

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



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## MoRE-DE Toolbox

Projektauswahl

- Meer ⓘ
- MoRE-DE 2016-2018 ⓘ
- MoRE-DE Gewässerrandstreifen ⓘ
- MoRE-DE 1880 ⓘ
- Abwasserbehandlung ⓘ

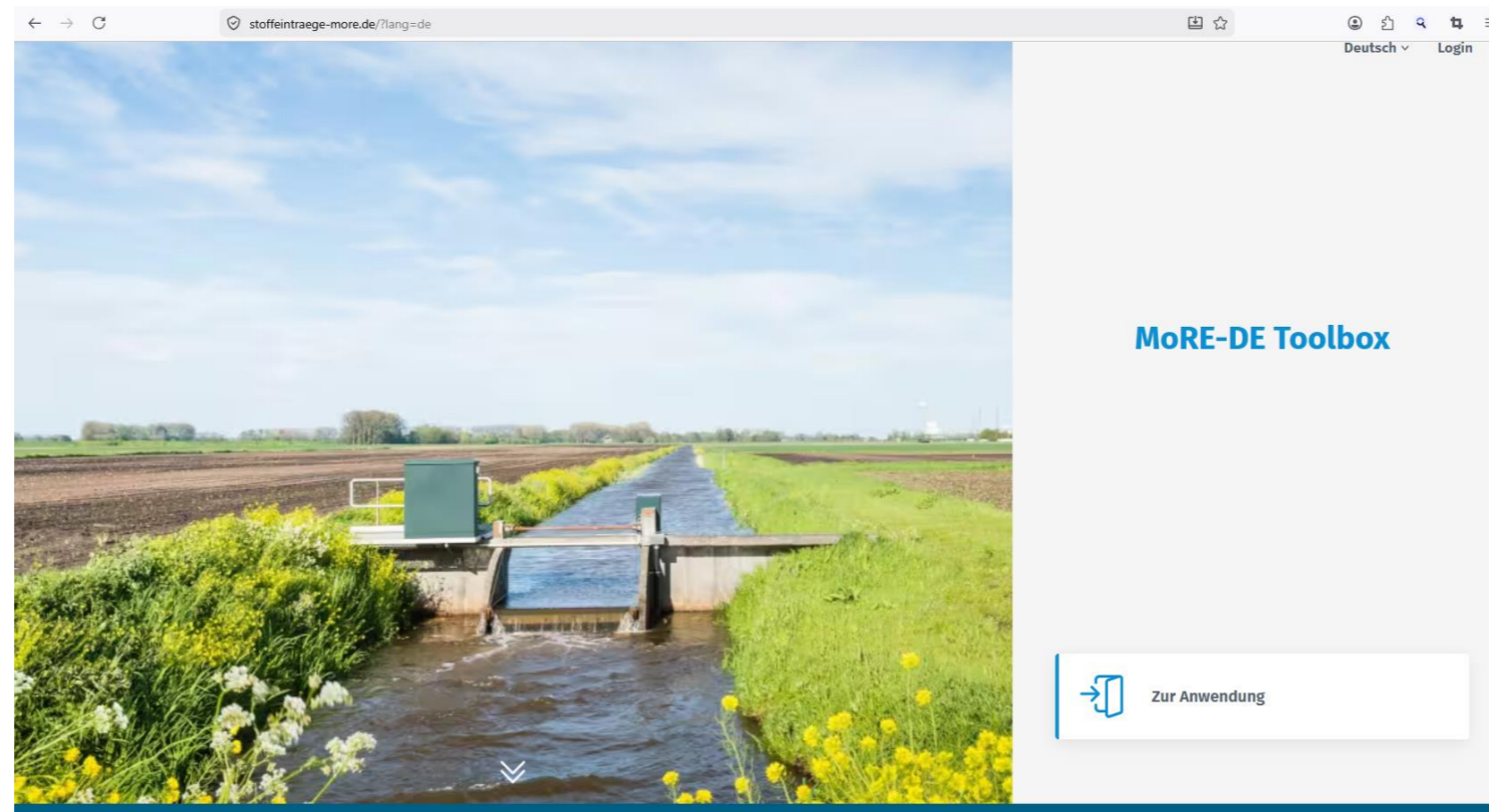
# Challenges and objectives for integrated river basin management

- 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.





