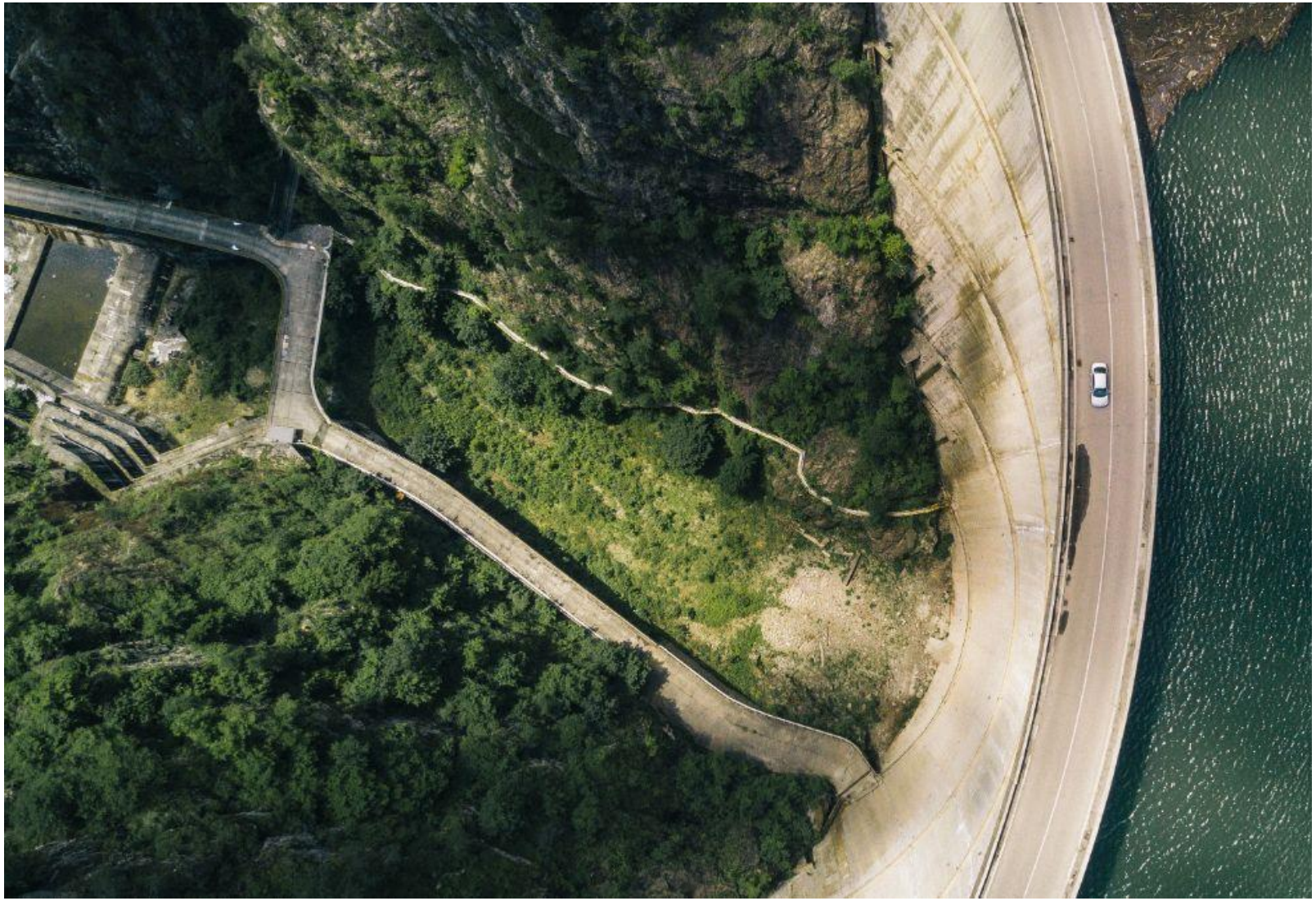


How fragmented are Europe's rivers?

Wouter van de Bund - Joint Research Centre, European Commission

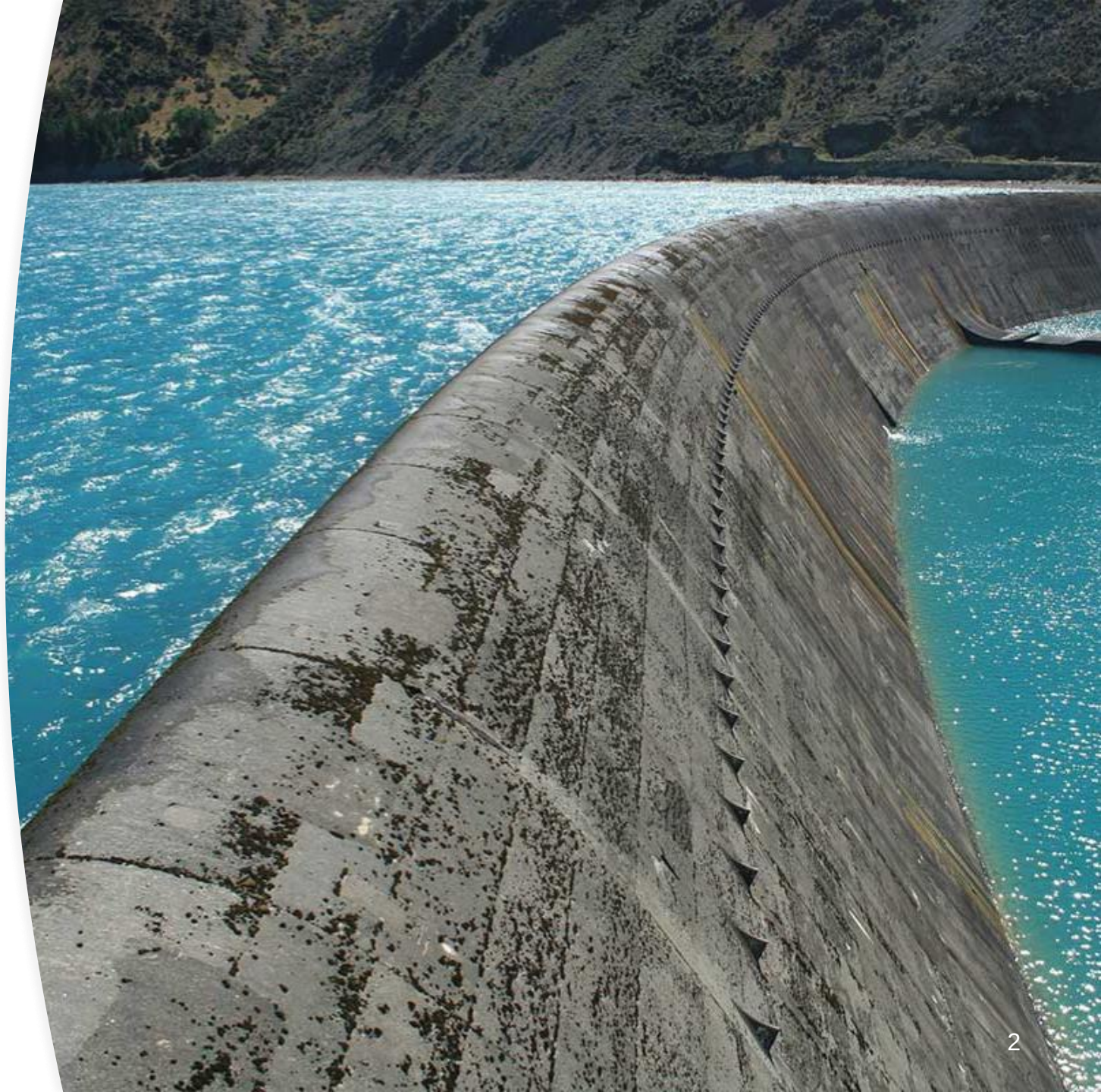
Simone Bizzi - University of Padua

Barbara Belletti - Polytechnic University of Milan; CNRS EVS-UMR5600, University of Lyon

