Global Water Monitor & Forecast Watch List

March 15, 2019

For more information, contact:
Thomas M. Parris, President, 802-864-2999, parris@isciences.com

Table of Contents

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 February 2019 and an ensemble of forecasts issued the last week of February 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.

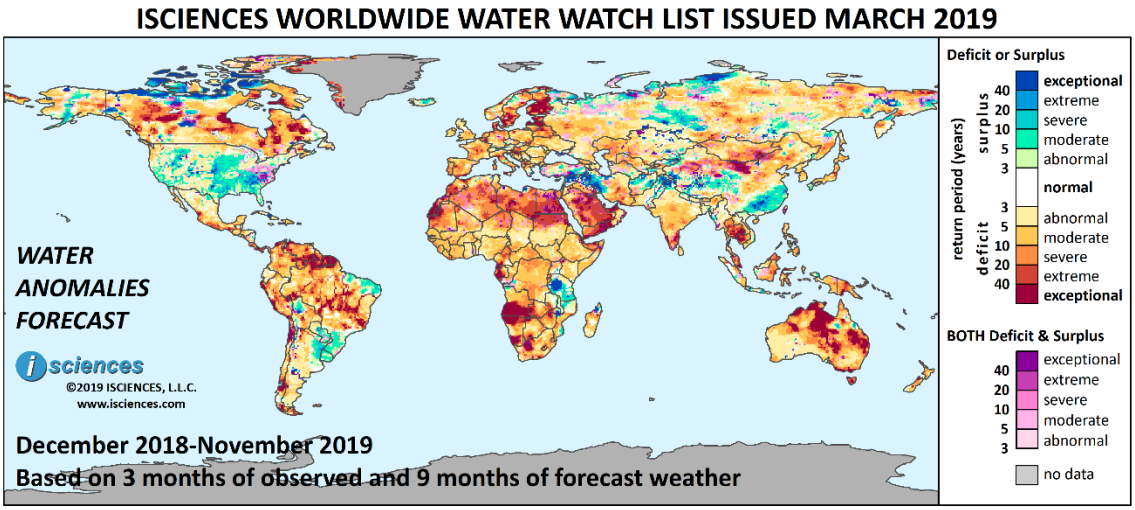
Deficits and surpluses are stated in terms of return period – a measure that characterizes the rarity of an anomaly. For example, a return period of 10 years indicates an anomaly that would occur, on average, once every ten years. Higher return periods indicate more extreme and, therefore, more disruptive 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.

Worldwide Water Watch List

This map presents a selection of regions likely to encounter significant water anomalies during the one-year period beginning in December 2018 and running through November 2019 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: Most notable in the forecast through May is the absence of widespread, intense water surpluses observed in the East in prior months and the emergence of surpluses in the West. Surpluses will shrink and downgrade in the center of the country but remain widespread in a broad path from southern Minnesota to the Gulf of Mexico and will be intense in Kansas. Moderate surpluses will cover much of California, and many Rocky Mountain States will transition from deficit to surplus.

Canada: The major changes forecast through May are that exceptional water deficits will shrink in Quebec though large pockets will persist, and widespread surpluses in Northern Ontario will transition to deficit. As for major population areas, intense deficits are forecast for Southern Ontario and through southern Quebec; near Vancouver, British Columbia; near Winnipeg, Manitoba; and surrounding Regina, Saskatchewan. Deficits of varying intensity are forecast in many parts of the country. In British Columbia, surpluses will increase in the southeast and transition to deficit in the southwest.

Mexico, Central America, and the Caribbean: The forecast through May indicates a patchwork of water anomalies. In Mexico, moderate to extreme deficits are forecast in Nayarit, Guerrero, Chiapas, and Yucatan. Conditions of both deficit and surplus are forecast from southern Durango southeast through Morelos. Regions forecast with surpluses include northern Coahuila, Nuevo León, southern Tamaulipas,

eastern San Luis Potosí, Distrito Federal, and northern Oaxaca into central Veracruz. Exceptional deficits are expected in western Panama, and moderate deficits in Dominican Republic.

South America: The forecast through May indicates that water deficits in Brazil will shrink and downgrade significantly, though intense deficits are forecast for eastern Minas Gerais, Espíritu Santo, and São Paulo. Surpluses will emerge in northeastern states and will moderate but increase in the south. Exceptional deficits are forecast for Suriname and French Guiana, and deficits of varying intensity for Brazil's northern neighbors, and Peru, Chile, eastern Bolivia, and Argentina. Surpluses will shrink in northern Bolivia, downgrade in central Paraguay, and moderate in northeastern Argentina and Uruguay.

Europe: The forecast through May indicates an increase in the extent of water deficits overall. Though surpluses are forecast for Austria, Switzerland, Norway, and northwestern Sweden, much of the rest of Europe can expect deficit conditions. Exceptional deficits will persist in Finland, southern Sweden, Estonia, Latvia, eastern Slovenia, and Croatia. Severe deficits will be widespread in Portugal, Spain, France, and Hungary. Pockets of intense deficit are forecast for many other regions.

Africa: The forecast through May indicates that water deficits will downgrade, with moderate anomalies throughout most of the continent, some pockets of greater intensity, and surpluses in Tanzania. Exceptional deficits are forecast in the Ethiopian Highlands. Other areas of significant deficit include Equatorial Guinea, Lesotho, Guinea-Bissau, central Republic of the Congo, eastern Angola, western Zambia and central Zambia and along the Zambezi River, and northern Zimbabwe.

Middle East: The forecast through May indicates that water deficits will downgrade considerably, though an intense pocket will persist around Kuwait and deficits will be severe in Yemen. Surpluses will downgrade overall but exceptional surpluses are forecast for northern Syria; near Mosul, Iraq; along Iran's Caspian Sea coast northeast of Tehran; and in Khuzestan, Iran.

Central Asia and Russia: The forecast through May indicates that water surpluses in Russia's Ob River Basin will downgrade but remain widespread. Other areas of surplus include eastern Kyrgyzstan, western Tajikistan, and southern Turkmenistan. Deficits are forecast for the Volga River Basin, the Fergana Valley in eastern Uzbekistan and into Kyrgyzstan, central Tajikistan, and southern Kazakhstan. Deficits will be intense in the Fergana Valley.

South Asia: The forecast through May indicates that exceptional water deficits will shrink in southern India but are expected along the Tungabhadra River through Karnataka and in northern Kerala. Moderate deficits are forecast from Gujarat to Andhra Pradesh, and more intense pockets in Madhya Pradesh. Areas of surplus include northern India and the Gangetic Plain, Bangladesh, Nepal, northern Pakistan and the Indus River system, and Afghanistan.

Southeast Asia and the Pacific: The forecast through May indicates that exceptional deficits will shrink in Cambodia and Thailand, but deficits will remain widespread and severe deficits will emerge in northern Thailand. Intense deficits will emerge in southern Myanmar, the Malay Peninsula, northern

Sumatra, central Laos, southern Vietnam, Philippines, and northeastern Borneo. Deficits will persist in Papua New Guinea. Areas of surplus include western Myanmar, Indonesian Borneo and Java.

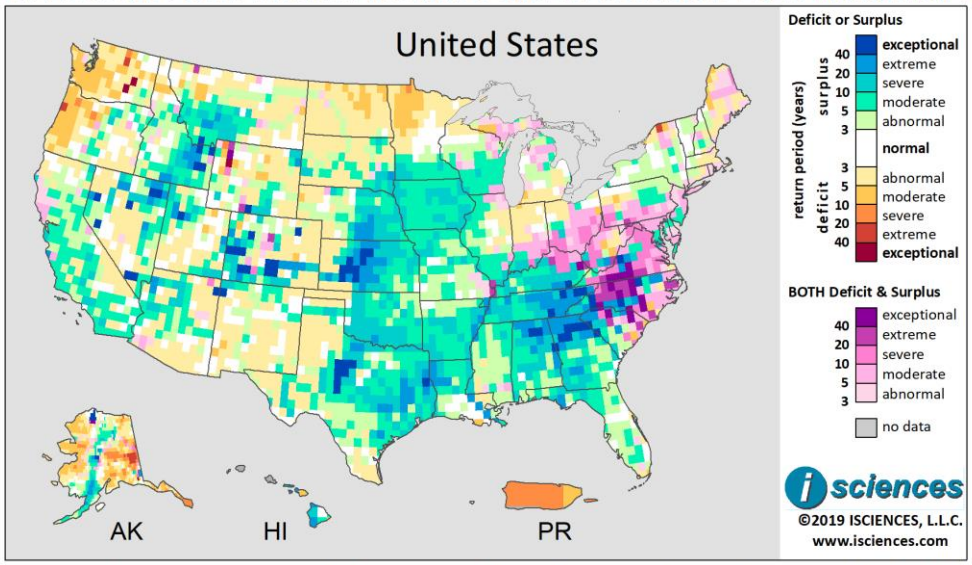
East Asia: The forecast through May indicates the emergence of a vast stretch of extreme to exceptional water deficits in southern and eastern Mongolia and Inner Mongolia, China. Widespread surpluses will downgrade but persist in the Yangtze Basin's Lower Reaches and in the southern portion of the Middle Reaches. Moderate deficits will emerge in Hainan and conditions in Taiwan will transition to near-normal. Intense deficits will emerge on the Korean Peninsula and will increase in much of Japan.

Australia & New Zealand: The forecast through May indicates that the widespread, exceptional water deficits that have dominated Australia in prior months will diminish considerably. However, exceptional deficits are forecast in the far north and in northern South Australia. Severe deficits are forecast in eastern Queensland and extreme anomalies in the Northern Tableland of New South Wales. Intense deficits are also forecast for Tasmania, New Zealand, and New Caledonia.

