The CoMet Mission

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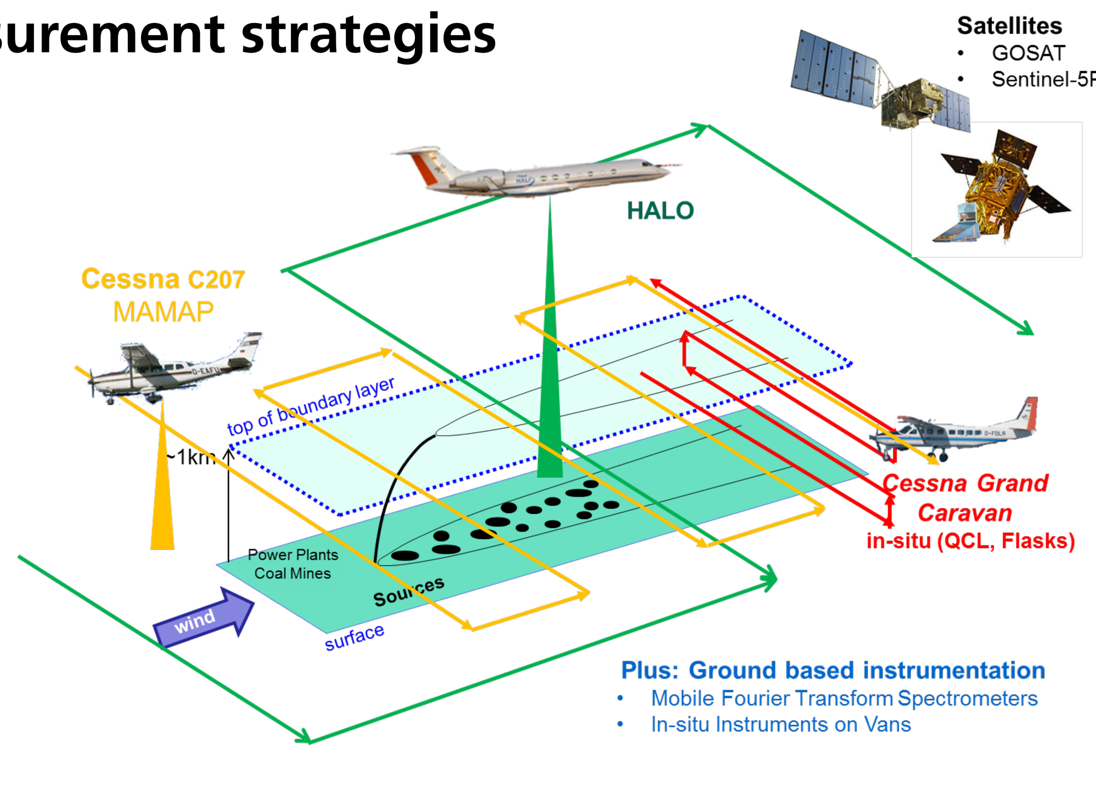
Overview

CoMet is an airborne mission dedicated to measure the most important anthropogenic greenhouse gases, **CO2 and CH4**. The overarching goal is to improve our understanding about and better quantify the **Global Carbon Cycle** by means of both measurements and models. The results will be utilized for predicting future climate and will help to assess the effectiveness of emission reduction schemes (e.g. Paris Agreement). The CoMet mission will be carried out in **May/June 2018** (14.05.-12.06).

Airborne Instrumentation: Active and passive remote sensing + in-situ on three aircraft

