

# Pathfinder

## Manual

## Run a simulation















Very basic instructions for now:


















- import the model: `from core_fct.mod_Cdriven import PF_Cdriven as PF;`
- create or load parameters (`Par`), some drivers (`For`), and optionally initial states (`Ini`);
- run the model (with xarray): `Var = PF.run_xarray(Par, For, get_Var2=True);`
- enjoy!



















For a clearer example, see [run\\_scripts/run\\_diagnostics](#).

## Notations




### Forcings and Variables

























In manual	In code	Description	Units	Prog?	Dims
	<code>RFco2</code>	CO2 (effective) radiative forcing	$\text{W m}^{-2}$		
	<code>ERFx</code>	Non-CO2 effective radiative forcing	$\text{W m}^{-2}$		
	<code>ERF</code>	Effective radiative forcing	$\text{W m}^{-2}$		
	<code>T</code>	Global surface temperature anomaly	K	yes	
	<code>Td</code>	Deep ocean temperature anomaly	K	yes	
	<code>logit_ff</code>	Logit of the climate feedback factor (for calib.)	1		
	<code>OHC</code>	Ocean heat content (anomaly)	$\text{W yr m}^{-2}$		
	<code>Hthx</code>	Thermosteric sea level rise	mm		
	<code>Hgla</code>	Glaciers' contribution to sea level rise	mm	yes	
	<code>Hgis</code>	Grenland ice sheet's contribution to sea level rise	mm	yes	
	<code>Hais_smb</code>	Surface mass balance component of <code>Hais</code>	mm		
	<code>Hais</code>	Antartica ice sheet's contribution to sea level rise	mm	yes	
	<code>Htot</code>	Total sea level rise	mm		
	<code>Hlia</code>	Sea level rise from relaxation after LIA between 1900 and 2005 (for calib.)	mm		

In manual	In code	Description	Units	Prog?	Dims
	Co_j	Change in surface ocean carbon subpools	PgC	yes	
	Co	Change in surface ocean carbon pool	PgC		
	Cd	Change in deep ocean carbon pool	yes		
	dic	Change in surface DIC	$\mu\text{mol kg}^{-1}$		
	pdic	Subcomponent of pCO <sub>2</sub>	ppm		
	pCO <sub>2</sub>	CO <sub>2</sub> partial pressure at the ocean surface	ppm		
	Focean	Ocean carbon sink	PgC yr <sup>-1</sup>		
	r_npp	Relative change in NPP	1		
	r_fire	Relative change in wildfire intensity	1		
	r_rh	Relative change in heterotrophic respiration rate	1		
	NPP	Net primary productivity	PgC yr <sup>-1</sup>		
	Efire	Emissions from wildfire	PgC yr <sup>-1</sup>		
	Eharv	Emissions from harvest and grazing	PgC yr <sup>-1</sup>		
	Fmort	Mortality flux	PgC yr <sup>-1</sup>		
	RH1	Litter heterotrophic respiration	PgC yr <sup>-1</sup>		
	Fstab	Stabilization flux	PgC yr <sup>-1</sup>		
	RH2	Active soil heterotrophic respiration	PgC yr <sup>-1</sup>		
	Fpass	Passivization flux	PgC yr <sup>-1</sup>		























In manual	In code	Description	Units	Prog?	Dims
	RH3	Passive soil heterotrophic respiration	PgC yr <sup>-1</sup>		
	Fland	Land carbon sink	PgC yr <sup>-1</sup>		
	RH	Heterotrophic respiration	PgC yr <sup>-1</sup>		
	Cv	Vegetation carbon pool	PgC	yes	
	Cs1	Litter carbon pool	PgC	yes	
	Cs2	Active soil carbon pool	PgC	yes	
	Cs3	Passive soil carbon pool	PgC	yes	
	Cs	Total soil carbon pool	PgC		
	r_rt	Relative change in permafrost respiration rate	1		
	abar	Theoretical thawed fraction	1		
	a	Actual thawed fraction	1	yes	
	Epf	Emissions from permafrost	PgC yr <sup>-1</sup>		
	Cth_j	Thawed permafrost carbon subpools	PgC	yes	
	Cfr	Frozen permafrost carbon pool	PgC		
	Eco2	Anthropogenic CO2 emissions	PgC yr <sup>-1</sup>		
	CO2	Atmospheric CO2 concentration	ppm	yes	
	pH	Surface ocean pH	1		

## Parameters

In manual	In code	Description	Units	Dims
	phi	Radiative parameter of CO2	W m <sup>-2</sup>	
	T2x	Equilibrium climate sensitivity	K	
	THs	Heat capacity of the surface	W yr m <sup>-2</sup> K <sup>-1</sup>	

