Abstract

Several studies carried out in recent years showed that airborne measurements of methane can make a valuable contribution to the increasingly important task of greenhouse gas emission monitoring and attribution. One emerging point of focus for near-term emission mitigation and reduction is the CH_4 emitted from coal seams during open-pit and underground mining operations. The Bowen Basin located in Queensland, Australia covers more than $60.000\,km^2$ with 44 mining locations. It contains the largest coal reserves in Australia and is one of the world's largest deposits of bituminous coal. This survey was motivated by an earlier satellite data analysis suggesting long-term averaged high methane enhancements in the region while raising the question of source allocation. This thesis utilizes the method of mass balance-based emission flux estimates to determine the fluxes of four coal mining operations in the basin using a dataset acquired during the Bowen Basin Coal Mapping (BBCMap) 2023 Pre-Survey conducted by ARA. A single-engine research plane was equipped with a greenhouse gas analyzer, an air data probe and a light detection and ranging (LIDAR) scanner to obtain concentration measurements downwind of the source regions and scans of the mine's topography. In this thesis an algorithm was developed, tested and applied that calculates the resulting flux including the error estimate for every downwind wall flown. The measured horizontal transects at different heights were interpolated using linear interpolation and Kriging. The resulting fluxes, while being insensitive to the interpolation technique, showed significant discrepancies when compared with emissions calculated from productivity data reported by government sources. The results indicate that some of the mining operations surveyed likely emit higher quantities of methane than calculated using basin-wide emission factors. To substantiate these findings, multiple measurements during different days and meteorological conditions for one mine would be required to compensate for variations in the mine's emission intensity.