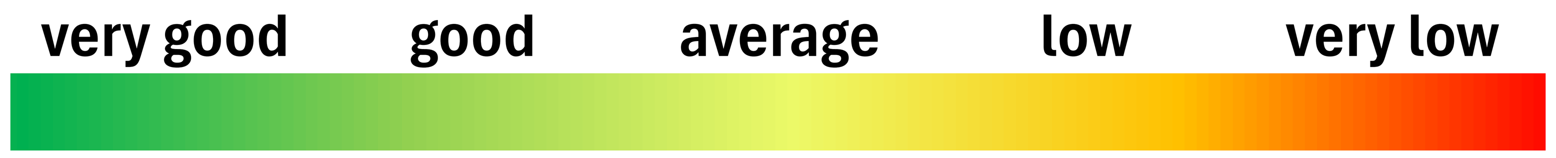
Water supply in the Upper Rhine region: critical periods and areas between now and 2050

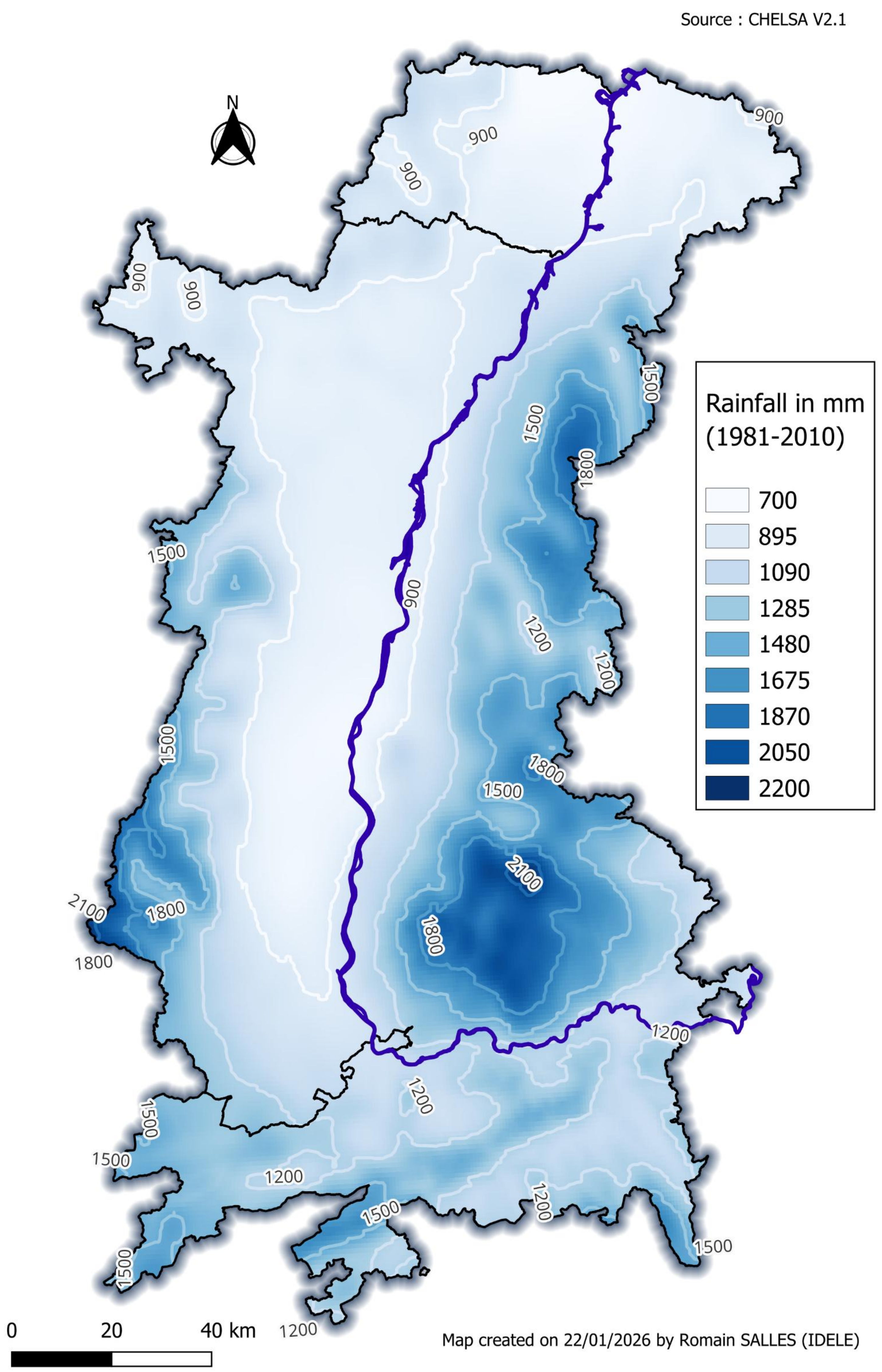
| Context: Water resources are subject to increasingly frequent critical periods in terms of supply.

