Propagation of increasing variability of precipitation and evaporation past 50 years to Dutch groundwater heads?



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29 April 2025 EGU25-7370 Session HS2.4.3 Room 2.15 16:50-17:00

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Trends precipitation and evaporation



- Average temperature increasing
- Average evaporation increasing
- Average precipitation increasing

Data: Royal Netherlands Meteorological Institute (<u>https://www.knmi.nl</u>) Bartholomeus et al. (2015) HESS, doi:10.5194/hess-19-997-2015



Trends potential groundwater recharge (= precipitation minus evaporation)



- Moving average 30 years: No continuous trend
- Moving standard deviation: Clear increase



precipitation and evaporation strong influence on Groundwater heads



- How does increased variability of potential groundwater recharge (precipitation minus Makkink evaporation) influence groundwater heads in the Netherlands?
- Use observed groundwater heads
- Timeseries > 50 years

Geologische Dienst

Zaadnoordijk et al. (2019) Groundwater, doi: 10.1111/gwat.128

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Analysis collection of gw head timeseries > 50y



No genereal increase in variability

- Why?
 - Data?
 - Groundwater system?
 - Other influences?



Role groundwatersystem in head response



Time series models: Zaadnoordijk et al. (2019) Groundwater, doi: 10.1111/gwat.128 Simulation software: Collenteur et al. (2019) Groundwater, doi: 10.1111/gwat.12925



Role groundwatersystem in head response



- Groundwater system dampens variability potential recharge
- Only for short response times (and • response periods) increased variability groundwater heads exponential response function
- Validation with simpler • response function (exponential)



1970

1980

time

1990 2000

2010 2020



Measured groundwater heads with fast response



 Based on simulations: increased variability in groundwater heads expected only for short response times (and response periods)

! Not prominent in observed series !



Data: https://www.DINOloket.nl

Data insufficient?



- Long timeseries mostly in areas with good quality groundwater
- Manual measurements usually 24 per year or less
- Recently more and more automatic pressure transducers with at least 1 measurement/day



Other influences?



- Irrigation After each dry year more irrigation systems installed
- Drainage
- Infiltration surface water or precipitation
- Adaptation of surface waters



Conclusion



- Increased variability of potential recharge not prominent in Dutch groundwater levels
 - Damping in slower reacting groundwater systems
 - Anthropogenic adaptation
 - Oversight in monitoring? (measurement frequency and location time series >50 y?)



Thank you!

And what are your thoughts about variability gw heads vs. prec/evap?



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