Polish Open Science Conference 2024

Data in the Service of Science and Society

10-12.04.2024 Cracow, Poland

Anna Leśnodorska

TCS AH Consortium Director
Head of the TCS AH Coordination Department of The
Institute of Geophysics Polish Academy of Sciences

EPOS Thematic Core Service Anthropogenic Hazards - history, tasks, EPOS - the path to scientific excellence

Institute of Geophysics
Polish Academy of Sciences

Polish
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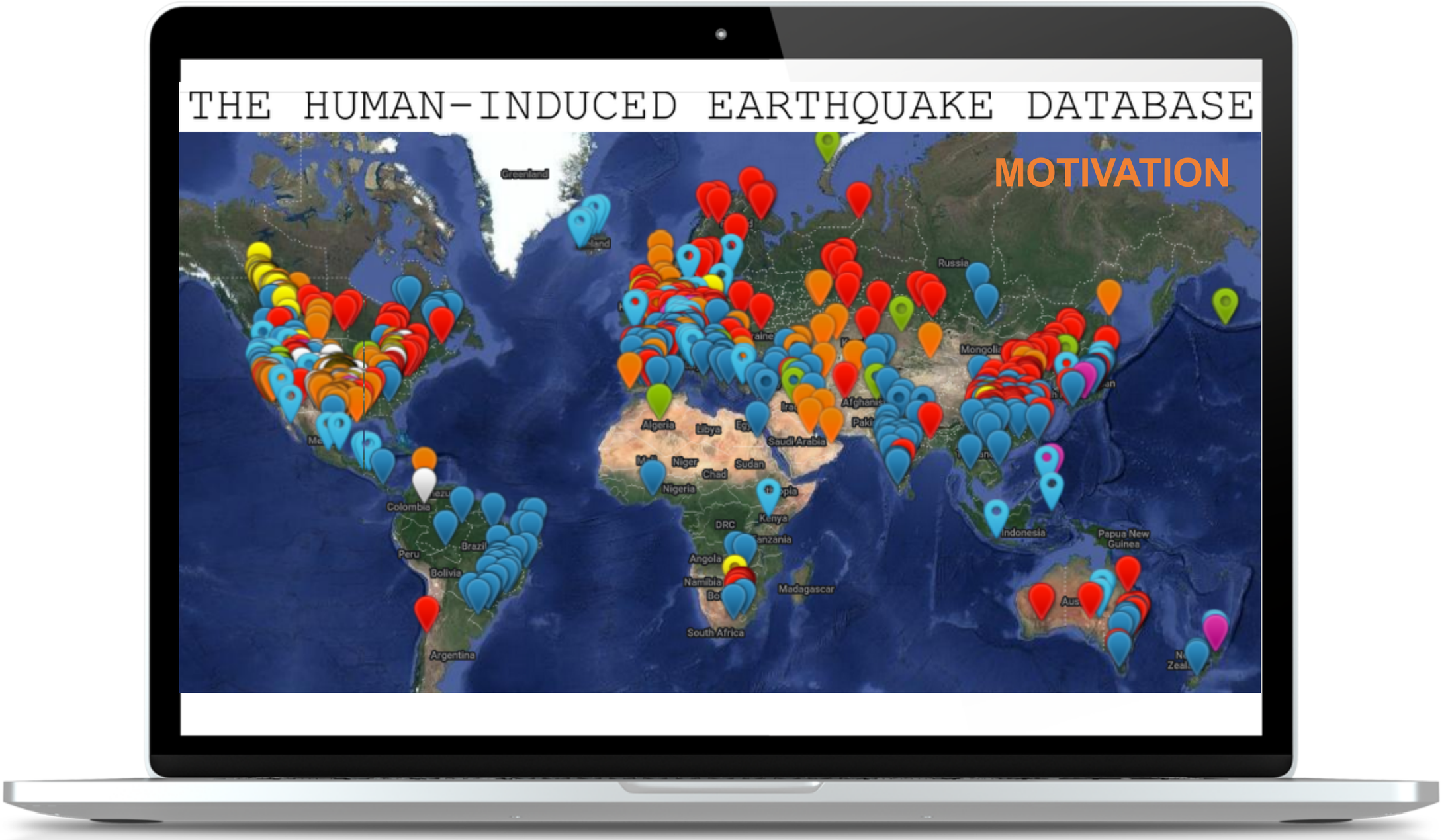

THE HUMAN-INDUCED EARTHQUAKE DATABASE
MOTIVATION
Greenland
Russia
Mongolia
Algeria
Libya
Saudi Arabia
Niger
Chad
Sudan
Nigeria
Colombia
Peru
Brazil
Bolivia
Argentina
DRC
Kenya
Angola
Namibia
Madagascar
South Africa
Indonesia
Papua New Guinea

Anthropogenic Hazards Science Plan Path

Key Point

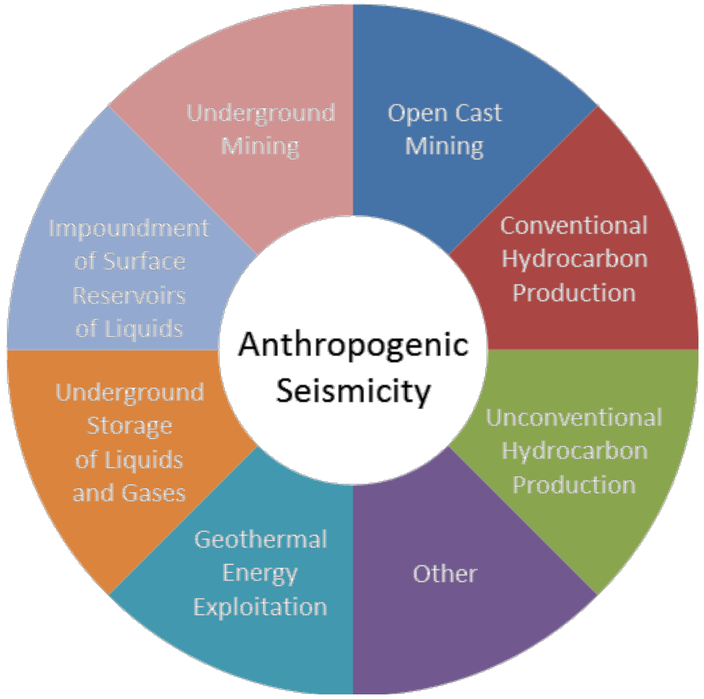
Anthropogenic seismicity is induced by technological activity.

