World Climate Service
Summer Outlook

Forecast and Diagnostic Discussion

May 2013

World Climate Service

If you knew then what we knew then ...

Published by:

World Climate Service

Suite 229 Technology Center
200 Innovation Blvd

State College, PA 16803

www.worldclimateservice.com

info@worldclimateservice.com

Copyright © 2013

Table of Contents

Probability Seasonal Forecasts

Probability seasonal forecasts are computed by linking computer models that simulate motion and energy transfer in the atmosphere and ocean and then running tens of cases to encompass the range of uncertainties in observations and in the numerical models. The probabilities are computed from the ensemble of individual forecasts.

The World Climate Service probability forecasts are based on the seasonal ensemble forecasts produced by the Seasonal Forecast System of the European Centre for Medium-Range Weather Forecasts (ECMWF), an international center in Reading, England, supported by 31 member states, and by the Climate Forecast System (CFS) of the U.S. National Weather Service.

The World Climate Service also employs analog techniques to derive forecast information that cannot be ascertained from the use of dynamical probability models. The additional independent probabilistic forecast information can be used to confirm those models or to reveal the level of uncertainty in the forecast.

Unless otherwise noted, the data for observational analyses and analog calculations are obtained from the U.S. National Weather Service.

The World Climate Service is a collaborative enterprise of Prescient Weather Ltd in the United States and MeteoGroup in Europe, the United States, and Asia.

Forecast Summary for Summer: June, July, August

The summer forecast is based largely on analog methods owing to generally weak signals from oceanic oscillations and to disagreement and rapid change in the computer models.

North America

Warm and dry conditions will prevail in the southwest U.S. while the Upper Midwest will be relatively cool and moist. A repetition of the widespread heat and drought of 2012 is unlikely.

Europe

Scandinavia and a region north of the Black and Caspian Seas will be warm and dry. Cool and moist conditions will prevail in the Alpine regions and near the Adriatic Sea.

Confidence

In North American, confidence forecast is low to perhaps moderate.

In Europe, confidence is moderate east of Ukraine and low to moderate elsewhere.

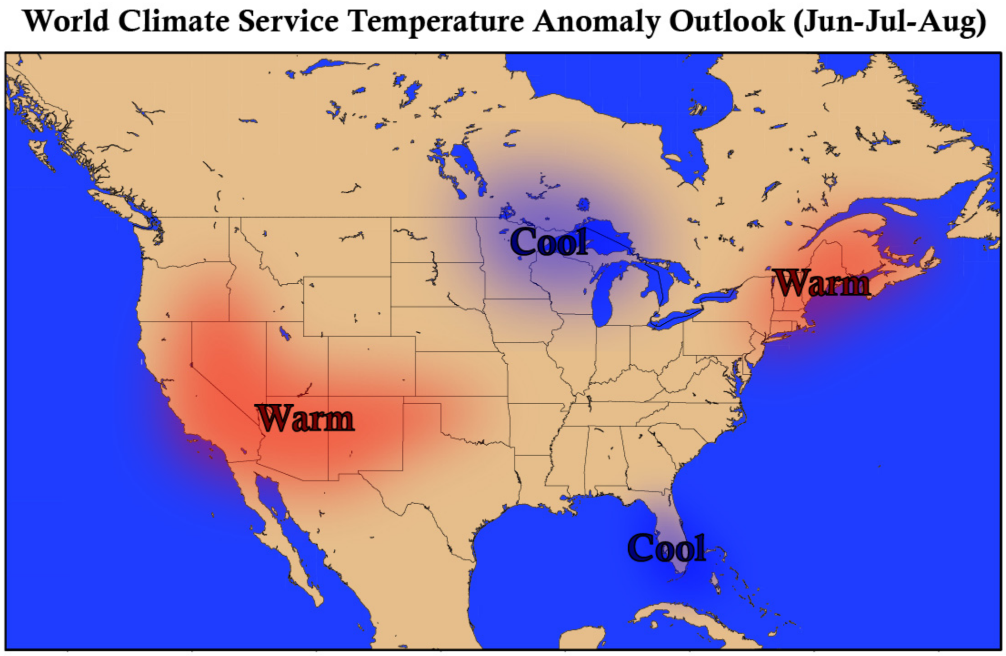


Figure 1. WCS North American temperature anomaly outlook for June through August 2013.

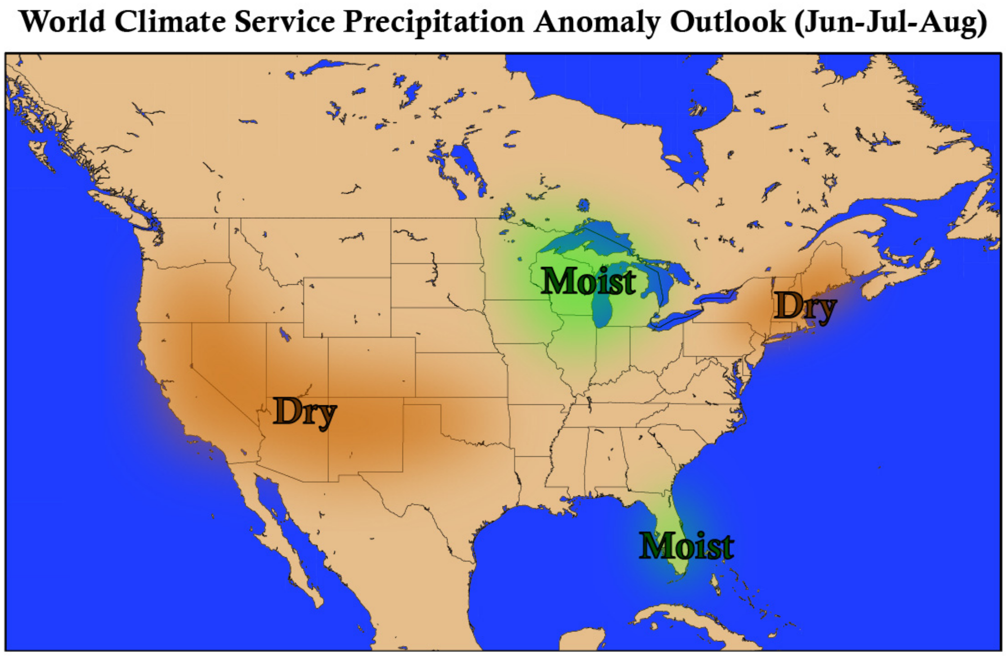


Figure 2. WCS North American precipitation anomaly outlook for June through August 2013.

World Climate Service Temperature Anomaly Outlook (Jun-Jul-Aug)

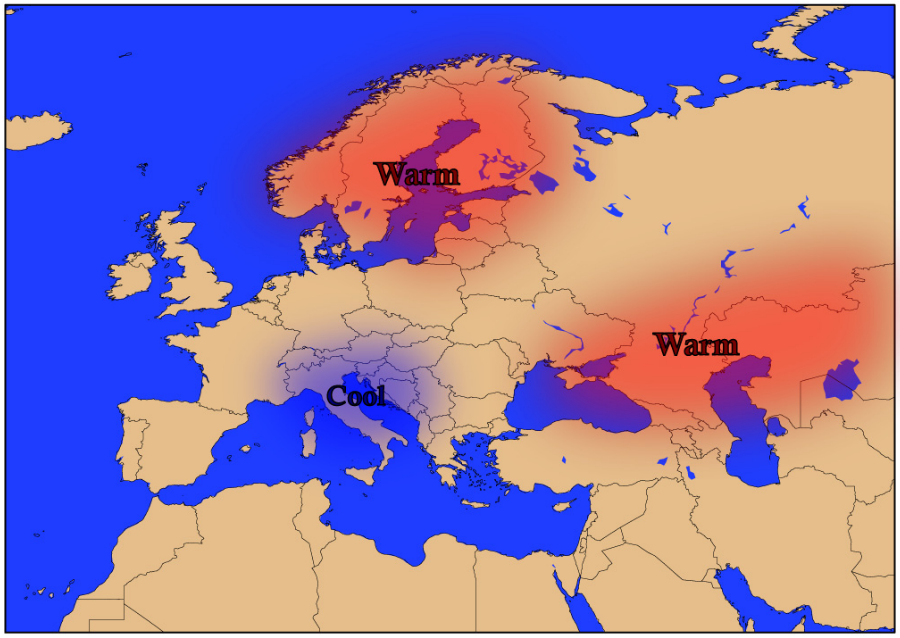


Figure 3. WCS European temperature anomaly outlook for June through August 2013

World Climate Service Precipitation Anomaly Outlook (Jun-Jul-Aug)

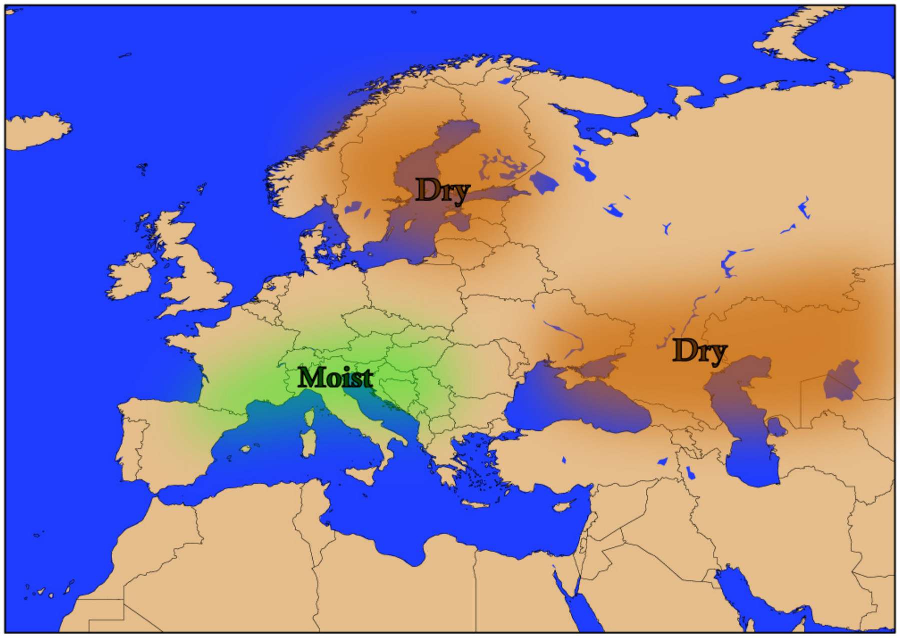


Figure 4. WCS European precipitation anomaly outlook for June through August 2013.

Summer Forecast:
U.S. Summer Will Not Repeat 2012
As the Flow Patterns Remain Variable

Relatively warm and dry conditions are expected in much of the western parts of the southern United States in the summer months of June, July, and August (JJA), according to the World Climate Service (WCS). In contrast, parts of southern Europe will be relatively cool.

The WCS forecasts for summer are based largely on analog methods and persistence because the numerical guidance is in serious disagreement, discontinuous with earlier guidance, and seemingly not credible. As a result, the predictions of the WCS multi-model formed from the seasonal probability models of the U.S. National Weather Service and the European Centre for Medium-Range Forecasts are given little credence in the 2013 summer forecast.

According to present indications, the North American summer is likely to be dominated by variable flow patterns rather than the stagnant high pressure that maintained the exceptional heat and drought over much of the U.S. last year. The WCS expects the pattern to lead to showers and cool weather over parts of the Upper Midwest and to relative warmth in New England. Warm and dry conditions will extend from western Texas to the southern California coast and northward to Idaho and eastern Oregon. Southern Florida will be cool and moist.

Cool and sometimes moist weather is expected in the areas surrounding the Adriatic Sea. Most of Scandinavia and northeastern Europe will experience relatively warm and dry conditions during the summer. Warm and dry will also prevail from the Black Sea northeast into Ukraine and southwestern Russia, where dry conditions are already a threat to agriculture.

The El Niño-Southern Oscillation is likely to continue in neutral conditions through the summer and into the fall. The Pacific Decadal Oscillation is in a nearly neutral phase and the Atlantic Multidecadal Oscillation is positive while the Quasi Biennial Oscillation has passed into a westerly phase. Thus, there is weak forcing of climate variability for most of the world.

Argentina will be relatively warm with seasonal conditions prevailing to the north into southeast Brazil. Australia will have warm winter temperatures in the north and a moist start for winter for most of the continent.

Summer Diagnostics:
Weak Ocean Forcing and Unusual Spring Blocking Will Produce a Summer Pattern Different From 2012

The El Niño Southern Oscillation (ENSO) will have minimal impact on summer climate as it is expected to remain in the neutral phase. Niño 3.4 sea-surface temperature (SST) anomalies are nearly normal, and even though the Southern Oscillation Index (SOI) has become more negative, there has been little change in the SST anomalies in the tropical Pacific during the past month.

The consensus of international dynamical and statistical ENSO models shows a strong likelihood of ENSO neutral conditions prevailing this summer. Most of the models indicate SST anomalies in a quasi-steady state for the next several months. The WCS analog model foresees ENSO neutral conditions being most likely, followed by El Niño and then La Niña. The WCS believes that during summer there is a 70 percent probability of ENSO neutral conditions prevailing, a 15 percent probability of La Niña developing, and a 15 percent probability of El Niño developing.

The pattern this spring has evolved much differently from last year. Significant high-latitude blocking associated with a record negative Arctic Oscillation (AO) occurred during March, and meridional flow and cutoff lows have repeatedly developed across the Northern Hemisphere as spring has progressed. In contrast, last year zonal flow locked the coldest air near the pole and produced a record-warm spring across the U.S. With such pronounced differences to the spring pattern and a Pacific Decadal Oscillation (PDO) that is nearly neutral instead of negative, the WCS does not foresee a repeat to the record dry and hot pattern that occurred across the central U.S. last summer. Instead, it is likely that the ridge of high pressure will develop over the abnormally dry soil in the southwestern U.S. and produce warm and persistently dry conditions from Texas to California. To the east of this ridge, occasional northwesterly flow will bring cool and moist conditions to the Upper Midwest, especially in June as lingering cold air from melting snowpack in northwestern Canada is advected southward.