| Proposition: develop appropriate tools to anticipate these changes, limit their impact on production and thus improve the resilience of cattle farming in the face of the challenges posed by climate change



Average future availability of water resources

Map of current rainfall

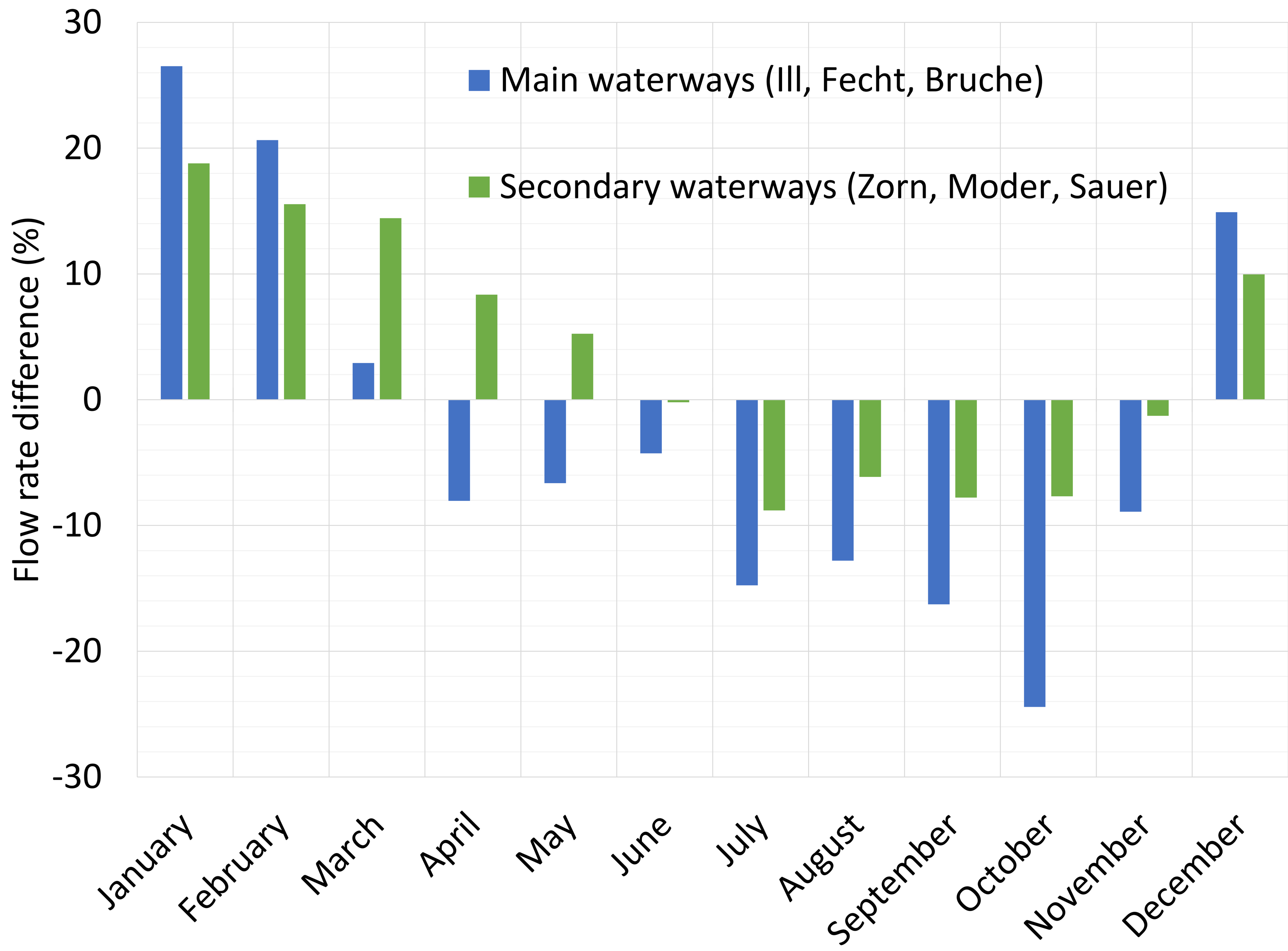


