INTERNATIONAL COOPERATION TO SUPPORT THE ADAPTATION OF THE MINING SECTOR AND TO PROTECT POST-MINING AREAS FROM EXTREME WEATHER EVENTS

- TEXMIN PROJECT

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Central Mining Institute (GIG)

HR EXCELLENCE IN RESEARCH

Katowice, GIG, 13.07.2022

BASIC INFORMATION

The impact of EXtreme weather events on MINing operations

TEXMIN

The TEXMIN project is implemented under the **Research Fund for Coal and Steel (RFCS)** by an international consortium of 9 partners from 5 countries:

1. Główny Instytut Górnictwa (GIG – Lider projektu, PL),
2. University of Exeter (UNEXE, UK),
3. Politechnika Śląska (PL),
4. Centre for Research and Technology Hellas (CERTH, GR),
5. Subterra Ingenieria, S.L. (SUB, ES),
6. DMT GmbH & Co. KG (DMT, DE),
7. Výzkumný ústav pro Hnědé Uhlí (VUHU, CZ),
8. Spółka Restrukturyzacji Kopalń S.A (SRK, PL)
9. Tauron Wydobycie S.A. (TWD, PL).

GIG Instytut Badawczy

University of Exeter

Silesian University of Technology

CERTH Centre for Research & Technology Hellas

Subterra

DMT

VÚHU a.s.

SRK S.A.

TAURON Wydobycie

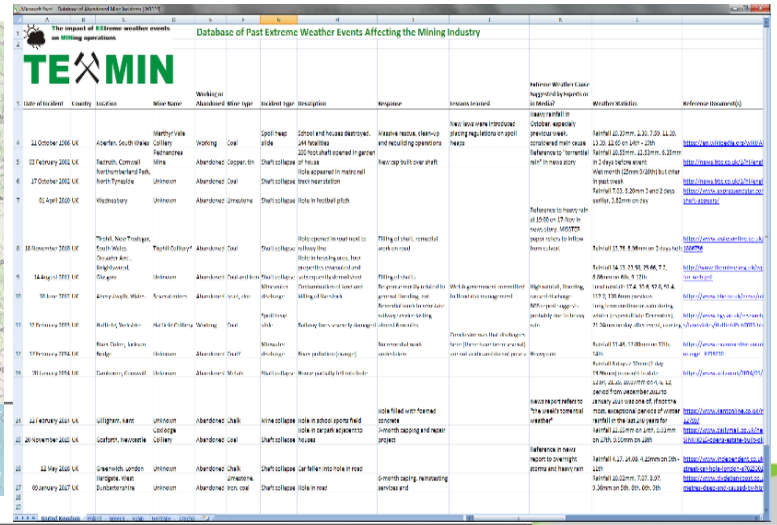
GIG Instytut Badawczy

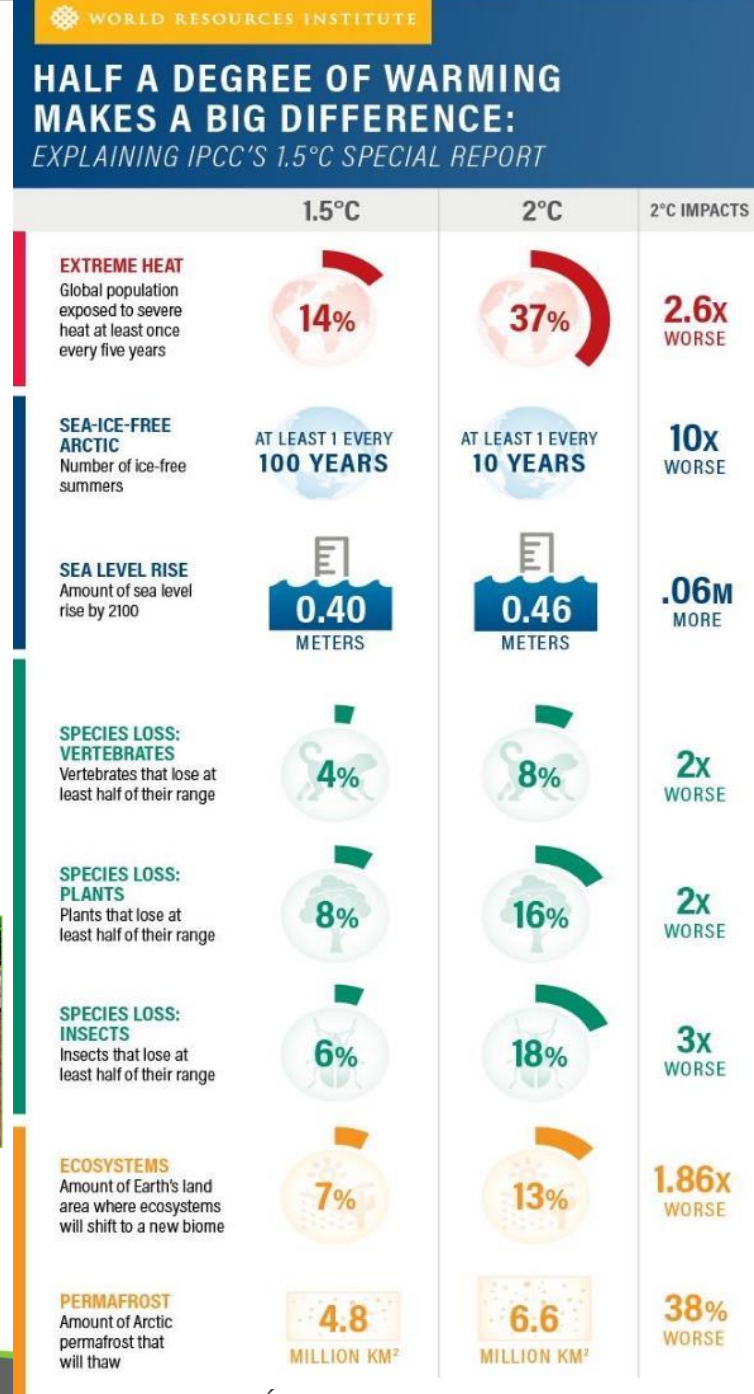
TEXMIN AIMS

The aim of the project is to **identify and assess the environmental impacts caused by both short-term extreme weather events and long-term climate change.**

The project is aimed at **assessing risks and hazards resulting from climate change** and **developing adaptation strategies for mining regions, especially post-mining areas.**

In the region, identified r**emedial actions for shafts and mining waste dumps have been also tested on a pilot scale.**





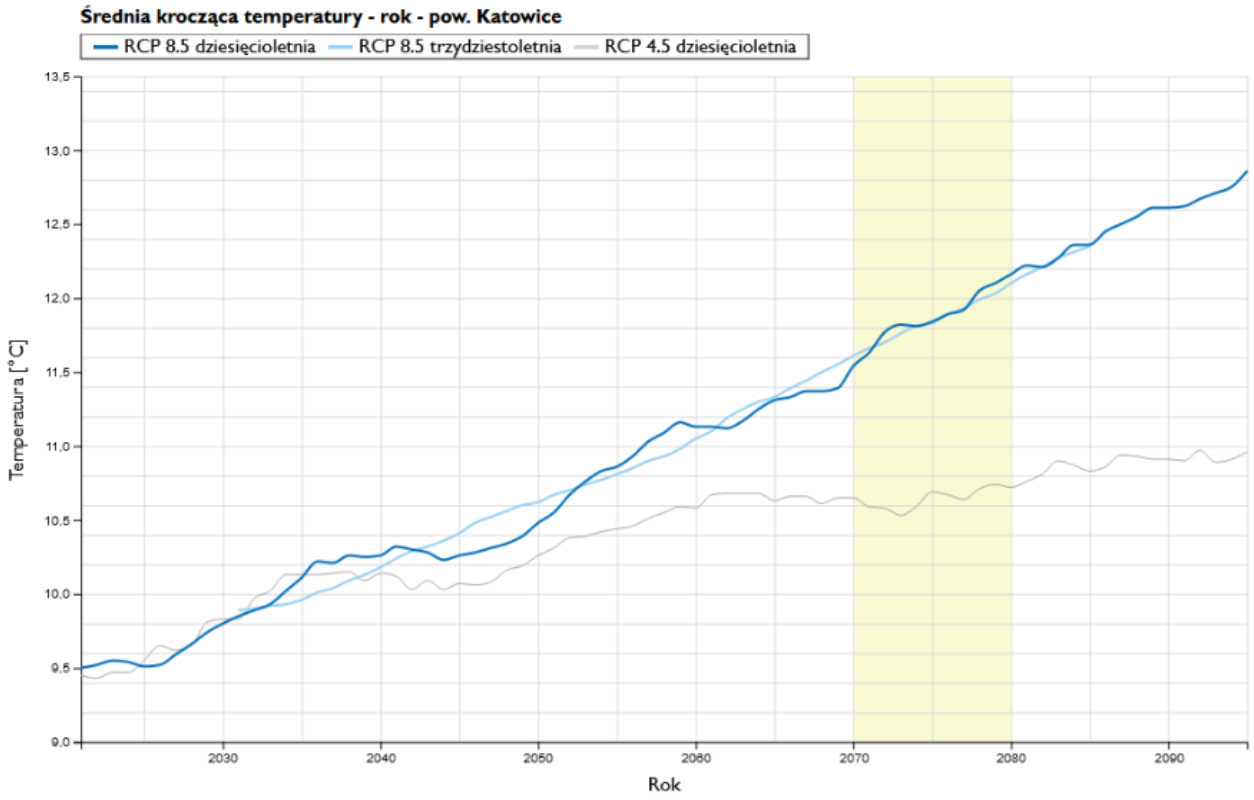
Źródło: https://wri.org.cn

BASIS: CLIMATE CHANGE SCENARIOS

RCP (Representative Concentration Pathways) Scenarios – scenarios of changes in carbon dioxide concentration, which were accepted by the Intergovernmental Panel on Climate Change (IPCC), were used as the basis for analyses.