The dynamical computer models are not in strong agreement for summer; the ECMWF foresees an unusually large region of cooler than normal temperatures from Canada to the Gulf Coast while the CFSv2 expects warm condition along the West Coast, parts of Canada, and near New England. Both models suggest a positive phase of the PDO developing, and while possible, the WCS believes that the models are reacting too strongly to a recent warm anomaly that has developed off the west coast of the U.S.

With the ocean forcing remaining weak, the dynamical model guidance showing conflicting and unusual patterns and increased uncertainty about the evolution of the PDO and antecedent drought conditions, there is considerable uncertainty in the summer forecast. Thus overall confidence in the North American summer forecast is low to perhaps moderate.

El Niño – Southern Oscillation (ENSO)

The Southern Oscillation Index (SOI) has become increasingly negative in recent weeks (Figure 5), but this change has not produced any significant warming of the SST anomalies in the eastern tropical Pacific. Niño 3.4 SST anomalies warmed briefly in early April but quickly returned to nearly normal. In recent weeks, there has not been any indication of imminent changes (Figure 6).

Despite the change to a more negative SOI, SST anomalies off the west coast of South America remain cooler than average (Niño region 1+2, Figure 7). Typically, a negative SOI would weaken the easterly trade winds and result in warming SSTs in that region, but it appears ENSO is firmly entrenched in the neutral phase as upper oceanic heat content is nearly normal from the west coast of South America to the International Dateline (Figure 8). There have been minimal changes during the past month in the cross sections of equatorial Pacific subsurface anomalies (Figure 9), further supporting the expectation of ENSO neutral persisting.

The WCS Niño 3.4 SST analog method assembles similar historical states of tropical Pacific SSTs to predict the future evolution of ENSO. The method objectively identifies the most analogous Niño 3.4 anomalies during the period August through April, with recent months more heavily weighted. Twelve analog years were selected that most closely match the evolution of Niño 3.4 SST anomalies in 2012 and 2013. Starting with the best matching year, the analog years for the forecast year include: 1994, 1961, 2004, 1960, 1981, 2006, 1954, 2002, 1980, 1979, 1952, and 1991. For those analog years, the WCS analyzed the evolution of Niño 3.4 SST anomalies for the next nine months (Figure 10). By August, ENSO neutral is most likely and there is a slightly greater chance of El Niño than La Niña; six years show ENSO neutral conditions persisting (-0.5°C < Niño 3.4 SST anomaly < 0.5°C), four analog years show El Niño conditions (Niño 3.4 SST > 0.5°C), and two years indicate La Niña conditions (Niño 3.4 < -0.5°C).

The international dynamical and statistical ENSO model forecasts differ on the magnitude of the Niño 3.4 SST anomaly, but each model is in a remarkable quasi-steady state for the next six months. Only a few of the models indicate significant changes in the Niño 3.4 SST anomaly, while 21 of the 24 models indicate a persistence of ENSO neutral conditions and 3 of 24 models suggest the development of La Niña (Figure 11). As discussed last month, until something triggers ENSO, like enhanced or weakened trade winds, ENSO will remain neutral and the models are likely to forecast persistence.

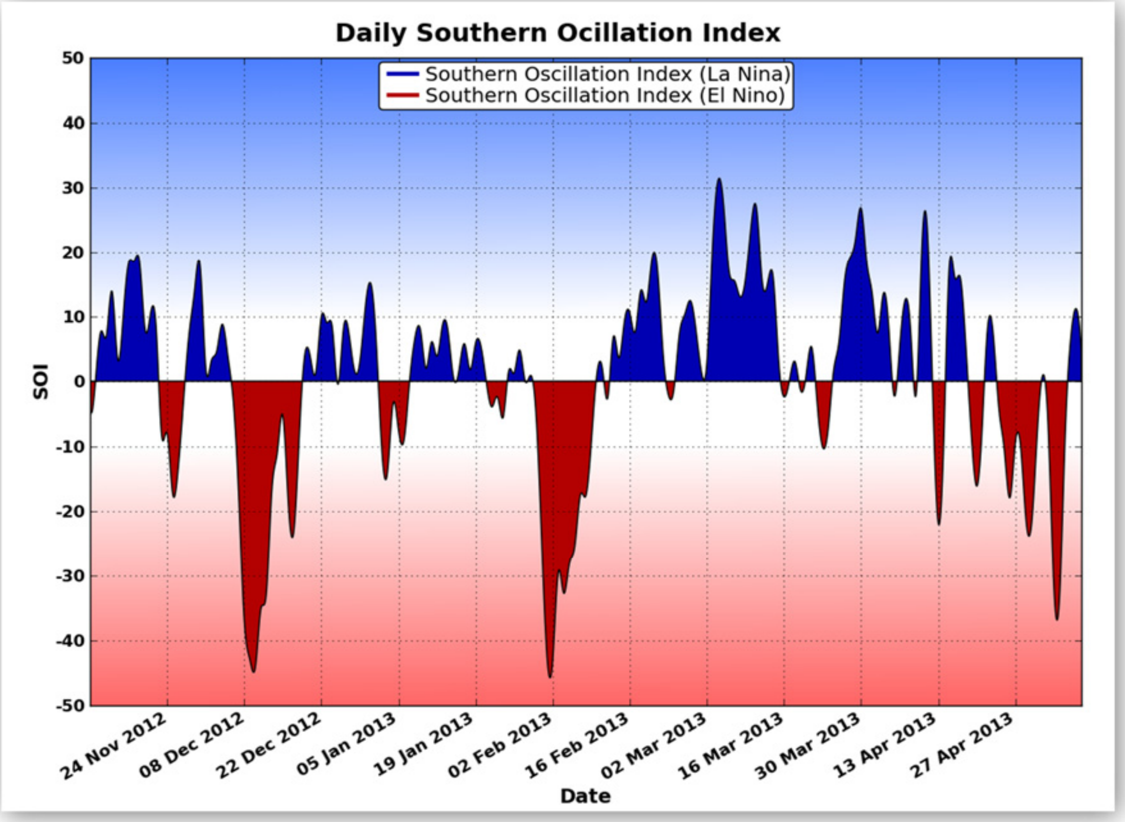


Figure 5. Daily Southern Oscillation Index values for the previous six months. Negative values (red) typically accompany El Niño conditions; positive values (blue) accompany La Niña conditions.

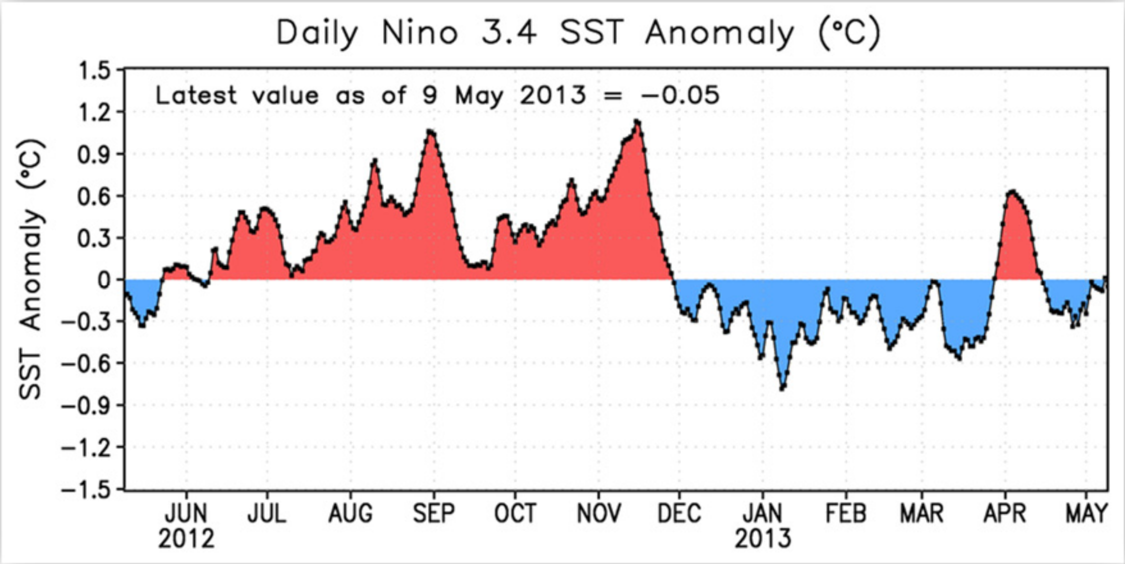


Figure 6. Daily Niño 3.4 SST anomaly derived from daily NOAA Optimum Interpolation SST analyses.

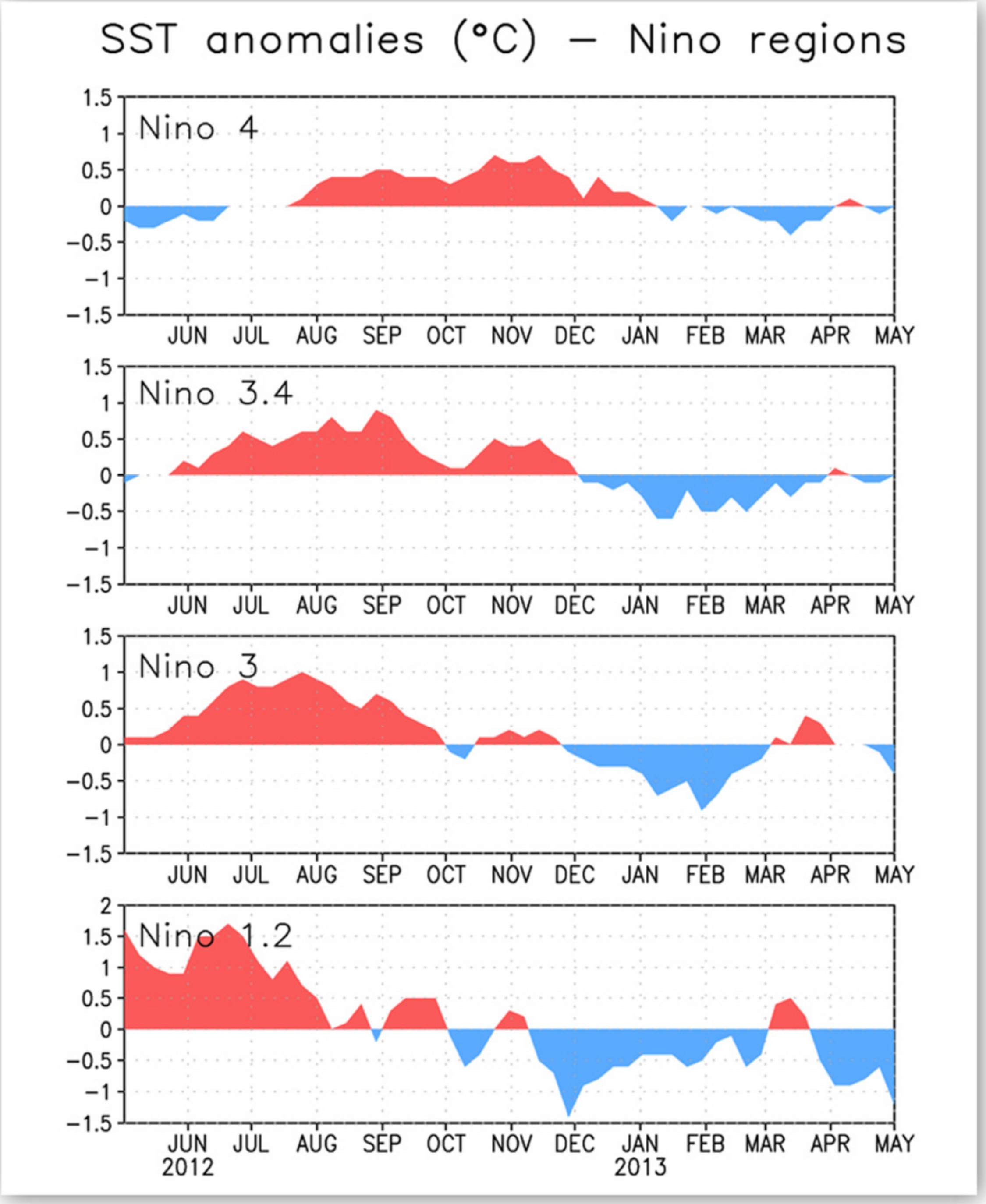


Figure 7. Evolution of SST anomalies in the four Niño regions from May 2012 through May 2013.

