WATER CONVENTION

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Climate change and low flow monitoring: the work of the International Commission for the Protection of the Rhine (ICPR)

Jan Kruijshoop

President of the ICPR Working group "Flood and low water" and Expert group "Climate change"

Dutch representative within the International Commission for the Hydrology of the Rhine basin (CHR)

Member of the EU Stars4Water project

State employee at Min. IenW / Rijkswaterstaat WVL (The Netherlands)

IKSR CIPR ICBR

CHR KHR

STARS4Water

Ministry of Infrastructure and Water Management

UNECE

Schweizerische Eidgenossenschaft Confédération suisse Confederazione Svizzera Confederaziun svizra
Bundesamt für Umwelt BAFU
Office fédéral de l'environnement OFEV
Ufficio federale dell'ambiente UFAM
Uffizi federal d'ambient UFAM

United Nations Convention to Combat Desertification

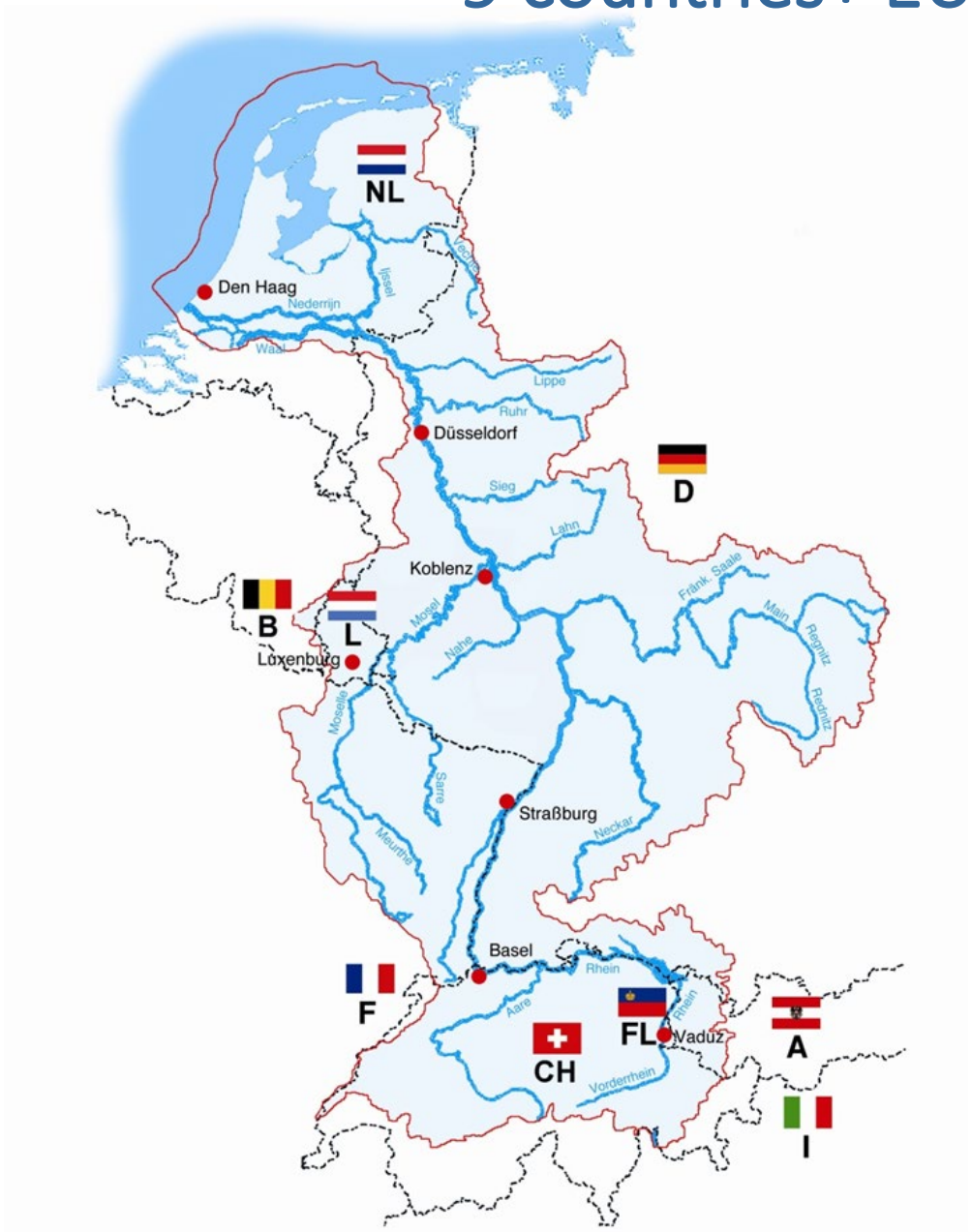
UNDRR UN Office for Disaster Risk Reduction

