EUROGEO WORKSHOP 2022

Autonomous Multi-Format In-Situ Observation Platform for Atmospheric Carbon Dioxide and Methane Monitoring in Permafrost & Wetlands - MISO

(TOPIC ID: HORIZON-CL6-2022-GOVERNANCE-01-07-
New technologies for acquiring in-situ observation datasets to address climate change effects)

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NILU-Norwegian Institute for Air Research

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Autonomous Multi-Format In-Situ Observation Platform for Atmospheric Carbon Dioxide and Methane Monitoring in Permafrost & Wetlands - MISO

Participant No.	Participant organisation name	Country
1 (Coordinator)	**NILU** - NORWEGIAN INSTITUTE FOR AIR RESEARCH	NORWAY
2	**SA** - SENSEAIR AB	SWEDEN
3	**QUB**-QUEEN'S UNIVERSITY OF BELFAST	UK
4	**UiT**-UNIVERSITY OF TROMSØ	NORWAY
5	**TEG** - TEGNOLOGY APS	DENMARK
6	**AWI**- ALFRED WEGENER INSTITUTE FOR POLAR AND MARINE RESEARCH	GERMANY
7	**AZD**- AZUR DRONES	FRANCE
8	**ISP-CNR** -NATIONAL RESEARCH COUNCIL OF ITALY - INSTITUTE OF POLAR SCIENCE	ITALY

For the topic: New technologies for acquiring in-situ observation datasets to address **climate change effects**

TOPIC ID: HORIZON-CL6-2022-GOVERNANCE-01-07

https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-cl6-2022-governance-01-07

TOTAL BUDGET: 3.5 mil EUR **(Period: 01.01.2023 – 30.06.2026)**

The Gaps: lack of in-situ measurements in hard-to-reach areas to address climate change effects

Meas. type	Advantages	Disadvantage
Space-based measurements (*e.g Satellite measurements):*	achieve complete global spatial coverage at long or short timescales	do not have sufficient coverage for reliable measurements at small scales
Aircraft-based measurement	vertical profiles of GHG concentrations,	high cost, not long time series, limited temporal snapshot
Tower-based measurement	precise across the towers sensitivity footprint; & consistent measurements.	long time series can not be guaranteed, high cost and difficult to maintain
UAV-based measurement	high temporal-spatial resolution with specific targets of emission sources	limited temporal snapshot, and not able to provide long time series of measurements
Direct-source measurement	quantify emission rates from a small source area, portable and can be deployed in remote areas	require sufficient power supply and human resources, only capture short time measurement periods.