Conclusion

Recognition of the relationships between the parameters of technological activity and the parameters of the seismic proces will allow to keep the anthropogenic seismic hazard within acceptable limits.

Science Plan Highlight

Science Plan Highlight: Studying the relationship between technological activity (cause) and anthropogenic seismicity (effect)

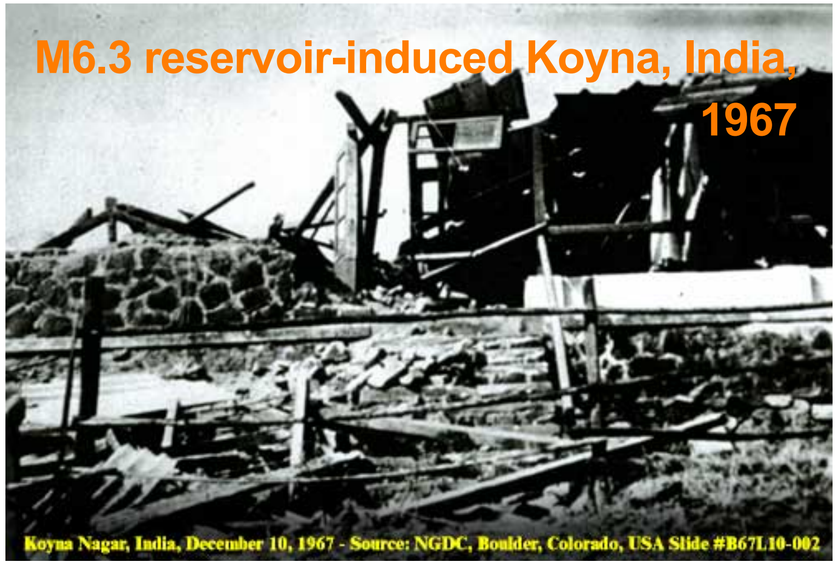


Anthropogenic seismicity appearing in association with diverse geo-resources exploitation activities has a significant socio-economic impact

Stronger AS events can cause damage, injuries and even fatalities. The hazard posed be induced seismicity can be considerable,

M5.3 mining-induced Stilfontein, Rep. South Africa, 2005

M6.3 reservoir-induced Koyna, India, 1967



M5.6 injection-induced Oklahoma, USA, 2011

phot. Brian Sherrod, USGS

Bit of history of the Anthropogenic Hazards Community: 2010-2023

2010 THAIS - Teamwork for Hazard Assessment for Induced Seismicity

2011 - 2012 WG 10 Infrastructure for GeoResources

2013 IS-EPOS Platform - Digital Research Space dedicated to iduced seismicity for EPOS purposes

2015 - 2018 SHEER - „Shale gas Exploration and Exploitation induced Risks," Horizon 2020.

2015 - 216 EPOS IP - WP14 „EPOS IP" (EPOS Implementation Phase Project)

2016 - 2021 EPOS-PL

2017 - 2020 SERA - Seismology and Earthquake Engineering Research Infrastructure Alliance for Europe", H2020

2020 - 2023 EPOS SP EPOS SP Project (Sustainability Phase

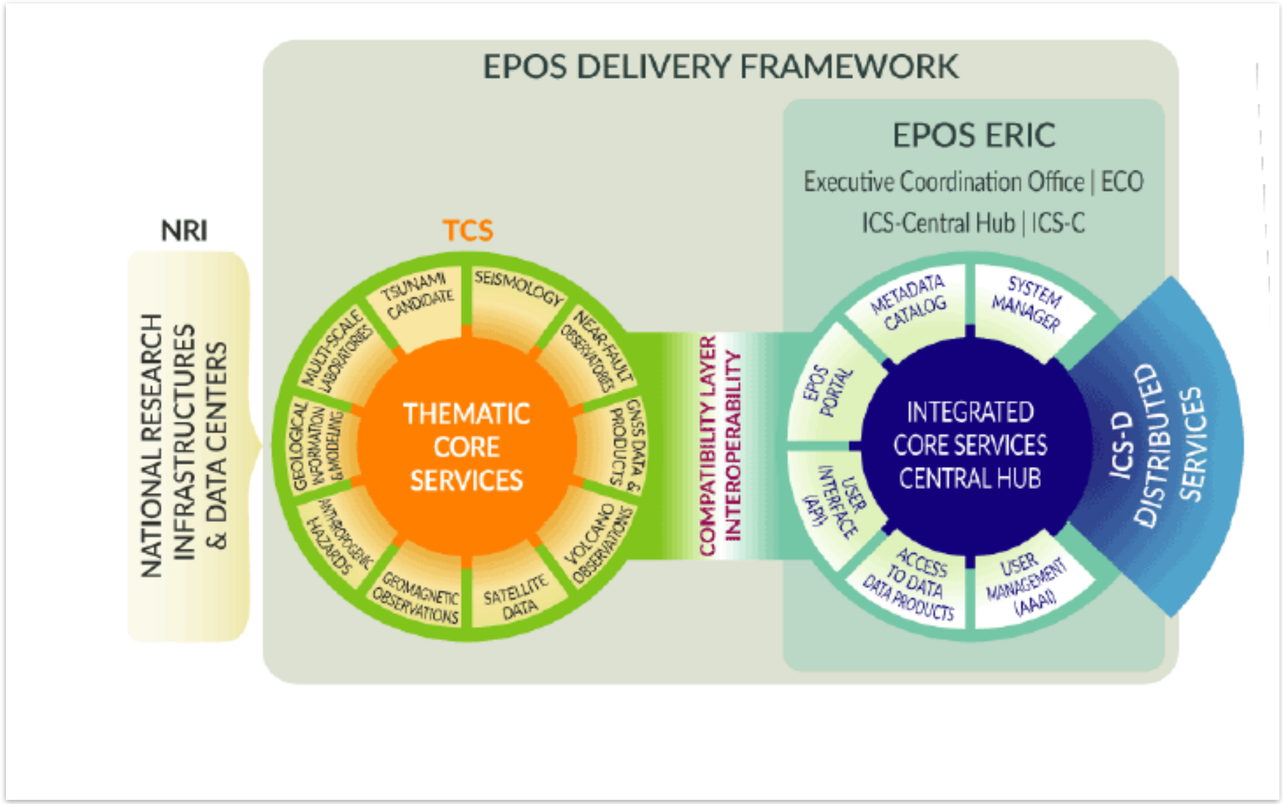
2020 - 2023 EPOS-PL+

2018 - 2022 S4CE Science For Clean Energy, H2020

2019 EPOS Thematic Core Service Anthropogenic Hazards

EUROPEANPLATEOBSERVINGSYSTEM

A multidisciplinary, distributed research infrastructure that facilitates the integrated use of data, data products, and facilities from the solid Earth science community in Europe.



