?

SeaRISE*: An Update…

15th Annual CCSM workshop, July 2010

Sophie Nowicki

and the SeaRISE participants

***Sea-level Response to Ice Sheet Evolution**

Why SeaRISE…

IPCC AR-4

...include the full effects of changes in ice sheet flow, because a basis in published literature is lacking... understanding of (rapid dynamical changes in ice flow) is too limited to assess their likelihood or provide a best estimate or an upper bound for sea level rise.

IPCC, 4th Assessment Report

Consensus on Improvements?

Findings of NOAA GFDL Meeting, January 2007

Processes that should be incorporated into models includes:

- ice streams, whose modeling requires higher-order flow physics, and
- a basal processes sub-model,
- iceberg calving, which is important in ice shelf collapse as well as outlet glacier dynamics and requires the application of fracture mechanics,
- interaction of ice sheets with the ocean, which requires models of regional oceanic circulation, melting and freezing in sub-shelf cavities, a better representation of continental shelf processes, and coupling to the global ocean, flow of
- water at the surface, within, and beneath the ice.

SeaRISE Goals

To provide estimates of ice sheet contributions to sea level for the next 200 yrs, along with appropriate uncertainties.

How?

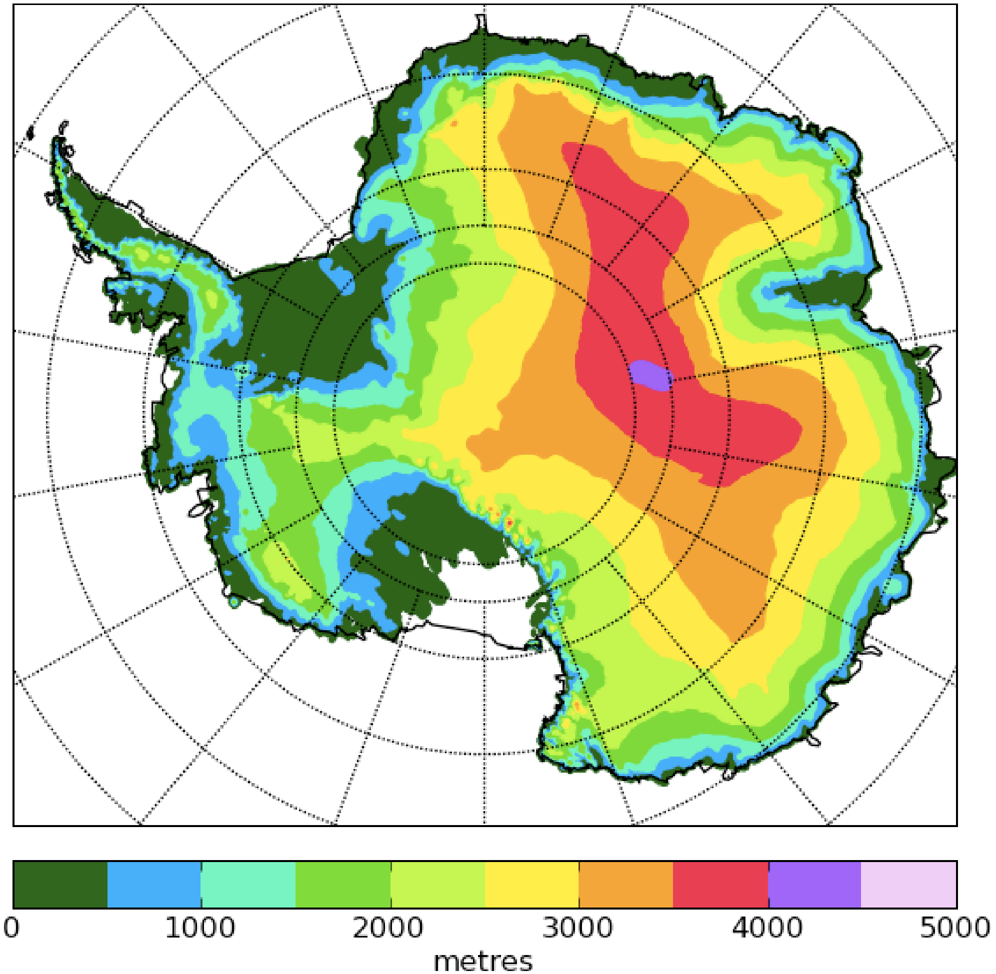
- Developing a set of common input data.
- Effort includes both regional models and whole ice sheet models (everyone is more right than anyone).
- Subject numerical models to extreme climate scenarios to obtain upper bound, and refinement of more realistic scenarios later.

The Data…

Dataset for Antarctica (5km)

- Ice surface elevation
- Bed topography
- Ice thickness
- Basal heat flux
- Air temperature
- Accumulation rate
- Surface velocity
- Thickness mask
- Sea level time series
- Basal melting beneath Ross ice stream

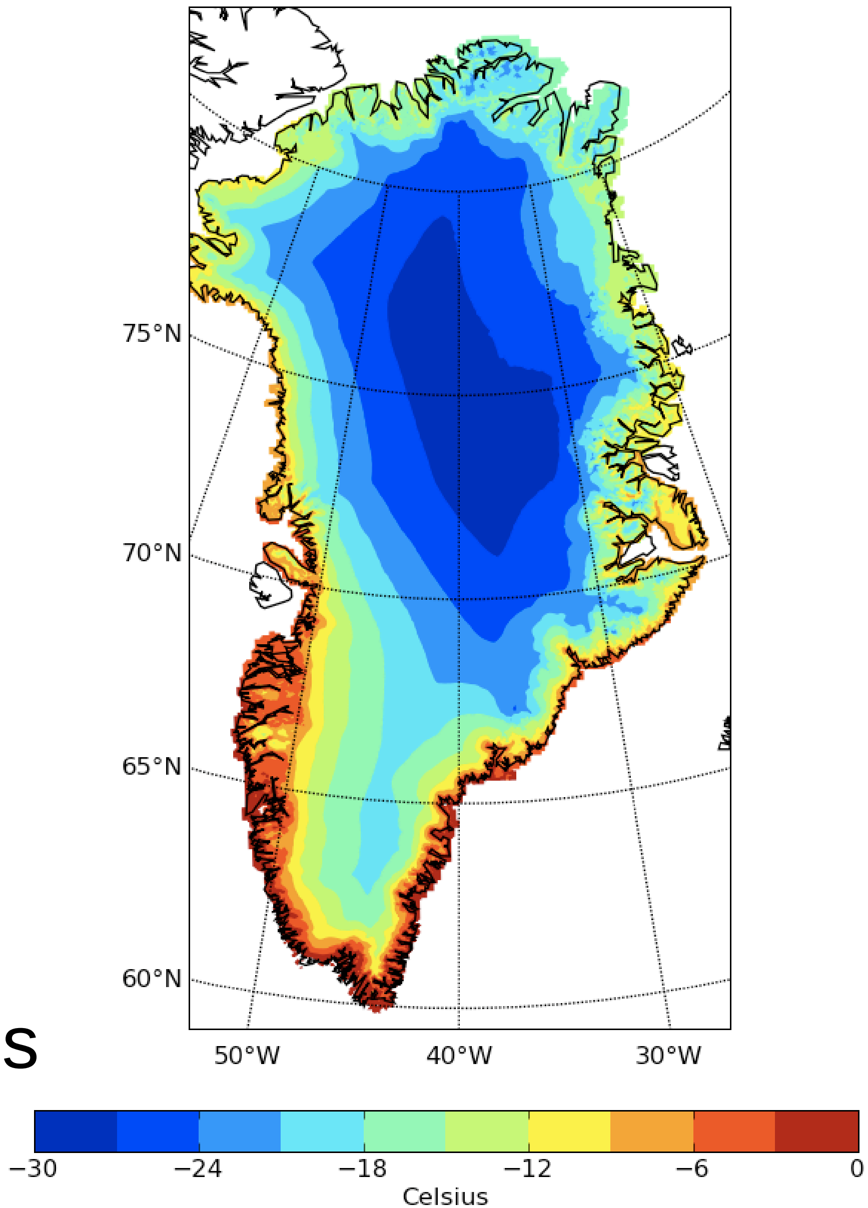
Surface elevation
(DiMarzio et al, 2007)



