CESM Workshop 2025

Using the CISM to Inform Ice Core Drilling Efforts in the Antarctic Interior and Blue Ice Areas

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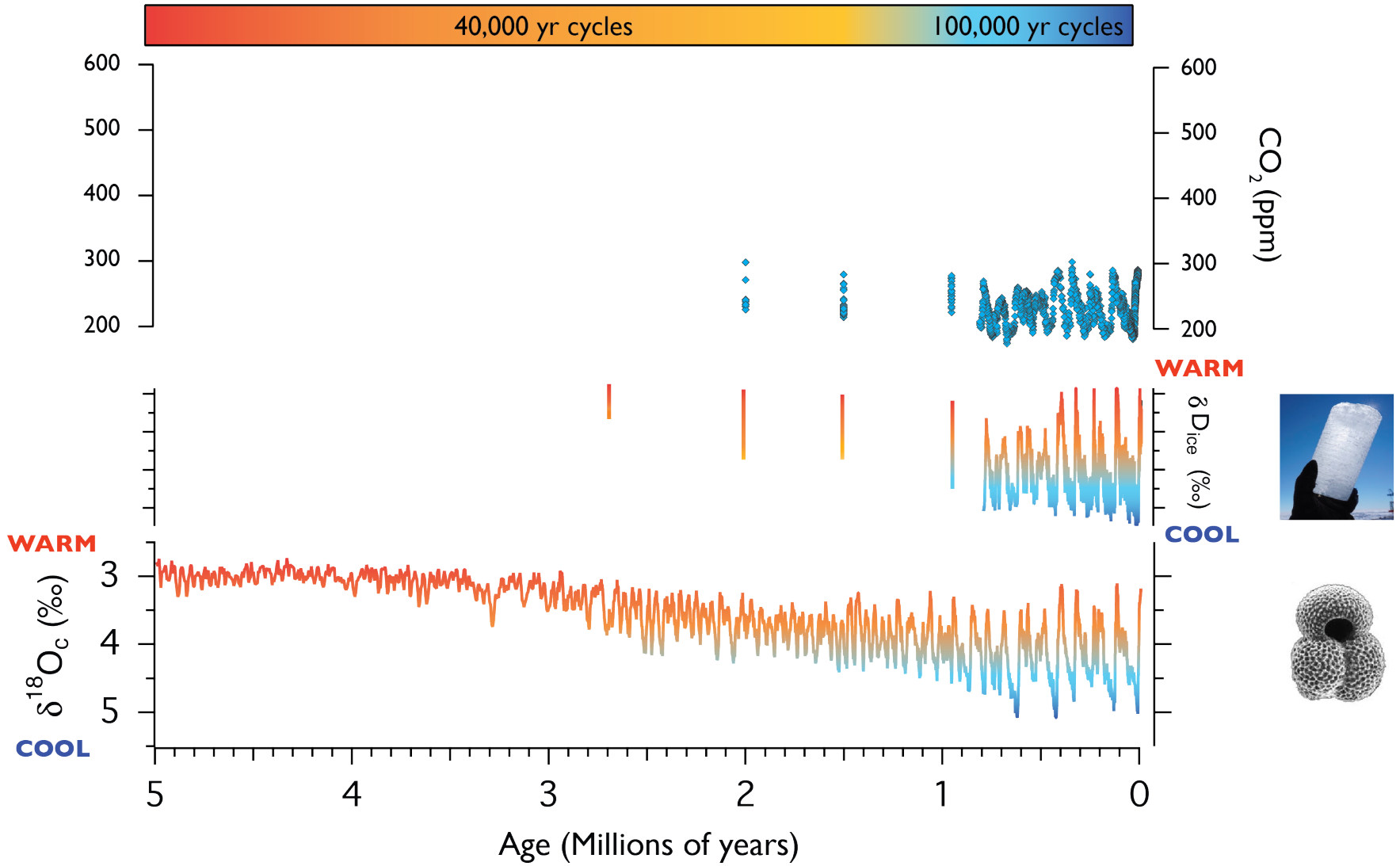
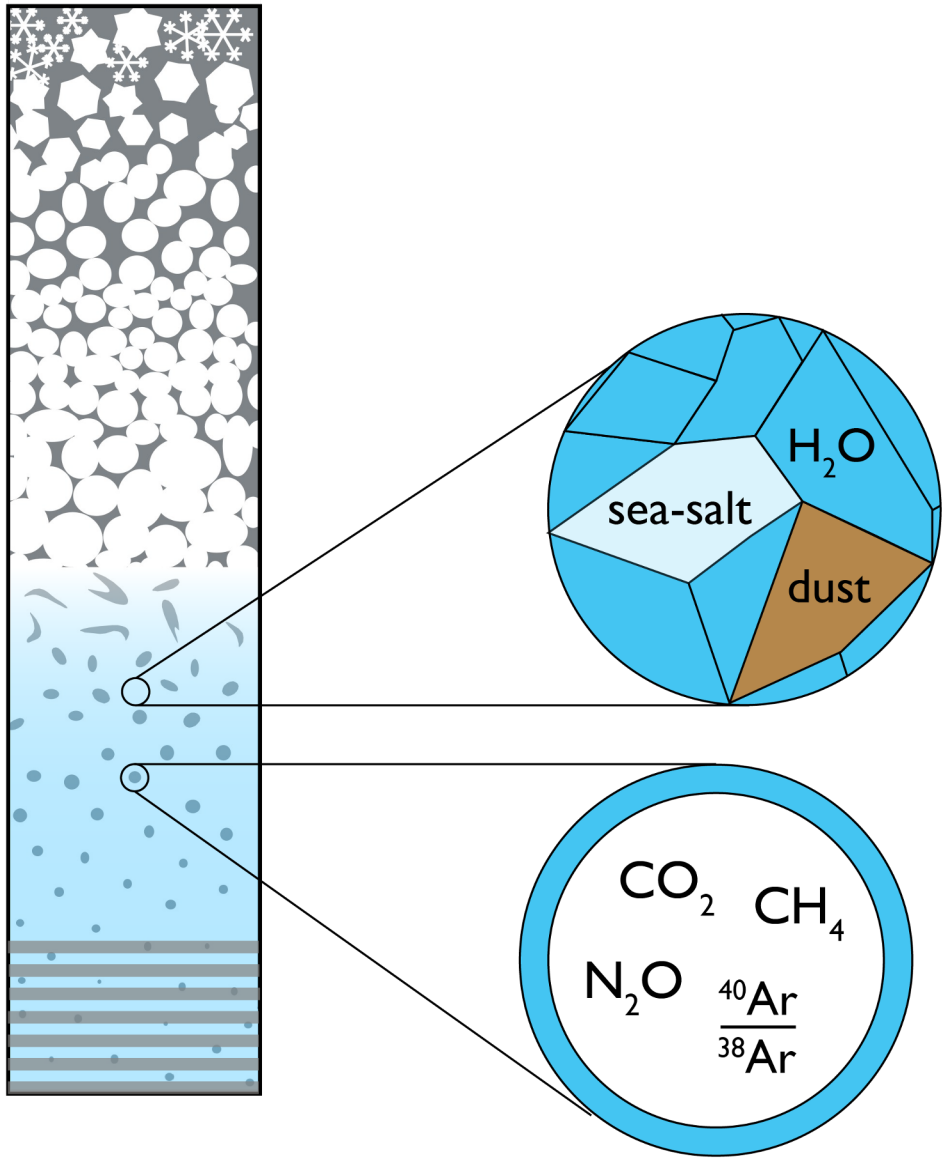
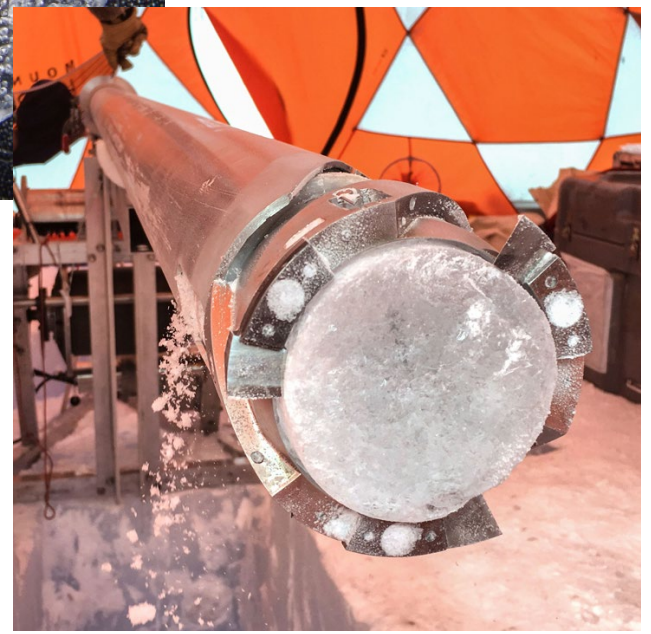
5 Millions Years of Climate History in Proxies



