Methane to Go Poland recap:

TDLAS device usage to measure methane concentration in ventilation shafts

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This research has been funded in the framework of UNEP's International Methane Emissions Observatory (IMEO).

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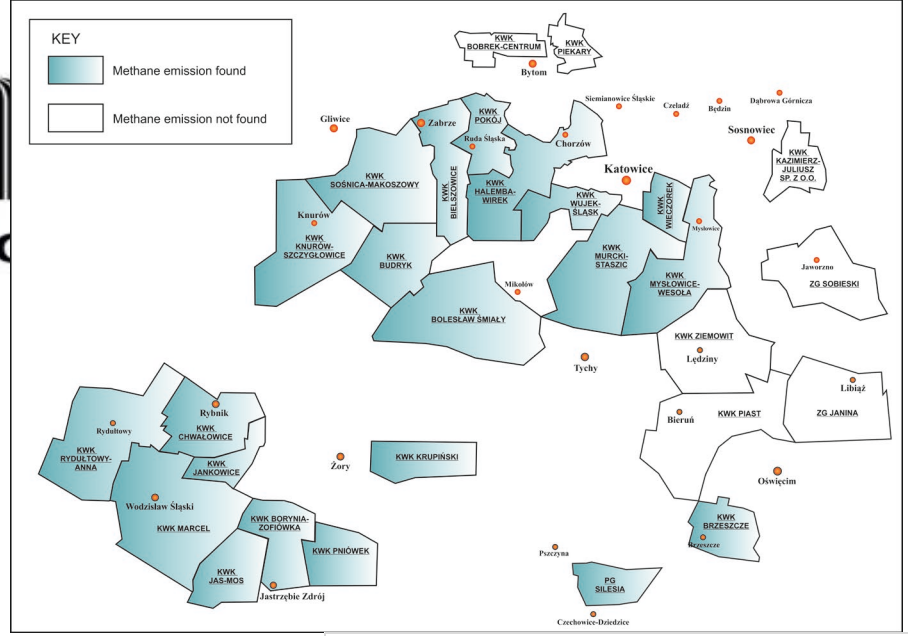
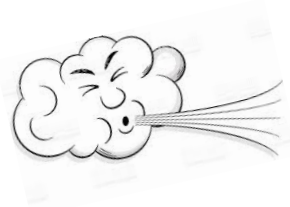


The Polish global underground mining sector in the period from 2015 to 2022 emitted 0.49 Mt of methane per year on the average.

