NCEP Quarterly Newsletter - June 2014

Print

EMC – Improvements to Hurricane Models

The landfall of Hurricane Arthur, the first named tropical system in the Atlantic for 2014, brought a quick start to this year's hurricane season. Perhaps lost in the predictions and preparations for Arthur's landfall was the fact that there have been major upgrades this year to the two operational National Weather Service (NWS) regional hurricane prediction systems, the GFDL and HWRF models.

Since 1995, the GFDL huricane model has been an official operational product of the NWS, providing forecast guidance on track and intensity for the National Hurricane Center (NHC). The model was originally developed as a research tool, by scientists at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) in Princeton, to help understand the behavior and structure of tropical cyclones, and such topics as hurricane formation, decay and intensification. To adequately represent the structure of the hurricane and its inner core, the GFDL hurricane model required high resolution (distance between the individual grid points where the atmosphere equations of motion are solved), compared to other models of the atmosphere that define processes over the entire globe (typically called general circulation or global models). Also, advanced physics were required to correctly reproduce the processes that occur in the hurricane core, as well as the interaction with the ocean below.

In the early 2000s scientists at the NWS National Center for Environmental Prediction (NCEP) began to develop a new state of the art hurricane model using the most advanced numerical techniques available, to more accurately solve the mathematical equations that represent the processes of the atmosphere. This model (named HWRF, or Hurricane WRF) became operational in 2007, as an official product of the National Weather Service. Since then, improvements have been made to the HWRF modelling system every year, resulting in a steady reduction in track and intensity forecast errors. The recently upgraded HWRF model implemented for the 2014 hurricane season has shown much reduced track forecast errors compared to the 2013 version of HWRF for a large sample of North Atlantic basin tropical cyclones, with its performance comparable to the NHC Official Forecasts (Figure 1).

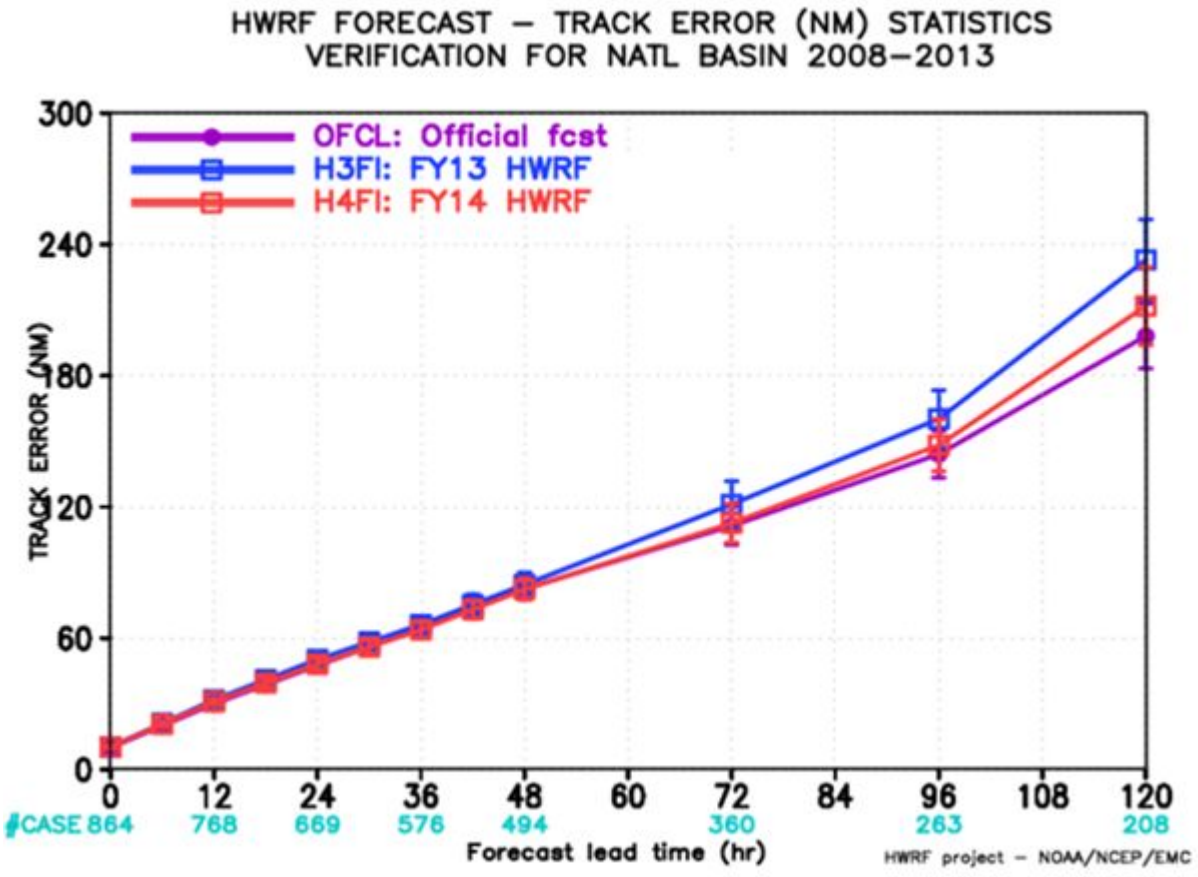


Figure 1: Track forecast errors from 2014 HWRF upgrades (H4FI, red) compared to previous year's operational HWRF (2013 version, H3FI, blue) and NHC Official Forecasts (OFCL, purple) shown for a large sample of North Atlantic storms from 2008 to 2013.

A major accomplishment is the significant reduction of intensity errors from the HWRF model in the past three years since the model was upgraded to run using cloud-permitting, 3 km resolution nests (see Figure 2), making it a primary model for intensity forecast guidance for NHC. Much of the increased skill seen in the HWRF model over the past 3 years was due to the successful collaboration between agencies within NOAA (GFDL, NCEP, AOML, ESRL) and partners within the academic community (such as the University of Rhode Island), that was made possible through the coordinated efforts and support from NOAA's Hurricane Forecast Improvement Project (HFIP). Apart from providing operational forecast guidance to the NHC for the Atlantic and Eastern Pacific basins, the HWRF model is also run in real-time for all global oceanic basins, providing forecast guidance to the US Navy's Joint Typhoon Warning Center (JTWC). All real-time forecast products from operational HWRF can be accessed from the HWRF website.

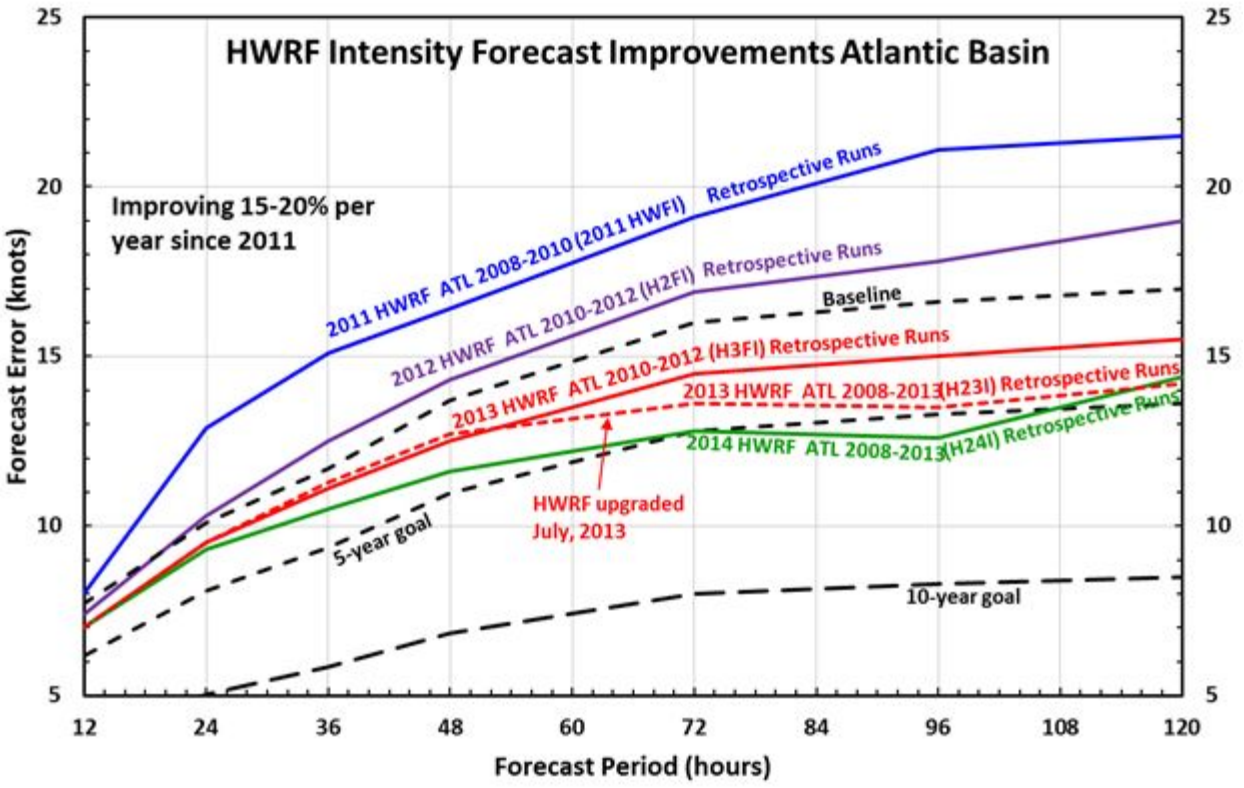


Figure 2: HWRF model intensity forecast improvements from 2011 to 2013 for North Atlantic basin. The intensity errors shown here are collected from hundreds of retrospective simulations for each upgraded HWRF configuration since 2011. 2011 version of HWRF (blue) was run at 9km resolution while the model was upgraded to run at 3km resolution in 2012 (purple). 2013 HWRF (red) was able to meet or exceed the HFIP intensity error baseline whereas the 2014 HWRF (green) further reduced the intensity errors, approaching the HFIP 5-year intensity error goal.