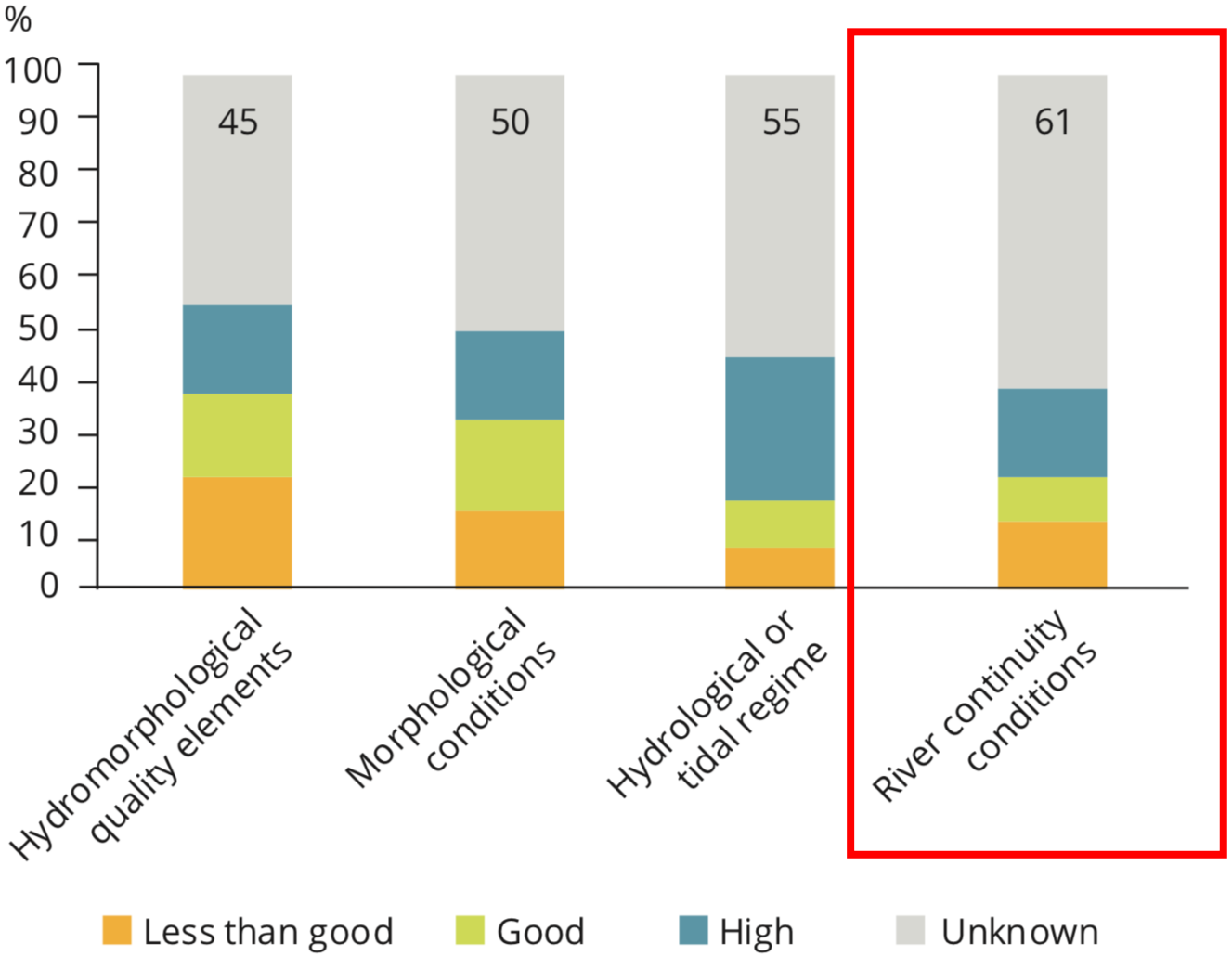
EU Biodiversity Strategy 2030

“At least 25,000 km of rivers will be restored into free-flowing rivers by 2030 through the removal of primarily obsolete barriers and the restoration of floodplains and wetlands”

Crucial question: How fragmented are Europe’s rivers?

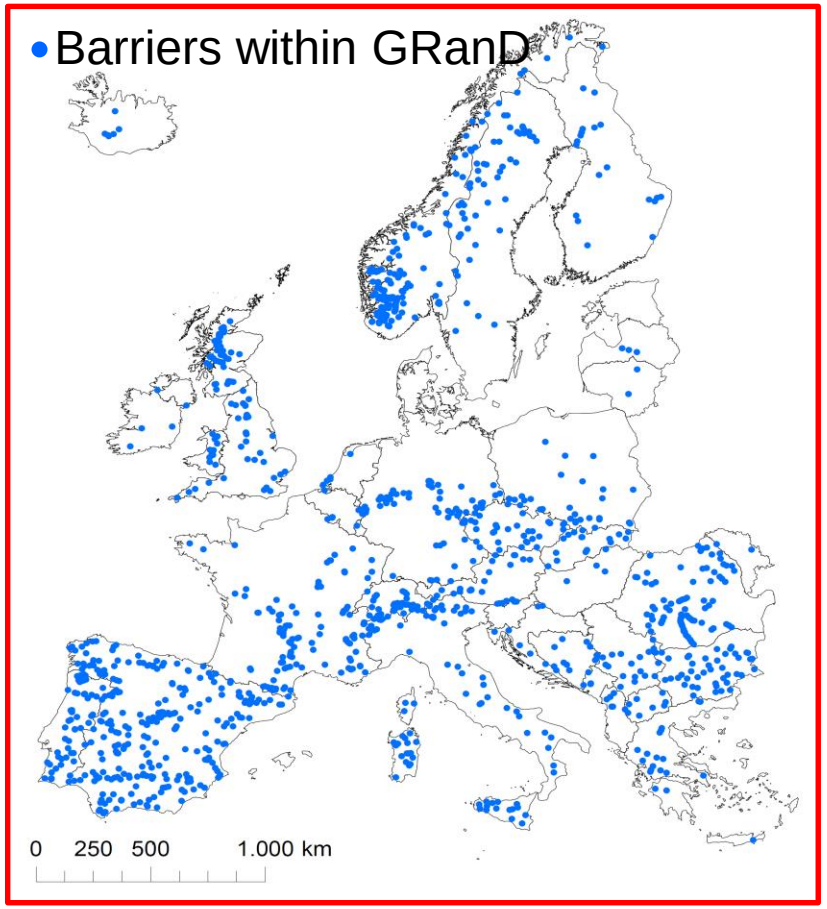


EU Water Framework Directive reporting: continuity conditions unknown in 61% of rivers

