Methane and its isotopologues simulated with a chemistry-climate model to evaluate the atmospheric burden and the uncertainty of emissions

Current estimates of atmospheric methane and its emissions still inherit large uncertainties. Chemistry-climate models can help to reduce these uncertainties and improve insight into atmospheric processes.

The ECHAM/MESSy Atmospheric Chemistry (EMAC) model is a modular and high flexible 3D chemistry-climate model. Using the EMAC model we simulate atmospheric methane by applying the submodel CH4, which calculates the methane chemistry including the isotopologues $^{12}CH_4$ and $^{13}CH_4$, and CH_4 and CH_3D respectively, with adjusted reaction rates regarding the kinetic fractionation effect (KIE). We use different emission set-ups and isotopic ratios of methane sources, to assess the model sensitivity and prepare simulation data for inverse modelling of emission rates.

We show first results comparing the burden of simulated atmospheric methane using various data sets as, for example from the NOAA/ESRL, the CARIBIC project and balloon borne measurements, with the latter one also providing $\delta D(CH_4)$ and $\delta^{13}C(CH_4)$. Furthermore, we suggest a framework to use information about the isotopological composition for the evaluation of distinct methane emission sources on local scale.