

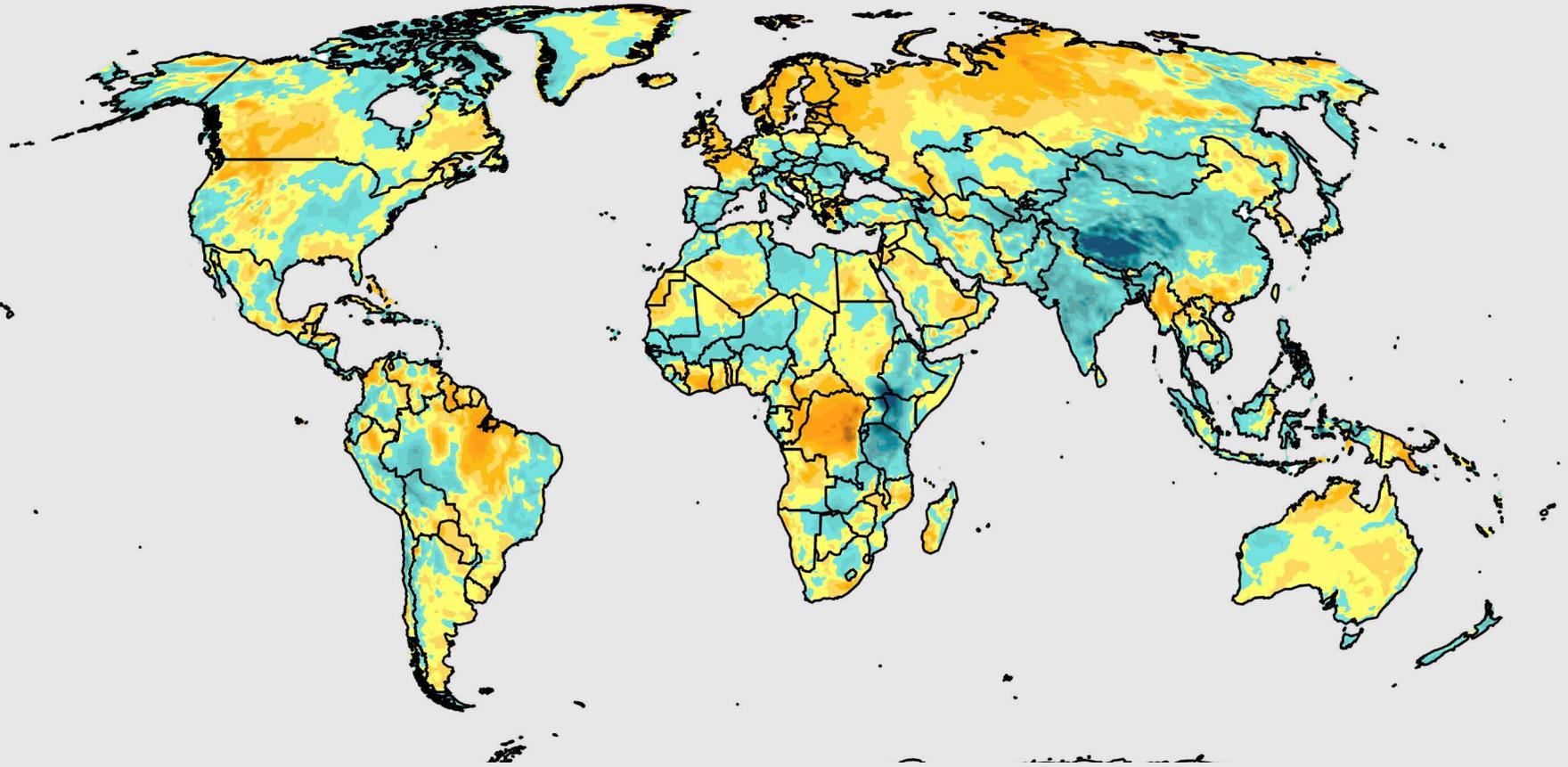
WIND TRENDS

GLOBAL WIND SPEED PERFORMANCE

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Global
Annual 2020



Global

According to reanalysis data, the global wind speeds in 2020 normalized relative to the long-term norm. The wind speeds across key wind power producing areas in North America rebounded to near-normal levels in 2020, up from a deficit in 2019. The wind speed deficit in Asia continued to grow, marking a second year of consistently below-normal winds across the region. The wind speed resource across Europe as a whole improved in 2020, with deficits in the south and east balanced



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GLOBAL WIND SPEED PERFORMANCE

Global
Annual 2020

by a surplus of wind in the north and west. The annual wind resource was generally in line with the long-term norm in other regions. Strong and notable wind speed departures in 2020 across some high wind capacity areas include: Northern Europe in Q1 (+10% to +20%), Central Europe in Q3 (-6% to -9%), Brazil in Q1 (-9 to -12%), and India in Q3 (-12 to -15%).

