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TRANSCOM 3: ANNUAL MEAN CO₂ FLUX ESTIMATES FROM ATMOSPHERIC INVERSIONS (LVL 1)

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Summary:

This data set provides the model outputs and annual mean CO₂ flux estimates from the TransCom 3, Level I CO₂ inversion intercomparison. Surface-atmosphere CO₂ annual mean fluxes were estimated for the 1992-1996 period from an intercomparison of 16 different atmospheric tracer transport models. The results can be used to assess the contribution of uncertainties in transport to the uncertainties in flux estimates for the annual mean (Gurney et al., 2002).

Annual mean CO₂ concentration data (GLOBALVIEW-CO₂, 2000) were used to infer CO₂ sources. The annual average CO₂ fluxes were estimated using output from each of the 16 transport models and a common inversion set-up (Gurney et al., 2002). Methodological choices for this control inversion were selected on the basis of knowledge gained from a wide range of sensitivity tests (Law et al., 2003). Gurney et al. (2003) present results from the control inversion for individual models as well as results from a number of sensitivity tests related to the specification of prior flux information.

TransCom 3 involved a CO₂ inversion calculation intercomparison. Participating transport models were used to simulate the atmospheric response to an agreed-upon set of surface fluxes ("basis functions") representing regional emissions and uptake of CO₂ due to various processes (industrial emissions, ecosystem metabolism, air-sea gas exchange, biomass burning, etc). The focus of this inversion intercomparison activity was to produce a formal estimate of the degree of uncertainty in such an inversion calculation that arises directly from the uncertainty in the model transport, the inversion methodology, and the observational data set used.

Specific information about the experimental protocol and results are provided in two companion files:

- http://daac.ornl.gov/daacdata/transcom/level_1_annual_co2/comp/transcom3_level1_readme.pdf, and
- http://daac.ornl.gov/daacdata/transcom/level_1_annual_co2/comp/transcom3_level1_experimental_protocol.pdf

TransCom Background

The Atmospheric Tracer Transport Model Intercomparison Project (TransCom) was created to quantify and diagnose the uncertainty in inversion calculations of the global carbon budget that results from errors in simulated atmospheric transport, the choice of measured atmospheric carbon dioxide data used, and the inversion methodology employed. Under the third phase of TransCom (TransCom 3), surface-atmosphere CO₂ fluxes were estimated from an intercomparison of 16 different atmospheric tracer transport models and model variants in order to assess the contribution of uncertainties in transport to the uncertainties in flux estimates for annual mean, seasonal cycle, and interannual inversions (referred to as Level 1, 2, and 3 experiments, respectively).

The TransCom project web site (<http://transcom.project.asu.edu/index.php>) contains additional information.

TransCom 3, Level 1 Products in this Data Set

- Input Data for model simulations
- Model Output from participating transport models
- Estimated Fluxes (inversion results)

Data Citation:

Cite this data set as follows:

Gurney, K. R., and A. S. Denning. 2008. TransCom 3: Annual Mean CO₂ Flux Estimates from Atmospheric Inversions (Level 1). ORNL DAAC, Oak Ridge, Tennessee, U.S.A. doi:[10.3334/ORNLDAAC/895](https://doi.org/10.3334/ORNLDAAC/895).

References:

GLOBALVIEW-CO₂. 2000. Cooperative Atmospheric Data Integration Project–Carbon Dioxide. CD-ROM, NOAA CMDL, Boulder, CO.

Gurney, K. R., R. M. Law, A. S. Denning, P. J. Rayner, D. Baker, P. Bousquet, L. Bruhwilerk, Y-H. Chen, P. Ciais, S. Fan, I. Y. Fung, M. Gloor, M. Heimann, K. Higuchi, J. John, E. Kowalczyk, T. Maki, S. Maksyutov, P. Peylin, M. Prather, B. C. Pak, J. Sarmiento, S. Taguchi, T. Takahashi, and C-W. Yuen. 2003. TransCom 3 CO₂ inversion intercomparison: 1. Annual mean control results and sensitivity to transport and prior flux information. *Tellus 55B*: 555-579.

Gurney, K. R., R. M. Law, A. S. Denning, P. J. Rayner, D. Baker, P. Bousquet, L. Bruhwilerk, Y-H. Chen, P. Ciais, S. Fan, I. Y. Fung, M. Gloor, M. Heimann, K. Higuchi, J. John, E. Kowalczyk, T. Maki, S. Maksyutov, P. Peylin, M. Prather, B. C. Pak, J. Randerson, J. Sarmiento, S. Taguchi, T. Takahashi, and C-W. Yuen. 2002. Towards robust regional estimates of CO₂ sources and sinks using atmospheric transport models. *Nature 415*: 626-630.

Law, R. M., Y-H. Chen, K. R. Gurney, and TransCom 3 modelers. 2003. TransCom 3 CO₂ inversion intercomparison: 2. Sensitivity of annual mean results to data choices. *Tellus 55B*: 580-595.