In manual	In code	Description	Units	Dims
	THd	Heat capacity of the deep ocean	$\text{W yr m}^{-2} \text{K}^{-1}$	
	th	Heat exchange coefficient	$\text{W m}^{-2} \text{K}^{-1}$	
	eheat	Deep ocean heat uptake efficacy	1	
	T2x0	Minimal value of the ECS distribution (for calib.)	K	
	aOHC	Fraction of energy warming the ocean	1	
	Lthx	Proportionality factor of thermosteric SLR	$\text{mm m}^2 \text{W}^{-1} \text{yr}^{-1}$	
	lgla0	Initial imbalance in SLR from Glaciers	$\text{mm yr}^{-1}$	
	Lgla	Maximum contribution to SLR from Glaciers	mm	
	Ggla1	Linear sensitivity of steady-state Glaciers SLR to climate	$\text{K}^{-1}$	
	Ggla3	Cubic sensitivity of steady-state Glaciers SLR to climate	$\text{K}^{-3}$	
	tgla	Timescale of Glaciers' contribution to SLR	yr	
	ggla	Sensitivity of Glaciers' timescale to climate	$\text{K}^{-1}$	
	lgis0	Initial imbalance in SLR from GIS	$\text{mm yr}^{-1}$	
	Lgis1	Linear sensitivity of steady-state GIS SLR to climate	$\text{mm K}^{-1}$	
	Lgis3	Cubic sensitivity of steady-state GIS SLR to climate	$\text{mm K}^{-3}$	
	tgis	Timescale of GIS contribution to SLR	yr	
	Lais_smb	Sensitivity of AIS SMB increase due to climate	$\text{mm yr}^{-1} \text{K}^{-1}$	
	lais	Initial imbalance in SLR from AIS	$\text{mm yr}^{-1}$	
	Lais	Sensitivity of steady-state AIS SLR to climate	$\text{mm K}^{-1}$	
	tais	Timescale of AIS contribution to SLR	yr	
	aaais	Sensitivity of AIS timescale to AIS SLR	$\text{mm}^{-1}$	
	adic	Conversion factor for DIC	$\mu\text{mol kg}^{-1} \text{PgC}^{-1}$	
	bdic	Inverse-scaling factor for DIC	1	
	gdic	Sensitivity of pCO2 to climate	$\text{K}^{-1}$	

In manual	In code	Description	Units	Dims
	To	Preindustrial surface ocean temperature	°C	
	vgx	Surface ocean gas exchange rate	yr <sup>-1</sup>	
	ggx	Sensitivity of gas exchange to climate	K <sup>-1</sup>	
	aoc_j	Surface ocean subpools fractions	1	
	toc_j	Timescales of surface ocean subpools	yr	
	k_toc	Scaling factor for timescales of surface ocean subpools	1	
	bnpp	Sensitivity of NPP to CO2 (= fertilization effect)	1	
	anpp	Shape parameter for fertilization effect	1	
	gnpp	Sensitivity of NPP to climate	K <sup>-1</sup>	
	bfire	Sensitivity of wildfire intensity to CO2	1	
	gfire	Sensitivity of wildfire intensity to climate	K <sup>-1</sup>	
	brh	Sensitivity of heterotrophic respiration to fresh organic matter	1	
	grh	Sensitivity of heterotrophic respiration to climate	K <sup>-1</sup>	
	npp0	Preindustrial NPP	PgC yr <sup>-1</sup>	
	vfire	Wildfire intensity	yr <sup>-1</sup>	
	vharv	Harvest and grazing rate	yr <sup>-1</sup>	
	vmort	Mortality rate	yr <sup>-1</sup>	
	vstab	Stabilization rate	yr <sup>-1</sup>	
	vrh1	Litter heterotrophic respiration rate	yr <sup>-1</sup>	
	vrh23	Soil (active and passive) respiration rate	yr <sup>-1</sup>	
	vrh3	Passive soil respiration rate	yr <sup>-1</sup>	
	apass	Fraction of passive soil	1	
	aLST	Climate scaling factor over permafrost regions	1	
	grt1	Sensitivity of (boreal) heterotrophic respiration to climate	K <sup>-1</sup>	

In manual	In code	Description	Units	Dims
	grt2	Sensitivity of (boreal) heterotrophic respiration to climate (quadratic)	K <sup>-2</sup>	
	krt	Scaling factor for sensitivity of permafrost respiration to climate	1	
	amin	Minimal thawed fraction	1	
	ka	Shape parameter for theoretical thawed fraction	1	
	ga	Sensitivity of theoretical thawed fraction to climate	K <sup>-1</sup>	
	vthaw	Thawing rate	yr <sup>-1</sup>	
	vfroz	Freezing rate	yr <sup>-1</sup>	
	ath_j	Thawed permafrost carbon subpools fractions	1	
	tth_j	Timescales of thawed permafrost carbon subpools	yr	
	k_tth	Scaling factor for timescales of surface ocean subpools	1	
	Cfr0	Preindustrial frozen permafrost carbon pool	PgC	
	aCO2	Conversion factor for atmospheric CO2	PgC ppm <sup>-1</sup>	
	CO2pi	Preindustrial CO2 concentration	ppm	
	k_pH	Scaling factor for surface ocean pH	1	
	std_CO2	Relative standard deviation of the historical CO2 time series (for calib.)	1	
	amp1_CO2	Noise amplitude of the historical CO2 time series (for calib.)	ppm	
	corr_CO2	Autocorrelation of the historical CO2 time series (for calib.)	1	
	std_T	Relative standard deviation of the historical T time series (for calib.)	1	
	amp1_T	Noise amplitude of the historical T time series (for calib.)	K	
	corr_T	Autocorrelation of the historical T time series (for calib.)	1	

## Equations

### 1. Climate

diagnostic

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**prognostic**

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**diagnostic (2nd; for calib.)**

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2. Sea level

**diagnostic**

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**prognostic**

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**diagnostic (2nd)**






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**diagnostic (3rd; for calib.)**



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3. Ocean carbon

**diagnostic**














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**prognostic**




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4. Land carbon

**diagnostic**

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**prognostic**

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**diagnostic (2nd)**

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5. Permafrost carbon

**diagnostic**

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**prognostic**

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**diagnostic (2nd)**

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6. Atmospheric CO2

**diagnostic**

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**prognostic**

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