Dataset for Greenland (5km)

- Ice thickness
- Bed topography
- Ice surface elevation
- Precipitation
- Basal heat flux
- Air temperature
- Surface velocity
- Temperature time series
- Oxygen isotope time series
- Sea level time series

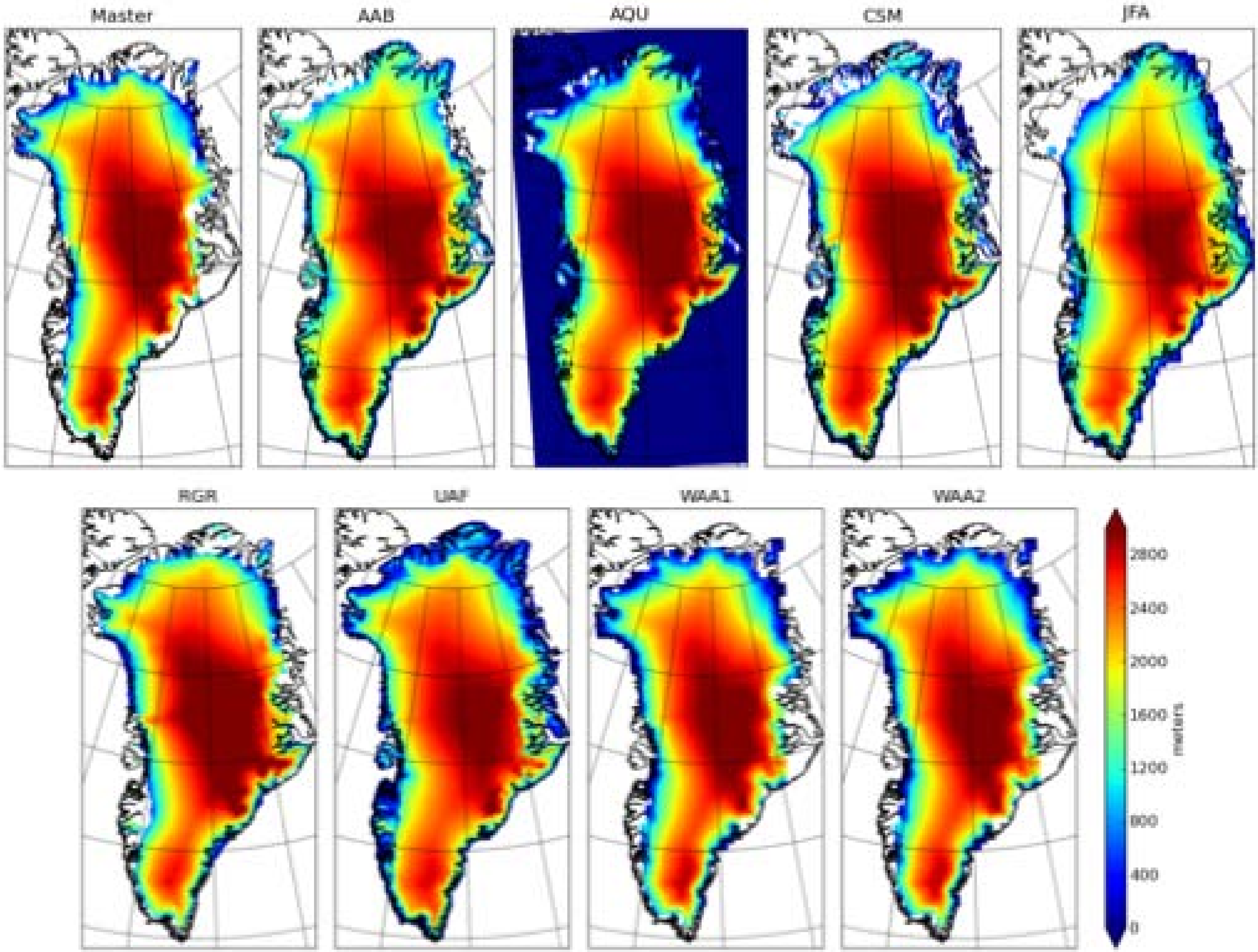
Mean annual surface temperature (Fausto et al., 2009)



The Models…

Whole Ice Sheet Models Strategy

- Each starts from its own control run
  - Various spin-up/initialization approaches
  - Two control runs defined:
    - Constant climate
    - AR4 (A1B) climate (thanks to Tom Bracegirdle)
  - Run for 500 years
- Scenario “experiments” are compared to a model’s own control run
- SeaRISE is NOT a model intercomparison project



Master
AAB
AQU
CSM
JFA
RGR
UAF
WAA1
WAA2
2800
2400
2000
1600
1200
800
400
0
meters

