

# Global Water Monitor & Forecast Watch List

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## Introduction

The ISciences Water Security Indicator Model (WSIM) monitors and forecasts water anomalies on a global basis. Each month we produce data and a report that document current conditions and provide forecasts with lead times from 1-9 months. WSIM has been run continuously since April 2011 and has been validated against subsequently observed data.

ISciences also provides assessments of the impacts of water anomalies on people, agriculture, and electricity generation. Detailed data and reports are available for purchase. Additional information and pricing are available upon request.

We have recently completed the latest Water Security Indicator Model (WSIM) analysis of global water anomalies using observed temperature and precipitation through April 2019 and an ensemble of forecasts issued the last week of April 2019. This edition of *Global Water Monitor & Forecast Watch List* presents a selection of regions likely to encounter significant water anomalies in the next few months.

All maps have half-degree resolution and depict our composite water anomaly index, which is based on WSIM estimates of soil moisture, evapotranspiration deficit, runoff, and total blue water anomalies. Shades of red indicate deficits and shades of blue indicate surpluses. Since different variables are used to estimate deficits and surpluses, it is possible for a single half-degree cell to register both a deficit and a surplus in a given month. These cases are depicted on the maps in shades of purple, with the more extreme value (deficit or surplus) used to determine the shade.

Deficits and surpluses are stated in terms of return period – a measure that characterizes the rarity of an anomaly. For example, a return period of 10 years indicates an anomaly that would occur, on average, once every ten years. Higher return periods indicate more extreme and, therefore, more disruptive anomalies. Anomaly levels correspond to return periods: abnormal=3-5 years, moderate=5-10 years, severe=10-20 years, extreme=20-40 years, and exceptional=greater than 40 years. Return period is computed by comparison to cell-specific distributions of data from 1950 through 2009.

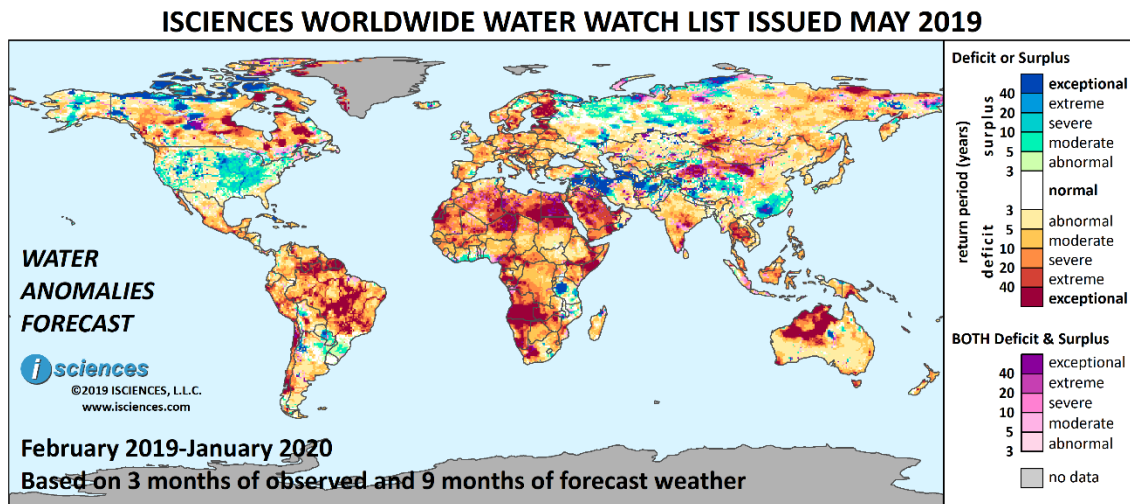
Please note that the WSIM model makes use of seasonal temperature and precipitation forecasts produced by the U.S. National Oceanic and Atmospheric Administration (NOAA) Climate Forecast System Version 2 (CFSv2). These forecasts predict broad temperature and precipitation patterns, but do not effectively predict singular events such as tropical storms. Detailed outlooks and analyses of tropical storms are available from the [NOAA National Hurricane Center](#).

There are numerous regions around the world where country borders are contested. ISciences depicts country boundaries on these maps solely to provide some geographic context. The boundaries are nominal, not legal, descriptions of each entity. The use of these boundaries does not imply any judgement on the legal status of any territory, or any endorsement or acceptance of disputed boundaries on the part of ISciences or our data providers.

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## Worldwide Water Watch List

This map presents a selection of regions likely to encounter significant water anomalies during the one-year period beginning in February 2019 and running through January 2020 using 3 months of observed temperature and precipitation data and 9 months of forecast data.



## Watch List: Regional Synopsis

This synopsis provides highlights of regional water forecasts. More detailed analysis is available in “Watch List: Regional Details” immediately following the synopsis.

**United States:** The forecast through July indicates widespread water surpluses of varying intensity a vast area on either side of the Mississippi River. Exceptional anomalies are forecast around Sioux Falls, and along the Mississippi River on either side of Memphis and from Louisiana to the Gulf. Surpluses will increase in the Rockies and shrink slightly and moderate in California. In the Pacific Northwest, deficits will shrink in Washington; Oregon will transition from deficit to moderate surplus.

**Canada:** The forecast through July indicates that conditions from the westernmost point of the Ottawa River stretching east to the Gulf of St. Lawrence will transition out of exceptional water surplus to milder anomalies, while conditions around Montreal and near Ottawa transition to moderate surplus, and surpluses from Toronto to Lake Huron increase and intensify. Deficits will cover much of the nation, with intense deficits on Vancouver Island and surpluses in southeastern British Columbia.

**Mexico, Central America, and the Caribbean:** The forecast through July indicates that intense water deficits observed in Mexico will downgrade considerably. Severe to extreme deficits are, however, expected in Baja and along the Pacific Coast from Sinaloa through Guerrero. Severe deficits are forecast for Tabasco and moderate deficits elsewhere around the Gulf of Mexico. Moderate deficits are also expected in Guatemala, El Salvador, Haiti, and western Cuba.

**South America:** The forecast through July indicates that the extent of exceptional water deficits on the continent will shrink somewhat but deficits will dominate much of the northern bulk. Exceptional deficits are forecast for French Guiana, Suriname, and southern Venezuela, central Brazil, the southern Amazon Basin, many Brazilian rivers, and along the Pacific Coast from Lima through the Atacama Desert. Surpluses are expected to increase in Paraguay and will be exceptional in central Paraguay.

**Europe:** The forecast through July indicates widespread water deficits throughout much of Europe, including exceptional deficits in Finland, Estonia, Latvia, Lithuania, and Belarus. Moderate to extreme deficits are forecast for remaining areas of Europe and will be especially intense in southern Germany and along many rivers including the Danube, Drava, Allier, and Dordogne. Moderate surpluses are forecast for Ireland, and intense surpluses for southeastern Spain.

**Africa:** The forecast through July indicates that water deficits will downgrade in the southern half of the continent and across its midsection from the Gulf of Guinea to the Horn of Africa but will intensify across northern Africa with exceptional deficits expected. Moderate to severe deficits are forecast in the south, with intense deficits in Namibia. Areas of surpluses include Tanzania, northern Madagascar, the mouth of the Congo River, and the northern coast of the Gulf of Guinea.

**Middle East:** The forecast through July indicates that widespread, intense water surpluses will persist from northern Syria into southern Turkey, from the Tigris River in Iraq well into western Iran, and in northern Iran along the Caspian coast and the border with Turkmenistan. Widespread, intense deficits are forecast for the Arabian Peninsula. Extreme to exceptional deficits are forecast for Kuwait, southern Iraq, and west of the Euphrates. Severe deficits will emerge in central Iran's Yazd Province.

**Central Asia and Russia:** The forecast through July indicates that exceptional water surpluses will persist in southern Turkmenistan. Deficits will emerge in northern Turkmenistan, Uzbekistan, and around Aktobe in northwestern Kazakhstan. Surpluses in Russia's Ob River Basin will shrink and moderate overall, and deficits will emerge in the Yenisei River Basin. In the Volga region, surpluses will persist in the Lower Volga northeast of Volgograd, and deficits are forecast in the Middle Volga region.

**South Asia:** The forecast through July indicates exceptional water deficits in coastal Maharashtra, and severe to extreme deficits in a vast stretch across central India including much of Madhya Pradesh, Maharashtra, Chhattisgarh, and southern Odisha. In the south, deficits will downgrade in Tamil Nadu but intensify in Karnataka. Surpluses will remain intense and widespread across central Afghanistan. Exceptional deficits will emerge in southern Pakistan.

**Southeast Asia and the Pacific:** The forecast through July indicates that water deficits in Thailand and Cambodia will downgrade from exceptional but remain widespread and severe in Thailand and moderate in Cambodia. Prior surpluses in Southeast Asia and Indonesia will nearly disappear as deficits emerge. Severe to extreme deficits are forecast for peninsular Thailand, Malaysia, Borneo, pockets of Sumatra, southern Philippines, and Papua New Guinea.

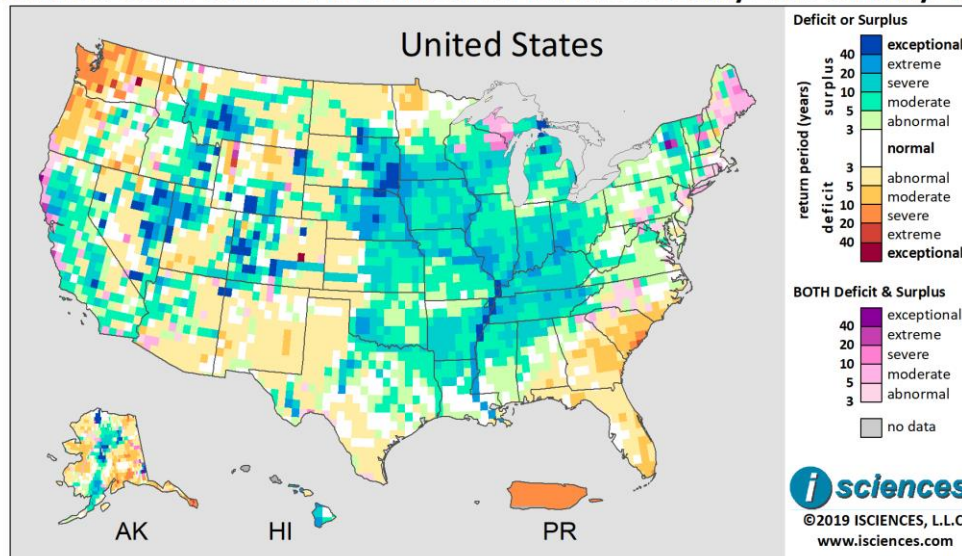
**East Asia:** The forecast through July indicates that widespread water surpluses will nearly disappear in southeastern China but will persist in the south and will include exceptional anomalies. Taiwan will transition from deficit to moderate surplus. Exceptional deficits will persist in western Inner Mongolia, and moderate to extreme deficits in Mongolia. Deficits are forecast between the Yellow and Yangtze Rivers. Severe deficits are forecast for northern Japan.

