On the spatial and temporal resolution of land cover products for applied use in wind resource mapping

Hasager, Charlotte Bay; Badger, Merete; Dellwik, Ebba; Floors, Rogier Ralph; Hahmann, Andrea N.; Mann, Jakob

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):
Hasager, C. B., Badger, M., Dellwik, E., Floors, R. R., Hahmann, A. N., & Mann, J. (2017). *On the spatial and temporal resolution of land cover products for applied use in wind resource mapping*. Poster session presented at WorldCover 2017, Rome, Italy.

ID 29

DTU Wind Energy
Department of Wind Energy

On the spatial and temporal resolution of land cover products for applied use in wind resource mapping

Charlotte Hasager (cbha@dtu.dk), Merete Badger, Ebba Dellwik, Rogier Floors, Andrea Hahmann, Jakob Mann, DTU Wind Energy, Denmark

The suitability of Copernicus Global Land Service products for wind resource assessment are investigated using two approaches.

Nut-shell on wind resource assessment. Basic input for wind resource assessment are roughness map, digital elevation map and wind data. The modelling of winds over terrain is typically done using mesoscale model coupled with microscale flow model. The output is the wind resource map for siting (Figure 1).

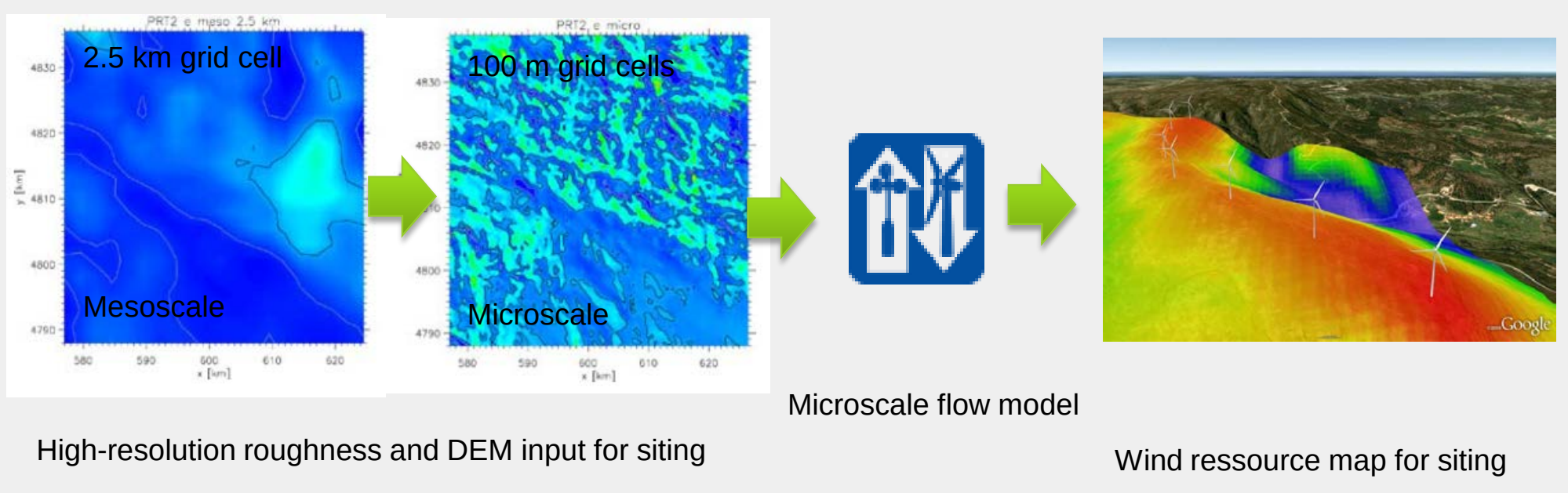


Figure 1. Wind resource assessment method.

In the first approach the CORINE land cover database and the pan-European high-resolution products were considered as input to atmospheric flow models. The CORINE data (Figure 2) was used as input for modelling the wind conditions over a Danish near-coastal flat region characterized mainly by low vegetation. The flow model results were compared to alternative use of USGS land cover (Figure 3). For both maps each land cover class were assigned a representative roughness value. Low roughness for low vegetation and higher roughness for tall vegetation (Esch *et al.* 2016).

