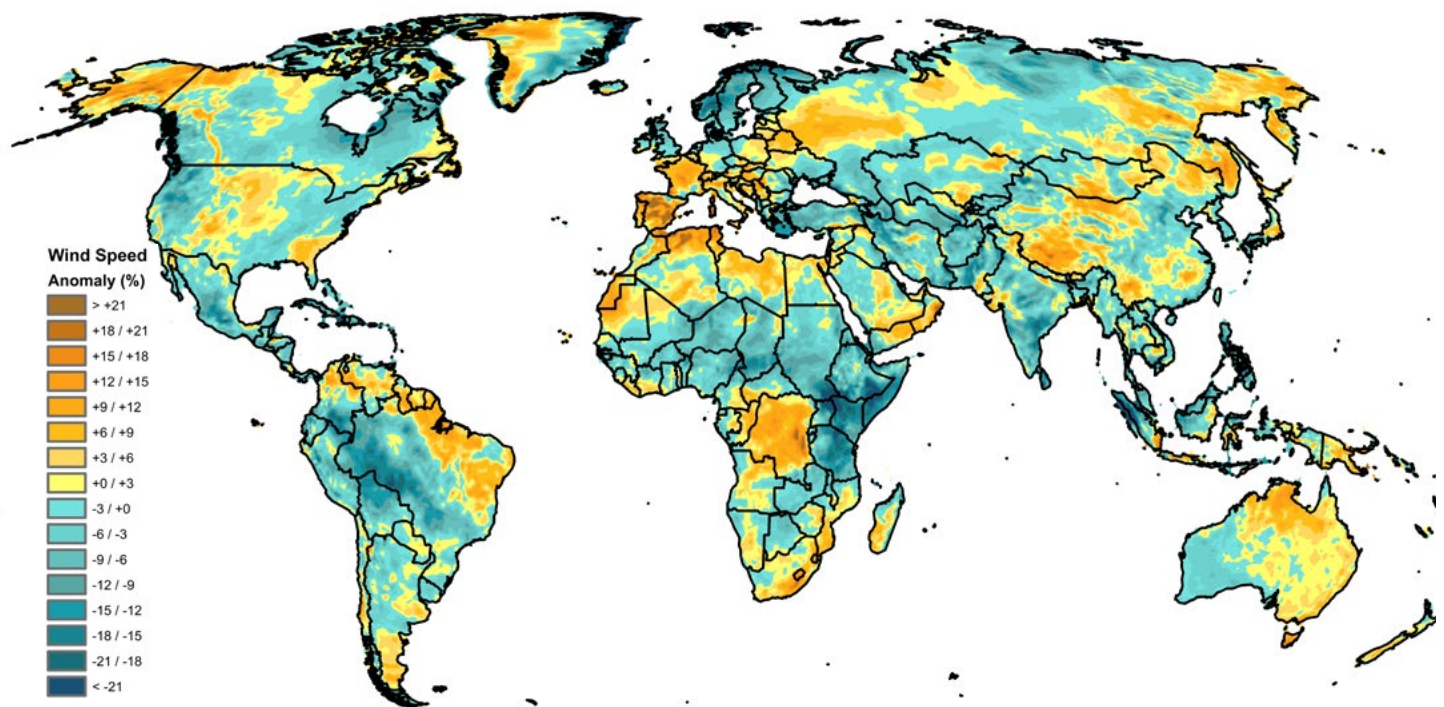


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GLOBAL

Q4 2019

In the fourth quarter of 2019, winds were above normal relative to the long-term, fourth-quarter norm (1988-2014) across key wind power producing areas of the interior United States, Brazil, Western Europe, coastal North Africa, and eastern Australia. Winds were below normal across the western and Midwest United States, Mexico, Central America, Scandinavia, India, and eastern China.

Wind speed departures waned across much of North America. The wind speed deficit over the Northwest U.S. and British Columbia intensified this quarter (-9 to -18%), while below-normal winds persisted across Hawaii (where below-normal quarterly winds have occurred for the past several years). The Midwest and southern Great Lakes region rounded out 2019 with another quarterly wind speed deficit,



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quite different from the earlier half of the year. Winds across central and southern Texas dipped back below the norm, a pattern for much of the past year. Elsewhere, a wind speed deficit established across much of Mexico and Central America for the duration of the quarter. However, not all regional winds were below normal. The pattern of above-normal wind speeds across the interior U.S. shifted northward in the fourth quarter, allowing for areas in the northern plains (e.g., ND, SD, and NE) to experience consecutive months of above-normal winds for the first time this year (up to 9%). The wind speeds rebounded across New England and the Canadian Maritimes, after a third quarter lull.

Wind speeds across key wind power producing areas of South America rose above the norm, despite differences across the region. Northeast Brazil finished the quarter with above-normal winds, due to a strong finish in December (up to 21%). Below-normal winds persisted throughout the final quarter of 2019 across Ecuador, Peru, and Bolivia (where a deficit in excess of -18 to -21% established). A wind speed deficit also persisted throughout the quarter across Uruguay. The wind speeds moderated across Argentina and Chile after much variation in the third quarter; these countries rounded out the fourth quarter at slightly above normal.