**Australia & New Zealand:** The forecast through July indicates that widespread, exceptional water deficits will shrink considerably. Severe to exceptional deficits are, however, forecast in northern Australia from the Kimberly region through Top End, Northern Territory and along the southern shore of the Gulf of Carpentaria. Deficits will also be intense in the southern tip of Western Australia, Tasmania, New Caledonia, and North Island, New Zealand.

## Watch List: Regional Details

### United States

#### ISCIONES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The 12-month forecast ending January 2020 indicates that water surpluses of varying intensity will affect many parts of the U.S. but will be especially widespread in a vast path at least two states deep on either side of the Mississippi River reaching from eastern South Dakota through Michigan, and south nearly to the Gulf. Extreme surpluses are forecast along much of the Mississippi River and exceptional surpluses along stretches on either side of Memphis, Tennessee. Surpluses will be extreme on much of the Missouri River as well. Other areas where surpluses are expected to be particularly intense include Sioux Falls, Omaha, and Cincinnati.

In the West, moderate to severe surpluses are forecast for much of California and more intense surpluses in the Rockies, including southwestern Montana, Idaho, southern Wyoming, eastern Nevada into Utah, and western Colorado. Surpluses are also forecast along many rivers. In the Northeast, primarily moderate surpluses are forecast in eastern New York, Vermont, and pockets of surrounding states.

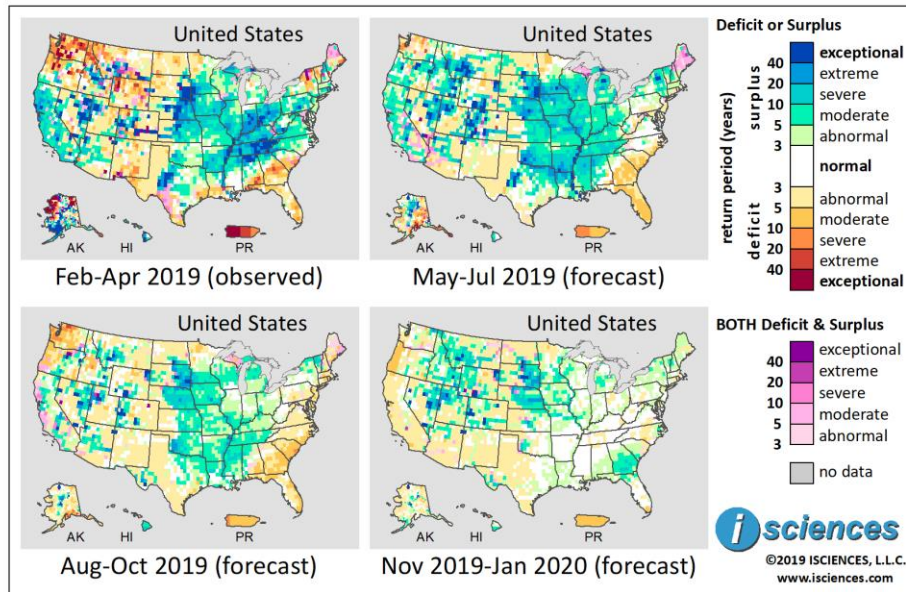
Moderate to severe deficits are expected in the Pacific Northwest, and moderate deficits in northwestern Minnesota, South Carolina, eastern Georgia, and southern Florida.

Outside the contiguous U.S., surpluses are forecast for much of Hawaii. In Alaska, surpluses are forecast southeast of Barrow in the far north, and along the Upper Koyukuk and central Yukon Rivers and will include exceptional anomalies. Moderate to severe surpluses will reach south to Bristol Bay. Moderate deficits are expected in the Seward Peninsula and into western Alaska; along the Tanana River east of

Fairbanks; around Anchorage and Valdez in the south; and at the tip of the Alaska Panhandle. Severe deficits are forecast for Puerto Rico.

The 3-month maps (below) show the evolving conditions in more detail.

### ISCIONES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

From May through July, widespread surpluses of varying intensity are forecast in a vast area on either side of the Mississippi River. Surpluses will moderate in the Ohio River Valley and downgrade somewhat in South Dakota, Nebraska, and Kansas, but will intensify in Wisconsin and increase in Michigan, Oklahoma, eastern Texas, and the Gulf States. Exceptional anomalies are forecast around Sioux Falls, and along the Mississippi River on either side of Memphis and from Louisiana to the Gulf. Surpluses are also expected along the Missouri, North Platte, Arkansas, and Red Rivers. Farther west, surpluses will increase in the Rockies, transitioning from deficits in northern Idaho and Montana. Surpluses in California will decrease somewhat and moderate. In the Pacific Northwest, deficits will shrink in Washington, and Oregon will transition from deficit to moderate surplus.

In the East, surpluses are forecast for New York, Vermont, and New Hampshire, including a small pocket of exceptional intensity in Upstate New York. Moderate deficits are forecast in the Southeast in South Carolina, Georgia, and Florida.

From August through October, surpluses will shrink and downgrade in states on the eastern side of the Mississippi, with nearly normal conditions returning to parts of the Ohio River Valley. Surpluses will downgrade in states on the western side of the Mississippi but will remain widespread. Anomalies will be most intense in eastern South Dakota. Surpluses will shrink considerably in California and the Rockies, but many pockets of surplus are forecast for southwestern Montana, eastern Nevada into Utah,

southern Wyoming, and western Colorado. Moderate surpluses will persist across central Arizona. Moderate to severe deficits will increase somewhat in the Pacific Northwest. Some moderate deficits are forecast during this period for South Carolina, Georgia, and pockets of Florida.

The forecast for the final months – November 2019 through January 2020 – indicates surpluses in the Upper Mississippi Basin, the Rockies, and in southern Georgia, and moderate deficits in western Oregon.

(It should be noted that forecast skill declines with longer lead times.)

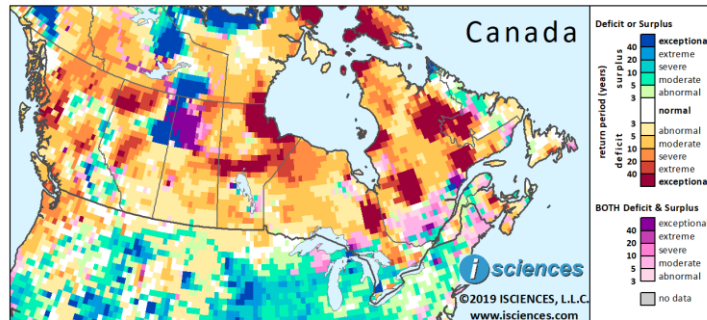
## Canada

The 12-month outlook for Canada through January 2020 indicates widespread water deficits of varying intensity, with vast pockets of exceptional deficit in Quebec, Ontario, and Manitoba.

A large block of exceptional surplus is forecast surrounding Fort McMurray, Alberta leading east past Churchill Lake, Saskatchewan. Surpluses of generally lesser intensity are forecast along the border of British Columbia and Alberta near Fort St. John in the north and in southeastern British Columbia. At the opposite end of the country, surpluses are expected in southern Ontario from Toronto to Lake Huron, in southern Quebec around Montreal, and at the mouth of the Saint Lawrence River near the Manicouagan River.

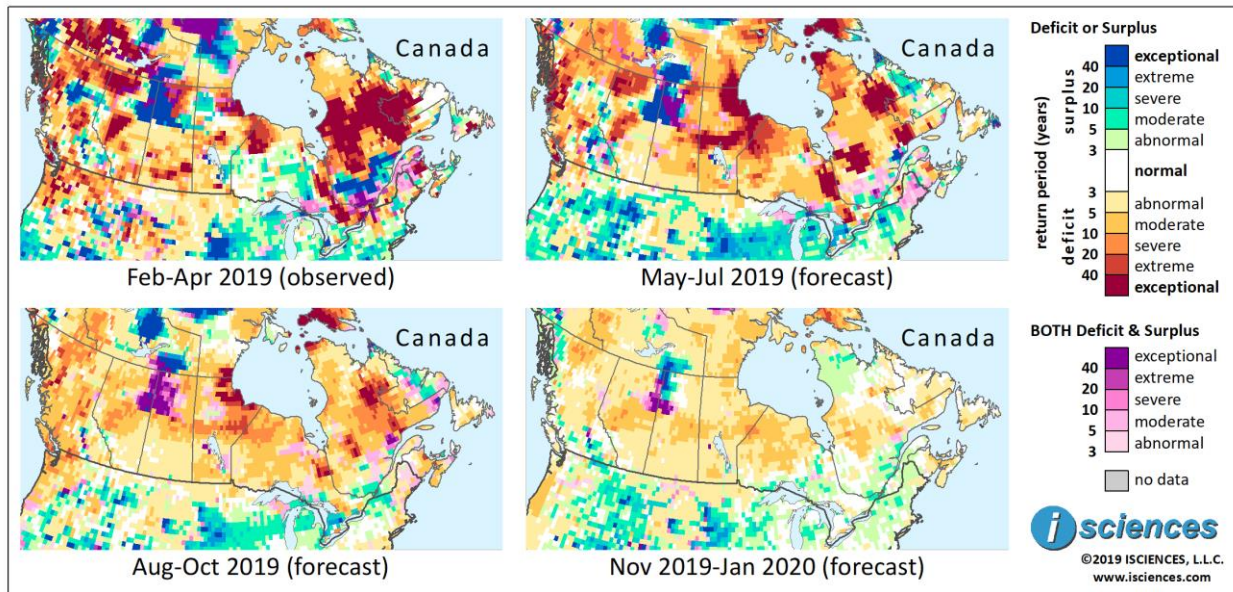
The 3-month maps (below) show the evolving conditions in more detail.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and  
forecasts issued April 24-30, 2019.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The forecast through July indicates that deficits will emerge in much of Northern Ontario (ON), transitioning from surplus in some areas. Widespread, exceptional deficits in northern Quebec (QC) will shrink. In southern Quebec, from the westernmost point of the Ottawa River stretching east to the Gulf of St. Lawrence, conditions will transition out of exceptional surplus to milder anomalies, while

conditions around Montreal and near Ottawa will transition to moderate surplus. Surpluses will increase and intensify from Toronto to Lake Huron.

