Global Water Monitor & Forecast Watch List

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Introduction

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

ISciences also provides assessments of the impacts of water anomalies on people, agriculture, and electricity generation. Detailed data and reports are available for purchase. Additional information and pricing is 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 May 2018 and an ensemble of forecasts issued the last week of May 2018. 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.

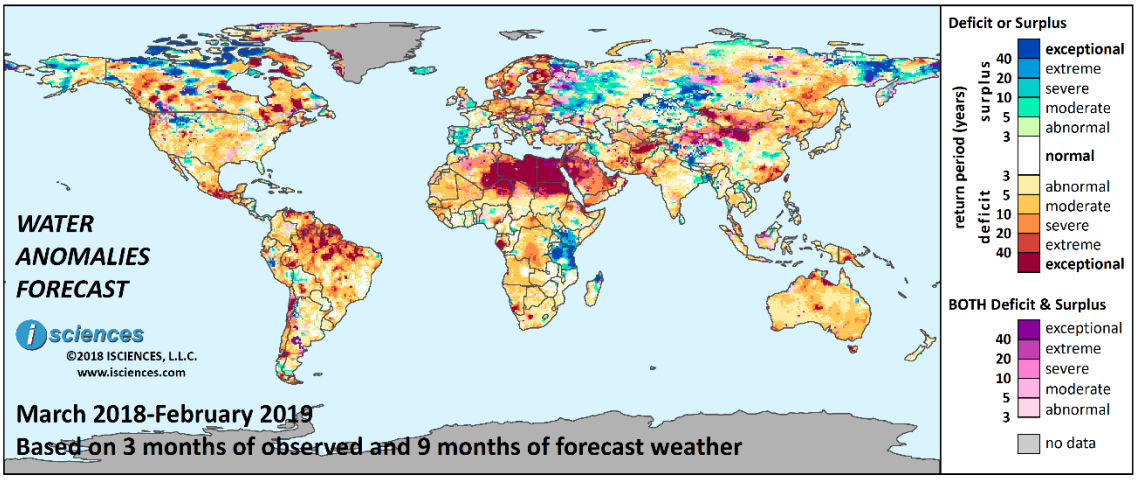
Please note that the WSIM model makes use of seasonal temperature and precipitation forecasts produced by the U.S. National Oceanic and Atmospheric Administration (NOAA) Climate Forecast System Version 2 (CFSv2). These forecasts predict broad temperature and precipitation patterns, but do not effectively predict singular events such as tropical storms. Detailed outlooks and analyses of tropical storms are available from 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 March 2018 and running through February 2019 using 3 months of observed temperature and precipitation data and 9 months of forecast data.

ISCIENCES WORLDWIDE WATER WATCH LIST ISSUED JUNE 2018



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 August indicates deficits in the Northeast, which could be exceptional in southern Maine. Moderate to severe surpluses are forecast scattered from Virginia through Alabama, and covering nearly all of Florida. Primarily moderate deficits are forecast for the Mississippi River Basin. Intense deficits are forecast for western Colorado, northern Utah, western Oregon, western Washington, and southernmost Texas. Primarily moderate deficits are expected in California. Surpluses will diminish in Idaho and downgrade slightly from exceptional in Montana.

Canada: Exceptional water deficits are expected to decrease but will persist in many areas, including along Ontario's eastern border. Surpluses are expected northwest of Toronto, and moderate deficits from Peterborough to Ottawa. In Quebec, deficits will be extreme around Sherbrooke. Severe deficits are forecast for southern Manitoba. Deficits will be intense in the Upper Athabasca and Lower Peace River Regions of Alberta, and surrounding Prince George, BC. Surpluses will increase in southern BC and will be exceptional around Kamloops and Kelowna.

Mexico, Central America, and the Caribbean: Mexico will transition away from significant water deficits in the northwest but widespread, intense deficits will emerge across the south and in the east. Deficits may be exceptional in Puebla, Veracruz, Oaxaca, Tabasco, and Chiapas. Surpluses are forecast to emerge in northeastern Sonora. In Central America surpluses will shrink considerably but will persist in eastern

Honduras and Nicaragua, and will emerge in Panama. Deficits are forecast for Guatemala, El Salvador, and western Honduras. Deficits of varying severity are also forecast for much of the Caribbean.

South America: Exceptional water deficits will diminish over the next few months, but large pockets are forecast for Brazil in Acre, Rondônia, Pará, Tocantins, Goiás, Minas Gerais, Mato Grosso do Sul, and São Paolo. Intense deficits elsewhere include: Venezuela east of Lake Maracaibo and near the border with Guyana; southern Bolivia; and along a path beginning south of Lima, Peru, through northern Chile. Deficits in Argentina will moderate and surpluses will emerge in northern Buenos Aires Province.

Europe: The forecast through August indicates widespread water deficits of varying severity in Central, Eastern, and Northern Europe, with intense deficits sprinkled throughout but especially prevalent in Finland, Estonia, and Latvia. Surpluses will persist on the Iberian Peninsula and may be exceptional between the Tajo and Guadiana Rivers, and from Toledo south to Granada. In European Russia, surpluses ranging from moderate to exceptional are forecast for the Don River Basin and much of the Volga River Basin.

Africa: Exceptional water deficits in North Africa will diminish but persist, and severe deficits are forecast in Gabon and in Nigeria south of the Benue River. Deficits will also persist in western Zambia and are expected to be extreme on the Kafue River. Moderate to exceptional deficits will emerge in central Botswana. Exceptional surpluses will persist in Tanzania, Kenya, and northern Uganda, but diminish somewhat in northern Madagascar. Surpluses east of Kinshasa in Democratic Republic of the Congo are forecast to increase in both extent and intensity, becoming severe.

Middle East: The forecast through August indicates that exceptional water deficits in the northern Arabian Peninsula will shrink but deficits overall in the Peninsula will be widespread. Exceptional deficits are forecast for Lebanon, Israel, and West Bank. Deficits of varying severity are forecast throughout Turkey and Syria, though deficits in western Turkey will downgrade from exceptional. In southern Iran deficits will become more severe, reaching exceptional intensity in Kerman and neighboring provinces.

Central Asia and Russia: Water surpluses will shrink in European Russia, transitioning to both deficit and surplus the Northern European Plain. Widespread deficits along the Pechora Sea through Yamal Peninsula and into the Central Siberian Plateau will retreat considerably. Surpluses in the Upper Ob and Tom River regions will diminish but remain widespread. Deficits will increase in the Bolshoy Yugan River watershed in the Middle Ob. Surpluses will persist in northern Kazakhstan, and deficits are forecast for Turkmenistan, eastern Uzbekistan, central Kyrgyzstan, and Tajikistan.

South Asia: Exceptional water deficits are forecast to persist in Afghanistan, retreating slightly in the north but increasing in the south. Pakistan should get a reprieve as intense deficits diminish considerably, leaving moderate to severe conditions in western Baluchistan. India will transition out of widespread deficit to milder conditions, with moderate deficits in the south and more severe deficits in the Far Northeast, particularly Assam. Surpluses will downgrade to moderate in West Bengal, and will shrink and downgrade in Bangladesh while remaining fairly intense, especially in Dhaka Division.

Southeast Asia and the Pacific: The forecast indicates a transition away from widespread, intense water surplus to deficit. Surpluses are forecast, however, for parts of Myanmar, northern Laos, northwestern Vietnam, eastern Cambodia, central Philippines, and East Nusa Tengara. Intense deficits will emerge in southernmost Thailand, and spread in Malaysia and northern Sumatra. Deficits of varying intensity are expected to emerge throughout Indonesia and may be extreme in West Nusa Tengara and Timor-Leste. Deficits in Papua New Guinea will downgrade but remain severe.

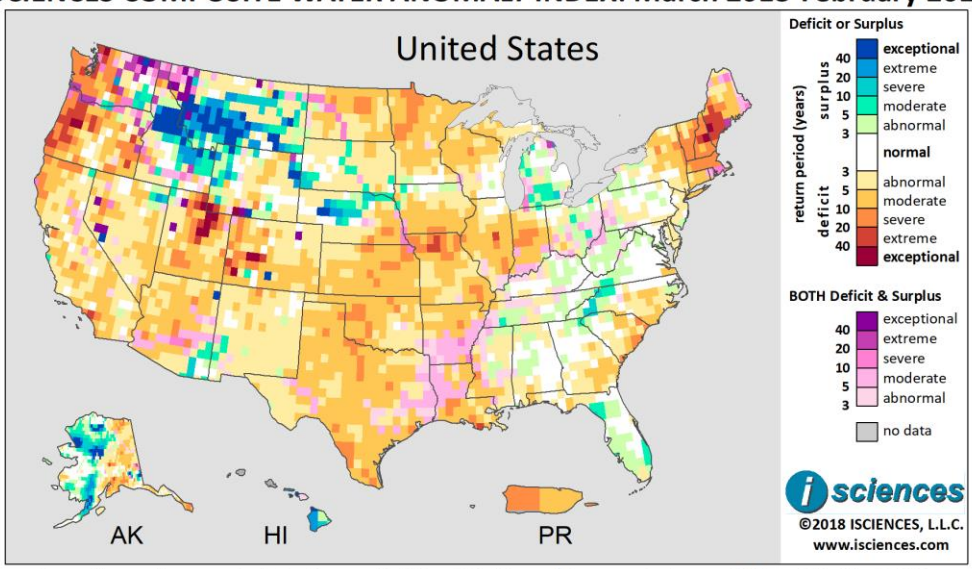
East Asia: Exceptional water deficits in Mongolia and Inner Mongolia through southern Xinjiang will diminish considerably, though widespread deficits of varying severity are expected. Deficits will increase in Northeast China and are expected to be intense in Liaoning, Jilin, and Heilongjiang. In Southeast China, moderate to exceptional deficits are forecast for Fujian, Guangdong, Jiangxi, Hunan, Guangxi, Hong Kong, and Taiwan. Surpluses are forecast for the Huai River Basin. Moderate deficits are forecast for much of North Korea but deficits may be severe north of Pyongyang.