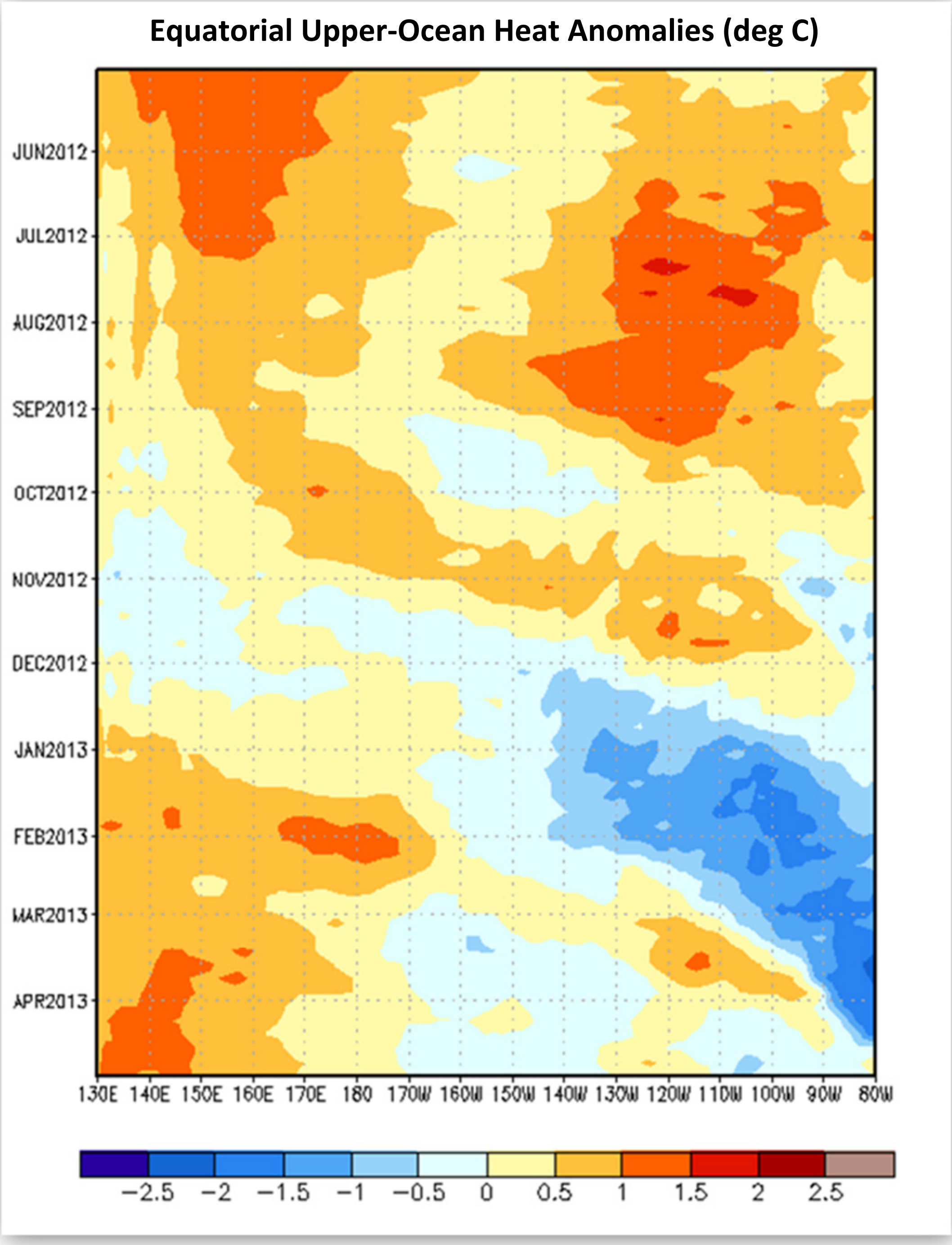
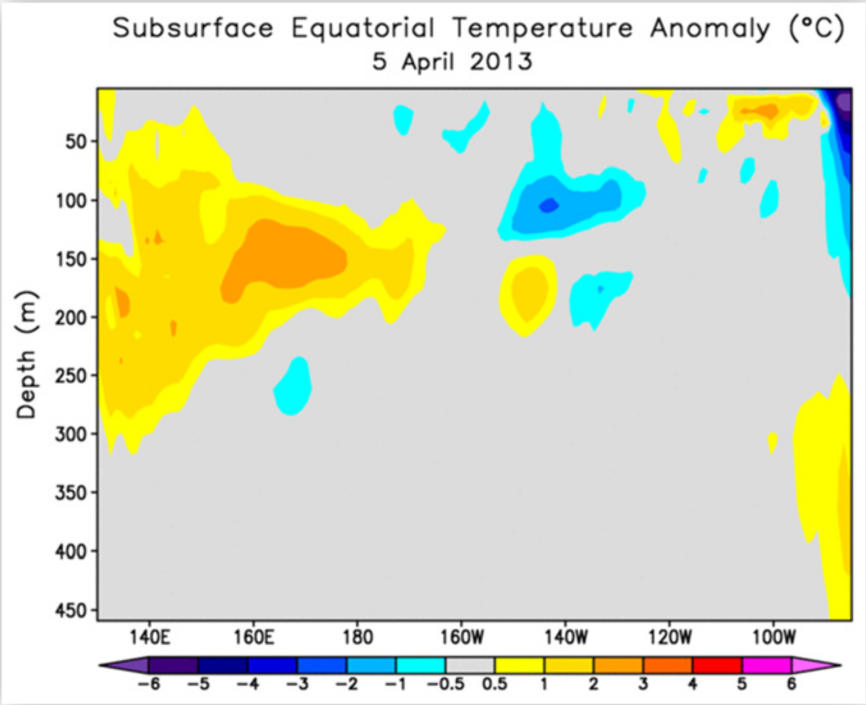


Figure 8. Equatorial Pacific upper oceanic heat content anomalies from May 2012 through May 2013. (Source: Figure from the NWS Climate Prediction Center)



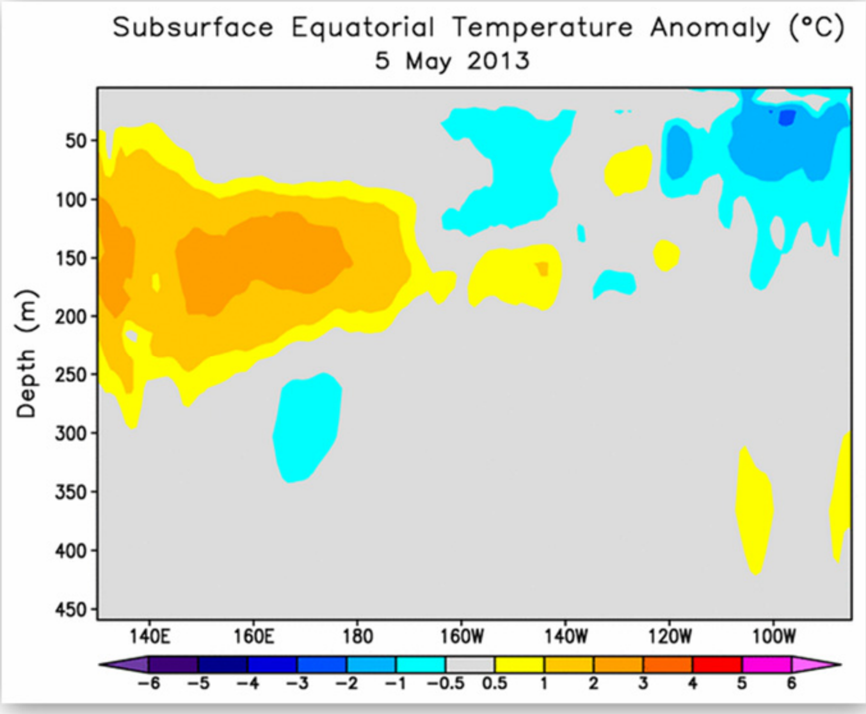


Figure 9. Subsurface equatorial ocean temperature anomalies on 5 April 2013 (top) and 5 May 2013 (bottom).

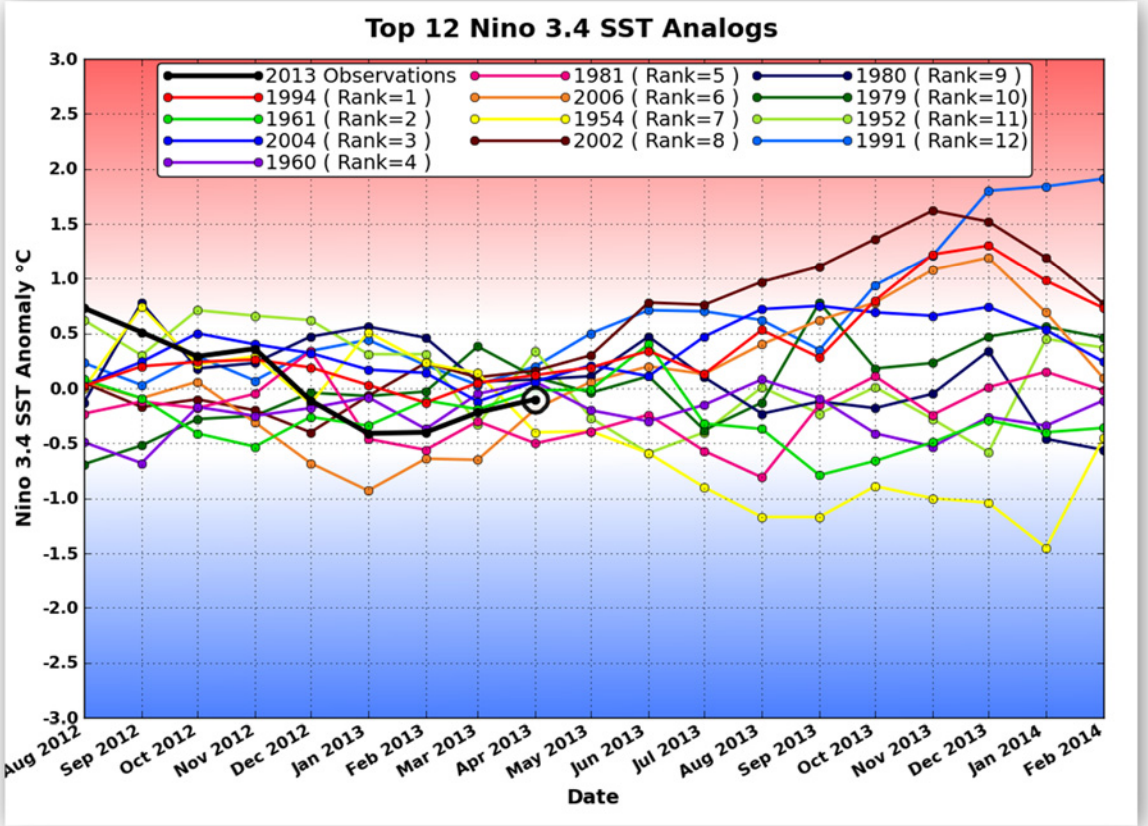


Figure 10. Observed nine-month Niño 3.4 SST anomalies since August 2012 (black line) and 18-month evolution of the twelve analog years (colored lines). The April 2013 Niño 3.4 anomaly is -0.10°C (black and white circle).

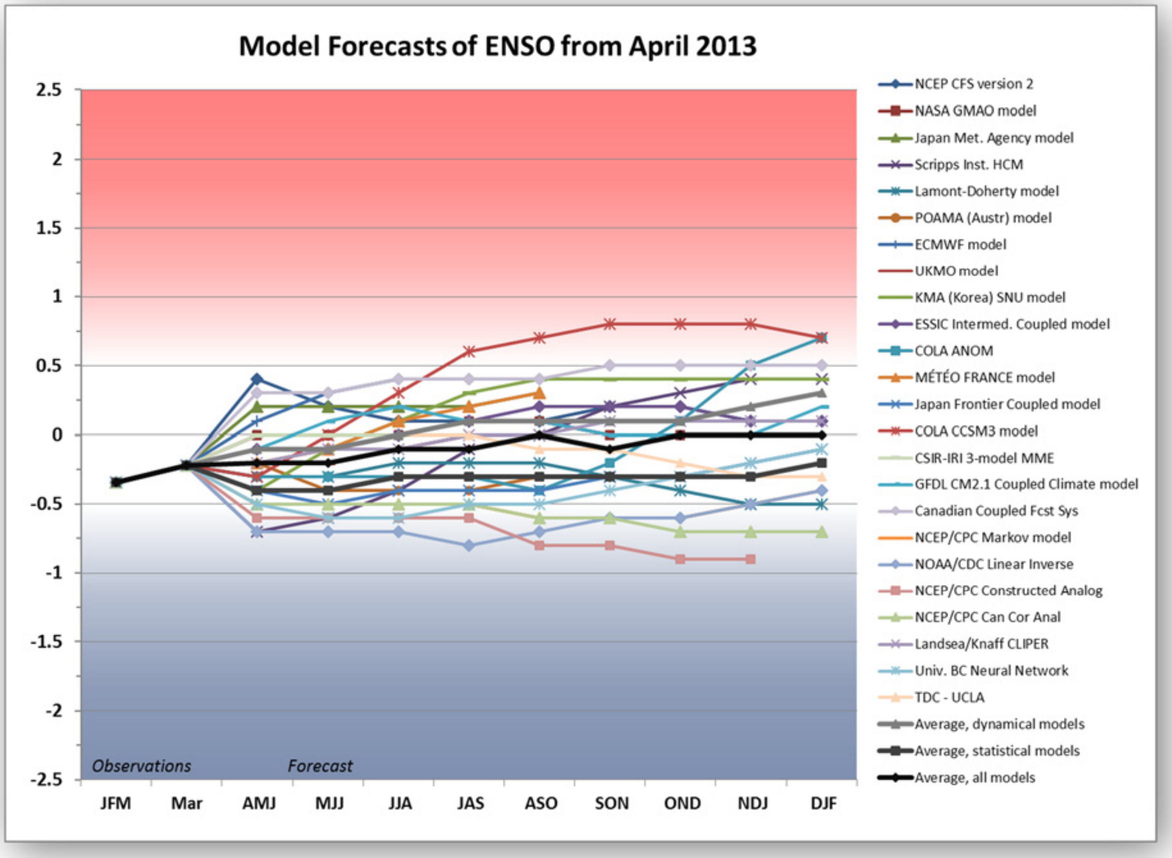


Figure 11. April 2013 nine-month ensemble prediction of Niño 3.4 SST anomalies. The ensemble prediction is composed of the best statistical and dynamical ENSO models from various national centers and international organizations. (Source: World Climate Service analysis of data from the International Research Institute for Climate and Society.)

