CISM and CESM3 updates

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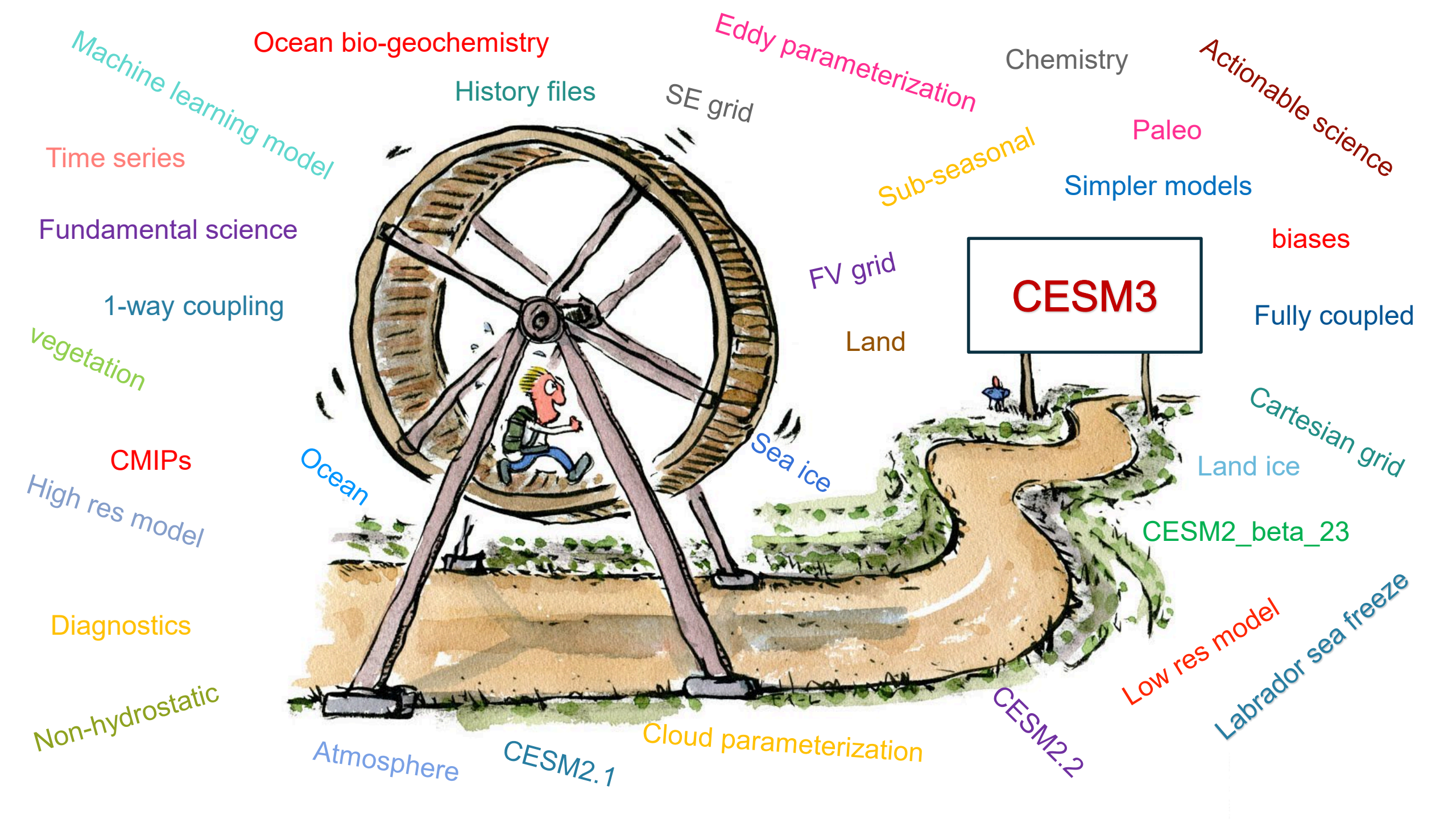
