3FMProject

Bringing
Dublin Port
To 2040

Environmental Impact Assessment Report

Appendix 13.2

Volume 3 Part 7

COMHLACHT CHALAFORT
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DUBLIN PORT COMPANY

A TETRA TECH COMPANY

Third & Final
Masterplan
Project

APPENDIX 13-2 – MODEL CALIBRATION AND VALIDATON

This appendix describes the calibration and validation process undertaken to ensure that the hydraulic model systems used to assess the potential impact of the proposed development on coastal processes were accurate and fit for purpose.

1.1 Model Validation

The validation process was undertaken using surface elevation information recorded by the Dublin Port tide gauge and also current regime information recorded by eight individual Acoustic Doppler Current Profilers (ADCPs) that were moored throughout Dublin Bay between 2013 and present as part of various monitoring programmes. The location of the ADCP devices in relation to Dublin Port is illustrated in Figure 1.

The validation process focused on establishing agreement between the model output and recorded observations and thus assessing overall model performance based several key parameters including tidal range, current speed, phase and direction.

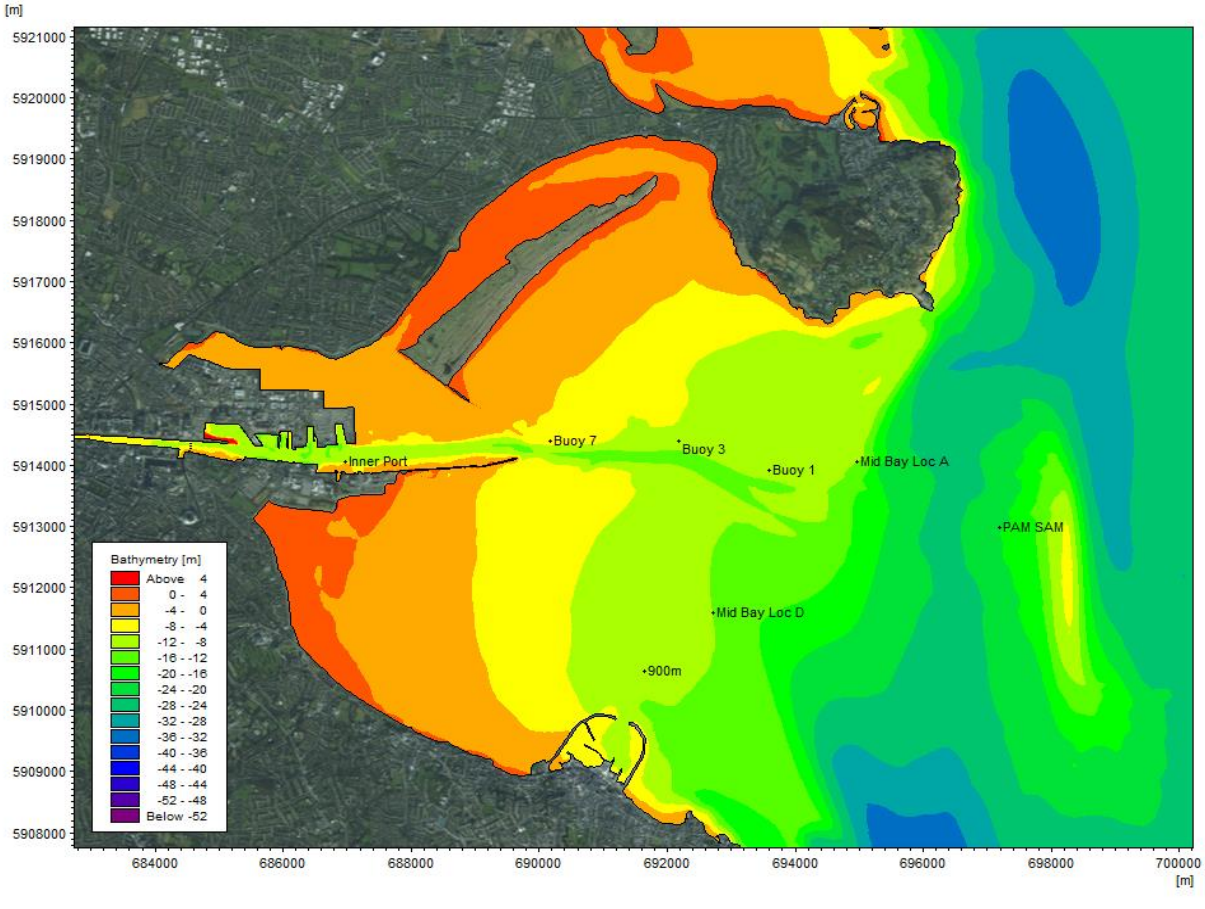


Figure 1: Location of the various measurement recording sites throughout Dublin Bay used to validate RPS' baseline numerical model

1.1.1 Validation of simulated tidal ranges

Figure 2 presents a comparison between surface elevation data recorded by the Dublin Tide Gauge over a typical spring neap tidal cycle in 2016 and surface elevation data simulated by the Dublin Bay numerical model for the same period. As can be seen from this figure the hydrodynamic model simulates the surface elevations in Dublin Port to a very high degree of accuracy.

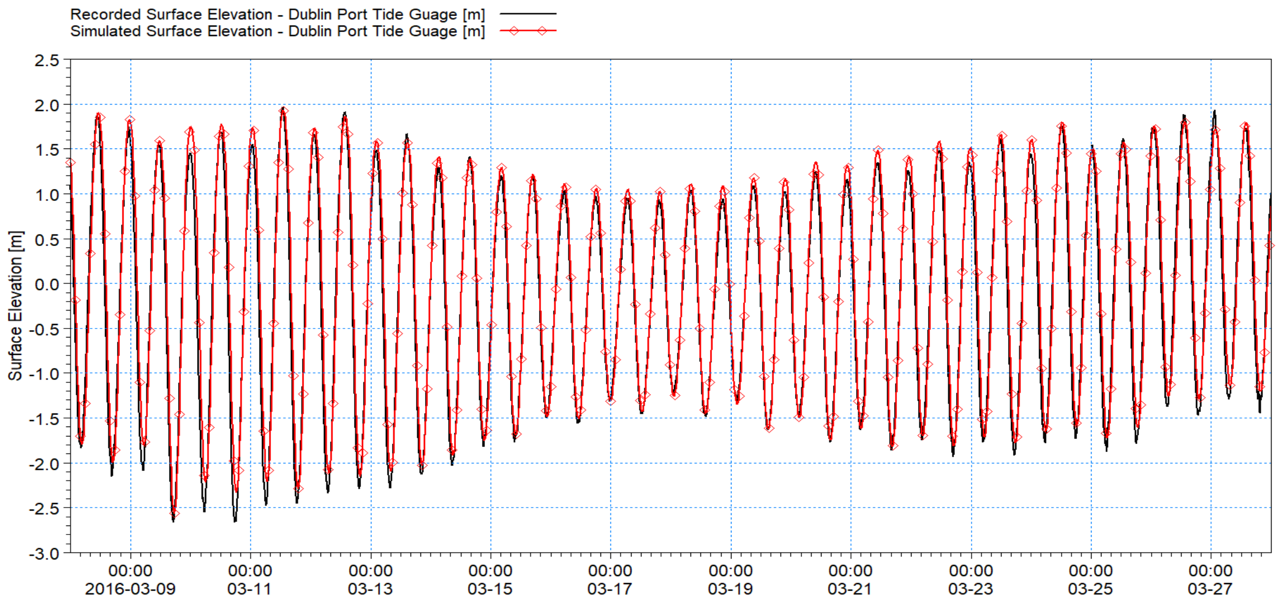


Figure 2: Comparison of recorded and simulated surface elevations at the Dublin Port tide gauge

1.1.2 Validation of simulated current regime

The validation of the simulated tidal current regime was undertaken using data recorded by eight individual ADCP devices that were deployed throughout the model domain at various times between 2013 and present as part of various hydrographic and environmental monitoring programmes. It should therefore be noted that the temporal duration of the validation plots vary depending on the device location.

All ADCP devices were setup to record current speed, phase and direction at multiple depths throughout the water column. The multiple depth recordings were then grouped together to create representative bottom, middle and top layer signals.

To validate the two-dimensional Dublin Bay model, depth averaged simulated data were compared with data recorded at all sites except the inner Port where stratified conditions prevail. In this area, simulated data from RPS' three-dimensional Dublin Bay model were compared with data recorded by the inner Port ADCP across the top, middle and bottom layers of the water column. For convenience an index for the various validation plots across spring and neap tidal conditions has been presented in Table 0.1 overleaf.

Table 0.1: Index of the validation plots at each of the validation sites for spring and neap conditions

Validation Type	Validation Site	Spring Conditions	Neap Conditions
Depth averaged (2D)	Buoy 1	Figure 3	Figure 10
	Buoy 3	Figure 4	Figure 11
	Buoy 7	Figure 5	Figure 12
	Mid Bay A	Figure 6	Figure 13
	Mid Bay D	Figure 7	Figure 14
	VD 900	Figure 8	Figure 15
	PAM SAM	Figure 9	Figure 16
Three dimensional (3D)	Inner Port	Figure 17	Figure 18

Examination of the two-dimensional depth averaged plots used to validate simulate date model outside of the Port demonstrate that the hydrodynamic model predicted current speed, phase and direction during both spring and neap tidal conditions throughout the entire model domain to a very high degree of accuracy. At all validation sites the simulated depth averaged current speed, phase and direction values nearly always falls between the range values observed in the top and bottom layers. It may be noted that there is an minor difference between the modelled and recorded data in the top layer at buoys 3 and 7, however this difference can be attributed to prevailing weather conditions such as high surface winds etc. which would not have been account for in the hydrodynamic model.

Examination of Figure 17 and Figure 18 which illustrate the plots used to validate RPS' baseline three-dimensional model inside of Dublin Port demonstrate that the actual current speed, phase and direction are all well predicted by the hydrodynamic model. The minor difference observed in current speeds and directions within the top layer of the model is due prevailing weather conditions which would not have been accounted for in the model.

A close inspection of the recorded current speeds and directions within Dublin Port indicates the presence of a salt wedge within the Liffey channel; this is a classic phenomenon observed at the mouth of any estuary or fresh water river that meets the sea. As demonstrated in Figure 19 to Figure 22 which illustrate the salinity of bottom, middle and top layers of the water column at various phases of a typical spring tidal cycle, RPS' three dimensional model simulates this dynamic pycnocline process very well.

Overall the validation process demonstrated that RPS' two dimensional and three dimensional baseline models of Dublin Bay simulated the current speed, phase, range and direction to a high degree of accuracy throughout the entire model domain. The current regime within the inner harbour flow is complex with some level of circulation, stratification and bi-directional flows; however these phenomena are all well represented by the model. The validation process therefore considered the 2D and 3D baseline models to be fit for purpose and adequate to assess the coastal processes in Dublin Port in context of the 3FM Project.

