Accelerating R2O and O2R for Climate Prediction

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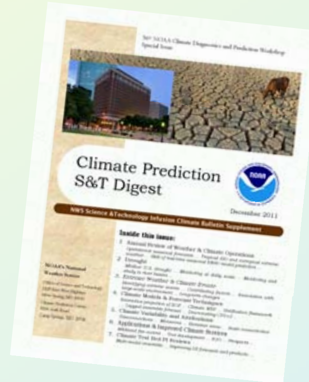


INTRODUCTION

As NOAA works to enhance the weather-climate connection and push for integrated services both across the agency and with external partners, the 36th NOAA Climate Diagnostics and Prediction Workshop (CDPW) was held in Fort Worth, TX from 3 to 6 October 2011. A diverse group of scientists from more than 70 domestic and international institutes gathered to explore current operational climate prediction capabilities, identify opportunities for advances, and discuss new products needed to support regional decision makers. To ensure that climate research advances are shared with the broader climate community and transitioned into operations, the ***2011 NWS Climate Prediction S&T Digest***, a collection volume of extended summaries, was organized and made available online. As is clearly evident in this synthesis volume, the climate community continues to make great strides in our ability to simulate and predict climate.

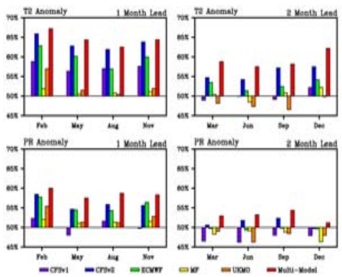
This poster highlights recent progress in research, operations and basic understanding.

1. Research Progress

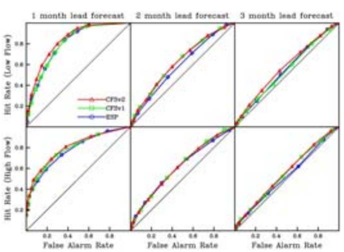
Improved Climate Forecast System

A comparison of the hindcast and forecast skill of NCEP's latest operational seasonal forecast model (CFSv2) with the earlier version (CFSv1) and with EUROSIP models, shows that CFSv2 has improved skill for land surface air temperature and precipitation, and is comparable to ECMWF.

CFS-based seasonal hydrologic forecasts were generally more skillful, outperforming Ensemble Streamflow Prediction (ESP) out to three months for low flows (one month for high flows). For the month-1 streamflow forecast, CFSv2 outperformed CFSv1 by 10% on average. *(by E. Wood)*



← Percentage of positive Ranked Probability Skill Scores (RPSS) for monthly surface air temperature and precipitation anomalies over global land areas during 1982-2005.

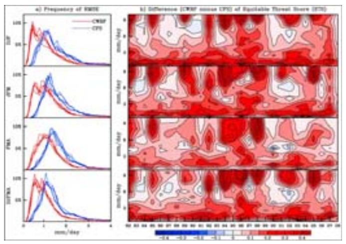


← Relative Operating Characteristic (ROC) diagram for low and high flow forecasts averaged at 130 gauges for the first three months.

CWRF ready for climate service

The Climate extension of the Weather Research and Forecasting (CWRF) model incorporates numerous improvements in the representation of physical processes and the integration of external forcing that is crucial at climate scales. This extension inherits all WRF functionalities for numerical weather prediction while enhancing the capability for climate modeling. It can be applied for seamless weather to climate prediction.

The CWRF facilitates the use of an optimized physics ensemble approach to improve weather and / or climate prediction along with a reliable uncertainty estimate. CWRF has been coupled with detailed models of terrestrial hydrology, coastal oceans, crop growth, air quality, and interactive water quality and ecosystems. The output provides an enhanced scientific basis for decision makers to achieve economic, societal and environmental goals. *(by X.-Z. Liang & J. Wang)*



← Seasonal mean precipitation over North America. Left column: spatial frequency distribution of root mean square error (mm/day) predicted by the CFS and downscaled by the CWRF. Right column: difference (CWRF minus CFS) in the equitable threat score.

