

Climber3 α +C simulations for marine biogeochemistry and primary production

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2. Citation

When using the data please cite:

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The data are supplementary material to:

Citation of article "Shutdown of Atlantic overturning circulation could cause persistent increase of primary production in the Pacific" when available

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3. Data Description

The data comprise Climber3 α +C simulations created by Matthias Hofmann (PIK) as part of the Work Package 2.1 of the EU-Horizon2020 COMFORT project as well as model input data and PyFerret scripts (written by Ralf Liebermann and Matthias Hofmann) used for their evaluation. The purpose was to analyze the simulations regarding climate change-induced changes in marine biogeochemistry and primary production, which will be published under the title "Shutdown of Atlantic overturning circulation could cause persistent increase of primary production in the Pacific" (Liebermann et al., 2023).

The simulation data consist of netCDF files (snap_*.nc and history.nc) for ocean, atmosphere and mixed layer depth (hmxl) performed for different idealized scenarios summarized in the Table below:

- CONTROL, which represents the baseline equilibrium with preindustrial CO₂ concentrations (280ppm)
- CO2X2 and CO2X4, which represent transient double (X2) and fourfold (X4) atmospheric CO₂ concentrations after an increase of 1%/year, followed by a similar decrease
- CO2X2_HOSING and CO2X4_HOSING, which represent transient double and fourfold atmospheric CO₂ concentrations plus a forcing of North Atlantic freshwater addition (hosing)

Furthermore, tracer simulations for CONTROL, CO2X4, CO2X4_HOSING as well as simulations with constant scavenging (i.e. without CO₂ impact on scavenging) for CO2X4 are included. Input data are monthly values of sea surface wind stress data (in dyn/cm²): tau_x.mom for zonal values, tau_y.mom for meridional values.

3.1.Data processing

Climate Data Operators (CDO) was used to aggregate monthly simulation data into annual data contained in the snap_*.nc files.

4. File description

4.1.File inventory

The directory is named COMFORT WP 2.1 simulations, according to the research project and the working group. The subdirectory names correspond to the names of the scenarios (CONTROL, CO2X2, CO2X2_HOSING, CO2X4, CO2X4_HOSING) under which the associated simulation files were created. Wind stress data for model input are filed under "Input Data", PyFerret scripts are in the eponymous directory.

4.2.File naming convention

history.nc files (included in CONTROL, CO2X2, CO2X4, CO2X2_HOSING, CO2X4_HOSING, CO2X4_FROZ_SCAV) represent overview files with annual values. Snap_*.nc files are named after their respective Earth subsystem i.e. ocean, atmos for atmosphere, or the model with which they have been produced (potsdam2 = atmospheric module in Climber3). File names including "1000" contain continuous values for at least 1000 simulation years, file names including "hosing" stem from scenarios with freshwater addition (freshwater forcing). Files stemming from tracer simulations named with "ink", files containing ocean mixed layer depths are named with "hmxl".

4.3.Folder and file content

The data are organized in seven folders with the following contents:

Folder name	File names	content
CO2X2/	history.nc	overview file with annual simulation values for scenario of transient doubling (X2) of atmospheric CO ₂
	snap_hmxl.nc	ocean mixed layer depths for scenario of transient doubling (X2) of atmospheric CO ₂
	snap_ocean.nc	Simulation data from the ocean module for scenario of transient doubling (X2) of atmospheric CO ₂

