



MAPP
Modeling, Analysis,
Predictions, and Projections

Process-Oriented Model Diagnosis to Improve Modeling Systems

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Tuesday, September 18, 2018





P-O Diagnostics Background

Performance Metrics

The whether

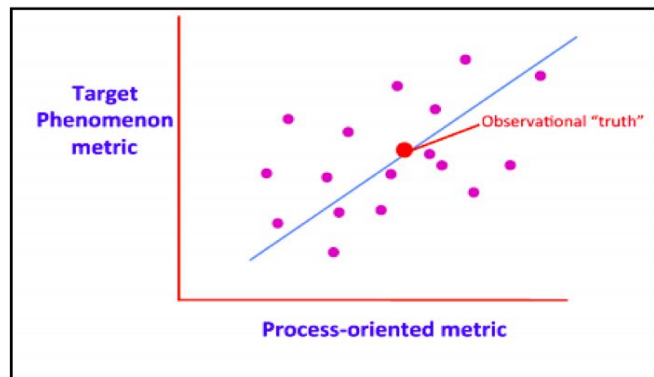


Process-Oriented Diagnostics

The why

Community evolution toward process diagnostics:

- WGNE Climate Model Metrics Panel
- YOTC MJO Task Force
- ESMValTool effort
- PCMDI Metrics Package
- NOAA/MAPP CMIP5 Task Force
- ...



Process-oriented diagnostics characterize a specific physical process or emergent behavior that is related to the ability to simulate an observed phenomenon.



MDTF Introduction

In 2014 and 2017, MAPP solicited three-year proposals to:

- Develop process-oriented diagnostics
- Develop and advance a software framework for these diagnostics

Goals:

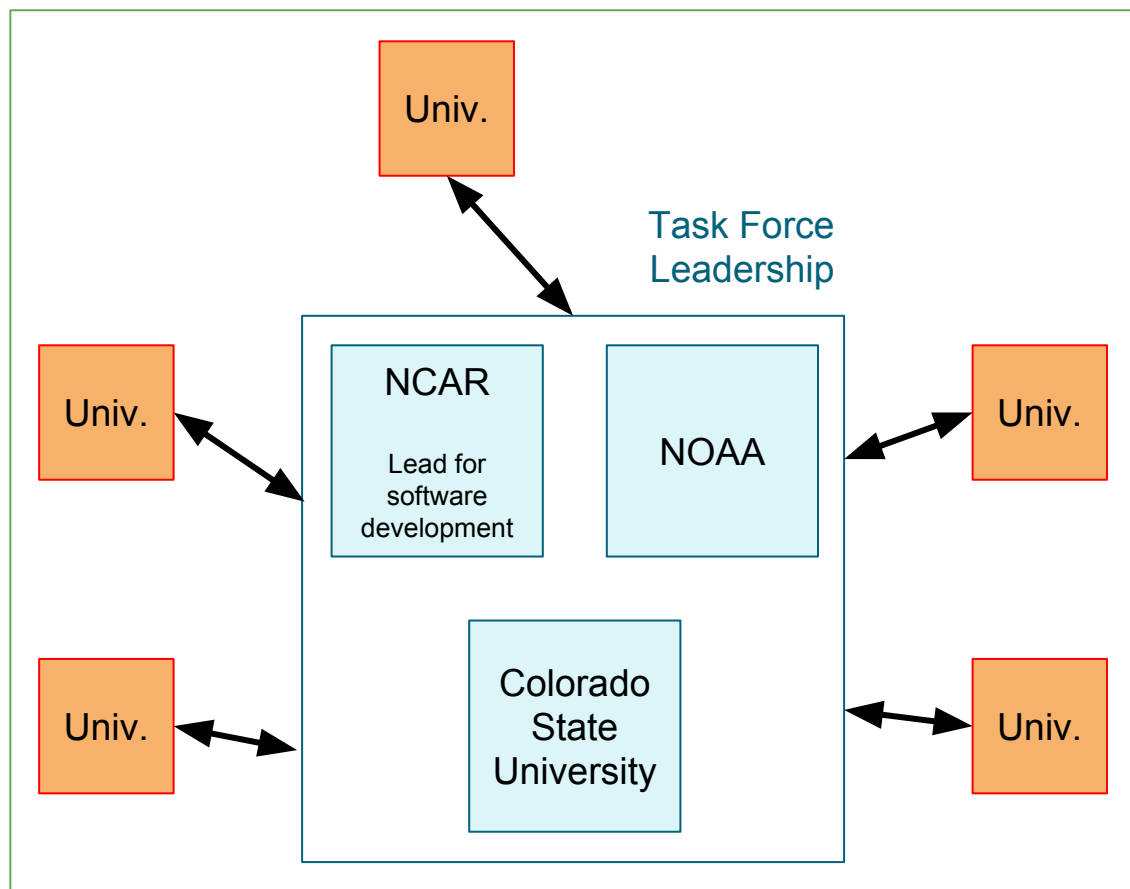
- Contribute to next-generation model development at centers
- Leverage CMIP to build development-grade diagnostics
- Link development and evaluation across modeling centers





