

OVERVIEW and STATUS of the METHANE REMOTE SENSING LIDAR MISSION: MERLIN

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Methane (CH₄) is known to be the second most important greenhouse gas after Carbon Dioxide (CO₂). On a 20-year timescale, the warming potential of CH₄ is even 84 times higher than that of CO₂. Therefore, reducing CH₄ emissions to slow down man-made climate change is of great urgency. Detailed observations of CH₄ also from space are critical to monitor and control the progress of these efforts.

The Methane Remote Sensing Lidar Mission (MERLIN), a joint cooperation between Germany and France on developing and operating a satellite dedicated to monitor atmospheric CH₄ from space, will be the first greenhouse gas space mission using active remote sensing. The method is based on an Integrated Path Differential Absorption (IPDA) nadir-viewing Lidar instrument. After successfully completing the payload and satellite critical design reviews, MERLIN is in phase D of its mission life cycle since 2021. The launch of MERLIN is anticipated to take place in ~ 2027.

Once in orbit MERLIN will deliver weighted atmospheric columns of CH₄ dry-air mole fractions for all latitudes and all seasons with an estimated systematic error of only 1.8 ppb. This offers the potential to constrain CH₄ fluxes significantly better than with current passive remote sensors, especially in the Arctic where those instruments have observation gaps in seasons with low solar zenith angles and in particular during the polar night.

In order to prepare the validation of MERLIN various campaigns such as the MAGIC campaigns (a French initiative) and the CoMet campaigns led by the DLR Institute for Atmospheric Physics have taken or will take place. CHARM-F, an airborne demonstrator of MERLIN, has already measured weighted vertical columns of CH₄ (and CO₂) during CoMet 1.0 in 2018 on board the German HALO aircraft and during the MAGIC campaign in 2021 on board the French research aircraft ATR-42, respectively. This instrument will also be on board the HALO aircraft during the CoMet 2.0 campaign in August and September 2022, focusing on the Canadian Arctic region. Together with complementary data from various other CH₄ sensors, the collected airborne lidar data during these campaigns are important not only for preparing the MERLIN validation. They also allow for mission support such as for e. g. algorithm development and improvement.