The AquiFR hydrogeological modeling platform

Evaluation of the 1958-2017 long-term simulation for the main regional multilayer aquifers in France

J.-P. Vergnes, N. Amraoui, F. Habets, N. Roux, D. Thiéry, P. Viennot

CMWR 2018 - Saint Malo
5 juin 2018

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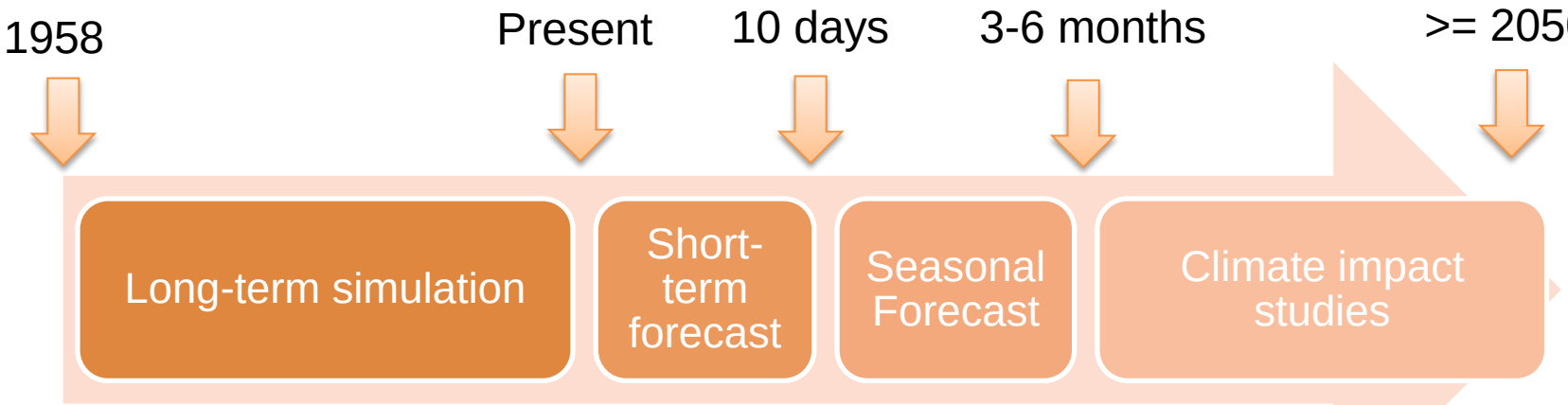
Introduction

- Gathering **hydrogeological models** developed over **France** inside a **single numeric tool** for operational and research purposes



