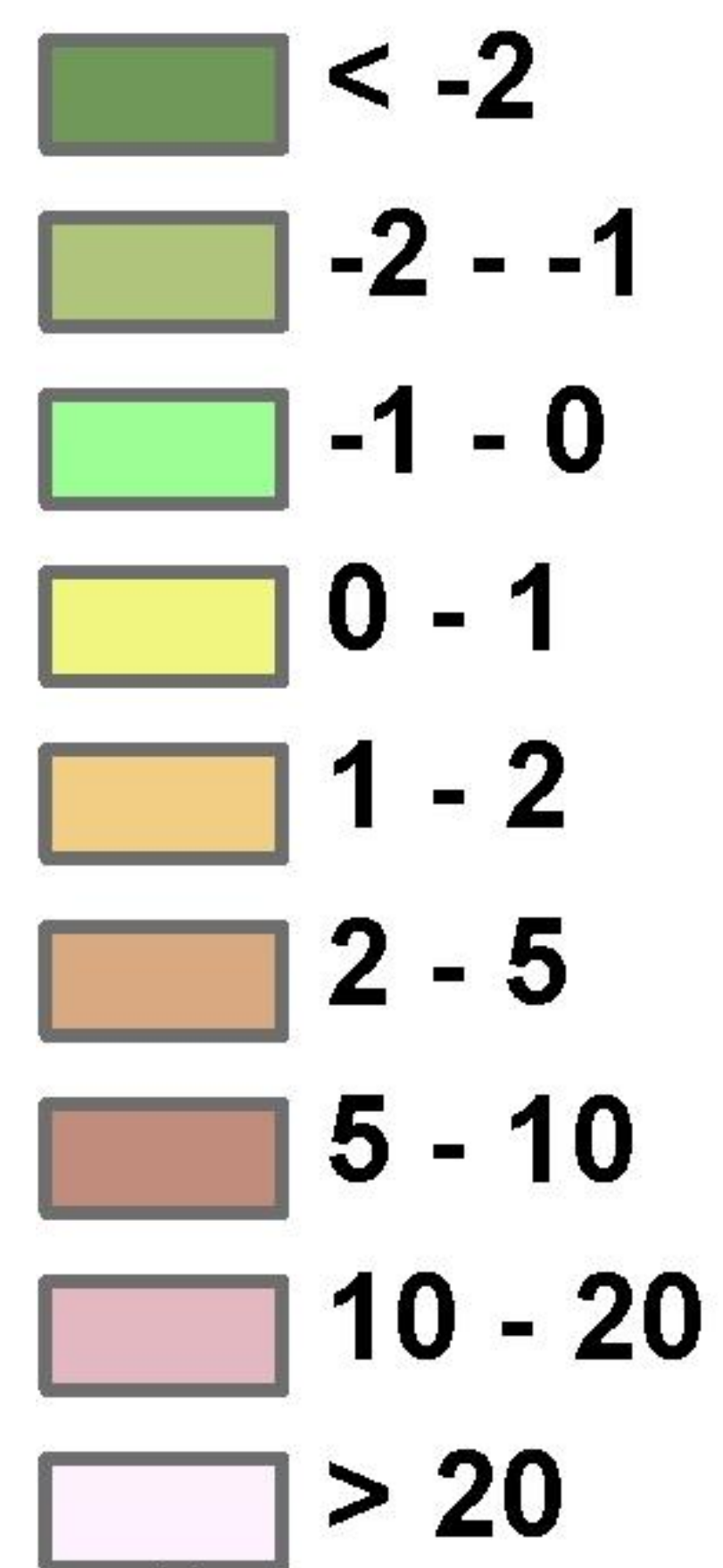
## **Climate Proof Areas: Innovative solutions for improving the freshwater availability!**

Esther van Baaren  
Gualbert Oude Essink  
Pieter Pauw  
Perry de Louw  
Marta Faneca Sanchez  
Valesca Harezlak

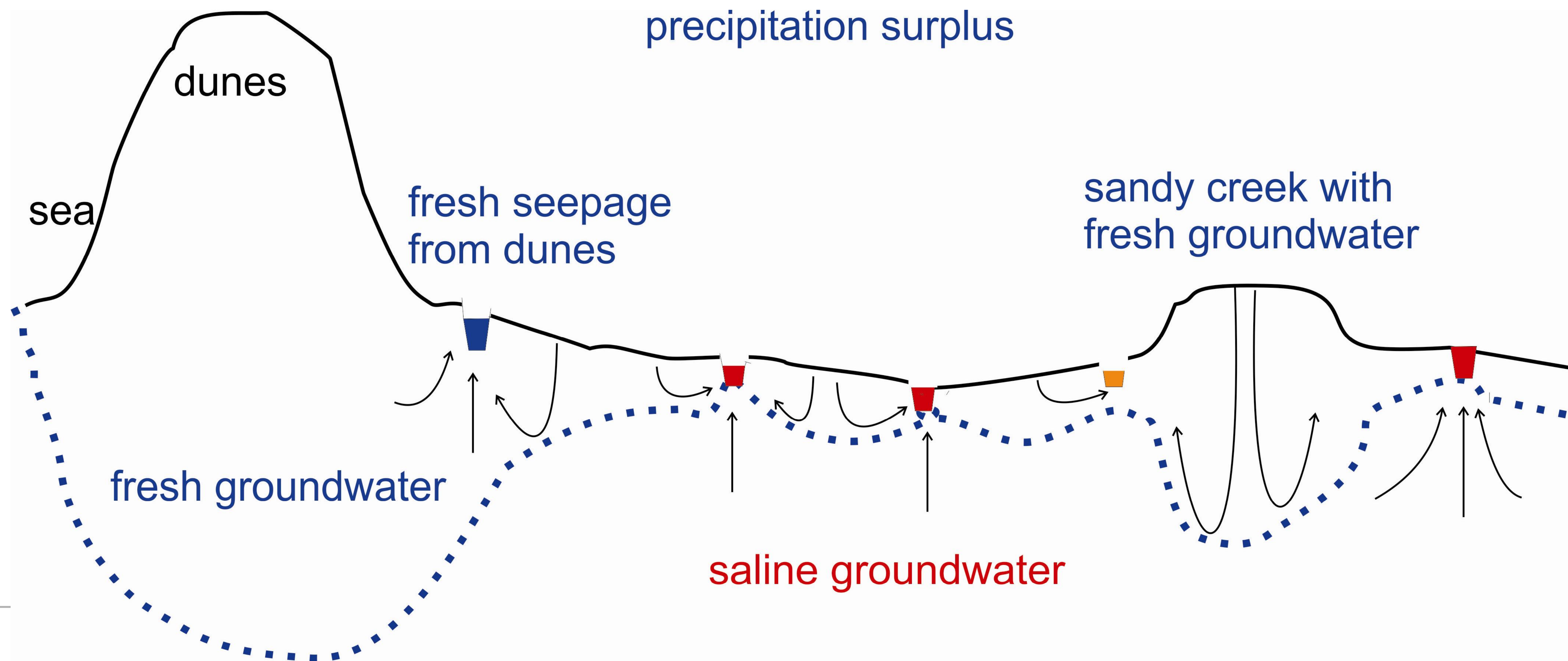


# Groundwater system Schouwen-Duiveland

Elevation [m m.s.l.]



precipitation surplus





# Problem definition

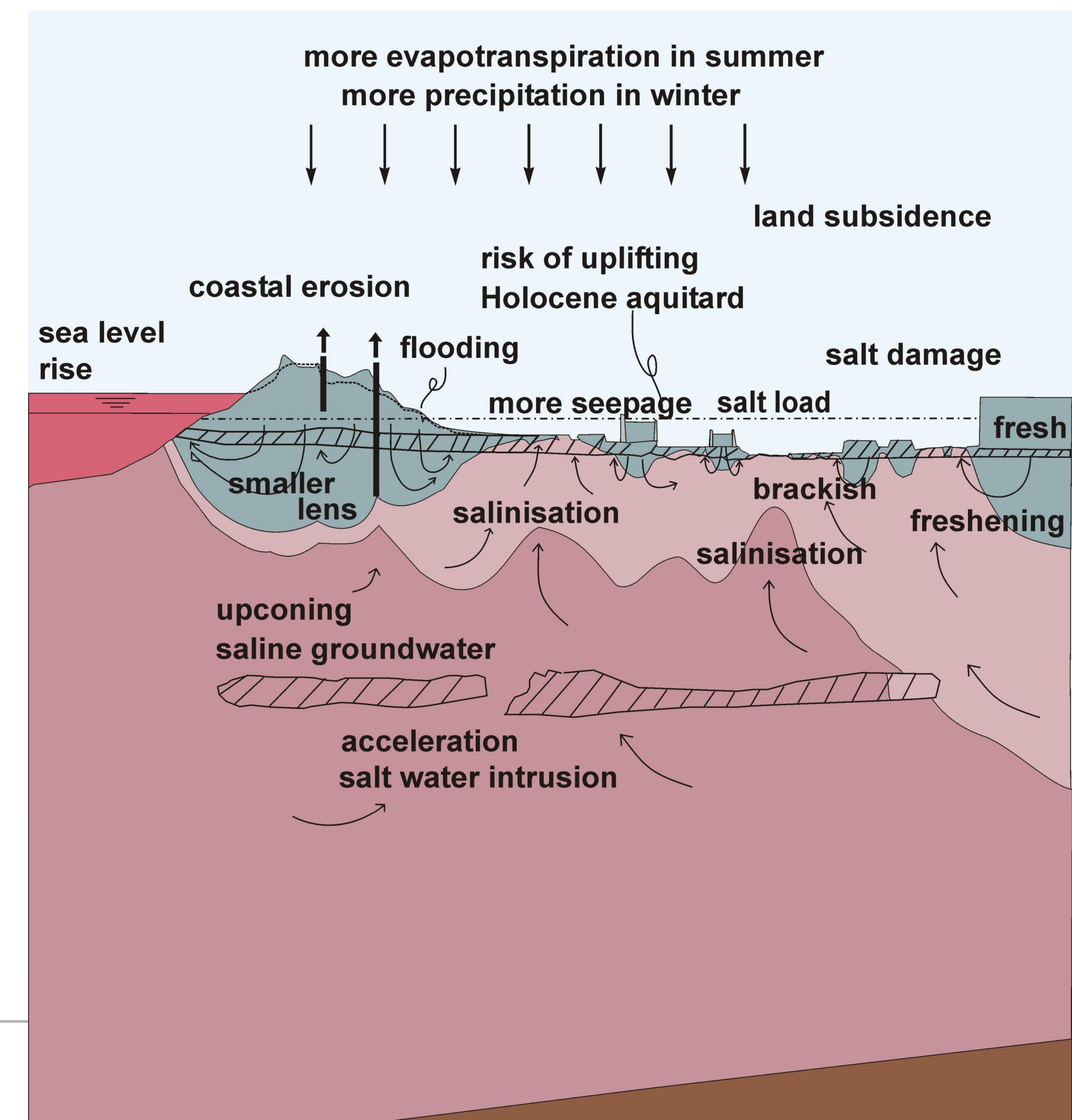
Salinisation shallow groundwater leads to:

- salinisation surface water
- salinisation root zone
- decrease freshwater volumes



