Geophysical Research Abstracts
Vol. 17, EGU2015-5135, 2015
EGU General Assembly 2015

Fugitive methane emissions from natural, urban, agricultural, and energy-production landscapes of eastern Australia

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Modern cavity ringdown spectroscopy systems (CRDS) enable the continuous measurement of methane concentration. This allows for improved quantification of greenhouse gas emissions associated with various natural and human landscapes. We present a subset of over 4000 km of continuous methane surveying along the east coast of Australia, made using a Picarro G2301 CRDS, deployed in a utility vehicle with an air inlet above the roof at 2.2 mAGL. Measurements were made every 5 seconds to a precision of <0.5 ppb for CH4. These surveys were undertaken during dry daytime hours and all measurements were moisture corrected. We compare the concentration of methane in the near surface atmosphere adjacent to open-cut coal mines, unconventional gas developments (coal seam gas; CSG), and leaks detected in cities and country towns.

In areas of dryland crops the median methane concentration was 1.78 ppm, while in the irrigation districts located on vertisol soils the concentration was as low as 1.76 ppm, which may indicate that these soils are a sink for methane.

In the Hunter Valley, New South Wales, open-cut coal mining district we mapped a continuous 50 km interval where the concentration of methane exceeded 1.80 ppm. The median concentration in this interval was 2.02 ppm. Peak readings were beyond the range of the reliable measurement (in excess of 3.00 ppm). This extended plume is an amalgamation of plumes from 17 major pits 1 to 10 km in length.

Adjacent to CSG developments in the Surat Basin, southeast Queensland, only small anomalies were detected near the well-heads. Throughout the vast majority of the gas fields the concentration of methane was below 1.80 ppm. The largest source of fugitive methane associated with CSG was off-gassing methane from the co-produced water holding ponds. At one location the down wind plume had a cross section of approximately 1 km where the concentration of methane was above 1.80 ppm. The median concentration within this section was 1.82 ppm, with a peak reading of 2.11 ppm.

The ambient air methane concentration was always higher in urban environments compared to the surrounding countryside. Along one major road in Sydney we mapped an interval that extended for 6 km where the concentration was greater than 1.80 ppm. The median concentration in this interval was 1.90 ppm, with a peak reading of 1.97 ppm. This high reading in an urban setting is most likely due to leaks from the domestic gas distribution system. Methane leaks were detected in all country towns.

Our measurements show that at the point of resource extraction the methane emission footprint of CSG is smaller than that of open-cut coal mining. However, leaking gas from urban centers must be added to the fugitive emissions of CSG to calculate the total fugitive emission footprint of CSG, which may therefore not be as low as claimed in the national greenhouse gas accounts. Our results highlight the need for additional continuous monitoring of methane emissions from all sectors, and for the full life-cycle of energy resources to be considered.