CO2X2_ HOSING/	history.nc	overview file with annual simulation values for scenario of transient doubling (X2) of atmospheric CO2 and North Atlantic freshwater addition (HOSING)
	snap_hmxi_hosing.nc	ocean mixed layer depths for scenario of transient doubling (X2) of atmospheric CO2 and North Atlantic freshwater addition (HOSING)
	snap_ocean_hosing.nc	Diverse simulation data from the ocean module for scenario of transient doubling (X2) of atmospheric CO2 and North Atlantic freshwater addition (HOSING)
CO2X4/	history.nc	overview file with annual simulation values for scenario of transient quadrupling (X4) of atmospheric CO2
	snap_atmos_1000.nc	Diverse simulation data from the atmosphere module for scenario of transient quadrupling (X4) of atmospheric CO2; min. 1000 simulation years
	snap_hmxi_1000.nc	ocean mixed layer depths for scenario of transient quadrupling (X4) of atmospheric CO2; min. 1000 simulation years
	snap_ocean_1000.nc	Diverse simulation data from the ocean module for scenario of transient quadrupling (X4) of atmospheric CO2; min. 1000 simulation years
	snap_ocean_ink.nc	Tracer simulation data from the ocean module for scenario of transient quadrupling (X4) of atmospheric CO2; shows only tracer (ink) dispersion with injection at Westafrican Coast
CO2X4_FROZ _SCAV/	history.nc	overview file with annual simulation values for scenario of transient quadrupling (X4) of atmospheric CO2, but with constant scavenging at baseline level (FROZ_SCAV)
	snap_ocean_froz_snav.nc	Diverse simulation data from the ocean module for scenario of transient quadrupling (X4) of atmospheric CO2, but with constant scavenging at baseline level (FROZ_SCAV)
CO2X4_ HOSING/	history.nc	overview file with annual simulation values for scenario of transient quadrupling (X4) of atmospheric CO2 and North Atlantic freshwater addition (HOSING)
	snap_hmxi_hosing_1000.nc	ocean mixed layer depths for scenario of transient quadrupling (X4) of atmospheric CO2 and North Atlantic freshwater addition (HOSING); min. 1000 simulation years
	snap_ocean_hosing_1000.nc	Diverse simulation data from the ocean module for scenario of transient quadrupling (X4) of atmospheric CO2 and North Atlantic freshwater addition (HOSING); min. 1000 simulation years
	snap_ocean_ink.nc	Tracer simulation data from the ocean module for scenario of transient quadrupling (X4) of atmospheric CO2 and North Atlantic freshwater addition (HOSING); shows only tracer (ink) dispersion with injection at Westafrican Coast
	snap_potsdam2_hosing_1000.nc	Diverse simulation data from the atmosphere module (Potsdam2) for scenario of transient quadrupling (X4) of atmospheric CO2 and North Atlantic freshwater addition (HOSING); min. 1000 simulation years
CONTROL/	history.nc	overview file with annual simulation values for scenario of constant atmospheric CO2 (at 280ppm)

	snap_hmxi_1000.nc	ocean mixed layer depths for scenario of constant atmospheric CO ₂ (at 280ppm); min. 1000 simulation years
	snap_ink_indian.nc	Tracer simulation data from the ocean module for scenario of constant atmospheric CO ₂ (at 280ppm); shows only tracer (ink) dispersion with injection at Arabian Sea (Indian ocean)
	snap_ocean_1000.nc	Diverse simulation data from the ocean module for scenario of constant atmospheric CO ₂ (at 280ppm) min. 1000 simulation years
	snap_ocean_ink.nc	Tracer simulation data from the ocean module for scenario of constant atmospheric CO ₂ (at 280ppm); shows only tracer (ink) dispersion with injection at Westafrican Coast
	snap_potsdam2_1000.nc	Diverse simulation data from the atmosphere module for scenario of constant atmospheric CO ₂ (at 280ppm); min. 1000 simulation years
InputData/	taux.mom	Zonal, monthly values of sea surface wind stress data (in dyn/cm ²) for model input
	tauy.mom	Meridional, monthly values of sea surface wind stress data (in dyn/cm ²) for model input
PyFerretScripts/	COMFORT_froz_scav.jnl	plots scavenging rates under 4xCO ₂ : compares normal 4xCO ₂ -scavenging and scavenging without 4xCO ₂ impact (scavenging rate frozen at baseline)
	COMFORT_ink-tracer.jnl	shows global maps of marine tracer dispersion
	COMFORT_map-projections.jnl	global maps of net primary production (NPP) and limitation factors of PO ₄ and Fe: NPP maps showing difference between all forcing scenarios (2xCO ₂ , 4xCO ₂ , 2xCO ₂ hosing, 4xCO ₂ hosing) and CONTROL scenario after 500 years; limitation factor maps (L _{PO₄} , L _{Fe}) showing difference between strong forcing scenarios (4xCO ₂ , 4xCO ₂ hosing) and CONTROL scenario after 500 years
	COMFORT_nutrient-map-projections.jnl	global maps of PO ₄ and Fe showing difference between strong forcing scenarios (4xCO ₂ , 4xCO ₂ hosing) and CONTROL scenario after 500 years
	COMFORT_paper.jnl	plots of mixed layer height and net primary production comparing 5 scenarios (CONTROL, 2xCO ₂ , 2xCO ₂ hosing, 4xCO ₂ , 4xCO ₂ hosing) and 3 regions (East equatorial Pacific, Southern Ocean and Indian Ocean)
	COMFORT_plots-with-legend.jnl	plots atmospheric CO ₂ , freshwater forcing, net primary production, Atlantic meridional overturning circulation and limitation factors for PO ₄ and Fe

5. References

Add citation of Liebermann et al. (2023) "Shutdown of Atlantic overturning circulation could cause persistent increase of primary production in the Pacific" when available