Summary of POS Panel Breakout Sessions - continued

Joint Session with PPAI on Observation and Synthesis Requirements for Predictability and Prediction Studies

- Recommendations of the 2012 CLIVAR/GSOP/WHOI air-sea flux workshop, follow-on activities, and specific recommendations for reducing air-sea flux estimation errors (Lisan Yu)
- International Quality Controlled Ocean Database, IQuOD (Janet Sprintall)
- Predictability associated with Pacific Ocean subsurface: decadal prediction of hypoxia along the US West Coast (Emanuele Di Lorenzo)
- Advancing the Nation's capability to anticipate tornado and severe weather risk (Scott Weaver)

Joint Session with PSMI on Diagnostic Tools and Metrics for Intercomparison of Reanalyses and Utilization of Innovation, Increments, and Residuals

- Innovation, increments, and residuals: Definitions and Examples (Patrick Heimbach)
- Example utilization of simulation and assimilation residuals (Dimitris Menemenlis)
- Challenges in evaluating lower-dimensional features (Gad Levy)
- Metrics based on fuzzy similarities between lower dimensional features for intercomparison of reanalyses (Barnabas Bede)

Automatic Differentiation Tool

- Automatic Differentiation Tool (Patrick Heimbach)
- Fuzzy differentiation tools (Barnabas Bede)

POS recommendations and action items

WG to investigate influences of rapidly changed Arctic on recent Northern Hemisphere midlatitude storm tracks, surface climate, and extreme events (Xiangdong Zhang).

WG to investigate global warming "hiatus" and deep ocean heat content (Xiao-Hai Yan and Patrick Heimbach).

WG to investigate uncertainties in air-sea fluxes and their impacts on ocean property budgets (Lisan Yu).

WG/ST to investigate global water cycle studies and connection to key climate indices (Subrahmanyam Bulusu).

Encourage ENSO diversity working group to address forecasting. Propose that ENSO prediction and impacts be considered as a Grand Challenge (Yan Xue).

Process-oriented evaluation of coupled model simulations in Tropical Pacific. What processes are missing in coupled models and what observations are needed to constrain models.

Encourage regional evaluations of model representation of short-term extreme dynamics (Matt Barlow).

POS Action items - continued

In US, there is a need to fund climate quality ocean reanalyses that are easily available to the research community and general public.

The POS panel supports Ana4MIPs to include ocean reanalyses in addition to atmospheric reanalyses for CMIP model validations and climate research.

Letter in support of open-source differentiation tools by DOE (Patrick Heimbach).

Recommend that we address the decline of the US fleet which limits ability to sustain and improve ocean observations (Renellys Perez).

Support operational/near-real-time oceanography and field programs in the event of government shutdowns (Renellys Perez).

Letter in support of International Quality Controlled Ocean Database (IQuOD) for improving climate records and ocean synthesis products (Janet Sprintall).

Encourage studies on subsurface climate variability for ecosystem applications (Emanuele Di Lorenzo and Art Miller).

Innovations, increments, and residuals in ocean syntheses should be saved and used to examine and motivate climate process studies.

PSMIP breakout summary

Gad Levy, Tom Farrar, Aneesh Subramanian, Alessandra Giannini, Caroline Ummenhofer, Igor Kamenkovich, Maria Flatau, Joellen Russell

Denver, CO

2014 Summit

Session 1: Process Study Reviews

Session 2: Joint Session with PPAI on Modeling Metrics for Quantifying Predictions and Predictability
    Limits

Session 3: CPT reviews

Session 4: Joint Session with POS – Diagnostic Tools and Metrics for Intercomparison of Reanalyses and
    Utilization of Innovation, Increments, and Residuals

Session 5: Discussion of CPTs (current and future)

Process Study Review

- Reviewed 11 process studies (5 oral, 6 written)
- Last year: 17 process studies (12 oral, 5 written)

- Conclusions
  - The "Best Practices" guidelines coming out of a previous PSMI Panel (Cronin, Legg, and Zuidema, 2009 BAMS note) have partly become standard practice (with some variations).
    - Data Management & Openness (PSMI should still push on this, give examples of successes)
    - Collaboration between Obs. & Modelers in planning stage is the norm
    - Only "best practice" not widely followed is production of synthesis products for easy use by modelers (but, e.g., DYNAMO)
  - Successful written ~4pg format for sunsetting projects or projects where team cannot attend. Very short discussion of these was suggested last year, and this proved sufficient.
  - Next year: Two joint sessions is too much for PSMIP– review/discussion of process studies and CPTs is important but takes time

Climate Process Team review and discussion of past, present and future for CPTs

- CPT model seen as very successful:
  - NSF/NOAA funding model and process viewed as adequate
  - Participation/buy-in from modeling centers good
  - From 2008 report:
    - Relevance: The process must be one which is currently poorly represented in climate models, but where improvement in representation could lead to better and more credible climate simulations.
    - Readiness: A process where recent developments from theory/ process modeling/obs are ready to be transferred to climate models
    - Focus: Narrow well-defined focus (narrow enough for 3-5 years)
    - Model independence: Topic of interest to multiple climate model development teams
    - Commitment: A CPT should be led by someone able to fully commit to the CPT activity, and whose career will benefit from the success of the team.

