

**Columbia River Project Water Use Plan**

**Columbia White Sturgeon Management Plan**

**Mid Columbia River White Sturgeon Spawning Habitat  
Assessment and  
Mid Columbia River Effects of Flow Changes on Incubation  
and Early Rearing Sturgeon**

**Implementation Years 1-4**

**Reference: CLBMON-20 and CLBMON-54 Appendices**

*Effects of Flow Changes on White Sturgeon Spawning, Incubation, and  
Early Rearing Habitats in the Middle Columbia River*

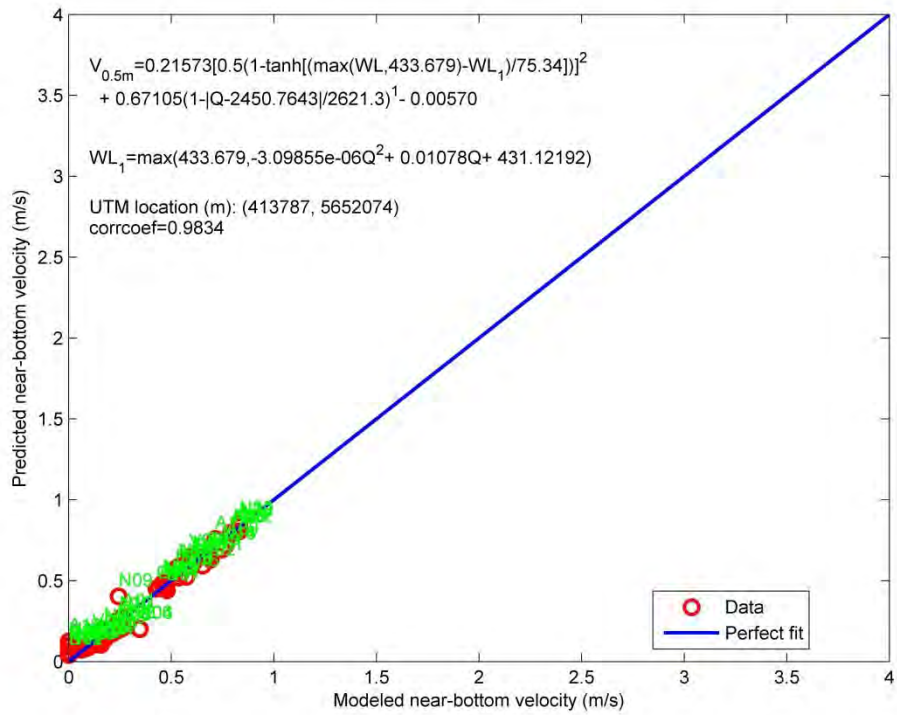
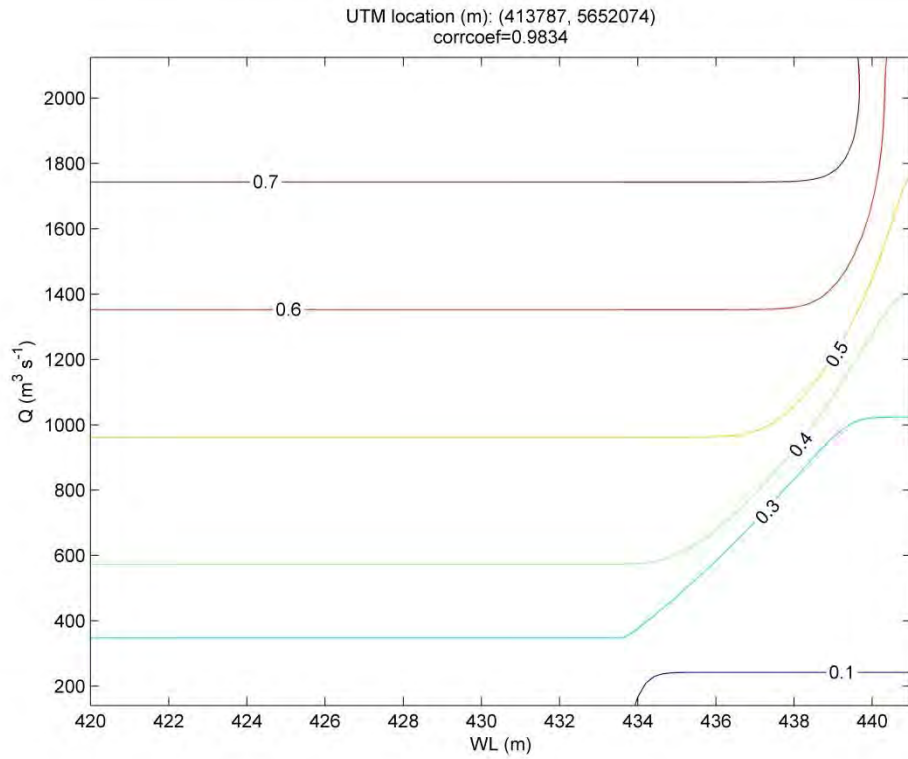
**Study Period: June 2010 to August 2014**

**Golder Associates  
ASL Environmental Sciences**

**September 12, 2014**

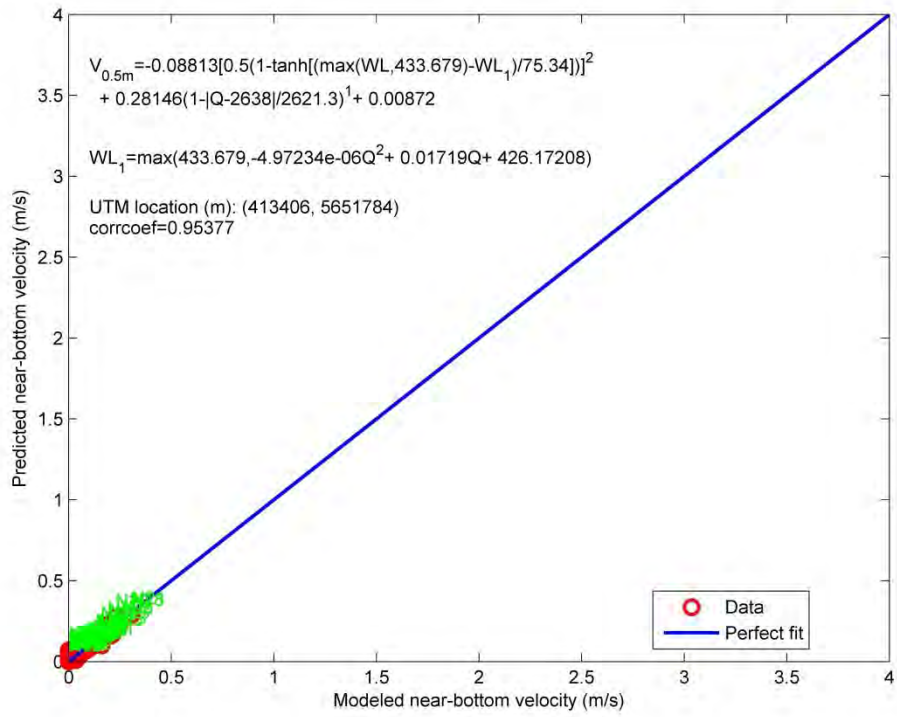
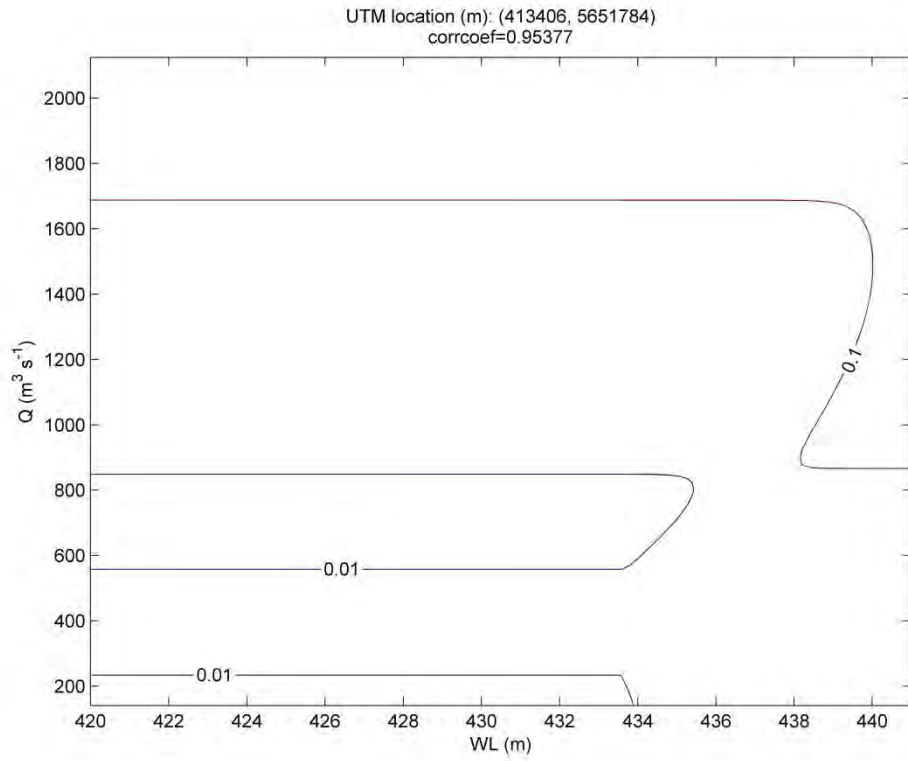
**Appendix A: Empirical function analysis at the 34 selected egg mat sites.**

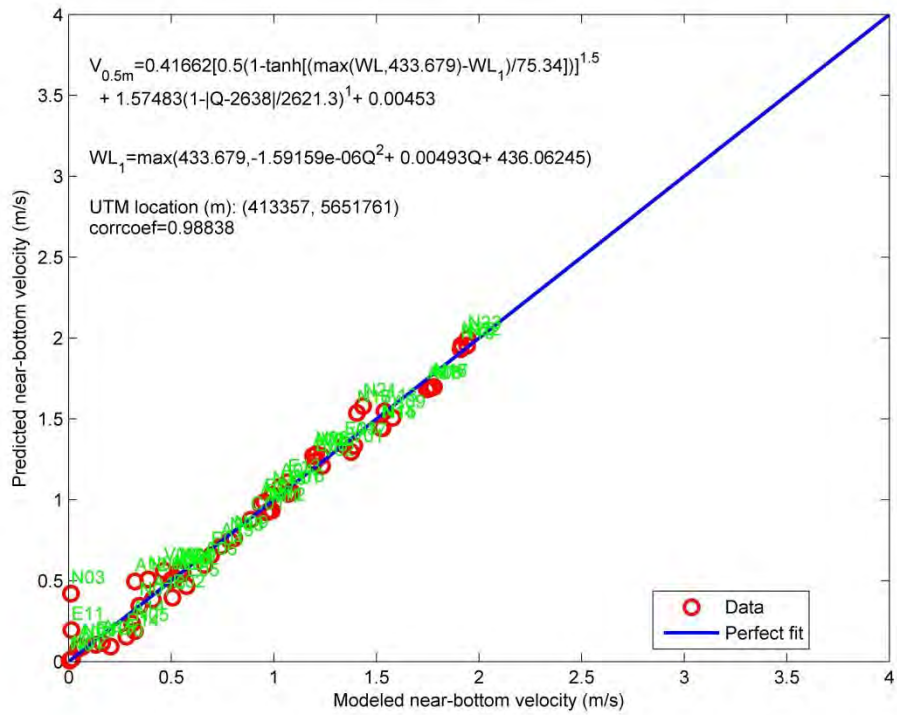
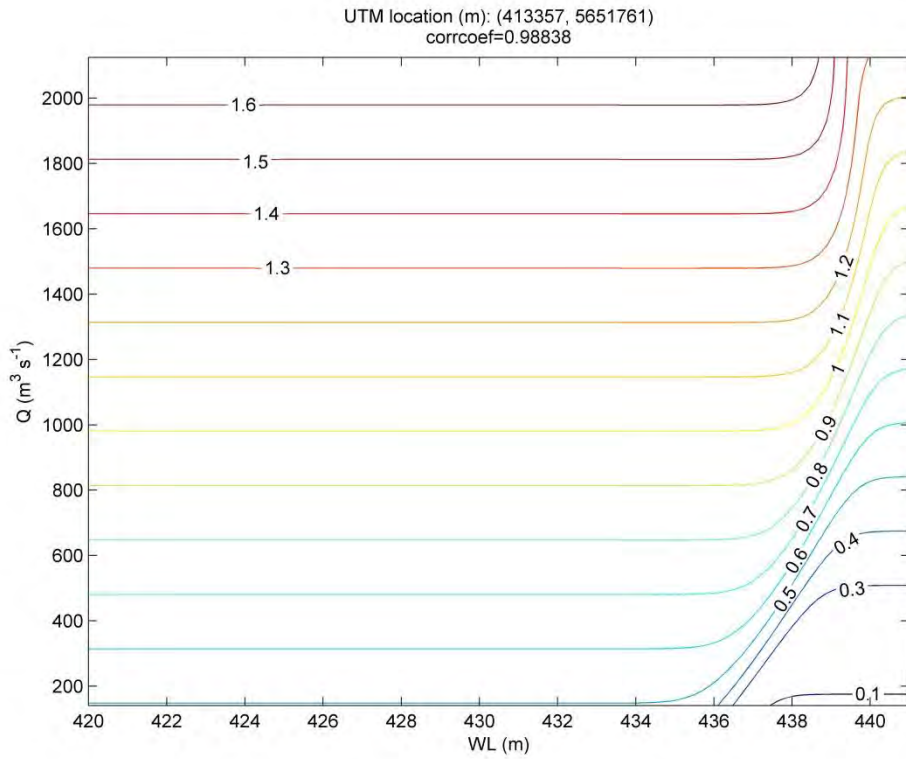
Site 1

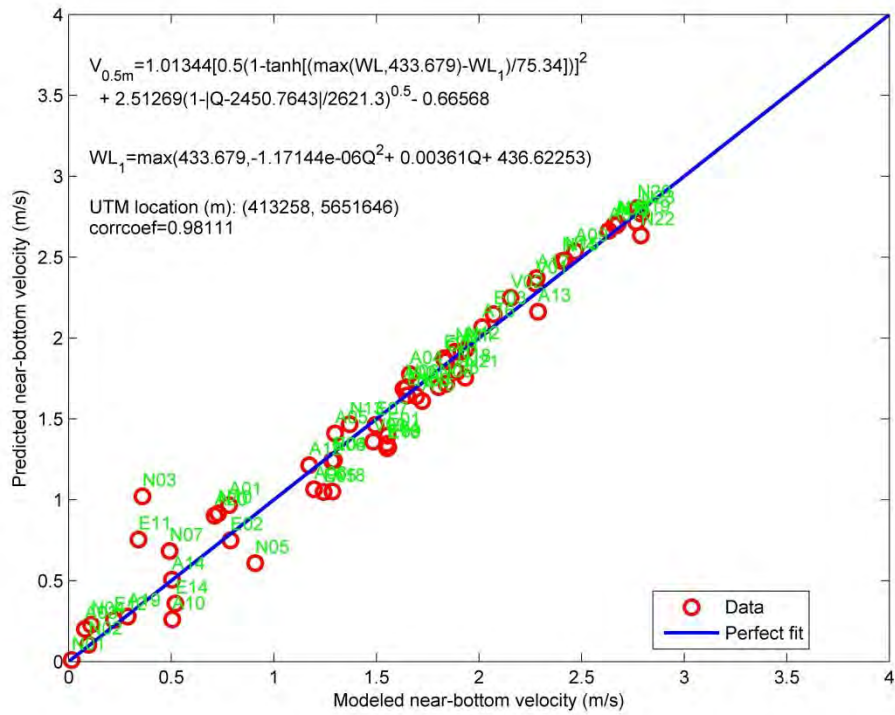
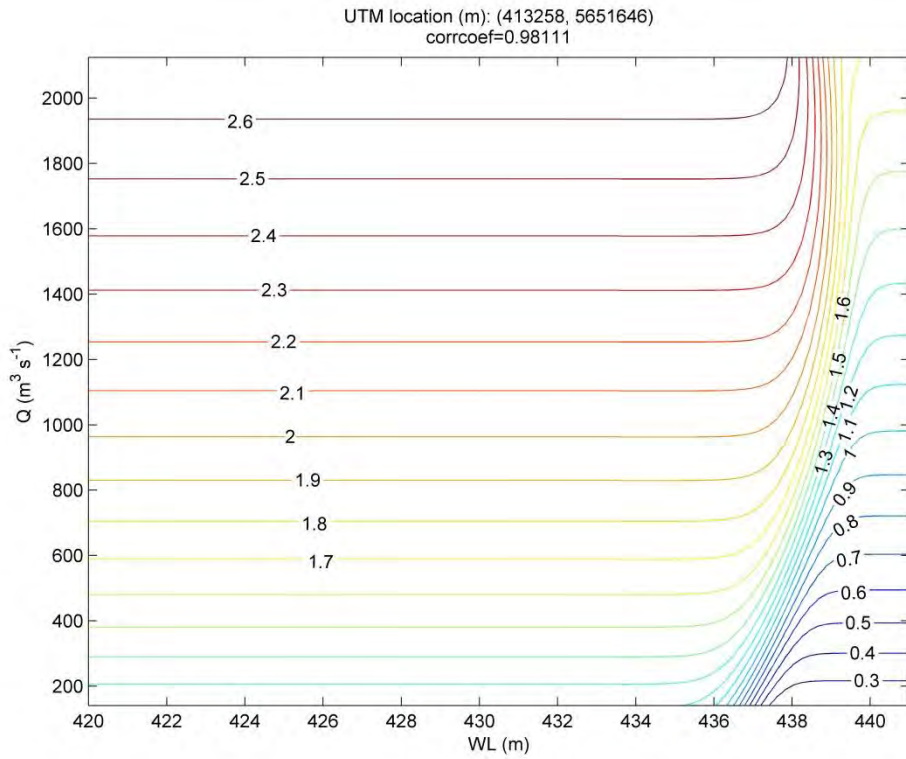


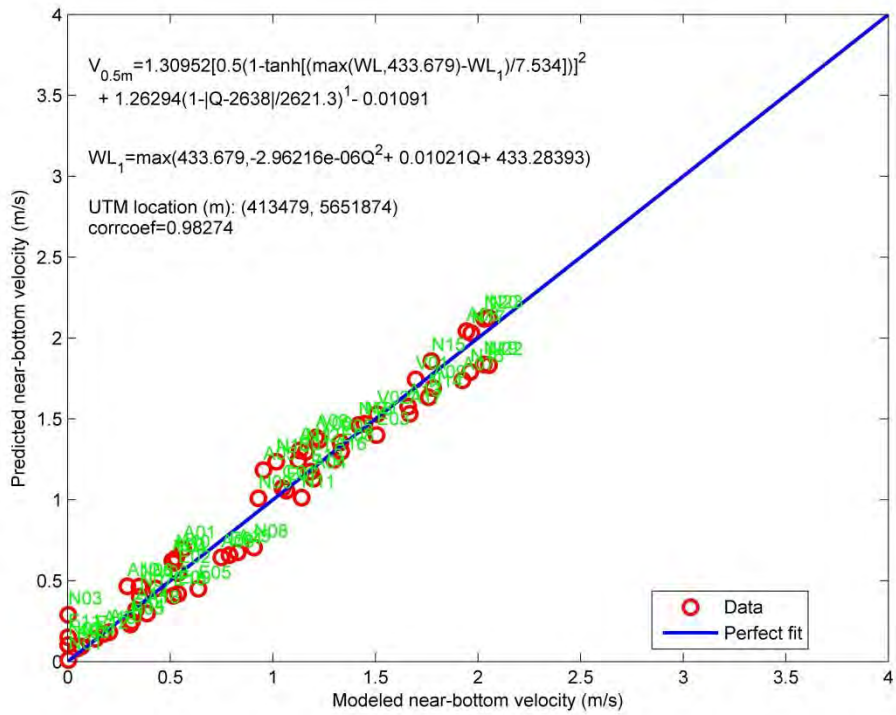
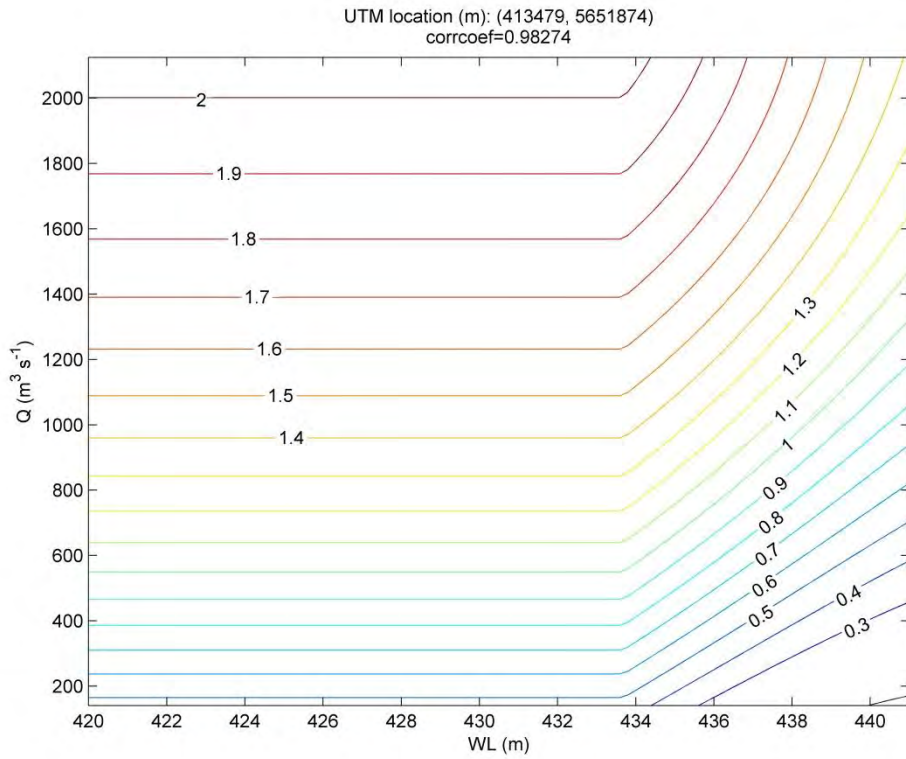
Site 2 (Dry)

