

0. Creator

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1. Inversion system and settings

System name

NISMON-CO2

Transport model

NICAM-TM (Niwa, Tomita et al., 2011; Niwa, Tomita et al., 2017)

Horizontal resolution: glevel-5 (~223 km)

Vertical layers: 40 (up to ~45km)

Meteorological data: horizontal winds are nudged towards JRA-55 (Kobayashi et al., 2015)

See more references listed below for transport performances.

Flux model

Scaling factors are optimized for each flux category, which can be described as below.

$$f_{\text{CO}_2}(x, t) = f_{\text{fos}}(x, t) - (1 + \Delta a_{\text{GPP}}(x, t))f_{\text{GPP}}(x, t) \\ + (1 + \Delta a_{\text{RE}}(x, t))f_{\text{RE}}(x, t) + (1 + \Delta a_{\text{LUC}}(x, t))f_{\text{LUC}}(x, t) \\ + (1 + \Delta a_{\text{fire}}(x, t))f_{\text{fire}}(x, t) \\ + f_{\text{ocn}}(x, t) + \Delta a_{\text{ocn,anu}}(x, t)f_{\text{ocn,ltm}}(x),$$

where f denotes a prescribed flux dataset; Δa describes the scaling factor, which is to be optimized in the inversion. f_{GPP} and f_{RE} have 3-hourly temporal resolution data, while f_{fos} , f_{fire} , f_{ocn} , and f_{LUC} are monthly mean data. $f_{\text{ocn,ltm}}$ means a long-term annual mean data. Every scaling factor has monthly resolution, except for $\Delta a_{\text{ocn,anu}}$, which has annual resolution.

Optimization method

POpULar (Fujii and Kamachi, 2003; Fujii, 2005; Niwa, Fujii et al., 2017)

a quasi-Newton BFGS method

Prescribed flux

fossil fuel: GCP-GridFEDv2020.1 (Jones et al.)

terrestrial biosphere (GPP, RE, LUC): VISIT (Ito and Inatomi, 2012; Ito, 2019)

air-sea exchange: JMA air-sea flux data (Iida et al., 2015; Takatani et al., 2014)

https://www.data.jma.go.jp/gmd/kaiyou/english/co2_flux/co2_flux_data_en.html

biomass burning: GFEDv4.1s (van der Werf et al., 2017)

Note: For the years GFED does not cover (i.e., 1990-1996), the climatological data were used and their prior uncertainties were inflated by 2.

Analysis period

Jan 1990 – Dec 2019

(one year spin-up of Jan 1989 – Dec 1989 and three month spin-down of Jan 2020 – Mar 2020)

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2. Observations

See `observation_list.ver.2020.1.csv`.

Basically, all the ObsPack data (`obspack_co2_1_GLOBALVIEWplus_v5.0_2019-08-12` & `obspack_co2_1_NRT_v5.2_2020-06-03`) provided from NOAA, CSIRO, EC, FMI, LSCE, JMA,

NCAR, SIO, TU, EMPA, and NILU with obs_flag=1 are used. In addition, the NIES data, which are available from the NIES database NIES-GED, are also used.

3. Transport model performances

Advection scheme, radon simulation

- Niwa, Y., Tomita, H., Satoh, M., and Imasu, R.: A Three-Dimensional Icosahedral Grid Advection Scheme Preserving Monotonicity and Consistency with Continuity for Atmospheric Tracer Transport, *J. Meteor. Soc. Japan*, 89, 255–268, <https://doi.org/10.2151/jmsj.2011-306>, 2011.

SF6 simulation

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Model intercomparison

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