Australia & New Zealand: Moderate water deficits, punctuated by more intense pockets, are expected across a large portion of the east and southeast including the Murray-Darling Basin, scattered across the north, and in the southwest tip of the country. Deficits are expected to be intense in Tasmania, pockets along the southeast coast, the southwest tip, Darwin and the Daly River region, and along the southern shore of the Gulf of Carpentaria. Intense deficits are forecast for New Caledonia.

Watch List: Regional Details

United States

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

The 12-month forecast indicates severe water deficits in the Northeast, relatively normal conditions in the Appalachian region south to the Gulf, primarily moderate deficits in the interior plains, intense surpluses in the Northern Rockies, and moderate to exceptional deficits in the southern Rockies, Southwest, and West.

Severe deficits are forecast for Vermont and Massachusetts, and deficits in central New Hampshire and southern Maine could be extreme to exceptional. Extreme to exceptional deficits are also forecast for southwestern Colorado and northeastern Utah, with deficits nearly as intense in Oregon and western Washington. Severe to exceptional surpluses are expected in Montana and Idaho, northwestern Wyoming, and central Nebraska, and are expected to be especially intense and widespread in the southeast quadrant of Montana and the east-west portion of the Salmon River across central Idaho. Generally less intense anomalies elsewhere include moderate surpluses in southern Michigan, western North Carolina, and Florida's southeast coast and Gulf coast west of Gainesville. Primarily moderate deficits are forecast for eastern portions of the Carolinas and southeastern Georgia.

Outside the contiguous US, intense surpluses are forecast for Hawaii and for northwestern Alaska and the northern half of the Alaskan Peninsula trailing well into the interior. Deficits are forecast in patches of the eastern half of the state. Deficits are expected in Puerto Rico and will be severe in the west.

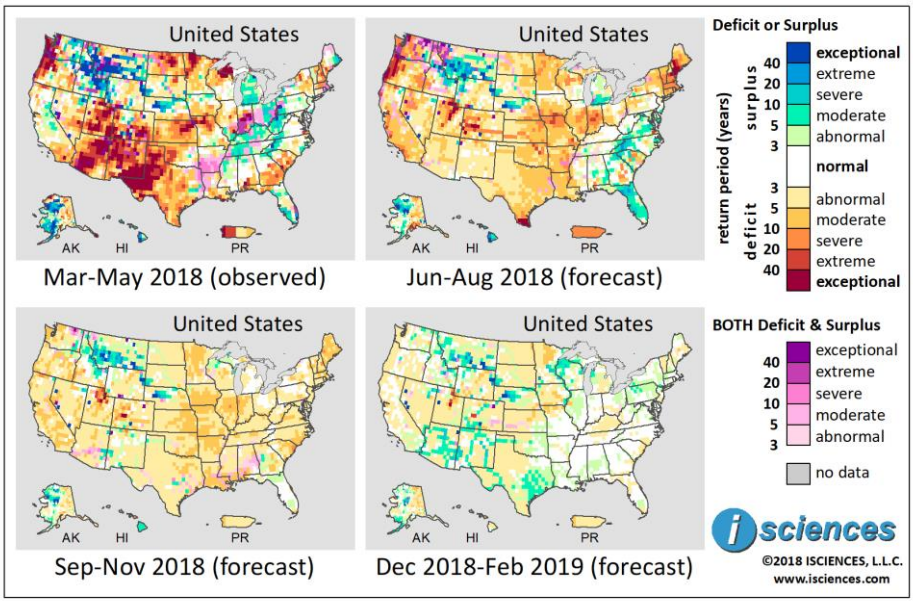
The 3-month maps (below) show the evolving conditions in more detail.

The near-term forecast through August indicates deficits in the Northeast which could be exceptional in southern Maine. Some deficits are forecast for eastern South Carolina and southeastern Georgia, but moderate to severe surpluses are expected in western South Carolina and northeastern Georgia, as well as in Virginia, North Carolina, southeastern Alabama, and Florida. Surpluses of equal intensity are forecast for southern Michigan.

Primarily moderate deficits are forecast for the vast Mississippi River Basin with areas of more intense deficit along the border of Iowa and Missouri. Severe deficits are forecast for central Indiana and along the Arkansas River to western Colorado, where deficits could be exceptional. Severe to exceptional deficits are expected in northern Utah, western Oregon, western Washington, and southernmost Texas. Primarily moderate deficits are forecast for California with pockets of greater severity scattered along the coast.

Surpluses in Idaho are forecast to diminish in extent and severity. Surpluses in Montana will downgrade from exceptional but will remain intense. Both deficits and surpluses are forecast for northwestern Montana, northern Idaho, and northeastern Washington.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

From September through November surpluses will persist in Idaho, Montana, along the border of Wyoming and South Dakota, and central Nebraska, and some moderate surpluses will emerge at the central border of Arizona and New Mexico. Moderate deficits are forecast for the Mississippi River Basin, and deficits in the West and Northeast will moderate. However, severe to exceptional deficits will persist in northern Utah and western Colorado. Some mild deficits will emerge in the Ohio River Basin down to the Gulf. Aforementioned surpluses in middle and south Atlantic states will transition to mild deficits. Conditions in Florida and Michigan will transition from surplus to near-normal.

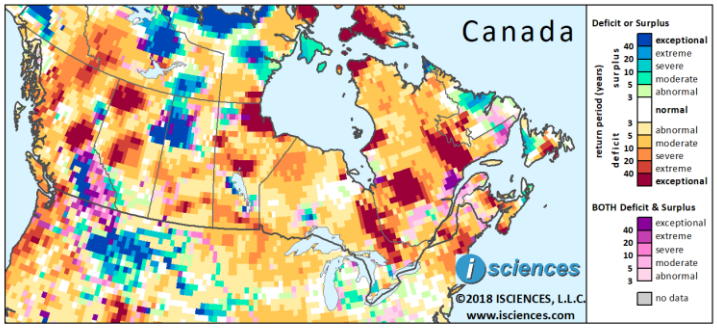
The forecast for the final months – December through February – indicates near-normal conditions east of the Mississippi, and the emergence of numerous areas of moderate surplus west of the Mississippi. Surpluses will persist in Idaho, Montana, the border of Wyoming and South Dakota, and central Nebraska, and will emerge in Wisconsin, southeastern Texas, southern Colorado, and many rivers in the southwest.

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

Canada

The 12-month outlook for Canada through February 2019 (right) indicates water deficits of varying intensity in many parts of the country, with the exception of southern British Columbia and northwestern Saskatchewan into Alberta, where intense surpluses are expected.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



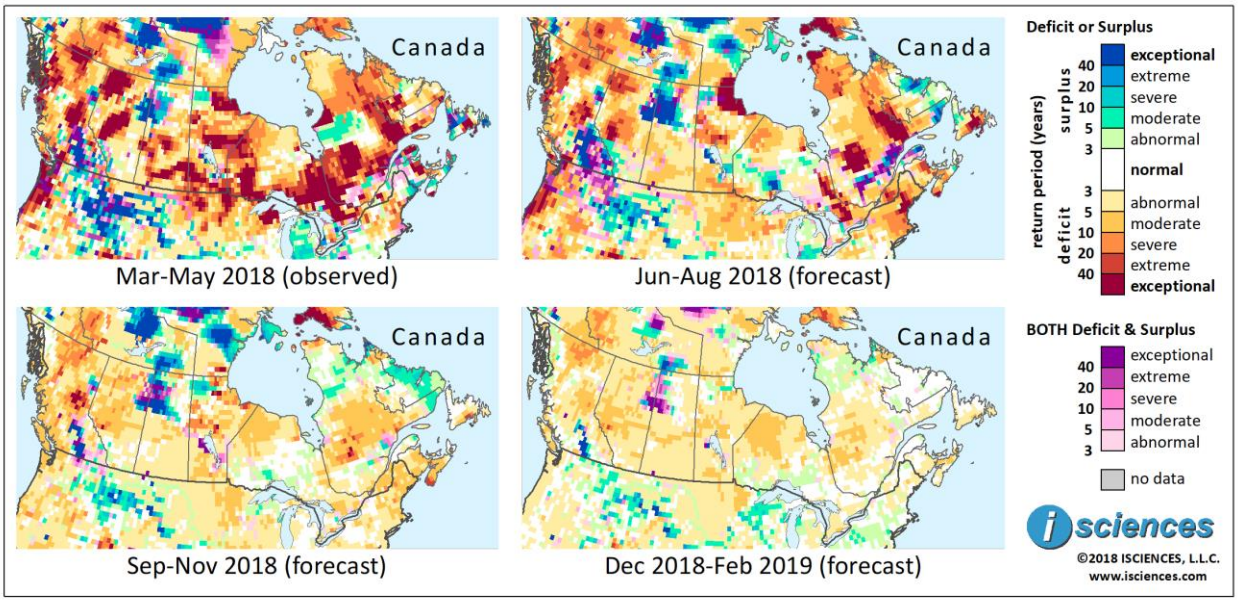
Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

Deficits are forecast to be intense in a large block of eastern Quebec from the Caniapiscau Reservoir to the St. Lawrence River, and around Lake Mistassini in central Quebec; Ontario's eastern border; and, northeastern Manitoba and north of Lake Winnipeg. In the West, significant deficits are forecast for the Lower Athabasca and Lower Peace River regions of Alberta, and a large pocket in British Columbia (BC) surrounding Prince George.