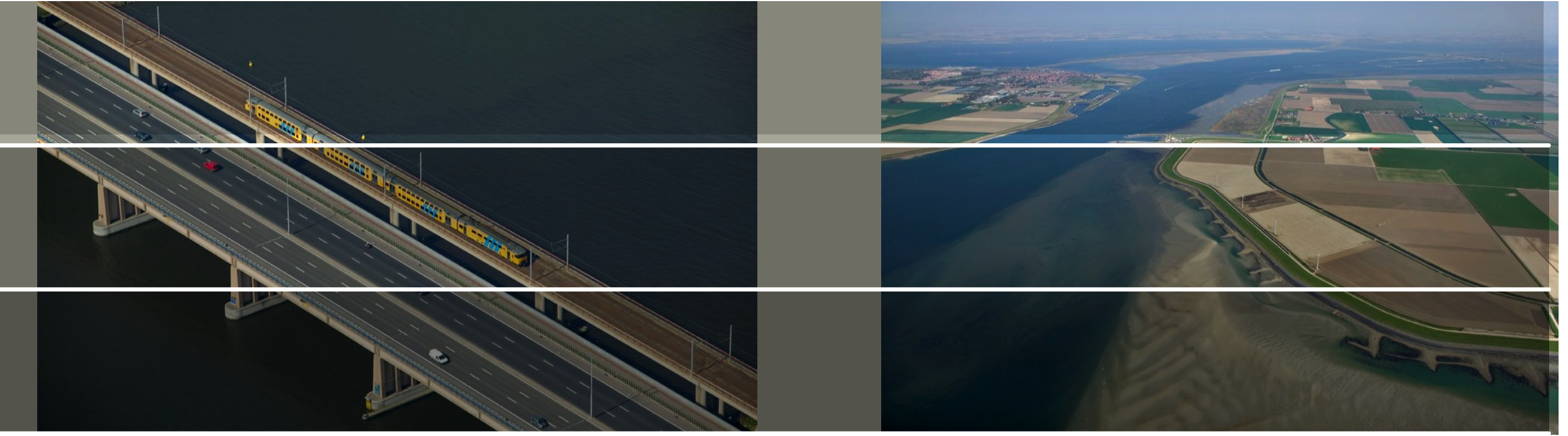
Fresh groundwater resources are jeopardized by:

1. saline seepage from old marine deposits
  - no balance fresh-salt groundwater distribution
2. anthropogenic activities
  - groundwater exploitation
  - water level management
3. land subsidence
4. sea level rise
5. climate change



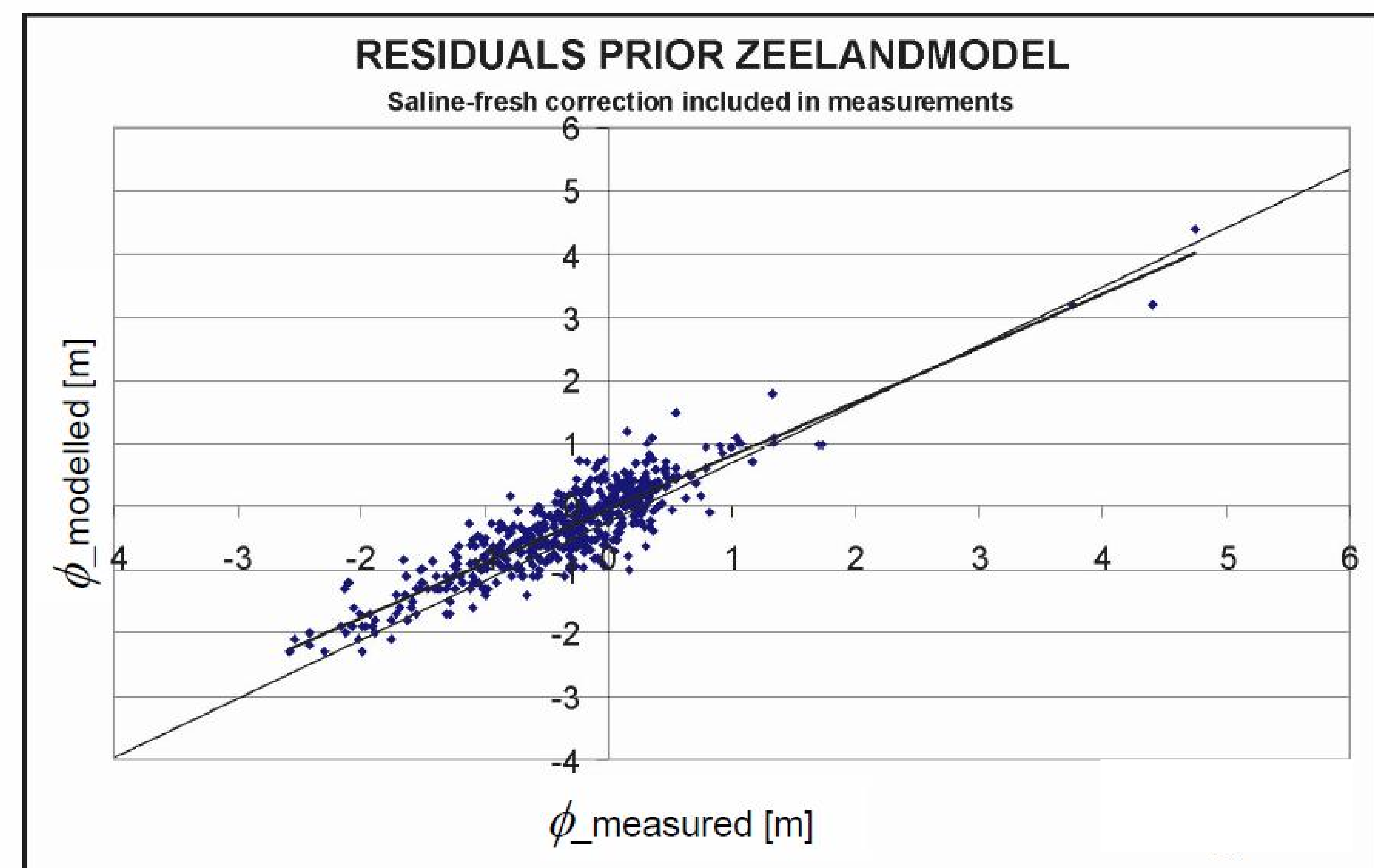
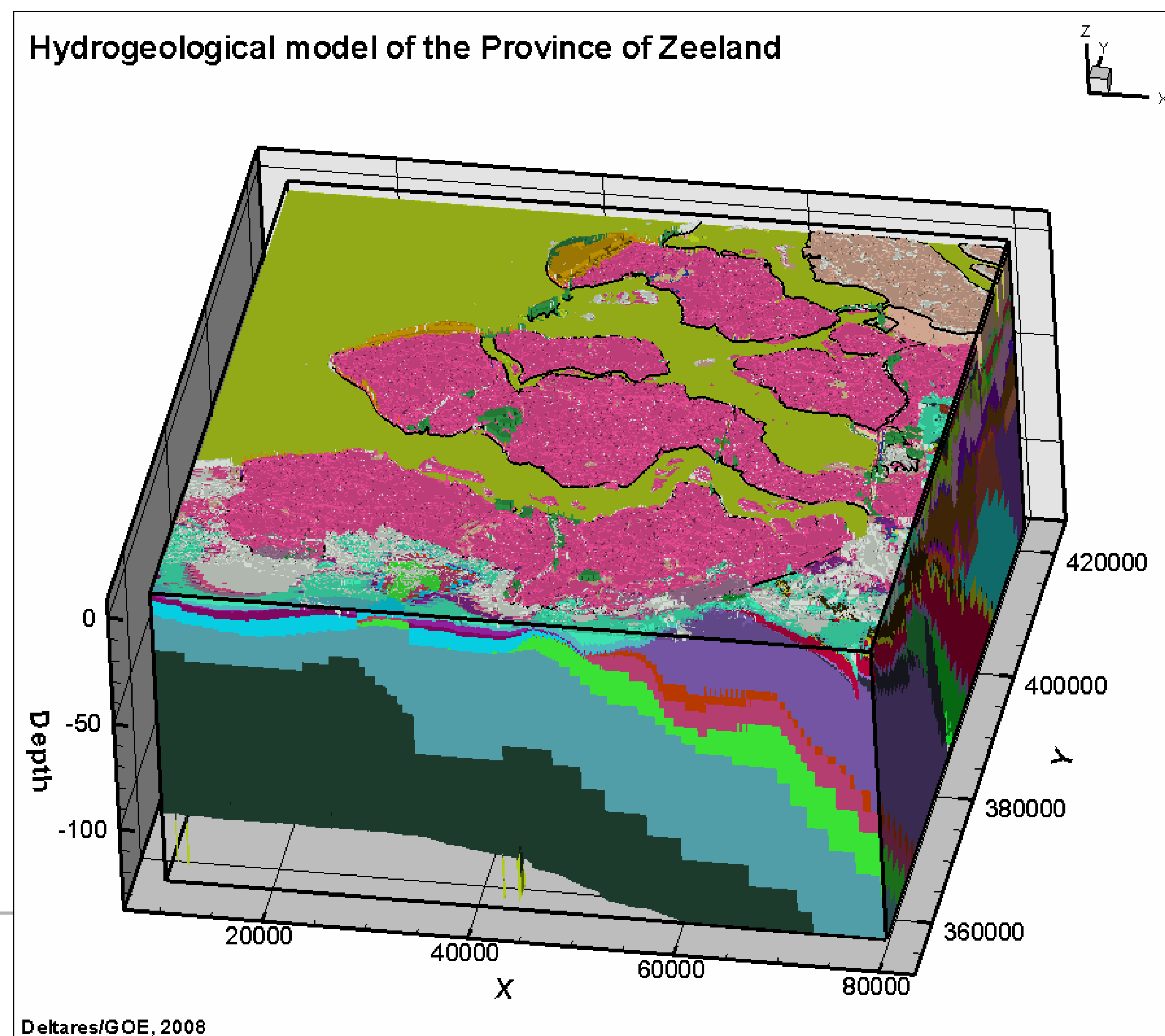


# Regional groundwater model



## Approach:

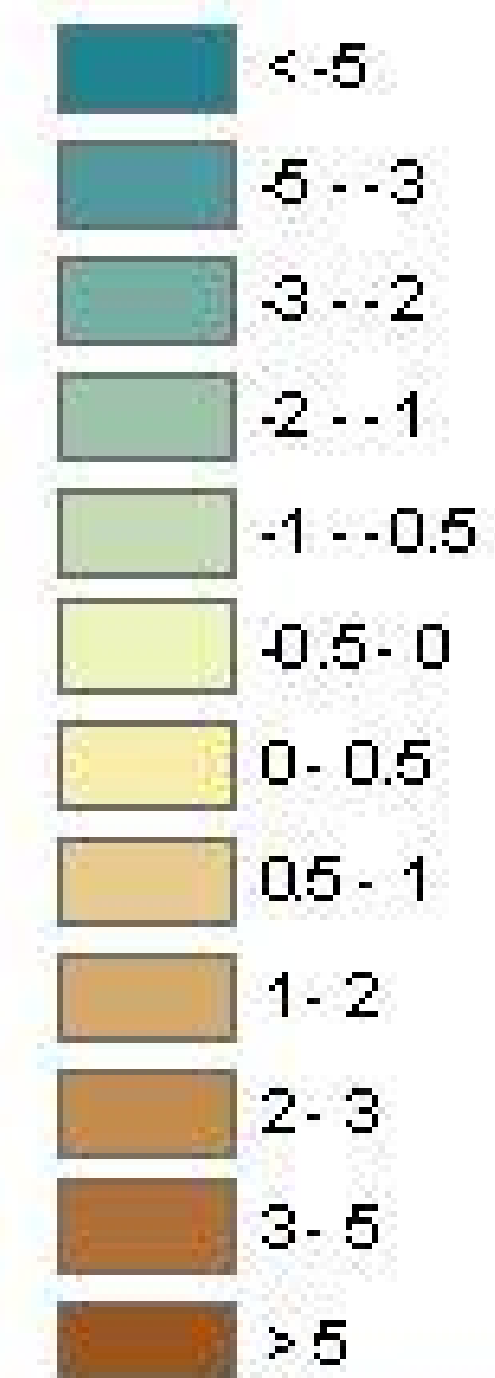
- 3D density dependent groundwater model (MOCDENS3D)
- Model cells 100\*100m<sup>2</sup>
- 40 model layers, top layers 0.5m
- detailed Holocene lithology
- calibration with measured head corrected to freshwater heads