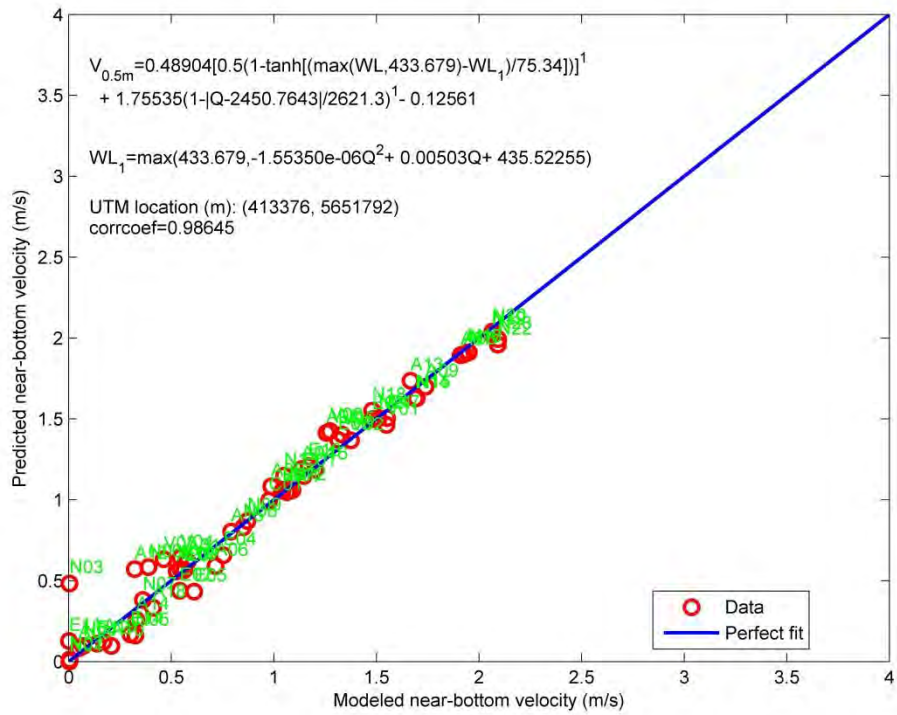
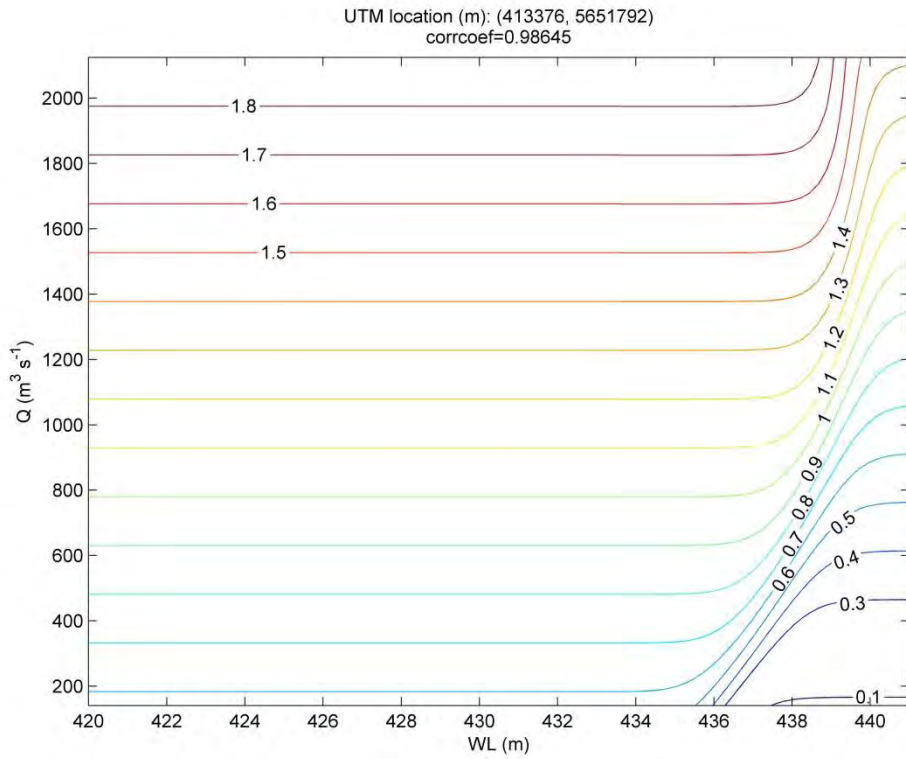


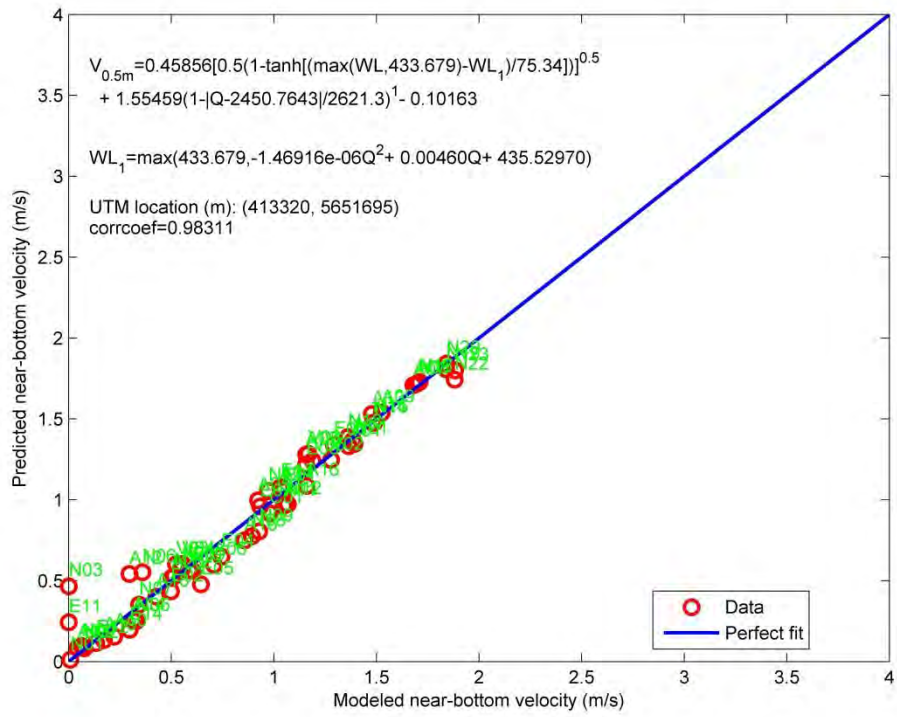
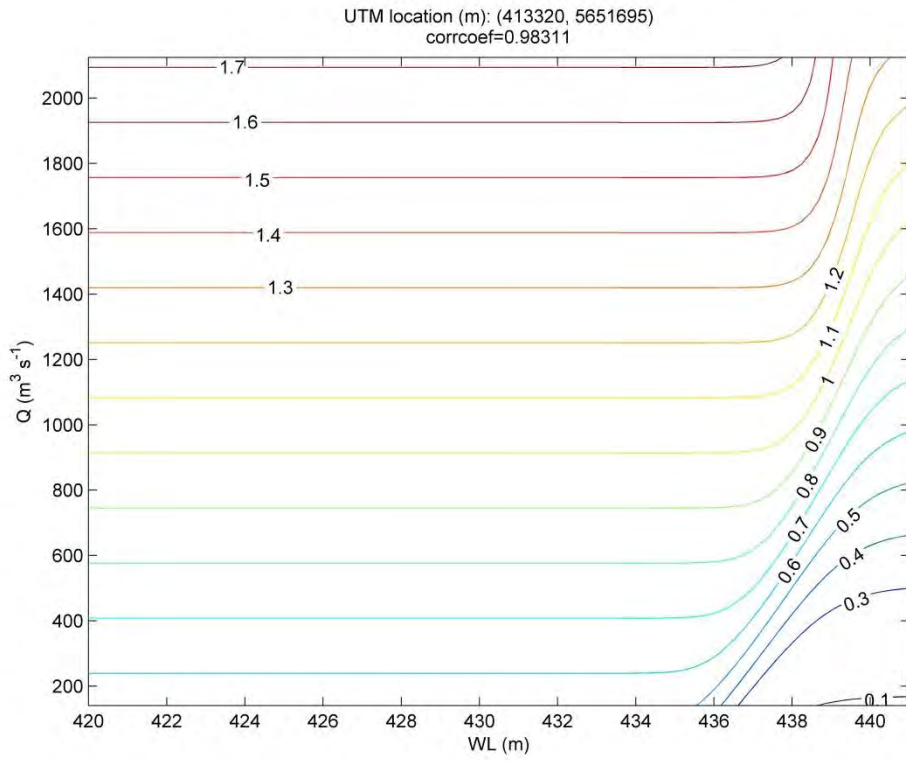




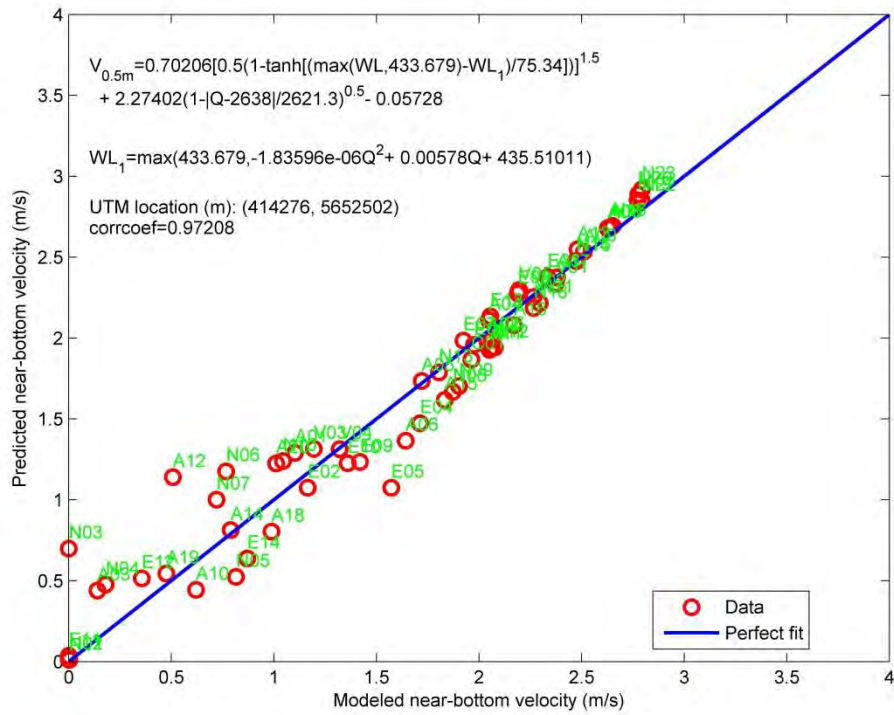
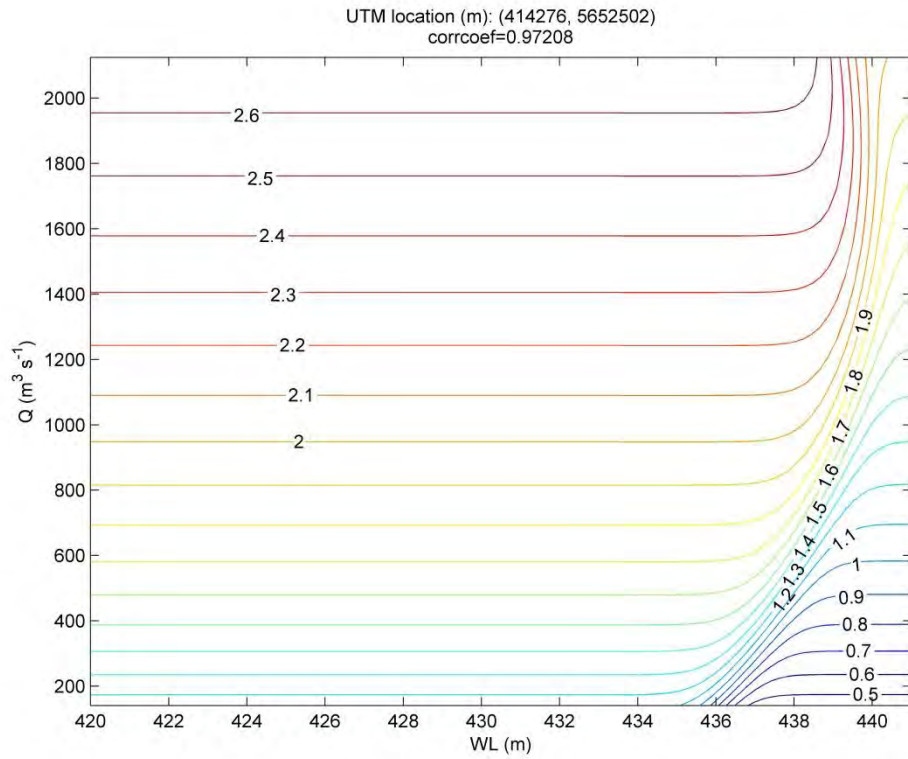


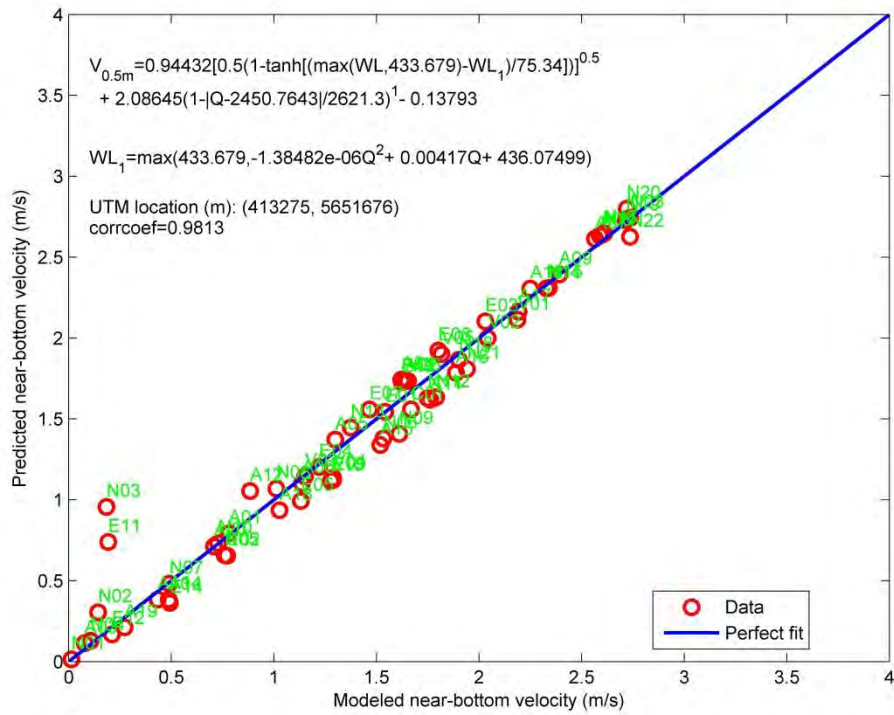
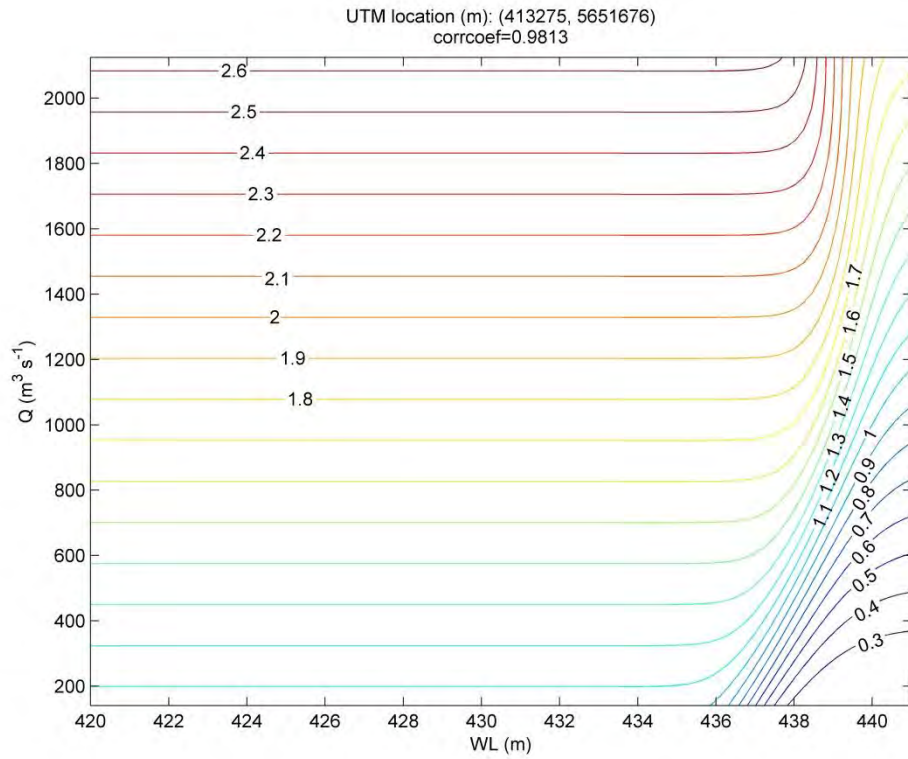




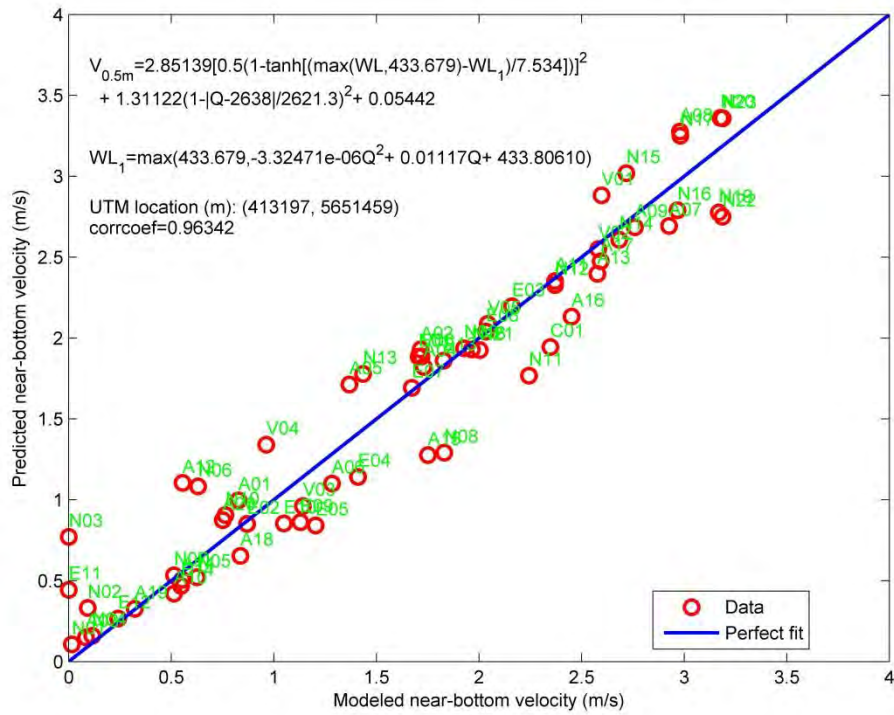
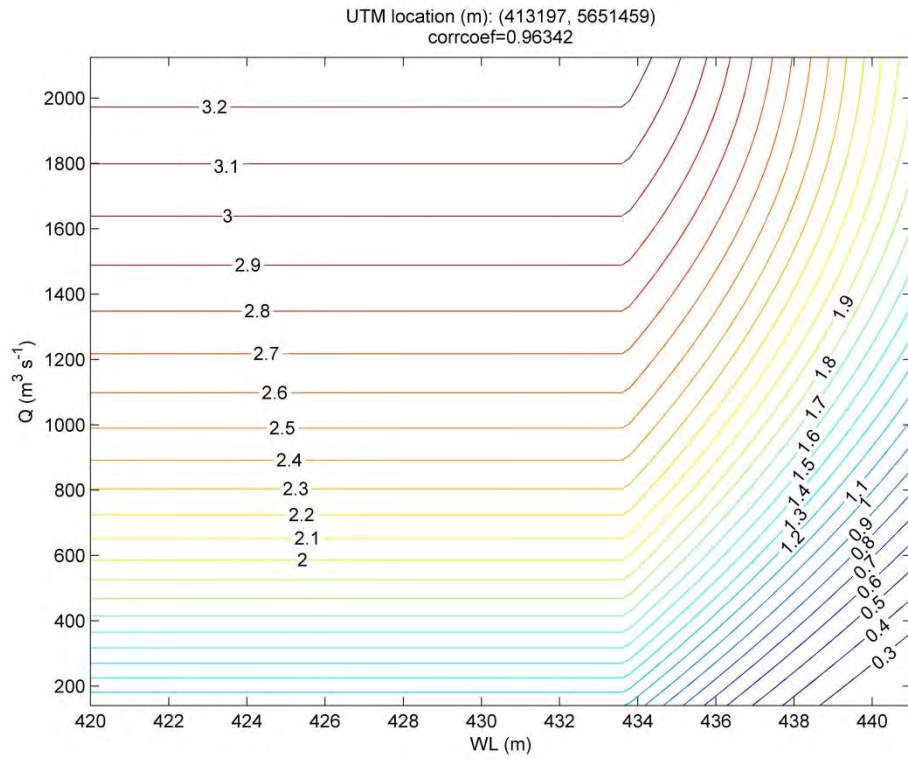


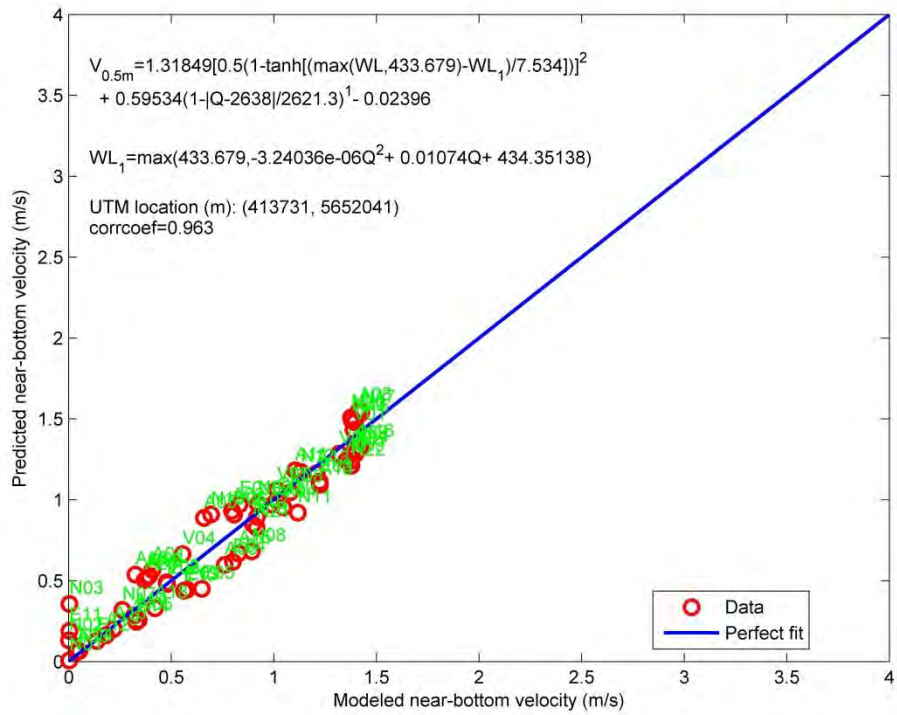
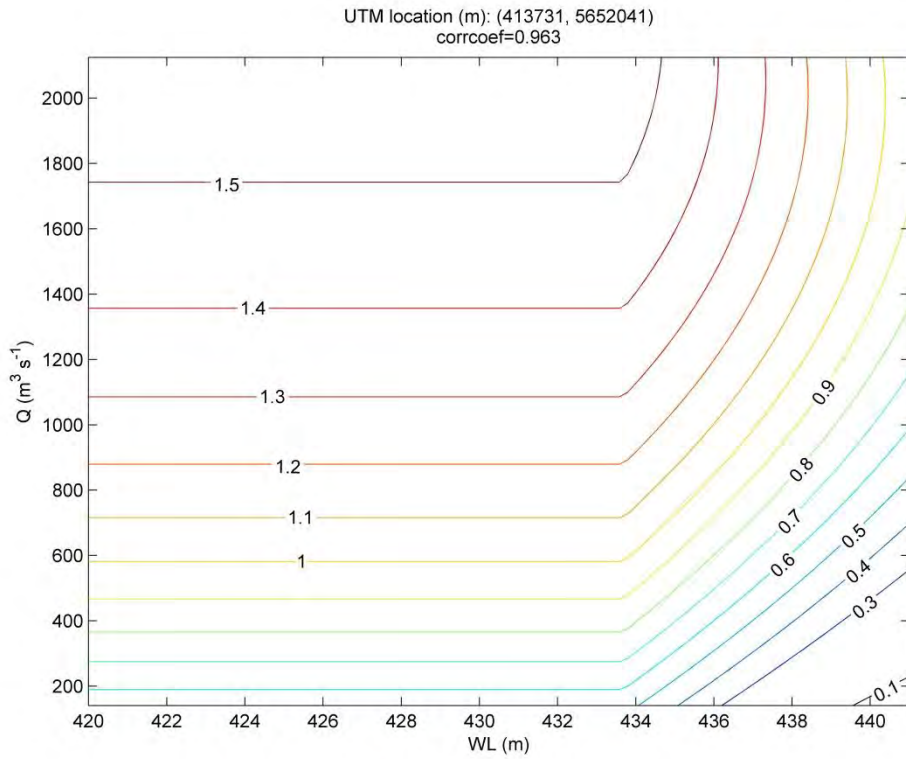


