

Global Water Monitor & Forecast Watch List

April 15, 2019

For more information, contact:

Thomas M. Parris, President, 802-864-2999, parris@isciences.com

Table of Contents

Introduction	2
Worldwide Water Watch List.....	4
Watch List: Regional Synopsis.....	4
Watch List: Regional Details.....	7
United States	7
Canada	10
Mexico, Central America, and the Caribbean	12
South America.....	15
Europe	18
Africa.....	20
Middle East	23
Central Asia and Russia	26
South Asia	29
Southeast Asia and the Pacific	32
East Asia.....	34
Australia & New Zealand.....	37

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 March 2019 and an ensemble of forecasts issued the last week of March 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](#).

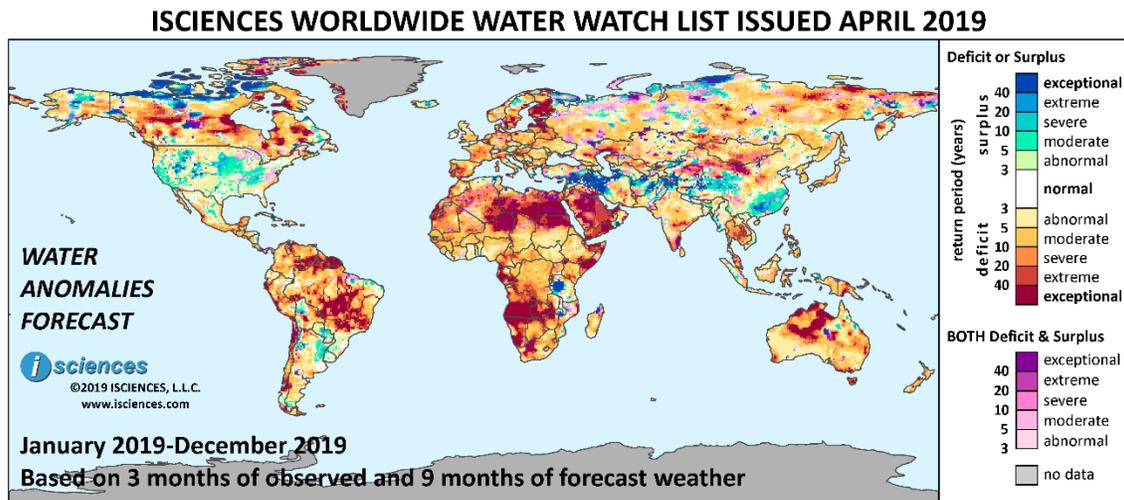
There are numerous regions around the world where country borders are contested. ISciences depicts country boundaries on these maps solely to provide some geographic context. The boundaries are nominal, not legal, descriptions of each entity. The use of these boundaries does not imply any judgement on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

Copyright 2019 ISCIENCES, L.L.C. Global Water Monitor & Forecast Watch List is the property of ISCIENCES, L.L.C. It is protected by U.S. copyright laws and may not be reproduced in any way without the written permission of ISCIENCES, L.L.C.

The user assumes the entire risk related to user's use of information in ISCIENCES, L.L.C. Global Water Monitor & Forecast: Watch List, including information derived from Water Security Indicators Model (WSIM). This information may include forecasts, projections and other predictive statements that represent ISCIENCES, L.L.C.'s assumptions and expectations in light of currently available information and using the highest professional standards. Actual results may differ from those projected. Consequently, no guarantee is presented or implied as to the accuracy of specific forecasts, projections or predictive statements contained herein. ISCIENCES, L.L.C. provides such information "as is," and disclaims any and all warranties, whether express or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose. In no event will ISCIENCES, L.L.C. be liable to you or to any third party for any direct, indirect, incidental, consequential, special or exemplary damages or lost profit resulting from any use or misuse of this data.

Worldwide Water Watch List

This map presents a selection of regions likely to encounter significant water anomalies during the one-year period beginning in January 2019 and running through December 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: The forecast through June indicates that surpluses East of the Mississippi will nearly disappear. Moderate deficits are forecast for the South Atlantic States and parts of the Deep South. Surpluses are forecast in the center of the country radiating from Nebraska and Iowa and will emerge in the Rockies with intense anomalies in many places, particularly Colorado. Primarily moderate surpluses are forecast for nearly all of California as well as northern Arizona and much of Oregon.

Canada: The forecast through June indicates that exceptional deficits will retreat from Quebec’s Ottawa-Gatineau Watershed; surpluses in Northern Ontario will transition to deficit; and deficits in the Middle Reaches of the Athabasca River Watershed in Alberta will become exceptional. Primarily moderate deficits are forecast across southern Manitoba and Saskatchewan. Intense surpluses will emerge in the Columbia River Basin in British Columbia, and deficits near Vancouver will persist but downgrade.

Mexico, Central America, and the Caribbean: The forecast through June indicates water deficits in Baja, Mexico, coastal Sonora, southern Chihuahua, the Pacific Coast from southern Sinaloa through Chiapas, and the Yucatan Peninsula. Areas of surplus include Coahuila, the southern border of Chihuahua and Sonora, and pockets in the center of the country. Some moderate deficits are expected Central America, Haiti, and Dominican Republic.

South America: The forecast through June indicates that water deficits in Brazil will shrink, with nearly normal conditions in Pará and Amazonas, but intense deficits are forecast for Mato Grosso, Tocantins, Goiás, Mato Grosso do Sul, Minas Gerais, western São Paulo, and along many rivers. Surpluses will increase in northeastern states. Exceptional deficits will trace a path along the Pacific Coast from Lima, Peru reaching almost to Santiago, Chile. Surpluses will increase and intensify in Paraguay.

Europe: The forecast through June indicates widespread water deficits of varying intensity throughout much of Europe, including exceptional deficits in Finland, Estonia, Latvia, Belarus north of Minsk, southern Sweden, and eastern Croatia. Deficits will moderate in Spain but intensify in central France, especially along the Loire and Dordogne Rivers. Surpluses are forecast for pockets of Switzerland and Austria, southern Umbria in central Italy, northwestern Sweden, and Murmansk, Russia.

Africa: The forecast through June indicates that water deficits will downgrade in the southern half of the continent and its midsection but will intensify across the north. In the Horn, deficits will downgrade but exceptional deficits are forecast for Somalia from the Jubba River past the Shabelle River. Intense deficits are expected in Zambia, Zimbabwe, southwestern Angola, and the Okavango Delta. Areas of surplus include western Tanzania and south-central Chad.

Middle East: The forecast through June indicates that widespread water surpluses will persist from northern Syria into southern Turkey, from the Euphrates River in Iraq well into western Iran, and in northern Iran along the coast. Deficits will downgrade on the Arabian Peninsula but will remain widespread. Central and northern Turkey will transition from surplus to moderate deficit.

Central Asia and Russia: The forecast through June indicates that water surpluses in the Ob River Basin of Russia will shrink and moderate, and intense deficits will emerge in the Tom River Basin's southern reaches. Intense deficits will also emerge in the Yenisei River Basin. Severe deficits are forecast for western Kazakhstan, and eastern Uzbekistan's Fergana Valley. Surpluses are expected in eastern Kyrgyzstan and southern Turkmenistan.

South Asia: The forecast through June indicates that intense water deficits will emerge throughout much of India south and west of the Gangetic Plain. Intense surpluses are forecast in northern India, northern Pakistan, and much of Afghanistan. Anomalies will reach exceptional intensity in many of these regions. Deficits will emerge in southern Afghanistan and will be severe in the southwest. Surpluses are forecast in Nepal, Bangladesh along the Padma River and in the northeast, and nearby regions of India.

Southeast Asia and the Pacific: The forecast through June indicates that water deficits in Thailand and Cambodia will downgrade but will be widespread and severe, and deficits will emerge in much of Southeast Asia. Moderate to severe deficits are expected in the Philippines, northeastern Borneo, and scattered pockets of Indonesia. Exceptional deficits will persist around the Gulf of Papua in Papua New Guinea. Surpluses will downgrade slightly in north-central New Guinea around Jayapura.

East Asia: The forecast through June indicates that widespread water surpluses will persist in southeast China but will moderate overall. However, anomalies will be extreme to exceptional in Guangxi and into

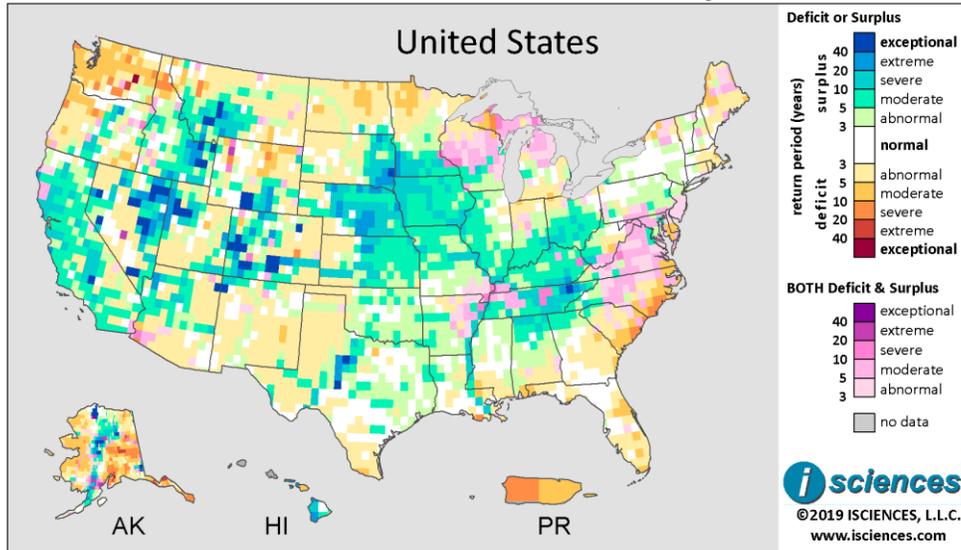
western Guangdong. Intense surpluses will persist in the Tibetan Plateau. Intense deficits are forecast for Mongolia and from western Inner Mongolia in China across central Xinjiang. Moderate deficits will emerge in North Korea, and moderate to extreme deficits are forecast for Japan.