Data from: Lüthi et al., (2008) and Jouzel et al. (2007)

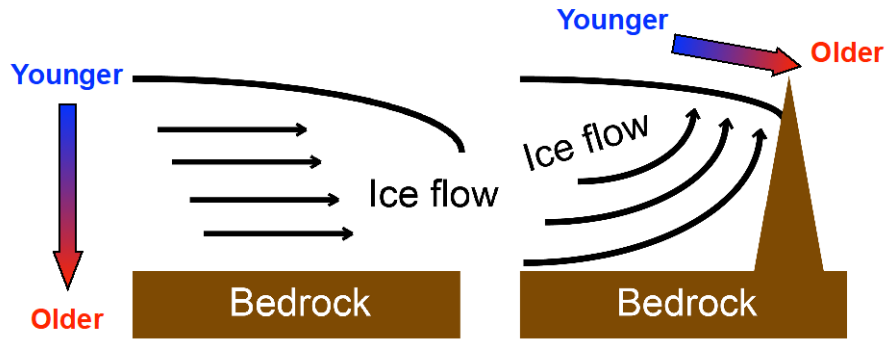
Ice Cores are Fantastic Climate Archives!





Finding the Oldest Ice – Blue Ice Areas (BIAs)

- A combination of geomorphological (bedrock topography) and meteorological (ablation > accumulation) factors preserve old ice at these locations
- Ice core samples as old as 6.7 million years have been recently retrieved from the Allan Hills BIA



Data from: Tollenaar et al. (2024)

Old Ice Preservation at Allan Hills Raises Several Questions

Data from: Tollenaar et al. (2024)

- What factors in the Antarctic ice sheet contributes to such old ice preservation?
- Do all BIAs in Antarctica have the potential to preserve ice core records this old?
- Can we systematically identify such old ice drilling sites in Antarctica (both BIA and interior)?

We plan to use the Community Ice Sheet Model to investigate!