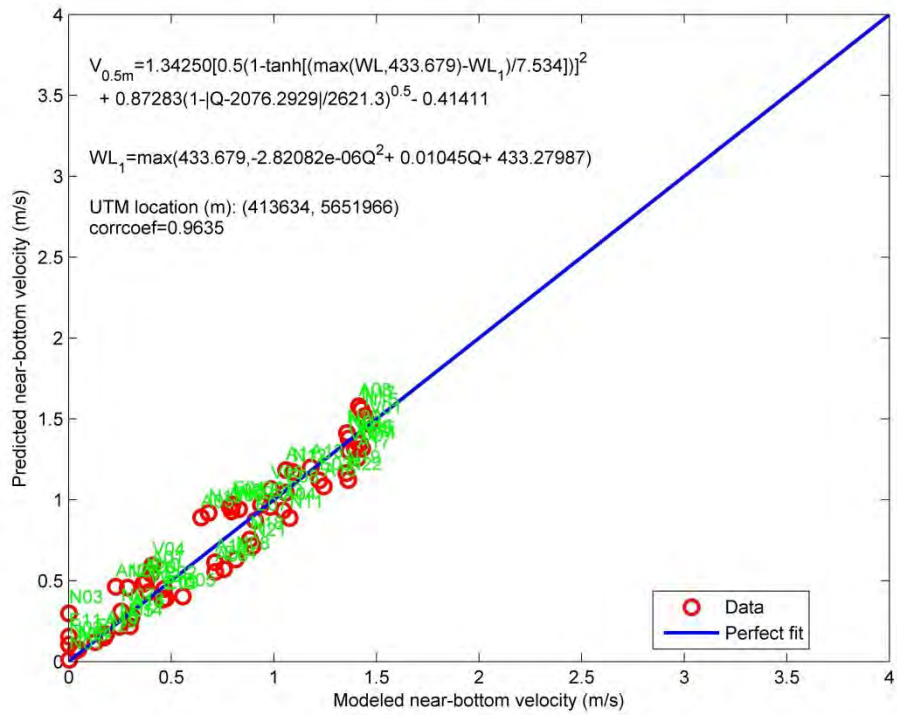
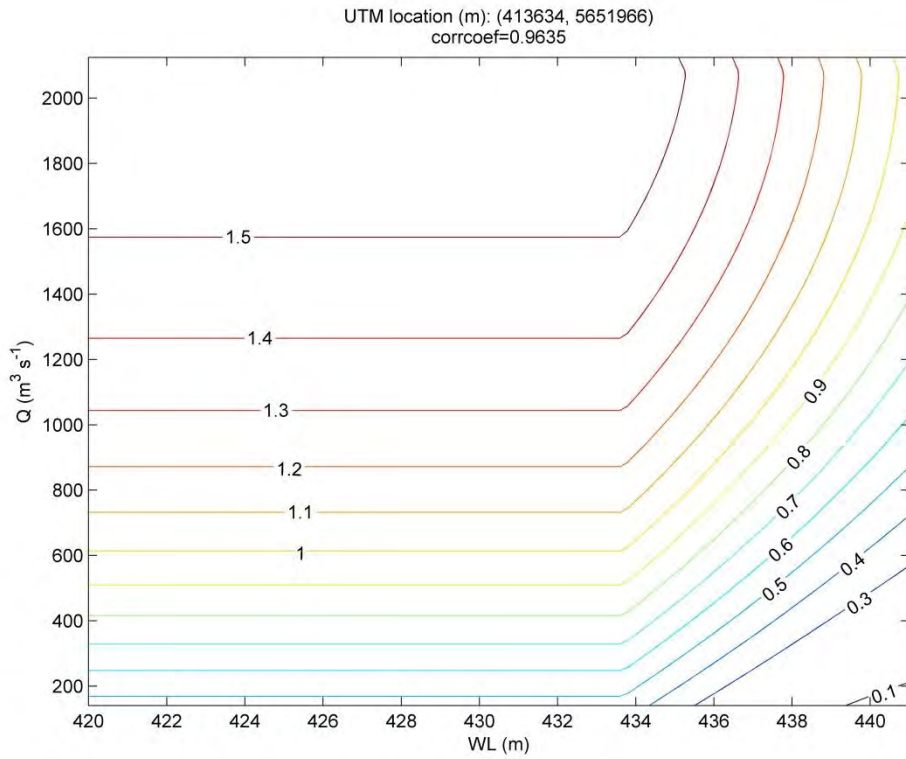


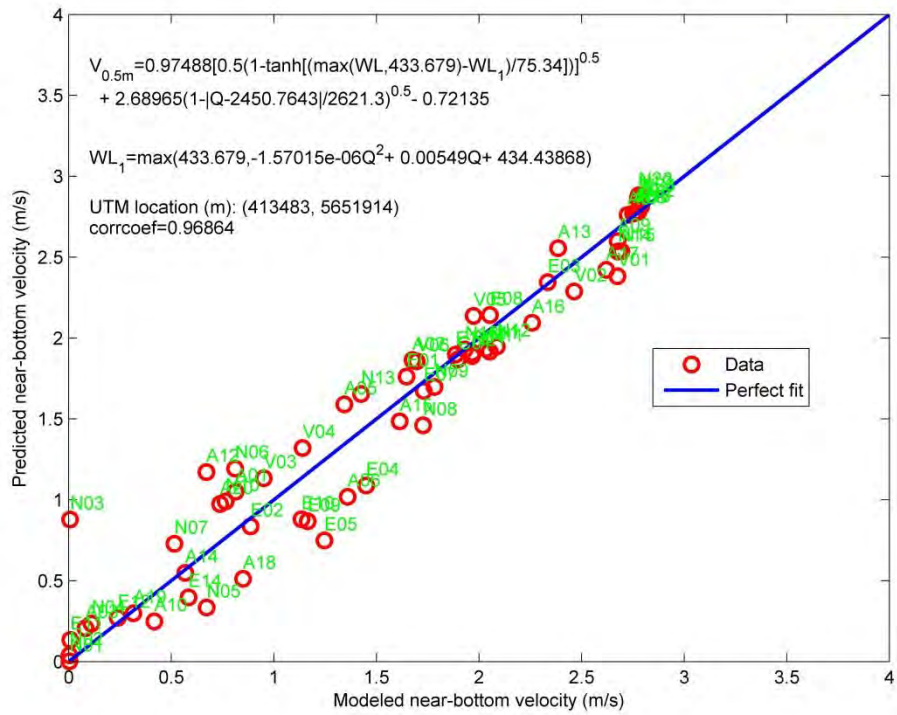
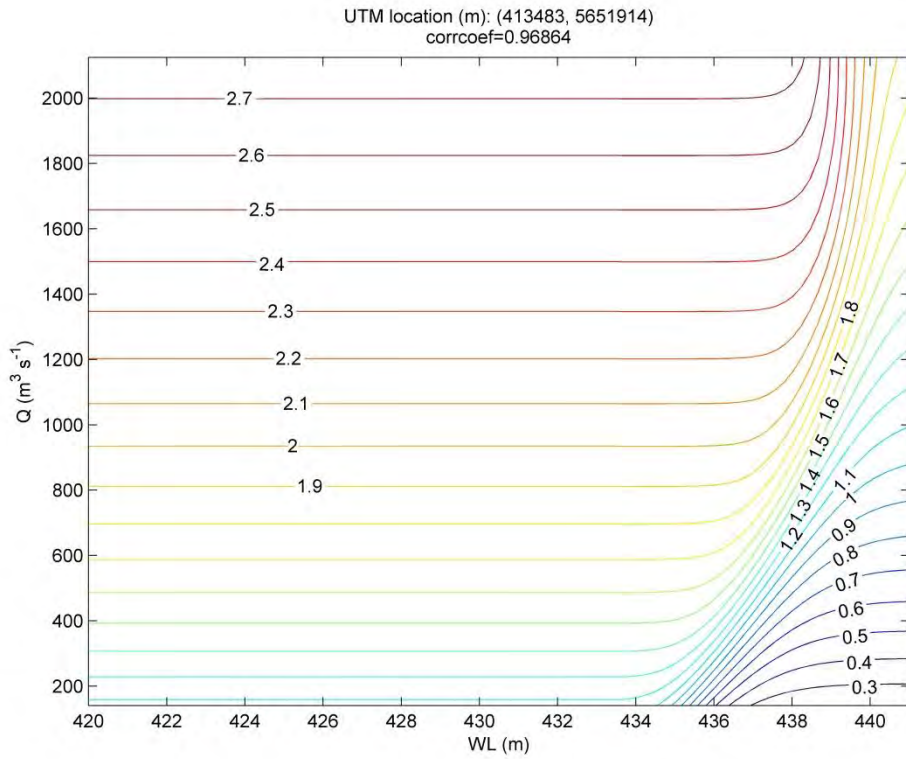


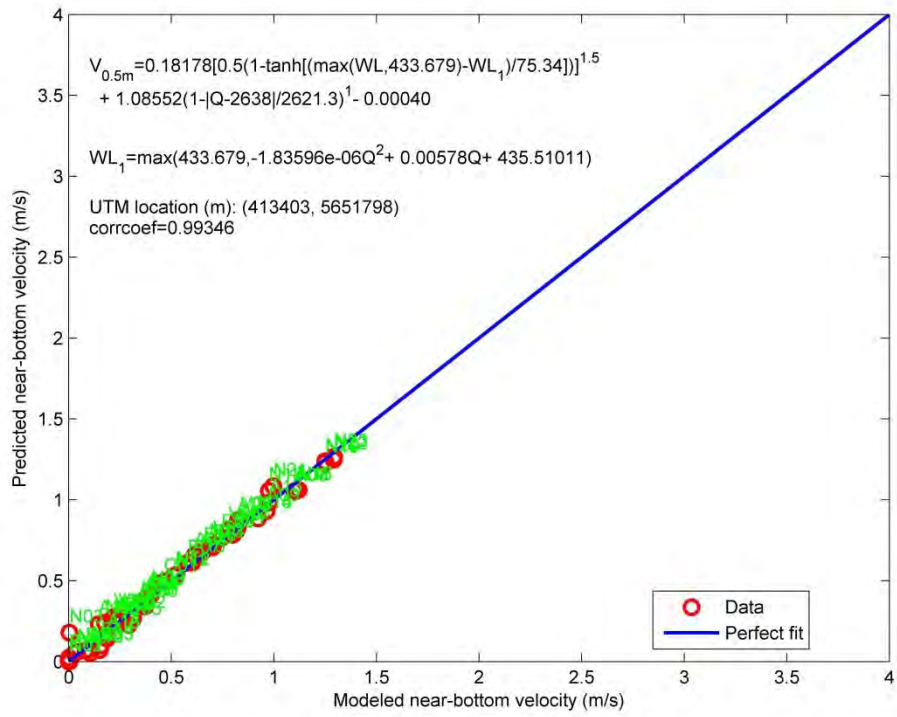
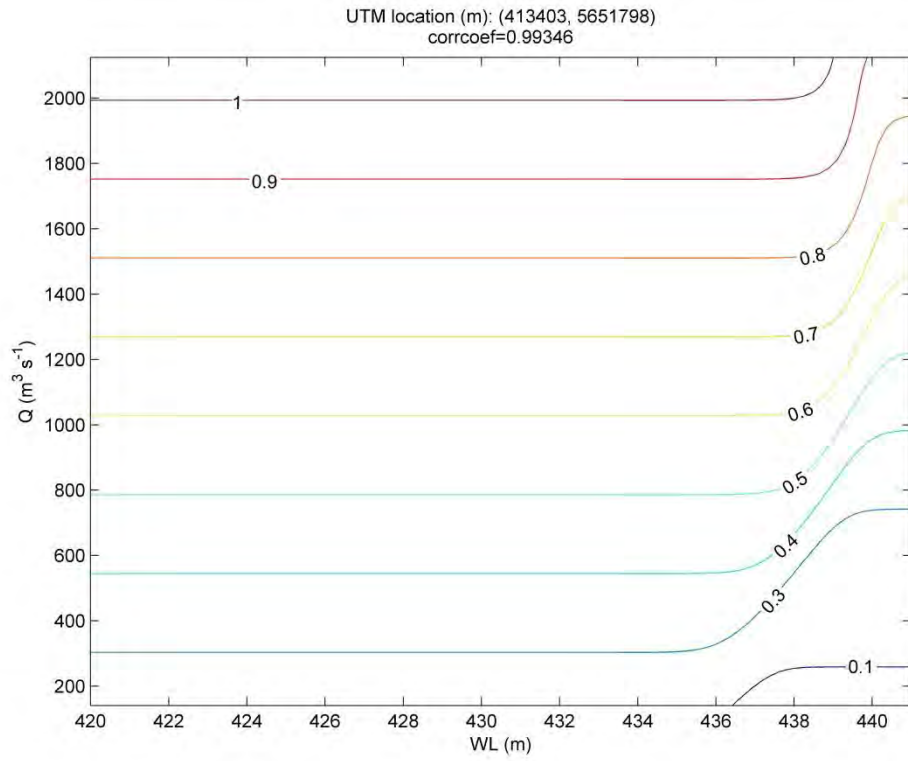




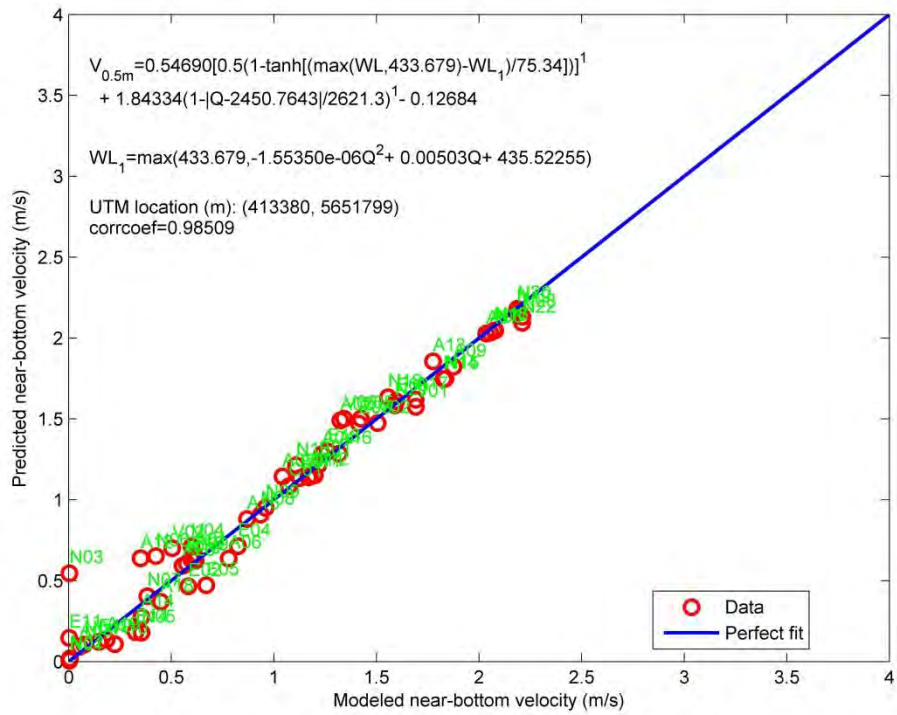
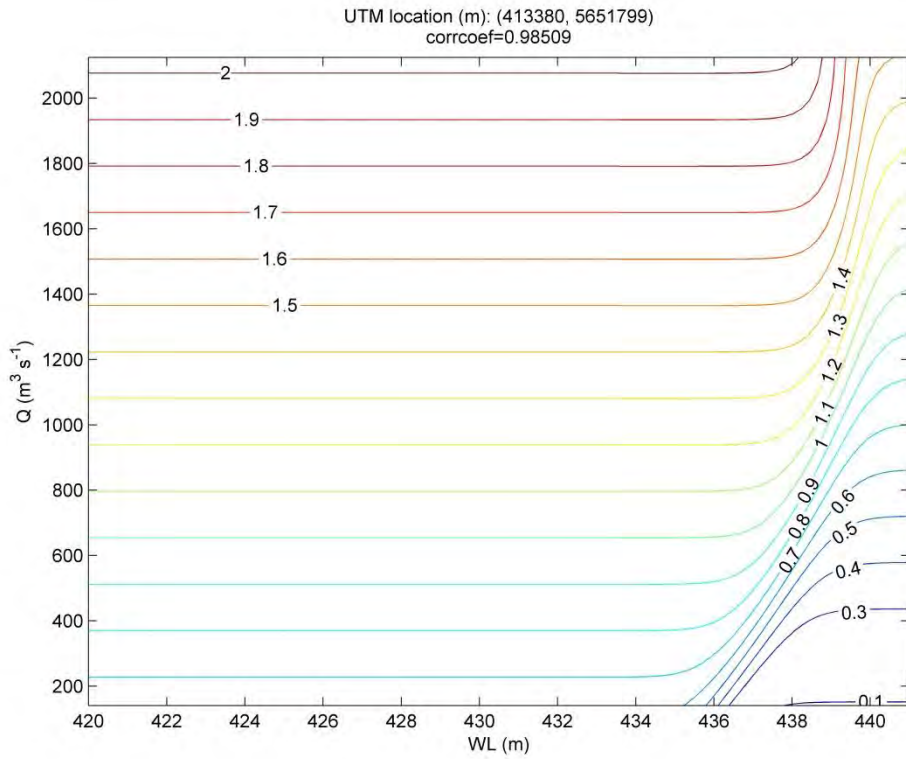


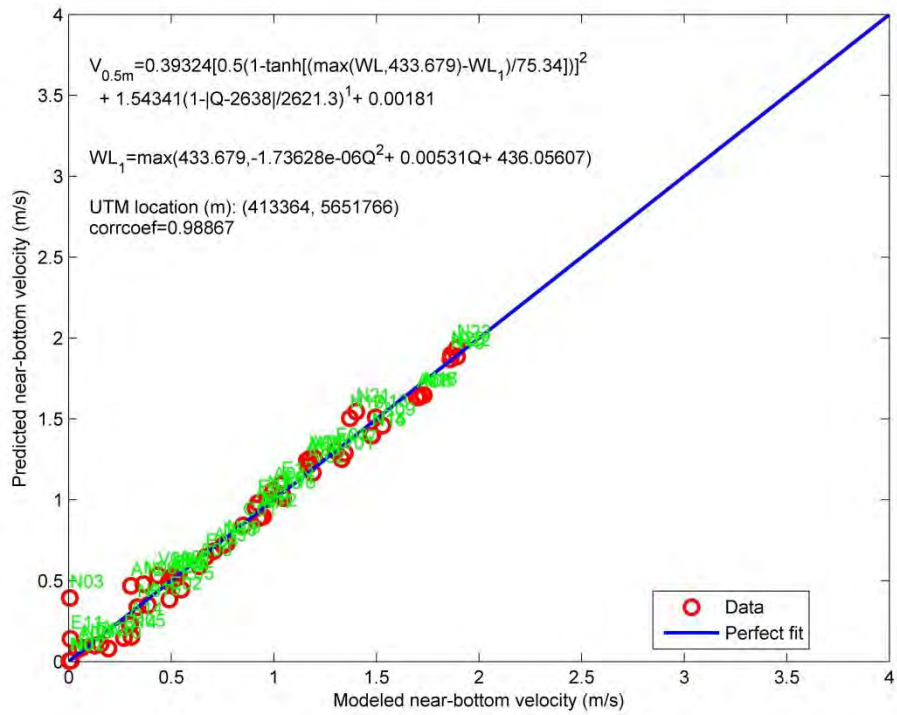
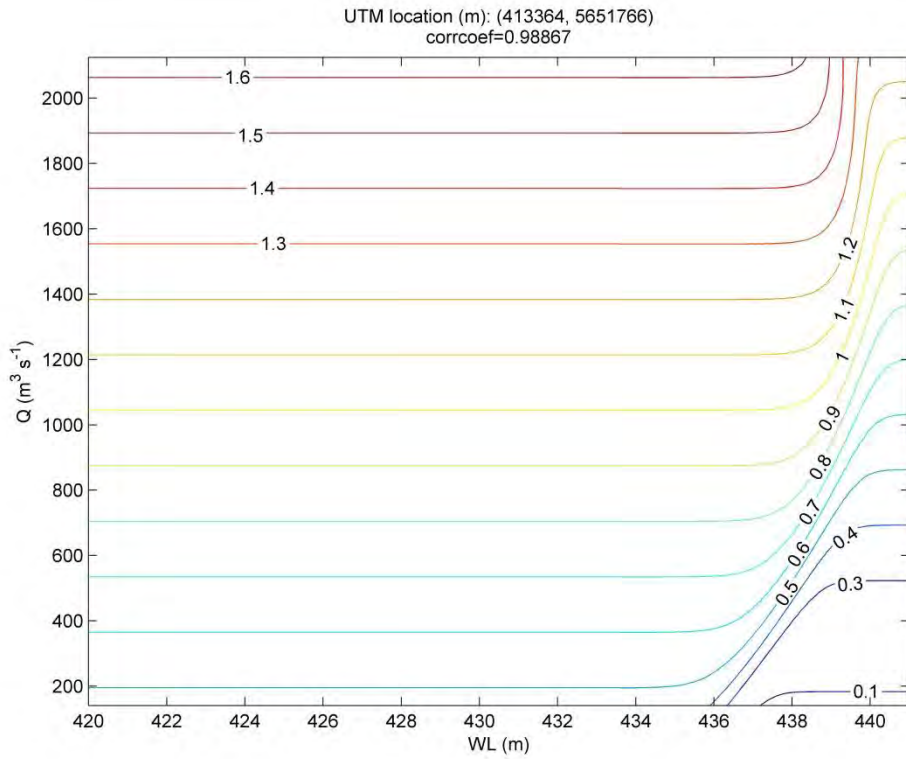






