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NEWS

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Wind farms can affect crop growth

Large wind farms have a noticeable effect on the local weather, a new study (http://iopscience.iop.org/1748-9326/8/1/015002/article) shows. Draughts of air from whirling blades affect the exchange of heat and water vapour, altering the air temperature and humidity in the lower atmosphere. Such changes could impact on crop yields and ecosystem dynamics underneath wind farms.

In order to study the impact that large wind farms have on the weather, Fernando Porté-Agel from the École Polytechnique Fédérale de Lausanne in Switzerland and colleagues carried out experiments in a wind tunnel at the University of Minnesota, US, on a model wind farm. Using mini turbines, constructed at approximately one thousandth of their true scale, they were able to investigate the impact of wind-farm layout on heat flux and moisture transfer.

Mirroring real wind farms, the model layout had more than 10 rows of turbines, with a distance equivalent to at least four rotor diameters between turbines. An array of sensors mapped the surface heat flux inside the wind tunnel.

Overall, Porté-Agel and the team found that the total change in surface heat flux produced by the wind farm was small – nearly zero for a wind farm with aligned turbines, and around 4% for a farm with a staggered layout. However, changes in spatial distribution of heat flux were significant, with a difference of up to 12% between the maximum and minimum surface heat flux in the aligned turbine case, and 7% in the staggered case.

"In the aligned case, the rotating wake flows shed by each turbine are perfectly aligned," said Porté-Agel. "As a result, that rotation effect is 'superimposed' and 'magnified' as one moves inside the wind farm, leading to one side – the side where the flow moves downward due to wake rotation – being more efficient at mixing air and thus producing larger near-surface heat flux, compared with the other side." The changes were less in the staggered turbine arrangement because the wakes were no longer aligned.

Such changes can affect local meteorology, in particular the air temperature and moisture concentration of the lower atmosphere. "If turbines are placed on agricultural land, as is often the case, then this could affect crop yields by reducing or increasing heat and moisture losses during droughts or extreme hot or cold periods," said Porté-Agel. Even on non-agricultural land the changes in heat and moisture exchange could have ecological effects, perhaps changing the spatial distribution of vegetation and hence ecosystem structure and dynamics.

Sometimes those changes may be positive, as in the case of a field campaign on the effects of wind-turbine wakes on crops in central Iowa. This found that the wind turbine cools the near-surface air in the summer, which helps crops to thrive. But in other cases the potential drying of the land and resulting need for increased irrigation may not be favourable.

Until now, most wind farms have been optimized to produce maximum power. This study addresses some of the side effects that wind farms may have on the environment. "In some cases, like that of intensive agriculture, our findings could be used to help minimize negative effects – for example planning for more irrigation in areas that are expected to dry more – or to maximize positive effects, for example due to the fact that locally less water may be required or extreme temperatures may become milder," explained Porté-Agel.

Porté-Agel and colleagues reported their work in **Environmental Research Letters** (**ERL**) (http://iopscience.iop.org/1748-9326/8/1/015002/article) as part of the **ERL** Focus on the Environmental Impact of Wind Energy (http://iopscience.iop.org/1748-9326/focus/Environmental%20impact%20of%20wind%20energy).

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Experimental study of the impact of large-scale wind farms on land-atmosphere exchanges, Wei Zhang, Corey D Markfort and Fernando Porté-Agel 2013 **Environ. Res. Lett.** 8 015002 (http://iopscience.iop.org/1748-9326/8/1/015002/article)

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About the author

Kate Ravilious is a contributing editor for **environmentalresearchweb**. This article was amended on 22nd March to modify the explanation in the fifth paragraph of the aligned wake flow effects.