North America

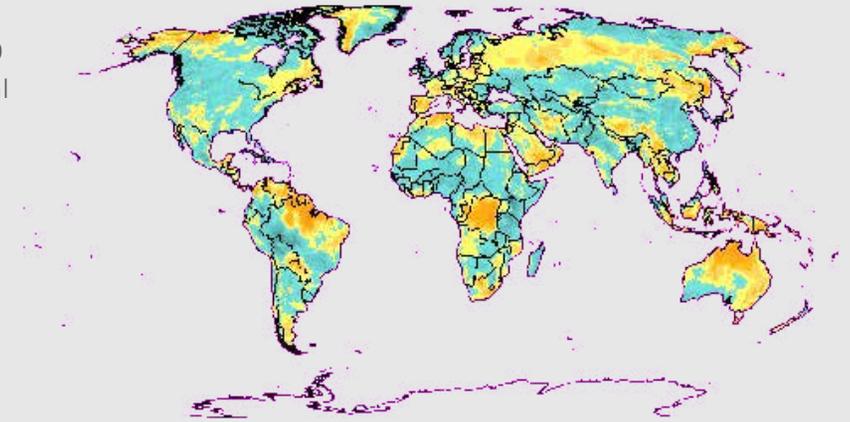
Wind speeds rose to near normal or slightly above the norm across much of North America after two consecutive years of deficits (2018-2019). A lackluster start to the year gave way to improving conditions as the regional wind index for North America picked up in Q3 and Q4. Key wind power producing areas of the western U.S. and Canada remained consistently above the norm throughout much of 2020 e.g., Montana, Wyoming, Colorado, the Pacific Northwest, Alberta, and British Columbia (3 to 12%); while key areas of the interior U.S. remained consistently below normal e.g., the upper Great Plains, eastern Nebraska and Oklahoma, and the Midwest (0 to -6%). Hawaii rounded out another year with a wind speed deficit, after a fleeting period of above-normal winds in Q1. Overall wind speeds across Mexico were just at or slightly below the long-term norm. A wind speed deficit persisted across the northeast and interior (0 to -6%), with above-normal winds across Veracruz, far northeast Oaxaca, and the Yucatan peninsula (3 to 9%). Many of the wind power producing areas of Central America saw an overall annual wind speed deficit in 2020 (-3 to -9%), despite a moderately strong start to the year in Q1 (3 to 6%). The wind index across the Caribbean was split, with a surplus across the north and west e.g., Cuba and the Bahamas (3 to 9%), and a deficit to the east and south e.g., Puerto Rico and the Lesser Antilles (-3 to -9%).

South America

South America rounded out 2020 just at or slightly below the norm. In general, above-normal wind speeds prevailed across the south, with deficits in the north. Three of the four countries with the most installed capacity in the region are located in the south (Uruguay, Chile, and Argentina) and finished the year with slightly above-normal wind speeds (0 to 3%)—albeit after quite some variation between quarters. Much of this surplus was negated by Brazil—the country with the most installed capacity in South America. Brazil rounded out the year at slightly below normal (0 to -3%) due to a strong wind speed deficit in Q1 (-9 to -12%), which was followed by near-normal speeds during the remainder of the year.

Europe

The European wind speeds were at or slightly above the long-term norm for a second consecutive year; quite a departure from the three prior years of deficits (2016-2018). Nearly the mirror opposite of 2019, wind speeds in the north and west were above normal, with deficits in the south and



Annual 2019 global wind anomaly map



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east. This gradient pattern in the annual wind index originates from some moderate and strong local departures. Strongly above-normal wind speeds persisted across Scandinavia, the Baltic States, northern France, Germany, the UK and Ireland throughout Q1 (12 to 15%). The third and fourth quarters brought moderately below-normal wind speeds to much of Central and Southern Europe (0 to -9%), negating any surplus earlier in the year. In terms of the annual wind speed, the UK and France lead the pack with most improved wind index from the year prior (for countries with relatively high installed capacity). At the bottom of the list are Italy and Spain, with the most significant decrease in the annual wind speed index from 2019 to 2020.

Africa and the Middle East

Africa and the Middle East rounded out 2020 at or slightly above the long-term norm. This was driven by four straight quarters of consistently above-normal speeds in South Africa (which leads the region in wind capacity). Aside from South Africa and Western Sahara, the region's other high capacity holders all saw a wind speed deficit in 2020. However, not all of the year was bleak; Q3 was very favorable for the major players in the region. The top 8 countries (representing 95% of the regional capacity) were all well above normal in the third quarter, but this was not enough to balance three other quarters of deficits.

Asia

The wind speed deficit for Asia strengthened between 2019 and 2020, with persistently below-normal wind speeds throughout the year. Of the top 5 countries with the highest capacity in the region (representing 98% of installations), only South Korea finished the year with above-normal wind speeds. The favorable conditions there were due to a relatively strong midyear wind index (6 to 15% in Q2 and Q3). Wind speeds across much of China remained consistently below the norm, with the exception of the far northeast and southwest areas (particularly later in the year). The persistent wind speed deficit across India reached nearly unprecedented levels in Q2 and Q3: -12 to -15 % on average, with deficits of -18 % or stronger over a large swath of the central states. This "wind drought" finally gave way to a surplus of winds in Q4, which was the first time India had consecutive months of above-normal wind speeds since mid to late 2019. Much of Southeast Asia saw wind speeds below the norm in 2020, mainly due to strongly below-normal conditions in Q3 (despite mild gains in other quarters).

