# Web based river basin management with the MoRE-DE toolbox


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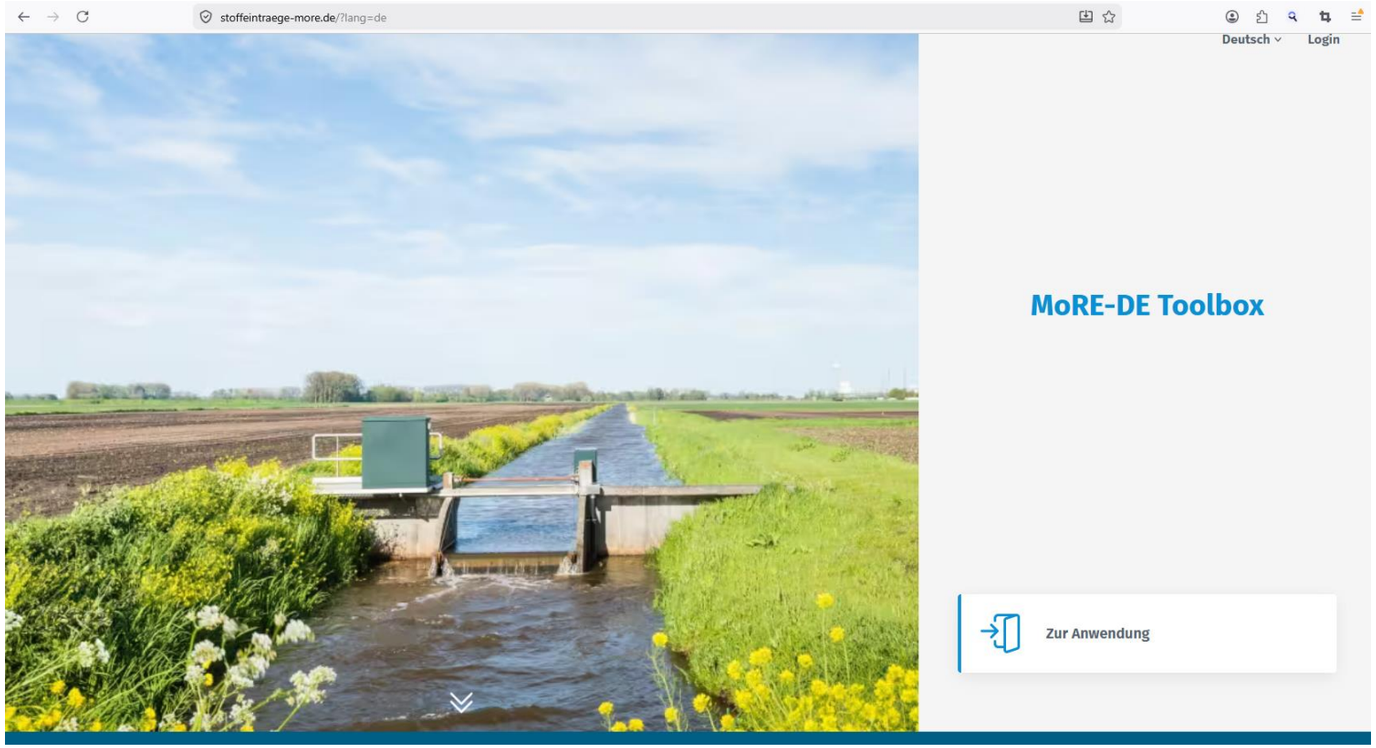
# Challenges and objectives for integrated river basin management

- Nutrients and pollutants threaten water quality in surface waters, preventing compliance with legally established environmental quality standards.
- Knowledge of relevant sources, input pathways and turnover processes is crucial for reducing diffuse and point source pollution in water bodies.
- Nutrient and pollutant levels have to be monitored and predicted.
- Mitigation options have to be derived and their effectiveness has to be assessed.

# Requirements for an integrated river basin management

- Arise from the obligation to comply with legal guidelines like
  - EU-Directive 2026/805 (“Water Package”)
  - EU Urban Wastewater Treatment Directive (2024/3019, UWWTD)
- Have to be fulfilled by a cross-scale analysis in space and time
- Needs intelligent model instruments to predict nutrient and pollutant levels
- Needs suitable interactive tools for dynamically linking the available information
- Needs user friendly webbased systems to provide experts, decision-makers and the public with relevant information
- Interoperable systems minimise data losses and errors and simplify data transfers

# MoRE-DE- Toolbox as an interactive, web based and interoperable system for an integrated river basin management.

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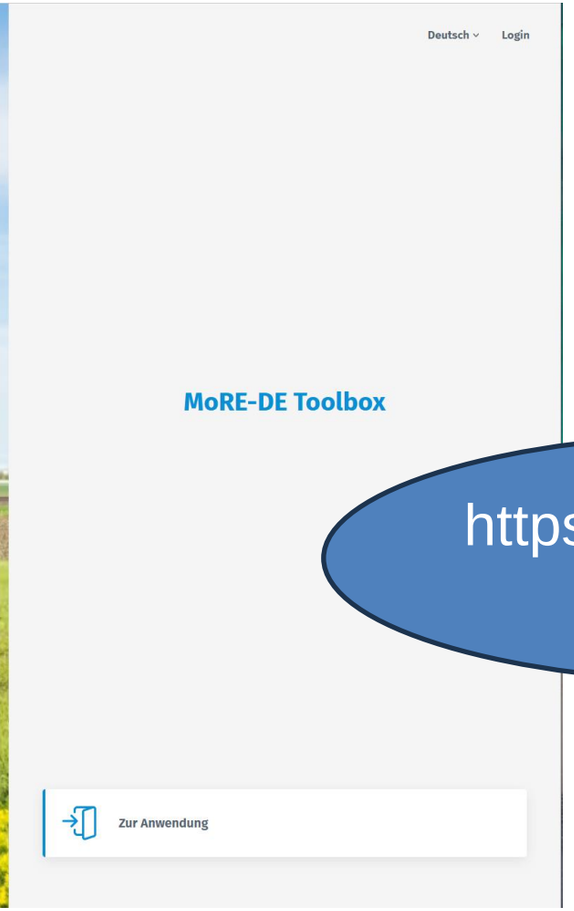