At the same time, scientists at GFDL have also upgraded the GFDL hurricane modeling system, with major improvements made operational in 2014, particularly to improve the prediction of hurricane intensity as shown in Figure 3. Note that the improvements made to the GFDL hurricane model reduced the error in the prediction of the storm maximum wind about 15% in the 3 to 5 day forecast time period, for a set of forecasts rerun from the 2008, 2010, 2011, and 2012 Atlantic hurricane seasons, using both the 2013 version of the GFDL model and the newly upgraded model.

The National Hurricane Center continues to support both of these operational regional hurricane models (HWRF and GFDL) since the forecast error of both models is often not correlated (individual model errors often go in different directions). Numerous scientific studies suggest that the average forecast from models that are well behaved produce errors that are less than those from the individual models. This has led to an increase in the use of model ensembles (models with slightly different initial conditions or different physics). For example, as shown in Figure 4, a consensus made up of the average of the intensity forecasts from the 2014 versions of the GFDL and HWRF (solid black line) results in an intensity forecast error that is significantly less than either the HWRF or GFDL model at every forecast lead time. Note that the average intensity forecast error of the 2-model consensus is even less than the HFIP 5 year goal at days 4 and 5, established in 2010.

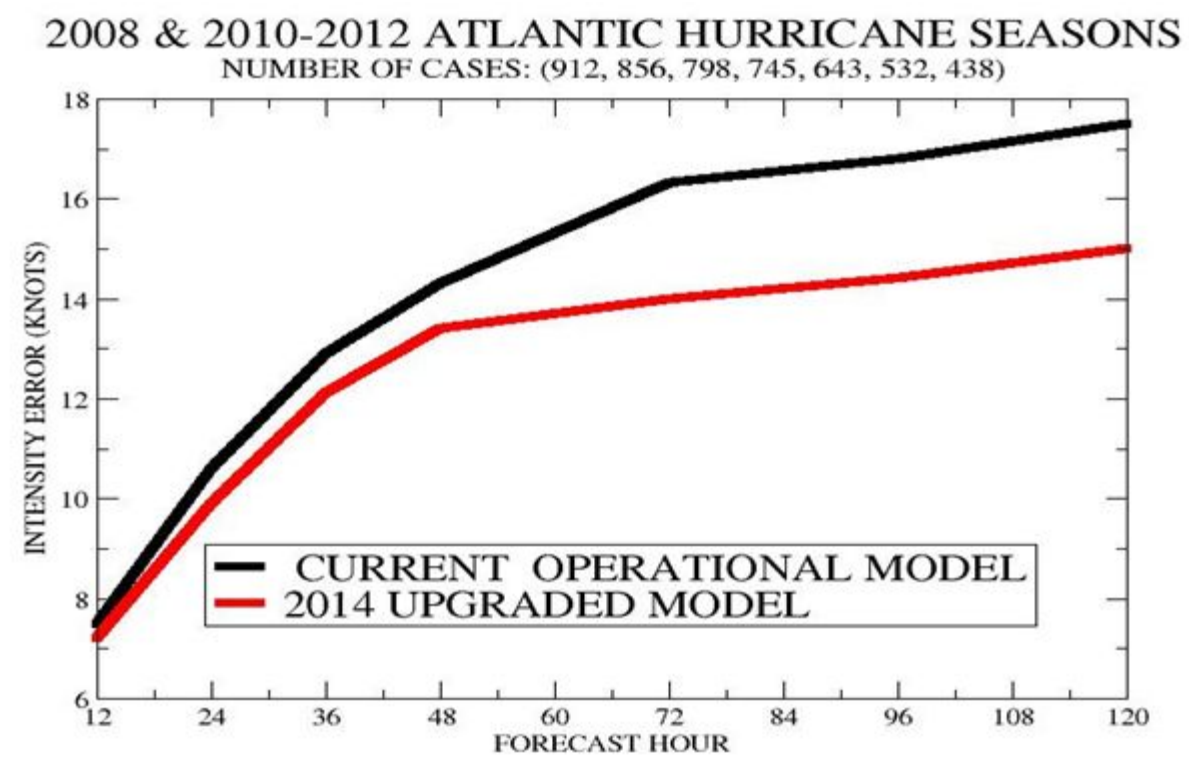


Figure 3: Comparison of the intensity forecasts errors (in knots) from 12 to 120 hours in the future, for Atlantic storms rerun from the 2008, 2010, 2011 and 2012 Atlantic hurricane season. Plotted are the forecast errors for the version of the GFDL hurricane model used in 2013 (black line), compared to the version recently made operational in 2014 (red line).

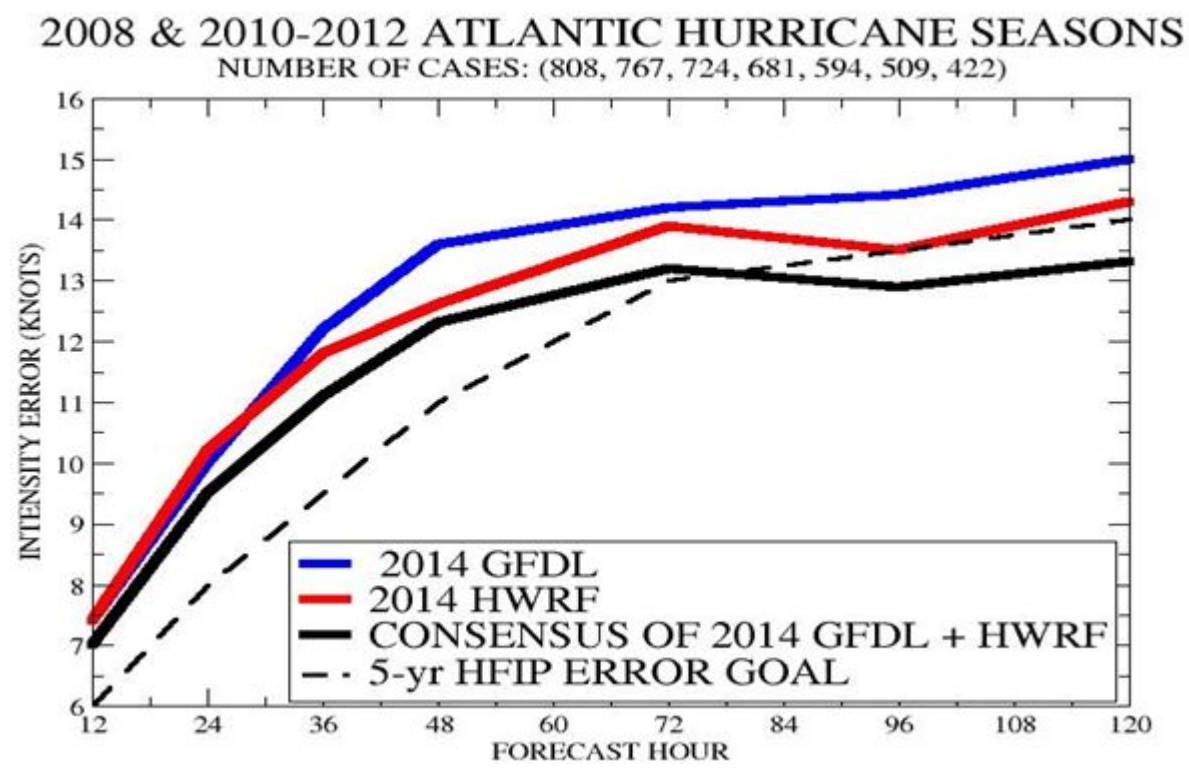


Figure 4: Intensity forecast errors at hours 12 through 120, for the 2014 versions of the GFDL (blue) and HWRF (red) models for over 800 forecasts from the 2008, 2010, 2011 and 2012 Atlantic hurricane seasons, compared to the forecast

error for the consensus model made up of the average intensity prediction of GFDL + HWRF.

Both the upgraded GFDL and HWRF modeling system did well for track and intensity forecasts for Hurricane Arthur, the first hurricane of the 2014 Atlantic hurricane season (Figure 5). The new GFDL and HWRF had very low track errors although the sample size was small, with the average intensity errors comparable to the other two top NWS intensity prediction models (Decay SHIPS and the LGEM). HWRF forecasts for Hurricane Arthur indicated perfect landfall location, timing and intensity at landfall, and the advanced products from HWRF model have been helpful to the NHC forecasters and NWS WFOs. An example of HWRF simulated composite radar reflectivity animation along with storm specific products are shown in Figure 6.

With continuous advancements to the NCEP hurricane models supported by HFIP, and enhanced computational resources available for operational models, we anticipate further improvements in track and intensity forecasts through improved hurricane physics, advanced inner core data assimilation, and increased horizontal and vertical resolutions. Apart from coupling the atmospheric model to the ocean model, future efforts also include coupling to wave, land surface, hydrology, and surge and inundation models for improved prediction of land falling storms.