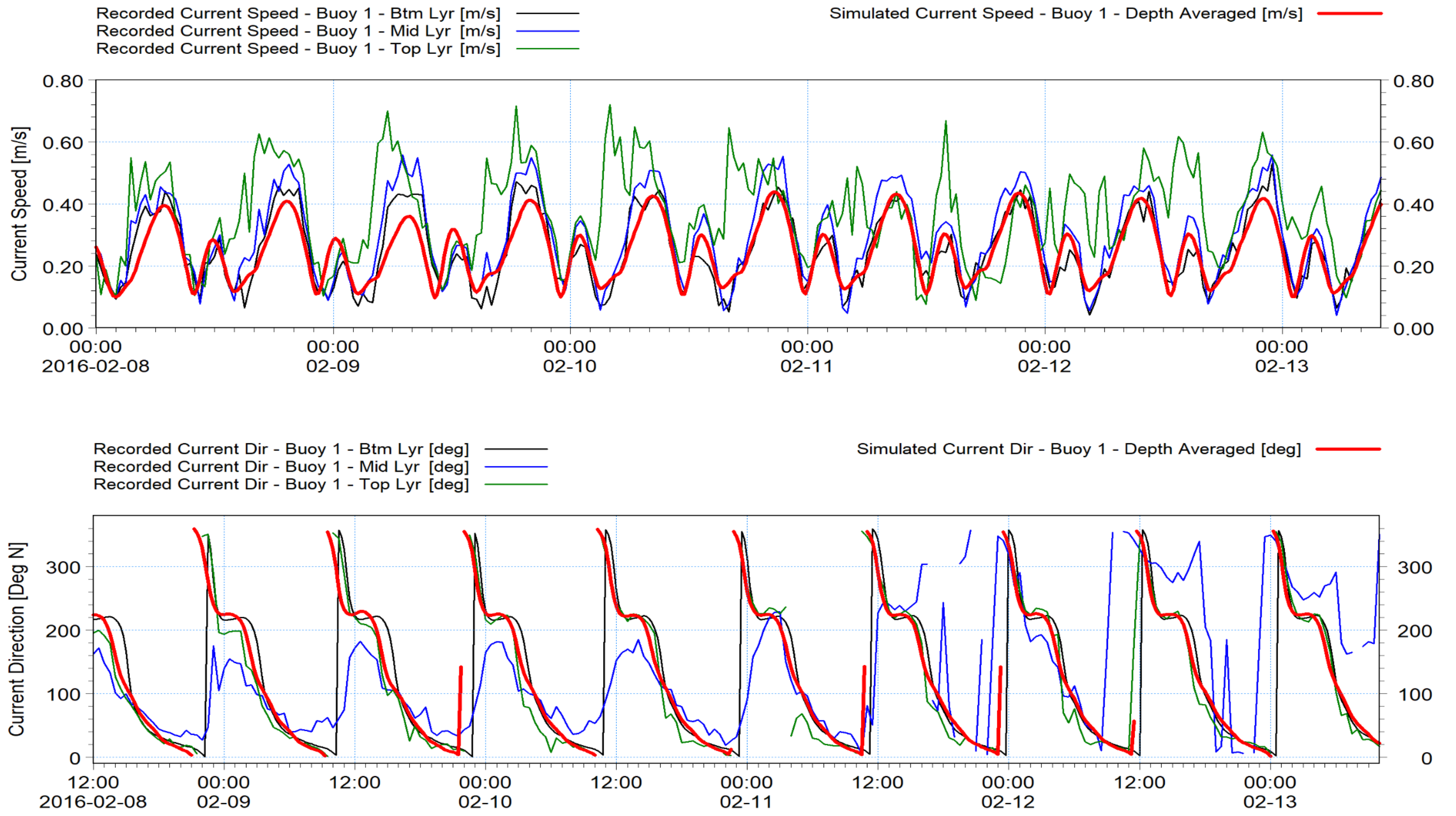


Figure 3: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 1 - Spring Tides

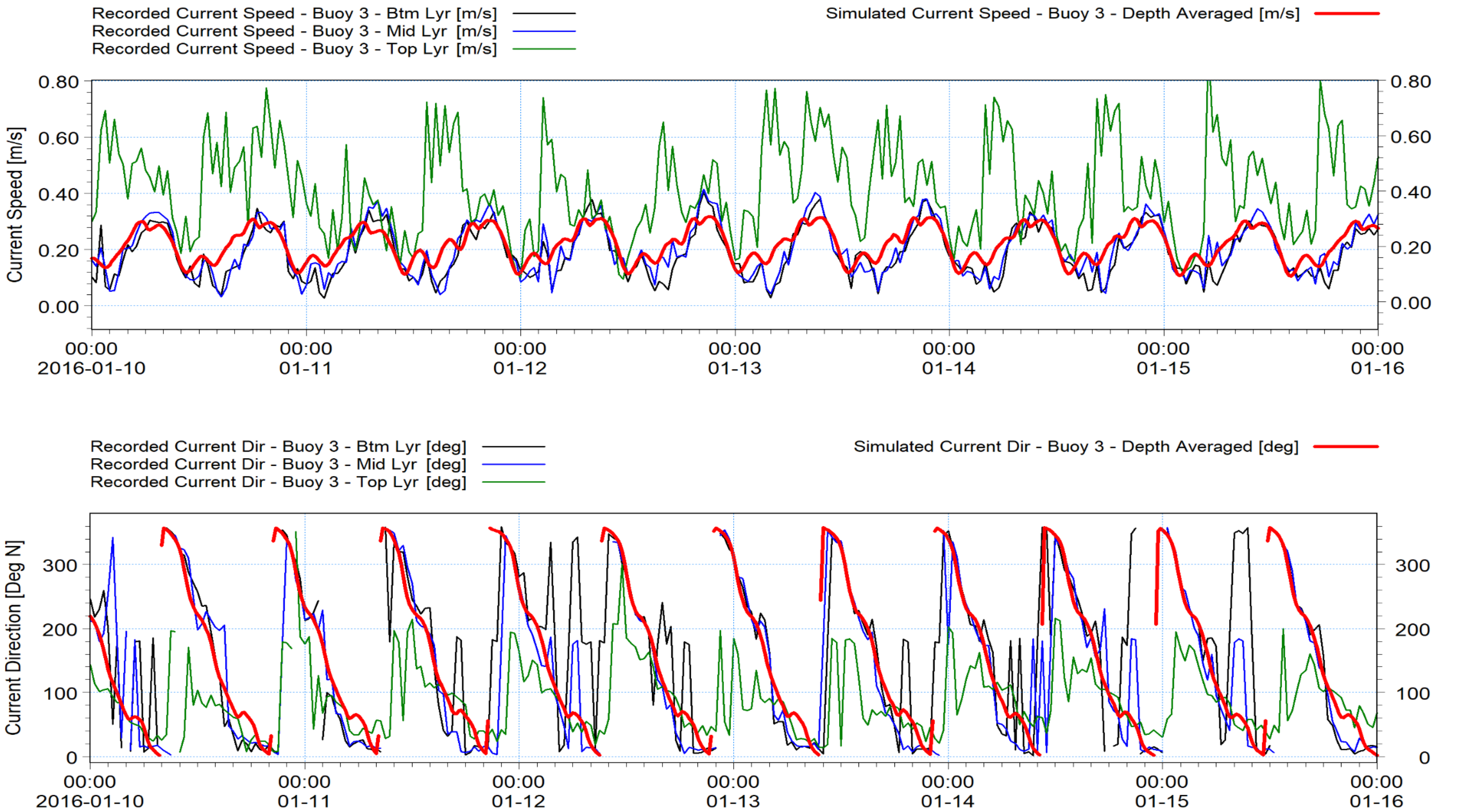


Figure 4: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 3 - Spring Tides

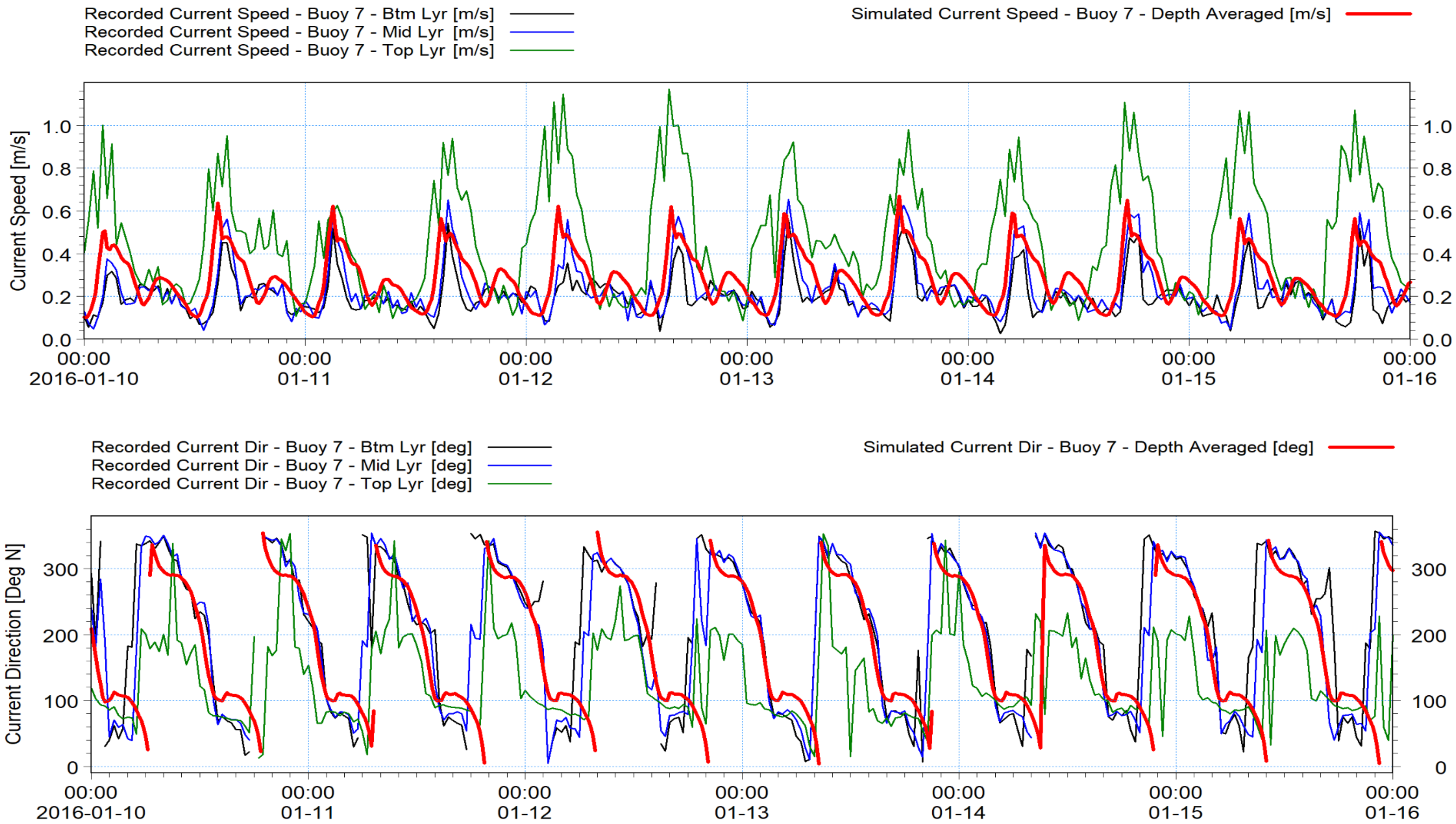
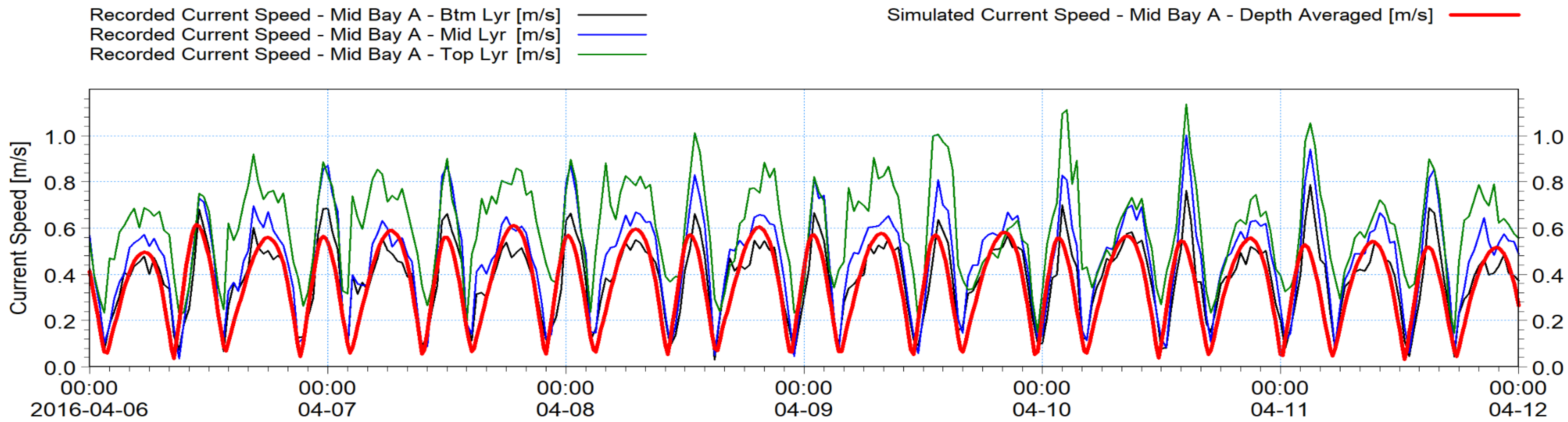


