Anthropogenic Hazards

Thematic Core Service

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EPOS EUROPEANPLATEOBSERVINGSYSTEM

The EPOS SP project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 871121

EPOS Thematic Core Service Anthropogenic Hazards (TCS AH) Consortium

14 Institutions from 8 European and 1 Non-European Countries

ACK UST, University of Science and Technology - Academic Computer Centre Cyfronet (PL),
CMI, Central Mining Institute (PL)
CNRS, Centre national de la recherche scientifique – IPGS, Institut de Physique du Globe de Strasbourg (FR) & ISTerre, Institut des Scientes de la Terre (FR)
DPPL Legal (PL)
GFZ, Helmholtz Zentrum Potsdam Deutsches Geoforschungszentrum (DE)
IG ASCR, Geofyzikalni Ustav AV CR (CZ)
IG PAS, Institute of Geophysics Polish Academy of Sciences (PL)
INERIS, Institut National de l'Environnement et des Risques (FR)
INGV, Instituto Nazionale di Geofisica e Vulcanologia, (IT)
KU, University of Keele (UK)
LTU, Lulea Tekniska Universitet (SE)
OULU, Oulun Yliopisto (FIN)
PMG, Polish Mining Group (PL)
UFRN, Universidade Federal do Rio Grande do Norte (BR)

Mission: *To integrate – within EPOS – the research infrastructures related to studies of geo-hazards of anthropogenic origin, particularly those caused by the exploration and exploitation of geo-resources.*

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CURRENTLY, WE MOSTLY DEAL WITH ANTHROPOGENIC SEISMICITY

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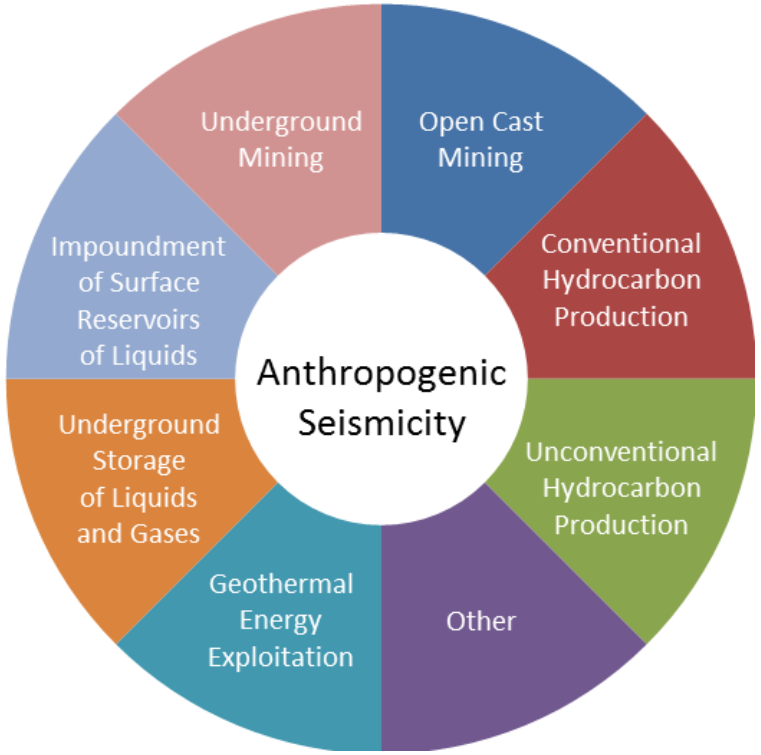


Anthropogenic seismicity appearing in association with diverse geo-resources exploitation activities has a significant socio-economic impact

