Global Water Monitor & Forecast Watch List

August 15, 2017

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

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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 July 2017 and an ensemble of forecasts issued the last week of July 2017. 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.

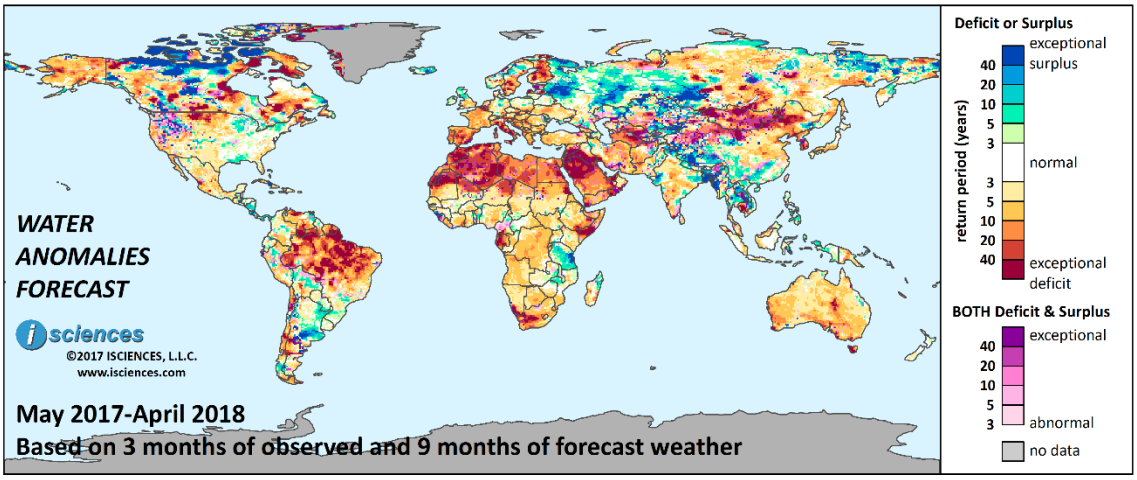
Deficits and surpluses are stated in terms of return period – a measure that characterizes the rarity of an anomaly. For example, a return period of 10 years indicates an anomaly that would occur, on average, once every ten years. Higher return periods indicate more extreme and, therefore, more disruptive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

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 May 2017 and running through April 2018 using 3 months of observed temperature and precipitation data and 9 months of forecast data.

ISCIENCES WORLDWIDE WATER WATCH LIST ISSUED AUGUST 2017



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: After July the Northern Plains States should see a significant retreat of exceptional water deficits. Surpluses will persist in the Gulf region, diminish in the Great Lakes States, and transition to mild deficits in Virginia and North Carolina. After October moderate water surpluses will re-emerge in most of the Great Lakes States and in the Ohio River Valley, and pockets of surplus will continue to emerge in Idaho and surrounding states. Deficits in the southern states of the East Coast are expected to ratchet up slightly to moderate intensity and emerge in Florida.

Canada: The near-term forecast through October indicates a significant retreat of exceptional water deficits in the Prairie Provinces. Deficits will persist in central Quebec and southern Newfoundland, and emerge east of the St. Lawrence River, in New Brunswick, and in southern Nova Scotia. Surpluses are expected to persist in central Manitoba west of Lake Winnipeg, a large block of northwestern Saskatchewan into Alberta, southeastern British Columbia, and near Ottawa and west of Toronto. After October conditions will continue to moderate, though some exceptional surpluses will persist.

Mexico, Central America, and the Caribbean: Intense water deficits in Mexico and western Cuba are forecast to retreat after July. However, severe to exceptional deficits remain in the forecast for northern Baja, in Nayarit, and peppered along the Gulf of Mexico from Tamaulipas through Tabasco. Surpluses are forecast for the border of Guatemala and Honduras, and in Nicaragua, Costa Rica, Panama, and

western Jamaica. After October deficits will continue to emerge in southern Mexico; surpluses in Central America are forecast to diminish to near-normal conditions.

South America: Though a slight reduction in the extent of exceptional deficits is expected, the forecast for the next three months indicates a basic pattern of water conditions similar to observed conditions in the prior three months which includes widespread, intense deficits in most of Brazil north of Rio de Janeiro and surpluses in La Pampa Province, Argentina. In addition, a transition from surplus to deficit is forecast in Brazilian states south of Rio and in eastern Paraguay. After October deficits across northern South America are forecast to shrink considerably.

Europe: The extent of exceptional water deficits is expected to diminish considerably in the coming months though southern Europe will remain in moderate deficit through April 2018. Some relief is in the near-term forecast, particularly for Italy, Spain, Portugal, and Belgium, as exceptional deficits shrink through October, though Finland will remain in the grip of intense deficits. Surpluses are forecast for western Russia, the border of Romania and Moldova, and a pocket in north-central Germany.

Africa: The extent of exceptional water deficits is expected to diminish considerably through October – particularly in the southern half of the continent – but deficits reaching exceptional intensity are forecast from northern Mauritania through northern Sudan, and in Somaliland, Somalia, and eastern Ethiopia. A large block of exceptional surplus is forecast in eastern Tanzania, and some exceptional surplus is also expected in northern Madagascar. Overall, deficits will continue to downgrade through January 2018, while surpluses will increase in Tanzania and will emerge in Malawi, northern Mozambique, eastern Zambia, Uganda, western Kenya, and along the While Nile in South Sudan.

Middle East: Exceptional water deficits in the Middle East are forecast to nearly disappear after October though widespread deficits of lesser intensity will continue to emerge. Until then, however, extreme to exceptional deficits will blanket much of the Arabian Peninsula, Syria, Jordan, Iraq west of the Euphrates, much of Georgia, and a pocket of southwestern Turkey surrounding Antalya. After October significant deficits remain in the forecast for Georgia, northern Saudi Arabia, Iraq west of the Euphrates, pockets of central Iran, and southwestern and eastern Yemen.

Central Asia and Russia: Water surpluses of varying intensity are forecast in Russia stretching from western European Russia to the Western Siberian Plain through April 2018 and are expected to be exceptional in large pockets of the Volga Basin and between the Upper Ob and Tom Rivers surrounding Novosibirsk from August 2017 through January 2018. In the near-term, August through October, deficit conditions in Turkmenistan and Uzbekistan are expected to ameliorate, leaving modest deficits. Exceptional surpluses will continue to emerge in northern Kyrgyzstan, including Bishkek.

South Asia: The near-term forecast through October indicates that exceptional deficits will nearly disappear in India but moderate to severe deficits will continue to emerge, covering much of the north/south extent of the country. Surpluses are forecast for Gujarat, Jammu and Kashmir, West Bengal, and Mizoram. Deficits are forecast for southern Afghanistan, central and southern Pakistan, and eastern Bhutan. Exceptional surpluses will continue to emerge in much of Bangladesh and central Nepal. Deficits

in Sri Lanka will ameliorate, leaving moderate deficits in the east. Beyond October primarily moderate deficits will continue to emerge in central India through April 2018.

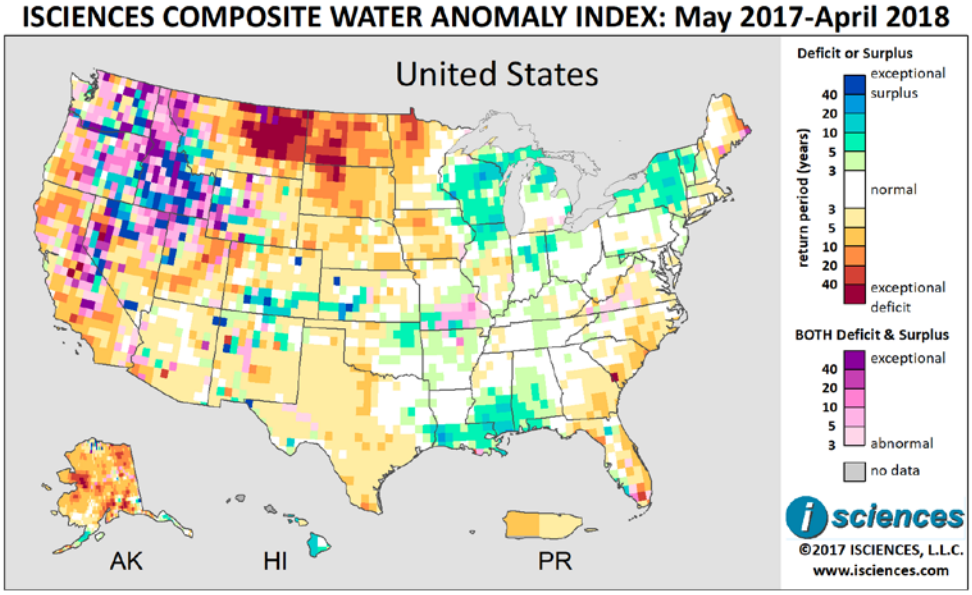
Southeast Asia and the Pacific: Though a significant retreat of exceptional water surplus in the region is forecast through October, exceptional surpluses remain in the forecast for: western Myanmar; eastern Thailand into southern Laos; and, southeastern Sulawesi and Sumbawa and Flores Islands in Indonesia. Exceptional deficits are forecast for a large block of western Cambodia, and deficits of varying severity are forecast for the Mekong Delta, southern Thailand, Singapore, Malaysian Borneo, southern Sumatra, and pockets in central Papua New Guinea. After October, near-normal conditions are expected in many parts of the region and deficits in western Cambodia will moderate.

