Subseasonal to Seasonal Outlooks from CPC

David Miskus / Jon Gottschalck
CPC/Operational Prediction Branch

U.S. Drought Monitor Workshop:
Forecasting, Monitoring, & Responding
To Drought in the Southeast

Phillips Market Center,
SC State Farmers Market,
West Columbia, SC
February 4, 2020
NOAA Seamless Suite of Forecast Products
Spanning Climate and Weather

Service Center Perspective

- Climate Outlooks
- Climate Predictions
- Weather Forecasts
- Warnings

Forecast Lead Time
- Minutes
- Hours
- Days
- 1 week
- 2 weeks
- Months
- Seasons
- Years

Impact-Based Decision Support

RECOVERY RESPONSE PREPARATION

CPC

HPC OPC TPC

SPC AWC SWPC

Forecast Uncertainty

Collaborative Forecasts

Climate/Weather Linkage
Outline

- Overview of CPC Outlooks, Process, Tools, and Services:
  1) Week 2 (Days 8-14; *also Days 6-10*)
  2) Week 3-4
  3) Monthly and Seasonal Outlooks (LLF)
  4) Global Tropics Hazards Outlook (GTH)
  5) Drought Outlooks (SDO & MDO)

- Verification of Outlooks
Overview of CPC Outlooks, Process, Tools and Services:

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Verification of Outlooks
Week 2: Interpretation

C. CA
Below: 32%
Near: 36%
Above: 32%

Wisconsin
Below: 3%
Near: 32%
Above: 65%

SW. Utah
Below: 25%
Near: 33%
Above: 42%

SW. Alaska
Below: 22%
Near: 33%
Above: 45%

Arizona
Below: 52%
Near: 33%
Above: 15%
Week 2 U.S. Hazards

- Targets the Days 8-14 period, probabilistic in nature
- Highlights areas for *slight, moderate or high risk* for hazardous conditions related to temperature, precipitation and winds
- Hazardous conditions are defined based on thresholds or exceeding percentiles or both

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**Risk of Hazardous Temperatures**

Valid: 06/18/2019-06/24/2019

- **Excessive Heat**
  - Moderate: 6/18/2019 - 6/24/2019

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**Risk of Heavy Precipitation**

Valid: 04/13/2019-04/19/2019

- **Slight**
  - 4/13/2019 - 4/19/2019

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Climate Prediction Center
Made: 06/10/2019 3PM EDT
Follow us: www.cpc.ncep.noaa.gov

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Climate Prediction Center
Made: 04/05/2019 3PM EDT
Follow us: www.cpc.ncep.noaa.gov
Week 2: Forecast Process

Considerations
- Inter-model agreement
- Spatial Correlation
- Recent anomaly correlations
- Agreement with canonical teleconnections

Dynamical model forecasts

Weighted average 500-hPa height and anomaly forecast (BLEND)

- Official height forecast
- Analogs
- Regression based specifications
Week 2: Forecast Process

**Surface**

- **Dynamical model forecasts**
  - Bias Corrections, Calibrations, Consolidation
  - Autoblend
    - Human in the Loop Modifications
      - Write the forecast bulletin, FXUS06 KWBC
      - Dissemination to public between 3-4 PM Eastern Time

- **Analogs**
- **Regression based specifications**
  - Official height forecast
    - Environmental conditions (snow cover, soil moisture, sea ice, SSTs, etc)
    - Atmospheric Phenomena (MJO, Stratosphere, etc)
DYNAMICAL MODELS
• Global Forecast System (GFS) and ensembles
• European Centre for Medium-range Weather Forecasts (ECMWF) ensembles
• Canadian ensembles

POST-PROCESSING / STATISTICAL TOOLS
• GEFS/ECWMF T, P – bias corrected/calibrated, using reforecasts
• NAEFS – Bias-corrected ensemble forecasts – T, P
• Consolidation – GEFS and ECMWF – Dynamic, skill weighted combination
• GFS P, T – Dynamical model output– calibrated P, T
• Analog composites – Average T, P for the 10 best 500-hPa analogs
• Klein T – Regression
• Teleconnections – Simultaneous, significant temporal correlations for two or more widely separated locations
Week 2: 500-hPa Height Guidance

Forecaster considerations:

- Overall model system agreement
- Ensemble spread
- Run-to-run continuity, outliers
- Consistency with tropical forcing?
- Slowly evolving boundary conditions (snow, soil moisture, local SSTs)
Week 2: 500-hPa Height Outlook