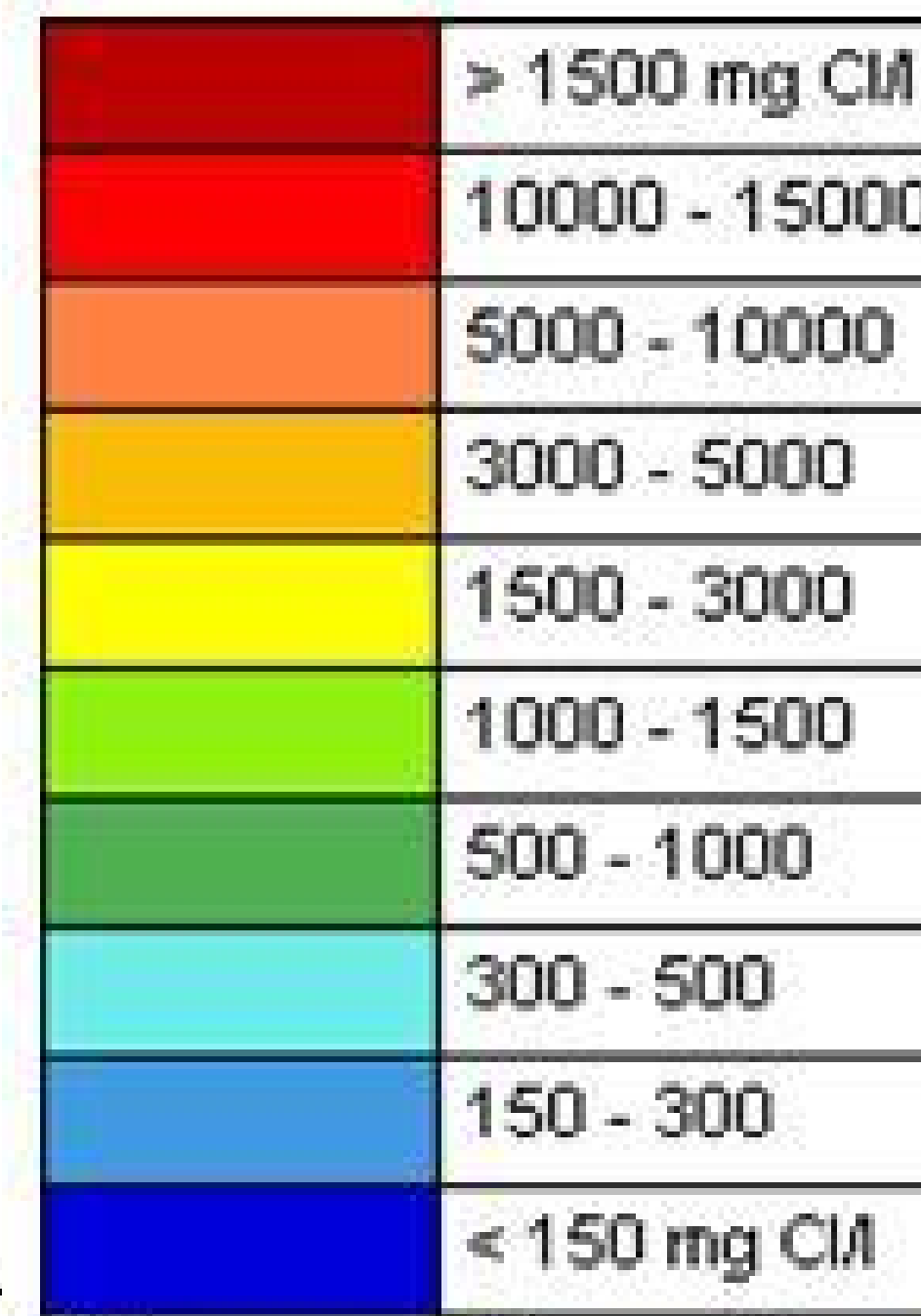


# Regional groundwater model: fresh-brackish-saline groundwater

Surface level  
[m msl]



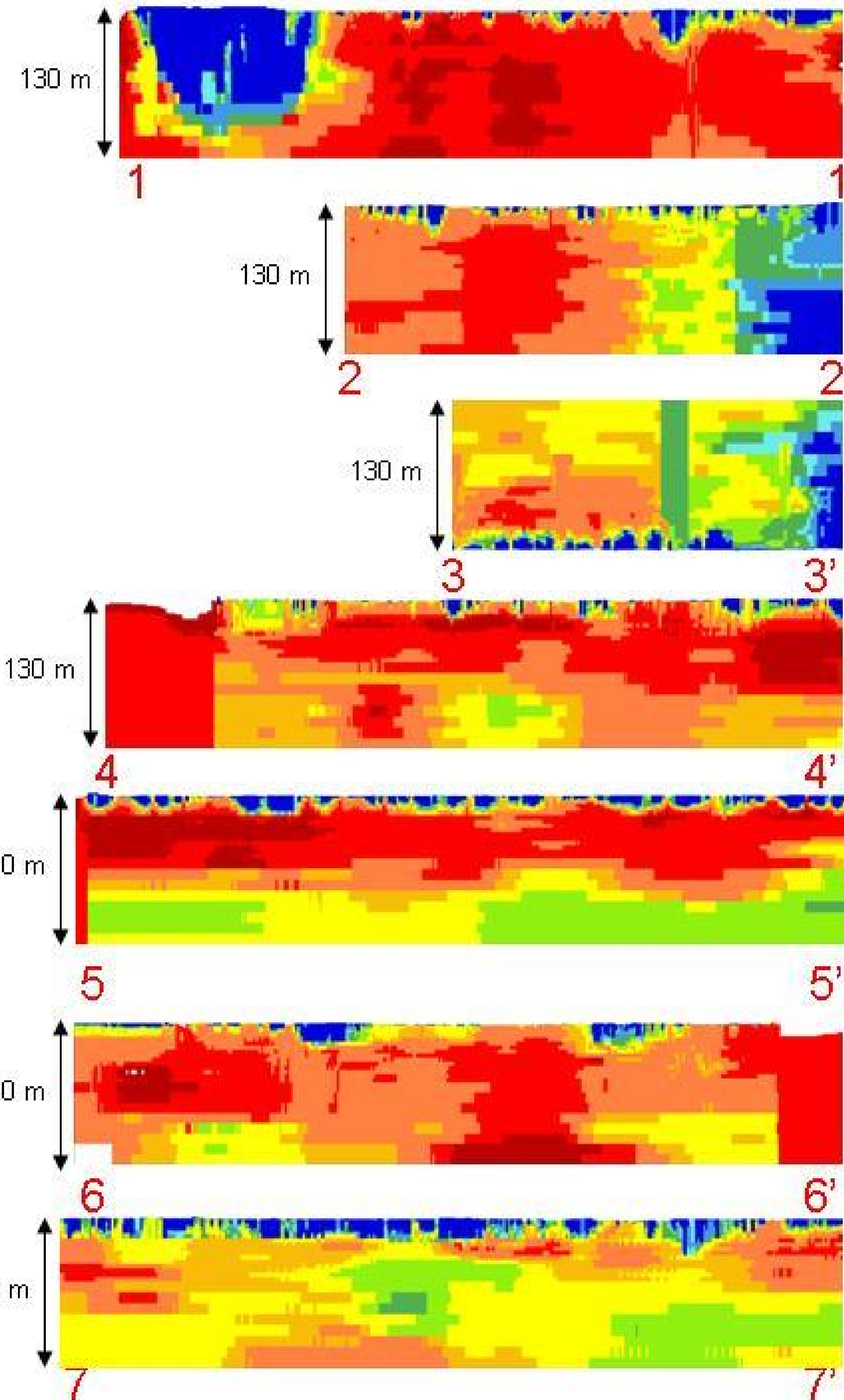
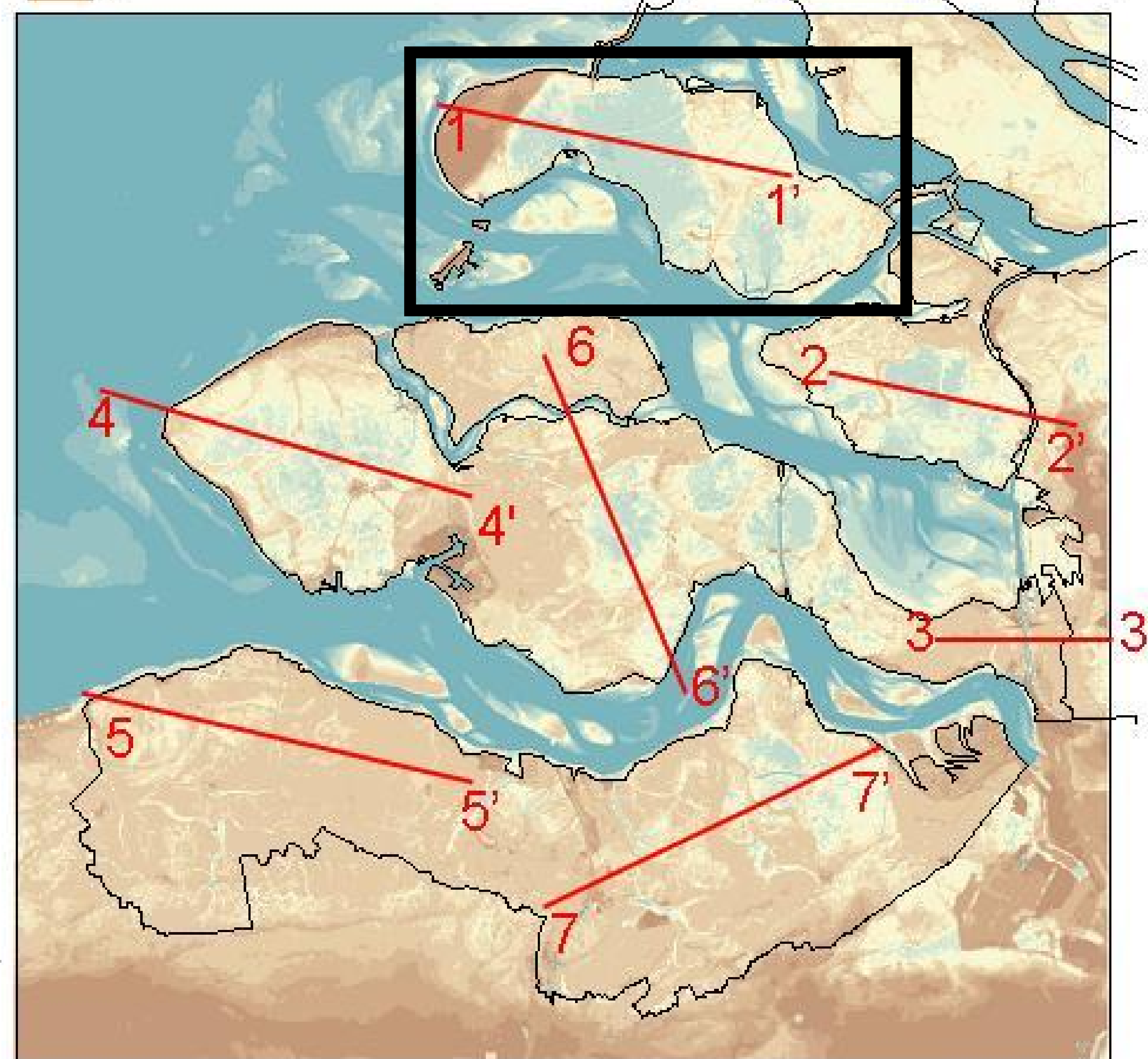
mg Cl/l  
groundwater