Europe finished the quarter with near-normal winds, despite strong local departures during individual months. October brought strongly below-normal winds for most of the region, especially in the east. Deficits well in excess of -21% set up along the Black Sea coast (e.g., Crimea in Ukraine, coastal Romania and Bulgaria), with lesser but still strong deficits around the southern Adriatic (-18 to -21%). A dipole in wind speed departures set up in November; strongly below-normal winds established across northern Europe (-21% or less across the western Norway coast and the northern U.K), and above-normal winds were found to the south and east (well over 21% in Spain, Portugal, and Serbia). December ushered in more quiescent conditions. Notable quarterly wind speed departures established by year end were seen. Portugal and Spain rose well above the quarterly norm (9 to 12%). There was a strong wind speed deficit across Italy in the previous quarter, that gave way to above-normal conditions. Also below-normal wind speeds persisted across Germany and Denmark fell moderately below the norm.

Wind speeds rose above normal across many key wind power producing areas of Africa. The largest upturn in wind speed departures was evident across the southernmost extent of the region (e.g., South Africa) and coastal North Africa (where fourth quarter winds were 15-21% above the norm). Elsewhere, the strong deficit across the East African Islands gave way to near-normal wind speeds. However, not all of the region experienced a windier quarter. Wind speed deficits across East Africa fell to -18%, and significant areas in the Middle East fell below their long-term norm (-2 to -9%).

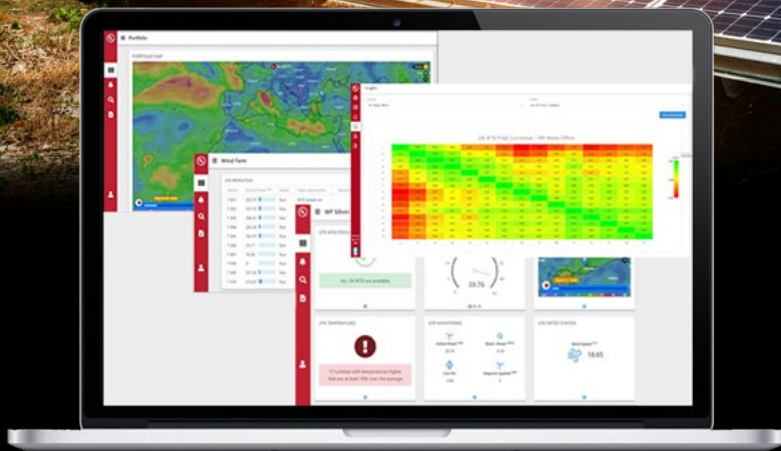
Asia remained near normal in the final quarter of 2019. Above-average wind speeds across southeast Asia and southern India in the third quarter eased, giving way to below-normal winds by the year's end. Strongly below-normal conditions established in southeast India (e.g., the state of Andhra Pradesh) and across Sri Lanka, Thailand, and the Philippines during October (i.e., deficits in excess of -21%). China remained near normal, as deficits in the North China Plain were countered by above-normal winds across the far northern and northeast provinces, as well as more localized areas in central China. Wind across South Korea fell below the norm.

Wind speeds rose above the norm for Oceania overall, although quiescent conditions persisted across some areas. Below-normal winds have persisted for another quarter across southwest Australia (-3 to -9%), while above-normal winds overspread the east (6 to 12%). Above-normal winds continue for New Zealand, although less so than in the previous quarter (particularly in the vicinity of the North Island, and the Cook Strait). Winds rose above normal across New Caledonia, Fiji, and Vanuatu.



