

2. WindPRO BASIS

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2.0 BASIS – Intro, files, step-by-step guide etc.

2.0.1 Introduction to WindPRO BASIS

The WindPRO BASIS module is, as the name implies, the basis for all WindPRO calculation modules. With BASIS you have access to create a project, which typically consists of background maps and WTGs positioned on the map. Also, most of the other objects such as digital height contour lines, neighbors for noise calculations, etc., can be established from the BASIS module. In addition, the WTG Catalogue is managed through the BASIS module.

Enter all relevant information for a given wind energy project in BASIS, and use the WTG Catalogue to get detailed technical information for most of the wind turbines on the market and for adding new turbines to the Catalogue, e.g. for documentation and comparison purposes.

The calculations you can carry out depend upon which WindPRO calculation modules you have purchased. Non-activated modules can operate in DEMO mode, which means that you can input data, print reports (e.g. from the samples), but not calculate.

In the folder WindPRO Data\samples, some examples are included from which reports can be printed.

2.0.1.1 Conversion of previous projects

There is an almost full backwards compatibility to WindPRO projects created in the very first versions. In general you just open older WindPRO projects with the latest version, and conversion of data structures that might be revised will be performed. In the latest version, there will be "save as" feature allowing for saving in previous version.

In case of version conversion problems, please contact WindPRO hotline, and the team will do what's possible to help you out.

2.0.1.2 File type overview

The WindPRO-2 data files:

In the folder \WindPRO Data\Projects\...

*.w28p – WindPRO-2.8 project file – holds data stored in objects, plus calculation reports and links to files.

*.~w28p – backup of WindPRO-2.8 project file – is made when you save an opened project and is a backup of the opened project. This gives you the opportunity to revert to the original project file if you make serious mistakes (delete or change data) or if your PC or software should "break down" during the saving process and damage your project file.

*.w3p – WindPRO-2.6 – 2.7 project file – as above.

*.~w3p – as above.

*.w2p – WindPRO-2.0 – 2.5 project file – as above.

*.~w2p – as above.

*.wpe – WindPRO-1 export file – during export you can select which data to be included in the file (e.g. bitmap maps).

*.w2e – WindPRO-2.0 – 2.5 export file - during export you can select which data to be included in the file (e.g. bitmap maps).

*.w3e – WindPRO-2.6 – 2.7 export file - during export you can select which data to be included in the file (e.g. bitmap maps).

*.w2.8e – WindPRO-2.8 export file - during export you can select which data to be included in the file (e.g. bit-map maps).

*.bmi - Binary map info. Coordinate settings for user-defined maps. When a local coordinate system is used, it can be imported to another project from a BMI file.

*.bx Bitmap maps with coordinates defined in a BMI file. In the current version the files are saved in a PCX format but this can be changed later. "x" is the file number, starting with "0" for the first one.

*.wpo – Digitized lines from Line Object – holds height contour or roughness lines plus a digital elevation model (Triangular Irregular Network (TIN)).

*.wpg – Digital elevation data as gridded data saved from the elevation grid object – holds regular spaced digital elevation points, can hold more layers with different grid resolutions.

*.w2r – WindPRO regions – digitized polygons from Area Objects.

*.lty - Landscape types for WindPRO Area Object. (The landscape types are included in the .w2r files, but the .lty files makes it possible to exchange the definitions with other .w2r objects).

External file types (data from other sources), used with WindPRO:

*.map – WAsP map file format for digitized height contour and/or roughness lines

*.rsf – WAsP Wind Resource Map

In the folder \WindPRO Data\Standards

*.wmi – meteo import filter .

*.wbs – WINDBANK input file (template or complete input data file for economy calculation).

*.wsh – Solar and/or wind distribution for SHADOW calculation.

*.linecolorsetup – WindPRO color setting.

*.rastercolorsetup – WindPRO color setting.

*.noisemapsetup – WindPRO color setting for specific country and model.

*.flickermapsetup – WindPRO color setting for specific country.

*.lty – Landscape types – can be used from Area Object to import/export predefined landscape types from one Area Object to another.

*.wti – Wind Time variation file to use for time varying AEP calculations and loss calculations. There will be some example files included that can be used.

In the folder \WindPRO Data\Windstatistics

*.wvs – WindPRO Wind Statistics. Binary equivalent to LIB files, in addition to the Wind Statistics information, it contains information about country, coordinates, creation time, source, elevation, height and other info on the basis for the wind statistic. Also user comments written when the wind statistic is saved are included. File type can be locked so a license key is required to use the file (see Chapter 3).

*.LIB – Wind Statistics in Risoe's WAsP format (when saved from WindPRO, coordinate information is included) (see Chapter 3).

In the folder C:\WindPRO Data\WTG data

*.wtg – Wind turbine file – holds all relevant data of a specific WTG type, defined from manufacturer, type-designation, kW_{nom} - kW_{small} , Rotor diameter and Tower type. A typical name: **VESTAS V66 1650-300 66.0 !O!.wtg**, Where "!O!" means tubular tower and !# means lattice tower and "!3!" mean 3-leg tower and lastly "!" means unknown or other tower type. All information is integrated in a file, which is flexible to hold more different sets of e.g. power curves, noise data etc. In the .wtg files from EMD, the power curves etc. are integrated in the .wtg file. If the user adds some data, these will be placed in a separate file so an update from EMD can update previous data without destroying the user added data.

*.uwt – User-defined wind turbine file, which holds additional data to the .wtg file, added by the user. Note: The .uwt file only works together with a .wtg file with exactly the same name. If you want to send wtg data to another user, BOTH files must be copied.

*.wbl – WindPRO blade file, defines the shape of a blade for visualization purposes.

Other relevant file formats:

*.shp – Shape file (from Arc View GIS software) – polygons, which can be used as an overlay map in the Project Explorer and later on imported in the Area Object or added as background map. Samples can be found in **C:\WindPRO Data\Globe**

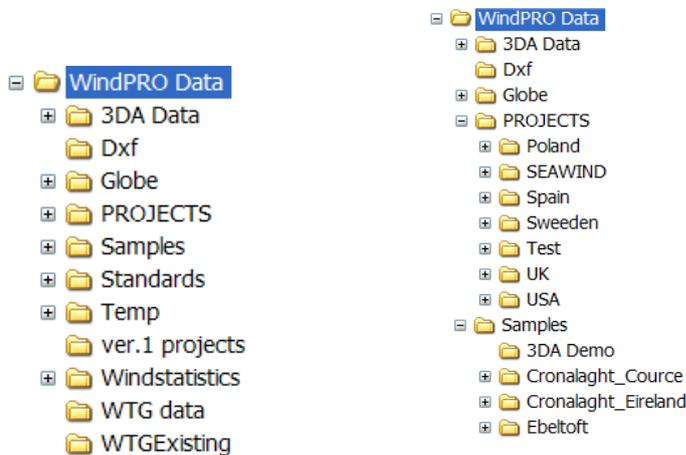
*.dxf – Auto desk exchange file format (Auto Cad) – can be digitized height contour lines, which can be imported in the Line Object or drawings of e.g. high voltage mast or lattice WTG-towers, which can be used for visualization purposes.

*.ntf – From the UK Ordinance Survey, digitized height contour lines can be imported in the Line Object.

2.0.1.3 Proposed way to organize data

We recommend that you create a folder in \WindPRO Data\projects\ for each new project (or group of projects in same region). In this folder, the project file (*.w2p) is stored as well as the local bitmap maps, digitized files, e.g. height contour maps, measured wind data, generated Wind Statistics, photos for visualization, site specific WTG-types etc. Hereafter it's always possible to have all data in the same folder, which makes backup of a complete project or handing over a complete project to other WindPRO-2 users easy.

Below on the left, the structure of default sub-folders to WindPRO Data is shown. To the right, the sub folder PROJECTS is expanded with an example grouping project sub-folders by country. If you only work in one country, other substructures might be better, depending upon how many projects you expect to handle. If only a few, each project should just have a folder with the project name.



For Wind Statistics and WTG-types that you might use for other projects, it's recommended to store a copy in the folders:

WindPRO Data\WTG Data
WindPRO Data\Windstatistics

If you are connected to a server and need to have files there for sharing of data with other employees, you simply create a folder on the server and add this folder to your Project Browser (and WTG and Wind Statistics Browsers). This folder should have exactly the same structure as the one described above, which makes it easier, e.g. when you want to move projects from the server to your local PC or Laptop for travelling.

Note: In the WindPRO project file (*.w3p), all files, which cannot be found in the original folder will be searched for and, when found, replaced automatically in the actual project folder or sub-folder to this (working directory).

The mentioned rules of addressing files means that links to data (for example folders with WTG Data or wind statistics) will be replaced with links on the new PC if project files are moved from one PC to another.

If you always want to use WTG Data from a common server, make sure that only a search path for this is specified in the WTG Explorer.

To be completely sure that you are working with exactly the same files as your colleague, but from another PC, make an export file (from menu files|export) with all files included and open them from your own PC, or work directly with the project files placed on a common server version.

2.0.2 Recommended hardware and auxiliary software

HARDWARE

PC	WindPRO2.8 can run under Windows 2000/XP/Vista/7 (Both 32 and 64 bit). Hardware requirements are as follows: Minimum specification is a 1GHz Pentium processor, 1GB RAM, 1GB HD free space. Recommended specification is 2GHz processor, 2 GB RAM, 2 GB HD free space. For 3D-Animator, a 3D-accelerated graphics card is required. Minimum screen resolution 1024 x 768.
Printer	Most publications are as PDF documents today. If real "quality" reports are needed, sending the job to a copy shop often will be chosen. Inhouse printer choice should be based on individual demands.
Scanner	If you don't have access to digital map sources, you will need a scanner to integrate background maps in WindPRO. An average to high quality scanner is recommended, as in low-cost solutions, deformations are likely to occur. For scanning large paper maps an A1-A0 drum scanner is ultimate, but if seldom used it will be cheaper to get this as external service.
Digital camera	For photomontages or just in general for documentation of the site a digital camera is a must. 2 Mpixel or more is preferable for visualization of WTGs. Knowledge of the exact focal length of the lens in 35 mm film equivalent is important – if the camera has zoom lens, it is an advantage to use the known min/max zoom, which then not should be too extreme. E.g. 35 – 70 mm (35mm equivalent) can be used in most tasks. Round 45 mm is closest to the human eye's "focal length" and preferred by many as "fixed lens". Most digital cameras stores EXIF info in the picture files, which is very usefully for photomontage use. The Camera object in WindPRO reads this information and you thereby get like date-time and focal length automatically loaded from photo. Some of the latest cameras store GPS coordinates for the photo position and even the direction the photo is taken. This makes it even easier to make a photomontage with WindPRO.
GPS (Global Positioning System)	A useful device (a must) for acquiring coordinates of objects (e.g. Existing WTGs, Measuring mast positions, Photographers' positions) in fieldwork. Expensive differential models can offer increased accuracy (0.1m), but need additional references (which must be purchased in addition) where "standard models" has round 10m, which in most cases are sufficient. Cable to transfer data to PC is very useful + software to download Waypoints (although this can be done from Google Earth) etc. (See chapter 2.5.4 import/export)

SOFTWARE

WASP from Risø/DTU from ver. 6 and higher (Windows)	Energy calculation engine used by WindPRO for calculations on complex terrain – so far the only real difference in WASP versions used from WindPRO is the calculation
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	speed and the size of digital contour data they can handle. WAsP 9 handles 1 mio. points, where 10.2 handles 2 mio. points. There are some differences from WAsP 9 to later versions, see separate notes on this topic at EMD Helpdesk. The page can be opened from WindPRO menu "Help – FAQ (Internet)".
WENG (WAsP Engineering ver. 3.0) from Risø/DTU	For the Site Compliance module this software can contribute with valuable calculation options in turbulence and extreme wind calculations.
Image and photo editor software (Paint shop PRO, Photoshop...)	A graphic tool for preparing scanned maps or digital photos for use in WindPRO. You can, e.g delete already existing WTGs on photos, if you wish to repower an existing project (use the "Clone" function to copy the landscape on top of the existing WTGs). A stitching program is also useful to prepare the panorama photo for photomontage.
Adobe Reader / Adobe Acrobat	To be able to read/view "PDF-files" it is a must on any PC to-day, this requires the free downloadable Adobe Reader – WindPRO also can save reports as .pdf. But being able to manipulate .pdf files like merging more files, have pdf as a standard printer etc. requires the extended version called Adobe Acrobat. But there are many different products within this field to-day, so search the web to find your needs. Installing a PDF printer is extremely convenient, while you then can print all reports as .pdf documents. There are free tools available for this purpose.

For some purposes, additional software will be required such as the WAsP software for energy calculation in complex terrain.

2.0.3 Getting started – language selection, etc.

To start WindPRO, click on the START button and then find "All Programs" and then the WindPRO subdirectory (if defaults are used when installing) and then press WindPRO-2.x language selection.

WindPRO 2.x – let you select language when starting (if more language modules are purchased). To start with a specific language, just click on the flag. Unlicensed languages can be started in DEMO mode.



2.0.3.1 Printing language

Printing reports in another language than you are working in is possible. To use this feature it requires a Print Language module. See in the start menu (shown above) which languages are available.

2.0.4 On-line data services



The WindPRO on-line data service is for many of our users the difference between WindPRO and all other tools. We put continuously a large effort in finding and testing free Internet based data sources of relevance for wind energy project development. Most of these sources are very difficult to get in to and requires basically programming skills to extract and after this engineering expertise to understand and convert to something that can be used. This would often take weeks for the user to get to the “useable level” of these data. We put them on our server and establish the conversions, so the user just need a few mouse clicks and a few minutes, then the data are ready for use.

At present we have the following on-line data sets:

- Background maps (See Project properties, 2.4.3.5 EMD Online maps)
- Elevation data (See Line object, 2.8.0.2 EMD online elevation data)
- Surface roughness data (See Area object, 2.9.2.4 Tab Sheet: Import/Export – with online data)
- Meteorological data (See 3.3.2.1 Guide – including on line data)
- Existing turbines, position, type and actual production (only DK) (See 2.7.1 Importing existing turbines)

Besides we have the comprehensive wind turbine catalogue, which we do not refer to as an online service, while the catalogue is build and maintained solely by EMD. But the catalogue can also be updated from a click at the update button in the turbine catalogue.

2.0.4.1 On line data for older WindPRO versions expires

The On-line data services are quite comprehensive to maintain, it is extreme huge data amounts to host. So the On line servers at EMD are frequently (each 1-3 years) updated to new larger computers. When this happens, we do not any longer update the software needed for downloading from older versions of WindPRO. This means having continuously access to the online data services, can only be guaranteed if you have the latest version of WindPRO.

2.0.5 Step-by-step Guide for creating a basic project

Follow this simple guide to get started fast and easy:

- ☑ Click at cross hair **New project:**  then at the location at the globe for the new project.
- ☑ Save the project in \WindPRO Data\Projects\My first test
- ☑ Go to tab Background Maps, click “Online Map” – take OpenStretMap (or another) – zoom to reasonable level (or select size) and click OK
- ☑ Then click OK to the “Project properties” form.
- ☑ Insert an Elevation Grid object – click on the  in right menu bar.
- ☑ Choose “On-line data”, go through the download process. Try out the color setup.
- ☑ Insert New turbines – click the  in right menu bar. Make 5 in a row.
- ☑ Open the Google window – click the  in left menu bar.

Now you start to have an idea about how WindPRO can be used!

Create relevant objects depending on which calculations you wish to perform. Simply click on the object in the right part of map window, and then click on the map. Read the relevant parts of the manual for a specific object and calculation. Follow the step-by-step guide for the desired calculation.

Go to the calculation menu, when the necessary objects have been established.

Perform the calculation and print the reports.

2.0.6 Auto save / recovery

There is an automatic auto save feature. This runs each time a calculation is performed and by several other events. It is “intelligent” so it check how long time last auto save did run, if less than 3 minutes it won't run and thereby it disturb as little as possible. If the software or the PC crashes, a restart of WindPRO will start asking if you want to open the recover file.

You can also load the backup file, the project file that was opened last, by choosing the *.~wXp file.

2.1 BASIS - The structure of WindPRO

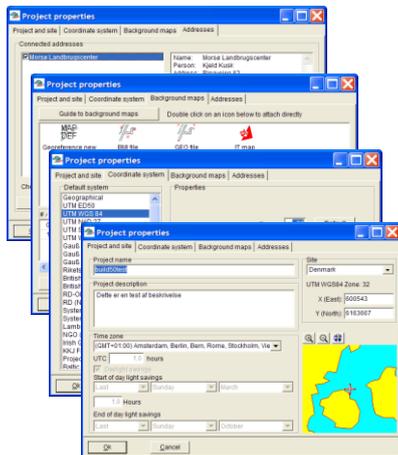
2.1.1 WindPRO structure – System overview

WindPRO System overview

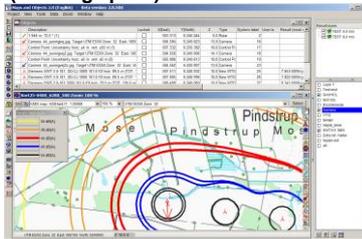


Project Properties

Basic settings: Costumer, coordinate system, Maps



Maps and Objects (Working space)



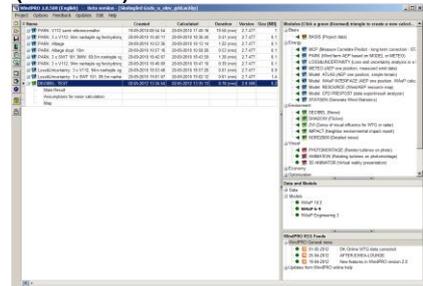
WindPRO data:

- WTG Data
- Windstatistics
- Standards
- ON-LINE data (maps,meteo,terrain)

Objects: (data containers)

- New WTG
- Existing WTG
- Park Layout (Only with Optimize)
- WTG area (Boundaries,optimize)
- Line object (height/roughness/3DA-track)
- Elevation grid (heights as grid data)
- Area object (ZVI, roughnes etc.)
- Meteo data (energy)
- Obstacle (energy)
- Site data (energy)
- Noise Sens. Area (decibel)
- Shadow receptor (flicker)
- Camera (visual)
- Control mark (visual)
- 3D-object (visual)
- Virtual Reality (3D Animation)
- Radar
- eGRID (electrical - EXPANDABLE)
- Measure tool
- Shape tool (Also for Gridlines on map)
- Text

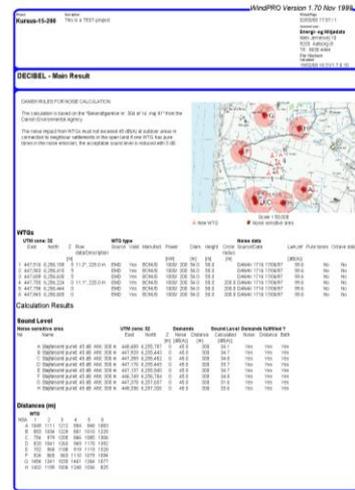
Calculation modules (Main menu)



Reports - ready for authorities and investor

Full documentation for project approval and banks

Printout example



Input to the program is given in the following menu items:

Project Properties, where the general project information is entered (name, project description, client, coordinate system and any associated map).

Maps and Objects, where the specific conditions for the project are entered (wind turbine positions, wind turbine type, information on calculation of wind conditions, noise conditions, etc., depending upon the type of calculations desired).

Calculation modules. When a calculation module is activated you can restrict the calculation to selected objects from the object/map list. You are also given various choices, e.g. which calculation module to select when more than one calculation module can be used.

The five icons shown below indicate the shortcuts to input of information:

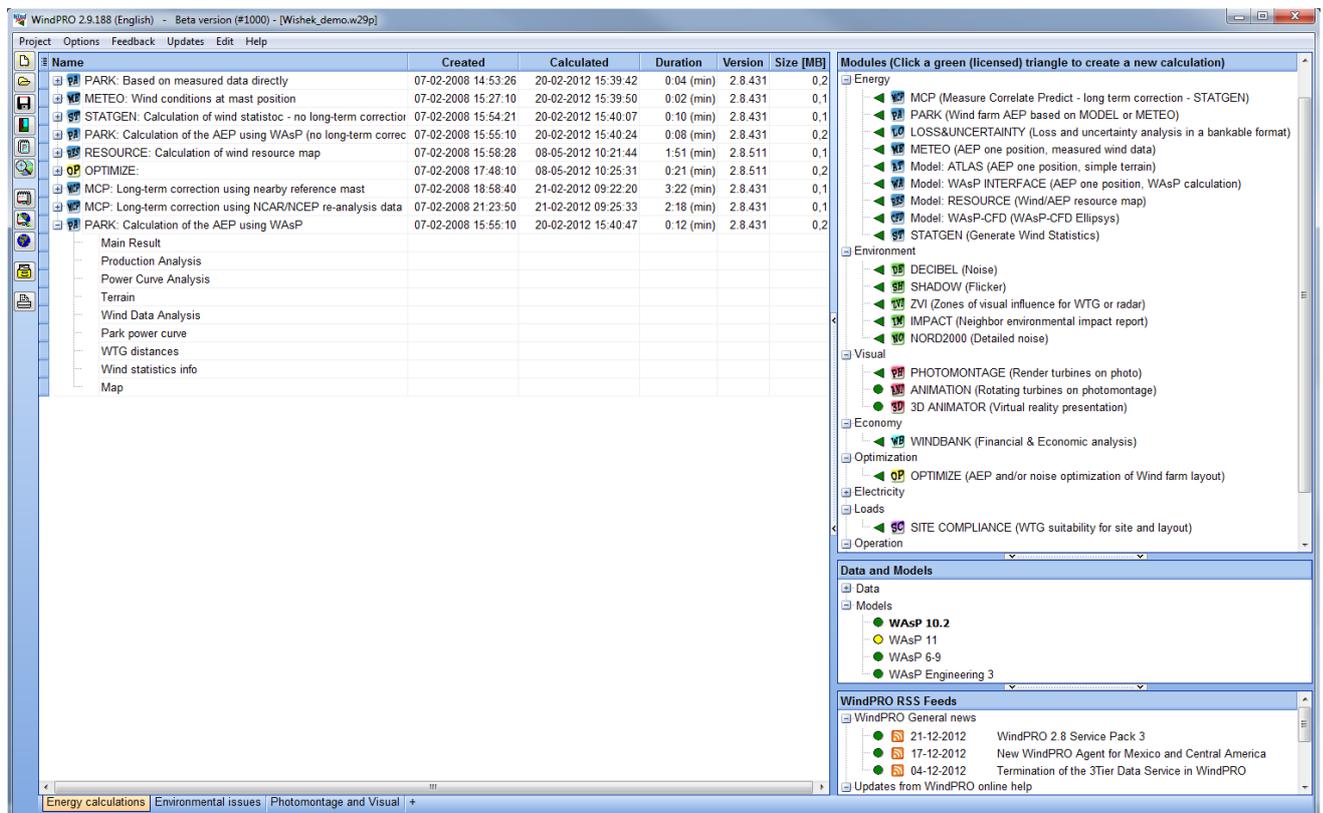
-  Project Properties
-  Objects (coordinates and object description, e.g. for the wind turbines)
-  Maps (graphic viewing of background map and entering of objects)
-  Maps and Objects (both the map and Object Lists are shown on screen)
-  Calculation (menu with calculation modules)

Calculations and outputs (reports) are carried out in the last item.

2.1.2 WindPRO structure – Calculation and report window

Calculation output (in the form of reports) is stored in WindPRO. If a printout of an earlier calculation is needed, you just have to open the project in question and print out the needed reports without having to rerun the calculations.

The output is arranged in a tree structure similar to the Windows Explorer. It gives you a good overview of the calculations carried out. This tree structure is shown on the calculation icon button.

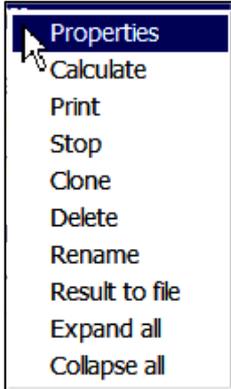


Name	Created	Calculated	Duration	Version	Size [MB]
PARK: Based on measured data directly	07-02-2008 14:53:26	20-02-2012 15:39:42	0:04 (min)	2.8.431	0.2
METEO: Wind conditions at mast position	07-02-2008 15:27:10	20-02-2012 15:39:50	0:02 (min)	2.8.431	0.1
STATGEN: Calculation of wind statistoc - no long-term correctio	07-02-2008 15:54:21	20-02-2012 15:40:07	0:10 (min)	2.8.431	0.1
PARK: Calculation of the AEP using WAsP (no long-term correc	07-02-2008 15:55:10	20-02-2012 15:40:24	0:08 (min)	2.8.431	0.2
RESOURCE: Calculation of wind resource map	07-02-2008 15:58:28	08-05-2012 10:21:44	1:51 (min)	2.8.511	0.1
OPTIMIZE:	07-02-2008 17:48:10	08-05-2012 10:25:31	0:21 (min)	2.8.511	0.2
MCP: Long-term correction using nearby reference mast	07-02-2008 18:58:40	21-02-2012 09:22:20	3:22 (min)	2.8.431	0.1
MCP: Long-term correction using NCAR/NCEP re-analysis data	07-02-2008 21:23:50	21-02-2012 09:25:33	2:18 (min)	2.8.431	0.1
PARK: Calculation of the AEP using WAsP	07-02-2008 15:55:10	20-02-2012 15:40:47	0:12 (min)	2.8.431	0.2

When a calculation has finished, the window shown above will appear, listing the available reports that can be printed.

There will be info columns telling when calculation was created, last calculated, the duration and with which version. The size in MB show how much space the given calculation takes in the project file. Having many MB in project file slow down save/open, so it is worth deleting large calculations no longer used.

A sub-level report will automatically pop up on the screen if you double-click on a sub-level report name. The sub-level report has its own right-click options, where you can define report details. When you right-click on the calculation header or on one of the calculation reports, you get access to this menu:



Choosing “print” gives access to setup all report features that can be modified.

The “clone” makes a copy of the calculation, so it is easy to e.g. calculate another turbine layout with exact same settings – just the turbine selection shall be changed.

The Result to file allow for saving some results in other formats, e.g. copy to clipboard and then paste to excel or save results as text files. Some graphic outputs, like iso noise lines, can be saved as shape files.

2.1.3 WindPRO structure – Menus in maps and objects

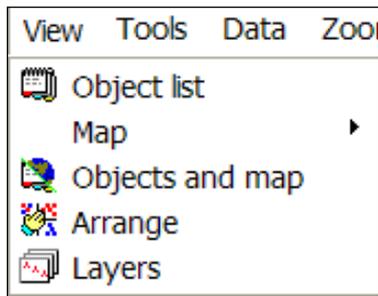
In this section, an overview of the menus is given. Note that by pressing the <Alt> key (if activated in your windows setup), all menus can be activated from the keyboard by pressing the underlined letter when the <Alt> key is held down.

2.1.3.1 Project



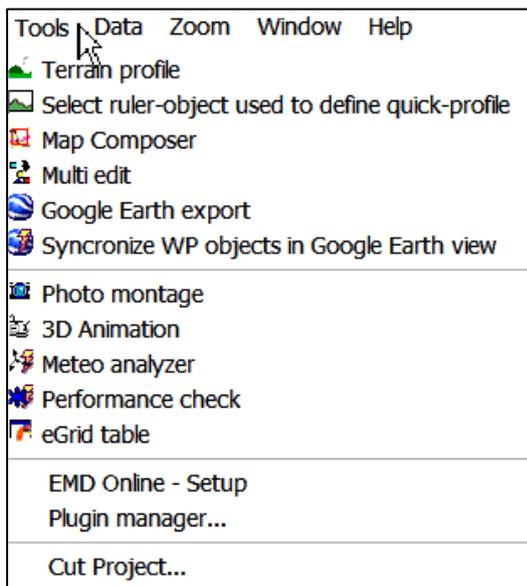
Direct links to the main functions – note that the “Save as” function is only available from the WindPRO main menu.

2.1.3.2 View



The Layer structure is very useful for organizing your objects. You can save a preferred layer structure and load it in other projects by right-click at the layer form. The layer form can be docked into the main window.

2.1.3.3 Tools



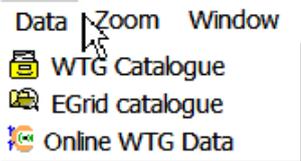
First group are general tools, just requiring a BASIS license. The next group is module specific tools that require a license to related modules to work fully. The different tools are described in relevant chapters (perform eventually a search to find where)

The EMD online – setup should be checked if on line data service do not work.

The Plugin manager is more an “internal tool” that can be used to disable some services if unexpected errors occur.

The “Cut project” tool makes it possible to delete all data outside a given area. If you import a large amount of GIS data or height data from other sources and only wish to work on a limited part, this is an easy way to get rid of many different types of unwanted data in one operation.

2.1.3.4 Data

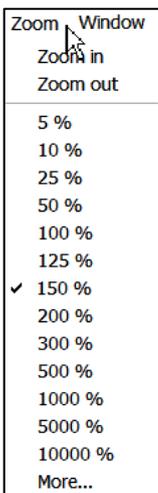


WTG catalogue holds comprehensive data on all turbines.

Egrid catalogue on transformers, lines and cables.

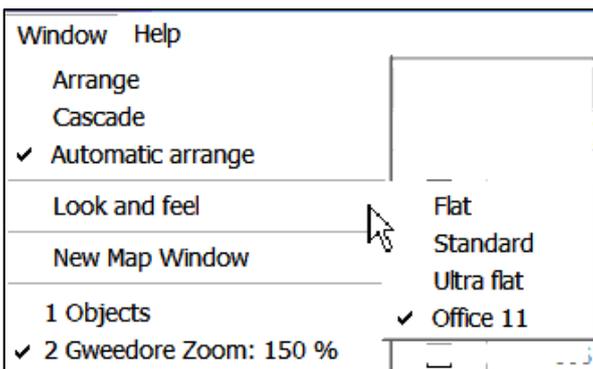
Online WTG data imports existing turbines as objects in a specified radius, so far only for Denmark, but planned extended to other countries in time.

2.1.3.5 Zoom



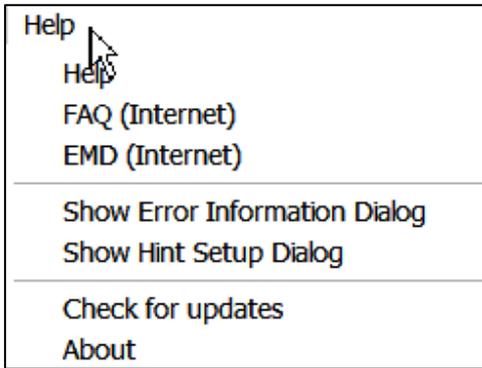
By “More” the zoom can be freely defined.

2.1.3.6 Window

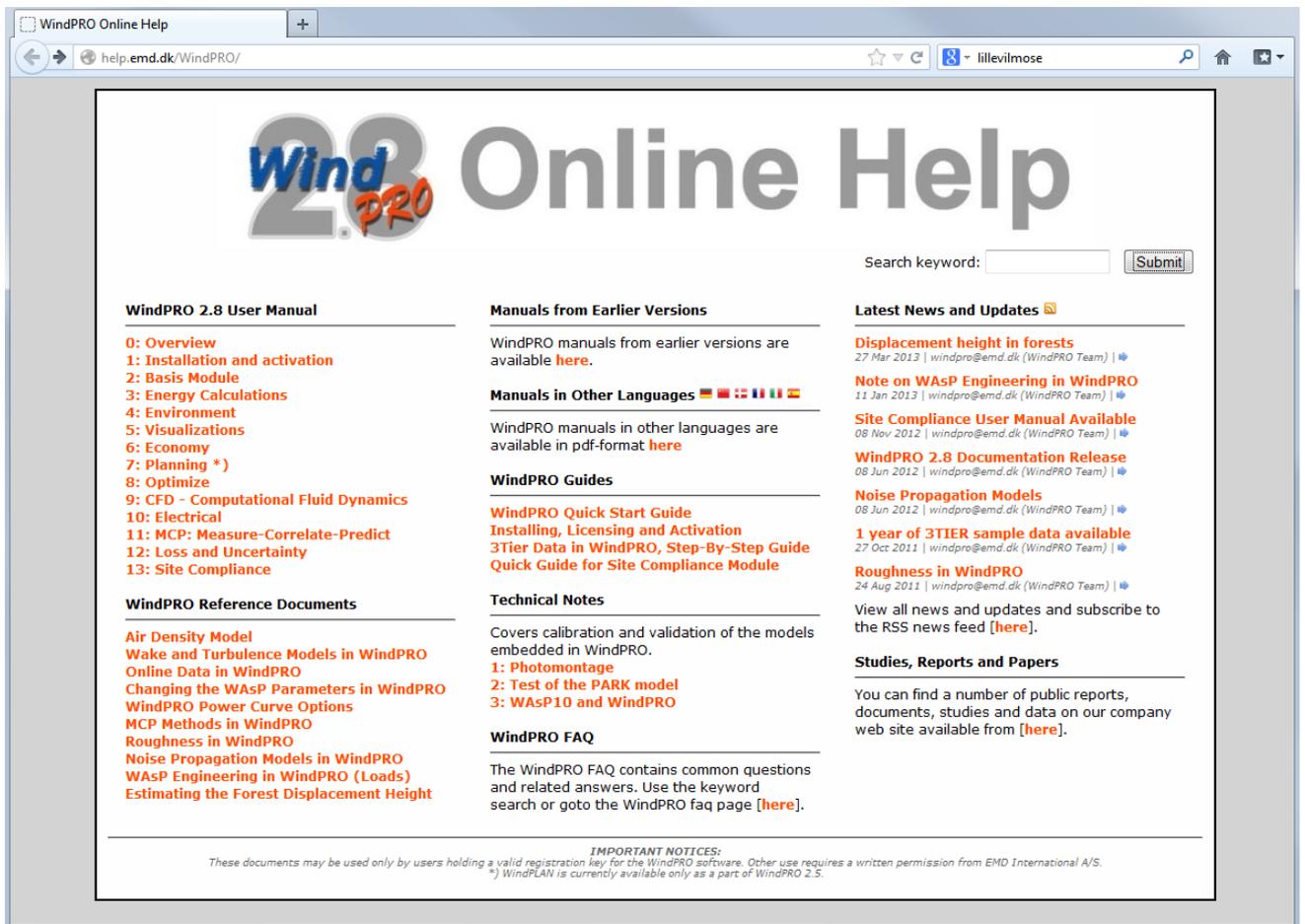


Standard Windows-arrange functions and the “look and feel” giving different options for setting the way the windows are presented.

2.1.3.7 Help

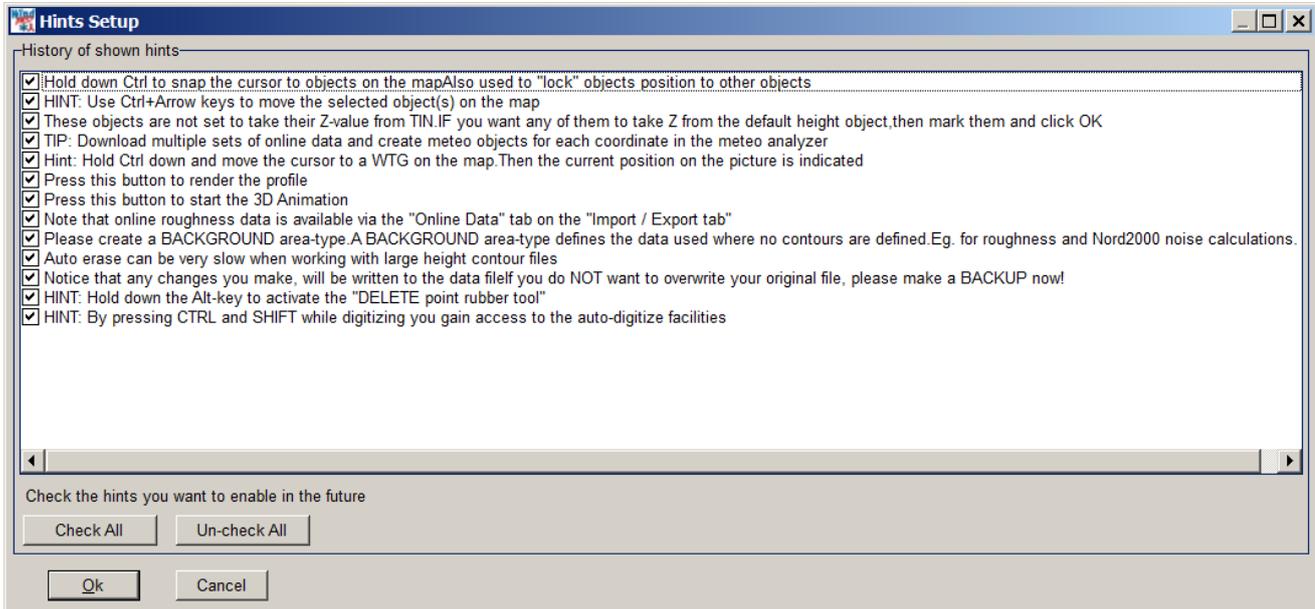


Help, FAQ gives access to comprehensive help desk, the EMD leads to the EMD home page.



The FAQ help desk – full free text search in all documents.

Hint setup makes it possible to choose where hint dialogues shall appear and where it won't be convenient, see list below.

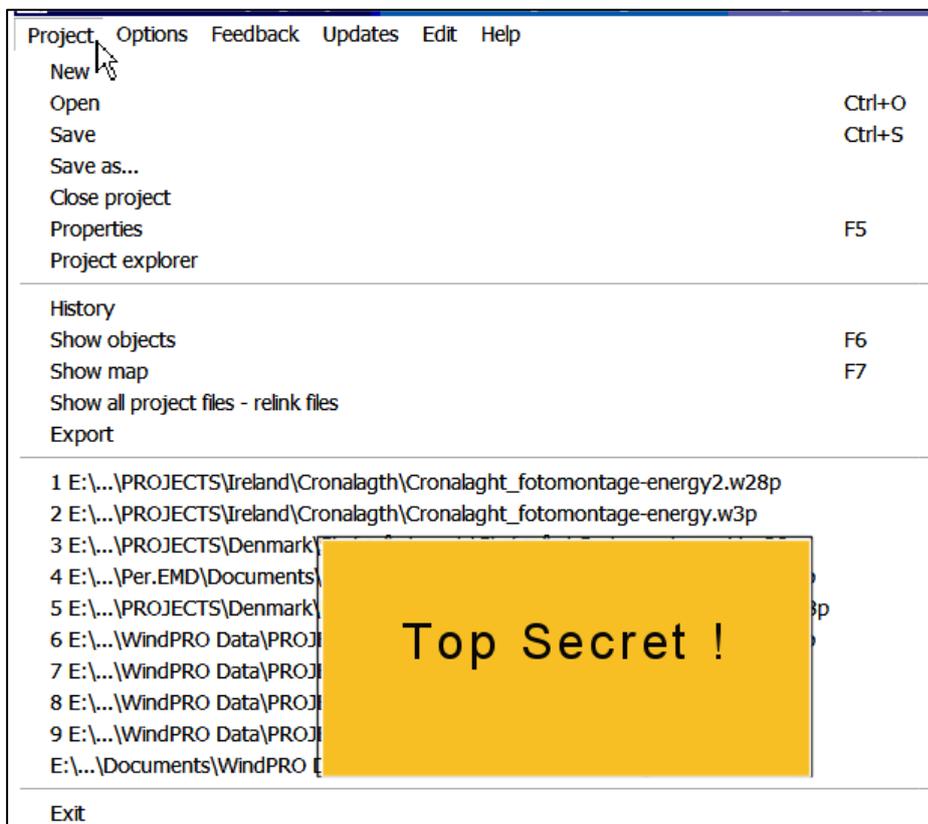


2.2 BASIS - General functions, setup and help

2.2.0 Introduction to general functions and setup

Below you will find a description of the main features, which can be found in the menu boxes under Project, Options, Feedback and Help, shown in the top menu bar shown above. In addition, you can work with the "Project Explorer", which is described in the next Section 2.3, and which will appear as the start screen unless you have deselected this option.

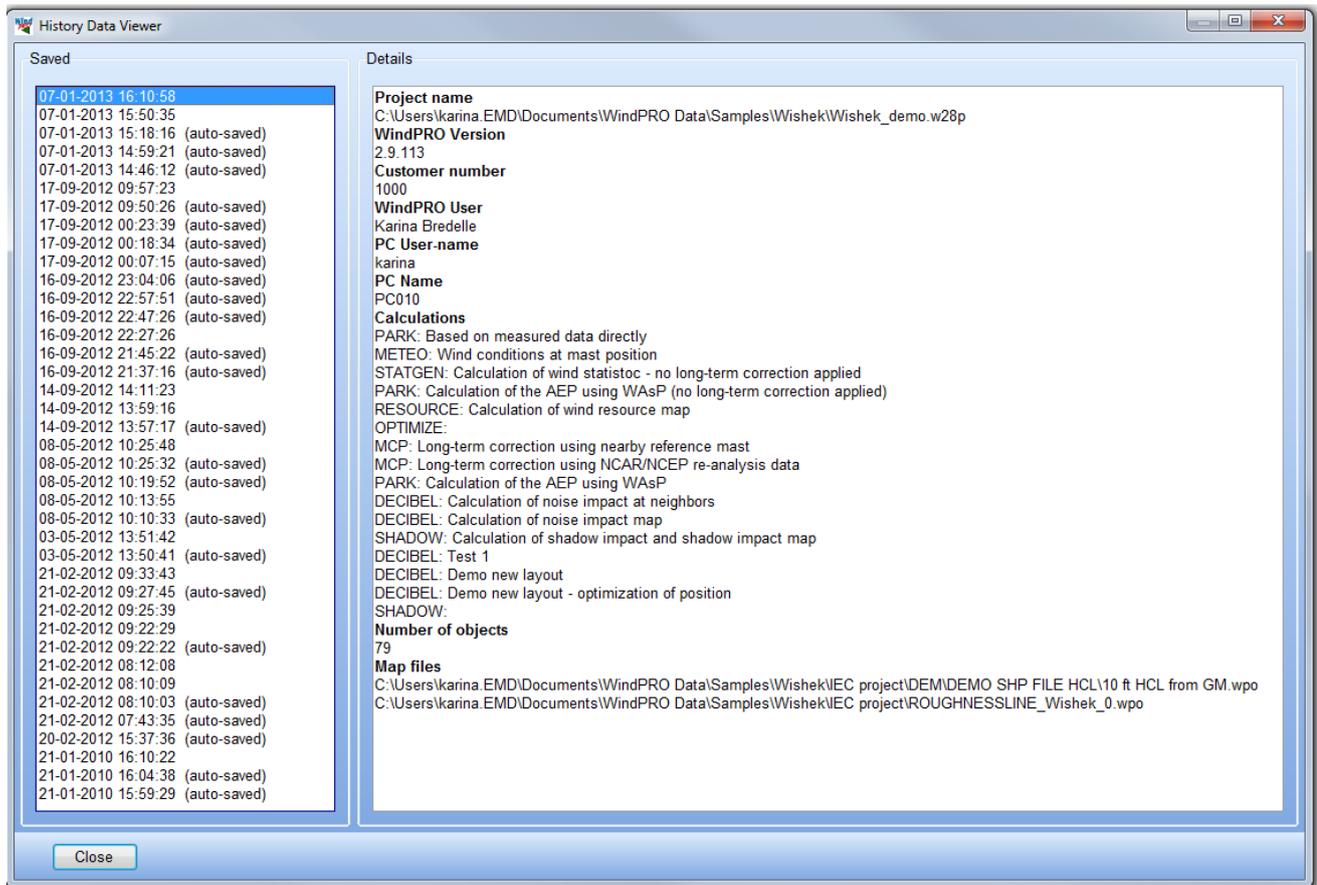
2.2.1 Project menu



The project menu is used for "normal" navigation purposes known from other Windows software products. Below some details are explained.

2.2.1.2 History

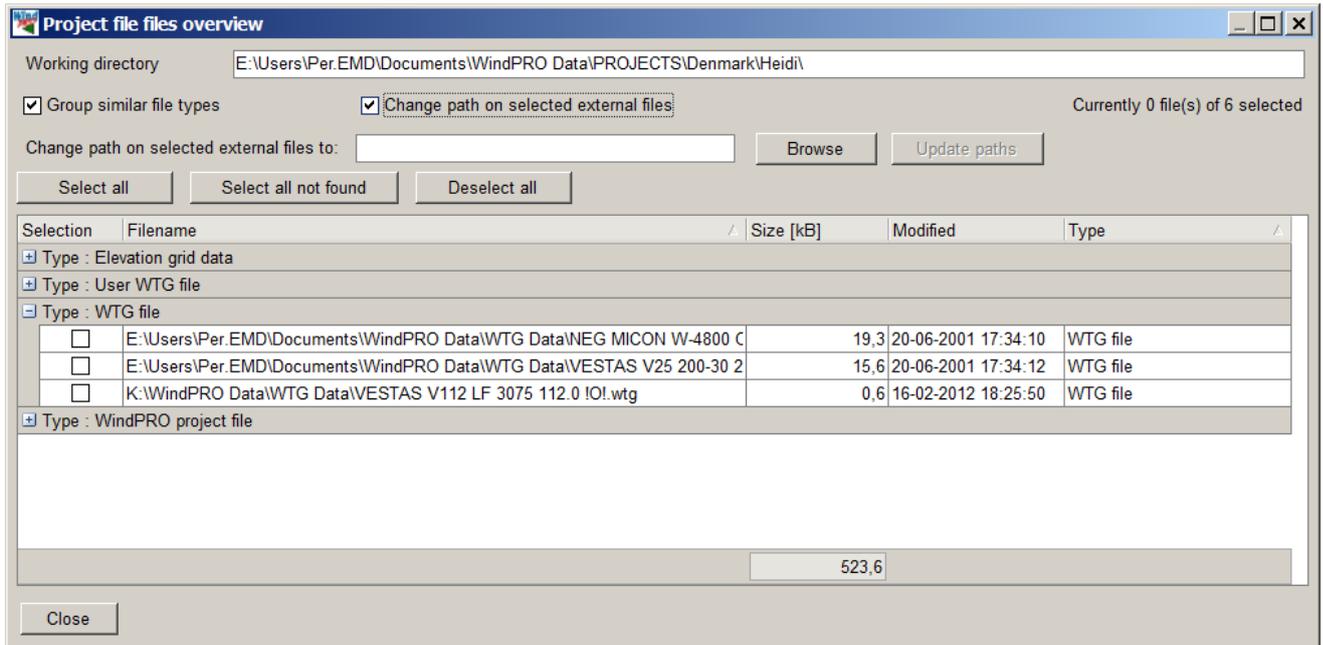
In the project menu, history show different information of your project history.



This can be used to identify which changes/calculations you made when. And to see like how many objects are in project.

2.2.1.3 Show all project files – relink files

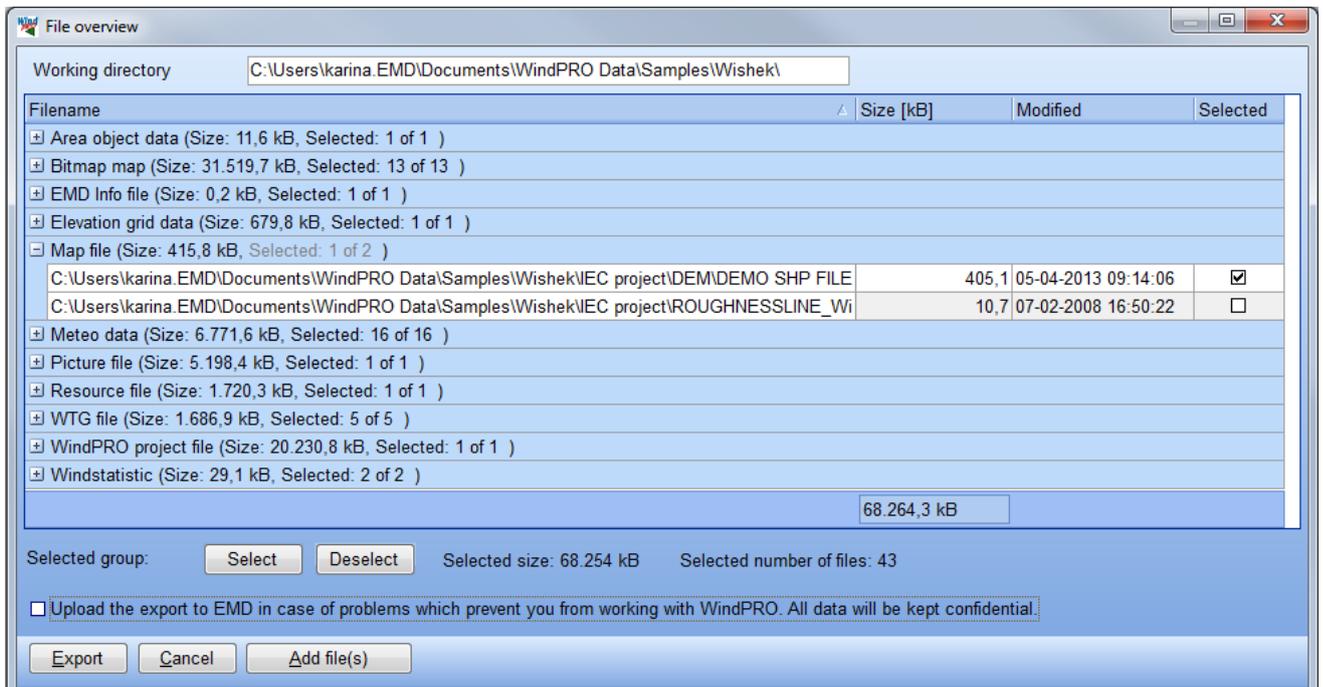
In the project menu, show all files leads to a tool where external files linked to the project can be relinked. This can be used if an extra hard drive for data is installed at your PC or projects are moved from server to PC or opposite. If you move by exporting (recommended), all files should be relinked correct when importing. But in special cases, like by installing an extra hard drive, so your projects e.g. are moved from C:\ to E:\ files that not are located in your project folder or below, will not be found. Then the relink feature is efficient.



Files can be grouped by type and selected by group. After selection, browse for new location and click “update paths”. Then the files are relinked and operational in the project.

2.2.1.4 Exporting WindPRO project files

The export function is used when you want to copy project information from one PC to another or create complete backup packages. Since the data is structured in files, a "normal" copy with the Explorer can be used, but then you will have to make sure that all files needed by the receiver are included and that the files are placed in same folder structure. Otherwise, you have to re-link bitmap maps, Line Object files, etc. With the export function, you can let WindPRO organize what should be included, and all data will be packed into one file ready to be opened from another WindPRO-2 application with updated links.



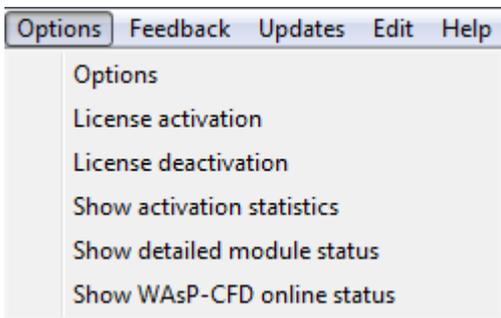
In the window shown above you can see how WindPRO lists all the relevant files for the export file. At this point, files can be deselected in order to reduce the export file size or to exclude information from the export file.

Simply expand the type of data and double-click on the file you want to select or deselect. Then click on “Export”.

In addition to those files suggested by WindPRO, you can also add files into the export from the "Add file(s)" button (before exporting).

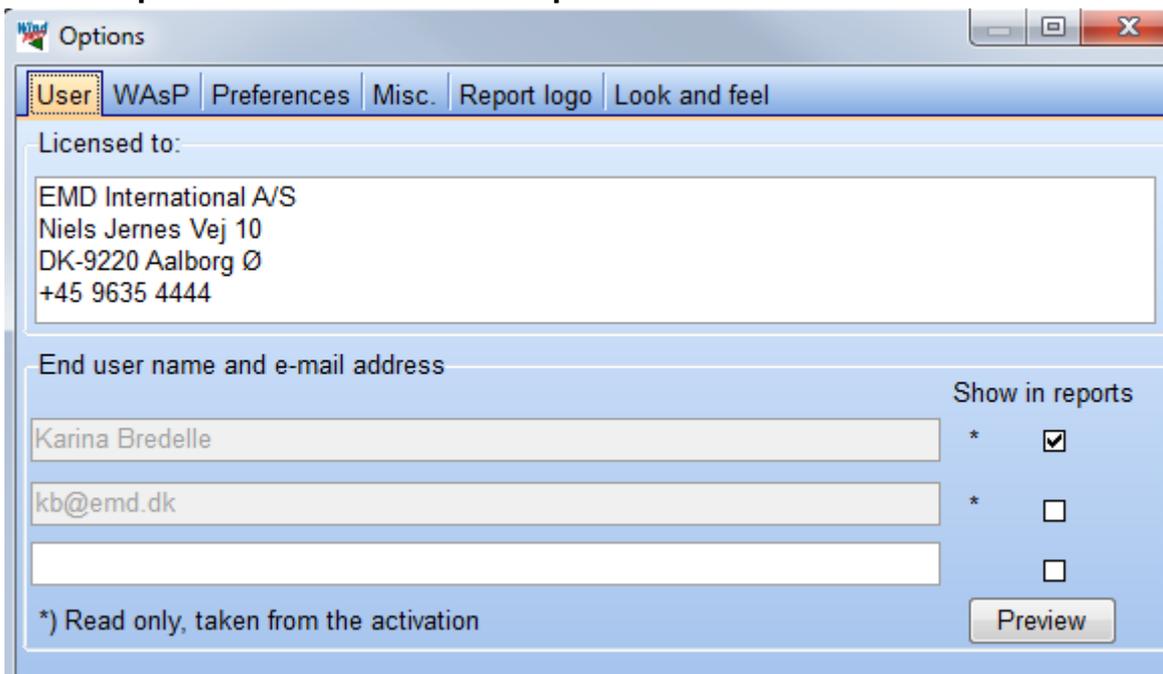
For WindPRO support, it is possible to upload the export to EMD (local agency) by checking the box at the bottom of the window. The export will be securely uploaded to EMD’s server and an email will automatically be sent to the support agent.

2.2.2 Options



The menu item “Options” gives access to defining or changing a range of settings, which typically need to be set only once. This menu item is continuously updated as new functions are added. The license-activation related topics are explained in Chapter 1.

