Knowledge Transfer: Climate Modeling Centers

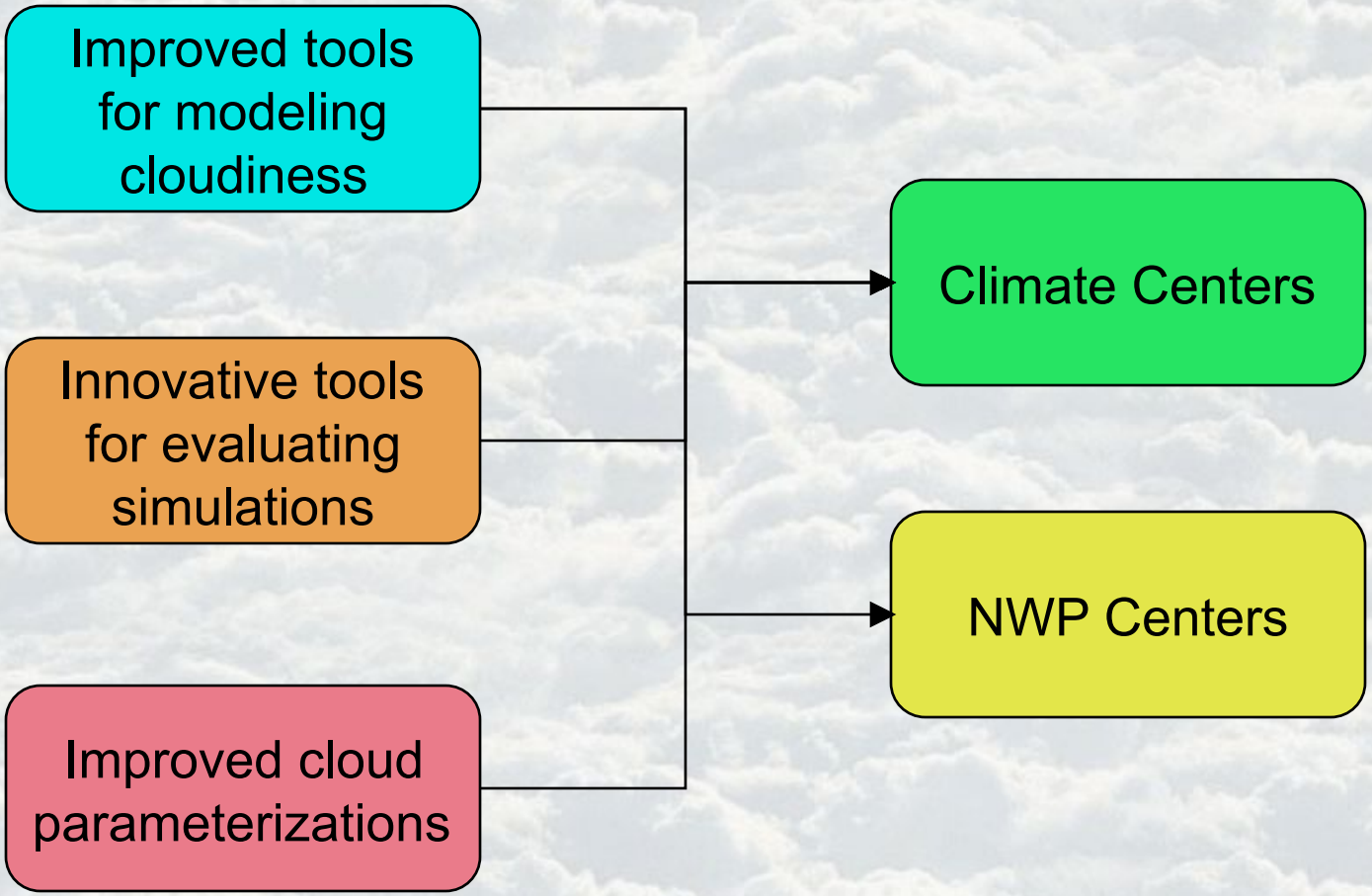
Bill Collins

UC Berkeley and LBL

Knowledge Transfer

CMMAP
Reach for the sky.

Goals of Knowledge Transfer with Weather and Climate Centers



Knowledge Transfer

CMMAP
Reach for the sky.

Recent developments in Knowledge Transfer

- **Objective: analyze Multiscale Modeling Frameworks using diagnostics familiar to climate and weather centers:**
  - —!National Center for Atmospheric Research
  - —!Geophysical Fluid Dynamics Laboratory
  - —!National Center for Environmental Prediction

- **This will help centers understand the implications of MMF using critical diagnostics for their applications.**

Knowledge Transfer

CMMAP
Reach for the sky.

