R&D Webinar - NESTORE Project Outcomes | 26/05/2026

Towards cumulative impact assessment of offshore wind farms

With the financial support of:

Uncertainties in models: Accounting for uncertainties in OWF impact assessment using ecosystem models.

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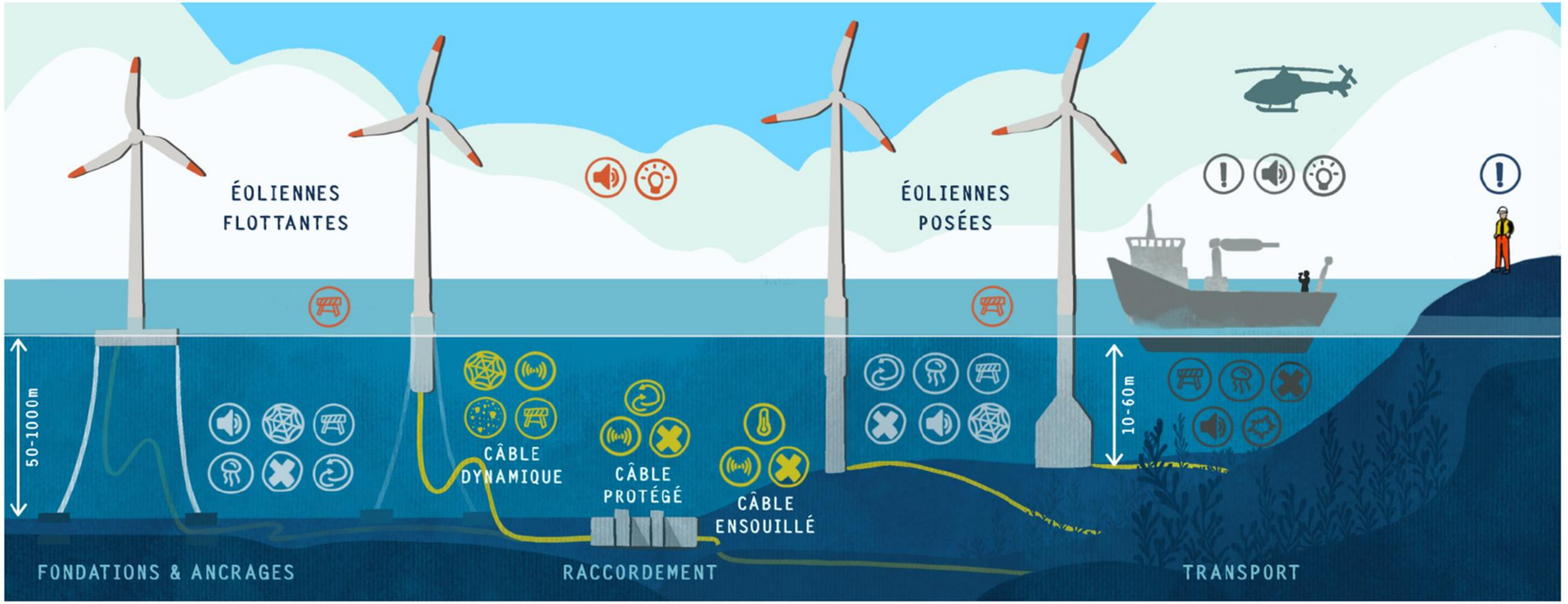
Diversity of OFW effects on marine ecosystem



- Habitat changes
- Turbidity
- Temperature modification
- Collision
- Entanglement
- Movement restriction
- Light emission
- Noise emission
- EMF emission
- New species introduction
- Disturbance
- Pollution