The four scenarios RCP2.6, RCP4.5, RCP6 & RCP8.5. The values determine the estimated amount of radiative forcing by greenhouse gases in the year 2100 (2.6, 4.5, 6.0 i 8.5 W/m^2 respectively).

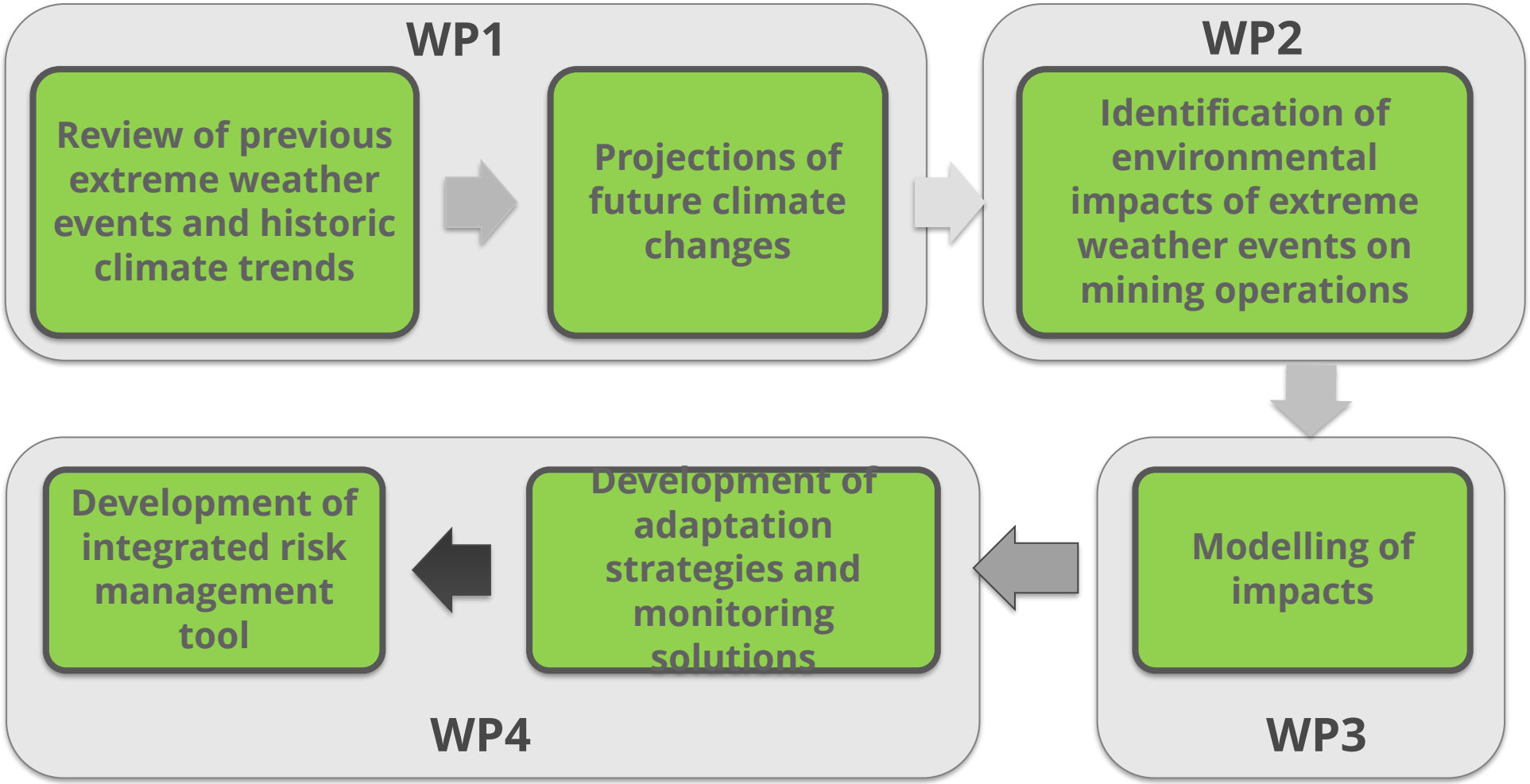
- It is currently 3 W/m^2 and depends on the greenhouse gas content of the atmosphere - 410 ppm CO2 in 2020.
- This translates into changes in temperature, precipitation and wind strength.
- According to RCP4.5, the average annual temperature in Poland will increase by 1.3 °C over the century.
- According to RCP8.5, the upward trend in annual average temperature is much stronger.



PROJECT LOGIC

The impact of EXtreme weather events on MINing operations

TEXMIN



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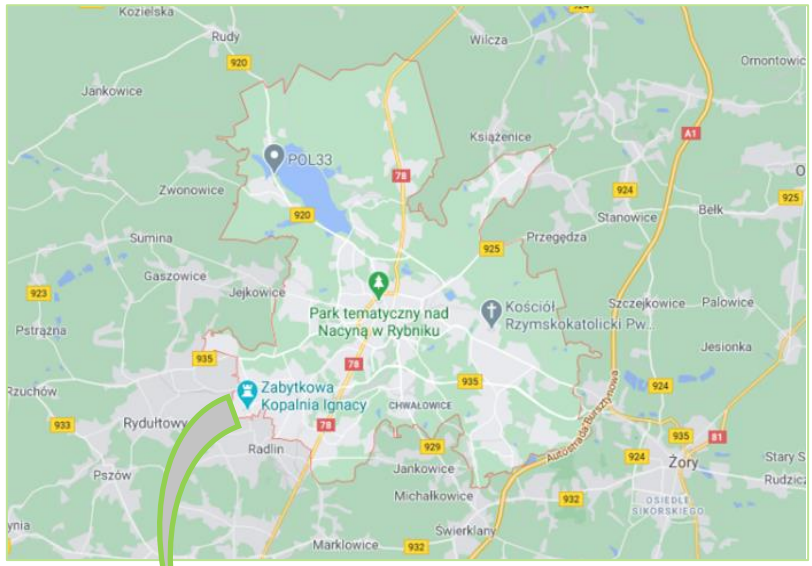
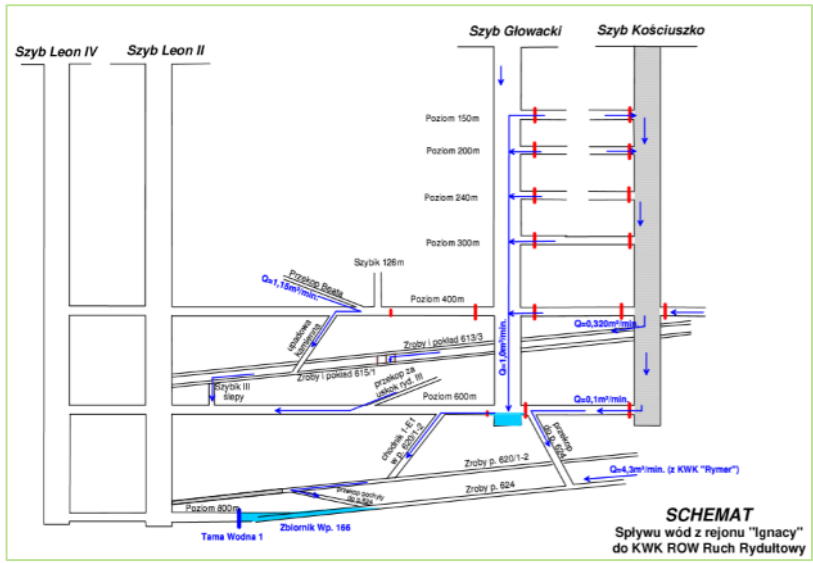
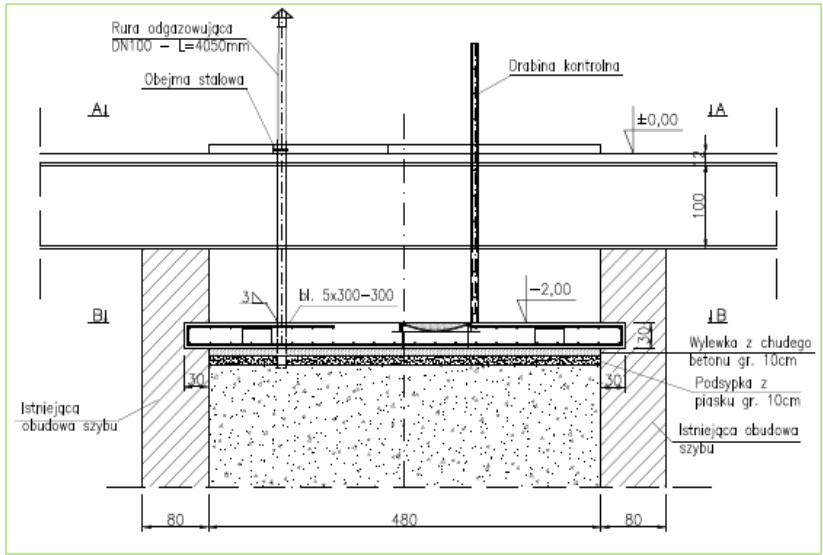
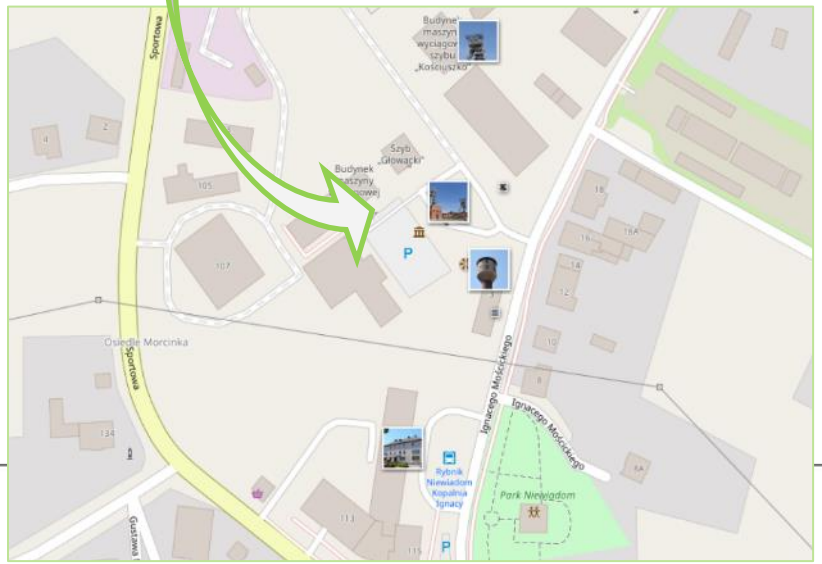
REGIONAL ACTIVITIES