Difference in rainfall (in %) between the future (2041–2070) and historical data

Annual average	In summer	In winter
+ 8 %	- 3 %	+ 26 %

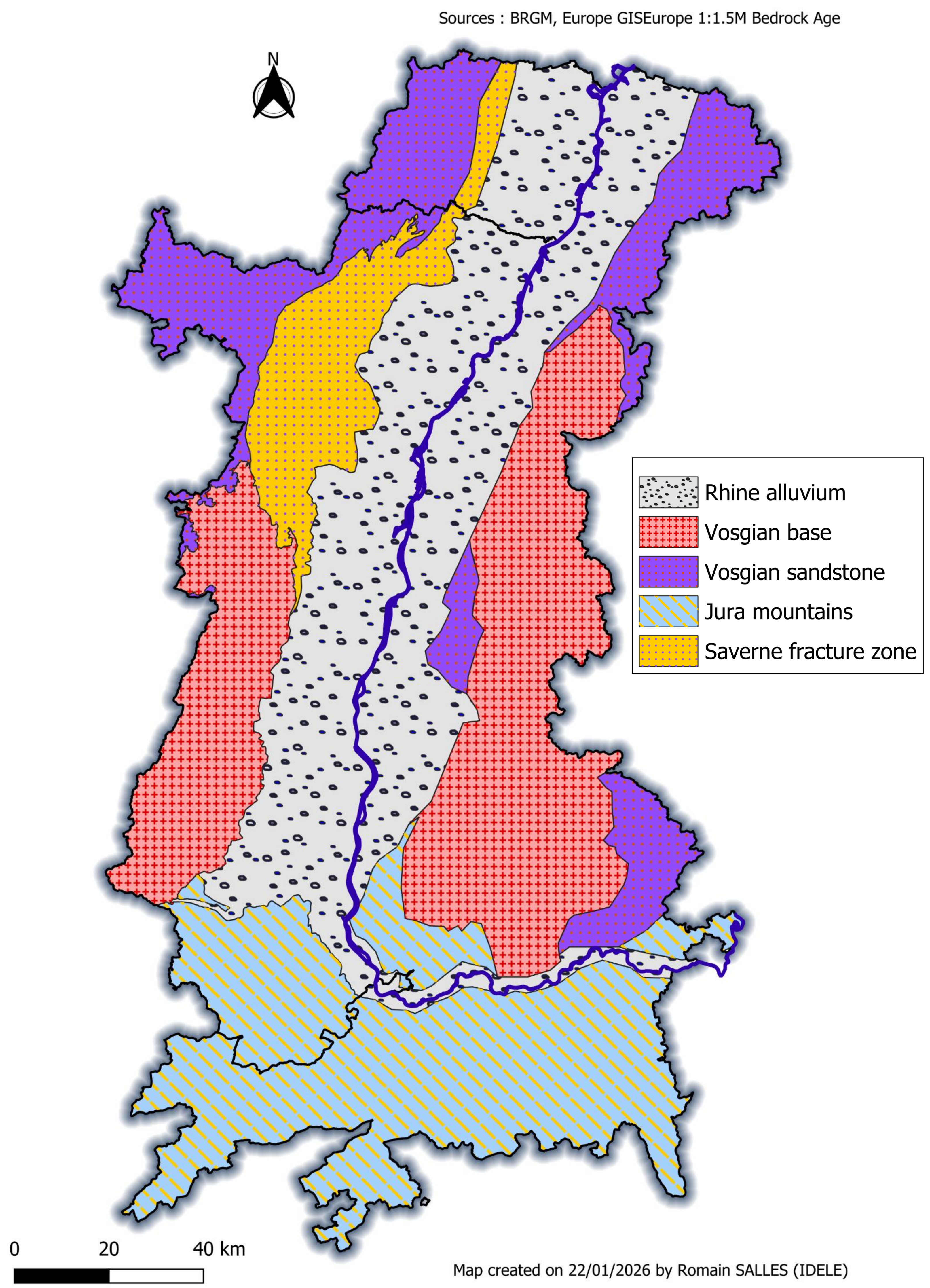
source : DRIAS

Difference in river flow rates (in %) between future (2041–2070) and historical data for major rivers



