Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Seasonal Hurricane Activity Outlook

Project Description

Summary

This proposal calls for the development of a website that will provide a compilation of all publicly-available seasonal hurricane forecasts for the Atlantic basin. In addition to predicted numbers, the website will also contain background information regarding each forecast technique and provide end-of-season verifications.

Background Information

The first attempt at Atlantic tropical cyclone seasonal forecasting dates back to 1984 (Gray, 1984). More than three decades later, seasonal forecasts of tropical cyclone activity are routinely performed in almost all major ocean basins that support tropical cyclone formation. While these seasonal forecasts have yet to show skill at predicting landfalling storms, recent studies suggests that seasonal forecasts at the regional scale are becoming possible (Vecchi et al., 2014; Camp et al., 2015).

Seasonal hurricane forecasts are produced ahead of each hurricane season by a range of different groups, from meteorological services to academic groups to catastrophe modelers. In fact, for the Atlantic basin alone, a large number of different groups are producing statistical (or combined statistical/dynamical) seasonal forecasts in the months leading up to the climatological start of the peak of the hurricane season (August 1st). In addition, four different groups also produce seasonal forecasts using coupled global circulation models (so-called dynamical forecasts) for all basins supporting tropical cyclogenesis. At this point, we are aware of approximately 20 entities issuing Atlantic basin seasonal forecasts.

However, while these forecasts are generally made freely available by the groups who produce them (usually on their organization's website), there currently exists no website centralizing this information, making gathering that information time consuming (if one is aware of all the given forecasts in the first place). This also makes comparisons between different forecast agencies difficult.

Given that the number of such forecasts is likely to keep increasing in the future, we believe this offers an opportunity to create a website/portal where all of the information available in regards to upcoming seasonal hurricane activity would be centralized and supported by the peer-reviewed literature. Given the high profile of some of these storms, we believe such a website would garner interest beyond the scientific

community.

It is worth noting that a similar effort relating to Arctic sea ice was started a few years ago (an effort in which members of ES-BSC are involved) and is by all measure a success, with nearly 40 Arctic sea ice forecasts submitted in 2015.

Objectives

The current project proposes to create a website displaying all of the seasonal hurricane forecasts available ahead of the hurricane season in one central location in order to 1) provide the best estimate of upcoming seasonal hurricane activity and 2) allow for easy comparisons between various forecasting techniques.

The website will be self-sufficient, i.e. that in addition to the actual forecasts, it will also provide sufficient background information to provide a general understanding of the different techniques used to produce them (e.g. dynamical vs statistical) and to evaluate them.

Finally, a post-mortem section discussing the general performance of the forecasts will be done at the end of the Atlantic hurricane season.

Scientific level

While the hurricane/climate community will be interested in such a product, the website will be constructed to reach a large audience outside of that community. The target audience could be described as anyone with an interest in hurricane activity (e.g. insurance industry representatives, amateur meteorologists, reporters, students, government employees, etc). While some basic level of understanding of climate science will be necessary, efforts will be made to make it as accessible as possible. Links to papers and other websites will be provided for those interested in a deeper understanding of the science supporting these forecasts.

Content

The content of the website can be divided into two different categories: 1) actual hurricane forecasts and 2) added-value products.

1) The hurricane forecasts

As mentioned earlier, there currently exist approximately 20 different groups producing

Atlantic hurricane forecasts. There are likely several other groups issuing seasonal forecast that will contribute their predictions once the website is established. The statistical (or statistical/dynamical hybrid) forecasts that we are currently aware of are:

Colorado State University
National Oceanic and Atmospheric Administration (NOAA)
Cuban Institute of Meteorology (INSMET)
Geophysical Fluid Dynamics Laboratory (GFDL)
Penn State University
North Carolina State University (CFDL)
Coastal Carolina University
National Meteorological Service of Mexico (NSM)
University of Arizona
Environment Canada
Weatherbell
ImpactWeather
The Weather Company (WSI)
Tropical Storm Risk (TSR)

Dynamical forecasts are produced by:

European Centre for Medium-Range Weather Forecasts (ECMWF)
United Kingdom Met Office (UKMO)
Florida State University (FSU)
Geophysical Fluid Dynamics Laboratory (GFDL)

All of these forecasts will be collected once they are produced and displayed on their respective organization's website. In order to minimize the amount of time spent on collecting the information, we will try to reach an agreement with the various groups such that they are sent to us directly whenever possible when they are issued. An automated email reminder will be sent a few days prior to the issuing of the forecasts. The website could be updated monthly in the months leading up to the hurricane seasons (April-August).

It should be noted that ECMWF forecasts are for member states only and, if made available to us, will need to be password protected and likely excluded from any ensemble analysis.

The values that will be forecasted are the number of named storms, hurricanes, major hurricanes and ACE, when available. The forecasts will also include any uncertainty ranges associated with these predictions. It should be noted that some effort will need to go into making the forecasts comparable since different groups issue predictions for different variables and different lead times.