Australia & New Zealand: The forecast through June indicates that the exceptional water deficits that have dominated much of Australia in prior months will nearly disappear, though intense anomalies are forecast in the north. Primarily moderate deficits are expected from Adelaide through Victoria and along rivers in the Murray-Darling system. Deficits are expected to be more intense in northeastern New South Wales, Tasmania, the southwestern tip of Western Australia, New Zealand, and New Caledonia.

Watch List: Regional Details

United States

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The 12-month forecast ending December 2019 indicates that water surpluses of varying intensity will affect many parts of the conterminous U.S.

In the center of the country, primarily moderate to severe surpluses are forecast in eastern South Dakota, southern Minnesota, Iowa, western Illinois, Nebraska, Kansas, and Missouri, but anomalies may be more intense near Sioux Falls (SD) and in south-central Nebraska. Surpluses are expected to be severe along the Mississippi River from Iowa to the Gulf of Mexico. Surpluses of generally lesser intensity are forecast for pockets of Oklahoma, Arkansas, and Texas including parts of the Pecos River and the Rio Grande. Surpluses will, however, be extreme to exceptional around Abilene, TX. In the northern Midwest, some severe deficits are forecast for the western half of Michigan's Upper Peninsula, and some moderate deficits in pockets of northern Minnesota and North Dakota.

Surpluses are forecast in the central Ohio River Basin and are expected to be especially intense around Knoxville, TN. In the East, a patchwork of anomalies is forecast from Maine through Florida, though most conditions are forecast to be relatively mild. Moderate deficits are expected in pockets along the coast in Delaware and Virginia, and deficits in North and South Carolina could be severe. Some pockets of moderate deficit are also expected in Florida.

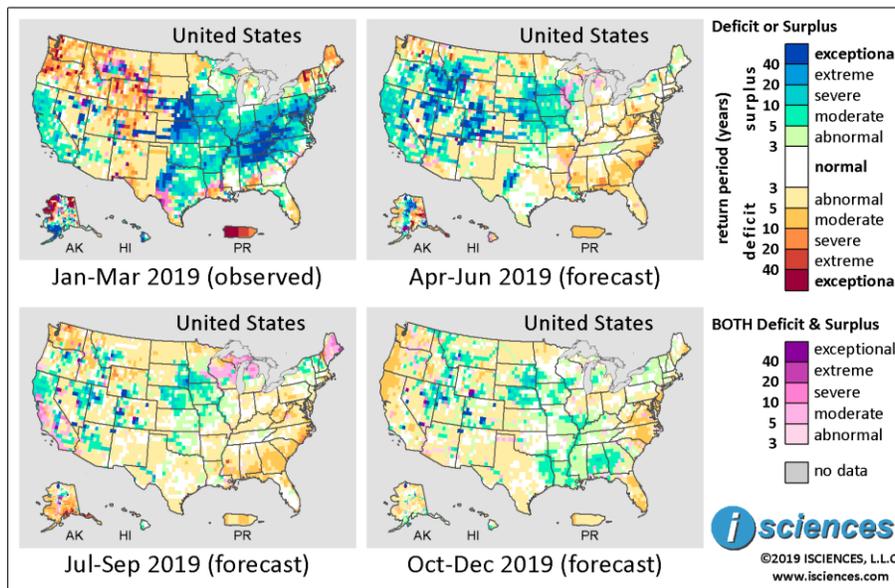
In the western half of the U.S., surpluses are forecast throughout California, down the center of Oregon, and in Idaho, southwestern Montana, Nevada, Utah, Colorado, south-central Wyoming, and Arizona.

Surpluses will be intense in pockets of Nevada, eastern Idaho, Montana, and Colorado. Primarily moderate deficits are expected in western Oregon, Washington, and pockets of northern Wyoming.

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 at the base of the Alaska Peninsula on Bristol Bay and reaching inland. Surpluses are also forecast southeast of Barrow in the far north and along the Upper Koyukuk and central Yukon Rivers and will include exceptional anomalies. Deficits are expected in the Seward Peninsula and into western Alaska, along the Tanana River through Fairbanks, around Anchorage, and in the Alaska Panhandle. Deficits may be extreme around Fairbanks and Anchorage. Severe deficits are forecast for western Puerto Rico and moderate deficits in the east.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

Most notable in the April through June forecast is the absence of widespread, intense surpluses observed East of the Mississippi in prior months and a transition to surplus in the Rockies.

In the Northeast, a few areas of scattered, surplus are forecast. Moderate to severe deficits are expected in western Pennsylvania, West Virginia, eastern North Carolina and southern South Carolina, and Georgia; and, curving around the Gulf through the Florida Panhandle, and southern Alabama and Mississippi.

In the center of the country, surpluses ranging from moderate to extreme are forecast for eastern South Dakota, southern Minnesota into Wisconsin, Iowa, Nebraska, Kansas, the Arkansas River, northern Missouri, pockets of Oklahoma, and a large pocket in Texas surrounding Abilene where surpluses could

reach exceptional intensity. Moderate deficits are forecast for eastern Arkansas and pockets of Louisiana, though moderate surpluses are expected on the Lower Mississippi through Louisiana.

Widespread surpluses of varying intensity will emerge in the Rocky Mountain States including Idaho, Montana, Wyoming, Nevada, Utah, and Colorado, and will be exceptional in many pockets. Primarily moderate surpluses are forecast on the Missouri and Yellowstone Rivers. Moderate to severe surpluses are forecast for nearly all of California, and in northern Arizona and Oregon.

From July through September, surpluses will shrink and downgrade. Moderate to severe surpluses are forecast for eastern South Dakota, southern Minnesota, Iowa, Nebraska, and into pockets of Arkansas and Kansas. Surpluses are also expected on the Canadian River in Oklahoma and on the Pecos River in Texas. Pockets of surplus are forecast for the Rocky Mountain States and moderate surpluses in central Arizona, pockets of southern and central California, most of northern California, and pockets in Oregon. Some deficits are forecast in Washington, northern Wyoming, and northern Minnesota. In the East, moderate surpluses are forecast for northern New York, Vermont, and western New Hampshire. Primarily moderate deficits are expected from southern Pennsylvania through the Virginias and Carolinas, in Georgia, northern Florida, and southern Alabama and Mississippi.

The forecast for the final months – October through December – indicates surpluses in South Dakota, Nebraska, Iowa, the Lower Mississippi Basin, eastern Texas, the Deep South, pockets throughout the Rockies, and the Yellowstone River. Some moderate deficits are forecast for northern California, western Oregon and Washington, the Mid-Atlantic States, and Florida.

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

Canada

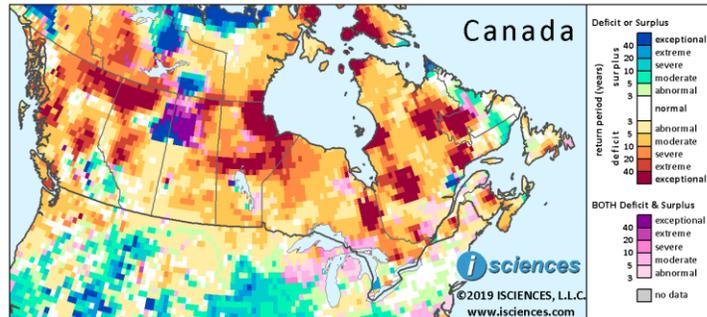
The 12-month outlook for Canada through December 2019 indicates water deficits of varying intensity nearly coast-to-coast in the provinces, with large pockets of exceptional deficit in Quebec, the Prairie Provinces' northern environs, and northern British Columbia.

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

A large block of exceptional surplus is forecast surrounding Fort McMurray, Alberta leading 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 Saint Lawrence River west of the Manicouagan River.

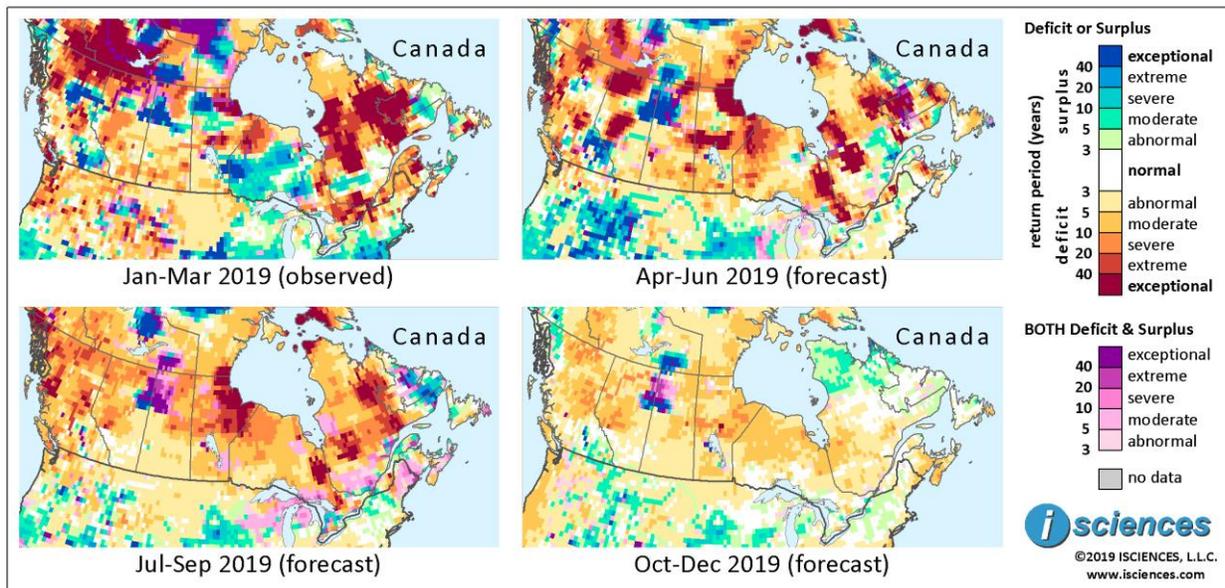
The 3-month maps (below) show the evolving conditions in more detail.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The major changes forecast through June are that exceptional deficits in the Ottawa-Gatineau Watershed of Quebec (QC) will downgrade to mild; widespread surpluses in much of Northern Ontario

(ON) will transition to deficit; and deficits in the Middle Reaches of the Athabasca River Watershed in Alberta (AB) will become exceptional while exceptional surpluses increase in the Lower Reaches.