source : DRIAS Eau

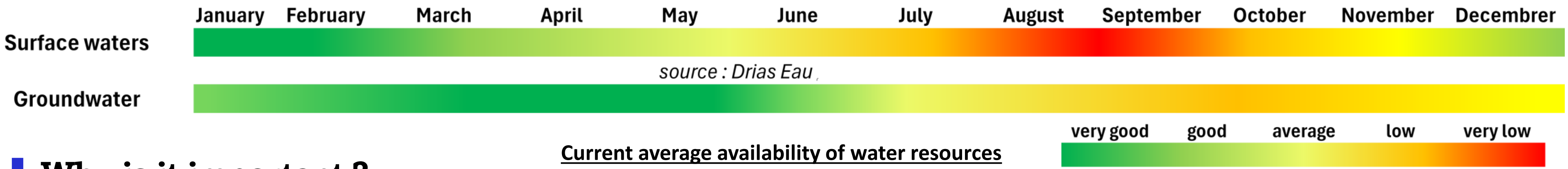
Simplified geological map



Water availability in an average year

What it shows

- Monthly projection of **water availability for cattle farming** over an average year between now and 2050.



Why is it important ?

- **Seasonal water availability** determines the proper functioning of cattle farming systems.
- It affects **livestock watering**, **pasture growth** and **fodder production**.
- In the **Upper Rhine region**, **seasonal imbalances** are becoming more pronounced: **more rain in winter**, **drier and hotter summers**, during times when **water demand** reaches its peak.
- These changes lead to **periods of critical water stress**, threatening **animal welfare**, **grassland health** and the **economic stability of farms**.
- Having a **clear picture** of water availability over time makes it possible to **anticipate periods of risk**, **adjust farming practices** and **prevent crises** rather than react to them.

Watering animals accounts for a significant proportion of water consumption in livestock farming.

Water availability in an average year

Connection with agriculture

- This calendar provides a **temporal overview** of **critical periods of water availability**, which is useful for **planning** and **synchronising** agricultural activities.
- It allows farmers to:
    - **Optimise water storage** during months with excess water (rainwater harvesting, reservoirs).
    - **Adapt grazing schedules** and **herd movements** according to periods of drought.
    - **Adjust sowing** and **irrigation** of fodder crops according to water availability.
    - **Build up fodder stocks** in anticipation of summer shortages.
    - **Develop early warning systems** or **regional coordination** mechanisms to manage critical episodes.

- This approach promotes **proactive water cycle management** by linking **animal needs**, **pasture dynamics** and **resource planning** at the regional level.

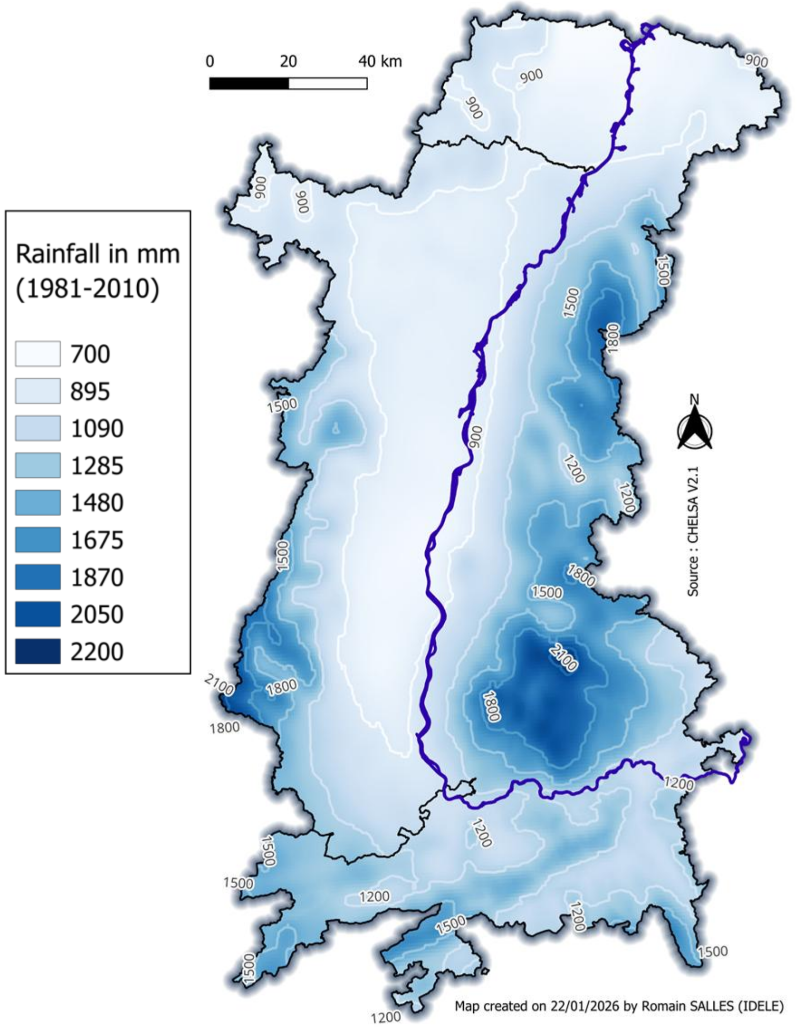
Development of rainfall (current vs. 2050)

