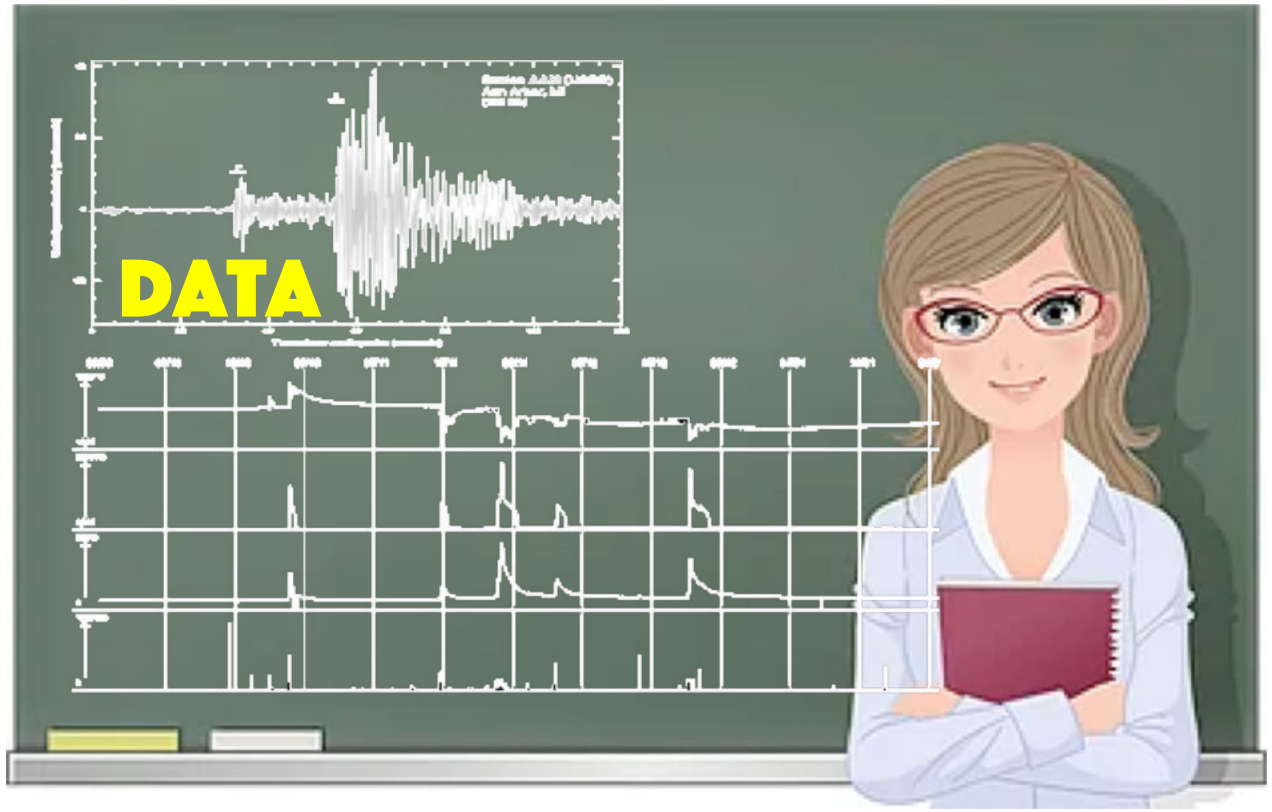
GIFT 2023

Tuned in to the Earth : data mining at school

Jean-Luc Berenguer, University Côte d'Azur, EDUMED Observatory, France



The use of data is a key part of the scientific process, especially in geoscience!

Let us go back to some case studies …

EGU Education

CASE STUDY
Agenda 2030 /
Natural Hazards

Turkey / Syria struck by strong magnitude earthquakes

Damage in many cities with many buildings collapsing.

2023, Feb. 06

CASE STUDY
Agenda 2030 /
Climate change

Mediterranean weather storm destroyed many villages in the valley

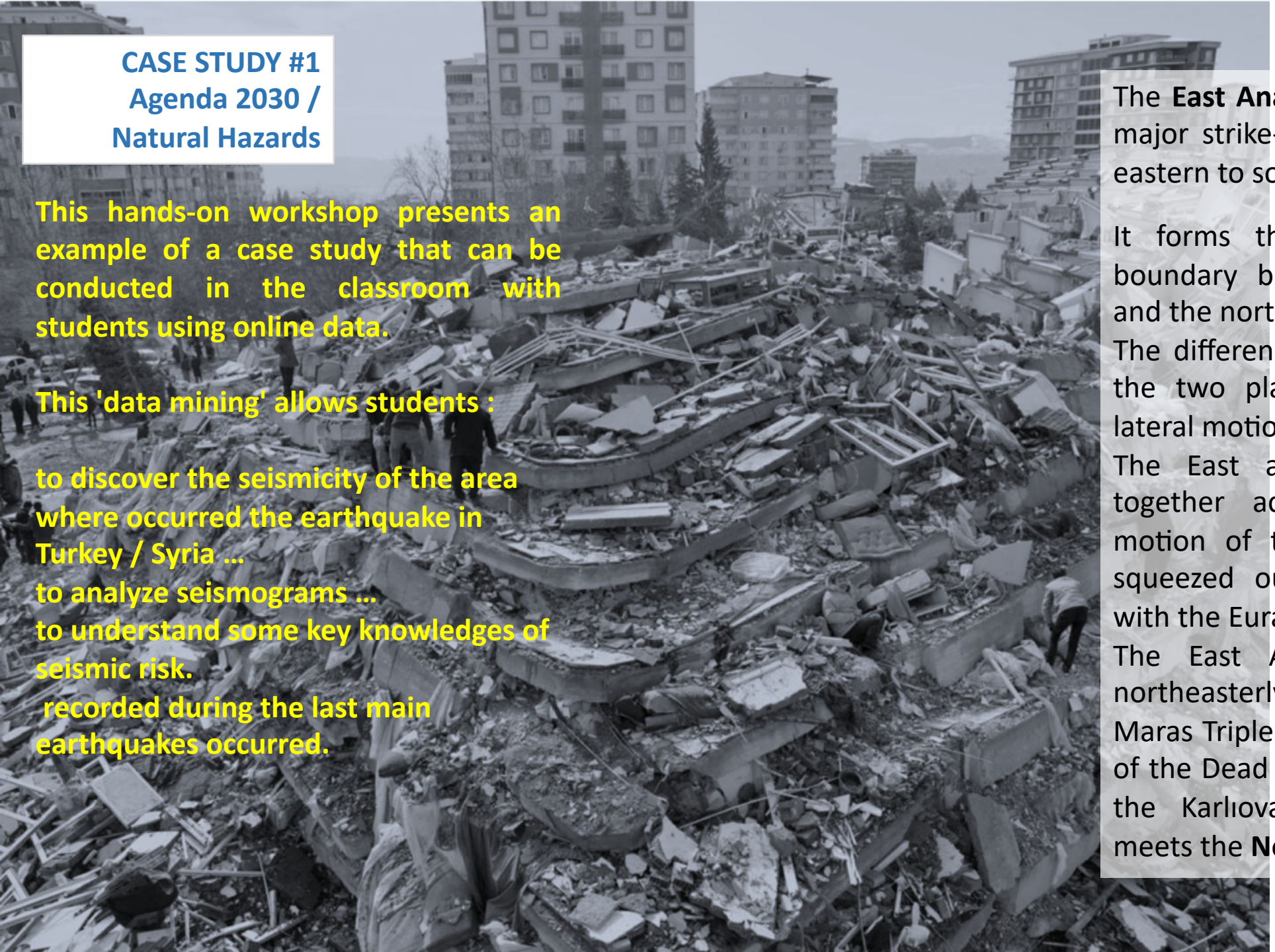
A few hours after the Mediterranean storm Alex at the French-Italian border.

2020, Oct. 02

What means data mining ….

You have to find:

Database on line
Tools to analyse data
Strategy to use data



CASE STUDY #1
Agenda 2030 / Natural Hazards

This hands-on workshop presents an example of a case study that can be conducted in the classroom with students using online data.

This 'data mining' allows students :

to discover the seismicity of the area where occurred the earthquake in Turkey / Syria …
to analyze seismograms …
to understand some key knowledges of seismic risk.
recorded during the last main earthquakes occurred.

The **East Anatolian Fault** Zone (EAFZ) is a major strike-slip fault zone running from eastern to south-central Turkey.

It forms the transform type tectonic boundary between the Anatolian Plate and the northward-moving Arabian Plate.
The difference in the relative motions of the two plates is manifest in the left lateral motion along the fault.
The East and North Anatolian faults together accommodate the westward motion of the Anatolian Plate as it is squeezed out by the ongoing collision with the Eurasian Plate.
The East Anatolian Fault runs in a northeasterly direction, starting from the Maras Triple Junction at the northern end of the Dead Sea Transform, and ending at the Karlıova Triple Junction where it meets the **North Anatolian Fault.**

Step 1 > Where to find DATA for Education purpose ? >>>

http://edumed.unice.fr/data-center/seismo

SEISMO case studies for Education purpose

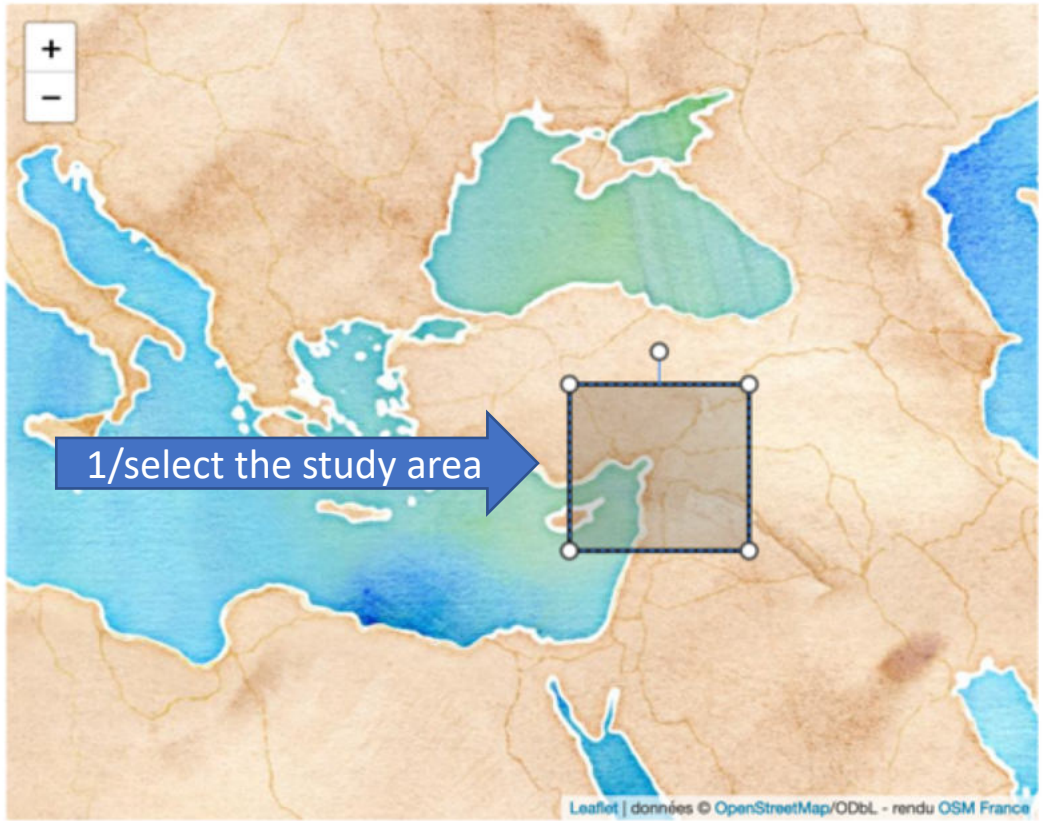
Step 2 > Data Request : seismicity recorded in border Turkey / Syria

http://edumed.unice.fr/data-center/seismo/catalog.php

Seismicity archived : 2023, Feb. 6th to 26th

Request in a database on seismicity recorded in Turkey/Syria

The form below allows to get stored seismicity, from the catalog of the ***Euro-Mediterranean Seismological Center***.



