



Science Teacher
GEOAZUR Education & Outreach team
University Côte d'Azur (OCA, CNRS, IRD)

UNIVERSITÉ
CÔTE D'AZUR

EGU | Education
European Geosciences Union

Data mining na escola: utilização de dados reais online no ensino das Geociências

Formação Contínua de Professores

APG
ASSOCIAÇÃO PORTUGUESA DE GEÓLOGOS

Formador

Jean-Luc Berenguer



Sábado
06 ABR, 2024



09:00-13:00
4 Horas



AFCD
Sessões E@D

*Ação de Formação de Curta Duração



Grupos
100, 110, 230, 420, 510 e 520

INSCRIÇÃO [>]

apgformacao.wordpress.com



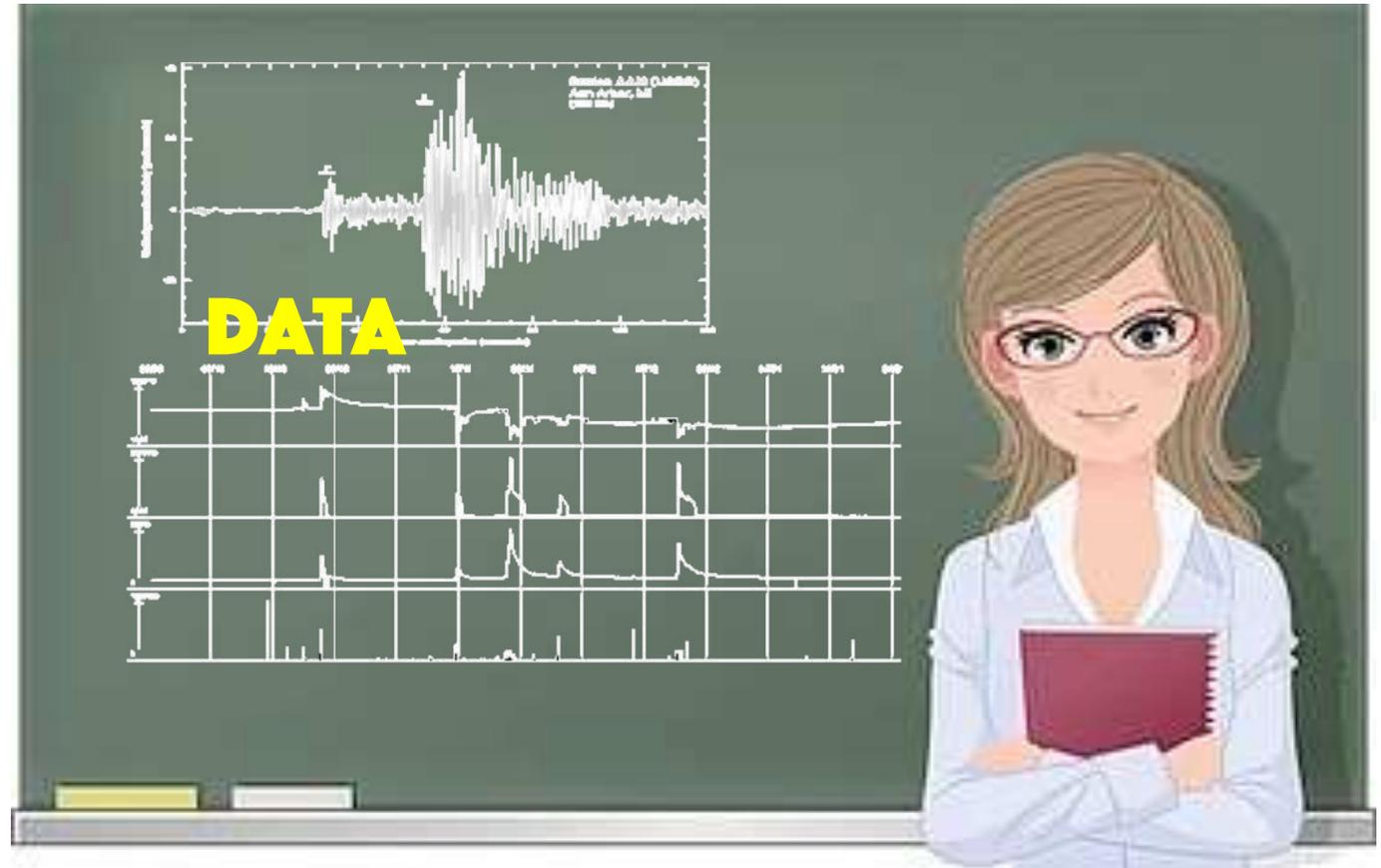
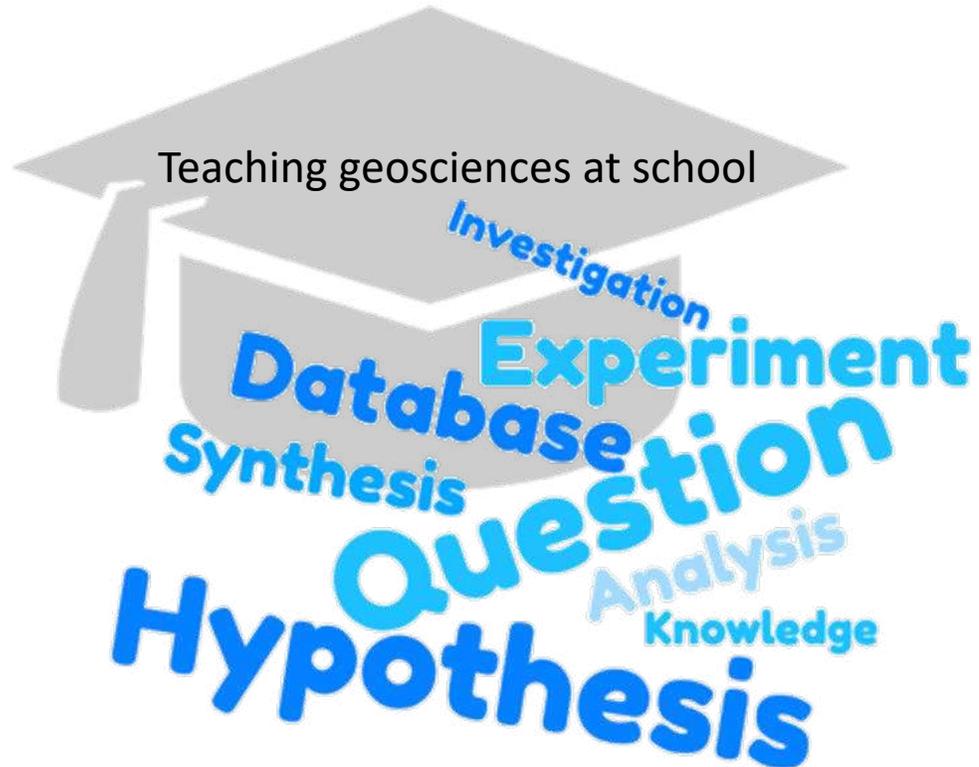
info@apegeologos.pt | apegeologos.pt | 912 818 243

Data mining na escola:

utilização de dados reais online no ensino das Geociências

Data mining at school:

Tuned in to the Earth or how to find, to use data on line in real time



Ficar tranquilo ! / Take it easy!

Data mining does not call into question the didactics of science teaching

... Following the scientific approach:

Data request
Consistent choices
Investigation
Report



A prospeção de dados não compromete a didática do ensino das ciências

... sempre nos princípios básicos:

Pedido de dados
Escolha coerente de dados
Investigação do pacote de dados
Relatório de atividades e Conclusões



A utilização de dados é uma parte fundamental do processo científico, especialmente em geociências!
The use of data is a key part of the scientific process, especially in geoscience!

O que significa extração de dados ... / What means data mining

Tem de procurar:

Bases de dados em linha

Instrumentos de análise de dados

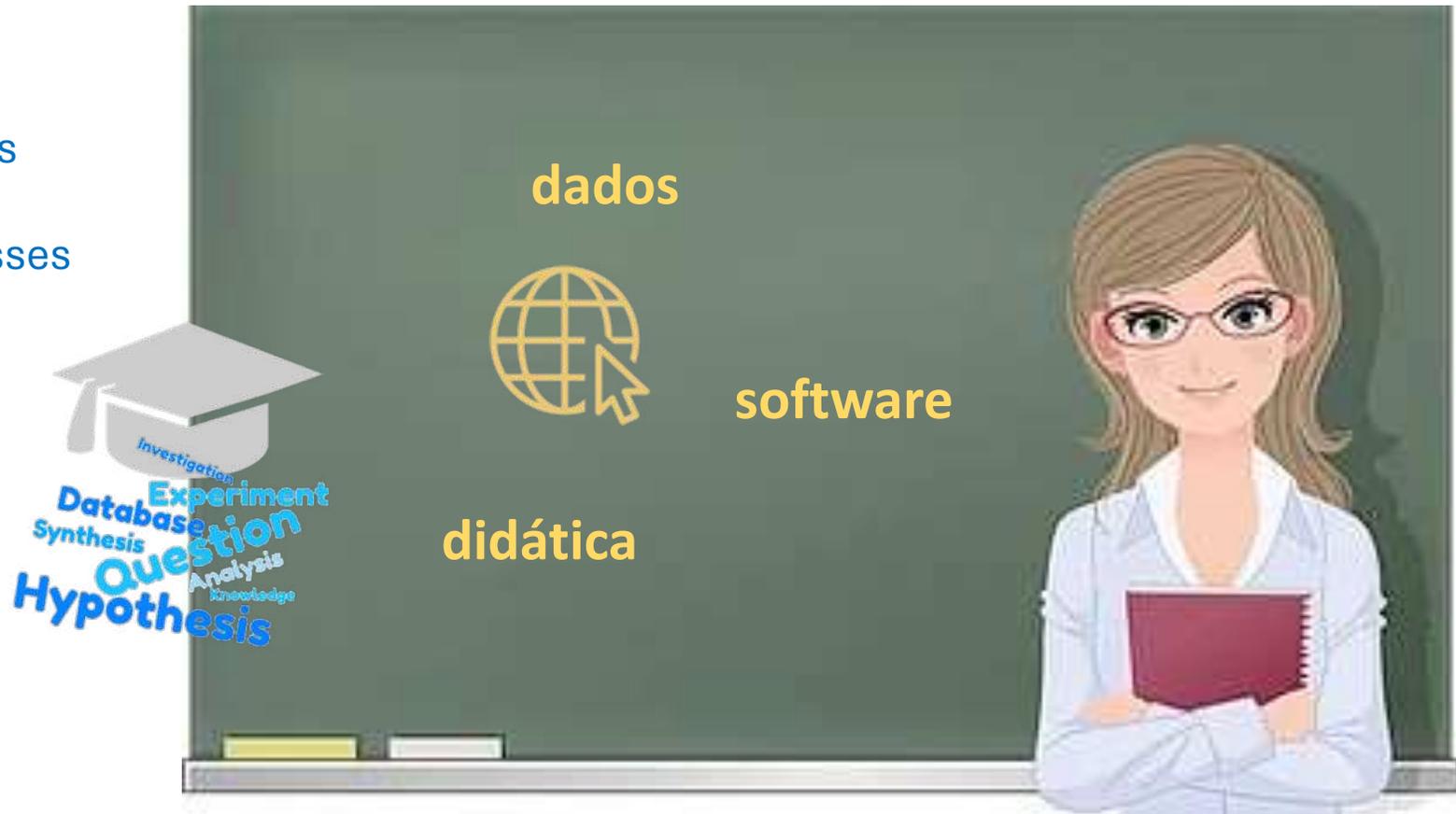
e trabalhar numa estratégia para utilizar esses dados

You have to find:

Database on line

Tools to analyse data

and working on a strategy to use data



Fazer da utilização de dados uma prioridade no ensino das ciências

Making the use of data a priority in science teaching

data : maps, measures, recordings,
field observations, etc.

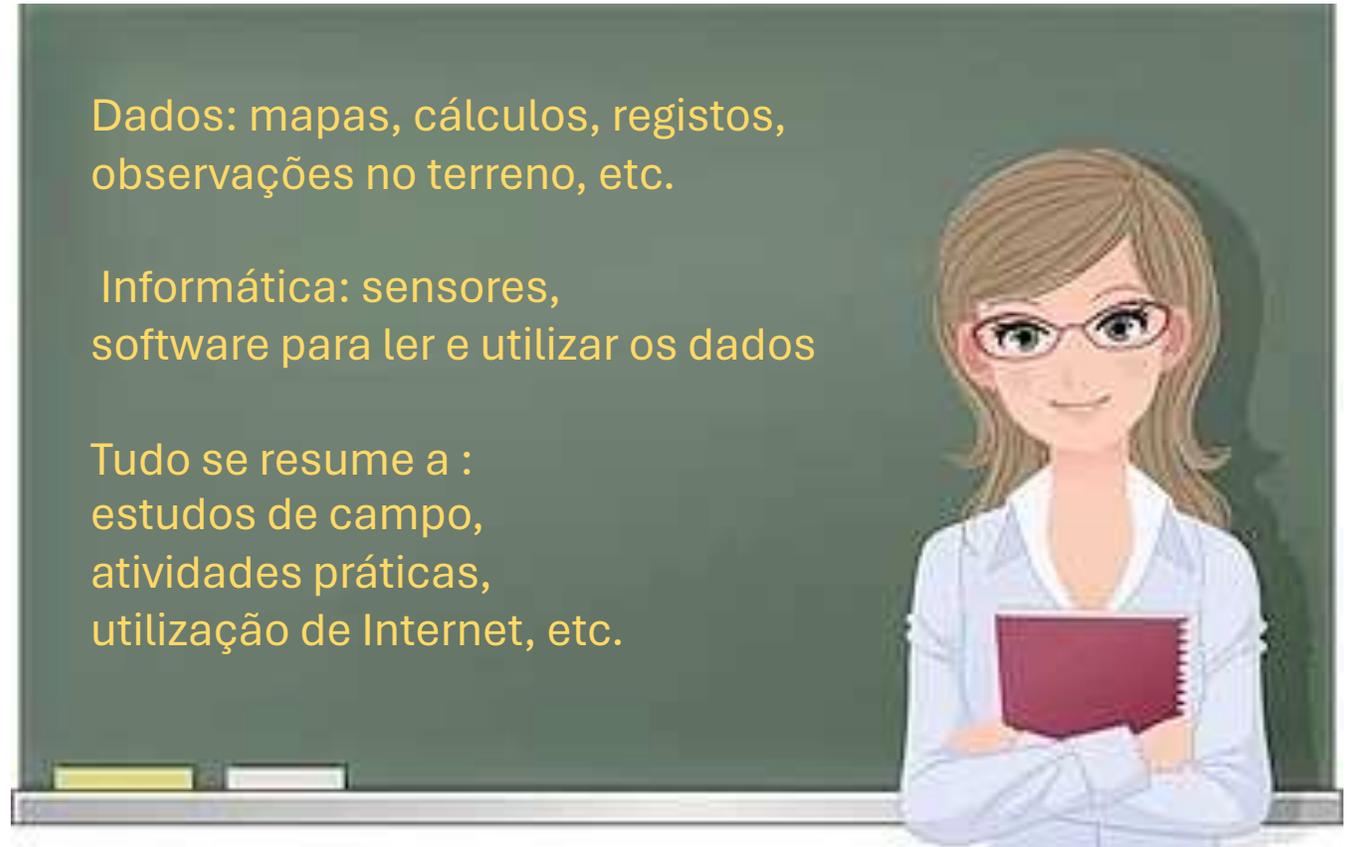
IT tools : sensors,
software for reading and using data

It's all about :
field studies,
practical activities, use of online servers, etc.

Dados: mapas, cálculos, registos,
observações no terreno, etc.

Informática: sensores,
software para ler e utilizar os dados

Tudo se resume a :
estudos de campo,
atividades práticas,
utilização de Internet, etc.



Never a teacher had so much data available on the Internet...

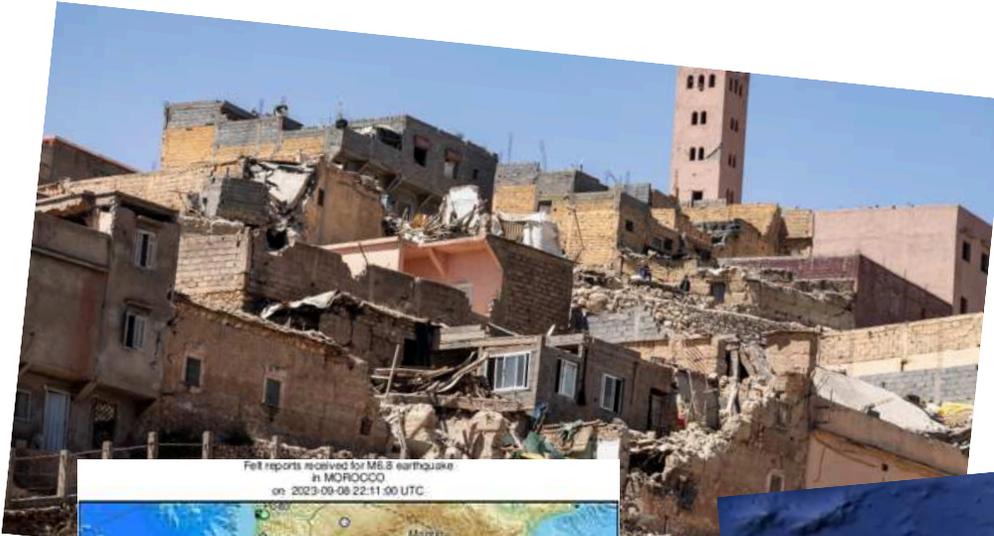
But how easy is it to use in the classroom, and how well are we trained to use it?

Nunca antes um professor teve tantos dados disponíveis na Internet...

Mas será que são assim tão fáceis de utilizar na sala de aula e será que estamos preparados para os utilizar?

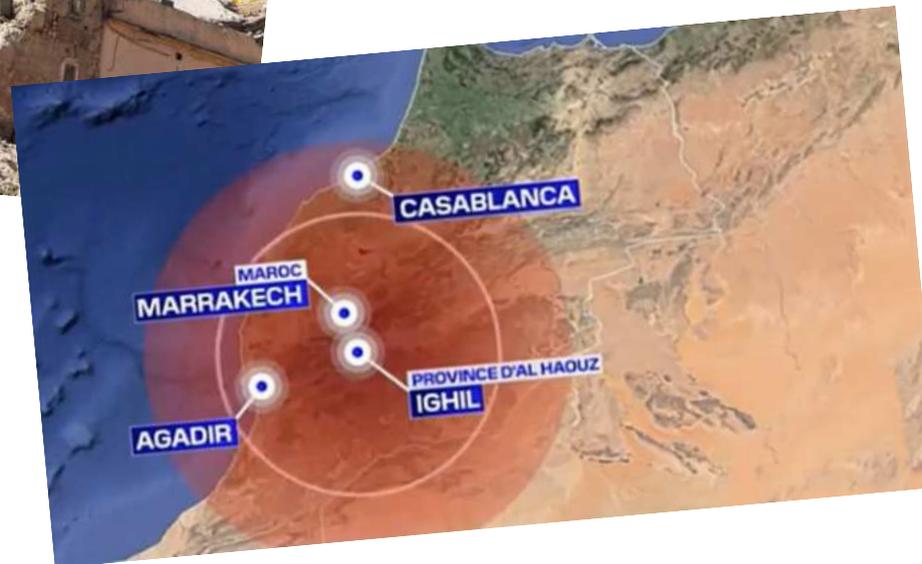
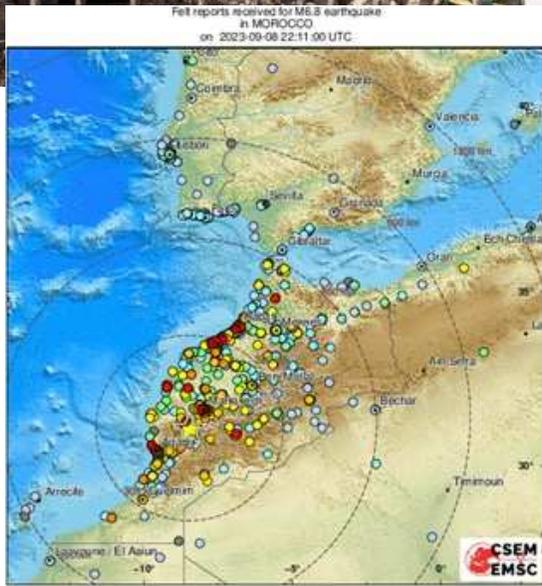


Comecemos com um estudo de caso / Let us begin with a case study



Tema : sismologia / Topic : Seismology

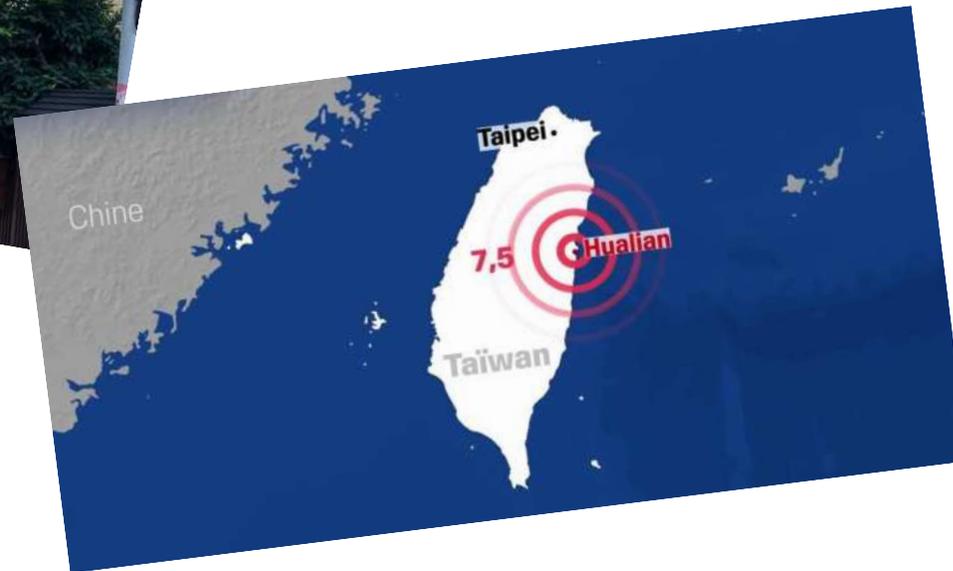
Sismo de grande magnitude em Marrocos em 8 de setembro de 2023
Huge earthquake in Morocco on September 8, 2023



Comecemos com um estudo de caso / Let us begin with a case study

Tema : sismologia / Topic : Seismology

Grande sismo em Taiwan a 3 de abril de 2024
Huge earthquake in Taiwan on April 3, 2024



Notícias sobre eventos sísmicos / seismic event breaknews



Um forte **sismo** de magnitude $M_w=6,8$ afetou a região de Marraquexe, **Marrocos**, contabilizando-se cerca de 3.000 mortos, 6.000 feridos e uma destruição generalizada.

O sismo ocorrido na noite de sexta-feira, 8, para sábado, 9, de setembro/2023 foi o maior evento sísmico registado **por instrumentos científicos** das estações sísmicas na história do país

E este só é ultrapassado pelo sismo que atingiu Lisboa a 1 de novembro de 1755, com uma magnitude estimada de 8,5 a 8,7.



Onde se podem recolher os sismogramas?

Posso utilizar os dados disponíveis para localizar o epicentro?

Posso situar este evento num contexto geodinâmico?

Posso concluir, a partir deste exemplo, sobre o fenómeno sísmico em Marrocos?



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

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

Centro de Datos Sismológicos para o Ensino

Bienvenue dans l'Observatoire Éducatif Méditerranéen

EDU MED UNIVERSITÉ CÔTE D'AZUR

UCA J.E.D.I. UNIVERSITÉ CÔTE D'AZUR

Académie de Nice Région académique PROVENCE-ALPES-CÔTE D'AZUR GeoAZUR

Network Live Data Center Tools Lab Teachers Room EDUSEIS Virtual Tour EduChallenge

Partenaires SEISMO METEO HYDRO OCEANO VOLCANO

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

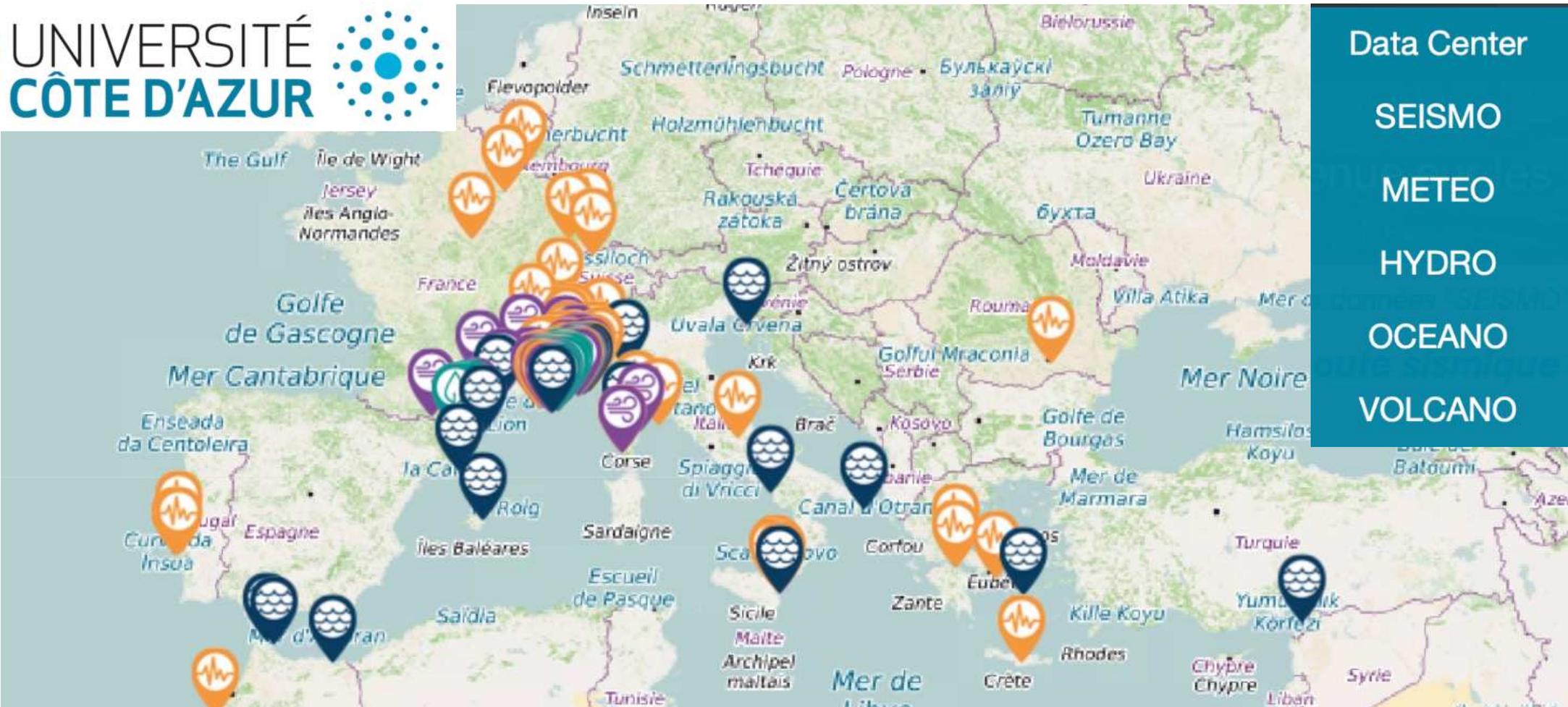
SEISMO case studies for Education purpose

Centro de Dados Sismológicos para o Ensino

uma rede de sensores no terreno, instalados em escolas, registrando diferentes informações



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CÔTE D'AZUR



Data Center
SEISMO
METEO
HYDRO
OCEANO
VOLCANO

 **Capteurs SISMO**

 **Capteurs METEO**

 **Capteurs HYDRO**

 **Capteurs OCEANO**

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

Centro de Dados Sismológicas para o Ensino

- Data Center
- SEISMO**
- METEO
- HYDRO
- OCEANO
- VOLCANO

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

1 / Daily recordings (live – 03/04/2024)

