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The atmospheric cycling of radiomethane and the "fossil fraction" of the methane source

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Abstract. The cycling of $^{14}CH_4$ ("radiomethane") through the atmosphere has been strongly perturbed in the industrial era by the release of ^{14}C-free methane from geologic reservoirs ("fossil methane" emissions), and in the nuclear era, especially since ca 1970, by the direct release of nucleogenic radiomethane from nuclear power facilities. Contemporary measurements of atmospheric radiomethane have been used to estimate the proportion of fossil methane in the global methane source (the "fossil fraction"), but such estimates carry high uncertainty due to the ill-determined nuclear-power source. Guided by a mass-balance formulation in a companion paper, we apply a contemporary time series of atmospheric radiomethane to quantify both the fossil fraction and the strength of the nuclear power source. We deduce that 30.0±2.3% (1 s.d.) of the global methane source for 1986–2000 has fossil origin, a fraction which may include some ^{14}C-depleted refractory carbon such as from aged peat deposits. Since this estimate depends upon the validity of assumptions underlying a linear regression model, it should be seen as providing a plausible re-estimate rather than a definitive revision. Such a fossil fraction would be much larger (by 50%) than is commonly accepted, with implications for inventory compilation. The co-estimated strength of the global nuclear-power source of radiomethane is consistent with values inferred independently from local nuclear facilities.

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