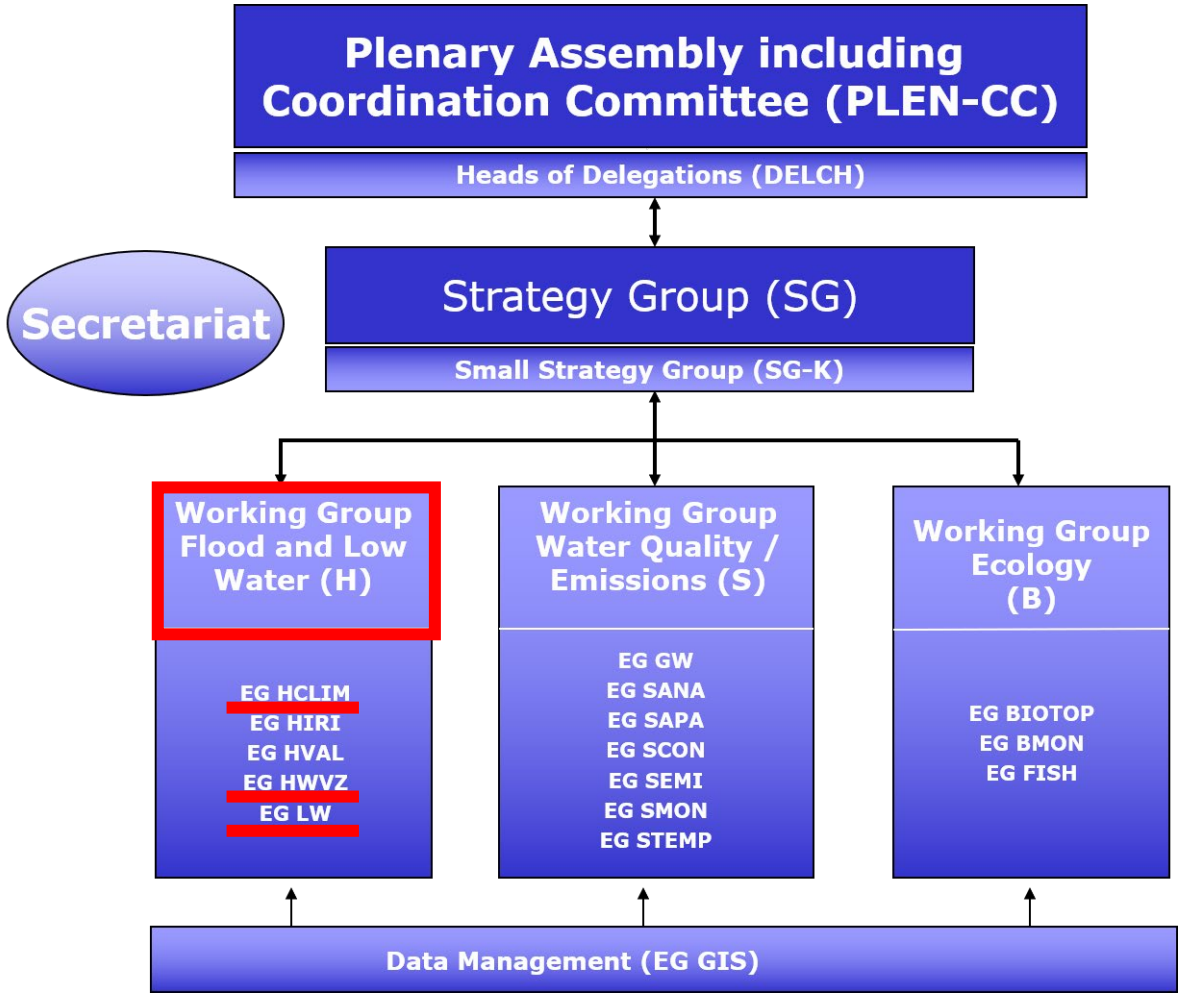
WORLD BANK GROUP Water

WORLD METEOROLOGICAL ORGANIZATION

INTERNATIONAL NETWORK OF BASIN ORGANIZATIONS

International Rhine river basin : 9 countries+ EU cooperating within the ICPR





CC, forecasting and low water related groups

General Goals of Rhine 2040:

"The Rhine and its catchment: sustainably managed and climate-resilient"

Specific goals/objectives with measures/actions:

1. Networked habitats – more biodiversity
2. Good water quality
3. Mitigation of flood risks
4. Managing low water*
5. Cooperation with other commissions and stakeholders, public relations

** Related objective for 2040:* *"Due to low water monitoring and jointly developed evaluation methods and solutions, the Rhine catchment area can better manage the negative effects of pronounced low water events."*

→ *Remark: Despite mentioning "low water", topic of "drought/water scarcity" is increasingly coming to the forefront.*

https://www.iksr.org/en/icpr/rhine-2040

General objective for 2040 (Rhine 2040): Rhine basin is sustainably managed and climate-resilient

Measures *(amongst others)*

1. Updating discharge and water temperature projections for near (2050) and far (2100) future *(update every 10 years)* → *new results 2024*
2. Updating the ICPR's climate change adaptation strategy (from 2015) → *end of 2025*

EG HCLIM's followed work process for updating discharge projections:

Integration of national/regional available CC and hydro. model data (daily resolution, different hydrological parameters, selected Rhine gauges, IPCC AR5, RCP8.5)