EPOS THEMATIC CORE SERVICES

- *Seismology*
- *Near-Fault Observatories*
- *GNSS Data and Products*
- *Volcano Observations*
- *Satellite Data*
- *Geomagnetic Observations*
- ***Anthropogenic Hazards***
- *Geological Information and Modeling*
- *Multi-Scale Laboratories*
- *Tsunami*

ANTHROPOGENIC HAZARDS

EPOS provides open and easy access to high-quality data, following FAIR – Findability, Accessibillity, Interoperability, and Reusability - principles to data and metadata management.

Seismology

Near-Fault Observatories

GNSS Data and Products

Volcano Observations

Satellite Data

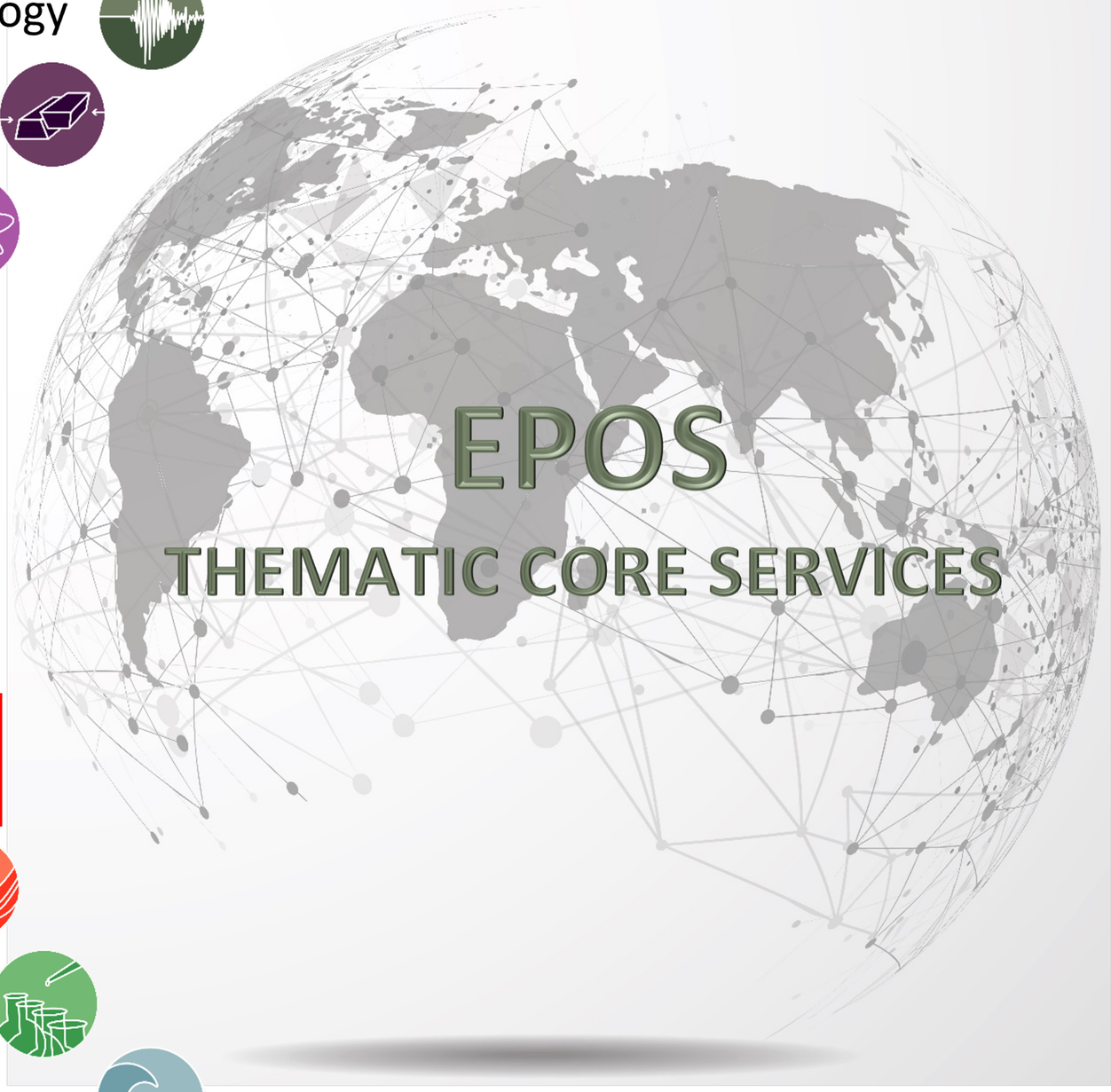
Geomagnetic Observations

Anthropogenic Hazards

Geological Information and Modeling

Multi- Scale Laboratories

Tsunami



EPOS Thematic Core Service Anthropogenic Hazards (TCS AH) Consortium

EPISODES PLATFORM

16 Institutions from 8 European and 1 Non-European Country

Institute of Geophysics Polish Academy of Sciences

GEOFYZIKÁLNÍ ÚSTAV AKADEMIE VĚD ČESKÉ REPUBLIKY, v. v. i.