U.S. CLIVAR: CLIMATE VARIABILITY AND PREDICTABILITY

REVIEW OF U.S. CLIVAR PILOT CLIMATE PROCESS TEAMS, AND RECOMMENDATIONS FOR FUTURE CLIMATE PROCESS TEAMS

October 2008

U.S. CLIVAR Report No. 2008-3
October 2008

U.S. CLIVAR Office Washington, DC

- Increased interaction between model developers and observationalists/ theorists in the formulation stage (prior to proposal) would be beneficial. One suggestion for stimulating new, successful CPTs is to hold a workshop on needs and directions for CPTs at a major modeling center (to facilitate two-way exchange); a survey would be another approach
- First 3 years for development of parameterization and 2 years for implementation/testing

Climate Process Team review and discussion of past, present and future for CPTs

- Action item: Update US CLIVAR CPT web page
- Action item: Survey to solicit input from modeling centers, and possibly the broader community, on *needs* for future CPTs (perhaps focusing on biases, not readiness);
  - complete summer 2014 (Amala, Caroline, Aneesh); use this as basis for CPT workshop planning
- Action item: request information from current/previous CPTs on early interactions with modeling centers;

•Recommendations for 2015 Summit and coming year:

- Joint session with POS on observing system/process study overlap – long time scale processes, process studies organized around elements of the global observing system, transitioning from process studies to long-term observing
- Joint session: Wrap-up reports to plenary on large field programs (e.g., DYNAMO)
- Distribute written process study reports earlier
- Time is ripe for a working group on best practices for establishing metrics– check with DOE

Action items suggested at the conclusion of last year's summit:

"The PSMIP noted a few action items that might be used to organize future summit meetings."
- ✓ The PSMIP Terms of Reference should be reviewed for consistency with the new Science Plan
- ✓ A recommendation that future process study reviews might request a "Nature Figure" rather than a long list of slides. It is hoped that this figure might actually be used in a future publication, but in the meantime it would serve as a focal point for PSMI discussions.
- ✓ Best practices for metrics that demonstrate model impact . Gad Levy (and others) have suggested that the next needed best practices document should cover metrics and demonstration of impact of particular processes. Many panel members were eager to volunteer to help carry forward this project in future years.

In process

Process Study "Best Practices" (Cronin, Legg, and Zuidema, 2009)

– Modelers and observationalists should be integrated in the study from the planning stage onward. [(theorists)]

– Integrated and synthesized datasets should be generated from the process study observations to provide model-comparable data that can be used as benchmarks for assessing and validating models. Furthermore, diagnostics shown in much-cited published figures should be provided in digital format as "synthesis products."

– Broad use of the data should be encouraged through

• open data policies;

• centralized access to all components of the experiment; and

• data archiving in a user-friendly format, and with sampling information ("metadata") that is necessary for understanding the measurement.

• [data policy negotiated at outset, e.g., SPURS]

Joint Session with PPAI on Modeling Metrics for Quantifying Predictions and Predictability Limits

PSMIP relevant summary:

We heard four talks about Drought monitoring, Quantifying predictability limits, Predictions using fuzzy metrics based aggregation, and Metrics from the perspective of a practitioner's dilemma, which lead to the following Discussion points:

• Scientists and users should know what each other want and can provide.

• Users do not always know what they can get and use for their purposes.

• Another issue discussed was the scalability of the products provided and climate metrics.

• Simpler metrics provided are better to explain to users and will become more popular. Also, emphasize on visually appealing metrics that users can grasp as soon as they see.

Joint Session with POS – Diagnostic Tools and Metrics for Intercomparison of Reanalyses and Utilization of Innovation, Increments, and Residuals

PSMIP relevant summary:

We heard four talks about Innovations, increments and residuals (overview), Example of utilization of residuals & evaluating lower dimensional features, and Metrics based on fuzzy similarities, which lead to the following Discussion points:

•   How are subgrid scale processes assimilated into models that do not resolve these processes?

•   Examples discussed were eddy representation in climate models and key point made was that it was important to get the statistics of these features right rather than exact reproduction.

•   What are the nonlinear inverse methods for identifying nonlinear processes that impact the model biases ?

PPAI: Benchmarking Predictions and Predictability Limits

GOALS:

- Identify science-limited targets for improved predictability,

- identify best practices for quantifying improvements in predictions/predictability, and

- gain guidance on communicating prediction improvement to research, operational, and user communities.

