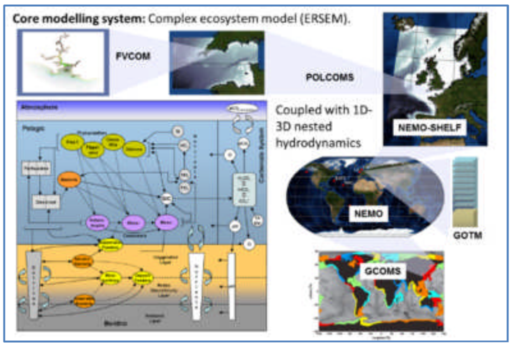
# European Regional Seas Ecosystem Model (ERSEM)

**Model type:** ERSEM is a planktonic ecosystem model has been coupled to a number of different hydrodynamic models. It describes the biogeochemical cycling of carbon and the nutrients nitrogen, phosphorous, silicon, oxygen, iron. The ecosystem is subdivided into three functional types: producers (phytoplankton), decomposers (bacteria) and consumers (zooplankton), and then further subdivided by trait (size, silica uptake) to create a foodweb. Physiological and population processes are included in the descriptions of functional group dynamics. Four phytoplankton, three zooplankton and one bacteria are represented, along with the cycling of carbon, nitrogen, phosphorous, silicon, and oxygen through pelagic and benthic ecosystems.




**Existing Models for UK shelf seas:**

| Area Modelled | Includes | | Spatial Scale | | Quality (data used) |
|---|---|---|---|---|---|
| | Hydro | BGC | Domain | Res. (km) | |
| Water column (GOTM-ERSEM) | x | x | Any location | N/A | 4,6,8, 14, 16, 22 |
| Global (NEMO) | x | X | Global | 111 | 8, 11, 19, 20, 21, |
| North Atlantic (NEMO) | x | x | 20S-80N, | 28 | 8, 11,19, 20, 21 |
| North Atlantic (NEMO-shelf) | x | X | 20N-80N, | 7 | 8, 11,19, 20, 21 |
| Irish and Celtic Seas (FVCOM) | x | X | 48.8-56.8N, 9.6-2.5W | 3.5 | 7, 23, 24, 25 |
| NW European shelf (NEMO) | | X | 40N-65N,20W-13E | 7 | 3, 8, 11, 12, 13, 14, 19 |
| NW European shelf (POLCOMS) | x | X | 40N-65N,20W-13E | 10 | 3, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19 |
| NW European shelf (POLCOMS with data assimilation) | x | X | 40N-65N,20W-13E | 10 | 2, 3, 8, 9, 10, 12 ,13, 14, 15, 17 |
| AMM7 NW European –Baltic – GCOMS | x | X | 46.4-63N, 17.5W-13E | 10 | 3, 8, 11, 14, 17, 18 |
| WEC | x | X | 48.5-50.9N, 7.6-1.25W | 1.9 | 2,4,8,12,13,14 |
| WEC (data assimilation) | x | x | 48.5-50.9N, 7.6-1.25W | 7 | 1,2,4,8,12,13,14 |

1. Glocolour ocean colour, 2. ESA CCI ocean colour, 3. North Sea Project cruises, 4. Western Channel Observatory, 5. Tide gauges, 6. Smart Buoy data 7. NCEP reanalysis, 8. World Ocean Atlas, 9. ICES temperature and salinity, 10. ICES nutrients and chlorophyll, 11. IPCC climate forcing (HADGEM, IPSL, ECHAM), 12. EA riverine nutrients data, 13. European river data, 14. ECMWF reanalysis meteorology. 15. DMI reanalysis meteorology, 16 ESSC ocean reanalysis, 17-GLORYS reanalysis, 18-GLOBAL NEWS river data, 19 GLODAP, 20 DFS atmospheric reanalysis, 21 GEM/GLORI river data, 22 BATS data, 23 HF Radar and CTD Data 24 NTSLF data, 25 CEH river discharge and temperature

**Existing uses:**

- **Natural resources:** understanding biogeochemical cycles, biodiversity, and valuation of ecosystem services.
- **Resilience to environmental hazards**: eutrophication, microplastics, fishing pressure, invasive species and harmful algal blooms. Impacts of offshore renewable energy and ecological risks of carbon capture and storage.
- **Environmental change:** climate change impacts, ocean acidification, multiple stressors, and sustainable fisheries.
- Run operationally by the UK Met Office to predict water quality.
- Estimation of the carbon budget of the UK shelf.

**Potential new uses:**

- Understanding shelf seas carbon ('blue carbon') and nutrient budgets (past and future climate).
- Expansion to represent biodiversity-relevant processes over a range of spatial and temporal scales, and simulate changes in function in the context of ecosystem services.
- Implementation and testing scalable models of differing complexity.

**Key modelling issues:**

- Setting inputs (parameterisation) and testing outputs against real data (calibration) is an essential, but resource-intensive and on-going process to ensure quality and improve predictions. Understanding the impact of changing inputs on the outputs from the models (sensitivity) and the effect of uncertainty in model parameters on robustness of model predictions.
- Challenge to assess model capability with respect to seasonal variability, long-term changes, regime shift and tipping points due to limitations of the data available.
- Complexity of model leads to a need for significant interpretation and explanation for stakeholders.
- Potential mismatch between scales of model output and data sets.
- Significant expertise needed to operate system and high performance parallel computing facility required.

**For further details contact:** Prof Icarus Allen (jia@pml.ac.uk)