Autonomous profiling glider observations in Storm Bay

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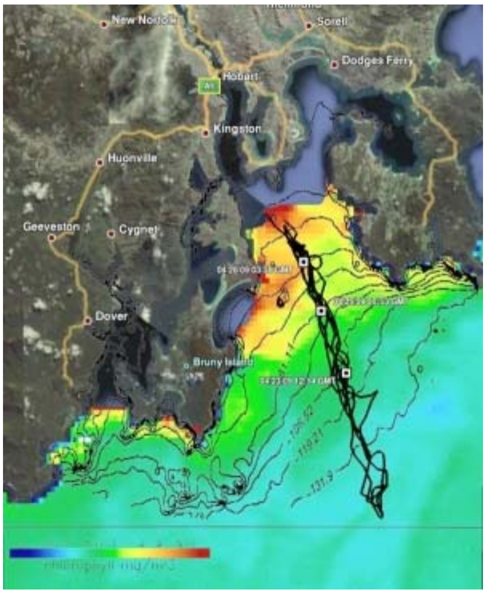

Fig. 1. Glider track in Storm Bay showing depth contours and satelite image of cholorphyll data

***Abstract*— Glider data collected along a sawtooth section crossing Storm Bay in south east Tasmania, show high spatial and temporal variability in temperature, salinity, fluorescence and dissolved oxygen . A Slocum glider was used to repeat 6 transects from the mouth of the Derwent Estuary to the continental shelf in autumn 2009. The instrument was deployed for 25 days, travelled 974 km and dived to within 10m of the bottom (50-160m) providing high resolution (5 second sampling interval) profiles of water properties. Data were quality controlled by comparison with calibrated CTD casts and bottle samples at the beginning and end of the deployment. This very high resolution dataset is the first of its kind for the region and provides a unique insight into the autumnal water column dynamics of Storm Bay.**

I. Introduction

Prelimanary analysis shows a complex physical structure evolving in both space and time that includes low salinity estuarine plumes, intrusions of oceanic water in the bottom layers, deep mixed layers and a surface intrusion of warm salty water from the south. Fluoresence and dissolved oxygen measurements show substantial small scale spatial variability which correlates with water mass characteristics.

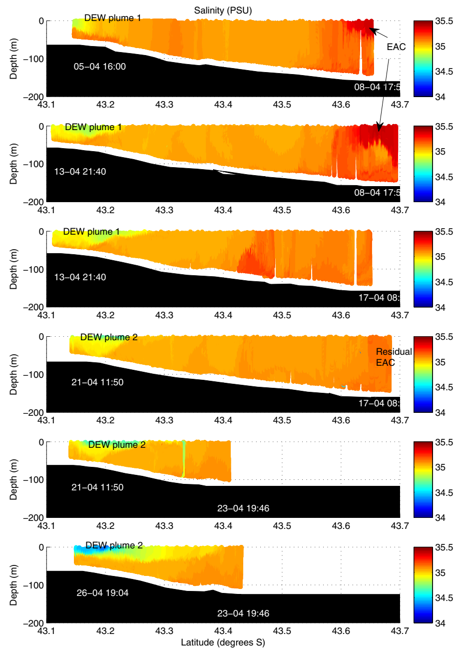

Fig. 2. Transects showing Salinity

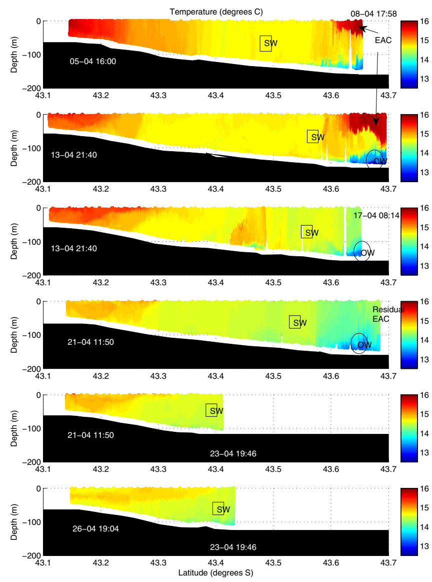

Fig. 3. Transects showing Temperature. SW:Shelf Water, OW:Offshore Water

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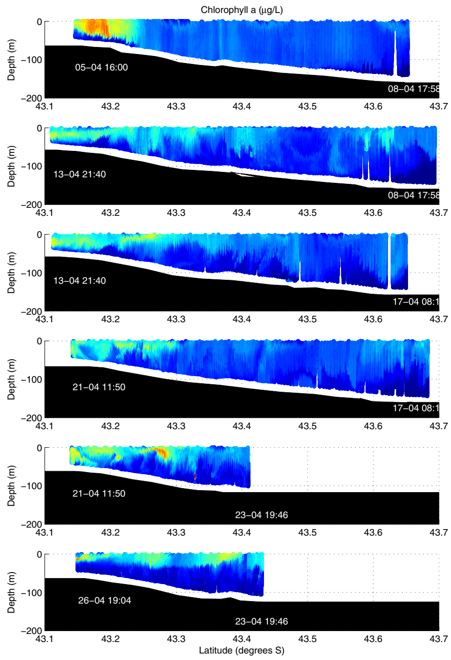