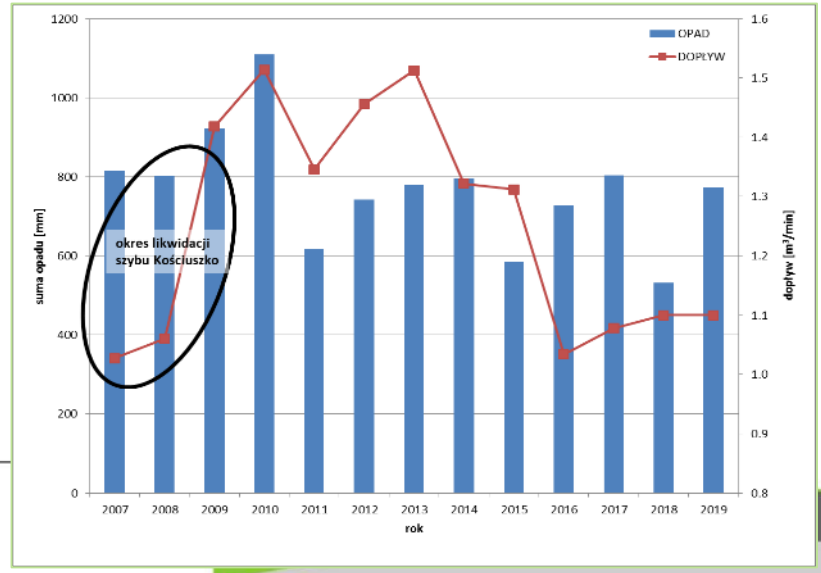
LIQUIDATION OF THE GŁOWACKI SHAFT - TECHNICAL PROJECT



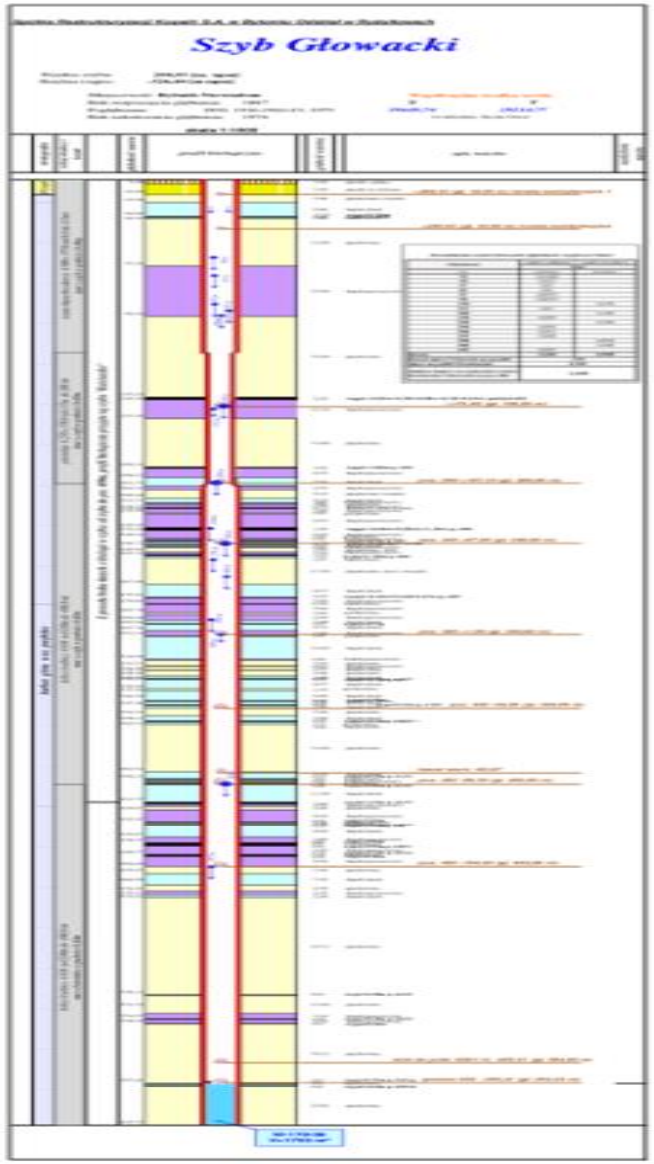








PILOT INSTALATION: THE REMEDIAL MEASURES FOR STABILIZATION OF SEALED SHAFT IN SITUATION OF EXTREME WEATHER EVENTS OCCURRENCE



ANALYSIS OF THE INFLUENCE OF EXTREME WEATHER EVENTS ON THE STABILITY OF POST-MINING DUMPS

The impact of EXtreme weather events on MINing operations

TEXMIN

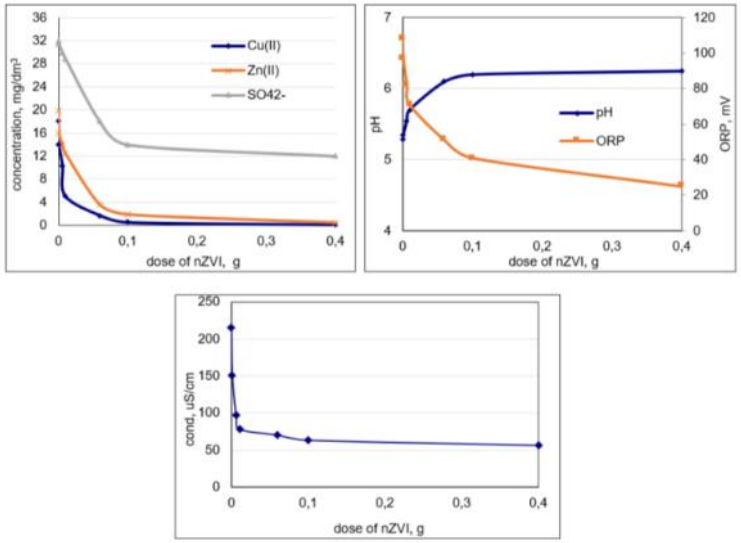
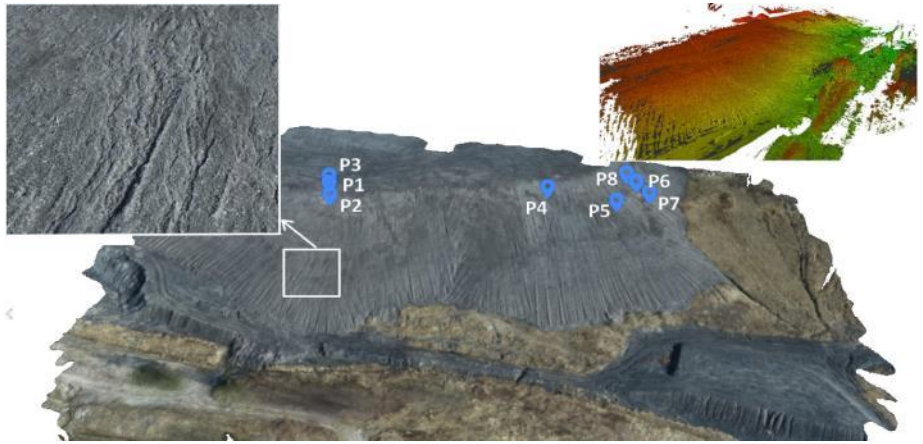
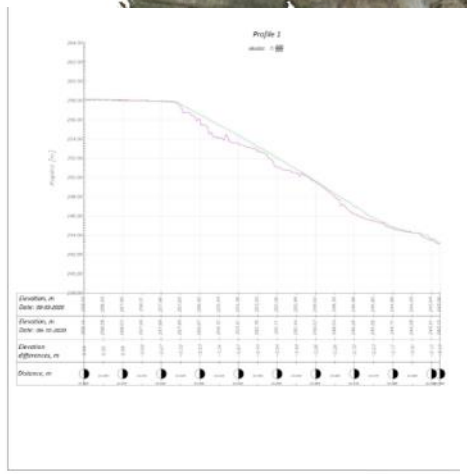


Fig. 2 Influence of nZVI doses on mine drainage chemistry





Hydrodynamic and hydrochemical model for evaluation and simulation of the impact of climate change on the quality and quantity of leachates from landfills and their impact on the aquatic environment (prepared by the Silesian University of Technology)