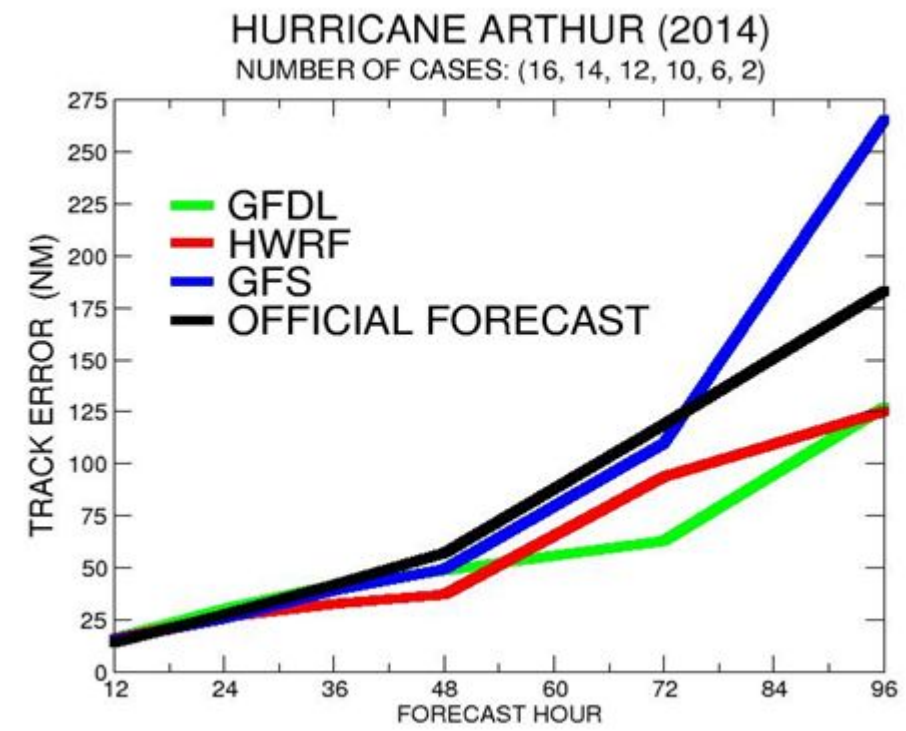


Figure 5a: Average track forecast error for the upgraded GFDL model (green), the upgraded HWRF (red), compared to the official forecast of the National Hurricane Center (black), and other NWS operational models, for all forecasts of Hurricane Arthur (2014).

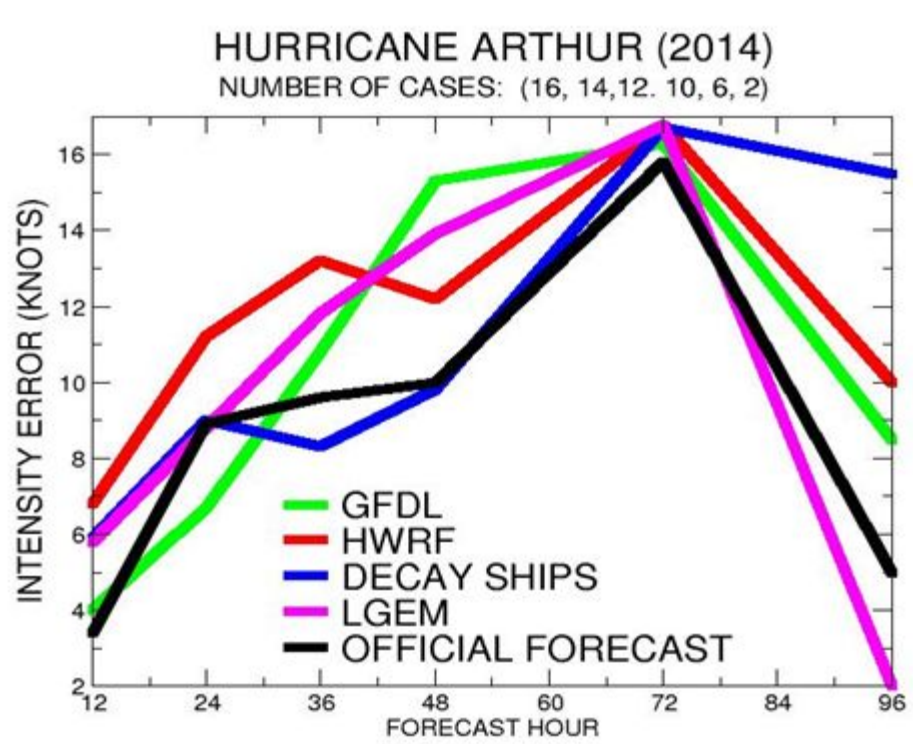


Figure 5b: Average errors in the forecasted maximum surface winds for the upgraded GFDL model (green), the upgraded HWRF (red), compared to the official forecast of the National Hurricane Center (black), and other NWS operational models, for all forecasts of Hurricane Arthur (2014).

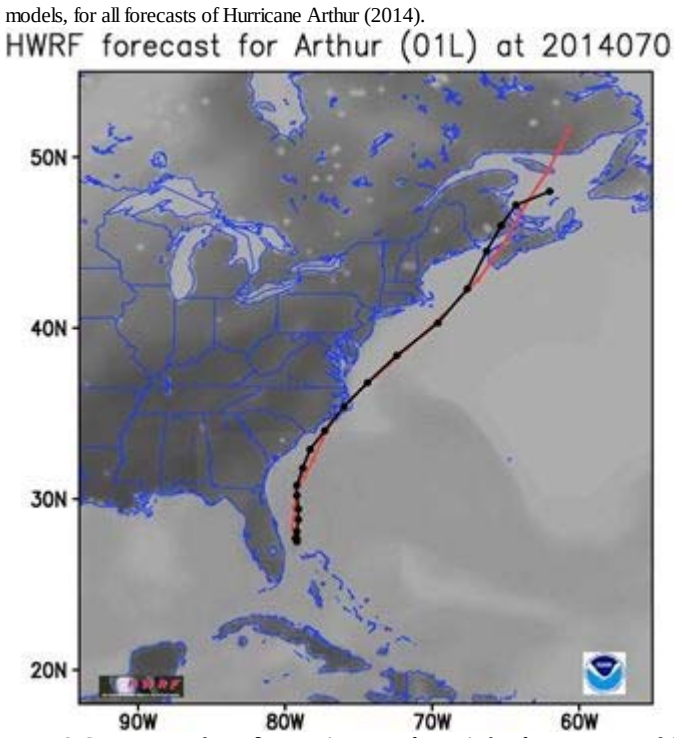


Figure 6: Composite Radar Reflectivity Animation for H. Arthur from HWRF model initialized on 18Z July 1, 2014.

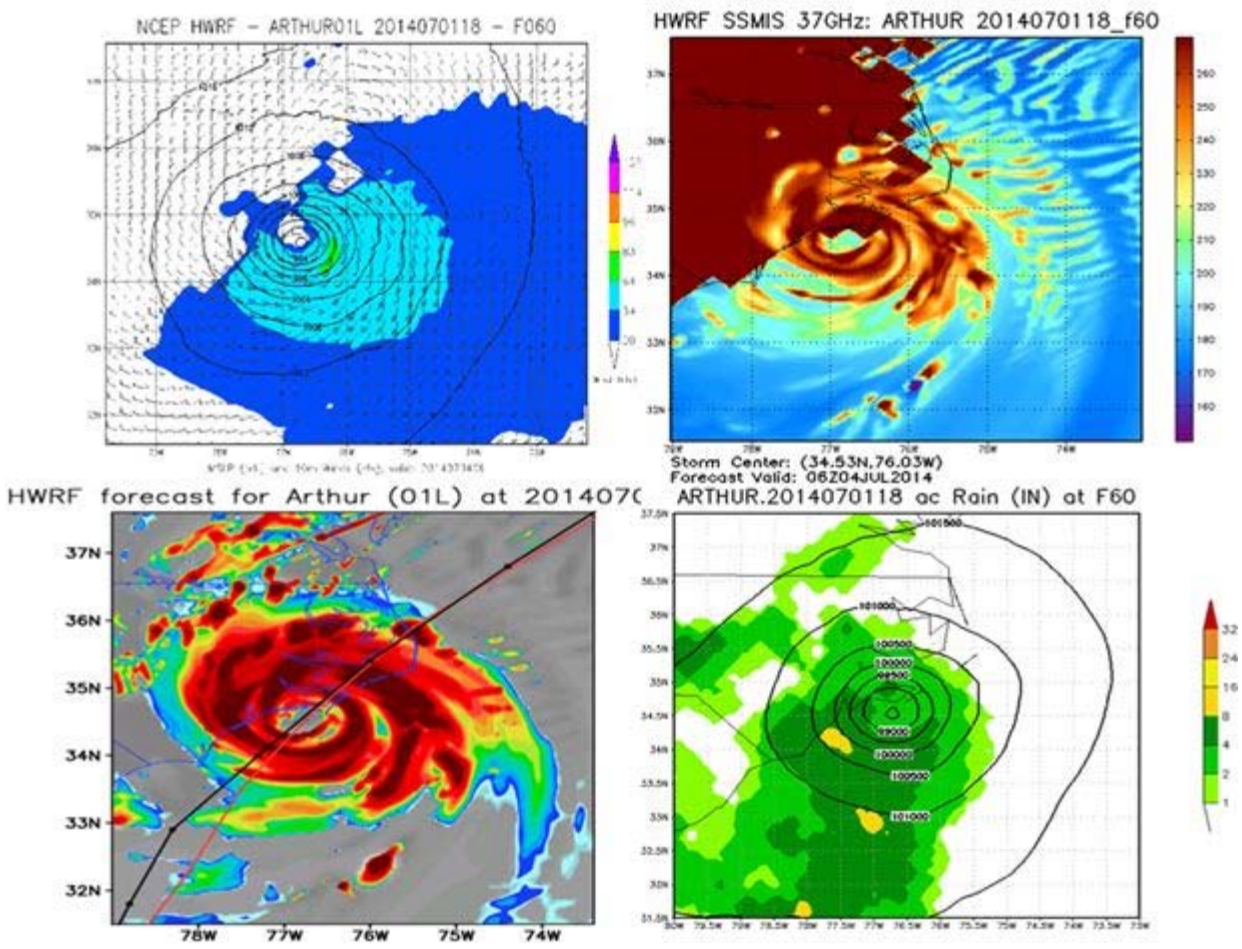
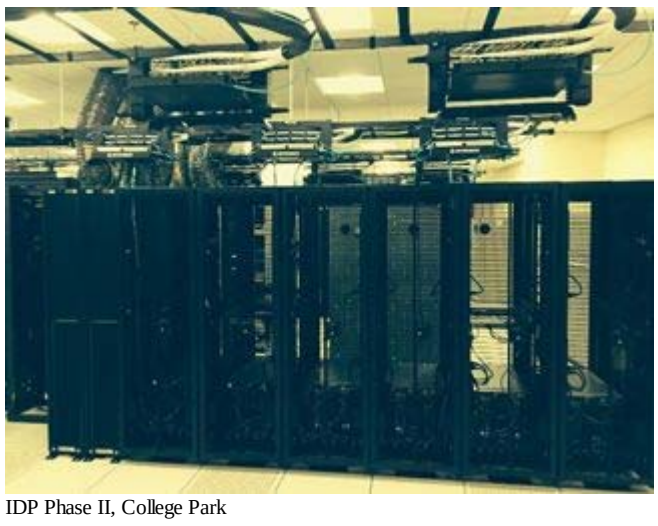