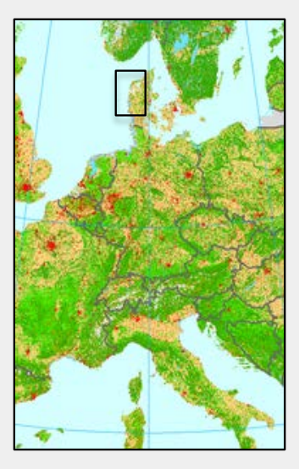


Figure 2. CORINE Overview of area Sub-set in Denmark is investigated.

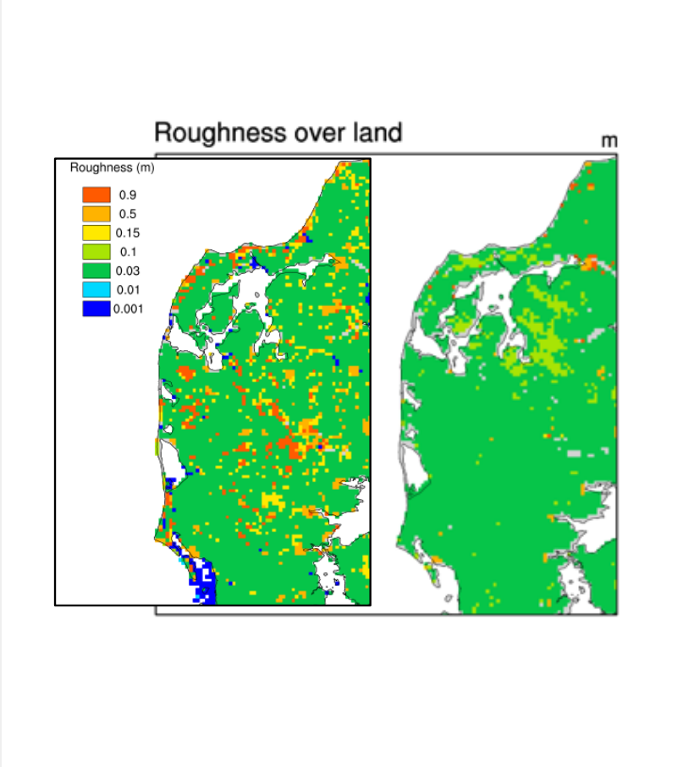


Figure 3. CORINE (left) and USGS (right) over part of Denmark.