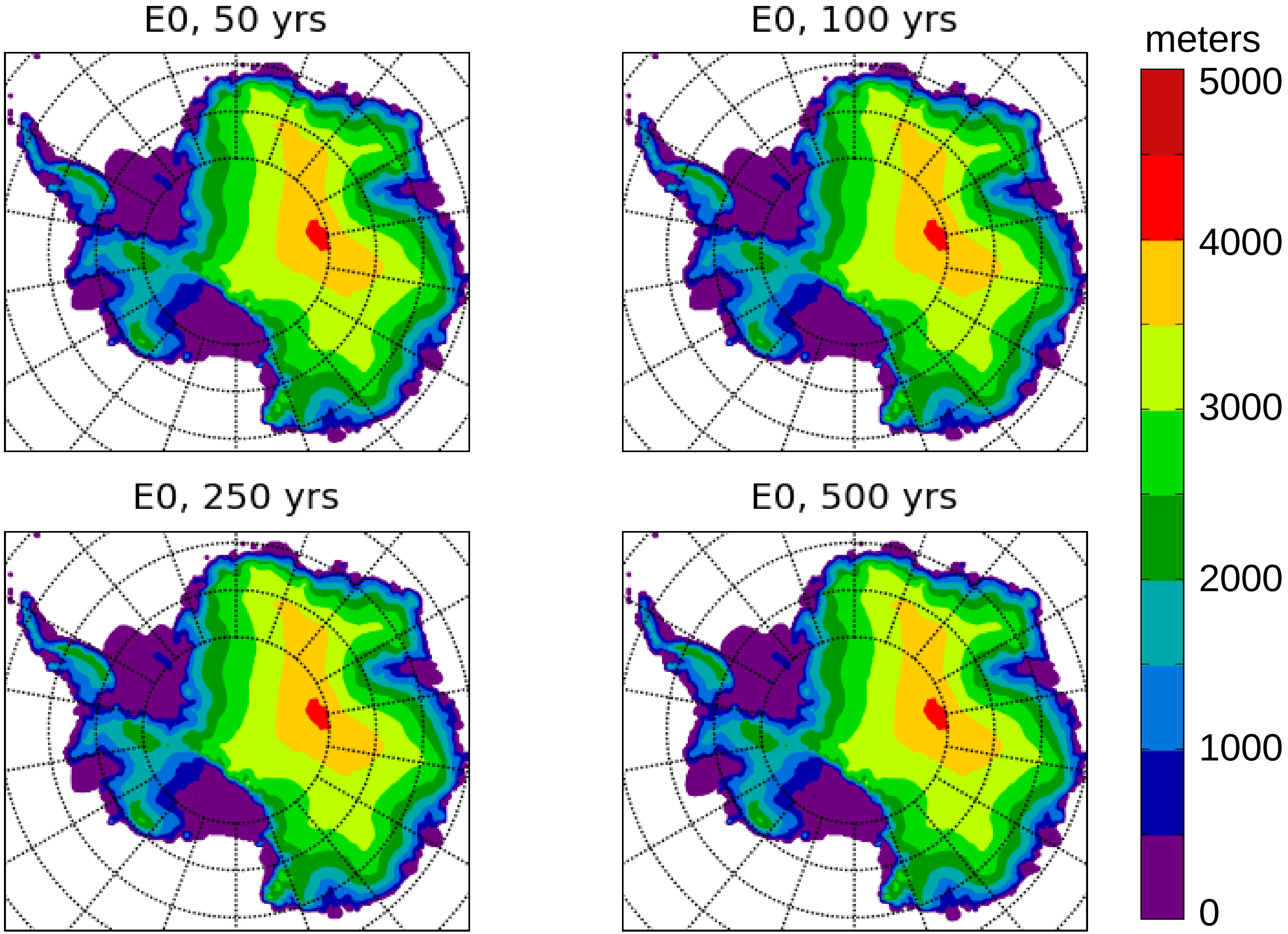
Regional Models Strategy

- Initialized from control runs of whole ice sheet models
- Inform the whole ice sheet models through forcing boundary conditions, e.g., prescribe:
  - rate of grounding line retreat
  - changing ice shelf backpressure
  - perimeter thinning
  - basal lubrication from surface meltwater

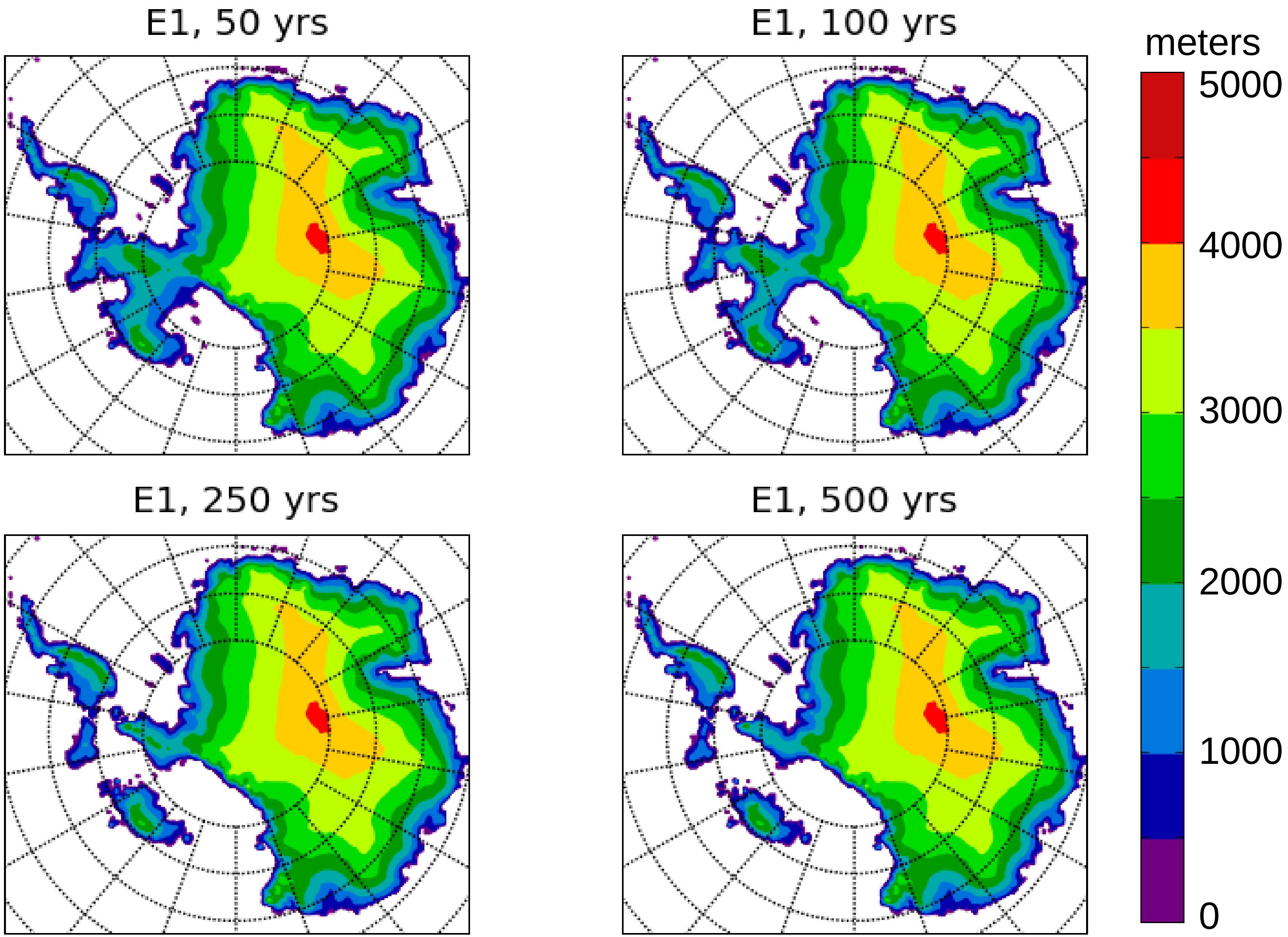
The Extreme Hot Shelves Experiment…

(more tomorrow in the Denver Room)