East Asia: Recent exceptional deficits in Mongolia into Northeast China, on the Korean Peninsula, and in Honshu, Japan are expected to moderate in the near term – August through October – but severe to extreme deficits will continue to emerge in the northeast and moderate deficits will emerge from southern Gansu to the East China Sea. Widespread surpluses are forecast across much of southern China. After October intense deficits in northwestern China will increase in extent, in Xinjiang through Inner Mongolia and Mongolia, and deficits of lesser severity will continue to emerge in the Northeast China and in the North China Plain.

Australia: Exceptional water deficits observed in recent months over much of Australia should diminish considerably in the near-term and through April 2018. However, significant deficits are forecast through October in: Western Australia from the Hamersley Range to the southernmost tip; southeastern Australia and Tasmania; the north across Northern Territory and Queensland; and, New Caledonia. Deficits may be exceptional north and south of Perth; east of Melbourne; central Tasmania; around the Gulf of Carpentaria; and Darwin. Along Queensland's northeast coast surpluses will persist near Mackay. Past October moderate deficits will continue to emerge in Victoria and New South Wales.

Watch List: Regional Details

United States



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

The dark red block covering eastern Montana in the 12-month forecast above indicates exceptional water deficits in the state and severe to exceptional deficits in the neighboring states of North Dakota, South Dakota, and into northwestern Minnesota. Moderate deficits are forecast for parts of western Iowa and in Nebraska.

Further west, Utah, Nevada, and California are expected to see deficits ranging from moderate to severe along with scattered small pockets of exceptional surplus in northern Nevada and northwestern Utah, and both deficits and surpluses in central California into western and northern Nevada and northwestern Utah. Extreme to exceptional surpluses are forecast along the Snake River and in the Salmon River Mountains in Idaho, and along the Columbia River separating Washington and Oregon. Both deficits and surpluses cover much of the remaining Northwest, including Idaho, much of Oregon, Washington, and far western Montana.

Some mild water deficits are forecast in the US Southeast from eastern North Carolina through southeast Georgia, and also west of the Brazos River in Texas.

Surpluses ranging from moderate to occasionally extreme are expected in: Wisconsin, northern Illinois, northern Michigan, central Indiana, New York, and Vermont. Surpluses of equal intensity are forecast along the Gulf in southern Louisiana, Mississippi, and Alabama; and, along the Arkansas River through western Kansas into Colorado, and in southern Colorado.

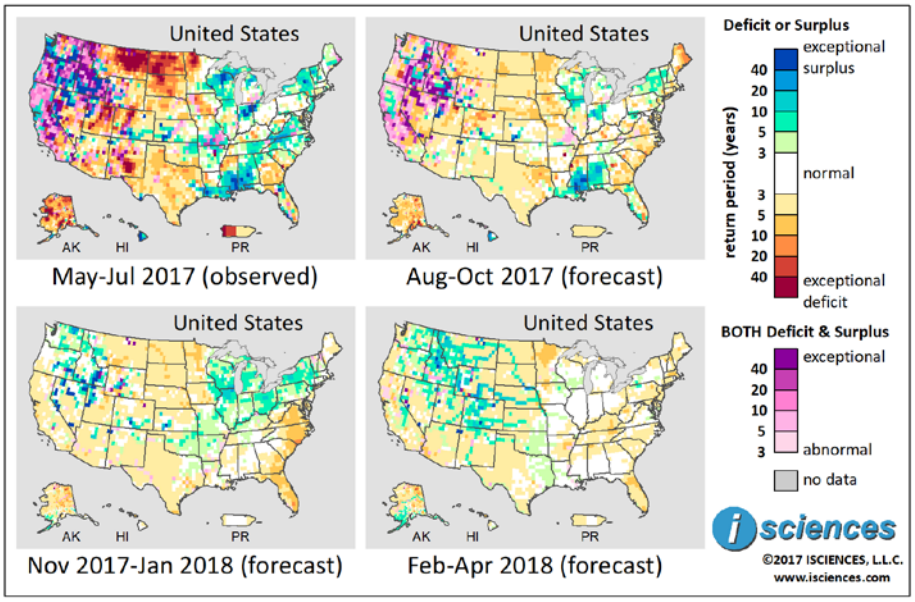
Outside the contiguous US, deficits are forecast for Alaska and western Puerto Rico, and surpluses are forecast for Hawaii.

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

Though observed conditions through July show exceptional deficits in the Northern Plains States, the forecast maps from August 2017 through April 2018 indicate significant retreat and even a transition to surplus in early 2018. However, in the near-term moderate deficits are expected to persist in southwestern North Dakota, northern Minnesota, Iowa, Nebraska, as well as in northeastern Texas through October. Deficits of greater severity will emerge in Maine near Portland and in the north and east.

Surpluses in the Gulf region will persist, remaining extreme in southern Mississippi, and decreasing slightly in severity in southern Louisiana and in extent in Alabama. Surpluses observed in prior months in the Great Lakes states will diminish, and surpluses in Virginia and North Carolina will transition to mild deficits. Both deficits and surpluses are forecast for the West Coast into the northern US Rocky Mountain states.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

From November through January primarily moderate water surpluses will re-emerge in most of the Great Lakes States and in the Ohio River Valley. Pockets of surplus will continue to emerge in Idaho and surrounding states, which may reach exceptional intensity west of Pocatello. Deficits in the southern states of the Eastern Seaboard are expected to ratchet up slightly to moderate intensity and extend through Florida.

The forecast for the final months of the forecast period – February through April – indicates near-normal conditions in the eastern US and surpluses in the Rocky Mountain States and along the Missouri, Yellowstone, Platte, and Arkansas Rivers.

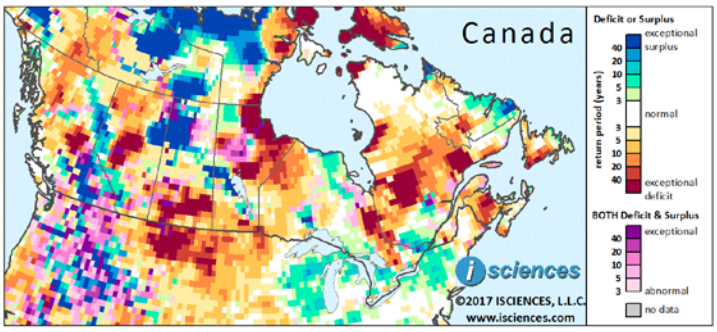
(It should be noted that forecast skill declines with longer lead times.)

Canada

The 12-month outlook for Canada through April 2018 (right) indicates large blocks of exceptional water deficit in central Quebec, eastern Ontario, northeastern Manitoba, southern Saskatchewan, and central Alberta and British Columbia.

Exceptional surpluses are forecast for central Manitoba west of Lake Winnipeg; a large block of northwestern Saskatchewan into Alberta; and in southeastern BC.