1/select the study area

Date 1 06-02-2023 Date 2 26-02-2023

2/select the period

Latitude max : 39.10

Longitude min : 33.15

Longitude max : 40.03

Latitude min : 33.98

Sismicité mondiale / Worldwide seismicity

Magnitudes : de 0 à 10

Profondeur (Depth) : de 0 à 1000 km

J'ai choisi / Submit

3/submit your request

4/display with Tectoglob3D

Ouvrir avec / Display with Tectoglob3D

Access to the website

Step 3 > Analyse seismicity request, plotted on a map

Quake 1:
LAT: 37,23 N / LON: 37,12 S

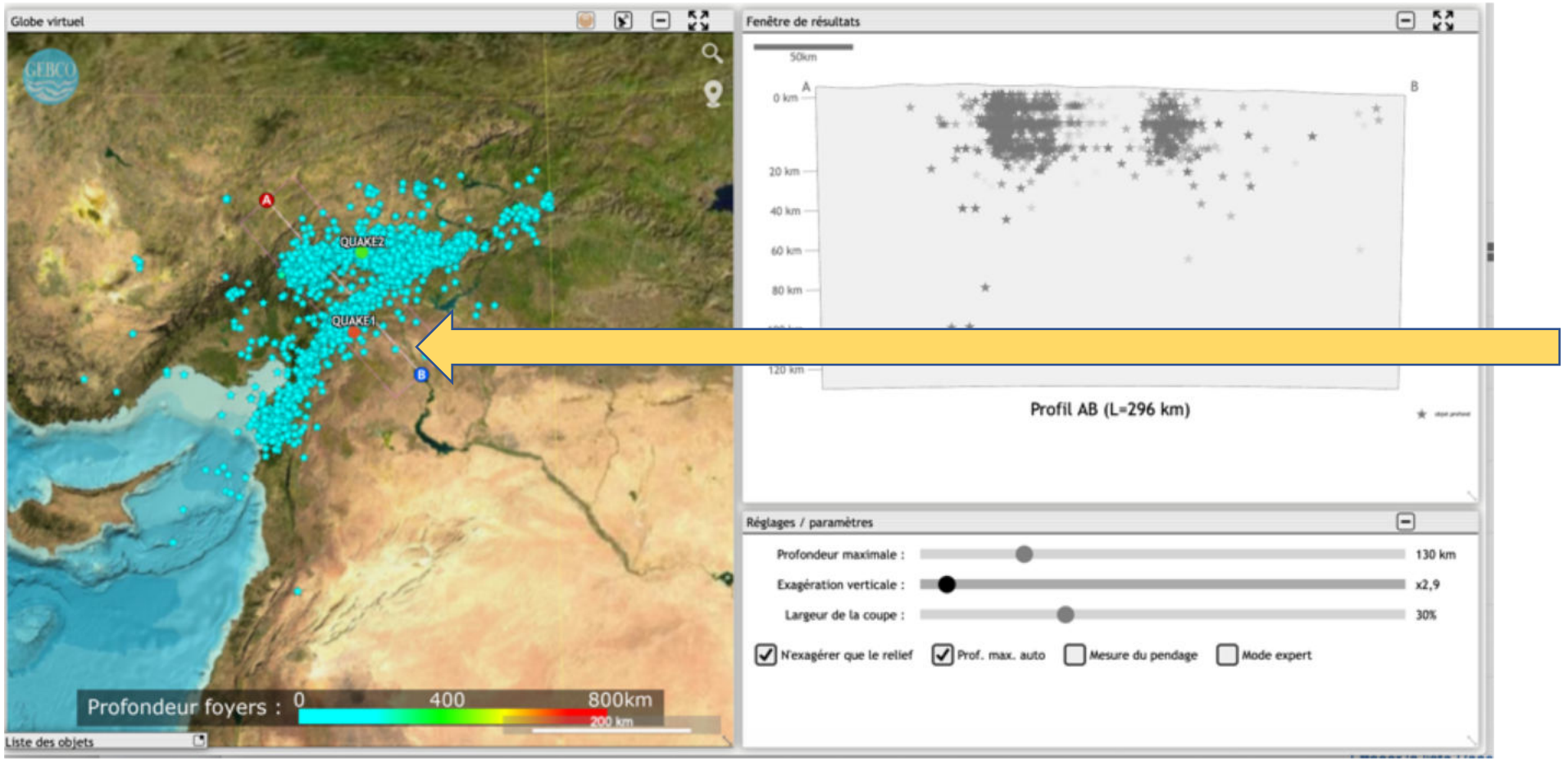
Quake 2:
LAT: 38,14 N/ LON: 37,21 S

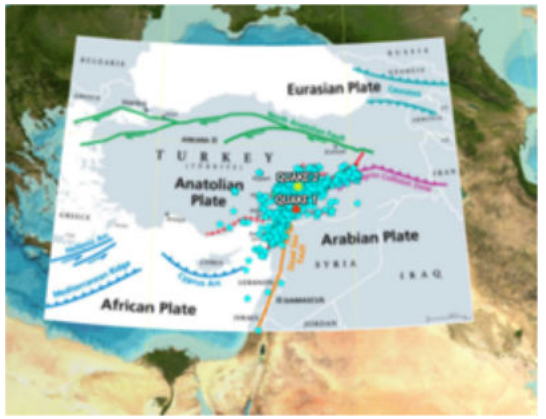
Seismicity displayed with TECTOGLOB 3D

> Add the two major epicenters Quake 1 and 2 (Action > Add landmarks)

> Compare the location of all the hypocenters (Action > Draw cross section)

> Display faults context in this area (File > Import map* - KMZ format)

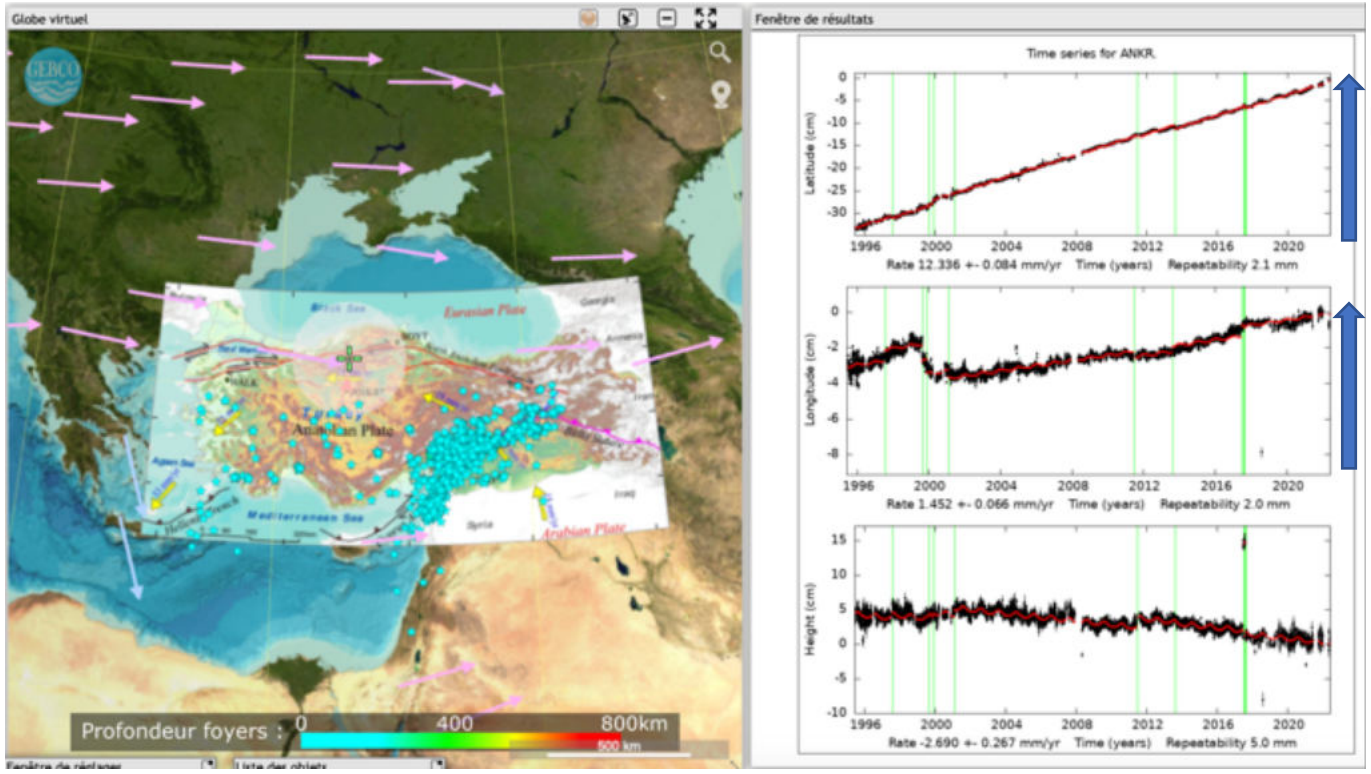




* Anatolian-faults-network (KMZ file)

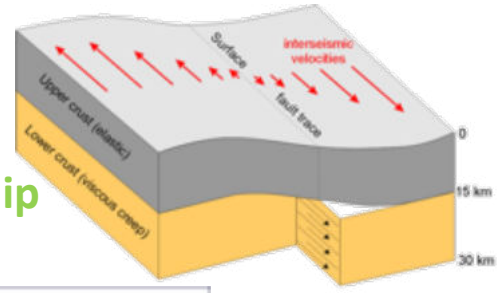
Step 4 > Seismic Risk prevention – some ideas using data