Upper surface elevation: control run



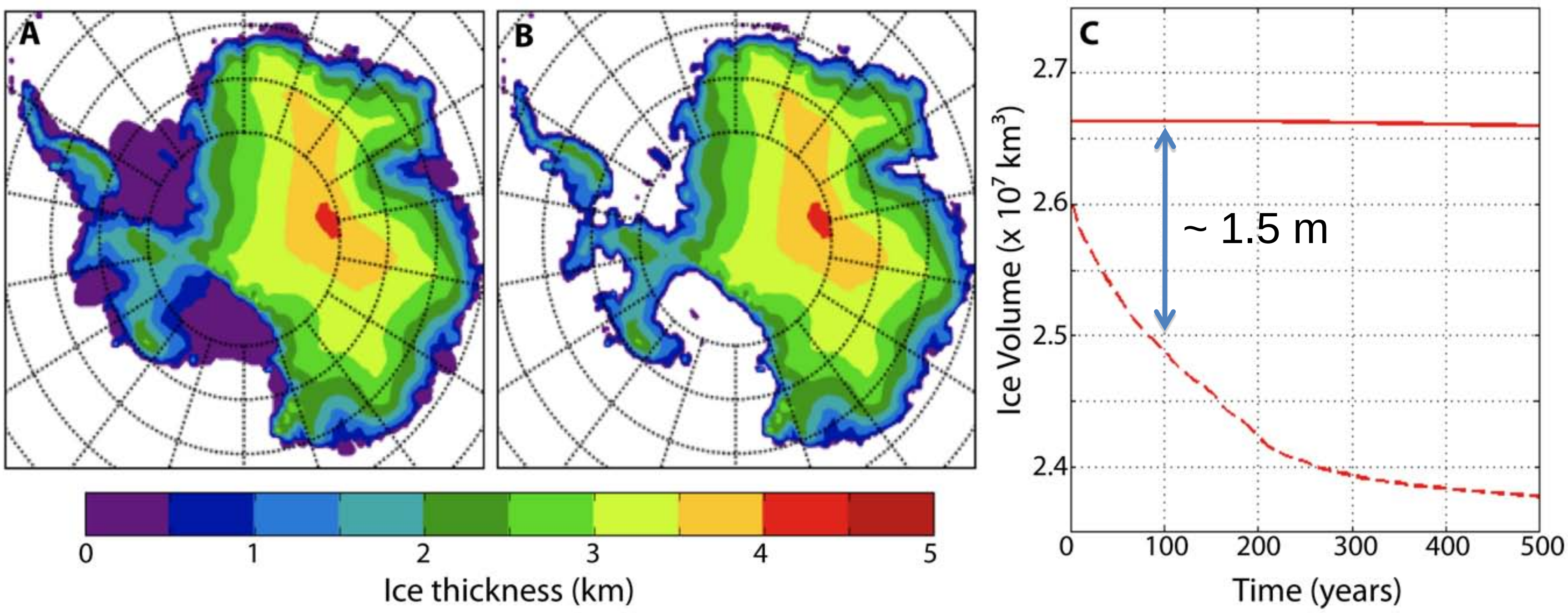
Upper surface elevation: Hot Shelves



“Extreme Hot Shelves” from PSU

Upper surface elevation at year 100

Volume Evolution



SeaRISE: An Update…

http://websrv.cs.umt.edu/isis/index.php/SeaRISE_Assessment
(or just google seaRISE)

- Rich dataset available for Greenland and Antarctica.
- Different models differ in their outputs, but differences are not “large”.
- Everyone is more right than anyone.
- Control runs normalization allows the comparison of experiment results from different models.

Thank you to:

- Robert Bindschadler (NASA GSFC)
- Ayako Abe-Ouchi (U. Tokyo)
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- Richard Alley (Penn State)
- Jeremy Bassis (U. Chicago)
- Ed Bueler (UAF)
- Bea Csatho (U Buffalo)
- Mike Dinniman (Old Dominion)
- Todd Dupont (UC Irvine)
- Jim Fastook (U. Maine)
- Carl Gladish (NYU/Courant)
- Dan Goldberg (NYU/Courant/GFDL)
- Glen Granzow (U. Mont.)
- Ralf Greve (LTI/Hokaido)
- Brian Hand (U. Mont.)
- David Holland (NYU/Courant)
- Paul Holland (BAS)
- Christina Hulbe (Portland State)
- Charles Jackson (UTIG)
- Jesse Johnson (U. Mont.)
- John Klinck (Old Dominion)
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- Maria Martin (Potsdam)
- Byron Parizek (Penn State)
- David Pollard (Penn State)
- Steve Price (LANL)
- Catherine Ritz (LGGE)
- Diandong Ren (U. Texas)
- Fuyuki Saito (Japan)
- Olga Sergienko (GFDL)
- Miren Vizcaino Trueba (UC Berkeley)
- Slawek Tulaczyk (UC Santa Cruz)
- Kees van der Veen (KU/CReSIS)
- Ryan Walker (Penn State)
- Weili Wang (NASA GSFC)
- …

Others are welcomed

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Climate, Ocean and Sea Ice Modeling

CISM: The Community Ice Sheet Model

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This group has evolved into a multi-model effort call SeaRISE (Sea-level Response to Ice Sheet Evolution). It is led by Bob Bindschadler, robert.a.bindschadler@nasa.gov.