Figure 7: HWRF forecasts for Surface wind field, synthetic SSMI/S 37 GHz imagery, composite radar reflectivity and rainfall estimates at the time of landfall are shown below.

NCO – IDP Phase 2

NCEP Central Operations (NCO) continues to lead the NOAA Integration Dissemination Program (IDP) Dissemination Infrastructure Project. On June 17, 2014, NCO completed the Phase II of the build-out of a commonly shared operational dissemination infrastructure in College Park, MD. The IDP System is delivering enterprise operationally dissemination capabilities:

- Scalable, robust, secure, and 7x24x365 operational dissemination infrastructure at College Park, MD and Boulder, CO, to host existing and new dissemination systems;
- Resilient and high capacity network for National Weather Service (NWS) Field Offices and Centers, and increasing the Advanced Weather Interactive Processing System (AWIPS) Satellite Broadcast Network (SBN) from 30Mpbs to ˜70Mpbs;
- Upgrading the NWS antennas & product generation for the Geostationary Operational Environmental Satellite R-Series (GOES-R) era; and
- Enterprise operational ESRI and Boundless (OpenGeo) Geographic Information System (GIS) capabilities on IDP operational dissemination infrastructure.



IDP Phase II, College Park

The IDP is initiating the onboarding of critical NOAA and National Weather Service (NWS) dissemination applications at the primary site, including the integration of the NWS Dissemination Systems (NIDS). IDP's goal is to partner with NOAA/NWS teams to deliver capabilities for NOAA/NWS customers and partners. The Program's approach is two-fold: (a) identify and migrate operational dissemination systems running on NWS Offices end-of-life hardware and (b) deliver new dissemination capabilities through research-to-operations (R2O) transitions. Currently, the IDP system operationally hosts the Model Analyses and Guidance (MAG) website, NOAAs Operational Model Archive and Distribution System (NOMADS), and NCEPs FTP server.

IDP uses balanced project management disciplines to deliver projects on schedule and within budget. Provided below are some of IDP's migration projects and capabilities being delivered.

- Multi-Radar/Multi-Sensor System (MRMS) Migration: IDP is migrating MRMS to the operational dissemination infrastructure which will be completed by September 2014. MRMS (https://www.nssl.noaa.gov/projects/mrms) is currently running experimentally at the NOAA National Severe Storms Laboratory and at the Federal Aviation Administration's (FAA's) William J. Hughes Technical Center.
- nowCOAST Migration: IDP is migrating NOAA's National Ocean Service's nowCOAST GIS Web Mapping Portal (http://nowcoast.noaa.gov) to the operational dissemination infrastructure. nowCOAST is presently operated by NOS' Office of Coast Survey in Silver Spring, MD, and provides users with near-real-time observations, imagery, forecasts, and warnings from across NOAA.
- Southern Region GIS services Migration: IDP is in the process of migrating Southern Region's GIS services to the operational dissemination infrastructure which will be completed by September 2014. Functionality being migrated include: Advanced Hydrologic Prediction Service (AHPS) gauges, Flood Outlook Product, Climate Prediction Center Weather Hazards, Quantitative Precipitation Forecasts, Watches/Warnings and Advisories, Weather Features, Radar (1x1 km base reflectivity), Hurricane tracks/wind/surge and Storm Prediction Center Outlooks.
- Meteorological Assimilation Data Ingest System (MADIS) Migration: IDP is migrating MADIS to the operational dissemination infrastructure. MADIS (http://madis.noaa.gov) leverages partnerships with international agencies; federal, state, and local agencies, universities, volunteer networks, and the private sector to integrate observations from their stations with those of NOAA to provide a finer density, higher frequency observational database.

IDP is focused on addressing dissemination problems and providing dissemination capabilities to best serve our Field offices, customers and partners.

Service Center Activities

CPC – Africa Desk 20th Anniversary

The National Oceanic and Atmospheric Administration (NOAA)'s Climate Prediction Center (CPC) celebrated the 20th anniversary of the African Desk April 18, 2014 at the National Center for Weather and Climate Prediction (NCWCP) in College Park, MD. For two decades NOAA has been providing support to African National Meteorological Services (NMSs) to build capacity in weather and climate forecasting through a residency training program and the delivery of products required for operational monitoring and forecasting of weather and climate. NOAA has worked with sister agencies with specific interests in Africa and the developing world to support decision making in areas that are challenged by natural disasters like droughts, floods, tropical cyclones, etc., and considered economically vulnerable due to potential food or drinking water shortages. The 20th anniversary of the African Desk was hosted by CPC and attended by Dr. Louis Uccellini, Director of the National Weather Service (NWS) and Dr. William Lapenta, Director of the National Centers for Environmental Predictions (NCEP).

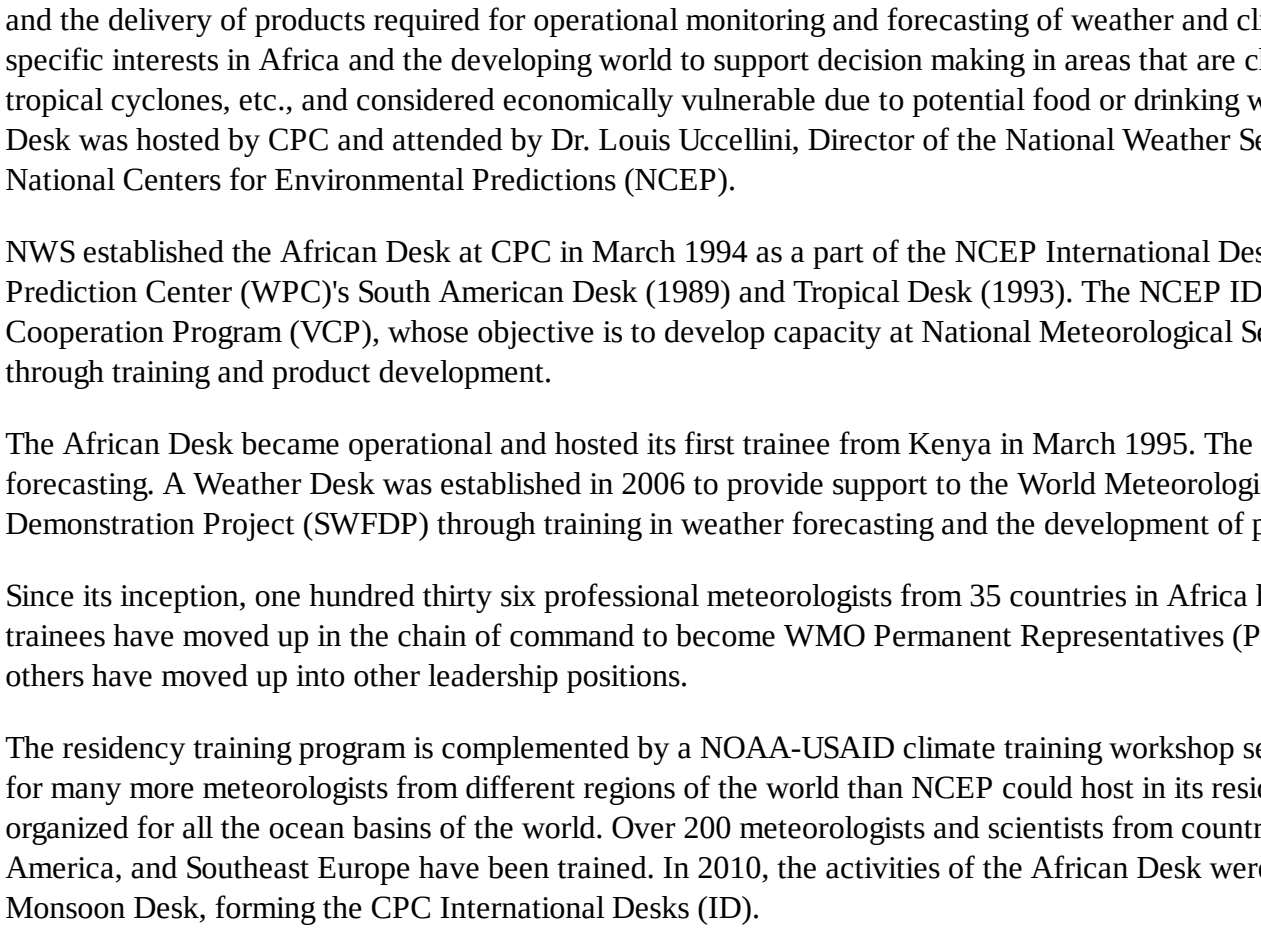
NWS established the African Desk at CPC in March 1994 as a part of the NCEP International Desks (ID). The NCEP IDs include the Weather Prediction Center (WPC)'s South American Desk (1989) and Tropical Desk (1993). The NCEP IDs are a US contribution to the WMO Voluntary Cooperation Program (VCP), whose objective is to develop capacity at National Meteorological Services (NMSs) in climate monitoring and forecasting through training and product development.

