

# ESTUARINE CIRCULATION, INFLUENCED BY WEATHER CONDITIONS



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## Estuarine circulation

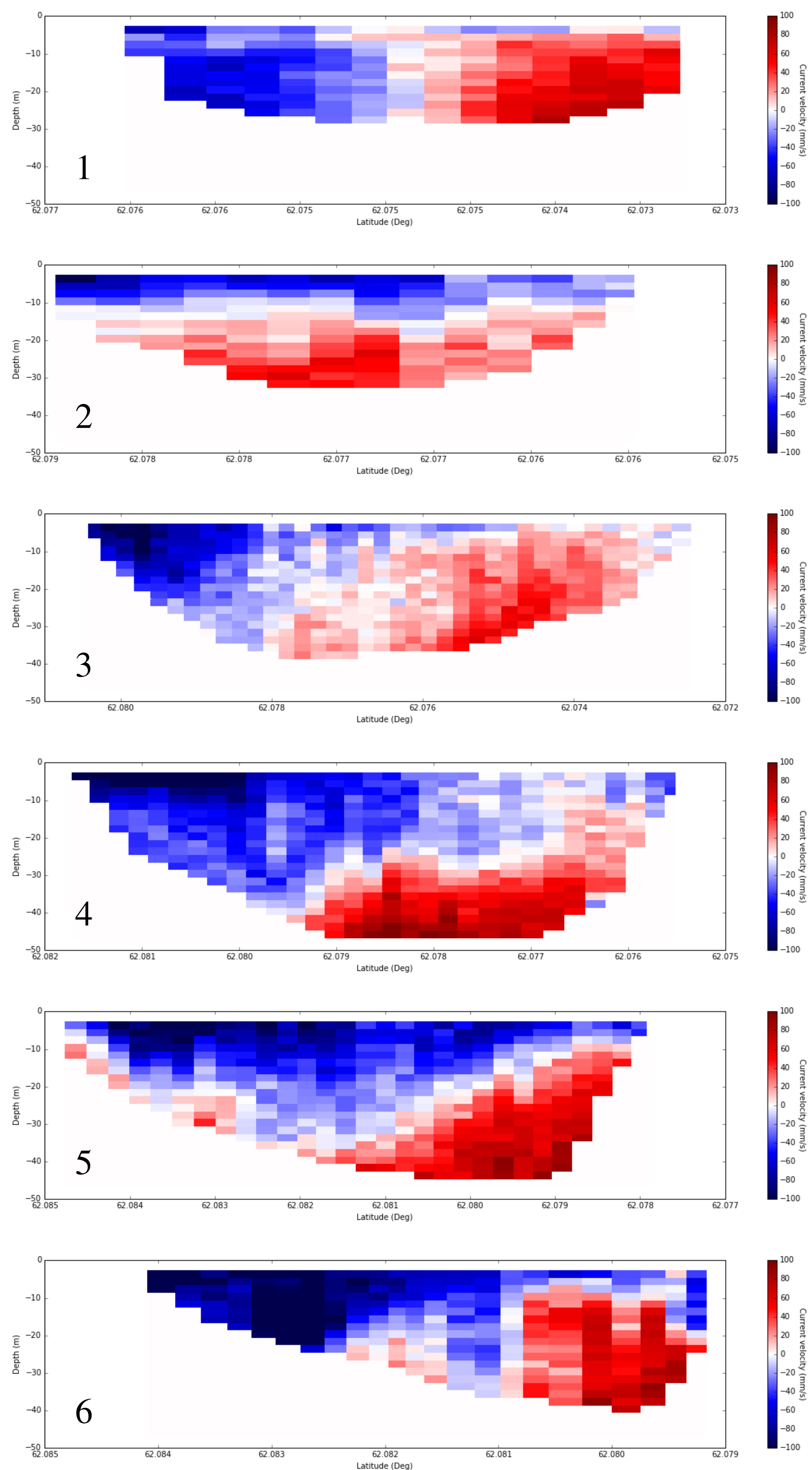


Figure 1: A situation with estuarine circulation in the fjord. Winds were outward of the fjord with average wind speeds of 2-6 m/s. Currents directed out of the fjord are shown with blue colours, and current into the fjord are shown with red colours. The numbers refer to the transects shown in figure 4.

