Dear Reviewer, thank you very much for all your comments on this manuscript, which are extremely helpful to improve the expression of our manuscript. We have revised the full text of the right based on the comments you marked in our manuscript PDF. And we make response to each comment one by one. Words in blue color are your comments, and our responses are in black color words.

Effective emission height

The effective height is related with emission intensity of the source, the emitted speed of the gas, the meteorological conditions (wind, atmospheric temperature, humidity and pressure, et al.) and solar radiation intensity. We illustrate it by Fig.R1 and Holland formulas.

As is shown in Fig.R1, H (m) is the effective stack height which is the sum of h and Δh, h (m) is the stack height, Δh (m) is the plume rise height.

Δh is calculated by the Holland formulas given in Equations 1 and 2.

$$\Delta h = \frac{u_s \times D_s}{u_0}(1.5 + 2.7\frac{T_s - T_a}{T_s}) = \frac{1}{u_0}(1.5u_s D_s + 9.79 \times 10^{-6} Q_H) \qquad 1$$

$$Q_H = 0.35 \times Pa \times Q_v \times \frac{T_s - T_a}{T_s} \qquad 2$$

where u_s (m/s) represents the exit speed of the CO_2 emitted from a stack, D_s (m) represents the diameter of a stack, u_0 (m/s) is the mean wind speed at the height of the stack, T_s (K) is the temperature of the emission from the stack, Q_H (kJ/s) is the heat emission efficiency, and Q_v (m³/s) is the actual emission rate of CO_2 from the stack.

As you mentioned that the emission heights of 2 Flights are different, because the selected 2 Flights were collected around the Pniówek coal mine on two different days, (a) August 18, 2017 and (b) August 21, 2017 respectively. The wind speed, emission intensity of methane are both different, which would lead to different emission height.

Applicability of GA-IPPF

Thank you for pointing that this method is not applicable to the quantification of gas emissions from non-point sources.GA-IPPF is designed to quantify methane emissions from strong point sources from coal mines, refers to ventilation shaft in this manuscript, and in order to avoid misunderstanding for readers, we have emphasized the type of application of this method in the our latest manuscript. For example, "strong point emission source" and "ventilation shaft".

In order to highlight the practical applicability of GA-IPPF model, we demonstrated performance of GA-IPPFmodel in quantifying strong point source by different sample systems:
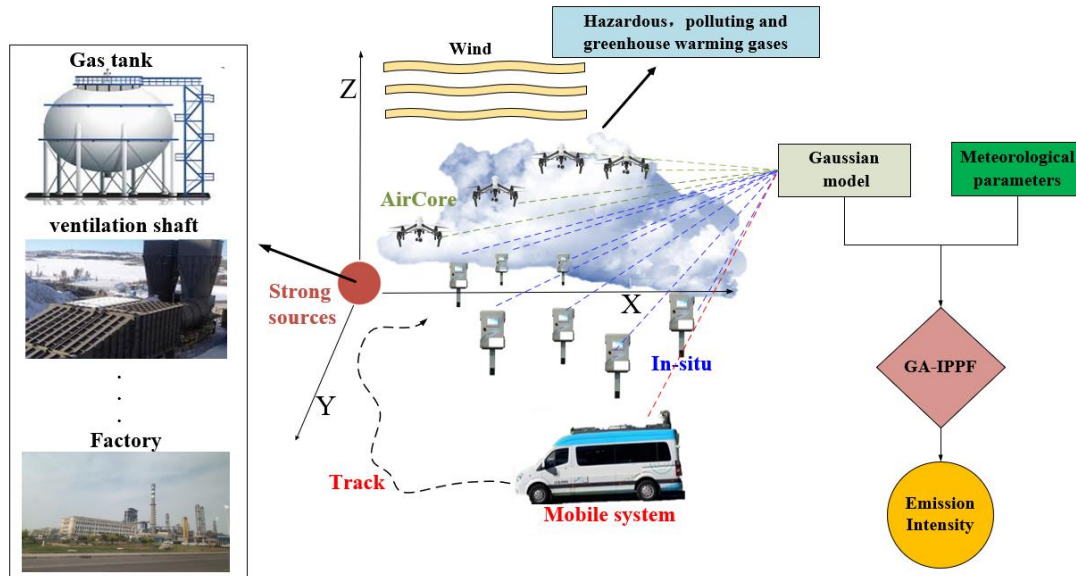
Fig.9. Application of GA-IPPF in quantifying emission source of gases through different sample systems；including UAV-based Aircore system, ground-based In-situ network and mobile collection system.

"Emission Estimates in control release experiment

To evaluate the performance of GA-IPPF in control release experiments, we quantified the gases emission rates in release experiment through different gases sample systems, including UAV-based AirCore system, mobile sampling system and ground-based in-situ network. Detailed introduction of the concerned release experiment are as follows:

Agrar Hauser control release

This CH_4 release experiment was conducted on Agrar Hauser field near Dübendorf, Switzerland(Morales et al., 2022). The controlled CH_4 was release from an artificial source, 50 L high-pressure cylinder with a height of 1.5 m. Meteorological information were acquired by 3D anemometers around the emission source. UAV-based sample systems used in these release experiments contained two sensors, Quantum cascade laser spectrometer (QCLAS) and active AirCore. It carried series active measurements from 23 February to 14 March 2020.There was no other CH_4 source around Agrar Hauser field and the topography was flat. In this section, active AirCore CH_4 samples on 12 march 2020 (312_01) were chosen to use GA-IPPF to quantify methane release rate.