saline

brackish

fresh groundwater



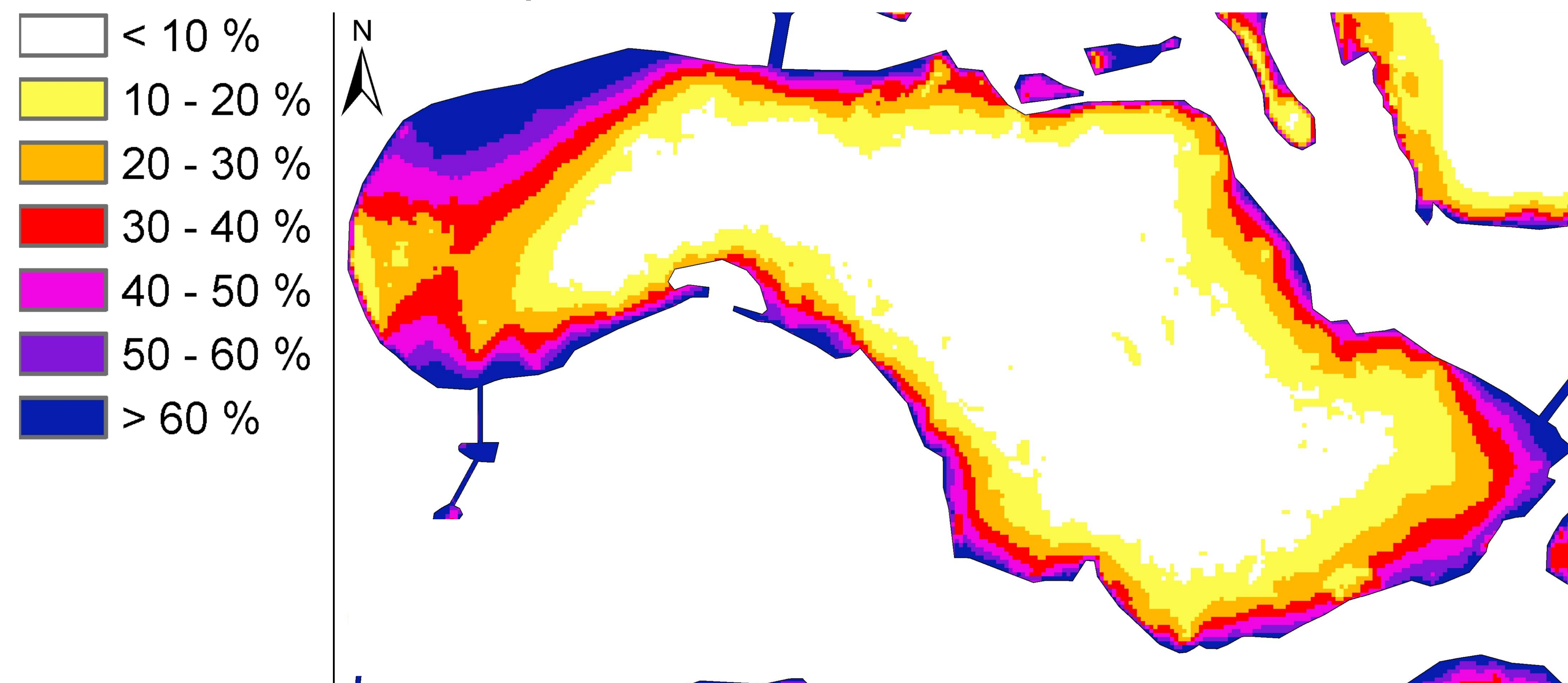


# Influence sea level rise on groundwater system

Sea level rise scenarios The Netherlands:

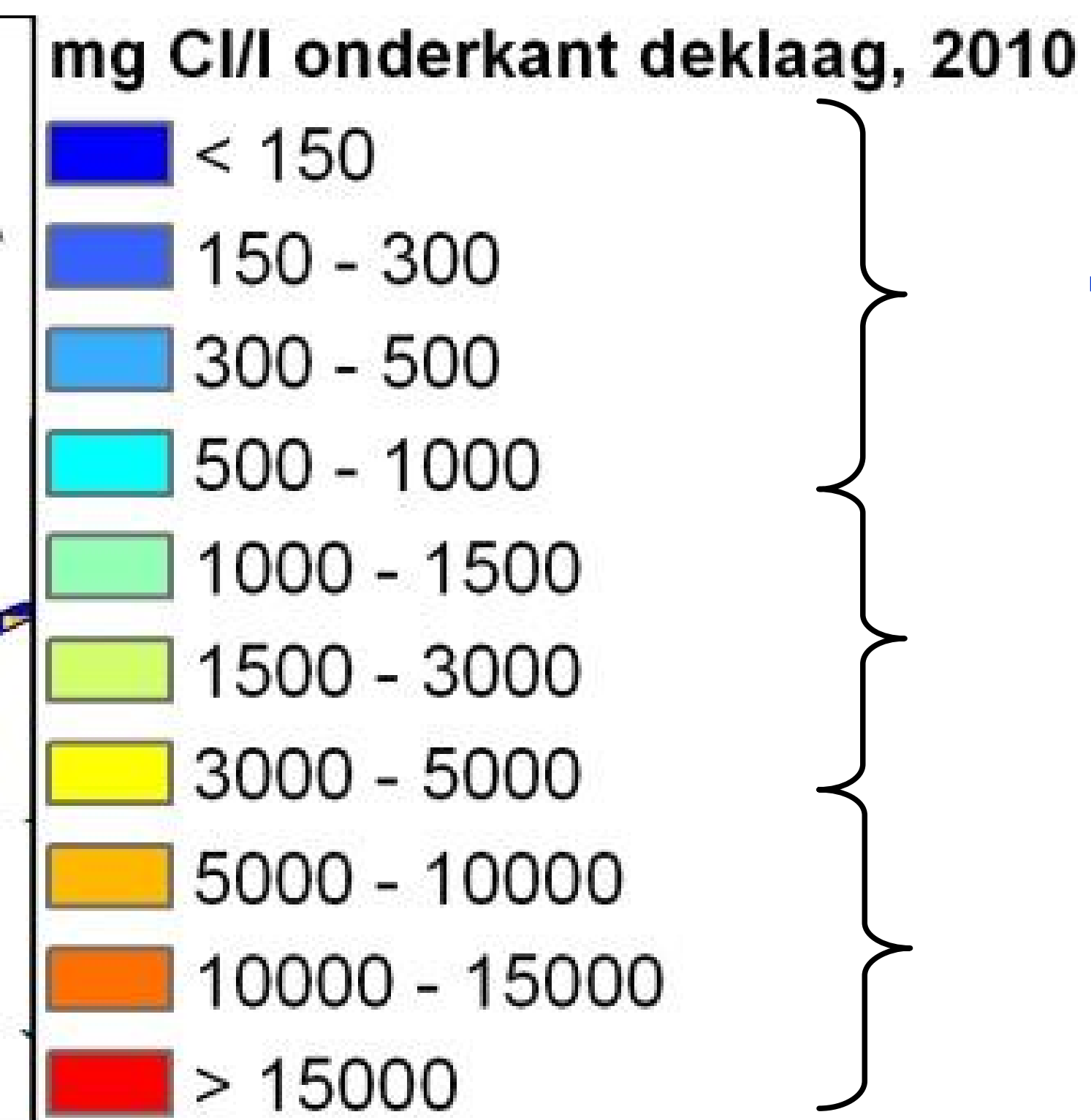
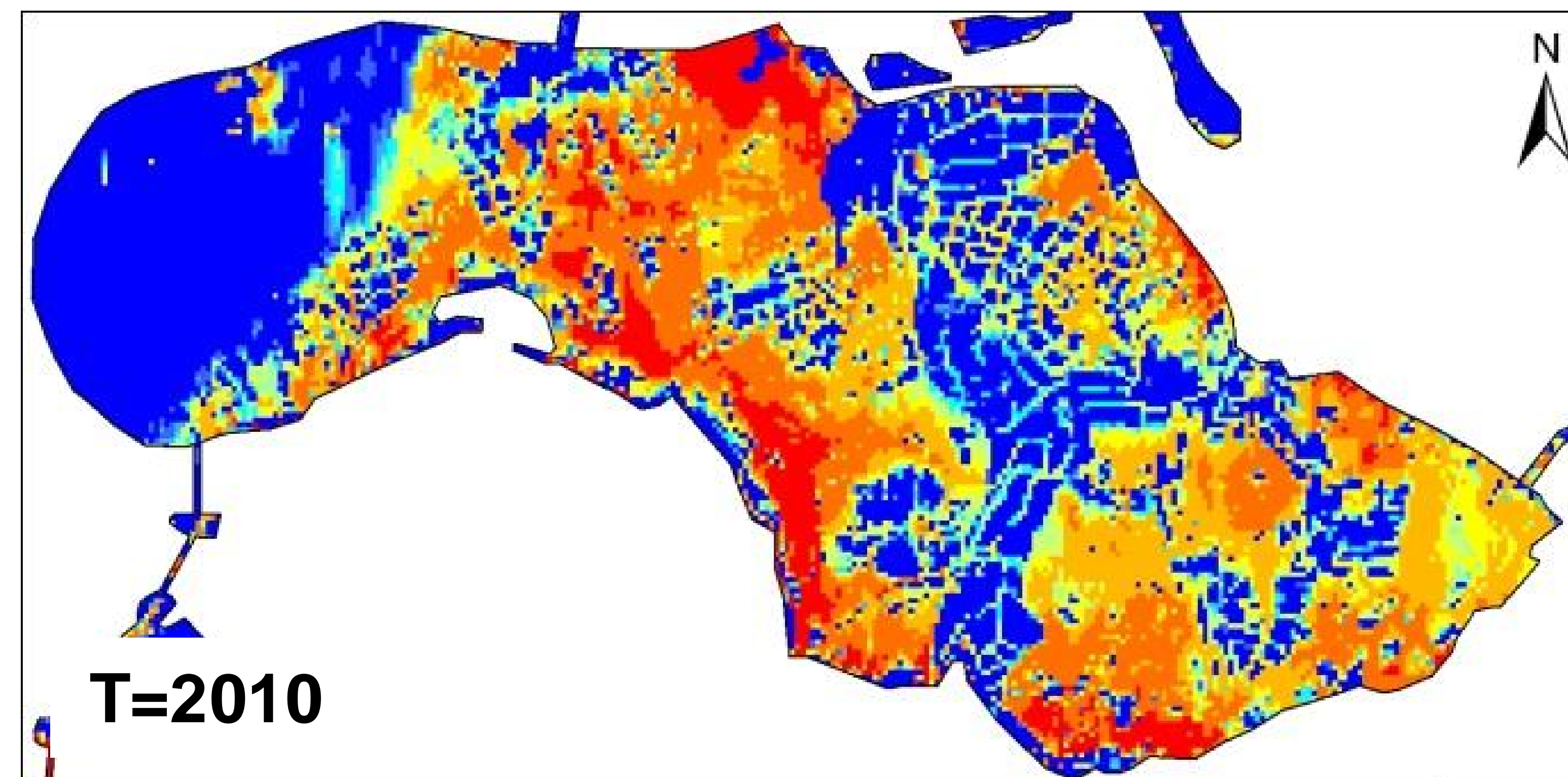
- 15 – 25 cm 2050 (KNMI G, G+)
- 20 – 35 cm 2050 (KNMI W, W+)
- 65 – 130 cm 2100 (Delta committee)