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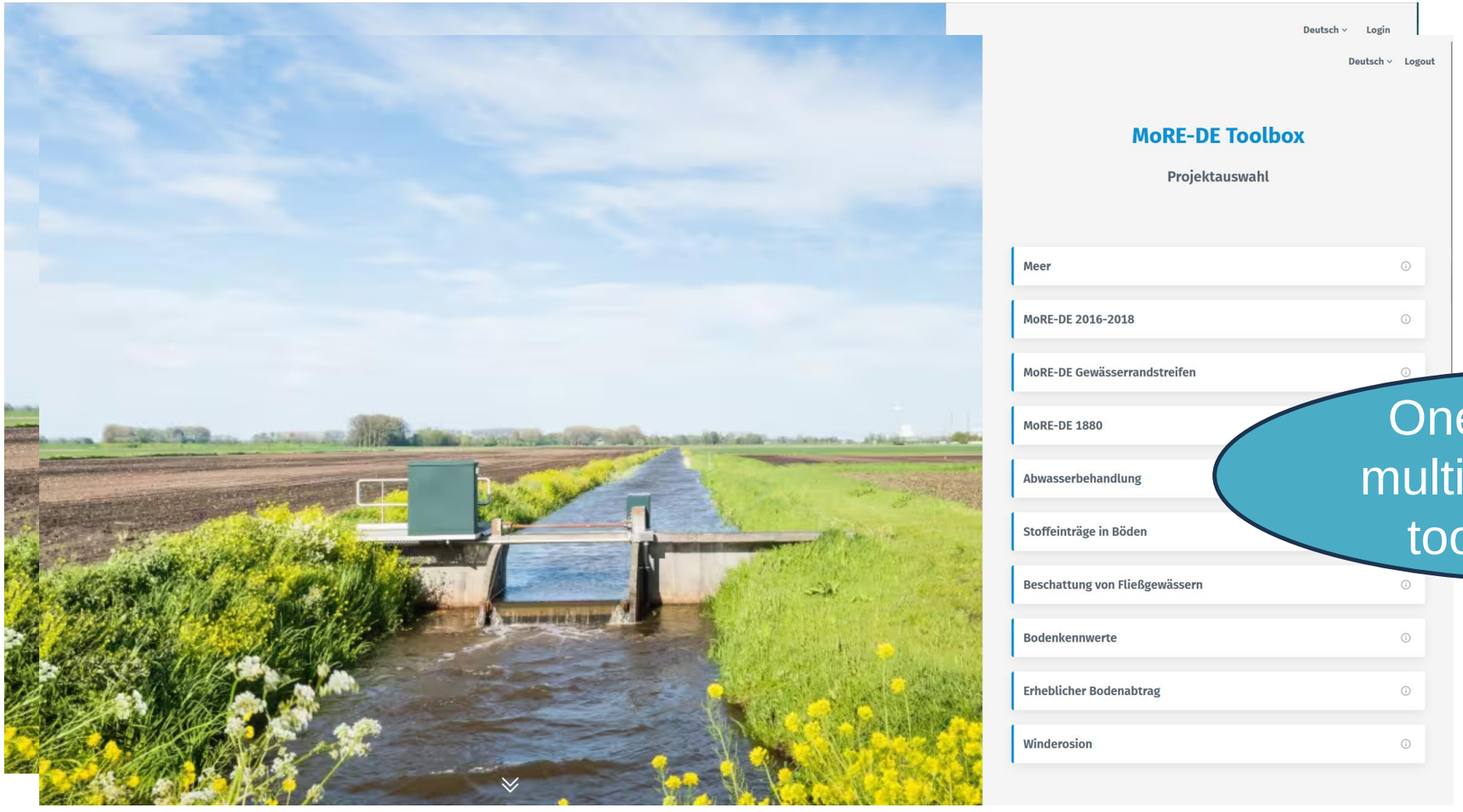
# Mouse click: selection of available tools / projects




One application, multiple decoupled tools / projects

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Pollutant, nutrient and sediment input into surface waters

