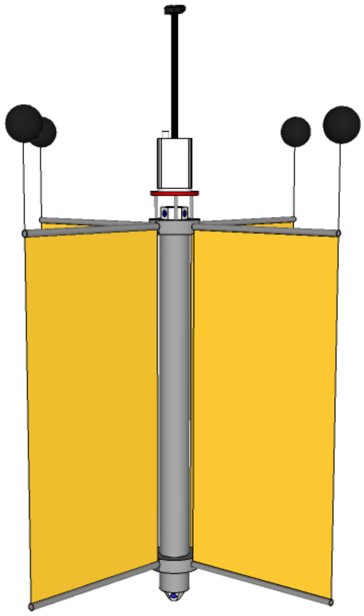

OGS PROTOTYPE CODE DRIFTER EQUIPPED WITH CURRENT METER AND CURRENT PROFILER: REALIZATION AND TESTS

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Approved by: ……………………………
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1. Introduction

Nowadays, drifters are universally used by all the scientific community to study the surface currents. The SVP drifters (Sybrandy and Niiler, 1991; Lumpkin and Pazos, 2007) and the CODE drifters (Davis, 1985) have become a standard for the measurement of the near surface (about 15 meters or deeper) and the top meter currents, respectively.

The behaviour of these instruments with respect to the wind, waves and surface current was intensively considered. Various authors gave an estimate of the drifter-inferred velocities as a function of wind, waves and relative surrounding water flow through direct slippage measurements (Kirwan et al. 1975; Geyer 1989; Niiler et al. 1995), through complex or linear regression models (Poulain et al. 1996; Pazan and Niiler 2001; Poulain et al., 2009), by comparing real drifter observations with synthetic drifter derived by models (Edwards et al., 2006) or from tank tests and dye patch comparisons (Niiler et al., 1997). Despite these efforts, the water-following characteristics of drifters, and especially of the CODE designs, with respect to the vertical current shear are still poorly known.

With this purpose and following a previous experiment (Poulain et al., 2002), a prototype drifter similar to the CODE drifter and equipped with a current meter and a current profiler was realized at the National Institute of Oceanography and Experimental Geophysics (OGS). This technical report illustrates the production steps and the mechanical solutions adopted to construct the drifter (chapter 2) and describes the early stage experiments carried out in the Gulf of Trieste to set-up the system (chapters 3, 4 and 5).

2. Prototype drifter characteristics and realization

The OGS prototype CODE drifter has nearly the same structure of the CODE drifter (compare the two images of Fig. 1).

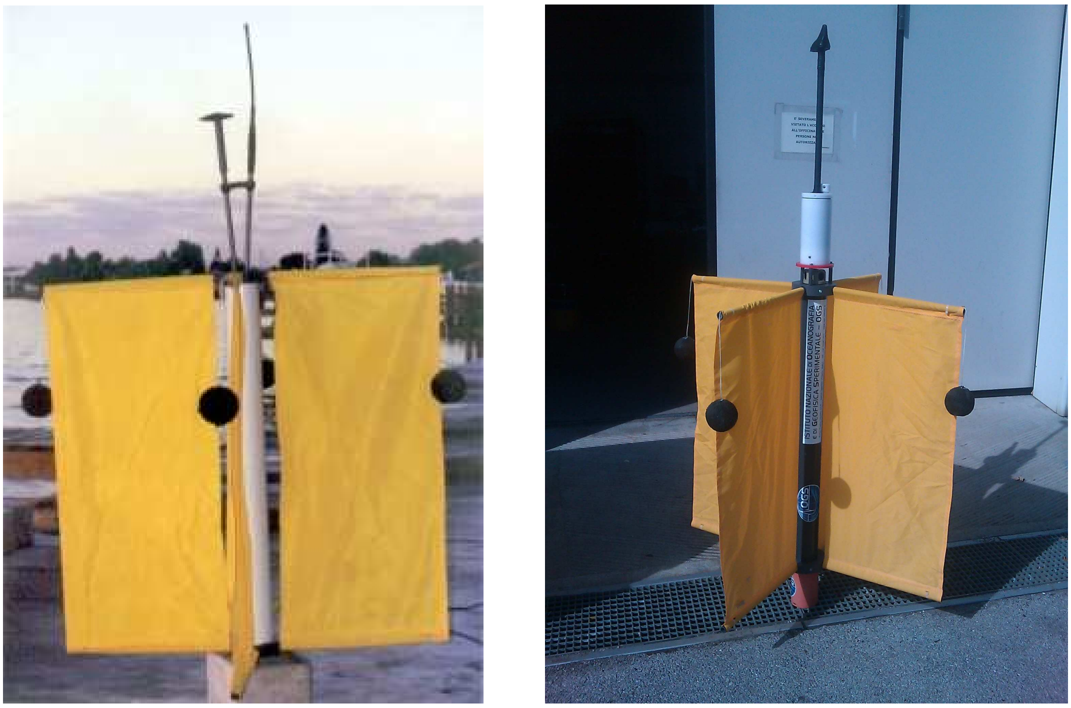

Fig. 1. CODE drifter (left) and the prototype drifter realized at OGS (right).

The vertical tube does not contain the electronic and the battery, but holds a current meter and a current profiler and can be flooded. The GPS position is provided by an independent module that is attached on the upper part of the drifter (Fig. 2). This module was developed by the OGS TECDEV group and is appropriate for coastal uses (Brunetti and Zuppelli, 2011). The transmission of the positions and all the other recorded parameters (temperature, battery level, …) occurs through SMS messages using land-based cellular phone network (GSM/GPRS).

The current meter of the prototype is a Nortek Aquadopp current meter and was already used for analogous applications. It is mounted on the upper part of the prototype tube (Fig. 2 and Fig. 11) so as to measure the current of the layer immediately below the surface. In the past, it was used without the original case, but, to guarantee a perfect watertight, we preferred to have the electronic inside the original case. Additionally, a 1 MHz Nortek Aquadopp current profiler is mounted upside-down with the sensor head at the bottom of the drifter (Fig. 3).

Fig. 2. The GPS/GSM position/transmission module and the Aquadopp current meter head visible below the red PVC plate.

Fig. 3. The Aquadopp current profiler at the bottom of the prototype drifter.

The nominal maximum profiling range of this ADCP is 20 m with cell size between 30 cm and 4 m and minimum blanking of about 20 cm. These characteristics make this instrument particularly suitable for the current studies in the Gulf of Trieste (maximum depth: 23 m). Both the Aquadopps have the old version end bell (Fig. 4) that better fits into the prototype structure and requires less room (Fig. 5).

Fig. 4. The old version and current version of the end bell (from the Aquadopp manual).

Fig. 5. The two end bells of the two Aquadopps mounted on the drifter.

Fig. 6. The operator while fixing one of the drifter arms.

The prototype was built in the OGS machine shop. It is entirely fabricated with PVC material assembled with stainless steel bolts.

In particular we attached two PVC collars (obtained on a lathe from a PVC bar; external diameter: 150 mm; height: 31 mm) by means of four M6 Allen head bolts to a PVC tube (internal diameter: 80 mm; external diameter: 90 mm). Each collar has four holes (diameter: 21 mm) that house the arms of the X-shape sails of the original CODE design (Fig. 2 and Fig. 3). It was impossible to maintain these arms in position with the rubber band like in the CODE drifter because of the presence of the Aquadopp current meter/profiler inside the tube, therefore the arms were attached to the collars by using M4 Allen button head bolts (Fig. 6).

As said, the two Aquadopp instruments were located inside the tube. Ad-hoc collars (obtained on a lathe from a solid tube; Fig. 7) were built to fill the gap between the tube and the instrument in correspondence of the minimum diameter (i.e. indentation) of the instrument case (Fig. 8). The collars were first positioned on the instrument case (in correspondence of the indentation, see Fig. 9) and, after inserting the instrument inside the tube, the collars were fixed to the tube by means of four M4 Allen headless bolts so as to avoid any vertical slide or rotation of the instrument (four of these bolts can be seen in Fig. 5).

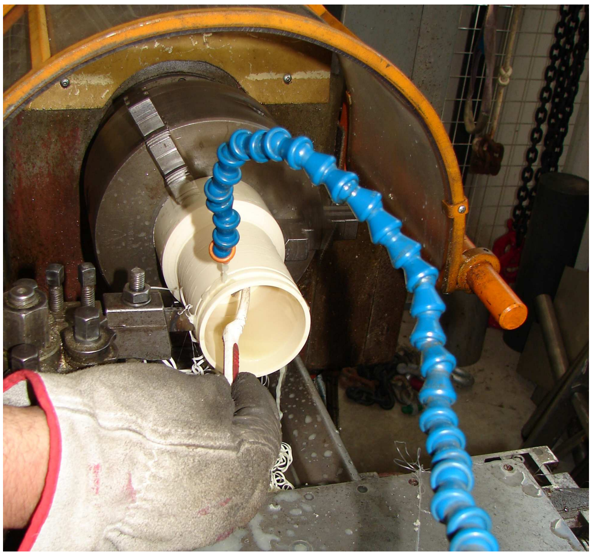

Fig. 7. Realization of the collar on the lathe. The piece was obtained from a PVC solid tube.

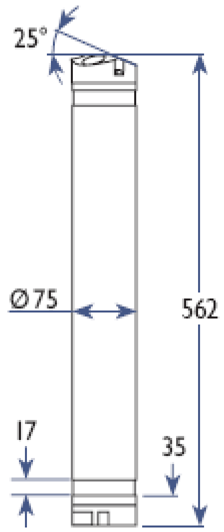

Fig. 8. A schema of the Aquadopp profiler showing the two indentations on the instrument case.

Fig. 9. The collar mounted on the Aquadopp profiler in correspondence of the indentation (see also Fig. 8).

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A PVC plate (diameter: 140 mm; thickness: 9 mm) was attached to the upper collar at a distance of 57 mm from the upper face of the collar by means of three PVC cylinders and three M6 Allen head bolts (Fig. 2 and Fig. 10). This structure allows the current meter to work properly and provides a base where to place the GPS/GSM position/telemetry module. No modifications were done on the structure of this module.

The prototype was tested for buoyancy and stability in the OGS water tank. The four small spherical surface floats of the modified CODE drifter did not provide the requested buoyancy and an additional floating ring was placed around the prototype (Fig. 11).

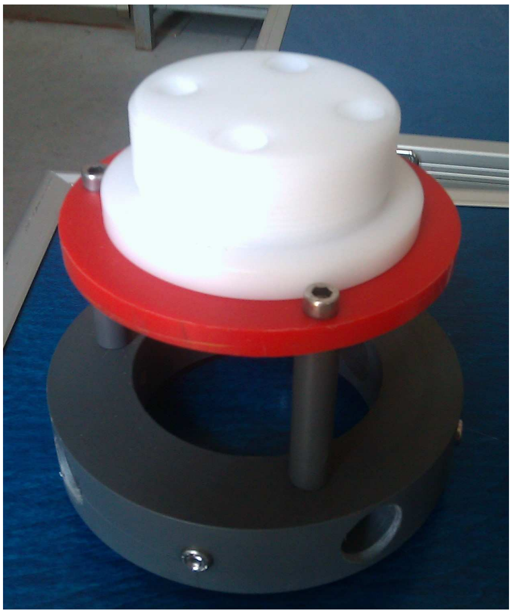


Fig. 10. The structure on the upper part of the prototype with the coupling element for the GPS/GSM module (white PVC piece).

Fig. 11. The floating ring added around the tube below the top current meter to correct buoyancy.

3. First test at sea

On the 28th of July 2011, a first test was carried out in the Gulf of Trieste. The prototype drifter was deployed together with a CODE drifter equipped with the GPS/GSM position/transmission module just offshore the Natural Marine Reserve area of Miramare. The drifters moved coherently for 1.5 hours (0).

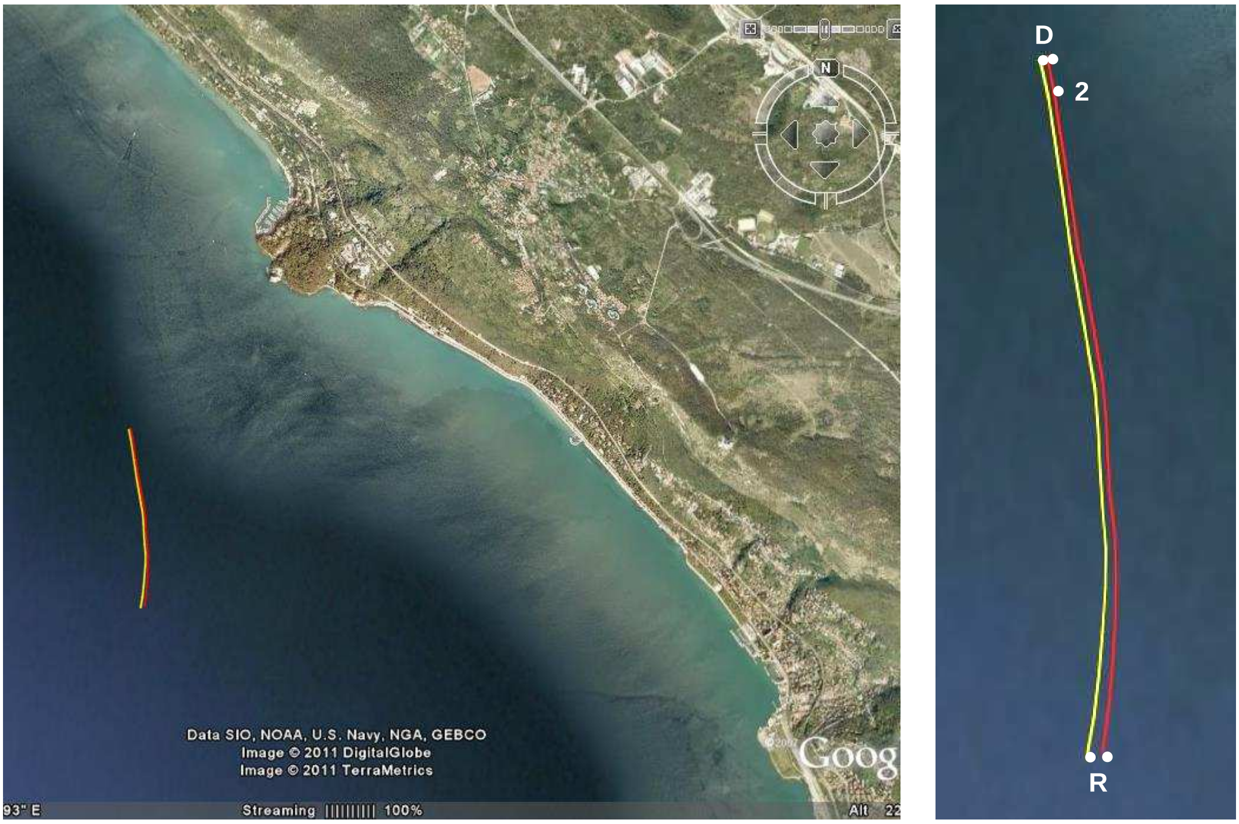


Fig. 12. Prototype drifter (red) and drifter (yellow) trajectories during the first test off Miramare (left) with a zoom on the right (D: deployment position; 2: position after 5 minutes; R: recovery position).

The prototype drifter resulted a bit heavy, but the previous days the measured salinity was very low. All the prototype structure was submerged except the temperature sensor (anyway, there are two other temperature sensors in the two current meter/profiler sensor heads) and the antenna (Fig. 13). In this configuration, the current meter and the current profiler sensor heads are located at about 18 cm and 1.67 m below the surface, respectively. On the contrary, the CODE drifter with the GPS/GSM module was noticeably light with the temperature sensor outside the water too (Fig. 14). This suggest the need of adding another floating ring to the prototype or changing the existing one with another material with higher buoyancy.

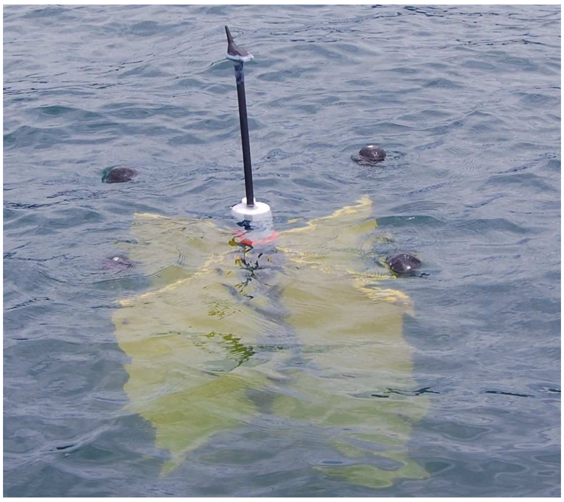


Fig. 13. The prototype drifter. The temperature sensor is not submerged. The instrument is a bit heavy in water.

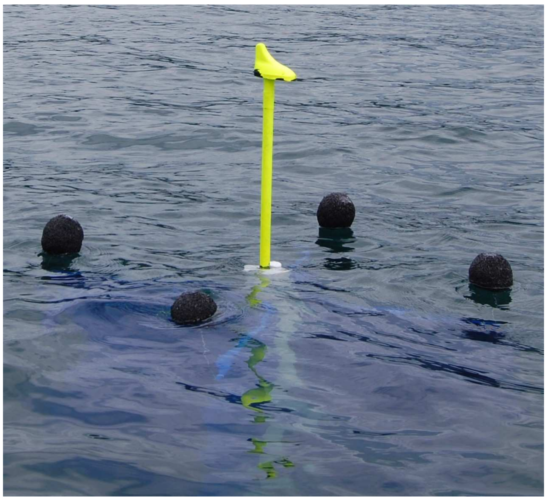


Fig. 14. The CODE drifter with the GPS/GSM position/transmission module. Also for this drifter the temperature sensor is not submerged. The instrument is noticeably light in water.

The current meter and the current profiler were set so as to record the average of 1 minute measurements every 5 minutes (see Table 1 and Table 2).

```
Measurement interval  (s) : 300
Average interval      (s) : 60
Blanking distance     (m) : 0.37
Diagnostics interval(min) : 720
Power level               : LOW+
Compass upd. rate     (s) : 2
Coordinate System         : ENU
```

Table 1. Current meter parameters

```
Profile interval      (s) : 300
Number of cells           : 60
Cell size             (m) : 0.25
Blanking distance     (m) : 0.41
Average interval      (s) : 60
Power level               : HIGH
Compass upd. rate     (s) : 1
Coordinate System         : ENU
```

Table 2. Current profiler parameters

The technical data, recorded during the 1.5 h test, demonstrate that the pitch, roll and heading of the two Aquadopps are coherent (Fig. 15, Fig. 16 and Fig. 17). The weather conditions were good during the experiment and the instrument remained nearly always vertical (i.e. no large pitch and roll); additionally, the prototype drifter did not display barrel-roll (i.e. there is no large variation of heading). Fig. 17 displays also that the two sensor heads were mounted properly. Indeed, there is no angle difference between them. The gap between the two lines is not constant, rather it changes with time and the lines can overlap and cross. Concerning the temperature (Fig. 18), the sensors need about 1 hour to respond and show a difference of about 0.5℃ betwee n the two heads.

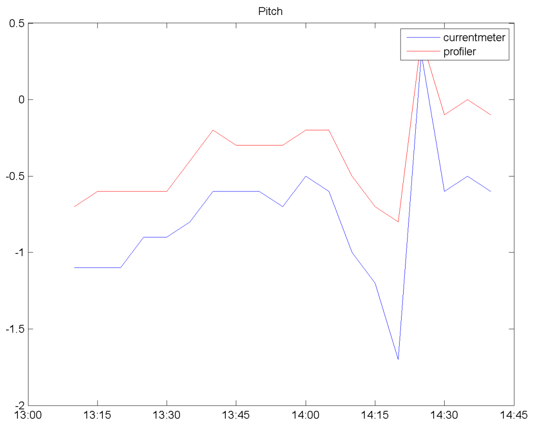


Fig. 15. Pitch (degree) measured by the currentmeter (blue line) and by the profiler (red line). X-axis: time (h).

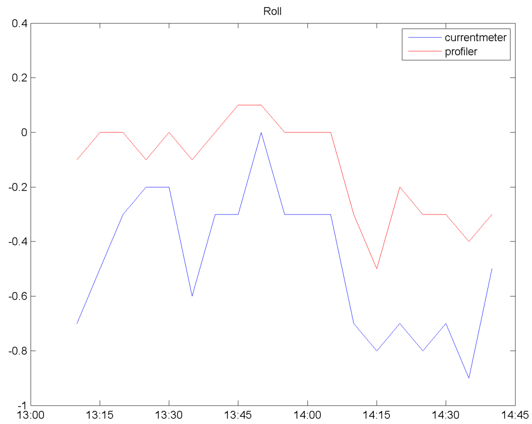


Fig. 16. Roll (degree) measured by the currentmeter (blue line) and by the profiler (red line). X-axis: time (h).

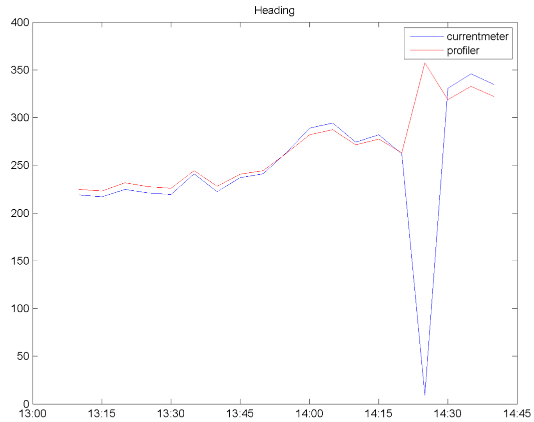


Fig. 17. Heading (degree) measured by the currentmeter (blue line) and by the profiler (red line). X-axis: time (h).

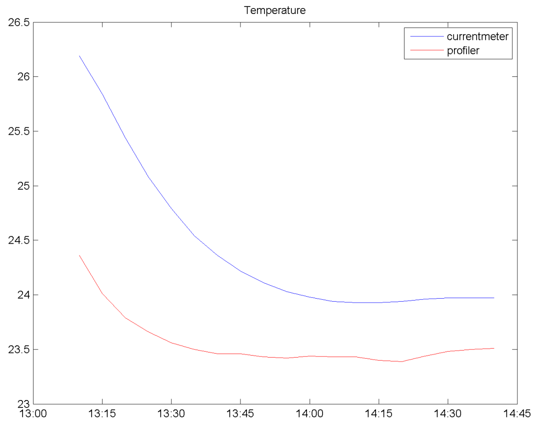


Fig. 18. Temperature (℃) measured by the currentmeter (blue line) and by the profiler (red line). X-axis: time (h).

The GPS data were used to compute the prototype velocity (by finite differencing the location sampled every 5 minutes: $u_i = \dfrac{x_{i+1} - x_{i-1}}{t_{i+1} - t_{i-1}}$, with u zonal velocity, t time and i an arbitrary index). This velocity was added to the current measured by the Aquadopp instruments (added because of the “head toward” rule for the current). These data are a bit confused and display large horizontal and vertical variations, mainly in direction (see examples in Fig. 19 and Fig. 20; all the plots can be found in Appendix A). It is to remark that the data were collected every 5 minutes and represent the average of 1 minute measurements. Anyway, not a zig-zag but a smoother curve was expected. Therefore, a second test was programmed with the instruments recording continuously (every second) without any automatic average.

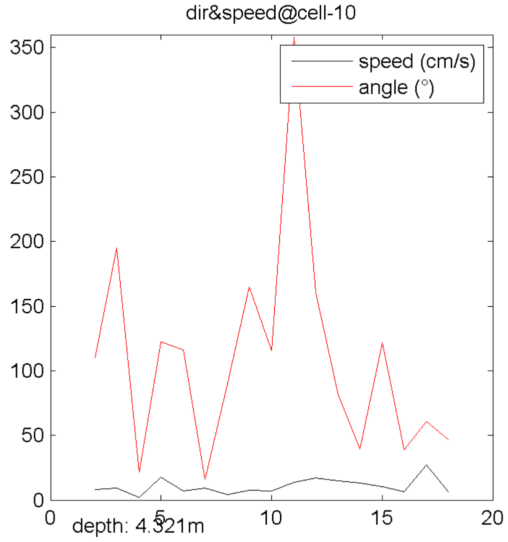


Fig. 19. Speed (blue line) and angle (red line) at a layer of about 4.3 m. X-axis: positions, y-axis: speed (cm/s) and angle (degree).

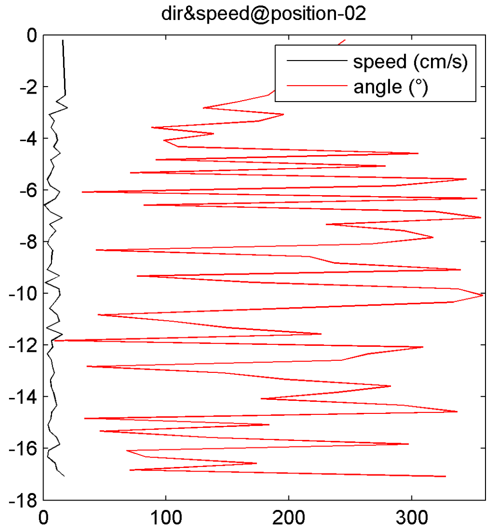


Fig. 20. Speed (blue line) and angle (red line) at position 2 (see 0 for the geographical reference). X-axis: speed (cm/s) and angle (degree), y-axis: depth (m).

4. Second test at sea

After about one month (on the 25th of August 2011), a second test was achieved in the Gulf of Trieste. We deployed three drifters in line separated about 2.5 meters one to the other (Fig. 21). In particular, the prototype drifter was deployed at first (in Fig. 21, the drifter with the yellow sails and the antenna), then we released a CODE drifter without the antenna (in Fig. 21, the drifter with the yellow sails without the antenna) and finally a CODE with the GPS/GSM module (in Fig. 21, the drifter with the blue sails).

No changes on the floating ring was made in order to check the buoyancy of the instrument with higher salinity with respect to the first test, but again the salinity was very low (around 35 psu). Consequently, the prototype resulted again a bit heavy in water.

This time, the current meter and the current profiler were set so as to store data each second with no average and with a cell size double with respect to the first experiment (see Table 3 and Table 4). Additionally, the Power level (amount of acoustic energy emitted in water) of the currentmeter was increased from “LOW+” to “HIGH” in order to guarantee of the backscatter.

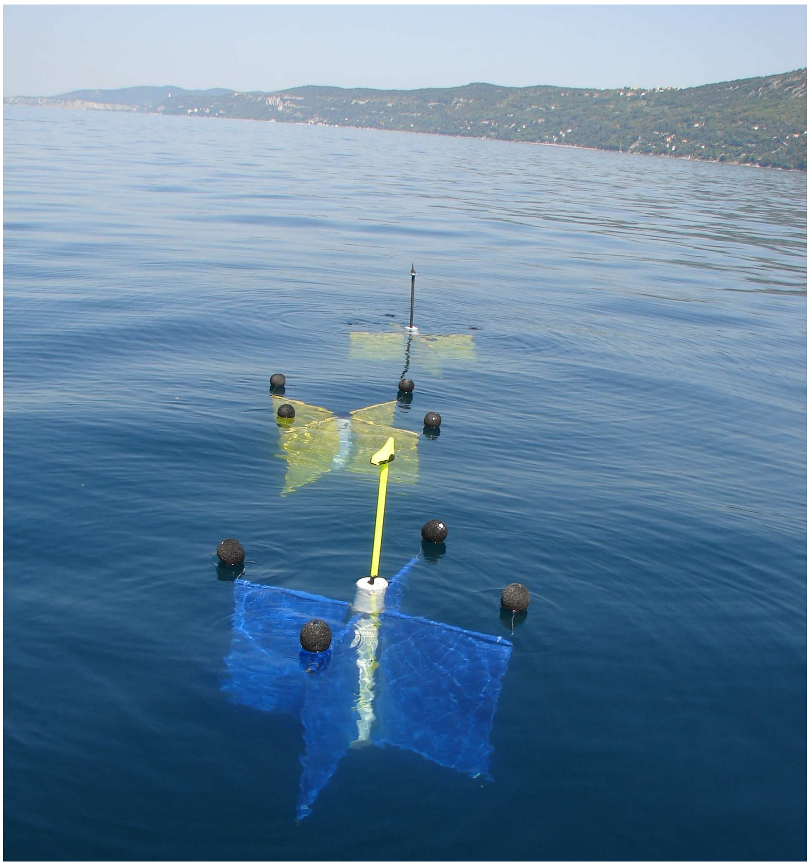


Fig. 21. Deployment of the three drifters during the second test off Miramare.

```
Measurement interval  (s) : 1
Average interval      (s) : 1
Blanking distance     (m) : 0.35
Diagnostics interval(min) : N/A
Power level               : HIGH
Compass upd. rate     (s) : 1
Coordinate System         : ENU
```

Table 3. Current meter parameters

```
Profile interval      (s) : 1
Number of cells           : 30
Cell size             (m) : 0.5
Blanking distance     (m) : 0.43
Average interval      (s) : 1
Power level               : HIGH
Compass upd. rate     (s) : 1
Coordinate System         : ENU
```

Table 4. Current profiler parameters

The test lasted 1 hour and the drifters moved coherently southward (Fig. 22). The distance between the prototype and the original CODE drifter did not change so much, while the CODE drifter equipped with the GPS/GSM module lagged a bit behind doubling the gap from the prototype (from 4.6 m to 8.9 m; compare Fig. 21 with Fig. 23 and Fig. 24).

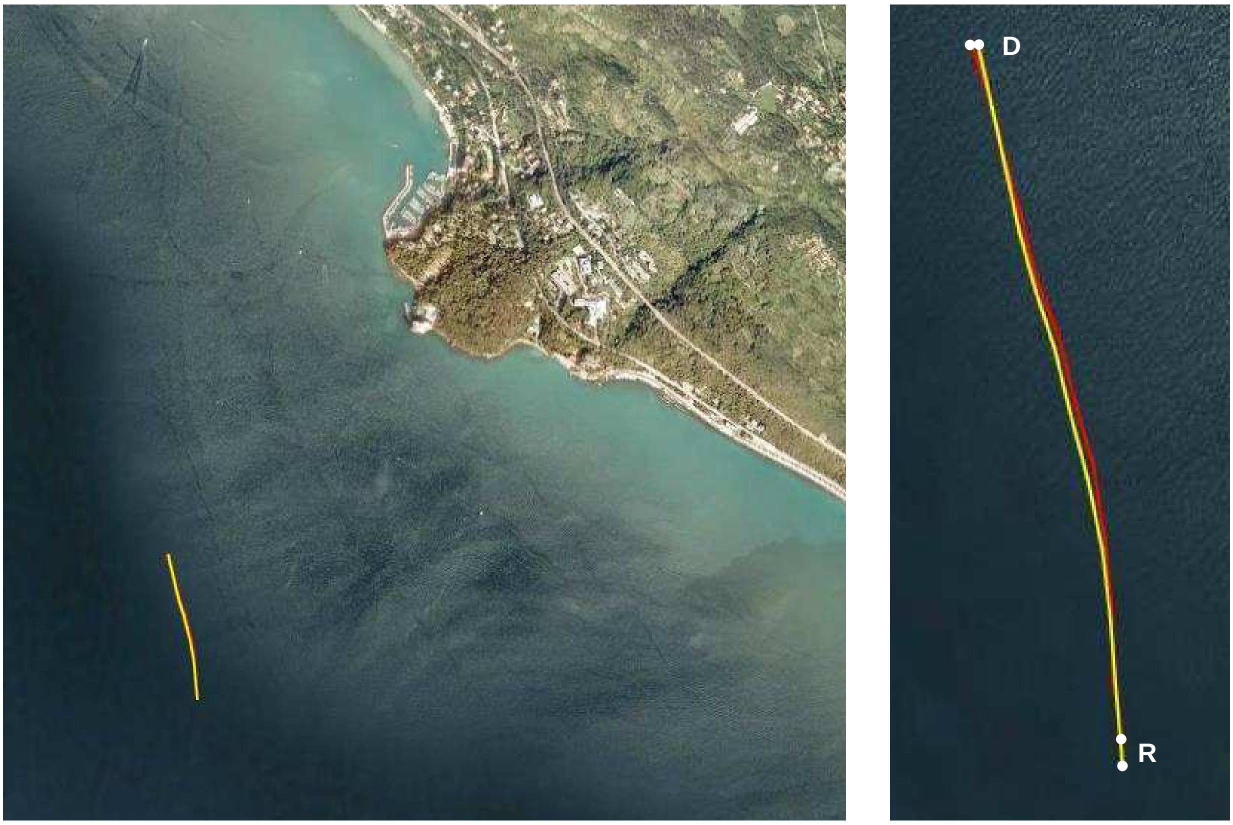


Fig. 22. Prototype drifter (red) and CODE drifter (yellow) trajectories during the second test off Miramare (left) with a zoom on the right (D: deployment position; R: recovery position).

