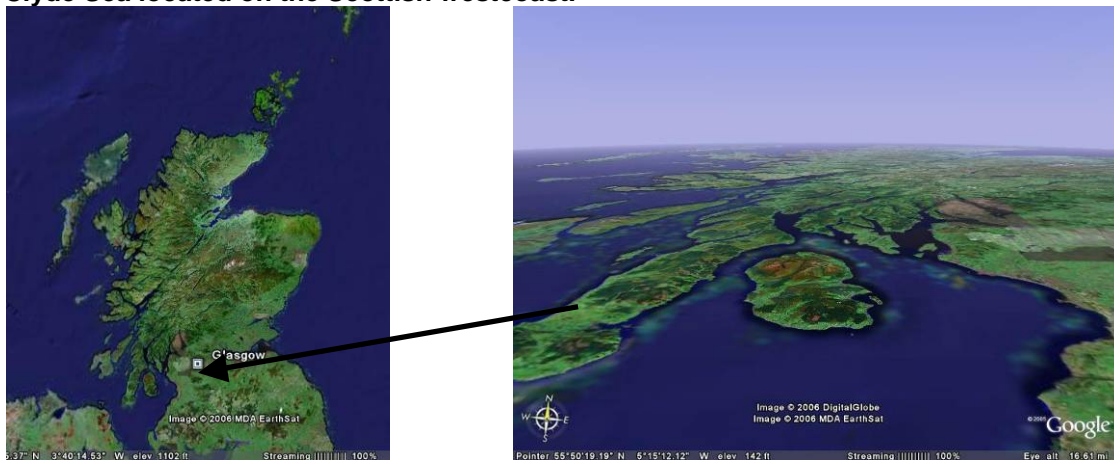


WT 7.7 THE CLYDE SEA

1. Host Institution: Scottish Association for Marine Science. **Contact:** Kenny Black, Kenny.Black@sams.ac.uk

2. The Clyde Sea located on the Scottish westcoast.



3. Characteristics

<i>Marine System</i>	The Clyde Sea is Scotland’s largest and deepest (190 m) fjordic system. It is marine dominated but separated from the Northern part of the Irish Sea by a shallow (50 m) sill. Deep water remains isolated from the surface during the summer months because of a strong seasonal density gradient. Vertical mixing is dominated by internal waves generated at the sill.
<i>Watershed</i>	It receives inputs from several smaller sea loch systems each with its own restrictive sill, and the Clyde River system, which passes directly through Scotland’s major conurbation, Glasgow (pop. ~1 million). The Clyde river extends into the Southern Uplands with a catchment of 3900 km ² above Greenock. The Clyde Lochs include Fyne, Gairloch, Goil, Holy Loch, Long and Stiven which penetrate the Highlands to the north, together having a catchment of 693 km ² and runoff of 1.3x 10 ⁹ m ³ yr ⁻¹ . The rural catchment is dominated livestock production. Higher ground is a mixture of moorland, intensive forestry and sheep farming. Until the 1990s, sewage sludge from the Glasgow area was dumped in the central Clyde Sea but is now processed through several large treatment works with long-sea outfalls. The Ayrshire coast has several industrial chemical manufacturing facilities discharging into the Clyde.
<i>Human Activities</i>	Shellfish and Finfish Fisheries and Aquaculture, Agriculture, Industrial and Urban Effluents, Forestry, Tourism, Shipping, Sailing
<i>Impact Responses</i>	Nutrient enhancement, Habitat Destruction, Biodiversity changes, Trophic Web Change, Pathogens/toxins

4. Policy

<i>Policy issues</i>	The carrying capacity for shellfish culture and the assimilative capacity for finfish culture. Consequences for fishing and aquaculture of increased recreational sailing activity in terms of space competition both at sea and in harbours. What is the sustainable harvest of wild shellfish and finfish. The role of Marine Protected Areas for enhancing fisheries and for conservation. The consequences for the ecosystem of reduced sewage inputs.
<i>Policy changes</i>	Aquaculture planning processes transferring from National to Local Authority. Implementation of the WFD and Catchment Management Planning Marine Spatial Planning proposals. Proposed UK Marine Act.

5. Stakeholders and Institutional Governance

<i>Major organisations</i>	Scottish Environmental Protection Agency Scottish Natural Heritage Scottish Executive DEFRA
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	Fisheries Research Services
<i>Other leading organisations</i>	Scottish Coastal Forum Firth of Clyde Forum Argyll Fisheries Trust Scottish Quality Salmon Association of Scottish Shellfish Growers Clyde Fishermans Association

6. Partner Collaboration

SPICOSA Partner Collaborations.	Partner: UoP Plymouth Marine Laboratory; UC University of Cardiff, Department of Earth Sciences ; NUE University of Napier, School of Life Sciences.
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7. Systems Studies

<i>Long time series</i>	<p>Few long-time series for any parameter exist on the marine west-coast of Scotland but many research projects have made multiple year measurements of a wide range of parameters. Water quality measurements have been made in the Clyde River system for many years. There is a long time series (~40 years) of surface Temperature and Salinity at the Isle of Cumbrae withi8n the Clyde Sea and a much longer series from the Isle of Man to the South of the Clyde Sea. Several major European Projects such as PROVESS and OARRE have studied the Clyde as have many institutions from around the UK. SAMS has short time series (1-3 years) for a wide range of physical and chemical data taken over the past 100 years.</p> <p>Input data on weather can be obtained from several sources, river-borne nutrient data from can be obtained from SEPA together with some physical and nutrient data and details of all industrial discharges to the area; data from the former Clyde Sewage Sludge Dumping Ground is readily available.</p>
<i>Research Projects</i>	<p>PROFILE: Processes in regions of freshwater influence PROFILE, an EU MAST2 project, generating understanding of processes relating to hydrodynamics, sediments dynamics and microbiology, incorporated in a tested fully coupled model for regions of freshwater influence (ROFIs) was completed successfully in 1996. Studies of the discharge into an idealised Clyde Sea using the POL 3D-B model showed that the area of freshwater stratification near the river mouth, forming a bulge of a typical river plume in a low friction, low entrainment case, could readily form a persistent region of anticyclonic circulation. This can then affect the direction of subsequent discharges as the outflow varies in time.</p> <p>OAERRE: Oceanographic Applications to Eutrophication in Regions of Restricted Exchange EU FP5 OAERRE's objectives were:</p> <ol style="list-style-type: none"> 1. Observations of the physics of vertical and open boundary exchange in Restricted Exchange Environments (REEs), leading to improved parameterisation of these processes in research and simplified models. 2. Study of the phytoplankton and pelagic micro-heterotrophs responsible for production and decomposition of organic material, and of sedimentation, benthic processes and benthic-pelagic coupling, in REEs, with the results expressed as basin-scale parameters. 3. Construction of closed budgets and coupled physical-biological research models for nutrient (especially nitrogen) and organic carbon cycling in REEs, allowing tests of hypotheses about biogeochemistry, water quality and the balance of organisms. 4. Construction of simplified 'screening' models for the definition, assessment and prediction of eutrophication, involving collaboration with 'end-users', and the use of these models to analyse the costs and benefits of amelioration scenarios. <p>OAERRE is a collaboration amongst physical, chemical and biological oceanographers, and coastal resource managers, with intensive studies relating to eutrophication at sites that exemplify a range of hydrographic and enrichment conditions.</p>