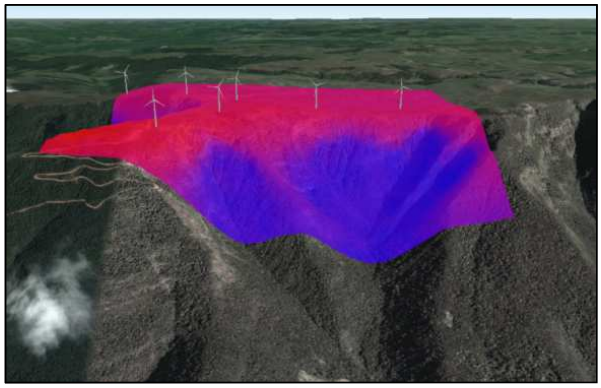
Introducing WindPRO V2.9

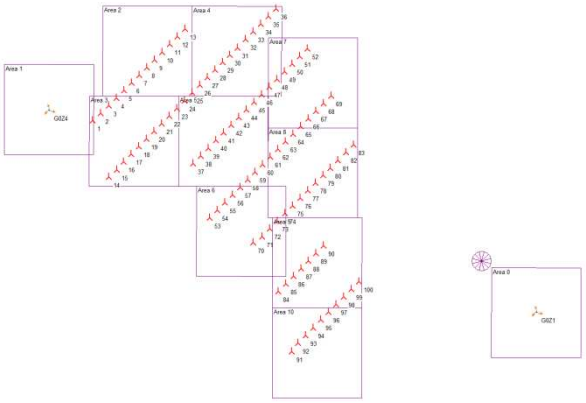
New Features and Enhancements

WAsP CFD Calculations in WindPRO

WindPRO V2.9 provides a user-friendly interface for conducting very detailed CFD calculations directly from WindPRO without any initial investments in hardware or CFD licenses by using a dedicated high-performance computer cluster operated by EMD, delivering calculation results directly to your computer within a few hours after your data has been uploaded.



The WAsP CFD model in WindPRO is designed with ease-of-use in mind. As a WindPRO user, you can use your existing WindPRO and WAsP expertise and skills to calculate accurate energy yield estimates in simple and complex terrain. Performing an analysis with the WAsP CFD model in WindPRO is very efficient since you are essentially using the same input data for your analysis as you would with a WAsP calculation. The use of the CFD tool requires a license to WAsP 11 and a licence for the WindPRO MODEL module.



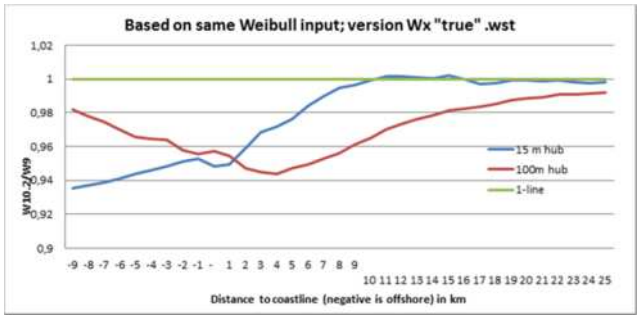
A calculation unit is defined to compute a 2 x 2 km area, so large sites require more units. The WindPRO software can auto-generate the calculation units needed based on WTG-area object data. It also has user friendly editing tools allowing the 2 x 2 km units to be edited graphically on the background map. The example to the right shows a site with 100 turbines and two measurement masts. As illustrated, 11 calculation units will be needed for coverage of this site.

One calculation unit will be processed in 20 to 30 minutes on the remote cluster operated by EMD, based on a first-in first-out queue. The user will be informed on the expected time of finalization when submitting the job. The price for running a WAsP CFD calculation on the cluster is 200 € per calculation unit. For comparison, a standard computer would take 3 days to calculate one 2 x 2 km area with the same high resolution as used by the WAsP CFD model, which includes many years of development and research to determine the resolution required to reduce the numerical uncertainty to a reasonable level.