Les images des mouvements du sol / Pictures of ground motions recorded

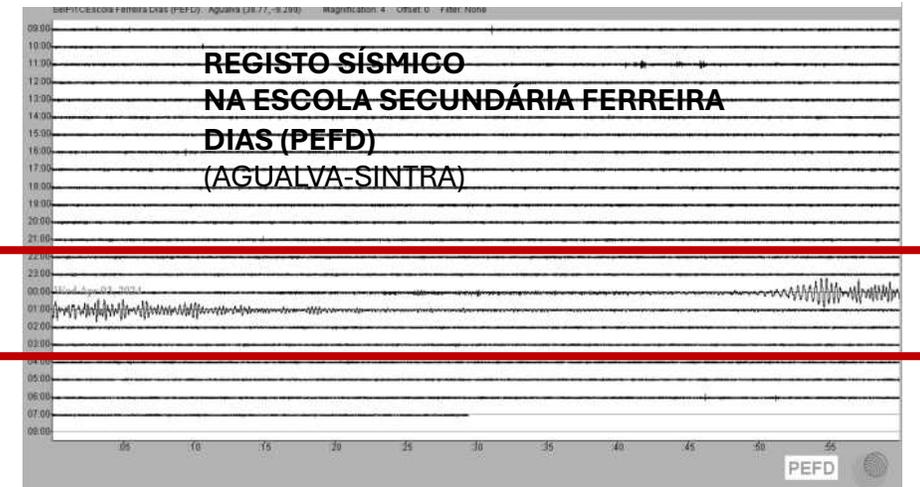
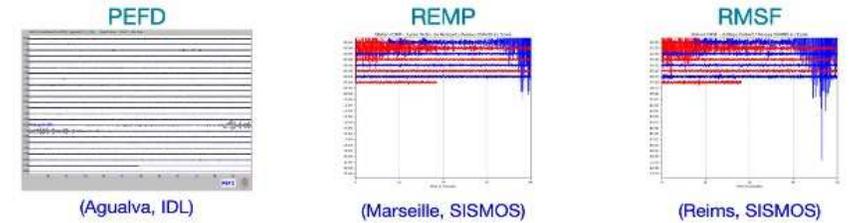
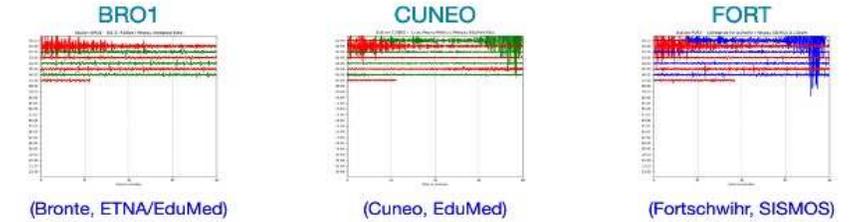
1



La sismicité / Seismicity



Les sismogrammes / Seismograms



Each line > 1 hour

Time > GMT

Screen shot > image

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

Centro de Datos Sismológicos para o Ensino

Les images des mouvements du sol / Pictures of ground motions recorded

Mouvements du sol / Ground motions

Données archivées / Stored data

2

La sismicité / Seismicity

Séismes récents / Last earthquakes

| Date | Heure | Mag | Prof |
|------|-------|-----|------|
| 2023 | 08:00 | 2.0 | 10 |
| 2023 | 07:50 | 2.0 | 10 |
| 2023 | 07:40 | 2.0 | 10 |
| 2023 | 07:30 | 2.0 | 10 |
| 2023 | 07:20 | 2.0 | 10 |
| 2023 | 07:10 | 2.0 | 10 |
| 2023 | 07:00 | 2.0 | 10 |
| 2023 | 06:50 | 2.0 | 10 |
| 2023 | 06:40 | 2.0 | 10 |
| 2023 | 06:30 | 2.0 | 10 |
| 2023 | 06:20 | 2.0 | 10 |
| 2023 | 06:10 | 2.0 | 10 |
| 2023 | 06:00 | 2.0 | 10 |
| 2023 | 05:50 | 2.0 | 10 |
| 2023 | 05:40 | 2.0 | 10 |
| 2023 | 05:30 | 2.0 | 10 |
| 2023 | 05:20 | 2.0 | 10 |
| 2023 | 05:10 | 2.0 | 10 |
| 2023 | 05:00 | 2.0 | 10 |
| 2023 | 04:50 | 2.0 | 10 |
| 2023 | 04:40 | 2.0 | 10 |
| 2023 | 04:30 | 2.0 | 10 |
| 2023 | 04:20 | 2.0 | 10 |
| 2023 | 04:10 | 2.0 | 10 |
| 2023 | 04:00 | 2.0 | 10 |
| 2023 | 03:50 | 2.0 | 10 |
| 2023 | 03:40 | 2.0 | 10 |
| 2023 | 03:30 | 2.0 | 10 |
| 2023 | 03:20 | 2.0 | 10 |
| 2023 | 03:10 | 2.0 | 10 |
| 2023 | 03:00 | 2.0 | 10 |
| 2023 | 02:50 | 2.0 | 10 |
| 2023 | 02:40 | 2.0 | 10 |
| 2023 | 02:30 | 2.0 | 10 |
| 2023 | 02:20 | 2.0 | 10 |
| 2023 | 02:10 | 2.0 | 10 |
| 2023 | 02:00 | 2.0 | 10 |
| 2023 | 01:50 | 2.0 | 10 |
| 2023 | 01:40 | 2.0 | 10 |
| 2023 | 01:30 | 2.0 | 10 |
| 2023 | 01:20 | 2.0 | 10 |
| 2023 | 01:10 | 2.0 | 10 |
| 2023 | 01:00 | 2.0 | 10 |
| 2023 | 00:50 | 2.0 | 10 |
| 2023 | 00:40 | 2.0 | 10 |
| 2023 | 00:30 | 2.0 | 10 |
| 2023 | 00:20 | 2.0 | 10 |
| 2023 | 00:10 | 2.0 | 10 |
| 2023 | 00:00 | 2.0 | 10 |

Recherche de séismes / Seismicity

Les sismogrammes / Seismograms

Sismogrammes d'intérêt pédagogique / Seismograms for educational purpose

Ma station / My station

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

2 / Archives recordings

Choose stations

Define Time slot

EduMed :

- Athènes (ATHE)
- Casablanca (CASA1)
- Barcelonnette (BARF)
- Le Beusset (BSTP)
- Beausoleil (CBBF)
- Valbonne (CRV)
- Cuni (CUNEO)
- Draguignan (DRGF)
- Gémenos (GEMC)
- Dubai (LLFPM)
- Nice (LYMP)
- Saint-Sauveur-sur-Tinée (SAUV)
- Saint-Jean-de-Bourmay (SJOB)
- Saint-Vallier-de-Thy (SVLF)
- Sospel (SOSP)

Epos-France :

- Ajaccio (AJAC)
- L'Arbois (ARBF)
- Artigues (ARTF)
- Les-Blancs (BLAF)
- Calern (CALF)
- Enaux (ENALX)
- Flassans-sur-Issole (FLAF)
- Monaco (MON)
- Morsiglia (MORSI)
- L'Argentière-la-Bessée (OGAG)
- Dignes les Bains (OGDI)
- Rustré (RUSF)
- La Sagne (SALSA)

EduMed (suite) :

- Trets (Trets)
- Aix-en-Provence (ZADX)

EduMed - Insegnaci Etna :

- Acireale (ACI2)
- Bronte (BRO1)
- Catane (CAT1)
- Randazzo (RAN1)

ROEDUSEIS :

- Bucarest (BUGA)

EKFE Fthiotidas :

- Ypati (YPAT)

INGV :

- L'Aquila (AQU)
- Coli (BOB)
- Celeste (CEL)
- San Piero in Campo Elba (CELB)
- Grotta di Bossa (GBOS)
- Anogia (DI)
- Moncucco Torinese (MONC)
- Rocca Remolon (RL)

Corinth Rift Laboratory :

- Psaromita (PSAM)

SISMOS à l'Ecole :

- Saint-Louis (ALSA)
- Artz-de-Béam (ARTZ)
- Challette-sur-Loing (CHAL)
- Santiago du Chili (CHL)
- Fortschwehr (FORT)
- Annemasse (LIMA)
- Pamandz (LPTP)
- Le Luc (LUCF)
- Remiremont (MRVF)
- Monthemé (MTMF)
- Merton (MTON)
- Marseille (REMP)
- Reims (RMSF)

Date initiale

Date finale

Request result

BARF - 08/09/2023

CUNEO - 08/09/2023

ACI2 - 08/09/2023

ARTZ - 08/09/2023

AJAC - 08/09/2023

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

Centro de Datos Sismológicos para o Ensino

Les images des mouvements du sol / Pictures of ground motions recorded

Mouvements du sol / Ground motions

Données archivées / Stored data

La sismicité / Seismicity

Séismes récents / Last earthquakes

Recherche de séismes / Seismicity

Les sismogrammes / Seismograms

Sismogrammes d'intérêt pédagogique / Seismograms for educational purpose

Ma station / My station

3

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

3 / Recent seismicity (Live)

Mediterranean (Last 150 earthquakes)

or worldwide seismicity (M>5)

Request result

En Méditerranée / Mediterranean Dans le monde / Worldwide

Format to display data

Fichier CSV / CSV file Fichier KML / KML file Ouvrir avec TectoGlo3D Display into TectoGlo3D

Retrouvez ici les 150 derniers séismes méditerranéens

| date (UTC) | longitude (deg) | latitude (deg) | profondeur (km) | magnitude | lieu |
|---------------------|-----------------|----------------|-----------------|-----------|----------------|
| 2024/03/10-14:59:02 | 37.144 | 37.290 | -7.0 | 1.3 | CENTRAL TURKEY |
| 2024/03/10-14:45:15 | 36.575 | 37.878 | -7.0 | 2.9 | CENTRAL TURKEY |
| 2024/03/10-14:41:49 | 41.559 | 38.289 | -7.0 | 1.0 | EASTERN TURKEY |
| 2024/03/10-14:26:08 | -0.876 | 43.116 | -5.2 | 1.9 | PYRENEES |
| 2024/03/10-14:07:15 | 23.850 | 40.440 | -7.0 | 2.1 | GREECE |
| 2024/03/10-13:55:55 | 30.036 | 36.069 | -21.0 | 4.8 | WESTERN TURKEY |
| 2024/03/10-13:00:53 | 20.490 | 38.380 | -5.0 | 3.0 | GREECE |
| 2024/03/10-12:29:52 | 21.760 | 38.350 | -5.0 | 2.4 | GREECE |
| 2024/03/10-12:13:42 | 27.600 | 37.860 | -7.0 | 2.4 | WESTERN TURKEY |
| 2024/03/10-11:37:47 | 20.277 | 41.128 | -15.0 | 2.1 | ALBANIA |
| 2024/03/10-11:30:01 | 22.820 | 38.210 | -5.0 | 2.1 | GREECE |
| 2024/03/10-10:57:42 | 12.904 | 46.149 | -20.0 | 0.8 | NORTHERN ITALY |
| 2024/03/10-10:28:57 | 37.155 | 37.425 | -9.9 | 2.0 | CENTRAL TURKEY |

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

Centro de Datos Sismológicos para o Ensino

Les images des mouvements du sol / Pictures of ground motions recorded

Mouvements du sol / Ground motions

Données archivées / Stored data

La sismicité / Seismicity

Séismes récents / Last earthquakes

| Mag | Coord | Prof | Mag | Coord | Prof |
|-------|--------|------|-----|-------|------|
| 4.000 | 30.000 | 4.0 | 3.0 | 3.0 | 3.0 |
| 3.500 | 30.000 | 4.0 | 3.0 | 3.0 | 3.0 |
| 3.000 | 30.000 | 4.0 | 3.0 | 3.0 | 3.0 |
| 2.500 | 30.000 | 4.0 | 3.0 | 3.0 | 3.0 |
| 2.000 | 30.000 | 4.0 | 3.0 | 3.0 | 3.0 |
| 1.500 | 30.000 | 4.0 | 3.0 | 3.0 | 3.0 |
| 1.000 | 30.000 | 4.0 | 3.0 | 3.0 | 3.0 |
| 500 | 30.000 | 4.0 | 3.0 | 3.0 | 3.0 |
| 250 | 30.000 | 4.0 | 3.0 | 3.0 | 3.0 |
| 100 | 30.000 | 4.0 | 3.0 | 3.0 | 3.0 |

Recherche de séismes / Seismicity

Les sismogrammes / Seismograms

Sismogrammes d'intérêt pédagogique / Seismograms for educational purpose

Ma station / My station

5

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

6 / Data available for 'My station'

Choose station

EduMed :

- Aix-en-Provence (AIXF)
- Athènes (ATHE)
- La Trinité (AZU1)
- Barcelonnette (BARF)
- Le Beausset (BSTF)
- Casablanca (CASA)
- Beausoleil (CBBF)
- Valbonne (CIVV)
- Coni (CUNEO)
- Dragulgnan (DRGF)
- Gémenos (GEMC)
- Dubaï (LLFPM)
- Nice (LYMP)
- Saint-Sauveur-sur-Tinée
- Saint-Jean-de-Bourmay
- Sospel (SOSP)
- Sète (SPVF)
- Saint-Vallier-de-Thiery
- Trets (Trets)
- Vinon-sur-Verdon (VINO)

Edumed - Insegnaci Etna :

- Acireale (ACI2)
- Bronte (BRO1)
- Randazzo (RAN1)

Roeduseis :

- Bucarest (BUCA)

Centre de formation SVT marocain :

- Agadir (AGLA)

EKFE Fthiotidas :

- Ypati (YPATI)

Sismologia na escola :

- Aqualva (PEFD)

SISMOS à l'Ecole :

- Aurillac (ACDF)
- Saint-Louis (ALSA)
- Artez-de-Béarn (ARTZ)
- Carcassonne (CARC)
- Châlette-sur-Loing (CHAL)
- Fortschwirh (FORT)
- Lisbonne (LFCL)
- Caracas (LFCV)
- Annemasse (LJMA)
- Le Luc (LUCF)
- Moorea (MOOR)
- Remimont (MRVF)
- Monthermé (MTMF)
- Menton (MTON)
- Pontacq (PONQ)
- Marseille (REMP)
- Reims (RMSF)
- Saint-Laurent-du-Var
- Valencia (VALE)
- Bordeaux (VMTE)

J'ai choisi !

Voir le résultat de la requête

Décocher la station sélectionnée

Request result

Format to display data

20/05/2022 -- 12h 35min 49sec -- M5.5 -- GIBRALTAR (Données du CSEM / Data from EMSC)

Télécharger le zip
Tectoglob3D
Tectoglob3D

Virtual globe

Output window

Event : GIBRALTAR
Date : 20/05/2022
Magnitude : 5,5 Hypocenter depth : 10 km Epicenter :

Station PEFD (network Sismologia na escola) 38,8°N ; 9,3°E

PEFD
Comp. : BHZ



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

Centro de Dados Sismológico para o Ensino

Les images des mouvements du sol / Pictures of ground motions recorded

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Sismogrammes d'intérêt pédagogique / Seismograms for educational purpose

Ma station / My station

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

4 / seismic event records (seismograms)

Date and place

Format to display data

2024.01.27 / Turkish earthquake (M5.0, CSEM)
Seismograms from EduMed-Obs, EKFE Fihitidas, and Roedusels educational networks, and from Mednet and Corinth Rift Laboratory research networks.

Data format SAC Tectoglob3D view

2023.09.08 / Moroccan earthquake (M6.8, EMSC)
Following the dramatic earthquake near Oukaimeden in Morocco on 8 September 2023, data (seismograms, mapping of faults and aftershocks from the first week) are available for use in observing and understanding the seismic nature of the area. This is a key approach to raising awareness of seismic risk.

Data format SAC Tectoglob3D view

2023.06.08 / Greek earthquake (M4.9, EMSC)
Use data from the hellenic seismic network (HL from the NOA) and the educational station ATHE (EduMed Obs) to estimate the epicentral location of the 2023 8th June earthquake.

Data format SAC Tectoglob3D view

Request result :

Data displayed directly with the software (Tectoglob3D)

Globe virtuel

Fenêtre de résultats

Évènement : MAROC
Date : 08/09/2023
Magnitude : 6,8 Profondeur du foyer : 12 km

Station TIO (réseau Western Mediterranean Network) 30,9°N ; -7,3°E ; dist. épicentre : 117km (1,156°)

TIO
Canal : BHZ

Station AGLA (réseau Centre de formation des professeurs de SVT marocains) 30,4°N ; -9,6°E ; dist. épicentre : 129km (1,156°)

AGLA
Canal : BHZ

Station CASA (réseau EduMed-Obs) 33,5°N ; -7,6°E ; dist. épicentre : 282km (2,533°)

CASA
Canal : BHZ

Réglages / paramètres 15



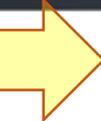
Bienvenue dans l'Observatoire Éducatif Méditerranéen



- Network
- Live
- Data Center ▼
- Tools Lab
- Teachers Room
- EDUSEIS ▼
- Virtual Tour ▼
- EduChallenge

Partenaires

- Data Center
- SEISMO**
- METEO
- HYDRO
- OCEANO
- VOLCANO



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



Atividade prática I

Explorar a base de dados sísmológicos EDUMED - OBS
> <http://edumed.unice.fr/data-center/sismo>

Missão 1 / Visualizar o movimento do terreno registado hoje pelo PEFD

Missão 2 / Procurar registos de movimentos do terreno no dia 19-20 e 21 de maio de 2022 pelo PEFD

Missão 3 / Produzir um mapa de sismicidade de Portugal desde 1 de janeiro de 2023 até à data de hoje

Missão 4 / Filtrar a sismicidade do seu mapa para guardar apenas os sismos de magnitude igual ou superior 3



15 minutos



Atividade prática II

Analisar os dados sismológicos com EDUMED - OBS
> <http://edumed.unice.fr/data-center/sismo>

Missão 1 / Abrir os sismogramas selecionados para o sismo de 8 de setembro de 2023

Missão 2 / Análise de um sismograma de referência com a chegada das ondas sísmicas por exemplo > BRO1

Missão 3 / Tempo de chegada das ondas sísmicas e princípio de localização do epicentro

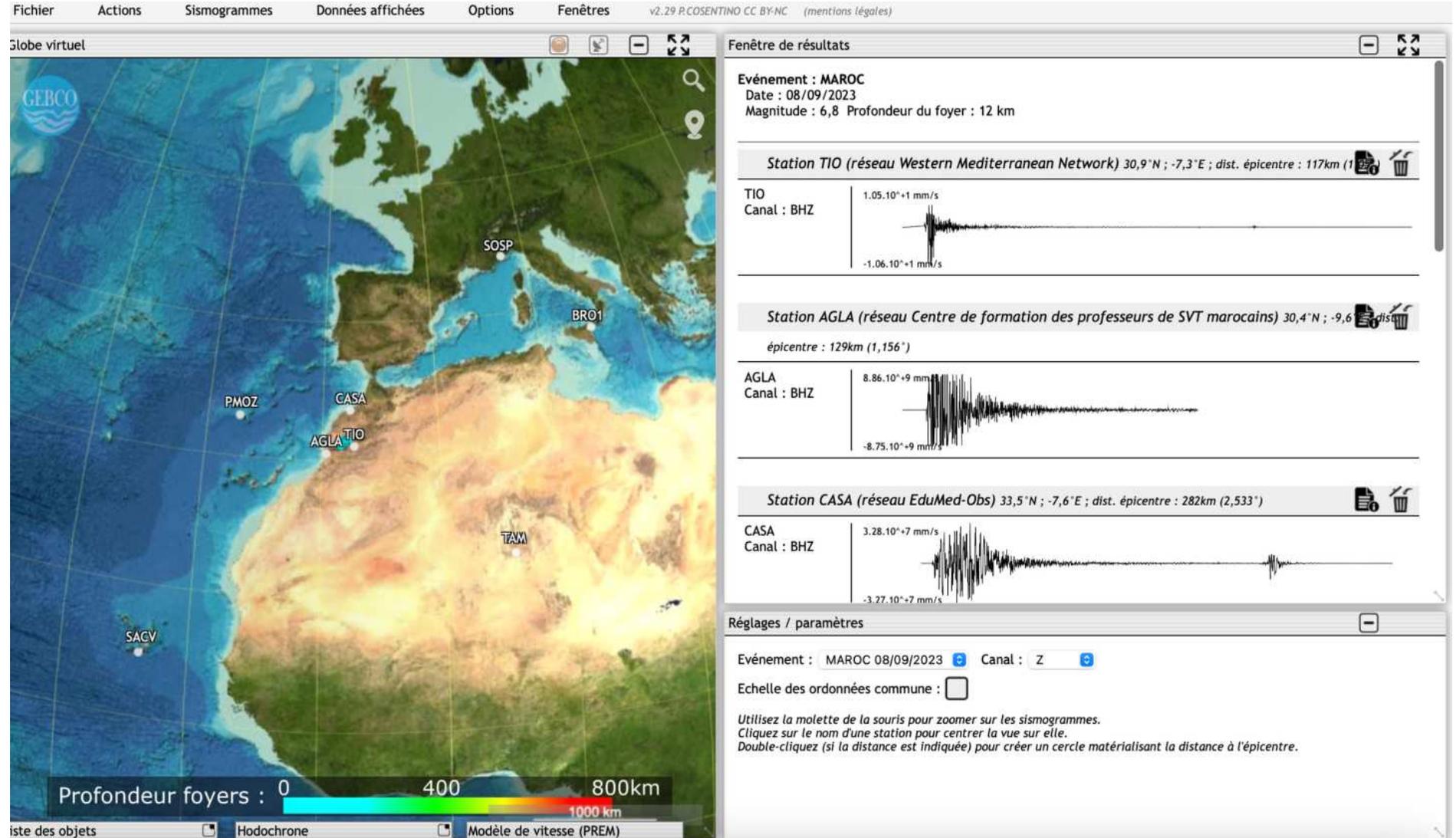
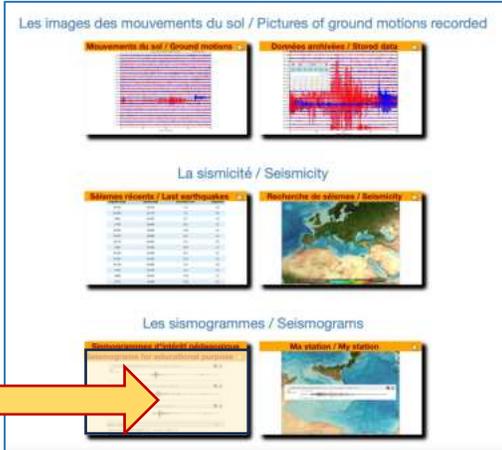
Missão 4 / Localização do epicentro e relação com a sismicidade da região estudada



30 minutos

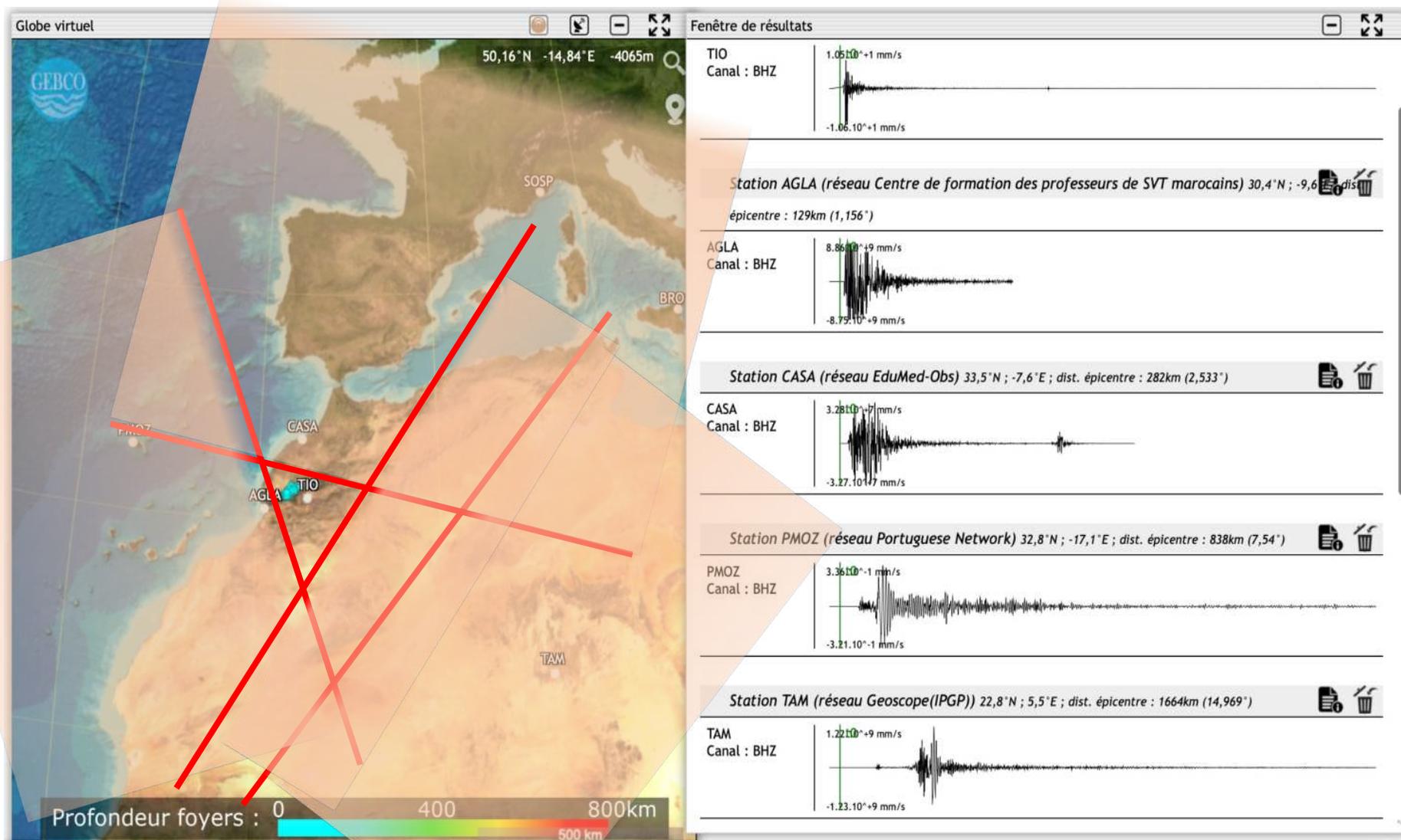
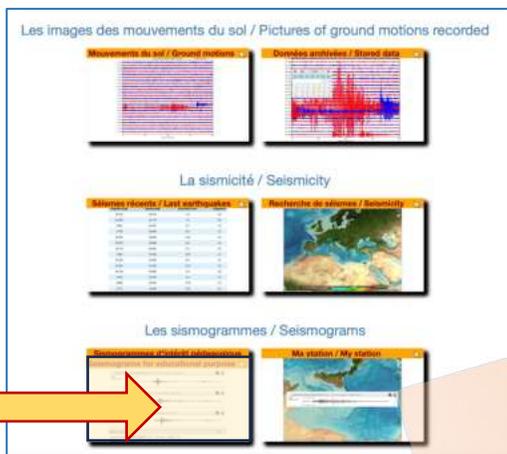
Step 2 > Data Request : seismograms recorded in Marocco (8 Sept. 2023)

sismogramas registados em Marrocos (8 de setembro de 2023)