EPA methane control release

Environmental Protection Agency (EPA),USA developed OTM 33A method to quantify oil and gas leakage based on mobile measurement platforms(Brantley et al., 2014), which consisted CH_4 in-situ sensor (G1301-fc cavity ring-down spectrometer (Picarro)), a collocated compact weather station and a Hemisphere Crescent R100 Series GPS system. The accuracy of in-situ sample was within $\pm 5\%$, and in-situ sensor was implemented at height of 2.7 m based on vehicle. Weather station provided atmospheric temperature, pressure and humidity, as well as 3-D wind direction and wind speed. A 99.9% CH_4 high pressure cylinders was used as the gas supply to simulate the CH_4 leakage source. EPA published total 20 experiments of control releases to evaluate OTM 33A method.

Prairie Grass emission experiment

Prairie Grass emission experiment was mainly conducted to evaluate the diffusion of SO_2 from point source under different meteorological circumstances (Barad et al, 1958). The height of emission source

was 0.46 m, and all in-situ sensors were set at heights of 1.5 m. SO_2 concentration was sampled by the in-situ network at the radius of 50 m, 100 m, 200 m, 400 m and 800 m around the source. Samples in R57 release (10-minute sampling periods), total 94, were selected to quantified SO_2 emission rate from release instrument. The reported emission rate of SO_2 in R57 was 105.1 g/s, and the samples collected at the radius of 800 m were neglected in this discussion because of their very small quantity. The reported wind speed was 4.85±1 m/s, wind direction was 184±10°.

Table 4 Performance of GA-IPPF model in different control release experiments

Database	Number	Gas	Release rates (g/s)	Retrieved by GA-IPPF (g/s)
Agrar Hauser	312_01	CH_4	0.31±0.03	0.3±0.03
EPA	STR_6061411_01	CH_4	0.60	0.57±0.04
Prairie Grass	57	SO_2	101.5	104.7±3.7

Table 4 shows the emission rates and uncertainties through GA-IPPF in control release experiments, and the reported emission rates. The average difference between retrieved emission rates and reported ones is 3.8 %, which indicates the high accuracy of GA-IPPF in quantification estimation.
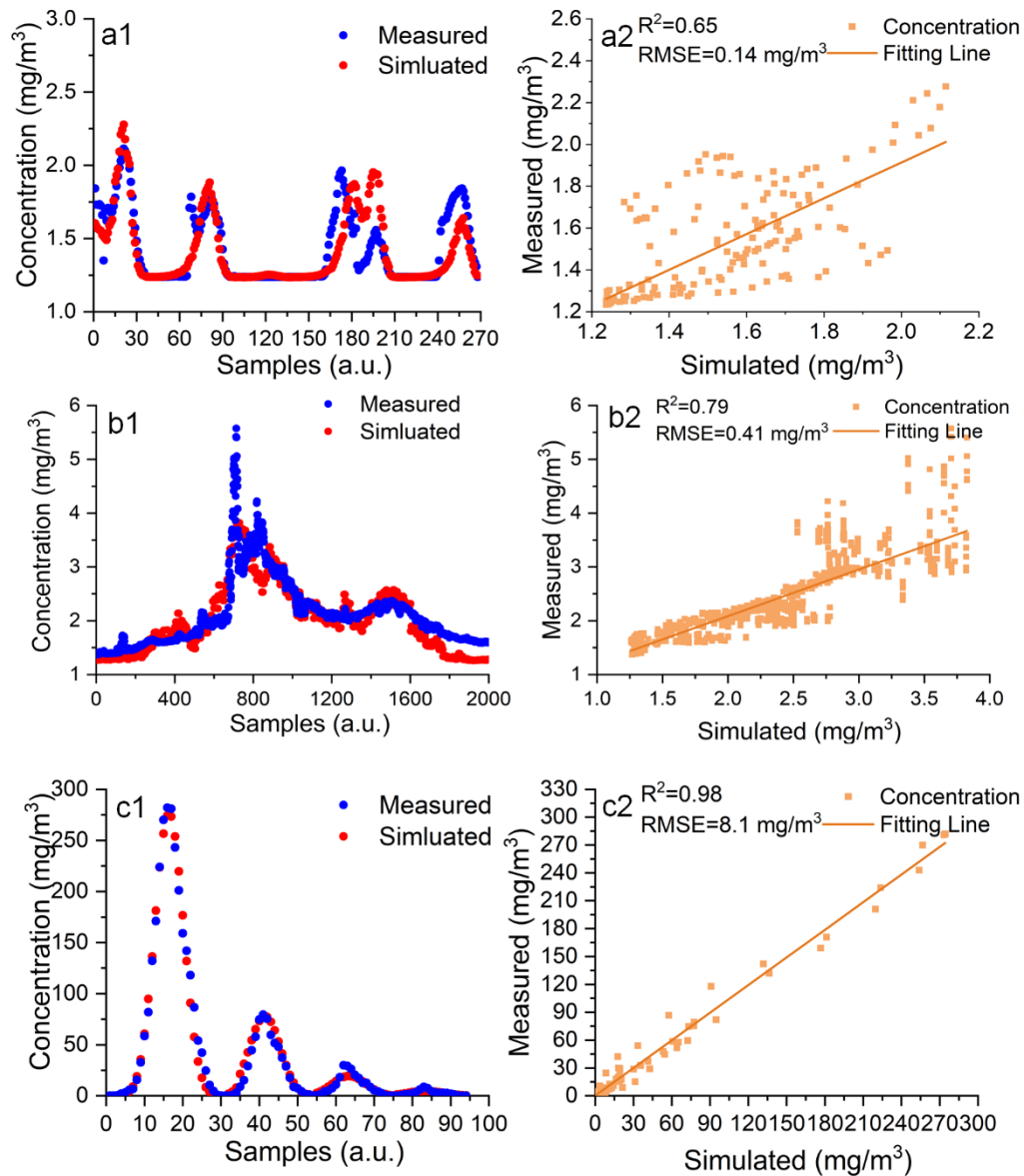