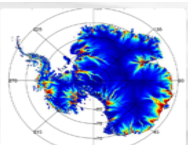
- AssessmentTeleconNotes
- PlanningDocument

The SeaRISE group has written a white paper outlining a set of modeling experiments for ice-sheet and sea-level prediction. The latest version is here: http://websrv.cs.umt.edu/isis/index.php/Assessment#Antarctica

Attachments

- IceSheetModelFeatures.xls (22.0 kB) -"Characteristics comparison of whole ice sheet models", added by bindschadler on 12/05/08 11:58:06.

http://oceans11.lanl.gov/trac/CISM/wiki/AssessmentGroup



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Development of a Community Ice Sheet Model

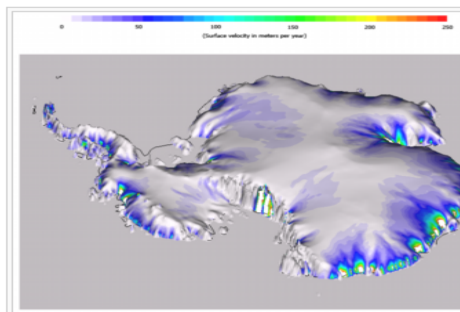
Overview

[edit]

National Science Foundation **Grant NSF-IPY 0632161** *"IPY:* Collaborative Research: Development of a Community Ice Sheet Model with Specific Applications to Abrupt Change in the Amundsen Sea Embayment" *Primary Investigator* *Jesse Johnson* *Co-investigators:* Christina Hulbe, Joel Henry, Martin L. Barett, Slawek Tulaczyk, Dacian Deascu, William Robertson, and Cheryl Seals. This collaborative research effort is to carry out novel predictive modeling experiments on the Amundsen Sea Embayment region of Antarctica. Specifically, we seek to understand how interactions between basal processes and ice sheet dynamics can result in abrupt reconfigurations of ice-sheets, and how those reconfigurations impact other Earth systems, such as atmospheres and oceans. The proposed research is distinctive