Moving west, deficits are forecast for nearly all of Manitoba (MB), including large pockets of exceptional deficit along Hudson Bay and spanning the province's central region north of Lake Winnipeg. Moderate deficits are expected in southern Manitoba and southern Saskatchewan (SK). In Alberta (AB), extreme deficits are forecast in the far northwest corner and in the Middle Reaches of the Athabasca River Watershed. A vast block of exceptional surplus is forecast in the Upper Reaches of the Athabasca surrounding Fort McMurray and leading across the border into Saskatchewan. In British Columbia (BC), surpluses will increase in the southeast but diminish in the north along the Peace River from Fort St. John and around Williston Lake. Intense deficits will persist on Vancouver Island.

From August through October, anomalies will downgrade overall. Moderate surpluses will persist around Montreal and Ottawa, and more intense surpluses from Toronto to Lake Huron. Surpluses in southeastern BC will nearly disappear, and the vast block of intense surplus across the northern border of Alberta and Saskatchewan will begin to transition, with conditions of both deficit and surplus (purple).

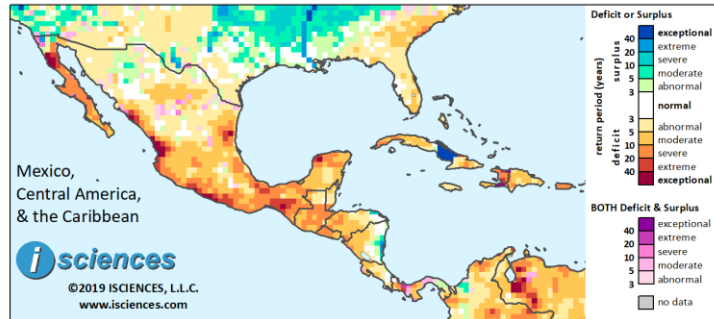
The forecast for the final three months – November 2019 through January 2020 – indicates moderate deficits spanning the central regions of the Prairie Provinces and much of Northern ON. Surpluses are forecast for pockets of southern BC, a block in SK's far northwestern corner, and scattered in eastern QC following the St. Lawrence River.

(It should be noted that forecast skill declines with longer lead times.)

## Mexico, Central America, and the Caribbean

The 12-month forecast ending January 2020 indicates deficits of varying intensity in most of Mexico's Baja Peninsula and throughout the central and southern regions of the country. Anomalies are expected to be extreme to exceptional in a pocket of northwestern Baja; pockets along the Pacific Coast in Nayarit, Guerrero, and Chiapas; near Merida in the Yucatan; and southern Tamaulipas on the Gulf.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



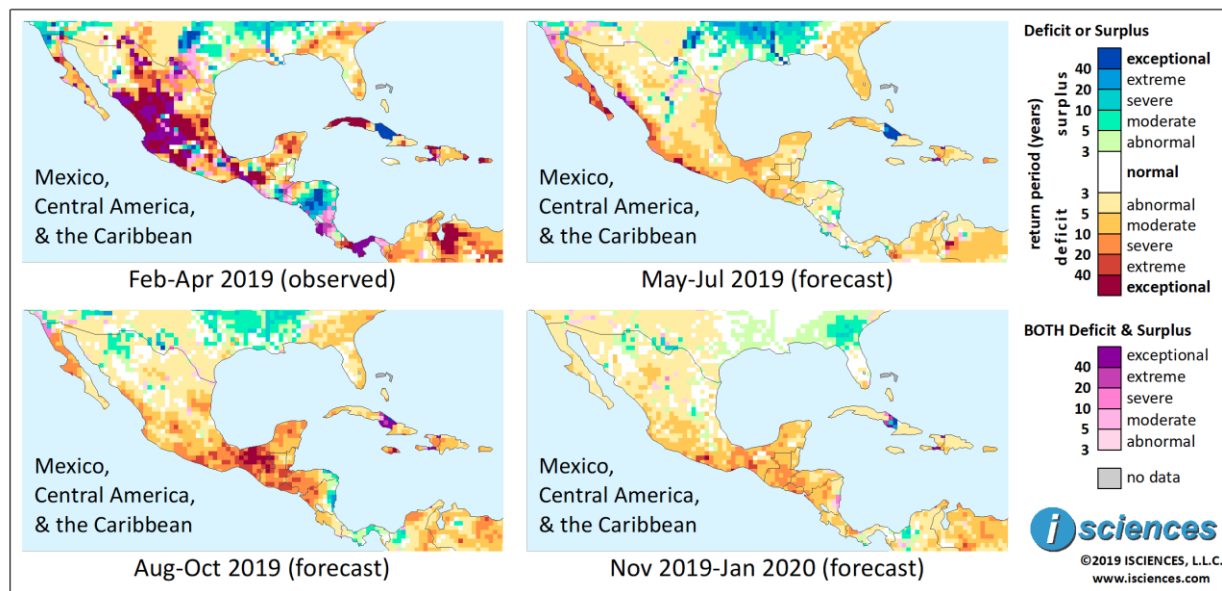
Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

Moderate deficits are forecast in the north from southeastern Chihuahua across central Coahuila, and some pockets of moderate surplus in western Chihuahua.

In Central America, moderate to severe deficits are forecast for Guatemala, Belize, western Honduras, El Salvador, western Nicaragua, and western Panama. Moderate surpluses are expected in a pocket on Nicaragua's central Caribbean Coast. Severe deficits are forecast for Haiti, moderate to severe deficits in Cuba, and moderate deficits in Dominican Republic.

The 3-month maps (below) show the evolving conditions in more detail.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The forecast through July indicates that intense deficits observed in the prior three months in Mexico will downgrade considerably. Severe to extreme deficits are, however, expected in Baja, particularly in the south, and trailing along the Pacific Coast from Sinaloa along the southern Gulf of California through Nayarit, Michoacán, and Guerrero. Severe deficits are forecast for Tabasco on the southern Gulf of Mexico, and moderate deficits elsewhere around the Gulf of Mexico. Moderate deficits will emerge in the north in western Sonora, and some surpluses in Zacatecas. Moderate deficits are expected in Guatemala, El Salvador, Haiti, and western Cuba, and moderate surpluses in southeastern Nicaragua and other small pockets of Central America.

From August through October, deficits will downgrade along Mexico's central Pacific Coast but will intensify in southern states, with extreme to exceptional anomalies between the southern Gulf of Mexico and the Pacific in Tabasco and Chiapas. In the north, moderate surpluses will emerge from eastern Sonora into western Chihuahua; deficits will retreat from southern Baja, but severe deficits are forecast for the northern half of the peninsula. Deficits will intensify in Guatemala, El Salvador, western Honduras, and western Nicaragua. Surpluses will increase along the Caribbean coast in Honduras and Nicaragua and will emerge in Panama. Intense deficits are expected to emerge in Jamaica, deficits in Haiti will become severe, and moderate deficits will increase in Dominican Republic.

For the final three months – November 2019 through January 2020 – generally mild anomalies are forecast for northern Mexico and deficits in the south will downgrade, leaving primarily moderate to severe anomalies. Deficits will downgrade in Central America as well, and nearly normal conditions are forecast in the Caribbean.

(It should be noted that forecast skill declines with longer lead times.)

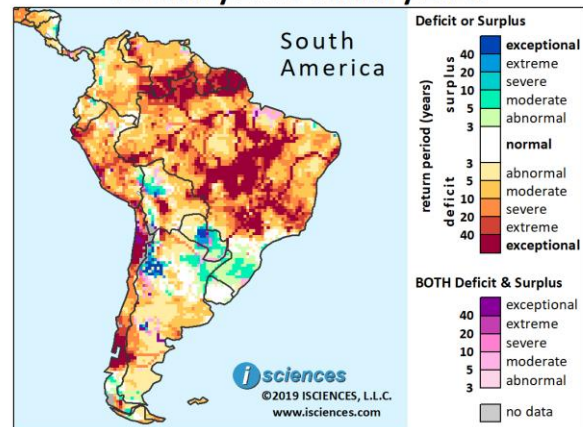
## South America

The 12-month forecast through January 2020 indicates water deficits across nearly all the northern bulk of the continent as well as through most of Chile and the eastern Argentine Pampas.

Deficits will be intense across a vast stretch of central Brazil and along many rivers. Areas of exceptional deficit include Mato Grosso, Tocantins, Maranhão, Minas Gerais, and São Paulo. Deficits reaching exceptional intensity are forecast for French Guiana, Suriname, southern Guyana, southern Venezuela, and a pocket in central Bolivia. Deficits of varying intensity will cover Peru and most of Chile and will be especially intense along Peru's coast, the Atacama Desert in Chile, and further south around the Gulf of Corcovado.