Watch List: Regional Details

United States

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The 12-month forecast ending November 2019 indicates that water surpluses of varying intensity will affect many parts of the conterminous U.S. Primarily moderate to severe surpluses are forecast in a broad path down the center of the country from the southern portions of Minnesota and Wisconsin through the central Plains and Mississippi River states and most of Texas to the Gulf of Mexico. Surpluses will be extreme to exceptional in central Kansas and the northern Edwards Plateau in Texas around Abilene, and extreme along the Lower Mississippi River. Surpluses will also be widespread south of the Ohio River through northern Florida and will be intense in eastern Tennessee, northern Alabama, and northern Georgia. In the western half of the U.S., surpluses are forecast in California, the northern Rockies, Nevada, Utah, northern Arizona, Colorado, and along many rivers.

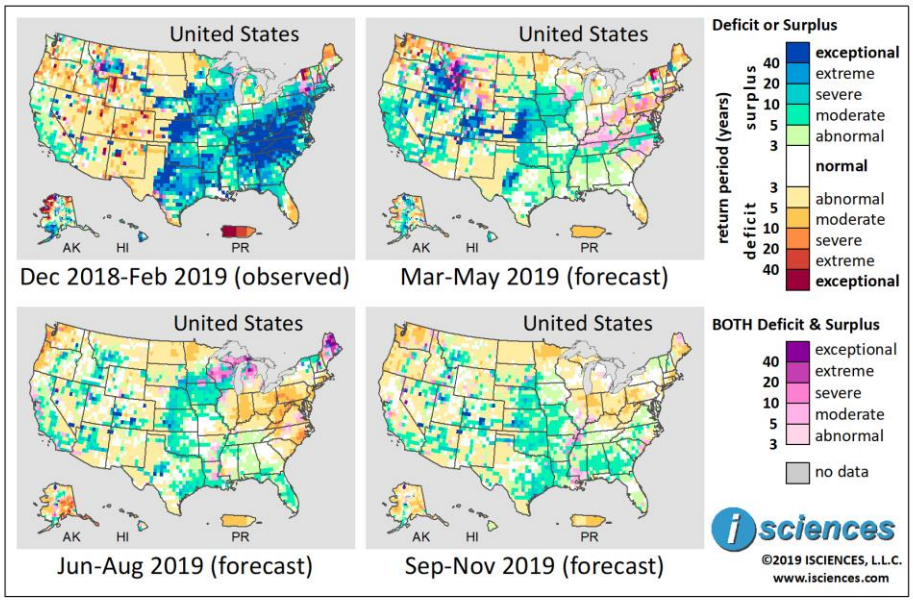
Back East, conditions of both deficit and surplus are forecast for the northern Ohio River Basin and from New Jersey through South Carolina.

Primarily moderate deficits are expected in western Oregon, Washington, northern Minnesota and pockets of North Dakota.

Outside the contiguous U.S., in Hawaii surpluses are forecast for western Hawai'i, Moloka'i, and Lana'i, and moderate deficits on Maui. In Alaska, surpluses are forecast on the Alaska Peninsula reaching inland; southeast of Barrow in the far north; and along the Upper Koyukuk and central Yukon Rivers. Deficits are expected in the Seward Peninsula and into western Alaska; along the Tanana River through Fairbanks; around Anchorage; and in the Alaska Panhandle. Severe deficits are forecast for Puerto Rico.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

Most notable in the forecast for March through May is the absence of widespread, intense surpluses observed in the East in prior months, and the emergence of surpluses in the West.

In the center of the country, surpluses will shrink and downgrade but remain widespread in a broad path that includes southern Minnesota, southeastern Wisconsin, Iowa, Nebraska, Kansas, northern Missouri, Oklahoma, Arkansas, Louisiana, and parts of Texas. Surpluses will be especially intense in Kansas and in Texas in the northern Edwards Plateau. Moderate deficits are forecast for northern Minnesota.

In the West, Colorado will transition from deficit to intense surplus as will Idaho, Nevada, and northwestern and eastern Utah. Moderate surpluses will increase in California, covering much of the state. Other areas of surplus include northern Arizona and pockets of central Oregon. Deficits are forecast for Washington, pockets of Oregon and the Northern Rockies, and in northern Wyoming.

Surpluses are forecast along many rivers, with exceptional surpluses along the Arkansas River from Kansas into Colorado and the Snake River in Idaho; extreme surpluses on the San Juan River through New Mexico, Colorado, and Arizona; and moderate to severe surpluses on the Mississippi, the Missouri, the Canadian, and North Platte Rivers.

In the East, moderate surpluses are forecast for Virginia, Tennessee, northern North Carolina, northeastern Mississippi, northern Alabama, and small pockets in the Northeast, including New York and northern New Hampshire. Intense deficits will persist in northern New York. Regions with a forecast of less intense deficit include Maine, Vermont, Pennsylvania, Connecticut, New Jersey, West Virginia, and southern Florida.

From June through August, surpluses in the center of the country and the West will diminish but persist, and exceptional deficits will nearly disappear. Primarily moderate surpluses are forecast for southern Minnesota, southern Wisconsin, southeastern South Dakota, Iowa, eastern Nebraska, Kansas, northern Missouri, Oklahoma, west-central and south-east Texas and southern Louisiana. Severe surpluses will emerge on the Pecos River in western Texas. Moderate to severe deficits will persist in Oregon and Washington. Primarily moderate deficits will emerge in the northern Ohio River Basin reaching the Mid-Atlantic States, and severe deficits in eastern North Carolina. Moderate surpluses will emerge in Florida.

The forecast for the final months – September through November – indicates moderate surpluses down the center of the country, in the Deep South, pockets throughout the West, and along many rivers. Moderate deficits are forecast for the Pacific Northwest, northern Wisconsin, pockets of the northern Ohio River Basin, and Maine.

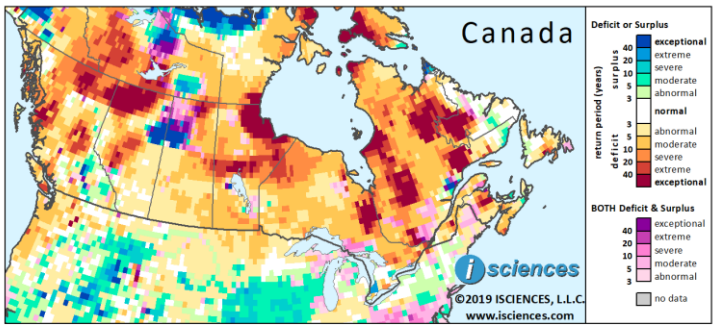
(It should be noted that forecast skill declines with longer lead times.)

Canada

The 12-month outlook for Canada through November 2019 indicates water deficits nearly coast-to-coast in the provinces, with large pockets of exceptional deficit in Quebec and in parts of the Prairie Provinces' northern environs and British Columbia.

Intense deficits are also forecast in a block on the northern portion of Ontario's eastern border, central New Brunswick, and southern Vancouver Island, British Columbia.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019

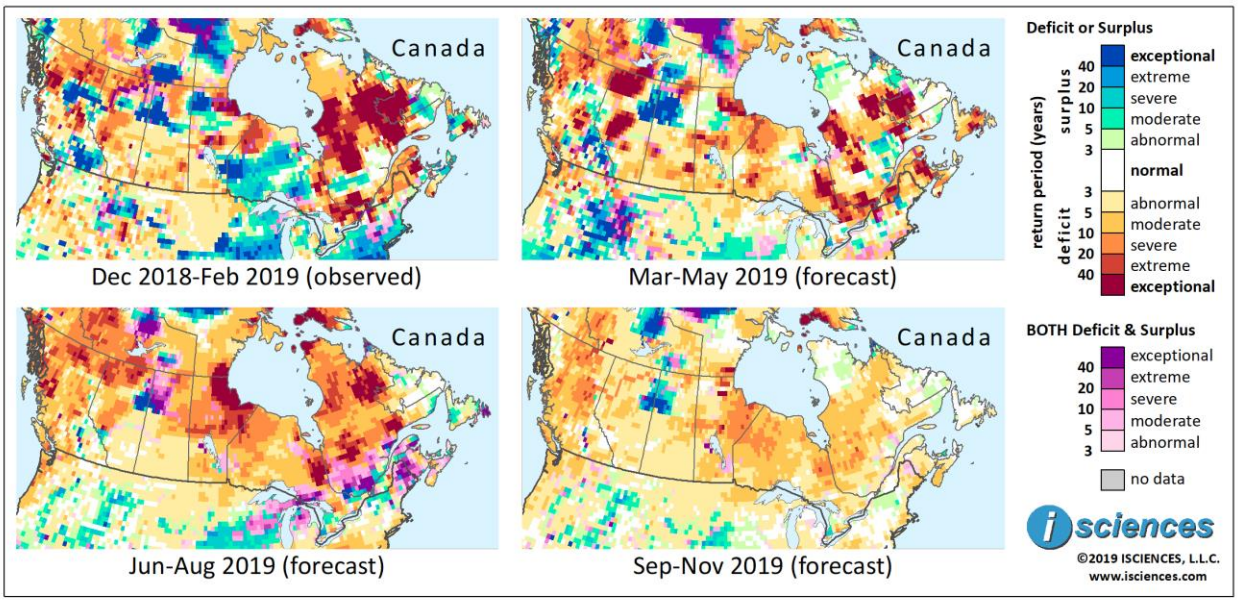


Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

A large block of exceptional surplus is forecast from Fort McMurray, Alberta past Churchill Lake, Saskatchewan. Surpluses of varying intensity are forecast for southeastern British Columbia, and at the opposite end of the country at the mouth of the St. Lawrence River west of the Manicouagan River.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The major changes forecast through May are that exceptional deficits will shrink in Quebec (QC) though large pockets will persist, and widespread surpluses in Northern Ontario (ON) will transition to deficit. As for major population areas in the country, intense deficits remain in the forecast for Southern Ontario

east of Georgian Bay and through southern QC east of the St. Lawrence River. Conditions west of Toronto will be relatively normal. In other metropolitan areas, extreme to exceptional deficits are forecast near Vancouver, British Columbia (BC); extreme deficits near Winnipeg, Manitoba (MB); and severe deficits surrounding Regina, Saskatchewan (SK).

