



GEFÖRDERT VOM



Bundesministerium  
für Bildung  
und Forschung

**FONA**

Forschung für Nachhaltigkeit

Eine Initiative des Bundesministeriums  
für Bildung und Forschung



Wasser: N  
SCHUTZ. NUTZUNG. INNOVATION.

**LURCH**

Grundwasser nachhaltig bewirtschaften



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Summerschool *LURCH*young

9 May 2025, Raitenhaslach

**What data is needed to build an  
*isoscape* for a country?**

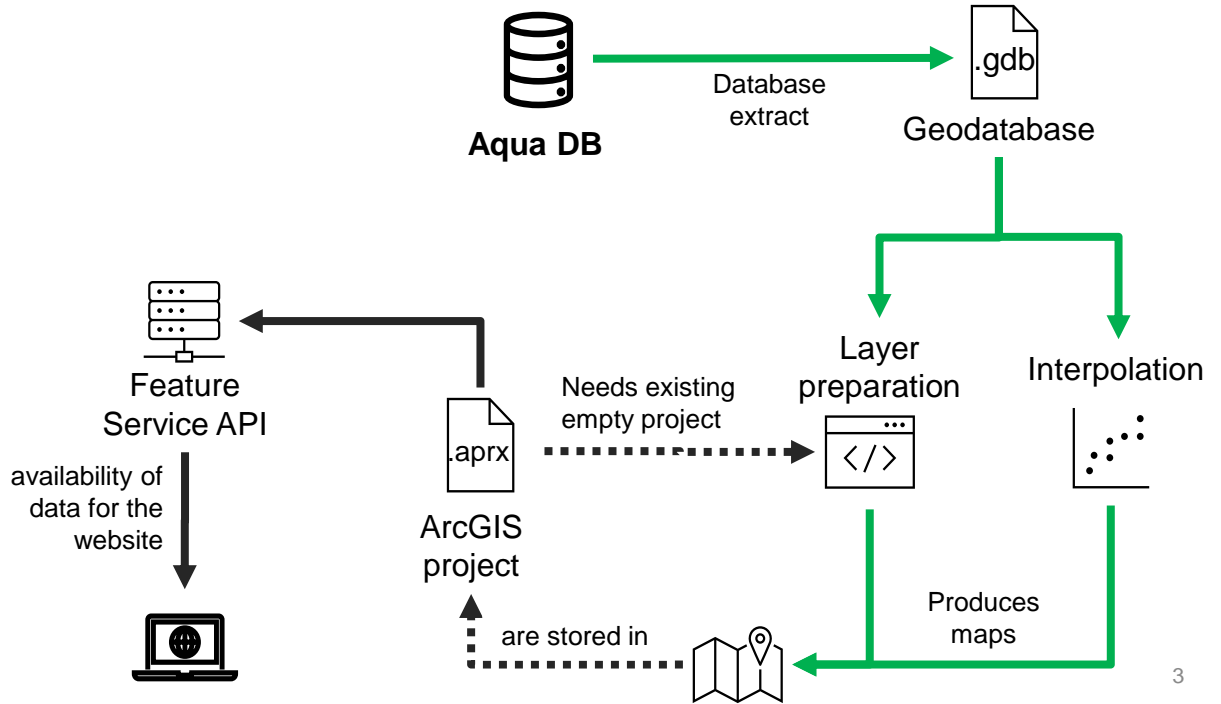
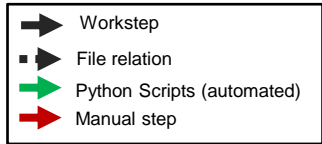