Figure 5: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 7 -Spring Tides



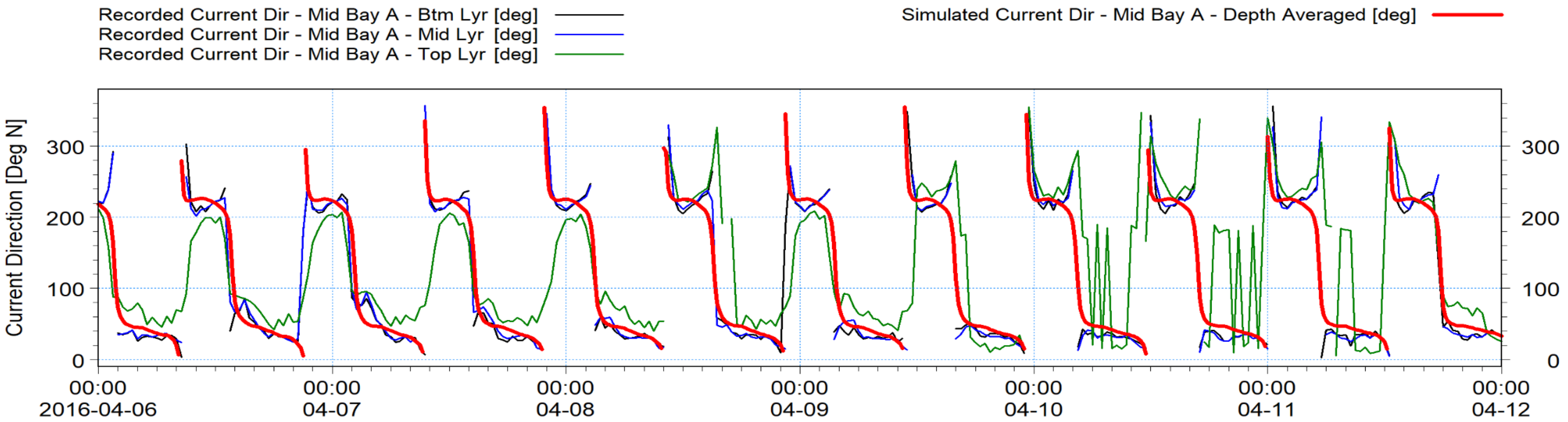


Figure 6: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Mid Bay A - Spring Tides

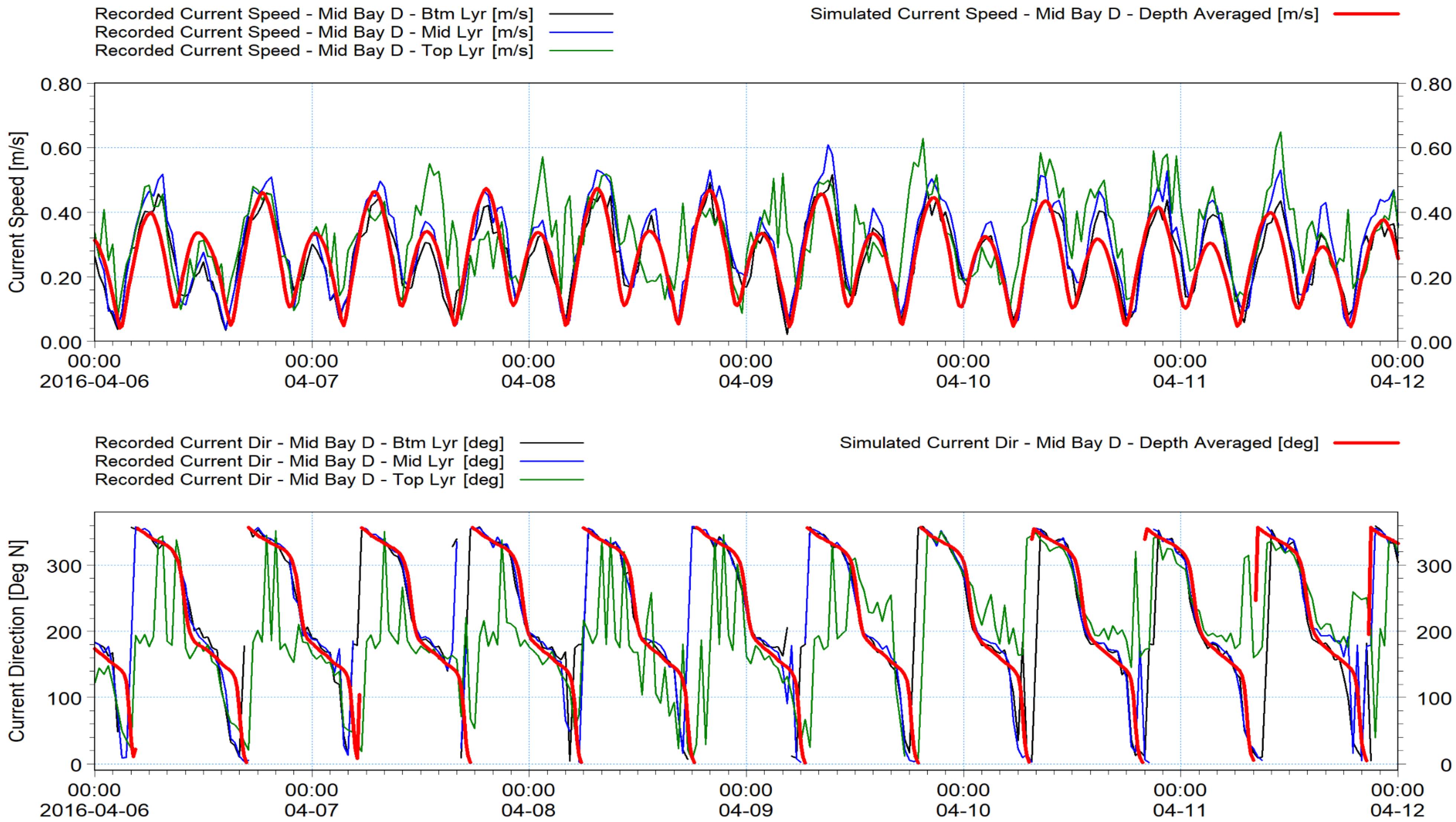


Figure 7: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Mid Bay D - Spring Tides

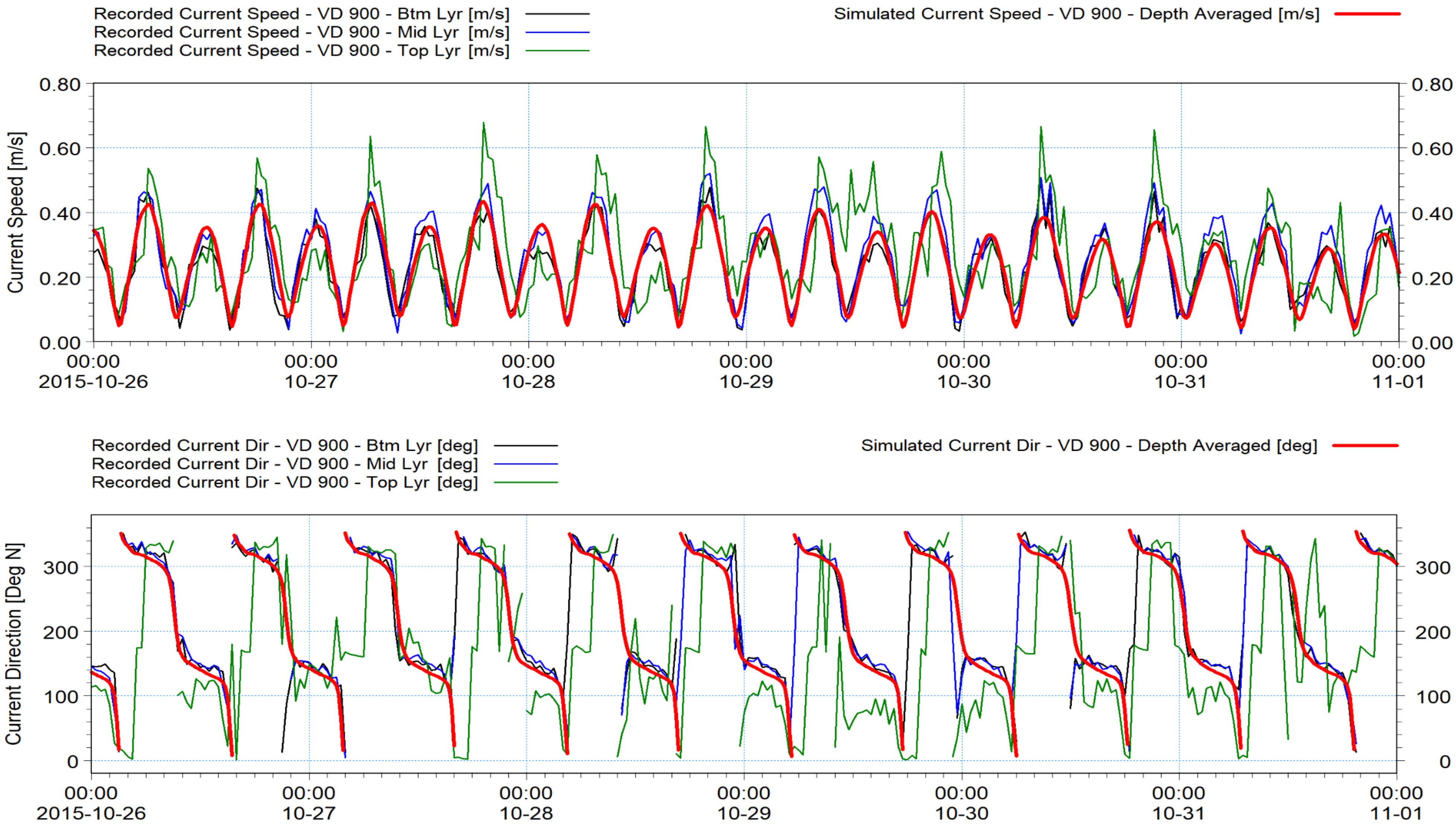


Figure 8: Comparison of recorded and simulated current speeds (upper) and directions (lower) at VD 900 -Spring Tides

