The Value of Meso-Scale Data in Wind Analysis and WindSim's Advanced Capabilities

The Role of Meso-Scale Wind Data

Meso-scale wind data plays a pivotal role in modern wind resource assessment, offering a bridge between large-scale atmospheric dynamics and site-specific wind conditions. Meso-micro coupling can prepare site-specific inflow under realistic atmospheric stability conditions (rather than assuming neutral or using idealized profiles). When a region experiences significant mesoscale meteorological phenomena, such as land-sea breezes, katabatic/anabatic flows, or persistent regional wind systems, meso-micro coupling could improve results. WindSim has demonstrated significantly improved results in validation studies.
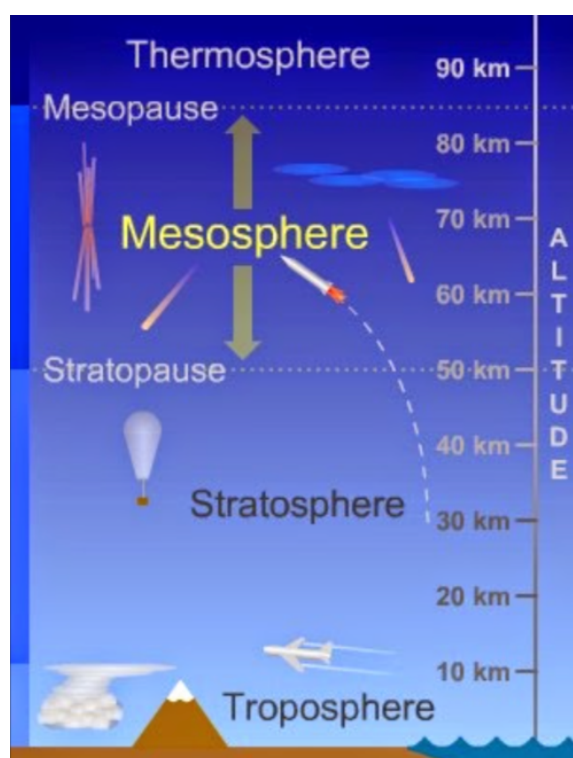

Figure 1 The mesosphere is between the stratosphere and thermosphere.

Meso-scale data provides broad spatial coverage (typically 10–1000 km) and long-term historical records, enabling developers and analysts to better understand wind variability, identify promising regions for wind energy projects, and make informed decisions early in the planning process. Its ability to resolve key weather patterns, orographic influences, and land-sea interactions contributes to more accurate wind forecasts and energy yield estimates.

WindSim's Meso-Scale Capabilities

WindSim leverages these benefits with two advanced approaches for generating high-quality Weather Research and Forecasting (WRF) meso-scale data. The first method uses datasets like ERA-5 as a foundation to generate high-resolution WRF outputs. This approach produces rich, high-quality time series

data with resolutions ranging from 9×9 km down to 1×1 km. Such results are valuable standalone or in combination with CFD analysis – i.e. in applying Meso-Microscale Coupling (MMC), see below for more information. Figure 2 shows mean wind speed at 120m height from WRF data generated by WindSim for a large-scale screening and Wind Atlas project (see below).
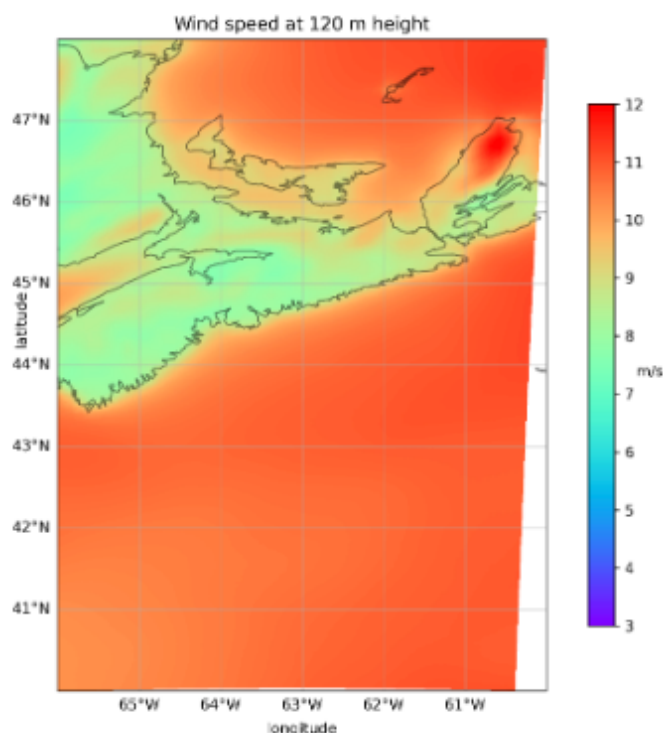
The second approach generates a WRG (Wind Resource Grid) output and is based on data from the Global Wind Atlas (GWS). While this method offers slightly