Fig. 23. The three drifters 17 minutes after the deployment (Fig. 21).

Fig. 24. The three drifters about 1 hour after the deployment (Fig. 21).

The technical data confirm what was already noticed in the previous test. The temperature (Fig. 25) seems to have a response time of about 1 hour. Pitch, roll and heading (Fig. 26, Fig. 27 and Fig. 28) are noisy, but do not vary so much with calm sea conditions. It is important to note that the pressure sensor of the currentmeter failed and gives always zero values (Fig. 29). Finally, the battery display a consumption of about 0.2-0.3 V per 1-hour experiment (Fig. 30).

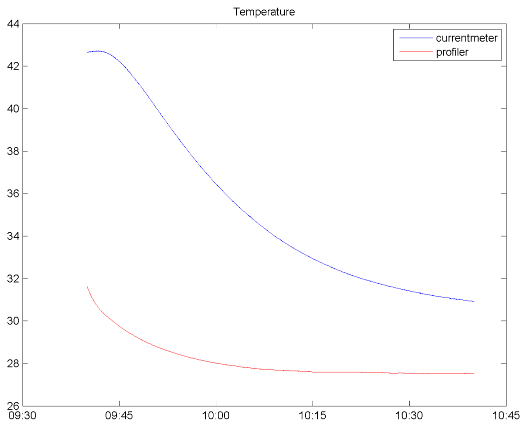


Fig. 25. Temperature (℃) measured by the currentmeter (blue line) and by the profiler (red line). X-axis: time (h).

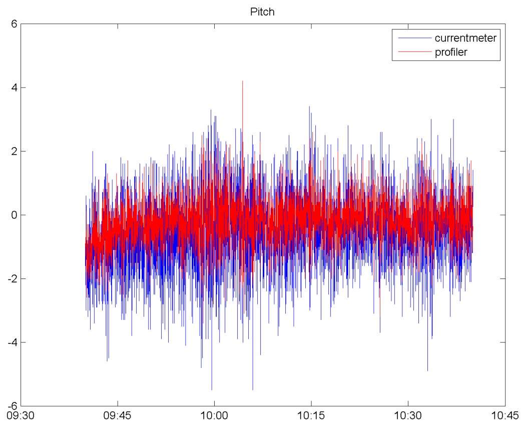


Fig. 26. Pitch (degree) measured by the currentmeter (blue line) and by the profiler (red line). X-axis: time (h).

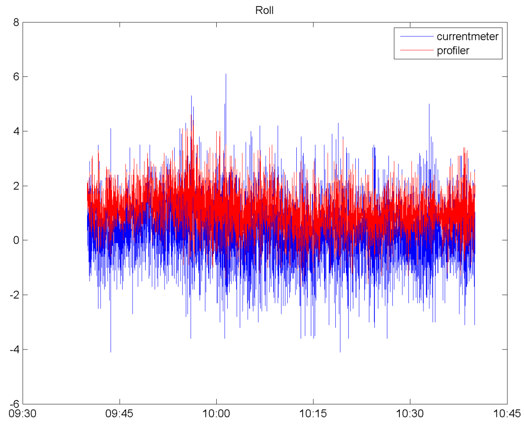


Fig. 27. Roll (degree) measured by the currentmeter (blue line) and by the profiler (red line). X-axis: time (h).

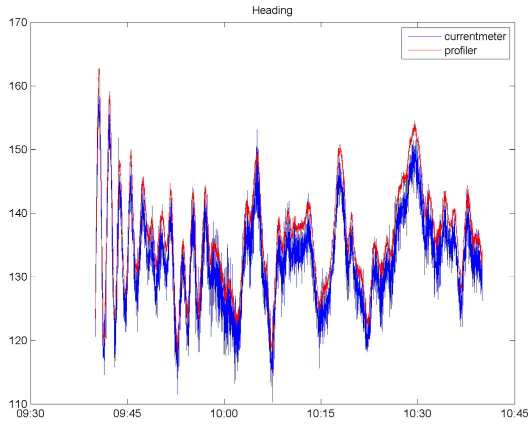


Fig. 28. Heading (degree) measured by the currentmeter (blue line) and by the profiler (red line). X-axis: time (h).

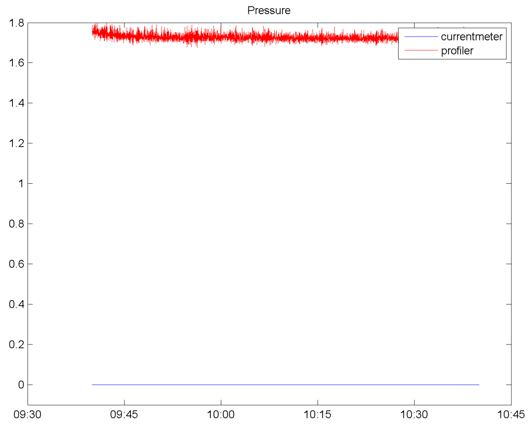


Fig. 29. Pressure (m) measured by the currentmeter (blue line) and by the profiler (red line). X-axis: time (h).

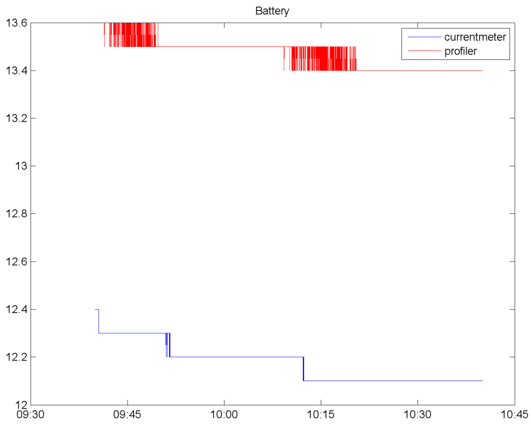


Fig. 30. Battery voltage (V) measured by the currentmeter (blue line) and by the profiler (red line). X-axis: time (h).

The 1-second data recorded are noisy because they include the signal induced by the waves (blue plot in Fig. 31). An average of some minutes can help to eliminate this high frequency variability.

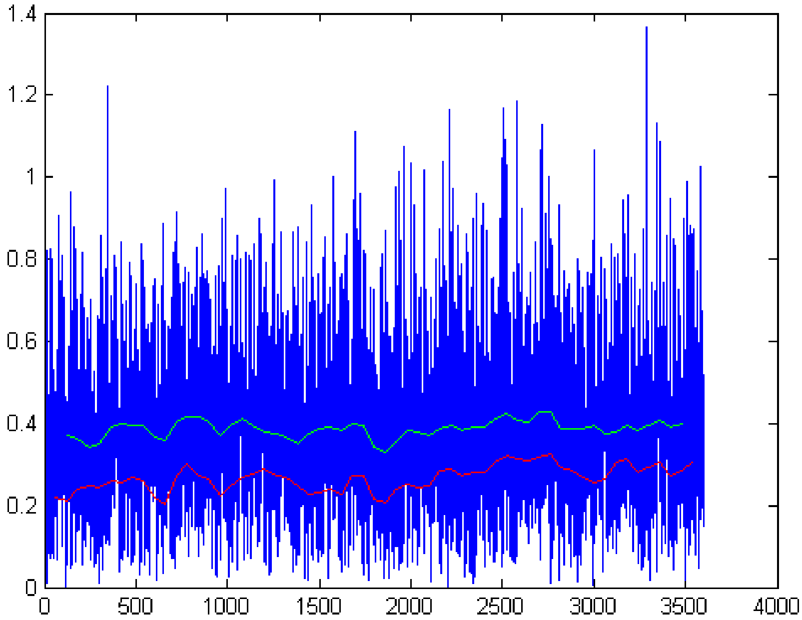


Fig. 31. Speed (m/s) recorded by the profiler at the first cell (blue: 1-s measurements; green: 2-minute average of the speed; red: speed obtained from the 2- minutes average of the components). X-axis: Time after deployment (s).

To this aim, a 2-minute velocity running average was performed each minute. Resulting speeds (red line in Fig. 31) are lower than the simple 1-D average of the speed (green line in Fig. 31) because it derive from the average of the zonal and meridional components (2-D). Considering the average of the velocity, the plots of the speed and the direction are smoother with respect to the figures obtained with the data of the first test (example are given in Fig. 32 and Fig. 33, all the plots can be found in Appendix B). In particular, there is less variability in the first layers, but also at mid depths and less variability along the water column in each position. The speed of the surface layer is markedly larger than the speeds recorded in the water column (about 35-40 cm/s compared to less than 10 cm/s). The speed and direction plots rarely show a layer structure and display a preferential direction toward the south - southeast all along the water column (see plots in Appendix B).

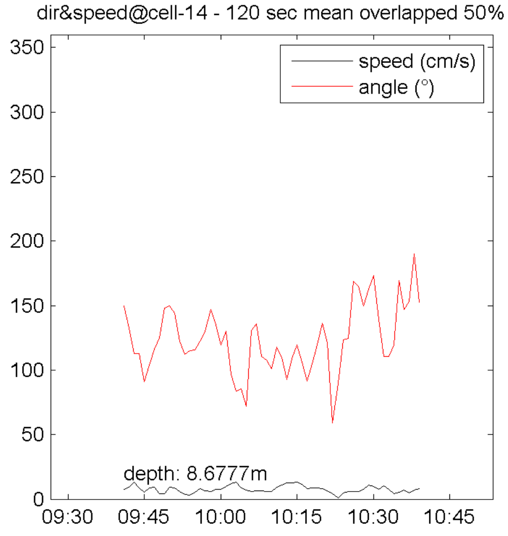


Fig. 32. Speed (blue line) and angle (red line) at a layer of about 4.2 m. X-axis: time (h), y-axis: speed (cm/s) and angle (degree).

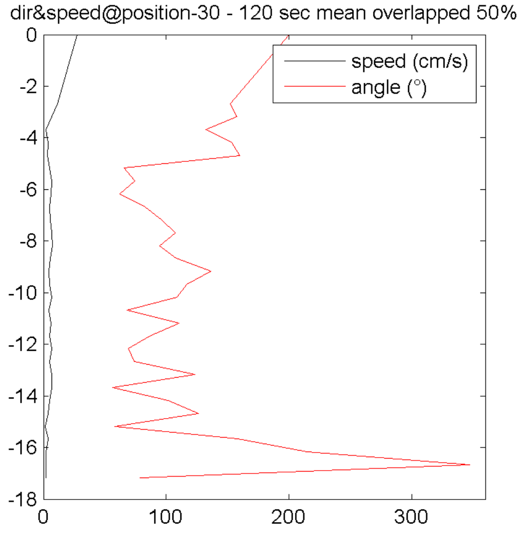


Fig. 33. Speed (blue line) and angle (red line) at halfway. X-axis: speed (cm/s) and angle (degree), y-axis: depth (m)

Surely, having doubled the cell size parameter of the profiler helped to decrease the data noise. Additionally, an overlapped average can partially smooth the plots, However, one additional test is required. Indeed, it is very important to compare the average values given by the Aquadopp with the raw data. To do this, we need to use the prototype first acquiring each second and then, for example, recording the average of 5 minutes measurements every 15 minutes.

5. Third test at sea

The third test was carried out on the 26th of September 2011. The prototype drifter was deployed three times acquiring data every second for 10 minutes, then recording a 5-minutes average every 15 minutes for one hour and finally again recording every second for 10 minutes. The current meter and current profiler configurations were the same as the second test (Tables 3 and 4), except for the timing. Again, no change on the floating ring was made.

The salinity was higher than the previous two tests and the prototype disclosed a better buoyancy in water.

The prototype drifter initially moved north-westward (green line) and then northward during the second and third phase of the test (yellow and red lines, respectively). The trajectories of the three phases reveal that the prototype speed increased during the test. Indeed, the path done by the drifter during the first 10-minutes mission (green line in Fig. 34) is noticeably shorter than the one of the third phase (red line in Fig. 34).

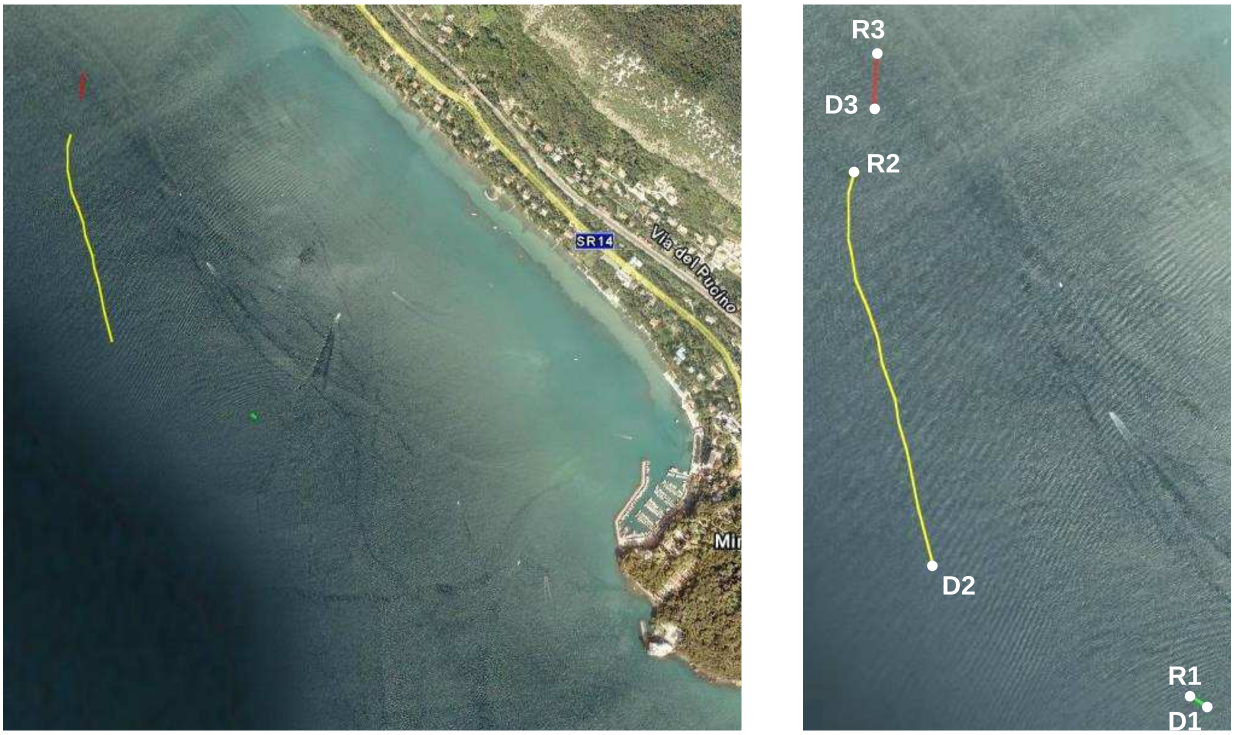


Fig. 34. Prototype drifter missions during the third test. First 10-minutes mission (green), long mission with 5-minutes average acquisition every 15 minutes (yellow) and second 10-minutes mission (red). Zoomed area an the right (D: deployment position; R: recovery position).

Wind speed also increased a bit during the experiments and, during the second and third missions, the prototype remained clearly entrapped into a foam trail (Fig. 35). The drifter seems to respond immediately to the wind changes. Unfortunately, the current meter did not work during this test. Without these data, it is impossible to determine the behaviour of the water current at the surface layer and to make any comparison with the drifter motion. Anyway, it is possible to note a rising tendency in the current speed plot during the first and third phases of the test, at least in the first 5-meters and from 10 to 15 meters (see Fig. 40 and Appendix C).

The main technical data (from Fig. 36 to Fig. 39) display that the parameters recorded during the three phase of the test are coherent. In particular, the pitch and roll information match quite well, while the heading data seem a bit too noisy with an anomalous value around 13:00; anyway a decreasing tendency with the time can be recognized.

Fig. 35. The prototype drifter into a foam trail formed during the second phase of the test.

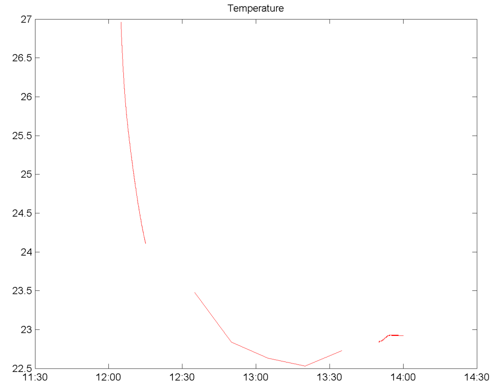


Fig. 36. Temperature (℃) recorded by the current profiler. X-axis: time (h).

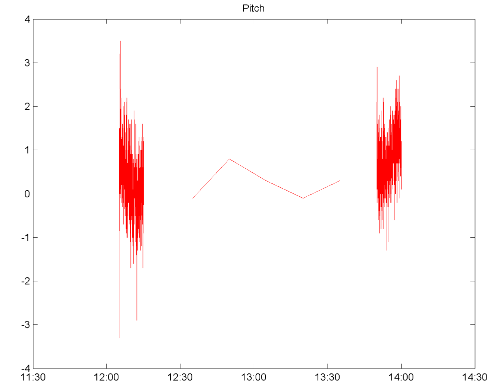


Fig. 37. Pitch (degree) measured by the current profiler. X-axis: time (h).

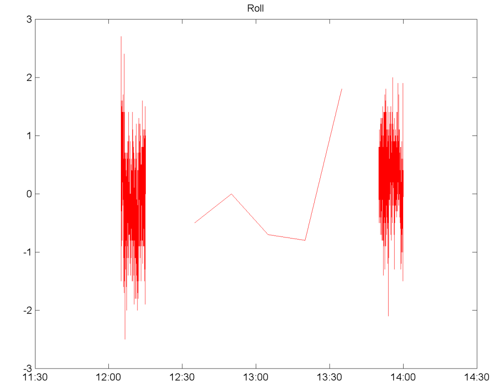


Fig. 38. Roll (degree) measured by the current profiler. X-axis: time (h).

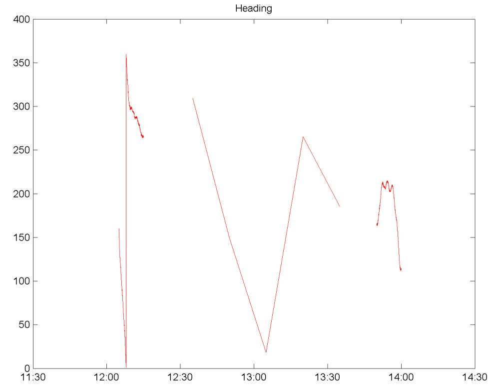


Fig. 39. Heading (degree) measured by the current profiler. X-axis: time (h).

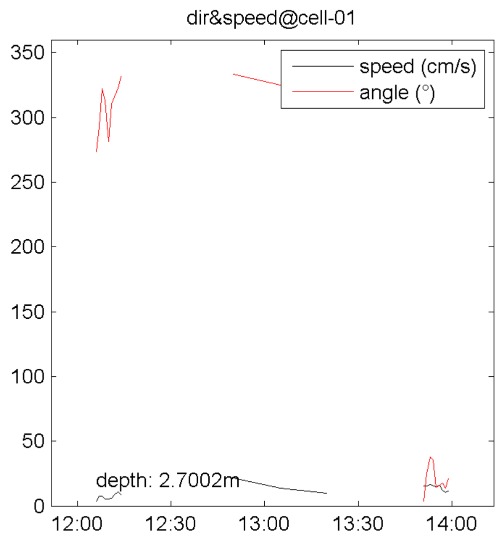


Fig. 40. Speed (blue line) and angle (red line) at a layer of about 2.7 m. X-axis: time (h), y-axis: speed (cm/s) and angle (degree)..

Comparing the 5-minutes averages (second phase of the test) with the values of the first and third phases, it seems that the current values recorded during the second phase are quite consistent with the other values recorded immediately before and after.

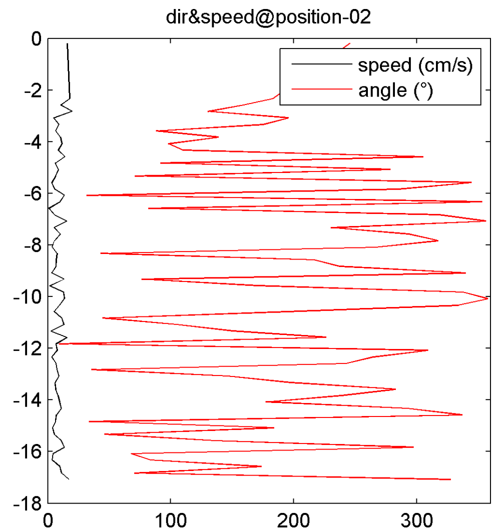
The 5-minutes average maybe excessively smooth the data (see plots in Appendix C). Therefore, considering also the good results obtained by 2-minutes averaging the data (second test and first and third mission of the third test), a 2-minutes automatic average interval seems to be more appropriate and can be used without introducing any additional noise. Moreover, diminishing the value of this parameter allows reducing power consumption and extends the operative life of the instrument.

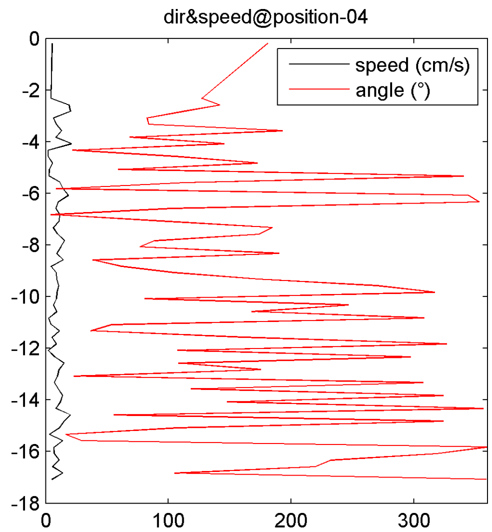
Acknowledgments

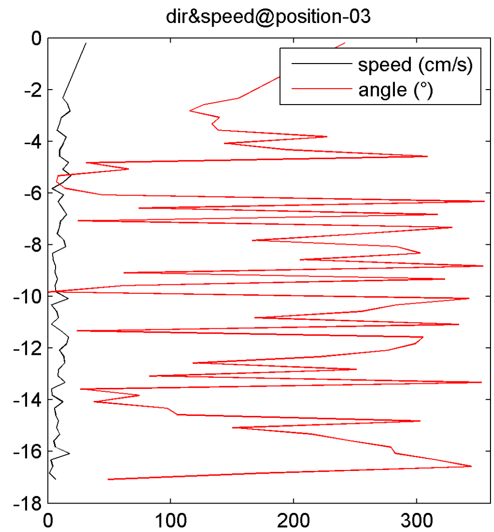
The authors would like to thanks Mr. Belletti for the precious help during all the phase of the prototype realization, Dr. Brunetti for the support with the GPS/GSM module, Dr. Vinzi, Dr. Ciriaco and Mr. Pipino for their help during the tests at sea.

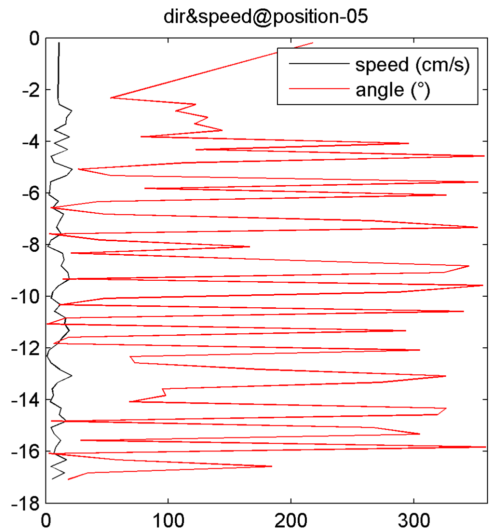
Appendix A – first test plots

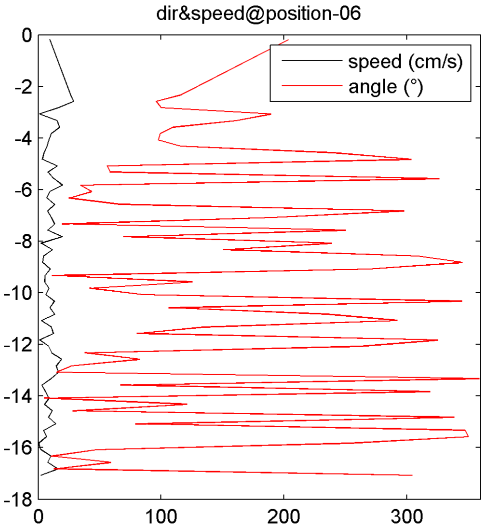
Here below we report the speed and direction plots recorded during the first test along the water column at the different position (i.e. while moving). X-axis: speed (cm/s) and angle (degree), y-axis: depth (m).

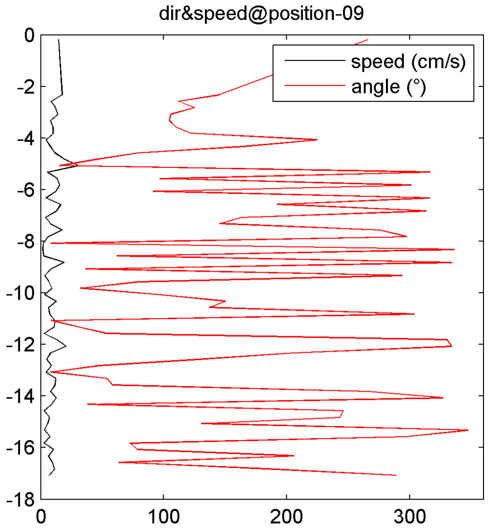


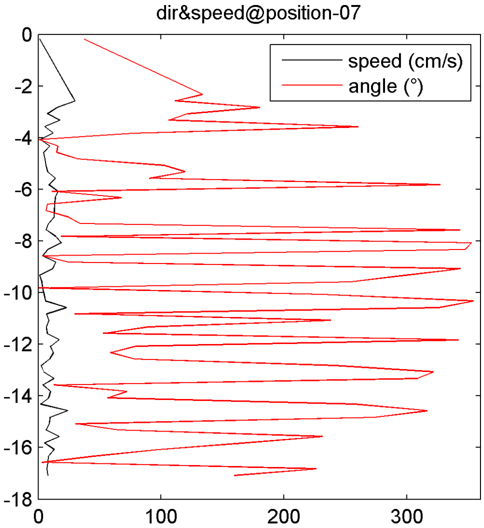


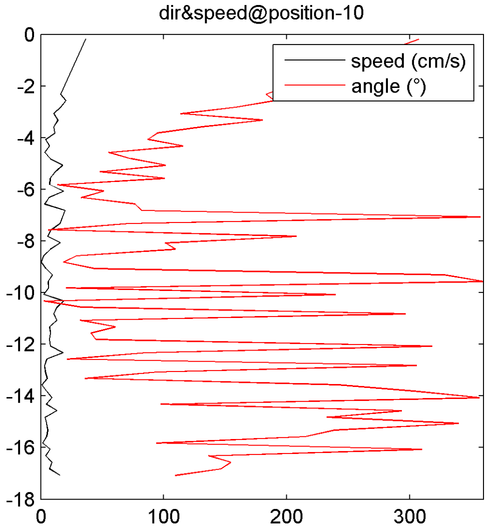


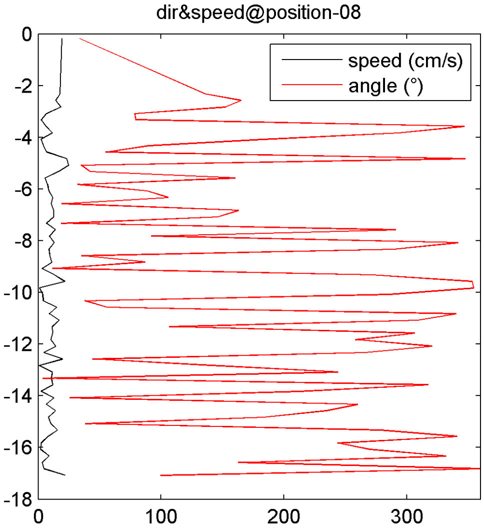


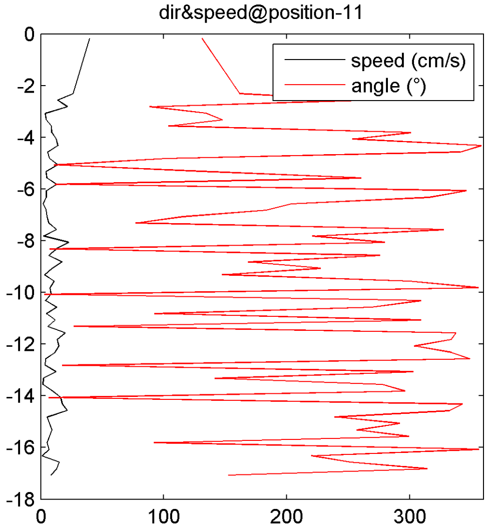

dir&speed@position-06
speed (cm/s)
angle (°)

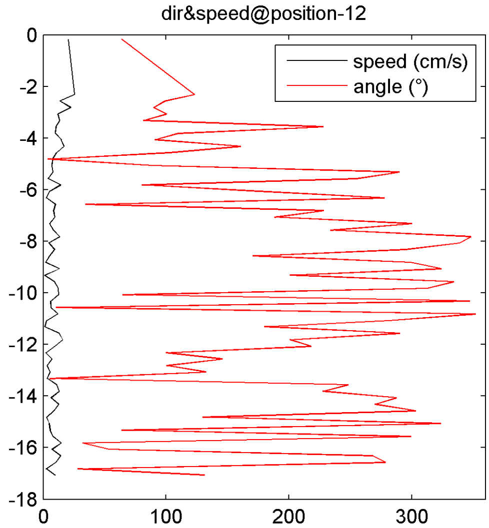

dir&speed@position-09
speed (cm/s)
angle (°)

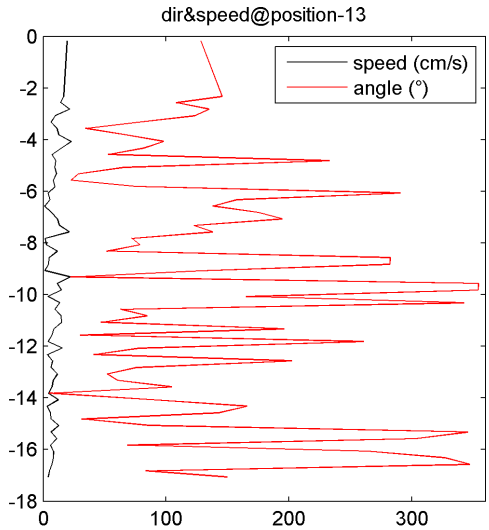

dir&speed@position-07
speed (cm/s)
angle (°)

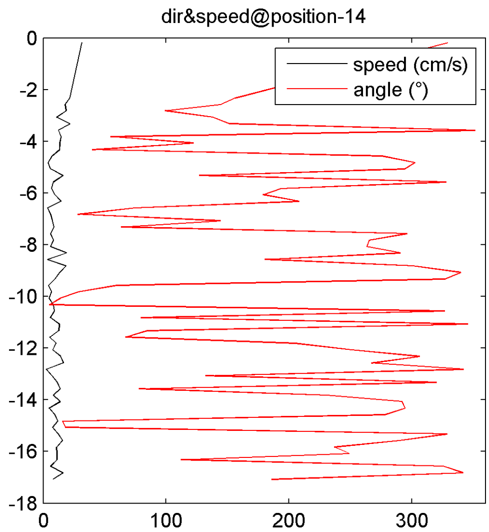

dir&speed@position-10
speed (cm/s)
angle (°)

