



CESM Land Model and Biogeochemistry Working Group Meeting

*Will Wieder & Rosie Fisher
LWMMG Co-chairs*

*Keith Lindsey, Abby Swann & Gretchen
Keppel-Aleks
BGCWG Co-chairs*

February 27, 2024



DEI lunch discussion Weds in
Chapman Room & Google Meet

Here we value respectful dialogue, please ...



CGD's Vision: A Culture of Respect & Belonging
[https:// www.cgd.ucar.edu /about/diversity](https://www.cgd.ucar.edu/about/diversity)



Meeting Goals:

- Share our science
- Seek out advice, suggestions, ideas
- Communicate priorities
- Discuss short and long-term goals
- Appreciate collaboration & community

Dinner Weds. 5:30 Under the Sun

LMWG Andrew Slater Award

Drew was a key member of the LMWG community who brought a deep dedication, understanding, and joy to his research, which he shared with everyone around him. Since 2018, winners of the Slater award have been made to WG members who make meaningful contributions to the LMWG including:

- Creative applications of the model;
- Significant model development activities;
- Identifying major issues, biases, or gaps in CTSM; and a
- High level of engagement with the LMWG



LMWG Andrew Slater Award

2023 Joshua Rady

CLM-U team:
Bowen Fang, Cathy Li,
Joyce Yang, Keer Zhang

2022 Claire Zarakas

Yifan Cheng

2021 Yue Li

Inne Vanderkelen

2020 Leah Birch

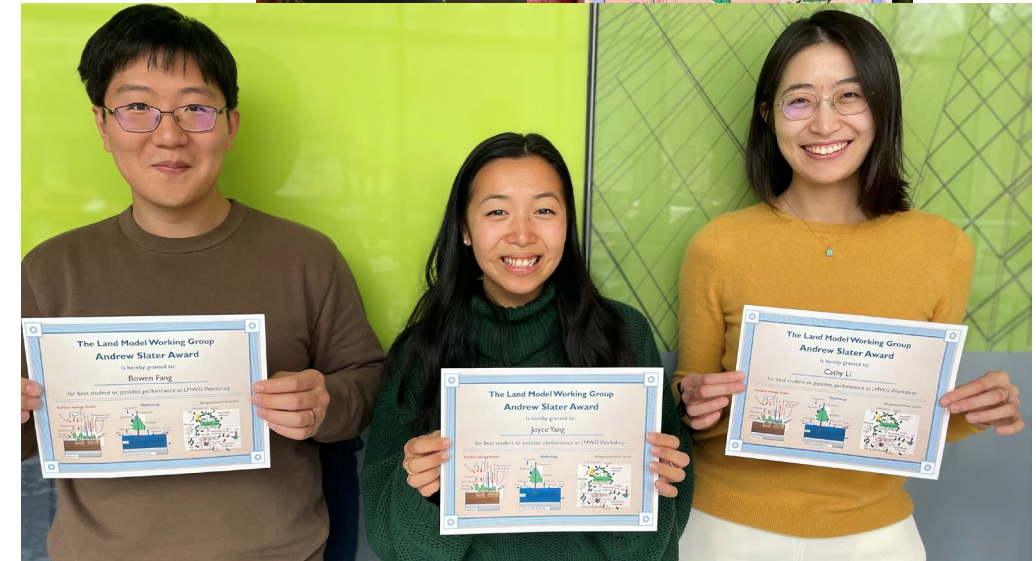
Jessica Needham

2019 Katie Dagon

Meg Fowler

2018 Marysa Laguë

Daniel Kennedy



LMWG focus areas: Ecosystems, Water & Food

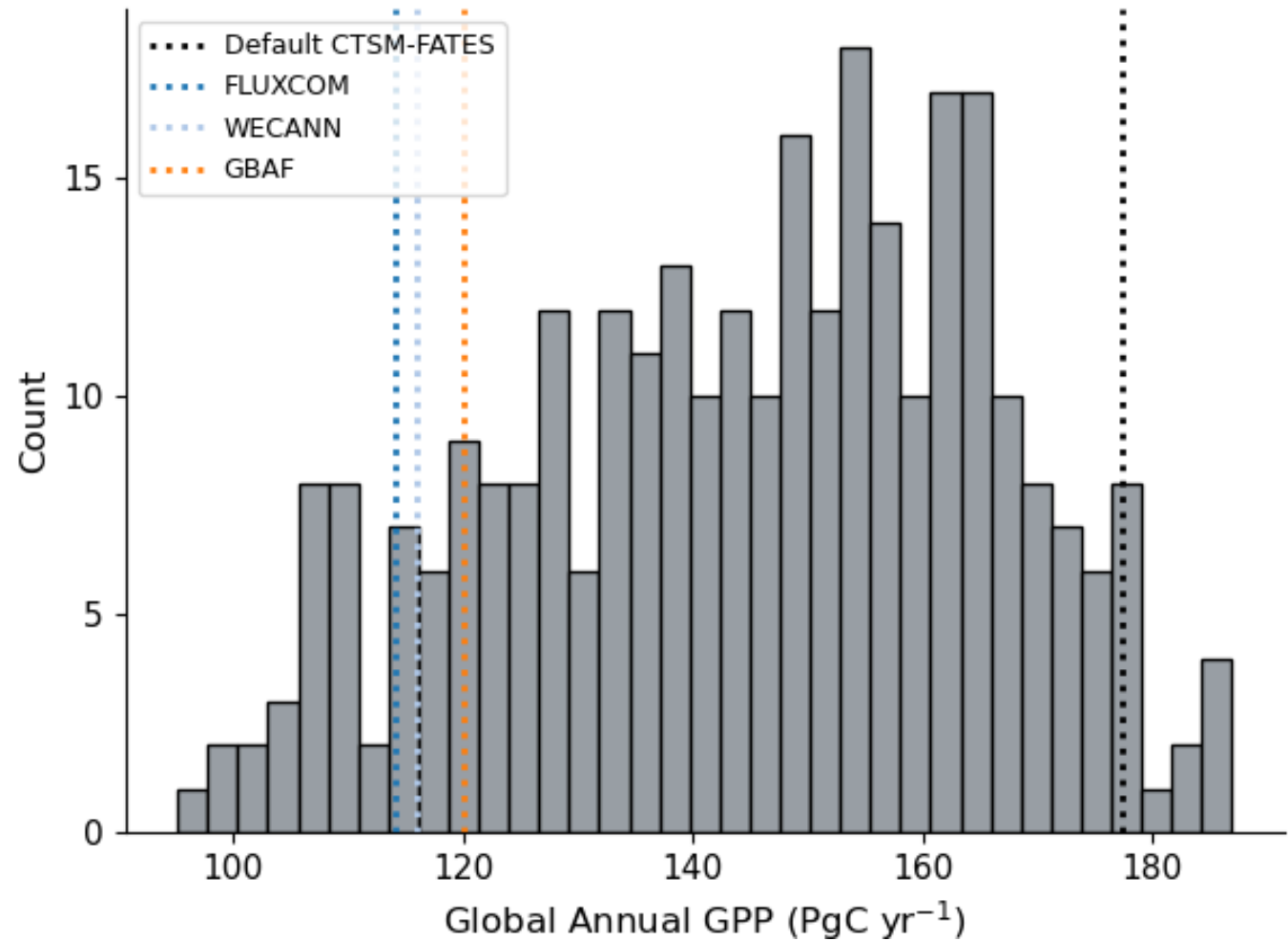


- Science Highlights
- New Features
- Addressing dead Arctic vegetation
- CESM3 timeline & priorities

CLM6 Highlights: Ecosystems

FATES:

- LULCC
- Calibrated SP and no-comp global parameters
- 2 stream radiation
- Much more [Thursday PM]



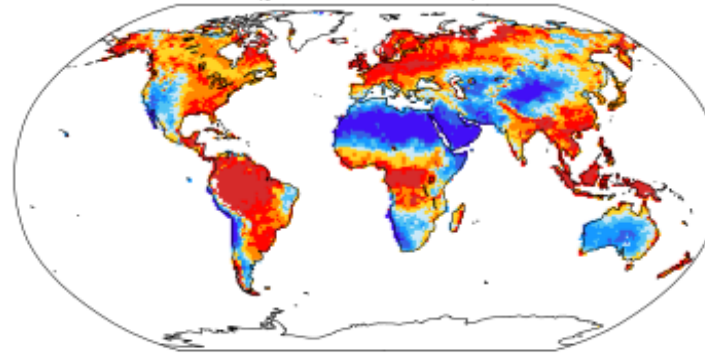
CLM6 Highlights: Water

Hydrology & Snow

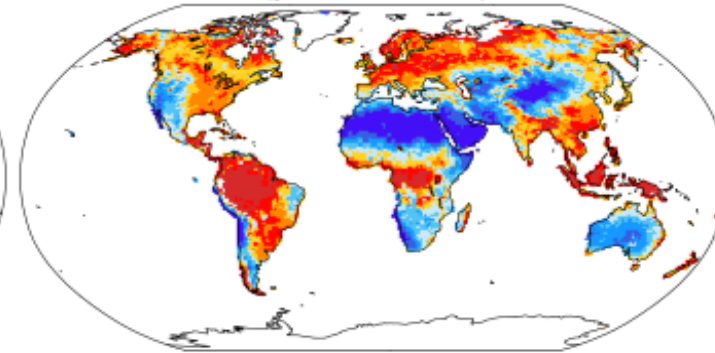
- Hillslope Hydrology
- mizuRoute
- SNICAR updates
- Snow thermal properties
- More [Wednesday AM]

