CESM/CISM Software Engineering Update: Towards CESM2.0

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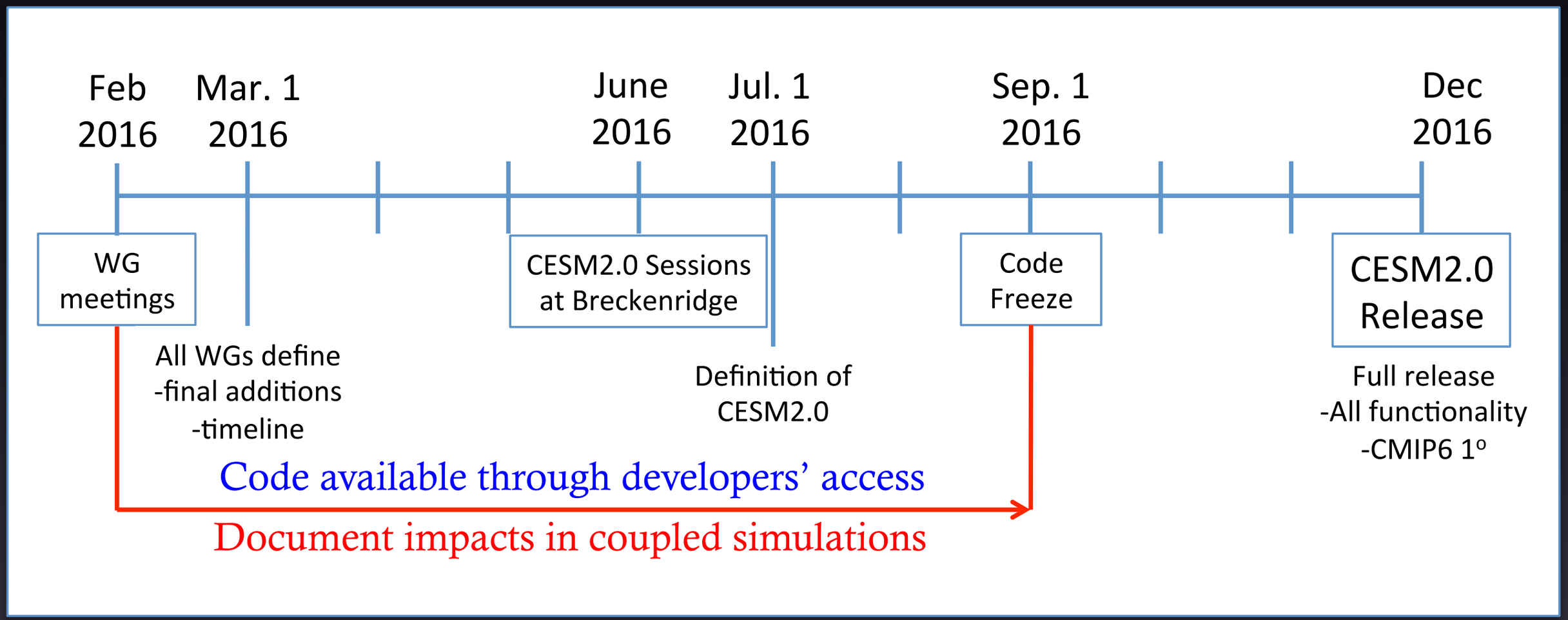
With contributions from many others in the LIWG
and the CESM Software Engineering Group (CSEG)

Timeline for CESM2.0 Release



Land Ice: From CESM1 to CESM2

CESM1.0	CESM2.0
One-way coupling	Two-way coupling
Serial, shallow ice approximation	Parallel, higher-order
No way to run standalone CISM	TG compset for running standalone CISM
1-m snow pack in CLM	10-m snow pack in CLM
Only 3 land/atm resolutions supported	All land/atm resolutions supported
SMB only computed in runs done by LIWG	SMB computed in all runs

Major Science Changes Since Last Year

- Improvements to CISM code and default configuration options to support robust, higher-order Greenland Ice Sheet simulations
  - Bill Lipscomb, Jeremy Fyke, Lauren Vargo, Steve Price
- Improved snow physics in CLM
  - Leo van Kampenhout, Jan Lenaerts, Bill Lipscomb, Drew Slater
  - Allow deeper snow pack: 10m water equivalent for CLM5
  - Reworked snow capping: mass taken from bottom rather than from top
  - Wind-dependent snow density
- Downscaling to elevation classes: repartition rain/snow from atmosphere