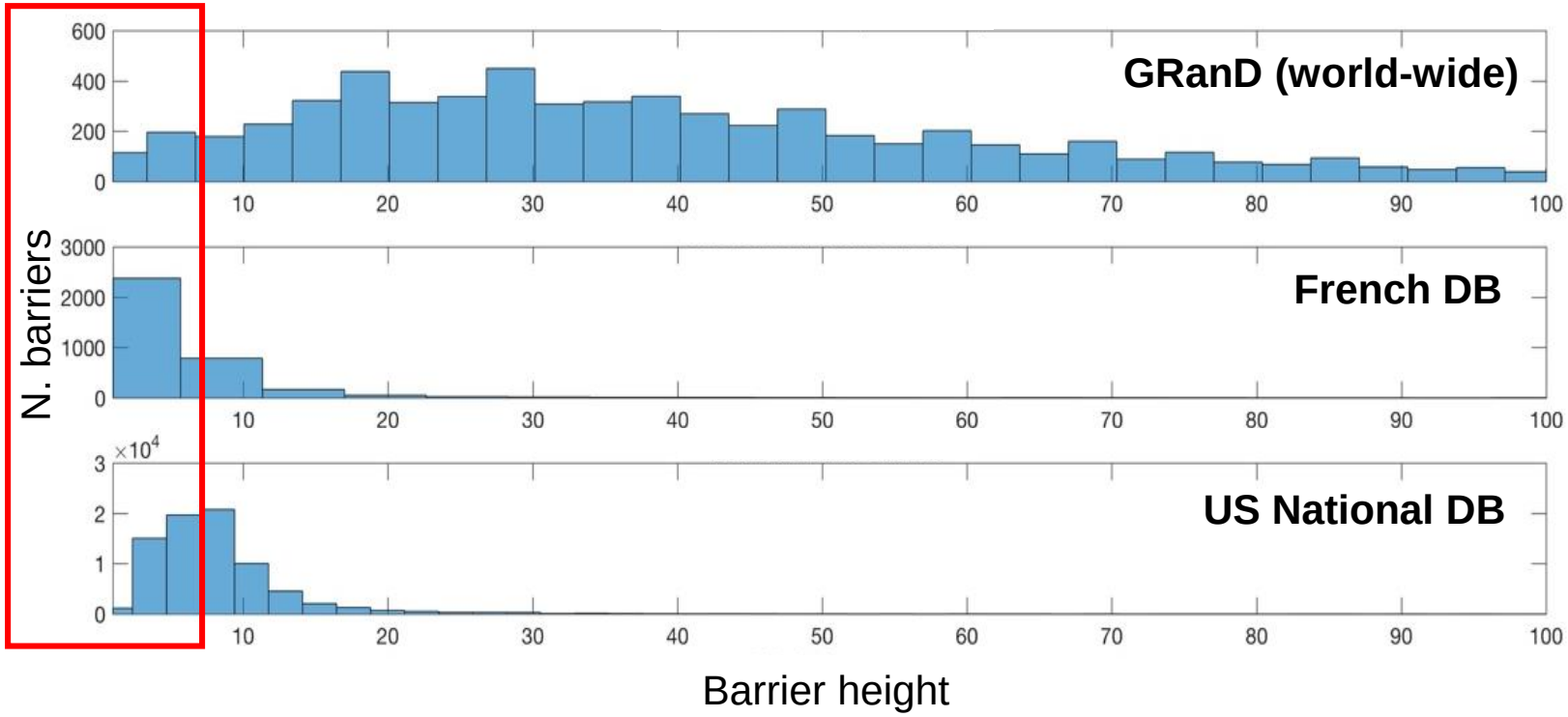


EEA (2018). European waters - Assessment of pressures and status. EEA Report 7/2018 ISSN 1977-8449

Extent of river fragmentation on EU rivers



- GRanD Database: about **1200** in EU
- GRanD + ICOLDS: about **5000** in EU



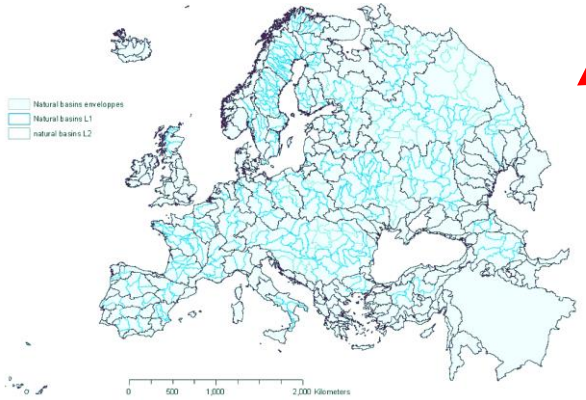
WHERE ARE ALL THE SMALLER BARRIERS?

AMBER project: building a pan-European river barrier atlas

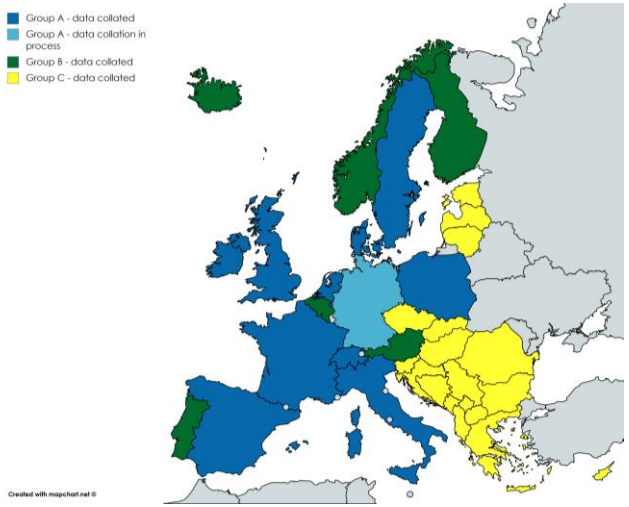
All barriers matter

AMBER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 689682.



European barrier ATLAS



All existing institutional databases

Barrier ID-card

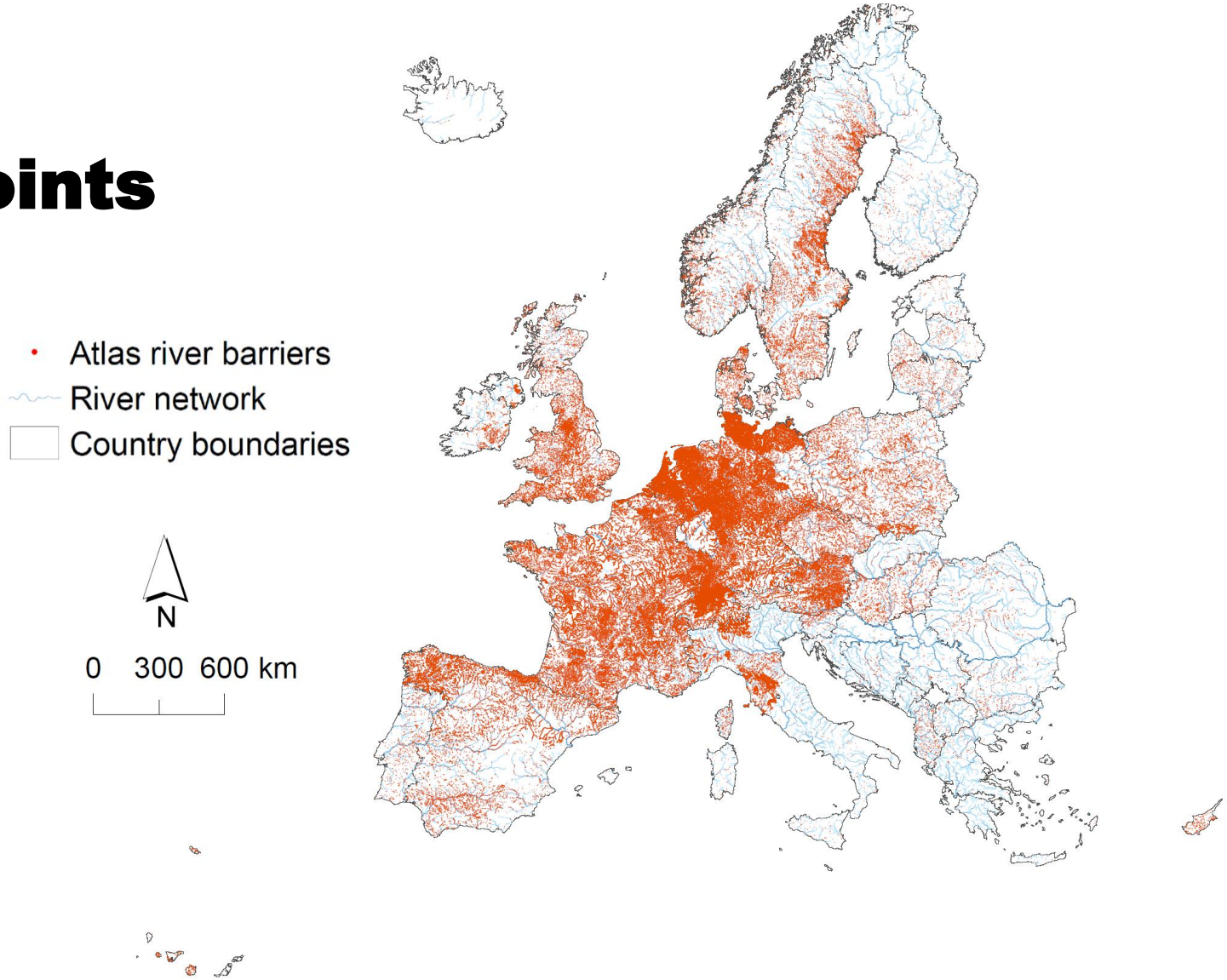
ATLAS_ID	New ID defined within AMBER
Source_ID	ID of the source database
URL	Link to data source
Country	EU country
X_coord	Latitude (WGS84)
Y_coord	Longitude (WGS84)
River	Name of the river
Basin	Name of river basin
Height	Barrier height (m)
Type	Dam, weir, spillway, etc.
Year	Date of building (end)