ANN EVAPFRAC (unitless)

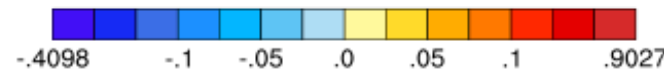
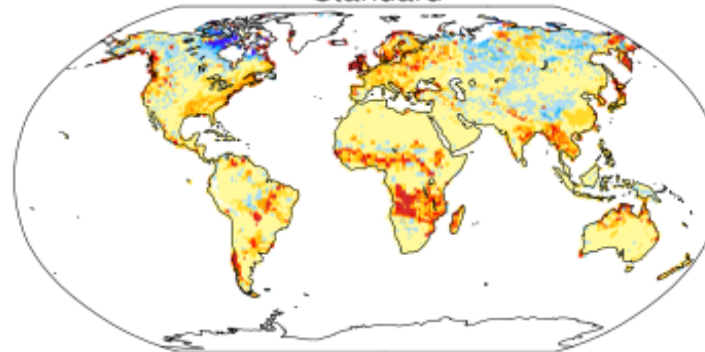
Hillslope
(yrs 1990-2009)



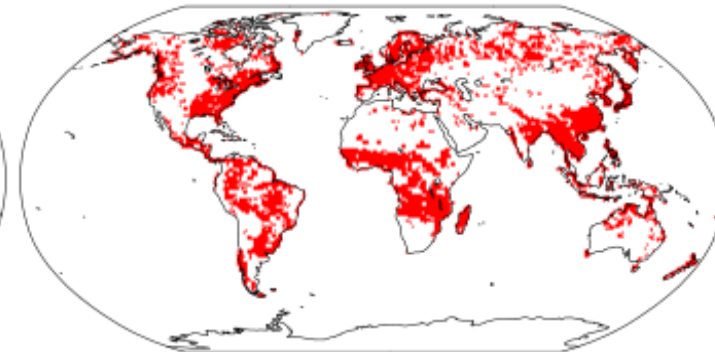
Standard
(yrs 1990-2009)



Hillslope
- Standard



T-Test of two Case means at each grid point



Cells are significant at 0.1 level

CLM6 Highlights: Water

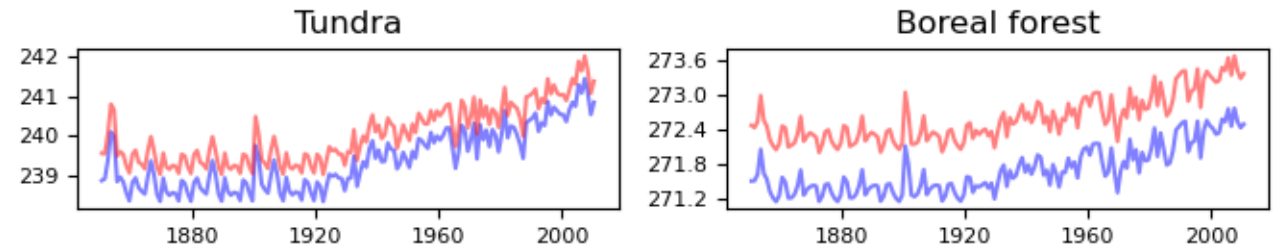
South aspect

North aspect

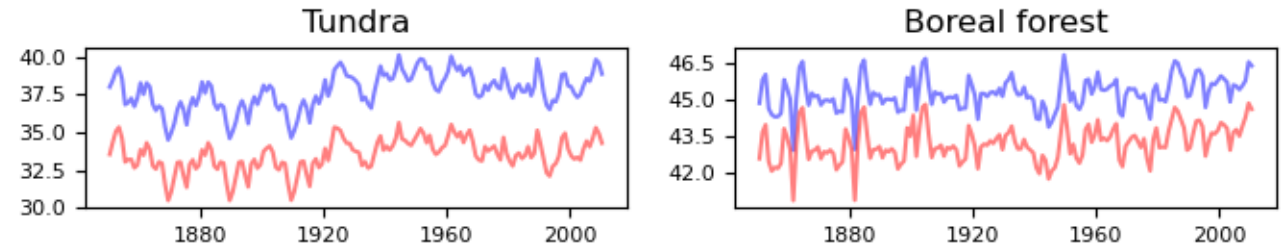
Hydrology & Snow

- Hillslope Hydrology
- mizuRoute
- SNICAR updates
- Snow thermal properties
- More [Wednesday AM]