What it shows

- Spatial (map) and seasonal (table) change in **average precipitation** between historical reference values and projected values for 2050.
- The focus is on **seasonal changes**, particularly in spring and summer.
- The change in mm/month is represented by a colour scale.

Why is it important

- **Precipitation** is the **main source of all water resources** – rivers, groundwater and soil moisture – and directly determines **agricultural productivity**.
- In the **Upper Rhine** region, projections indicate **more intense winter precipitation**, but **longer periods of drought** in spring and summer.
- These changes increase **interannual variability**, raise the **risk of erosion and flooding**, and complicate **agricultural planning**.
- For livestock farming, this means **less predictable water availability**, **more unstable fodder production** and **greater dependence on irrigation systems**.
- A better understanding of **regional rainfall trends** is therefore essential for **adapting water and grassland management**, building **resilience to climate extremes**, and **preserving the viability of livestock farms**.



Annual rainfall in millimetres (1981–2010)

Annual	June-July-August	December-January-February
+8%	-3%	+26%

Future rainfall trends (average in 2050)

(Source : DRIAS)

Development of rainfall (current vs. 2050)

Connection with agriculture

- This technical sheet helps to **identify the areas most exposed** to changes in rainfall patterns and to **adapt agricultural practices accordingly.**

- Farmers can thus:
  - **Plan crops and rotations** according to **favourable climatic windows**.
  - **Improve water retention in soils** through **cover crops**, **reduced tillage** or **agroforestry**.
  - **Adapt pasture management**, in particular by **adjusting rotations** to new growth periods.
  - **Prevent erosion and runoff** in sensitive areas through appropriate **landscape planning**.
  - **Prioritise irrigation** in areas with summer deficits and **make use of winter surpluses** by **collecting rainwater**.

