



Workshop on High-Resolution Coupling and Initialization to Improve Predictability and Predictions in Climate Models

NOAA Center for Weather and Climate Prediction, College Park MD
September 30th–October 2nd, 2015

Agenda

Day 1

8:30 am–8:45 am *Welcoming Remarks, Scope of the Workshop and Relevance to NOAA and DOE*
Bill Lapenta, NCEP Director
Mike Kuperberg, USGCRP Executive Director
Annarita Mariotti, OAR Climate Program Office
Renu Joseph, DOE Office of Science

8:45 am–12:30 pm Session 1: Setting the Stage – Team talks and discussions on current state-of-the-science

[Presentations include input from Team 1-4 participants as part of workshop preparations. A bulleted resume of key points from the presentations and Q&A discussions will inform the meeting report]

Chairs: Franco Molteni and Bill Collins

Rapporteurs: Travis O'Brien and Cristiana Stan

8:45 am *Team 1: State of the science in seamless sub-seasonal to seasonal predictions*
Jim Kinter and Shian-Jiann Lin, Team 1 Leads

9:15 am Q&A

9:35 am *Team 2: State of the science in using initialized climate models for testing model physics and understanding model processes and biases [e.g. CAPT]*
Brian Medeiros, Travis O'Brien and Steve Klein, Team 2 Leads

10:05 am Q&A

10:25 am Break

10:50 am *Team 3: Current initialization capabilities*
Steve Penny and Kevin Raeder, Team 3 Leads

11:20 am Q&A

11:40 am *Team 4: Computational and infrastructure environment in the next 5 years and the limits on high resolution initialized simulations*

Bill Putman, Brian Gross, and Bill Collins, Team 4 Leads

12:10 pm Q&A

12:30 pm–1:30 pm Lunch

1:30 pm – 5:00 pm Session 2: The Nexus: Resolution – Processes – Prediction

Chair: S.J. Lin

Rapporteurs: Kinter and Putman

1:30 pm *The impact of super-parameterization on the sub-seasonal forecast skill*
Cristiana Stan, COLA, George Mason University

1:45 pm Discussion

2:00 pm *Tackling seasonal prediction of extremes with high-res coupled models: extratropical storm tracks*
XiaoSong Yang and Gabriel Vecchi, GFDL

2:15 pm Discussion

2:30 pm *High-resolution sea-ice prediction: coupled processes and prediction system development*
Cecelia Bitz, University of Washington and Patrick Hogan, Naval Research Laboratory

2:50 pm Discussion

3:00 pm Break

3:30 pm *High-resolution extended-range predictions at ECMWF: results and expectations*
Franco Molteni, ECMWF

3:45 pm Discussion

4:00 pm *Addressing the Discussion Questions*
Facilitated by Jim Kinter and S.J. Lin (Team 1) and Bill Putman (Team 4)

- How does prediction skill and fidelity change when resolution is increased in combination for the various components of the prediction system?
- How can we diagnose and address model behaviors that lead to the above sensitivity?
- Are there specific or related processes in the coupled system that drive both short-term prediction error and climate simulation bias?
- What resolutions are necessary to adequately resolve these processes?

Questions to be discussed in the context of state-of-art HPC computing and data storage systems available to the U.S. community in the next 5 years. A bulleted resume of key outcomes by the rapporteurs will inform meeting report.

5:00 pm Adjourn

6:00 pm **Informal Dinner at Franklins Restaurant**

Day 2

8:30 am–12:00 pm Session 3: Frameworks for Diagnosing Fast Physics in the Coupled System