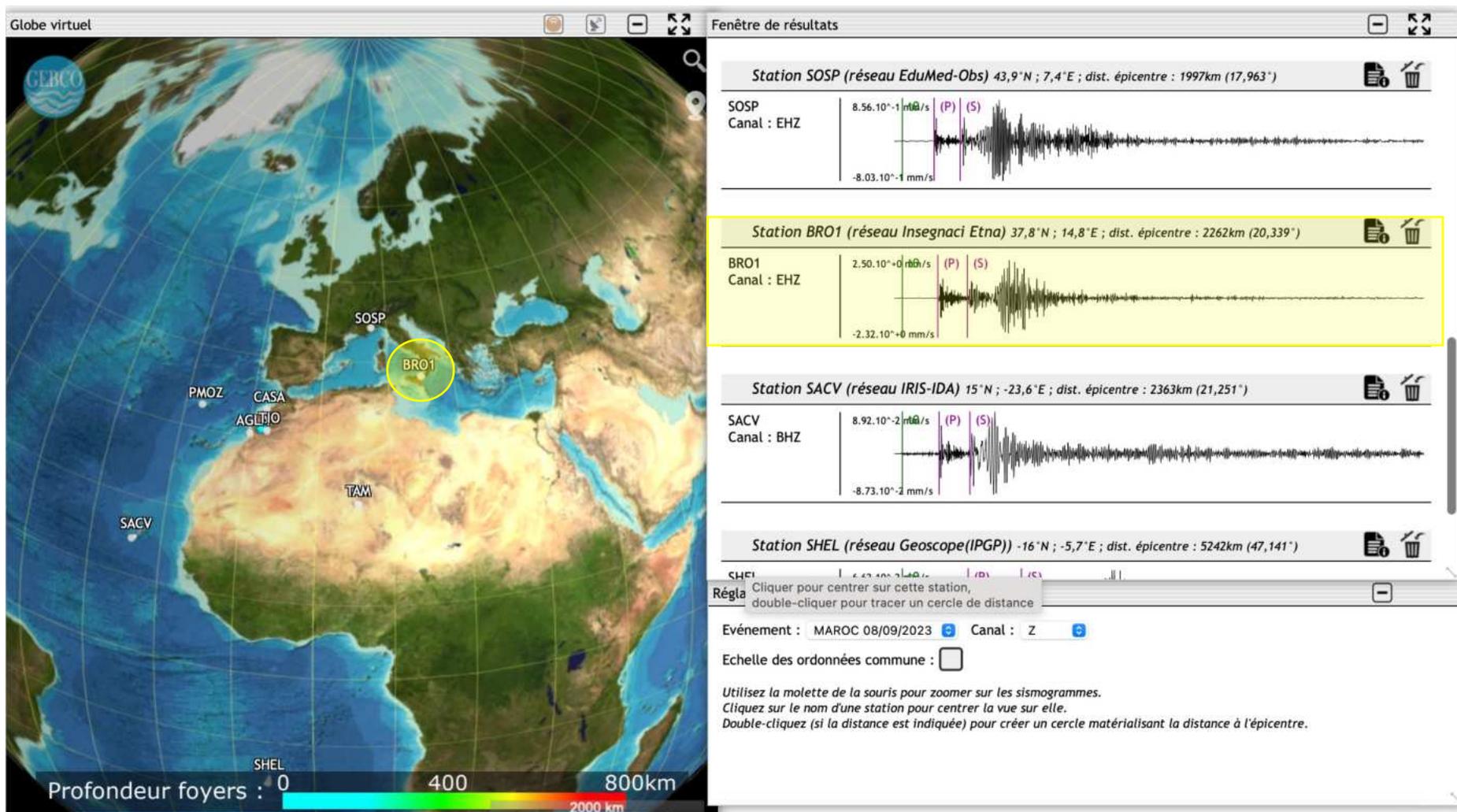
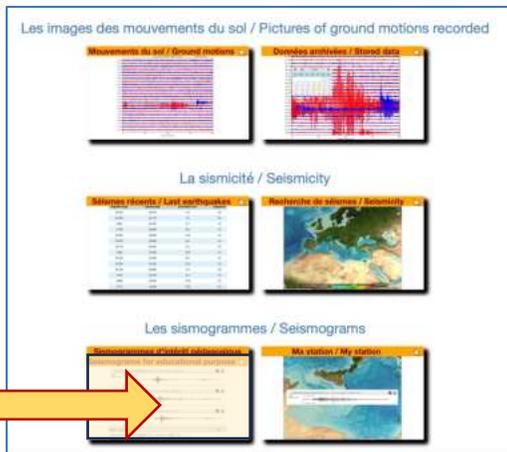
Step 3 > Analyze data / Localization with bisectors

sismogramas registados em Marrocos (8 de setembro de 2023)



Utilizamos
o tempo de chegada
do primeiro grupo
de ondas sísmicas
e
Utilizamos os bissectores

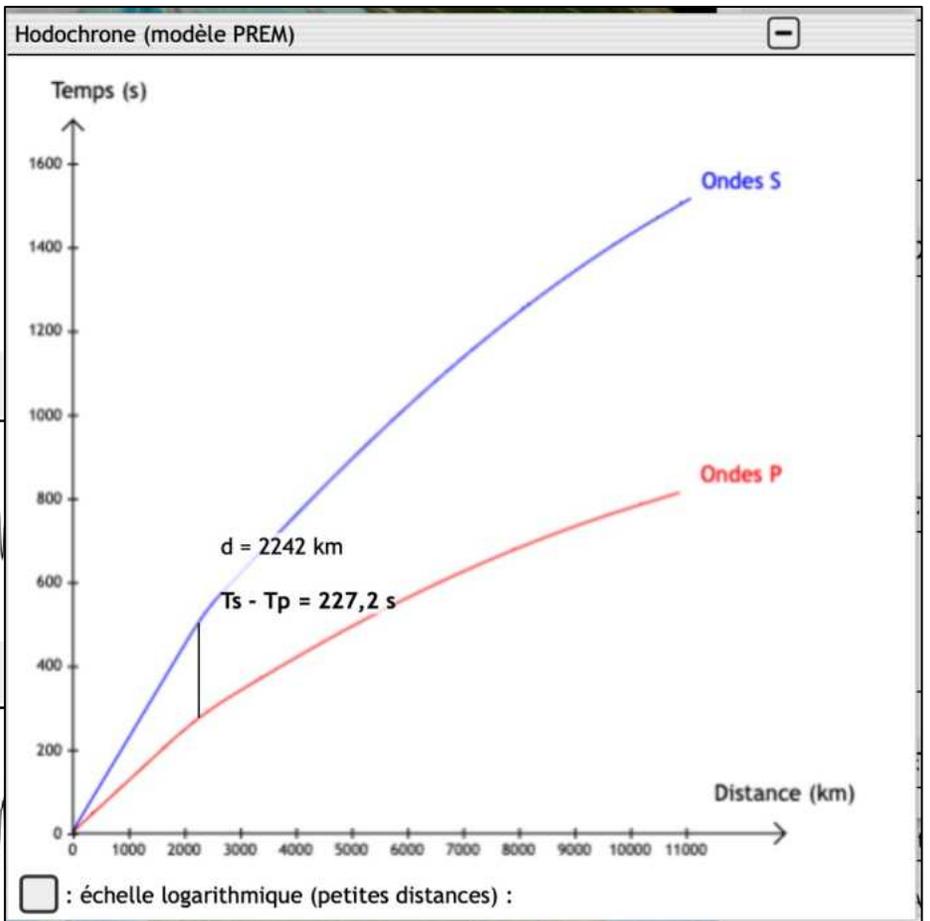
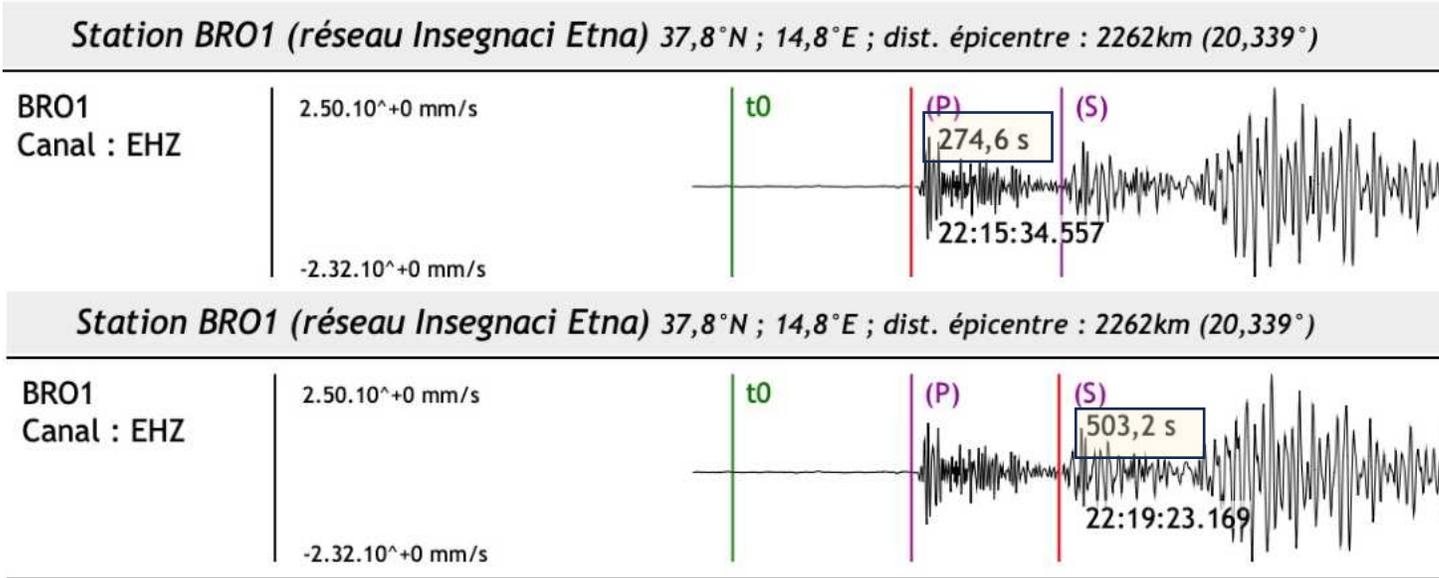
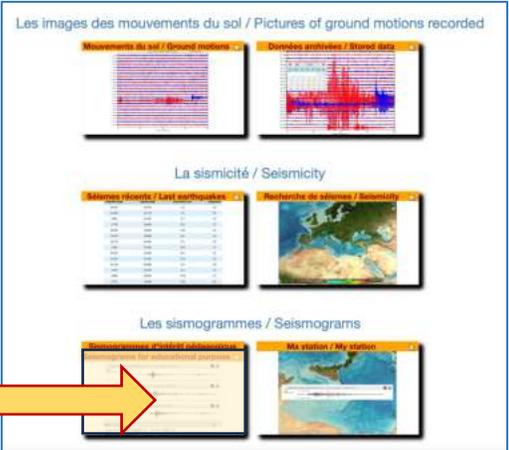
sismogramas registados em Marrocos (8 de setembro de 2023)



Utilizamos o tempo de chegada das ondas sísmicas: $t_s - t_p$.
P e S: grupo de ondas sísmicas

Step4> Localization with circles

sismogramas registados em Marrocos (8 de setembro de 2023)



Step 4 > Localization with circles

sismogramas registrados em Marrocos (8 de setembro de 2023)

Les images des mouvements du sol / Pictures of ground motions recorded

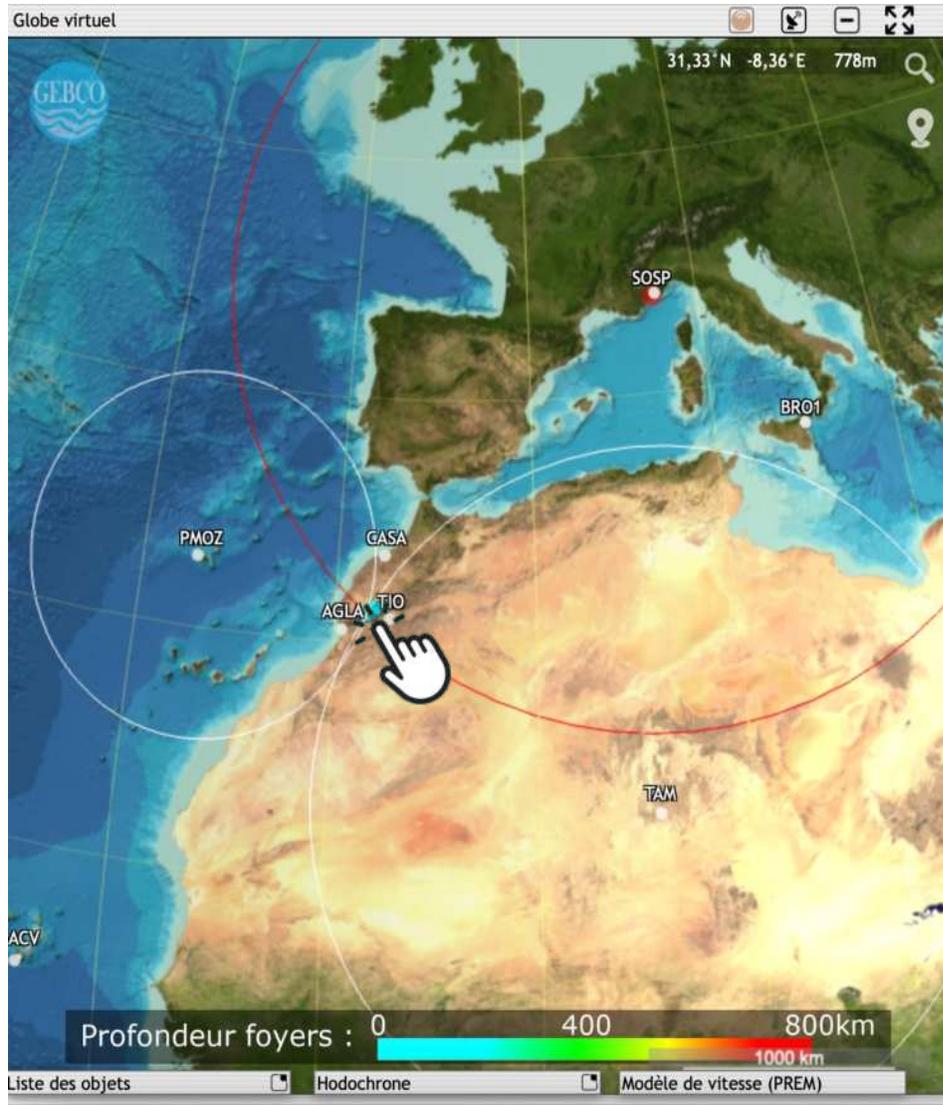
Mouvements du sol / Ground motions

Données sismiques / Seismic data

La sismicité / Seismicity

Sismogrammes / Seismograms

Ma station / My station



Fenêtre de résultats

Station PMOZ (réseau Portuguese Network) 32,8°N ; -17,1°E ; dist. épicentre : 838km (7,54°)

PMOZ Canal : BHZ

Station TAM (réseau Geoscope(IPGP)) 22,8°N ; 5,5°E ; dist. épicentre : 1664km (14,96°)

TAM Canal : BHZ

Station SOSP (réseau EduMed-Obs) 43,9°N ; 7,4°E ; dist. épicentre : 1997km (17,96°)

SOSP Canal : EHZ

Réglages / paramètres

Événement : MAROC 08/09/2023 Canal : Z

Echelle des ordonnées commune :

Utilisez la molette de la souris pour zoomer sur les sismogrammes. Cliquez sur le nom d'une station pour centrer la vue sur elle. Double-cliquez (si la distance est indiquée) pour créer un cercle matérialisant la distance à l'épicentre.



LONG : 31,33 N
LAT : - 8,36 E

Step 5 > Geodynamic context and natural hazards

sismogramas registrados em Marrocos (8 de setembro de 2023)

Les images des mouvements du sol / Pictures of ground motions recorded

Mouvements du sol / Ground motions

Données sismiques / Seismic data

La sismicité / Seismicity

Tableaux / Tables

Ma station / My station

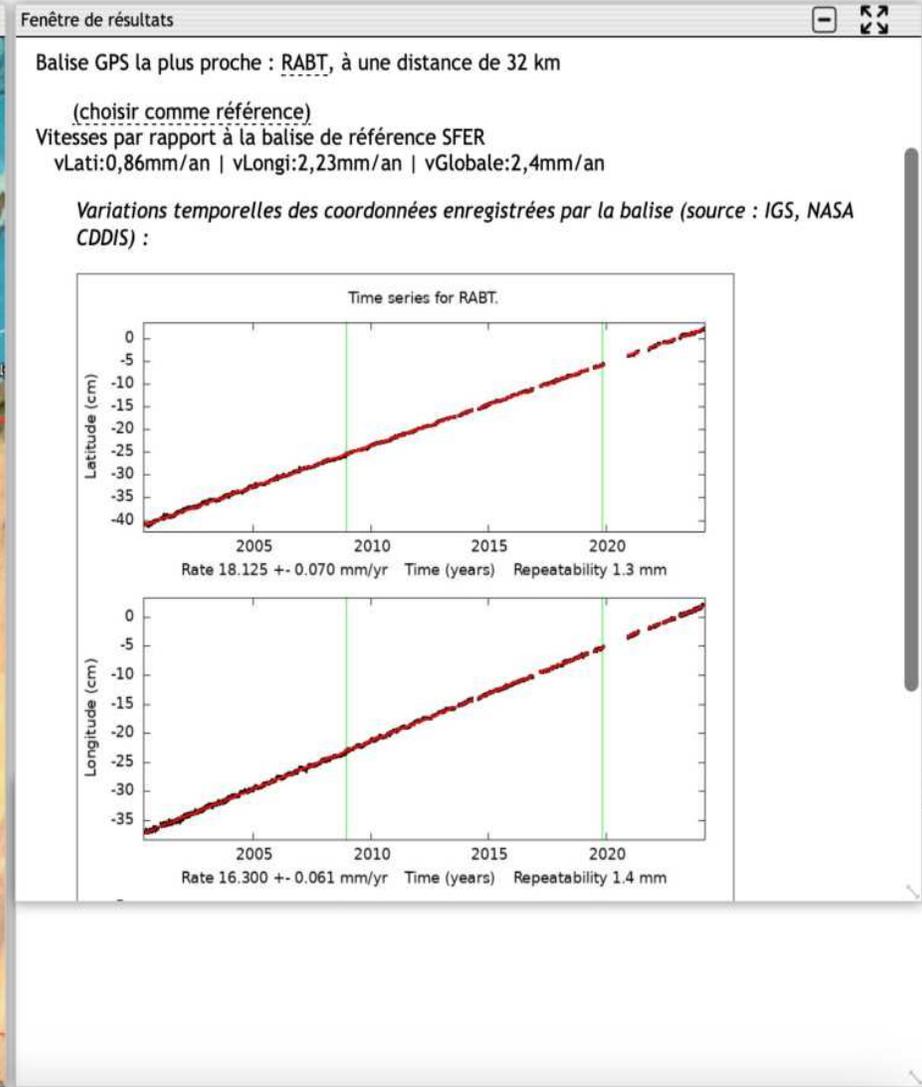
Les sismogrammes / Seismograms



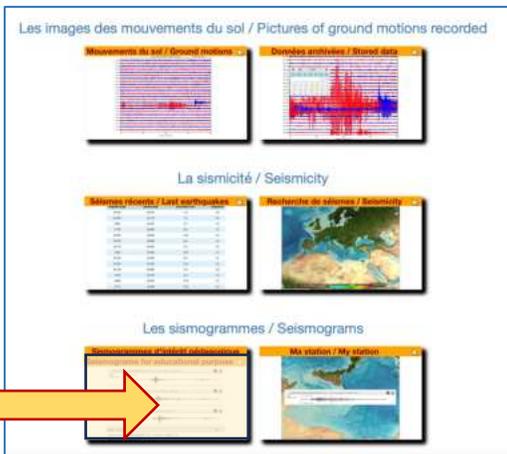
GPS data
Compare RABT & ITRN

Regional seismicity
& aftershocks events

Tectonic plates boundaries



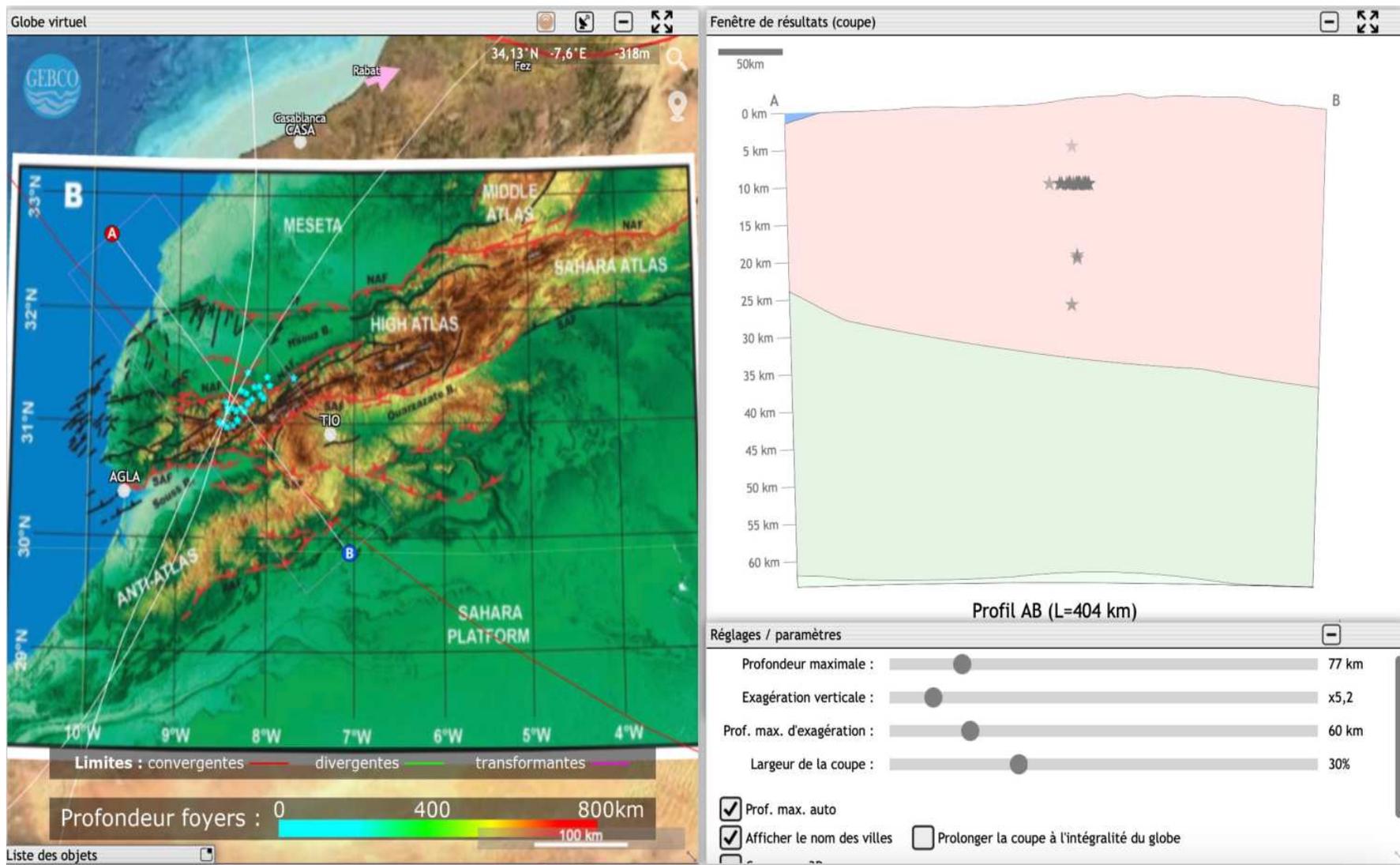
sismogramas registados em Marrocos (8 de setembro de 2023)

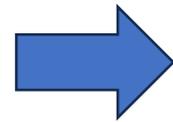
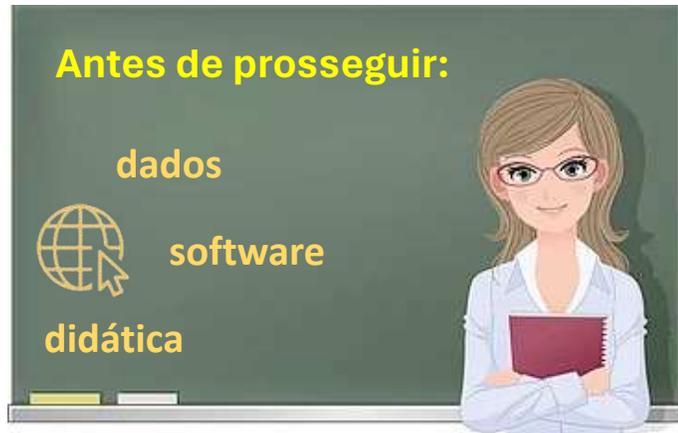


Overlay faults map

Compare seismic events and faults localisation

Seismicity and cross section





Existem bases de dados sísmicos dedicadas ao ensino e software informático para as analisar

No entanto, é ainda necessário adotar uma estratégia para utilizar esses dados

Esta estratégia pode depender do objetivo da formação:



A sismologia é um sector das geociências que pode ser útil para:



Trabalhar na prevenção dos riscos sísmicos

Trabalhar sobre a estrutura dos planetas terrestres



Atividade prática III

Riscos e eventos sísmicos na Turquia/Síria

> News

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

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



Os sismos da Turquia e da Síria foram uma sequência sísmica que ocorreu numa localização perto da fronteira entre a Síria e a Turquia com início a 6 de fevereiro de 2023.

O primeiro, e maior, ocorreu em 6 de fevereiro às 1 h 17 min 36 s (UTC) perto das cidades de Gaziantep e Kahramanmaraş, Turquia (magnitude 7,5 a 7,9).

O segundo ocorreu a cerca de 95 km a noroeste do primeiro, a norte de Ekinözü também na Turquia, no mesmo dia às 10 h 28 min 49 s (UTC) e atingiu uma magnitude de 7,5 a 7,9.

Seguiram-se milhares de réplicas nas semanas seguintes. Foram contabilizadas mais de 56 000 mortes.

Em 9 de fevereiro de 2023, o Secretário-Geral das Nações Unidas declarou que este duplo sismo foi uma das maiores catástrofes naturais do nosso tempo.

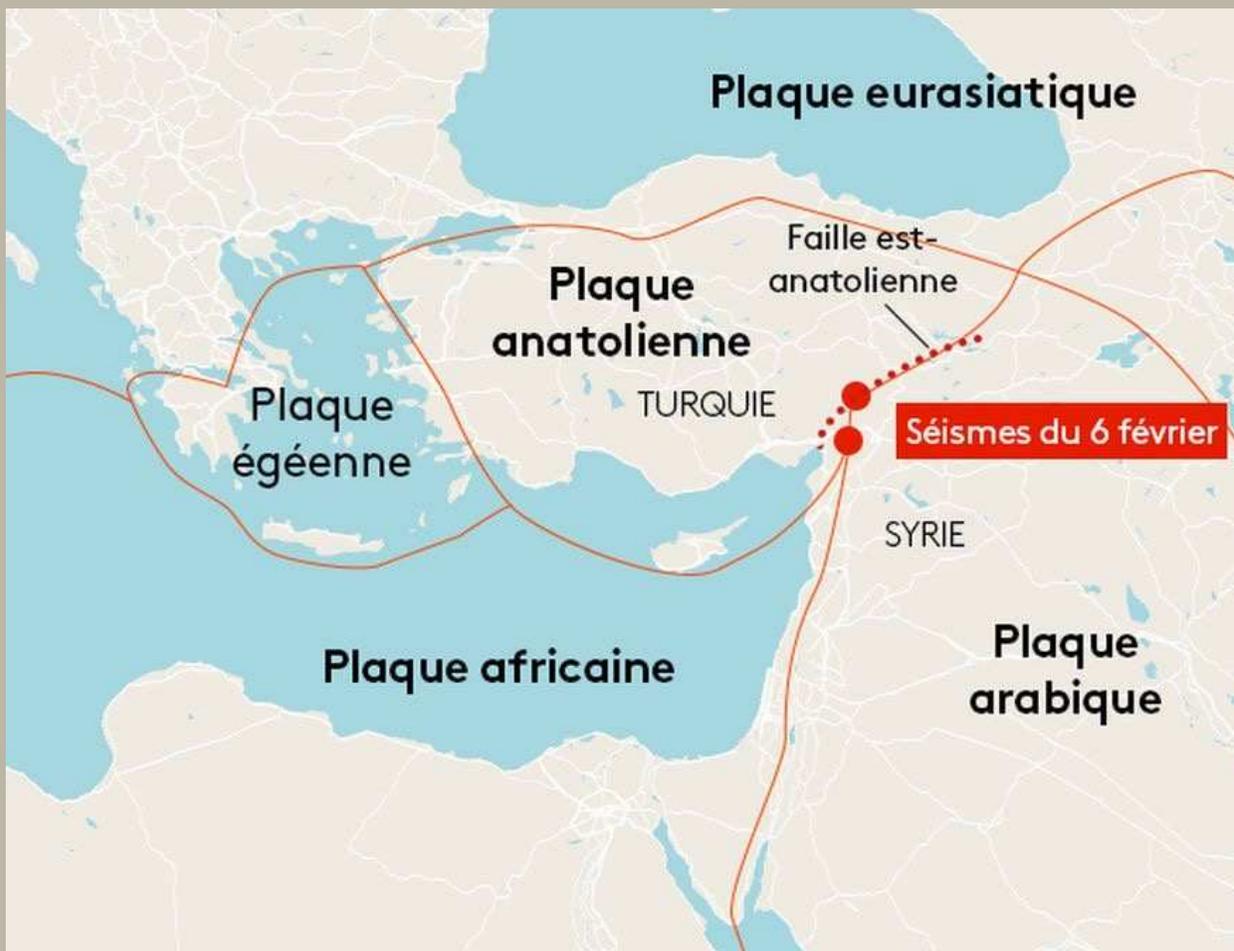


Atividade prática III

Riscos e eventos sísmicos na Turquia/Síria
> geoscience maps

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

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



A **Zona de Falha Anatoliana Oriental (EAFZ)** é uma grande zona de falha de deslizamento lateral que se estende do leste ao centro-sul da Turquia.

Esta zona constitui a fronteira tectónica do tipo transformante entre a Placa Anatoliana e a Placa Árabe, que se desloca para norte.

As falhas Anatoliana Oriental e Setentrional juntas acomodam o movimento para oeste da Placa Anatoliana, à medida que esta é comprimida pela contínua colisão com a Placa Eurasiática.

A Falha Anatoliana Oriental segue numa direção nordeste, começando no Triplo Junção de Maras, na extremidade norte da Transformação do Mar Morto, e terminando no Triplo Junção de Karlıova, onde encontra a **Falha Anatoliana Setentrional**.