Fig.10. The simulated gases diffusions based on retrieved parameters in control release experiments; a1

and a2 are comparisons between simulated diffusion and actual samples in Agrar Hauser; b1 and b2 are comparisons between simulated diffusion and actual samples in EPA control release; c1 and c2 are comparisons between simulated diffusion and actual samples in Prairie Grass experiment.

As shown in Fig.10, the gases diffusions simulated by GA-IPPF in the three control release experiments conform to logic. Simulated gases concentrations are in good agreement with actual samples (see Fig.10.a1, Fig.10.b1 and Fig.10.c1,), and each peak of the samples in control release experiments can be reconstructed. The correlations between simulated gases concentrations and actual samples are larger than 0.65, and the RMSE are within 2.7% (relative to the mean value of the selected samples' concentration).

In general, reconstructions of gases concentration based on both mobile-platform and UAV are worse than that based on in-situ network. Collected data by in-situ network is usually the mean value of a certain time, like 10 min in Prairie Grass emission experiment, which provides stabile inputs data for GA-IPPF, especially concentration samples. While the concentrations sampled by mobile-platform and UAV-based AirCore experiments are instantaneous, which may be inaccurate and exist fluctuations in collections. The advantages of vehicle-based and UAV-based sample systems are flexibility, that is, they can freely acquire the distribution of gases around the target monitoring sources. In-situ network implement is complicated with a high cost, and the wind direction should be considered during deployment. But its high stability and accuracy can help us to quantify emission source. Therefore, environmental protection departments can choose detection systems according to actual emission monitoring needs.
"

There should be some recommendation as to how many flights would be required to minimize the errors on the model results.

In this study, we focus on methane emissions from ventilation shaft in coal mine, which is treated as strong emission point source. The volatility of its emissions is significant. We assume that the intensity of methane emission is constant during the Aircore sampling collection. However, if methane emission rate is always fixed and a constant value, then multiple Aircore Flight would certainly improve the accuracy of quantified emission rate. Actually, methane emission rate from coal mine is always different between two Flights periods, so it is unreasonable to use multiple Flights to reduce emission error. We understand that you want us to present the data requirements of the Aircore system for the actual users, and we summarized the performance of GA-IPPF based on a certain number of samples. We recommended that the amount of samples in a single UAV-based Aircore system (with accuracy better than 99 .5%) larger than 90, the accuracy of retrieved emission rate would be better than 99 %, when error in wind speed is ± 0.3 m/s and error in wind direction is $\pm 30°$.

Detailed suggestions

1. In section of Introduction, expression of "a Pniówek coal-mine ventilation shafts" should be modified.
    Dear reviewer, thank you for this suggestion, "a Pniówek coal-mine ventilation shafts" has been revised as "CH_4-emission rates from a ventilation shaft in Pniówek coal (Silesia coal mining region mine, Poland)."

2. In section of Introduction, expression of "are not allowed to repeat the quantification of CH_4 emission from coals in the same day" should be modified, Poor English and not clear - you mean that the orbital pattern of the satellite means that they do not pass over the same area twice within the same day.

Sorry for our mistake for this expression, and your understand is really correctly, the original meaning is orbital pattern of the satellites have low possibility to pass over the same area twice in same day.

we have modified this sentence in our latest manuscript as follows:

"but orbital patterns of the satellites have low possibility to pass over the same area twice in a single day, which would not allow to multiple quantify CH_4 emission from coals in one day"

3. In section of Introduction, "Most ground-based sensors have the advantage to sample the concentration around the source continuously," I presume you mean fixed location. This is also dependent on wind direction, so the emission will not be sampled all of the time, unless monitoring is inside of the source.

