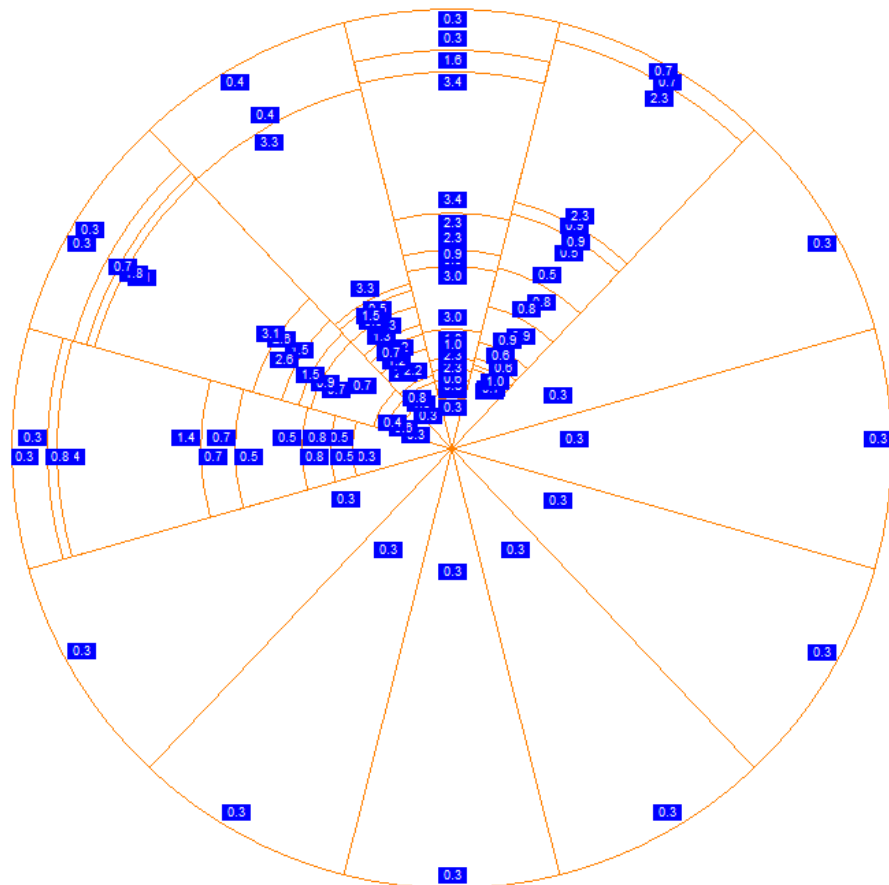


WindPRO / Energy

Roughness in WindPRO



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Front cover

The front cover shows a roughness rose.

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This is a short note about the possibilities using roughness maps in WindPRO 2.7.

1 Use of roughness in WindPRO (WASP)

Roughness maps are required in several calculations in WindPRO. In particular calculations where the WASP flow model is utilized require an appropriate roughness description of the surface.

Currently, all such calculations in WindPRO require a Site data object. These calculations are:

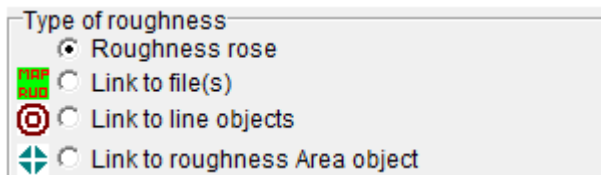
- Statgen (generation of wind atlas/statistic)
- WASP Interface (energy prediction at a single position based on a wind atlas)
- Park (energy prediction for many turbines based on wind atlas)

However, also in the Meteo Object and the Meteo Analyzer, WASP calculations using roughness maps can be performed in the prediction of the vertical profile or cross predictions. Again a site data object is required (with purpose: Statgen).

The way that WASP internally “understands” roughness is in the form of a roughness rose. A roughness rose is a table specifying the roughness values for the segments within each of typically 12 sectors centred on a single point of interest in the terrain. The table consists of roughness values and distances to the next roughness change for each sector as illustrated below.

Sector	Roughness at WTG	Distance to 1. change	Roughness after 1. change	Distance to 2. change	Roughness after 2. change	Distance to 3. change	Roughness after 3. change	Distance to 4. change	Roughness after 4. change	Distance to 5. change	Roughness after 5. change	Distance to 6. change	Roughness after 6. change
0-N		0											
1-NNE	0.1447	0											
2-ENE	0.1507	0											
3-E	0.1320	1,247	0.3286	2,500	0.1979	12,023	0.1629	16,907	0.0529	19,858	0.1951	0	
4-ESE	0.1334	861	0.3655	2,737	0.1913	0							
5-SSE	0.1496	0											
6-S	0.1503	0											
7-SSW	0.1584	0											
8-WSW	0.1515	0											
9-W	0.2281	5,030	0.1440	0									
10-WNW	0.1594	0											
11-NNW	0.1477	0											

However, several options exist for how to provide WASP with roughness roses for each relevant position in the calculation (e.g. mast or wind turbine position). These options are manifested in the options at the Roughness tab of the WindPRO Site data object (see below).



1.1 Roughness Rose

If the roughness information is specified directly as a rose this rose will be used for all positions in the particular calculation e.g. the measurement mast in Statgen or all WTG positions in a Park

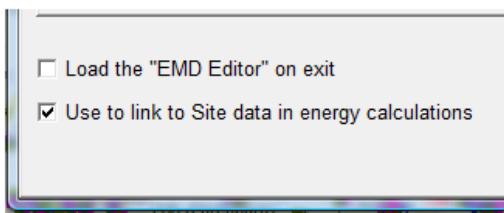
calculation. This is so regardless of the position of the site data object holding the rose relative to e.g. the mast position. Only minor exception is a park calculation with several Site data objects selected, each holding a roughness rose. In that case the Site data object (including its roughness rose) nearest to each turbine will be used for that turbine position.