Chair: Steve Klein and Brian Medeiros

Rapporteurs: Travis O'Brien and Bill Collins

- 8:30 am *Prospects for high resolution to improve small-scale atmospheric processes*
Julio Bacmeister, NCAR
- 8:45 am Discussion
- 9:00 am *Prospects for high resolution to improve small-scale land processes and land-atmosphere interactions*
Ruby Leung, PNNL
- 9:15 am Discussion
- 9:30 am *Prospects for high resolution to improve small-scale ocean processes and ocean-atmosphere interactions*
Frank Bryan, NCAR
- 9:45 am Discussion
- 10:00 am Break
- 10:30 am *Using initialized and high-resolution simulations to diagnose the growth of systematic biases in the coupled system and the contribution of fast physical processes to systematic biases*
Eric Guilyardi, IPSL and U of Reading
- 10:45 am Discussion
- 11:00 am *Addressing the Discussion Questions*
Facilitated by Steve Klein, Brian Medeiros, Travis O'Brien (Team 2) and Bill Collins (Team 4)
- How does the fidelity of small-scale physical processes in the climate system change as resolution is increased?
 - For what phenomena would initialized coupled models (e.g. coupled CAPT) be of use for diagnosing fast physical processes of the climate system?
 - What can initialized simulations (either single component or coupled) reveal about fast coupled processes, such as rapid development of flux errors that lead to long-term bias and prediction error for the climate system?
 - What timescales should be targeted by such efforts?

Questions to be discussed in the context of state-of-art HPC computing and data storage systems available to the U.S. community in the next 5 years. A bulleted resume of key outcomes by the rapporteurs will inform meeting report.

12:00 pm–1:30 pm Lunch

1:30 pm–5:00 pm Session 4: Initialization at High Resolution and Uncertainty Sampling for Sub-seasonal to Seasonal Prediction

Chair: Suru Saha

Rapporteurs: Steve Penny and Brian Gross

1:30 pm *Data assimilation for high resolution prediction initialization at NASA*
Bill Putman, Guillaume Vernieres and Clara Draper, NASA

1:45 pm Discussion

2:00 pm *Two promising solutions for the CFS systematic errors: Strongly coupled data assimilation, and bias correction based on analysis increments*
Eugenia Kalnay, UMD

2:15 pm Discussion

2:30 pm *Initialization of global ocean eddy resolving coupled simulations*
Ben Kirtman, U of Miami

2:45 pm Discussion

3:00 pm Break

3:30 pm *Fully coupled data assimilation for high-res initialization in DART*
Kevin Raeder, NCAR

3:45 pm Discussion

4:00 pm *Addressing the Discussion Questions*
Facilitated by Steve Penny and Kevin Rader (Team 3) and Brian Gross (Team 4)

- What initialization techniques are best applied for prediction at the various spatial and temporal scales?
- What level of initialization sophistication is useful or necessary for diagnosing fast physical processes in initialized climate model simulations (e.g. CAPT)?
- What is the ideal size of the ensemble needed for this effort, both for prediction and for understanding coupled processes and biases?
- What resolution is feasible given the state-of-art HPC systems available to the U.S. community? How will increasingly high-resolution data be stored and shared for community research?

Questions to be discussed in the context of state-of-art HPC computing and data storage systems available to the U.S. community in the next 5 years. A bulleted resume of key outcomes by the rapporteurs will inform meeting report.

5:00 pm Adjourn

6:30 pm - 8:30 pm Team Leads Working Dinner

Day 3

8:30 am–10:30 am Session 5: Future HR Experimental Frameworks

Organized by all Team Leads

Chairs: TBD

Rapporteurs: TBD

- What are key points stemming from Sessions 1–4 to inform future experimentation?
[Rapporteur summary from Sessions 1–4, with focus on science gaps identified (10 mins each)
 - o Is there agreement on the science gaps identified; are there others?
 - o Is there anything relevant to this workshop that has not been considered?]
- What are the timescales for which there is the most pressing need to improve scientific understanding of resolution-dependent improvements in light of current HPC capabilities?
- Is there a feasible experimental framework to systematically and optimally address major questions about the use of high resolution in initialized coupled climate models?
- What is the interest of the various institutions in participating?

[This session will be a discussion guided by the session chairs. A bulleted resume of key outcomes will inform meeting report].

10:30 am Break

10:45 am–11:45 am **Report preparation – Outline, Roles, Tasks and Timeline**

11:45 am–12:00 pm **Closing Remarks and Impressions**

Gary Geernaert, DOE Office of Science, Division Director

NOAA representatives

Co-organizers and other participants

12:00 pm Meeting Adjourns