Other WAsP issues

The new WindPRO 2.9/WAsP 11 combination introduces a new way of interfacing between WindPRO and WAsP. Whereas previous versions of WindPRO contained an integrated WAsP module, WindPRO 2.9 will simply find and utilize the standard WAsP 11 installation on the hard drive. The interface change is purely technical. Once WindPRO is running, the calculations are performed in the same seamless manner as before. Notice that the change only applies to WAsP 11. The use of WAsP 6-9 and WAsP 10 is unchanged. Using the new WindPRO/WAsP 11 combination, it is now possible to dump the more detailed WAsP output parameters such as calculated turn, roughness, orography and obstacles, speed-up and mesoscale roughness. These outputs are found in the PARK Result-to-File table for each turbine and each direction sector. Some of these features will also be included in an upcoming more advanced time-varying PARK calculation.

Note also that stability correction has been refined (from WAsP 10.2) where, especially for offshore and in coastal regions, different results will appear in relation to what is seen with WAsP 9 and previous versions. The graph shown on the right illustrates the effect of these modifications. The MAP file extract for WAsP is now based on a “clean cut” by the specified distance to include. Previously, it included all lines fully, that had even a single point inside the specified square. In some cases this created map coverage over a very large area, which lowered the WAsP calculation resolution.



Calculated Energy output with WAsP 10.2 (same as WAsP 11) relative to WAsP 9. Up to round 6% less can be seen in this specific example. And it shall be noted that there is a large hub height dependency.

Mesoscale Data Set

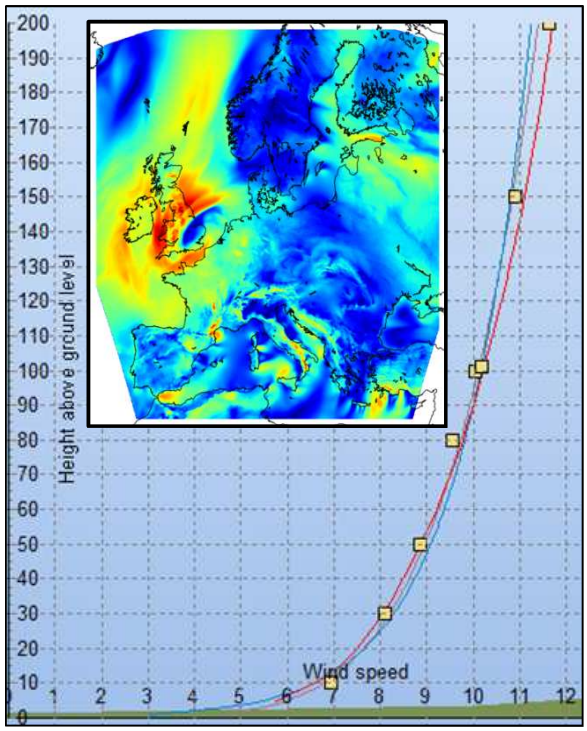
WindPRO V2.9 introduces an attractively priced subscription service offering access to download long-term time series from a high-resolution mesoscale data set covering all of Europe, modelled in-house by EMD and ConWx www.conwx.com.

The mesoscale data set is run at a high spatial resolution of 0.03° x 0.03° (approximately 3 x 3 km) with an hourly temporal resolution. ERA Interim data from ECMWF is the global boundary data set. Wind speed and direction will be provided at heights of 10, 25, 50, 75, 100, 150 and 200 m above ground level. For one or more heights, temperature, pressure and numerous other climatic parameters such as solar radiation, cloud cover, rain, humidity etc. are available. Data will initially be available from the year 2000 to present, but will be extended back 20 years during 2013. Monthly updates will be run with a delay time of approximately 3 months (depends on when ERA data are available).

Comprehensive tests against measurements are running continuously and any deviations found will be reported on the download page so users will be informed in the case where an offset or scaling will be required for a certain area to adjust the mesoscale data to the correct level. A comparison between the mesoscale profile and the WAsP calculated profile (red line) is shown to the right. At this site, a 160 m tall wind measurement mast was used to verify that the WAsP profile is correct.

The new data set covers Europe including larger parts of Turkey and Ukraine, excluding the northern extreme of Scandinavia. The coverage map for Europe is shown to the right.

The annual price for a subscription to download data from the EMD/ConWx mesoscale data set is 1,500 € for the first license and 450 € for each additional license. There is no limit on the number of data points which can be downloaded, as long it is within "reasonable use". Systematic download of data is not allowed and access will then be terminated.