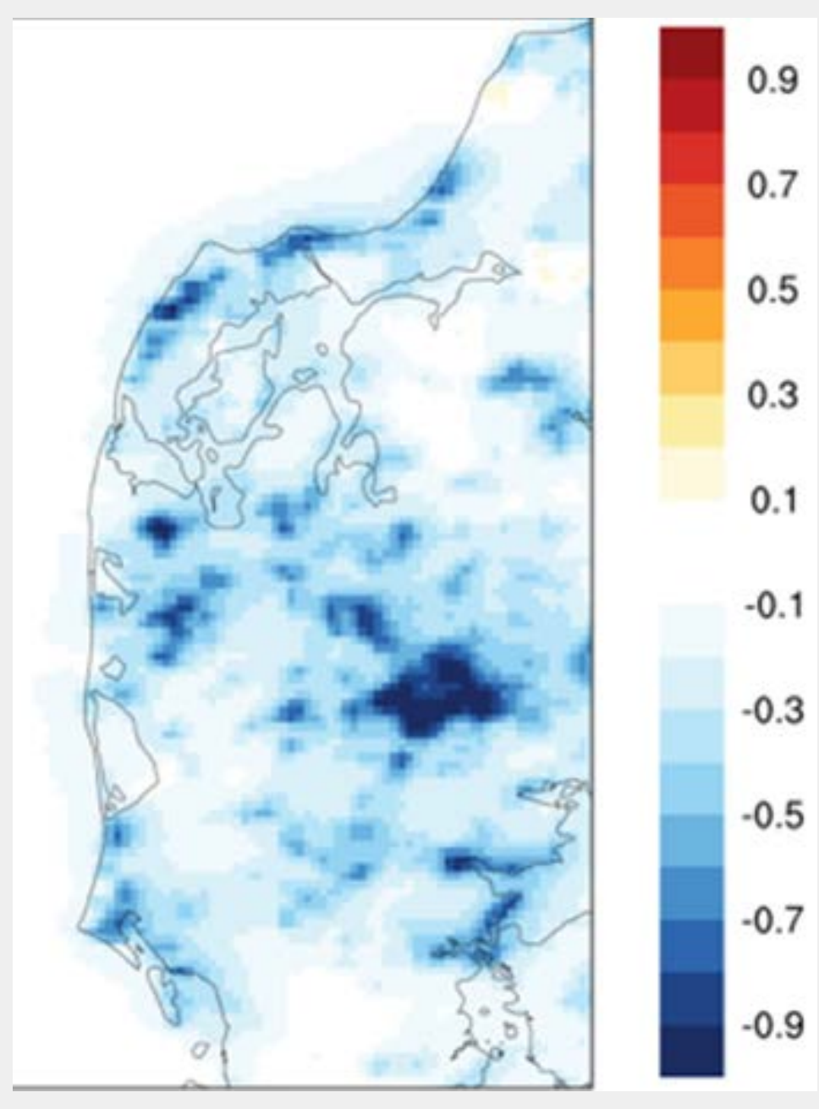


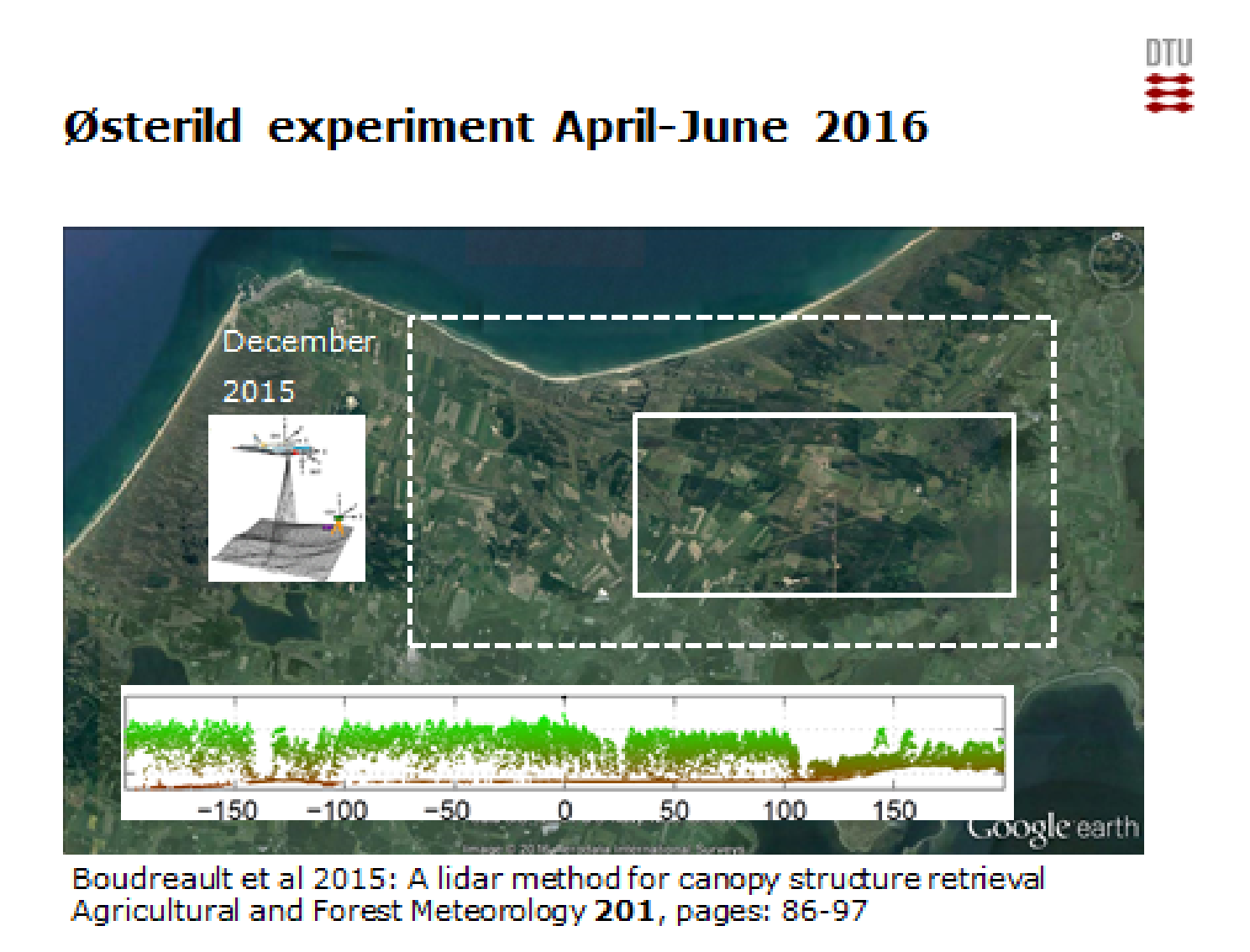
Figure 4. Wind speed difference using CORINE and USGS as input for part of Denmark.