Oceania

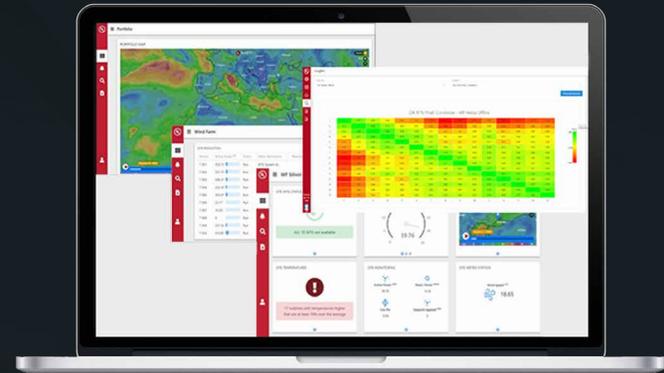
The annual wind index moderated to near normal for the Oceania region, despite early and midyear variability. Areas in the north saw a modest surplus of wind speeds in Q1 e.g., New Caledonia, Fiji, and Vanuatu. Variable local indices in the second and third quarters gave way to near-normal and slightly below-normal wind speeds in the final quarter of 2020.



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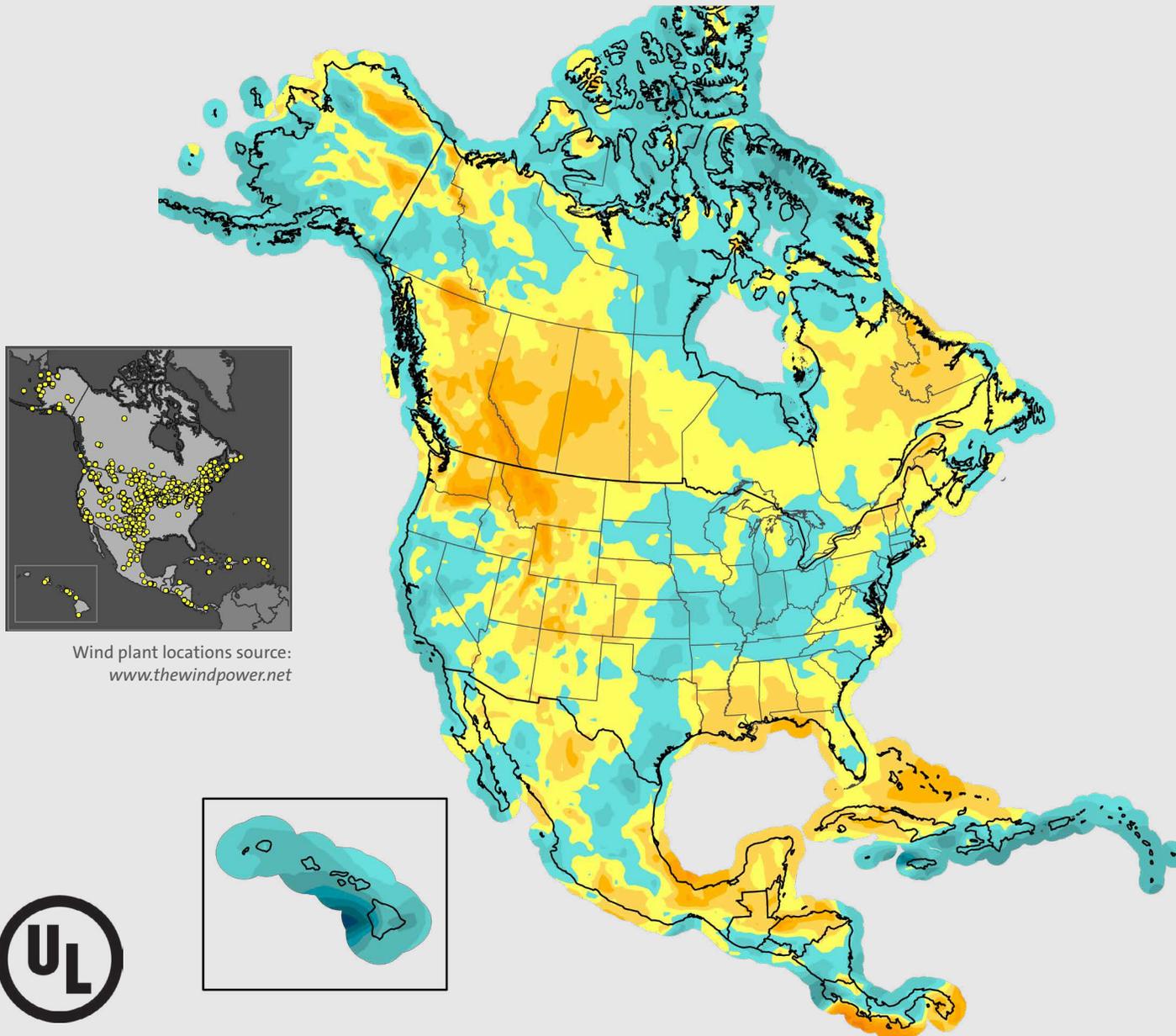
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North America Annual 2020



Below Normal:

- The Midwest U.S.
- California
- Hawaii
- Eastern Caribbean
- Central America

Above Normal:

- Northern New England and Gaspé Peninsula
- Great Plains (U.S. and Canada)
- Montana
- Pacific Northwest, U.S.
- The Four Corners, U.S.
- Yucatan Peninsula
- Western Caribbean