As for major population areas, deficits of varying intensity are forecast from Quebec City to Sherbrooke QC; moderate surpluses west of Toronto ON and extreme surpluses near Sarnia; extreme deficits around Winnipeg, Manitoba (MB); a pocket of severe deficits west of Regina, Saskatchewan (SK); some moderate surpluses east of Edmonton AB along the North Saskatchewan River, transitioning from moderate deficits; and relatively normal conditions in Calgary. Intense deficits will persist in the Vancouver area though the extent of exceptional deficits will diminish.

Surpluses will emerge in QC where the Manicouagan River meets the mouth of the Saint Lawrence River, leading northwest. Intense deficits will persist in Southern ON east of Georgian Bay to the Ottawa River and will increase farther north along the eastern ON border. Primarily moderate deficits are forecast across southern Manitoba and Saskatchewan, with more intense anomalies around Winnipeg, as previously mentioned, and in the Upper Assiniboine River Watershed on the southeastern border of SK. Exceptional surpluses will increase in a vast block across the northern border of AB into SK. In British Columbia (BC), exceptional surpluses are forecast in the Columbia River Basin in the southeast.

From July through September, surpluses will nearly disappear in southeastern BC, will shrink around Fort McMurray AB and transition to conditions of both deficit and surplus across the border in SK, and will emerge in the eastern portion of mainland Newfoundland and Labrador. Deficits will remain widespread across the nation in much the same distribution pattern as in the forecast for the prior three months, but the extent of exceptional deficits will diminish somewhat particularly in BC and AB. Relatively mild deficits are expected across the southern portion of the Prairie Provinces.

The forecast for the final three months – October through December – indicates primarily moderate deficits from BC through western QC, along with some severe pockets. Areas of surplus include northern QC, the northern border of AB and SK, and southeastern BC.

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

Mexico, Central America, and the Caribbean

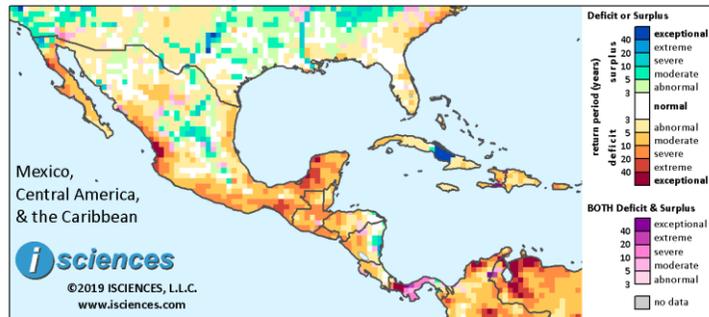
The 12-month forecast ending December 2019 indicates deficits of varying intensity in most of Mexico’s Baja Peninsula, along the country’s central and southern Pacific Coast, and in the southern states and the Yucatan Peninsula. Surpluses are forecast for central Mexico.

Deficits are expected to be exceptional in Nayarit on Mexico’s Pacific Coast, severe in Guerrero and Oaxaca in the south, and severe to extreme in Chiapas and much of the western Yucatan Peninsula.

Surpluses are forecast for Zacatecas, San Luis Potosi, pockets in southeastern and northern Coahuila, and some stretches of the Rio Grande.

In Central America, moderate to severe deficits are forecast for Guatemala, Belize, El Salvador, western Nicaragua, and western Costa Rica. A small pocket of exceptional deficit is forecast for western Panama with conditions of both deficit and surplus to the east. Moderate surpluses are expected in a pocket of Nicaragua’s central Caribbean Coast. Primarily moderate deficits are forecast for Haiti, Dominican Republic, and western Cuba.

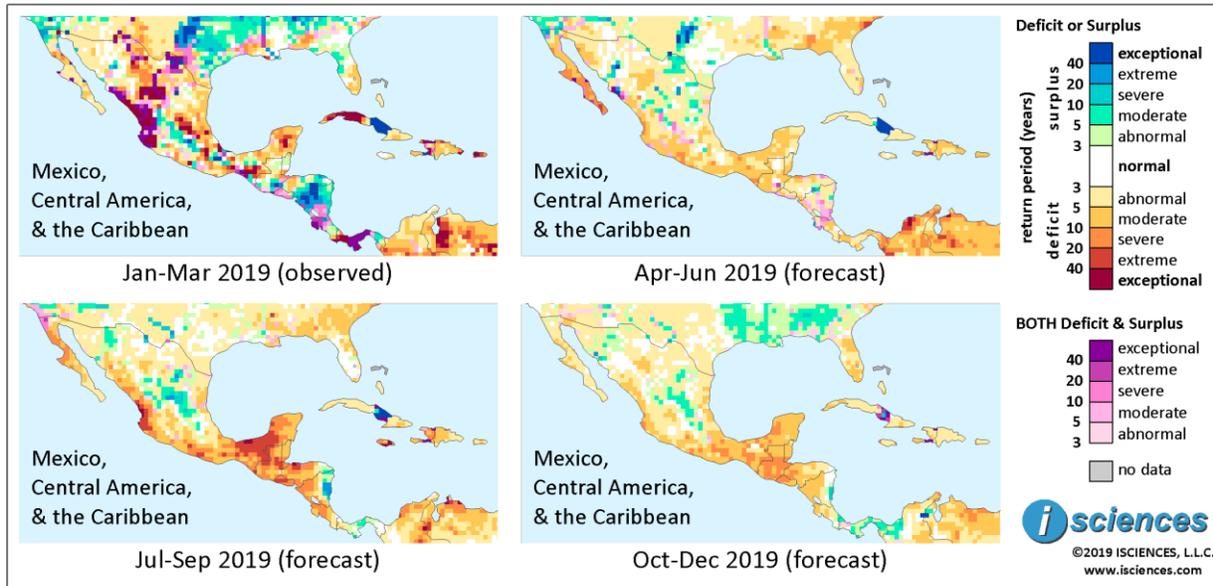
ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The forecast through June indicates some surpluses in far northern Baja, Mexico; moderate deficits in northern Baja and across the Gulf of California into coastal Sonora; and severe deficits in southern Baja. Primarily moderate deficits are forecast for southern Chihuahua, along the Pacific Coast from southern Sinaloa through Chiapas, and through the Yucatan Peninsula. Surpluses are forecast for northern and southeastern Coahuila, along the southern border of Chihuahua and Sonora, and pockets of Durango, Zacatecas, Nuevo León, Tamaulipas, and San Luis Petosi. Moderate deficits are expected in Guatemala, Belize, northern Honduras, Panama, Haiti, and Dominican Republic.

From July through September, the extent and pattern of deficits in Mexico will be much the same as in the forecast for the prior three months but deficits will intensify, becoming severe to extreme in most of the aforementioned regions, while downgrading in southern Baja. Surpluses will increase in the center of the country in Zacatecas and San Luis Potosi, will disappear in northern Coahuila, and will transition to deficit along the southern border of Chihuahua and Sonora while emerging along the northern border. Deficits will intensify in Guatemala, Belize, and Honduras and emerge in western Nicaragua and Costa Rica. Extreme surpluses are forecast for Nicaragua's central Caribbean Coast. Panama will transition from deficit to moderate surplus or normal conditions. Intense deficits will emerge in Jamaica, and deficits will intensify somewhat in Haiti.

For the final three months – October through December – moderate to severe deficits will cover Mexico's southern half as well as northern Central America. Surpluses will persist in central Mexico but will shrink and moderate. Moderate surpluses will persist in east-central Nicaragua and will increase in Panama.

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

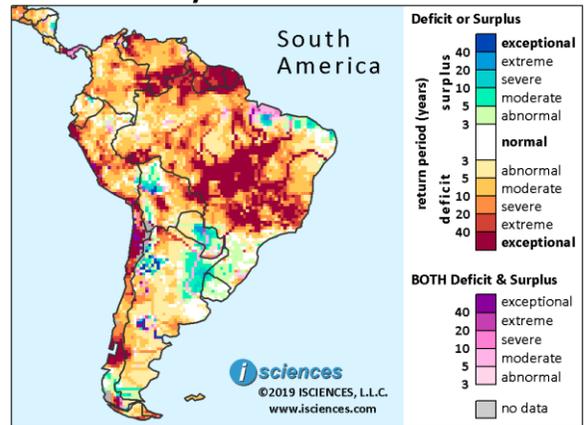
South America

The 12-month forecast through December 2019 indicates water deficits of varying intensity across much of the northern bulk of the continent as well as through most of Chile and pockets of Argentina.

