The development of wind energy generation requires precise methods for wind resource assessment, which is the initial step of wind farm project. The research work carried out is to reduce the uncertainty in the prediction of wind resource in a complex terrain using CFD code. Non-linear CFD models are able to give better prediction in atmospheric flows for complex terrains. The main cause of the uncertainty is due to the usage of theoretical wind profile conditions in the atmospheric CFD flow, which don’t include the real features of the actual boundary condition.

To overcome this, the lateral boundary conditions of the local scale simulations is provided by coupling between the mesoscale model and field measurements. The \textit{k}-mean clustering methodology was used to reduce the number of situation to be simulated. This methodology was tested on a complex terrain and significant reduction in error when compared with the traditional approach. The detailed comparison with the measurements of wind and turbulence on some situations selected by the clustering method and a statistical error analysis over the whole data set was carried out.

This new methodology shows better results than WasP on a complex terrain, decreasing the relative error by 50% on average. Improvement of this methodology based on clustering methods, variables used to minimize the distance between clusters, correction of errors in mesoscale data and coupling the mesoscale and measurements data. The main goal is to improve this new methodology, to optimise the turbine lay-out and to reduces uncertainty in the load estimation.