Mean soil data resampled from BÜK200

Soil losses induced by water and wind erosion

Pollutants in soils


LARSIM-ME Runoff

Shadowing of watercourses

Extended applications

Urban wastewater treatment planning

Coupled emission-and-immission approach

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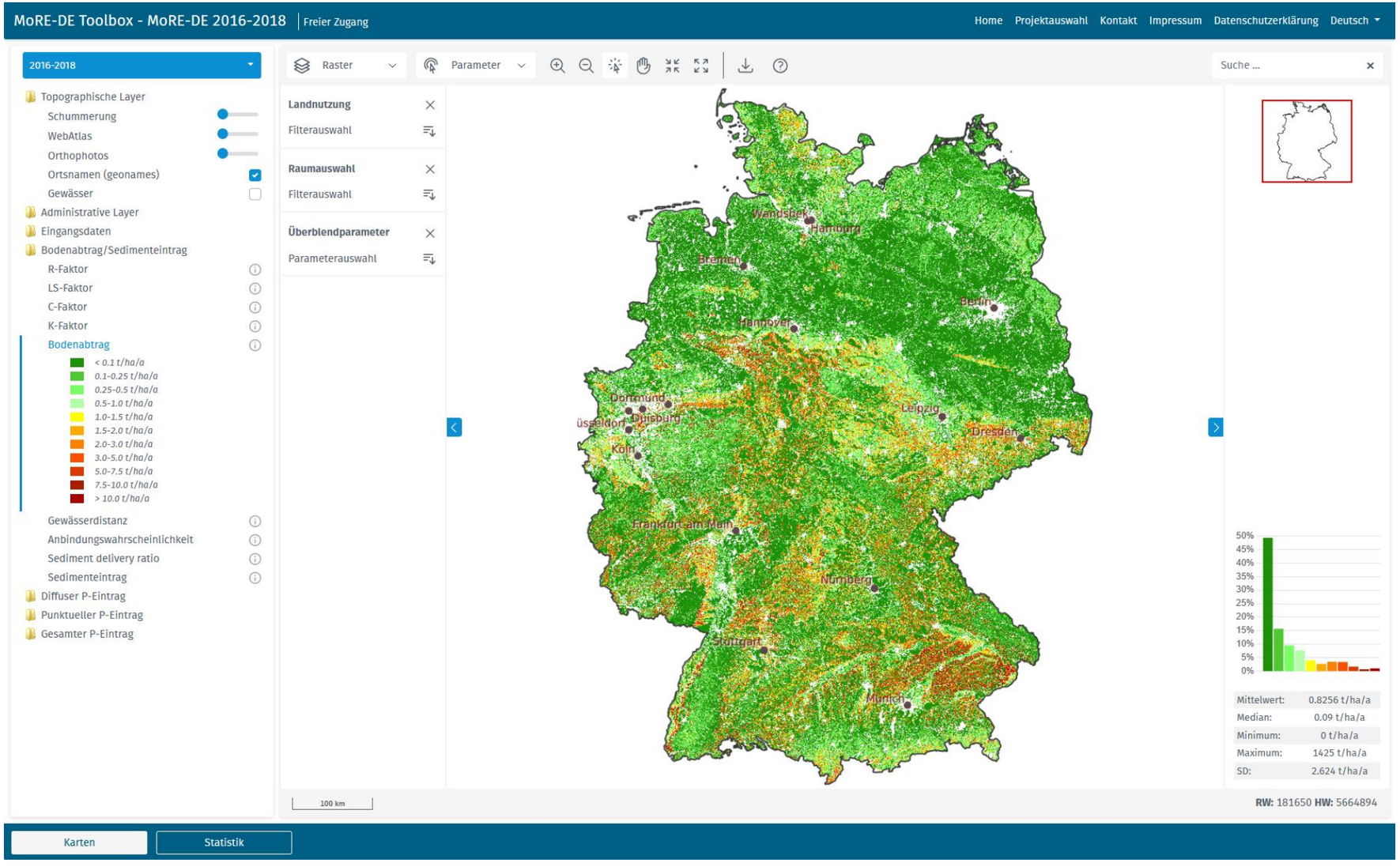
Mouse click on project → different map themes can be selected




Multi-demensional data

Topological relations-ships

Maps and statistics on the fly

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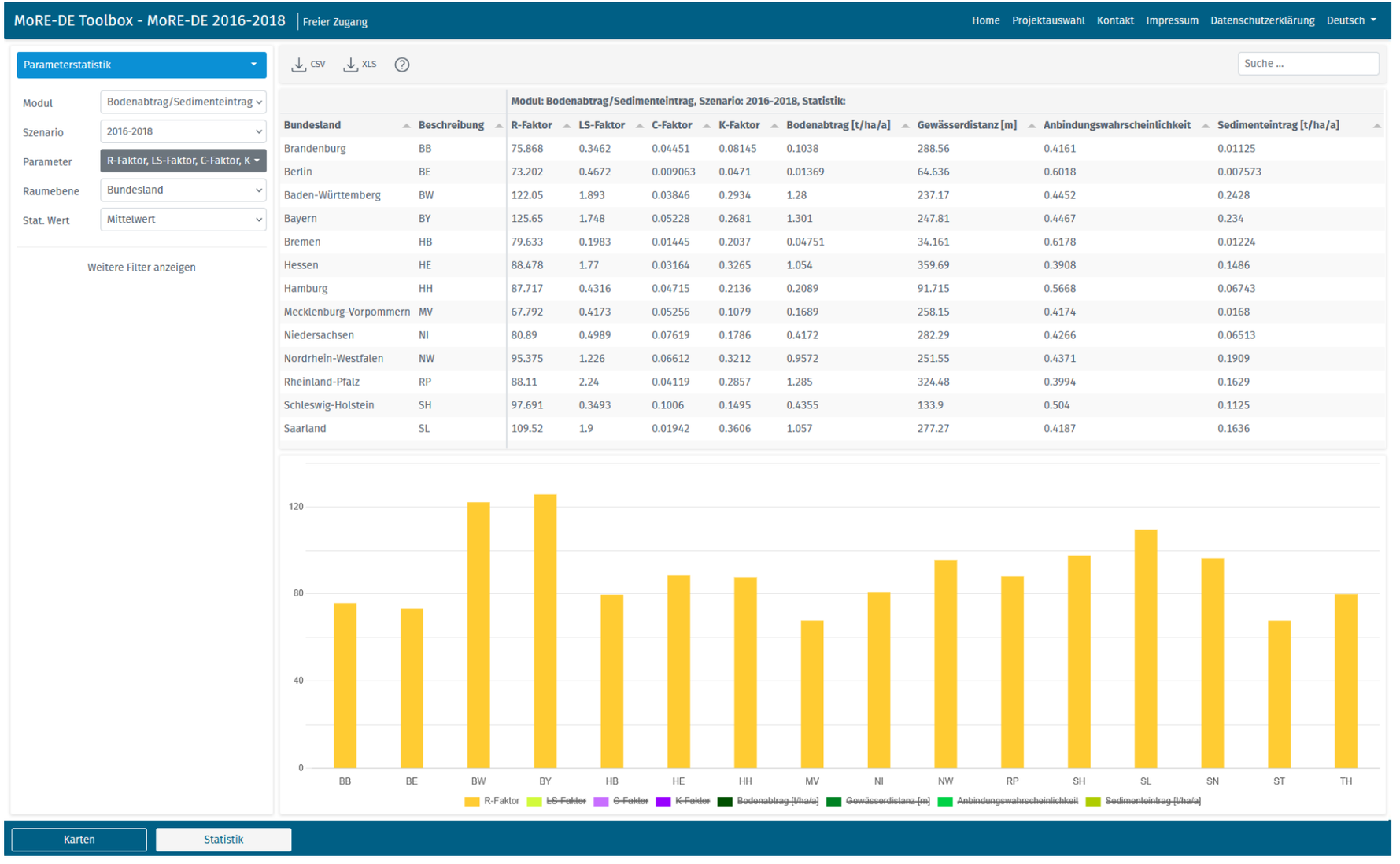
# Mouse click on statistics: statistical analysis by user selected tables and charts