Surpluses are forecast in northwestern Bolivia, central and eastern Paraguay, and Rio Grande do Sul, Brazil, and will be exceptional in central Paraguay. In Argentina, surpluses are expected in Catamarca and La Rioja Provinces in the northwest and several northeastern provinces. Moderate deficits are forecast for Buenos Aires Province, and severe deficits along the Bermejo River in the north and the Chubut and Chico Rivers in the south.

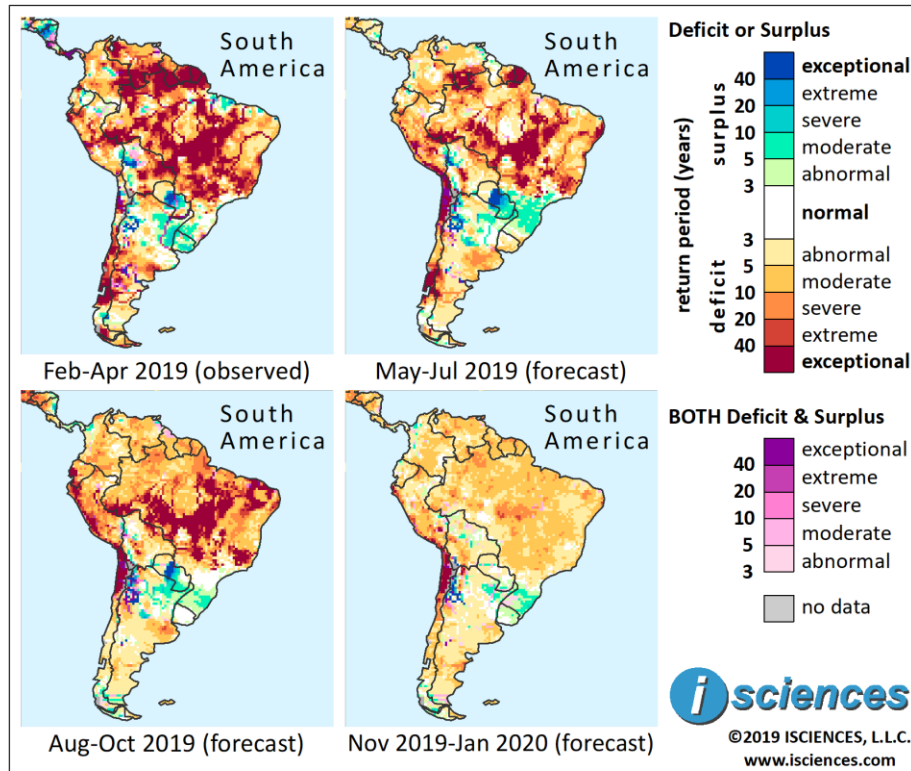
### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The 3-month maps (below) for the same 12-month period show the evolving conditions in greater detail.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The forecast through July indicates that the extent of exceptional deficits on the continent will shrink somewhat, but deficits will dominate much of the northern bulk. Exceptional deficits are forecast for French Guiana, Suriname, and southern Venezuela; central Brazil, the southern Amazon Basin, and many Brazilian rivers; and along the Pacific Coast from, roughly, Lima, Peru through the Atacama Desert in Chile and around the Gulf of Corcovado. Severe deficits are forecast for Buenos Aires Province, Argentina and long the Chubut and Chico Rivers in the south. Surpluses are expected to increase in Paraguay covering the central and eastern portions of the country and will be exceptional in central Paraguay. Moderate surpluses are forecast for southern Brazil and pockets of northern Argentina, with more intense anomalies in northwestern Argentina. Surpluses are expected to persist north of La Paz, Bolivia. Uruguay will transition from surplus to mild deficit.

From August through October, deficits will downgrade in southern Venezuela, Suriname, and French Guiana, with moderate to severe anomalies forecast in coastal nations from eastern Ecuador through French Guiana, and across the breadth of the northern Amazon Basin in Brazil. Extreme to exceptional deficits will increase in the southern Amazon Basin, persist in central Brazil, increase in Minas Gerais, and emerge in pockets of the northeast. Exceptional deficits will emerge in southwestern Ecuador and intense deficits are forecast throughout much of Peru, especially in the west. Exceptional deficits are

expected to persist in northern Chile but will retreat from the south. Exceptional surpluses will persist in central Paraguay while surpluses in the eastern region of the country will shrink, as will surpluses in southern Brazil. In Argentina, some surpluses will persist in pockets of the north, deficits will moderate in western Buenos Aires Province as severe deficits emerge farther east, and deficits in southern Argentina will become mild.

In the final quarter – November 2019 through January 2020 – primarily moderate deficits are expected across most of the northern bulk of the continent. Exceptional deficits will persist in the Atacama Desert. Some surpluses will persist in southern Brazil and pockets of northern Argentina but will nearly disappear in Paraguay.

(It should be noted that forecast skill declines with longer lead times.)

## Europe

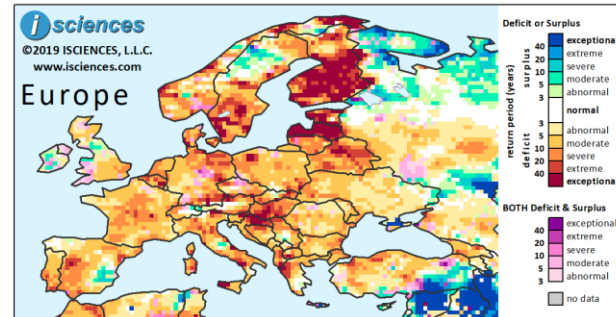
The 12-month forecast through January 2020 indicates deficits of varying intensity throughout much of Europe. Exceptional deficits are forecast for Finland, Estonia, Latvia, Belarus north of Minsk, pockets of southern Sweden, and eastern Croatia.

Severe to extreme deficits are forecast for many regions including eastern and southern Germany, Hungary, and Spain west of Madrid.

Areas with a forecast of surplus include Murmansk in Russia, northwestern Sweden, central United Kingdom and western Ireland, Umbria in central Italy, and southeastern Spain.

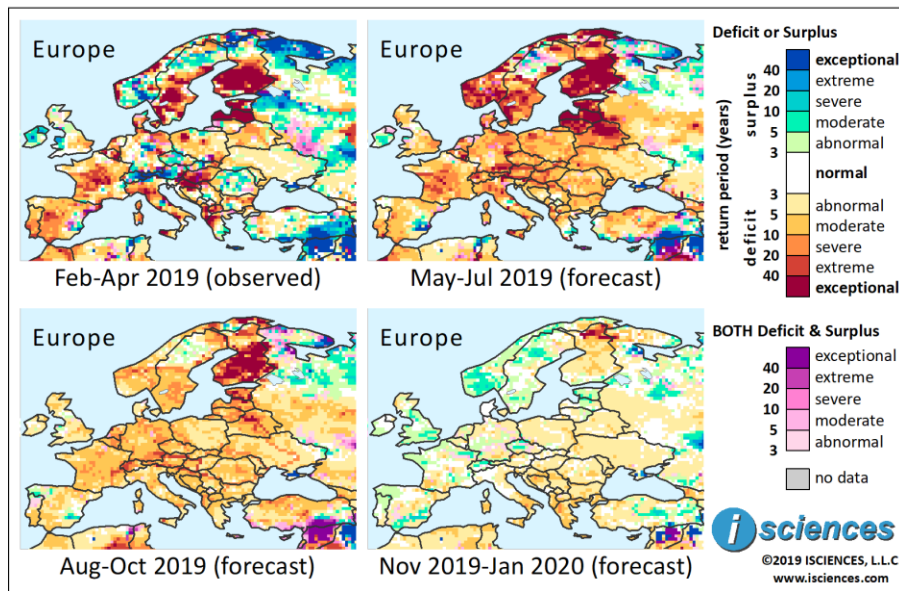
The 3-month composites (below) for the same 12-month time period show the evolving conditions.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The forecast through July indicates widespread deficits of varying intensity throughout much of Europe as European Russia transitions from surplus to deficit and surpluses in parts of Central and Eastern Europe diminish or transition. Deficits of exceptional intensity are expected to persist in Finland, Estonia, and Latvia, and will emerge in Lithuania and Belarus north of Minsk. Deficits in southern Sweden will remain intense, though the extent of exceptional deficits will shrink somewhat. Much of Norway is

expected to transition from surplus to intense deficit. Moderate to extreme deficits are forecast for remaining areas of Europe and will be especially intense in southern Germany and along many rivers including the Danube, Drava, Allier, and Dordogne. Deficits will be primarily moderate in the United Kingdom and on the Iberian Peninsula. Moderate surpluses are forecast for Ireland, and intense surpluses for southeastern Spain.

From August through October deficits will moderate overall, though exceptional deficits will persist in Finland and severe to extreme deficits in the Baltics, Belarus, Switzerland, and along the Danube, Drava, Dnipro (Dnieper), Dniester, and Rhine Rivers. Moderate surpluses are forecast for northern European Russia and southeastern Spain.

The forecast for the remaining months – November 2019 through January 2020 – indicates primarily mild deficits in Eastern Europe, the Balkans, and Finland, though exceptional deficits are forecast for Lapland in northern Finland. Scattered, moderate surpluses are expected in Scandinavia, Central and Western Europe, and the Iberian Peninsula.

(It should be noted that forecast skill declines with longer lead times.)

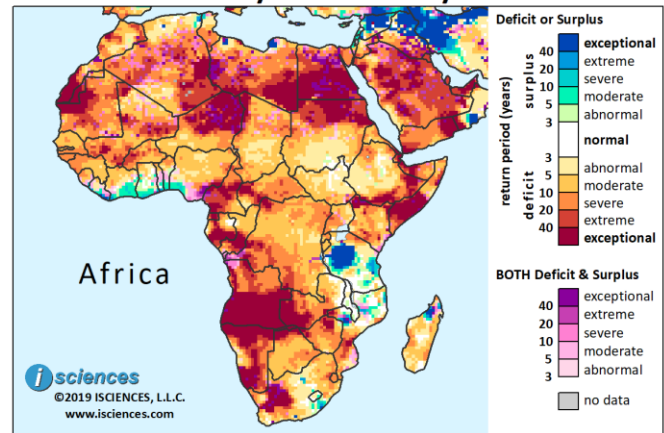
## Africa

The 12-month forecast through January 2020 indicates deficits of varying intensity throughout much of Africa, including many vast blocks of exceptional deficit. Severe to exceptional water deficits are expected across northern Africa, in the Horn, and in central and southern nations from Cameroon through South Africa.