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GEOSCIENCES Rennes

AGENCE FRANÇAISE POUR LA BIODIVERSITÉ
ÉTABLISSEMENT PUBLIC DE L'ÉTAT

METEO FRANCE

MINES ParisTech

Laboratoire d'Hydrologie et de Géochimie de Strasbourg

metis UMR 7619

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Implemented softwares

SAFRAN atmospheric reanalyses

Rainfall, Temperature,
Wind, PET…

SURFEX Land surface model

Surface runoff,
Groundwater recharge

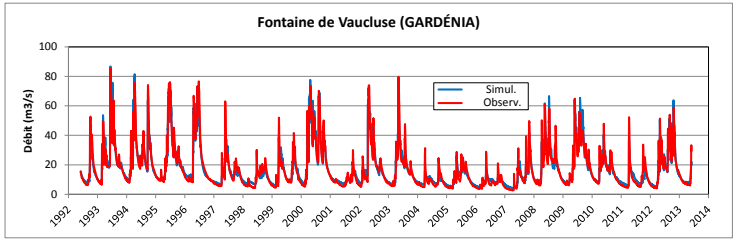
EROS lumped model for karsts

Spatially distributed hydrogeological model

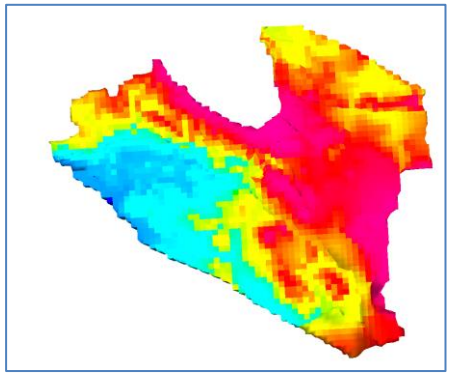
MARTHE

EauDyssée

Karst discharges



Piezometric heads



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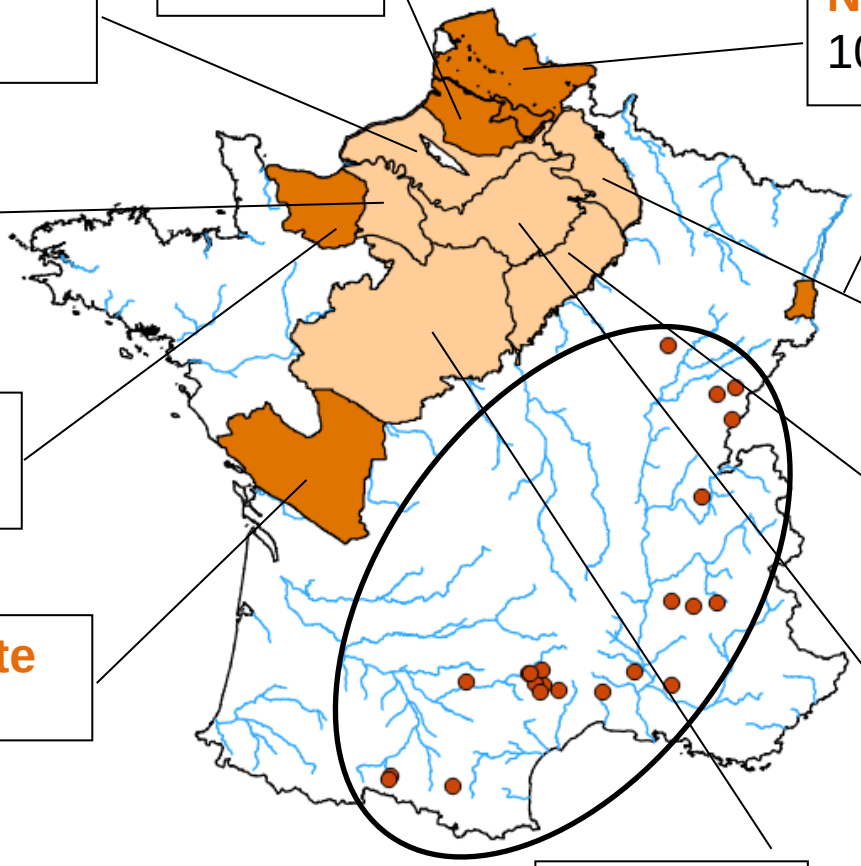
Map of the models

MARTHE distributed models

EauDyssée distributed models

EROS lumped models



Somme
1 layer

Seine-Oise
4 layers

Nord-Pas de Calais
10 layers

Seine-Eure
1 layer

Alsace
3 layers

Marne-Oise
2 layers

Basse-Normandie
10 layers

Marne-Loing
3 layers

Poitou-Charente
8 layers

Seine
6 layers

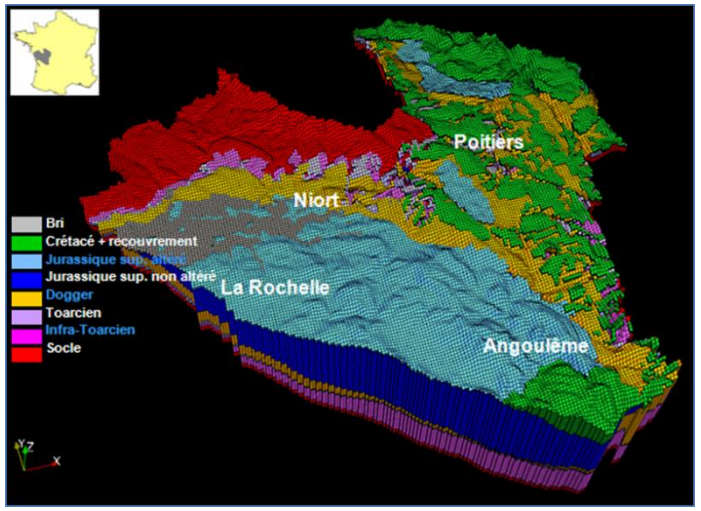
Karsts
23 basins

Loire
3 layers

Example of a spatially distributed model

Jurassic-Poitou Charentes model

- Regular grid with 1-km resolution with 8 layers
- Coupling between surface water and groundwater
- Pumping for agriculture, drinking water or industry
  - 1850 groundwater pumpings
  - 100 surface water pumpings
- Initially calibrated on the 2000-2007 period



3d view of the model layer

Area of the model

19 200 km²

Models recalibrated with the SURFEX surface runoff and recharge (except the Seine and Loire models)