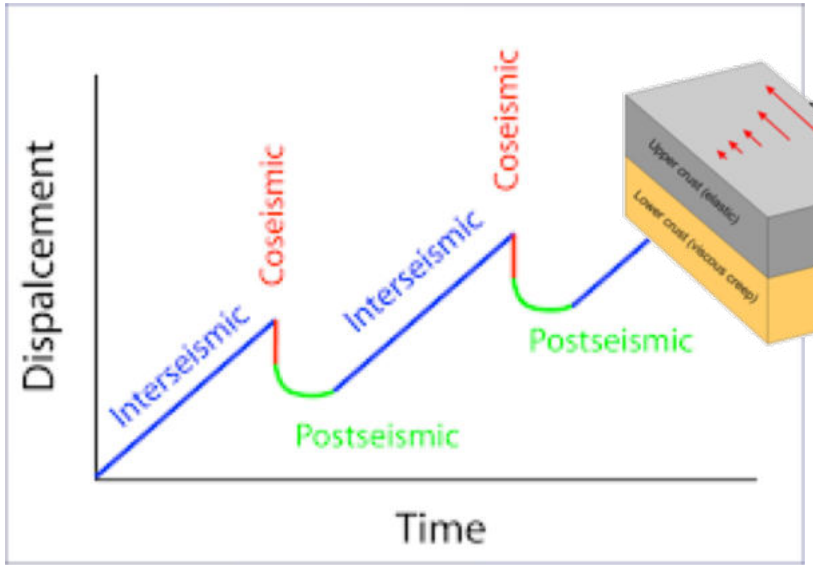
The GPS data accessible with Tectoglob3D software (Data displayed > GPS vectors) allows the measured movement of the tectonic plates to be visualised over time.
In the context of this faults network, the measurements highlight the seismic cycle.



Ankara GPS

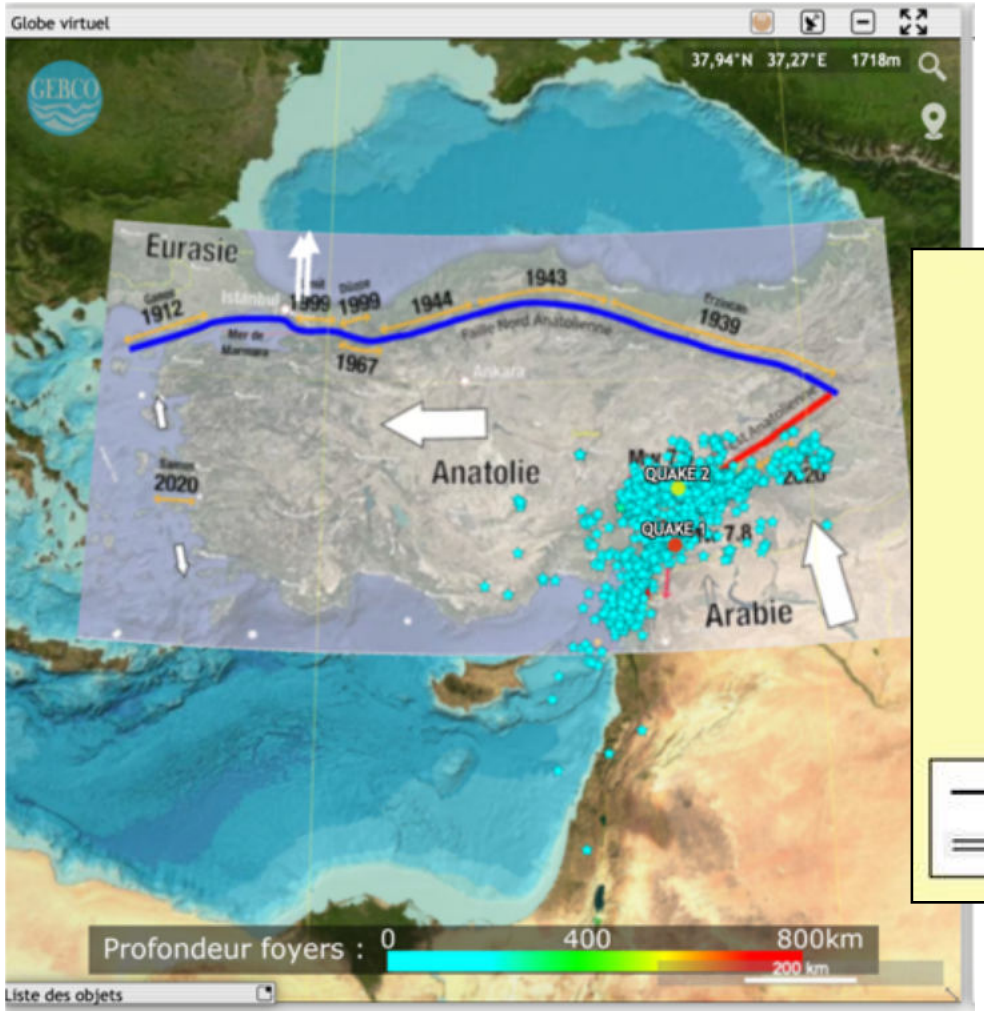
The **seismic cycle** can be divided into three periods, consisting of
inter-seismic slip,
co-seismic slip,
post-seismic slip



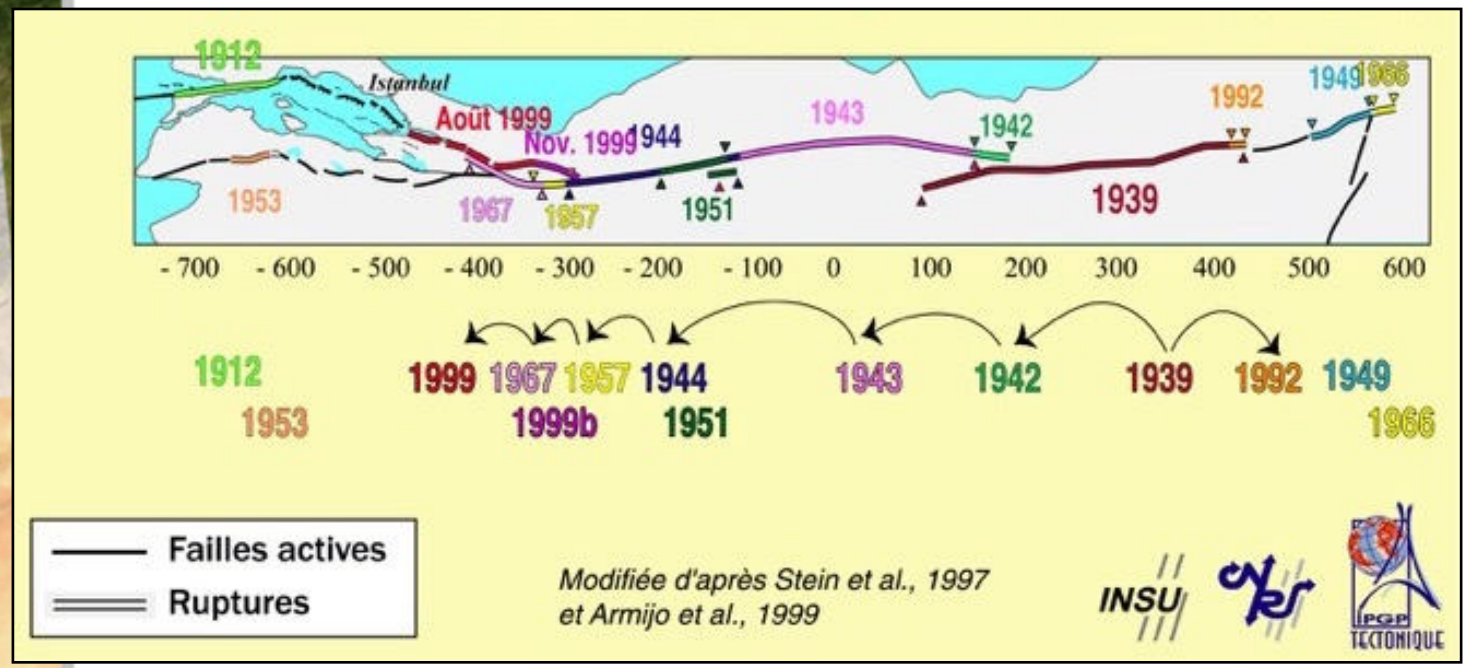


Step 4 > Seismic Risk prevention – some ideas using data

The historical study of earthquakes along a fault such as the North Anatolian Fault also perfectly illustrates the behaviour of faults that evolve between locked fault and energy release.

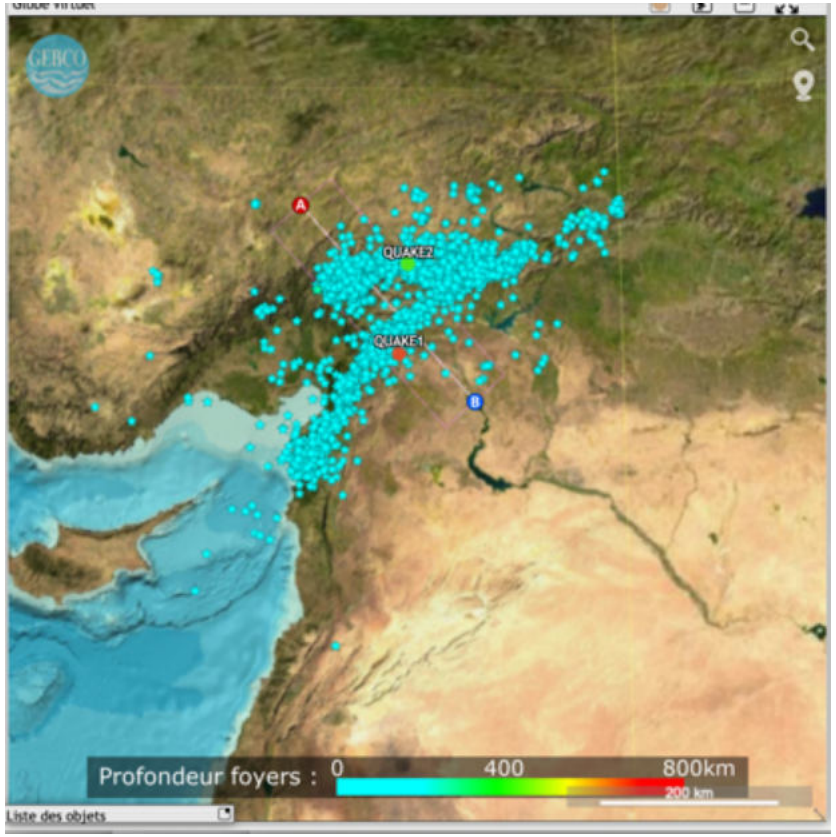


> Display context in this area (File > Import Anatolian fault history - KMZ format)



Step 4 > Seismic Risk prevention – some ideas using data

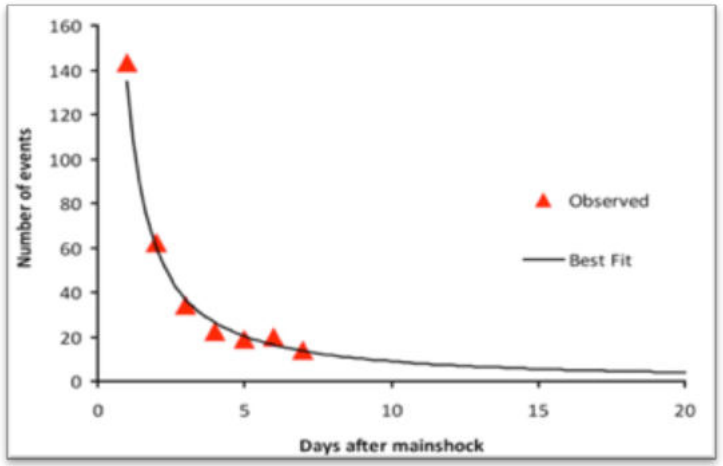
Omori's law It defines the decrease in the number of aftershocks after a major earthquake. This empirical formula was discovered by Japanese seismologist Fusakichi Ōmori in 1894, based on the seismic sequence after the Nobi earthquake of 1891.