The results in Figure 4 were compared to meteorological observations observed at a meteorological mast and from several ground-based wind profiling lidars. The model simulations using CORINE provide better wind flow results than using USGS on the investigated site.

The results from the wind modelling analysis show significant variations in the wind speed using the two different roughness maps based on CORINE and USGS (Figure 4). It is worth to note that for wind energy high accuracy in wind speed in crucial.

First conclusion is that CORINE Copernicus data are advantageous.

The next step towards improvement of flow model inputs is to investigate in further detail applied use of satellite maps in forested areas. 75% of new land-based wind farms are planned in or near forests in Europe. In forested areas the near surface atmospheric flow is more challenging to calculate than in regions with low vegetation because the tall vegetation to a high degree influences the atmospheric flow. Also in many forests the variation in forest plant structure is high. The forest structure depends on the tree height, the tree density, the existence of clearings, the types of leafs and branches and their structure. So the usual method of assigning one typical roughness length for land cover type 'forest' is at many sites not sufficient.



Østerild experiment April-June 2016

December 2015

Boudreault et al 2015: A lidar method for canopy structure retrieval Agricultural and Forest Meteorology **201**, pages: 86-97

Figure 5. Northern Denmark. The map shows the study area and the insert the horizontal profile from aerial lidar data.

In our second approach, we look at a forested area in Northern Denmark (Figure 5), where an aerial lidar scanned the terrain height, tree height and derived plant parameters (Figure 6). These map provided a novel input for atmospheric flow modelling in forested areas. The flow model results were compared to horizontally scanning wind lidar observations (Figure 7) and the results are very promising.

