Virtual Exchange on Artificial Intelligence for
Integrated Drought Risk Management

STARS 4 Water

MLMapper: a versatile AI tool for spatial mapping

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EU Grant Agreement
101059372

Concept

It is posible to use machine learning to predict any spatially-distributed variable in space (and time) based on a series of predictor variables and ground truth to calibrate the algorithms

“AI-based predictive mapping”

Worked extensively with groundwater exploration -- *crucial for drought-proofing in arid and semiarid regions*

Where to find groundwater

Where/how to maximize borehole yields

Which areas are more vulnerable to groundwater contamination

Where to drill monitoring boreholes to monitor/manage groundwater contamination

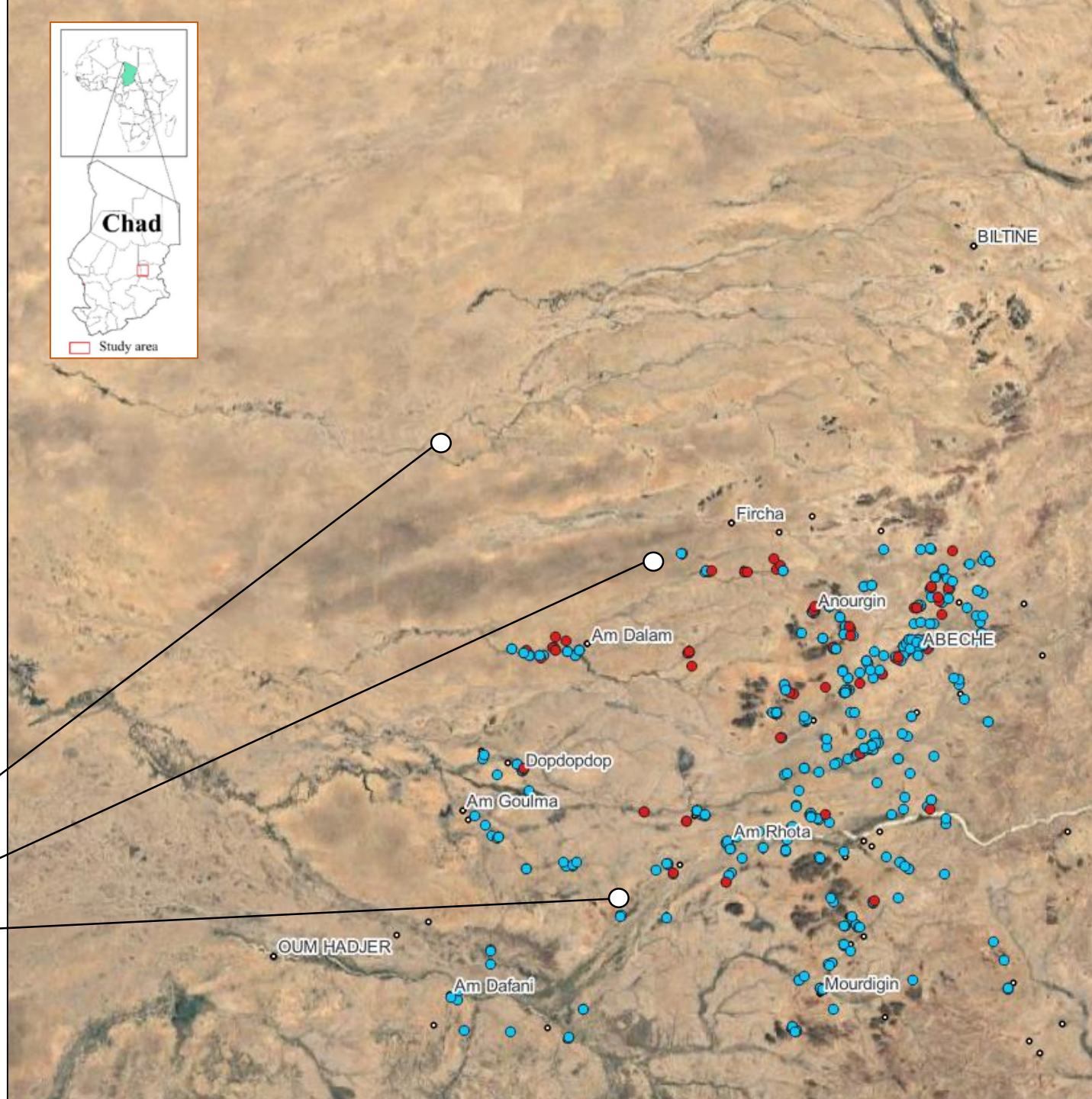
Mapping and protecting groundwater-dependent ecosystems

(…)

Currently incorporating the temporal dimension

TARGET VARIABLE

Would I find groundwater if I drilled here?



How does it work?

