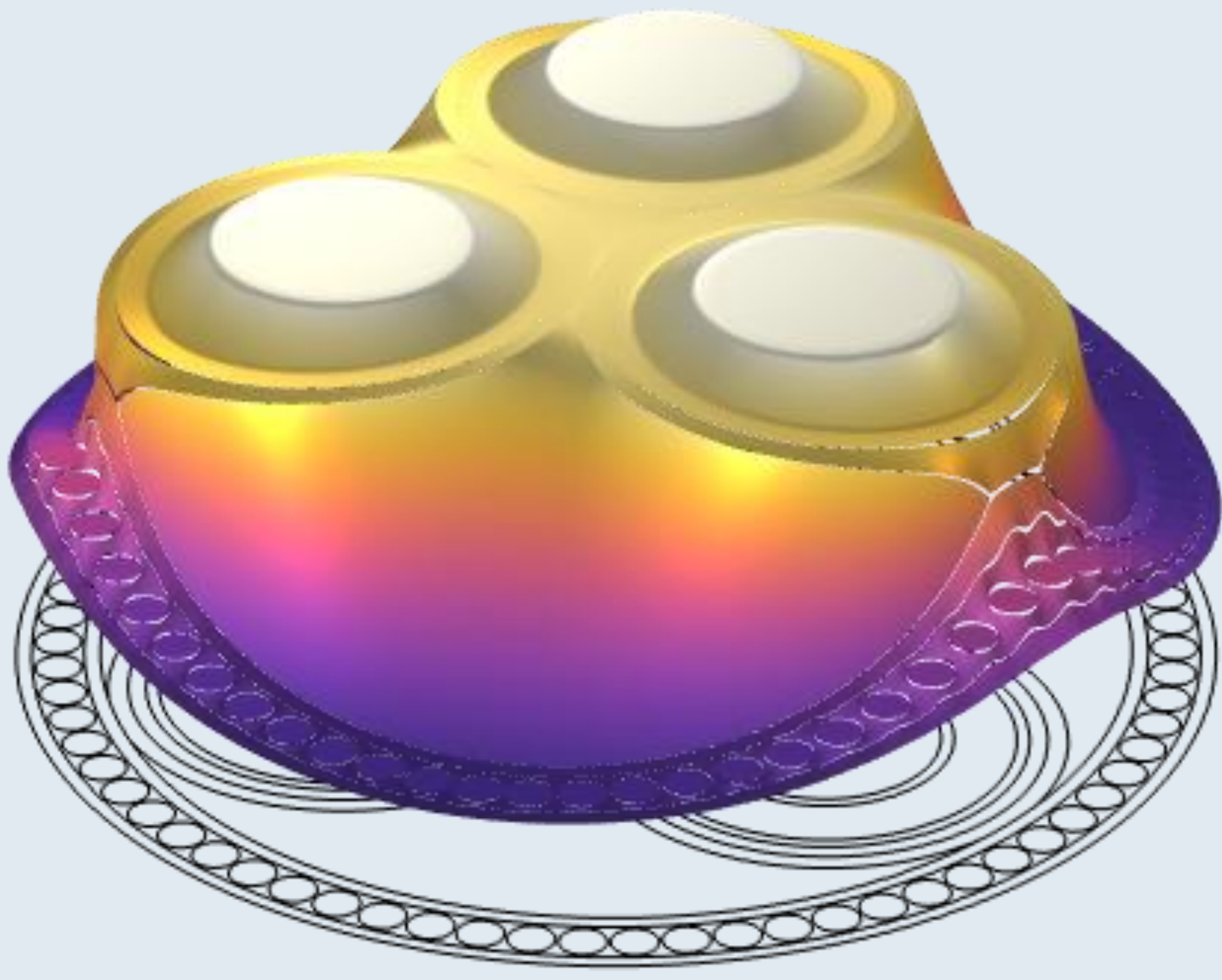




Note: The temperature-profile result (shown above) was generated using a simplified COMSOL model based on CIGRE TB 880 Case Study 2 and informed by the COMSOL cable tutorial series [1][2]. Simplifications and assumptions were introduced for illustration only. No client-specific data are presented.

Coupled Electro-Thermal Modelling of Offshore Wind Cables for Monitoring and O&M Support

Subsea power cables are critical to offshore wind farms, but their thermal behaviour depends on loading and environmental conditions. This work explores how COMSOL modelling can support hotspot assessment, monitoring and O&M planning.

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Introduction & Goals

Subsea power cables are critical to offshore wind farms, but their thermal behaviour depends on electrical loading, environmental conditions and installation configuration. For floating offshore wind, additional cable and accessory interfaces may introduce local hotspots that are not captured by conventional rating assumptions.