MDTF Structure

Task Force



Leadership:

- Develops software
- Supports diagnostic integration
- Develops diagnostics
- Organizes Task Force
- Provides access to development versions of models
- Organizes meetings, sessions, special collection

University Participants:

- Perform Research
- Develop diagnostics
- Integrate and test diagnostics in software package



Projects and Participants

Diagnostic development areas

- Warm cloud microphysics (K. Suzuki)
- Tropical (S. Camargo) and extratropical (J. Booth) Cyclones
- ENSO teleconnections (H. Annamalai)
- Land/atmosphere coupling (E. Wood)
- MJO (X. Jiang)
- Diurnal cycle (A. Dai)
- AMOC (X. Xu co-support from CVP program)
- Task Force Leadership (Maloney)

Eric Maloney (Colorado State University; **TF lead**)
Yi Ming (GFDL; **TF co-lead**)
Andrew Gettelman (NCAR; **TF co-lead**)
Aiguo Dai (University at Albany)
Kentaro Suzuki (University of Tokyo)
Huan Guo (GFDL)
Peter Bogenschutz (LLNL)
Xianwen Jing (University of Tokyo)
Suzana Camargo (Columbia University)
Daehyun Kim (University of Washington)
Adam Sobel (Columbia University)
Anthony Del Genio (NASA GISS)
James Booth (City University of New York)
Catherine Naud (Columbia University)
Leo Donner (NOAA GFDL)
Eric Wood (Princeton University)
Zhengzhao Luo (CUNY)
H. Annamalai (University of Hawaii)
Arun Kumar (NOAA CPC)
Xianan Jiang (UCLA)
Ming Zhao (NOAA GFDL)
Yumin Moon (University of Washington)
Shian-Jiann Lin (NOAA GFDL)
Alexis Berg (Princeton University)
Angel Adames (NOAA GFDL)
David Neelin (UCLA)
Junhong Wang (University at Albany)
Xiaobiao Xu (Florida State University)
Molly Basinger (NOAA AOML)
Eric Chassignet (FSU)
Shenfu Dong (NOAA AOML)