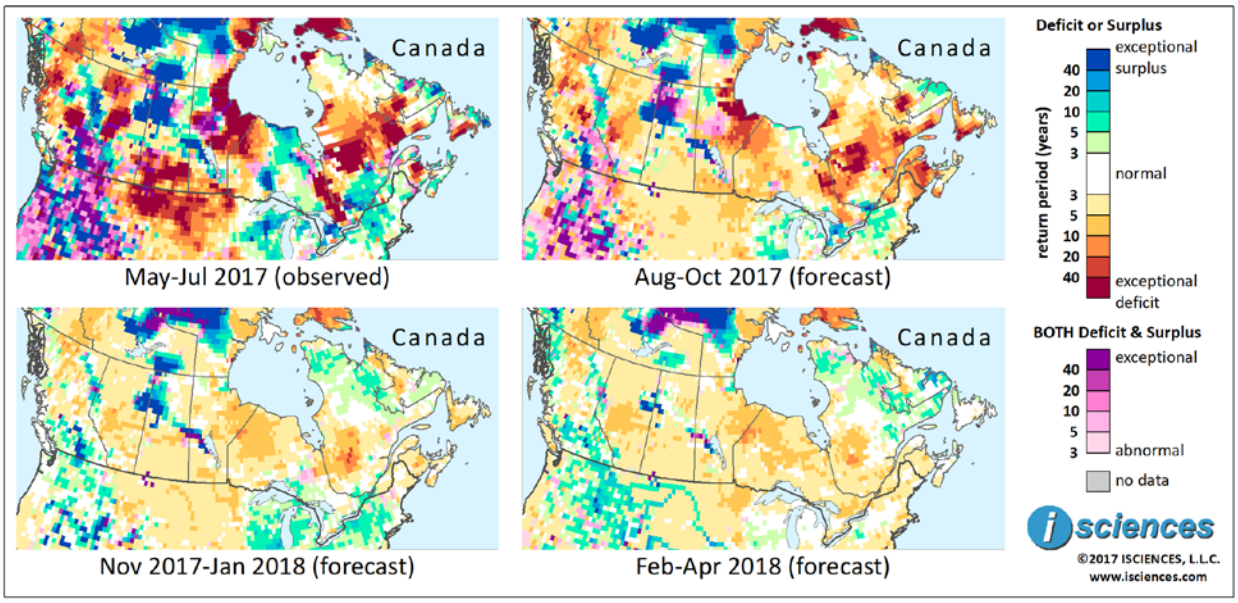
ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

The near-term forecast – August through October – indicates a significant retreat of exceptional deficits in the Prairie Provinces, particularly southern Saskatchewan, though exceptional deficits will persist in northeastern Manitoba along Hudson Bay. Exceptional deficits will retreat slightly in Quebec but will persist in southern Newfoundland, and severe to extreme deficits will emerge east of the St. Lawrence River, in New Brunswick, and in southern Nova Scotia. Surpluses of exceptional intensity are expected to persist in central Manitoba west of Lake Winnipeg, a large block of northwestern Saskatchewan into Alberta, and in southeastern BC surrounding Kelowna. Surpluses will persist in Ontario near Ottawa and

west of Toronto, but much of the remainder of the province will see deficits of varying intensity, particularly along the eastern border.

The bottom two maps, representing forecasts for the final six months, show a more subdued color range at least with regard to water deficits, indicating the near-absence of exceptional deficits. Moderate deficits are forecast during this period in central Alberta, northeastern Manitoba, and Ontario. Deficits of greater severity are expected in southern Nord-du-Québec. Exceptional surpluses are forecast to persist west of Lake Winnipeg in Manitoba, and in northwestern Saskatchewan and across the border to Fort McMurray, Alberta. These surpluses are expected to diminish in extent and severity in early 2018.

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

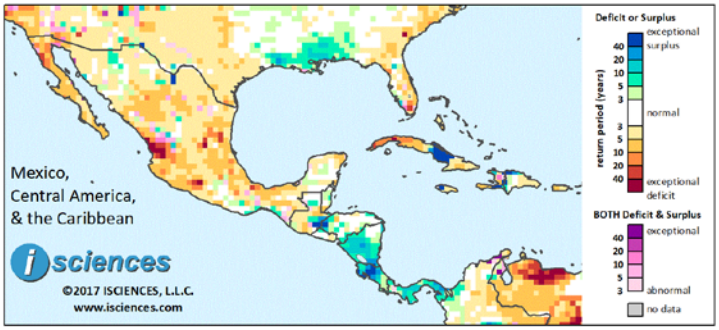
Mexico, Central America, and the Caribbean

The 12-month forecast ending April 2018 (right) indicates moderate drought throughout much of Mexico a pocket of exceptional water deficit north of Puerto Vallarta. Deficits are also forecast in western Cuba.

Surpluses are forecast for the border of Guatemala and Honduras, and Nicaragua, Costa Rica, and Panama. Surpluses may be most severe in Costa Rica.

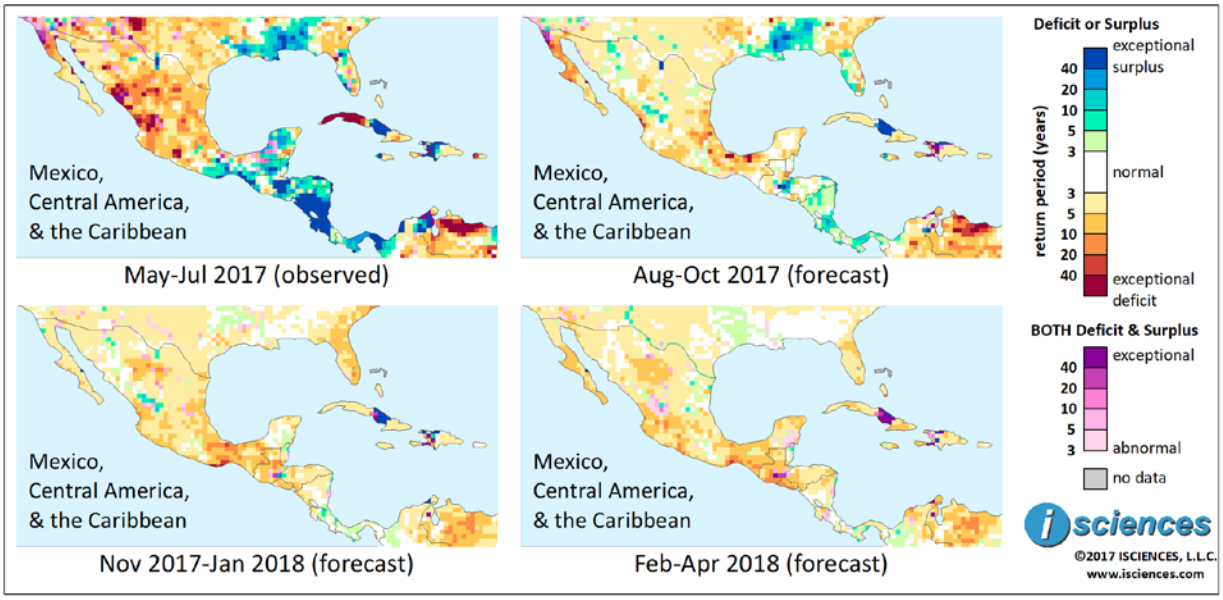
The 3-month maps (below) show the evolving conditions in more detail.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

The August through October forecast shows the retreat of intense deficits in Mexico and western Cuba. However, severe to exceptional deficits are forecast in northern Baja, in Nayarit on the west coast, and peppered along the Gulf of Mexico from Tamaulipas through Veracruz and Tabasco and into Hidalgo and Oaxaca. Moderate deficits are forecast for Michoacán. Exceptional surpluses may persist on the border of Guatemala and Honduras, and surpluses of generally lesser severity are forecast for Nicaragua, Costa Rica, Panama, and western Jamaica. Surpluses may emerge in west-central Mexico in southern Durango into Zacatecas.

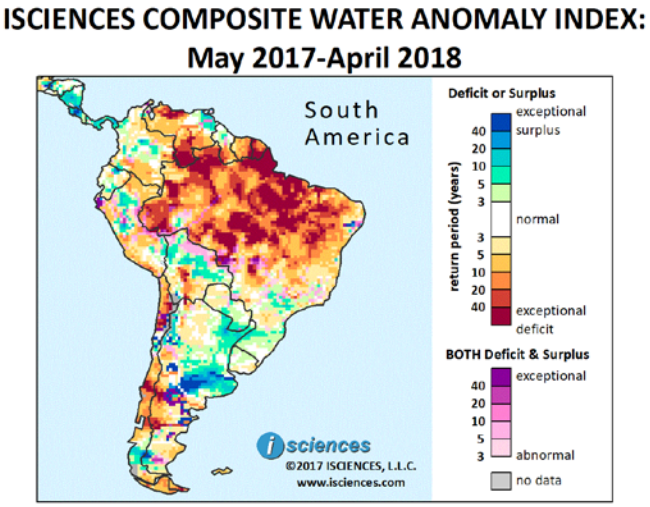
After October deficits ranging from moderate to occasionally exceptional will continue to emerge in southern Mexico between the Gulf of Mexico and the Gulf of Tehuantepec with greatest severity expected in coastal Oaxaca. Mostly moderate deficits are forecast in the north at the intersection of Chihuahua, Coahuila, and Durango, and also in Nayarit, and in Guatemala and El Salvador. Surpluses elsewhere in Central America are forecast to diminish to near-normal conditions.

The forecast for the final months – February through April – shows the continued presence of deficits in large pockets of Mexico, Guatemala, and El Salvador.