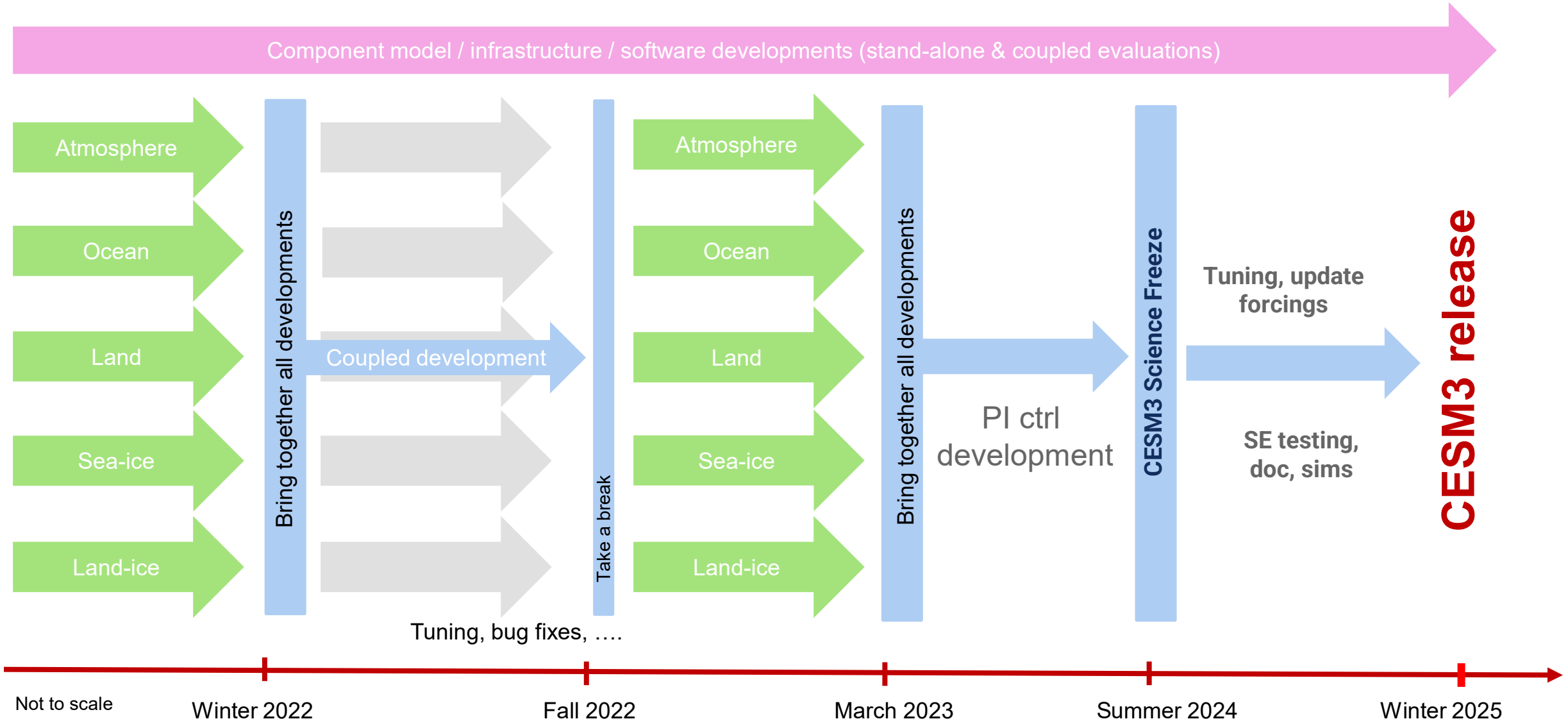
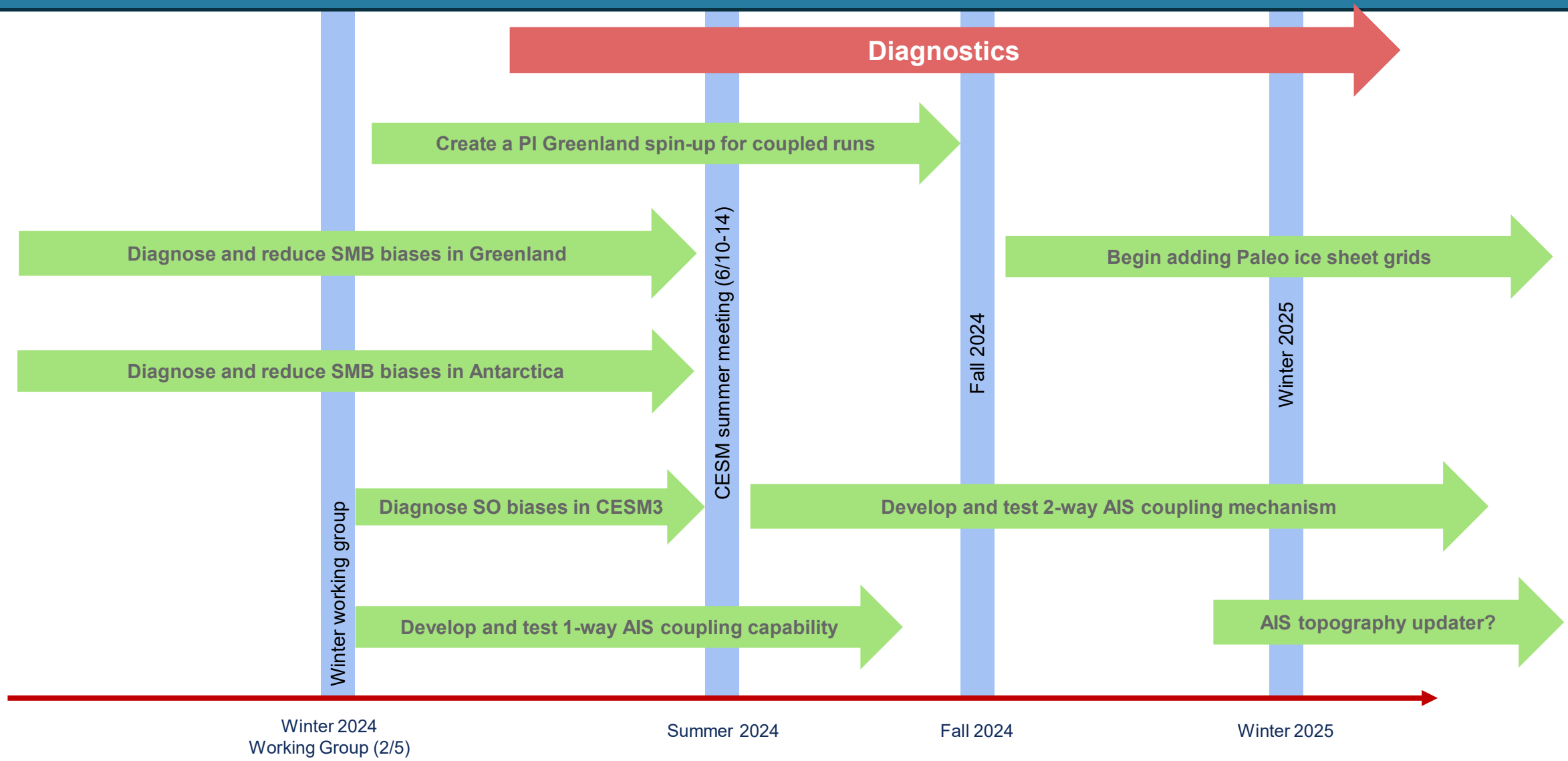

