Geophysical Research Abstracts,
Vol. 11, EGU2009-8372-2, 2009
EGU General Assembly 2009

Inverse model algorithms for GOSAT L4 regional carbon flux product

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An inverse modeling system for retrieval of the regional fluxes of carbon dioxide from GOSAT data is being developed and tested. The system is based on tracer transport models for ocean and atmosphere, observation optimized process models of the carbon cycle in the atmosphere and ocean, inventories of the anthropogenic and natural flux components for which process models are not available (fires, fossil fuel emissions). Offline atmospheric tracer transport model used in the inversion has been modified to employ mass conservative flux-form transport algorithm on a reduced grid, resulting in better vertical profile simulation and more consistent regional flux distribution simulated with inverse model. Northern extra-tropical land sink simulated with the model is now close to the range supported by independent observations. Global atmospheric transport model is also enhanced with a Lagrangian particle diffusion model running in backward mode, than can simulate realistic fine resolution observation footprints and better synoptic scale variability. Fossil fuel emissions are improved by using databases of large point sources and weather-dependent electricity demand parameterization. The parameterization is based on monthly energy statistics collected mainly for North American regions. The terrestrial biosphere is modeled with a process based VISIT model at a daily time step. It has been validated against atmospheric observations. Although the model phenology is driven by meteorology alone without use of remote sensing products it is reproducing atmospheric CO_2seasonal cycle phase and amplitude. A merged precipitation dataset based on JCDAS and NCEP reanalyses is used to compensate modeled precipitation biases. Oceanic surface pCO_2 is simulated with an ocean tracer transport model based on reanalyzed currents coupled with simple ocean biogeochemistry model (after McKinley et al), which is further adjusted to observed surface pCO_2 data from LDEO and NIES databases using 4-D variational assimilation technique. A spatially varying constrain on pCO_2 is used to allow for large interannual variations of air-sea pCO_2 fluxes in the regions sensitive to climate variability. In the most of the globe the ocean model flux seasonality show good correlation with observation based climatology. Inverse model of atmospheric transport solves for monthly mean fluxes at 64 regions globally, with possible increase in number of regions and time resolution in near future.