



## Remote sensing methods for identification of blockage effects

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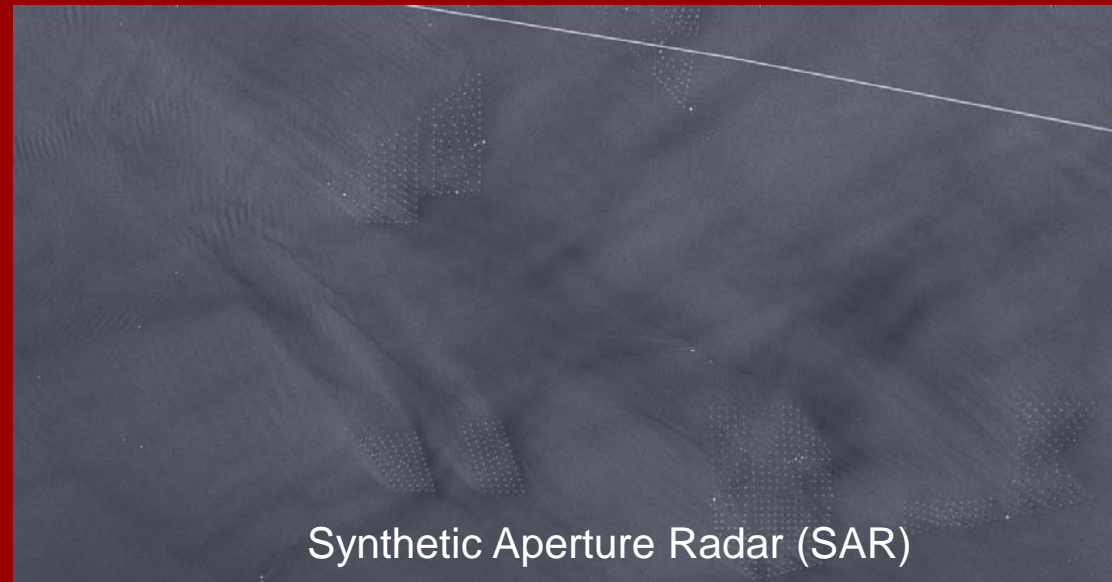
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# Remote sensing methods for identification of blockage effects

Charlotte Hasager, Merete Badger

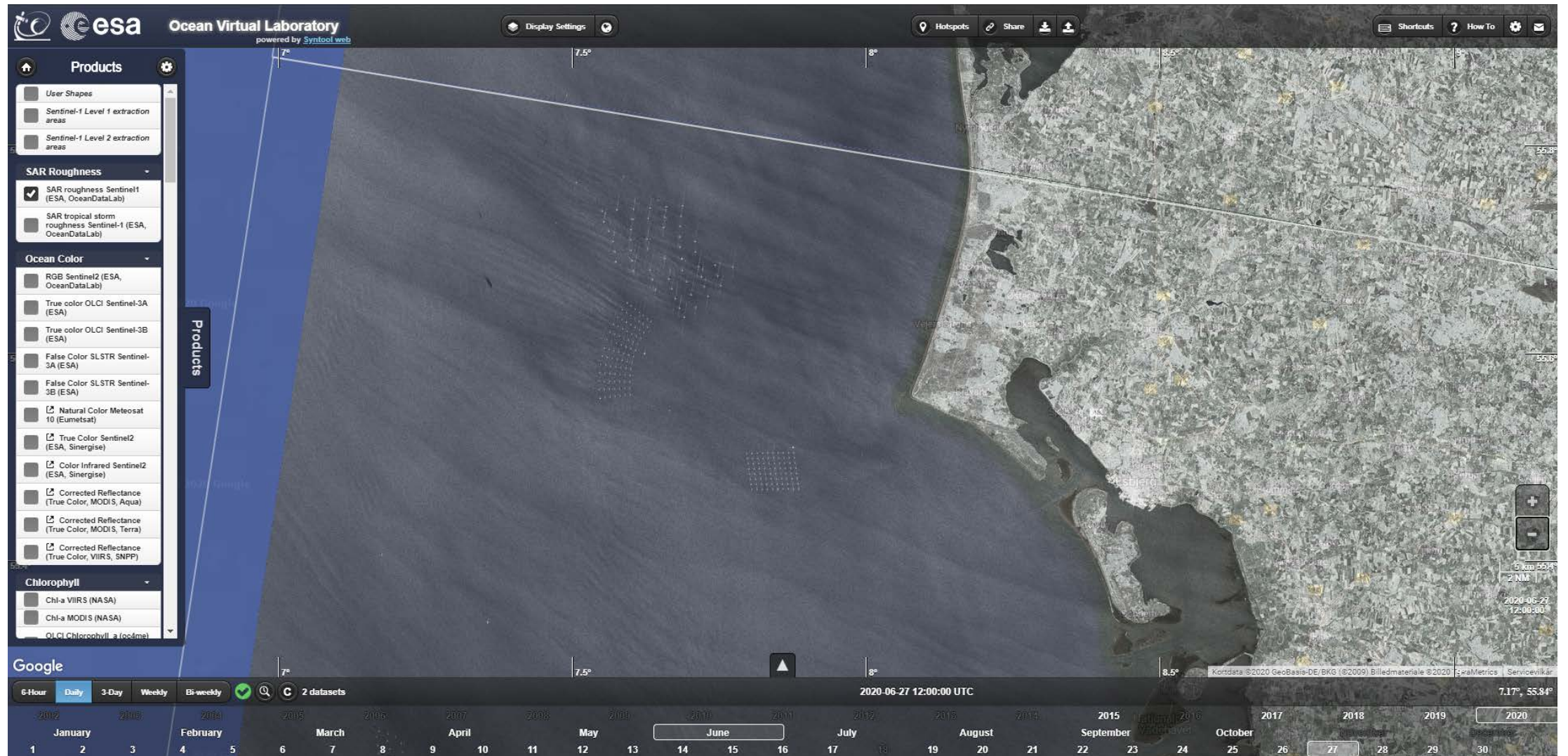
VindKraftNet, 29 October 2021, online workshop



