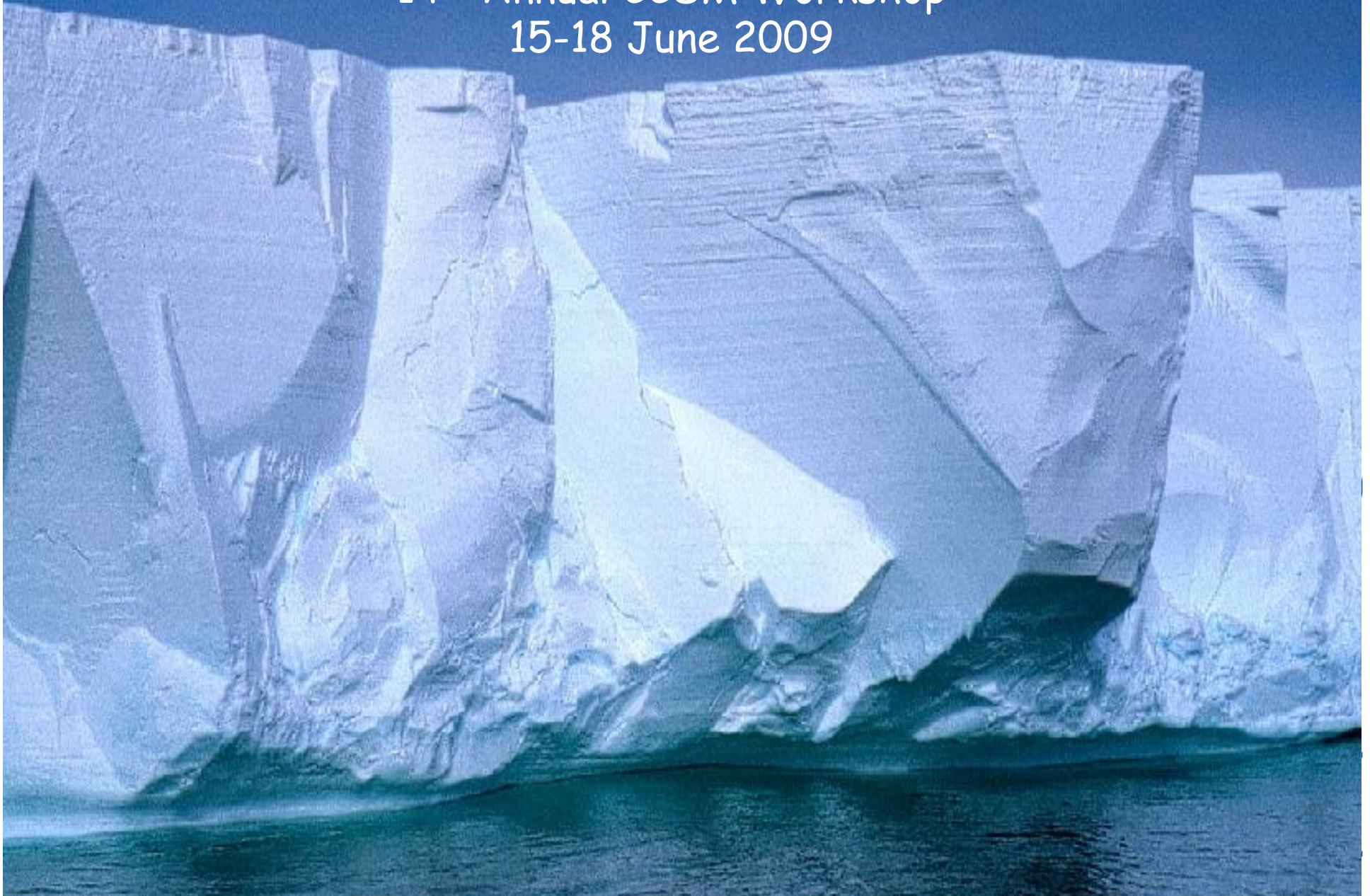


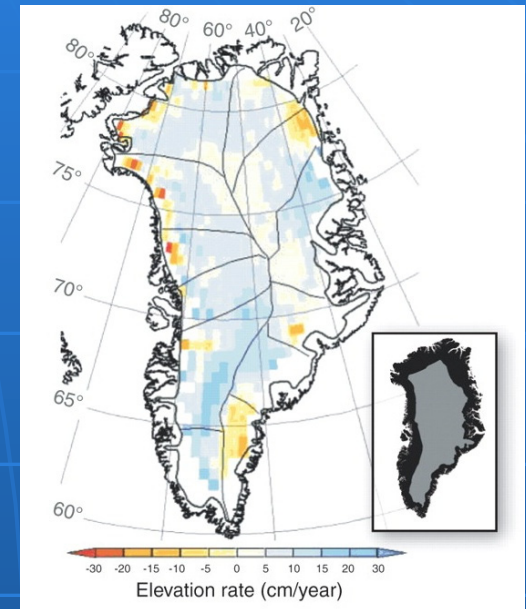
Land Ice in CCSM

14th Annual CCSM Workshop
15-18 June 2009

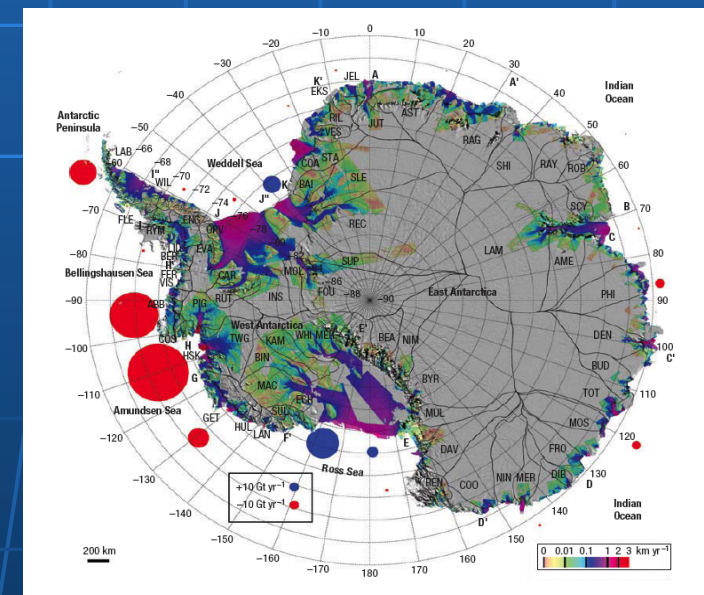


Motivation

- Global mean sea level is rising by ~ 3 mm/year, with a significant and growing contribution from the Greenland and Antarctic ice sheets (as well as mountain glaciers and small ice caps).
- IPCC AR4: Sea level will rise by $\sim 18\text{-}59$ cm in the 21st century, excluding "*rapid dynamical changes in ice flow.*"
- Ice sheet models used for AR4 were inadequate for sea level assessment (shallow-ice dynamics, crude physics, coarse resolution, not coupled to GCMs).
- There is considerable pressure on ice sheet modelers to do better for AR5.