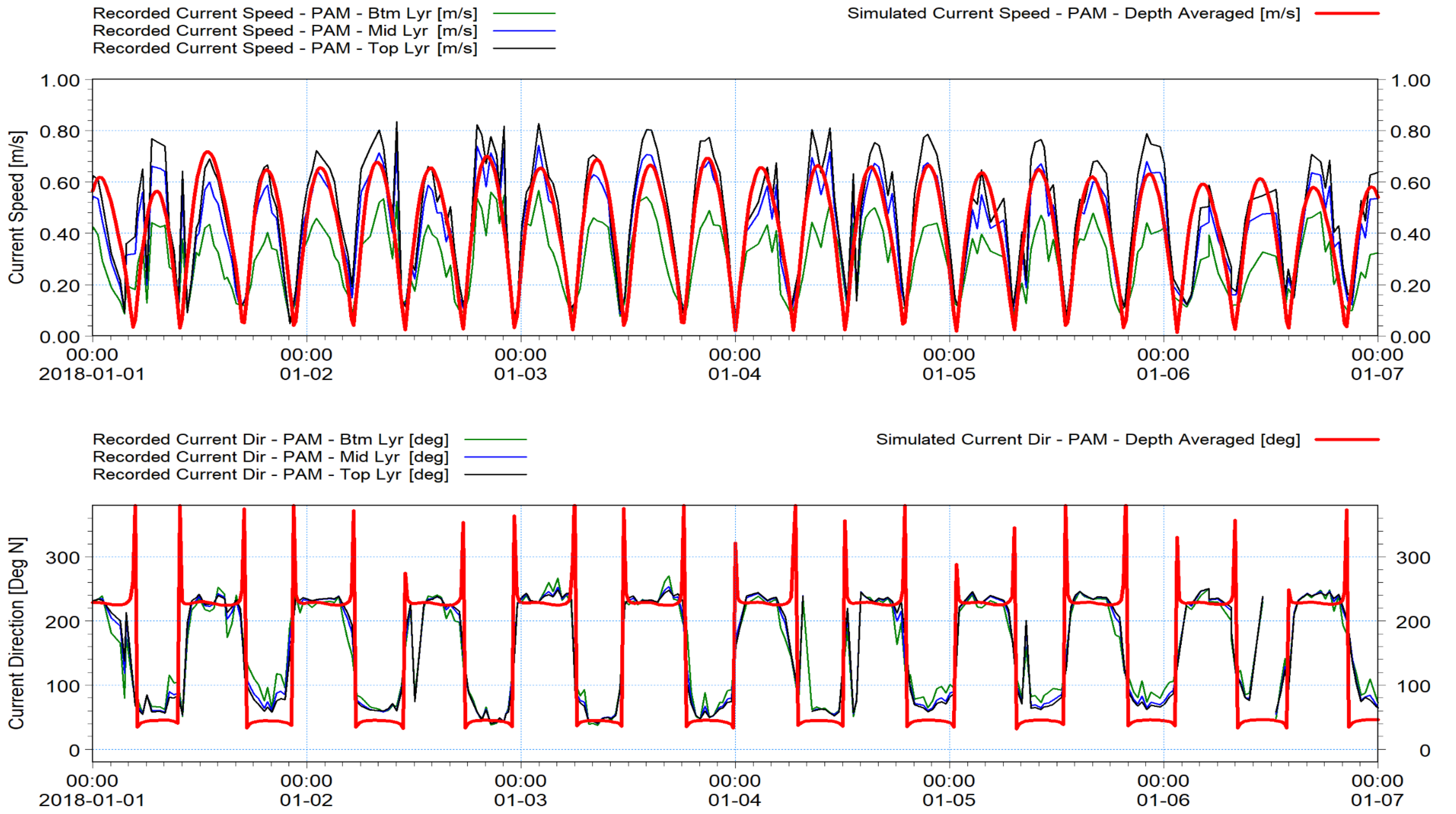


Figure 9: Comparison of recorded and simulated current speeds (upper) and directions (lower) at PAM Site -Spring Tides

