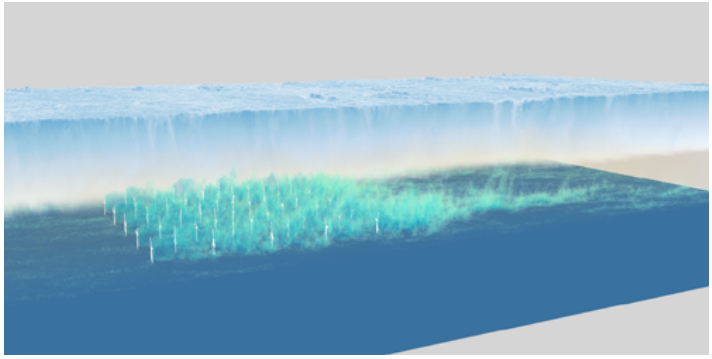
The Effect of Clouds on Wind Farms

Simulations suggest that clouds can reduce the length of a wind farm's slow-air wake, potentially increasing power production of neighboring wind farms.

By **David Ehrenstein**

Air slows down as it moves through a wind farm, producing a wake of slower air that can stretch for up to 70 km. In wind-farm-dense regions such as the North Sea, this wake can reduce power generation at another wind farm. Now Davide Selvatici and Richard Stevens from the University of Twente in the Netherlands have shown in simulations that a cloud phenomenon called radiative cooling can increase vertical air movement and dramatically reduce the length of such a wake [**1**]. The results suggest that planners will need to account for the effects of clouds in future models.

Power production increases in proportion to the wind speed raised to the third power, so even a small speed reduction can have a significant impact. Various atmospheric factors are known to affect the length of the wake, but clouds have often been ignored. Selvatici and Stevens focused on radiative cooling, the process by which the top surface of a cloud cools by emitting more infrared energy than it absorbs from the Sun.



Credit: D. Selvatici and R. J. A. M. Stevens/University of Twente

The cooler air sinks and can drive vertical convection flows and turbulence, which in turn bring faster-moving air down to lower altitudes.

Selvatici and Stevens ran simulations of a wind farm in three scenarios: clear skies, cloudy skies that lacked radiative cooling, and cloudy skies that included radiative cooling. In the final case, the mean wake wind speed returned to 90% of its pre-wind-farm value within 17 km, whereas without radiative cooling, it took more than 32 km. Selvatici says that despite the clouds, the simulated atmosphere was still quite idealized, so the pair cannot conclude definitively that clouds always reduce wakes until they have more data for a range of conditions.

David Ehrenstein is a Senior Editor for *Physics Magazine*.

REFERENCES

1. D. Selvatici and R. J. A. M. Stevens, "Low-level cloud radiative forcing enhances wind-farm wake recovery," **PRX Energy 5, 033014 (2026).**