2.2.2.1 Options – User Reference in printouts



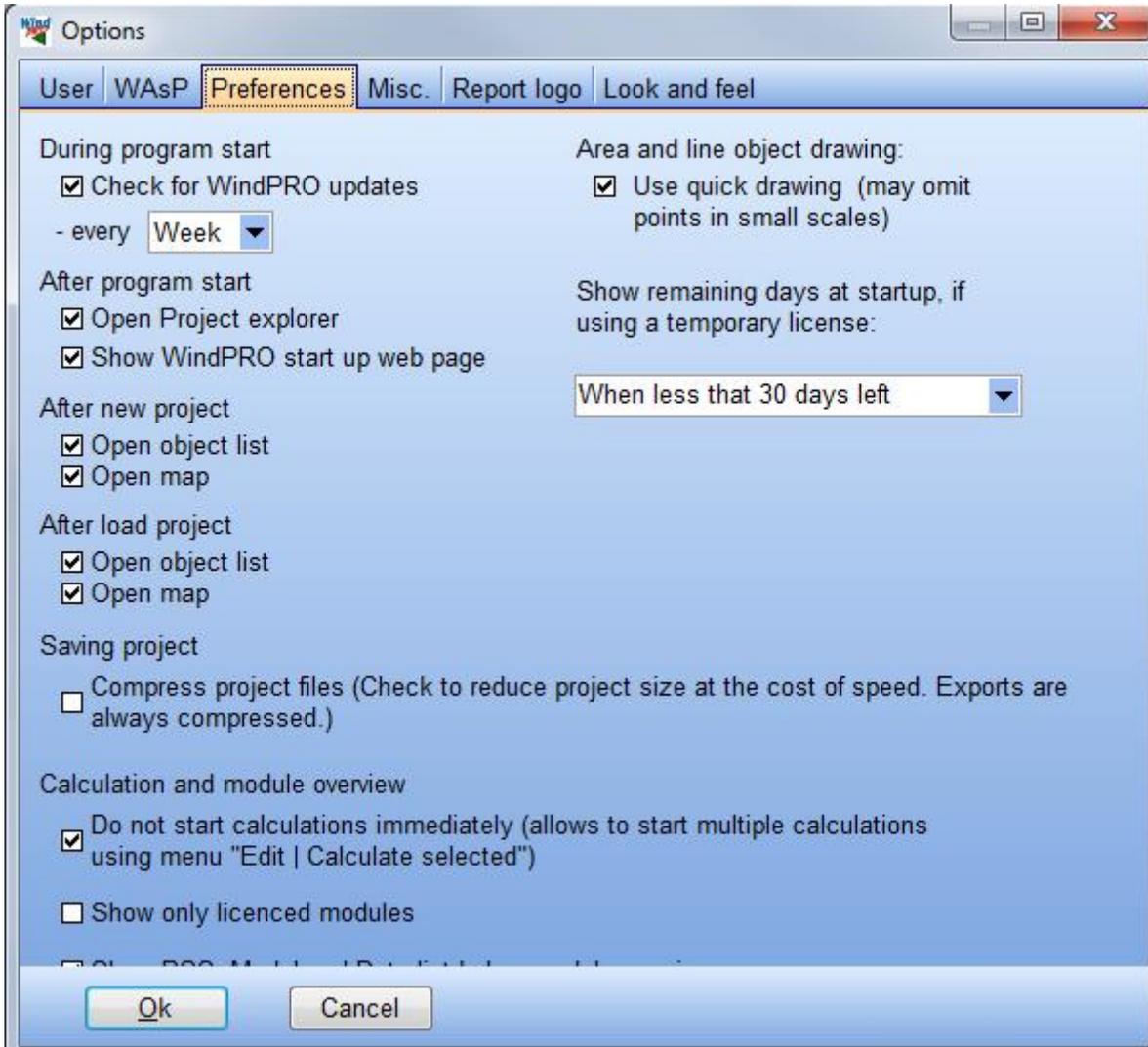
Here the name of the person and email address are from the activation (License) – it can be checked which lines shall be shown in reports. An additional line is available for e.g. department name.

2.2.2.2 Options – WAsP Setup



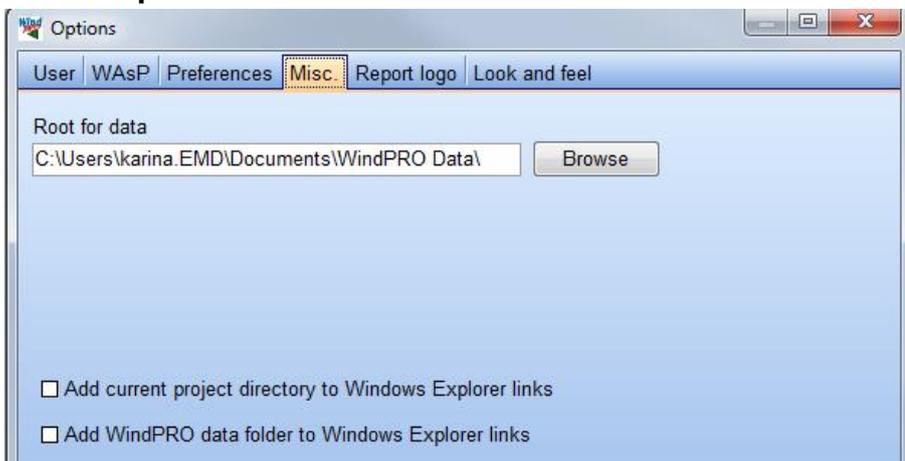
If the WAsP program from RISOE/DTU is used by one of the energy calculation modules, the version of the program must be chosen here. The WAsP 10.0 is normally not recommended due to this had “partly corrections”, that first fully were finalized in the 10.2 version.

2.2.2.3 Options – Preferences



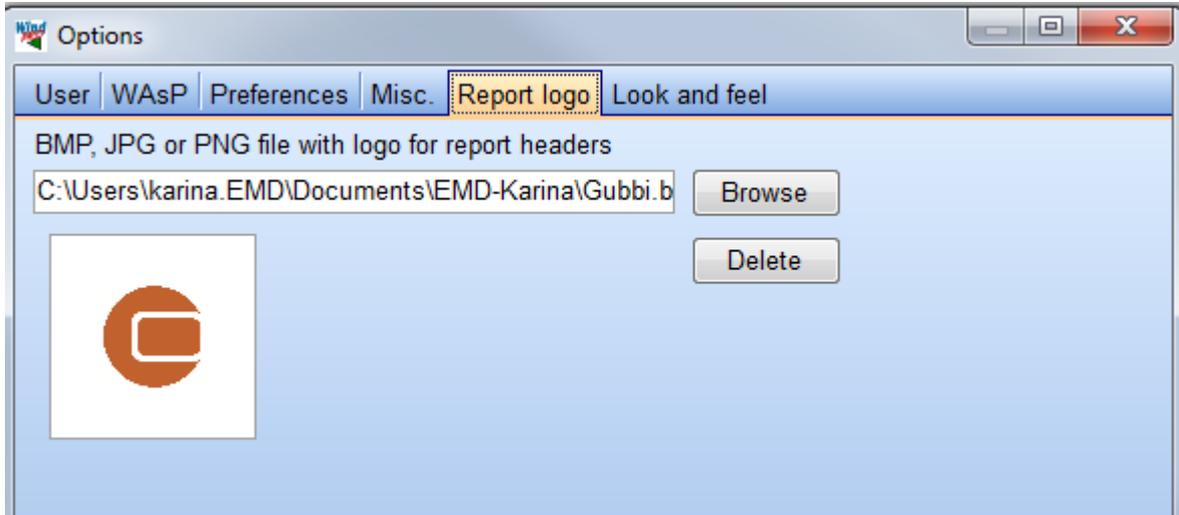
Many different preferences are collected at this page.

2.2.2.4 Options – Misc. Path for WindPRO Data



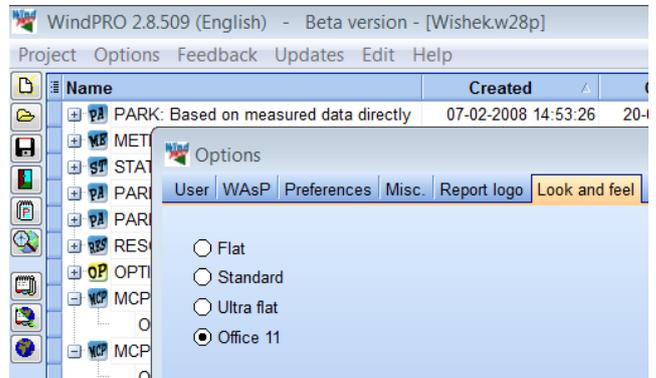
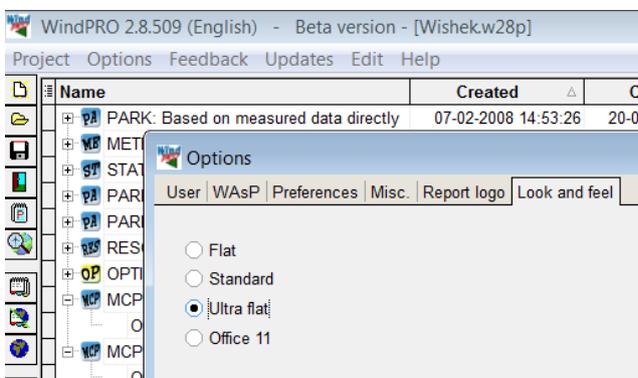
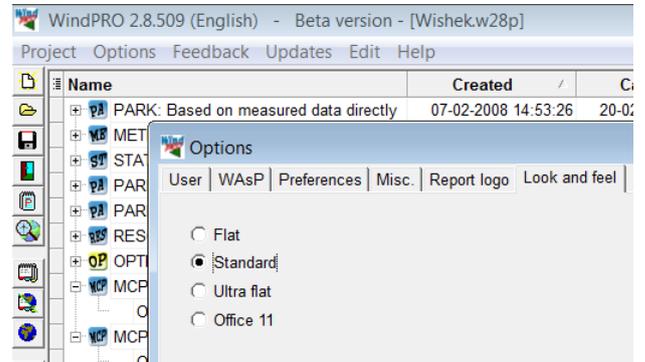
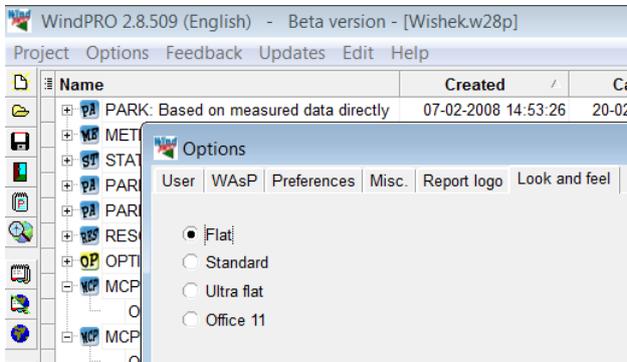
The root for your WindPRO data gives WindPRO information on where the default file location is for storing new projects, and where to search for projects, data etc.

2.2.2.5 Options – Report logo

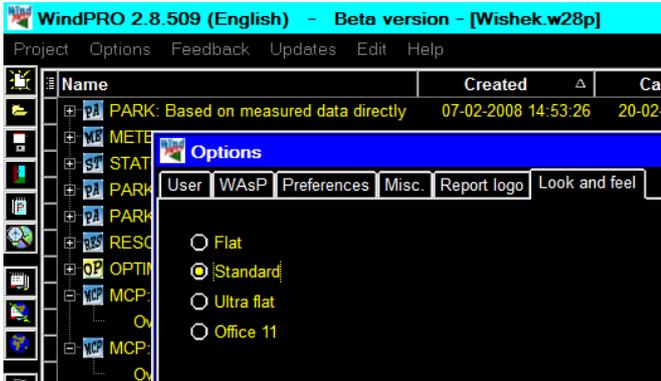


A company logo can be included which will appear on all reports.

2.2.2.6 Options – Look and feel



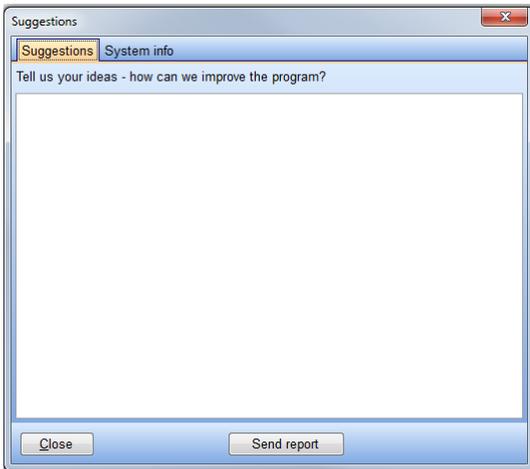
As seen not the very big differences in the 4 theme variants, especially not in the 3 first. But note that the Windows theme settings will invoke the look, which gives further flexibility. See example below where the Windows theme “high contrast” is chosen.



Not recommended!

2.2.3 Feedback

The feedback option, gives us the chance to make WindPRO even better.



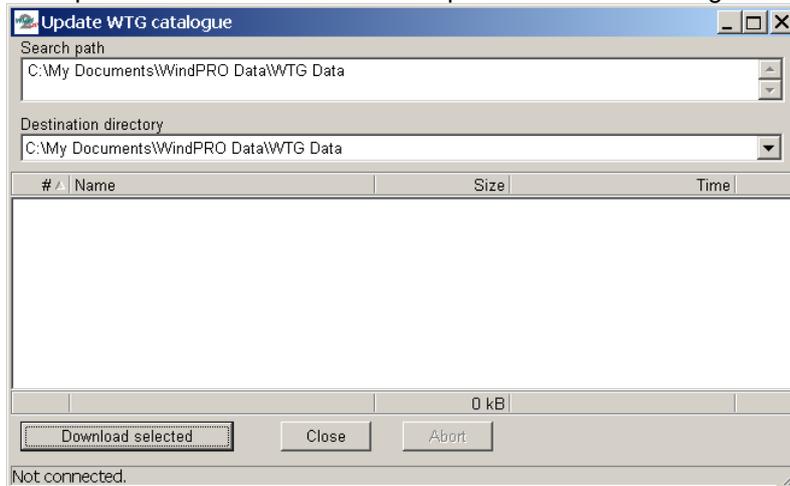
You can send suggestions. When sending by email, you have to set up your server connection. This is done in the "Advanced configuration", where you have to find your email server (outgoing). This is found in your email software, e.g. in Outlook, in "Tools|Services" (or accounts in older Outlook versions). You find the server in "properties" (see the below example).

Note: If you don't have a permanent connection you have to connect before emailing.



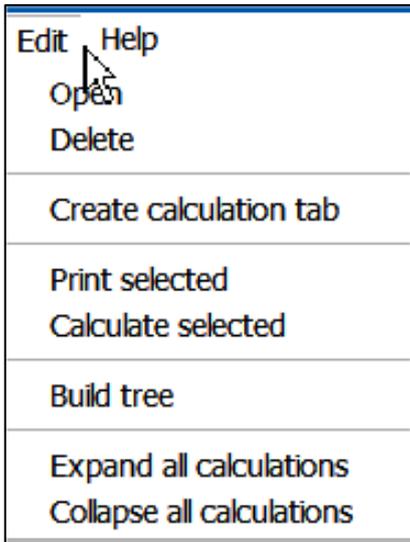
2.2.4 Updates

The Updates menu offers access to update the WTG catalogue.



Specify the path for the WTG Data, normally directly below the WindPRO Data directory. Both the search path for existing data and destination directory can be set. Based upon the search path, WindPRO determines which new or updated WTGs will be available. The specific WTGs to be downloaded can be selected by pressing the “Download selected” button.

2.2.5 Edit



In the Edit part different services are available.

Create calculation tab offer to organize the calculation trees to get a better overview. E.g. the environmental calculations on one tab, energy on another – or one layout at one tab etc.

When selecting more performed calculations (select like in windows explorer), these can be “group printed” or “group calculated” – convenient when you go to lunch and have all calculations updated with the revised layout when you are back.

Build tree rebuilds the tree structure if corrupted.

2.2.6 Help

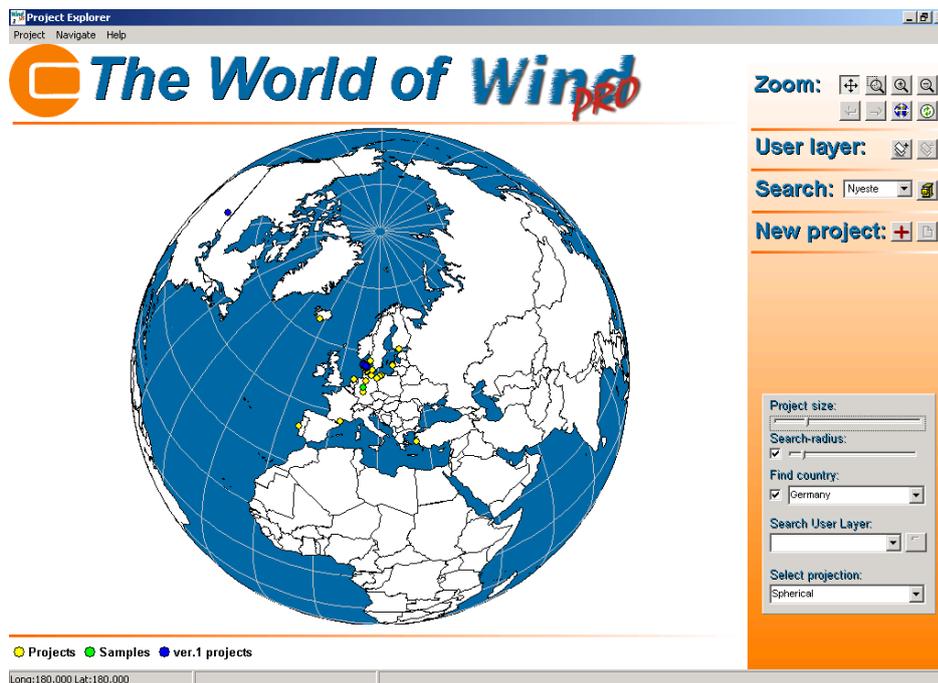
See 2.1.3.7 Help

2.3 BASIS- Project Manager (Project Explorer)

2.3.1 Project Explorer – map and globe navigation

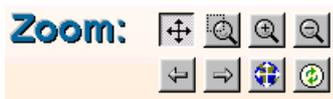
By default, the Project Explorer is enabled. From the WindPRO main menu, Options, Preferences, you can disable this feature if you prefer the ordinary Windows Explorer method of locating your projects.

Projects are opened from the Project Explorer by hovering over a spot on the map, and then double-clicking on the relevant project in the drop down list, which will appear containing all projects located within the user-defined search radius.



The above figure shows the start-up desktop for WindPRO if the use of the Project Explorer is not deselected. The colored dots on the globe are the projects, which are in the search paths and accepted by possible filter settings (search profiles). At the bottom of the map, the actual search paths are shown. It is possible to assign different colors to each search path in order to better organize the project view.

Navigation on the map/globe is fairly intuitive; however, a detailed description of the tools is as follows:



The Zoom buttons



Click on the button in order to move the map/globe when holding down the left mouse button.



Click on the button in order to drag a square that is then zoomed.



The buttons zoom in given steps.



Back and forward. Remembers your "zoom history", so you can quickly return to a previous zoom.



Zoom to full extend gives you the entire globe.

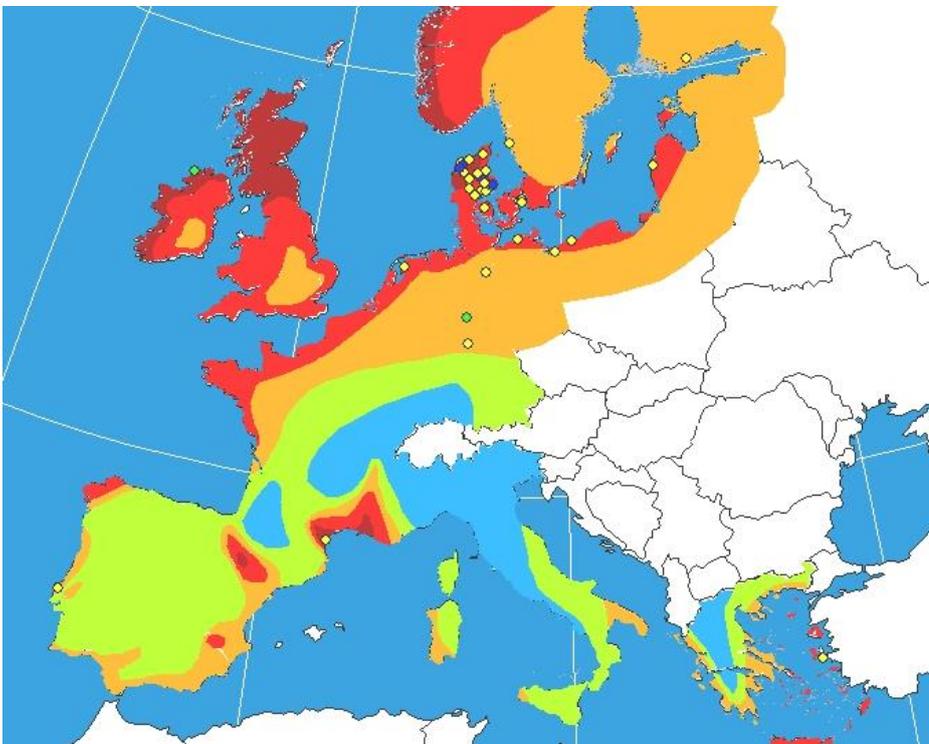


The refresh button refreshes your project list (colored dots on the map), if you e.g. copied some projects with the Windows Explorer into your Project Explorer search path or if connected to a server with additional projects.

User layer:



The “User layer” feature makes it possible to add a layer on top of the map/globe, which gives additional information e.g. roads or local administrative borders. The user layer must be a shape file (from Arc View GIS-system) where the coordinates are a geographic system (latitude/longitude). Some examples are enclosed in WindPRO Data\Globe\ and can be opened. These can provide a more precise background map and e.g. the State borders for the USA, the wind resource map from "European Wind Atlas" (see figure below), a detailed Wind Resource Map for Denmark, etc. See \WindPRO Data\Globe\ or add your own. NOTE: It's possible to search on data in the user layer (covered later).



Search:



The search option gives access to the Project Explorer list, where search paths can be added (covered later), e.g. to show only projects within a given search path. An example could be "Changed during year 2001". When this search path is selected in a drop down box, only the projects fulfilling the search path criteria will be shown on the map.

New project:



With a click on the “New Project” cross hair, you will be able to mark a specific place for creating a new project. Coordinates and country will then be transferred to Project Properties (see later), when clicking on the right button "New Project".



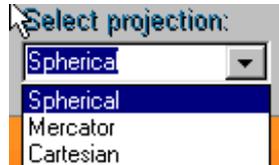
Project size adjusts the size of project dots on the map.

Search radius specifies the radius within which projects are found when "hovering" with the cursor over an area on the map.

Find country interacts with the map/globe. Click on a country that is shown in the list, and it's then highlighted on the map. You really have a brilliant tool for learning country geography as an extra benefit.

Search user layer gives the opportunity to search/show a user parameter from the user layer (shape file), if there is a database linked to the user layer (a .dbf file). The "data field button" to the right, gives access to select which field from the database to be shown in the "Search User Layer" field.

Projection – shows a map as a "round globe" or flattened out, see possibilities below.



The check boxes next to the search radius and country make it possible to disconnect these functions.

The upper left menu bar, also gives access to the project list and the same functions as in the tool panel in the right part of the screen. The last 10 opened projects can also be reopened from here.

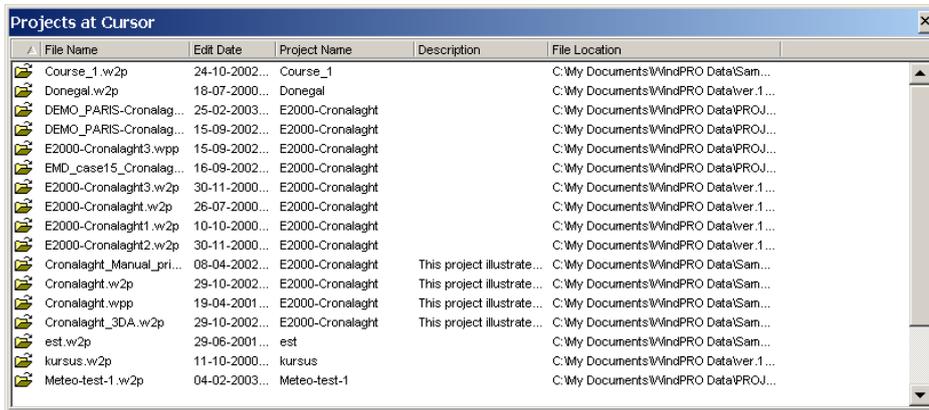
2.3.2 WindPRO Explorer List

The WindPRO Explorer List will appear in following places:

- Project Explorer
- WTG Catalogue
- Wind Statistics

Address list (in a reduced form without search profiles and same search path as the Project Explorer).

Therefore, a common review is given here in general terms.



The WindPRO Explorer List consists of 2 important elements:

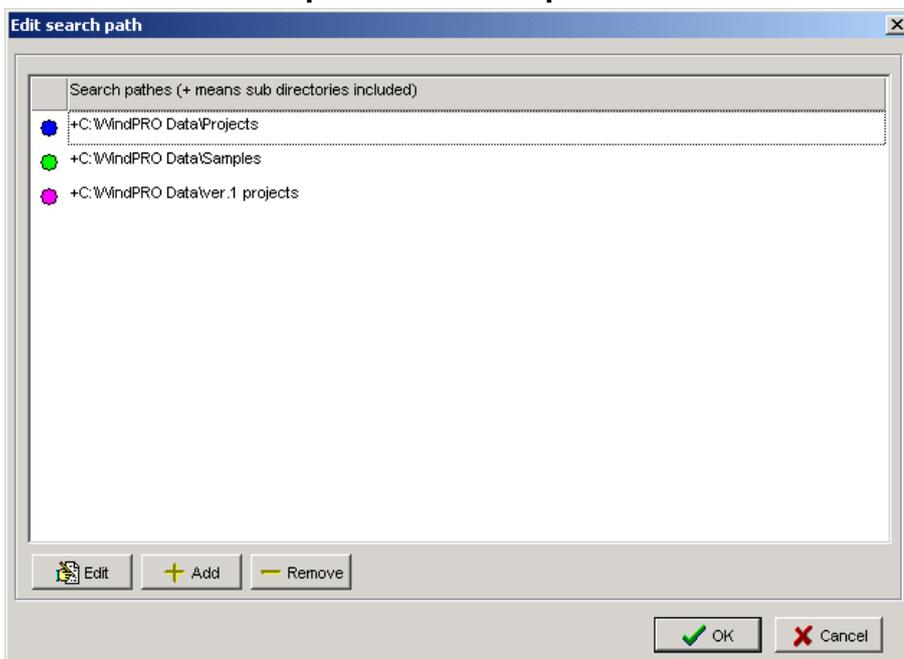
The search path setup - which specifies where to search for relevant files. This makes searching faster and makes it possible to organize projects in different ways, e.g. partly on a local disc and partly on a server.

The search profile - which is a filter to give a conditional view of files in order to find relevant files faster.

Different information on the files is shown in the list. The list can be sorted by clicking on the appropriate column heading.

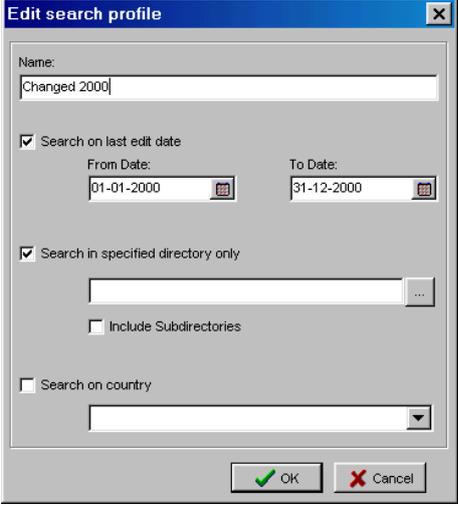
Double-clicking on a file in the list will open the project.

2.3.2.1 WindPRO Explorer – search path



Adding locations on the local disk(s) or network neighborhood gives access to the project you may want to see or work on, without searching through Giga bytes of files every time you open the software. When adding a new search path, a color can be specified which will determine how the file is shown on the map/globe.

2.3.2.2 WindPRO Explorer – search profile



The screenshot shows a dialog box titled "Edit search profile" with a close button (X) in the top right corner. The dialog contains the following fields and options:

- Name:** A text input field containing "Changed 2000".
- Search on last edit date**
 - From Date:** A date input field containing "01-01-2000" with a calendar icon.
 - To Date:** A date input field containing "31-12-2000" with a calendar icon.
- Search in specified directory only**
 - A text input field for the directory path, followed by a browse button (...).
 - Include Subdirectories**
- Search on country**
 - A dropdown menu for selecting a country.

At the bottom of the dialog are two buttons: "OK" (with a green checkmark icon) and "Cancel" (with a red X icon).

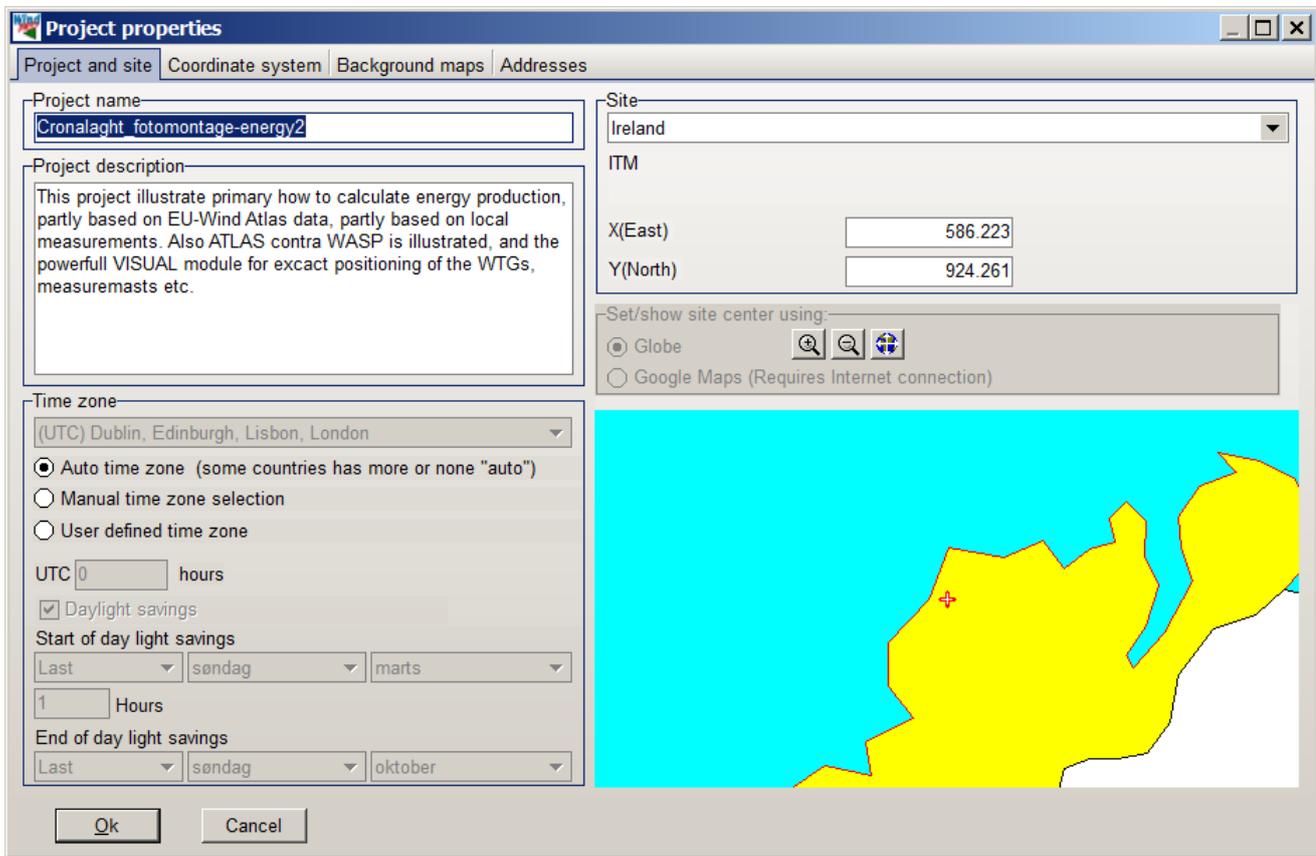
The search profile is individually designed depending on where in WindPRO the Explorer is used. The search profiles are a filter, which allows the user to limit the number of files to the ones fulfilling specific criteria in order to get an easy and fast search result of files, or to give an overview for certain presentations, e.g. sales meetings.

2.4 BASIS - Project Properties and attachment of Maps

2.4.0 Introduction to Project Properties (PP)

The term "Project Properties" is a generic term covering all information regarding site description, coordinate system, maps and addresses.

If you select "Project Properties", or if you click on the shortcut icon  or create a new project, the window for input of project information will pop up. Please see below:



Project properties

Project and site | Coordinate system | Background maps | Addresses

Project name
Cronalaght_fotomontage-energy2

Project description
This project illustrate primary how to calculate energy production, partly based on EU-Wind Atlas data, partly based on local measurements. Also ATLAS contra WASP is illustrated, and the powerfull VISUAL module for exact positioning of the WTGs, measuremasts etc.

Time zone
(UTC) Dublin, Edinburgh, Lisbon, London
 Auto time zone (some countries has more or none "auto")
 Manual time zone selection
 User defined time zone
 UTC 0 hours
 Daylight savings
 Start of day light savings
 Last søndag marts
 1 Hours
 End of day light savings
 Last søndag oktober

Site
Ireland
ITM
X(East) 586.223
Y(North) 924.261

Set/show site center using:
 Globe
 Google Maps (Requires Internet connection)

Ok Cancel

2.4.1 PP Tab Sheet: Project and site

2.4.1.1 Project name and site description

A project name and a description of the project site and other information, which will appear on printouts, can be entered. Please note, that for each calculation performed, additional text relevant to the calculation can be entered. This means that the site description is the overall description of the site or general assumptions.

2.4.1.2 Site coordinates

The preliminary site coordinates are entered here. If you have created a new project from the Project Explorer, site coordinates will already be filled in with approximate coordinates. The site coordinates (site center) will later appear on the map as an orange crosshair and can be adjusted. The site center will be centered on the

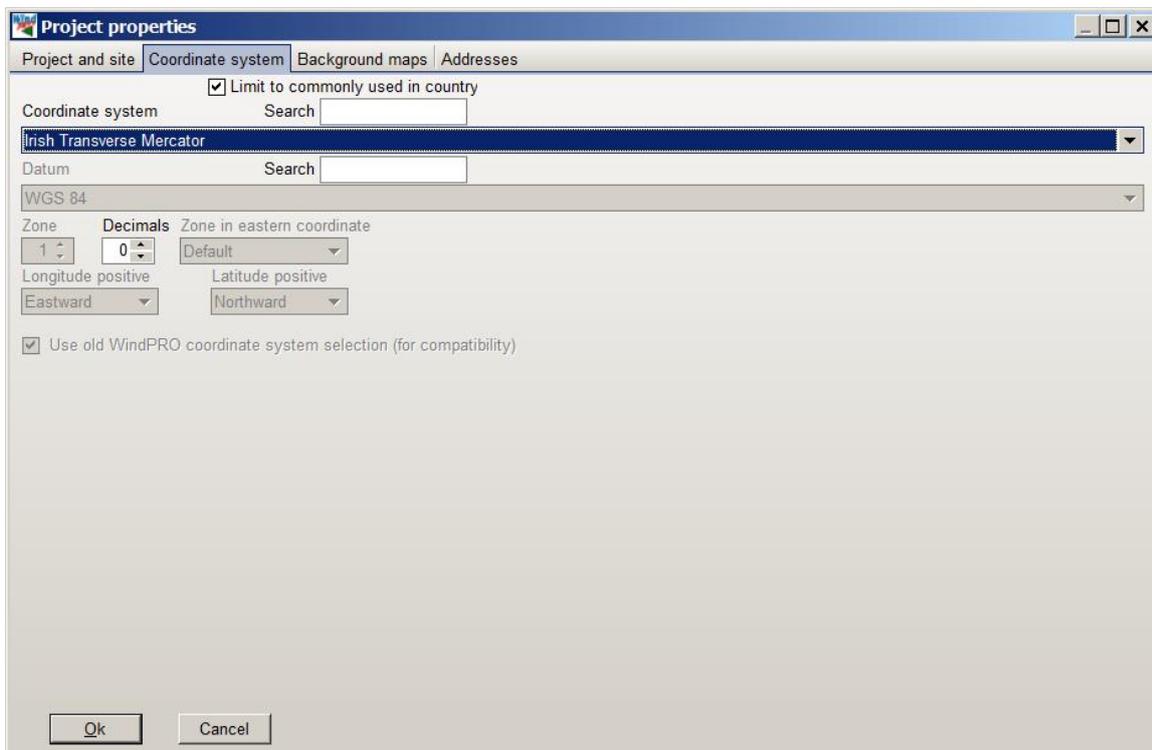
screen when opening maps later in the project design phase. If you are connected to Internet, the Google maps will be available as background for fine tuning the position.

2.4.1.3 Time zone

Selecting the correct time zone is important in order to perform a correct shadow flicker calculation or photo-montage. WindPRO will aid you in the right choice showing major cities in the different time zones. For most locations, the time zone will be detected automatically based on site country. Where more time zones are used in a specific country, the manual selection will give you only the relevant ones. With user defined, all time zones are available.

2.4.2 PP Tab Sheet: Coordinate System

Move on to the Tab Sheet with coordinate system information by clicking on the relevant tab sheet.



On this page you can select which coordinate system you wish to work with. If you have created a new project from the Project Explorer (see Section 2.3.1), a default coordinate system and zone will automatically be provided, based on the country and the location. It's important that you select the system which matches the scanned maps you will be using.

On standard maps (paper) the coordinate system used is printed. Almost all maps will contain a latitude - longitude (lat/long) grid. Therefore this system can always be used. However, the system (degrees, minutes and seconds) is inconvenient to work with and makes measurements, conversions, checks, etc. a tiresome task. If the information is also available in a metric system, this system should be used.

Number of decimals on coordinates can be chosen to 0, 1 or 2.

The coordinate systems shown can be filtered, so only the most relevant ones for the project country are shown.

Projects created from WindPRO versions before 2.8 will be locked to use the "old" coordinate system structure. The new coordinate system structure from 2.8 is more comprehensive, offering more systems and more freedom to define combinations of system and datum.

2.4.2.1 The UTM System

The UTM system is used worldwide, and is often printed on the map material.

The earth is divided into 60 zones as defined in the figures below. Each UTM zone has an east-west width of 6 degrees. The median line of a 6 degree section has, by definition, the value of 500,000 meters. The widest part of a section (approximately 667 000 m) is at the Equator, (the Earth's circumference of 40,000,000 m / 60 sections). The x-coordinate value (Easting) thus lies between 167,000 and 834,000 meters, and is always positive.

In the northern hemisphere, the y-coordinate (Northing) equals the distance to the Equator. In the southern hemisphere, the y-coordinate equals 20,000,000 meters minus the distance to the Equator. This means that 1 km south of equator, the y-coordinate is 19,999,000.

The UTM South system is used more commonly, where the y-coordinate is 10,000,000 minus the distance to the Equator. In this case, 1 km south of the Equator, the y-coordinate is 9,999,000.

The DATUM of the UTM system indicates how much the globe differs from being exactly round (the Datum refers to the set of "unfolding" algorithms used to change the curved surface of the globe into a flat map, often referred to as the Ellipsoid). Several different DATUM'S are used in different parts of the world, but more and more countries are changing to the WGS 84 also named ETRS89 in the EU.

Common Datum's used with UTM coordinate system:

WGS 84 = World Geographic System, the "New" world standard since 1984. This is similar to EUREF89.

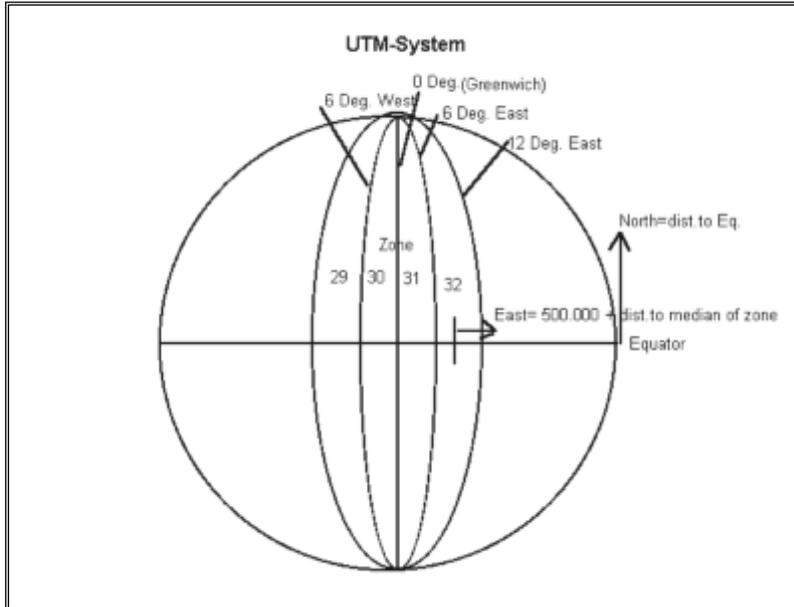
ED 50 = European Datum since 1950 = Hayfort

NAD = North American Datum (More variants)

SAD = South American Datum

Overview of Longitudes and UTM-zones

Western longitude (West of Greenwich)			Eastern longitude (East of Greenwich)		
From	To	UTM- Zone	From	To	UTM- Zone
180	174	1	0	6	31
174	168	2	6	12	32
168	162	3	12	18	33
162	156	4	18	24	34
156	150	5	24	30	35
150	144	6	30	36	36
144	138	7	36	42	37
138	132	8	42	48	38
132	126	9	48	54	39
126	120	10	54	60	40
120	114	11	60	66	41
114	108	12	66	72	42
108	102	13	72	78	43
102	96	14	78	84	44
96	90	15	84	90	45
90	84	16	90	96	46
84	78	17	96	102	47
78	72	18	102	108	48
72	66	19	108	114	49
66	60	20	114	120	50
60	54	21	120	126	51
54	48	22	126	132	52
48	42	23	132	138	53
42	36	24	138	144	54
36	30	25	144	150	55
30	24	26	150	156	56
24	18	27	156	162	57
18	12	28	162	168	58
12	6	29	168	174	59
6	0	30	174	180	60



2.4.2.2 Other metric systems

Also, many countries have defined their own systems, which are being used instead of the UTM system. In Denmark, the System 34 is used. In Germany it's the Gauss Krüger system, and in Great Britain it's the British National Grid that is used. The list of which coordinate systems WindPRO recognizes will be updated continuously.

The British National Grid calculates with two different Ellipsoids (Datums); the AIRY and the GRS80. The British Ordnance Survey has informed us that all British maps use the AIRY Ellipsoid. The British National Grid has its origin at Lat. 49 N and Long. 2 W.

If the system you are currently working with is not included in the WindPRO list, you can define your own local system, and indicate (0,0) as the bottom left corner of the project area.

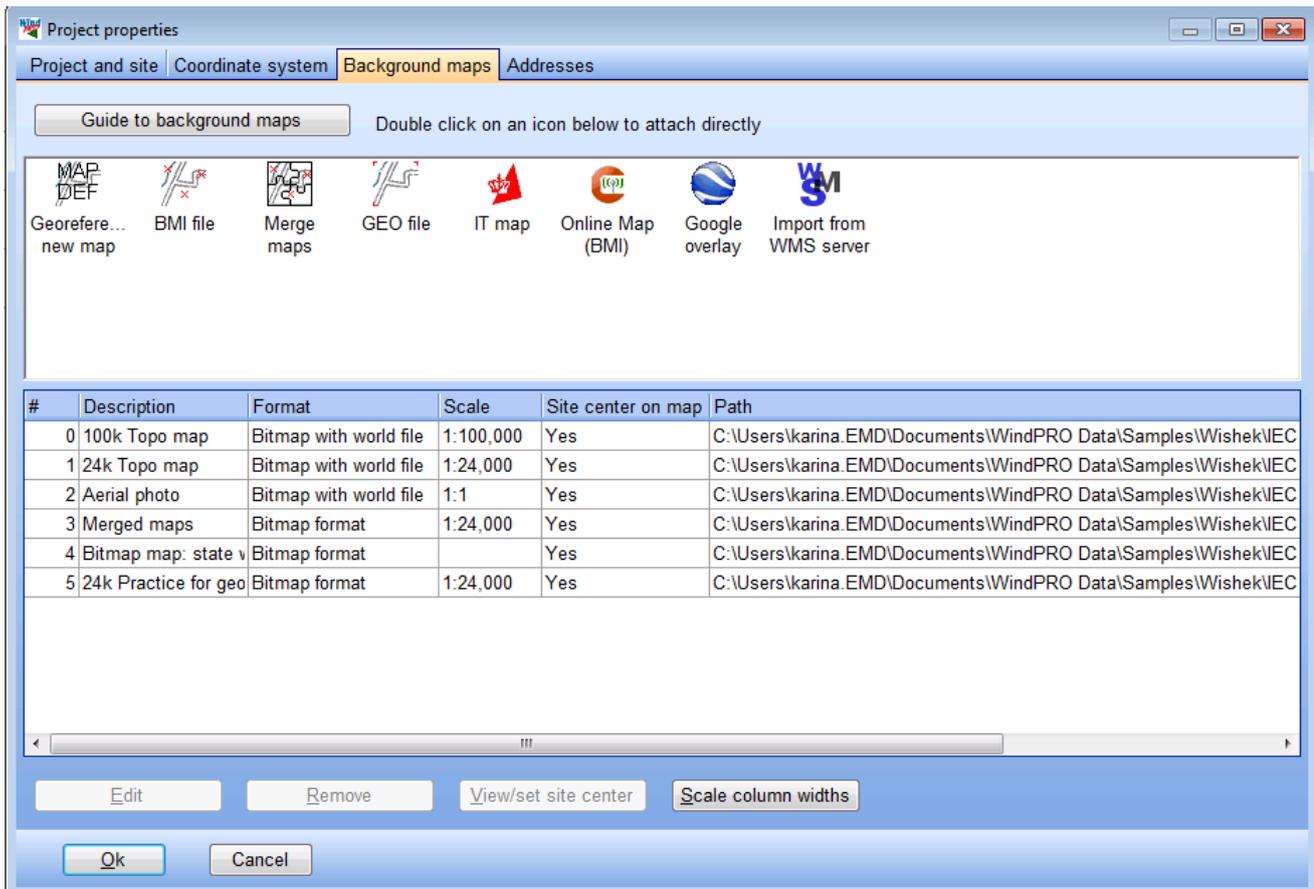
If the "Local System" is selected, you have to enter 1-3 reference points for the local system, in a coordinate system which is recognized by WindPRO in order for it to be able to calculate the exact geographic position. Several of the calculation modules and most printouts use the geographic position. Lastly, you can enter deviation data if the system used calculates with an angular deviation to geographic (true) north. This deviation is often indicated on the map material (if only at one fixed point).

One of the advantages of using a local system is that you can work with small coordinate values instead of the 6 and 7 digit coordinate values used by other systems. Another advantage is that you can continue to work with client information when you receive information from a client in his local system which he would like to see applied, e.g. in layouts.

Please notice, that your choice of coordinate system determines the system in which you can enter coordinate information. However, you can always change the system during your work and let WindPRO handle the conversion. Coordinates already entered will automatically be converted to the new system, as all coordinates are stored internally as latitude/longitude degree values. This means, that you can enter different information in different coordinate systems, e.g. wind turbine positions in the UTM system from GPS measurements and information from local authorities regarding existing populated areas (for noise calculation) in the latitude/longitude system.

2.4.3 PP Tab Sheet: Background maps

In the Tab Sheet "Background maps", link to maps and the preliminary site coordinates (site center) can be entered. This data can be adjusted later on during the project design work.



There are more ways to attach background maps:

Use MAPDEF for defining scanned maps from scratch or for stitching additional maps that already contain coordinate information (GEO Tiff maps).

BMI files (WindPRO's internal background map format), that holds information on geo-referencing and coordinate system.

Merge maps is a function where you can open a number of .bmi files and the software will automatically merge these into one map in the screen view. Note: all maps must have same resolution (pixels/m).

GEO refers to geo-referenced "world file format" which is two files, an image file and a coordinate specification file, like .JPG and .JWG files or .TIF and .TWF files can be attached just by pointing out the location of the formatted map file(s).

IT map format (DK only)

Online maps gives the user access to download background maps from EMD server.

Google overlay enables to import an image/map calibrated in Google Earth as an overlay.

WMS (Web Map Service) is a standard protocol for serving georeferenced map images over the Internet that are generated by a map server using data from a GIS database. WindPRO has setup some WMS servers, but users can add WMS servers to the list.

2.4.3.1 Relevant background maps

As previously mentioned, maps make the project design work much easier. The maps used in WindPRO are primarily bitmap background maps, which show populated areas, roads, forests and other objects that you need to take into consideration when planning the project layout. Digital orography maps (Height Contour Lines) or roughness maps are described in Chapter 8, Line Object.

You choose the maps according to your kind of work. As a guideline, the following map scales are recommended:

1:10,000 For very accurate positioning of turbines and measuring distances for noise calculations. Possibly with landowner boundaries for planning consent work

1:25,000 Normal scale for positioning of turbines, definition of local obstacles, input of orography, measuring distances for noise calculations and entering check points for visualization.

1:50,000 Suitable for roughness classification within the nearest 5-10 km of the site.

1:100,000 Used for roughness classification between 10-20 km from the site.

If you scan the maps yourself, a combination of 1:25,000 and 1:100,000 will probably be a reasonable compromise between time consumption and usefulness.

The link to the maps function is an option - not a requirement for carrying out calculations under WindPRO. However, this option should be used whenever possible, as it's this function, which makes WindPRO unique, compared with other software - including the earlier calculation tools from EMD.

You can connect a map to WindPRO in more different ways, where new options will appear in future. The present ones in version 2.4 are:

A CD-ROM map in a format, which is recognized by WindPRO

Maps, which are bitmap graphics, scanned or cut from a CD-ROM and subsequently defined with 3, coordinate points in WindPRO

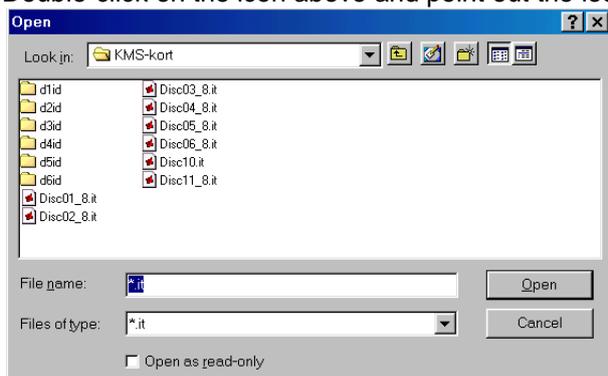
Geo-TIFF maps which mean that they consist of a graphic/bitmap *.TIF file + a *.TFW file, having the coordinate information

2.4.3.2 CD-ROM maps recognized by WindPRO

This import option allows to load maps in IT format from the Danish Kort- og Matrikelstyrelsen (the Danish Ordinance Survey). This option is the easiest one as the coordinates are already associated to the map and a complete reader for this format is included.



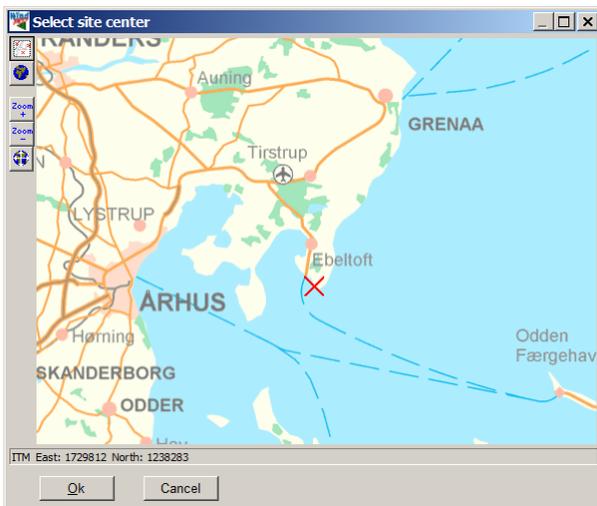
Double-click on the icon above and point out the location of your *.IT maps.



If the IT format is selected, a click on the file list button [Browse] will invoke the Windows standard file browser. Here, you can browse to find the needed file (refer to the Windows manual for help regarding the use of the file browser), click on the needed file and then choose "Open" (or double-click on the file name) to attach the map to the project.

It's optional to enter an individual description of the map file, but it may be of great help to you when having to relocate the map file on a CD-ROM when you are editing a project at a later stage.

It's now possible to select the site center from the attached IT map. Click on the attached map and then on the View/set site center button just below. This will invoke the following map, **depending on the scale chosen!**



You can move the map around on the screen by holding down the left mouse button. A click with the left button on the map creates a red cross. If the position is wrong, you simply click on a new position. Please notice, that you must not move the mouse when you are going to mark a position. If the mouse is moving when you click it, the program will interpret it as a command to move the map around instead. In the above example, a preliminary position has been marked at the port of Ebeltoft.

Click on the "OK" bitmap button to exit the map. Now, all the general project information is entered and the project design work can begin.

2.4.3.3 Calibration of bitmap maps with MAPDEF

Bitmap files can be scanned or digital images of maps, where you subsequently have to make a coordinate calibration. MAPDEF is used for the Geo TIFF maps, where the TFW file holds the coordinate information. It's also used for stitching additional maps together, rotating, cutting etc.



Double-click on the icon MAPDEF in order to start processing one or more new maps for the project.

How to process (Geo-reference, cut, rotate etc.) a bitmap map in WindPRO is explained below. Apart from the main items described here, a range of other functions are available, e.g. adjustment of brightness and colors. Also the color resolution or map size can be reduced so that it occupies less space on the hard disk and is

faster to use (requires less RAM). It should be noted however, that the quality (sharpness) of the map is reduced as well.

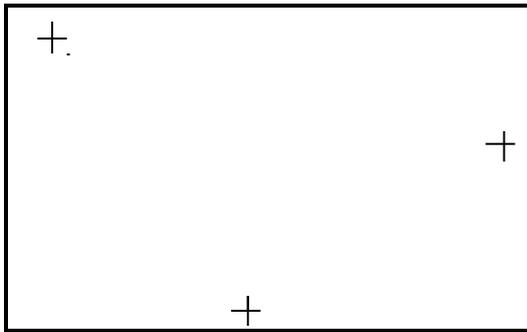
Using a bitmap image without coordinate information

Scan the needed map sections, or cut from a CD-ROM.

Select the bitmap map containing the map sections.

Rotate the map so that it's aligned with north (pointing up).

Mark three points and enter their coordinates. An example of positioning of the points you use for the calibration of a bitmap to a .BMI file is shown on the below sketch.



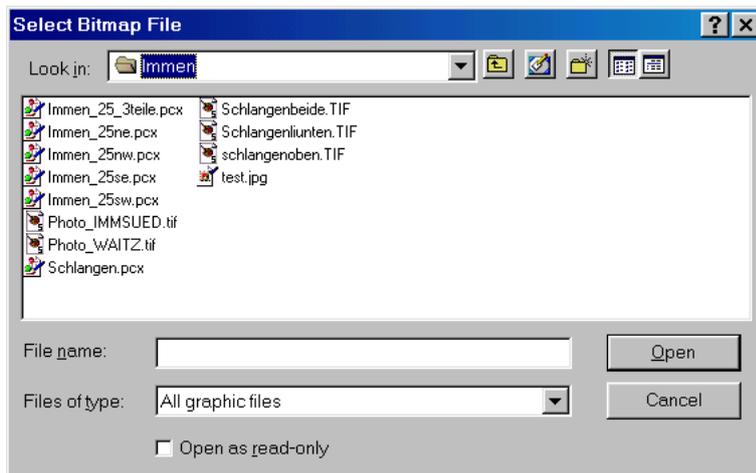
Repeat step 1-4 until three coordinates have defined each map section.

Orient the maps so they are correctly rotated for merging (combining the maps).

Cut eventually the edges of the map sections. Note map 1 (first attached) is at the bottom, which means that no cutting is needed for this one.

Save the .BMI map.

