EGU22-2333
https://doi.org/10.5194/egusphere-egu22-2333
EGU General Assembly 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Effects of historic changes in regional drainage characteristics on the drawdown of groundwater abstractions

Marjolein van Huijgevoort[1], Gijsbert Cirkel[1], and **Ruud Bartholomeus**[1,2]
[1]KWR Water Research Institute, Nieuwegein, the Netherlands
[2]Wageningen University, Soil Physics and Land Management Group, Wageningen, the Netherlands

Calculating the drawdown of groundwater abstractions for drinking water is usually done considering the current land use and regional drainage characteristics. However, many drinking water abstractions already exist for several decades and abstracted volumes have increased over time. In the Netherlands, especially in the more elevated parts of the country, the drainage characteristics were also significantly altered to prevent water logging and to optimize the water management for agricultural use, often after establishment of the groundwater abstraction site. These changes were intended to lower the phreatic groundwater levels to prevent waterlogging, but unintendedly also made the regions more vulnerable to drought. The question is whether groundwater abstractions for groundwater would have a similar impact in the former historic hydrological context and whether restoring the system to this state would ameliorate current drought problems.

In this study we investigated whether a drinking water abstraction would have the same drawdown if the regional drainage characteristics would not have been altered and whether restoring the historic situation would decrease drought impacts. First, a literature study was conducted to understand the changes to the drainage system over time. These changes were then implemented in a regional groundwater model (based on Modflow) for a conceptual region, representative for the eastern part of the Netherlands. Results from both the literature study and the groundwater model indicated that changes in the drainage system lowered the groundwater levels by tens of centimetres (differences ranged from 20 to 100 cm). Drawdown from the drinking water abstraction was larger in the historical situation than in the current situation, even though groundwater levels were higher. In the historical situation less reduction in transpiration occurred, leading to a lower recharge of the groundwater and thus a larger drawdown. However, when irrigation was applied, this effect was not found. This implied that a correct estimate of groundwater recharge is crucial to calculate drawdown from abstractions. Recharge depends on actual evapotranspiration, of which the conceptualization in regional models could be improved. Returning the drainage system to the historical situation leads to higher groundwater levels, thereby reducing the drought impact, but also increasing the risk of oxygen stress in crops. More research with regard to the impact on crop yields is needed on local scale, before measures to mitigate drought impacts can be taken.

26-05-2022

Effects of historic changes in regional drainage characteristics on the drawdown of groundwater abstractions