Thank you for this helpful suggestion, we are sorry for this incorrectly sentence. We strongly agree with you that ground-based equipment, such as vehicle-based monitoring system, and in-situ networking systems, need to collect data in downwind direction from emission source to be able to quantify the emission sources based on GA-IPPF. As shown in Fig 9.
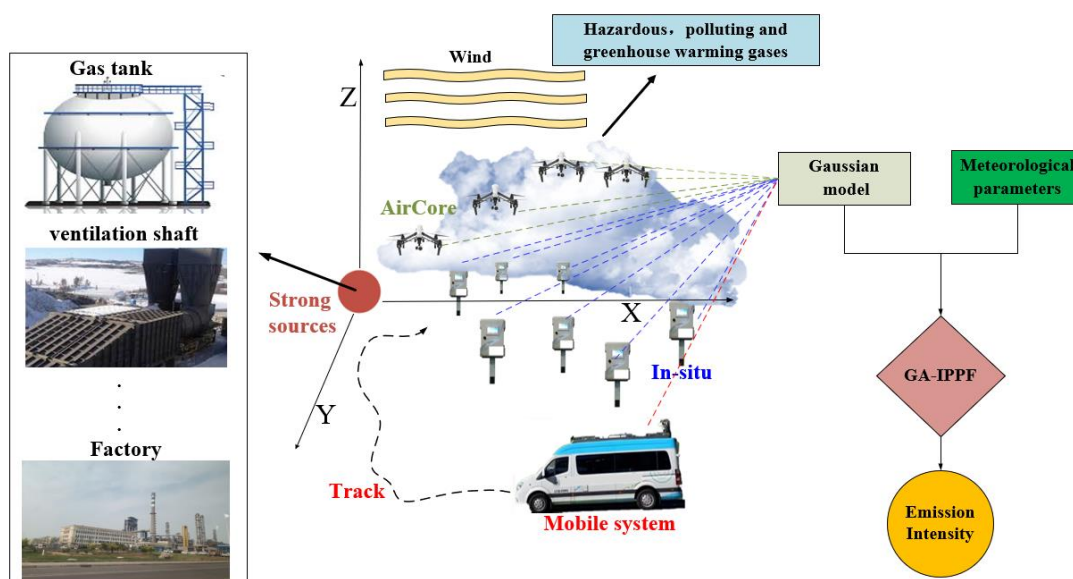

Fig.9. Measured gases concentration in downwind direction by Ground-based sensors, include in-situ network and vehicle-based sample system.

We have modified this sentence according your suggestion as follows :

"When ground-based sensors fixed in appropriate position, they have the advantage that sampling gas concentration in downwind direction form the source continuously"

4. In section of Introduction, "data" should be added after "concentration"; the "high accuracy" means what? AirCore only collects the sample so presumably GPS location X.Y.Z co-ordinates at high frequency.

We have changed "concentration" to "concentration data" throughout in our latest manuscript.
Sorry for the wrong expression in our original manuscript, "high accuracy" means the accuracy of CH_4 concentration samples. Aircore actually only collects samples, which would be analyzed by cavity ring down Spectrometer model G2401-m. The spectrometer could promise the accuracy of CH_4

concentration during the Flight. Hence, we modified this sentence as follows:

"In 2017, we developed an UAV-based active AirCore system, which could sample spatial atmospheric CO_2, CH_4, and CO with high accuracy (Andersen et al., 2018), aiming to retrieve greenhouse gases emission for strong sources."

5. In section 2.1, Need to be clear that the AirCore sample is removed from the drone and replayed through the Picarro on the ground.

Thank you for this suggestion, we have added this information in our latest manuscript as follows:;

"After obtaining air samples from the drones during field campaigns, CO_2, CH_4 and CO collected by AirCore system would be analyzed by ground-based cavity ring down Spectrometer model G2401-m (Picarro)."

This item is really helpful for readers to understand the collection process of AirCore system.

6. In section 2.3, "coal" should be revised as methane.

Thank you, we have modified "coal" as "q (g/s) is the emission rate of CH_4 from coal mine"

7. What do you mean by oral ?

Sorry for this mistake, we have revised "oral" as "original" in our latest manuscript.

8. Section 2.4, This section needs to go before the model section as the location is mentioned. You should also make it clear what type of source this is as this will make a big difference to the model. Is a large open coal pit, or emission from a deep mine shaft or vent, or is it a combination of both.

Thank you for this comment, we have move this section to section 2.3 in our latest submission, and we have also indicate that the methane emission source is ventilation shaft, strong point source. We revised this sentence as follows:

"As part of the Carbon Dioxide and Methane Mission (CoMet) pre-campaign,15 active AirCore flights successfully collected data around a ventilation shaft of Pniówek coal mine on August 18, 2017 and August 21, 2017."

9.Fig2. Caption needs more explanation. What actually is the zoomed map showing? Where is the mine? Is pink the mine buidlings? is it deep mine with shaft or open pit?