CIME: Common Infrastructure for Modeling the Earth

Mariana Vertenstein, Jim Edwards, and others in CSEG and ACME

- Clean extraction of the CESM infrastructure
  - Scripting infrastructure
  - Driver/coupler
  - Data & stub models
  - Code shared between components
- Promotes collaboration between earth system modeling groups (CESM, ACME, NOAA, etc.)
  - For LIWG, especially relevant for coupling infrastructure
- Promotes swappability of components

Remapping Moved into CESM Coupler

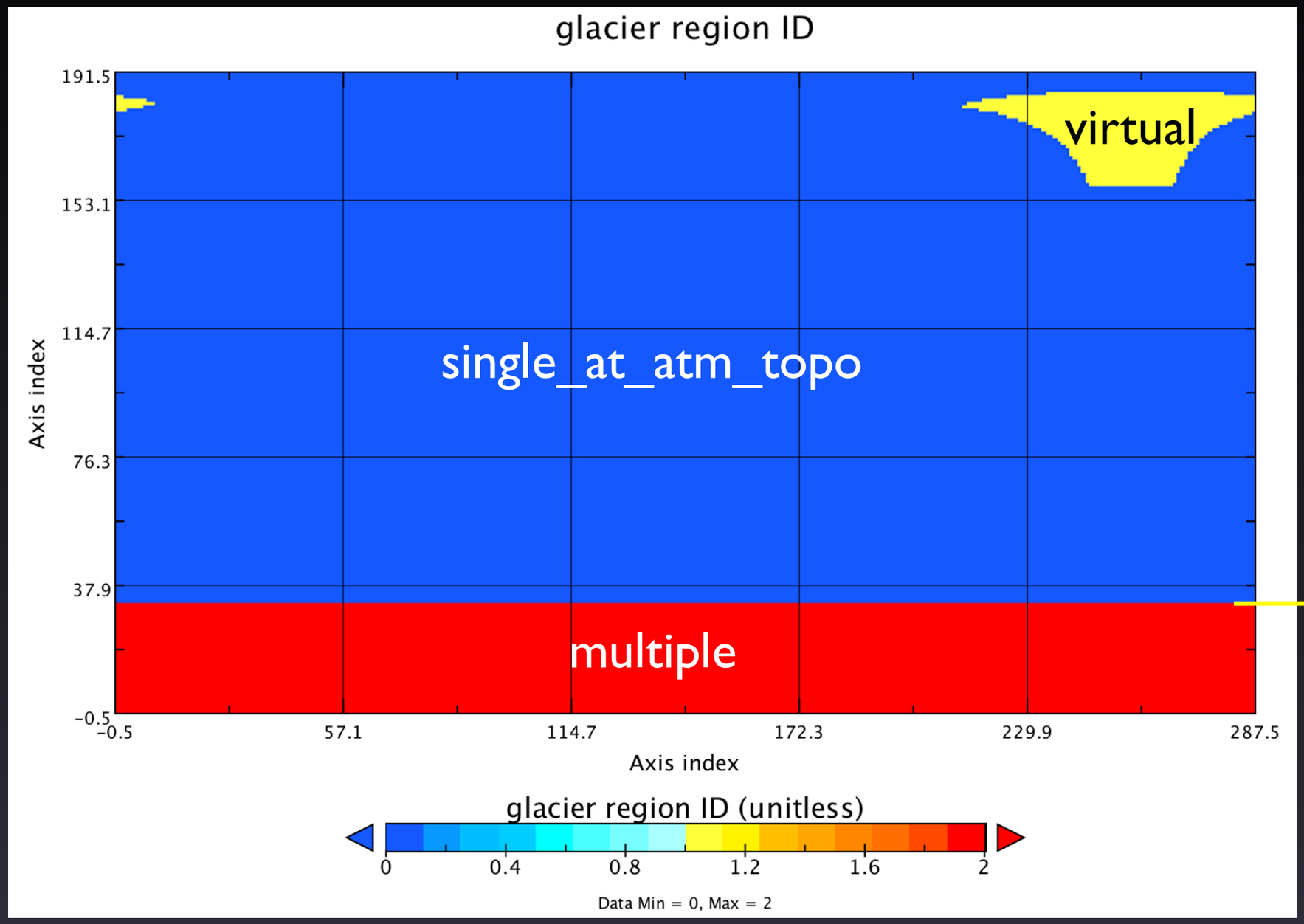
- Previously: CLM-CISM remapping done by glint
  - Only worked with regular lat/lon land grids
  - Bilinear interpolation – not conservative
  - Big burden on alternative ice sheet models
- Remapping now in coupler
  - glint replaced by lighter-weight interface: glad
- Still need to handle some edge cases
- Note: PDD no longer supported at all

