

Introduction

At the north-western margin of the European Continental Shelf the waters of western Channel exhibit hydrographic and biological properties characteristic of coastal and Atlantic regimes. The region heavily stratifies to the west of Plymouth with strong frontal boundaries in the region of the Ushant front and lesser gradients in the central channel. Hydrographic data have been collected in the English Channel since the beginning of the 20th century (Matthews, 1907 quoted in Pingree, 1980), however much of this data is from research cruises operating over limited time periods and a coherent understanding of commonly observed features using modern instruments is yet to be fully established.



Figure 1: Survey Lines covered during Corystes 8 and 11/03

Lagrangian Circulation

Observations of the physical and nutrient structure of the Western English Channel were made from the R.V Corystes during 26th – 9th July (Cor 8/03) and 14th – 27th August 2003 (Cor 11/03). During the intervening period, Lagrangian measurements of the flow were made using satellite tracked drifting buoys and two thermistor chains were deployed between the cruises. The locations of towed undulating CTD sections and mooring deployments are shown in Figure 1, with drifter tracks shown in Figures 2a and 2b. Hourly values of wind speed and direction (Figure 3b) were available from a mesoscale meteorological model (Cullen, 1993) at 10 m above sea level at position 51° 30' N 6° 00' W

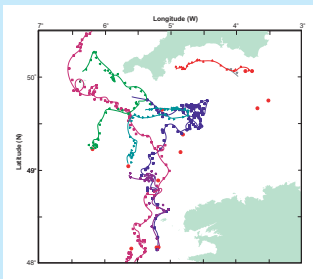


Figure 2a: Argos Drifters not wind driven

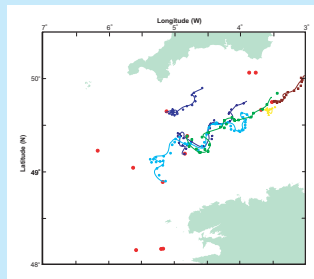


Figure 2b: Significantly wind driven drifters

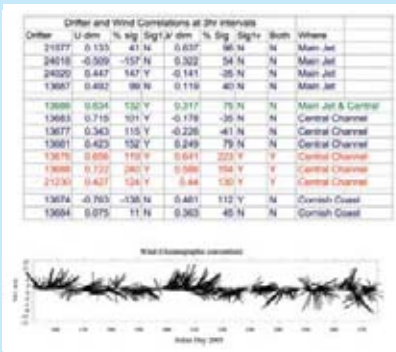


Figure 3a: Correlation of fluctuating component of Drifter Velocities with the wind at 3 Hr Intervals. With wind velocity from mid channel

The drifters were correlated with winds so that significant driven flows could be derived. Three groupings were evident, those in the main jet region where flows were typically 14–20 cm s⁻¹ and were not correlated with the wind (blue). Those in the Central region where the tracks were significantly correlated and flows were typically < 5 cm s⁻¹ and those along the Cornish coast which were not wind driven and had velocities in the region 8–12 cm s⁻¹ (blue).

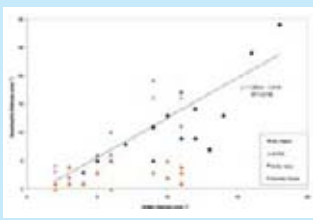


Figure 3b: Geostrophic Velocity Estimate versus Drifter Velocity

References

- Lyons et al., 2004. Observations of the structure of *Karenia Mikimotoi* in relation to the physical structure in the Western Channel/UK Marine science 2004. Liverpool.
- Matthews, D. J. 1907. Report on the physical conditions in the English Channel and adjacent waters, 1906, with a note on the mean conditions for 1903–1909. Rep. North Sea Fish. Invest. Comm. (1906–1908), 269–282.
- Pingree, R. D. (1980) *Physical Oceanography of the Celtic Sea and English Channel*. In: Banner, T. L., Collins M. B., Massie K. S. (eds) *The north-west European shelf seas: the seabed and the sea in motion 2. Physical and chemical oceanography and physical resources*. Elsevier, New York, p 638.