This work investigates a COMSOL-based electro-thermal modelling

approach for offshore wind subsea cables. The aim is to estimate cable losses, temperature distribution and hotspot behaviour, and to explore how simulation outputs can support condition monitoring, virtual thermal sensing and O&M planning.

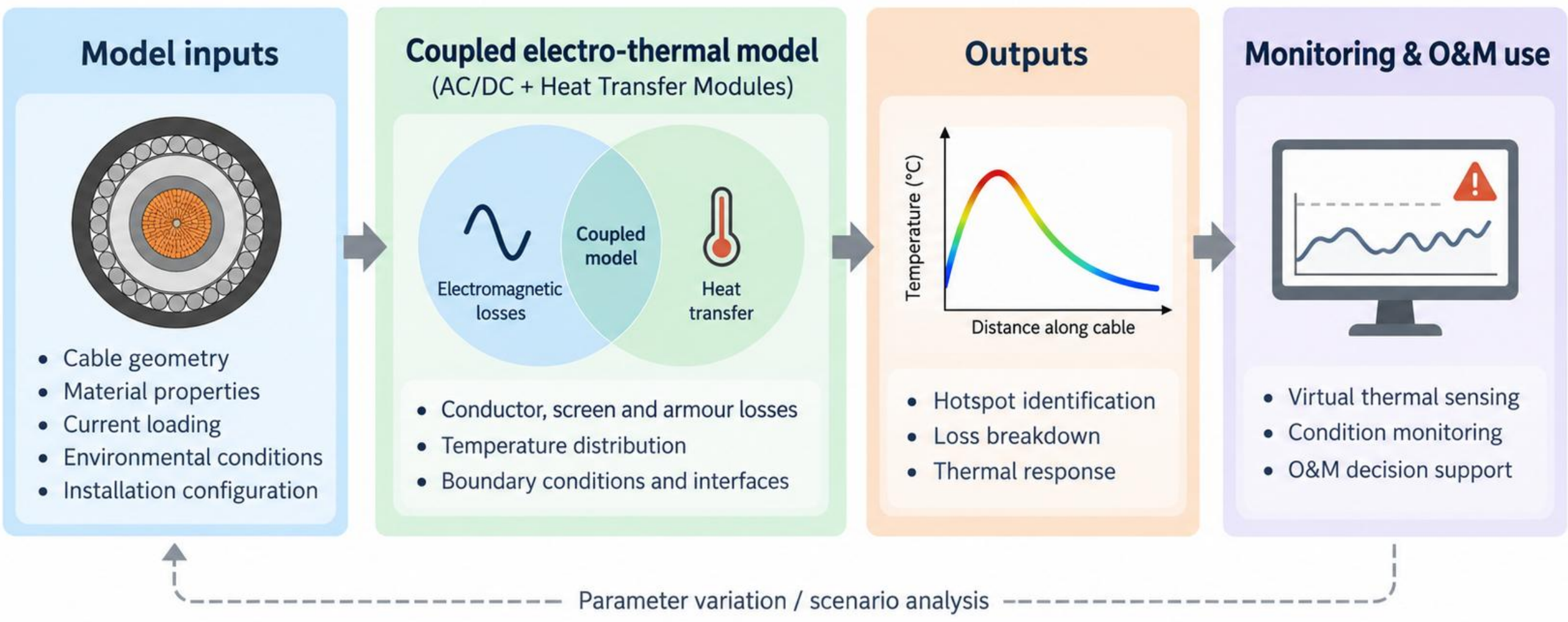


Figure 1. Proposed COMSOL electro-thermal modelling workflow linking cable inputs, coupled electromagnetic and thermal analysis, hotspot assessment, and monitoring-oriented outputs for O&M decision support. Prepared with assistance from ChatGPT (OpenAI) for illustrative purposes.

Methodology

A coupled electro-thermal modelling workflow is developed in COMSOL Multiphysics® to assess the thermal behaviour of offshore wind subsea cables under representative operating and environmental conditions. The electromagnetic model is used to estimate losses in the conductor and metallic layers, which are then coupled with the heat transfer model to calculate temperature distribution and hotspot formation.

The workflow considers cable geometry, material properties, current loading, environmental boundary conditions and installation configuration. The resulting loss and temperature profiles can be interpreted as physics-based indicators for hotspot assessment, virtual thermal sensing, condition monitoring and future O&M decision support.

Expected Outputs & Future Use

At this stage, the work is presented as a modelling concept rather than a fully validated operational tool. The COMSOL model is expected to provide layer-specific losses, temperature distribution, hotspot locations and thermal exposure indicators under representative operating conditions.