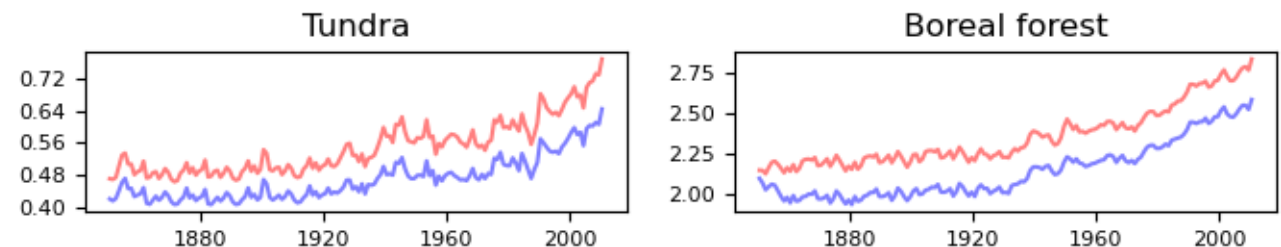
Annual Mean TSOI_10CM



Annual Mean SOILWATER_10CM



Annual Mean TLAI

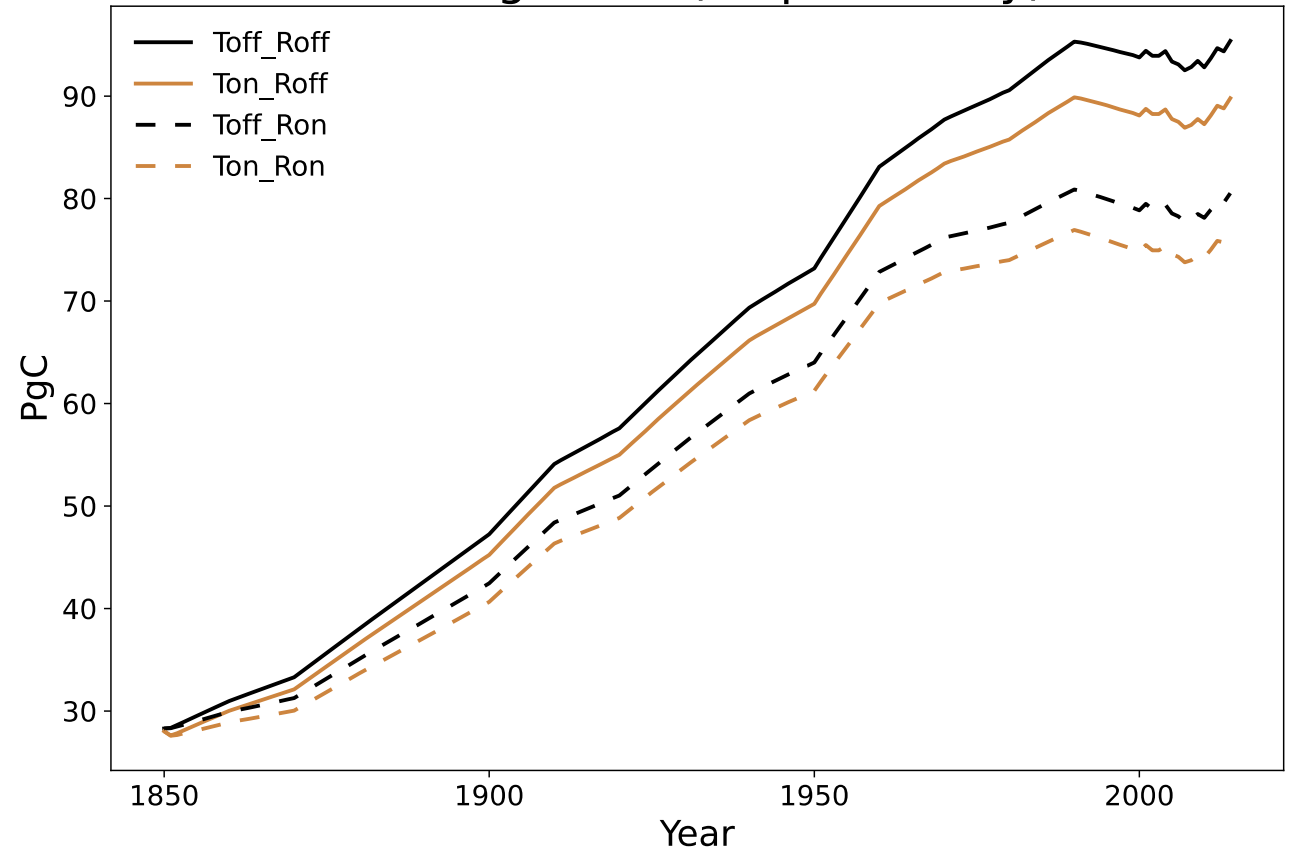


CLM6 Highlights: Food

Crop Model

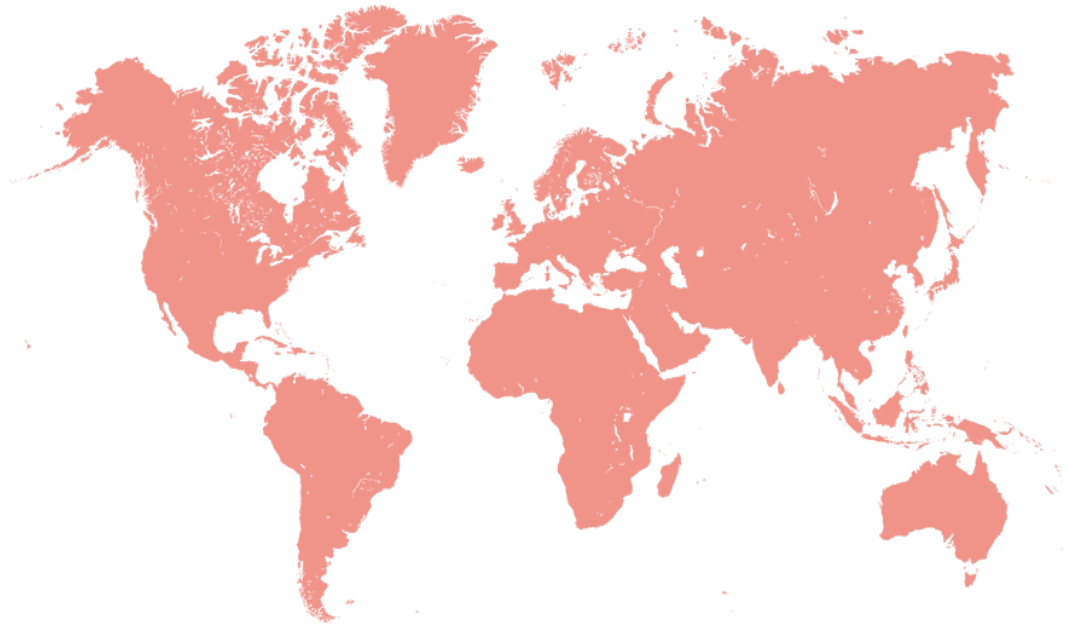
- Crop phenology & planting dates
- Tillage & residue management
- More [Wednesday PM]

Soil organic C (cropland only)



CLM6 Features

New Surface Datasets



CTSM5.2

Includes:

- Transient urban [Weds AM]
- Dynamic & new lake dataset
- Improved crop distribution
- Updated soils dataset
- Gross unrepresented land use transitions
- Increased capacity for creating high resolution datasets

* Thanks to Mariana, Sam L, Erik, Peter, Negin, Jim & more

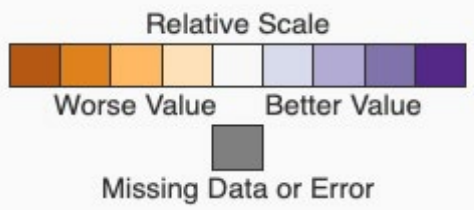
CLM6 DATM options

	Dataset	Spatial resolution	Temporal extent	Temporal resolution	Notes
CLM5	GSWP3	0.5 deg	1901-2014	1.5 hour	No longer updated Low tropical humidity
	CRUNCEP	0.5 deg	1901-2016	6 hour	No longer updated. Longwave not used.
CLM6	CRU-JRA (Trendy)	0.25 deg	1901-2022	6 hour	No longer being updated, Used for GCP & SMYLE land initialization. NO data over Antarctica.
	ERA5	0.25 deg	1940-present	1 hour	Being updated, Known precip biases (among others) Candidate for initializing OMWG, ESPWG & SIMA runs.

CLM6 DATM options ILAMB

Ecosystem and Carbon Cycle				
Gross Primary Productivity				
Hydrology Cycle				
Evapotranspiration				
Evaporative Fraction				
Latent Heat				
Runoff				
Sensible Heat				
Terrestrial Water Storage Anomaly				
Snow Water Equivalent				
Permafrost				
Surface Soil Moisture				
Radiation and Energy Cycle				
Albedo				
Surface Upward SW Radiation				
Surface Net SW Radiation				
Surface Upward LW Radiation				
Surface Net LW Radiation				
Surface Net Radiation				
Ground Heat Flux				
Forcings				
Surface Air Temperature				
Diurnal Max Temperature				
Diurnal Min Temperature				
Diurnal Temperature Range				
CRU4.02				
Precipitation				
Surface Relative Humidity				
Surface Downward SW Radiation				
Surface Downward LW Radiation				
Relationships				
GrossPrimary/Productivity/FLUXCOM				
GrossPrimary/Productivity/GBAF				
Evapotranspiration/GLEAMv3.3a				
Evapotranspiration/MODIS				
Evapotranspiration/MOD16A2				

CTSM51_GSWP3V1
 CTSM51_CRUNCEPV7
 CTSM51_CRUJRA
 CTSM51_CRUJRA_FLDS



CLM6 Features

SASU spinup (matrix)

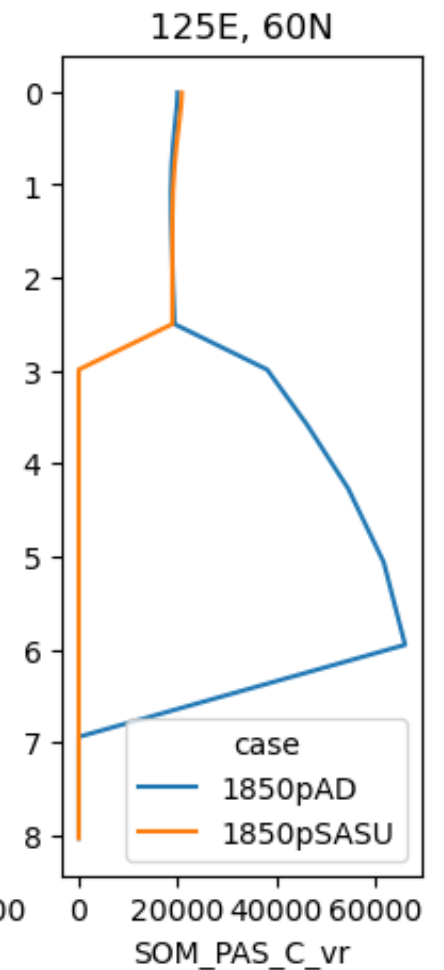
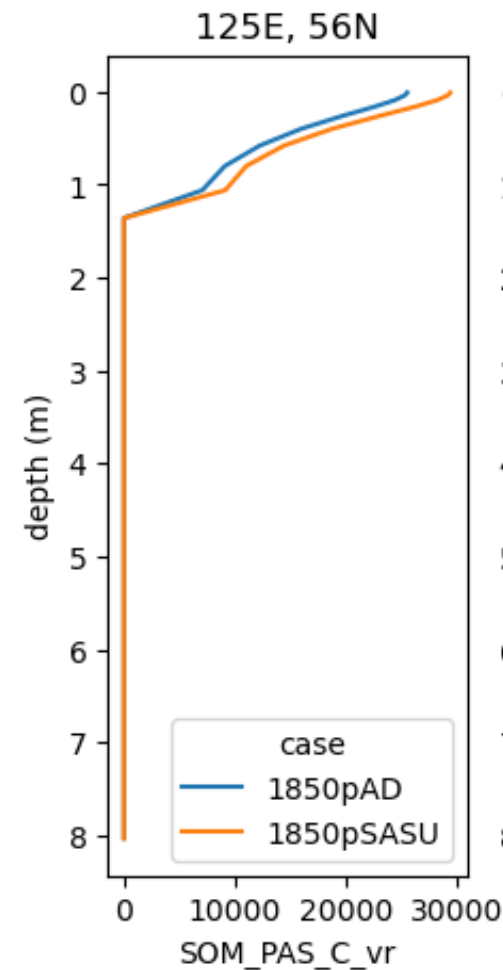
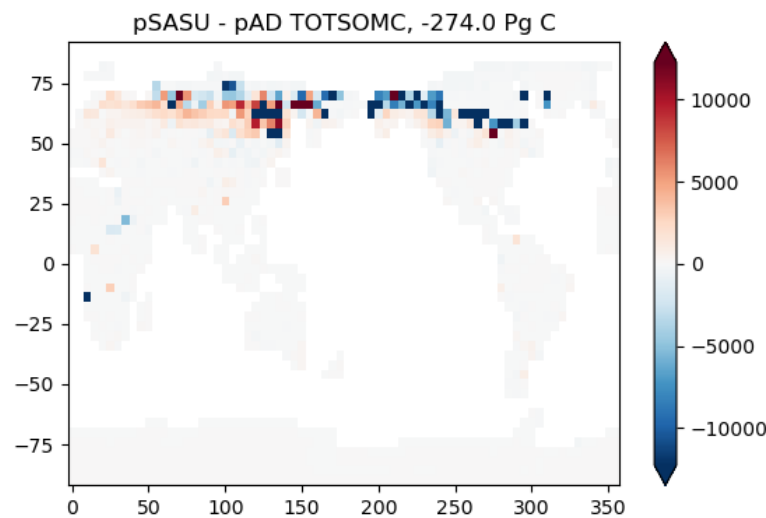
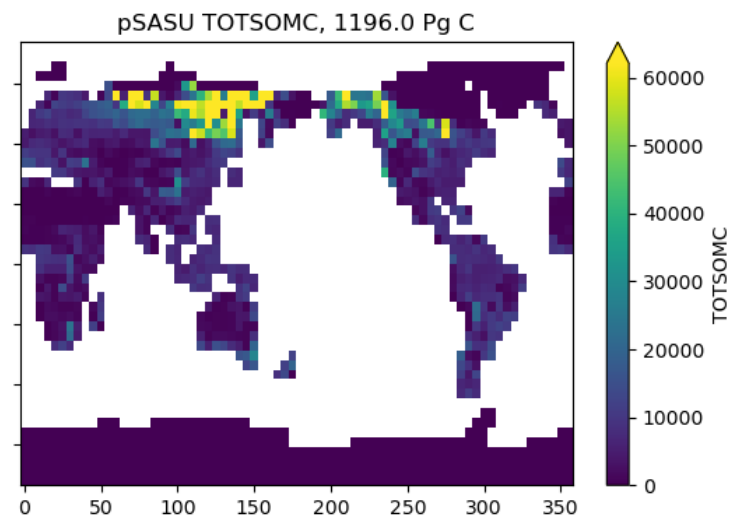
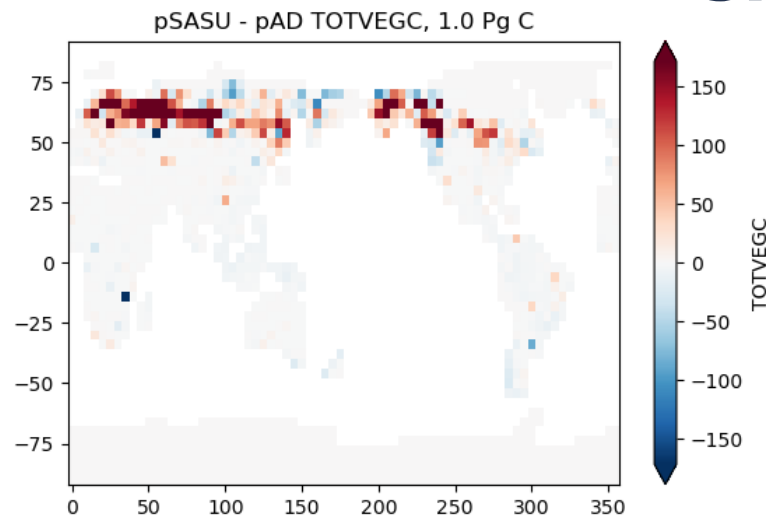
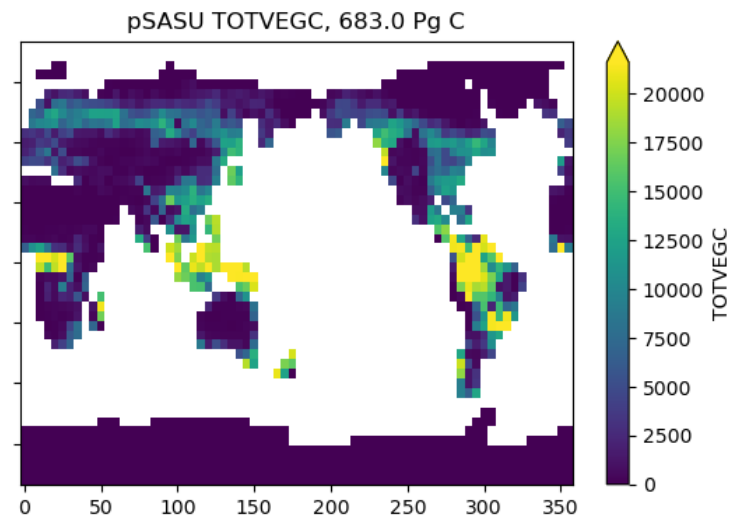
PPE Calibration
Workflow