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# Some basic features of the MoRE-DE-Toolbox

- High resolution of raster layers (1 m to 10 m)
- Grid-based land use (based on ATKIS-DLM) and soil data (based on BÜK200)
- Embedded filters for land use and spatial units
- Overlay function for two selected themes can be used seamlessly
- Full aggregation across other spatial (e. g. administrative) units is possible
- Aerial photographs and topographical maps can be displayed seamlessly
- All parameters include a description and a citation reference
- Download is possible for most of the themes in every given aggregation as SHP-file, Geotiff, xlsx-, csv-file
- Statistics are presented on the fly in form of tables and charts
- Scenario statistic allows to compare different scenarios

# A brief reference on technical aspects

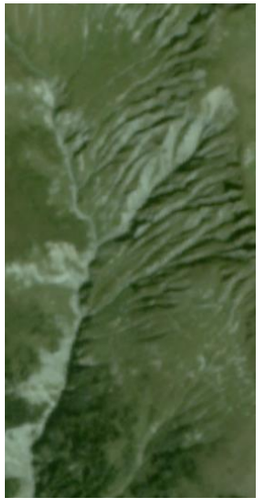
- Implementation uses the developer friendly Python framework Django
- Containerisation with Docker (application is capsulated / separated from operating system).
- Class-based JavaScript is used for the frontend programming.
- Project management uses OpenProject
- Automated deployment pipelines for the effective roll-out of the system.
- Automated end-point tests are based on the Apache airflow workflow management system (identifies errors or inconsistencies at an early stage).
- Large amounts of data (~TB) generated in a 1 or 10 m grid are converted into powerful column-oriented data formats and processed using automated ETL processes.
- Leads to significant improvements in processing time (performance) and a correspondingly good usability.

# Operating environment

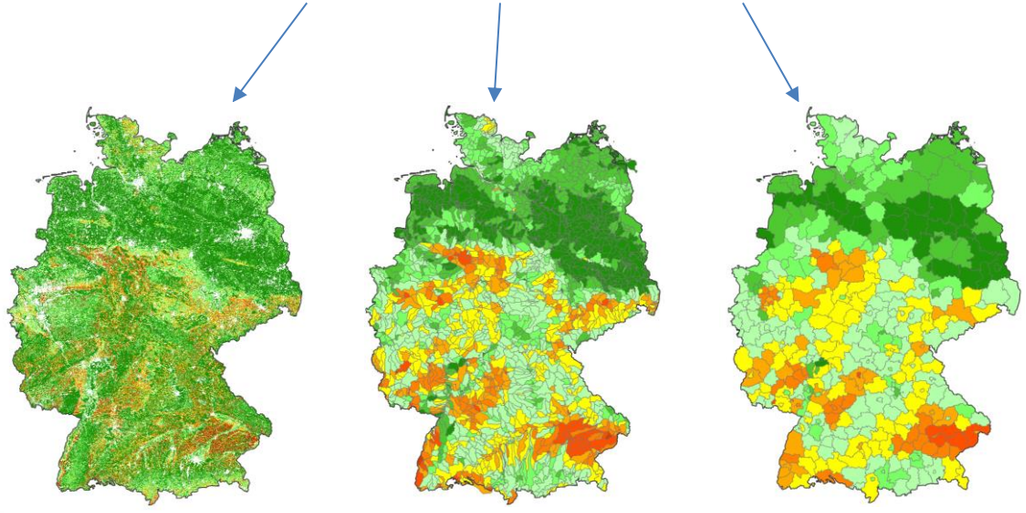
- Development, testing, integration and production environments
- Mirrored web servers
- High-performance hardware for handling large volumes of data
- Load balancers distribute the load and ensure reliability
- Graphics cards are used for complex pre-processing tasks (e.g. wind erosion, shading of water bodies)

# Important user-specific benefits so far

- High-resolution visualisation
- Validation and plausibility check
- Full data download (geotiff, SHP, XLSX, CSV)
- Automated analysis of data and model results
- Cross-scale analysis / automated aggregation




| | Modul: Bodenabtrag/Sedimenteintrag, Szenario: Meer MF, Statistik: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Land | Gewässerdistanz [m] | R-Faktor | K-Faktor | LS-Faktor | C-Faktor | Bodenabtrag [t/ha/a] | Anbindungswahrscheinlichkeit | Sediment delivery ratio |
| Austria | 718.88 | 90.189 | 0.3424 | 11.326 | 0.06397 | 19.968 | 0.3576 | 0.0467 |
| Belgium | 508.59 | 65.962 | 0.4759 | 1.639 | 0.07574 | 1.184 | 0.1755 | 0.08231 |
| Czechia | 466.27 | 53.927 | 0.3695 | 1.835 | 0.05929 | 1.09 | 0.2236 | 0.09691 |
| Denmark | 159.38 | 52.65 | 0.1977 | 0.2126 | 0.1322 | 0.286 | 0.336 | 0.1693 |
| France | 670.22 | 55.712 | 0.3923 | 2.005 | 0.06063 | 0.9332 | 0.1745 | 0.07247 |
| Germany | 481.64 | 51.171 | 0.3276 | 1.466 | 0.067 | 0.6783 | 0.1773 | 0.06477 |
| Liechtenstein | 561.72 | 95.815 | 0.3632 | 11.277 | 0.08153 | 9.162 | 0.4052 | 0.05709 |
| Luxembourg | 340.13 | 67.429 | 0.4327 | 2.549 | 0.06655 | 2.205 | 0.2525 | 0.08073 |
| Netherlands | 74.713 | 46.349 | 0.2475 | 0.1539 | 0.1337 | 0.1354 | 0.1311 | 0.2786 |
| Poland | 419.2 | 46.95 | 0.2466 | 0.464 | 0.07473 | 0.3491 | 0.1807 | 0.09128 |