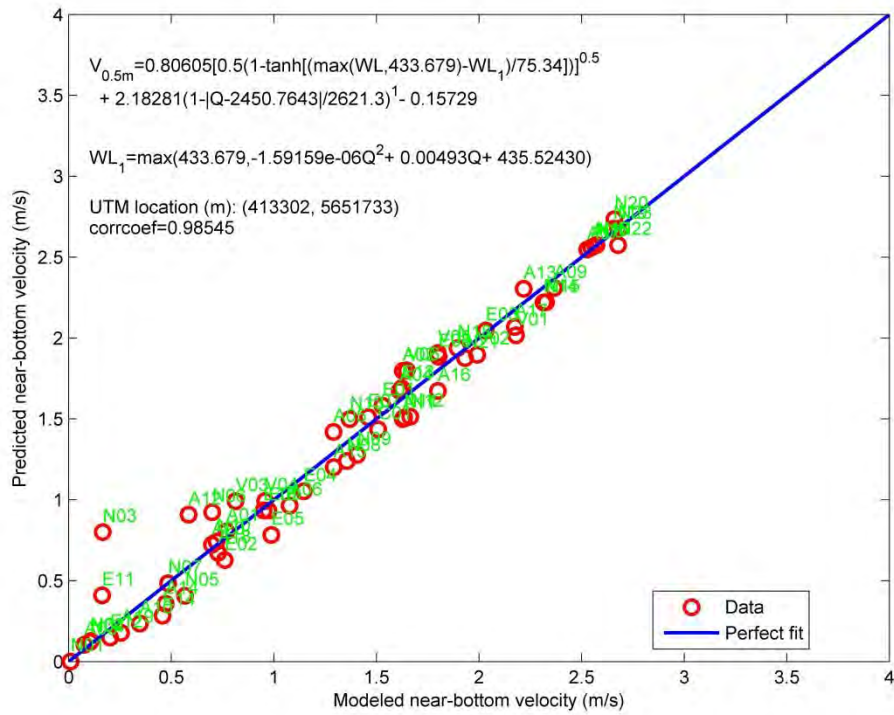
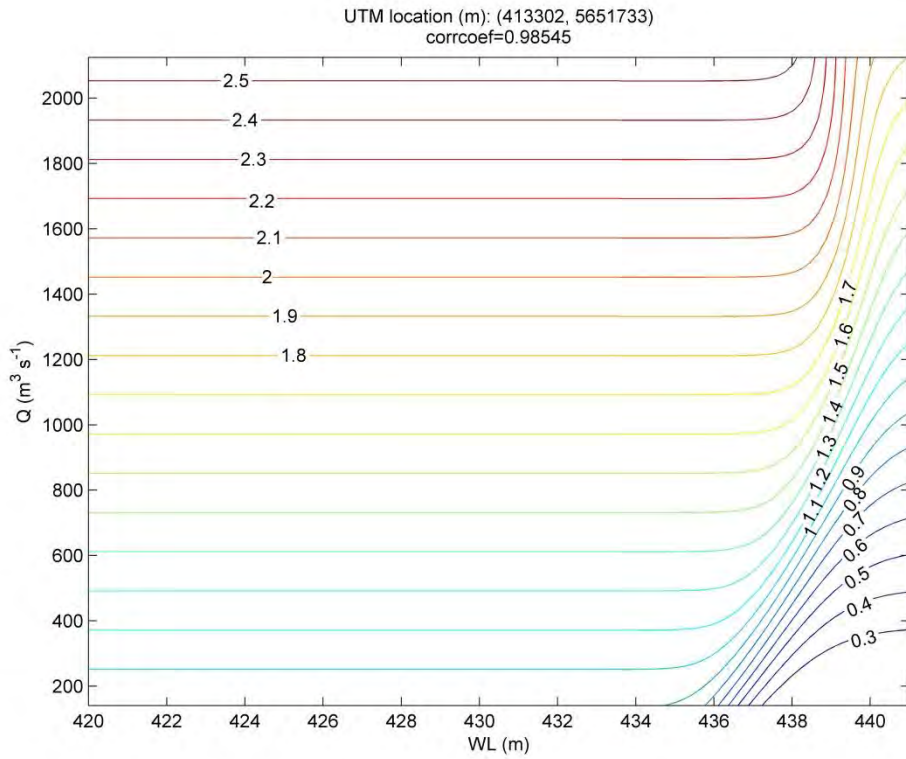


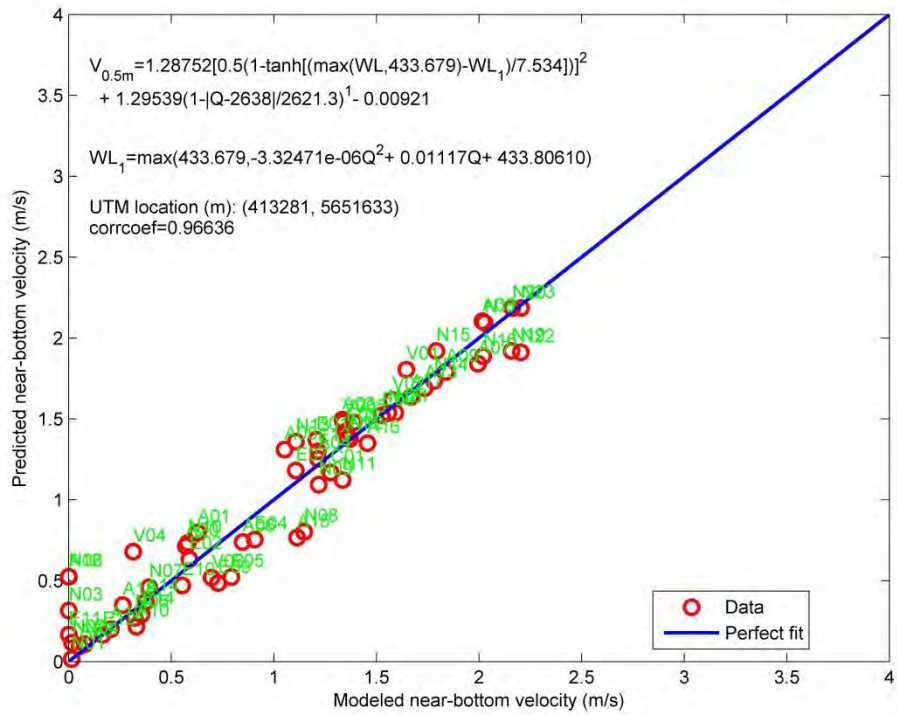
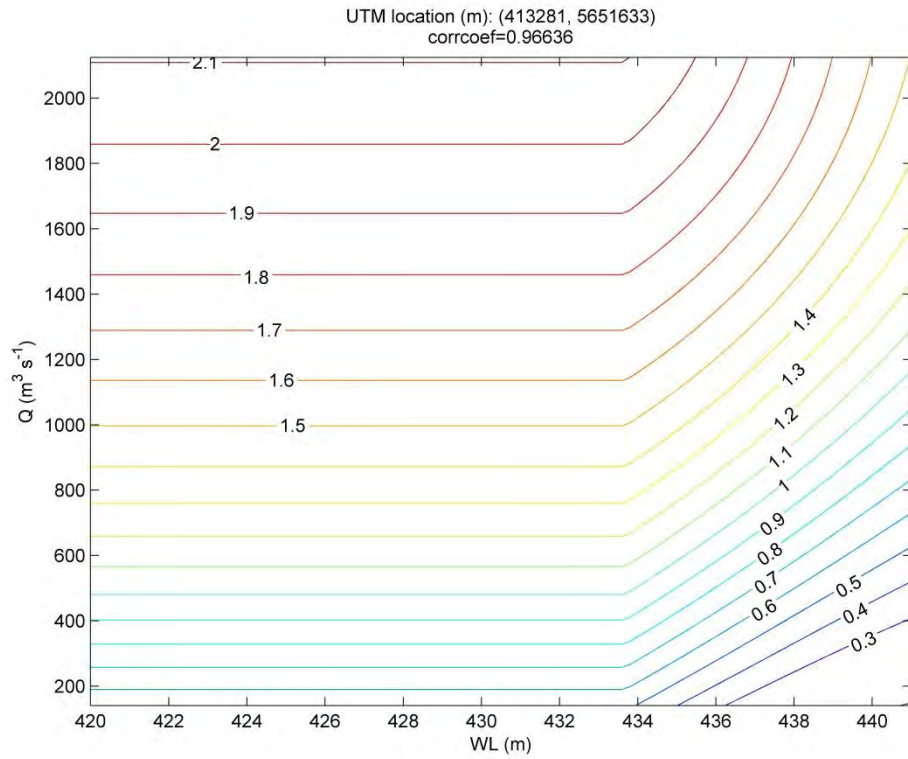


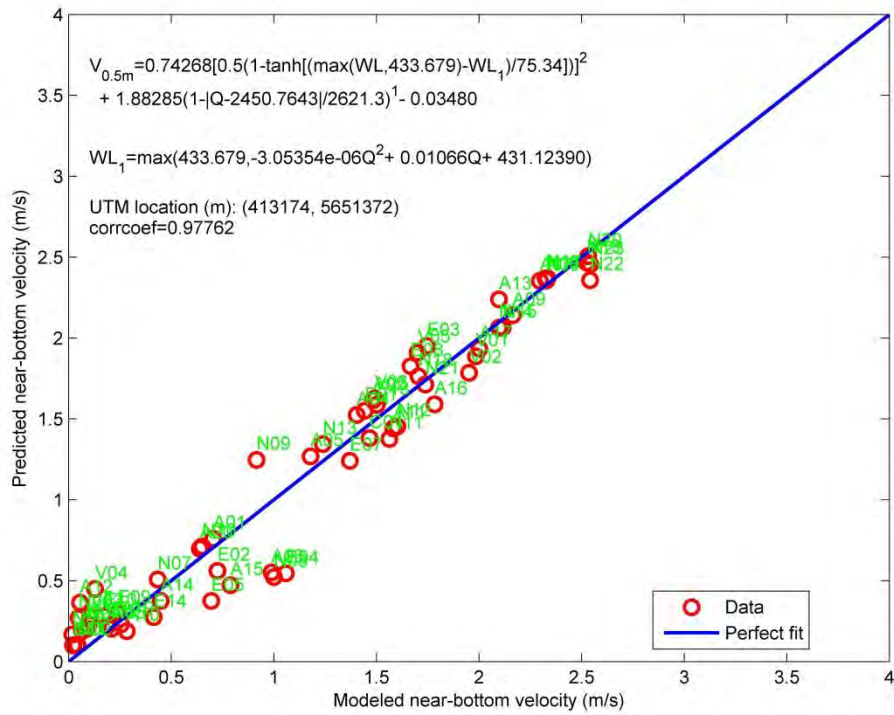
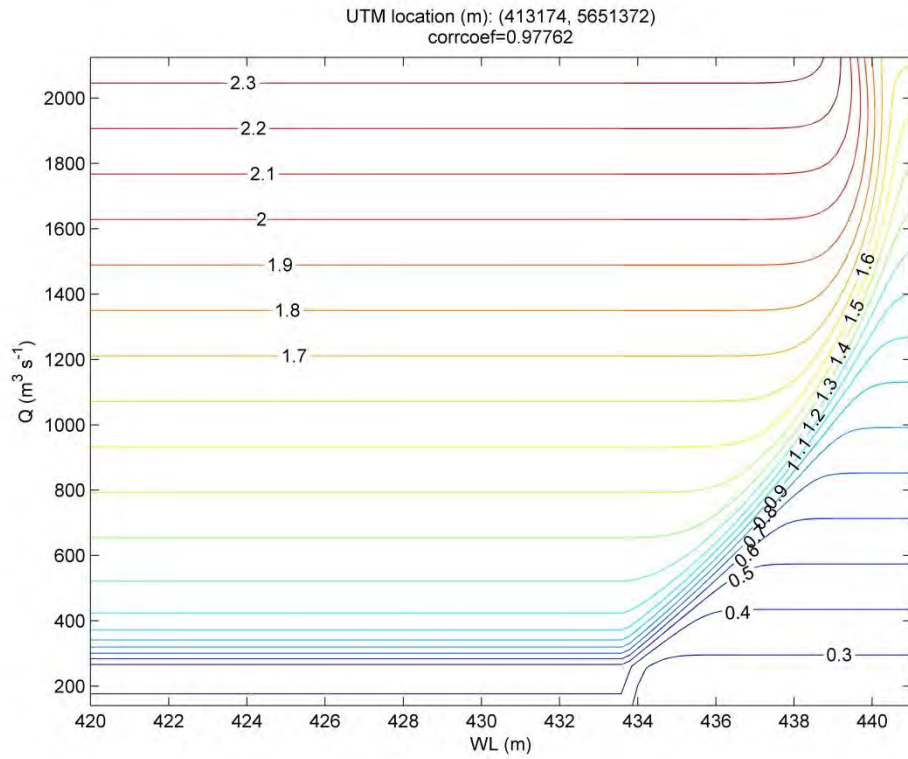


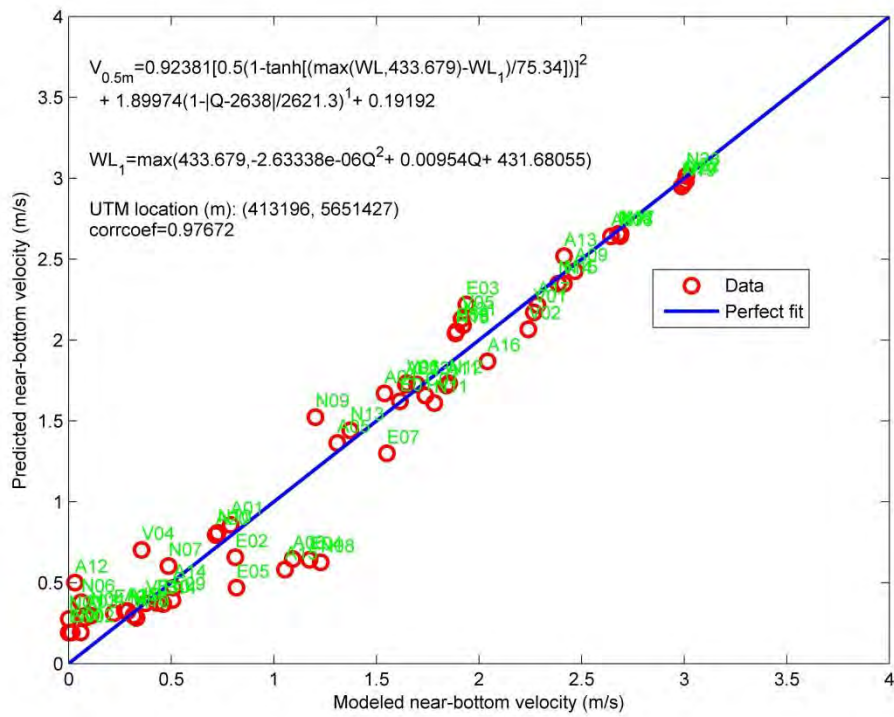
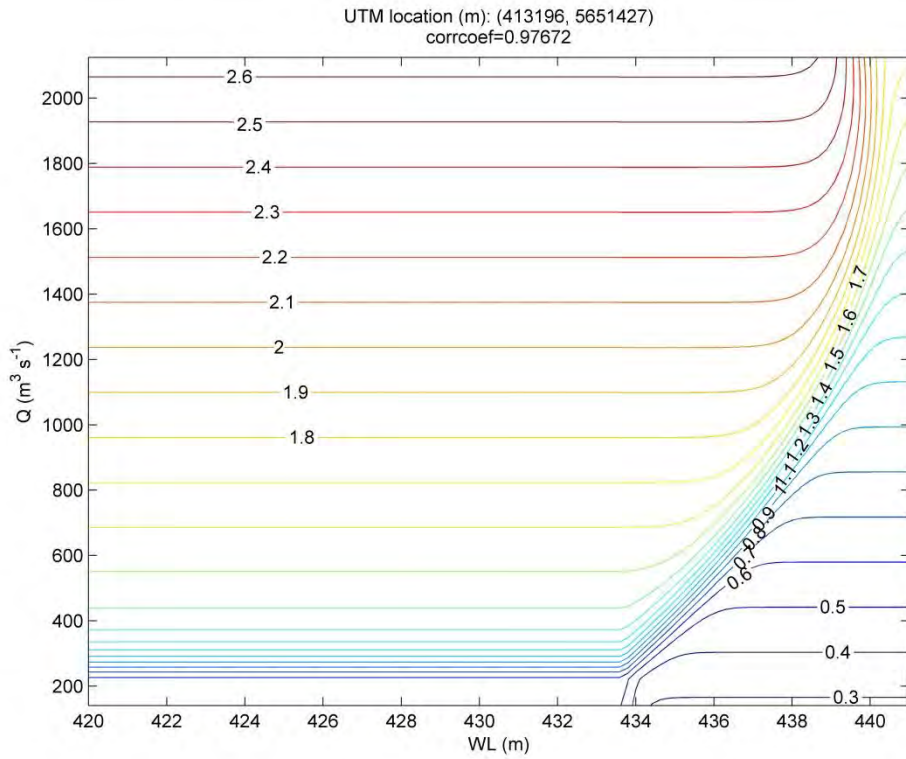


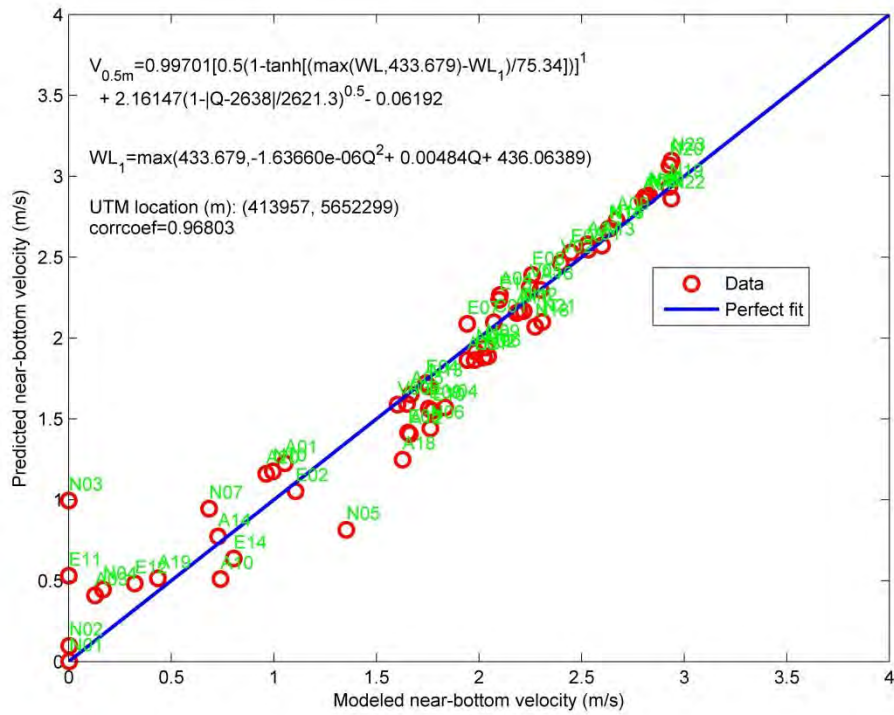
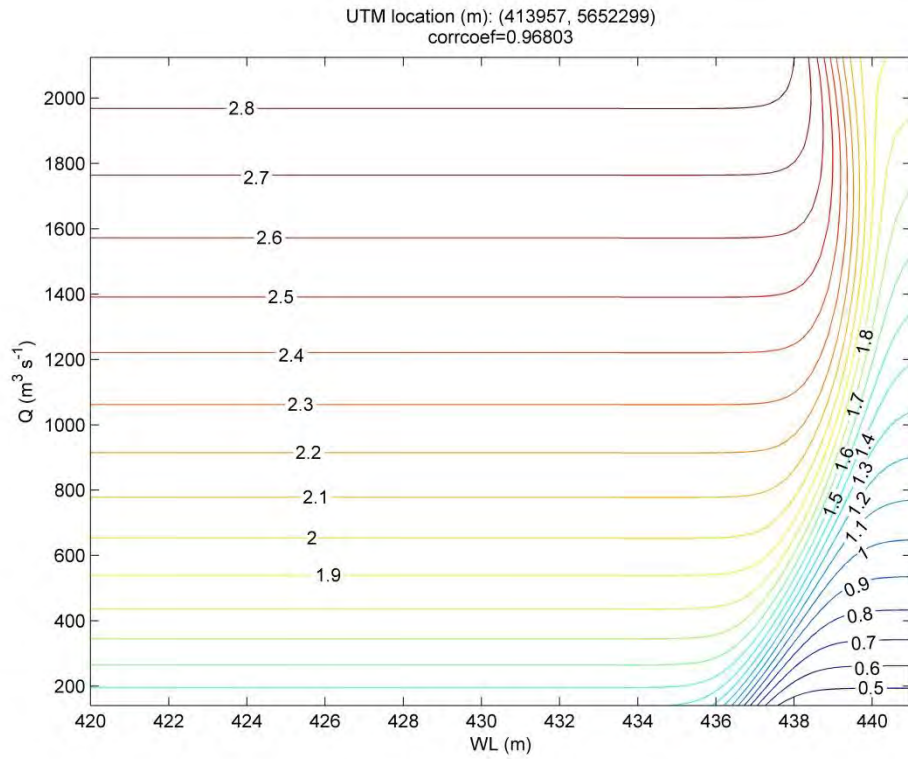




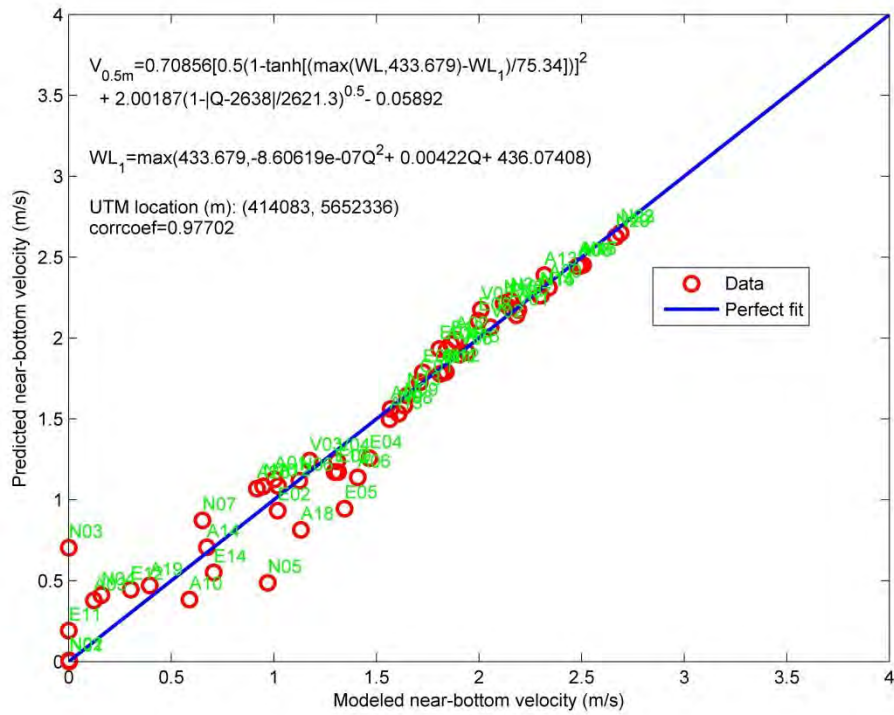
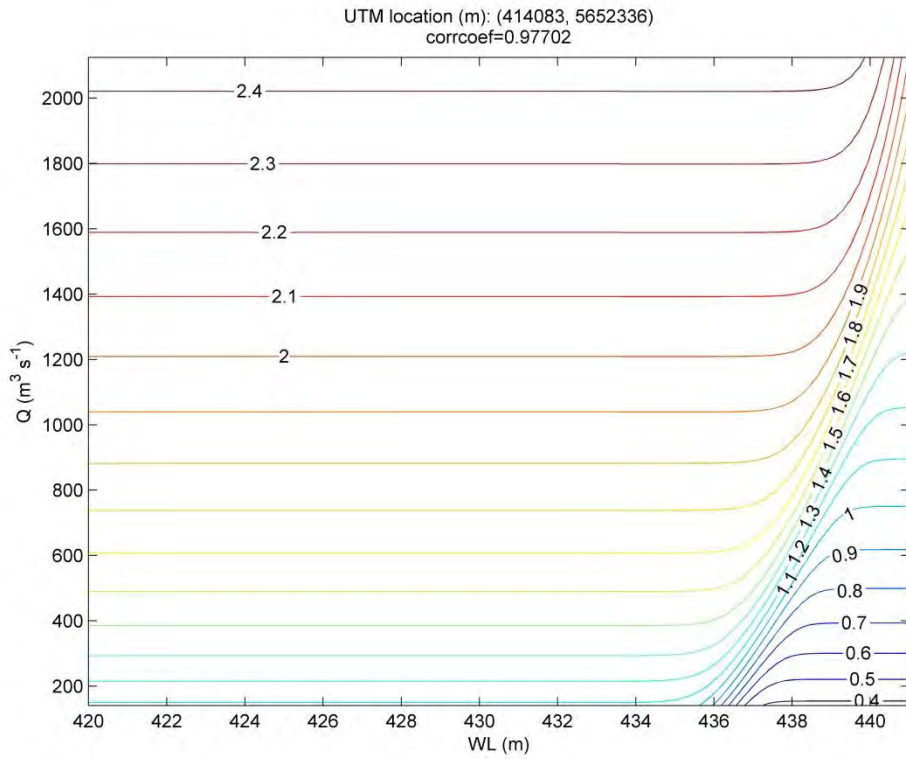