Surplus conditions are expected in a large block of northwestern Saskatchewan around Churchill Lake westward to Fort McMurray, Alberta; and surrounding Kamloops and Kelowna, BC.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

The forecast through August indicates a significant retreat of exceptional deficits in the center of the country. In Ontario, however, exceptional deficits will persist in a path along its eastern border leading to the south end of Georgian Bay. Northwest of Lake Superior, a transition from deficit to surplus is forecast. In Southern Ontario, surpluses are expected northwest of Toronto, and moderate deficits are forecast from Peterborough to Ottawa. In Quebec, deficits will be extreme around Sherbrooke, and exceptional near Lake Mistassini and from the Caniapiscau Reservoir to the St. Lawrence River. The area east of Hudson Bay will transition from surplus to mild deficit. Deficits are forecast for the remainder of the province with the exception of a wide path west of the St. Lawrence River exhibiting conditions of both deficit and surplus.

In the Prairie Provinces, moderate deficits are forecast for southern Saskatchewan but deficits may be severe in southern Manitoba. Even more intense deficits are forecast north of Lake Winnipeg and around Hudson Bay in Manitoba, and in the Upper Athabasca and Lower Peace River Regions of Alberta. Deficits will also be intense surrounding Prince George, BC and in northern BC. Surpluses will increase in southern BC and across the border into southwestern Alberta, and will reach exceptional levels around Kamloops and Kelowna. Exceptional surpluses will also increase in northwestern Saskatchewan, reaching west to Fort McMurray, Alberta.

From September through November, deficits nationwide are expected to moderate, though intense deficits will persist in some areas, including Prince George, BC. Surpluses will downgrade near Kamloops but will remain exceptional near Kelowna, BC. The large block of intense surpluses in northern Alberta into Saskatchewan will persist but will begin to transition as deficits emerge. Deficits in southern Manitoba will downgrade from severe to moderate, and deficits in southern Saskatchewan will become merely mild.

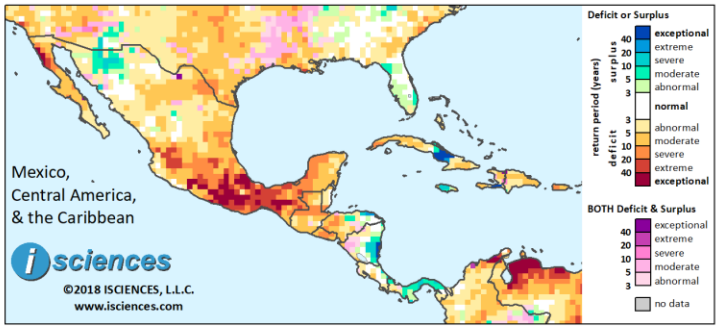
The forecast for the final three months – December through February – indicates mild anomalies overall, with moderate deficits in central Quebec; northern Ontario; along the North Saskatchewan, Athabasca, and Peace Rivers in the West; and northern and central BC. Significant surpluses are forecast to persist around Kelowna.

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

Mexico, Central America, and the Caribbean

The 12-month forecast ending February 2019 (right) indicates severe to exceptional water deficits in southern Mexico and in Baja California. Primarily moderate deficits are forecast for much of the remainder of the country, but surpluses are expected in northeastern Sonora.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



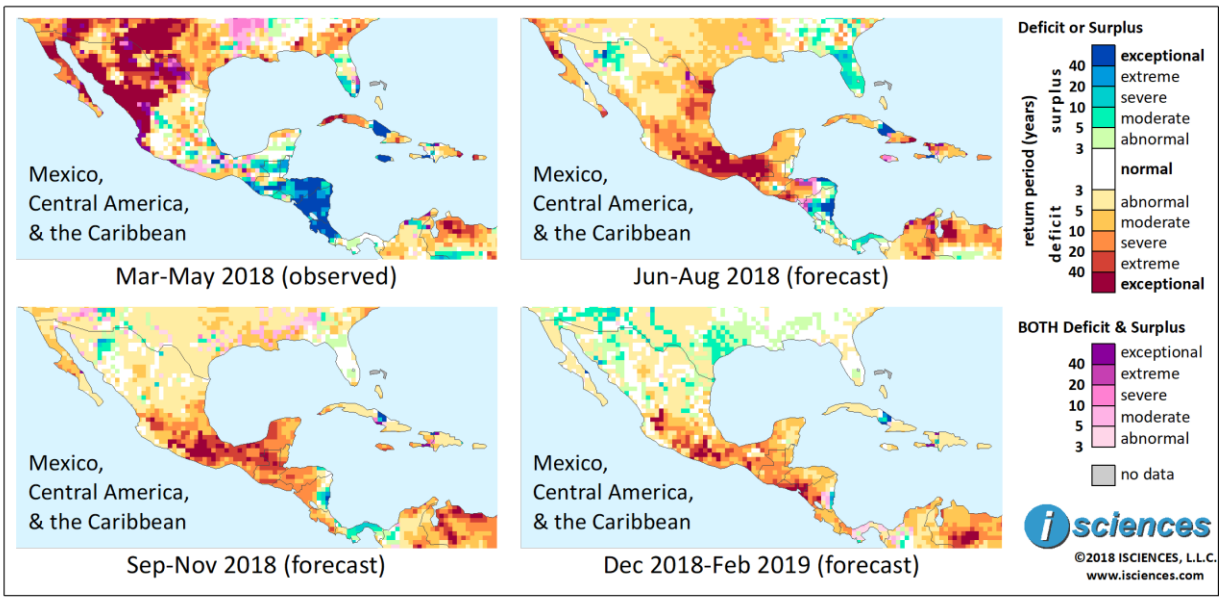
Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

In Central America, moderate to severe deficits are forecast for Guatemala, southern Belize, western Honduras, and El Salvador. Surpluses are forecast in southeastern Nicaragua and in Panama.

In the Caribbean, surpluses are expected in central Cuba and Jamaica. Moderate to severe deficits are forecast for the remainder of Cuba and for Haiti and the Dominican Republic.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

Apparent in the map series above is a transition away from significant deficits in northwestern Mexico and the emergence of significant deficits in the east and south. In the northwest, intense deficits will, however, persist in Baja California and will emerge in the southernmost tip of Baja California Sur.

Widespread extreme to exceptional deficits are expected to emerge in the southern Mexican states of Puebla, Veracruz, Oaxaca, Tabasco, and Chiapas. Deficits only slightly less intense are forecast for a wide band through the central states and in Tamaulipas on the Gulf. Deficits in Tamaulipas may be extreme. Surpluses are forecast to emerge in northeastern Sonora.

Surpluses in Central America will shrink considerably but persist in eastern Honduras, Nicaragua, and will emerge in Panama. Moderate to extreme deficits are forecast for Guatemala, El Salvador, and western Honduras. In the Caribbean, surpluses are forecast in central Cuba while deficits in the western half of the country moderate and deficits in the east become more intense. Intense deficits are also forecast to emerge in Haiti; deficits in Dominican Republic will be moderate. Both deficits and surpluses are forecast in Jamaica as it transitions away from surplus to deficit.

From September through November conditions in Mexico's northern half will become nearly normal in many regions, with mild deficits overall and some lingering surpluses in northeastern Sonora. In the southern half, however, intense deficits will dominate, with exceptional deficits in Guerrero, Puebla, and Oaxaca. Moderate deficits on the Yucatan Peninsula will intensify, becoming severe to extreme. Likewise, deficits in Guatemala will increase and become more intense. Severe deficits are forecast in western Honduras, El Salvador, and western Nicaragua. Deficits will emerge in Costa Rica. Severe surpluses are expected to persist in southeastern Nicaragua and in much of Panama. In the Caribbean, deficits will downgrade in Cuba, Haiti, and Dominican Republic, but Jamaica will transition to severe deficits.

The forecast for the final three months – December through February – indicates that deficits in southern Mexico and Central America will downgrade slightly but remain intense; some surpluses are forecast in scattered pockets across northern Mexico and along the Rio Grande.

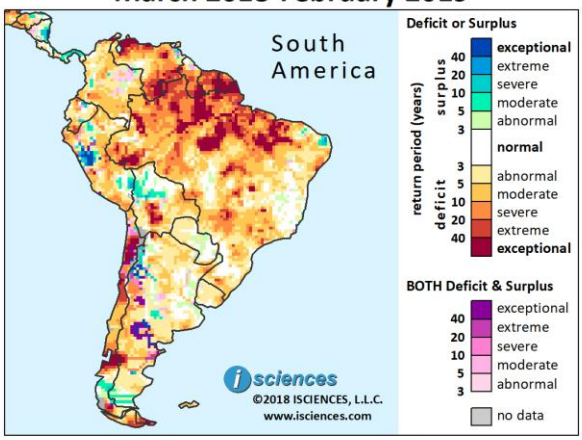
(It should be noted that forecast skill declines with longer lead times.)

South America

The 12-month forecast through February 2019 indicates significant water deficits in large pockets across northern Brazil. Deficits may be exceptional in the states of Amapá, Pará, Maranhão, Amazonas, and Acre.