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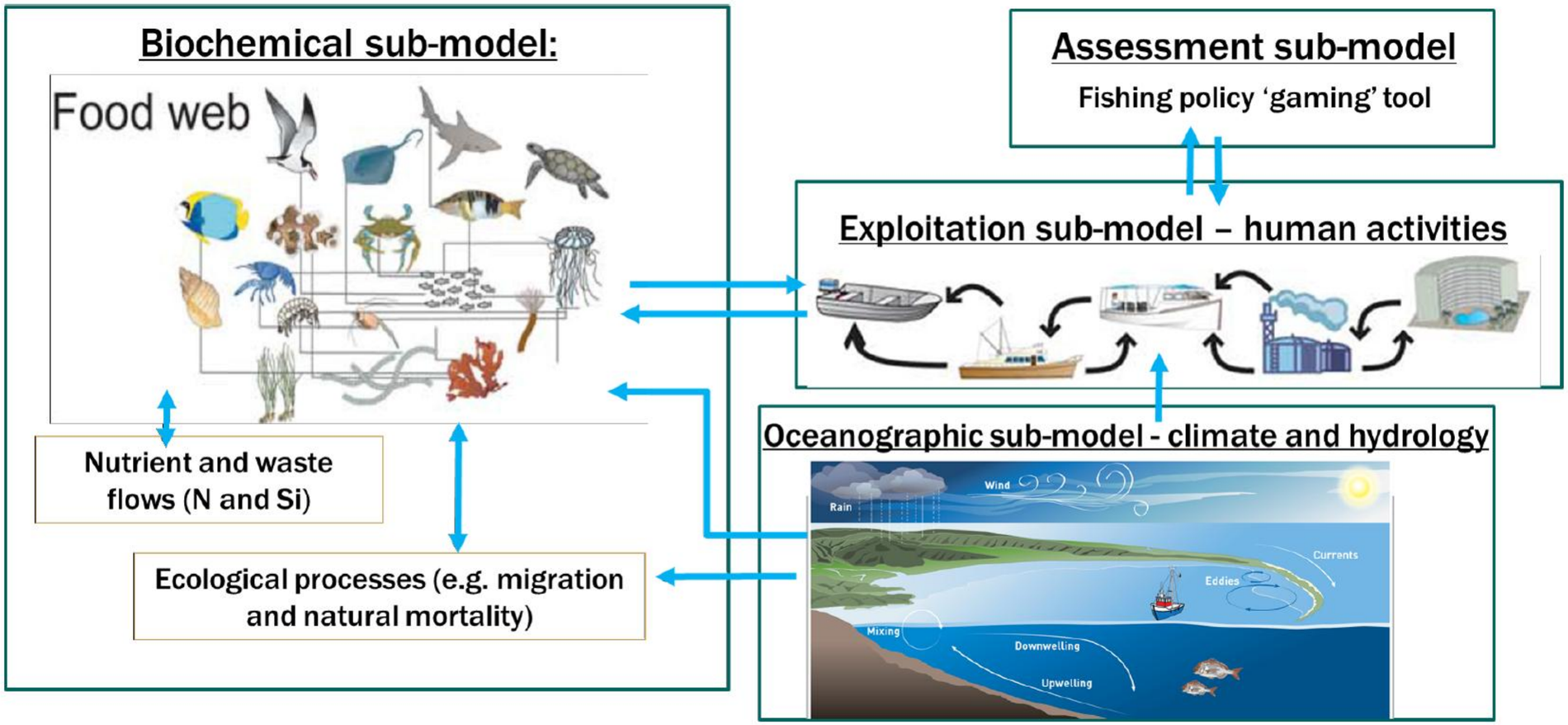
Marine ecosystem model and human impact assessment

« Managing and understanding complex system require complex tools adapted to system complexity »
(Ashby 1956, An Introduction to Cybernetics)