# Content

- Where to find the SAR data
- Image examples from wind farms offshore
- Published examples
- Ideas for systematic analysis

# Browse quick-looks: <https://ovl.oceandatalab.com/>



Scene from October 27, 2020: [https://odl.bzh/vYJ0j\\_RO](https://odl.bzh/vYJ0j_RO)

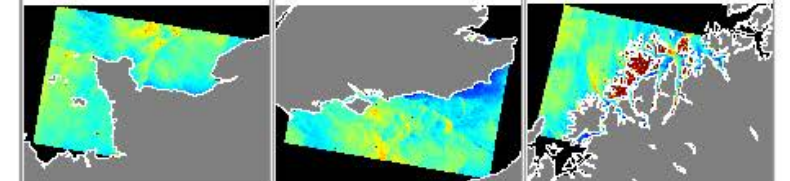


Total suitable records: 278658

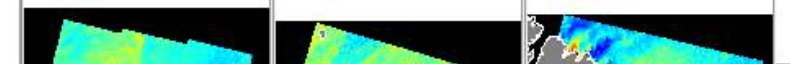
Page size

Page:  / 5574

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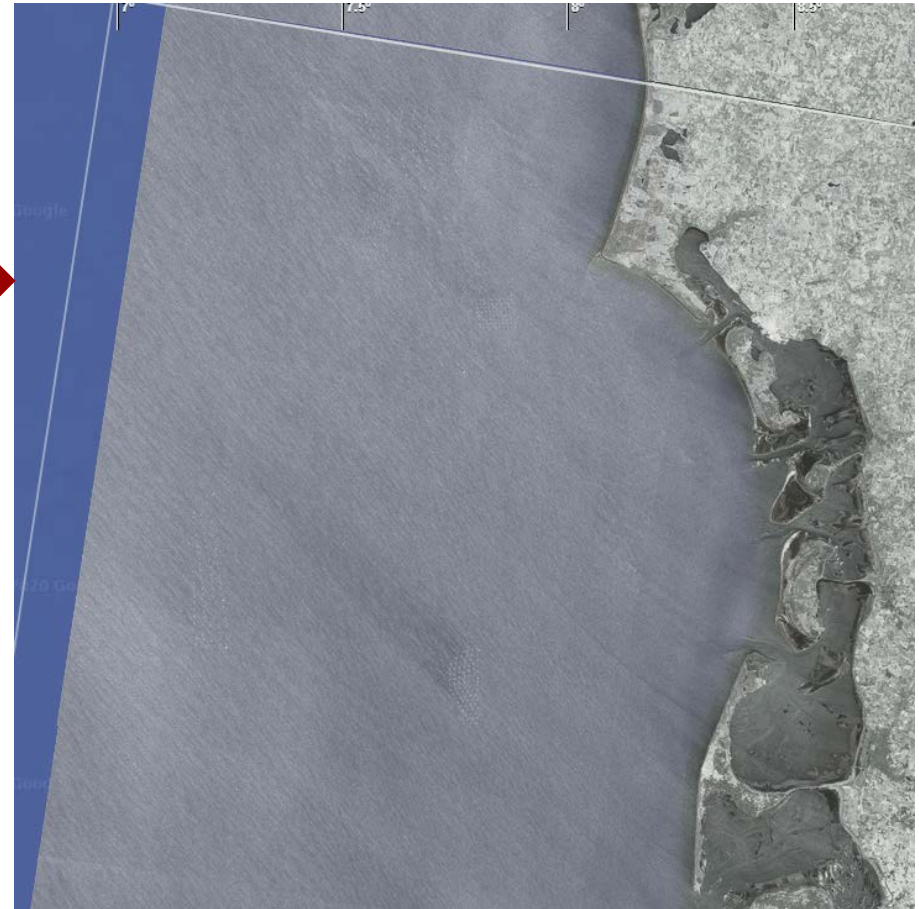
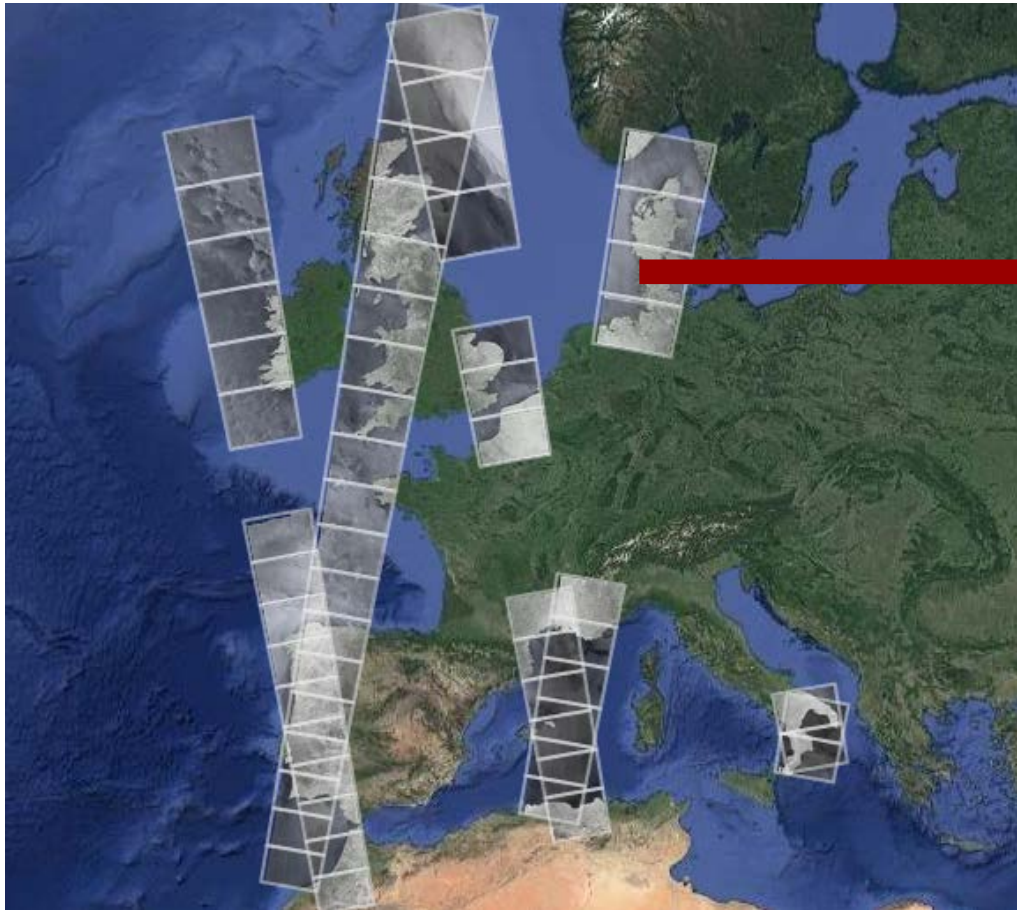