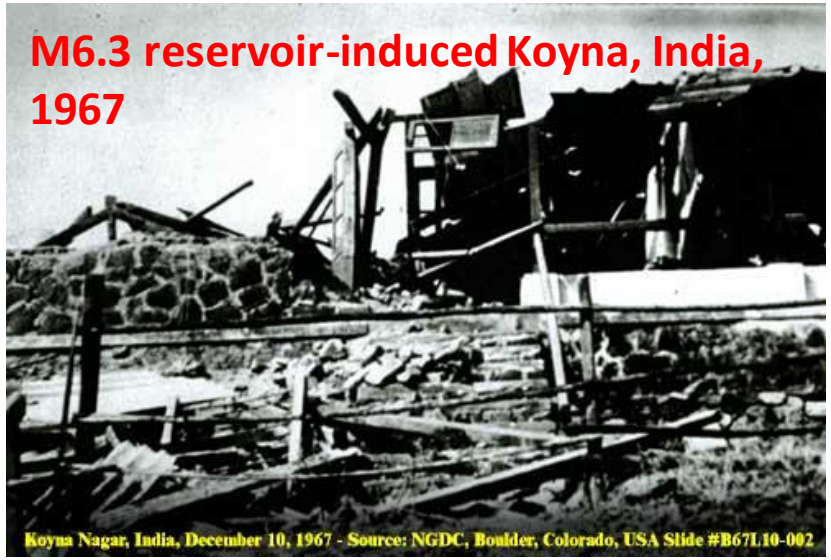
Stronger AS events can cause damage, injuries and even fatalities.

The hazard posed be induced seismicity can be considerable,

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

Durrheim 2010

M6.3 reservoir-induced Koyna, India, 1967



M5.6 injection-induced Oklahoma, USA, 2011

phot. Brian Sherrod,

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Key Point: Anthropogenic seismicity is induced by technological activity.

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

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

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THAIS Teamwork for Hazard Assessment for Induced Seismicity

The World Initiative 2010

(S. Lasocki, B. Orlecka-Sikora, IG PAS)
IASPEI CoSOI WG „Triggered and Induced Seismicity"

THREE STEPS TO BETTER RESEARCH INTO THE ASSESSMENT AND MITIGATION OF ANTHROPOGENIC SEISMIC HAZARDS

1. Cross-disciplinary approach to the problem. Integration of research groups investigating the problem. Information exchange with other Earth sciences communities.
2. Integration of research infrastructure both intra-disciplinary and interdisciplinary using the newest ICT.
3. Particular attention focused on studies of technology-nature couplings ↔ Deep science – industry synergy based on mutual understanding of concerns and respect of interests.

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TCS AH Integrated Infrastructures

USERS

USERS

DATA NODES

Maintain and develop the distributed episode database.

EPISODES Platform

https://tcs.ah-epos.eu

- *Provides a virtual access to the integrated infrastructures to ensure researchers unconstrained possibilities to perform in-silico experiments.*
- *Plugs in Data Nodes*
- *Maintains and develops bespoke and standard applications.*