Elsewhere around the country, deficits of varying intensity are forecast for Newfoundland, Nova Scotia, New Brunswick, and many regions of MB, SK, Alberta (AB), and BC. Deficits will be exceptional in northeastern MB around Hudson Bay; the Upper Assiniboine River Watershed on the southeastern border of SK; the Middle and Upper Reaches of the Athabasca River in AB and in the northwest of the province; and pockets in BC around Prince George.

Surpluses will downgrade in northwestern MB and in the Peace River region west of Fort St. John, BC; and will increase in a vast stretch from Fort McMurray, AB to Cree Lake, SK. In southern BC, surpluses will increase in the southeast and transition to deficit in the southwest.

From June through August, deficits will increase. Moderate to exceptional deficits are forecast for much of QB, ON, and MB, though surpluses will emerge in southern QC and conditions of both deficit and surplus as transitions occur. In the Prairie Provinces, mild deficits are forecast in southern AB and southern SK, and primarily moderate deficits in southern MB. Deficits will increase across the northern halves of the Prairie Provinces and in BC. Exceptional surpluses will persist around Fort McMurray, AB; exceptional deficits in the Middle and Upper Reaches of the Athabasca River will downgrade but will be severe. Surpluses in BC will shrink, persisting in pockets of the southeast.

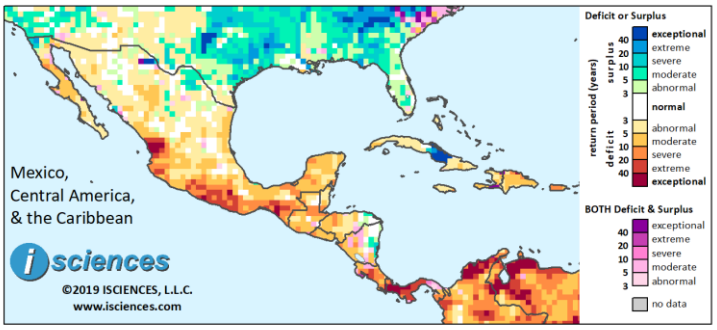
The forecast for the final three months – September through November – indicates that deficits will shrink and downgrade overall. Surpluses will persist and increase across the shared northern border of AB and SK.

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

Mexico, Central America, and the Caribbean

The 12-month forecast ending November 2019 indicates exceptional water deficits in Nayarit on Mexico's Pacific Coast, and severe to extreme deficits in western Jalisco, Guerrero, Oaxaca, and Chiapas.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

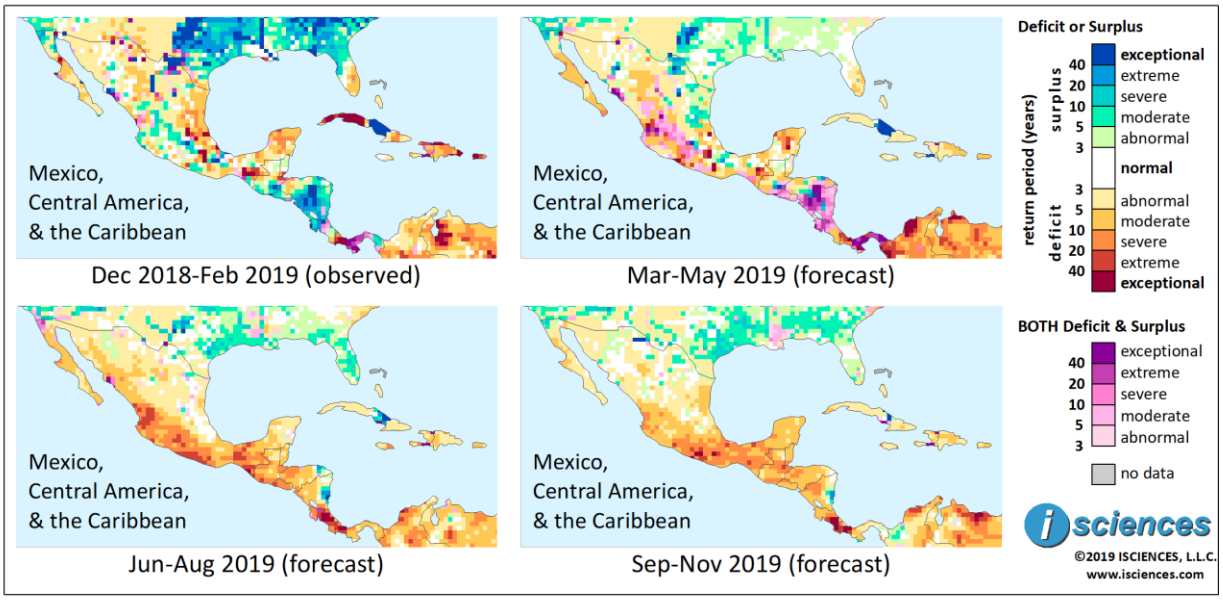
Primarily moderate deficits are forecast for central Baja, southern Chihuahua, pockets in the central states, around the Gulf of Mexico, and the Yucatan.

Exceptional surpluses are expected in a pocket of northern Chihuahua, moderate to severe surpluses in northern Coahuila and the northern extreme of Baja, and moderate surpluses in southeastern Chihuahua and eastern Durango.

In Central America, exceptional deficits are forecast in Panama, severe to extreme deficits in Costa Rica, and moderate to severe deficits in Guatemala, El Salvador, and western Honduras and Nicaragua. Moderate surpluses are expected in east-central Nicaragua. Primarily moderate deficits are expected in Haiti and Dominican Republic.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The forecast through May indicates a patchwork of water anomalies in the region. In Mexico, moderate to extreme deficits are forecast in Nayarit, Guerrero, Chiapas, and Yucatan; and moderate deficits in central and southern Baja, southern Chihuahua, and Durango. Small, isolated pockets of intense deficit will pepper the southern states. A wide path of both deficit and surplus conditions is forecast from southern Durango arcing southeast through Morelos as deficits emerge in areas of prior surplus. Regions forecast with surpluses include a pocket in western Chihuahua, northern Coahuila, Nuevo León, southern Tamaulipas, eastern San Luis Potosí, Distrito Federal, and northern Oaxaca into central Veracruz.

In Central America, exceptional deficits are expected in western Panama and pockets of moderate deficit in Guatemala and western Honduras. Remaining regions are expected to see conditions of both deficit and surplus as transitions occur, with some pockets of surplus persisting. In the Caribbean, moderate deficits are forecast for Dominican Republic.

From June through August, surpluses in Mexico will nearly disappear. Moderate deficits are forecast for Baja and along the mainland across the Gulf of California. From Nayarit through the western states and between the Gulf of Mexico and the Gulf of Tehuantepec, severe to extreme deficits are forecast. Moderate to severe deficits are expected in Guatemala, El Salvador, western Honduras, western Nicaragua, and eastern Panama. Intense deficits are forecast for Costa Rica and western Panama. Surpluses are forecast around Laguna de Perlas in eastern Nicaragua and in Colon, Honduras. Moderate deficits are forecast in Haiti and severe deficits in eastern Jamaica.

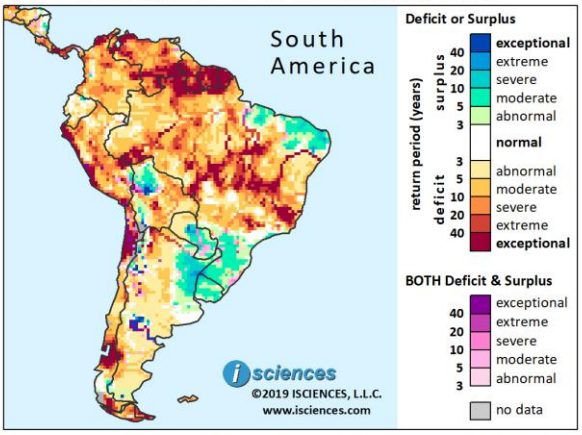
For the final three months – September through November – moderate to severe deficits will cover Mexico's southern half as well as much of Central America. Exceptional deficits will persist in Costa Rica and western Panama.

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

South America

The 12-month forecast through November 2019 indicates water deficits ranging from moderate to exceptional in much of Brazil, with intense deficits forecast along many rivers. Surpluses, primarily moderate, are forecast in northeastern Brazil and in the south.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



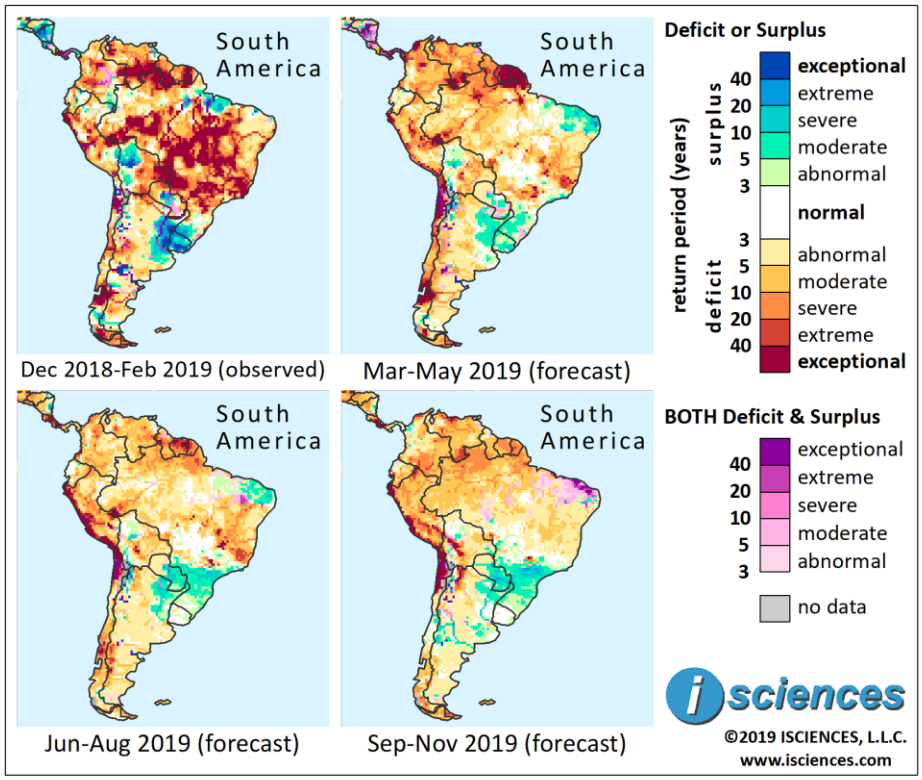
Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

Brazil's northern neighbors will also see intense deficits including exceptional deficits in French Guiana, Suriname, Guyana, and pockets of Venezuela. Deficits of varying intensity are expected in Peru, southern Bolivia, Chile, and Argentina. Deficits will reach exceptional intensity in coastal Peru, the Atacama Desert in northern Chile and the Gulf of Corcovado in the south, and Tierra del Fuego. Extreme deficits are expected on the Bermejo River in northern Argentina.