Innovative Ideas on the *Climate and Weather Connection*

U.S. tornado counts and the large-scale environment

To find a path toward extended-range prediction of tornado activity, relationships between observed monthly-averaged environmental parameters and monthly U.S. tornado activity was investigated. Poisson regression was used to construct an index that captures aspects of the climatological and year-to-year variability of tornado activity. The same procedure based on an operational seasonal forecast model showed significant skill in forecasting June tornado activity. *(by M.K. Tippett)*

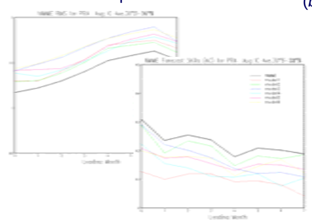
Monitoring meteorological drought at daily time-scale

Decision-makers want to know the present day flood or drought conditions of a location or area, as well as the flood and drought tendency in the days ahead. The flood and drought extent depends on both the current precipitation and on that of the previous days. An index was defined to measure the daily flood and drought extent, in order to capture the onset, duration, breaks, and strength of these events. The interannual variability and long-term change of these events was evaluated. *(by E. Lu)*

2. Operational Development

Multi-model ensemble prediction system

Seven models from various US institutes (NCEP-CFSv1, NCEP-CFSv2, GFDL-CM2.2, NCAR/U.Miami/COLA-CCSM3, NASA-GEOS5, IRI (ECHAM-a and ECHAM-f)) are participating in an experimental National Multi-Mdel Ensemble Prediction System (NMME). Three variables (monthly mean precipitation, sea surface temperature, and 2 meter air temperature) are available on a 1x1 degree grid, all with at least 29 years of hindcasts (1982-2010). Real time experimental forecasts were first conducted in August 2011 and are currently used in CPC forecast operations. *(by Q. Zhang et al.)*



← The NMME forecast skill (right) and RSME (left) in comparison with individual model performance for precipitation averaged 30°S-30°N with August ICs.

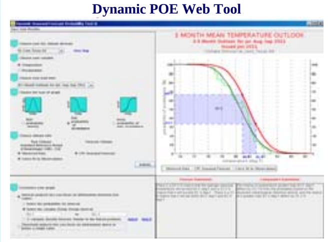
An emerging R2O protocol

Following a successful CPC/CLIMAS collaboration, an R2O protocol is emerging, which promises to radically improve operational capabilities to implement new products, while continuing to maintain existing ones. Five elements are identified: (1) Project Planning, (2) Software Version Control, (3) Issue-Tracking, (4) Wiki usage, and (5) Collaborative Software Development. CLIMAS introduced (2), (3) and (5) to CPC. These tools provide accountability and leverage the talents of coders inside and outside of the organization. Two examples, namely the Verification web tool (VWT) and Dynamic Probability of Exceedance (dPOE) web tool, have been successfully completed. *(by E. O'Lenic et al.)*

Verification Web Tool

← The VWT allows a user to request skill graphs or maps, for temperature and precipitation forecasts, for a variety of forecast periods, geographical regions, and historical periods.

Dynamic POE Web Tool

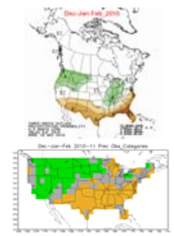


← The dPOE allows a user to request graphs, which place a temperature or precipitation forecast into the context of a reference distribution that may be viewed in 3 different formats.

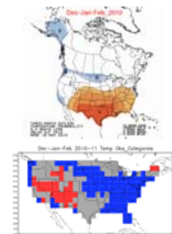
3. Science Needs

Learning from 2010-11 seasonal forecasts

The fall, winter and spring of late 2010 and 2011 were characterized by a moderate to strong La Niña across the tropical Pacific Ocean, which shaped CPC's seasonal outlooks for those seasons.



← Precipitation forecasts for September – November 2010 through April – June 2011 scored at least 30% better than a climatological forecast, the longest streak (eight) of successful forecasts since CPC began issuing seasonal forecasts in 1995.



→ In contrast, the temperature forecasts during the heart of the winter (November – January, December – February, and January – March) were not as successful, with Heidke skill scores near or below zero.

What caused the disparity in skill between the temperature and precipitation forecasts? The answer could be the seasonally dependent influence of unpredictable factors, *i.e.* AO, PNA *et al.* *(by M. Halpert)*

POSTSCRIPT

The CDPW proceedings (printed copies, 1976-2000) were produced by the Department of Commerce, which played an important role in improved understanding and more realistic simulation and prediction of climate variability. The newly developed NWS Climate Prediction S&T Digest (an electronic version, 2009 onwards) is a continuation of the CDPW proceedings. Recently, it has been included in the NOAA Library online catalog, NOAALINC, and available to the public.

http://docs.lib.noaa.gov/noaa_documents/NWS/NCEP/CDPW/

A more reader friendly environment is also provided via issuu.com.

Acknowledgments

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