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

South America

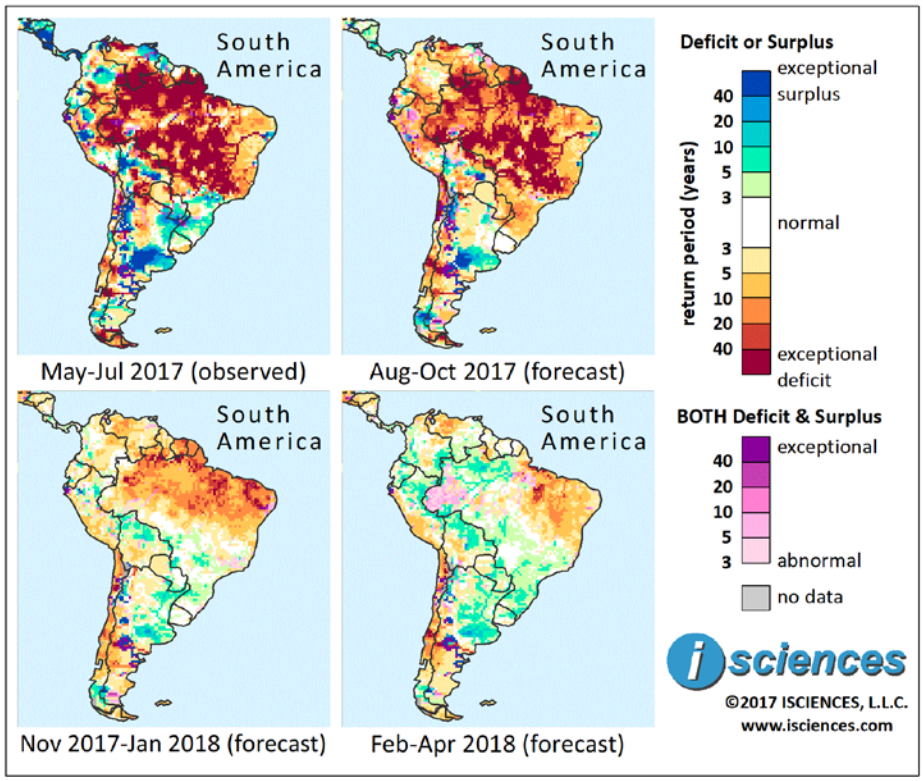
Water deficits are forecast for much of Brazil north of Rio and are expected to be exceptional in many regions. Deficits reaching exceptional severity are also forecast for: northwest and southern Venezuela; French Guiana; Cochabamba, Bolivia; northern Chile; Bío-Bío in central Chile and across the border into Argentina; and the Chubut River in Argentina.



Exceptional surpluses are expected in central Mendoza Province, La Pampa Province, and along the Salado River in Buenos Aries Province in Argentina. Surpluses of lesser severity are forecast for the border area between Argentina, Paraguay and Brazil, and in a band across central Bolivia.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

Though a slight reduction in the extent of exceptional deficits is expected, the forecast for the next three months indicates a basic pattern of water conditions similar to observed conditions in the prior three months which includes widespread, intense deficits in most of Brazil north of Rio de Janeiro and surpluses in La Pampa Province, Argentina. Exceptional deficits will continue to emerge in northern Chile, and will persist in Bío-Bío, and along the Chubut River in Argentina. In addition, the August through October forecast indicates a transition from surplus to deficit in Brazilian states south of Rio and in eastern Paraguay. Prior surpluses in northern Peru, Ecuador, central Colombia, northeast Venezuela, and northern Guyana are forecast to recede considerably. The extent of exceptional surpluses in La Pampa, Argentina will shrink somewhat, and the intensity of surpluses in nearby Buenos Aires Province – including along the Río Salado – will diminish.

Widespread deficits across northern South America are forecast to shrink considerably November 2017 through January 2018, though severe to occasionally exceptional deficits remain in the forecast for northern Brazil, Suriname, and French Guiana. Surpluses in La Pampa, Argentina will diminish, but moderate to extreme surpluses will continue to emerge in nearby Buenos Aires Province. Primarily moderate surpluses will emerge in the Iberá Wetlands of northeastern Argentina, across the border into northern Rio Grande do Sul, Brazil, and along the Rios Uruguay and Paraná.

The forecast for the final months – February through April – indicates deficits in northeastern Brazil and in Chile, and the emergence of moderate surpluses in the northern Amazon Basin.

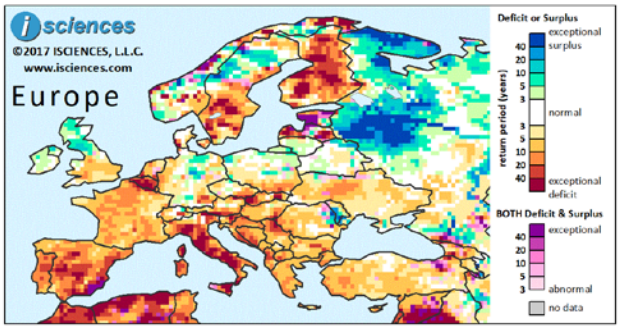
(It should be noted that forecast skill declines with longer lead times.)

Europe

The 12-month forecast through April 2018 indicates a predominance of water deficits of varying severity in many parts of Europe. Deficits are expected to be especially widespread and intense in Italy, the Iberian Peninsula, Belgium, and Finland.

Exceptional water surpluses are forecast in western Russia and along the Volga. Surpluses of nearly equal intensity are forecast along the border of Romania and Moldova.

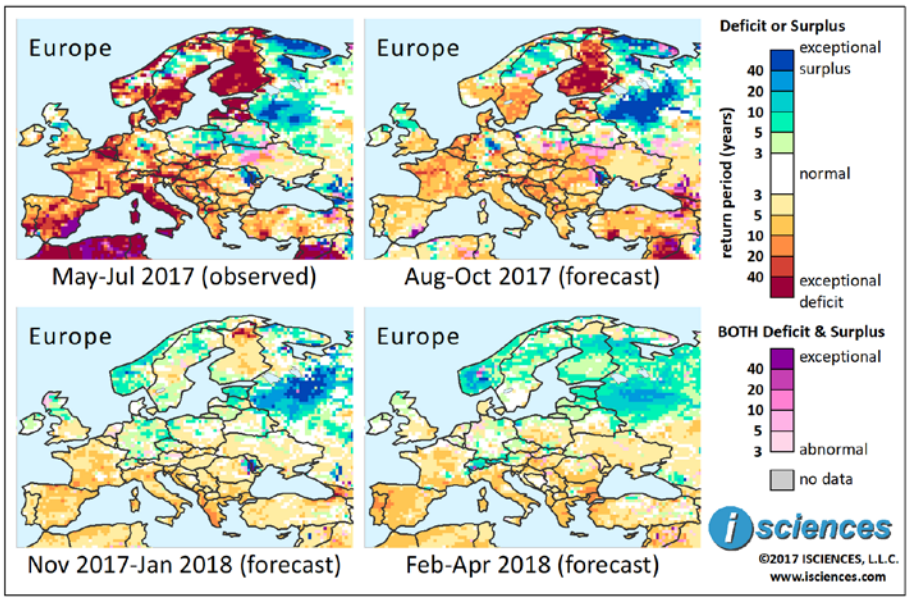
ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

As is clear in the map progression, the extent of exceptional water deficits is expected to diminish considerably in the coming months, particularly after October, though southern Europe will remain in deficit for the extent of the 12-month forecast period.

From August through October some relief is forecast – particularly for Italy, Spain, Portugal, and Belgium – as the extent of exceptional deficits in Europe shrinks. Other than some isolated pockets, only Finland will remain in the grip of widespread, exceptional water deficits. Deficits of varying severity will, however, continue to envelop much of Europe. Severe to extreme deficits are forecast for: France,

Belgium, Netherlands, southern Sweden, Estonia, Slovakia, Slovenia, Croatia, and Bosnia and Herzegovina. Moderate to severe deficits are expected in much of the remainder of Europe. Western Russia stands out in obvious contrast with exceptional surpluses forecast to increase in extent. Intense surpluses are also forecast for the border of Romania and Moldova, and a pocket in north-central Germany. Surpluses of lesser severity are forecast for Northern Ireland, Scotland, northern Sweden, and northeastern Poland into western Belarus.

The forecast for November 2017 through January 2018 indicates a continued recession of deficits, leaving moderate deficits in Spain, France, Italy, and some severe deficits in Greece, Albania, and Croatia. A dramatic retreat of exceptional deficits is forecast in Finland though exceptional deficits are expected to persist in a patch of northern Lapland. Surpluses will diminish considerably in Murmansk; elsewhere in western Russia surpluses ranging from moderate to exceptional will continue to emerge. Intense surpluses may persist on the border of Romania and Moldova. Conditions in Estonia and Latvia are expected to transition from deficit to surplus, and moderate to severe surpluses will emerge throughout Norway.