Fig. 4. Transects showing Chlorophyll

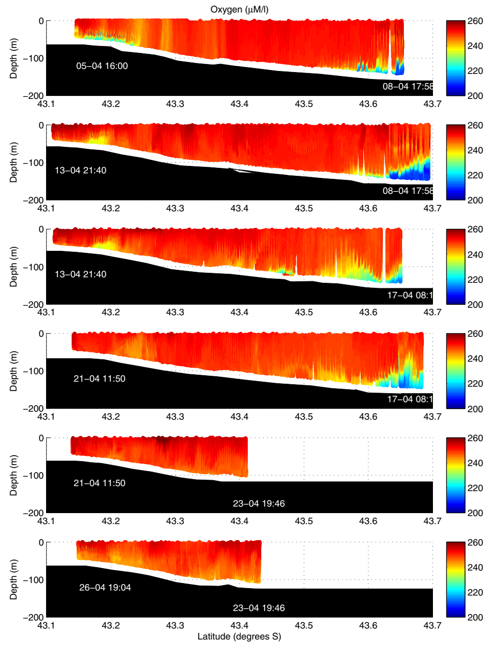

Fig. 5. Transects showing Dissolved Oxygen

II. Results

A. Water masses

The across-shelf transects (Figures 2 and 3) have identified four different water masses. The Derwent estuary has delivered two distinct plumes that reside in the surface layer of the inshore region. The Derwent Estuary Water (DEW) is characterised as having relatively low salinities (<35) with temperatures between 14.5^{o}C and 16^{o}C. A warm (15^{o}C-16^{o}C) salty (>35.3) water mass extending from the surface down to 100 m was observed at the southern end of the first transect. Remotely sensed sea surface temperature (SST) maps suggest this water mass is derived from the extension of the East Australian Current (EAC). A cold, salty water mass lies below the EAC water, at depths below 100 m. The remaining water residing in Storm Bay, is characterised as being cool (13^{o}C-14.5^{o}C) and being of typical ocean salinity (˜35).

Spatial and temporal variation in chlorophyll and dissolved oxygen across Storm Bay is related to local phytoplankton dynamics and the distribution of water masses. Inshore waters have elevated chlorophyll, associated with riverine and coastal supply of nutrients to surface waters. Chlorophyll is found in the upper 50m of the water column across the bay and occasionally at greater depths due to vertical mixing and/or sinking. Diurnal variation in chlorophyll concentration could result from daily cycles in phytoplankton growth and grazing. Dissolved oxygen concentrations are lowest in deep water offshore, however inshore bottom waters also showed some drawdown in concentration likely due to local remineralisation of organic material.

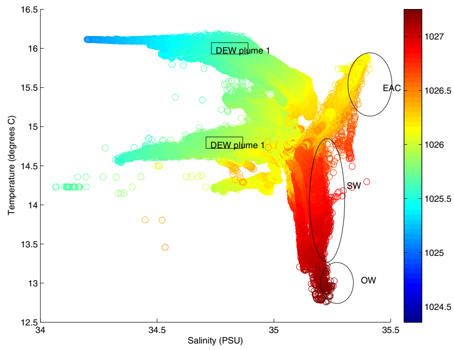

Fig. 6. T/S plot showing density. DEW:Derwent Estuary Water, EAC:East Australian Current, SW:Shelf Water, OW:Offshore Water