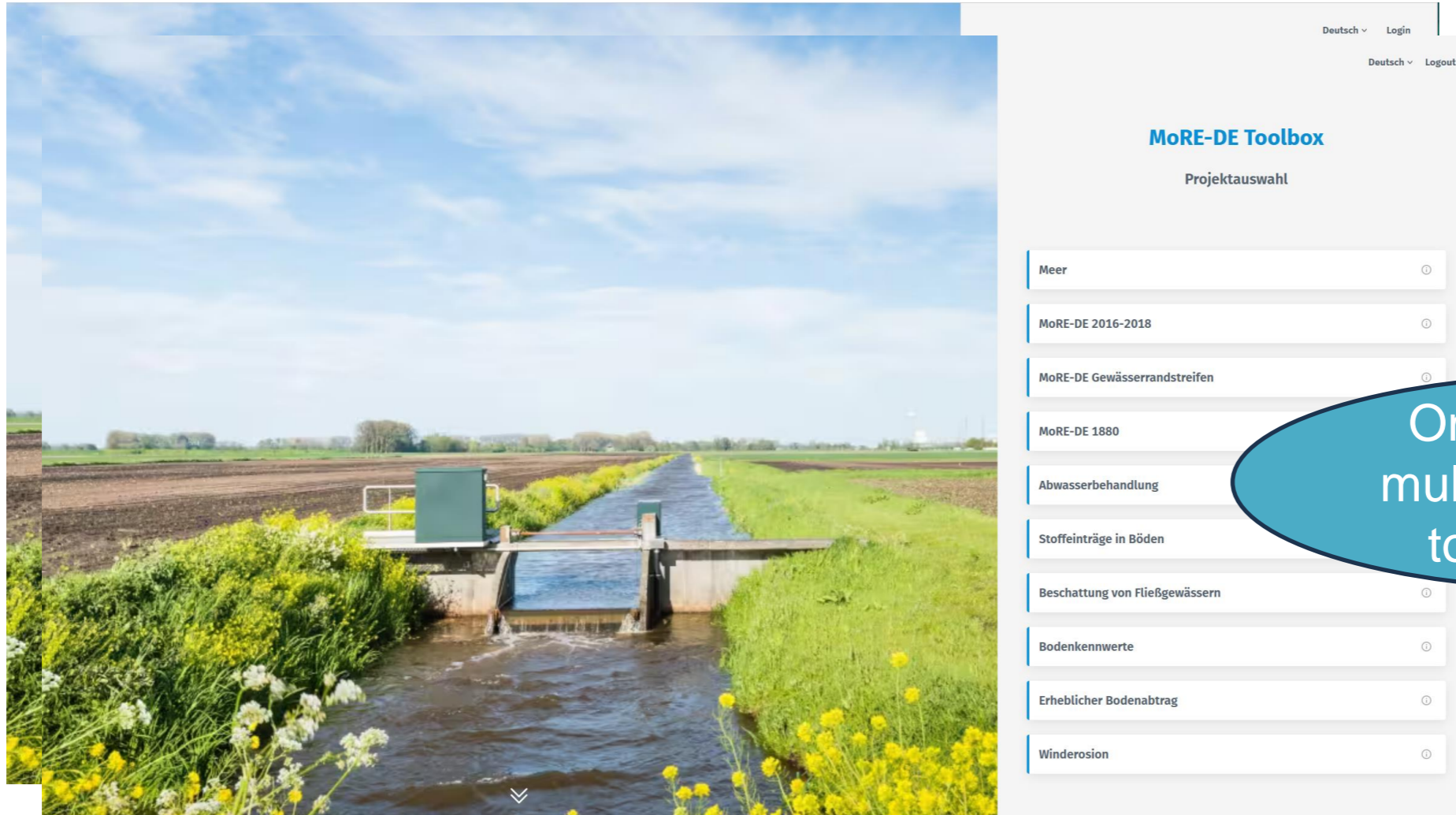
MoRE-DE Toolbox

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<https://stoffeintraege-more.de>