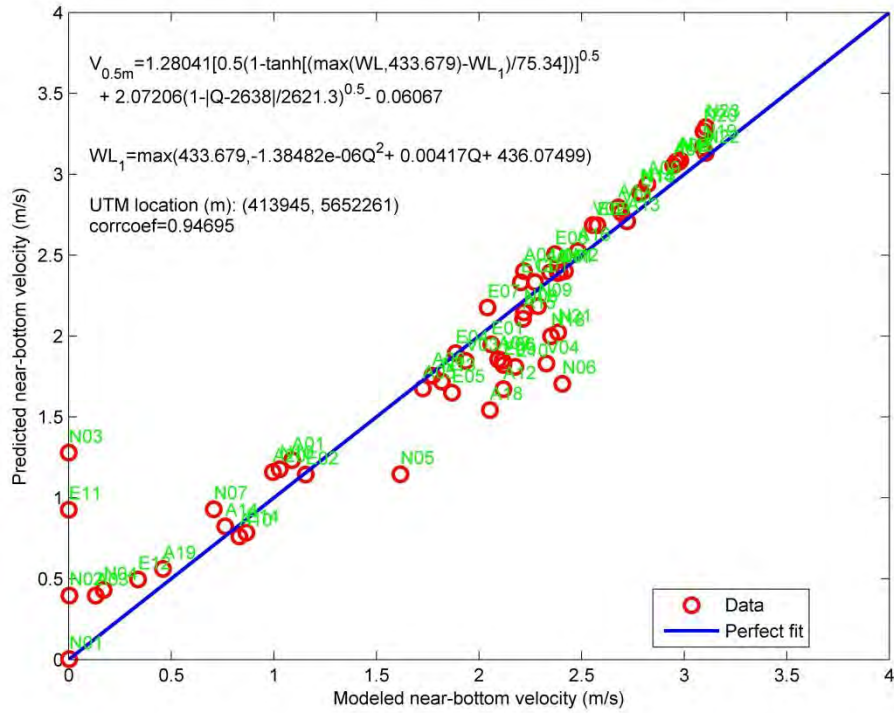
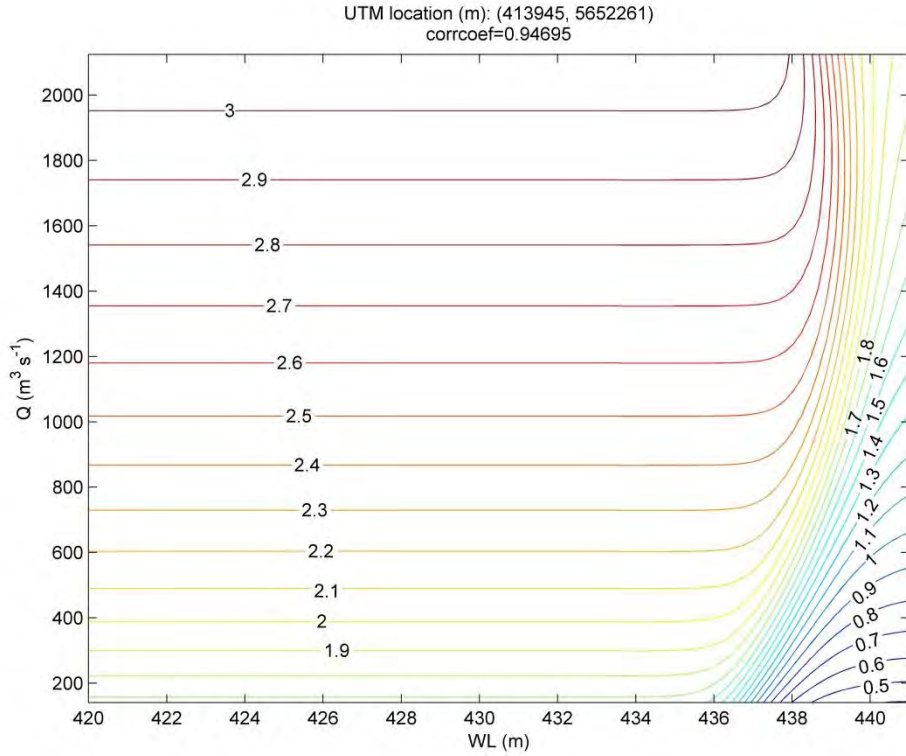


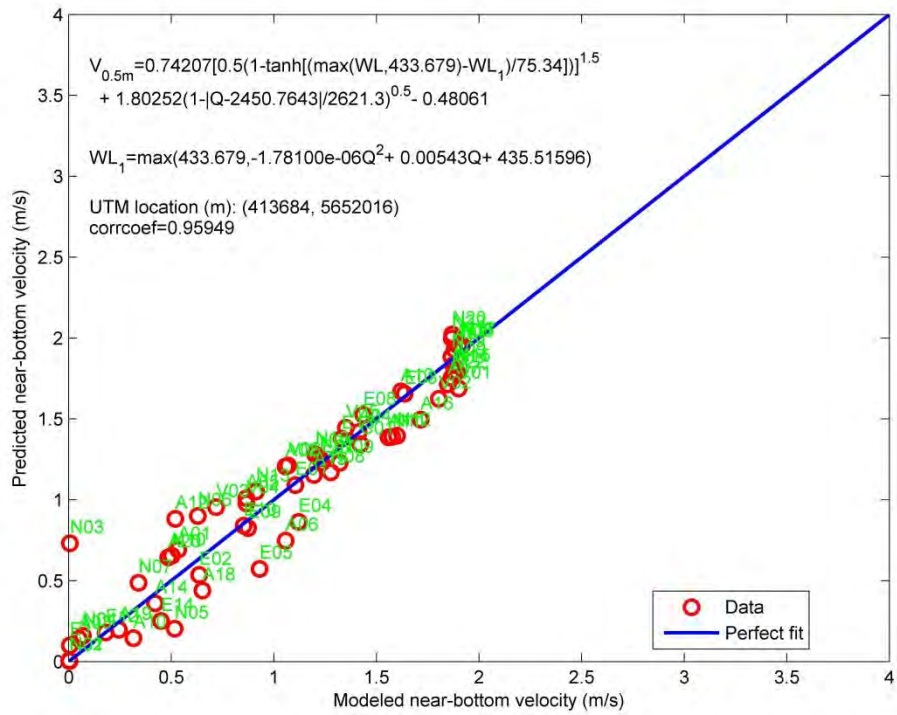
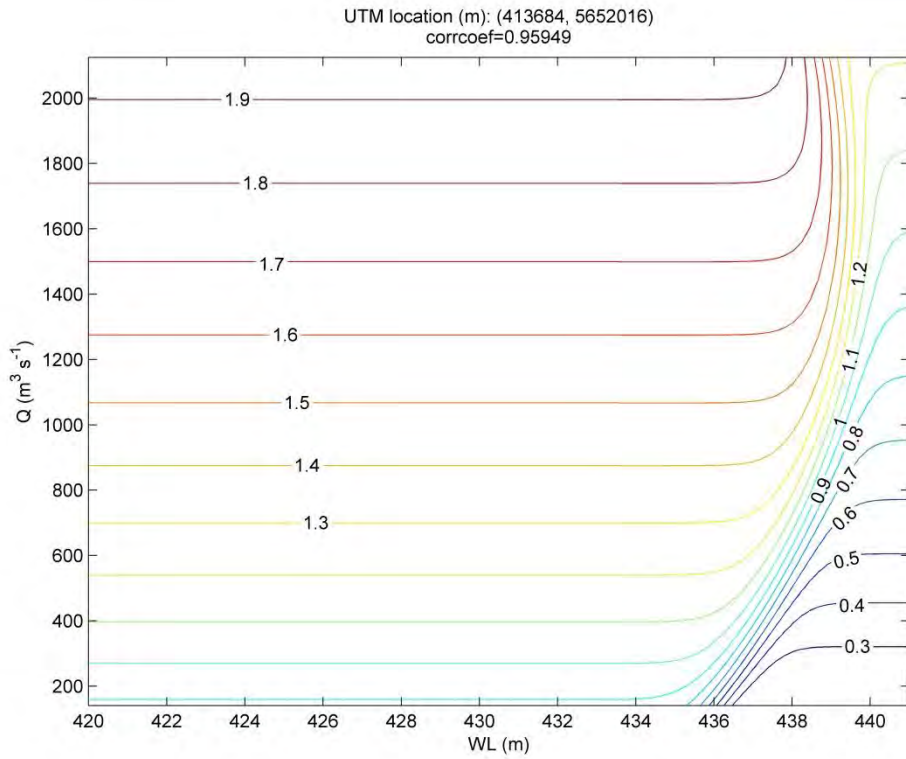




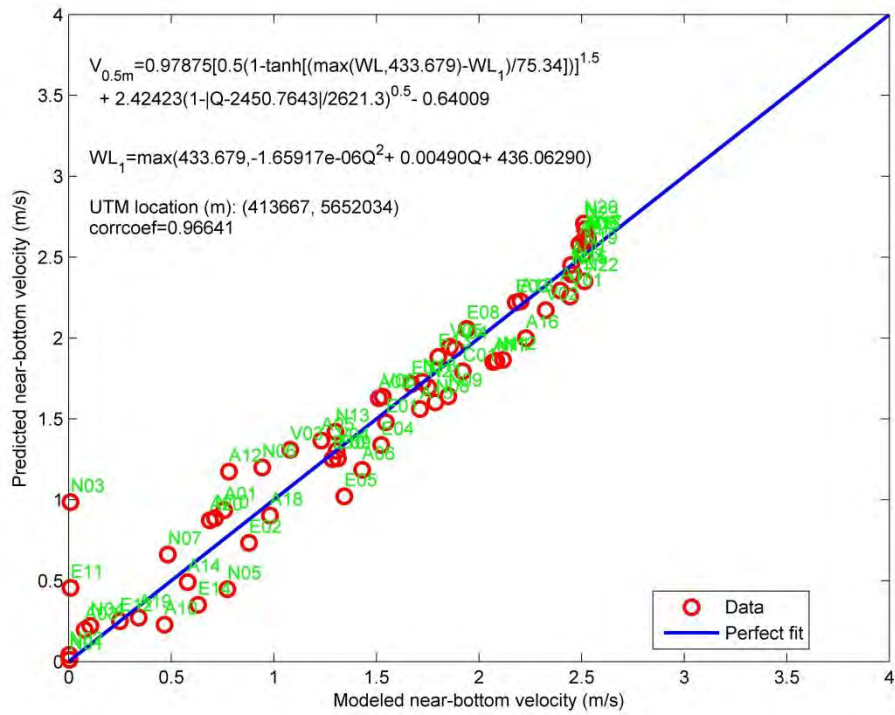
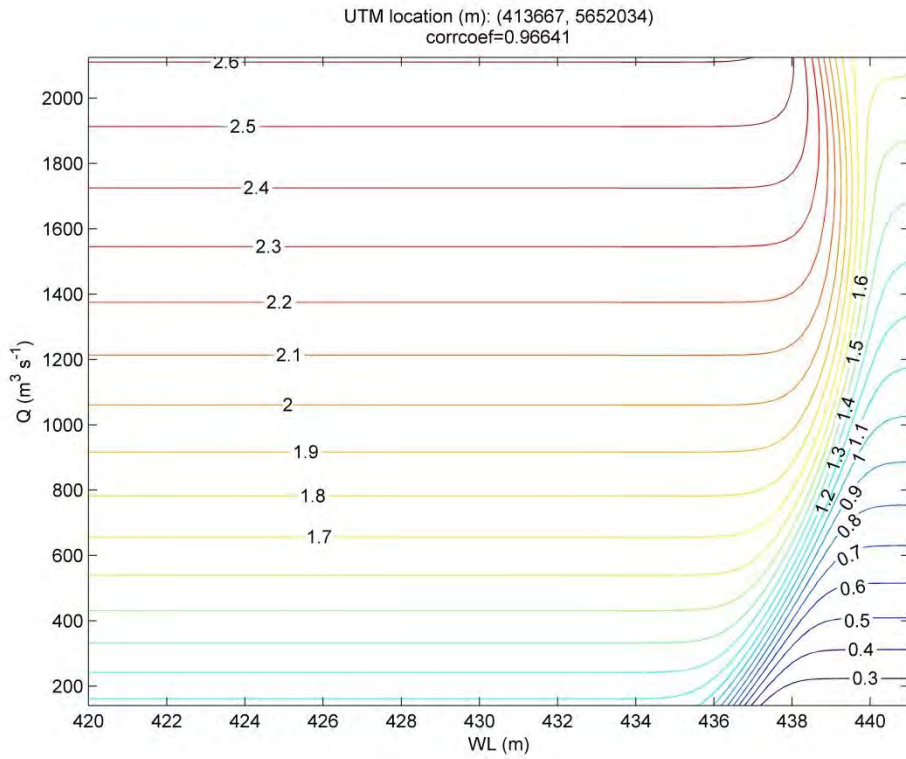


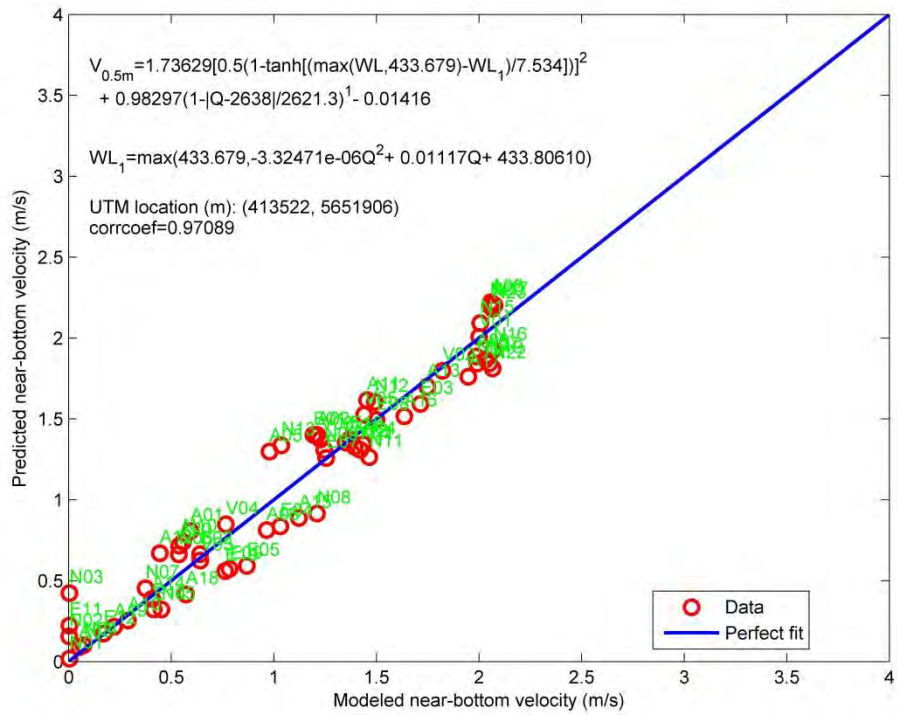
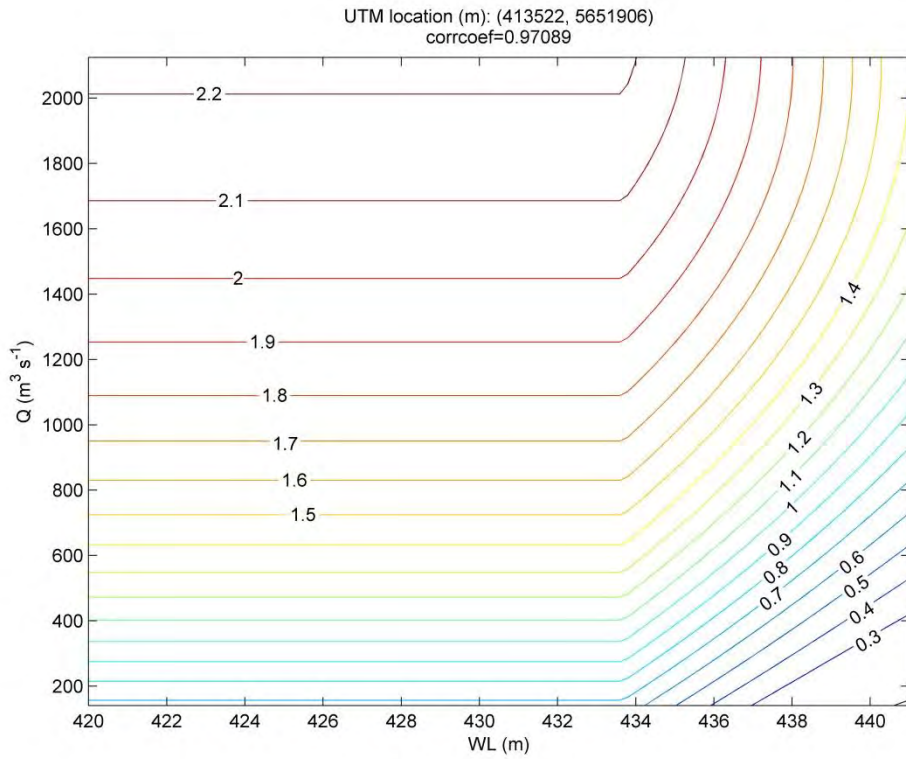


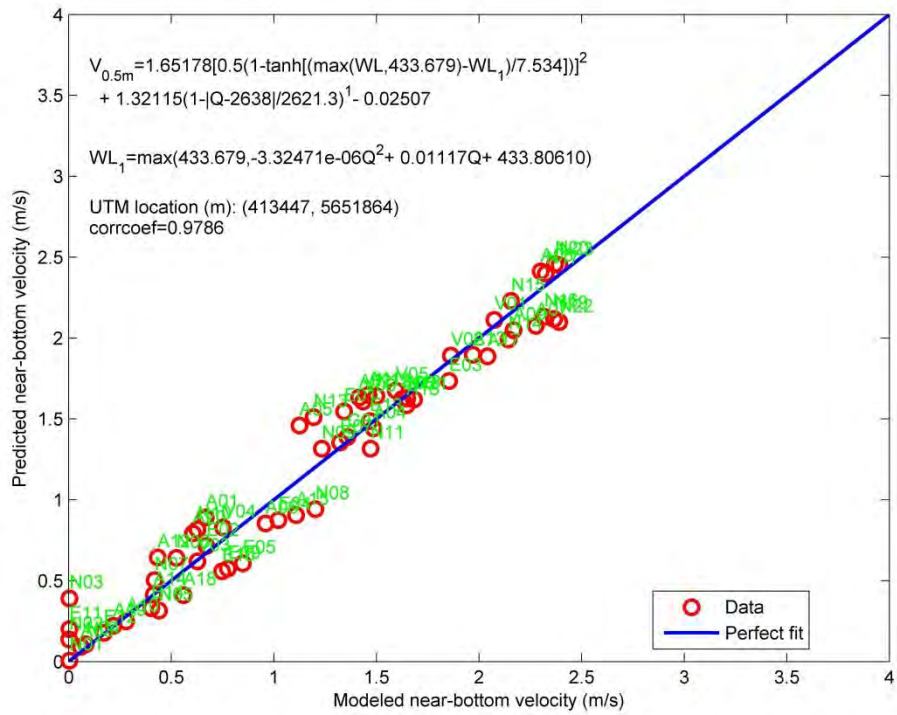
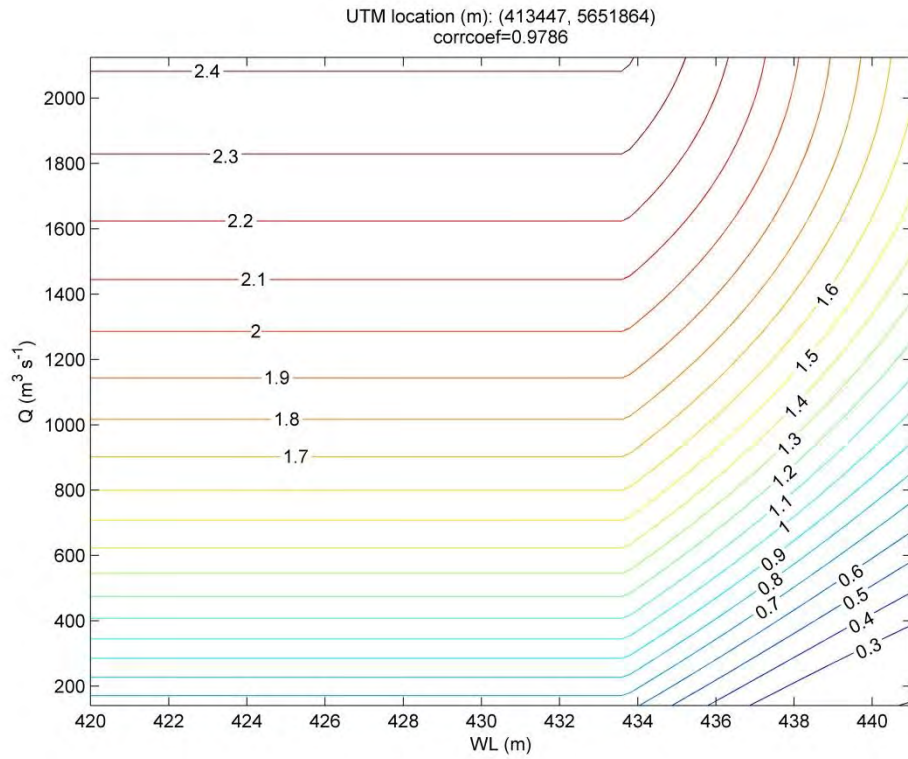