The African Desk became operational and hosted its first trainee from Kenya in March 1995. The desk focused initially on climate monitoring and forecasting. A Weather Desk was established in 2006 to provide support to the World Meteorological Organization (WMO) Severe Weather Forecasting Demonstration Project (SWFDP) through training in weather forecasting and the development of products required for severe weather forecasting.

Since its inception, one hundred thirty six professional meteorologists from 35 countries in Africa have been trained at the African Desk. Four former trainees have moved up in the chain of command to become WMO Permanent Representatives (PRs) for their respective countries, while dozens of others have moved up into other leadership positions.

The residency training program is complemented by a NOAA-USAID climate training workshop series initiated in 2009 that has enabled climate training for many more meteorologists from different regions of the world than NCEP could host in its residency program. The training workshops have been organized for all the ocean basins of the world. Over 200 meteorologists and scientists from countries in Africa, Asia, Caribbean, Central America, South America, and Southeast Europe have been trained. In 2010, the activities of the African Desk were further expanded with the establishment of a Monsoon Desk, forming the CPC International Desks (ID).

Besides training, one of the key missions of the CPC ID is to provide domestic and international agencies with access to real time NCEP operational weather and climate forecasts for any given region of the world. The CPC ID also provides support to many domestic and international programs, including USAID's Famine Early Warning System (FEWS) and Disaster Risk Reduction (DRR) Program, Regional Climate Outlook Forums, and more recently World Health Organization (WHO) climate and health initiative.



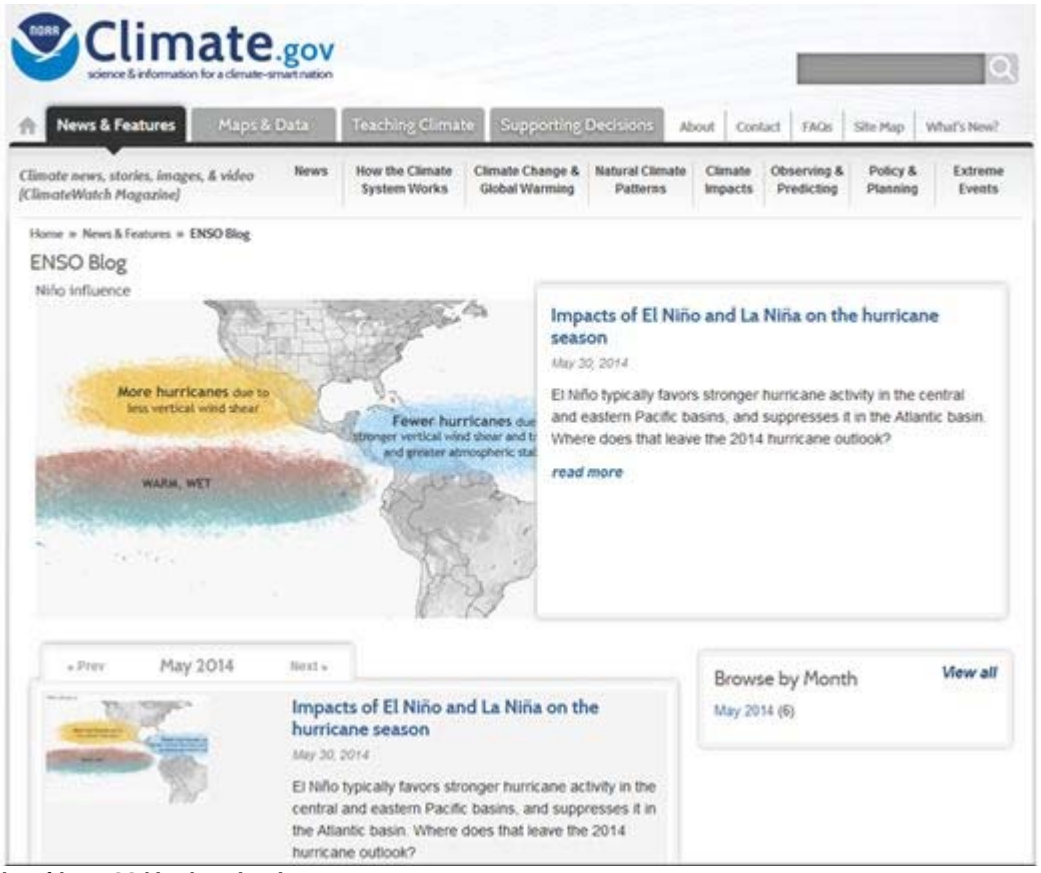
Cutting the cake for the anniversary celebration are (from left to right), Mike Halpert, Acting Director, CPC, Wassila Thiaw, Team Leader African Desk, Louis Uccellini, NOAA AA for Weather Services, Bill Lapenta, NCEP Director and Wayne Higgins, NOAA Climate Program Office Director.

CPC – ENSO Blog

In early May, the Climate Prediction Center partnered with the International Research Institute (IRI) for Climate and Society and the Climate Program Office (CPO) to launch a blog dedicated to the El Niño-Southern Oscillation (ENSO). The blog is hosted on Climate.gov and is available at the following address: http://www.climate.gov/news-features/department/enso-blog

The blogging team will consist of Michelle L'Heureux, the lead of CPC's ENSO team, Emily Becker, a researcher with Innovim, and Tony Barnston, chief forecaster at the IRI. Rebecca Lindsey, managing editor of the News and Features part of the climate portal, will ensure that posts are written in complete sentences and not entirely in mathematical equations. Over the next year, they'll be discussing the evolving ENSO and offering perspectives and analysis on the progression of El Niño and related topics.

The blog will rely on other contributors, who will weigh in with their own perspectives and research not only specific to ENSO, but on related topics such as associated societal impacts. The goal is to provide at least one new post per week and the hope is that the blog will be both a fun and informative experience for the readers, and also provide a mechanism for those interested in ENSO to ask questions to ENSO experts. The blog is currently proposed to run experimentally for the next year.



Screen shot of the ENSO blog, hosted at climate.gov.

NHC – National Hurricane Conference

Attendance was up, and so were the number of media interviews, at the 36th annual National Hurricane Conference held in Orlando, Florida, April 14-17, 2014. NOAA/NHC hurricane specialists joined experts from other federal agencies, academia and the emergency management community, conducting workshops and panel discussions regarding tropical cyclones.

NHC personnel provided nearly 80 media on-site interviews over the span of the four-day conference. In addition, a press conference was conducted with NHC Director Dr. Rick Knabb and FEMA Administrator Craig Fugate. A lot of emphasis was placed on not using the seasonal outlook as a guide for preparation, regardless of how many storms are forecast for the season.

NHC Director Dr. Rick Knabb speaks with Associated Press at the National Hurricane Conference in Orlando.

NHC - NOAA Hurricane Awareness Tour

After a two year hiatus, NOAA's Hurricane Awareness Tour (HAT) visited five cities in late May along the U.S. Gulf Coast - Corpus Christi, Texas; Houston, Texas; New Orleans, Louisiana; Tallahassee, Florida; and Tampa, Florida.

This was a very successful event with more than 2500 hundred members of the public and another 2800 school children touring the aircraft. NHC personnel provided more than one hundred media interviews over the span of the five day tour and NOAA's Hurricane Hunter crew provided an additional 40 interviews.

The NOAA P-3 Aircraft was joined by a USAF Reserve WC130-J aircraft at the Tallahassee site of the HAT. Both planes were available for tours and media interviews, and displayed the cooperative efforts of both DOD and DOC.

Social media played a large role in the HAT, with several postings made on the NHC Facebook page each day of the HAT, and numerous live tweets using #hurricaneprep

NHC Director Dr. Rick Knabb provides a television interview to former NHC Director Bill Read, now a consultant for a Houston TV station.