Wind plant locations source:
www.thewindpower.net



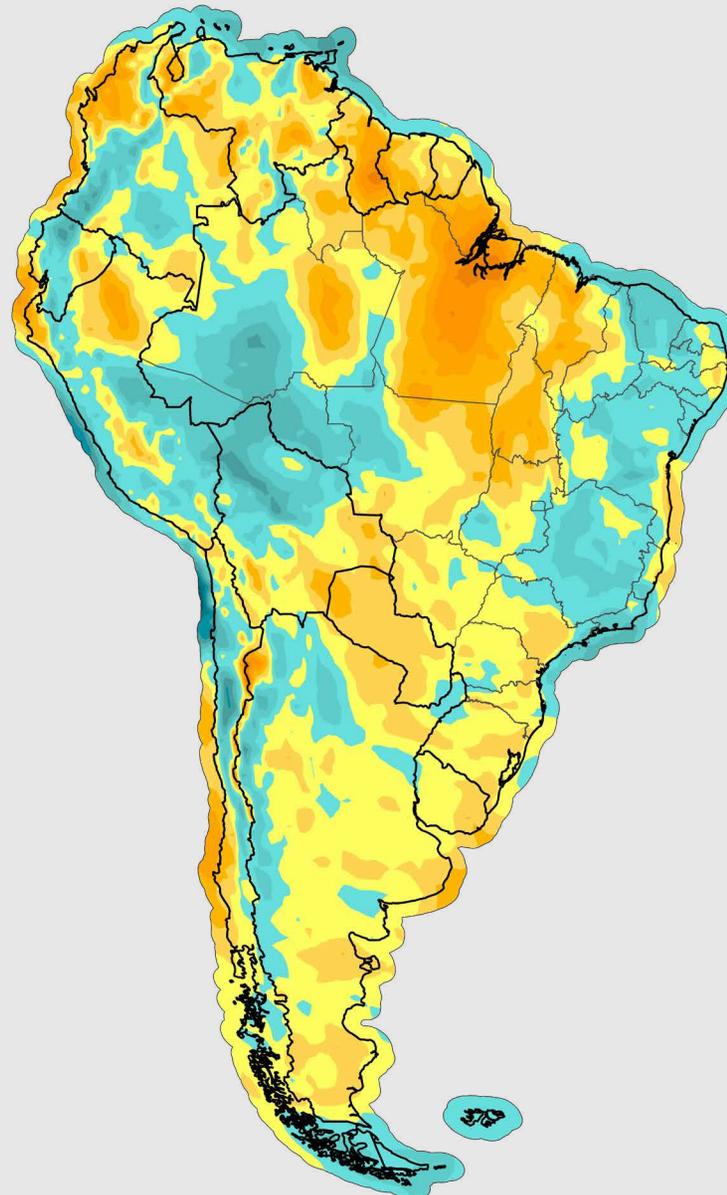
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South America Annual 2020



Wind plant locations source:
www.thewindpower.net



Wind Speed Anomaly (%)



Below Normal:

- Central Bahia and coastal Northeast Brazil
- Northern Bolivia
- Western Ecuador
- Northern coast and ABC Islands

Above Normal:

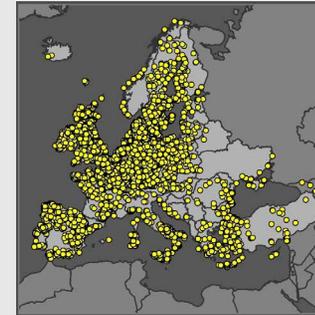
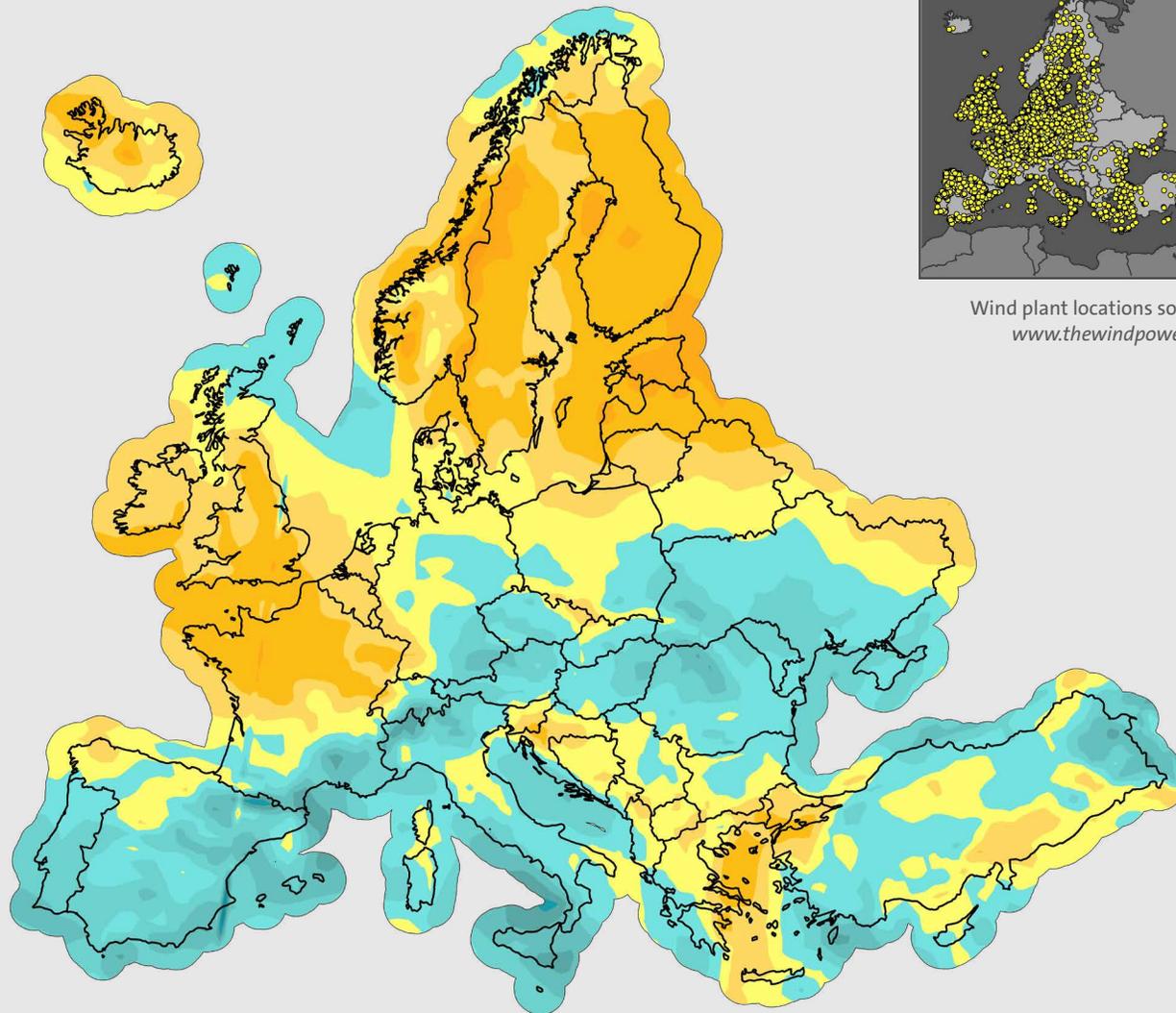
- Uruguay
- Coastal Chile
- Argentina