Increase head first aquifer as % of sea level rise





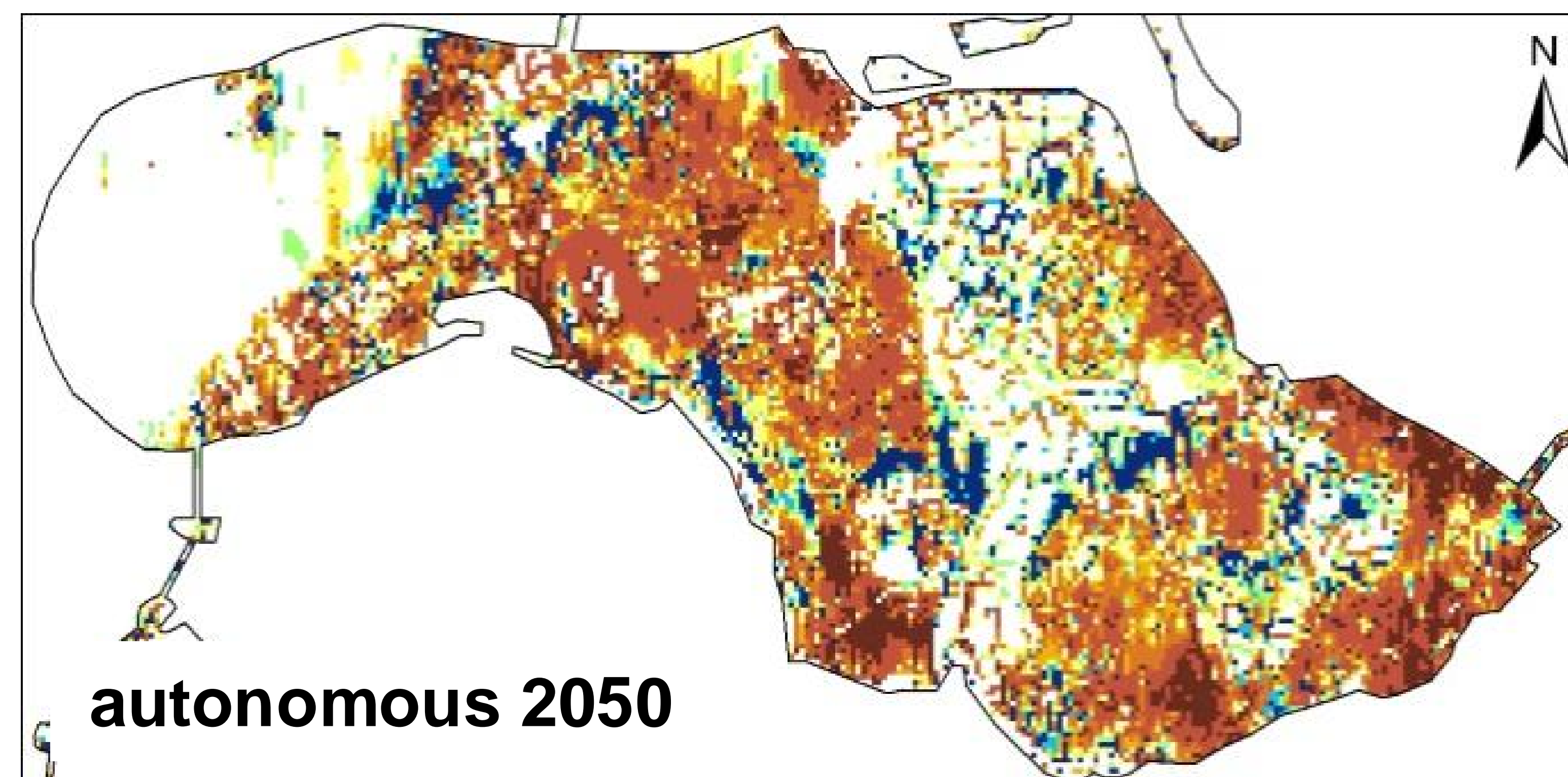
# Salinisation Island Schouwen-Duiveland



**fresh groundwater**

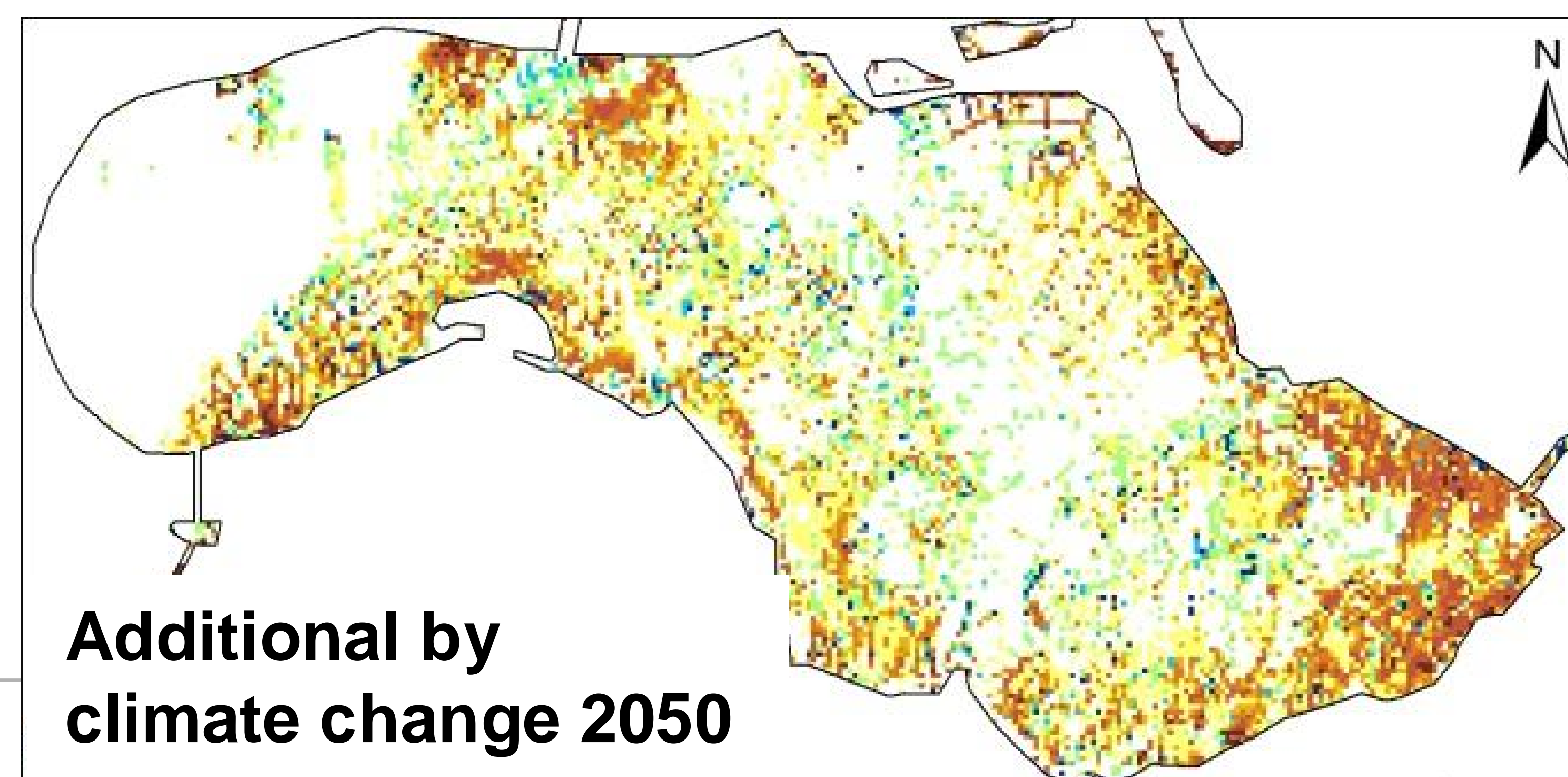
**brackish**

**saline**



**freshening**

**salinisation**



Increase seepage by climate change (W+):

1. sea level rise
2. decrease groundwater recharge



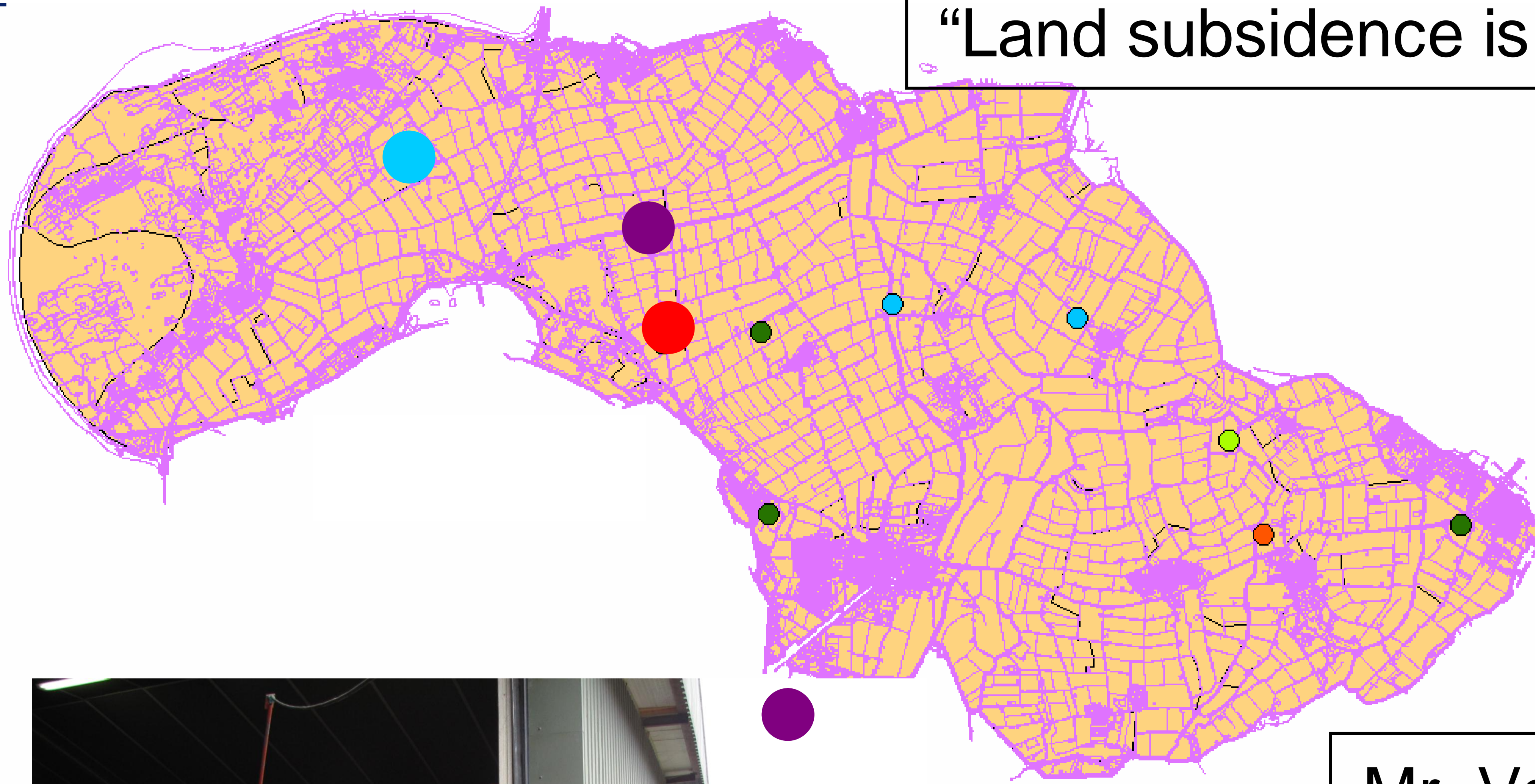
# Sense of Urgency: agriculture and climate change

farmers

Mr. Van den Hoek:

“Spring starts earlier: sowing earlier means increased production!”

“Land subsidence is a threat for my house and the crops”



Mr. Rentmeester:

“Climate change is uncertain, hence not relevant for the management of my farm.”

Mr. Van der Velde:

“In recent years more noticeable extremes: wetter, colder and drier.”