Thursday AM

CLM6 Features

SASU spinup (matrix)





CLM6 Features

Supported tower capabilities



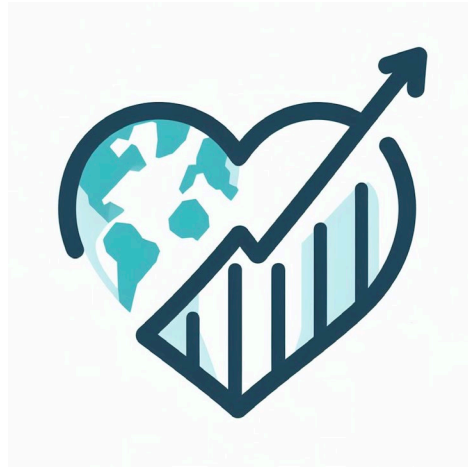
NEON education group

* Thanks to Tegan, Danica, Gordon, Sam L & more




CLM6 Features

Diagnostics



CUPiD:
CESM Unified
Postprocessing and
Diagnostics

CAM Diagnostics



[Case Home](#) [Plots](#) [Links](#) [About](#) [Contact](#)

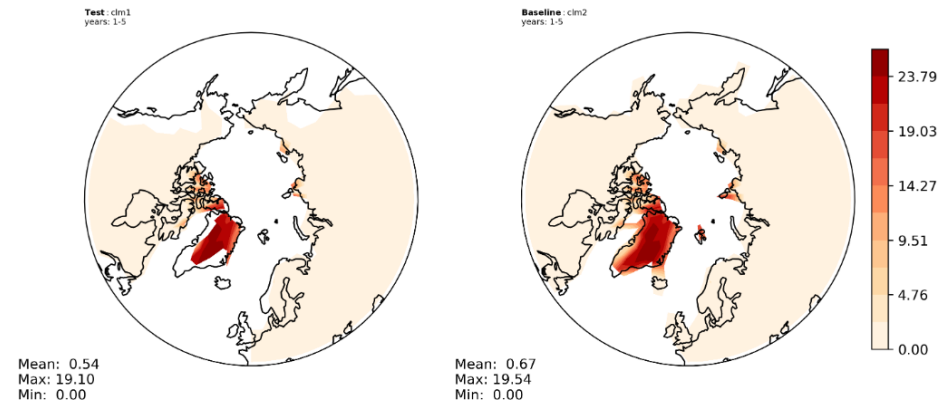
Test Case: ctsm51d159_f45_GSWP3_bgccrop_1850pAD - years: 1 - 5
Baseline Case: ctsm51d159_f45_GSWP3_bgccrop_1850pSASU - years: 1 - 5

NHPolar - SNOWDP

[Back to NHPolar](#) [Back to Plot Types](#)

[ANN](#) [DJF](#) [MAM](#) [JJA](#) [SON](#)

SNOWDP - MAM - NHPolar



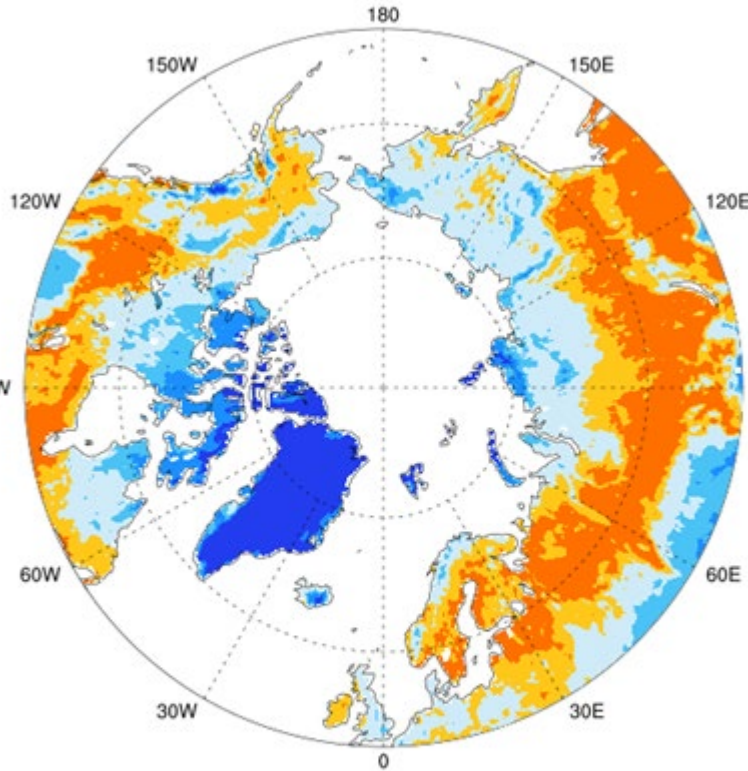
* Thanks to Tegan, Mike w/ CUPiD + Justin Richling & ADF team

Dead Arctic Vegetation

MODIS Obs.

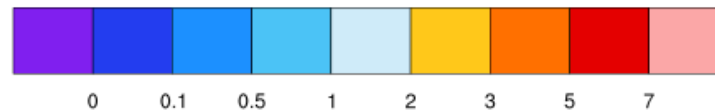
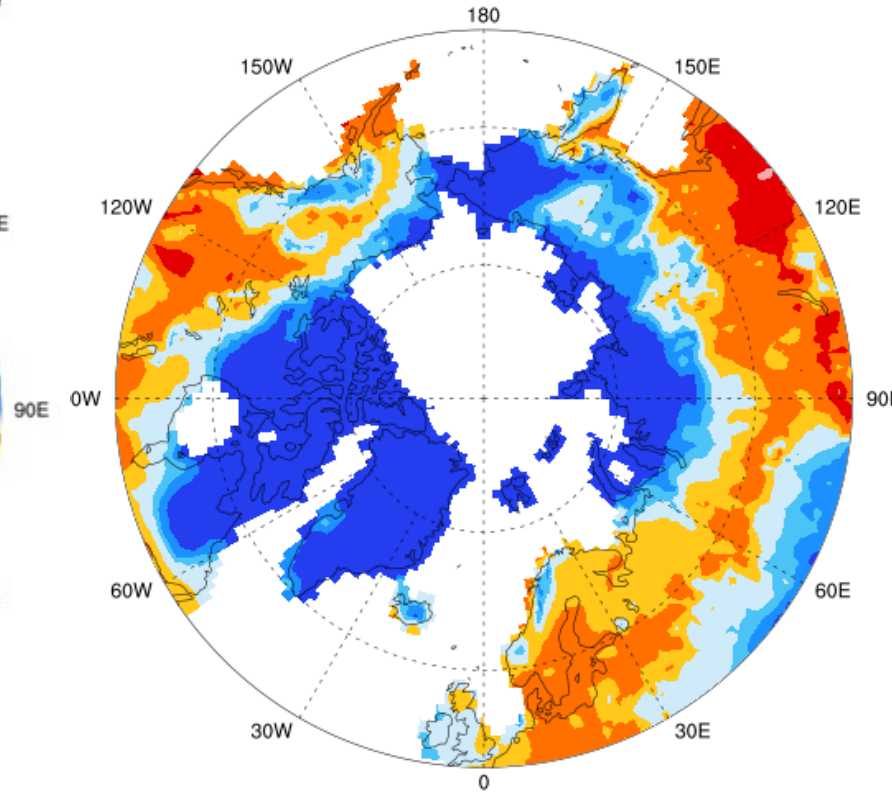
total projected leaf area index