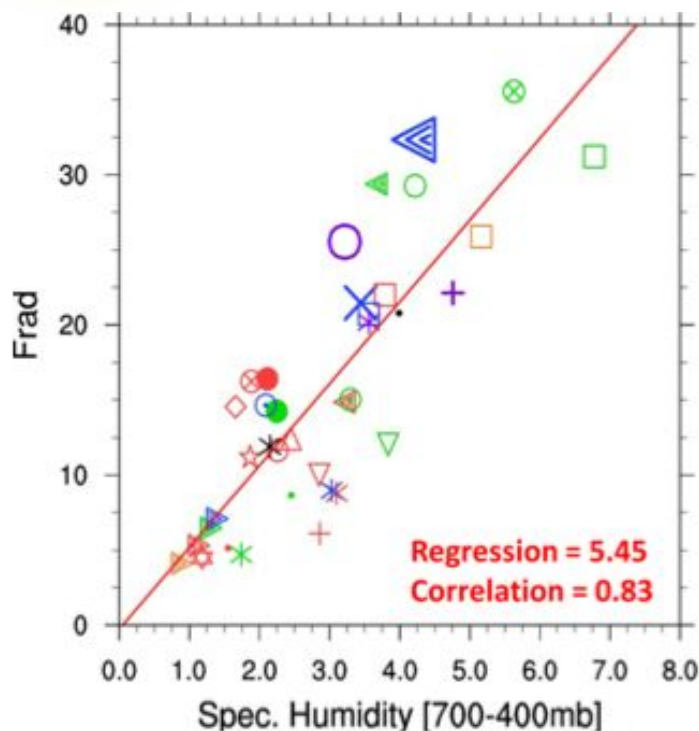




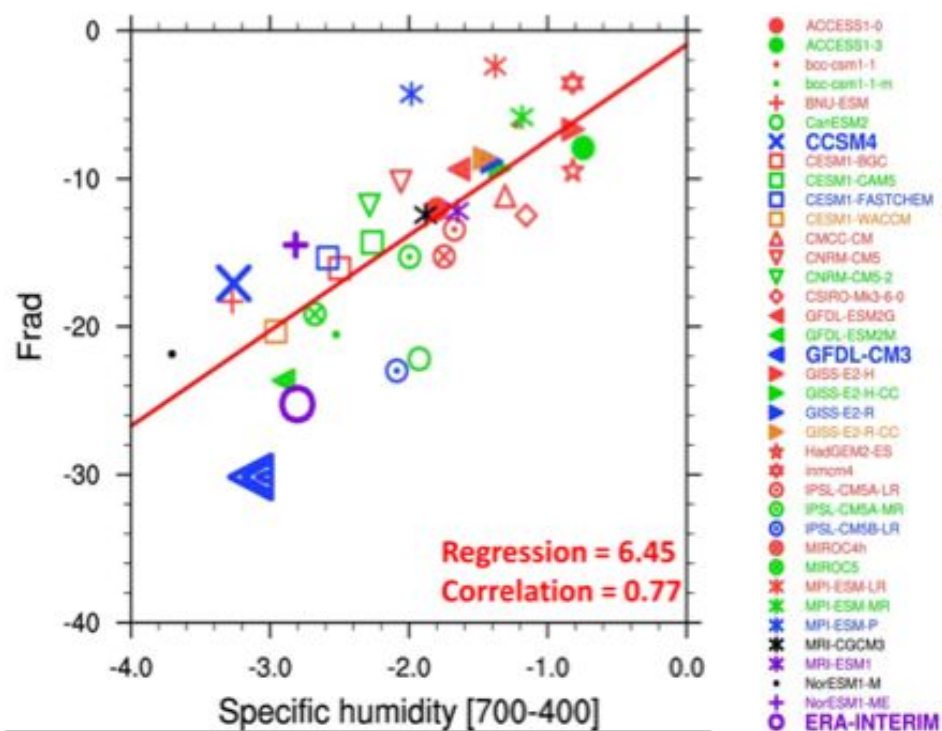
Example 1 (H. Annamalai)

ENSO - Atmospheric Biases

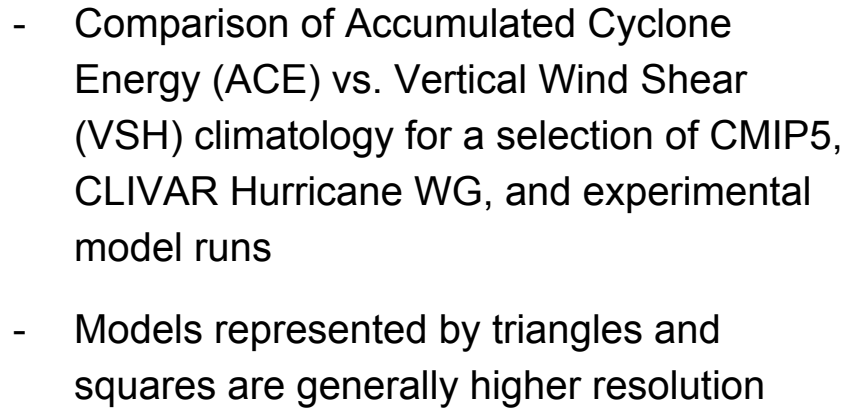
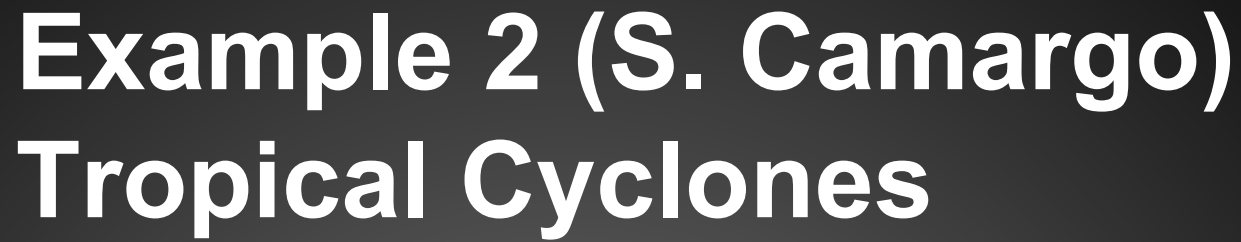
El Niño winters



