Modelling and analysis challenges of floating offshore wind

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INNOSEA – specialized technical consultancy in Offshore Renewables

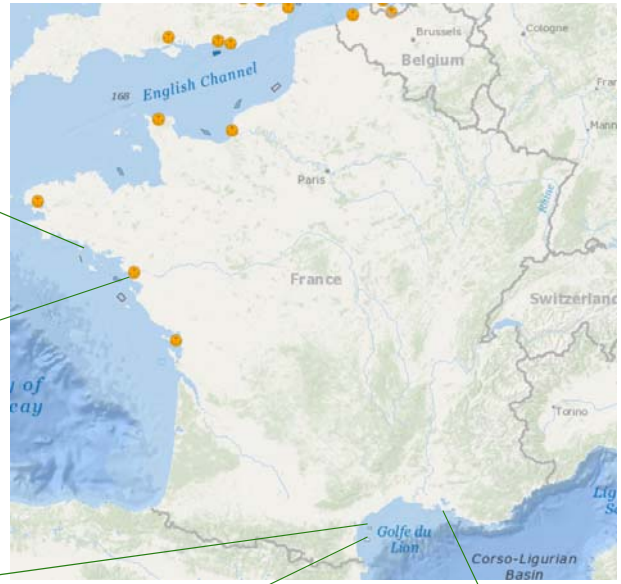
- We are an independent technical consultancy 100% focused on Marine Renewables, including mostly Offshore Wind.
- We support developers, turbine suppliers, contractors, investors, public agencies.
- Focus:
  - Optimize design;
  - Reduce project technical risks.
- We are active on all aspects of the projects:
  - Engineering Management
  - Cost and risk analyses
  - Feasibility studies
  - From Concept to Detailed Design, including related modelling & analyses.

Groix – Belle Ile
Developer: Eolfi/CGN
4 x GE 6MW turbines
Floater Naval Energies
(demonstrator)

Floatgen
European project
1 x Vestas 2MW turbine
Floater Ideol
In Operation

EolMed
Developer: EolMed
4 x Senvion 6MW turbines
Floater Ideol - Bouygues

Eoliennes flottantes Golfe du Lion
Developer: Engie/EDPR/CDC
4 x GE 6MW turbines
Floater: Eiffage/PPI



Provence Grand Large
Developer: EDF EN
3 x Siemens 8MW WTGs
Floater: SBM/IFPEN
(demonstrator)

LOC & INNOSEA have provided engineering services for these 5 projets

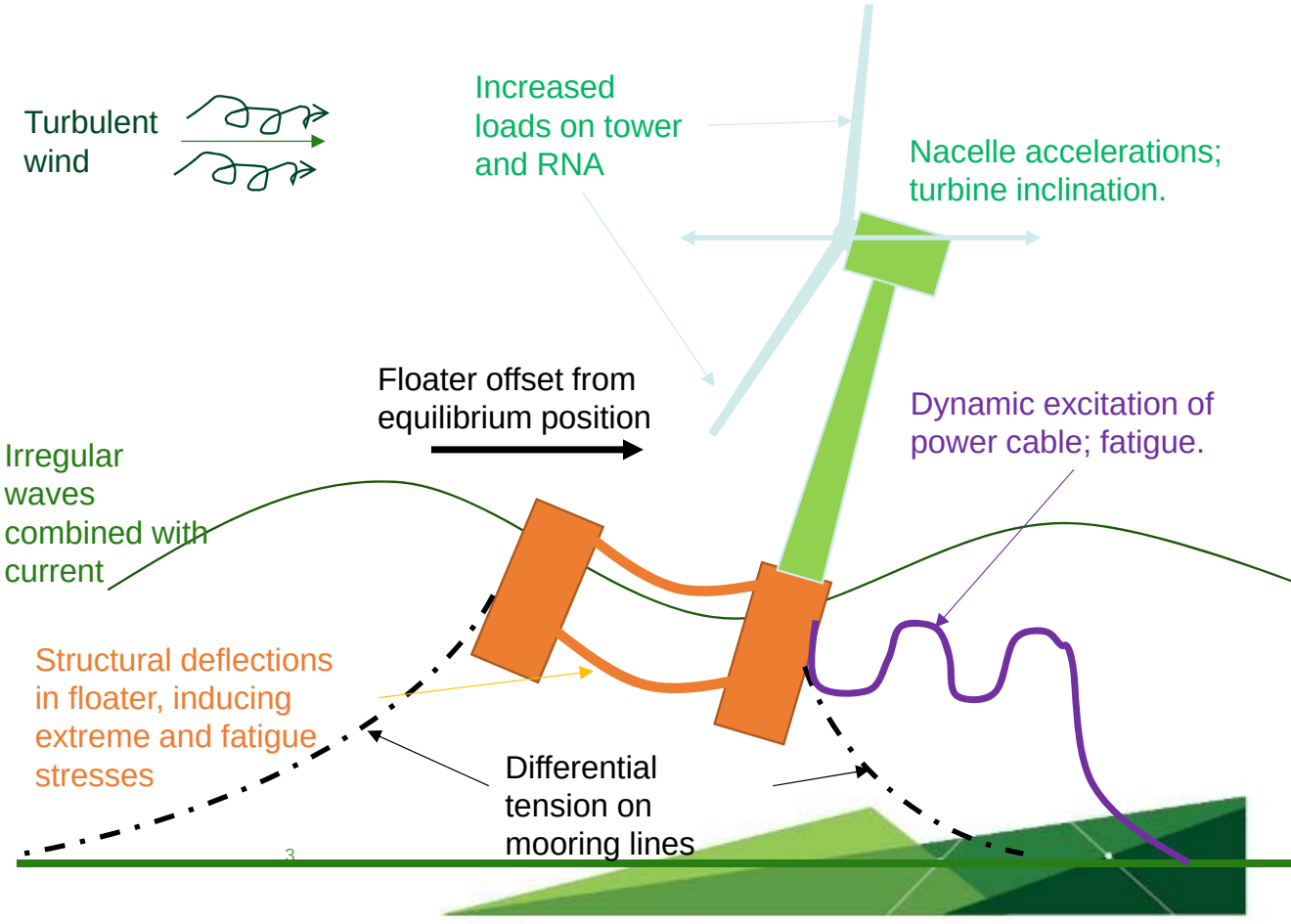
Simplified illustration of floating offshore wind complexity

