

Absolute Velocity Estimates from a Glider Mounted ADCP

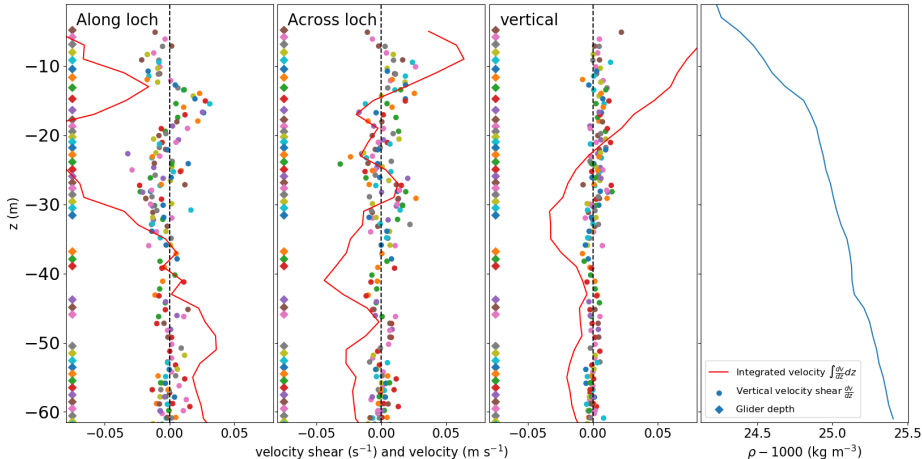
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Velocity shear coloured by the depth of the glider during at the time of the ensemble

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

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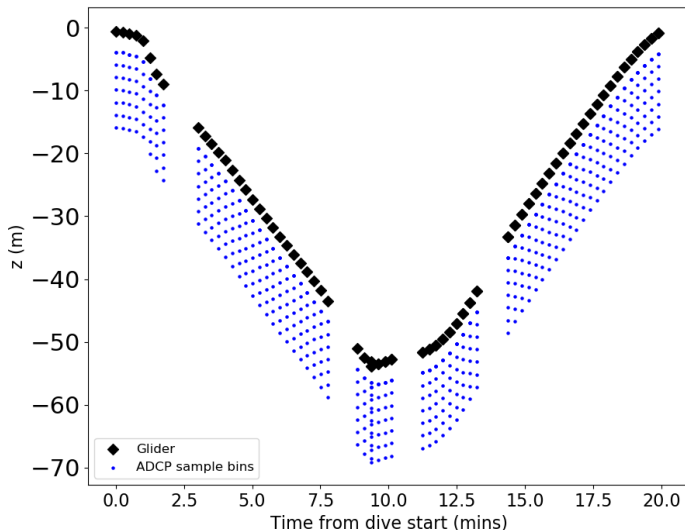
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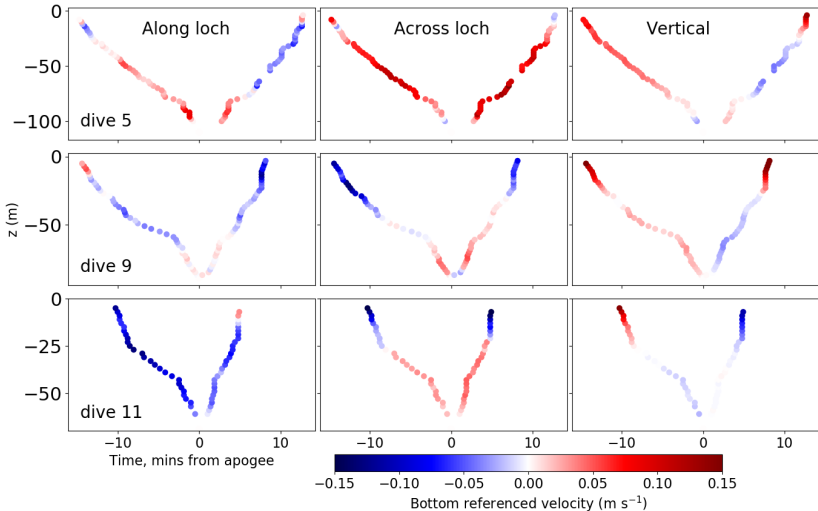


Dive profile from trials with glider depth and bins out to 15 m plotted

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Good agreement for horizontal velocities between descents and ascents