Marjolein van Huijgevoort, Gijsbert Cirkel, Ruud Bartholomeus

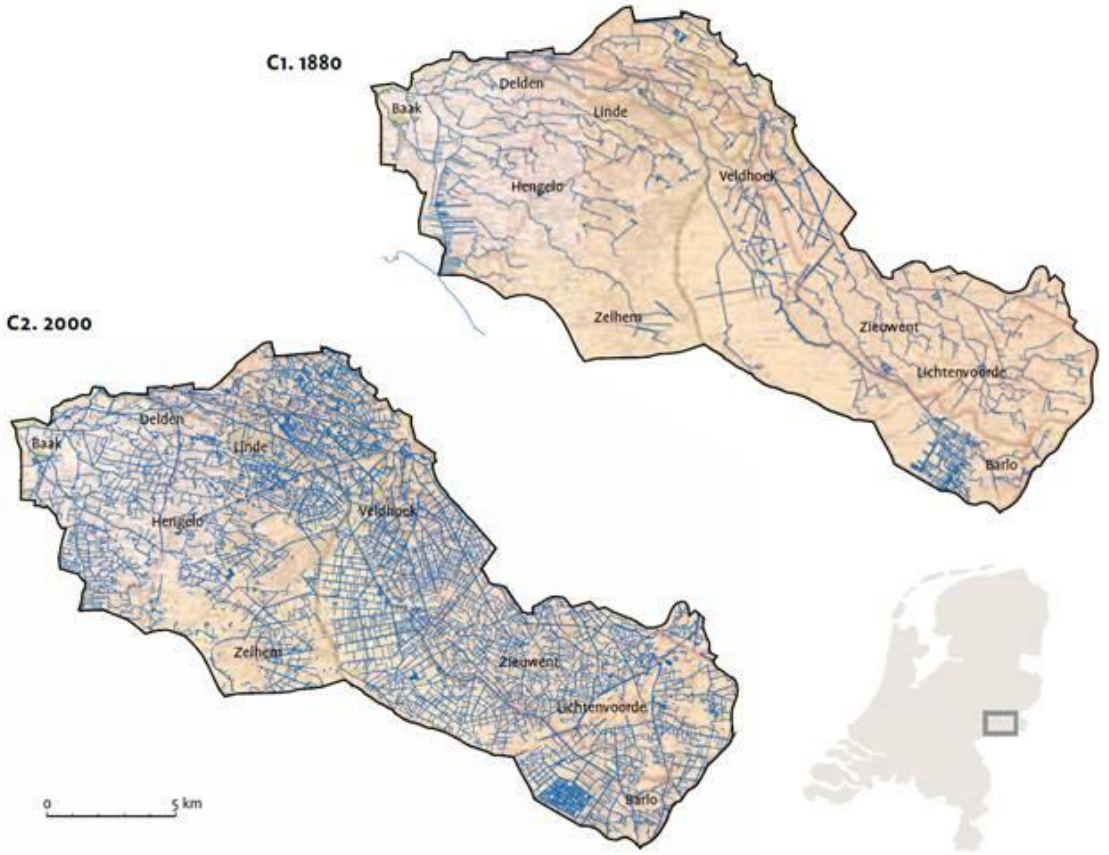
KWR

Bridging Science to Practice

Aim of the study

- Drawdown effects of groundwater abstractions for drinking water supply are calculated based on the current land use and regional drainage characteristics
