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Quantifying the relative contribution of natural gas fugitive emissions to total methane emissions in Colorado and Utah using mobile stable isotope (13CH4) analysis

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Fugitive emissions of methane into the atmosphere are a major concern facing the natural gas production industry. Because methane is more energy-rich than coal per kg of CO_2 emitted into the atmosphere, it represents an attractive alternative to coal for electricity generation. However, given that the global warming potential of methane is many times greater than that of carbon dioxide (Solomon et al. 2007), the importance of quantifying the fugitive emissions of methane throughout the natural gas production and distribution process becomes clear (Howarth et al. 2011). A key step in the process of assessing the emissions arising from natural gas production activities is partitioning the observed methane emissions between natural gas fugitive emissions and other sources of methane, such as from landfills or agricultural activities. One effective method for assessing the contribution of these different sources is stable isotope analysis. In particular, the 13CH4 signature of natural gas (-35 to -40 permil) is significantly different that the signature of other significant sources of methane, such as landfills or ruminants (-45 to -70 permil).

In this paper we present measurements of mobile field 13CH4 using a spectroscopic stable isotope analyzer based on cavity ringdown spectroscopy, in two intense natural gas producing regions of the United States: the Denver-Julesburg basin in Colorado, and the Uintah basin in Utah. Mobile isotope measurements in the nocturnal boundary layer have been made, over a total path of 100s of km throughout the regions, allowing spatially resolved measurements of the regional isotope signature. Secondly, this analyzer was used to quantify the isotopic signature of those individual sources (natural gas fugitive emissions, concentrated animal feeding operations, and landfills) that constitute the majority of methane emissions in these regions, by making measurements of the isotope ratio directly in the downwind plume from each source. These data are combined to establish the fraction of the observed methane emissions that can be attributed to natural gas activities in the regions. The fraction of total methane emissions in the Denver-Julesburg basin that can be attributed to natural gas fugitive emissions has been determined to be 71 +/- 9%.

References:
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