Machine learning model
Ocean bio-geochemistry
History files
SE grid
Eddy parameterization
Chemistry
Actionable science
Time series
Sub-seasonal
Paleo
Simpler models
Fundamental science
biases
FV grid
CESM3
1-way coupling
Fully coupled
Land
vegetation
Cartesian grid
CMIPs
Ocean
Sea ice
Land ice
High res model
CESM2_beta_23
Diagnostics
Low res model
Labrador sea freeze
Non-hydrostatic
Atmosphere
CESM2.1
Cloud parameterization
CESM2.2

Towards CESM3

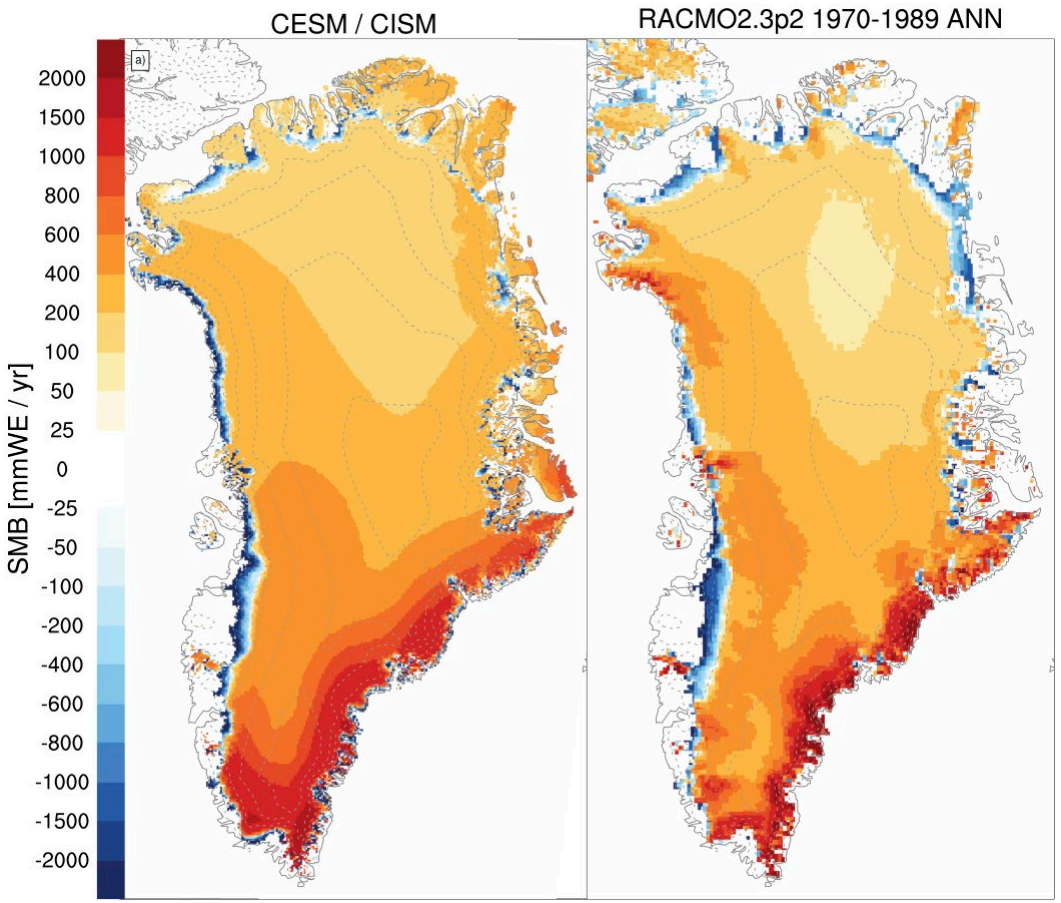


LIWG land ice plans for CESM3



Greenland SMB in CESM2

Greenland climate/SMB



Van Kampenhout et al. 2019

- RACMO is averaged between 1970 and 1989.
- CESM/CISM averaged from 1850.
- Good agreement between CESM and RACMO in the ablation zone (blue).
- Narrower southwest ablation zone in CESM2 could be due to earlier time period.
- CISM set to no-evolve: ice is not added where there is no ice originally. (But CLM can form ice over bare tundra.)
- Some cause of biases:
  - Snow surviving winter in North GrIS
  - Too much snowfall in Southern Greenland interior (resolution dependent).