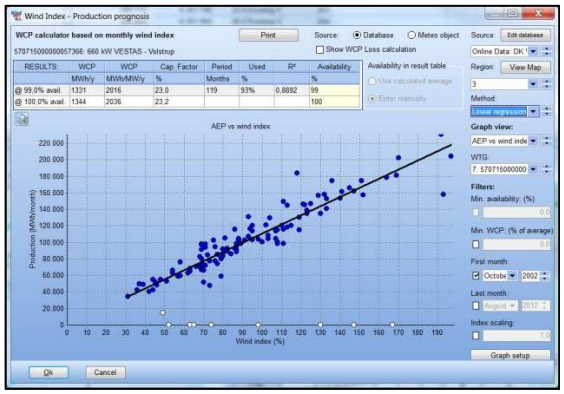
New Performance Check Module

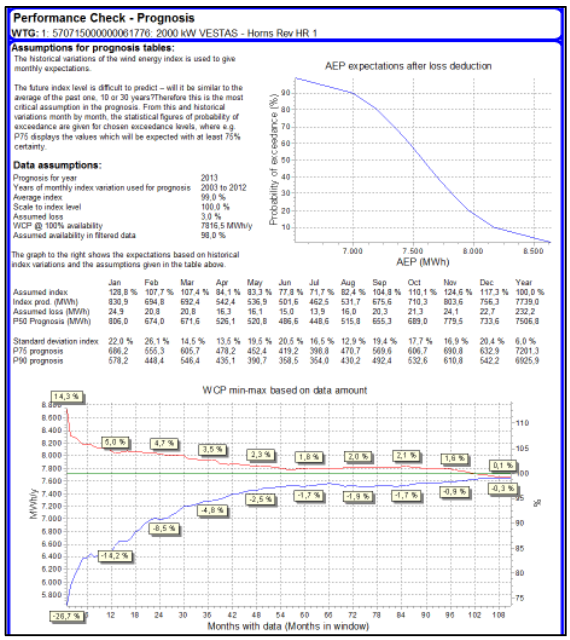
The Performance Check module is used for analysis of the actual production of turbines and wind farms. The main purpose is to determine if the turbines are producing as expected or if not, with the knowledge gained after a period of operation, what production to expect. In addition, the module is also a unique tool to determine if the calculation models and model inputs are working properly, or if the turbines are performing according to their power curves.

The tool works with both 10-min SCADA data as well as hourly, daily or monthly values. A more detailed time resolution will result in a more precise analysis, but when having many turbines with a long production period, if the purpose is just to get a general overview of the performance, it will be faster and more efficient to work with reduced resolution. In connection with this tool, the time-varying PARK calculation has been improved with flexible turbine selection for reporting, and features for time-aggregation to reduce the data to a workable level.

A comprehensive wind index system is also available. The user can create index databases and simply copy and paste indexes from Excel spreadsheets. Indexes can also be created from wind data in Meteo objects, where the features for scaling from the MCP module are included in an extended version. For example, having downloaded MERRA data for an entire country, a full country index database can be created with a few mouse clicks. Similarly, monthly updates require only a few mouse clicks. First click on "load new" for all Meteo objects in the Meteo analyzer, and then click on "update all" in the index database.

Calculation of wind index-corrected production (WCP) from monthly production figures and the index databases provides very useful information. In addition, reports can be generated to be provided to the turbine owner, which shows not only the expected long-term production, but also the loss analyses based on index production (real production, month by month and year by year). In addition, prognoses pages are available based on historical index variations and the calculated WCP. With the index, the standard variations probability-of-exceedance values are calculated, such as P75 and P90 for the next year on a monthly basis.

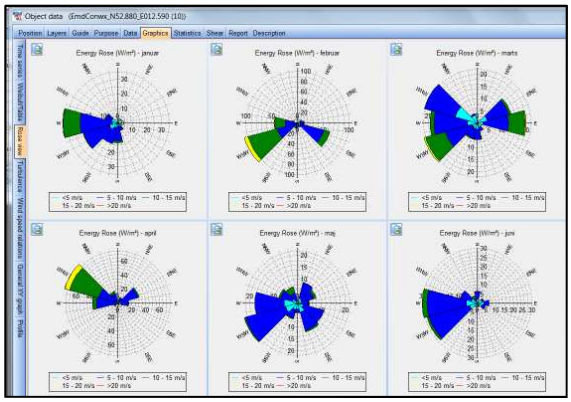




New METEO Object Features

The METEO object in V2.9 includes several new features making the data analyses even more comprehensive. New features include:

- Outliers on scatter plot (XY graph, etc.) can be shown in a time series graph by double-clicking on an outlier point. Disable the point by right - clicking.
- Disable line feature makes it possible to disable all outliers based on an XY graph with a single mouse click.
- Synthesized data series based on detailed shear matrix, like 24 x 12 for each direction. The shear matrix itself is quite a comprehensive tool for evaluation of the data quality (see example on screen shown to the right) where it is very clear that the shear is high in the winter and at night. Only in the middle of the day when sun is up is the shear considered “normal”. This is a northern Swedish site without sun in the winter months. Due to the forested location, the shear is in general, very high. The feature is found at the “Add” button, with a drop down for “Add Merged” and “Add Synthesized”.
- Copy button on each graph for extracting all graphed data for import into Excel or other spreadsheet.
- Graph zooms by mouse drag.
- Improved rose views with rounded slices, monthly frequency, as well as energy and power curve-weighted energy divided into wind speed intervals. See graph example shown to the right.
- Direct read of .RWD files from NRG loggers.
- Templates for Meteo reports can be saved or loaded. No need to start from scratch every time.
- XY and direction difference graphs load by default, the first two heights for preview, which is much easier and faster to work with. When the cursor is moved on top of a point, the time stamp is now shown on all graphs that are not aggregated.
- Toggle buttons in Wind Profile graph for height and wind speed. Thus, a fully mouse controlled form.
- And finally: When reloading data (e.g. with other calibration factors), the partially-disabled signals are not reset. The disabling flags are retained so that the entire screening process does not need to be repeated.



Other New Features

Although the aforementioned features make up the main new features of WindPRO 2.9, other valuable enhancements have been made.

New ON-LINE data services:

CFSR model wind data with global coverage: This is an alternative to MERRA, which in some places correlates better to measurements. Having two alternative data sets for long term correction will reduce the risk of incorrect estimates and reduce uncertainty.

WMS map service: A global format for background maps is the WMS format. Now these services can be used from WindPRO by typing the URL address. Some examples are included in the list, but the user can also add their own services. The new free Danish high-quality maps is one example of new maps available from this service.

Google overlay map import: Makes it possible to geo-reference maps with the Google Earth tool for this purpose, dragging the overlay map to the right position with correct orientation and sizing. Save the map from Google as a .kmz file and import into WindPRO.

Elevation data: Partly new, free KMS DK data as lines and grid points (very high quality and resolution). The data can be loaded from the line object or the elevation grid object via the On-line Data button. The data sources appear depending on location from where you start the download (position of object).

DECIBEL – NORD2000:

Demands for Noise Sensitive Areas (NSA) can be chosen at calculation time. This makes it more flexible to use different calculation models without the need to modify all NSAs. A mix of fixed demands and demands set at calculation is possible. The individual NSAs are given the property “select at calculation” as an option.

Distance to demand feature is a new option in the report. It is then easy to see how much a project can or must be moved in order to satisfy demands. Also, the reader of the report can see how close the turbines are to demands, not only in decibels but also in meters. The inclusion can be unchecked at calculation.

Checking distance demands is now possible in all noise calculations (also Danish low frequency), and it can be unchecked at calculation time. This will be appreciated by Danish users, because it is more logical to check distance demands in the low frequency calculation since the NSA point in this case is located at the house. For “normal” noise calculations, it is located 15 m from the house.

Finally, the new Dutch (Netherlands) noise model is improved. This model is quite complicated compared to other noise models, but is now easy to use directly from WindPRO and the results are confirmed to comply with expectations.