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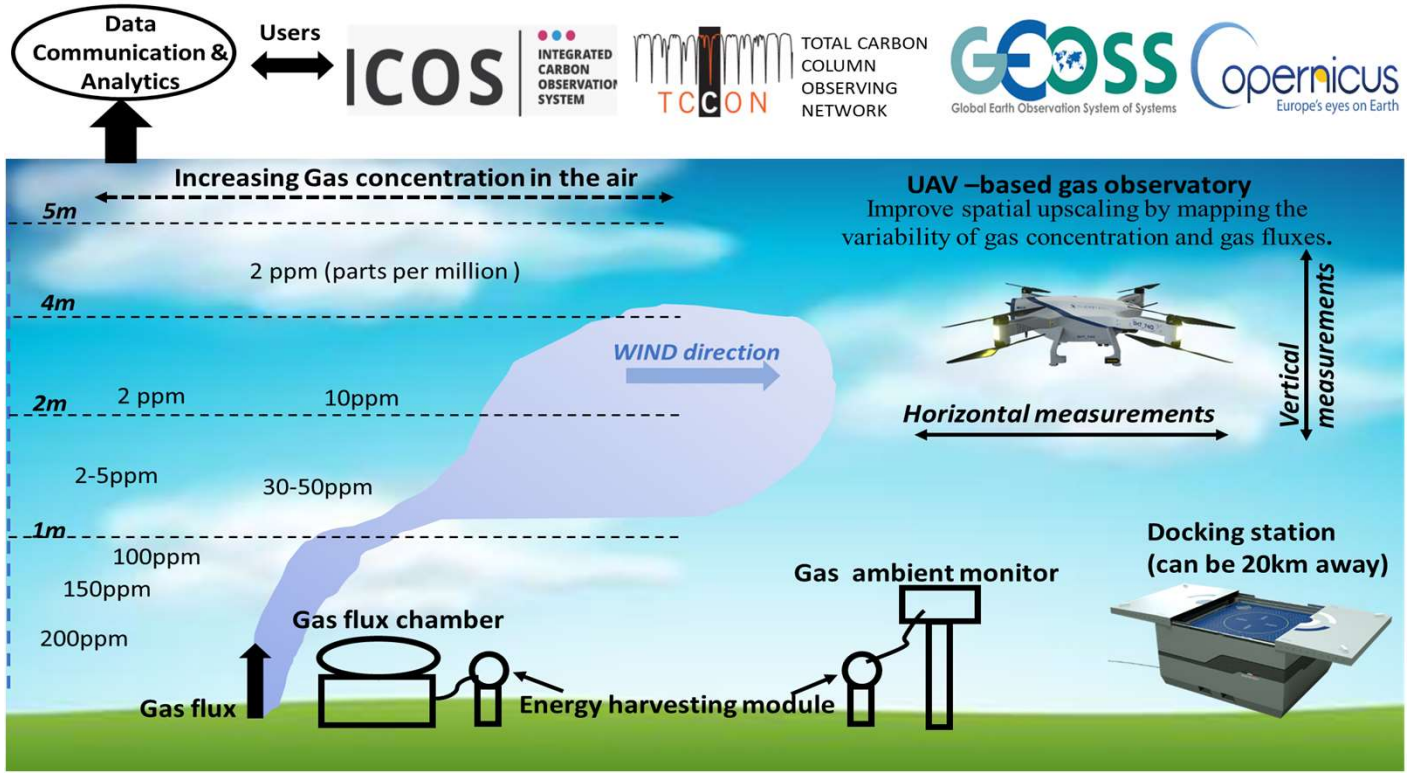
The main objective of MISO is to develop and deploy an **autonomous** **in-situ observation platform** for use in hard-to-reach areas, for detecting and quantifying carbon dioxide and methane gasses.



We will develop 3 autonomous observatories to monitor CO2 and CH4

Observatories	Target measurements
Static observatory 1- *continuous ambient GHG monitor (edge intelligence)*	Gas ambient concentration in the air in Arctic and Wetland
Static observatory 2- *GHG flux chambers (edge intelligence)*	Gas fluxes from the sources in Arctic and Wetlands
UAV-based *observatory (Drone-in a box system) (edge intelligence)*	Mapping the variability of gas concentration& fluxes. Monitoring "hotspots".

MISO AMBITION:

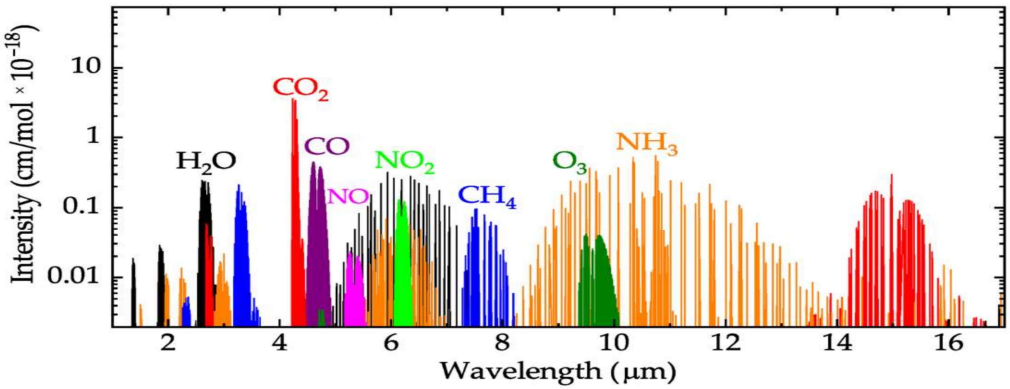
Ambition 1-New low-cost non-dispersive infrared sensors with breakthrough characteristics for GHG monitoring in harsh environmental conditions.