 Zur Anwendung

Mouse click: selection of available tools / projects



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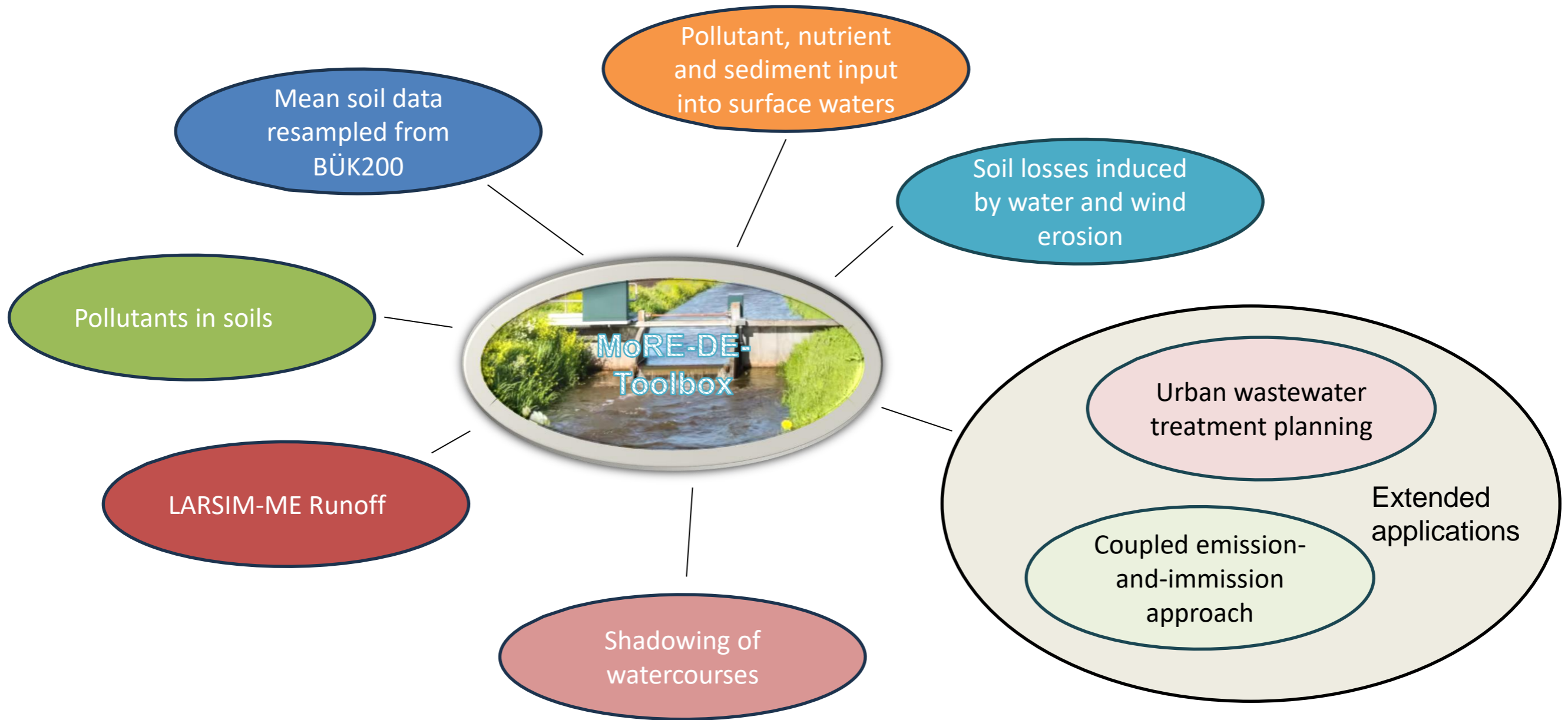
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### MoRE-DE Toolbox

Projektauswahl

- Meer
- MoRE-DE 2016-2018
- MoRE-DE Gewässerrandstreifen
- MoRE-DE 1880
- Abwasserbehandlung
- Stoffeinträge in Böden
- Beschattung von Fließgewässern
- Bodenkennwerte
- Erheblicher Bodenabtrag
- Winderosion

One application,  
multiple decoupled  
tools / projects



Mouse click on project → different **map** themes can be selected

The screenshot shows the MoRE-DE Toolbox interface for the 2016-2018 period. The main map displays sediment load data across Germany, color-coded from green (low) to red (high). Major cities like Hamburg, Berlin, Frankfurt, and Munich are labeled. A legend on the left lists various layers, with 'Bodenabtrag' (soil erosion) selected. A histogram on the right shows the distribution of sediment load, with a table of statistics below it.

Mittelwert:	0.8256 t/ha/a
Median:	0.09 t/ha/a
Minimum:	0 t/ha/a
Maximum:	1425 t/ha/a
SD:	2.624 t/ha/a

Additional statistics shown: RW: 181650 HW: 5664894

Multi-dimensional data

Topological relationships

Maps and statistics on the fly

# Mouse click on [statistics](#): statistical analysis by user selected tables and charts

MoRE-DE Toolbox - MoRE-DE 2016-2018 | Freier Zugang Home Projektauswahl Kontakt Impressum Datenschutzerklärung Deutsch ▾

Parameterstatistik Suche ...

Modul: Bodenabtrag/Sedimenteintrag

Szenario: 2016-2018

Parameter: R-Faktor, LS-Faktor, C-Faktor, K

Raumbene: Bundesland

Stat. Wert: Mittelwert

Weitere Filter anzeigen

Bundesland	Beschreibung	R-Faktor	LS-Faktor	C-Faktor	K-Faktor	Bodenabtrag [t/ha/a]	Gewässerdistanz [m]	Anbindungswahrscheinlichkeit	Sedimenteintrag [t/ha/a]
Brandenburg	BB	75.868	0.3462	0.04451	0.08145	0.1038	288.56	0.4161	0.01125
Berlin	BE	73.202	0.4672	0.009063	0.0471	0.01369	64.636	0.6018	0.007573
Baden-Württemberg	BW	122.05	1.893	0.03846	0.2934	1.28	237.17	0.4452	0.2428
Bayern	BY	125.65	1.748	0.05228	0.2681	1.301	247.81	0.4467	0.234
Bremen	HB	79.633	0.1983	0.01445	0.2037	0.04751	34.161	0.6178	0.01224
Hessen	HE	88.478	1.77	0.03164	0.3265	1.054	359.69	0.3908	0.1486
Hamburg	HH	87.717	0.4316	0.04715	0.2136	0.2089	91.715	0.5668	0.06743
Mecklenburg-Vorpommern	MV	67.792	0.4173	0.05256	0.1079	0.1689	258.15	0.4174	0.0168
Niedersachsen	NI	80.89	0.4989	0.07619	0.1786	0.4172	282.29	0.4266	0.06513
Nordrhein-Westfalen	NW	95.375	1.226	0.06612	0.3212	0.9572	251.55	0.4371	0.1909
Rheinland-Pfalz	RP	88.11	2.24	0.04119	0.2857	1.285	324.48	0.3994	0.1629
Schleswig-Holstein	SH	97.691	0.3493	0.1006	0.1495	0.4355	133.9	0.504	0.1125
Saarland	SL	109.52	1.9	0.01942	0.3606	1.057	277.27	0.4187	0.1636

