Study engineer position at CEREA on:

Atmospheric flow modelling for applications to wind resource assessment and pollutants dispersion

Position : study engineer

Contract duration : 18 months
Employer : Ecole des Ponts-ParisTech
Location : Champs sur Marne - Ile-de-France – France
Main scientific domain: Atmospheric environment
Keywords: Atmospheric modelling, atmospheric boundary layer, wind energy, pollutants dispersion
Starting date: 1rst of January 2022

Laboratory: CEREA (web site: https://www.cerea-lab.fr/)

The CEREA (Atmospheric environment research and teaching center) is a center of excellence for the modeling of atmospheric composition and environment. It is a common Lab between EDF R&D and ENPC (Ecole des Ponts ParisTech) with two locations: ENPC Champs sur Marne and EDF R&D Chatou. Its research activities are focused on air pollution and renewable energies resource (wind, solar). These activities range from academic research to impact assessment studies. They include modelling of the atmospheric flow and of reactive pollutant transport, at regional level or at the local level (urban air pollution, indoor air quality, offshore wind resource …). These activities are coupled with the programs of EDF R&D and strongly related to the other organizations of the French Ministry for Ecology (MTES), through its Research Directorate (DRI).

Position description

The current strong development of offshore wind energy capacity is expected to continue the next years. However, this development is linked to the need of LCOE (Levelized Cost of Energy) reduction in order to insure a good profitability of the farms. Improving the accuracy of the energy production estimation is one of the main ways to obtain this LCOE reduction.

The prediction of the energy expected to be produced by a future wind farm during its whole life includes different steps. The first one consists in estimating the wind resource for the target site. The mesoscale meteorological model WRF (Weather Research and Forecasting) is widely used by the wind industry to perform this assessment, especially for offshore wind farms projects for which measurements are much more difficult and expensive to carry out than for onshore wind farms. This model provides the 3D meteorological fields at a horizontal resolution of some km and can be used at different steps of a wind resource assessment study, in a stand-alone mode or in combination with measurements. As the computation outputs have to be representative of the lifetime scale of a wind farm, long simulations are generally required (at least several years). A second step of the energy production prediction consists in estimating the effect of the presence of wind turbines. These turbines induce wakes leading to a reduction of the wind speed and to an increase of mechanical loads. Besides this wake effect, the blockage effect has been recently raised by the wind industry as a potential additional source of energy loss. Currently both effects are generally estimated with simplified approaches. The use of a CFD model (at the wind farm scale) is a possible alternative but

still needs some methodological developments and validations. Some developments and validations have been carried out at CEREA during the last years with the CFD code code_saturne developed at EDF-R&D. Both WRF and code_saturne simulations are performed on high performance supercomputers.

The study engineer will be involved in a R&D project related to the development of new methodologies for offshore wind farms. The main task will aim at optimising the use of the WRF model in order to reduce the uncertainties on the estimation of variables which are of great importance for the wind resource assessment and wind turbines sitting: mainly wind speed and direction, but also turbulence, temperature, humidity. For that, different configurations and functionalities of this model will be tested (impact of high spatial resolution, Large Eddy Simulation, data assimilation).

Another important domain of applications of mesoscale meteorological models is the modelling of pollutants dispersion. The dispersion of pollutants close to the ground is very sensitive to parameters like wind speed and direction, vertical stability, boundary layer height. Thus the study engineer will be involved in CEREA projects in which mesoscale meteorological simulations are required to provide the 3D fields of those parameters for air quality studies or for studies of the atmospheric impact of urban or industrial pollution sources.

Depending on its experience the candidate could also be involved in tasks related to the modelling of the wind farms blockage and wake effects with the CFD code code_saturne.

Skill requirements

- PhD or engineer degree in atmospheric sciences.
- Strong experience in scientific computing (linux based systems).
- Experience in numerical modelling with WRF will be highly appreciated.
- Experience in CFD will be an asset.
- Proficiency in data analysis and visualization.

Contact

The interested candidate should send a CV with motivation letter to:
Eric Dupont, researcher at CEREA: eric.dupont@edf.fr