Underlying hypothesis: “we can predict groundwater presence in space based on a set of predictor variables and a ground-truth database”

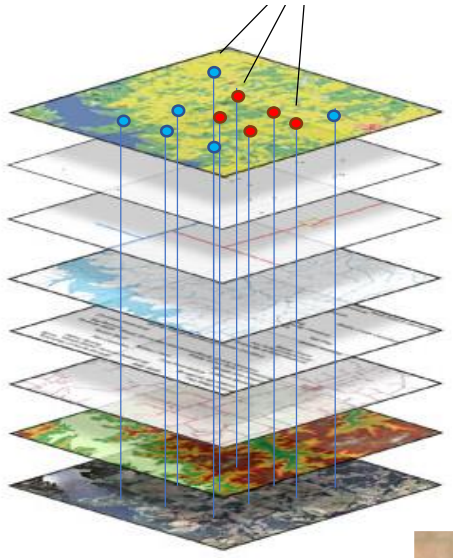
Target variable: presence/absence of groundwater

GIS Environment

Predictor variables

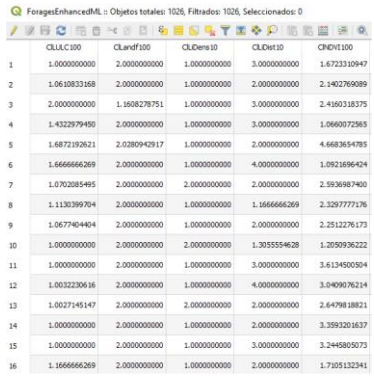
- Lithology
- Presence of fractures
- Slope
- (…)
- Soil
- Proximity to surface water
- NDVI – dry season

Ground-truth database



Colinearity test

Each borehole is associated with a pixel value for each explanatory variable



Cross validation

Random-search parameter fitting

Feature ellimination

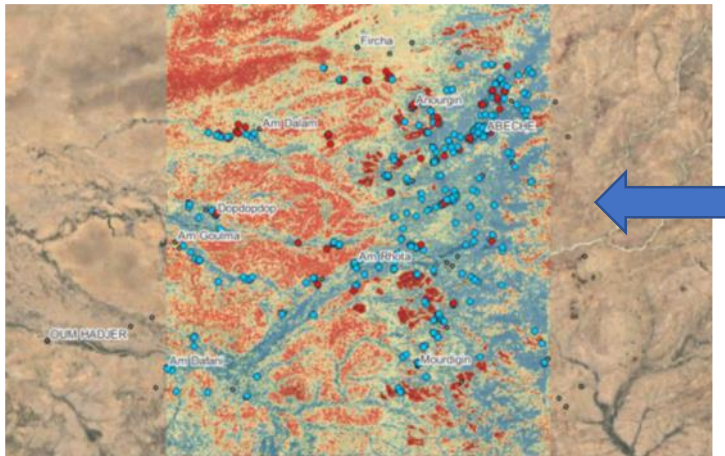
These algorithms are used to find the combination of explanatory variables that render a positive/negative outcome

A part of the dataset is used to learn and the other part is used to calibrate the results

Scoring metrics

When test score > suitable threshold we can extrapolate

That gives us a predictive map



scikit learn

QGIS

MLMAPPER

- Linear vector support
- Support vector machine
- Multilayer perceptron
- K-Neighbours
- Naïve Bayes
- Gaussian process classifier
- Linear Discriminant
- Gradient boosting
- Quadratic Discriminant
- Logistic Regression
- Random Forest
- Decision Tree
- AdaBoost

“Identification by similarity”