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0Z GEFS Mean</td>
<td>20</td>
</tr>
<tr>
<td>6Z GEFS Mean</td>
<td>20</td>
</tr>
<tr>
<td>6Z GFS</td>
<td>15</td>
</tr>
<tr>
<td>0Z ECMWF Mean</td>
<td>20</td>
</tr>
<tr>
<td>y12Z EC Mean</td>
<td>5</td>
</tr>
<tr>
<td>0Z CAN Mean</td>
<td>15</td>
</tr>
<tr>
<td>y12 CAN Mean</td>
<td>5</td>
</tr>
</tbody>
</table>
Bias corrected using forecasts and observations over the past 120 days using a decaying average mean error
Week 2: Bias-Correction (short)

Uncorrected

Bias Corrected

45-day bias removal
Week 2: Bias-Correction (reforecast)

ECENS-00Z Raw Precip Probabilities
8-14Day Forecast Issued 2018-08-05
Valid 2018-08-13 to 2018-08-19

ECENS-00Z Rfcst-Cal Precip Probabilities
8-14Day Forecast Issued 2018-08-05
Valid 2018-08-13 to 2018-08-19

Bias correction and calibration using ~20 year reforecast - GEFS and ECMWF (working with Canada to initiate)
Week 2: Simple “First Guess”

25% NAEFS
25% GEFS Reforecast
25% Bias Corrected European
8.3% Analogs, Kleins, Raw European

20% NAEFS
40% GEFS Reforecast
30% ECMWF Reforecast
10% Analogs from ECMWF
Week 2: Consolidation “First Guess”

Skill Weighted Consolidation of Week-2 Forecasts
(NOAA/NWS/NCEP/Climate Prediction Center)

Using past forecasts and observations...
- 1x1 Degree Gridded Reforecast Data
- Ensemble Regression Calibration
- 1985-2010 Reference Period

Count the number of times each model “wins”
- Observation Sources: Global Telecommunication System (Temperature), CPC Unified Gauge-Based Analysis (Precipitation)
- 9 Point Smoother (1x1 Degree Resolution)

Calculate weights by summing winning counts over similar type grid points

Model weight = \# land point wins / (\# land pts) * (\# days w/ no missing data)

... optimally combine real-time forecasts

Prelim Verification (January 1 - September 1 2016)
- Temperature/Heidke Skill Score
- Precipitation/Heidke Skill Score

final probability (prob) = weight_{model1} * prob_{model1} + weight_{model2} * prob_{model2}

- 135 Day Evaluation Period
- 90 Days from Previous Year (Centered on Forecast Valid Period)
- Last 45 Days from Current Year
Week 2: Consolidation “First Guess”

Consolidated 8-14 day tmean issued 20181126 valid 20181204 - 20181210

Consolidated 8-14 day precip issued 20181126 valid 20181204 - 20181210
Week 2: Natural Analogs

500-hPa height

Temperature

Precipitation
Week 2: Teleconnections

- Inspect data for remote relationships based on phase, location and season of a height anomaly center of action
- Link with observed temperature and precipitation for these respective cases
Overview of CPC Outlooks, Process, Tools and Services:

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2) **Week 3-4**
3) Monthly and Seasonal Outlooks (LLF)
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Verification of Outlooks
Week 3-4: Interpretation

- Two category outlook for above- or below-normal 2-week mean temperature and 2-week total precipitation amounts
- "EC" areas indicate 50% probability for each category
Week 3-4: Process

Dynamical model forecasts

Bias Corrections, Calibrations, Consolidation

Statistical Tools

Create surface temp/precip outlooks (probabilities, dominant category) using tools
Write the forecast bulletin

Dissemination to public between 3-4 PM
Eastern Time
Weekly - Friday
Dynamical Model Guidance

- Climate Forecast System (CFS) lagged ensemble
- European Centre for Medium-range Weather Forecasts (ECMWF) ensembles
- Japan Meteorological Agency (JMA) ensembles
- Environment Canada Climate and Change (ECCC) ensembles
- Experimental Sub-X forecast guidance