Compiling and merging existing national, regional and global data sets

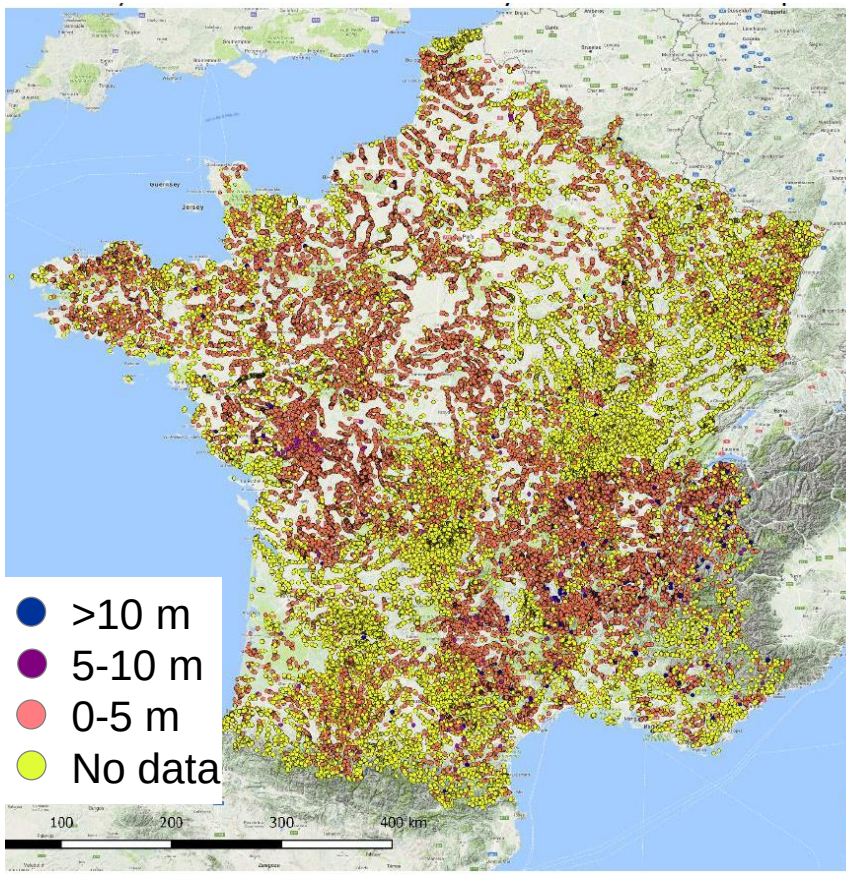
>750.000 records

630,000 unique data points

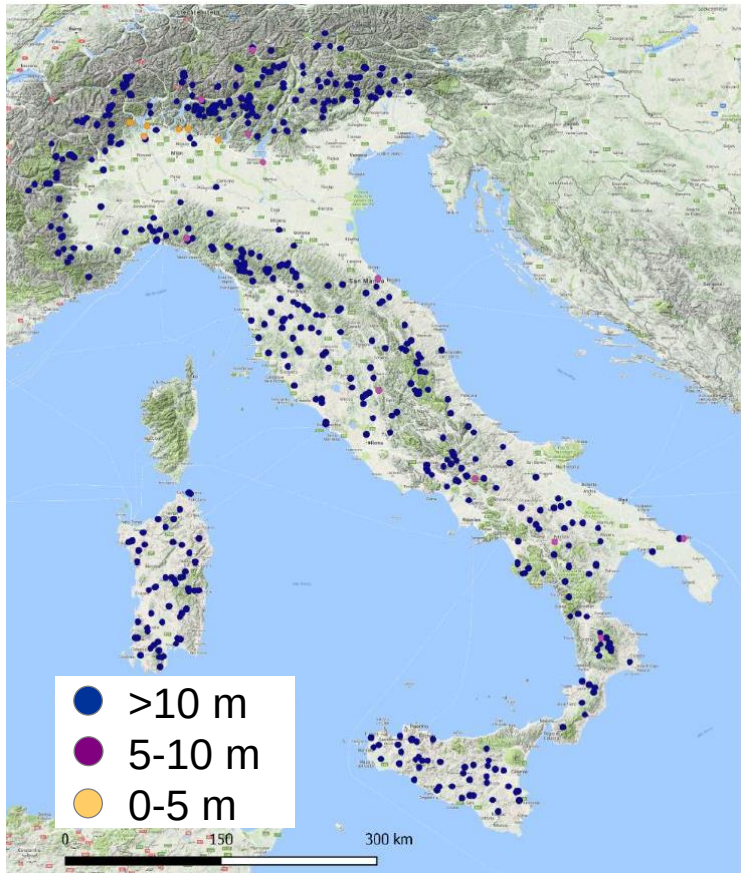
- 120 source databases
  - 4 global
  - 52 national
  - 65 local/regional
- 36 countries



But existing data are inconsistent among countries and data quality is far from being satisfactory



Very detailed and consistent database



Only main dams recorded at national scale

- barrier height data often lacking
- >1,000 different types of barriers
- No barrier age

How to quantify the real fragmentation of EU rivers?

- Field validation (‘bottom-up’ approach)
- Building realistic models of barrier density and river fragmentation (‘top-down’ approach)