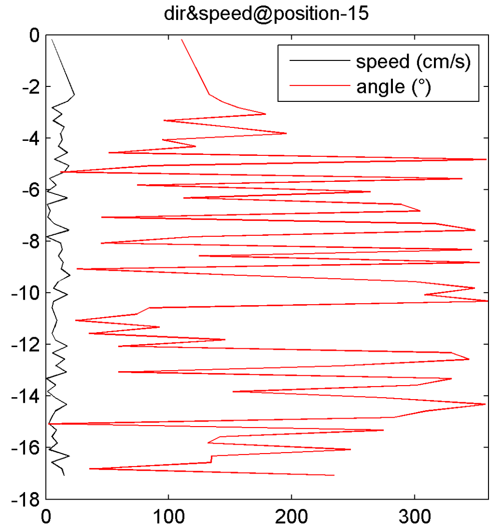

dir&speed@position-08
speed (cm/s)
angle (°)

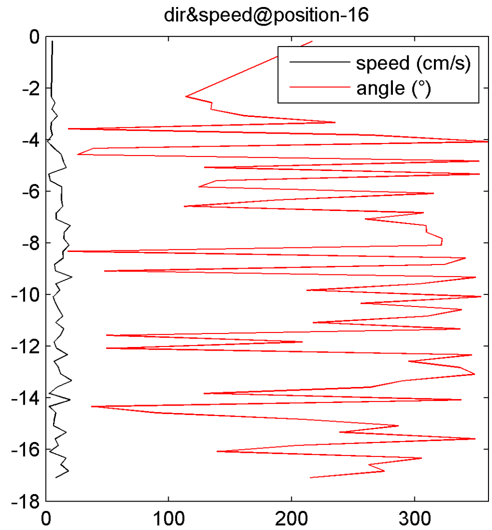

dir&speed@position-11
speed (cm/s)
angle (°)

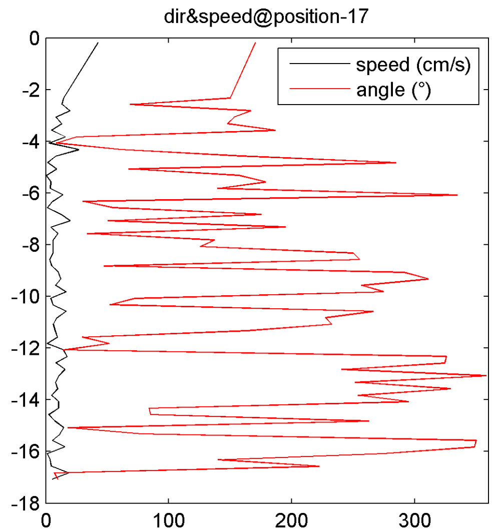

dir&speed@position-12
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

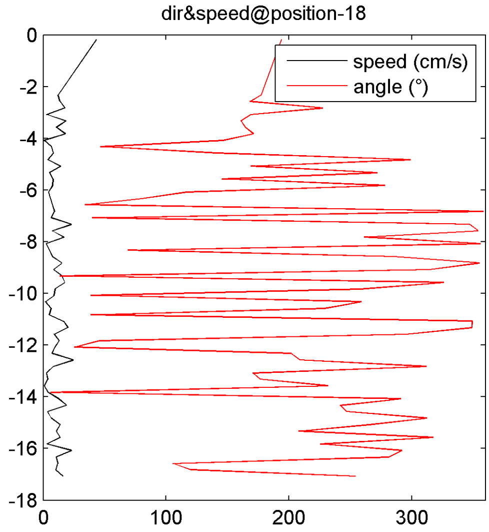

dir&speed@position-13
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300


dir&speed@position-14
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

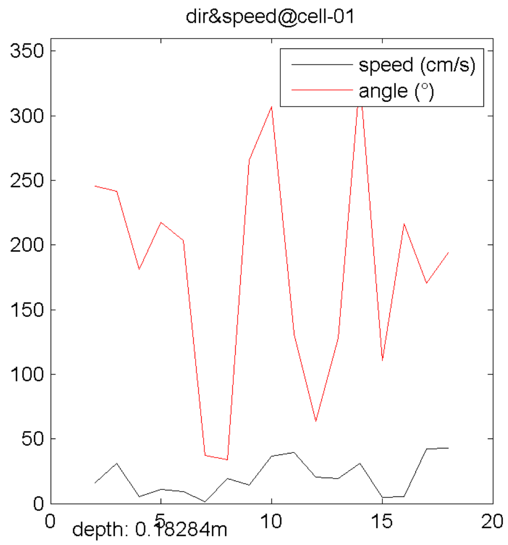

dir&speed@position-15
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

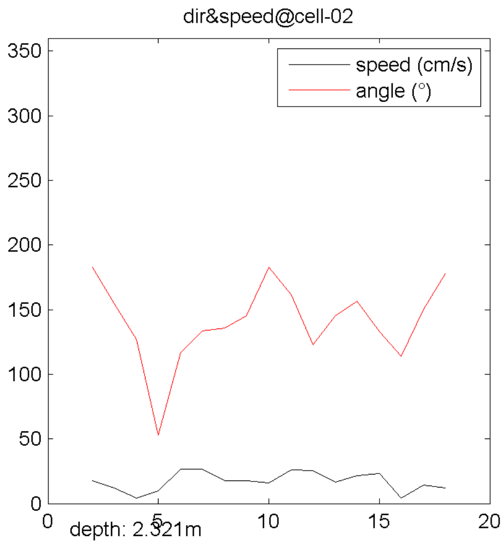

dir&speed@position-16
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

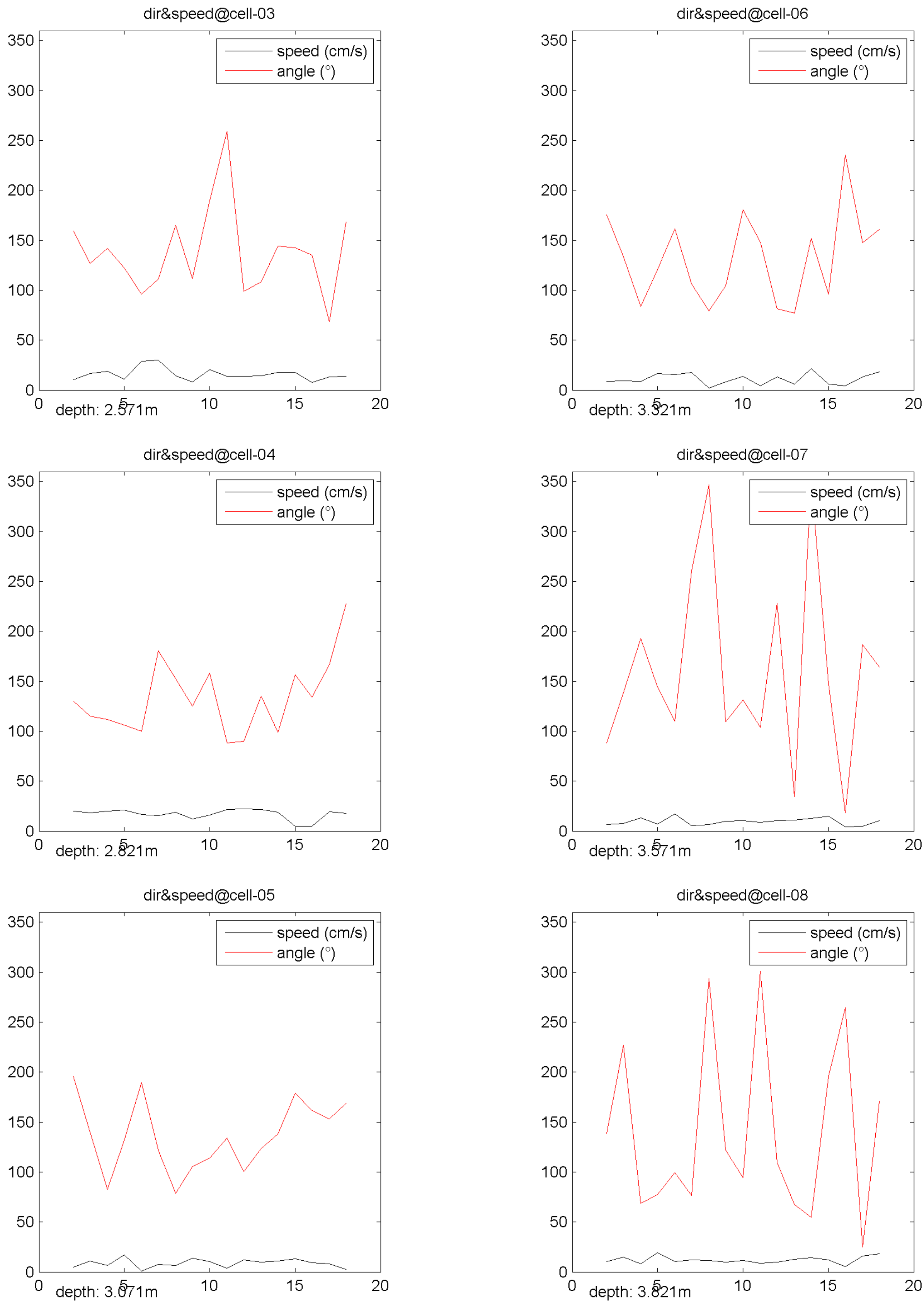

dir&speed@position-17
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

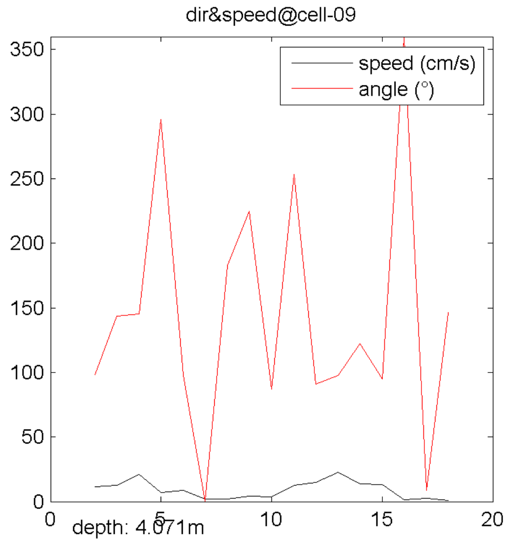


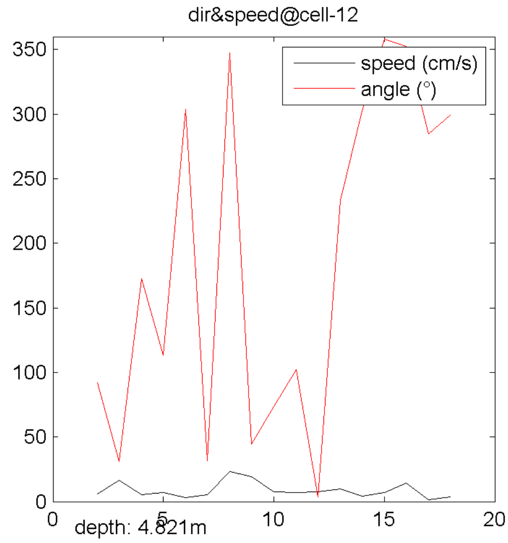
Here below we report the speed and direction plots recorded during the first test along the path at different layer of depth. X-axis: positions, y-axis: speed (cm/s) and angle (degree).

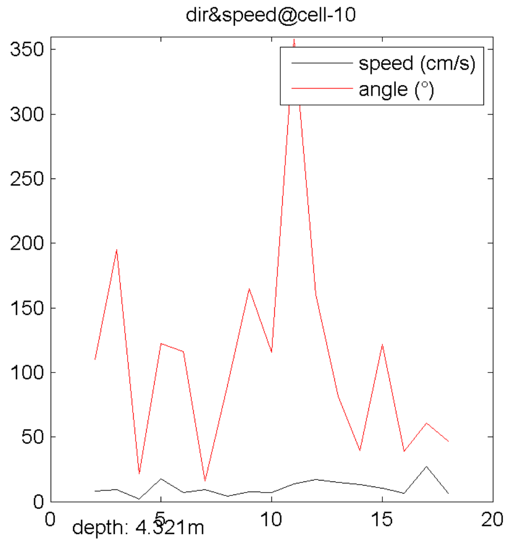


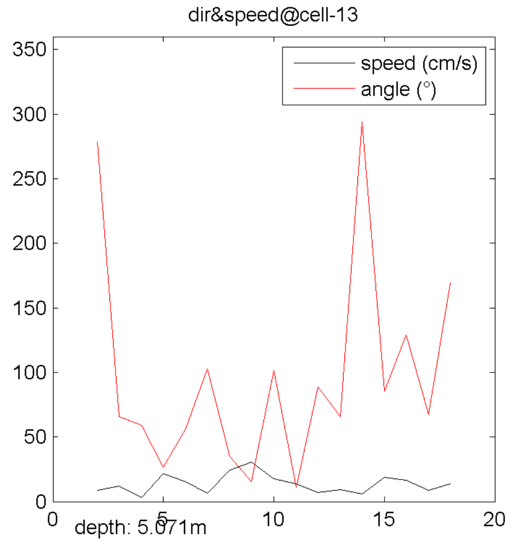


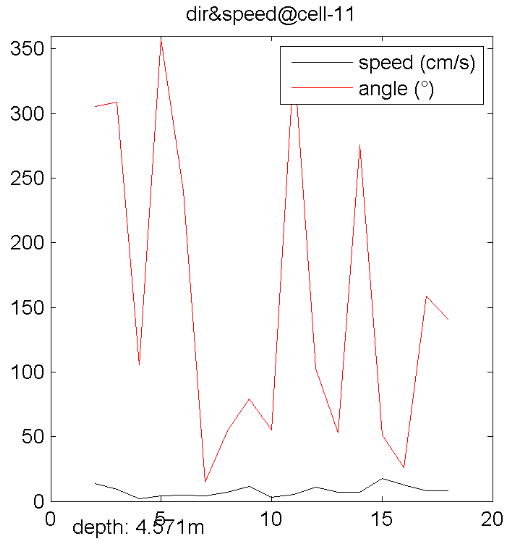

dir&speed@cell-03
speed (cm/s)
angle (°)
depth: 2.571m
dir&speed@cell-06
depth: 3.321m
dir&speed@cell-04
depth: 2.821m
dir&speed@cell-07
depth: 3.571m
dir&speed@cell-05
depth: 3.071m
dir&speed@cell-08
depth: 3.821m

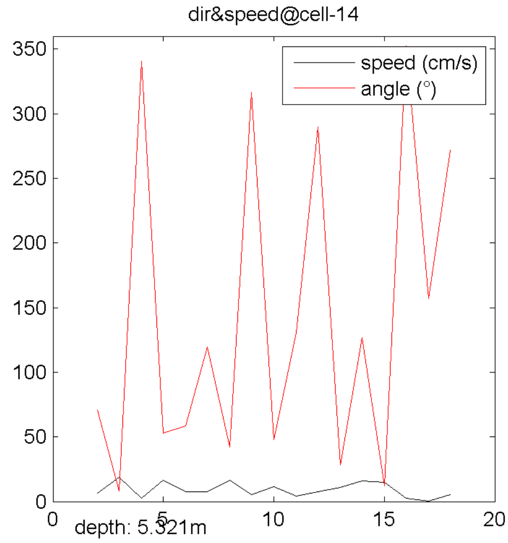

dir&speed@cell-09
speed (cm/s)
angle (°)
depth: 4.071m

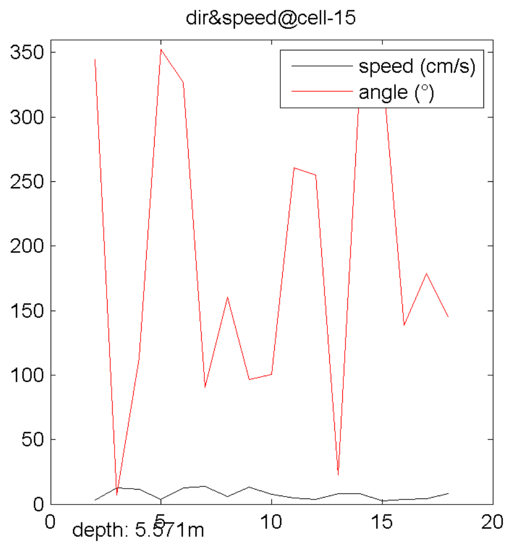

dir&speed@cell-12
speed (cm/s)
angle (°)
depth: 4.821m

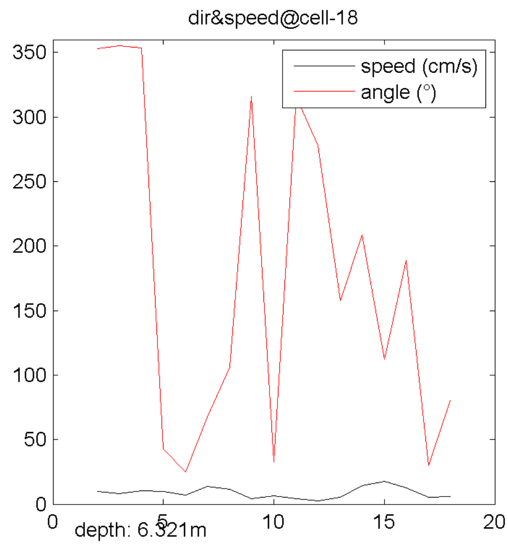

dir&speed@cell-10
speed (cm/s)
angle (°)
depth: 4.321m

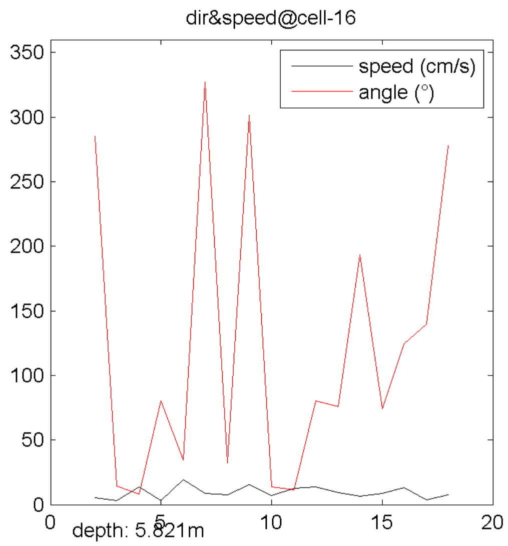

dir&speed@cell-13
speed (cm/s)
angle (°)
depth: 5.071m

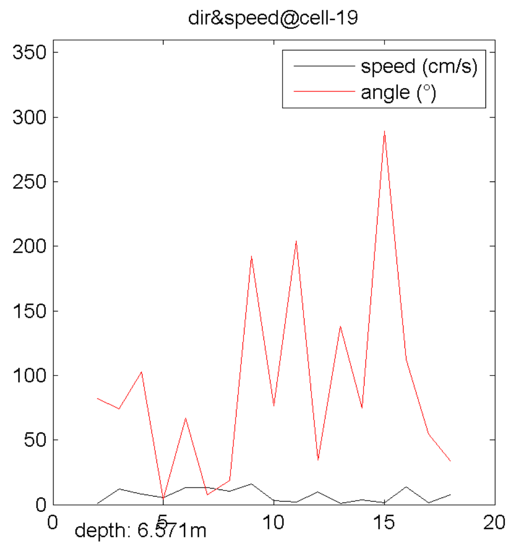

dir&speed@cell-11
speed (cm/s)
angle (°)
depth: 4.571m

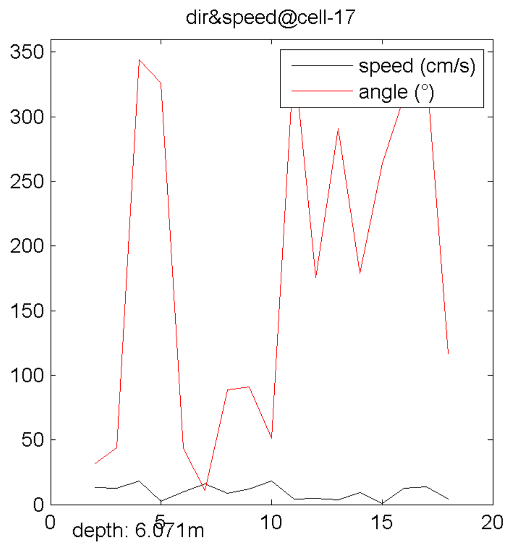

dir&speed@cell-14
speed (cm/s)
angle (°)
depth: 5.321m

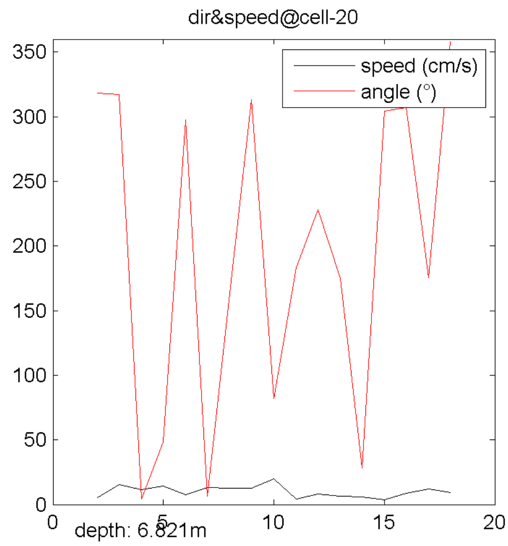

dir&speed@cell-15
speed (cm/s)
angle (°)
350
300
250
200
150
100
50
0
0
5
10
15
20
depth: 5.571m

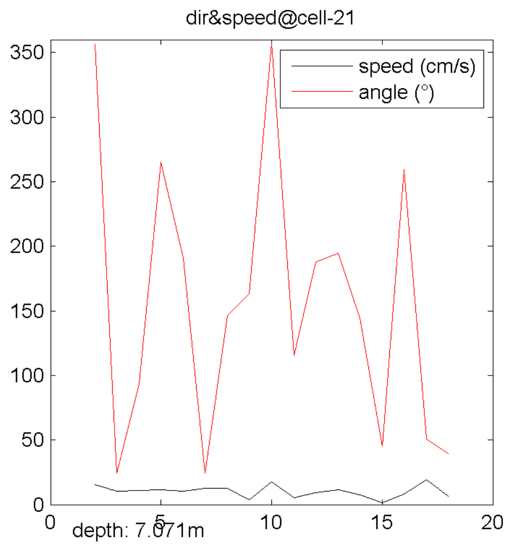

dir&speed@cell-18
speed (cm/s)
angle (°)
350
300
250
200
150
100
50
0
0
5
10
15
20
depth: 6.321m

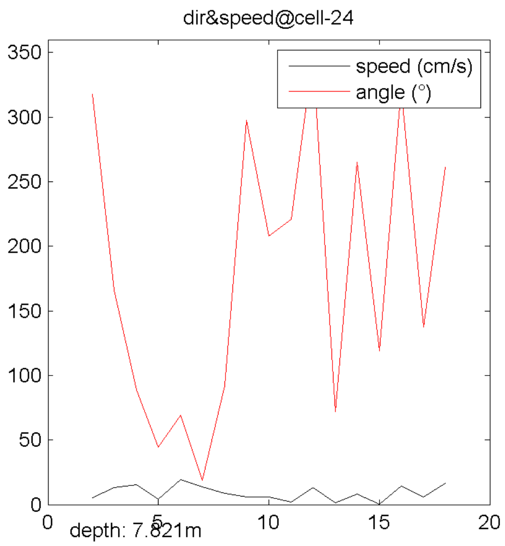

dir&speed@cell-16
speed (cm/s)
angle (°)
350
300
250
200
150
100
50
0
0
5
10
15
20
depth: 5.821m

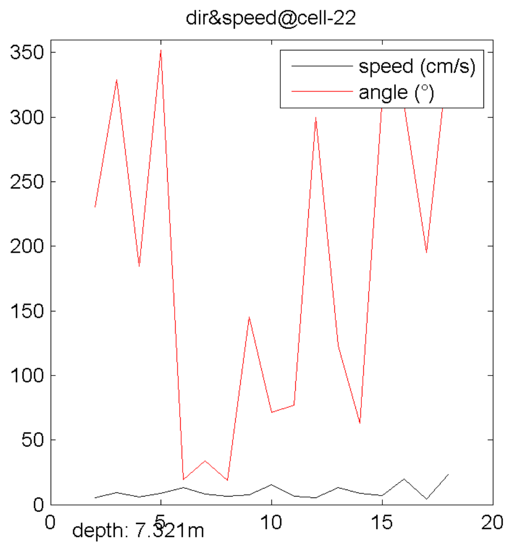

dir&speed@cell-19
speed (cm/s)
angle (°)
350
300
250
200
150
100
50
0
0
5
10
15
20
depth: 6.571m

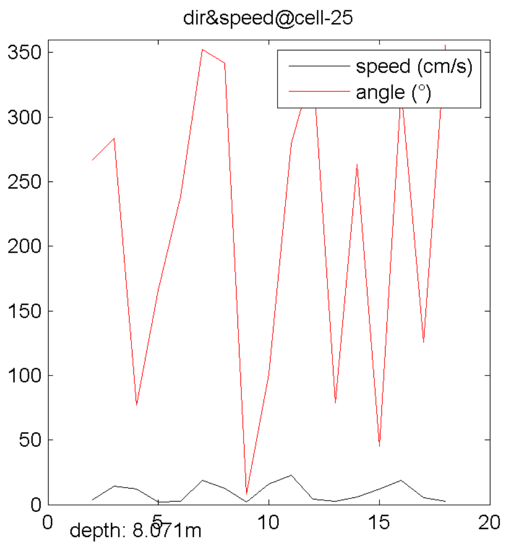

dir&speed@cell-17
speed (cm/s)
angle (°)
350
300
250
200
150
100
50
0
0
5
10
15
20
depth: 6.071m

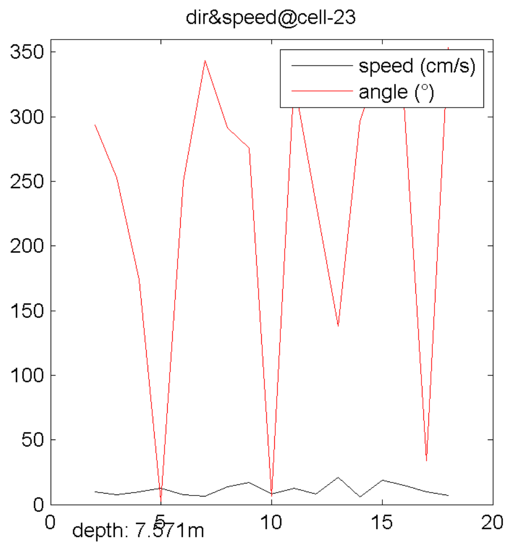

dir&speed@cell-20
speed (cm/s)
angle (°)
350
300
250
200
150
100
50
0
0
5
10
15
20
depth: 6.821m