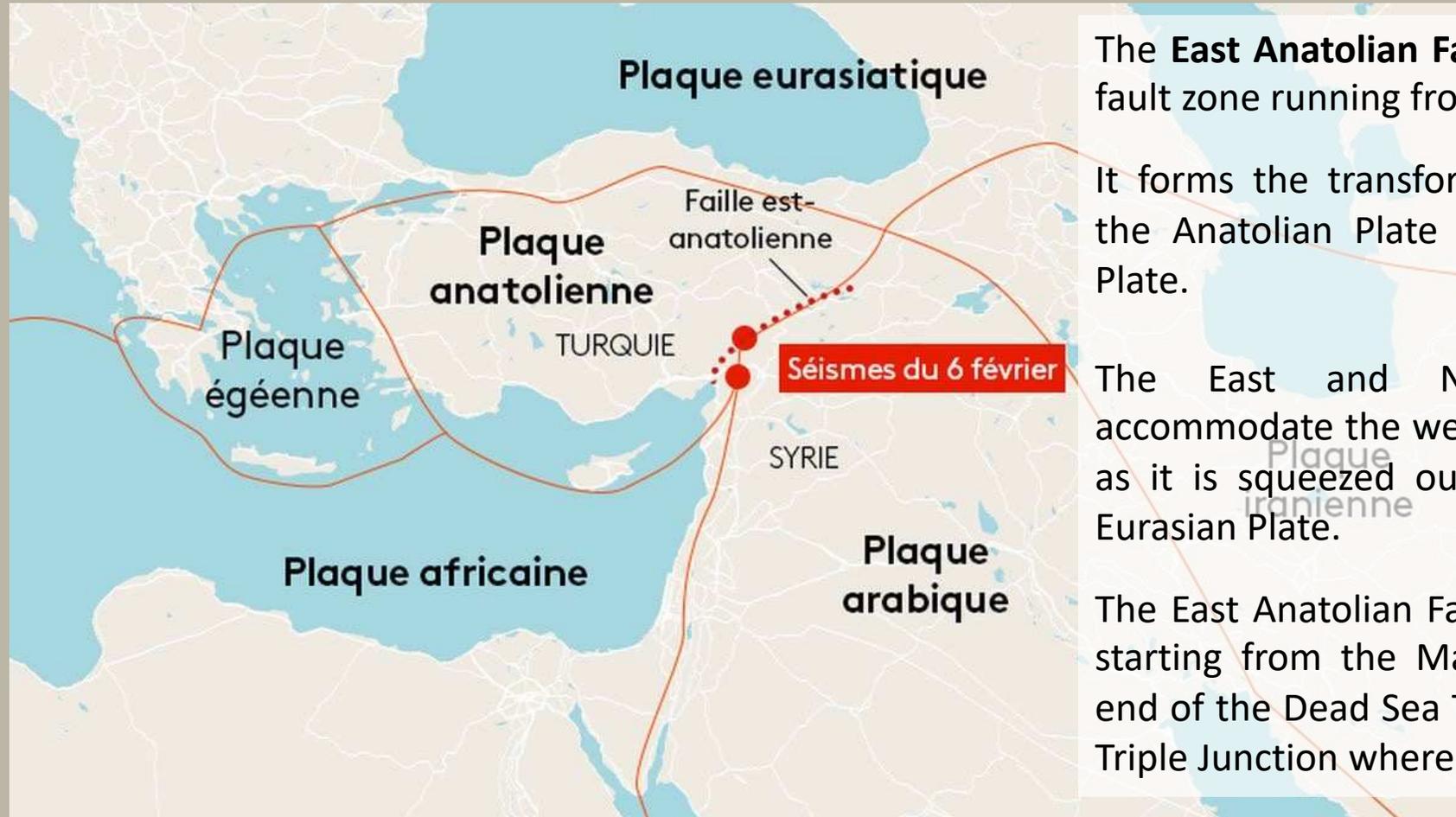


Atividade prática III

Riscos e eventos sísmicos na Turquia/Síria
> geoscience maps

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

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



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 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 Karliova Triple Junction where it meets the **North Anatolian Fault**.



Atividade prática III

Riscos e eventos sísmicos na Turquia/Síria

> <http://edumed.unice.fr/data-center/sismo>

Missão 1 / Pesquisar sismogramas arquivados para o(s) sismo(s) que ocorreu(ram) na Turquia/Síria em 6 de fevereiro de 2023

Missão 2 / Explorar os dados disponíveis (sismos, GPS, falhas, sismicidade e réplicas) com Tectoglob3D e EDUMED-OBS

Missão 3 / Estabelecer as linhas mestras de uma atividade prática para realçar o perigo sísmico nesta região, utilizando os dados disponíveis.

Discussão em grupo



40 minutos

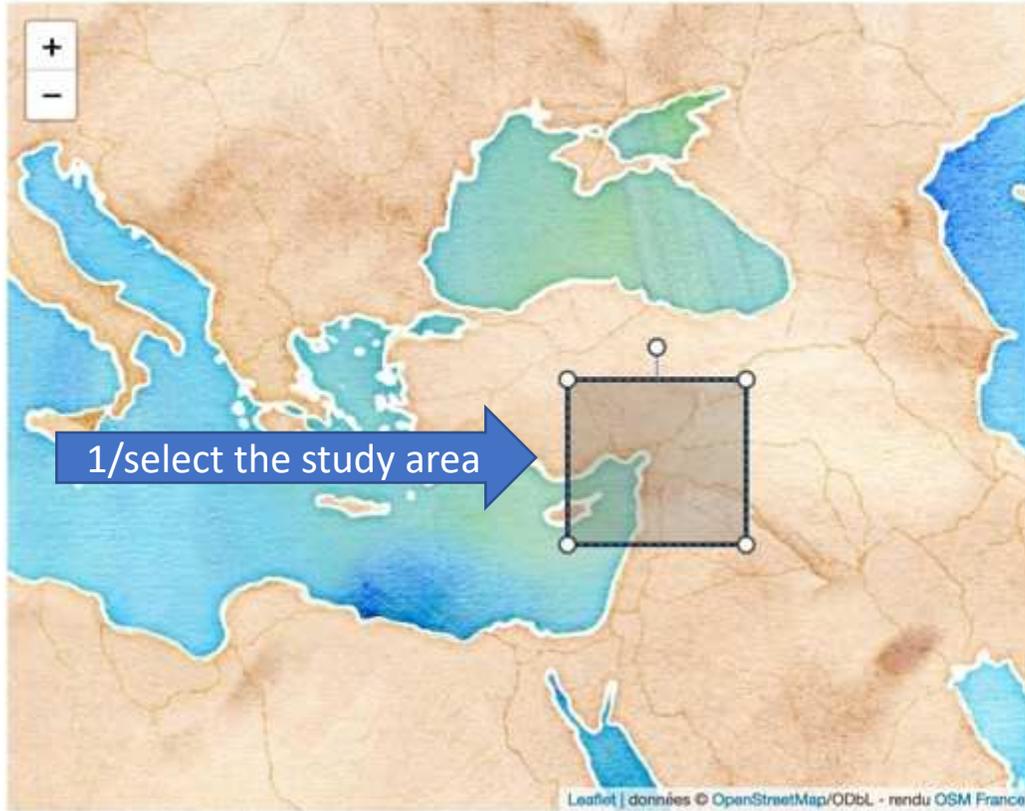
Step 1 > Data Request : seismicity recorded in border Turkey / Syria

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

Request in a database on seismicity recorded in Turkey/Syria

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

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



Date 1 Date 2

Latitude max :

Longitude min : Longitude max :

Latitude min :

Magnitudes : de 0 à 10

Profondeur (Depth) : de 0 à 1000 km

2/select the period

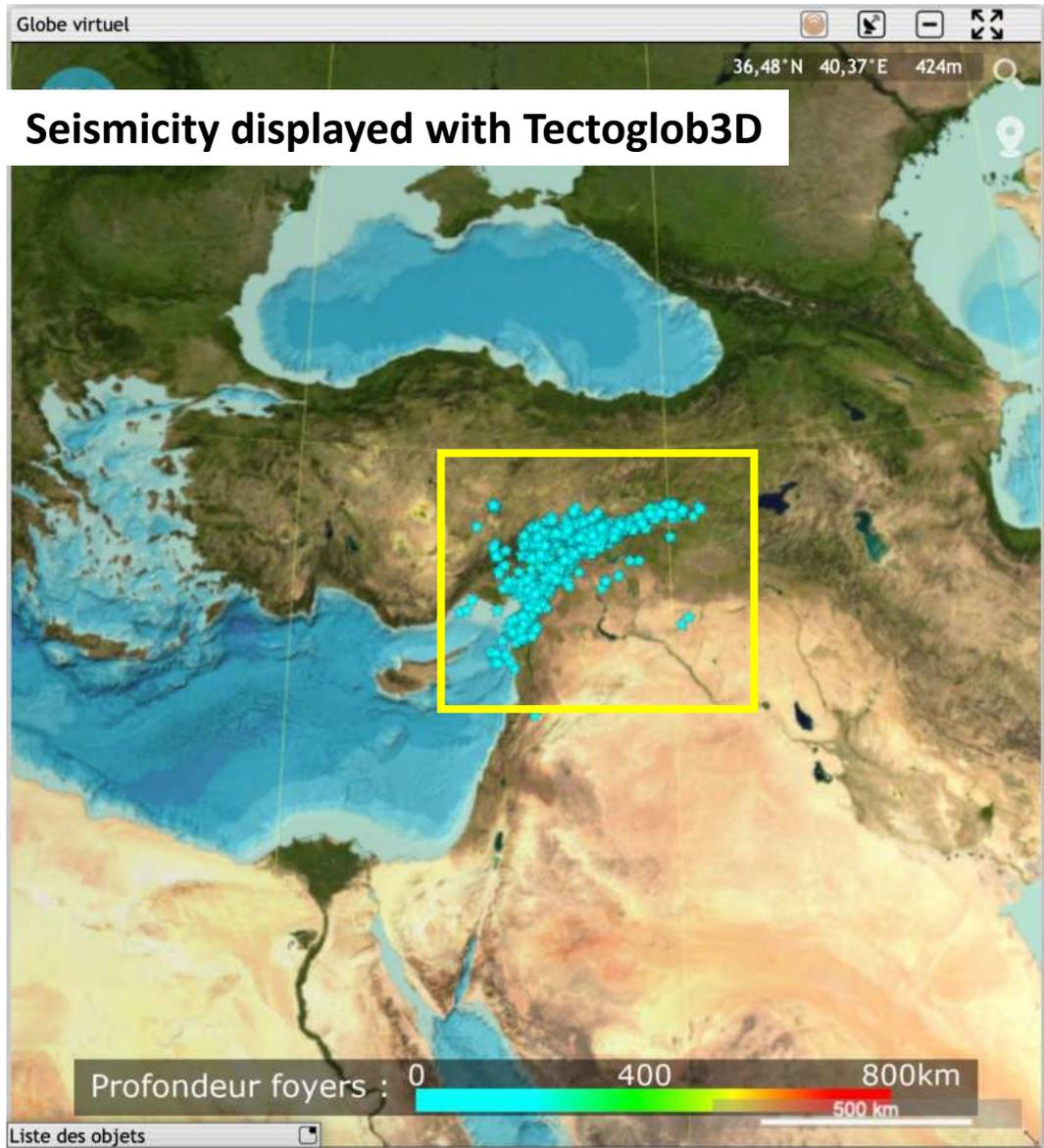
3/submit your request

4/display with Tectoglob3D

[Access to the website](#)

Step 1 > Data Request : seismicity recorded in border Turkey / Syria

Quake 1: LAT: 37,23 N / LON: 37,12 S
Quake 2: LAT: 38,14 N / LON: 37,21 S

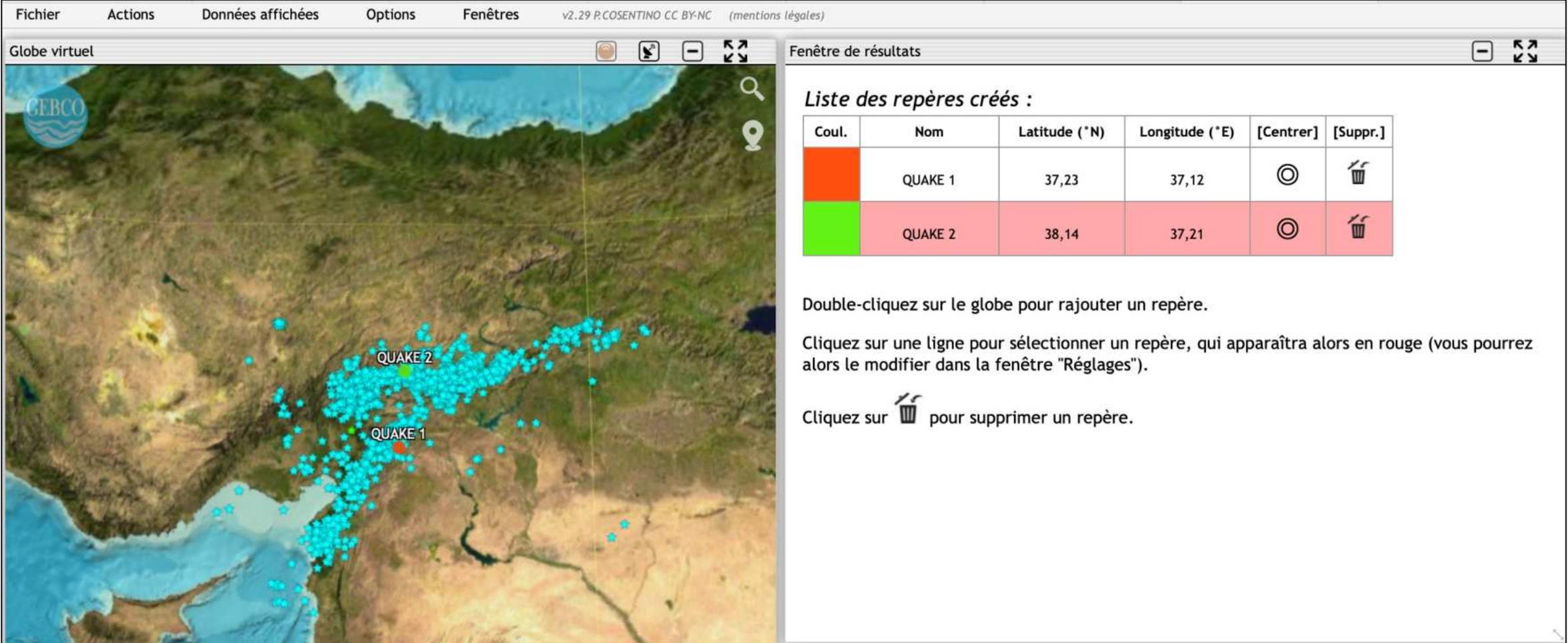


Step 2 > Analyse seismicity request, plotted on a map

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



The screenshot shows the TECTOGLOB 3D software interface. The main window displays a 3D map of the Mediterranean region with numerous blue hypocenters. Two specific earthquakes are highlighted: 'QUAKE 1' (red dot) and 'QUAKE 2' (green dot). The interface includes a menu bar with 'Fichier', 'Actions', 'Données affichées', 'Options', and 'Fenêtres'. The title bar indicates 'v2.29 P.COSENTINO CC BY-NC (mentions légales)'. A 'Globe virtuel' toolbar is visible above the map. On the right, a 'Fenêtre de résultats' window displays a table of created markers.

| Coul. | Nom | Latitude (°N) | Longitude (°E) | [Centrer] | [Suppr.] |
|--------|---------|---------------|----------------|-----------|----------|
| Orange | QUAKE 1 | 37,23 | 37,12 | 🎯 | 🗑️ |
| Vert | QUAKE 2 | 38,14 | 37,21 | 🎯 | 🗑️ |

Double-cliquez sur le globe pour rajouter un repère.

Cliquez sur une ligne pour sélectionner un repère, qui apparaîtra alors en rouge (vous pourrez alors le modifier dans la fenêtre "Réglages").

Cliquez sur 🗑️ pour supprimer un repère.

Step 2 > Analyse seismicity request, plotted on a map

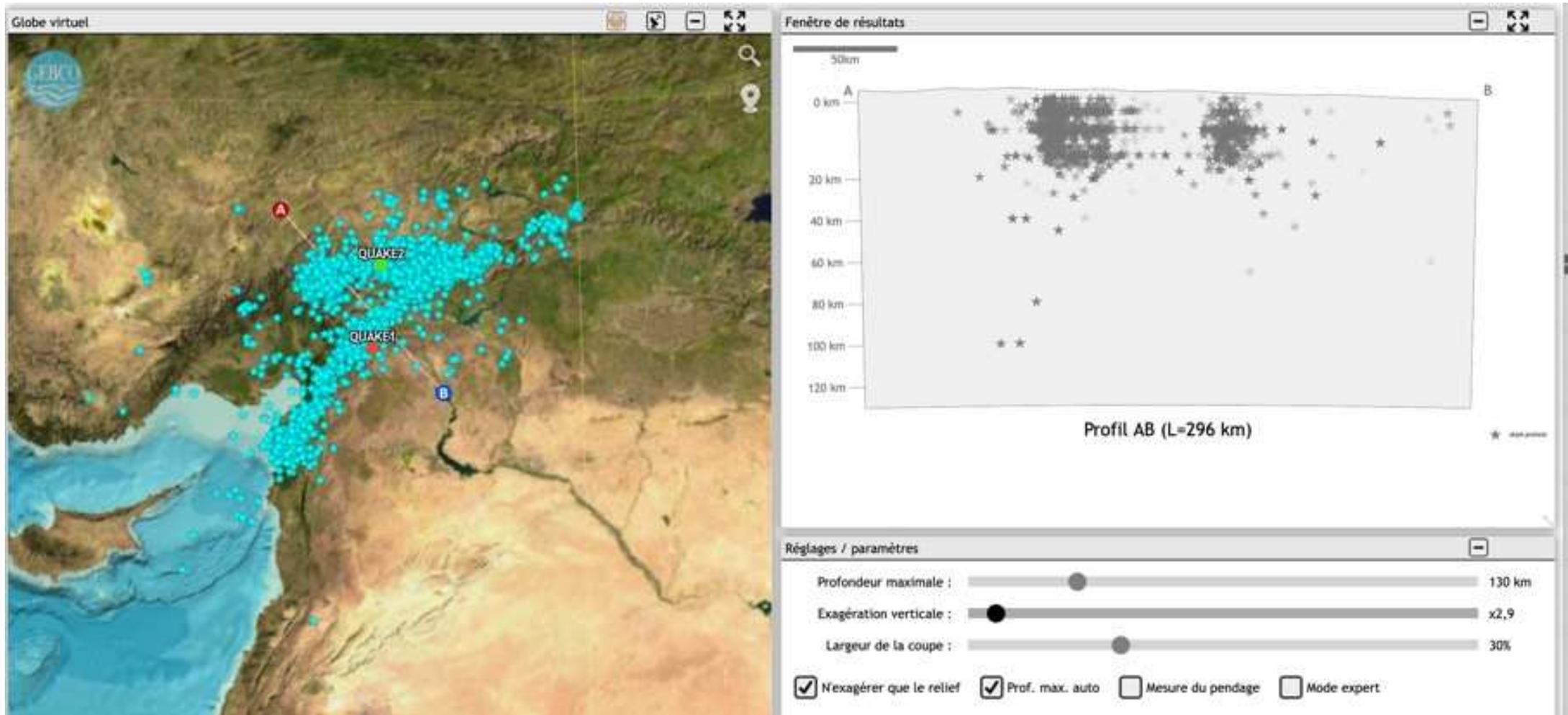
Quake 1: LAT: 37,23 N / LON: 37,12 S

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

Seismicity displayed with TECTOGLOB 3D

Compare the location of all the hypocenters

Action > Draw cross section



Step 2 > Analyse seismicity request, plotted on a map

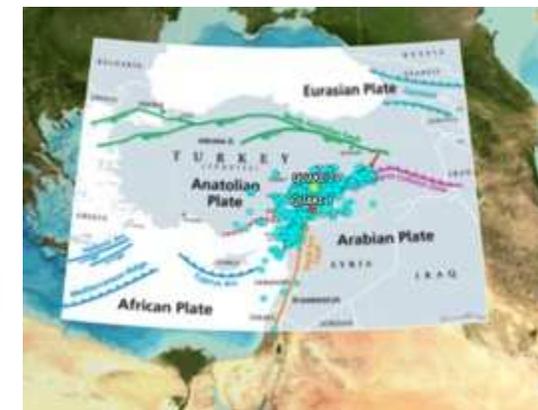
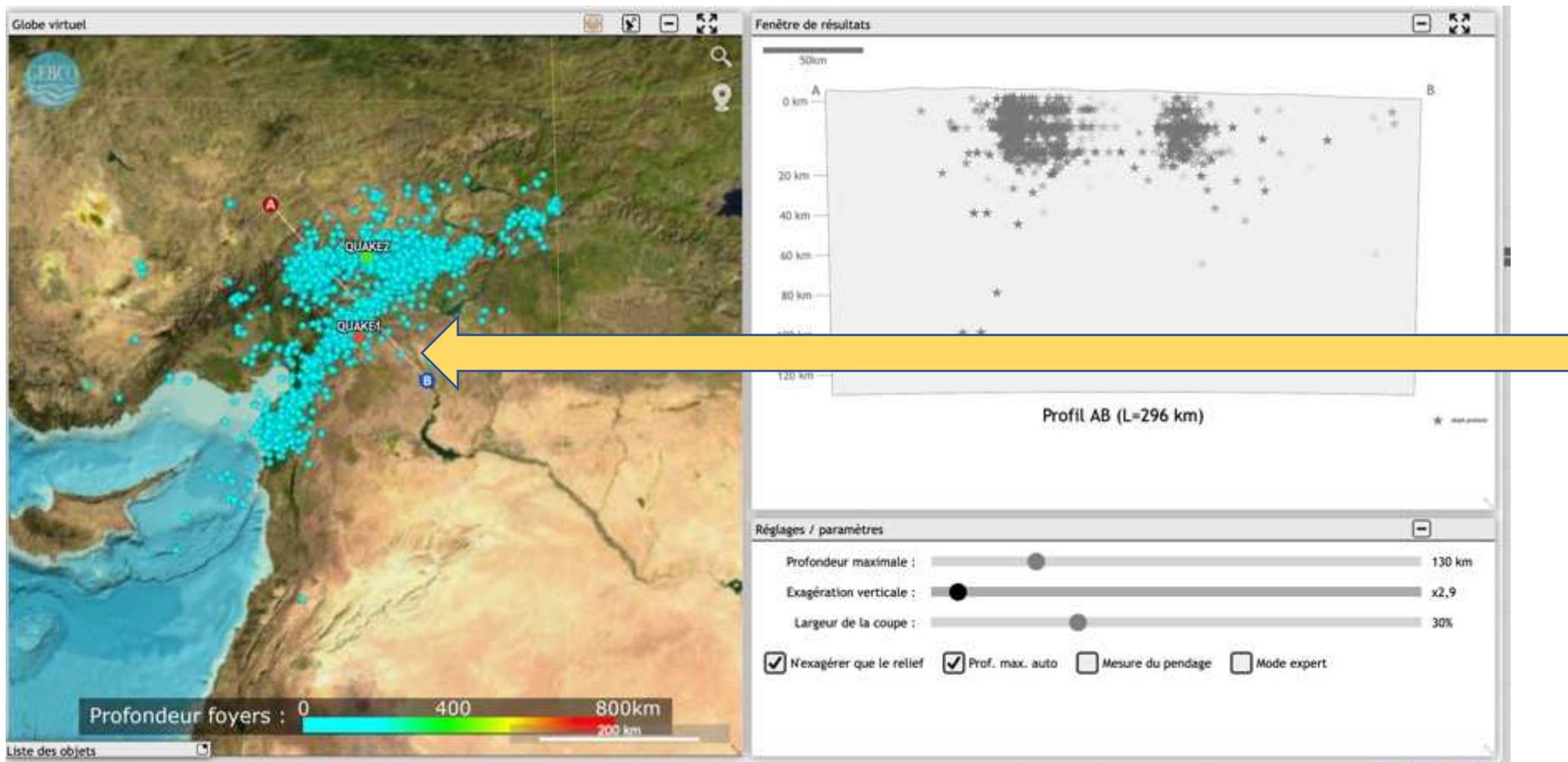
Quake 1: LAT: 37,23 N / LON: 37,12 S

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

Seismicity displayed with TECTOGLOB 3D

> Display faults context in this area

File > Import map* - KMZ format



* Anatolian-faults-network (KMZ file)

Step 2 > Analyse seismicity request, plotted on a map

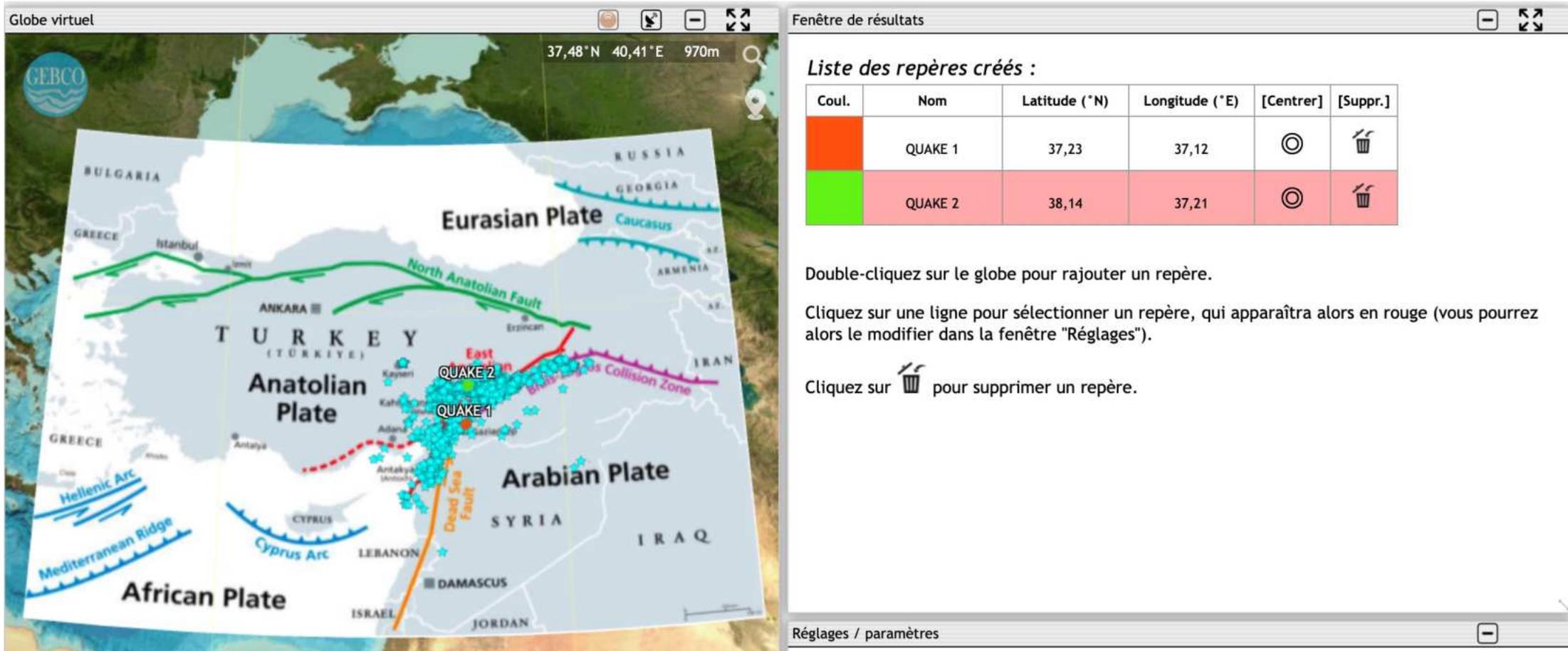
Quake 1: LAT: 37,23 N / LON: 37,12 S

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

Seismicity displayed with TECTOglob 3D

> Display faults context in this area

File > Import map* - KMZ format



Globe virtuel

37,48°N 40,41°E 970m

GEBCO

BULGARIA GREECE ANKARA TURKEY (TÜRKIYE) SYRIA IRAQ

Eurasian Plate

North Anatolian Fault

East Anatolian Fault

Armenian Collision Zone

Arabian Plate

Dead Sea Fault

ANATOLIAN FAULTS NETWORK

QUAKE 2

QUAKE 1

Fenêtre de résultats

Liste des repères créés :

| Coul. | Nom | Latitude (°N) | Longitude (°E) | [Centrer] | [Suppr.] |
|--------|---------|---------------|----------------|-----------|----------|
| Orange | QUAKE 1 | 37,23 | 37,12 | 🎯 | 🗑️ |
| Vert | QUAKE 2 | 38,14 | 37,21 | 🎯 | 🗑️ |

Double-cliquez sur le globe pour rajouter un repère.

Cliquez sur une ligne pour sélectionner un repère, qui apparaîtra alors en rouge (vous pourrez alors le modifier dans la fenêtre "Réglages").

Cliquez sur 🗑️ pour supprimer un repère.

