

FINAL REPORT PROGRAM LEFE

Program LEFE-CHAT	Project Title: Monitoring of atmospheric composition and greenhouse gases through multi-instruments campaigns (MAGIC 2021)	Years 2021 – 2022
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Context

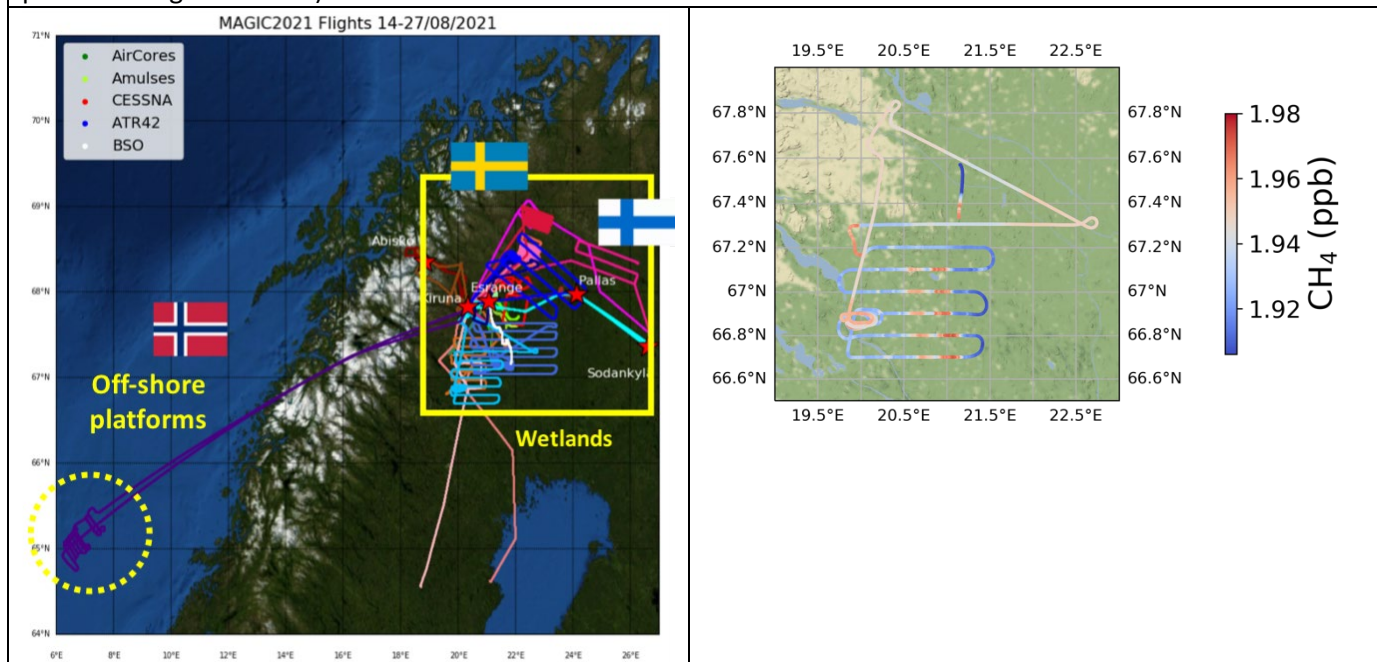
The MAGIC campaigns, organized every year since 2018, have two main objectives: 1) to improve our understanding of the atmospheric distribution of anthropogenic greenhouse gases (GHGs) and associated emissions; 2) to prepare future space missions observing GHGs and ensure their validation.

Objectives / scientific questions

The MAGIC 2021 campaign was organized from August 17th to 28th, 2021 in Lapland, around the city of Kiruna in Sweden. Bringing together 17 research teams from 7 countries, it aimed to study natural and anthropogenic methane emissions at high latitudes. The campaign was lead by CNRS and CNES and supported also by ESA, EUMETSAT and DLR.

Main results

More than 80 hours of flights by 3 research aircrafts, including SAFIRE ATR-42, 20 stratospheric balloons released, more than 3000 spectra measured by 5 ground-based Fourier transform spectrometers. All these measurements have shown the relevance of methane emission inventories in Lapland in terms of spatial distribution, but not in terms of amplitude. The simultaneous detection of methane signals from wetland emissions, which are detectable between 1 and 3 km altitude, and from biomass fires in Canada and Siberia, which are detectable between 5 and 7 km altitude, showed the difficulty of separating methane sources in the measurements, especially from total columns acquired from the ground or from space. These measurements also allowed the evaluation of different transport models (especially CAMS) and satellite products (temperature and humidity profiles and gas columns).



Left. All flights from 2 research aircrafts (DLR Cessna, SAFIRE ATR-42), Weather balloons carrying AirCore and Amulsel instruments and Large CNES BSO balloon performed over the Norwegian Sea to study emissions from off-shore oil and gas platforms and over Sweden and Finland to study wetland emissions.

Right. Focus on one flight of the ATR-42 on August 23rd for which a large plume of CH₄ (shown here) and CO was measured and attributed through atmospheric transport modeling to biomass burning in Canada and Siberia.

Future of the project :

The MAGIC campaigns continue on an annual basis. In 2022 and 2023, gathering 8 research teams from 3 countries, the campaigns focus on the monitoring of anthropogenic emissions from a mid-sized city (Reims) and nearby sources (industrial sites and methane digesters).

Current plans include: in 2024, another large-scale campaign in Lapland in May-June ; in 2025, a 6 month effort to validate columns of CO₂ from CNES MicroCarb mission during its commissioning phase following its launch planned for 2nd semester of 2024 ; in 2026, a large-scale international campaign in Brazil.

In addition to these annual campaigns, the MAGIC initiative includes: 1) the French AirCore program that aims at regular measurements of vertical profiles of CO₂ and CH₄ atmospheric concentration from 4 sites in France using stratospheric balloons; 2) the French consortium for the measurement of total columns of trace gases using FTIR instruments called EM27/SUNs.

More information may be found on <https://magic.aeris-data.fr> and <https://aircore.aeris-data.fr>

Number of publications, communications and theses

Data calibration is just finished. Publication is planned for the coming year.

One PhD student is supported by CNRS-MITI (Félix Langot, Study of methane emissions in the circumpolar region using field campaigns and space observation, Ecole Polytechnique)

Data availability

Once fully calibrated, all data will be accessible through AERIS website.

More info on <https://magic.aeris-data.fr>