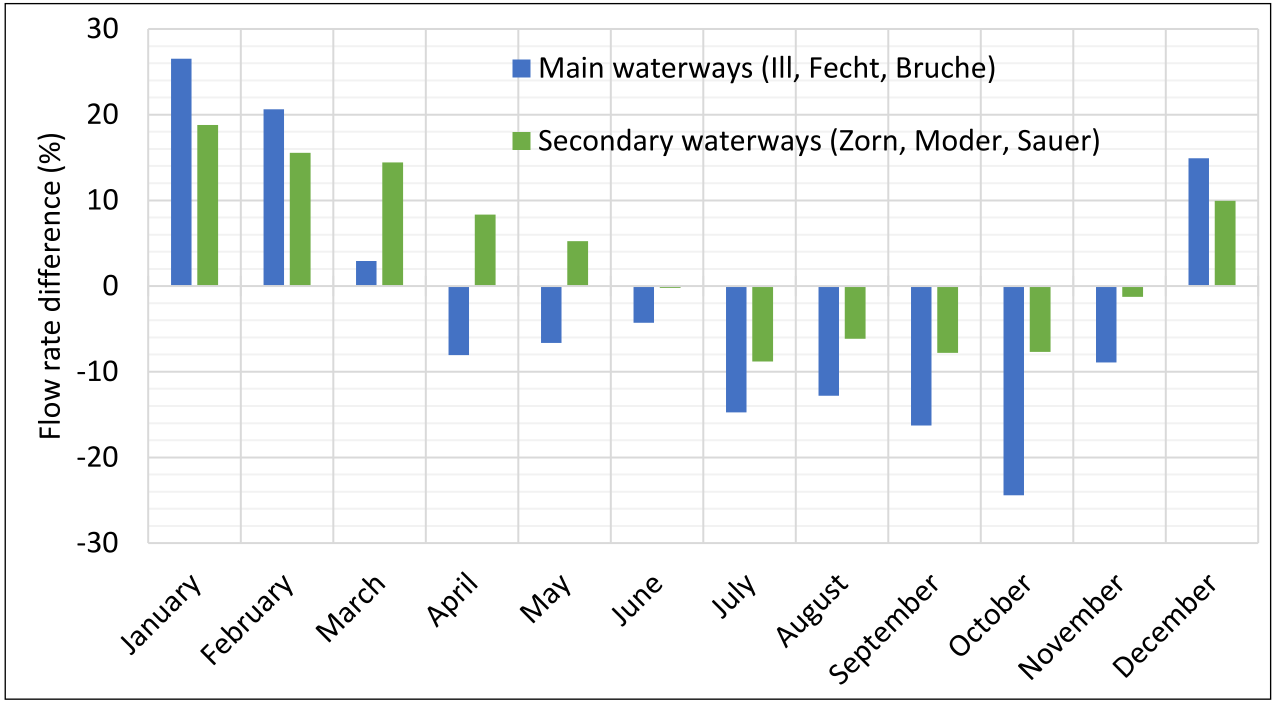
- This information supports **more coherent territorial water management**, promoting **agricultural productivity**, **soil protection** and **collective resilience to climate extremes**.

The level of rainfall is probably the most important factor when it comes to estimating the availability of water resources in the region.

Projection of river flow rates

What it shows

- Average monthly flows rates of the main rivers (Rhine, Ill, Thur, etc.)
- Comparison between past flows and projected flows for 2050
- Reveals changes in **seasonal distribution**: higher flows in winter and lower flows in summer



Difference in flow (in %) between the future (2041-2070) and today for the main rivers
Source: DRIAS Eau

Why is it important?