none



CESM3: F200 case

m^2/m^2

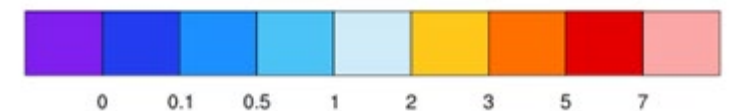
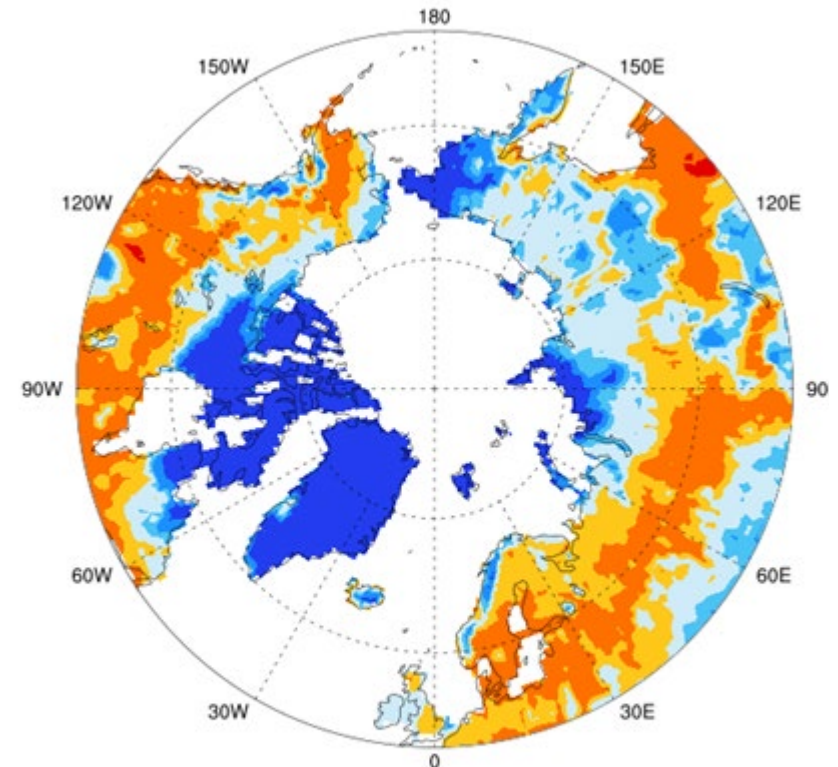


c CLM5.1-GSPW3

A TLAJ

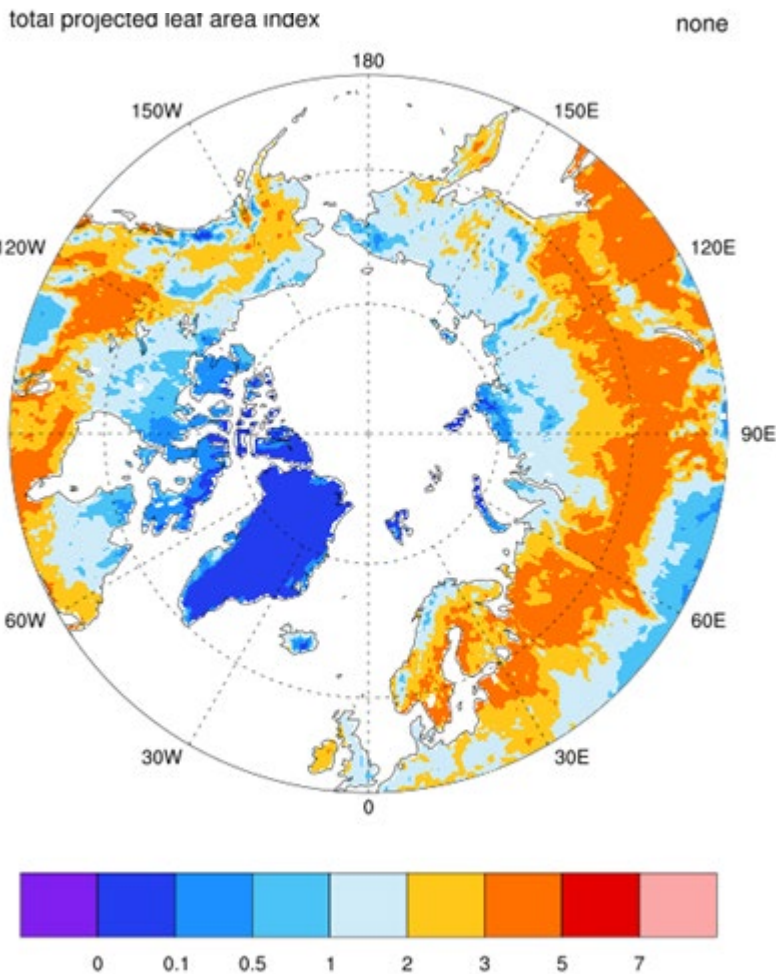
total projected leaf area index

m^2/m^2



Dead Arctic Vegetation

MODIS Obs.



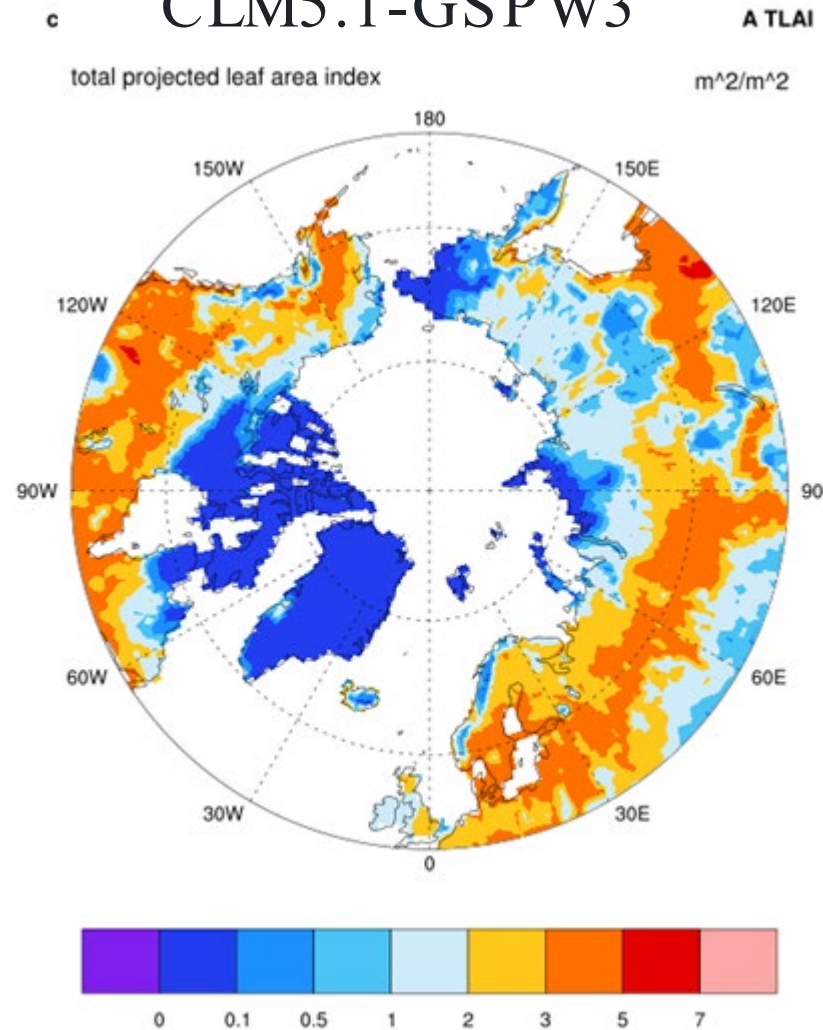
Persistent summer snow
Cold soils
Anemic vegetation