In the remaining months of the forecast – February through April 2018 – water surpluses are expected across the northern portions of Europe and moderate deficits in the south.

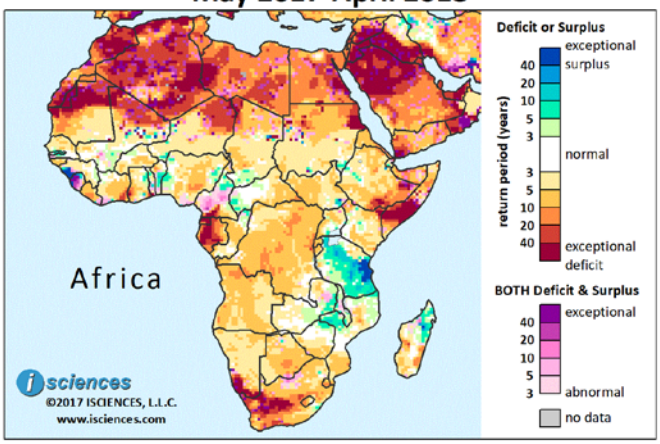
(It should be noted that forecast skill declines with longer lead times.)

Africa

The 12-month forecast (right) indicates widespread severe to exceptional deficits across northern Africa, and in Equatorial Guinea, Gabon, southern Somalia, eastern Ethiopia, southern Namibia, and western South Africa. Deficits of lesser severity are forecast for many other parts of Africa.

Surpluses are forecast for the southern coast of Guinea around Conakry into Sierra Leone, and Tanzania, northeastern Madagascar, and northwestern Mozambique.

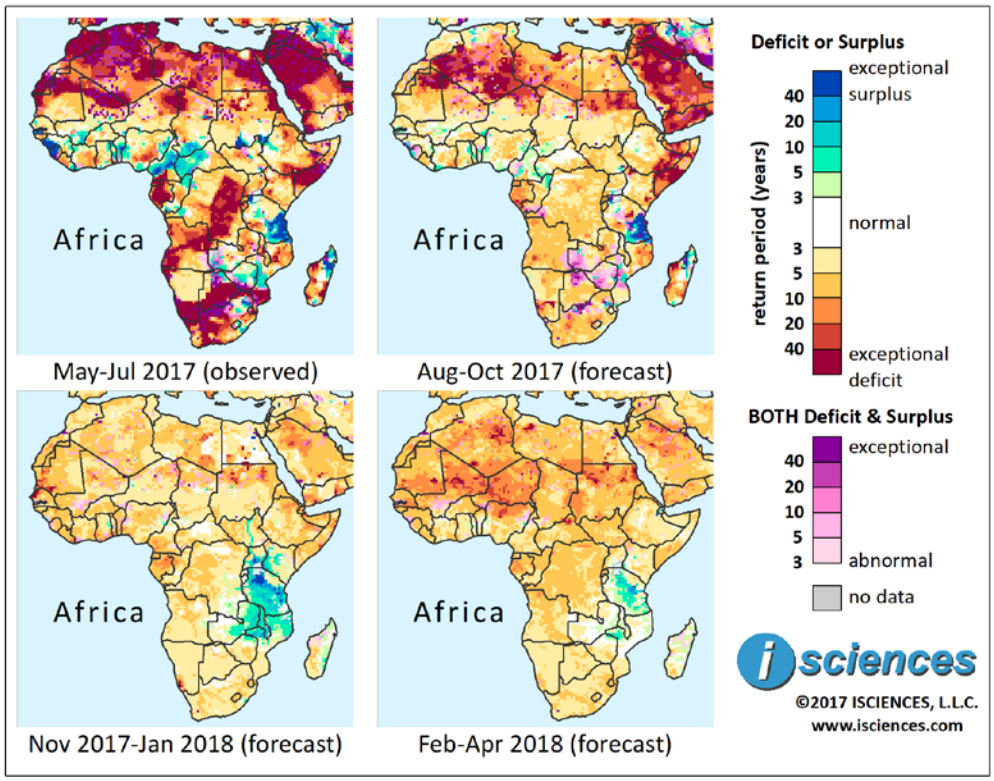
ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

The extent of exceptional water deficits is expected to diminish considerably August through October, particularly in the southern half of the continent. In the north, however, deficits reaching exceptional intensity are forecast from northern Mauritania through much of Algeria, northeastern Niger, Libya, northern Sudan, and also in Somaliland, much of Somalia, and eastern Ethiopia. Primarily moderate deficits are forecast for many southern African nations, but conditions may be more intense in Gabon, Equatorial Guinea, western Madagascar, and isolated pockets in Kenya, Tanzania, and Namibia. A large block of exceptional surplus is forecast to persist in eastern Tanzania, and some exceptional surplus is also expected in northern Madagascar.

For much of the continent, the forecast for November 2017 through January 2018 indicates a significant downgrade in the intensity of deficits overall to primarily moderate, with more severe conditions projected in western Mauritania into northern Senegal, northern Sudan, Gabon, and southwestern Namibia. And while the emphasis in prior months has been primarily on deficits, it is the large blue block of surpluses in East Africa that stands out. Though the intensity of water surpluses in eastern Tanzania is expected to diminish, the overall extent of surpluses is forecast to increase as surpluses ranging from severe to exceptional emerge across much of the remainder of the country, as well in nearby Malawi, northern Mozambique, and eastern Zambia. Surpluses are also forecast along the While Nile in South

Sudan, and in Uganda and western Kenya, where surpluses could reach exceptional intensity north and south of Lake Victoria, including near Kampala, Uganda.

The forecast for the final quarter – February through April 2018 – indicates a resurgence of more intense deficits encompassing much of the northern half of the continent, and a decrease in surplus conditions in East Africa.

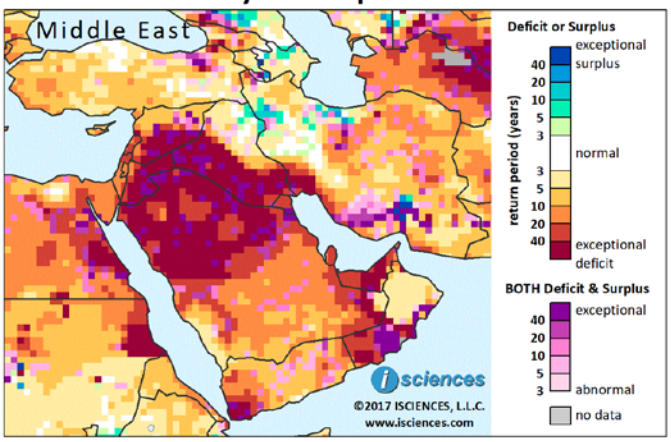
(It should be noted that forecast skill declines with longer lead times.)

Middle East

The forecast for the 12-month period ending April 2018 (right) indicates widespread extreme to exceptional water deficits in southern Syria, Jordan, Iraq west of the Euphrates River into southwestern Iran, Kuwait, northern Saudi Arabia, Qatar, United Arab Emirates, southern Oman, and southwestern Yemen.

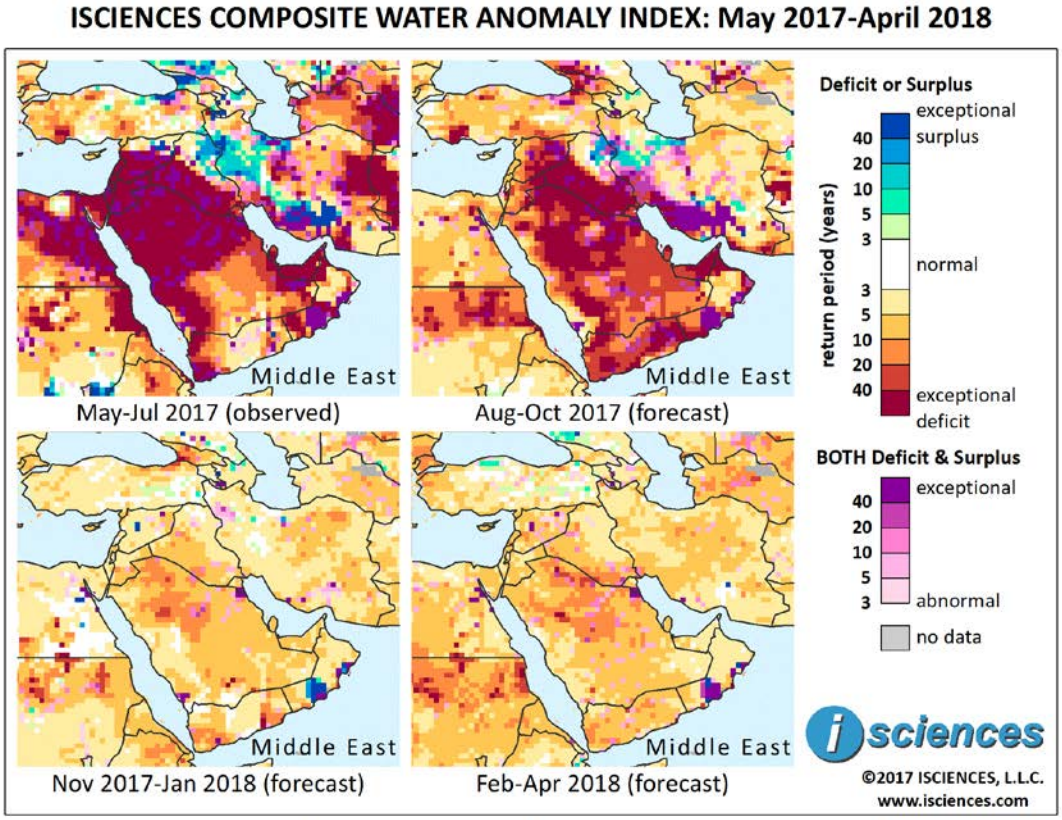
Deficits of varying intensity are forecast for the remainder of the Arabian Peninsula, Lebanon, Israel, West Bank, Georgia, and most of Iran's eastern two-thirds. Primarily moderate deficits are forecast for much of Turkey.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

