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Seasonal DOM dynamics: a year in the life of a temperate shelf sea

Nealy Carr
University of Liverpool, Liverpool, United Kingdom (n.carr@liv.ac.uk)

Dissolved organic matter (DOM) constitutes the largest organic carbon (C) pool in marine systems and thus is a potentially important vehicle for the transfer of C across shelf seas, which act as an interface between terrestrial and open ocean environments. Shelf seas are known to be highly productive regions of the global ocean, however the role of DOM in the transfer and potential export of C is still poorly understood. In the present study, we use a combination of optical techniques, and measurement of dissolved organic carbon (DOC) and amino acid concentrations to assess the relative sources, lability, and quantity of DOM on a seasonal cycle across a temperate shelf sea.

Samples were collected during winter, spring, summer and autumn in the Celtic Sea, part of the Northwest European shelf sea. We used absorbance measurements and fluorescence excitation emission matrices (EEMS) coupled with the parallel factor analysis (PARAFAC) model to identify four different components of the DOM pool: 1) terrestrial-humics of allochthonous origin, 2) terrestrial and marine humics of microbial origin, 3) autochthonous tyrosine-like proteins, and 4) autochthonous tryptophan-like proteins. Strong cross shelf gradients in humic components that were correlated with salinity were observed during all seasons, indicating the strong and persistent influence of terrestrially-derived DOM in the Celtic Sea. In addition, we observed humic DOM at the shelf edge, suggesting transport of refractory DOM across the shelf or resuspension of highly degraded sedimentary material. Whereas, autochthonous components and amino acid concentrations showed strong links to bloom events and increased rates of primary production, without exhibiting significant cross-shelf gradients.

Our findings show that terrestrially-derived and refractory DOM is transferred across wide shelf sea systems, with significant gradients correlated to salinity. In addition, in situ primary production contributes fresh, more labile DOM to the shelf sea DOM pool. These findings have significant implications for our understanding of the efficiency of C export from shelf seas.