Absolute Velocity Estimates from a Glider Mounted ADCP

Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK

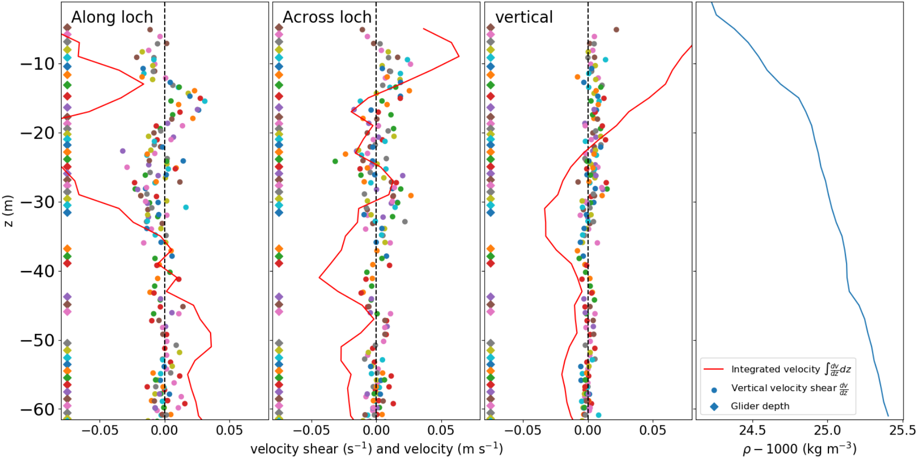
Absolute Velocity Estimates from a Glider Mounted ADCP

Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK

Photography encouraged

This presentation participates in OSPP

EGU Outstanding Student Poster & PICO Contest

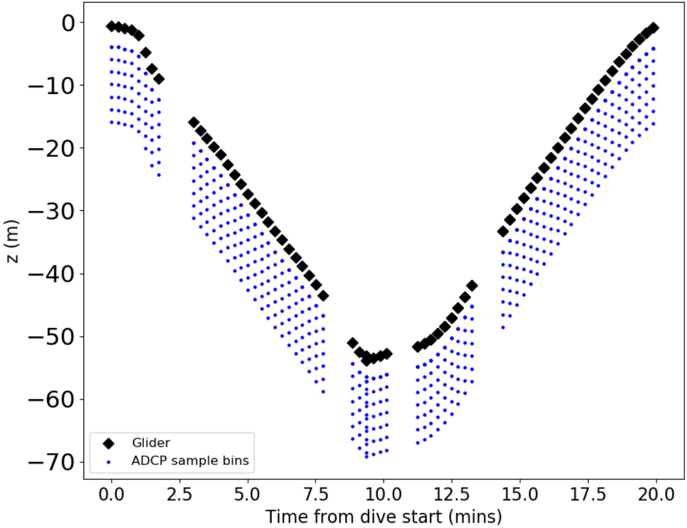


Velocity shear coloured by the depth of the glider during at the time of the ensemble

- Vertical shear of horizontal velocity coherent between ensembles
- Strong along loch shear across pycnocline

Absolute Velocity Estimates from a Glider Mounted ADCP

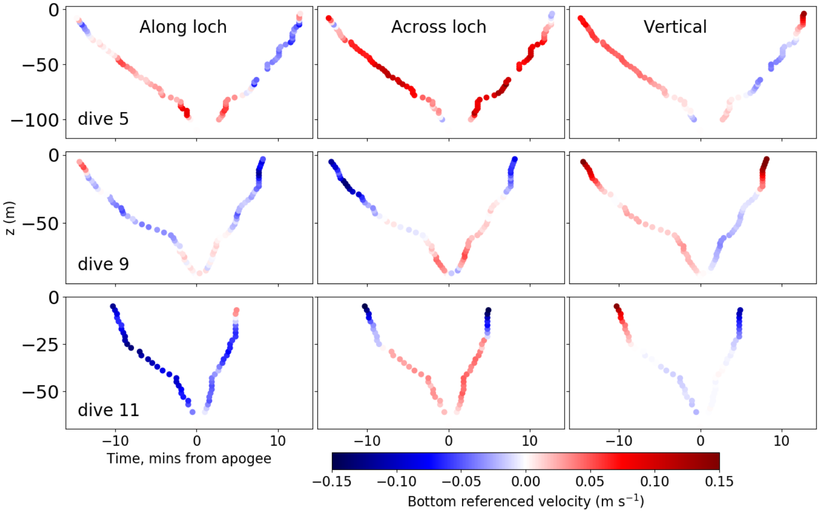
Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1] University of East Anglia, Norwich, UK [2] Marine Autonomous Robotics Systems group, Southampton UK