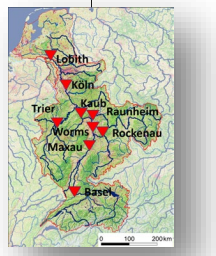
Changes in the flow regime (updated discharge projections to be published 2024)

- **Along the whole Rhine and its catchment:** Increases in winter **and** decreases in summer **discharges** (changes already observed increase in the future up to 2100)

- **Lesser water** compared to reference period „1981-2010“ (leading possibly to low water and drought)?
  - Decrease already observed (1991-2020) for all hydro. parameters (amongst others low flows) for summer and winter
  - Decrease projected (2031-2060 and 2071-2100) for mean summer flow as well as low flows (yearly, summer and partly winter low flow)

Example: result table for changes in summer low flows

Indicator	Gauge	Observed values (m/s³)	Observed change (%)	Projected change (%)	
		Reference 1981-2010	Present 1991-2020	Near Future 2031-2060	Distant Future 2071-2100
NM7Q Summer	Basel	648,4	-2	-35 to +5 (-7 to -5)	-62 to +7 (-)
	Maxau	750,8	-5	-36 to +2 (-12 to -5)	-57 to +2 (-)
	Worms	824,8	-5	-36 to +1 (-15 to -4)	-56 to -1 (-24 to -21)
	Kaub	956,3	-5	-35 to +1 (-19 to -3)	-54 to -5 (-28 to -18)
	Cologne	1105	-6	-34 to +1 (-22 to -3)	-53 to -6 (-32 to -17)
	Lobith	1173	-5	-33 to -0 (-22 to -2)	-53 to -6 (-32 to -17)
	Rockenau (Neckar)	47,21	-7	-24 to +16 (-20 to +8)	-38 to +7 (-23 to -2)
	Raunheim (Main)	81,35	-3	-33 to +22 (-21 to +4)	-46 to +15 (-23 to -6)
	Trier (Moselle)	58,07	-11	-51 to +9 (-28 to -7)	-68 to +9 (-32 to -26)



