

README

INTRODUCTION

This repository contains processed data for a suite of “q-flux patches experiments”, the abrupt4×CO₂ simulation in NCAR CAM5 coupled with a slab-ocean model, and the abrupt4×CO₂ simulation in CESM1 (CAM5.1, FV2) fully-coupled model.

PUBLICATION

This repository supports the following two papers:

1. Yuan-Jen Lin, Yen-Ting Hwang, Jian Lu, Fukai Liu, and Brian E. J. Rose. The dominant contribution of Southern Ocean heat uptake to time-evolving radiative feedback in CESM. *Submitted* to Geophysical Research Letters.
2. Jian Lu, Daokai Xue, L. Ruby Leung, Fukai Liu, Fengfei Song, Bryce Harrop, and Wenyu Zhou. The leading modes of Asian monsoon variability as pulses of atmospheric energy flow. *Submitted* to Geophysical Research Letters.

DATA

1. Abrupt4×CO₂ simulation

- 1.1. CAM5 coupled with a slab-ocean model

Data is stored in a PKL file, created by Pickle, a module of Python. In the file “[Anomalies_of_abrupt4CO2_in_SOM.pkl](#)”, the dictionary “Anomalies_SOM” contains 13 keys, which are 150-year anomalies (abrupt4×CO₂–piControl) of the 13 variables listed below.

- 1.2. CESM1 (CAM5.1, FV2) fully-coupled model

Data is stored in a PKL file, created by Pickle, a module of Python. In the file “[Anomalies_of_abrupt4CO2_in_FOM.pkl](#)”, the dictionary “Anomalies_FOM” contains 13 keys, which are 150-year anomalies (abrupt4×CO₂–piControl) of the 13 variables listed below.

Note that due to the data availability of CESM1 (CAM5.1, FV2), two particular variables (air temperature and relative humidity) in piControl simulation are taken from an alternative coupled model CESM1 (CAM5), which has slightly different settings in atmospheric component from our targeted coupled model. This data substitution in piControl simulation might lead to biases in *EIS*, *R_{lr}*, and *R_q* anomalies (see descriptions for the variables), but it does not alter the findings in Lin et al. (submitted) since the biases are time-invariant.

Key name of the dictionary	Description	Units
toa	Net radiation at the top-of-atmosphere (monthly)	Wm^{-2}
sfc	Net radiation at the surface (monthly)	Wm^{-2}
LHFLX	Surface latent heat flux (monthly)	Wm^{-2}
SHFLX	Surface sensible heat flux (monthly)	Wm^{-2}
PRECT	Total (convective and large-scale) precipitation rate (liq + ice) (monthly)	[1]
TS	Surface temperature (monthly)	K
EIS	Estimated Inversion Strength (annual-mean)	K
R_plk	Radiative anomalies related to changes in Planck emission (annual-mean)	Wm^{-2}
R_alb	Radiative anomalies related to changes in surface albedo (annual-mean)	Wm^{-2}
R_lr	Radiative anomalies related to changes in atmospheric lapse-rate (annual-mean)	Wm^{-2}
R_q	Radiative anomalies related to changes in relative humidity (annual-mean)	Wm^{-2}
R_SWcld	Shortwave radiative anomalies related to changes in clouds (annual-mean)	Wm^{-2}
R_LWcld	Longwave radiative anomalies related to changes in clouds (annual-mean)	Wm^{-2}

[1] The unit of PRECT in “[Anomalies_of_abrupt4CO2_in_SOM.pkl](#)” is $[\text{ms}^{-1}]$; while in “[Anomalies_of_abrupt4CO2_in_FOM.pkl](#)” is $[\text{kgm}^{-2}\text{s}^{-1}]$.

2. Q-flux patches experiments

Data is stored in the self-describing netCDF files.

- In the file “[qdp.PatchEXP.108.nc](#)”, the location, amplitudes, and the spatial structure of q-flux forcings in 108 patches are included.
- In the files “[SOM_Patches_<variable_name>.nc](#)”, anomalies of each variable in response to warm/ cold patches are included. Note that the coordinates “q_lon” and “q_lat” indicate the location of the center of the q-flux forcing, while the coordinate “q_sign” indicates the responses are forced with either the warm or the cold patch.

The variable names are listed below:

Name	Description	Units
TS	Surface temperature (monthly)	K
FSNT	Net solar flux at top of model (monthly)	Wm^{-2}
FLNT	Net longwave flux at top of model (monthly)	Wm^{-2}
FSNS	Net solar flux at surface (monthly)	Wm^{-2}
FLNS	Net longwave flux surface (monthly)	Wm^{-2}
LHFLX	Surface latent heat flux (monthly)	Wm^{-2}
SHFLX	Surface sensible heat flux (monthly)	Wm^{-2}
R_plk	Radiative anomalies related to changes in Planck emission (annual-mean)	Wm^{-2}
R_alb	Radiative anomalies related to changes in surface albedo (annual-mean)	Wm^{-2}
R_lr	Radiative anomalies related to changes in atmospheric lapse-rate (annual-mean)	Wm^{-2}
R_q	Radiative anomalies related to changes in relative humidity (annual-mean)	Wm^{-2}
R_SWcld	Shortwave radiative anomalies related to changes in clouds (annual-mean)	Wm^{-2}
R_LWcld	Longwave radiative anomalies related to changes in clouds (annual-mean)	Wm^{-2}
PRECT	Total (convective and large-scale) precipitation rate (liq + ice) (monthly)	ms^{-1}
Q	Specific humidity (monthly)	kgkg^{-1}
T	Temperature (monthly)	K
Z3	Geopotential Height (above sea level) (monthly)	m
U	Zonal wind (monthly)	ms^{-1}
V	Meridional wind (monthly)	ms^{-1}

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