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



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

As is apparent in the map group, exceptional water deficits in the Middle East are forecast to nearly disappear after October though widespread deficits of lesser intensity will continue to emerge. Until then, however, extreme to exceptional deficits will blanket much of the Arabian Peninsula, and Syria, Jordan, Iraq west of the Euphrates, much of Georgia, and a pocket of southwestern Turkey surrounding Antalya. Severe to exceptional deficits will emerge throughout Yemen joining those already observed in the west. Primarily moderate deficits will emerge in central and eastern Turkey, joining more severe deficits already present in Antalya, north of Ankara, and northeast of Adana. Prior observed surpluses in south-central Iran near the Persian Gulf will transition to conditions of both deficit and surplus. Surpluses along the northern borders of Iraq and Iran will persist or transition to deficit and surplus as will surpluses from Tehran to the southern Iraqi border.

As previously stated, deficits across the Middle East are forecast to diminish considerably from November 2017 through January 2018. However, severe to extreme deficits are forecast during this period in: Georgia and trailing along the Black Sea coast into Turkey; northern Saudi Arabia; Iraq west of the Euphrates; pockets of central Iran; and southwestern and eastern Yemen. Aforementioned surpluses in Iran and Iraq will transition to near-normal conditions, while a pocket of exceptional surplus may re-emerge in central Oman.

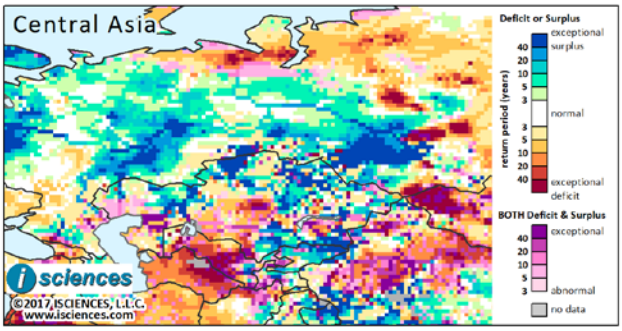
The forecast map for the final quarter, February through April 2018, indicates a slight uptick in deficits overall for the region.

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

Central Asia and Russia

The 12-month forecast for the region indicates widespread surplus water anomalies in western Russia reaching exceptional severity; primarily deficits from the Yamal Peninsula in the north curving southeast past Lake Baikal and east across the Siberian Plateau; and surpluses in northern Far East Russia. Intense deficits are forecast for Turkmenistan, Uzbekistan, and into western Kazakhstan.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018

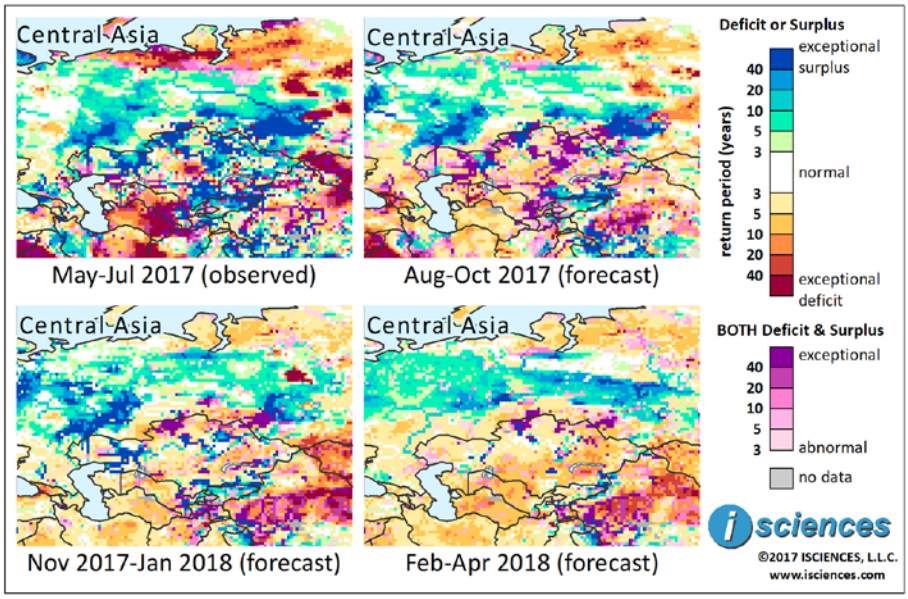


Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

Pockets of surplus conditions in Russia include the Upper Volga from Moscow to Novgorod, the eastern Volga Basin from Samara past Perm, and along the Ob River, particularly between the Upper Ob and Tom Rivers surrounding Novosibirsk. Surpluses are also forecast for northern and southern Kazakhstan and Kyrgyzstan.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

As seen in the map series above, water surpluses of varying intensity are forecast in Russia stretching from western European Russia to the Western Siberian Plain through April 2018. These surpluses are expected to be exceptional in large pockets of the Volga Basin and between the Upper Ob and Tom

Rivers surrounding Novosibirsk from August 2017 through January 2018. The near-term forecast, August through October, indicates that prior surpluses in Kazakhstan will transition to conditions of both surplus and deficit as deficits emerge. Deficit conditions in Turkmenistan and Uzbekistan are expected to ameliorate, leaving modest deficits. Exceptional surpluses will continue to emerge in northern Kyrgyzstan, including Bishkek, while both deficits and surpluses are forecast for the Fergana Valley in the southeast and in much of Tajikistan.

From November 2017 through January 2018 surplus conditions in Russia as previously described will remain much the same, though conditions west of Novosibirsk will transition to both deficit and surplus as deficits emerge. Surpluses in northern Kyrgyzstan will diminish very slightly but significant surpluses remain in the forecast for Bishkek. As deficits recede in parts of central Kazahkstan surpluses are expected to re-emerge east of Astana and in Aktobe Region.

The forecast for the final months, February through April, indicates a recession of exceptional surpluses in the Volga Basin, the emergence of widespread moderate surpluses between the Svernaya Dvina (Northern Dvina) and Pechora Rivers, and an increase in more severe surpluses along the Middle Ob River. Deficits are predicited for Turkmenistan, Uzbekistan, and Kazakhstan.

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

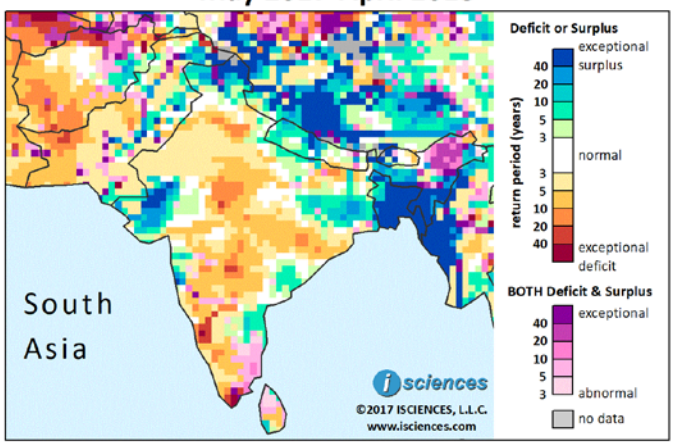
South Asia

For the 12-month forecast period ending April 2018 water deficits are forecast in much of central and southern India, while surpluses are expected in Gujarat, Jammu and Kashmir, West Bengal, Meghalaya, and Mizoram.

Elsewhere in the region, deficits are forecast for western Afghanistan and western Pakistan. Exceptional surpluses are expected in Bangladesh, central Nepal, and pockets of western Bhutan.