La Niña winters



- Net radiative flux divergence vs. free tropospheric humidity over central tropical Pacific for Boreal winter.
- Indicator of issues with cloud-radiative and moisture-convection feedbacks in the models manifesting as precipitation biases.

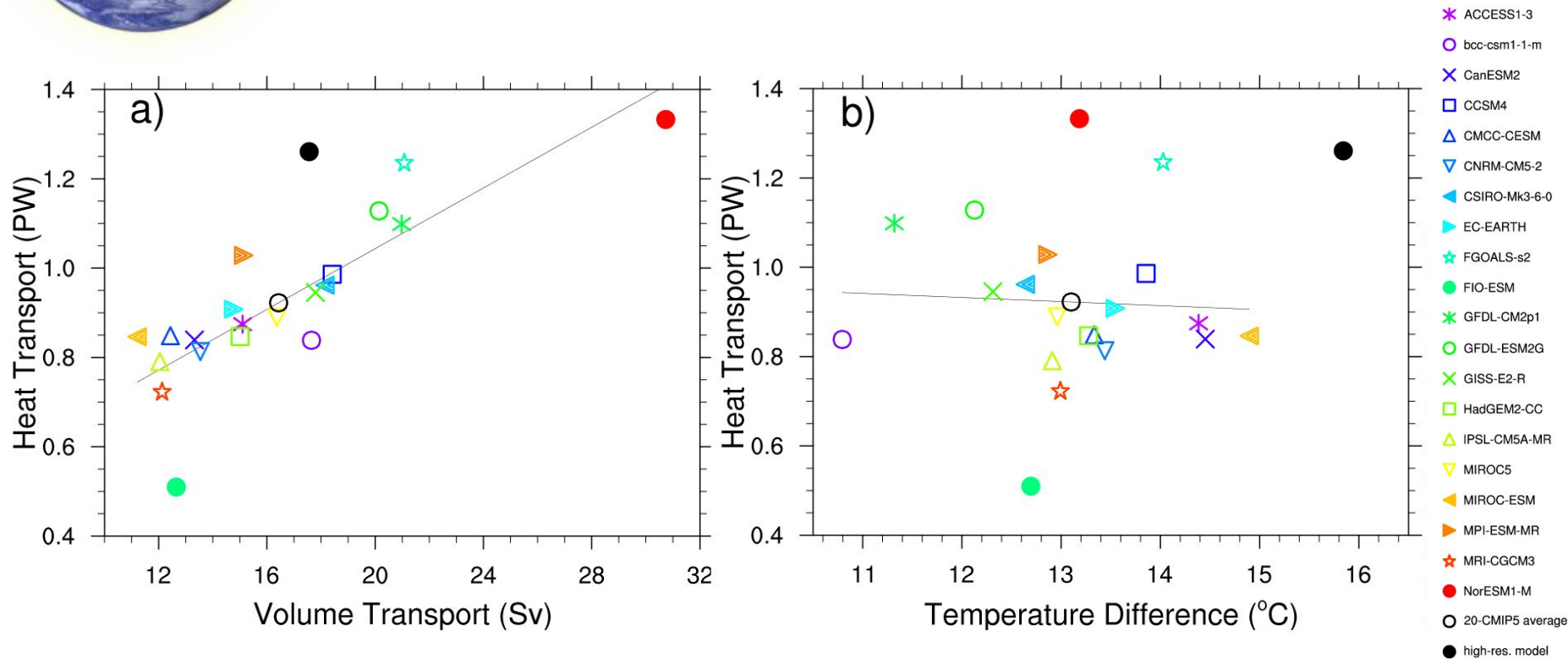


Camargo et al., in preparation



Example 3 (X. Xu)