IG PAS, Warsaw ← EPISODE PROVIDERS

IPGS, Strassbourg ← EPISODE PROVIDERS

KNMI, De Bilt ← EPISODE PROVIDERS

..... ← EPISODE PROVIDERS

SOFTWARE PROVIDERS

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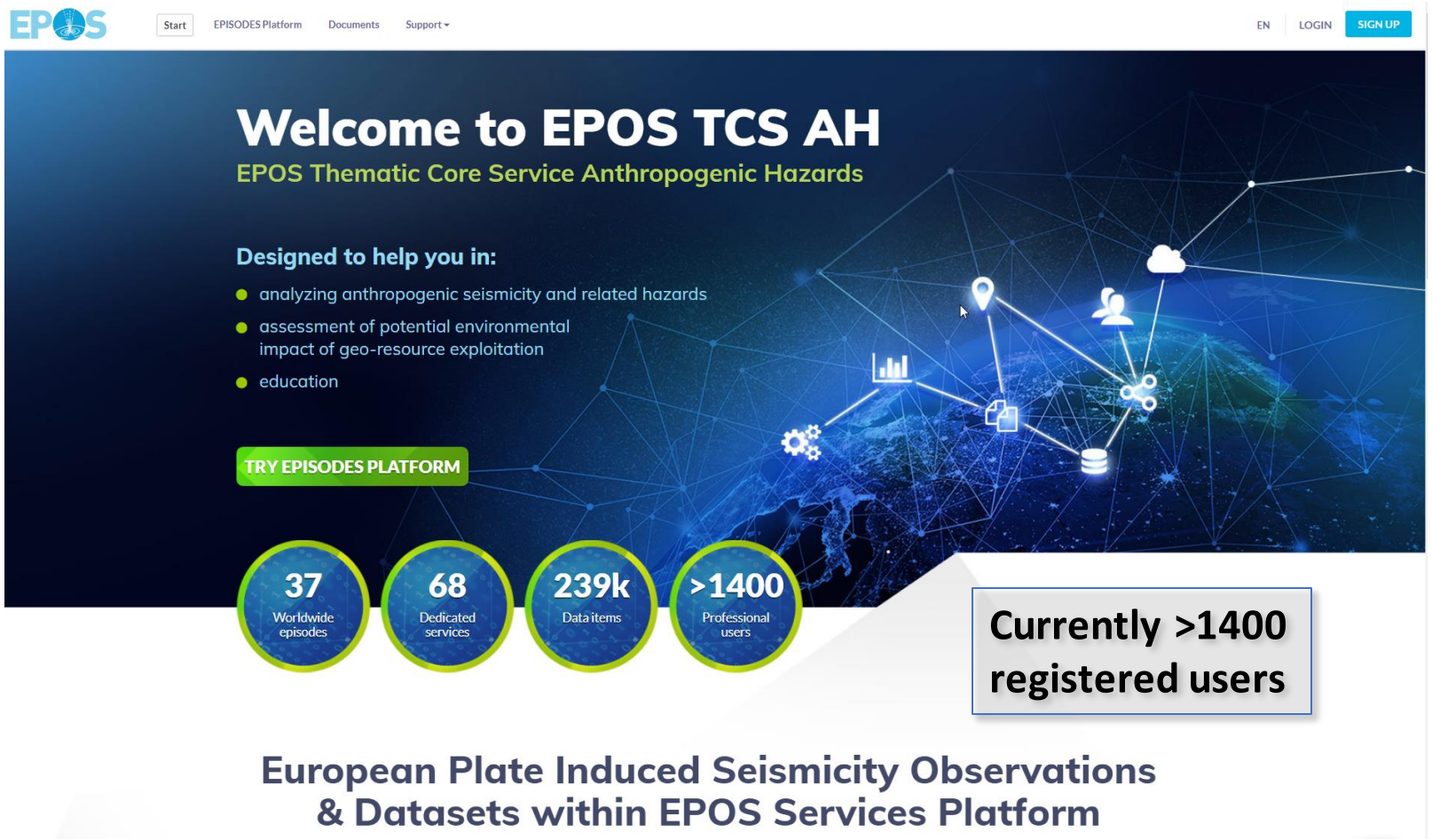
EPISODES PLATFORM

https://tcs.ah-epos.eu/

- Access to the integrated research infrastructure of EPOS TCS AH: episodes (datasets), applications (software), workspace, HPC, collaboration functionalities, document repository