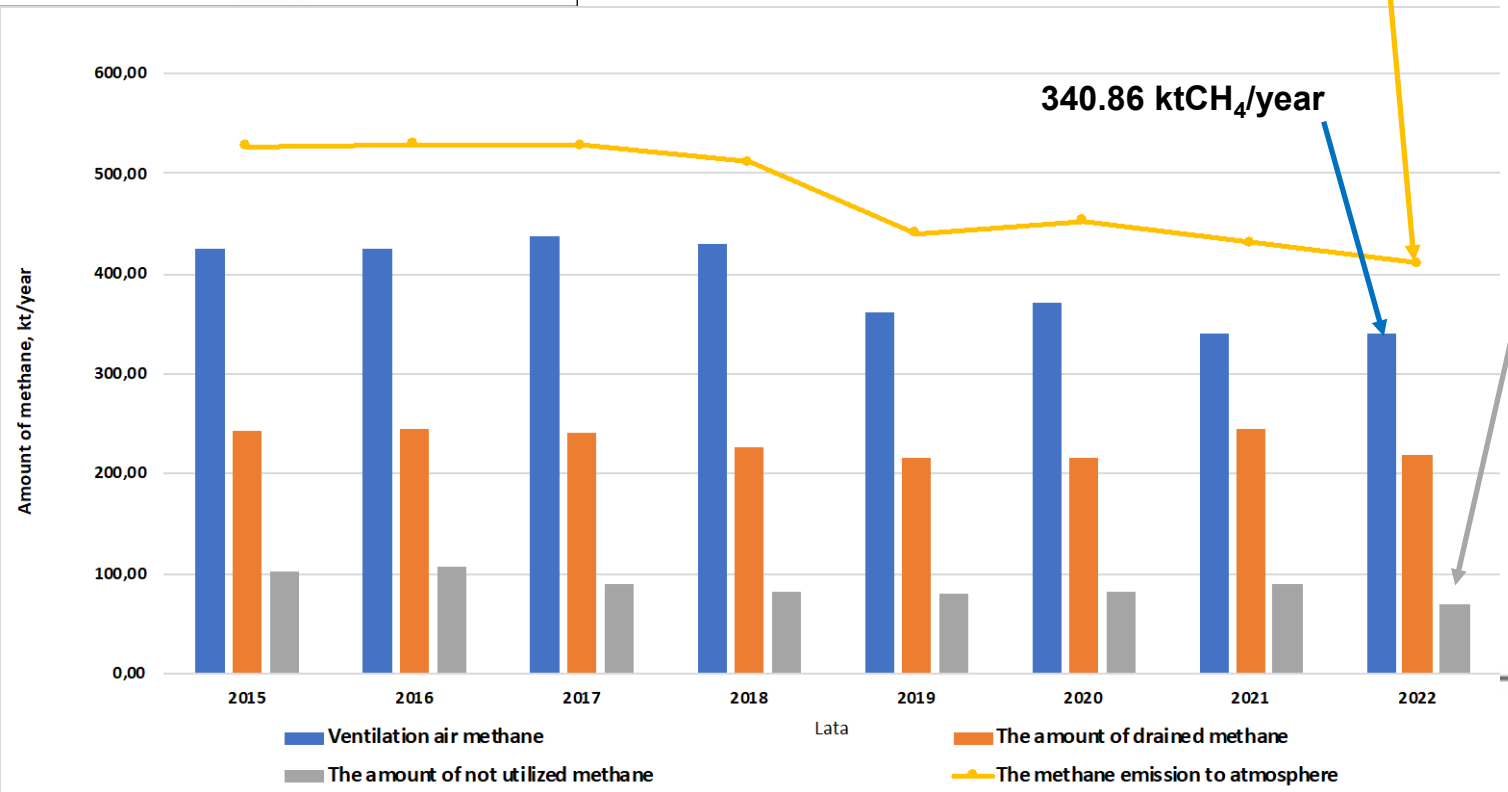


410.70 ktCH$_4$/year

69.84 ktCH$_4$/year

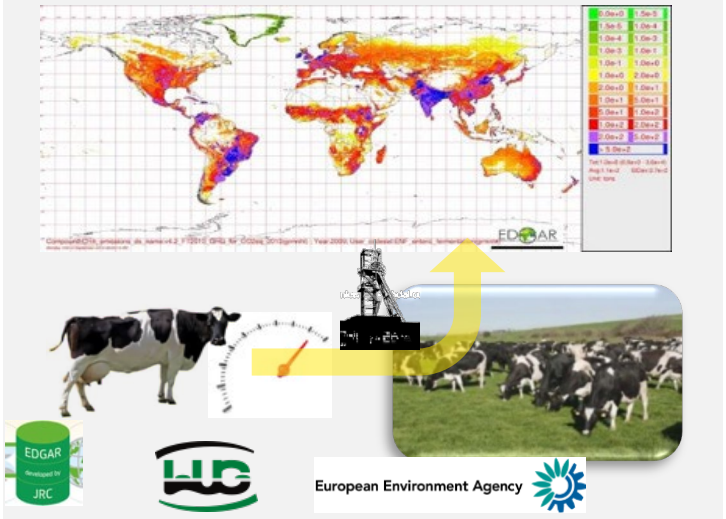
340.86 ktCH$_4$/year

Upper Silesian Coal Basin as the biggest hard coal mine region in EU



Two ways to estimate greenhouse gas emissions

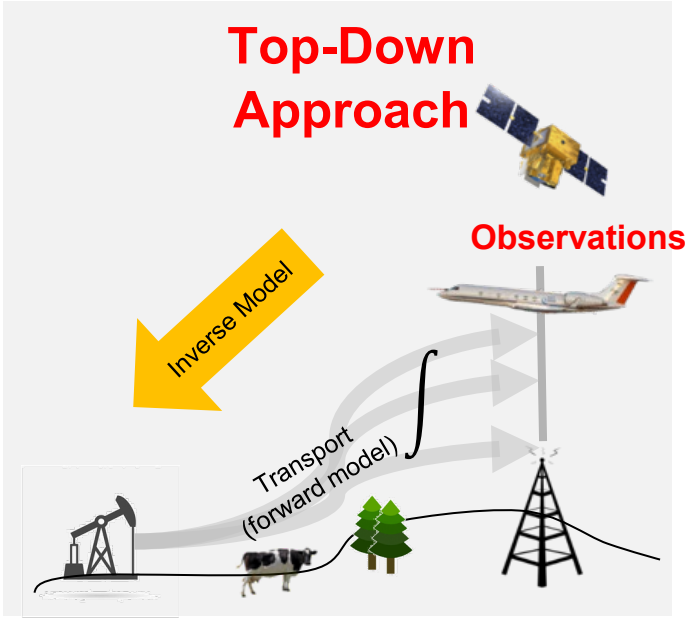
Bottom-Up Approach



In-situ measurements in coal mines and information form available databases.

Esta ishing a protoc for comparing CMM emissions estimated by TD and BU methods.

Top-Down Approach



Results of ground base, aerial and satellite observations

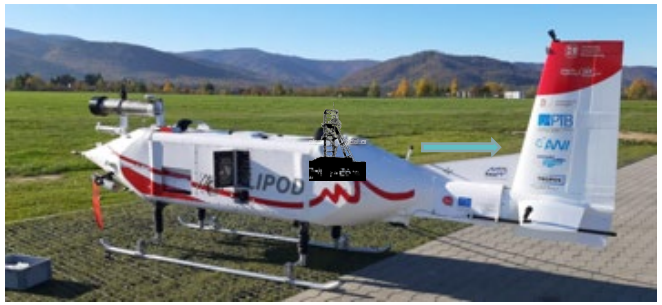
Methane to Go Poland

The project is conducted in the context of UNEP's **International Methane Emission Observatory**'s Methane Science Studies, which aim to improve the understanding of methane emissions globally.

The goal of the studies is to address the critical lack of methane emissions measurement data and
establish a protocol for comparing coal mine methane (CMM) emissions estimated by top-down (TD) and BU approaches .