# Objectives of IsoGW

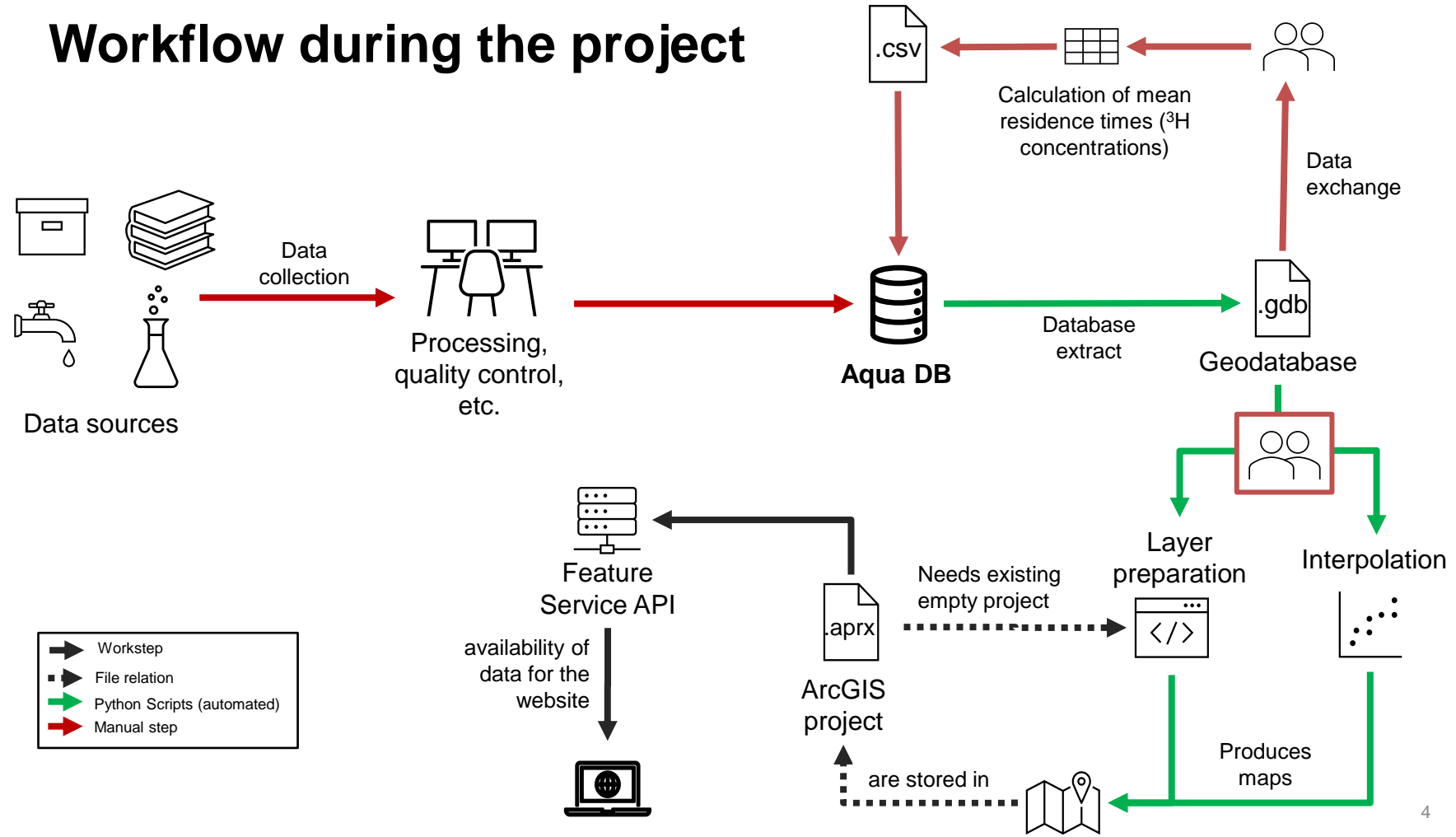
Produce a groundwater *isoscape* for Germany