Decrease snow albedo
Sturm snow conductivity
PFT & phenology changes

https://github.com/NCAR/LMWG_dev/discussions/3

c CLM5.1-GSPW3

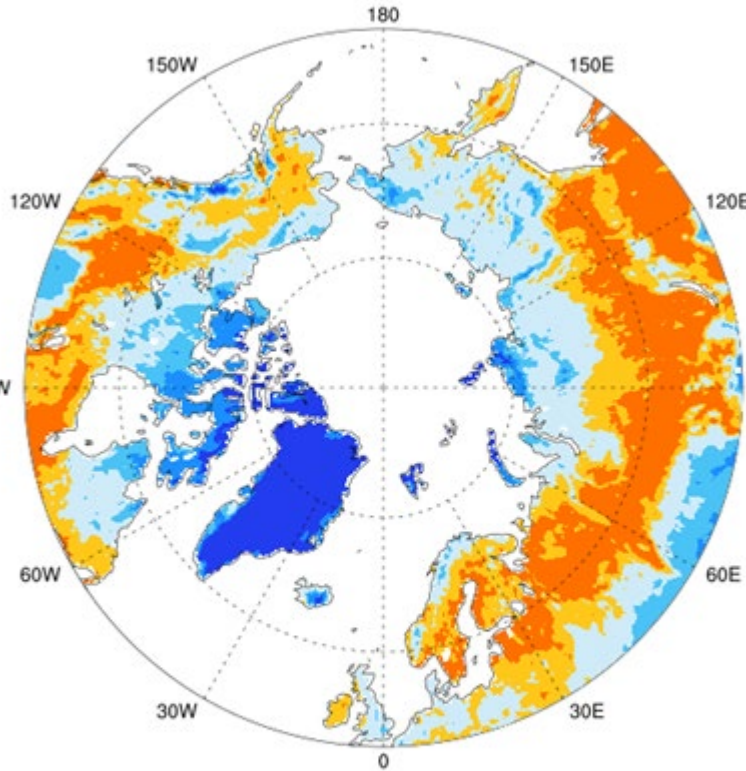


36% less dead Arctic vegetation, 1 -case

MODIS Obs.

total projected leaf area index

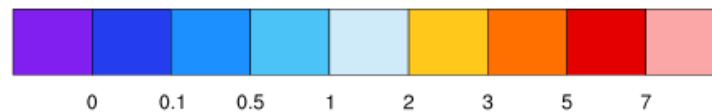
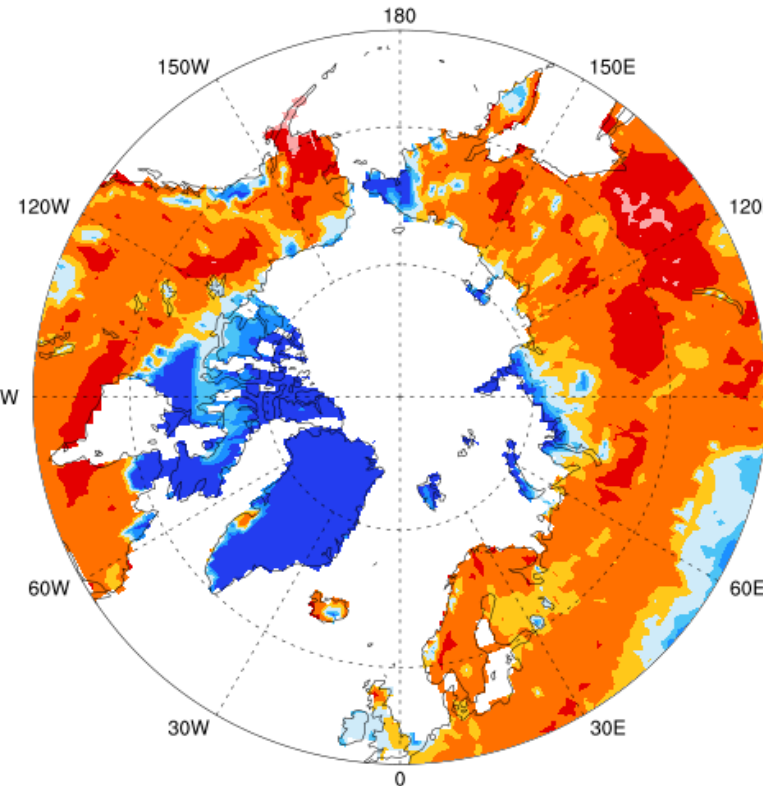
none