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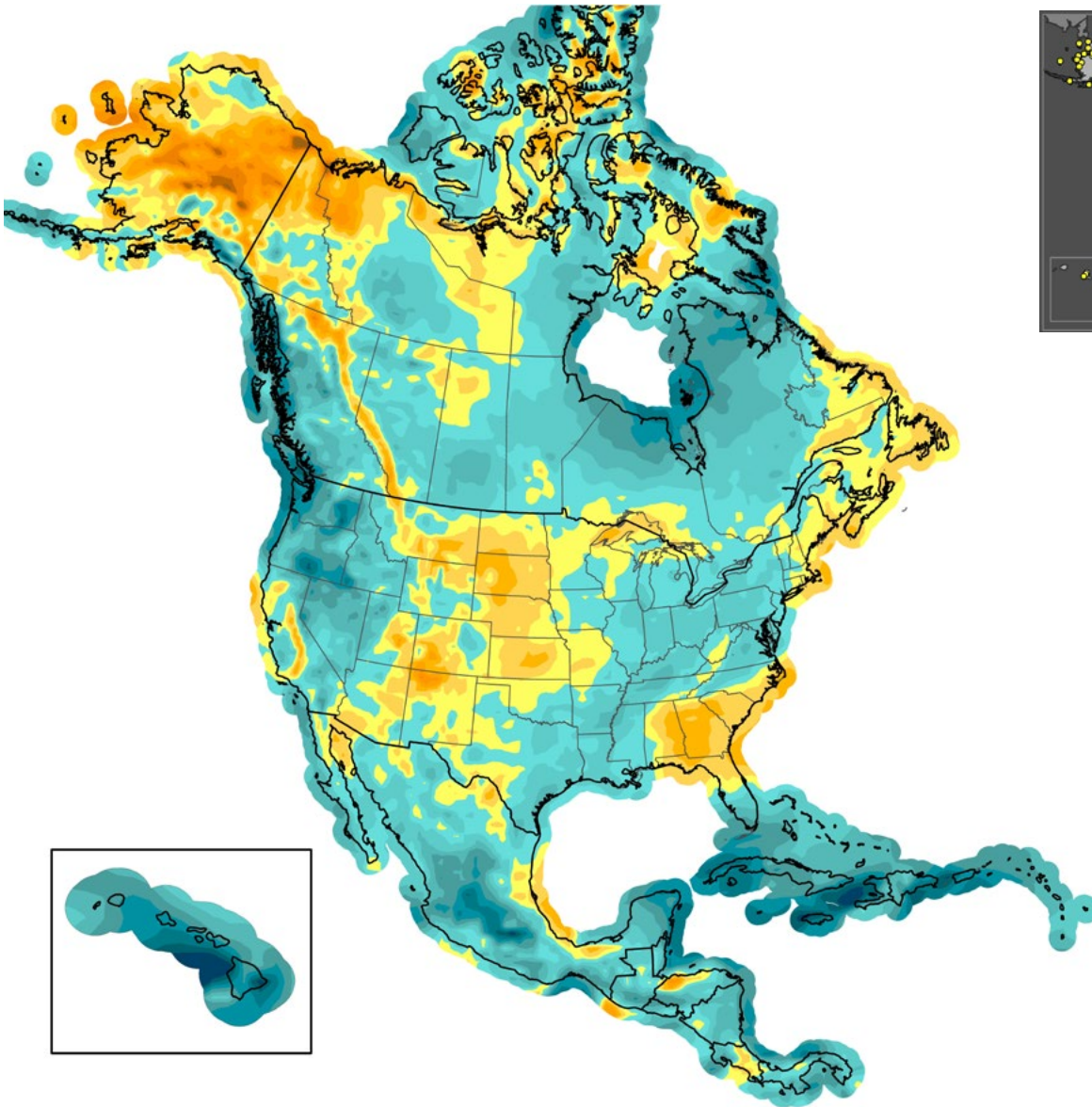
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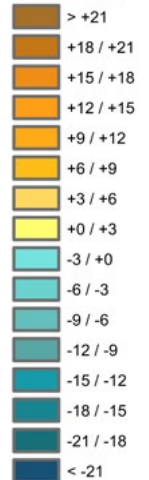
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Wind plant locations source:
www.thewindpower.net

Wind Speed Anomaly (%)



NORTH AMERICA

Q4 2019

Areas with below-average winds:

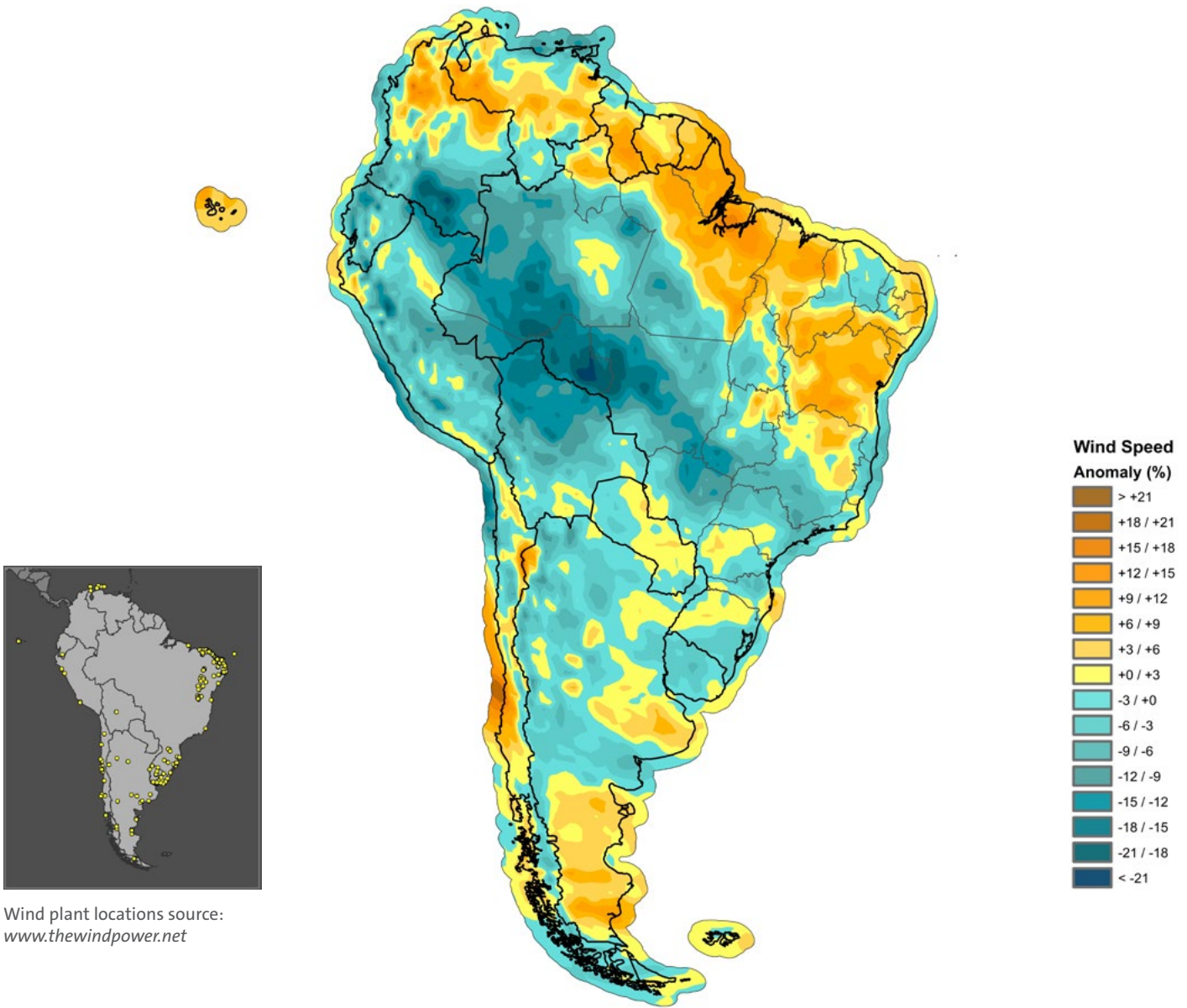
- Hawaii
- The Pacific Northwest, USA & British Columbia, CAN
- Eastern Texas
- Ohio River Valley
- New York & Pennsylvania
- Mexico, Central America, & the Caribbean

Areas with above-average winds:

- Alaska
- The Four Corners, USA
- Upper Great Plains, USA
- Nebraska
- The Canadian Maritimes

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SOUTH AMERICA

Q4 2019

Areas with below-average winds:

- Uruguay
- Peru
- Ecuador
- Bolivia

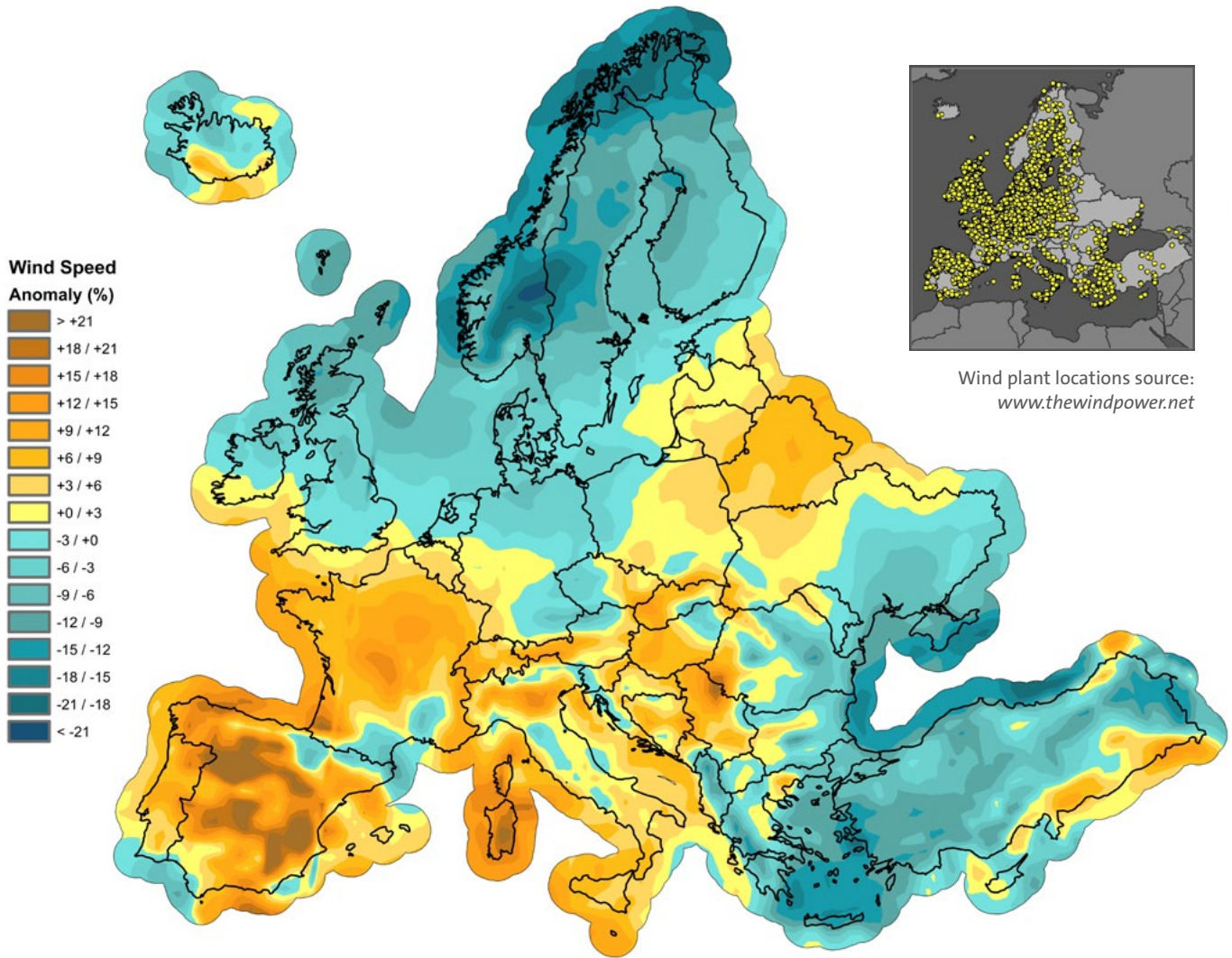
Areas with above-average winds:

- Northern Chile
- Southern Argentina
- Eastern Brazil



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EUROPE

Q4 2019

Areas with below-average winds:

- Germany
- The United Kingdom
- Scandinavia
- Turkey

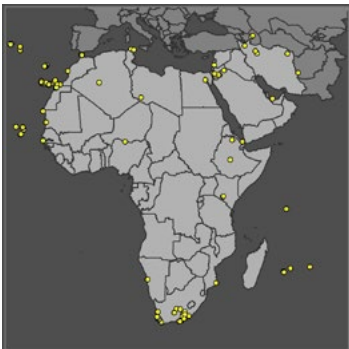
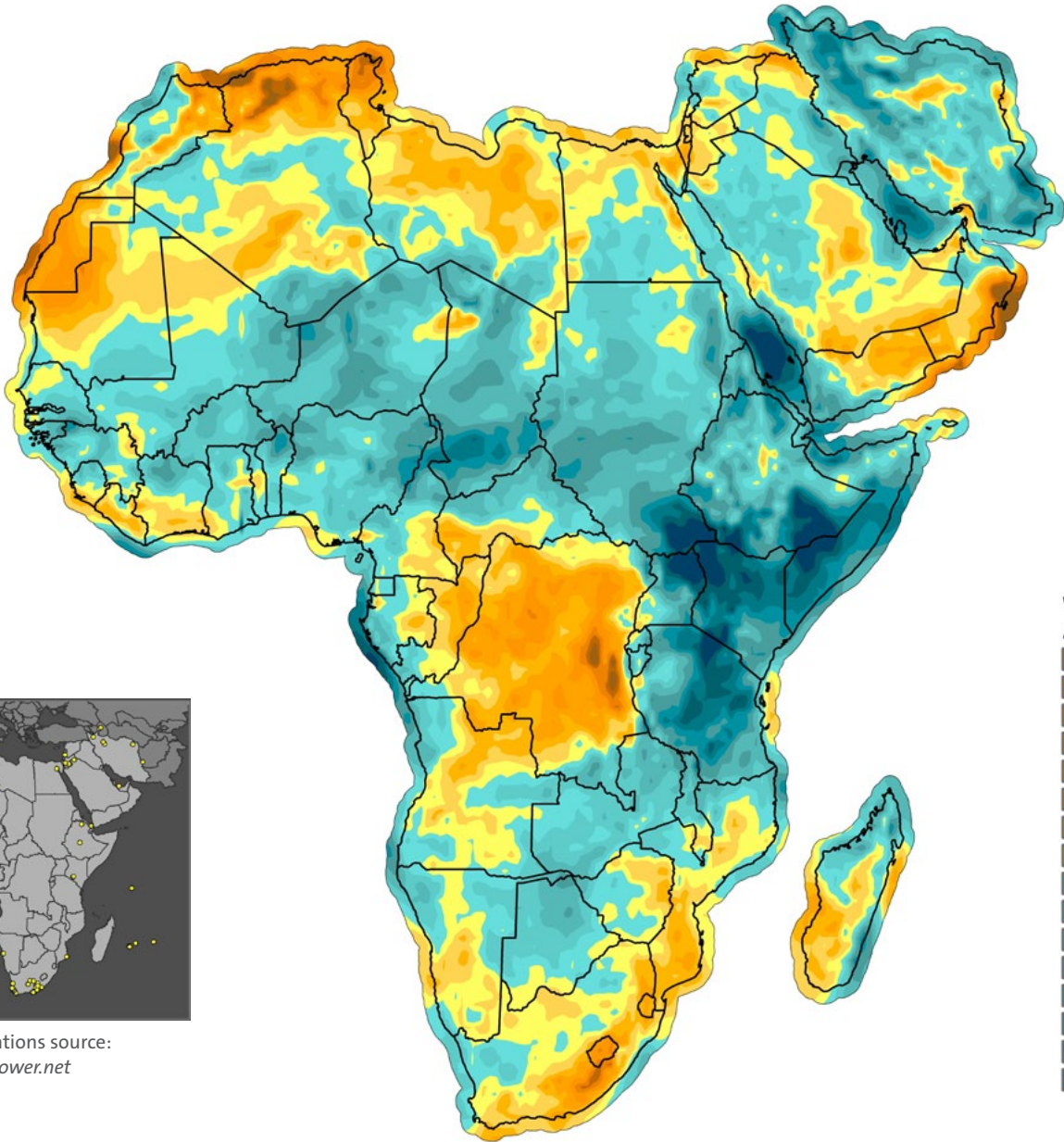
Areas with above-average winds:

- The Iberian Peninsula
- France
- Italy
- Hungary
- Switzerland



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Wind plant locations source:
www.thewindpower.net

AFRICA / MIDDLE EAST

Q4 2019

Areas with below-average winds:

- East Africa
- Iran
- Nigeria

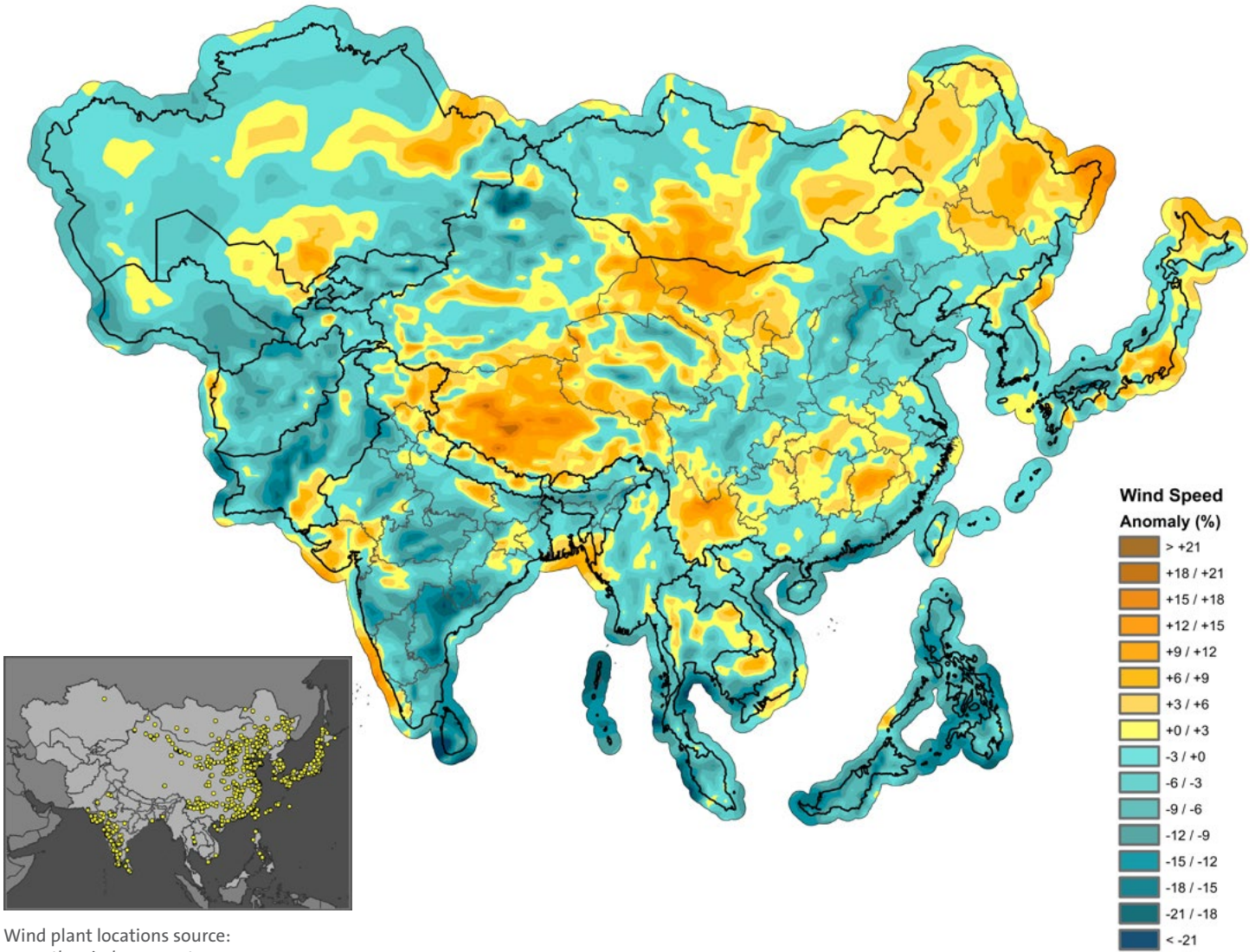
Areas with above-average winds:

- South Africa
- Coastal North Africa
- Jordan



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Wind plant locations source:
www.thewindpower.net

ASIA

Q4 2019

Areas with below-average winds:

- Eastern China
- India
- Sri Lanka
- South Korea
- The Philippines

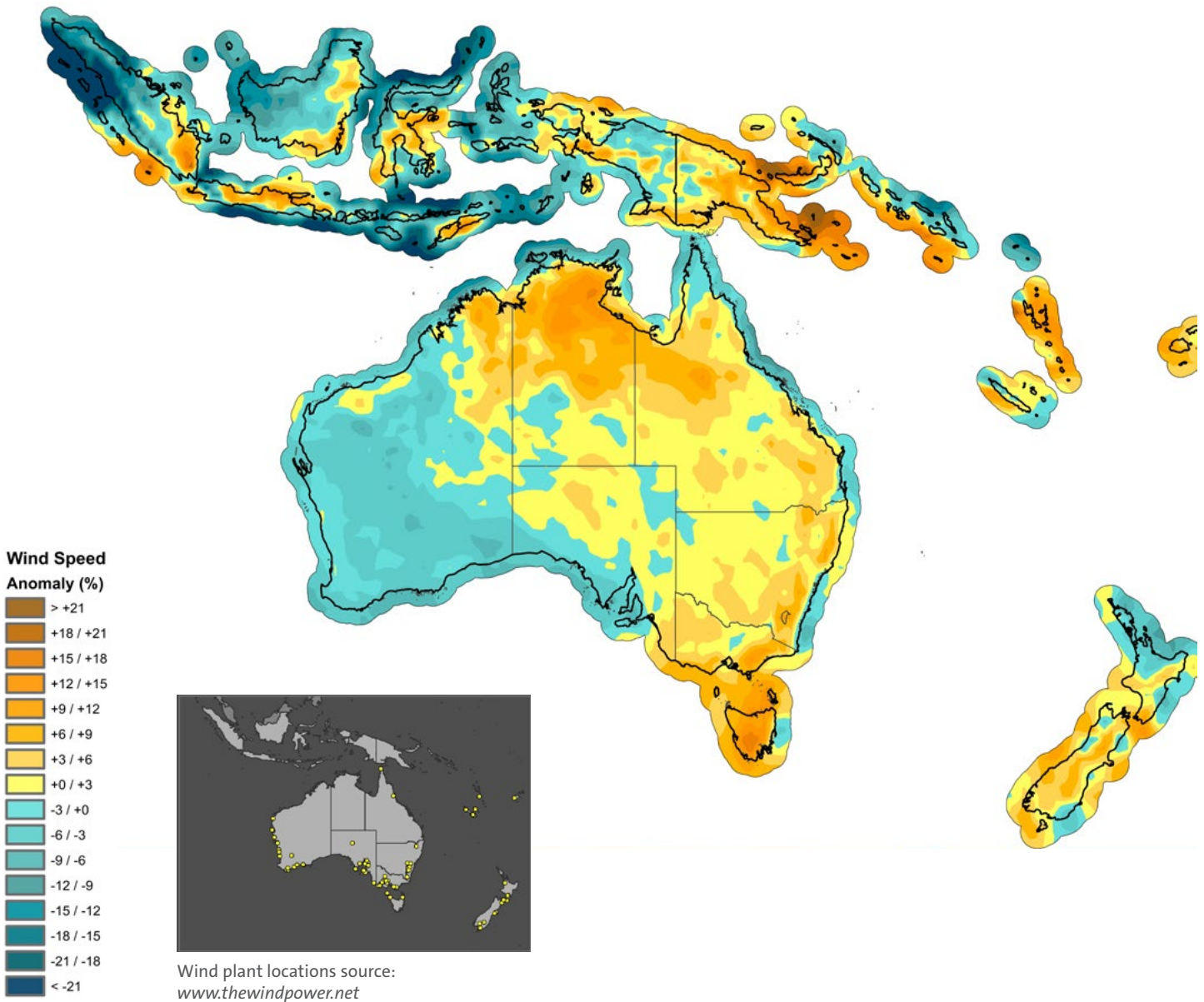
Areas with above-average winds:

- Western China
- Southern Pakistan
- Thailand



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INDONESIA, AUSTRALIA AND OCEANIA

Q4 2019

Areas with below-average winds:

- Western Australia

Areas with above-average winds:

- Eastern Australia
- Tasmania
- New Zealand
- Fiji



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2019 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 2018. 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.