Analysis of heap erosion, laser scanning

GIG Instytut Badawczy

PILOT INSTALLATION

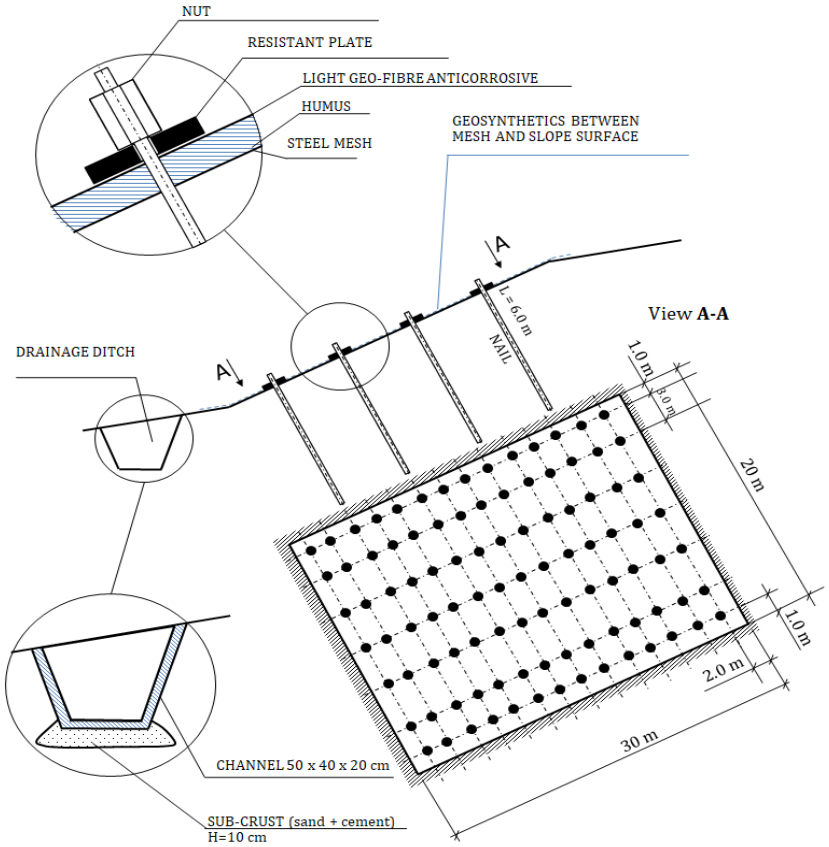
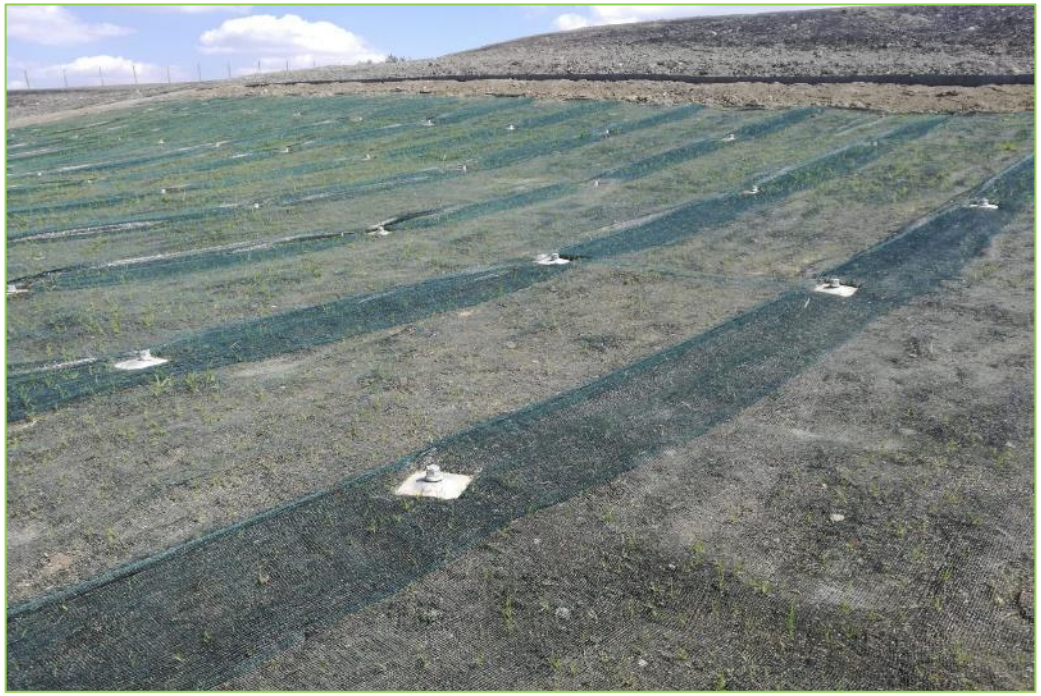


Diagram of the pilot installation - protection of the slope of the Janina mine tailings pile in Libiąż against the effects of extreme weather conditions (prepared by GIG)

Construction (TAURON Wydobycie i GIG)



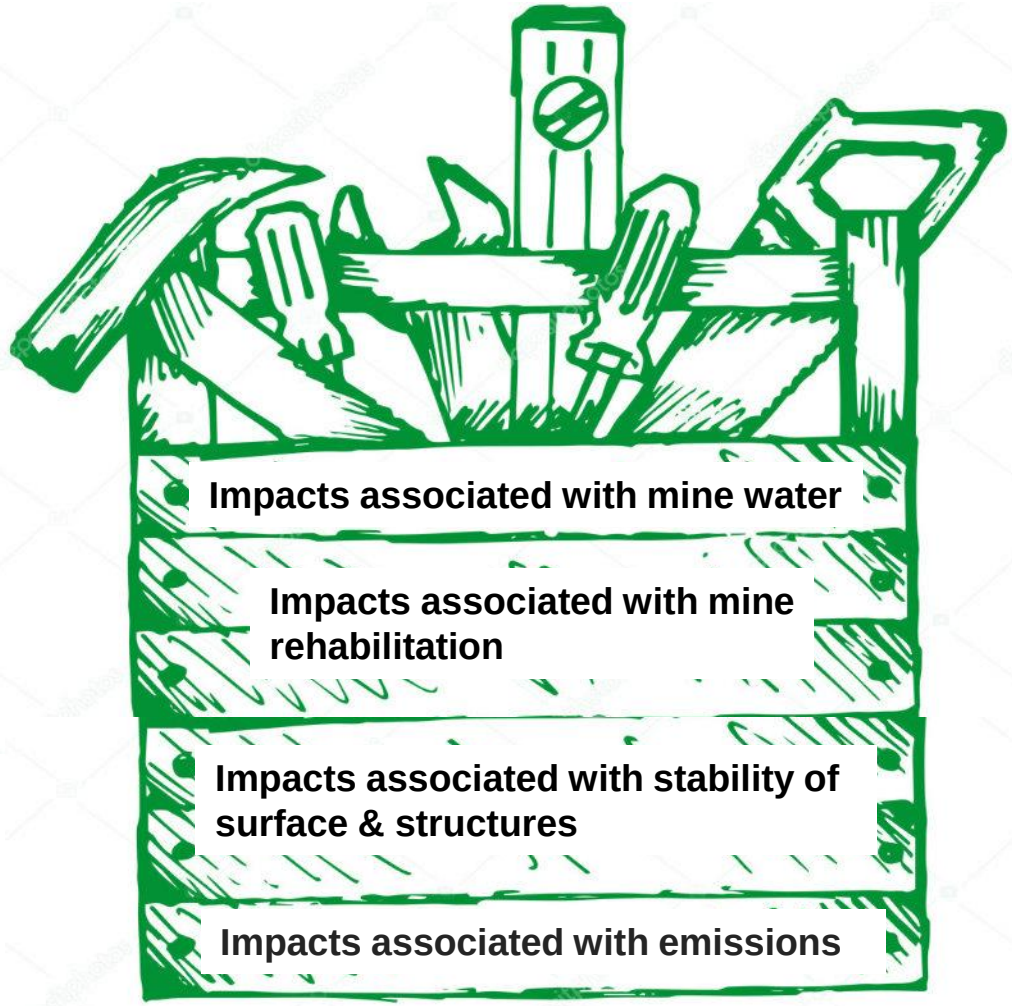
WP4 - RISK MITIGATION AND ADAPTATION TO CLIMATE CHANGE

Ongoing work includes:

Identification and prioritization of factors to be considered in risk reduction and climate change adaptation processes,

Development of short- and long-term strategies related to climate change mitigation and adaptation

Development of an integrated risk management tool



INTEGRATED RISK MANAGEMENT TOOL (PRODUCT)

enter data

basic / advanced:	HELP
→ advanced	←
Choose country:	HELP
→ Angola	←
Koppen-Geiger climate classification:	HELP
→ BWh	←
Direct / Non-direct climate variables:	
→ Direct	←
Specific type of object:	
→ Settling pond	←
Climate factor:	
→ Temperature	←
Hazard:	
→ incidence of malaria might increase	←
Risk:	
Risk:	IF Temperature is increasing THEN incidence of malaria might increase
Risk description:	Lorem ipsum dolor sit amet, consectetur adipiscing elit. Maecenas tortor nisi, ullamcorper sed mi ut, fringilla pharetra ligula. Proin turpis arcu, lobortis vitae ultrices quis, vestibulum id dui.
Perspective:	
→ 2030	←
1. Is the expected climate impacts related to heavy precipitation going to affect significantly the stability of the embankments?	
→ Yes	←
2. Is the settling pond construction exposed to strong winds?	
→ Yes	←
3. Is the low temperature going to impact the construction of the settling pond?	
→ No	←
4. Are the drought periods going to affect the construction of the settling pond?	
→ No	←

results

tool | V4.1 org | KÖPPEN-GEIGER | Koppen-ND-GAIN | ND-GAIN | KG List Country | Risk assessment survey SILNIK | ...