Dive profile from trials with glider depth and bins out to 15 m plotted

Absolute Velocity Estimates from a Glider Mounted ADCP

Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK



Good agreement for horizontal velocities between descents and ascents

Absolute Velocity Estimates from a Glider Mounted ADCP

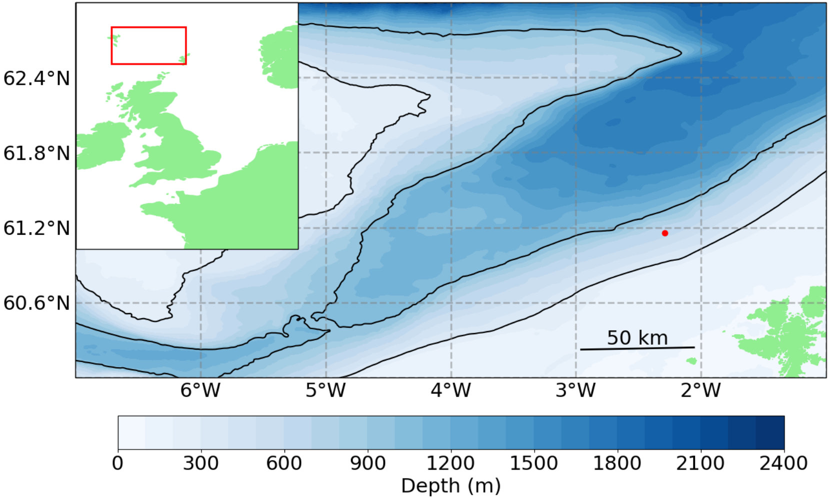
Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK

Presently, current velocities are directly measured primarily using moored ADCPs. These systems are reliable but come with drawbacks that we hope to address by using a glider instead:

- Moorings are often "trawled out" by fishing activity, a glider is much less vulnerable.
- Recovering and replacing moorings requires expensive ship time. Gliders can be launched and recovered from cheap, small vessels.
- Upward facing moored ADCPs suffer from reflections near the surface, the downward facing ADCP on a glider does not.
- As they profile, gliders collect salinity and temperature data every 5 s. Analysing this with coincident shear is of great scientific value.
- The higher frequency glider ADCP (1MHz vs 55 kHz) can resolve smaller features in current shear. see tech specs

Absolute Velocity Estimates from a Glider Mounted ADCP

Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK



Red dot marks planned deployment to the Faroe Shetland Channel April 2019 more details see expected conditions

Photography encouraged

This presentation participates in OSPP

Outstanding Student Poster & PICO Contest

Absolute Velocity Estimates from a Glider Mounted ADCP

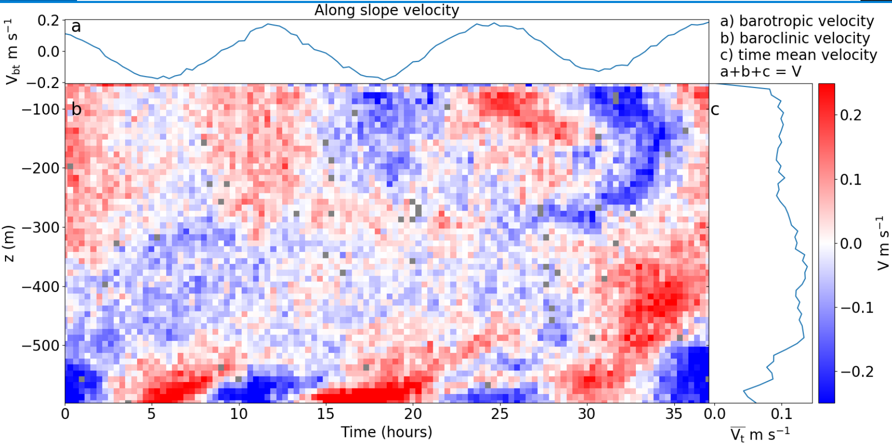
Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]