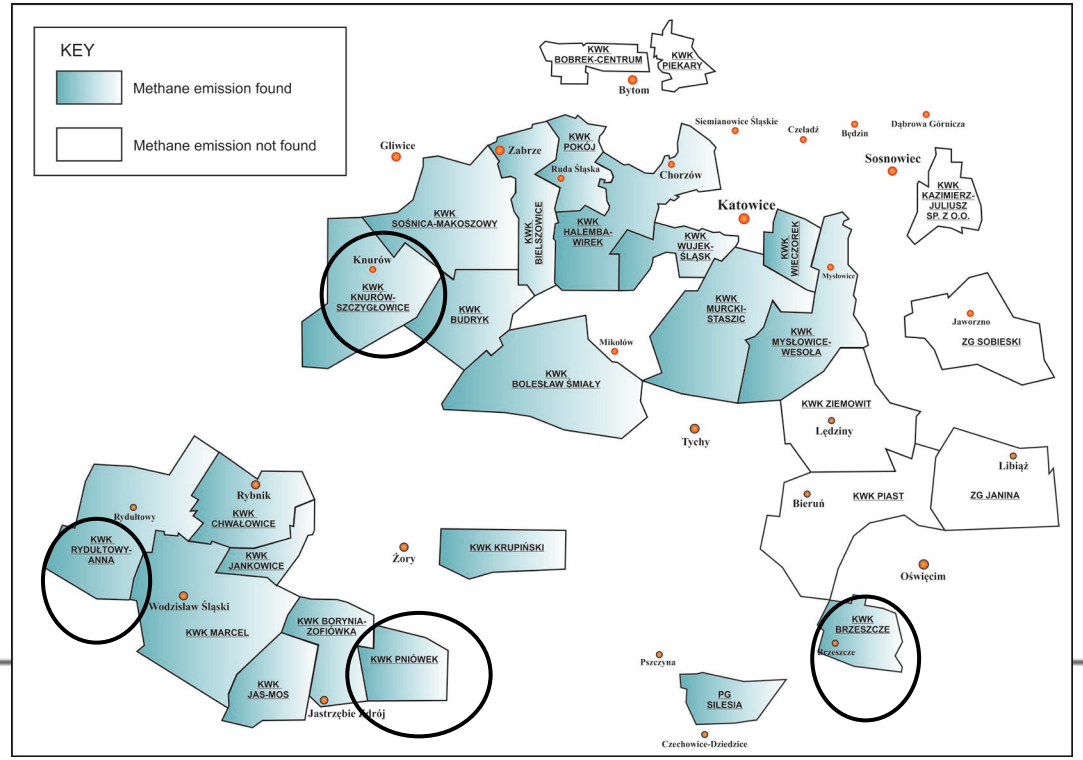
Obtaining data for results' validation was possible thanks to the cooperation **with JSW S.A. and PGG S.A.**

Methane to Go Poland
HELiPOD (DRL)

