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Trends and inter-annual variability of methane emissions derived from 1979-1993 global CTM simulations

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Abstract. The trend and interannual variability of methane sources are derived from multi-annual simulations of tropospheric photochemistry using a 3-D global chemistry-transport model. Our semi-inverse analysis uses the fifteen years (1979--1993) re-analysis of ECMWF meteorological data and annually varying emissions including photo-chemistry, in conjunction with observed CH_4 concentration distributions and trends derived from the NOAA-CMDL surface stations. Dividing the world in four zonal regions (45--90 N, 0--45 N, 0--45 S, 45--90 S) we find good agreement in each region between (top-down) calculated emission trends from model simulations and (bottom-up) estimated anthropogenic emission trends based on the EDGAR global anthropogenic emission database, which amounts for the period 1979--1993 2.7 Tg CH_4 yr^{-1}. Also the top-down determined total global methane emission compares well with the total of the bottom-up estimates. We use the difference between the bottom-up and top-down determined emission trends to calculate residual emissions. These residual emissions represent the inter-annual variability of the methane emissions. Simulations have been performed in which the year-to-year meteorology, the emissions of ozone precursor gases, and the stratospheric ozone column distribution are either varied, or kept constant. In studies of methane trends it is most important to include the trends and variability of the oxidant fields. The analyses reveals that the variability of the emissions is of the order of 8Tg CH_4 yr^{-1}, and likely related to wetland emissions and/or biomass burning.

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