- Both land use and drainage characteristics have changed significantly after abstractions started

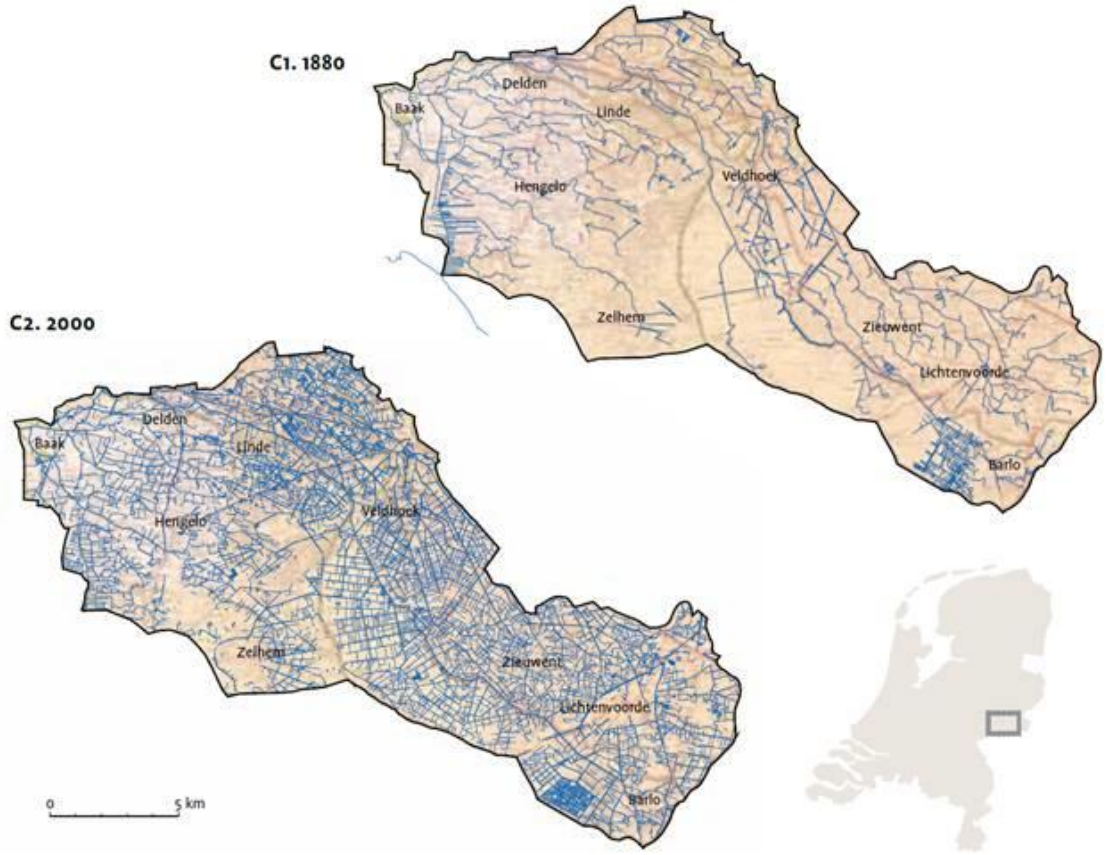
Would groundwater abstractions have a similar impact if the regional drainage characteristics had not been altered and could restoring the historic situation decrease drought impacts?