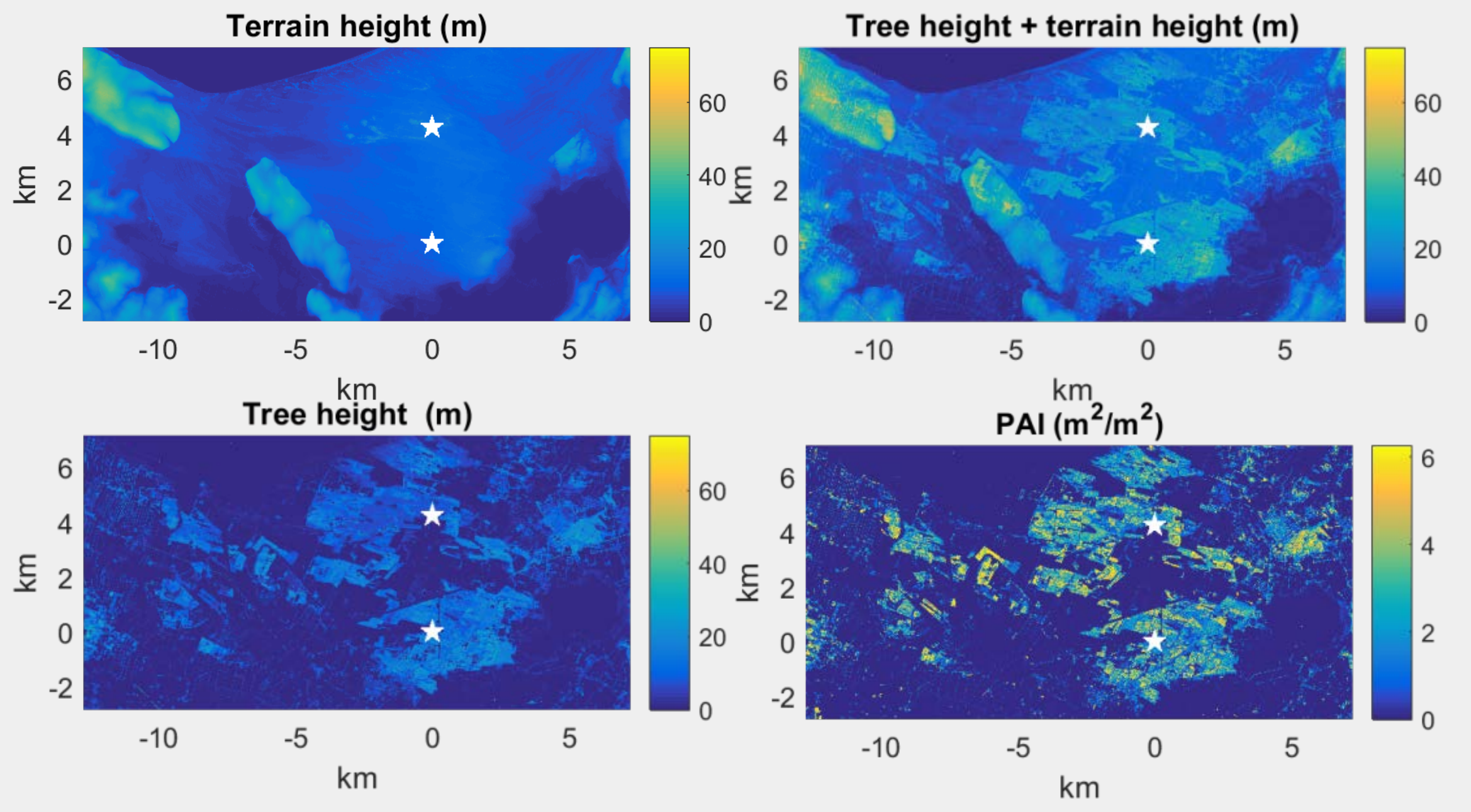


Figure 6. Terrain height, tree height and Plant Area Index (PAI) derived from aerial lidar in Northern Denmark.

Second conclusion is that detailed information on plant parameters from aerial lidar are useful in forested regions.

Since, aerial lidar data are not available everywhere, we discuss the possibility of using similar Copernicus Global Land Service products as input to the flow model. Thus the perspective is to investigate this further.