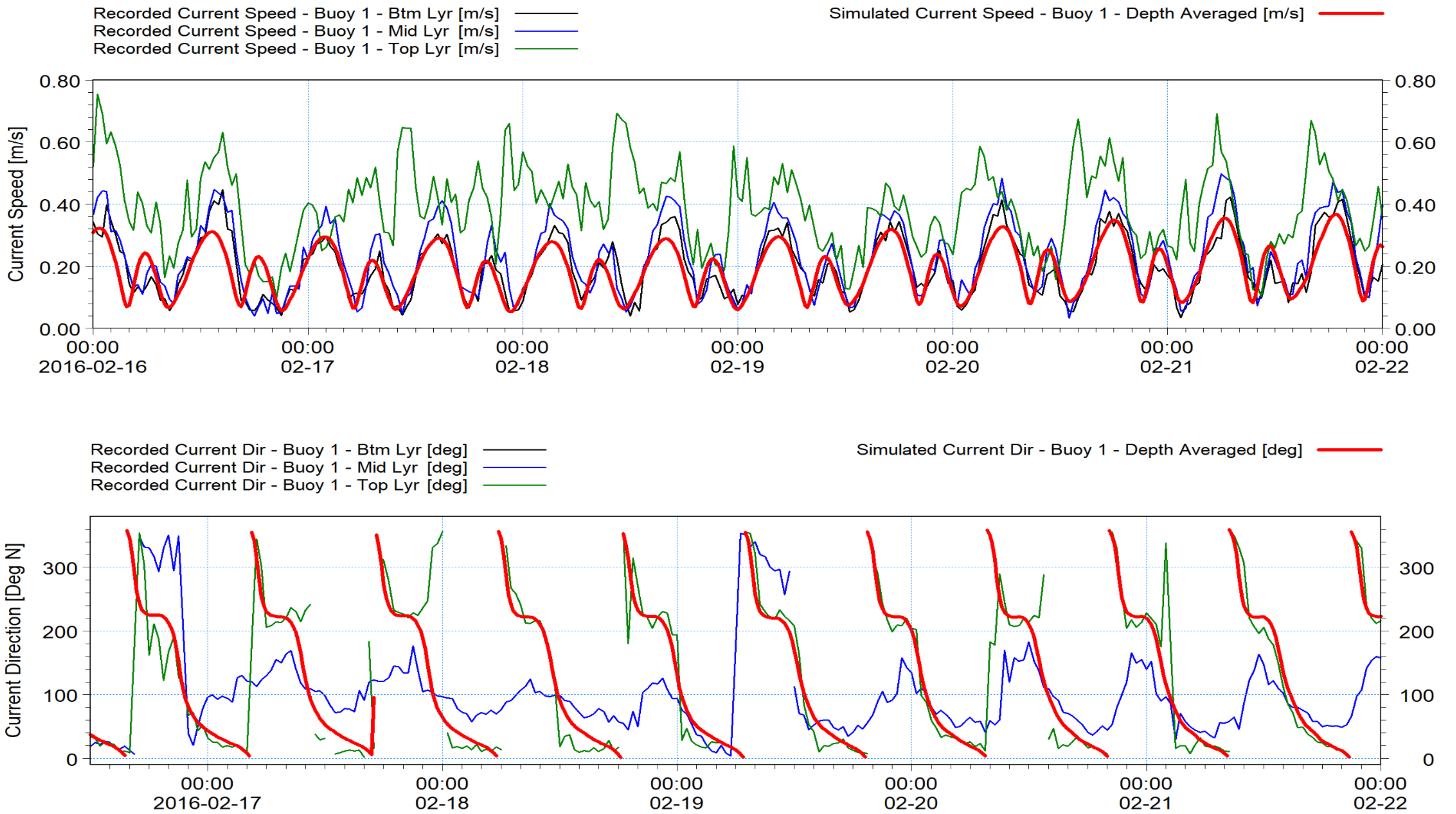


Figure 10: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 1 -Neap Tides

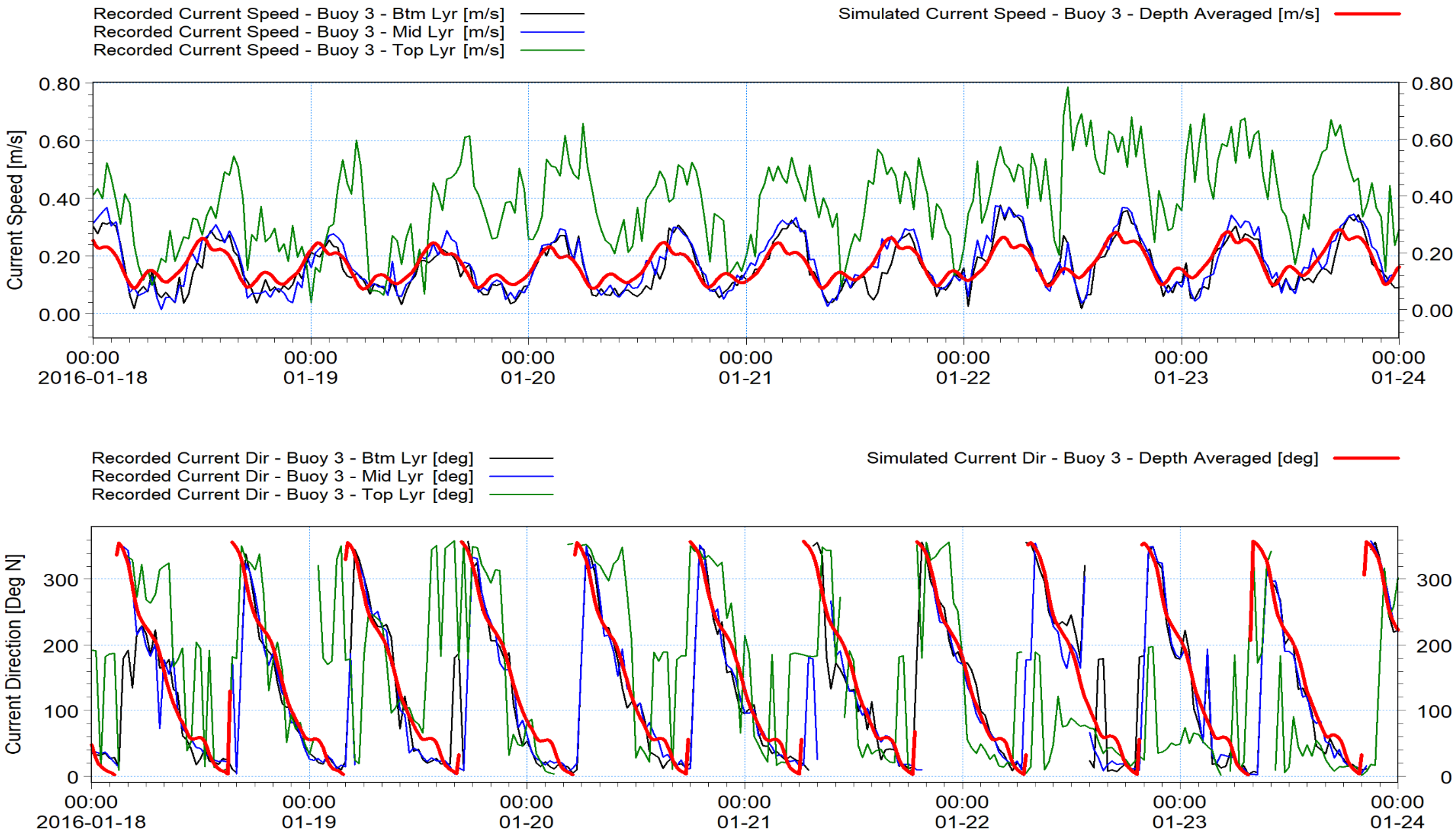


Figure 11: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 3 -Neap Tides

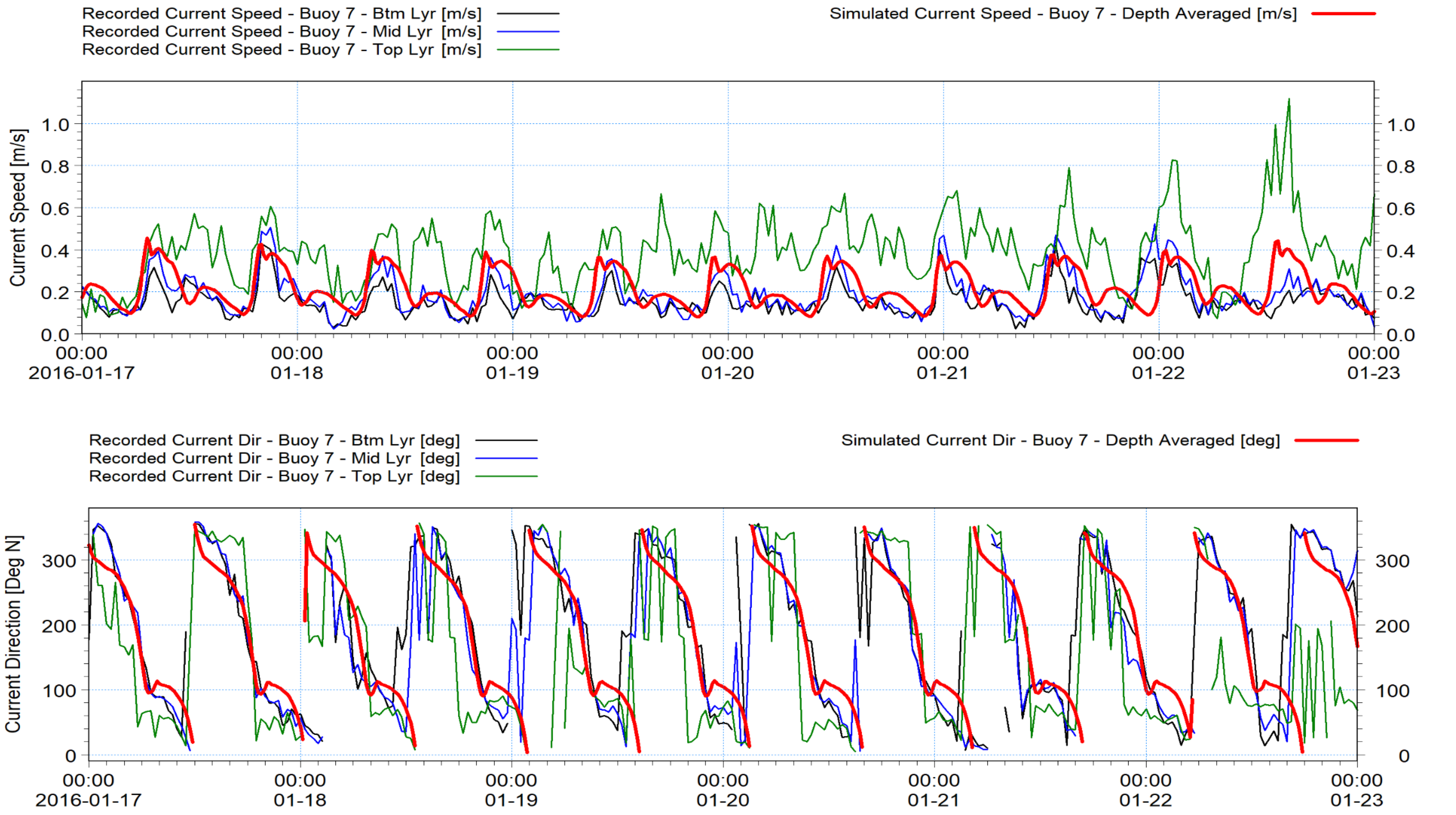


Figure 12: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 7 - Neap Tides

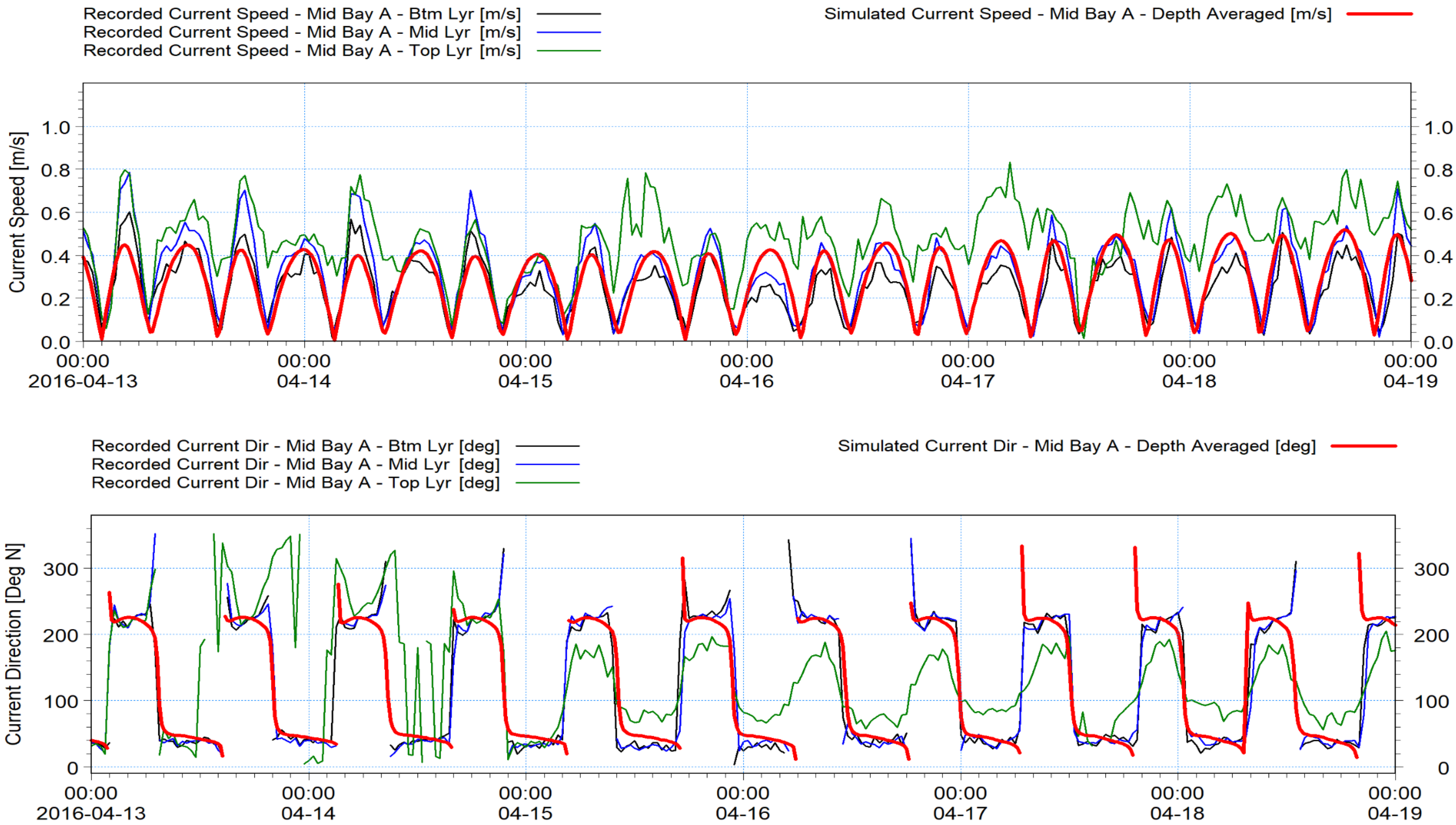


Figure 13: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Mid Bay A -Neap Tides