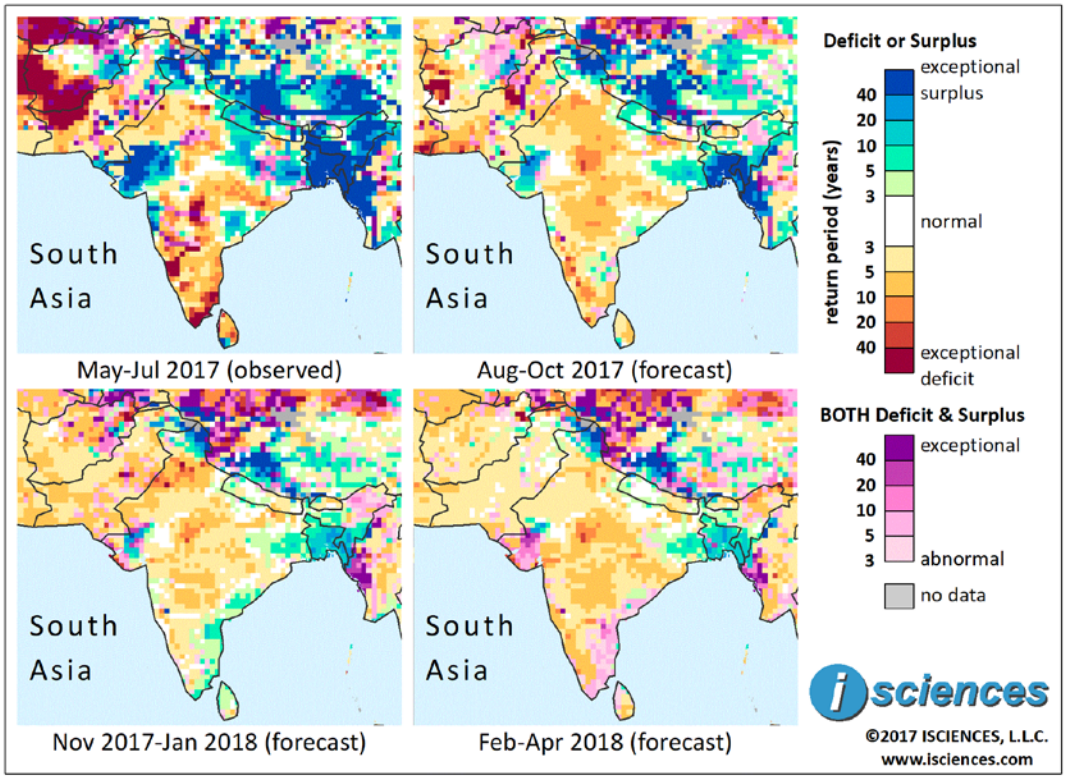
The 3-month composites (below) show the evolving conditions.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

The near-term forecast – August through October – indicates that while exceptional deficits will nearly disappear in India, moderate to severe deficits will continue to emerge, covering much of the north/south extent of the country. Deficits are expected to be severe in Punjab, Madhya Pradesh, northern Bihar, and Karnataka. Surpluses ranging from severe to exceptional are forecast for Gujarat, Jammu and Kashmir, West Bengal, and Mizoram. In Afghanistan exceptional deficits in the south will recede but persist. Surpluses are forecast east and south of Kabul. Deficits are forecast for central and southern Pakistan and eastern Bhutan. Exceptional surpluses will continue to emerge in much of Bangladesh and in central Nepal. Deficits in Sri Lanka will ameliorate, leaving moderate deficits in the east.

From November 2017 through January 2018 the extent of deficits in central India will diminish but intense deficits will emerge in northern Rajasthan, Punjab, southern Himachal Pradesh, coastal Gujarat, and northwestern Madhya Pradesh. Surpluses will persist in eastern Jammu and Kashmir, and diminish slightly in Gujarat, West Bengal, and Mizoram. Moderate surpluses will emerge in eastern Telangana and eastern Andhra Pradesh. Surpluses will continue to emerge in Bangladesh, and though no longer expected to be of exceptional intensity conditions will be severe. Moderate deficits are predicted for Afghanistan and Pakistan with some isolated surpluses in the north. Water conditions in Nepal and Bhutan are expected to be near-normal.

The forecast for the final period, February through April 2018, indicates a resurgence of deficits in central India.

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

Southeast Asia and the Pacific

The 12-month map (right) indicates exceptional water deficits in a large block of western Cambodia and a small pocket in northern Sumatra near Medan. Deficits of lesser severity are forecast for Malaysia and central Papua New Guinea.

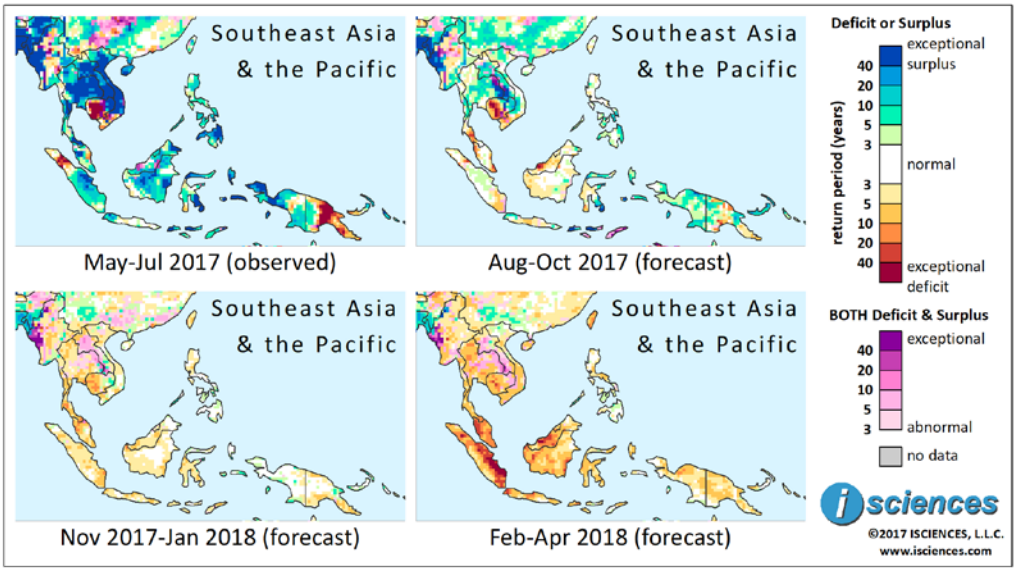
ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018

Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

Exceptional surpluses are forecast for western Myanmar and parts of the northern stretch of the Salween River; north-central and southwestern Laos; central and eastern Thailand; and southeastern Sulawesi. Surpluses of varying severity are forecast for: eastern Cambodia into Vietnam; northern Vietnam; Laos; southern Philippines; and western Papua, Indonesia.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

The August through October map indicates a significant retreat of exceptional water surplus in the region. However, exceptional surpluses are forecast for western Myanmar; eastern Thailand into southern Laos; and, southeastern Sulawesi and Sumbawa and Flores Islands in Indonesia. Moderate to extreme surpluses are forecast for: the Salween River and extreme south of Myanmar; much of Laos; central and northern Vietnam; Papua, Indonesia; and pockets in Papua New Guinea. Exceptional deficits are forecast for a large block of western Cambodia. Deficits are also forecast for: the Mekong Delta; southern Thailand trailing south into Malaysia; Singapore; Malaysian Borneo; southern Sumatra; and pockets in central Papua New Guinea.

The map for November 2017 through January 2018 shows a forecast of near-normal conditions for Vietnam, the Philippines, much of Indonesia, and Papua New Guinea. Deficits in western Cambodia are forecast to moderate. Both deficit and surplus conditions are forecast for western Myanmar and northern Laos as deficits emerge in areas of prior surplus.

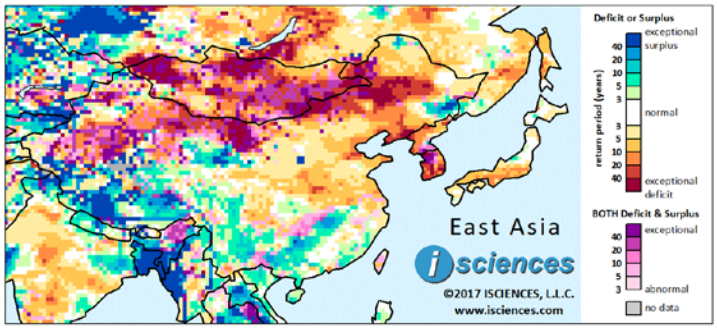
After January deficits are expected to emerge throughout much of the region.