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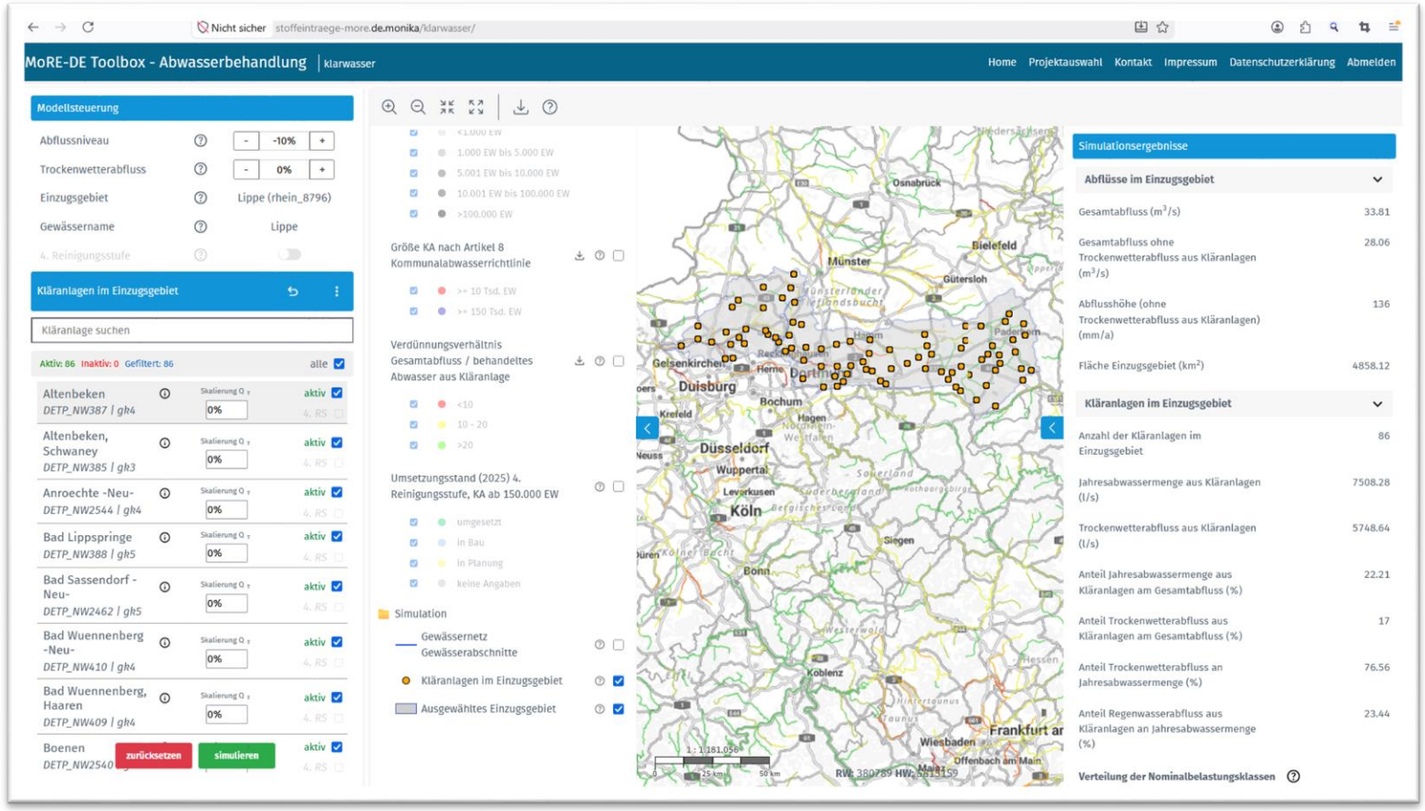
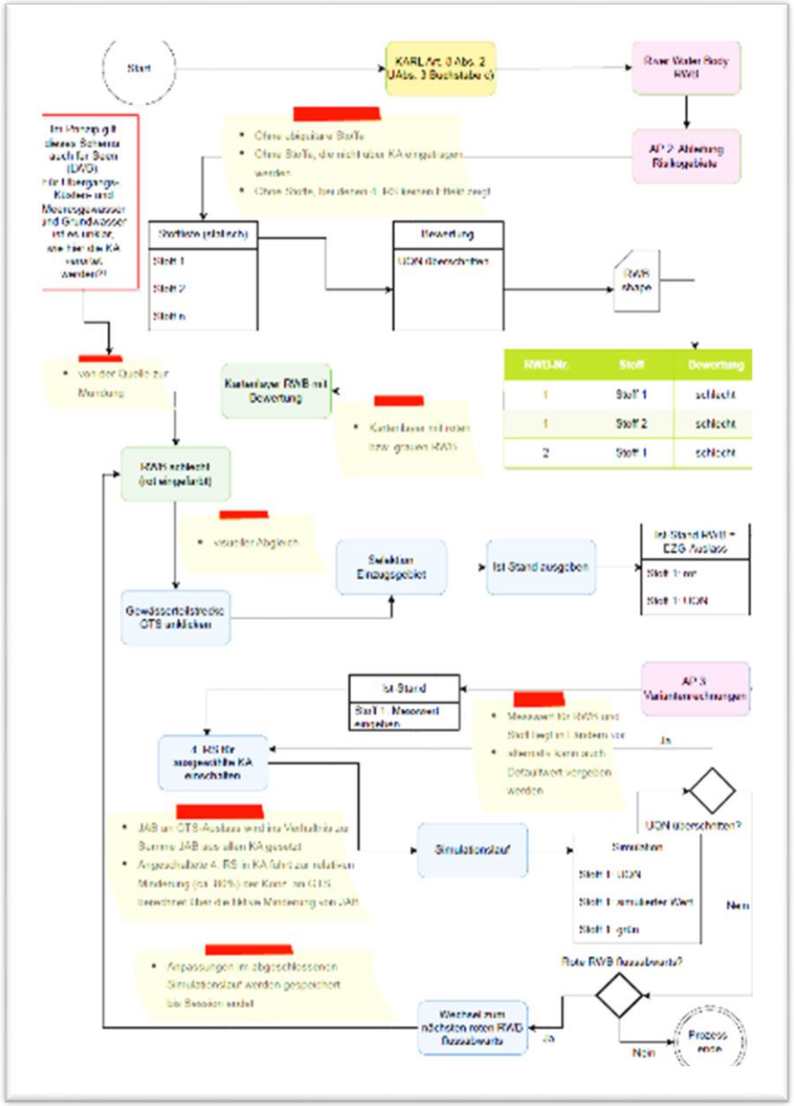
# Extended application for stakeholders (under development)