Thank you for this suggestion, we are sorry for our careless to not indicate the detailed instruction of each map, and we added the information in our latest manuscript as follows:
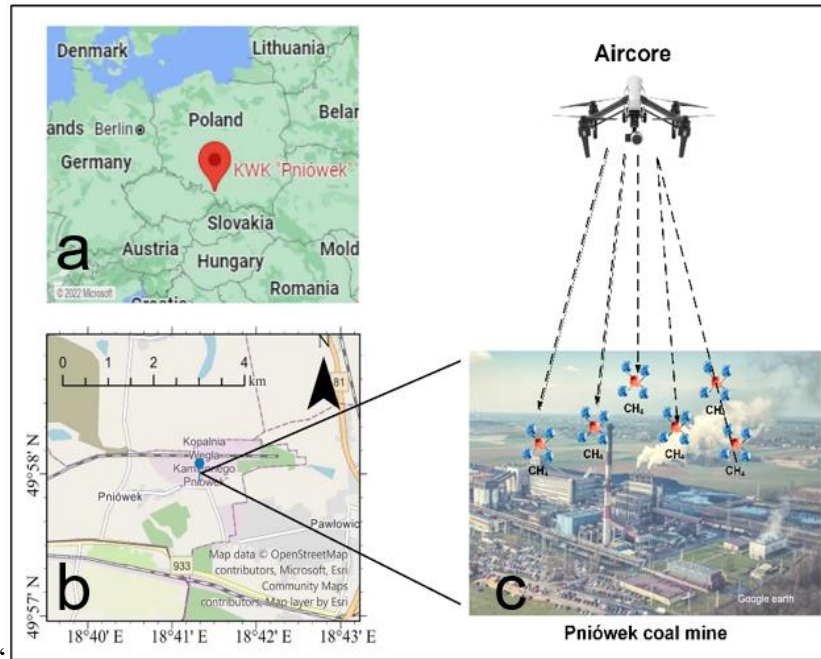
Fig.2. Pniówek coal mine; a. red mark represent the location of Pniówek coal mine in Poland; b. the surrounding circumstance of Pniówek coal mine, blue mark represent Pniówek coal mine; c. detailed layout of Pniówek coal mine, deep mine with shaft"

10.   In section 3.1, what is a coal?

Sorry for this wrong expression, we have modified "coal" as "strong point source" in our latest manuscript as follows:

"Firstly, the dispersion of CH_4 emission from a strong point source is simulated by equation 1"

11. As for fig 3. Showing simulated data without showing any real 3-D data from the AirCore. What does this look like? What are you trying to simulated?

Dear reviewer, thank you for this suggestion, this suggestion is very helpful and we have revised this Fig in our latest submission as follows:

Firstly, we simulated the diffusion of CH_4 from strong point source by formula 1 according to the parameters in Table.R1 as follows:

Table. R1. Parameters setting of CH_4 diffusion

Parameters	Actual
Emission intensity (g/s)	180
Wind speed (m/s)	3
Wind direction (°)	90
a	0.6
B	0.7
c	0.2
d	0.6
B (ppb)	1900
Emission height (m)	50
α	0.9
Accuracy of samples	99.5%

Amount of samples	99

$$C(x, y, z) = \frac{q}{2\pi u \sigma_y \sigma_z} \exp(\frac{-(y)^2}{2\sigma_y^2}) \left\{ \exp(\frac{-(z-H)^2}{2\sigma_z^2}) + \alpha \cdot \exp(\frac{-(z+H)^2}{2\sigma_z^2}) \right\} + B \qquad 1$$

Then, the simulated flight track of UAV was conducted in crossing section (300 m to strong source), in Fig 7. To make this Fig 7 easier to understand, we have revised the illustrations for this Fig 7 as followed,
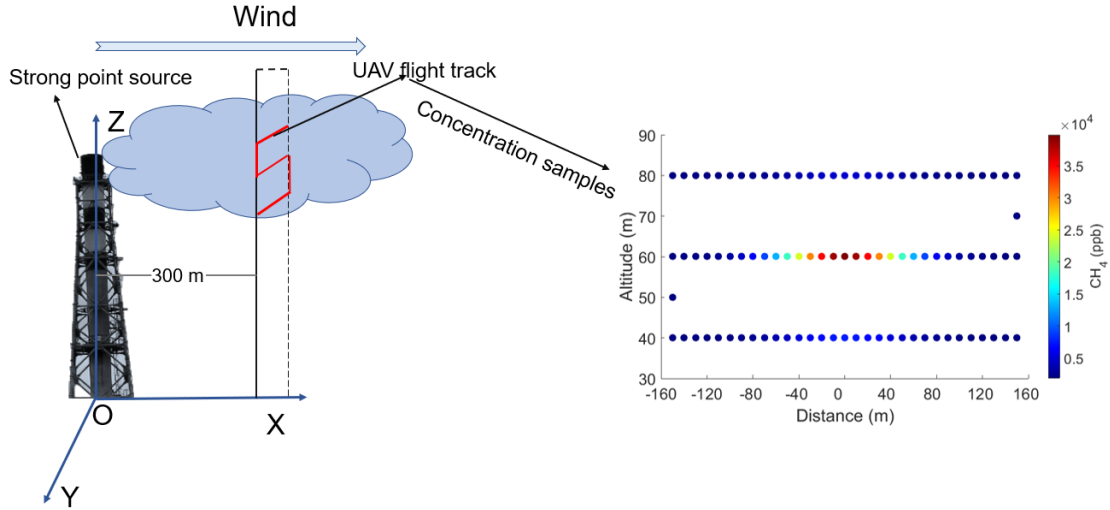

Fig. 7. Simulated concentration samples collected by UAV-based Aircore system. Rectangle represents crossing section perpendicular to wind direction, 300 m to point source; Red line represents simulated flight track of UAV-based Aircore system; colored points represent the CH_4 concentration samples in OSSEs, totally 99.