A field-based procedure to check the quality of ATLAS data

5 rivers x 20 km each = 100 km river network / country

Representative of a wide range of river types

Mountain, mid altitude, lowland

High vs. low slopes

Single-thread vs. multi-thread

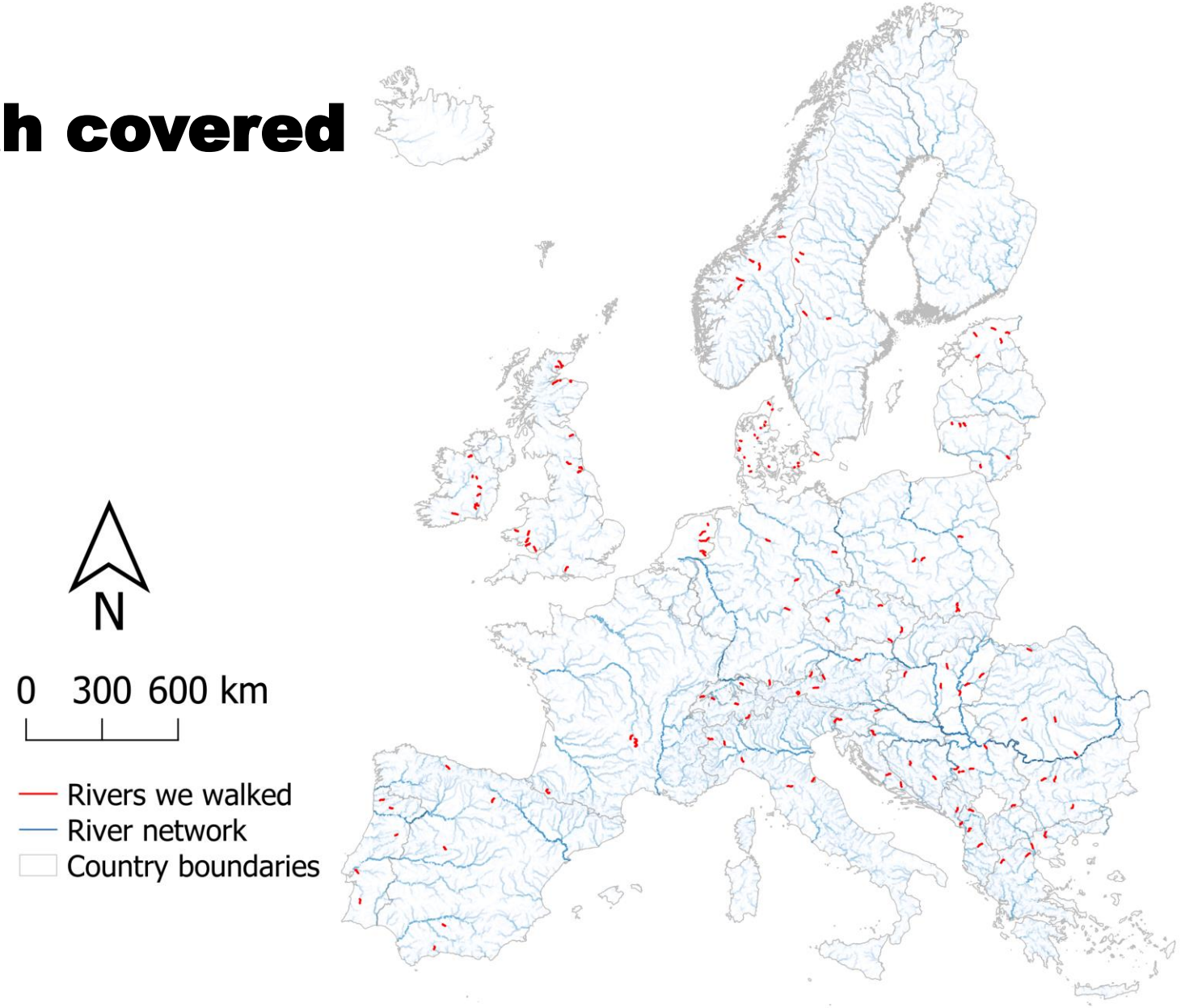
Walking along river banks and recording some key features

Name	Description
Picture	A photo of the barrier – provide a reference for the picture
Location	Lat/Long coordinates for e.g. via GPS chipset on phone
Date	Date of record in format day/month/year
Barrier type	Dam, weir, culvert, ford, ramp and bed sill, sluice, unknown
Barrier height	<0.5 m, 0.5 - 1.0 m, 1.0 – 2.0 m, 2.0 – 5.0 m, 5.0 – 10.0 m, >10.0 m
Barrier use	Barrier still useful/in-use, Y/N/don't know
Barrier width	Full width, Y/N

Calculation of correction factors for barrier density

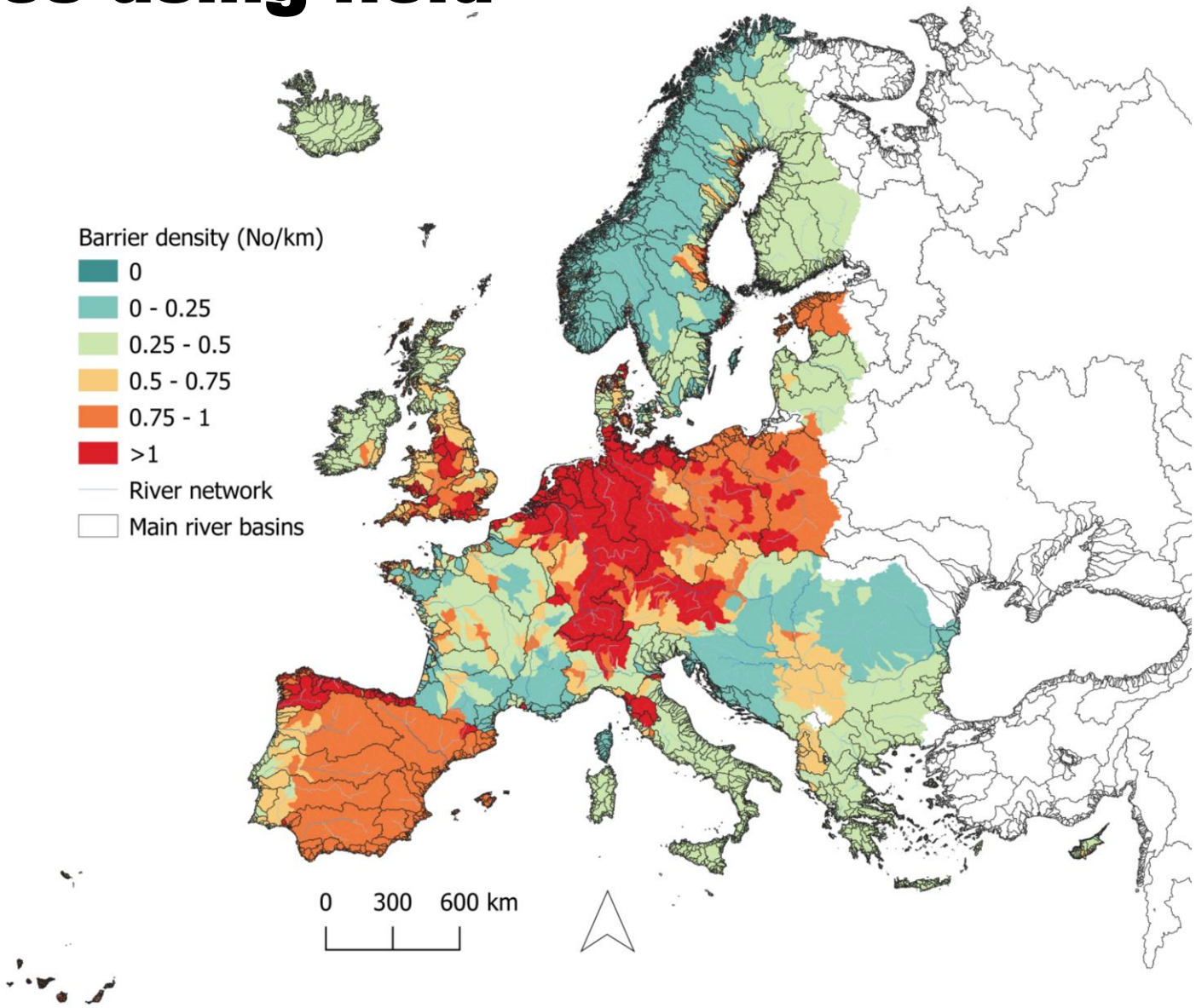
Field validation:
2,715 km of river length covered

- 26 countries and 147 rivers
- 1,583 barriers recorded of which 960 were new records for the study reaches
- None of the 147 surveyed rivers were free of artificial barriers
- The number of barriers recorded in the field was on average 3.8 times higher than those in existing inventories
- Correction factor varied considerably between countries