Legend: R-Faktor (orange), LS-Faktor (light green), C-Faktor (purple), K-Faktor (dark purple), Bodenabtrag [t/ha/a] (dark green), Gewässerdistanz [m] (green), Anbindungswahrscheinlichkeit (light green), Sedimenteintrag [t/ha/a] (yellow-green)

Karten | Statistik

# 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

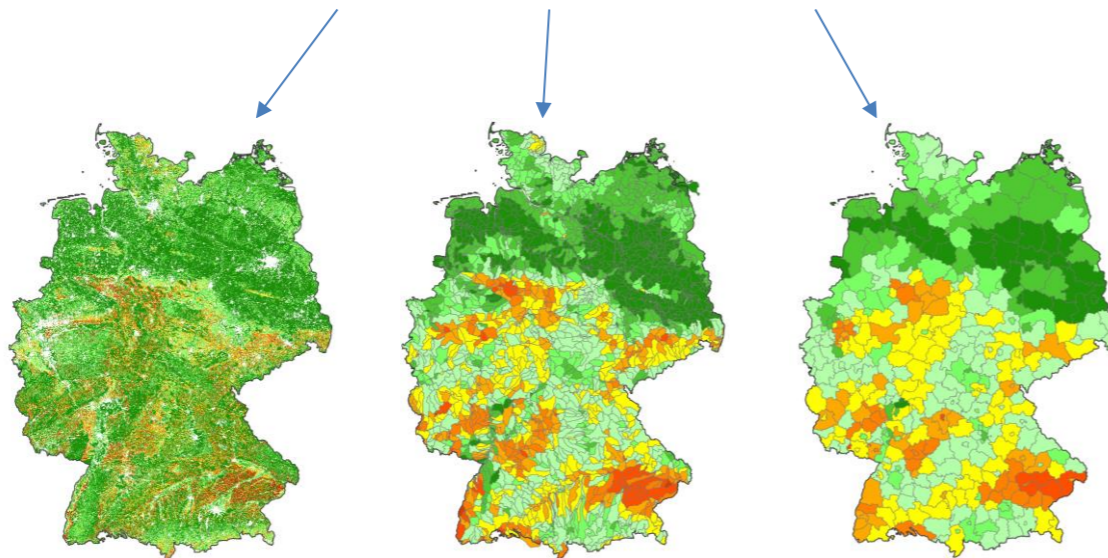
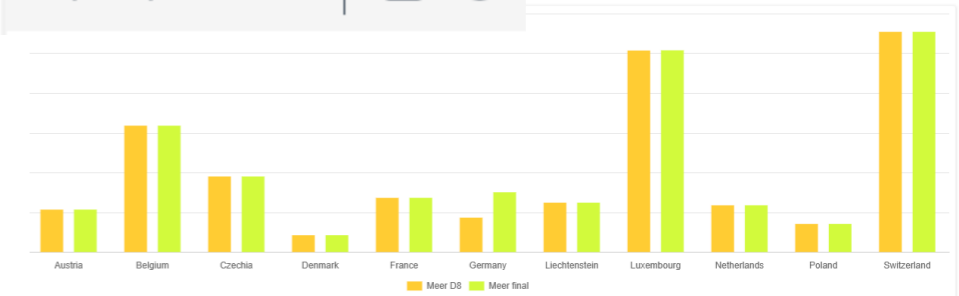
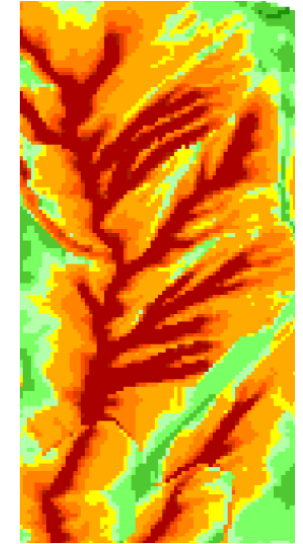
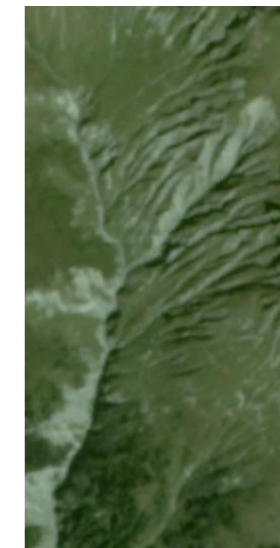
- Implementation uses the developer friendly Python framework [Django](#)
- Containerisation with [Docker](#) (application is capsulated / separated from operating system).
- Class-based [JavaScript](#) is used for the frontend programming.
- Project management uses [OpenProject](#)
- Automated [deployment 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**