in that we recognize that advancement of ice-sheet modeling is dependent upon appropriate advances in outreach and software design. As such we have assembled a team of glaciologists (Johnson, Hulbe, Tulaczyk), software engineers (Henry, Barrett), a numerical analyst (Daescu), and education/human computer interaction (Seals, Robertson).

The broader goal of the research is to increase participation in ice sheet modeling by improving the community's capacity to

1. access and utilize the present generation of ice sheet models.
2. improve the quality of ice sheet models both in terms of the scientific merit of the modeling approach and the quality of the underlying software.
3. understand the outcome of ice sheet modeling experiments.



Ice surface velocity (modeled) draped over ice surface elevation. These data and more can be found in the Data pages. This visual was produced with Unidata's [IDV], which works well with our file format

Navigation

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Software

[edit]

Find the software developed as part of this effort. This includes the Interactive System for Ice sheet Simulation (ISIS), a version with a simplified interface for high school educators (eduISIS) and the Community Ice Sheet Model (CISM).

[edit]

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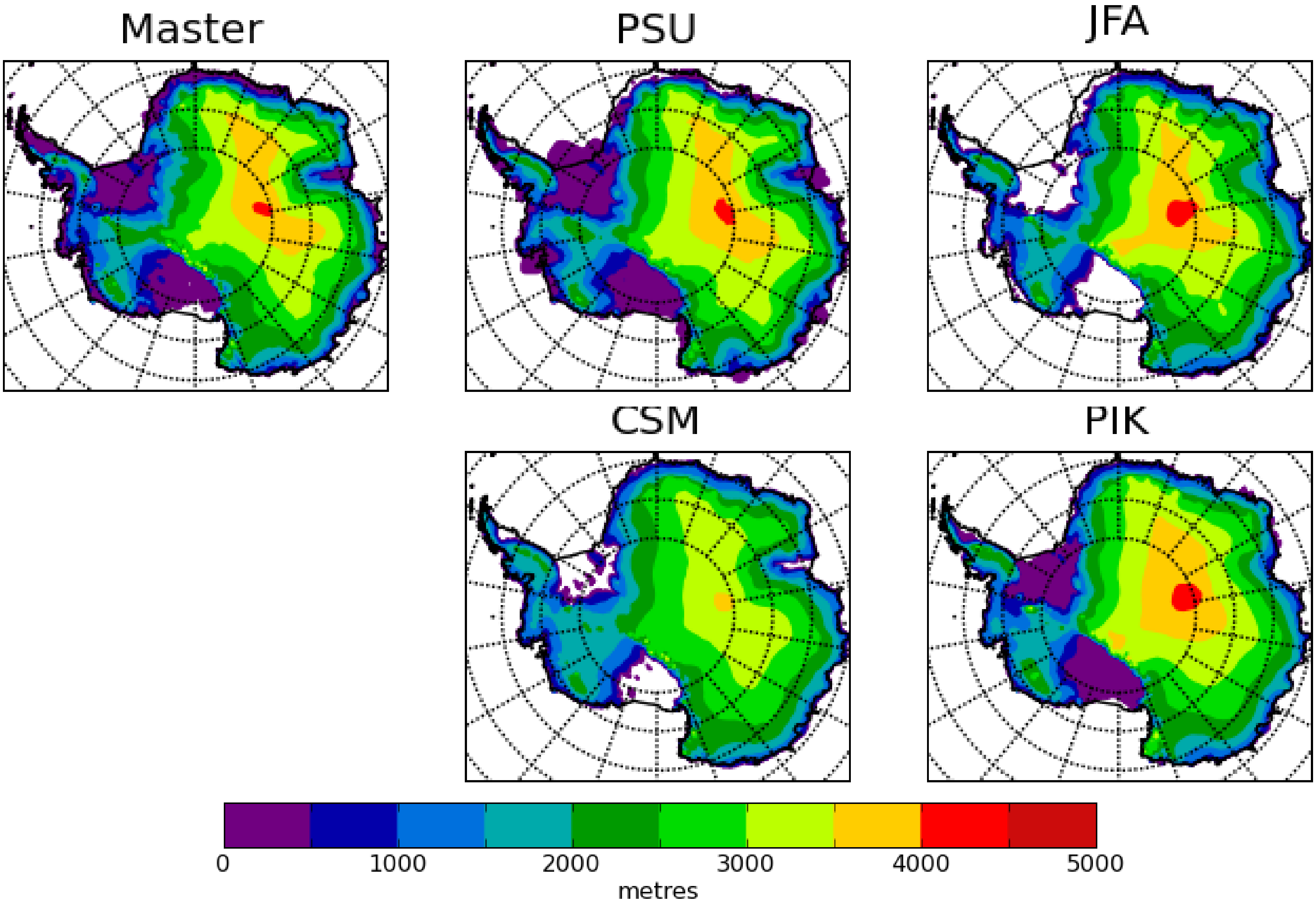
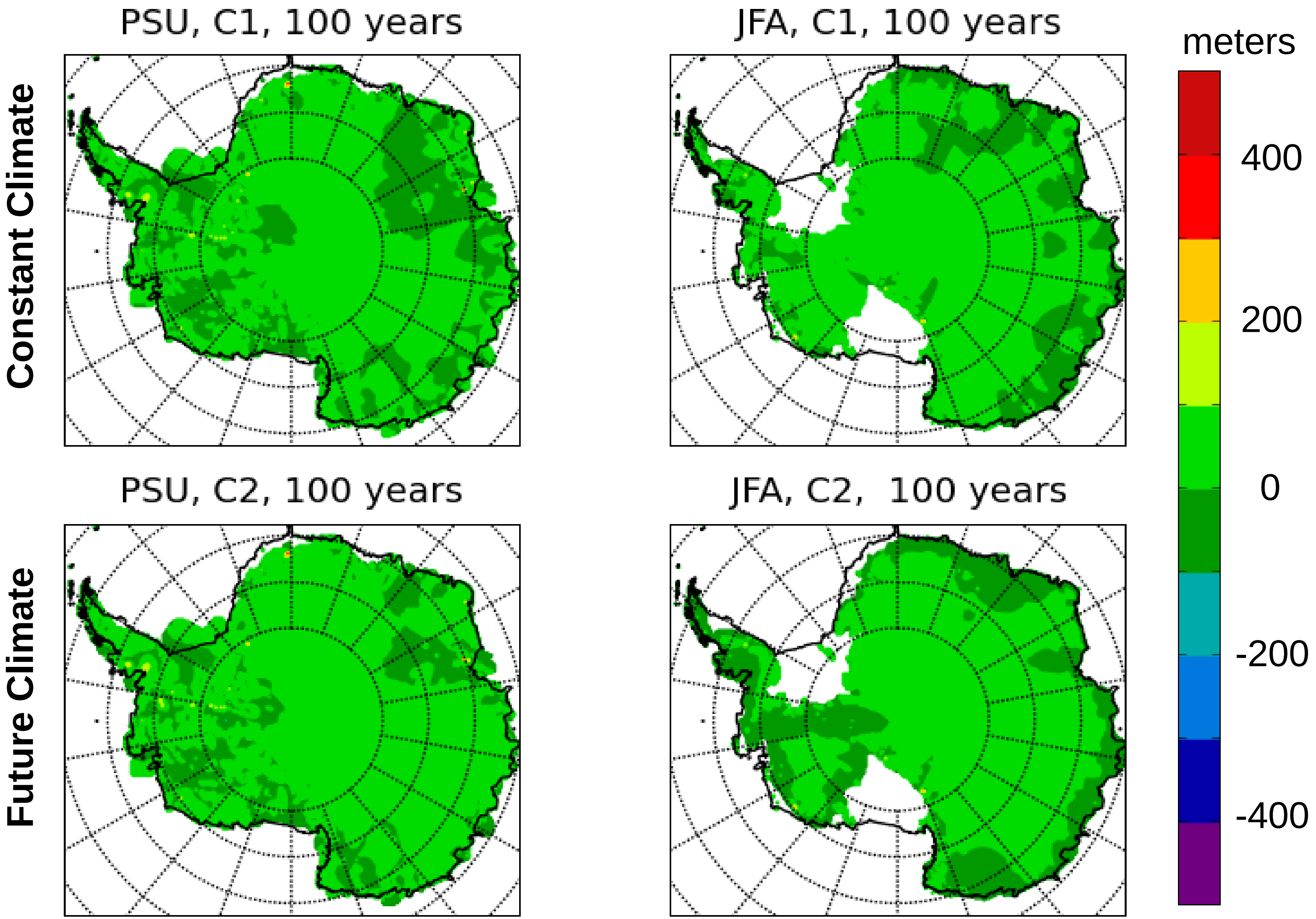
http://websrv.cs.umt.edu/isis/index.php/Main_Page