Use a scanner resolution of 100-150 dpi and 256 colors. The preferred bitmap format is .PCX, although most other formats will also work. Make sure to include the edges of the maps in the scanning process, as they usually hold the grid coordinates. Please notice that the user has the full responsibility of not violating any copyrights! Save the maps in folders that you use for this purpose only, or in the WindPRO project folder with the local project.



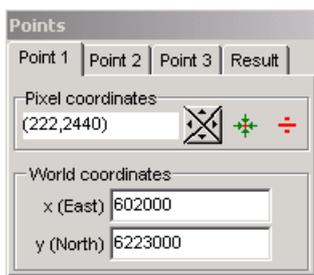
When "MAPDEF" is called, you have to select which map file(s) to add (more than one map can be added at a time). The file browser is used for this.



Once the first map segment has been scanned, the map is aligned with north and any necessary adjustments of colors and size are made. Note from ver 2.5 a color adjustment proposal will appear by default. This gives different reduction options with a preview option so you can decide which choices don't distort the map colors (which depends on the graphic image format). Hereafter, the definition of positions is made.

Try to avoid rotating the maps in steps other than $\pm 90^\circ$ and 180° . If the maps are rotated in other steps, the appearance on the screen will become distorted - text especially appears very unclear. The program will always keep track of north - providing that the coordinates have been entered correctly. BUT, if more maps are stitched together, a full horizontal or vertical edge might be needed in order to stitch without blank triangles.

The positions are marked by clicking on the positions on the map where coordinates can be read or obtained. Make sure to place the three defining coordinate sets as far away from each other as possible in order to be able to maximize the accuracy of the definition. When you mark the first point, you have to tell the program which coordinate system you are going to use. The coordinate system is usually printed on the map.



The four arrows indicate a fine adjustment of the pixel coordinates if e.g. an intersection between two gridlines hasn't been pointed out precisely enough.



The menu for entering positions enables you to center the map around the actual point (or to get it inside the area which is rendered on the screen).



If a position is incorrect (or too poorly positioned) it can be deleted.

The last Tab Sheet to the right in the menu box for entering positions is "Result". This window indicates the correlation between the entered coordinates and the pixel coordinates. One position is calculated based on the two other positions and the deviation is checked. The deviation is categorized into:

Fine

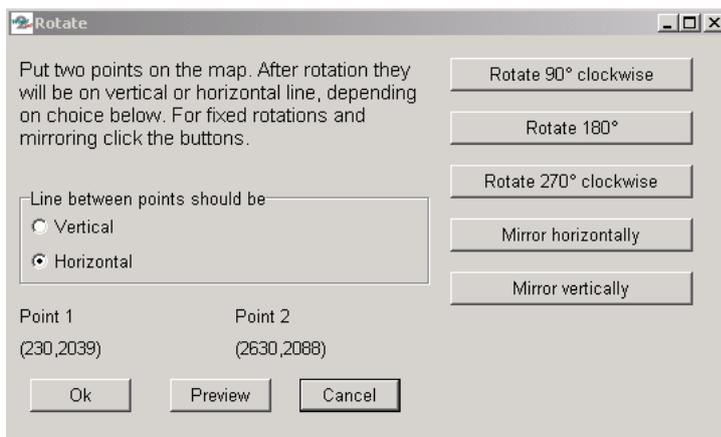
Not precise, but acceptable
Not acceptable

The third category result indicates that you have to look for possible errors or redo the definition. Note: The levels of acceptance can be defined manually in the “points | options” menu.

You add more maps by clicking on the green arrow in the upper left corner of the window (repeat the previous actions 1-4). Please notice that this menu item is used to add maps that are to be merged to the previous map(s). Different map scales or map types are created as new maps.



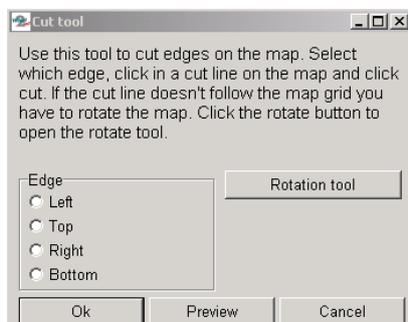
You align two maps by clicking on the icon with the two rotating maps.



When you click on the icon, the dialogue box shown above will appear. On the first map you can define a certain line as the horizontal or vertical line by clicking on two points on the map (e.g. two points on a grid line) or perform fixed rotations. The program rotates all the additional maps so they are aligned with the first map - this function is based purely on the coordinate definitions, which you have entered. After having created new maps, the individual maps should be checked visually for possible errors, i.e. incorrect orientation. A misaligned map holds incorrect coordinate definitions, which must be corrected. Then the map should be realigned.



Map collars, borders, etc. can be removed by using the cutting tool. When you click on the scissors the dialogue box shown below will appear.



Choose which side of the map to cut then click on the map to indicate where you want the cut line to be and then click on “OK”. It’s also possible to mark cuts off of all four sides before clicking on “OK”.

You save the map by clicking on the “OK” button. When you save the map it’s added to the list of maps that WindPRO can use in the actual project. The map is saved as a .BMI file which holds the coordinate information and file names for the new adjusted graphic files which are saved as .PXC files designated as .B0, .B1, .B2, etc. At this point, the original graphic files can be deleted to save disk space.

Once the .BMI file has been defined and linked to the project, you can define the site center coordinates on the map (for details see section 2.4.3.5 describing “view/set site center”).

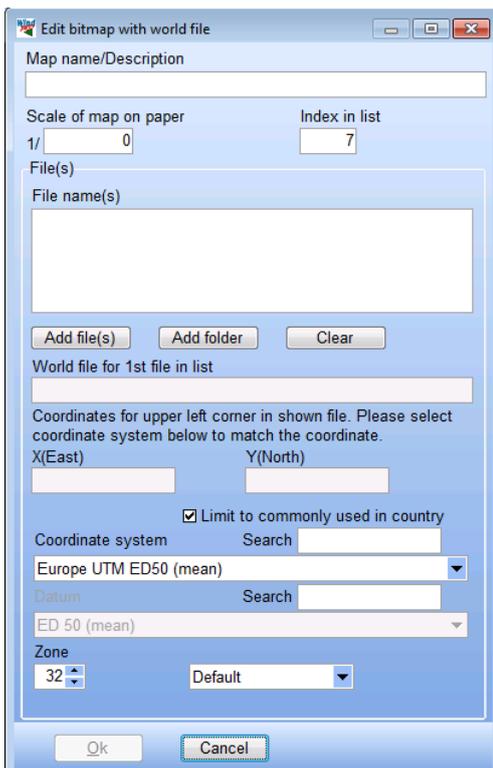
2.4.3.4 GEO “world file” maps.



Double-click on GEO file to add one or more georeferenced world files that can be .JPG and .JWG files or .TIF and TFW files. Click Add Files and simply select the file(s) in the list. Only the image files (.JPG or .TIF) files will be shown in the browser by default.

	O46096G6.TIF	2.500 KB	ACDSee TIF Image
	O46096G7.TFW	1 KB	TFW File

A small .TFW file holding the coordinate information must be available together with the main .TIF file holding the bitmap. WindPRO performs geo-referencing based on the .TFW file and the number of horizontal and vertical pixels in the .TIF file (so do not change the pixel size of the .TIF file without changing the info in the .TFW file!). However, it can be a good solution to change both the .TIF file and the .TFW file if the .TIF file is very large and far too detailed). Make sure that the .TFW file is stored in same folder as the .TIFF file and has the same name. Please notice that the .TFW file does not hold any information on coordinate system or datum. This must be known and given as input.



Add folder is used when you have a region or a large area covered by several georeferenced world files. By linking to the folder where the files are, WindPRO will find and show the relevant background map in Maps and Objects window. This is convenient in the case of a large number of files without knowing exactly which files is/are relevant for the project. This option is for example usefull for projects in Denmark, where Georferenced world file maps can be downloaded for free for the whole country and at different scales from www.kortforsyningen.dk . When Add folder is used it is important that the files in the same folder have the same scale and are of the same type.

2.4.3.5 EMD Online maps



Online maps gives the user access to download background maps from EMD server. It will automatically be detected which map sources that are available for the site location. EMD will develop the service continuously and add more and more sources.

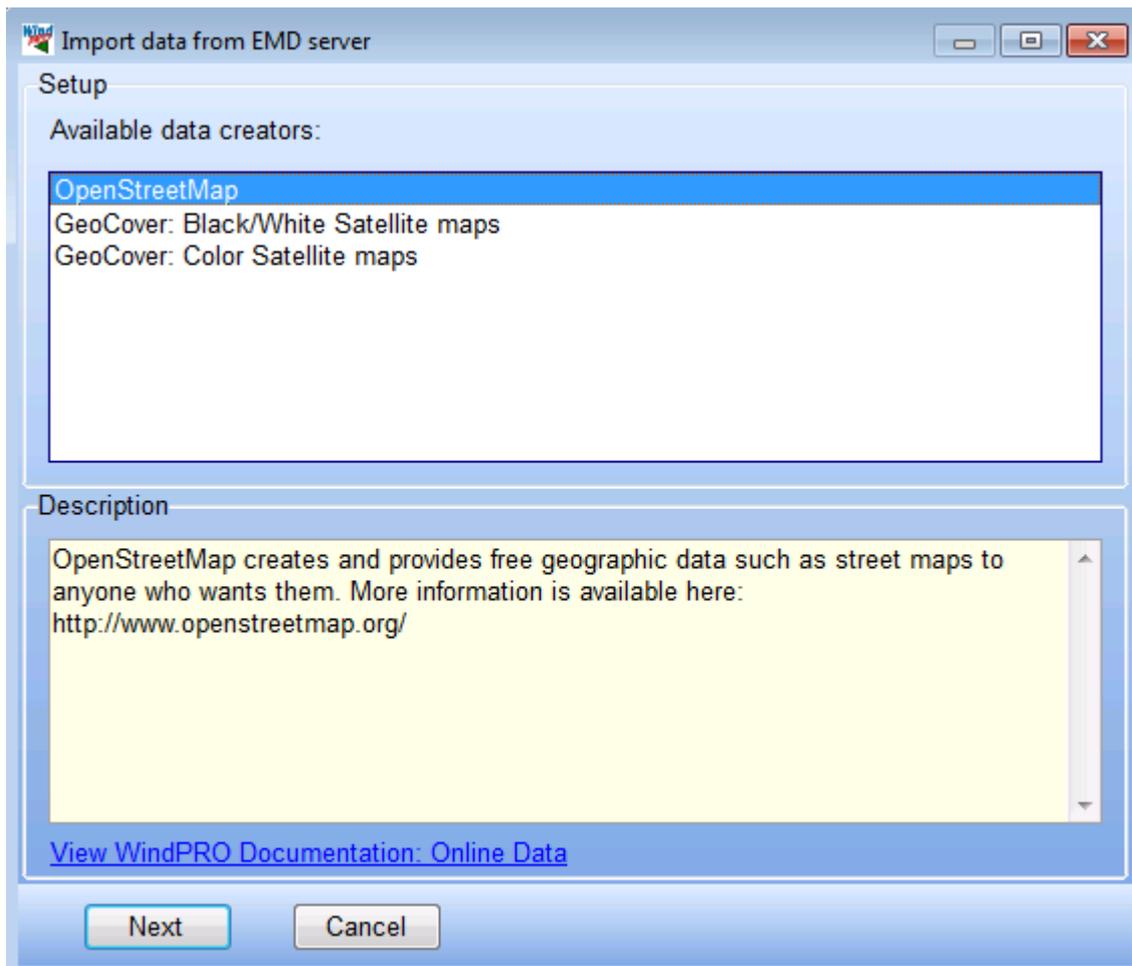


Figure 2 The online service detects which maps there are available around the location of the specified project site.

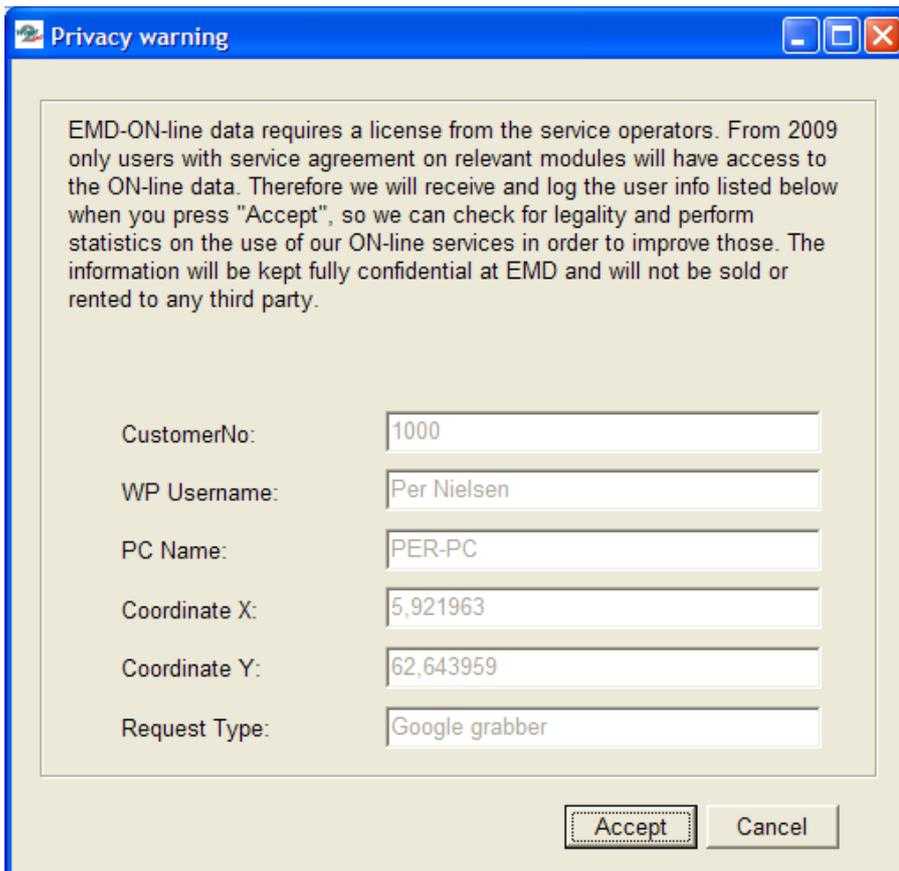


Figure 3 The service requires you to accept this "privacy warning".

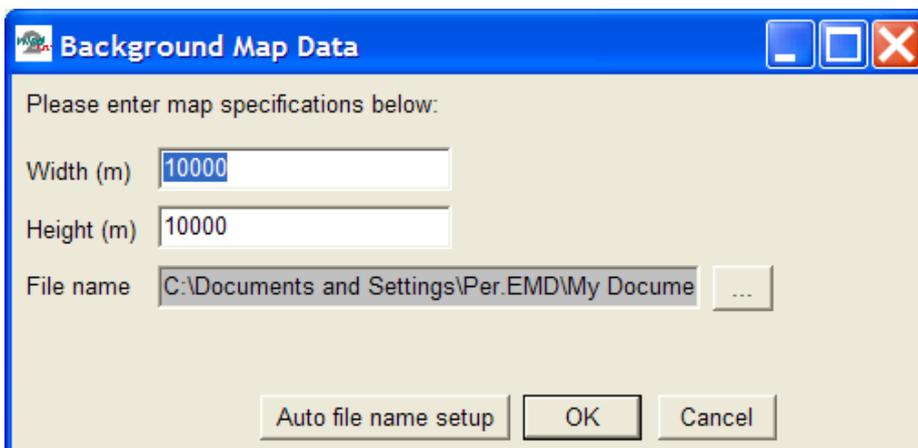


Figure 4 After selecting the source, you can specify width and height of map. The resolution will typically be automatically set to give a reasonably small file size that can be downloaded immediately, usually within a minute or so, depending on the speed of your internet connection. For some data sources you can choose resolution.

The ON-line map is added to the list as .BMI files, the internal WindPRO background map format.

2.4.3.6 Google overlay



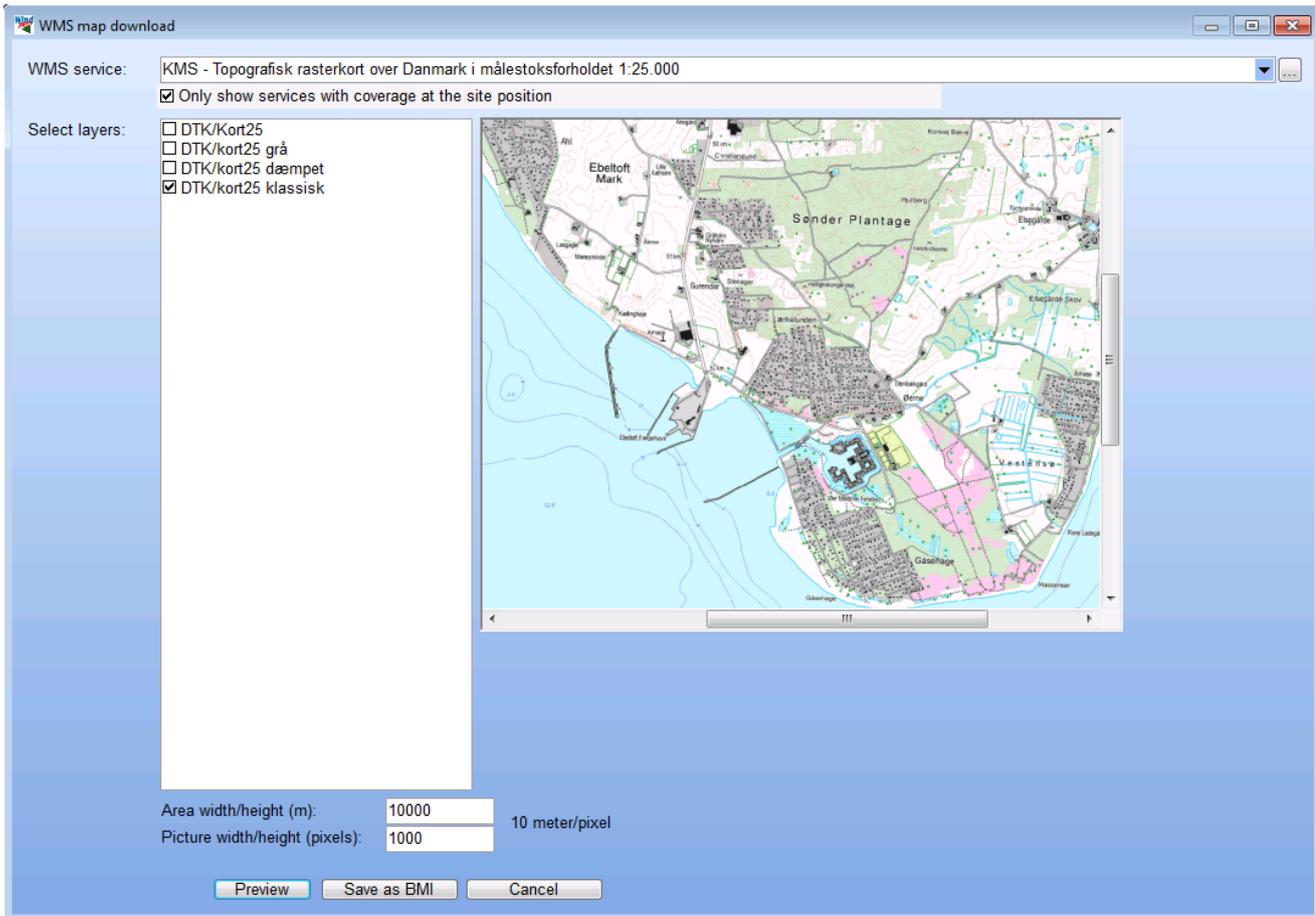
Google Overlay is used to import maps calibrated in Google Earth. In Google Earth, it is possible to add a bitmap as an overlay using this icon  in the top bar. The bitmap can then be stretched, rotated and moved in order to fit with the background of Google Earth. It might be useful to change the opacity to get a good match between the whole image and Google Earth. The view in Google Earth shall also be vertical to the map to avoid any distortion. Once the calibration of the image is done, right click on its layer and select Save as to save the overlay as a kmz file. This file can finally be loaded in WindPRO as a background map with the Google Overlay import.

2.4.3.7 WMS



A Web Map Service (WMS) is a standard protocol for serving georeferenced map images over the Internet that are generated by a map server using data from a GIS database. WindPRO has setup some WMS servers, but users can add WMS servers to the list. The WMS maps is saved in BMI format

Select the WMS service from the dropdown menu and then the relevant layers of available data. Define the area size (same height and width). The picture width/height defines the number of pixels that the image shall have. The limitation of the allowed number of meter/pixel depends on the WMS server.



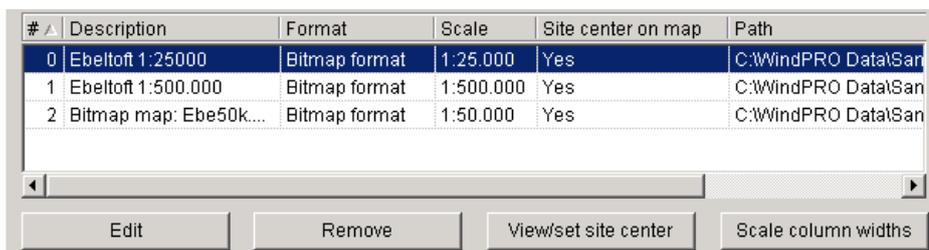
It is possible to add WMS server to the list by clicking on the three dots to the right and then on Add.



The GetCapabilities URL has to be found on the homepage of the WMS provider.

2.4.3.6 View and set site center

When you click on one of the attached maps and then on the View/set site center button shown below,



either the map will appear, or a square on the globe showing you that your site center is outside of the defined map (see below). If the site center is outside the defined map, either move site center or redo the geo-reference.

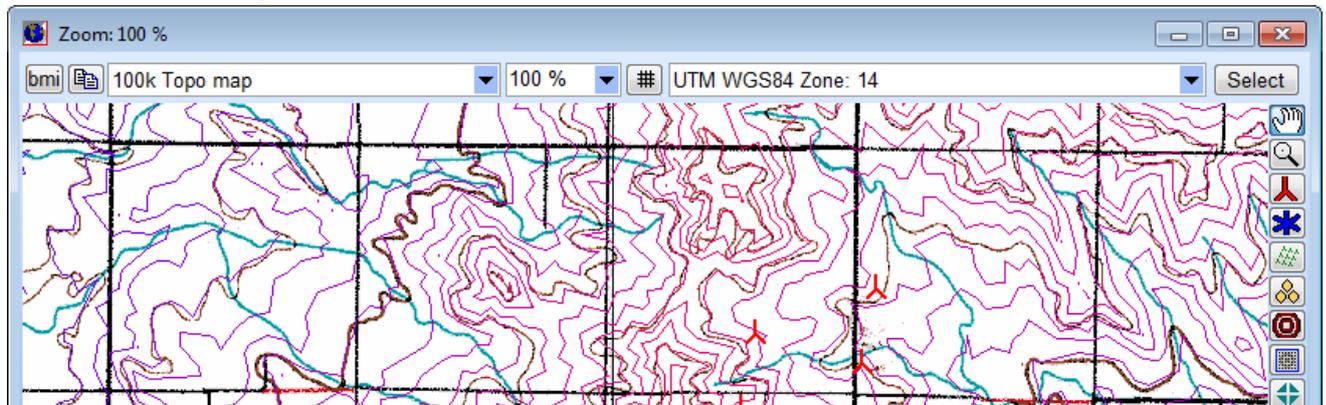


In the example shown above, the squares show the locations of the attached maps on the globe and the red cross shows the present location of the site center. The red line points to the center of the map that you are currently trying to view. To move site center inside the map, simply click inside the red square.

2.4.3.7 Blank map

If no maps are available, you can still enter objects graphically by using a blank map, which is simply a white background that is automatically scaled to your project design area. A blank map appears automatically if there are no other maps defined.

2.4.3.8 Some map window features

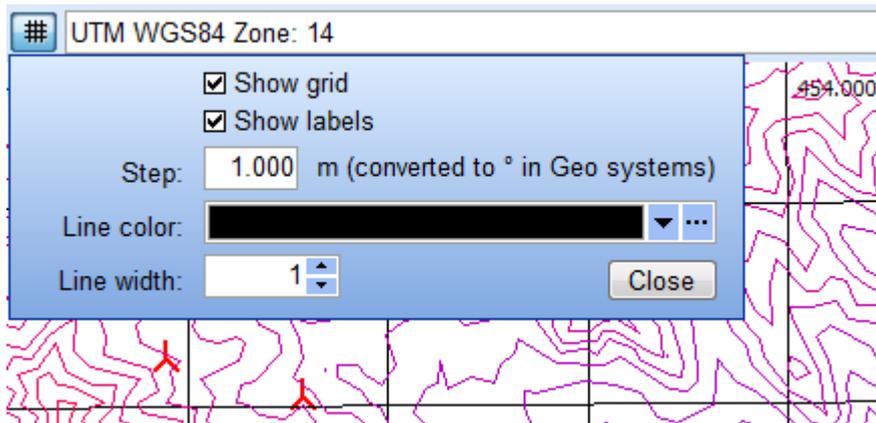


In the top bar of the map window, you'll find two buttons to the left.

First one creates a .bmi file (WindPRO's native background map format). This .BMI file is then including "what you see" on the map, like objects etc. The map is immediate loaded after pressing the button. If you have a large wind resource map file or detailed water depth map, that takes long time to render, it can be efficient to have a "hard copy" where you save the render waiting time.

Second one simply copy the map to clipboard, for pasting into like Word for documentation reports.

The zoom as well as the coordinate system and coordinate zone can at any time be changed by the drop down boxes. Zoom can also be changed by scroll button on mouse. Coordinate system choices can be limited to the country relevant ones to "reduce confusion". EMD maintain a list that pairs countries and coordinate systems.



The button between the zoom and the coordinate system is the grid button which allows showing a grid in the selected coordinate system. It is possible to have the coordinates shown as label and to define the properties of the grid.

2.4.3.9 Where to find other maps on the Internet?

In the USA, maps can be downloaded as zipped *.DRG files. They are either free or can be purchased for a relatively small fee.

Try these Internet locations:

www.mapmart.com

<http://data.geocomm.com/dem/demdownload.html>

After downloading, the unzipped files can be attached to the WindPRO project as described in section 2.4.3.4. Please notice that the world map files already are georeferenced and thereby easier to use.

In Europe, a site with links (mainly for commercial map products) is:

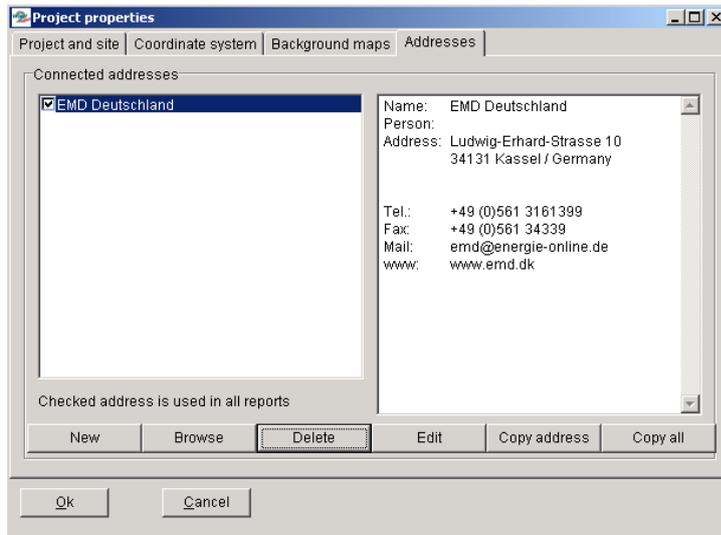
<http://www.eurogeographics.org>

2.4.3.10 Merge maps

With the merge map button, more maps can be “glued” to one map, although it requires all has same scale. Simply press the button and select the maps to be glued in the browser. The glued map will then be saved in the list as a new map.

2.4.4 PP Tab Sheet: Addresses

In the Address Tab Sheet shown below, you enter the address of the relevant customer, the electricity company, the county, etc. You can check one of the addresses, which means that this address will be printed on all printouts.



The buttons are as follow:

New: Create a new address.

Browse: Look in the list of addresses used in previous projects in order to use a previously typed address. See section 2.4.4.1 for further details.

Delete: Remove the highlighted address from the project.

Edit: Edit the highlighted address.

Copy address: Copy name, person and address to the clipboard in order to paste them into a text document e.g. a letter, a fax or an address label to send with the calculation reports.

Copy all: Copy all fields in the address record to clipboard

Besides the fields shown in the above screen, you have some additional "user-fields" in which you can add project status, costumer number referring to other costumer databank, more telephone numbers, contact persons, etc. All fields are shown below. The field lengths are practically unlimited, but remember that if you wish to use them in other databases, there might be a limited field length.

2.4.4.1 Address list browser

When you browse for addresses, you will get a list of all addresses in previous projects which are included in the project browser search path.

Filename	Name	Person	Address1	Address2	Address3	Address4	Telephone	Fax
C:\WindPRO Data\ver.1 projects\NE...	NEG-Micon		Alsvej 21	8900 Randers			8710 5000	8710 5001
C:\WindPRO Data\ver.1 projects\ne...	Anders Bundgård	Rørholtvej 76	9370 Hals				9825 4001	
C:\WindPRO Data\ver.1 projects\ne...	Test			lyestvej 2				
C:\WindPRO Data\ver.1 projects\NE...	NEG-Micon		Alsvej 21	8900 Randers			8710 5000	8710 5001
C:\WindPRO Data\ver.1 projects\NE...	Banestyrelsen, ...	Morten Stender ...	Salvgade 40 opg...	1349 København K			331 40 400	3391 1285
C:\WindPRO Data\ver.1 projects\NE...	IS Nordjyllandsv...	Jørgen Saxov	Postboks 51	9310 Vodskov			9954 5454	9954 5455
C:\WindPRO Data\ver.1 projects\NE...	NEG-Micon		Alsvej 21	8900 Randers			8710 5000	8710 5001
C:\WindPRO Data\ver.1 projects\NE...	VINDKRAFT PRO...	Endre Dingsør	Postboks 30	Sandslimærke 63	5049 SANDSLI		+47 55997242	+47 55997241
C:\WindPRO Data\ver.1 projects\No...	IS Nordjyllandsv...	Jørgen Saxov	Postboks 51	9310 Vodskov			9954 5454	9954 5455
C:\WindPRO Data\ver.1 projects\No...	VINDKRAFT PRO...	Endre Dingsør	Postboks 30	Sandslimærke 63	5049 SANDSLI		+47 55997242	+47 55997241
C:\WindPRO Data\ver.1 projects\NT...	NEG-Micon		Alsvej 21	8900 Randers			8710 5000	8710 5001
C:\WindPRO Data\ver.1 projects\NT...	NEG-Micon		Alsvej 21	8900 Randers			8710 5000	8710 5001
C:\WindPRO Data\ver.1 projects\NT...	NEG-Micon		Alsvej 21	8900 Randers			8710 5000	8710 5001
C:\WindPRO Data\ver.1 projects\Na...	Bonus Energy A/S		Fabriksvej 4	7330 Brande			9718 1122	9718 3086
C:\WindPRO Data\ver.1 projects\Op...	NEG-Micon		Alsvej 21	8900 Randers			8710 5000	8710 5001
C:\WindPRO Data\ver.1 projects\Op...	NEG-Micon		Alsvej 21	8900 Randers			8710 5000	8710 5001
C:\WindPRO Data\ver.1 projects\Pe...	Peder Villadsen	Holmevej 3	8305 Samsø				8659 0761	
C:\WindPRO Data\ver.1 projects\Pe...	Banestyrelsen, ...	Morten Stender ...	Salvgade 40 opg...	1349 København K			331 40 400	3391 1285

When opened with the browse button from Project Properties; if you double-click on an address, WindPRO will return the selected address. You can also return the address by highlighting and clicking on OK.

The address list can also be copied to other programs simply by making your selection the same as you would in the Windows Explorer (with the <Shift> key and/or the <Ctrl> key held down when clicking), then right-click and select "Copy". The entire address list with all fields can then be pasted into a spreadsheet. This can be useful when making status reports on all projects or transferring addresses to other software programs as general customer databases.

2.5 BASIS – Project design, import/export, calculation, print

2.5.1 Introduction to establishing a project

When the project properties have been entered, the actual project design work can begin. In this chapter we will describe how WTGs or other objects are entered and how general object editing, copying and import/export work. Other object inputs will depend upon the calculations you wish to perform. These other object inputs are described in the relevant chapters.

2.5.1.1 Map

WTGs and other Objects must be entered via the maps. Click on the map button to open the map window you prefer to create the objects into.



If one or more maps have been linked to the project, these maps can be invoked by clicking on the 5 map buttons.



Please notice that when you enter objects via maps, if you hold the <shift> key down while selecting a tool, this tool will become a default. This makes it possible to enter several objects with the same object properties, e.g. a series of noise objects with the same distance and dB requirements, or a number of parallel rows of WTGs etc.

You can insert bookmarks on the maps by <Ctrl+k> <1> for marking the first of up to 10 bookmarks, then <Ctrl + 1> for GOTO bookmark 1, etc. This makes it possible to move quickly between different “sweet spots” on your map.

2.5.1.2 Object List



The Object List can be opened parallel to the map. This is very useful to interact between the map view and the Object List view. In the Object List view, objects are marked with a red x if there are errors associated with the object (typically missing data that the object links to, or missing height information (TIN) where the object is placed). The latter error shows a red x in the Z-value column, only if the object is set to get its Z-value from the Digital Height Model (DHM), which in this case means the calculated Triangular Irregular Network (TIN) (see Section 2.8.2.2).

Description	Locked	X(East)	Y(North)	Z	Type	System label	User la	Result (most recent)
* 9851	<input type="checkbox"/>	586.182	923.976	293.3	Existing V	8		2.082 MWh/y, 4165 h, 47.5 % CF; 9.7 m/s; Wake eff. 96.7 %; Goodness: 113 %
* 9854	<input checked="" type="checkbox"/>	586.382	923.862	290.8	Existing V	9		2.077 MWh/y, 4153 h, 47.4 % CF; 9.5 m/s; Wake eff. 97.5 %; Goodness: 112 %
* 11054	<input type="checkbox"/>	585.997	924.150	291.5	Existing V	10		2.915 MWh/y, 4417 h, 50.4 % CF; 9.6 m/s; Wake eff. 97.3 %; Goodness: 0 %
* 11055	<input type="checkbox"/>	585.897	924.369	296.2	Existing V	11		2.983 MWh/y, 4519 h, 51.6 % CF; 9.8 m/s; Wake eff. 97.4 %; Goodness: 0 %
* 11056	<input type="checkbox"/>	585.967	924.600	312.5	Existing V	12		3.098 MWh/y, 4694 h, 53.5 % CF; 10.2 m/s; Wake eff. 97.5 %; Goodness: 0 %
Camera: Air-view.jpg Target ITM East: 586358 North: 924065 (4)	<input type="checkbox"/>	587.919	923.689	645.0	Camera	13		
Statgen-old mast	<input type="checkbox"/>	584.142	923.902	160.0	Site Data	14		
Local wind data	<input type="checkbox"/>	587.128	923.661	248.9	Site Data	15		
Old met mast, Gillespie	<input type="checkbox"/>	584.145	923.907	160.0	Meteorolo	17		9.40 m/s @ 30.0 m; 0.00 m/s @ 10.0 m
Local wind data- MCP with Malin Head	<input type="checkbox"/>	586.492	923.900	299.2	Site Data	25		
Site data 12 sectors; Radius: 20 000 m (9)	<input type="checkbox"/>	586.660	923.889	297.7	Site Data	26		
New local raw wst TEST ROSE	<input type="checkbox"/>	586.762	923.789	278.5	Site Data	31		

In the Object List you can select several objects in the same way you would in Windows Explorer. The selection will then work on the map also. For example you can then move all the selected objects in one operation by dragging them to a new location on the map. Note also the right-click features available for selected objects in Object List, such as Delete, Edit, Copy or import/export (described in details later).

Note the feature “Results”, which show the most recent main calculation results for some selected objects like Noise Sensitive Areas or WTGs. These results can also be shown as labels on the map, and they can be copied to clipboard – a very efficient way when analyzing a special case where many different smaller adjustments are performed.

A special feature for Line or Area Objects is the ability to center the object at the point where the linked data is on the map. This may help you find where the imported data in line or Area Objects are located and then possibly locate import errors.

It is possible to edit the object data direct in the object list, without opening the object. E.g. coordinates, user labels, description – just click in the cell and it goes into edit mode. It is important to try to get a little “feeling” about when object are selected and when a cell is selected, while the possible actions are different. E.g. you can edit selected objects, exporting etc. when objects (line(s)) are selected, while you only can edit the specific cell when a cell is selected. When a cell is selected it turn yellow, to make it easy to distinguish between cell and object selection.

2.5.2 Entering, moving, snapping, and selecting WTGs (and other objects)

WTGs can be created as individual WTGs or as rows with fixed in-row distance and WTG type. It’s always possible to turn a row into individual WTGs (with a right-click) and still be able to edit the coordinates and WTG type individually afterwards. The WTG type must be listed in the WTG Catalogue and so, must first be created in the Catalogue if not already listed in it. In energy production calculations for single WTGs (WIND ATLAS), the hub height can be changed during the calculations without having to create all the possible hub heights in the WTG Catalogue.

After you have entered WTGs via a map, you can position it at the correct location by clicking on the WTG mark and dragging it to the desired location on the map. You can fine tune the position by holding down the <Ctrl> key and moving the selected object with the arrow keys. You can also link an object to another by holding down the <Ctrl> key when moving one object towards another object. A hook appears to illustrate the activation of this “snap” feature.

To select an object when a number of objects are positioned close together, you can move the cursor over the group of objects to get a drop-down list of the objects. You can then select the one you wish to move or enter properties for.

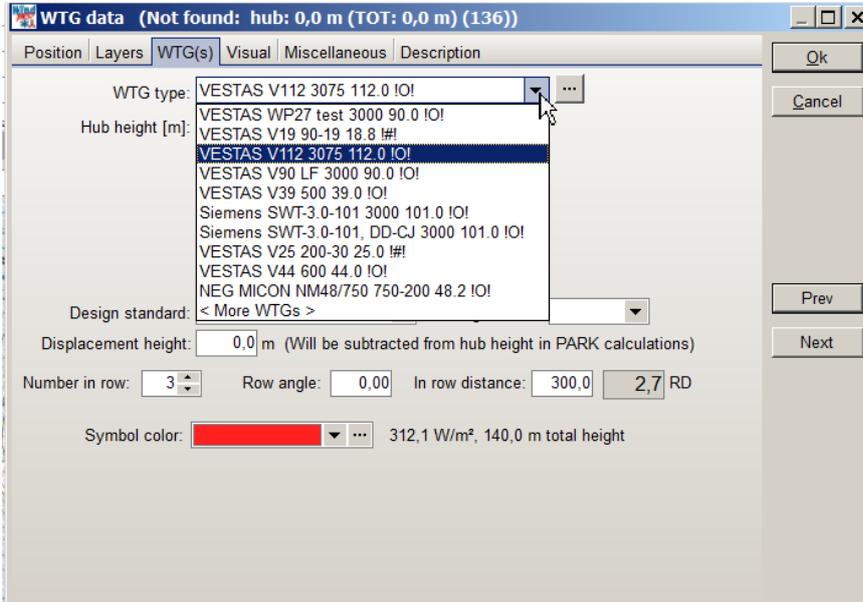
For rows of WTGs the following rule applies:

Place the cross hair inside the center mark, left-click and drag to move the row parallel to its original position. Place the cross hair inside an outer mark to rotate the row around the opposite outer mark. Hold down the <shift> key while dragging an outer mark to change the in-row distance.

2.5.2.1 WTG Object Tab Sheet: WTG(s)



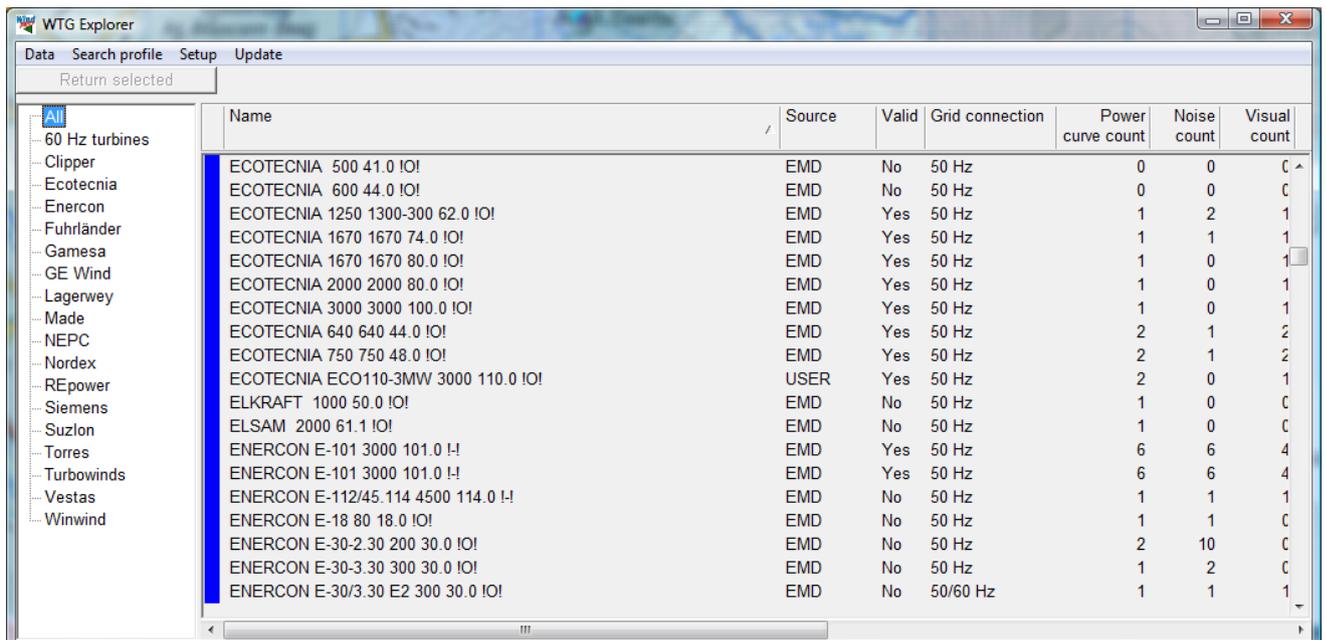
Activating the "new WTG" icon creates new WTGs by clicking on the desired position on the map. The following window will appear.



Entering new WTGs:

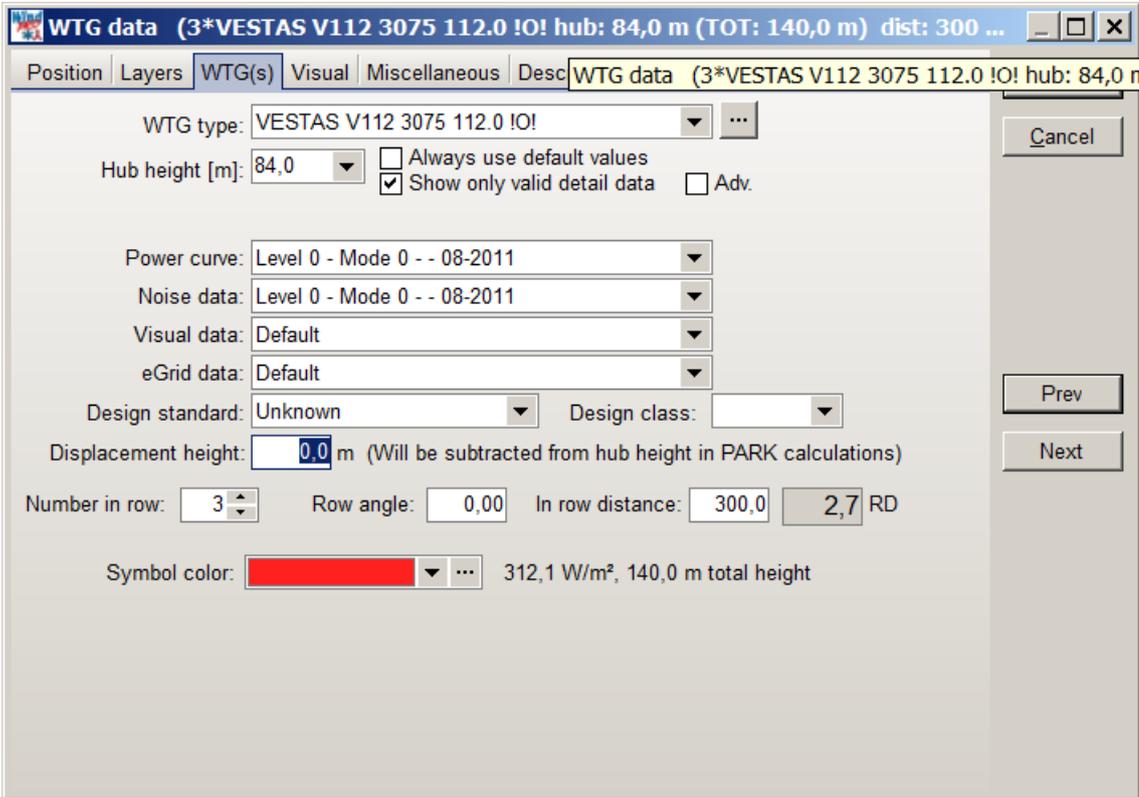
With the "Number in row" it's possible to create not only one WTG at a time, but also a row of WTGs with same in-row distance and on a straight line.

The WTG type is selected from the WTG Catalogue via the drop-down list, which holds the last 10 WTGs used. Select <more WTGs> to access the WTG Explorer (see figure below), where you can build different search profiles and select these in the WTG Explorer. This makes the searching and selecting of a specific WTG type easier and faster. Note from the Setup you can edit the search path, and thereby decide where to browse for turbines (in which folders). By default you browse in the WindPRO Data\WTG folder and the current project folder.



In the list you can sort by the different columns by clicking in the top of the column.

After having selected a WTG, it's possible to look for different power curves, noise data etc. by deselecting "Always use default" (see below).



Here 5 different sets of noise levels appear, and corresponding power curves will be selectable. It's the users' responsibility to select matching power curves and noise data, if these are coupled as for the WTG above. The "Adv." (Advanced) checkbox will be explained later.

After having entered the WTGs on a map it's easy to move them:

Click once on a WTG row to select it. Activate the center selection mark and drag the object sideways. Activate and drag an outer selection mark to rotate the row. Activate an outer selection mark while holding down the <Shift> key in order to change the in-row distance between the WTGs.



Z: 662,9 m | 2*VESTAS WP27 test 3000 90.0 !O! hub: 90,0 m (TOT: 135,0 m) dist: 349 m (3,9 RD) angle: 85° (68)

In the info field in bottom of the map screen, the distance in m as well as in Rotor Diameter (RD) is shown continuously updated, as well the hub height as total height (TOT) is shown.

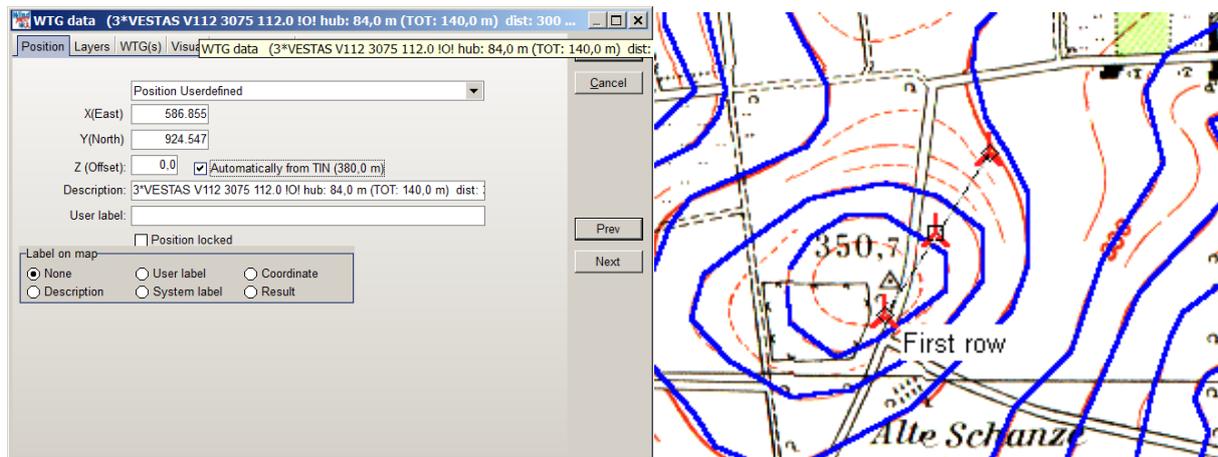
2.5.2.2 Object Tab Sheet: Position

By a right-click and selecting properties, the input window for a WTG or any other object will appear, and more details can be entered. The Tab Sheet "Position" is common for all objects. Here you can enter the exact coordinates. The Z-coordinate can be entered or read automatically from a Digital Terrain Model calculated on the BASIS of a Line Object (Height Contour Map), but then the object has to be inside the TIN radius, see Line Object. A description can be entered and used as label on map. It's shown in the Object List and will be shown on printouts too. You can also enter a "user label". The software automatically gives a "system label", where

the first created object gets no. 1, the second no.2 etc. These system labels can never be changed. Therefore you have the opportunity to assign your own user label to objects, e.g. for a special numbering order in your WTGs or other objects. Later on (in "Printing Reports"), you can choose to sort the WTGs by user label instead of system label and thereby obtain full control. If you use letters in the user label, normal alphabetic sorting will be used.

On the map following labels can be visible next to the object:

Description,
User label,
System label
Coordinates or
None

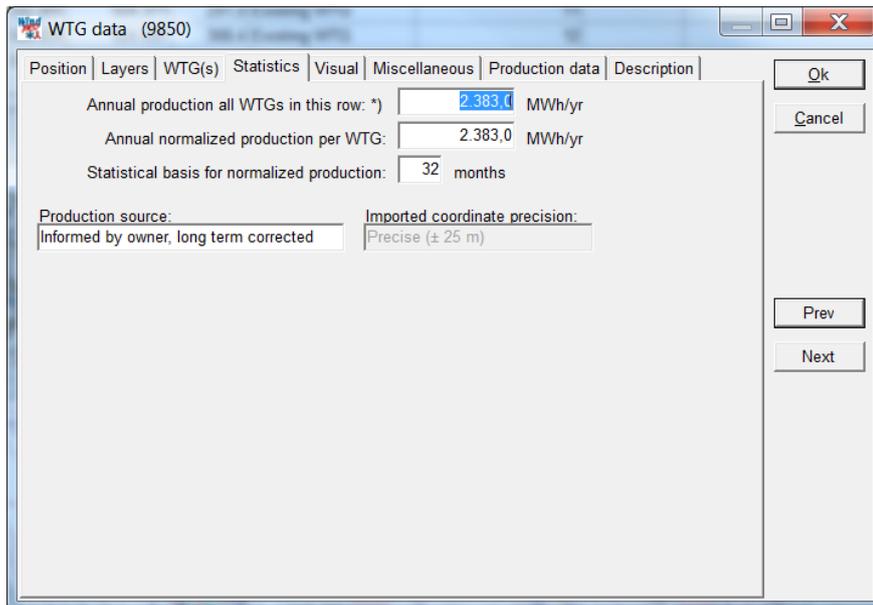


Under the Tab Sheet "Position" you can enter the exact coordinates. The Z-coordinate can be entered manually or read automatically from a Digital Terrain Model calculated on the basis of a Height Contour Map. Description can be entered and used as label on map. NOTE: Performing a WAsP calculation, an entered Z-value does not make any difference in calculation result. This calculation will always define the Z value based on the elevation data.

2.5.2.3 Existing WTGs Tab Sheet: Statistics



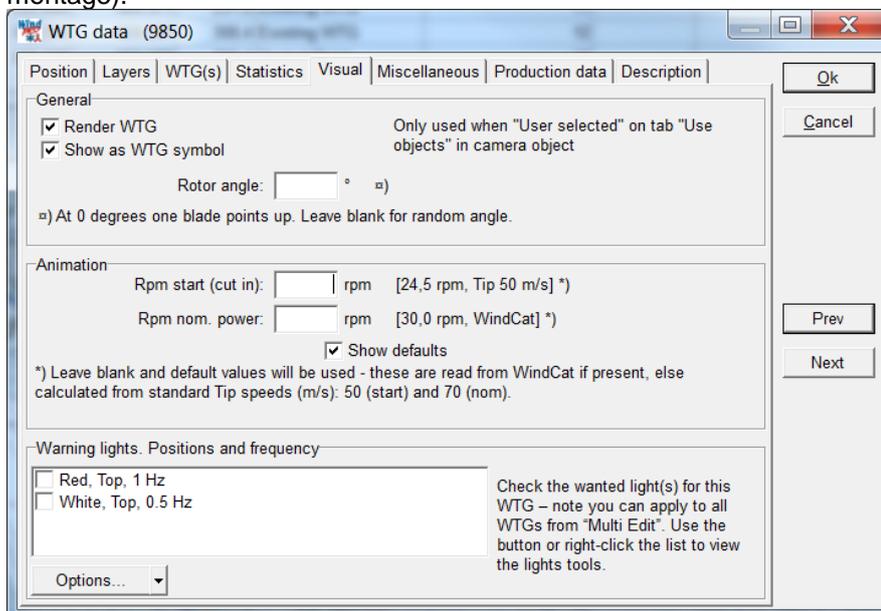
Existing WTGs are created the same way as the new WTGs. The only difference is that it's possible to input statistical data, i.e. actual production data, for the existing WTGs and thereby compare the energy production calculations. In a PARK calculation the results will be grouped in new and existing WTGs respectively, including information on the impact of the new WTGs on the production of the existing WTGs. How existing turbines are handled in PARK calculation reports is also decided by setting in tab "Miscellaneous".



The tab “production data” is more detailed production data, that can be used with the >2.8 “Performance Check” module.

2.5.2.4 WTG Object Tab Sheet: Visual

Here, the rotor angle (see Chapter 5, Photomontage) and the rotational speed for the WTG rotor can be specified (see Chapter 5, Animation module), and the Aviation light marking can be defined (see Chapter 5, Photomontage).



2.5.2.5 WTG Object Tab Sheet: Miscellaneous

WTG data (9850)

Position | Layers | WTG(s) | Statistics | Visual | Miscellaneous | Production data | Description

Show 1-2 distance circles/ellipses around WTG symbol's

1

Invisible
 Circle
 Ellipse

Axis Radius in meters Line color Width Angle

Major 0 + 4,0000 * Total height [m] [Red] 1 0,00 deg

Minor 0 + 0,0000 * Rotor diameter [m] Angle relative to row angle

2

Invisible
 Circle
 Ellipse

Axis Radius in meters Line color Width Angle

Major 0 + 3,0000 * Rotor diameter [m] [Green] 4 250,00 deg

Minor 0 + 7,0000 * Rotor diameter [m] Angle relative to row angle

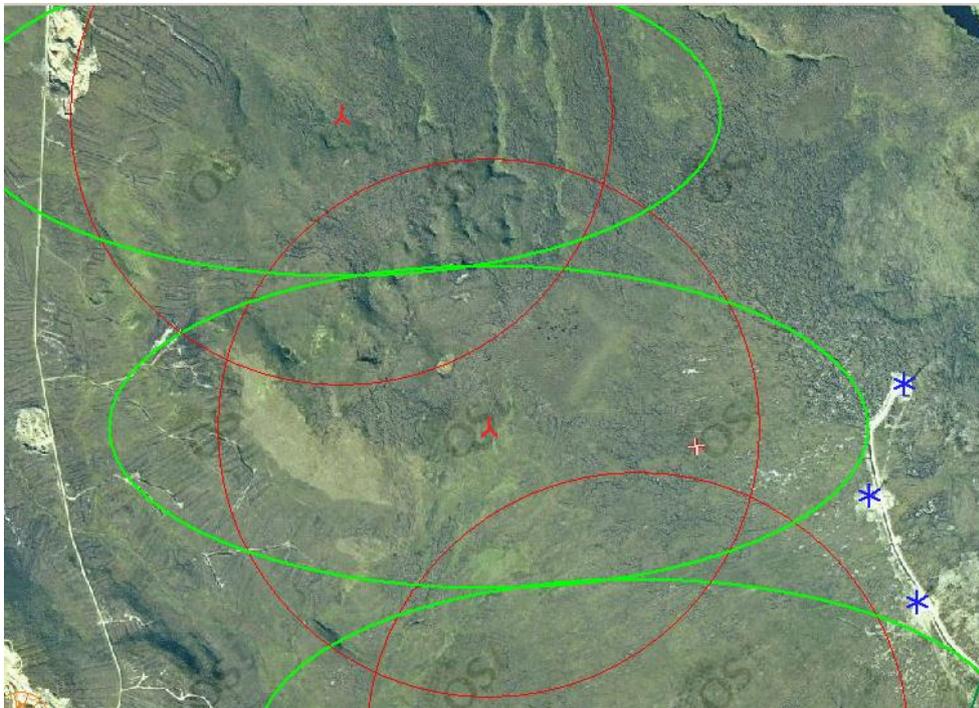
Treat as Park WTG (influences how it appears in printouts)

*) Notice: production should be corrected to normal wind year.

