1.0 Objective
The global atmospheric methane burden approached equilibrium from 1983 until 2006, after which atmospheric CH₄ increased because of increased emissions, decreased sink, or both.¹ Here we attempt to determine whether atmospheric CO records are consistent with the hypothesis that the recent increase in atmospheric CH₄ is entirely due to a decreased sink.

2.0 Methods
- CO and CH₄'s primary sink is the same: reaction with OH radical. If there was a change in the sink for CH₄, there would be a corresponding change in the behavior of CO observations.
- A one-box, global model was employed to model an approach to steady-state for the time period up to 2007 with the assumptions of a lifetime of 9.1 years¹ and constant emissions. How the lifetime would need to change in order to match global observations for 2007 to present was then calculated using the same constant emissions.

CH₄ One Box Model:

\[
\frac{d[CH₄]}{dt} = Q - \frac{[CH₄]}{\tau}
\]

- Where \([CH₄]\) is the burden (determined from measurements of its atmospheric mole fraction), Q is emissions, and \(\tau\) is the lifetime

2.1 Methods
- Many linear fits were made to fit methane observations for the time period from 2007 to present, using a Monte Carlo method: taking random samples with a standard normal distribution from the ranges of uncertainty of the observed data.
- Each linear fit corresponds to a different constant rate of change in the lifetime of CH₄ from year to year.

2.2 Methods
- These rates of change were then applied to the lifetimes of CO in a a two-box model using the following conversion.

\[
\frac{\Delta \tau_{CH₄}}{\tau_{CH₄}} = \frac{\Delta \tau_{CO}}{\tau_{CO}}
\]

2.3 Methods, CO Two Box Model:

\[
\frac{d[CO]}{dt} = Q - \frac{[CO]}{\tau} - f(N-S)
\]

- Where Q is emissions, \([CO]\) is the concentration of CO, \(\tau\) is the lifetime, f is the interhemispheric exchange constant, and N-S is the difference between Northern and Southern Hemisphere CO.

2.4 Methods
- Linear fits were calculated for up to 2007 by using an assumed constant lifetime of 0.18 years and finding the consequent trend in emissions for 1991-2006.
- This resulting linear fit was extrapolated through 2007-2015, to model no change.
- Curves calculated from the two-box model vary the time for interhemispheric transport by 3%, and annual lifetimes in accordance with modeled CH₄ lifetime changes

3.0 Results
- The two-box CO model results calculated with perturbed lifetimes to match CH₄ deviate only minimally from the linear trends – largely within the variability of the observed data.
- Based on our analysis of CO, it is inconclusive whether a change in lifetime was the sole cause for the increase in atmospheric CH₄ since 2007.

4.0 Bibliography

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