Changes in the flow regime (results 2024) *(cont'd)*

- Tendency towards more rain-fed regimes *(decreasing glacier- and snow-melt contribution, see also CHR results)*
- Past ICPR projections confirmed, but wider range → potential negative impacts on existing management practices → **Updating ICPR strategy is needed!**
- Need for further research ***(passed on to CHR's "Rheinblick2027")***

Specific goals for 2040 linked to "Coping with and managing low water" (Rhine 2040)

1. **ICPR low water monitoring** ***(see next slides)*** **is optimised**

- **Improvements and extension to predict potential drought periods** *(cooperation with the EU Drought Observatory)*
- **Studies on future water use and water availability by 2050** to identify potential cross-border problems or solutions *(cooperation with CHR's study "socioeconomic scenarios (SES)" and EU Horizon project "Stars4Water")*

2. **Development of common assessment and solution approaches to be better prepared for low water periods**

- **Compilation and evaluation of measures** (e.g.: raising awareness, wetland restoration/expansion, sustainable groundwater management)
- **Development of common assessment approaches**

Expert group “Low water” works on better understanding low water consequences

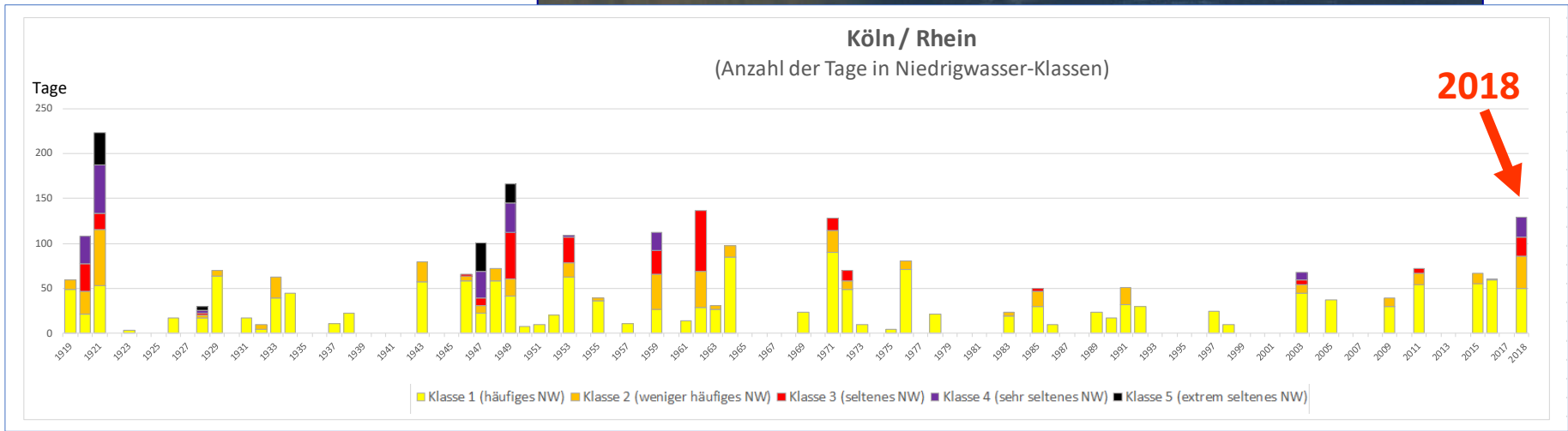
Inventory of low water condition :

End of 20st / Beginning 21st cent.: no increase of low flows compared to first half of 20st cent. but increased vulnerable uses;
Future (CC): Increased low flows