We also suggest including a third type of forecast, a so-called heuristic-type of forecast. These forecasts are those which are not documented in the scientific literature and could be submitted by anyone interested in doing so, provided that they submit a short explanation as to how that forecast came about. These forecasts will be used as a benchmark against which to evaluate the skill of the more official forecasts. They will also, we hope, engage some of the users of the website.

Finally, two additional baseline models will be used to evaluate the skill of the forecasts: 1) a climatological mean (say 1951-2000) and 2) the previous ten-year mean.

2. Added-Value

We will provide additional information to further the reader's understanding with respect to the forecasts presented. This will include:

1) an ensemble mean for the forecasted variables
2) short explanations (1-2 paragraph) describing each of the individual forecast techniques
3) the skill of past forecasts or hindcasts (in particular as a function of lead time)
4) uniformity between the different forecasts
5) a post-mortem analysis of the season

Depending on the resources available, we could also include a news section which would be updated at irregular intervals.

As a prototype for the website, we will begin with predictions for the just-completed 2015 Atlantic basin hurricane season.

Design

The hurricane forecast page will include a Drupal based webpage with a personalized project presentation and a number of additional page templates upon which to build the project, making it possible to grow according to the needs of the project. For instance, we could have a template for prediction outputs, a template page showing technical information, a template for partners, sponsors and related projects, etc.

The page will be a stand-alone page and will also be accessible through the climate service webpage of the ES-BSC, which is currently under construction. The webpage will be scroll responsive (compatible with smartphones and tablets) and will have a highly visual design. A few slides presenting the portfolio of the proposed designer is

attached to this proposal. A sample of his work can also be found [here](). He will work in collaboration with XLCatlin, ES-BSC and CSU, to personalize and find the right "corporate image" for this product.

Scientists/Center/Experience

This project is a collaboration between Colorado State University (CSU) and the Earth Science department of the Barcelona Supercomputing Centre (ES-BSC).

Colorado State University, led by Dr. William Gray, pioneered seasonal hurricane prediction for the Atlantic basin. In the early 1980s, Dr. Gray discovered several important climate relationships that allowed for predictive capability of seasonal hurricane activity, with the most important relationship being that El Niño reduced Atlantic storm activity through increases in vertical wind shear. CSU began issuing forecasts in 1984 and has issued annual forecasts continuously since that time. Dr. Phil Klotzbach was co-author on the forecasts from 2001-2005 and has been lead author since 2006. He has published nearly 30 peer-reviewed journal articles on various aspects of tropical cyclone prediction and has been an invited speaker at many insurance and emergency management conferences. He also currently serves as chair of the expert team on seasonal forecasting for the World Meteorological Organization.

The Barcelona Supercomputing Center (BSC) was established in 2005 and is the Spanish National Supercomputing facility and a hosting member of the PRACE distributed supercomputing infrastructure. The Center houses MareNostrum, one of the most powerful supercomputers in Europe. The mission of BSC is to research, develop and manage information technologies in order to facilitate scientific and societal progress. Within the BSC, the Earth Sciences Department, headed by Francisco Doblas-Reyes, is an active member of the climate prediction community, where it plays a leading role in the connection between global climate modeling and climate services. Dr. Louis-Philippe Caron, who is a post-doctoral fellow at the ES-BSC, will be the main contact from that institution. Dr. Caron is an expert in the representation of tropical cyclone activity by climate models and in seasonal to multi-annual forecasts of tropical cyclone activity. He also serves on the expert team on seasonal forecasting for the World Meteorological Organization. The ES-BSC will also supply a science communication expert to make the liaison with the web designer.

Under the umbrella of the WMO, the ES-BSC has already developed and currently maintains a forecast website, namely the "Sand and Dust Storm Warning Advisory and Assessment System ([SDS-WAS]()) for Northern Africa and Eastern Europe. It is also currently developing a [web portal]() for seasonal surface wind forecasts in conjunction with the wind power industry. This project will build on the expertise acquired during these two projects.

Division of Labour

The task of populating the content of the site will be shared equally by CSU and ES-BSC. The ES-BSC will take care of collecting and displaying the various forecasts at different lead times while CSU will handle the post-mortem at the end of the season. Both institutions will be responsible for producing and adding the supporting information relating to the various forecasts. ES-BSC will handle the design and maintenance of the website.

Budget

Institute	PM	Cost of 1 PM (€)	Total (€)
CSU	1.25	10,130	12,763
ES-BSC	1.00	10,210	10,130
Web designer fee	N/A	N/A	6,938
			29,831

We estimate it will take about two months (equally shared between CSU and BSD-ES) to create the content, set up the infrastructure and collect the data required to make the website operational. An additional 0.25PM is included for CSU to account for the post-mortem at the end of the 2016 season. The web designer fee is for a top of the line website and could be adjusted downward should we decide to go for a lower quality design.

For subsequent years, we expect that it would require around 1PM/year to keep this website operational.

Timeline

We expect the website to be operational for the next hurricane season (summer of 2016).

Bibliography

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