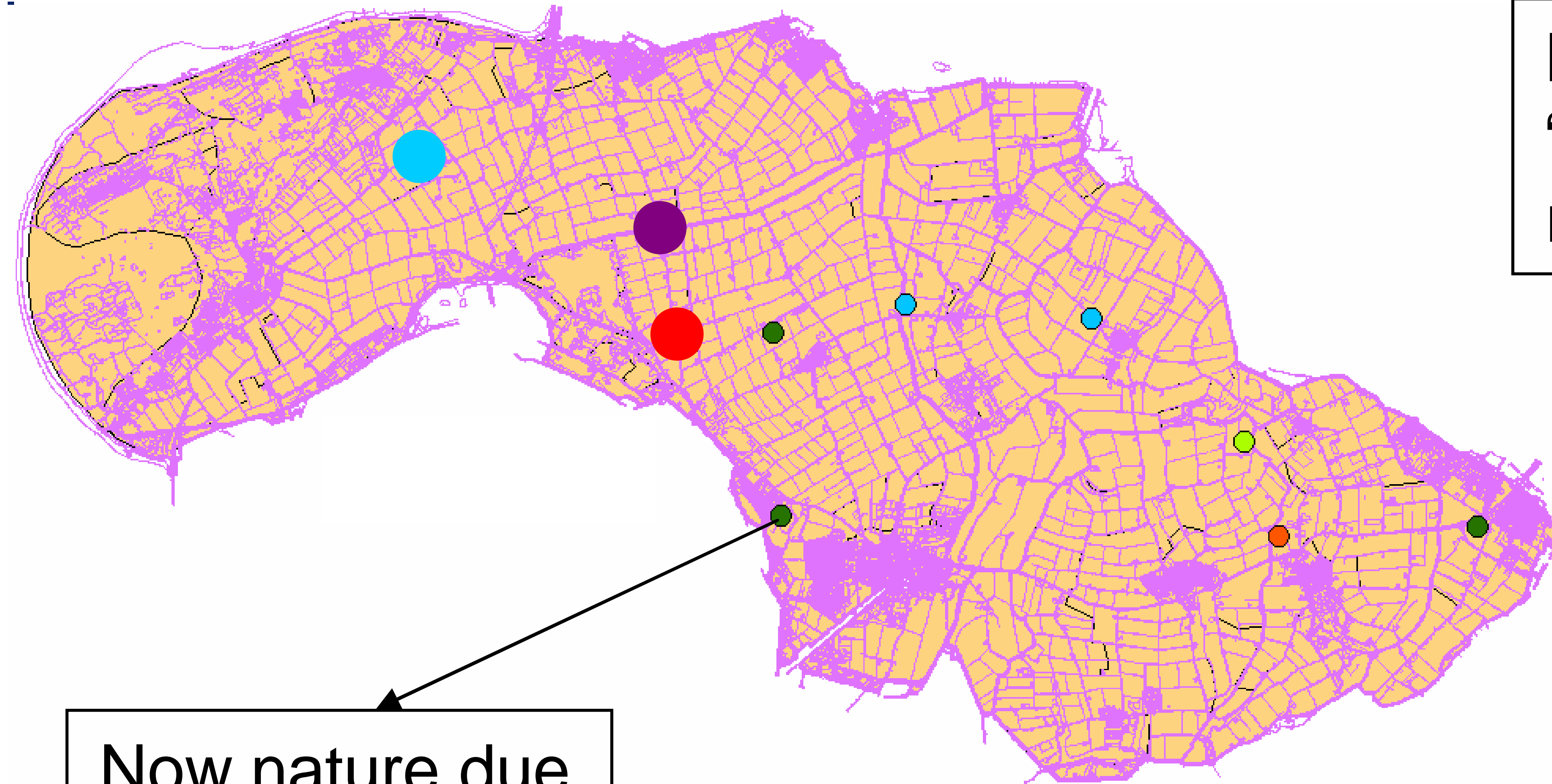
“We have little experience with measures against drought.”





# Sense of Urgency: agriculture and freshwater shortage

farmers



Now nature due to salinisation

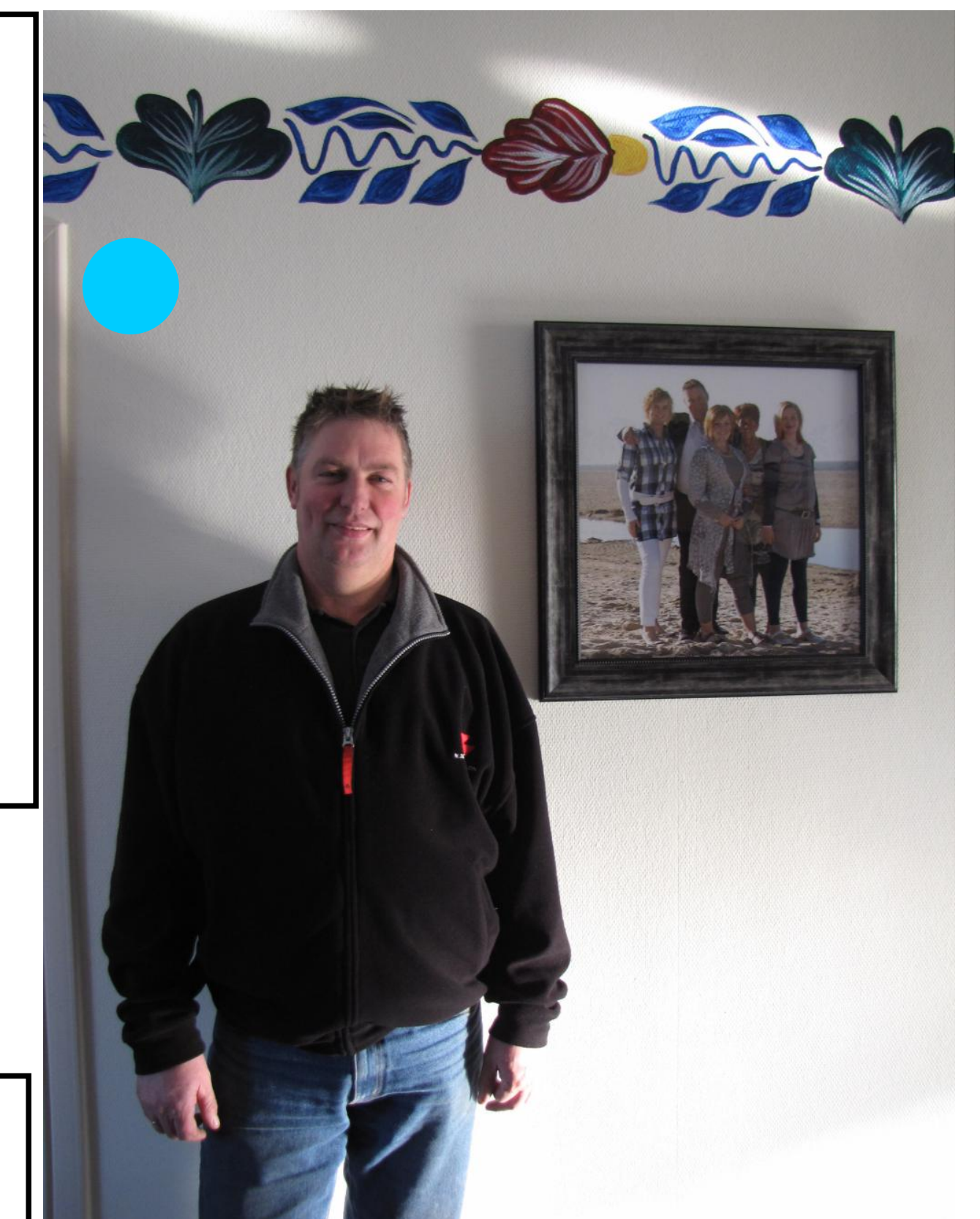
Mr. Van den Hoek:  
“Local drought is very annoying: prices don’t rise. My drought damage was 20-30% last year”



Mr. Van der Velde:  
“Wet damage in autumn because of drought in spring.”  
“I would like to have fresh water at the beginning of the growing season. Drawback are the costs.”

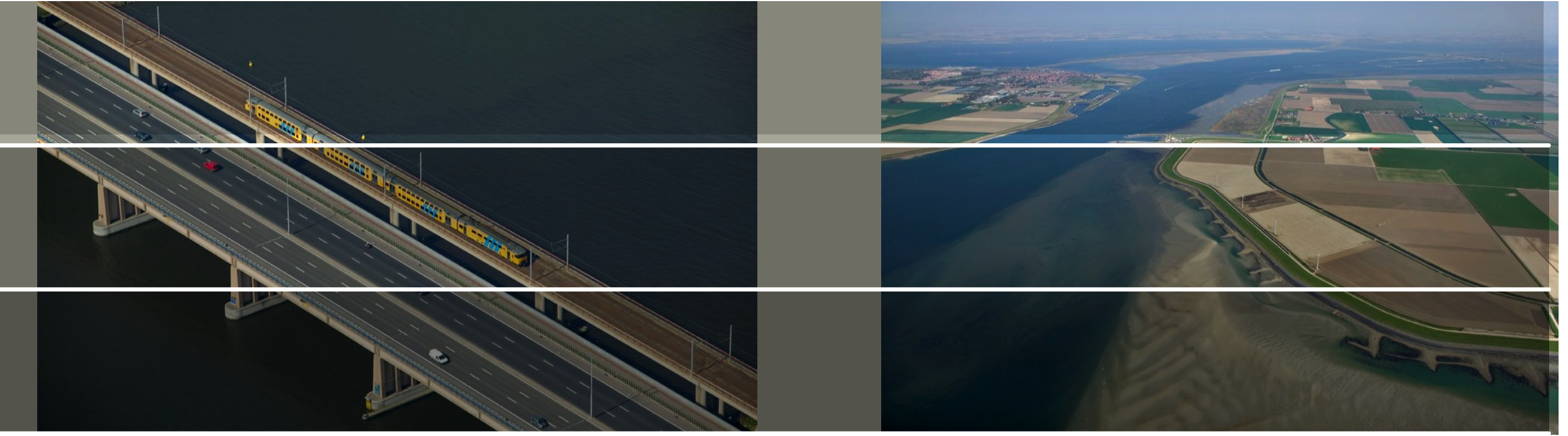


Mr. Rentmeester:  
“2010: 10% drought damage in June en July.”