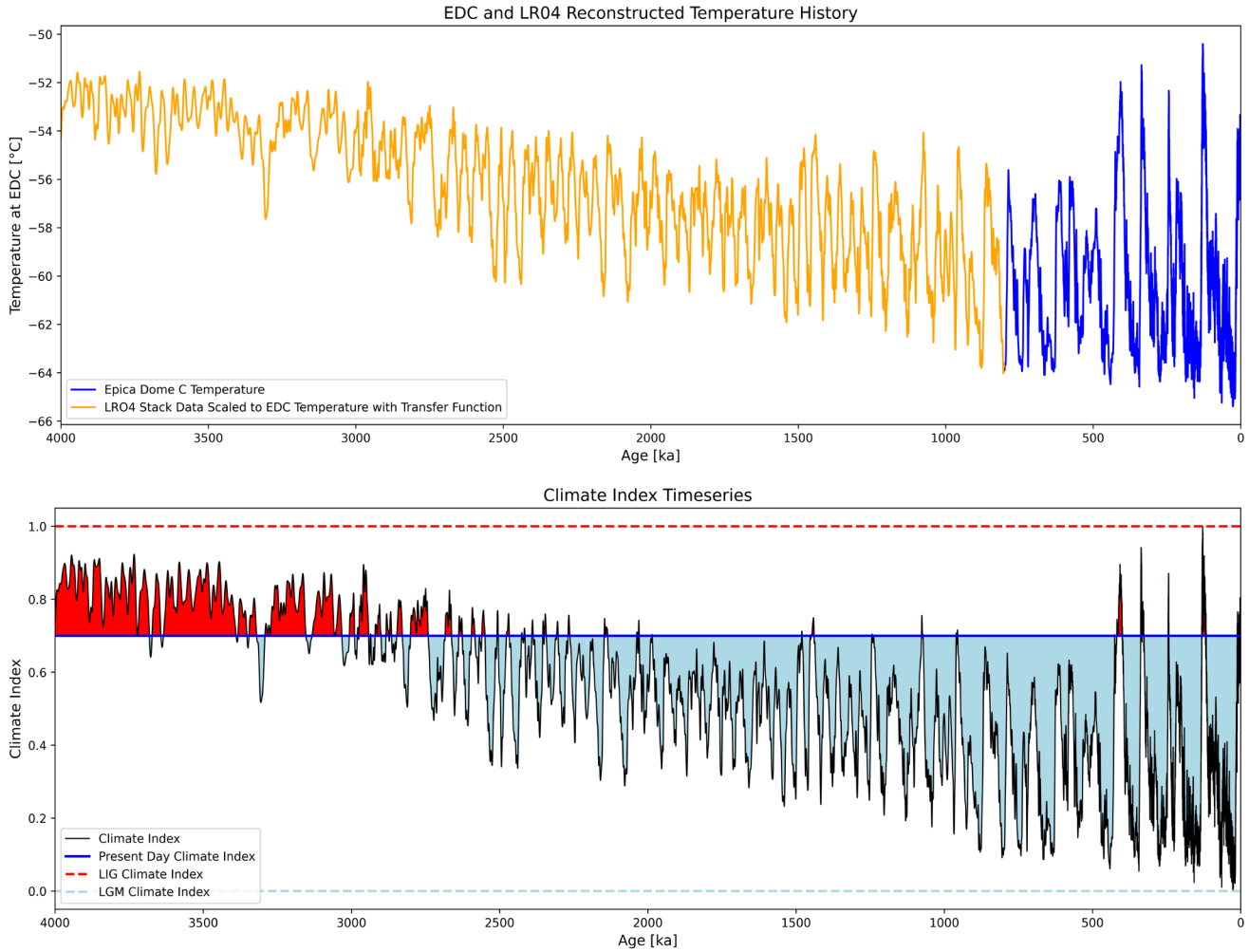
Running CISM with Paleo Forcing

- Instead of using a coupled climate-ice sheet model, we force CISM using paleoclimate records following the climate index method by Sutter et al. (2021)