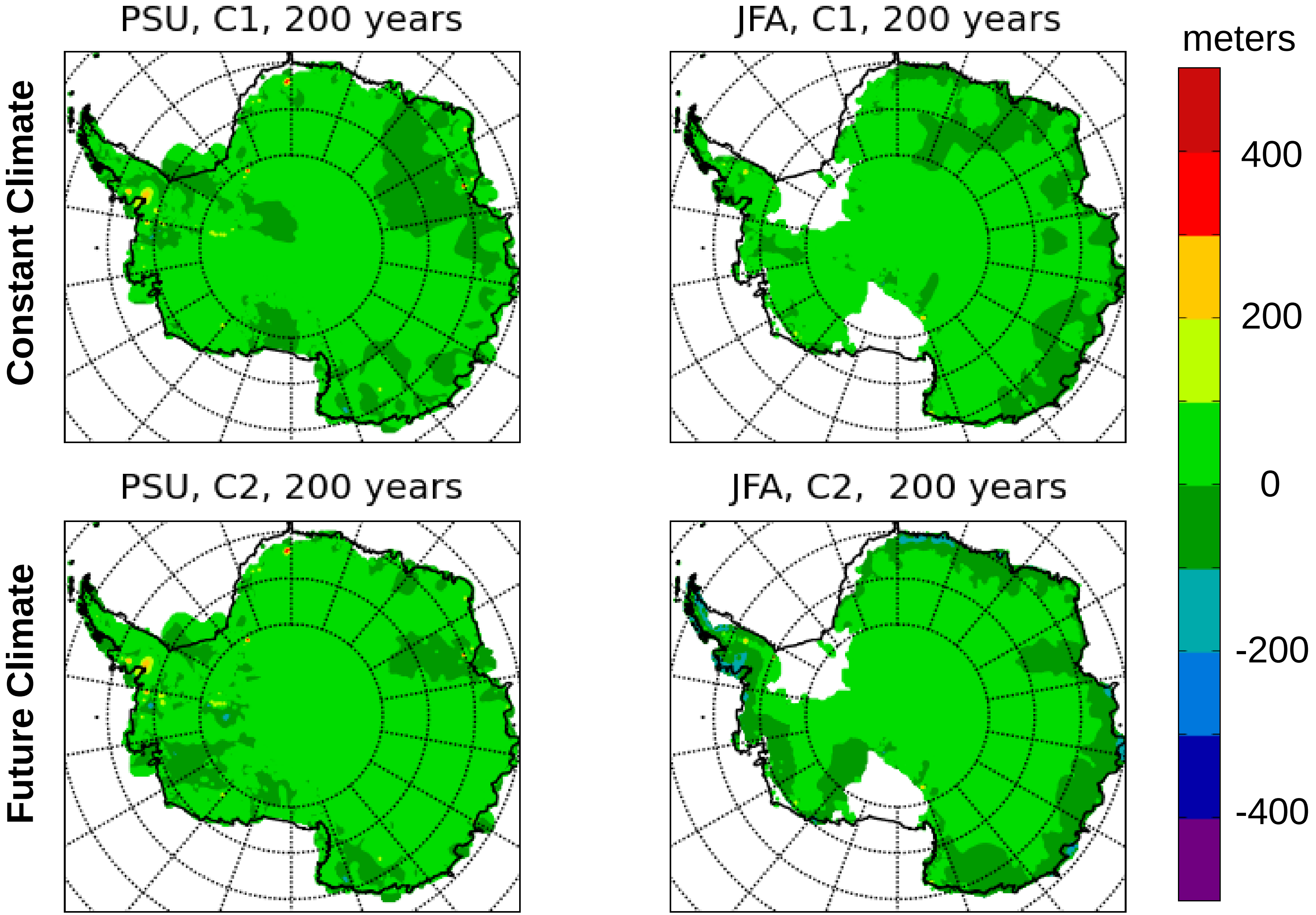
Initial Upper Surface Elevation



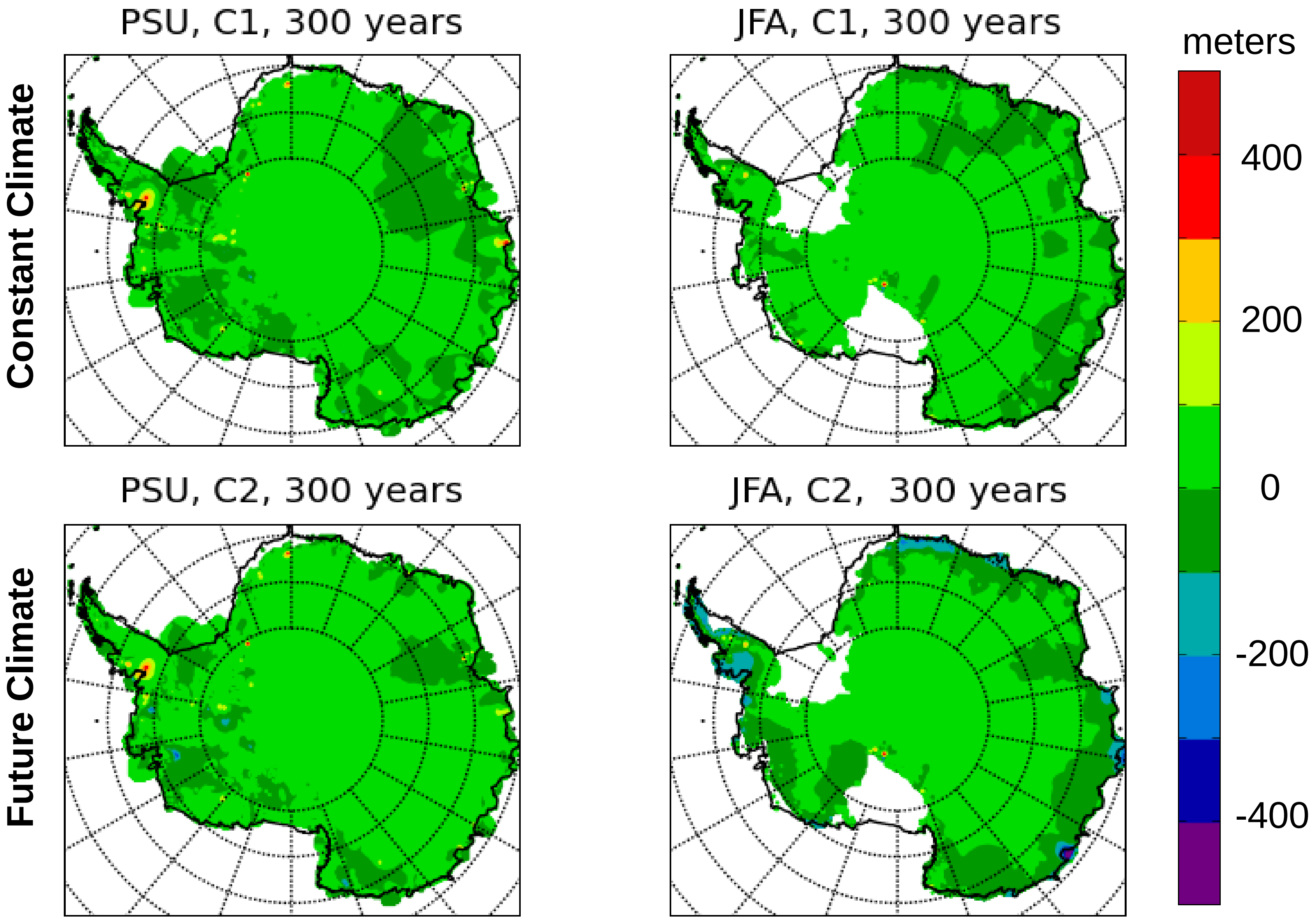
Difference in upper surface elevation (100yrs)