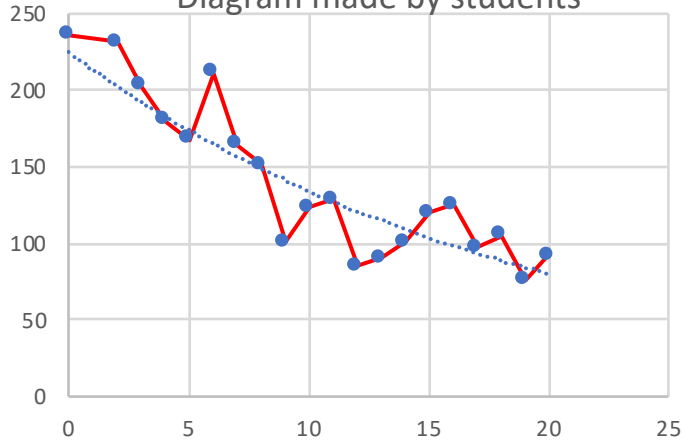
Omori's law describes the frequency of aftershocks after the main shock. This frequency decreases with the inverse of the time after the main shock.

It is expressed as follows:
k and c are constants, t is time.

$$n(t) = \frac{k}{(c+t)}$$

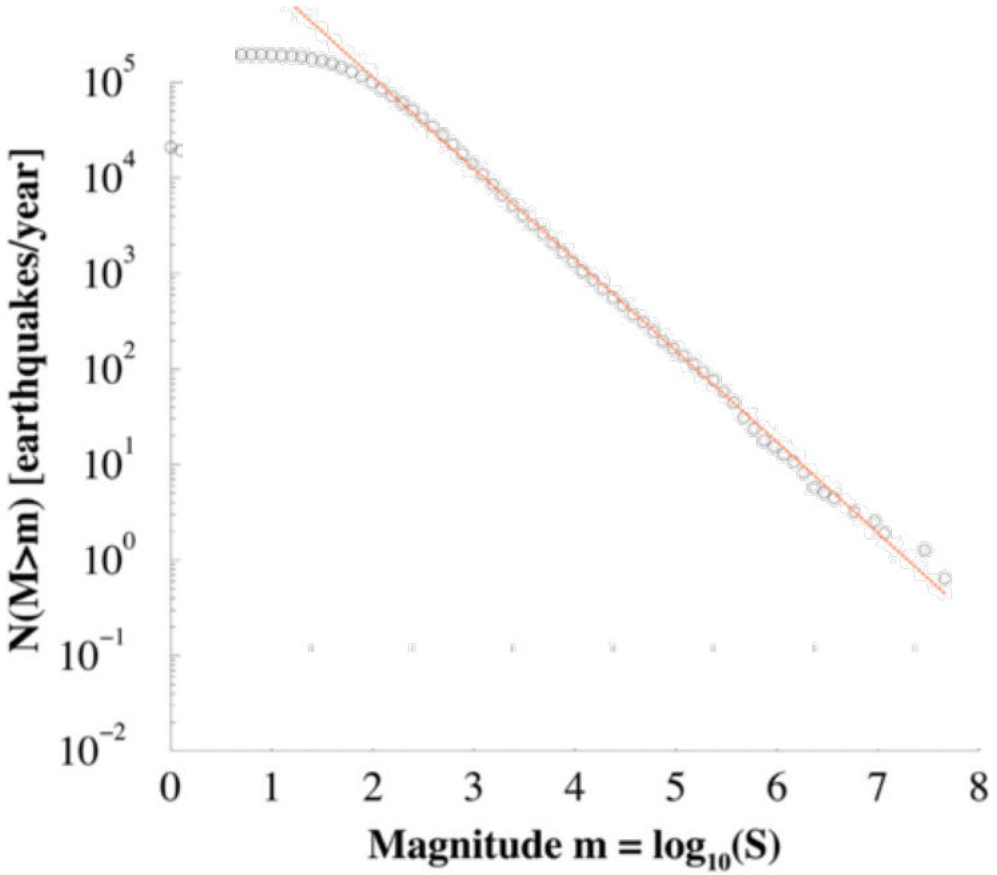


Aftershocks evolution
6th-26th February 2023
Diagram made by students



Step 4 > Seismic Risk prevention – some ideas using data

Could we expect strong aftershocks after the mainshock ?



Gutenberg-Richter law >

In seismology, the Gutenberg–Richter law (GR law) expresses the relationship between the magnitude and total number of earthquakes in any given region and time ...

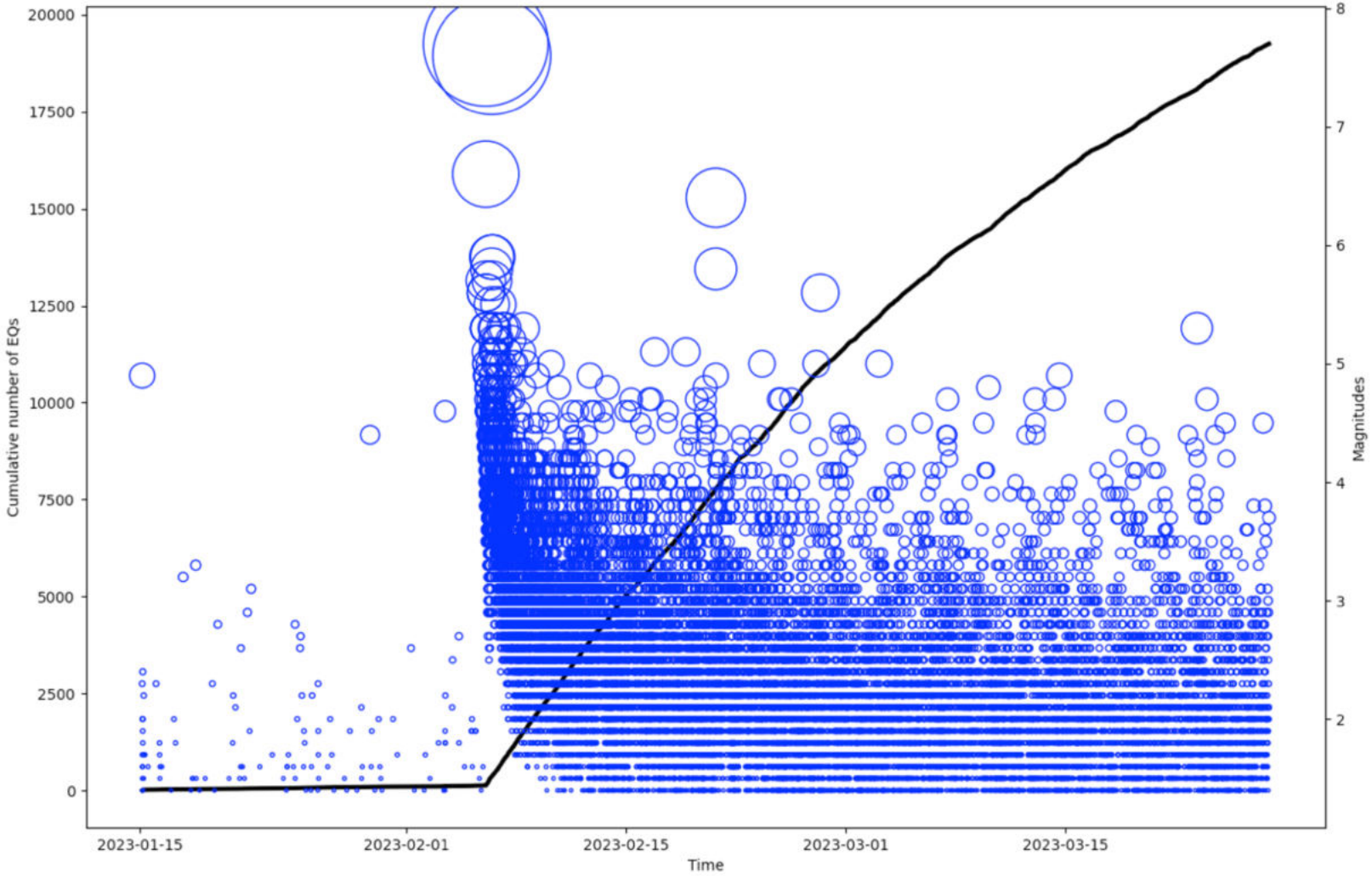
The Gutenberg–Richter (GR) law states that earthquake magnitudes are distributed exponentially (Gutenberg & Richter 1944) as **$\mathbf{Log_{10}N(m) = a - bm}$**,

where N(m) is the number of earthquakes with magnitude larger or equal to m, b is a scaling parameter and a is a constant.

Step 4 > Seismic Risk prevention – some ideas using data

Could we expect strong aftershocks after the mainshock ?

Gutenberg-Richter + Omori laws >



Turkey EQ 2023-02-06 – Thanks to Virginie Durand (University Côte d'Azur, GEOAZUR)

Case study … more ?