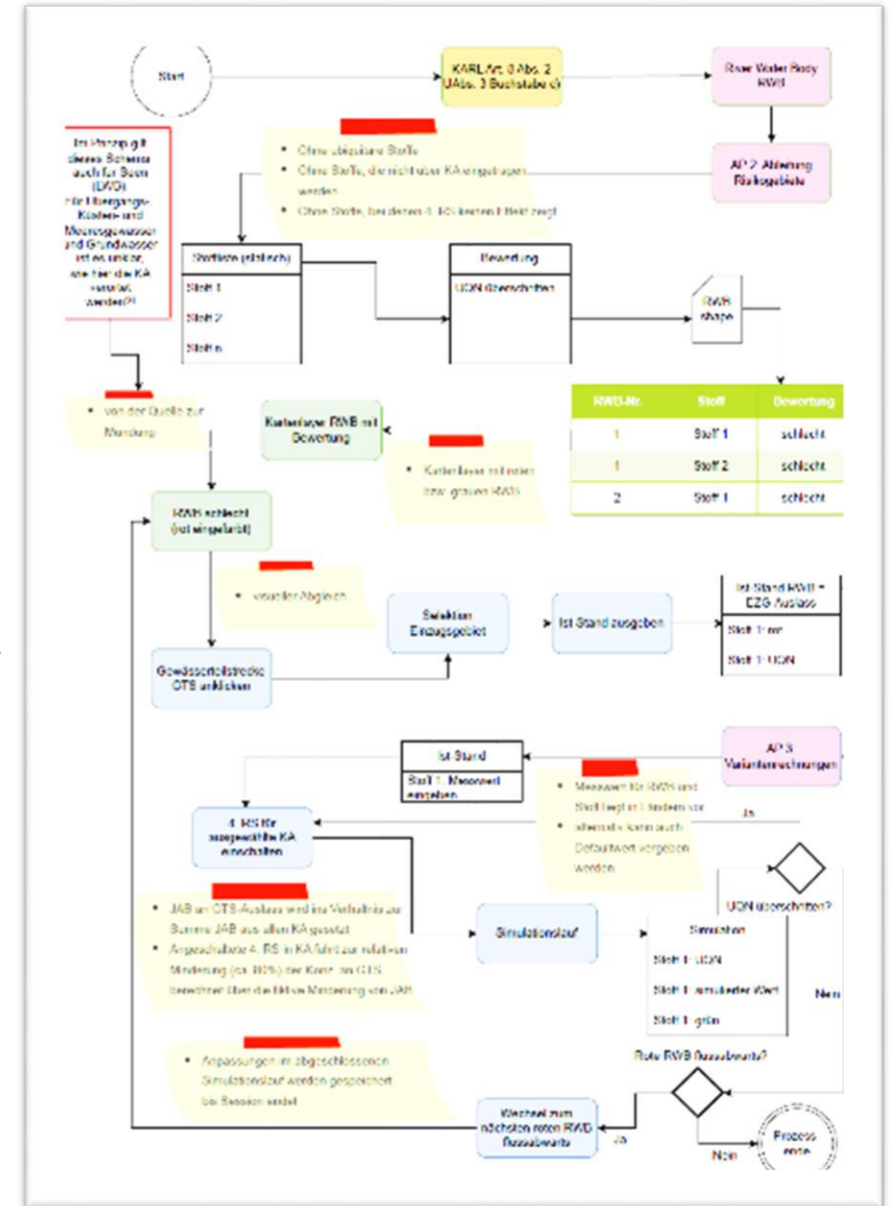
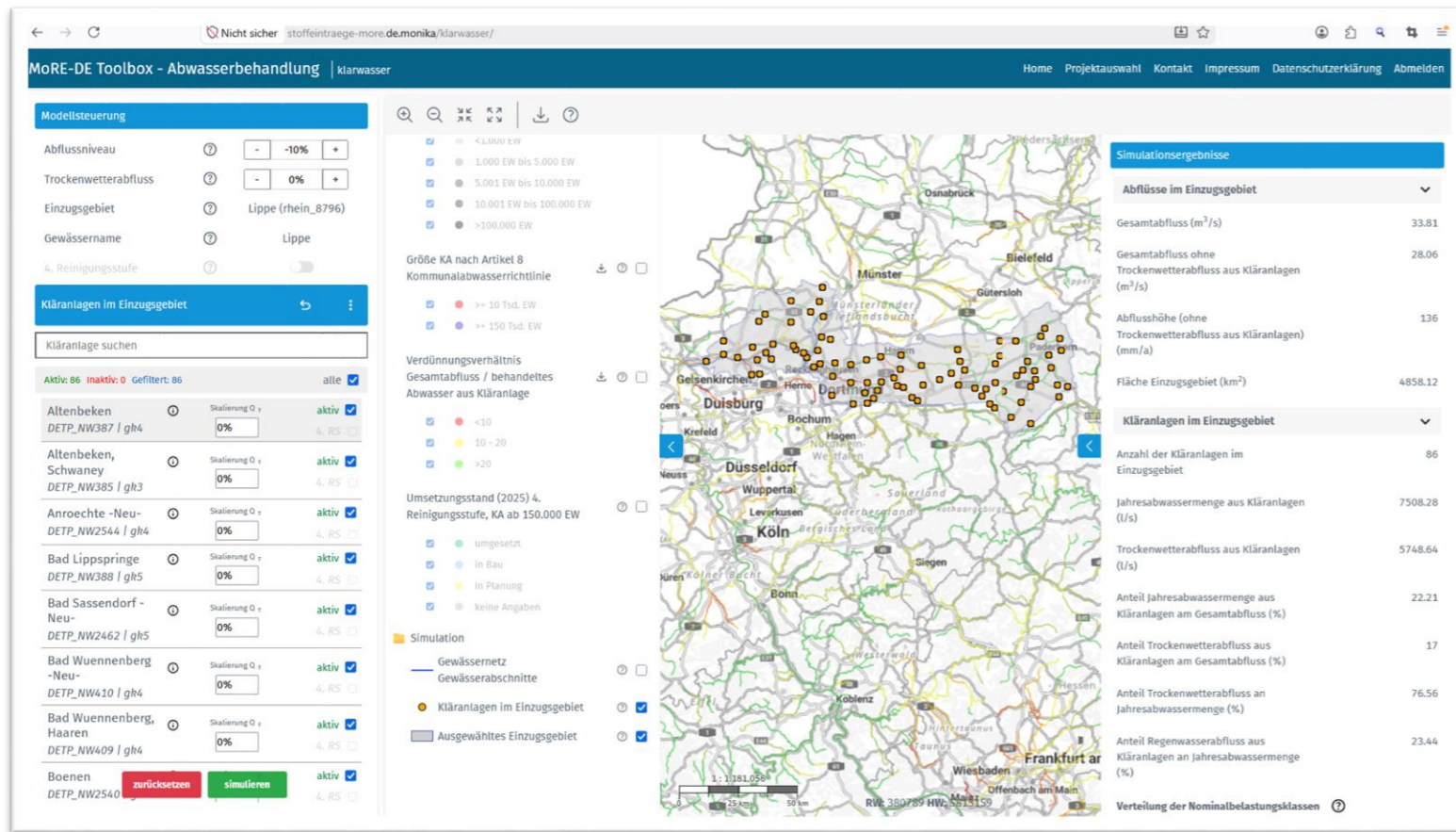