- Temperature fields are generated every 100 years using the following scheme

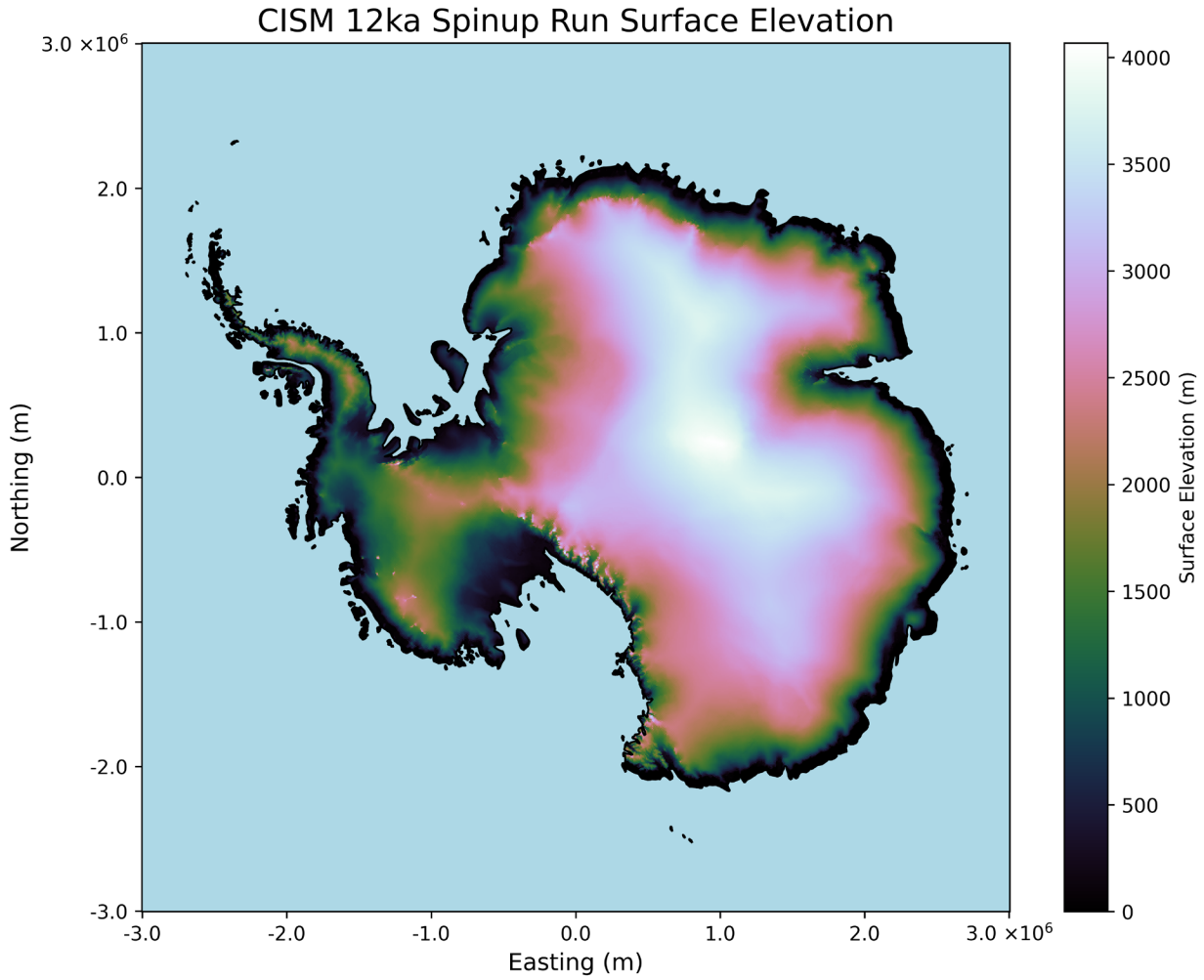
$$T(t) = T_{present} + w_{CI}\Delta T_{glacial/interglacial}$$