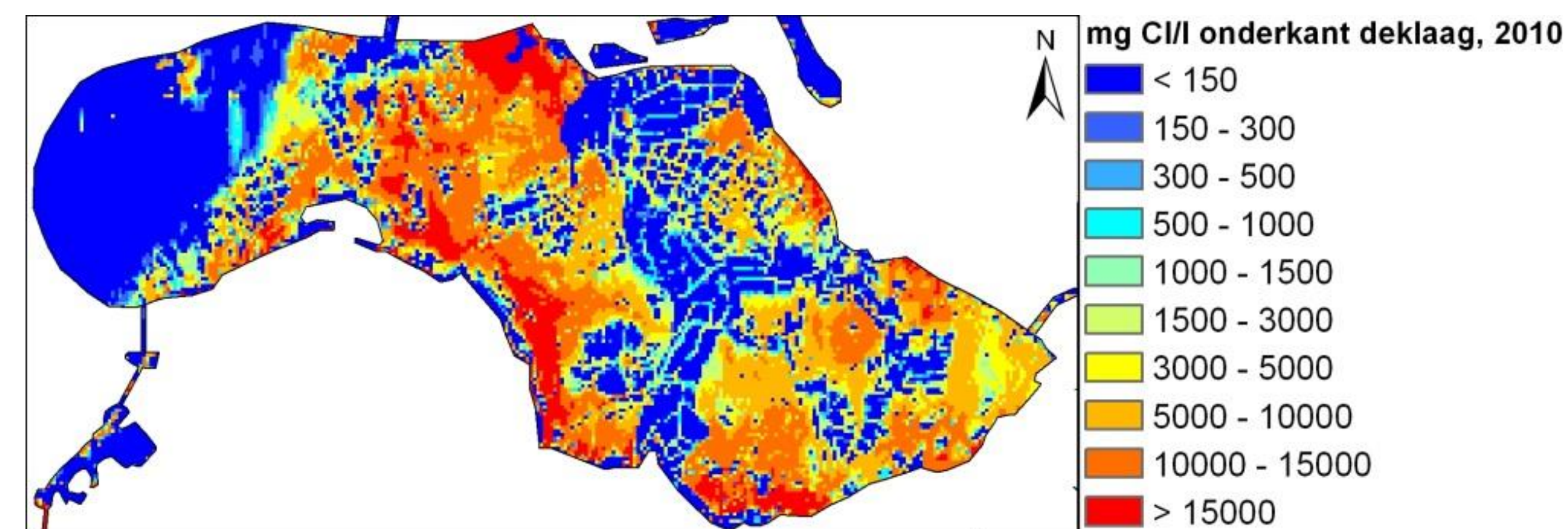




# Result combined approach



geohydrological research  
and  
quantification instrument



&

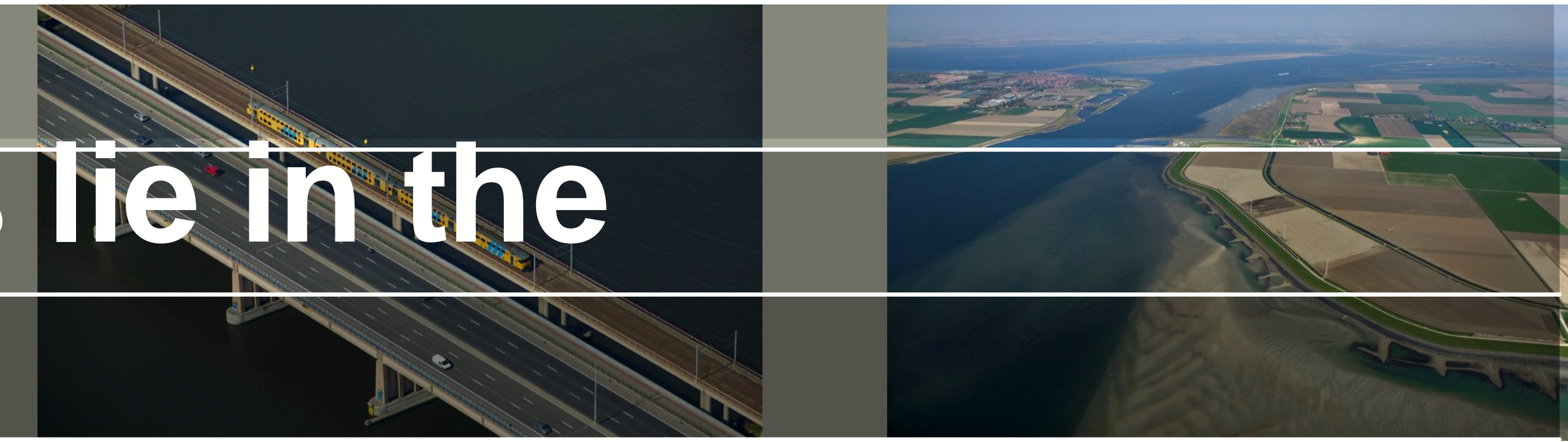
practical experience  
and  
sense of urgency farmers



1. Strategic vision freshwater management local government
2. Opportunities innovative countermeasures climate-proof freshwater supply

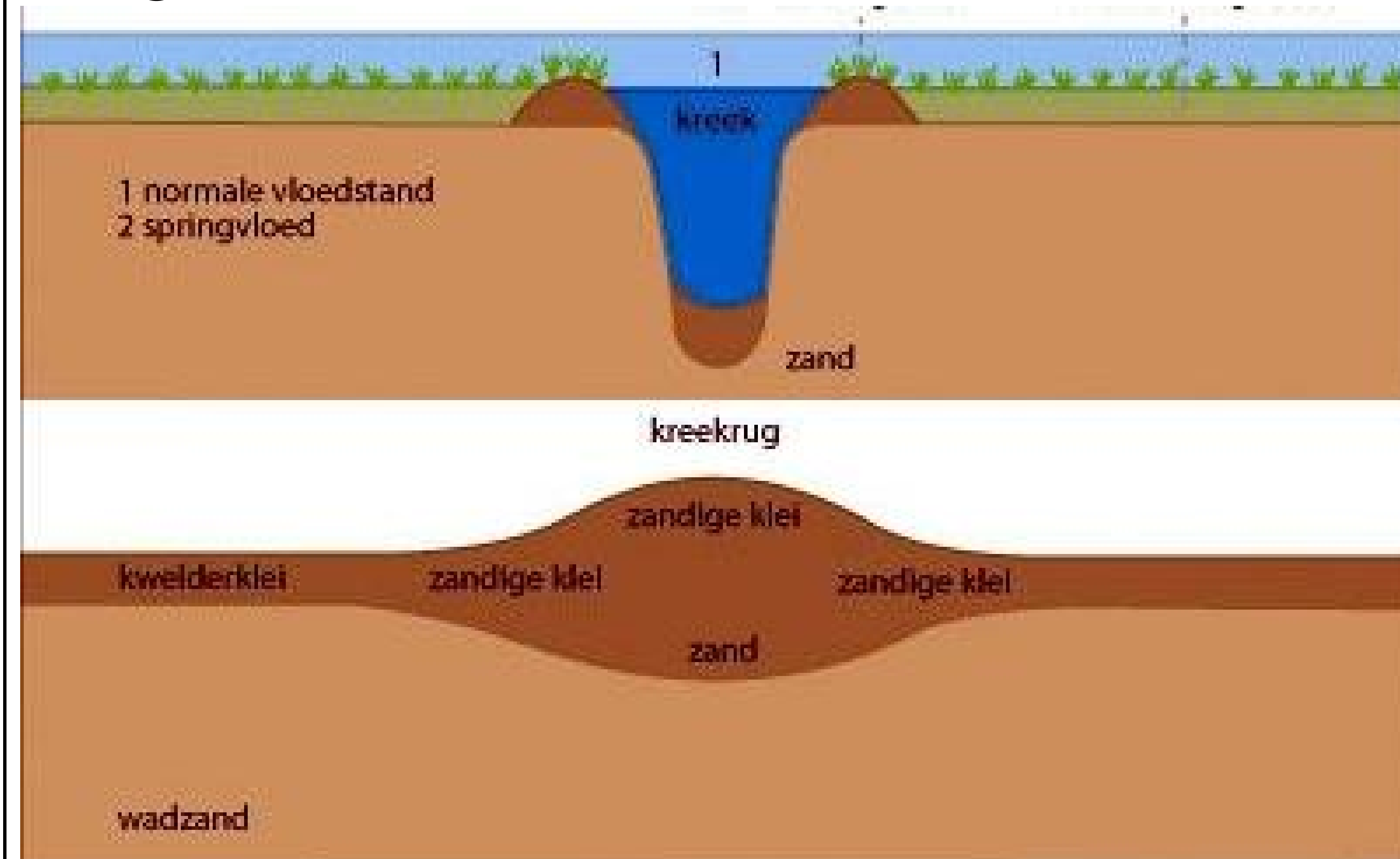


# Solutions for freshwater shortages lie in the geohydrological system!



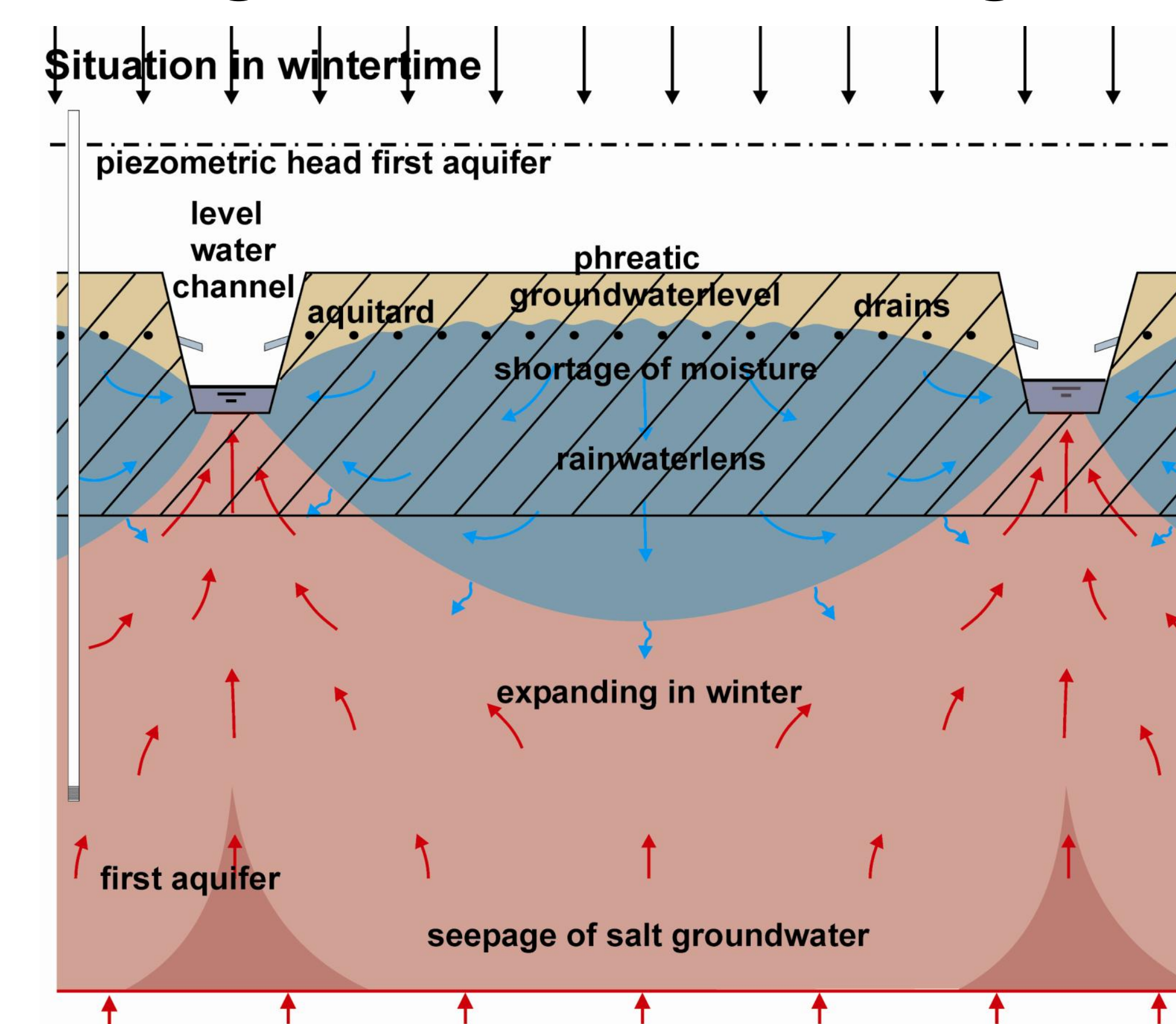
Possible innovative solutions were developed:

## 1. increase freshwater lenses for irrigation



*fennel  
cauliflower*

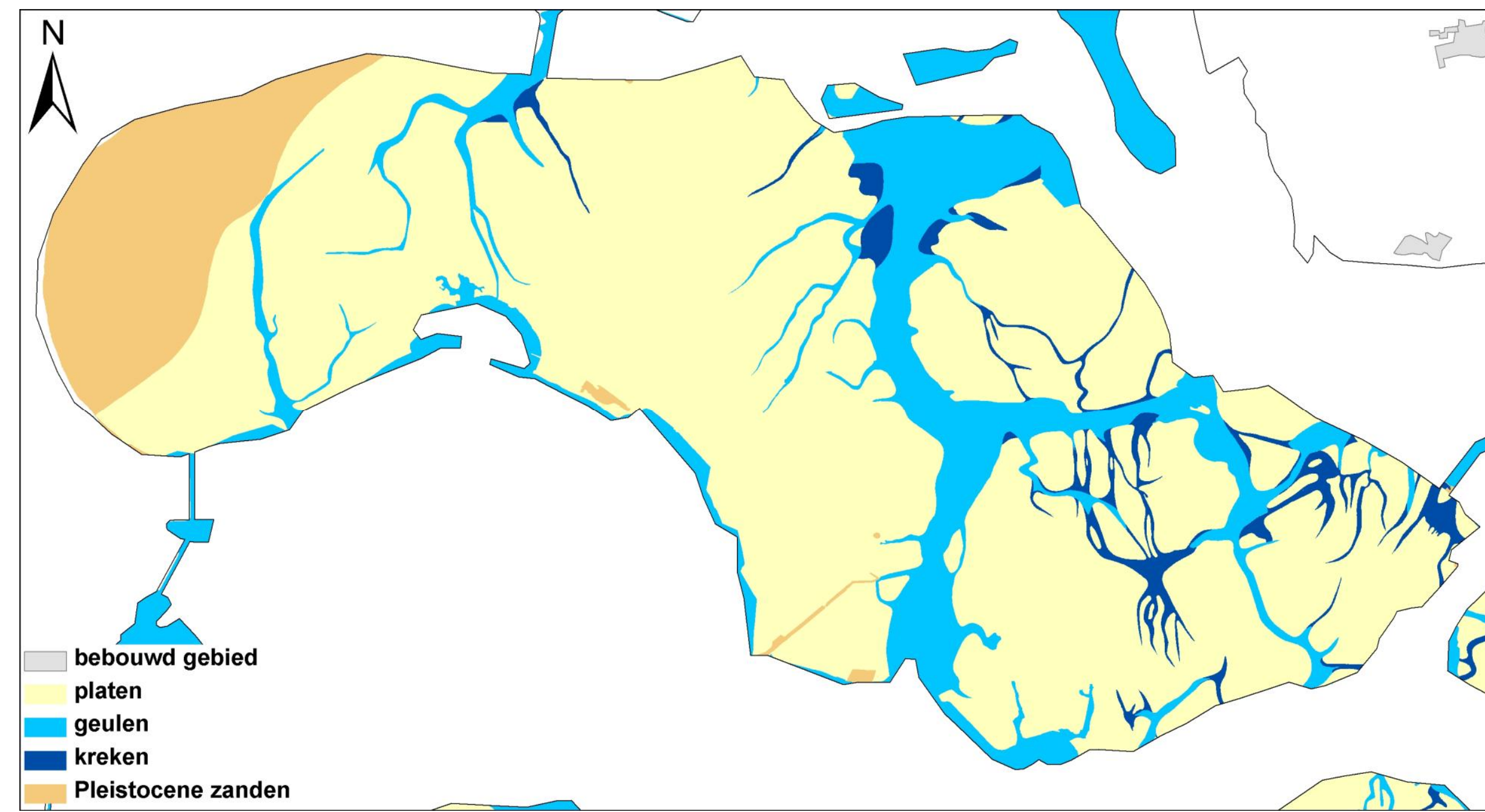
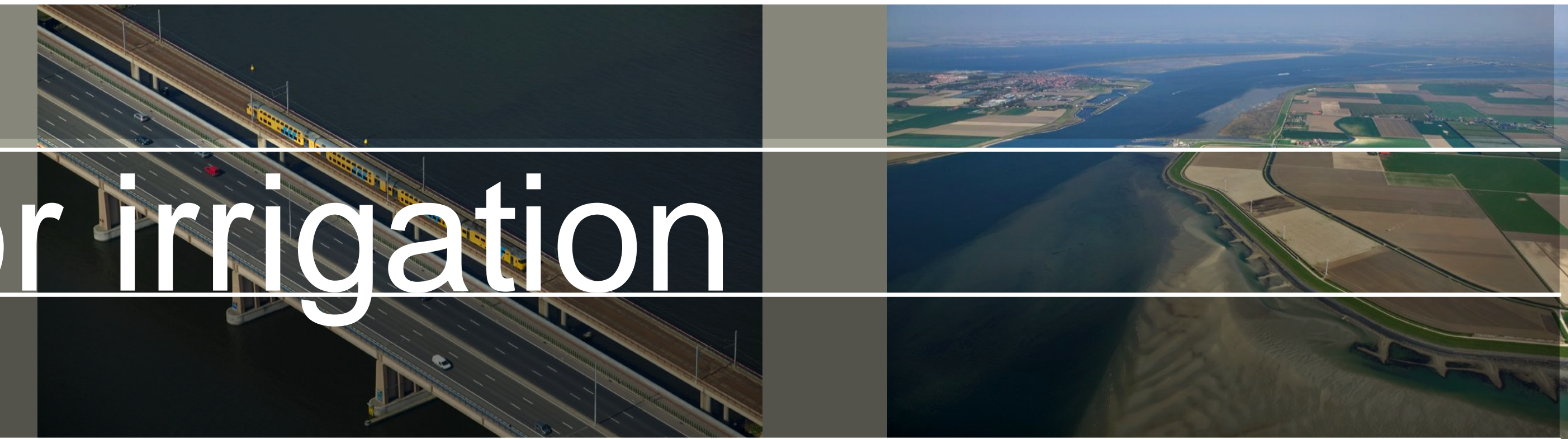
## 2. robust rainwater lenses in saline seepage areas (no irrigation)



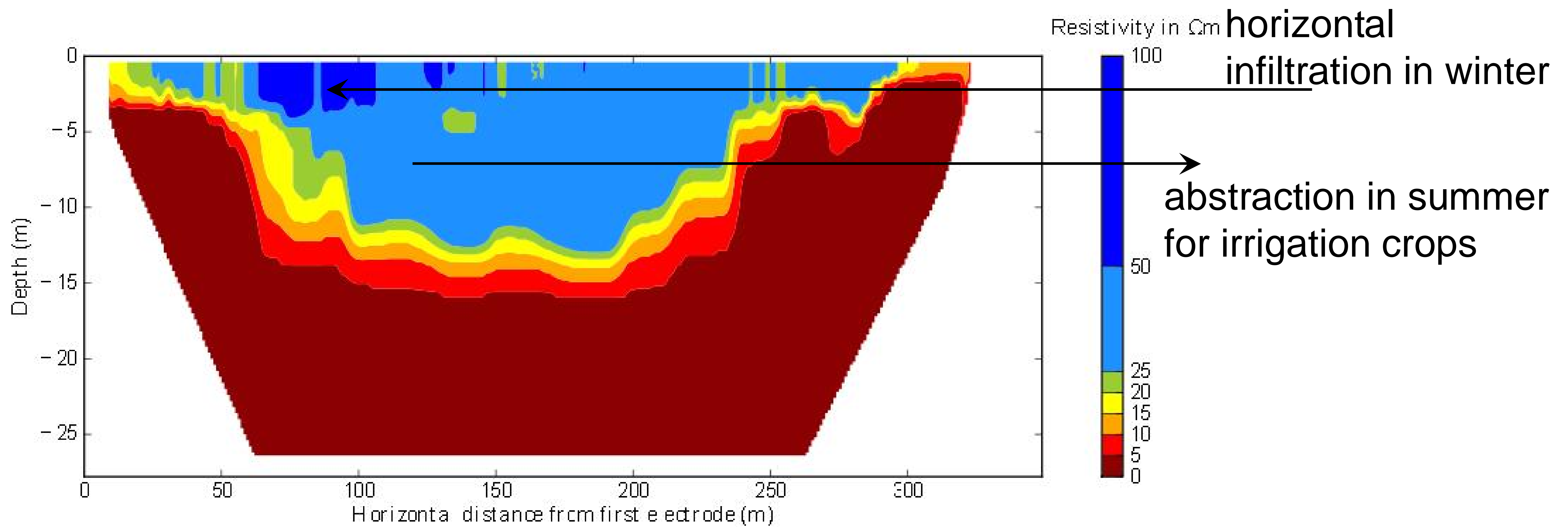
*potatoes  
onions*



# 1. increase freshwater lenses for irrigation



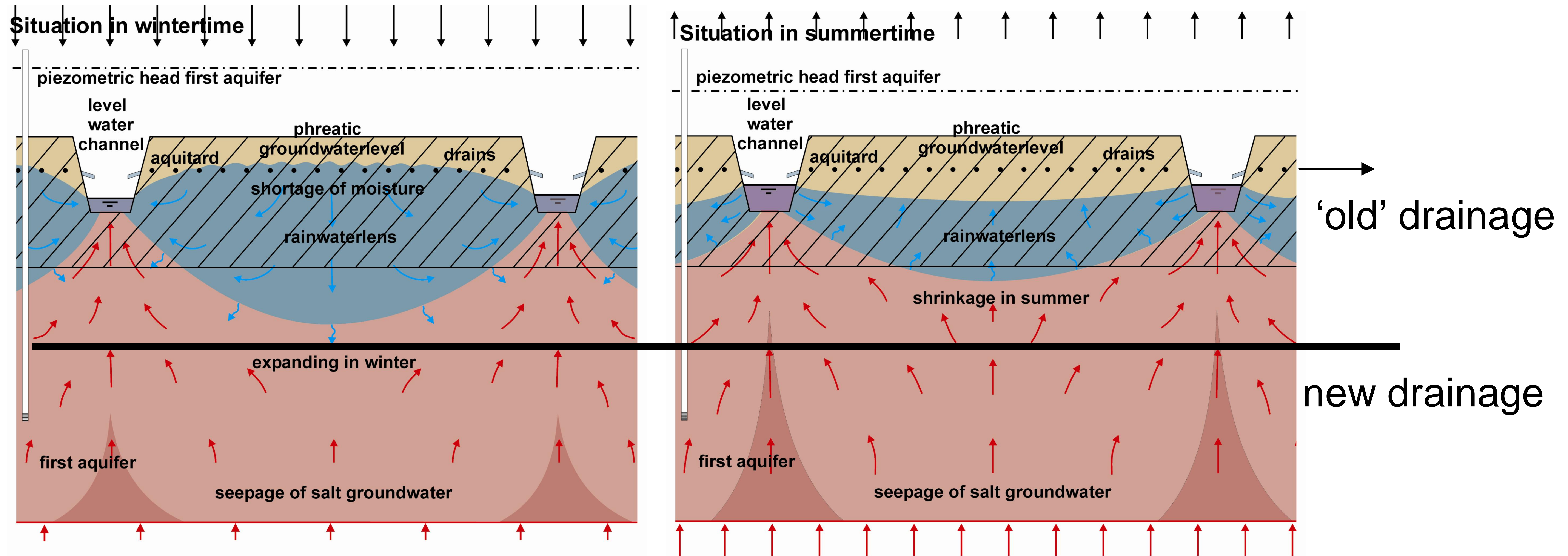
reclaimed salt marshes  
creek deposits  
dunes



→ First field test this year!



## 2. robust rainwater lenses in saline seepage areas



'old' drainage:

- discharge of fresh/brackish water

new drainage:

- discharge of saline water with the same drainage level
- Increase fresh water lens (no salinisation root zone)

First field test this year on Schouwen-Duiveland!





# Further research and conclusions

## Conclusions:

- Currently drought and salt damage
  - Salinisation and number of dry periods will increase
  - Freshwater availability in the subsoil can be improved
  - Better storage recharge surplus in theory possible
- Schouwen-Duiveland is ready for innovative countermeasures!

## Next steps (within Knowledge for Climate 2012 - 2014):

- Field tests for hydrological feasibility
- Combined with economical feasibility and participation stakeholders
- If successful: worldwide approach vulnerable saline deltas



ALTEERRA  
WAGENINGEN UR

KWR



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Website: [freshsalt.deltares.nl](http://freshsalt.deltares.nl)

**Deltares**





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28 juni 2012

**Deltares**



# Sense of Urgency: nature and climate change

nature managers



“Climate change is uncertain and nature is elastic. Politics also affect achieving ecological objectives”



*Dunes:*

“Climate change causes drought damage to the ecology of the dunes. The periods with extreme recharge on the other hand give an impuls to the ecological value”.

*Nature in saline areas:*

“Undesirable developments are countered by good water management”



“Large fluctuations in salt concentration in the surface water is bad for the ecology.”