Post processing – Statistical Forecast Guidance

- CFS/ECWMF/JMA/ECCC T, P – bias corrected/calibrated using reforecasts
- Consolidation products – Equal weighted, correlation weighted combination
- Multiple linear regression (ENSO, MJO, Trend)
- Constructed Analogue (based on 200-hPa streamfunction)
- Subjectively weighted “autoblend” first guess forecast tool
Week 3-4: 500-hPa Height Guidance
Week 3-4: Temperature Guidance

- Bias-corrected and calibrated probabilistic temperature forecasts
- Objective combinations available
Week 3-4: Precipitation Guidance

- Bias-corrected and calibrated precipitation anomaly forecasts
- Objective combinations available
Week 3-4: Multiple Linear Regression

MLR–MJO Temperature Anomalies Issued 05Jan2018
Week–3/4 Forecast Ending 02Feb2018

MLR–ENSO Temperature Anomalies Issued 05Jan2018
Week–3/4 Forecast Ending 02Feb2018

MLR–Trend Temperature Anomalies Issued 05Jan2018
Week–3/4 Forecast Ending 02Feb2018

MLR–Combined Temperature Probabilities Issued 05Jan2018
Week–3/4 Forecast Ending 02Feb2018

MJO

ENSO

Trend

Combined
Week 3-4: Consolidation “First Guess”

- Autobblend combination of dynamical and statistical guidance
- Weights in this forecast tool are subjectively chosen (red box)

MLR Week 3/4: 35%
ECMWF: 30%
CFS: 25%
JMA: 16%
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LLF Outlooks: Interpretation

Temperature

NW Utah
Below: 4%
Near: 33%
Above: 63%

N. Dakota
Below: 33%
Near: 33%
Above: 33%

N. Arizona
Below: 24%
Near: 33%
Above: 43%

Precipitation

Northwest Coast
Below: 41%
Near: 33%
Above: 26%
IMPORTANT: Static maps (previous slide) can hide the fact that all locations actually relate information about odds for all three categories.
LLF Outlooks: Forecast Basis

• **Persistent or recurring atmospheric circulation patterns** associated with anomalies in:
  - ✔ the initial state of the climate system, or
  - ✔ boundary conditions

• **El Niño and La Niña**: anomalous climate states whose development, persistence and evolution are somewhat understood

• Potentially persistent or recurring atmospheric circulation patterns that are less well understood: AO, NAO, PNA

• **Unidentified persistent atmospheric patterns** may arise from the initial state of the climate system or from boundary forcing

• **Decadal variability or trends**
LLF Outlooks: Process

- Seasonal temperature and precipitation forecasts are based on a combination of statistical and dynamical forecasts
- An objective consolidation of forecast information often provides the starting point for the outlook map
- Model forecasts (specifically the NMME) now play a large role
- A forecaster subjectively adjusts the forecast
- A team of seasonal forecasters reviews the forecasts with input from across NOAA and other agencies

  - Internally, forecasters gather Friday before release date to review the current climate state, previous forecasts and draw preliminary maps
  - Call on Tuesday before release date to review the forecaster’s preliminary maps is open to entire NWS

- Release date every third Thursday of the month
- Monthly ENSO forecast is always updated prior to the start of the seasonal forecast process (2nd Thursday)
LLF Outlooks: ENSO

NMME Nino3.4 Fcst, IC=201812

Early-December 2018 CPC/IRI Official Probabilistic ENSO Forecasts
ENSO state based on NINO3.4 SST Anomaly
Neutral ENSO: -0.5 °C to 0.5 °C

JFM ENSO PRECIPITATION ANOMALIES (mm) AND FREQUENCY OF OCCURRENCE (%)
LLF Outlooks: Boundary Conditions

Snow cover

Soil moisture

Local SSTs

U.S. Drought Monitor

January 28, 2014
(Released Thursday, Jan. 30, 2014)

Weekly OI SST Anom. (°C)

Departure from Normal - December 2013
LLF Outlooks: Long Term Trends

- **Optimal Climate Normal (OCN)**
- Difference between some predetermined averaging period and the standard 1981-2010 normal
- CPC uses 15 years for this period at the current time
- Both temperature and precipitation
LLF Outlooks: Statistical Tools

1. Canonical Correlation Analysis (CCA) (top left)
2. Constructed Analogue (CA) (bottom left)
3. ENSO-Trend combination (ENSO/OCN) (top right)
LLF Outlooks: Dynamical Model Guidance
LLF Outlooks: Consolidation “First Guess”