Data Description:

TransCom3 Level 1 Input Map Data:

File Name	Results Category	Description	Data Format
input_data_all.zip	Input Data Set for Forward Model Simulations	The input.new.le.dat file contains seven records, each of which is a distinct tracer category: fossil-fuel CO ₂ pre-subtraction emissions (for 1990 and 1995, respectively); neutral biosphere pre-subtraction; ocean ex-change pre-subtraction; terrestrial carbon basis functions; ocean carbon basis functions; and SF ₆ basis functions.	The zipped input.new.le.dat file is in a FORTRAN based unformatted binary format (each record has 4 bytes of header and 4 bytes of footer information) and all variables are double precision. All the input arrays represent 0.5 x 0.5 degree surface maps in which the first grid cell is centered at 89.75 S latitude, 179.75 W longitude, proceeding in the longitudinal direction.
		The statlocs.dat file contains a list of the CO ₂ monitoring station locations. Read.statlocs.f is a FORTRAN code to read the statlocs.dat file.	ASCII (.dat) format.
basis_function_map_all.zip	Basis function map and associated files	Basis function map data file and explanation of the methodology used to construct the basis function map	Binary file (.bin), readme file and pdf.
		make.map.new.fis a spatial smoother routine used to generate source/sink regions with smooth, continuous boundaries	Fortran code
		newmap.adj.jpg shows terrestrial regions, no smoothing applied; smoothmap2.final.2.jpg is the final smoothed basis function map; supp.figure.1.jpg shows GLOBALVIEW stations overlaid on the basis function map; vemap.ncar.present.jpg is the landcover classification map used as the starting point for source/sink region boundaries.	.jpg maps

TransCom3 Level 1 Results:

(1) Model Output

File Name	Results Category	Description	Data Format

model_results_co2_fields_all.zip	Selected CO₂ Fields from All of the Submitted Models	Annual mean surface concentrations	.jpg maps
		Annual mean cross-sections	.jpg plots
		Annual mean surface zonal means	.pdf charts
model_results_statco_all.zip	High-frequency Station CO₂ Concentration Output	CO ₂ concentrations for 228 station locations (the Pacific Ocean stations did not require high frequency reporting)	Each data file (.dat) is tarred and compressed along with a readme file. For example, CSU.gurney.L1.statco2.le.tar.gz
model_results_gmatrices_all.zip	Annual Mean Response for All Stations and Tracers	Response functions for 245 stations and 26 tracers	ASCII (.dat) files. The first two lines contain explanatory information, the following 246 contain the response functions at each station/tracer, the last line contains an additional line for closing the atmospheric carbon budget. For example, CSU.gurney.Gmat.dat
model_results_surfdat_all.zip	Grid Information Files	Lon and lat dimensions for models	ASCII (.info) files. For example, CSU.gurney.grid.info
model_results_sf6_all.zip	SF₆ Surface Concentrations	Monthly SF6 surface concentration for 11 land basis functions (BF)	Zipped binary (.dat) files containing an array dimensioned as lon x lat x land BF (11) x month (12). For example, CSU.gurney.L1.sf6.le.dat.gz
model_results_mmean_3D_all.zip	3D Monthly Mean Concentrations	Monthly mean CO ₂ concentrations at 9 vertical pressure levels for 26 tracers (4 background + 22 BF)	Zipped binary files containing an array dimensioned as: lon x lat x pressure level (9) x month (12) x tracers (26). For example, CSU.gurney.L1.mmean.le.3D.gz
model_results_mmean_2D_all.zip	2D Monthly Mean Concentrations	Monthly mean CO ₂ concentrations at the surface or the layer above the surface (re: index number) for 26 tracers (4 background + 22 BF)	Zipped binary files containing an array dimensioned as: lon x lat x month (12) x tracers (26) x index (2). For example, CSU.gurney.L1.mmean.le.2D.gz

(2) Inversion Results

File Name	Results Category	Description	Data Format
inversion_results_invout_all.zip	Inversion output files	The inversion.tar.Z file contains the basic inversion output files	Zipped and tarred ASCII (.dat) files
		The outsum.allpre.dat file contains model mean posterior fluxes for all 22 basis function regions and regional groupings. Also contains within and between uncertainties. All presubtraction fields are included.	ASCII (.dat) file

		The outmod.allpre.dat file contains individual model posterior fluxes and uncertainties.	ASCII (.dat) file
		The outgrp.allpre.dat file contains individual model results for the regional groupings.	ASCII (.dat) file
inversion_code_all.zip	Inversion code and associated files	transcom.pro is the inversion code.	transcom.pro was written using IDL code
		The transcom.pro code requires observational data (datafile.dat), prior flux/uncertainties (prior.flux.dat), and a control file (control.dat) which contains paths to the model response functions, direction on which pre-subtracted field to include, and information on regional aggregation.	ASCII (.dat) files

(3) Model Output Specifications

File Name	Results Category	Description	Data Format
make.output.l1.f	netCDF routines	FORTRAN routine for writing level 1 output to standardized netCDF format.	

Companion Files

Additional information about the experimental protocol and results is provided in the companion files [[link to transcom3_level1_readme_20070620.pdf](#)], [[link to transcom3_level1_experimental_protocol_20070620.pdf](#)], and the TransCom project web site (<http://transcom.project.asu.edu/index.php>).

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