Exceptional deficits will be particularly widespread in Egypt and northern Sudan, northern Niger, southern Somalia, Angola, Namibia, and Northern Cape, South Africa. Deficits of varying intensity are forecast for much of the remainder of the continent.

Exceptional surpluses are forecast for a large block of western Tanzania, and moderate to extreme surpluses in an eastern pocket radiating from Dar es Salaam. Surpluses are also forecast for pockets of northern Mozambique and northern Madagascar; south of Durban, South Africa; near Benghazi and Tripoli, Libya; and along the northern coast of the Gulf of Guinea in Côte d'Ivoire, Ghana, Togo, Benin, and southwestern Nigeria.

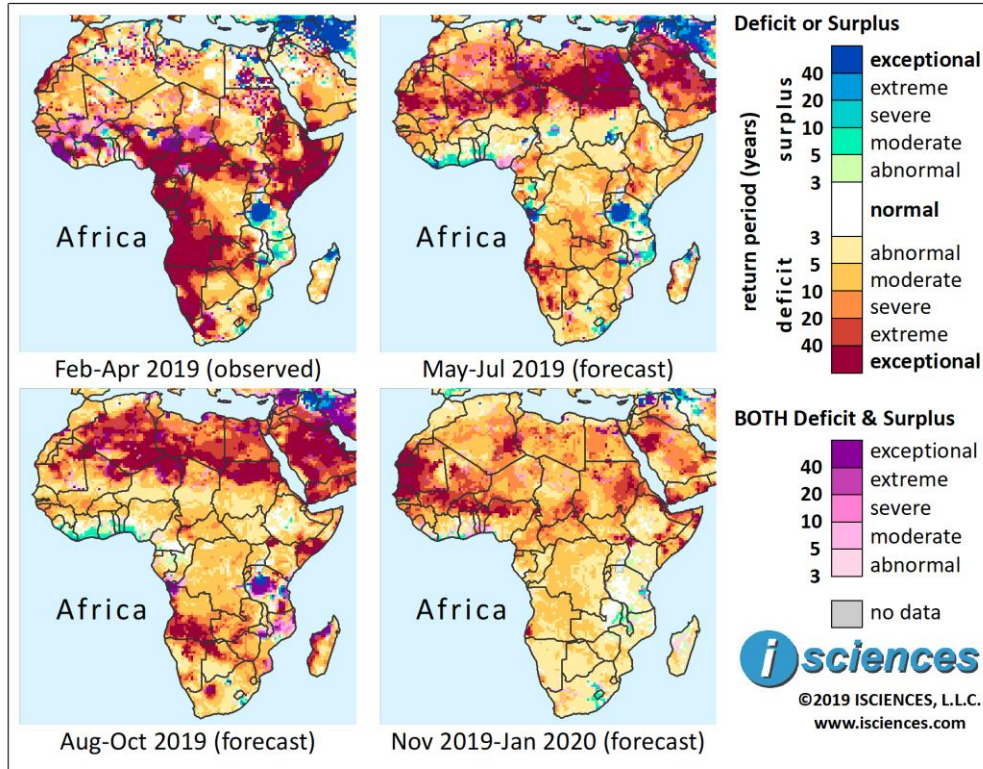
### ISCIONES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The 3-month maps (below) show the evolving conditions in greater detail.

**ISCIONES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020**



**Based on observed data through April 2019 and forecasts issued April 24-30, 2019.**

The forecast through July indicates that deficits will downgrade in the southern half of the continent and across its midsection from the Gulf of Guinea to the Horn of Africa but will intensify across northern Africa. In the north, intense deficits are expected across the breadth of the Sahara including widespread exceptional deficits in Egypt and across its borders into northern Sudan and southeastern Libya. Generally mild deficits are expected in the Sahel. Primarily moderate surpluses are forecast along the northern coast of the Gulf of Guinea in Liberia, Côte d'Ivoire, Ghana, Togo, Benin, and southwestern Nigeria.

In the Horn, deficits will moderate in Somalia but severe to extreme deficits are forecast for the Ethiopian Highlands and western Kenya. Moderate to severe deficits are forecast for much of the southern half of the continent with extreme to exceptional deficits in pockets of Namibia and southern Angola. Surpluses are expected in Tanzania, northern Mozambique and a pocket of northern Madagascar, and south of Durban, South Africa. Surpluses will be exceptional in western Tanzania. Conditions at the mouth of the Congo River as it empties into the Atlantic Ocean in westernmost Democratic Republic of the Congo will transition from intense deficit to intense surplus.

From August through October, intense deficits are forecast across northern Africa, though exceptional deficits in Egypt will downgrade slightly, becoming severe to extreme. Mild to moderate deficits are forecast for the Sahel and central African nations, while deficits in southern Somalia intensify, becoming exceptional. Moderate surpluses will persist along the northern coast of the Gulf of Guinea, and conditions of both surplus and deficit are forecast for Tanzania as transitions occur. Deficits will become exceptional in Angola's southern half. Exceptional deficits will persist in pockets of Namibia; emerge in the Okavango Delta in Botswana and in Northern Cape, South Africa; and increase along Madagascar's western coast.

During the final quarter – November 2019 through January 2020 – deficits will moderate across northern Africa though exceptional deficits are forecast in the west and the western Sahel. Pockets of intense deficit are expected in the Horn, moderate to severe deficits in central African nations, and mild deficits in the south with some moderate surpluses surrounding Lesotho.

(It should be noted that forecast skill declines with longer lead times.)

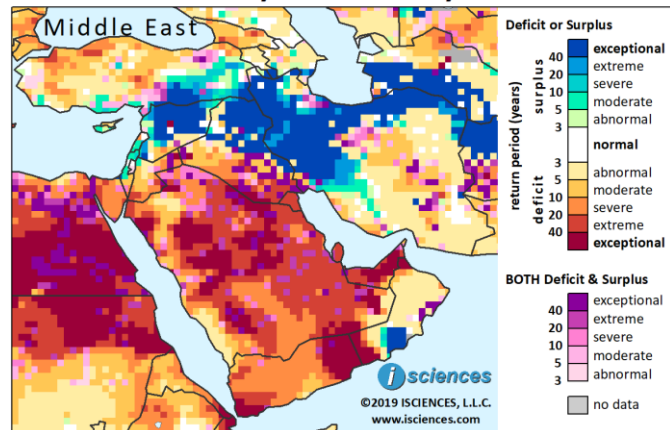
## Middle East

The forecast for the 12-month period ending January 2020 indicates widespread, intense water deficits on the Arabian Peninsula including exceptional deficits in pockets of Saudi Arabia, United Arab Emirates, Yemen, and western Oman.

Intense deficits are also forecast for southern Iraq along with conditions of both deficit and surplus as transitions occur. Moderate to severe deficits are forecast for northwestern Turkey and in Georgia, and moderate deficits in central Iran.

Exceptional surpluses are forecast from northern Syria into Turkey; Iraq along the northern Euphrates River and from the Tigris River well into western Iran; and along Iran's Caspian Sea coast and its border with Turkmenistan. These areas of surplus include Aleppo (Syria); Mosul, Kirkuk, and Baghdad (Iraq); and Tehran, Iran.

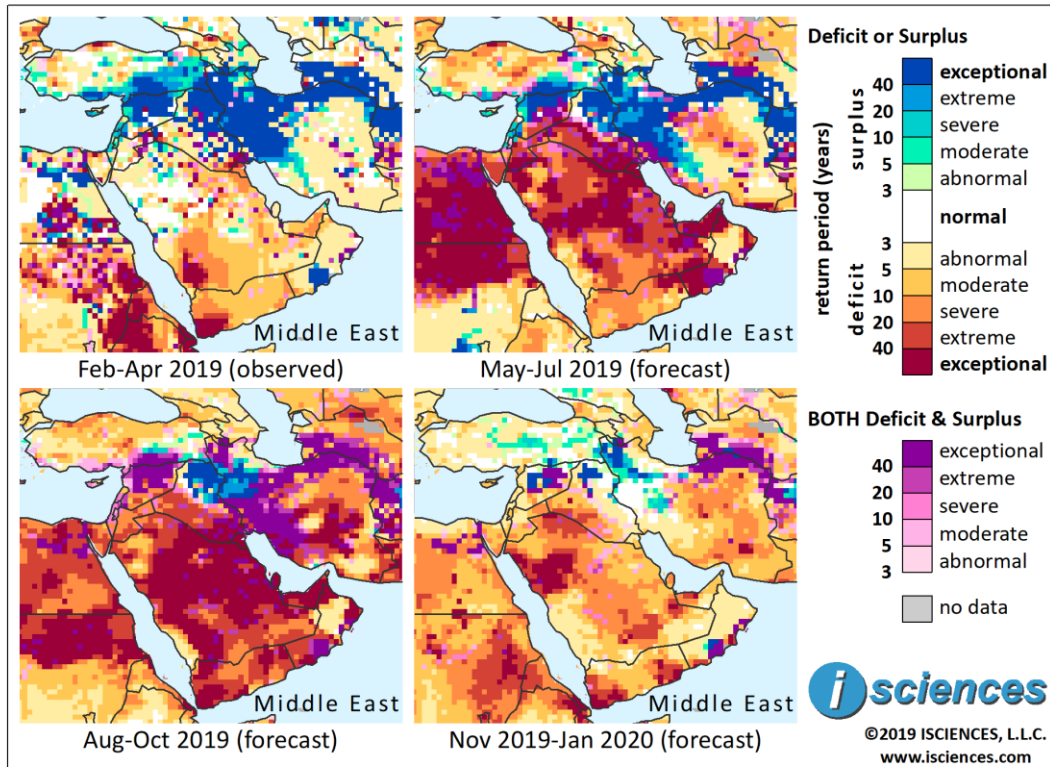
### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The 3-month maps (below) show the evolving conditions in greater detail.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The forecast through July indicates that widespread water surpluses will persist in the region from northern Syria into southern Turkey, from the Tigris River in Iraq well into western Iran, and in northern Iran along the Caspian coast and the border with Turkmenistan. The extent of exceptional surplus will diminish slightly, but surpluses ranging from severe to exceptional will remain widespread. Moderate to extreme surpluses will reach further into Fars Province in southwestern Iran. Primarily moderate surpluses are forecast for Cyprus, northern Israel, and southern Lebanon.