Massop, 2019

Historic and current drainage characteristics

- Drainage characteristics in the Netherlands were altered significantly to prevent water logging and to optimize water management for agriculture
- Limited studies have investigated the effects of these changes. Differences in shallow groundwater levels up to several decimetres have been found, but hard to quantify changes.



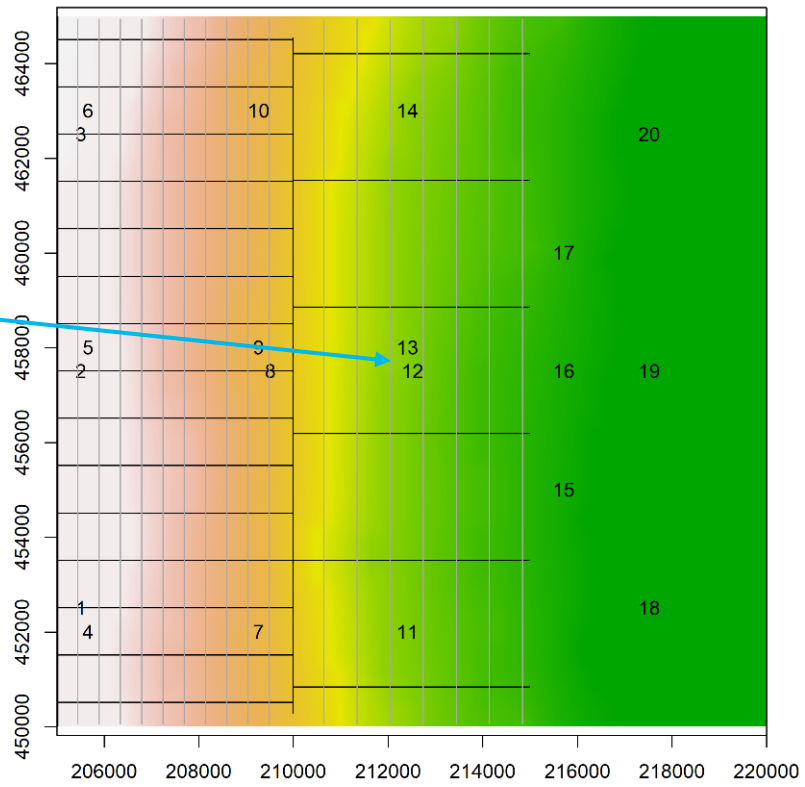
Massop, 2019

Regional model

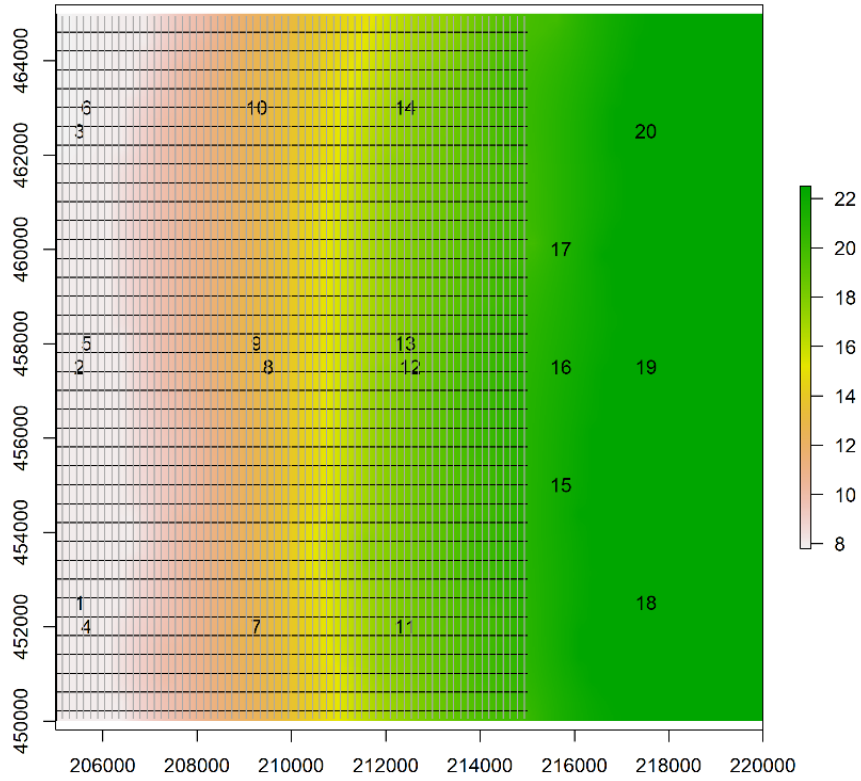
Simplified conceptual model representative for eastern part of the Netherlands

- Model domain 15 x 15 km
- Cell size 25 x 25 m
- 2 soil types
- 3 aquifers
- Land use grass
- Groundwater abstraction
  4 000 000 m^3/year
- Period 1995-2019