Global SST Anomalies

To examine whether large-scale SST anomalies influence seasonal climate, the WCS regularly computes and monitors the North Atlantic and North Pacific SST anomalies using area-weighted basin-wide averages of daily NOAA SST analyses.

Late winter and early spring blocking caused SST anomalies in the North Atlantic to cool, however the high-latitude blocking has dissipated and SSTs in the North Atlantic are warming (Figure 12). The tropical North Atlantic has also warmed and consequently the Atlantic Multidecadal Oscillation (AMO) has become more positive and favors an active hurricane season. The basin-wide average SST anomalies in the North Pacific have been fluctuating between warmer than and cooler than normal in recent weeks (Figure 13). Most of these changes can be attributed to the fluctuations in the Pacific Decadal Oscillation (PDO), which is nearly neutral but warmed significantly in early April.

Two of the most notable changes in global SST anomalies from April to May have been the warming west of North America and the warming surrounding Europe (Figure 15). The warming in the North Pacific is largely responsible for the increase in the PDO index. These warmer SSTs appear to have been initialized in the May ECMWF and CFSv2 seasonal models, and consequently this is influencing the ECMWF forecast for North America. The ECMWF forecast for summer foresees the development of a positive phase of the PDO, resulting in cooler than average conditions in much of the central and eastern U.S. However, the observed warming in the Pacific does not appear to be part of a major shift in the PDO phase, so the WCS suspects that the ECMWF could be overreacting to the recent warming in the North Pacific. The warming SSTs surrounding Europe have been caused by a warmer pattern that developed as the North Atlantic blocking dissipated. With the coolest anomalies now dissipating, the surrounding ocean is no longer likely to bring localized cool anomalies to coastal countries in northwestern Europe.

Several regions around the globe have notable SST anomalies including the eastern tropical Pacific, the Gulf of Mexico, and the tropical Atlantic (Figure 16). The eastern tropical Pacific remains much cooler than average and shows no sign of a transition to El Niño at this point. The Gulf of Mexico is much cooler than normal and is likely to inhibit early season tropical storm development. However, from the Caribbean to the northwest coast of Africa, SST anomalies are much above average. Warmer than average SSTs in that region combined with ENSO neutral conditions (reduced wind shear) are likely to produce an Atlantic hurricane season that is more active than usual. The WCS expects that there will be 15-18 named storms, 7-10 hurricanes, and 3-5 major hurricanes. While the number of hurricanes that make landfall is difficult to predict, it is interesting to note that the U.S. has not seen a land-falling major hurricane (category 3 or stronger) for seven consecutive years, the longest stretch since the 1860s. The last major hurricane to strike the U.S. was hurricane Wilma in 2005.

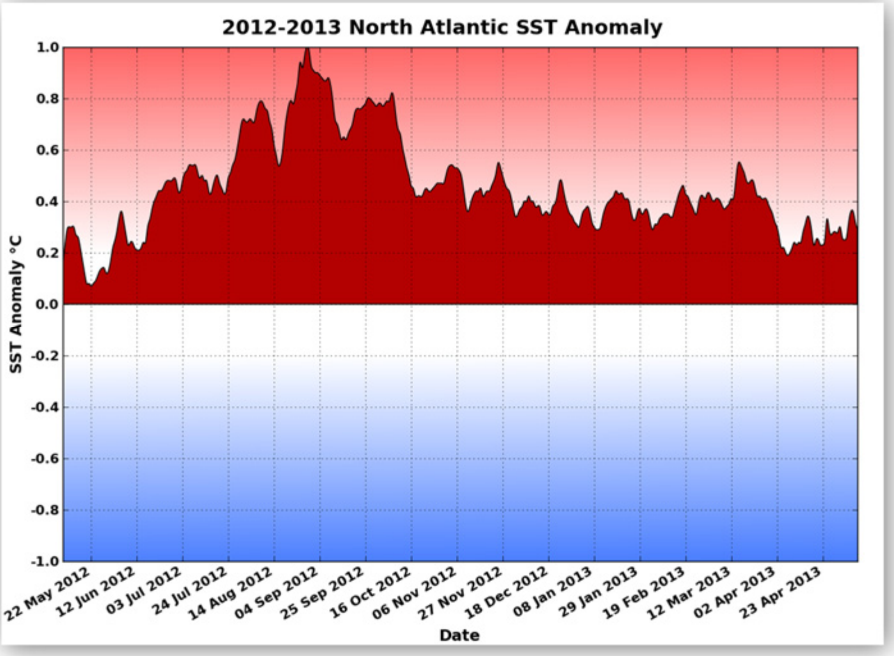


Figure 12. North Atlantic average SST 2012-2013 anomaly relative to 1981-present, obtained from daily NOAA AVHRR optimal interpolation version 2 data and averaged from 75°W to 0°E and from 0°N to 70°N.

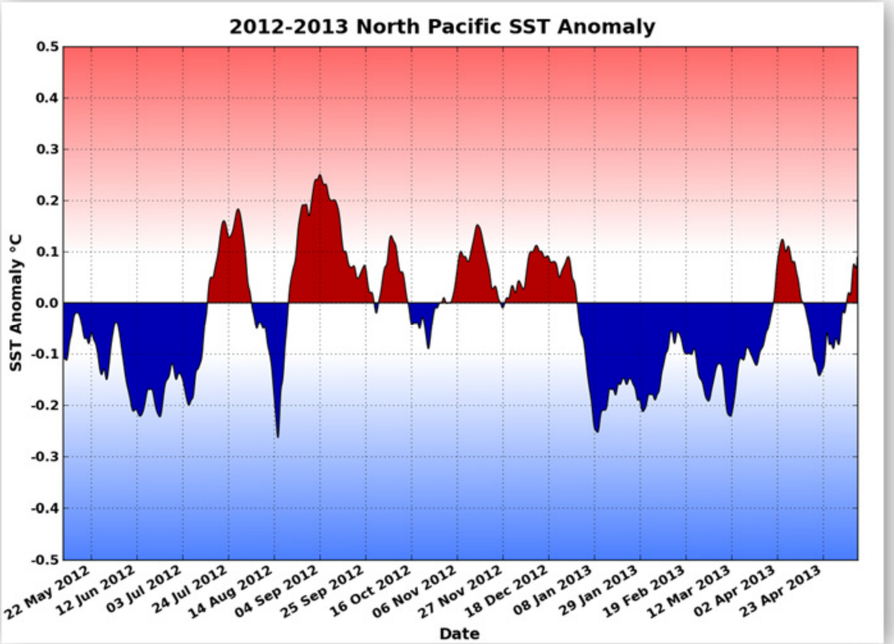


Figure 13. North Pacific average SST 2012-2013 anomaly relative to 1981-present, obtained from daily NOAA AVHRR optimal interpolation version 2 data and averaged from 120°E to 95°W and from 0°N to 70°N.

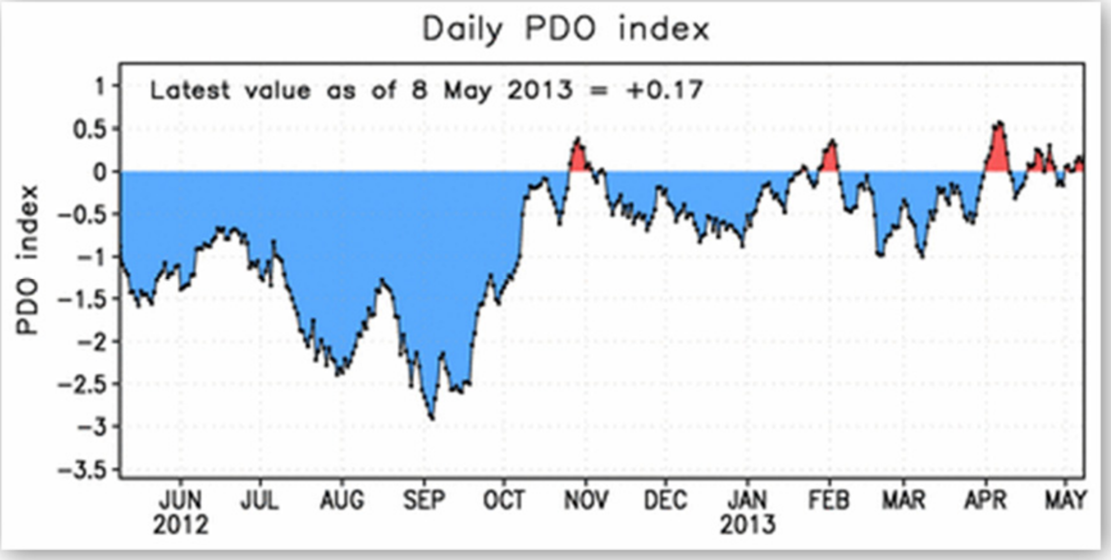


Figure 14. Daily PDO index from May 2012 through May 2013.

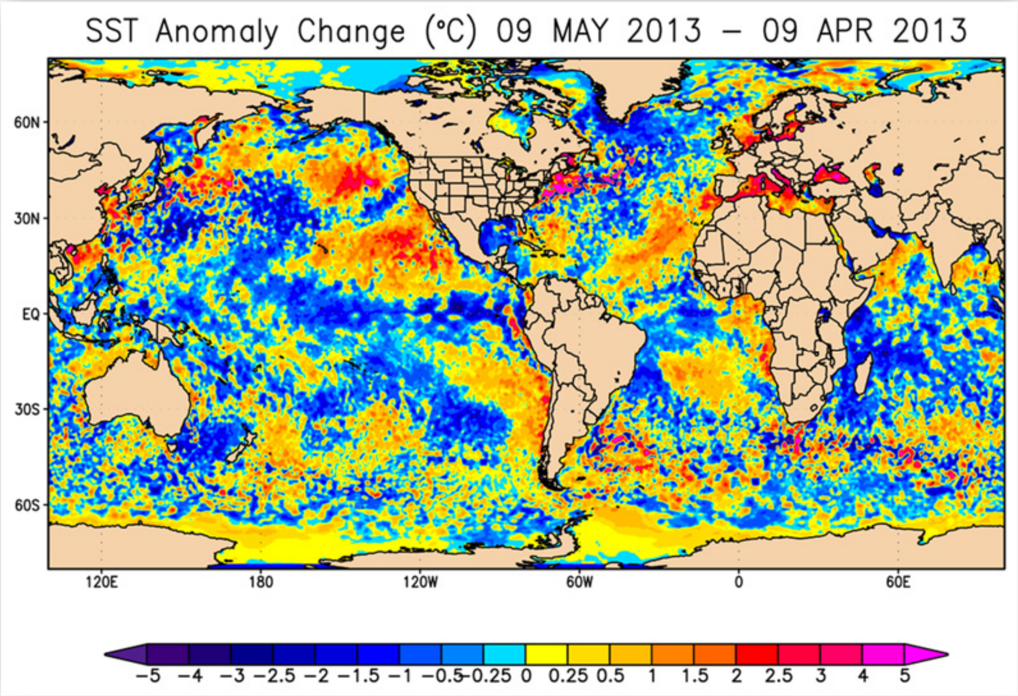


Figure 15. Global sea surface temperature anomaly change between 9 April 2013 and 9 May 2013.

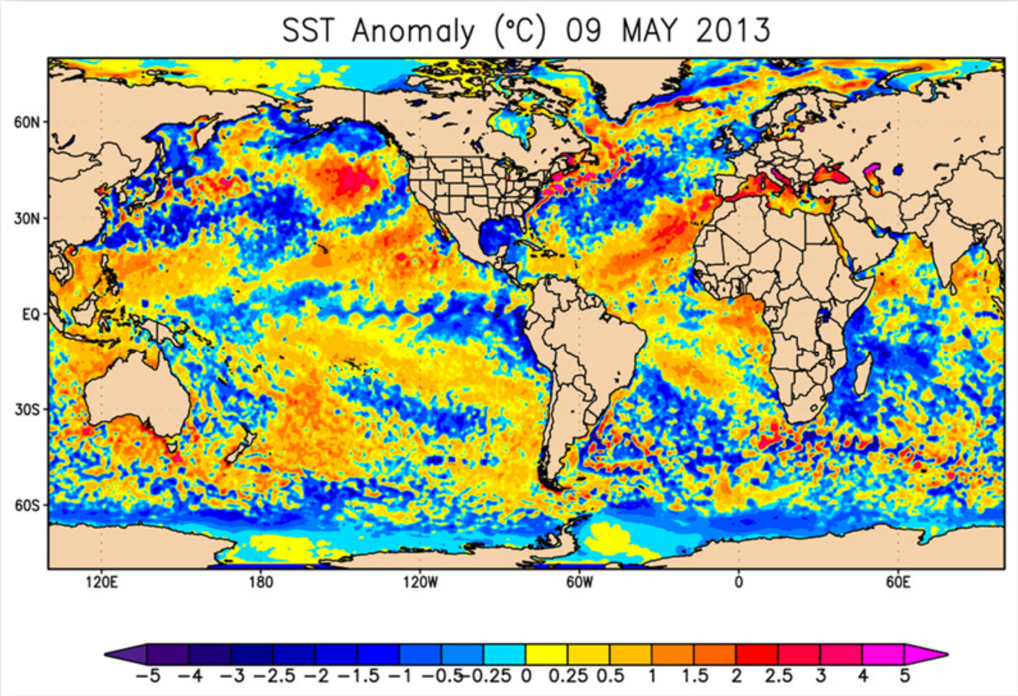


Figure 16. Global sea surface temperature anomaly on 9 May 2013.

North American Seasonal Outlook

The WCS outlook for summer seasonal variations in North America considers prognostic information from international computer probability models, historical analogs, and climatological analyses conditioned on major large-scale ocean indices such as the PDO, AMO, and ENSO.