Language versions: English, French, Polish, Italien

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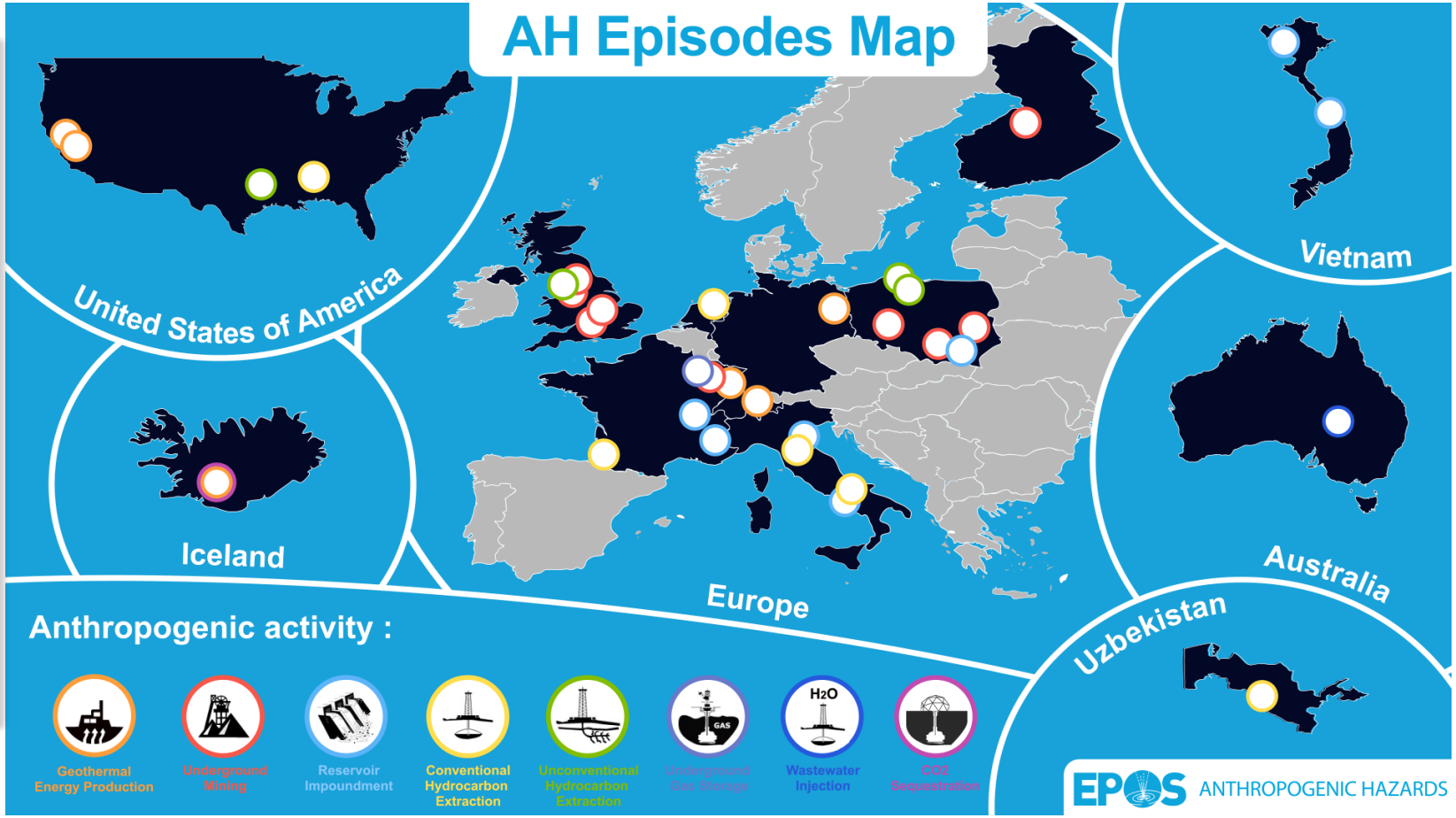
Episodes: Sets of time-correlated geophysical (seismological), technological and other relevant geodata that relate comprehensively hazardous proceses (currently anthropogenic seismicity) to its industrial causes

Inducing technologies:

CO2 sequestration	- 1
Conventional hydrocarbon extraction	- 5
Geothermal energy production	- 11
Reservoir impoundment	- 6
Underground gas storage	- 1
Unconventional hydrocarbon extraction	- 5
Underground mining	- 10
Wastewater injection	- 2
Under integration	*- 5*



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Episodes:

Conventional hydrocarbon eltraction	GAZLI GRONINGEN FIELD LIVE EPISO LACQ GAS FIELD OKLAHOMA* VAL D'AGRI FIELD*
Geothermal energy production	1993 Soultz-sous-Forêts Stimulation 2000 Soultz-sous-Forêts Stimulation 2003 Soultz-sous-Forêts Stimulation 2004 Soultz-sous-Forêts Stimulation 2005 Soultz-sous-Forêts Stimulation CARBFIX* COOPER BASIN GROSS SCHOENEBECK ST. GALLEN THE GEYSERS Prati 9 & Prati 29 cluster THE GEYSERS

Reservoir impoundment	CZORSZTYN LAI CHAU LIVE EPISODE MONTEYNARD SONG TRANH VAL D'AGRI VOUGLANS
Unconventional hydrocarbon extraction	COTTON VALLEY LUBOCINO PREESE HALL WYSIN
Underground mining	ASFORDBY BOBREK MINE BOGDANKA LIVE EPISODE GISOS-CERVILLE LGCD LIVE EPISODE NORTHWICH PREESALL MINE PYHASALMI MINE THORESBY COLLIERY USCB LIVE EPISODE
Underground gas storage	STARFISH

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Applications: Bespoke software tools to process and analyze the data with particular attention to analyzing correlations between technology, geophysical response, and resulting hazard.