CYFRONET

CNRS

POLSKA GRUPA GÓRNICZA

INERIS maîtriser le risque pour un développement durable

GIG National Research Institute

UNIVERSITY OF OULU

DPPL DROBOT POPŁAWSKI PRZYBYŁOWICZ LISZKA-GRONEK

Keele UNIVERSITY

WROCŁAW UNIVERSITY OF ENVIRONMENTAL AND LIFE SCIENCES

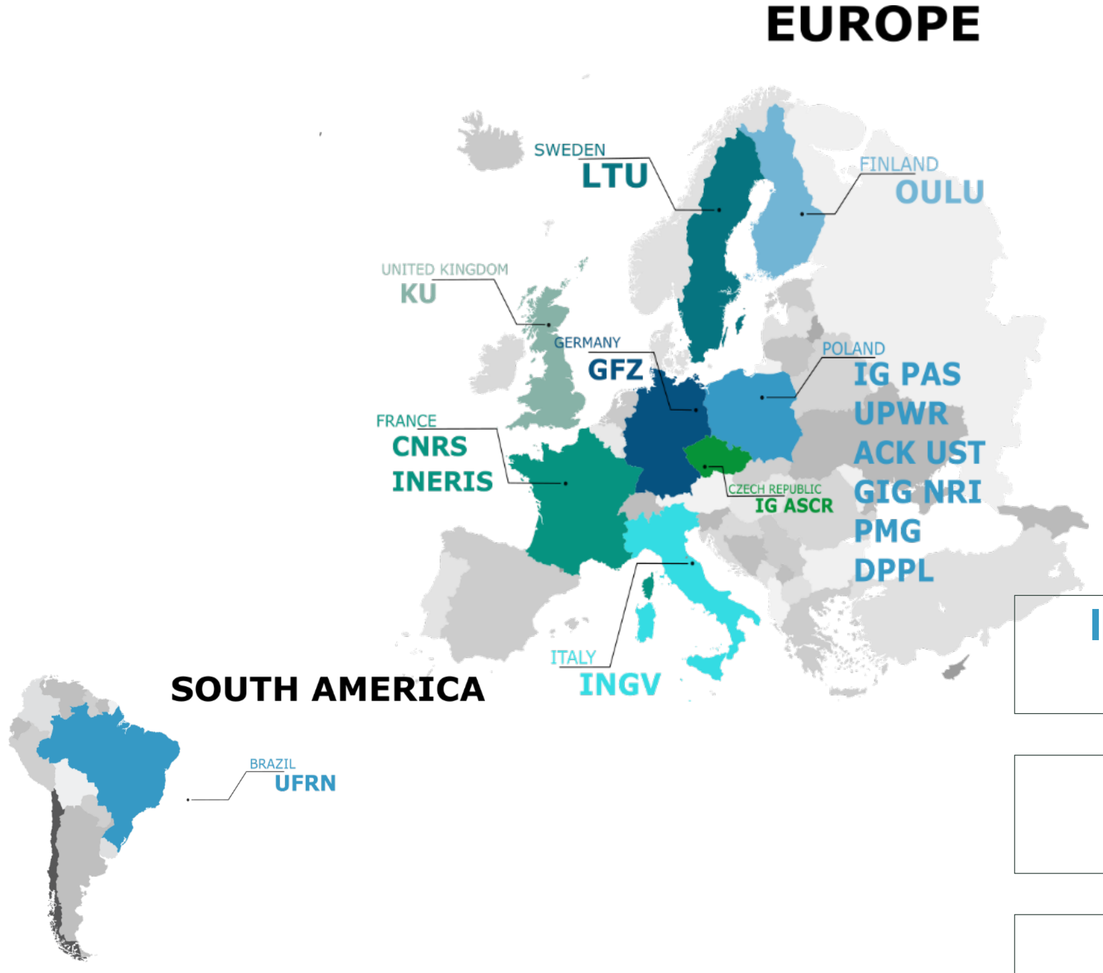
GFZ Helmholtz Centre POTSDAM

ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

LULEÅ TEKNISKA UNIVERSITET

UFRN UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

ING PAN



TCS AH Consortium Board

TCS AH DIRECTOR

TCS AH ECO

EXTERNAL COMMITTEES

WORKING SECTIONS

INNOVATION ADVISORY COMMITTEE

LEADER: Christophe Maisons

USER COMMITTEE

LEADER: Ian Stimpson

DATA PROVIDER COMMITTEE

LEADER: Sławomir Olechowski

Polish Open Science Conference 2024

EPOS ERIC EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM

Data in the Service of Science and Society

10-12.04.2024 Cracow, Poland

EPOS Thematic Core Service Anthropogenic Hazards (TCS AH)

TCS AH Consortium

for managing infrastructure integration in cooperation with EPOS ERIC

TCS AH e-NODES

gather episodes with their multidisciplinary data, manage them and provide access to AH data

TCS AH EPISODES Platform

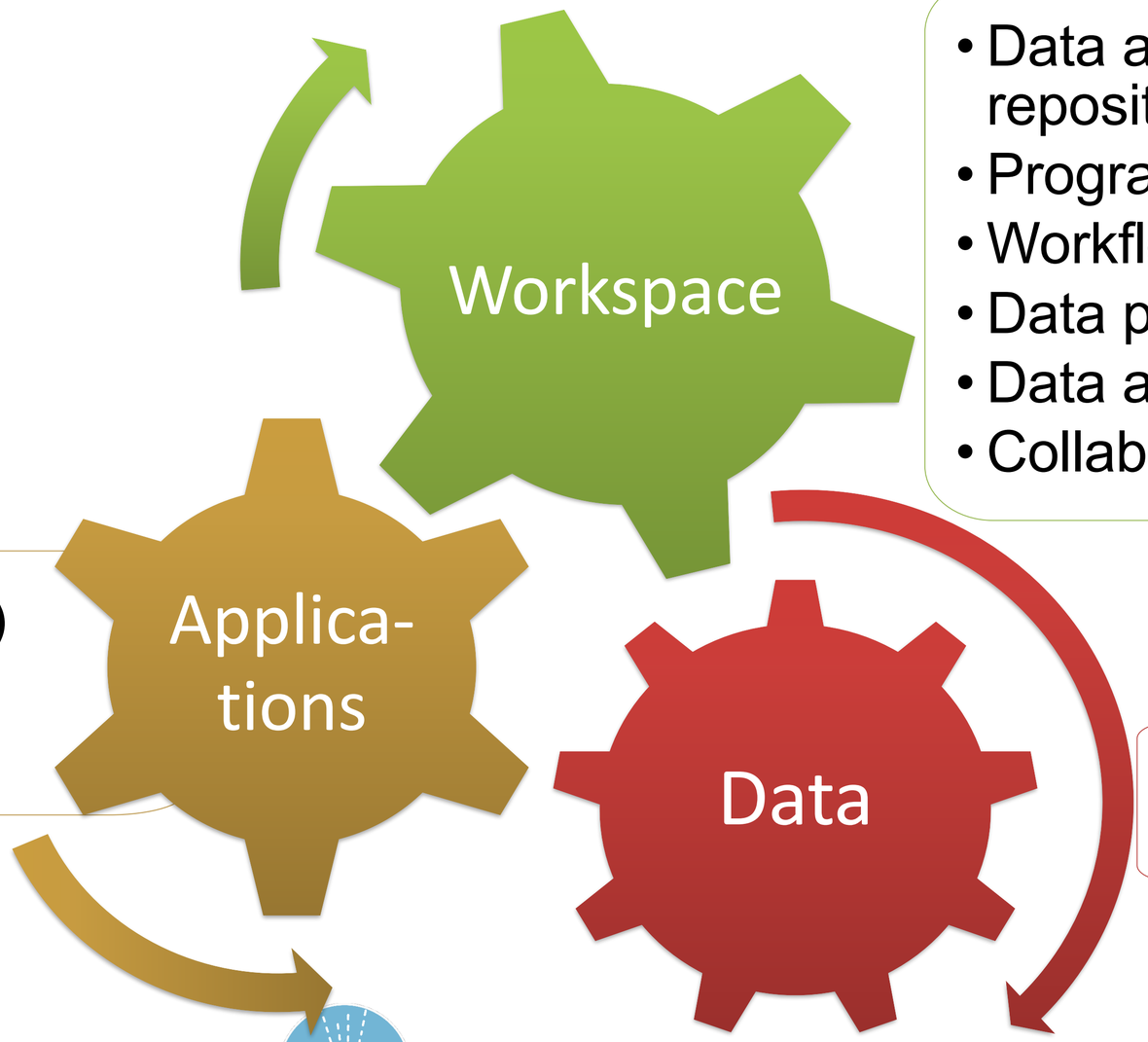
provides access to the episodes' data, software, applications and computational resources for advanced analysis and visualization