NHC - Media Day

NHC provided its annual media opportunity at its Miami facility on May 29th, just a few days before the start of the Atlantic hurricane season. And the turnout was huge! In a span of five hours, nearly 50 interviews were provided by several NHC personnel.

A key message for this season was the experimental potential storm surge flooding map. It will be introduced with the first issuance of a hurricane watch, and sometimes a tropical storm watch, along the U.S. East Coast and Gulf Coast.

NHC storm surge team leader Jamie Rhome discusses the new potential storm surge flooding map with Ft. Myers' TV station WBBH-TV2.

OPC - 2014 Presidents Day Colloquium

On 28 May, 2014, the Ocean Prediction Center (OPC) and Weather Prediction Center (WPC) co-hosted a one day colloquium at the NOAA Center for Climate and Weather Prediction (NCWCP) to reflect on the 1979 Presidents' Day snowstorm, the advances to our understanding and predictive capabilities as a result of an ensuing decade and a half of research and improvements, and to address future challenges. The meeting, entitled "Advances in Extratropical Cyclone Understanding and Prediction Since the 1979 Presidents' Day Storm", featured twelve speakers and was anchored by Dr. Louis Uccellini, Director of the National Weather Service (NWS), and Dr. Lance Bosart, professor from the State University of NY Albany.

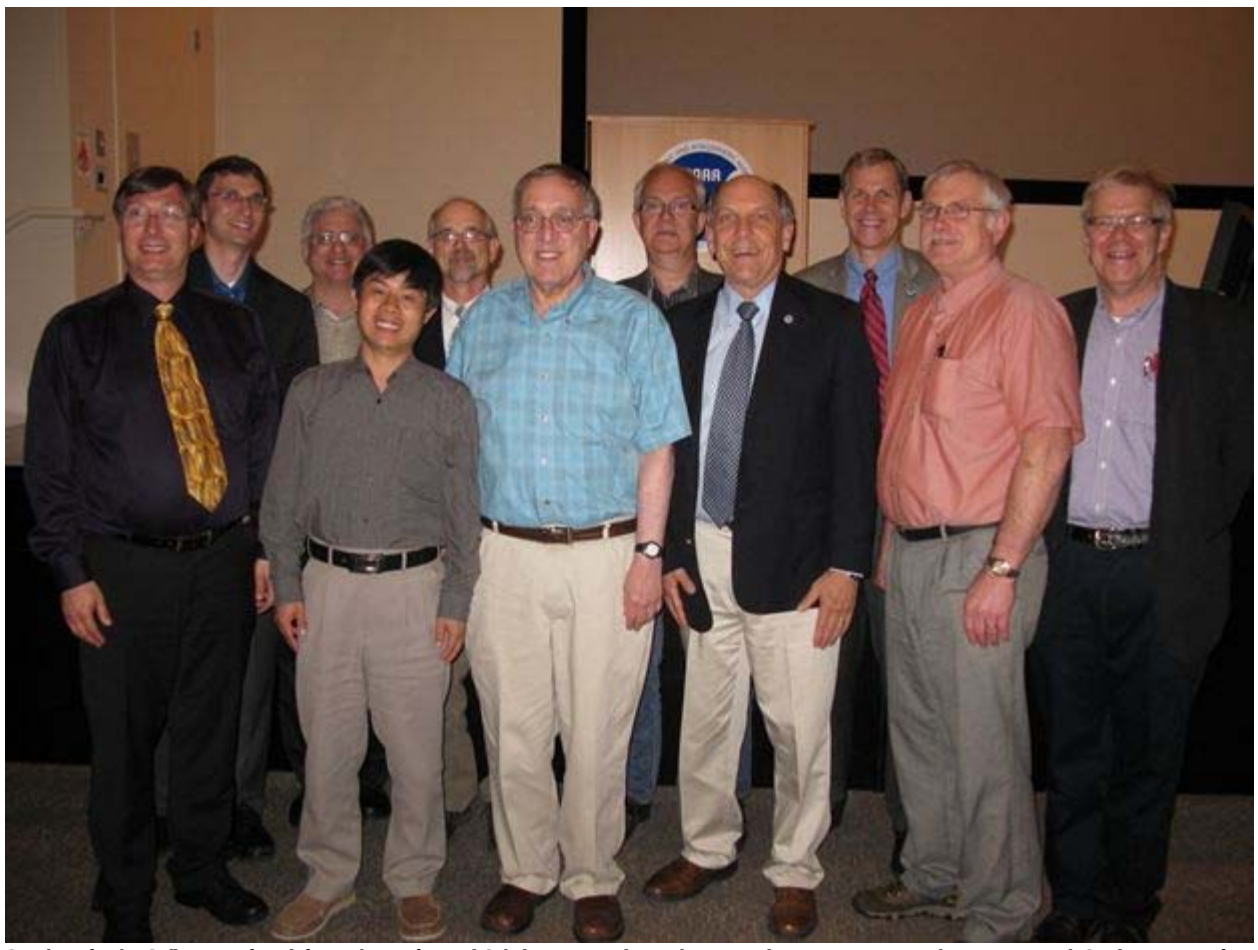
Paul Kocin of the WPC set the stage by revealing the challenges of the day and that two differing perspectives were held at the time, the importance of diabatic effects and larger scale dynamics in the form of jet streaks. Dr. Uccellini gave a very comprehensive talk and laid out the challenges of the day and the methodology used to diagnose the rapid intensification of the Presidents' Day storm. Dr. Uccellini's team at NASA Goddard was the first to use numerical simulations and visualizations to diagnose cyclone behavior. Dr. Bosart discussed the weather - climate linkages and challenged us all to better understand the linkages in reference to periods of enhanced cyclone activity. Prof. John Gyakum of McGill University spoke about times of hyper-cyclone activity over the oceans and recommended a North Atlantic Storm Index (NASTI) to help better anticipate periods of increased activity and storminess. Prof. Gyakum's talk solidified Dr. Bosart's points concerning the challenges of weather and climate linkages.

Fuqing Zhang of Penn State gave an eloquent talk concerning data assimilation, diagnosing predictability, and discussed the significance of small scale features including gravity waves. The Pacific Northwest perspective was given by Prof. Cliff Mass of the University of Washington. Prof. Mass sang the praises of the advances of weather prediction and services for larger events in the Pacific Northwest. His talk was one of the more entertaining and highlighted the contribution of some of the pioneering work from the Pacific Northwest.

Hendrik Tolman, acting Environmental Modeling Center Director, presented the history of wave modeling and storm surge and began with the D-Day landing and forecast. Prof. David Schultz of University of Manchester talked about extreme winds in extratropical cyclones and the forcing associated with the development of very high winds. Service and forecast aspects were given by Steve Zubrick of WFO Sterling, Rich Grumm of WFO State College, Dave Novak of WPC and Joe Sienkiewicz of OPC.

Lunch was held in the conference center and was a rare opportunity for people to sit and talk informally. An impromptu discussion concerning the challenges of messaging, communication, and the social science aspects of communication was held with Dr. Uccellini and former TV Meteorologist and past President of the AMS Bob Ryan taking the lead.

All talks were recorded so that the questions, observations, and comments will be available to a broader audience. They are available on the following website: www.opc.ncep.noaa.gov/35th.php



Speakers for the Colloquium, from left to right: Prof. David Schultz, Dr. David Novak, Mr. Paul Kocin, Dr. Fuqing Zhang, Mr. Joseph Sienkiewicz, Prof. Lance Bosart, Dr. Hendrik Tolman, Dr. Louis Uccellini, Dr. Steven Zubrick, Mr. Richard Grumm, and Prof. John Gyakum

OPC - New Zones

The Ocean Prediction Center (OPC) implemented new offshore marine zones on April 1, 2014. This was a major change to the OPC's product suite that took approximately one year to plan and implement. It involved collaboration with all of the coastal Weather Forecast Offices. OPC increased the number of zones in the Atlantic from 8 to 18 (Figure 1) and in the Pacific from 5 to 19 (Figure 2). User feedback over the years focused on the fact that the old forecast zones were too large to provide detailed forecasts for their needs and also that the forecast zones were not always aligned with the various user areas of responsibilities or key bathymetric features. The new forecast zones address many of our users' concerns and were designed to meet their needs for clear, concise forecasts that are aligned with other National Weather Service (NWS) boundaries. Current forecasts are available on the OPC website for the Atlantic and Pacific Ocean Offshore areas.

One key to making this large service change was taking advantage of new capabilities provided by the Graphical Forecast Editor (GFE). The text formatters in the Advanced Weather Interactive Processing System GFE allow for the creation of much smaller zones which provide detailed forecasts for each zone, thus eliminating excessive wording necessary to describe conditions in larger zones. OPC creates a "digital" forecast database that allows the flexibility to generate additional forecasts for smaller zones without a significant increase in work load. The end result is a suite of improved products for OPC customers.

The text formatter in GFE works best with smaller zones which are based on local climate regimes that are more or less homogenous. The new zone configurations were designed with this in mind. A key consideration for the layout of the new zones was the climatology of satellite derived Quickscat winds. Local climatology and bathymetry were other factors considered as well. An "inner" marine zone was added wherever practical in order to help local weather offices maintain an effective NOAA Weather Radio program as well as to provide more specific information to mariners near the coast. The position of the Gulf Stream was taken into account for the Atlantic zones. The zone configurations were adjusted where possible to coincide with existing marine boundaries from coastal weather forecast offices. Input from coastal offices was taken into account to define the boundaries. Customer feedback for the changes has been positive since users had expressed the concern that the old offshore forecasts covered such a large area that they often times were not specific enough for their needs.

