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High-resolution water isotope modelling on a global scale

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In this study, we report results of the atmosphere general circulation model ECHAM5, which has recently been enhanced by explicit water isotope diagnosis (named ECHAM5wiso hereafter). Several new climate control simulations with present-day boundary conditions have been performed to evaluate the overall capability of the ECHAM5wiso model. While most of these new ECHAM5wiso simulations were run with an ordinary horizontal model resolution between 3.8° (T31 spectral resolution) and 1.8° (T63), an additional ECHAM5wiso simulation in T159 spectral mode employed a very fine spatial resolution of 0.75° by 0.75°. This is, to our knowledge, among the highest spatial resolution used for an atmospheric isotope general circulation model study, so far. Further studies with the ECHAM5wiso model setup include transient simulations covering the period 1958 – 2009, both in default and nudged simulation mode. In the latter case, atmospheric pressure and temperature fields of the ECHAM5 simulation have been relaxed towards observational values (ERA40 reanalysis and ERA-Interim data sets). Our analyses of these first ECHAM5wiso simulations reveal that the different simulation results are on a global scale in good agreement with different observational data sets, e.g. from the Global Network of Isotopes in Precipitation (GNIP). An overall convergence towards more realistic ECHAM5wiso simulation results can be detected for an increased horizontal and vertical model resolution. We also analyze, how much the agreement between the simulated isotopic composition in precipitation and vapor and various available observational data sets improves, when the ECHAM5wiso model is run in a nudged climate simulation mode.