1. Statistical consolidation (STAT) (top left)
2. NMME consolidation (NMME) (bottom left)
3. Final consolidation (Final) (top right)
Additional Seasonal Precipitation Information

Anomaly (inches) of the median value of the outlook distribution

Dashed lines are the 1981-2010 median value

Shading are anomalies

Northern Florida Climate Division

Probability of Exceedance Graph

Illustrates the shift in the distribution
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Verification of Outlooks
GTH Outlook: Interpretation

Global Tropics Hazards and Benefits Outlook - Climate Prediction Center

Week 1 - Valid: Jun 27, 2018 - Jul 03, 2018

Week 2 - Valid: Jul 04, 2018 - Jul 10, 2018

Product is updated once per week, except from 6/1 - 11/30 for the region from 120E to 0, 0 to 40N. The product targets broad scale conditions integrated over a 7-day period for US interests only. Consult your local responsible forecast agency.
There is a weak MJO signal apparent in both the RMM-based and CPC velocity potential-based indices, with the enhanced (suppressed) phase over Africa and the far western Indian Ocean (western and central Pacific). The presence of an intraseasonal signal is more apparent in the wind field than the convective anomalies, and other modes continue to interfere with the overall picture. The suppressed phase of an equatorial Rossby wave over the west Pacific appears to be constructively interfering with the suppressed phase of the MJO, but Kelvin wave activity over the East Pacific is restricting the eastern extent of the signal. There is considerable uncertainty among the dynamical model RMM-index forecasts, with the ECMWF generally supporting weak MJO activity that strengthens by the end of Week 2 over the Maritime Continent, and the GEFS depicting no eastward propagation and instead bringing the index outside of the circle back in Phase-1. It is possible that model-forecasted tropical cyclone activity over the East Pacific is interfering with the RMM-index forecasts, acting to pull the index back towards the Western Hemisphere, especially given the lack of a robust intraseasonal convective signal. Therefore, the MJO may be active during the next two weeks, but there is too much uncertainty to project potential impacts of this signal on the global tropical convective pattern.

Tropical Storm Daniel formed over the East Pacific on June 24, and remained well out to sea before becoming post-tropical. No additional tropical cyclone development occurred across the global basins during the past week. During Week-1, the East Pacific is anticipated to become extremely active, partly due to the aforementioned recent Kelvin wave activity. The National Hurricane Center (NHC) is currently monitoring a broad area of disturbed weather approximately 600 miles south of Acapulco, Mexico, and forecasts a 90% chance of tropical cyclone formation over the next 5 days. Additionally, a tropical wave currently over Central America has a 90% chance of development per NHC during the next 5 days after emerging over the East Pacific and moving westward to the south of El Salvador, Guatemala, and Mexico. The GFS forecasts both of these systems to become intense hurricanes, and also shows a third tropical cyclone formation during late Week-1 or early Week-2. Based on these forecasts, a broad high confidence tropical cyclone formation area is depicted on the outlook during Week-1. A smaller moderate confidence region is maintained during Week-2, in case the potential third system develops at the beginning of that period. Over the West Pacific, the GFS ensembles show potential development early in the period east of the Philippines, with a second potential tropical cyclones forming near or north of Guam. Both of these potential formation regions were covered with a single high confidence shape during Week-1 of the outlook period. For Week-2, additional tropical cyclone development is possible once again in the vicinity of Guam, with the threat extending northwestward well east of the Philippines. No tropical cyclone formation is anticipated over the Atlantic basin, but NHC is monitoring a non-tropical low pressure system anticipated to move offshore of the Carolinas along a frontal boundary, with a low potential existing for tropical or subtropical development.

In the absence of robust MJO-related convective anomalies in the recent observations, the forecasts for enhanced or suppressed rainfall rely primarily on a consensus of dynamical model forecasts and anticipated tropical cyclone activity. The CFS and ECMWF both depict a continued reduction in monsoon precipitation over South and Southeast Asia, which is fairly consistent with the low-level zonal flow anomalies associated with potential MJO activity over the western Indian Ocean. Enhanced convection is forecast over the equatorial Maritime Continent, extending south-southwestward to the central Pacific near 10°S. An active ICTZ is anticipated south of Hawaii, with a small area of suppressed convection between this region and the potential East Pacific tropical cyclones due to subsidence. During Week-2, enhanced precipitation is favored across parts of the West Pacific, with potential ongoing tropical cyclone activity generating enhanced convection to the south and southwest of Mexico. Broad suppressed rainfall is favored to overspread southern Mexico and parts of Central America later in Week-2, due in part to subsidence and reduced SSTs in the wake of the earlier tropical cyclone activity. There is too much uncertainty in both model guidance and MJO forecasts to depict regions of enhanced or suppressed rainfall over the Indian Ocean basin or Maritime Continent for Week-2.
GTH Outlook: Release Schedule