(P) \ (I)	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

SPECIFIC TYPE OF OBJECT	RISK	RISK EVALUATION				
		2022	2030	2040	2050	Consequence (1-5)
		Probability (1-5)	Probability (1-5)	Probability (1-5)	Probability (1-5)	
Working mine	IF Pressure drop intensity is increasing THEN increased emissions in CH4 and CO2 may be observed	3	3	3	3	3
Abandoned mine	IF Pressure drop intensity is increasing THEN increased emissions in CH4 and CO2 may be observed	3	3	3	3	4
Working mine	IF Temperature is increasing THEN accelerated gas emissions process may occurs	3	3	3	3	1
Abandoned mine	IF Temperature is increasing THEN accelerated gas emissions process may occurs	3	3	3	3	2
Working mine	IF Wind velocity is rising THEN the extension of the range of the zone with high gas concentration may occurs	3	3	3	3	2
Abandoned mine	IF Wind velocity is rising THEN the extension of the range of the zone with high gas concentration may occurs	3	3	3	3	2
Waste heap	IF Wind speed is increasing THEN increase in thermal activity, especially on the western slope of a dump may be observed	3	3	3	3	4

Mathematically calculated risk				Expression			
2022	2030	2040	2050	2022	2030	2040	2050
4	4	4	4	Low	Low	Low	Low
4	4	4	8	Low	Low	Low	Moderate
4	4	4	8	Low	Low	Low	Moderate
8	12	12	8	Moderate	High	High	Moderate
8	12	8	8	Moderate	High	Moderate	Moderate
8	12	8	8	Moderate	High	Moderate	Moderate
8	8	8	8	Moderate	Moderate	Moderate	Moderate
12	12	12	8	High	High	High	Moderate
12	12	12	8	High	High	High	Moderate
12	12	12	8	High	High	High	Moderate
12	12	12	8	High	High	High	Moderate

LESSONS LEARNT - RECOMMENDATIONS

- **To raise awareness among the public, including the industry/mining sector, of the interrelationship between climate and operations and the effects on quality of life.**

- **Increasing the awareness of regional decision makers to take into account in adaptation plans the need to protect post-mining facilities / mining activities:**
- **1)** cultural heritage,
- 2) environmental needs,
- 3) overlapping of impacts due to climate change and transition of coal regions

–> **further action is needed at multiple levels (administrative, legal, social, etc.).**

Sztola river in Bukowno (cessation of pumping of mine water vs drought

MORE INFORMATION…

The impact of EXtreme weather events on MINing operations

TEXMIN

HOME ABOUT PROJECT ACTIVITIES CONTACT US PROJECT PARTNERS

News & Events

TEXMIN project entitled "The impact of EXtreme weather events on MINing operations" is a three-years RFCS research project, interdisciplinary consortium of 9 institutions from 6 countries, ie. the UK, Greece, Spain, Germany, Czech Republic and Poland, focused minimising the environmental impact of extreme weather events on mining operations.

The duration of project realization: **01.06.2019 – 31.05.2022.**

Floods in Western Europe are more likely

31/08/2021

Extreme rainfall events caused by climate change are more likely to happen. The article showed that more than 400 studies have examined whether climate change made particular weather events more likely.

Read more here

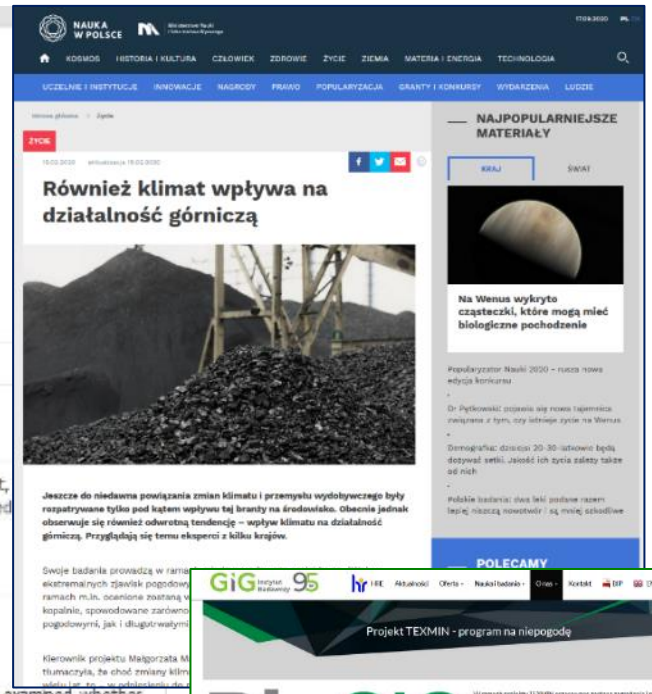
The first part of the IPCC 6th Assesment Report released

10/08/2021

The Sixth Assessment Report, Climate Change 2021: The Physical Science Basis was released on the 9 of August 2021. It was finalized on 6 August 2021 during the 14th Session of Working Group I. The reports integrates changes in the climate in every region in the Earth. It delivers new estimates of the global warming in the next decades and proves that human have a chance to determine the future course of climate.

Read more on www.ipcc.ch

The full report is available here



www.texmin.gig.eu

EFFICIENT USE OF MINE WATER

- EXAMPLES OF RESEARCH AND WORK CONDUCTED BY GIG

Ewa Janson

Central Mining Institute (GIG)

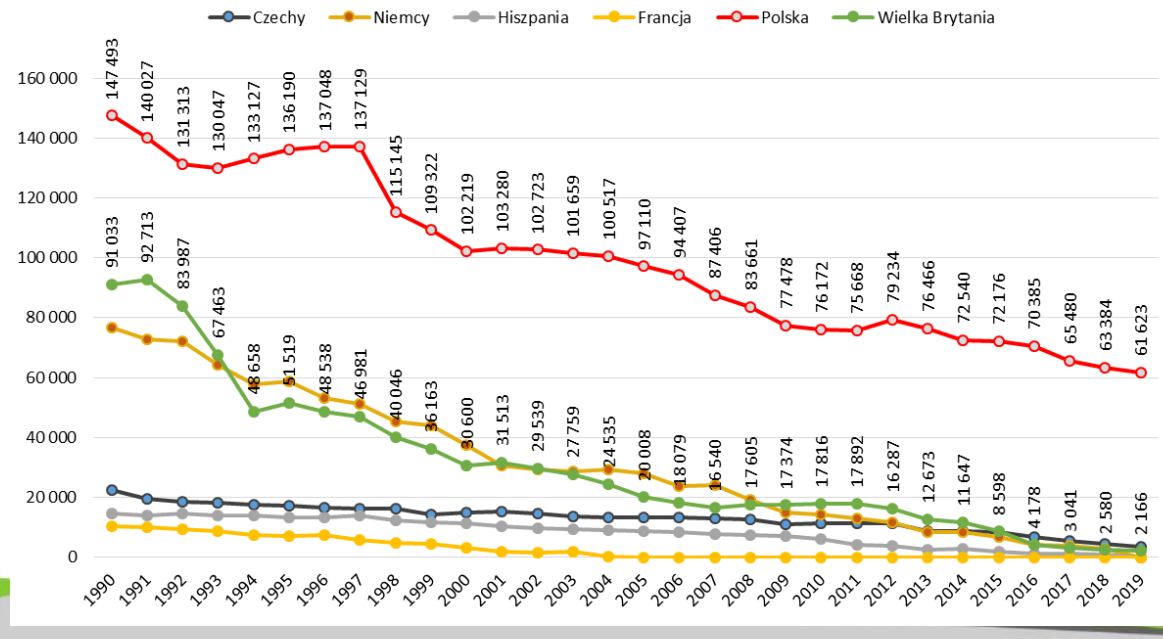
HR EXCELLENCE IN RESEARCH

Katowice, GIG, 13.07.2022

UPPER SILESIAN COAL BASIN - 200 YEARS OF MINING INFLUENCE

- Hard coal had been mined from the surface here since about 1540, and the first underground mine, Murcki, began working in about 1750.
- By the end of 1980' Poland's hard coal production was the highest in history, reaching about 180 million tons in 65 mining areas.
- Since 1990, so since the beginning of the transformation of the mining sector in Poland, of the 65 mines, active mining sites account for 30% - mining continues at 22 sites. Coal mining has been steadily declining and currently stands at about 50 million tons of coal per year.

- Associated with coal mining is the dewatering of coal deposits, and the water from this process is discharged into the aquatic environment.
- The decrease in coal mining has not significantly reduced the amount of mine water discharged into the environment - this is due, among other things, to the existing hydraulic connections between mines (active and decommissioned) and the need to drain the workings of decommissioned mines.