Compared to last year, the spring patterns in North America have evolved much differently. First, snow cover and persistent cold lingered in the northern High Plains for much of early spring. The flow pattern has remained largely meridional, bringing significant cutoff lows and even snow in May to parts of the Midwest. Last year, the flow pattern was mostly zonal, locking the cold air in Canada and causing much above normal temperatures and dry conditions. Regardless of the forcing responsible for these contrasting patterns, it is quite evident that the flow patterns are different this year, and a repeat of the record-breaking dryness and heat in the Midwest seems unlikely.

The major ocean indices are nearly neutral, and thus the U.S. summer forecast is relying upon persistence and the effects of localized feedbacks from soil moisture and melting snow cover in northern Canada. In recent weeks, there have been frequent rains in the Plains, which has brought significant drought relief to the eastern High Plains. Throughout the spring, there has been a slow erosion of the drought from east to west, and thus it appears the driest conditions are shifting westward into the southern Rockies and into California. The U.S. drought monitor graphics from the Climate Prediction Center (CPC) illustrate this scenario quite well (Figure 17 and Figure 18). Thus, the WCS expects the warmest conditions to develop over the southern Rockies and extend westward to California. If the PDO were to turn negative again, coastal California might remain cooler.

With above normal snow pack in Alaska and the western territories of Canada, northwesterly flow from Canada could bring cooler than normal temperatures to the Upper Midwest, especially early in the summer. With a strongly negative PDO unlikely, there is an increased possibility of northwesterly flow in the Upper Midwest because a ridge would be more likely to develop along the west coast of North America. Thus the WCS expects cooler than average temperatures in the Upper Midwest and western Great Lakes region. With a trough centered over the Upper Midwest, a ridge may develop over New England and bring warmer and drier than usual summer conditions.

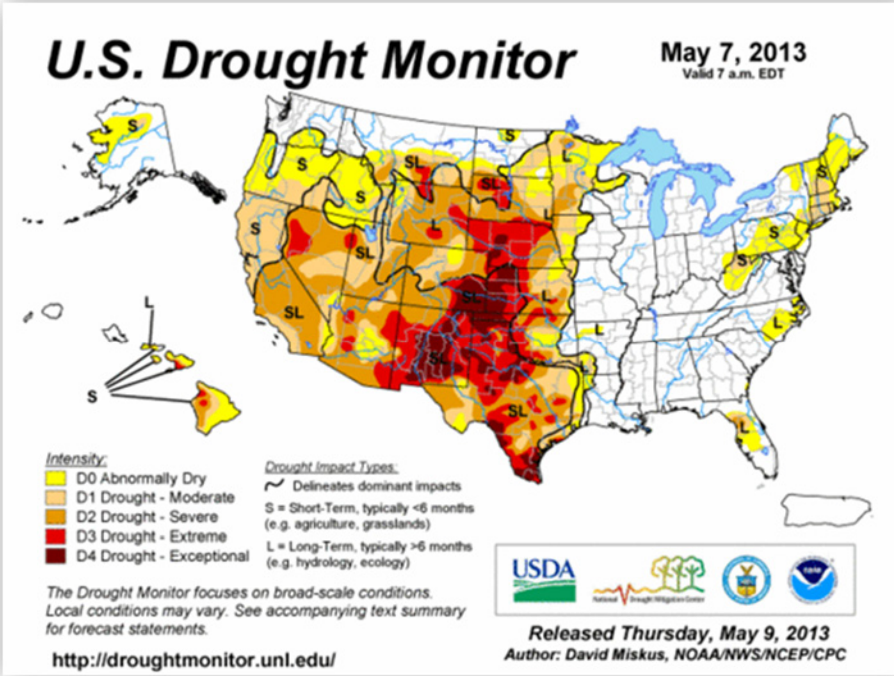


Figure 17. Climate Prediction Center U.S. Drought Monitor from 7 May 2013.

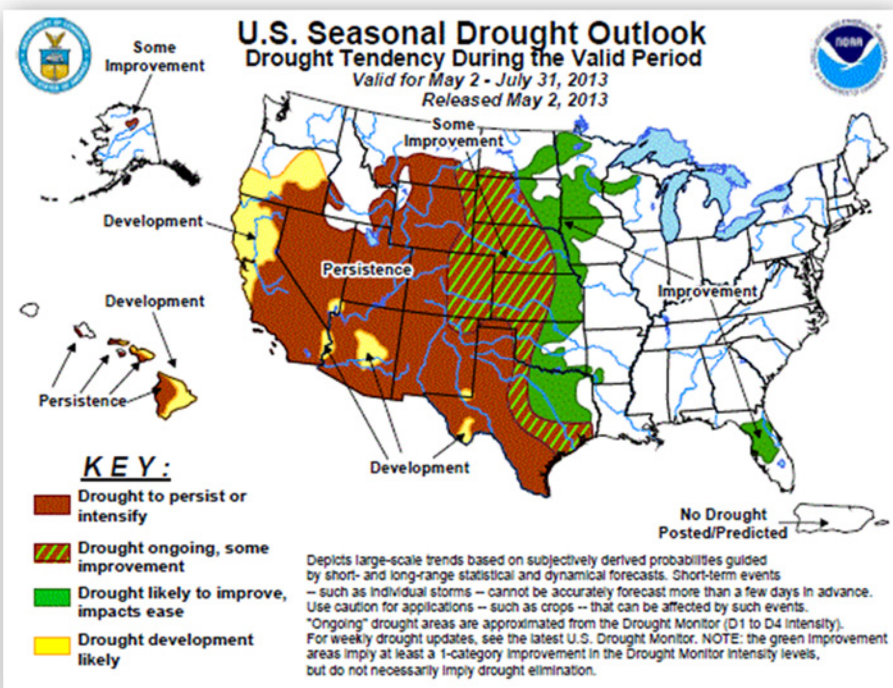


Figure 18. Climate Prediction Center U.S. Seasonal Drought Outlook from 2 May 2013.

Computer Model Guidance

With the major ocean indices nearly neutral, the North American WCS forecast for summer must rely on localized feedbacks such as soil moisture and the seasonal dynamical probability guidance. Unfortunately, the CFSv2 and ECMWF models do not show consistent forecast signals for summer (Figure 19 and Figure 20). The most noteworthy signal is the ECMWF's expectation of cooler than average temperatures from the Canadian Prairies to the Gulf Coast. Such a strong signal would normally warrant careful consideration in the forecast, but it appears that the cool pattern is associated with northwest flow and driven by the warm ridge that develops over the Pacific. As previously discussed, the ocean model in the ECMWF may be over intensifying the warm SST anomaly that has developed west of North America. The WCS believes this warm anomaly in the North Pacific is temporary and is likely to dissipate in the coming months as the PDO stays neutral or returns to the negative phase. Thus, the WCS foresees cooler than average temperatures over a smaller region in the Upper Midwest.

Unfortunately, the WCS multi-model based on these two models also offers little useful guidance for North America (Figure 21 and Figure 22). The multi-model foresees a ridge and unusually warm conditions near New England and warmer than normal temperatures in California. The combination of the much cooler than normal ECMWF forecast with the CFSv2 produces a slightly greater probability of cooler than average temperatures in the western Corn Belt. The multi-model precipitation forecast offers little guidance this month. Overall, the dynamical model guidance for summer is disappointing.

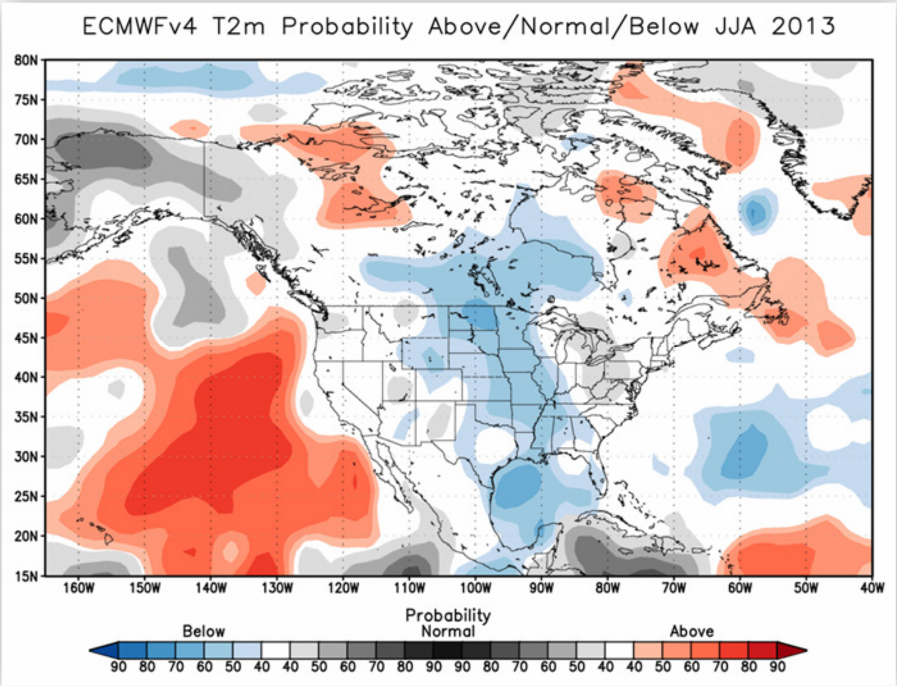


Figure 19. ECMWF temperature probability forecasts for summer (JJA 2013).

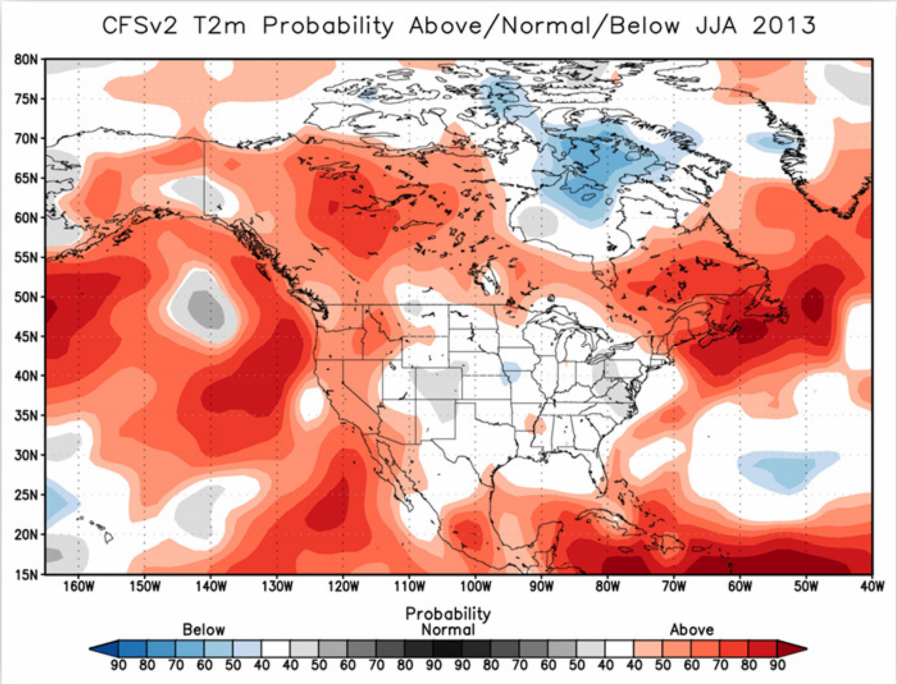


Figure 20. CFSv2 temperature probability forecasts for summer (JJA 2013).

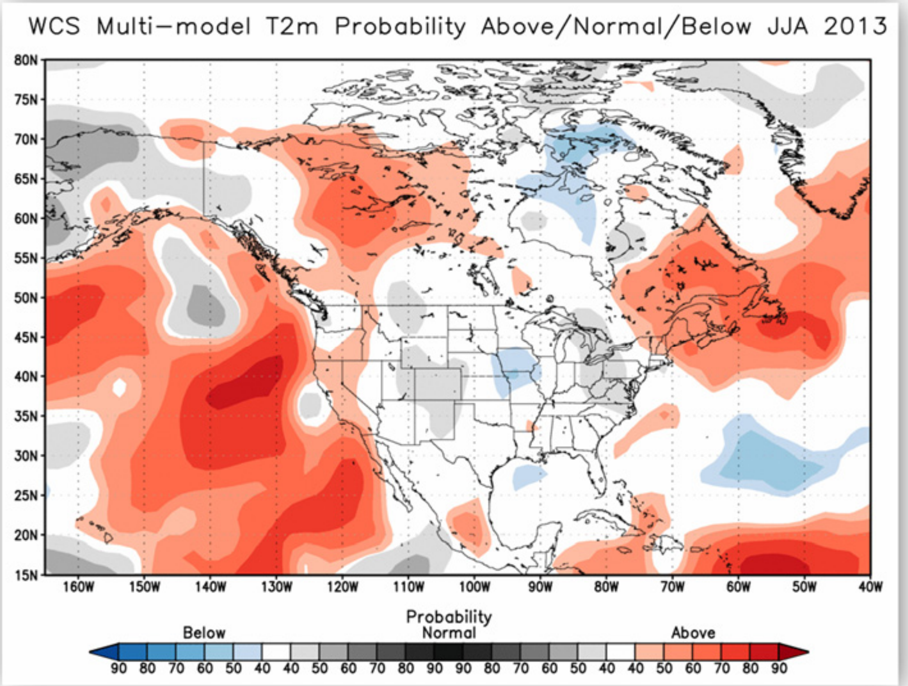


Figure 21. WCS multi-model (ECMWF and CFSv2) temperature probability forecasts for summer (JJA 2013).

