

**Title:** Evaluation of climate change data for wind energy applications

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**Background:**

In the design of future wind farms, wind resource assessment is based on historical meteorological data obtained through both measurements and reanalysis. However, several studies have shown how climate change might impact the wind resource, decreasing the correlation between historical and future values of relevant climate variables, such as wind speed and ambient temperature. Therefore, there is the increasing need to account for climate change projections in wind resource assessment in order to evaluate the reliability of the historical data. Climate change projections are obtained through climate models, which usually provide results at a low spatial resolution. Such low-resolution data are successively downscaled to provide results at higher resolutions, following the same procedures used in the downscaling of historical reanalysis data.

When working with historical reanalysis data, the benefit of downscaling is clear, as the correlation with site measurements is increased. However, climate projections are subject to high uncertainty, which might outweigh the benefit of downscaling. Additionally, the need for downscaling is closely related to the specific application of the climate change projections. This thesis aims to evaluate the benefit of downscaling climate change projections for several wind energy applications and to investigate how to postprocess climate data in order to get useful and reliable information for wind energy applications.

**Objectives:**

The main objective is to evaluate how the climate model resolution affects the prediction of the climate change impact on wind power projects. For which applications is it really necessary to use high-resolution climate change data? In what cases no benefit is provided by increasing the spatial resolution? Is there a scale range beneath which is not useful to rescale? Different methods should be tested to turn climate projections into technology-specific KPIs, e.g., how to retrieve variations in the energy production from wind speed projections. Additionally, if possible, the scope of the thesis might be extended by testing data-driven approaches to retrieve projections of climate variables which are not given by the climate models, such as atmospheric stability and turbulence intensity. In summary, the project will assess the benefits/drawbacks of downscaling. Attention should be paid to the model chain used in the downscaling. Different models have different assumptions and physics, etc, and these can contribute to prediction uncertainty.

The candidate will work with climate change projections from both publicly available and commercial datasets, implementing Python scripts to process, analyze and compare the data.