Surpluses are forecast in northwestern Bolivia; central and eastern Paraguay; Uruguay; Argentina's northeastern provinces and at the intersection of Neuquén, La Pampa, and Rio Negro Provinces.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The forecast through May indicates that deficits in Brazil will shrink and downgrade significantly, with nearly normal conditions returning to southern Pará, Maranhão, Tocantins, southeastern Mato Grosso, and southern Goiás. Deficits will downgrade in Roraima but will be severe overall; moderate deficits will increase in northern Amazonas; and deficits will be fairly intense along rivers in the Amazon. Moderate to extreme deficits are forecast for eastern Minas Gerais, Espíritu Santo, and São Paulo, and moderate to severe deficits on the São Francisco River. Surpluses will shrink in northern Pará; emerge in the northeastern states of Piauí, Ceará, Río Grande do Norte, Paraíba, and Pernambuco; and moderate but increase in Río Grande do Sul, reaching into Santa Catarina. Surpluses will also emerge between Río and São Paulo.

Across the northern arc of the continent, primarily moderate to severe deficits are forecast from Colombia through Guyana with exceptional deficits in southern Venezuela. Deficits in Suriname and French Guiana will increase and intensify, becoming exceptional. Deficits of varying intensity are forecast for Peru, Chile, eastern Bolivia, and parts of Argentina, primarily rivers. Deficits will be exceptional in pockets along Peru's coast, and the Atacama Desert and the Gulf of Corcovado in Chile. Surpluses will shrink in northern Bolivia, shrink and downgrade in central Paraguay, and moderate in northeastern Argentina and Uruguay.

From June through August, deficits are forecast to generally downgrade, except along Peru's coast where exceptional deficits will increase, tracing a path extending into Chile. Severe to exceptional deficits are forecast for Guyana, Suriname, and French Guiana. Mild to moderate deficits are forecast for Brazil, with more intense pockets in Minas Gerais and northern São Paulo. Deficits will be severe on the São Francisco and Jequitinhonha Rivers in the east. Surpluses will shrink in northeastern Brazil and in Río Grande do Sul but will increase in Santa Catarina and emerge in Paraná and southern Mato Grosso do Sul. Surpluses will increase in Paraguay, shrink somewhat in northeastern Argentina, and conditions in Uruguay will return to normal.

In the final quarter – September through November – deficits will downgrade in eastern Brazil, increase in the Amazon Basin, remain severe across the northern arc of the continent, increase in Peru, and emerge in the Cordillera Real Mountains in western Bolivia. Surpluses will persist in Paraguay, neighboring states in Brazil, and northeastern Argentina, and emerge in central Argentina.

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

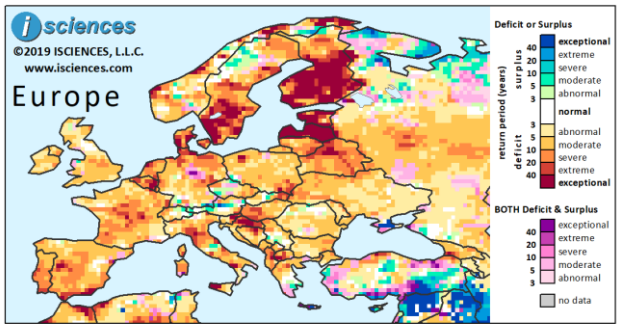
Europe

The 12-month forecast through November 2019 indicates deficits of varying intensity throughout much of Europe. Exceptional deficits are forecast for southern Sweden, Finland, Estonia, Latvia, and pockets of Denmark, Slovenia, and Croatia.

Severe to extreme deficits are forecast for many regions.

Areas with a forecast of surplus include central Austria, Crimea, and Murmansk, Russia.

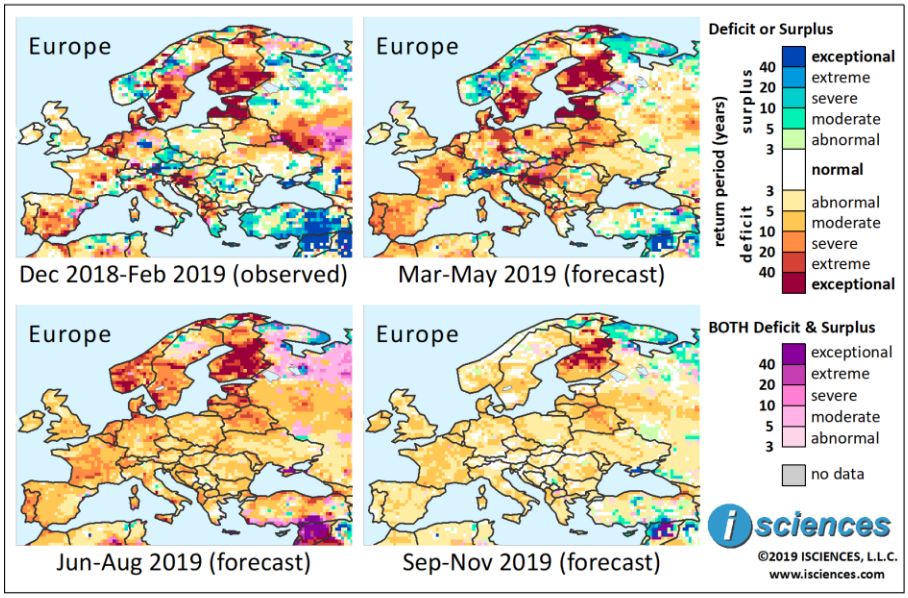
ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The forecast through May indicates an increase in the extent of deficits overall. Though intense surpluses are forecast for Austria and surpluses of varying severity in Switzerland, Norway, northwestern Sweden, and Murmansk, Russia, much of the rest of Europe can expect deficit conditions. Exceptional deficits will persist in Finland, southern Sweden, Estonia, Latvia, eastern Slovenia, and Croatia. Pockets of severe to extreme deficit are forecast for Denmark, Belgium, Netherlands, eastern Germany, Poland, Belarus, eastern Slovakia, and scattered throughout the Balkans. Severe to extreme

deficits are expected to blanket Hungary and will cover much of France, particularly northern Auvergne. Severe deficits will emerge throughout Portugal and in most of Spain west of Madrid.

From June through August surpluses will nearly disappear as deficits emerge throughout most of Europe. The extent of intense deficits will diminish but exceptional anomalies will persist in Finland. In nearby Baltic regions, deficits will downgrade in Estonia, Latvia, and southern Sweden but will be severe with some exceptional pockets; Norway will transition from surplus to intense deficit. Primarily moderate deficits are forecast for the remainder of Europe. However, deficits will be more intense in Belarus, Portugal, France, Switzerland, Belgium, Netherlands, northern Germany, eastern Croatia, and Sicily.

The forecast for the remaining months – September through November – indicates mild to moderate deficit conditions throughout most of Europe, with the exception of Finland. Exceptional deficits will shrink in Finland but remain widespread. Surpluses will re-emerge in Murmansk, Russia.

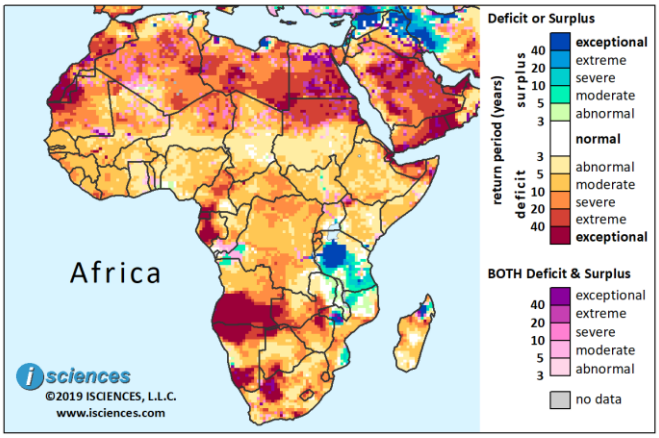
(It should be noted that forecast skill declines with longer lead times.)

Africa

The 12-month forecast through November 2019 indicates severe to extreme water deficits across northern Africa with exceptional deficits in Western Sahara and pockets of Egypt. Exceptional deficits are also forecast in many parts of southern Africa including Angola's southern half; Namibia's northern and southern thirds; Northern Cape, South Africa; and northern Zimbabwe.