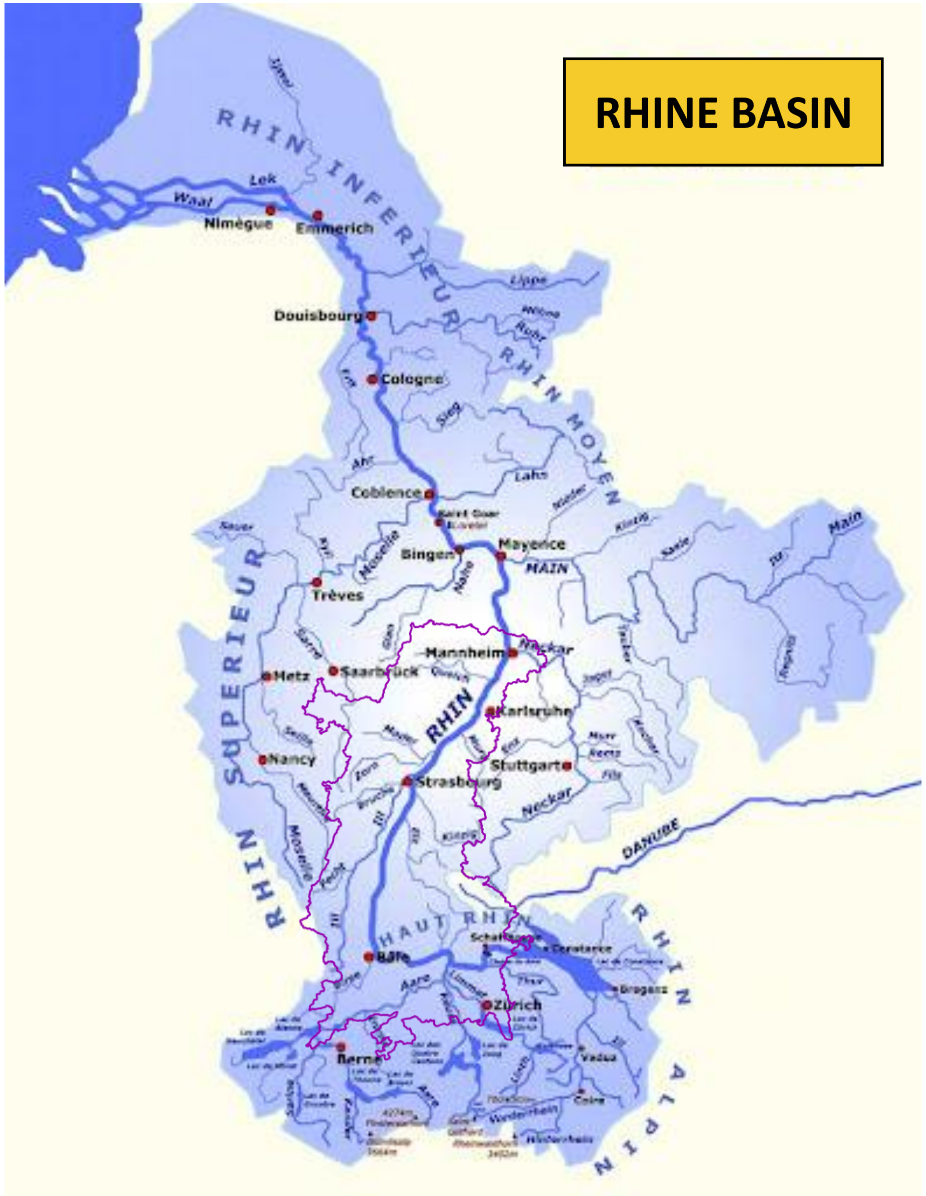
- The **rivers of the Upper Rhine** play a key role in **water supply for livestock farming and irrigation**.
- Their **flow rates reflect** both **precipitation patterns** and the **melting of Alpine snow**.
- **Global warming**, **milder winters** and **earlier snowmelt** are reducing **summer water availability**, which is critical for agriculture.
- These changes are altering the **seasonal distribution of flows** and increasing the **risk of water shortages** during the hot months. They also make **irrigation systems dependent on rivers** more vulnerable and increase **tensions over resource sharing**.
- Monitoring changes in **river flows** makes it possible to **anticipate periods of low availability, adjust agricultural withdrawals** and **ensure the sustainability** of water supplies.

Projection of river flow rates

Connection with agriculture

- **River flow** projections provide a better understanding of **when and where** river-dependent systems become vulnerable. This information is crucial for farmers in the **Upper Rhine region**, where irrigation and watering often depend on **rivers and alluvial channels**.
- Actions include:
  - **Store water** during periods of high flow for use in summer.
  - **Adapt irrigation schedules** and water allocation according to **periods of excess flow**.
  - **Strengthen cooperation** between users (farmers, local authorities, ecologists) to preserve **minimum ecological flow.**
  - **Invest in more efficient and flexible systems**, such as micro-irrigation or programmed watering systems.

- Integrating **hydrological forecasts** into agricultural management makes it possible to **anticipate restrictions**, **preserve resources** and **reduce tensions** related to summer water scarcity.