Evaluation of the 1958-2017 long-term simulation

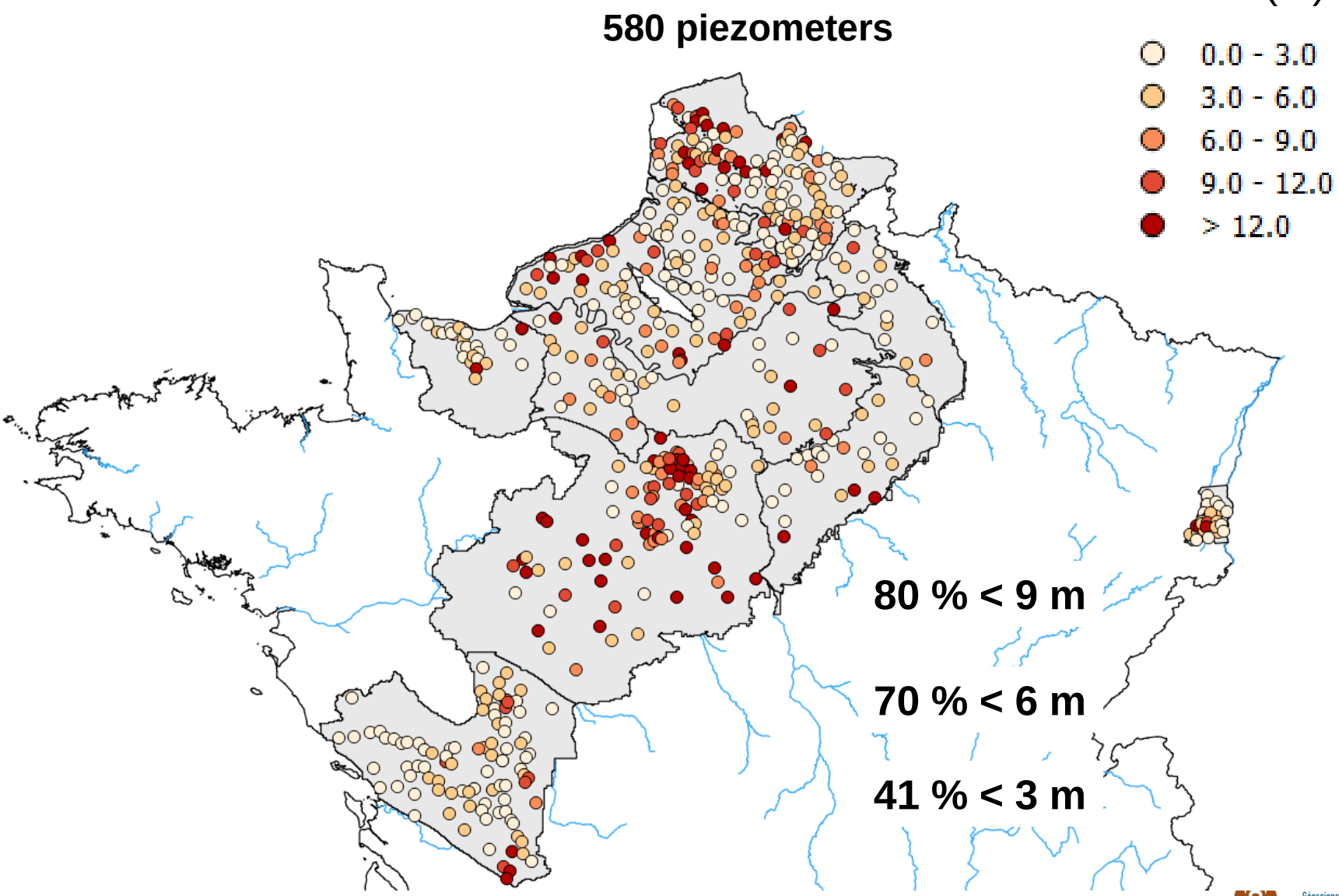
Why?

- Models **recalibrated using the SURFEX surface runoff and recharge**
- Validate the approach on a long-term period with observations for future long-term climate study
- Initial states for hindcasts

Characteristics

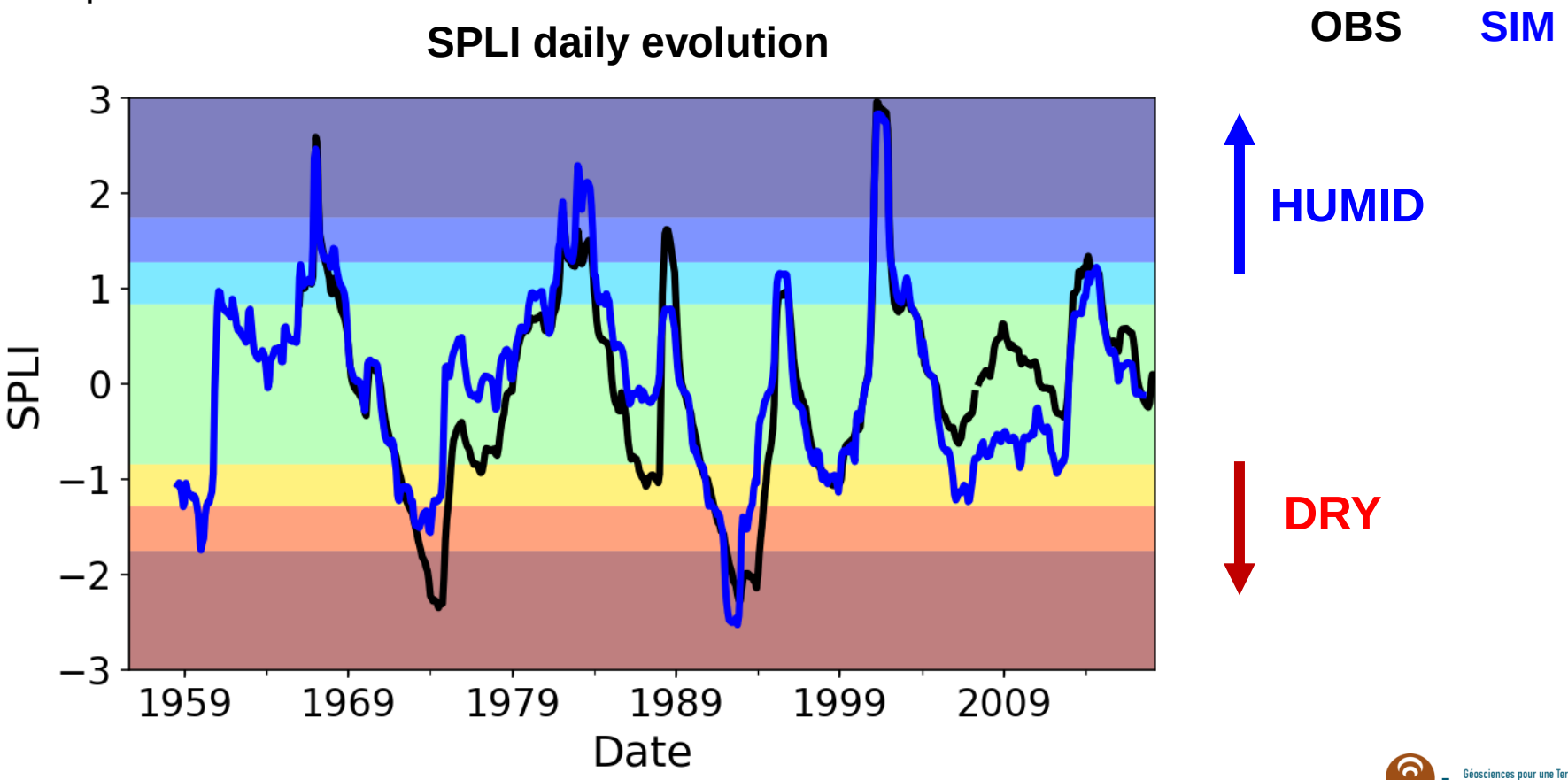
- Daily simulation from 1st August 1958 to 31th July 2017
- Initial state : 1st August 2006
- Outputs :
  - Monthly piezometric head maps (unconfined aquifers)
  - 580 daily piezometers levels and 23 karst discharges
  - Groundwater-surface water exchanges