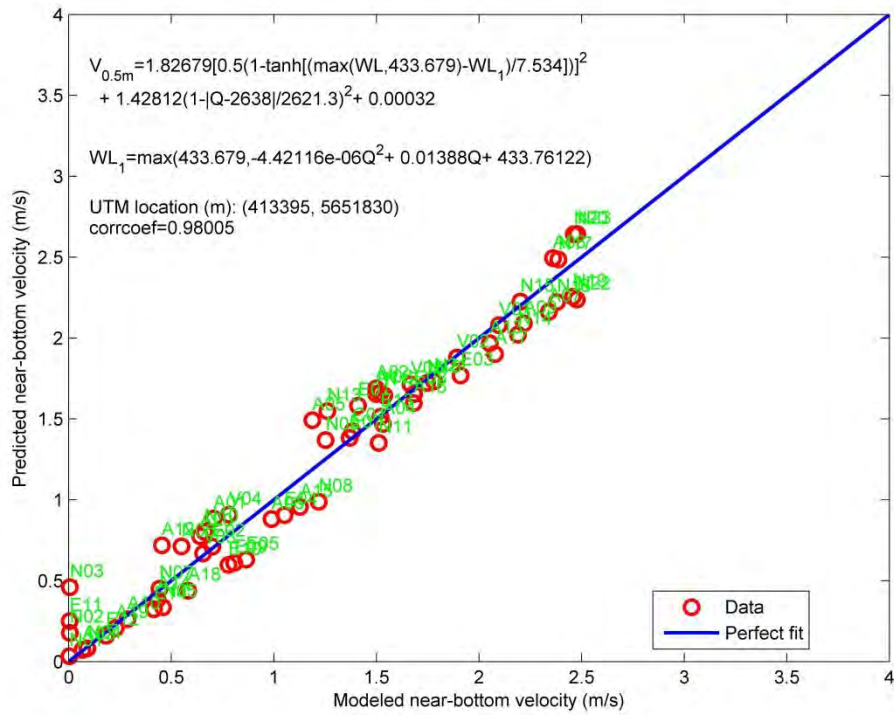
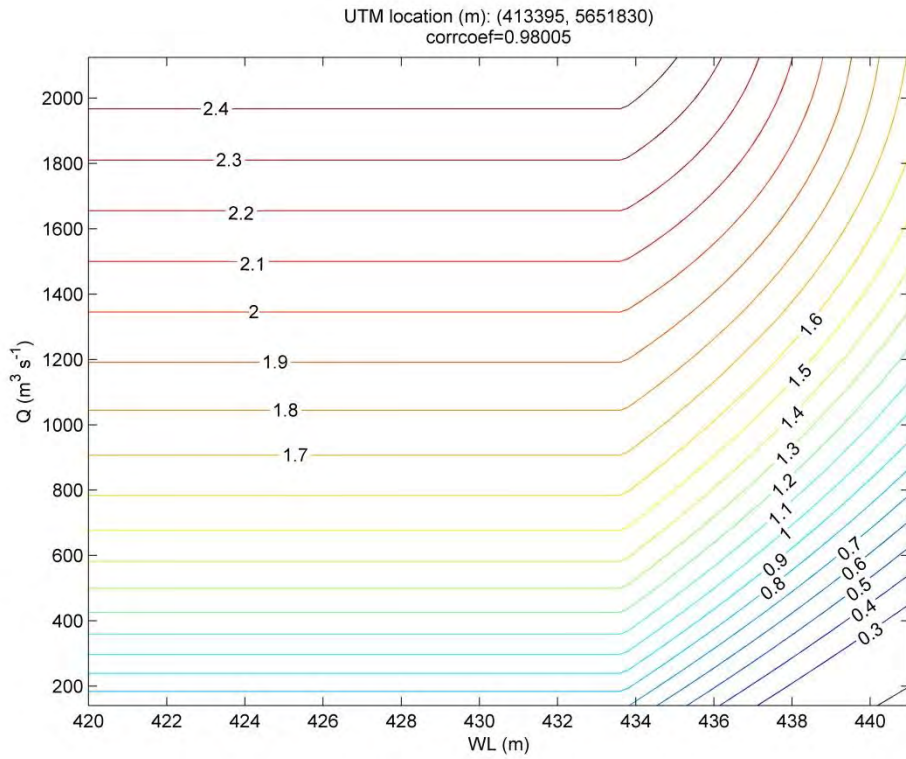


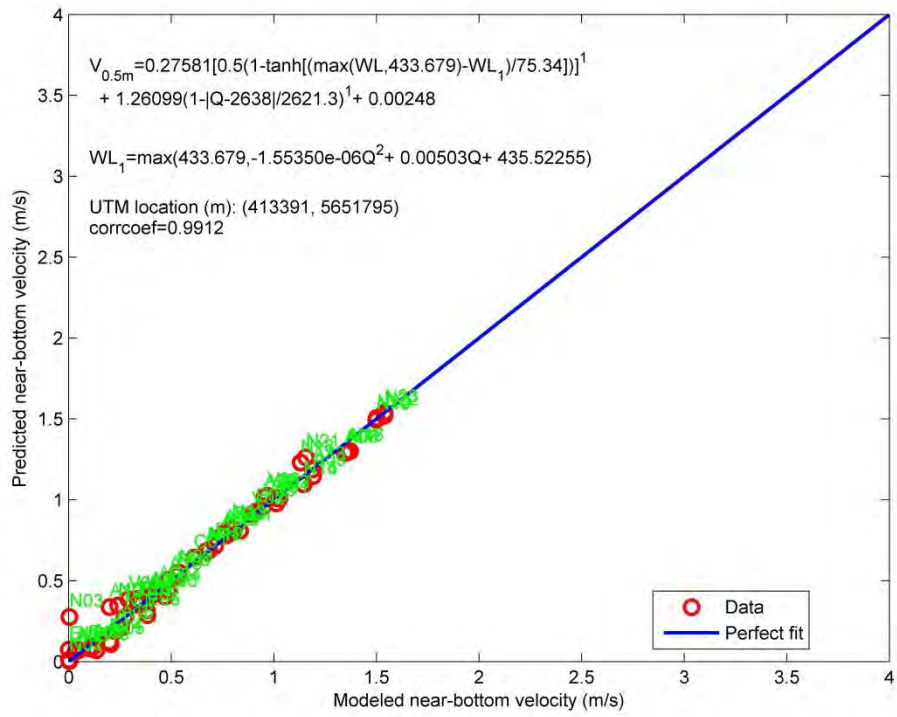
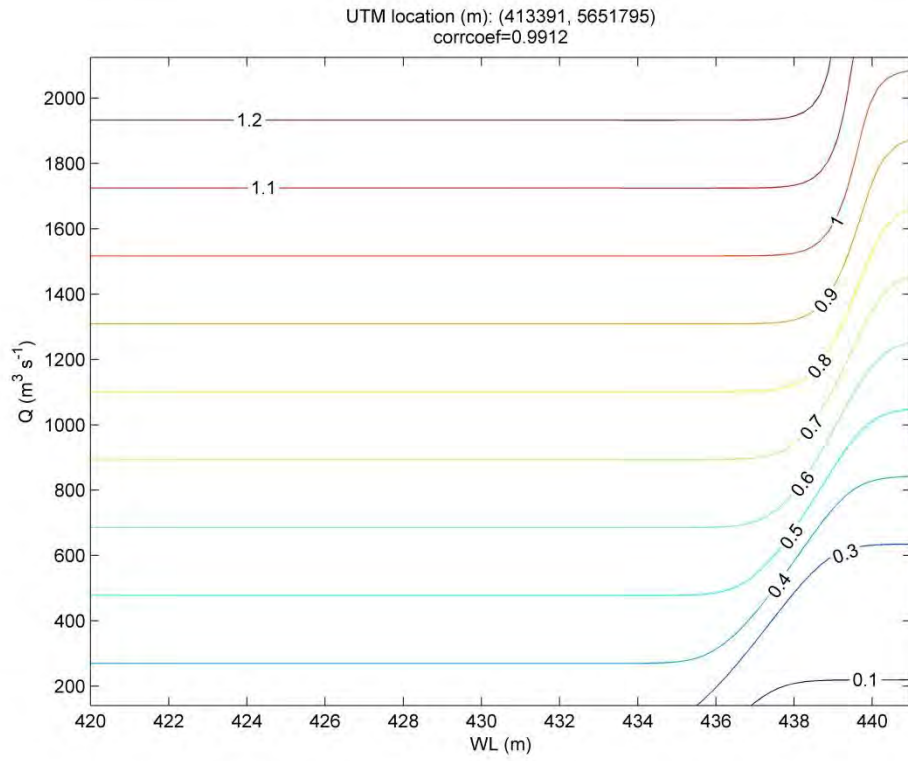




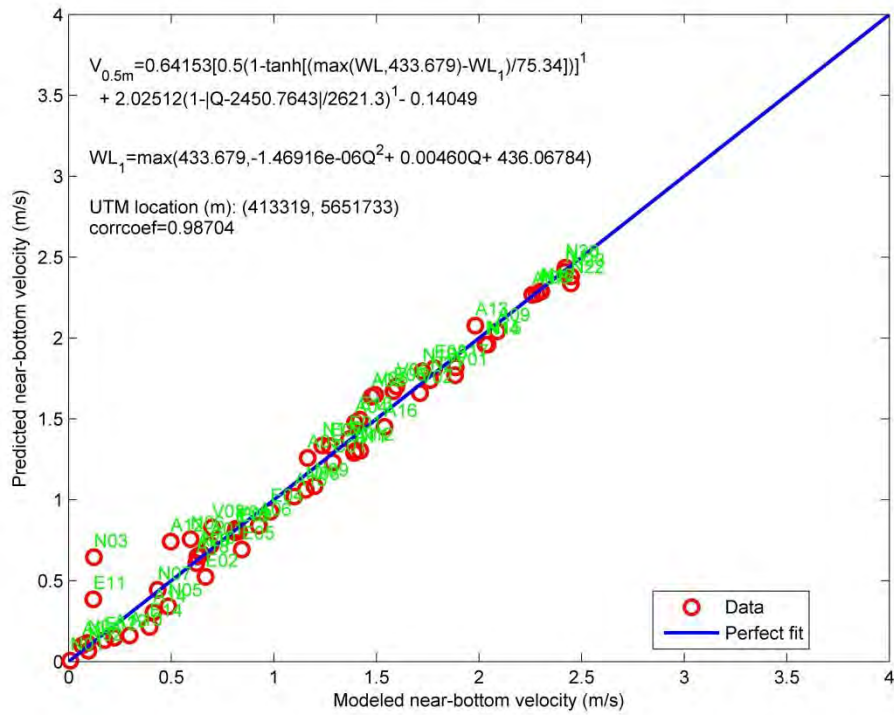
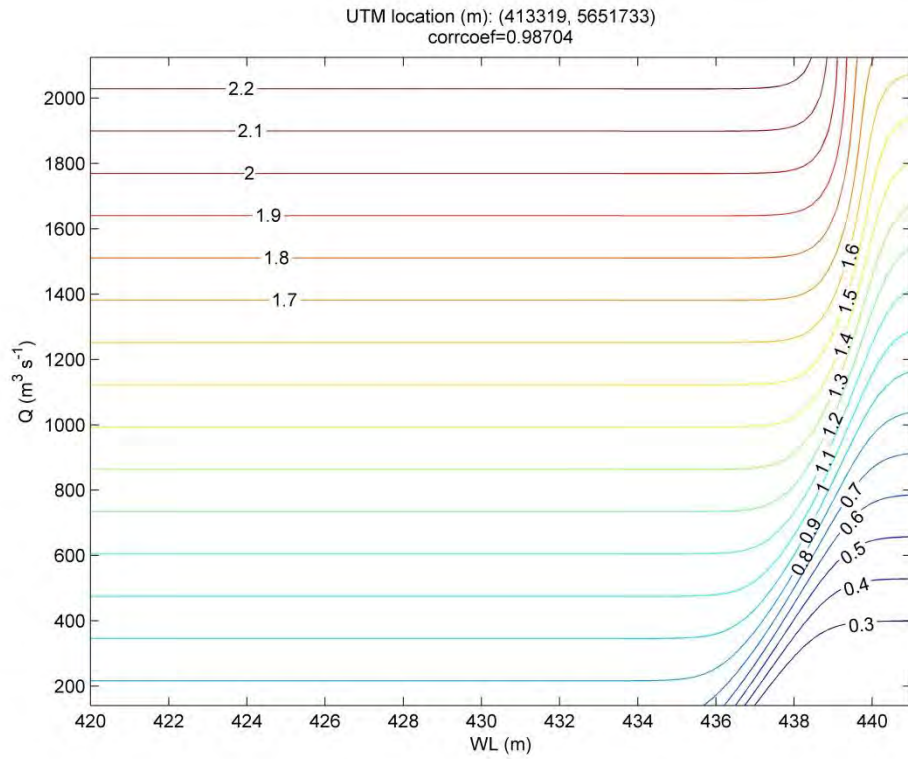


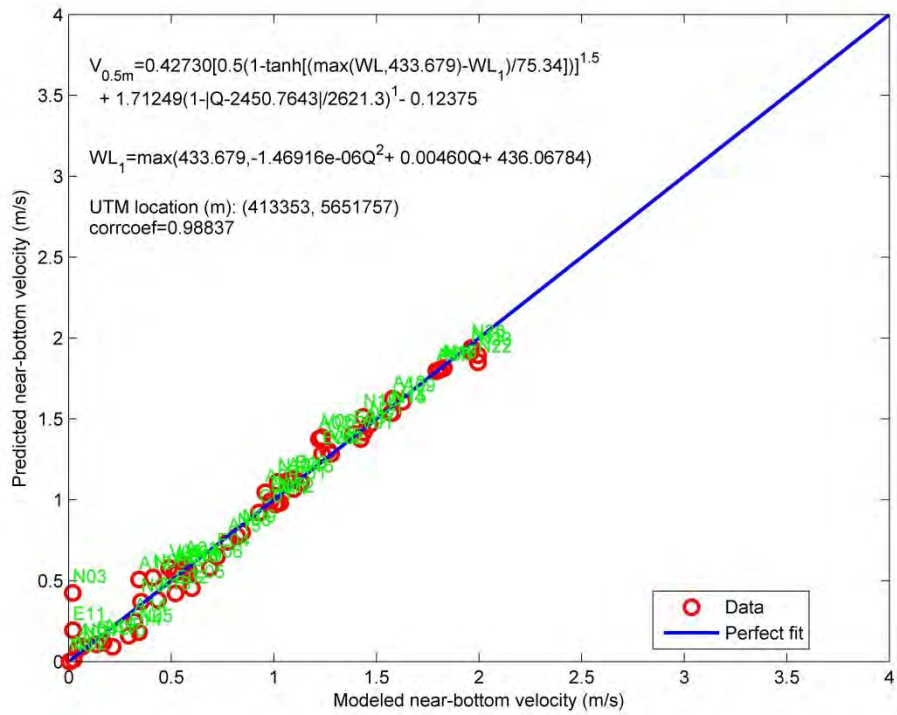
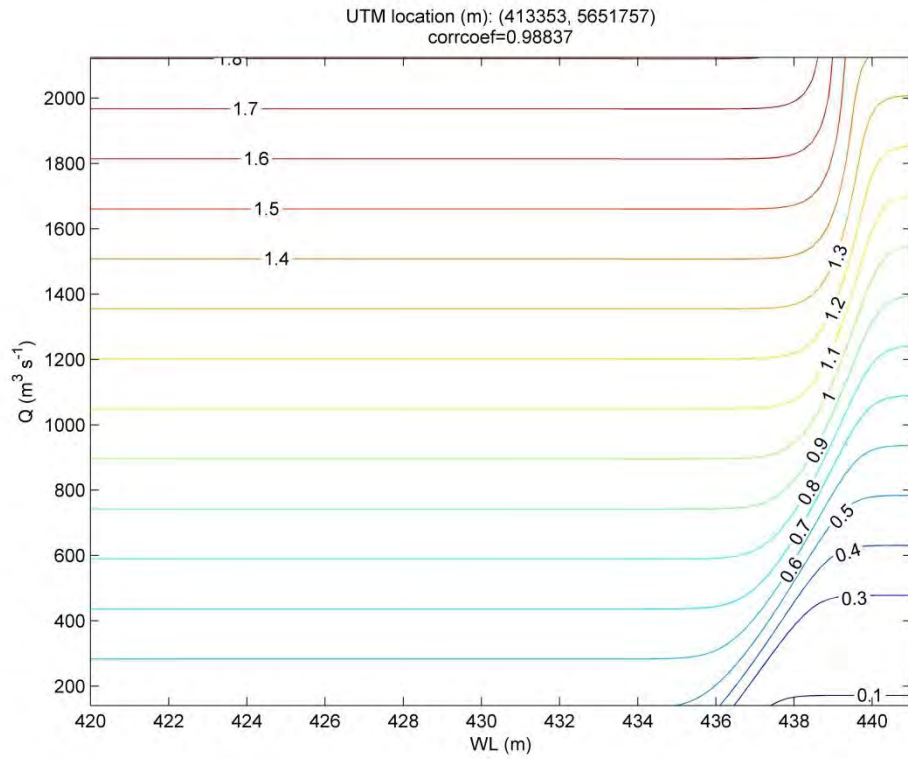


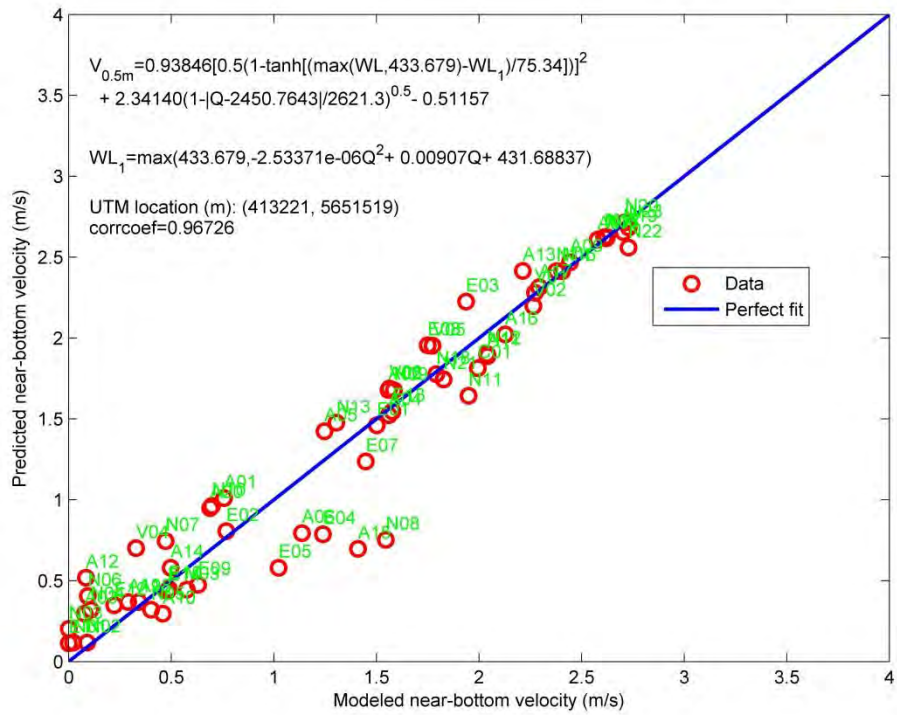
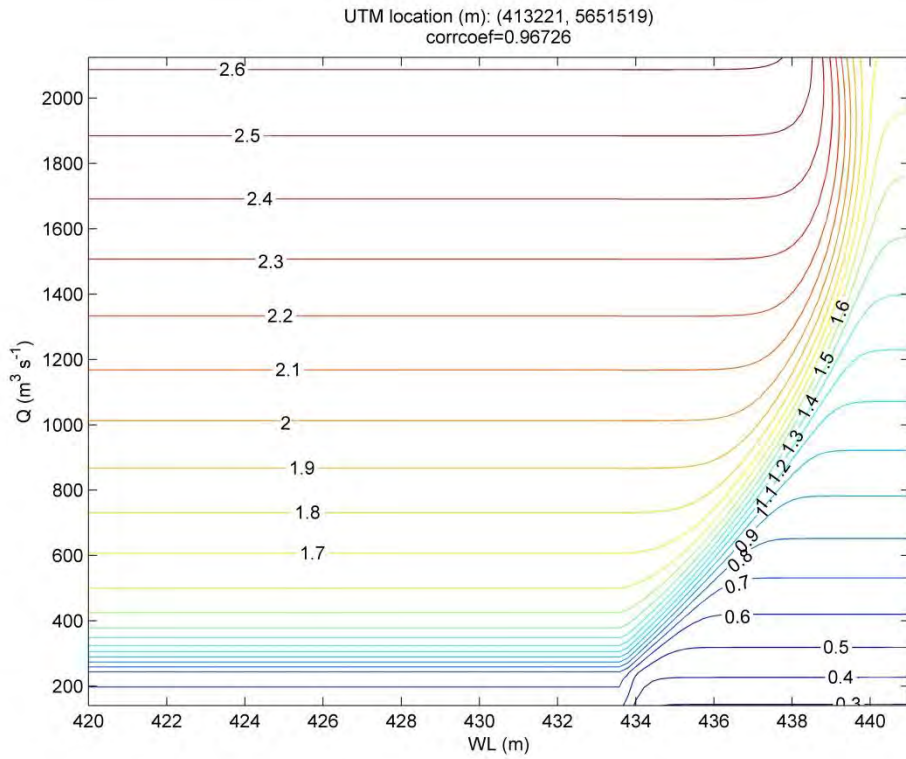