Significant deficits are also forecast for Guyana, Suriname, French Guiana, and Venezuela, and in south-central Bolivia beginning near Cochabamba, northern Chile, the Gulf of Corcovado in southern Chile, and Tierra del Fuego.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019

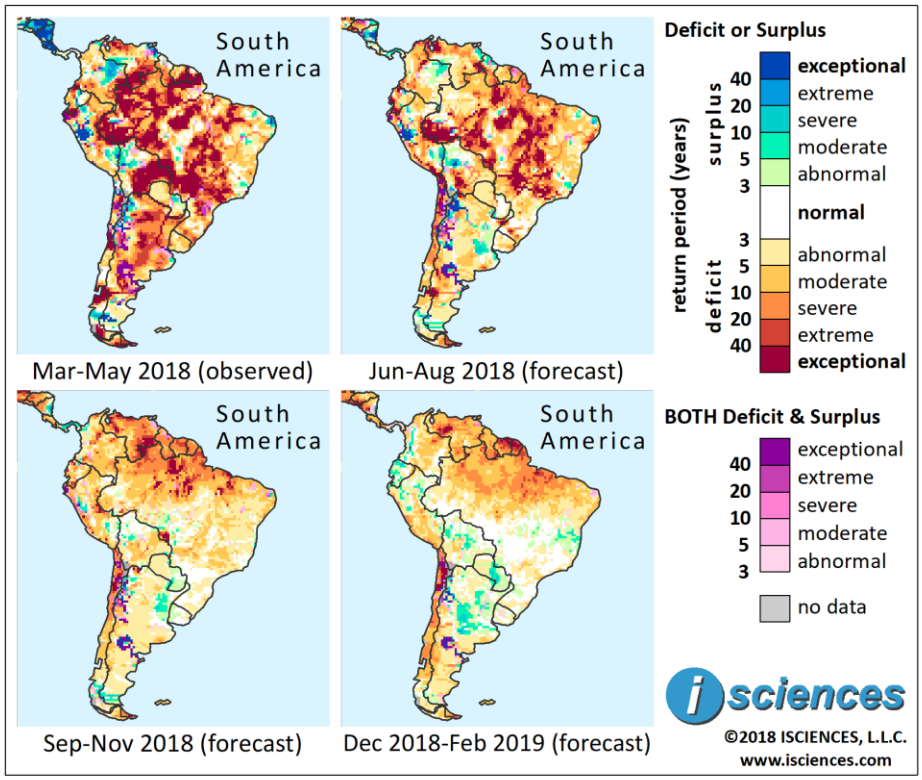


Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

Surpluses are expected in Huánuco Region of central Peru; Peru's border with Bolivia and well into central Bolivia; Brazil's easternmost tip (Rio Grande do Norte); and in Patagonia surrounding O'Higgins/San Martín Lake and to the east in Argentina.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

Though the extent of exceptional deficit is forecast to diminish in South America over the next several months, large pockets of intense deficit are forecast for Brazil in Acre, Rondônia, Pará, Tocantins, Goiás, western Minas Gerais, northern Mato Grosso do Sul, and São Paolo. Deficits are also expected to be intense along many rivers.

Intense deficits are also forecast for: Venezuela east of Lake Maracaibo and near the border with Guyana; southwestern Ecuador; southern Bolivia; Río Paraná through Paraguay; along a path beginning south of Lima, Peru, through northern Chile; near the Gulf of Corcovado in southern Chile and eastward along the Río Chubut into Argentina; and Tierra del Fuego. Deficits in Santiago Chile will downgrade slightly from exceptional to extreme, with severe deficits in the surrounding region. Deficits in Argentina will moderate and some surpluses are expected to emerge in northern Buenos Aires Province and along parts of the Río Salado in northwestern Argentina.

Intense surpluses will persist in Peru's Huánuco Region, and moderate to exceptional surpluses along the border with Bolivia leading into central Bolivia. Surpluses are also forecast for: northern Guyana into Venezuela; Vichada in eastern Colombia; Salta Province in northwestern Argentina and Neuquén

Province in the south; surrounding O'Higgins/ San Martín Lake in Patagonia; and along the Río Santa Cruz in Patagonia.

From September through November deficits will diminish in Brazil's southern two-thirds, with conditions becoming moderate or even normal. In the northern states, however, severe to exceptional deficits are forecast. Likewise, deficits will be intense in Venezuela, Guyana, Suriname, and French Guiana. Primarily moderate deficits are forecast for Colombia, Ecuador, Peru, and Bolivia's southern half. In Chile, severe to exceptional deficits are forecast in the north, with moderate deficits south of Santiago. In northern Buenos Aires Province, Argentina, conditions will transition from surplus to near-normal but moderate surpluses will emerge farther north in Santa Fe and Entre Ríos Provinces, and in central Paraguay along the Río Paraguay.

In the final quarter – December through February – severe deficits are forecast for Brazil's northern half and neighboring countries to the north, and also in Chile. Primarily moderate surpluses are expected to emerge across central Argentina, central Paraguay, Ecuador, and the Río Cauca in western Colombia.

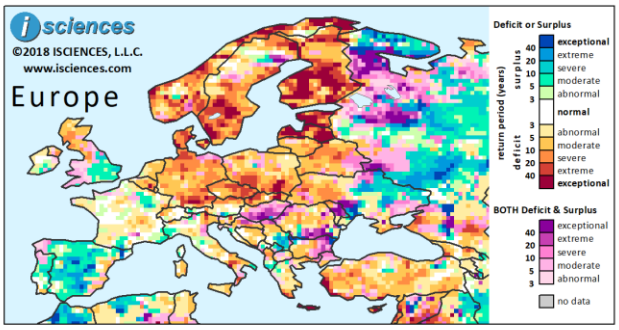
(It should be noted that forecast skill declines with longer lead times.)

Europe

The 12-month forecast indicates deficits of varying severity blanketing much of Central, Eastern, and Northern Europe. Deficits are expected to reach exceptional intensity in Finland, Estonia, Latvia, and Crete.

Surpluses are forecast for the Iberian Peninsula, England, along the Marne River and parts of the Seine in France, the Riviera, southern Serbia and east along the Danube into Bulgaria, eastern Ukraine and many parts of European Russia.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019

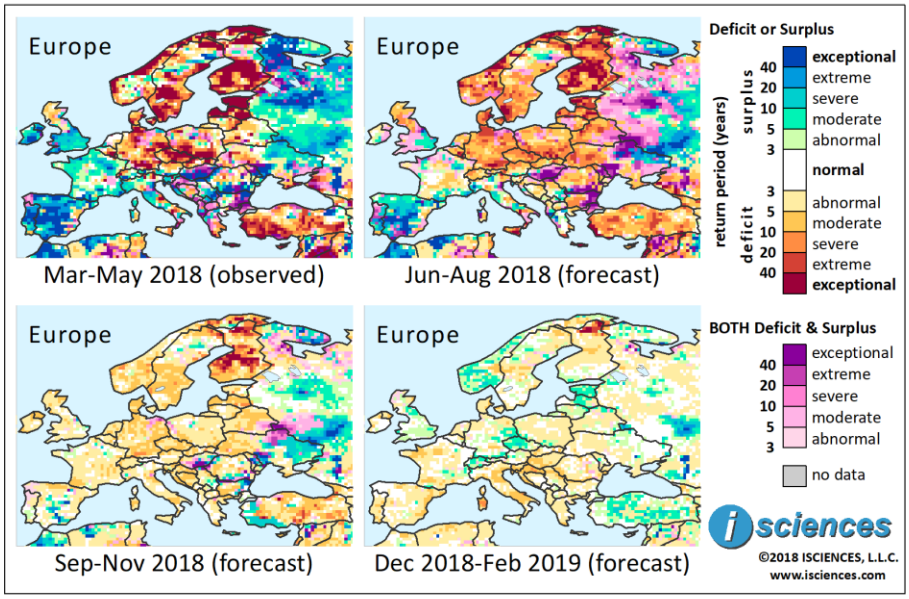


Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

Conditions of both deficit and surplus are expected in areas of transition, including Hungary, southeastern Romania, eastern Bulgaria, Moldova, and western European Russia.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

The forecast through August indicates widespread deficits of varying severity in Central, Eastern, and Northern Europe. Deficits are expected to be intense in Finland, Estonia, Latvia, southwestern Sweden, Denmark, Germany (surrounding Hamburg in the north and also south of the Danube River), southern Belgium, Sicily, and Crete. Surpluses will persist on the Iberian Peninsula and may be exceptional between the Tajo and Guadiana Rivers, and from Toledo south to Granada. Primarily moderate

surpluses are forecast England; pockets in eastern and southern France; Piedmont, Tuscany, and Campania, Italy; and southern Serbia. In European Russia, surpluses ranging from moderate to exceptional are forecast for the Don River Basin and much of the Volga River Basin, but both deficits and surpluses are expected in the west as transitions occur.

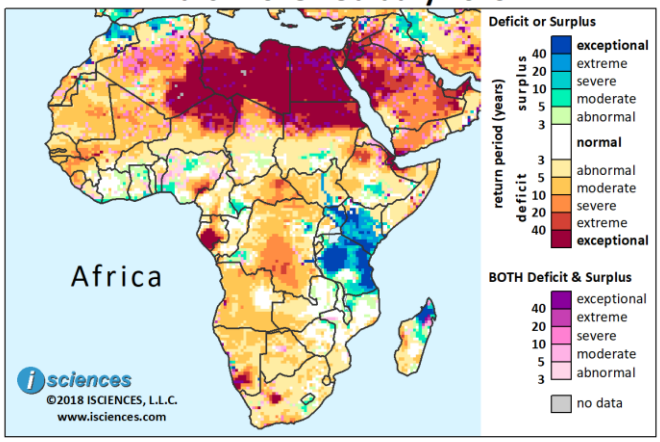
From September through November both deficit and surplus anomalies are forecast to moderate overall, but significant deficits will persist in Finland. Significant surpluses will persist in eastern Ukraine and the Don and Volga River Basins in Russia, and will re-emerge west of Rybinsk Reservoir. Surpluses will also persist in Spain from Toledo to Granada, and in Hungary, southern Serbia, southern Romania, eastern Bulgaria, and Moldova.

The forecast for the remaining months – December through February – indicates mild deficits in Europe, with the exception of northern Finland where deficits will be exceptional, and surpluses in Norway, the Baltics, Czechia (Czech Republic), Switzerland, and parts of the Don and Volga River Basins.

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

Africa

The 12-month forecast (right) indicates exceptional water deficits in North Africa and exceptional surpluses in East Africa.