TCS AH mission:

Thematic Core Service Anthropogenic Hazards mission is to integrate - within EPOS - the research infrastructures related to studies of geo-hazards of anthropogenic origin, in particular those caused by the exploration and exploitation of geo-resources.

EPISODES platform – A virtual laboratory

HPC processing, data on AS cases (episodes), AS-tailored software (applications), collaboration



- Data and apps private repository
- Programming
- Workflow building
- Data processing → HPC
- Data and results sharing
- Collaboration

- Implemented (public) software tools
- Private applications

- Integrated episodes
- User Uploads

EPISODES PLATFORM

EPISODES Platform | Documents | Support | EN | LOGIN | SIGN UP

EPISODES Platform provides open access to the integrated research infrastructures of **EPOS TCS AH**, giving users the possibility to:

- analyze anthropogenic seismicity and related hazards
- assess the potential impact of geo-resources exploitation
- use educational resources on anthropogenic hazards

EPISODES Platform › EPOS TCS AH ›

Language versions: English, French, Italian, Polish

Integration with EPOS Data Portal

https://www.epos-eu.org/dataportal

>50 (JCR) papers, PhD disertaions, habilitations, …

42 Worldwide episodes

75 Dedicated services

304 000 Data items

1800+ Professional users

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ANTHROPOGENIC HAZARDS

EPOS EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM

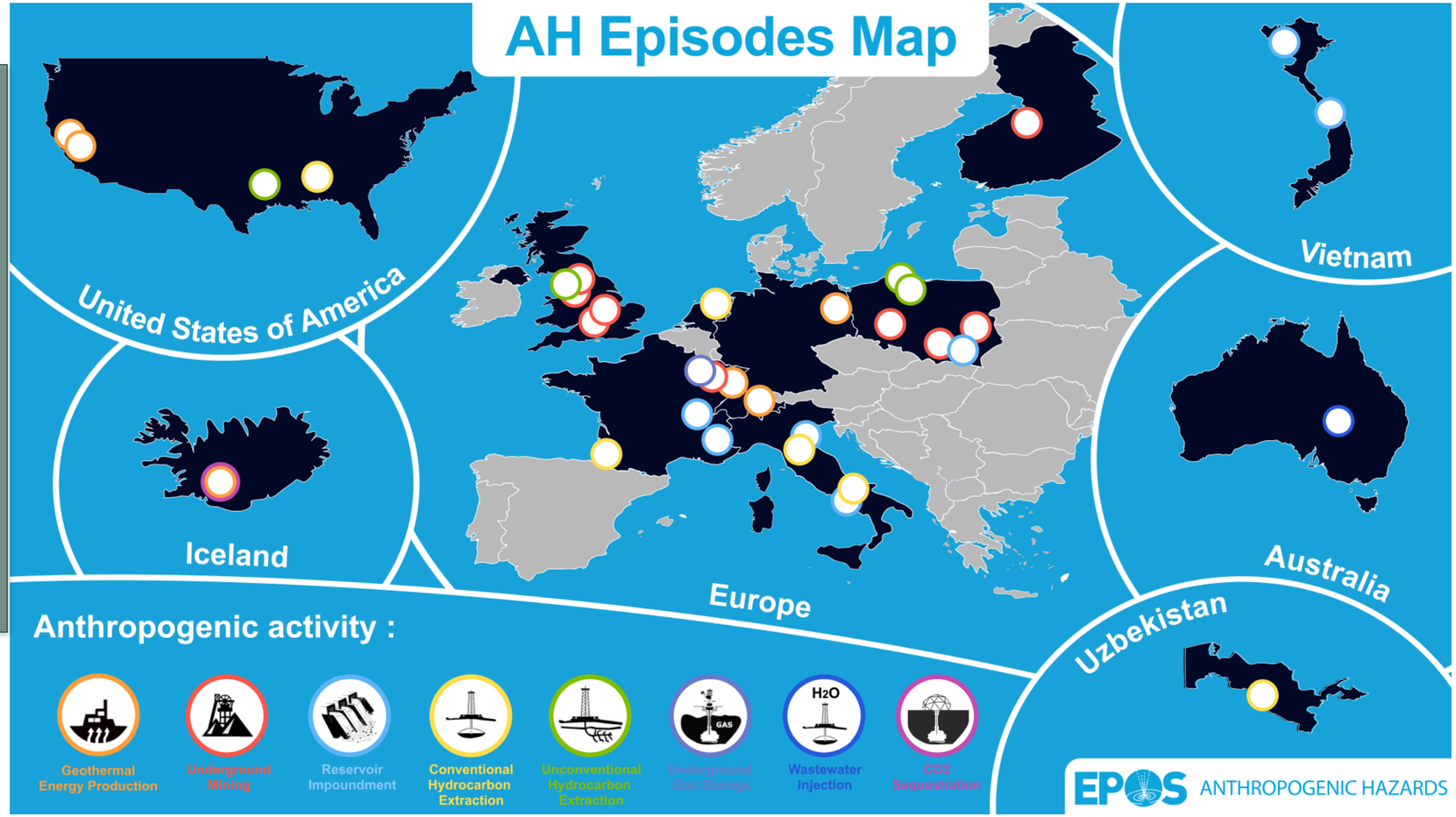
Data in the Service of Science and Society