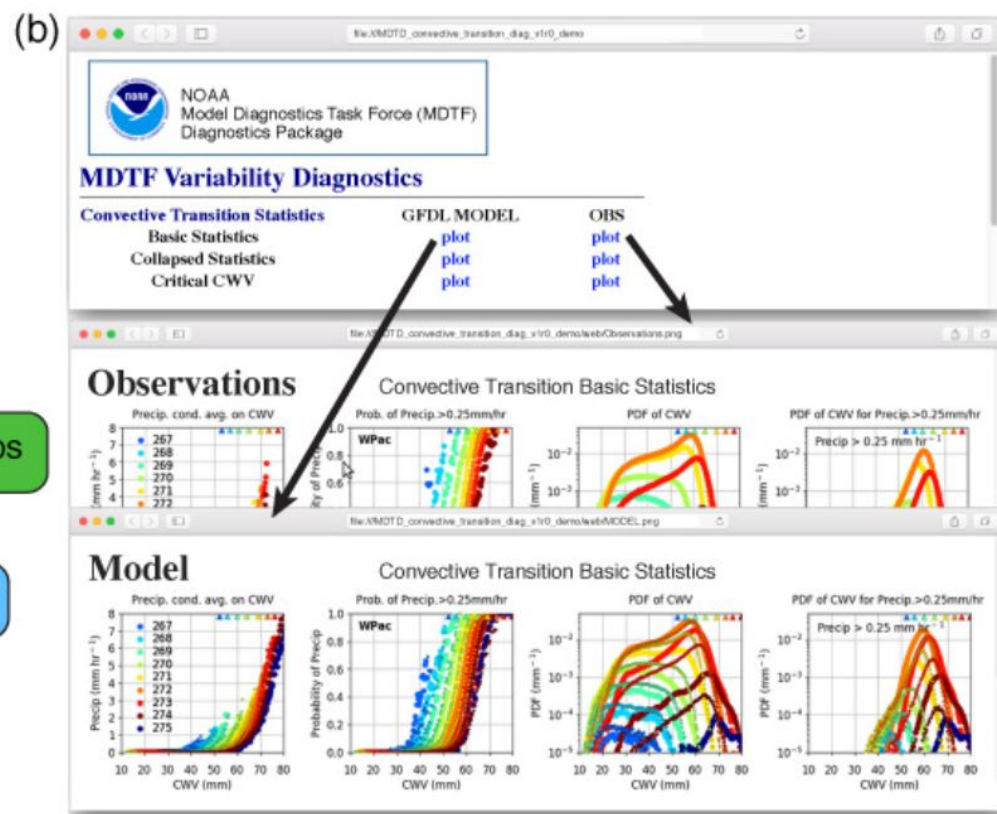
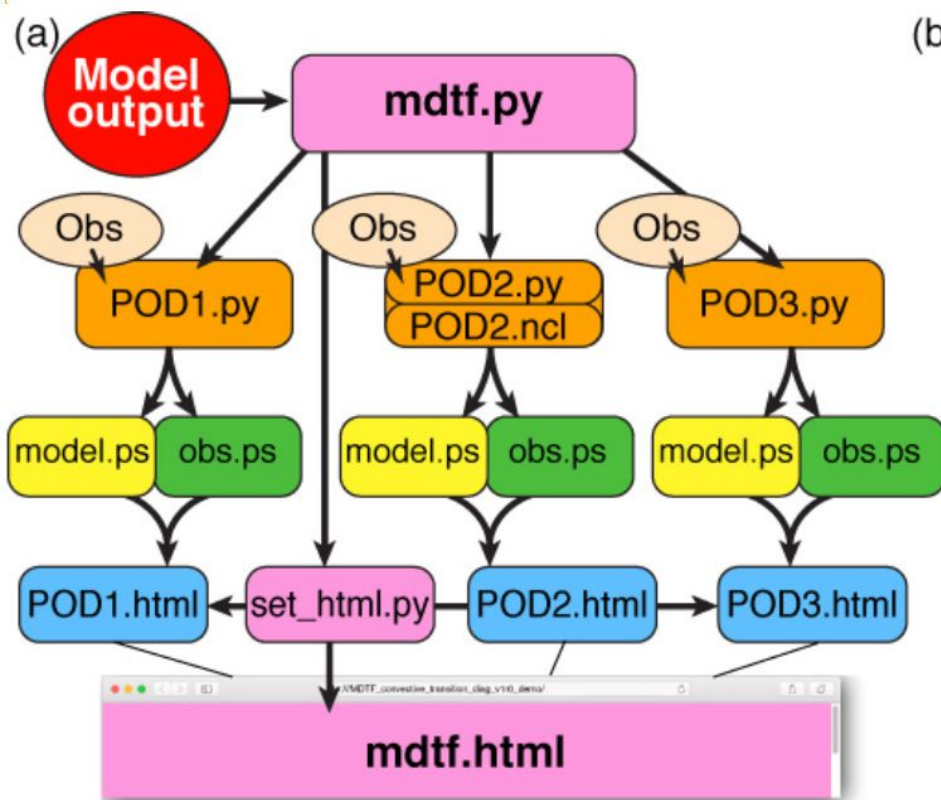
AMOC