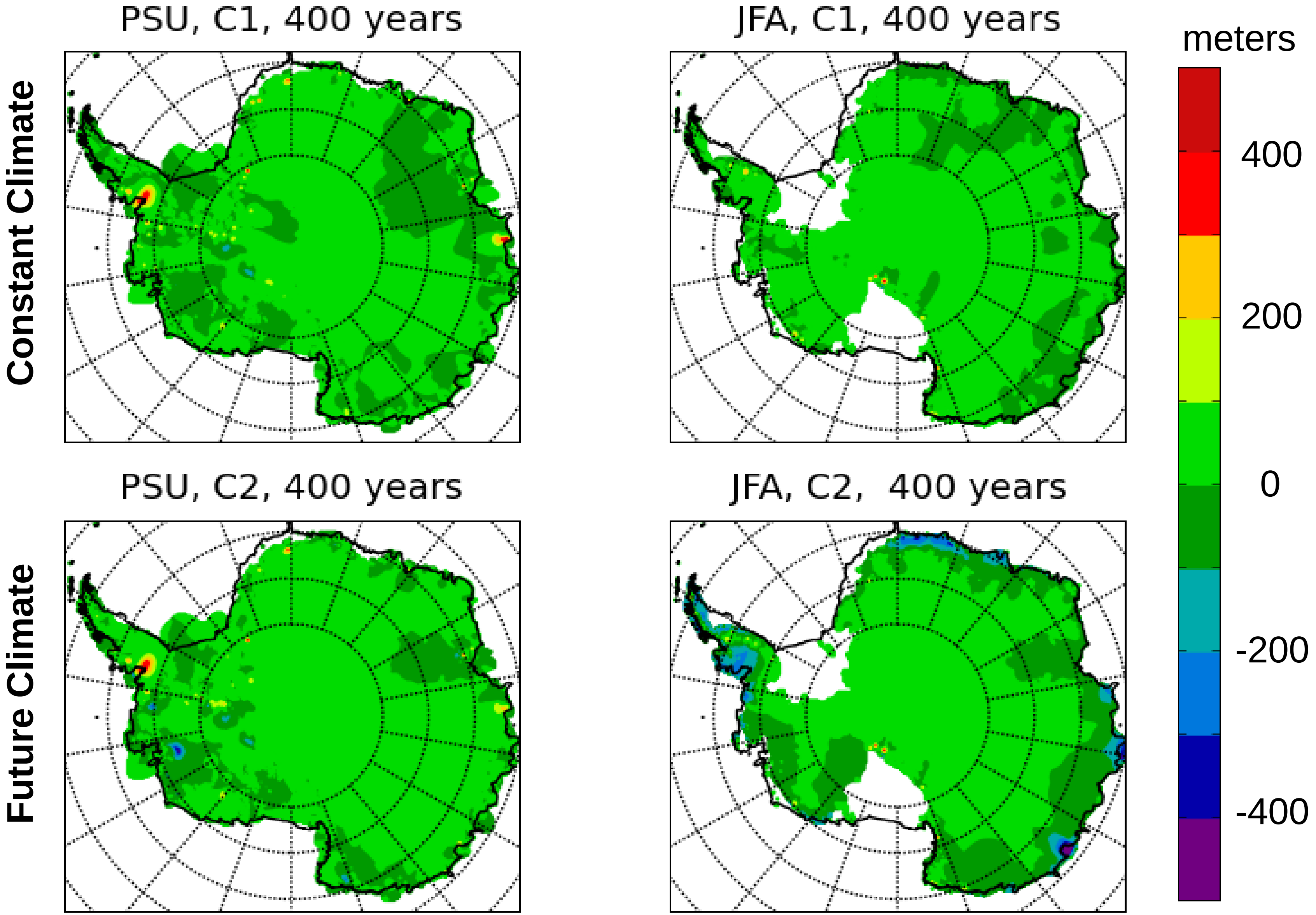
Difference in upper surface elevation (200yrs)



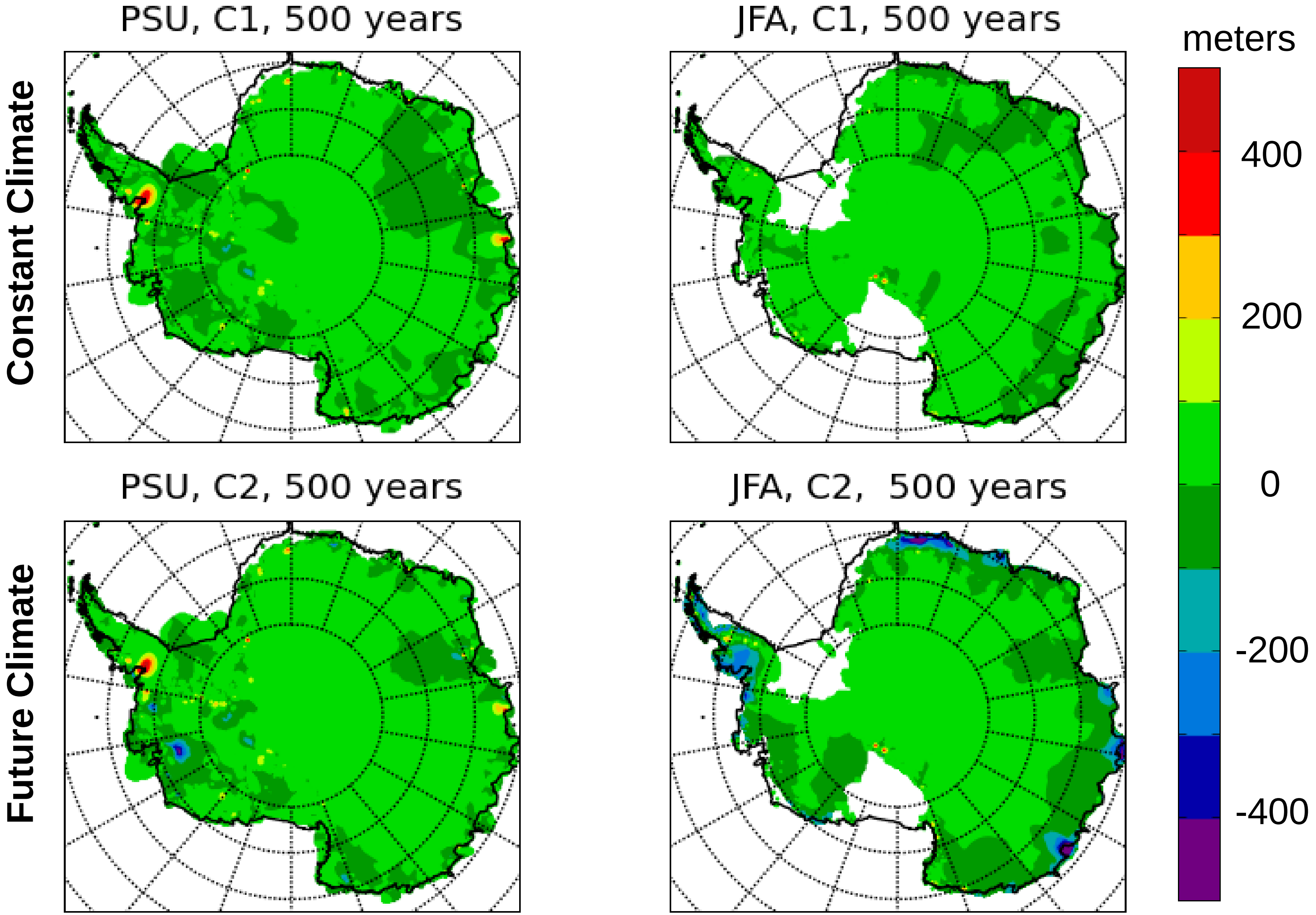
Difference in upper surface elevation (300yrs)



Difference in upper surface elevation (400yrs)



Difference in upper surface elevation (500yrs)



Participating Whole Ice Sheet Models

Model	Contact	Control climate		Slippery bed		Hot Shelves	
		Constant	AR4	Constant	AR4	Constant	AR4
CISM	Jesse Johnson						
PISM	Ed Bueler						
PISM-PIK	Maria Martin						
PennState	David Pollard						
Maine	Jim Fastook						
SICOPOLIS	Ralf Greeve						
Elmer Ice	Hakime Seddik						
Segment Ice	Diandong Ren						
Wang	Weili Wang						
GLAM	Steve Price						
GRISLI	Catherine Ritz						
ICIES	Ayako Abe-Ouchi						
JPL-ICE	Helene + Mathieu						