Global wind map identifies wind power potential

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A new global wind power map has quantified global wind power and may help planners place turbines in locations that can maximize power from the winds and provide widely available low-cost energy. After analyzing more than 8,000 wind speed measurements in an effort to identify the world's wind power potential for the first time, Cristina Archer and Mark Jacobson of Stanford University suggest that wind captured at specific locations, if even partially harnessed, can generate more than enough power to satisfy the world's energy demands. Their report will be published in May in the Journal of Geophysical Research-Atmospheres, a publication of the American Geophysical Union.

The researchers collected wind speed measurements from approximately 7,500 surface stations and another 500 balloon-launch stations to determine global wind speeds at 80 meters [300 feet] above the ground surface, which is the hub height of modern wind turbines. Using a new interpolation technique to estimate the wind speed at that elevation, the authors report that nearly 13 percent of the stations they reviewed experience winds with an average annual speed strong enough for power generation. They note that, based on their expectations of other global areas, an even greater percentage of locations would likely reach the 6.9 meters per second [15 miles per hour] wind speed considered strong enough to be economically feasible.

Such wind speeds at 80 meters, referred to as wind power Class 3, were found in every region of the world, although North America was found to have the greatest wind power potential. The researchers also found that some of the strongest winds were observed in Northern Europe, along the North Sea, while the southern tip of South America and the Australian island of Tasmania also recorded significant and sustained strong winds at the turbine blade height. In North America, the most consistent winds were found in the Great Lakes region and from ocean breezes along the eastern, western and southern coasts. Overall, the researchers calculated winds at 80 meters [300 feet] traveled over the ocean at approximately 8.6 meters per second and at nearly 4.5 meters per second over land [20 and 10 miles per hour, respectively].

"The main implication of this study is that wind, for low-cost wind energy, is more widely available than was previously recognized," Archer said. "The methodology in the paper can be utilized for several applications, such as determining elevated wind speeds in remote areas or to evaluate the benefits of distributed wind power."

The study also estimated the amount of global wind power that could be harvested at locations with suitably strong winds. The authors found that the locations with sustainable Class 3 winds could produce approximately 72 terawatts and that capturing even a fraction of that energy could provide the 1.6-1.8 terawatts that made up the world's electricity usage in the year 2000. A terawatt is 1 billion watts, a quantity of energy that would otherwise require more than 500 nuclear reactors or thousands of coal-burning plants. Converting as little as 20 percent of potential wind energy to electricity could satisfy the entirety of the world's energy demands, but the researchers caution that there are considerable practical barriers to reaping the wind's potential energy.

Chief among those barriers is creating and maintaining a dense array of modern turbines that would be needed to harness the wind power. Some sources have suggested that millions of turbines would be needed to produce an acceptable level of energy and that alternative energy sources would still be necessary to produce power when the wind speeds fall below a certain threshold. Creating a large field of turbines could also be hazardous to birds and may produce unacceptable noise levels.

The current research, however, indicates that several of those limitations can be overcome with better placement of wind turbines. The researchers report that their study can assist in locating wind farms in regions known for strong and consistent winds, which may help avoid some of the problems with intermittent winds. In addition, they suggest that the inland locations of many existing wind farms may explain their inefficiency.

"It is our hope that this study will foster more research in areas that were not covered by our data, or economic analyses of the barriers to the implementation of a wind-based global energy scenario," Archer concluded.

Source: American Geophysical Union