Product released weekly according to the following steps:

**MONDAY**: Forecaster updates the MJO weekly update PPT/PDF and prepares draft GTH outlook maps and posts to preliminary page  
**MONDAY**: Forecaster sends out message to collaborators for feedback announcing technical call  
**MONDAY**: Conduct 2:30 PM ET conference call with available partners/contributors  
**MONDAY**: Finalize MJO weekly update PPT/PDF and post to web by 4 PM ET

**TUESDAY**: Forecaster updates outlook maps based on feedback and latest forecast information  
**TUESDAY**: Forecaster writes PMD, performs last round of coordination with NHC by 1 PM ET  
**TUESDAY**: Forecaster posts final outlook maps and PMD to web and confirms release  
**TUESDAY**: Forecaster conducts Global Tropics Briefing at 2:30 PM ET

**FRIDAY**: An update is prepared during the Atlantic hurricane season 6/1-11/30, reduced region (120 E to 0, 0 to 40 N)

Product released at 2:30 PM ET Tuesday, update on Friday  
GTH Outlook: Process

Assess ENSO rainfall patterns

Knowledge of MJO impacts

Assess current strength and phase of MJO

Include predictive information related to other coherent tropical modes (KW, ER, AEW, etc.)

Include extratropical related factors (low latitude frontal activity, blocking, etc.)

Statistical forecast tools (precip, TCs)

Dynamical model forecast tools (precip, TCs)

Outlook maps
GTH Outlook: Forecast Tools

Cold Episode Relationships
December - February

Cold Episode Relationships
June - August

High Resolution Images can be found at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ENSO/ENSO-Global-Impacts/
GTH Outlook: Forecast Tools

Madden-Julian Oscillation (MJO)

200-hPa Velocity Potential Anomalies (10N – 10S)

MJO Index Forecast for 07May2013-21May2013

DP1
DP2
DP3

Phase 1
Phase 2
Phase 3
Phase 4
Phase 5
Phase 6
Phase 7
Phase 8
GTH Outlook: Forecast Tools

EWP

CMH 200 hPa 40-DAY forecast (02z27jun2018–08aug2018)
(based on EWP spherical harmonics)

CA

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (07 Apr 2018)

C-LIM

OLR/WND200
GTH Outlook: Forecast Tools

CFS Precipitation Anomalies (mm) Issued 27Jun2018
Week–2 Forecast Ending 12Jul2018

Week–2 ECMWF Prec % of Normal
GTH Outlook: Forecast Tools

Five-Day Graphical Tropical Weather Outlook
National Hurricane Center Miami, Florida

GFS 200mb-850mb Wind Shear (knots) & Low Centers (mb)

JOINT TYPHOON WARNING CENTER

NO SUSPECT AREAS (ABIO)

GFS MSLP and Anomaly (hPa) (based on CF91 1981-2010 Climatology)

TC development unlikely within 24 hours
TC development likely within 24 hours
Reference TCFA

Tropical Cyclone (Tropical Warning)
GTH Outlook: Forecast Tools

Tropical Cyclone Storm Tracks
CFSv2 45-Day Forecasts

a) Week 1: 0625–0702

b) Week 2: 0703–0709

c) Week 3: 0710–0716

d) Week 4: 0717–0723

CFSv2 45-Day Forecasts
Week 2: 0703–0709

Forecast Tracks

Track Anomaly

False Alarm Climatology

CWB TC Tracker for NCEP GEFS (AllCriteria)
1. Commerce is Global: Support sectors of U.S. economy (financial, energy, agriculture, water resource management, aid organizations, etc.) that have international interests

- Advance notice of hazards and benefits in the Tropics
- Assessment of weather / climate pattern changes

2. Support NOAA: Support the National Weather Service (NWS) field, among other U.S. government agencies, by:

- Assessing and forecasting the distribution of large scale tropical convection
- Providing advance notice for potential pattern changes across the U.S.
- Providing subseasonal tropical cyclone forecasts for U.S. government agencies