CLM5.1*-CRU-JRA

total projected leaf area index

m²/m²

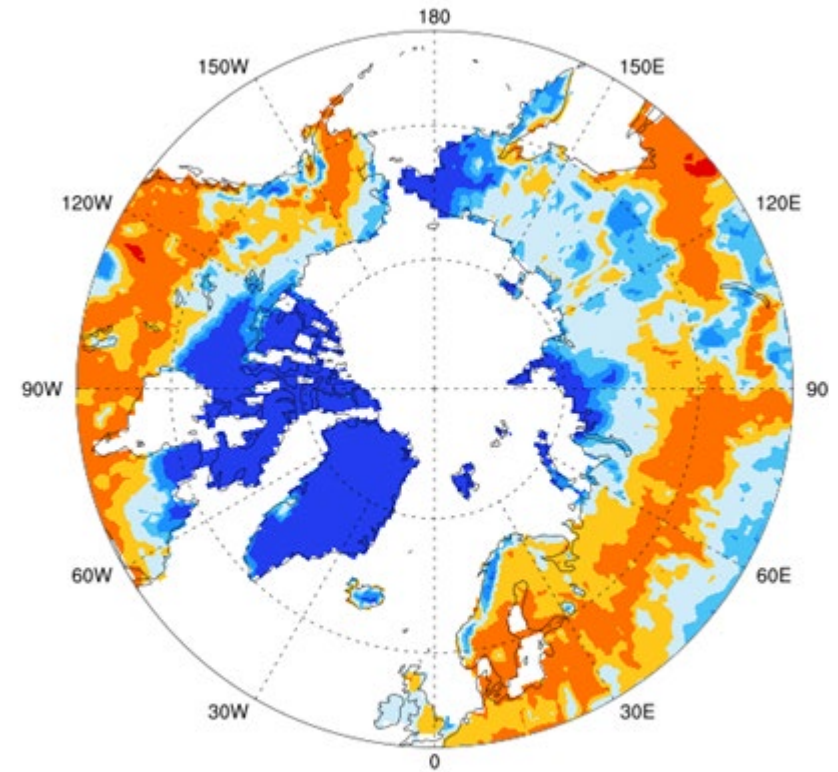


c CLM5.1-GSPW3

A TLAI

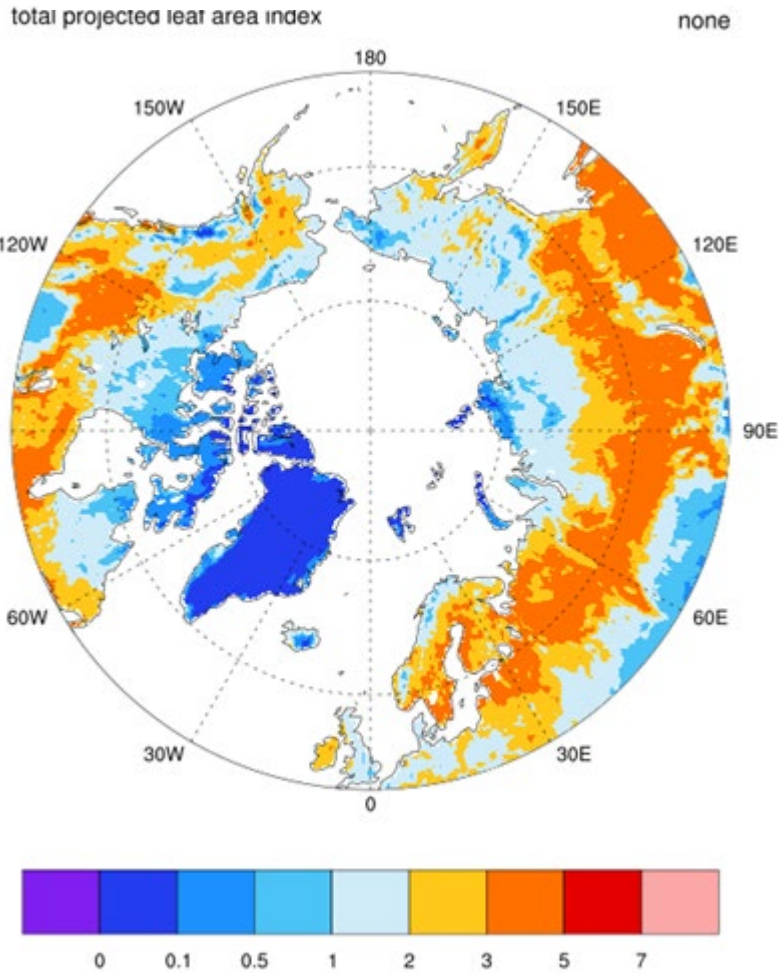
total projected leaf area index

m²/m²

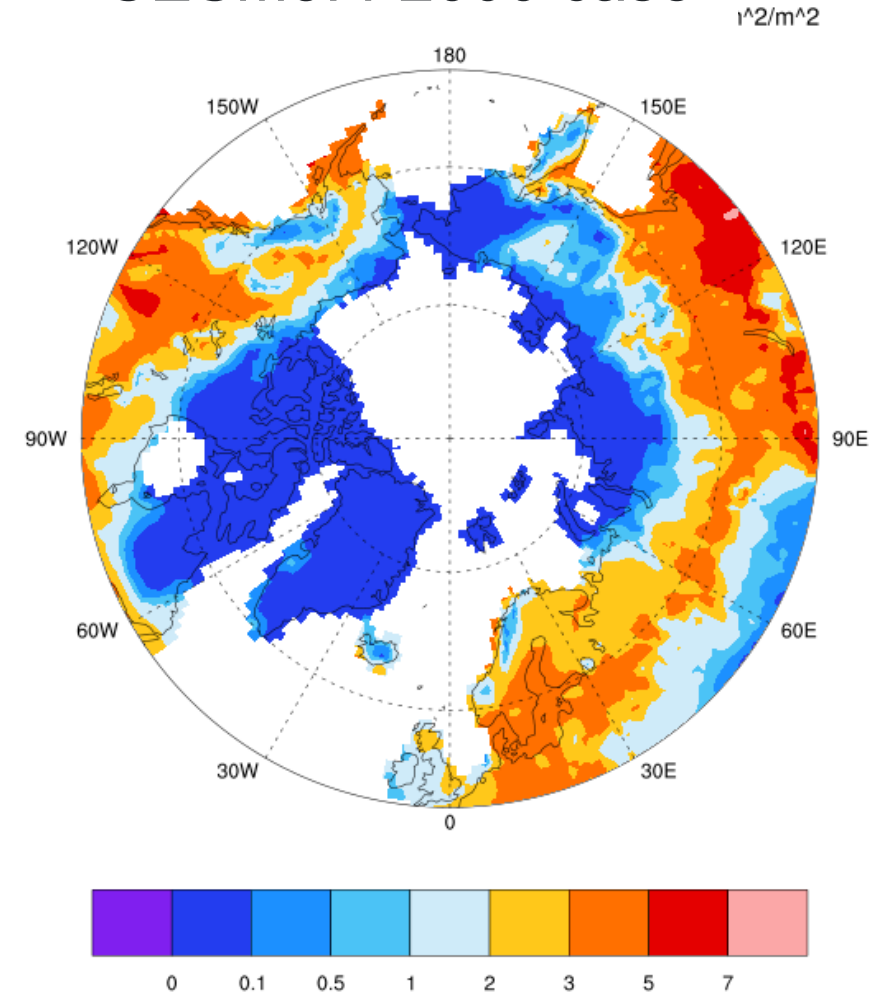


Dead Arctic vegetation F -Case

MODIS Obs.



CESM3: F2000 case

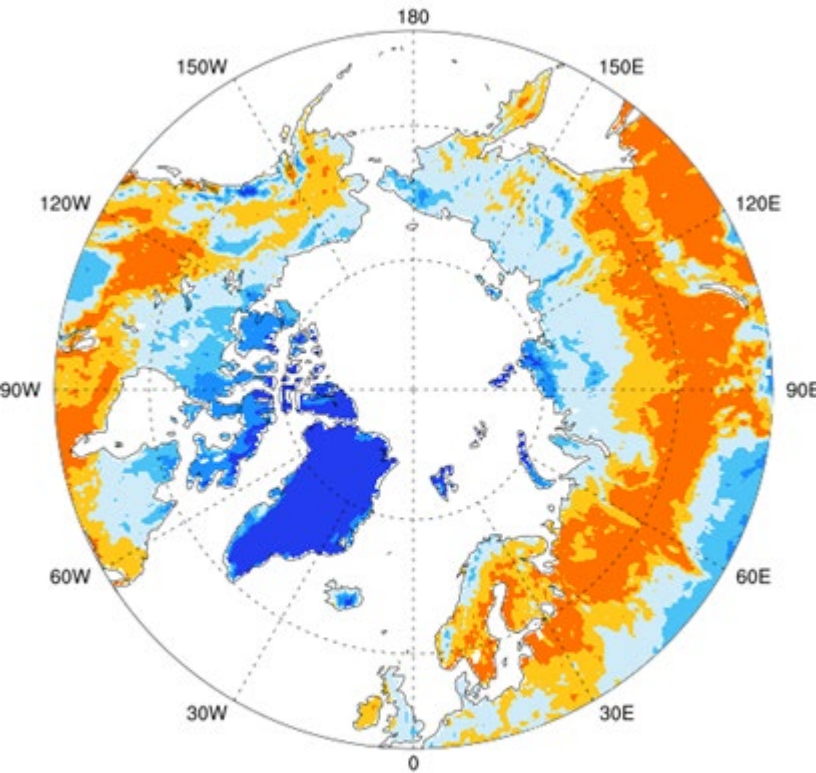


54% less dead Arctic vegetation F₂₀₀₀ -case

MODIS Obs.

total projected leaf area index

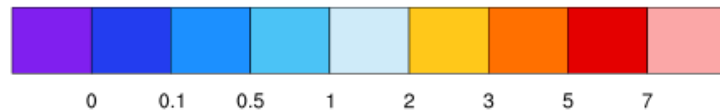
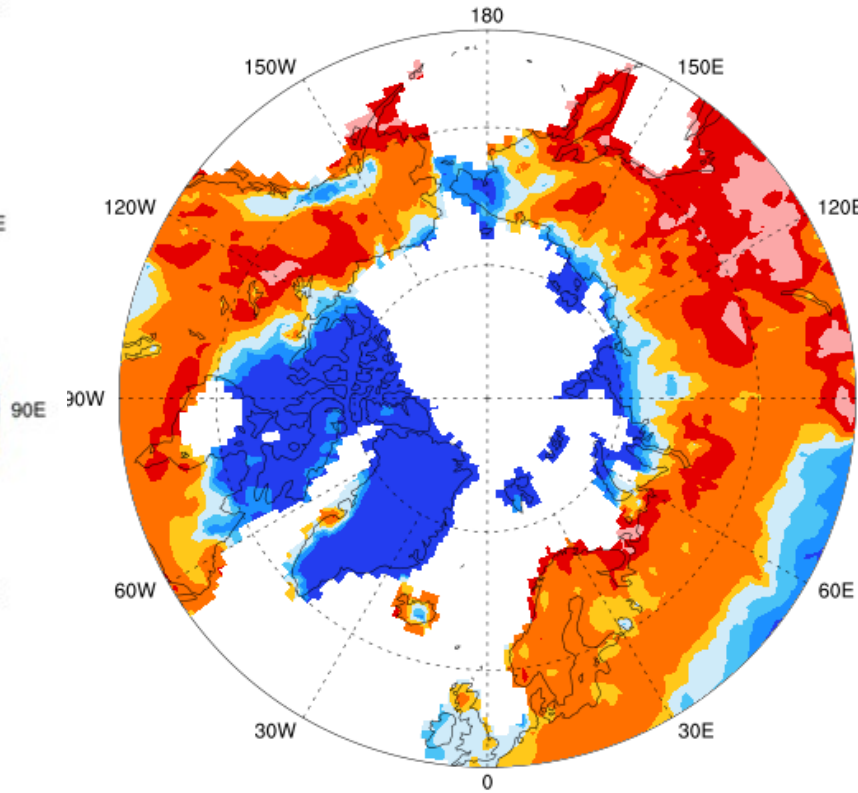
none



CESM3*: F2000 case

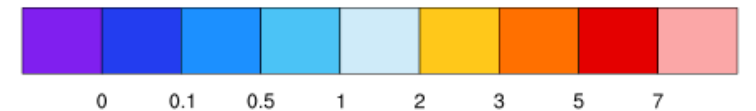
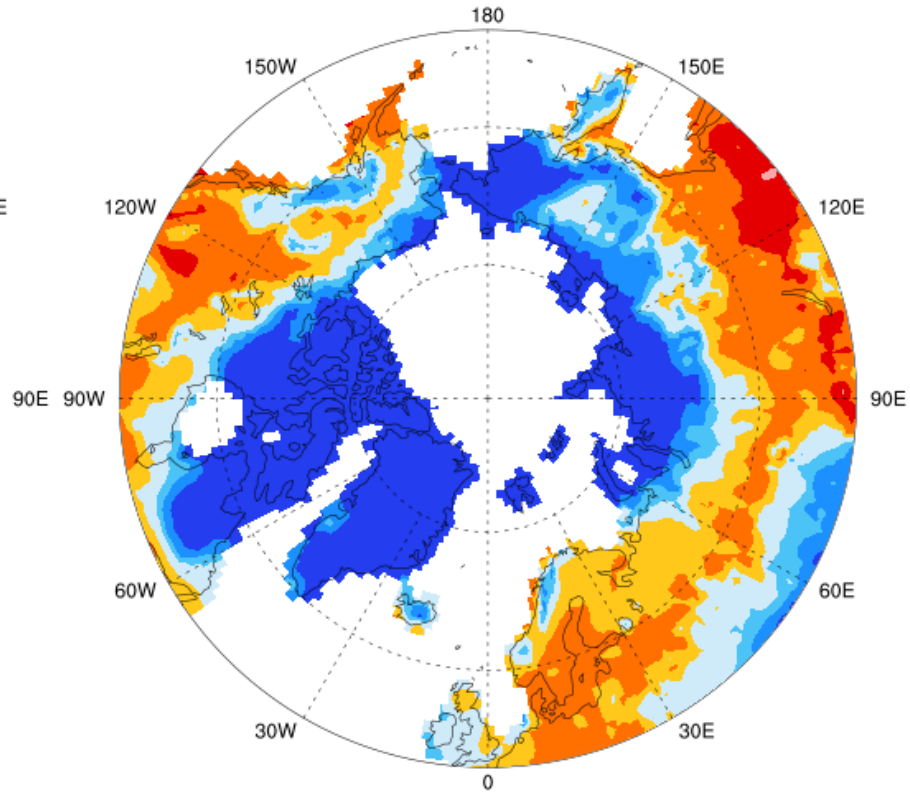
total