- MoRE-DE-Toolbox – Waste water treatment planning
- Takes the step from a static evaluation system to a dynamic and interactive working tool
- Helps to fulfill the requirements of the EU Urban Wastewater Treatment Directive (2024/3019, UWWTD, Art. 8 Quarternary treatment)
- Supports the risk assessment and planning of a quaternary treatment of sewage treatment plants serving population equivalents of over 10.000 in high-risk areas in Germany

# The application serves as a tool to manage the complex workflow behind

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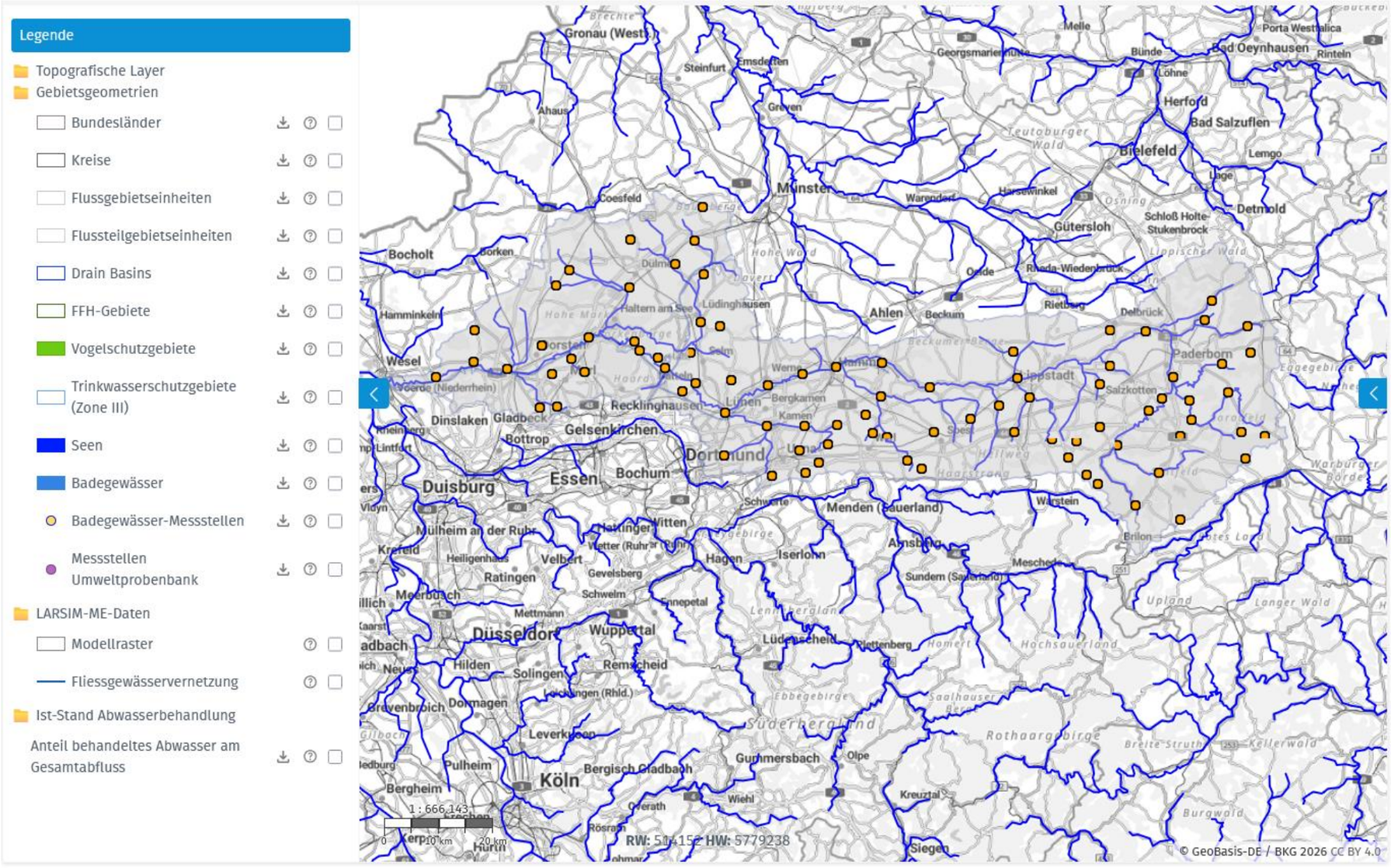
# Key essential features

- Routed river network to derive catchment areas with UWWT plants for each given river section

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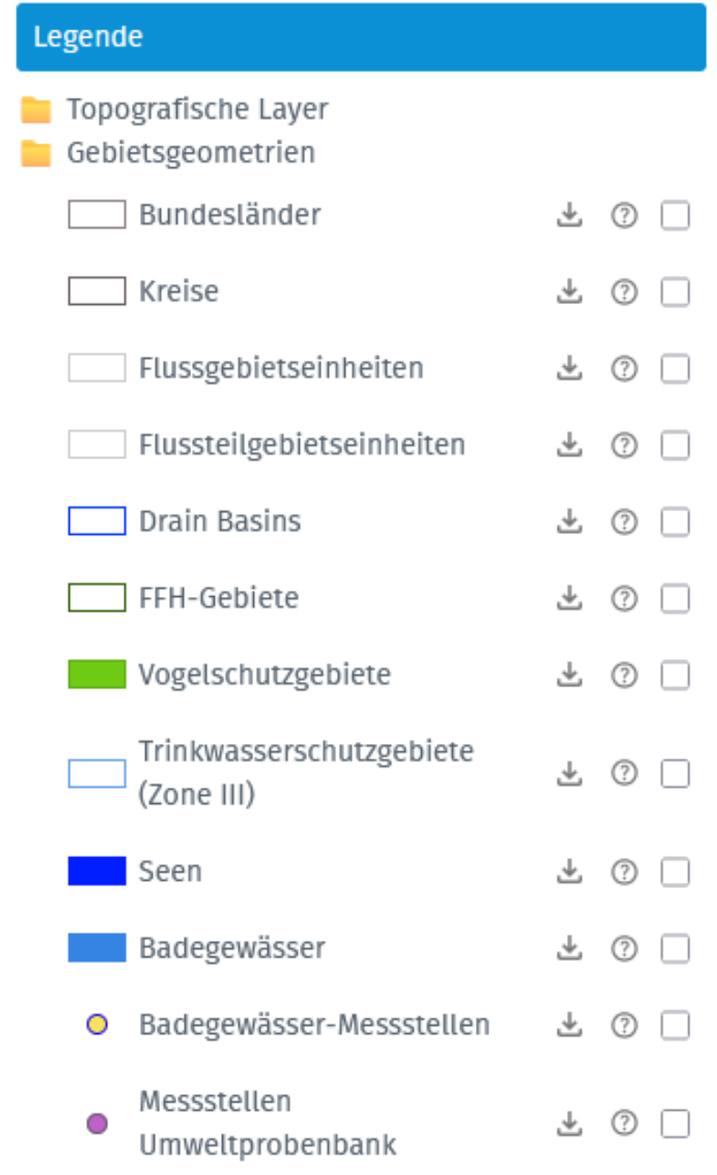
# Key essential features

