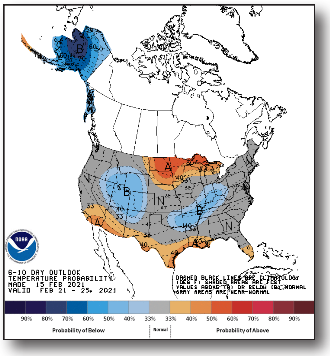
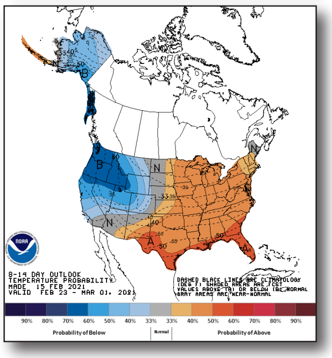
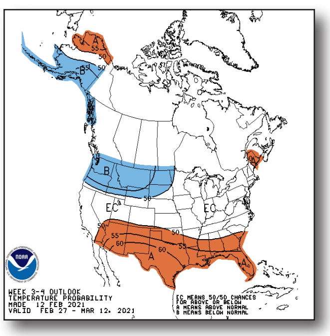
NWS Climate Forecasts and Tools



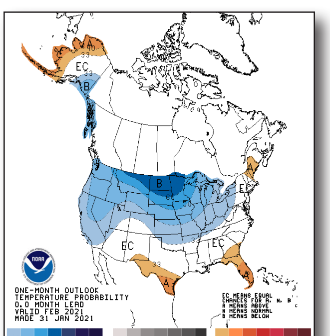
6-10 Day



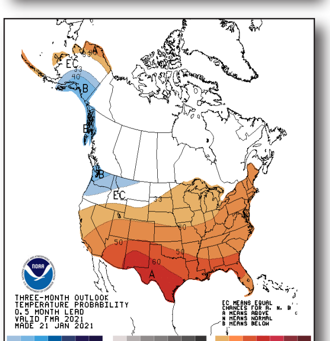
8-14 Day



Week 3-4



One-Month



Three-Month

Extended Range Forecast (ERF) Tool Summary

The information used in the production of the Climate Prediction Center's Extended Range Outlooks can broadly be characterized in terms of dynamical and statistical tools. These tools are generally produced in probabilistic format, which allows the user to evaluate the odds that the mean temperature or total precipitation in the upcoming 6-10 and 8-14 day period will be below, near, or above normal (with below, near, and above normal defined by dividing historical observations from the World Meteorological Organization's 30-year climatology period into three equal parts).

Dynamical tools consist of numerical ensemble model inputs derived from various sources including the Global Ensemble Forecast System (GEFS), the European Centre for Medium Range Weather Forecasts (ECMWF), and Environment and Climate Change Canada (ECCC). Various post-processing techniques are used in producing these dynamical tools including long term calibrations (to improve model inputs by taking long term skill into account), short term bias corrections (to incorporate recent trends), and raw model inputs (to identify potential pattern changes and significant events).

Statistical tools consist of composites derived from comparing model outputs to conditions that have occurred in the historical record. Methodologies for producing these statistical tools include analog composites (derived from averaging the closest 10 cases to the predicted 500-hPa pattern), teleconnection-based specifications (derived from calculations based on forecast 500- and 700-hPa anomaly centers), and composites based on well known atmospheric phenomena (such as the Arctic Oscillation (AO), North Atlantic Oscillation (NAO), Madden-Julian Oscillation (MJO), and others).

Additionally, analysis of antecedent conditions are incorporated into the outlooks. These antecedent conditions include (but are not limited to) analysis of soil moisture, snow cover, sea ice extent, and sea surface temperatures. Finally, the CPC combines the various tools described above into consolidations that are used as a first guess for the outlooks. These consolidations consist of statically weighted averages of the most skillful dynamical and statistical inputs as well as a dynamically weighted consolidation of dynamical tools which incorporates both temporal and spatial variations of skill into the averages.