Deficits will be intense across a vast stretch of central Brazil and along many rivers and will include exceptional deficits in Mato Gross, Tocantins, Minas Gerais, and São Paulo. Exceptional deficits are also forecast for French Guiana, Suriname, southern Venezuela, a pocket in central Bolivia, along the Pacific coast from Peru through the Atacama Desert in Chile, and further south around the Gulf of Corcovado.

Surpluses are forecast in pockets of northeastern Brazil, northwestern Bolivia, and central Paraguay. In Argentina, surpluses are expected in Catamarca and La Rioja Provinces in the northwest; several northeastern provinces; at the intersection of Neuquén, La Pampa, and Rio Negro Provinces; and along the Santa Cruz River in southern Argentina. Primarily moderate deficits are forecast elsewhere in Argentina though deficits will be extreme along the Bermejo River in the north; normal conditions are forecast for much of Buenos Aires Province.

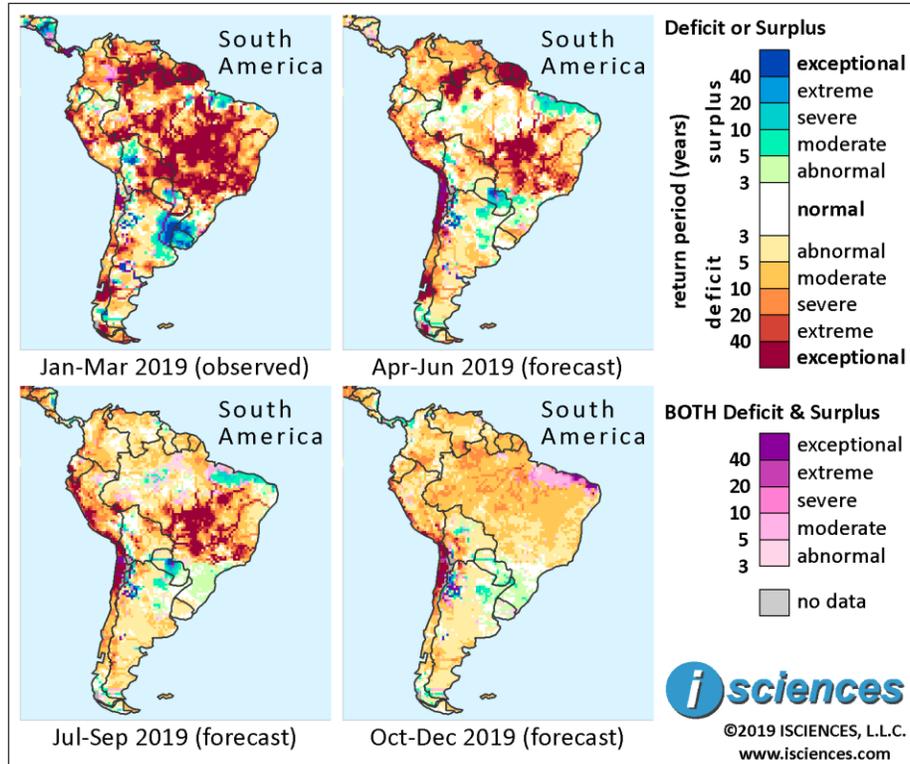
ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The forecast through June indicates that deficits in Brazil will shrink and downgrade, with nearly normal conditions returning to much of Pará and Amazonas, and surpluses increasing in northeastern states. Intense deficits are forecast in Mato Grosso, Tocantins, Goiás, eastern Mato Grosso do Sul, Minas Gerais, western São Paulo, and along many rivers including the São Francisco, Parnaíba, Xingu, and Araguaia. Moderate to severe deficits are forecast for Colombia, Venezuela, and Guyana, but deficits will be exceptional in southern Venezuela, Suriname, and French Guiana. Deficits of varying intensity are forecast for much of central Peru and northeastern and central Bolivia. Exceptional deficits will trace a path along the Pacific Coast from Lima, Peru reaching almost to Santiago, Chile, and around the Gulf of Corcovado in southern Chile.

Surpluses will increase in central and eastern Paraguay and are expected to be intense in the center of the country. Other areas of surplus include central La Paz Department in northeastern Bolivia, and Chaco, Santa Fe, Entre Rios, Catamarca, and La Rioja Provinces in Argentina. Primarily mild to moderate deficits are forecast elsewhere in Argentina but deficits will be severe along the Chubut, Chico, and Lower Reaches of the Colorado River.

From July through September, deficits are forecast to downgrade overall but exceptional anomalies will persist in central Brazil in a pattern nearly duplicating the forecast for April through June. Intense deficits along the Pacific Coast will increase in northern Peru reaching into Ecuador but will recede around the Gulf of Corcovado in Chile. Surpluses will persist in northeastern Brazil, central Paraguay, and pockets of northern Argentina. Moderate surpluses are expected to emerge in a line dissecting northern Paraguay.

In the final quarter – October through December – deficits will downgrade to moderate in central Brazil, while moderate to severe deficits emerge in the Amazon Basin and areas of surplus in northeastern Brazil begin to transition to deficit. Intense deficits along the Pacific Coast are expected to shrink slightly in Peru but will persist through the Atacama Desert in Chile. Surpluses will shrink and downgrade in Paraguay and Argentina.

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

Europe

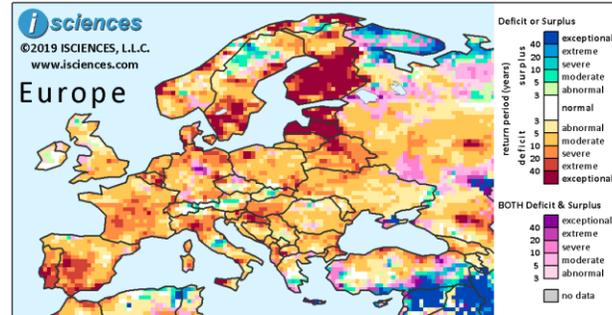
The 12-month forecast through December 2019 indicates deficits of varying intensity throughout much of Europe. Exceptional deficits are forecast for southern Finland, Estonia, Latvia, Belarus north of Minsk, and pockets of southern Sweden.

Severe to extreme deficits are forecast for many regions including Portugal, southwestern Spain, France, northern Italy, eastern Croatia, Denmark, and Belgium.

Areas with a forecast of surplus include central Austria, Umbria in central Italy, northwestern Sweden, and Murmansk, Russia.

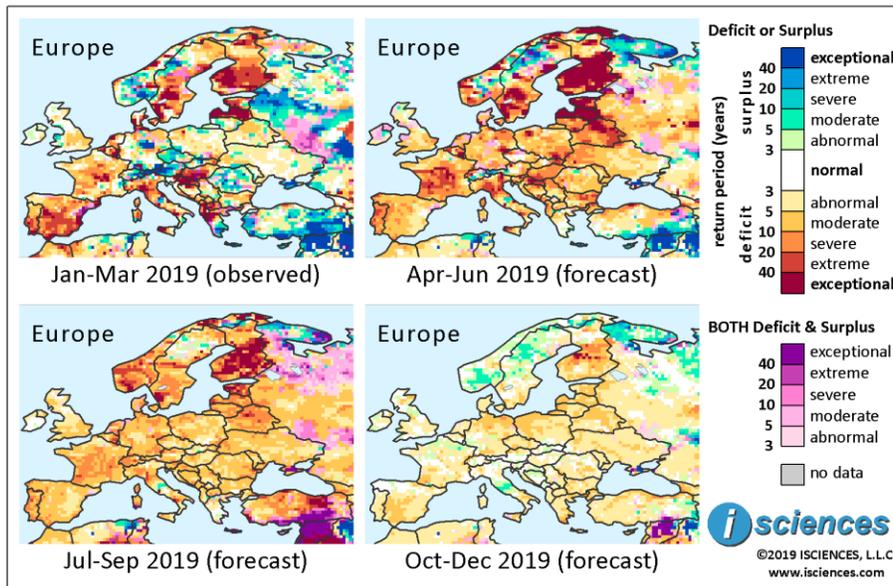
The 3-month composites (below) for the same 12-month time period show the evolving conditions.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The forecast through June indicates widespread deficits of varying intensity throughout much of Europe as European Russia transitions from surplus to deficits and surpluses in parts of Central and Eastern Europe diminish or transition. Deficits of exceptional intensity are expected to increase in Finland, Estonia, and Latvia; emerge in Belarus north of Minsk; persist in southern Sweden; downgrade to severe in Hungary; and shrink slightly in eastern Croatia. Other notable changes: deficits will moderate in Spain but intensify in central France and will include extreme to exceptional deficits on the Loire and

Dordogne Rivers. Surpluses are forecast for pockets of Switzerland and Austria, southern Umbria in central Italy, northwestern Sweden, and Murmansk, Russia.

From July through September, deficits will cover most of Europe but will moderate overall in Western, Central, and Eastern Europe, with more intense deficits in Scandinavia and the Baltics. Severe deficits are forecast for France, Switzerland, and other pockets of Central Europe. In the north, exceptional deficits will persist in Finland, shrinking somewhat. Deficits will be extreme to exceptional in Estonia, Norway, and southern Sweden; severe in Latvia, Lithuania, and Belarus; and moderate in much of European Russia. Surpluses will shrink but persist in Murmansk.

The forecast for the remaining months – October through December – indicates mild to moderate deficits in much of Europe, with some nearly normal conditions; some pockets of more intense deficit in Finland though much diminished from prior months; and surpluses in Norway, Sweden, and Murmansk.