Widespread, intense deficits are forecast for the Arabian Peninsula with exceptional deficits in many areas including central Saudi Arabia, United Arab Emirates, and pockets of Oman. Extreme to exceptional deficits are forecast for Kuwait, southern Iraq, and west of the Euphrates. Severe deficits are expected to emerge in central Iran's Yazd Province along with more intense deficits along Iran's Persian Gulf coast and southern coast on the Gulf of Oman. Severe deficits will increase in Georgia and in Turkey and will emerge along the Kizilirmak River in central Turkey.

From August through October, deficits will persist on the Arabian Peninsula and the extent of exceptional deficits will increase. Intense surpluses will persist from northeastern Iraq into western Iran but conditions of both surplus and deficits (purple) are forecast as transitions occur in northern Syria and the eastern Mediterranean coast, northwestern Iran, Iran's border with Turkmenistan, and

provinces north of the Persian Gulf. Deficits in central and eastern Iran will increase and intensify, while deficits in Georgia and Turkey will moderate overall.

In the final quarter – November 2019 through January 2020 – deficits will downgrade on the Arabian Peninsula and in Iran's eastern two-thirds. Surpluses are forecast in Turkey along the Kizilirmak and Murat Rivers, northern Syria, northeastern Iraq, and northwestern Iran.

(It should be noted that forecast skill declines with longer lead times.)

## Central Asia and Russia

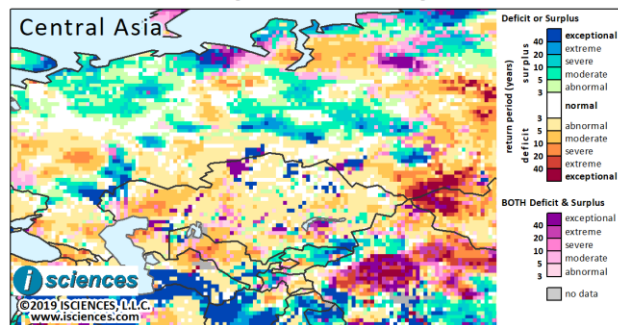
The 12-month forecast through January 2020 indicates intense surpluses in southern Turkmenistan, and surpluses of varying intensity in eastern Uzbekistan into western Tajikistan, and across the breadth of Kyrgyzstan.

Moderate to severe deficits are forecast for northern Turkmenistan, central Uzbekistan and the Fergana Valley to the east, and western Kazakhstan northeast of the Caspian Sea.

In Russia, intense surpluses are forecast in the lower Volga region upstream of Volgograd, and severe deficits in the Middle Volga south of Nizhny Novgorod. Primarily moderate surpluses are expected in the Northern European Plain, and surpluses of varying intensity in the Upper and Middle Ob River Basin. Surpluses will be exceptional east of Kemerovo in the northern portion of the Tom River Basin. Deficits are forecast in most of the Yenisei River Basin and will be intense in the Upper Basin.

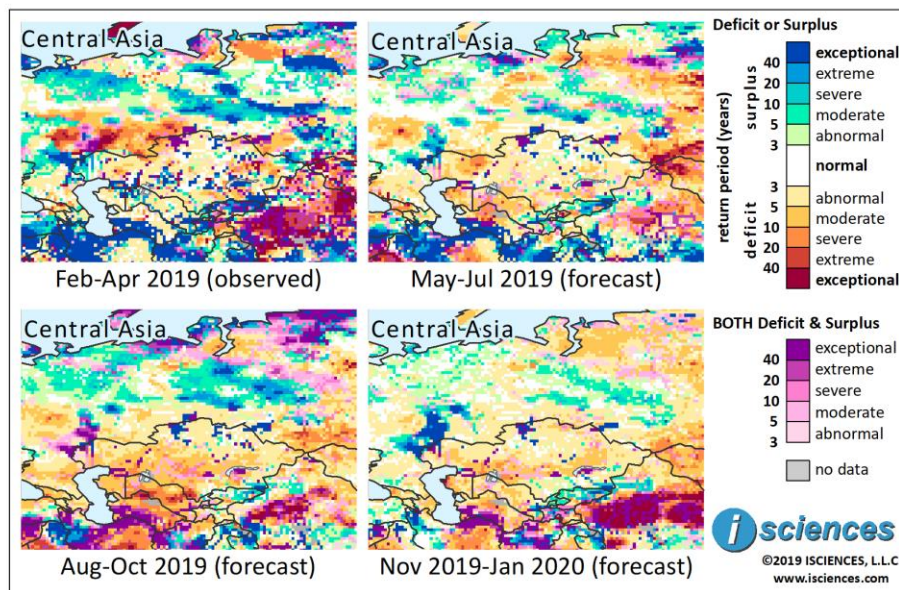
The 3-month composites (below) for the same 12-month period show the evolving conditions in more detail.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The forecast through July indicates that surpluses in the Ob River Basin of Russia will shrink and moderate overall, though surpluses will be intense along portions of the Irtysh River as it joins the Ob. Surpluses will also be intense in the northern portion of the Tom River Basin east of Kemerovo. Deficits will emerge in the Yenisei River Basin and will be intense in the regions of the Nizhnyaya and Podkamennaya Tunguska Rivers, the Angara River, and north of Mongolia. In the Volga region, surpluses will persist northeast of Volgograd, severe deficits are forecast in the Middle Volga region south of Nizhny Novgorod, and moderate deficits are expected in the Upper Volga region.

Exceptional surpluses will persist in southern Turkmenistan. Surpluses of generally lesser intensity are forecast for eastern Uzbekistan, western Tajikistan, and eastern Kyrgyzstan. Severe deficits will emerge in northern Turkmenistan, and primarily moderate deficits in Uzbekistan, though deficits will be intense in the Fergana Valley in the east. Severe deficits are forecast surrounding Aktobe in northwestern Kazakhstan.

From August through October, deficits will increase in Turkmenistan, Uzbekistan, and southern Kazakhstan, with pockets of extreme anomalies. Conditions of both surplus and deficits (purple) are forecast for southern Turkmenistan as transitions occur. Surpluses will moderate in eastern Kyrgyzstan. In Russia, surpluses will increase in the Ob River Basin and in the Northern European Plain, while surpluses in the Lower Volga region transition, with conditions of both deficit and surplus.

The forecast for the final months – November 2019 through January 2020 – indicates that exceptional surpluses will re-emerge in the Lower Volga Basin north of Volgograd, and surpluses will diminish in the Ob River Basin and in the Northern European Plain. Deficits in Central Asia will moderate.

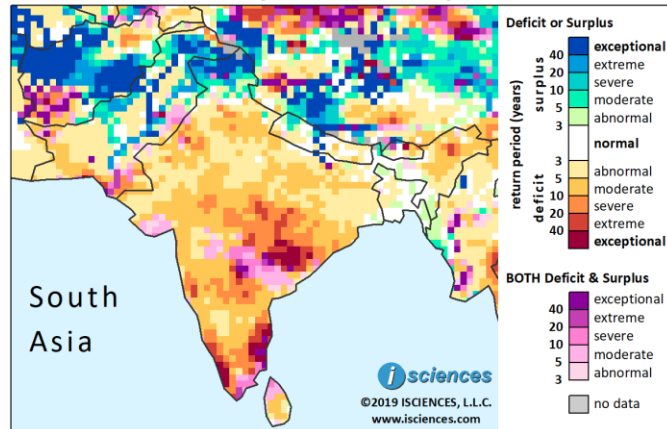
(It should be noted that forecast skill declines with longer lead times.)

## South Asia

The 12-month forecast through January 2020 indicates intense water surpluses in Jammu and Kashmir, India, moderate deficits in large pockets elsewhere across the north, and more intense deficits in central and southern India.

Exceptional deficits are forecast for the Indravati River watershed in southern Chhattisgarh with severe to extreme deficits in surrounding regions. Intense deficits are also expected in Tamil Nadu and Kerala in southern India.

### ISCSCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

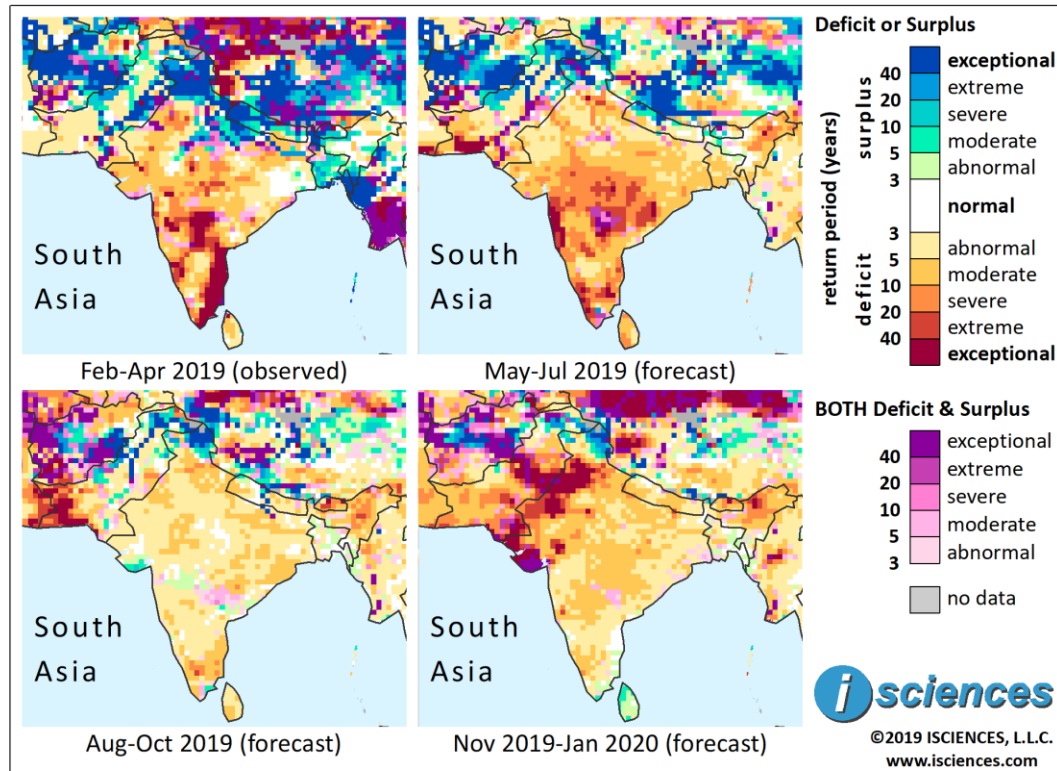
Surpluses are forecast in northern Pakistan and along the Indus, Jhelum, and Chenab Rivers, and will be exceptional along the northern Indus. Severe deficits are forecast in the southeast from Karachi past Hyderabad, and some moderate deficits in the southwest.

