Webinar - Optimising design of offshore wind turbines by characterising turbulence

Measurement and modelling of offshore turbulence (POWSEIDOM & DRACCAR-NEMO JIP)

With the financial support of:

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- **Need to improve the accuracy of TI measurement using lidars**
  - Development of the variance method to remove the beams cross-contamination effect + noise filtering
  - Could be applied in the future to get a more accurate TI, providing an evolution of the lidar beams configuration
- **Need of turbulence measurements specifically for offshore sites : measuring TI using floating lidars**
  - Development of two correction methods:
    - A motion-compensation algorithm based on the spectrum of the LoS velocity
    - A geometric correction of the instantaneous measurements
  - Could be applied in the future after additional validations using on site measurements
- **Need of data sets over areas of interest for offshore development**
  - One year data set at Ile du Planier
  - Includes turbulent variables : TI components, TKE, integral length scale
  - Helps to improve the understanding of the processes in the marine atmospheric boundary layer near a coast: thermal stratification, LLJ occurrence, seasonal and diurnal variations …

- **Need of turbulence modeling**
  - ➢ Should provide horizontal and vertical gradients of turbulence variables
  - ➢ Need of long term time series → modeling should not be too much computationally expensive
  - ➢ Important questions currently addressed in NEMO:
    - Relation between turbulence variables that are provided by a mesoscale meteorological model and the reference measured TI
    - What horizontal resolution ? Should we downscale up to the grey zone ?
    - What turbulence model ?
    - Validation of meso-scale simulations in comparison with scanning lidar measurements and LES data

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- **Turbulence measurements in Mediterranean Sea**
  - Deep waters in Mediterranean sea favorable to floating wind farm development
  - Floating foundation design highly sensitive to turbulence level
  - Offshore fixed LiDAR measurements carried out on Ile du Planier important reference on Gulf du Lion
- **Ground-based LiDAR**
  - TI measured by LiDAR generally not accepted
  - Correction methods required for TI measurements -> Variance method, ML approaches…
  - Improve the acceptability of such correction methods (standards / certification body). Which KPIs?
- **Floating LiDAR**
  - Floating LiDAR TI highly impacted by buoy motions
  - Motion compensation methods required for Floating LiDAR (agnostic approach)
  - Improve the acceptability of such compensation methods (standards / certification body)
- **Alternative approaches for turbulence measurements**
  - Dual-Doppler scanning LiDARs appear as a relevant alternative for turbulence measurements
  - Needs of validated numerical modelling approaches for TI

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Thank you for your attention!