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

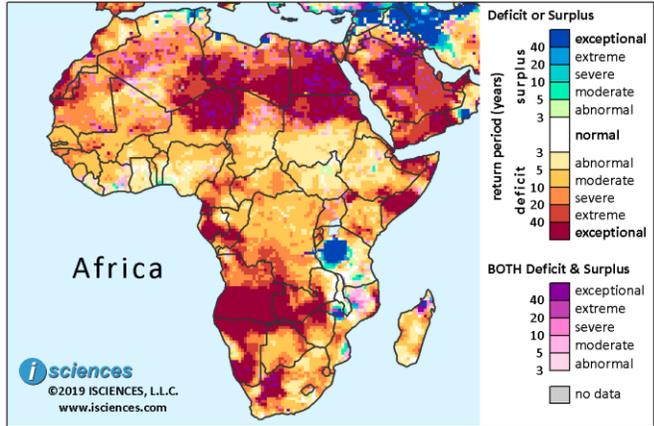
Africa

The 12-month forecast through December 2019 indicates severe to extreme water deficits in the north with exceptional deficits in northern Niger, southern Libya, Egypt, and northern Sudan.

Exceptional deficits elsewhere include Somalia, Gabon, Angola, Namibia, Zambia, 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. Surpluses are also forecast for relatively small pockets in western and southeastern Mozambique, northern Madagascar, Algeria’s northeastern coast into Tunisia, and near Benghazi and Tripoli, Libya.

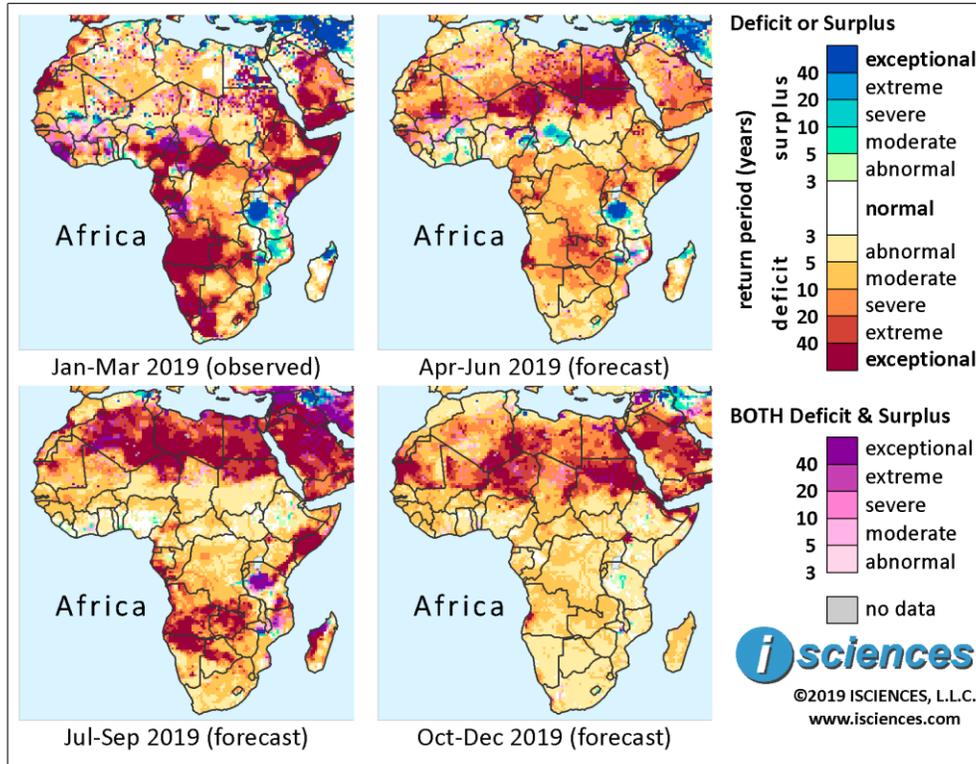
ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The forecast through June 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. However, deficits will become more intense across northern Africa. In the north, deficits of varying intensity are forecast across the southern Sahara and the Sahel with exceptional deficits in northern Niger, southeastern Libya, southern Egypt, and northern Sudan. Surpluses are forecast for eastern Nigeria into northern Cameroon, south-central Chad, southeastern Côte d'Ivoire, Burkina Faso, and around Lake Volta in Ghana. In the Horn deficits will downgrade, but exceptional deficits are forecast for Somalia from the Jubba River past the Shabelle River including Mogadishu.

Intense deficits are expected in Burundi, Rwanda, Uganda, and exceptional deficits northwest of Nairobi, Kenya. Exceptional surpluses will persist in western Tanzania and pockets of western and northern Mozambique. Surpluses in northern Madagascar will moderate. Intense deficits are expected in Zambia, Zimbabwe, southwestern Angola, and the Okavango Delta in northern Botswana.

From July through September deficits across northern Africa will intensify significantly with extreme to exceptional deficits across the Sahara. Primarily mild deficits are forecast across the Sahel. Exceptional deficits in southern Somalia will increase and deficits of equal intensity will emerge in southeastern Ethiopia and southeastern Kenya. Farther south, deficits will intensify in Angola, Namibia, Zambia, southern Democratic Republic of the Congo and central Botswana, becoming exceptional in many areas. Exceptional deficits are expected to emerge in western Madagascar. Both deficits and surpluses (purple) are forecast in western Tanzania and northern Mozambique as transitions occur.

During the final quarter – October through December – intense deficits will continue across much of northern Africa in the Sahara and the Sahel, though the extent of exceptional deficits will diminish. Primarily moderate deficits are forecast in the remainder of the continent and some moderate surpluses in central Tanzania.

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

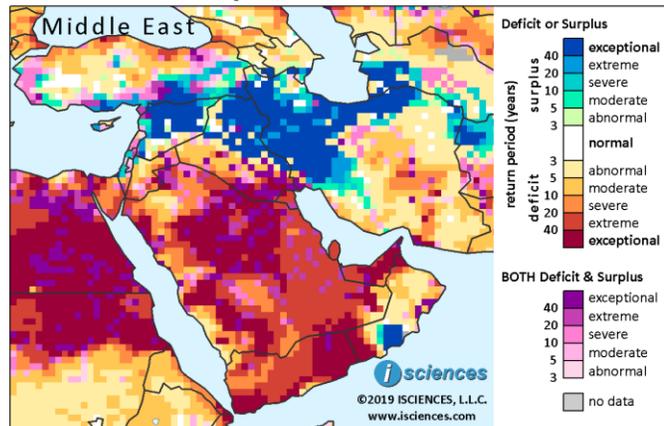
Middle East

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

Intense deficits are also forecast for southern Iraq along with conditions of both deficit and surplus as transitions occur. Primarily moderate to severe deficits are expected Kerman Province, Iran, along Turkey's Black Sea coast, and in Georgia.

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

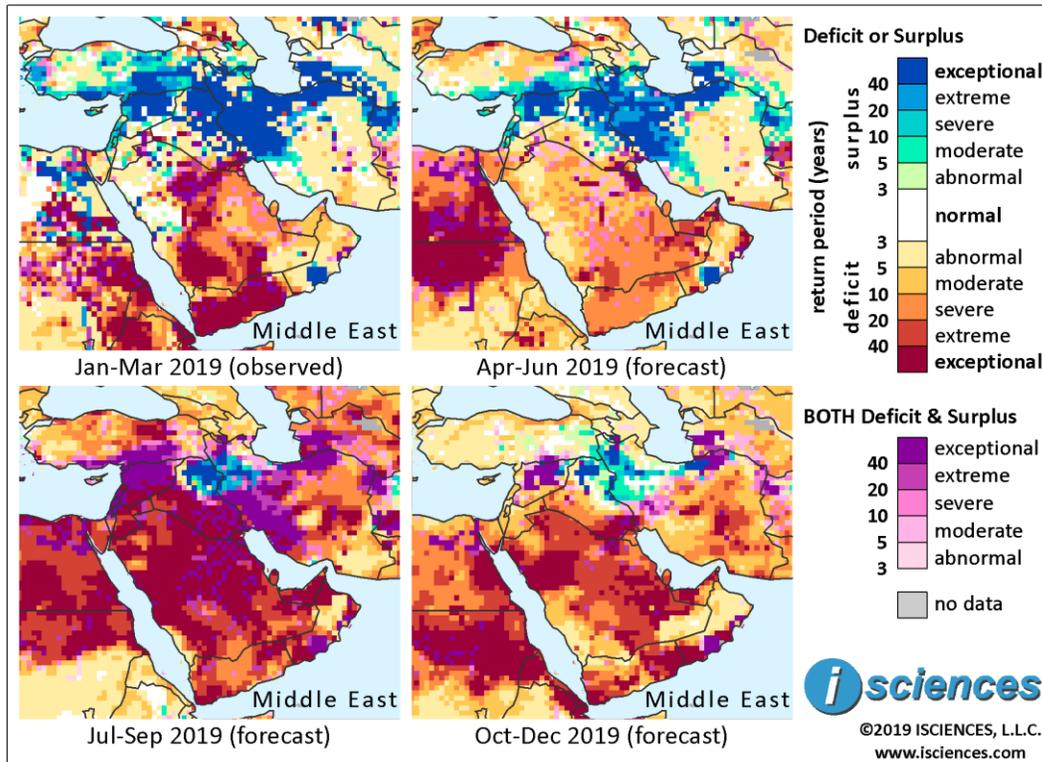
ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The forecast through June indicates that widespread water surpluses will persist in the region from northern Syria into southern Turkey, from the Euphrates River in Iraq well into western Iran, and in northern Iran along the coast. The extent of exceptional surplus will diminish somewhat, 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, West Bank, and Lebanon.