Then, the 99 points were discussed to analysis the influence of different parameters on final retrieved emission, such wind speed, wind direction, the amount and accuracy of measurement.

11. "As shown in Table 1, q retrieved by GA-IPPF has only 0.17% bias compared with the set values. Emission height only has 0.3 m bias to set one." Show which is q in Table 1.

Thank you for this suggestion, q is emission rate, we have modified this sentence as follows:

"As shown in Table 1, emission rate retrieved by GA-IPPF has only 0.17% bias compared with the set values."

12. In section 3.2, "which is defined the plane coordinates of CH_4 samples" , something is missing here.

This suggestion is really help readers to understand, we have enriched this sentence as follows:

"In the coordinate system established in Gaussian diffusion model, wind direction determines the X axis, which further determines the position of the gas concentration sample in the two-dimensional plane (XOY)."

13. Need to make clear earlier that q = emissions in g/s.

Thank you for this helpful suggestion, and we noted that q is emission rate (g/s) in Section 2.3.1 as follows:

"q (g/s) is the emission rate of CH_4 from coal mine"

15. In line 221, "Wind direction determines the spatial location of the sampling point, and wrong location information leads to distinct errors in emission estimation." This implies that there could be big errors in q if the source is not a point source, but unequally distributed over an area, which could be the case

We totally agree with your comment, if the concerned emission source is not a point source, such as farms, cattle farms or landfills, or other irregular emission sources, generally for this kind source, mass-balance approach method is usually used to quantify their emission rate.

$$F_{(CH4)} = \iint v \sin(\alpha) \cdot (C_{(x,z)} - C_{bg}) dx dz \qquad (12)$$

Where v is the wind speed, α is the angle between wind direction and the two-dimensional plane, $C_{(x,z)}$ is the density of CH_4 in each grid, and C_{bg} is the background of CH_4 in each grid.

And as you mentioned, the wind direction would accuse big error in final quantification. In order to avoid readers' misunderstanding, we declare the application of GA-IPPF is mainly focus on quantitative evaluation of point sources in the full text. For examples:

We have modified our title of this manuscript as "Retrieving CH_4 emission rate from coal mine ventilation shaft using UAV-based AirCore observations and the GA-IPPF model"

"In this study, we developed a genetic algorithm–interior point penalty function (GA-IPPF) model to calculate the emission rate of large point sources of CH_4 based on concentration samples."

"Firstly, the dispersion of CH_4 emission from a point source is simulated by equation 1"

16.In line 225, How do you know these are errors and not limitations of instrument precision?

Dear reviewer, the errors added in wind speed, wind direction and gas concentration are set in simulation experiments, which are aimed to present the adjustment of GA-IPPF on retrieved emission rate. Each additional error would be discussed according to the controlled variables method. The original parameters settings (in red line) are shown in our latest manuscript.

Table 4. The parameters setting in dispersion simulation and the retrieved results by GA-IPPF

Parameters	Lower boundary	Upper boundary	Actual	Retrieved
Emission intensity (g/s)	0	100000	180	180.2±0.02
Wind speed (m/s)	0	100000	3	3±0.01
Wind direction (°)	70	110	90	90±0.10
a	0	1000	0.6	0.6±0.02
B	0	1000	0.7	0.7±0.02
c	0	1000	0.2	0.2±0.01
d	0	1000	0.6	0.6±0.01
B (ppb)	1700	2500	1900	1900±2.7
Emission height (m)	0	150	50	49.8±1.1
α	0	1	0.9	0.91±0.01

"Actual" means the set values of parameters, and "Retrieved" means the average values of parameters retrieved by GA-IPPF model through 10 000 times of simulation.

This part dose not refers to actual experiment, so it has no directly correction with the instrument precision. It worth nothing that all the set ranges of errors in the simulations are larger than the precision of instruments, for examples, the ranges of added wind error are 0 ~2.0 m/s, the ranges of added simulated gas concentration samples are 0.5 %~5.0%

17.In line 228, "The AirCore system could acquire more than 70 CH_4 samples in actual feasible measurements" . Not clear what this means. Number of air Core samples that can be collected and analysed within a given time period within the same source emission plume.