Working with seismogram : Earthquake in Turkey / Syria – 2023, Feb. 6

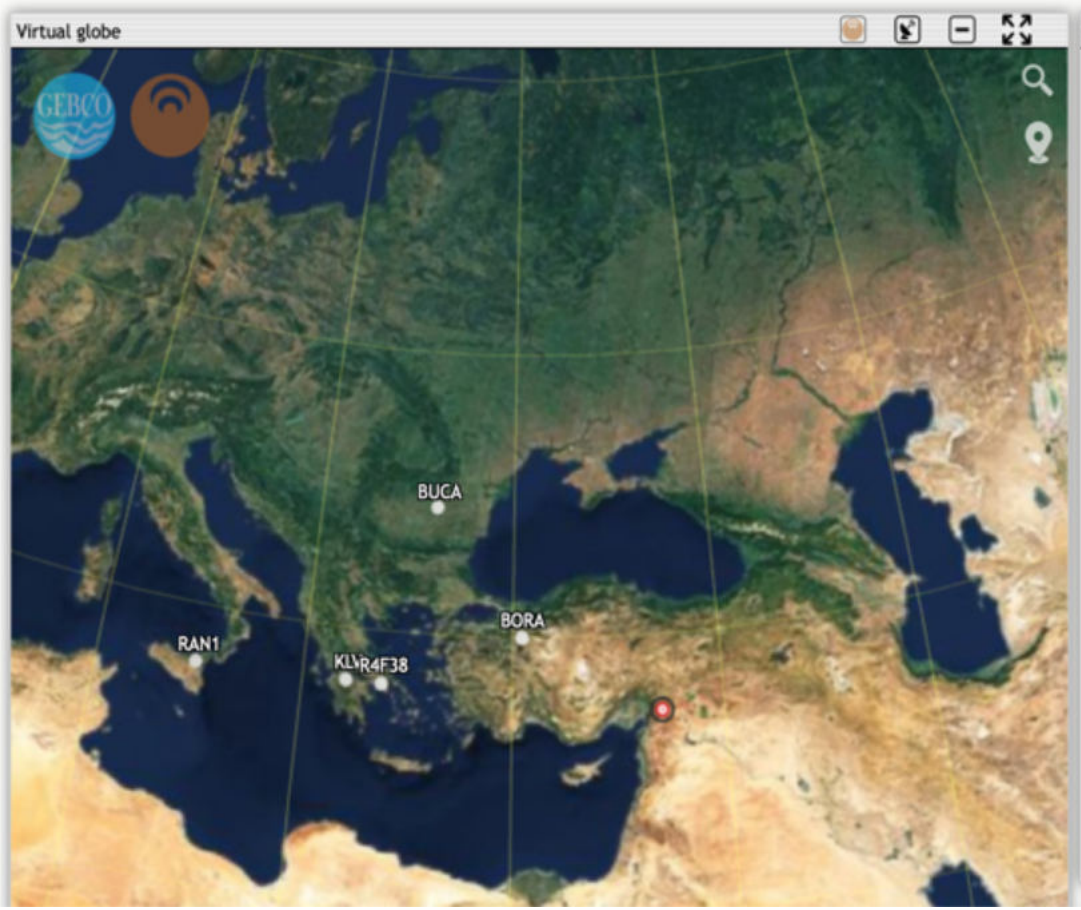
http://edumed.unice.fr/data-center/seismo/seismograms.php

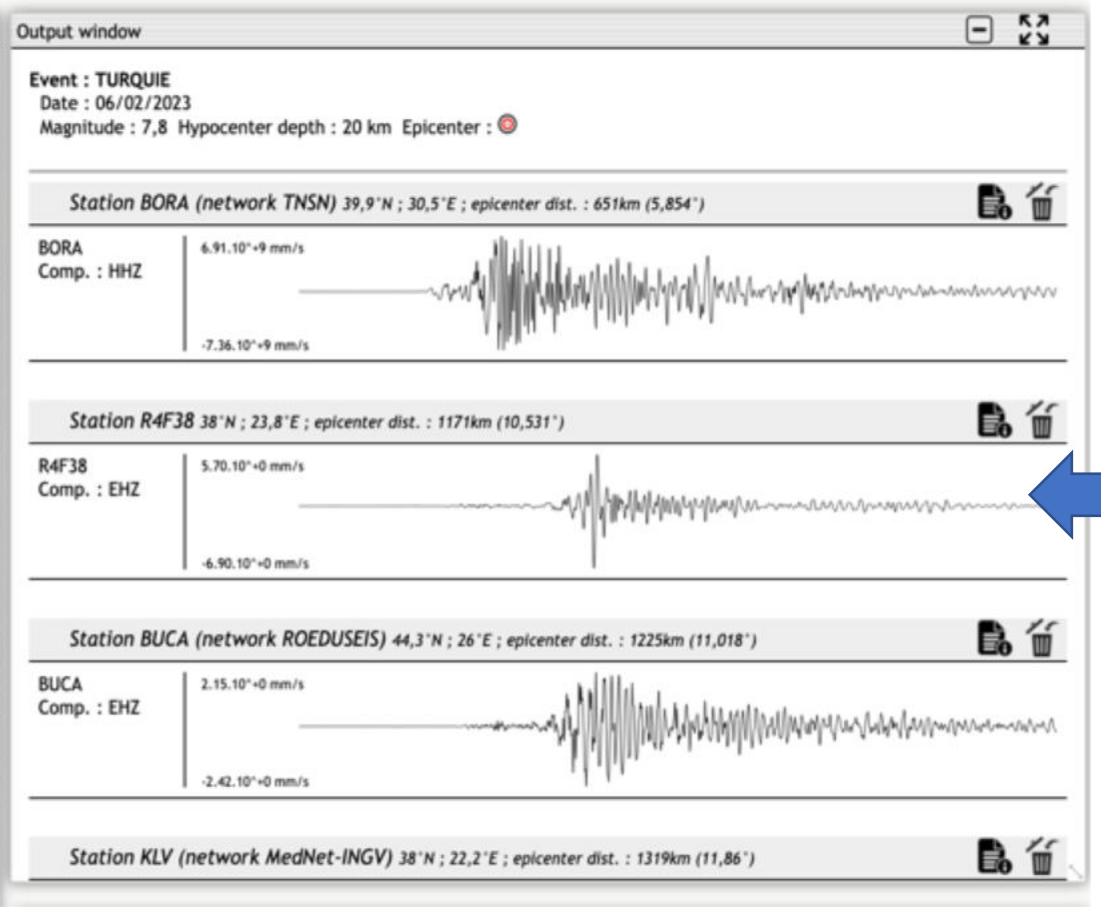
2023.02.06 / First turkish earthquake (M7.8, EMSC)

Find some data from research networks and the educational station RAN1 (Insegnaci Etna) of the Mw 7.8 turkish earthquake. A regional map with tectonic settings is available.

Download ZIP file

Display with Tectoglob3D





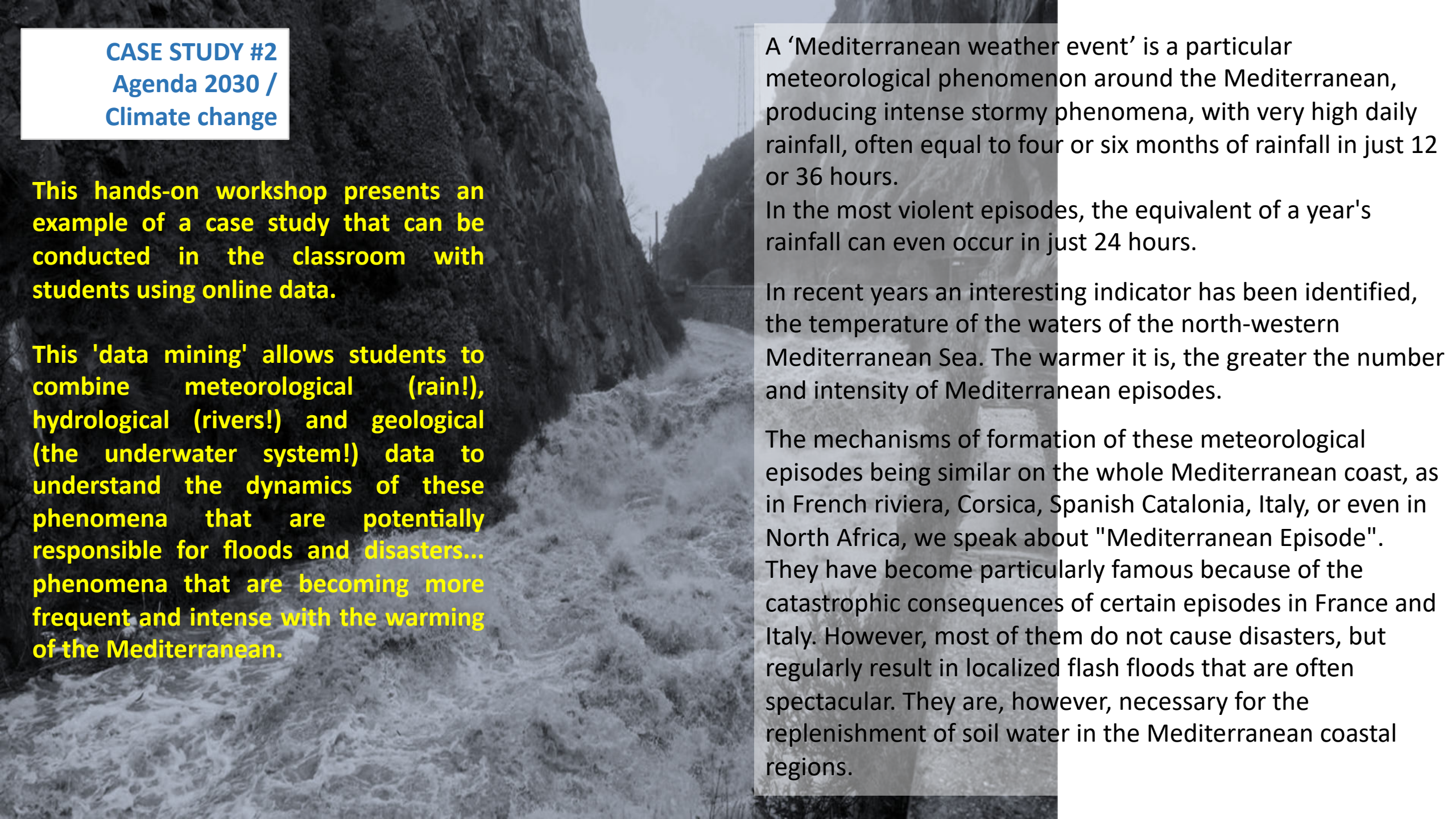
Case study … more ?

Working with seismogram : Earthquake in Turkey / Syria – 2023, Feb. 6

http://edumed.unice.fr/data-center/seismo/seismograms.php

So many things to propose to your students

Discovery seismograms recorded
Origin time, ranking stations /distance
Epicenter location / drawing circles
Data displayed GPs movement
Data displayed plate tectonic
Data displayed faults map



CASE STUDY #2
Agenda 2030 / Climate change

This hands-on workshop presents an example of a case study that can be conducted in the classroom with students using online data.