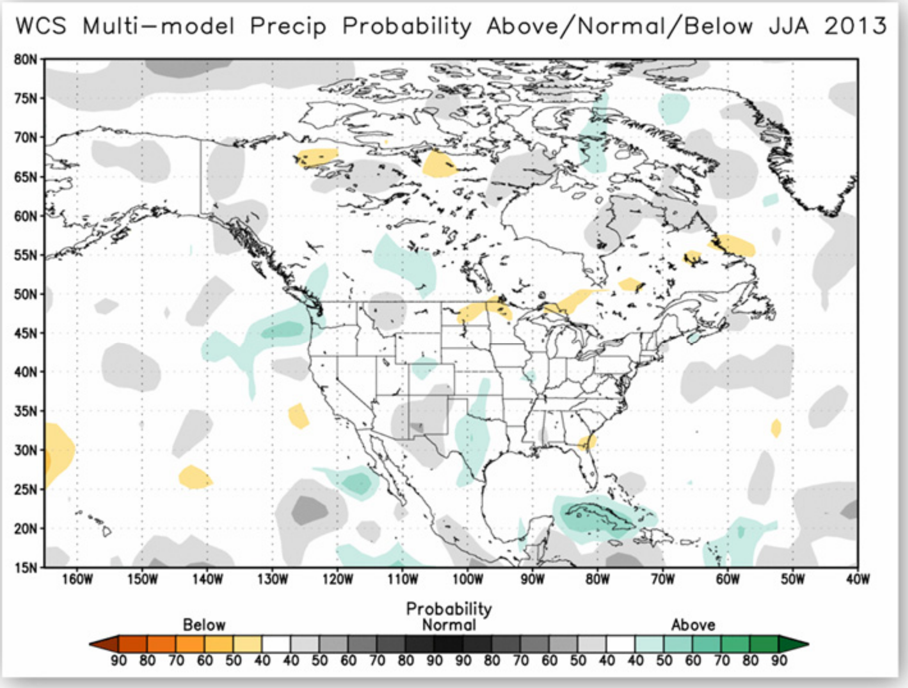


Figure 22. WCS multi-model (ECMWF and CFSv2) precipitation probability forecasts for summer (JJA 2013).

U.S. Summer (JJA) Analog Temperature and Precipitation Forecasts

The WCS developed two analog models based on the observed occurrence of climate-significant events to determine whether any robust statistical signals exist for summer.

Analog model 1 (ENSO Evolution): developed using the twelve years since 1950 that most closely match the nine-month evolution of Niño 3.4 SST anomalies. This is the same set of years used in Figure 10. The analog forecast years for summer include 1952, 1954, 1960, 1961, 1979, 1980, 1981, 1991, 1994, 2002, 2004, and 2006.

Analog model 2 (Southern Rockies and Southern Plains Drought – Record Minimum May PDSI): compiled from the analog years beginning in 1895 with a near record minimum Palmer Drought Severity Index (PDSI) during May in Oklahoma, Kansas, New Mexico, and Colorado. The analog years for summer include 1925, 1934, 1953, 1954, 1955, 1956, 1963, 1964, 2006, and 2012.

The analog probabilities are computed for each climate division by counting the number of years with above-normal temperatures or precipitation and dividing by the total number of analog years. The probabilities for below normal can then be inferred or computed by subtracting the above-normal probability from 100 percent; in other words, the below-normal probability is the complement of the above-normal probability. Such analog probabilities are more robust than the ensemble mean since they cannot be skewed by a very strong anomaly in a single year.

Analog Temperature Forecasts

The ENSO evolution analog indicates a wide range of scenarios in the tropical Pacific, and thus the summer forecast signal is not particularly robust. Nevertheless, the ENSO analog for summer foresees generally warmer than average temperatures in the western third of the U.S., with cooler than average conditions in the eastern Great Lakes (Figure 23). The highest probability of warm conditions is in the central Rockies.

As already shown, the most severe drought conditions are centered near the Colorado, Kansas, Oklahoma, and New Mexico borders (Figure 17). While the eastern parts of Oklahoma and Kansas have seen significant drought relief, these four states are considered the focal point when comparing the current drought conditions to previous years. Thus, the WCS developed an analog from the 10 years with the smallest May PDSI value averaged over all climate divisions from the four states. Interestingly, four consecutive analog years were found from 1953-1956, a four-year period when the PDO was among the most negative on record. With the PDO now becoming neutral or even slightly positive, it is possible this analog is not as robust as it seems, or the pattern could be displaced westward. Nevertheless, the analog probabilities are quite remarkable and are certainly worth examining given the lack of other strong climate forcing. The drought analog indicates a high probability of warmer than average temperatures from the Front Range to the Mississippi Valley (Figure 24). Many of the climate divisions show at least 9 out of 10 years with above normal temperatures, quite remarkable for a simple soil moisture analog. The expectation of cool conditions along the West Coast is likely a result of a negative PDO during the analog years. The WCS expects that this pattern will be displaced farther westward this summer because of the more neutral PDO.

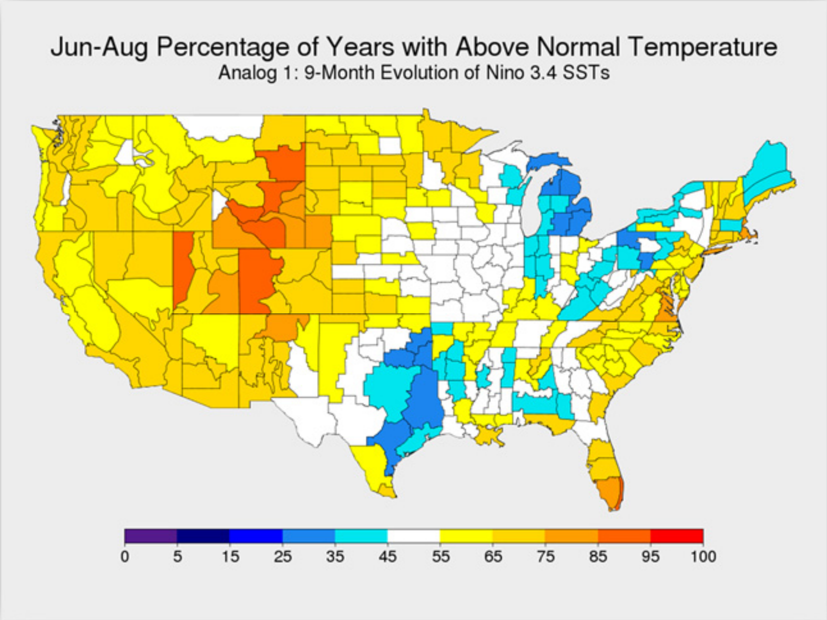


Figure 23. Analog model 1: Percentage of years with above-normal temperatures during June through August from analog years (1952, 1954, 1960, 1961, 1979, 1980, 1981, 1991, 1994, 2002, 2004, and 2006) most closely matching the Niño 3.4 SST anomalies from the prior year period August through April.

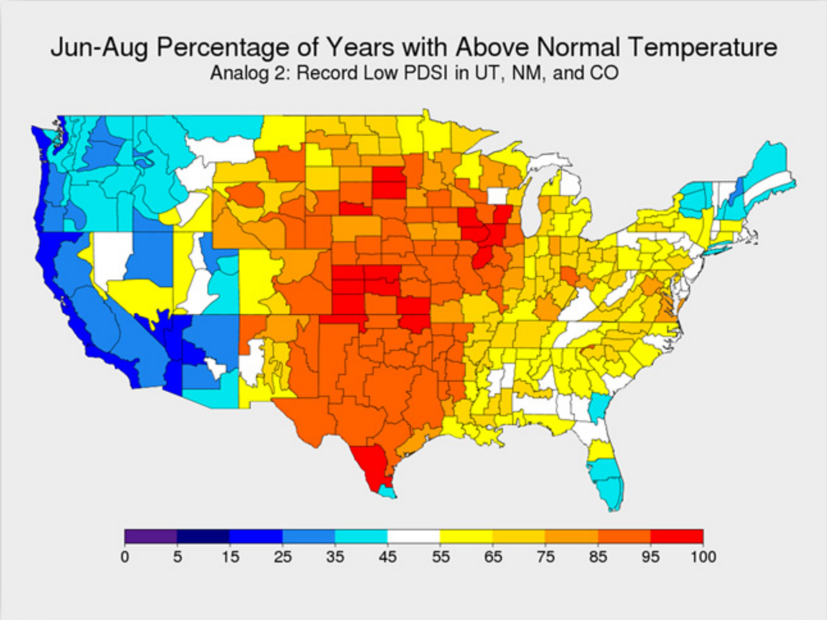


Figure 24. Analog model 2**:** Percentage of years with above-normal temperatures during June through August from analog years (1925, 1934, 1953, 1954, 1955, 1956, 1963, 1964, 2006, and 2012) having near record minimum PDSI in the southern Rockies and southern Plains during May.

Analog Precipitation Forecasts

The summer precipitation forecasts from the ENSO analog indicate dry conditions in the Southwest and northern Rockies and moist conditions near the Great Lakes, consistent with the WCS expectations (Figure 25).

The drought analog foresees a precipitation pattern that is nearly as robust as the drought analog temperature pattern. A high probability of dry conditions is expected from the southern Plains into the Ohio Valley (Figure 26). Normally such an analog would be highly regarded, but since the PDO is not in a similar state as many of the analog years, the driest conditions are likely to be centered farther west. If the PDO becomes significantly more negative in the coming months, then the drought analog scenarios would be more probable.

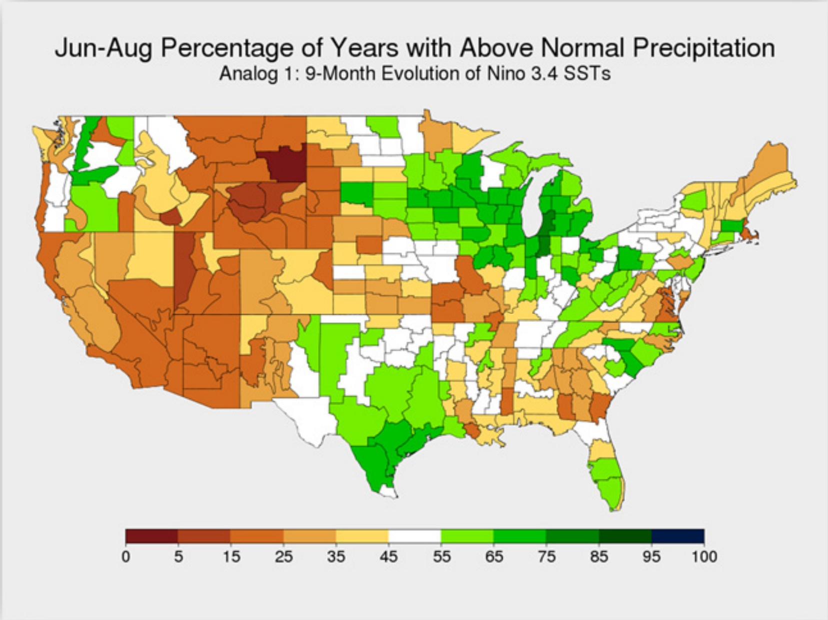


Figure 25. Analog model 1: Percentage of years with above-normal precipitation during June through August from analog years (1952, 1954, 1960, 1961, 1979, 1980, 1981, 1991, 1994, 2002, 2004, and 2006) most closely matching the Niño 3.4 SST anomalies from the prior year period August through April.

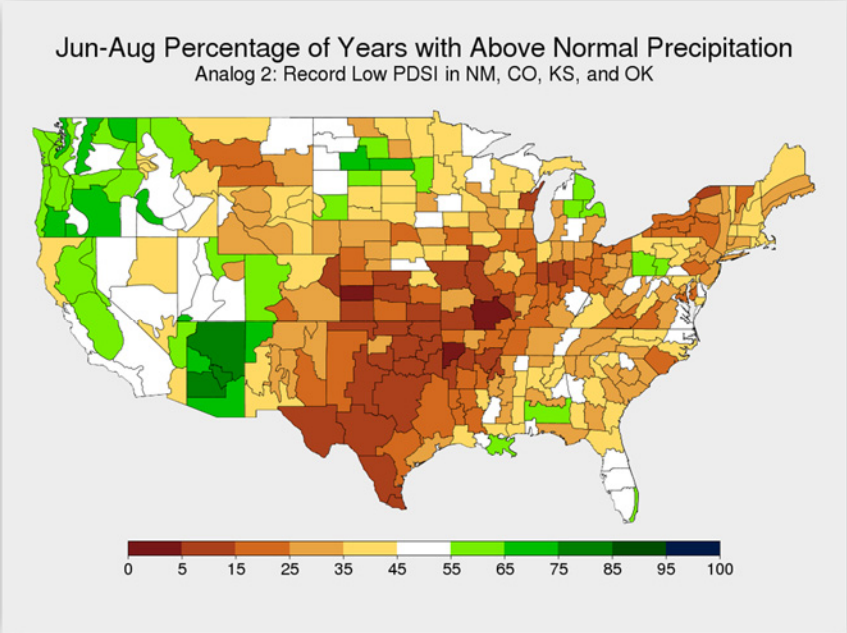


Figure 26. Analog model 2**:** Percentage of years with above-normal precipitation during June through August from analog years (1925, 1934, 1953, 1954, 1955, 1956, 1963, 1964, 2006, and 2012) having near record minimum PDSI in the southern Rockies and southern Plains during May.