10-12.04.2024 Cracow, Poland

42 Episodes: Sets of time-correlated geophysical, technological and other relevant geodata that relate comprehensively anthropogenic seismic proceses to its industrial causes

Inducing technologies:

CO_2 sequestration	- 1
Conventional hydrocarbon extraction	- 6
Geothermal energy production	- 11
Reservoir impoundment	- 6
Underground gas storage	- 1
Unconventional hydrocarbon extraction	- 5
Underground mining	- 13
Wastewater injection	- 2



Episode: VAL D'AGRI FIELD

VAL D'AGRI FIELD: conventional hydrocarbon extraction

Description

Seismic monitoring of the initial stage of wastewater injection into a disposal well of the Val d'Agri oil field. The monitoring unraveled a low magnitude swarm induced by disposal operations that initiated just a few hours after the beginning of injection. Main objective is to provide seismic data to be analyzed with advanced techniques for a better understanding of the mechanisms of injection-linked seismicity and of physical properties of the reservoir.

Episode integrated in the framework of:
• EPOS IP project, European Plate Observing System Implementation Phase. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 676564

If you use data from this episode in a publication, then you must cite the data source as follows:
IS EPOS (2017), Episode: VDF, https://tcs.ah-epos.eu/#episode:VDF, doi:10.25171/InstGeoph_PAS_ISEPOS-2017-017

Data

DATA RELEVANT FOR THE CONSIDERED HAZARDS

SEISMIC

- Catalog 69 events from 02/06/2006 to 11/06/2006, magnitude ML range: 0.0 to 1.8
- Event Related Waveforms Event related waveforms available from 02/06/2006 to 11/06/2006
- Seismic Network Locations and parameters of seismic stations that operated since 02/06/2006 to 11/06/2006 at Val D'Agri oil field

INDUSTRIAL

- Injection Volume Injection volume in well at Val d'Agri oil field
- Wellhead Pressure Wellhead pressure in well at Val d'Agri oil field

GEODATA

- Velocity Model Seismic velocity model of Val d'Agri oil field

ALL DATA RELATED TO THIS EPISODE | AVAILABLE VISUALIZATIONS

See more information in Document Repository

Data provided by

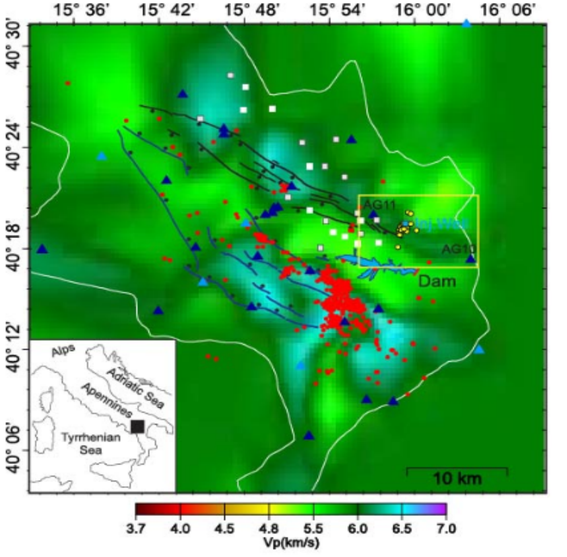
Istituto Nazionale di Geofisica e Vulcanologia (INGV), Italy

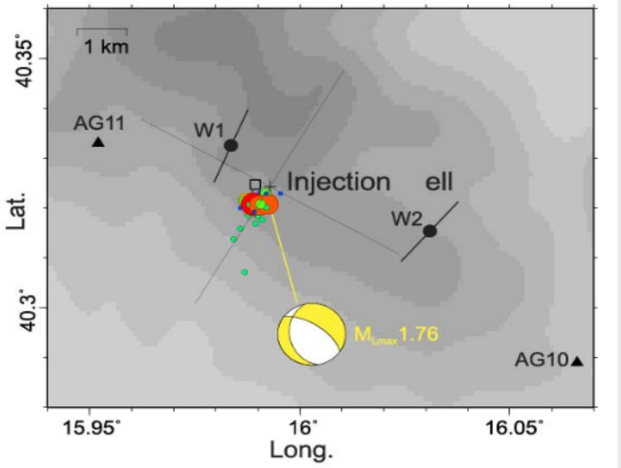
Resources

- EPOS IP Project Website

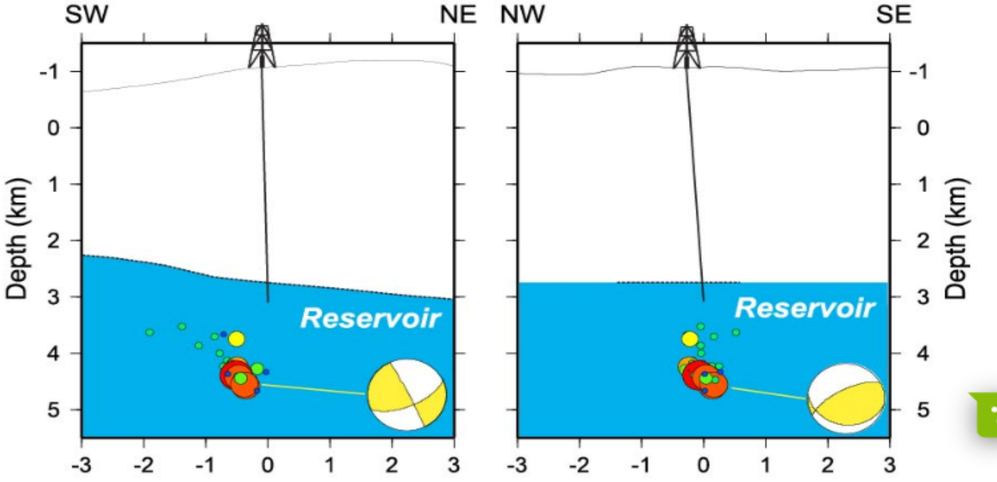
Status details

Impacting factor:	Conventional hydrocarbon extraction, Wastewater injection
Region:	Italy, southern Apennines
Project association:	EPOS-IP