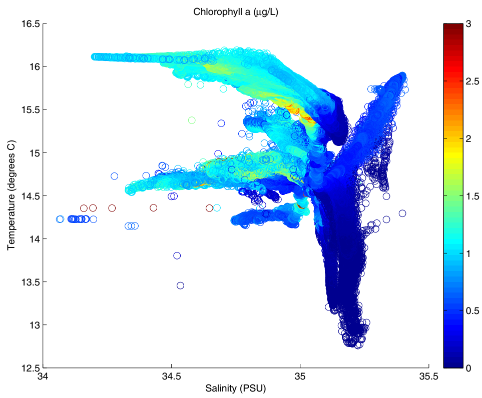

Fig. 7. T/S plot showing cholorophyll data

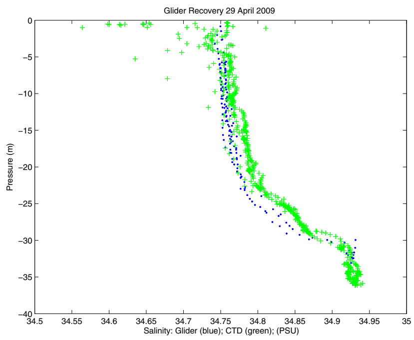

Fig. 8. Comparison of salinity data with CTD cast

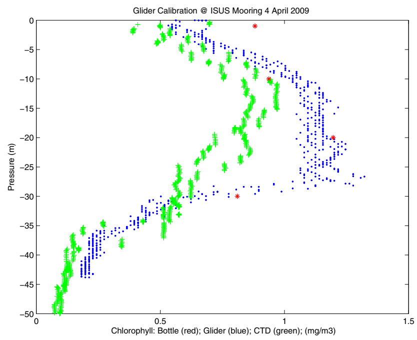

Fig. 10. Comparison of chlorophyll data with CTD cast and bottle samples

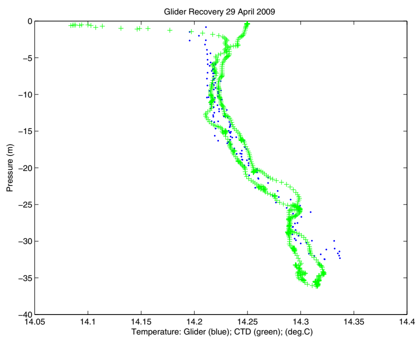

Fig. 9. Comparison of temperature data with CTD cast

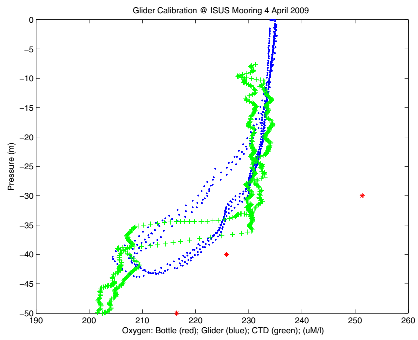

Fig. 11. Comparison of dissolved oxygen data with CTD cast and bottle samples

B. Calibration

CTD casts, including temperature, salinity, dissolved oxygen, and chlorophyll fluorescence, were taken near the glider on deployment and recovery of the unit. Bottle samples were also obtained and analysed for phytoplankton pigments, dissolved oxygen and salinity. Glider temperature and salinity data were consistent with CTD and bottle samples. Glider chlorophyll fluorescence agreed with bottle sampled chlorophyll (the CTD fluorometer underestimated chlorophyll) Glider and CTD dissolved oxygen were 20μM/l lower than bottle oxygen data and this offset was corrected in the dataset.

C. Differences in up/down-casts

As the glider data is varying in both space and time it presents us with a few challenges in its interpretation. Figure 12 shows a typical dive/climb (termed yo) profile. In deep water the dive could take up to 20 mins which is of a much longer duration than a typical CTD cast as well as moving horizonatlly in space. The vertical velocity also has bearing on the results. A fast rate, on the one hand, is advantageous as it keeps the temporal and spatial (horizontal) variation to a minimum but on the other, this gives the sensor less time to equilibrate to the surrounds which could result in sensor lag. The converse is also true. These differences between up/down casts can be important considerations in any numercial analysis of the data. The results shown in earlier figures are the original uncorrected [for lag] data showing both casts which is sufficient for the purposes of qualitative analysis.

III. Conclusion and Future Work

This data set shows that continuous glider observations are helpful in the characterisation of regions with complex water mass dynamics which would be difficult to resolve by discrete sampling arrays. The glider data will be used to assist in the validation of a 3-dimensional hydrodynamic, sediment and biogeochemical numercial model of the region and for the calibration of remote sensing observations.

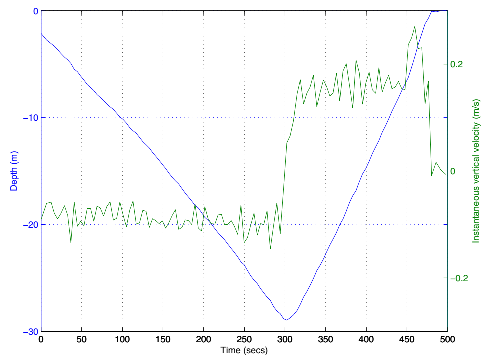

Fig. 12. Typcial dive/climb profile of the glider showing depth and instantaneous vertical velocity