Deficits of varying intensity are forecast for much of the remainder of the continent and Madagascar including intense deficits in the northern Horn of Africa, Cameroon, Equatorial Guinea, and Gabon.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019

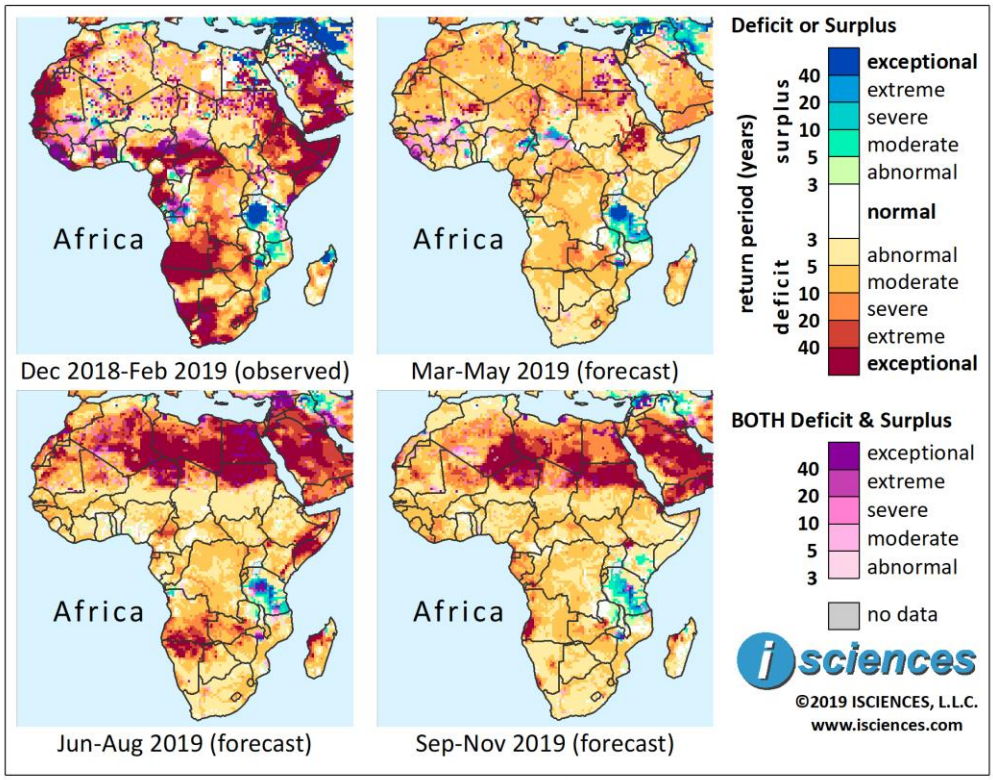


Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

Exceptional surpluses are forecast for western Tanzania, a pocket in western Mozambique, and a pocket in northern Madagascar. Surpluses of lesser intensity are expected in eastern Tanzania, northern Mozambique and along Mozambique's southern coast.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The forecast through May indicates that deficits will downgrade, leaving much of the continent with moderate anomalies along with pockets of greater intensity. Exceptional deficits are forecast in the Ethiopian Highlands, especially surrounding Lake Tana, and along the Atbara River leading well into Sudan. Deficits will be extreme on the Blue Nile. Mild to moderate deficits are expected in the remainder of the Horn of Africa. Across northern Africa, primarily moderate to severe deficits are expected with some areas of greater intensity in northern Sudan and eastern Mali. Surpluses are forecast in a few pockets along Libya's coast near Benghazi and west of Tripoli.

Deficits reaching extreme or even exceptional intensity are expected in Equatorial Guinea, Boeny Region in northwestern Madagascar, Lesotho, Guinea-Bissau, and central Republic of the Congo. Severe deficits are forecast along rivers in northern Democratic Republic of the Congo and Central African Republic (DRC) and along the Kasai River in southwestern DRC; in Rwanda and Burundi; in eastern Angola into western Zambia and along the Zambezi River, and central Zambia; and northern Zimbabwe.

Surpluses are forecast for much of Tanzania and will be exceptional in the west, downgrading to moderate as they lead through northeastern Zambia. Intense surpluses are forecast around Tete in

western Mozambique. Surpluses elsewhere include northeastern Nigeria into northernmost Cameroon, south-central Chad, north-central Burkina Faso, and in Ghana around the northern portion of Lake Volta.

From June through August deficits across northern Africa will intensify significantly with exceptional deficits across the Sahara. Mild deficits are forecast in the Sahel. Intense deficits will emerge in Somalia, particularly in the south, and eastern Ethiopia, while deficits in the Ethiopian Highlands downgrade to mild. In Kenya, intense deficits will emerge along a path in the east from the Somalia border to the Tanzania border, and northwest of Lake Turkana. Deficits in southern Angola and northern Namibia will intensify, becoming severe to exceptional. Intense deficits elsewhere include pockets in Zambia and Madagascar's central west coast. Surpluses will persist in Tanzania, downgrading somewhat. Surpluses elsewhere will nearly disappear.

During the final quarter – September through November – intense deficits will continue across much of northern Africa though the extent of exceptional deficits will diminish. Primarily moderate deficits are forecast in the remainder of the continent with intense deficits in southwestern Angola and surpluses in East Africa.

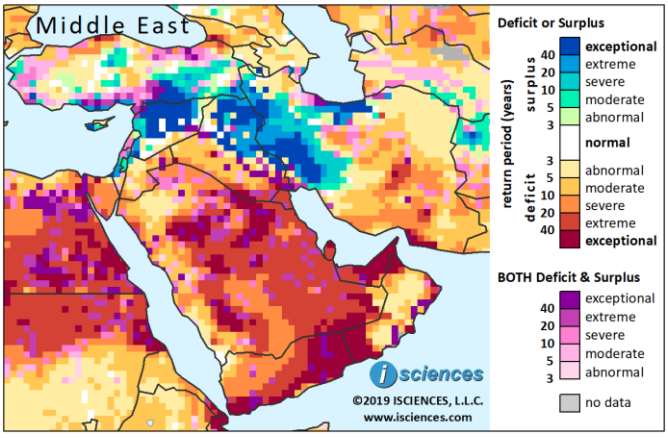
(It should be noted that forecast skill declines with longer lead times.)

Middle East

The forecast for the 12-month period ending November 2019 indicates widespread, intense water deficits on the Arabian Peninsula including exceptional deficits in pockets of Saudi Arabia, United Arab Emirates, Yemen, and western Oman. Exceptional deficits are also forecast along the Gulf of Oman.

Extreme deficits are forecast in Kuwait and Qatar; moderate to extreme deficits in much of southern Iran and Georgia; and deficits of generally lesser intensity in Jordan, Iraq west of the Euphrates River, and scattered along Turkey's Black Sea Coast.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019

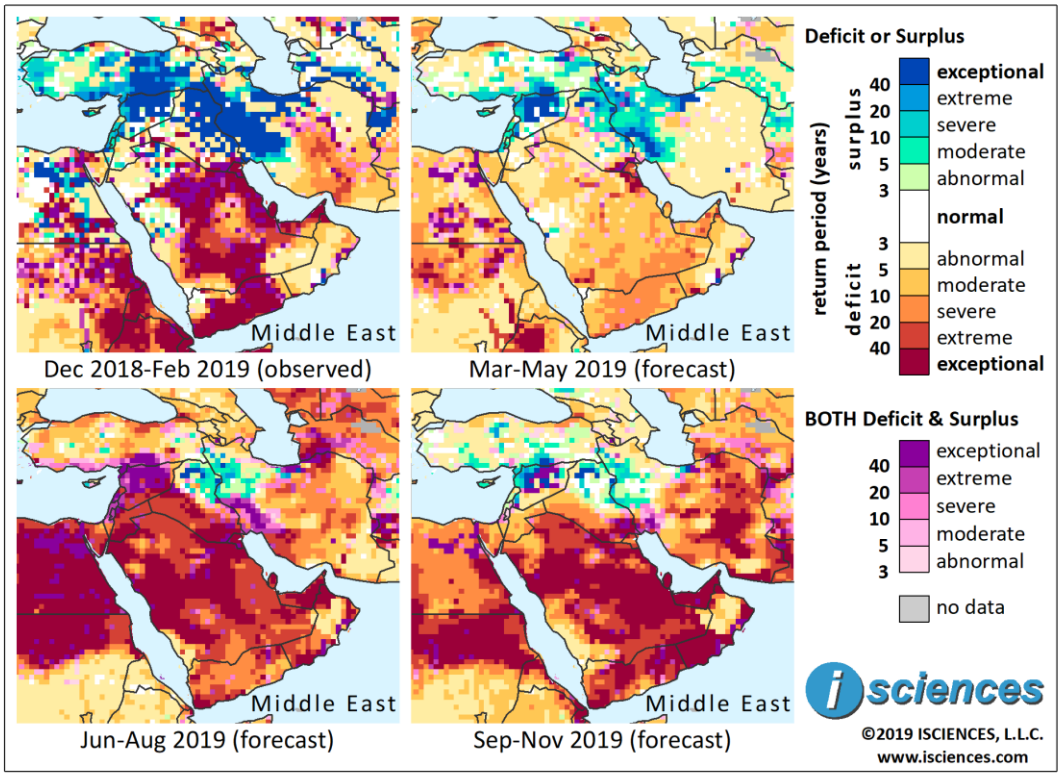


Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

Surpluses are forecast in Cyprus; from Gaza through West Bank; northern Syria and across the border into Turkey; from the Euphrates River in Iraq into western Iran; and along Iran's central Caspian Sea coast. Surpluses will be exceptional in Syria; around Mosul and Kirkuk, Iraq; and Lorestan, eastern Khuzestan, and Mazandaran, Iran.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The forecast through May indicates that deficits in the region will downgrade considerably, though an intense pocket will persist around Kuwait. Severe deficits are forecast for Yemen, and moderate to severe deficits in Saudi Arabia and United Arab Emirates. Surpluses will downgrade as well from the intensity of the prior three-month period. However, exceptional surpluses are forecast for northern Syria; near Mosul, Iraq; along Iran's Caspian Sea coast northeast of Tehran; and in Khuzestan, Iran. Surpluses of lesser intensity are forecast along the eastern Mediterranean coast; pockets of Turkey and along the Murat River in the northeast; and from eastern Iraq through western Iran.

From June through August deficits will intensify significantly on the Arabian Peninsula and will emerge in the Levant, with conditions of both deficit and surplus (purple) as transitions occur. Deficits will be extreme to exceptional and the affected area will include Iraq west of the Euphrates. Surpluses will shrink in the region, but surpluses are forecast in northeastern Iraq and into northwestern Iran through Hamadan Province. Surpluses will nearly disappear in Turkey as deficits of varying severity emerge. Deficits will emerge in much of Iran's eastern bulk and will be extreme near the Persian Gulf.

In the final quarter – September through November – deficits will downgrade in the Levant, surpluses will re-emerge in northern Syrian and pockets of Turkey, but extreme to exceptional deficits are forecast for the Arabian Peninsula and many areas in Iran's eastern bulk.