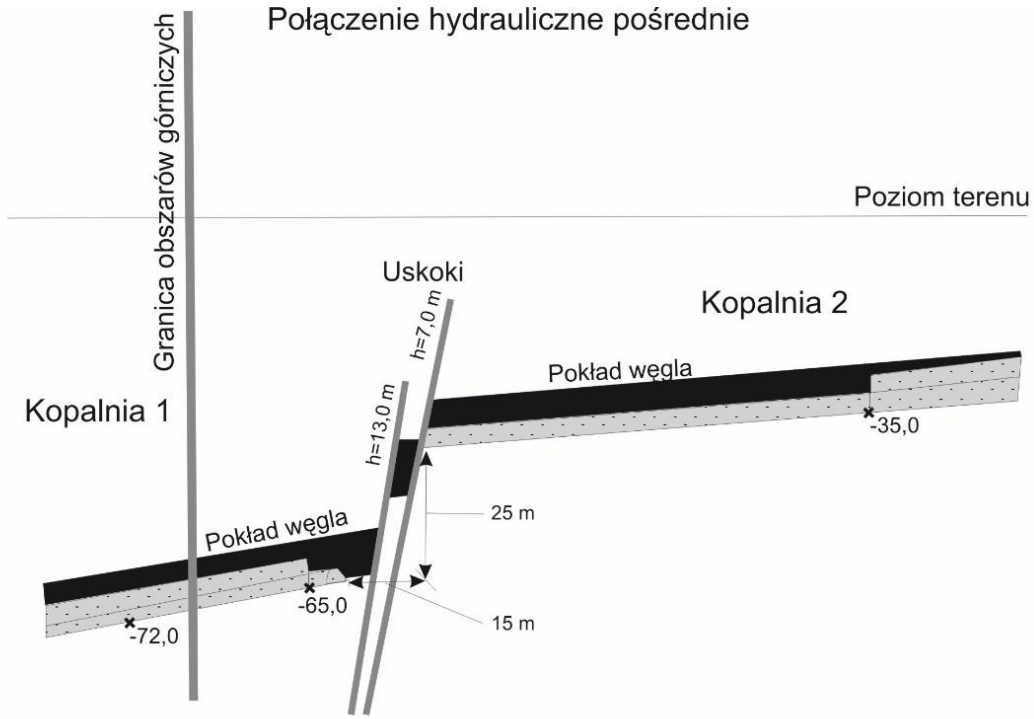


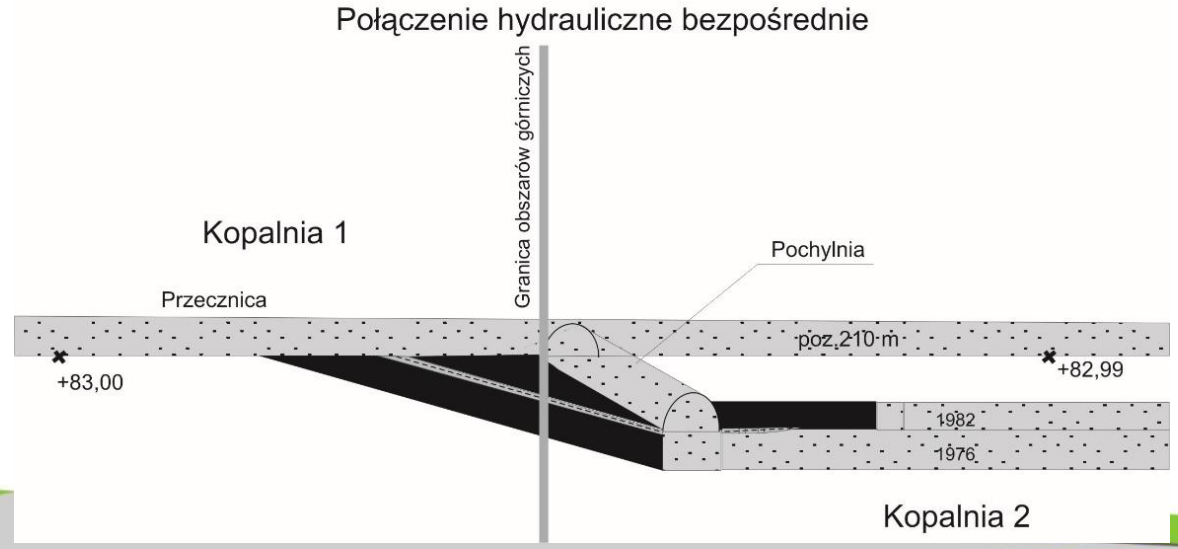
Source of the picture: https://www.locja.pl/raport-rynkowy/produkcja-i-zuzycie-wegla-w-polsce-i-unii-europejskiej,200

DEWATERING OF MINES

1. It is implemented because of the hydraulic connections between mines (active and decommissioned), as it's necessary to protect active mining (under a license) from water hazards from a decommissioned mine.

2. In the process of transformation of the mining sector in Poland, it has become necessary to establish an entity responsible for the implementation of mining restructuring activities, including the maintenance of drainage systems (a separate entity SRK S.A.).





ENVIRONMENTAL PROBLEMS CONNECTED WITH MINE WATER

Wentylacja kopalni
CO_2 i O_2

Eksploatacja górnicza
odwadnianie górotworu
warunki utleniające

Utlenienie pirytu
wytrącenie
produktów utlenienia

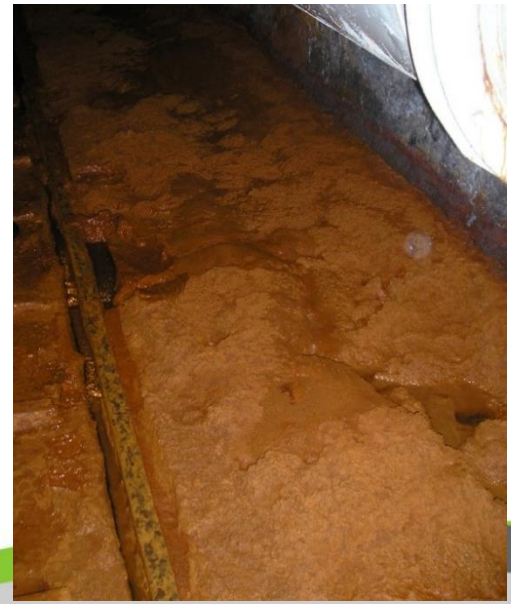
Likwidacja kopalni
zaprzestanie odwadniania
podniesienie poziomu
zwierciadła
wody podziemnej

Hydroliza produktów utlenienia
rozpuszczanie węglanów
zmiana pH

Wzrost zawartości
siarczanów, żelaza
oraz manganu
i zawiesiny ogólnej
w wodach

Dopływ wód

Dopływ wód

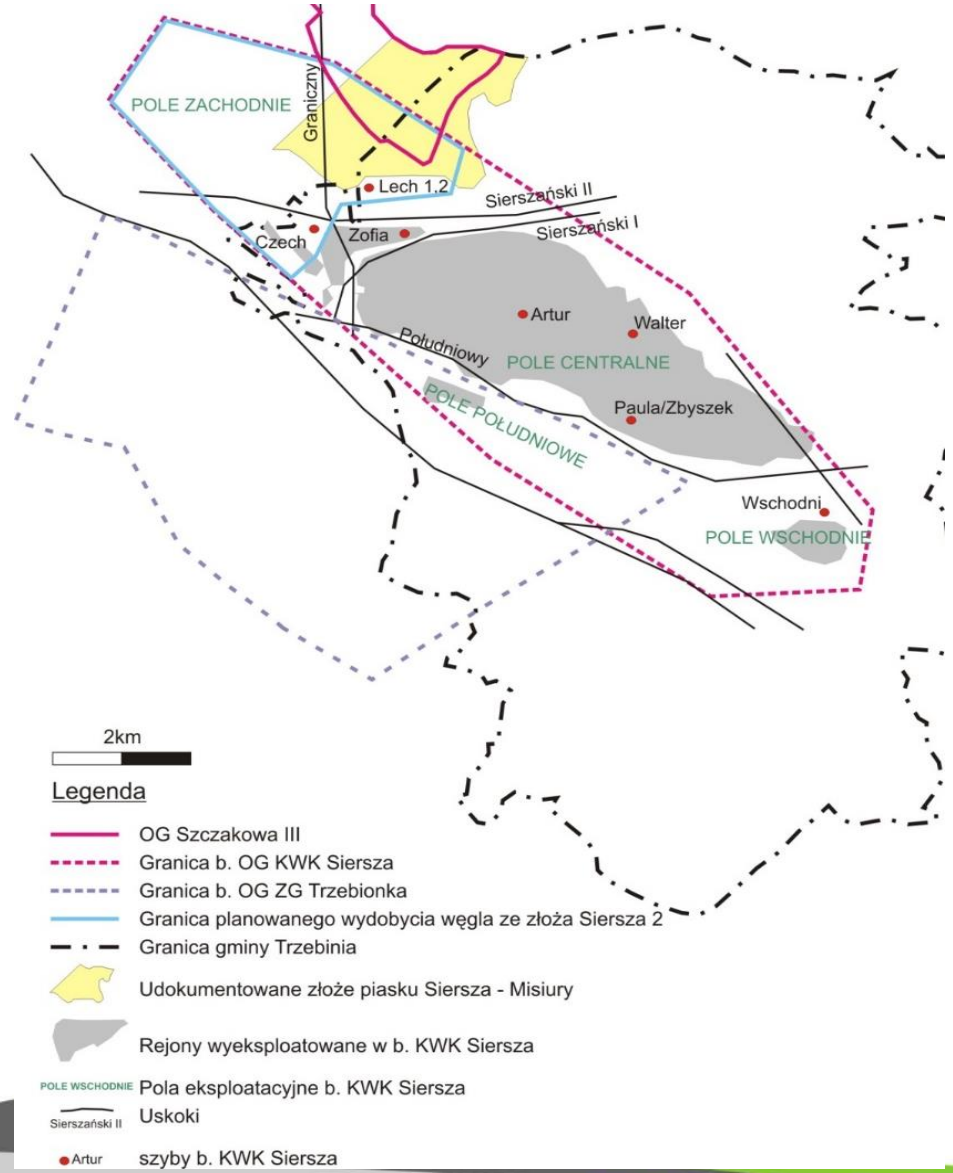


CHANGES IN WATER RELATIONS AFTER MINE DECOMMISSIONING - MONITORING

As a result of the transformation of the mining sector and the decommissioning of mines, and the resulting sinking of mines, it is necessary to conduct monitoring of water relations on the surface.
This monitoring, in the case of an isolated and sunken mine, lasts continuously for 20 years, including a number of field works:

- measurements of flows in watercourses in the area of the former mine,
- measurements of the water table in piezometers and wells,
- observations of the area from the point of view of the appearance of self-flowing waters.

