

Impact of Meteorological Uncertainties in the Methane Retrieval Ground Segment of the MERLIN Lidar Mission.

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MERLIN (MEthane Remote sensing LIdar missioN) is a Franco-German space mission designed to provide weighted columns of atmospheric methane through a processing of the lidar signal using a priori information on the atmospheric state. Uncertainties in the meteorological parameters used in the ground segment contribute to the error budget on the retrieved methane column.

Previous studies estimate this budget from statistics of the differences between numerical weather model forecasts and observations and conclude to a bias of 0.7 ppb and a standard deviation of 7 ppb.

With the LIDSIM (LIDar SIMulator) data simulator and the PROLID (PROcessor LIDar) inversion processor developed for MERLIN, we perform an impact experiment using ECMWF (European Centre for Medium Weather Range Forecast) ensemble forecast data. Using fifty perturbed forecasts representing the uncertainties around the actual state, we estimate the error in the methane column due to the uncertainties in the meteorological parameters used in the lidar signal processing as a bias of 0.4 ppb and a standard deviation of 0.6 ppb, half induced by the uncertainty in the surface pressure and for the remaining part half induced by the uncertainty in the total amount of water (the improvement compared to previous studies is mainly due to the progress in numerical weather forecasting).

Furthermore, we innovate by discussing the impact of interpolation both in time and space. We focus on vertical extrapolations under topography by testing state-of-the-art methods (using standard gradients as in the usual operational treatments by meteorological centers or conservation properties to keep the boundary layer structure).

We conclude that in areas where the topography variations exceed 10 m over 10 km with highly variable topography, an additional random error of 0.1 ppb is to take into account because of these extrapolations.

But more importantly we refer to unpublished results to highlight that the main source of regional bias can be as high as 2 ppm (which is a major problem for models trying to identify methane sinks and sources) in relation to the 3-hour time interpolation of tidal waves. Work will be done on that point in the future.