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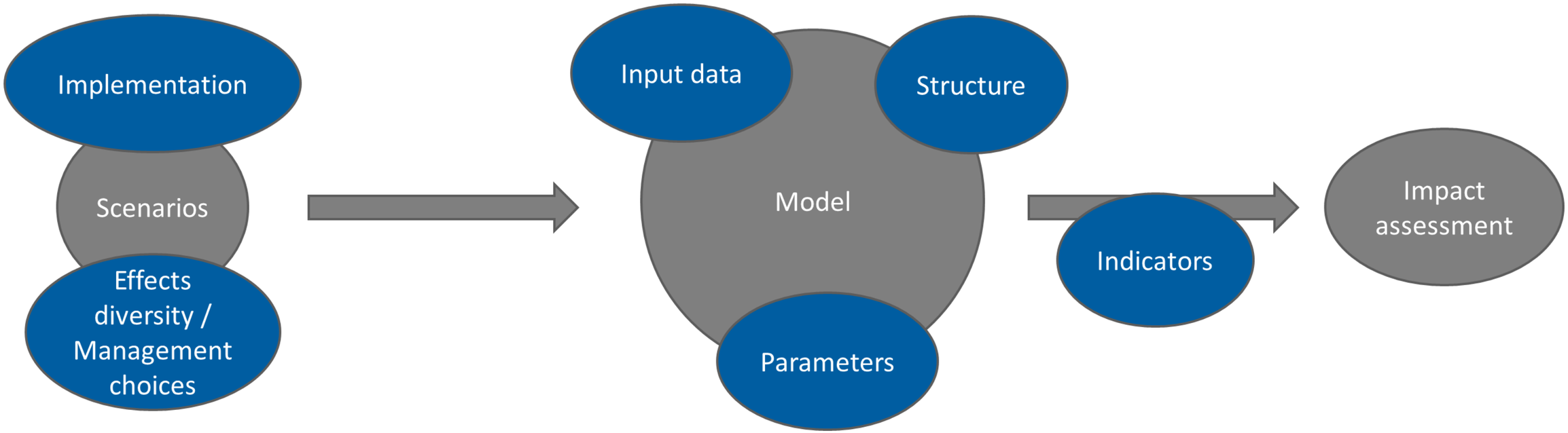
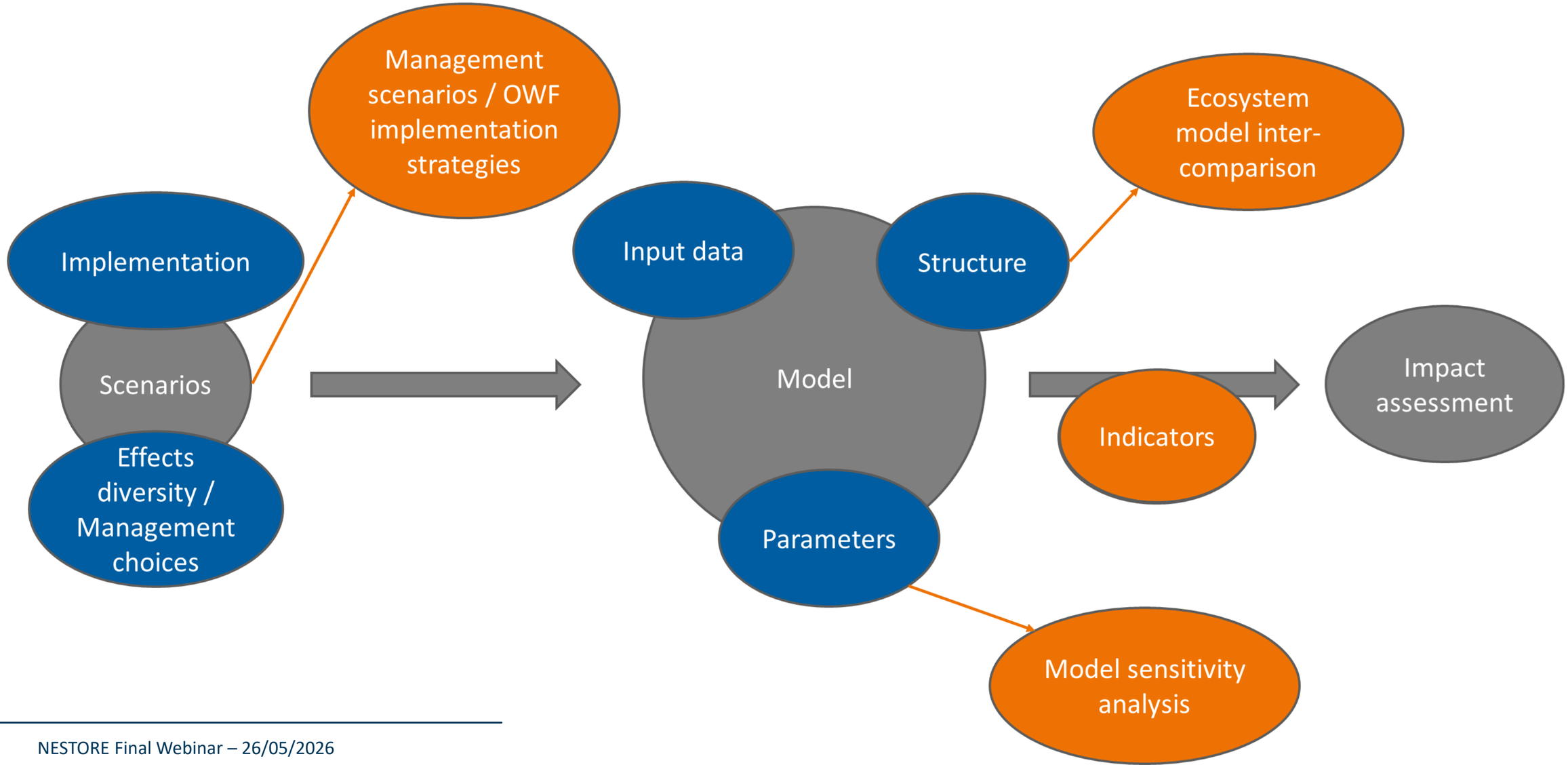
Sources of uncertainties in impact assessment modeling