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

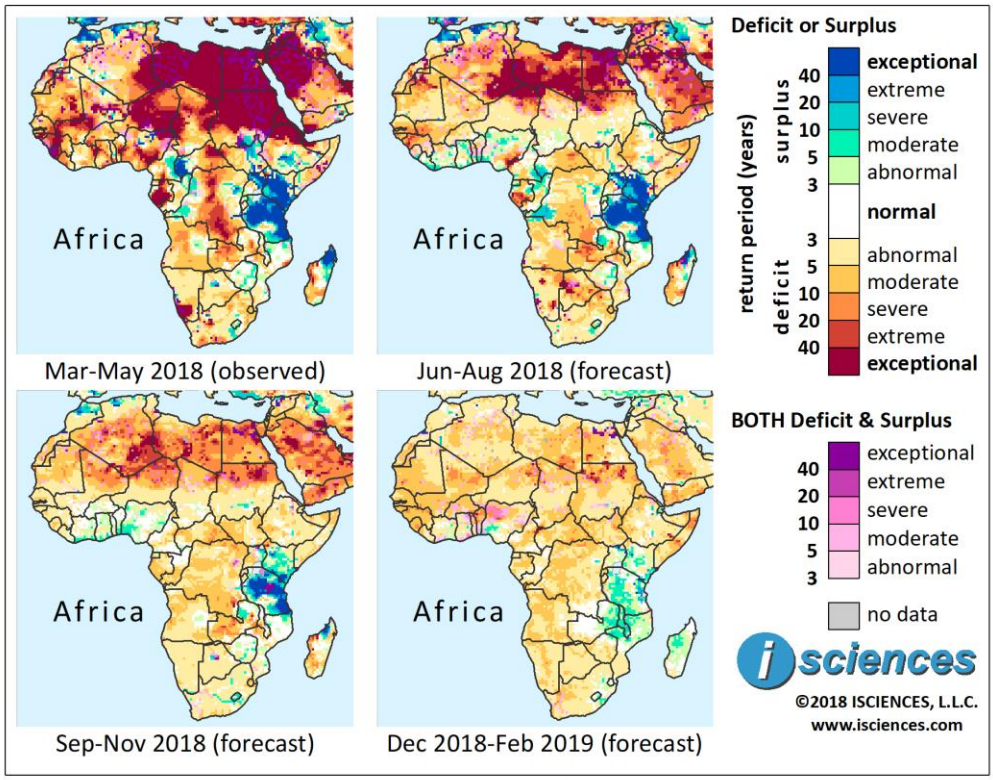
Exceptional deficits are forecast in southeast Algeria and northern Niger, across Libya, Egypt, and northern Sudan. Deficits of equal intensity are expected in southern Eritrea, Djibouti and across the border into Somalia; Gabon; southwest Namibia; and a pocket in central Northern Cape, South Africa.

Moderate to extreme deficits are forecast in Nigeria south of the Benue River, eastern Central African Republic, northern Ethiopia, and Democratic Republic of the Congo. Primarily moderate deficits are forecast for West Africa down through Sierra Leone, and in Angola and northern Namibia.

In East Africa exceptional surplus conditions are forecast for much of Tanzania and surpluses nearly as intense for Kenya, northern Uganda, and the White Nile through South Sudan. Surpluses are also forecast for northern Madagascar, northern Morocco, the central coast of Algeria, south-central Ethiopia, and pockets around the Gulf of Guinea.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

The forecast through August indicates that exceptional deficits across North and West Africa will diminish but severe to exceptional deficits are expected in southeast Algeria, northern Niger, Libya, Egypt, and northern Sudan. Deficits will shrink and downgrade in Gabon but remain severe, as will deficits south of the Benue River in Nigeria and across the border into Cameroon. Deficits are expected to downgrade in Central African Republic, Democratic Republic of the Congo, and Angola, becoming primarily moderate. Deficits will persist in western Zambia and are expected to be extreme on the Kafue River. Moderate surpluses will emerge in northwestern Zambia, but deficits will persist east of the Chambeshi River in the north and around Zambia's conjoined borders with Malawi and Mozambique. Moderate to exceptional deficits are forecast to emerge in central Botswana.

Exceptional surpluses will persist in Tanzania, Kenya, and northern Uganda, but will diminish somewhat in northern Madagascar. Surpluses east of Kinshasa in DRC will increase in both extent and intensity, becoming severe. Elsewhere, surpluses are forecast to: shrink in south-central Ethiopia; downgrade slightly on the White Nile through South Sudan; shrink and downgrade in western Central African Republic and southeastern Cameroon; emerge in moderate pockets in countries along the north coast of the Gulf of Guinea; and persist in northern Morocco and along Algeria's central coast.

From September through November moderate to exceptional deficits will continue to emerge across North Africa but exceptional deficits will shrink considerably. Surpluses will remain intense in Tanzania

but will shrink and downgrade in Kenya. Aforementioned surpluses in Morocco and Algeria will downgrade, and moderate surpluses remain in the forecast around the Gulf of Guinea. Primarily moderate deficits are expected in the center of the continent and mild deficits in the south. Deficits in Zambia will remain severe, including along the Kafue River. Moderate surpluses will increase in Lesotho and westward along the Orange River in South Africa until it meets the Vaal in the center of the country, picking up again on the Lower Orange along the southern border of Namibia.

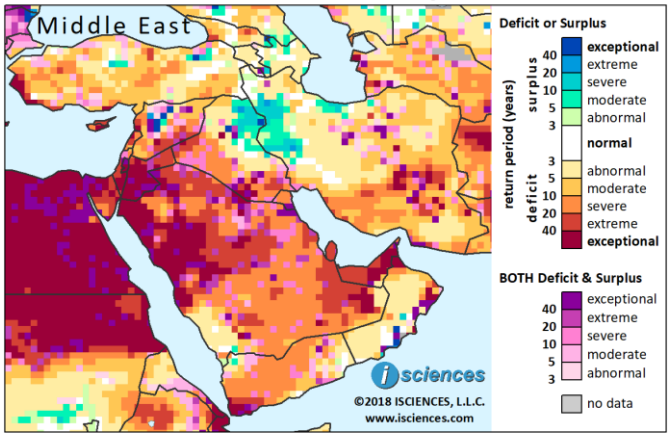
The forecast for the final quarter – December through February – indicates moderate deficits across much of the continent with moderate surpluses in East Africa.

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

Middle East

The forecast for the 12-month period ending February 2019 (right) indicates exceptional deficits in West Bank, Israel, Jordan, northwestern Saudi Arabia, and United Arab Emirates.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



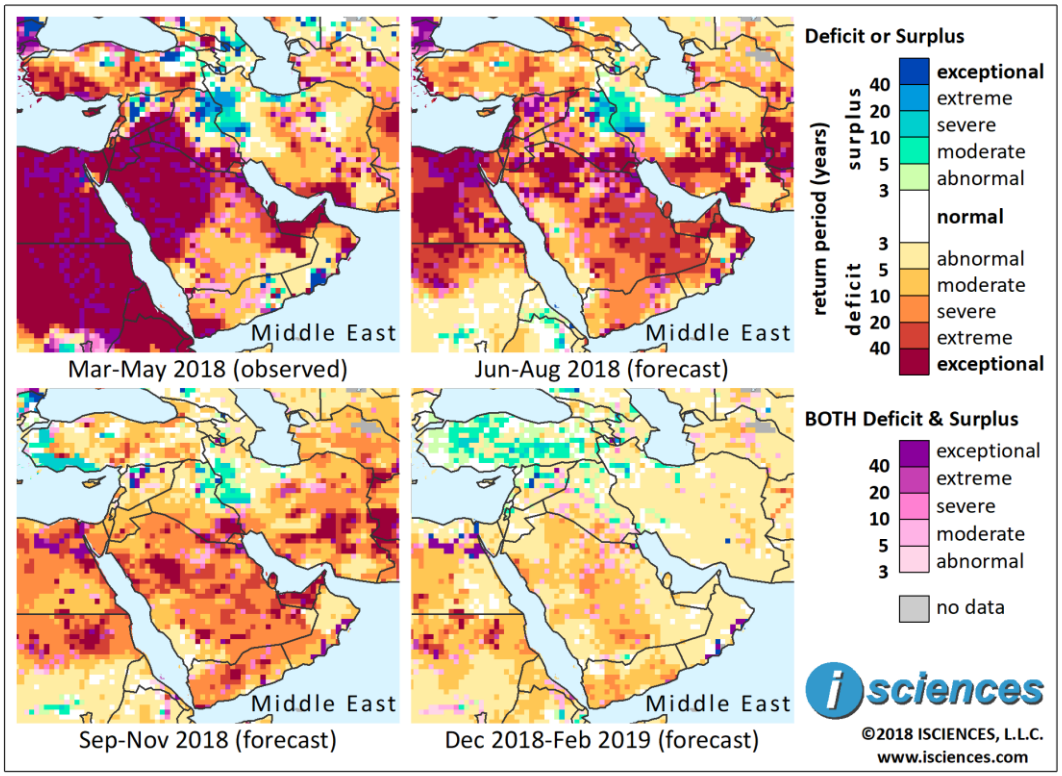
Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

Severe to extreme deficits will blanket much of the remainder of Saudi Arabia, as well as Iraq to the Euphrates River, Qatar, and Yemen. Deficits will also be intense in Cyprus, Lebanon, and southern Syria. Deficits of generally lesser severity are forecast for many parts of Turkey.

Deficits ranging from moderate to exceptional are forecast in south-central Iran, with some particularly intense pockets expected in Kerman Province. Surplus conditions are forecast across the northern border of Iraq and Iran.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

The forecast for the next several months, through August, indicates that exceptional deficits occupying a vast block of the northern Arabian Peninsula are expected to shrink considerably but will persist in northern Saudi Arabia and southern Iraq. Deficits will increase in both extent and intensity in southern Saudi Arabia and into Oman and Yemen, while deficits in Qatar and UAE will downgrade slightly but remain intense. In the Levant, exceptional deficits are forecast for Lebanon, Israel, and West Bank. Deficits of varying severity are forecast throughout Turkey and Syria, though deficits in western Turkey will downgrade from exceptional. Likewise, conditions in Cyprus will downgrade from exceptional but remain intense. Surpluses will persist across the northern border of Iraq and Iran, while deficits will become more severe in southern Iran, reaching exceptional intensity in Kerman Province and neighboring Fars and South Khorasan Provinces.