Find areas that present similar markers to those that we know to be contaminated

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Demonstration cases

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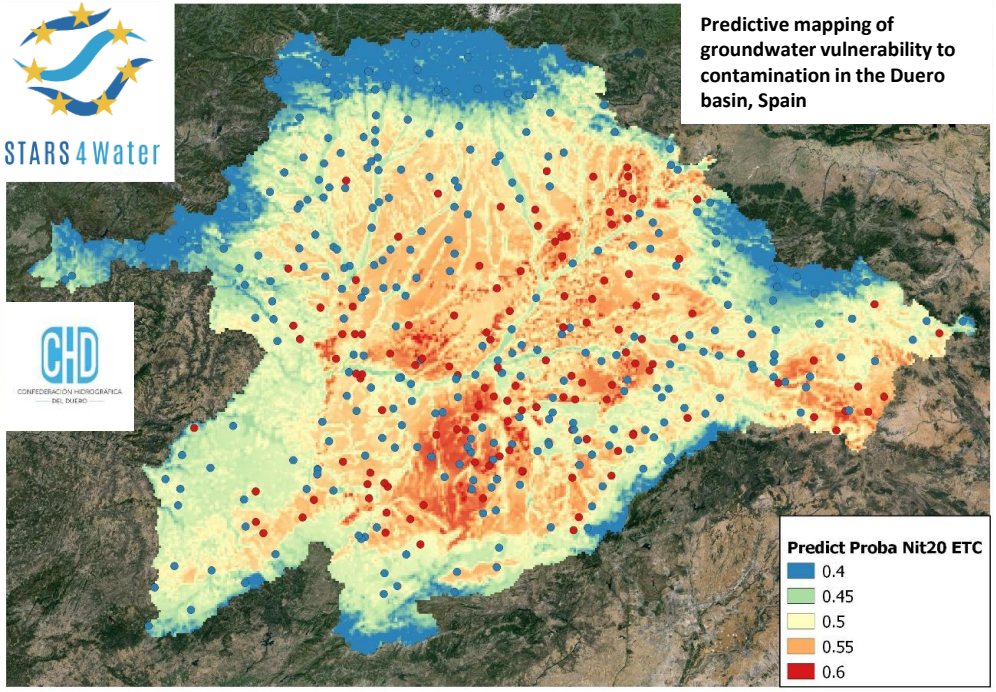
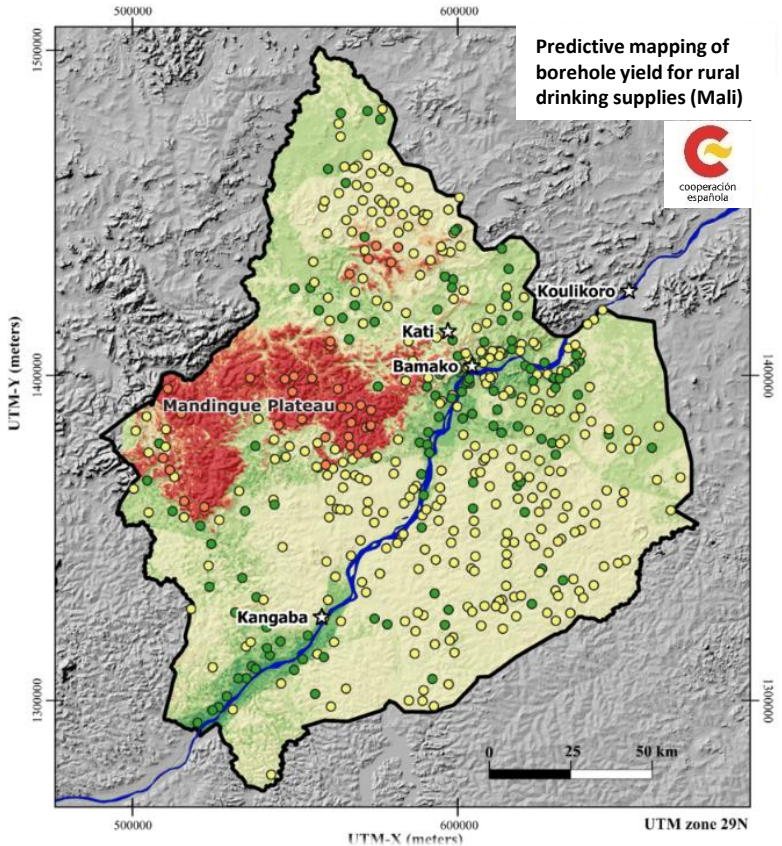


Predictive mapping of groundwater vulnerability to contamination in the Duero basin, Spain

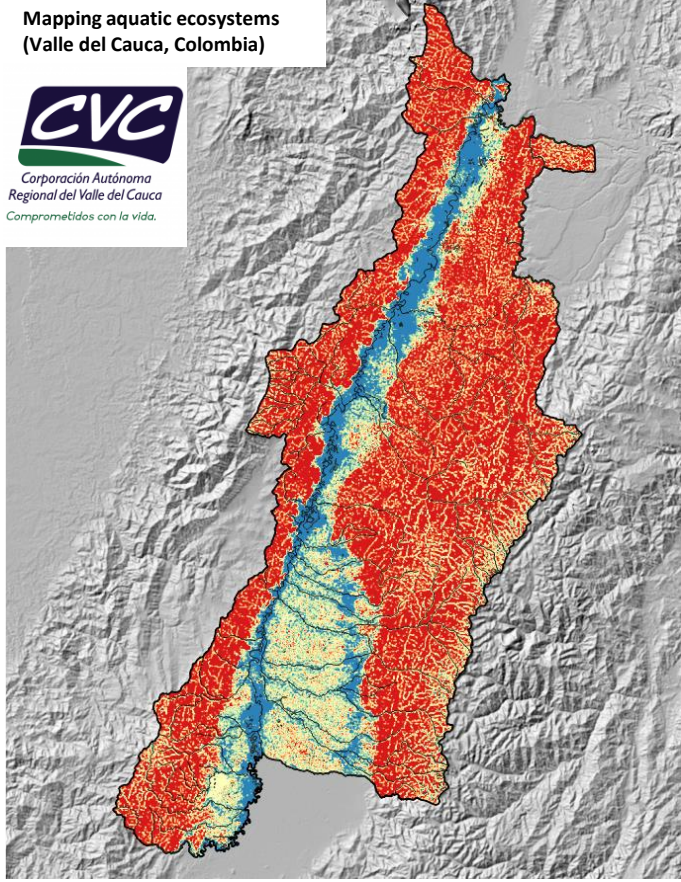


Predictive mapping of borehole yield for rural drinking supplies (Mali)