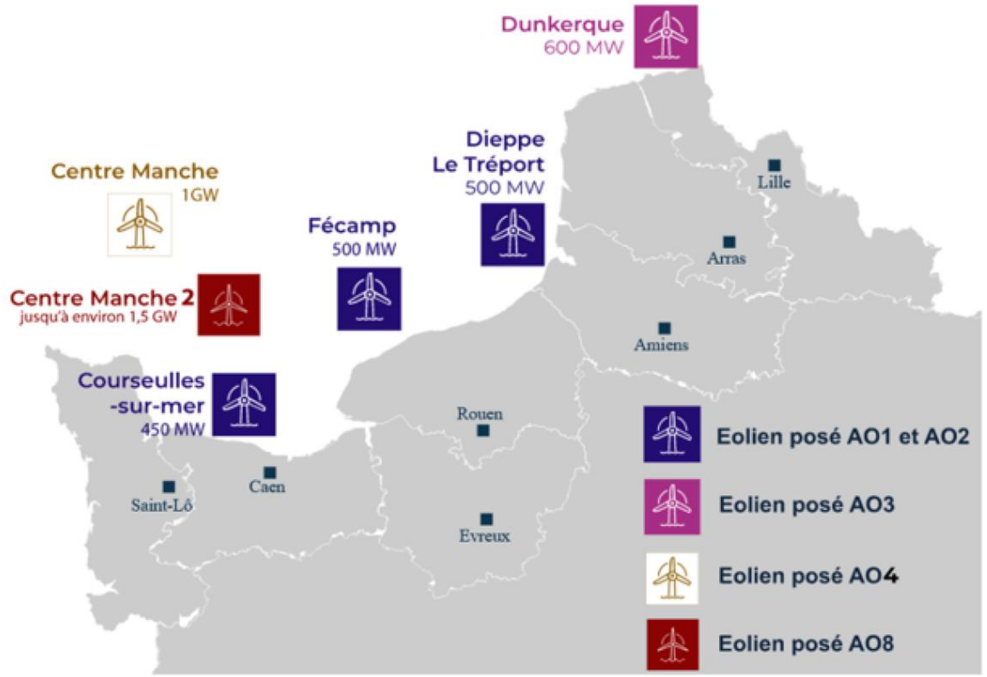


Sources of uncertainties in impact assessment modeling

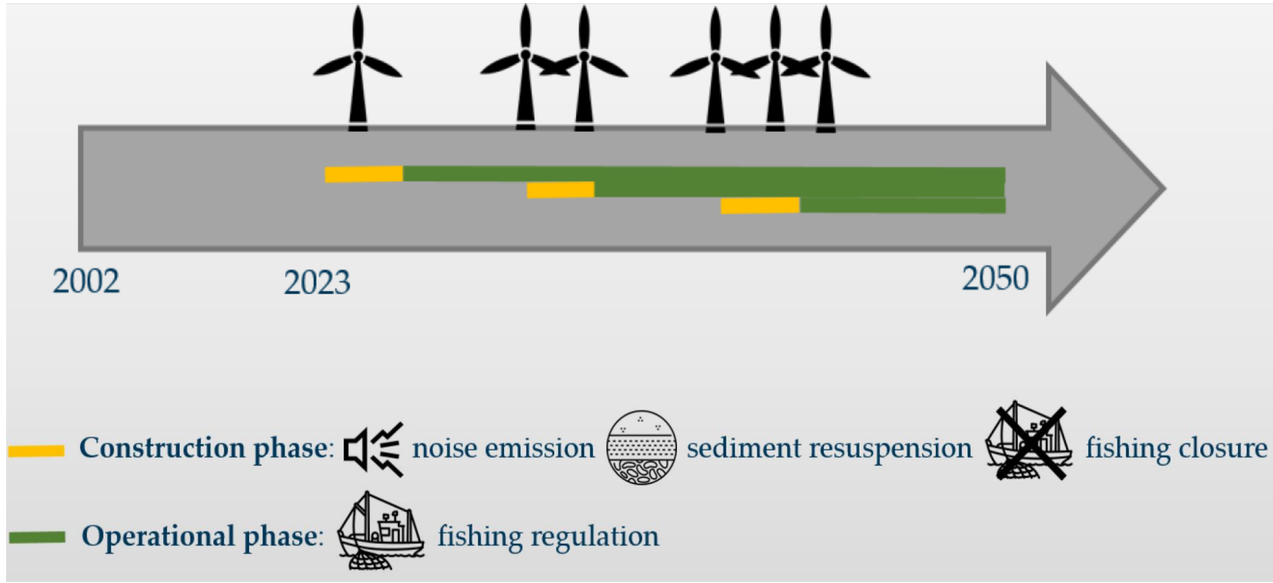


Scenarios implementation and management uncertainties

OWF impact assessment in the Eastern English Channel (EEC) accounting for several effects & OWF life cycle

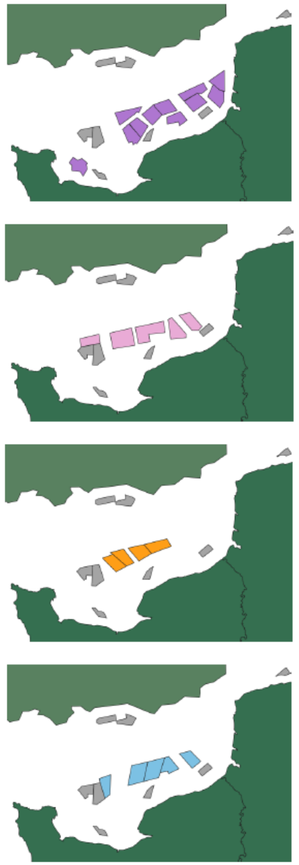


©Éolienne en mer en France



Scenarios implementation and management uncertainties

OWF deployment scenarios[1]