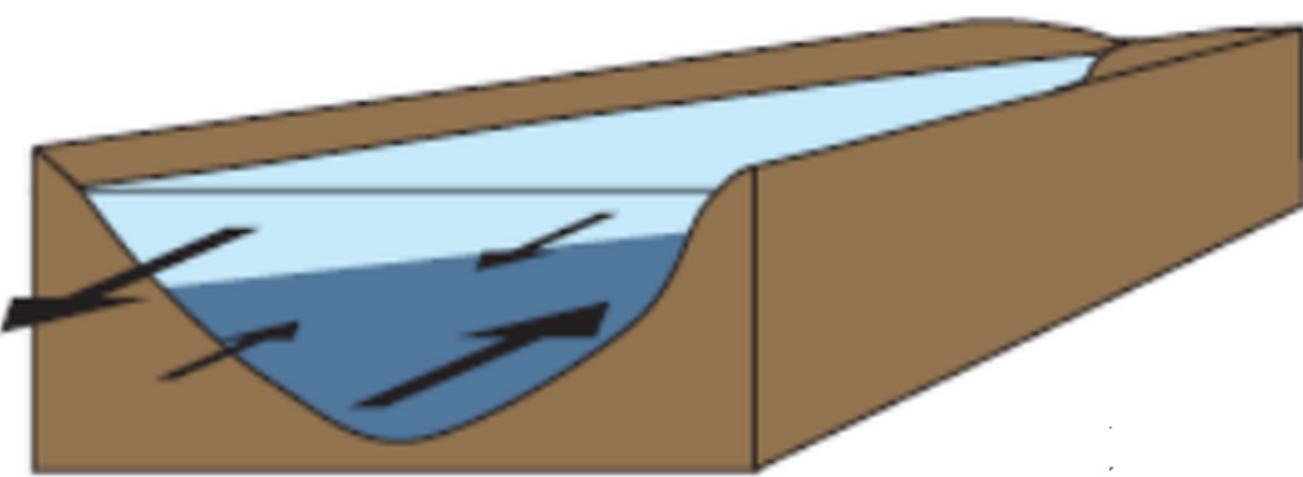


Figure 2: Estuarine circulation is driven by the freshwater runoff from land causing the uppermost water masses to flow out of the fjord, while the more dense water from outside the fjord is entrained into the fjord at greater depth. The coriolis force, caused by the rotation of the earth, pushes the water masses towards the right of the flow direction. From the book Havið by Bogi Hansen

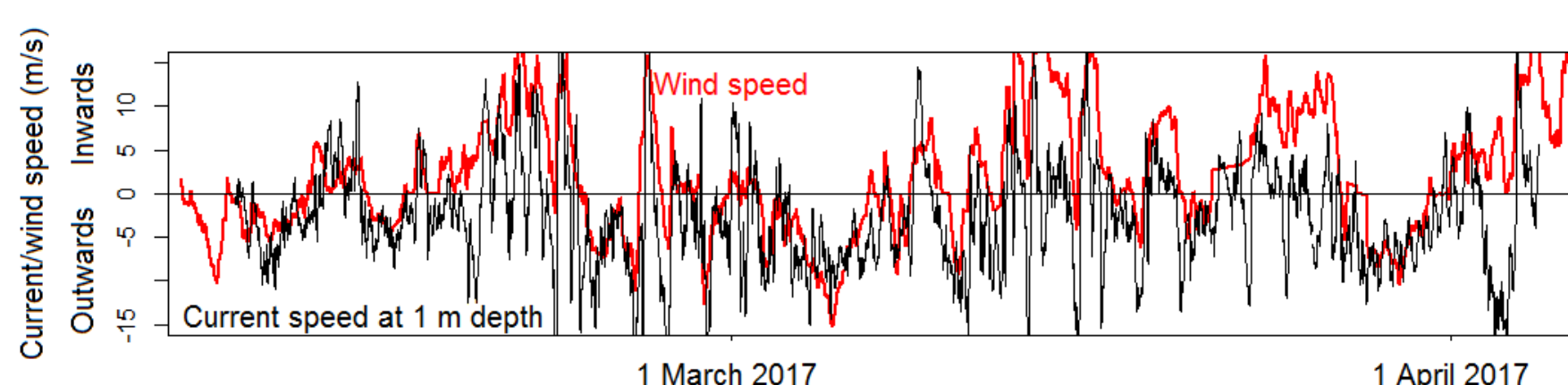


Figure 3: Wind and current speed in to the fjord (negative values) and out of the fjord (positive values). The wind speed is from Glyvursnes (www.landsverk.fo) and current speed is measured at location x in figure 4 at one meter depth.