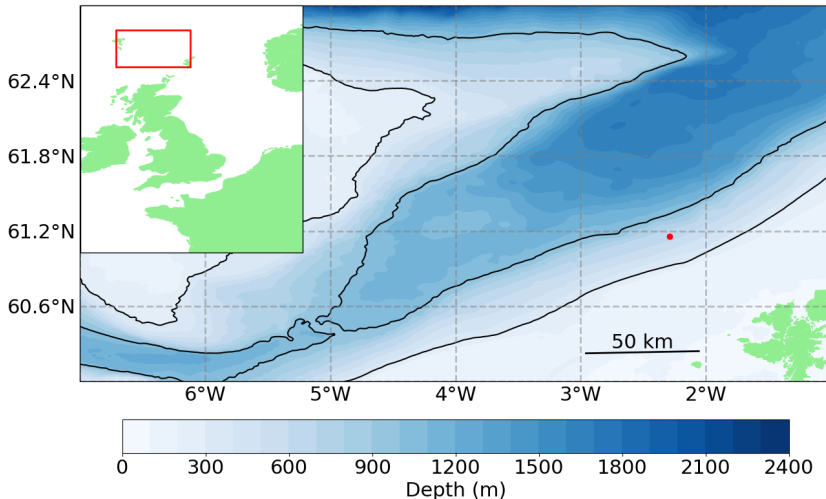
Presently, current velocities are directly measured primarily using moored ADCPs. These systems are reliable but come with drawbacks that we hope to address by using a glider instead:

- ▶ 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](#)

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Red dot marks planned deployment to the Faroe Shetland Channel
 April 2019 [more details](#) [see expected conditions](#)

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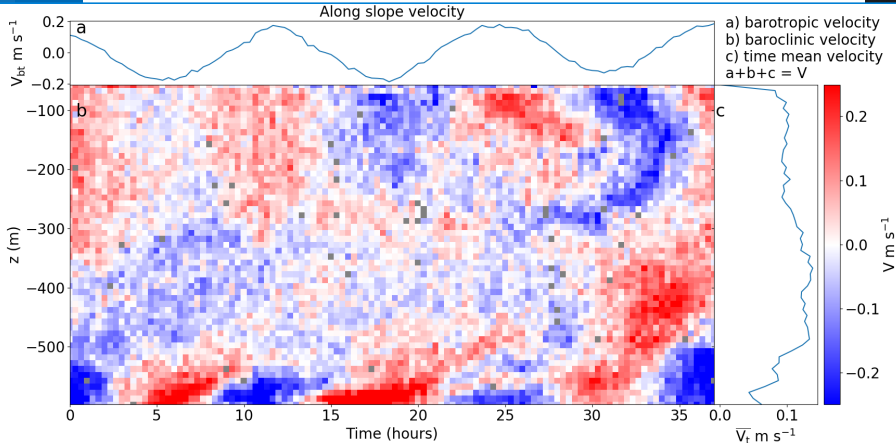
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- ▶ Glider will be deployed for 14+ days to resolve a tidal cycle at a point on the slope in 600 m depth of water.
- ▶ At the same location we will deploy a 55 kHz moored ADCP to validate the shear velocities estimated from the glider.
- ▶ A Pressure 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

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



Photography
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Quality control and calculation steps

- ▶ Discard cells where glider attitude causes beam miss of > 1 m as the beam swill 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 each remaining adjacent cell
- ▶ Average shear data 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](#)

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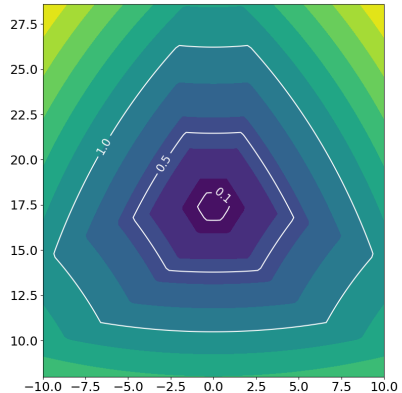
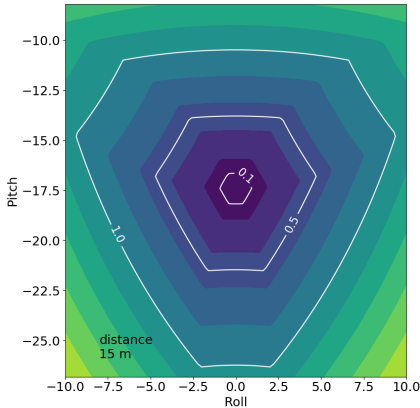
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Flight angle affects the vertical location of the three beams. Plot shows the vertical distance between beams sampling a cell 15 m from the glider over a range of pitch and roll angles. Perfect sampling is achieved at $\pm 17.3^\circ$ pitch 0° roll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