Another advantage of using smaller forecast zones is the increased clarity of depicting hazards graphically on the Internet, such as the National Weather Service homepage www.weather.gov. The original large forecast zones in the OPC Offshore waters area often resulted in the appearance of over-warning for certain regions. When a marine or tropical cyclone warning was issued for any portion of the large Offshore waters zones, the entire zone was highlighted in the Watch Warning Advisory (WWA) map on www.weather.gov. This representation resulted in confusion for OPC's users as well as local NWS Forecast Offices. The smaller zones helped solve the problem by providing more specific areal delineation of warnings and reducing the confusion about warnings for the user community and the NWS forecast offices.

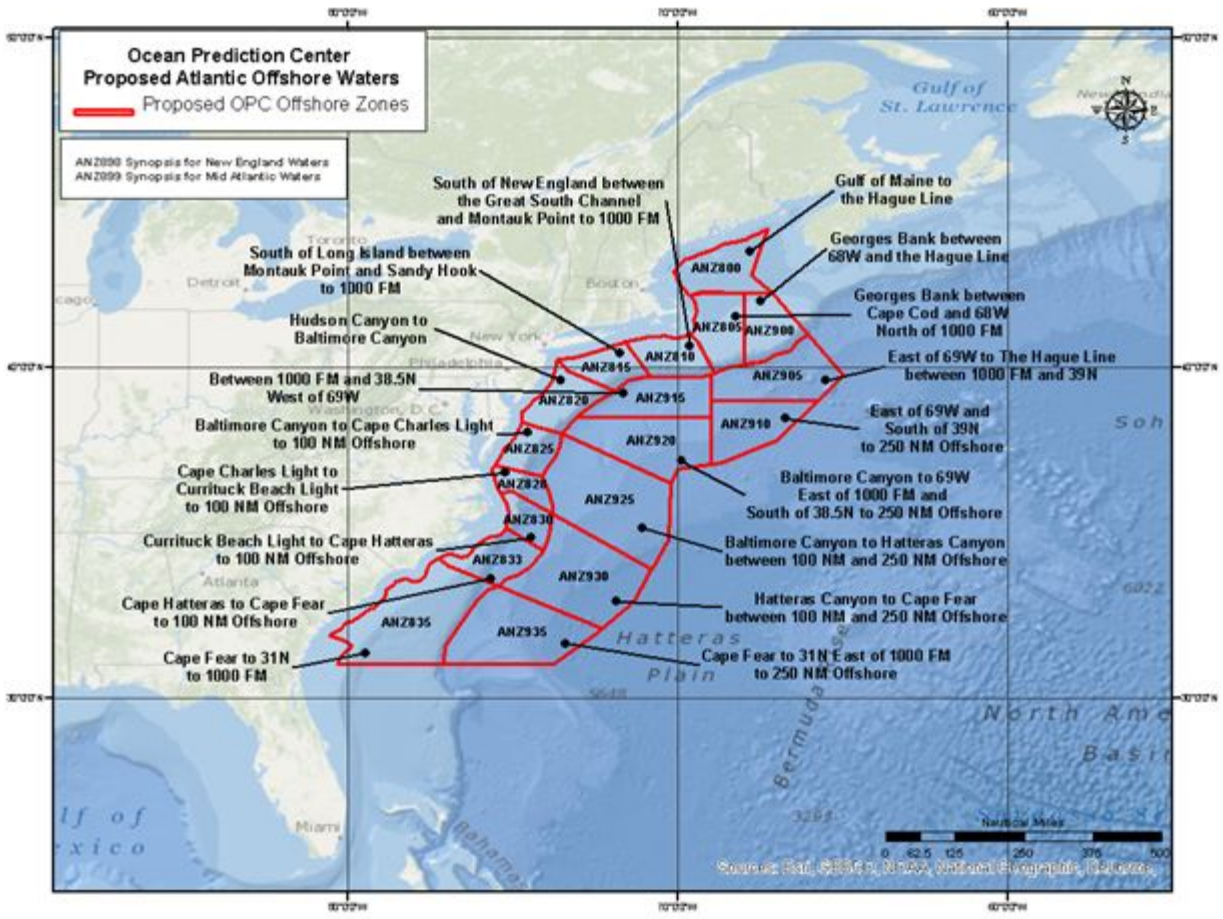


Figure 1: New Atlantic Coastal Offshore Forecast zones, implemented 1 April 2014.

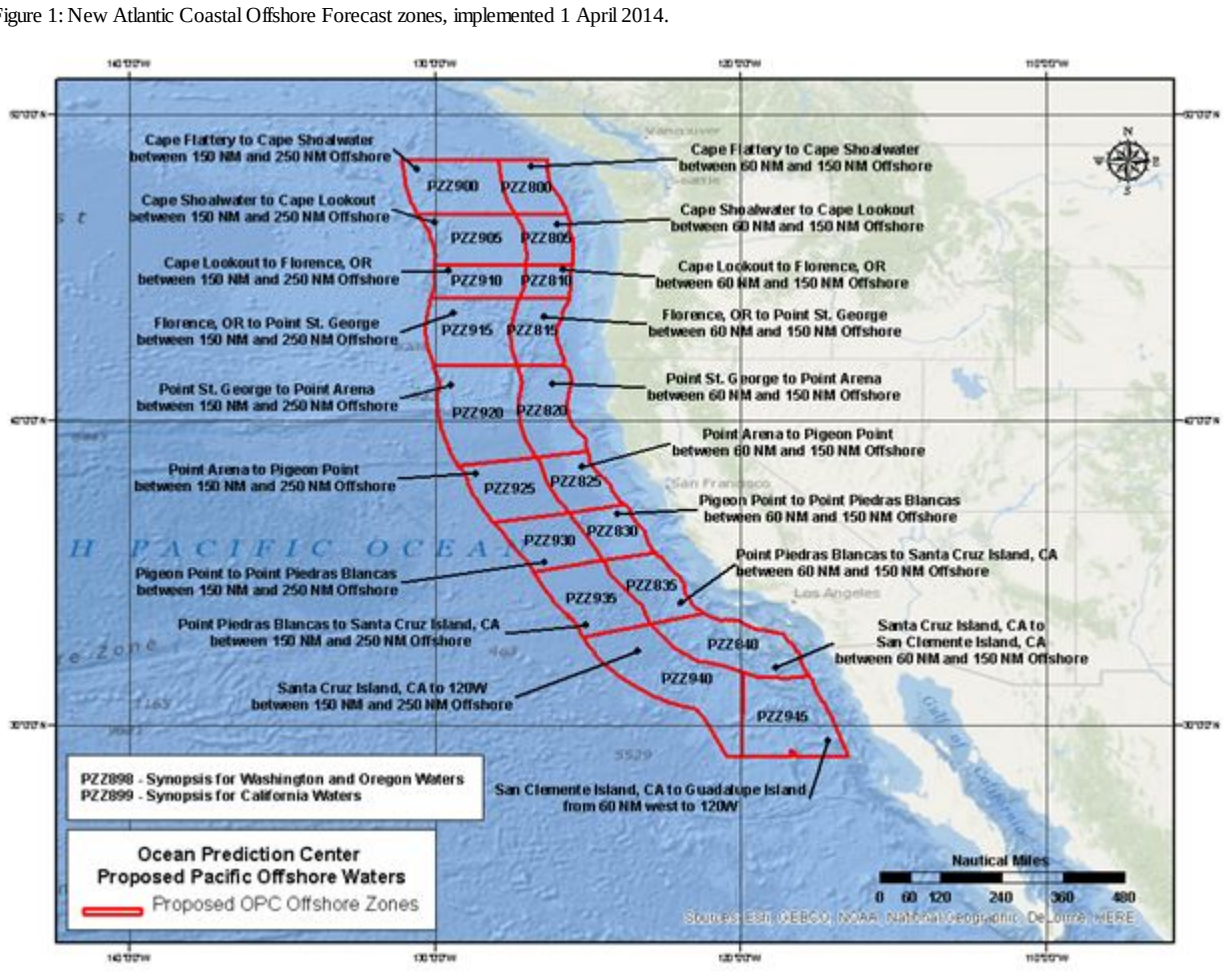


Figure 2: New Pacific Coastal Offshore Forecast zones, implemented 1 April 2014.

SWPC - Electric Infrastructure Security Summit

On June 30, SWPC staff participated in the EISS in the U.K. Houses of Parliament in London. On June 30, SWPC staff participated in the EISS in the U.K. Houses of Parliament in London. The Summit presented a forum for international infrastructure security cooperation and coordination during catastrophes, particularly on the electric power grid. EISS V focused on resilience, response and collaboration. Summit sessions examined severe hazards, including geomagnetic storms, on the electric power grid, considered policy implications, and reviewed the status of the enhanced resilience and response planning now beginning to take place in both public and private sectors. The EISS was sponsored by the US Department of Energy and the North American Electricity Reliability Corporation.

EISS Summit in session.

Leadership policy perspectives on achieving resilience to extreme events were presented by US senior government leaders including Suzanne Spaulding, Undersecretary for National Protection and Programs Directorate, DHS; Caitlin Durkovich, Assistant Secretary for Infrastructure Protection, DHS, and Cheryl Lafleur, Acting Chairman, Federal Energy Regulatory Commission. Bill Murtagh, Program Coordinator at the NOAA Space Weather Prediction Center, presented latest developments in NOAA's space weather modeling efforts and shared latest details on NOAA's efforts to endure continuity of critical space weather observations. Senior industry representatives including Terry Boston, CEO, PJM Interconnection and Robin Manning, Executive Vice President, Tennessee Valley Authority also participated and provided corporate perspectives on achieving societal resilience to severe space

weather and other hazards.