NOAA National Weather Service
Climate Services Program

Week 3-4 Temperature and Precipitation Outlooks

In preparation of the Week 3-4 temperature and precipitation outlooks, the CPC utilizes numerous dynamical models. The realtime forecasts are bias corrected using each system's reforecast data. Forecast guidance products have been developed that include 500-hPa mean height, height anomalies, and spread. By comparing real-time forecasts to the model reforecast-based climatologies, the forecasts are bias-corrected. Additionally, Tools that indicate 2-m temperature anomalies and probabilities for above/below normal temperatures, as well as precipitation anomalies, percent of normal precipitation, and probabilities for above/below median precipitation are also utilize. Probabilities of above and below average are derived by counting the number of ensemble members from realtime model runs that exceed or do not exceed the model climatological mean (temperature) or median (precipitation).

In addition to numerical guidance, CPC uses statistical based tools. A multiple linear regression (MLR) model uses Nino 3.4, MJO indices, and the long-term (30-year) trend as predictors with CPC's gridded temperature and precipitation analyses as predictands. The relationship between past values of Nino3.4, MJO, and trend with past values of temperature and precipitation are applied to current values to make outlooks. There is also an ENSO-MJO phase model that was developed at GFDL which was implemented at CPC. Constructed analogues are also employed. The Constructed analogue (CA) method first constructs an analogue of an initial condition of a predictor with a weighted average of historical data, and then constructs a forecast by applying the same weights to the lagged predictand data in history. In the week 3-4 forecast, the predictor is chosen to be the weekly mean 200-hPa streamfunction over the tropics and Northern Hemisphere, and the predictands are weekly mean 2-m temperature, precipitation, and 500 hPa geopotential height. CPC has automated methods to combine these tools to create a first guess, and the optimization of multiple input tools is always an open development item.

Global Tropical Hazards/Benefits Outlook (GTH)

The Global Tropical Hazards/Benefits Outlook (GTH) uses a wide range of inputs, including model output and statistical relationships of tropical intraseasonal oscillations with precipitation and tropical cyclones. Models directly used to predict precipitation include GEFS, ECMWF, ECCC, and CFS. Tools to understand intramodel agreement are employed in the process. To assess future states of tropical intraseasonal oscillations (including the MJO and other modes of variability), output from many international modeling centers is analyzed. Additionally, filtering methods are used to highlight the varying modes, many of which are associated with clusters of tropical cyclones.

The statistical tools used consist of composites of tropical cyclone formation (binned by MJO phase), fuzzy logic tracking algorithms applied to GEFS data, and composites based on MJO phase and ENSO phase are also employed. Guidance from CPC's International Desk is directly included, specifically the International Desk Africa Hazards, while information on monsoons is typically included indirectly and for context.

Monthly Forecasts

Monthly forecasts are based on a number of tools, including dynamical models, statistical tools, and hybrid models. The dynamical models are largely from the North American Multi-Model Ensemble (NMME), with many methods used to process those models further, resulting in hybrid statistical-dynamical models. CPC also analyzes and includes trends from the past 15 years (Optimal Climate Normals), impacts from ENSO are integrated through composites or statistical models that link temperatures/precipitation to sea surface temperatures in the Pacific, and potential impacts from MJO (via composites and atmospheric wave filtering). Additionally, CPC uses correlations with soil moisture during seasons when that is impactful. A skill (accuracy) based consolidation of GEFS and CFS is also used for the end-of-month update.

Seasonal Forecasts

Seasonal forecasts at CPC are based on a number of tools, including dynamical models, statistical tools, and hybrid models. The dynamical models are largely from the North American Multi-Model Ensemble (NMME), with many methods used to process those models further, resulting in hybrid statistical-dynamical models. CPC also analyzes and includes trends from the past 15 years (Optimal Climate Normals). Impacts from ENSO are integrated through composites or statistical models that link temperatures/precipitation to sea surface temperatures in the Pacific. Additionally, CPC uses constructed analogs based on sea surface temperatures or soil moisture. A skill (accuracy) based consolidation of many of these inputs is created as a starting point for the forecasters.