Advancing Climate Monitoring, Assessment and Prediction - 2010 CDPW Contribution

Jiayu Zhou, S&TI Climate Mission, Office of Science and Technology
Wayne Higgins, Climate Prediction Center/NCEP
NOAA's National Weather Service

Overview

The 35th NOAA Climate Diagnostics and Prediction Workshop (CDPW), which focused on the status and prospects for advancing climate monitoring, assessment and prediction, was held in Raleigh, NC from 4 to 7 October 2010. It was hosted by the Cooperative Institute for Climate and Satellites (CICS) and North Carolina State University, and co-sponsored by the Climate Prediction Center (CPC) and National Climatic Data Center (NCDC). A diverse group of about 165 scientists from more than 40 domestic and international partner institutes gathered to exchange ideas and build mutually beneficial collaborations.

The emphases of the 35th CDPW were: 1) Use of climate data records including satellite data, climatologies for improving climate predictions/predictability, and understanding and attribution of climate variability and its impacts; 2) Improving climate services through development and delivery of climate models, applications, and products in support of adaptation strategies; 3) Improving coastal monitoring and prediction in support of assessing climate impacts in the coastal zone.

This poster highlights the outcome of the 35th CDPW.

1. Recent advancement in MJO prediction

✓ *Significant skill improvement*

A significant increase (from ~6 days to ~ 16 days) of useable skill in predicting the MJO was demonstrated in moving from CFSv1 to CFSv2.

✓ *Service implication*

Because the MJO modulates global weather and climate events from tropical cyclones, to mid-latitude extremes, to active and break phases of monsoon systems, the improved prediction skill offers the potential for the development of many new types of outlook products (*e.g.* extreme event outlooks such as heat and cold waves, floods and flash droughts) on timescales out to 2-4 weeks. This information has considerable socio-economic value particularly for weather sensitive sectors, *e.g.* water management, agriculture, disaster prevention, *etc.*

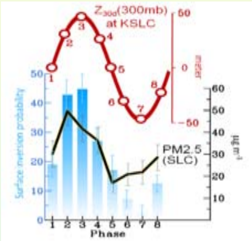

Figure 1 The occurrence of persistent inversions in the Intermountain West is "phase locked" with the MJO, fluctuating in response to the tropical-extratropical linkages of the MJO. (Gillies *et al.*)

✓ *Research advances*

The MJO prediction barrier across the Maritime Continent is most likely a modeling problem rather than a predictability issue. To continue advancing MJO prediction, synergetic efforts between the weather and climate communities are needed in at least four areas:

(i) Enhance the observing system and improve data assimilation techniques for better initial conditions,

(ii) Improve the representation of organized tropical convection and its interactions with the large-scale circulation in atmospheric models,

(iii) Improve ocean models in representing ocean mixed layer processes,

(iv) Improve the coupling among the atmosphere, ocean, and land that are crucial to realistic simulations of the MJO.

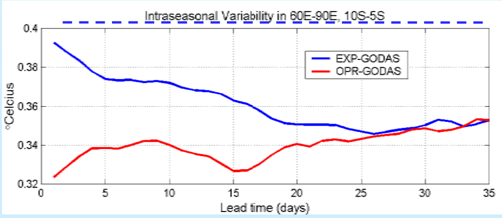

Figure 2 Drift of standard deviation of intraseasonal SST as a function of lead time (solid lines) (Vintzileos and Gottschalck)

2. Product assessment

- CPC Unified Precipitation Estimates – bias corrected CMORPH

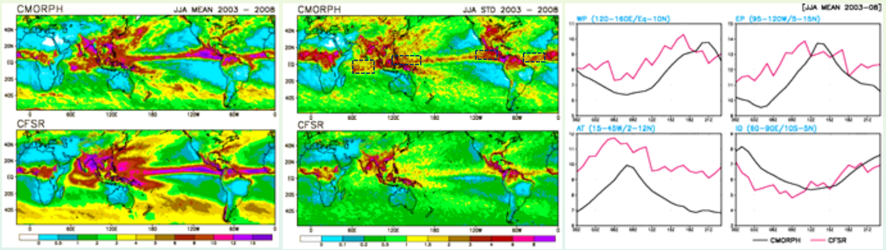

Figure 3 CFSR precipitation evaluation using CPC unified precipitation estimates.