- Stable water isotopes  $\delta^{18}\text{O}$ ,  $\delta^2\text{H}$  & radioactive isotope  $^3\text{H}$
- Interpolated values  $\rightarrow$  *isoscape*
  - 1st unconfined aquifer  $\rightarrow$  actively take part in the hydrological cycle
- Provide data and interpolated maps via a geoportal (BGR)
- Long-term and expandable with new data
- Isotopes in precipitation and surface waters
- Mean residence times via corrected and normalized  $^3\text{H}$  concentrations

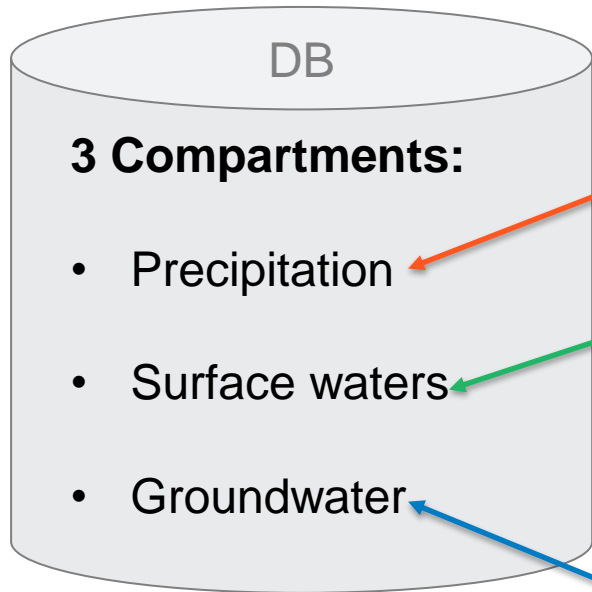
# Workflow



# Workflow during the project



# Data sources



GIN network  $\cap$  GNIP

GIN network  $\cap$  BfG

Monitoring networks

- 1) Queries at state offices
- 2) Samplings with state offices
- 3) Queries at project partners & labs
- 4) Work with other partners, e.g. drinking water suppliers

"new samplings"

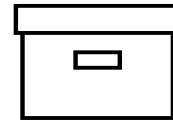
"historic data"  
"existing data"

# What data do we need?

- Good spatial point **density** and **distribution**!
- Information about:
  - Borehole/station:
    - ID
    - Coordinates
    - Type
    - Depth
    - Aquifer
  - Samples:
    - Sampling date
    - Isotope values** and **uncertainties**
    - Methods/Lab
  - Metadata:
    - Source
    - Publication/use of the data?

*Focus: 1st unconfined aquifer*

Historic data 



New samplings





# What data do we need?

- Good spatial point **density** and **distribution!**
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*Focus: 1st unconfined aquifer*