- **Simplified illustration**: illustration is in 2D, assuming wind and waves are co-aligned

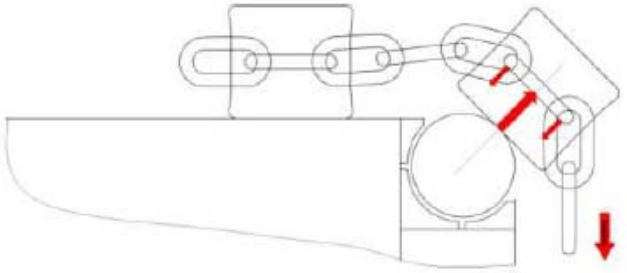
- **Complexity**:
  - even in 2D, many phenomena interact: waves, wind, structural dynamics, control, mooring lines and cable dynamics.

  - These phenomena and interactions must be modelled, to evaluate design inputs for each components, such as motions, deflections, forces, stresses.

  - On this basis the components of the floating wind turbines can be designed and optimized



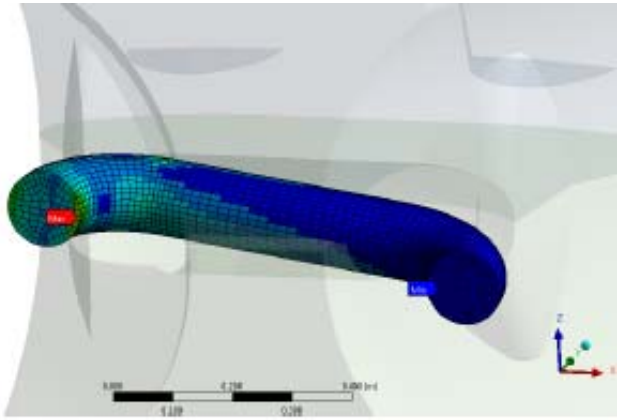
Case study 1
Clump weight design

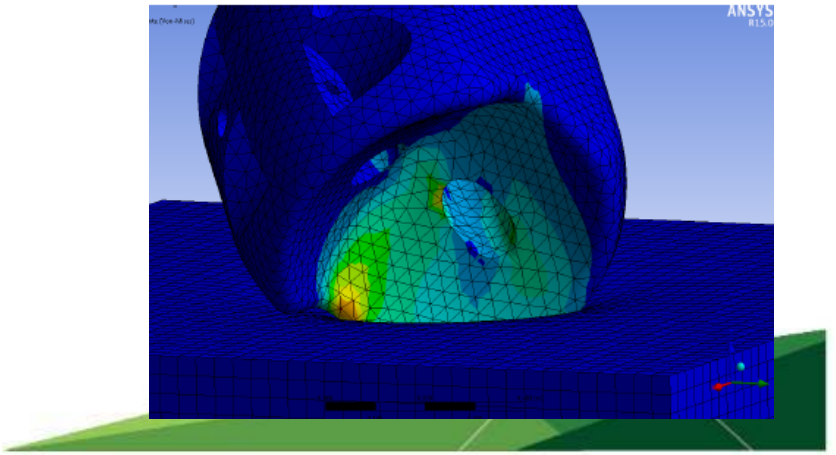


- **Clump Weight used for mooring lines optimization**
  - Offset the vertical force against the anchor
  - Limit the lateral offset of the floater with a weighted segment on the mooring line.

- **Clump weight design cases**
  - Installation cases
    - Stern-roller passage
    - Deck roughness
  - In-place case: impact on soil assessment (clay, dense gravel)

- **Non-linear calculations**
  - Plastic strain evaluation (non-linear material properties)
  - Non-linear contacts:
    - Contact to be initialized
    - Contact stiffness to be set properly





Case study 2
Impact of soil degradation on foundation design

- **Collaborative research project led by FEM with industrial partners**

- **Understand the soil behavior change impact on monopile design**
  - Evaluate soil properties change due to cyclic loading during OWF life
  - Estimate the impact on MP design
  - Limit the safety factor to be considered for geotechnical design due to soil uncertainties

- **Interest for floating offshore wind industry**
  - Shallow water mooring systems are dynamic inducing cyclic loadings
  - Soil properties database, methodology and developed tools can be used for suction piles and anchor design
  - Reduction of geotechnical safety factors to achieve optimal design

Thank you for your attention