Post-Doctoral Fellowship: Proposal Outline

Topic	Ecological modelling; climate modelling; climate science; seasonal forecasting; hydrological modelling; oceanographic modelling; aquaculture; fisheries modelling; marine management and monitoring.
Research Theme(s)	Climate Modelling
Background and Rationale	Long-term climate change, extreme events, and seasonal variations in weather have profound impacts on water quality in open ocean and transitional coastal marine waters (tidal, estuarine, embayment) and in the lakes and rivers that flow into them. There is a pressing need for tools anticipating the impacts of these environmental changes, and enabling effective water management that safeguards the ecosystem goods and services freshwater and marine systems provide. The increasing availability of new meteorological data products and advances in modelling tools now mean that it is possible for the first time to produce reliable forecasts for marine, marine transitional, lake and river water quality on a regional and global scale, an unexploited potential in the water sector and for those sectors upon which their economic activity depends on high quality freshwater and marine aquatic ecosystems. For example, in transitional marine environments, particularly coastal waters where salmon farming and other aquaculture activities (shellfish culture) are undertaken, the outputs of seasonal and longer-term projections of climate would be critical for on-farm management of salmon parasites (e.g. sea lice, Amoebic Gill Disease, jelly fish) and determination of future parasite loadings and the associated risk to co-occurring wild salmonids in salmon farming areas[1]. Seasonal forecasting of microbiological hazards to do with raw and partially treated sewage and other sources of waste (e.g. agriculture) received from discharging rivers would be an essential component of shellfish management, particularly in the context of public health[2]. In rivers accurate forecasts of future temperatures and flow regimes will be critical for the identification of future climate sensitive habitats and for climate sensitive aquatic species and subsequently in the development of adaptive strategies for their protection[3,4]. In a broader ocean fisheries context model outputs could be used in combination with fishing data at both at global and regional scales to examine food-web and ecosystem responses to climate variability separating the relative influence of temperature and net primary productivity on future projections of fish stock productivity[5].
Scope of Research (Scientific/ Technical Challenge)	The overarching aim of this fellowship would be to evaluate the potential of and to deploy seasonal forecast models to project likely environmental and ecological responses to future climate change in open ocean, river and lake, and in transitional marine ecosystems in a number of environmentally and socio-economically relevant case studies

The fellowship should address four key research objectives as follows:

- Case study selection;
- Model selection and development;
- Model application and validation;
- Application of models outputs in respect to management.

Expected Impact(s)	The fellow will engage with relevant national and international networks, and explore opportunities for collaboration and securing further research funding under Horizon Europe. This fellowship will help to build national expertise in this research area. The fellow will produce policy briefs for stakeholders, and publish their research findings as widely as possible through peer-reviewed papers, conference presentations, articles, etc.
Outcomes	A 'Fellow' equipped and working effectively in climate science and forecasting and the associated disciplines of climate modelling, ecological modelling, statistical and mathematical modelling. The development within the Marine Institute of state-of-the-art capabilities in climate modelling with critical potential for practical/applied application in the key areas of responsibility in fisheries, aquaculture and biodiversity protection.
Specific Collaboration	Specific collaborations will depend on case studies selected. In marine and marine transitional waters collaborations could be with the salmon farming interests; agencies responsible for the marine spatial planning; agencies responsible for marine biodiversity. In freshwater and transitional waters partnerships might be developed with agencies and interest groups associated with diadromous fish.
Location of Fellow	Marine Institute – Newport, Co Mayo
Duration and Funding Available	4 years €100,000 per annum (i.e. total €400,000 maximum for duration of four years)

References	1. 1. Rittenhouse, M. A., Revie, C. W., & Hurford, A. (2016). A model for sea lice (*Lepeophtheirus salmonis*) dynamics in a seasonally changing environment. *Epidemics*, *16*, 8–16. 2. Rupnik, A., Keaveney, S., Devilly, L., Butler, F., & Doré, W. (2018). The Impact of Winter Relocation and Depuration on Norovirus Concentrations in Pacific Oysters Harvested from a Commercial Production Site. *Food and Environmental Virology*, *10*(3), 288–296. 3. Jones, E.R., Bierkens, M.F.P., Wanders, N. *et al.* Current wastewater treatment targets are insufficient to protect surface water quality. *Commun Earth Environ* **3**, 221 (2022). 4. Wanders, N., van Vliet, M.T.H., Wada, Y., Bierkens, M.F.P. & van Beek L.P.H. (2019). High-Resolution Global Water Temperature Modeling. *Water Resources Research* 10.1029/2018WR023250. 5. Tittensor, D.P., Novaglio, C., Harrison, C.S. et al., (2021). Next generation ensemble projections reveal higher climate risks for marine ecosystems. *Nature Climate Change*, 11, 973–981.