Glider study on the advective transport of harmful phytoplankton in UK shelf seas

Beatrix Siemering, SAMS

1 Introduction

Harmful phytoplankton can contaminate or kill aquaculture life stock, causing huge economic losses and posing a threat to human health. Common harmful phytoplankton management techniques rely on frequent monitoring (Swan and Davidson, 2011); however, the number of sampling sites and sampling frequency is limited by financial and logistical reasons and very sporadic and short lived events might not me captured (e.g. Whyte et al., 2014).

To mitigate the damage to aquaculture, prediction of bloom occurrence and development is desirable. Advective transport is thought to be an important mechanism in the appearance of many harmful blooms at coastal aquaculture sites (Gillibrand et al., 2016). The proposed glider project will develop enhanced understanding of phytoplankton bloom dynamics and advection and hence results will be of interest to aquaculture management as well as to regulators such as the Food Standards Agency and Marine Scotland Science.

Gliders are buoyancy driven and energy-efficient autonomous vehicles that can undertake independent journeys for up to seven months at depths between the surface and 1000m making continuous measurements of a range of seawater properties. They relay the collected data in real-time to the Institute and communicate with a pilot back at base using an Iridium satellite link. They are capable of carrying a range of sensors to evaluate parameters such as fluorescence, oxygen, temperature, salinity and pressure. Gliders are not be limited by cloud cover, unlike satellite data, or fixed cruise dates and tracks of scientific boat cruises. Glider deployments offer a new and exciting methodology to study spatial and temporal variability and transport of phytoplankton in shelf sea environments which, to our knowledge, has not been attempted in UK coastal waters.

The three month glider project is part of a three year PhD project on advective transport of phytoplankton in UK shelf seas. The PhD project aims to determine the role of advection in phytoplankton bloom formation and transport in connection with other environmental factors and regional oceanographic features such as the shelf edge. Increasing knowledge of harmful bloom dynamics provides the basis for the development of bio-physical models supporting the prediction of bloom occurrence, development and transport of blooms towards aquaculture sites.

2 Methods

The University of Washington Seaglider (serial number sg156) 'Talisker' was deployed from the 24th June to the 16th August 2015 to collect data on salinity, water temperature, chlorophyll fluorescence, red backscatter at 700nm (bb) and coloured dissolved organic matter (cdom) fluorescence (Eco-Triplet sensor, WET Labs Inc.). The glider moved with a speed of 0.1m/s and the angle of dive profiles was 30°. The glider completed a total of 1238 dives while moving accross the Malin shelf (Figure 1). Data was processed using Basestation 2.08 (Seaglider Quality Control Manual, University of Washington) and bin averaged to 5 m depth bins. Optical sensor data were calibrated following the manufacturers instruction.