RMSE of piezometric heads

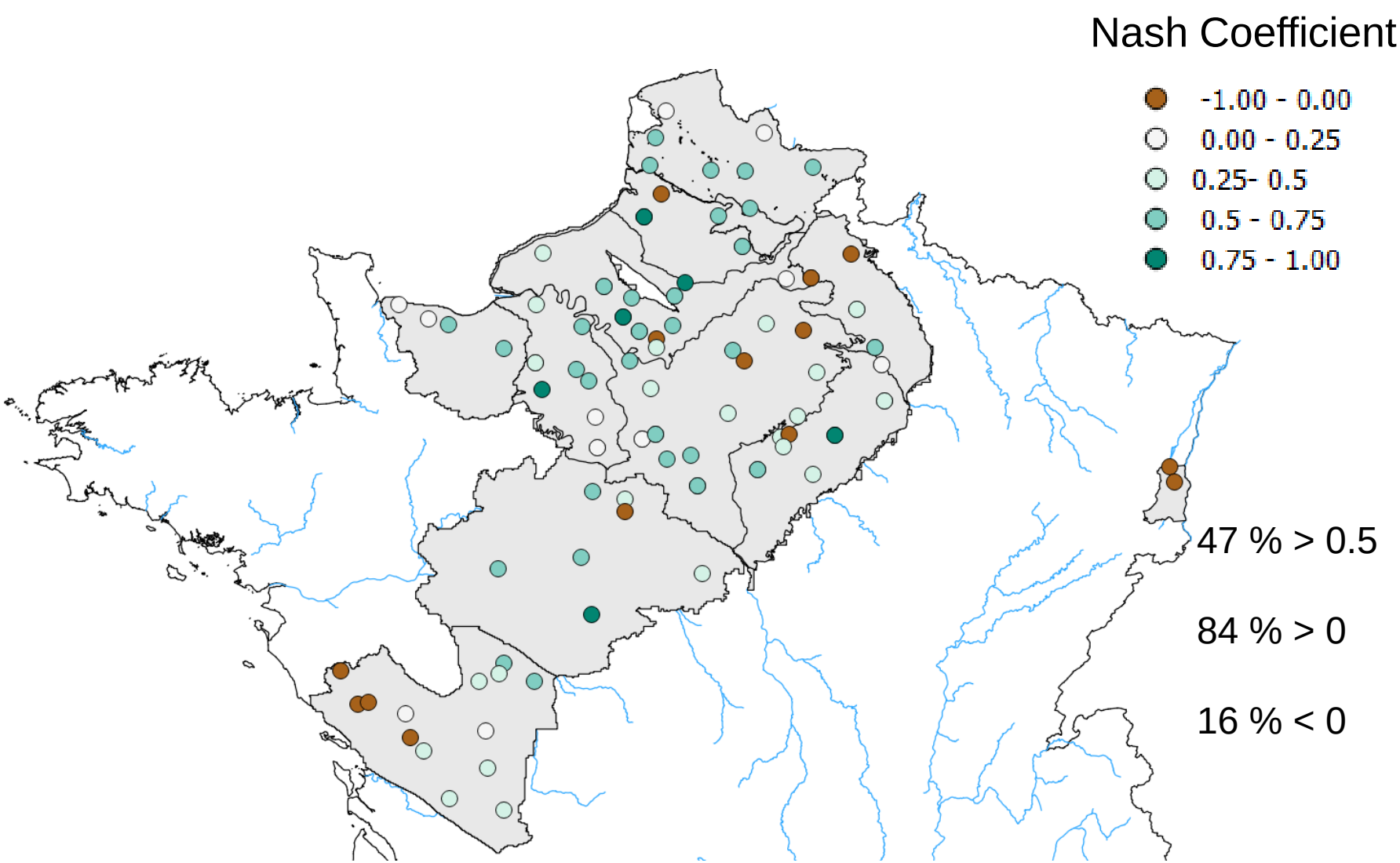


The Standardized Piezometric Level Index (SPLI)

- Indicator to compare groundwater time series
- Based on the Standardized Precipitation Index for meteorological drought
- Used in France in the **Monthly Hydrological