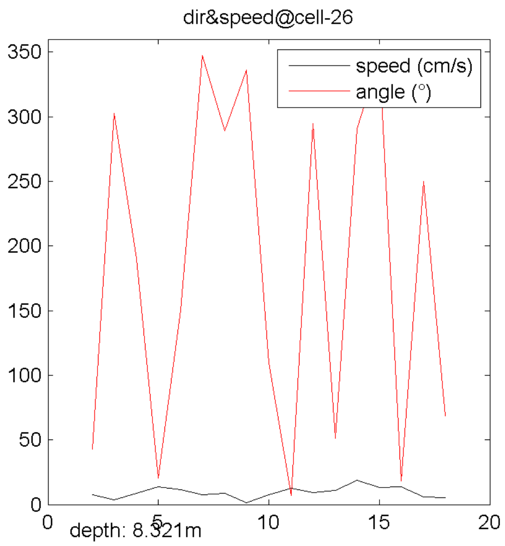

dir&speed@cell-21
speed (cm/s)
angle (°)
depth: 7.071m

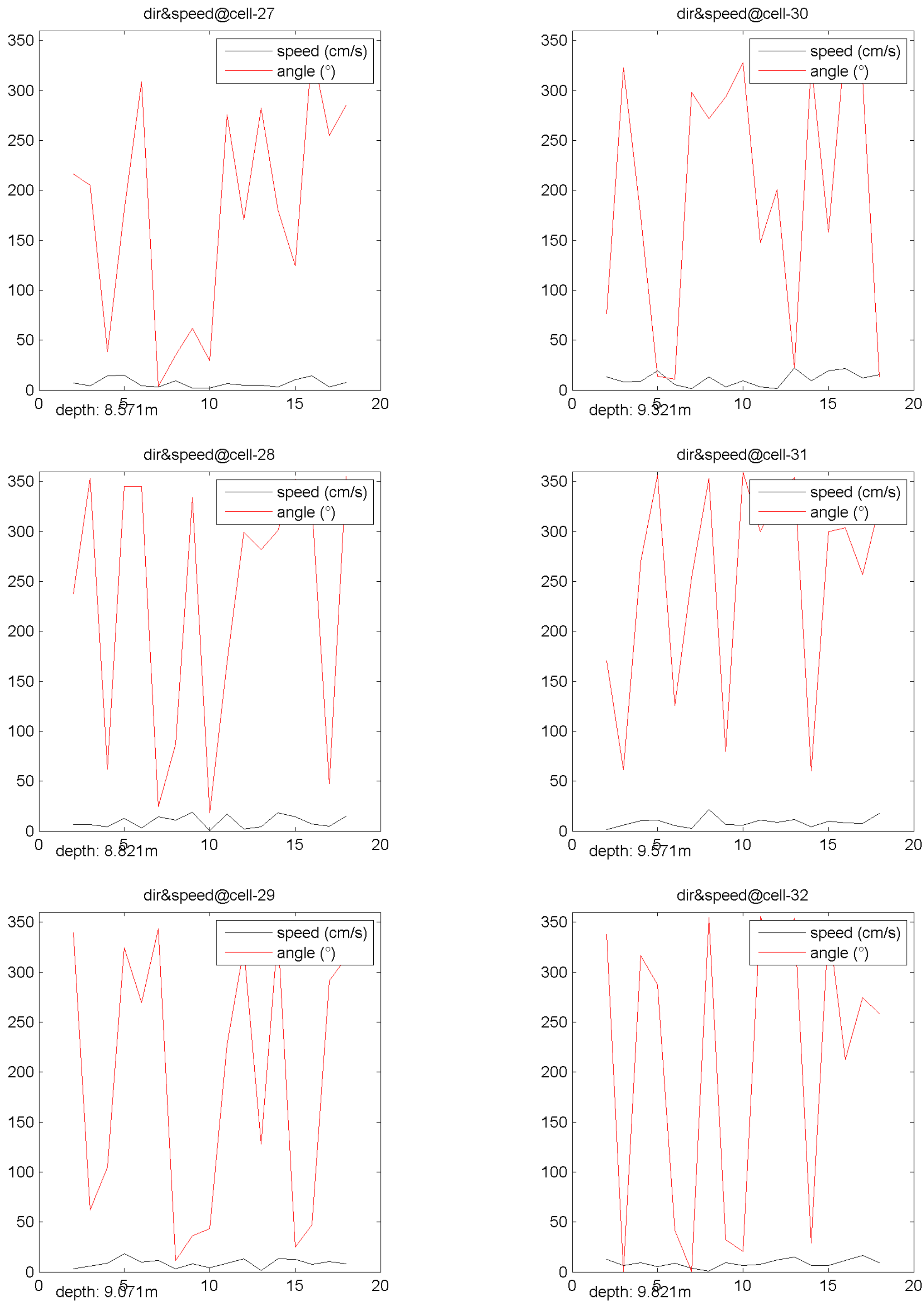

dir&speed@cell-24
speed (cm/s)
angle (°)
depth: 7.821m

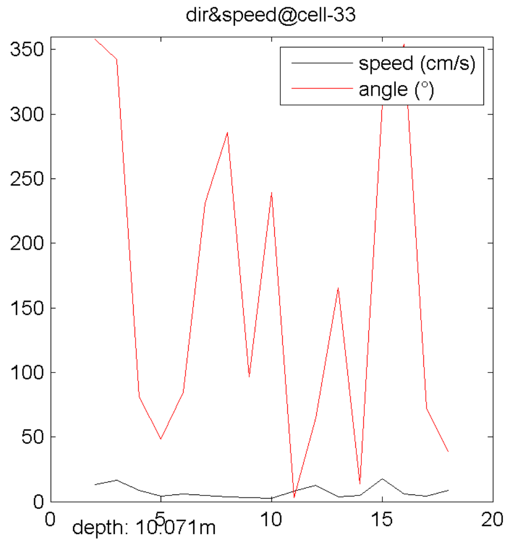

dir&speed@cell-22
speed (cm/s)
angle (°)
depth: 7.321m

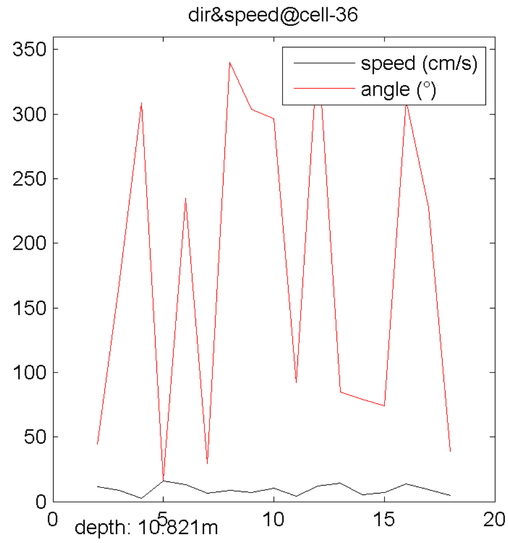

dir&speed@cell-25
speed (cm/s)
angle (°)
depth: 8.071m

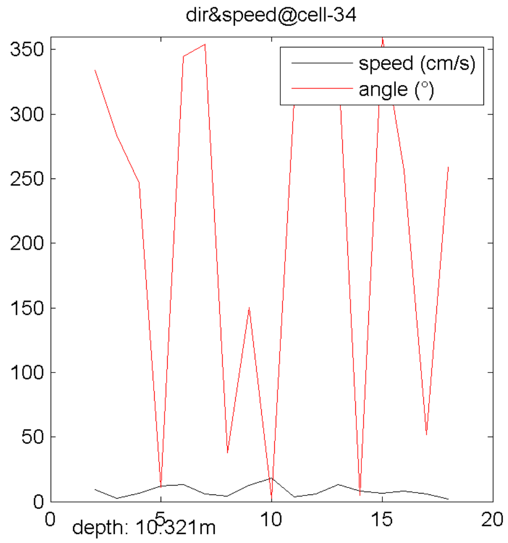

dir&speed@cell-23
speed (cm/s)
angle (°)
depth: 7.571m

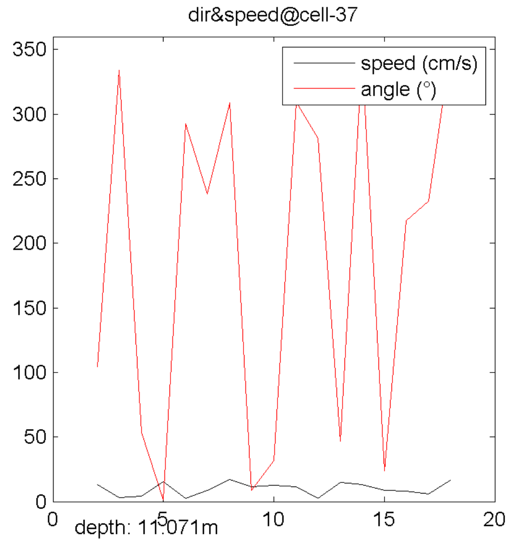

dir&speed@cell-26
speed (cm/s)
angle (°)
depth: 8.321m

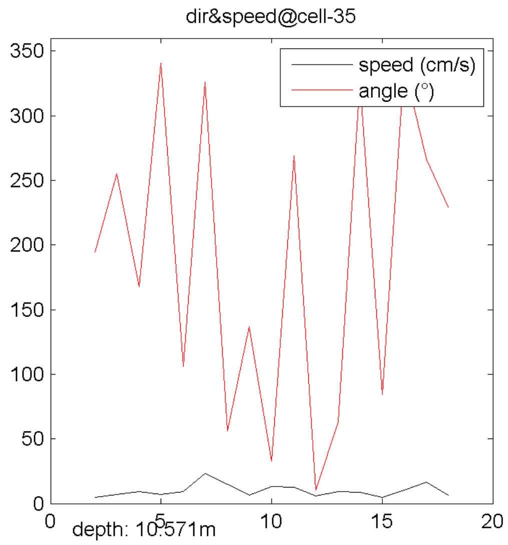

dir&speed@cell-27
speed (cm/s)
angle (°)
depth: 8.571m
dir&speed@cell-30
depth: 9.321m
dir&speed@cell-28
depth: 8.821m
dir&speed@cell-31
depth: 9.571m
dir&speed@cell-29
depth: 9.071m
dir&speed@cell-32
depth: 9.821m

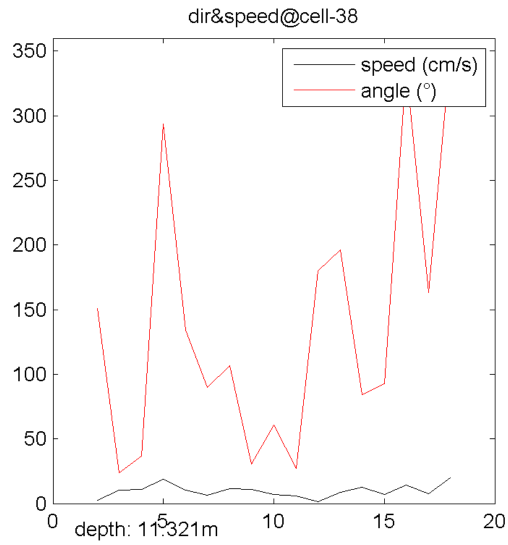

dir&speed@cell-33
speed (cm/s)
angle (°)
depth: 10.071m
0 5 10 15 20
0 50 100 150 200 250 300 350

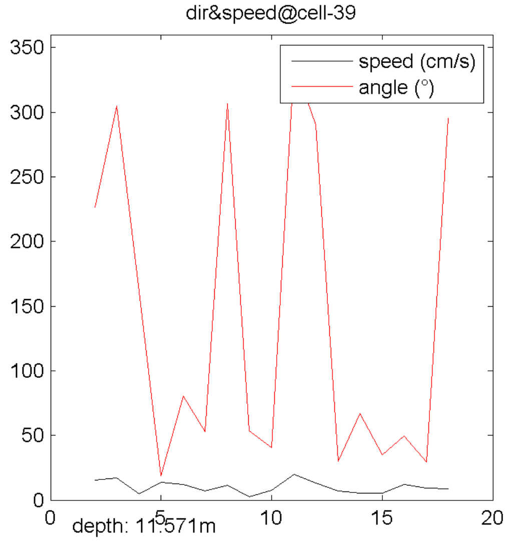

dir&speed@cell-36
speed (cm/s)
angle (°)
depth: 10.821m
0 5 10 15 20
0 50 100 150 200 250 300 350

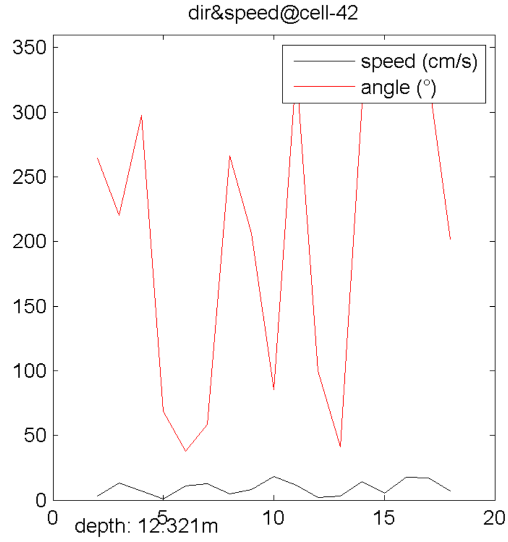

dir&speed@cell-34
speed (cm/s)
angle (°)
depth: 10.321m
0 5 10 15 20
0 50 100 150 200 250 300 350

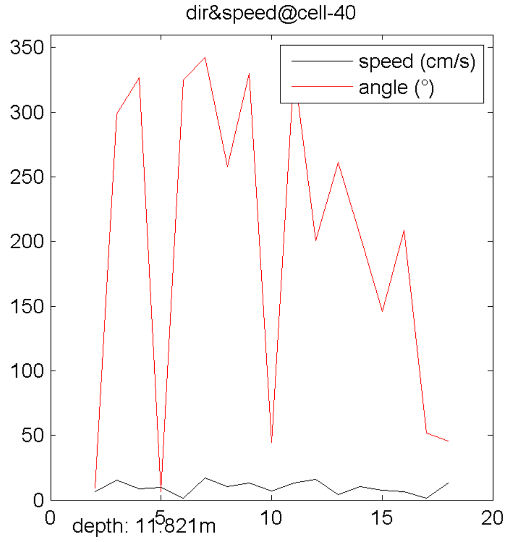

dir&speed@cell-37
speed (cm/s)
angle (°)
depth: 11.071m
0 5 10 15 20
0 50 100 150 200 250 300 350

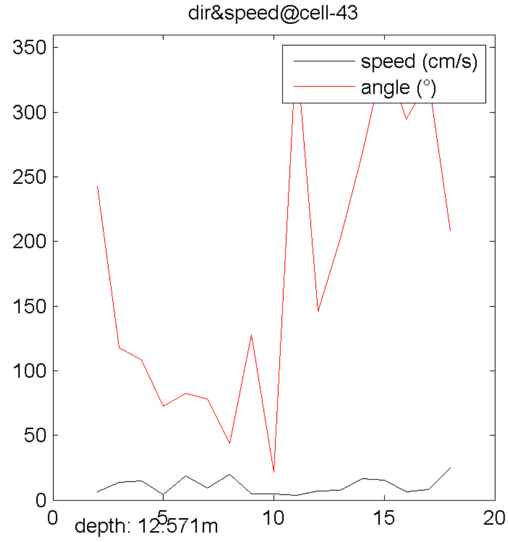

dir&speed@cell-35
speed (cm/s)
angle (°)
depth: 10.571m
0 5 10 15 20
0 50 100 150 200 250 300 350

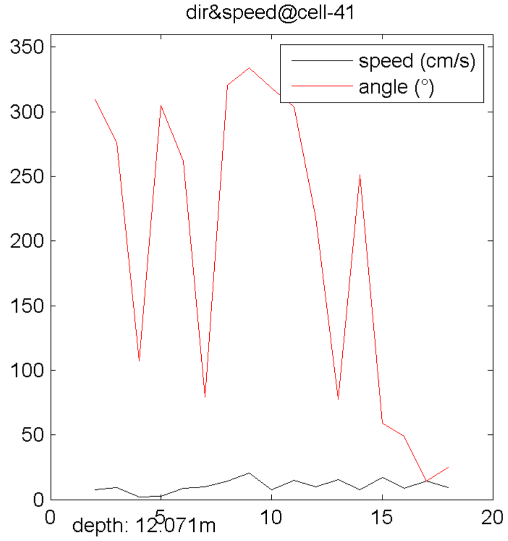

dir&speed@cell-38
speed (cm/s)
angle (°)
depth: 11.321m
0 5 10 15 20
0 50 100 150 200 250 300 350

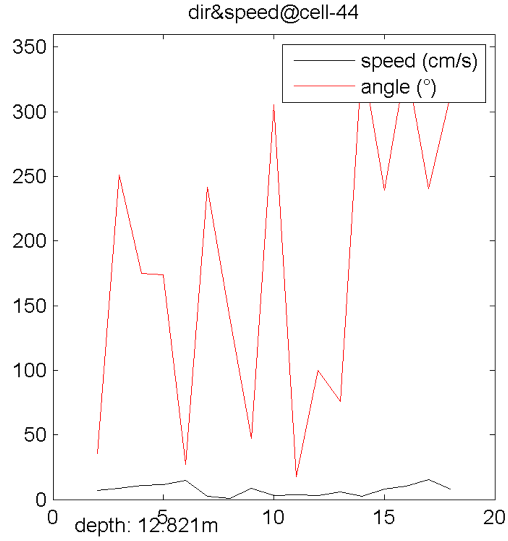

dir&speed@cell-39
speed (cm/s)
angle (°)
depth: 11.571m

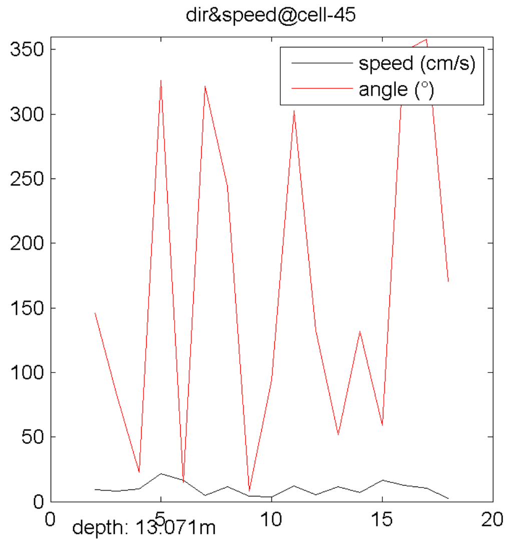

dir&speed@cell-42
speed (cm/s)
angle (°)
depth: 12.321m

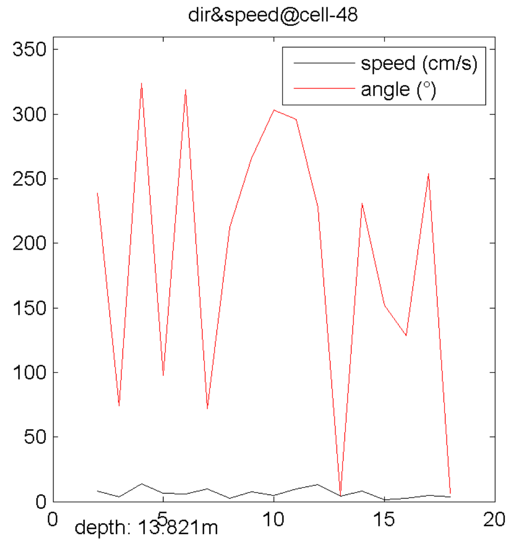

dir&speed@cell-40
speed (cm/s)
angle (°)
depth: 11.821m

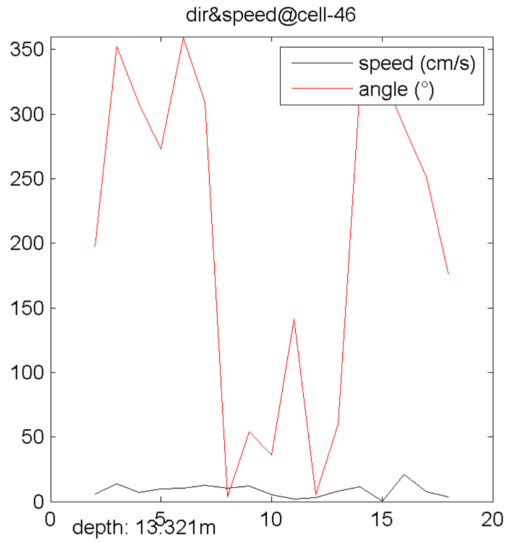

dir&speed@cell-43
speed (cm/s)
angle (°)
depth: 12.571m

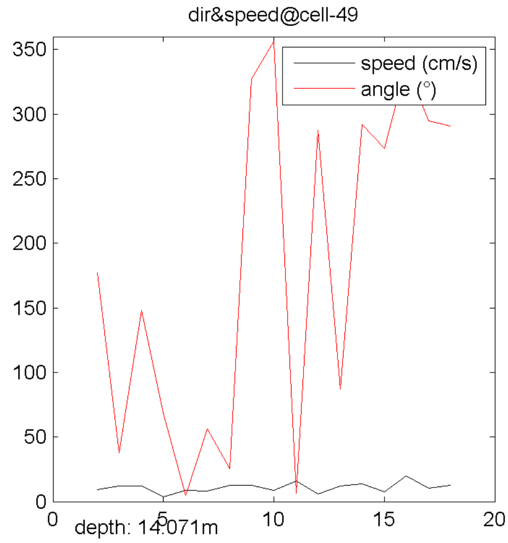

dir&speed@cell-41
speed (cm/s)
angle (°)
depth: 12.071m

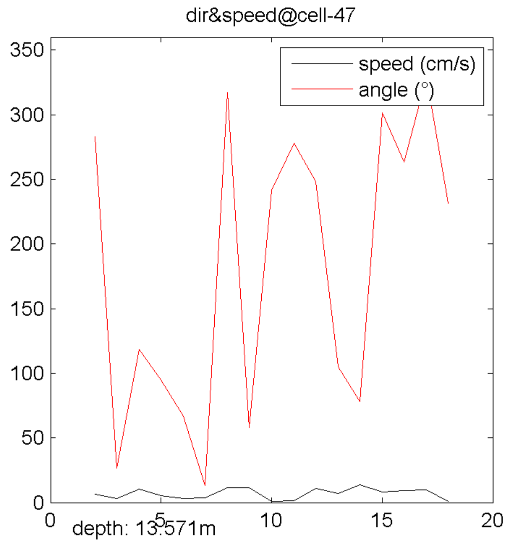

dir&speed@cell-44
speed (cm/s)
angle (°)
depth: 12.821m

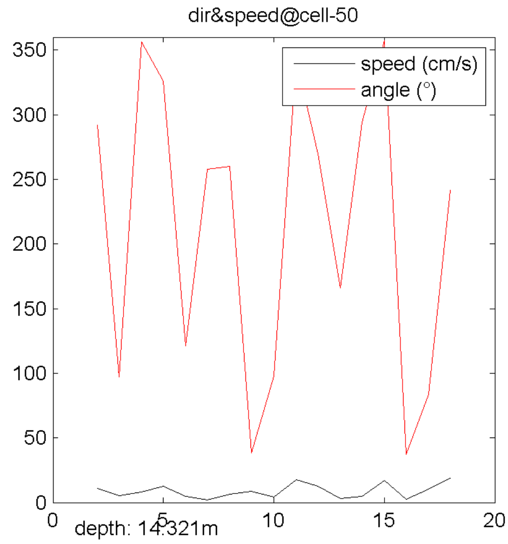

dir&speed@cell-45
speed (cm/s)
angle (°)
0 50 100 150 200 250 300 350
0 5 10 15 20
depth: 13.071m

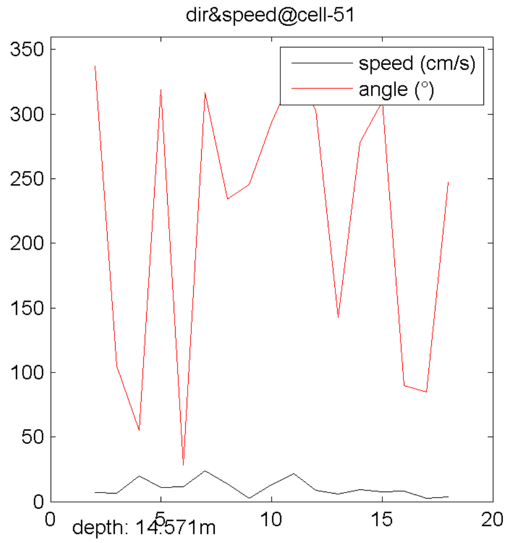

dir&speed@cell-48
speed (cm/s)
angle (°)
0 50 100 150 200 250 300 350
0 5 10 15 20
depth: 13.821m

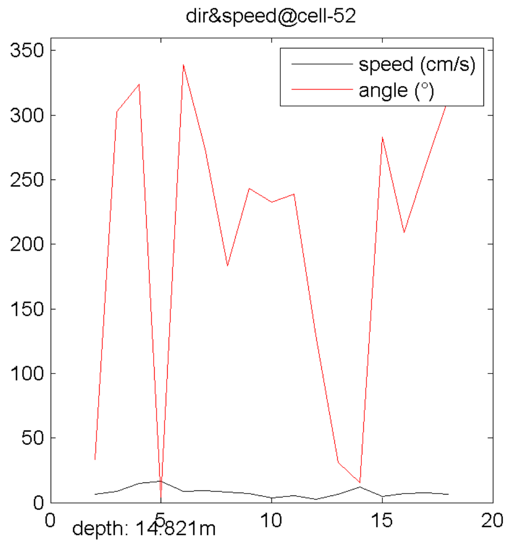

dir&speed@cell-46
speed (cm/s)
angle (°)
0 50 100 150 200 250 300 350
0 5 10 15 20
depth: 13.321m

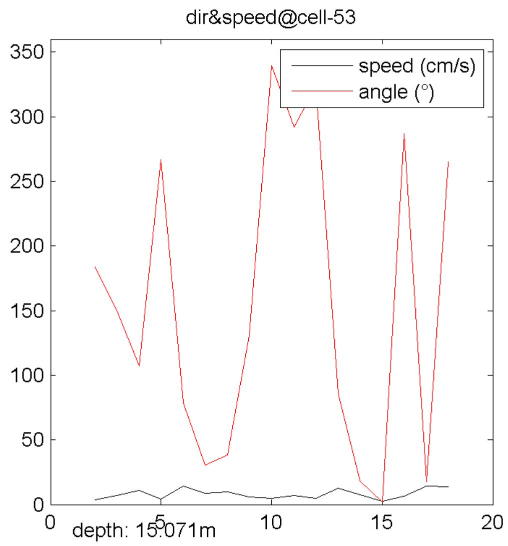

dir&speed@cell-49
speed (cm/s)
angle (°)
0 50 100 150 200 250 300 350
0 5 10 15 20
depth: 14.071m

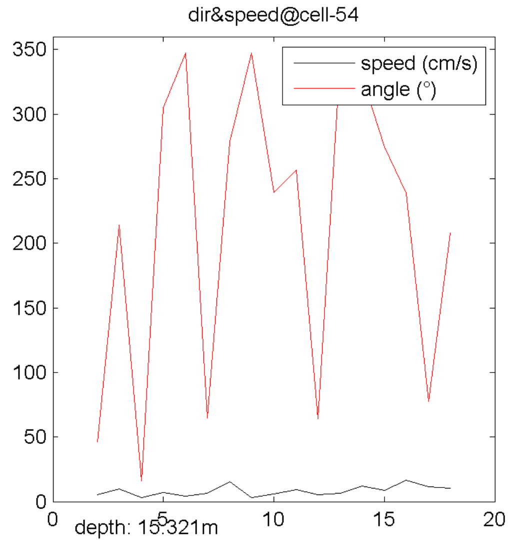

dir&speed@cell-47
speed (cm/s)
angle (°)
0 50 100 150 200 250 300 350
0 5 10 15 20
depth: 13.571m

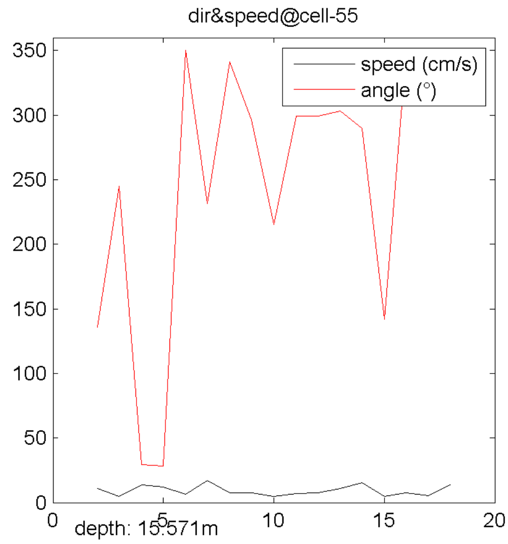

dir&speed@cell-50
speed (cm/s)
angle (°)
0 50 100 150 200 250 300 350
0 5 10 15 20
depth: 14.321m

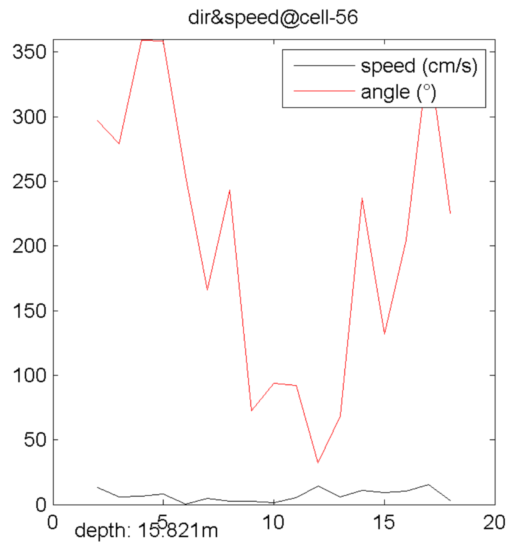

dir&speed@cell-51
speed (cm/s)
angle (°)
depth: 14.571m
0
50
100
150
200
250
300
350
0
5
10
15
20

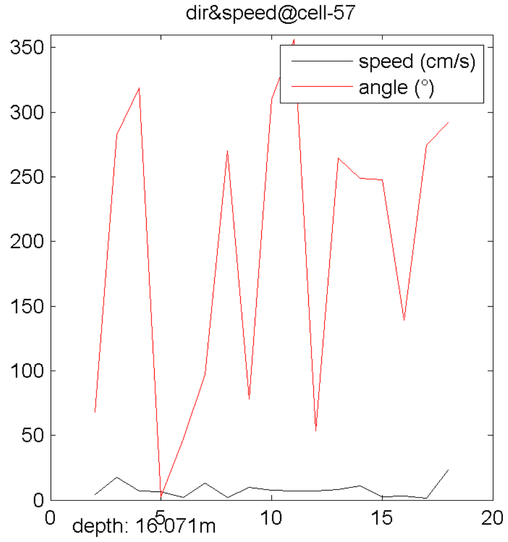

dir&speed@cell-52
speed (cm/s)
angle (°)
depth: 14.821m
0
50
100
150
200
250
300
350
0
5
10
15
20

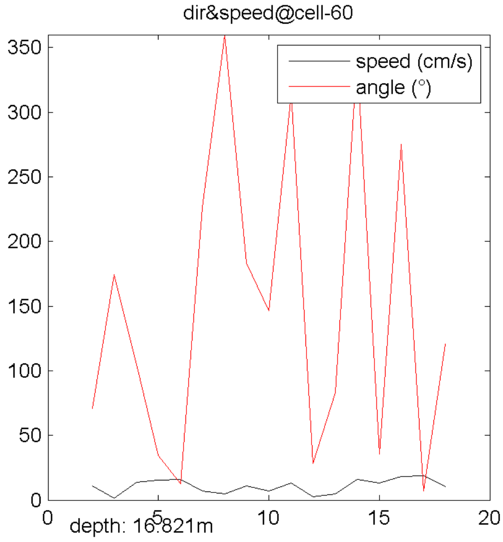

dir&speed@cell-53
speed (cm/s)
angle (°)
depth: 15.071m
0
50
100
150
200
250
300
350
0
5
10
15
20

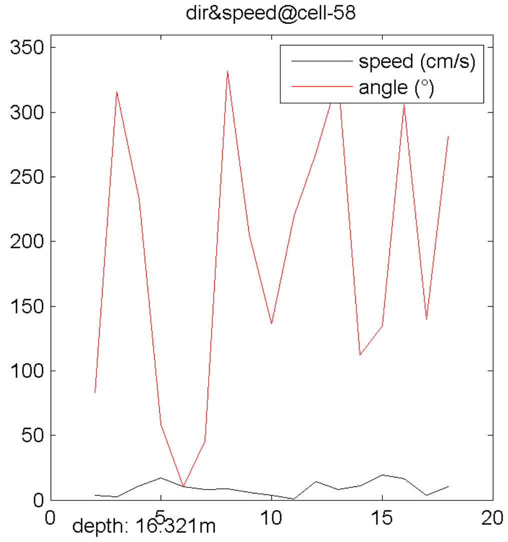

dir&speed@cell-54
speed (cm/s)
angle (°)
depth: 15.321m
0
50
100
150
200
250
300
350
0
5
10
15
20

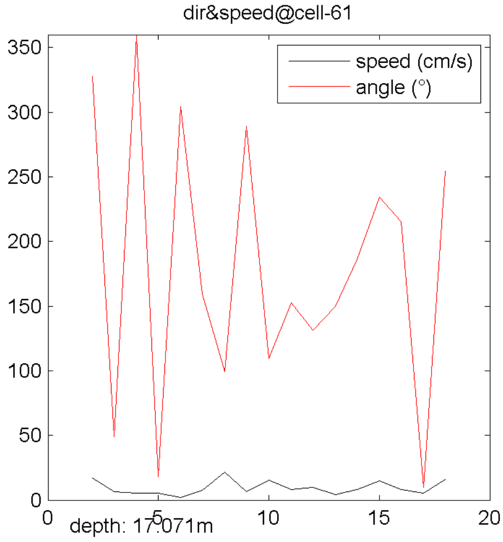

dir&speed@cell-55
speed (cm/s)
angle (°)
depth: 15.571m
0
50
100
150
200
250
300
350
0
5
10
15
20

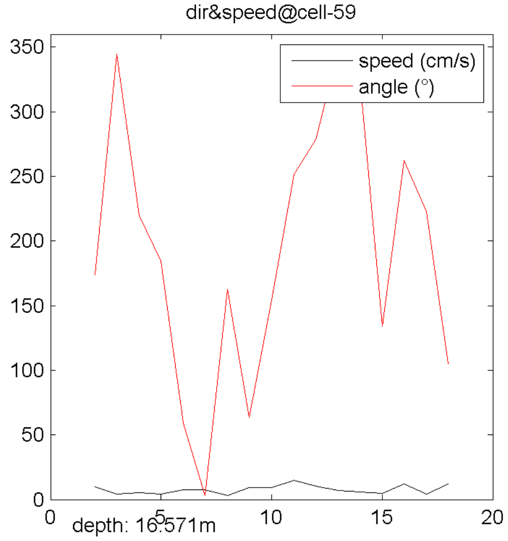

dir&speed@cell-56
speed (cm/s)
angle (°)
depth: 15.821m
0
50
100
150
200
250
300
350
0
5
10
15
20


dir&speed@cell-57
speed (cm/s)
angle (°)
depth: 16.071m


dir&speed@cell-60
speed (cm/s)
angle (°)
depth: 16.821m

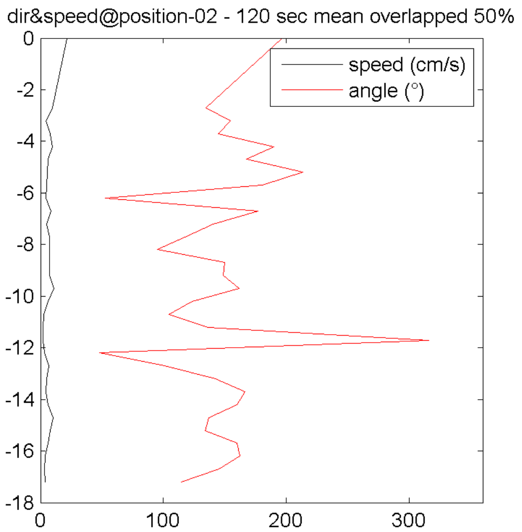

dir&speed@cell-58
speed (cm/s)
angle (°)
depth: 16.321m

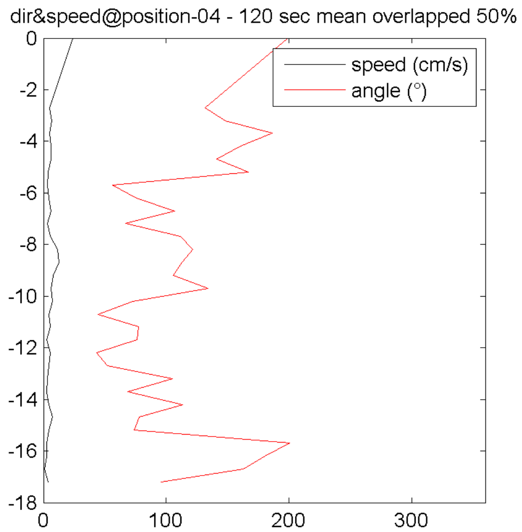

dir&speed@cell-61
speed (cm/s)
angle (°)
depth: 17.071m

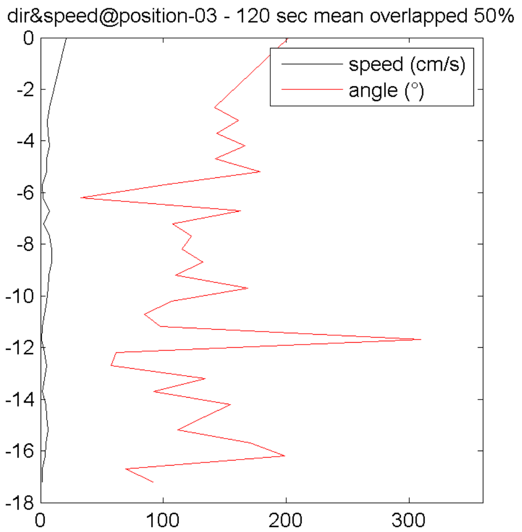

dir&speed@cell-59
speed (cm/s)
angle (°)
depth: 16.571m

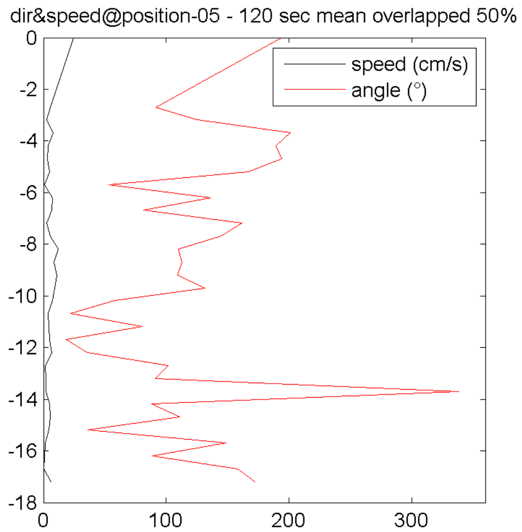
Appendix B – second test plots

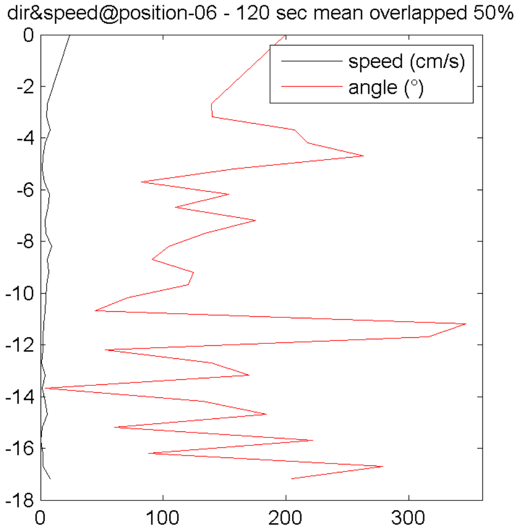
Here below we report the speed and direction plots recorded during the second test along the water column at the different position (i.e. while moving). X-axis: speed (cm/s) and angle (degree), y-axis: depth (m).