Sorry for this incorrect expression,. We have modified this section as follows:

Then, the simulated flight track of UAV was conducted in crossing section (300 m to strong source), in Fig 7. The spatial resolution of the supposed samples is 10 m, and 99 samples were selected from the simulated dispersion to represent the data acquired by the UAV-based AirCore.
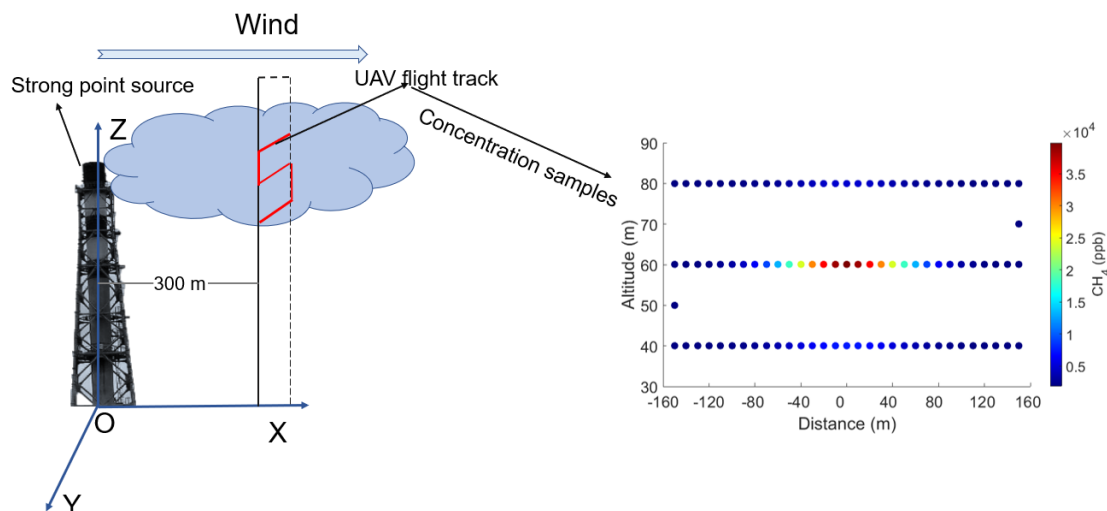

Fig. 7. Rectangle represents crossing section perpendicular to wind direction, 300 m to point source; Red line represents simulated flight track of UAV-based Aircore system; colored points represent the CH$_4$ concentration samples in OSSEs, totally 99.

We want to model the colored point to represent the concentration samples in actual Flight. Aircore system is actual sampling continually during the Flight, the spatial resolution is 10 m in this section, which is regarded as the integral period of each value of CH$_4$ concentration in different locations.

we have modified this sentence as

"UAV-based AirCore system could acquire more than 99 CH$_4$ samples (with accuracy better than 99.5 %) in single Flight."

17.In line 240, "were "should be modified as "are"

Thank you, we revised "were" as "are" in latest manuscript.

"In this section, the performance of the GA-IPPF model and the influence of the four key input parameters are discussed."

18.In line 246, "Flight 6" says Flight 8 in text above.

Sorry for this mistake, we have modified it as Flight 6 in our latest manuscript.

19.In line 247, "spirally", in a spiral pattern

We changed "spirally" to "in a spiral pattern" in our latest submission.

20. In line 249, "samples", The Picarro measurement rate doesn't change so why 376 measurements in 7 minutes and 400 in 9 minutes?

Sorry for this careless expression, the resolution of final stored time is min, we have mistaken the store time to express the total collected time, detailed responses are shown as follows:

Actually, for Flight 6 and Flight 15, Aircore system could get about 50 samples per minute. In Flight 15, it only collected 17 samples in 2017/8/21 10:59:00 (start time). The total collected time is 8 min 04 s. similar to Flight 8, and similarly, the total collected time is 7 min 33 s in Flight 8.

2	2017/8/21 10:59	18.73753	49.97458	10.38571	2.897267	3170.951
3	2017/8/21 10:59	18.73752	49.97459	10.38571	3.058225	3346.012
4	2017/8/21 10:59	18.73749	49.9746	10.38571	2.651128	3555.731
5	2017/8/21 10:59	18.73745	49.97463	10.38571	2.674649	3695.523
6	2017/8/21 10:59	18.73743	49.97464	10.38571	2.879437	3835.335
7	2017/8/21 10:59	18.73742	49.97466	10.38571	3.214906	4031.251
8	2017/8/21 10:59	18.7374	49.97467	10.38571	3.700835	4227.167
9	2017/8/21 10:59	18.73738	49.9747	10.38571	4.989239	4422.981
10	2017/8/21 10:59	18.73737	49.97471	10.38571	5.881123	4748.13
11	2017/8/21 10:59	18.73737	49.97473	10.38571	6.856142	5135.842
12	2017/8/21 10:59	18.73737	49.97476	10.38571	10.16905	5394.239
13	2017/8/21 10:59	18.73739	49.97481	10.38571	15.10969	5802.599
14	2017/8/21 10:59	18.7374	49.97484	10.38571	17.88322	6252.263
15	2017/8/21 10:59	18.73743	49.97489	10.38571	23.53596	6552.136
16	2017/8/21 10:59	18.73744	49.97491	10.38571	26.3497	6851.917
17	2017/8/21 10:59	18.73745	49.97494	10.38571	28.84725	7161.872
18	2017/8/21 10:59	18.73745	49.97496	10.38571	31.46561	7471.827
19	2017/8/21 11:00	18.73747	49.97504	10.38571	38.81091	7781.77
20	2017/8/21 11:00	18.73748	49.97507	10.38571	42.14035	8091.725
21	2017/8/21 11:00	18.7375	49.9751	10.38571	45.80456	8322.311
22	2017/8/21 11:00	18.73752	49.97512	10.33571	48.43182	8552.896
23	2017/8/21 11:00	18.73755	49.97517	10.38571	53.73717	8898.847

Start time in Flight 15

21. In line 254. Surely an AirCore is one sample that has enough air to allow 400 measurements when attached to the Picarro?