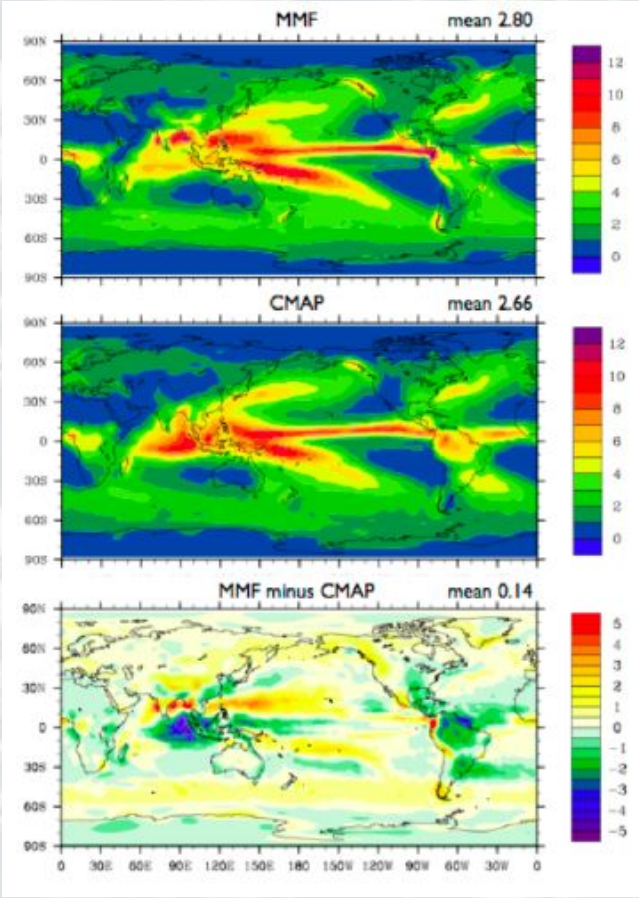
Climatological simulation with Super CAM

- *Objective:*
  Examine the climate of Super CAM in the same way that climate models are analyzed.

- *Simulation:*
  Two-decade integration using observed ocean surface temperatures (SSTs) and sea ice distributions. This follows the *Atmospheric Model Intercomparison Project (AMIP)* Protocol.

- *Manuscript:*
  Evaluation of the simulated interannual and subseasonal variability in an AMIP-style simulation using the CSU Multi-scale Modeling Framework

  Marat Khairoutdinov, Charlotte DeMott, and David Randall
  J. Climate, 2008, 21, 413-431.

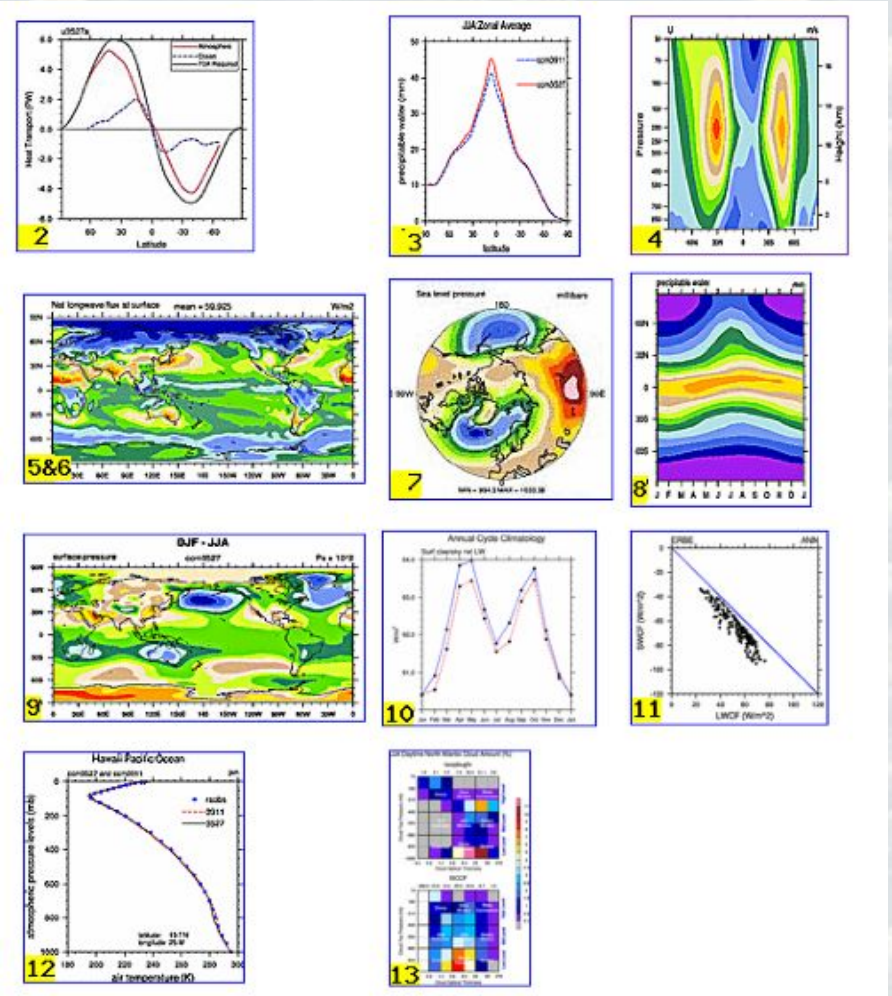


Knowledge Transfer

CMMAP
Reach for the sky.