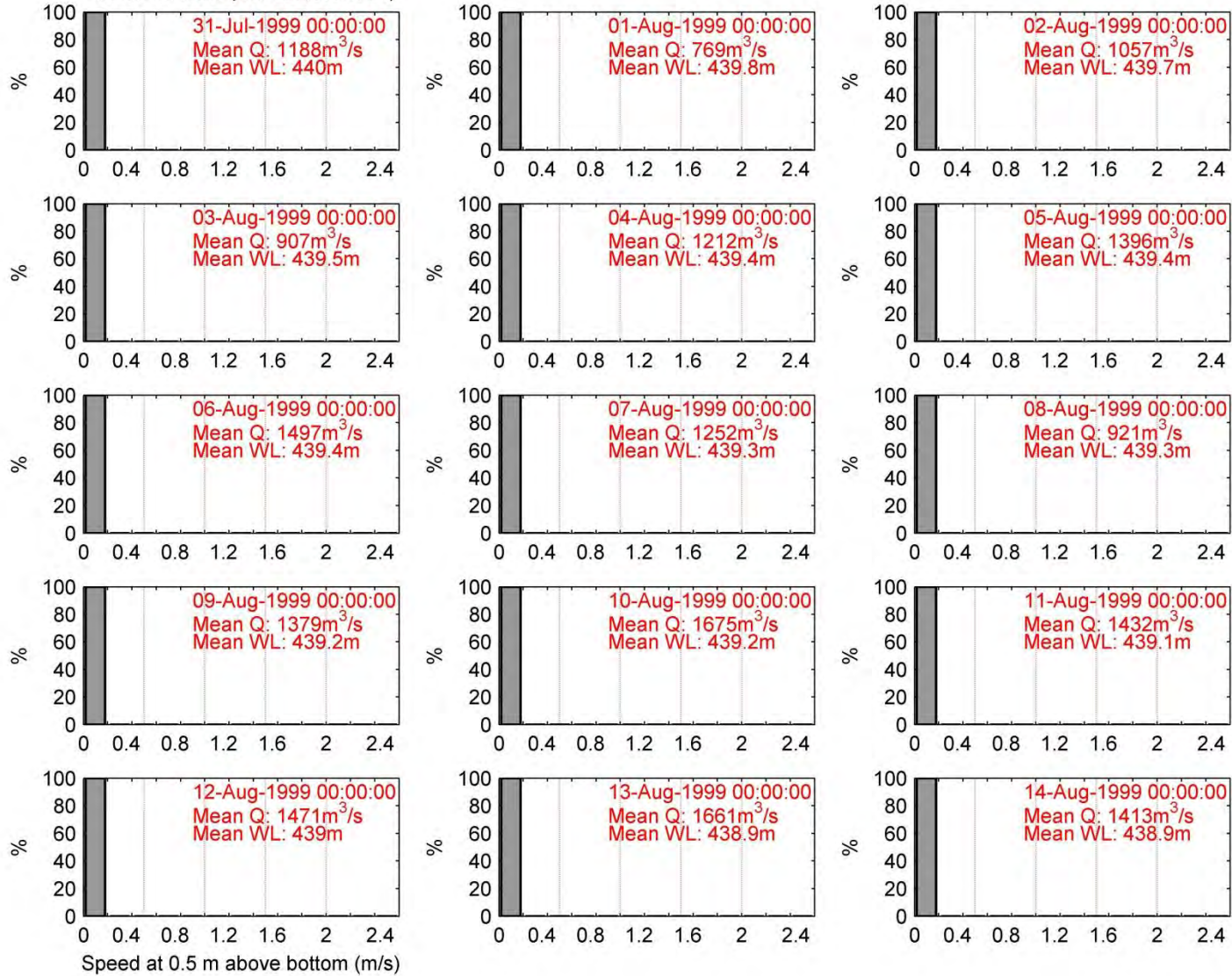


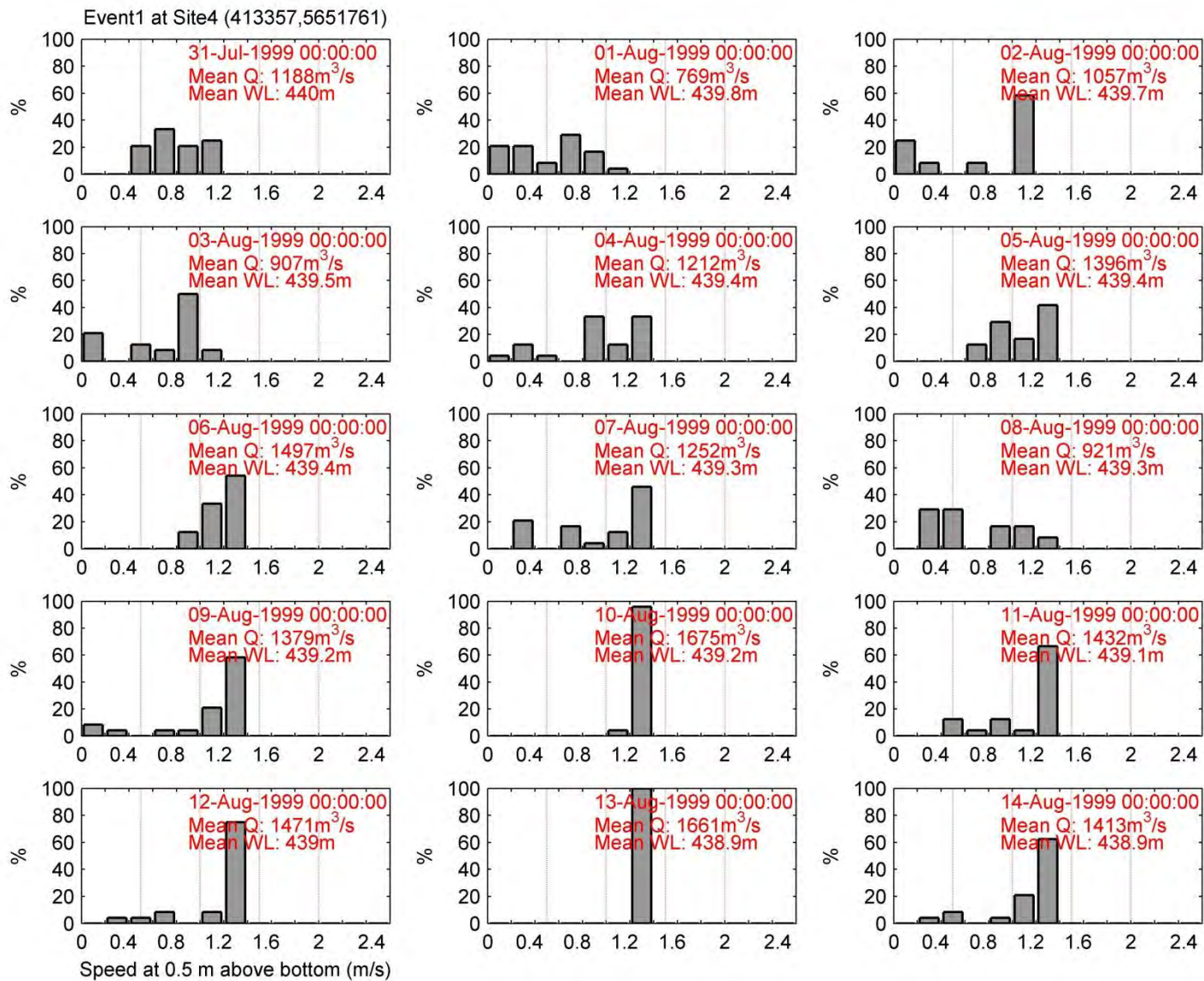


**Appendix B: Daily distribution of near bottom velocities at the 34 sites over the 15 day period following each spawning event.**

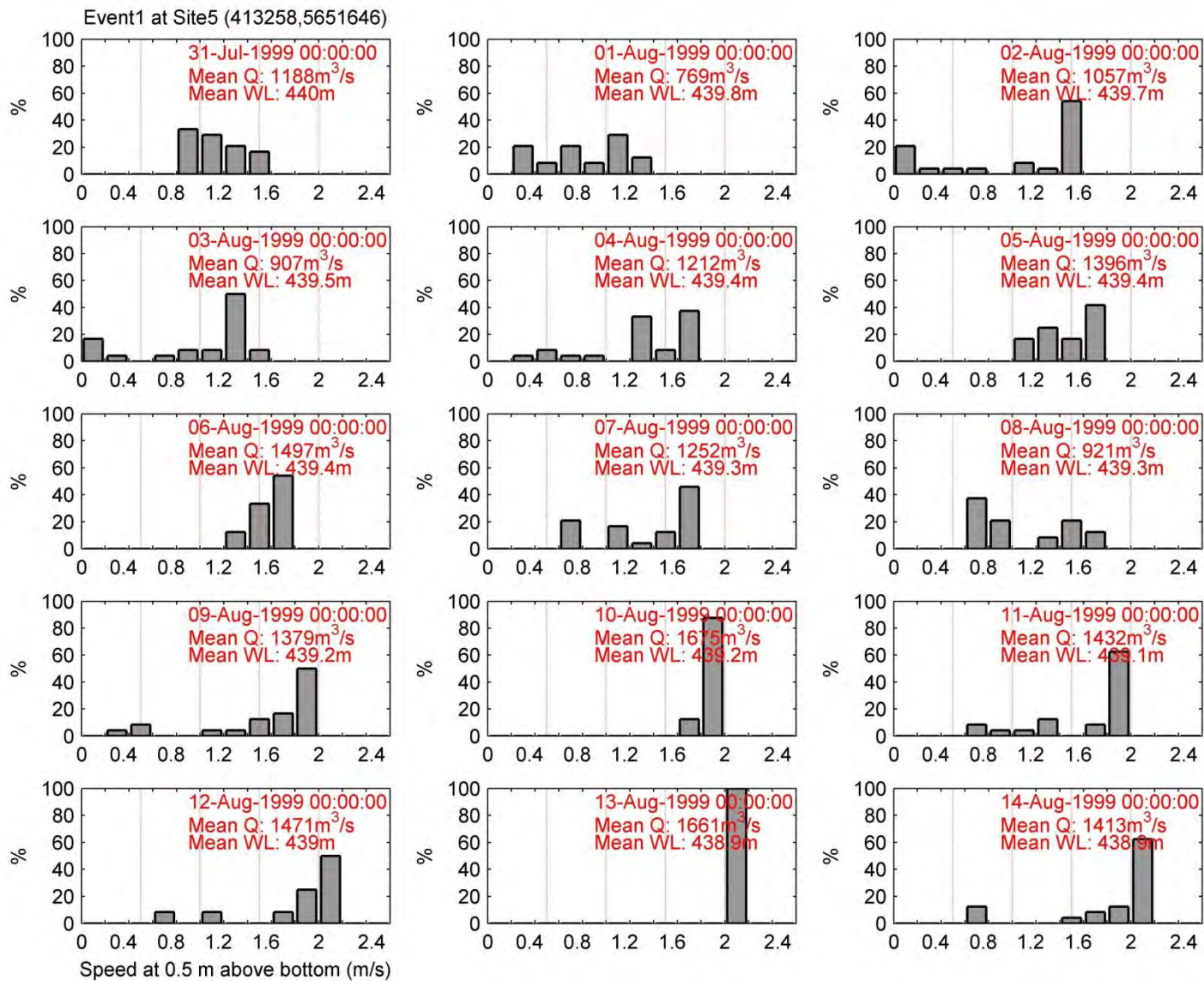
**Appendix B: Daily distribution of near bottom velocities at the 34 sites over the 15 day period following each spawning event.**

Event1 at Site3 (413406,5651784)

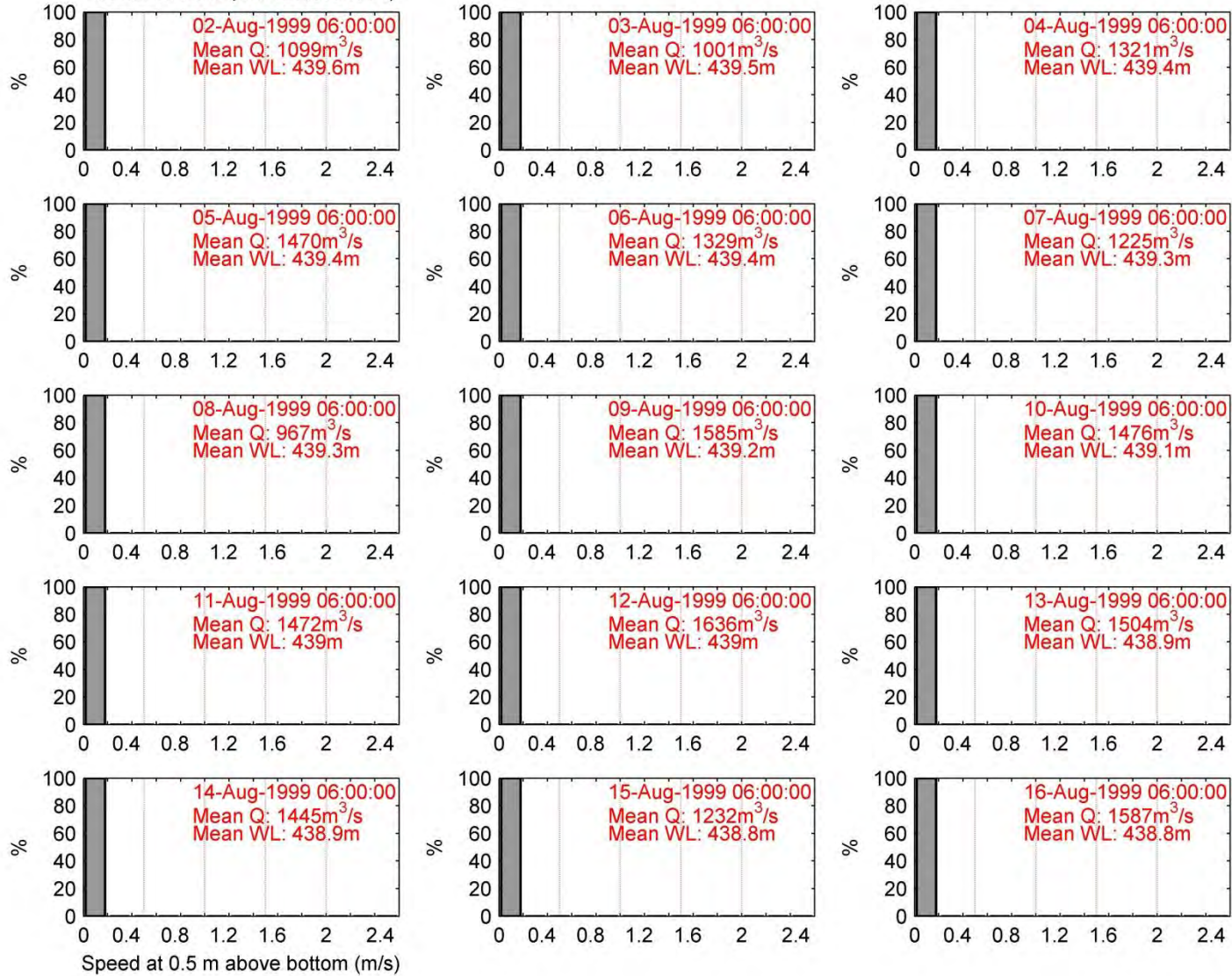




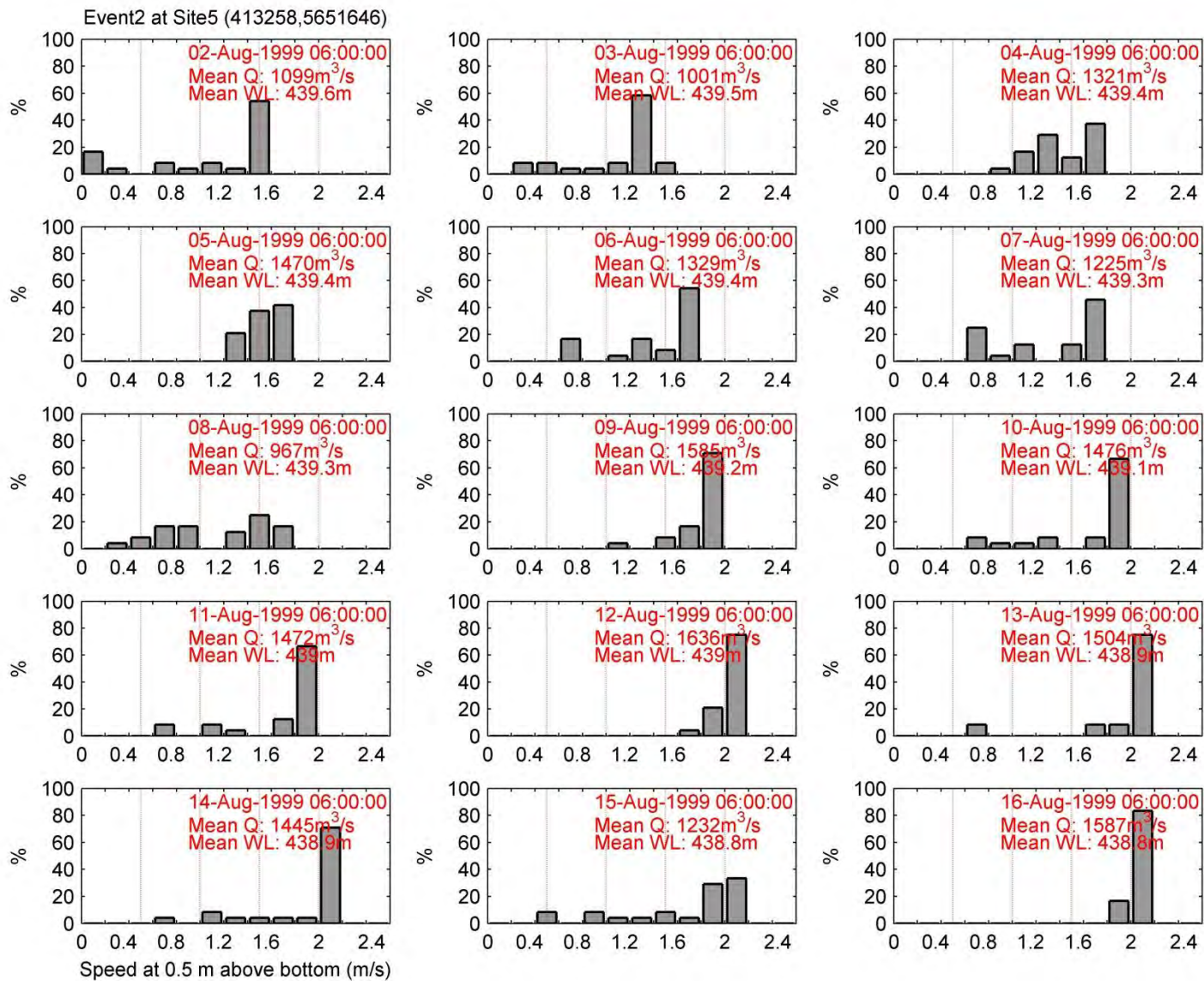




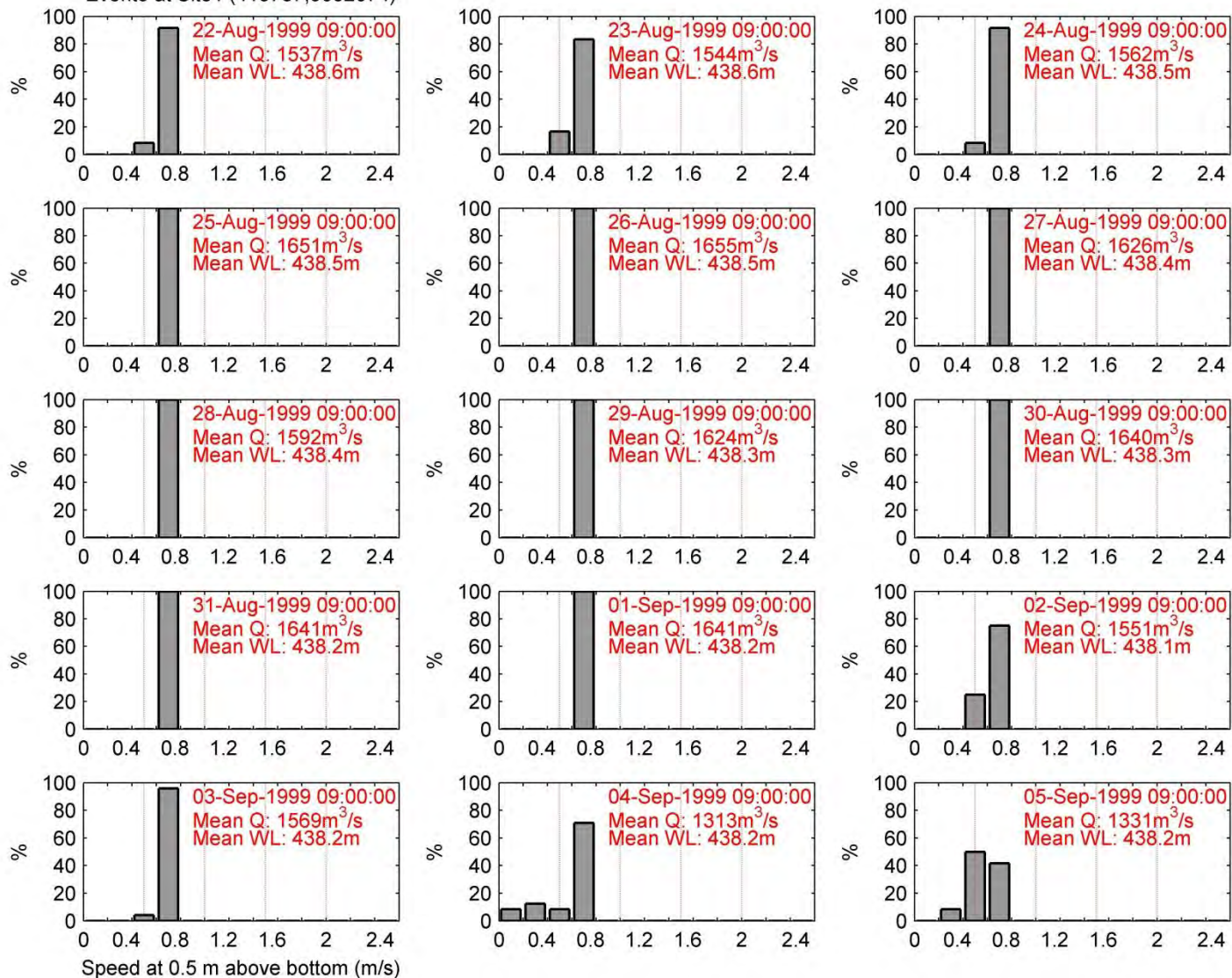
Event2 at Site3 (413406,5651784)





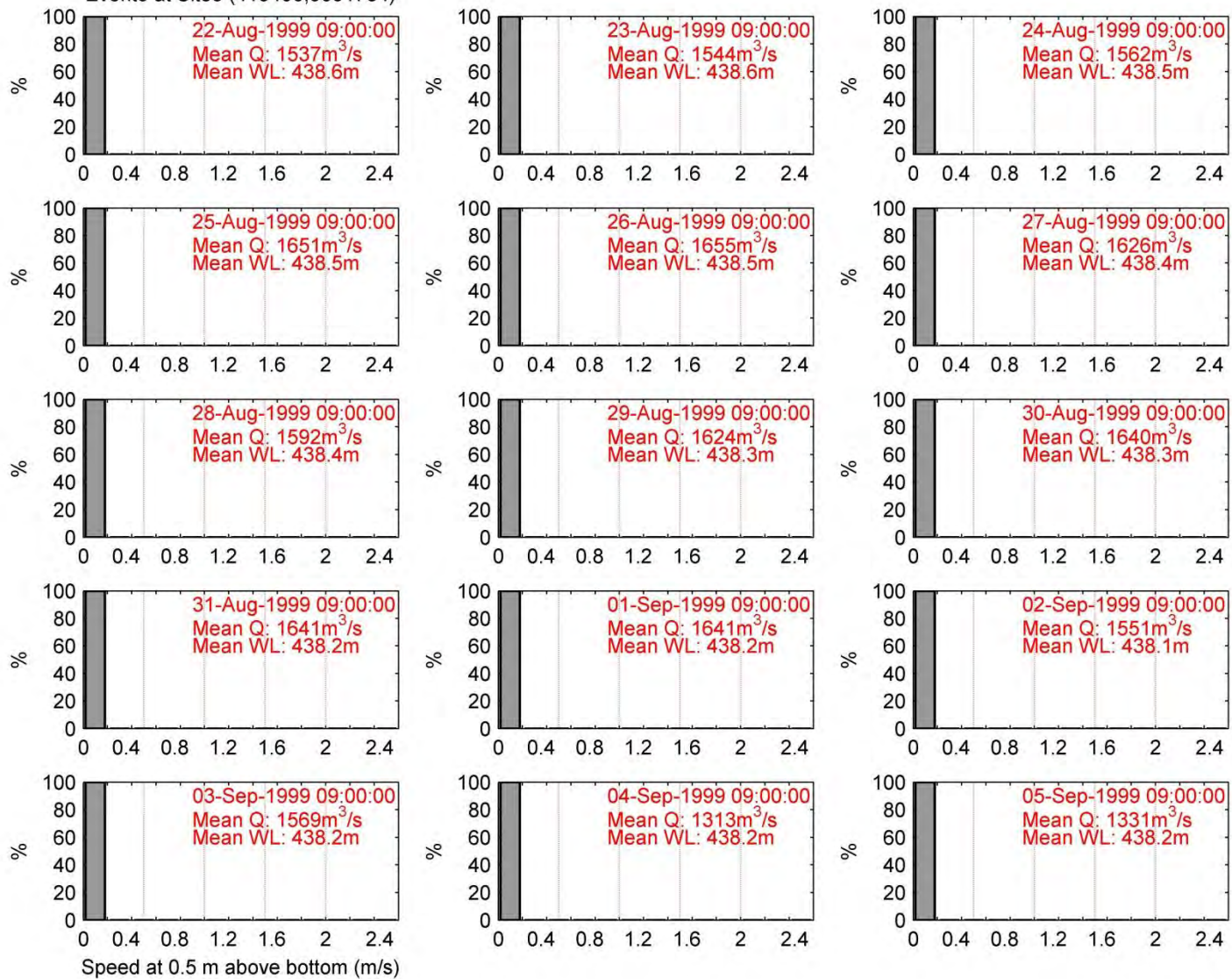


Event3 at Site1 (413787,5652074)