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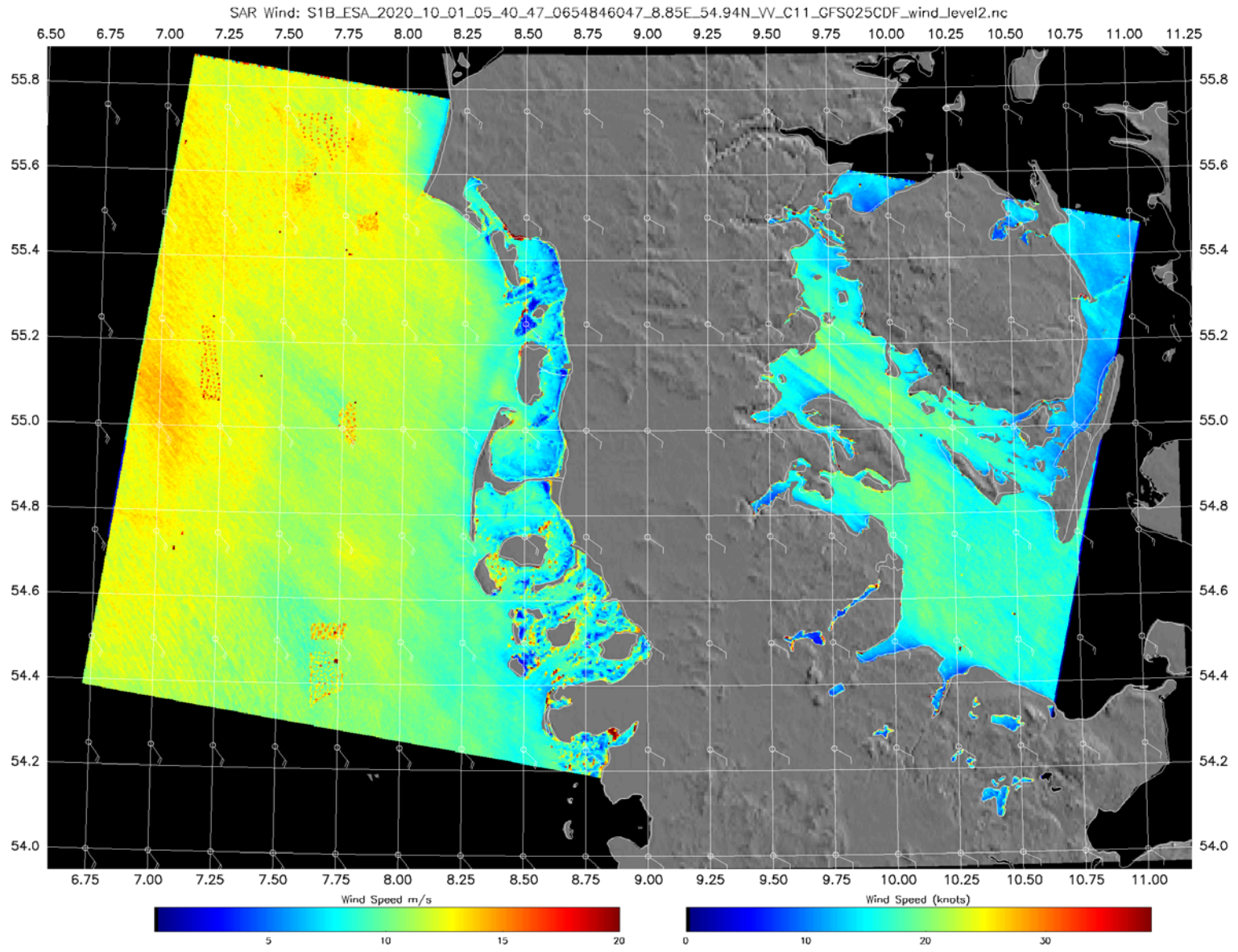


