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TECHNICAL NOTE: SITERES

Generalized gridded results format for wind farm site and climate parameters

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Introduction

In several of the last major releases of windPRO, EMD has implemented improved interchange formats to interact with 3rd party tools, such as CFD-models [1, 2] and Optimization models [3]. This document describes the SITERES format, an open and accessible results-format. The SITERES format allows the wind analyst to export and consolidate a complete set of modelled flow conditions. The main purpose is to:

Provide a complete description of the spatial variation of relevant site- and climate-parameters needed to complete a number of wind farm modelling analysis'. The format is to be self-contained.

The SITERES format is - as such - a generalized format and will be useful in wind resource analysis' (AEP-calculations), input to optimization models and site-compliance analysis'. In windPRO 3.2+, the SITERES format is generated by a windPRO RESOURCE calculation.

Important Note: This is an experimental feature. Thus, in this edition of the SITERES format, we only support Weibull wind distributions (similar to the RSF-format) and a number of parameters relevant for site-compliance studies. In later revisions we will support other parameters too, please let us know if you have any special requirements.

1. Site Results Format

The purpose of the site results format is to consolidate (or export) a set of relevant data to define:

- Site elevations
- Wind resources
- Wind veer
- Wind shear
- Turbulence
- Temperatures
- Other parameters

All information is contained in a single file (a zipped file, with extension *.siteres, see Figure 2). This file holds an xml-file describing the zip-file content (SiteResult.xml) and several surfer grid files with the actual gridded parameter information (*.grd). The format is self-describing – and allows for inclusion of any parameter that varies in 3D-space – and with a directional dependence – if required.

The overall structure of an SITERES XML file is shown in the Figure 3. A detailed description of each of the node is also available in the following section. A preliminary version of the XML Schema Definition can be found in the download link, while an example of an “.siteres” file is also available from the links:

SITERES Request XSD: <http://www.emd.dk/files/flow/SiteResults.xsd>
SampleFile: http://www.emd.dk/files/flow/SiteResults_Sample20170528.siteres

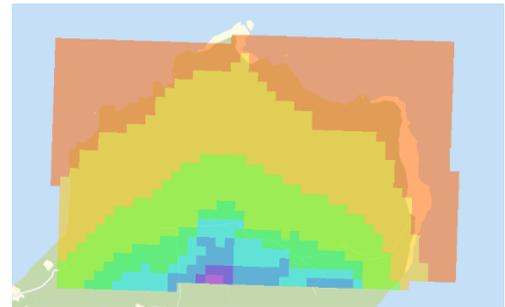


Figure 1: Wind Resources - Loaded into windPRO from SITERES file.

Elevation_X_X	grd	161,215	2017-05-11 15:21
SiteResult	xml	20,746	2017-05-11 15:21
WeibullA_0_0	grd	139,648	2017-05-11 15:21
WeibullA_0_1	grd	139,648	2017-05-11 15:21
WeibullA_0_2	grd	139,648	2017-05-11 15:21
WeibullA_1_0	grd	139,648	2017-05-11 15:21
WeibullA_1_1	grd	139,648	2017-05-11 15:21
WeibullA_1_2	grd	139,648	2017-05-11 15:21
WeibullA_10_0	grd	148,065	2017-05-11 15:21
WeibullA_10_1	grd	150,375	2017-05-11 15:21
WeibullA_10_2	grd	150,474	2017-05-11 15:21
WeibullA_11_0	grd	139,648	2017-05-11 15:21
WeibullA_11_1	grd	139,648	2017-05-11 15:21
WeibullA_11_2	grd	139,648	2017-05-11 15:21
WeibullA_2_0	grd	139,648	2017-05-11 15:21
WeibullA_2_1	grd	139,648	2017-05-11 15:21
WeibullA_2_2	grd	139,648	2017-05-11 15:21
WeibullA_3_0	grd	139,648	2017-05-11 15:21
WeibullA_3_1	grd	139,648	2017-05-11 15:21
WeibullA_3_2	grd	139,648	2017-05-11 15:21
WeibullA_4_0	grd	150,474	2017-05-11 15:21

Figure 2: Part of contents-listing of a SITERES file.

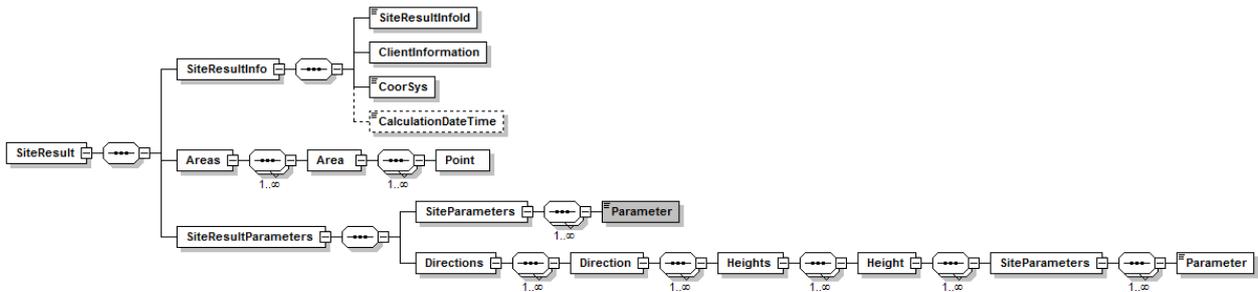


Figure 3: Outline of Site Result Format (XML Schema Definition).