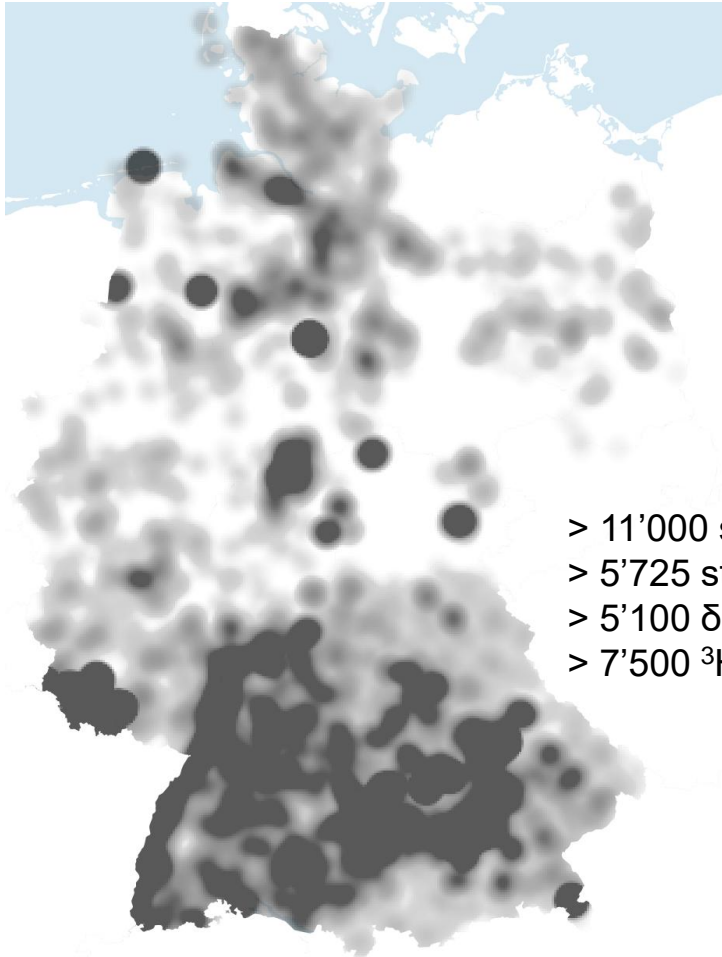
## **Challenges:**

- Finding the data/contacts
- Completeness
- Accuracy
- Format

## **Data filters and quality check**

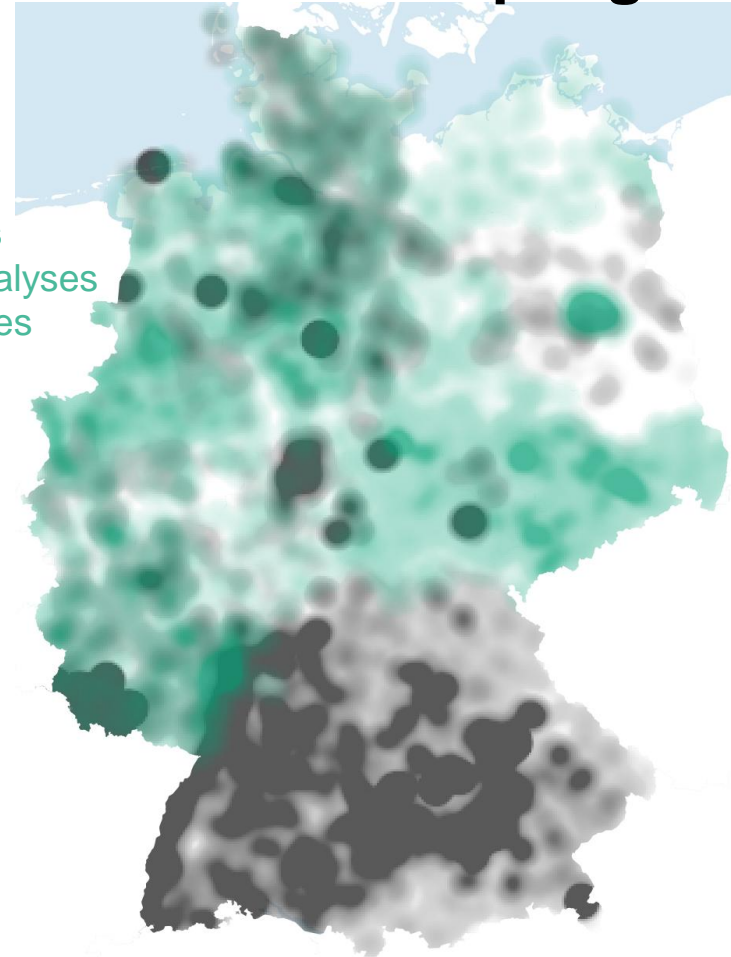
- Unify classification categories
- Positive isotope values?
- Deep groundwater?
- Time periods?