Evaluation of the record low water in 2018:

Biggest event since approx. 50 years!, different negative consequences *(e.g. 2.5 billion EUR losses for DE)*

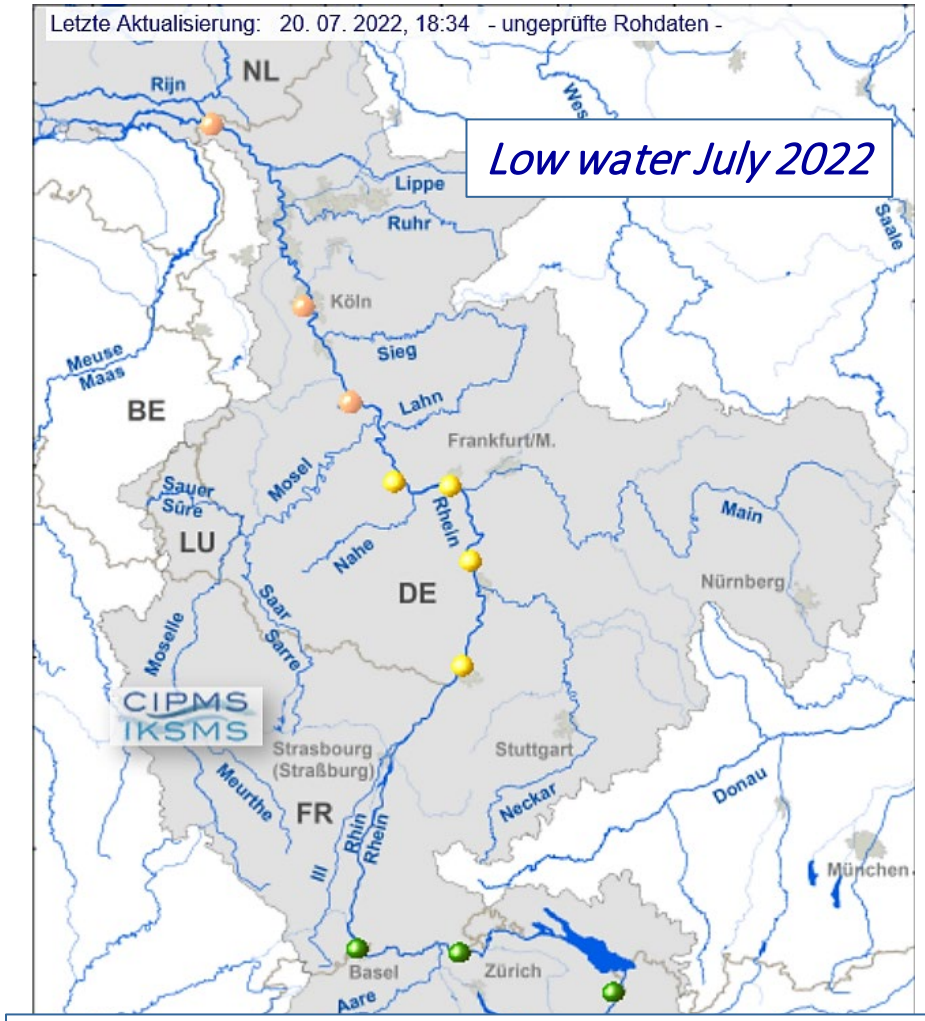
Ongoing reporting on **extreme low flow 2022** (*see first press release*)



