研究課題名：大気輸送モデルとインバースモデルによる温室効果ガス収支量の推定とその高精度化に関する研究（Application of transport models for inverse modeling of the greenhouse gas fluxes)

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実施年度：平成 20 年度～平成 22 年度

1. Objective

We study the global and regional distributions of CO_2 and methane surface fluxes with the ground-based, aircraft observations and GOSAT satellite observation data, using forward and inverse tracer transport modeling schemes.

2. Research plan

Our current research focuses on the use of the CO_2 and methane observations of the whole troposphere as observed by monitoring programs and GOSAT satellite. Numerical simulation of CO_2 and methane is used to explain seasonal and interannual variations of the greenhouse gases and other relevant tracers along with observations by NIES monitoring programs over Siberia, East Asia, the Pacific Ocean, and by JAL aircraft. To provide more accurate estimation of the surface fluxes with inverse modeling, the atmospheric transport model and inversion algorithms have to be improved.

3. Progress

Atmospheric tracer transport model algorithms were improved by applying isentropic vertical coordinates in the stratosphere which led to increasing stratospheric transport delay for stable tracers closer to observed values (Fig .1). The transport model was utilized in the inverse modeling of the regional-level CO_2 fluxes with the column average CO_2 data from GOSAT satellite. Preliminary analysis showed usefulness of the satellite observations in the areas of poor ground-based observation coverage. Multiyear simulations of the methane transport were completed for Transcom-CH_4 intercomparison. Methane flux inversion was used to improve estimate of the West Siberian wetland emission. For analysis of fossil fuel emissions, we designed simulations with a Lagrangian-Eulerian transport model using surface fluxes of 1 km resolution globally. Corresponding fossil fuel emission dataset was developed based on remote sensing data of anthropogenic activity and large point source emissions. Simulated fluxes by an ecosystem model were also remapped to 1 km resolution based on satellite-based ecosystem type map. With an ocean pCO_2 data assimilation system we assimilated the surface ocean pCO_2 fields from 1996 to 2008, using assimilated ocean currents from NCEP. Computationally efficient inverse modeling algorithm based on Kalman smoother method was implemented with significant reduction in sensitivity matrix computation. Observed atmospheric CO_2 seasonal cycles were used in an inverse model to optimize and the terrestrial ecosystem model VISIT parameters.

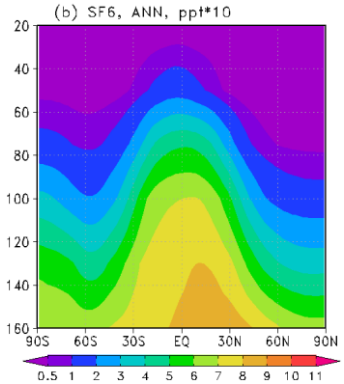

Fig. 1. Two-dimensional view of the global distribution of stratospheric SF_6 simulated on isentropic grid.

4. Future plan

We will continue the analysis of the GOSAT data and develop advanced inverse modeling algorithms using Lagrangian-based high resolution transport and an adjoint version of the transport model. Terrestrial biospheric model VISIT optimization will be extended to use of the Fluxnet and biomass data.

5. Current status of CPU use (from April to September 2010)

11users, CPU hours<1 node: 3,026 hrs, 1 node: 318 hrs, 2 node: 0 hr, total: 3,344 hors