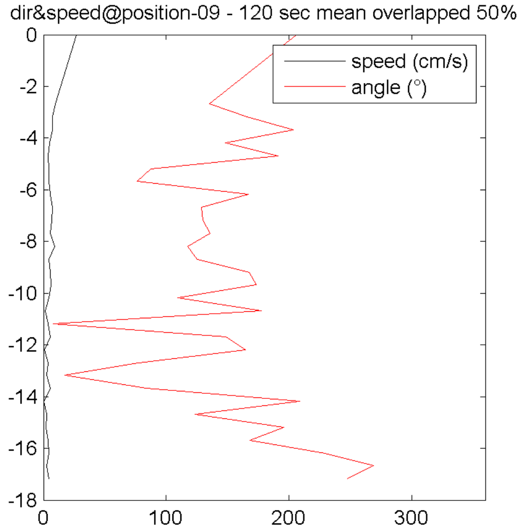


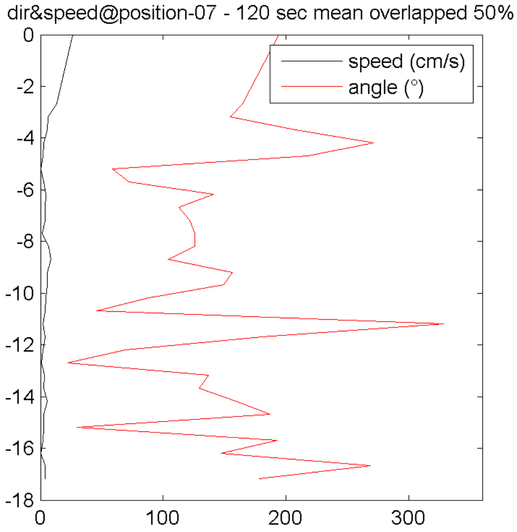


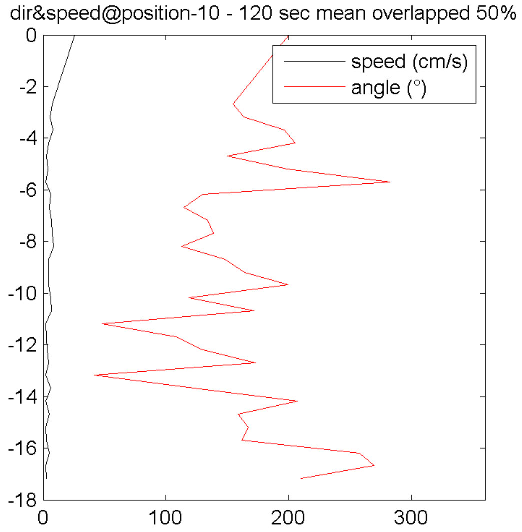


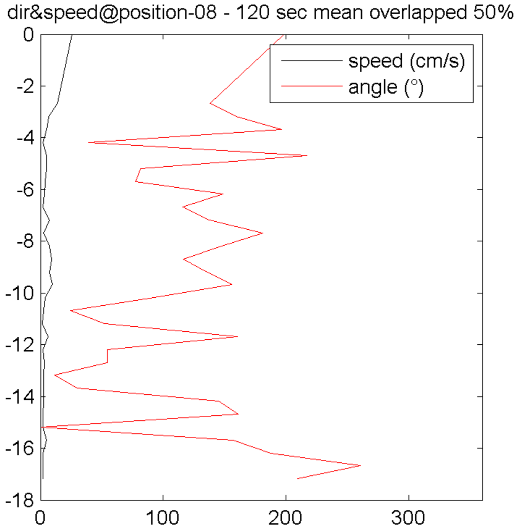


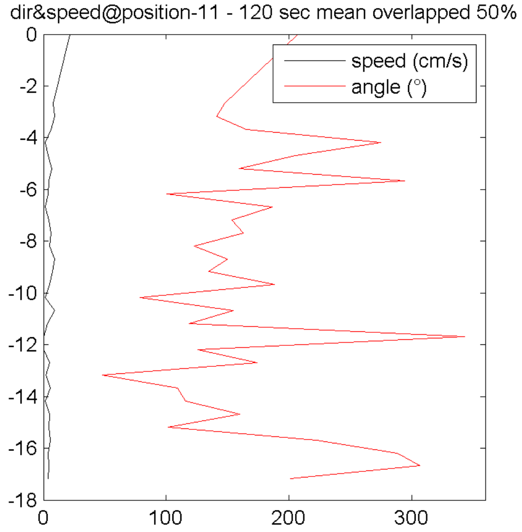

dir&speed@position-06 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

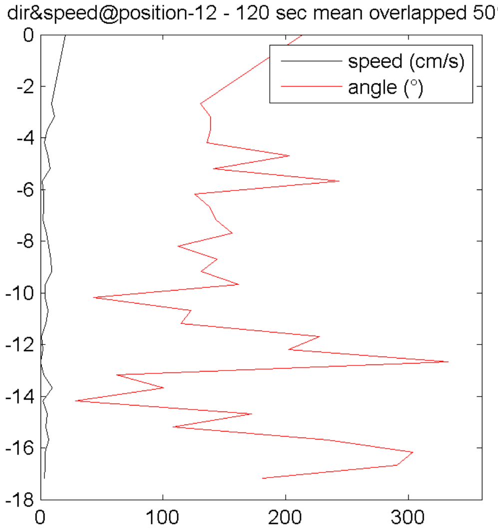

dir&speed@position-09 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

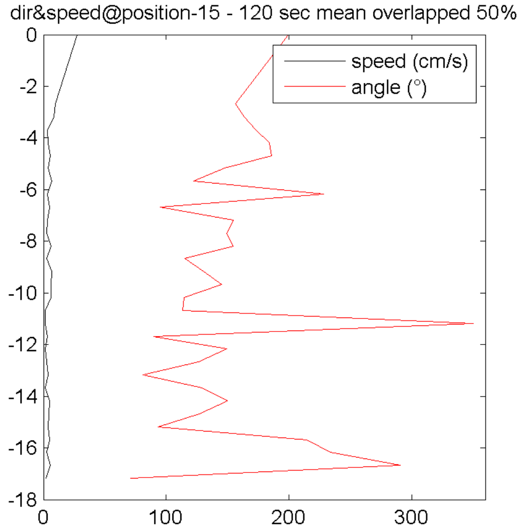

dir&speed@position-07 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

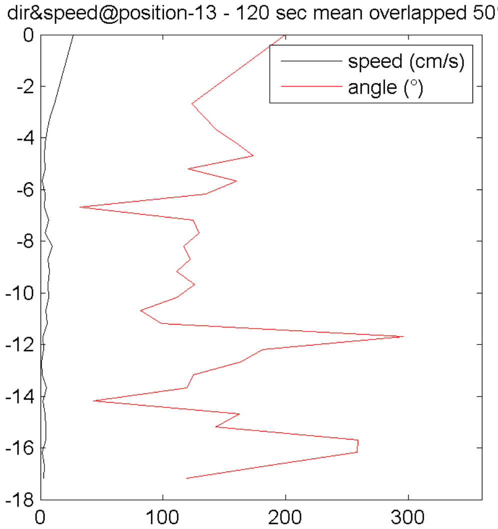

dir&speed@position-10 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

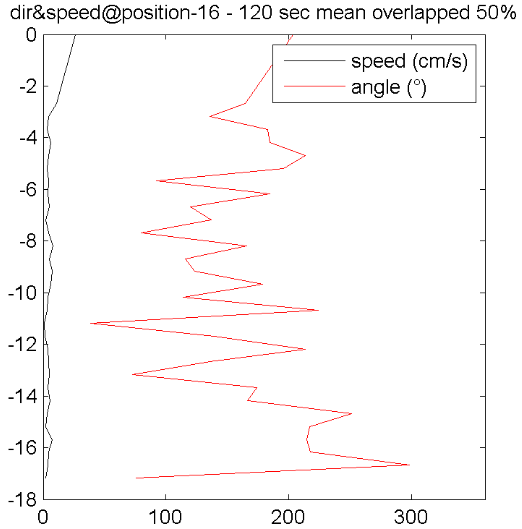

dir&speed@position-08 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

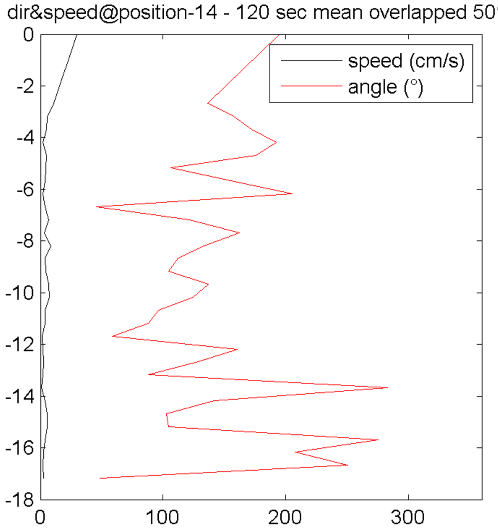

dir&speed@position-11 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

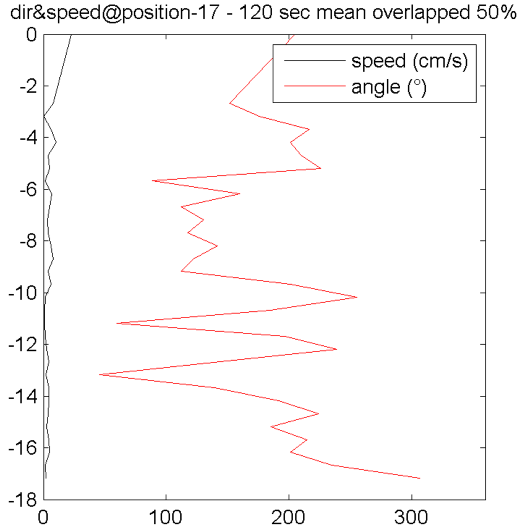

dir&speed@position-12 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

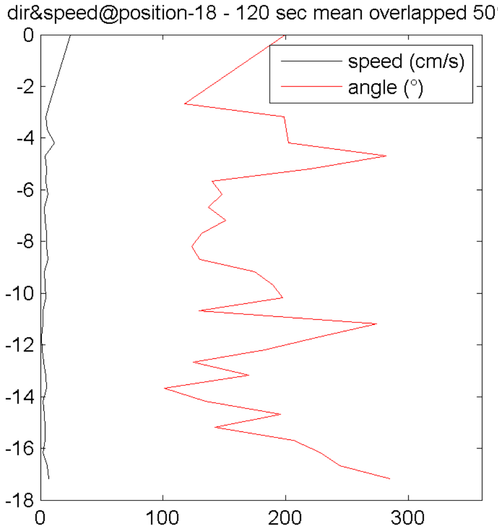

dir&speed@position-15 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

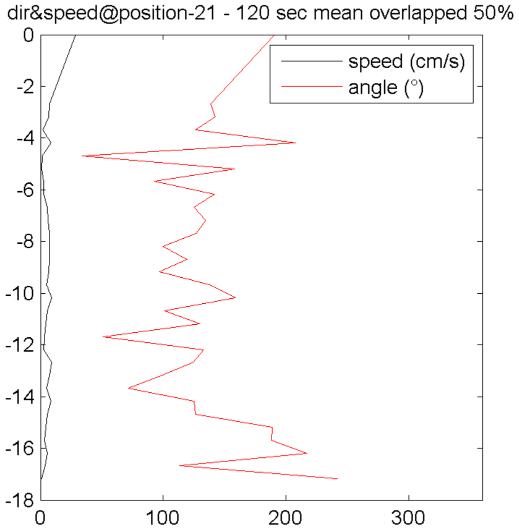

dir&speed@position-13 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

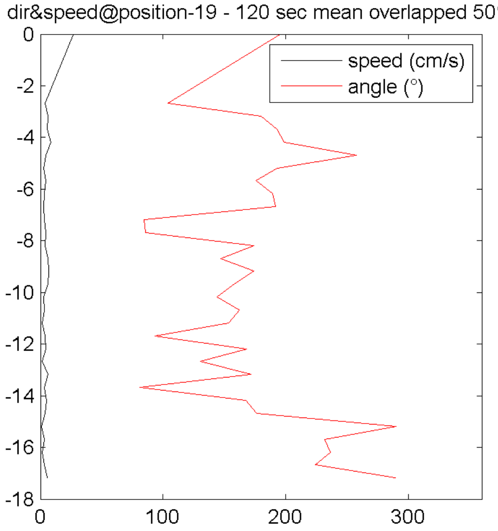

dir&speed@position-16 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

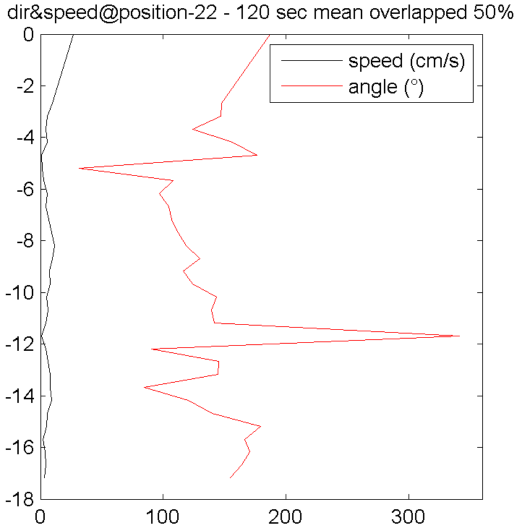

dir&speed@position-14 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

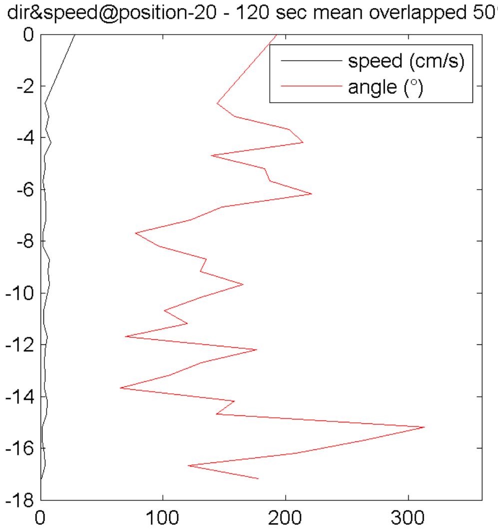

dir&speed@position-17 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

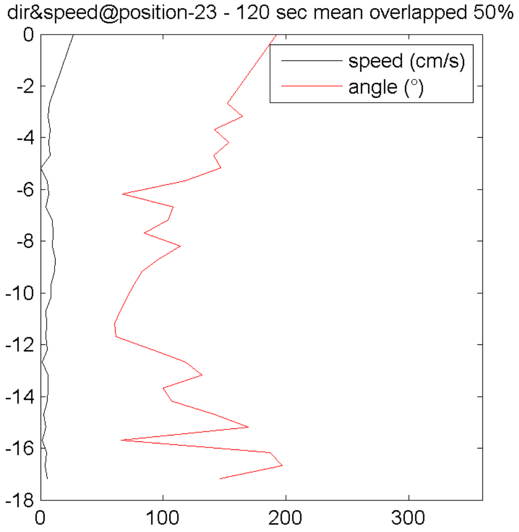

dir&speed@position-18 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

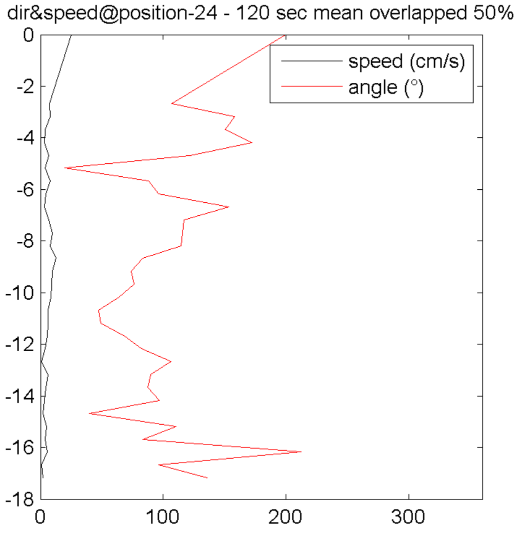

dir&speed@position-21 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

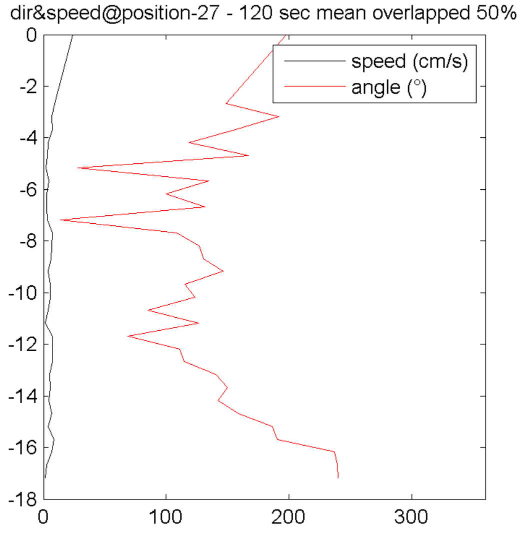

dir&speed@position-19 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

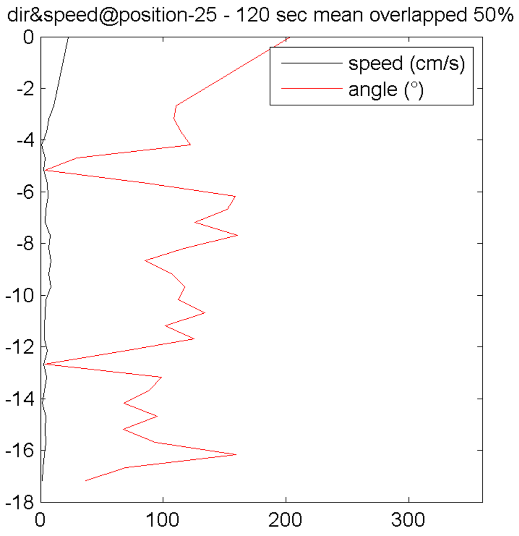

dir&speed@position-22 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

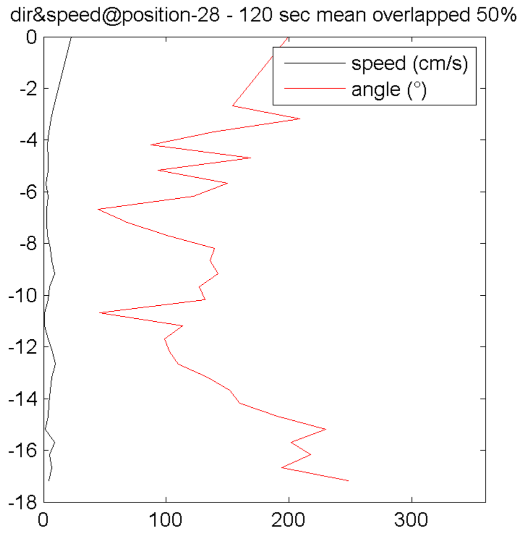

dir&speed@position-20 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

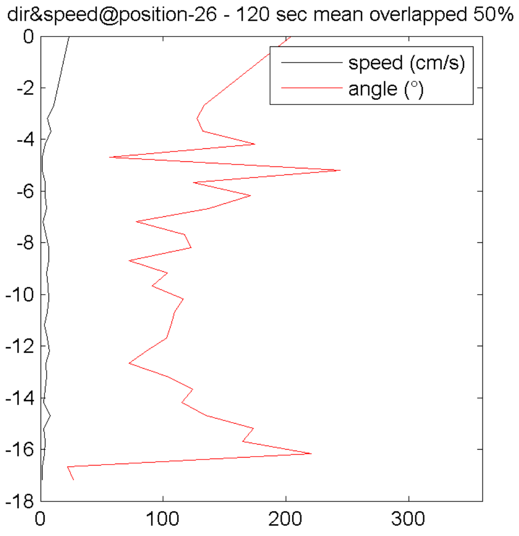

dir&speed@position-23 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

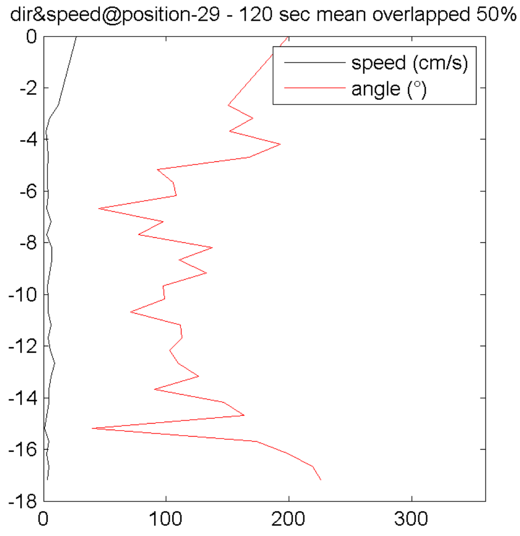

dir&speed@position-24 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

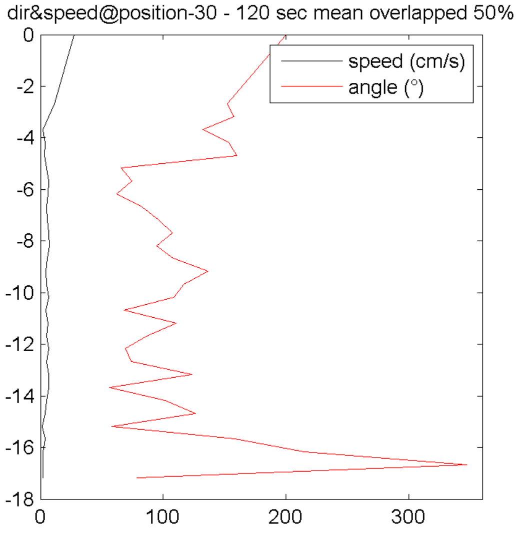

dir&speed@position-27 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

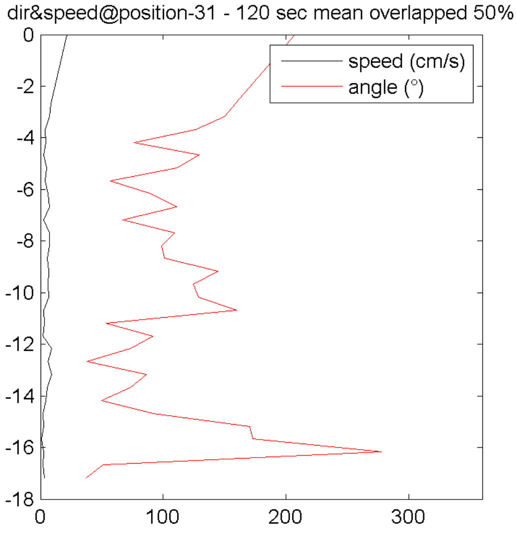

dir&speed@position-25 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

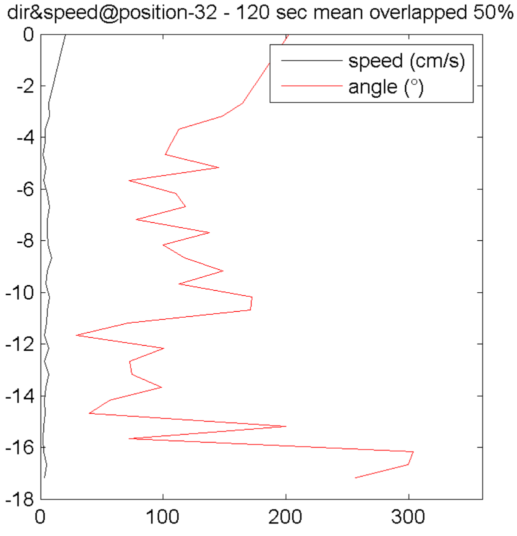

dir&speed@position-28 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

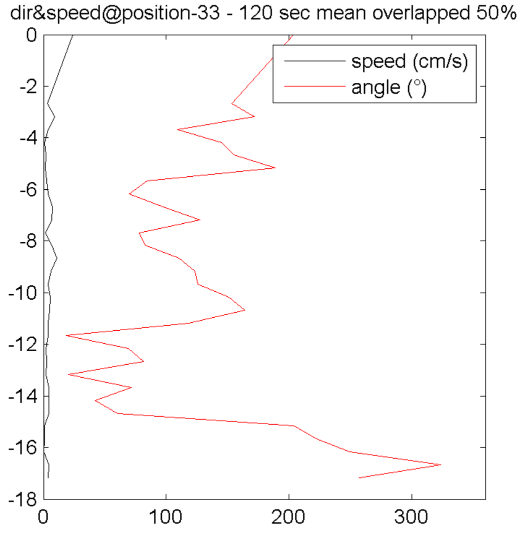

dir&speed@position-26 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

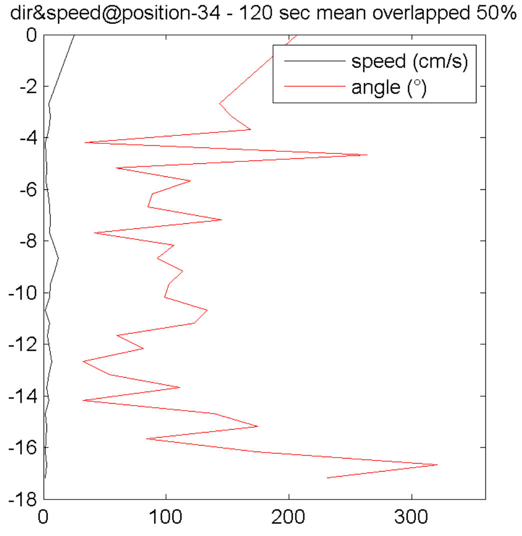

dir&speed@position-29 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

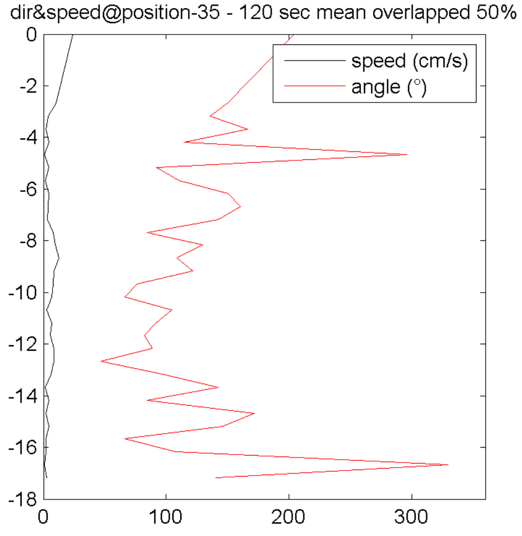

dir&speed@position-30 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

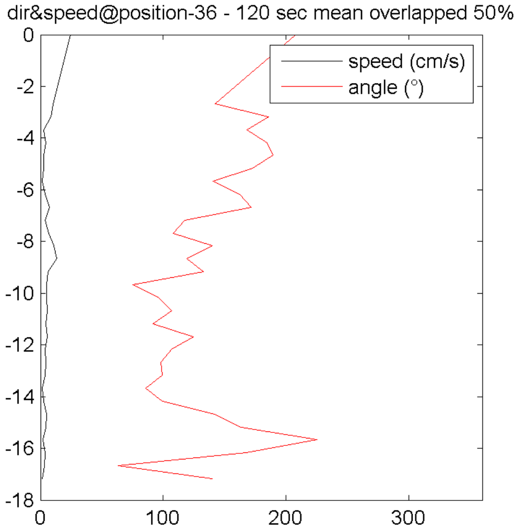

dir&speed@position-31 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

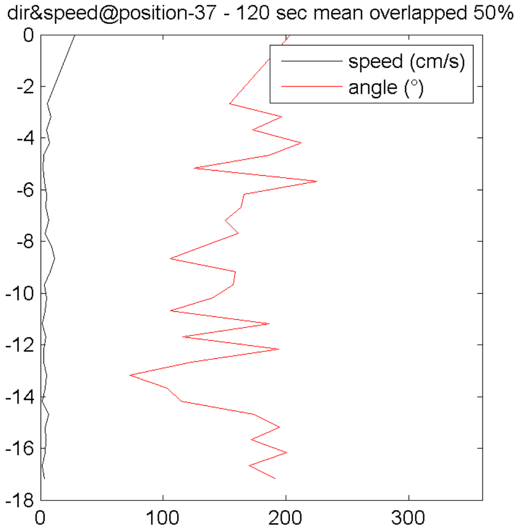

dir&speed@position-32 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

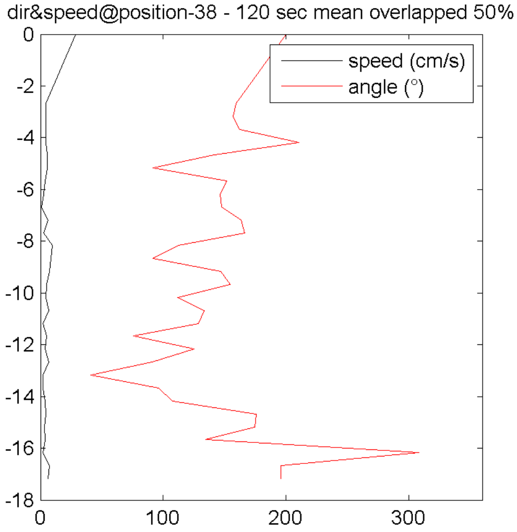

dir&speed@position-33 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

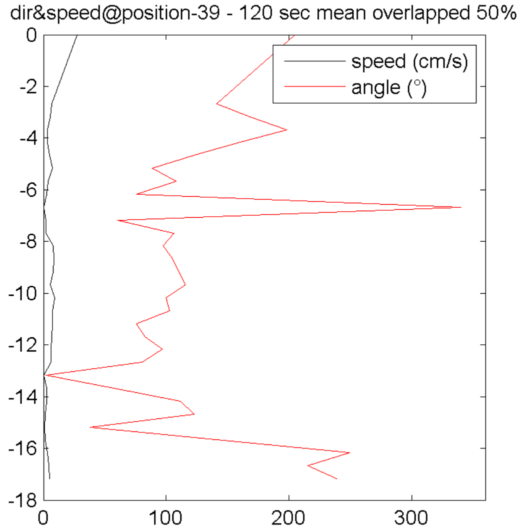

dir&speed@position-34 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

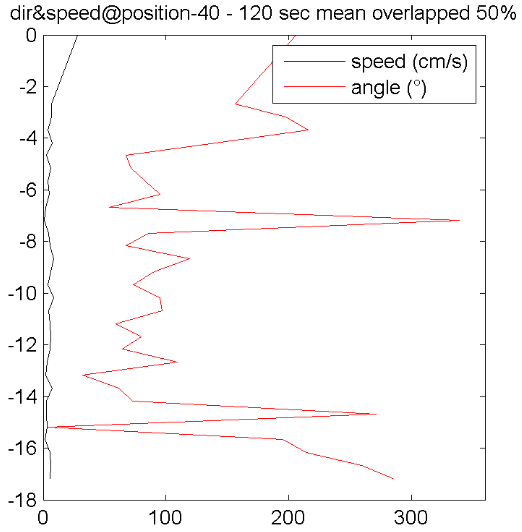

dir&speed@position-35 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