Summary** for a set of chosen piezometers



Evaluation of the Standardized Piezometric Level Index (SPLI)



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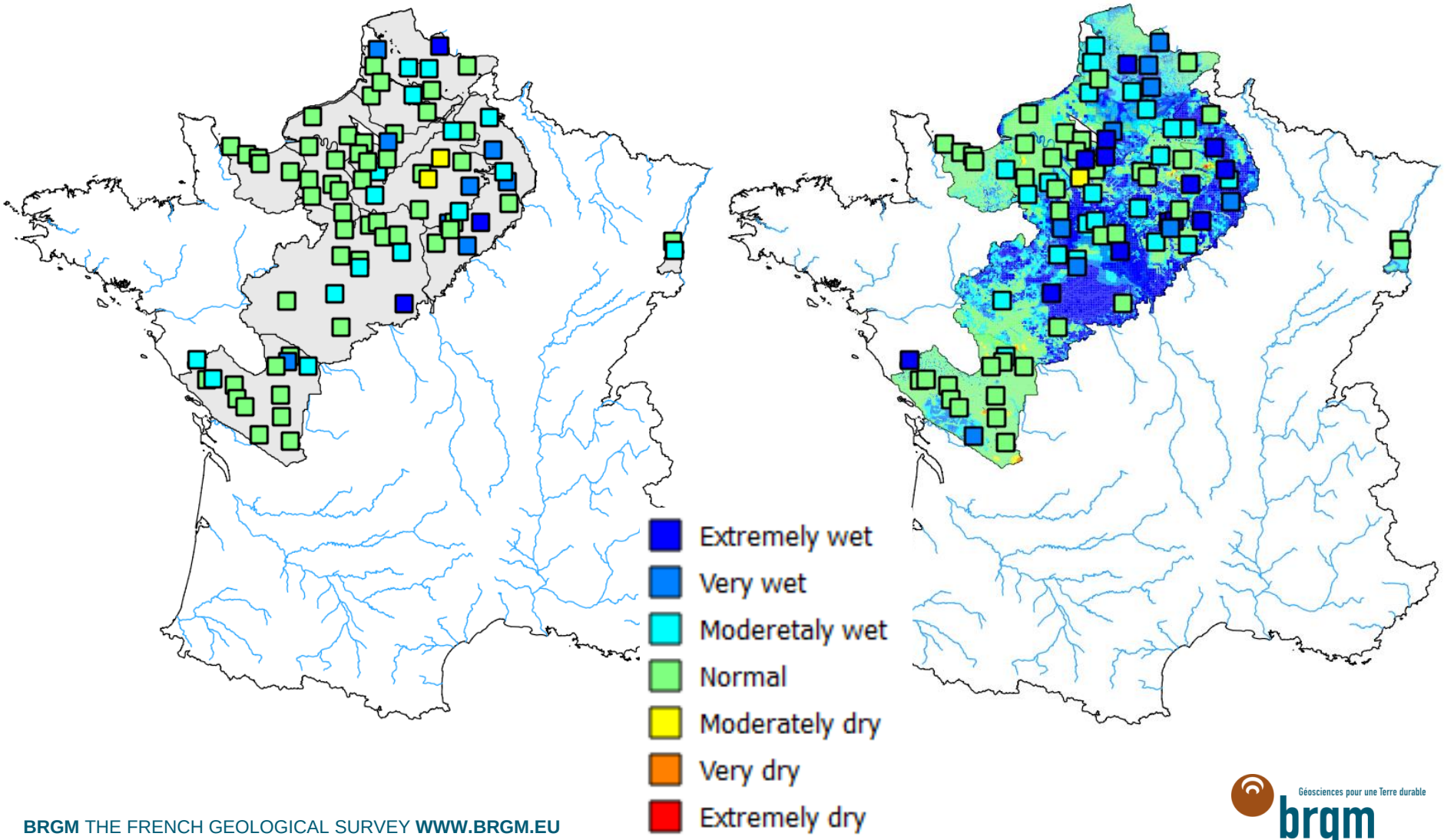
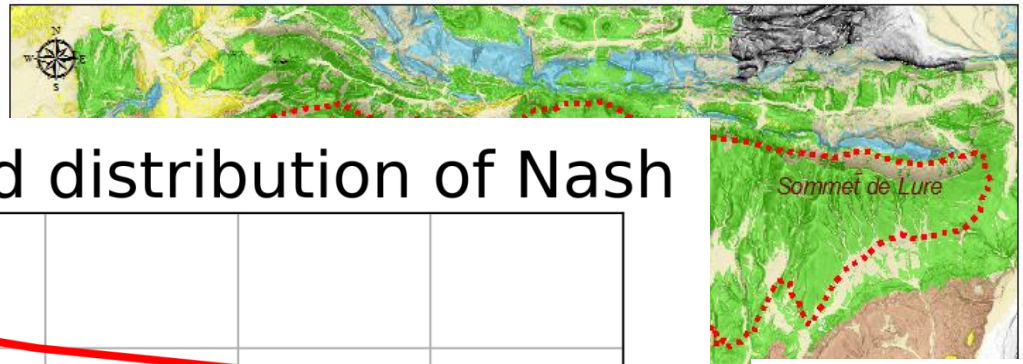
Example of SPLI maps – August 2016