Deficits will downgrade on the Arabian Peninsula during this period but will remain widespread, with severe to extreme anomalies in southern Saudi Arabia, Yemen, Qatar, and United Arab Emirates, and some pockets of exceptional anomalies. Central and northern Turkey will transition from surplus to moderate deficit.

From July through September, deficits will cover of the region, intensifying significantly on the Arabian Peninsula and in Iraq west of the Euphrates, where anomalies will be exceptional. While intense surpluses are expected to persist in northern Iraq and into western Iran, much of the prior areas of surplus will begin to transition with both deficits and surpluses expected in northern Syria, southern Turkey, Iran's Caspian Sea coast, and the bulk of western Iran. Intense deficits will emerge in the Levant;

other areas of intense deficit include northern Kerman Province, Iran, and Turkey's central-north province of Erzincan.

In the final quarter – October through December – deficits will downgrade significantly in Turkey and the Levant; widespread deficits ranging from severe to exceptional are forecast for the Arabian Peninsula, western and southern Iraq, and Iran's eastern two-thirds; and surpluses will persist, but downgrade, from northern Iraq through western Iran.

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

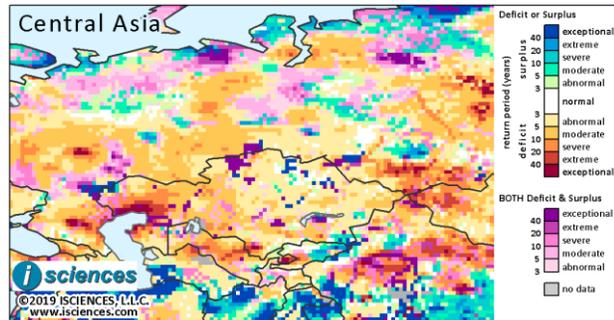
Central Asia and Russia

The 12-month forecast through December 2019 indicates intense deficits along the northern shore of the Caspian Sea in western Kazakhstan and in central Uzbekistan and the Fergana Valley in the east.

Intense surpluses are forecast in the far northwestern tip of Kazakhstan and across the border into Russia, upstream of Volgograd. Intense surpluses are also forecast for southwestern Turkmenistan, and moderate surpluses in the southeast. Surpluses in eastern Kyrgyzstan are expected to range from moderate to extreme.

In Russia, intense deficits are forecast for the southern reaches of the Tom River Basin and the eastern Yenisei River Basin nearly to Lake Baikal. Moderate deficits are forecast for Trans Volga and the Upper Volga Basin, with more intense deficits south of Nizhny Novgorod. Moderate surpluses are expected in the Middle Ob River Basin in Russia, and moderate to extreme surpluses east of Kemerovo in the northern portion of the Tom River Basin.

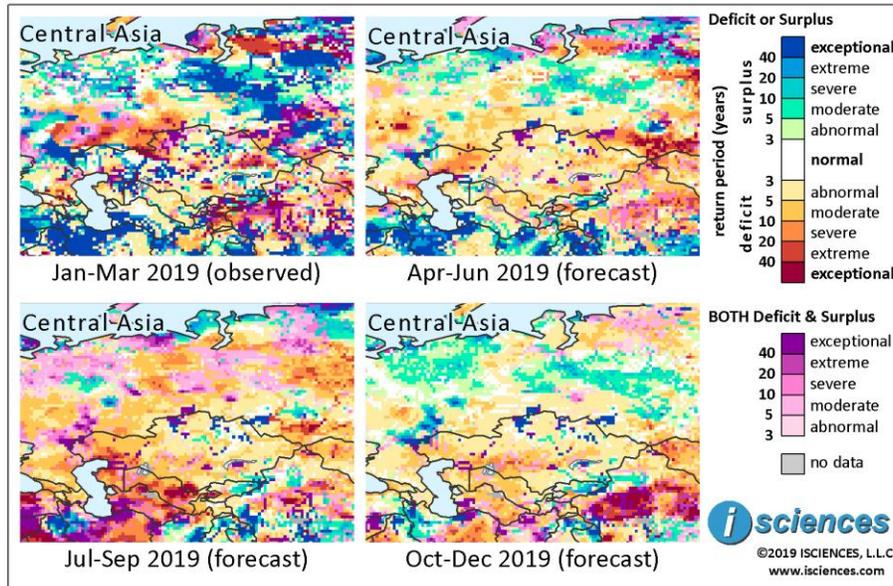
ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The forecast through June indicates that surpluses in the Ob River Basin of Russia will shrink and moderate overall. Intense surpluses will persist east of Kemerovo in the northern portion of the Tom River Basin while severe to exceptional deficits will emerge in the basin’s southern reaches. Intense deficits will also emerge in the Yenisei River Basin in the regions of the Nizhnyaya and Podkamennaya Tunguska Rivers and the Angara River. In the Volga region, surpluses will persist northeast of Volgograd, and intense deficits are forecast in the Middle Volga region south of Nizhny Novgorod.

Primarily severe deficits are forecast for western Kazakhstan north of the Caspian Sea, as well as in eastern Uzbekistan’s Fergana Valley leading into Kyrgyzstan. Intense surpluses are expected in eastern Kyrgyzstan and southwestern Turkmenistan, and some moderate surpluses in southeastern Turkmenistan. Scattered surpluses are expected in central Tajikistan and severe deficits in the east.

From July through September, intense deficits will emerge in Turkmenistan, Uzbekistan, western Kazakhstan, and southern South Kazakhstan region, with pockets of exceptional anomalies. Deficits in the Fergana Valley will intensify, becoming extreme. Primarily moderate surpluses are forecast for eastern Kyrgyzstan; moderate deficits are forecast for western Tajikistan. In Russia, many prior areas of surplus will exhibit conditions of both deficit and surplus as transitions occur. Surpluses are forecast for much of the Yamal Peninsula.

The forecast for the final months – October through December – indicates that deficits will moderate in Central Asia. In Russia, surpluses will emerge in the Ob River Basin; across the north from the Kola Peninsula to the northern Ural Mountains; and in the lower Volga Uplands and Trans Volga.

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

South Asia

The 12-month forecast through December 2019 indicates intense water deficits in southern India, in the middle Godavari River Basin and the Indravati watershed, and a pocket in central Madhya Pradesh.

Moderate deficits are expected in the center of the country, Gujarat, the northern Gangetic Plain, and the Far Northeast. Exceptional surpluses are forecast for Jammu and Kashmir in the north.

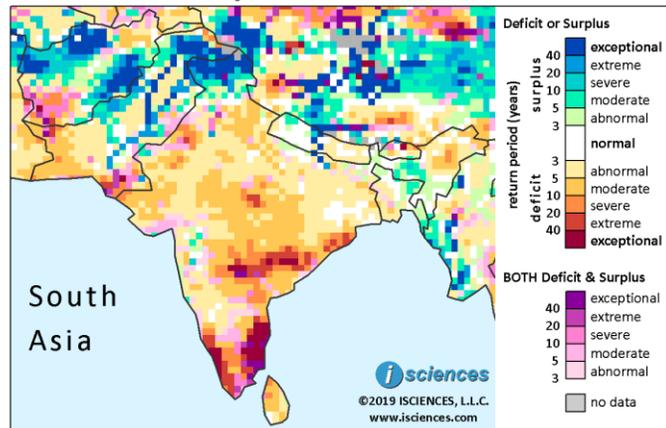
Intense surpluses are also forecast across the border in northern

Pakistan and along the Indus, Jhelum, and Chenab Rivers, and will be exceptional along the northern Indus. Deficits are expected in southern Pakistan and will be extreme in the southeast from Karachi past Hyderabad. Primarily moderate deficits are forecast in the southwest.

In Afghanistan, intense surpluses are forecast east of the Helmand River from Kandahar to Kabul, and in the west from Herat to Mazar-e Sharif.

In central Nepal, surpluses are forecast along the Gandaki River leading into India, and some moderate surpluses are expected in eastern Bangladesh and north into India. Some pockets of moderate to severe deficit are forecast for Bhutan, and moderate deficits in Sri Lanka.

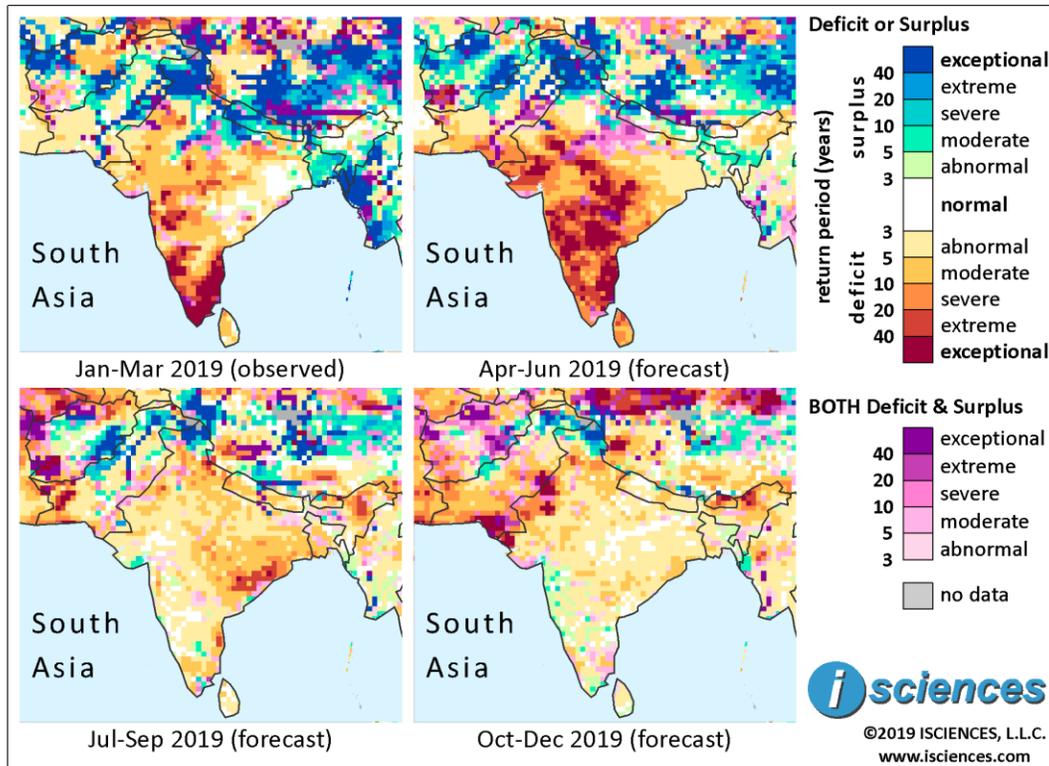
ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The forecast through June indicates that severe to exceptional deficits will emerge throughout much of India south and west of the Gangetic Plain. Exceptional deficits will be especially widespread in eastern Tamil Nadu and Telangana. Exceptional surpluses are forecast in the northern states of Punjab, Himachal Pradesh, and Jammu and Kashmir.