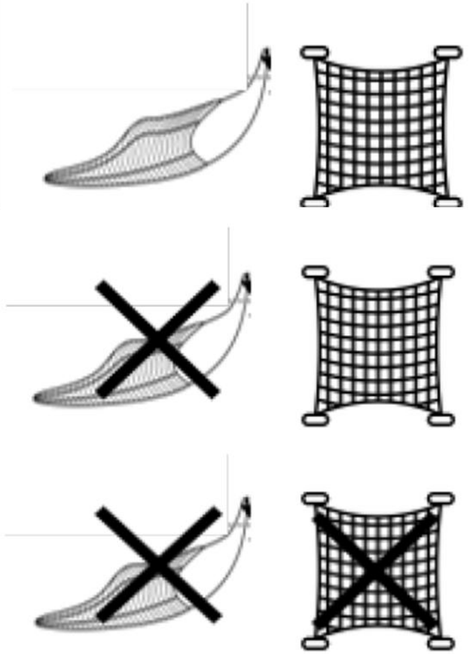
Energy cost efficiency

Outside protected areas

Distance from shore

Balance

Fishing scenarios within OWF during operational phase



No restriction

Closed to active gear

No Fishing

[1]L'éolien en mer en 2050, Syndicat des énergies renouvelables (SER), 2024

Model structure uncertainties

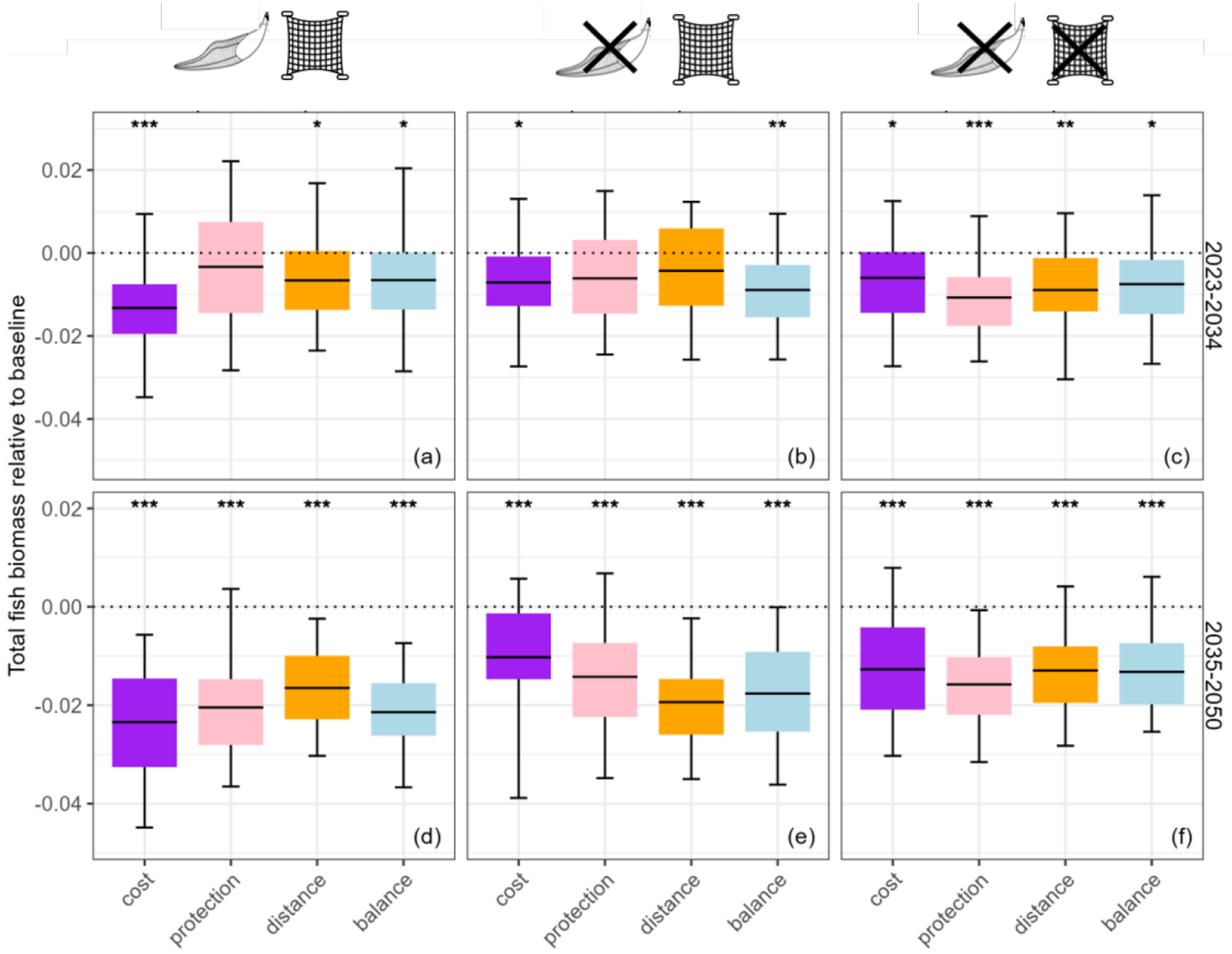
Compare ecosystem modeling approaches applied in the Eastern English channel

	OSMOSE[1]	Ecospace[2]
Main Hypothesis	IBM & opportunistic predation	Mass and energy conservation
Group definition	Super-individuals (Fish school)	Species or functional groups
Spatial coverage	Eastern English channel	Eastern English channel & southern North Sea
Calibration period	2002-2021	2006-2018
Biological groups	Fish, cephalopods, planktons and benthos	Fish, cephalopods, planktons, benthos, birds, and mammals
Fishing fleets	4	8
Species movement within distribution area	Stochastics	Biology, predation and habitat preference