Land	Gewässerdistanz [m]	R-Faktor	K-Faktor	LS-Faktor	C-Faktor	Bodenabtrag [t/ha/a]	Anbindungswahrscheinlichkeit	Sediment delivery ratio
Austria	718.88	90.189	0.3424	11.326	0.06397	19.968	0.3576	0.0467
Belgium	508.59	65.962	0.4759	1.639	0.07574	1.184	0.1755	0.08231
Czechia	466.27	53.927	0.3695	1.835	0.05929	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

# Extended application for stakeholders (under development)

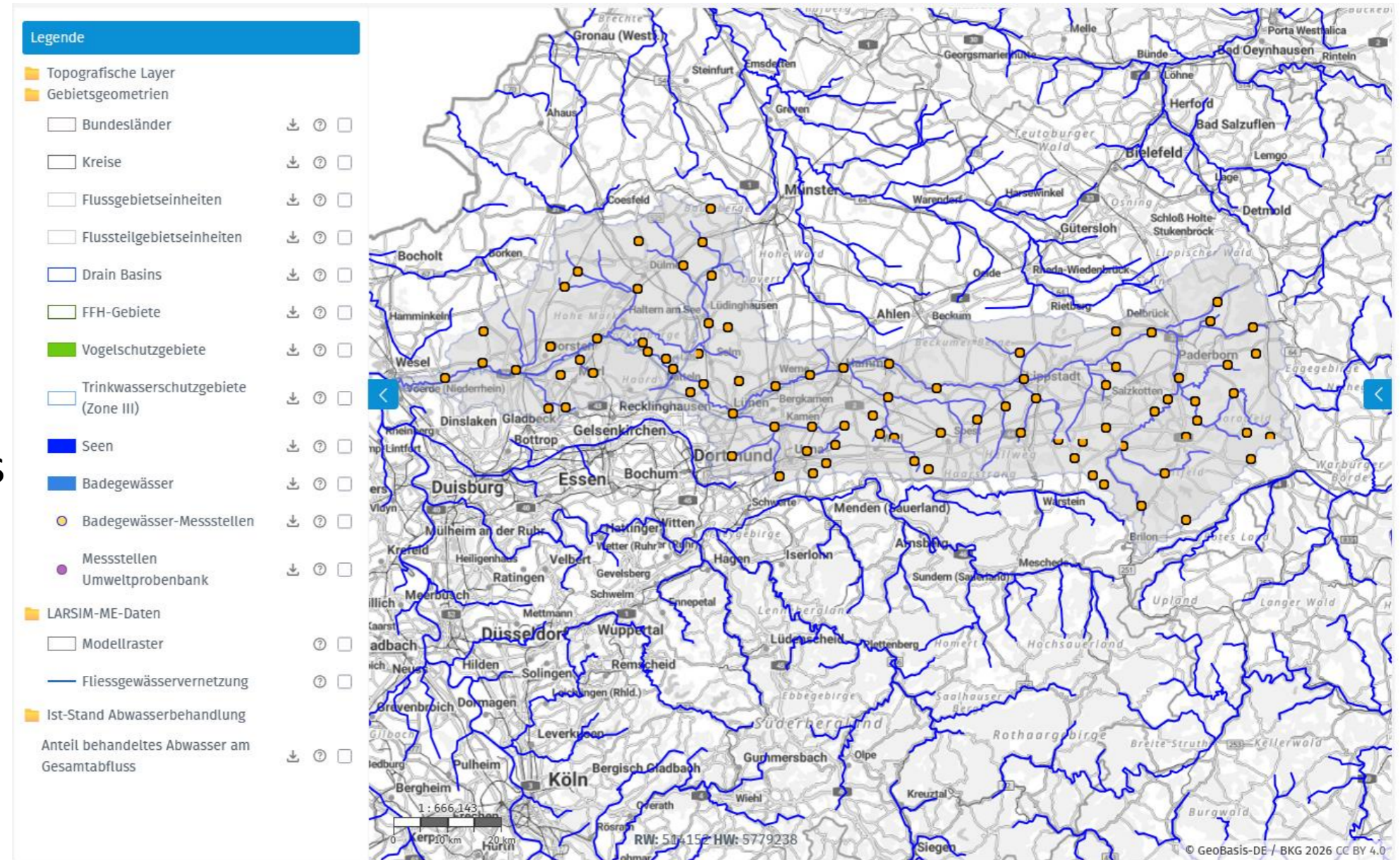
- MoRE-DE-Toolbox – [Waste water treatment planning](#)
- Takes the step from a static evaluation system to a [dynamic and interactive working tool](#)
- Helps to fulfill the requirements of the [EU Urban Wastewater Treatment Directive \(2024/3019, UWWTD, Art. 8 Quaternary treatment\)](#)
- Supports 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
































