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Running a new 3-D variational inversion system to assimilate isotopic observations along with CH4 observations.

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Atmospheric CH4 mixing ratios resumed their increase in 2007 after a plateau during the period 1999-2006, suggesting a change of mix between sources and/or varying sinks. Exploiting observations within an inverse modeling framework (top-down estimates) is a powerful approach that reconciles observed and simulated CH4 mixing ratios using prior knowledge of CH4 sources and sinks. It is nevertheless challenging to efficiently differentiate co-located emissions from different sectors categories with CH4 observations alone. As a result, understanding CH4 burden changes and attributing these changes to specific source variations are difficult. CH4 source isotopic signatures differ between emission categories (biogenic, thermogenic and pyrogenic), and can therefore be included to disentangle overlapping sources.

However, assimilating 13CH4 observations using inversion methods is challenging, especially with a variational framework. Here, a new 3-D variational inverse modeling framework implemented within the Community Inversion Framework [Berchet et al., 2020] and designed to assimilate 13CH4 and CH3D observations along CH4 observations is presented. This system is capable of optimizing emissions and associated source signatures of multiple emission categories independently at the pixel scale. Multiple tracers are transported by the LMDz 3-D model in order to properly simulate the clumped isotopologues of CH4.

We present very briefly the technical implementation of such multi-constraints in the variational system and show preliminary results of long-term inversions for the period 1998-2018.

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