Observation

Simulation

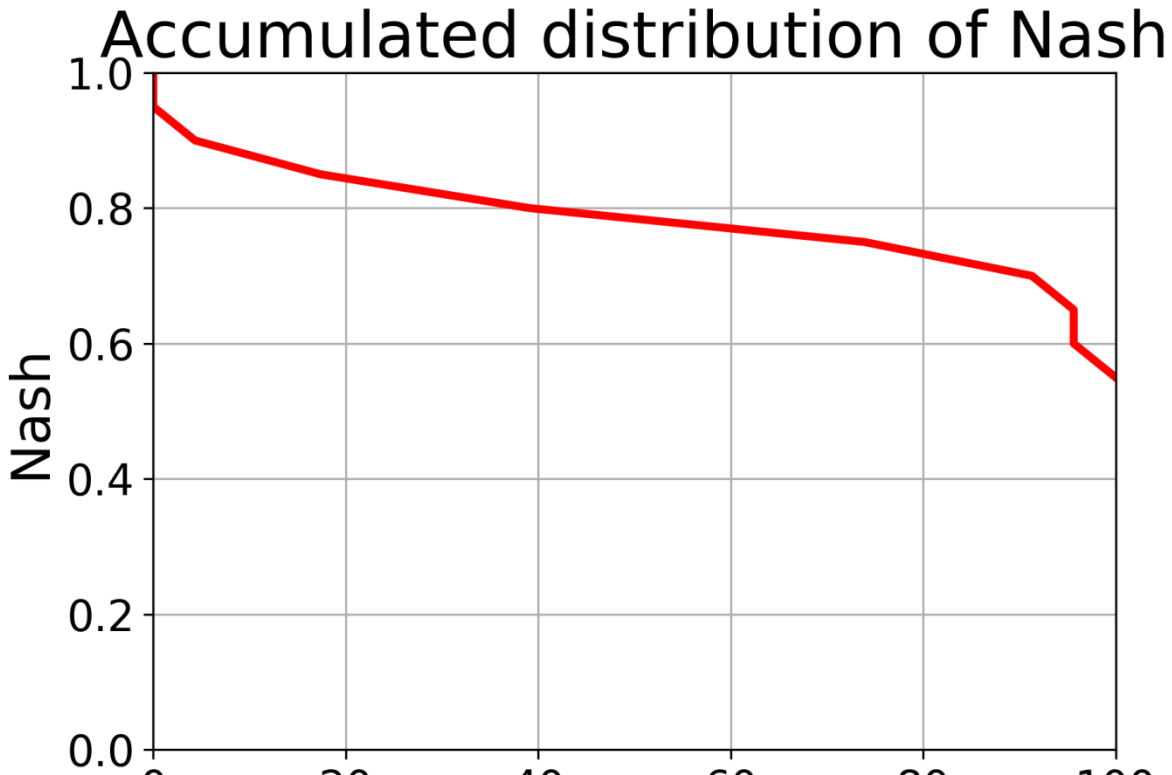


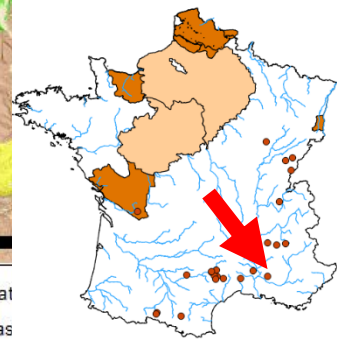
Example of karst system: La Fontaine de Vaucluse