Ok Cancel Prev Next

In the Tab Sheet "Miscellaneous" you can enter:

Distance circle/ellipses – this is often useful for project design. It's activated by right-clicking on WTG symbol and checking "Show distance circle". Two circles/ellipses can be established and the radius can be made dependent on WTG main size specifications. Color and line width can also be specified.



An example of how to use the distance circles to both ensure the distance to settlements (law requirements) and to existing turbines (turbulence).

The "Treat as PARK WTG" means: If checked, the turbine is handled as a part of the wind farm to be calculated. The results for the existing PARK WTGs will appear at main results and take part in the PARK Total as well e.g. in time varying calculation results.

If NOT checked (default), the existing turbines are considered as "reference turbines" and are reported on separate page and do not take part in the totals or time varying results. As reference turbines it is possible to get a check of calculated versus actual production (Goodness) as part of the reference turbine print.

2.5.2.6 Object Tab Sheet: Layer

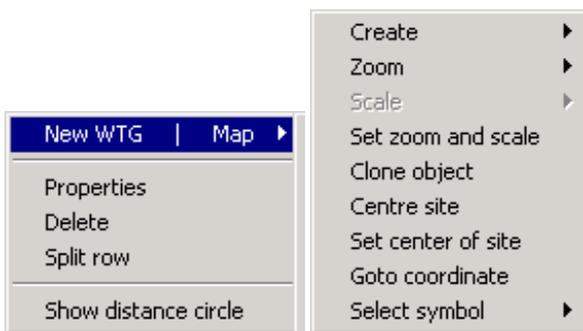
(See layer structure, Section 2.11)

2.5.3 Clone object (copy) and multi-editing

Two useful tools are available for all types of objects.

2.5.3.1 Clone object

Select one or more objects to clone (copy) from the map or the Object List. Select an object simply by clicking on the object with the left mouse button. Select additional objects by holding down the <Ctrl> key when clicking on objects on the map or multi-select in the Object List as you would in Windows Explorer. Once the objects have been selected, click on the right mouse button, then select "Clone Object" (go to the right from the top of the menu "New WTG | Map >" and a local object menu appears) (see below).



The cloned objects are placed 100 m East and 100 m South of the original ones. If the original object positions are locked, the cloned objects will be positioned at the exact same coordinates as the originals. The cloned objects can be moved normally when not locked. Cloning is a useful feature, especially for the terrain data object (see the module Energy Calculation), since you don't have to enter values twice e.g. two roughness classifications nearby each other that are almost identical. It's also a good way to ensure that parallel rows of WTGs have identical properties.

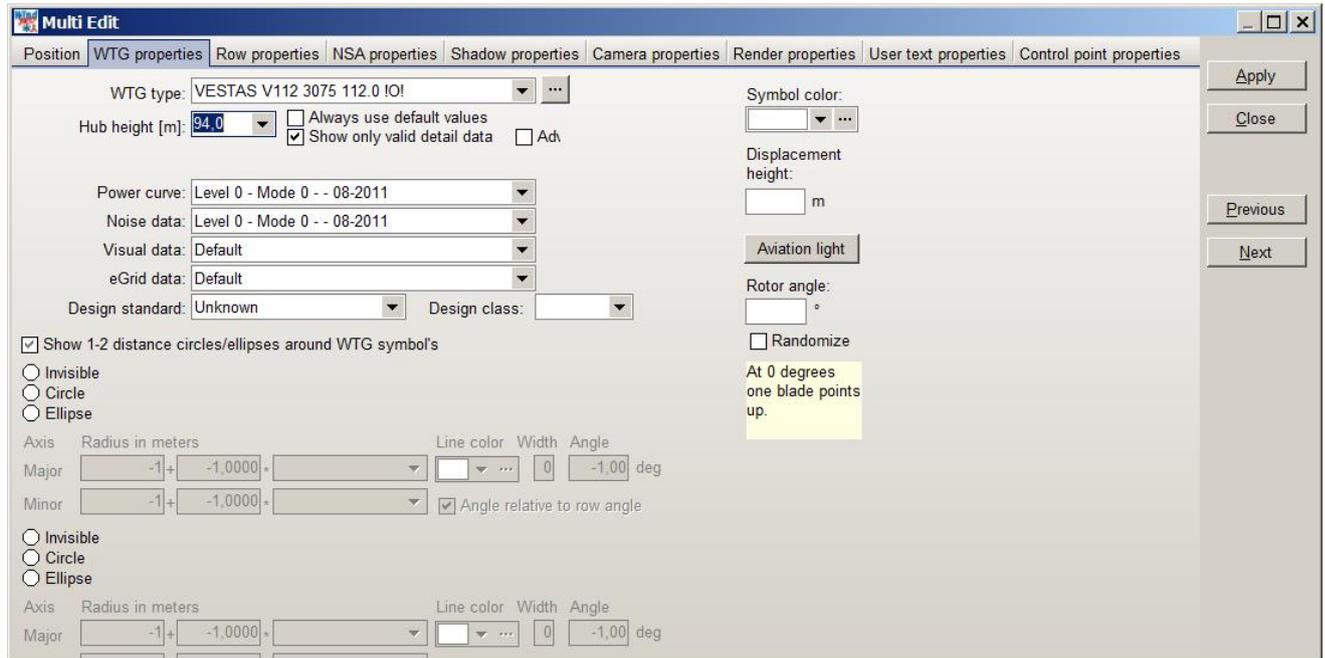
2.5.3.2 Multi-editing

When working with many WTGs or e.g. noise sensitive areas, where you need to change the WTG type in general, the hub height or noise emission data, or attach all objects to a height contour Line Object in order to read the Z-coordinates automatically, multi-editing is an efficient way of changing the characteristics for a large number of objects.

The Multi-editing tool works either by starting to select the objects to edit (possible with different WTG-types if e.g. the Z-coordinates are to be changed) or by firstly starting the "Multi-edit-window" and secondly selecting the objects to edit.



Start the "Multi-edit" tool by clicking on the symbol shown to the left. The "Multi-edit" window will appear as shown below.



Select which properties to edit as shown above, e.g. the WTG type. There are different ways of Multi-editing present different choices to edit different types of objects at the same time. Only the relevant changes for each object are performed. The program will notify you of the different selected types of objects before handling.

2.5.4 Import/export and copy/paste of object data

Electronic exchange of data is becoming more and more common. You may receive coordinates for objects (WTGs, neighbors, etc.) via an email that you don't wish to enter manually. Or, you need to make some changes to a wind farm layout with the aid of a spreadsheet calculation. Maybe you want to copy all noise sensitive areas to shadow receptors at the same positions, or copy a roughness rose from one project to another. All of these operations as well as many others can be performed with help from the import/export and copy/paste functions.

The Object List window shown below is from where these functions typically are used. But it is also possible to export by right click on an object on the map and export from there.

Description	Locked	X(East)	Y(North)	Z	Type	System	User Ia...	Result (most recent)
Camera: Mvc-299f_rot1.jpg Target...	No	188.891	422.061	120,3	Camera	3		
Camera: Mvc-305f_rot1.5.jpg Targ...	No	185.928	422.965	146,3	Camera	4		
9850	Yes	186.530	424.058	325,6	Existing ...	5		2.384 MWh/y; 3974 h; 45,3 % CF; 9,7 m/s; Wake eff. 97,7 %;
9852	Yes	186.308	424.183	332,5	Existing ...	6		2.455 MWh/y; 4092 h; 46,7 % CF; 9,9 m/s; Wake eff. 97,7 %;
9853	Yes	186.220	424.382	345,0	Existing ...	7		2.546 MWh/y; 4243 h; 48,4 % CF; 10,1 m/s; Wake eff. 98,3 %;
9851	Yes	186.224	423.942	289,7	Existing ...	8		2.300 MWh/y; 3834 h; 43,7 % CF; 9,4 m/s; Wake eff. 98,8 %;
9854	Yes	186.442	423.838	287,0	Existing ...	9		2.243 MWh/y; 3738 h; 42,6 % CF; 9,2 m/s; Wake eff. 98,6 %;

To export (copy) one or more objects, simply mark the objects by dragging when holding left mouse button down or, as in Windows Explorer, by holding down the <Ctrl> key or, by marking the first selection and then holding down the <shift> key when marking the last. When objects are selected, right-click and get the menu shown below:

Edit selected objects	Enter
Delete selected object(s)	Del
Clone object(s)	
Export	▶
Import	▶
Select all	Ctrl+A
Copy object(s)	Ctrl+C
Paste object(s)	Ctrl+V
Copy result(s)	Ctrl+R
Replace object data	

Choose “Copy object(s)” and all the stored information for the objects is placed in the Windows clipboard. The data can be pasted back as new objects or as a replacement of the copied data with the changes made in a spreadsheet, e.g. adding a user label (see next section).

2.5.4.1 Copy/paste for remote editing of object data in spreadsheet

From the clipboard, you simply paste the objects into a spreadsheet (or into the Object List in another project) and if into a spreadsheet, the list appears as shown below.

Descriptio	Object type	System lal	Object ID	X	Y	Z	Object de	User label	File name	Hub heigh	Productio	Use defau	Power cur
9850	Existing WTG	5	1	186530	424058	325,6	9850		C:\Users\j...	40,5	2383	yes	
9852	Existing WTG	6	1	186308	424183	332,5	9852		C:\Users\j...	40,5	2501	yes	
9853	Existing WTG	7	1	186220	424382	345	9853		C:\Users\j...	40,5	2632	yes	
9851	Existing WTG	8	1	186224	423942	289,7	9851		C:\Users\j...	40,5	2346	yes	
9854	Existing WTG	9	1	186442	423838	287	9854		C:\Users\j...	40,5	2321	yes	
Paste from here if you want to replace object data													
Paste from here if you want to create new object by type													
Paste from here if you want to get a pop up list for selecting object type													

The following properties are common for all object types:

Description – Same as in Object description

Object type – Name, identifying type of object (see later in list).

(The properties listed above will not be used when copying changed object data back to the Object List).

System label – unique internal number assigned when the new object is created (cannot be edited).

Object ID – Number OR Text, identifying the type of object (see list later in 2.5.4.5)

X – East coordinate

Y – North coordinate

Z – Elevation (above ground level)

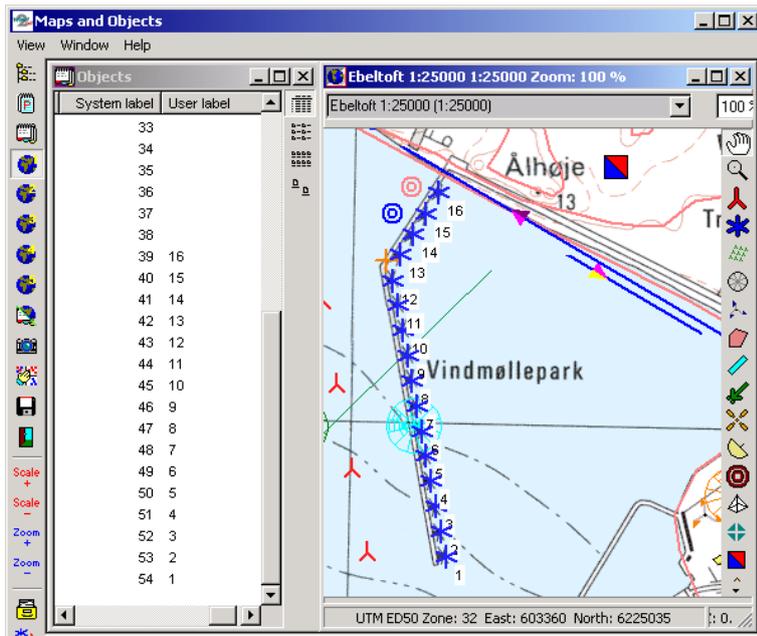
Object description - (User specified description, if no user description it is auto generated)

User label - (User label e.g. internal numbering for sorting in printout)

Lastly, depending of the type of object, additional information such as **Hub height** and **WTG type** for WTGs. See Section 2.5.4.4.

Data can now be modified in the spreadsheet and copied back to object list, see what to include in list shown above.

In the figure below, you can see how the copied 16 existing WTGs in the Ebeltoft DEMO project have been given a user label corresponding to the correct WTG number. This can be used later for deciding the print order in reports.



2.5.4.2 Export data from object list

Export		Export object position(s) to a Shape file
Import		Export to file...
Select all	Ctrl+A	Export object position(s) to a waypoint GPX file
Copy object(s)	Ctrl+C	Export to Google Earth kmz-file

There are at present 4 export options:

To shape files (for import in GIS software), a .shp file is created.

To file – a WindPRO object file (.wprobjects) is created – this is an efficient way to transport objects from one WindPRO project to another – this includes all data “behind” the objects.

To waypoint GPX file, the “standard” within GPS, meaning this is the format that can be imported into a GPS.

To Google Earth .kmz file, see chapter 2.16

2.5.4.3 Import data to object list

Import		Import placemarks from Google Earth KMZ file...
Select all	Ctrl+A	Import from file...
Copy object(s)	Ctrl+C	Import placemarks from a waypoint GPX file...

Here are at present 3 different options:

From Google kmz file, the points in the file (e.g. turbine positions specified by client) will be established as control marks in WindPRO. By copy to like Excel and paste back you can change the controlmarks to the wanted object type.

From file – the native WindPRO *.wpobjects can be imported including all object information's. Waypoints from GPX file, the GPS file format, see additional options about GPS coordinates below.

If you have data in a GPS, you need getting the data into a spreadsheet before copying. This can be done simply by typing data from the GPS screen into a spreadsheet. Or, in the case of a larger number of GPS points, by importing GPS data into a PC (a special cable is required to do this). Free software can be found on the Internet – e.g. at www.gpsu.co.uk, or purchased together with GPS. Shown below is an example of the screen in the free GPS software, GPS Utility, after downloading waypoints.

ID	Coordinate	Symbol	TPO	Alt (m)	Comment
019	33U 582714 6015554	Flag	T E	-21	
010	33U 542565 6000921	Flag	T E	-21	
012	33U 542232 5999755	Flag	T E	-21	
013	33U 542232 5999756	Flag	T E	-21	
017	33U 526533 5994968	Flag	T E	-31	
020	33U 582169 6016313	Flag	T E	-31	
HFN	32U 588369 6141252	House	T E	-31	
FARMOR	32U 602357 6162803	House	T E	-31	
021	33U 580779 6015721	Flag	T E	-31	

41 waypoints

To get the coordinates pasted into a spreadsheet, you need to select one row at a time and then paste. Afterwards, you have to divide the coordinate column into two in the spreadsheet e.g. use the "MID(A1;5;6)" function to extract, starting with the 5th character, the following 6 characters from cell A1 (the X-coordinate). There are other free GPS tools like "Easy GPS" that seem to work better.

2.5.4.4 Identify what can be copy/pasted by object list

While the features that can be copied/pasted between object list and a spreadsheet will be revised from version to version, we recommend you simply copy the objects of interest from object list to spreadsheet, and there you will be able to see which features are included and thereby what can be "pasted back".

2.5.4.5 List of Object IDs

	Old ID	New ID
	0	NewWTG
	1	ExistWTG
	2	SiteData
	3	Obstacle
	4	NSA
	8	Shadow
	9	CtrlPoint
	10	Camera
	11	HCDData
	12	Obj3DData
	13	AreaObj
	15	WTGnet
	16	WTGareas
	17	UsrTextData28
	18	Ruler
	19	VR
	21	Shape
	24	EGrid
	25	BusBar
	26	Transformer
	27	ExtGrid
	28	ELoad
	N/A	RadarObject
	N/A	MeteoObjectData
	N/A	HCGridObj

From ver. 2.8 the object ID is changed to the object type (text ID), but the above numbers can still be used. For the later created objects (Radar, new Meteo and Elevation grid), numbers cannot longer be used, only the text ID. To repeat: Pasting one of these strings into the object list will create a control point at the specified coordinate location:

9 514273 7513830

CtrlPoint 514273 7513830

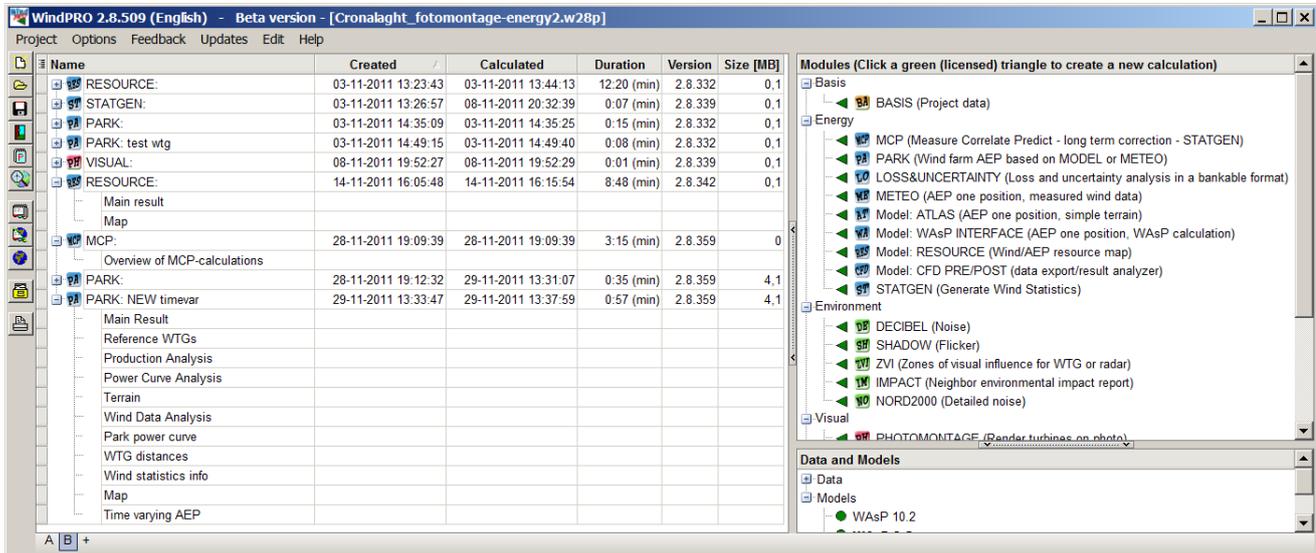
2.5.5 BASIS calculation

With the module WindPRO BASIS alone, it's possible to perform a so-called "BASIS-calculation". The "BASIS-calculation" does not calculate, it merely generates a complete report of the data that has been inputted, and a map with a presentation of the project. This gives e.g. the potential buyer of WTGs the opportunity to work with different project layouts using the WindPRO program at a very favorable price and the ability to forward the information (e.g. a WindPRO export file) to different manufacturers for calculations and quotations.

After a calculation, you can copy the calculation (by right-clicking on the report header). Then a copy of the report and all calculation settings is made. If you later change the WTG layout on the map, you can recalculate the copied calculation, so you now have two calculation reports with same specifications (e.g. air density), but with different WTG layouts so that the two sets of calculations are identical except for the layout.

2.5.6 Printing – general tips and setup

When a calculation has been performed, the following window appears.



Depending on the calculation, two or more reports will be generated. The line with the calculation name (in this case PARK), is the "header" of the calculations report. The name the user gives the calculation (in this case "NEW timevar"), also appears in the header. The reports follow subsequently.

To view setup or print the reports, there are a number of options described as follows:

2.5.6.1 Preview print and save file (.bmp, .jpg, .pdf, HTML)

See next sections on how to get into the preview window.

In the top of the preview window there are some functions that are used as follows:



The zoom and "full margin" buttons are self-explanatory.



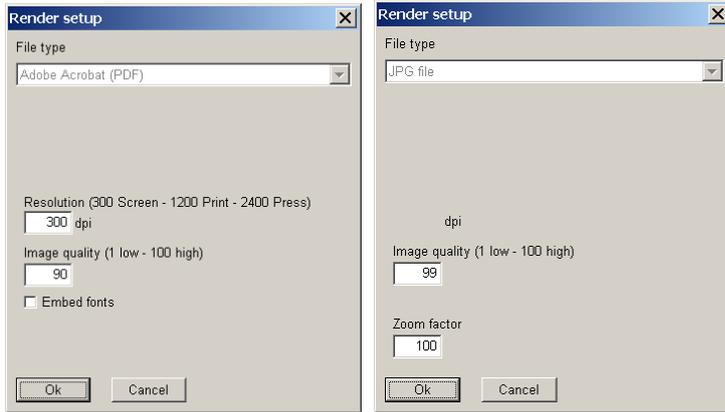
Copy to clipboard – afterwards the entire page can be pasted into another Windows document as a graphic.



Copy to file – or use the menu "file" > "save as" and choose between following options:



Note that the printer driver selected before preview will determine if there will be colors on the print preview and in the print file. This can be overruled by setting "Force color printing" or "Force monochrome printing" in the report setup



If .pdf or .jpg format is selected, then the setup options shown above will appear. This gives the option to decide the quality and size of the file.



The arrows are used to move backward and forward between pages. If only one page exists in the preview, the arrows will be grey.



The printer symbol – print the current page, selected pages or the entire report.

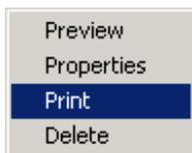


The door – closes the preview.

The Zoom window allows you to user-define the zoom factor. NOTE: Use a large zoom factor to ensure picture/graphics quality if reports are being copied to a file or to the clipboard.

2.5.6.2 Print a single report with default settings/preview

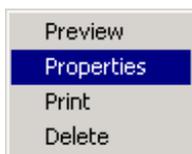
To print a single report, select report (click on report) and click on the printer symbol or right-click and select “print” from following menu:



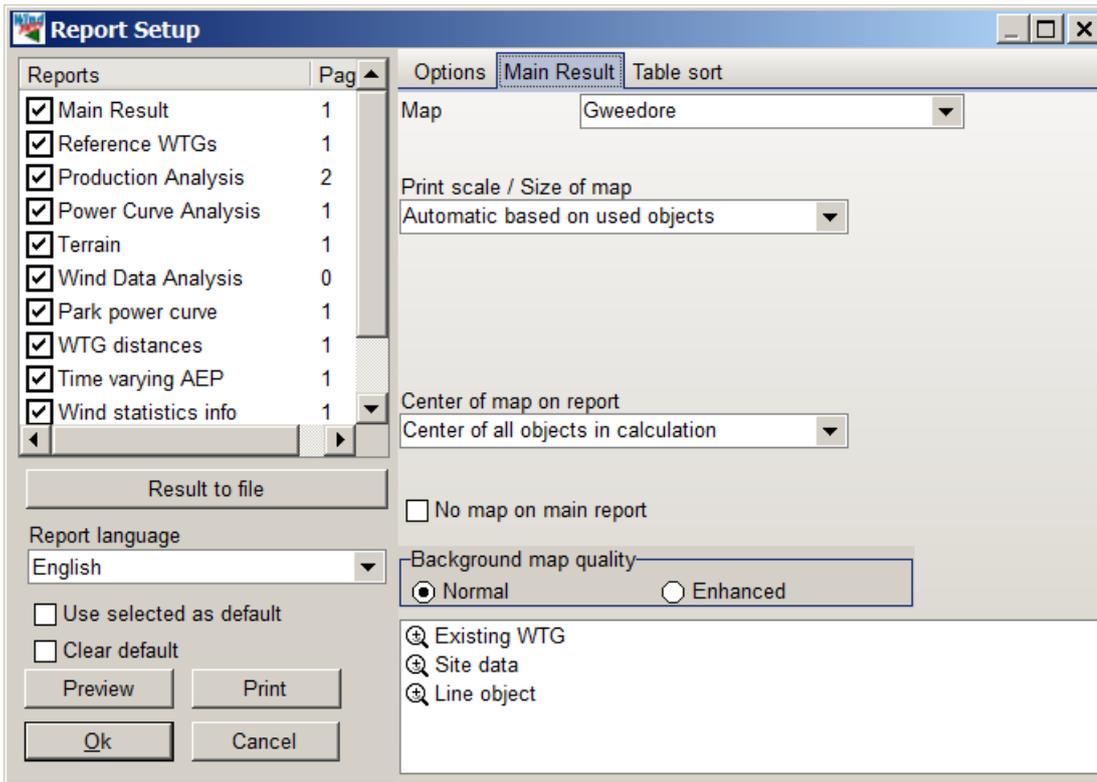
To preview a single report with default settings, simply double-click on the report, e.g. on "Map".

2.5.6.3 Setup a single report

Right-click on report name and select Properties from the following menu:



The following window appears depending on which report you have selected.

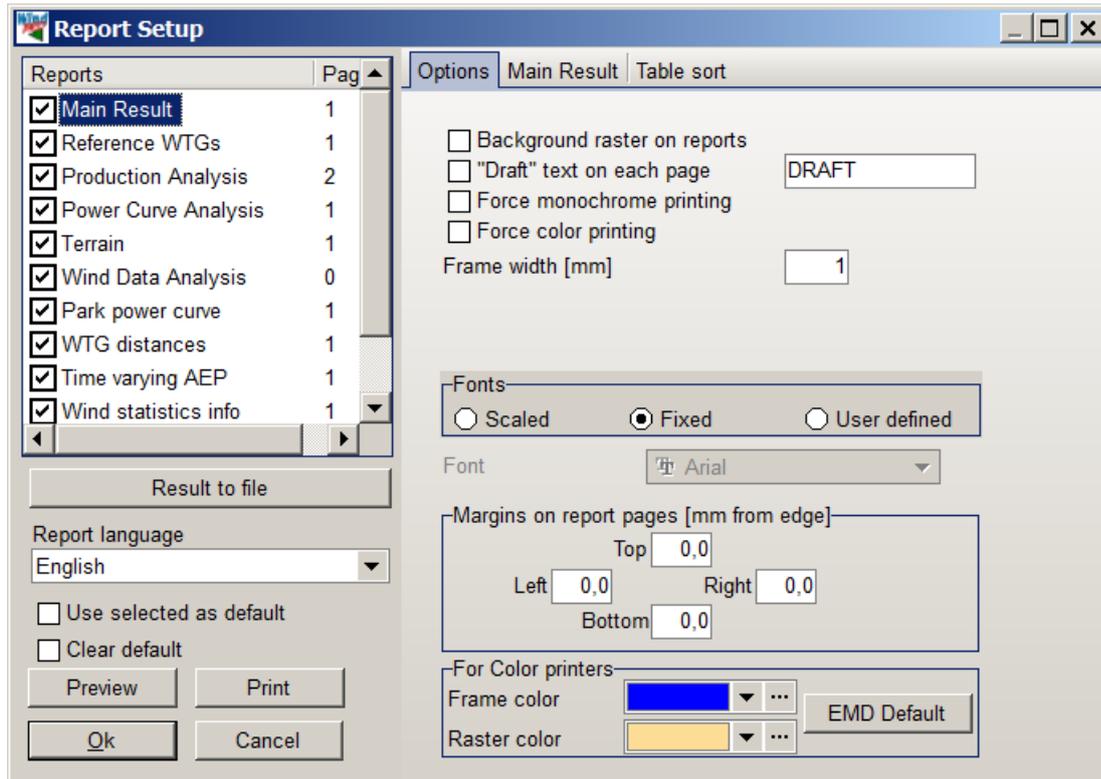


In the right half of the window you get different tab sheets where individual settings can be applied to the report. In the left part are following important features:

Result to file - in more reports; the calculation results can be saved to a file or to the clipboard for further processing in e.g. spreadsheet tools.

Report language – from version 2.4 on, some print languages will be available (if license is purchased).

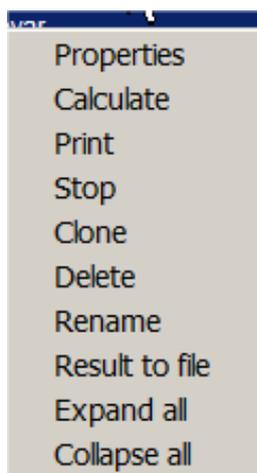
The “Report language” can be checked so it’s used in all calculations until WindPRO is shut down. The next time WindPRO is started, the original language will reappear as a default unless “use as default” is checked.



On the "Options" tab sheet, you can select "Force color printing", which is advantageous if your default printer is a black & white printer, and you want to save e.g. PDF files with colors. The many other layout options should be self-explanatory.

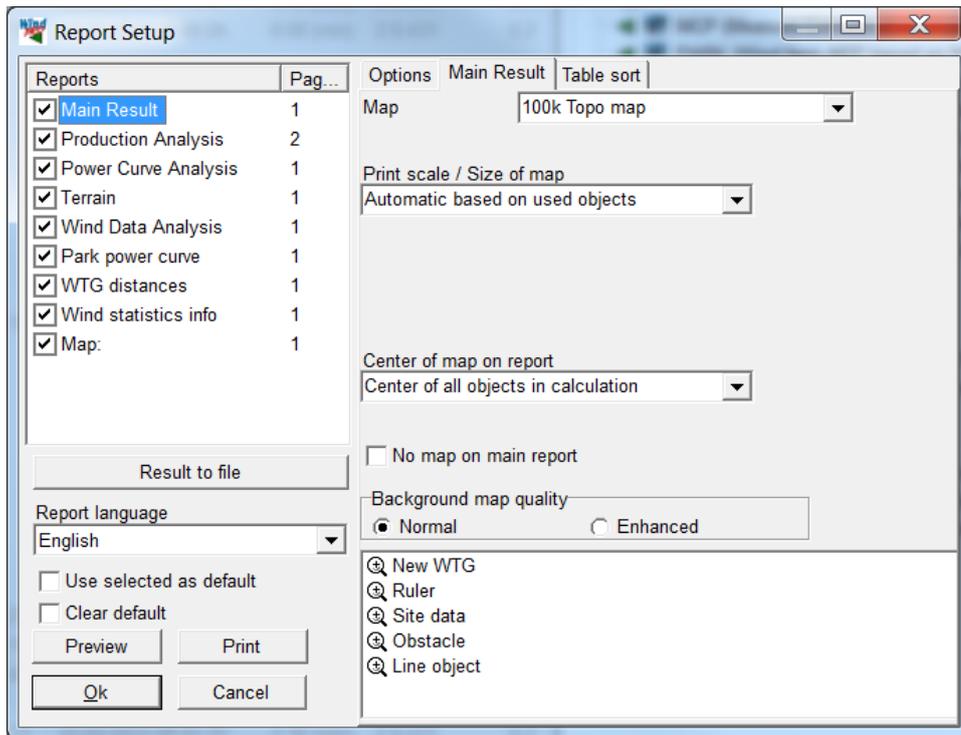
2.5.6.4 Print all reports, define reports and settings, symbol scaling, etc.

To print all reports or to set up a complete calculation report, select the report header by left-clicking on it and then click on the Printer symbol , or you can right-click on the header and select "Print" as shown in the menu below.



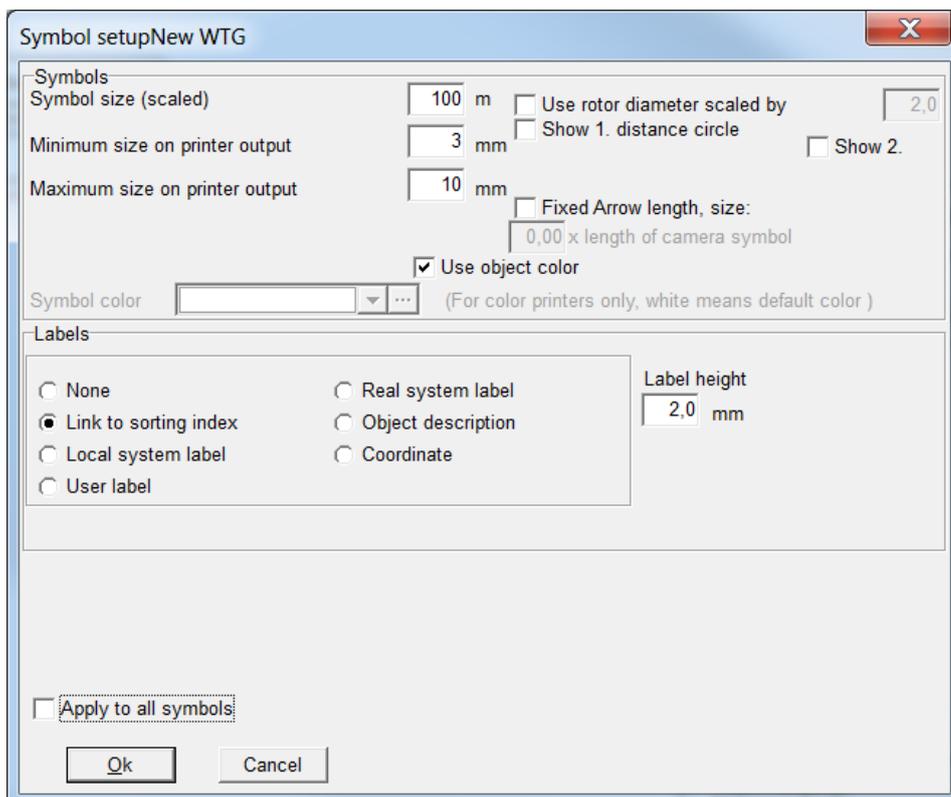
Note: With the "Rename" function you can change the calculation name and the description without recalculating.

When selecting "Print", the Report Setup menu appears.



On the left side you can select the different parts of the report you want to print, and on the right you can set up individual parameters, depending upon which report is selected.

In particular for the "Map" report, you can define which part of the map to print and which objects to be included. By clicking on the button , you can define the appearance of the objects individually in the different reports.



2.5.6.5 Sorting the objects by user label etc.

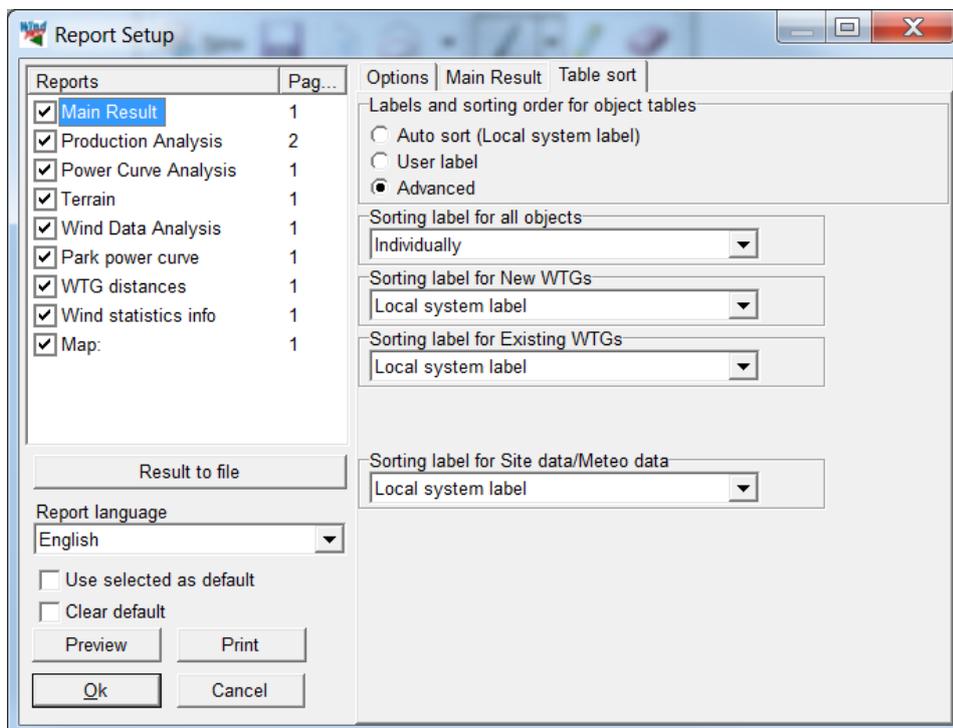
A unique feature in WindPRO is the ability to sort objects by user or other label.

Default objects listed in reports are sorted by object system label, but are numbered after a local system label (where objects are numbered 1, 2, 3...or a, b, c...). This option is called "Auto sort" (Local system label).

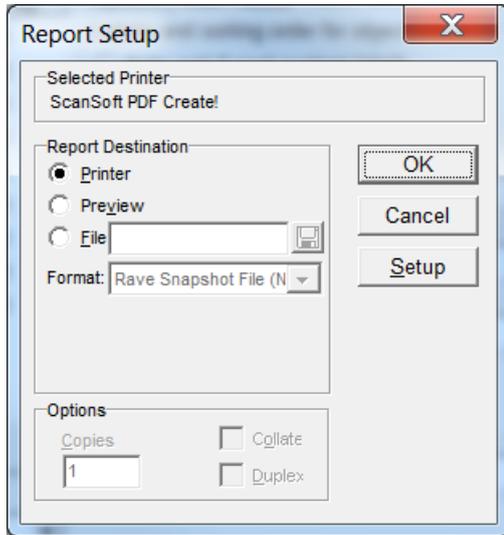
Selecting to sort by "User label", you specify the label on the print (by supplying the objects user label) and the objects are then sorted by that user label (numerically or alphabetically).

Lastly the "Advanced" option allows you to use the WindPRO-assigned system label in printouts, in which case you always have the same label assigned to the same object, regardless of which objects have been inserted or deleted. In "Advanced", you can choose different sorting options for different types of objects.

This feature is found under the Tab Sheet "Table sort".



2.5.6.6 Printer setup



Click on “Print” to select a printer or to specify the printer setup. This follows the normal Windows convention (please refer to your local printer manual).

If you want to output a standard file type e.g. for attaching results to an E-mail, choose “Preview”. From the Preview window you can save reports as standard PDF documents (without having to purchase Acrobat writer) or JPEG’s (see section 2.5.6.1).

Note: If you want to print to a file you must have an appropriate printer driver installed. For example, you would need a Postscript printer driver to produce a postscript file, which many copy centers can print for you on high quality printers for inexpensive mass production. An even better solution is to print with Adobe PDF writer (cost: approx. 150 US\$), PDF files are readable from Adobe Acrobat reader, which is probably the most common file format for mixed text and graphics. The Adobe reader is free on the Internet, so everybody with Internet access can read and print your reports. With a PDF file, the formatting will always remain the same independent of the printer. An advantage is that the PDF format can be highly compressed, although you can select the compression of the bitmaps (graphics), in order to get a reasonable compromise between qualities and file size.

2.6 BASIS - The WTG Catalogue

2.6.0 Introduction to wind turbine catalogue

Over the years, more than 1000 different WTG types and variations have been collected by EMD from a number of sources, and are included in the WTG Catalogue. The Catalogue is continuously updated.

You can add your own new wind turbines to the Catalogue and you can supply the ones created by EMD with your own data (new power curves, noise data etc.). You cannot edit the data that has been supplied by EMD. You can however, make a copy of an "EMD" turbine, and use it as a template for a new user-defined WTG.

Note, that the WTG Catalogue keeps track of whether the data is created/edited by EMD or the user. In the "Source" field in WTG Explorer, there will be 3 possibilities:

EMD
USER
EMD-U

The EMD-U designation means that it's a WTG created by EMD, but the user has added some information. Depending upon the power curve used in the calculation, it could be either an EMD or a USER power curve. In the printouts of the energy calculation, it will indicate whether an EMD or a USER power curve was used.

The information registered in the Catalogue is primarily the type of information which is most important during the design phase of a project.

The Catalogue is structured such that, if a WTG is considered to be of a certain type (same manufacturer, generator-system, rotor diameter and tower type), it's stored in one file. Inside this file there can be additional power curves, noise data sets, visualization data sets, egrid data, and different hub heights (tower heights). This is a compromise between reusing data and keeping the structure simple.

2.6.1 Invoke and Modify the WTG Catalogue



The WTG Catalogue is invoked from the WindPRO main menu by clicking on the "Archive drawer" icon.

2.6.1.1 The WTG Explorer

When the Catalogue is invoked, the WTG Explorer appears. Please see further details in the WindPRO Explorer search path and search profiles in Section 2.3.2 WindPRO Explorer list.

	Name	Source	Company	Variant	Power	Sec. p...	Diameter	Def. ...	Edit d...	Prod. c...
- All	VESTAS V19 90 19.0 10!	EMD	VESTAS	V19	90		19.0	23.4	15-02...	DK
- Bonus	VESTAS V19 90-19 18.8 #!	EMD	VESTAS	V19	90	19	18.8	24.0	07-10...	DK
- NEQ-Moon	VESTAS V19 90-19 18.8 10!	EMD	VESTAS	V19	90	19	18.8	23.4	26-08...	DK
- Vestas	VESTAS V20 100 20.0 #!	EMD	VESTAS	V20	100		20.0	23.4	01-10...	DK
	VESTAS V20 100 20.0 10!	EMD	VESTAS	V20	100		20.0	23.2	29-10...	DK
	VESTAS V23 200-30 23.0 #!	EMD	VESTAS	V23	200	30	23.0	28.7	01-10...	DK
	VESTAS V25 150-30 25.0 #!	EMD	VESTAS	V25	150	30	25.0	28.7	01-10...	DK
	VESTAS V25 200-30 25.0 #!	EMD	VESTAS	V25	200	30	25.0	29.0	01-10...	DK
	VESTAS V25 200-30 25.0 10!	EMD	VESTAS	V25	200	30	25.0	29.0	23-10...	DK
	VESTAS V27 150-50 27.0 #!	EMD	VESTAS	V27	150	50	27.0	30.0	01-10...	DK
	VESTAS V27 150-50 27.0 10!	EMD	VESTAS	V27	150	50	27.0	30.0	29-10...	DK
	VESTAS V27 225-50 27.0 #!	EMD	VESTAS	V27	225	50	27.0	31.5	02-11...	DK
	VESTAS V27 225-50 27.0 10!	EMD	VESTAS	V27	225	50	27.0	31.5	22-11...	DK
	VESTAS V27 225-50 27.0 10!	EMD	VESTAS	V27	225	50	27.0	31.5	09-11...	DK
	VESTAS V27 225-50 27.0 10!	EMD	VESTAS	V27	225	50	27.0	31.5	22-11...	DK

Simply right-click or double-click on a WTG, to enter the edit menu.

2.6.2 WTG Catalogue Tab Sheet: Main

Tab Sheet "Main" has two groups of information:

Main		Remarks
Manufacturer	VESTAS	<input type="text" value=""/> <input type="button" value="Load picture"/> <input type="button" value="Remove picture"/> 
Type/Version	V90	
Rated power	1.800,0 kW	
Secondary generator	kW	
Rotor diameter	90,0 m	
Tower	IO! Tubular	
Grid connection	50 Hz	
Country (origin)	Denmark	
Blade type	Vestas	
Generator type	One generator #)	
Rated	14,9 rpm	<input type="text" value=""/>
Initial	9,0 rpm	
Default hub height	80,0 m	
Alternative hub heights (m)	95,0	
<input type="button" value="Add"/> <input type="button" value="Remove"/>		
Maximum blade width	3,42 m *)	
Blade width for 90% radius	0,94 m *)	
Valid	<input checked="" type="checkbox"/>	
Unique ID: {30EC982A-AEB7-4BEC-A1D6-6E6CB58B4663}		
<small>*) If values in both fields are identical, alternative ways of calculating average width are used #) The choice influences the HP value check - "Variable" should be used for the "modern generation" of larger turbines with full variable speed and blade pitch!</small>		

The upper section contains the unique identification and description for the turbine type, i.e.: Manufacturer, Type, kWh (large/small generator), Rotor Diameter, Hub Height and Tower Type(s).

The lower section contains additional information such as: Country of Origin, Blade Type, Generator type (rpm Control), rpm, default hub height and alternative hub heights. For a SHADOW calculation, the blade width can be entered, which allows the shadow calculation to determine the distance from the turbine at which flicker may be a problem (at 20% sun coverage). Lastly, there is a field indicating whether or not the WTG is valid, a remark field and a picture.

Note that the choice of generator type decides the HP-check, see section 3.5.2 Checking the Power Curve.

The Unique ID is an internal software generated code, that makes the link to a turbine from a calculation unique, so later recalculations always will use same data. This secures that old calculations can be reproduced, if data from EMD is used. EMD do never change data once send out, but creates new sets of data, if specifications for a turbine has been modified.

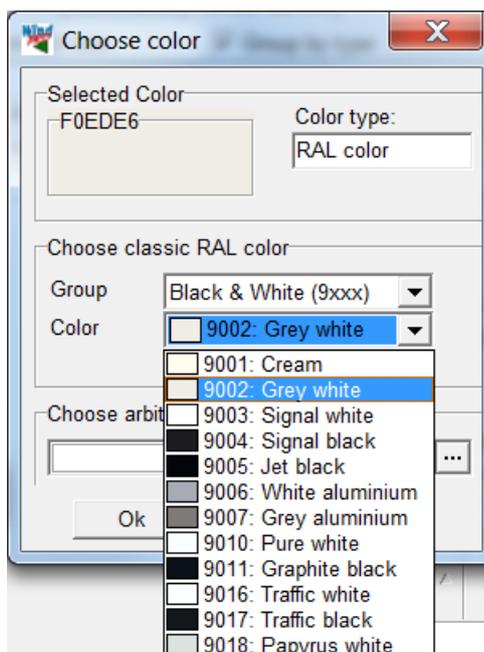
2.6.3 WTG Catalogue Tab Sheet: Details

Type	Name	Default	Valid	Creator	Create date	Edit date	Source	Source date	Remark
Type : Noise									
Noise	Level 0 - calculated - Mode 0 - 07-2009	<input checked="" type="checkbox"/>	Yes	EMD	23-08-2004	16-07-2010	Manufacturer	09-07-2009	Please contact Vestas on information c
Noise	Level 1 - calculated - Mode 1 - 07-2009	<input type="checkbox"/>	Yes	EMD	23-08-2004	16-07-2010	Manufacturer	09-07-2009	Please contact Vestas on information c
Noise	Level 2 - calculated - Mode 2 - 07-2009	<input type="checkbox"/>	Yes	EMD	23-08-2004	16-07-2010	Manufacturer	09-07-2009	Please contact Vestas on information c
Noise	PN-MANUEL 4m/s	<input type="checkbox"/>	Yes	USER	10-03-2006	10-03-2006		10-03-2006	
Noise	PN-Oktav-data v 8ms	<input type="checkbox"/>	Yes	USER	23-08-2004	17-01-2007	PN	27-06-2005	Noise based on Item no. 950019.R4 da
Type : Power curve									
Power curve	Level 1 - Mode 1 - 07-2009	<input type="checkbox"/>	Yes	EMD	23-08-2004	16-07-2010	Manufacturer	09-07-2009	Curves based on Item no. 0004-6207 Vi
Power curve	Level 0 - Mode 0 - 07-2009	<input checked="" type="checkbox"/>	Yes	EMD	23-08-2004	16-07-2010	Manufacturer	09-07-2009	Curves based on Item no. 0004-6207 Vi
Power curve	Level 2 - Mode 2 - 07-2009	<input type="checkbox"/>	Yes	EMD	23-08-2004	16-07-2010	Manufacturer	09-07-2009	Curves based on Item no. 0004-6207 Vi
Power curve	Level 2 -Airdens 1,09	<input type="checkbox"/>	Yes	USER	23-08-2004	20-10-2009	Manufacturer	05-05-2008	Ct curve based on Item no. 950001.R1
Power curve	Level 0 - Mode 0 - PN 2009	<input type="checkbox"/>	Yes	USER	23-08-2004	20-10-2009	Manufacturer	05-05-2008	Ct curve based on Item no. 950001.R1
Power curve	Level 0 -Airdens 1,09	<input type="checkbox"/>	Yes	USER	23-08-2004	20-10-2009	Manufacturer	05-05-2008	Ct curve based on Item no. 950001.R1
Type : Visual									
Visual	Visual	<input type="checkbox"/>	Yes	EMD	25-08-2004	18-08-2010	Manufacturer	29-04-2010	

Under Tab Sheet “Details”, it’s possible to add multiple sets of data belonging to different variants of the specific WTG type, different sets of power curves, noise data, visual data, or eGrid data.

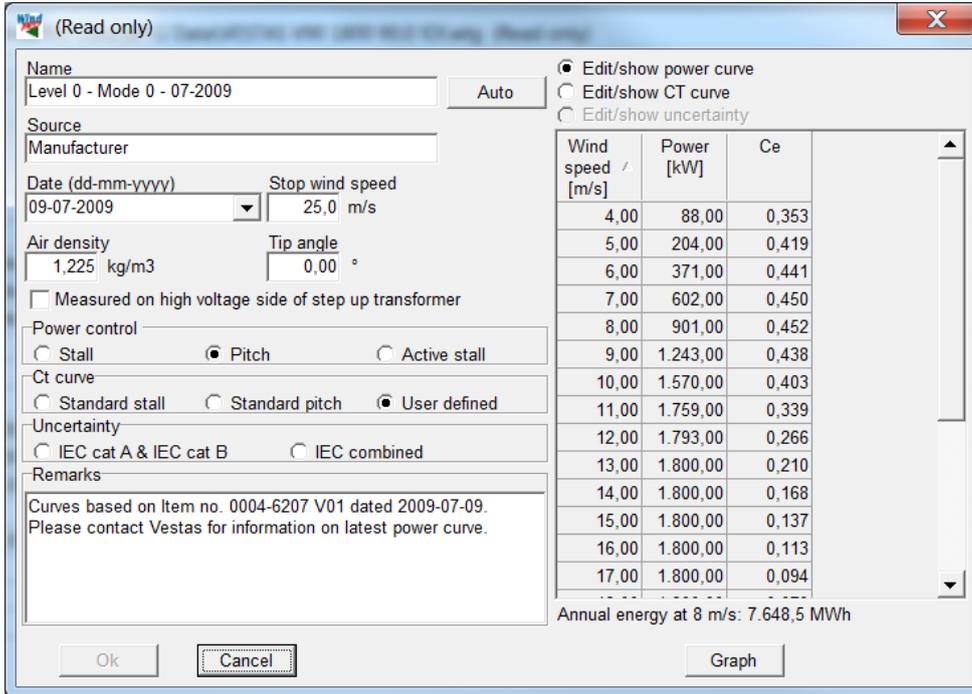
2.6.3.0 WTG Catalogue general about entering data

The way data are entered is changing over time. It therefore is possible to have some habits, which no longer work well entering data. So just a hint when entering data in: Use the <Enter> or <TAB> button, not the mouse to move from one input field to the next! Then input will work logical, jumping to next relevant field and end the input line correct.



In the color selection boxes it is possible to choose colors from the RAL color system.

2.6.3.1 WTG Catalogue power curve editing



Power Curve tab sheet includes information on Source, Date, Stop wind speed (Cut-out wind), Air density for the specific power curve, Power control system, Ct curve, uncertainty specification etc.

Please note when entering data in the table:

Enter first two sets of wind speed and value, then the increase in wind speed is calculated and auto filled for the remaining inputs of value. More complicated data sets should be entered in Excel, and copy - pasted into the table.

Note that the choice of power control decides the HP-check, see section 3.5.2 Checking the Power Curve

Click on the “Graph” button to get a plot of the power curve and the Ce curve respectively.

The Power curves are named according to different noise levels, where “level 0” is the power curve corresponding to “no noise reduced” operation, and the different noise reduced levels follow as “level 1”, “level 2”, and so forth. The name of a power curve also mentions whether it has been calculated or measured (when the information is available).

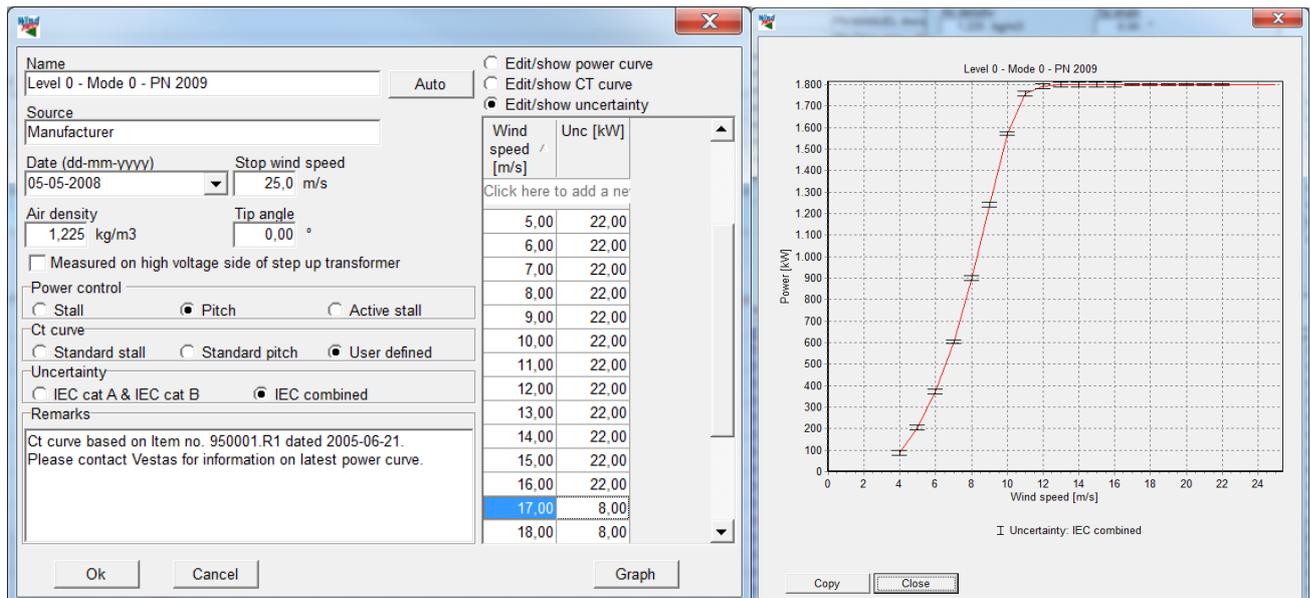
NOTE on Air density:

The air density, which has to be entered along with the power curve, is the one that the power curve is valid for. Below a few examples:

1) The power curve is measured at an air density of 1.1 kg/m³ and after that, normalized to a standard air density of 1.225 kg/m³. In this case, the standard air density of 1.225 must be entered.

2) A power curve is recalculated and entered with an air density changed from 1.225 kg/m³ to 1.05 kg/m³ (thin air conditions). Then the air density value of 1.05 must be entered (as well as when entering air density in the later energy calculation where used with thin air conditions). The recalculated power curve will then be saved correctly as well as used correctly on the specific site.