In Afghanistan, surpluses are also forecast across center of the country and will be exceptional surrounding Herat and the Harirud River in the west extending north to Mazar-e Sharif, and in the east from Kandahar to Kabul.

Surpluses are forecast along the Gandaki River in central Nepal leading into India.

The 3-month composites (below) show the evolving conditions in greater detail.

**ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020**



**Based on observed data through April 2019 and forecasts issued April 24-30, 2019.**

The forecast through July indicates that exceptional deficits in Tamil Nadu and Andhra Pradesh in southeastern India will downgrade somewhat. Exceptional deficits at the intersection of Maharashtra, Andhra Pradesh, and Karnataka will shrink and downgrade but will be extreme, and deficits will intensify in regions just north, becoming severe in a vast stretch of central India including much of Madhya Pradesh, Maharashtra, Chhattisgarh, and southern Odisha. Deficits will be exceptional in coastal Maharashtra. Surpluses will shrink in the Far North and will disappear in the Gangetic Plain as moderate deficits emerge. Severe deficits will emerge on the Yamuna River in the north and in India's Far Northeast.

Surpluses will shrink considerably in Nepal and Bhutan, and Bangladesh will transition from surplus to moderate deficit. Surpluses will remain intense in northern Pakistan, especially along the northern Indus River, but exceptional deficits will emerge in southern Pakistan. Surpluses will also remain intense and widespread across central Afghanistan.

From August through October, deficits in India will downgrade considerably, leaving mild to moderate anomalies overall with some moderate to severe deficits persisting in the Far Northeast, intense surpluses persisting in Jammu and Kashmir, and moderate surpluses emerging on Gujarat's southern

coast. Surpluses are forecast on the Gandaki River in central Nepal; severe deficits will emerge in Bhutan. Intense deficits will increase in southwestern Pakistan, and intense surpluses will persist in the north and along the northern Indus River. Surpluses in Afghanistan will shrink, and transitions will occur as deficits emerge.

The forecast for the final months – November 2019 through January 2020 – indicates the emergence of intense deficits spanning the India-Pakistan border well into both nations. Moderate deficits are forecast for much of the remainder of India and moderate to severe deficits in Pakistan. Areas of surplus include central Afghanistan, northern Pakistan, and northern India.

(It should be noted that forecast skill declines with longer lead times.)

## Southeast Asia and the Pacific

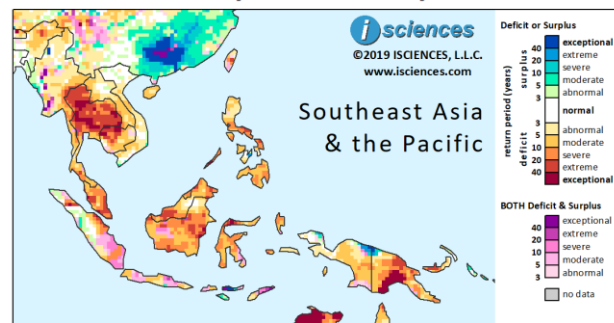
The 12-month forecast through January 2020 indicates extreme to exceptional water deficits throughout Thailand and into northwestern Cambodia. Moderate deficits are forecast for much of the remainder of Cambodia as well as southern Laos, eastern Myanmar, and pockets of central and southern Vietnam.

Moderate to extreme deficits are expected in the Philippines, Malaysia, Borneo, pockets of Sumatra, Sulawesi, West Papua, and Papua New Guinea, where deficits will be exceptional around the Gulf of Papua.

Surpluses are forecast for the north-central coast of New Guinea around Jayapura.

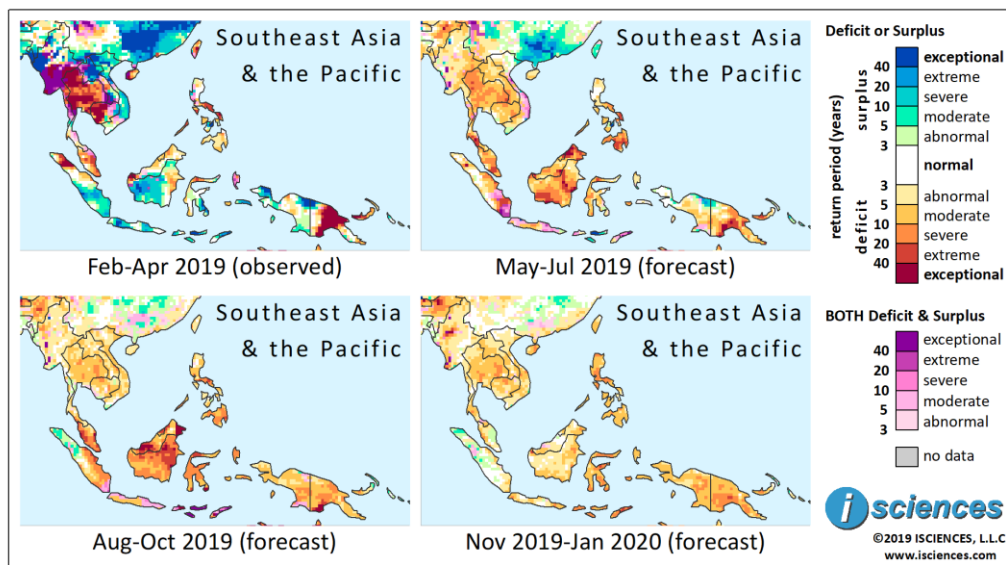
The 3-month maps (below) show the evolving conditions in more detail.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The forecast through July indicates that deficits in Thailand and Cambodia will downgrade from exceptional. Deficits will be widespread and severe in Thailand and moderate in Cambodia. Laos will transition from surplus to moderate deficit and Vietnam will begin to transition. Moderate deficits are also forecast for eastern Myanmar. Severe to extreme deficits are forecast for peninsular Thailand and Malaysia. Various stages of transition from surplus to deficit are forecast for Indonesia, with deficits ranging from moderate to exceptional on Borneo and southern Sumatra, while surpluses are expected

to linger in the Lesser Sunda Islands. Moderate to extreme deficits are forecast in southern Luzon, Philippines and Mindanao, and a pocket of surplus near Cebu. Deficits will downgrade in Papua New Guinea but will remain intense around the Gulf of Papua. Surpluses around Japapura on the central north shore of New Guinea will moderate.

From August through October, deficits will continue to downgrade in Southeast Asia, leaving primarily moderate deficits in Thailand and scattered small pockets in the rest of the region. More intense deficits are forecast during this period for Malaysia and many parts of Indonesia, and deficits will be particularly intense in pockets of Borneo. Moderate surpluses will emerge in northern Sumatra and moderate deficits are forecast in the east and south. Deficits in the Philippines will downgrade and shrink somewhat. In New Guinea, surpluses on the north coast will nearly disappear, deficits in Papua New Guinea will downgrade overall but the extent of moderate deficits will increase, and moderate to severe deficits will increase in West Papua.

The forecast for the final months – November 2019 through January 2020 – indicates primarily moderate deficits in Thailand and pockets of Southeast Asia and Borneo, and moderate to severe deficits in Philippines, Sulawesi, the Lesser Sunda Islands, and New Guinea.

(It should be noted that forecast skill declines with longer lead times.)

## East Asia

The 12-month forecast for East Asia through January 2020 indicates widespread surpluses in southeastern China including exceptional surpluses in the south. Surpluses will also be widespread in much of the Tibetan Plateau. Intense deficits are forecast from western Inner Mongolia across central Xinjiang, and in northwestern Mongolia.

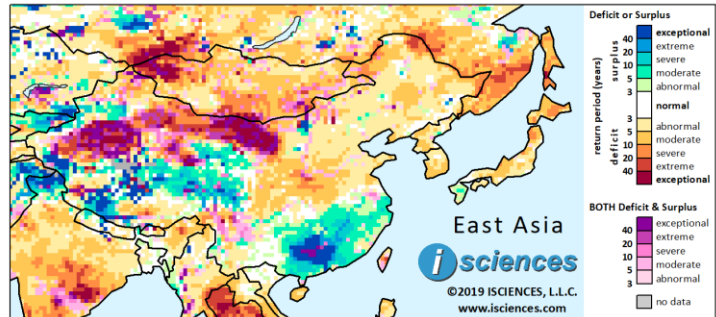
Moderate deficits are expected in a large block of China from eastern Sichuan through Henan and will reach extreme intensity at the border of Shaanxi and Henan.

Moderate to severe deficits are forecast for Mongolia, and moderate deficits in pockets of Northeast China and on the Korean Peninsula.

In Japan, surpluses are forecast for Kyushu, moderate deficits in Honshu, and moderate to severe deficits in Hokkaido.