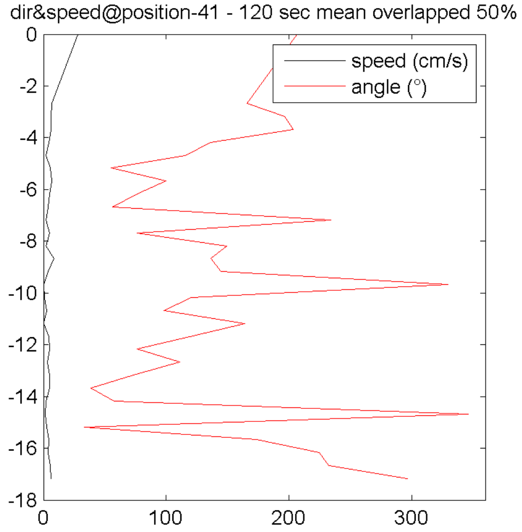

dir&speed@position-36 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300


dir&speed@position-37 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

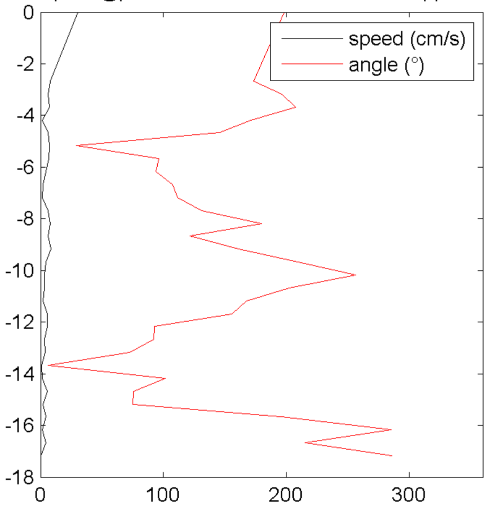

dir&speed@position-38 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300


dir&speed@position-39 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

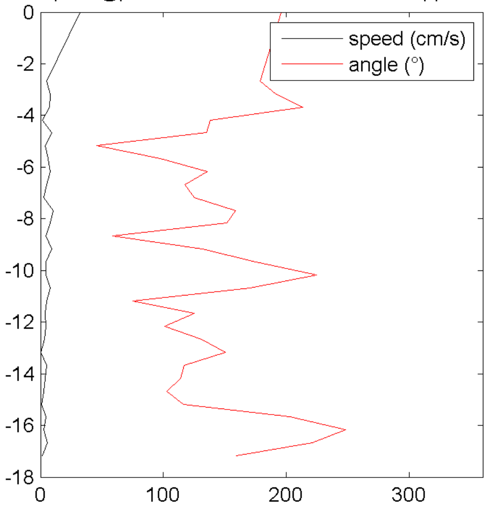

dir&speed@position-40 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300


dir&speed@position-41 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

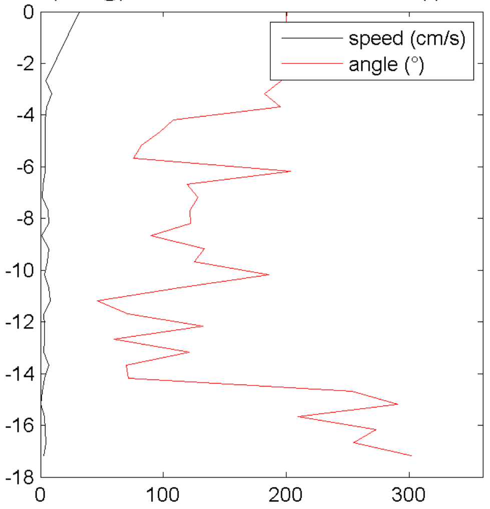
dir&speed@position-42 - 120 sec mean overlapped 50%



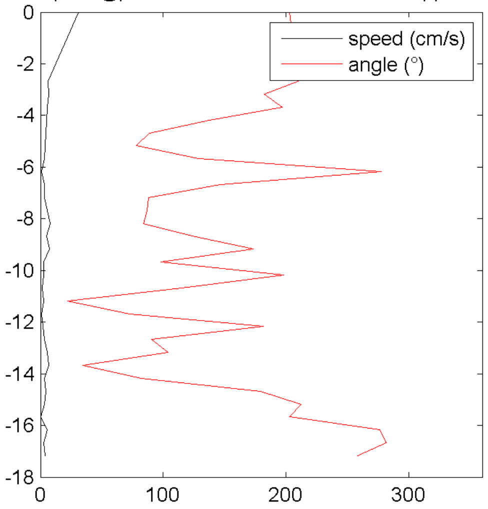
dir&speed@position-43 - 120 sec mean overlapped 50%



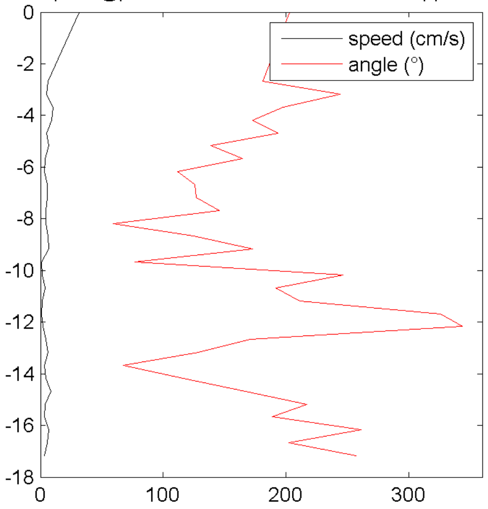
dir&speed@position-44 - 120 sec mean overlapped 50%



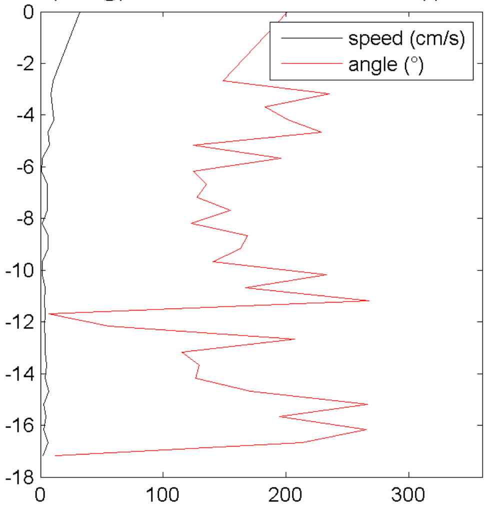
dir&speed@position-45 - 120 sec mean overlapped 50%

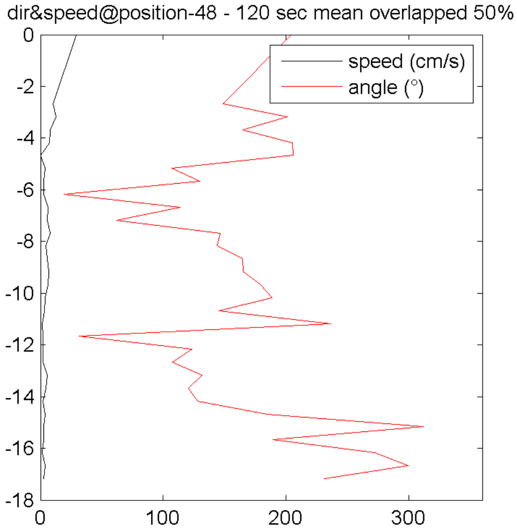


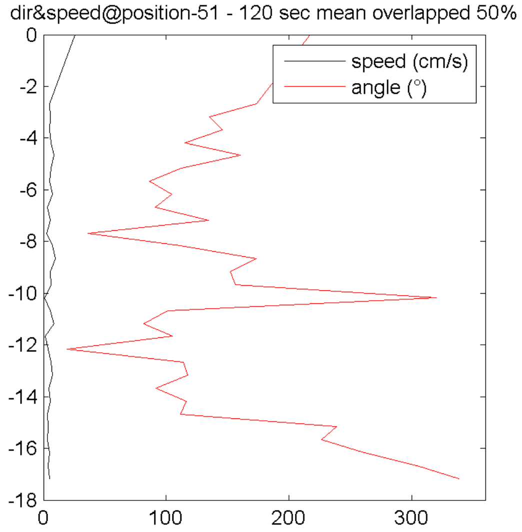
dir&speed@position-46 - 120 sec mean overlapped 50%

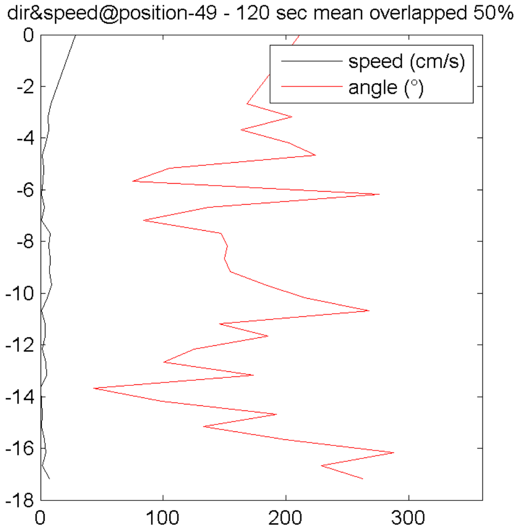


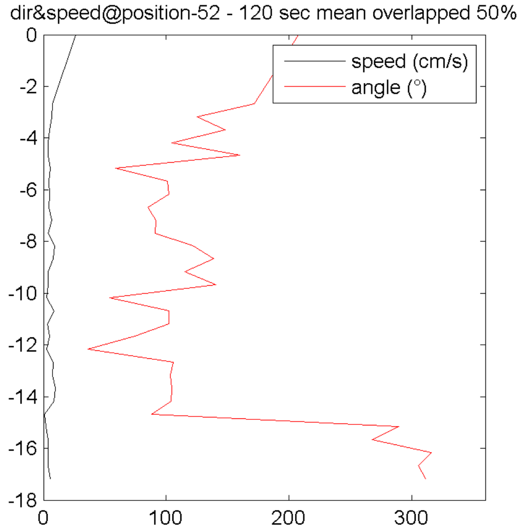
dir&speed@position-47 - 120 sec mean overlapped 50%

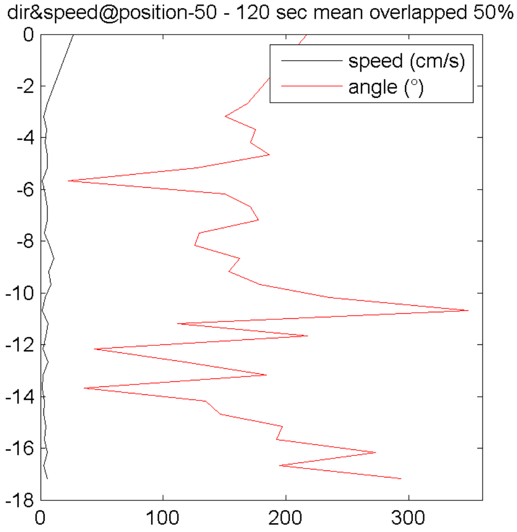


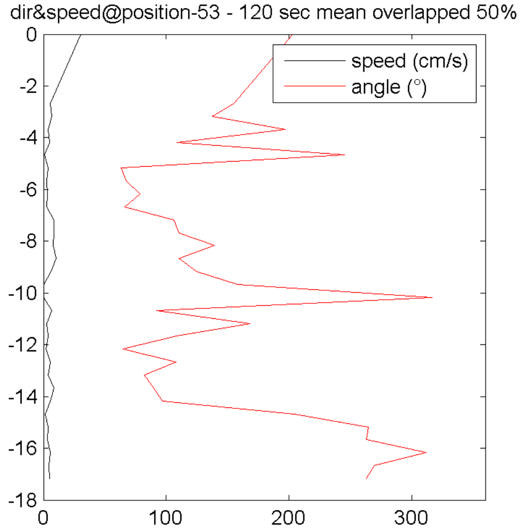

dir&speed@position-48 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

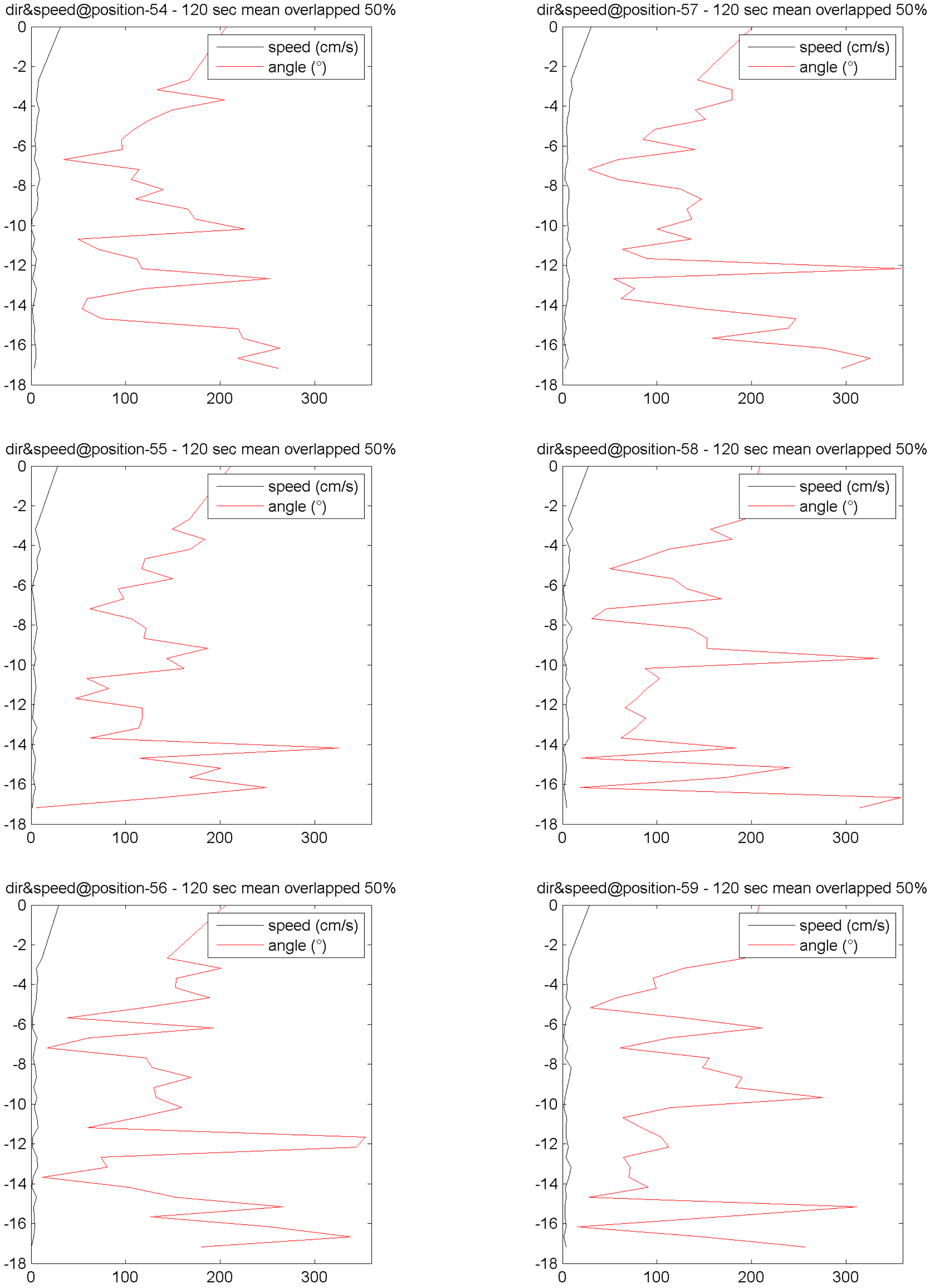

dir&speed@position-51 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

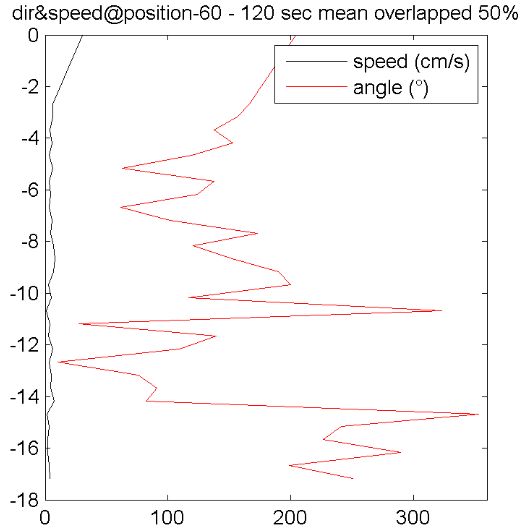

dir&speed@position-49 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)


dir&speed@position-52 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

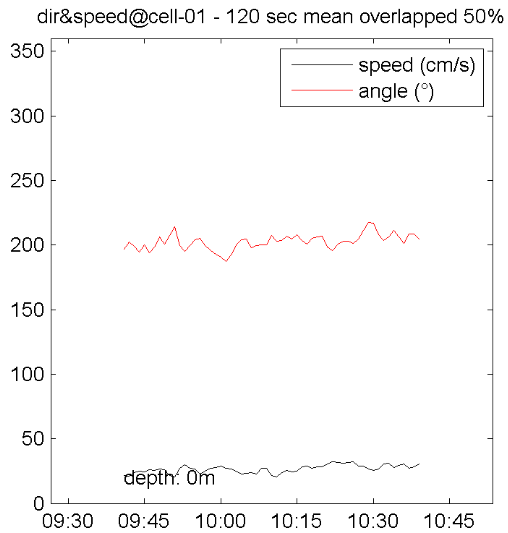

dir&speed@position-50 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

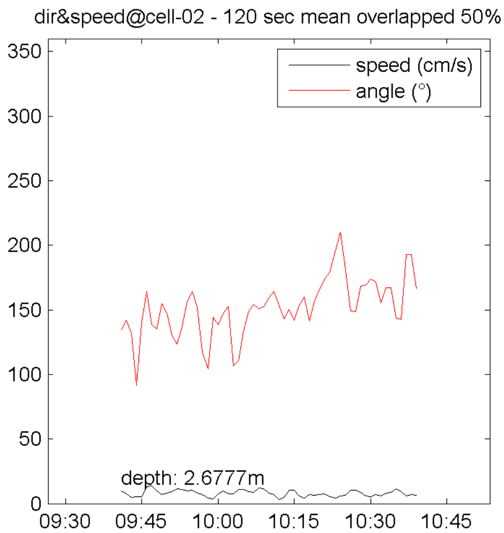

dir&speed@position-53 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

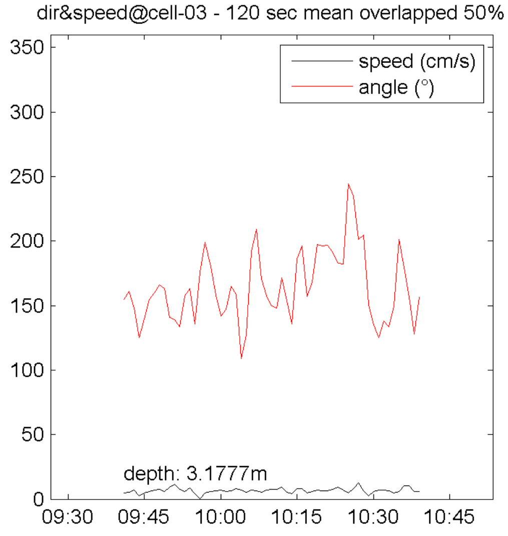

dir&speed@position-54 - 120 sec mean overlapped 50%
dir&speed@position-57 - 120 sec mean overlapped 50%
dir&speed@position-55 - 120 sec mean overlapped 50%
dir&speed@position-58 - 120 sec mean overlapped 50%
dir&speed@position-56 - 120 sec mean overlapped 50%
dir&speed@position-59 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

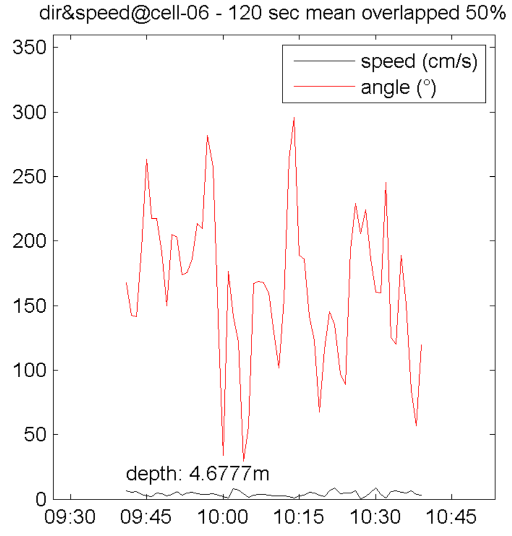


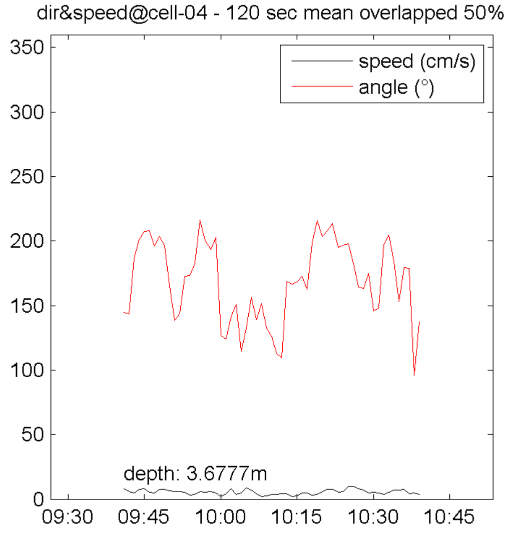
Here below we report the speed and direction plots recorded during the second test along the path at different layer of depth. X-axis: time (s), y-axis: speed (cm/s) and angle (degree).

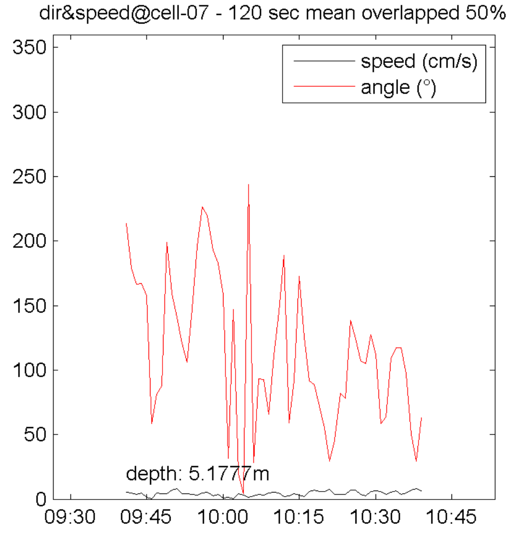


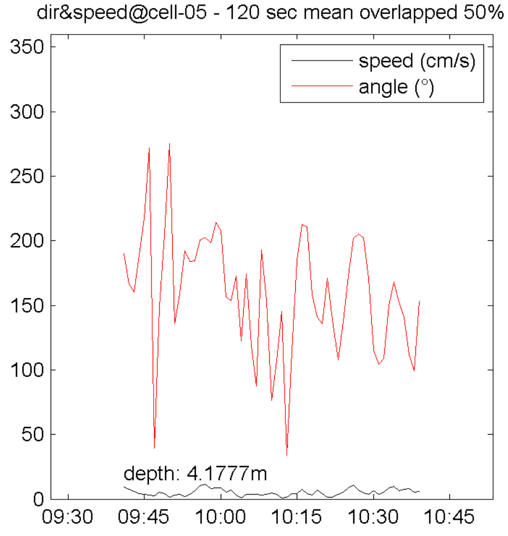


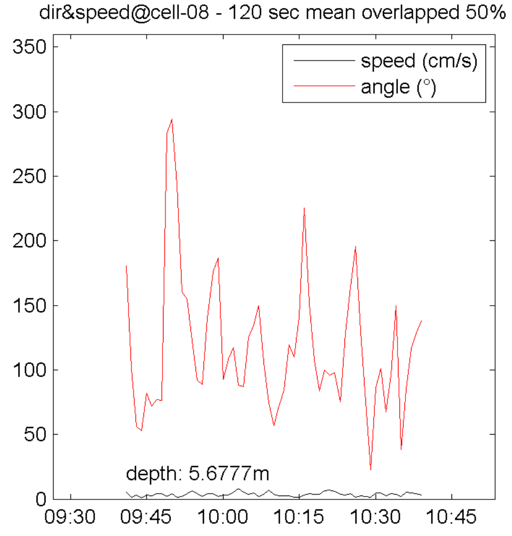

dir&speed@cell-03 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 3.1777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

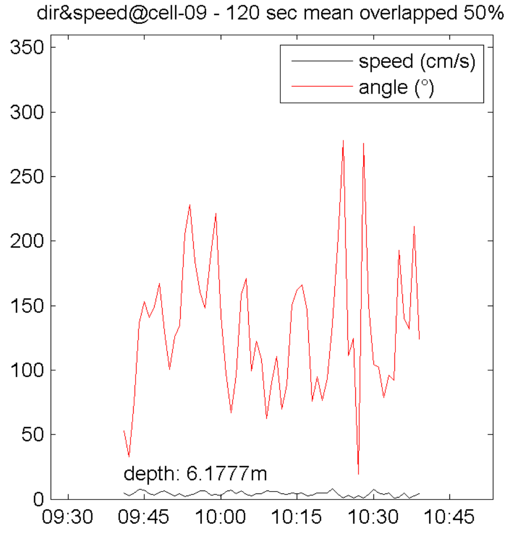

dir&speed@cell-06 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 4.6777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

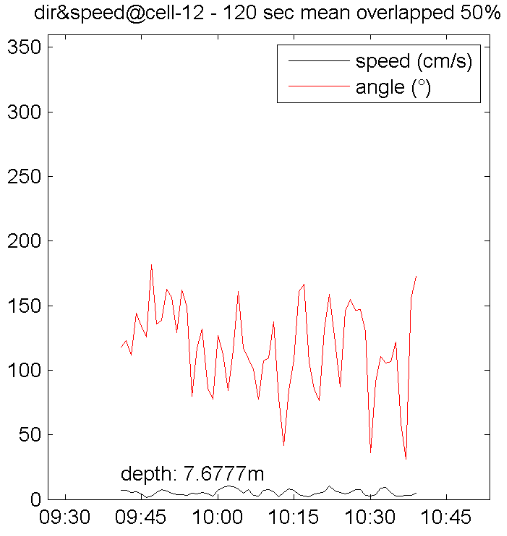

dir&speed@cell-04 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 3.6777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

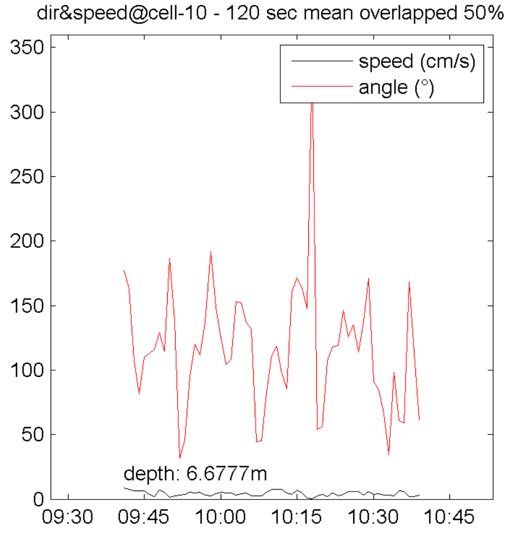

dir&speed@cell-07 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 5.1777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

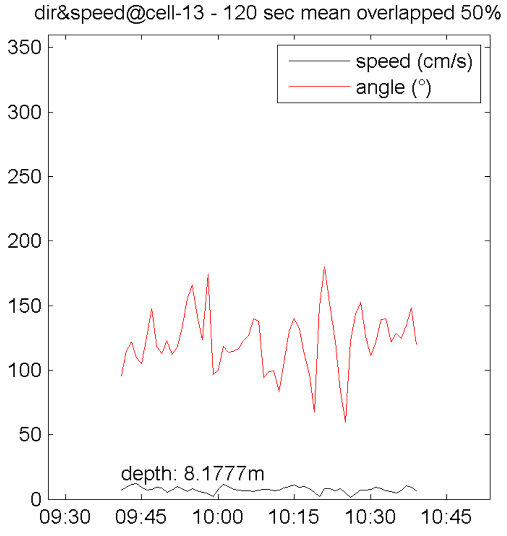

dir&speed@cell-05 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 4.1777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

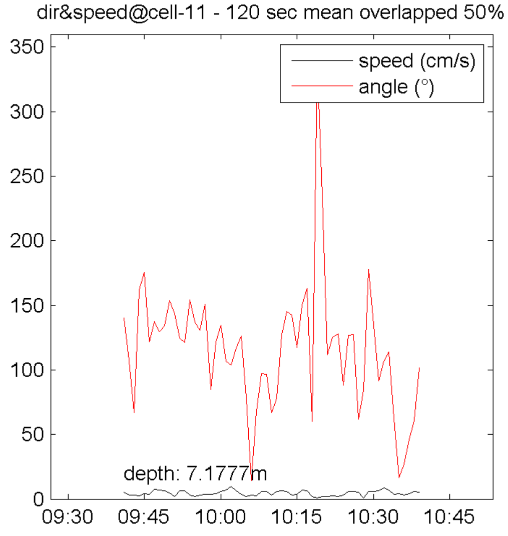

dir&speed@cell-08 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 5.6777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