Density Structure

The strong bathymetry change and increased tidal mixing results in a strong bottom front at this location which drives a strong jet flow North confirmed by the ARGOS drifters. Inshore salinity contributed to the buoyancy difference but temperature is the primary determined of the density structure in the remainder of the section.

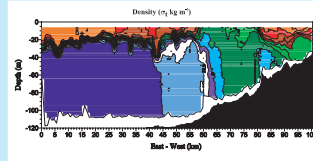


Figure 4a: Density Section, from undulating CTD (scanfish) section along the southern most line from Atlantic margin into the Brittany coast near Brest (red line on figure 1)

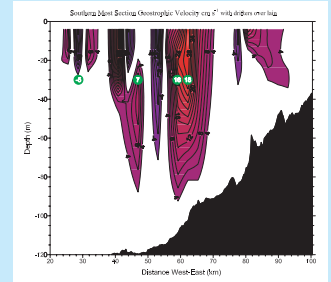


Figure 4b: Geostrophic Velocity estimate referred to the bed, with drifter velocities overlain

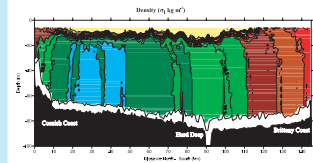


Figure 5: Density Section in the Central Channel (red line on figure 1)

The shallow thermocline and well mixed conditions on the Brittany coast are indicative of the strong tides in this region which increase to the Brittany coast. Evident on the Cornish coast are strong bottom fronts while towards the French coast the horizontal gradients are much weaker.

Regional Circulation

Circulation mosaic of the seasonal circulation showing major geostrophic pathways and drifter tracks from the Celtic Sea in 1998 and the west coast of Ireland in 2001.

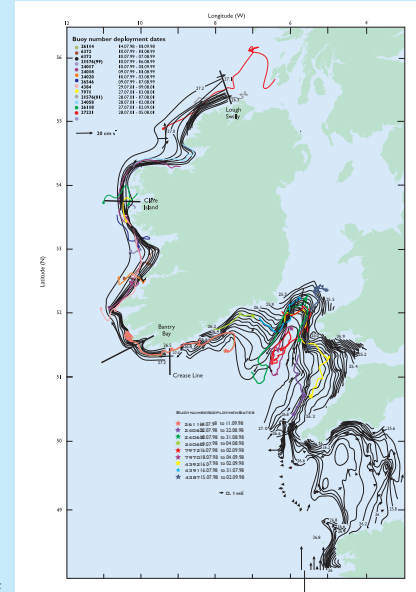


Figure 6: Bottom density with geostrophic velocity and drifter tracks overlain

Summary

The combination of drifters and towed undulator measurements demonstrated the strong baroclinic flows in the west of the region and along the southern coast of the UK. The flows in the central region are due to a combination of tidal residual, wind driven and weak baroclinic forcing.

A transport pathway due to a combination of mechanisms exists from the coasts of Brittany to the southern English coast and then around the Irish coast towards the west Scottish coast.

The shallow thermocline and strong stable conditions are ideal for bloom species such as *Karenia Mikimotoi*. An extensive bloom, was observed and is reported in a companion poster (Lyons et al., 2004).

Islands in the Stream

The Isles of Scilly act as a mixing rod in an otherwise stratified sea. Strong bottom fronts are setup around the Isles resulting in cyclonic motion.

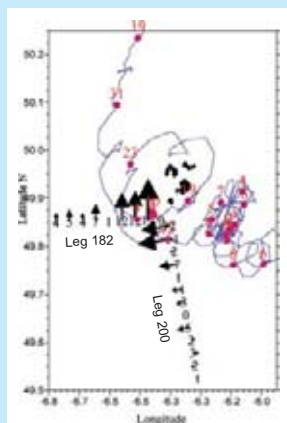


Figure 8: Detail around the Scilly Islands. Drifter showing position every 24 hours and average velocity (red) overlain on the geostrophic estimate derived from the scanfish sections (black)

Figure 9: Density Sections derived from the scanfish showing the mixing rod effect of the Scilly Isles