Fixed Interpolation of CLM Initial Conditions

- Needed when changing CLM resolution, number of elevation classes, number of snow layers, etc.
- Had been broken for multiple elevation classes – finally fixed!
- Handles
  - Changing number of elevation classes
  - Changing number of snow layers: new vertical interpolation
- Now done at runtime, rather than with a separate tool

Specifying Glacier Regions in CLM

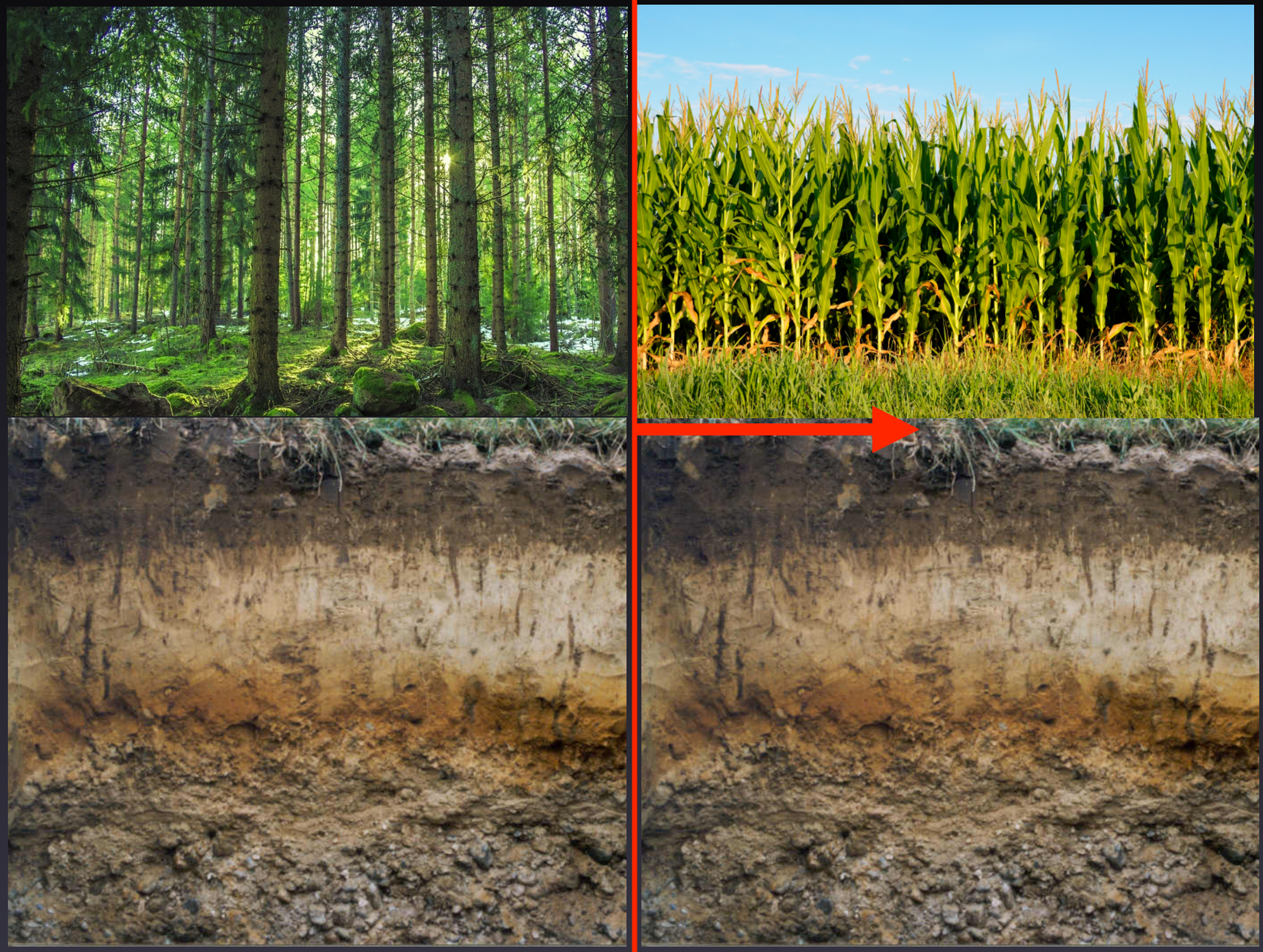
CLM surface dataset field: GLACIER_REGION