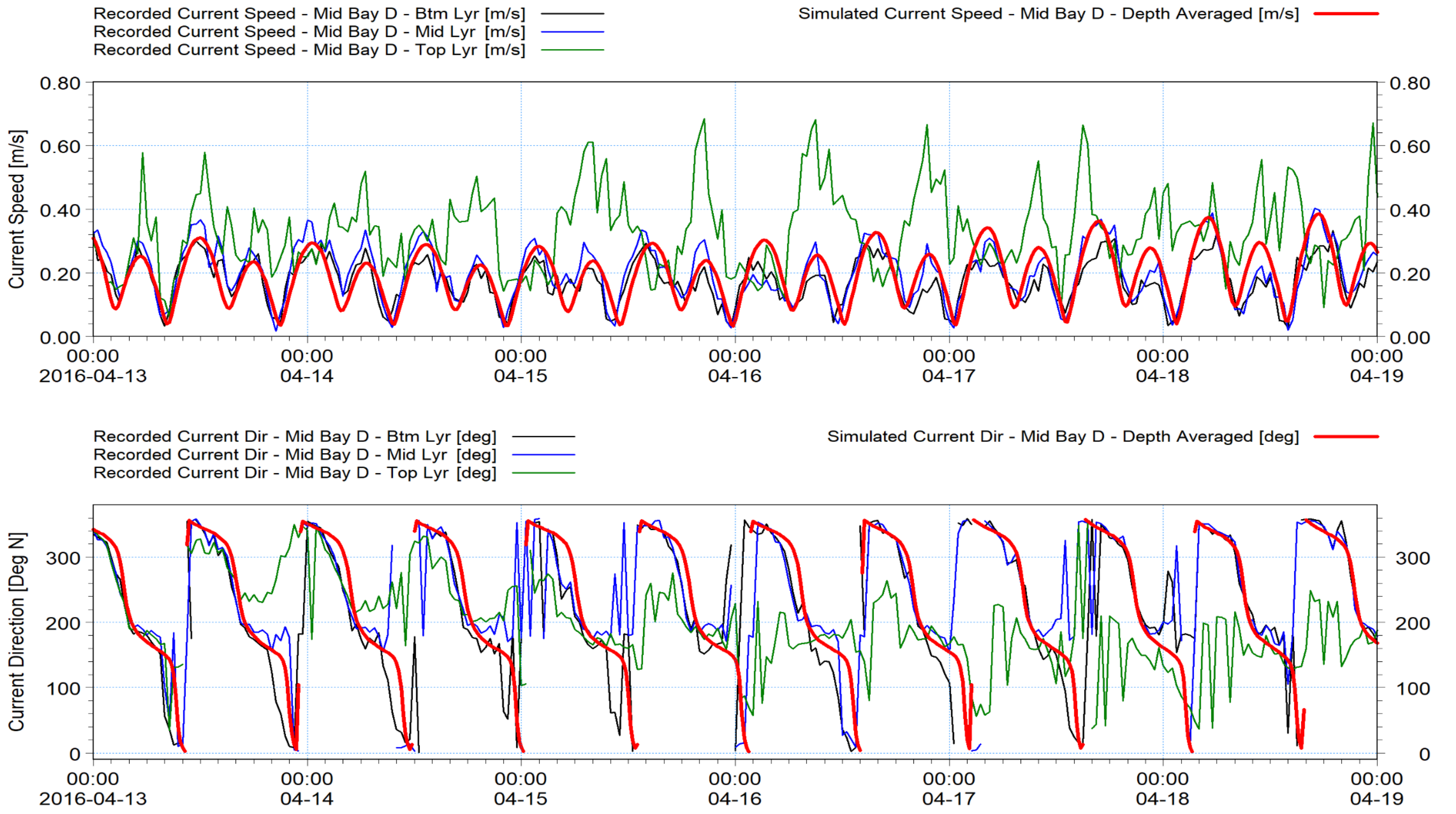
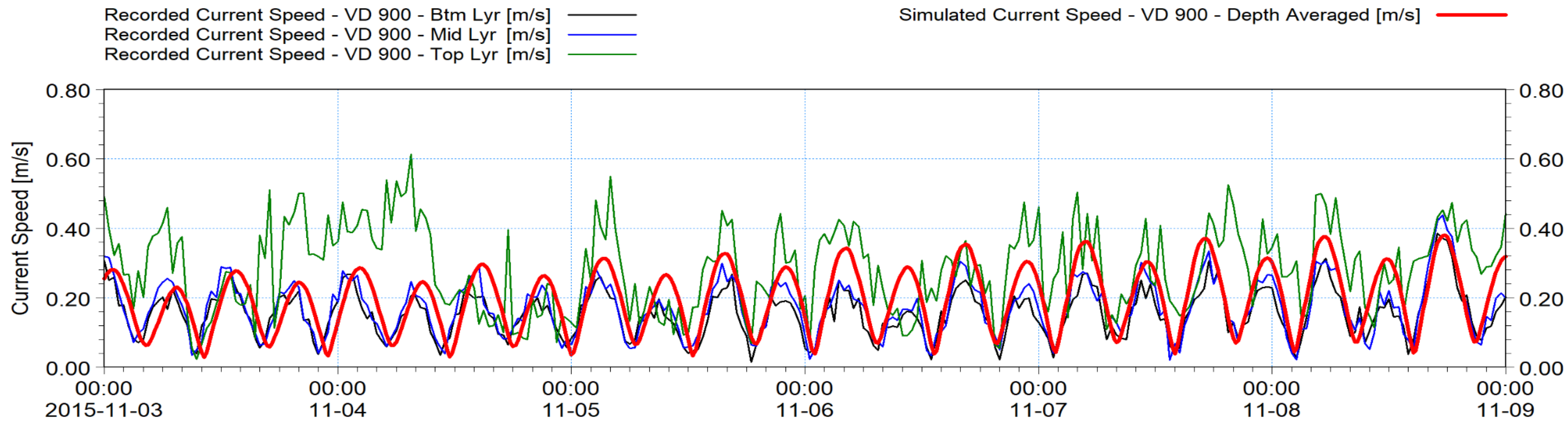


Figure 14: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Mid Bay D -Neap Tides



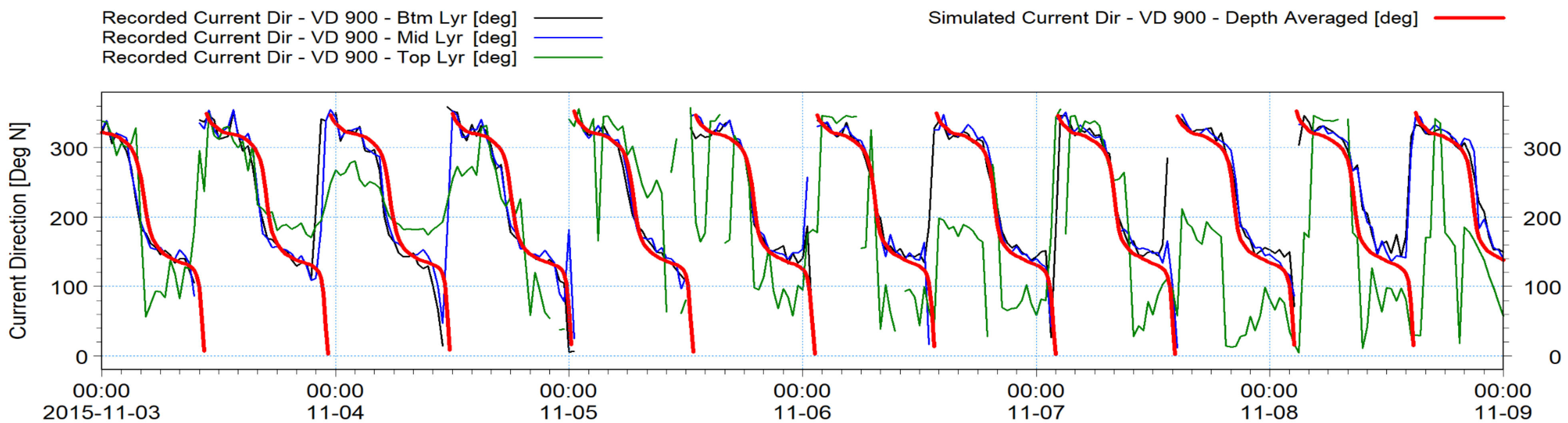


Figure 15: Comparison of recorded and simulated current speeds (upper) and directions (lower) at VD 900 -Neap Tides

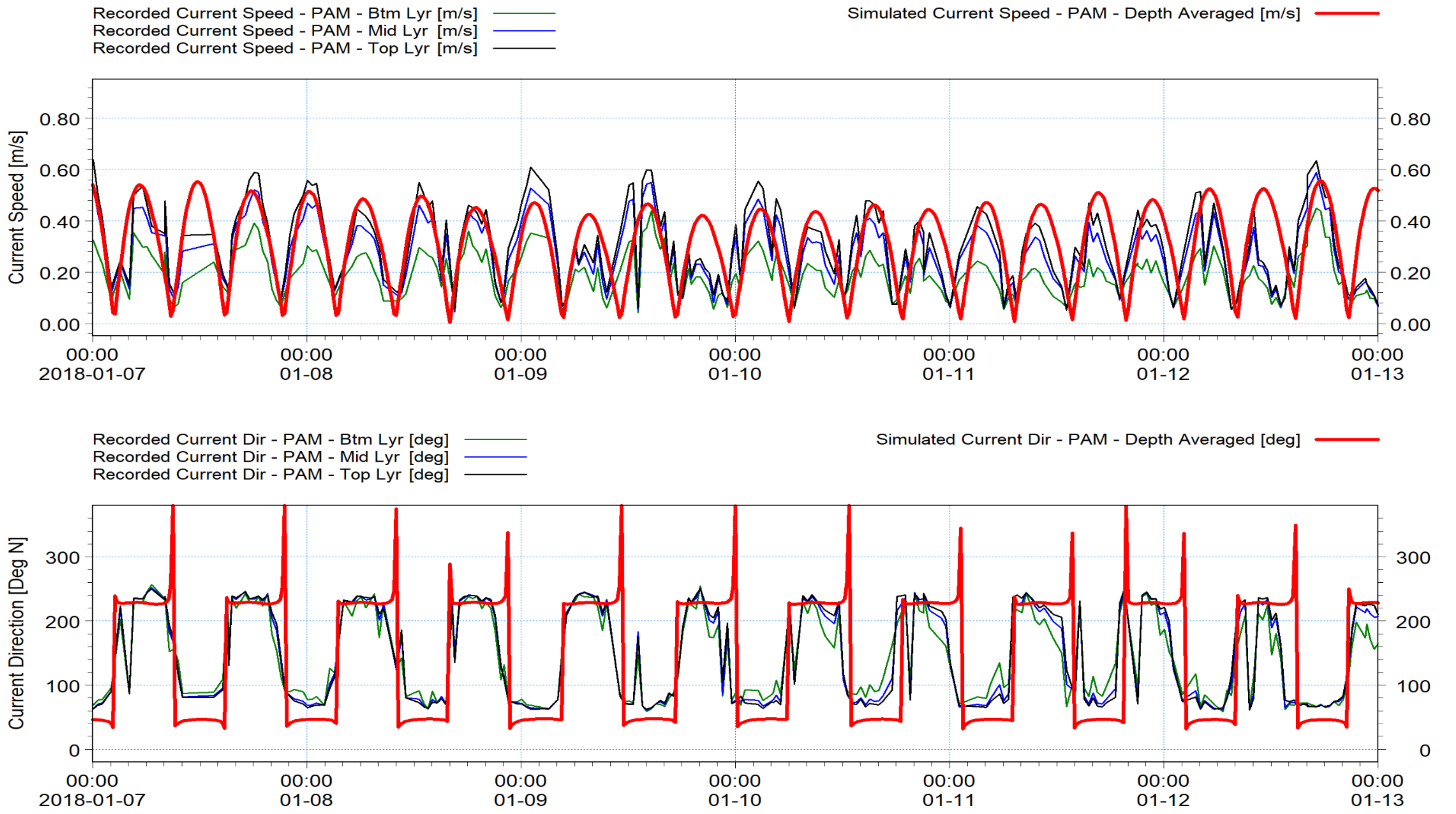


Figure 16: Comparison of recorded and simulated current speeds (upper) and directions (lower) at PAM Site -Neap Tides

