QUICK GUIDE - EMD-WRF ON-DEMAND ICING

Purpose:

This quick guide shows you how to get icing losses into windPRO. With EMD-WRF On-Demand ICING, you only need to provide a geographical location and time period. From windPRO you can directly request icing estimates similar to other EMD-WRF On-Demand services. Modelled time series of ice growth, ice load, instrumental and meteorological icing meeting the industry standards are available alongside the raw WRF dataset specifically configured for icing purposes.

Outline of Guide:

- **Price structure and meso credits**

- **Running calculations**

- **Data included in the results**

1.   PRICE STRUCTURE AND MESO CREDITS

No special modules have to be purchased in order to run EMD-WRF OD ICING calculations. The calculations are paid as requested using EMDs "meso credits". Similar to other EMD-WRF OD calculations, the price depends on length of the requested time series. One month of hourly time series data with icing results costs 2 meso credits. A complete icing analysis requires a 10-year time series and the cost will be: 2 meso credits * 12 (months) * 10 (years) = 240 meso credits. The meso credits are purchased by contacting sales@emd.dk or by ordering online.
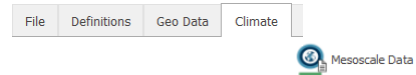
2.   RUNNING CALCULATIONS

Requesting a EMD-WRF OD ICING run is very simple and follows the EMD-WRF OD services. You need to specify:
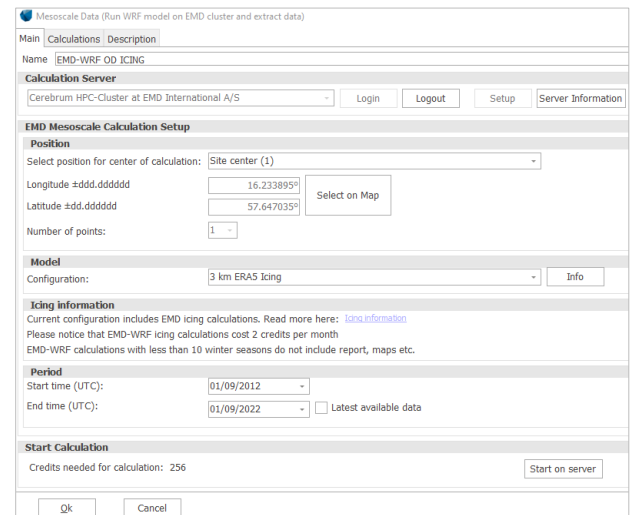- ✓ Geographical location
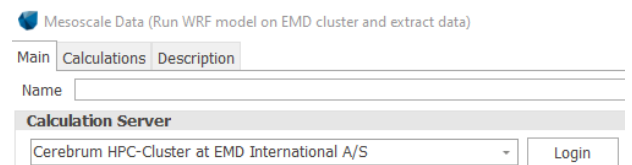- ✓ Time period

3.   CALCULATION SETUP

To start a new calculation, you go to Mesoscale Data under the Climate tab.
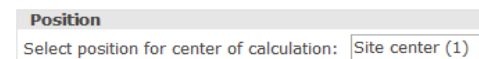

A calculation setup window will open, as seen below.

Start by giving the calculation a name and press the Login button to connect to the computer cluster at EMD:
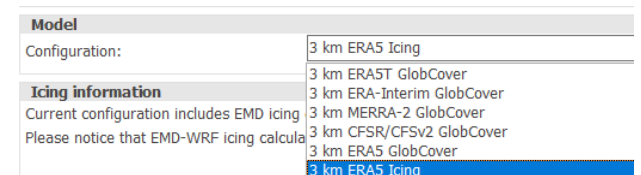

Select the position of the calculation:

The position can be defined based on another object in windPRO, it can be manually entered (user defined) or you can select the position on the map by clicking on it.

Select the model configuration "3 km ERA5 Icing":

The last thing to define before starting the calculation is the period you want.

Note: A complete icing analysis (reports, maps and raw WRF timeseries) requires minimum 10 seasons, whereas shorter time periods include only the raw EMD-WRF OD ICING timeseries.