# Examples

# October 1<sup>st</sup> 2020

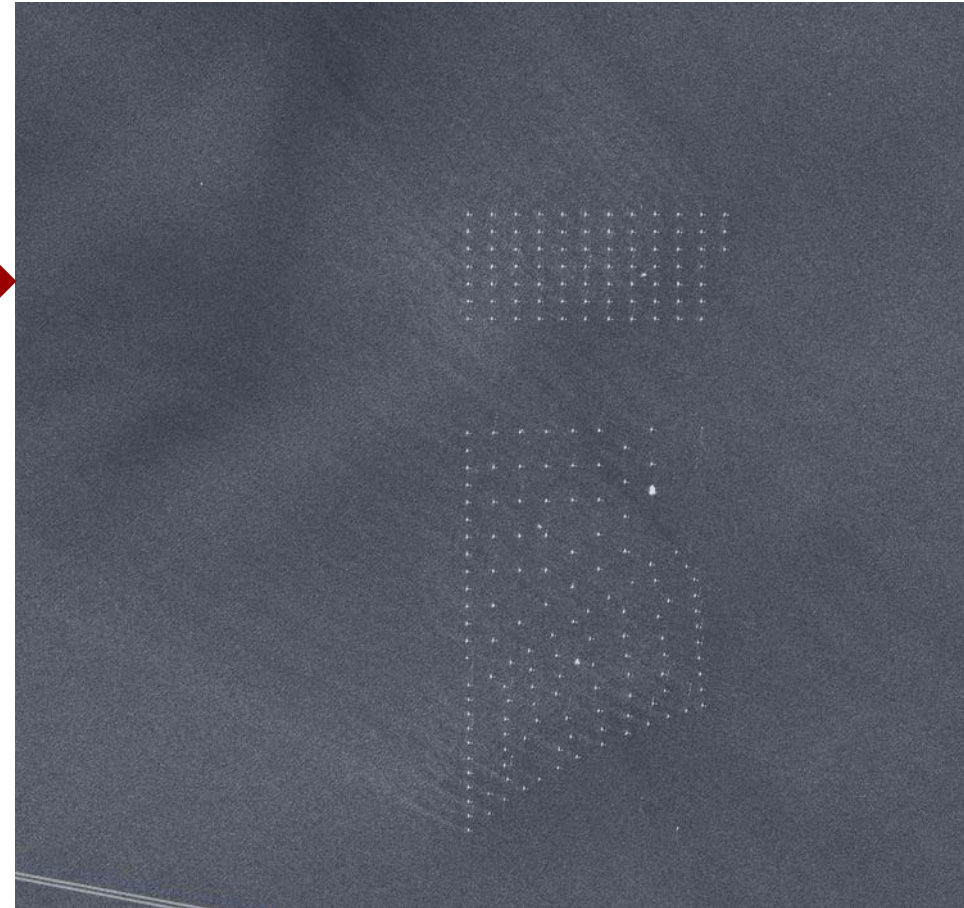
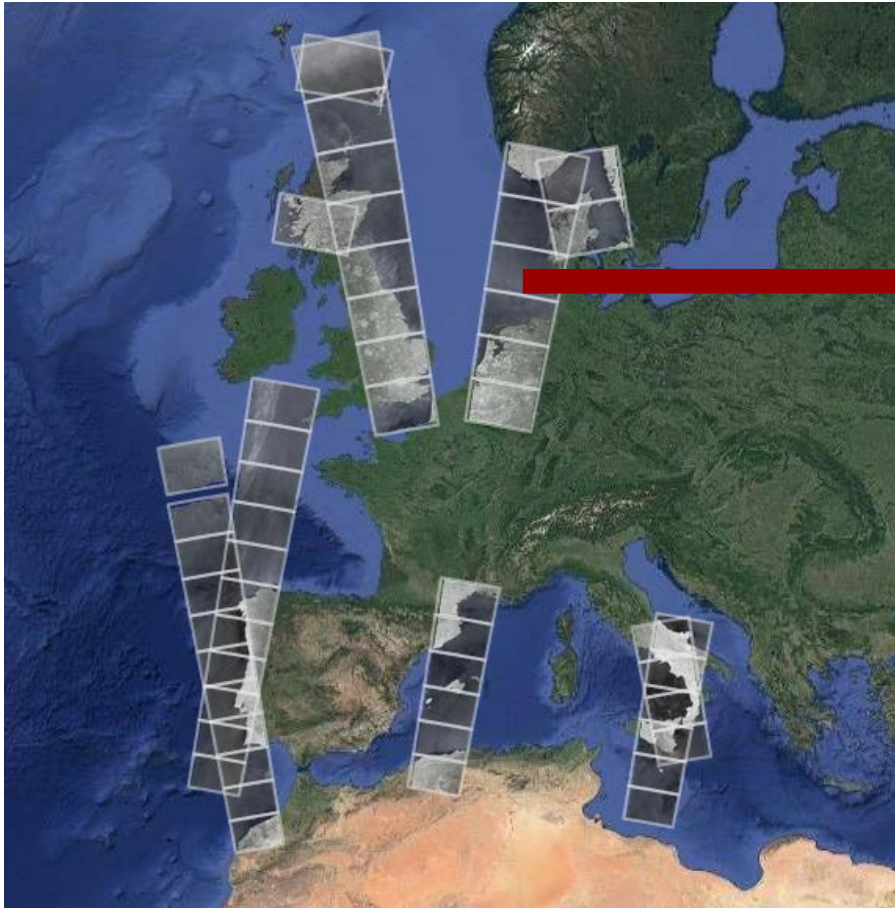