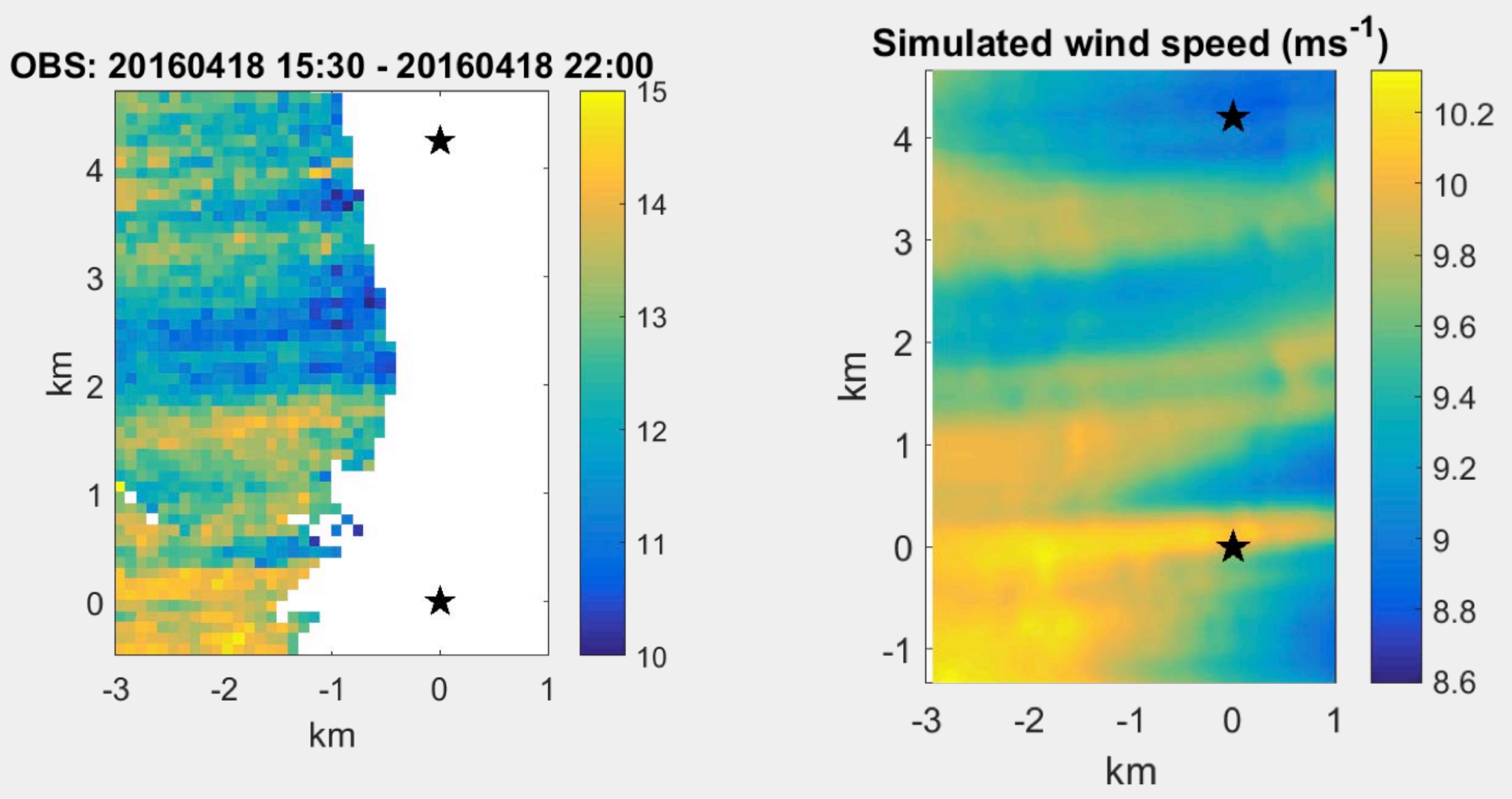


Figure 7. Observed wind speed using two lidars installed at the position of the black stars (left) and simulated wind speed using the input from aerial lidar (right) in Northern Denmark.

References:
Esch, T., Hasager, C.B., Elsner, P., Deutscher, J., Hirschmugl, M. Metz, A., Rieck, A. 2016. Support of wind resource modeling using Earth observation – A European perspective on the status and future options. In Qiaho Weng (ed.) *Remote Sensing for Sustainability,* CRC Press, Taylor & Francis Group.

Acknowledments:
RUNE project funded by Danish ForsEl and New European Wind Atlas funded by national agencies and ERA NET+ http://www.neweuropeanwindatlas.eu.

World Cover 2017 Conference, ESA, ESRIN, 14- 16 March 2017, Frascati (Rome), Italy