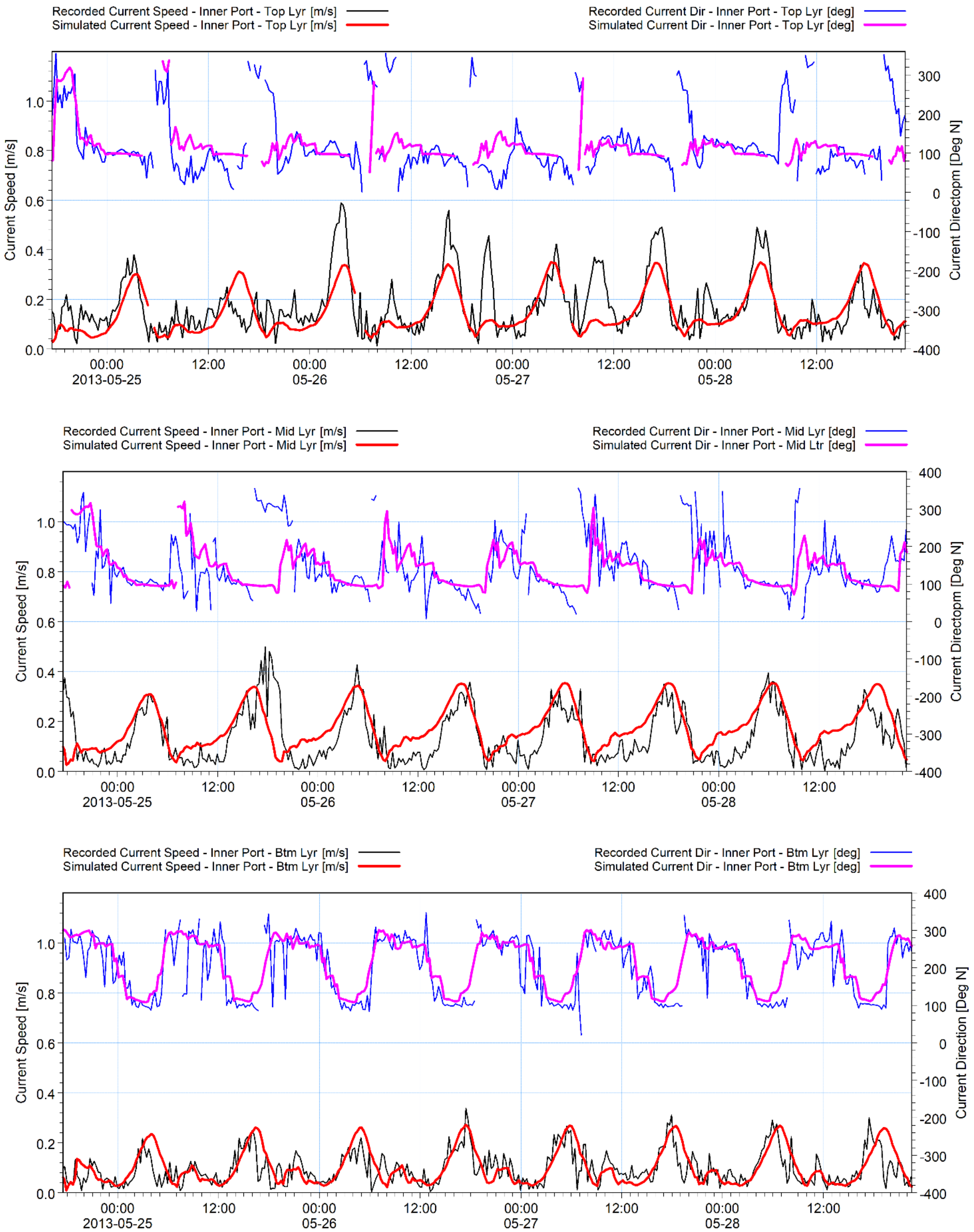


Figure 17: Comparison of recorded and simulated current speeds and directions throughout the top, middle and bottom layers of the water column at the Inner Port ADCP - Spring Tides

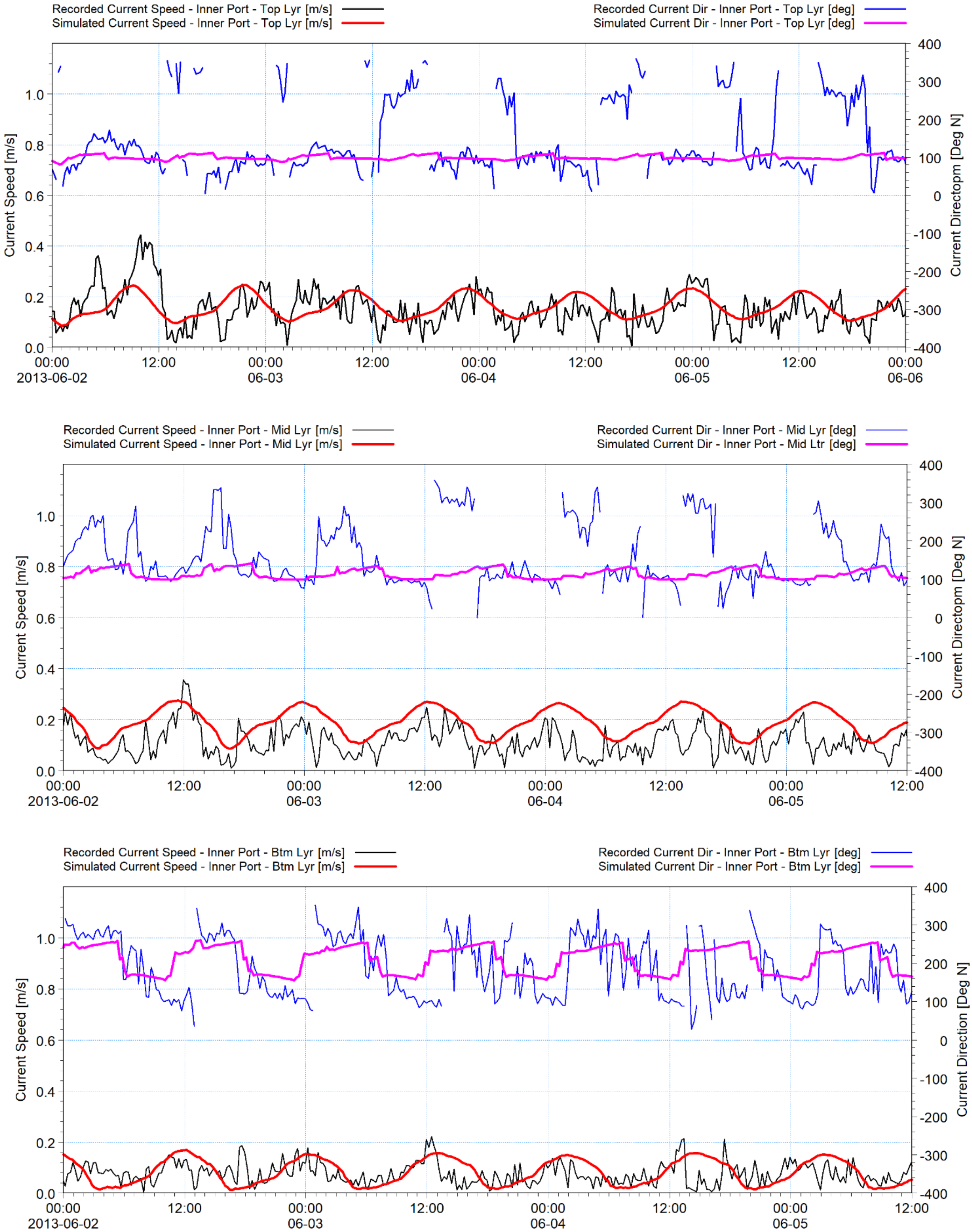


Figure 18: Comparison of recorded and simulated current speeds and directions throughout the top, middle and bottom layers of the water column at the Inner Port ADCP - Neap Tides

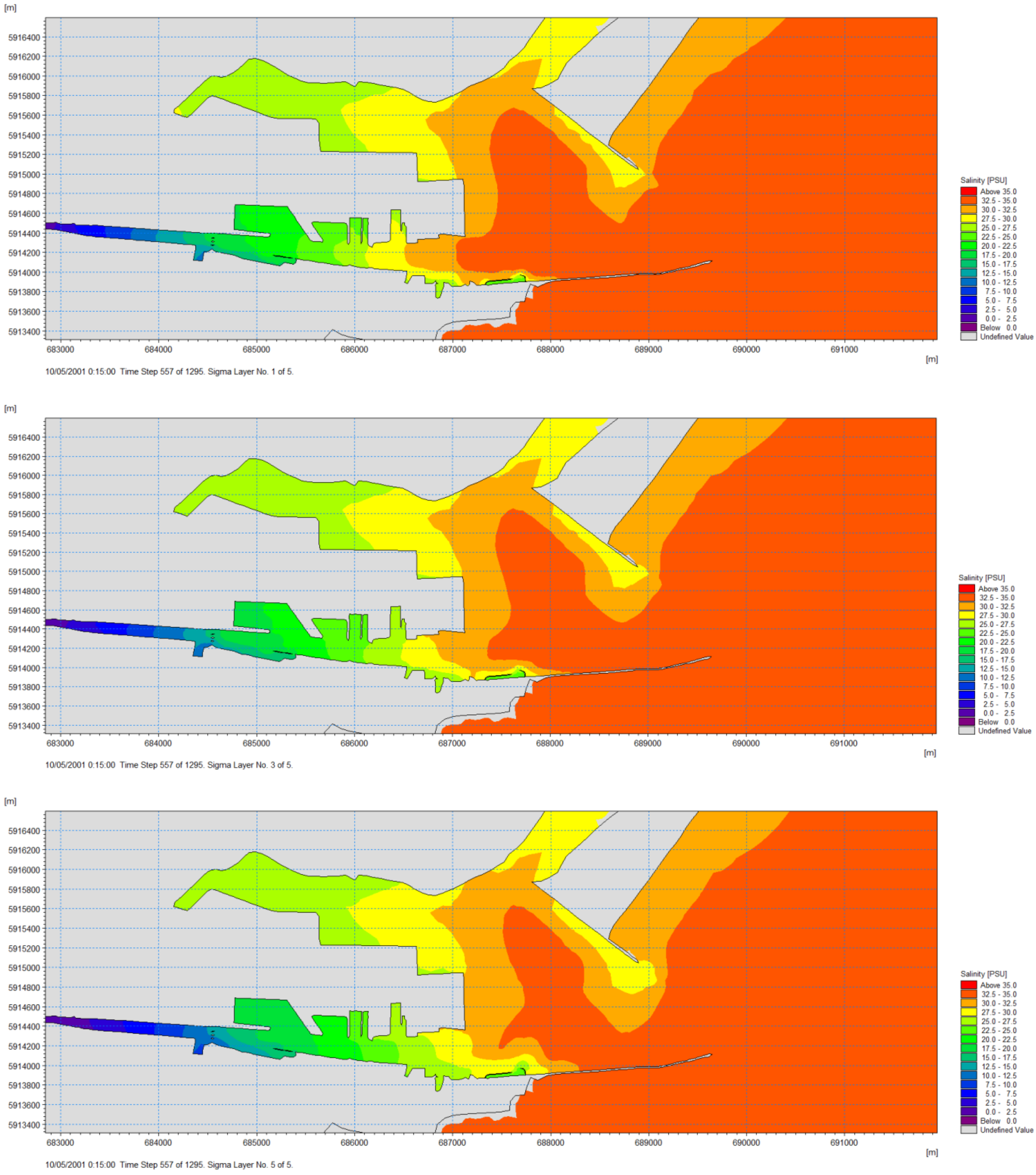


Figure 19: Salinity of the bottom, middle and surface layers respectively during a typical high spring tide