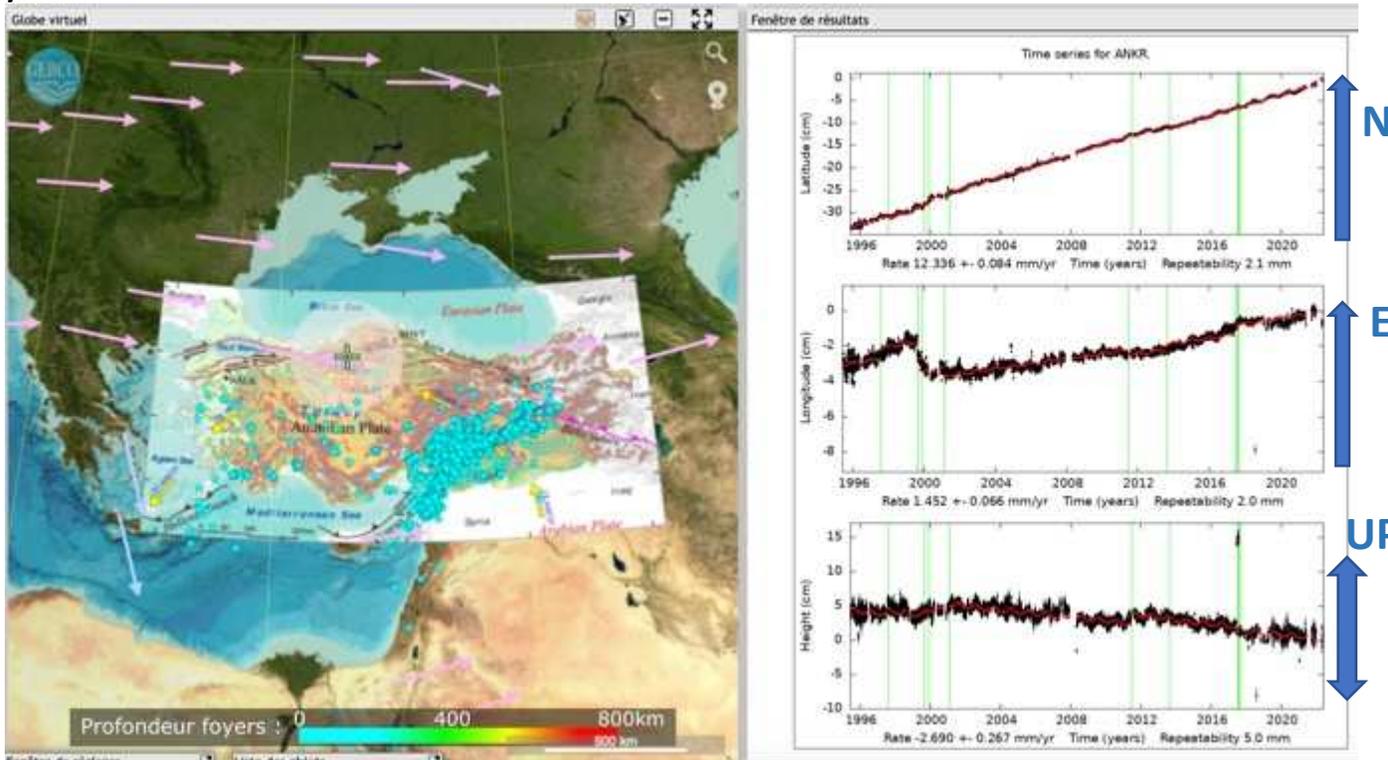
Réglages / paramètres

* Anatolian-faults-network (KMZ file)

Step 3 > Seismic Risk prevention – some ideas using data

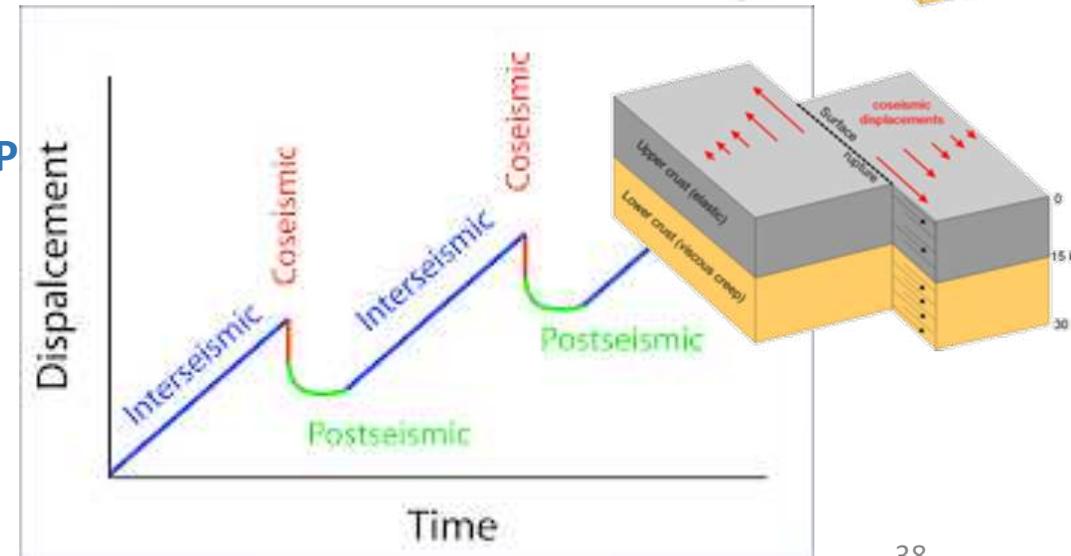
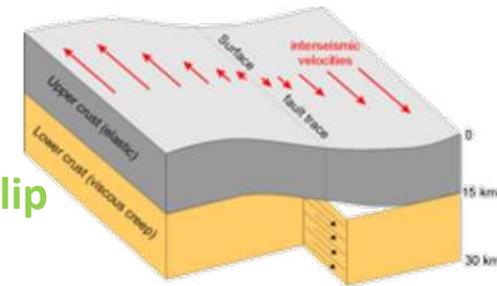
The GPS data accessible with Tectoglob3D software (Data displayed > GPS vectors) allows the measured movement of the tectonic plates to be visualised over time. In the context of this faults network, the measurements highlight the seismic cycle.

Os dados de GPS acessíveis com o software Tectoglob3D (Dados exibidos > Vetores GPS) permitem visualizar o movimento das placas tectónicas medido ao longo do tempo. No contexto desta rede de falhas, as medições destacam o ciclo sísmico



Ankara GPS

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

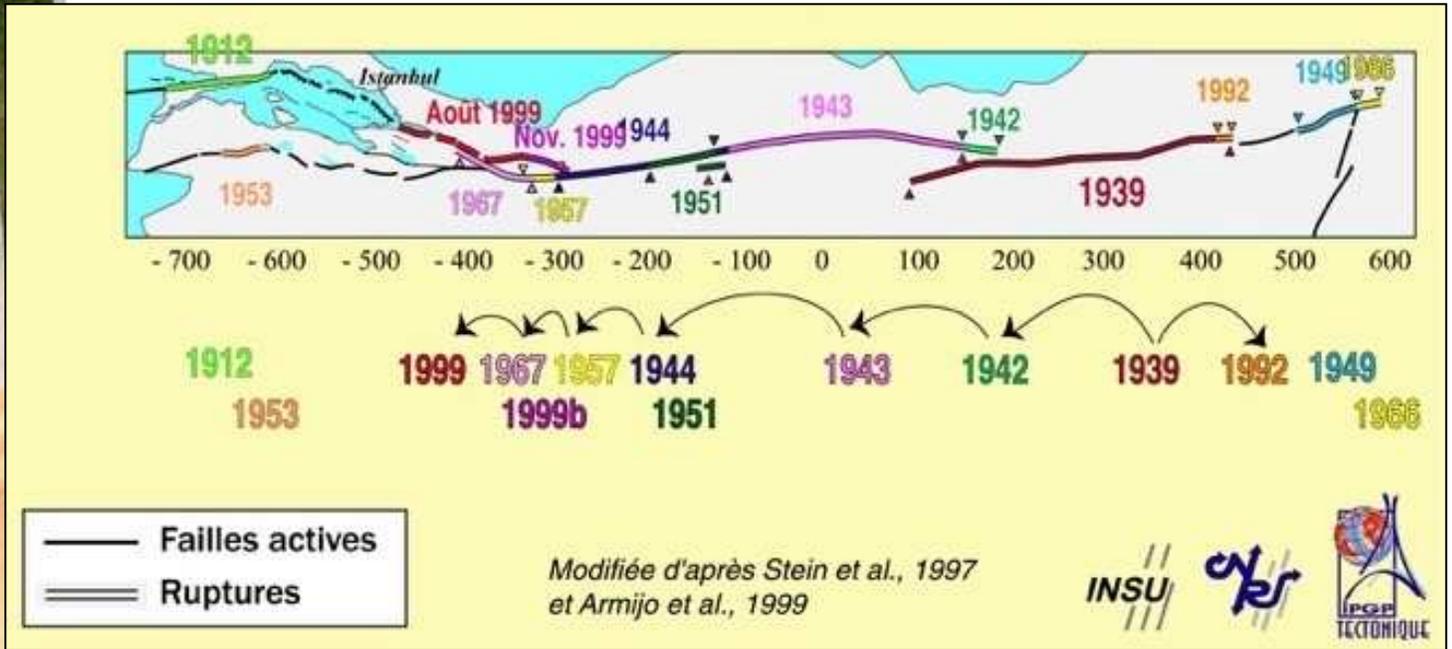


Step 4 > Seismic Risk prevention – some ideas using data

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.

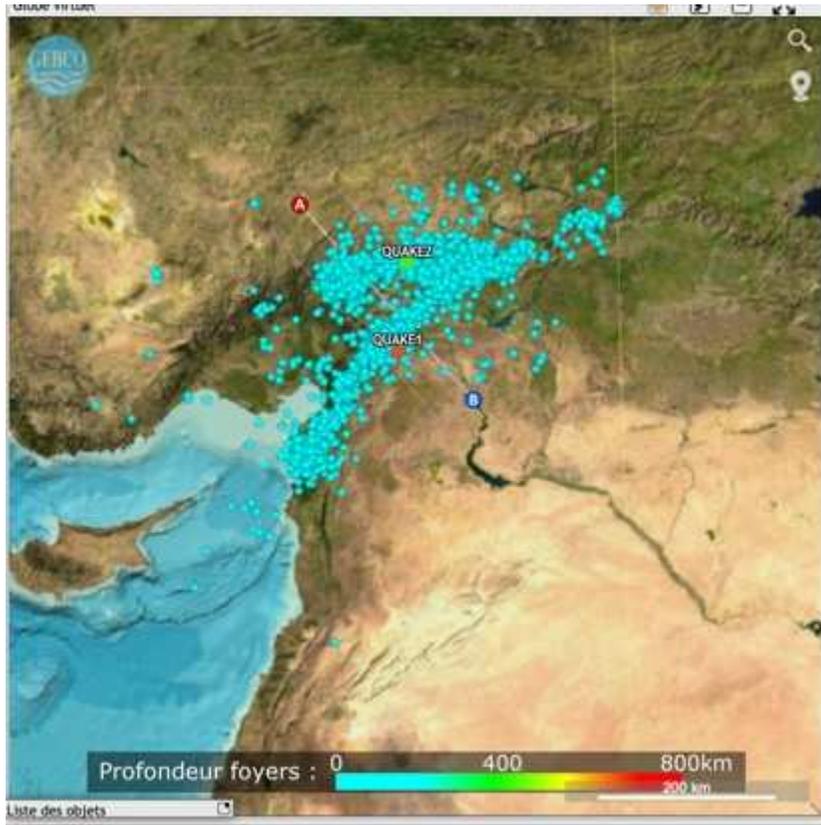
O estudo histórico dos sismos ao longo de uma falha como a Falha Anatoliana Setentrional também ilustra perfeitamente o comportamento das falhas que evoluem entre a falha bloqueada e a libertação de energia

> 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.

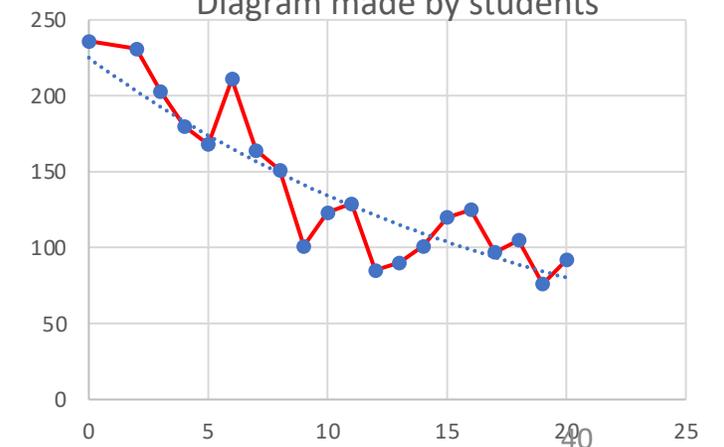
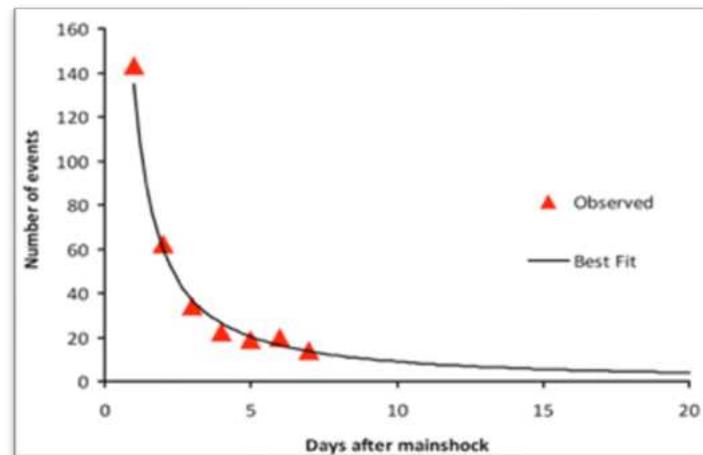
A Lei de Omori descreve a frequência de réplicas após o choque principal. Esta frequência diminui com o inverso do tempo após o choque principal

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

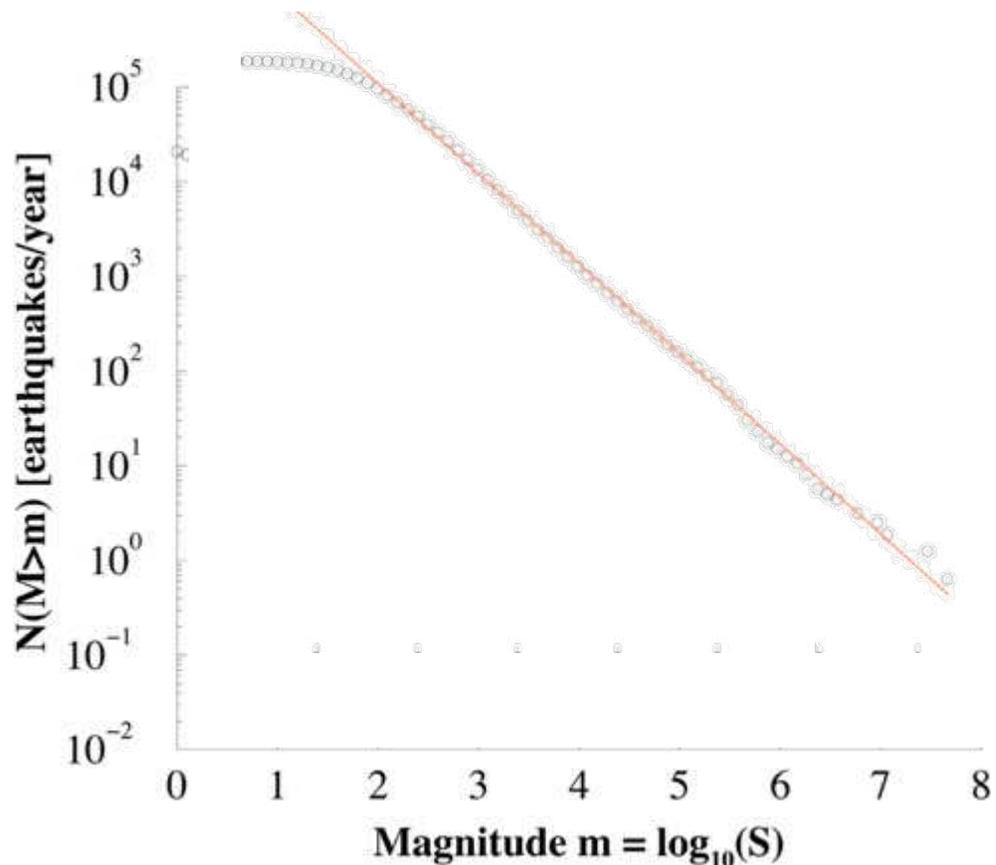
Diagram made by students



Step 4 > Seismic Risk prevention – some ideas using data

Could we expect strong aftershocks after the mainshock ?

Podemos esperar fortes réplicas após o sismo principal?



Gutenberg-Richter law > A Lei de Gutenberg-Richter

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 ...

Em sismologia, a Lei de Gutenberg-Richter (Lei GR) expressa a relação entre a magnitude e o número total de sismos de uma determinada região e período de tempo...

The Gutenberg–Richter (GR) law states that earthquake magnitudes are distributed exponentially (Gutenberg & Richter 1944) as

$$\text{Log}_{10}N(m) = a - bm,$$

A lei de Gutenberg-Richter (GR) afirma que as magnitudes dos sismos são distribuídas exponencialmente (Gutenberg & Richter 1944) como $\text{Log}_{10}N(m) = a - bm$

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.

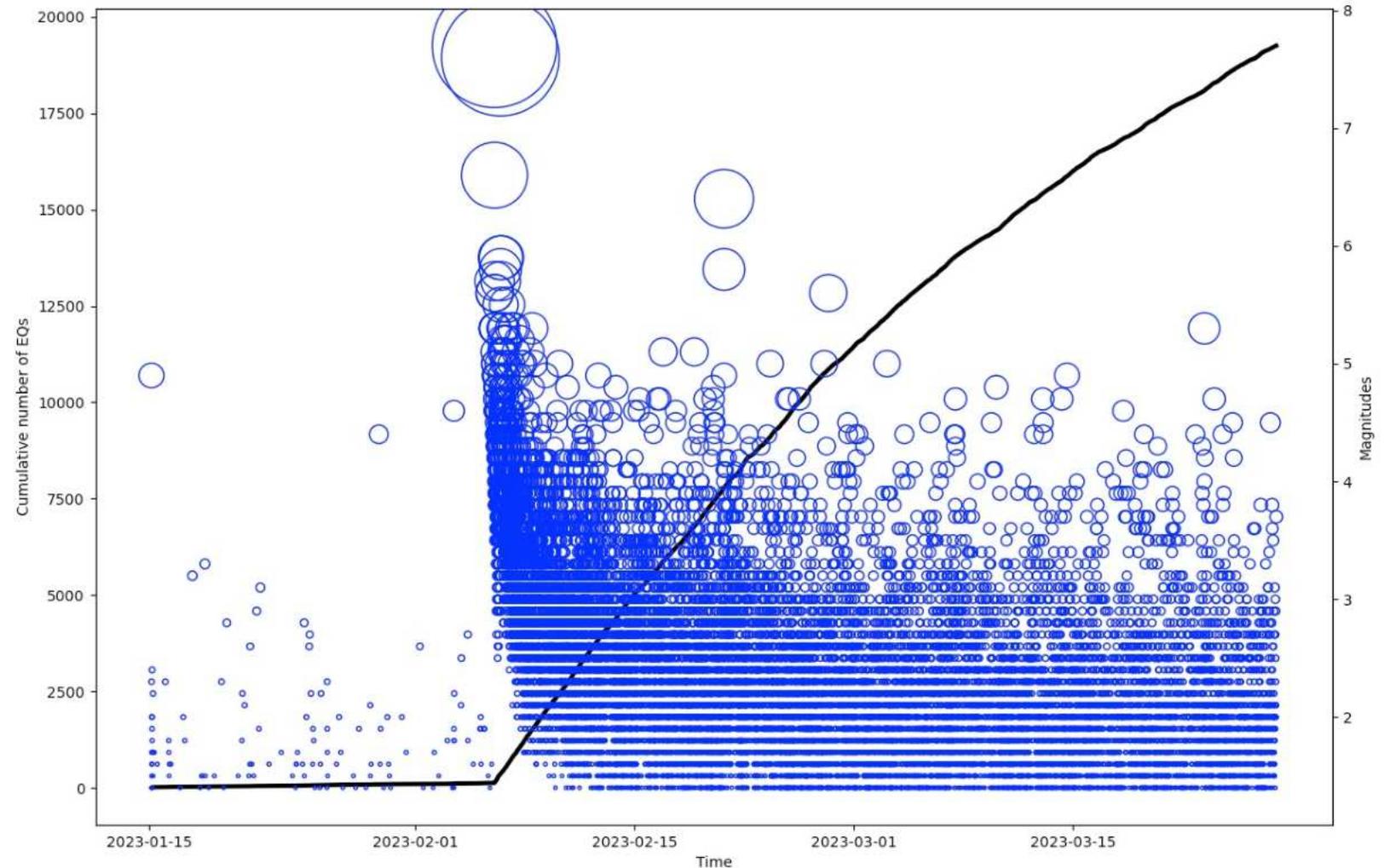
onde $N(m)$ é o n.º de sismos com magnitude maior ou igual a m , b é um parâmetro de escala e a é uma constante.

Step 4 > Seismic Risk prevention – some ideas using data

Could we expect strong aftershocks after the mainshock ?

Podemos esperar fortes réplicas após o sismo principal?

Gutenberg-Richter + Omori laws >



Case study ... more ?

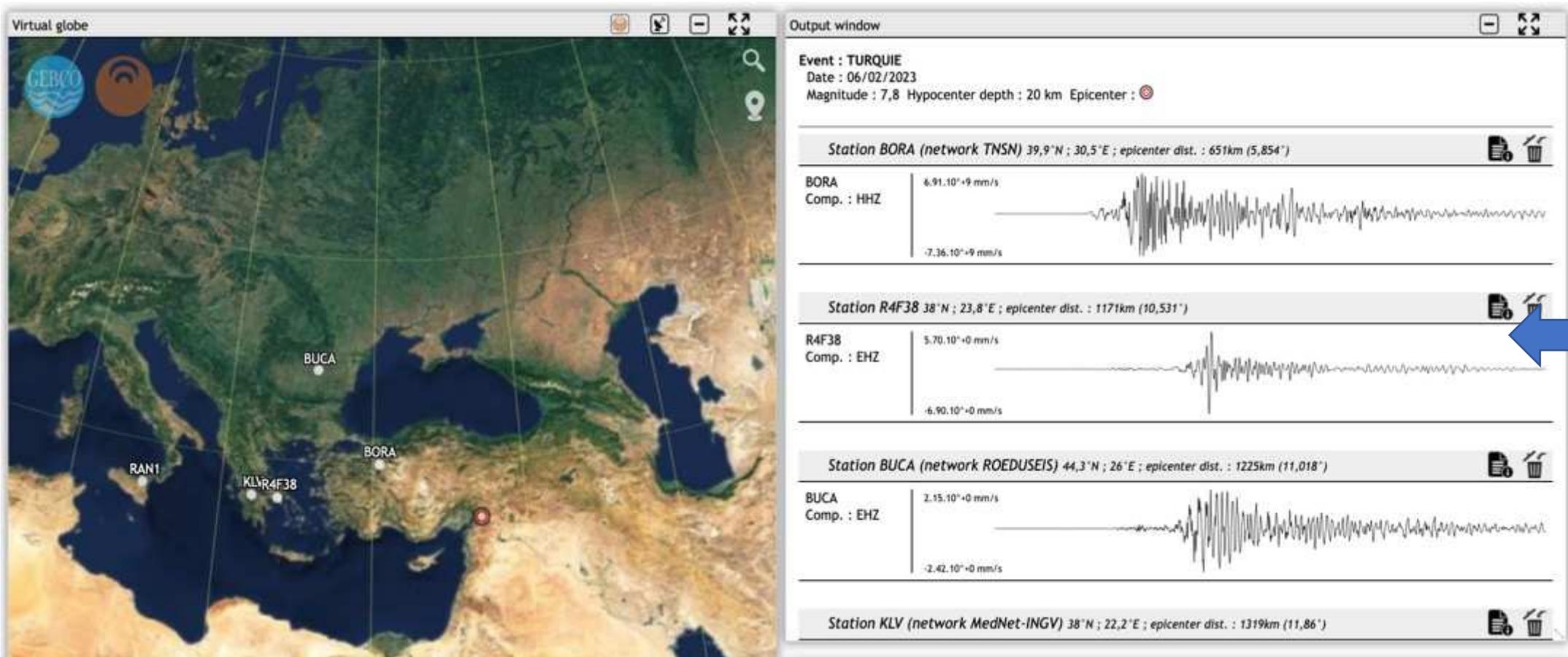
Working with seismogram : Earthquake in Turkey / Syria – 2023, Feb. 6

<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.

Data format SAC  Tectoglob3D view 



The screenshot displays a web-based interface for viewing seismograms. On the left is a 'Virtual globe' showing a map of the Mediterranean region with several seismic stations marked: RAN1, KLV, R4F38, BUCA, and BORA. A red circle on the map indicates the earthquake's epicenter. On the right is an 'Output window' containing event details and four seismogram traces.