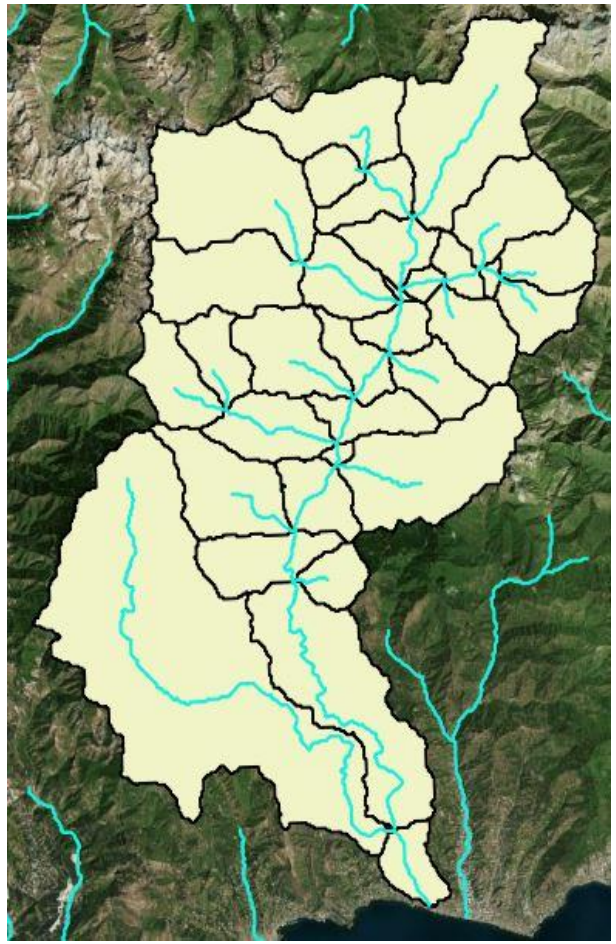


Barrier density estimates using field validation

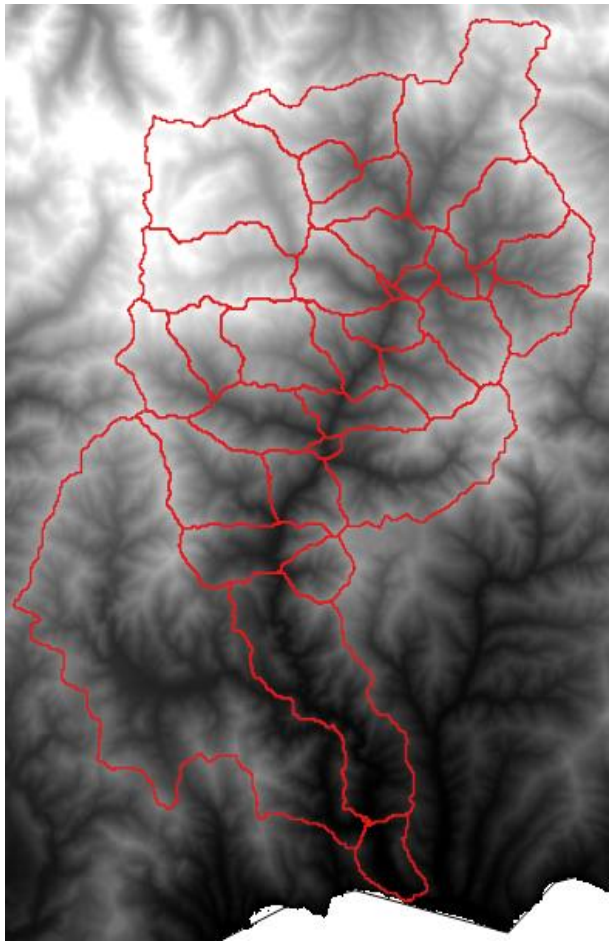
Based on the field survey results we derived a correction factor to be applied to existing databases for each country and to generate a pan-European map of barrier density.