EPISODES PLATFORM | Start | EPISODES Platform | Documents | Support | Profile and affiliations | EN | Stanisław Lasocki

AH EPISODES | APPLICATIONS | MY APPS MANAGEMENT | MY WORKSPACE

MERGER: Dynamic risk analysis using a bow-tie approach

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);
:ions, the longer the computation time);
the probabilities, the longer the computation time);

or getting the results may range from a few minutes to hours according to these

REFERENCES

User Guide
Document Repository

CATEGORY

Probabilistic Seismic Hazard Analysis

KEYWORDS

Dynamic bow-tie analysis, Fault-tree, E
production impact

CITATION

If you use the results or visualizations retrieved from this application in a publication, then you must cite the data source as follows:
Garcia-Aristizabal, A., J. Kocot, R. Russ
application to environmental risk asses
10.1007/s11600-018-0201-7
Orlecka-Sikora, B., Lasocki, S., Kocot, J.
exploitation., Sci Data 7, 89, doi: 10.10

Application categories:

Analysis and Modelling Apps

- Source & Shaking Parameters Estimation – 10
- Stress Field Modelling – 2
- Exploratory Statistical Analysis – 13
- Hazard & Risk Analysis – 17

Data Handling Apps

- Download Tools – 2
- Converters – 13
- Reconstruction Tools – 8

Visualizations Apps – 6

Institute of Geophysics
Polish Academy of Sciences

ANTHROPOGENIC HAZARDS

EPOS
PROGRAMME UNDER GRANT AGREEMENT N° 871121

Applications:

CATEGORY	APPLICATIONS
SOURCE & SHAKING PARAMETERS ESTIMATION	Seismogram picking tool
	Template-matching based event detection algorithm
	Waveform-based seismic event location
	Localization: TRMLOC localization / relocalization
	FOCI: Seismic moment tensor estimation
	Mechanism: Full Moment Tensor estimation
	Mechanism: Shear Slip estimation
	Mechanism: Shear-Tensile Crack estimation
	Spectral Analysis
	Ground Motion Parameters
STRESS FIELD MODELLING	Stress inversion
	Effective stress drop estimate
EXPLORATORY STATISTICAL ANALYSIS	Anderson-Darling test for exponentiality of inter-event time
	Anderson-Darling test for magnitude distribution
	Test for multimodal magnitude distribution
	Autocorrelation
	Cross-correlation
	Coefficient of randomness
	Priestley-Subba Rao (PSR) test
	Cluster Analysis
	Completeness Magnitude estimation
	Earthquake interactions: Georesource scale
	Earthquake interactions: Mainshock scale
	Earthquake swarm (reshuffling analysis)
	Time correlated earthquakes (Seasonal trends)
HAZARD & RISK ANALYSIS	Source size distribution functions/Stationary Hazard
	Stationary Hazard: Exceedance Probability
	Stationary Hazard: Maximum Credible Magnitude
	Stationary Hazard: Mean Return Period
	Interval Estimation of Hazard Parameters
	Estimate of maximum possible magnitude for reservoir triggered seismicity
	Estimation of source parameters in time-varying production parameters geometry
	Time dependent hazard in mining front surroundings
	Time dependent hazard in selected area
	TDASHA: Time-dependent Anthropogenic Seismic Hazard Assessment
	Ground Motion Prediction Equations: Final model analysis
	Ground Motion Prediction Equations: GMPE calculation
	Ground Motion Prediction Equations: Residuals analysis
	Coda Wave Interferometry detection of velocity changes
	Stress and strain changes induced by fluid injection and temperature change driven by geothermal injection
	MIDSTREAM: Load Data
	MERGER: Dynamic risk analysis using a bow-tie approach

CATEGORY	APPLICATIONS
DOWNLOAD TOOLS	Signal download tool
	Waveform download tool
CONVERTERS	CSV to Catalog converter
	Catalog to CSV converter
	Catalog to Vectors converter
	GDF to CSV converter
	GDF to Vectors converter
	SEED to ASCII (SLIST) converter
	SEED to FDSN Station XML converter
	SEED to SAC converter
	SEED to datalessSEED converter
	SEED to miniSEED converter
	miniSEED to ASCII (SLIST) converter
	miniSEED to SAC converter
	miniSEED to miniSEED converter
RECONSTRUCTION TOOLS	Signal Processing
	Ground Motion Parameters Catalog Builder
	Time Series builder
	Catalog editor
	Catalog merger
	Basic Vector Operations
	Magnitude conversion
	Transformation to Equivalent Dimensions
VISUALIZATION APPLICATIONS	Integrated Google Maps data visualization
	Fracture Network Models - Mechanical Stresses
	GDF with Seismic Activity data visualization
	GDF with Seismic Activity histogram data visualization
	Front Advance histograms
	Seismic Activity with Front Advance
	GIS 3D Visualization