This 'data mining' allows students to combine meteorological (rain!), hydrological (rivers!) and geological (the underwater system!) data to understand the dynamics of these phenomena that are potentially responsible for floods and disasters... phenomena that are becoming more frequent and intense with the warming of the Mediterranean.

A ‘Mediterranean weather event’ is a particular meteorological phenomenon around the Mediterranean, producing intense stormy phenomena, with very high daily rainfall, often equal to four or six months of rainfall in just 12 or 36 hours.
In the most violent episodes, the equivalent of a year's rainfall can even occur in just 24 hours.

In recent years an interesting indicator has been identified, the temperature of the waters of the north-western Mediterranean Sea. The warmer it is, the greater the number and intensity of Mediterranean episodes.

The mechanisms of formation of these meteorological episodes being similar on the whole Mediterranean coast, as in French riviera, Corsica, Spanish Catalonia, Italy, or even in North Africa, we speak about "Mediterranean Episode". They have become particularly famous because of the catastrophic consequences of certain episodes in France and Italy. However, most of them do not cause disasters, but regularly result in localized flash floods that are often spectacular. They are, however, necessary for the replenishment of soil water in the Mediterranean coastal regions.

Step 1 > Where to find DATA for Education purpose

http://edumed.unice.fr/data-center/hydro

HYDRO case studies for Education purpose

http://edumed.unice.fr/data-center/hydro/archiveshydro.php

Step 2 > choose a Case study > Intense rainfall in autumn 2019 over south-eastern France

http://edumed.unice.fr/data-center/hydro/archiveshydro.php

Gapeau River (Var, Southern France), Autumn 2019

Because of their seasonality, frequency and virulence, Mediterranean episodes are regularly observed. They result in very localised and often spectacular floods. However, they are necessary for the recharge of groundwater in the Mediterranean coastal regions. This study presents an example on the Gapeau river (Var) based on online data recorded in autumn 2019. The study combines meteorological (rain!), hydrological (river!) and geological (underground!) data to understand the dynamics of these phenomena that are potentially responsible for floods and disasters... phenomena that are becoming more frequent and more intense with the warming of the Mediterranean.

Download the CSV file

Display with Csview

CSV data visualization.

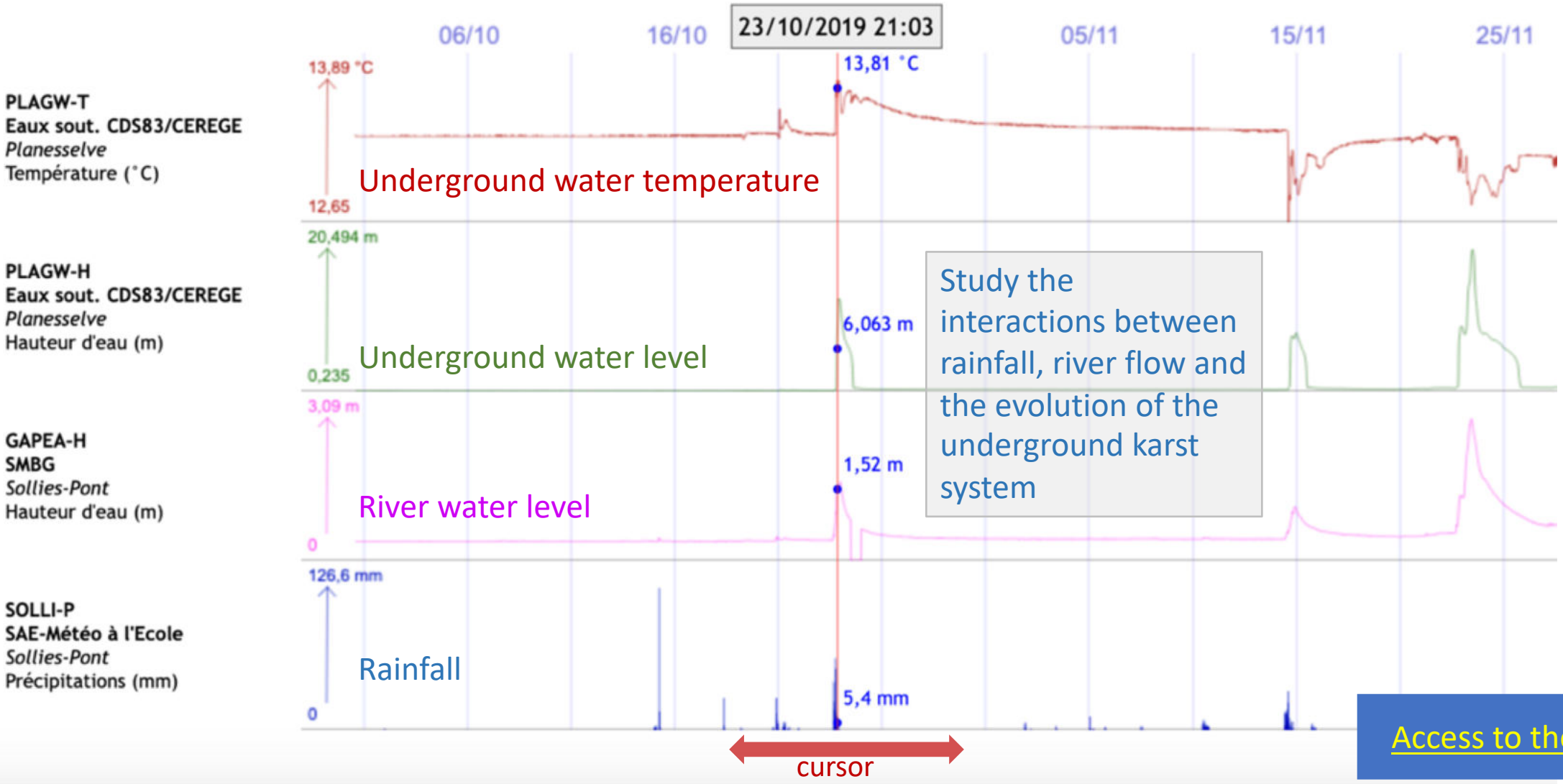
Loaded file : https://namazu.unice.fr/EDUMEDOBS/hydro/data/gapeau_automne2019.csv
Number of sensors : 4, number of records : 13154

Use the left mouse button to move the graph or map, and the mouse wheel to zoom.

Hover over a marker on the map to see its name.
Hover over the graph to get precise values.

Step 3 > characterise the dynamics of a Mediterranean storm, using hydro data with ‘csview’

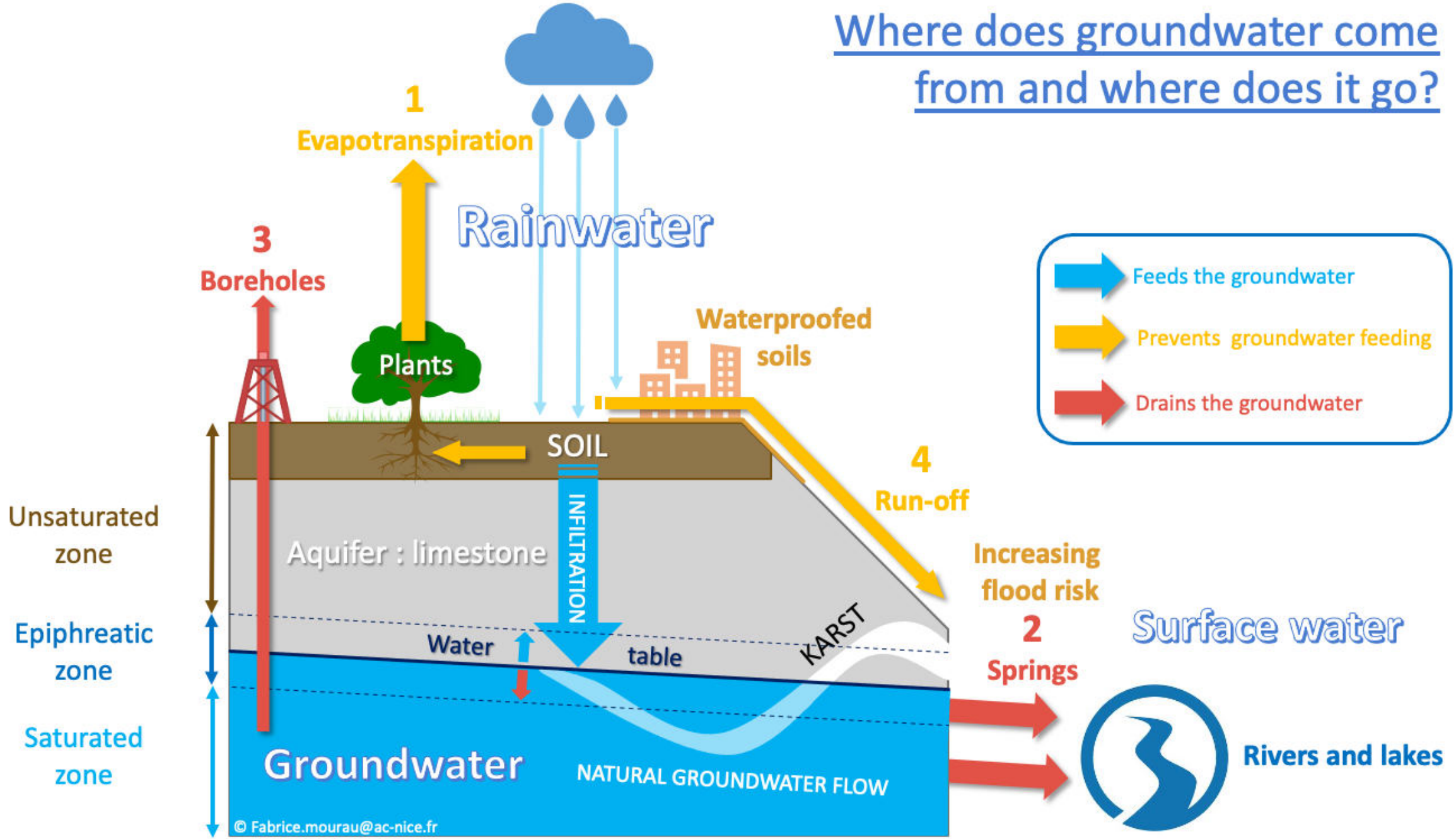
http://edumed.unice.fr/data-center/hydro/archiveshydro.php



Study the interactions between rainfall, river flow and the evolution of the underground karst system