Regarding the power curve information, it should be noted that the selection of the Ct curve affects the wake loss calculations.



Uncertainty input can be as category A & B or combined, see IEC 61400-12-1 for details. The uncertainty can when entered be used in the Loss & Uncertainty module. When viewing the graph the uncertainty is shown as horizontal bars on the power curve. It is not that common to use the actual measurement uncertainty specifications, while this lead to a very high uncertainty. In “real life” the uncertainty typically are lower while the manufacturer get power curve measurements on more different turbines on more different locations and thereby bring down the uncertainty by clever choice of official power curve among more.

It's possible to copy the power curve to a spreadsheet. Mark an arbitrary point inside the power curve (right-click and choose copy). In this fashion, it's possible to copy a power curve or a CT curve to a spreadsheet. Pasting into a power curve from a spreadsheet can be performed in the same fashion.

2.6.3.2 WTG Catalogue noise data editing

Name: Example of noise
Source: EMD
Date: 28-09-2012

Wind speed at 10 m

Normal frequency [m/s]	Low frequency	80,0 m	90,0 m
3,0		95,5	95,5
4,0		98,5	98,5
5,0		102,2	102,2
6,0		104,5*)	105,6*)
7,0		104,5*)	107,5*)
8,0		104,5*)	107,5*)
9,0		104,5*)	107,5*)
10,0		105,5	107,5

Wind speed at hub height

Normal frequency [m/s]	Hub height
5,0	97,1
6,0	99,4
7,0	102,0
8,0	104,5*)
9,0	106,3*)
10,0	107,4*)
11,0	107,4*)
12,0	107,4*)

Octave data

Frequency [Hz]	Lwa,p [dB]
62,5	83,4
125,0	94,3
250,0	97,9
500,0	100,5
1.000,0	100,2
2.000,0	96,4
4.000,0	91,0
8.000,0	80,2

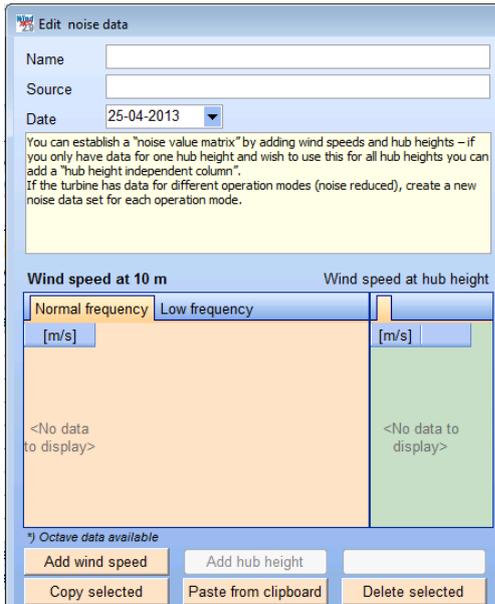
1/3 octave data

Frequency [Hz]	Lwa,p [dB]
10,0	34,0
12,5	43,6
16,0	48,0
20,0	63,8
25,0	62,5
31,5	63,6
40,0	69,6
50,0 *)	73,6
63,0 *)	75,4
80,0 *)	82,1
100,0 *)	85,2
125,0 *)	92,0
160,0 *)	88,9
200,0 *)	90,8
250,0 *)	92,9

Remarks:

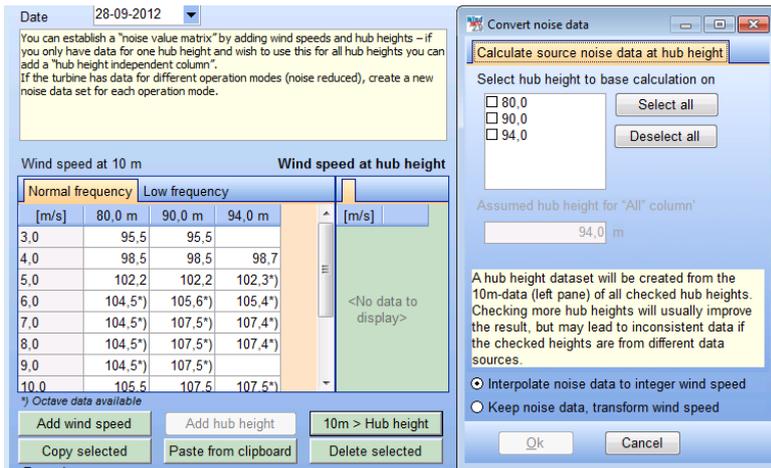
*) Used in standard noise calculation

The table at left gives the overview of all combinations of noise data for hub heights and wind speeds **at 10m height (left side) and at hub height (right side)**. To the right are seen details for the selected data from the left table. For example the table of Octave data or 1/3 Octave data is shown when available (as marked with a * in the left table). Frequencies marked with asterisk are used in regular noise calculations, those without only for low frequency calculations.



When creating a new noise data set click in the orange part of the table to activate the input of noise data given for wind speed at 10m or in the green part to activate the input of data given for wind speed at hub height. Click on Add wind speed and Add a hub height or paste from the Clipboard. In order to paste from the clipboard from excel for example, the wind speed must be in column 1, the hub height in column 2 and the noise value in column 3.

It is possible also to enter low frequency noise data. As decided by law in Denmark pr. 1.1.2012 the low frequency noise must be calculated and demands must be fulfilled. Basically Low frequency data is just a part of the 1/3 octave band data, which can be entered from 10 – 10000 Hz. The values from 10-160 Hz are used in the Danish Low frequency regulations. From 50 – 10000 Hz are used in standard noise calculations. So there is an overlap, and therefore having the complete frequency specter data, no additional input is needed for complying with all calculation methods. Having only data for the low frequency spectrum, 10-160 Hz, the data shall be entered with the tab “Low frequency” selected. If 1/3 Hz data are available for all frequencies, it will be the same table that is seen for 10 m and for 10m low frequency and thereby editing in the one will edit the other.



If noise data for wind speed at hub height is required but not available, it is possible to create this data on the basis of the noise data for wind speed at 10m (if available). Click in the green part of the table to make it active and press 10m > Hub height. Several hub heights can be used if they are consistent (from the same data source). The wind speed at hub height is obtained through the extrapolation of 10m wind speed with standard IEC profile (z0=0,05m). It is possible to have the table showing either the calculated wind speed along with the original noise values (option: “Keep noise data, transform wind speed”) or wind speed as integers requiring the

noise data to be interpolated (option "Interpolate noise data to integer wind speed"). Rules and common practice usually require data at integer wind speed(s).

The other way around, it is also possible to create noise tables for wind speed(s) at 10m based on existing data for wind speed(s) at hub height.

The **name** of the data set should include level or mode, e.g. Level 0 for not noise reduced mode, Level 1 for little noise reduction etc. The name could also include the "most important" noise figure, e.g. 8 m/s typical hub height value.

The source should include if it is measured or calculated – and by whom.

The name of the noise data should match with a power curve with the same name. This power curve corresponding to this noise-reduced mode of operation should be used to make the energy calculation.

Detailed information's:

Pure Tones

If the noise measurement report states that pure tones are observed, then the field "Pure Tones" must be marked. Pure tones will result in more restrictive requirements in the calculation models.

Octave Data

Data available as octave band values (i.e. for 8 standard frequency levels), can be entered. This gives a more precise calculation, but it's not a requirement in most models used today.

Frequency Data

Data available as octave band values (i.e. very detailed, given on XX number of standard frequency levels), can be entered. This gives a more precise calculation, and is a requirement in more models used today.

A-weighted

If the data are given as octave band levels, this information may also be given as A-weighted values (if so, it should be stated in the noise measurement report). In this case, you should mark the field "A-weighted".

Wind speed dependency

If data are missing at given wind speeds, WindPRO will use the wind speed dependency factor to calculate the missing noise data. By default, it's set to 1 dB(A)/ m/s but it can be changed by the user if measurement report show other dependency.

2.6.3.3 WTG Catalogue visual data editing

Visualization data - describing the geometry of the turbine and its color(s)

The visualization data are divided into:

- Tower
- Nacelle
- Rotor/Hub
- Optional; Blade

Please notice that a visualization of the input data is shown on a sketch during the input phase. You can build both the tower and the nacelle using up to 10 sections. Note also, that skew edges (different top and bottom lengths) are only allowed for the outer sections of the nacelle.

Lattice towers can be selected from a .dxf (AutoCAD) file. Some standard towers are available from the WindPRO\dxf\ library, but you can also draw your own lattice towers (see also the comments on .dxf files in section 1 of this chapter). Lattice towers are automatically scaled to the correct hub height and can also be scaled to certain widths at the bottom and top of the tower.

An example is given below:

Edit visual data
 Info | Tower | Cabin | Rotor and hub | Blade data
 Name: TEST
 Source: PN-test
 Date (dd-mm-yyyy): 03-05-2012
 Hub height (Optional): 80,0 m
 Comments: This is a test
 Ok Cancel

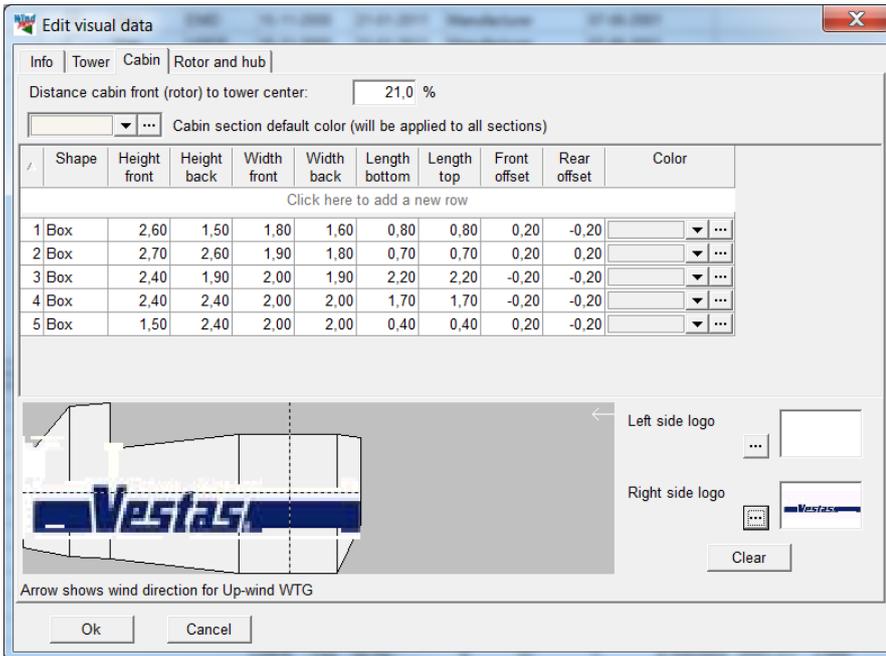
The Tab Sheet “Info” provides the ability to choose a specific hub height. Normally only one data set for all hub heights is provided and the software automatically stretches the tower to the hub height given in the WTG data input field. If data for more hub heights are entered, it will be possible to select the best-suited for the given hub height when selecting the WTG.

Edit visual data
 Info | Tower | Cabin | Rotor and hub | Blade data
 Tower type: Built in tubular Dxf file Bitmap
 Tower section default color (will be applied to all sections)

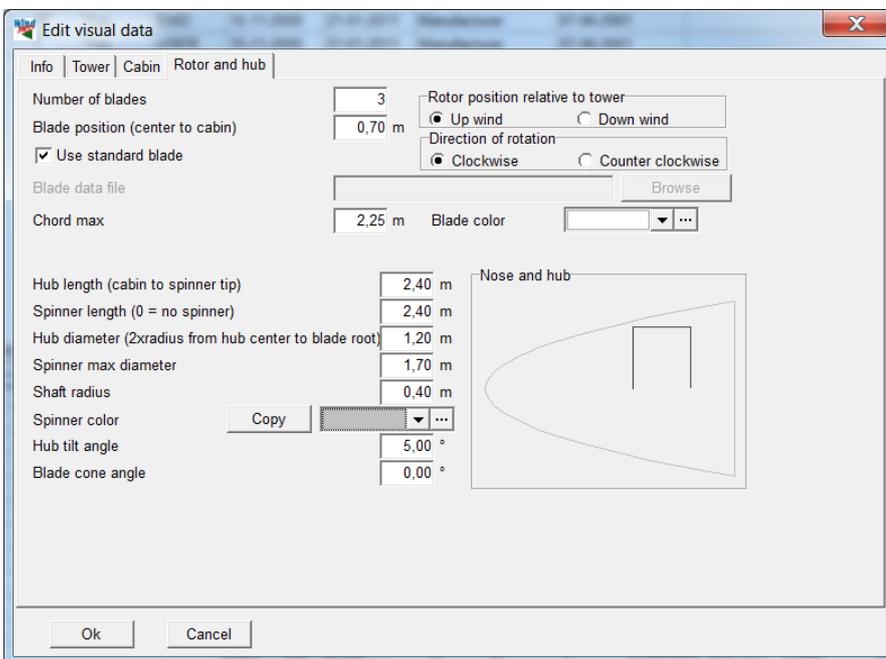
	Sides	Height [m]	Bottom diameter [m]	Top diameter [m]	Color
Click here to add a new row					
1	0	80,00	5,00	3,00	
2	0	2,00	9,00	5,00	
3	0	2,00	9,00	9,00	
4	0	2,00	9,00	9,00	

 0 sides means cylindrical tower section.
 Ok Cancel

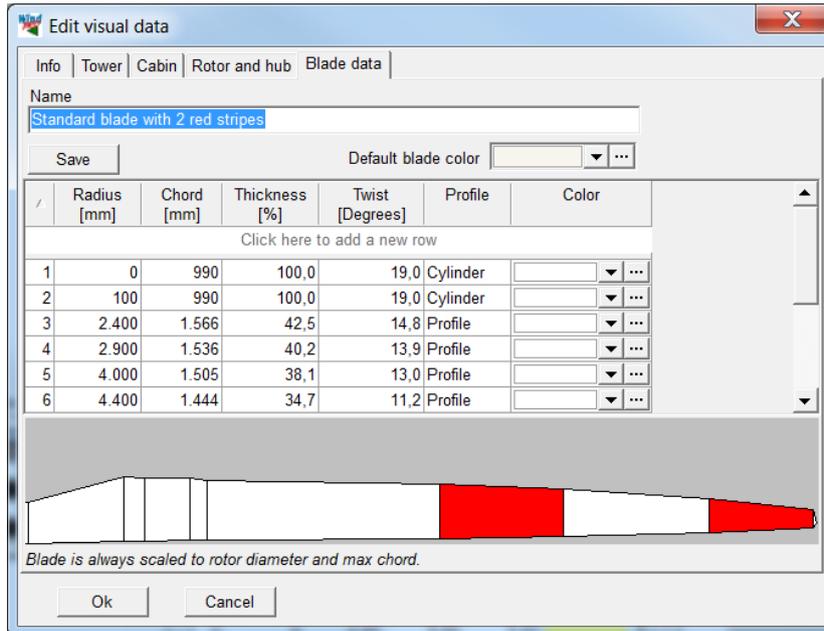
The tower can be a built-in tubular tower or a .dxf file, which allows full flexibility to specify the tower with an AUTOCAD drawing. Note that the AUTOCAD drawing has to be drawn following some specific rules (contact EMD to get these). A tubular tower can be fully round or with a user-specified number of sides (edges). More sections can be applied (e.g. 3 sections as shown above). More sections are added by placing the cursor in the lower right data line and pressing the <Enter> key. Data lines can be rearranged by dragging them (right-click with the mouse on the section number column).



The cabin is designed in vertical sections. A bitmap can be attached with a logo. You have to adjust the bitmap yourself so the size and placement on the cabin is correct. The bitmap will use a square around the whole shape for positioning, so it's just a question of having the right bitmap canvas size relative to the logo size.



It's possible to choose up-wind or down-wind. This, together with the wind direction set in the Camera Object in Photomontage, determines on which side of the tower the rotor appears. Direction of rotation is only important when creating animations.

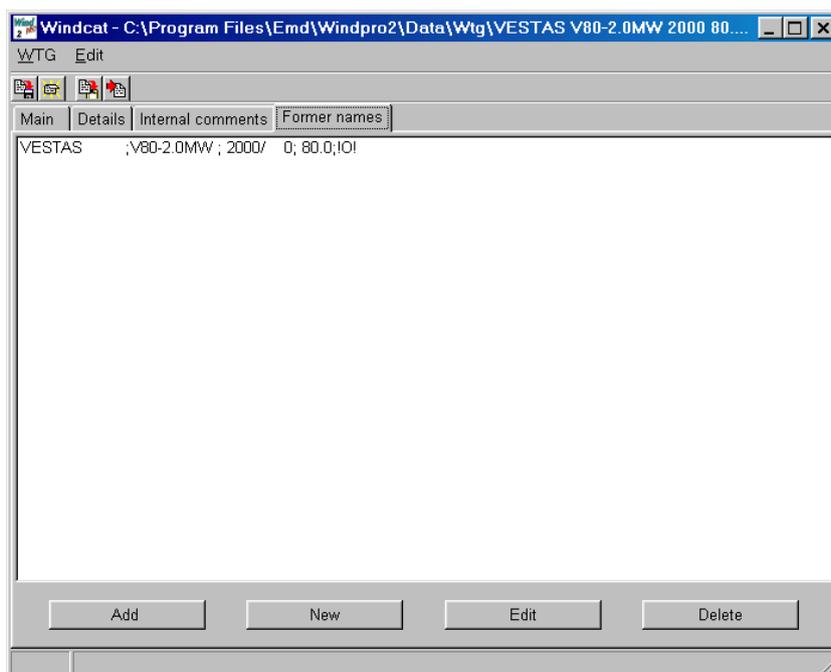


By deselecting “Use standard blade” in previous form, you will have complete flexibility to design the blade yourself. Normally, it’s only the addition of different color stripes (e.g. different blade-tip color) or by unusual glade geometry that it will be necessarily to define blade shape. Even in short distance visualization it will be difficult to see different blade shapes on a photomontage.

2.6.3.4 WTG Catalogue eGRID data editing

The eGRID data of the WTG catalogue are fully described in the eGRID chapter of the Manuel. Please refer to Section 10.1.4.

2.6.4 Former names



Here, former names from previous software versions can be given so that restructuring names will not affect the link from former projects to the specific WTG type.

2.6.5 Creating a new wind turbine

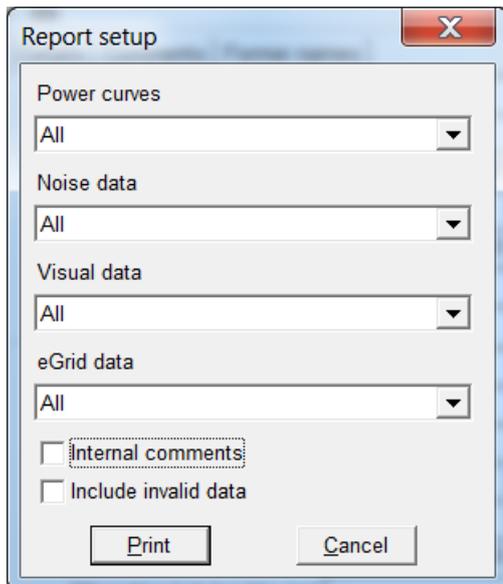
2.6.5.1 Copying and editing an existing wind turbine

It's often advantageous to use an existing turbine as a template for a new one. This can be done by entering "edit mode" of the WTG and then from the menu bar "WTG", choose "Create copy". Now the turbine is ready for editing and can be saved afterwards.

After selecting the "New WTG" icon, you are presented with a blank input form. If a manufacturer is not listed in the "Manufacturer List", you can create a new one under this menu item. The same applies for several other fields where you can select information from a list.

2.6.6 Printing WTGs

 When a WTG is "open" for view/editing use the print option to select which parts of the data to print (see Report setup below).



Report setup

Power curves
All

Noise data
All

Visual data
All

eGrid data
All

Internal comments

Include invalid data

Print Cancel

When one or more WTGs are selected in the WTG Explorer, all data for each selected WTG will be printed. The print function can be selected from the WTG menu drop-down by right-clicking or simply with by pressing the <Ctrl + P> keys.

2.7 BASIS – Import of existing WTGs

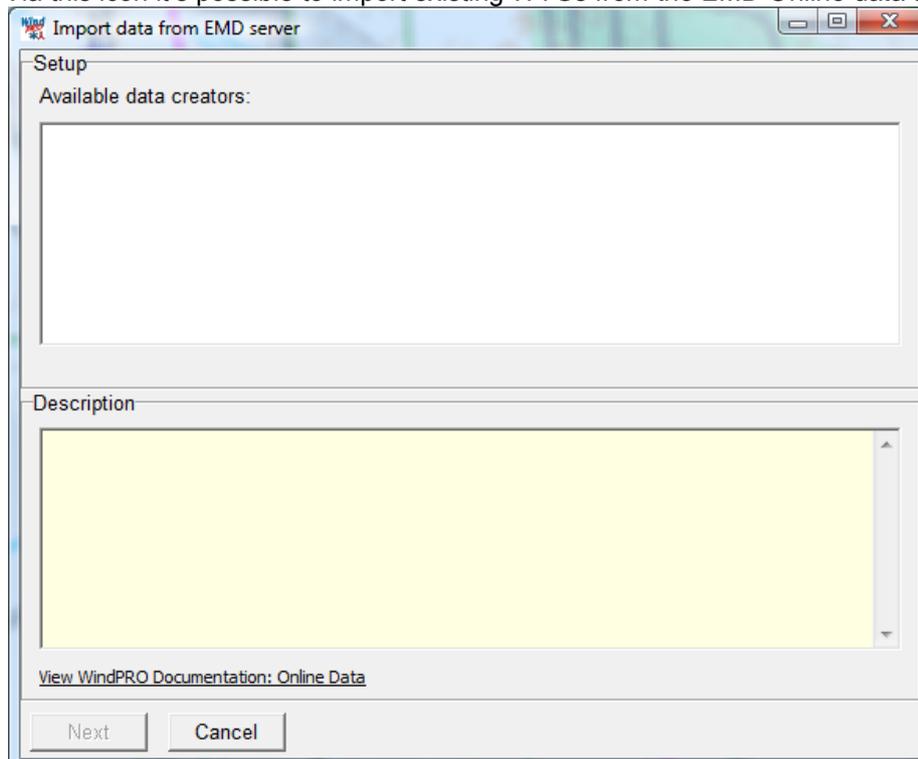
2.7.0 Introduction to Import of existing WTGs

The “Import of existing WTGs” (into a project) is a very powerful function. It can be used for project design in local areas where there are existing WTGs, as well as for planning for a larger region where existing WTGs must be taken into consideration. The use of existing WTGs is especially powerful if information on actual energy production is available. Then, existing WTGs can have a distinct influence on the energy calculation in the new project. Also, it’s often necessary in environmental calculations to include existing WTGs in order to calculate the impact on the environment not only from the new turbines, but also from all existing WTGs in the neighborhood.

2.7.1 Importing existing turbines from On line data



Via this icon it’s possible to import existing WTGs from the EMD Online data server.



When there are available existing (operating) turbine data for the region, these will appear in the list above. So far only Danish turbines are available, but it is our hope to include data for more countries in the future.

When data are available, the radius for import can be specified and the turbines will be established as “existing WTGs” in the project.

2.8 BASIS - Line Object (height, roughness and 3DA lines)

2.8.0 Introduction to the Line Object



From WindPRO ver. 2.8 the line object has got a brother for handling elevation data, the elevation grid object. This should be used if you are going to import gridded data of nature, see section 2.10.

The WindPRO Line Object gives you a unique visual control over the height contours or roughness lines, which are often the most important inputs for the energy production calculation. The Line Object also contributes to a significant reduction in workload when the user has to find and read Z-coordinates on traditional maps before calculating, e.g., shadow flickering, noise impact and visual impacts. Height contour lines also form the basis for computer generated 3D landscape models used for visualization.

One of the major advantages of the Line Object is that it allows the user to establish on-screen lines just by clicking with the mouse and, in the same way, it's easy to edit existing height contour or roughness line files. The object also offers valuable help tools in the auto-digitizing features based on color recognition (hold down the <Ctrl> key), or the auto point mode (hold down the <Shift> key) when moving the mouse. Backward deleting of points is performed by holding down the <Alt> key.

Important terms when using Line Objects with height contour lines:

DHM - Digital Height Model: Normally used for a table of (X,Y,Z) values defining discrete points on the surface. An interpolation routine such as the TIN model (see below) is needed to find the Z-values for points in between the table values.

TIN - Triangular Irregular Network: The triangle model established from the digital points (basis of the contour lines), which makes it possible to calculate Z-coordinates at any point. The TIN will usually only be calculated for a selected section of the digitized lines, as they are only needed within the area where the objects are placed. Calculation time depends on the size of the TIN-radius. Due to the large number of calculations required when there is a large amount of data is present, there are very advanced features for the TIN calculation (for more information see Section 2.8.2.2).

2.8.0.1 File formats for height contour lines

WindPRO can load the following file types:

WindPRO format: *.wpo - Internal format optimized for speed. Height contours or roughness lines in one file. Includes the calculated TIN model, which means that the TIN calculations don't need to be done every time you reopen a project.

WAsP MAP file: *.map - From the energy calculation program WAsP (Risoe). Both height and roughness can be included in the same file, but when saved from WindPRO, only the data from selected purpose is saved. For this reason, always make a backup of the original .map file before editing from the Line Object. Note that some binary versions may not be read from the Line Object. If this happens, open the file in WAsP and save it as an ASCII .map file (with the DUM* command in DOS-WAsP) before loading.

(The two formats discussed above are the only two that the WindPRO Line Object can save)

KMS GTX file: *.gtx - from the Danish Ordnance Survey. Only height contour lines can be read from this format.

AutoDesk *.dxf file: *.dxf - standard format from e.g. AutoCAD digitization).**

** Please note, that reading of .dxf files requires that certain regulations be respected when producing the .dxf file.

*.hgt – format of the Shuttle Radar Topography Mission (loads direct from the hgt.zip files)

*.xyz, .GRD or .asc gridded data - grid format where you know the Z-value e.g., for each square of a 50 m x 50 m. Note these data might be more convenient to load from the elevation grid object.

ArcView *.shp files – standard GIS (Geographical Information System) format from ESRI.

DEM files – standard GIS format in the USA. These files must be converted to *.dxf format using e.g. Micro-DEM before they can be utilized. Please see section 2.8.0.3 below

2.8.0.2 EMD online elevation data

The Online data makes it very simple to establish elevation data. Simply click the online button in line object and everything works automatically. First the service check if there are any data sources available for the site location, then you select the source and specify the height and width or the area you want to cover with data.

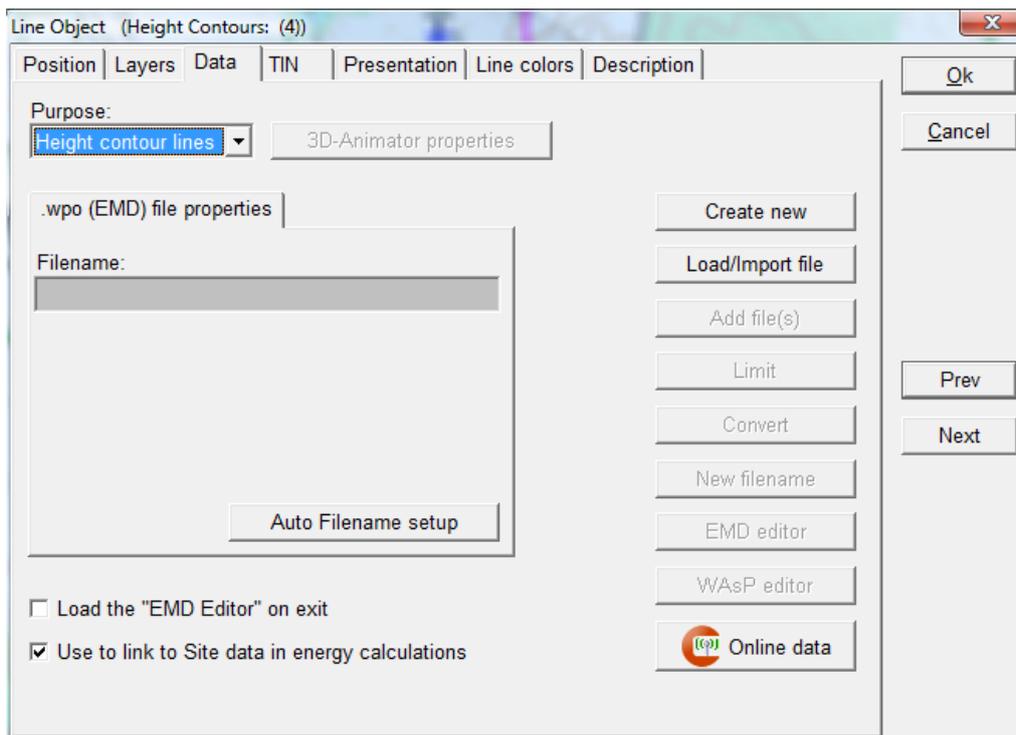


Figure 5 Shuttle Radar Topographic Mission data with 90 m equidistance will be available in the line object. Set purpose to height contours and choose the “Online Data” button.

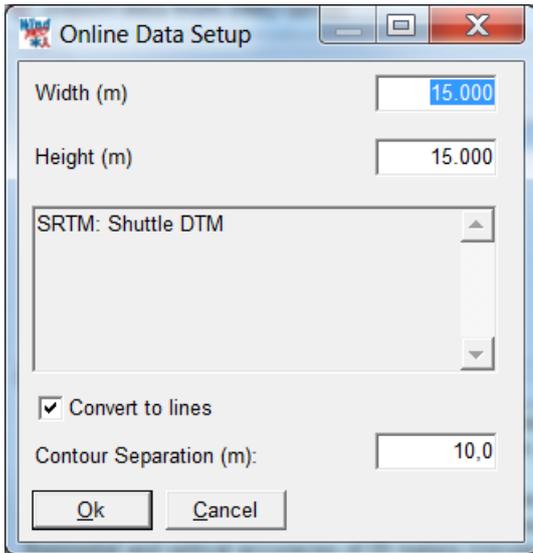
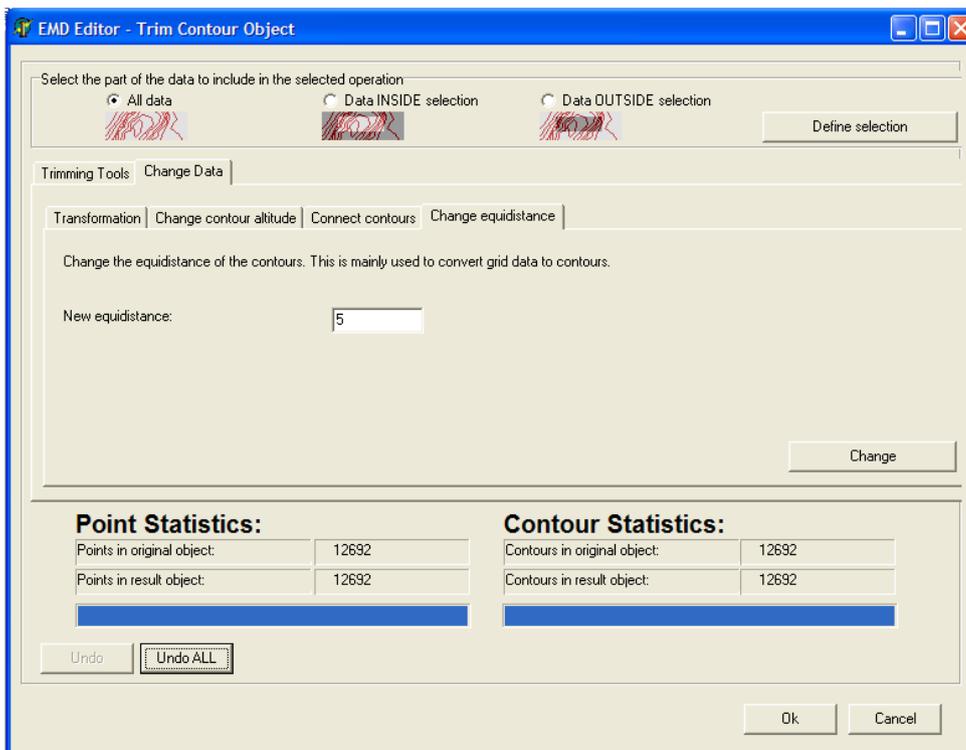


Figure 6 For elevation data, SRTM data are available covering most of the globe. A few other data sources are available, mainly covering the non SRTM cover.

2.8.0.3 Conversion of X,Y,Z and hgt data formats to lines

Height data from .xyz and .hgt files are inserted through the Line Object as point data. Point data are usable in all WindPRO modules except for energy calculations based on the WASP interface (PARK, RESOURCE and WASP interface).

If you want to use the height data in WASP, or show the data as lines, you need to convert the point data to lines using the EMD Editor. The conversion can be done in the EMD Editor by changing the equidistance of the file. But more convenient, use the elevation grid object, section 2.10.



In the EMD Editor, click “Change” and then “OK”.

2.8.0.4 Download and conversion of DEM data formats

DEMs (Digital Elevation Models) exist in many different formats and can be downloaded from many places on the Internet. This is especially true for data covering the United States. The following websites have DEM data available for download:

<http://datagateway.nrcs.usda.gov/>

or

www.mapmart.com

or

<http://data.geocomm.com/dem/demdownload.html>

To extract the data in a format readable from WindPRO, conversions might be needed. WindPRO will be continuously updated to read the most common formats directly – see also Elevation grid object.

For file conversions, the “Global Mapper” software tool is very comprehensive and easy to use. For additional references, the WindPRO help desk <http://help.emd.dk/WindPRO/> has the latest information on downloading DEMs and converting to compatible file formats to use in WindPRO.

2.8.1 How to use the Line Object

In the current version, the Line Object can work with three types of data:

Height Contour Lines - The Line Object can use a number of different formats (see section 2.8.0.1), but lines can only be added or edited if the format is converted to the WAsP .map format or to the *.wpo format.

Roughness Lines - The Line Object can use .map or .wpo file formats. Please note that the Area Object (next section) can also be used for digitizing roughness areas, which can then be exported as roughness lines. This is a very useful method, because it protects against crossing and inconsistent roughness lines. We recommend using this method for new projects, since the new project won't be based upon previously established .map roughness line files.

3D Animator Lines - Used for roads or tracks to follow when creating a virtual drive or flight in 3D

Height contours as well as roughness lines can be used together with WAsP or WindSIM for energy calculations.

The modules DECIBEL, SHADOW and VISUAL can only use the Line Object if it contains height contour lines. With the Line Object, you can calculate triangles (TIN) between all the digitized points to allow interpolation of elevations (Z-values) to any specific location on the map within the specified TIN radius. Zones of Visual Influence (ZVI) are calculated based upon height contour lines, so for a ZVI calculation, no TIN radius is needed.

The principle is that, WTGs, noise sensitive areas, shadow recipients, etc. that are included in the calculation will automatically take their Z-coordinate (their height above sea level) from the TIN.

The calculation of shadow isolines (SHADOW module) and noise isolines using the TIN provides a more realistic calculation of the isolines by taking the variation of the terrain's elevation into account.

For visualization, you can use the TIN for the calculation of either an artificial landscape, or the visualization of a wire grid landscape. The latter is well-suited to control the camera model or to view the WTG project in proportion to the landscape without "disrupting" elements in the landscape.

For 3D Animation, a Line Object can be assigned the special purpose “road”. This presents two possibilities:

It can show a road bitmap in the 3D animation
It can be used as a track that the camera “locks on to”.

Both can be used individually, or in combination so that you can see the road you are following (see Section 5.3.4 for further details).

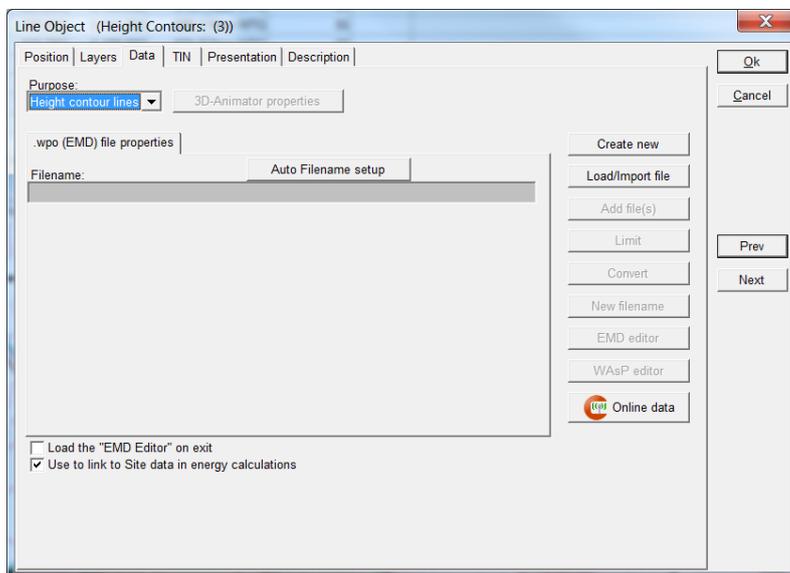
2.8.2 Establishment and presentation of the Line Object

Line Objects can be edited on-screen when they are in edit mode. The symbols shown below indicate whether the Line Object is in edit mode or not. You can activate or deactivate the edit mode by right-clicking the object symbol on the map or by pressing the <Ctrl + c> keys when an object is selected.

-  A Line Object which is not in edit mode
-  A Line Object which is in edit mode on the current map.
-  A Line Object which is in edit mode on another map (from version 2.5 this should not occur because you now can change maps while staying in edit mode).

The same principle applies for the Area Object and WTG Area Object.

2.8.2.1 Tab Sheet: Data



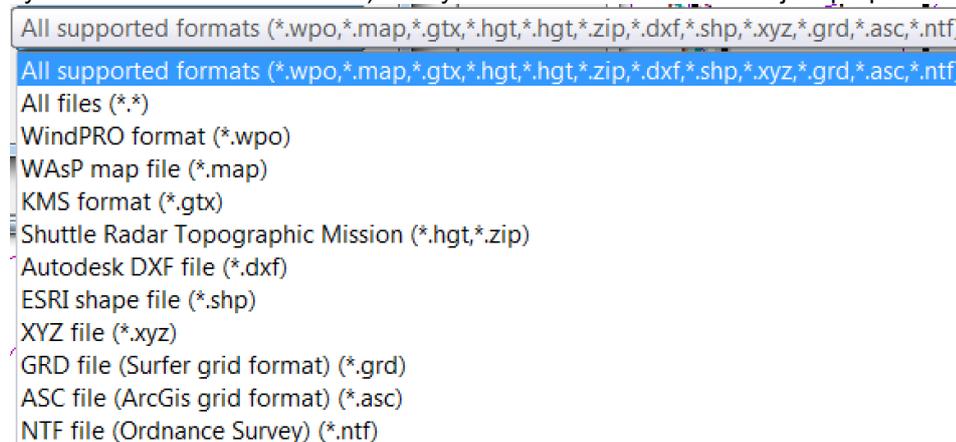
Create new - Used when starting digitizing data from scratch. First, select the input type, i.e. height contour lines, roughness or 3D animator lines in the "purpose" field.

You can choose to save data in the WASP .map file format or in the WindPRO .wpo file format. When choosing a file format, the following points should be taken into consideration:

If files are large, the .wpo format is faster and for large TIN calculations (height contour lines only), the .wpo format has the advantage that the TIN is saved in the .wpo file, avoiding the need for recalculating when re-opening the project. On the other hand, the .map file format has the advantage that the file can be used for stand-alone WASP calculations (if this is relevant), and that the file can be loaded directly from the WASP map

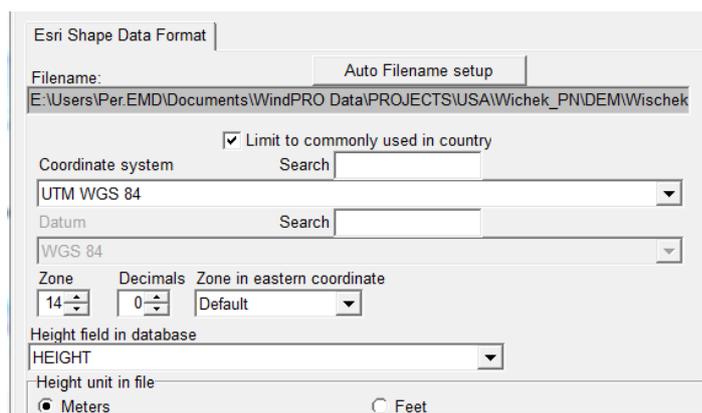
editor (if installed and the path is set under "options", see Section 2.2.2.2). However, you can convert between these two formats at any time using the "Convert" button.

Load file - Loads an existing file with line data. Different file formats can be loaded (imported, see 2.8.0.1). The coordinate system in which data is given must be known. If the coordinate system is a local system (or a system unknown to WindPRO) the system can be defined in "Project properties" before loading.



The supported file formats are shown in the list.

When GIS shape files with height contours are loaded, the dialog box changes as shown below:



In addition to the normal input, the projection datum (e.g. ED 50) must be entered along with the selection of which field in the shape file contains data on the elevation and the height unit used.

Add file - Used for merging additional files together in the same object. (see Sections 2.8.0.1 and 2.8.0.2 for file formats and conversions).

By clicking on "New filename", the file name of the file in which data is saved is changed and a copy of the file is made. The following corrections will only appear under the new file name.

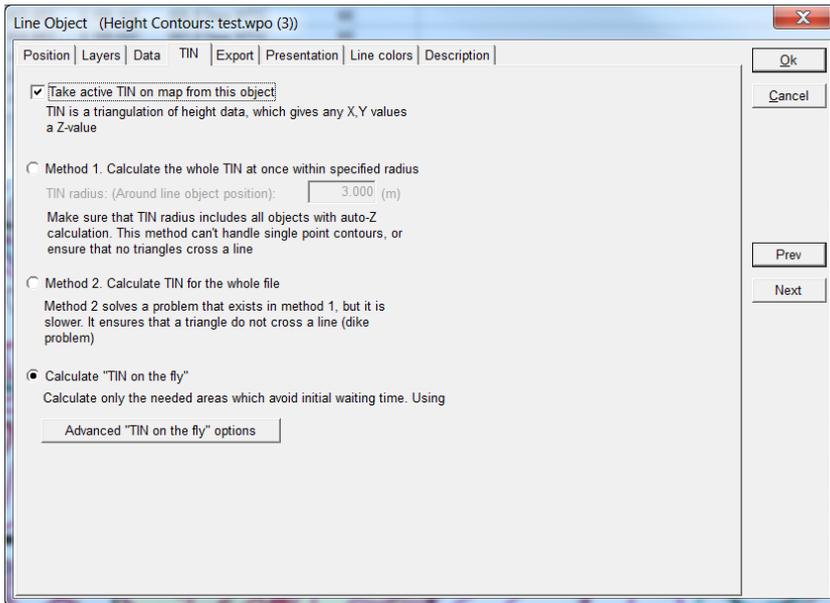
After loading large files, you may not wish to use the entire amount of data for the specific project. In order to make the file-handling process faster and to save space on disk, you can **limit** the file so that only lines with points inside a given radius will be stored. For more advanced data-limiting operations on a .map file (e.g. cut out a square, spline, etc.), the **EMD editor** can be used, see section 2.13. The EMD editor can be loaded at closing the line object by checking box in bottom of form.

On-line data is used to download elevation data from EMD server. For most of the globe SRTM data are available, for some regions other datasets. This is the fast and easy way to get elevation data, although they might not be detailed enough.

Extend data is replacing the “On-Line” button in Line objects where data have already been loaded. It allows extending the existing data with On-line data. To extend the data with any other data (in format known by WindPRO), you can use the Extend data option from the EMD Editor (see section 2.13).

By checking the box "Use to link to Site data in energy calculations" the data contained in the Line Object will be used by default in energy calculations when creating a Site Data Object.

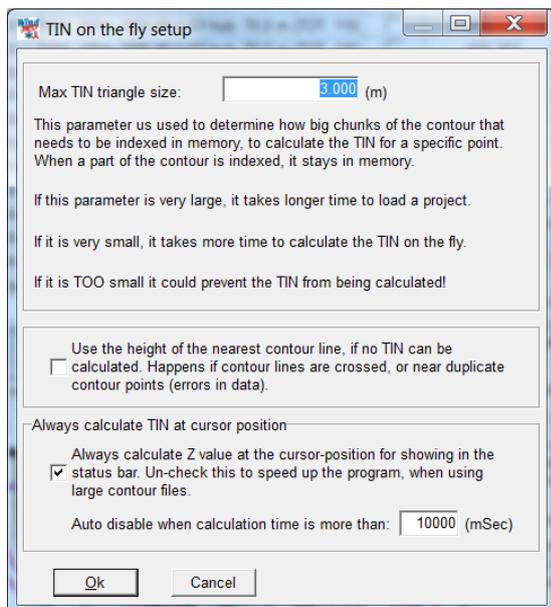
2.8.2.2 Tab Sheet: TIN



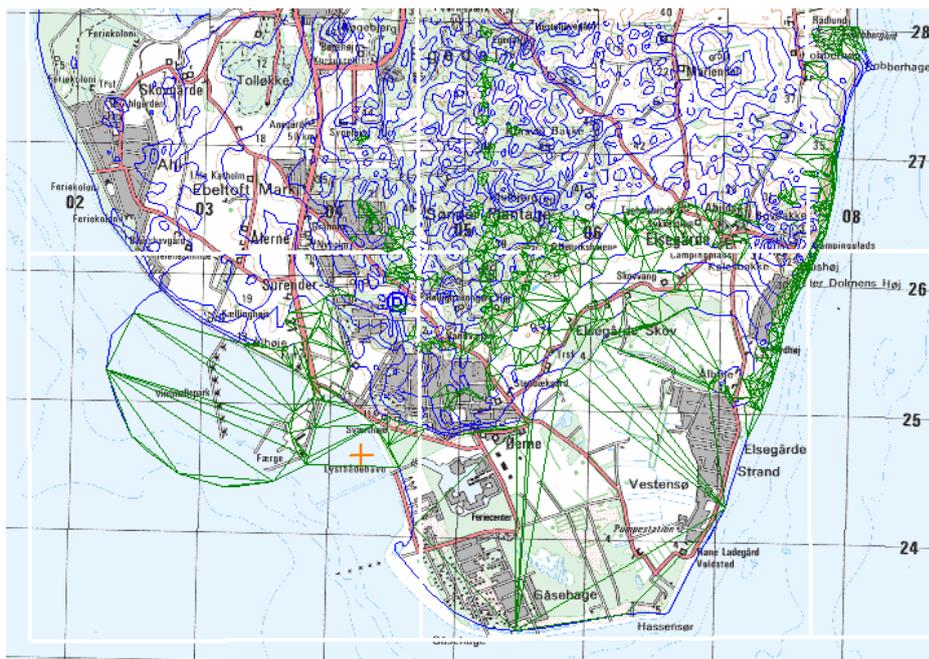
The TIN calculation can be very time consuming. For this reason, advanced settings for the TIN calculation are available. For smaller, less complex projects with a limited amount of data, method 1 or 2 will be the best choice (typically used when a .map file is preferred). Method 1 is the fastest, but doesn't guard against crossing triangles, a problem that can cause problems, particularly at dikes, where long lines based on a few points can result in triangles across the dike.

For larger amounts of data, the “TIN on the fly” method (used as default) is recommended. With this method, the TIN is calculated only as-needed while you work. The TIN database is built up as a background calculation without disturbing the current operation and will always have the necessary TIN values (e.g. where the objects is placed). It's important to know that the “TIN on the fly” calculation will be auto-disabled if it uses too much of the computer's resources. The default setting is to auto-disable the calculation if it takes more than 1000 ms (1 second) to complete.

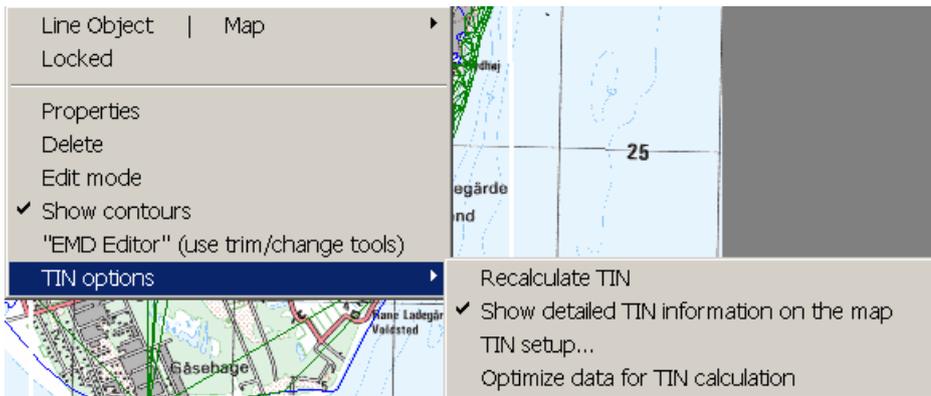
In the “Advanced “TIN on the fly” options”, the unchecked box “Always enable TIN at cursor position” in the form below indicates that “TIN on the fly” at the cursor position has been disabled. This is simply because when working with large files, the “TIN on the fly” calculation will interrupt the user too much. When the TIN is needed in some calculation, the TIN is automatically calculated for the needed region. If you need the TIN for inspecting Z-levels in specific regions while working on the map, you can enable “Always enable TIN at cursor position” and eventually increase the auto-disable time limit.



When Calculating the TIN on the fly, the model is divided into a number of squares as shown below. If there are TIN triangles larger than this grid size (white lines shown on the map), there may be problems calculating the whole region. For this reason, the “Max TIN triangle size” should be set to avoid this problem.



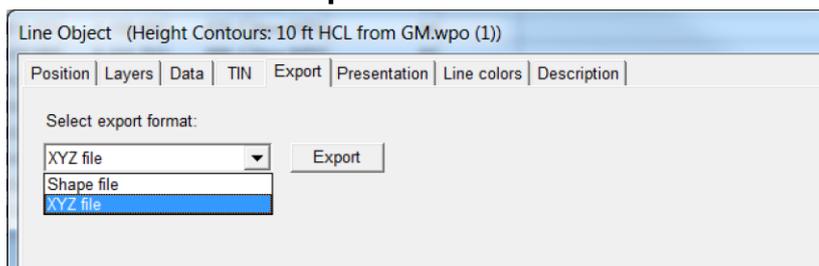
In the map shown above, the green lines show the TIN triangles that have been calculated so far. These can be shown by right-clicking on the Line Object or by right-clicking in the square in the bottom line where the Z-level is shown. After right-clicking, the menus as shown below will appear. Note that the option “Show detailed TIN information on the map” has been selected, which allows the green TIN triangles to be visible on the map.



Optimize file when loading

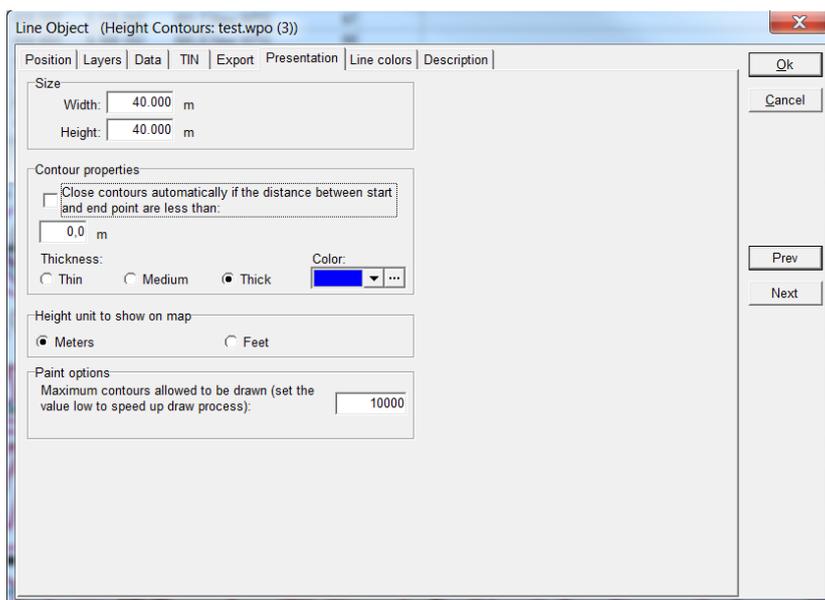
When a file is loaded, by default, an optimizer will pop up that removes unneeded points. The first of the three options can be chosen without the loss of any relevant information. Data will be lost when choosing option 2 or 3, but calculation speed will be increased. The selection should be made based upon your modeling requirements.

2.8.2.3 Tab Sheet: Export



The line object data can be exported to shape files or xyz files.

2.8.2.4 Tab Sheet: Presentation



On this tab sheet, you choose how much of the line data you want to see on the screen. Usually it's only necessary to limit the amount of data if you work with very large data sets. The TIN radius is the radius within

which the Triangular Irregular Network is created. It's only within this radius that the Z-coordinate is automatically calculated and an artificial landscape can be generated.

Due to calculation time, it may be necessary to limit the calculation of the TIN to the specific area for which you need full 3D information.

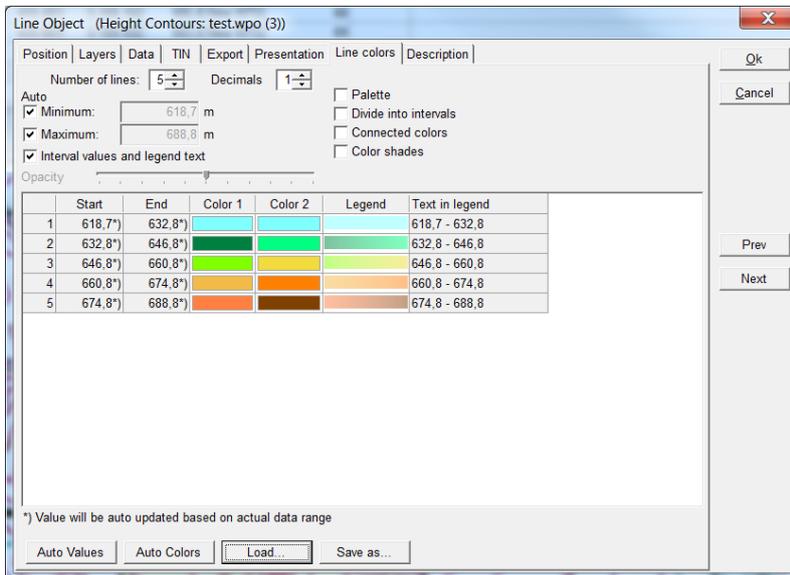
You may set the object to "Close contours automatically" for lines where two end points are positioned within the specified distance (this may improve the accuracy of the calculation and create nicer looking documentation).

You can also change the color and thickness of the isolines.

Lastly, you can choose whether the Line Object will show data in meters or feet.

Note: In WindPRO, height contour data is always stored in meters, since e.g. WAsP always assumes meters when calculating. So if you accidentally end up with a .map file that is in feet, please use the WAsP map editor to convert it to meters. WindPRO does not convert the height data. It only offers the ability to show and digitize in feet.

2.8.2.5 Tab Sheet: Line colors

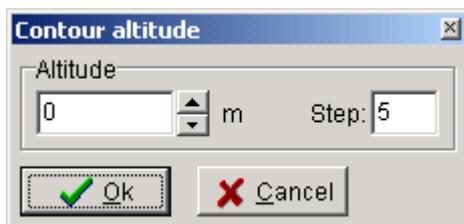


Line color definitions can be freely set. Line color definition schemes can be saved and reloaded later.