- Precipitations fields are generated from present-day precipitation and scaled using paleo temperature fields

$$P(t) = P_{present} + \Delta T(t)\alpha$$

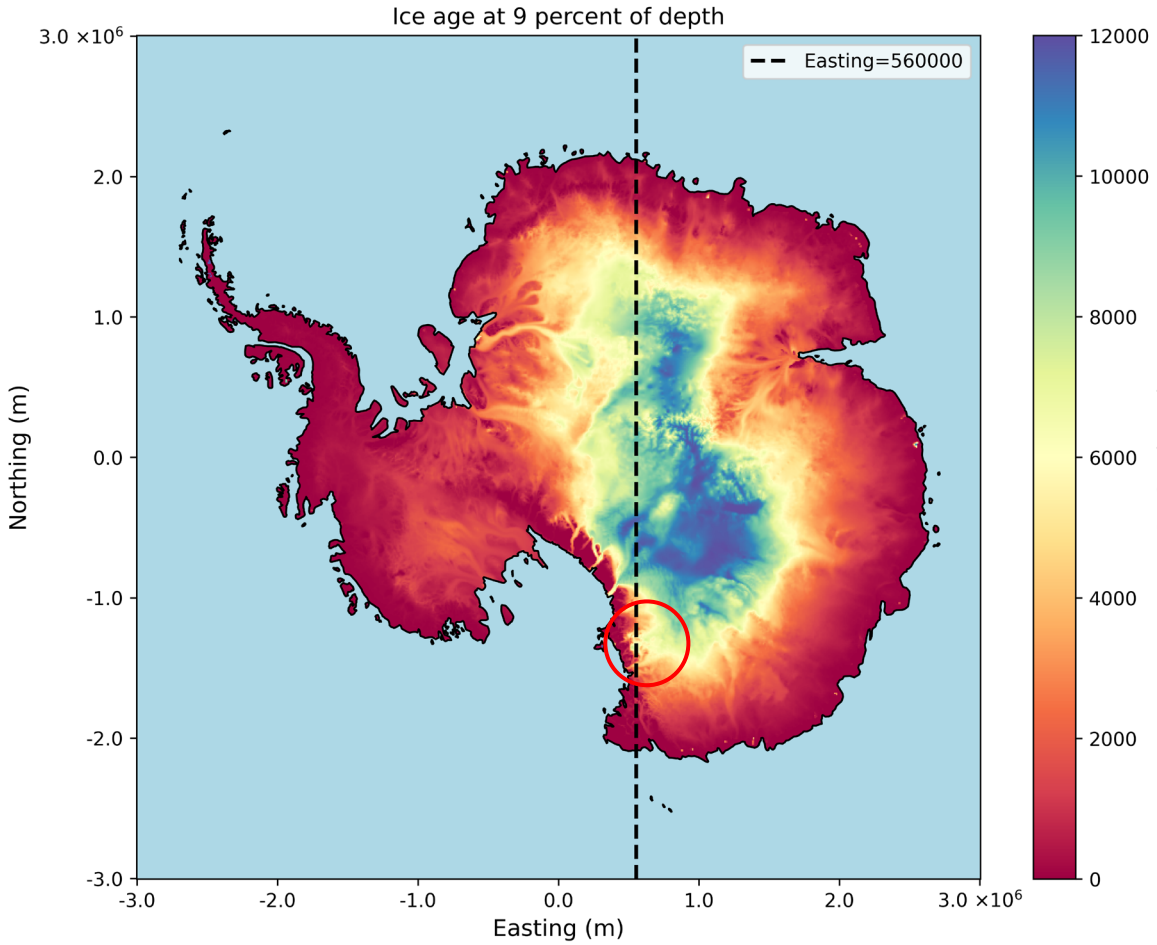


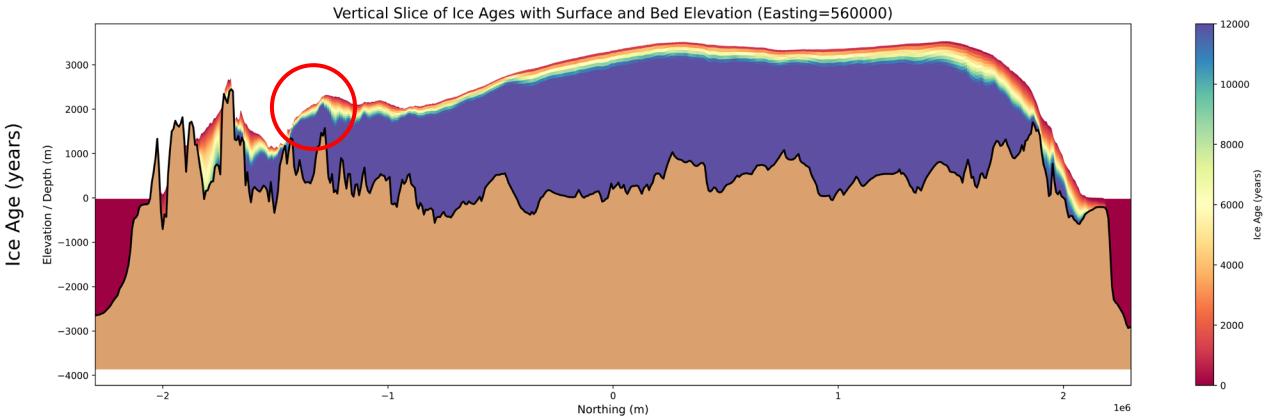
Preliminary Spinup Run (12,000 years)