Left column (total precipitation): CFSR captures the observed spatial distribution, but amounts are over-estimated.

Middle column (diurnal cycle): CFSR underestimates observed amplitude over most of the ocean and land, except over the Asian monsoon regions.

Right column (diurnal cycle): In CFSR, the phase of diurnal cycle over ocean (and land, not shown) is shifted approximately 3 ~ 4 hour earlier than in observations. (Yoo *et al.*)

3. Exploration of forecast means

- NPS statistical-dynamical approach to predict tropical cyclones (TC).

The NPS TC Formation Forecasting System is a multi-lead, multi-forecast product, skillful at lead times out to 30 days. Preliminary evaluation of 60 and 90 day lead forecasts (and beyond) seem to indicate skill as well.

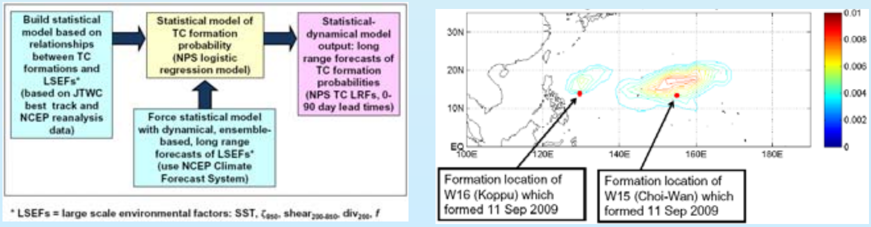

Figure 4 *Left:* Configuration of NPS TC formation forecasting system. *Right:* 30-day lead TC formation probability forecast issued 12 Aug 2009, valid 11 Sep 2009. (Murphree & Meyer)

4. Predictability theory for weather-climate prediction

✓ *Classical view*: The predictability of short-range weather forecasts depends on initial conditions, and that of long-range climate prediction relies primarily on slowly-varying boundary conditions. The memory of initial condition in the system will be lost after a few days.

✓ *Emerging View*: Predictability limits depend on "the extent to which a process contributes to prediction quality." **(National Academy NRC Committee on Assessment of ISI Climate Prediction and Predictability)**

✓ *Significance*:

(i) Verification of forecasts provides a lower bound for predictability.

(ii) Traditional predictability studies are model dependent, hence qualitatively useful.

(iii) Quantitative estimates of the upper limit of predictability for the climate system are impossible.

(iv) Errors in ISI prediction are related to errors in both short term climate predictions and long term climate projections.

These advances in understanding pave the way to accelerate modeling advances that link short-term forecasts and long-term prediction.

5. Quasi real-time attribution

- The 2009-10 winter was characterized by the combination of El Niño and extreme negative AO/NAO (the lowest NAO values in almost 200 years of record-keeping), which caused record-breaking snow season for Mid-Atlantic states.

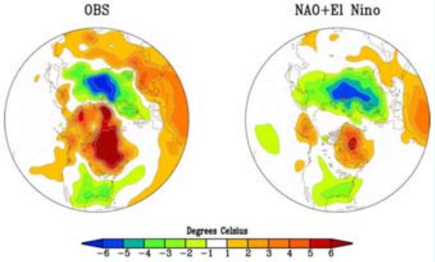

Figure 5 Dec - Feb 2010 observed surface temperature anomalies (left), and the linear combination of El Niño and NAO (right) , based on monthly NCEP/NCAR Reanalysis. Combining El Niño with negative NAO explains much of what happened during the 2009-10 winter. (Wolter)

Seasonal diagnostics and quasi-real time attribution of the combined impacts of ENSO, AO/NAO, PNA and MJO etc. could be of significant benefit in forecast operations and of tremendous societal benefit.

Figure 6 Considerations of conditions leading to strong tornado development over Florida in dry season. (Hagemeyer)

Acknowledgements. This presentation is based on the workshop digest and ppts accessible at http://www.weather.gov/ost/climate/STIP/35cdpw_digest.htm and http://www.cicsnc.org/CDPW.html, respectively.