ICPR low flow monitoring system

International low water monitoring system *(since 2019)*

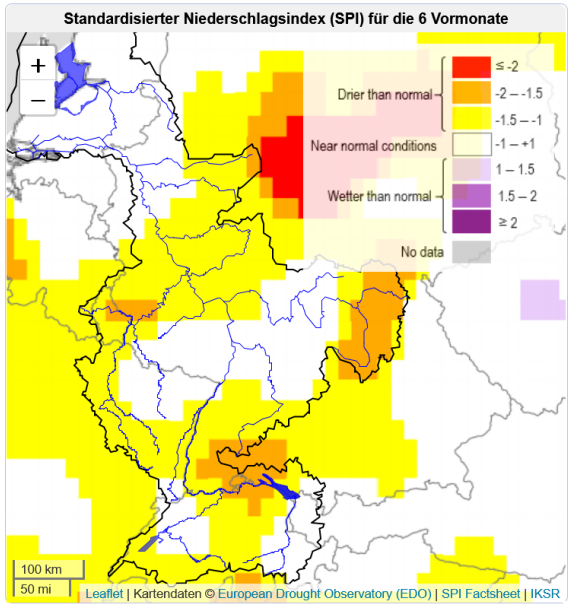
Scale with six colors helps to classify the current discharges and water levels

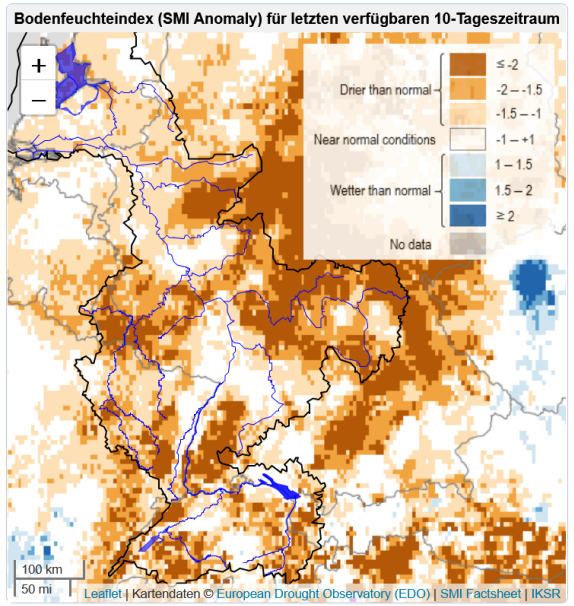


- no low flow / very frequent low flow (Q ≥ 2-year NM7Q)
- frequent low flow (Q < 2-year NM7Q)
- less frequent low flow (Q <5-year NM7Q)
- rare low flow (Q < 10-year NM7Q)
- very rare low flow (Q < 20-year NM7Q)
- extremely rare low flow (Q < 50-year NM7Q)
- no up-to-date flow data

+: table with the duration of the event, water temperature, oxygen content

Including: two maps on precipitation and soil moisture anomalies ("EDO drought maps"):





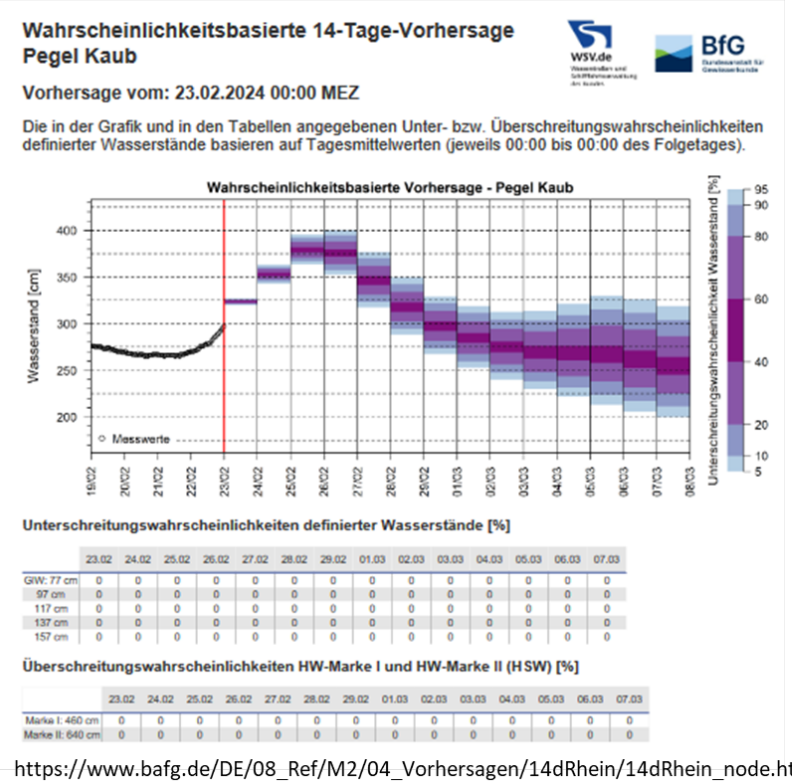
https://www.iksr.org/en/topics/low-water/low-water-monitoring