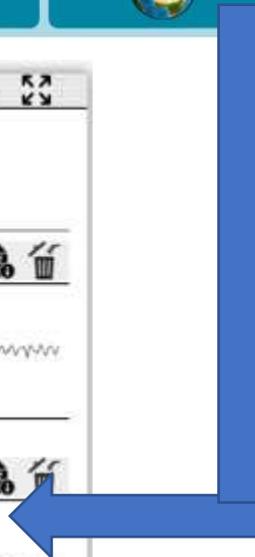
Event Details:
 Event : TURQUIE
 Date : 06/02/2023
 Magnitude : 7,8 Hypocenter depth : 20 km Epicenter :

Station BORA (network TNSN) 39,9°N ; 30,5°E ; epicenter dist. : 651km (5,854°)
 BORA
 Comp. : HHZ
 6.91.10⁺⁹ mm/s
 -7.36.10⁺⁹ mm/s

Station R4F38 38°N ; 23,8°E ; epicenter dist. : 1171km (10,531°)
 R4F38
 Comp. : EHZ
 5.70.10⁺⁰ mm/s
 -6.90.10⁺⁰ mm/s

Station BUCA (network ROEDUSEIS) 44,3°N ; 26°E ; epicenter dist. : 1225km (11,018°)
 BUCA
 Comp. : EHZ
 2.15.10⁺⁰ mm/s
 -2.42.10⁺⁰ mm/s

Station KLV (network MedNet-INGV) 38°N ; 22,2°E ; epicenter dist. : 1319km (11,86°)



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

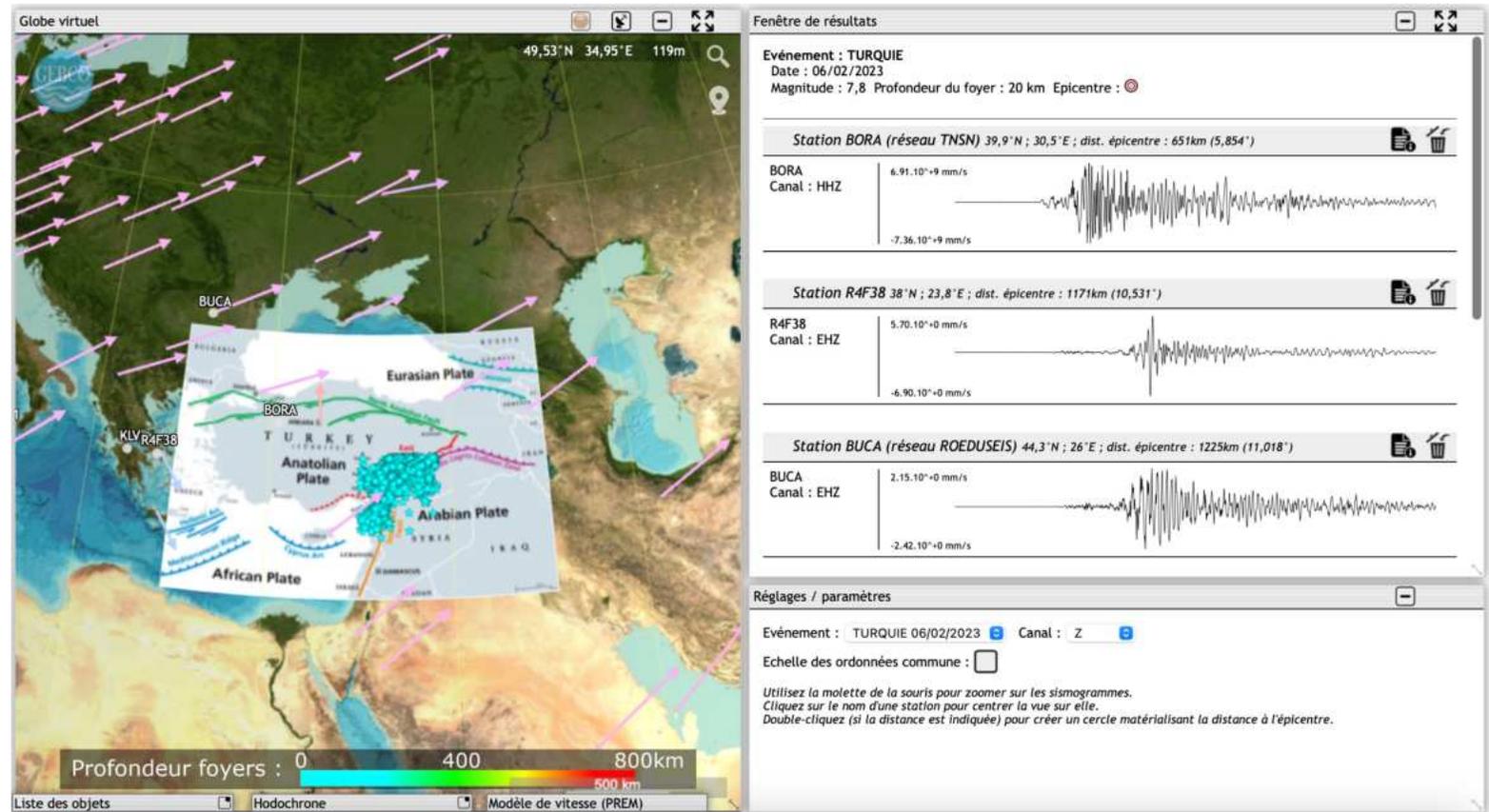
Display with Tectoglob3D

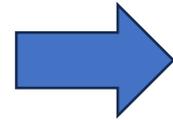
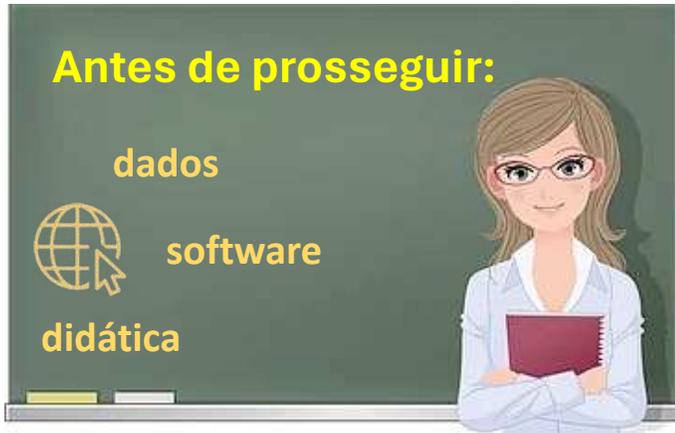


So many things to propose to your students
Tantas coisas para propor aos seus alunos

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

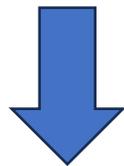
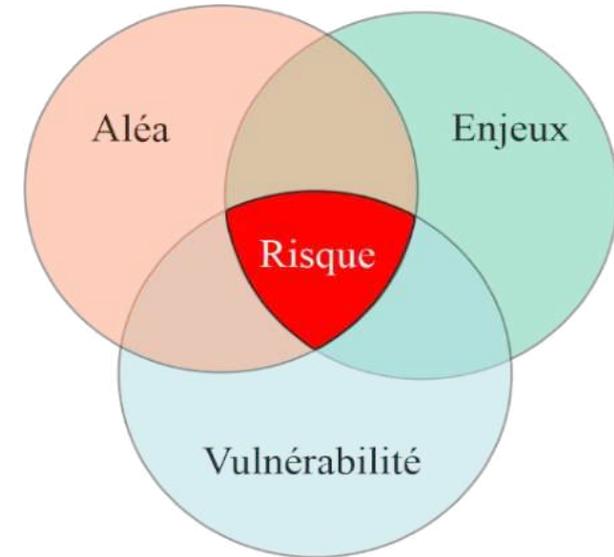
Descoberta de sismogramas/Hora de origem,
estações ranking / Localização da distância do
epicentro / desenho de círculos
Dados exibindo movimento do GPS
Dados exibindo tectónica de placas
Dados exibidos mapas de falhas





A educação para o risco sísmico pode ser efetuada através de uma metodologia científica baseada em estudos de caso e na análise de dados.

Observo, meço, analiso para compreender...
Compreendo para poder reagir!



A sismologia é também uma ótima ajuda para estudar as partes mais profundas do globo terrestre.

> Registo do trajeto das ondas sísmicas ao atravessarem o globo

Podemos estudar a estrutura interna do globo terrestre utilizando dados sismológicos com o Tectoglob 3D.

Escolha um sismo de elevada magnitude que esteja bem registado em todo o globo.

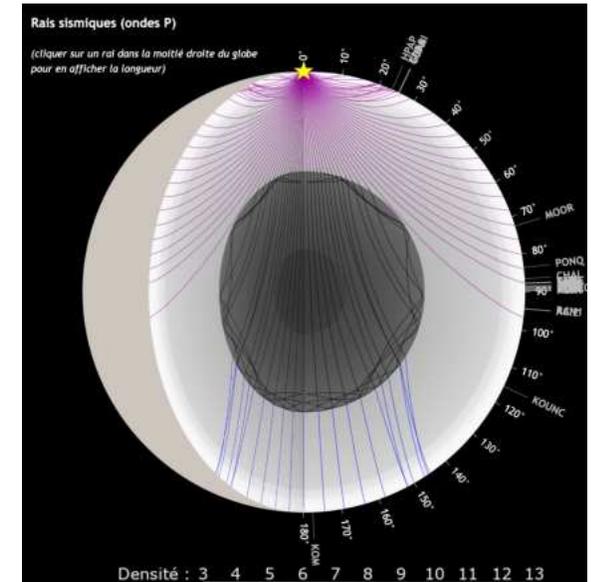
Ao analisar os sismogramas das várias estações localizadas a diferentes distâncias no globo (20°, 45°, 110°, 160°, 180°), pode relacionar a estrutura interna deste com um modelo da velocidade da Terra.

Por exemplo, descarregue os dados para o sismo de 22 de fevereiro de 2019 (Peru-Ecuador), de EduMed- Obs. Abrir os dados com o Tectoglob3d.

O primeiro passo é projetar os tempos de chegada das ondas em estações próximas (estações ANWA, ANMO, CALF até 90°). A velocidade de propagação das ondas aumenta com a profundidade do globo atravessado.

Quando observamos as estações mais distantes (KOUNC, COCO, KOM para além de 100°), o software já não mostra ondas P e S diretas. As ondas nem chegam a certas estações... terão encontrado obstáculos que as atrasam ou desviam.

Um exame do modelo PREM indica a presença de um núcleo com duas partes (externo-líquido, interno-sólido). A ausência de PKP e de ondas S diretas em KOUNC (110°) permite definir a zona de sombra que atesta a presença deste núcleo.





Atividade prática IV

A sismologia ao serviço da estrutura interna do planeta

Missão 1 / Procurar na base de dados de um sismo de elevada magnitude registado por muitas estações na Terra. exemplo: 2021.11.28 / Terramoto no Perú

Missão 2 / Analisar os registos de diferentes estações.

Missão 3 / Calcular a velocidade das ondas sísmicas que atravessam o globo, porque a partir da sua velocidade podemos deduzir noções sobre a estrutura das zonas profundas do globo.

Discussão em grupo

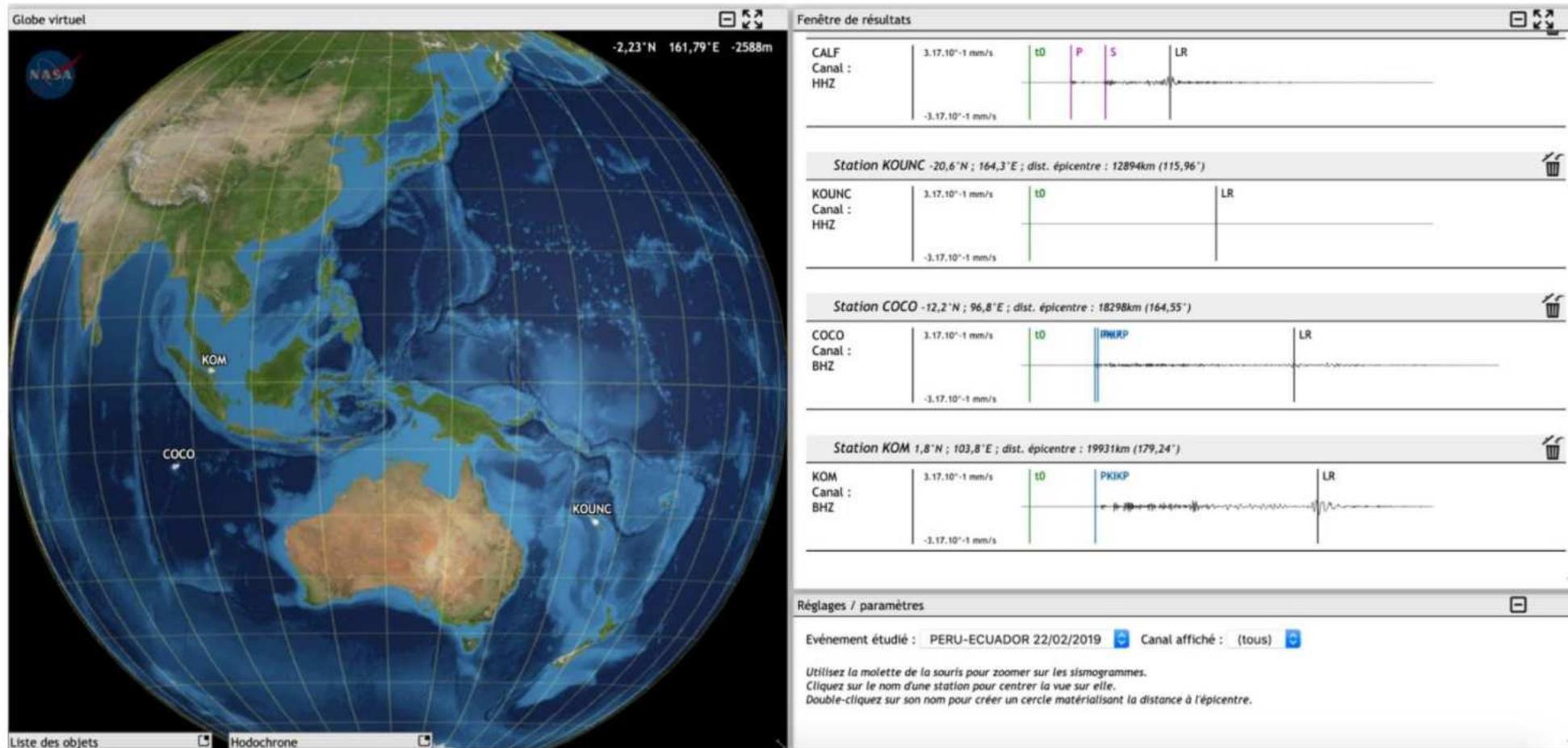


30 minutos

> Recordação do trajeto das ondas sísmicas ao atravessarem o globo

Este sismo de elevada magnitude foi registado por estações de todo o mundo. Localizar rapidamente as estações de registo : ANWB, RPN, ANMO, CALF, KOUNC, COCO, KOM. `

Uma ecografia do globo terrestre através de um estudo comparativo destes registos.

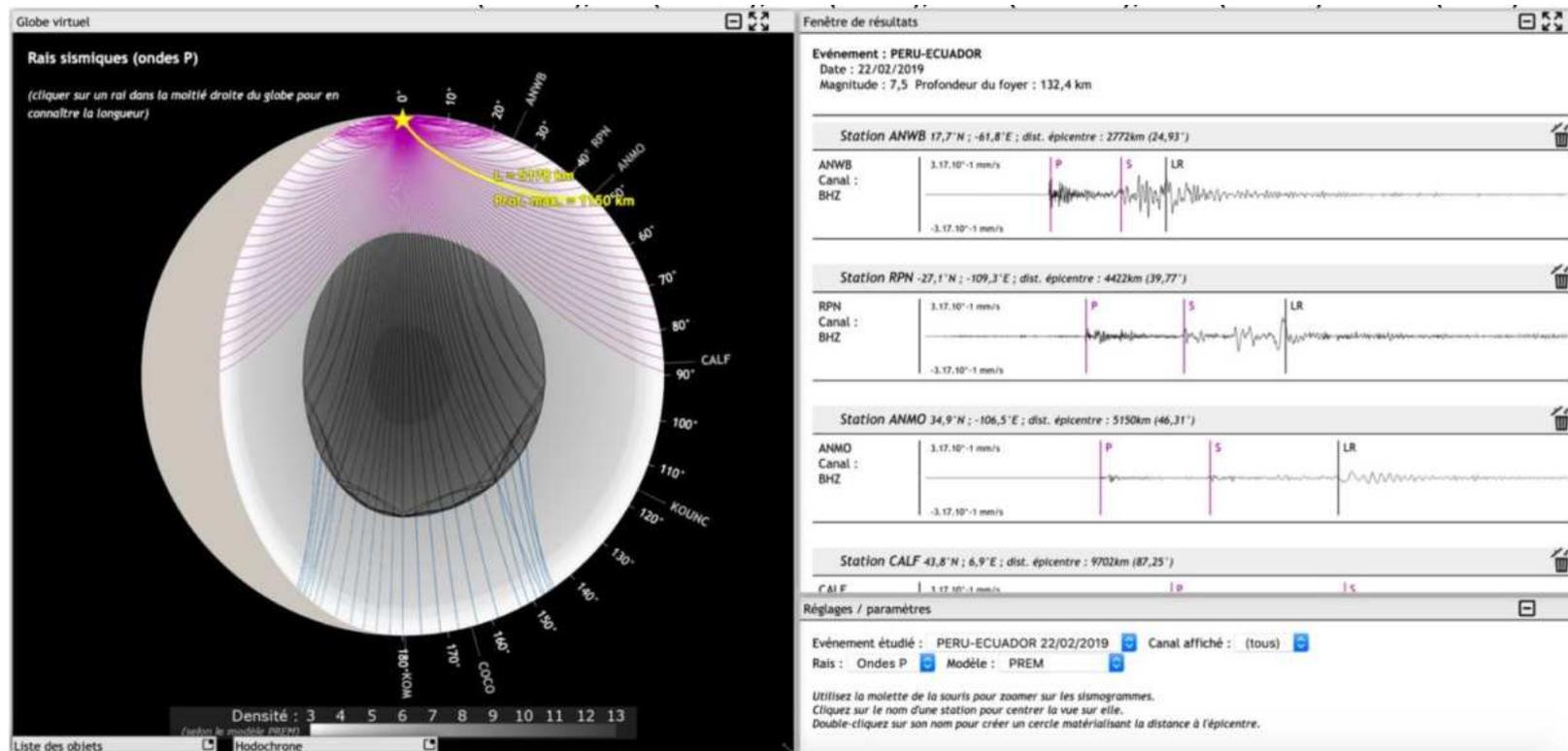


> Recordação do trajeto das ondas sísmicas ao atravessarem o globo

Vamos traçar os tempos de chegada das ondas de volume (uma vez que atravessam as partes mais profundas do globo) nas três primeiras estações ANWA, ANMO e CALF.

Mostrar a hora de origem do sismo. Utilizamos o modelo PREM para visualizar os pontos teóricos das ondas P diretas [menu Sismogramas].

Para avaliar a velocidade das ondas P volumétricas em cada estação é necessário utilizar a distância epicentral... para isso, utilize o modelo PREM disponível (sismogramas > projetar estações numa secção transversal do globo).

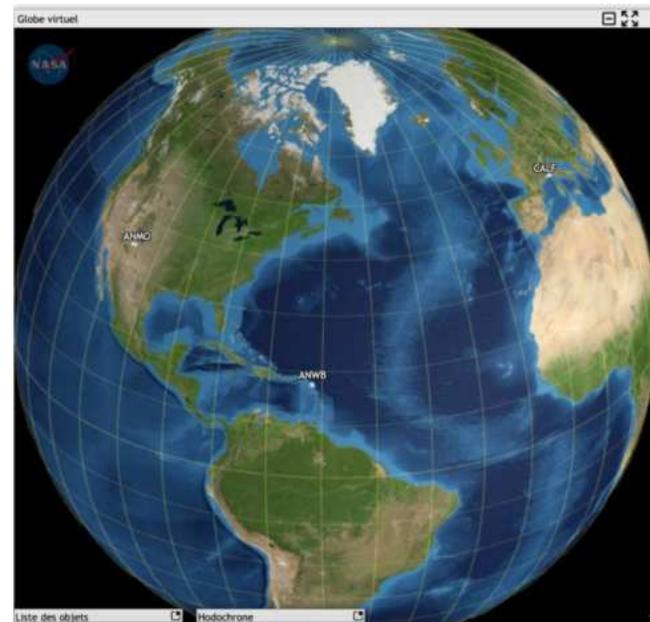
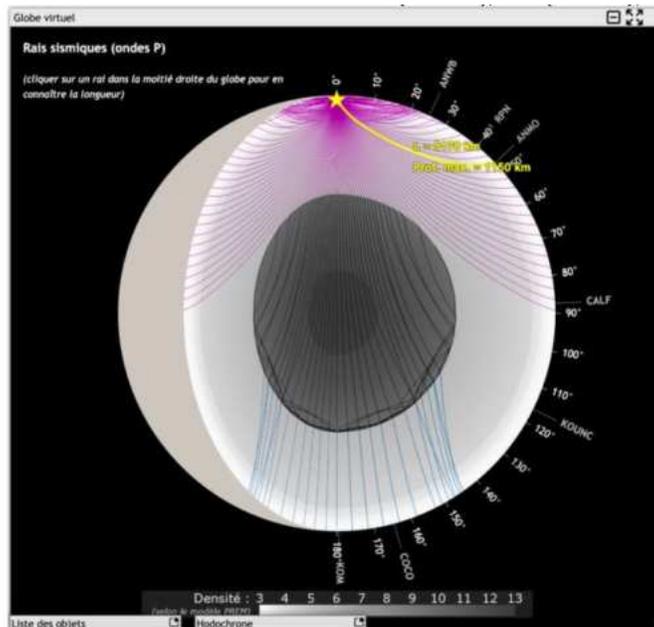


> Recordação do trajeto das ondas sísmicas ao atravessarem o globo

Podemos verificar que a velocidade de propagação das ondas P aumenta com a profundidade do globo terrestre percorrido... daí uma primeira hipótese entre as características físicas e químicas da Terra e a velocidade de propagação das ondas P.

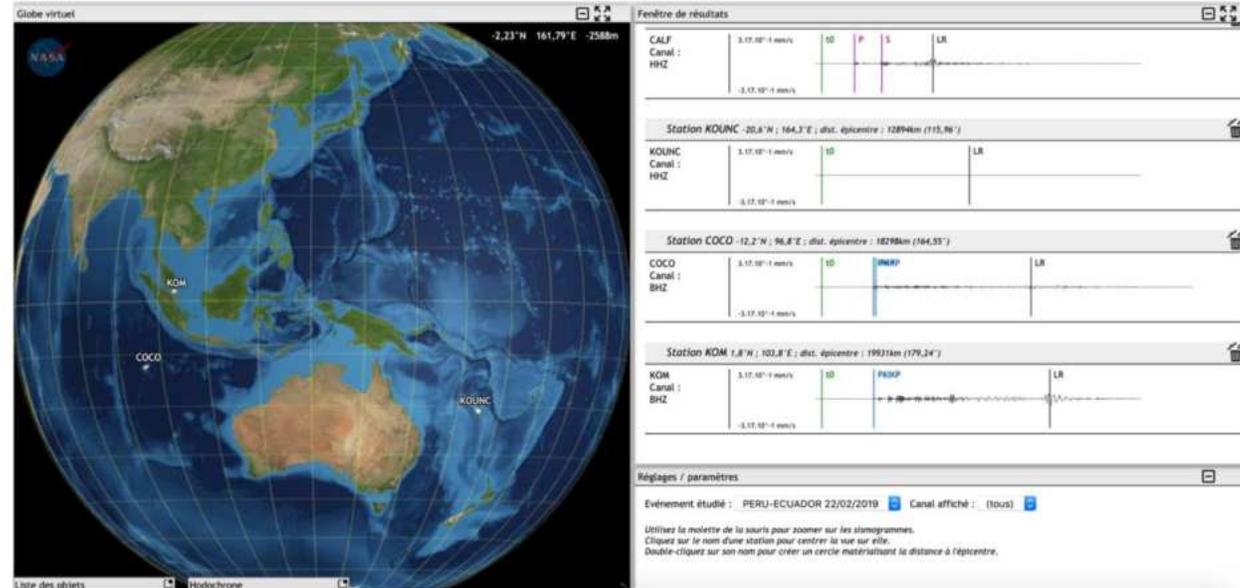
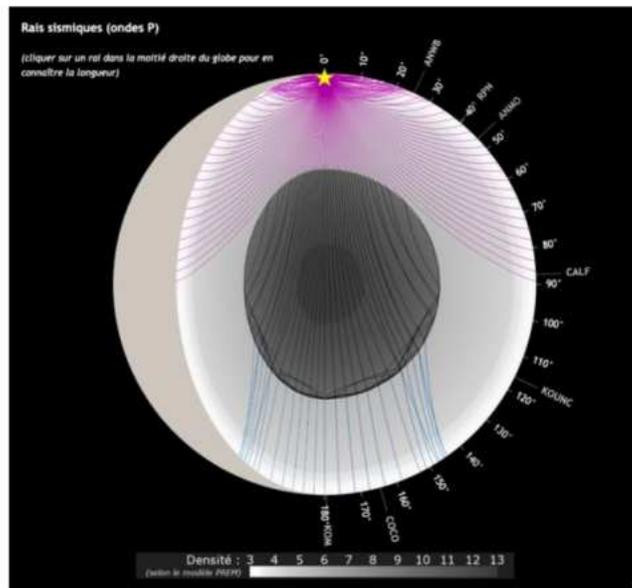
Résultats de l'analyse des pointés

| Station : | Distance épicentrale (deg) | Distance épicentrale (kms) | Longueur parcours (kms) | Temps parcours (sec) | Vitesse ondes P (km/s) |
|-----------|----------------------------|----------------------------|-------------------------|----------------------|------------------------|
| ANWB | 24 | 2769 | 2975 | 310 | 9,60 |
| ANMO | 46 | 5144 | 5240 | 492 | 10,65 |
| CALF | 87 | 9691 | 9020 | 751 | 12,02 |
| | Info sismogramme | | Info Rais | | calcul |



> Recordação do trajeto das ondas sísmicas ao atravessarem o globo

Podemos então analisar as estações mais distantes (KOUNC, COCO, KOM).
O Tectoglob3D não mostra ondas P ou S diretas. As ondas diretas não chegam às estações.
Terão portanto encontrado obstáculos no globo que as atrasam ou desviam.



| Station : | Distance epicentrale (deg) | Distance epicentrale (kms) | Longueur parcours (kms) | Temps parcours (sec) | Vitesse ondes P (km/s) |
|---------------|----------------------------|----------------------------|-------------------------|----------------------|------------------------|
| KOUNC / PKIKP | 115 | 12880 | 11653 | 1106 | 10,53 |
| COCO / PKIKP | 165 | 18277 | 12642 | 1187 | 10,65 |
| KOM / PKIKP | 179 | 19908 | 12746 | 1194 | 10,67 |
| COCO / PKP | 165 | 18277 | 13494 | 1242 | 10,86 |
| | Info sismogramme | | Info Rais | | calcul |



Atividade prática V

Sismicidade em Portugal

Missão 1 / Produzir um mapa de sismicidade de Portugal desde 1 de janeiro de 2023 até à data de hoje (Missão 3 / Actividade I)

Missão 2 / Explorar os dados disponíveis (GPS, mapa de falhas, outros mapas ...)

Missão 3 / Portugal no centro do Mundo ... ou reduzir o zoom para ver o globo.

Missão 4 / Explorar zonas de divergência (por exemplo, Islândia) e zonas de convergência (por exemplo, Chile) utilizando sismicidade, GPS, vulcões, secções 2D, secções 3D, tomografia sísmica, etc.

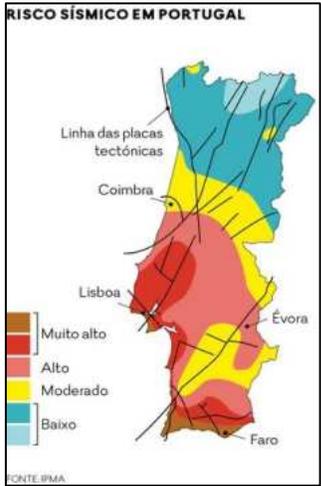
Discussão em grupo



30 minutos

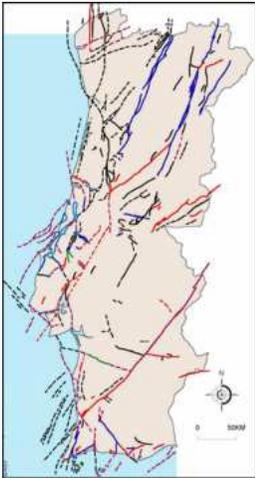
O Portugal ... centro do Mundo

Sismicidade Portugal e Espanha (magnitude 3 e mais)