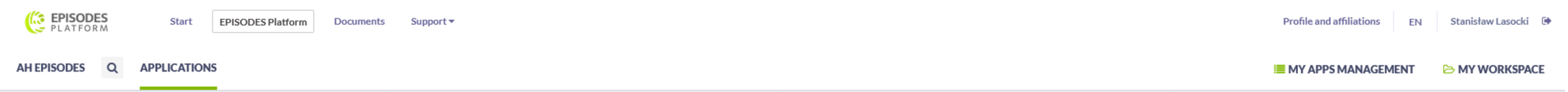




modified by Improta et al. (2015)



73 Applications: Bespoke software tools to process and analyze the data with particular attention to analyzing **correlations between technology, anthropogenic seismicity, and resulting hazard.**



MERGER: Dynamic risk analysis using a bow-tie approach

ADD TO WORKSPACE

DESCRIPTION

MERGER, a simulator for multi-hazard risk assessment in ExploRation/exploitation of GeoResources, is a tool for performing dynamic risk analyses using a bow-tie approach. The tool has been designed for solving fault trees (FT) and event trees (ET) linked in a bow-tie structure and using a Monte Carlo approach.

The methodology implemented in this service is suitable for performing highly specialized dynamic risk analyses using state-of-the-art knowledge and is characterised by (for details see Garcia-Aristizabal et al. 2019):

a. The bow-tie structure coupled with a wide range of probabilistic models flexible enough to consider different typologies of phenomena;
b. A Bayesian implementation for data assimilation, allowing the user to update assessments as new data becomes available;
c. The handling and propagation of modelling uncertainties.

Parameters:
MERGER-FT:

1. The fault tree structure
2. Setting of the FT's basic events (BE). For each BE, it is required to set the kind of model used for evaluating the BE and the related parameters for setting

MERGER-ET: not yet available

Note: The current release of the system includes the basic tools for assessing the fault tree component only (MERGER-FT). The following integrated tools for modelling Basic events in FTs have been implemented: Homogeneous Poisson processes, non-homogeneous Poisson processes, and Binomial processes. Soon, Physical reliability models will be integrated, as well as the tool for solving event trees (MERGER-ET).

"

AUTHOR

Alexander Garcia-Aristizabal, INGV, within EPOS-IP project

LAST UPDATE

2019 Aug 08

DIRECTORY NAME

Merger

COMPUTATIONAL CHARACTERISTIC

The computation time strongly depends on different parameters, in particular:

1. The number of Basic events (BE) defined in the fault-tree structure (increasing the number of BEs increases computation time);
2. The number of iterations (the higher the number of iterations, the longer the computation time);
3. The probability values characterizing the BEs (the lower the probabilities, the longer the computation time);

Therefore, once you launch the application, the time required for getting the results may range from a few minutes to hours according to these settings.

REFERENCES

User Guide
Document Repository

CATEGORY

Probabilistic Seismic Hazard Analysis

KEYWORDS

Dynamic bow-tie analysis, Fault-tree, Event tree, Statistical analysis, Multi-hazard risk assessment, Monte Carlo simulations, Geo-resource production impact

CITATION

If you use the results or visualizations retri
Garcia-Aristizabal, A., J. Kocot, R. Russo, and P. Gasparini (2019). A probabilistic tool for multi-hazard risk analysis using a bow-tie approach: application to environmental risk assessme
10.1007/s11600-018-0201-7
Orlecka-Sikora, B., Lasocki, S., Kocot, J. et al. (2020) An open data infrastructure for the study of anthropogenic hazards linked to georesource exploitation., Sci Data 7, 89, doi: 10.1038/s4

Application categories:

Analysis and Modelling Apps

- Source & Shaking Parameters Estimation – 10
- Stress Field Modelling – 2
- Exploratory Statistical Analysis – 13
- Hazard & Risk Analysis – 15

Data Handling Apps

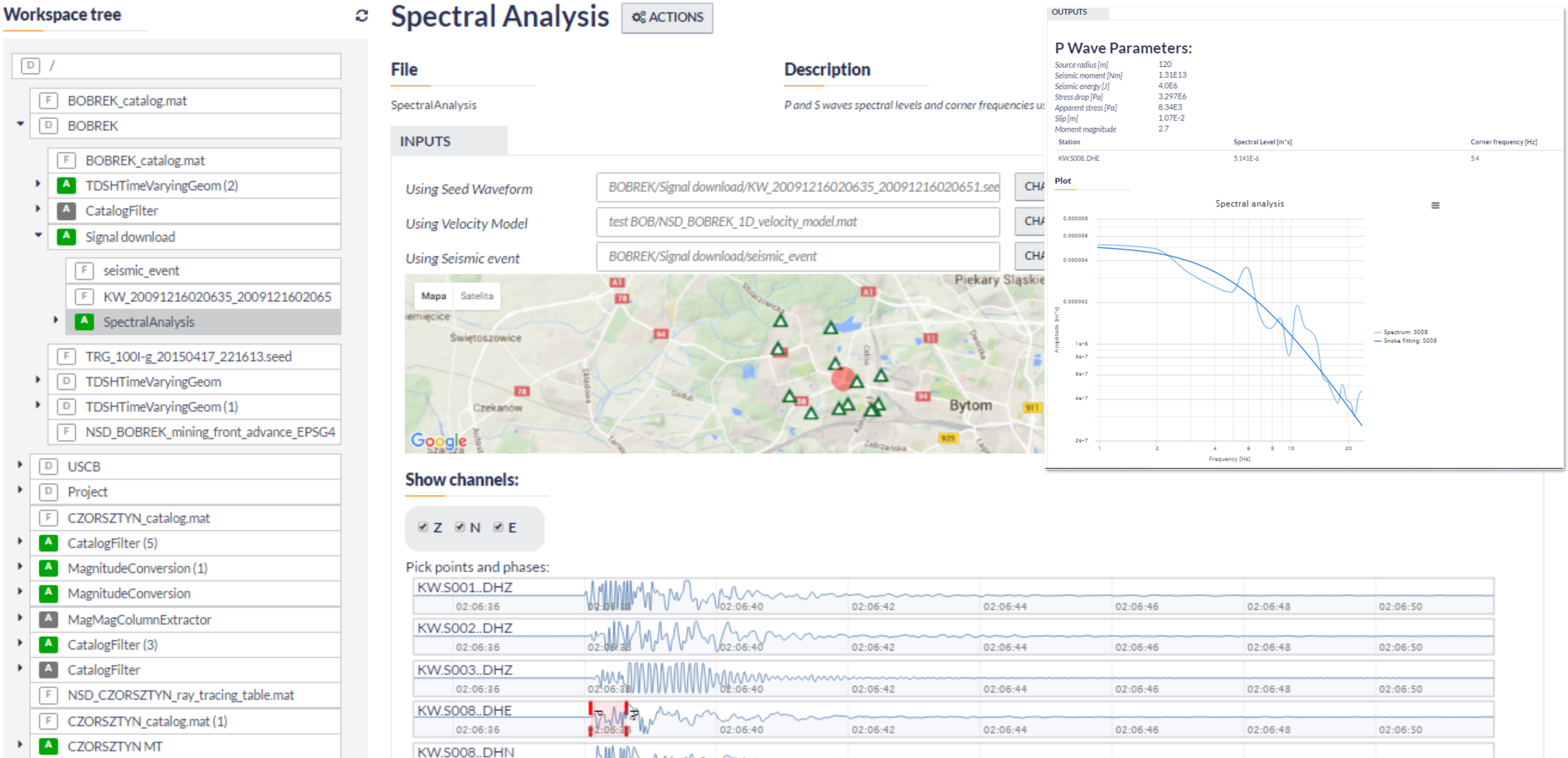
- Download Tools – 2
- Converters – 13
- Reconstruction Tools – 9