Climate Diagnostics for Multiscale Framework

- !CSU has analyzed the climatological run with the diagnostics used by the Community Climate System Model project.
- !The diagnostics include measures for both mean climate and climate variability.
- !These are exactly the same diagnostics used for the operational climate model.
- !CMMAP has provided the diagnostics for free and open use by the whole CCSM.



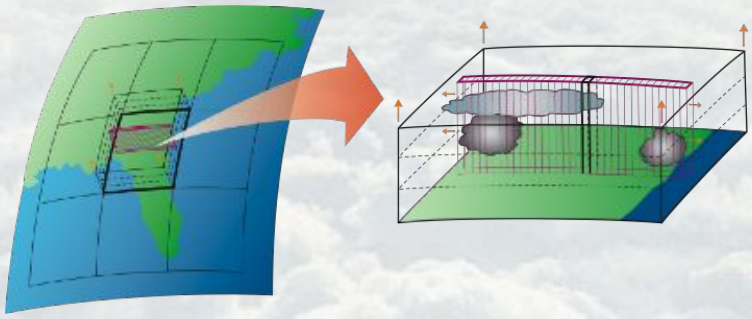
Knowledge Transfer

CMMAP
Reach for the sky.

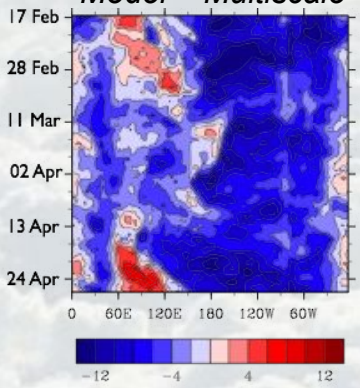
First presentation on MMF to the CCSM Project

- **Dave Randall and Bill Collins discussed MMF and the diagnostics with the Atmospheric Model Working Group, part of the Community Climate System Model project, at their Feb. 2008 meeting.**
- **Goals of the presentations:**
  - *Introduce the scientific scope of the MMF project*
  - *Highlight some early scientific achievements*
  - *Showcase analysis of MMF with CCSM climate diagnostics*

