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# Multi-years simulations of atmospheric $CH_4$, $\delta^{13}$C-$CH_4$ and $\delta$D-$CH_4$

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The atmospheric concentration of methane has increased by more than a factor of two since the start of the preindustrial era, due to human activities such as fossil fuel usage and intensive agriculture. After a continuous increase during the $20^{th}$ century, measurements show an almost steady mixing ratio from 1999 to 2006, followed by a new increase since 2007.

The main driver of those recent changes is the subject of a scientific debate. Plausible hypothesis have been proposed for the growth-rate slowdown, which however remain difficult to prove. The main obstacle in understanding the observed trend of methane is the lack of accurate estimates of the individual source processes involved in the methane cycle. Moreover, the main sink, the hydroxyl radical, OH, is not directly measurable on a large scale and is therefore poorly constrained.

In order to better characterize the methane budget, one possibility is to use isotopic ratios of atmospheric methane, as these ratios carry process specific information. During the last 15 years, isotopic measurements have become more common and we have now a relatively good geographical coverage, of time series spanning several years.

We used the global chemistry-transport model TM3 to investigate the constraint imposed by the isotopic measurements. We performed coupled simulations of $CH_4$ and its two most common stable isotopologues, $^{13}$C-$CH_4$ and CH3D, using different sources and sink scenarios. The aim is to evaluate the isotopic implications of the different hypothesis explaining the recent methane growth rate variations. We evaluated the probability of those hypotheses by comparison of our results with the available measurements.

We will present first results which clearly show that isotopic measurements bring important information, confirming their usefulness, although a better characterizations of the isotopic fractionation factors of the individual process and a larger amount of measurements is needed, in particular for $CH_3D$.