4. STARTING THE CALCULATION

The calculation is started on the computer cluster at EMD by pressing the "Start on Server" button, giving you the following window:
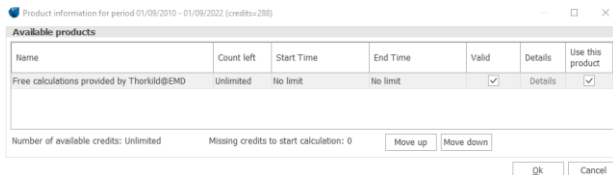
For this example, you can see that it requires 240 meso credits. Once you are ready press the "Ok" button to start the calculation. You will see one more confirmation dialog before the calculation is actually started. Simply click "Yes" if you are sure you want to start the calculation. When the calculation has started you will see the "Calculations" tab showing the actual calculation and the estimated completion time for the job. Click "Ok".

5. DOWNLOADING THE RESULTS

You will receive an e-mail when the job is completed, and the results are ready for download in windPRO. Open the project in windPRO and find the MesoScaleData calculation and open it:

On the "Calculations" tab you should see the calculation you started and the button "Download results" should now be enabled. Click the button to download the results from the server. After the download completes the results are added as a Meteo object. If a complete 10 season+ icing analysis was run, a Result layer will also be loaded.

6. DATA INCLUDED IN THE RESULTS

A time period of 10 seasons (or more) will include the complete icing analysis:

✓ Icing reports as pdfs hub-heights; 100m, 150m and 200m (Including predicted AEP loss)

✓ Icing maps at hub-heights; 100m, 150m and 200m
  o IEA ice class, IEA Ice loss (% AEP) and modelled meteorological icing (icing rate > 10 g/h)

✓ Monthly, yearly and seasonal icing analysis and bin-sector analysis as csv-files

✓ Timeseries of raw WRF data and modelled icing

Please find more information on the EMD-WRF OD ICING dataset and the complete icing analysis here: [knowledgebase.](#)

Note: EMD-WRF OD ICING relies on a downscaling approach with coupled-modelling at both mesoscale (3km grid resolution) and microscale (30m grid resolution). However, when in complex terrain, these resolutions are not always fine enough to ensure sufficient modelling accuracy. If the differences between meso- and micro terrain elevations are large (some hundreds of meters), then caution is advised, and users should expect increased uncertainty in results. If you are an EMD-WRF OD ICING user, feel free to contact the modelling team through the windPRO support hotline for further guidance and recommendations (support@emd.dk)

7. RESULTS IN THE METEO OBJECT

In the Meteo object you find the raw EMD-WRF OD ICING data, from where wind speed, wind direction, turbulence intensity, icing intensity, ice load, instrumental icing and meteorological icing are the default loaded parameters.
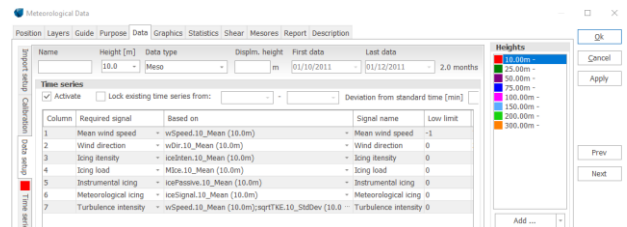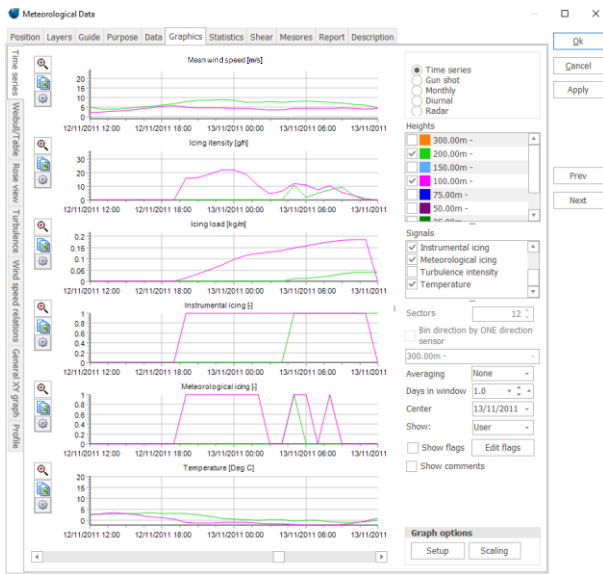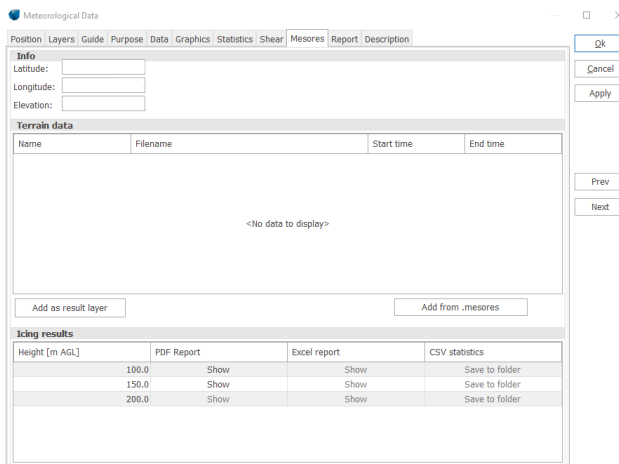
For the complete icing analysis of minimum 10 years, the Mesores tab in the Meteo object will show the PDF reports, summary sheets either as excel exports or csv-files:
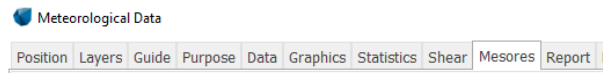
Please click the "Show" buttons or "Save to Folder".