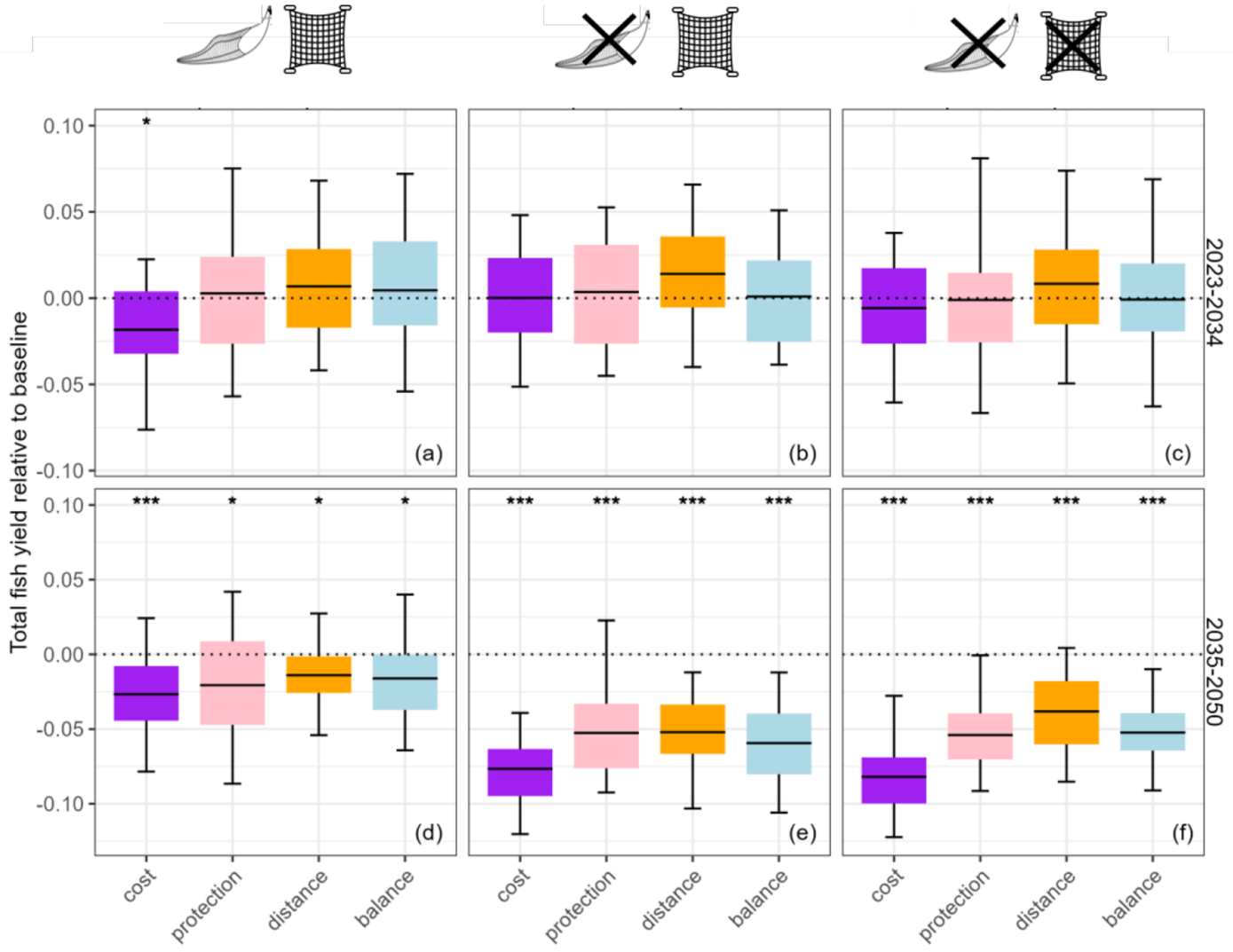
[1] Huang et al. 2025, An ecosystem modelling approach to assess potential impacts of offshore wind farms, ICES Journal of Marine Science

[2] Araignous et al. preprint, An End-to-End Modelling Approach to Evaluate Different Facets of Climate Change on the Eastern Channel and Southern North Sea Ecosystem

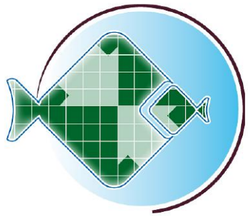
OWF impact assessment and scenario uncertainties