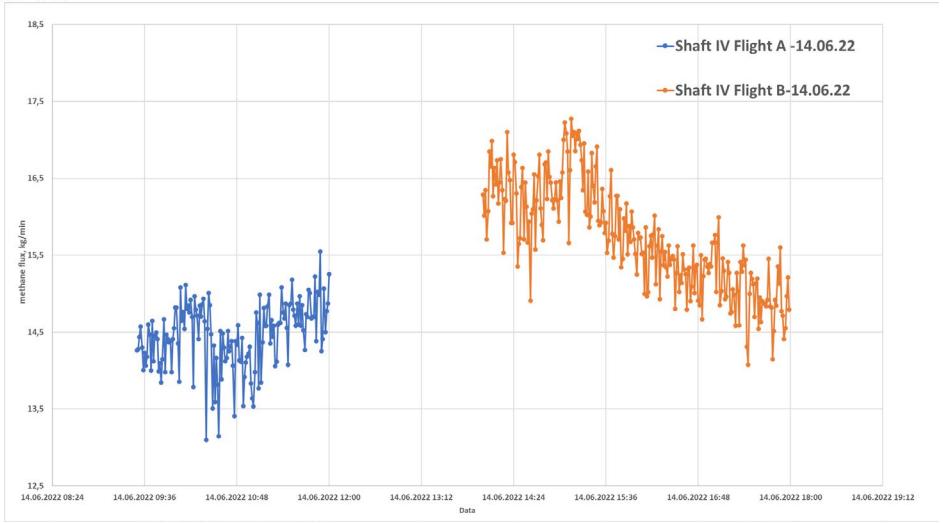


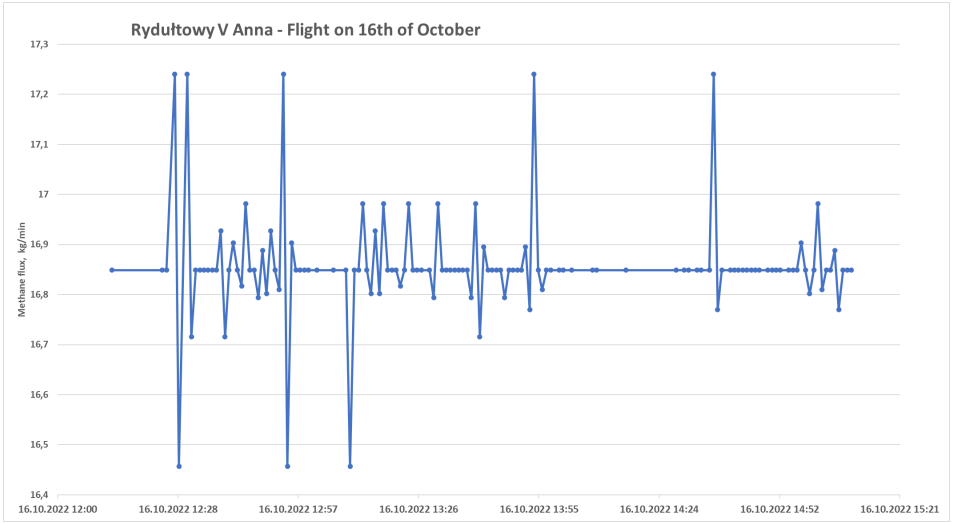
June 2022
October 2022

Targets:
4 shafts in



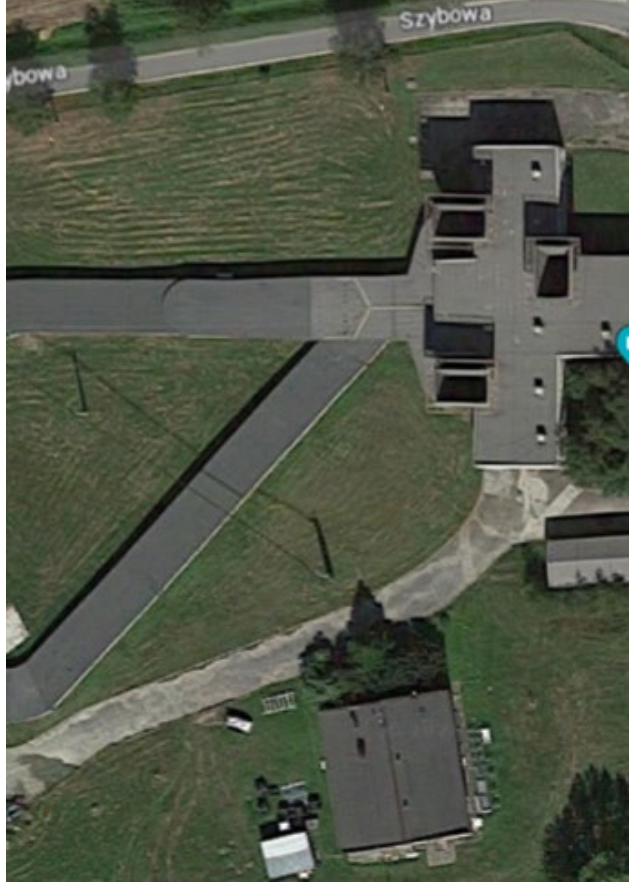
Methane to Go Poland
HELiPOD (DRL)





flight	HELiPOD mean flux [kg/h]	HELiPOD $RMSE_H$ [%]	wind conditions	vertical coverage	Industry* mean flux [kg/h]	Industry* $RMSE_I$ [%]
F03	1180	18			865	3
F04	745	5			937	3
F06	968	19			1005	5
F07	1926	58			982	5
F08	2528	43			-	
F10	1027	8			-	
F12	1172	68			-	
F04	1610	45			-	
F09	2713	26			1335	13
F13	987	73			941	
F03	3062	23			2019	1
F05	2993	5			2393	6
F06	997	29			1012	1
F07	856	51			1012	1

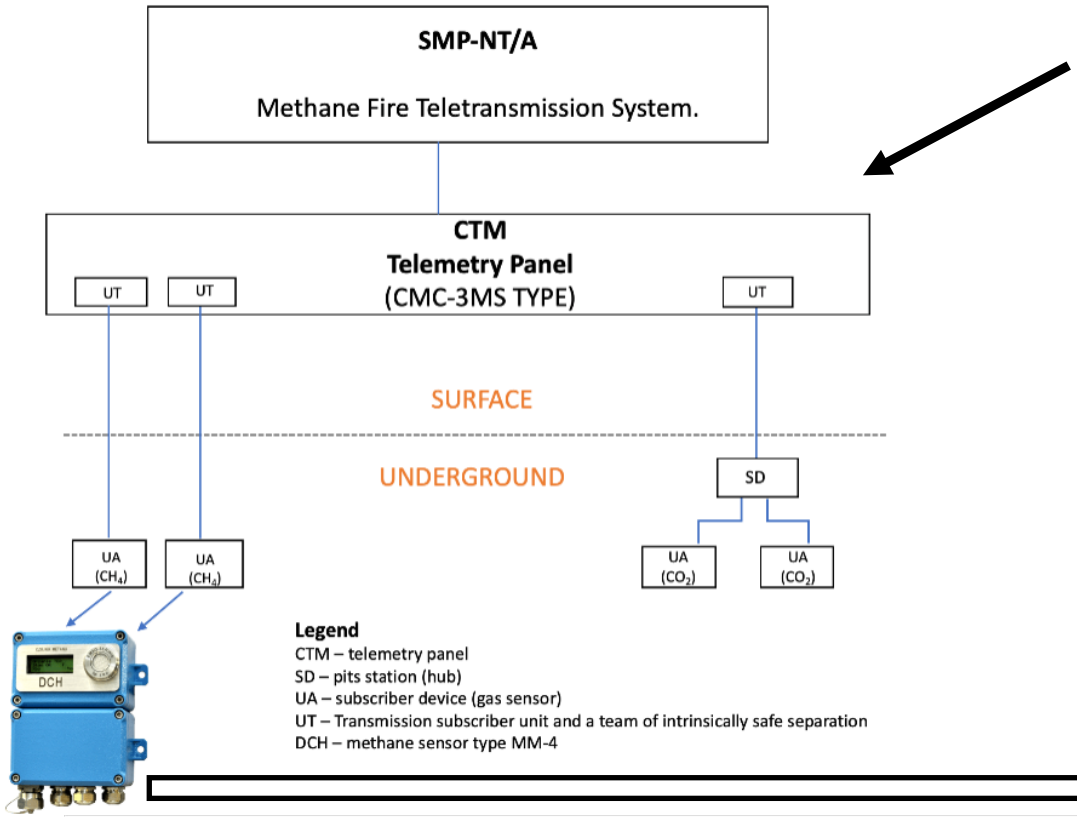
good conditions | not optimal conditions | poor conditions