# Key essential features

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



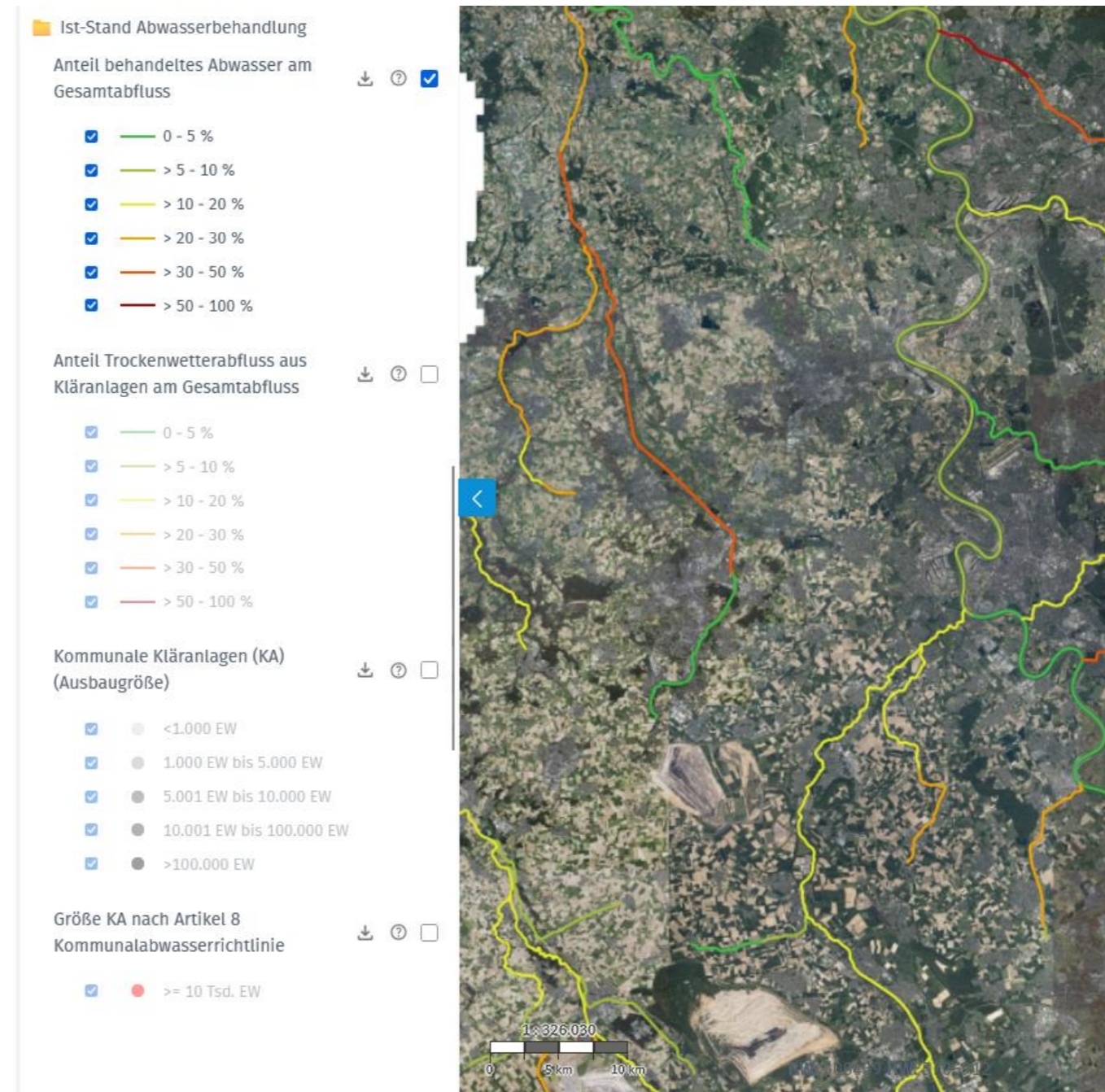
# Key essential features

- 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**

Legende		
 Topografische Layer		
 Gebietsgeometrien		
 Bundesländer	  	
 Kreise	  	
 Flussgebietseinheiten	  	
 Flussteilgebietseinheiten	  	
 Drain Basins	  	
 FFH-Gebiete	  	
 Vogelschutzgebiete	  	
 Trinkwasserschutzgebiete (Zone III)	  	
 Seen	  	
 Badegewässer	  	
 Badegewässer-Messstellen	  	
 Messstellen Umweltprobenbank	  	

# 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



# 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**

DET\_NW388 (Bad Lippspringe)

Name	Bad Lippspringe	Jahresabwassermenge (m³/a)	2.373.594   2.373.594
Kennzahl	DETP_NW388	Trockenwetterabfluss (m³/a)	2.164.689   2.164.689
Ausbaugröße (EW)	30.000	Regenwasserabfluss (m³/a)	208.905
Nominalbelastung (EW)	17.850		
Zuleitungsgewässer	Lippe		

### Abflussverhältnisse

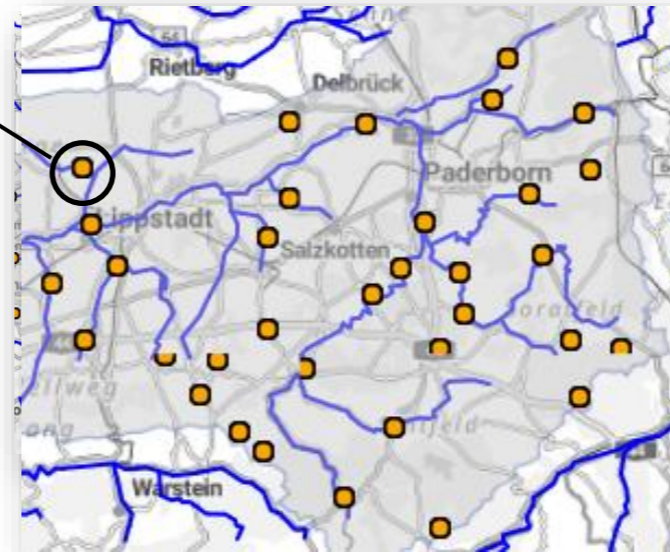
Verdünnungsverhältnis, KA ab 10.000 EW Gesamtabfluss/Jahresabwassermenge	8,62   8,62
Anteil Regenwasserabfluss an Jahresabwassermenge (%)	8,8   8,8
Anteil Trockenwetterabfluss an Jahresabwassermenge (%)	91,2   91,2