Visualizations Apps – 6

Workspace: Data from episodes or uploaded are processed by selected apps in users' workspaces.

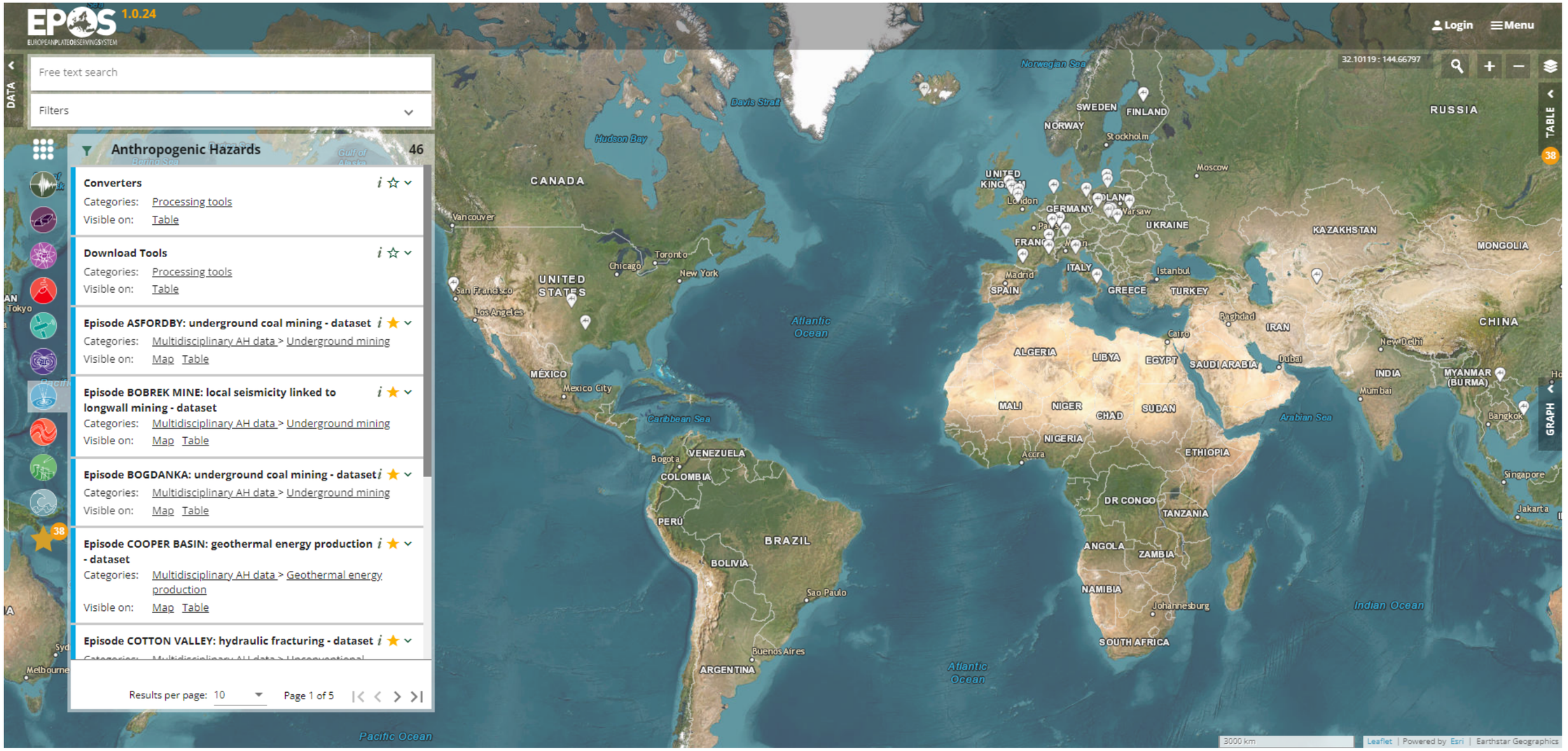
Application Workbench: A functionality to build workflows from user's codes and platform apps.

HPC: The processing is delegated to cloud or high-performance computers.



https://www.epos-eu.org/dataportal

Integration with EPOS Data Portal



Challenges facing EPOS TCS AH

Cross-disciplinary

dimension of events related to anthropogenic threats.

The relationship

between anthropogenic hazard and technological processes.

Integration

of the scientific community. Taking up common challenges.

Further development

of integrated AH infrastructure.

Financial sustainability

AI artificial intelligence

- development of web-services dedicated to AH (in technical, ethical and financial aspects).

Please accept our kind invitation to visit:

EPISODES PLATFORM

EpisodesPlatform.eu

ANTHROPOGENIC HAZARDS

tcs.ah-epos.eu