- Integration of relevant geometries for UWWTD
  - Catchment areas for abstraction points of water intended for human consumption
  - Bathing waters
  - Areas where aquaculture activities take place
  - Lakes
  - Rivers / rivers with a dilution ratio below 10
  - Areas where additional treatment is necessary to meet the requirements set out in Directives 2000/60/EC, 2006/118/EC and 2008/105/EC
  - Special areas of conservation and special protection areas
  - Coastal waters
  - Transitional waters
  - Marine waters

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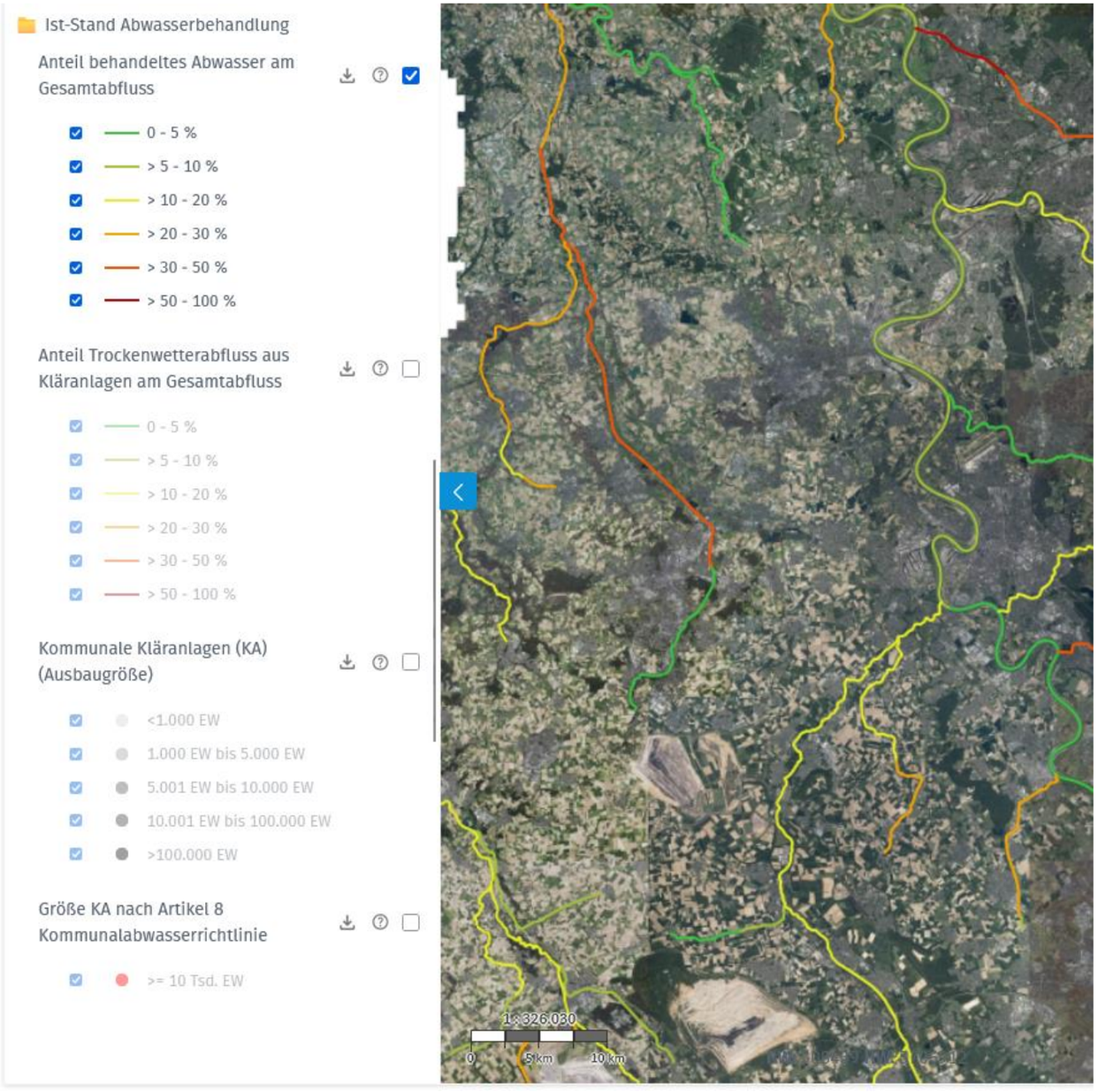
# Key essential features

- Integration of wastewater-specific input data and model results
  - Proportion of wastewater in total discharge for each river section / Dilution ratio
  - Location and capacity of municipal wastewater treatment plants
  - Dilution ratios for each municipal wastewater treatment plant of 10.000 p. e. and above

