Seasonal Forecasting at Climate Prediction Center

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Outline

- Seasonal outlooks: Some background
- Methods for making seasonal outlooks
- CPC’s seasonal outlooks
- Other climate watches and seasonal outlooks from CPC
- Summary
Seasonal Outlooks

• A seasonal outlook is a statement about the expectation for the seasonal mean climate relative to a climatology, for example, an outlook that the seasonal mean rainfall in NDJ over Bogota will be higher than its mean over 1981-2010 period.
• Seasonal outlooks don’t provide information about the exact possible outcome for the seasonal mean but are about probabilities of various outcomes.
• There are various methods for making seasonal outlooks.
What makes seasonal outlook feasible?

• Year-to-year changes in slowly evolving boundary conditions influence local and remote climate variability.
• An example of local influence
  – Drier soil moisture conditions lead to warmer surface temperature
• The largest contributor to our ability to make seasonal outlooks is the slowly evolving sea surface temperature (SST) conditions, particularly those related to ENSO.
LRFMME – Precipitation Outlook

Probabilistic Multi-Model Ensemble Forecast

Probabilistic Seasonal Precipitation Outlook
WMO Lead-Center for LRF
Methods for generating seasonal outlooks

• Empirical prediction tools
  – Advantages
    • Developed based on historical observations
    • Unbiased
    • Simple and computationally efficient
  – Disadvantages
    • Limited by observational data
    • Mostly depend on linear relationships
    • Non-stationarity in climate is hard to include
    • Cannot handle unprecedented situations
Large scale influence of ENSO on precipitation
Methods for generating seasonal outlooks

• Dynamical Prediction Tools
  – Advantages
    • Non-linearity and non-stationarity is not an issue
    • Easier to infer probabilities for various seasonal mean outcomes
    • Easier to handle unprecedented situations
  – Disadvantages
    • Computationally expensive and require a large infrastructure
    • Forecast systems have biases that requires special attention
Methods for generating seasonal outlooks

• Properties of empirical and dynamical prediction tools are complementary in nature, and in general, and generally both are used in the development of final seasonal outlook.
CPC’s seasonal outlook process

• The outlook is based on guidance from many different prediction tools (both empirical and dynamical).
• An objective (skill based) consolidation of various tools provides the first guess for the seasonal outlook.
• Discussion of various tools (similar to the Climate Outlook Forums)
• Final seasonal outlook released to the public ~ 15 of the calendar month and is associated with a text discussion
• Seasonal outlook is updated once a month
• Verifications are an integral part of the seasonal outlook process
CPC’s seasonal outlook process

• Empirical prediction tools
  – ENSO composites
  – Recent trends (relative to 30-year climatology)
  – Canonical correlation analysis (CCA)
  – Multiple linear regression (MLR)
  – Constructed analog (CA)
CPC’s seasonal outlook process

• Dynamical prediction tools
  – NCEP’s Climate Forecast System v2 (CFSV2)
  – North American Multi-Model Ensemble (NMME)
    • Seasonal forecasts from six different dynamical models that exist across various institutions in North America
  – Seasonal forecasts from WMO’s Global Producing Centers (GPCs) for Long-range forecasts
    • 13 GPC-LRF
    • One lead center to facilitate the exchange and coordination of data among GPCs
An example of CPC’s seasonal outlook products
Prognostic Discussion

- Summary of outlook
- Current atmospheric/ocean conditions
- Prognostic discussion of SSTs
- Prognostics tools used in the outlook
- Prognostic discussion of outlooks
  - Temperature
  - Precipitation
Outlook verification

Temperature Forecast Heidke Skill Scores:
Non-Equal Chance (non EC) forecasts: 49.64
All forecasts: 29.96
% coverage not Equal Chance forecasts: 60.34

Precipitation Forecast Heidke Skill Scores:
Non-Equal Chance (non EC) forecasts: 7.69
All forecasts: 3.68
% coverage not Equal Chance forecasts: 50.43

Outlook
Temperature
Observation

Outlook
Precipitation
Observation
Other CPC Seasonal Outlooks and Watches

• Monthly temperature and precipitation outlook
• ENSO outlook
• Drought outlook
• Seasonal hurricane outlooks
• US Hazards
Monthly ENSO outlook

EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

issued by CLIMATE PREDICTION CENTER/NCEP/NWS and the International Research Institute for Climate and Society

12 October 2017

ENSO Alert System Status: La Niña Watch

Synopsis: La Niña conditions are favored (~55-65%) during the Northern Hemisphere fall and winter 2017-18.

During September, ENSO-neutral conditions were reflected in near-to-below average sea surface temperatures (SSTs) across most of the central and eastern Pacific Ocean [Fig. 1]. The weekly Niño Indices were volatile during the month, with negative values increasing to near zero during the past week in the Niño-4, Niño-3.4, and Niño-3 regions [Fig. 2]. In contrast, sub-surface temperature anomalies were increasingly negative during September [Fig. 3], reflecting the shallow depth of the thermocline across the central and eastern Pacific [Fig. 4]. Also, convection was suppressed near the International Date Line and enhanced near Indonesia [Fig. 5]. Over the western equatorial Pacific Ocean, low-level trade winds were anomalously easterly and upper-level winds were anomalously westerly. Overall, the ocean and atmosphere system remains consistent...
Seasonal hurricane outlook

NOAA 2017 Atlantic Hurricane Season Outlook

Issued: 9 August 2017

Realtime monitoring of tropical Atlantic conditions
Realtime monitoring of tropical East Pacific conditions

The updated 2017 Atlantic hurricane season outlook is an official product of the National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center (CPC). The outlook is produced in collaboration with hurricane experts from the National Hurricane Center (NHC) and the Hurricane Research Division (HRD). The Atlantic hurricane region includes the North Atlantic Ocean, Caribbean Sea, and Gulf of Mexico.

Interpretation of NOAA’s Atlantic hurricane season outlook
This outlook is a general guide to the expected overall activity during the upcoming hurricane season. It is not a seasonal hurricane landfall forecast, and it does not predict levels of activity for any particular location.
Real-time Climate Monitoring

• Real-time climate monitoring is an integral part of the CPC’s activities
• Oceans – ENSO, ocean heat content...
• Surface – soil moisture, surface temperature, precipitation...
• Troposphere – modes of variability (MJO, blocking, PNA, NAO...), temperature, heights...
• Stratosphere
• Monthly briefings – monsoons, drought, ocean, climate attribution
Summary

• CPC’s seasonal outlooks are based on multitude of empirical and dynamical prediction tools and are complemented by real-time climate monitoring products.
• There is a wealth of historical observations available that could be used to explore development of empirical prediction tools.
• There is mature infrastructure with WMO that can assist in the development of dynamical seasonal prediction tools.