Although it is quite clear, that the wind influences the current direction at one meter depth (Fig. 3), the influence is limited. Currents directed into the fjord (Reversed circulation) were only observed 31% of the time, even though the wind was directed into the fjord 58% of the time.

## Studysite

The measurements are from a study conducted for the fish farming company Hiddenfjord (hiddenfjord.com), at the fjord Sörvágur, in order to understand the sea lice infection pressure.

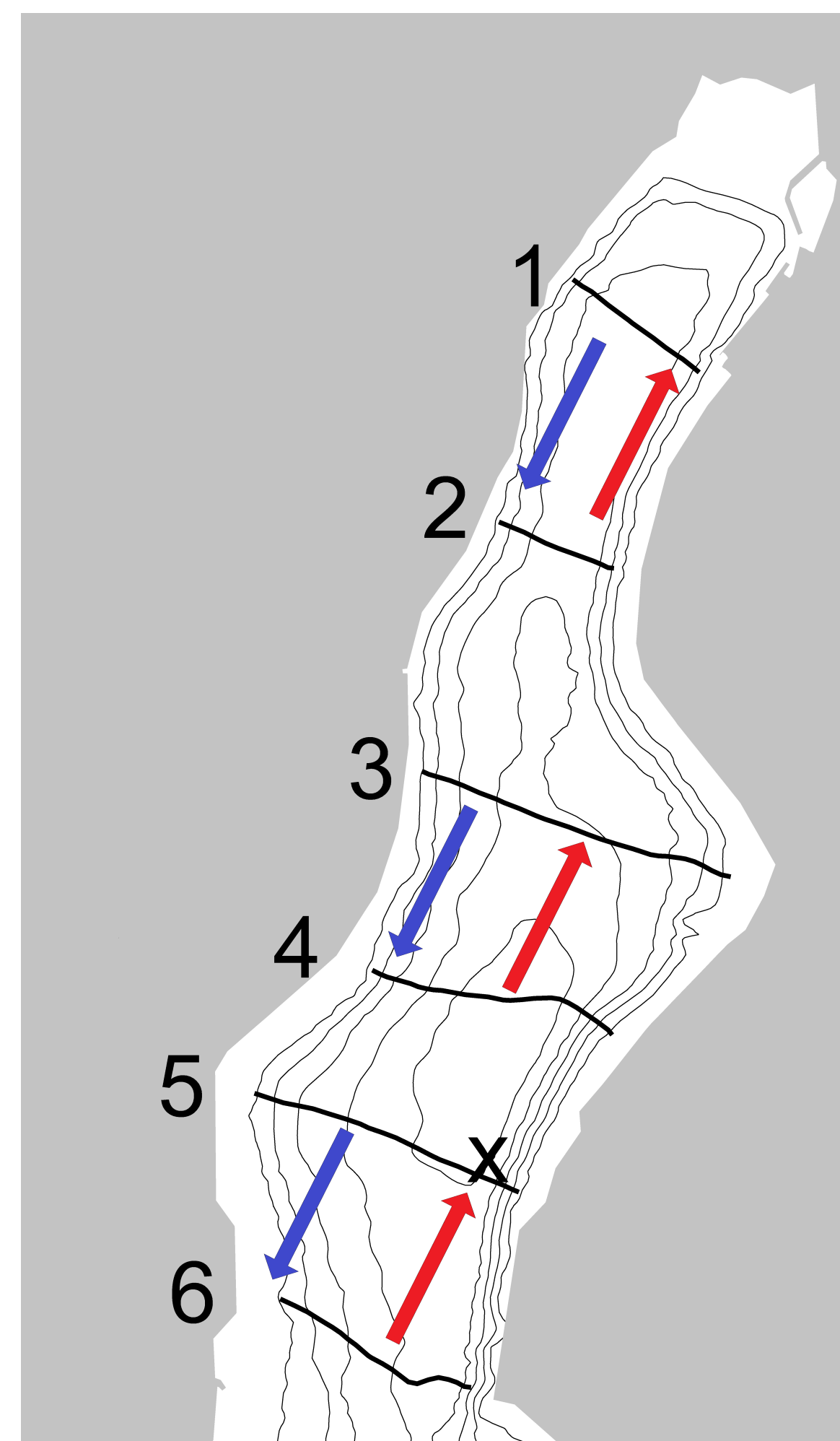


Figure 4: The studied fjord. Lines denote the location of the current measurement transects and the cross denotes the position of the stationary current measurement. The arrows describe the coloring scheme used in figures 1 and 6.