Source: ESA Ocean Virtual Laboratory,  
<https://ovl.oceandatalab.com>





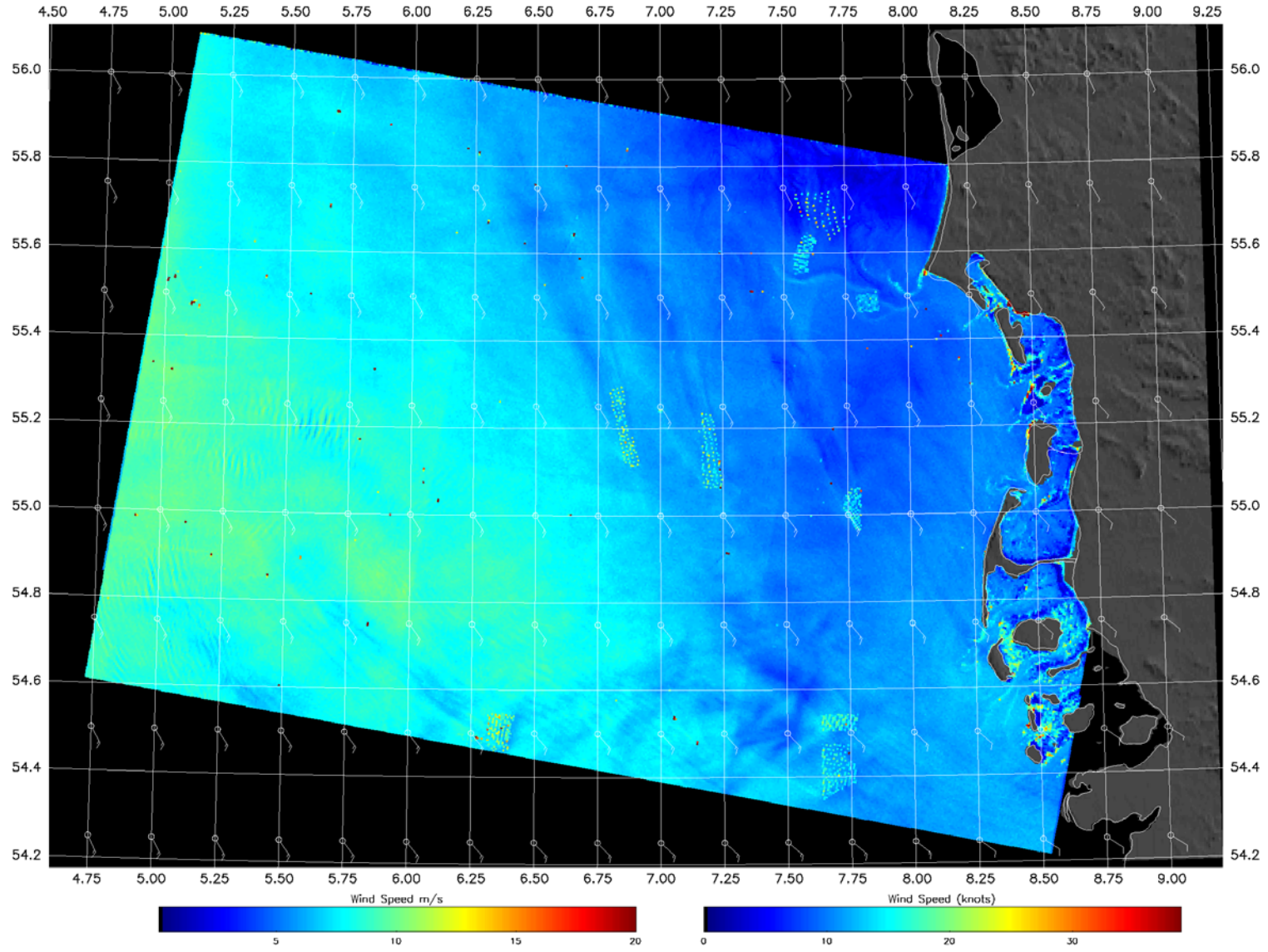
# June 2, 2019



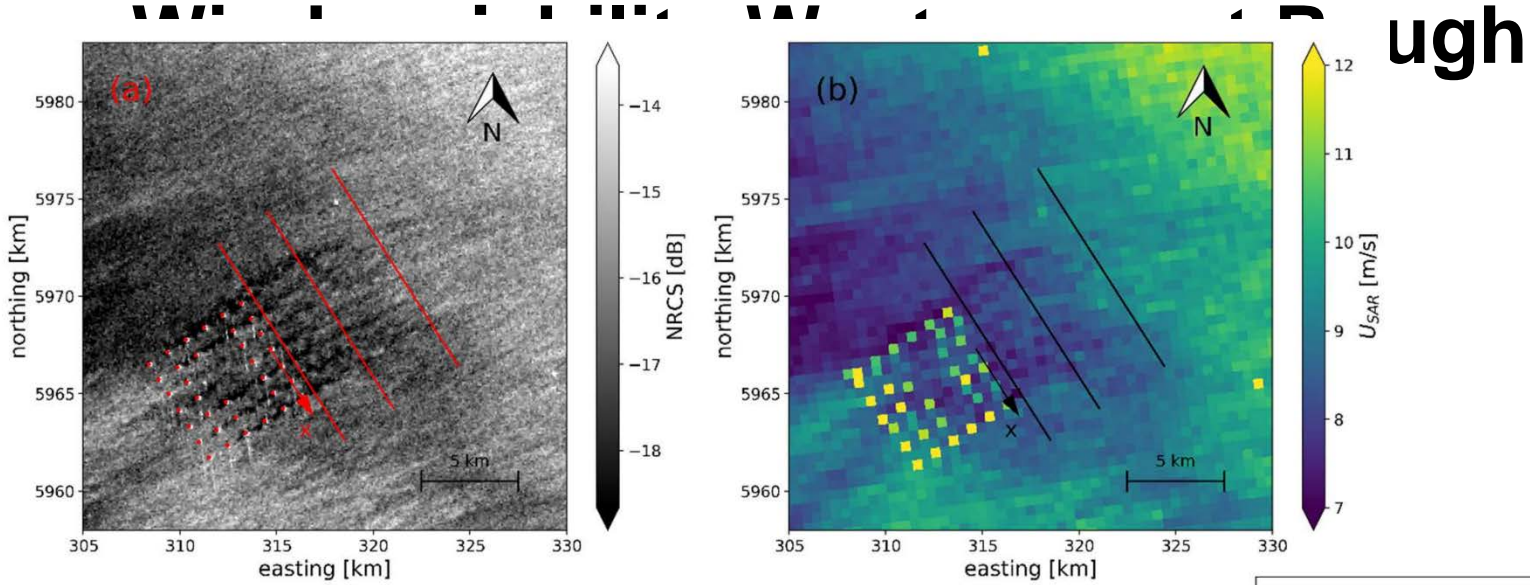
Source: ESA Ocean Virtual Laboratory,  
<https://ovl.oceandatalab.com>