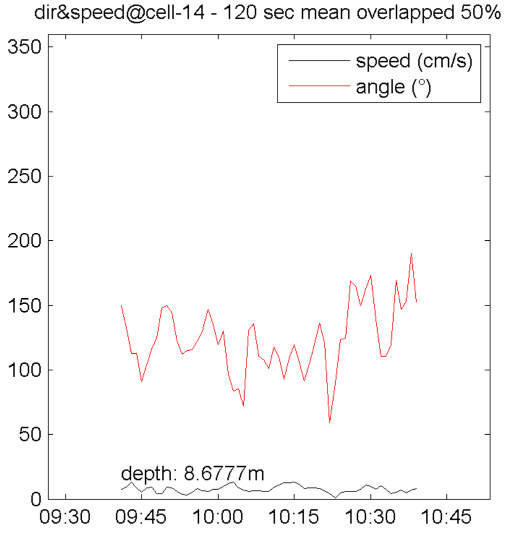

dir&speed@cell-09 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 6.1777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

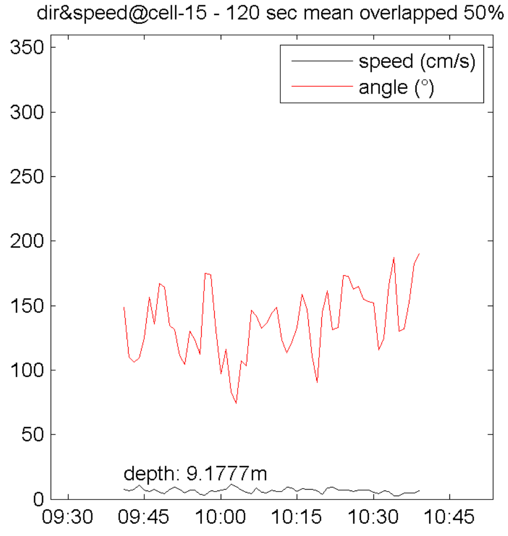

dir&speed@cell-12 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 7.6777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

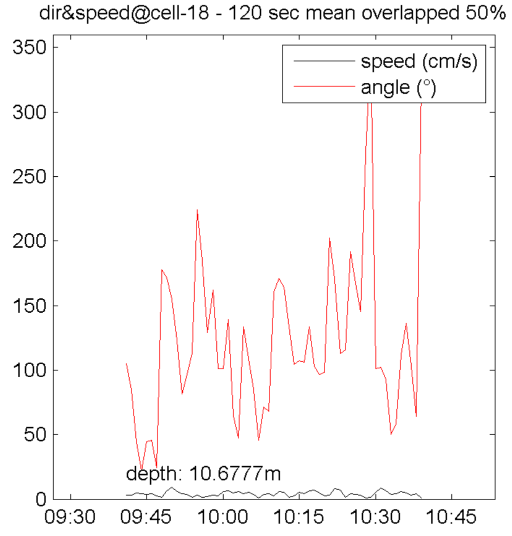

dir&speed@cell-10 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 6.6777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

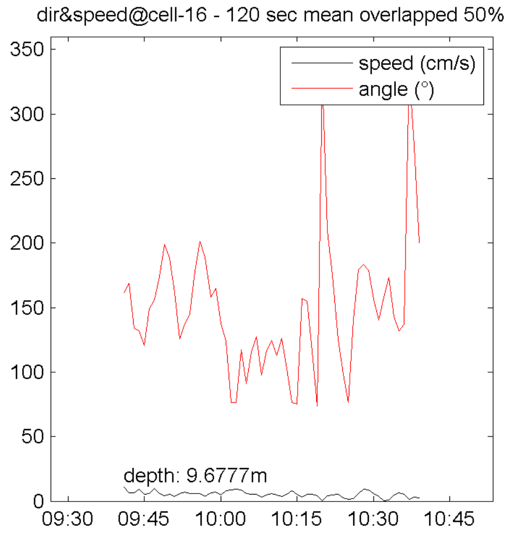

dir&speed@cell-13 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 8.1777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

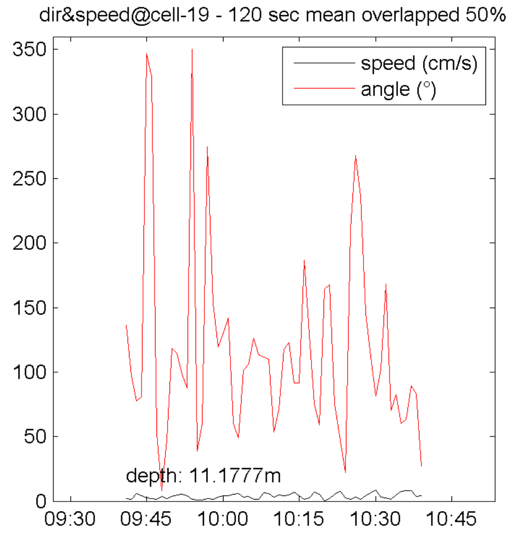

dir&speed@cell-11 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 7.1777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

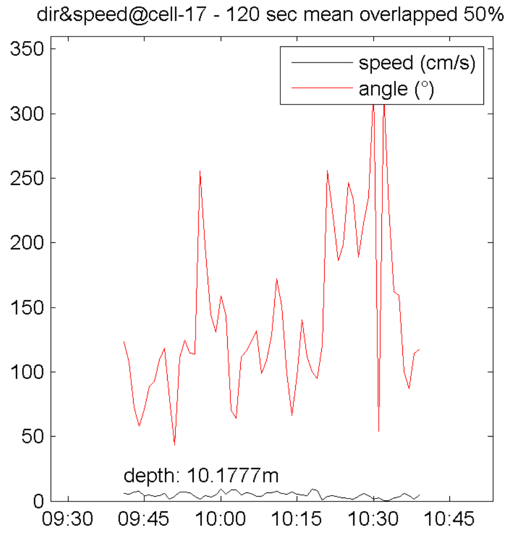

dir&speed@cell-14 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 8.6777m
0
50
100
150
200
250
300
350
09:30
09:45
10:00
10:15
10:30
10:45

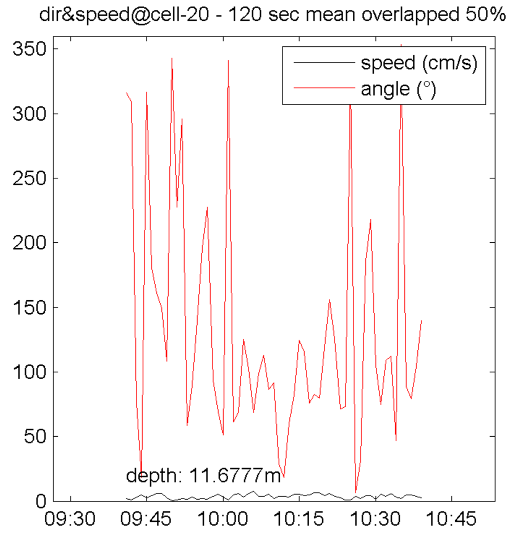

dir&speed@cell-15 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 9.1777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

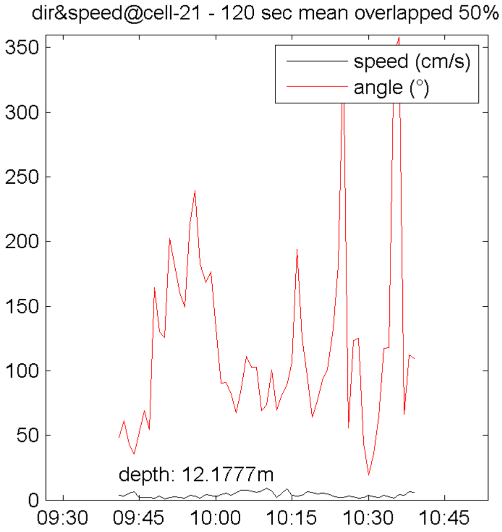

dir&speed@cell-18 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 10.6777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

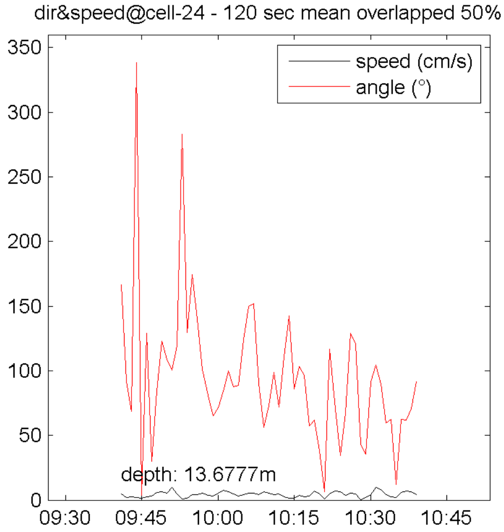

dir&speed@cell-16 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 9.6777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

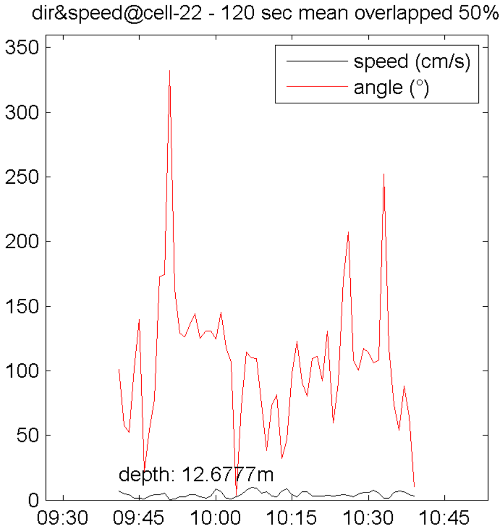

dir&speed@cell-19 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 11.1777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

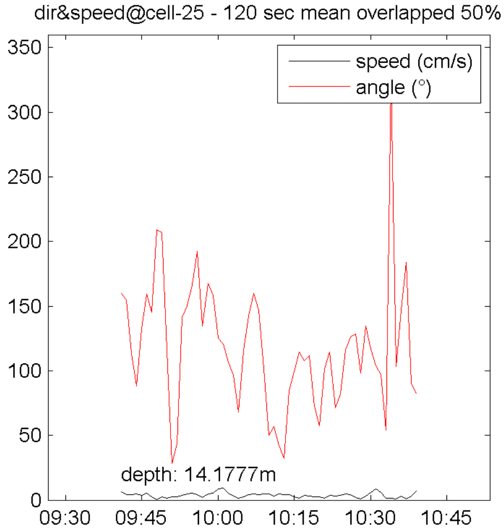

dir&speed@cell-17 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 10.1777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

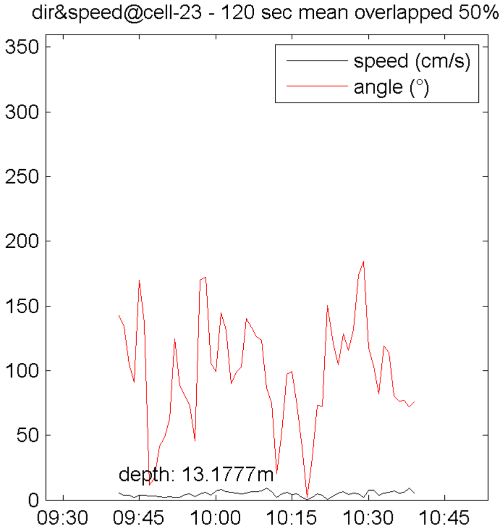

dir&speed@cell-20 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 11.6777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

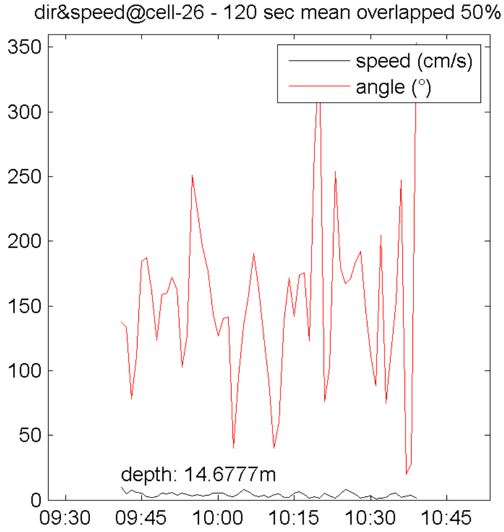

dir&speed@cell-21 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 12.1777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

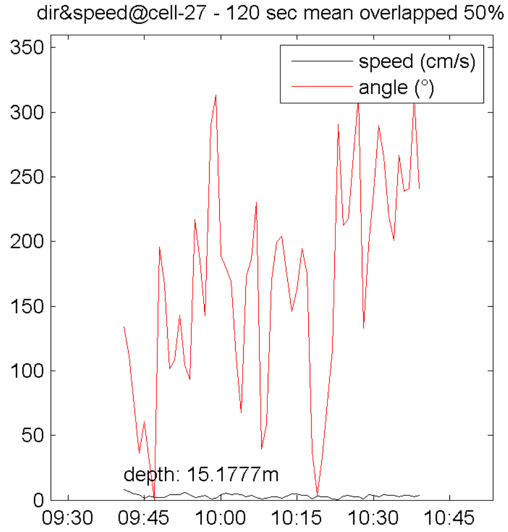

dir&speed@cell-24 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 13.6777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

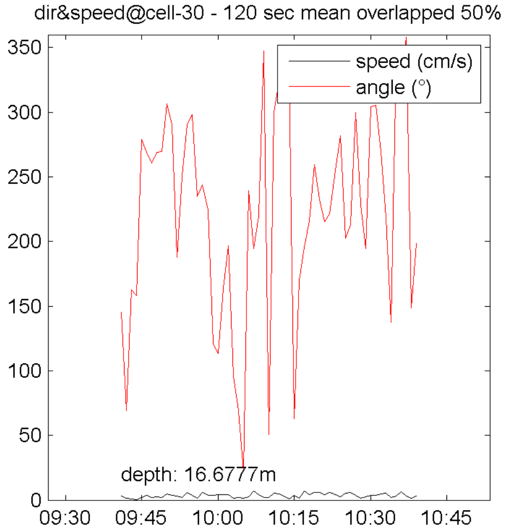

dir&speed@cell-22 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 12.6777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

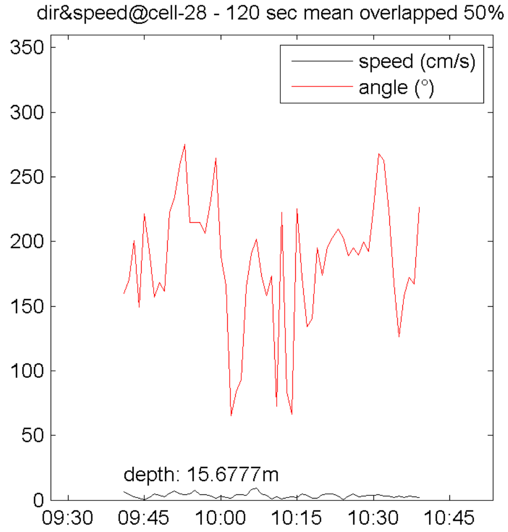

dir&speed@cell-25 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 14.1777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

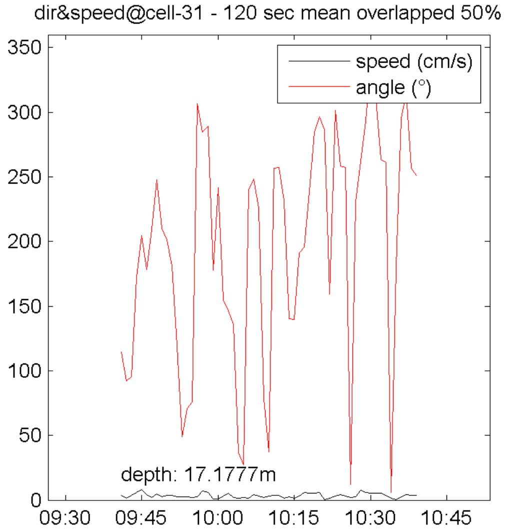

dir&speed@cell-23 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 13.1777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

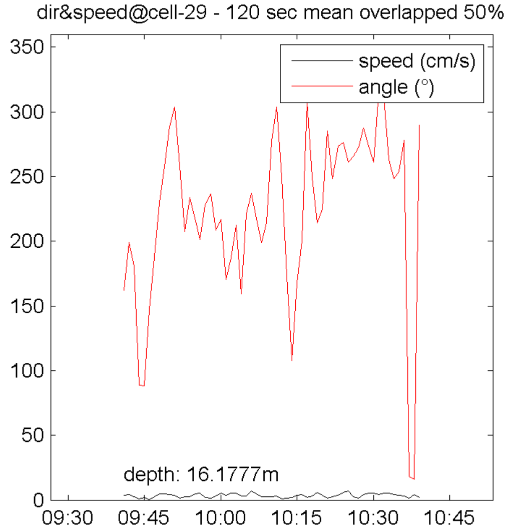

dir&speed@cell-26 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 14.6777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45


dir&speed@cell-27 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 15.1777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45


dir&speed@cell-30 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 16.6777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

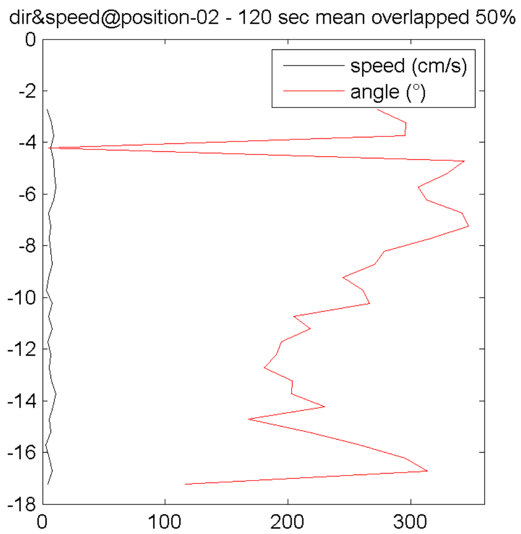

dir&speed@cell-28 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 15.6777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

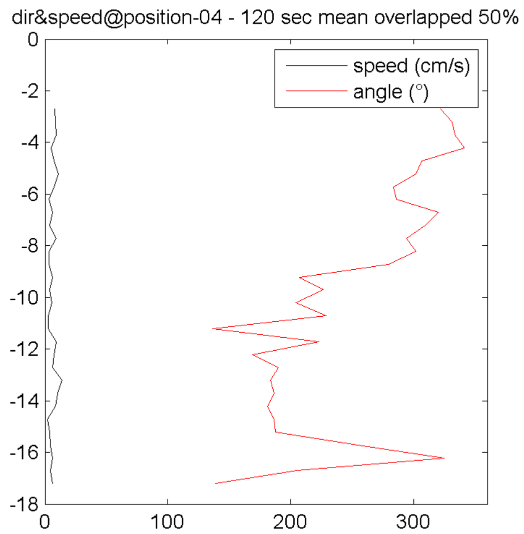

dir&speed@cell-31 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 17.1777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

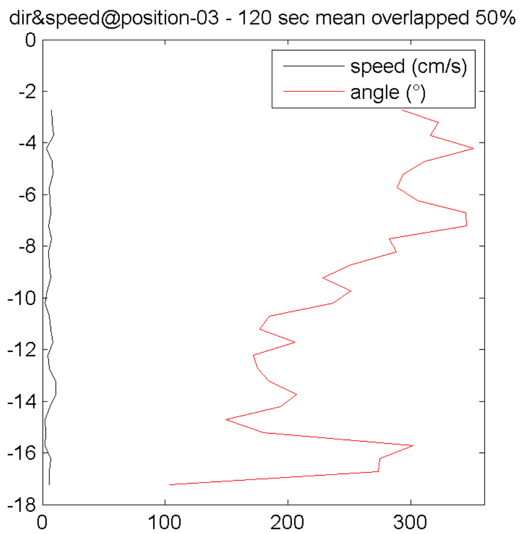

dir&speed@cell-29 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
depth: 16.1777m
350
300
250
200
150
100
50
0
09:30
09:45
10:00
10:15
10:30
10:45

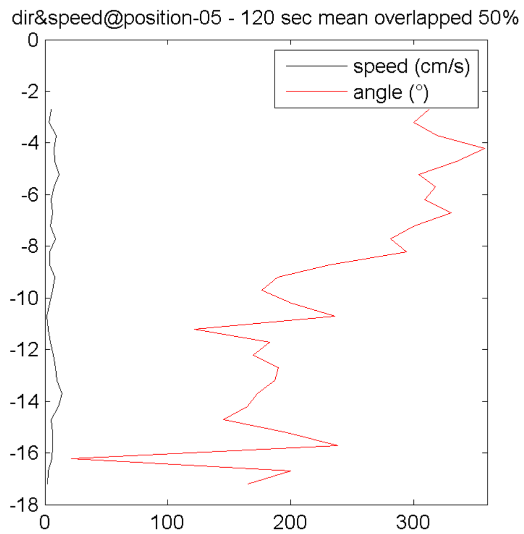
Appendix C – third test plots

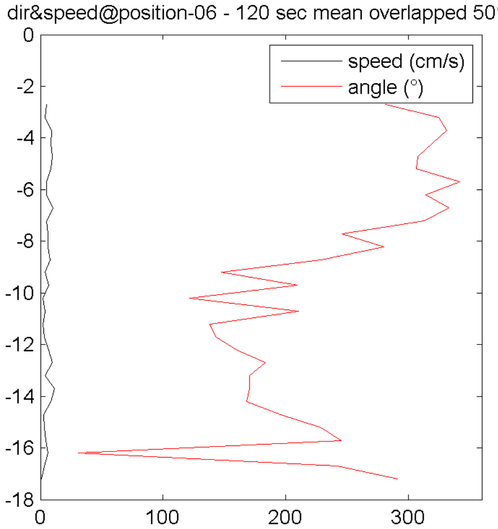
Here below we report the speed and direction plots recorded during the third test along the water column at the different position (i.e. while moving). Positions 12 and 14 are referred to the second phase of the test (5-minutes average every 15 minutes). X-axis: speed (cm/s) and angle (degree), y-axis: depth (m).

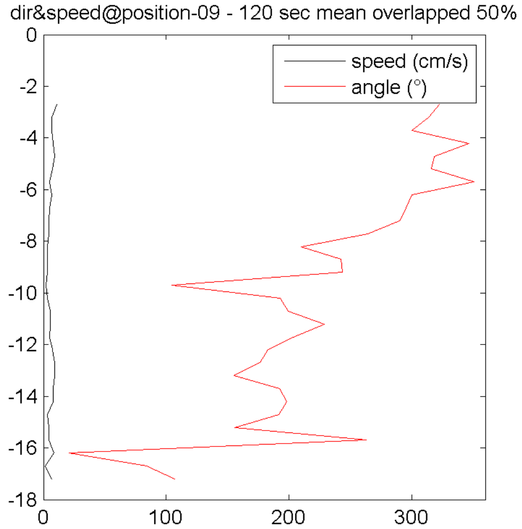


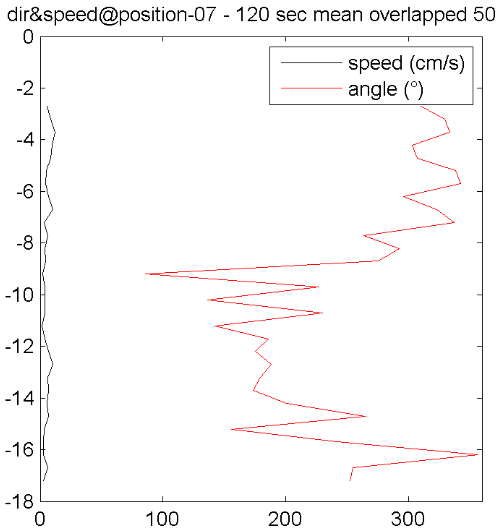


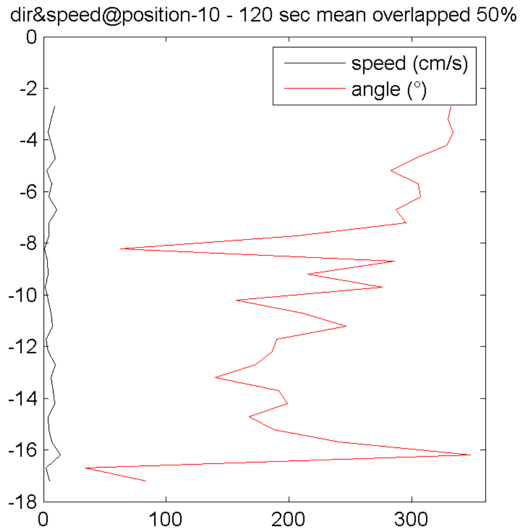


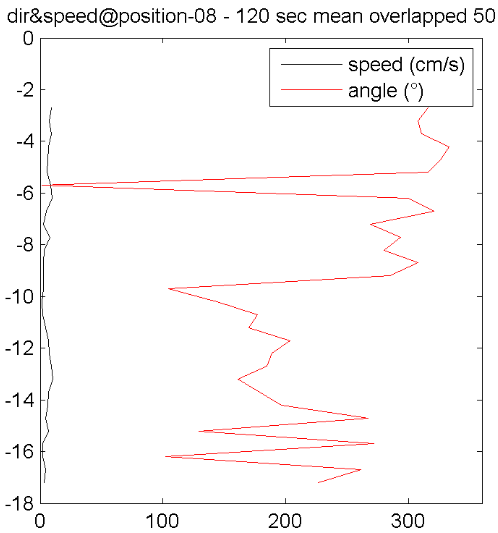


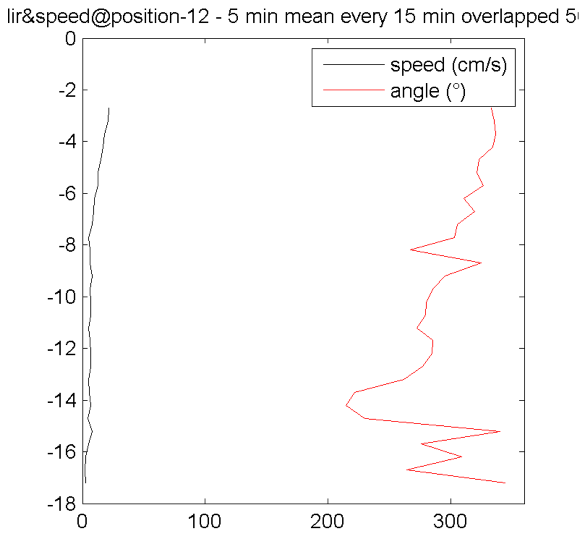

dir&speed@position-06 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0 -2 -4 -6 -8 -10 -12 -14 -16 -18
0 100 200 300

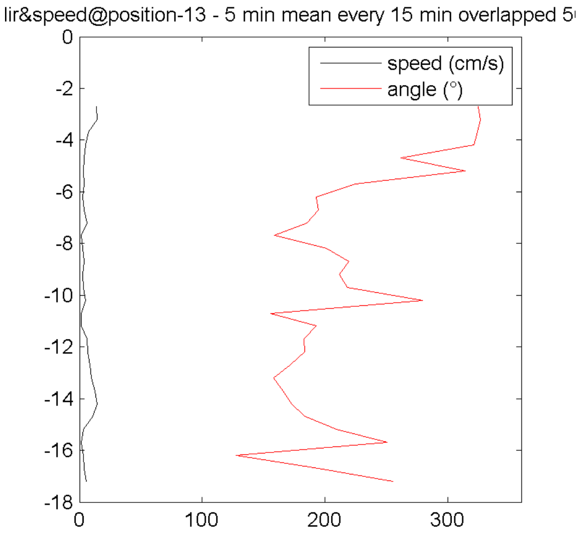

dir&speed@position-09 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0 -2 -4 -6 -8 -10 -12 -14 -16 -18
0 100 200 300

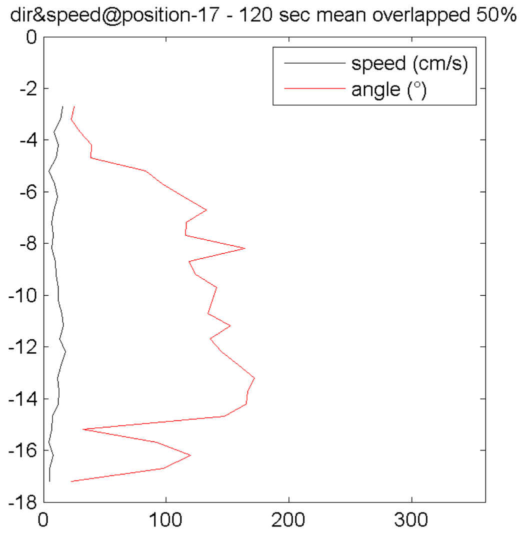

dir&speed@position-07 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0 -2 -4 -6 -8 -10 -12 -14 -16 -18
0 100 200 300

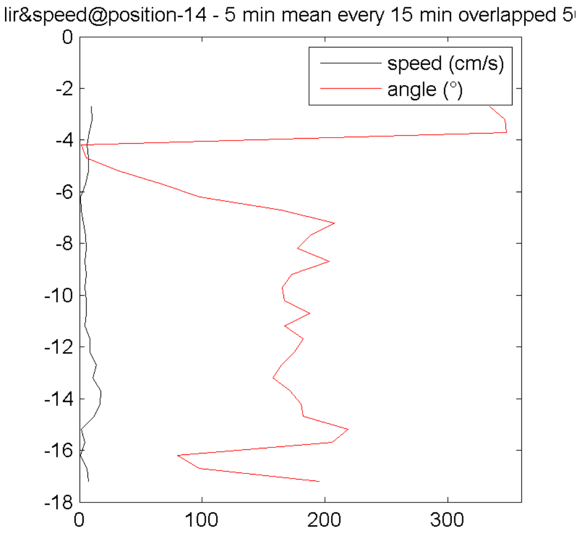

dir&speed@position-10 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0 -2 -4 -6 -8 -10 -12 -14 -16 -18
0 100 200 300

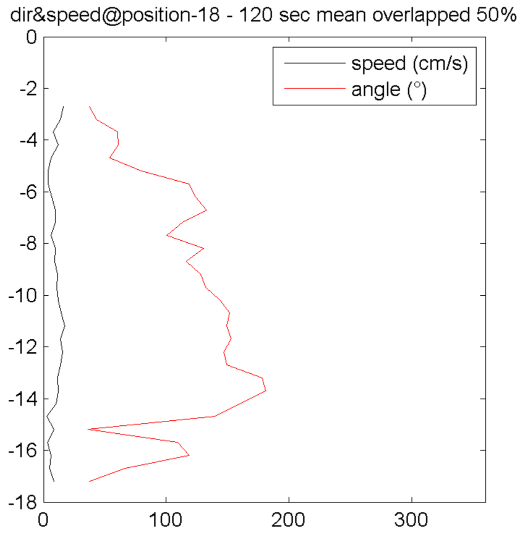

dir&speed@position-08 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0 -2 -4 -6 -8 -10 -12 -14 -16 -18
0 100 200 300

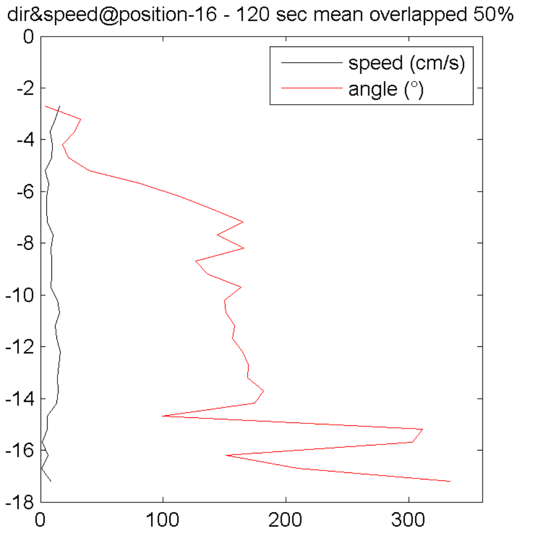

lir&speed@position-12 - 5 min mean every 15 min overlapped 5
speed (cm/s)
angle (°)
0 -2 -4 -6 -8 -10 -12 -14 -16 -18
0 100 200 300