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Europe
Annual 2020



Wind plant locations source:
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Wind Speed Anomaly (%)



Below Normal:

- Iberian Peninsula and Western Mediterranean
- Southern Central Europe
- Ukraine

Above Normal:

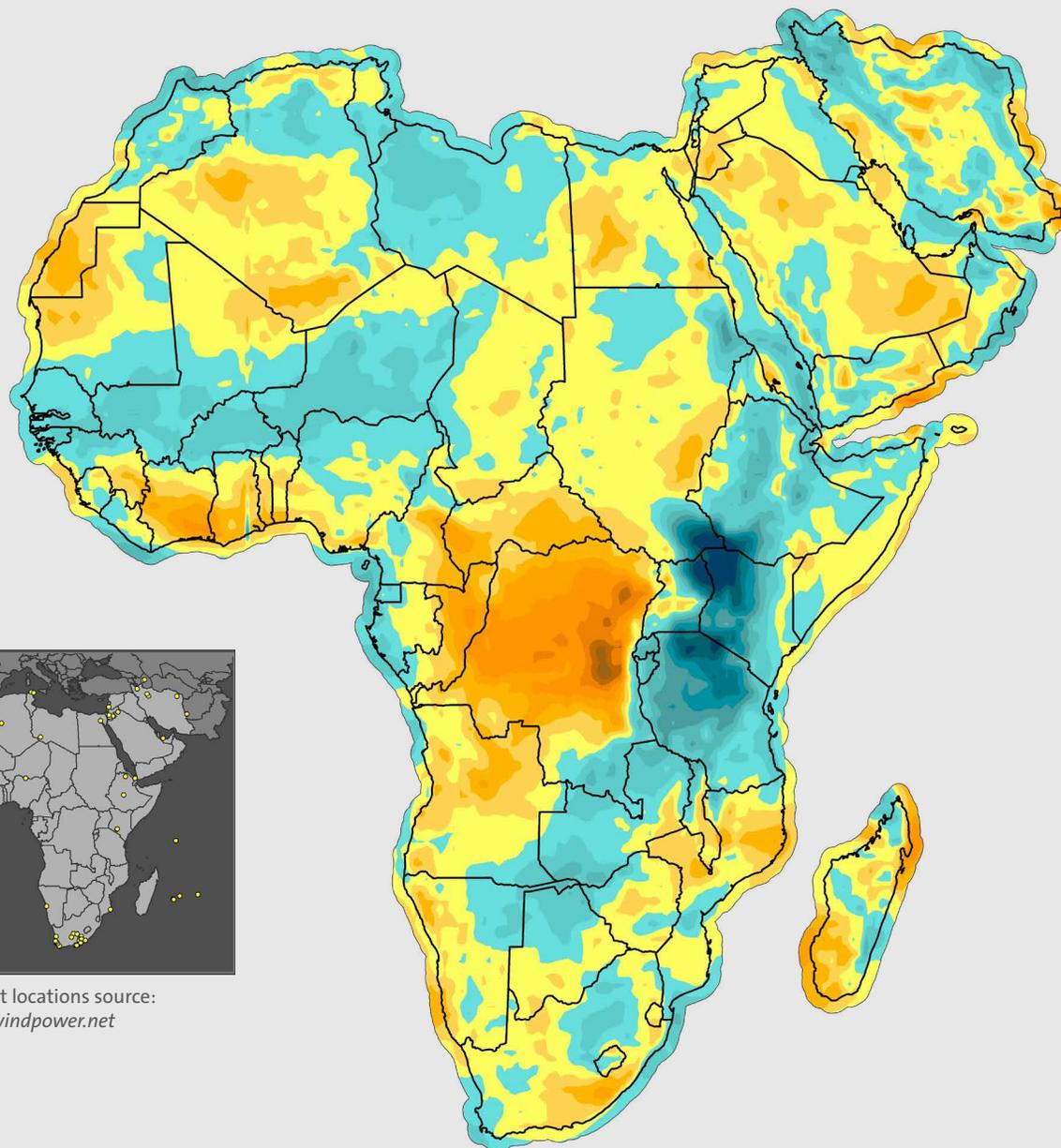
- Northern Europe and Baltic States
- Western Europe
- Aegean Sea