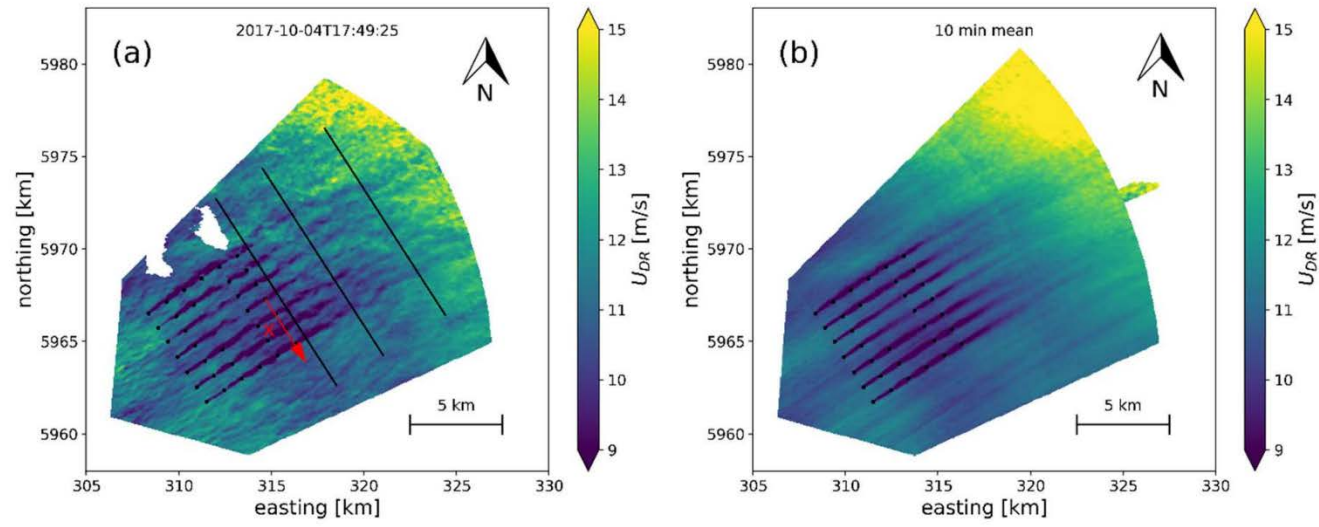


# Published results



ugh

Satellite-based radar backscatter and 10-m wind speed



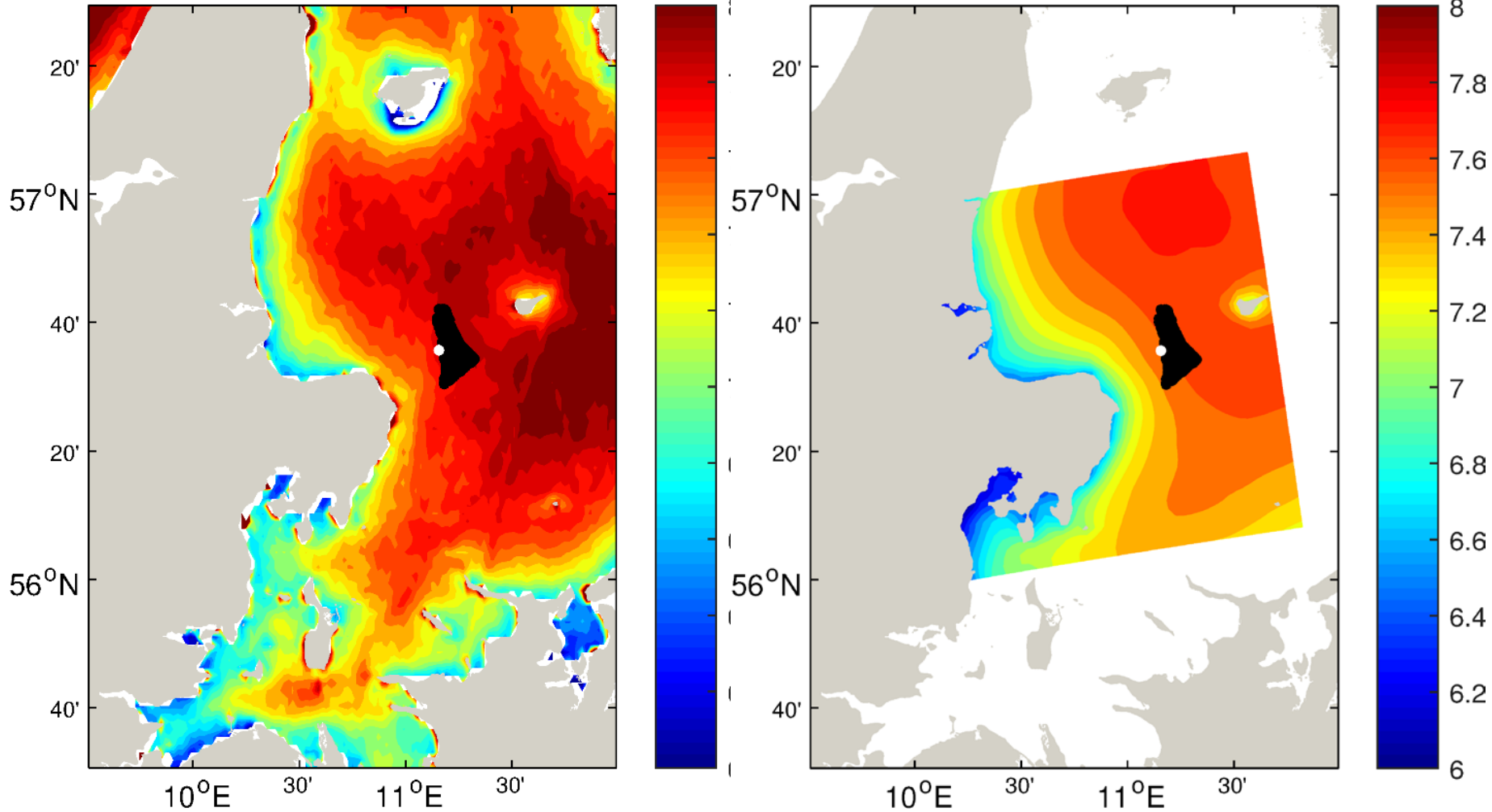
Ground-based Doppler Radar 10-m wind speed

Source: Ahsbahs, T.; Nygaard, N.G.; Newcombe, A.; Badger, M. Wind Farm Wakes from SAR and Doppler Radar. *Remote Sens.* **2020**, *12*, 462.

