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Methane in Arctic Air during 2008: Monitoring Methane Mixing Ratio and Stable Isotopic Composition

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The Arctic contains vast quantities of stored methane and emissions from these sources are very sensitive to temperature change. Warming of the Arctic will increase methane emissions from sources such as wetlands and clathrate, producing a feedback effect. 2007-2008 saw an increase in global methane concentrations and increased emissions from the Arctic may have contributed to the rise. Stable isotopic analysis of atmospheric methane (δ^{13}C), together with back trajectory analysis of the air masses sampled can be used to obtain isotopic signatures of the major source regions, and help in identification of changing sources. By determining the incremental mixing ratio and change in δ^{13}C of methane in air coming from a chosen sector, compared with regional background, the signature of the methane source(s) can be calculated.

Methane δ^{13}C has been measured in air samples collected every two weeks at the Zeppelin station in Spitsbergen since July 2007. Samples were also collected daily at the station throughout the summer of 2008.

The release of methane from geological sources along the West Spitsbergen continental slope was investigated during a cruise on the Royal Research Ship James Clark Ross between 23 August and 24 September 2008 as part of a UK NERC funded International Polar Year Project, 'Dynamics of Gas hydrates in polar marine environments'. Plumes of gas bubbles were identified using a 38-kHz sonar, and concentrations of methane dissolved in seawater at the sites of some of these plumes were measured. At the plume sites, located in water depths shallower than 400 m, concentrations of dissolved methane were up to 20 times greater at the bottom of the water column than in surface water.

Despite the presence of the gas plumes in the water column, atmospheric methane mixing ratios measured from the ship tended to be slightly lower than measurements made at the Zeppelin station on the same days. The highest atmospheric methane mixing ratios were measured when 5-day back trajectories had passed over Siberia. Methane in these samples was relatively depleted in ^{13}C. For example air masses that had passed over the Ob River gas field area had a methane δ^{13}C source signature of -58 $\pm$ 2 ‰. This is likely to originate from mixing between methane derived from gas (around -49 ‰) and wetland (around -67 ‰).

Throughout this period samples were collected for methane isotope measurements along the northern coast of Siberia on the H/V Jacob Smirnitsky (International Siberian Shelf Study 2008). Mixing ratio and stable isotopic composition of methane in air collected during the two cruises will be compared.

Methane mixing ratio and δ^{13}C have also been measured in samples collected 4 to 5 days a week throughout August and September 2008 at Mace Head, an Atlantic background station on the west coast of Ireland and source signatures for the Arctic sector calculated.

Continued monitoring of δ^{13}C of Arctic methane is vital to monitor changes in emission from sources within this highly sensitive region.