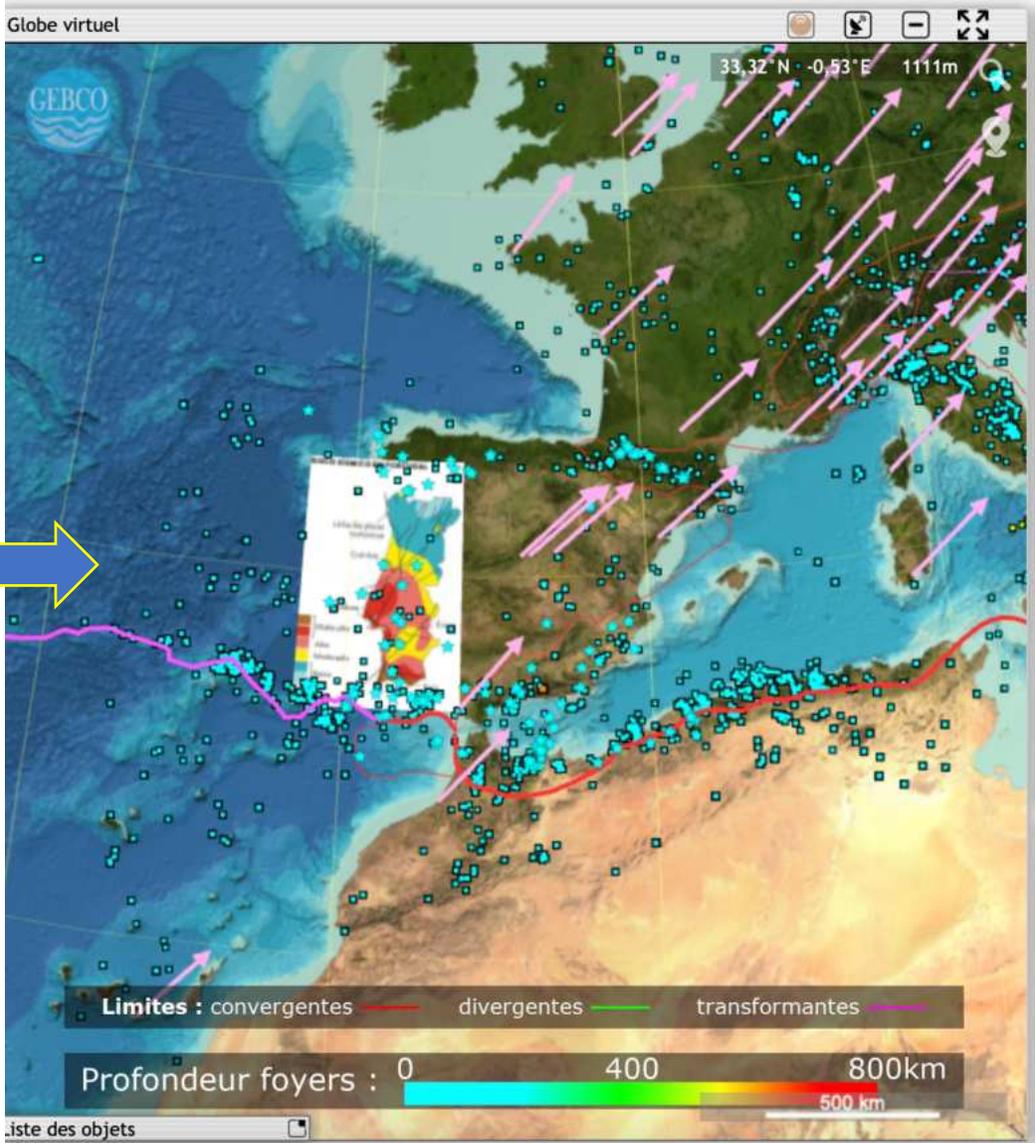


GPS vectors

Plate tectonic boundaries

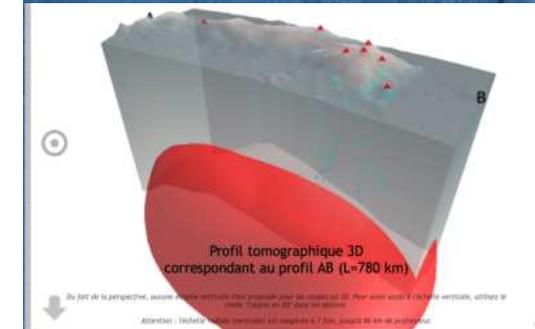
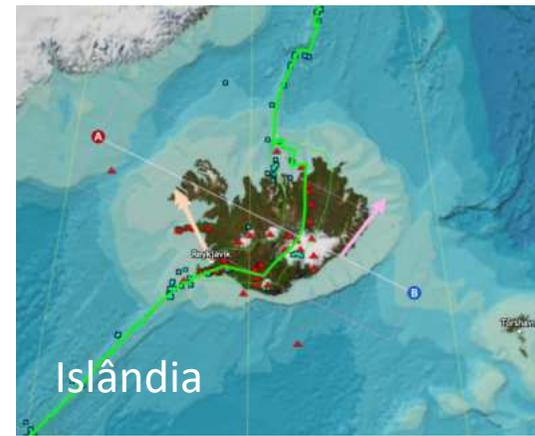
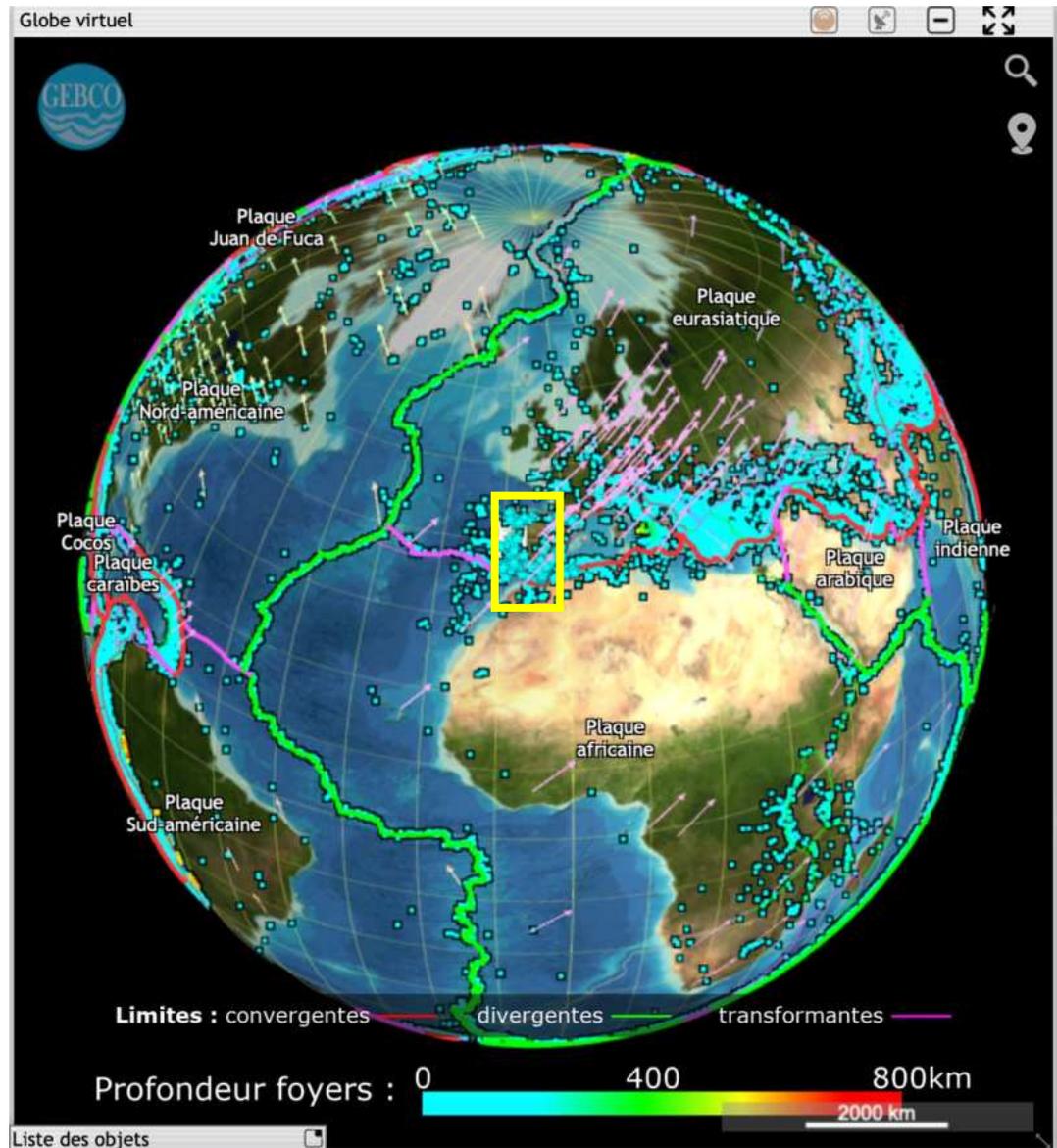
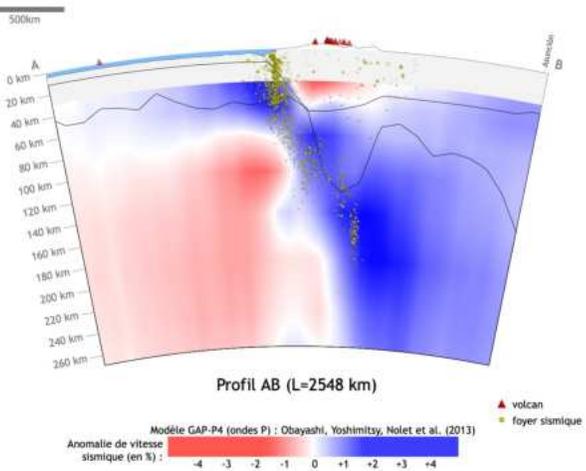
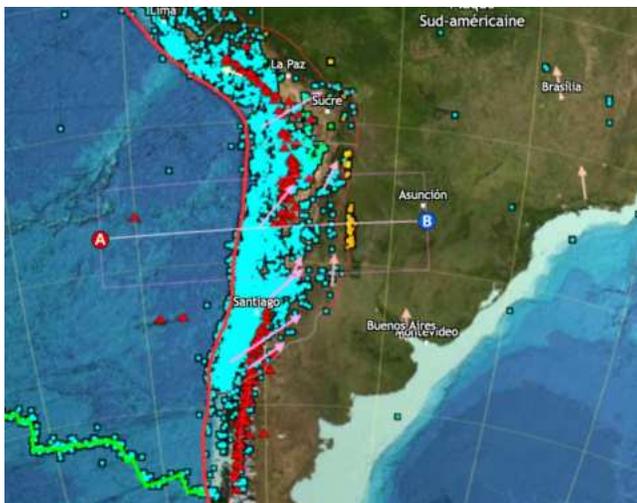


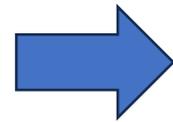
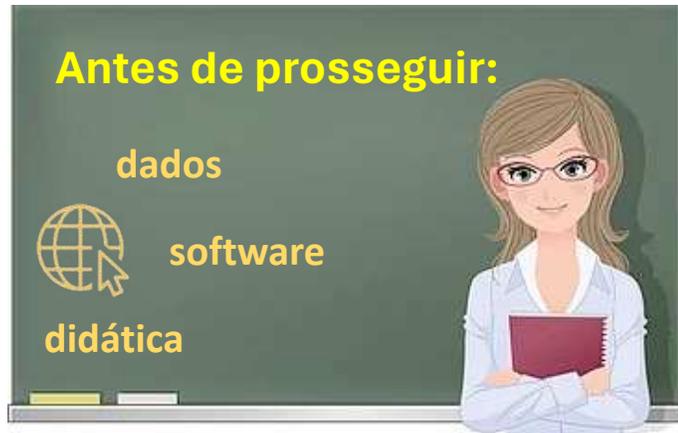
- falha com movimento desconhecido
- - - falha provável com movimento desconhecido
- ... falha com movimento vertical desconhecido
- · - · falha provável com mov. vertical desconhec.
- falha inversa
- falha provável inversa
- falha normal
- falha provável normal
- falha de desligamento
- falha provável de desligamento
- diapiro activo



O Portugal ... centro do Mundo

Dados de todo o mundo
no Tectoglob3D





A estrutura dos planetas terrestres pode ser ensinada utilizando dados online

No entanto, há que ter o cuidado de associar estes dados a atividades práticas concretas.



É importante efetuar experiências práticas :

para se familiarizar com sensores simples na sala de aula
para fazer uma reflexão crítica sobre os dados
para demonstrar o carácter complementar dos estudos científicos





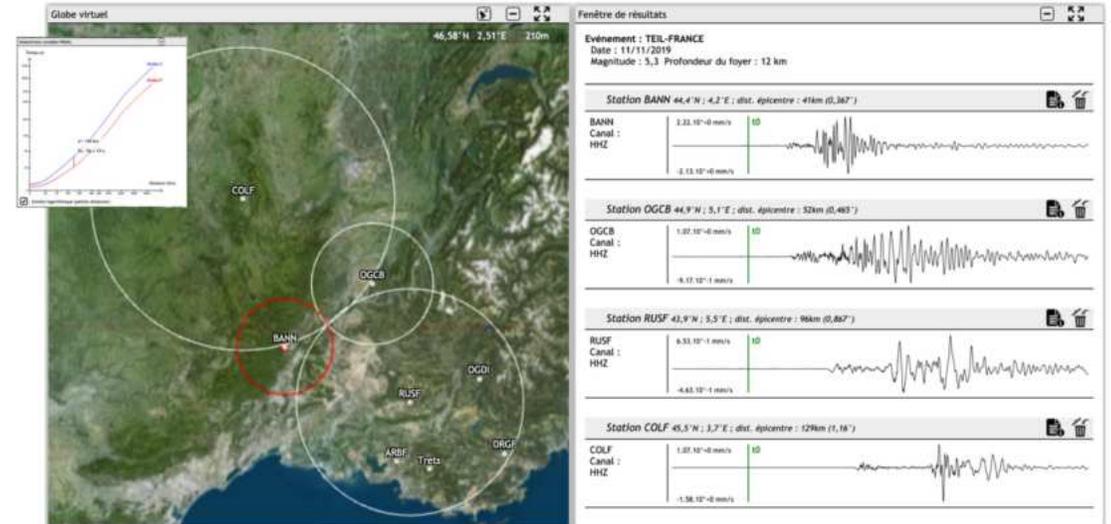
<https://namazu.unice.fr/cahier-sismo/>

SISMO Collector

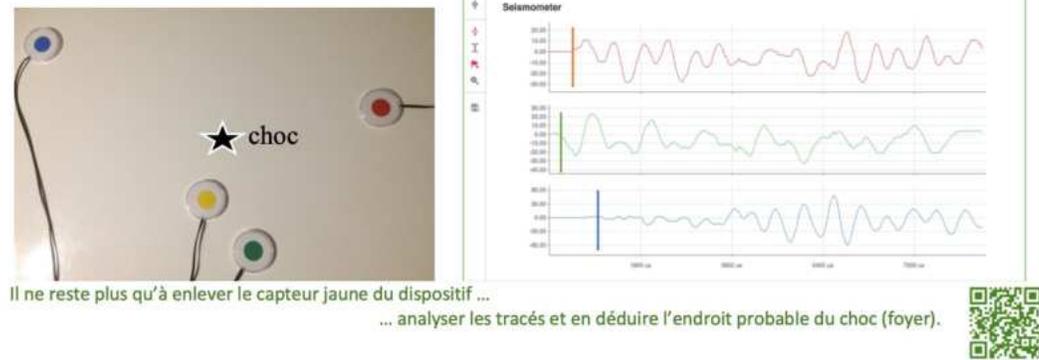


An online electronic supplement allows further extension of the activities

Dados online



Experiência prática

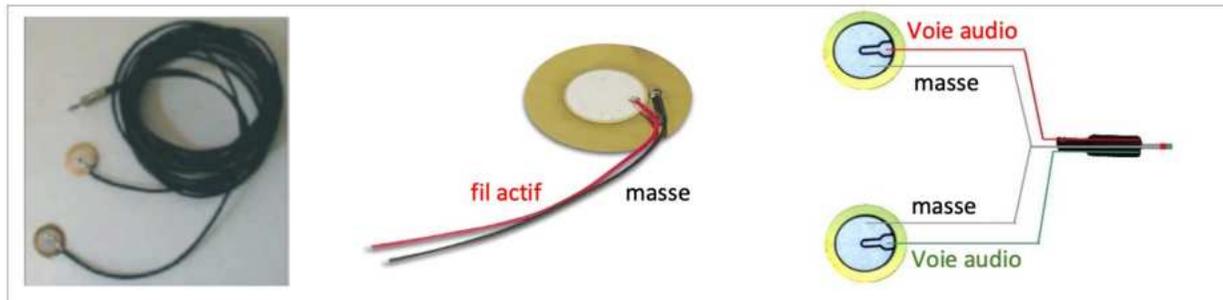




Example :
Sensors for the classroom **Sensores para a sala de aula**

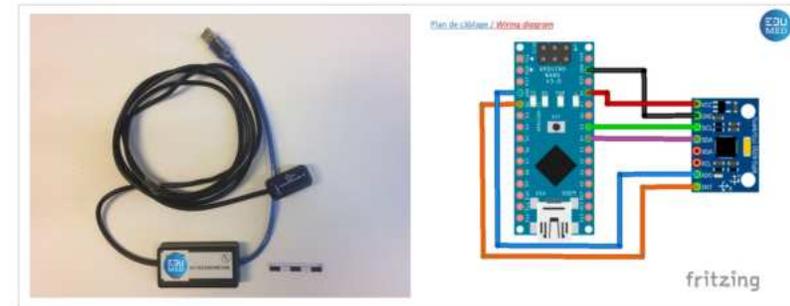
Piezo electric cells (Audacity software)

http://edumed.unice.fr/files/toolslab/files/Tutoriel_piezo.pdf



Accelerometer 3D (RISSC software)

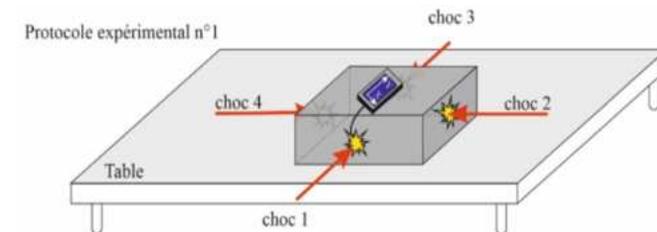
<http://edumed.unice.fr/toolslab/RISSC/>



The EduMed-Obs accelerometer, and its wiring plan (<http://edumed.unice.fr>)



Matériel : deux cellules piézo-électriques, un câble audio avec prise Jack stéréo

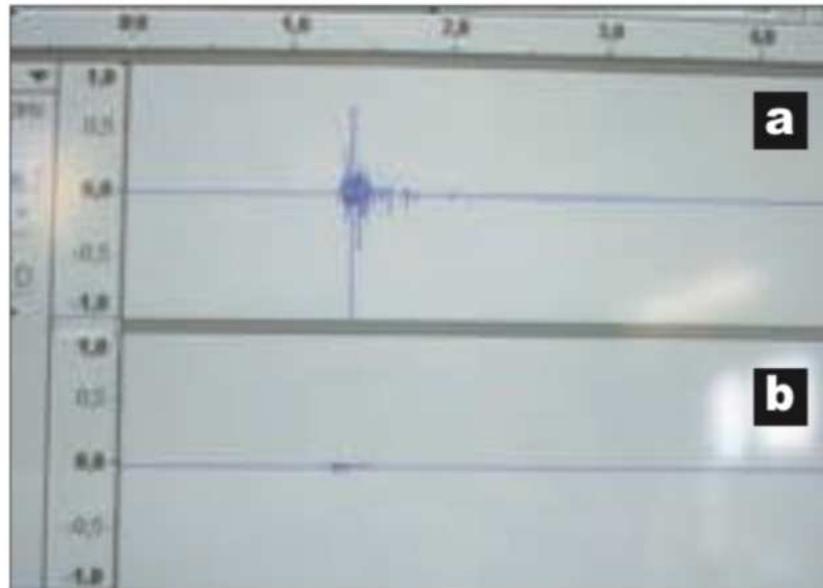
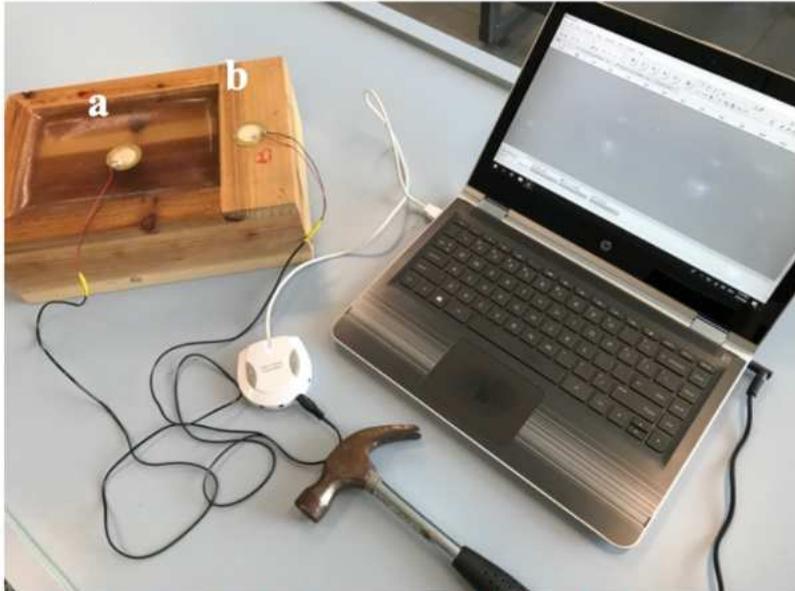




Example :
Site effect (topic > risc)

PRACTICAL Activities

The piezo sensor is embedded in jelly (or candle wax, or wet sand). The sensor must adhere to the support. The other sensor is attached to the wood. The recordings obtained (with Audacity) show a “site” effect, especially since the two sensors are placed at an equal distance from the shock.

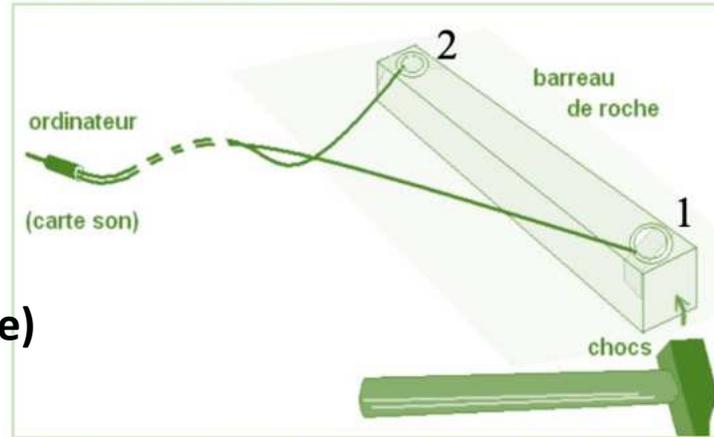


An amplification in duration and amplitude of the signal on the jelly can be demonstrated. These results are consistent with the case studies (Mexico City earthquake in 1985, ou Bordighera en 2019).

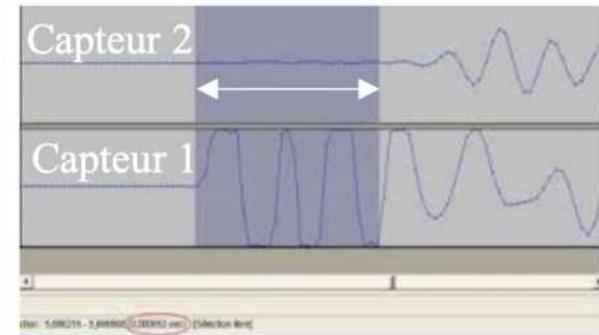
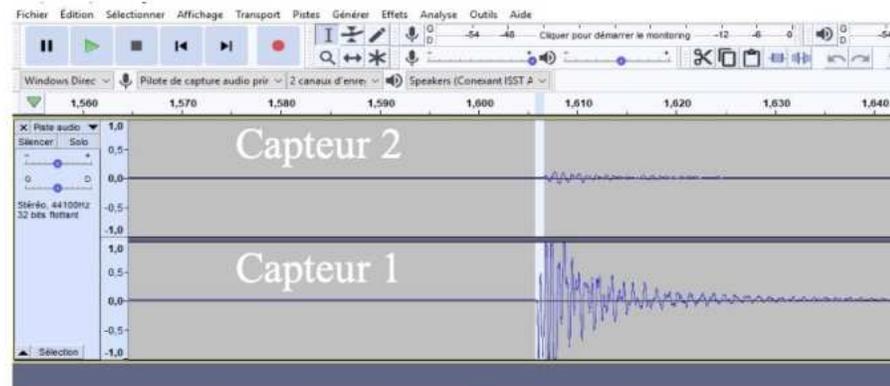


Example :
Waves speed (topic > Earth structure)

PRACTICAL Activities



Experiment set-up: the two piezoelectric cells are connected to the sound card of the computer. The shock must be strong enough to clearly visualize the wavefront. Measurements can be made with 1m to 1.5m bars (steel, granite, wood, polystyrene ...)



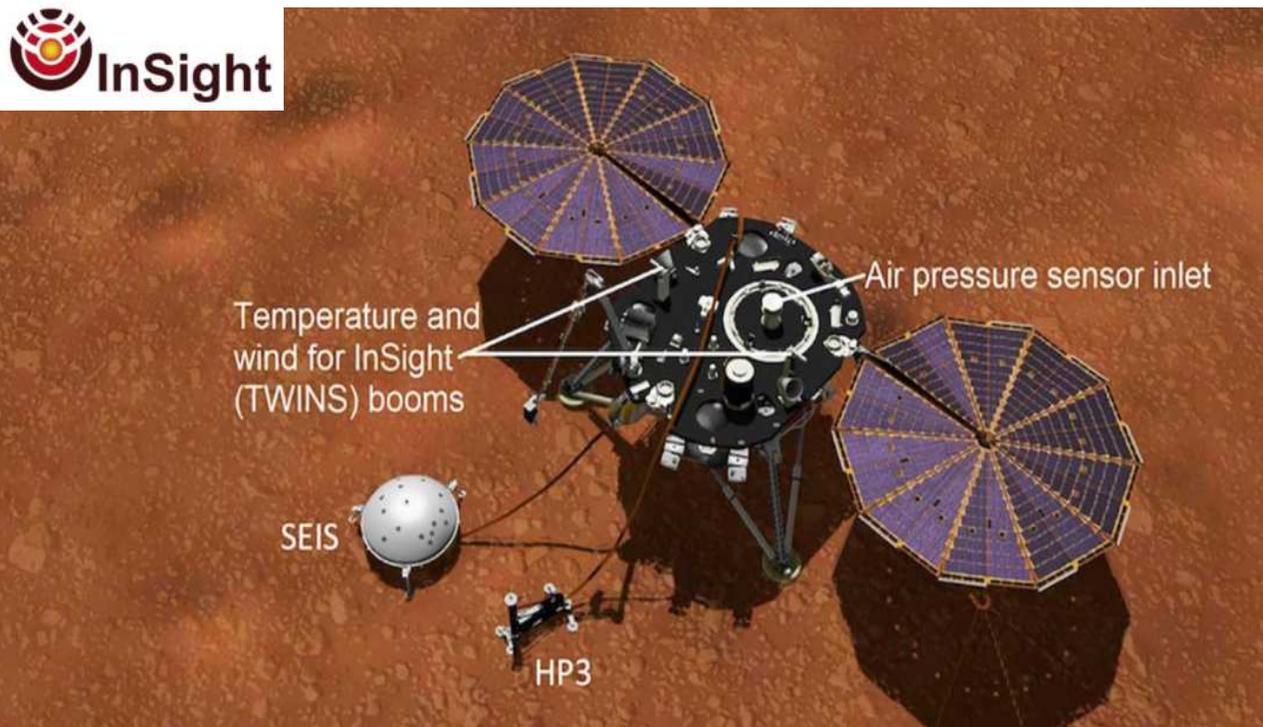
The two sensors recorded the passage of a train of waves generated by the shock. We go from the raw recording to the detail thanks to the 'magnifying glass' option of the Audacity software. The delay of arrival times on each sensor is calculated by the software. Given the distance between the two sensors, we can estimate a wave propagation speed on the tested material.



A estrutura dos planetas terrestres pode ser ensinada utilizando dados online

Para ir ainda mais longe, faça uma viagem a Marte com marsquakes!

<https://namazu.unice.fr/marsview/>

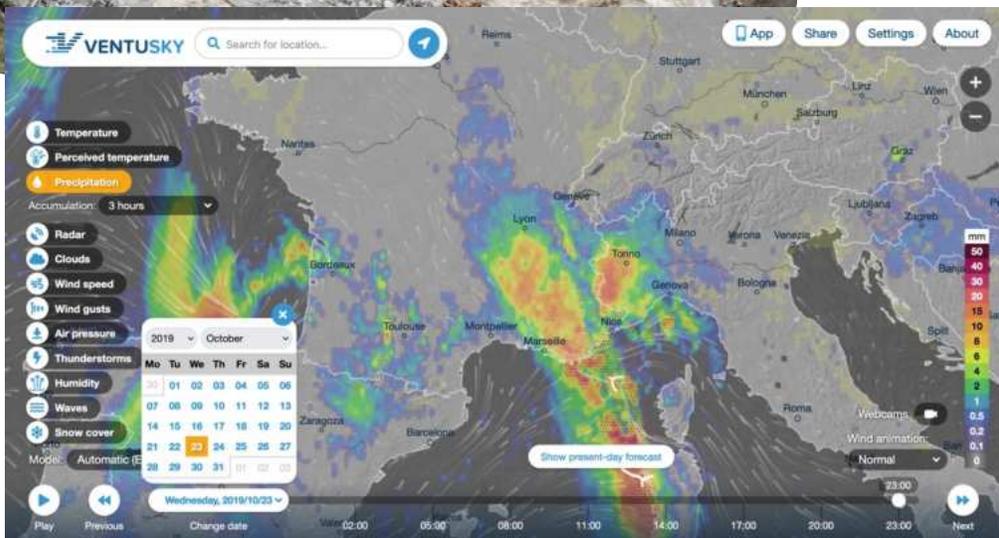


Outro exemplo de um risco natural: tempestade mediterrânea



Tema : meteorologia e hidrologia

**A tempestade mediterrânea destruiu muitas aldeias do vale /
Mediterranean weather storm destroyed many villages in the valley**





Atividade prática III

riscos e fenómenos meteorológicos no Mediterrâneo

> News

Alex tempest South France / Italy
rain and flooding on 2 october 2020

Um "evento meteorológico mediterrânico" é um fenómeno meteorológico particular em torno do Mediterrâneo, que produz tempestades intensas, com chuvas diárias muito elevadas, frequentemente iguais a quatro ou seis meses de chuva em apenas 12 ou 36 horas. Nos episódios mais violentos, o equivalente a um ano de chuva pode ocorrer em apenas 24 horas..

Nos últimos anos, foi identificado um indicador interessante, a temperatura das águas do noroeste do Mar Mediterrâneo. Quanto mais quente estiver, maior será o número e a intensidade dos episódios mediterrânicos.

Os mecanismos de formação desses episódios meteorológicos, sendo semelhantes em toda a costa do Mediterrâneo (Riviera Francesa, Córsega, Catalunha espanhola, Itália, ou mesmo no norte da África) são designados de "Episódio Mediterrânico".



Atividade prática III

riscos e fenómenos meteorológicos no Mediterrâneo

> News

Alex tempest South France / Italy
rain and flooding on 2 October 2020

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".