# Kattegat Strait mean wind speed

SAR – no wind farm

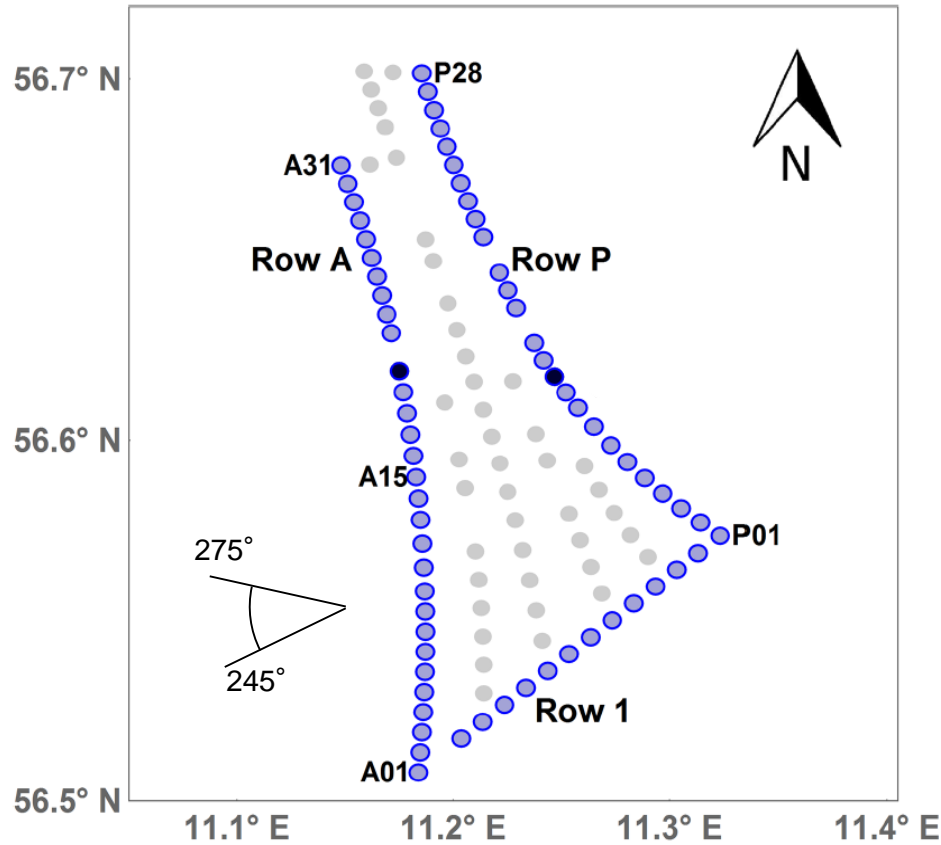
WRF – 2014



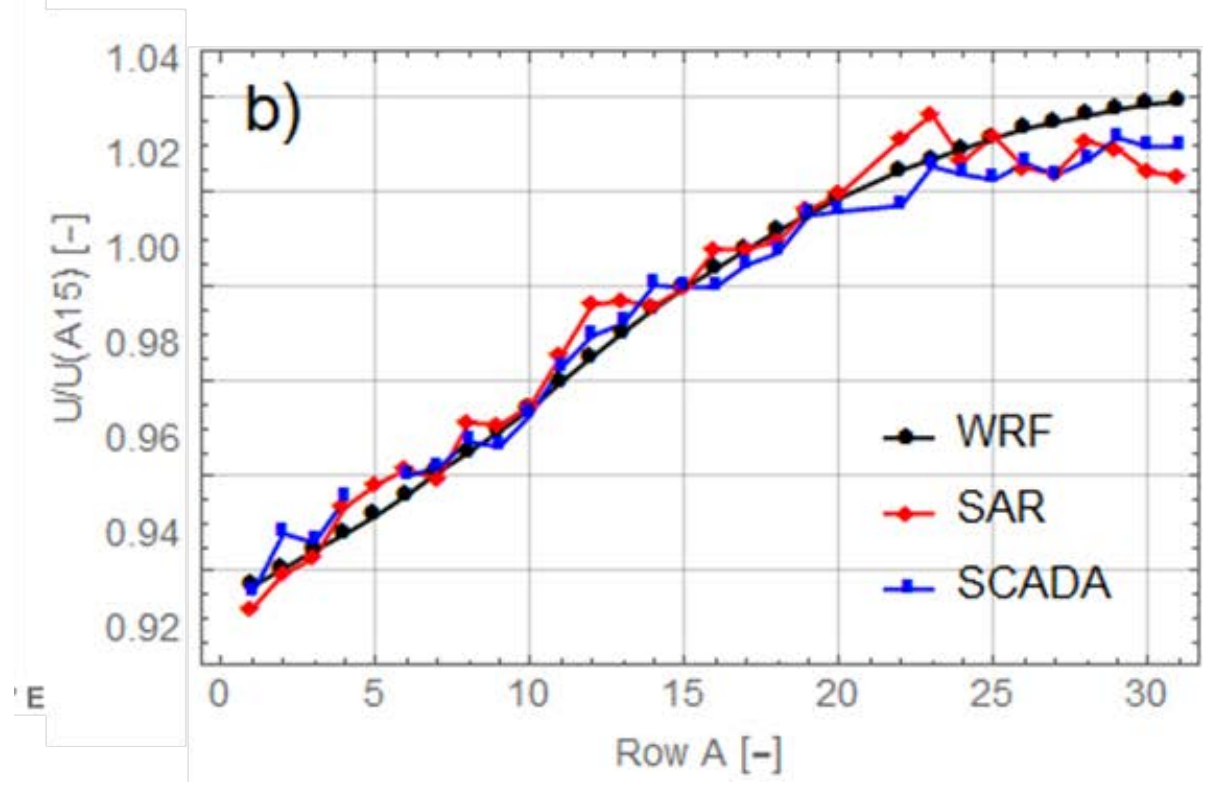
Peña, A & Hahmann, A. N.  
 2017, 30-year mesoscale model  
 simulations for the “Noise from  
 wind turbines and risk of  
 cardiovascular disease” project.  
 DTU Wind Energy E, vol. 0055

Ahsbahs, T., Badger, M., Volker, P., Hansen, K.S., Hasager, C.B. 2018 Applications of satellite winds for the offshore wind farm site Anholt. *Wind Energy Science*  
<https://doi.org/10.5194/wes-2018-2>

# Anholt wind farm



Mean wind speed normalized at turbine 15



Ahsbahs, T., Badger, M., Volker, P., Hansen, K.S., Hasager, C.B. 2018 Applications of satellite winds for the offshore wind farm site Anholt. *Wind Energy Science* <https://doi.org/10.5194/wes-2018-2>



# Djath *et al.* 2018, Satellite SAR analysis

Citation 1 from the paper:

*“One unexpected behaviour of  $\sigma_0$  that is found in about one quarter of the wake scenes was studied in more detail. In stable conditions, the radar cross section is typically increased with respect to the background values within a downstream distance of about 10km. In more unstable conditions, the cross section shows a rapid drop in the cross section immediately downstream the OWF, which is more in accordance with the expectations. “*

Citation 2 from the paper:

*“For example, offshore turbines are an obstacle for the airflow and hence one can expect a “blockage” effect related to mass conservation, which can lead to acceleration of the air below hub height.”*

[Djath<sup>1</sup>](#), [J. Schulz-Stellenfleth<sup>1,a\)</sup>](#), and [B. Cañadillas<sup>2</sup>](#) 2018  
[Journal of Renewable and Sustainable Energy](#)

# Ideas for systematic analysis

PhD student at DTU in the ITN Train2Wind project

Study title: SAR for offshore wind farms

Period: 1 November 2020 to 31 October 2023

Supervisors: Merete Badger, Ioanna Karagali (DTU) and Charles Meneveau (JHU)

*We expect, the value of SAR will be best in combination with other data*