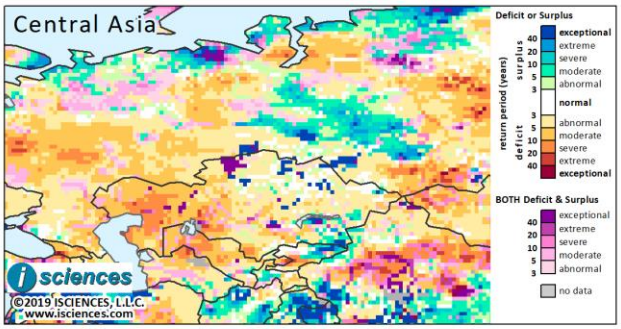
(It should be noted that forecast skill declines with longer lead times.)

Central Asia and Russia

The 12-month forecast through November 2019 indicates moderate to severe deficits in the Volga River Basin's Middle and Upper regions in Russia, and moderate to extreme deficits in the bulk of the Yenisei River Basin.

Surpluses of varying intensity are forecast in the Middle Ob River Basin and in the northern portion of the Tom River Basin in Russia.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019

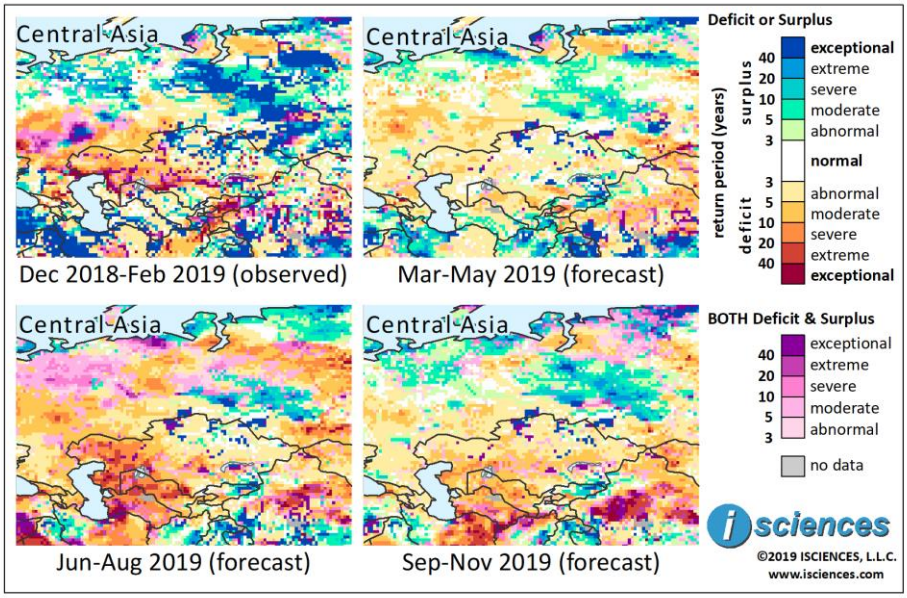


Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

Moderate to severe deficits are forecast for northern Turkmenistan, central Uzbekistan, and western Kazakhstan. Severe to extreme deficits are forecast for the Fergana Valley in eastern Uzbekistan reaching across Kyrgyzstan's narrow girth. Surpluses are expected in eastern Kyrgyzstan and could reach exceptional intensity. Surpluses are also forecast in Kazakhstan south of Lake Balkash, scattered pockets in northern Kazakhstan, and western Tajikistan.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The forecast through May indicates that surpluses in the Ob River Basin of Russia will shrink somewhat and downgrade, with exceptional surpluses nearly disappearing. In the Yenisei River Basin, deficits are forecast in the lower reaches; surpluses along the Kureyka River, an eastern tributary; and deficits in the regions of the Lower and Podkamennaya Tunguska Rivers, and Angara River. Moderate to severe deficits are forecast in the Middle Volga River Basin and moderate deficits in Trans Volga and in the southern Ural Mountains.

Moderate to exceptional surpluses are forecast for scattered pockets in Kazakhstan, particularly in the north, south of Lake Balkash, eastern Kyrgyzstan, and western Tajikistan. Moderate surpluses are expected in southern Turkmenistan and southeastern Uzbekistan. Severe to extreme deficits are forecast in the Fergana Valley in Uzbekistan and across Kyrgyzstan's narrow girth; moderate to extreme deficits in central Tajikistan and southern Kazakhstan; and moderate deficits in central Uzbekistan and pockets of northwestern Kazakhstan.

From June through August, severe to extreme deficits will emerge in Turkmenistan, Uzbekistan, and western Kazakhstan, with pockets of exceptional anomalies. Deficits in the Fergana Valley will moderate; severe deficits will persist in a narrow band in central Kyrgyzstan; and severe deficits will emerge in southern Qaraghandy Region, Kazakhstan. Surpluses will persist in eastern Kyrgyzstan and across the border into Almaty Region, Kazakhstan. In Russia, deficits will persist in the Volga Basin, and conditions of both deficit and surplus are forecast for the Northern European Plain. Surpluses will persist in the Upper Ob River Basin and deficits will increase in much of the Yenisei River Basin.

The forecast for the final months – September through November – indicates that deficits will shrink in the Volga and Yenisei Basins and downgrade overall in Central Asia. Surpluses will persist in eastern Kyrgyzstan and in the Ob River Basin.

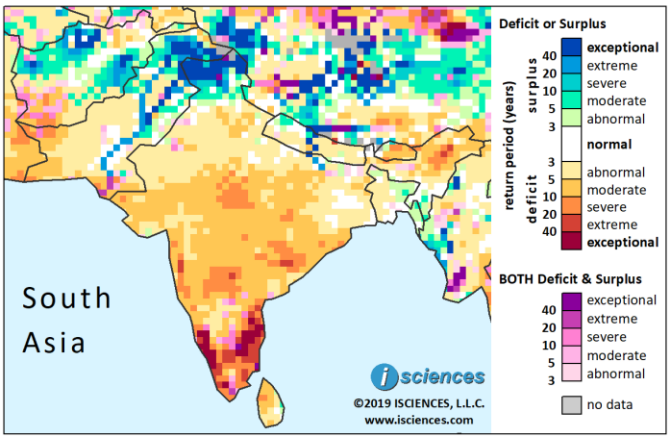
(It should be noted that forecast skill declines with longer lead times.)

South Asia

The 12-month forecast through November 2019 indicates intense water deficits in southern India, moderate to severe deficits across much of the center of the country and in the Far Northeast, and intense surpluses in Jammu and Kashmir in the north.

Intense surpluses are also forecast across the border in northern Pakistan and along the Indus, Jhelum, and Chenab Rivers in Pakistan. Moderate deficits are expected in southwestern Pakistan.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



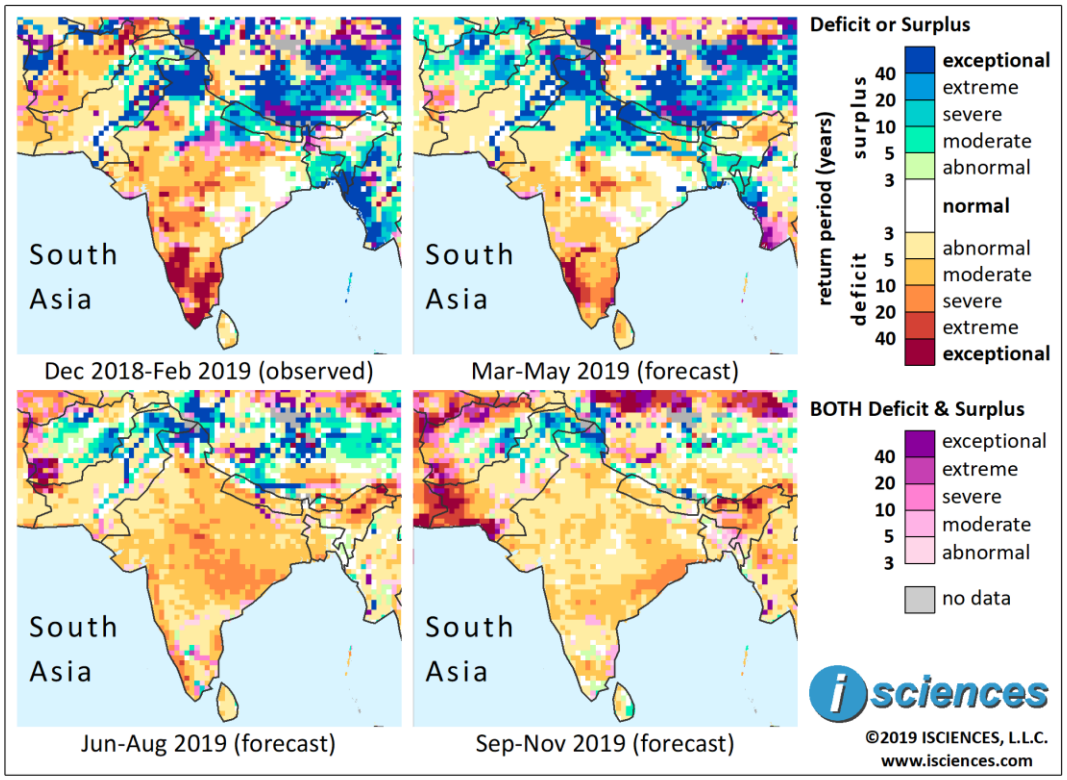
Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

In Afghanistan, surpluses of varying intensity are forecast east of the Helmand River from Kandahar to Kabul, and in the west from Herat to Mazar-e Sharif. Surpluses will be exceptional around Kabul, Herat, and Mazar-e-Sharif.