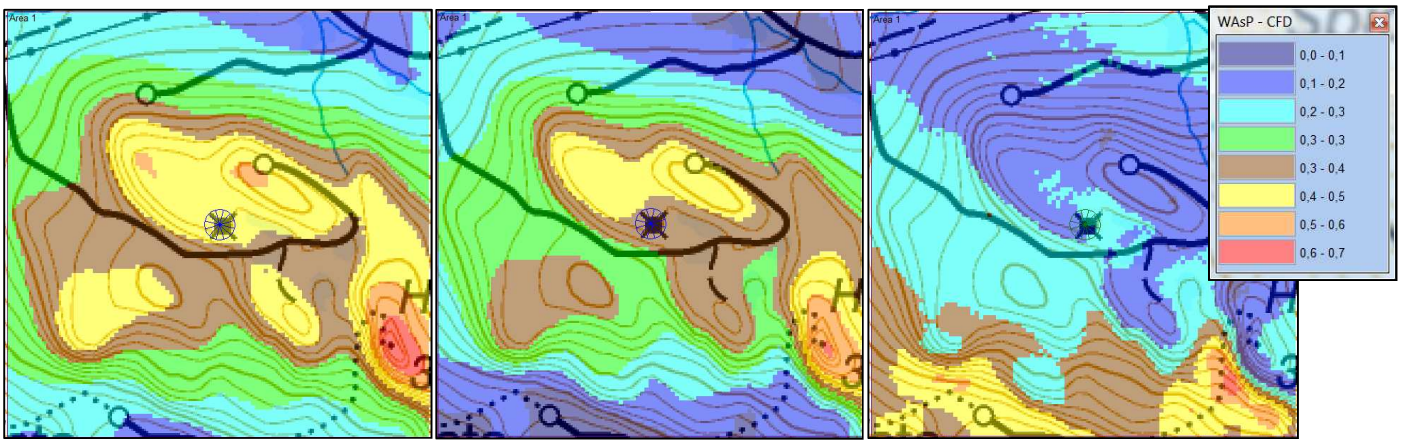
For NORD 2000, the major improvement is in the way the calculation engine runs. It no longer “fully takes over” the computer during the calculation. Instead, it runs in the background, which makes it much easier and faster to work with.

SHADOW

A minor improvement has been made in the accuracy of the calculation. In the past, the calculated flicker time that is below 2 minutes was rounded up to 2 minutes due to the time resolution used in the calculation. Therefore, the final result did not always match what was seen in the shadow calendar. This has now been fixed since rounding is no longer performed.

Result Layer – With compare layer feature.

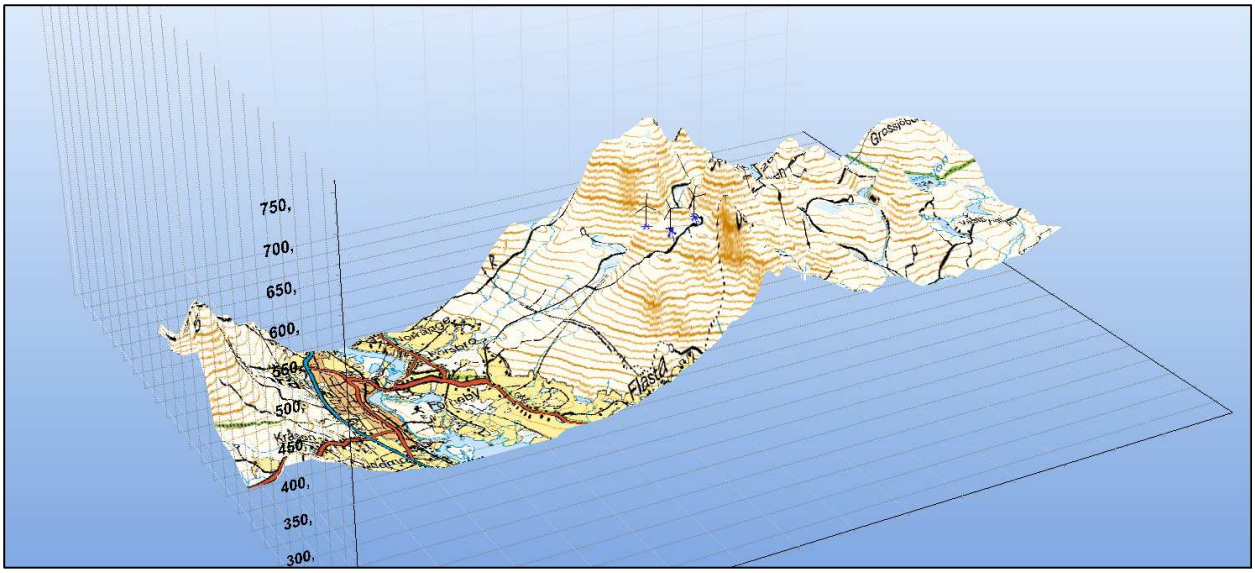
Two result layers can now be compared (e.g. a wind resource map based on CFD calculation is subtracted from a WAsP calculated map), and the model difference will become very visible. Any result layers can be compared, and even user-specified formulas can be used to define the comparison. For example, combining a noise result layer and a flicker result layer can be given a formula for calculating the combined impact (only limited by the imagination).