3. Additional resource for international met organizations
GTH Outlook: Partners, Applications

**Partners:**

**NOAA National Centers:**
- National Hurricane Center
- Central Pacific Hurricane Center

**Dept. Of Defense:**
- Joint Typhoon Warning Center
- Naval Postgraduate School

**International Agencies:**
- Australian Bureau of Meteorology
- Taiwan Central Weather Bureau

**Academia:**
- SUNY, NC-CICS

**Stakeholders:**

**NWS:** NCEP, WFOs, RFCs, Regional HQs

**NOAA agencies:** National Marine Fisheries Service

**Aid Organizations:** U.S. and International Red Cross, USAID

**Private Sector:** Energy, agriculture, financial, and water resources sectors

**Others:** Other U.S. Agencies, International weather agencies, TV mets

**Example Applications:**

**Field Campaigns**

**Haiti Relief**

**Oil Spill**
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5) **Drought Outlooks (SDO & MDO)**

Verification of Outlooks
Produced in conjunction with monthly and seasonal T/P outlooks

Drought Monitor is starting point for outlooks

Forecaster consults with extended-range, subseasonal and seasonal forecasters / guidance for consistency

Forecaster sends draft outlook to stakeholders for feedback. Typically, several dozen stakeholders will request changes to the forecast over 2-3 days.
Drought: DO Short Term Tools

Predicted Soil Moisture Anomaly (mm) (20Jun2018–04Jul2018)
Drought: DO Long Term Tools
Discussion for the Seasonal Drought Outlook

Tools used in the U.S. Seasonal Drought Outlook (SDO) included the official Climate Prediction Center (CPC) temperature and precipitation outlooks for December 2017 through February 2018 (DIF 2017-18), various short- and medium-range forecasts and models such as the 7-day quantitative precipitation forecast (QPF) totals from the Weather Prediction Center (WPC), the 5-10 day and 5-14 day CPC extended-range forecasts (ERFs), Weeks 3-4, dynamical model forecast runs of the seasonal time scale, 240-hour total precipitation forecasts from several runs of the GFS, 240-hour total precipitation forecasts from the ECMWF, climatology for the DIF season including median soil moisture changes, and initial conditions (the U.S. Drought Monitor valid on November 14, 2017). La Niña conditions are predicted to continue (~65-76% chance) at least through boreal winter 2017-18.

Across the Northeast during the past 30 days, the departure from Normal Precipitation (DNP) map depicts near-normal conditions across approximately the eastern and eastern thirds of this region, with intervening near- to drier-than-normal conditions for the central third. A few areas, such as near and along the New Hampshire-Maine border, and northern New York’s Tug Hill Plateau area, report precipitation surplus of at least 4 inches during the past 30 days. Looking back over the past 121 years of record, the Northeast typically receives 20-30 percent of its annual precipitation during the three-month period. Though there are a few widely scattered areas of abnormal dryness (DD) on the U.S. Drought Monitor in the northeast, there is no drought at this time. It is unlikely that drought will develop across this region during the winter.

Confidence for the Northeast is moderate to high.

Thirty-day precipitation anomalies in the Southeast indicate mostly below-to-near-normal precipitation, with the exception of far western sections of Virginia and the Carolinas, and over southern Florida, where above-normal precipitation fell. Typically during the DIF season, most of this region receives 20-38 percent of its annual precipitation. The exception is the Florida Peninsula, where the historical record reveals a gradient of values ranging from 16-20 percent in the north to 5-10 percent in the south. Existing moderate drought (DO) from the Carolina Piedmont region into southern Virginia (and over a localized area along the southern border of Alabama/Georgia) is expected to persist and possibly intensify during the DIF period, as precipitation predictions at nearly all time-scales are less than 50% certainty. A season in advance support below-normal precipitation. Drought development is anticipated across portions of the Southeast region. This is a common (though not guaranteed) occurrence during La Niña winters. Across most of peninsular Florida, drought development is considered much less likely, as it received copious rainfall from both Hurricane Irma earlier in the season and from a recent wet season this year.

Confidence for the Southeast is moderate to high.