2.8.3 Digitizing and editing lines

2.8.3.1 Digitizing new lines in simple mode

When a new Line Object is placed on the background map, it will be in edit mode by default. Place the cursor where you want to start digitizing the first line, then right-click and select "Create new contour". You will now be asked to enter the elevation (for height contour lines) or the roughness on the left and on the right side of the line you are going to digitize (for roughness lines). Then simply click along the line you want to digitize.



Note: In the contour elevation form, the step size when using the up/down arrows can be set in the “step” field. This is helpful when digitizing lines of equidistant elevations.

When you finish a line, you can choose between "Stop" and "Close". If you choose “Close”, the last point will then be connected to the first one you digitized.

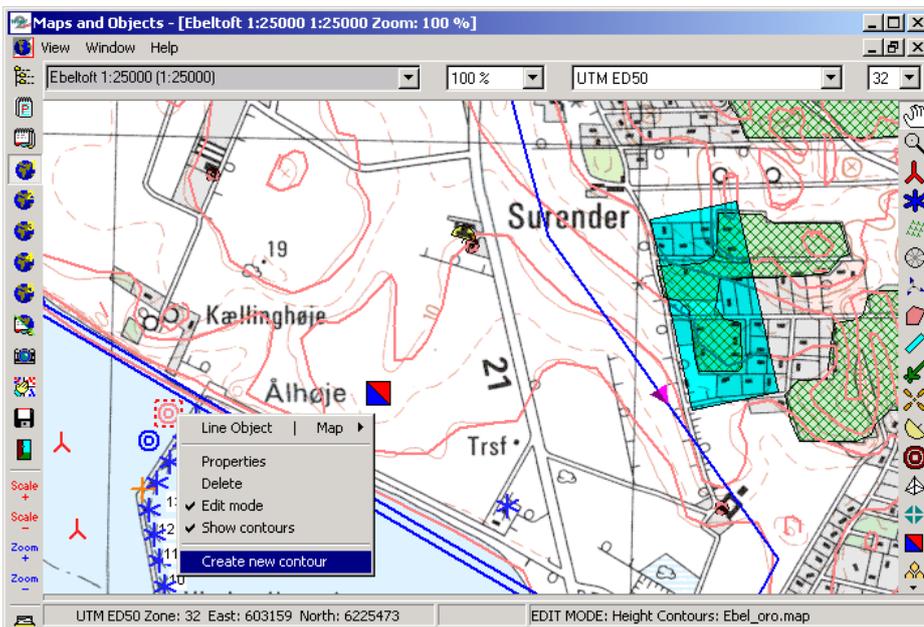
Important: When you reach the edge of the map shown on the screen, you may want to move the map while digitizing (without stopping). This can be done by setting one of your mouse buttons (if more you have than 2) to the function "middle mouse button" in Windows mouse setup. When this button is held down, you can move the map while digitizing.

Note on digitizing roughness lines:

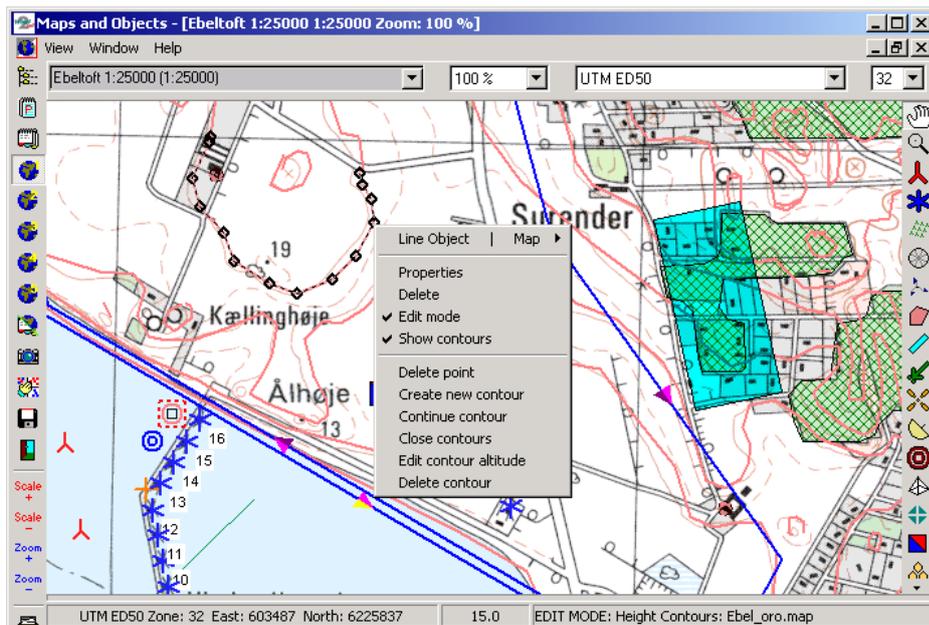
It's necessary to enter the roughness values on both the left and right side of the line in the direction of digitization. It's the user's responsibility to ensure consistency between different roughness lines. Considerable differences, e.g. unintentionally crossing lines, can result in large calculation errors with no warning message given, when using WASP. Another way to digitize roughness lines is to use the Area Object. With this method, area polygons are digitized, and lines are then exported. The export procedure makes sure that there are no consistency problems with the lines.

2.8.3.2 Viewing and editing existing lines

The Line Object makes it possible to import a file containing height contours on top of a background map. If the object is marked "Edit mode", you can edit in the imported contours by clicking once on the curve to activate it. You can then drag the individual lines or points to their correct positions by holding down the left mouse button when the cursor is inside a point and then dragging. You can also add new points, delete points, connect lines, or add new lines. In addition, it's also possible to edit the values of the individual lines.



As shown on the map above, when right-clicking on the object, a pop-up menu appears containing several options including the "Edit mode". Lines cannot be edited unless the Line Object has been set to “Edit mode”.



As shown above, with the Line Object in “Edit mode”, clicking on a line will activate all the points in that line. When you hover on the height contour line, its value will be shown in the line at the bottom of the window.

After selecting a line, you can drag any one of the activated height contour lines in any direction. You can also right-click on the isoline to get a menu, which gives you several options for further manipulation.

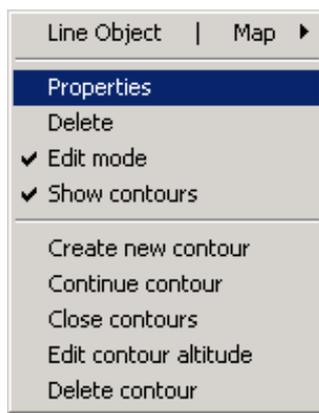
Note: Right-clicking will present different menus depending upon whether the cursor is placed on a point or on a line between two points (see below).

Another line edit function is to connect two lines. If you click on one line, and then hold down the <Ctrl> key while clicking on another line, you can select "connect contours" and the two lines will be merged. If the two lines have different values, you will be asked to enter a value.

Shown below are the four "right-click menus" that can appear when line is activated.



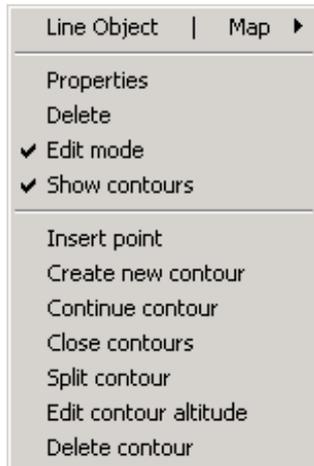
1) Cursor outside the line



2) Cursor on a point on active line



3) Cursor on a line



4) Two lines selected (between points) on an active line

Lastly, when you exit the "Edit Mode", the TIN is recalculated.

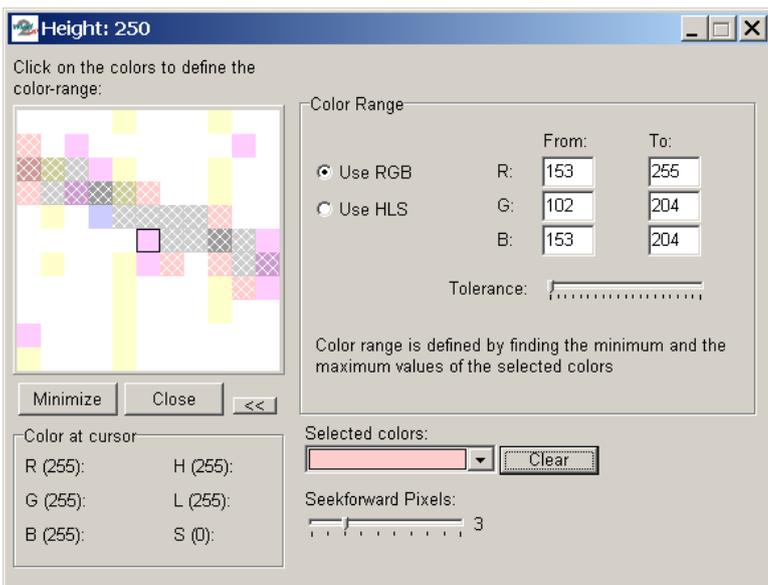
2.8.3.3 Digitizing new lines without clicking

Instead of mouse clicking for each point, simply by holding down the <Shift> key, the software will do the clicking for you. When the mouse is moved while the <Shift> key is held down, the points are set automatically.

2.8.3.4 Digitizing new lines by auto-detect

The most advanced way to digitize lines is by letting the software recognize the lines on the map by color recognition. This works as follows:

When you hold down the <Ctrl> key, a window appears in the upper left corner. Place the cursor on a line you wish to digitize then release the <Ctrl> key and move the cursor up into the window. Click on the colors (pixels) that can be identified as having the color information of the contour lines. Diagonal cross-hatching indicates the selected pixel colors (see below).



When the relevant pixel colors have been marked, move cursor back to the line you want to digitize, again hold down the <Ctrl> key and click on the line. WindPRO will auto-detect the line until it comes to a section where it does not know how to proceed further. Click on the line to help WindPRO continue in the right direction. If it

finds the wrong way, simply right-click and select “Undo last autodetect” as shown below. In addition, the <Alt> key or the <Backspace> key can be used to delete the last point and thereby “move backwards”, until the digitized line is back on the track.



Then manually click a few points (release the <Ctrl> key) to help it past the critical point and press down the <Ctrl> key again to continue the auto-detect operation.

It's important to select the right pixel colors in order to achieve successful auto-detection. It's also important that the background map has relatively clean colors for the lines. If it does, then this method can be very efficient and large maps can be digitized quickly.

2.8.4 Save and use data from Line Object

The data file containing the lines is saved when you exit the edit mode. Note that if you are working on an existing file, it will be overwritten. To prevent this (if you've made changes that you don't want to save), open the file from Windows Explorer and make a copy before leaving edit mode.

The Energy Calculation module can use the Line Object's height contour data file (only with WAsP). There are two ways to use the data; by linking the Line Object to a Site Data Object (default) or by attaching the saved file to a Site Data Object. The latter option allows you to use the data without having a Line Object in your current project.

The other calculation modules (SHADOW, VISUAL, and DECIBEL) can only use DHM (the TIN) created within a certain radius around the position of the Height Contour Object. In order to be able to use the DHM you have to mark this option on the Tab Sheet "Position" under the Line Object, and indicate that the Z-coordinates of the relevant objects (WTGs, Shadow Recipients, etc.) are taken automatically from the DHM. This must also be marked on the "Position" tab sheet for the relevant objects.

2.8.5 Trimming data in Line Object

There are a number of tools available for trimming (see Section 2.13)

2.8.6 Roughness consistency check

The Line Object can be used to check the consistency of roughness lines. Inconsistency is indicated as red dots or red shaded areas (see example below).

2.9 BASIS - Area and WTG Area Object

2.9.0 Introduction to Area Objects



The Area Object in WindPRO provides the user with a tool for importing or digitizing areas as closed polygons, each having similar characteristics. Elements such as forests, cities, water, or other landscape feature can be described using the Area Object. They typically have uniform characteristics and so can be treated similarly in e.g. a roughness classification or other landscape evaluation.

The Area Object has the advantage of allowing the user to quickly establish areas directly on-screen simply by using the mouse or importing data from e.g. GIS systems or maps in vector formats.

Note: Digitized areas can be used for other purposes also, and it is important to consider the intended purpose prior to digitizing.

Advanced digitizing options with auto-point settings are available from version 2.4. The auto-point setting is invoked by pressing the <Shift> key. Pressing the <Alt> key launches an eraser tool for deleting points.

If the areas will be used for exporting a roughness line map or for a ZVI calculation, it may require the definition of landscape types. When carrying out ZVI calculations, farm land can normally be considered as one type.

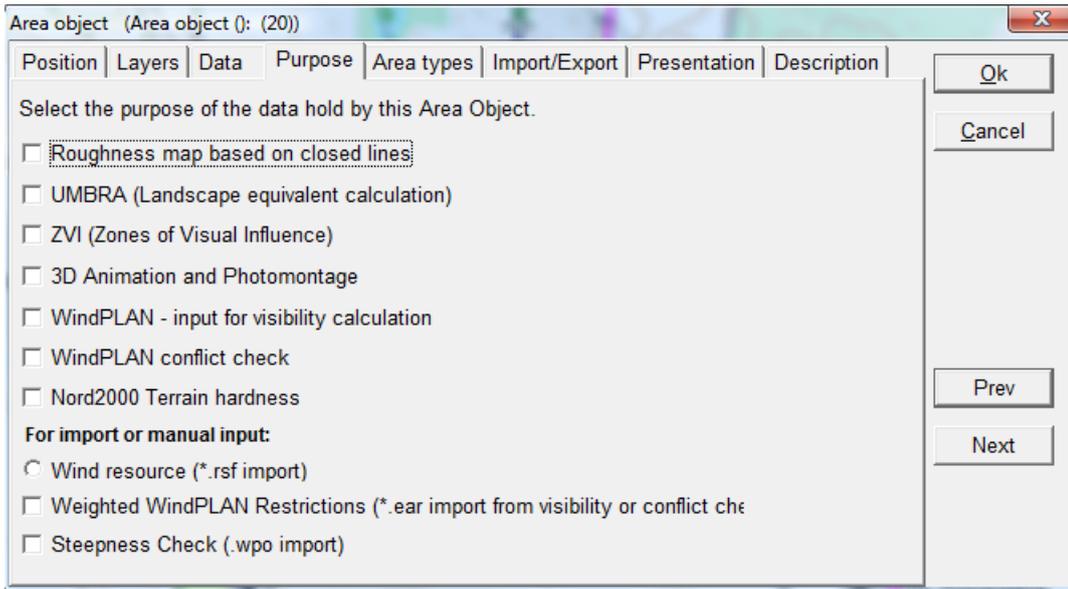
In order to use the Area Object for the export of roughness lines, it's necessary to divide the farmland into different areas controlled by a roughness subset representing the farmland. For example, a division into "farm land with low roughness" and "farm land with high roughness" (many windbreaks) may be necessary.



The WTG Area Object is a special variant of the Area Object, specialized for OPTIMIZE and WindPLAN purposes and for use together with the Park Design Object. See these chapters for further details on this object.

2.9.1 Where to use the Area Object

In the present version, the Area Object can be used for a number of different purposes including the shown below:

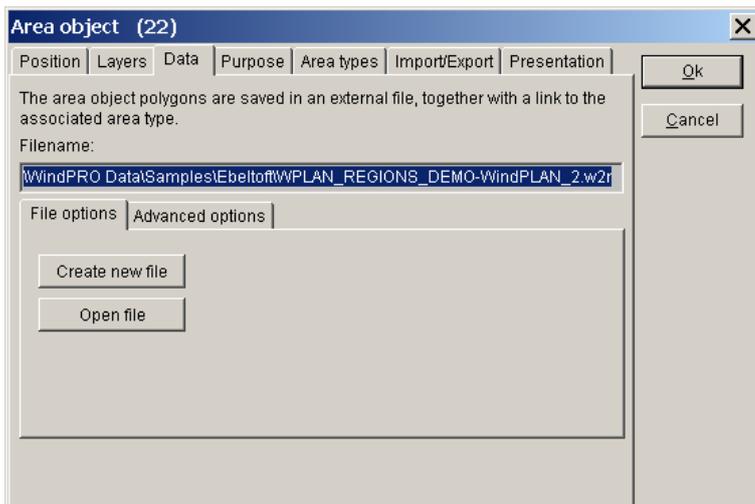


Note that the Area Object can also be used to produce roughness lines, a very useful method because it protects against crossing and inconsistent roughness lines. However, you must perform an “Export to roughness lines”, before they can be used. The exported file must be attached to a Site Data Object (via a Line Object). With regard to crossing lines, the rule when exporting is; if areas overlap, the area with highest roughness value takes precedence over the area with the lower roughness value.

Although roughness areas can also be used direct in calculations, Where EMD has established a converter from roughness areas to roughness roses. It has to be noted this feature go beyond the WAsP model, and for a full WAsP compatible calculation, the export to roughness lines should be used. Direct use of roughness areas in energy calculations shall be seen as an experimental feature so far.

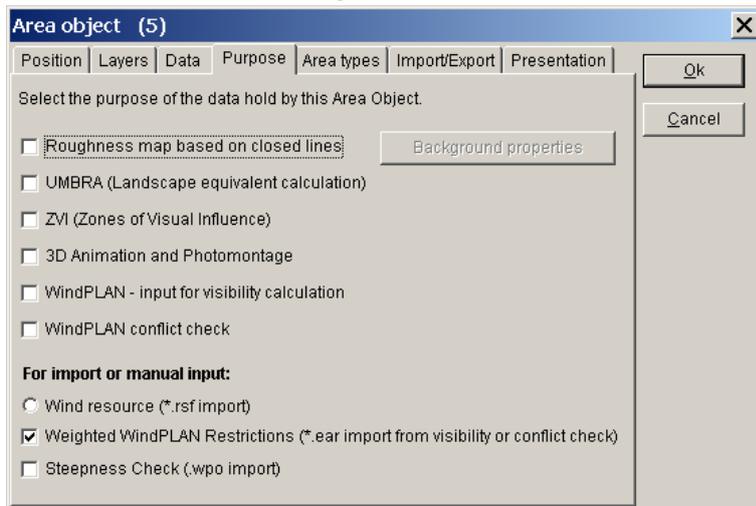
2.9.2 Establishment and presentation of the Area Object

2.9.2.1 Tab Sheet: Data



The data associated with an Area Object is saved in a file. You can create a new area file or load an existing file saved from another Area Object (a WindPRO regions .wpr file). To import data from other sources, see Tab Sheet “Import/export”.

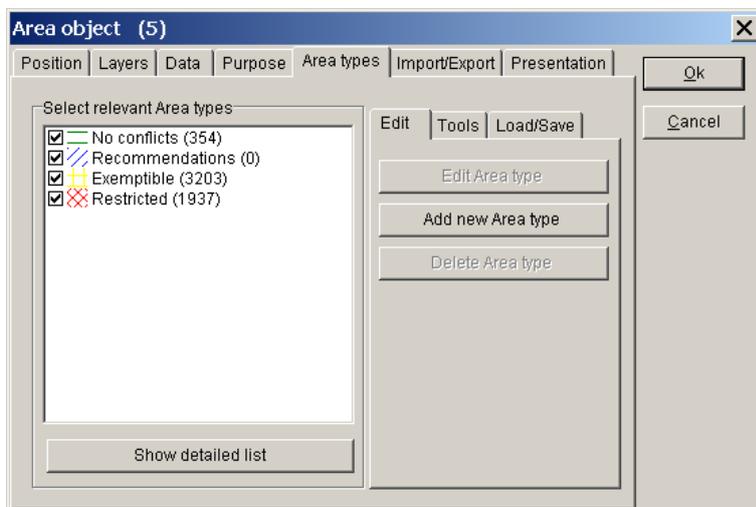
2.9.2.2 Tab Sheet: Purpose

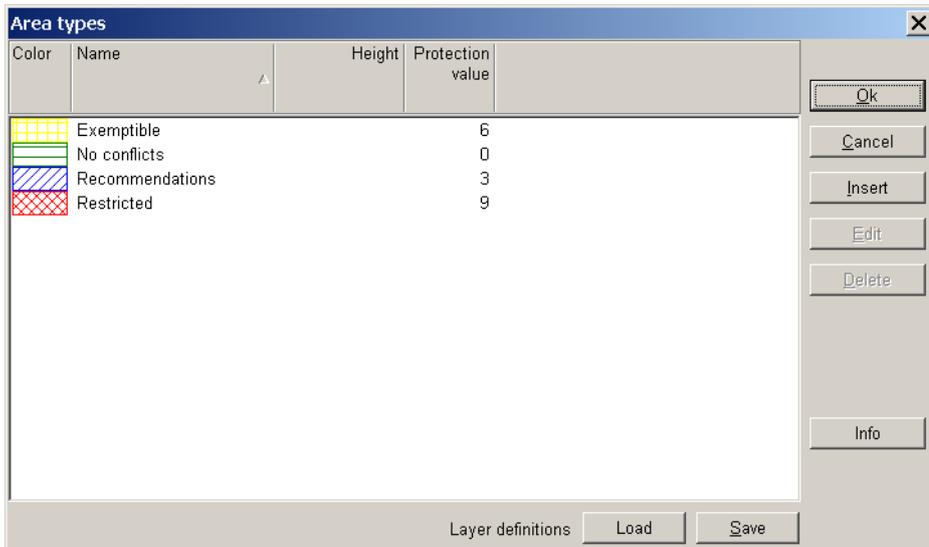


The Area Object can have multiple purposes. More than one purpose can be checked at the same time. The top group are normally physical landscape elements such as a village, a forest, or water, while the bottom three are used for more specialized data. Note that the purpose “Steepness Check” is described in more detailed in Section 2.9.6 (last section in this chapter

2.9.2.3 Tab Sheet: Area types - definition of areas

To define area types, click at an Area Object and then select either "Edit Area type" or “Add new area type”.

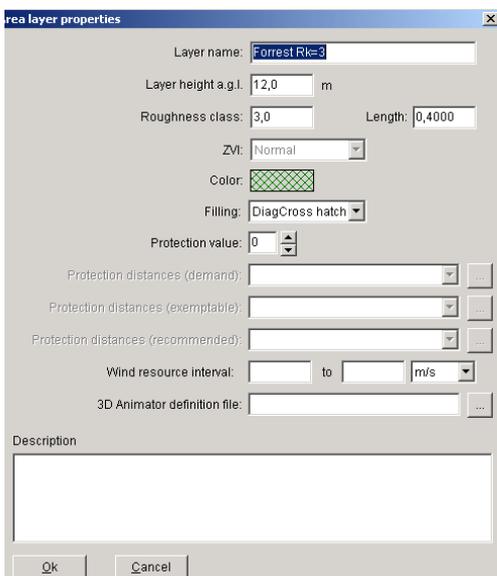




Definitions can be imported from a previously-defined Area Object, or from an .lty file which can be saved from the “Area type” dialog box. Some area definitions are available in the folder \WindPRO Data\Standards\.

Some area types shown above are mainly for roughness classification purposes, but they are also useable for ZVI purposes.

New area types can be added by clicking on the "Add new area type" option. Previously defined area types can be edited by double-clicking on an area layer name and the dialog box shown window will appear.



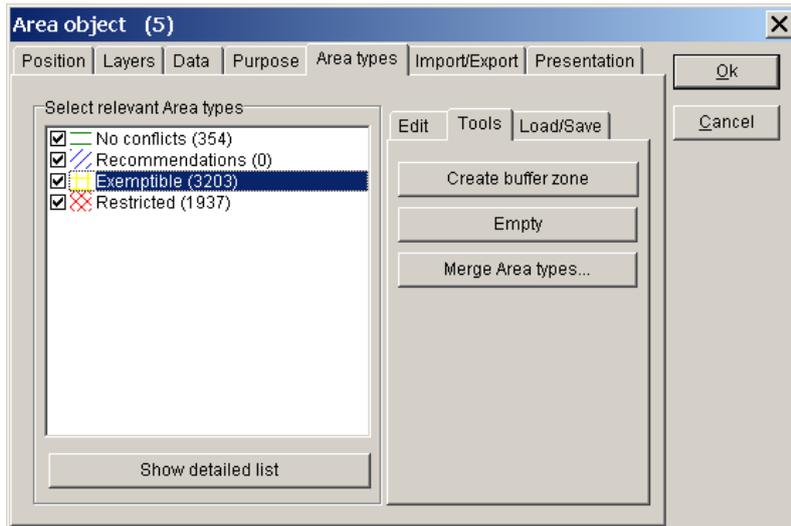
When finished defining or editing area layers, click “OK” and you are returned to the “Area types” window.

In this dialog box, you can check the area types you want to use for your current task. These are the ones that will appear in the drop-down selection menu when digitizing new areas, and will be visible on the map.

Edit background area type is required for roughness purposes and is optional for a ZVI calculation. The background area is the default value that digitized areas will replace where they have been created.

Tools

There are various tools available for utilizing the area types.



The tool "Create buffer zone" allows you to create new area types based upon already defined areas, where a new area is created in a zone defined by the user.

Clicking on "Empty" simply deletes the areas of a specific type.

The "Move Area data..." moves area data from one type to another. This is very useful when importing data in multiple steps.

2.9.2.4 Tab Sheet: Import/Export – with online data

The Online data run fully automatized, while import from other sources require more settings.

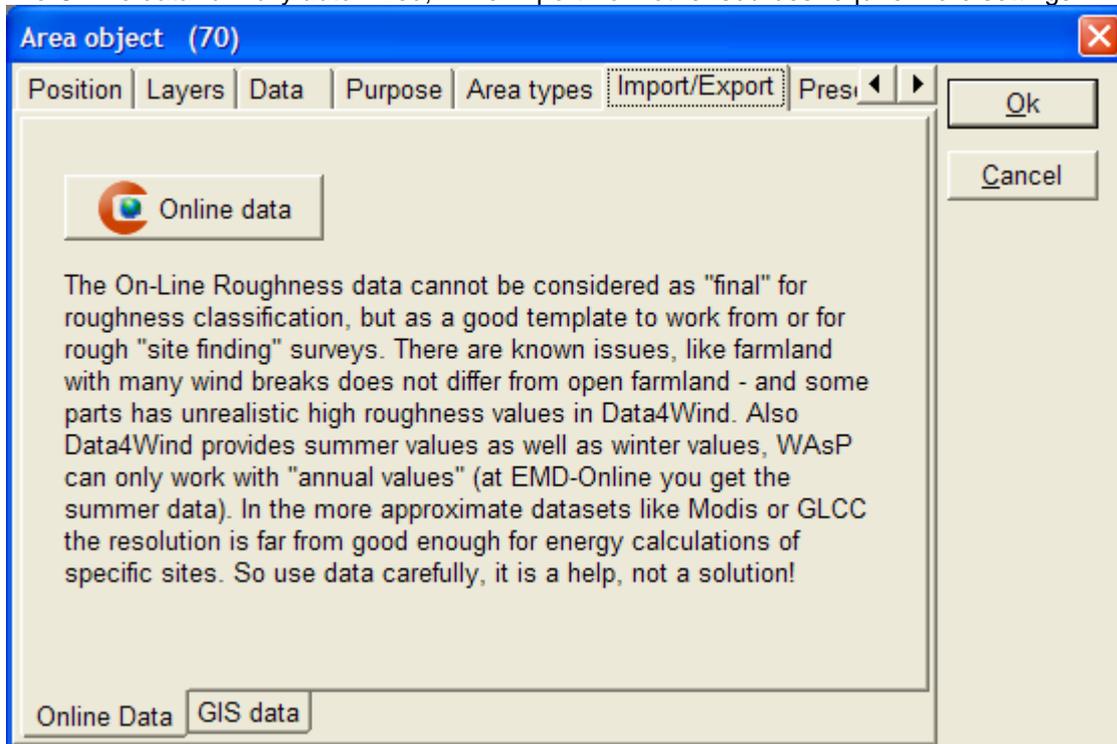


Figure 7 With the area object set to "roughness data" as purpose; you can get access to on-line data from the "Import/Export" tab.

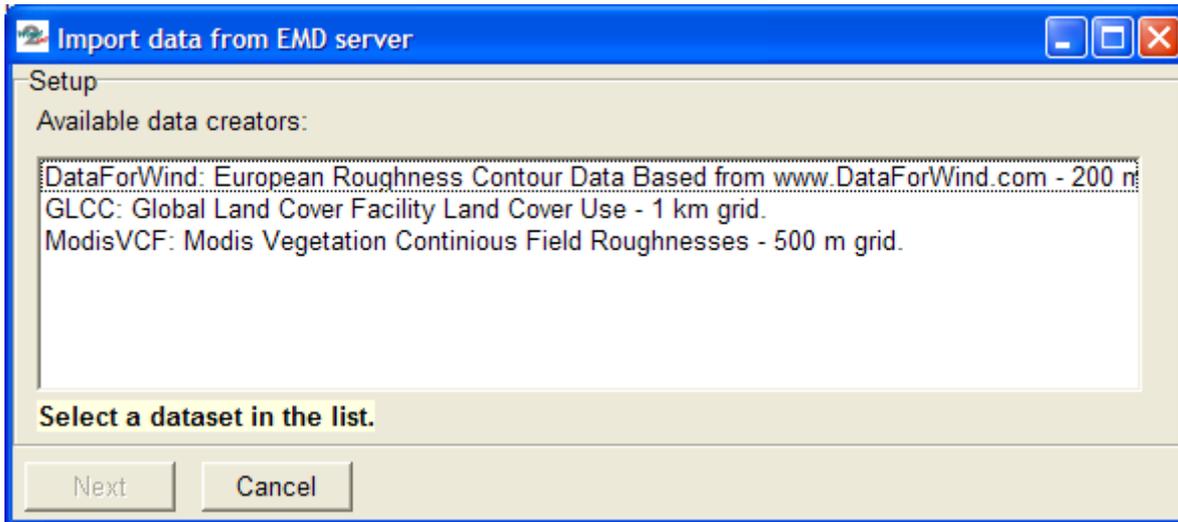


Figure 8 Example of roughness data sources at a European site.

There will be more or less types of roughness data files available describing the roughness in more or less detail, depending on where in the world the site is located. NOTE: these data will not be sufficient for a detailed energy calculation for a specific project, but are to be considered as an initial classification of roughness around a site. E.g. the Modis data only holds information on vegetation, not urban regions, so there will be some manual work required to edit and improve the accuracy of these data before they can be used for an energy calculation.

Import from other sources

Previously digitized data (polygons) from other sources (.dxf and .shp files), or for a Wind Resource map, output files from WAsP calculations, can be imported.

The process of importing data is as follows:

Press the "Import" button.

Select the file to be imported

Select the coordinate system and the datum in which the data is geo-referenced (e.g. ED 50). NOTE: This must be known. If it is a local coordinate system (or a system unknown to WindPRO), it can be defined in "Project properties" prior to importing.

The procedure for importing .dxf and .shp files is slightly different as follows:

DXF-files

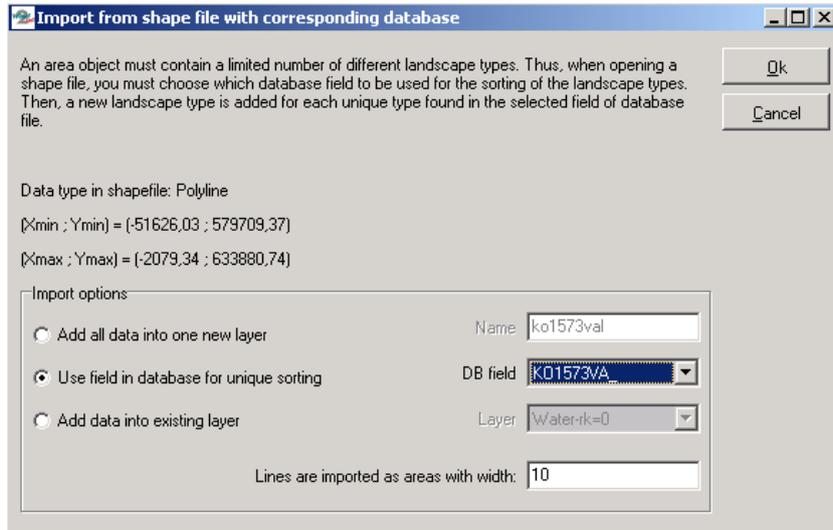
After reading the file (which may take a long time, start with a small file to test), the layers from the imported file appear in the list of landscape types with the layer number as the name.

Identify the imported layers and then select "Merge area layer" to place it into the defined layer that matches the type of data in the file (or redefine the layer).

Repeat the above steps until all imported layers are defined.

Shp-files

After defining the coordinate system, the dialog box shown below appears:



Here you can see the corner coordinates of the shape file limits (which will indicate whether or not you've chosen the correct coordinate system – if not, cancel and chose "Import" again).

There are several options for importing .shp file data:

Adding all data from all database fields into one layer

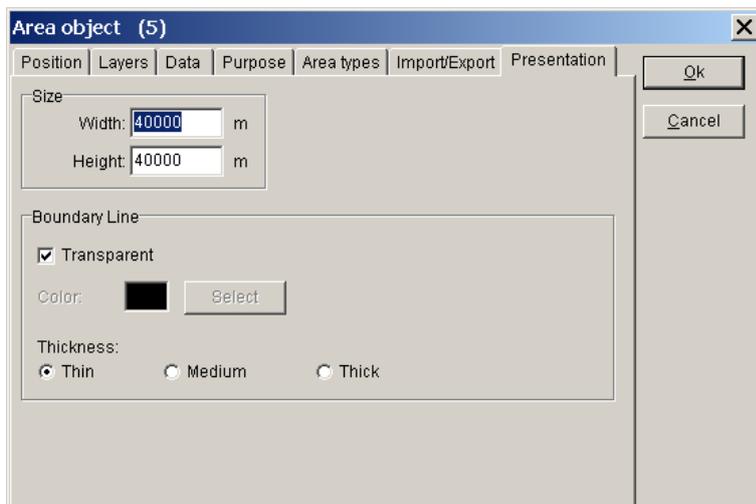
Creating one separate area layer for each unique entry into one of the database fields or adding all data into previously-defined area layers (more typical option).

After reading the file (which can take a long time – start with a small file to test), the layers from the imported file appear in the list of landscape types.

Caution:

When classifying roughness using areas, everything outside the digitized areas will be interpreted as background values. The background roughness must be given a value. For example, on islands far from the mainland, it's appropriate to use the roughness value for water as the background roughness. However, if the mainland is closer than approximately 40 km in any direction, it must be digitized. On mainland, it's usually appropriate to choose the value for "open farmland" as background (roughness class 1-1.5) and then digitize the cities, forest, water areas, and farmland with higher roughness values. In general, everything within a 20-km radius must be digitized. At a distance of 40 km, the influence of the surface roughness normally has no effect.

2.9.2.5 Tab Sheet: Presentation



In this dialog box, the visible parts of the areas are defined. The only reason to limit the visible parts would be to increase computer response when regenerating on-screen graphics.

Note that the boundary line separating each area can be made transparent. This is useful for a Steepness Check or for a Wind Resource map, where the areas cover the entire map.

2.9.3 Digitizing on-screen, editing, and viewing

Using a background map brought into WindPRO as a background bitmap image (containing all relevant information, e.g. forests, cities, etc.), it's possible to digitize the sites manually, or to view the imported data on top of the map for editing as required. The same principles as described for the Line Object in Section 2.8.3 apply to the Area Object.

2.9.4 Save and use Area Objects in calculation modules

The data file containing the area information will be saved in the file specified in the Tab Sheet "Data" when you exit the edit mode. Note that if working on an existing file, the file will be overwritten. To prevent this (if you have made changes you wish to undo), open the file from the Windows Explorer and make a copy before exiting the edit mode.

2.9.4.1 Export of roughness .map files from the Area Object

From the Tab Sheet "Data", you can export the digitized polygons (if the purpose "Roughness" is checked) to a WAsP .map file format. In the so-called polygon-cutting routine, the areas with the highest roughness have the highest priority when the areas are overlapping. Remember to define all none-digitized areas in "Background properties" on the Tab Sheet "Areas". Complex polygons may cause the polygon-cutting routine to fail, particularly if two or more polygons are overlapping or if polygons have corners with very sharp angles. Data should be checked carefully. You should check the results by loading the exported line file into a Line Object.

2.9.4.2 Use of the Area Object data in a ZVI calculation

In a ZVI calculation, every area defined with a height will be built "on top" of the digital height model. This means that, for every point with an assigned height inside a polygon, the assigned height from the area region will be added to the height model and, if the height of the area polygon is higher than the observer point in the ZVI calculation, the WTGs are treated as invisible from any point within this area, e.g. a forest.

Naturally, this will not always be the case. For example, WTGs can be visible from some points inside a forest or city. If this needs to be taken into account, these regions must be digitized in greater detail, e.g. each house modeled as a separate area.

2.9.5 Trimming data in Area Object

There are a number of tools available for trimming, see section 2.13

2.9.6 Steepness calculation and presentation

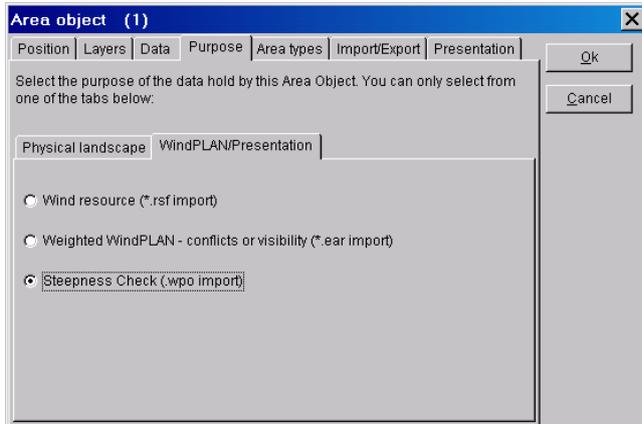
2.9.6.1 Purpose of the Steepness calculation

The Steepness Check (.wpo import) is used to generate areas (polygons) containing the "steepness" within certain intervals. These intervals may be used to exclude areas where it's impossible construct turbines or to build roads due to the steepness of the slopes of the terrain. The input data is a *.wpo file from a WindPRO Line Object, and the result is placed in an Area Object.

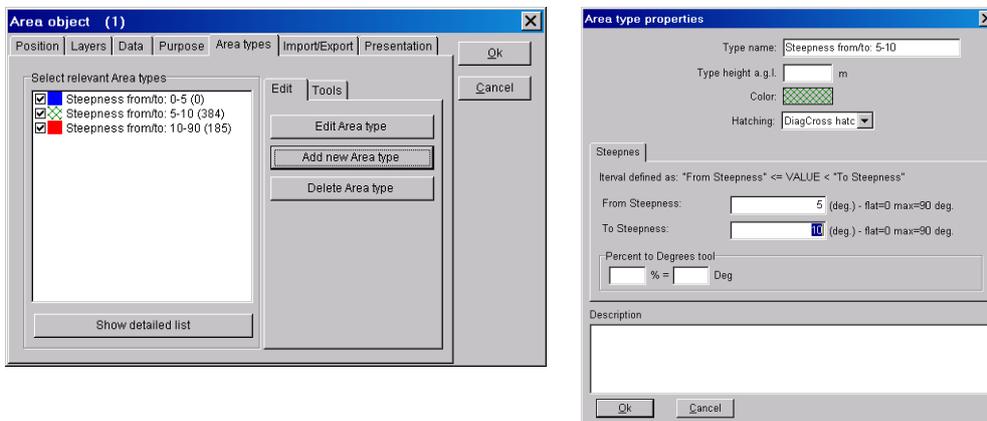
2.9.6.2 Calculation setup in the Steepness calculation

1. Insert an Area Object onto the map using the  icon.

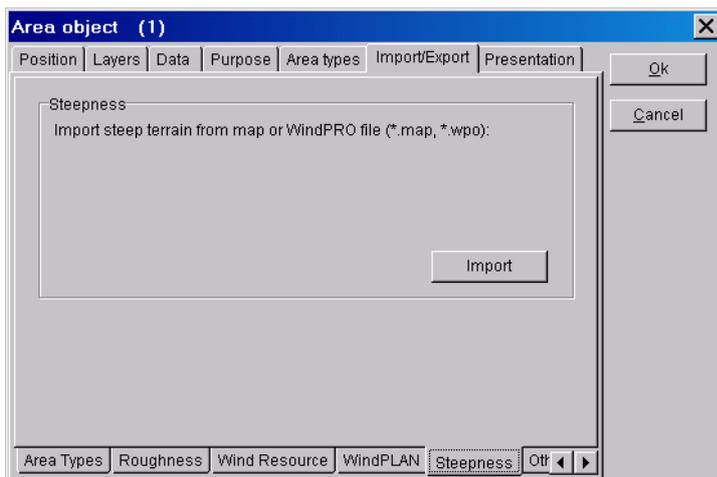
2. Select “Steepness Check” as the purpose for the Area Object.



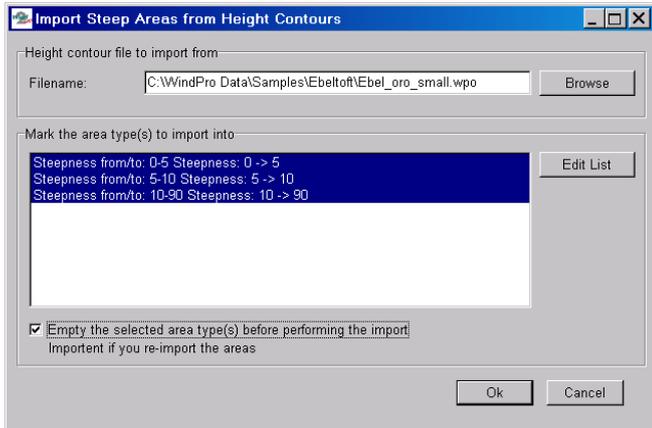
3. Create an area type for each steepness interval that should be created. Click on the “Add new area type” button on the “Area types” tab sheet.



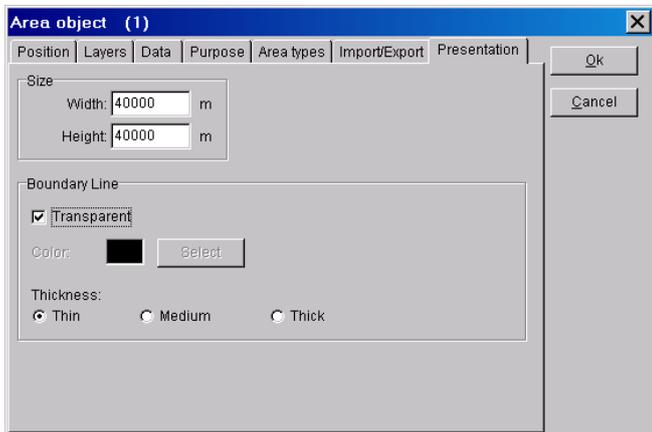
4. Select Import from the Import/Export | Steepness tab sheet.



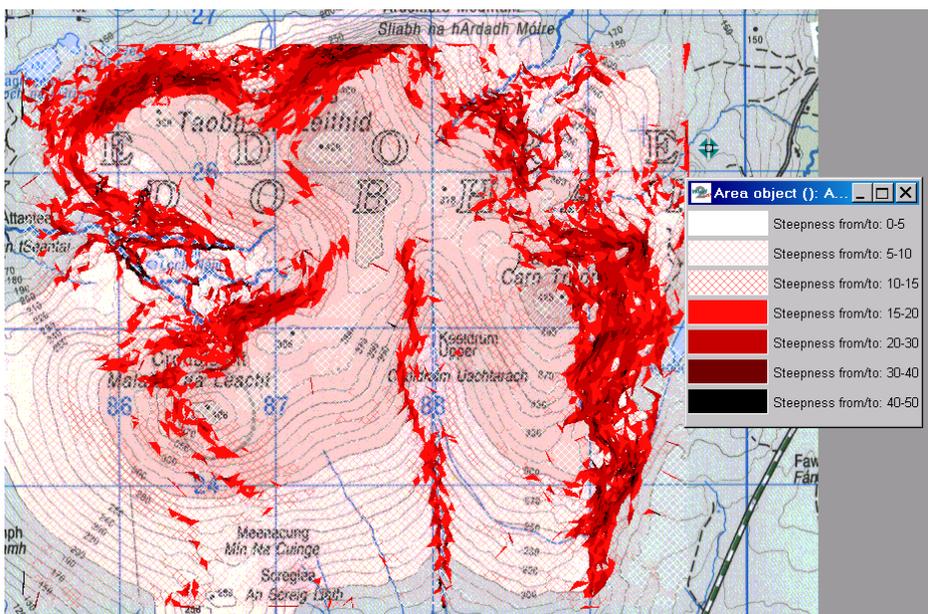
5. Now, select the *.wpo file (Line Object data file) to calculate or import the steepness data from. Mark the area types to import into (the areas that you just created). On import, WindPRO reads the steepness intervals from the area types. Make sure to mark the “Empty the selected area type(s) before performing the import”, if you re-import the areas. Otherwise, duplicate areas are created.



6. Lastly, in order to make the slopes look good on the map, select the Boundary Line to be “Transparent” on the Presentation tab sheet.

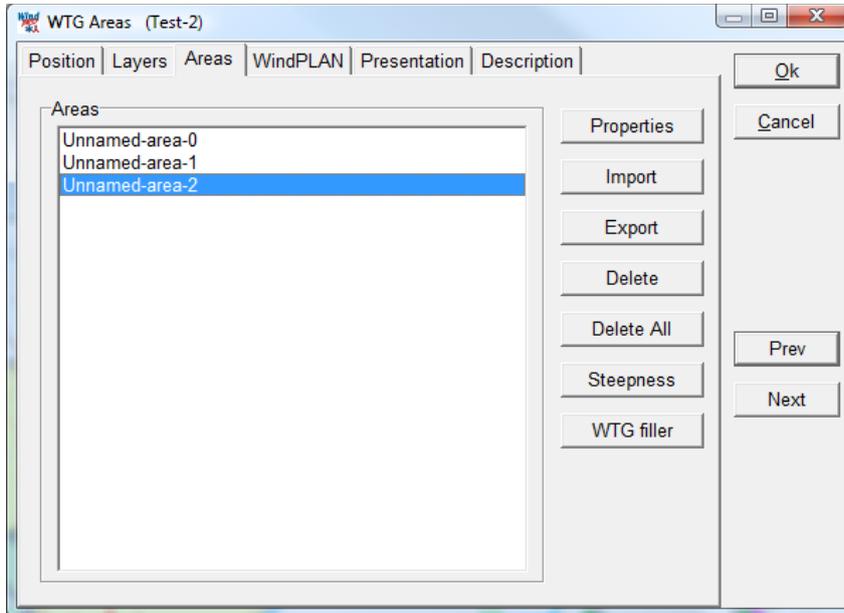


An example of results from a steepness calculation is shown in the figure below. Note that the turbines are erected in areas where the steepness (slope of the terrain) does not exceed five degrees.



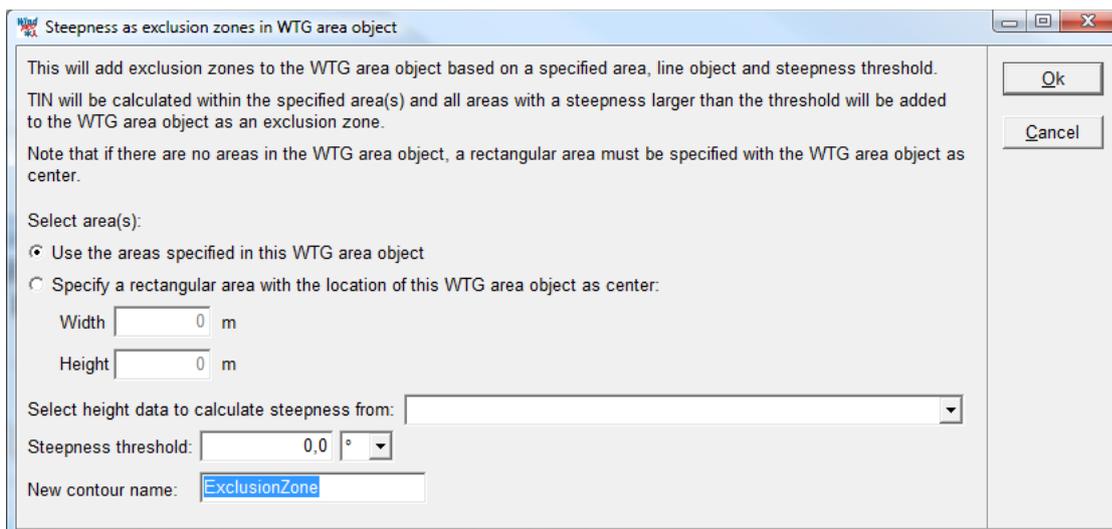
2.9.7 Specific WTG-area features

The WTG-area are as mentioned a variant of the Area object, with limited features, but specific designed for having the most needed features for designing a wind farm. The object is central for the OPTIMIZE module and shall typically always be used as the object that defines the borders of the site, e.g. based on land owner agreements.



The WTG area has some specialized features.

2.9.7.1 Steepness in WTG-area



Steepness can be established as exclusive zones based on a given steepness threshold. This is very efficient for avoiding placing turbines from e.g. the Optimize module in areas that are too steep.

2.9.7.2 WTG filler in WTG-area

The WTG filler can establish as many turbines as there are space for based on required distances, a fast way to evaluate the MW potential at a given site.

2.10 BASIS – Elevation grid object

2.10.0 How to use the elevation grid object

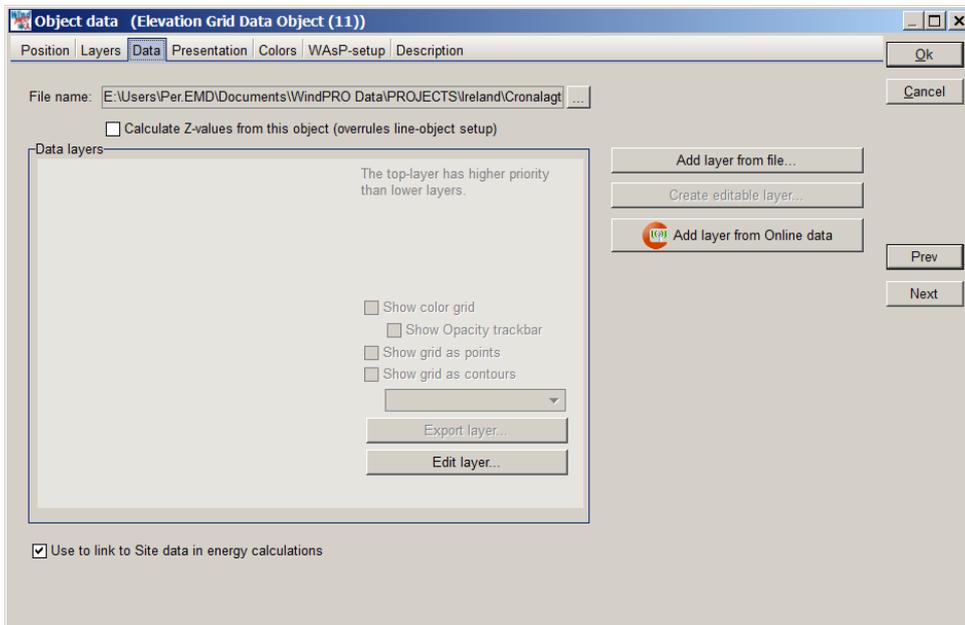
With elevation grid Object, it's possible to handle elevation data as gridded data meaning that the elevation data has a Z value for each point in regular grid spacing. This makes calculations much faster compared to contour lines and it gives options to present the elevation data in color scales to give a good overview of the elevation on a map. A special feature is the layer organization of the elevation data, where more layers mean that detailed data in the near site can flexible be combined with more coarse data in the remote region. While gridded elevation data normally not are editable, there has been established a special feature for creation of an editable layer, where grid data are converted to lines in a line object that can be edited and thereby like near measurement masts very detailed data can be established. The elevation grid data is thereby an efficient alternative to line object contour elevation data.

2.10.1 Creating an elevation grid object



Clicking on the object button creates the object.

2.10.1.1 Tab Sheet: Data

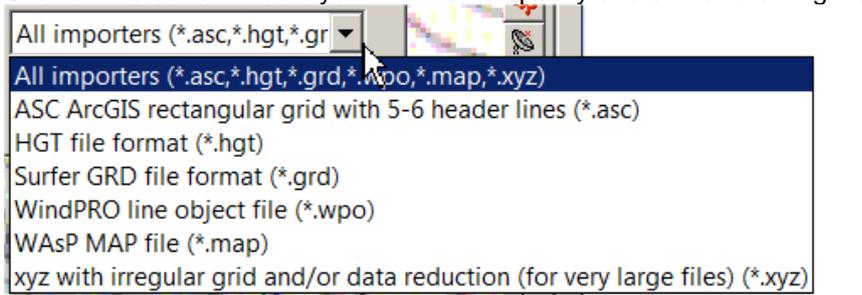


First option to deal with is if you want the Z values for all objects to be calculated from this object. If you already have established a line object with elevation data, you have to choose between these two alternatives. If only elevation grid data, this is the choice.

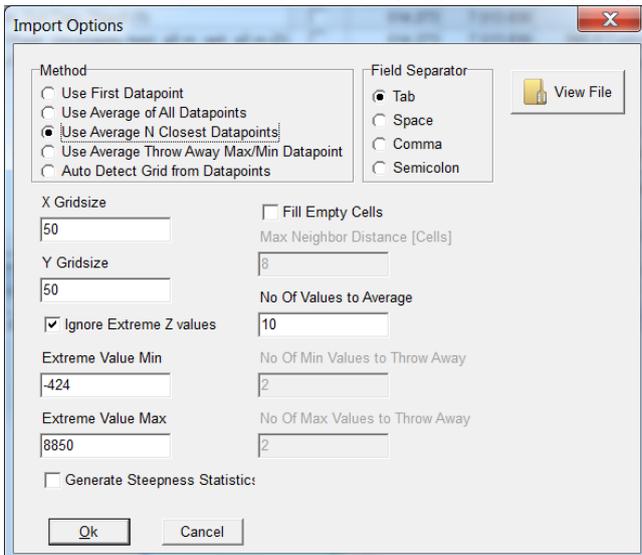
On the Tab Sheet "Data", you specified which data to load.

The "simple" way to get data is to "add layer from On-line data", where SRTM data easily are loaded, fast and efficient, while these data already are gridded data.

Click on the button "Add layer from file" to specify one of the following file types:



A special variant is the xyz with irregular grid. This is partly used to convert irregular grid to regular grid, partly to “thin” very detailed gridded data. E.g. Lidar surveys, where data might be as detailed as more points per m², which mean a data amount that is too detailed for “normal” wind energy calculations.

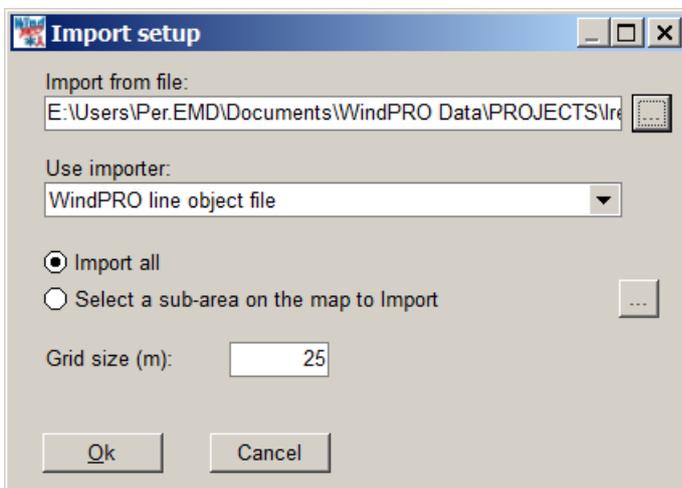


The import options for irregular grid or very high resolution grid data, that shall be thinned.