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Africa and the Middle East
Annual 2020

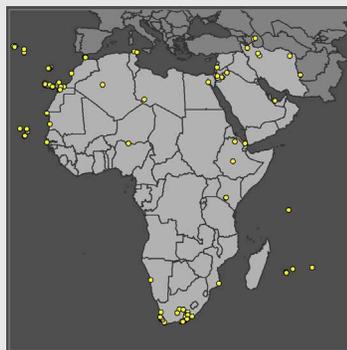


Below Normal:

- Mainland East Africa
- Morocco
- Tunisia
- Northern Iran

Above Normal:

- South Africa
- Western Sahara
- Jordan



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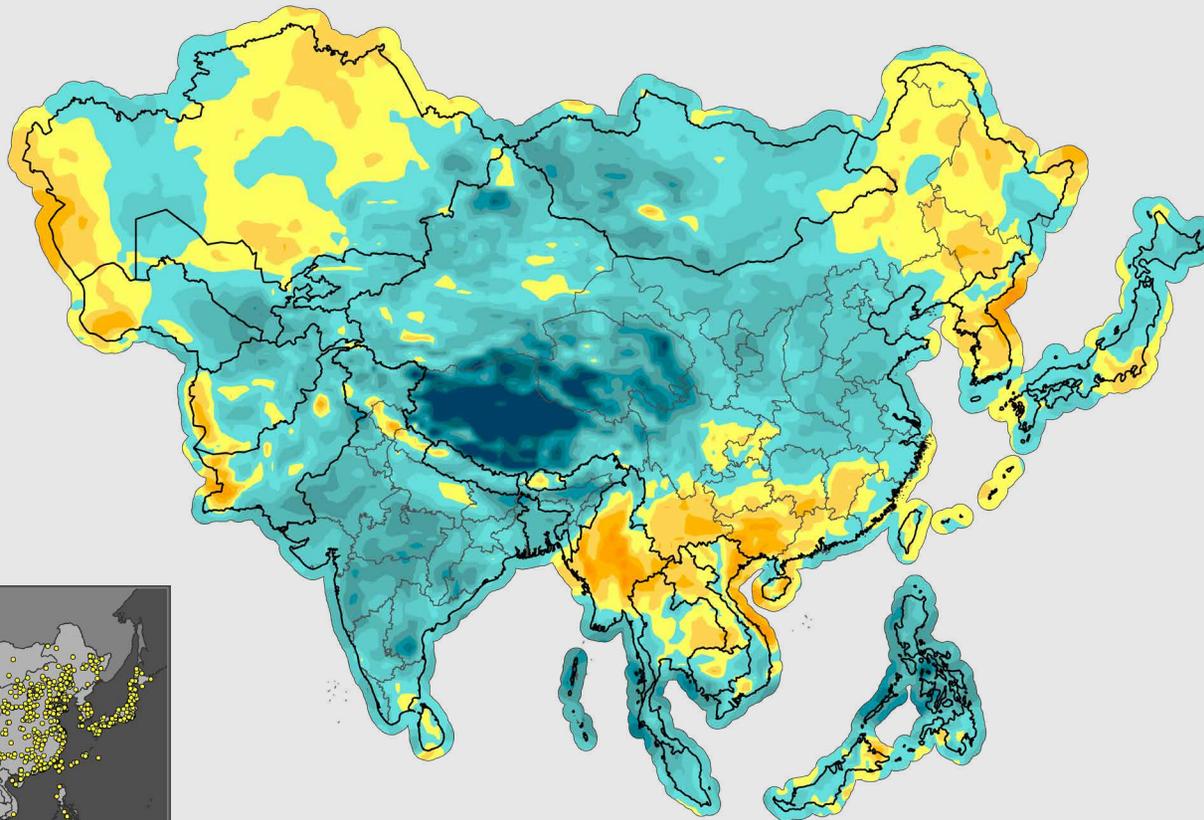


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Asia
Annual 2020

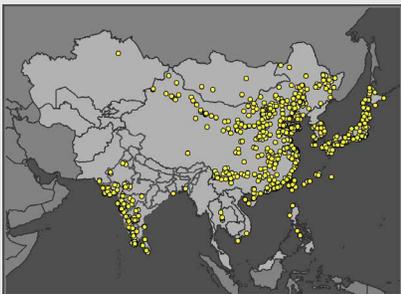


Below Normal:

- India
- Northern, Central and Eastern China
- Japan
- Southern Vietnam
- Philippines