In the PDF report you will find seasonal overview of climate and the modelled icing and icing losses. Example plots from the PDF report at 100m are shown next.
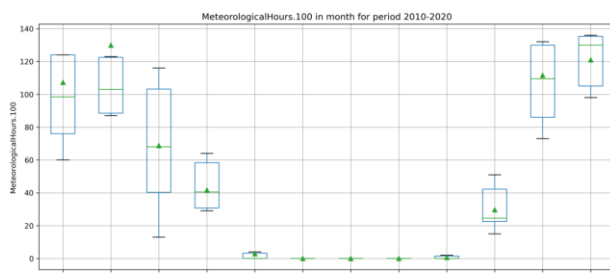

Figure 4: The mean number of meteorological icing hours (MeteorologicalHours.100) distribution on different months at 100m agl.
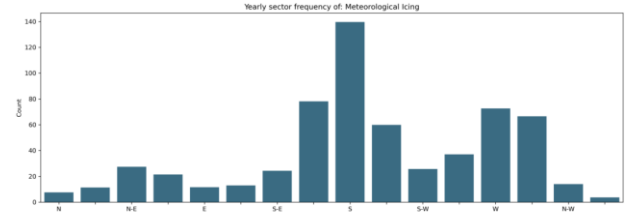

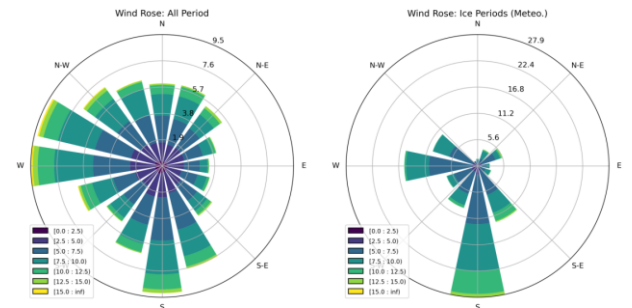Figure 7: Sector frequency of meteorological icing over the total number of years.

Figure 8: Left: all data and right: only during meteorological icing periods.
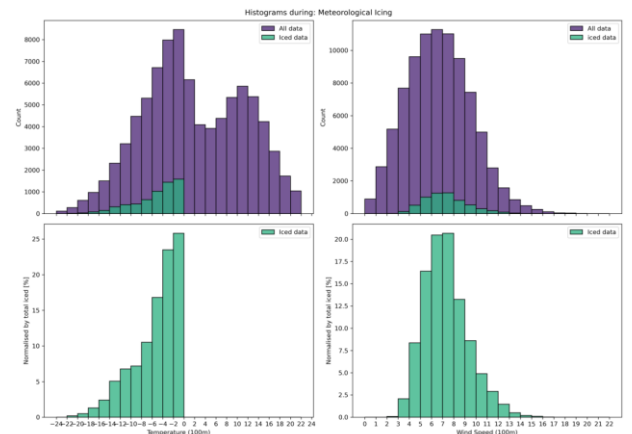

Figure 9: Wind speed histograms during meteorological icing periods. Top two as a function of the number of counts and bottom two, as the normalised percentage (%).

8. RESULTS IN THE RESULT LAYER

In the Result layers you will find icing maps if the complete icing analysis is run. Double click to show the icing maps (IEA loss, IEA ice class or meteorological icing).