## Current measurements

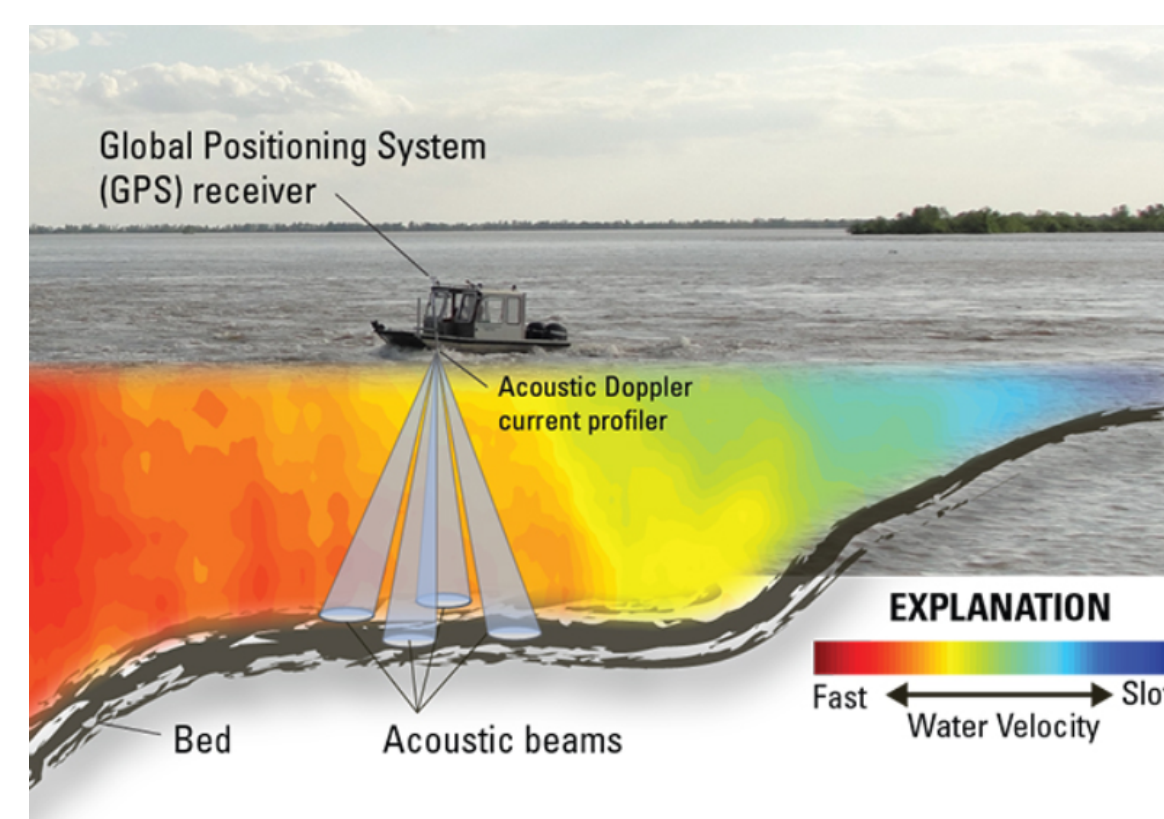


Figure 5: Acoustic Doppler Current Profilers (ADCP) measure 3d currents through the water column using acoustics. The water currents relative to the bottom are calculated from measurements of water currents relative to the boat as well as the movement of the seabed relative to the boat.