Improved snow physics and soil temperature in CLM might help with the biases TBD

Antarctic SMB in CESM2

- CESM2 has a good representation of the spatial pattern but is biased high.
- Some of the improvement since CESM1 due to deeper snowpack, new snow physics parameterizations, and bug fixes (van Kampenhout et al. 2017).

- Biases:
  - Stronger on the coast where SMB is largest (Dronning Maud land)
  - CESM2 is biased high compared to reconstruction.
- Low biases in the ASE.

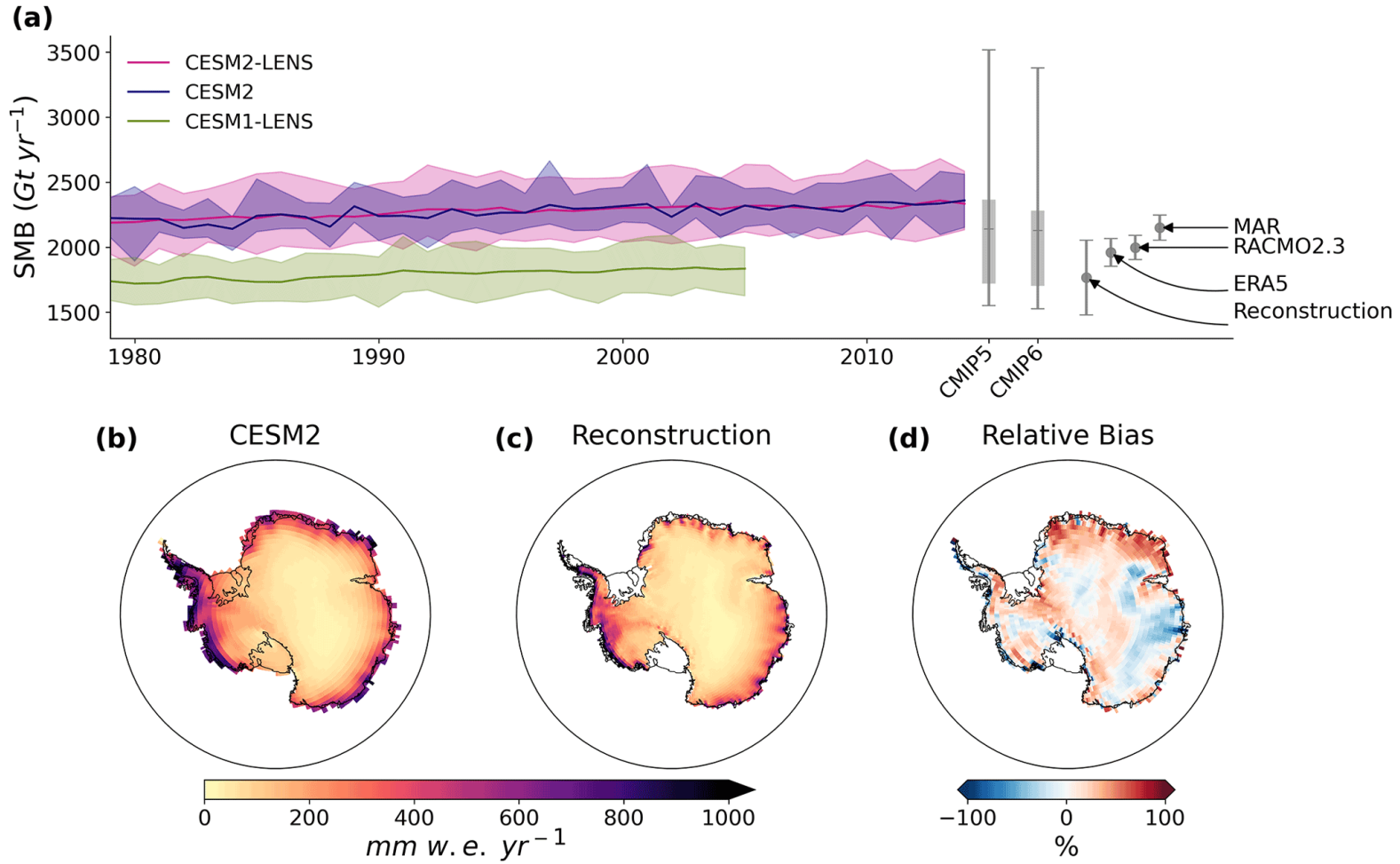


Figure (Dunmire et al 2022): **(a)** 1979–2015 time series of annual grounded AIS SMB, with ensemble mean (solid lines) and spread. **(b)** 1979–2015 annual AIS SMB from CESM2. **(c)** 1979–2000 annual AIS SMB from the MERRA-2 based reconstruction (MT2019) reconstruction. **(d)** Relative bias between CESM2 and MT2019 SMB.

Spinning up Greenland within CESM (PI ctrl)

Initialize CISM

- Bed topo + Ice thickness
- Geothermal heat flux
- Note: in CESM, we remove ice shelves in Greenland
- Work on our configuration options:
  - Grid resolution 4 km
  - Remove all floating ice
  - Use inversion for basal friction for historical and future runs.
- Use pseudo plastic or new hydrology scheme for paleo Greenland.

CISM stand alone

Stand alone spin-up

- Use SMB and air temperature from CESM PI ctrl.

Add to CESM

BG runs (run for 10,000 CISM yrs)

- Use SMB and air temperature from PI ctrl
- Run coupled model for ~30 years
- Accelerate CISM (*10+ to reach faster equilibrium)
- Update CAM topography

Spinning up Antarctica within CESM (PI ctrl)

Initialize CISM