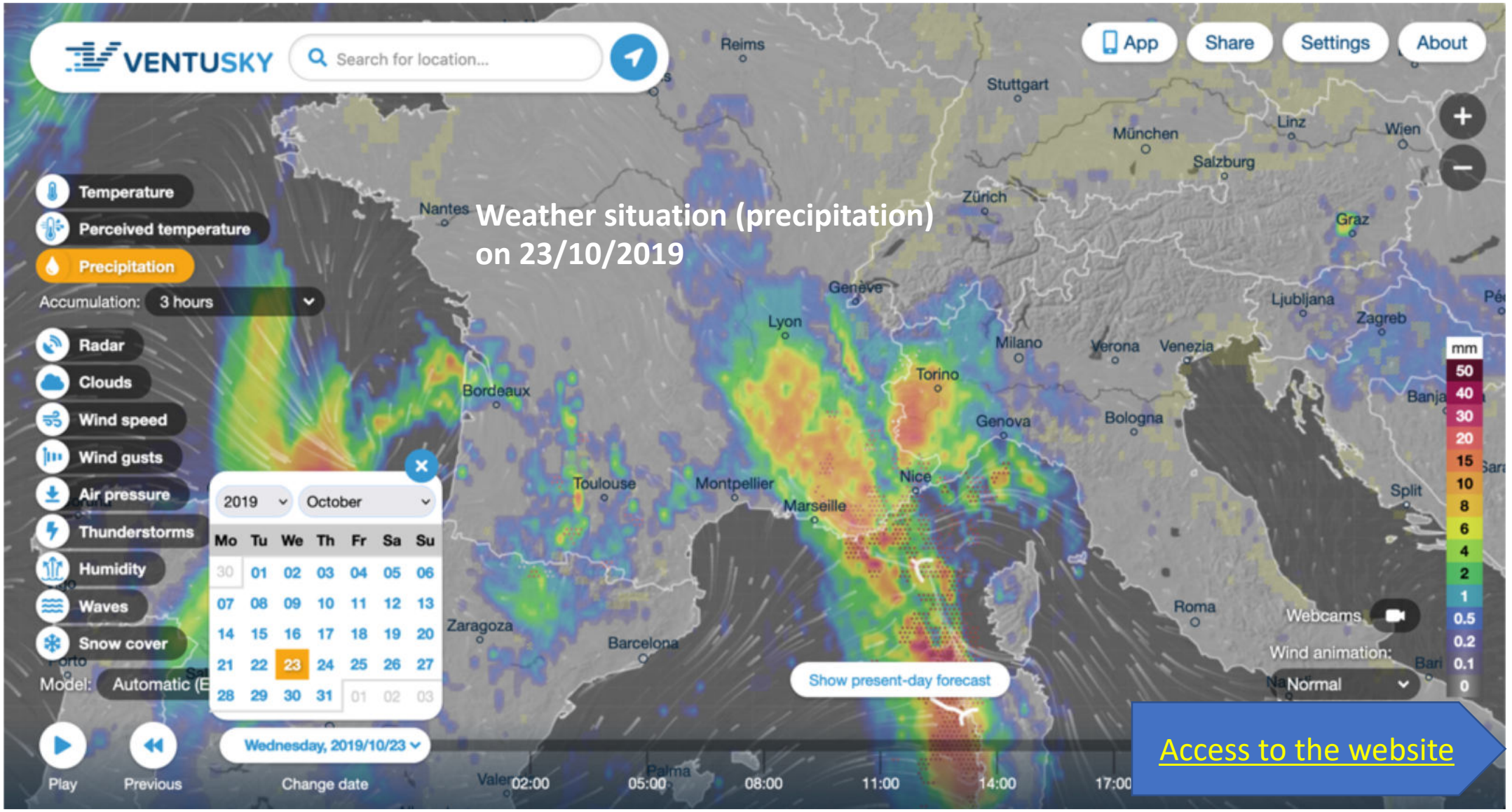
Access to the web site

Where does groundwater come from and where does it go?



Step 4 > Evolution of the weather situation of this period with the Ventusky web interface

https://www.ventusky.com/



Access to the website

Step 4 > Evolution of the weather situation of this period with the Ventusky web interface

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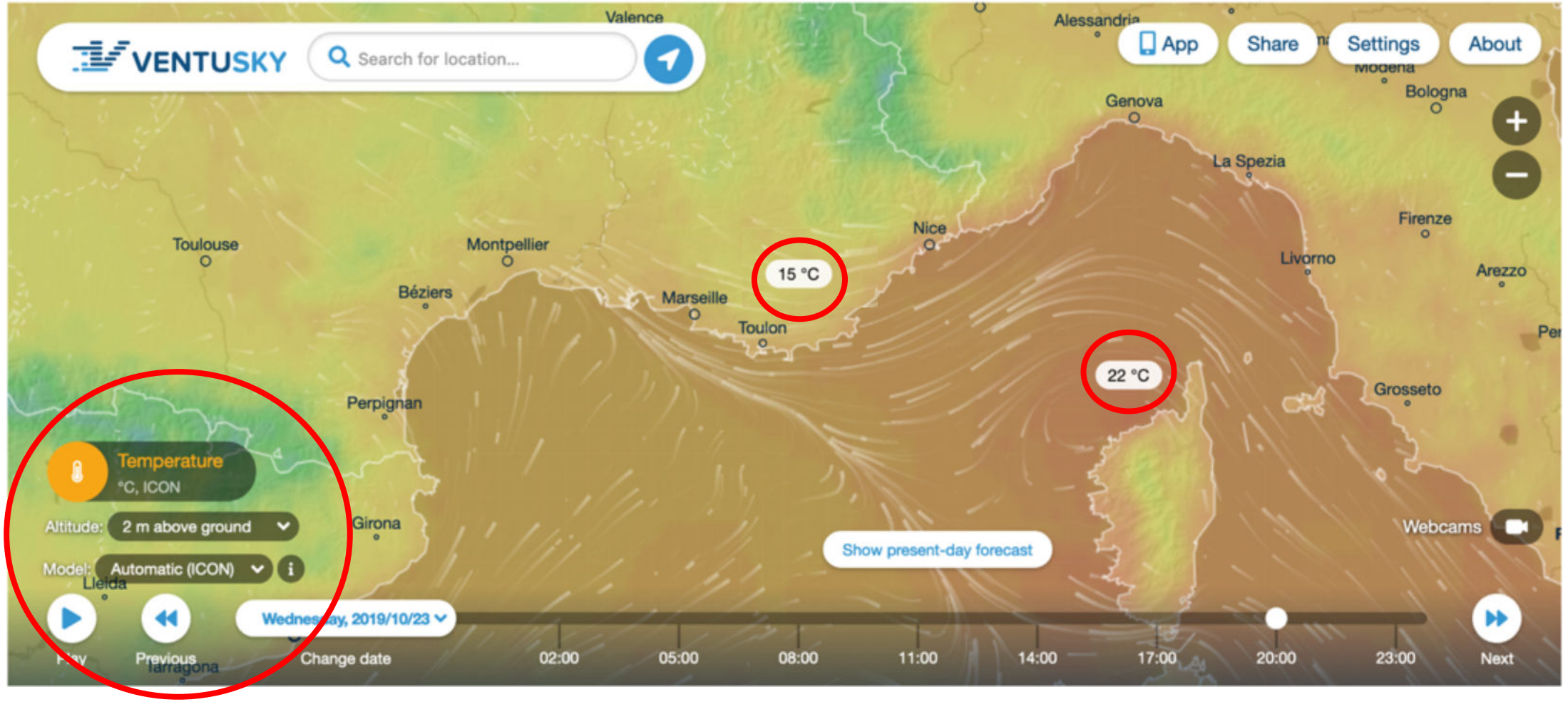
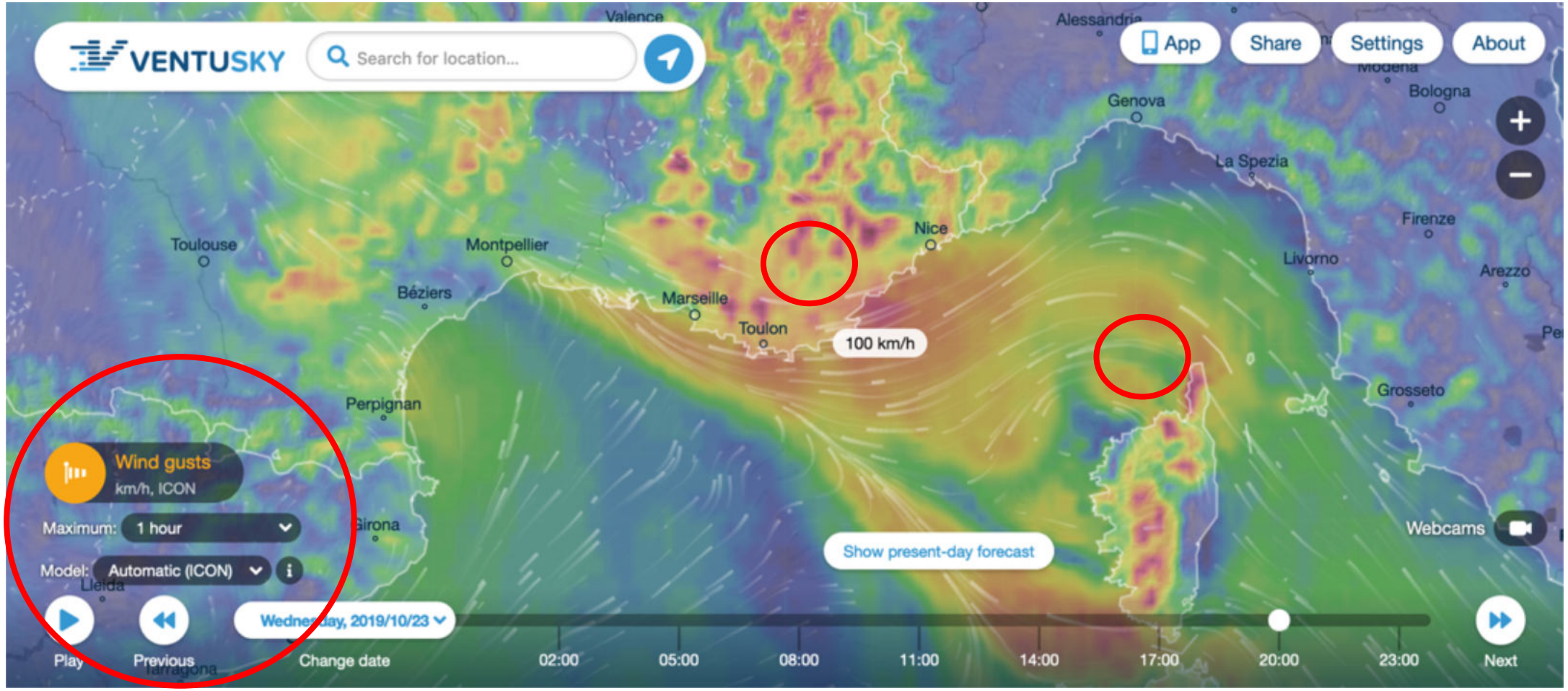


> Compare air temperature on the sea and on the coast ! At 2 m or more above the sea level

Step 4 > Evolution of the weather situation of this period with the Ventusky web interface

https://www.ventusky.com/



> Observe the direction of the winds coming from the South.