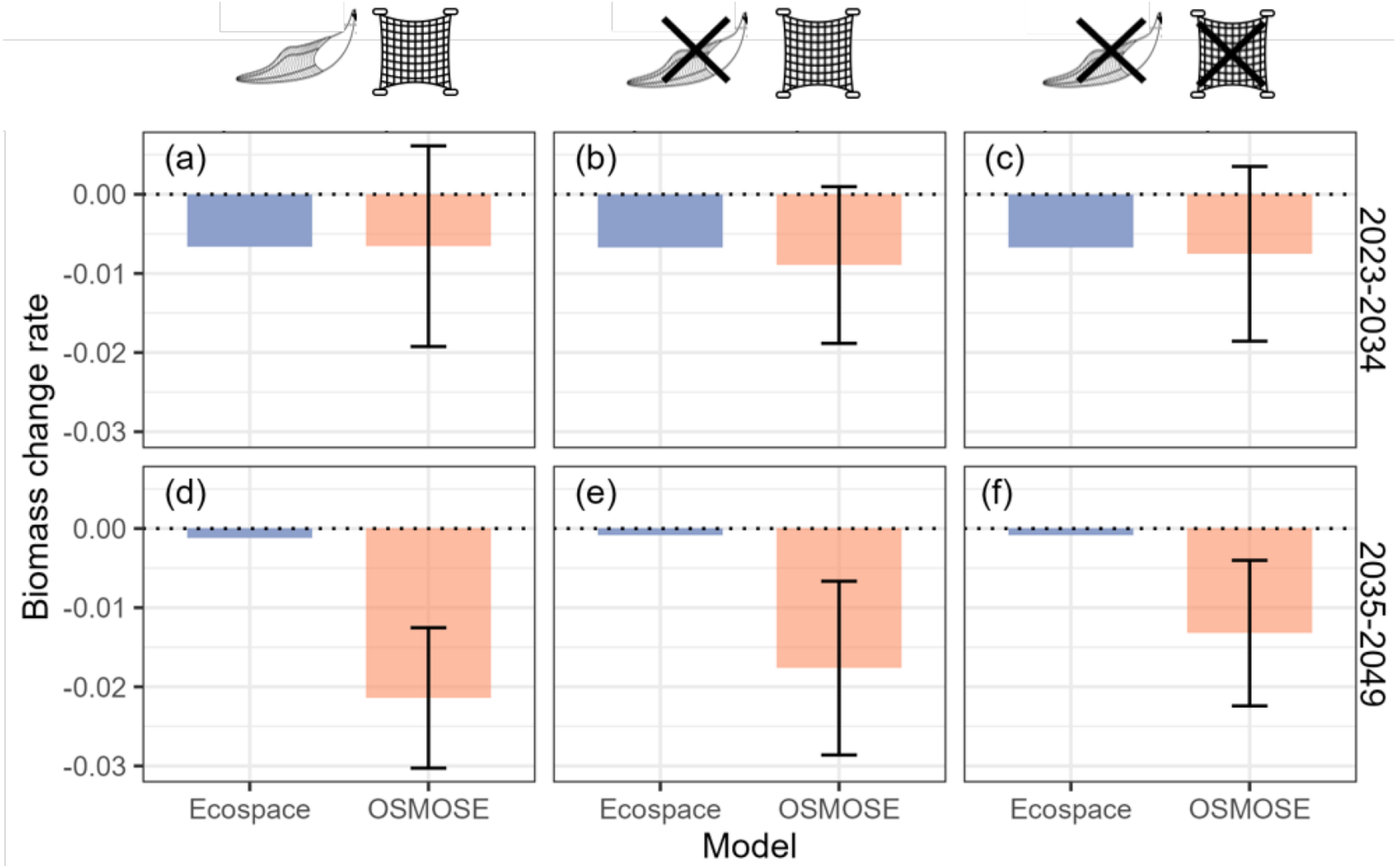
OWF impact assessment and scenario uncertainties



OWF impact assessment and structural uncertainties

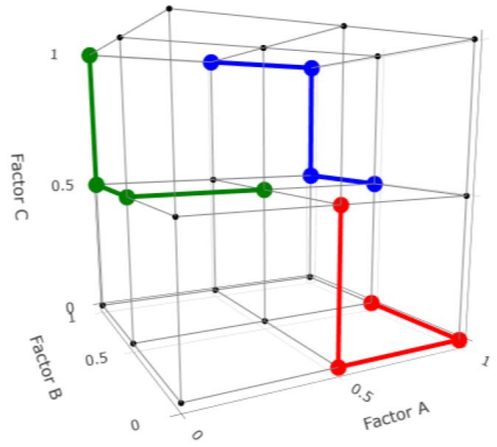


Balance



Parameter sensitivity analysis in OSMOSE

- 195 parameters governing growth, predation, mortalities, fishing
- ± 20% Perturbation with 8 values per parameter



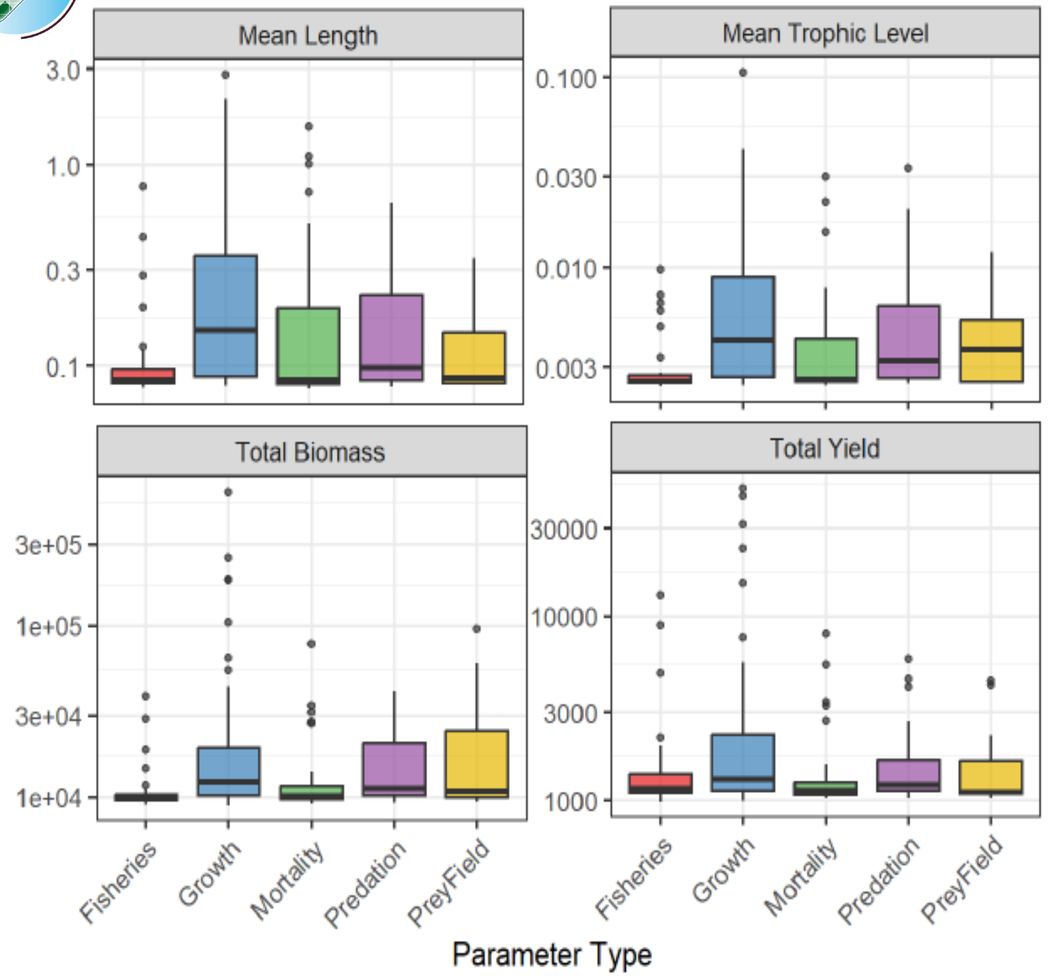
Morris OAT Factorial Plan :
2 million simulations