The AirCore is able to retrieve concentrations along the flight track because molecular diffusion inside of the AirCore is slow enough so that concentration profiles, instead of an integrated concentration average, can be retrieved. However, there is certainly mixing, especially during air sample analysis in the cavity of the CRDS analyzer, which determines the spatial resolution of the AirCore measurements. The AirCore sample was analyzed by a CRDS analyzer in a small flow rate, therefore, as many as 400 measurement points can be obtained.

22. In line 261. "5.7m and 3.64 m", Why is the calculated emission height an order of magnitude higher in the model results?

Sorry for our mistake in expression of Line 261, In two Flights, the actual emission height are 58.4 m and 35.5 m as shown in Table 1 in latest manuscript. In earlier calculation of emission rate, we ignored the actual height of ventilation shafts in Pniówek coal mine, which makes the retrieved emission height is unreasonable (5.7m and 3.64 m). We set the lower boundary of emission height is 5 m, the emission height are 58.4 m and 35.5 m respectively. We are sorry for not update the results in word expression previously. We have modified this error in our latest manuscript as follows:

"The exhaust gases of coal mine are emitted through the stack with effective emission heights of 58.4 and 35.5 m, respectively."

23. In table 2, Oral should be modified.

Thank you for this suggestion, we have modified "oral" as "original" in Table latest manuscript.

24. pay attention to superscript of expression.

Thank you, we have modified all superscript of the expressions in our latest manuscript, such as

"R^2", "CH_4".

25.In line 281, "adjust more weights" , Do you mean 'assign more weighting'

We are very grateful to you for pointing this error, "assign" is more suitable to express the actual meaning of this sentence. And we have modified "adjust" to "assign" in our latest manuscript.

26. In line 301, "a two-dimensional plane is selected according to the amount of CH_4 samples" should be modified.

Sorry for our wrong expression, we changed this sentence in the latest manuscript as:

"a two-dimensional plane is selected according to the flight trajectory of UAV"

27.In line 313. Added the missing date.

We have added the missing date as "Andersen et al. 2021"

28. In line 327. Why does this reference have no date and a number next to it (wrong style)

Thank you for this suggestion, we have modified all the references throughout in our latest manuscript.

29. In line 364. This is not a sentence. "To explore the reason that the acceptable difference of calculated methane emission rate by the two sources of meteorological data"

Thank you for this suggestion, we have modified this sentence as follows:

"We also explore the reason that little difference of the calculated emission rates by the two different sources of meteorological data"

30. In line 366. "were" should be modified as "are"

Thank you, we have modified "were" as "are" in latest manuscript.

31. oral should be modified

Thank you for this suggestion, we have modified "oral" as "original" in latest manuscript.

32. In line 392. Pipes leak, this is a fugitive vent emission

we are sorry for our wrong expression, and we have modified it as "the distribution of emitted gas"

33. In line 397. "lack no" this is a double negative.

Sorry for this mistake, and we have delete "no" in latest submission.

34.In section of Conclusion, Should include a recommendation of how many Air Core retrievals from a single point source are required to mininmise the errors on model results.

In this study, we focus on methane emissions from ventilation shaft in coal mine, which is treated as strong emission point source. The volatility of its emissions is significant. We assume that the intensity of methane emission is constant during the Aircore system collection. However, if methane emission rate is always fixed and a constant value, then multiple Aircore Flight would certainly improve the accuracy of quantified emission rate. Actually, methane emission rate from coal mine is always different between two Flights periods, so it is unreasonable to use multiple Flights to reduce emission error. We understand that you want us to present the data requirements of the Aircore system for the actual users, and we summarized the performance of GA-IPPF based on a certain number of samples. We recommended that the amount of samples in a single UAV-based Aircore system (with accuracy better than 99 .5%) larger than 90, the accuracy of retrieved emission rate would be better than 99 %, when error in wind speed is ± 0.3 m/s and error in wind direction is $\pm 30°$.

35. As for references, need complete references, add journal volume numbers and pages / DOI where missing.

Dear reviewer, thank you for this helpful suggestion, we have added the information of journal volume numbers, pages, DOI and published year in our latest submission, for example:

"Schneising, O., Buchwitz, M., Reuter, M., Vanselow, S., Bovensmann, H., and Burrows, J. P.: Remote sensing of methane leakage from natural gas and petroleum systems revisited, Atmos. Chem. Phys., 20, 9169–9182, https://doi.org/10.5194/acp-20-9169-2020, 2020."