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

East Asia

The 12-month forecast map for East Asia (right) indicates extreme to exceptional water deficit conditions in Mongolia, across northern China, and on the Korean Peninsula. Deficits are also forecast in central China from southern Gansu to the East China Sea and in southern Honshu, Japan.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018

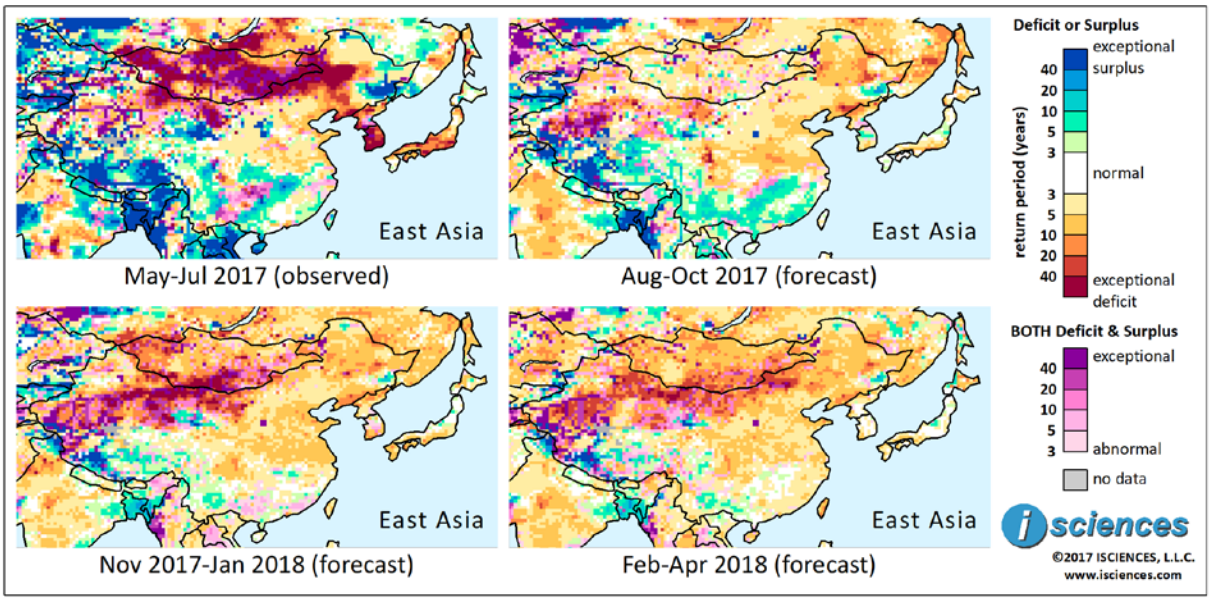


Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

Surpluses are forecast in: Northeast China from northeastern Jilin into Heilongjiang; north-central China in eastern Qinghai surrounding Qinghai Lake; southern China from Poyang Lake in Jiangxi southwest through Hunan into Guizhou and Yunnan, and northern Yunnan into central Sichuan; along the Pearl River (Zhujiang) and parts of the coastal southeast; and in Tibet.

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

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

Recent exceptional deficits in Mongolia into Northeast China, on the Korean Peninsula, and in Honshu, Japan are expected to moderate in the near term – August through October – but severe to extreme deficits will continue to emerge in the northeast and in the border region between Liaoning Province and North Korea. Primarily moderate deficits will emerge in central China from southern Gansu to the East China Sea and may be more intense in southern Gansu and across the border into northern

Sichuan. Widespread moderate to severe water surpluses are forecast during this period across much of southern China including the Pearl River (Zhujiang). Surpluses of varying severity are forecast for Tibet including along the Nu (Salween) River and Yarlung (Brahmaputra) River. Exceptional surpluses are forecast in western Tibet and surrounding Qinghai Lake in north-central China. Both deficits and surpluses are forecast in the Tarim Basin of northwest China's Xinjiang Province.

After October severe to exceptional deficits in northwestern China will increase in extent, reaching from westernmost Xinjiang through Inner Mongolia and Mongolia, and will include some pockets with both deficit and surplus conditions. Moderate to extreme deficits will continue to emerge in Northeast China into northern North Korea; primarily moderate deficits will continue in the North China Plain (eastern China). Surpluses will continue to emerge in western Tibet and surrounding Qinghai Lake in the north, but conditions in southeastern China will return to near-normal.

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

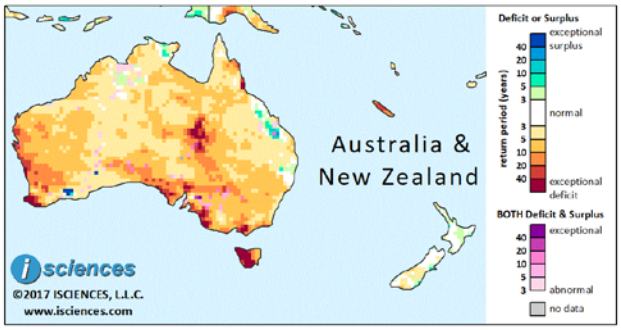
Australia & New Zealand

The 12-month map (right) indicates a forecast of deficits throughout much of Australia, reaching severe to exceptional intensity in: the far west reaches of Western Australia; southwestern Queensland; southern South Australia; coastal Victory; most of Tasmania; and New Caledonia.

Some surpluses are forecast in eastern Queensland west of Bundaberg, trailing north.

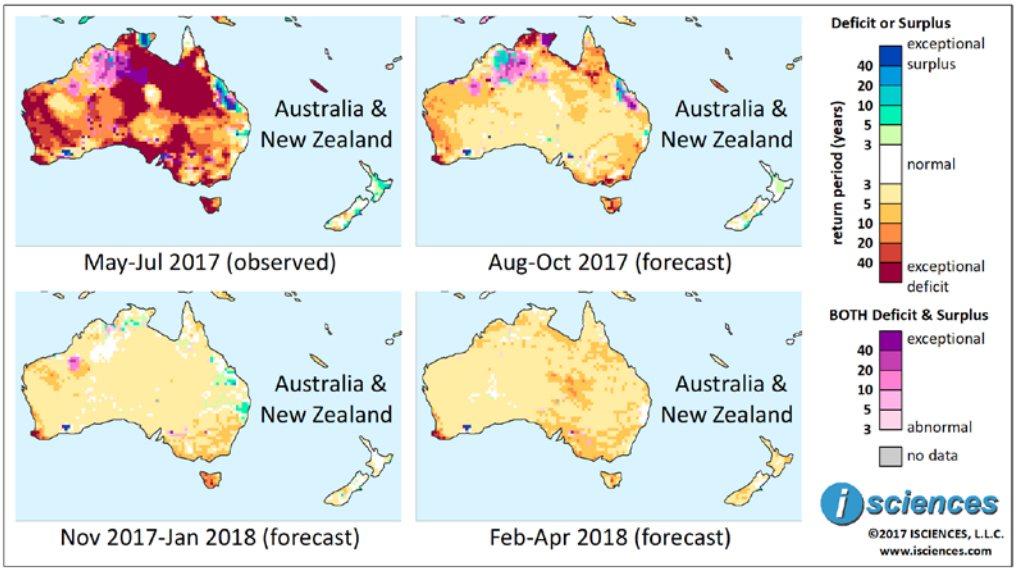
The 3-month maps (below) for the same 12-month period show the evolving conditions.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

ISCIENCES COMPOSITE WATER ANOMALY INDEX: May 2017-April 2018



Based on observed data through July 2017 and forecasts issued July 25-31, 2017.

As is apparent in the time series (above), exceptional deficits observed in recent months over much of Australia should diminish considerably in the near-term and through April 2018.

However, from August through October significant deficits are forecast in: Western Australia from the Hamersley Range in the north through the wheat belt to the southernmost tip of WA; from Adelaide along the southern coast through Victoria and New South Wales and in the eastern Murray-Darling Basin; Tasmania; northern Queensland and around the Gulf of Carpentaria; Top End in Northern Territory; and New Caledonia. Deficits may be exceptional north and south of Perth; east of Melbourne; central Tasmania; around the Gulf of Carpentaria; and Darwin. Deficits in the southwest tip of Western Australia and in Tasmania may linger through April 2018. Conditions in the Kimberly Plateau in the

northwest will transition to primarily surplus, but both deficits and surpluses will persist east of the Ord River to the Victoria River. Along Queensland's northeast coast surpluses will persist near Mackay, with both deficits and surpluses directly south from Rockhampton to Bundaberg.

Past October deficits will continue to retreat, though intense deficits will persist in WA's southwestern tip and in Tasmania. Moderate deficits will continue to emerge in Victoria and New South Wales. Conditions in New Caledonia and New Zealand are expected to be near-normal.

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