Historic

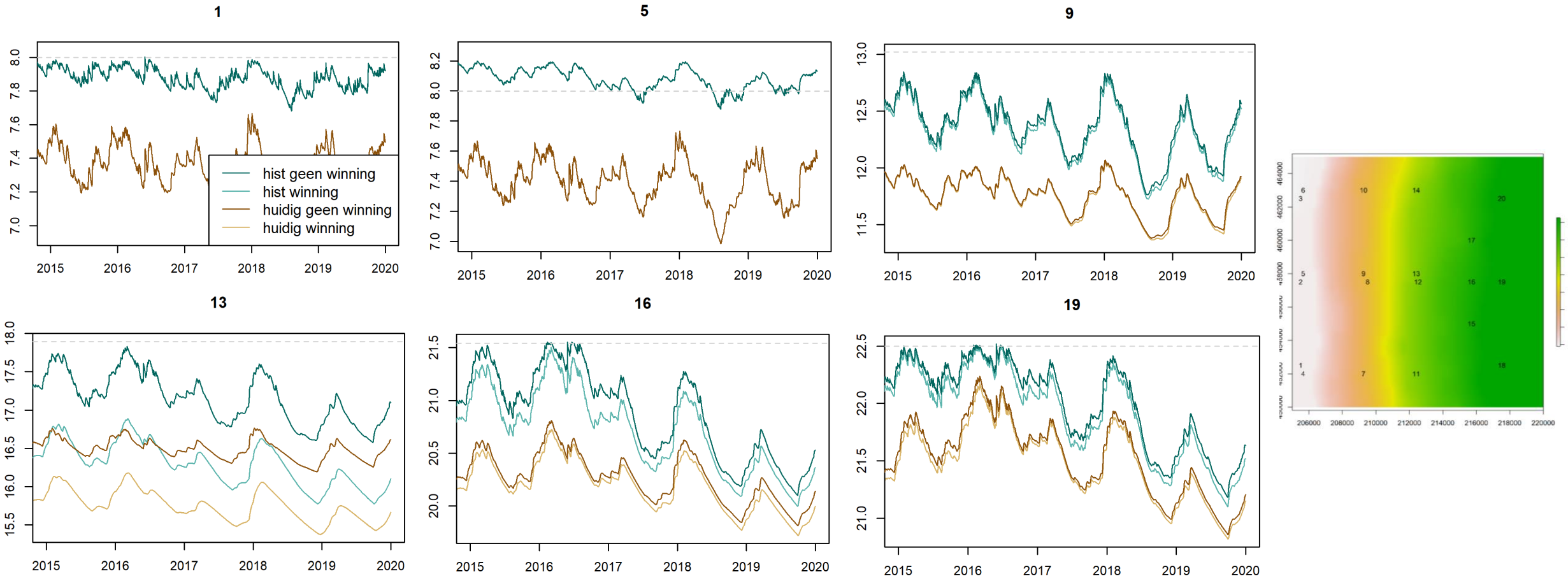


Current



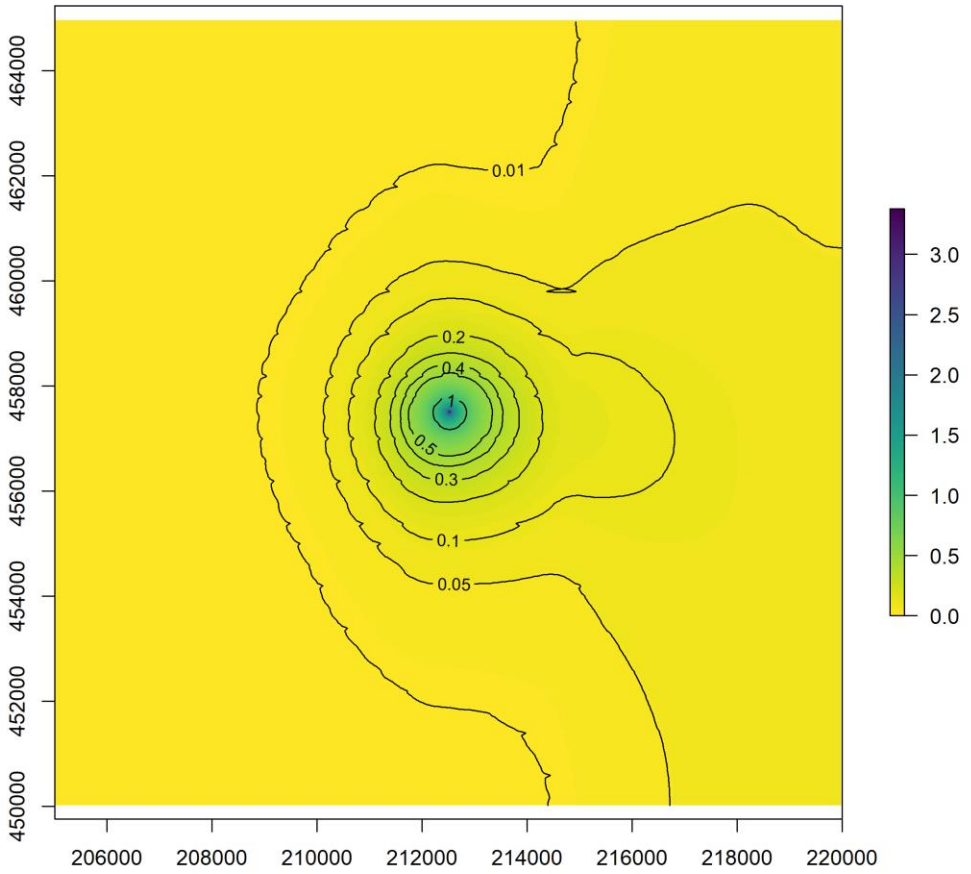
Groundwater levels

Groundwater levels up to a few decimetres higher with historical drainage situation

