Project: **1231**
Project title: **CAMELOT:**
Principal investigator: **Julia Marshall**
Report period: **2025-11-01 to 2026-10-31**

Overall, fewer computing resources than originally foreseen were carried out over the past year. There are three main reasons for this. Firstly, there were personnel limitations, particularly in WP5, where the student that was meant to carry out the simulations did not end up starting in January as planned. Additionally, substantial time and resources went into preparing for and carrying out the CoMet 3.0 Tropics flight campaign in Brazil in summer 2026, which affecting the scientists working on WPs 1, 4 and 6. Finally, the project PI took on the scientific lead of a joint German-Brazilian satellite mission (CO2Image) in April, once the Brazilian space agency (INPE) confirmed their participation. This resulted in a substantial change in the focus of their work for much of 2026.

WP1 – Regional greenhouse gas inversions using WRF-STILT

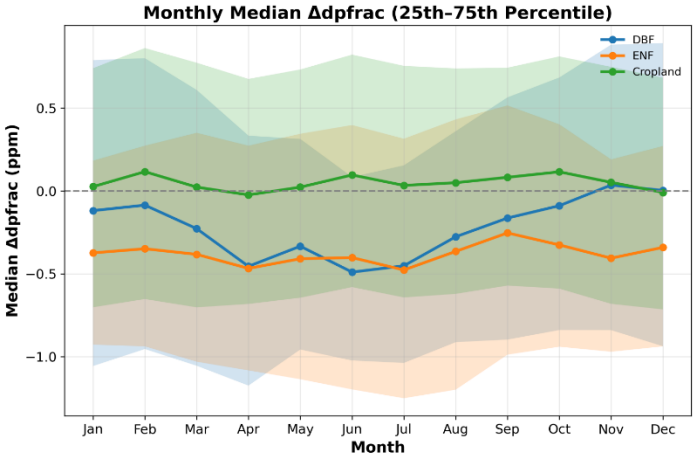
In 2026, STILT footprint simulations were computed for three CoMet 2.0 flights focussed over wetlands and Lake Winnipeg. Several iterations were done with different numbers of receptors. In addition, preliminary Bayesian inversion was carried out to estimate posterior flux for one CoMet 2.0 flight. This is still under progress, exploring the impact of tuning various parameters on the inversion results. In total, 198 CPU node hours and 1.51 TiB storage were consumed for this work. This work is planned to be continued on CoMet 2.0 flights and also will be extended to CoMet 3.0 wetland flights successfully conducted in summer 2026.

WP2 – Global greenhouse gas inversions

The global inversions for the GHG-CCI+ project will only be carried out in November and December, 2026, following a delayed project start for administrative reasons.

Work in the CH4DAS project has focussed on forward simulations of the wetland process model thus far, as the development of the adjoint code for the wetland model, carried out by a project partner, will be complete until early 2027. Thus, the coupling to the global inversion system will only take place in 2027.

In the DiSMISS project, work has continued on analysis of the seasonal variability in surface height, and what this means for remote sensing retrievals of atmospheric greenhouse gases. The analysis has been extended to include retrieval parameters from XCO_2 measured by OCO-2, specifically to look for seasonal signals in the difference between the prior and retrieved surface pressure as a function of land cover type. This is complicated by the fact that this pressure difference (dpfrac) contains several airmass-related effects, that first need to be subtracted. Thus, global, monthly zonal curve was fit for all dpfrac values, and subtracted, resulting in Δdpfrac. When analyzed globally as a function of dominant land cover type, a seasonal cycle is seen for deciduous broadleaf forest (DBF), which is lacking in evergreen needleleaf forest (ENF) and Cropland, as shown on the right (monthly medians, with shaded areas showing 25th and 75th percentiles). A manuscript describing these results is under preparation.



Related work resulted in a publication related to the ability of passive and active remote sensing satellites to measure Arctic methane signals, which was published in the reporting period (Pallandt et al., 2025), in which the use of DKRZ resources from this project were acknowledged.

WP3 – Development of AI methods for plume detection and biogenic flux estimation

Most of the work related to AI methods for biogenic flux estimation has been moved to a different computing facility (Terrabyte, of the Leibniz Supercomputing Centre) due to the availability of various remote sensing datasets – particularly Sentinel-2 reflectances – on disk there.

The work on the AI-based methods for plume detection and emission estimation continued, and the second

publication related to this work is currently under review for Atmospheric Measurement Techniques (Plewa et al. 2026), with appropriate acknowledgment of the computing resources. It was also presented at the IWGGMS 2026 meeting in Bonn [slides].This work is part of the doctoral thesis of Thomas Plewa, who will be defending his thesis at Ruprecht-Karls-Universität Heidelberg in January, 2027.

WP4 – Plume dispersion forecast and analyses for aircraft campaigns

The dispersion forecast simulations envisaged for the CoMet 3.0 Tropics campaign were not conducted after all, because (i) the focus was mostly on area sources, and (ii) with long lead times for planning, plus limited flexibility for approved flights, such simulations could not add much value. However, some of the requested resources were used for the processing of emission inventories that were then extensively used for flight planning during the campaign.

WP5 – LES modelling of plumes

Of the planned LES modelling work, only a fraction was carried out, as the doctoral candidate who was supposed to begin work in January ended up not joining DLR.

The planned simulations for hydrogen plume dispersion in the DLR-project CLEANLIEST are pending.

The scope of the simulations planned for the Horizon Europe project “SCARBOn” was substantially reduced because only one flight was carried out instead of the planned five. Approximately 10 node hours were used so far in the reporting period. Analysis of the results from the flight campaign is pending (including the finalized Level-2 retrievals from the instrument), so thus far only coarse-resolution test simulations have been carried out.

WP6 – Inverse modelling of CH_4 emissions from anthropogenic sources

The analysis of the CoMet 2.0 oil and gas data that was originally intended to proceed alongside other funded projects was simply not feasible, given personnel limitations and the demands of aircraft campaigns in 2026. As no personnel funding is currently available for this subtask, the work is on hold until further notice.

The storage occupied in 2026 (12.30 TiB) originates from the WRF-CTDAS simulations for the Upper Silesian Coal Basin. The results were published in a doctoral thesis (Wolff, LMU Munich, 2025), and a journal publication is in preparation. Until it is completed, the data cannot be moved to the long-term archive.

In addition, CTDAS-WRF simulations were carried out to support the ongoing development of the model. Approximately 150 node hours were used for this work.

The focus of WP6 was expanded into an inverse modelling project for European CO_2 fluxes. This project was an update of the work performed in WP1 from 2023, “Regional CO_2 inversions for Europe”. The previous results were updated to incorporate improvements in the CIF model. This work was part of an inverse model intercomparison project using CIF-WRF. The results were presented at EGU 2026 (Thanwerdas et al., 2026). A publication of these results is currently in preparation. In the reporting period, approximately 250 node hours were used for this work.

References

Pallandt, M. M. T. A. et al.: If the Yedoma thaws, will we notice? Quantifying detection limits of top-down methane monitoring infrastructures, Atmos. Meas. Tech., 18, 7053–7073, https://doi.org/10.5194/amt-18-7053-2025, 2025.

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Thanwerdas, J. et al.: The Community Inversion Framework as an operational tool for inverse modelling: towards robust, streamlined, and automatized intercomparisons of top-down estimates, EGU General Assembly 2026, Vienna, Austria, 3–8 May 2026, EGU26-18213, https://doi.org/10.5194/egusphere-egu26-18213, 2026.

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