Case study … more ?

Working with the data online in quite a real time

http://edumed.unice.fr/data-center/hydro/archiveshydro.php

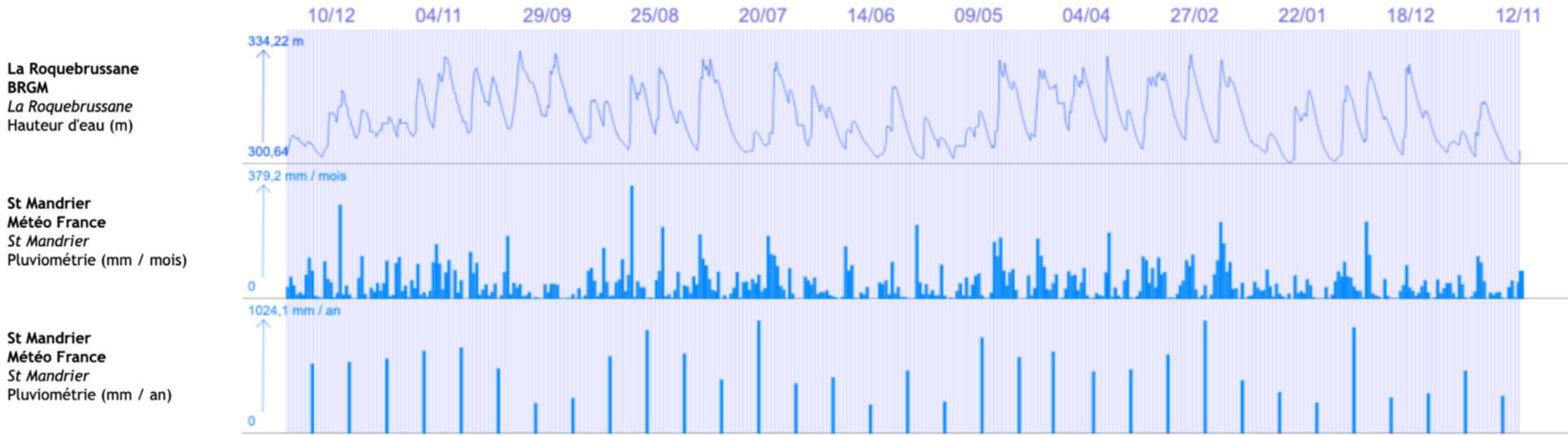
Piézomètre de la Roquebrussane (Var), août 1988 à février 2023

Série temporelle de suivi de la hauteur d'eau (données BRGM) du piézomètre de la Roquebrussane.

Télécharger le fichier

Afficher dans Csview

evolution of an aquifer: 34-years time series



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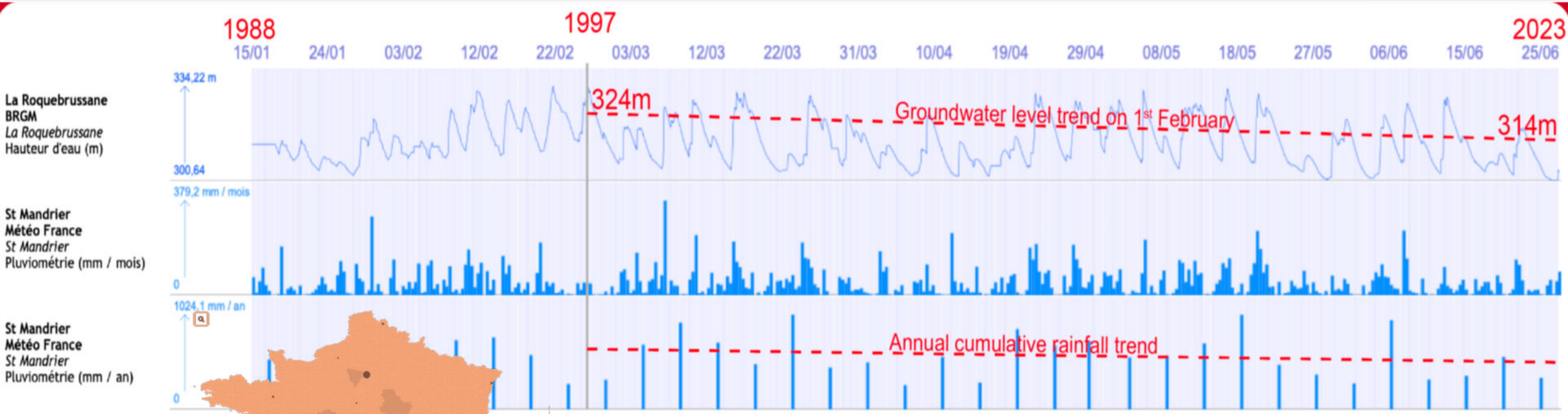
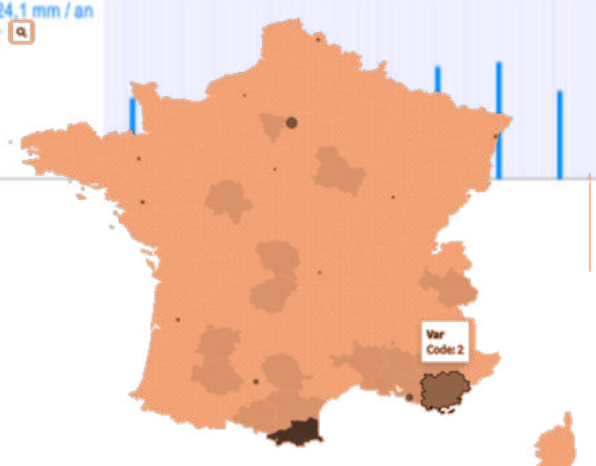




How bad is the drought in France? See restrictions in your department

Case study … more ?

Working with the data online in quite a real time

http://edumed.unice.fr/data-center/hydro/archives_hydro.php

> Find the hydro data of the Gapeau river these last months!

Hydro data sets (row data)

Open access to the 'hydro' data archived by EduMed-Obs. Currently, they are of two types:

- data on surface level variations of some coastal rivers;
- weather data from EduMed stations, the Météo France network ...

All these data are available in different formats:

- Csview: to view dynamically the data from a selection of 'hydro' and 'weather' stations for certain rivers,
- Zip: to download data from selected stations, data in csv format accompanied by a metadata file, all compressed in ZIP format.

Note: the display with Csview includes the metadata, the water level for the 'hydro' stations, and the rainfall for the 'weather' stations. On the other hand, downloading the ZIP file allows to recover all the parameters available for each station.

How to select your stations ?

Complete the form below:

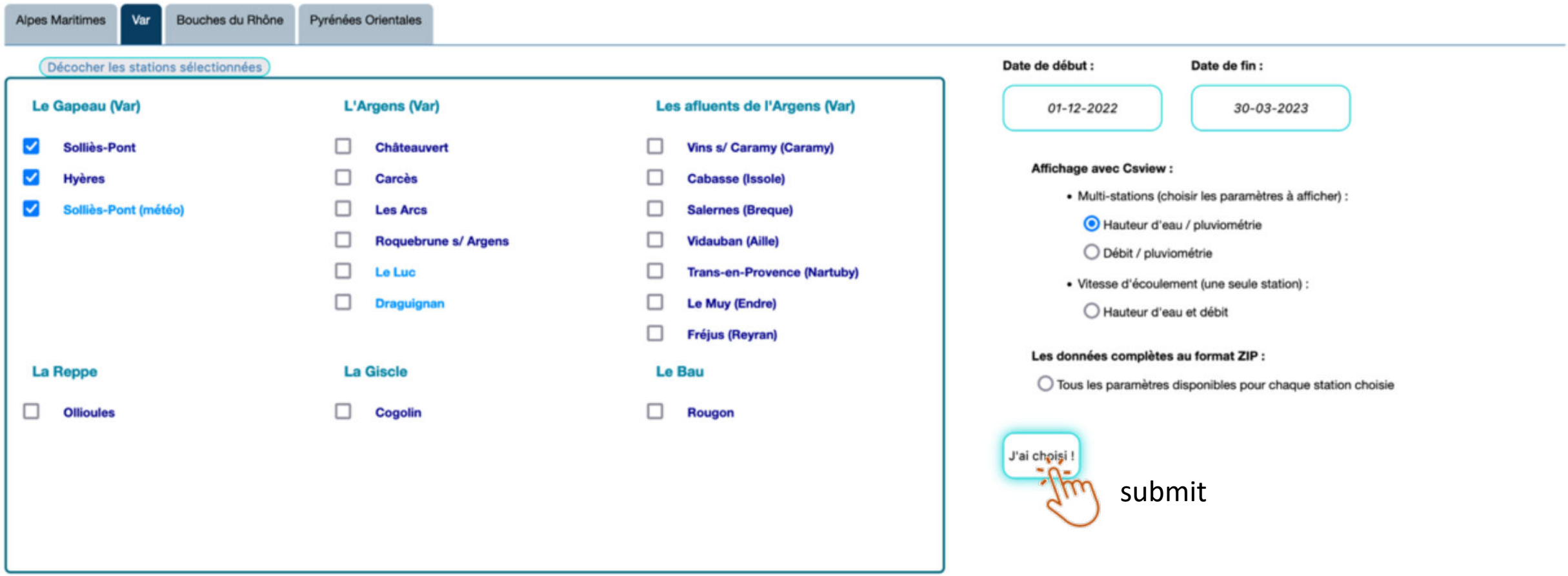
- select the study area,
- select 'hydro' and 'weather' stations,
- selection the time slot period,
- choose the parameters to display data with cswiewer

Once you have chosen your query, click on the submit button.

Case study … more ?

Working with the data online in quite a real time

Select the study area : ‘Var’, then the sensors : water level of the river ‘Le Gapeau’ at ‘Solliès Pont’ and ‘Hyères’ … and the precipitation at Solliès Pont
Choose the timeslot period : the last months
Choose parameters for the river (water level)



submit

Case study … more ?

Working with the data online in quite a real time

Result of your request !
Currently, the Var region is classified as a public water restriction area due to an early severe drought … as you can see !

CSV data visualization.

Loaded file : https://namazu.unice.fr/EDUMEDOBS/json/jsonedumed/dayplot_hydro/requeteNum_3591_csview.csv
Number of sensors : 3, number of records : 5761

Use the left mouse button to move the graph or map,
and the mouse wheel to zoom.

Hover over a marker on the map to see its name.
Hover over the graph to get precise values.