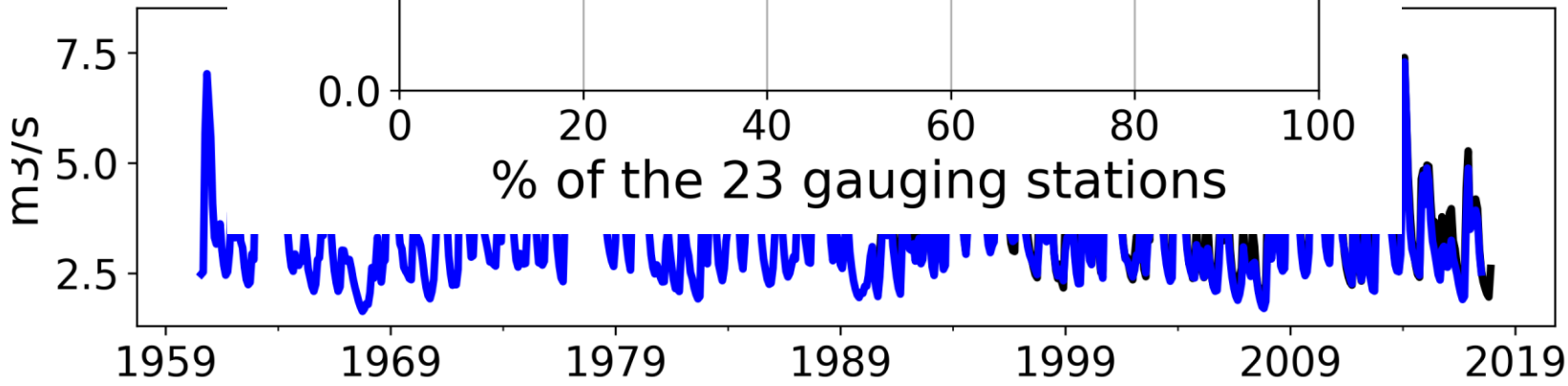


- Lumpe
- Basin A
- Calibra (1990-1
- Gaugin Sorgue

Daily Nas







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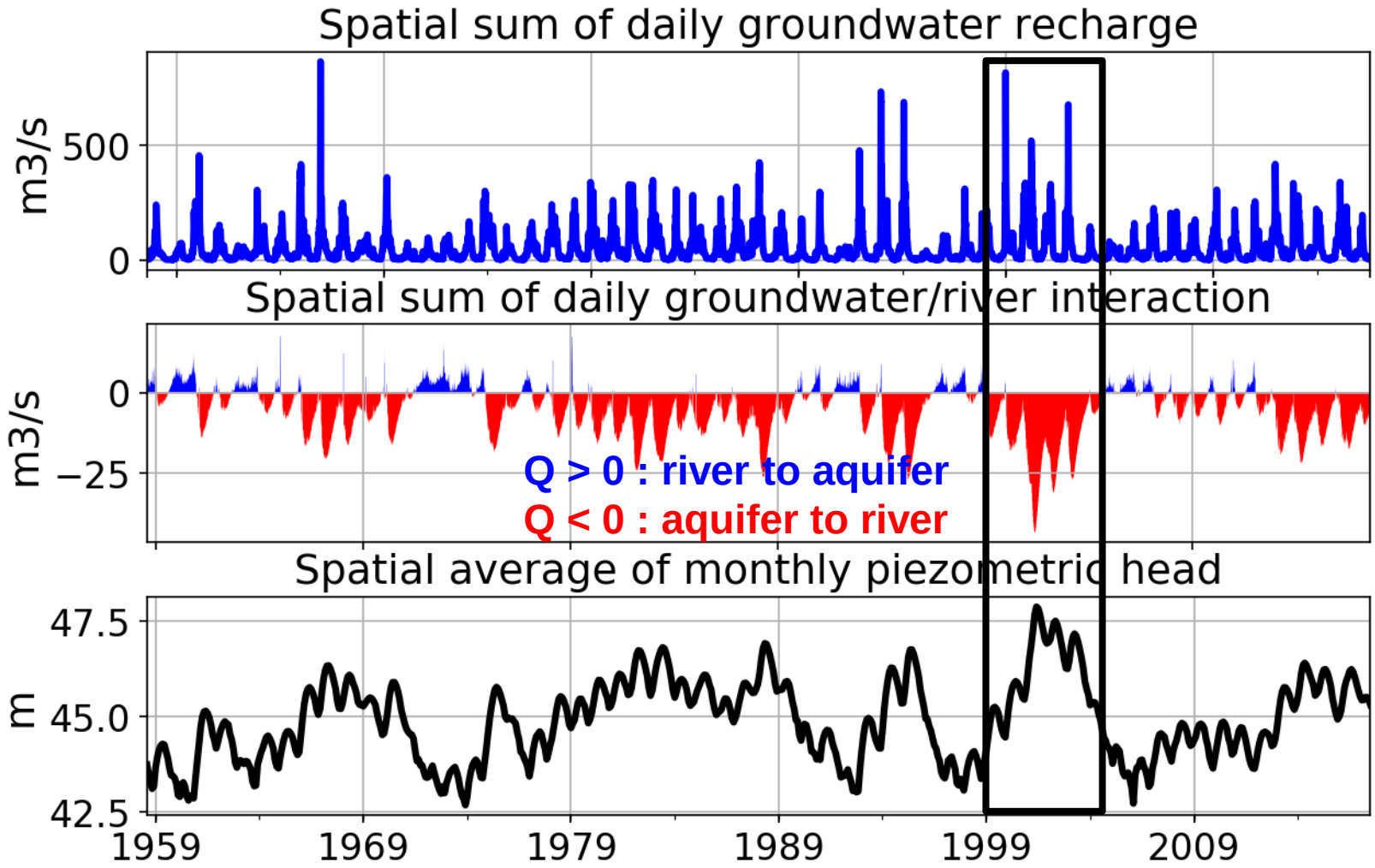
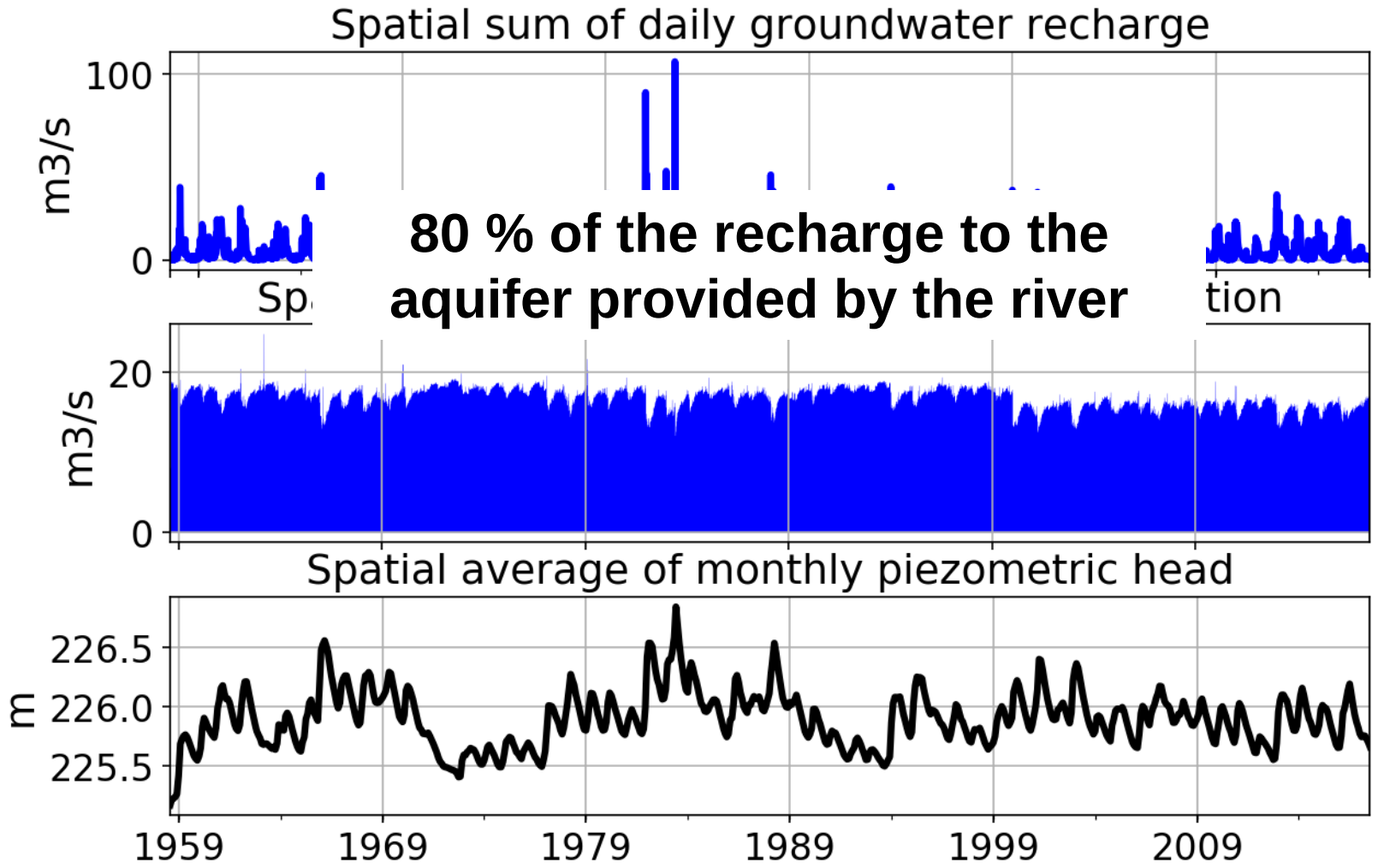
Groundwater-surface water interactions

Somme Model



Groundwater-surface water interactions

Alsace Model



80 % of the recharge to the aquifer provided by the river

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Conclusions

- AquiFR gathers **11 distributed models** and **23 lumped models** for karsts in a single tool
- **Consistent results** on the 1958-2017 long-term simulation
- Potential to produce **water resource indices** for operational purposes and climate services
  - Example : Standardized Piezometric Level Index for extreme events

Perspectives

- Add new models
- Analyze river discharge outputs
- Seasonal forecast up to 6 months
- Make outputs available to users for water resource management