In Pakistan, exceptional surpluses are forecast in the far north and along the Jhelum, Chenab, Ravi, and Sutlej Rivers, and extreme to exceptional surpluses along the northern Indus. Severe to extreme surpluses are expected in the northwest from Quetta to Peshawar. Deficits will emerge in the south and are expected to be severe in the southeast.

Surpluses will continue to emerge in much of Afghanistan but particularly from Kandahar to Kabul in the east and from Herat to Mazar-e-Sharif in the west where anomalies are expected to reach exceptional intensity. Intense deficits are forecast in southwestern Afghanistan. In Nepal, intense surpluses are forecast in the west and moderate surpluses in the east. Moderate surpluses are also forecast in Bangladesh along the Padma River, in northeastern Bangladesh, and east into Meghalaya and Manipur, India.

From July through September, deficits in India will downgrade considerably, leaving mild to moderate anomalies overall, but extreme deficits will emerge in Odisha. Primarily moderate deficits will emerge in the Gangetic Plain, Punjab, Himachal Pradesh, and Nepal, and deficits of greater intensity are expected in India's Far Northeast. Surpluses in Pakistan and Afghanistan will shrink somewhat but intense anomalies are forecast along the northern portion of the Indus River in Pakistan and in Afghanistan from east of Kandahar to Kabul. Deficits will downgrade in southeastern Pakistan and intensify in southwestern Pakistan. Exceptional deficits will persist in southwestern Afghanistan but conditions of both deficit and surplus are also forecast as transitions occur.

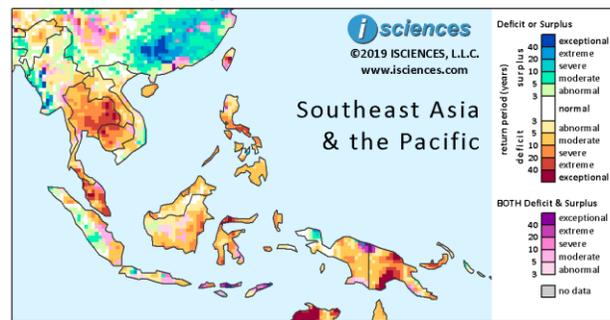
The forecast for the final months – October through December – indicates mild deficits in much of India with more intense deficits near the Pakistan border. Deficits are forecast across much of Pakistan's southern two-thirds with some pockets of exceptional deficit in the east and southeast; surpluses are forecast in the far north. Conditions of both deficit and surplus are expected in Afghanistan.

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

Southeast Asia and the Pacific

The 12-month forecast through December 2019 indicates deficits throughout Thailand and most of Cambodia, which are expected to be extreme from eastern Thailand into Cambodia. Primarily moderate deficits are forecast for Laos, pockets of central and southern Vietnam, and Myanmar's narrow, southern Tanintharyi Region. Intense deficits are expected in peninsular Malaysia. Pockets of surplus are forecast for western Myanmar.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



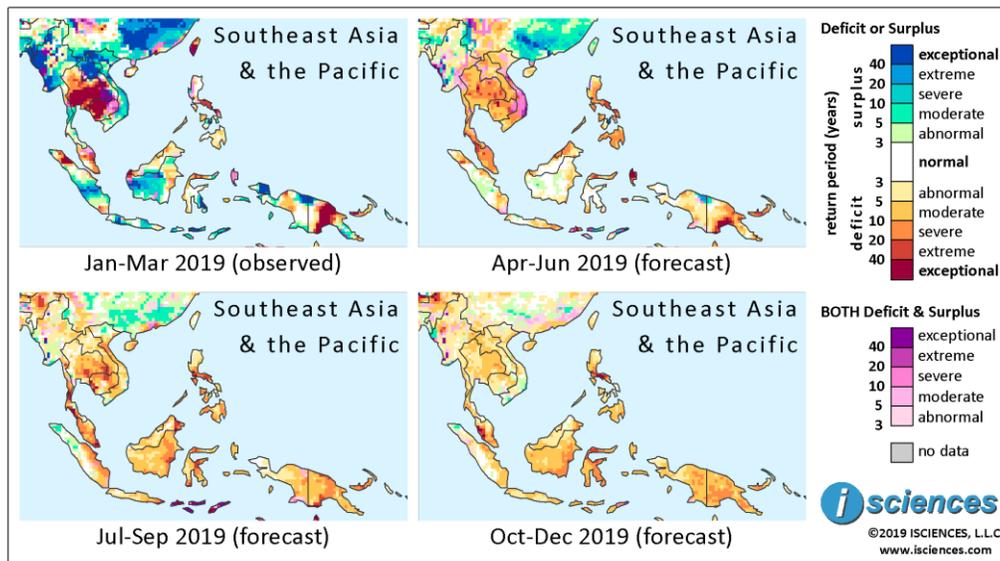
Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

Deficits of varying intensity are expected in Borneo, eastern and southern Sumatra, the Philippines, Sulawesi, and most of New Guinea. Anomalies will be intense in southern Luzon, Philippines; pockets of Sulawesi; and Papua New Guinea, particularly around the western shore of the Gulf of Papua.

Surpluses are forecast for pockets of western Sumatra 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: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The forecast through June indicates that deficits in Thailand and Cambodia will downgrade but will be widespread and severe. Laos and Vietnam will transition from surplus to deficit with both conditions forecast for central Vietnam. Moderate to severe deficits are forecast for southernmost Myanmar, and the Malay Peninsula. Elsewhere in Myanmar surpluses will shrink, persisting primarily in pockets of the

southwest. Moderate to severe deficits are expected in much of the Philippines, Brunei, and northeastern Malaysian Borneo. In Indonesia, conditions are expected to be normal in many regions but scattered pockets of deficit and of surplus are also forecast. Though deficits will downgrade in central Papua New Guinea, exceptional deficits will persist around the Gulf of Papua. Surpluses in north-central New Guinea around Jayapura, Indonesia, will downgrade slightly from exceptional to extreme.

From July through September, deficits will shrink and downgrade in Thailand and Cambodia leaving nearly normal conditions in western Thailand and central Cambodia, and moderate deficits pocked with deficits of greater intensity elsewhere in those two nations. Primarily moderate deficits are forecast for central and parts of southern Vietnam and for southern Laos, but deficits in the Malay Peninsula could reach greater intensity. The extent of deficits will diminish somewhat in the Philippines but moderate to severe deficits are expected in many regions and will be particularly intense in southern Luzon. Moderate to severe deficits are forecast for eastern Sumatra and many of the remaining regions of Malaysia, Indonesia, and Papua New Guinea, though deficits will downgrade around the Gulf of Papua. Some exceptional deficits are expected in the Lesser Sunda Islands. Moderate surpluses are forecast for north-central Vietnam and northern Sumatra.

The forecast for the final months – October through December – indicates moderate deficits in eastern Thailand, parts of Cambodia, and northern Laos. Primarily moderate deficits are also forecast for much of the remainder of the region, but deficits may be severe in Papua New Guinea and southeastern Borneo, and extreme in western peninsular Malaysia, pockets of Sulawesi, and southern Luzon, Philippines.

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

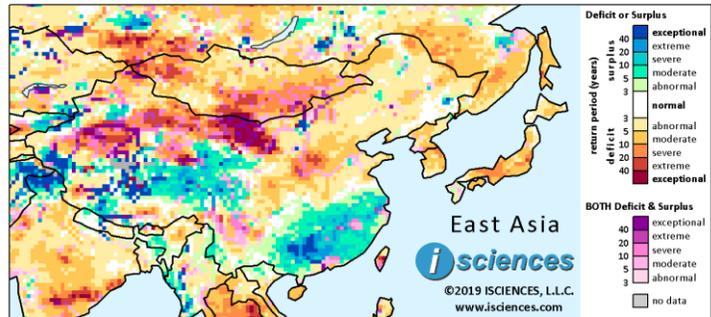
East Asia

The 12-month forecast for East Asia through December 2019 indicates widespread surpluses in southeastern China and in much of the Tibetan Plateau; intense deficits from western Inner Mongolia across central Xinjiang, and in Taiwan; and moderate to extreme deficits from Shaanxi nearly to Beijing.

Moderate to extreme deficits are also forecast for Mongolia, moderate to severe deficits in Japan and South Korea, and moderate deficits in North Korea.