Other Rhine forecasting and early warning systems

National water forecasting and warning centers along the Rhine are cooperating closely together in the frame of the ICPR (EG HWVZ); focus is shifting from only flood to low flow forecasting and warning.

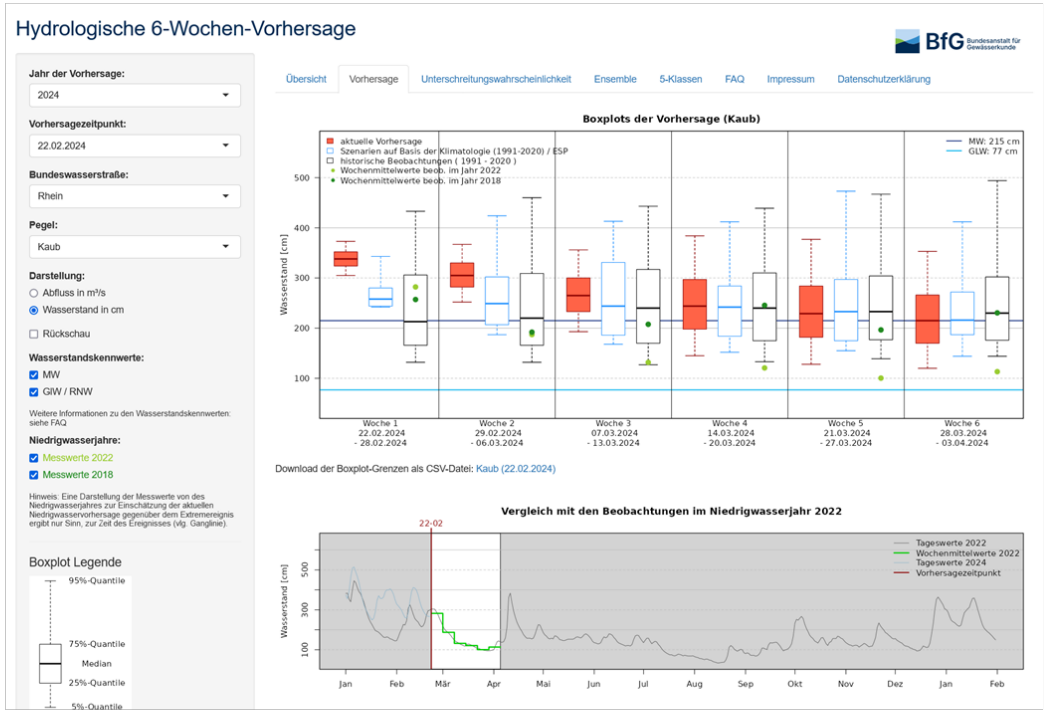
E.g.: German (BfG) innovative water level forecast for the Rhine (since July 2022), for selected relevant Rhine gauges and which runs also in time of low flows

14-day water level forecast *(probability-based)*



https://www.bafg.de/DE/08_Ref/M2/04_Vorhersagen/14dRhein/14dRhein_node.html

Hydological 6 weeks water level forecast *(statistical-based including also weather ensembles; weekly averages and corresponding forecast uncertainties; published twice a week)*



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Thank you

Email address: jan.kruijshoop@rws.nl, Sekretariat@iksr.de, adrian.schmid-breton@iksr.de

Websites:

https://www.iksr.org

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