The new E-PRO handbook was introduced which provides a decision framework and recommendations to reduce the impact and duration of extended and widespread power outages due to severe geomagnetic storms and other hazards. The summit provided a terrific opportunity to review and discuss vulnerability to critical infrastructure and address mitigation strategies. Delegates discussed appropriate policies and next steps to protect electric power grids and other critical infrastructure.

SWPC - Web Site

NOAA's Space Weather Prediction Center unveiled its new website at the annual Space Weather Workshop in Boulder in April (see Figure 1.). This completely redesigned site leverages the latest web technologies to reach the broadest possible audience. Our main objectives are to provide clean design for greatly improved accessibility (including mobile), to better meet the needs of both lay and expert audiences, and to improve maintainability. As a Beta release, the site incorporates the look-and-feel of the final site with major functions and content included. The site is still in development and SWPC is adding new content and capabilities nearly every week. Since its debut, the site has had over 11,000 sessions, 8,000 unique users, and has received 130 comments since the release. The results are very favorable with 48% positive to 9% negative feedback. The site is available at the following URL: http://origin-www.swpc.noaa.gov/ and user still have opportunity to provide feedback via a link on the front page.

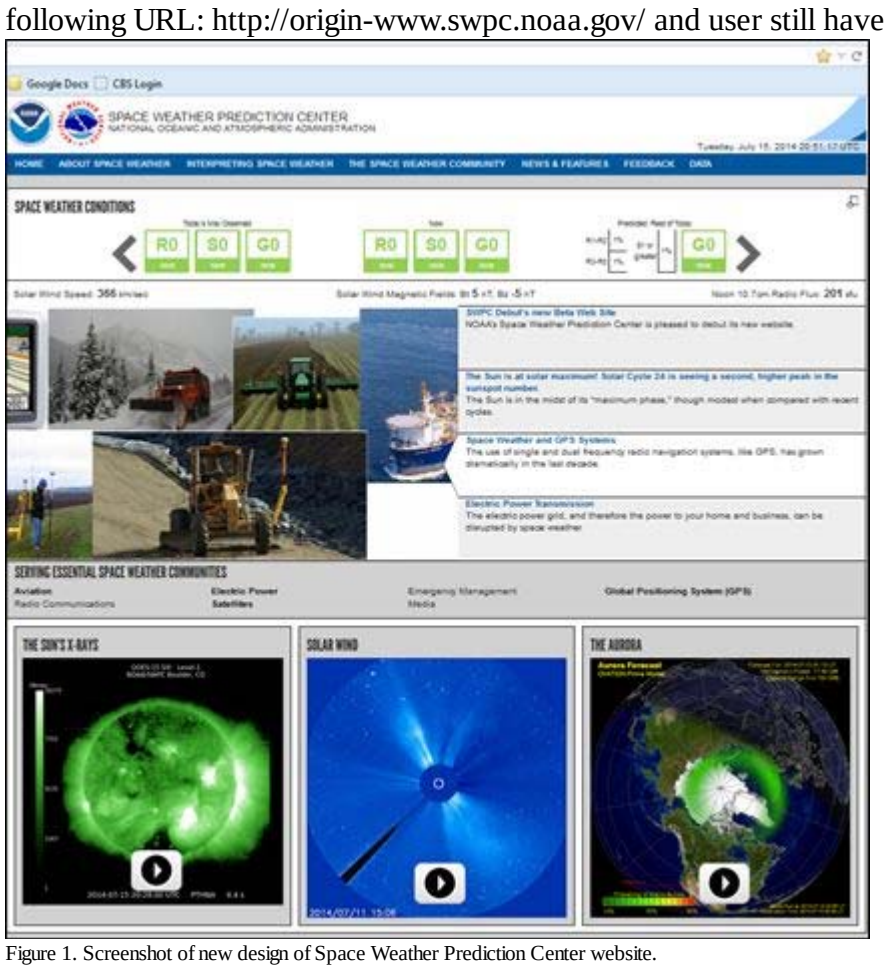


Figure 1. Screenshot of new design of Space Weather Prediction Center website.

WPC - Rainfall Forecast Performance Record

Forecasting warm season rainfall has been notoriously difficult. In fact, on average the worst rainfall forecast accuracy for models and forecasters alike is during the summer. During the warm season, the formation and movement of mesoscale rainfall systems are highly uncertain. At the same time, some of the heaviest rainfall of the year affects the US, increasing the need for accurate forecasts.

During June 2014, the Weather Prediction Center set a new record accuracy score for the month of June. The 1-inch Day 1 threat score for June 2014 was 0.245, which edged out the previous record achieved in 2012. For comparison, the median value for June from the past seven years is 0.196. Areal coverage of rainfall was just a fraction under the highest June value over the past 15 years, representing a very wet month. During June 2014 a relatively large number of slow moving, long duration, heavy rainfall events occurred over the Upper Midwest and Gulf Coast. The rainfall over the Upper Midwest contributed to major river flooding.

Of particular note is that WPC scores were significantly higher than the model scores, as the models struggled with these largely convective events. In fact, WPC forecasters were 54% more accurate than the NCEP GFS, and 29% more accurate than the ECMWF (Fig. 1).

Over the past 5 years the Hydrometeorological Testbed at WPC has focused on improving warm-season rainfall forecasts. This includes exposing forecasters to experimental high-resolution forecasts, ensembles, and innovative visualization of data. This has culminated in the establishment of the annual Flash Flood and Intense Rainfall experiment, where forecasters, model developers, and researchers work side-by-side in near-real time to test experimental datasets and concepts. Forecasters are now using several tools tested during the experiment, such as high resolution models, the Storm Scale Ensemble of Opportunity, and object-oriented verification. As Ed Danaher, the WPC Forecast Operations Branch Chief, states, "The Hydrometeorological Testbed has played a major role in the rapid improvements in our summer rainfall skill." The June 2014 record is a testament to the success of these R2O efforts.

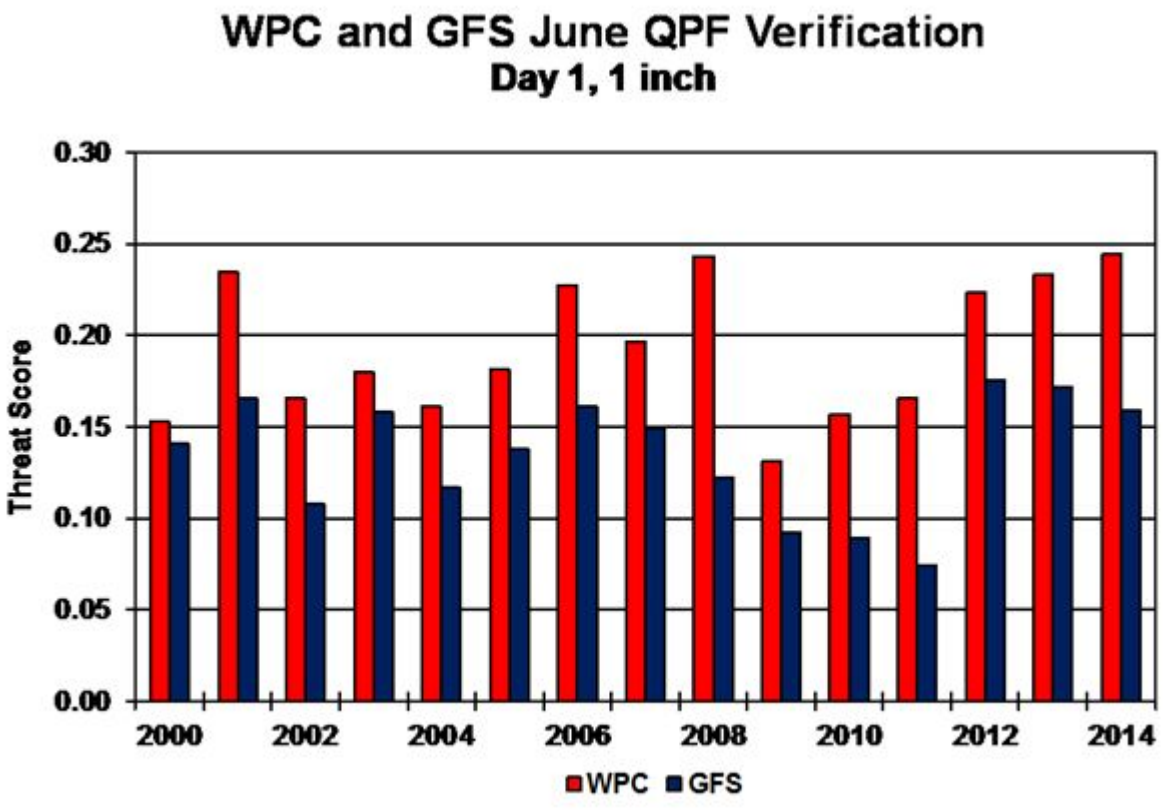


Fig. 1. History of the accuracy of the WPC heavy rainfall forecast during June for the 2000-2014 period. Accuracy is measured in terms of the threat score for the Day 1 forecast at the 1 inch threshold. WPC accuracy scores in 2014 set a new June record, and were a 54% improvement over the NCEP GFS.