Widespread surpluses in southeastern China will reach from Shanghai through Guangxi and will be exceptional in Hunan and northeastern Guangxi.

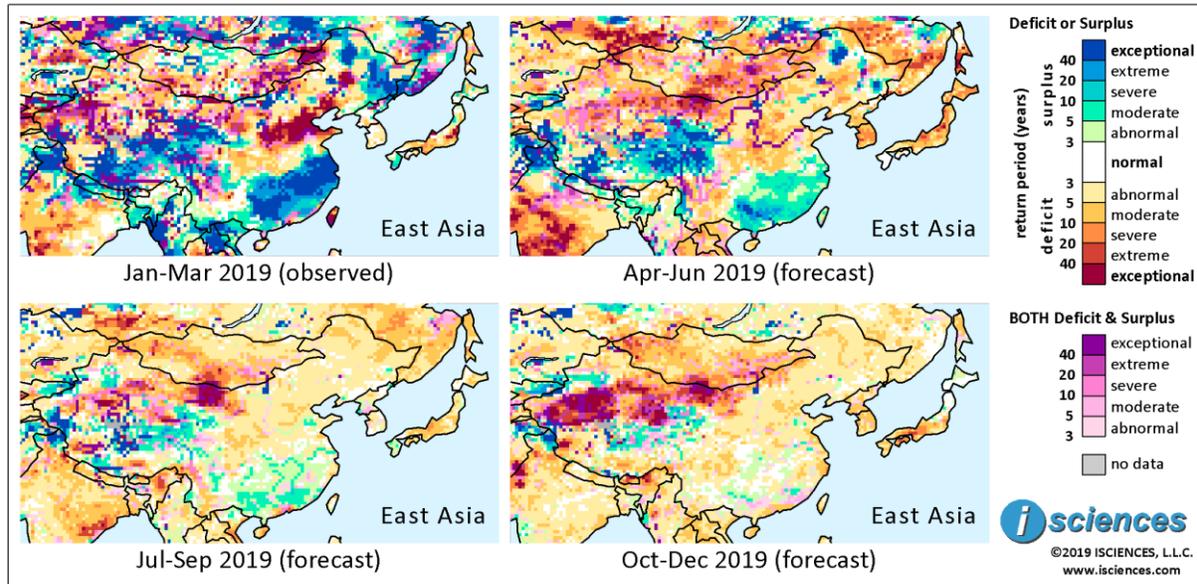
ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The forecast through June indicates that widespread surpluses will persist in southeast and southern China but will downgrade overall in intensity. Primarily moderate to severe surpluses are forecast in a vast stretch from Shanghai through Guangxi. However, anomalies will be extreme to exceptional in Guangxi and into western Guangdong, particularly along the Rong River in Guangxi. Intense surpluses will persist in the Tibetan Plateau.

Intense deficits are forecast for southern and eastern Mongolia and from western Inner Mongolia in China across central Xinjiang, along with conditions of both deficit and surplus as transitions occur. Both deficits and surpluses are also forecast along the Lower and Middle Reaches of the Yellow River and on the Ordos Loop. Primarily moderate deficits are expected in Shaanxi, Shanxi, northern Hubei, and Henan.

Moderate deficits will emerge in North Korea, and moderate to extreme deficits are forecast for South Korea and Honshu and Hokkaido, Japan. Taiwan will transition from deficit to moderate surplus.

From July through September, surpluses in southern and southeastern China will continue to shrink and downgrade leaving moderate surpluses in Guangxi, northern Guangdong, and along the Lower and Middle Reaches of the Yangtze River and some southern tributaries. Surpluses in the Tibetan Plateau will shrink and downgrade as well, though exceptional anomalies will persist in the central region. Exceptional deficits are forecast for a large pocket in western Inner Mongolia along with conditions of both deficit and surplus (purple). Deficits will downgrade overall in Mongolia but remain intense in the south. Much of China's eastern half north of the Yangtze will see primarily mild deficits, and nearly

normal conditions are forecast for the Korean Peninsula and Taiwan. Deficits in Japan will shrink and moderate and some moderate surpluses will emerge in Kyushu.

The forecast for the final three months – October through December – 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 surpluses will persist in the central Tibetan Plateau, while scattered deficits are forecast in the south. Moderate deficits are forecast for the Korean Peninsula and severe deficits for southern Honshu, Japan.

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

Australia & New Zealand

The 12-month forecast through December 2019 shows widespread, exceptional water deficits in Northern Territory reaching west through the Great Sandy Desert in Western Australia, and farther north in the Kimberley region. Exceptional deficits are also forecast for southwestern Queensland east of the Simpson Desert.

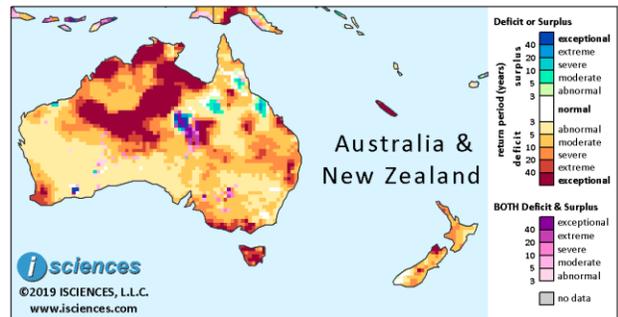
Regions where deficits will be nearly as intense include Australia's southeastern coast from Adelaide past Melbourne; Tasmania; along the east coast from Rockhampton in Queensland past Brisbane and into South Australia; and the southwestern tip of Western Australia from Perth to Albany.

Moderate to extreme deficits are forecast for large pockets in Queensland including the Darling Downs and southwestern Queensland.

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

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

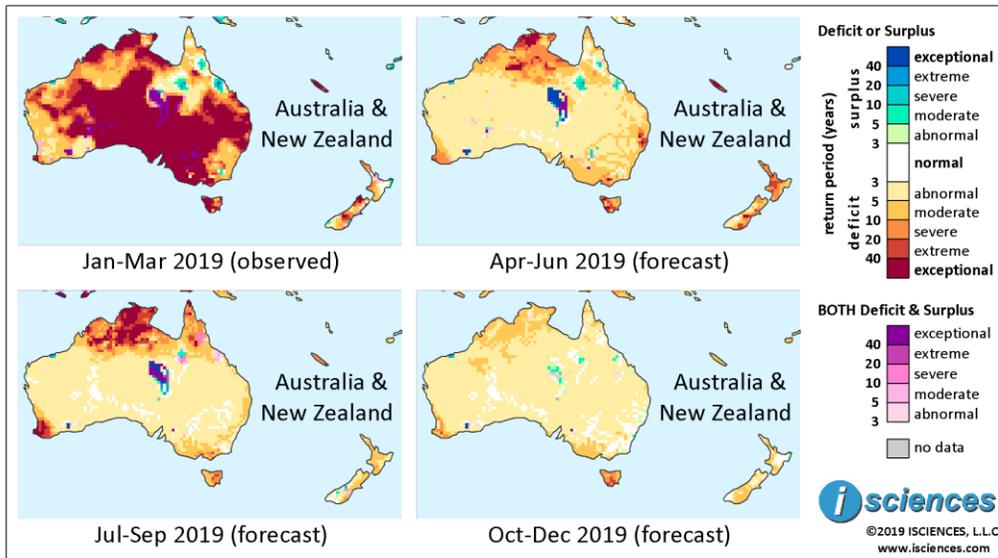
ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: January 2019-December 2019



Based on observed data through March 2019 and forecasts issued March 25-31, 2019.

The forecast through June indicates that widespread, exceptional deficits that have dominated much of Australia in prior months will nearly disappear. Exceptional deficits are forecast in Top End, Northern Territory (NT) north of the Katherine River and a pocket in the upper reaches of the Victoria River. Moderate to severe deficits are forecast for the remainder of the northern half of NT and extending west into the Kimberley region in Western Australia (WA), and east along the southern shore of the Gulf of Carpentaria. Moderate deficits are forecast surrounding the Gregory Range in northern Queensland (QLD); and, some pockets of moderate surplus east of the Selwyn Range, in the western Atherton Tableland, and south of Townsville.

In Australia's southeastern quadrant, primarily moderate deficits are expected from Adelaide through Victoria, with some more intense pockets east of Melbourne. Moderate deficits are forecast along the Murray, Darling, Lachlan, Macquarie, and Barwon Rivers. Severe to extreme deficits are expected in northeastern New South Wales, and severe to exceptional deficits in Tasmania. In WA's southwestern tip deficits will be severe.

A large pocket of exceptional surplus is forecast in southeast Northern Territory east of the MacDonnell Range.

Moderate to extreme deficits are forecast for New Zealand, and extreme to exceptional deficits in New Caledonia.

From July through September the extent of exceptional deficits will increase in northern NT and exceptional deficits will emerge in the Fitzroy and Ord River regions of northern WA. Deficits will emerge in the Cape York Peninsula of northern QLD, and surpluses in the region will diminish. Deficits in WA's

southwestern tip will intensify, becoming extreme to exceptional. In southeastern Australia, deficits will shrink leaving some primarily moderate anomalies from Adelaide through Victoria, and in a path from Canberra north to Brisbane. Conditions will normalize along most rivers in the Murray-Darling system. Deficits in Tasmania will downgrade but severe to extreme deficits are expected in the east. Some moderate deficits are expected in New Zealand, and severe deficits in New Caledonia.

The forecast for the final months – October through December – indicates mild deficits in most of Australia with moderate deficits across the north and in Victoria, severe deficits in the southwest tip of WA, and severe to extreme deficits 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.)