Methane Observations in Alberta and Saskatchewan (Canada): Distinct Signals from Oil and Gas Activities.

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Environment Canada's (EC) atmospheric greenhouse gas (GHG) measurement program currently conducts on-going accurate atmospheric measurements of carbon dioxide (CO_2), methane (CH_4), and other GHGs from 22 coastal, interior and high Arctic regions in Canada. The primary aim of the program is to use measurements, along with modeling to independently estimate anthropogenic and natural GHG emissions and sinks in Canada. The increase and decrease of observed concentrations in the lower atmosphere reflects the transport of surface emissions of GHGs over several hundred square kilometers, resulting from winds and mixing in the atmosphere. It is possible to infer the magnitude of emissions from observed atmospheric concentrations using atmospheric transport models, if the network of surface observational sites is sufficiently dense.

This presentation will focus on describing the observational patterns of methane observed in winter at 2 sites in Alberta at Lac la Biche (2007) and Esther (2009) and at 2 sites in Saskatchewan at East Trout Lake (2002) and Bratt's Lake (2009). These sites are of particular interest because emissions of methane from fossil fuel activities in Alberta and Saskatchewan account for ~70% of emissions from this source for the entire country. Figure 1 shows the hourly time series of methane from Lac la Biche (LLB). Often CH_4 mole fractions larger than 2500 nmol mol^{-1} are observed. Similar patterns are observed at the other 3 sites in winter as well. To investigate the potential CH_4 source regions influencing these measurement stations, the concentration weighted trajectory (CWT) receptor model (*Seibert et al.*,1994) was applied to the methane from the four stations during winter. Figure 2 shows the concentration distribution pattern from the CWT receptor model for Lac la Biche. It's clear that much of the higher signals are due to transport from the Edmonton area, located around 170 km south of the Lac la Biche station. These results are consistent with the CWT receptor model outputs for the other 3 stations as well. For 2008 to 2013, NOAA conducted quasi weekly sampling at Lac la Biche for a suite of parameters, including the stable isotope of ^{13}C in methane. The results show a very distinct source signature of -57.00±0.82‰, much lighter than expected for winter, but none the less, possibly highlighting the strong influence of CH_4 emissions from the gas industry on the CH_4 measurements at Lac la Biche.

Reference: Seibert, P., H. Kromp-Kolb, U. Baltensperger, D. Jost, M. Schwikowski, A. Kasper, and H. Puxbaum (1994), Trajectory analysis of aerosol measurements at high alpine sites, *Transport and Transformation of Pollutants in the Troposphere*, 689-693.

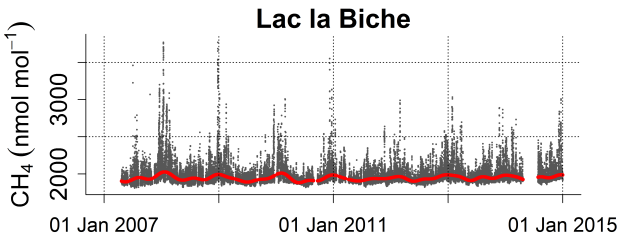

Figure 1. Hourly CH_4 mole fractions at Lac la Biche, Alberta. The red line is the smooth curve.

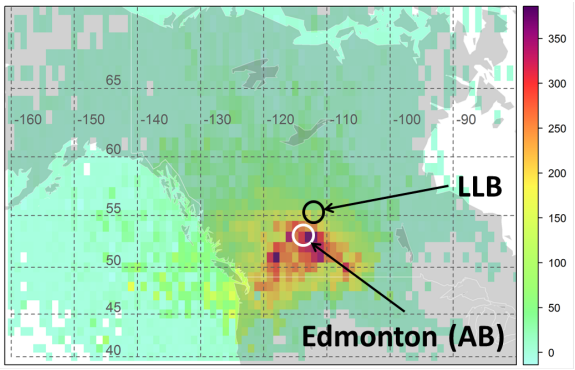

Figure 2. Result of the CWT receptor model at La la Biche (LLB) in winter.