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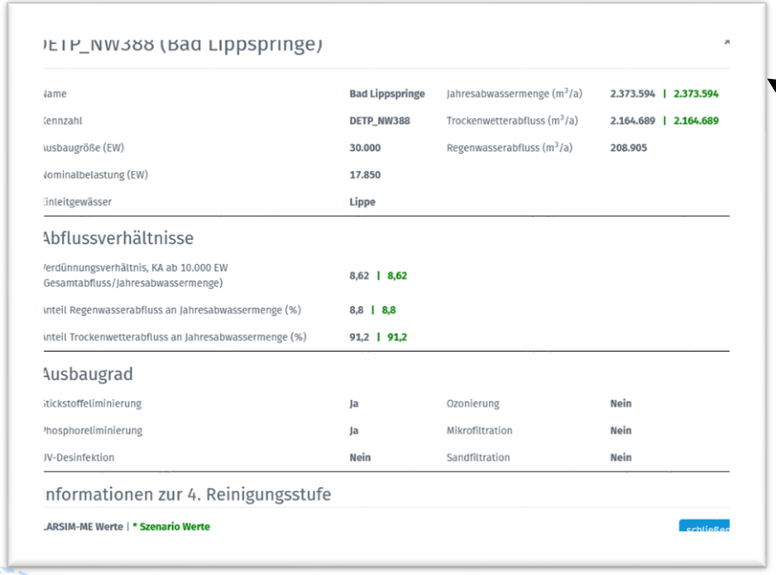
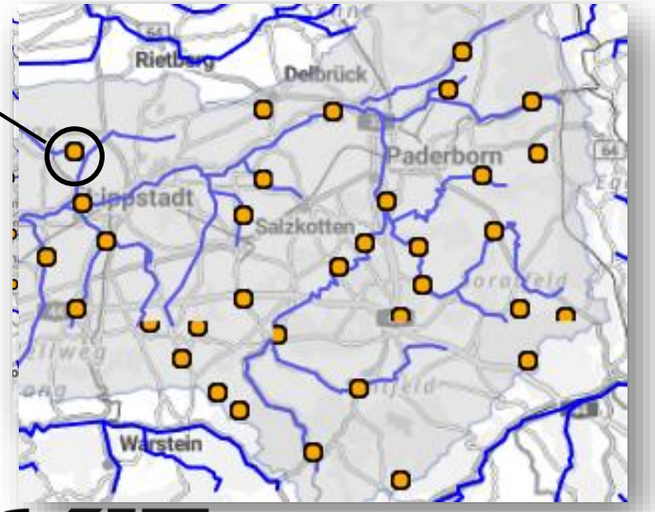
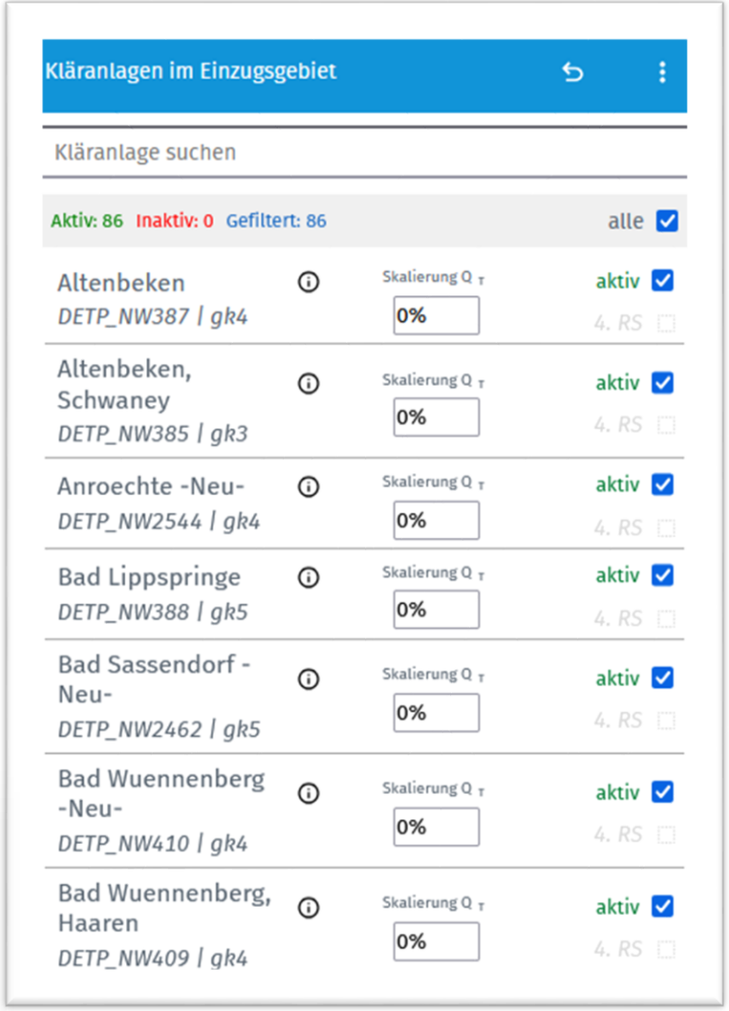
# Key essential features

- Generation of a list of sewage treatment plants for a selected catchment area
- Individual control of the sewage treatment plant and adjusting of the treatment capacity

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# Features that need to be implemented

- Conducting simulation runs for selected catchment areas to assess compliance with environmental quality standards for selected pollutants
  - Consideration of long-term total runoff in rivers
  - Consideration of measured or modelled concentrations of pollutants in sewage treatment plant effluents
  - Checking for exceedances of the environmental quality standards for each pollutant
  - Analysis of the effects of implementing the quarternary treatment to reach the environmental quality standards for each pollutant
  - Optimisation of the quarternary treatment implementation in a given catchment area in space to fulfill the requirements of the EU Urban Wastewater Treatment Directive in the given timeline

# Final conclusion

- In the field of river basin management web-based systems are a useful, and in many cases indispensable tool for
  - supporting the production of results to support river basin management (e.g. modelling) and
  - facilitating their transfer into planning and practical implementation.

# Thanks a lot

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https://visdat.de
https://iwu.kit.edu/wg/index.php
https://umweltbundesamt.de

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