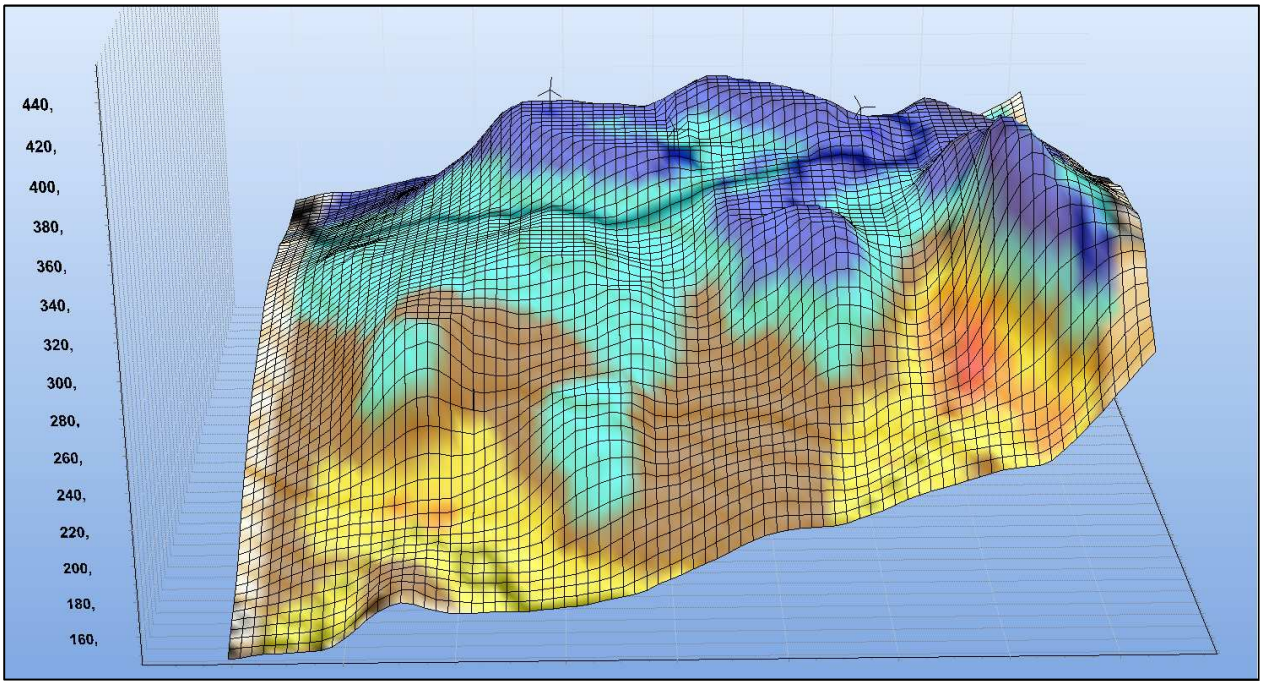


Figures above show calculated wind resource maps. To the left WAsP, in the middle CFD, and to the right the compare layer (WAsP minus CFD). As shown, up to a 0.7 m/s higher calculation value by WAsP than by CFD. Without the compare layer it would be hard to evaluate the more precise differences between the two models. See also graph at the end of next page.

3D Viewer – “Surfer-like”.

It’s finally here. This tool has been on our development list for many years. With the elevation grid data format, it became even more obvious to have. This is a fast tool for checking your site and elevation data. A few examples of possible views for the same site are shown below. Turbine objects are shown as a “sketch” with 3 blades, while other objects visible on the map are just shown as a bar. Any background map surface and/or result layer can be draped onto the terrain elevation data. The exaggeration can be adjusted and gridlines can be included. The portion to be displayed is controlled by what is visible in the map window. Finally and very importantly: It is extremely fast!





The last presentation shows the WAsP minus CFD result compare layer draped on elevation data. Here it is easy to see that it is in the valleys (areas behind hills), where the wind speeds are estimated a bit higher with the WAsP model compared to the CFD model.