## Acknowledgements

This study was funded by Hiddenfjord



## Reversed circulation

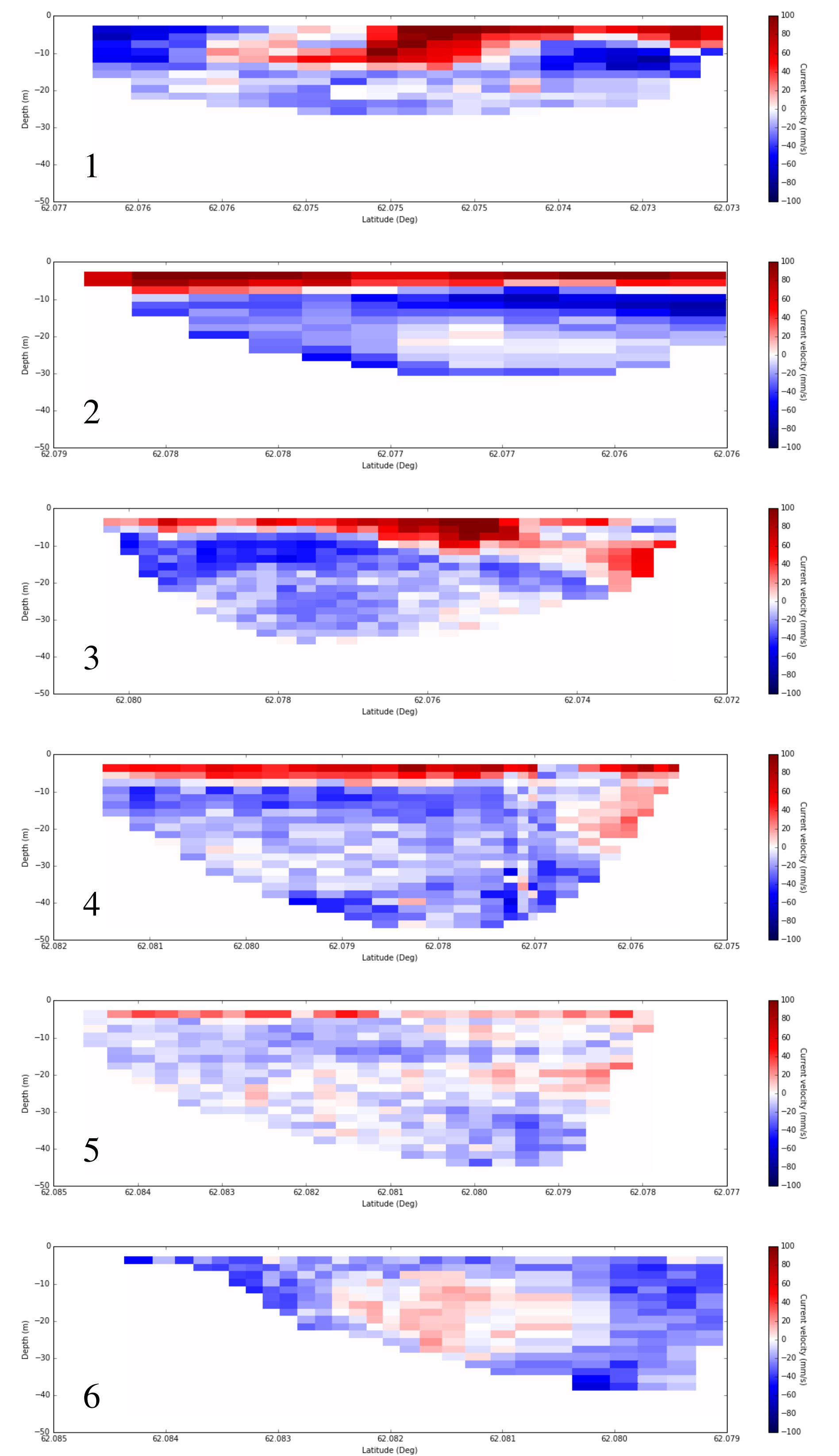


Figure 6: A situation where the circulation in the fjord is reversed by wind blowing into the fjord with average wind speeds between 2 and 13 m/s. Currents directed out of the fjord are shown with blue colours, and current into the fjord are shown with red colours. The numbers refer to the transects shown in figure 4.

