

An AGCM transport and multi-tracer based analysis of atmospheric CO₂

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The quality of forward transport model simulations of atmospheric CO₂ relies mainly upon surface flux distributions and model transport. On the other hand confidence on surface CO₂ source/sink inversion vary largely with the transport model and observational data in use (e.g. Patra et al., GRL, 33, L05814, 2006 and references therein). Here by using a multi-transport model inversion (period: 2000-2002) and a set of a priori fluxes we simulate CO₂ concentration, for the period 2002-2004, using the CCSR/NIES/FRCGC atmospheric general circulation model (AGCM) based transport model (version: 5.7b, T42 L32). To estimate role of dynamics on CO₂ simulations, the AGCM is driven by SSTs only and nudged to NCEP-2 reanalysis (<ftp.cdc.noaa.gov>) winds and temperatures. We have tested the sensitivity of model transport to changing temporal resolution of sea-surface temperature (SST), and found negligible impact in nudged mode runs but significant for the SST driven AGCM runs. The optimally interpolated (OI) SSTs at monthly, weekly and daily time intervals are used in this work. Our preliminary analysis suggests the AGCM transport driven by daily SST only simulates synoptic scale CO₂ variability most realistically.

For all model simulations CO₂ concentrations are obtained at daily time interval (averaged), and compared with the observational data available at WDCGG (<http://gaw.kishou.go.jp>; hourly data only) with an emphasis on the measurements around Japan. Our main emphasis in this study is focused on the time series observations at three Japanese sites; namely, Minamitorishima, Ryori, and Yonagunijima, due to the availability of simultaneous measurements of CO₂, CO and O₃. The latter gases two are used for inferring contribution of emission distribution to CO₂ time series in comparison to the atmospheric transport. Note here that this AGCM based forward model realistically simulates the synoptic to large scale transport as the main dynamical fields are nudged, and thus simulates CO, O₃ time series relatively well (Takigawa et al., JGR, 110, D21313, 2005). As seen from this study this is not the case for CO₂, and the model-data mismatches can be largely attributed to uncertainties in surface CO₂ fluxes, predominantly the biospheric components. Some distinct cases showing the impacts of land biosphere, fire events, and oceanic fluxes on atmospheric CO₂ variability are identified during 2002 for our analysis.

Further detailed analysis is being carried out and final results will be presented during the meeting.

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