[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK

- Glider will be deployed for 14+ days to resolve a tidal cycle at a point on the slope in 600 m depth of water.
- At the same location we will deploy a 55 kHz moored ADCP to validate the shear velocities estimated from the glider.
- A Pressure Inverted Echo Sounder (PIES) will also be deployed with the moored ADCP, this will provide information of sea surface height, sound velocity and thermocline location at high temporal resolution to complement glider data.
- We expect to resolve the spring-neap cycle and hope to see evidence of internal tides and solibores.
- If successful, the glider will transit to another nearby mooring and repeat the procedure, collecting shear velocity profiles between the two moorings

Absolute Velocity Estimates from a Glider Mounted ADCP

Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK



55 kHz moored ADCP data from the deployment location. Tidal currents of 0.2 $\mathrm{m\ s^{-1}}$ and bottom intensified baroclinic flows expected. ADCP data courtesy of Bee Berx, Marine Scotland Science

Absolute Velocity Estimates from a Glider Mounted ADCP

Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK

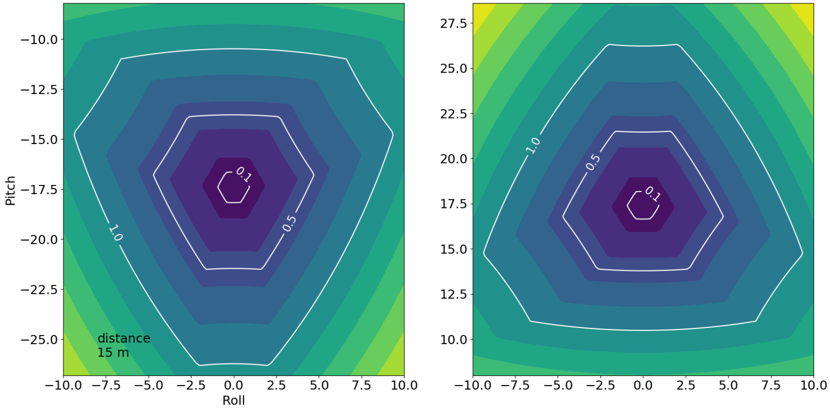
Quality control and calculation steps

- Discard cells where glider attitude causes beam miss of > 1 m as the beams will be sampling different bins see plot
- Discard cells where the ping correlation is less than 50% see plot
- Rotate from beam coordinates to East-North-Up using data from attitude sensors and compass on the ADCP
- Calculate shear between adjacent sampling cells in each ensemble
- Average shear data from all ensembles of the dive in 2 m vertical bins
- Integrate shear to get relative velocity profiles
- Reference relative velocity profiles using dive average current from the glider for "absolute" velocity profiles

What if we don't apply this quality control? see plot

Absolute Velocity Estimates from a Glider Mounted ADCP

Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK



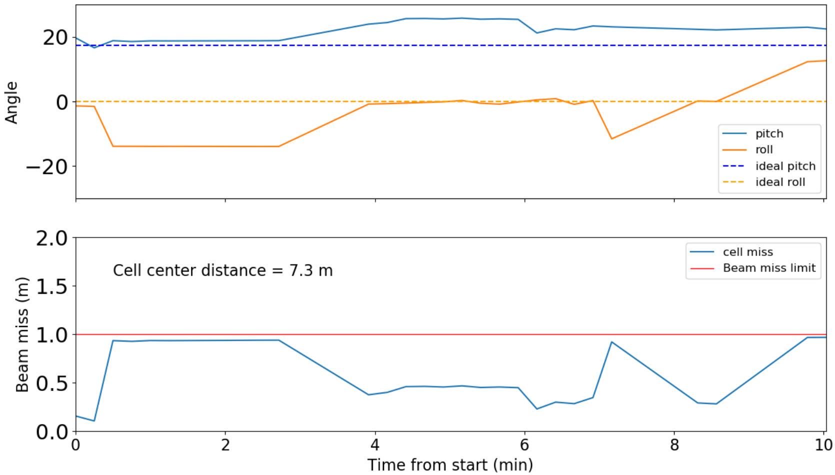
Flight angle affects the vertical location of the three beams. Plot shows the vertical distance between beams sampling a cell 15 m from the glider over a range of pitch and roll angles. Perfect sampling is achieved at $\pm 17.3^\circ$ pitch 0° roll show me an example