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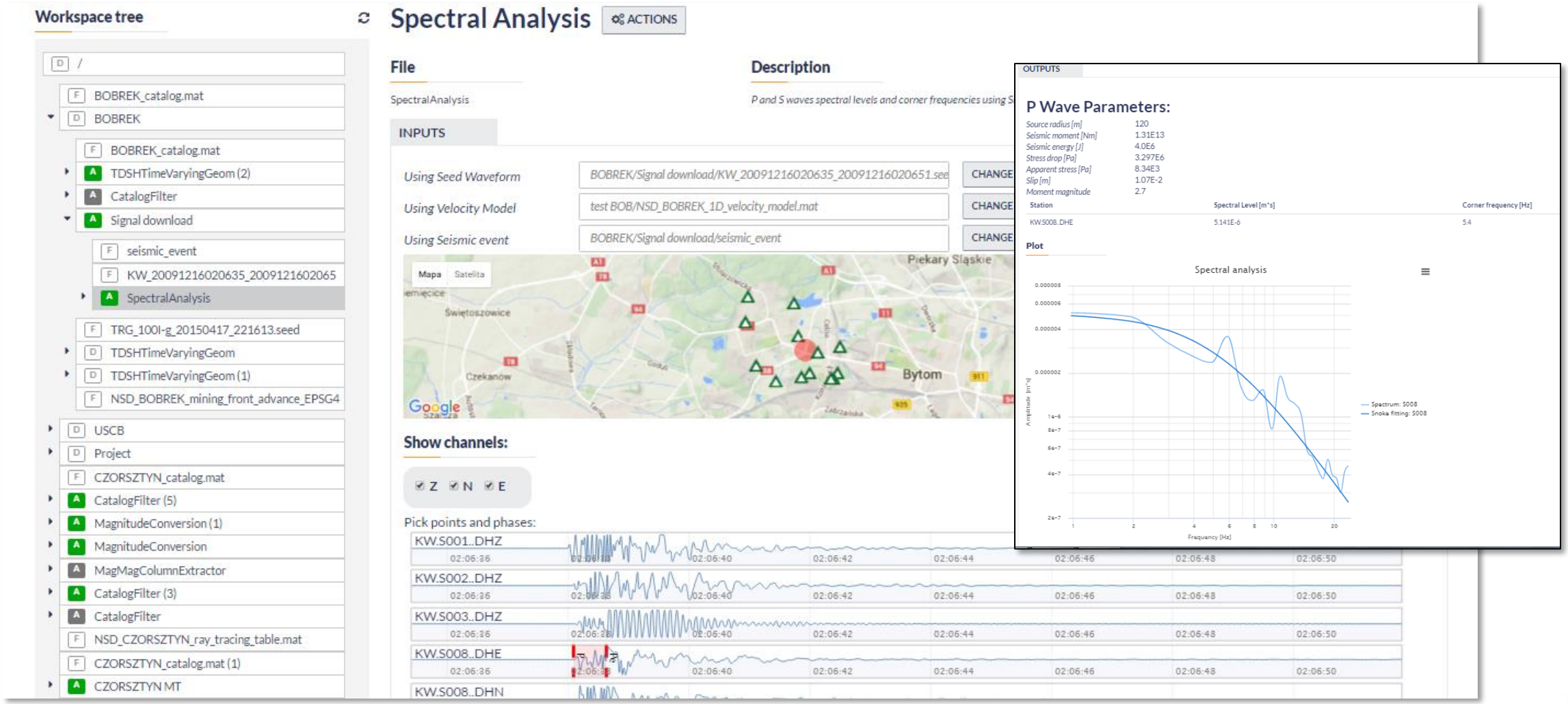
Workspace & HPC: Users add data from episodes and selected applications to their workspace for processing. Applications may be combined in a workflow. Users can also create codes and integrate them with the implemented apps to perform custom analyses. The processing is delegated to cloud or high-performance computers.