## Overview historic data



- > 11'000 samples
- > 5'725 stations
- > 5'100  $\delta^{18}\text{O}$  analyses
- > 7'500  $^3\text{H}$  analyses

## Additional samplings



- > 3'500 samples
- > 3'500  $\delta^{18}\text{O}$  analyses
- > 350  $^3\text{H}$  analyses



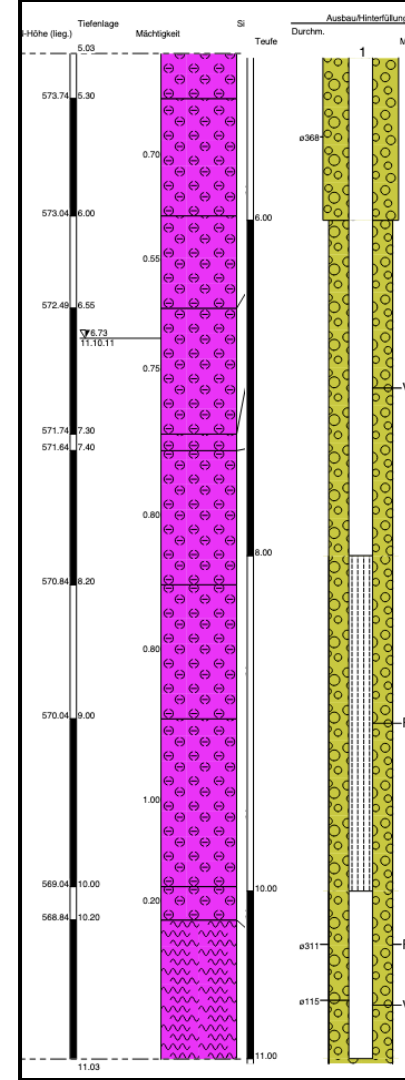
# Data filters and treatment

## Exclude deep aquifers

$^3\text{H}$  & mean residence times

Time slices

- Indicators for "surface near" groundwater
  - Depths (where provided)  $\geq 100\text{m}$
  - "Low"  $^3\text{H}$  values (where provided)
  - Often no information...
  - Aiming to minimize the loss of data






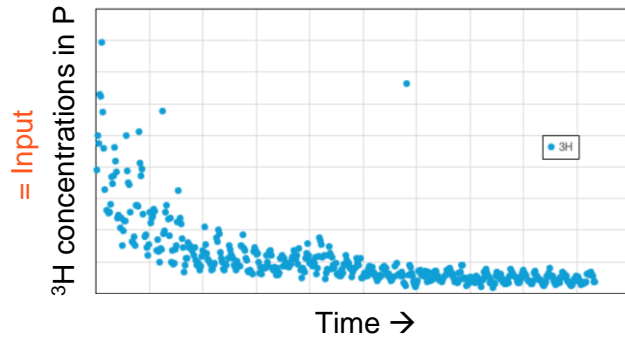
# Data filters and treatment

Exclude deep aquifers

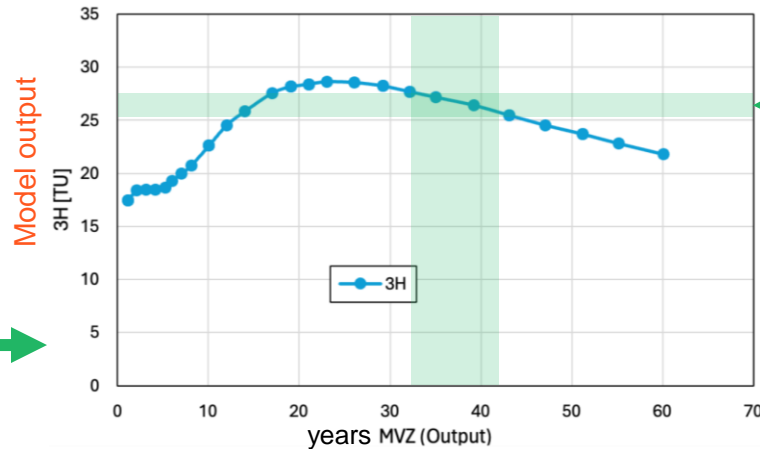
$^3\text{H}$  & mean residence times

Time slices

- Comparing  $^3\text{H}$  concentrations over time 
  - Radioactive & input concentrations change
- $^3\text{H}$  values alone don't give absolute GW age!
  - Need for a second tracer (e.g.  $\text{SF}_6$ )
- Mean residence time
  - Accounting for GW mixing
  - Young groundwaters