1.2 Link to file(s)

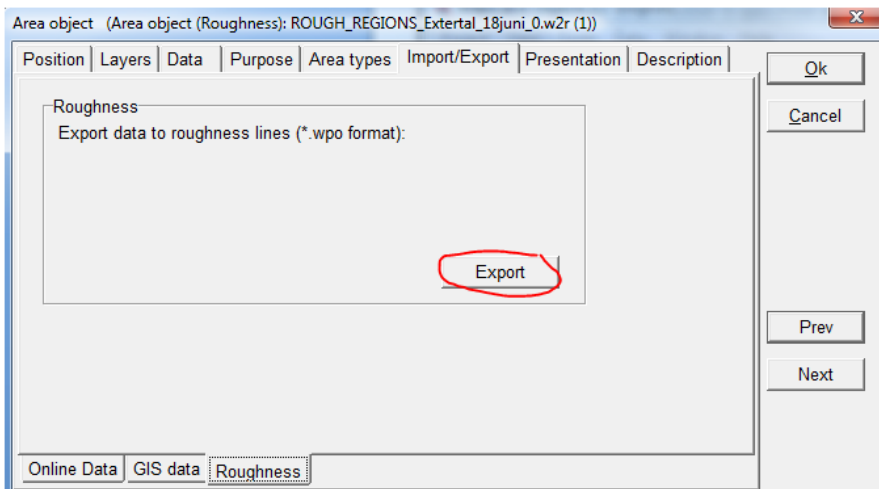
When choosing the option “Link to file(s)” the user has to specify the roughness file to be used. The format should be WASP .map format or WindPRO .wpo format.

1.3 Link to line objects

This is the most common way to utilize roughness maps in WindPRO if you have made the roughness line map in WindPRO. You should make sure that the relevant line object is set to “link to site data in energy calculations” on its data tab (see below).



A typical procedure working with roughness in WindPRO is to make a roughness map using the area object (i.e. ) , and then export it to a file with roughness lines (see below) which is then subsequently loaded in a line object. This line object is then used in e.g. a Statgen or Park calculation and, thus, passed to WASP which then internally converts it to roughness roses and the relevant positions.



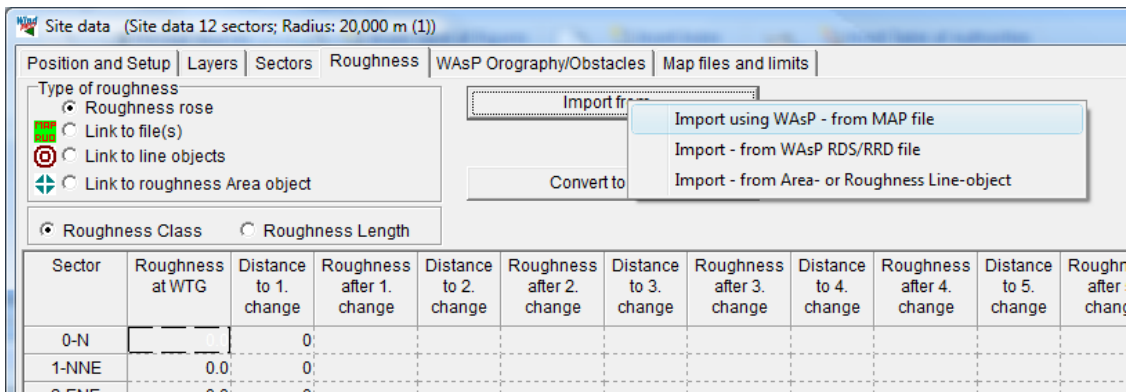
1.4 Link to roughness Area objects (caution)

This is a new an experimental feature in WindPRO 2.7 not (yet) suitable for full energy assessments, but quite good for a fast and easy “quick check calculation” using e.g. online roughness area data. Contrary to the above description of the typical use of roughness in Area objects above, the direct link to an Area object will make WindPRO do the conversion of

roughness areas directly to roughness roses without calling WAsP. Thus, this area-to-rose conversion routine is not fully consistent with that used internally in WAsP based on roughness lines.

2 Roughness rose import/conversion using WAsP or WindPRO

If the chosen input type of roughness in a Site data object is set to “Roughness Rose” (cf. section 1.1) the user is provided with three options for importing/converting roughness data into a roughness rose via clicking the button “Import from...”.



The three options are:

1. Import using WAsP - from map file
2. Import – from WAsP RRD/RDS file
3. Import – from Area- or Roughness Line-object (Caution!)

1. The first option allows the user to convert a file/line object with roughness lines to a roughness rose at the site data object’s position, automatically filling in the rose table (cf. p. 4). This import option is a very nice tool for gaining insight in the way WAsP handles and interprets complex maps of roughness lines. It can help the feeling for to which degree details are important in a roughness line map. Many users spend much time on very fine details of roughness lines – which upon WAsP’s conversion to a roughness rose is so much simplified that a coarser and much faster roughness digitization would have resulted in the same roughness rose and thus WAsP result.

2. The second option allows importing an already made roughness rose from a file in one of the two WAsP formats (.rrd or .rds).

3. The third option is equivalent to the procedure described in section 1.4, where WindPRO does the conversion from roughness areas/line alone without calling WAsP. Note that the resulting roughness roses are not fully consistent with roses converted using WAsP (Caution!)