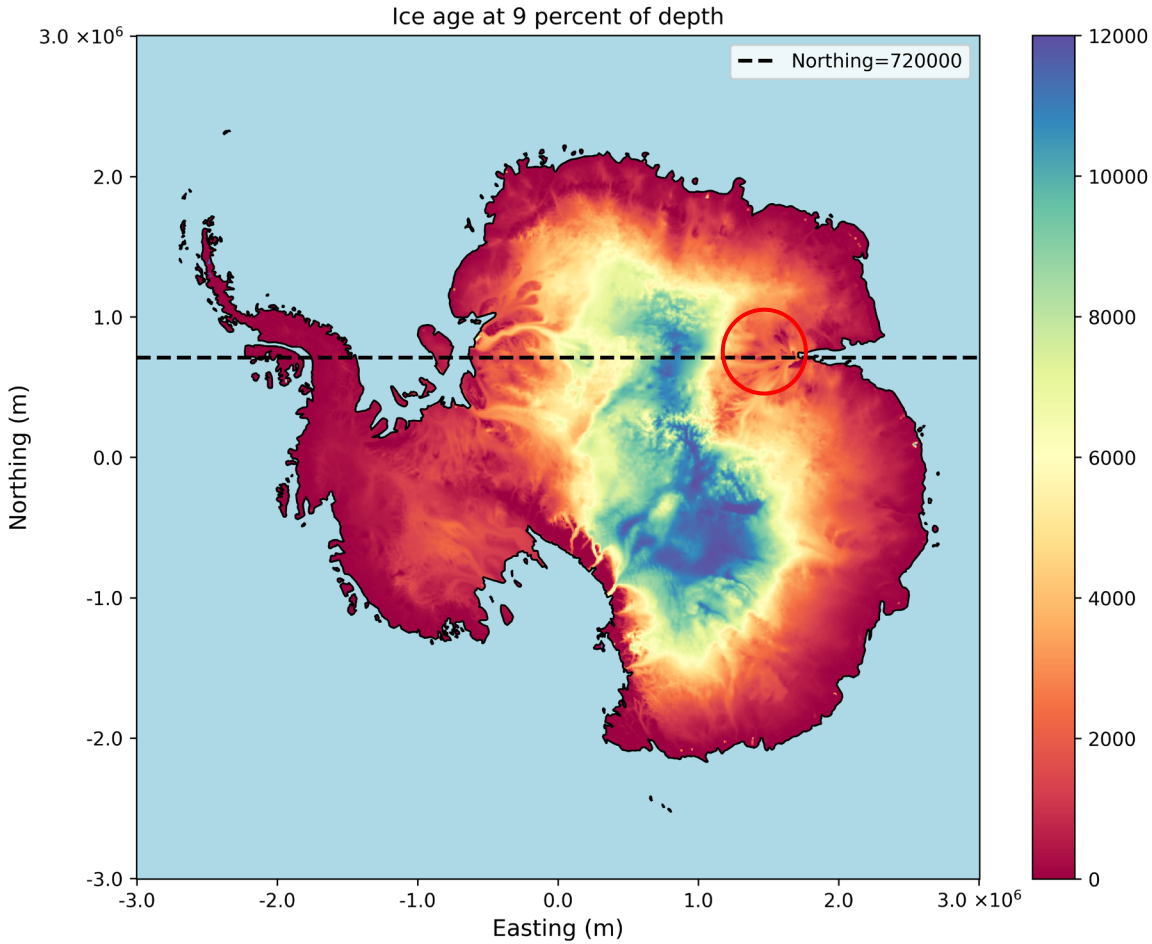
- 8km x 8km resolution run
- 41 vertical sigma levels
- ISMIP6 configuration
- 12,000 year run under constant climatology (time-step: 2 months)
- Ice age treated as a tracer and the tracer transport is done using an incremental remapping scheme

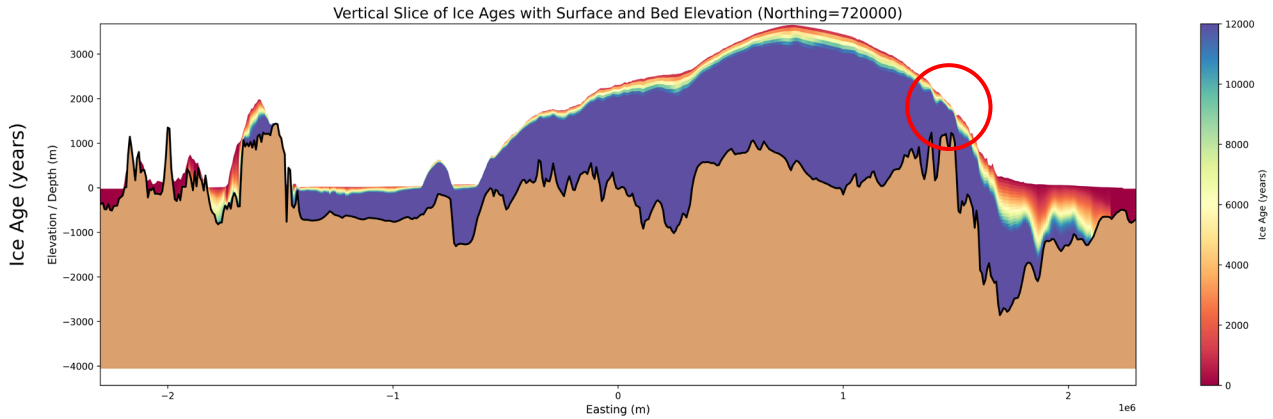
Age Tracer Distributions from the Spinup