LPM  
(exponential model)



$^3\text{H}$  value in  
GW-station



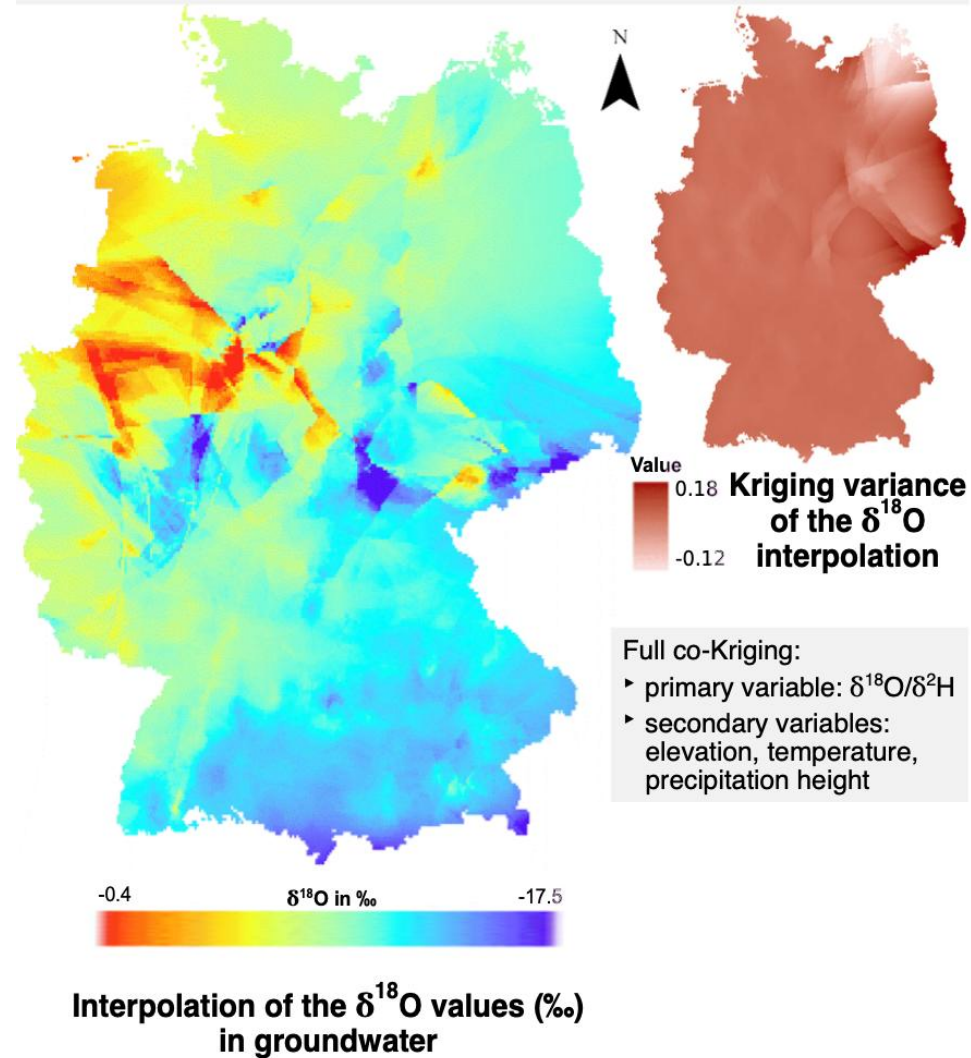
# Data filters and treatment

Exclude deep aquifers

$^3\text{H}$  & mean residence times

## Time slices

- Interpolation using all the data
  - Based on historic  $\delta^{18}\text{O}$  values
  - Data distribution not optimal
  - Completed by additional samplings
- Differentiate between time periods
  - 15 years
  - Long-term trends?
  - Identify (exclude) periods/areas with unsatisfactory data