PPAI: Benchmarking Predictions and Predictability Limits

- Opportunities for addressing noise-limited predictability, through forecasts of opportunity – by identifying time periods with higher skill

- Science-limited predictability can be addressed through process-based studies

- Best practices for gauging improvements were presented

- For communicating improvements:
  - Embed forecasts and projections in vulnerability and impact assessments – both numerically and through co-development

PPAI: Benchmarking Predictions and Predictability Limits

- **Suggestions/Action Items:**
  - Develop time history of predictability estimates
  - Develop a summary of methods for estimating predictability
  - Develop a quick guide to LIM
  - Coordinate with NOAA MAPP Climate Prediction Task Force, NMME, Intraseasonal Hindcast Variability Experiment and others

PPAI-PSMI: Modeling Metrics for Quantifying Predictions and Predictability Limits

GOALS:

- Determine metrics and protocols for quantifying improvements in predictions, projections, and hindcasts

- Gain guidance on predictable metrics that span the predictions-applications gap

PPAI-PSMI: Modeling Metrics for Quantifying Predictions and Predictability Limits

- Determine metrics that measure both research effectiveness and that are relevant to decision makers
  - Drought example: using phenomenological, event-based verification; measured against benchmarks, emphasizing skill scores

- Carefully select estimates of skill – because method can exaggerate apparent skill

- Fuzzy logic/set/rule methodologies explicitly acknowledge uncertainty, allow for rule-based co-development of metrics by practitioners and scientists
  - Great promise here

PPAI-PSMI: Modeling Metrics for Quantifying Predictions and Predictability Limits

- Suggestions/Action Items:
  - We encourage US CLIVAR to co-develop process-based metrics
    - Highly transparent, with metrics, metadata, and evaluation data made available to broader research community
  - Convene a scientist-practitioner workshop on metrics and climate change projection data
    - Explore/develop application-relevant, and process-based metrics

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PPAI-POS: Observation and Synthesis Requirements for Predictability and Prediction Studies

GOALS:

- Determine observational regions, fields and times that provide significant improvement to predictions and predictability

- Gain guidance observational efforts designed to improve predictive understanding and outcomes

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PPAI-POS: Observation and Synthesis Requirements for Predictability and Prediction Studies

- Large discrepancies in ocean and atmosphere reanalyses for evaluating surface ocean-atmos fluxes – these limit our ability to do, e.g. ENSO forecast, constrain global change estimates

- IQuOD (Int'l Quality controlled Ocean Database) is developing high quality subsurface temperature observations → Ocean Heat Content
  - Ramifications for attribution, impacts, and climate change studies

- Decadal variability in ocean gyre circulation and subsurface parameters (salinity) can be used for decadal prediction of ecosystem changes in upwelling regions

- Research is needed to further explore emerging link between ocean-atmos connections to severe weather, e.g. tornadoes

US CLIVAR

- Suggestions/Action Items:
  - Coupled, integrated analysis of surface fluxes (mixed-layer focus) is needed, and a working group could help with coordination across agency efforts, and development of strategies for reconciling data
    - International CLIVAR endorsement of IQuOD would help achieve consistency of OHC estimates
      - Future effort on salinity data could reap big benefits
      - Connection to gyre/upwelling/ecosystem research

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PPAI: Action Items

- Arctic-midlatitude influence on processes and predictability WG (Judah Cohen)

- Investigate development of APT using drought simulation (including regional climate projection), prediction, and management (decision making) as a proof of APT concept (Andrea Ray)

- Climate and marine ecosystems WG on ocean and climate influences on coastal (shelf) ecosystems (Enrique Curchitser)

PPAI: Action Items

- Subseasonal predictions: evaluation, uncertainty and predictability metrics WG (Hyemi Kim)
- Documentation of predictability metrics across time scales (Kathy Pegion)
  - 1-2 papers, outreach to decision-making communities, COMET course, short course
- Workshop on systems sensitive to decadal variations (Bruce Anderson)
- Cultivate participation in US CLIVAR of additional agencies (e.g., DOI, USDA)
  - Ex-officio or part of IAG

Action Items

- <u>Revise Terms of Reference</u>
  - Co-chairs developed new draft; Discuss during next Telecon
- <u>Promote assessment of seasonal predictability & predictions using NMME data sets</u>
  - PPAI to draft white paper describing motivation and benefits of an interagency program call (Arun lead, Bruce to help)
- <u>Promote Science Team on *Predictability and Predictions*</u>
  - Focus on methods, metrics, uncertainties, and applications as integrated study
  - Develop a concept paper for presentation at either 2014 or 2015 meeting
- <u>Develop additional thematic papers on current challenges for inclusion in CLIVAR Variations</u>
  - Communication and utilization of uncertainty in decision making
  - Predictability of high latitude climate variability