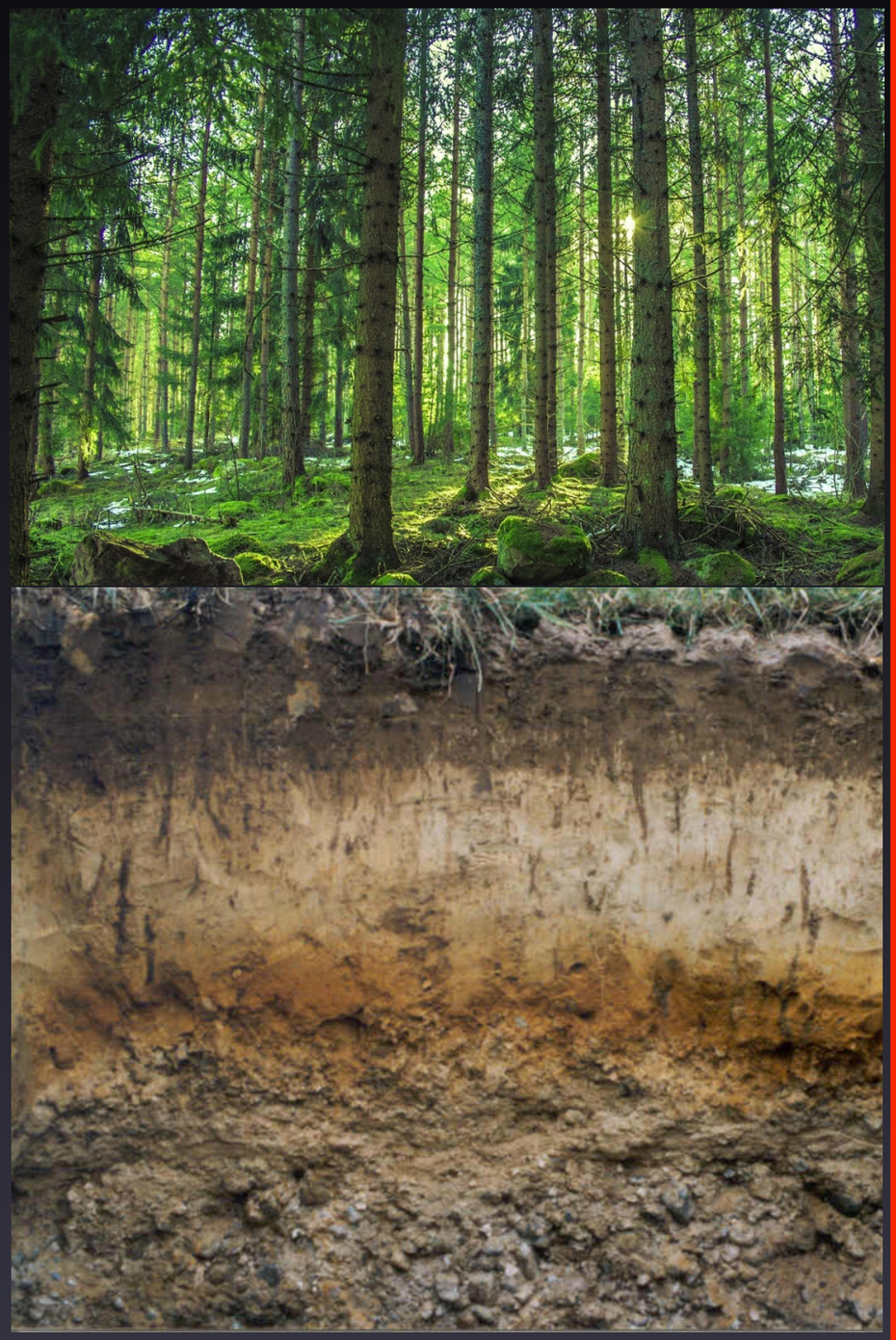
CLM namelist item:

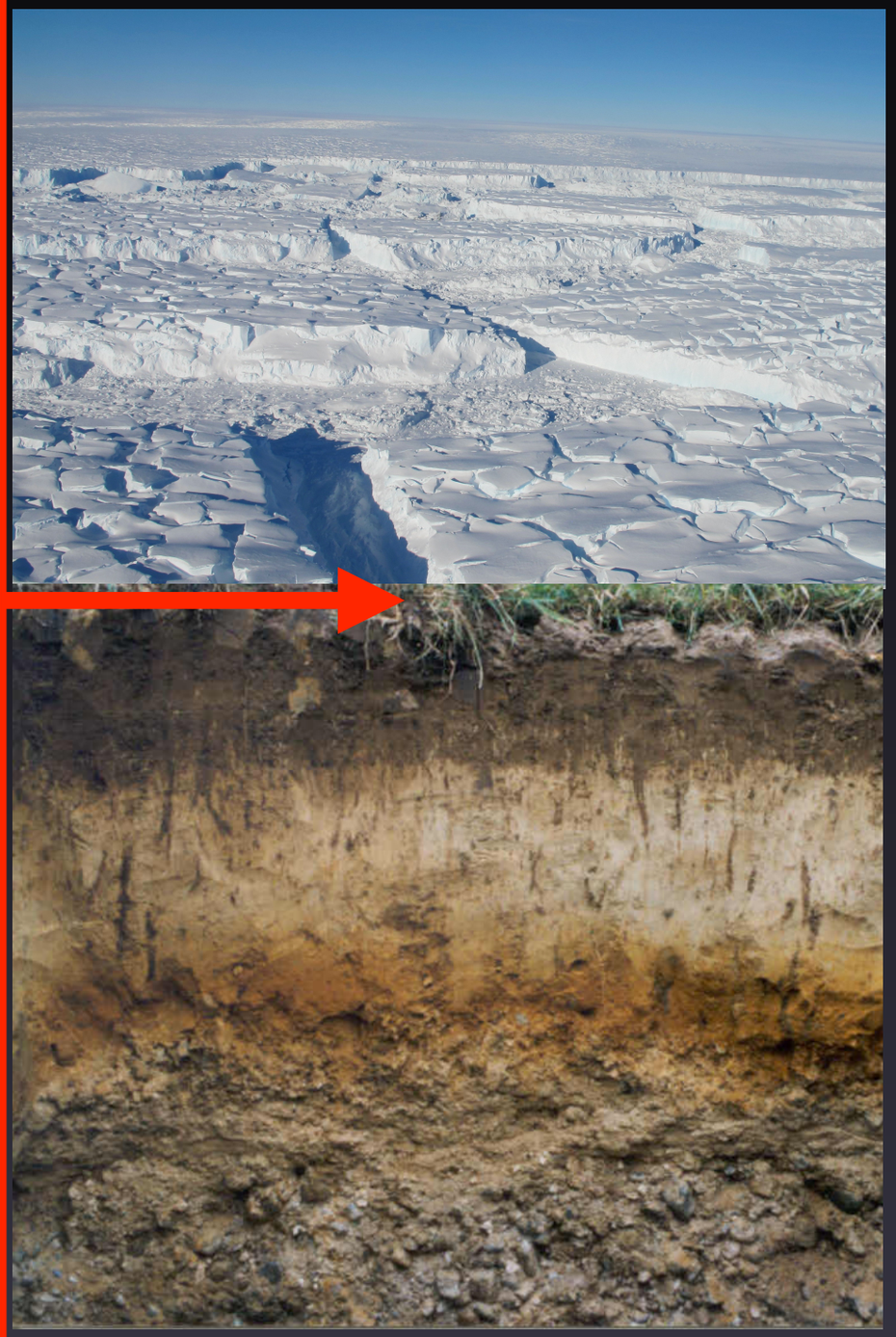
glacier_region_behavior = 'single_at_atm_topo', 'virtual', 'multiple'

In Progress: Carbon and Nitrogen Conservation with Dynamic Landunits



In Progress: Carbon and Nitrogen Conservation with Dynamic Landunits





In Progress: SMB Computed in *all* CESM RUNS

- Beginning with CESM2: SMB will be computed in all runs
  - For analyzing SMB given current ice sheet geometry
  - For forcing later standalone CISM runs
- Compset naming: IG/BG indicates two-way coupling; others use CISM as a diagnostic component
- This has required
  - Moving remapping into coupler
  - Removing resolution-specific glacier files from CLM
  - Porting CISM to the NAG compiler
- Big things left to do
  - Enable mid-year restarts
  - Make a lot of mapping files

Big Remaining Tasks for CESM2

- Create new out-of-the-box TG forcing data
  - Need to determine what model configuration(s) to use for this
- Rework SMB definition: all snow accumulation (melt) contributes to positive (negative) SMB
  - Need to determine whether this should be done for CESM2