Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06765, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06765
EGU General Assembly 2008

Early anthropogenic CH_4 emissions and the variation of CH_4 and $^{13}CH_4$ over the last Millennium

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This study presents a new hypothesis to explain the observed variation of CH_4 and δ^{13}C-CH_4 over the last millennium. It was originally proposed that the observed minimum of δ^{13}C-CH_4 prior to the start of industrialization is caused by a large shift in biomass burning emissions between 1400 and 1700 AD. According to our new hypothesis, however, the δ^{13}C-CH_4 minimum is the first sign of the global rise of anthropogenic CH_4 emissions. The main idea is that emissions of isotopically depleted CH4, from, for example, rice cultivation, domestic ruminants and waste treatment started increasing earlier than the isotopically enriched emissions from fossil fuel, which started with the start of industrialization. However, because the observed increase of atmospheric methane only started around 1750 AD, these preindustrial anthropogenic emissions must have been accompanied by a net reduction of natural CH_4 sources during the Little Ice Age compensating the increase of anthropogenic emissions during that period. We will present results of transient box model simulations for the last millennium showing that under the new hypothesis a close agreement can be obtained between model and measurements. However, as will be explained, this requires specific assumptions regarding the natural source composition and the response of those sources to climatic variations, which call for further research.