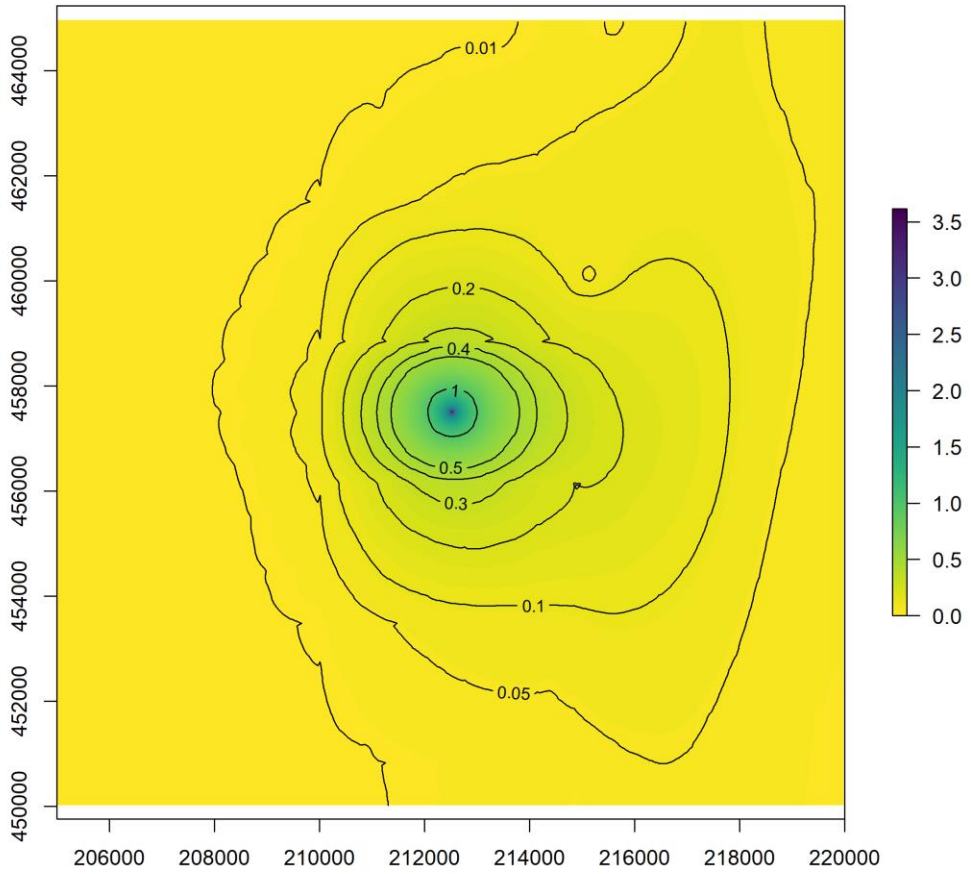


Drawdown groundwater abstraction

Current



Historical



Conclusion

- Correct estimate of groundwater recharge is crucial to calculate effects of groundwater abstractions. Recharge depends on actual evapotranspiration, of which the conceptualization in regional models could be improved.
- Restoring the drainage system to the historical situation leads to higher groundwater levels, thereby reducing the drought impact, but also increasing the risk of oxygen stress in crops.

Groningenhaven 7
3433 PE Nieuwegein
The Netherlands

T +31 (0)30 60 69 511
E info@kwrwater.nl
I www.kwrwater.nl

@KWR_Water KWR KWR_Water

Marjolein van Huijgevoort

Gijsbert Cirkel

Ruud Bartholomeus