European Seasonal Outlook

Climate anomalies in Europe have been influenced in recent weeks by a continued tendency for relatively weak westerly flow throughout the mid-latitudes and a lack of progression of significant weather features. While the North Atlantic Oscillation (NAO) and Arctic Oscillation (AO) phases have returned to positive or neutral, blocking episodes have continued to develop but at lower latitudes and in different locations from the canonical NAO and AO patterns. Foremost among the anomalies affecting Europe has been a strong ridge over southeast Europe that has brought much-above normal temperatures and dry conditions to southeast Europe and far southwest Russia. The lack of rainfall in Ukraine and southern Russia is of concern to agricultural interests, although long-term drought concerns were alleviated by a relatively wet winter in much of Ukraine and southeast Europe.

North Atlantic Oscillation Guidance

The analog and dynamical model guidance for the NAO agrees in suggesting that a negative phase is likely in June (Table 1 and Table 2, Figure 27 and Figure 28), but there is disagreement and uncertainty concerning the phase during the rest of the summer. Both the CFSv2 and ECMWF forecasts show a positive NAO index by August, but the WCS analogs do not show a strong signal one way or the other. Very little value can be ascribed to the dynamical model NAO forecasts at this time of year, because the historical reforecasts show that there is very little skill. However, the good agreement in the outlook for June suggests that unsettled, damp weather may be likely to affect Britain and France in June.

Analog Set	June	July	August	JJA
ENSO	30 %	60 %	40 %	30 %
PDO	50 %	60 %	50 %	60 %
WCS-SST	50 %	70 %	40 %	60 %
AMO	40 %	30 %	30 %	20 %
NAO	40 %	40 %	30 %	30 %
AO	30 %	50 %	50 %	50 %
QBO	30 %	80 %	60 %	60 %
Mean	38.6 %	55.7 %	42.9 %	44.3 %

Table 1. Frequency of positive average NAO (Climate Prediction Center) index values in June through August for sets of ten years in which analog indices were most similar to values in February through April 2013.

Analog Set	June	July	August	JJA
ENSO	30 %	40 %	50 %	40 %
PDO	50 %	40 %	40 %	40 %
WCS-SST	50 %	80 %	50 %	60 %
AMO	40 %	20 %	20 %	30 %
NAO	40 %	30 %	50 %	40 %
AO	30 %	40 %	50 %	20 %
QBO	20 %	50 %	70 %	30 %
Mean	37.1 %	42.9 %	47.1 %	37.1 %

Table 2. Frequency of positive average NAO (Climatic Research Unit) index values in June through August for sets of ten years in which analog indices were most similar to values in February through April 2013.

ECMWF Monthly NAO Forecasts (EOF Method)
Bias–Adjusted Ensemble Average

Forecast Made \ Forecast For	JUN2013	JUL2013	AUG2013	SEP2013	OCT2013	NOV2013
MAY 2013	−0.38	−0.04	+0.42	+0.14	+0.08	+0.13
APR 2013	−0.27	+0.30	+0.46	−0.10	+0.19	
MAR 2013	−0.26	+0.16	+0.66	−0.09		
FEB 2013	−0.26	+0.35	+0.38			
JAN 2013	−0.15	+0.22				
DEC 2012	−0.14					

Figure 27. ECMWF ensemble mean monthly forecasts of the NAO (Climate Prediction Center) index.

CFSv2 Monthly NAO Forecasts (EOF Method)
Bias–Adjusted Ensemble Average

Forecast Made \ Forecast For	JUN2013	JUL2013	AUG2013	SEP2013	OCT2013	NOV2013
MAY 2013	−0.31	+0.38	+0.52	+0.07	+0.29	+0.21
APR 2013	+0.24	+0.47	+0.72	+0.16	+0.19	
MAR 2013	−0.07	+0.13	+0.71	+0.18		
FEB 2013	−0.36	+0.38	+0.74			
JAN 2013	−0.16	+0.27				
DEC 2012	+0.26					

Figure 28. CFSv2 ensemble mean monthly forecasts of the NAO (Climate Prediction Center) index.

Computer Model Guidance

In contrast to last month's dynamical model forecasts for early summer (May through July), the latest ECMWF and CFSv2 temperature forecasts for summer (June through August, JJA) are in very strong disagreement for most of Europe (Figure 29 and Figure 30). The ECMWF forecast shows below-normal temperatures persisting across northern and western Europe throughout the summer and now shows a colder scenario than in last month's forecast, especially for August. However, the new CFSv2 forecast is dramatically warmer than last month's forecast. The CFSv2 shows above-normal temperatures throughout the summer over western Britain and Ireland, over northern Scandinavia, and also in western Russia and the central Mediterranean. The cold anomaly over the North Sea that was previously a notable feature of the forecast is now quite unremarkable.

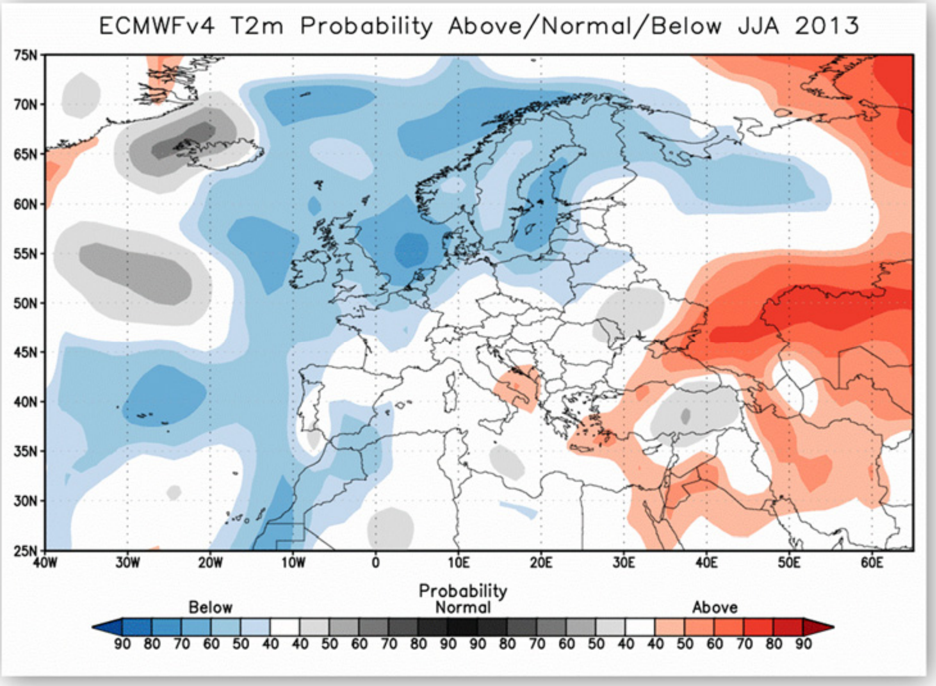


Figure 29. ECMWF temperature tercile probability forecast for June through August 2013.

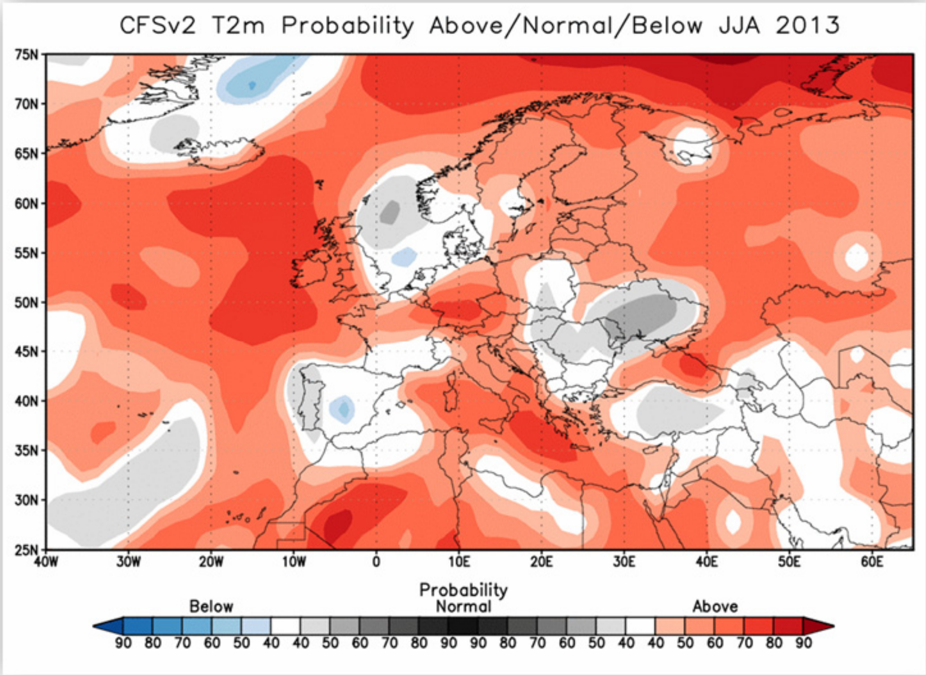


Figure 30. CFSv2 temperature tercile probability forecast for June through August 2013.

The dramatic change in the CFSv2 temperature forecast is unusual, and the divergence between the models raises doubts about the ability of either model to accurately foresee the summer anomalies. It is possible that the CFSv2 model has responded to significant warming at the sea surface in the waters surrounding Europe over the past month, but it is not clear why the ECMWF model would trend in the opposite direction. World Climate Service analysis of the historical reforecasts has revealed a general tendency for the CFSv2 model to outperform the ECMWF model in temperature forecasts for Europe, and the Bayesian multi-model technique also overweights the CFSv2 forecast; thus the multi-model forecast generally agrees with the CFSv2 but with smaller amplitude (Figure 31).

The computer precipitation forecasts show less disagreement than the temperature forecasts, with both models indicating generally above-normal precipitation in southern Europe and the Mediterranean basin and dry conditions in far southeastern Europe and southern Russia. Both models also show dry conditions in Scandinavia in June, but the signals are mixed for July and August in the north. The multi-model forecast with its characteristically small probabilities is shown in Figure 32.

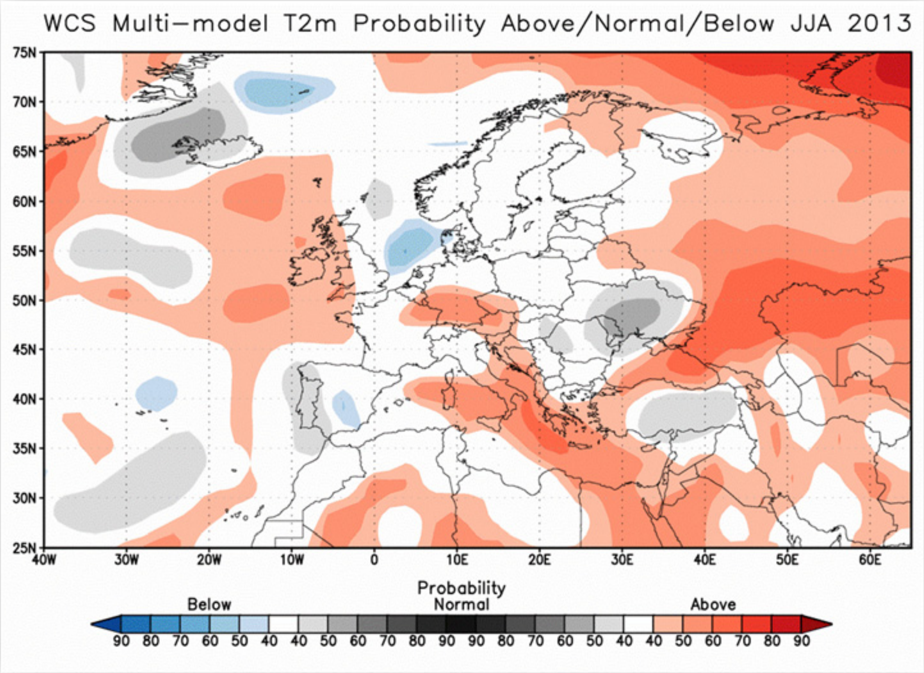


Figure 31. WCS Bayesian multi-model blend of the ECMWF and CFSv2 temperature forecasts for June through August 2013.

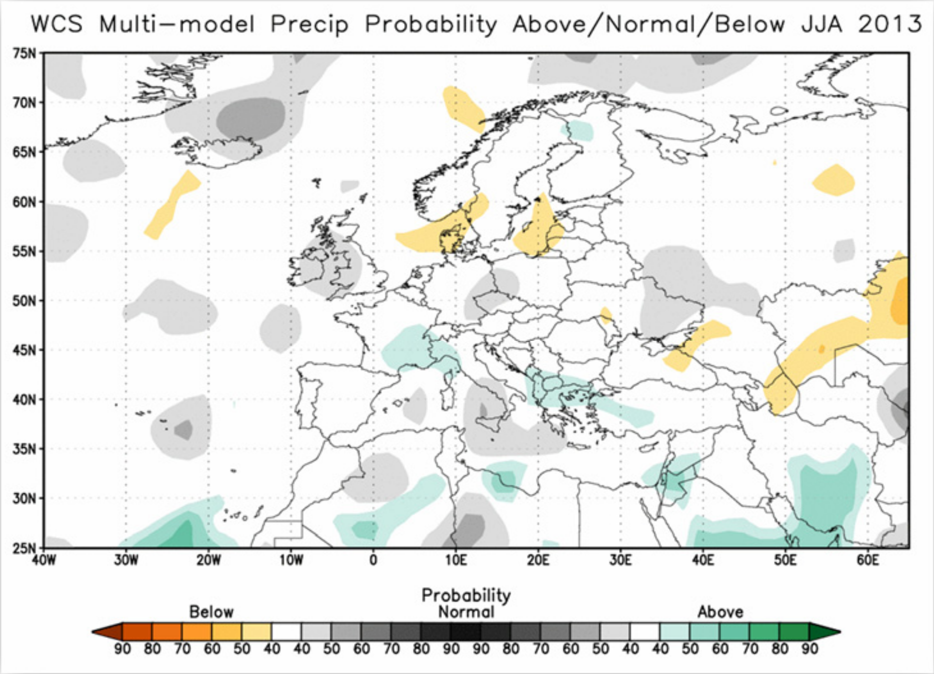


Figure 32. WCS Bayesian multi-model blend of the ECMWF and CFSv2 precipitation forecasts for June through August 2013.