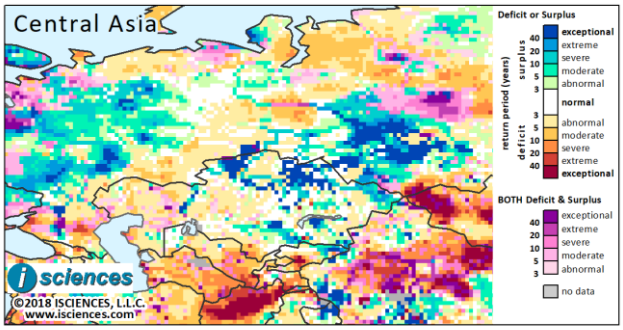
From September through August deficits will moderate in the Levant, and will downgrade somewhat on the Arabian Peninsula but remain fairly intense, especially in UAE. Intense deficits will emerge in central Yemen during this period. Exceptional deficits will persist surrounding Basrah, Iraq, and in Kerman Province, Iran. Severe surpluses are expected to emerge along Turkey's southwestern shore and in the northwest along the Simav River (Susurluk River).

The forecast for the final quarter – December through February – indicates that deficits will diminish in the region overall and moderate surpluses will emerge throughout much of Turkey.

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

Central Asia and Russia

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

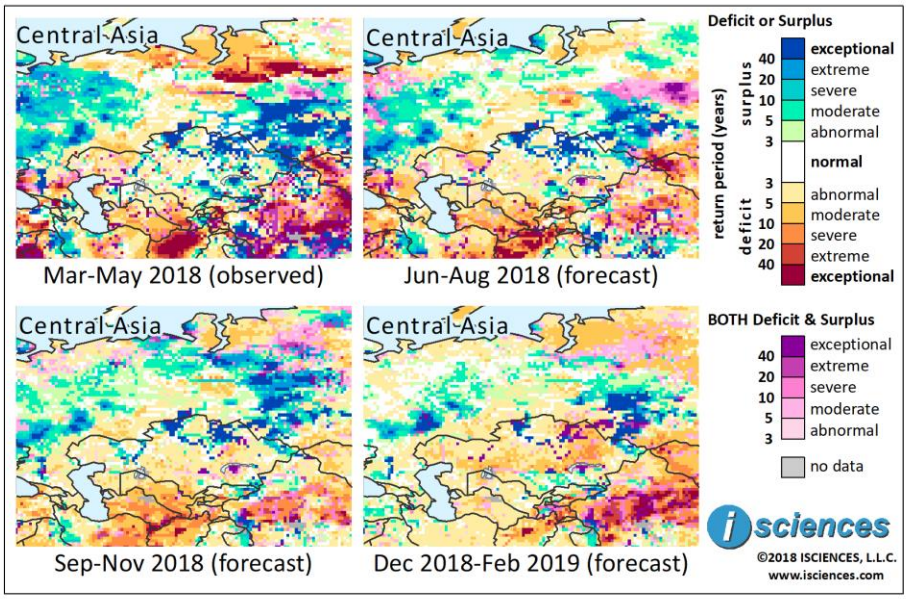
The 12-month forecast indicates widespread surpluses reaching exceptional levels in the Upper Ob and Tom River Basins in Russia, severe surpluses along the Irtysh and Ishim Rivers, and moderate surpluses on the Lower Ob River. Severe surpluses are forecast for the Vakh River, a tributary of the Ob, but moderate to severe deficits are expected in the Bolshoy Yugan River watershed in the Middle Ob region. Moderate deficits are forecast from the southern Yamal Peninsula into the Central Siberian Plateau.

In European Russia, widespread surpluses of varying severity are forecast for the Don River Basin, Volga Uplands, upper TransVolga, and the Upper Volga to Rybinsk Reservoir.

Exceptional surpluses are expected in northern Kazakhstan, and surpluses of varying severity in southern regions as well as in eastern Kyrgyzstan. Moderate deficits are forecast along the Ural River in northwestern Kazakhstan leading to Orenburg, Russia. Severe to exceptional deficits are forecast for central Kyrgyzstan. In the eastern portions of Turkmenistan, Uzbekistan, and Tajikistan severe deficits are forecast, with primarily moderate deficits in western Turkmenistan.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

The forecast through August in Russia indicates that surplus conditions will shrink in European Russia and transition to both deficit and surplus (shown in purple) in the Northern European Plain. Surpluses in the Upper Ob River region and the Tom River Basin will diminish somewhat in both extent and intensity but remain widespread. Moderate surpluses are expected along the Lower Ob, but moderate to extreme deficits will increase in the Bolshoy Yugan River watershed in the Middle Ob. Conditions of both deficit and surplus will increase in the Podkamennaya Tunguska watershed, a tributary of the Yenisei River, as transitions occur. Widespread deficits along the Pechora Sea through Yamal Peninsula and into the Central Siberian Plateau will retreat considerably, transitioning to surpluses in western Yamal.

In Kazakhstan, surpluses reaching exceptional intensity will continue in the north. Deficits are forecast for Turkmenistan, eastern Uzbekistan, central Kyrgyzstan, and Tajikistan, and will be most intense in eastern Turkmenistan and central Kyrgyzstan. Deficits are expected to be severe along the Amu Darya and Zaravshan Rivers. Surpluses are forecast for eastern Kyrgyzstan.

From September through November, surpluses in northern European Russia will diminish, but those in the Don River Basin and the Volga Uplands will persist with intensity, and surpluses will re-emerge around Rybinsk Reservoir. Surpluses will increase between the Lower Ob and Taz Rivers south of the Gulf of Ob and will upgrade in intensity. Surpluses of varying severity will continue to emerge in the Lower Ob and Tom River Basins. Severe surpluses will emerge along the Middle Ob River as it veers east, but deficits will persist in the surrounding region, including the Bolshoy Yugan River watershed to the south, downgrading to moderate.

Significant surpluses will persist in northern Kazakhstan, and will re-emerge in northwestern Aktobe Region. Deficits will increase slightly in Tajikistan, diminish in central Kyrgyzstan, and become somewhat more intense in Turkmenistan and Uzbekistan. Surpluses are expected to persist in eastern Kyrgyzstan.

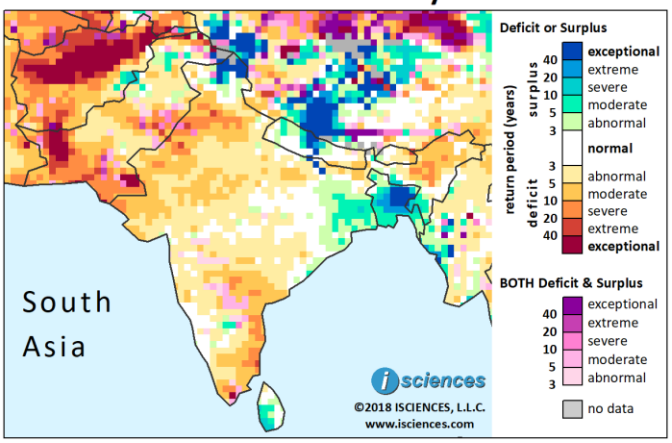
The forecast for the final months – December through February – indicates that deficits will downgrade in Turmenistan and Uzbekistan, intensify in Tajikisan, and emerge in eastern Kazakhstan and the Central Siberian Plateau.

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

South Asia

The 12-month forecast indicates exceptional water deficits in Afghanistan's northern half and deficits of varying severity throughout much of the rest of the country. Intense deficits are forecast for southern Pakistan as well, reaching exceptional levels in western Baluchistan and eastern Sindh.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

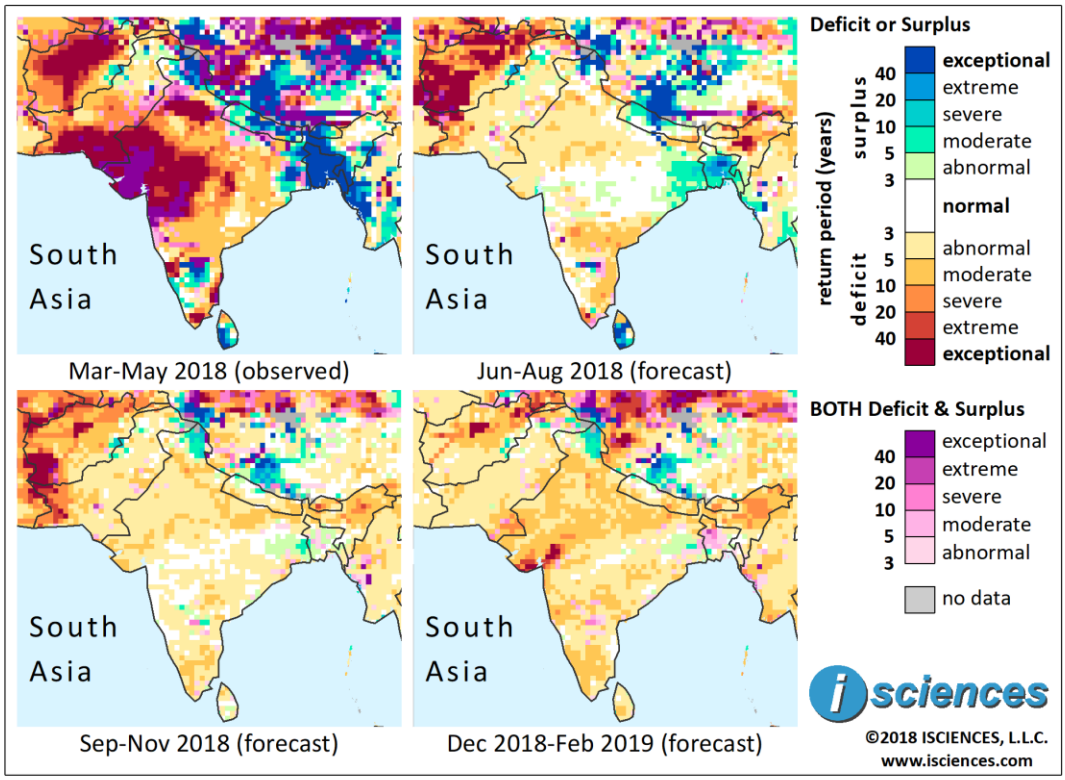
In India, moderate to severe deficits are forecast in the northwest for Punjab, Chandigarh, and northwestern Rajasthan; in Assam in the Far Northeast; and along the southeast coast.