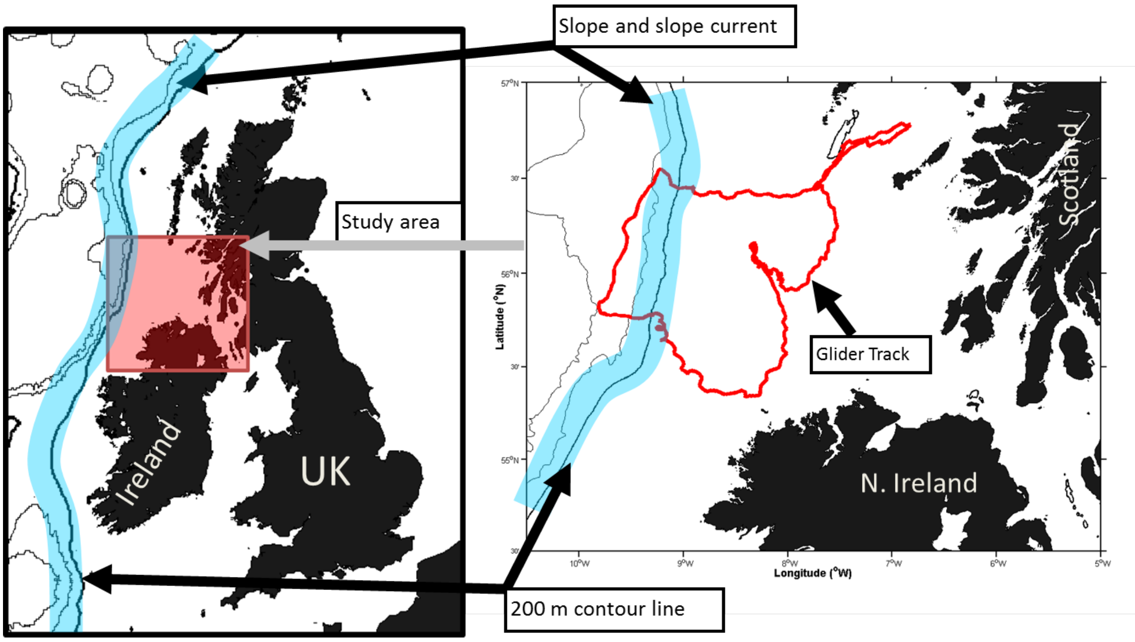

Figure 1: Glider track along the Malin Shelf

Further work includes using the hydrodynamic model POLCOMS coupled with an individual based biological model to investigate possible bloom pathways. Initial concentrations for models can be taken from satellite, glider or water sample data.

3 Preliminary results

The profiles for salinity, water temperature and chlorophyll for the whole length of the glider mission are shown in Figure 2. After 400km the glider crossed several interesting salinity structures linked to seasonal fronts present at the Malin Shelf in Summer. Chlorophyll distribution was patchy but responded to changing salinity. Chlorophyll distribution was strongly influenced by the position of the thermocline. Water samples near the location where the high chlorophyll signature is present (at around 700km) suggests presence of up to 1 million cells of *Phaeocystis* per litre. *Phaeocystis* are a nuisance genus that can produce a sticky polysaccharide mucus which might cause bio-fouling to the optical sensors on the glider.