Figure 2 Mean wind speed estimated from WRF using three years of data with high temporal resolution.

less spatial resolution and does not provide time series data, it delivers high-quality results with significantly faster turnaround, making it ideal for delivery of time-sensitive pre-screening and feasibility studies.

WindSim and MMC

WindSim also has deep expertise in MMC, which is critical for translating meso-scale insights into actionable microscale decisions. One method involves scaling the meso-scale data across a broader region using microscale insights from computational fluid dynamics (CFD) simulations. Another complementary technique enhances boundary condition accuracy for micro-siting applications by integrating meso-scale data directly.

Using these approaches together improves both horizontal and vertical resolution, resulting in more precise wind flow modelling and reduced uncertainty in energy yield predictions. The most relevant proof point of this is the large-scale project WindSim completed in 2025 for Stantec[1] on behalf of the

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[1] Stantec Inc. is a global design and consulting firm headquartered in Edmonton, Alberta, Canada. Founded in 1954, the company has grown into a leading provider of sustainable engineering, architecture, and environmental consulting services. As of 2024, Stantec employs over 32,000 professionals across more than 450 locations worldwide

Canadian government institution NZA (Net Zero Atlantic). For this project, WindSim generated high quality WRF data for a total area of more than 6million square kilometres. In addition, more than 100 high resolution CFD projects were run in a parallellized and semi-automated fashion. These results were then scaled against the WRF data using MMC for higher accuracy results.
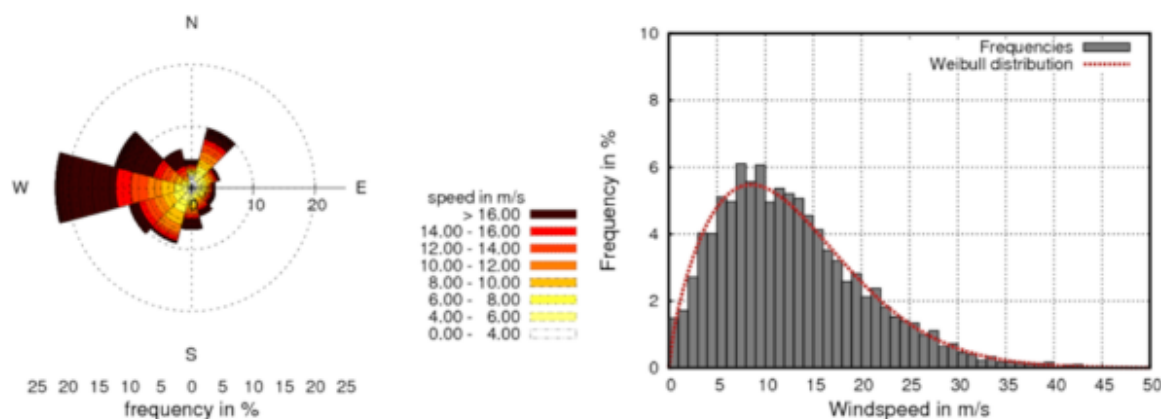

Figure 3 Wind rose and Weibull distribution for smaller area along the Canadian coast after MMC processing of CFD and WRF analysis.

Ready to learn more?

By combining high-quality meso-scale data with robust MMC techniques, WindSim empowers wind developers to optimize the pre-screening process and Wind Atlas generation with greater confidence and efficiency.

✉ Contact us to learn more or book a meeting at sales@windsim.com or consulting@windsim.com.