In central Nepal, surpluses are forecast along the Gandaki River leading into India. Moderate to severe deficits are forecast for Bhutan, and moderate deficits in northern Sri Lanka.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The near-term forecast through May indicates that exceptional deficits will shrink and downgrade in southern India but are expected along the Tungabhadra River through Karnataka and in northern Kerala. Primarily moderate deficits are forecast in Gujarat, Maharashtra, and Andhra Pradesh; some severe to extreme pockets are forecast in Madhya Pradesh around Chhindwara in the south and northwest of Bhopal. Moderate to severe deficits are expected in India's Far Northeast. Surpluses are forecast from Punjab through Jammu and Kashmir (J&K) in the north, and in the western Gangetic Plain in Uttar Pradesh. Surpluses will be exceptional in J&K and on the Ganges and the Ghaghara Rivers until they meet, and extreme on the Ganges through Bihar. Surpluses of varying intensity are expected along the Yamuna and Chambal Rivers.

In Pakistan, intense surpluses are forecast on the Indus, Jhelum, Chenab, Ravi, and Sutlej Rivers and in the north. Surpluses of varying intensity will emerge in eastern Afghanistan from Kandahar to Kabul and in the west from Herat to Mazar-e Sharif. Surpluses will be exceptional around Kabul and from Mazar-e Sharif leading southwest. Surpluses are also forecast throughout much of Nepal, many parts of Bangladesh, and east of Bangladesh in India's Tripura, Mizoram and Manipur regions.

From June through August, deficits in southern India will downgrade, becoming mild overall with moderate to severe deficits along the west coast and around Chennai in the southeast. Moderate deficits are forecast across much of the remainder of India, with severe deficits in a block from central Madhya Pradesh through eastern Maharashtra, southern Chhattisgarh, and southern Odisha. Surpluses will persist in J&K but surpluses in the Gangetic Plain will transition to moderate deficits. Deficits in India's Far Northeast will intensify.

Nepal and Bangladesh will transition from surplus to primarily moderate deficit, and deficits will emerge in Bhutan. Surpluses in Pakistan and Afghanistan will shrink somewhat. Conditions on the northern portion of the Indus River in Pakistan will intensify becoming exceptional while its southern stretch and eastern tributaries downgrade. Conditions of both intense deficit and surplus are forecast for southwestern Afghanistan.

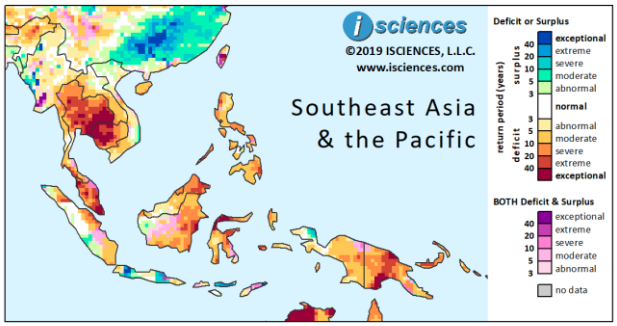
The forecast for the final months – September through November – indicates mild to moderate deficits overall in India with more intense conditions along the northern Bay of Bengal and in the Far Northeast. Intense deficits will emerge in southern Pakistan. Surpluses will downgrade somewhat in northern Pakistan and neighboring J&K, India; persist around Kabul, Afghanistan, and transition to deficit around Mazar-e Sharif.

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

Southeast Asia and the Pacific

The 12-month forecast through November 2019 indicates severe to exceptional water deficits in much of western Cambodia, Thailand, and peninsular Malaysia. Moderate deficits are expected in western and southern Laos and southern Vietnam centered around Ho Chi Minh City.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



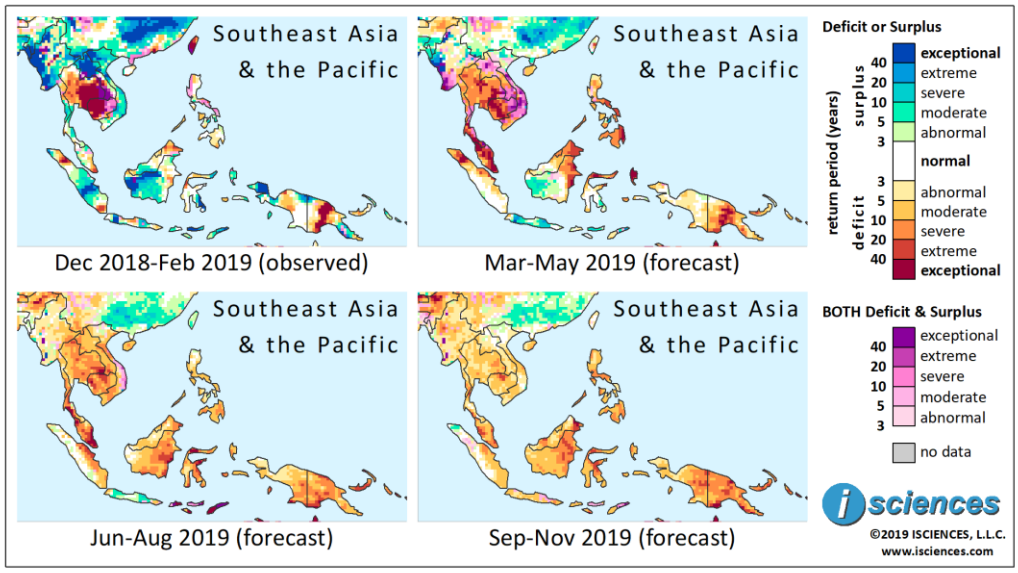
Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

Deficits of varying intensity are forecast for the Philippines, pockets in eastern and southern Sumatra, eastern and southern Borneo, and Sulawesi. Deficits are also forecast for much of New Guinea and will be exceptional in Papua New Guinea around the western shore of the Gulf of Papua.

Surpluses are forecast for Flores Island; pockets of western Myanmar and Java; and the eastern region of Bird's Head Peninsula on New Guinea.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The forecast through May indicates that, while the extent of exceptional deficits will shrink in Cambodia and Thailand, intense deficits will remain widespread in both nations and severe deficits will emerge in northern Thailand. Severe deficits are also expected to emerge in Myanmar's narrow, southern Tanintharyi Region, becoming extreme to exceptional on the Malay Peninsula and into northern Sumatra. Severe deficits are forecast in central Laos and southern Vietnam as conditions in those two

nations transition from surplus. Intense surpluses will persist in western Myanmar and both deficits and surpluses (purple) are forecast for the Irawaddy Delta as transitions occur.

Severe to exceptional deficits are forecast for the Philippines, particularly Mindanao, and a pocket of surplus is forecast around Cebu City. Moderate to exceptional deficits are forecast for northeastern Borneo, northern Sulawesi, Ternate Island, and central Papua New Guinea. Surpluses are forecast for western Indonesian Borneo, Java, and Flores Island.

From June through August, surpluses in the region will nearly disappear and deficits will downgrade somewhat overall but increase in extent. Deficits in Thailand and Cambodia will be severe with pockets of extreme intensity. Primarily moderate deficits are expected in eastern Myanmar and Laos, and severe deficits in Vietnam's narrow central region and in the south around Ho Chi Minh City. Deficit anomalies on the Malay Peninsula will shrink slightly but will reach extreme to exceptional intensity. Moderate deficits are expected in the southern Philippines, and deficits of varying severity in Borneo, eastern Sumatra, and Sulawesi. Exceptional deficits are forecast for the Lesser Sunda Islands. Deficits will emerge in western New Guinea but downgrade in Papua New Guinea. Some moderate surpluses are forecast for Java.

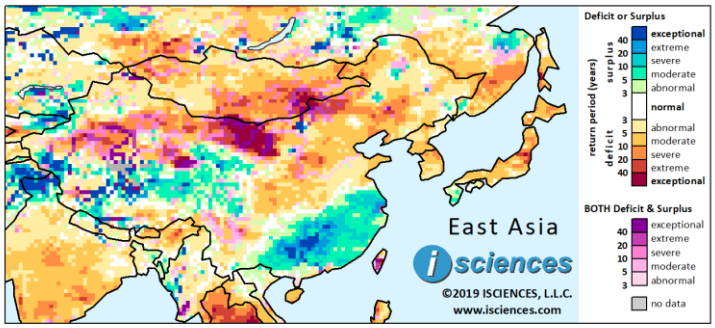
The forecast for the final months – September through November – indicates deficits of varying intensity throughout much of the region, mild to moderate in Southeast Asia but more intense elsewhere.

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

East Asia

The 12-month forecast for East Asia through November 2019 indicates widespread surpluses in southeastern China and in much of the Tibetan Plateau, intense deficits in Inner Mongolia and Mongolia, and deficits of varying intensity elsewhere in China, the Korean Peninsula, and most of Japan.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

In southeastern China, surpluses will be exceptional in Hunan and northeastern Guangxi, especially in the Xiang River region, a tributary of the Yangtze, and the Duliu River (Liu) in the Pearl River system.

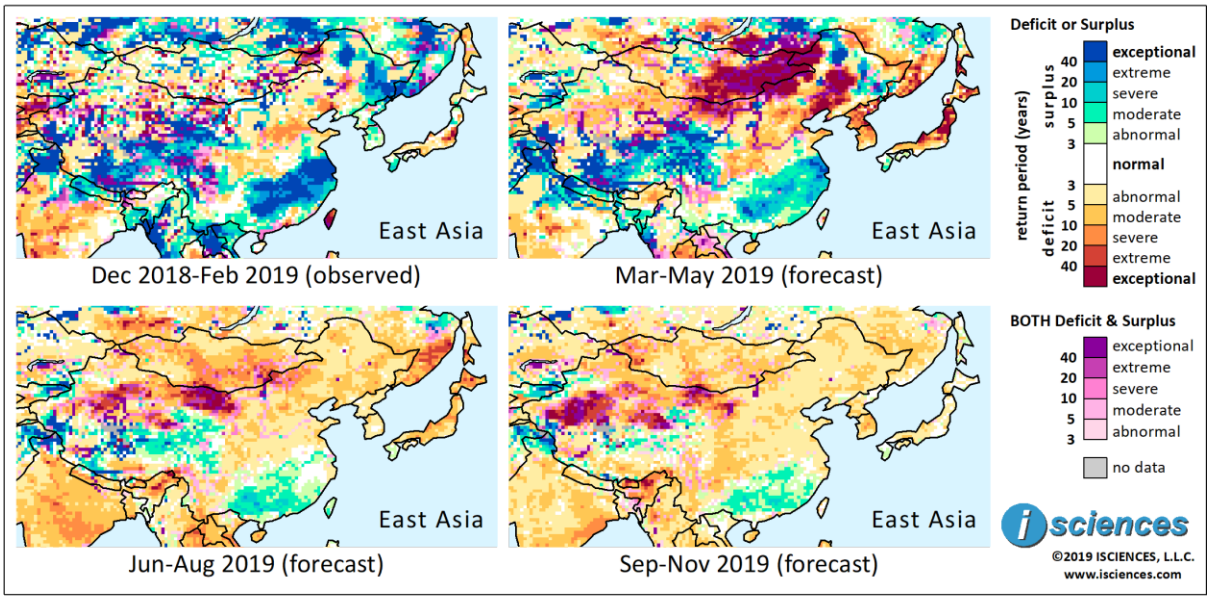
Deficits reaching exceptional intensity are forecast for western Inner Mongolia and southeastern Mongolia, along with conditions of both deficit and surplus (purple) as transitions occur.