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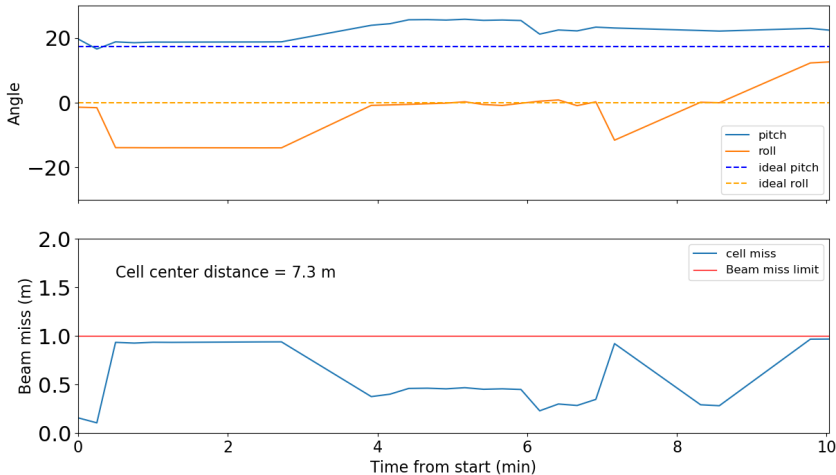
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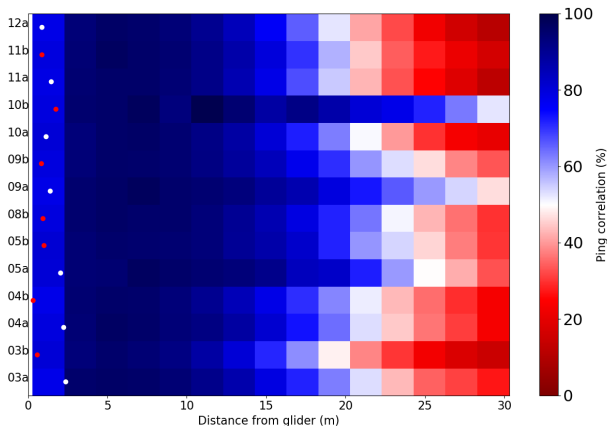
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Example ascent profile shows the difficulty of keeping the glider within the acceptable pitch and roll envelope [see plot](#), especially on short dives



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](#)

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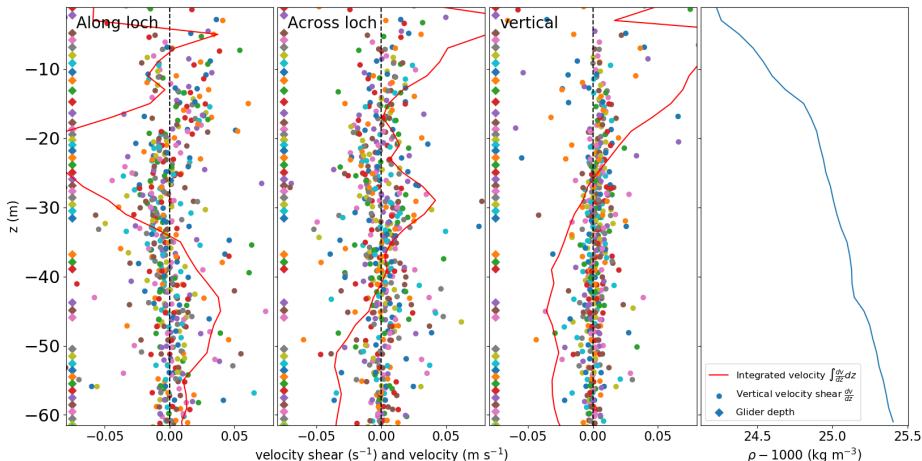
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The same data as [the introduction](#), without quality control steps. The shape of horizontal shear is visible, but the signal is extremely noisy.



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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

L^AT_EX available on my github github.com/callumrollo/pico-latex-presentation

Adapted from the template by Anselm Köhler:

github.com/snowtechblog/pico-latex-presentation