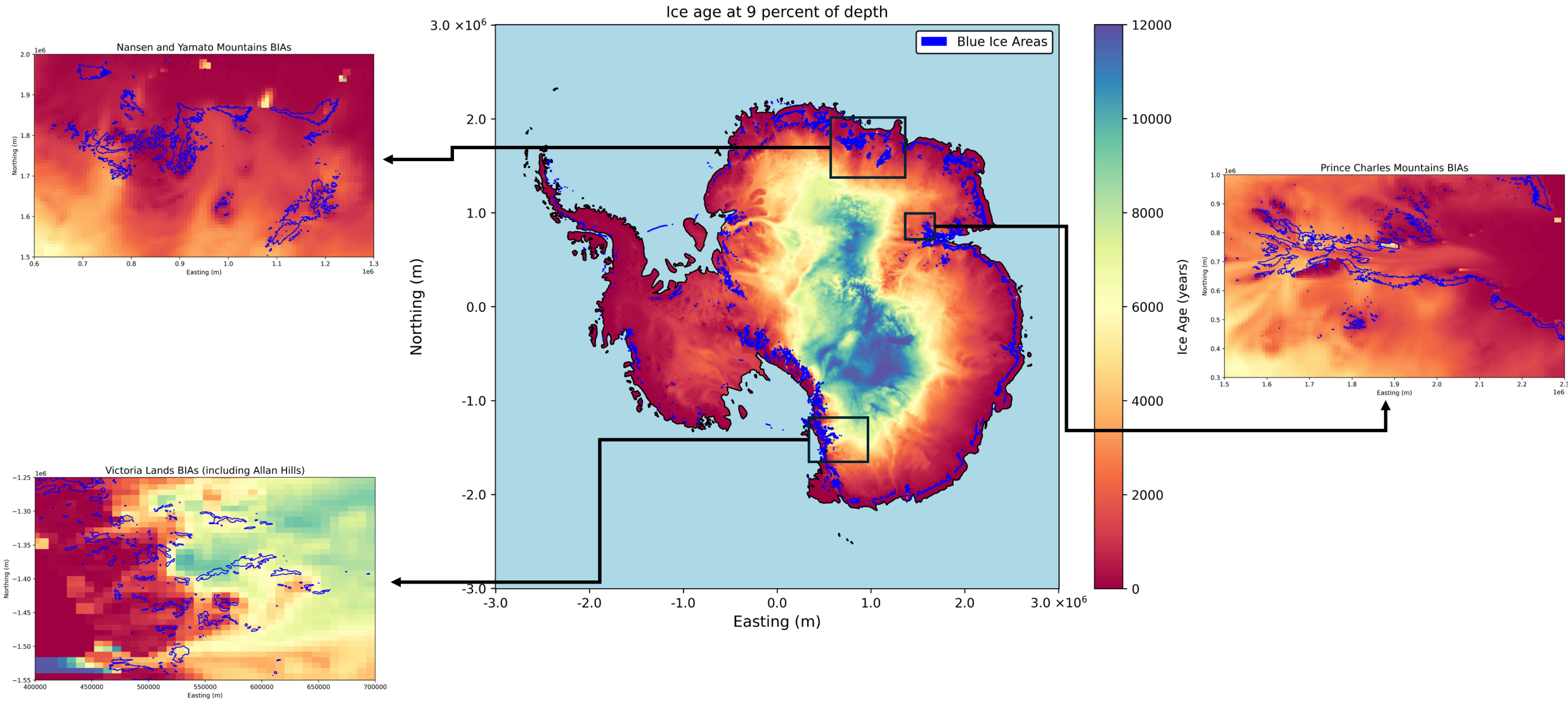


Age Tracer Distributions from the Spinup





Age Tracer Distributions and Present BIAs



Conclusion

- Work underway in developing a paleo forcing scheme for CISM that enables ice sheet evolution in deep time
- 12,000 year spinup run completed using the ISMIP6 configuration
- Longer model runs are needed for age tracers to become truly useful
- Limited Lagrangian age tracer transport will be compared to current incremental remapping tracer transport scheme
- Initial spinup experiments with age tracers reaffirm the usefulness of high resolution CISM runs to better understand the old ice preservation of blue ice areas

Acknowledgements
and
Q&A