	Aircraft	Instrument acronym		Description
D-ADLR operated by: DLR Max. altitude: ~15 km Endurance: > 10 h Typ. speed: 220 m/s Max. payload : ~ 3 t		CHARM-F	DLR	Lidar (IPDA) (**XCO_2 and XCH_4**)
		HALO_JIG	MPI	Cavity Ringdown Spectrometer (**CO_2, CH_4, CO, H_2O**)
		HALO_JAS	MPI	Flask sampler (**isotope** analysis, ^2H, ^{13}C, and ^{18}O)
		miniDOAS	IUP-UH	Differential Optical Absorption Spectroscopy (various trace gases)
		BAHAMAS	DLR	HALO basic data acquisition system (**p**, T, q, attitude)
		Dropsondes	DLR	Meteorological sondes (p, T, q, **wind**)
		FOKAL	Menlo/DLR	Miniaturized Frequency comb
D-EAFU operated by: FU Berlin Typ. op. height: 3-4 km Endurance: 3 h Typ. speed: 50-60m/s Payload: ~0.36 t		MAMAP	IUP-UB	NIR spectrometer (**XCO_2 and XCH_4**)
D-FDLR Operated by: DLR Max. altitude ~6 km Endurance 3-4h Typ. speed: 60-80m/s Max payload: 1.2 t Typ. Payload:		QCLS	DLR	Quantum Cascade Laser Spectrometer (**CH_4, CO, CO_2, C_2H_6, N_2O, H_2O**)
		CRDS	DLR	Cavity Ringdown Spectrometer (**CO_2, CH_4**)
		C-AS	DLR/MPI	Flask sampler (**isotope** analysis, ^2H, ^{13}C, and ^{18}O)
		METPOD	DLR	Cessna basic data acquisition system (**p**, T, **wind**, q, attitude)

CoMet measurement strategies



- Greenhouse gas columns using IPDA lidar from HALO flight level to ground (CHARM-F).
- Greenhouse gas columns from the boundary layer top using passive remote sensing (MAMAP).
- Accurate profiling from flight level to the boundary layer: in-situ.
- Extension of the profiles down into the boundary layer: Cessna aircraft.
- Identification of local and regional emission sources.
- Flux estimates (passive remote sensing, lidar, and in-situ mass balance approach.
- Origin identification by isotope analysis.
- Provision of data for regional inverse modeling, global climate chemistry model with global/regional nesting.
- Synergetic use of active and passive instruments.
- Test of this unique infrastructure for satellite validation (Sentinel-5P, GOSAT 2, MERLIN,…..)
- Characterize variability of XCH4 beyond and below satellite pixel size.

Goals of CoMet?

- Can we measure gradients of the dry-air columns of both **CH_4 and CO_2** to a degree where **local, regional and sub-continental scale fluxes** can be estimated by means of inversion modelling better than with existing approaches? Can we provide a better understanding of mesoscale inverse modelling?
- Can we identify and quantify (in a top/down approach) **local and regional sources of greenhouse gases** such as power plants, landfills, city plumes, geological sources, or wetlands?
- Can we prove that the proposed payload constitutes an adequate European infrastructure **to validate current and future spaceborne missions** such as Sentinel-5P, MERLIN, GOSAT-2, OCO-2, Sentinel-5, or ASCENDS?