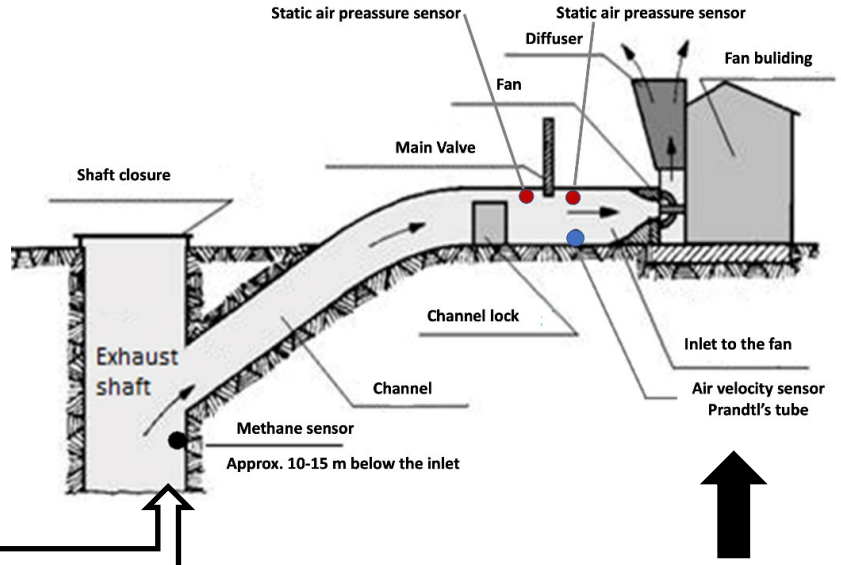


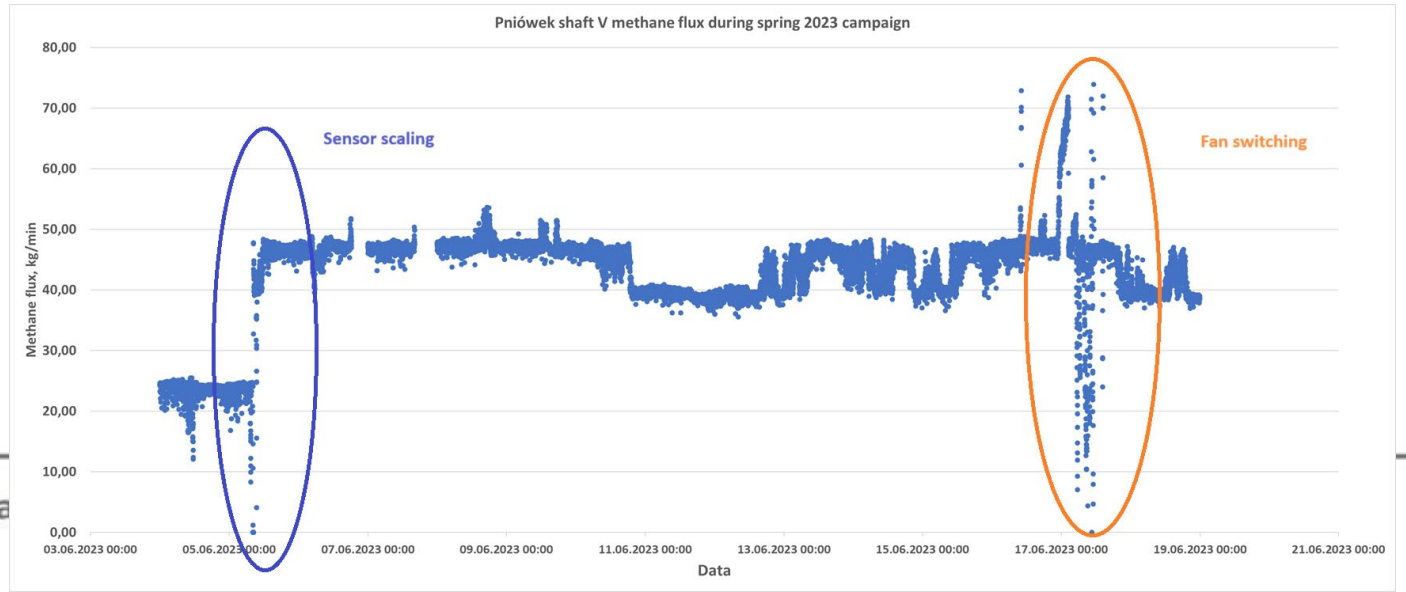
Methane to Go Poland
June 2023 campaign

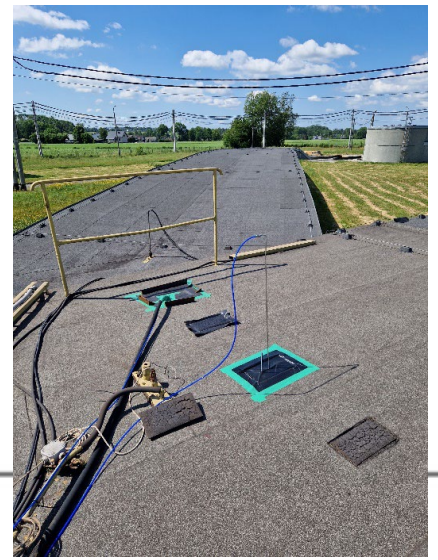
UN environment programme

Coal mine methane measurements









Short uncertainty calculation

$$CH_4(t_i) = C(t_i)\text{Flow\_rate}(t_i)$$

» If, $C(t_i)$=0.3%, $F\_r(t_i)$=10000m^3/min

and u(C)=0.1% and u(F_r)=100m^3/min

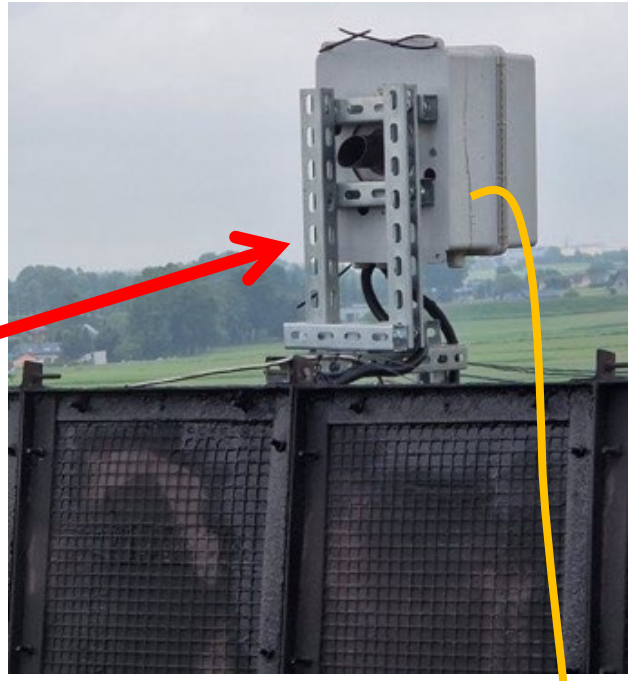
then:

$CH_4(t_i)$=30m^3/min , $u(CH_4(t_i))$=10m^3/min

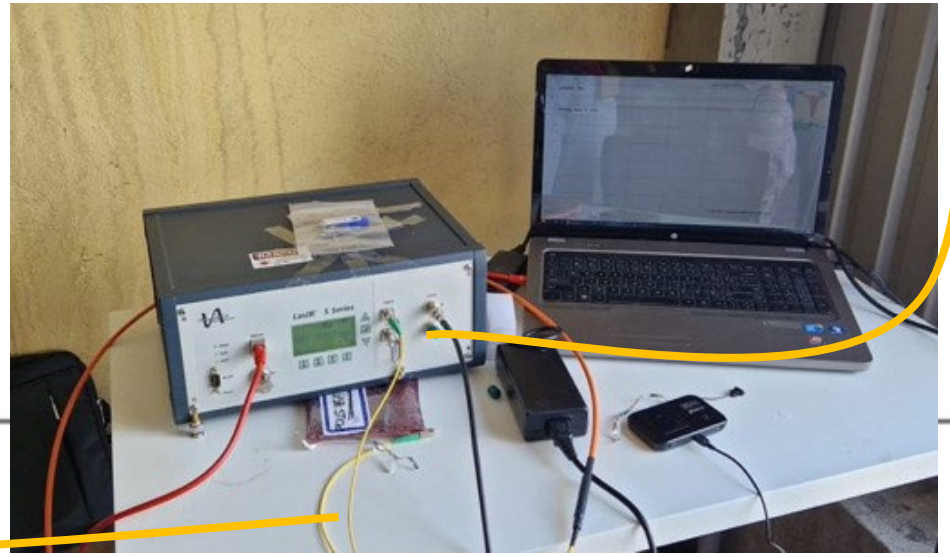
when aggregated to yearly

CH_4(year)=11±8kt

TDLAS

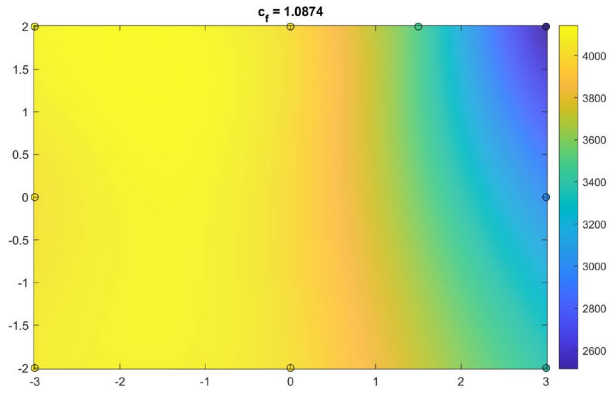


6,45m

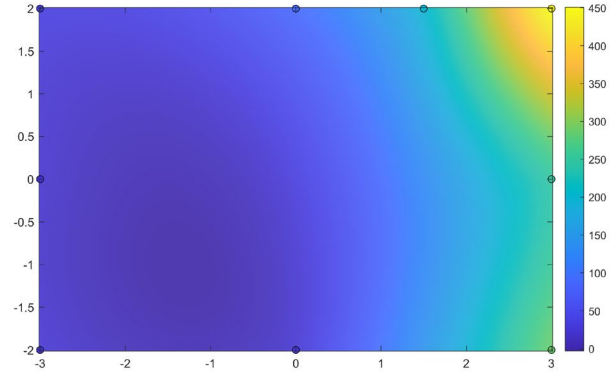


Distribution of methane at the diffuser

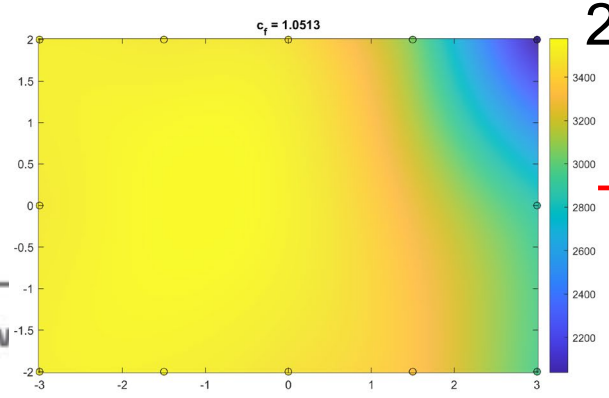
26.06



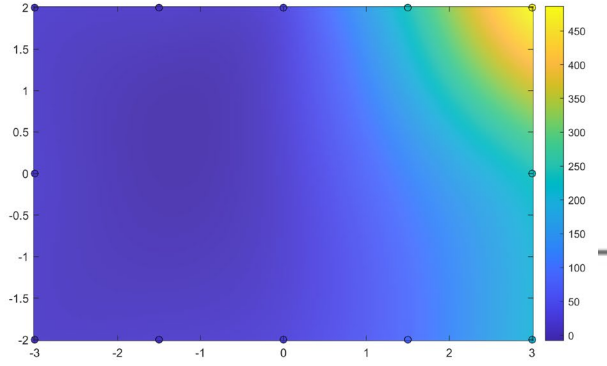
+8%



29.06



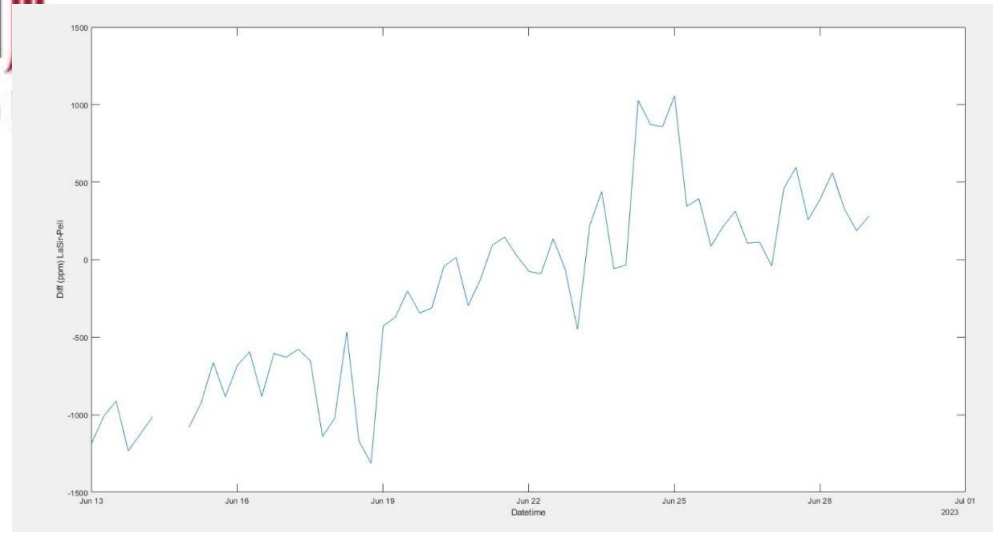
+5%



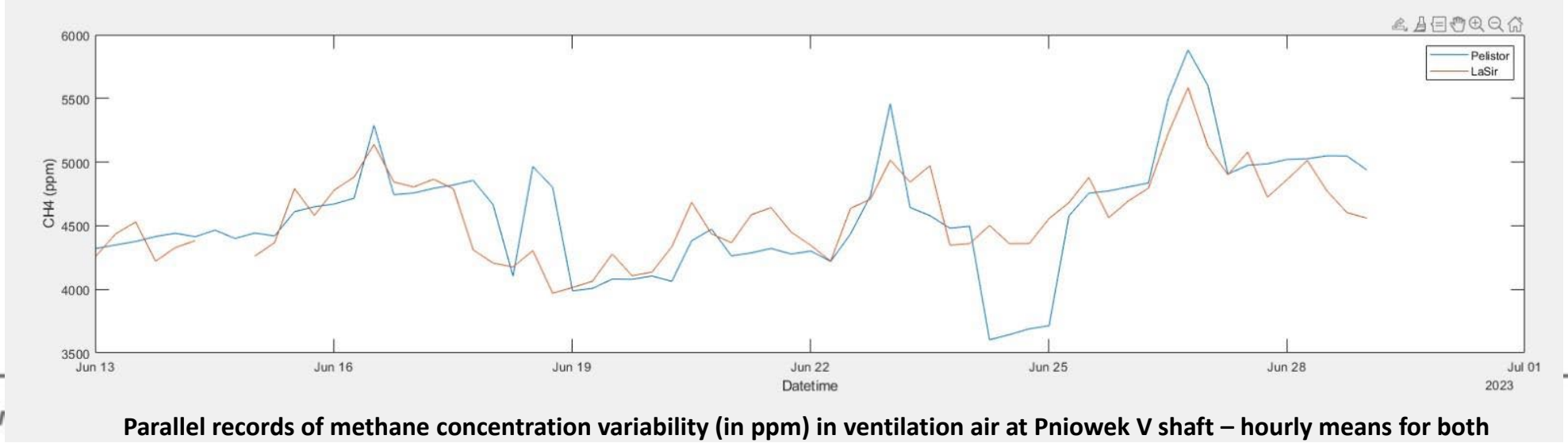
TDLAS versus pellistor

pellistor Q=2728kg/h u(C)=0.1%

TDLAS Q=2766kg/h u(C)=0.002%

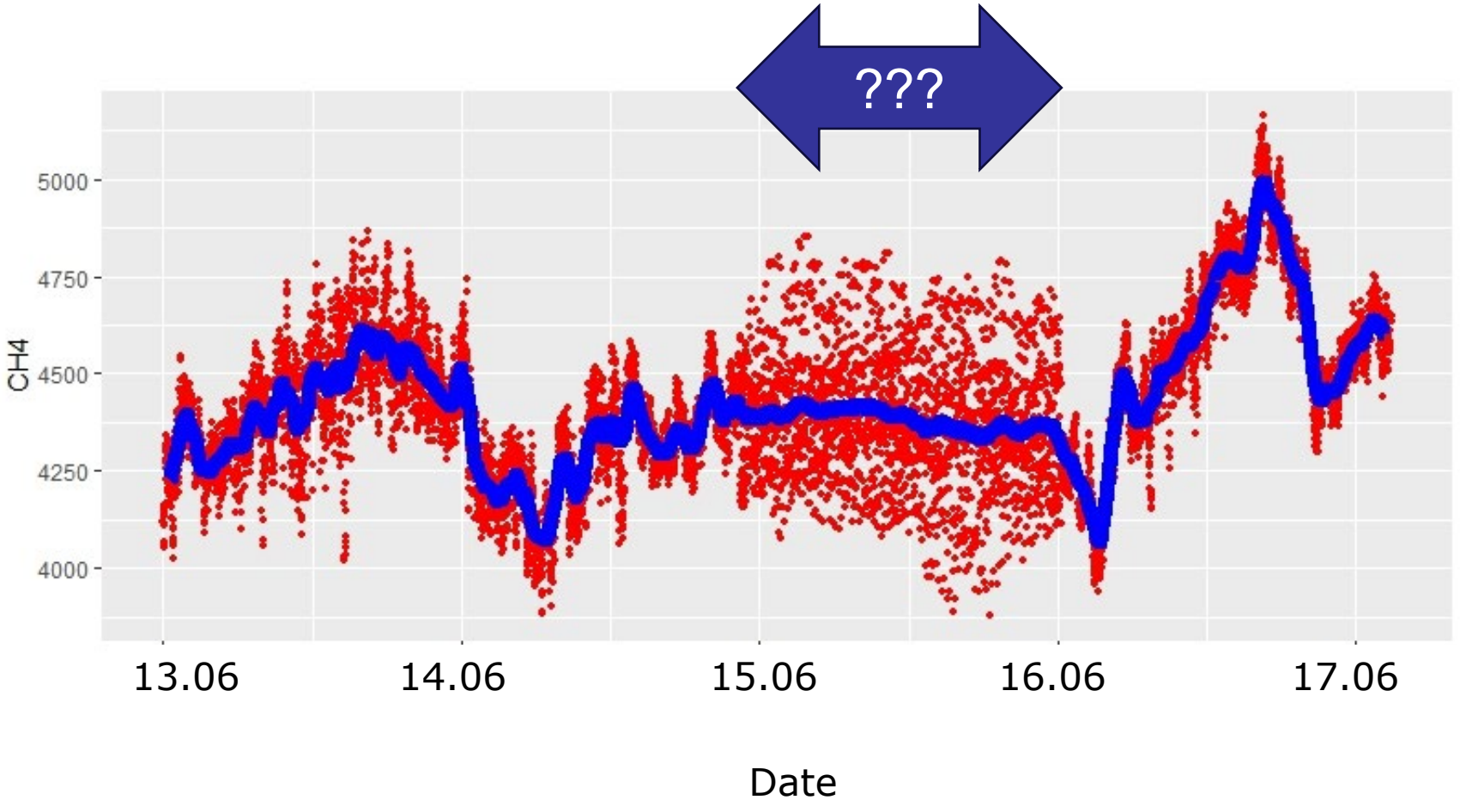


