

The shelf sea seasonal thermocline – physical variability and the biological response

Jonathan Sharples

*Proudman Oceanographic Laboratory, Joseph Proudman Building,
6 Brownlow Street, Liverpool L3 5DA*

The seasonal thermocline is an important zone of summer primary production, potentially providing organic fuel for the pelagic and benthic communities in stratified shelf regions during summer. The primary producers within this thermocline grow within a region of very low light and weak nutrient supply, and so are strongly dependent on the variability of physical processes, particularly turbulent mixing. This component of the shelf sea carbon cycle is invisible to mapping by satellites, and is a difficult feature to sample on a large scale using research vessels.

During a recent cruise through the Irish and Celtic Seas we attempted to sample this thermocline variability. A number of intensive 25-hour stations were carried out, measuring turbulent mixing, primary production, nutrient fluxes, and phytoplankton physiological state. These stations sampled a variety of thermocline types. They ranged from the shelf edge (with strong internal tidal oscillations generating high nutrient fluxes but also a highly variable light environment), through strongly and weakly stratified open shelf regions, to the vertically-homogeneous water of the Irish Sea. High-resolution cross-shelf surveys of the basic physical structure of the thermocline, and the chlorophyll and physiological patterns within it, provided the horizontal context within which these different stations could be understood. In this talk I will use this data to illustrate several key, but not fully understood properties of the thermocline physics and primary production. Within the apparently stable, stratified open shelf sea there was marked variability in physical and biochemical conditions in space (a strong dependence on both depth and local topographic variability) and time (meteorological variability, along with the spring-neap modification of mixing). The physiological status of the primary producers was remarkably uniform over the shelf sea, but changed abruptly at the shelf edge possibly as a result of the extreme internal mixing.

The observations will be discussed in terms of the increasing need to be able to model whole-shelf systems. Many of the questions we might want answering in shelf seas can arguably only be answered with numerical models, but our data illustrate some important requirements for any valid modelling exercise that are not yet fully met. Examples are the parameterisation of sub-gridscale internal mixing, the accuracy and resolution of bathymetric datasets, and our limited understanding of photosynthesis and nutrient assimilation within the thermocline.