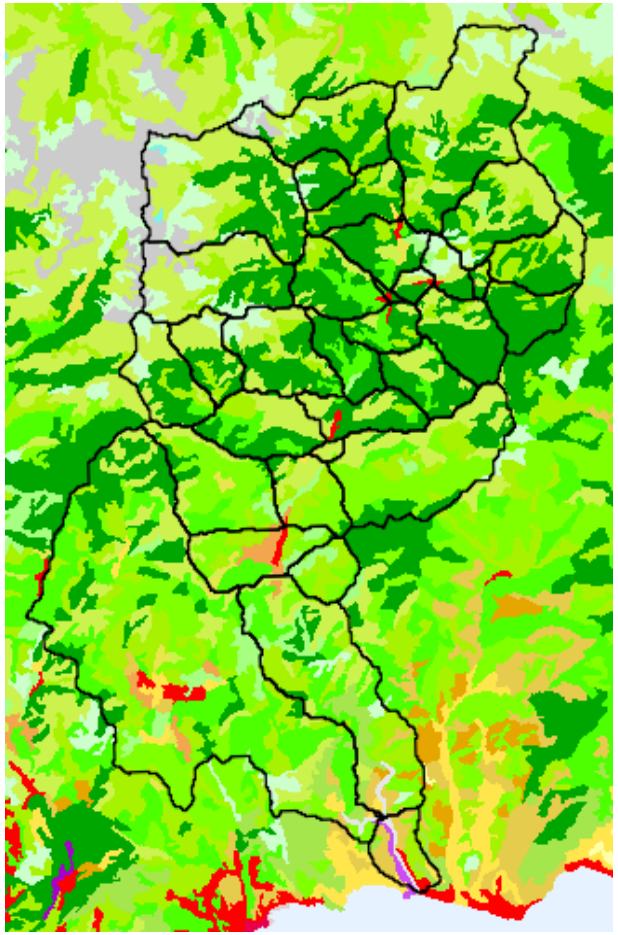
Modelling barrier densities



Hydrology



Morphology



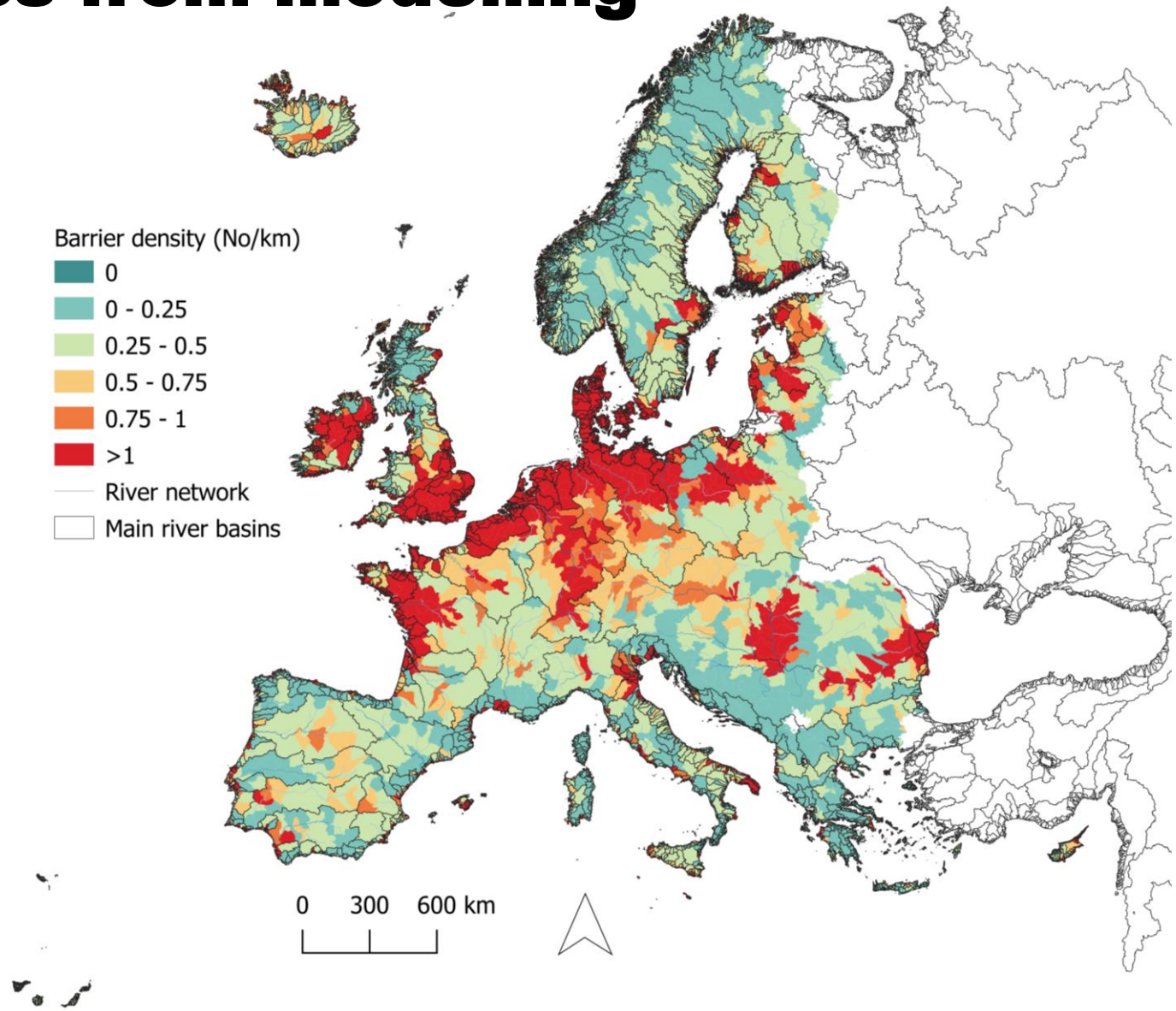
Land cover

Demography

Hypothesis: barrier density across Europe is related to other large-scale environmental or anthropic variables

Barrier density estimates from modelling

- We applied machine learning algorithms to build a model of barrier density across Europe.
- Best predictors resulted: agricultural pressure, road density, proportion of area covered by surface water, and elevation.

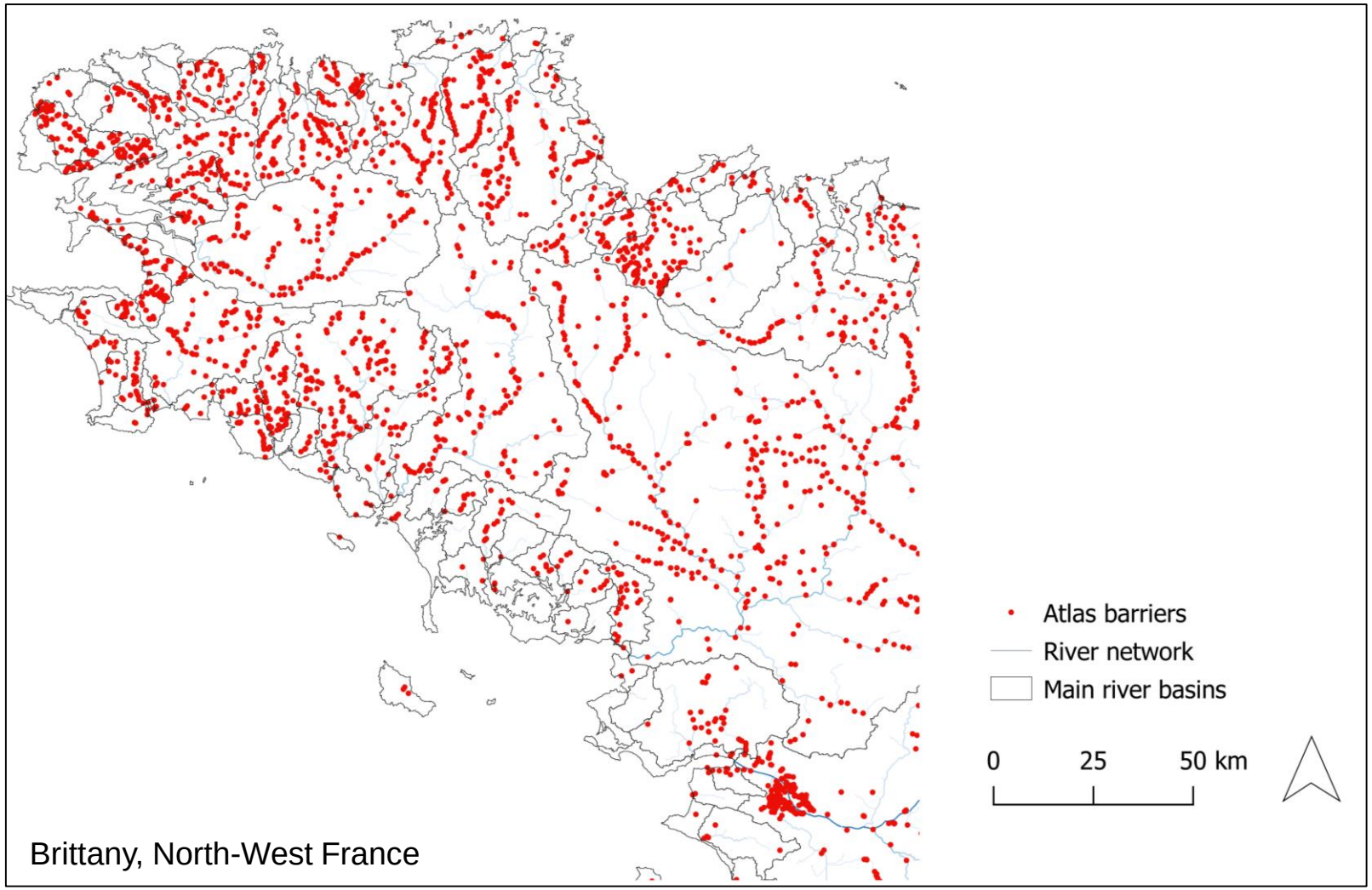


How many barriers are there in Europe

	No barriers	Barrier density (No/km)
AMBER Atlas	630,000	0.38
Field corrected	1,200,000	**0.74**
Modelled	991,300	**0.6**

- Good coherence between two very different modelling approaches: likely a robust estimation
- There is a problem of underreporting