Regions/Leading Wind Producing Countries	Jan	Feb	Mar	Q1	Apr	May	Jun	Q2	Jul	Aug	Sep	Q3	Oct	Nov	Dec	Q4	ANNUAL
North America	-1.1	3.1	-4.9	-1.3	-1.0	-5.2	-4.0	-3.4	1.0	-1.3	6.3	2.0	5.3	-4.5	-4.9	-1.5	
Canada	3.0	8.1	0.7	3.9	9.6	-5.2	0.8	2.0	-2.0	-2.5	-1.1	-1.8	-3.4	0.6	0.8	-0.6	
USA	-1.6	3.2	-6.0	-1.8	-2.4	-5.1	-4.8	-4.1	1.5	-0.8	7.7	2.8	7.6	-5.1	-5.6	-1.2	
Mexico	-2.5	-13.5	0.5	-4.9	1.4	-3.8	-3.5	-2.1	-5.9	-13.6	-1.2	-7.2	-18.6	-6.6	-3.9	-9.1	
South America	8.8	-9.2	-3.9	-0.9	-6.5	2.1	4.9	0.6	-1.0	3.8	-1.6	0.4	2.2	-0.4	6.4	2.6	
Brazil	11.1	-10.7	-6.6	-1.5	-7.8	1.9	4.7	0.1	-2.1	3.1	0.1	0.4	2.2	0.5	8.4	3.4	
Argentina	-0.7	5.9	1.2	2.0	1.7	-4.7	2.9	0.0	-4.0	4.2	12.4	4.1	3.8	5.7	-3.6	1.9	
Europe	0.1	-4.8	11.0	1.9	0.6	2.1	-0.1	0.8	-3.6	-2.6	3.4	-0.9	-4.6	2.4	4.4	0.9	
Denmark	-2.9	-3.2	13.5	2.2	-4.6	15.8	-1.8	3.1	7.5	-3.2	11.6	5.4	-11.3	-12.2	6.6	-5.4	
France	-7.7	-14.0	18.1	-1.7	-5.7	-1.6	-0.1	-2.6	-2.5	-2.7	11.2	2.1	6.9	4.9	9.6	7.0	
Germany	1.9	-7.6	19.7	4.6	3.8	1.1	-2.8	0.8	-4.8	-8.0	3.4	-3.1	0.0	-7.7	-0.8	-3.0	
Great Britain	-16.2	-7.5	9.8	-5.3	-2.1	-14.3	4.1	-4.4	-6.0	12.4	1.0	2.5	-2.0	-12.8	3.4	-3.7	
Ireland	-22.1	12.9	4.7	-2.8	12.9	-14.3	3.5	-1.2	-7.2	17.2	4.5	4.9	0.0	-7.5	3.6	-1.3	
Italy	17.3	16.4	6.4	13.2	-4.3	11.9	-7.2	0.2	-2.9	-17.3	-10.8	-10.2	-16.8	17.9	14.3	6.3	
Portugal	5.3	-7.3	-2.1	-0.9	5.8	15.8	1.4	7.6	-6.2	-2.8	5.3	-1.5	-6.0	24.1	14.0	10.9	
Spain	7.0	-12.1	-1.3	-1.9	1.5	9.8	3.3	4.7	0.9	-5.1	5.3	0.3	-7.3	36.2	10.6	13.5	
Africa / Middle East	5.7	-3.8	1.2	1.3	-1.5	0.7	-2.1	-0.9	5.7	-2.6	0.2	1.1	2.7	5.0	4.7	4.1	
South Africa	-5.5	-3.4	-1.0	1.6	-0.7	-2.8	3.0	0.0	17.4	-10.0	-1.9	1.8	4.7	1.9	13.7	6.7	
Egypt	8.0	-15.1	-3.7	-7.8	2.9	2.3	-11.1	-2.4	-1.2	-14.3	9.0	-1.8	-0.4	-5.2	1.0	-1.4	
Asia	-4.5	-2.8	-3.1	-3.5	-4.6	4.3	-1.8	-0.8	-3.0	4.4	-2.7	-0.6	-0.9	0.7	-0.9	-0.4	
China	-4.9	-4.0	-3.7	-4.2	-5.1	7.2	-1.3	0.2	-4.1	4.7	-3.8	-1.2	1.0	1.6	-1.6	0.3	
India	-4.1	5.7	0.3	0.3	-1.5	-9.0	-5.4	-5.5	1.5	2.5	2.2	1.8	-12.5	-3.0	4.6	-3.6	
Ind, Aus, Oceania	-2.5	1.7	-1.4	-0.9	3.9	13.0	-6.7	3.1	5.8	2.0	-5.3	0.8	-3.1	10.7	2.2	3.0	
Australia	-4.5	0.9	0.3	-1.3	5.4	13.3	-6.0	3.8	6.6	-0.3	-7.1	-0.3	-3.8	12.1	1.2	2.9	
World	-0.6	-1.7	2.2	-0.2	-0.9	0.4	-1.1	-0.5	-1.4	-0.4	2.1	0.9	-1.7	-5.6	-3.0	-3.4	

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