Analog Guidance

A useful analog for the summer climate anomalies in Europe is available from the current behavior of the Quasi-Biennial Oscillation, which appears likely to reach its cyclical peak during summer 2013. The last QBO peak was in the spring of 2011, and the cycle is usually a little over two years in length. Given that the average QBO index value for JJA is likely to be above 10, this summer will be one of the most strongly positive QBO summers since 1950; the observed temperature and precipitation patterns in such years are shown in Figure 33 and Figure 34. The QBO analog indicates a relatively high likelihood of unusual warmth from Britain to the Baltic and in the central Mediterranean and of unusual dryness in much of Scandinavia.

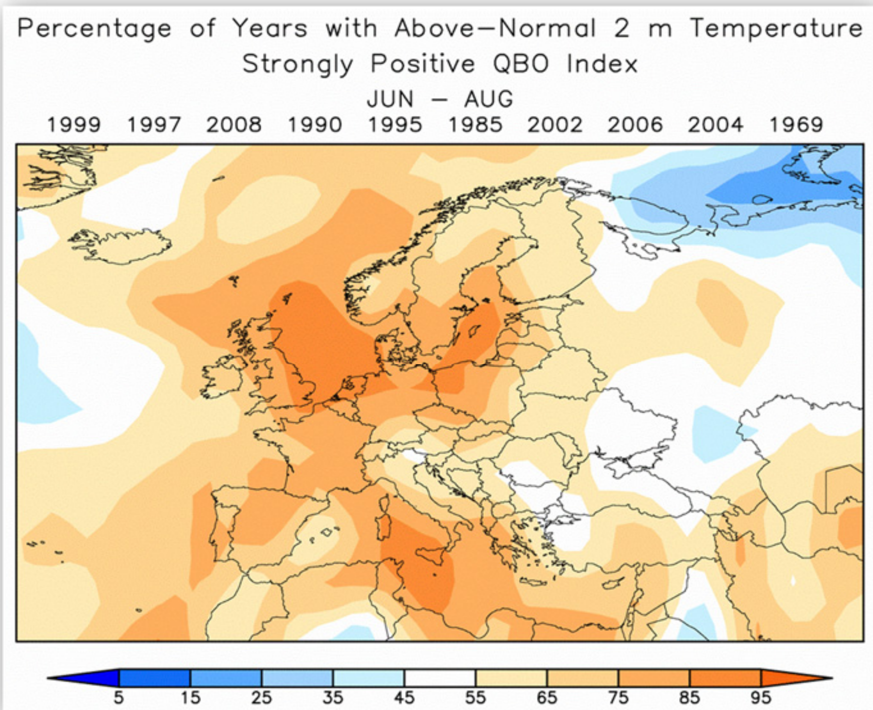


Figure 33. Conditional climatology of temperature anomalies in June through August for 10 years since 1950 in which the summer (JJA) QBO index was strongly positive.

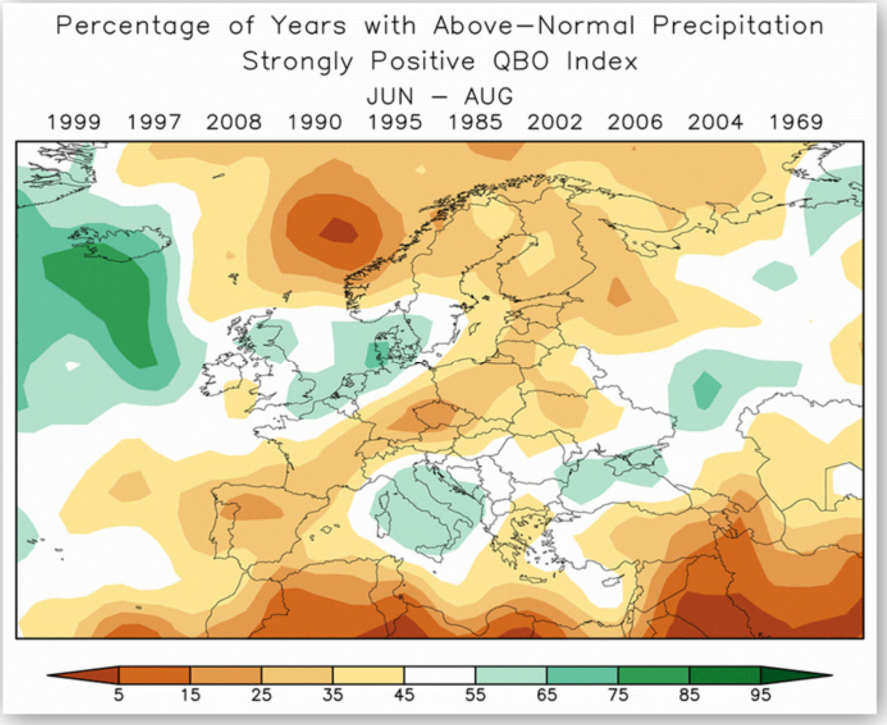


Figure 34. Conditional climatology of precipitation anomalies in June through August for 10 years since 1950 in which the summer (JJA) QBO index was strongly positive.

An alternative analog involving the QBO was obtained by examining only the QBO analog years (positive QBO index in JJA) in which the NAO phase was negative in March and in which the AMO phase was positive in January through April. Since 1950, these events have occurred together in 1955, 1969, and 2006, with 1953 and 1959 being more marginal matches. The JJA temperature and precipitation anomalies from these years are shown in Figure 35; a more detailed inspection can be obtained using the WCS Reanalysis Mapping page under Climate Analysis Tools. Remarkably, certain similarities appear in all five of the years, including unusual warmth in Scandinavia, unusual coolness near Italy and the Adriatic Sea, and unusually wet conditions near the Alps. Four of the five years experienced a dry summer in the vicinity of the Baltic Sea.

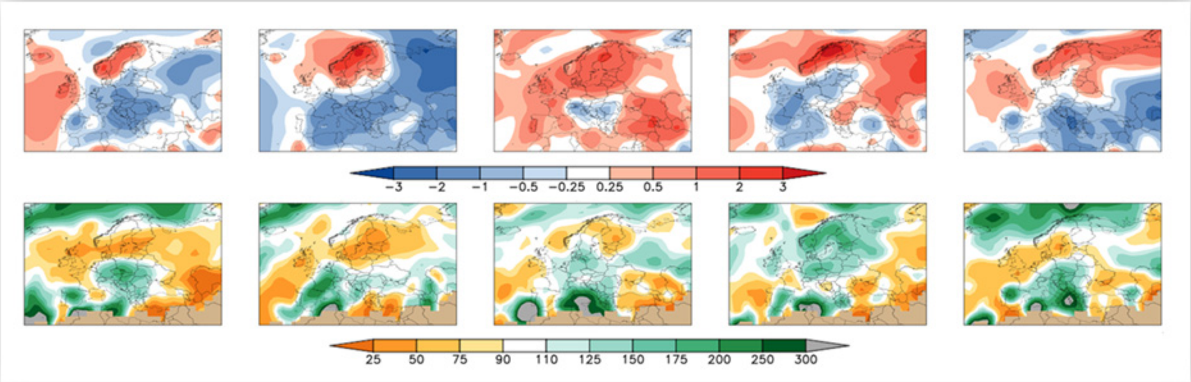


Figure 35. July-August average temperature (top row, °C) and precipitation (bottom row, percent of normal) anomalies in QBO analog years. The years from left to right are 1955, 1969, 2006, 1953, and 1959. These images may be inspected in more detail on the Reanalysis Mapping page on the WCS website under Climate Analysis Tools.

In addition to analogs involving the QBO, the usual sets of analogs based on oceanic and atmospheric climate indices were examined. Considerable variability was evident among the analog patterns, and some of the SST analogs (e.g. PDO, ENSO) were believed to be unreliable owing to the near-neutral phase and lack of variability in the respective SST indices. An analog that may be more robust is based on a WCS index of sea surface temperatures in the North Pacific (independent of the PDO), which have undergone substantial change in the past two months. In the most similar past years, the European summer was often characterized by cool conditions in the west and south and by above-normal rainfall in the eastern Alps and east-central Europe (Figure 36 and Figure 37).

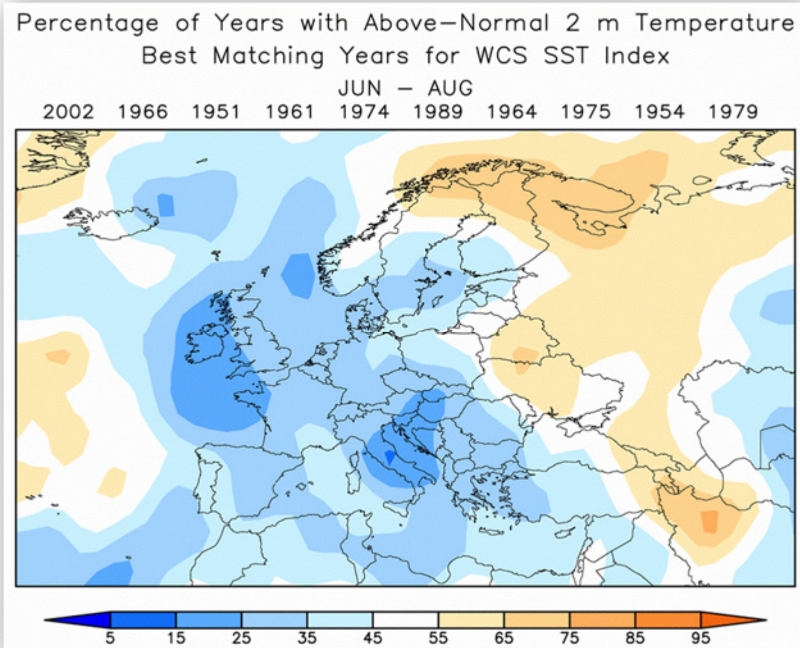


Figure 36. Conditional climatology of temperature anomalies in June through August for 10 years since 1950 in which the WCS SST index most closely matched the evolution in February through April 2013.

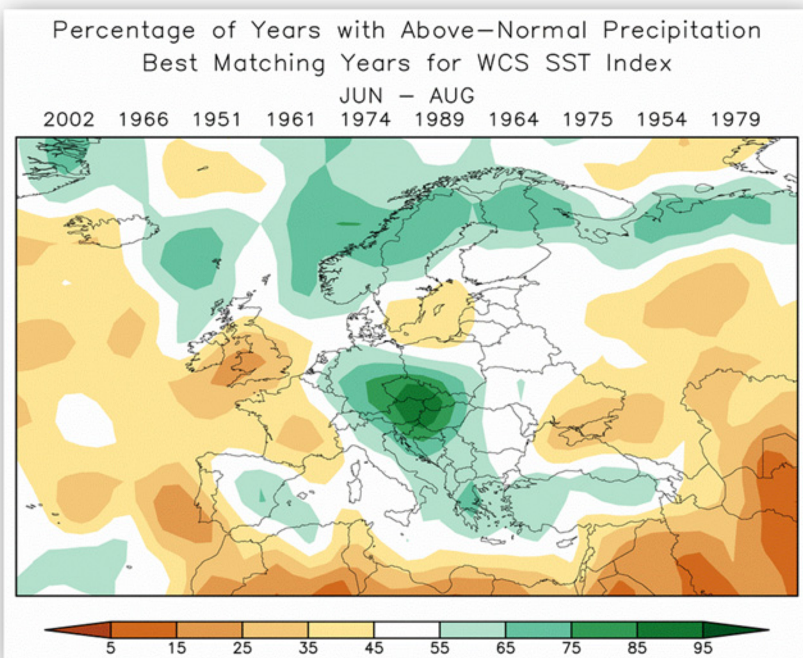


Figure 37. Conditional climatology of precipitation anomalies in June through August for 10 years since 1950 in which the WCS SST index most closely matched the evolution in February through April 2013.

Europe Summary

The World Climate Service outlook for summer in Europe is considerably different from the early outlook for JJA that was presented in the April forecast discussion. In particular, the persistence of cool conditions near the North Sea no longer seems especially likely for the seasonal average. The remarkable change in the CFSv2 forecast, showing much warmer conditions across most of northern and western Europe, reduces the probability that below-normal temperatures will prevail, and the stark disagreement between the leading models also reduces the confidence in the eventual outcome. However, both models now show warm conditions from the eastern Mediterranean to southern Russia and therefore bolster the WCS expectation for warm, dry conditions in eastern Ukraine and far southern Russia.

The history of past years in which a QBO maximum occurred in summer suggests quite strongly that above-normal temperatures are most likely in Scandinavia and below-normal temperatures near Italy and the Adriatic Sea. The accompanying precipitation anomalies typically involve above-normal rainfall near the Alps and unusual dryness near the Baltic Sea. An analog based on Pacific SSTs shows a similar outcome for south-central Europe. Thus in the absence of convincing computer model guidance, the WCS temperature forecast is similar to the consensus of these analogs. For precipitation, a broader region of above-normal rainfall is indicated from the Pyrenees to the Balkans, as the computer forecasts also indicate a wet summer throughout the south.

Confidence in the summer forecast for Europe is moderate from Ukraine eastward and low to moderate elsewhere.

Contact Information

For further information contact:

Jeremy D. Ross, Ph.D
jeremy.ross@prescientweather.com
814 380 9799

Richard P. James, Ph.D
richard.james@prescientweather.com
706 206 7380

John A. Dutton, Ph.D
john.dutton@prescientweather.com
814 466 2231