Step 1 > Where to find DATA for Education purpose

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

Bienvenue dans l'Observatoire Éducatif Méditerranéen

UCA UNIVERSITÉ CÔTE D'AZUR
Académie Nice
Région académique PROVENCE-ALPES-CÔTE D'AZUR
GeoAZUR

EDU MED UNIVERSITE CÔTE D'AZUR

Network Live Data Center Tools Lab Teachers Room EDUSEIS Virtual Tour EduChallenge

Partenaires

SEISMO
METEO
HYDRO
OCEANO
VOLCANO

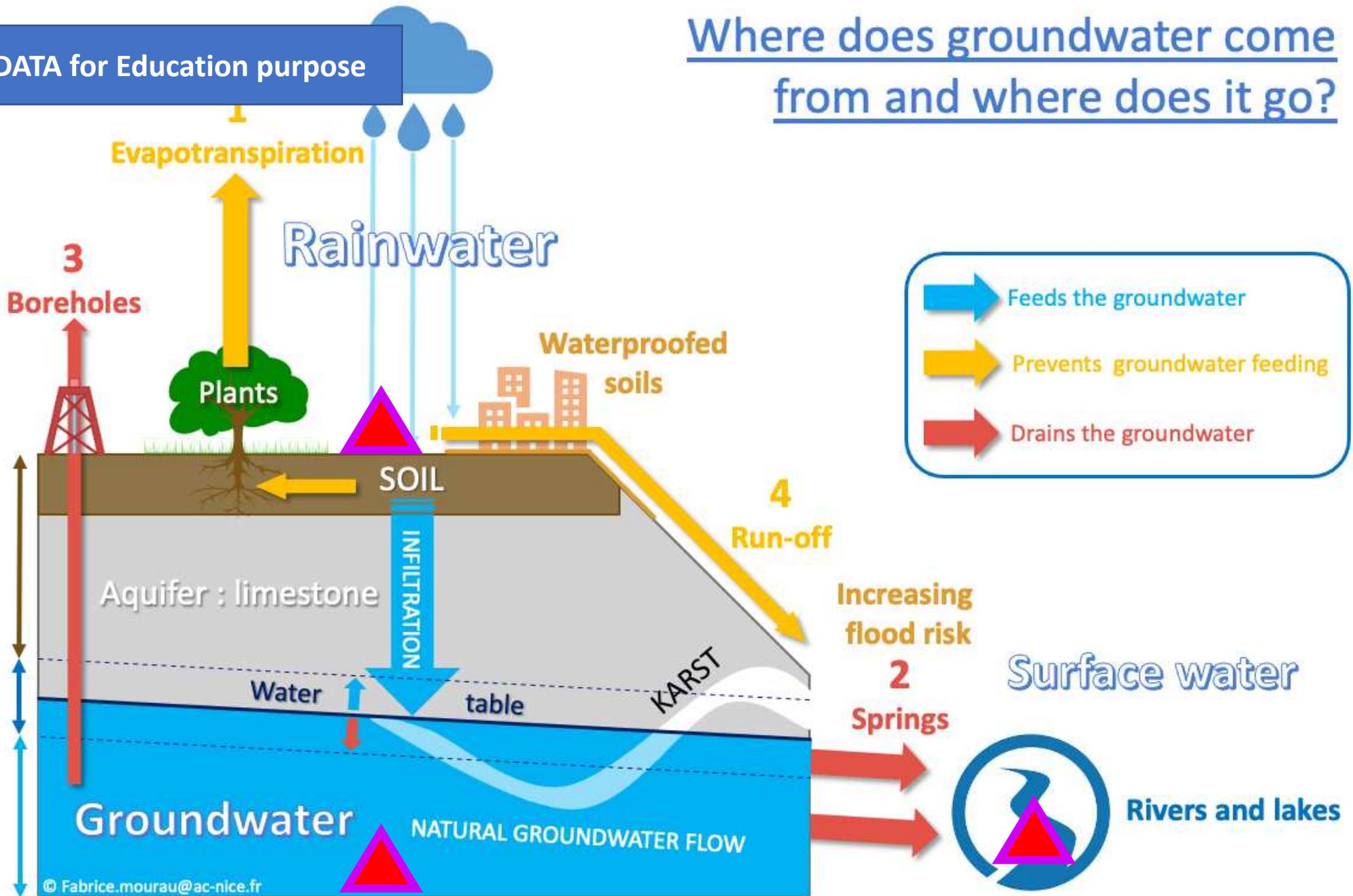
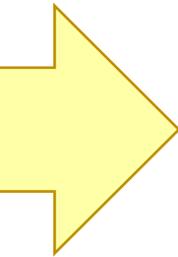
HYDRO case studies for Education purpose

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

Step 1 > Where to find DATA for Education purpose

Where does groundwater come from and where does it go?

- Data Center
- SEISMO
- METEO
- HYDRO
- OCEANO
- VOLCANO



© Fabrice.mourau@ac-nice.fr



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.

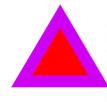
Hover over a marker on the map to see its name.
Hover over the graph to get precise values.



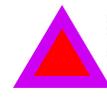
PLAGW-T
Eaux sout. CDS83/CEREGE
Planesselve
Température (°C)



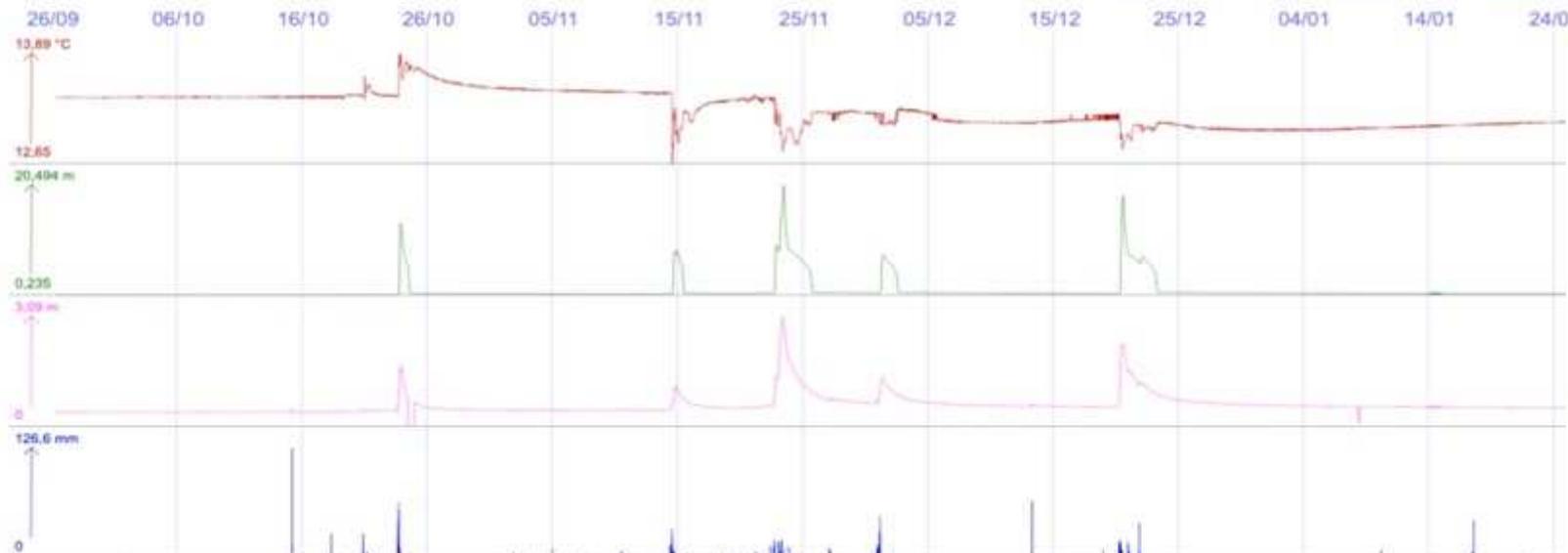
PLAGW-H
Eaux sout. CDS83/CEREGE
Planesselve
Hauteur d'eau (m)



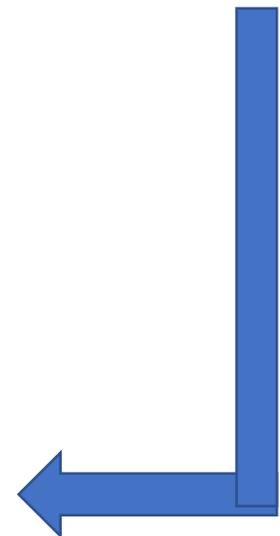
GAPEA-H
SMBG
Solles-Pont
Hauteur d'eau (m)



SOLLI-P
SAE-Météo à l'Ecole
Solles-Pont
Précipitations (mm)

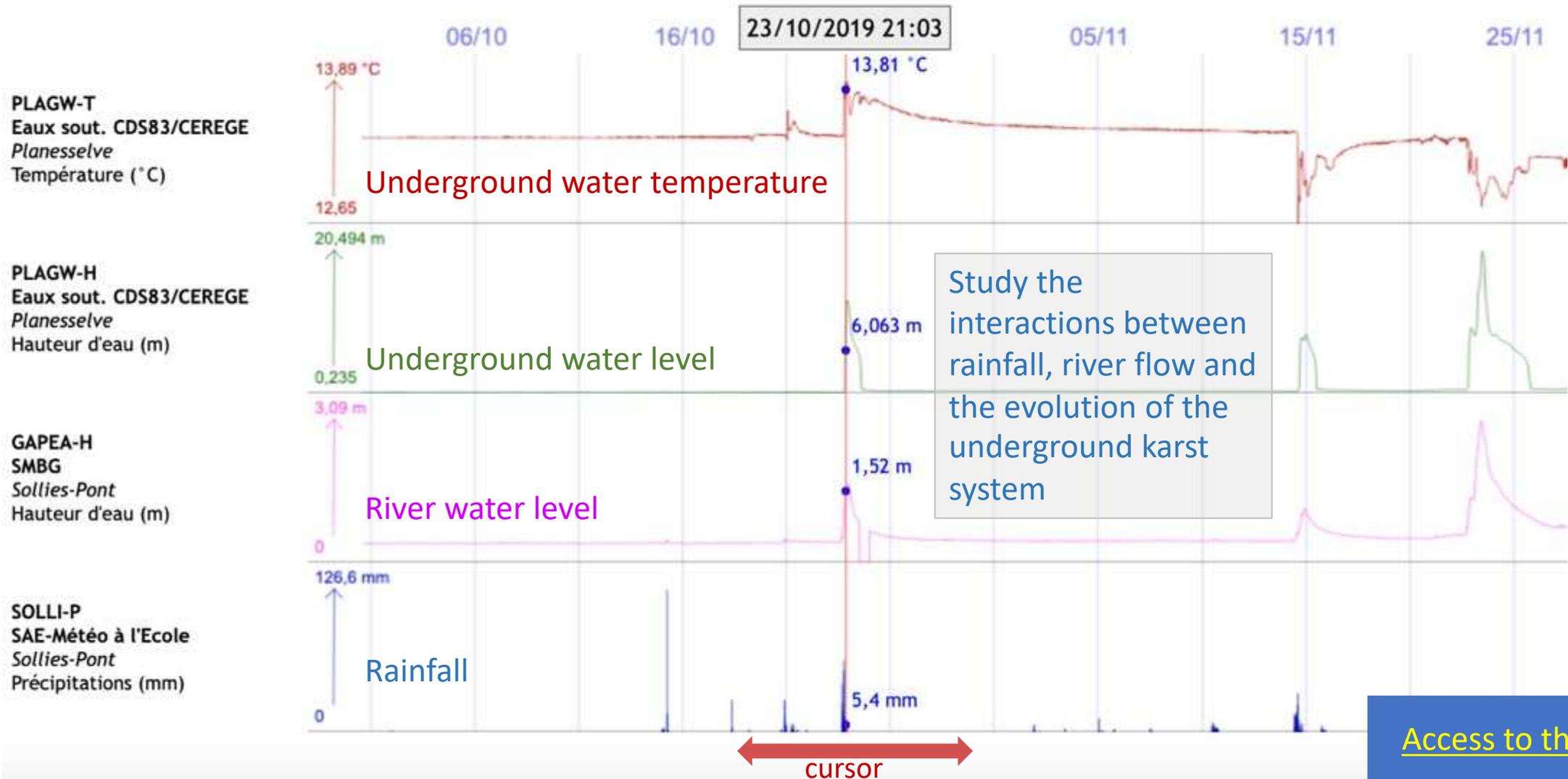


CC BY-NC P.Cosentino



Step 3 > characterise the dynamics of a Mediterranean storm, using hydro data with 'csvview'

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



Data Center

SEISMO

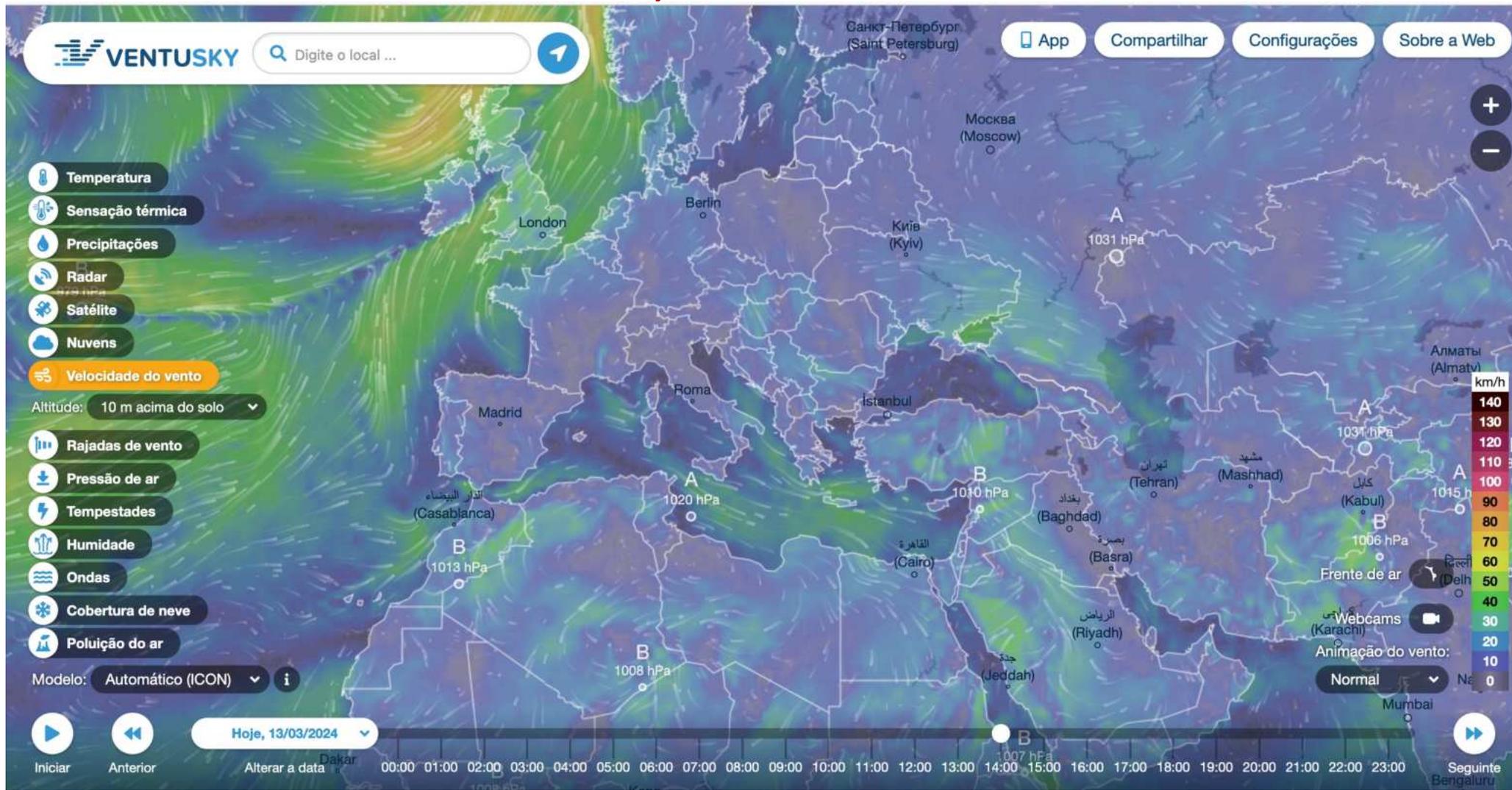
METEO

HYDRO

OCEANO

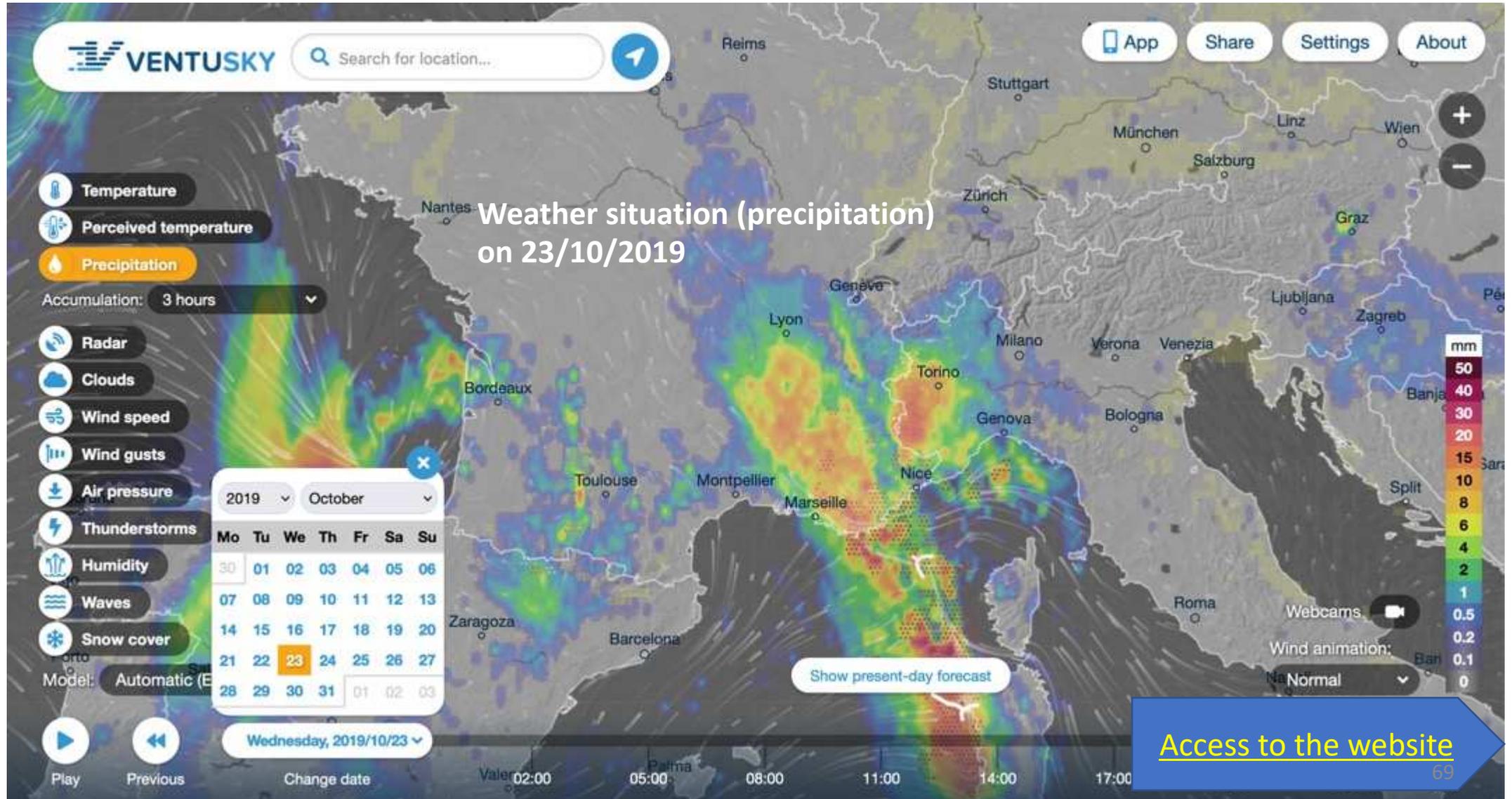
VOLCANO

<http://edumed.unice.fr/data-center/meteo/>



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

<https://www.ventusky.com/>



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

<https://www.ventusky.com/>



> 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.



Atividade prática VI

Monitorização do tempo em Portugal

Missão 1 / ligar-se a Ventusky, escolher a sua língua de trabalho
<http://edumed.unice.fr/data-center/ventusky/>

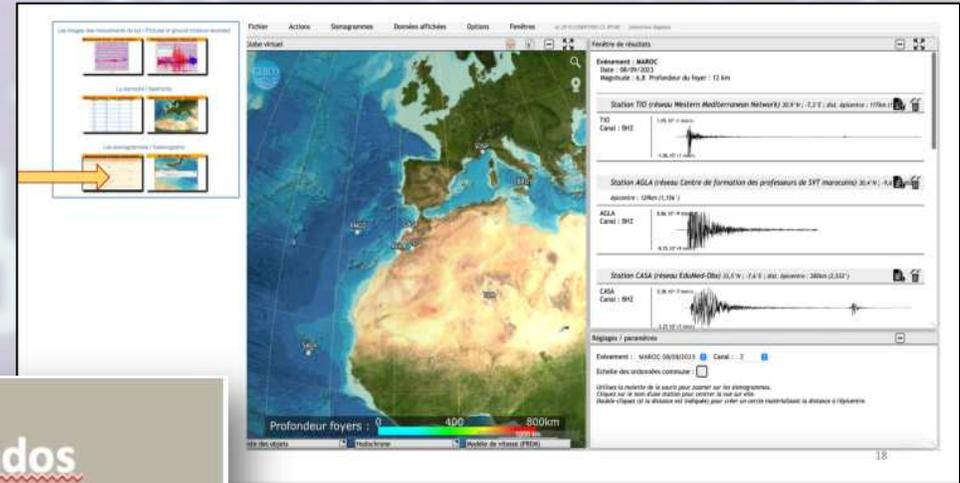
Missão 2 / explorar o estado do tempo atual (chuva, pressão, temperatura, etc.)

Missão 3 / Procurar um episódio de chuva intensa e monitorizar os vários parâmetros

Discussão em grupo



30 minutos



Case study ... more ?

Working with the data online in quite a real time

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

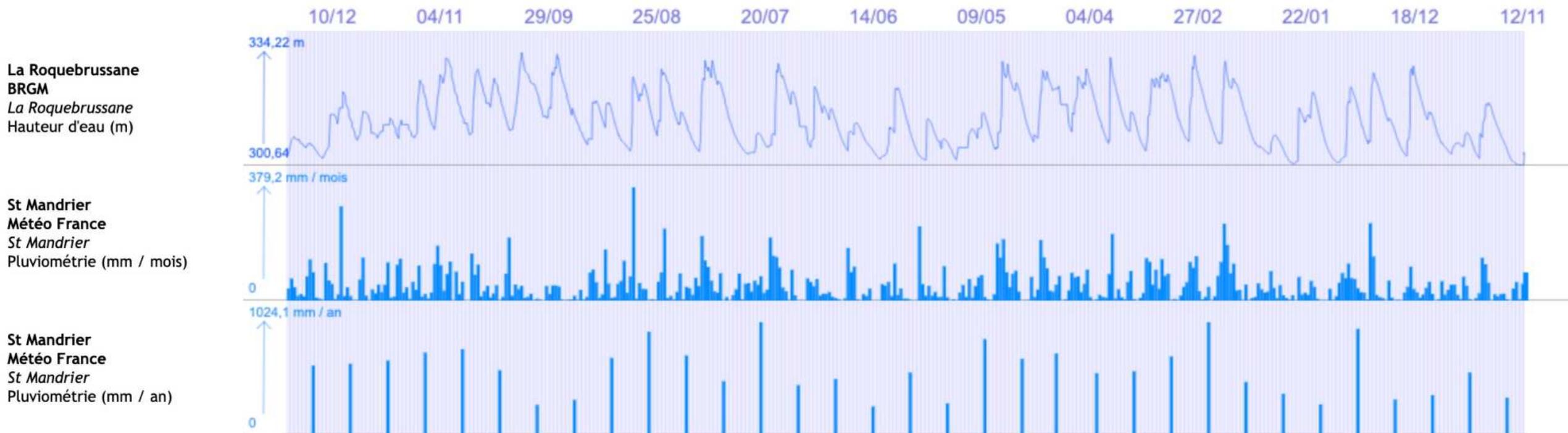
Piézomètre de la Roquebrussane (Var), août 1988 à février 2023

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



[Access to the web site](#)

Case study ... more ?

Working with the data online in quite a real time

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

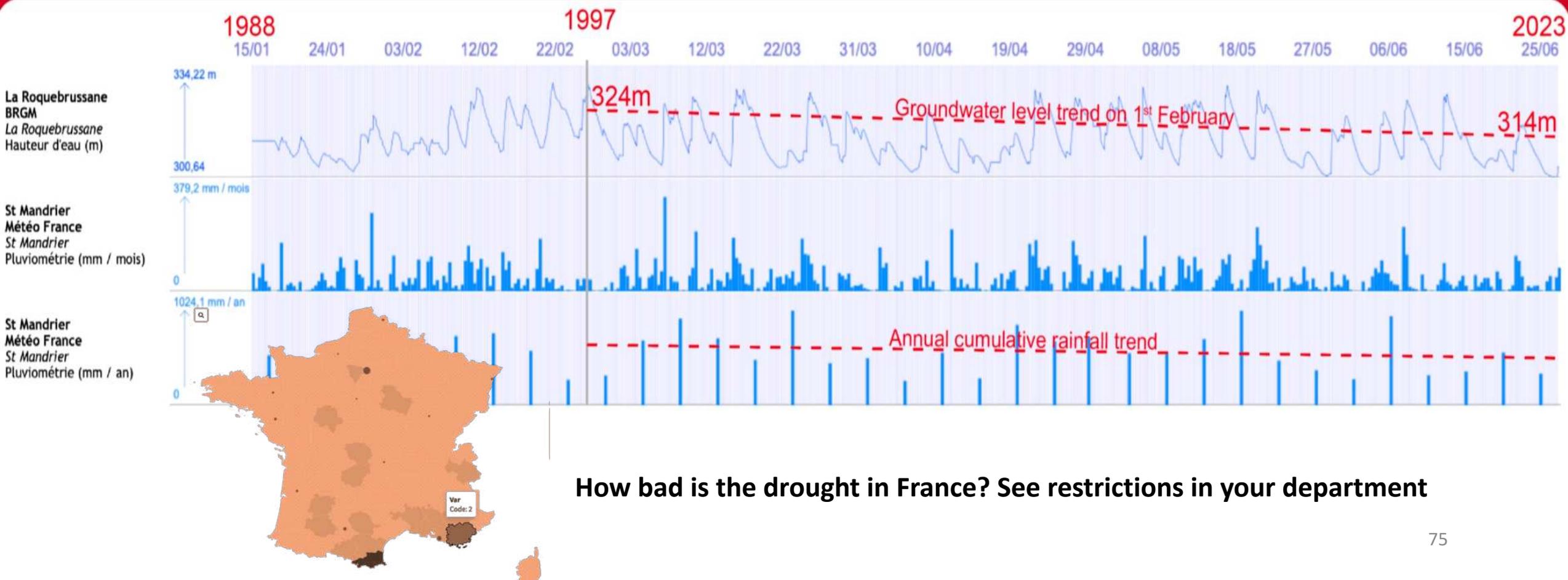
Piézomètre de la Roquebrussane (Var), août 1988 à février 2023

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-year time series



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

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)

Alpes Maritimes **Var** Bouches du Rhône Pyrénées Orientales

Décocher les stations sélectionnées

| | | |
|---|--|--|
| Le Gapeau (Var) <ul style="list-style-type: none"><input checked="" type="checkbox"/> Solliès-Pont<input checked="" type="checkbox"/> Hyères<input checked="" type="checkbox"/> Solliès-Pont (météo) | L'Argens (Var) <ul style="list-style-type: none"><input type="checkbox"/> Châteauvert<input type="checkbox"/> Carcès<input type="checkbox"/> Les Arcs<input type="checkbox"/> Roquebrune s/ Argens<input type="checkbox"/> Le Luc<input type="checkbox"/> Draguignan | Les affluents de l'Argens (Var) <ul style="list-style-type: none"><input type="checkbox"/> Vins s/ Caramy (Caramy)<input type="checkbox"/> Cabasse (Issole)<input type="checkbox"/> Salernes (Breque)<input type="checkbox"/> Vidauban (Aille)<input type="checkbox"/> Trans-en-Provence (Nartuby)<input type="checkbox"/> Le Muy (Endre)<input type="checkbox"/> Fréjus (Reyran) |
| La Reppe <ul style="list-style-type: none"><input type="checkbox"/> Ollioules | La Giscle <ul style="list-style-type: none"><input type="checkbox"/> Cogolin | Le Bau <ul style="list-style-type: none"><input type="checkbox"/> Rougon |

Date de début : 01-12-2022 Date de fin : 30-03-2023

Affichage avec Csview :

- Multi-stations (choisir les paramètres à afficher) :
 - Hauteur d'eau / pluviométrie
 - Débit / pluviométrie
- Vitesse d'écoulement (une seule station) :
 - Hauteur d'eau et débit

Les données complètes au format ZIP :
 Tous les paramètres disponibles pour chaque station choisie

J'ai choisi ! submit

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_csvview.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.