Difference between TDLAS and pellistor records (vertical axis is expressed in ppm) in time. From June 13 till June 30.



Parallel records of methane concentration variability (in ppm) in ventilation air at Pniowek V shaft – hourly means for both instruments are plotted.

TDLAS mid-term variability (days)



The new uncertainty approach

$$CH_4(t_i) = C(t_i)\text{Flow\_rate}(t_i)$$

- If, $C(t_i)=0.3\%$, $F\_r(t_i)=10000 m^3/min$

and $u(C)=0.002\%$ and $u(F\_r)=100 m^3/min$

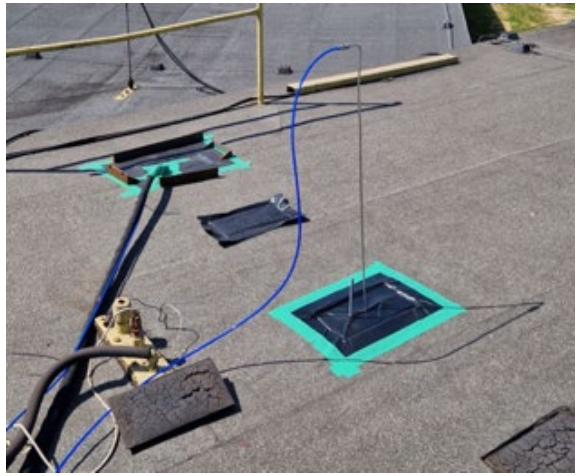
then:

$CH_4(t_i)=30 m^3/min$, $u(CH_4(t_i))=0.3 m^3/min$

when aggregated to yearly

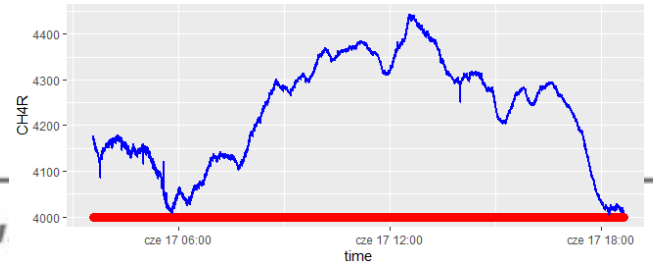
$CH_4(year)=11.3\pm0.5 kt$

Methane to Go Poland
June 2023 campaign