2



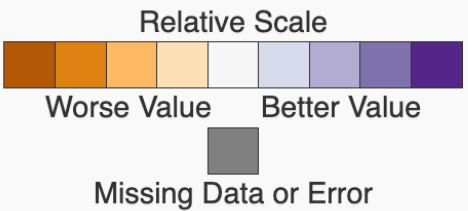
CESM3: F200 case

m^2/m^2



Calibration opportunities

	CLM50	CTSM51	DeadVeg
Ecosystem and Carbon Cycle			
Biomass			
Burned Area			
Carbon Dioxide			
Gross Primary Productivity			
Leaf Area Index			
Global Net Ecosystem Carbon Balance			
Net Ecosystem Exchange			
Ecosystem Respiration			
Soil Carbon			
Nitrogen Fixation			
Hydrology Cycle			
Evapotranspiration			
Evaporative Fraction			
Latent Heat			
Runoff			
Sensible Heat			
Terrestrial Water Storage Anomaly			
Snow Water Equivalent			
Permafrost			
Surface Soil Moisture			
Radiation and Energy Cycle			
Albedo			
Surface Upward SW Radiation			
Surface Net SW Radiation			
Surface Upward LW Radiation			
Surface Net LW Radiation			
Surface Net Radiation			
Ground Heat Flux			
Forcings			
Surface Air Temperature			
Diurnal Max Temperature			
Diurnal Min Temperature			
Diurnal Temperature Range			
Precipitation			
Surface Relative Humidity			
Surface Downward SW Radiation			
Surface Downward LW Radiation			
Relationships			
BurnedArea/GFED4.1S			
GrossPrimaryProductivity/FLUXCOM			
GrossPrimaryProductivity/GBAF			
LeafAreaIndex/AVHRR			
LeafAreaIndex/AVH15C1			
LeafAreaIndex/MODIS			
Evapotranspiration/GLEAMv3.3a			
Evapotranspiration/MODIS			
Evapotranspiration/MOD16A2			

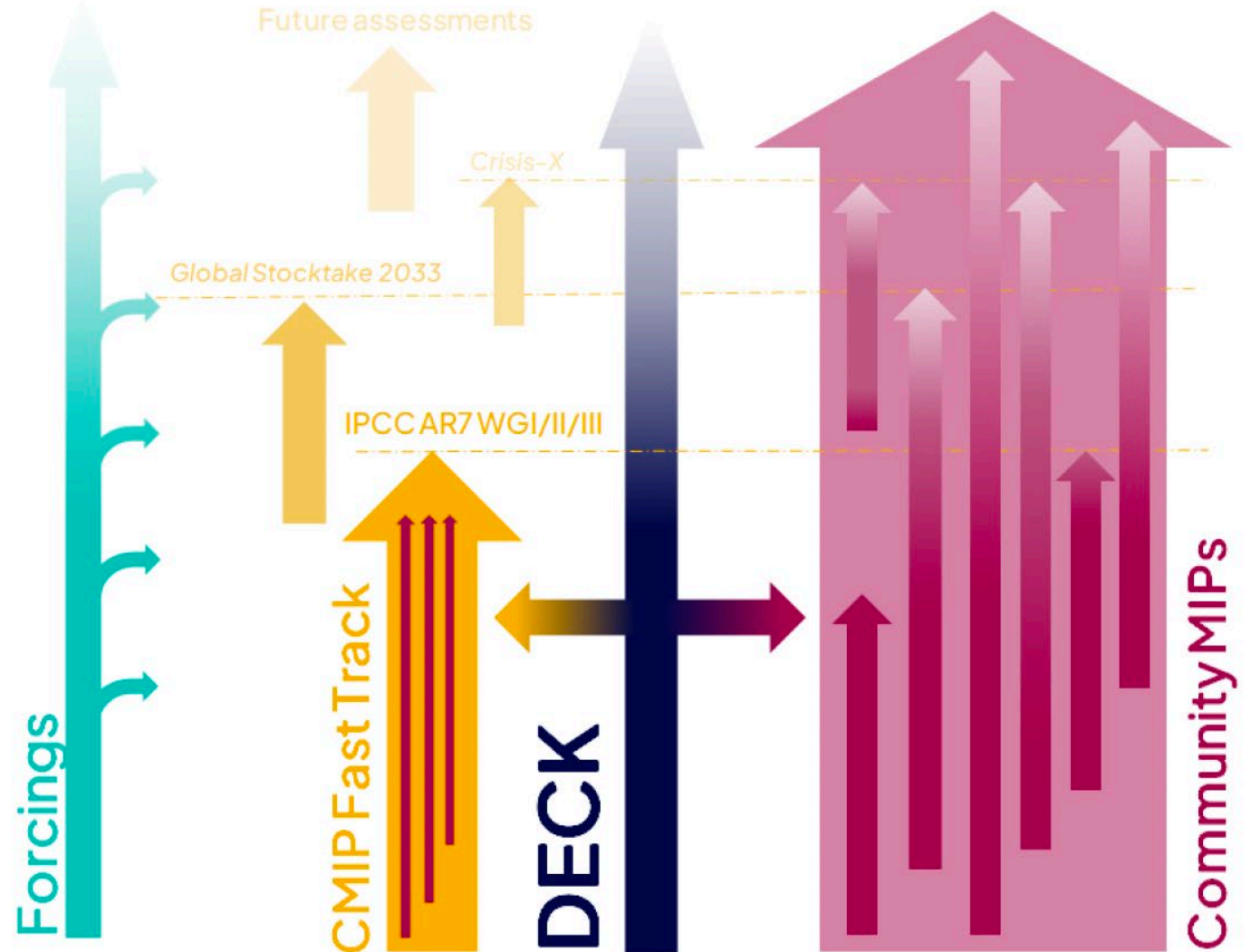


An evolving CMIP design

CMIP7 DECK experiments

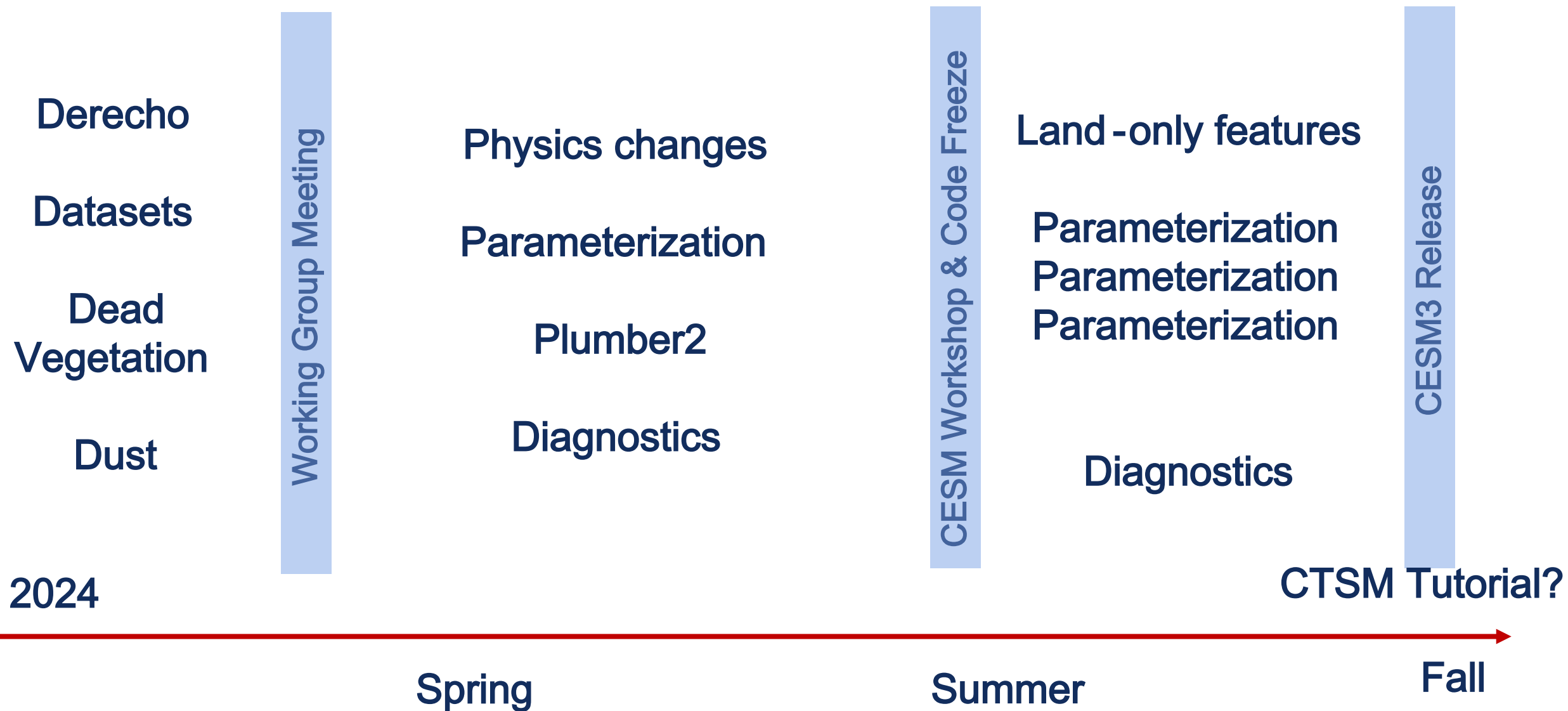
- amip
- abrupt4xCO2
- 1pctCO2
- historical
- **esm-hist (for ESMs only)**
- piControl / esm-piControl
- piClim-control
- piClim-anthro
- piClim-4xCO2

Starting 2025?



Towards CESM3 & CLM6 code base

(most likely optimistic timeline!)



LMWG focus areas: Ecosystems, Water & Food



- Science Highlights
- New Features
- Addressing dead Arctic vegetation
- CESM3 timeline & priorities