Future plans include a Probabilistic DO (consistent with other CPC outlooks)

Drought Outlook for Feb 2018

Summary - Short overall narrative

Detailed narrative by region that includes reasoning and confidence
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Verification of Outlooks
Verification: Modified HSS Metric

Modified Heidke Skill Score (HSS):
% Improvement over Random Forecasts

\[
HSS(\%) = 100 \times \frac{(H - E)}{(T - E)}
\]

H = Number of correct forecasts
E = Expected number of correct forecasts (1/3 of total)
T = Total number of valid forecast-observation pairs
Verification: Week-2

Temperature

8 to 14 Day Temperature Heidke Skill Score
365 Days of Manual Forecasts From 20171211 to 20181210

Precipitation

8 to 14 Day Precipitation Heidke Skill Score
365 Days of Manual Forecasts From 20171211 to 20181210

Average = 28.3

Average = 19.1
Heidke Skill Score -- Temperature

- CPC Non-EC Grids
- No Skill
- Two-month Running Mean
Verification: Week 3-4

Heidke Skill Score -- Precipitation

- CPC Non-EC Grids
- No Skill
- Two-month Running Mean
Verification: Week 3-4

Temperature

Precipitation

Official Week–3/4 Temperature Heidke Skill Scores
Forecasts issued 03Feb2019 to 02Aug2019

Last 180 days

Official Week–3/4 Precipitation Heidke Skill Scores
Forecasts issued 03Feb2019 to 02Aug2019

Last 365 days
Verification: Seasonal Outlook

**Temperature**

Seasonal (Lead 0.5 Months) Temperature Heidke Skill Score
DJF Manual Forecasts From 1995 to 2018

Average = 17.8

**Precipitation**

Seasonal (Lead 0.5 Months) Precipitation Heidke Skill Score
DJF Manual Forecasts From 1995 to 2018

Average = 7.9

Seasonal (Lead 0.5 Months) Temperature Heidke Skill Score
JJA Manual Forecasts From 1995 to 2018

Average = 14.9

Seasonal (Lead 0.5 Months) Precipitation Heidke Skill Score
JJA Manual Forecasts From 1995 to 2018

Average = 2.4
Verification: Seasonal Outlook

Temperature

Seasonal (Lead 0.5 months) Temperature Heidke Skill Scores (Combined Categories)
Verification: Seasonal Outlook

Precipitation

Seasonal (Lead 0.5 months) Precipitation Heidke Skill Scores (Combined Categories)
Verification: GPRA Metric

Verification: Seasonal Outlook

- Running 48 month average score for Lead 1 seasonal temperature outlooks (blue)
- NWS HQ FY goal (red triangles)
Verification: Comprehensive Metric

- Most CPC T/P outlooks from Days 6-10 through seasonal
- More heavily weights Week-2 outlooks
Verification - GTH

Official GTH Outlooks
Forecast Precipitation Areas
(both above- and below-normal areas)

2011-2019 Period
Official GTH Outlooks

Forecast Precipitation Areas (both above- and below-normal areas)

2011-2019 Period

From 2007-2012, HSS were calculated for Weeks1 & 2 in individual ocean basins where tropical cyclone favored development areas occurred (Atlantic, Pacific, Indian).
Verification: Drought Outlooks

**Monthly Drought Outlook Verification Statistics**

<table>
<thead>
<tr>
<th>Score</th>
<th>Baseline</th>
<th>Skill</th>
<th>Skill Linear Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Seasonal Drought Outlook: Median Percent of Area Successfully Forecast**

- Official Drought Outlook: 48.5%
- Persistence Forecast for ALL Existing Drought Areas: 39.2%
- D.O. Forecast of Improvement or Removal: 77.0%
- D.O. Forecast of Persistence: 67.6%
- D.O. Forecasts for ALL Existing Drought Areas: 68.5%
- D.O. Forecast of Development OR Development in Areas Not Forecast: 7.0%

**Verification Table**

<table>
<thead>
<tr>
<th>Forecast</th>
<th>Hit</th>
<th>Miss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvement/Removal</td>
<td>46,794</td>
<td>5,221</td>
</tr>
<tr>
<td>Persistence</td>
<td>10,208</td>
<td>38,090</td>
</tr>
<tr>
<td>Development</td>
<td>0</td>
<td>6,232</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>57,002</td>
<td>49,543</td>
</tr>
</tbody>
</table>

**Score**

53.5%

**Persistence Forecast Baseline**

15,429 | 91,116

**Persistence Forecast Score**

14.5%

**Skill**

Forecast score minus persistence score: +39.0
Thanks for your attention and time. Any comments, questions, or suggestions?

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(301) 683-3453