- NEW SENSING TECHNOLOGIES (NDIR-nondispersive infrared sensor) for CO2 and CH4 detection (by **Senseair**)

K96 sensor developed by Senseair

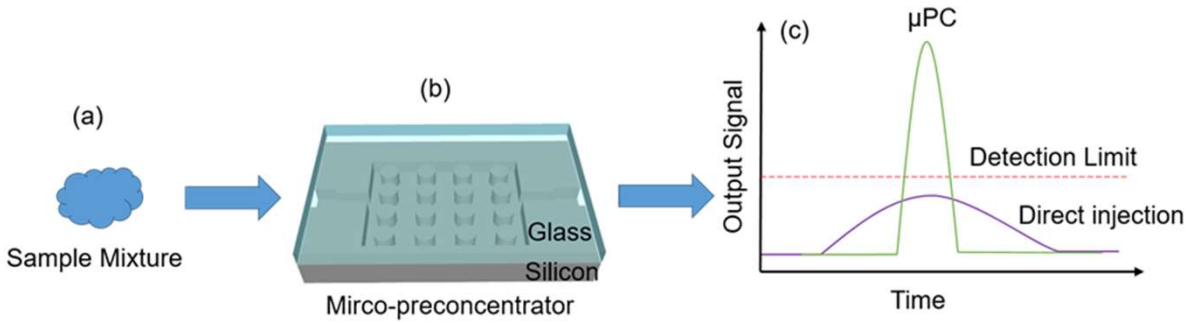
Low-cost gas sensing technologies comparison (performance scale: excellent – high – medium - poor). *Thermal Conductive: TC; Metal-Oxide Semiconductor: MOS*

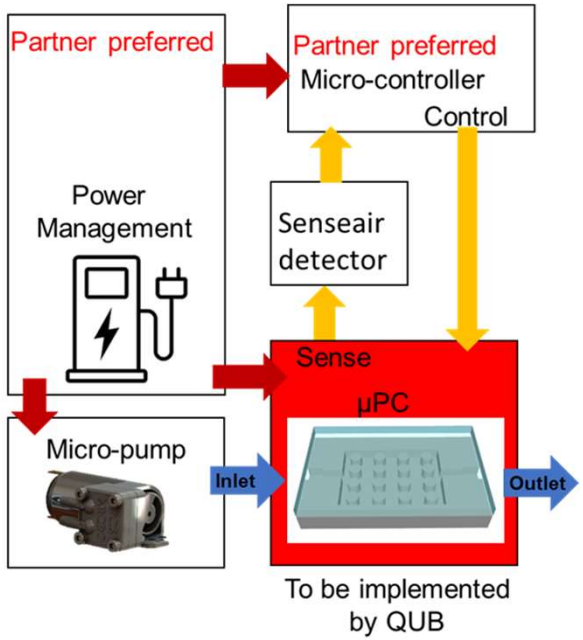
PARA-METERS	Low-cost gas sensors technology performance			
	Photonic	*MOS*	*Catalytic*	*TC*
Sensitivity	Excellent	Excellent	High	Poor
Selectivity	Excellent	Medium	Poor	Poor
Response time	High	Excellent	High	Excellent
Stability	High	High	Poor	High



Ambition 1-New low-cost non-dispersive infrared sensors with breakthrough characteristics for GHG monitoring in harsh environmental conditions.

- preconcentrator (µPC) to improve the detection limit of NDIR sensors including preconditioning (increasing concentration) of the target gas (by QUB)





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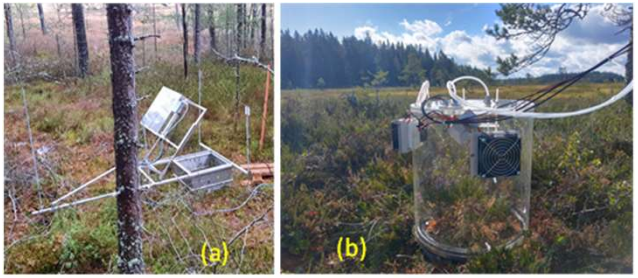
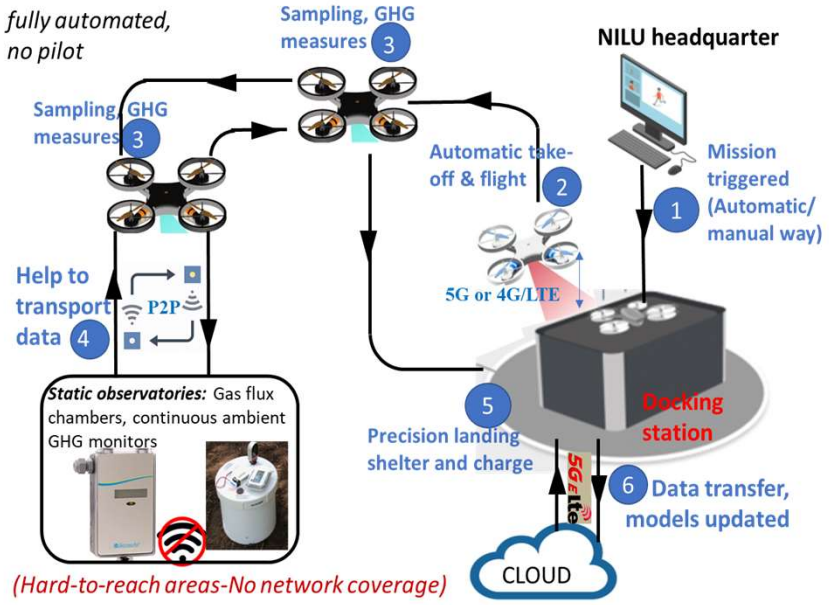
Ambition 2-- Cost-effective observatories for in-situ GHG observations in areas facing extreme physical conditions. *(SO3, WP3)*