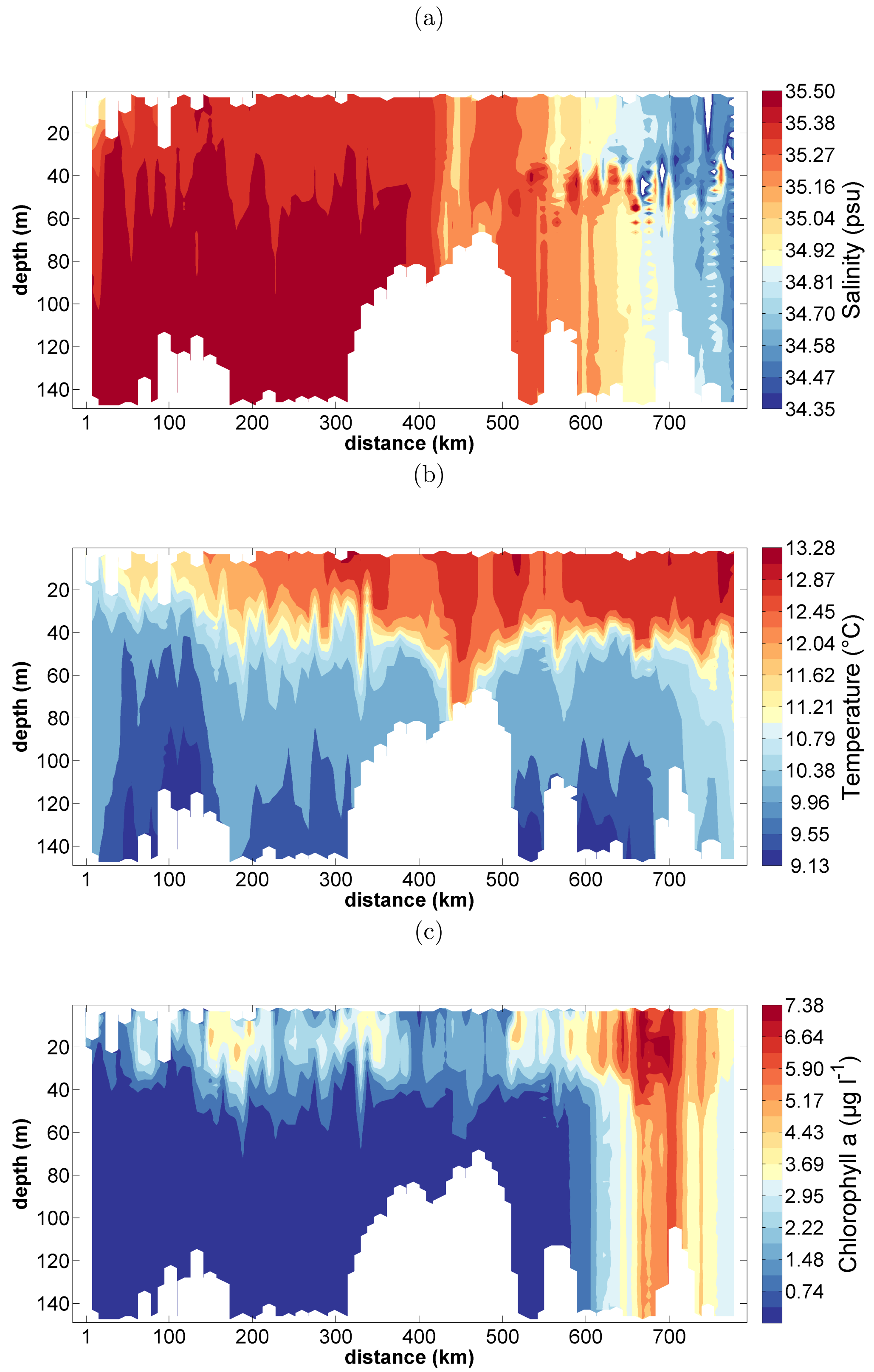

Figure 2: Glider profiles for the whole glider track for a) salinity, b) water temperature and c) Chlorophyll a

Initial model approaches used satellite images provided by NEODAAS as an initial input of cell position and concentrations (Figure 3). For this initial model run cells were treated as passive particles. Further work will include to formulate specific growth and mortality terms that can be linked to the model as done by Gillibrand et al. (2016) for *Karenia mikimotoi*.

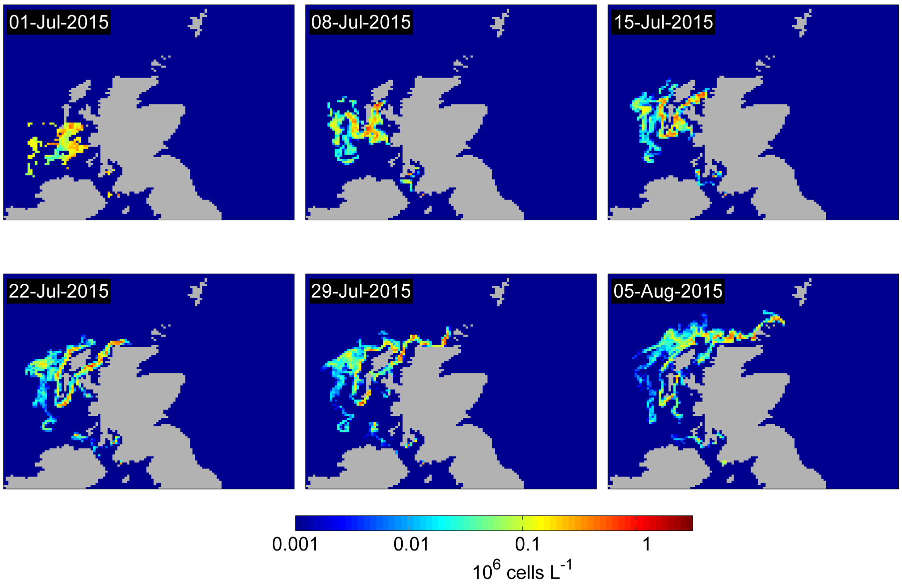

Figure 3: Preliminary modelling treating cells as passive particles and using data from satellite images as an initial input

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