Above Normal:

- Northeast and Southern China
- South Korea
- Northern Thailand and Vietnam



Wind plant locations source:
www.thewindpower.net

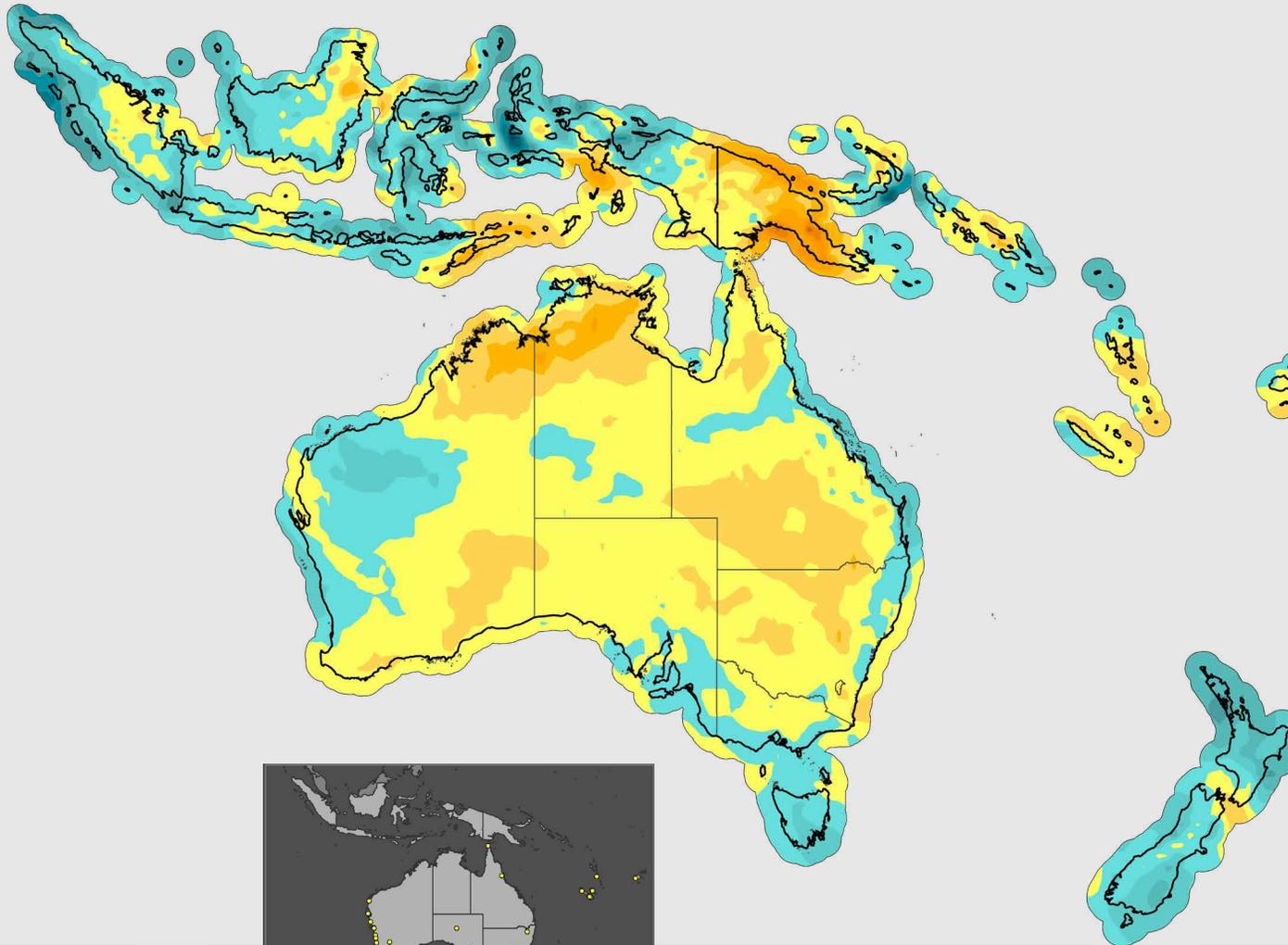


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Indonesia, Australia and Oceania
Annual 2020

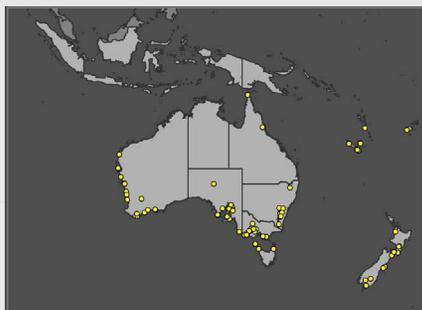


Below Normal:

- Western and Southeast Australia
- Tasmania
- New Zealand

Above Normal:

- Southwest Australia
- New Caledonia
- Vanuatu



Wind plant locations source:
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2020 Wind Index

This index represents the average wind anomaly (expressed as a percent deviation in mean speed from the 1988-2014 baseline for the corresponding calendar period) for each region and country shown, weighted by the location and megawatt capacity of wind projects in production by the end of 2019. The wind project locations and rated capacities are from The Wind Power database (TheWindPower.net). Note that not all operating projects are in the database, and coverage in certain countries such as China is weak. However, UL believes the findings are reasonably representative of wind conditions for the industry as a whole and for the key wind-producing countries.