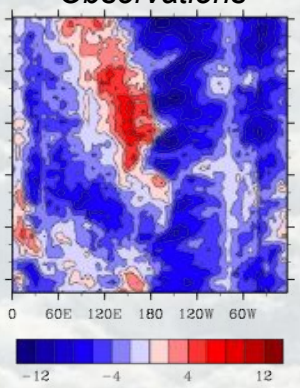
Multiscale Framework



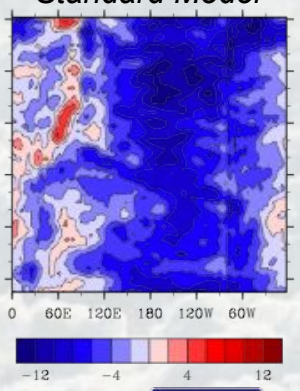
Model + Multiscale



Observations



Standard Model

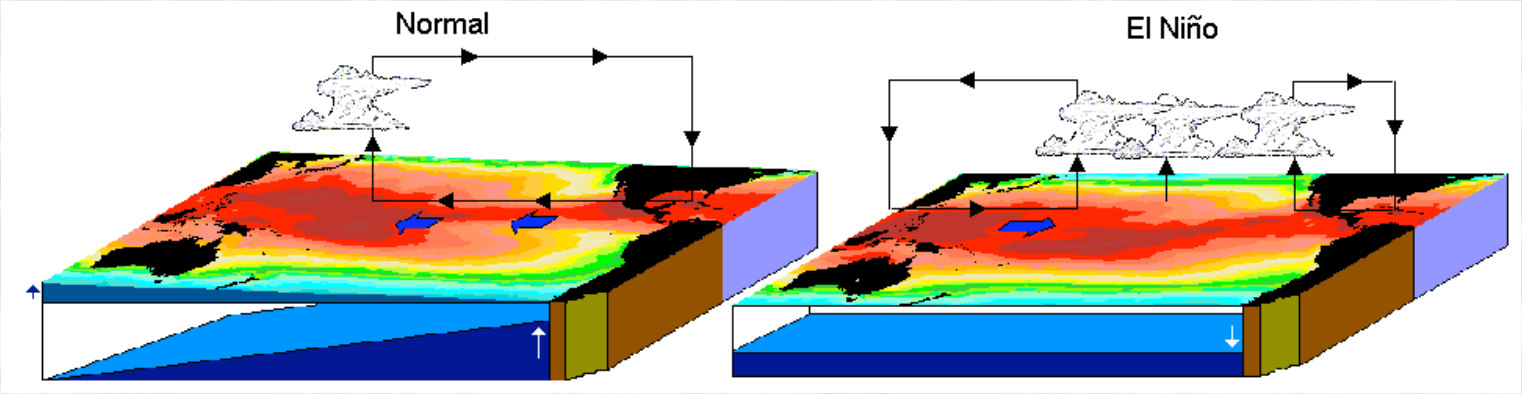


Knowledge Transfer

CMMAP
Reach for the sky.

Future coupled climate studies with Multiscale Framework?

- Studies suggest that intraseasonal variability can affect major modes of interannual variability
- Example: Influence of Madden Julian Oscillation (MJO) on El Nino Southern Oscillation (ENSO)
- Objectives:
  - Quantify differences between traditional parameterizations and MMF
  - Couple Super CAM to the CCSM ocean model to study interactions of the improved MJO with ENSO
- Studies to understand the coupling issues are underway.



Knowledge Transfer

CMMAP
Reach for the sky.

Collaboration with UC Berkeley and Lawrence Berkeley National Lab

- **CSU won a large DOE computing award to test the global cloud system resolving model (GCSRM)**

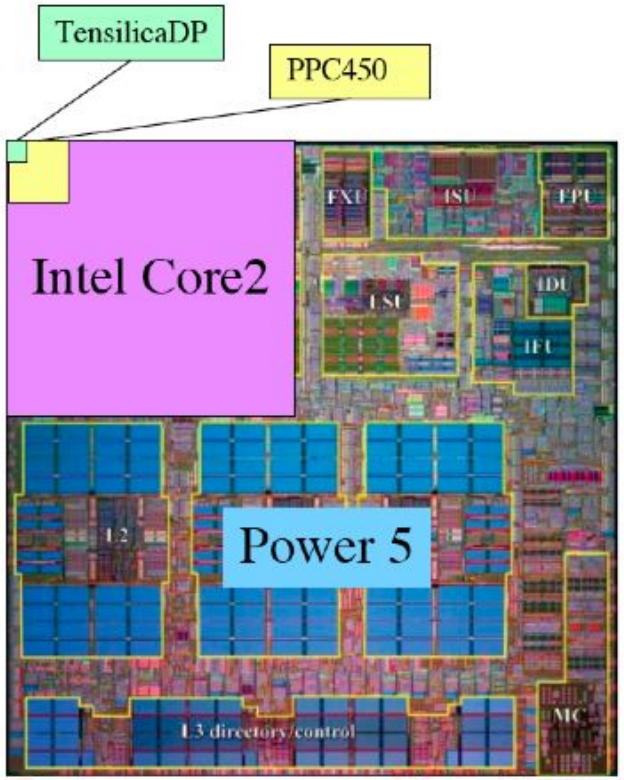
- **Independent of this, CSU and LBNL are working to:**
  - Develop the design of a 20 million CPU machine customized to run climate model integrations at the kilometer scale
  - Primary goal: reach sustained petaflop performance
  - Secondary goal: build a low-power “green” computer
  - Method: custom embedded processor technology

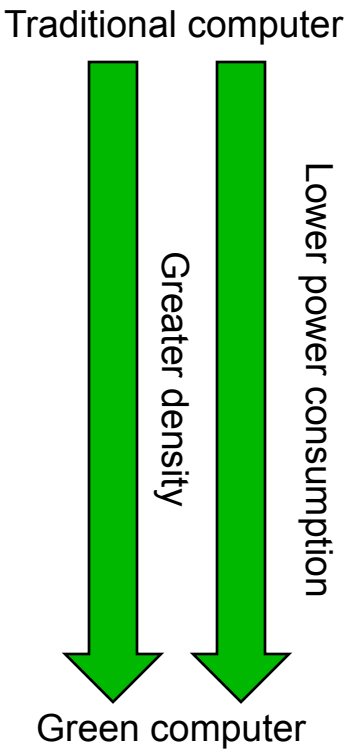
Knowledge Transfer

CMMAP
Reach for the sky.

Prospects for a Green Climate Computer

LBNL is exploring concepts for a “green” climate computer based upon CMMAP GCSRM.





Each core operates at 1/3 to 1/10th efficiency of largest chip, but you can pack 100x more cores onto a chip and consume 1/20 the power!

Knowledge Transfer

CMMAP
Reach for the sky.