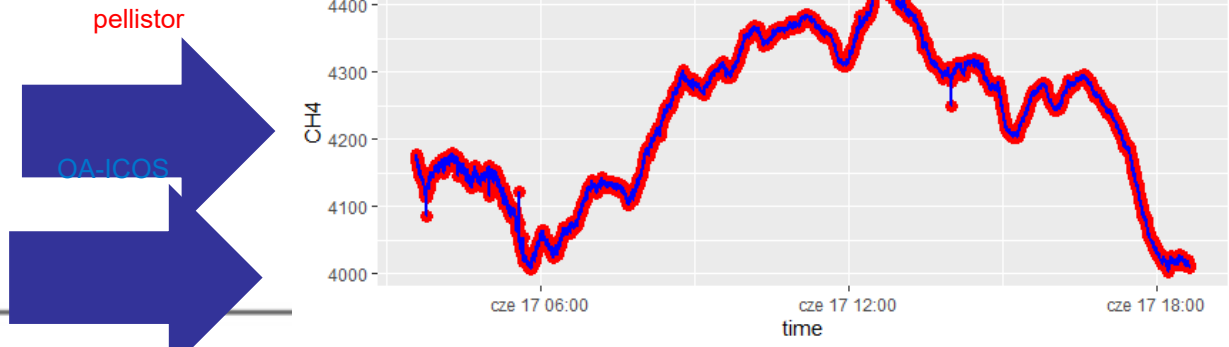


OA-ICOS (best moment)

- » pellistor Q=2451kg/h
- » OA-ICOS Q=2574kg/h



Dilution system 1:10



Can we measure the flux reliably?

» Current measuremetns (pellistors) give a good numbers of average emission

Uncertainty < 70%

» We can use HQ open path TDLAS (Atex required)

Uncertainty < 5%

» We could use enhanced cavity spectrofotometers (eg. LGR) – problems with dilution and spatial representativeness

Uncertainty < 2%

Next Step!!!

TDLAS installation in the ventilation shaft channel of the RYDUŁTOWY Coal Mine belonging to the PGG S.A. and its work for a minimum of 6 months

AGH

Thank you for your attention