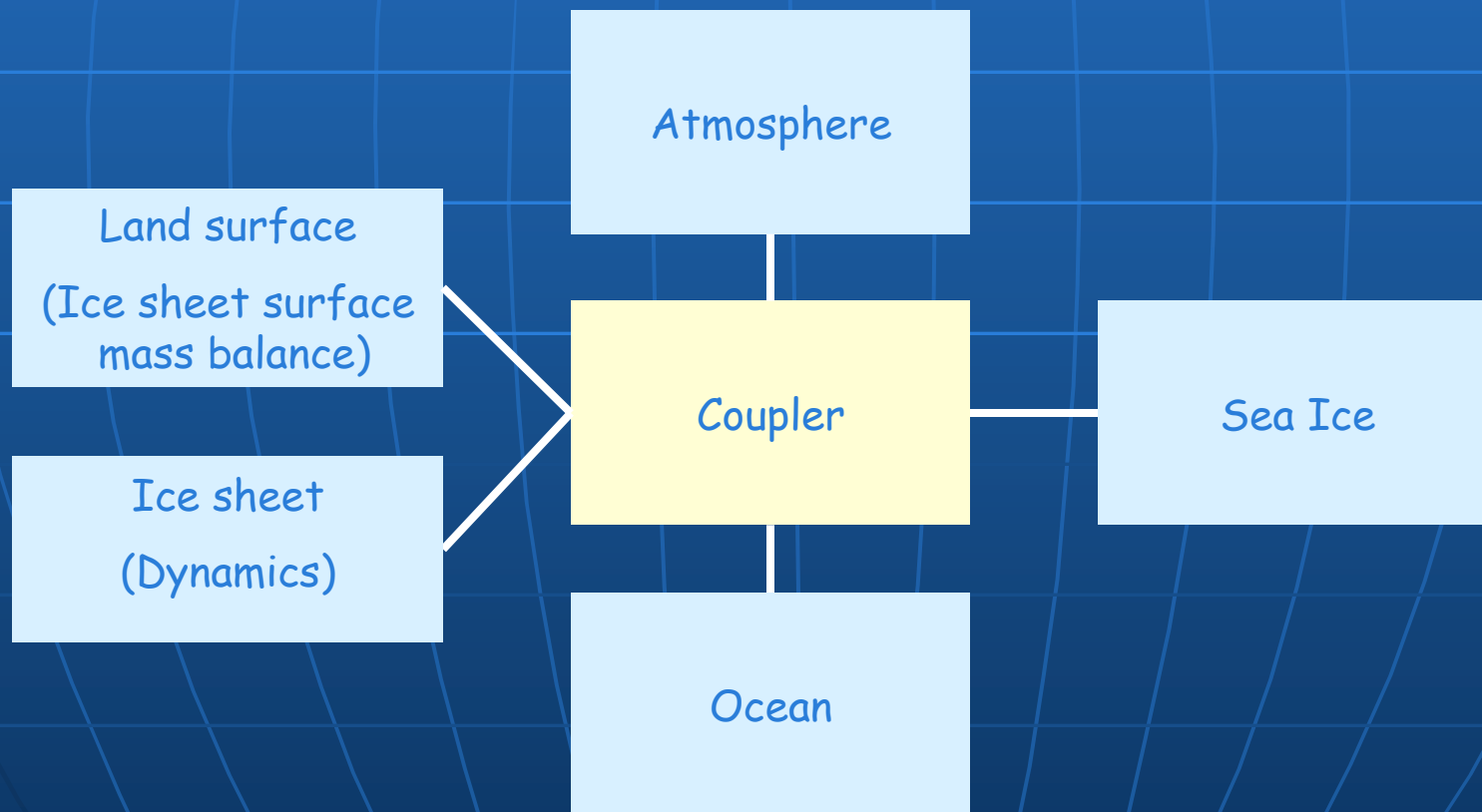
Shepherd and Wingham 2007



Rignot et al. 2008

Ice sheets in CCSM

- The GLIMMER ice sheet model has been coupled to CCSM 4.0 (just Greenland for now) and is ready for testing and tuning.
- The surface mass balance of ice sheets is computed in the land surface model (for ~10 elevation classes) and is passed to the ice sheet model via the coupler.



Community activities

- **Building a Next-Generation Community Ice Sheet Model:** Workshop at Los Alamos National Lab, Aug. 2008
 - Goal: Create a detailed plan for developing, testing, and applying a Community Ice Sheet Model (CISM) to aid in predicting 21st century sea level rise.
 - Focus groups on software development, datasets, hydrology, calving, ice-ocean coupling, and assessment
- **Wiki sites:**
 - <http://oceans11.lanl.gov/trac/CISM>
 - http://websrv.cs.umt.edu/isis/index.php/Main_Page
- **CCSM Land Ice Working Group**
 - *Wednesday, 11:00-3:30, Tarn room*
- **SeaRISE:** A multi-model sea-level prediction effort
 - *Thursday, 11:00-5:00, Tarn room*

CCSM Land Ice Working Group

■ Primary goals:

- To couple a well validated, fully dynamical ice sheet model to the CCSM
- To determine the likely range of decade-to-century-scale sea-level rise associated with the loss of land ice

■ Organization:

- Co-chairs Jesse Johnson (U. Montana) and Bill Lipscomb (LANL), liaison Steve Price (LANL)
- Two meetings per year: Summer (Breckenridge) and winter (Boulder or Santa Fe?)
- Web site and email list:

http://www.ccsm.ucar.edu/working_groups/Land+Ice/

Near-term challenges

■ Model development

- Transition from current GLIMMER (serial code with shallow-ice dynamics) to next-generation Community Ice Sheet Model (scalable parallel code with "higher-order" dynamics, improved physics and coupling)
- Coordination among modeling groups at various institutions funded by different agencies (DOE, NSF, NASA, NERC, etc.)

■ Model application

- Design of experiments for AR5 (regional and whole-ice-sheet)
- Organization and analysis of output from different models
- Coordination between SeaRISE (U.S.) and Ice2sea (E.U.) assessment efforts

Proposed CCSM4 simulations with GLIMMER/CISM (1° atm, 1° ocn)

1. Control

- Pre-industrial control, 230+ yrs
- 20th century (1870-2005)

2. IPCC AR5 scenarios

- RCP4.5, 100-300 yrs
- RCP8.5, 100-300 yrs

3. Long-term (asynchronous)

- Continuation of RCP4.5, 200 yrs (AOGCM), 2000 yrs (ice sheet)
- Branch runs of RCP4.5 and/or RCP8.5 (study irreversibility)
- Eemian interglacial: 1000 yr AOGCM w/ 10x accelerated Milankovich; 10,000 yr ice sheet