The obligation of monitoring is specified in the legislation, is carried out by SRK S.A., taking into account the facilities on the surface.



ECONOMIC POTENTIAL OF MINE WATERS

- **Mine water after mine decommissioning is a potential source of water for public supply, industry, heat and cooling recovery, and can be used for energy.**

- **In Poland's Upper Silesian Coal Basin, solutions are being sought and implemented to utilize the infrastructure of decommissioned mines and related resources, including the use of water and reducing pressure on the environment.**

MINE WATER MANAGEMENT

MANAGER project - Management of mine water discharges to mitigate environmental risks for post-mining period

Project carried out in an international consortium (Germany, Spain, France, UK, Greece, Poland).
Funded by the Research Coal and Steel Fund (RFCS).
Implementation period: 2013-2016

Report available on:
https://op.europa.eu/en/publication-detail/-/publication/f7550c73-9c46-11e8-a408-01aa75ed71a1

GIG team has developed principles and technology to reduce the negative impact of mine water on the environment

Implemented technology to neutralize acidic surface runoff water at Tauron Mining ZG Janina

HEAT RECOVERY FROM MINE WATER

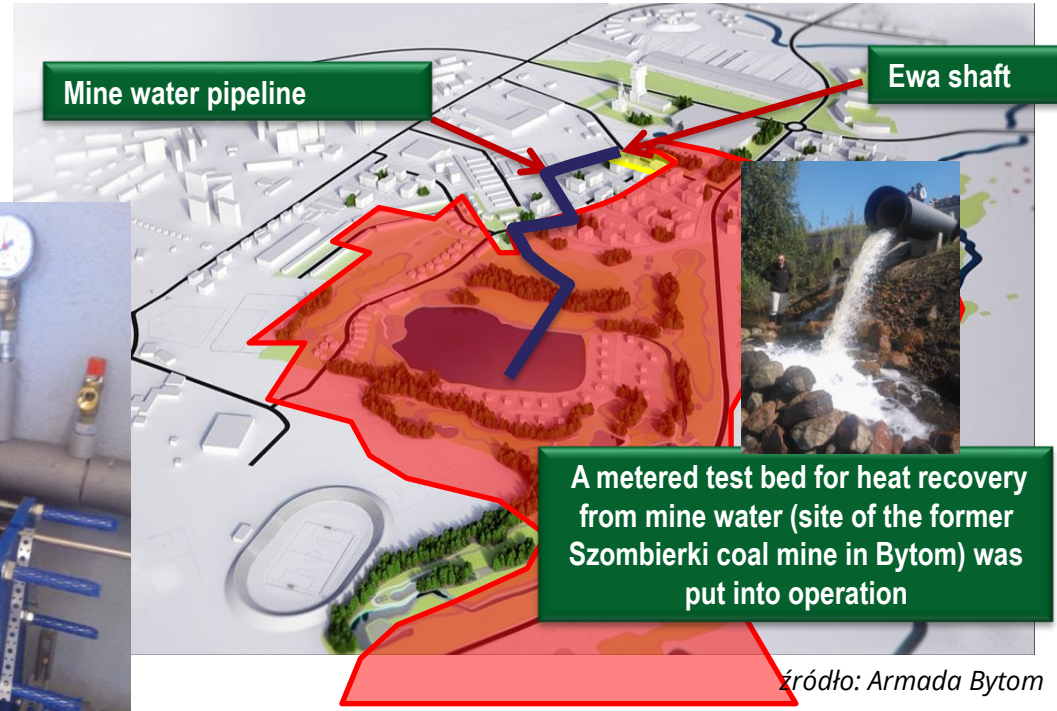
LOw Carbon After Life: LOCAL sustainable use of flooded coal mine voids as a thermal energy source - a baseline activity for minimising post-closure enviromental risks

Research Fund for Coal & Steel

Project carried out in an international consortium (Poland, Spain and UK).
Funded by the Research Coal and Steel Fund (RFCS).
Implementation period: 2014-2017

Information, report and tools available here:
http://local.gig.eu/index.php/results

Solutions and technologies for a low-carbon economy - implementations in the public service and business sector



źródło: Armada Bytom

The amount of water pumped out of the "Ewa" shaft is 5 m³/min (83 L/s) with an outlet temperature of 24 to 28°C