These outputs can support future condition monitoring by acting as physics-based thermal estimates, particularly where embedded fibre-optic monitoring is limited or unavailable. The next step is to validate the model using measured cable temperature data or suitable thermal proxy indicators before applying it to historical SCADA data and ageing assessment.

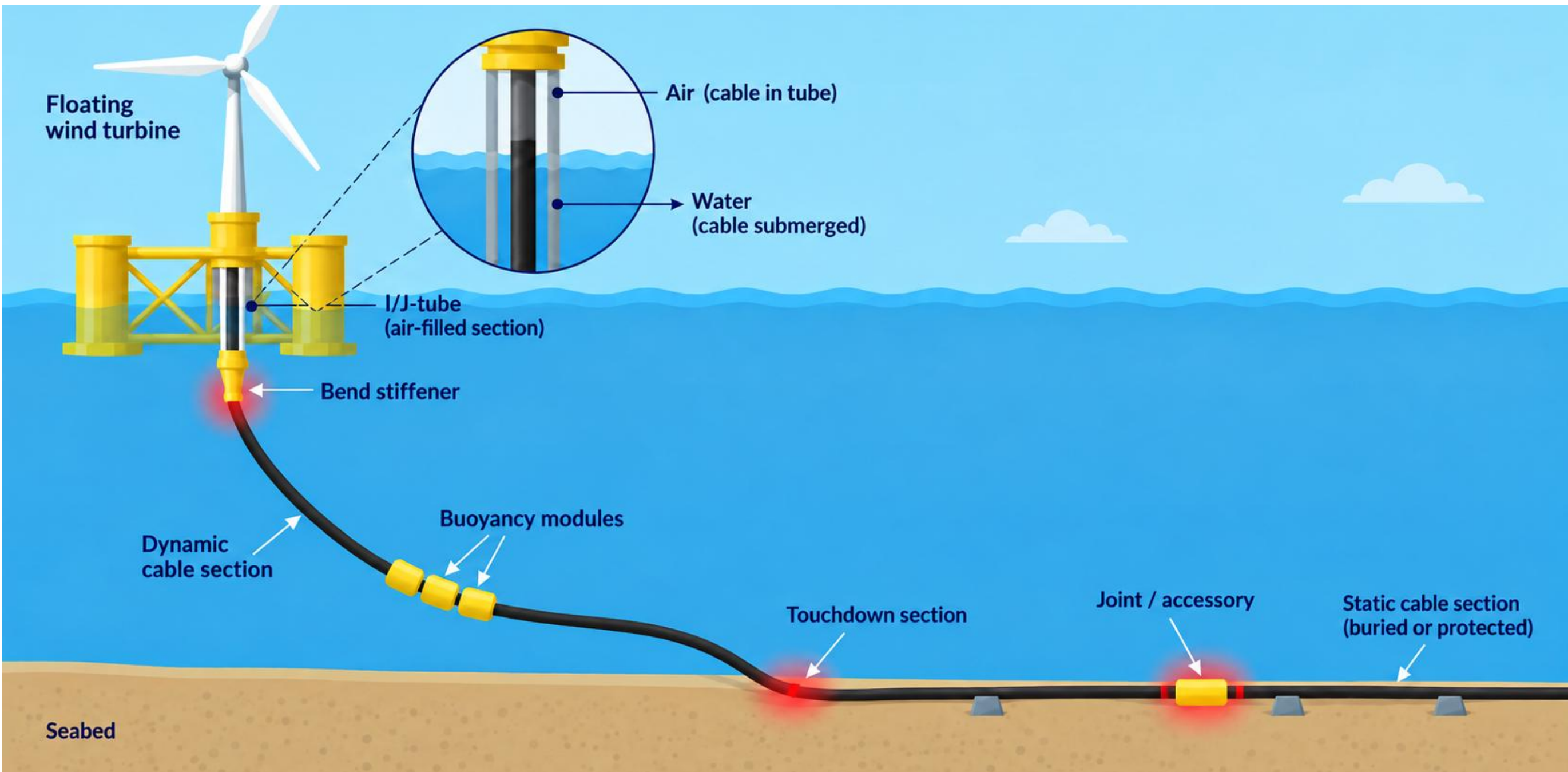


Figure 2. Conceptual floating offshore wind cable layout showing key regions for hotspot assessment, monitoring and O&M consideration. Prepared with assistance from ChatGPT (OpenAI) for illustrative purposes.

REFERENCES

[1] COMSOL, “Modeling Cables in COMSOL Multiphysics®: 8-Part Tutorial Series,” COMSOL Blog, 2020.

[2] CIGRE WG B1.56, *Power Cable Rating Examples for Calculation Tool Verification*, Technical Brochure 880, CIGRE, 2022.