- AMOC Heat Transport is low in CMIP5 models (colored symbols) compared with observations and high-resolution modeling (black dot).
- Volume transport is low in many models (left), and the temperature difference between the upper and lower limbs of the AMOC is too small (right).



Software Package





Software Availability

UCAR | NCAR | CESM™:: COMMUNITY EARTH SYSTEM MODEL



National Science Foundation
NSF

Google Custom Search



Home / CESM Working Groups / AMWG / MDTF Diagnostics Package

MDTF Diagnostics Package

About the MDTF diagnostics package

The MDTF (Model Diagnostics Task Force) diagnostic package is portable, extensible, usable, and open for contribution from the community. A goal is to allow diagnostics to be repeatable inside, or outside, of modeling center workflows. These are diagnostics focused on model improvement, and as such a slightly different focus from other efforts. The code runs on CESM model output, as well as on GFDL and CF-compliant model output.

- [Latest diagnostics code download](#)
- [Sample web page output of the package](#)

Software and sample
outputs available at:

http://www.cesm.ucar.edu/working_groups/Atmosphere/mdtf-diagnostics-package/





Special Collection



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Process-Oriented Model Diagnostics

Description of the collection:

This special collection is devoted to process-oriented evaluation of climate and Earth system models, and spans several American Meteorological Society journals. The Model Diagnostics Force (MDTF) of the NOAA Modeling, Analysis, Predictions, and Projections Program (MAPP) has organized this special collection. The collection is motivated by community interest in moving beyond performance-oriented metrics toward process-oriented metrics of models, current efforts to develop the next generation of climate and Earth system models including those related to the Coupled Model Intercomparison Project (CMIP), and a need to link model development and evaluation efforts across modeling centers. Assessing processes in climate and Earth system models is essential for understanding model biases, identifying model error origins, and developing next-generation models.

The papers detail studies not only by MDTF members, but also those contributed by the broader community.

Names and Affiliations of Collection Organizers:

Eric Maloney, Colorado State University
Daniel Barrie, NOAA MAPP Program
Aiguo Dai, University at Albany
Andrew Gettelman, National Center for Atmospheric Research
Yi Ming, NOAA Geophysical Fluid Dynamics Laboratory



BAMS overview paper: A framework for process-oriented evaluation of climate and weather forecasting models, Maloney et al., in prep., 2018



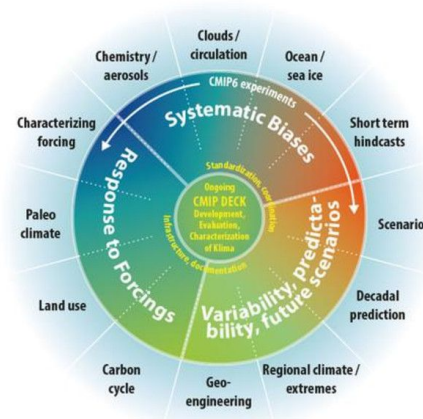
NOAA Research: Serving Society Through Science



New MDTF Projects and Participants (2018-2021)

Diagnostic development areas

- Task Force and assorted diagnostics (Neelin)
- Arctic Sea Ice (Bitz)
- ENSO - Atmospheric dynamics and Energetics (H. Annamalai)
- Lake Effect processes (Notaro)
- TC Genesis and Intensification (Kim)
- North American Monsoon (Wang)
- Pacific Sea Level (Yin)
- RF and Cloud-Circulation Feedbacks (Soden)
- Weather Typing/Extremes (Muñoz)