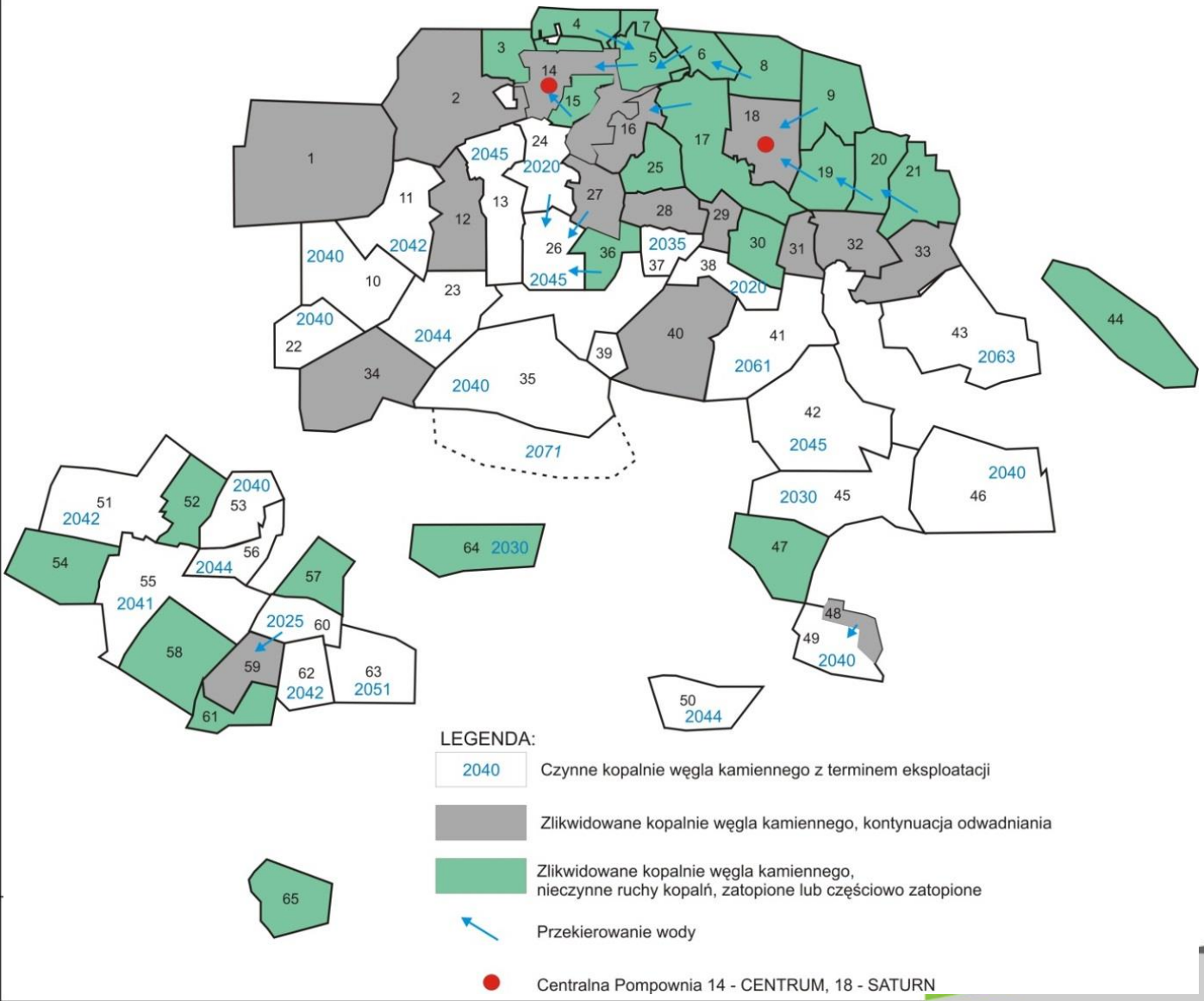
GIG Instytut Badawczy

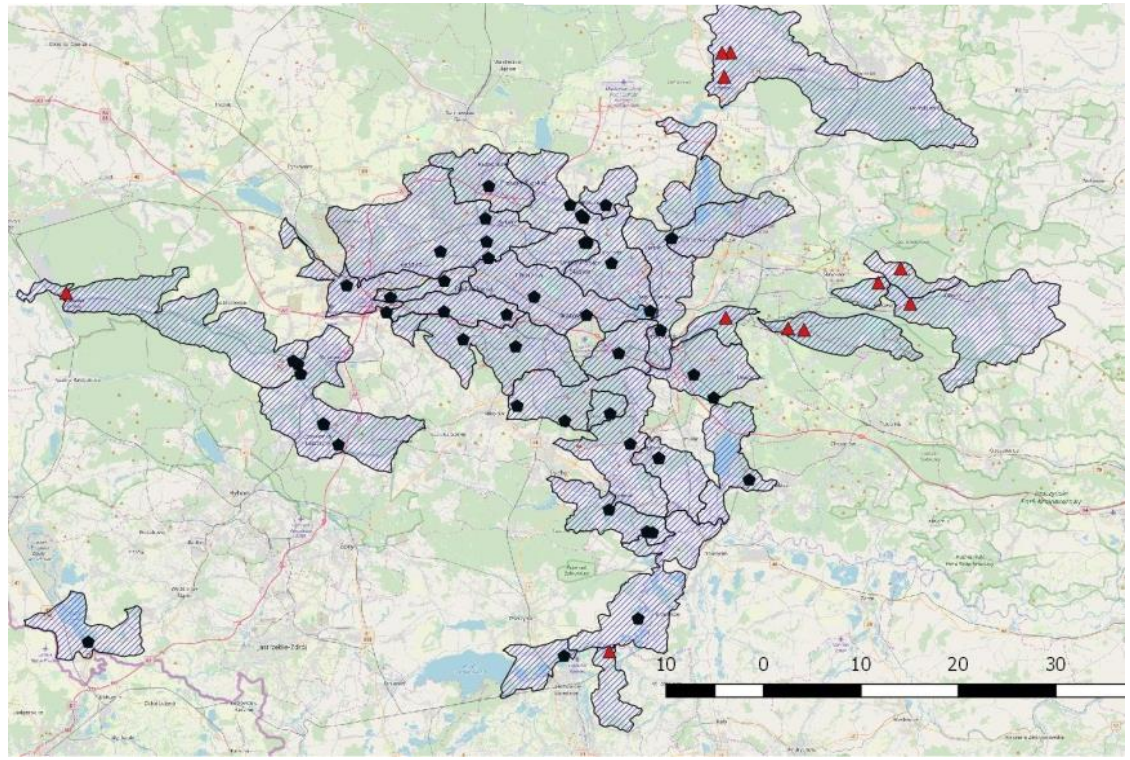
CONSEQUENCES OF MINING PLANT DECOMMISSIONING

Analysis of the hydrological and economic consequences of discontinuing or diverting the drainage of mine facilities.

Państwowe Gospodarstwo Wodne **Wody Polskie**

Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej



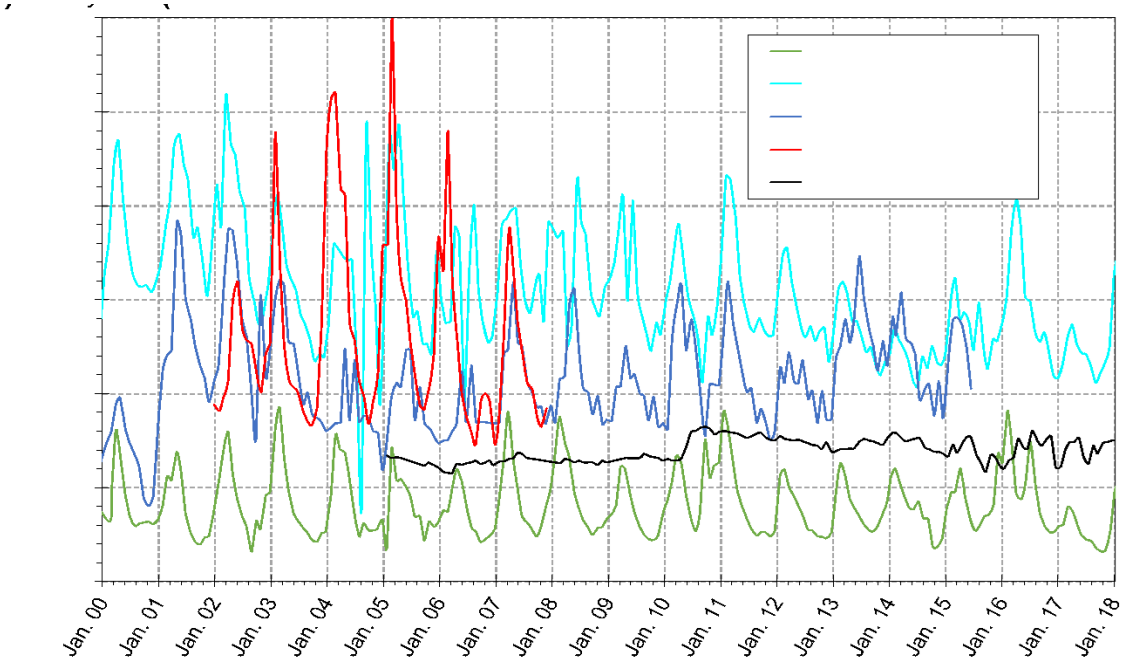


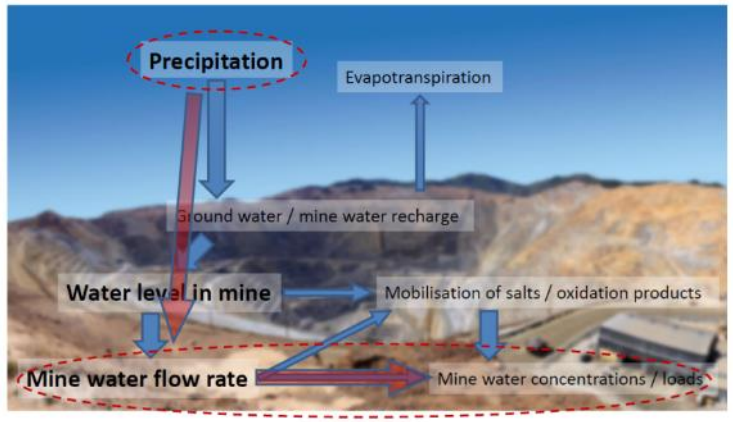
Instytut Badawczy

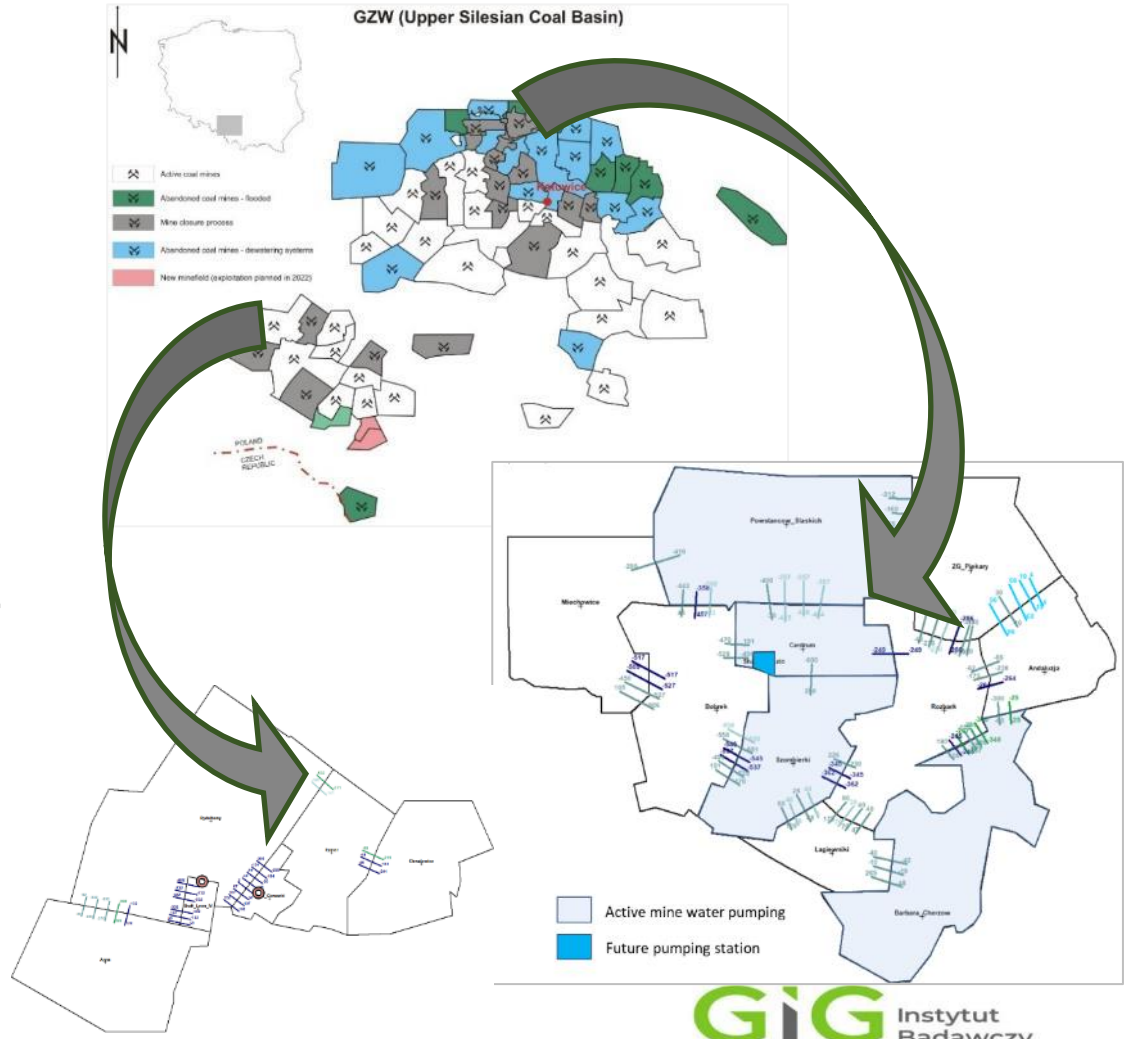
ANALYSIS AND MODELING OF CHANGES IN MINE WATER CHEMISTRY AND QUANTITY

The impact of EXtreme weather events on MINing operations

TEXMIN







GIG Instytut Badawczy

Thank you for you attention

Contact:

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mmarkowska@gig.eu

GIG Instytut Badawczy