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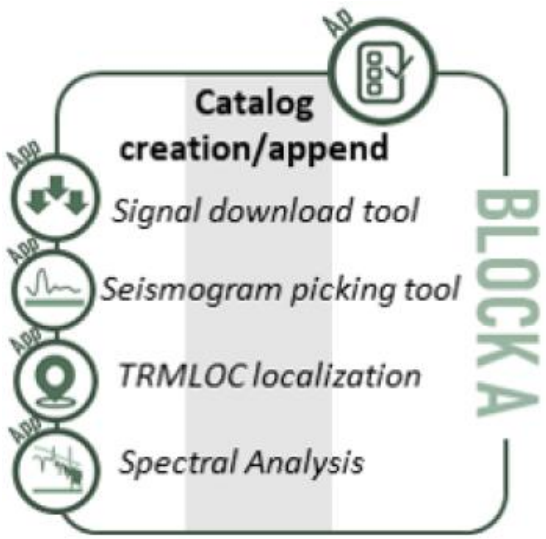
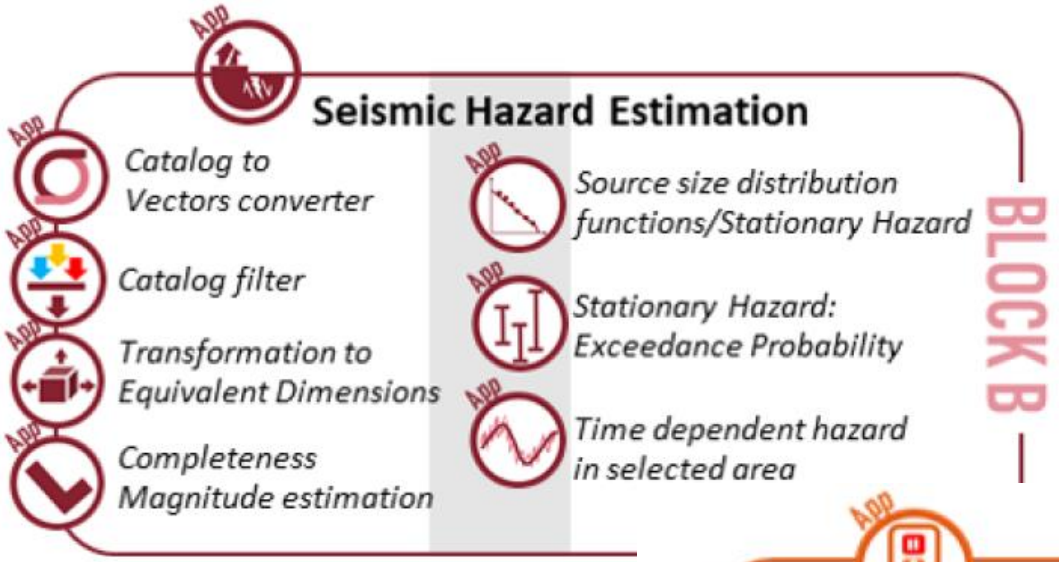
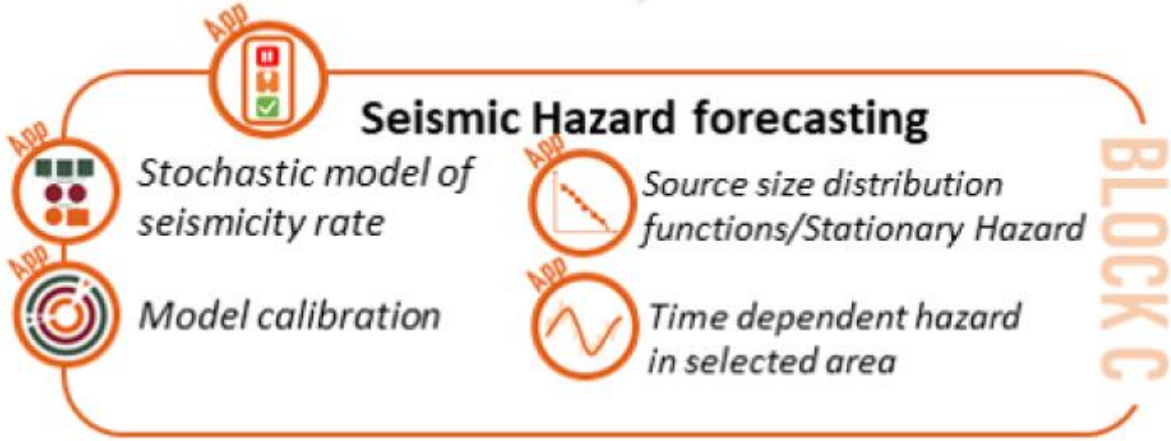
A sample custom application

Time-Dependent Anthropogenic Seismic Hazard Assessment (TDASHA)





EPISODES PLATFORM



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Thank you

Please, don't forget to visit tcs.ah-epos.eu

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