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Sensitivity experiment of vertical diffusional parameter and CO₂ surface flux on CO₂ transport model MJ98-CDTM

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We intend to carry out data assimilation experiments of CO₂ by using a chemical transport model. In general, assimilation results are seriously affected by the performance of the chemical transport. Prior to assimilation experiments, we are studying the performance of the chemical transport model, related to the impact of vertical diffusion and the surface flux. The model used in this experiment is an online chemical transport model directly coupled to an atmospheric general circulation model (MJ98-CDTM), which is developed at Meteorological Research Institute (MRI). The model is integrated with respect to time for five years from 2002 and nudged to the atmospheric reanalyses of JRA-25. CO₂ distributions for 2006 are compared with the JMA CO₂ analyses.

The chemical transport model parameterizes effects of shallow convections as an enhanced vertical diffusion. The vertical diffusion has large impacts on the distributions of CO₂ and it is carefully tuned up through the comparison with JMA CO₂ analysis. Further study is needed to assess actual effects of vertical diffusions.

The chemical transport model is subject to the ambiguity of the CO₂ surface flux. The so-called CASA data is widely used. CASA data are processed in different ways between MRI and Japan Agency Marine-Earth Science and Technology (JAMSTEC). For this reason, we also examine sensitivity experiments using two CASA fluxes, from MRI and from JAMSTEC. As is expected, CO₂ distributions are also sensitive to the replacement of the surface flux. However, both results are still different from the JMA analyses.

Now, we are going to conduct data assimilation experiments using real observation data. In this course, we will examine the sensitivity of data assimilation to the vertical diffusion and the surface flux. The surface flux will be modified from the first guess in the data assimilation. However, it is suspected that the surface flux is affected by the first guess of the climatic value, because coverage of observation data is not dense enough to converge flux values.

Keywords: CO₂, data assimilation