- Cost-efficient static observatories : 1) continuous ambient GHG monitoring device (by **NILU**) and 2) greenhouse gas flux measurement chambers (by **AWI**)

- UAV-based observatory using drone-in-a-box-system (autonomous drone and docking station) (By **AZD (France), NILU, Senseair**)



A. Smart Drone
B. Docking station
C. Camera and weather stations
D. Software/interface
E. Picture in Picture (PiP) taken by Skeyetech.

ATHENS 7-9 DECEMBER 2022

Ambition 2-- Cost-effective observatories for in-situ GHG observations in areas facing extreme physical conditions. *(SO3, WP3)*

- **UiT (Norway):** Smart software using CPS approaches (e.g., edge intelligence algorithms, data analytics libraries and runtimes) enabling in-situ observatories operating energy-efficiently *(improve energy efficiency of in-situ analytics by an order of magnitude)*, extending operational lifetime and tolerating typical faults in extreme environments

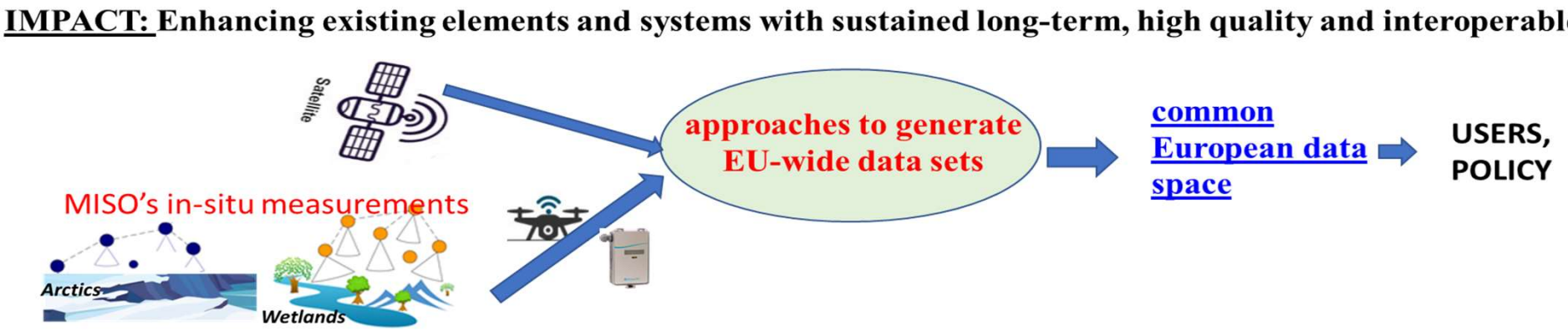
- **QUB (UK):** Innovative and reliable sensor communication solutions in Arctic, permafrost and wetland areas, even for areas with no network coverage (P2P) to guarantee data transmission.

- **TEG (Denmark):** Innovative combined energy solutions for Self-Powered or battery-life extended static observatories in hard-to-reach areas to guarantee long-time series of in situ climate gas observations.

Ambition 3- New frontiers for breakthrough understanding of fine-scaled carbon budgets in Wetlands, and the Arctic to address climate change effects *(SO4, WP4)*

demonstrate MISO observation platform in Arctic and Wetland to provide break-through understanding of high-latitude carbon budgets.

Ambition 4- Enhancing existing elements and systems with sustained long-term, high quality and interoperable data *(SO5, WP5)* (by NILU)



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