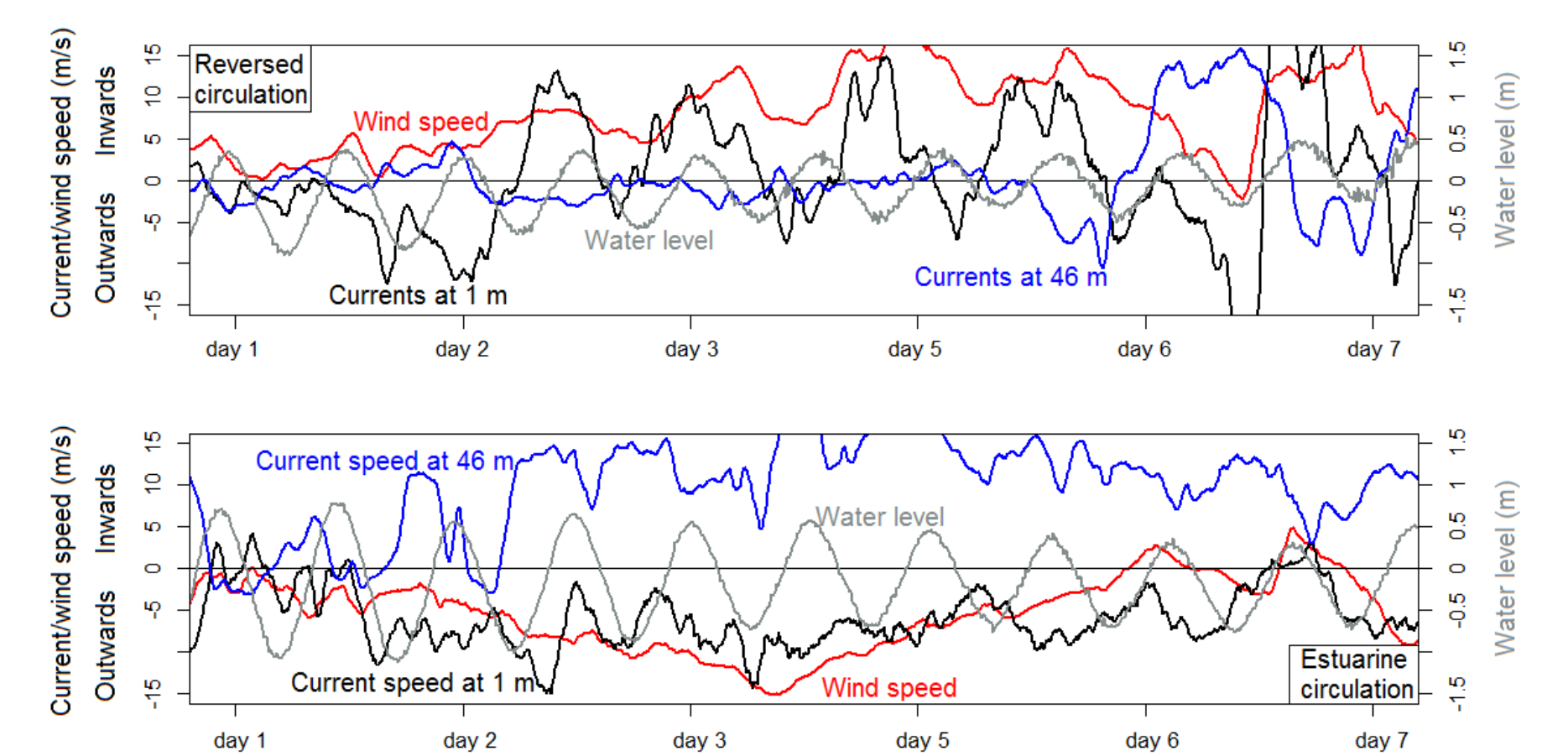


Figure 7: A situation with reversed circulation due to winds continuously directed into the fjord (upper figure) and one with estuarine circulation and winds outwards of the fjord (lower figure).

The reversed circulation pattern, with surface currents into the fjord can not be sustained indefinitely due to accumulation of the lighter surface water (freshwater mixed with seawater) in the fjord. In this study, pulses of surface water flowing out of the fjord, were observed approximately once a day, although winds continuously were directed into the fjord. The current speed in the deeper water masses was close to zero (Fig. 7). With winds blowing out of the fjord, estuarine circulation with surface currents out of the fjord and inwards currents in the deeper water masses was observed (Fig. 7).