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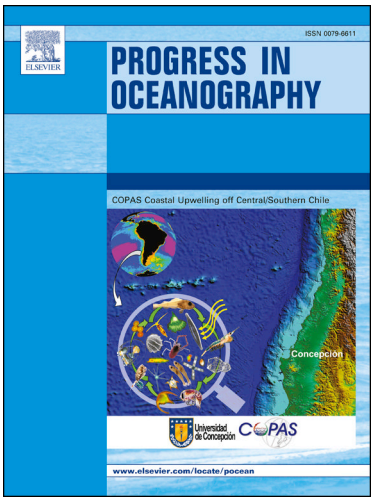

Decadal variability on the Northwest European continental shelf

Sam Jones, Finlo Cottier, Mark Inall, Colin Griffiths

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Sam Jones[a*], Finlo Cottier[a], Mark Inall[a], Colin Griffiths[a]
[a] *Scottish Association for Marine Science, Oban, Argyll, PA371QA, UK*

**Corresponding author*
Email: Sam.Jones@sams.ac.uk
Tel: +44 (0) 1631 559322

Abstract

Decadal scale time series of the shelf seas are important for understanding both climate and process studies. Despite numerous investigations of long-term temperature variability in the shelf seas, studies of salinity variability are few. Salt is a more conservative tracer than temperature in shallow seas, and it can reveal changes in local hydrographic conditions as well as transmitted basin-scale changes. Here, new inter-annual salinity time series on the northwest European shelf are developed and a 13 year high resolution salinity record from a coastal mooring in western Scotland is presented and analysed. We find strong temporal variability in coastal salinity on timescales ranging from tidal to inter-annual, with the magnitude of variability greatest during winter months. There is little seasonality and no significant decadal trend in the coastal time series of salinity. We propose 4 hydrographic states to explain salinity variance in the shelf area west of Scotland based on the interaction between a baroclinic coastal current and wind-forced barotropic flow: while wind forcing is important, we find that changes in the buoyancy-driven flow are more likely to influence long-term salinity observations. We calculate that during prevailing westerly wind conditions, surface waters in the Sea of the Hebrides receive a mix of 62 % Atlantic origin water to 38 % coastal sources. This contrasts with easterly wind conditions, during which the mix is 6 % Atlantic to 94 % coastal sources on average. This 'switching' between hydrographic states is expected to impact nutrient transport and therefore modify the level of primary productivity on the shelf. This strong local variability in salinity is roughly an order of magnitude greater than changes in the adjacent ocean basin, and we infer from this that Scottish coastal waters are likely to be resilient to decadal changes in ocean climate.

Keywords

European, Scottish, salinity, variability, wind, shelf

Abbreviations: SPG: Subpolar Gyre, SS: Surface Salinity, SCC: Scottish Coastal Current, SoH: Sea of the Hebrides, TPM: Tiree Passage Mooring, SAMS: Scottish Association for Marine Science, ROFI: Region of Freshwater Influence, TPC: Tiree Passage Composite time series, ESS: Ellett Line Surface Salinity time series, NAO: North Atlantic Oscillation