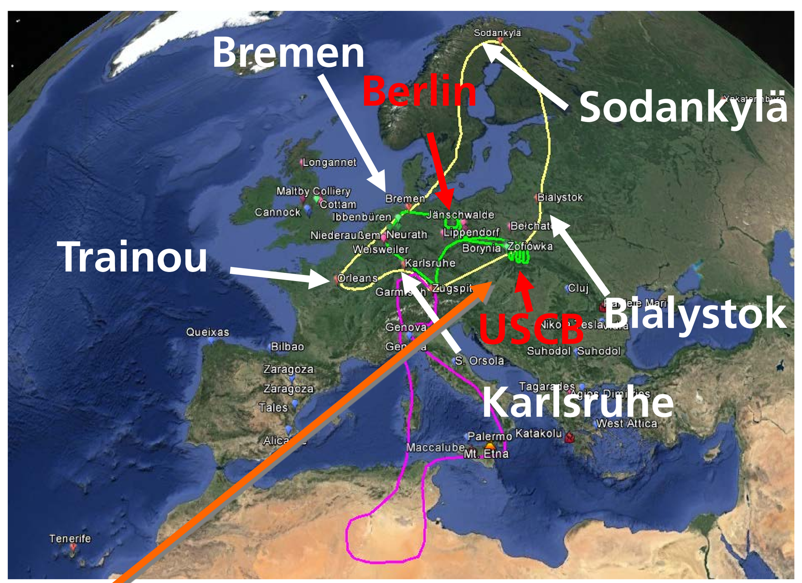
Flight Patterns

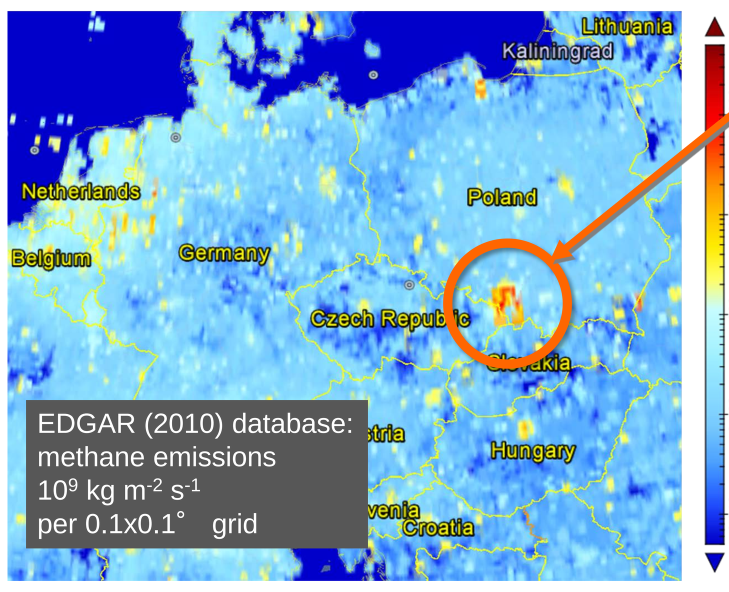
Tentative HALO flights:

- 63 flight hours, ~ 8 flights
- Base: Oberpfaffenhofen

Goals:

- TCCON sites and AirCore launches
- Latitudinal gradients
- Coal mines, power plants, landfills
- Urban areas
- Orography, vegetation, albedo



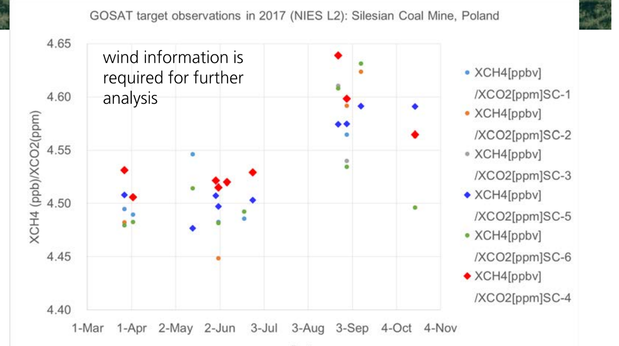


The upper Silesian Coal Basin (USCB) is a very interesting target area. Due to coal mining it is the European methane hot spot and also exhibits other anthropogenic and natural sources.

During CoMet, Katowice airport will be the base for the Cessna aircraft.

Satellite Validation (GOSAT and S5P)

For CoMet, GOSAT started to perform targeted measurements since early 2017 over six selected sites in Upper Silesia.



Credit:
Akihiko Kuze, JAXA

Additional Instrumentation / Partnering Institutions

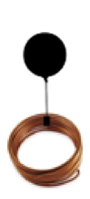
In **Poland**:
ground based measurements

Mobile EM27/SUN FTIR (COCCON) operated by KIT, TU Munich, DLR

Van-based in-situ instrumentation for GHGs and isotopic composition operated by AGH University, MEMO2 project (U Heidelberg, Utrecht, LSCE, …)

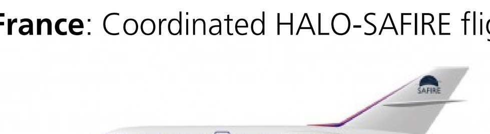
Ground based wind lidar operated by DLR

Drones with AirCore operated by U Groningen



AirCore launches in Sodankylä, FIN

In **France**: Coordinated HALO-SAFIRE flights



French SAFIRE F20

TCCON and EM27/SUN overflights
AIRCORE and airborne in-situ comparison

Partners: LSCE, CNES, CNRS, SAFIRE
Common goal: Preparation of MERLIN validation

Copernicus Atmosphere Monitoring System (CAMS)

Field Campaign Support

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30/01/2018