### Ausbaugrad

Stickstoffminimierung	Ja	Ozonierung	Nein
Phosphorminimierung	Ja	Mikrofiltration	Nein
N-Desinfektion	Nein	Sandfiltration	Nein

Informationen zur 4. Reinigungsstufe

JARSIM-ME Werte | \* Szenario Werte



Kläranlagen im Einzugsgebiet

Kläranlage suchen

Aktiv: 86 Inaktiv: 0 Gefiltert: 86 alle

Altenbeken DETP_NW387   gk4	①	Skalierung Q $\uparrow$	aktiv <input checked="" type="checkbox"/>
Altenbeken, Schwaney DETP_NW385   gk3	①	Skalierung Q $\uparrow$	aktiv <input checked="" type="checkbox"/>
Anroechte -Neu- DETP_NW2544   gk4	①	Skalierung Q $\uparrow$	aktiv <input checked="" type="checkbox"/>
Bad Lippspringe DETP_NW388   gk5	①	Skalierung Q $\uparrow$	aktiv <input checked="" type="checkbox"/>
Bad Sassendorf - Neu- DETP_NW2462   gk5	①	Skalierung Q $\uparrow$	aktiv <input checked="" type="checkbox"/>
Bad Wuennenberg -Neu- DETP_NW410   gk4	①	Skalierung Q $\uparrow$	aktiv <input checked="" type="checkbox"/>
Bad Wuennenberg, Haaren DETP_NW409   gk4	①	Skalierung Q $\uparrow$	aktiv <input checked="" type="checkbox"/>

# 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

<https://stoffeintraege-more.de>

<https://visdat.de>

<https://iwu.kit.edu/wg/index.php>

<https://umweltbundesamt.de>

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