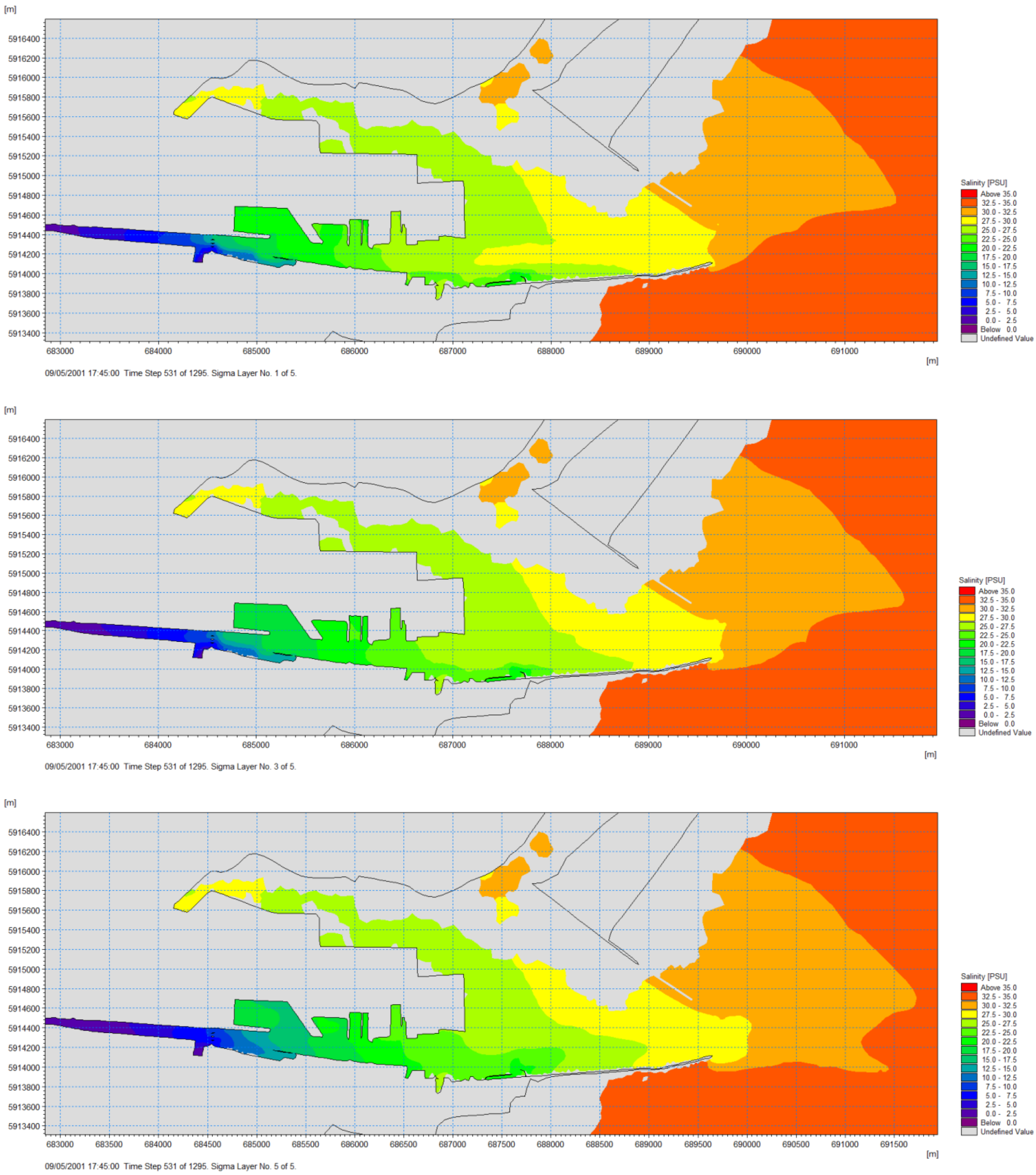


Figure 20: Salinity of the bottom, middle and surface layers respectively during a typical low spring tide

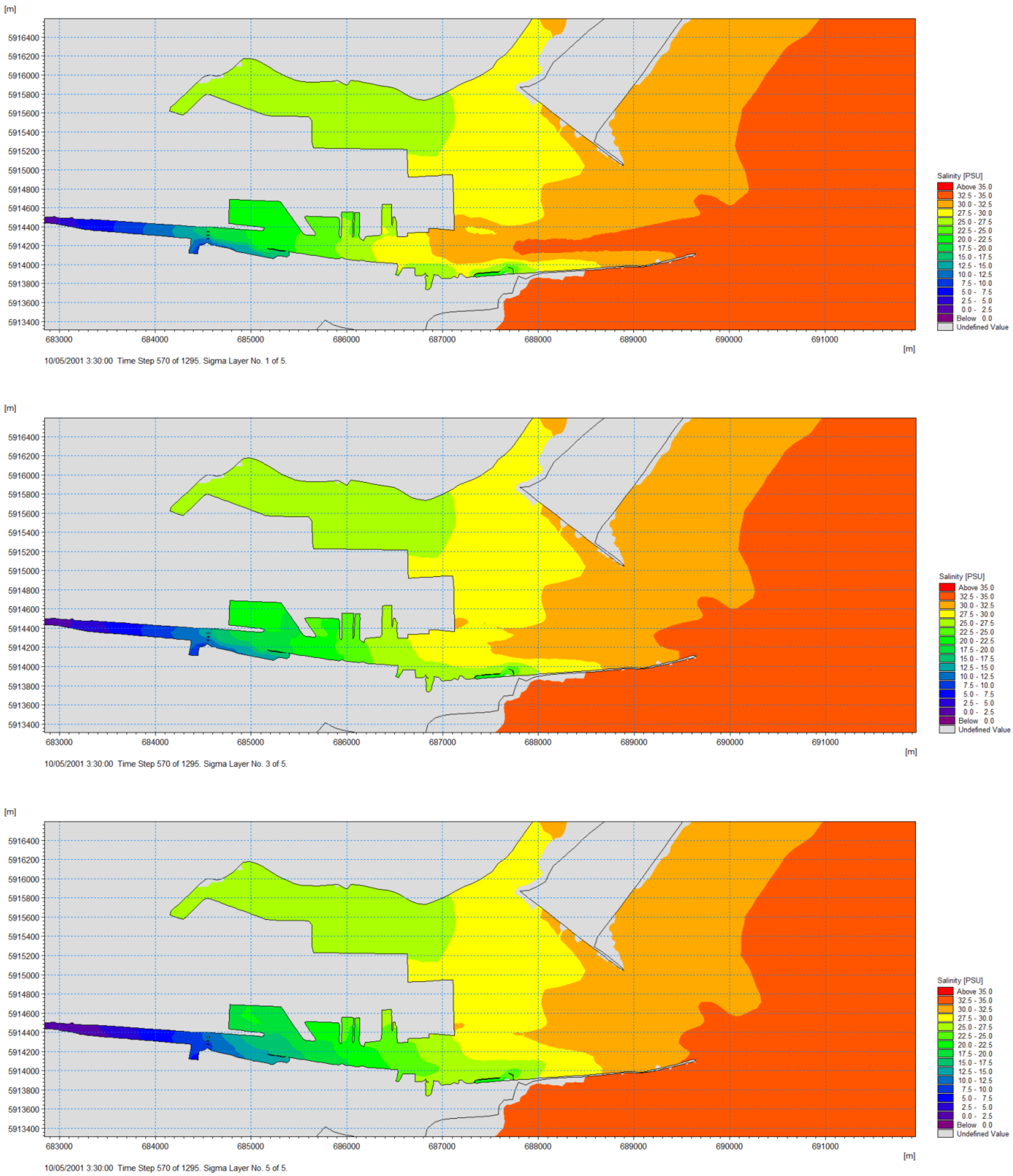


Figure 21: Salinity of the bottom, middle and surface layers respectively during a typical mid-ebb spring tide

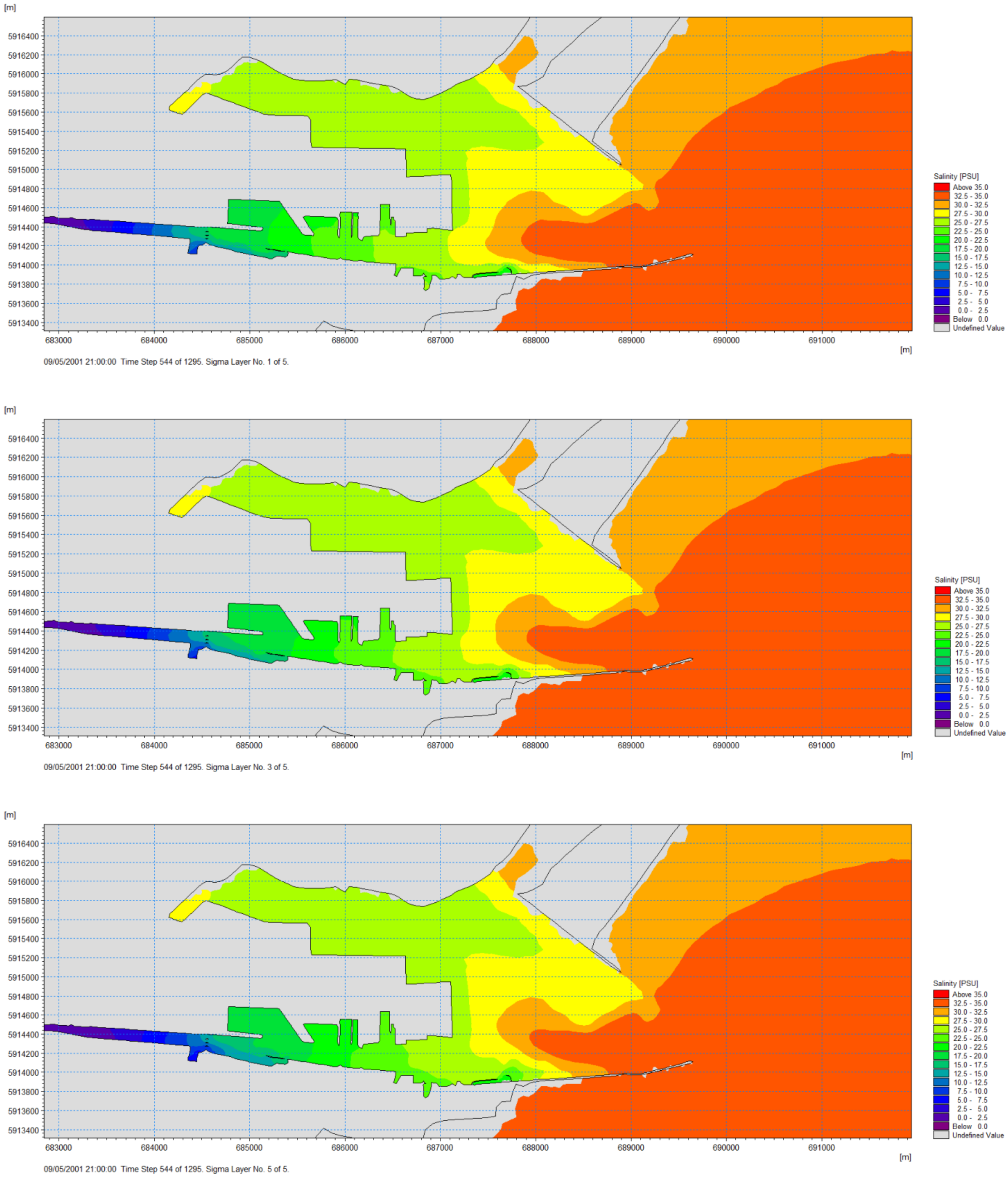


Figure 22: Salinity of the bottom, middle and surface layers respectively during a typical mid-flood spring tide