Exceptional surpluses are forecast in Jammu and Kashmir and moderate surpluses in West Bengal.

Elsewhere in the region, moderate to exceptional surpluses are expected in Bangladesh and in central Nepal along the Gandaki River well past the border into Bihar, India. Moderate surpluses are forecast for southwestern Sri Lanka.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

As is apparent in the map progression above, India is forecast to transition out of widespread deficit to milder conditions. In Afghanistan, however, exceptional deficits remain in the forecast, retreating only slightly in the north and emerging throughout much of the south. Pakistan should get a reprieve as exceptional deficits diminish considerably, leaving moderate to severe deficits in western Baluchistan, along with some pockets of exceptional deficit near the Afghan border.

Normal water conditions are expected to prevail in a wide band across central India. Moderate deficits are forecast for northern Karnataka, Telangana, eastern Andhra Pradesh and Tamil Nadu, but deficits are expected to be severe in southern Kerala. Severe to exceptional deficits will emerge in India's Far Northeast, particularly Assam. Primarily moderate surpluses are forecast for West Bengal into northern Odisha and eastern Jharkhand, and some exceptional surpluses will persist in Jammu and Kashmir. Conditions of both deficit and surplus are forecast in the western Penner River watershed in Andhra Pradesh and into eastern Karnataka.

Surpluses are forecast for northwestern and central Nepal which may be exceptional along the Gandaki River leading into Bihar, India. Surpluses in Bangladesh will shrink slightly and while remaining intense, especially in Dhaka Division, will downgrade overall from exceptional. Moderate deficits will persist in Sri Lanka's northern tip and intense surpluses will persist in the south.

From September through November exceptional deficits in Afghanistan will continue to shrink but persist, particularly in the south, while primarily moderate to severe deficits dominate the north. Severe deficits will persist on the Harirud River and severe to exceptional on the lower Helmand. Deficits in southwest Pakistan are forecast to increase and upgrade slightly overall. Mild deficits are forecast for much of India, with some moderate deficits in the southern tip and parts of the Gangetic Plain, and more severe deficits in India's Far Northeast and in Bhutan. Surpluses are expected to diminish in West Bengal, and nearly disappear in Nepal and Bangladesh. Moderate to severe surpluses are forecast for eastern Jammu and Kashmir. Sri Lanka will transition to relatively normal water conditions.

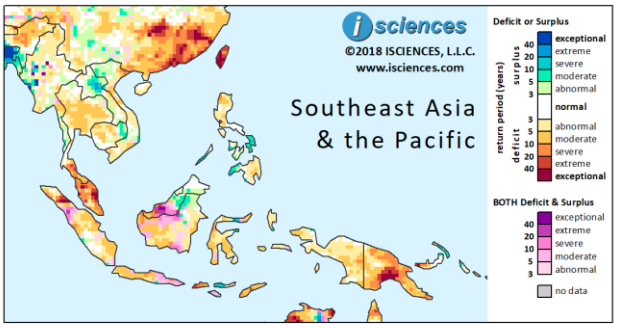
The forecast for the final period – December through February – indicates that deficits will diminish but persist in Afghanistan and will increase in India, with particular intensity in Gujarat.

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

Southeast Asia and the Pacific

The 12-month map (right) indicates severe to extreme water deficits in southernmost Thailand, peninsular Malaysia, western Malaysian Borneo, northern Sumatra, West Nusa Tengara, and Papua New Guinea. Deficits may reach exceptional intensity around the Gulf of Papua and some pockets of peninsular Malaysia and northern Sumatra.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



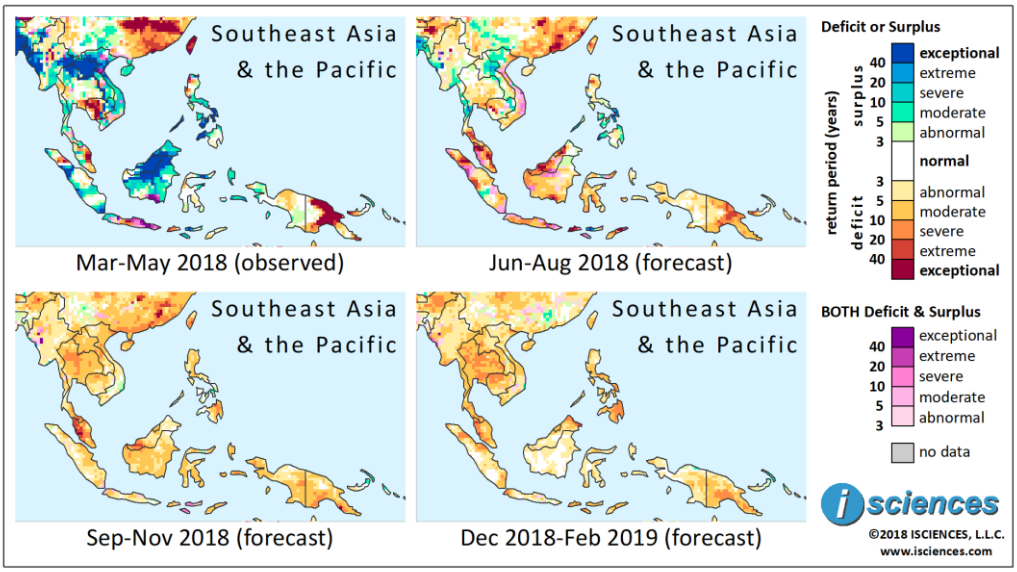
Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

Primarily moderate deficits are expected in much of mainland Thailand, western Cambodia, western Java, Timor-Leste, and scattered throughout Indonesia.

Moderate to extreme surpluses are forecast for northern Laos and East Nusa Tengara, and surpluses of generally lesser severity in pockets of western Myanmar, eastern Cambodia, parts of northeastern Borneo, and central Philippines.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

The near-term forecast through August indicates a transition away from widespread, intense surplus to deficit. Surpluses are forecast, however, for: pockets of western Myanmar, along the Sittaung River, and southern Myanmar; northern Laos; northwestern Vietnam; eastern Cambodia; central Philippines; and East Nusa Tengara. Deficits in western Cambodia will moderate overall but some extreme to exceptional

pockets will persist west of Tonlé Sap. Moderate deficits will emerge nearby in Thailand and in southern Vietnam. Intense deficits will spread in peninsular Malaysia, reaching into southernmost Thailand, and also spread in northern Sumatra. Conditions in Malaysian Borneo are forecast to transition from intense surplus to intense deficit. Deficits of varying intensity are expected to emerge throughout Indonesia and may be extreme in West Nusa Tengara and Timor-Leste. Deficits in Papua New Guinea will downgrade overall from exceptional to severe.

From September through November surpluses will nearly disappear and moderate deficits are forecast throughout much of the region with severe deficits in western Thailand, eastern Mindanao, and around the Gulf of Papua. Conditions may be even more intense – with a return period of 20 to 40 years – in peninsular Malaysia and western Malaysian Borneo.

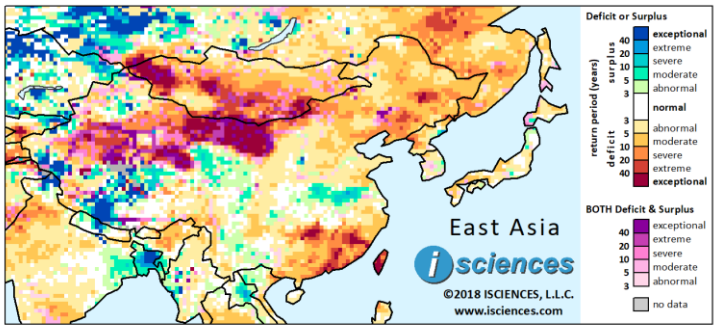
The forecast for the final months – December through February – indicates some normalization of conditions in Indonesia, with deficits in much of the remainder of the region, particularly Thailand.