Absolute Velocity Estimates from a Glider Mounted ADCP

Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK

Photography encouraged

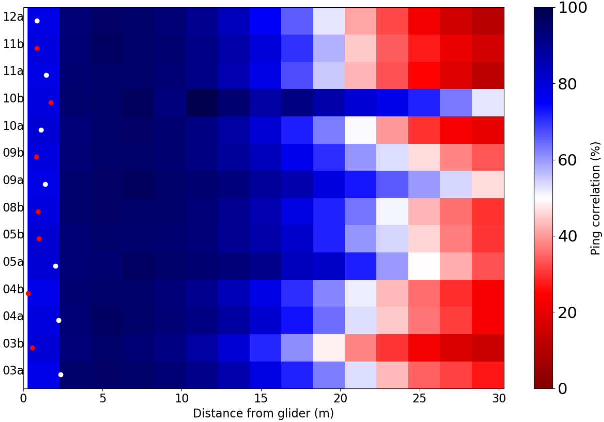
This presentation participates in OSPP
Outstanding Student Poster & PICO Contest



Example ascent profile shows the difficulty of keeping the glider within the acceptable pitch and roll envelope see plot, especially on short dives

Absolute Velocity Estimates from a Glider Mounted ADCP

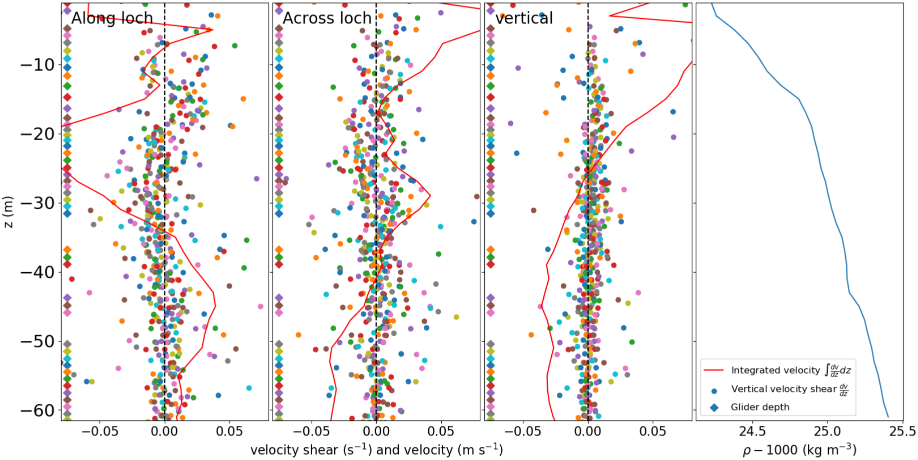
Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK



Average ping correlation over the course of 8 dives. Good correlation is achieved out to 15 - 20 m. Dots are average beam miss 15 m from glider, white for descent, red for ascent, as in beam miss from flight

Absolute Velocity Estimates from a Glider Mounted ADCP

Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK



The same data as the introduction, without quality control steps. The shape of horizontal shear is visible, but the signal is extremely noisy.

Photography encouraged

This presentation participates in OSPP

EGU

Outstanding Student Poster & PICO Contest

Absolute Velocity Estimates from a Glider Mounted ADCP

Callum Rollo[1] (c.rollo@uea.ac.uk) Karen J Heywood[1] Rob Hall[1] Alex Phillips[2]
[1]University of East Anglia, Norwich, UK [2]Marine Autonomous Robotics Systems group, Southampton UK

Seaglider spec: max depth 1000 m , vertical velocity $\approx 0.1 \text{ m s}^{-1}$

ADCP spec/deployment settings:

- Sampling frequency 1 MHz
- Range 30 m (max) 15-20 m (typical)
- 3 downward facing beams at 30 degrees from vertical
- Cell size 2 m
- Blanking distance 0.3 m
- 3 second ensemble of 8 pings every 30 seconds

Gives 80 - 85 % profile overlap (15-20 m range velocity shear profile every 3 m of glider vertical travel)

Expected endurance 6 weeks

LaTeX available on my github `github.com/callumrollo/pico-latex-presentation`
Adapted from the template by Anselm Köhler:
`github.com/snowtechblog/pico-latex-presentation`