cooperación española

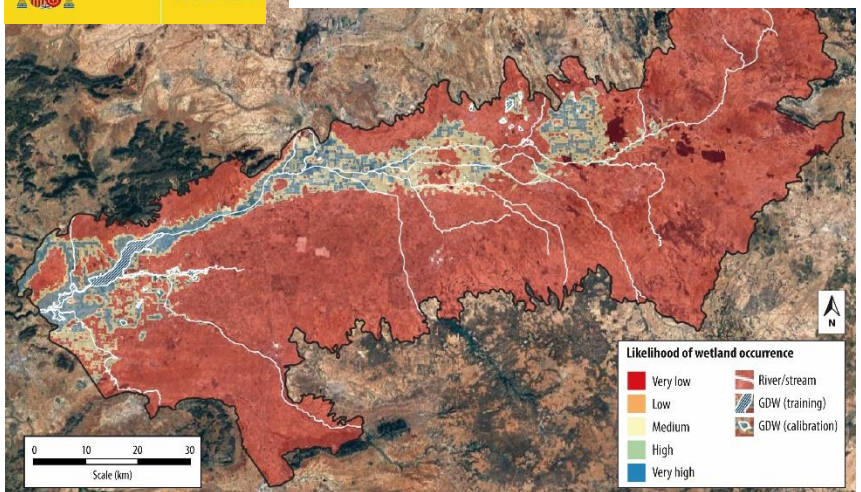
Mapping aquatic ecosystems (Valle del Cauca, Colombia)

CVC
Corporación Autónoma Regional del Valle del Cauca
Comprometidos con la vida.



GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

Predictive mapping of groundwater-dependent ecosystems (UNESCO's Mancha Húmeda Biosphere Reserve, Spain)



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
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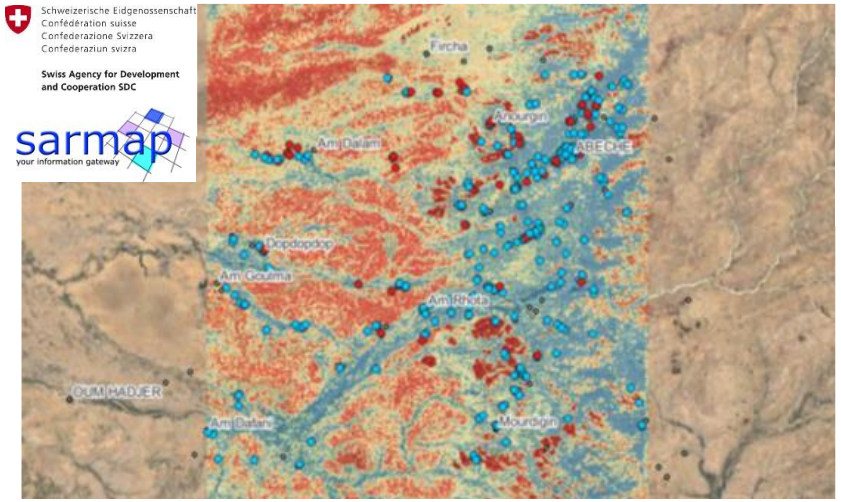
Swiss Agency for Development and Cooperation SDC

sarmap
your information gateway

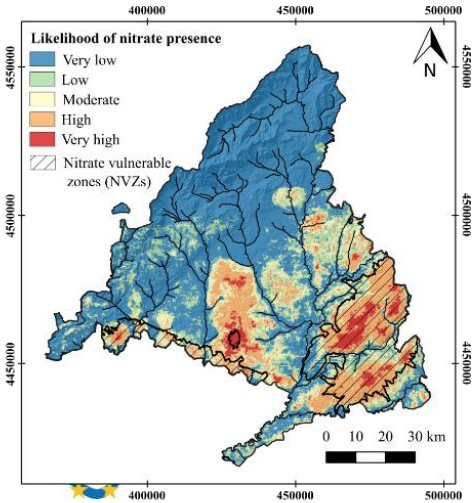


Groundwater potential mapping in the Ouaddai region, Republic of Chad

Predictive mapping of groundwater contamination in the Madrid Region (Spain)

talantiA

Comunidad de Madrid



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Thanks!

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