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

East Asia

The 12-month forecast for East Asia (right) indicates widespread, intense deficits reaching exceptional severity in western Inner Mongolia stretching west through northern Gansu, northwestern Qinghai, and southern Xinjiang, and north through Mongolia. Conditions of both deficit and surplus are also indicated for these regions as transitions occur.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

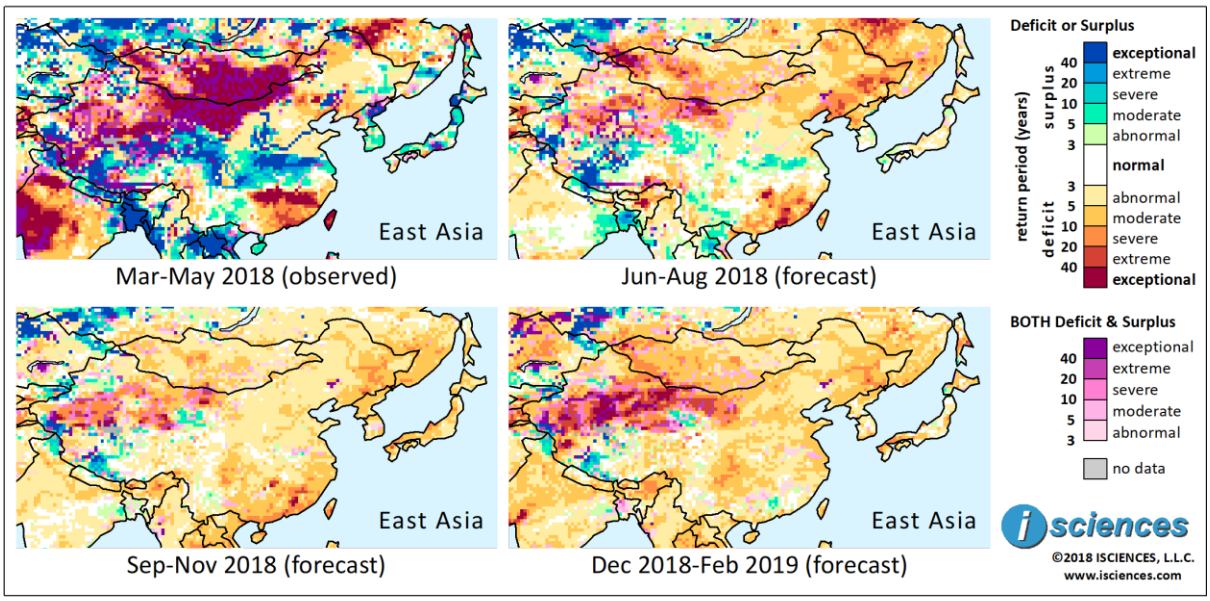
Moderate deficits are forecast in Northeast China with severe to extreme deficits in Liaoning and southern Heilongjiang. A vast stretch of Southeast China will also experience deficits, ranging from moderate to exceptional, including Fujian, Jiangxi, Guangdong, Hunan, as well as Hong Kong and Taiwan.

A pocket of exceptional surplus is expected at the central border of Shaanxi and Shanxi along the eastern arm of the Yangtze River's Ordos Loop. Moderate to severe surpluses are forecast in the Huai River Basin through Anhui and Henan, and moderate surpluses in eastern Qinghai. Surpluses are expected to reach exceptional intensity in western Tibet and along the western Yarlung River (Brahmaputra) north of Nepal.

Severe deficits are forecast for western North Korea. Some scattered moderate deficits are forecast for Japan.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

The near-term forecast through August indicates that the extent of exceptional deficits in Mongolia and Inner Mongolia through southern Xinjiang will diminish considerably, though widespread deficits of varying severity are expected and a large pocket of exceptional deficits will persist in western Inner Mongolia. Deficits will increase in Northeast China with some areas transitioning from surplus. Deficits are expected to be severe to extreme in Liaoning, Jilin, and Heilongjiang. Though exceptional deficits will shrink in Southeast China, moderate to exceptional deficits are forecast for Fujian, Guangdong, Jiangxi, Hunan, Guangxi, Hong Kong, and Taiwan.

Surpluses on the Lower and Middle Reaches of the Yellow River will nearly disappear, but moderate surpluses will persist in the Upper Reaches. Intense surpluses in the Yangtze Basin will retreat as well, but moderate to severe surpluses are forecast for the Huai River Basin. Moderate surpluses are forecast along Yunnan's northern border and into northwestern Guangxi. Exceptional surpluses are forecast in western Tibet and along the western Yarlung (Brahmaputra) River, with deficits in eastern Tibet. Hainan will transition from surplus to mild deficit.

Severe deficits will persist north of Pyongyang, and moderate deficits are forecast for much of the remainder of North Korea. In Japan, deficits are expected to be severe in Okinawa while primarily mild anomalies, both deficits and surpluses, are forecast for the rest of the country.

The forecast for September through November indicates that deficits will shrink and moderate in Mongolia. Across the border in China, severe to exceptional deficits will persist from western Inner Mongolia through southern Xinjiang, with some areas exhibiting both deficit and surplus conditions. Deficits will shrink in Northeast China but severe deficits are forecast for Jilin and southern Heilongjiang. Deficits will persist in Southeast China, with moderate deficits spreading north through Zhejiang, west

into Guizhou, Chongqing, and eastern Sichuan, and south through Hainan. Conditions in the Huai River Basin will transition from surplus to near-normal.

Moderate deficits are expected throughout North Korea, and will spread in Japan.

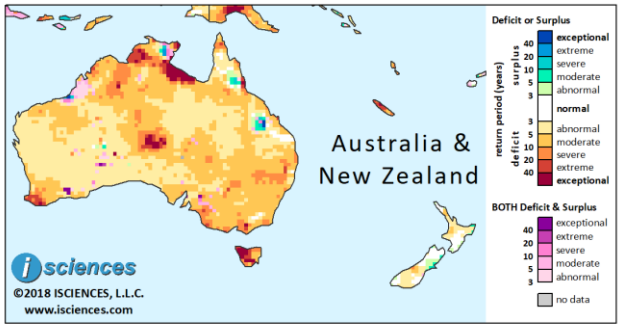
The forecast for the final months – December through February – indicates that conditions along China's southeast coast will transition from deficit to near-normal, but deficits will persist elsewhere in China and will spread in Mongolia.

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

Australia & New Zealand

The 12-month forecast (right) shows moderate water deficits – punctuated by pockets of greater severity – covering much of southeastern Australia, Northern Territory, and Australia's southwestern tip. Areas of intense deficit include: Northern Territory along the Gulf of Carpentaria; Darwin and the Daly River region; northwestern South Australia leading across the border into Northern Territory; and western Tasmania and the Derwent Estuary in the southeast.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

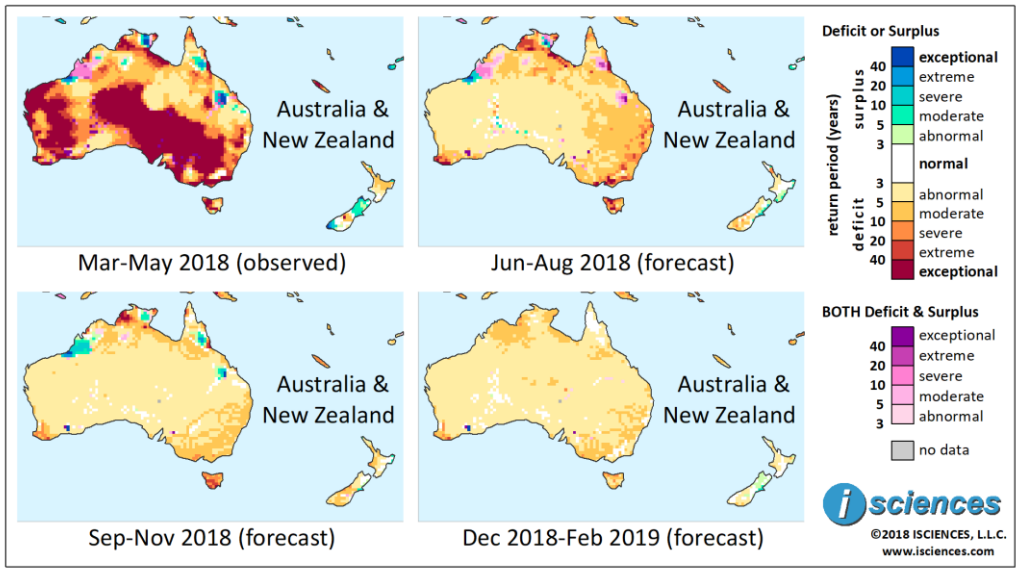
Severe deficits are expected in: the Ord River Basin in Western Australia; dotted along Australia's southeastern shore; and parts of the upper Murray-Darling Basin.

Some surplus conditions are expected around the Mackenzie River in eastern Queensland (QLD) and in the Atherton Tablelands of northern QLD.

Conditions in New Zealand are expected to be relatively normal, with some pockets of deficit north of Auckland and around Aoraki/Mount Cook National Park, and severe surplus conditions near Christchurch. Moderate to extreme deficits are forecast for New Caledonia.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: March 2018-February 2019



Based on observed data through May 2018 and forecasts issued May 25-31, 2018.

As is apparent in the map series above, the forecast indicates that the exceptional deficits which have dominated a vast stretch of Australia in prior months will nearly disappear. From June through August moderate deficits – punctuated by pockets of more intense deficits – are expected across a large portion of the east and southeast including the Murray-Darling Basin, scattered across the north, and in the southwest tip of the country. Deficits are expected to be intense in Tasmania, in pockets along the southeast coast from Brisbane past Melbourne, in the southwest from Busselton to Albany, in Darwin and the Daly River region of Northern Territory (NT), along the NT shore of the Gulf of Carpentaria, and near Cairns in Queensland (QLD).

Moderate to exceptional surpluses are forecast in southwest Kimberley region of Western Australia (WA), but conditions of both surplus and deficit are also forecast as transitions occur. Likewise, both deficits and surpluses are forecast for the Atherton Tablelands and Mackenzie River regions of QLD.

In New Zealand, primarily moderate deficits are forecast for southern South Island and northern North Island, and surpluses along the eastern shores from Christchurch north. Deficits in New Caledonia will downgrade slightly but remain severe to extreme.

From September through November deficits will remain intense near Darwin and the Daly River region, but will shrink and moderate elsewhere across the north as well as in the east and southeast. Deficits in the southwest tip of the country will downgrade, but severe deficits are forecast along the Blackwood River and extreme deficits near Albany. Intense deficits will continue to emerge in Tasmania, particularly in the south and the Derwent Estuary. Surpluses of varying severity will re-emerge in the Atherton Tablelands and near the Mackenzie River in QLD, and will spread in southwest Kimberley, WA. Moderate deficits will increase in New Zealand, and moderate to severe deficits will persist in New Caledonia.

The forecast for the final months – December through February – indicates that aforementioned regions of deficit will moderate overall and surpluses will nearly disappear.

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