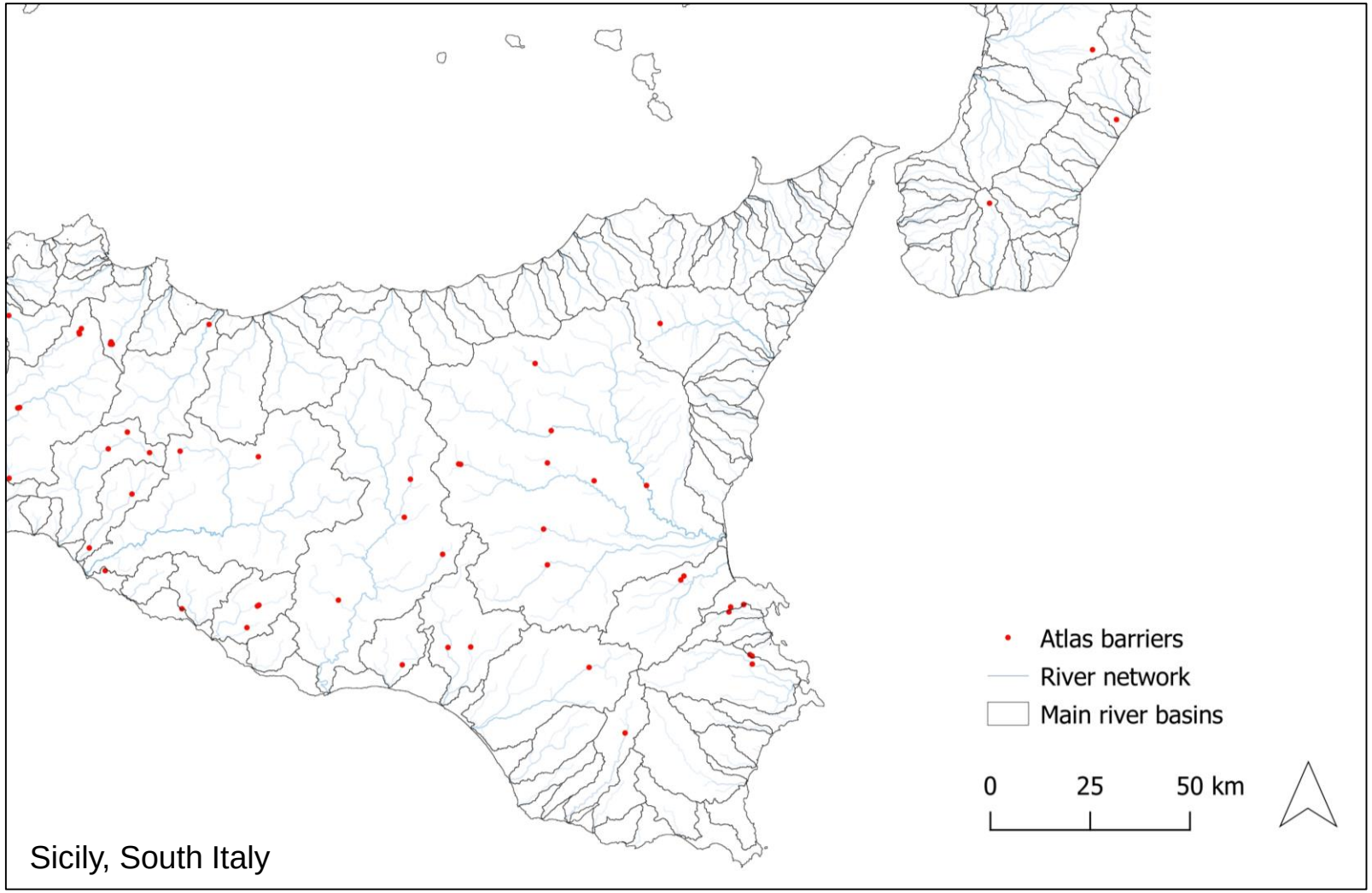
Importance of mapping and monitoring of barriers, especially the small ones



Brittany, North-West France

- (almost) all barriers known
- Possible to quantify connectivity, identify free-flowing rivers
- River basin managers have the information needed for management of river connectivity

Need for better mapping and monitoring of barriers, especially the small ones



Sicily, South Italy

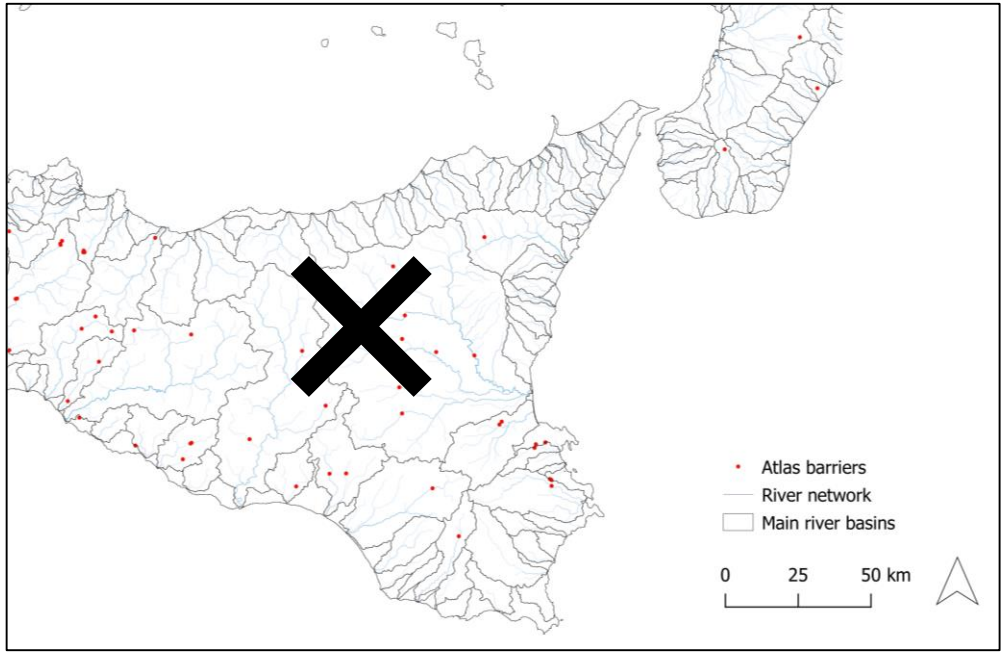
- There are orders of magnitude more barriers but it is unknown where they are located
- Impossible to quantify connectivity and identify free-flowing rivers
- Not possible for river basin managers to manage river connectivity without mapping the barriers in the field
- AMBER has developed guidance and tools for barrier monitoring assessment

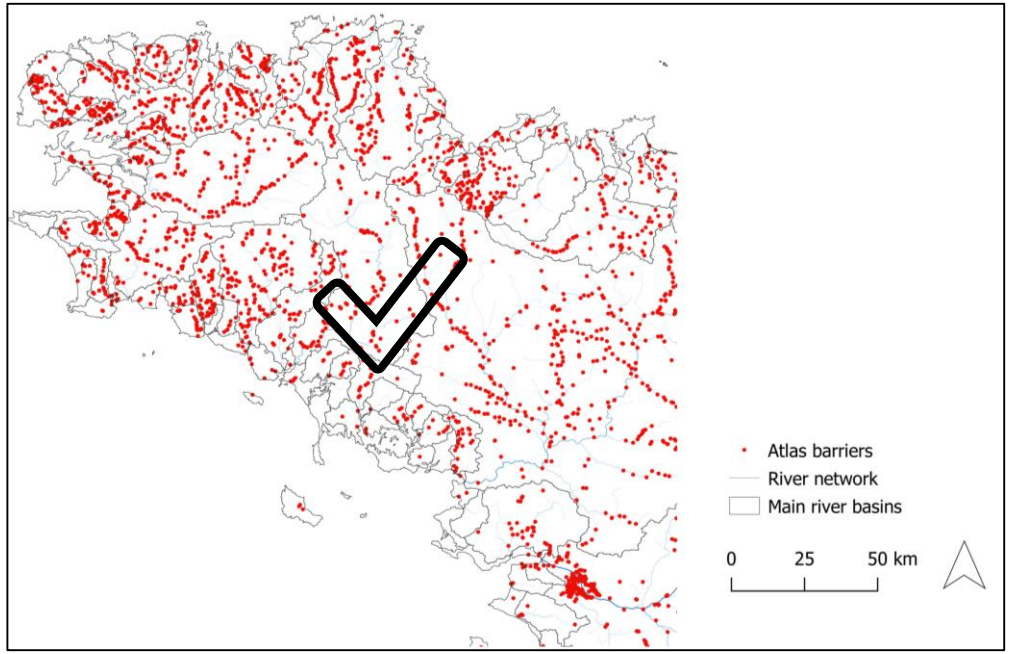
Need to recognize the importance of small barriers

What is more impacting ?

Need a paradigm shift that moves away from considering only the impacts of large dams on flows and megafauna, and recognises the more widespread, cumulative and (then) subtle impacts of hundreds of thousands of smaller structures on sediment transport, fauna and nutrient connectivity!

Need to map ALL barriers to manage connectivity





Moreover: many barriers are out of use and can be removed

(but in most cases we don’t know where they are and how old they are: this undermines management and planning!)

Arno (Italy)

Marecchia (Italy)

THANK YOU LET IT FLOW