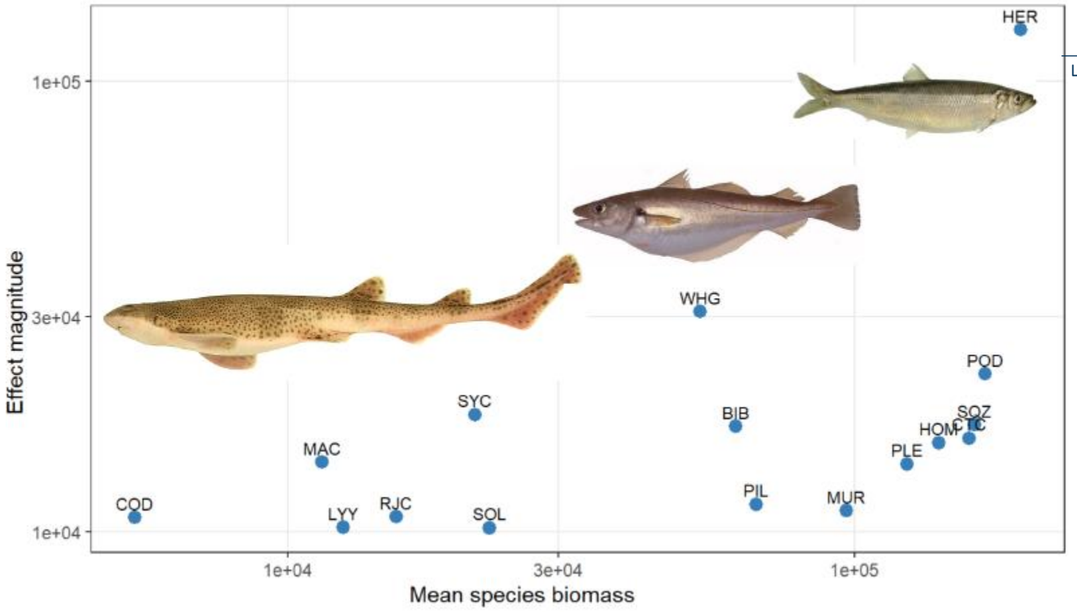
~ 10^172 years
of simulation
(Universe ~ 1.4 billion years)

~ 2-3 weeks of simulation
on DATARMOR

Morris 1991, Factorial Sampling Plans for Preliminary Computational Experiments
Huang et al. (under review), Global sensitivity analysis of a complex marine ecosystem model: Advancing the understanding of ecosystem functioning, *Ecological modeling*

Parameter sensitivity magnitude in OSMOSE EEC





Common name	FAO code
Lesser spotted dogfish	SYC
Striped red mullet	MUR
Pouting	BIB
Whiting	WHG
Poor cod	POD
Cod	COD
Dragonet	LYY
Sole	SOL
Plaice	PLE
Seabream	HOM
Mackerel	MAC
Herring	HER
Pilchard	PIL
Squid	SQZ
Cuttlefish	CTC
Thornback ray	RJC

Uncertainties in OWF impact assessment: Take-Home messages

- Overall effects of noise emission and sediment resuspension implemented through species displacement might lead to a small decrease of biomass

- Fishing closure within OFW during operational phase could compensate part of the decrease in biomass BUT at a greater loss (in tonnage) for the fishing sector.

- Model structure uncertainty leads to more or less persistent impact of the construction phase through time (OSMOSE vs Ecospace hypothesis)

- OFW effect affecting growth, herring, whiting and/or Lesser spotted dogfish are most likely to have an impact in OSMOSE EEC

Uncertainties in OWF impact assessment: Future works

- Development of models is required to properly account for other effects of OWF (Hydrodynamic, biogeochemical cycle, habitat or fishing behaviour modification...)
- Outcomes of the sensitivity analysis could tailor full uncertainty propagation analyses
- Propagation of uncertainties will allow for risk assessment in management strategy evaluation

Acknowledgement

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FRANCE ENERGIES MARINES

Thank you for your attention!