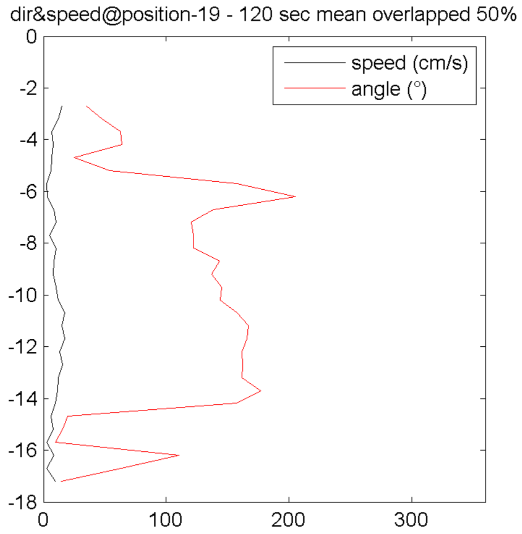

lir&speed@position-13 - 5 min mean every 15 min overlapped 5
speed (cm/s)
angle (°)

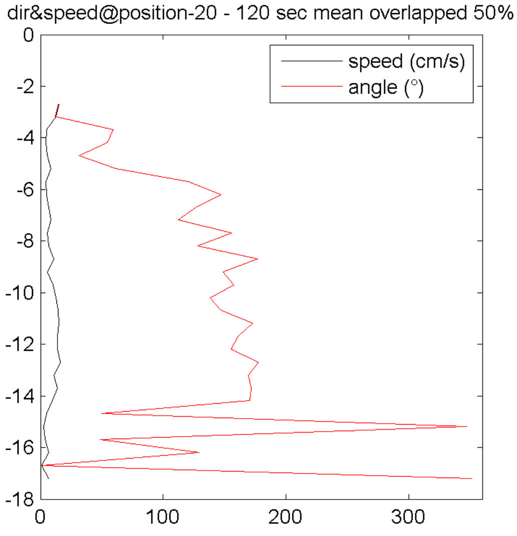

dir&speed@position-17 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

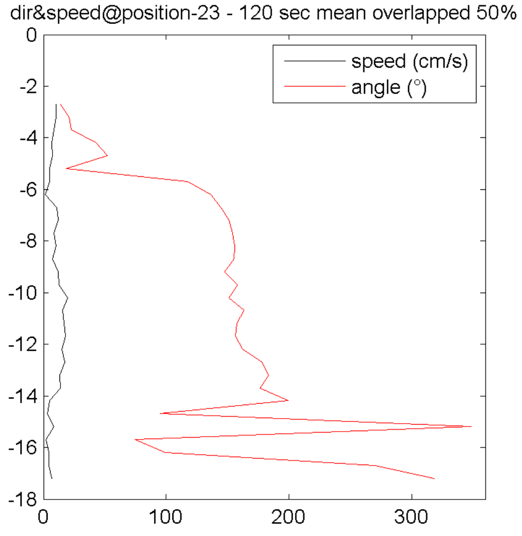

lir&speed@position-14 - 5 min mean every 15 min overlapped 5
speed (cm/s)
angle (°)

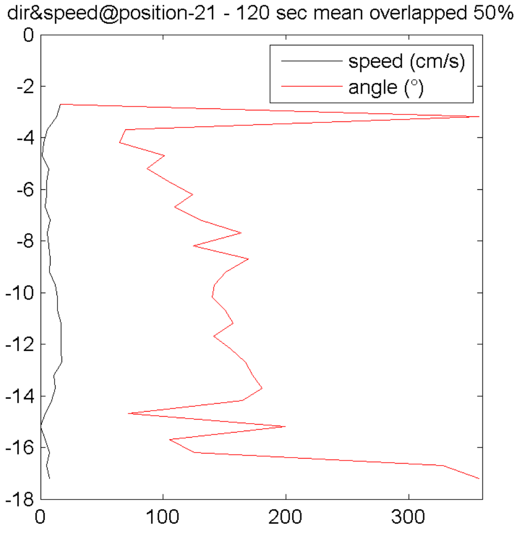

dir&speed@position-18 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

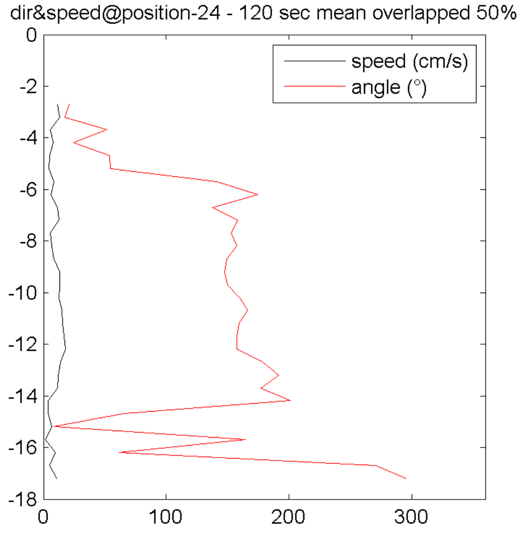

dir&speed@position-16 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)

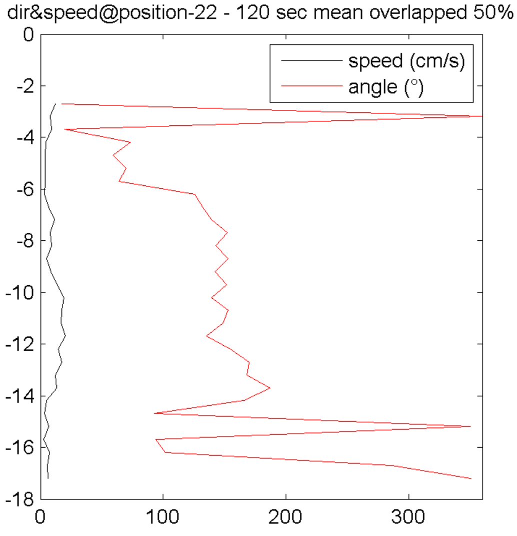

dir&speed@position-19 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)


dir&speed@position-20 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

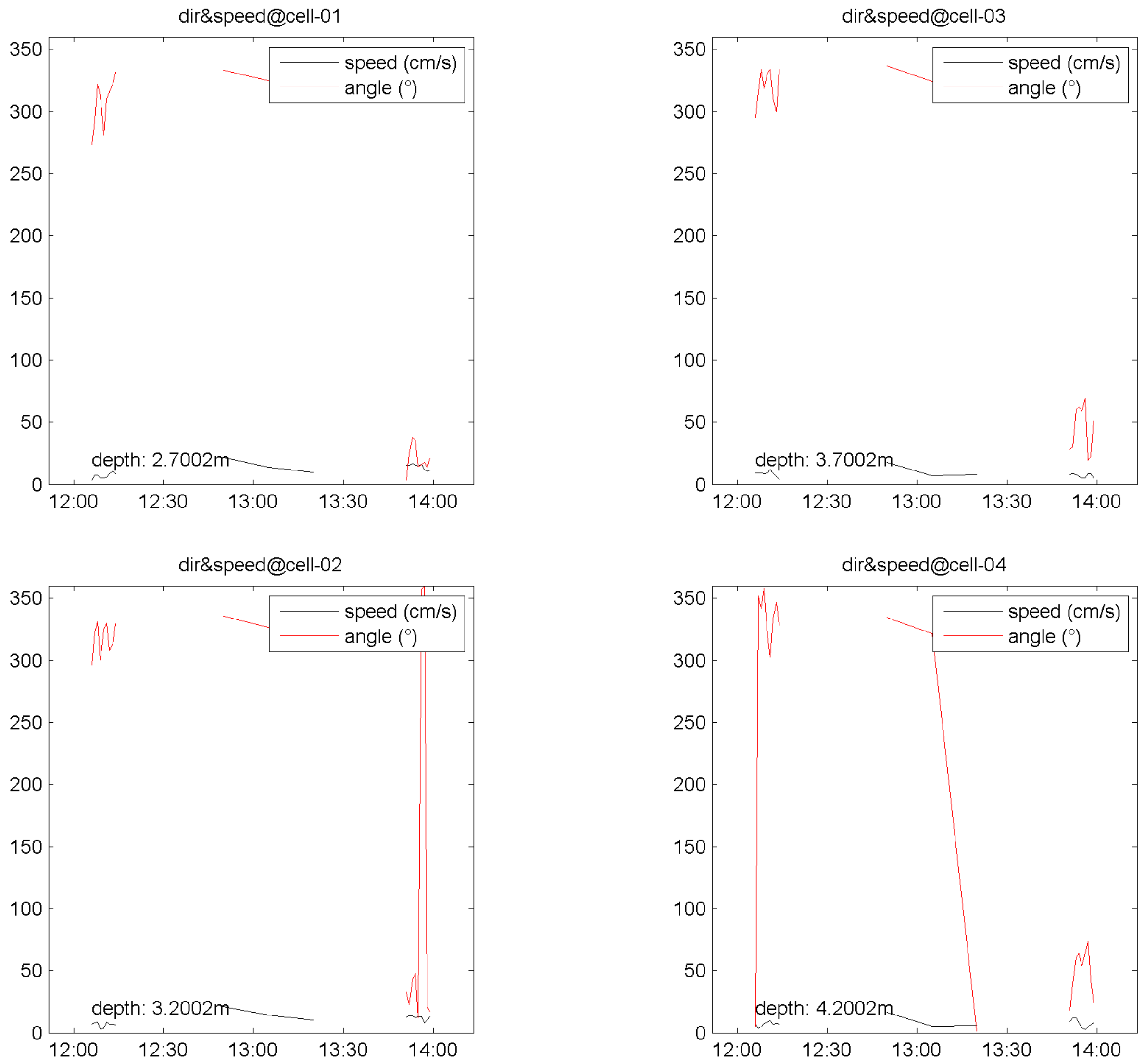

dir&speed@position-23 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

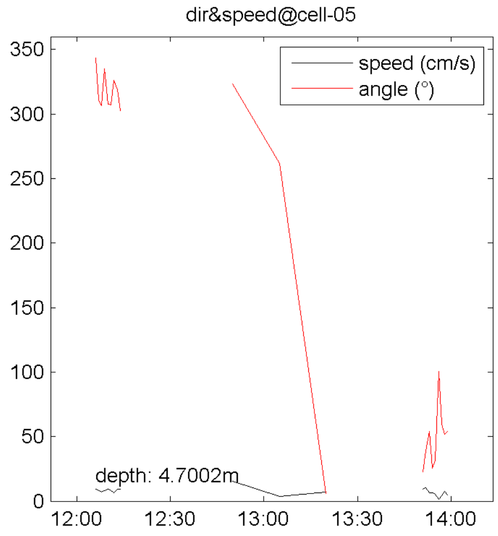

dir&speed@position-21 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

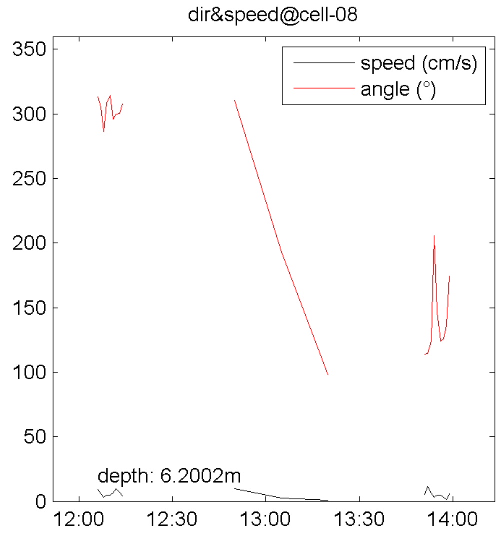

dir&speed@position-24 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

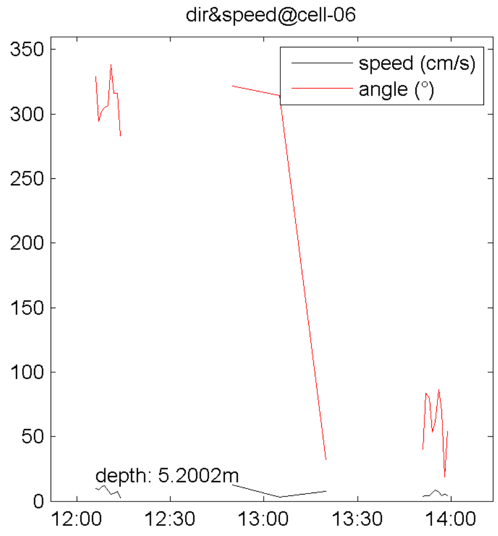

dir&speed@position-22 - 120 sec mean overlapped 50%
speed (cm/s)
angle (°)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
100
200
300

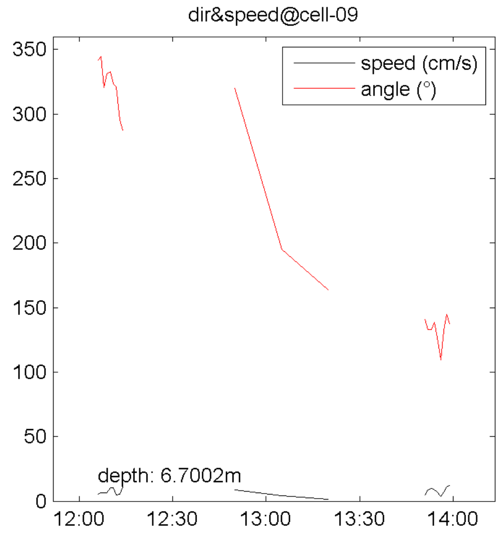
Here below we report the speed and direction plots recorded during the third test along the path at different layer of depth. X-axis: time (s), y-axis: speed (cm/s) and angle (degree).

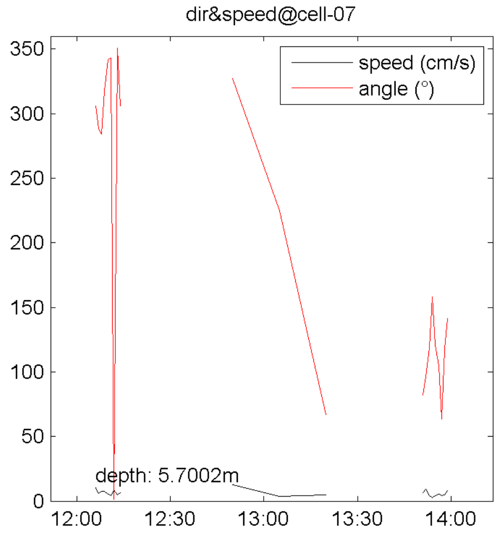


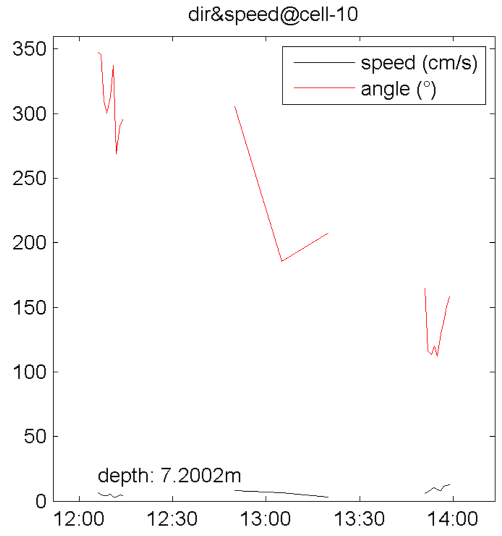












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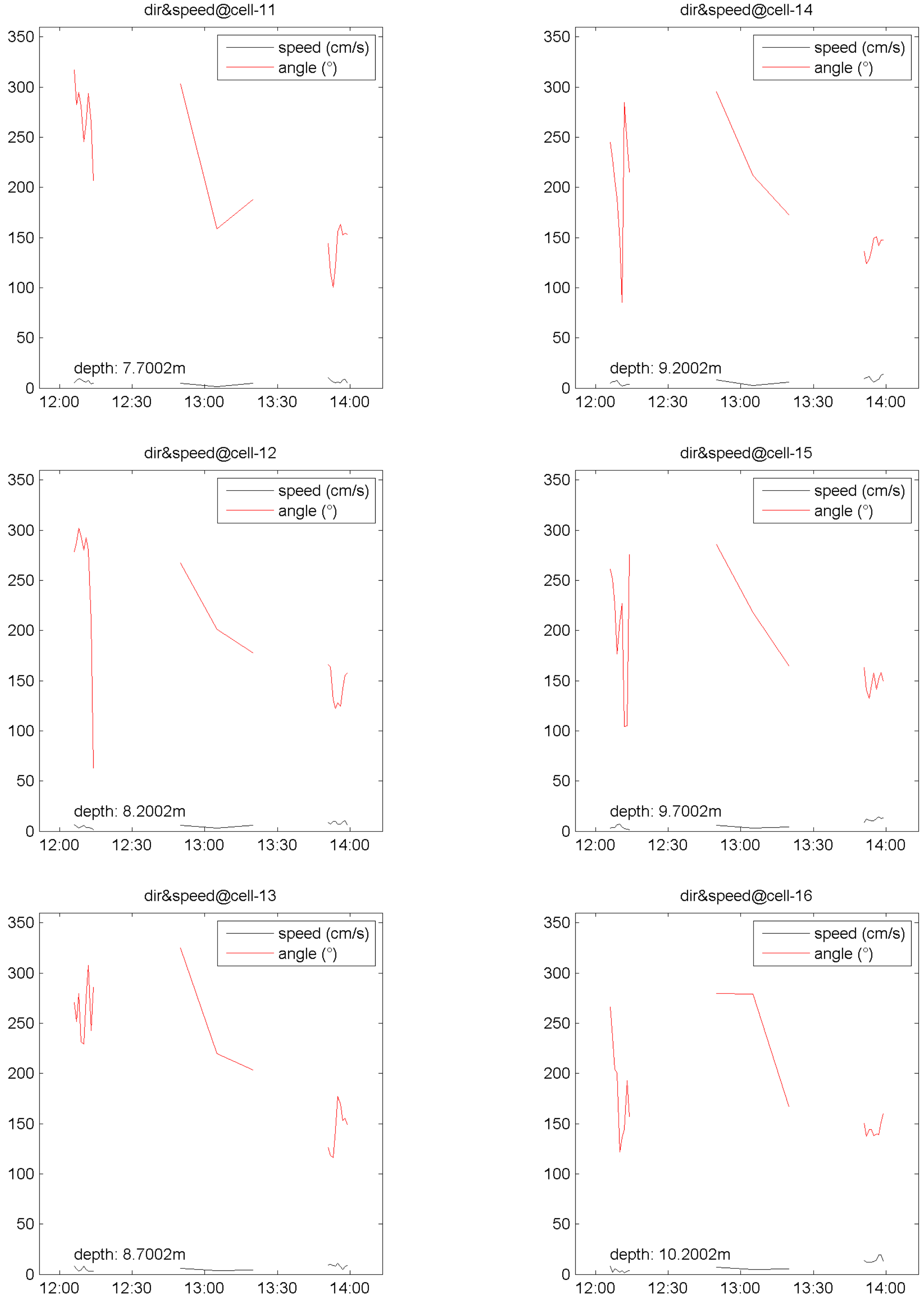
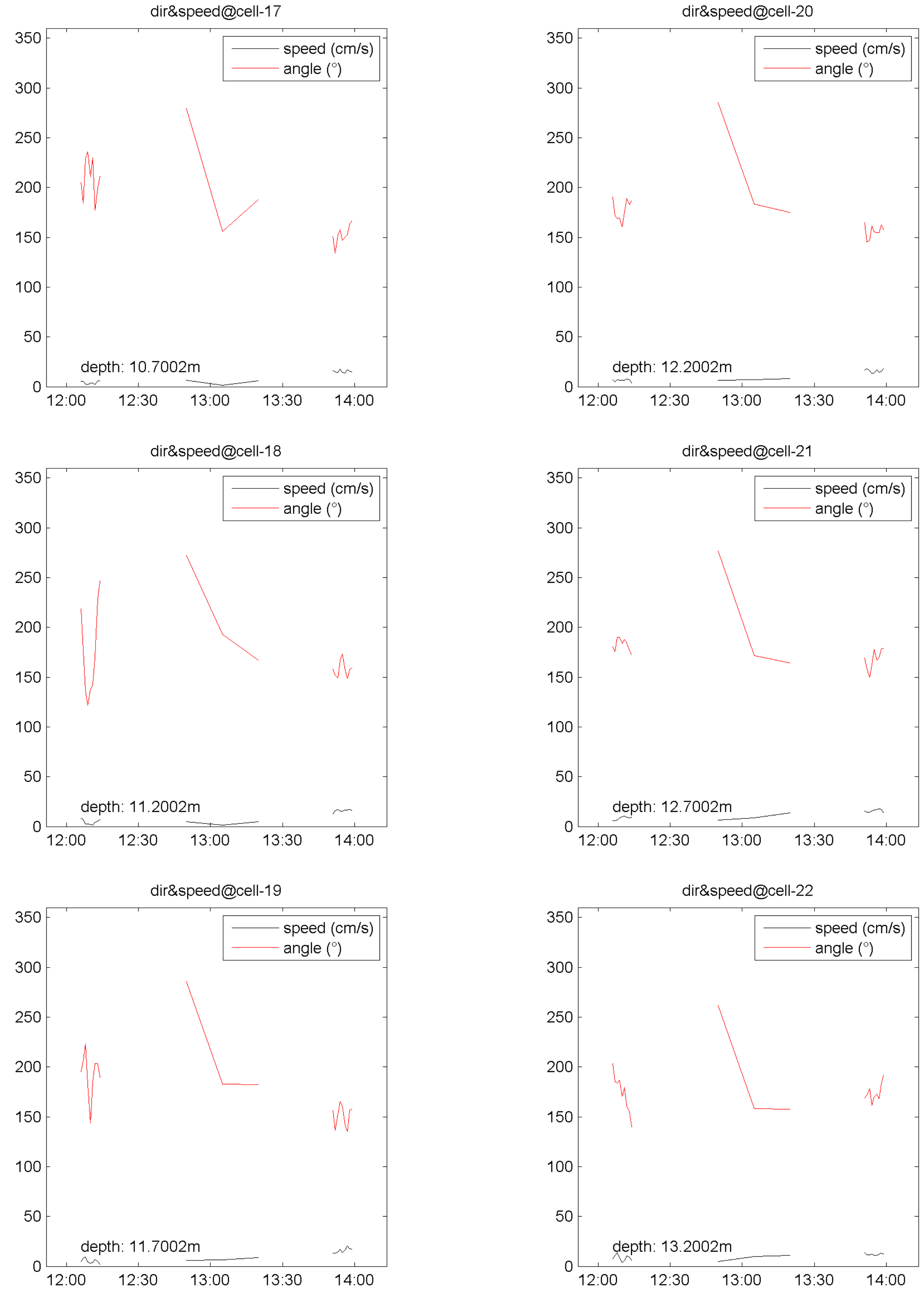
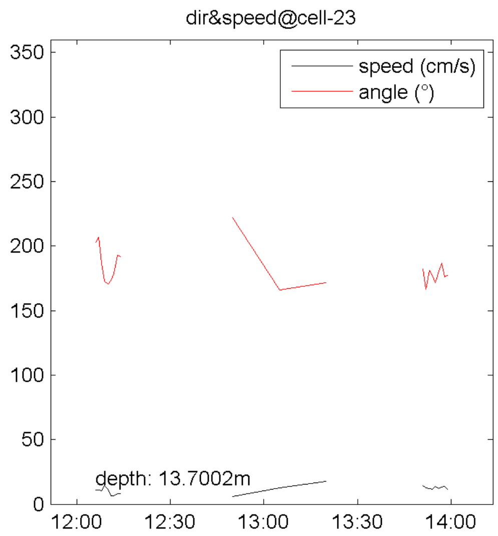
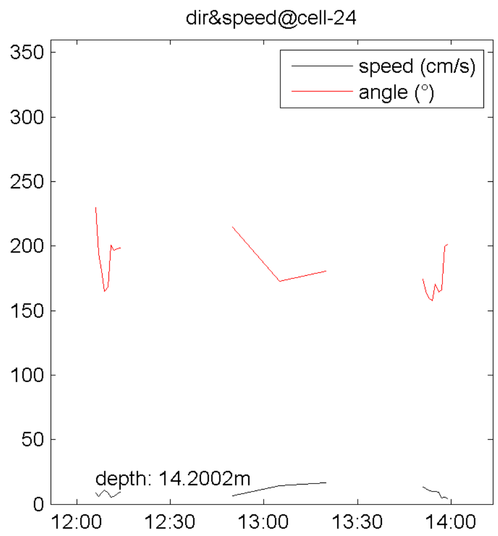
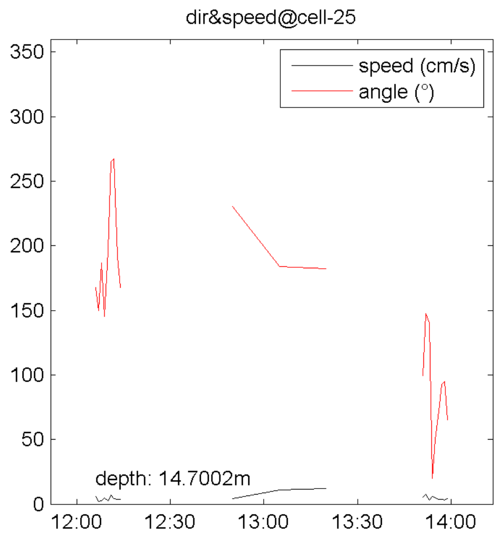
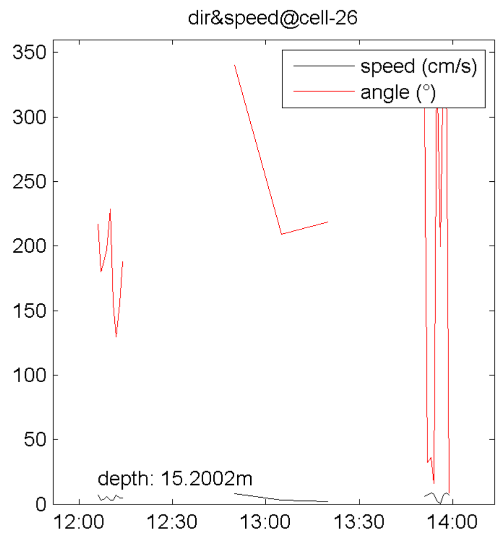

dir&speed@cell-11
speed (cm/s)
angle (°)
depth: 7.7002m
dir&speed@cell-14
depth: 9.2002m
dir&speed@cell-12
depth: 8.2002m
dir&speed@cell-15
depth: 9.7002m
dir&speed@cell-13
depth: 8.7002m
dir&speed@cell-16
depth: 10.2002m
12:00
12:30
13:00
13:30
14:00
0
50
100
150
200
250
300
350

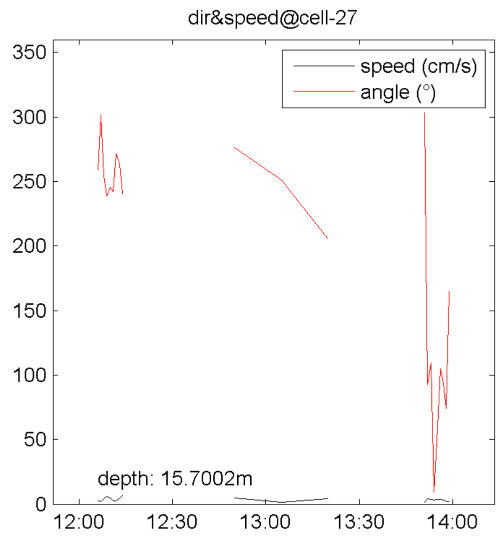

dir&speed@cell-17
speed (cm/s)
angle (°)
depth: 10.7002m
dir&speed@cell-20
speed (cm/s)
angle (°)
depth: 12.2002m
dir&speed@cell-18
speed (cm/s)
angle (°)
depth: 11.2002m
dir&speed@cell-21
speed (cm/s)
angle (°)
depth: 12.7002m
dir&speed@cell-19
speed (cm/s)
angle (°)
depth: 11.7002m
dir&speed@cell-22
speed (cm/s)
angle (°)
depth: 13.2002m
0
50
100
150
200
250
300
350
12:00
12:30
13:00
13:30
14:00

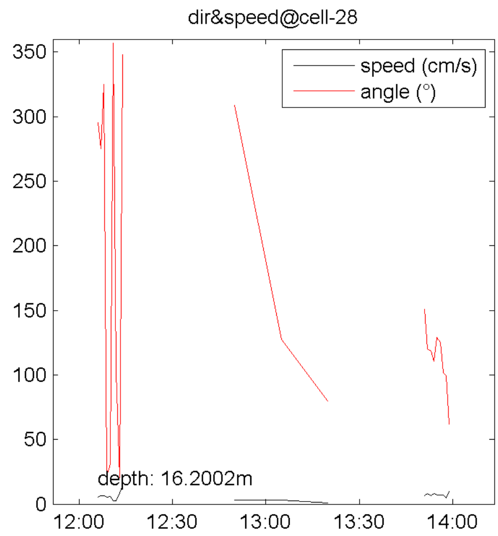

dir&speed@cell-23
speed (cm/s)
angle (°)
depth: 13.7002m
0 50 100 150 200 250 300 350
12:00 12:30 13:00 13:30 14:00

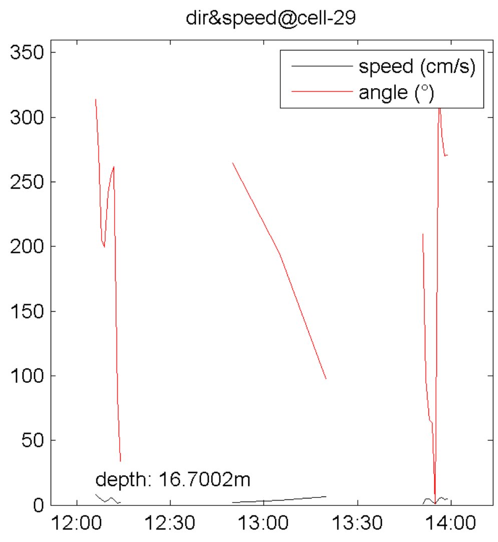

dir&speed@cell-24
speed (cm/s)
angle (°)
depth: 14.2002m
0 50 100 150 200 250 300 350
12:00 12:30 13:00 13:30 14:00

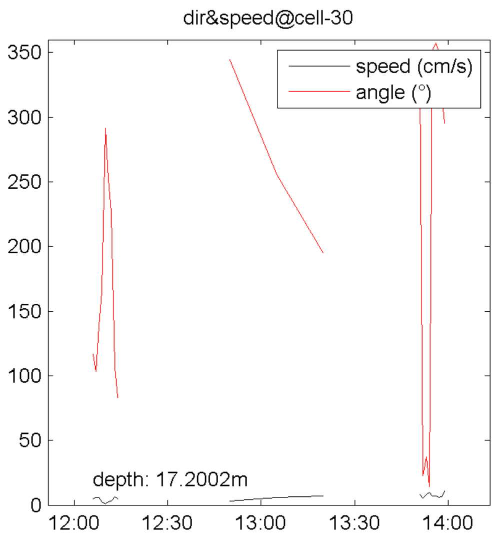

dir&speed@cell-25
speed (cm/s)
angle (°)
depth: 14.7002m
0 50 100 150 200 250 300 350
12:00 12:30 13:00 13:30 14:00


dir&speed@cell-26
speed (cm/s)
angle (°)
depth: 15.2002m
0 50 100 150 200 250 300 350
12:00 12:30 13:00 13:30 14:00


dir&speed@cell-27
speed (cm/s)
angle (°)
depth: 15.7002m
0 50 100 150 200 250 300 350
12:00 12:30 13:00 13:30 14:00


dir&speed@cell-28
speed (cm/s)
angle (°)
depth: 16.2002m
0 50 100 150 200 250 300 350
12:00 12:30 13:00 13:30 14:00


dir&speed@cell-29
speed (cm/s)
angle (°)
depth: 16.7002m
350
300
250
200
150
100
50
0
12:00
12:30
13:00
13:30
14:00


dir&speed@cell-30
speed (cm/s)
angle (°)
depth: 17.2002m
350
300
250
200
150
100
50
0
12:00
12:30
13:00
13:30
14:00

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