# Data filters and treatment

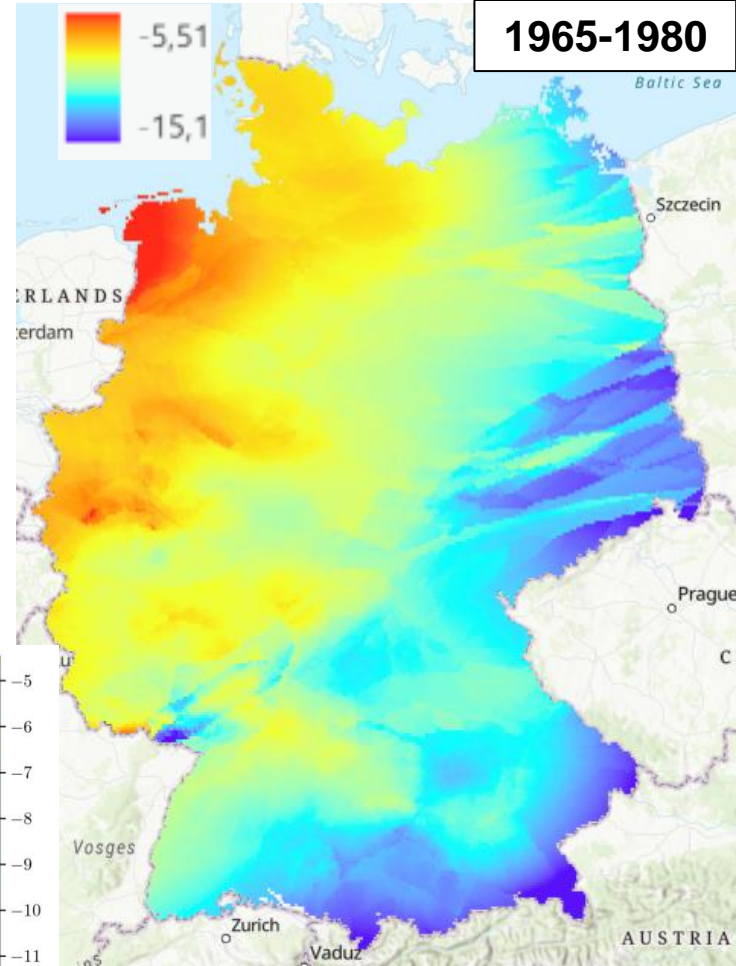
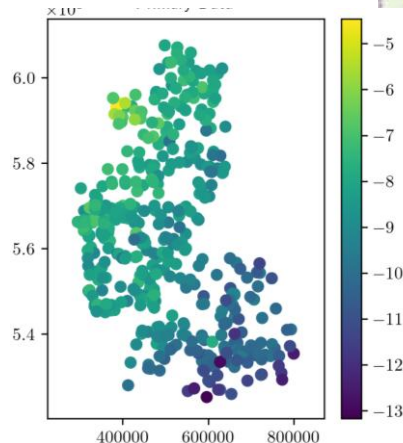
## Quality control

Exclude deep aquifers

$^3\text{H}$  & mean residence times

## Time slices

- No more changes in historic data
- Envelope/buffer for relevant regions based on point distribution
  - "Catalogue" of evolution
  - Normalisation of the scale
  - Error maps are not helpful near boundaries



## Conclusion / Discussion

- Satisfying point density and distribution are achievable!
- Regional and temporal disparities remain challenging
- Assumptions and approximations are necessary → importance of metadata!
- Now the fun starts!

- How to address seasonality?
- And long-term trends?
- Different aquifer types/geology?
- Different laboratory methods?
- 3D groundwater system?
- If you have analysed water isotopes in groundwater...
- Or you are interested in the data / the website...

**Thank you for your attention!**