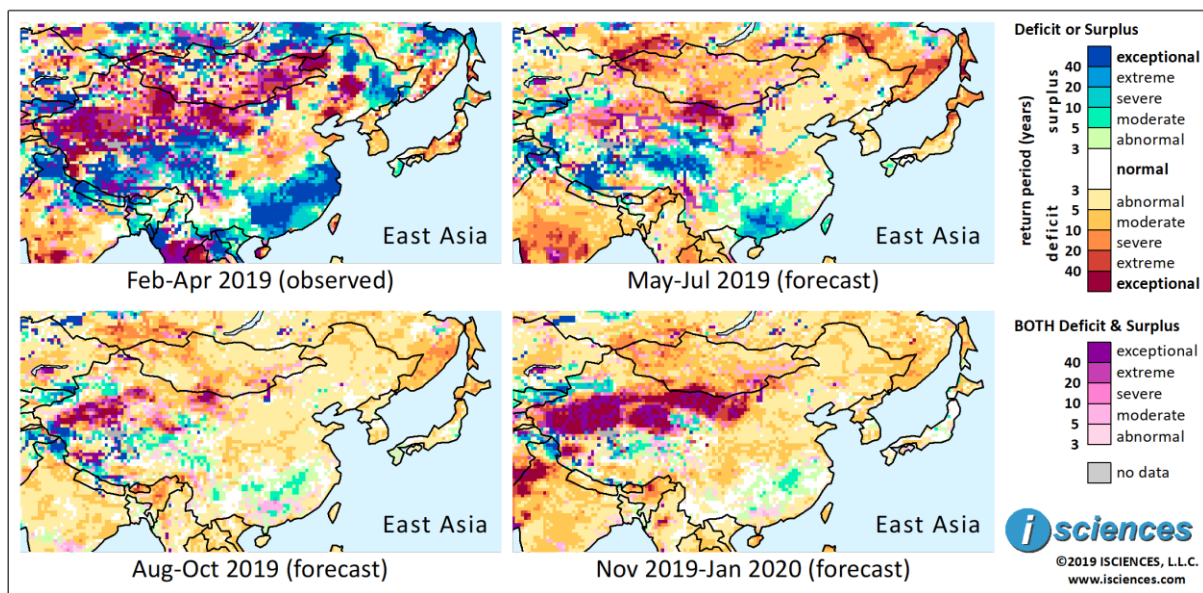
The 3-month time series maps below show the evolving conditions in more detail.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The forecast through July indicates that widespread surpluses will nearly disappear in southeastern China but will persist in the south and will include exceptional anomalies from eastern Guangxi into western Guangdong. Taiwan will transition from deficit to moderate surplus and moderate surpluses are forecast along portions of the Lower and Middle Yangtze River. Intense surpluses are forecast for western Sichuan, southern Qinghai, and western Tibet. Exceptional deficits will persist in western Inner Mongolia but will downgrade in regions to the west. Moderate to severe deficits are forecast between the Yellow and Yangtze Rivers, and some moderate surpluses will emerge along the Lower Yellow River. In Mongolia, moderate to severe deficits are expected in much of the country. In Japan, moderate surpluses are forecast for Kyushu and severe deficits in northern Honshu and Hokkaido.

From August through October, anomalies will downgrade significantly throughout the region. Exceptional deficits will, however, persist in a pocket of western Inner Mongolia and will increase across Xinjiang through the Tarim Basin. Some moderate deficits are forecast across central Mongolia and in Japan from northern Honshu through Hokkaido. Surpluses in southern and southeastern China will continue to shrink and downgrade leaving some moderate surpluses in, primarily, southern Hunan and Jiangxi.

The forecast for the final three months – November 2019 through January 2020 – indicates that exceptional deficits will increase in a vast stretch from western Inner Mongolia through northern Qinghai and across the Tarim Basin in Xinjiang. Some moderate deficits are forecast in Mongolia, North Korea, the northern portion of the Lower and Middle Yangtze Basin, and Taiwan. Moderate surpluses will persist in Jiangxi in southeastern China.

(It should be noted that forecast skill declines with longer lead times.)

## Australia & New Zealand

The 12-month forecast through January 2020 shows widespread, exceptional water deficits in Northern Territory reaching west to the Hamersley Range in Western Australia and north through the Kimberley region. Exceptional deficits are also forecast in Western Australia's southern tip, with deficits of lesser intensity reaching north past Perth.

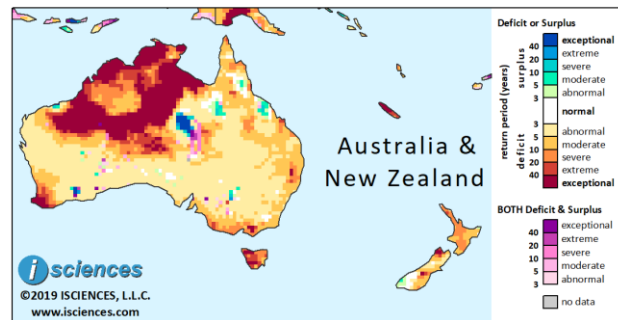
Moderate to extreme deficits are forecast along Australia's southeastern coast from Adelaide past Melbourne, and deficits will reach exceptional intensity in Tasmania.

Primarily moderate deficits are expected scattered along the country's eastern coast and through much of the Cape York Peninsula in the north, punctuated by some pockets of greater intensity between Sydney and Brisbane and near Rockhampton in Queensland.

Moderate surpluses are forecast for northeastern Queensland south of Townsville and northwestern Queensland east of the Selwyn Range. Intense surpluses are forecast in southeastern Northern Territory east of the MacDonnell Range.

Severe deficits are expected in New Zealand's North Island, and deficits of varying intensity in pockets of South Island. In New Caledonia, exceptional deficits are forecast.

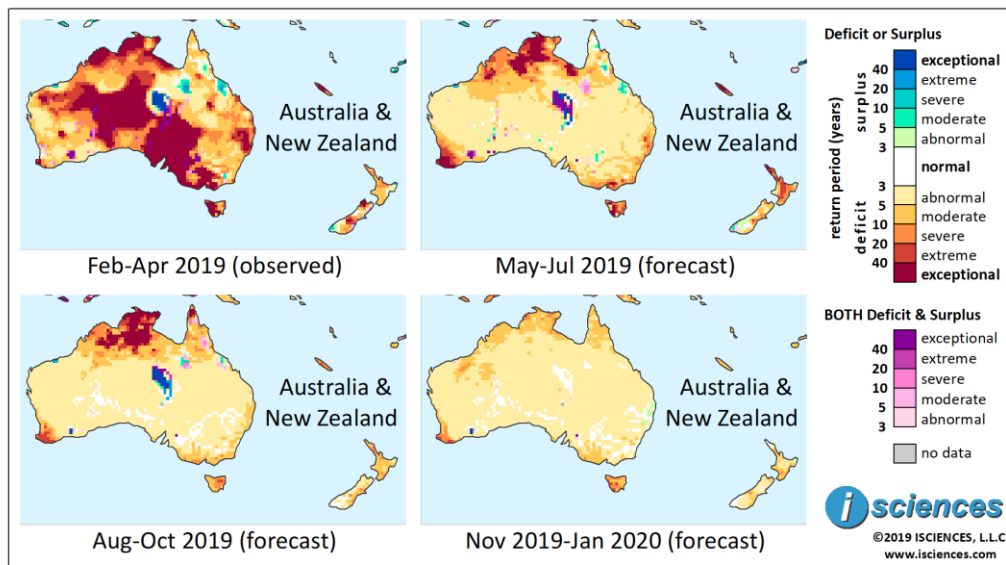
### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The 3-month maps (below) show the evolving conditions in greater detail.

### ISCIENCES COMPOSITE WATER ANOMALY INDEX: February 2019-January 2020



Based on observed data through April 2019 and forecasts issued April 24-30, 2019.

The forecast through July indicates that widespread, exceptional deficits that have dominated much of Australia in prior months will shrink considerably. Exceptional deficits are, however, forecast in Top End, Northern Territory (NT) reaching west to the Ord River in Western Australia (WA), with primarily severe deficits throughout the Kimberley Region, moderating south through the Great Sandy Desert. Severe to exceptional deficits will trail around the southern shore of the Gulf of Carpentaria into Queensland (QLD) leading to moderate deficits just south of Cape York Peninsula. Some pockets of moderate surplus are forecast in the northeast just west of Cairns and south of Townsville in QLD.

In Australia's southeastern quadrant, deficits of varying intensity are expected following the coast from Adelaide in the south to Brisbane in the east, with severe to extreme deficits near Melbourne and between Sydney and Brisbane. Moderate deficits are forecast for the Lachlan and Macquarie Rivers in New South Wales (NWS). Deficits will be intense in Tasmania. Intense deficits will increase in WA's southwestern tip. In the center of the country east of the MacDonnell Range in NT, a large pocket of exceptional surplus will begin to transition, with conditions of both deficit and surplus (purple).

In New Zealand, severe to exceptional deficits are forecast for North Island, and some pockets of primarily moderate deficit in South Island. Deficits in New Caledonia will be extreme to exceptional.

From August through October, exceptional deficits will increase in northern NT and deficits will intensify in the Fitzroy and Ord River regions of northern WA, becoming exceptional. Severe deficits will persist in the Kimberley. Exceptional deficits will emerge in the tip of Cape York Peninsula. Deficits in WA's southwestern tip will shrink and downgrade but will be severe. Along the southeastern coast of the country, deficits will moderate from Adelaide to Brisbane, but deficits will be severe in Tasmania.

Exceptional surpluses are expected to re-emerge east of the MacDonnell Range in southeastern NT. Some moderate deficits are forecast for New Zealand and deficits in New Caledonia will downgrade from exceptional to severe.

The forecast for the final months – November 2019 through January 2020 – indicates moderate deficits across northernmost Australia, and some severe deficits in the southwestern tip of WA and in Tasmania. Some moderate deficits are expected in New Zealand and New Caledonia.

(It should be noted that forecast skill declines with longer lead times.)