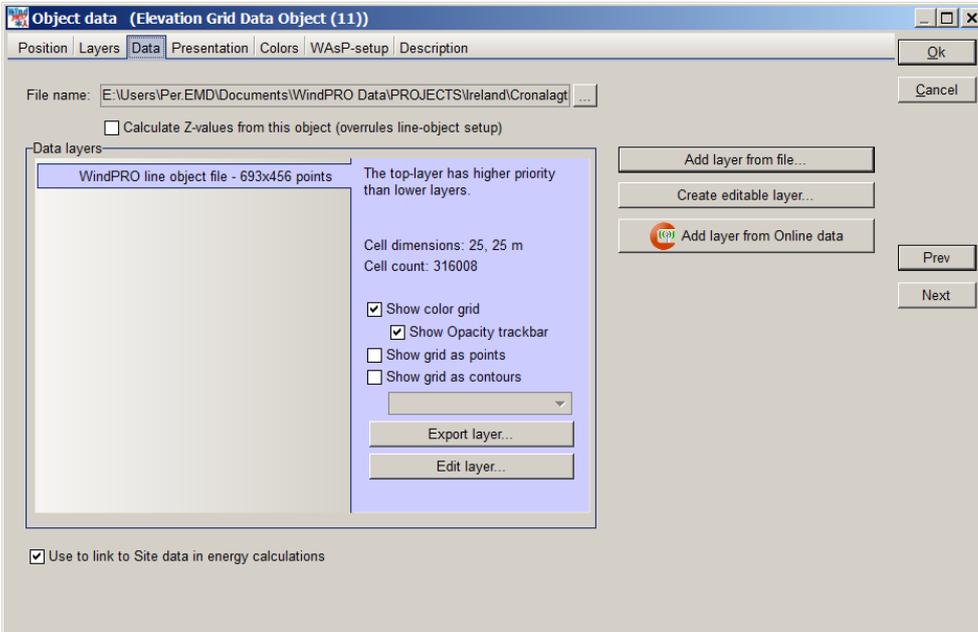
The most important features are:

Method: Typically choose: average N closest points or Auto detect (if highest possible resolution). But if data quality is poor, having many outliers, throw away Max/min.

The Fill empty cells option is also important. Normally you do not want holes in your data and want to fill. But it might be that the data is the top of a curved ridge, and you risk filling within the curve. So there can be compromises. But note that the “filled curve” can be erased later with the “Edit layer” option, so the lower layer data is taken within the curve.

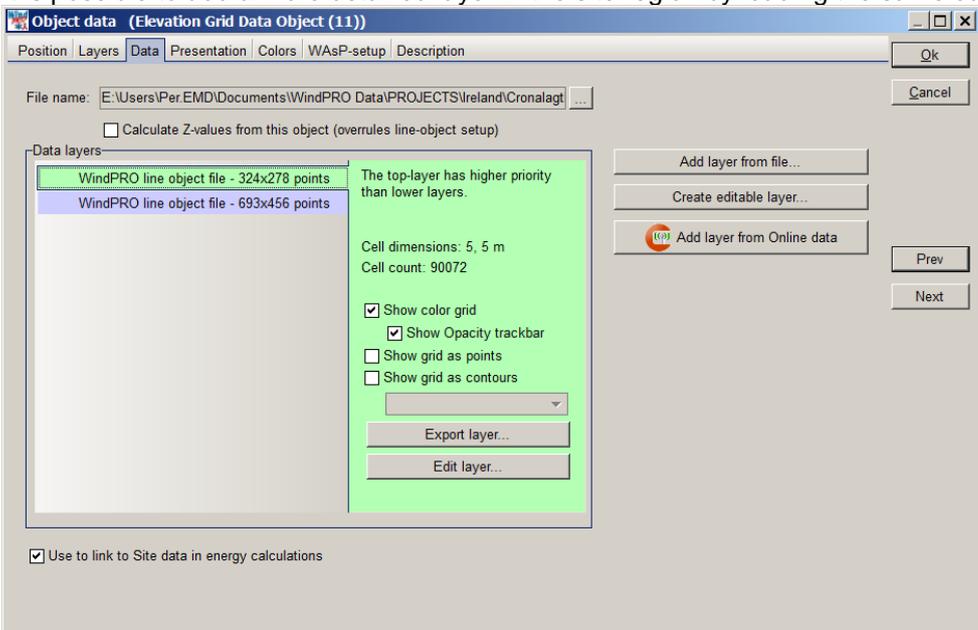


After selecting file next step is to choose importer (normally only one option), and then to decide if all data or a geographical sub set of data shall be imported. Finally the grid size must be decided. Having like line object data, the grid size is not trivial to decide. Too high resolution gives too many points, too low gives poor accuracy. But remember that the import can be done in more steps, making it detailed, like 10m near site, and then coarse, like 100m for the large area.

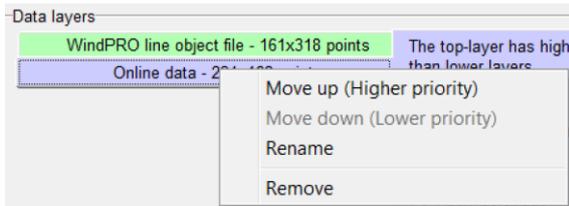


After import, some info is shown and the first layer established.

It is possible to add a more detailed layer in the site region by loading the same data but using a 5m grid

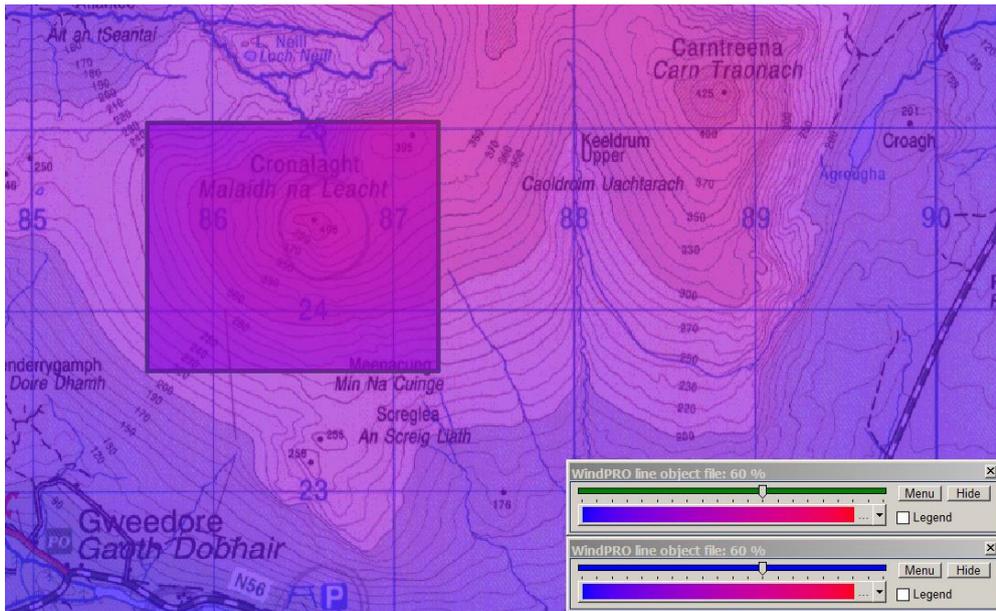


The normal area selection tools appear, and data are loaded in 5 m resolution. By right click on the layer, this is “moved up” to be the top layer. This mean that data from this layer are taken first in any calculation.

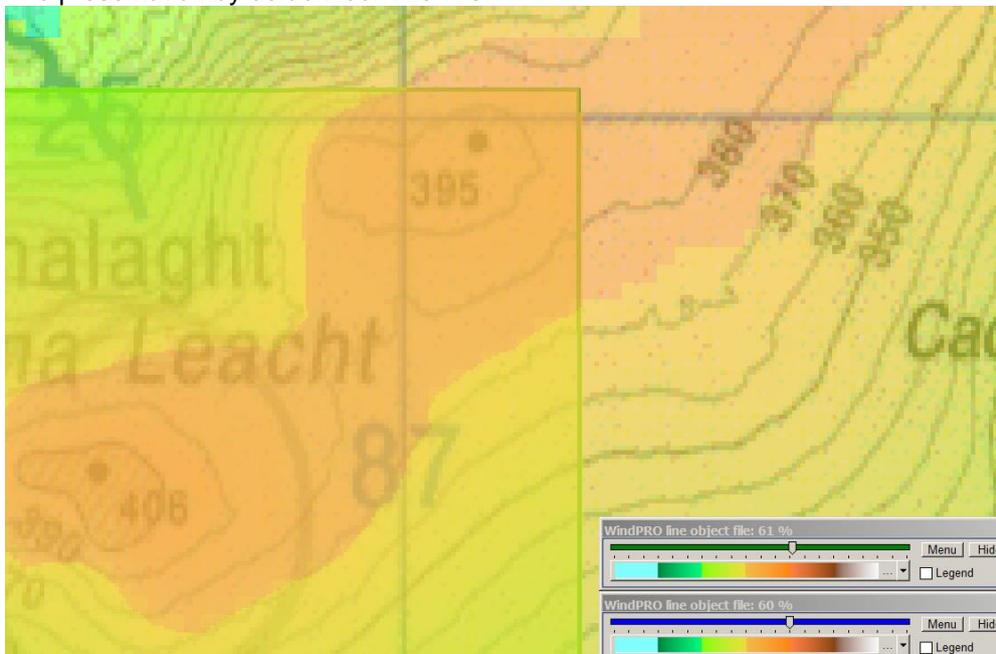


Right click on layer.

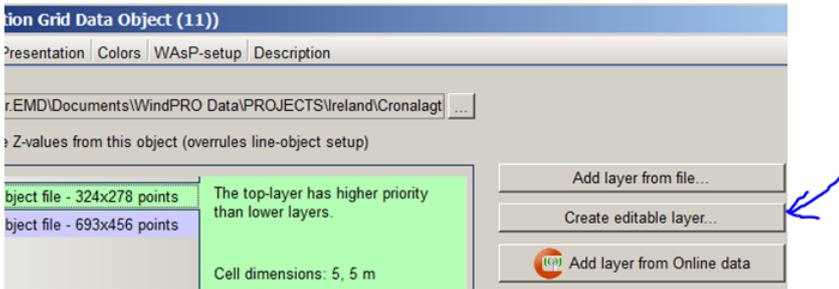
Note the many options for the elevation grid. Contour lines calculated from the grid data can be shown in any resolution. The grid points can be shown and there are features for high resolution painting of the grid, which correct for the problems given by the earth is round end thereby not making gridded data to precise in their direct presentation.



The presentation by default look like this.



Choosing another color scale and zooming in, show how the different layers has different resolutions. With the opacity track bar the visibility can be changed. Legends can be added and color scale settings changed. The "presentation" and Colors are similar to described by line objects and result layers.

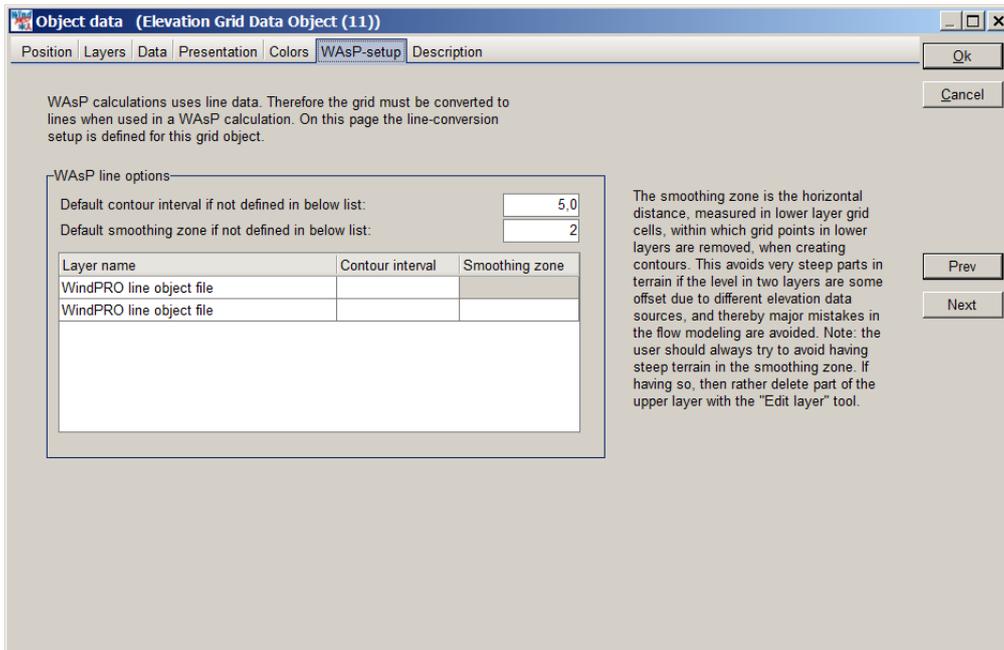


Creating an editable layer is a special feature for making it possible to “hand digitize” special areas of interest very accurate, e.g. the region around a measurement mast.

How to make manual changes to the grid elevation data:

When creating an editable layer, the gridded data is exported as contour lines to a line object for the specified area. The data is auto imported to a line object. This can then be edited by the tools described in line object. When editing are finalized, the data are automatically converted to grid data and replaced in the elevation grid object.

2.10.1.2 Tab Sheet: WASP setup



The WASP setup is special, while it allows for different contouring intervals for different layers. In mountainous terrain, it can be an advantage to reduce the resolution in the remote region, to avoid too many points/lines, which can violate the WASP capability.

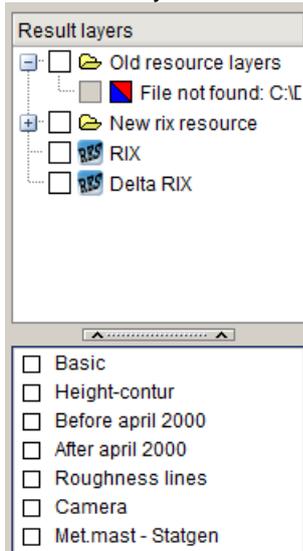
The smoothing zone is established to avoid steep region. In case where two different sources with slightly different elevation levels are used for the detailed and remote region, conversion to lines for WASP calculation would create some very steep slopes in transition zone. Therefore an option to define a smoothing zone based on number of grid cells.

2.11 BASIS - Layer structure - results and objects

2.11.0 Introduction to layer structure – docking

Using a layer structure similar to that used in many programs such as Google Earth, AutoCAD or PhotoShop, you can organize the results (geographical results) and objects in WindPRO. There are basically two layer structures: The result layers and the object layers. The result layers replaces for the users of WindPRO before version 2.8 the previous “result layer object”.

The result layer structure is placed in a layer structure above the object layer structure, see screen below.



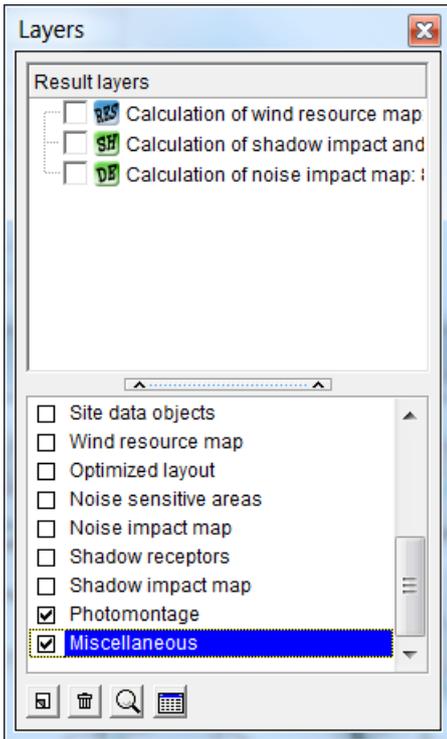
The result layer structure can be organized in sub layers, which is different from the object layer structure. From several calculation modules, result layers can automatically be created, like Decibel, Shadow, ZVI, and Resource. But result layers can also be established by right click in the result layer group, where files can be added, like .rsf files (wind resource files from WASP or CFD tools).

The result layers have the same options for color scales and legends as by report printing and viewing elevation grid data.

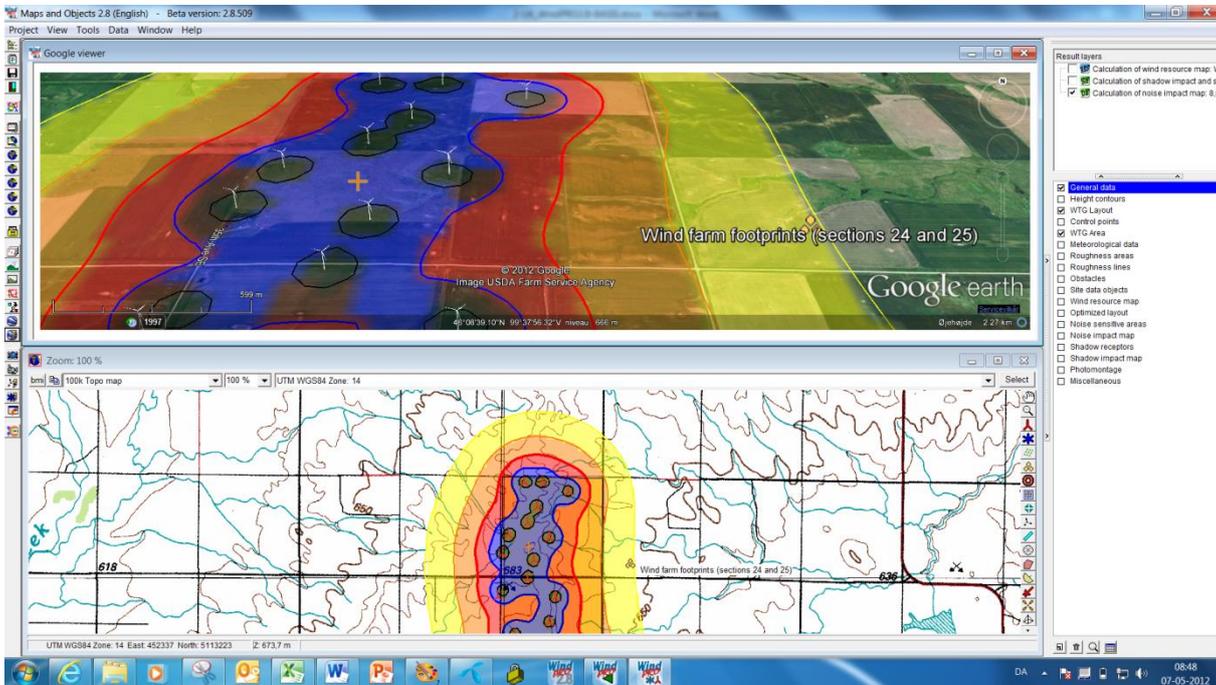
The layer structure is described in following.



Start the "Layer Manager" with the "Layer" button in the lower left menu bar.



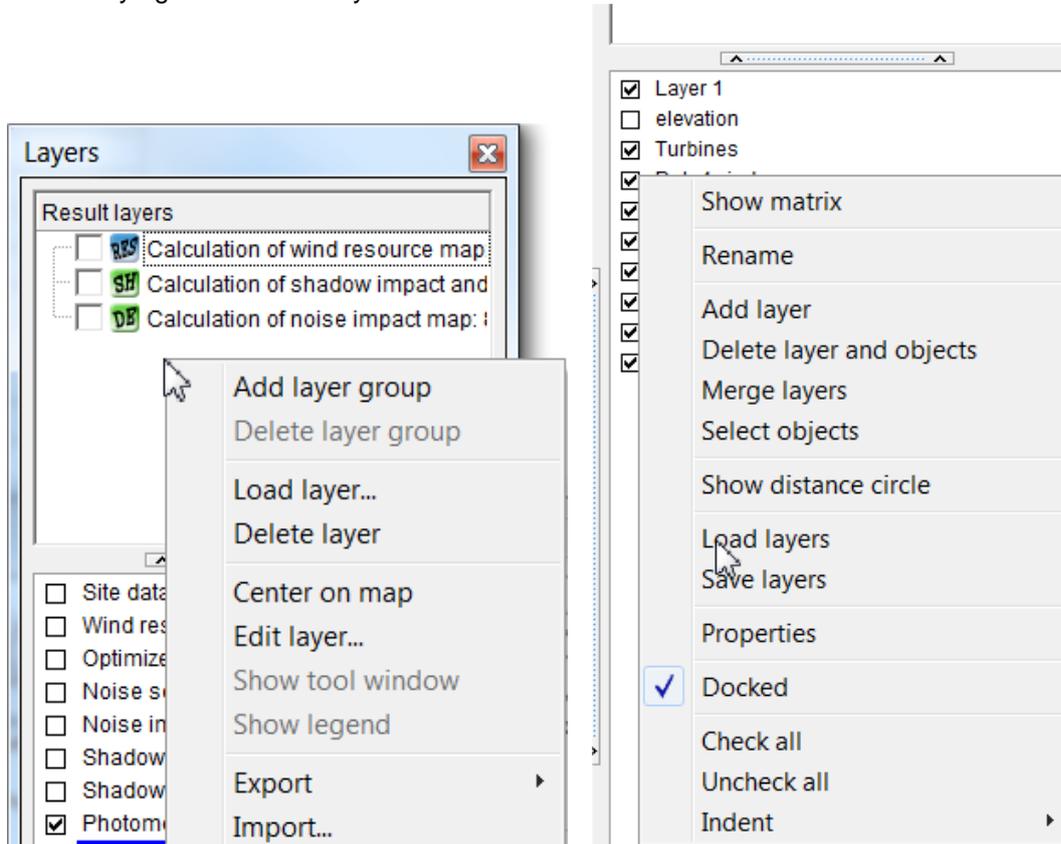
Most often it's preferable to let the layer manger be a docked window (a part of the "linked" windows instead of a "free" window within (on top of) the map). Simply dragging the window to one of the edges and releasing docks the window. Then it will automatically convert into a bar. To change it back into a free window, right-click on the Layer Manager and uncheck "docked" from the pop-up menu.



Screenshot showing the docked layer window to the right.

2.11.1 Create new layers and basis management

In this window you can create a new object layer by clicking on the small icon at the bottom of the page next to the "trash bin" icon (which deletes layers). The checkboxes next to layers show which has their objects visible on map and in object list. The blue background (Layer "Michellanous") indicates the current active layer. Any new objects created will be assigned to this layer until you click another layer and make this active. The result layers are created from calculations (auto created when this option is checked), but can also be created by right click in the layer area.



The right click menu in result layer area to the left and in the object layer area to the right. From these menus the available features are shown. Some will be explained more detailed.

2.11.2 Result layers

Result layers are typically established from a calculation.

Parameter	Hub height	WTG	Use lines	Edit line setup	Use raster	Edit raster setup	Show in result layer
Specific energy (kWh/m)			<input type="checkbox"/>	Edit	<input type="checkbox"/>	Edit	<input checked="" type="checkbox"/>

An example from wind resource map calculation. Check the "Show in result layer" and the layer will be created when the calculation ends.

2.11.2.1 Load or import into result layers

The difference in "load" and "import", the two possibilities for creating result layers from external files, is:

Load can add wind resource files (.rsf or .wrg files) while these has a special status with a known structure that has more different types of data that can be presented.

```

All importers (*.CFDRES,*.asc,*.hgt,*.grd,*.wpo,*.map,*.xyz,*.wpo,*.map)
CFD result\terrainheight.grd (*.CFDRES)
ASC ArcGIS rectangular grid with 5-6 header lines (*.asc)
HGT file format (*.hgt)
Surfer GRD file format (*.grd)
WindPRO line object file (*.wpo)
WASP MAP file (*.map)
xyz with irregular grid and/or data reduction (for very large files) (*.xyz)
WindPRO line object file - as points (faster than using TIN) (*.wpo)
Map file - as points (faster than using TIN) (*.map)
    
```

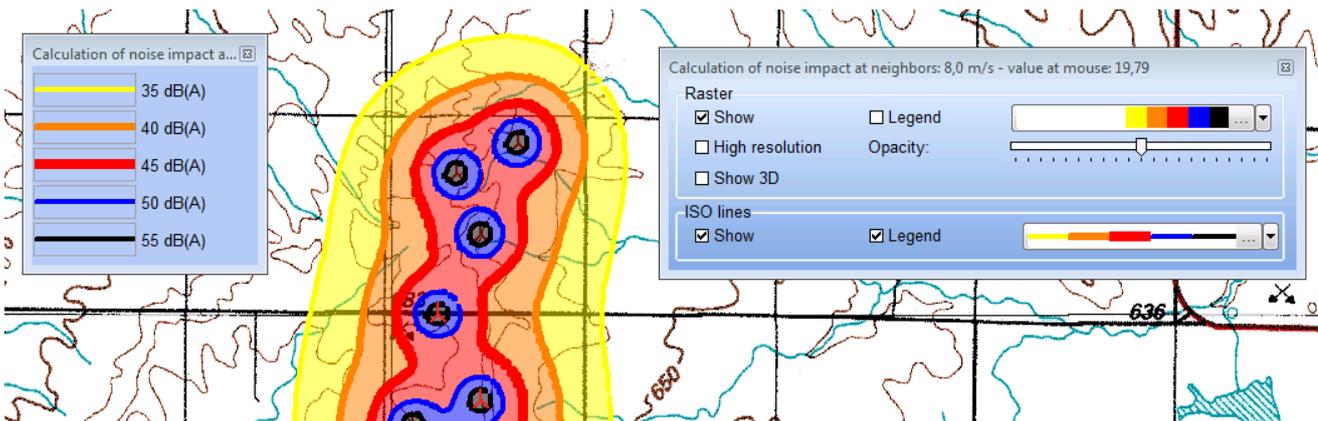
Import handles different file types, see list above, which for sure will be expanded with time.

Note: If elevation data, as can be viewed in result layers, shall be used for calculation purposes, these shall be loaded in the elevation grid object, not as result layers.

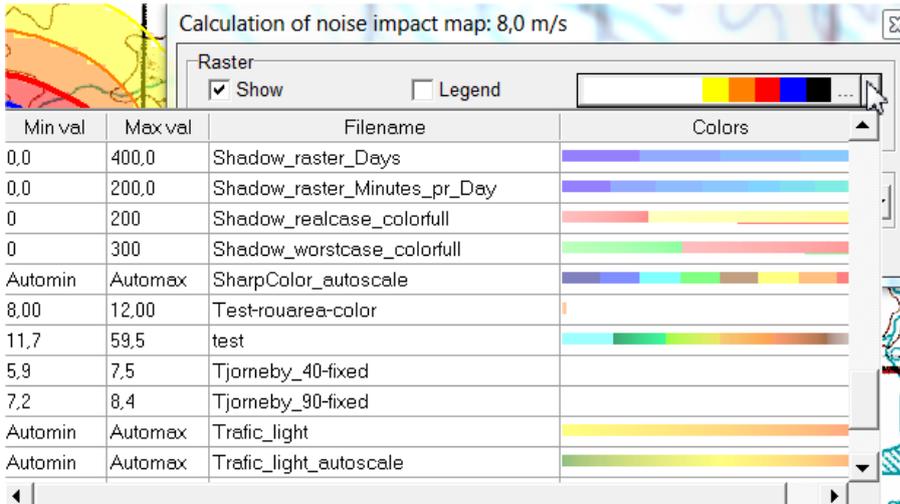
2.11.2.2 Result layers presentation setup

A very important feature for the result layers is the presentation setup.

Double click on the icon at the result layer, and the controller appear.



The controller gives access to control as well line as raster presentations. It's easy to choose another color scale by the little drop down arrow, or fully define a color setup by clicking next to this. A legend is appearing by a checkbox. Note also the opacity adjuster, making it possible to set the transparency. It is possible to show the result layer on a 3D map by selecting Show 3D (see 2.17). Finally it when pointing with the mouse on the map, the value at cursor position is shown in top bar of the controller. All in all a comprehensive controller, that should work intuitively.

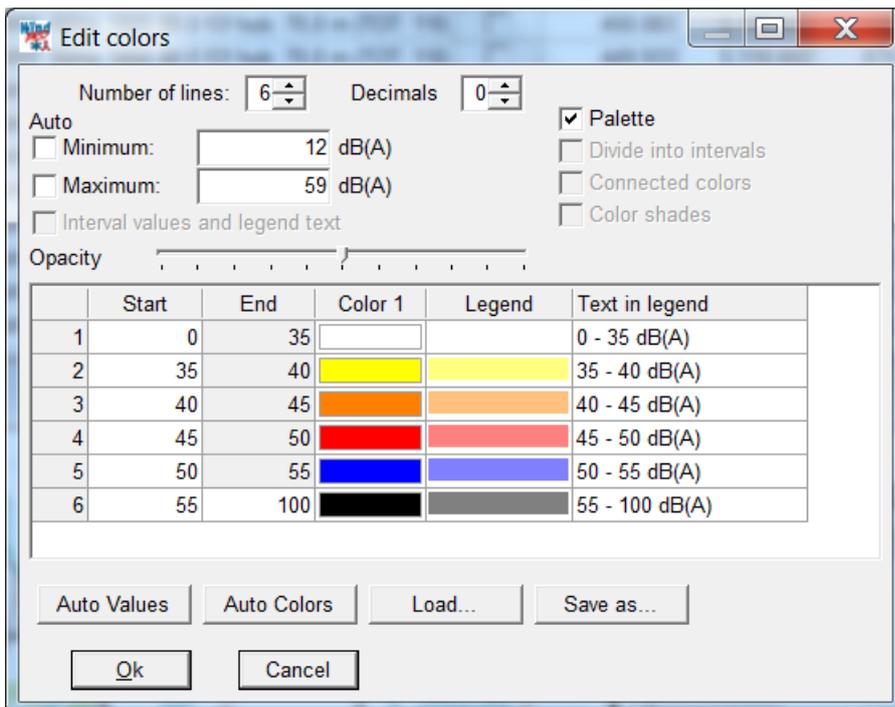


When clicking at the small arrow by the color scale a drop down box show the defined color scales, as well the ones included in WindPRO as the user defined. The color scales are shown with the present data loaded. Therefore only the ones with auto min/max will be shown with a full color scale while other based on fixed values might not be within the relevant range and therefor just shown as white. But these can still be chosen and the values can be edited. The edit mode is entered pressing the “...” button. See 2.11.2.3 Color scheme editor for editing the color schemes.

2.11.2.3 Color scheme editor

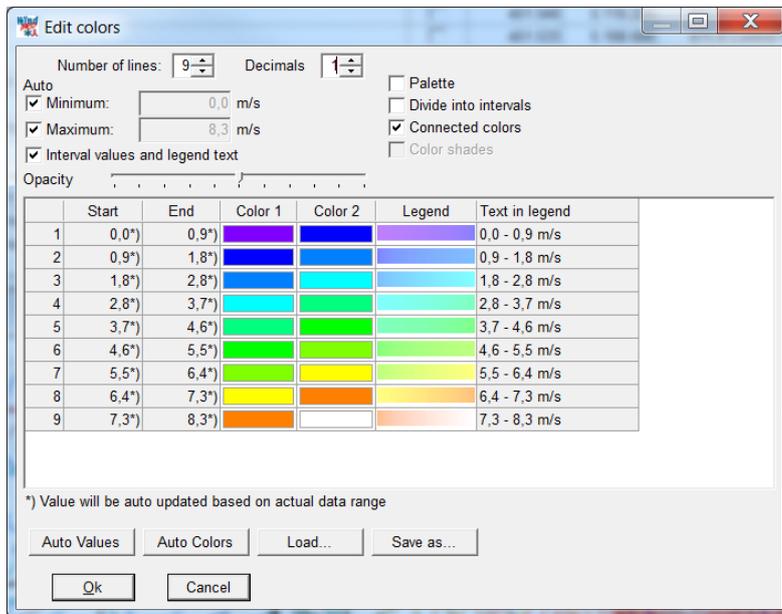
There will be a set of color scales for as well raster as lines. The files with definitions are by default located in WindPRO Data\Standards\, with extensions:

- *.linecolorsetup
- *.rastercolorsetup



The color scheme editor. When auto min, max and interval is checked, a general purpose color setup is created, where min and max is auto adjusted to the content in the loaded data. With save as this can be saved and will appear for later use. Whatever color settings is made can be used in current view without saving.

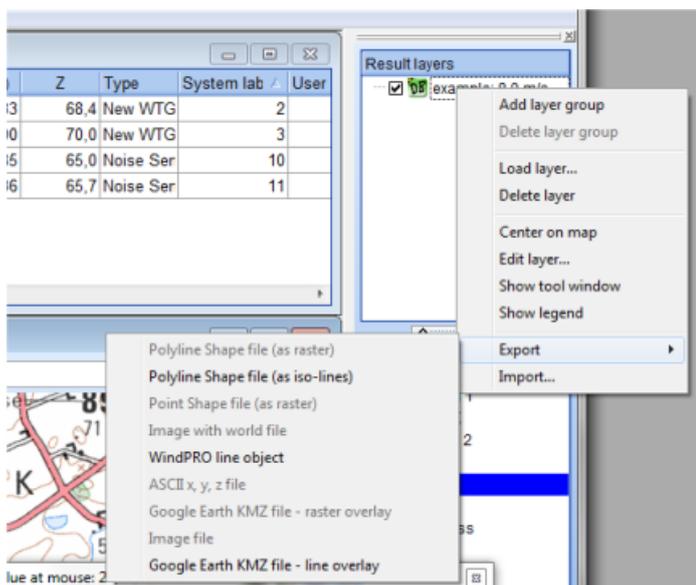
When auto is unchecked, figures can be written in the min/max fields, and click on “Auto values” will create the intervals based on “Number of lines”. Auto color generates a color scheme, by clicking in the color fields these can be edited manually.



The group “Palette” etc. gives several options for designing color schemes. Above is shown an example where the colors gradually changes from the one value to the next.

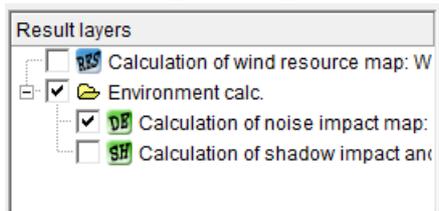
2.11.2.4 Export of result layers

The result layers can be exported to numerous formats. Right click on the result layer and select export.



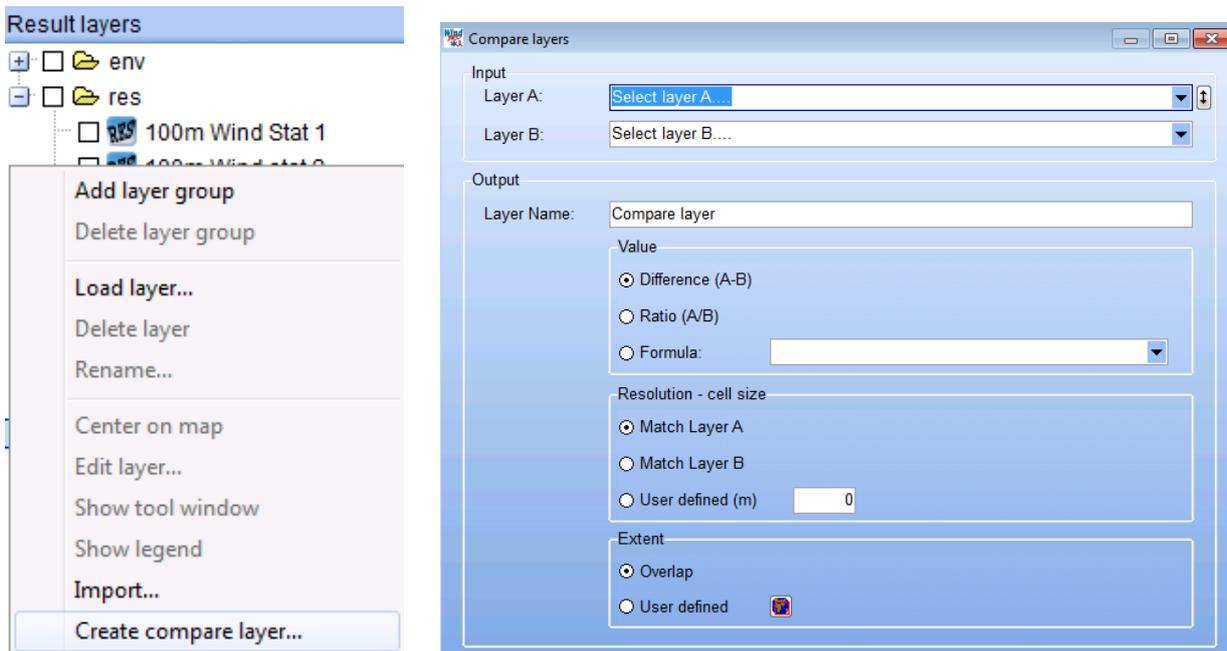
Depending if it is line or raster data (or both) shown, different types of exports are available.

2.11.2.5 Organizing result layers in folders



By right click and “Add layer group”, a folder symbol appears, and result layers can be organized by drag and drop. The structure are similar to Windows explorer, so no further explanation should be needed.

2.11.2.6 Comparing result layers



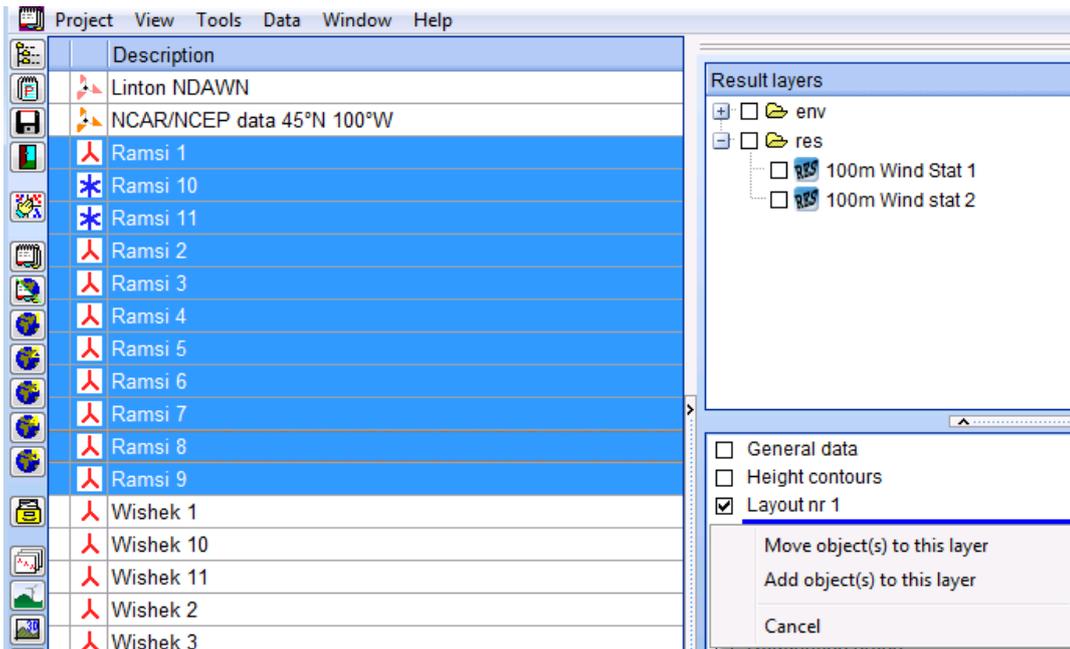
By a right click in the Result layers window, it is possible to “Create compare layer”. The difference, the ratio or a formula can be applied between two result layers. An example of formula is $IF(A>B;0;1,0)$ which means that the compare layer returns 0 if A is greater than B and 1 on the contrary. For each grid cell the calculation is made and returned in a new layer. The resolution of this compare layer can either Match the resolution of A or B or be user defined. The size of the area to compare is by default set to the overlap area between the two result layers but can also be user defined.

2.11.3 Objects layers

2.11.3.1 Objects layers - move or add objects

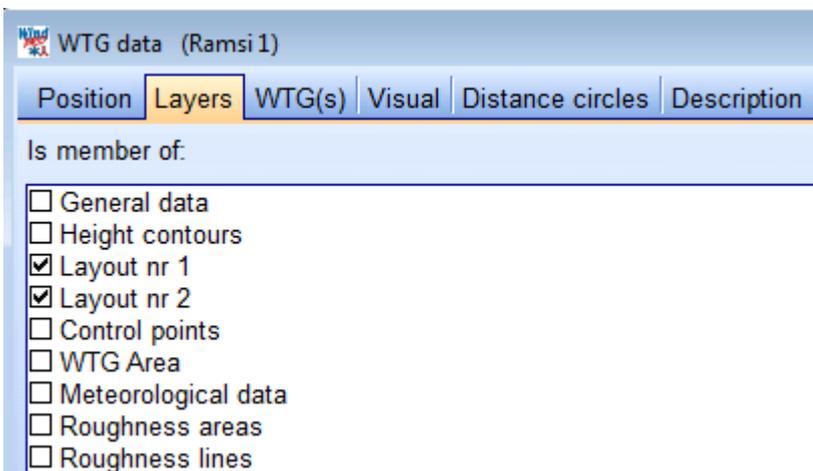
This can be done in three different ways:

- 1) Drag the selected objects (click on selected objects in object list) you want to move or copy from the Object List to a layer in the Layer Manager. WindPRO will then ask whether you want to move or add them to the layer. Please note that when adding objects to a layer, a duplicate set of objects are not created on the second layer. The objects are merely assigned to both layers. If you want to duplicate objects, use the clone or copy function.



In the above figure, WTGs are selected (click on the first one with the left mouse button, hold down the <Shift> key and click on the last one). Hold down the left mouse button and drag the selected objects to the wanted Layer. The program will ask whether you want to “move” or “add” them to the layer. If added, they will exist in the original layer as well as in the new one.

2) In the Object Properties, you can assign the object to one or more layers.



3) Use the Matrix (See 2.11.7)

2.11.3.2 Object layers - organize objects

WindPRO supports many ways of organizing objects in the layer structure. Here are a few examples:

a) Several different layout alternatives for one WTG project

Here it would be natural to organize each layout in its own layer. All the basic objects such as Terrain Evaluation, Height Contour, Neighbor, Camera etc. could then be placed in Layer 1. Each layout alternative has its own layer which makes it easy to quickly see and compare the different alternatives for an evaluation. When

adjusting a given layout, only one layer is visible at a time so you don't risk modifying other alternatives when moving the WTGs on the map.

b) Different object types for each layer

It's often difficult to "select" on object e.g. a noise sensitive area beneath a shadow recipient. This can be avoided by organizing all the noise sensitive areas in one layer and the shadow recipients in another. You can now make the final adjustments to the placements with one active layer without interference from the other objects.

c) Photos for visualization with different focal lengths

If, for a visualization, you have photos with different focal lengths, but taken at the same location, the Camera Objects will be placed on top of each other on the map and will be difficult to work with. Assigning each Camera Object to a separate layer is an easy way to work around the problem.

d) Line- and Area Objects disturb the overview

The map overview becomes cluttered if you have digitized many objects such as roughness, contour lines, areas, etc. If the various information is organized in layers, it's faster to activate or deactivate the layer than to find the individual objects in the Object List and then deselect "show lines" etc.

e) Several projects in the same area

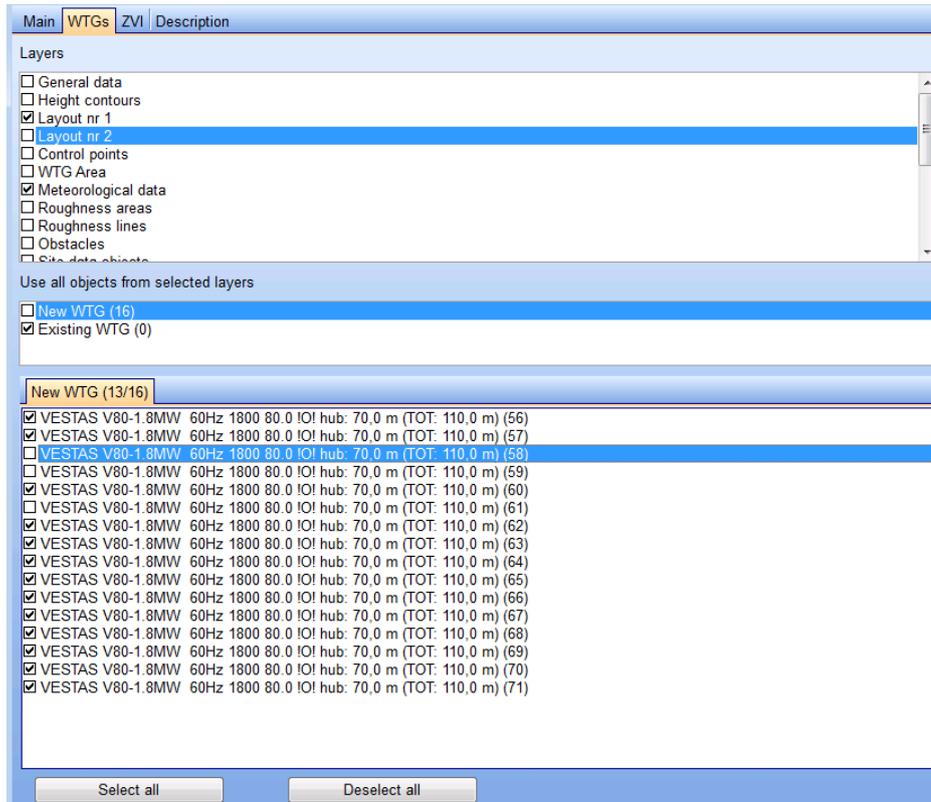
If you work with several projects within a limited geographical area it's possible to reuse much of the data and take advantage of working with many WTG projects in one WindPRO project. Information relating to each project is placed in its own layer, while all joint objects are placed in a "joint-layer", e.g. Layer 1.

f) For planning purposes

When a municipality for instance, is planning its WTG policy, they may want to organize the existing WTGs according to expected dismantle time or prioritized removal, for example. It's also possible to place new WTGs in different layers according to different development alternatives. Subsequently, it's very easy with the layer structure, to combine different dismantling and development alternatives and to perform different environmental calculations such as a ZVI calculation.

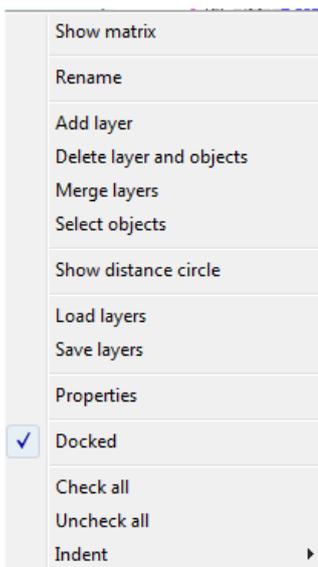
2.11.3.3 Usage of the layer structure in a calculation

When starting a calculation, it's possible to include WTGs from selected layers only for the calculation. You can deactivate single WTGs within each layer. Essentially, it will be much faster and more efficient to work with different alternatives in the same project.



2.11.3.4 Save/load layer structure

Right-click in the layer window and get the menu:



From this menu, a layer structure can be saved or loaded, which means that a good layer structure can be re-used in another project.

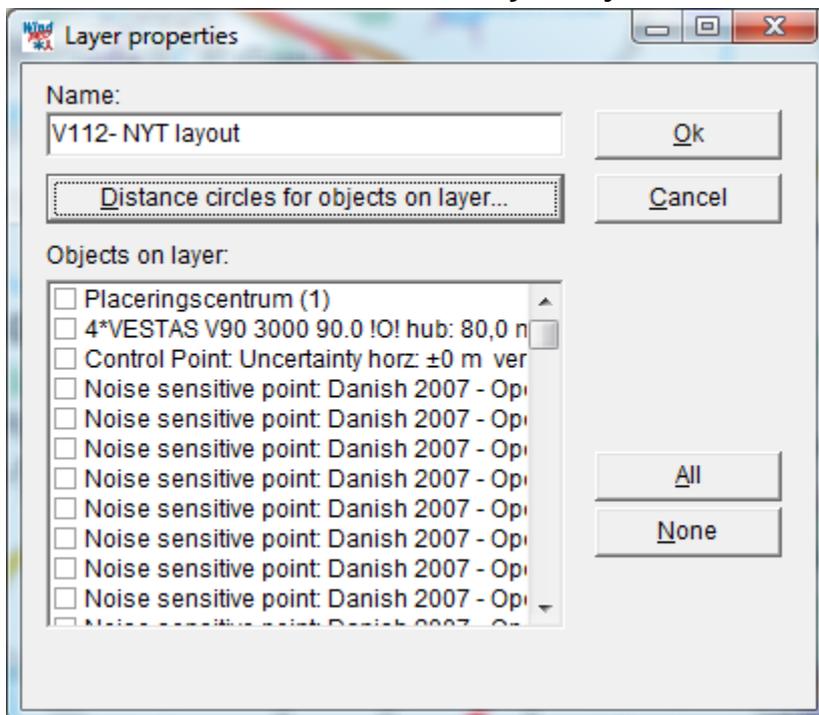
2.11.3.5 Matrix view, magnifier, and move layers

Note the “Show matrix” which allows you to see a complete overview of all layers and objects that are assigned to them (see example below).

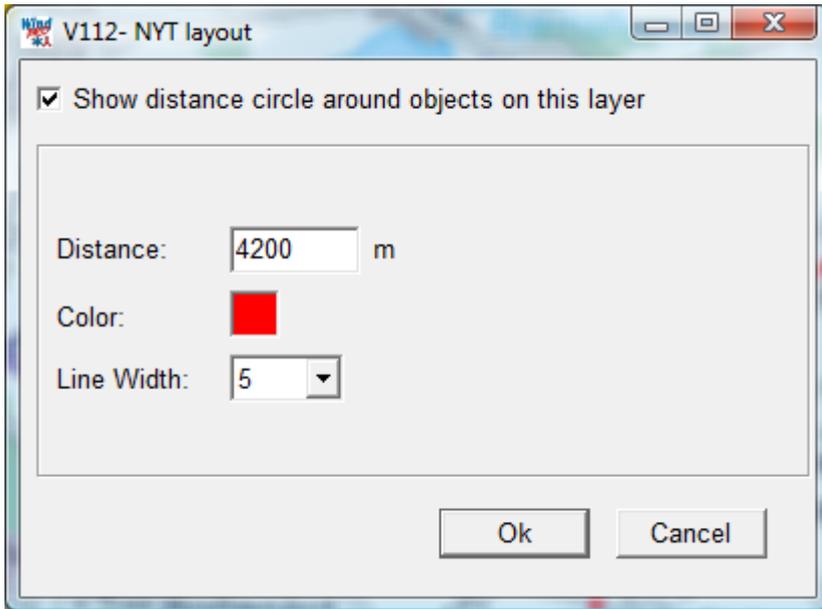
	Height contour	Steepness	Conflict data	calculation area	Conflict restrictions	Wind resources
	<input checked="" type="checkbox"/>					
Site Center	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Area object (0): STEEP_REGION	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Area object (ZVI): WPLAN_REC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shape: Rectangle, 6.819m x 7.5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Area object (0): WPLAN_REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Area object (0): WRES_REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
First plan-600kW	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
WindPLAN V	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Area object (0): WRES_REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Area object (0): WRES_REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.937 m; 177,3 °	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1000AC: 1.000 kW BONUS - BF	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2300XF: 2.300 kW BONUS - Sa	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

When the magnifying glass is activated (toggle by clicking on it), only the objects in the layer that you hold the cursor on will be shown in Object List. This can help you get a quick overview on which objects belong to which layers. Lastly, you now can move layers simply by dragging them with the left mouse button down.

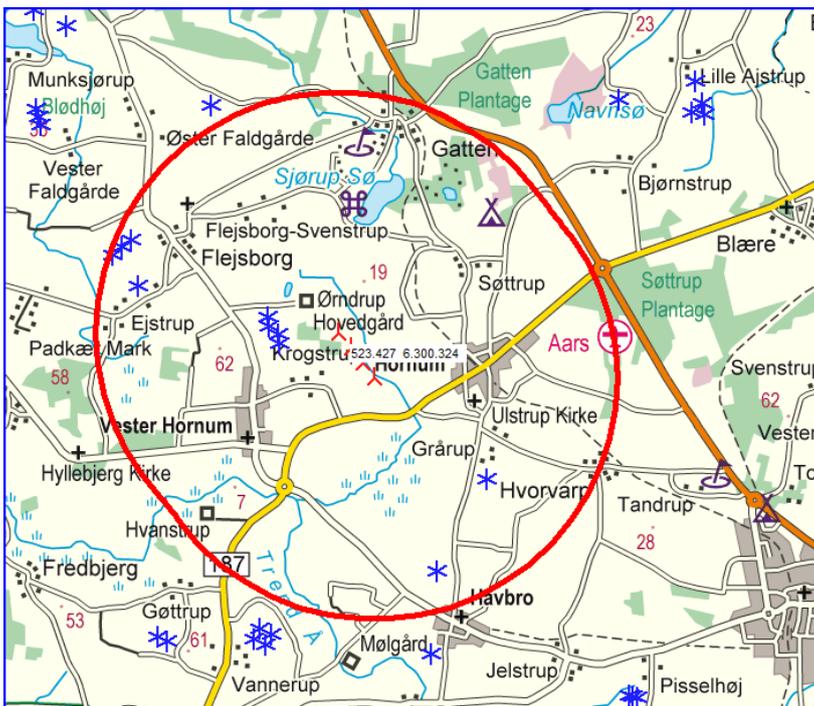
2.11.3.6 Distance circle around layer objects



The button “Distance circles for objects on layer” gives access to following:



Here the distance, color and line width be set. In Denmark e.g. there must be a special investigation if wind farms are established closer than 28 Rotor diameters to existing turbines. With this feature it is fast investigated if this is required:



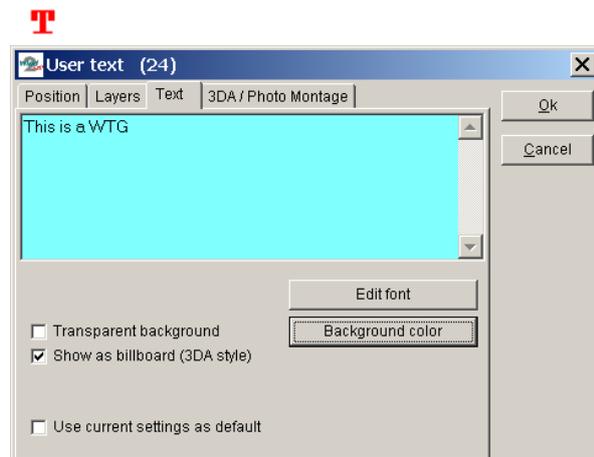
28 x rotor diameter around the new proposed project show which existing turbines that are closer.

2.12 BASIS – Text, ruler and Shape Object (profiles)

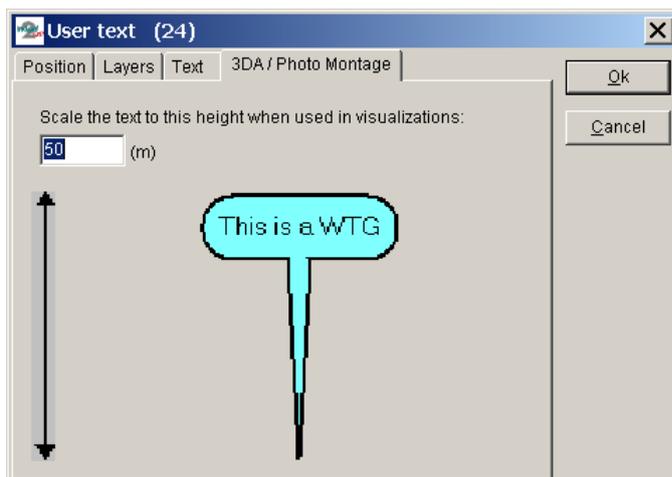
2.12.0 Auxiliary objects

WindPRO also has a group of objects that are not directly involved in calculations, but are very helpful for designing, measuring and presentation.

