0. Creator

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1. Inversion system and settings

System name

NISMON-CO_2 ver.2022.1

(refs: Niwa et al., 2017a,b, 2021, 2022)

Transport model

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

The surface CO_2 fluxes that are input to NICAM-TM can be described as

$$f_{\mathrm{CO_2}}(x,t) = f_{\mathrm{fos}}(x,t) - \beta_{\mathrm{GPP}}\left(f_{\mathrm{GPP}}(x,t) + \Delta f_{\mathrm{GPP}}(x,t)\right) + \beta_{\mathrm{RE}}\left(f_{\mathrm{RE}}(x,t) + \Delta f_{\mathrm{RE}}(x,t)\right) + \left(1 + \Delta\alpha_{\mathrm{LUC}}(x,t)\right) f_{\mathrm{LUC}}(x,t) + \left(1 + \Delta\alpha_{\mathrm{fire}}(x,t)\right) f_{\mathrm{fire}}(x,t) + f_{\mathrm{ocn}}(x,t) + \Delta f_{\mathrm{ocn}}(x,t),$$

where x and t represent flux location and time, respectively. Fluxes from fossil fuel use and cement production, gross primary production (GPP) and respiration (RE) of terrestrial biospheres, land use change (LUC), biomass burning, and oceans are denoted as f_{fos}, f_{GPP}, f_{RE}, f_{LUC}, f_{fire}, and f_{ocn}, respectively; they are prescribed by flux datasets prepared in advance and have monthly temporal resolution here. The above Δ variables are optimized in the inversion; their temporal resolutions are all set monthly except for the ocean flux Δf_{ocn}. The coefficients β_{GPP} and β_{RE} are scaling factors that reproduce diurnal variations; they distribute fluxes at 3-hourly resolution from the monthly fluxes.

Optimization method

POpULar (Fujii and Kamachi, 2003; Fujii, 2005; Niwa et al., 2017b)
a quasi-Newton BFGS method

Prescribed flux

fossil fuel: GCP-GridFEDv2022.2 (Jones et al., 2022)
https://doi.org/10.5281/zenodo.7016360
terrestrial biosphere (GPP, RE, LUC): VISIT (Ito and Inatomi, 2012; Ito, 2019)
air-sea exchange: JMA air-sea flux data (Iida et al., 2021)
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.

Analysis period

Jan 1990 – Dec 2021
(one year spin-up of Jan 1989 – Dec 1989 and three month spin-down of Jan 2022 – Mar 2022)

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2. Main changes from NISMON-CO_2 ver.2021.1

- Observations

In-situ continuous shipboard data from NIES and NOAA (Laurence M. Gould and R/V Ron Brown) and TIK data from FMI/MGO are added.

3. Observations

See observation_list.ver.2022.1.csv.
Basically, all the ObsPack data (obspack_co2_1_GLOBALVIEWplus_v7.0_2021-08-18 & obspack_co2_1_NRT_v7.2_2022-06-28) (Cox et al., 2021, 2022) provided from CSIRO, EC, Empa, FMI, IPEN, JMA, LSCE, NCAR, NIES, NILU, NIWA, NOAA, SIO, and TU/NIPR with obs_flag=1 were used. In addition, the NIES data, which are available from the NIES database NIES-GED, were also used.

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4. Transport model performances

Advection scheme, radon simulation

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