- Bed topo + Ice thickness
- Geothermal heat flux
- Test new calving mask
- Thermal forcing observation
- Work on our configuration options:
  - Grid resolution 4km
  - Use inversion for basal friction for historical and future runs.

CISM stand alone

Thermal forcing (TF) correction

1. Use SMB and air temperature from PI ctrl
2. Use CESM TF to which we add TF Correction.
3. TF correction:
   - Derive TF modern climatology (e.g.,1995-2014).
   - Correction = Obs – modern clim

Add to CESM

BG runs (run for 10,000 CISM yrs)

- Use SMB and air temperature from PI ctrl
- Use CESM TF to be added to TF correction
- Accelerate CISM (*10 to reach faster equilibrium)
- Update CAM topography?

CISM releases

CISM2.2 for CESM3 science freeze

Ice sheet physics

- New Coulomb basal sliding law (Zoet-Iverson) ✓
- Flux-routing basal hydrology scheme ✓
- Sub-ice-shelf cavity ocean T&S interpolation ✓

Ice sheet Initializations

- Spin-up with SMB ✓
- Spin-up with SMB + dh_dt ✓

Test cases (for Derecho and laptop)

- Antarctica ✓
- Greenland ✓

Code validation

- LIVVkit (Michael K.) ✓

CISM3 (for CESM3.1)

Dynamical core

- C-grid ice velocity solver

Ice sheet physics

- New calving schemes and options
- Sub-ice-shelf cavity circulation module

Mountain glaciers

- Inversion methods for glacier spin-up ✓

Tools and datasets

- Glacier grid generation and mapping tools
- Diagnostics (notebooks)

Documentation

Contact information

Website: https://www.cesm.ucar.edu/working-groups/land-ice

Co-chairs:

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Save the date: CESM summer workshop

June 10th-14th 2024