Severe deficits are forecast for western Jilin in Northeast China and neighboring regions of Inner Mongolia, with moderate deficits trailing southwest from there through eastern Sichuan, punctuated by severe deficits in the center of this path in Shanxi.

Some primarily moderate deficits are expected on the Korean Peninsula. In Japan, moderate to extreme deficits are forecast for Honshu and Hokkaido, and moderate surpluses for Kyushu.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The forecast through May indicates the emergence of a vast stretch of extreme to exceptional water deficits in southern and eastern Mongolia and into Inner Mongolia, China, interspersed with conditions of both deficit and surplus as transitions occur. Deficits will increase and intensify in western Jilin and western Liaoning to the Bohai Sea, becoming exceptional. Moderate to severe deficits will form a broad path from Beijing through Shanxi and Shaanxi into eastern Sichuan. Conditions of both deficit and surplus (purple) are forecast on the Ordos Loop of the Yellow River as transitions occur.

In the southeast, widespread surpluses will persist in the Yangtze Basin's Lower Reaches and in the southern portion of the Middle Reaches, reaching into Guangxi, but surpluses of exceptional intensity will nearly disappear, lingering around Shanghai and in the Duliu River (Liu) region of Guangxi. Moderate to severe deficits are forecast on the Han River, a northern tributary of the Yangtze, and intense surpluses are expected to persist in the Upper Yangtze Reaches and much of the Tibetan Plateau. Surpluses will be exceptional along the Yarlung River (Brahmaputra). Moderate deficits will emerge in Hainan and conditions in Taiwan will transition from intense deficit to near-normal.

On the Korean Peninsula, deficits will emerge, transitioning from normal or surplus conditions. Deficits will be severe to extreme and will be widespread in North Korea. In Japan, intense deficits will increase, with exceptional anomalies in Honshu and Hokkaido. Moderate surpluses will persist in eastern Kyushu.

From June through August, surpluses in southeastern China will diminish considerably leaving some moderate surpluses along the Lower and Middle Yangtze and nearly normal conditions in Anhui, Zheijiang, and eastern Jiangxi. Surpluses will increase in Guangxi and Guangdong, of generally moderate intensity but severe along many rivers. Moderate surpluses will emerge in southern Taiwan. Surpluses

will downgrade in the Tibetan Plateau. Deficits will downgrade in Mongolia but will be severe, and intense deficits will persist in western Inner Mongolia along with conditions of both deficit and surplus. Deficits in Northeast China and from Beijing through Sichuan will downgrade to moderate or mild. Mild deficits are forecast on the Korean Peninsula. In Japan, deficits will moderate on Honshu, but severe deficits are forecast for Hokkaido.

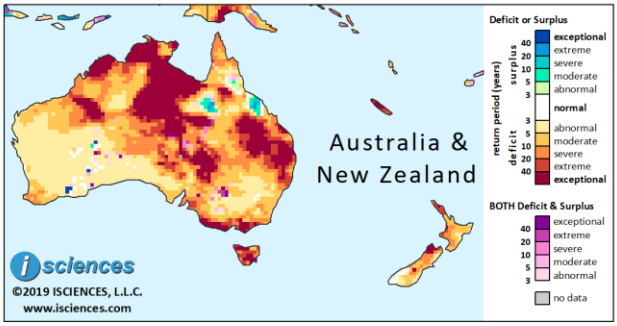
The forecast for the final three months – September through November – indicates extreme deficits in western Inner Mongolia and Xinjiang along with conditions of both deficit and surplus, and moderate deficits in Mongolia. Moderate deficits are also forecast in China radiating from the Sichuan Basin. Moderate surpluses will persist in the Pearl River Basin (Zhujiang) in the south.

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

Australia & New Zealand

The 12-month forecast through November 2019 shows widespread, exceptional water deficits in Northern Territory and southeastern Queensland, and Kimberley and the Great Sandy Desert in Western Australia. Intense deficits are forecast along Australia's southeastern coast from Adelaide past Melbourne, in Tasmania, and across northern South Australia into Queensland and New South Wales.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

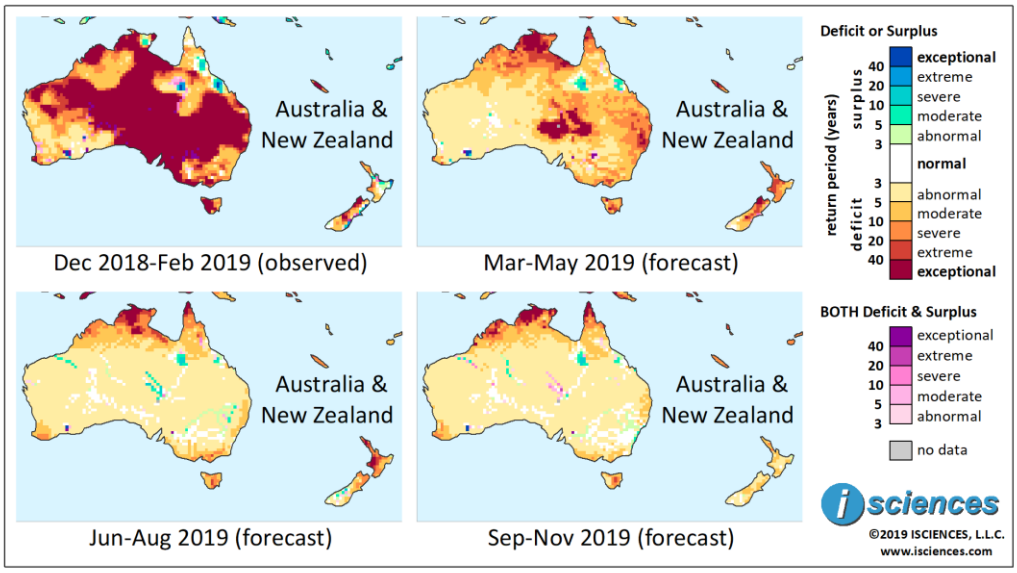
Moderate to severe deficits are forecast for the southwestern tip of Western Australia and the Cape York Peninsula in northern Queensland. In the southeastern quadrant of the country, deficits are expected to be moderate on the Darling and Murray Rivers. Deficits in Derwent Estuary in Tasmania will be exceptional.

Surpluses are forecast for northeastern Queensland south of Townsville and in northwestern Queensland east of the Selwyn Range.

In New Caledonia, severe to exceptional deficits are forecast. Deficits of varying intensity are expected in New Zealand.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: December 2018-November 2019



Based on observed data through February 2019 and forecasts issued February 22-28, 2019.

The forecast through May indicates that the widespread, exceptional deficits that have dominated much of Australia in prior months will diminish considerably. However, a wide pocket of exceptional deficit is forecast in South Australia in the southern portion of the Lake Eyre drainage basin and along South Australia's border with Queensland (QLD) through the Strzelecki Desert in New South Wales (NSW). Severe to exceptional deficits are forecast across northern reaches of the country from Kimberley Region in Western Australia (WA) through the northern Cape York Peninsula in QLD. Deficits will be exceptional in Top End, Northern Territory (NT).

Deficits will be severe in a large block in the east from Rockhampton, QLD, nearly to Sydney, and will reach extreme or even exceptional intensity in the Northern Tableland of NSW surrounding Armidale. In southeastern Australia, deficits will be moderate on the Darling and Lachlan Rivers, but severe on the Murray. Primarily moderate deficits are expected in Victoria, but conditions may be severe around Melbourne and extreme east of Melbourne. Deficits will downgrade in Tasmania but will remain widespread and will be extreme near Hobart and along the Derwent River.

Surpluses are forecast south of Townsville in northeastern QLD and in northwestern QLD east of the Selwyn Range.

In New Zealand, deficits will increase as pockets of surplus disappear. Anomalies are expected to be severe to extreme with exceptional conditions in Tasman District, South Island. Intense deficits will persist in New Caledonia.

From June through August, intense deficits will retreat to the north in Australia, persisting from Kimberley through Top End, NT and the northern Cape York Peninsula, and leaving primarily mild

anomalies throughout much of the remainder of the country. Moderate to severe deficits are forecast for the southwestern tip of WA, Victoria's coast, and Tasmania, where deficits will be extreme around the Derwent River. Some moderate deficits are forecast in eastern Victoria. Surpluses will shrink but persist south of Townsville, QLD; will persist east of the Selwyn Range, QLD; and will emerge along some rivers in the center of the country east of Alice Springs, along the De Grey River in WA, and some small pockets in the eastern Murray-Darling system.

Deficits will downgrade slightly in New Caledonia but will be severe. In New Zealand, intense deficits are forecast for North Island, deficits will shrink and downgrade in northern South Island, and some surpluses will emerge around Lake Pukaki and its sister lakes

The forecast for the final months – September through November – indicates that intense deficits will persist in far northern Australia. Deficits of varying intensity are forecast for Tasmania, the tip of WA, pockets of New Zealand, and New Caledonia.

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