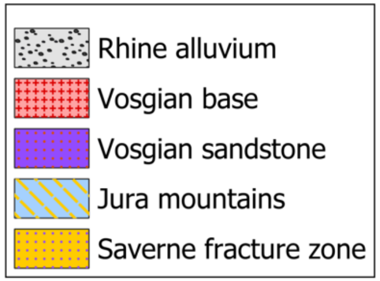


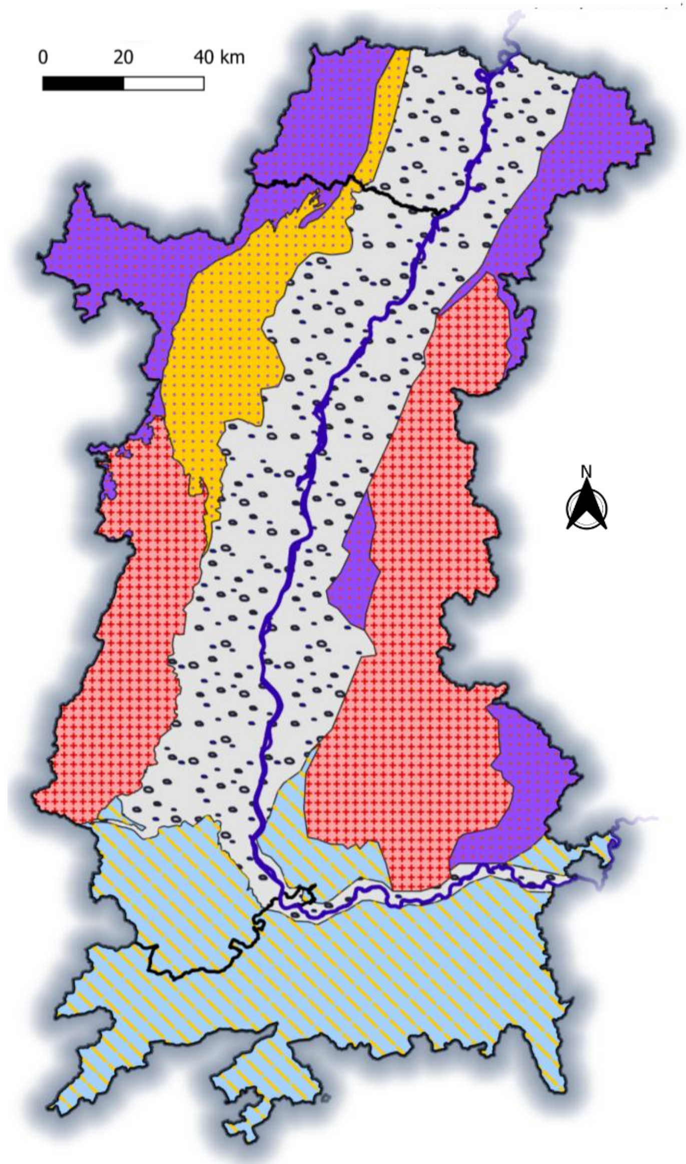
The Rhine consists of several drainage basins, each with a large number of watercourses of varying sizes (according to "Encyclopédie BS Editions"). Project ResKuh Upper Rhine region in purple.

Local hydrogeological context and vulnerabilities

What it shows

- **Significant geological diversity** leading to **differences in vulnerability** depending on the subsoil.
- The **Rhine plain** is not expected to experience any major difficulties in the future in terms of water availability, given its **large volume**.
- Conversely, the **foothills and mountain areas** will be highly **vulnerable to irregular rainfall**, with relatively **low** subsoil **storage capacity**.





Sources : BRGM, Europe GISEurope 1:1.5M Bedrock Age

Map created on 22/01/2026 by Romain SALLES (IDELE)

Simplified geological map

Why is it important

- The **groundwater** of the Upper Rhine represents a **strategic reserve** during periods of drought and provides **essential support** for the water stability of farms.
- Its **natural recharge** depends on precipitation and soil infiltration capacity, two parameters that are sensitive to **climate change**.
- **Wetter but shorter winters**, combined with **drier summers**, reduce the **effective penetration of water** into aquifers. This can lead to a **drop in the water table**, making **wells less productive** and increasing the **cost of accessing water**. Conversely, excessive rise can cause **local flooding** and **soil degradation**.
- Added to this are the **risks of diffuse pollution** (fertilisers, pesticides, effluents), which threaten the **quality of resources** used for irrigation and drinking water.
- Understanding **regional hydrogeological vulnerability** is therefore essential to **securing water supplies** and **supporting agricultural resilience** in the face of climate hazards.

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Local hydrogeological context and vulnerabilities

Groundwater recharge plays a decisive role in the availability of the resource throughout the year.

Connection with agriculture

- A detailed understanding of **groundwater behaviour** makes it possible to adapt agricultural practices and **secure** long-term **access to water**.
- In the **Upper Rhine**, declining recharge or fluctuations in groundwater levels require **targeted local strategies**:
  - **Monitor** groundwater levels and quality in order to detect imbalances early on.
  - **Promote natural or controlled recharge** through infiltration systems (buffer zones, basins, ditches).
  - **Maintain permeable soils** through practices such as **no-till farming**, **cover crops** and **conservation agriculture**.
  - **Anticipate water stress** by diversifying **water sources** (storage, shared wells, alternative catchments).
  - **Reduce diffuse pollution** through rational management of inputs and protection of catchment areas.

- Incorporating projections of **groundwater level changes** into agricultural planning helps **protect resources**, **reduce future costs** and **strengthen the resilience of farms** in the face of climate variability.