[Click HERE](#) to download index values for even more wind producing countries!



Regions/Leading Wind Producing Countries	Jan	Feb	Mar	Q1	Apr	May	Jun	Q2	Jul	Aug	Sep	Q3	Oct	Nov	Dec	Q4	ANNUAL
North America	0.0	2.7	-1.3	0.2	-4.8	-1.0	7.3	0.2	-1.2	2.1	2.0	1.0	2.8	4.5	-1.0	2.1	0.8
Canada	-9.5	6.3	4.1	-0.1	5.6	6.2	1.2	4.5	-4.4	6.7	7.7	3.5	-1.1	6.0	3.0	2.7	2.5
USA	1.2	2.2	-1.9	0.2	-5.7	-2.0	8.2	-0.2	-0.3	1.7	1.8	1.1	3.3	4.4	-1.4	2.1	0.7
Mexico	2.4	5.7	-5.9	0.6	-12.2	3.3	6.5	-2.0	-13.3	1.4	-2.0	-5	3.2	5.8	1.3	3.3	-0.6
South America	-8.8	-6.7	-12.9	-9.3	0.8	4.5	2.5	2.7	0.9	2.9	1.3	1.7	-1.1	-2.7	6.1	0.6	-0.6
Brazil	-10.8	-9.6	-15.9	-11.9	-0.5	3.2	1.8	1.7	1.6	2.4	2.7	2.3	-2.1	-2.8	7.3	0.5	-1.2
Argentina	5.1	1.4	-4.1	1.0	-3.8	2.5	3.1	0.7	-1.9	13.7	11.0	7.6	5.2	-1.9	2.0	1.8	2.9
Europe	0.4	22.3	5.3	9.1	-5.6	0.0	-2.0	-2.7	-0.9	-2.9	-3.5	-2.5	5.8	-6.2	-1.5	-1.0	1.2
Denmark	8.2	25.8	0.0	11.4	2.8	6.6	-10.3	-0.2	17.3	-14.2	-8.4	-2.2	-0.6	2.4	-6.2	-1.6	2.2
France	0.4	36.6	11.5	15.7	-10.6	1.2	0.5	-3.2	-0.2	2.8	-2.7	-0.1	16.9	-7.6	5.0	4.4	5.1
Germany	1.0	39.4	5.5	14.7	-3.0	-2.8	-4.6	-3.5	-5.2	-5.9	-15.2	-8.9	8.9	-5.5	-12.2	-3.9	0.6
Great Britain	5.0	35.9	5.2	15.2	-9.4	-1.6	5.2	-2.3	7.1	0.6	2.7	3.4	1.2	1.2	-7.0	-2.0	4.1
Ireland	-1.1	36.0	5.5	13.2	-18.9	1.7	7.2	-4.0	5.7	-4.4	-0.3	0.4	13.8	1.6	3.3	5.7	4.8
Italy	-10.4	13.4	-7.8	-1.7	-11.6	12.7	11.8	3.6	-12.5	-0.6	2.4	-3.6	5.6	-24.8	-5.9	-8.7	-2.7
Portugal	-1.5	-16.1	0.6	-5.3	-13.5	-10.2	1.3	-7.7	-5.2	0.5	0.6	-1.5	2.7	-4.5	8.8	2.5	-2.9
Spain	-7.8	-15.1	6.5	-5.5	-16.8	-4.6	-4.5	-9.1	-1.2	-2.9	2.9	-0.6	11.3	-15.4	21.3	6.0	-2.1
Africa / Middle East	-2.2	0.3	1.8	-0.1	-3.8	1.4	0.1	-0.7	5.3	6.7	1.4	4.5	2.4	-3	-1.5	-0.8	0.8
South Africa	2.4	2.8	4.2	3.2	1.7	2.3	3.2	2.6	9.3	6.3	1.0	5.6	-1.0	0.8	2.7	0.8	3.2
Egypt	5.8	-12.5	-8.0	-5.2	4.7	7.1	-3.6	2.5	7.1	-0.8	4.3	3.6	3.4	-6.4	-6.2	-2.8	-0.2
Asia	-11.9	-0.1	-0.3	-4.1	-5.5	0.4	-3.1	-2.8	-6.3	1.8	-4.6	-3.1	0.7	-3.3	-2.9	-1.9	-3.2
China	-13.5	-1.2	0.4	-4.7	-6.0	3.2	-1.3	-1.4	-3.7	2.9	-3.4	-1.5	0.7	-4.4	-3.6	-2.5	-2.6
India	-5.5	6.6	-3.4	-1.1	-7.9	-14	-13.8	-12	-20.3	-2.0	-14.3	-12.3	1.0	2.4	1.5	1.6	-6.9
Ind, Aus, Oceania	0.0	-0.3	2.2	0.6	11.4	10.4	-10.2	3.2	-16.4	0.1	7.5	-2.8	-5.1	0.3	6.1	0.3	0.1
Australia	-0.1	-0.2	2.7	0.8	11.6	14.1	-11.5	4.0	-18.6	0.5	4.7	-4.3	-4.6	1.4	6.3	0.9	0.2
World	-5.3	8.3	4.6	2.3	-2.2	-0.4	0.1	-1.1	-2.5	-2.4	-2.6	-2.5	1.8	-1.3	2.6	0.8	0.0