1.1 SiteResultInfo

The first part of a SITERES result file is the meta information in the SiteResultInfo tag. It holds information of the client generated the information – as well as job-id/folder and calculation time.

```
<SiteResultInfo>
  <SiteResultInfofold>d77caf38-ea88-4dcf-ac2e-25727e561614</SiteResultInfofold>
  <ClientInformation Name="windPRO" Version="3.2.330" UserName="mit@emd.dk"/>
  <CoorSys Type="WINDPRO">3: 20: 10: 0, UTM (north)-WGS84 Zone: 20</CoorSys>
  <CalculationDateTime>2017-05-11T15:21:34.243+02:00</CalculationDateTime>
</SiteResultInfo>
```

The CoorSys node can also be omitted if the coordinate system is not known, but once the result is used in windPRO, then the user will be asked to define the coordinate system. So, if the generating model knows the coordinate system, then it should be added into XML file. In the current version, there are two ways to define the coordinate system:

- WINDPRO: This type is a string that represents the coordinate system in windPRO and it is normally used in flow request files from windPRO and hence then copied to the result
- EPSG: This type allows the flow model to write the coordinate system as an EPSG code

As an option, it is possible to add a calculation time-stamp to the CalculationDateTime node.

1.2 Areas

The Areas node defines the horizontal areas that the user is interested in. Each Area node contains a number of point nodes which defines the polygon of the area. The area that is defined is only the area of interest. The flow model may use a much larger area around the area of interest in the simulations.

```
<Areas>
  <Area Name="A">
    <Point x="694542.064670361" y="5207904.54752704"/>
    <Point x="694542.064670361" y="5212079.54752704"/>
    <Point x="698092.064670361" y="5212079.54752704"/>
    <Point x="698092.064670361" y="5207904.54752704"/>
    <Point x="694542.064670361" y="5207904.54752704"/>
  </Area>
</Areas>
```

1.3 SiteResultParameters

SiteResultParameters section holds a description of each individual site parameter, a link to the area covered by the file, the file type and the height – along with a link to the data files. The site result parameters sections are divided into two sections, one for omni-directional results (SiteParameters) and one for directionally-dependent results (Directions).

1.3.1 SiteParameters

Currently the following parameters are allowed within a SITERES file:

Elevation	Roughness	WindSpeed
WeibullA	WeibullK	WeibullF
SpeedUp	WindVeer	Turbulence
Inclination		

An example of from the XML-file is shown in Figure 4 below.

```

<SiteParameters>
<Parameter Type="WindSpeed" Area="A" FileType="GRD" Height="80">WindSpeed_X_0.grd</Parameter>
<Parameter Type="WeibullA" Area="A" FileType="GRD" Height="80">WeibullA_X_0.grd</Parameter>
<Parameter Type="WeibullK" Area="A" FileType="GRD" Height="80">WeibullK_X_0.grd</Parameter>
<Parameter Type="WindSpeed" Area="A" FileType="GRD" Height="100">WindSpeed_X_1.grd</Parameter>
<Parameter Type="WeibullA" Area="A" FileType="GRD" Height="100">WeibullA_X_1.grd</Parameter>
<Parameter Type="WeibullK" Area="A" FileType="GRD" Height="100">WeibullK_X_1.grd</Parameter>
<Parameter Type="WindSpeed" Area="A" FileType="GRD" Height="120">WindSpeed_X_2.grd</Parameter>
<Parameter Type="WeibullA" Area="A" FileType="GRD" Height="120">WeibullA_X_2.grd</Parameter>
<Parameter Type="WeibullK" Area="A" FileType="GRD" Height="120">WeibullK_X_2.grd</Parameter>
<Parameter Type="Elevation" Area="A" FileType="GRD">Elevation_X_X.grd</Parameter>
</SiteParameters>

```

Figure 4: Omnidirectional Parameters in SITERES-file.

1.3.2 Directions

An example of the directionally dependent part of the SiteResultsParameters-node is shown in Figure 5 below.

```

<Directions>
<Direction Dir="0">
<Heights>
<Height AGL="80">
<SiteParameters>
<Parameter Type="WindSpeed" Area="A" FileType="GRD">WindSpeed_0_0.grd</Parameter>
<Parameter Type="WeibullA" Area="A" FileType="GRD">WeibullA_0_0.grd</Parameter>
<Parameter Type="WeibullK" Area="A" FileType="GRD">WeibullK_0_0.grd</Parameter>
<Parameter Type="WeibullF" Area="A" FileType="GRD">WeibullF_0_0.grd</Parameter>
</SiteParameters>
</Height>
<Height AGL="100">
<SiteParameters>
<Parameter Type="WindSpeed" Area="A" FileType="GRD">WindSpeed_0_1.grd</Parameter>
<Parameter Type="WeibullA" Area="A" FileType="GRD">WeibullA_0_1.grd</Parameter>
<Parameter Type="WeibullK" Area="A" FileType="GRD">WeibullK_0_1.grd</Parameter>

```

Figure 5: Directional Dependent Parameters in SITERES-file.

2. References

- [1] Sørensen T.G.: *Generalized Flow request and result format (version 1.4)*, EMD A/S, 2016-10-25, available at: http://www.emd.dk/files/flow/EMD_technote_Generalized_Flow_Request_Result.pdf
- [2] Svenningsen et al: *WAsP-CFD Validation Report, EMD International*, 2013-07-10, available at: http://help.emd.dk/knowledgebase/content/TechNotes/TechNote_4_WAsPCFD_EMD_ValidationReport.pdf
- [3] Thøgersen, M.L.: *GIRAFFA Generalized i/o-format for adapting optimization frameworks for windfarm-applications*, EMD A/S, 2017-05-15, available at: http://www.emd.dk/files/flow/EMD_technote_GIRAFFA_20170515.pdf

3. Document History

2017-05-16: First draft + review (MLT+TGS).

2017-05-28: Added more parameters (speedup, windveer, turbulence, inclination) – and updated sample

2018-03-07: Review