2.12.1 BASIS - Text Object



With the Text Object, you can attach text to the project map and later include it on the map printed in one of the calculation reports. You simply select the Object from the Object Bar and place it on the map and then enter the text. You can move or edit the position of the text exactly the same way as with all other objects.

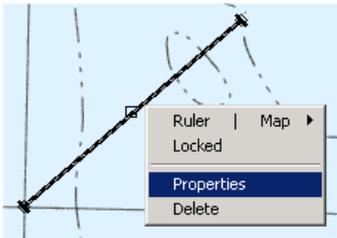


A unique feature in WindPRO is the ability to use the Text Object for showing “balloon text” on maps, as well as in Photomontages and 3D Animations, so that a specific location can be identified on map, on photo, or in the terrain model.

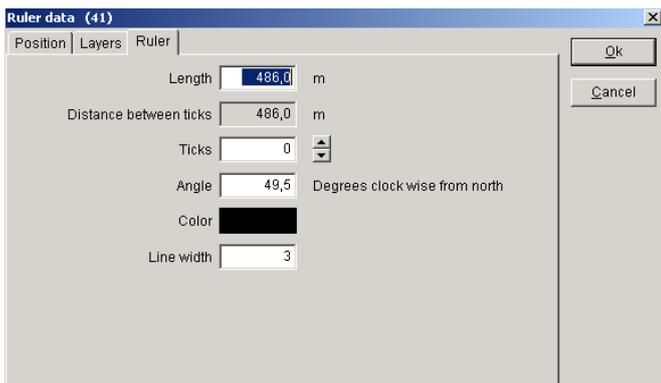
2.12.2 BASIS - Ruler Object



With the Ruler Object you can measure distances on the map. You select the button shown above from the Object Bar and place it on the map at the location where you want to start the measurement. Then you click on the location where you want to end measurement. Hovering with the cross hair over the measurement will cause the distance and the compass angle to be displayed in the status bar at the bottom of the screen. It's also possible to change the properties of the ruler. To do this, left-click on the line in order to activate it, then right-click and select "Properties" in the pop-up menu as shown below.



The following dialog box will now appear.



Here a fixed length or angle can be specified. The number of tick marks can be specified (e.g. to mark every 100 m distance) and the color and line width can be changed.

You can also move or edit the ruler line. Left-click on the line in order to activate it. Place the cross hair inside the center mark, then left-click and drag to move the ruler parallel to its original position. Place the cross hair inside an outer mark to rotate the row around the opposite outer mark. Hold down the <shift> key while dragging an outer mark to change the ruler length.

Lastly, you can measure a distance without creating a new Ruler Object. Simply create the ruler with left mouse button, but instead of finishing with a second left-click, use a right-click and the ruler will not be created.

2.12.2.1 Quick profile, based on object "ruler"



This button (at the bottom of the left-hand toolbar on "Maps and Objects" window) activates the profile after inserting a ruler;  found in the right-hand toolbar.

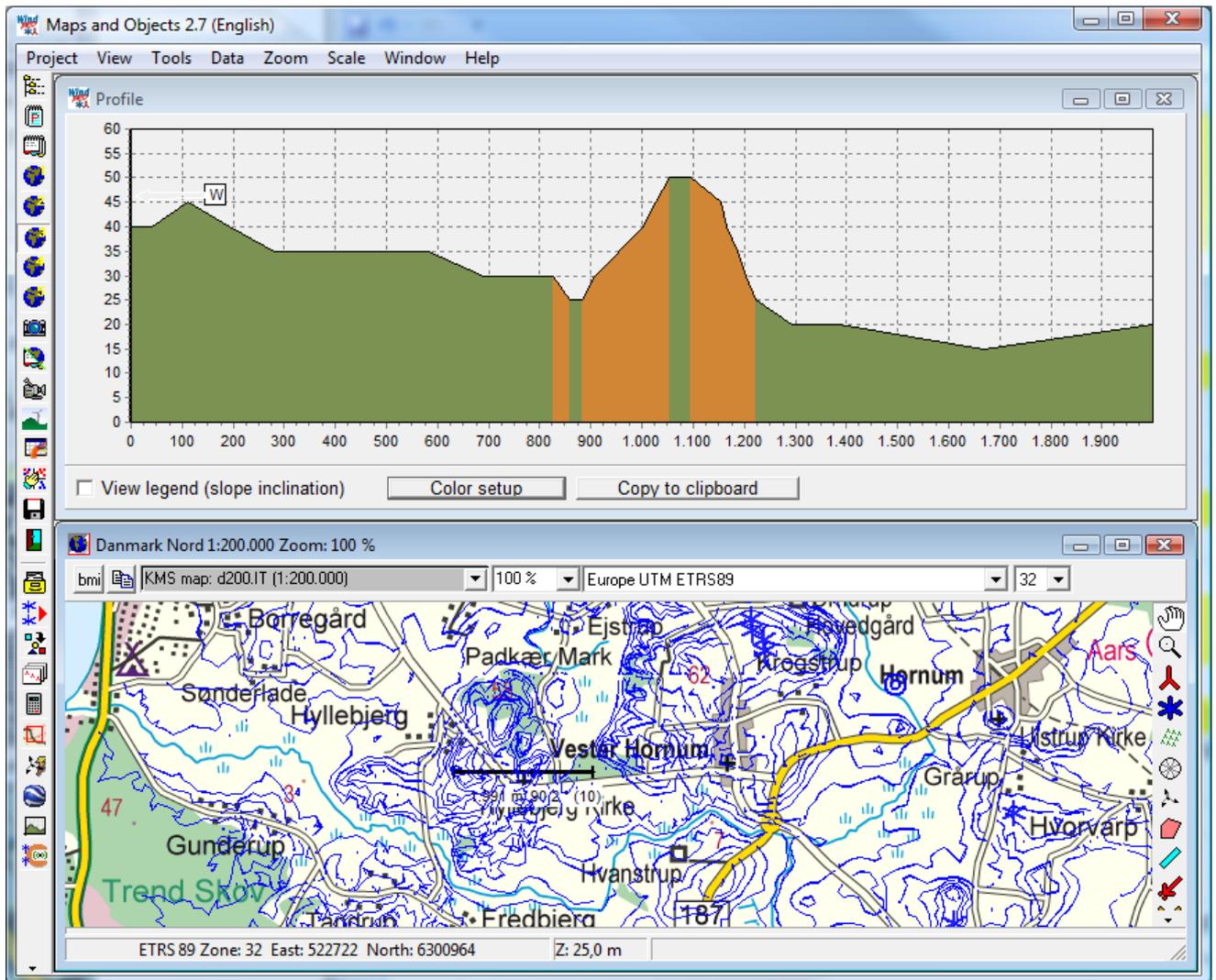


Figure 9 Create a ruler at map and right click, choose "Show Quick Profile" and a cross-sectional view is shown along the ruler line. Note: this tool uses the actual contour lines, the alternative "rendered" terrain profile based on the shape object, using the TIN.

The colors shown are pre-defined:

Green < 8°

Orange 8° - 17° (installing or transporting turbines may not be possible)

Brown > 17° (flow separation or WAsP model problems will start)

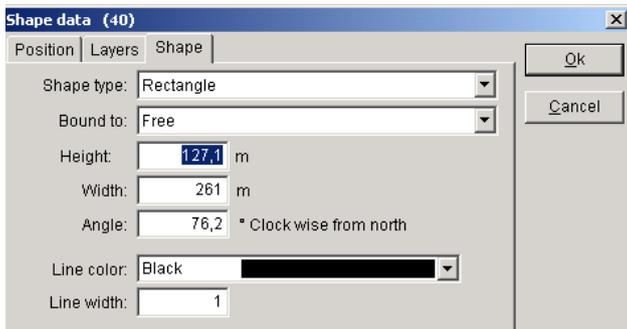
With the "color setup" button the colors and values can be user defined.

2.12.3 BASIS - Shape Object (also Grid lines)



With the Shape Object, rectangles, squares, circles, or a grid can be placed on the map as a helpful tool for measuring. Select the button shown above from the Object Bar and place it on the map where you want one of the corners of the rectangle or square to be located. Then mark the location of the opposite corner. For a circle, the two corners define the square of the inscribed circle. When the Shape Object is used as a grid, the object can be placed anywhere. Note that it is also possible to create a grid from the top bar of the map window, see 2.4.3.8.

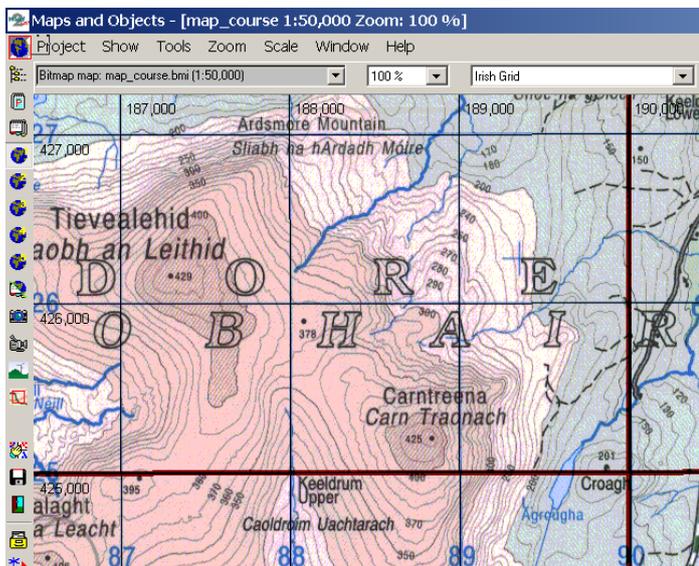
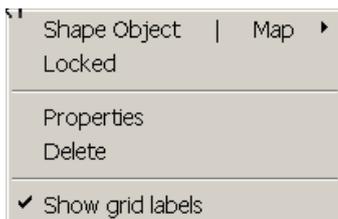
The shape object as rectangle is basis for terrain profile rendering, see 2.12.3.1



After selecting the second corner, the dialog box shown above appears. Here the shape type, size, angle, color, and line width are defined.

The size, angle, and location of the shape can also be edited on-screen. Left-click on the Shape Object in order to activate it.

When used as a grid, right-click on the map to access the option “Show grid labels”.



Shown above is an example of establishing two grid objects, one with thin black lines for every 1 km, and one with thick red lines for every 5 km. Notice the grid labels on the top and left edges of the map window. The labels will scroll in order to remain on the edges as the map is dragged.

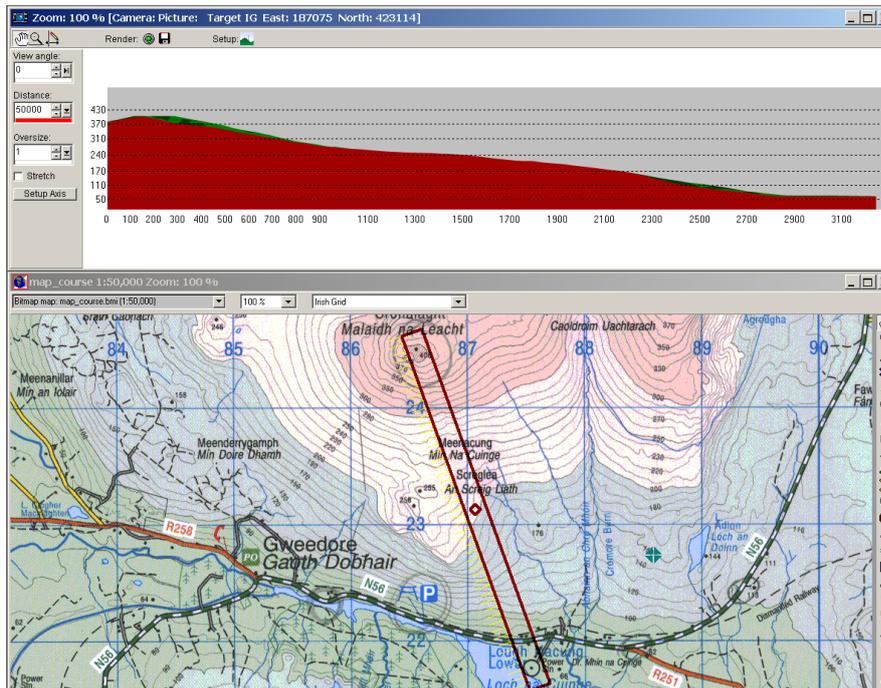
2.12.3.1 Terrain Profile - based on shape object



Using the Shape Object (right Object Bar) you first create a rectangle to define the profile cut for which you want to view the terrain profile.



The Terrain Profile tool is activated with the Terrain Profile icon (left tool bar). Note that there must be a TIN calculation based on a Line Object with height contour lines in order to use the Terrain Profile tool.

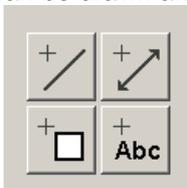


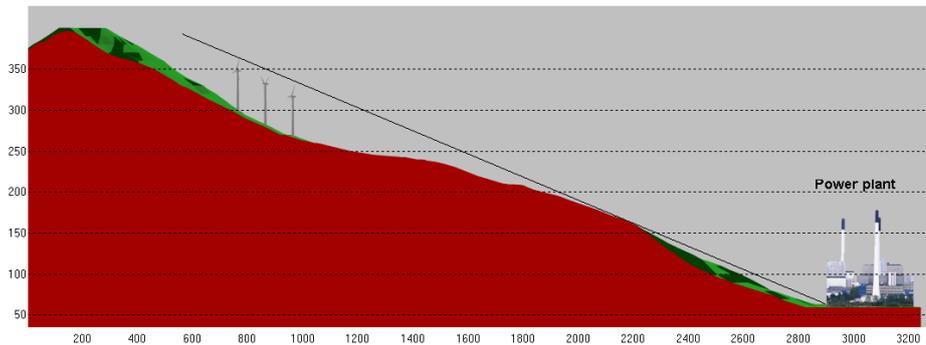
When you click on the Terrain Profile icon, a terrain profile for the selected profile-cut rectangle is rendered. The yellow arrows indicate the viewing direction for which the profile is being shown. The profile is always seen from the longer side of the rectangle. In order to view the terrain profile from the opposite side, the rectangle object must be rotated 180 degrees by dragging the corners.

The terrain profile can be over-sized and stretched, or just over-sized. The difference between stretching and over-sizing will be in the way that objects such as WTGs are shown on the terrain profile. If stretched, all objects shown will be stretched in the over-sizing operation. If “stretch” is not chosen, the objects, such as WTGs, will simply be over-sized both horizontally and vertically. This makes it easier to see the WTGs in the terrain profile, but it will also oversize them in the horizontal direction.



With the Draw Tool shown above, which is found in the tool menu at the top of the Terrain Profile window, lines can be drawn and text can be added to the profile view. Additional tools are available as described below.





The graphic above illustrates how a bitmap (the power plant) is inserted as a 3D Object and 3 WTGs are inserted on the hill. The profile and the objects are all oversized by a factor of 3. The line from the power plant over the edge of the hill illustrates that from the left base of the power plant the WTGs will not be visible.

The part of the hill shown in red is that which would be seen on the near side of the profile-cut rectangle. The part of the hill shown in green is that which would be seen from the far side of the profile-cut rectangle. The part of the hill shown in green can also be seen from the viewpoint.

The terrain profile is ideal for analyzing local conditions and can be used for many purposes. It is especially useful for illustrating proportions between the landscape, WTGs, and other elements.

Setup: 

Colors can be changed with the setup button.

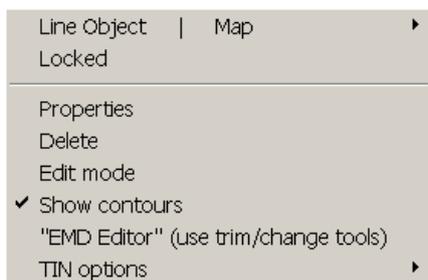
Render: 

After any settings are changed, or any new objects are added within the terrain profile rectangle on map, the “Render” button must be clicked to update the image to include the new elements. Clicking on the floppy disc icon will save the terrain profile image as a bitmap. There is no specific report that can be generated using the terrain profile. The bitmap image is the only possible result output.

2.13 BASIS – EMD Editor (Line, Area and grid Objects)

2.13.1 EMD Editor for lines and polygons- trim and change data

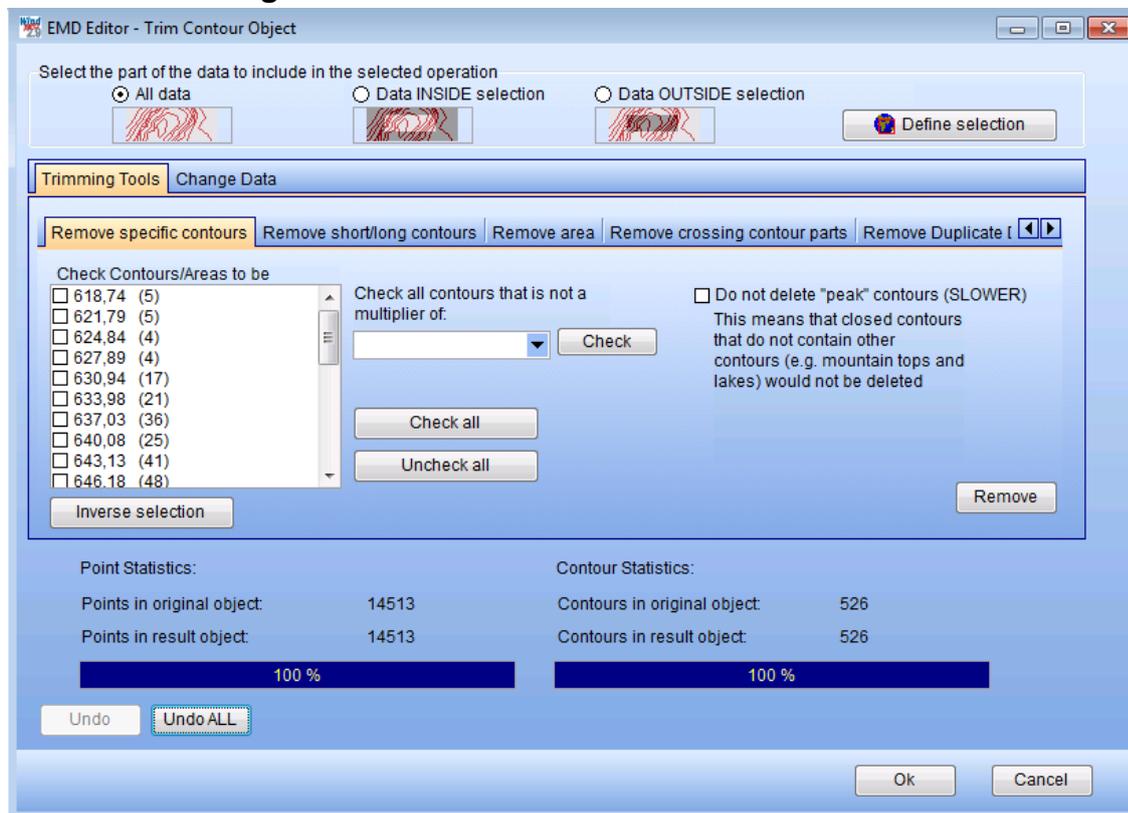
The EMD Editor works with data files associated with both Line Objects and Area Objects. A so far quite simple version is available from the elevation grid object. This is separate described at the end of this section. Often the data files hold far more points than needed, or they may be misplaced on the map due to digitizing in the wrong coordinate system, or they may simply contain errors, possibly from converting from one file format to another.



The EMD Editor is started from the pop-up menu that appears when you right-click on the Line, Area, or WTG Area Object. If the object is in Edit mode, the Trim menu cannot be selected. The editor can also be started from the Line or Area Object form.

There are two main groups of tools: Trimming and changing data.

2.13.1.1 Trimming tools

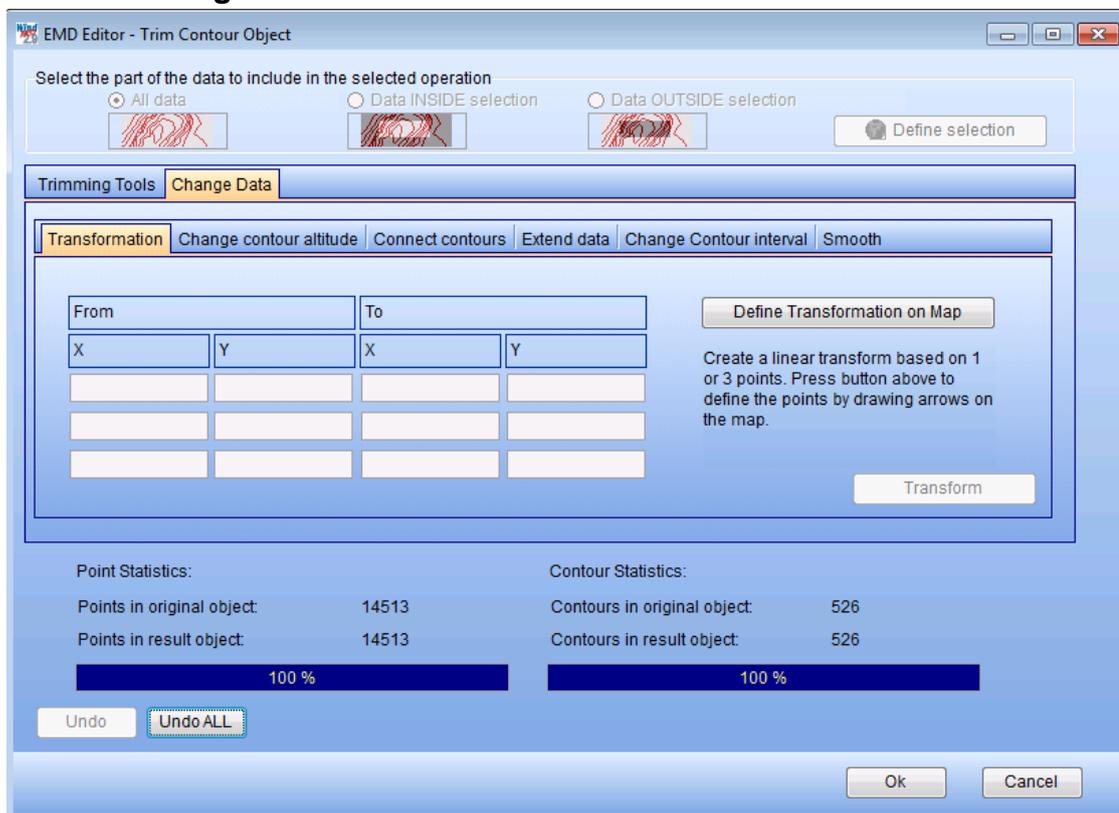


Trimming tools are typically used for removing points or lines or parts of a region to reduce the amount of data.

There are eight main Trimming Tools and each is explained in detail on the respective tab sheet:

- Remove points
- Remove specific contours
- Remove short contours
- Remove area
- Remove crossing contour parts
- Remove duplicated data
- Remove “No TIN” data
- Remove Orphan data

2.13.1.2 Change data



Change data tools are used for moving, scaling, adding or converting data, or simply manually changing of a group of data.

There are six main Change Data tools and each is explained in detail on the respective tab sheet:

Transformation (move, rotate, or twist data to correct for digitization errors, e.g. digitizing based on local or wrong coordinate system or datum). The transformation can be made graphically, where either 1 or 3 arrows on the map are dragged so the “from” and “to” points are shown, indicating the coordinates for the transformation.

Change contour altitude (user-specified conversion formula to change from e.g. feet to meters).

Connect contours (spline).

Extend data

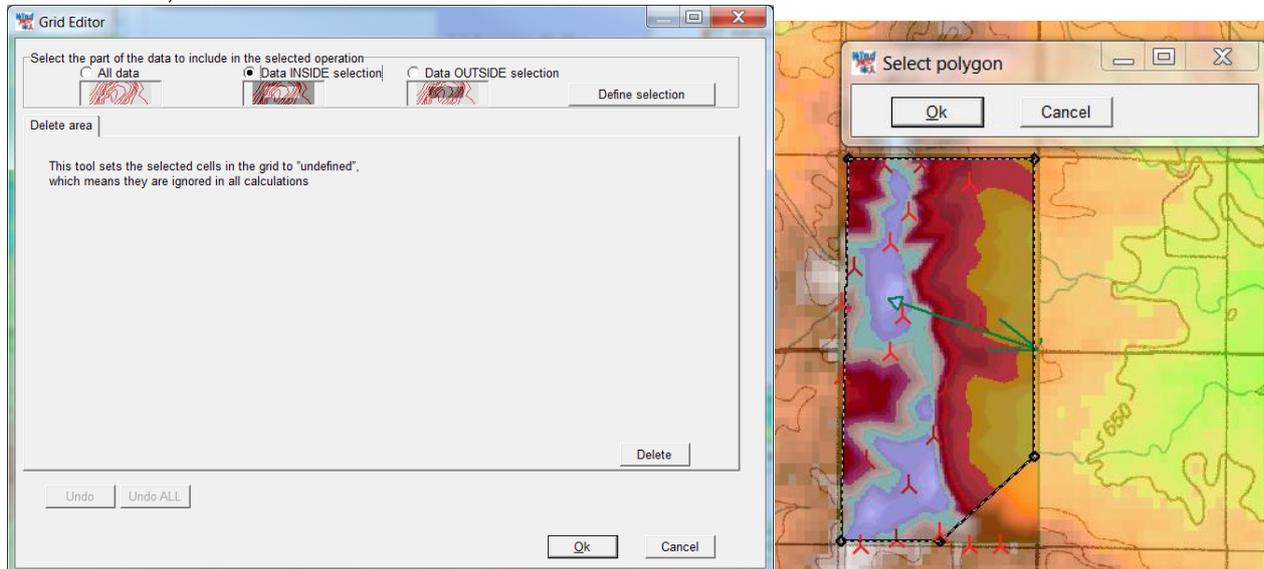
Change Contour interval

Smooth.

2.13.2 EMD Editor for grid data - remove data

So far for use from elevation grid object, first part of an editor for gridded data is available. It is loaded from the objects “data” tab, with the button “Edit layer”.

When started, one feature “Delete data” is found.



First decide if it shall be the data inside or outside later selected area.

Then select area. Note that a free polygon can be defined, starting with 4 corner points. These can be dragged, and right clicking on the lines between the points allows to “insert points”.

The delete data is typically used if reading high detailed information for e.g. a banana shape non purposed fill the inner round part of the curve with data filling that might be convenient to use in other parts of the data area. Then it is deleted afterwards to take data in this part from a less detailed source, but with real, not auto filled data.

2.14 BASIS - Map Composer

2.14.1 Start the Map Composer



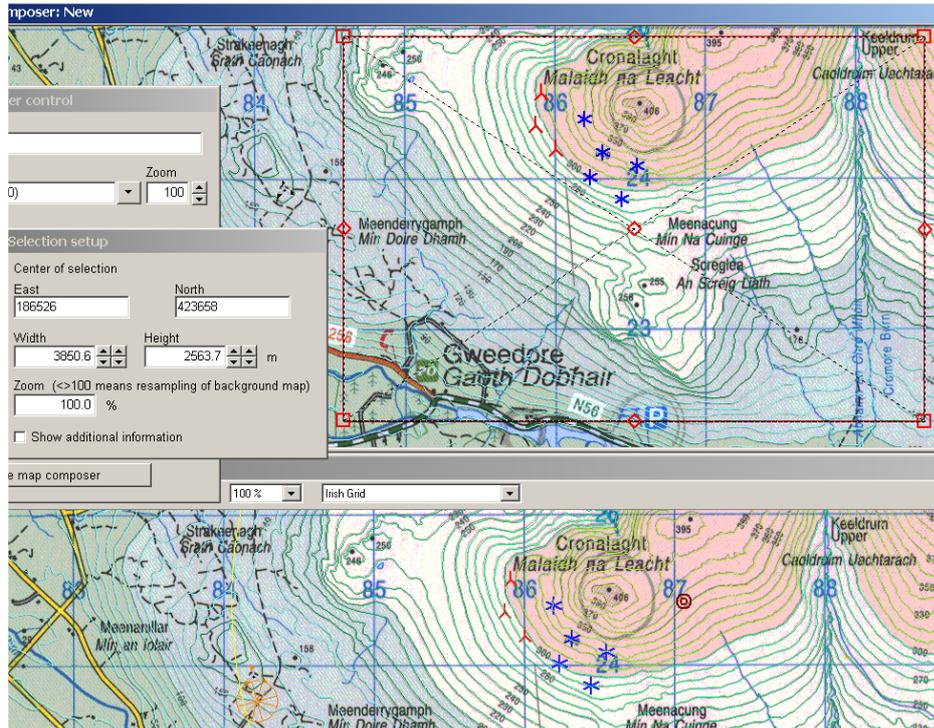
The Map Composer is used to prepare maps for use in reports. The Map Composer is started from the left tool bar by clicking on the button shown above.



Starting the Map Composer opens a split window containing the map (where the design of the composed map can be viewed), and the Map Composer Control window.

The Map Composer Control window has following options:

A name can be entered in order to find the map setup later. Different maps with different elements, scales, or symbol configurations can each be stored with a different name.

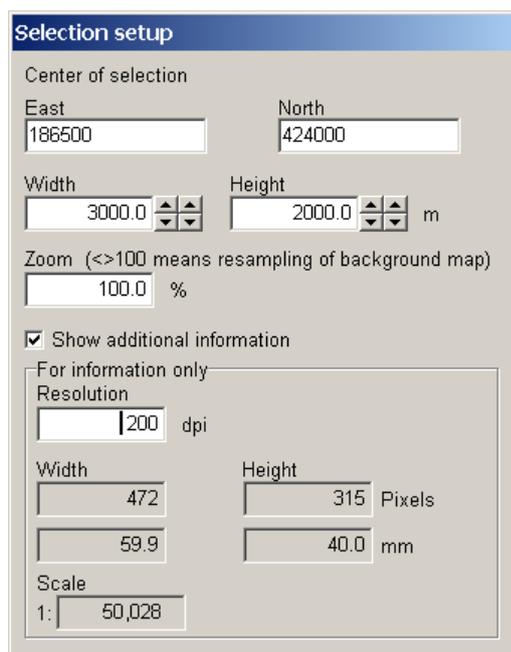


When the Map Composer option “Show selection tool” is checked, you can drag the square defining the part of the map that is to be copied to a report. This can also be specified exactly by specifying the coordinates, size, and zoom level.

With the option “Show additional information” you can specify a graphic resolution in dots per inch (dpi), which is important for reports that must be printed with high graphic quality.

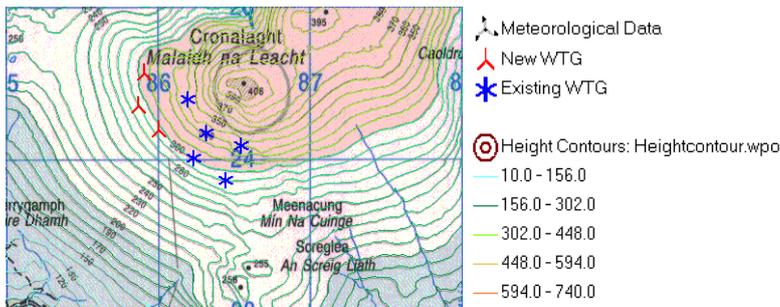
2.14.2 Select map portion and resolution with the Map Composer

Changing the resolution will change the size of the graphic in millimeters. If you specify a resolution (dpi value), the resulting width and height of the image as it will appear in the report are displayed.



If you want to show a larger map area while maintaining the size and resolution (dpi value), the zoom must be adjusted. The map will be resampled in order to fulfil your requirements.

In the example above, a 3 km x 2 km portion of the map is selected. For a 200 dpi map, an area that is 59.9 mm x 40 mm will be required on the report page. The scale will then be 1: 50.028 (it should actually be 1:50.000, but a slightly inaccurate coordinate setting makes the difference).

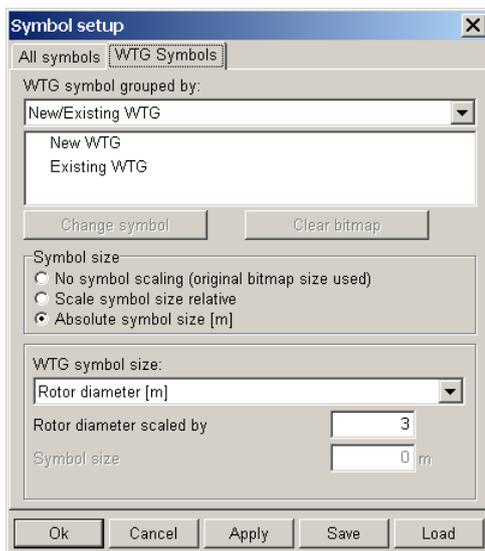


Above, the map is copied to the clipboard, and then in Word, the height is set exactly to 40 mm so that the map will print at a resolution of 200 dpi and a scale of 1:50000.

Shown above is an example of an ordinary screen dump (print screen), without the Legend, which can be added by clicking “Copy legend” in the Map Composer Control, and then pasting it into the Word document.

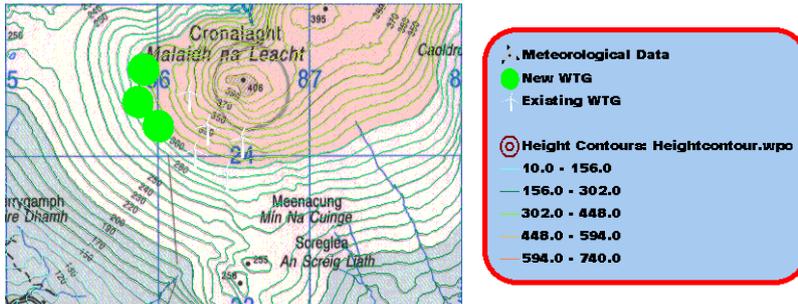
Note how the height contour lines have different colors for different heights (this is configured by a setting in the Line Object).

2.14.3 Symbol setup in Map Composer



One of the more useful features of the Map Composer is the one that allows you define custom symbols (mainly for WTGs), and to scale them according to the size of the WTG.

Any bitmap file can be used as a WTG symbol. Some examples can be found in the folder “WindPRO Data\Standards”, but any bitmap can be used. A map example with different types of symbols for new and existing WTGs is shown below.



If custom symbols are defined, the legend will be updated with the new symbols. In the example shown above, the legend has been modified slightly in order to illustrate the possibilities.

2.14.4 Legends and more options with Map Composer

The legend can be modified by the user in a number of different ways. The various options available can be seen in the Legend setup window shown below.

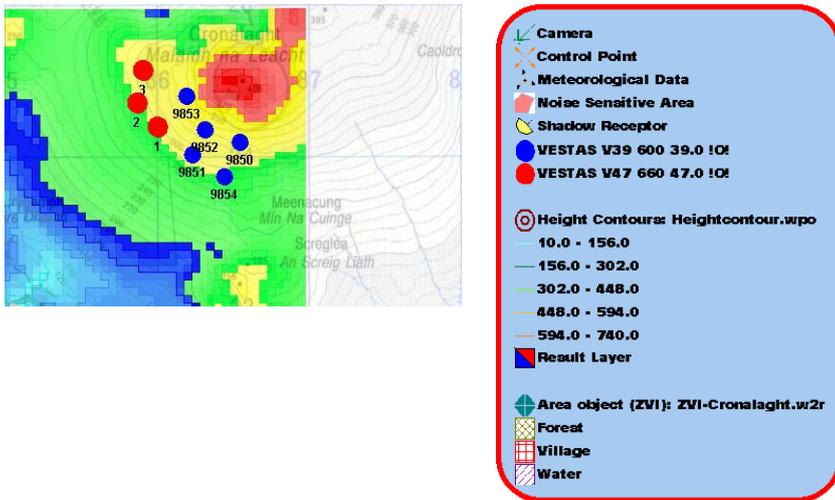


Font, background color, line height (the distance between lines in the legend), show frame, frame width, frame color, as well as rounded corners are the available options.

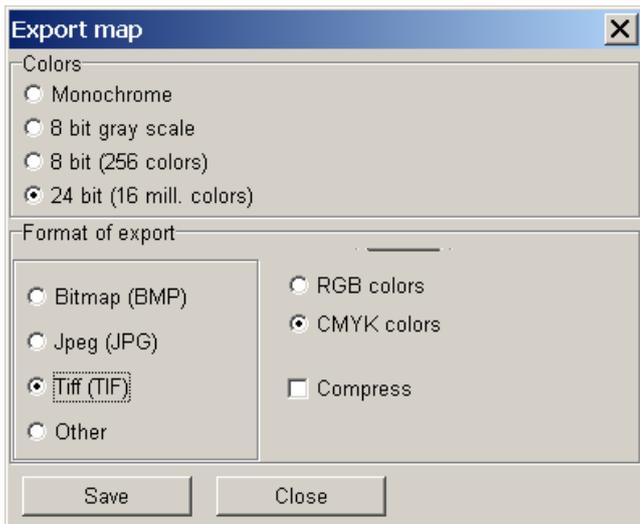
Lastly, shown below is an example which includes reduced background map intensity, symbols scaled by rotor diameter, labels, and the wind resource map from result layer.

The WTG symbols can also be divided by WTG type or manufacturer, which is illustrated by the legend for this example, with two different WTG types.

Note: The type of objects that appear in the visible layers will determine the appearance of the Legend, even though the objects may not be within the selected portion of the map.



After designing your individual map layout, you can copy it and make another map based on the same parameters, while including additional elements, e.g. one map for noise, one map for flicker, etc. This allows you to make a template, no longer limited by the default symbols in WindPRO, and then with the features you require, to copy the relevant elements to a professional report with uniform and high quality map presentations.



One final note on the Map Composer: When saving maps as .tiff files, you also have the option to save the file in the CMYK color format, which is the basic requirement for offset printing equipment.

2.15 BASIS - Google Earth exporter



With a click of this button, visible objects will be exported. You can also export from the Objects List, selecting those objects to export, then right-click and select “Export to Google Earth”.



Figure 10 You need to install Google Earth before using this tool.

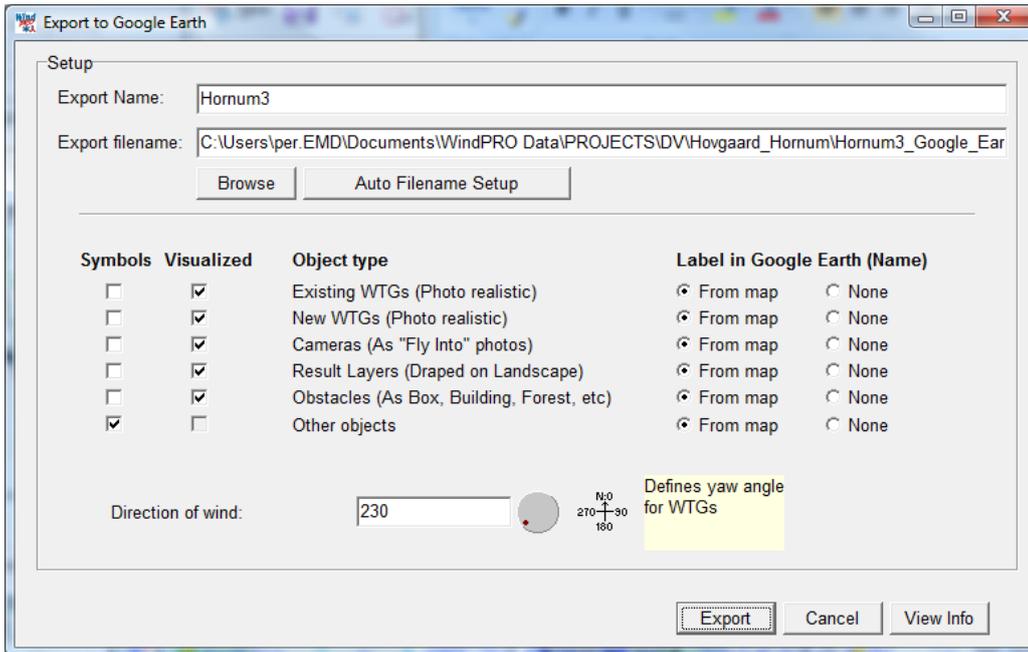


Figure 11 You can chose how some of the object types shall appear in Google Earth, including labels.

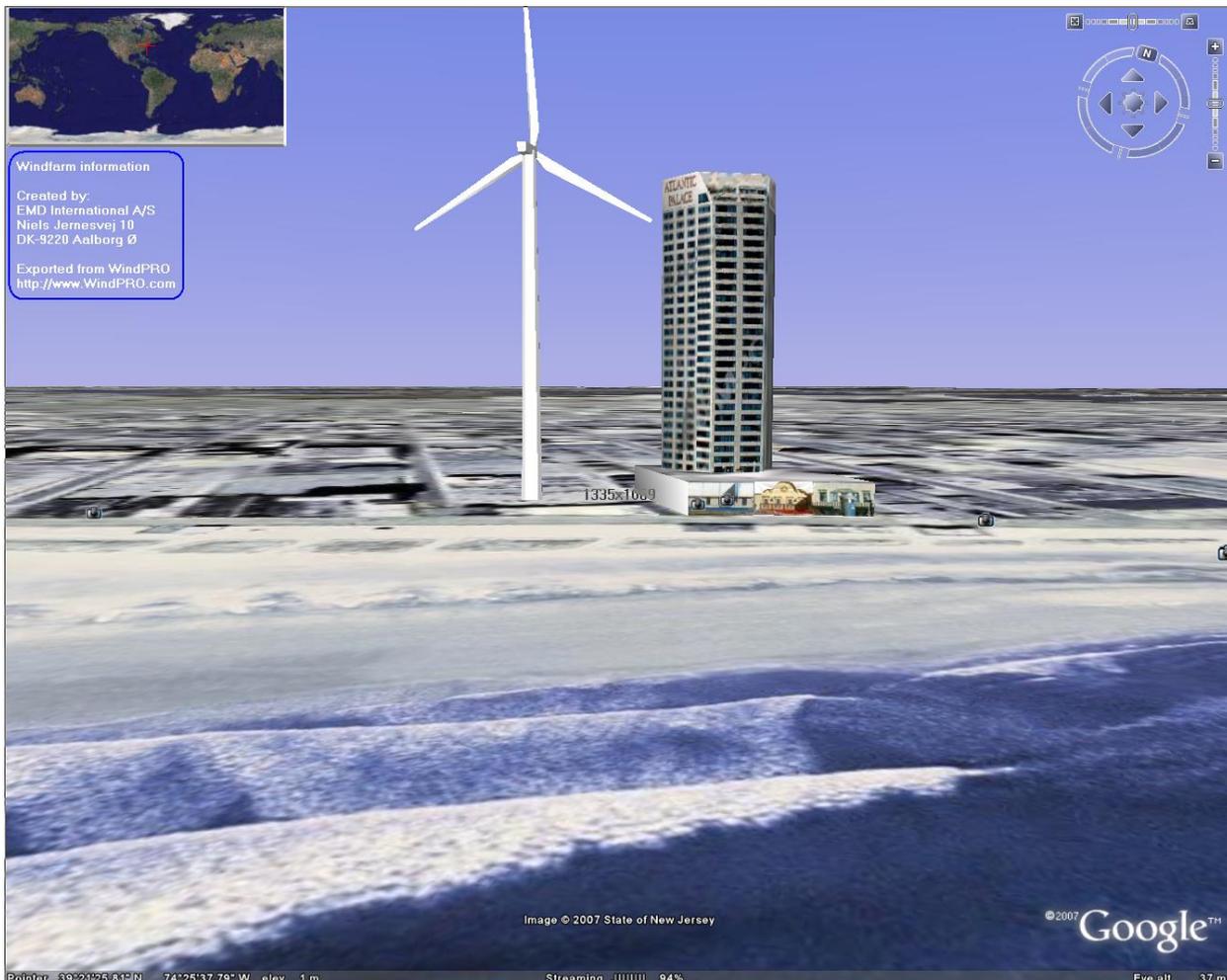


Figure 12 It has never been easier to compare a given turbine size with a known building! Or of course, to simply visualize your project.

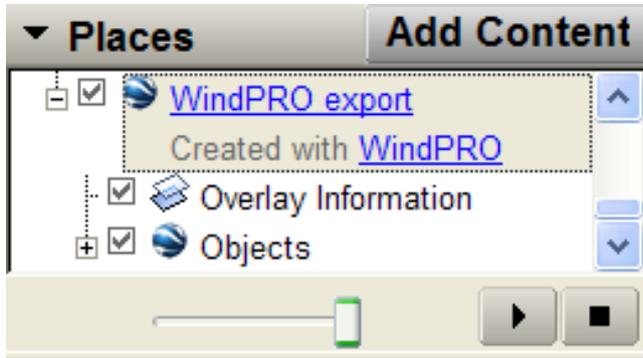


Figure 13 In the Google Earth layer structure, a WindPRO export layer is added with subfolders with object information etc. Right click at the WindPRO export and choose "Email" to send the Google Earth presentation to the chosen recipient's computer. The mail attachment is a .kmz file holding all the necessary information – this file can also be saved in your project folder (right click on the layer and choose "Save As") as part of the project documentation.

When Google Earth is closed, the file will be removed unless you perform a manual "Save As" operation. The idea is that you can "re-export" the project a number of times without getting your own Google Earth filled with several different layouts.

2.15.1 WTGs as photo realistic 3D objects

WTGs can be exported to Google Earth and shown as photo realistic 3D objects, just select the objects to export in object list and right click or click the Google Earth button.



Figure 14 Turbines exported to Google Earth.

2.15.2 Photomontages as "fly in"

Exporting cameras can give a unique test of your photomontages and a unique exporting feature, so anyone with Google Earth access can see your photomontages on a Google Earth background – creating a really impressive feature.



Figure 15 The photomontage as a "fly in" feature at Google Earth. By using the "transparency" slider in Google Earth, you can gradually increase transparency of your photo and thereby check how well it matches the Google Earth background.

2.15.3 Results layers as overlay

Result Layers exported to Google Earth will be draped on top of the Google Earth surface, ideal for wind resource maps, noise lines etc.

2.15.4 Other objects as symbols

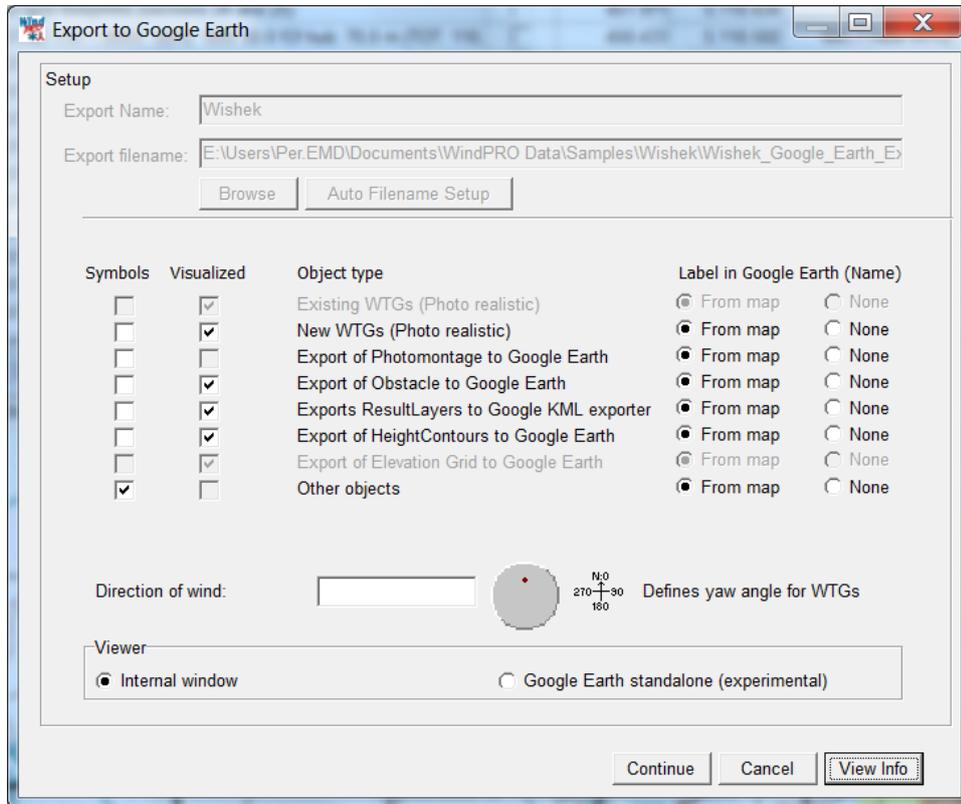
All other objects will for now "just" be exported as symbols, so there is still room for improvement in future versions.

2.16 BASIS - Google Earth synchronized view

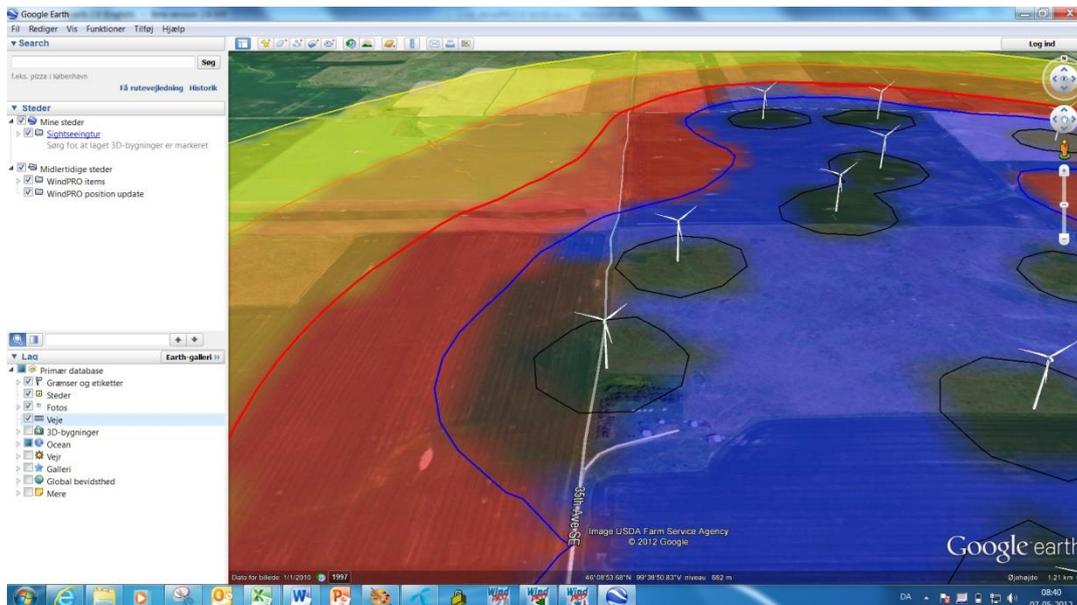


With a click of this button, a window in maps and objects will be opened, including Google earth background maps. The great benefit is that the WindPRO objects will be shown on the Google maps, and when positions are changed, this will immediately be seen on the Google map. It is thereby unique to use Google as "background map" for fine tuning position of objects, like neighbors, turbines etc. Note the turbine visualized in the synchronized view is simpler than the one exported as .kmz file. Taking the detailed descriptions from WindCat, will simply slow down the update speed too much. So for presentations where the look of the turbine shall be accurate, the exporter should be used.

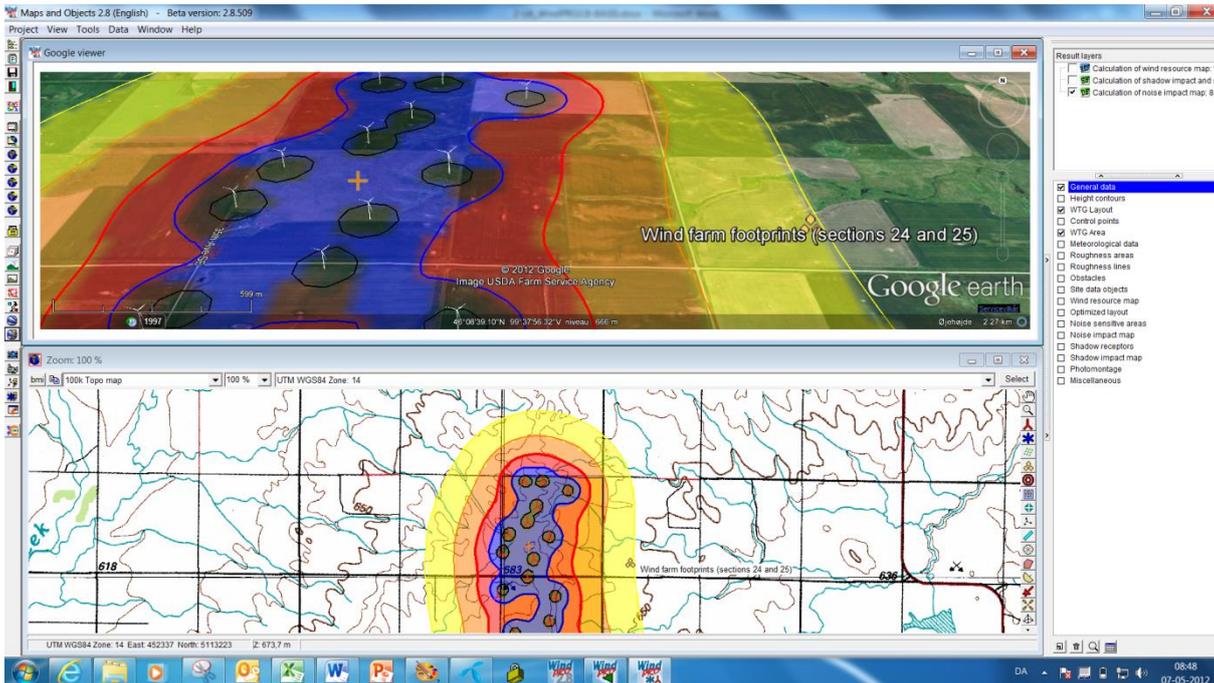
2.16.1 Two different views



The synchronized Google Earth view exists in two variants, the internal WindPRO window and the external Google Earth window. If you work with two screens, the external can be an advantage. Another advantage is that you have access to the full Google Earth user controls in the stand alone window.



Synchronized view as standalone window.



The internal Google Earth window can give a more “close” corporation between Google and other background maps. Moving the WindPRO map will make the Google view follow.

2.17 BASIS - 3D Map view



With a click of this button, a window in maps and objects will be opened showing the map in 3D. The background map as shown in 2D in Maps and Object window is draped over the elevation data in 3D. Any visible object on the 2D map is shown on the 3D map as a black stick; the turbines with three blades on to the stick. Any visible result layer is also draped. When objects are move on the 2D maps they will automatically be moved on the 3D map.

Viewing the map in 3D can be very useful to check the height contours, to understand the impact of the terrain on the wind resource, shadow, ZVI calculations etc...

The 3D map is updated every time the view in 2D is changed (zooming or moving the map by dragging the mouse).

On the top bar, several viewing options can be found to move, rotate, zoom, change the depth of the graph or copy/print to export the image.

On the left side it is possible to show the grid surface or to have the 3D map rotate. The vertical scale is very often increase by default in order to see the elevation differences. This scale can be changed by moving the arrow on the line. The sharpen button can be press to sharpen the view; the 3D map is however becoming too heavy to be moved in that mode.

It is recommended to use gridded elevation data for a faster and smoother viewing of the 3D map.