David Neelin (UCLA)
 Andrew Gettelman (NCAR)
 Eric Maloney (Colorado State University)
 Yi Ming (NOAA GFDL)
 Aaron Donohoe (University of Washington)
 Allison Wing (Florida State University)
 Andrew Robertson (Columbia University)
 Ángel Muñoz (Columbia University)
 Brian Soden (University of Miami)
 Cecilia Bitz (University of Washington)
 Daehyun Kim (University of Washington)
 Ed Blanchard-Wrigglesworth (University of Washington)
 Gabriel Vecchi (Princeton University)
 Gill Martin (Hadley Center)
 H Annamalai (University of Hawaii)
 Jianjun Yin (University of Arizona)
 Lucas Harris (NOAA GFDL)
 Michael Notaro (University of Wisconsin)
 Ming Zhao (NOAA GFDL)
 Peter Gleckler (Lawrence Livermore National Laboratory)
 Richard Neale (NCAR)
 Stephen Griffies (NOAA GFDL)
 Suzana Camargo (Columbia University)
 Wei Cheng (University of Washington)
 Zhuo Wang (University of Illinois)



Presenting at S2S Meeting





Next Steps

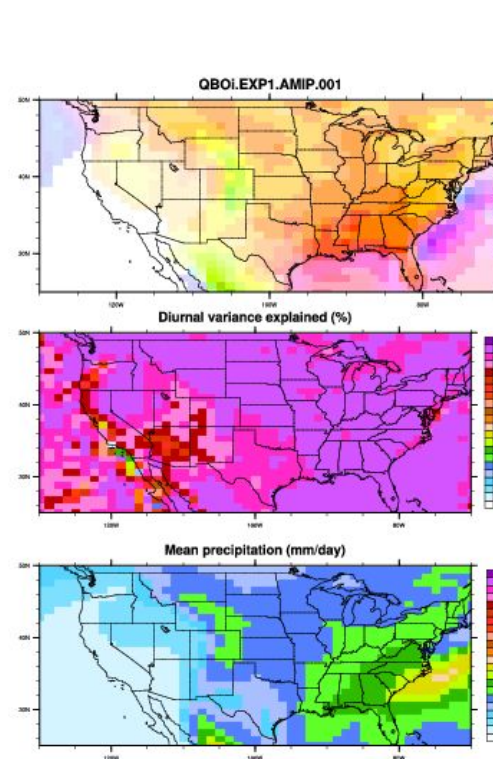
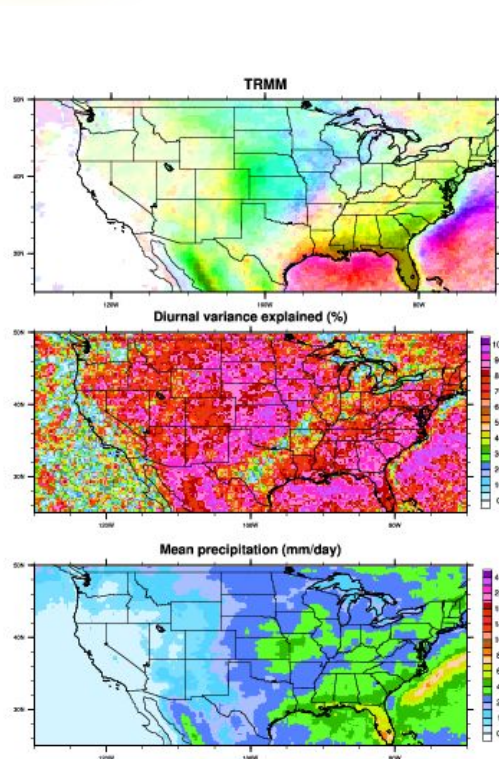
- Advance software package
- Process CMIP6 data and build new diagnostics
- Integrate new diagnostics into software package
- Explore development-phase models
- Broaden interactions (new centers, new communities)
- Explore compatibility with other diagnostic packages and efforts

Contact: daniel.barrie@noaa.gov





Diurnal Cycle



- Package includes diurnal cycle plots, after Gervais et al., J. Climate 2014