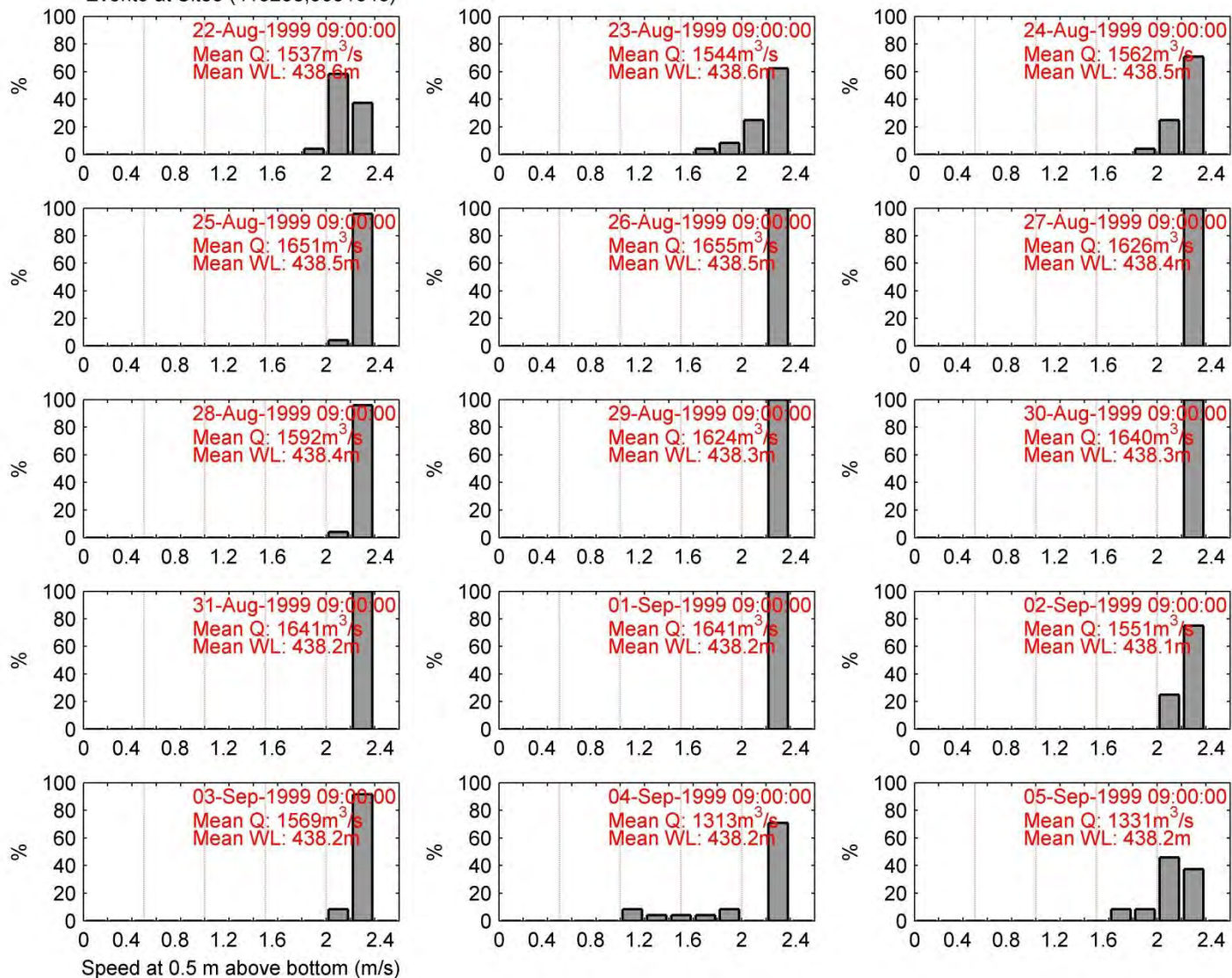




Event3 at Site3 (413406,5651784)

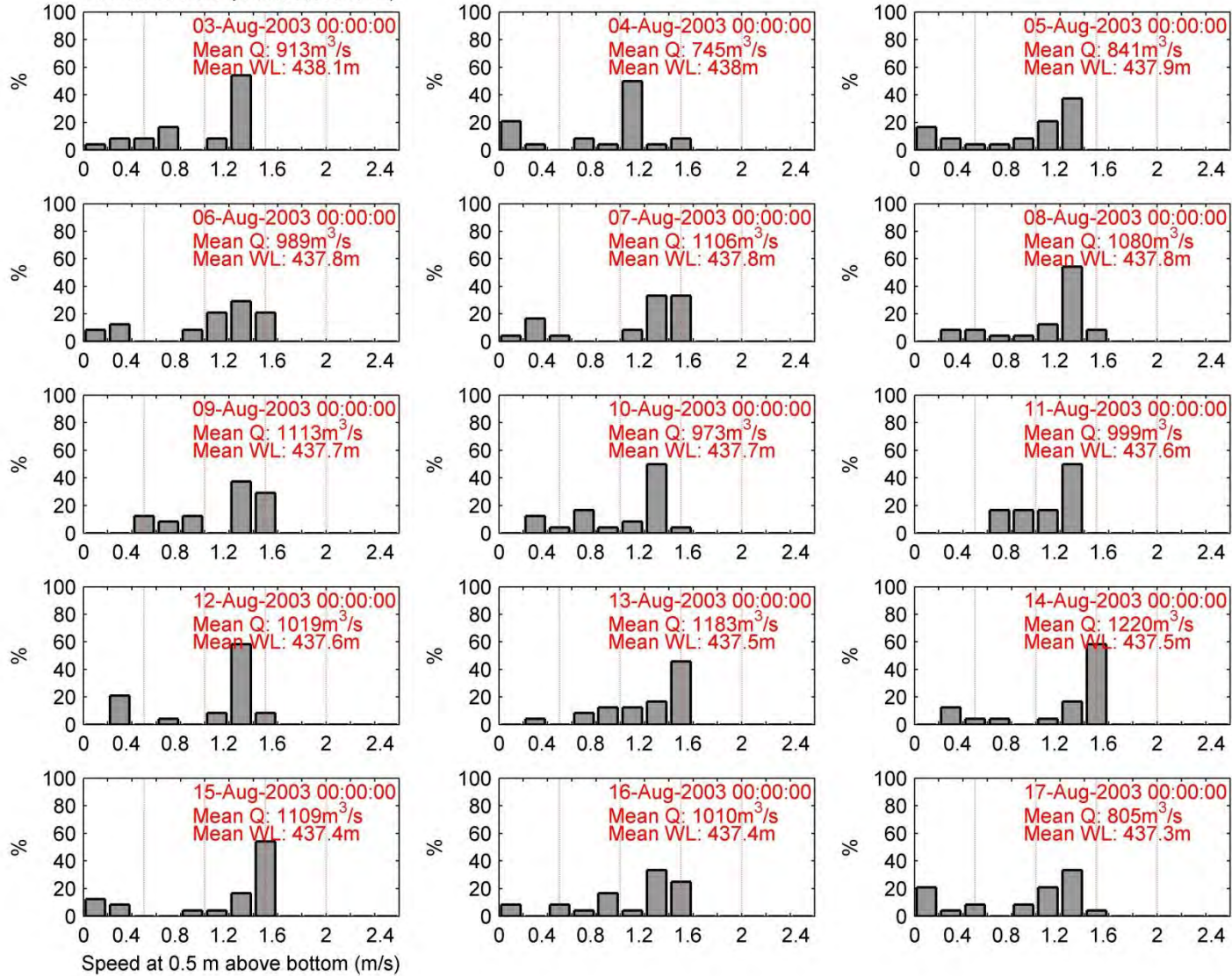


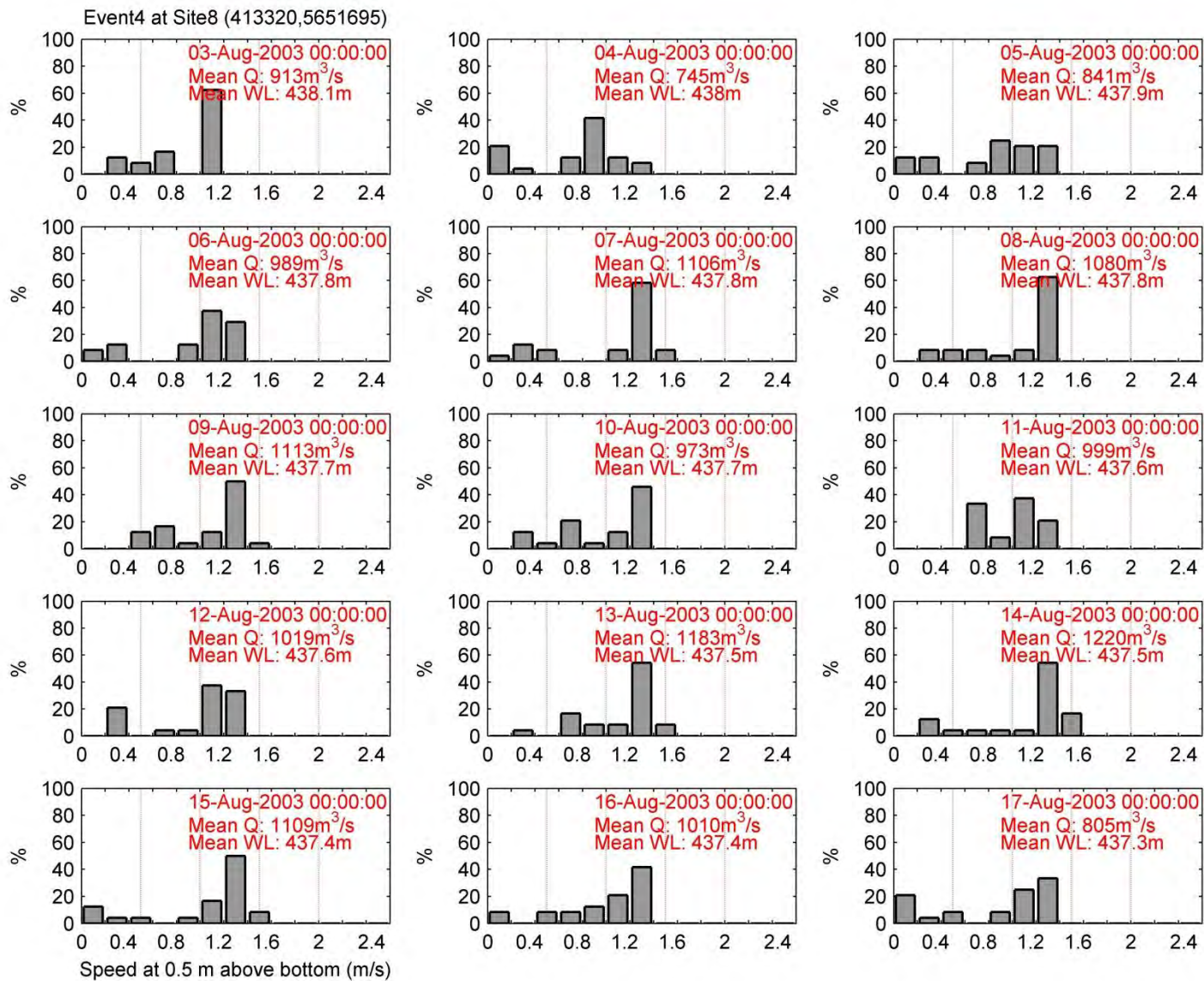
Event3 at Site5 (413258,5651646)





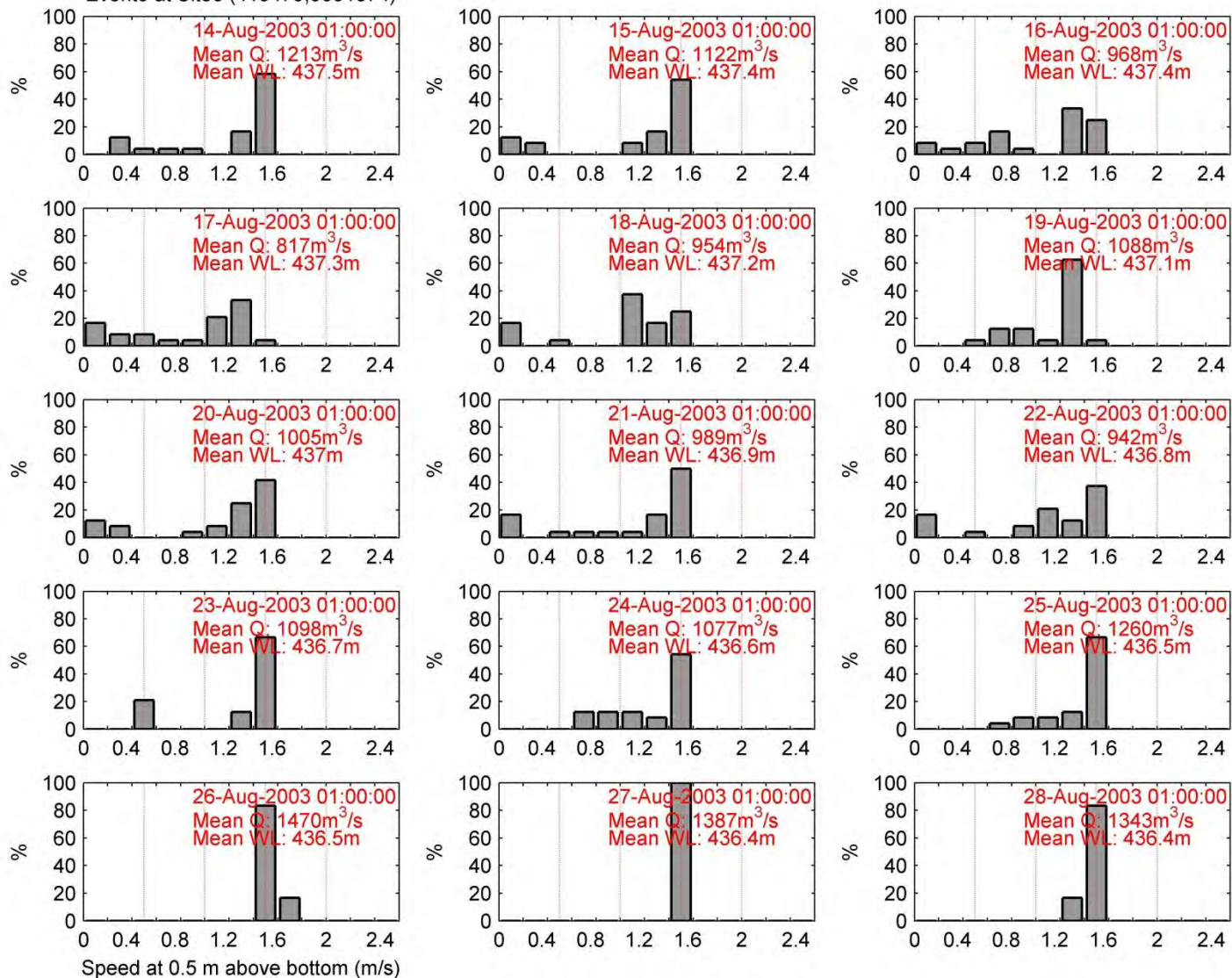
Event4 at Site7 (413376,5651792)



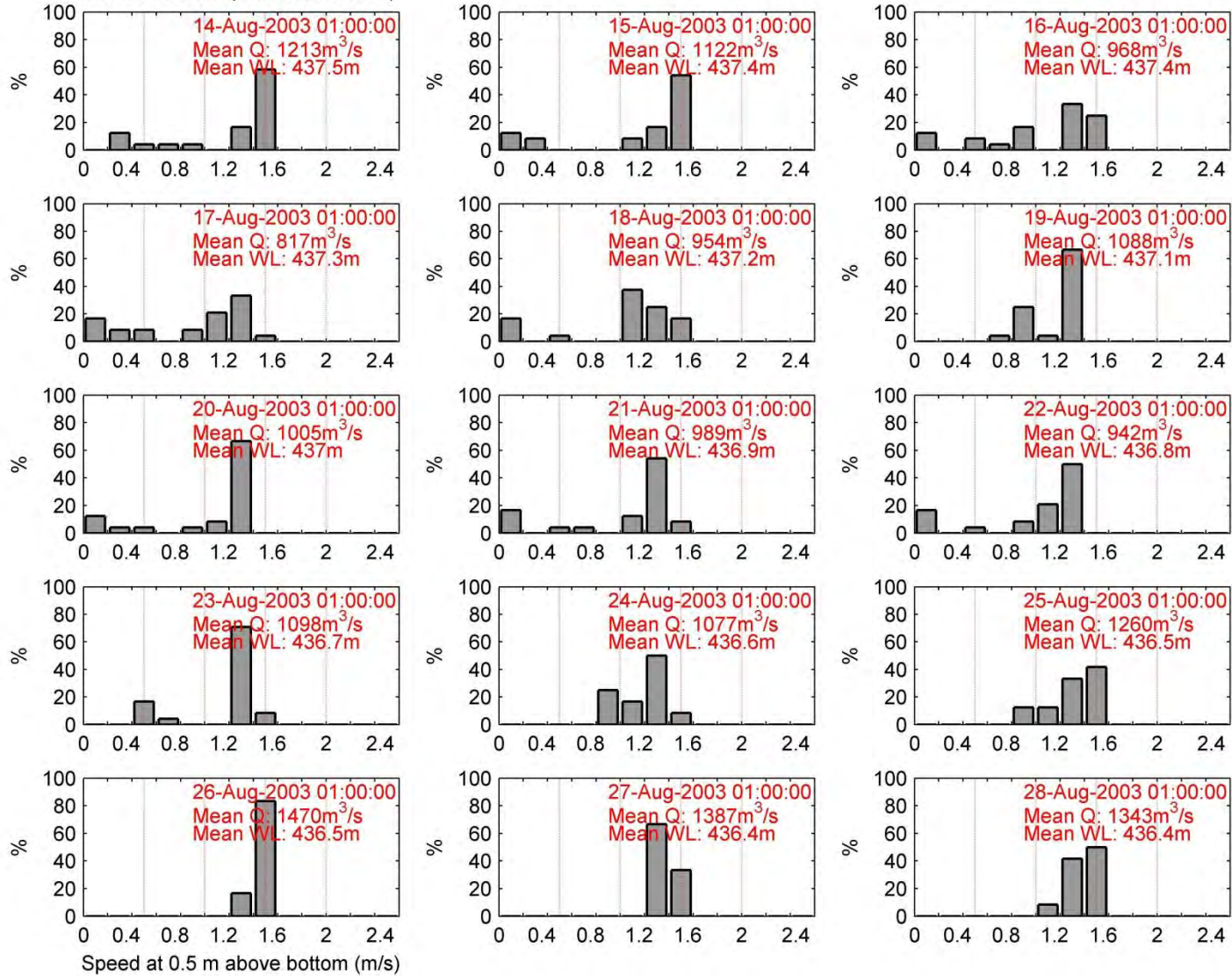




Event5 at Site6 (413479,5651874)

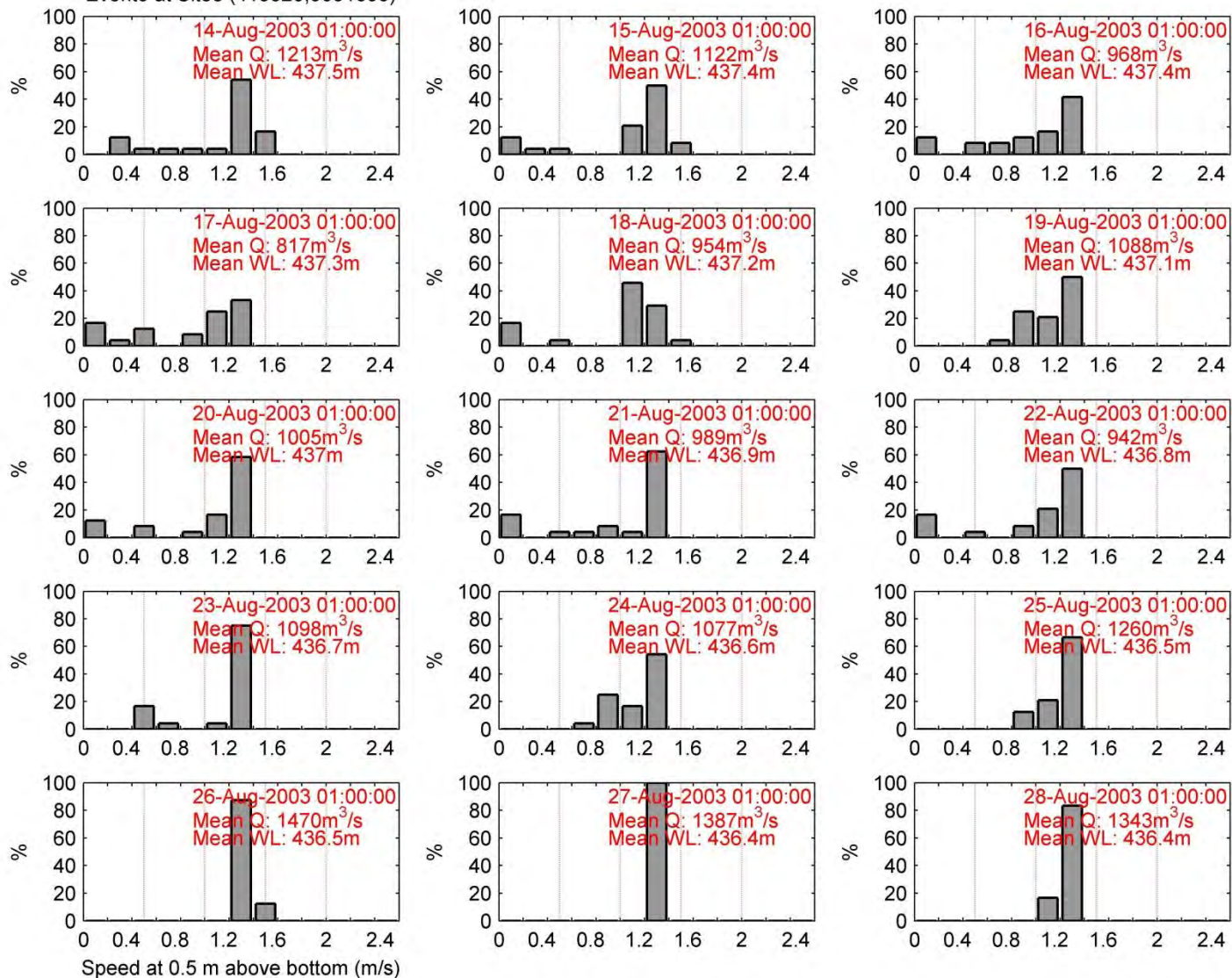


Event5 at Site7 (413376,5651792)

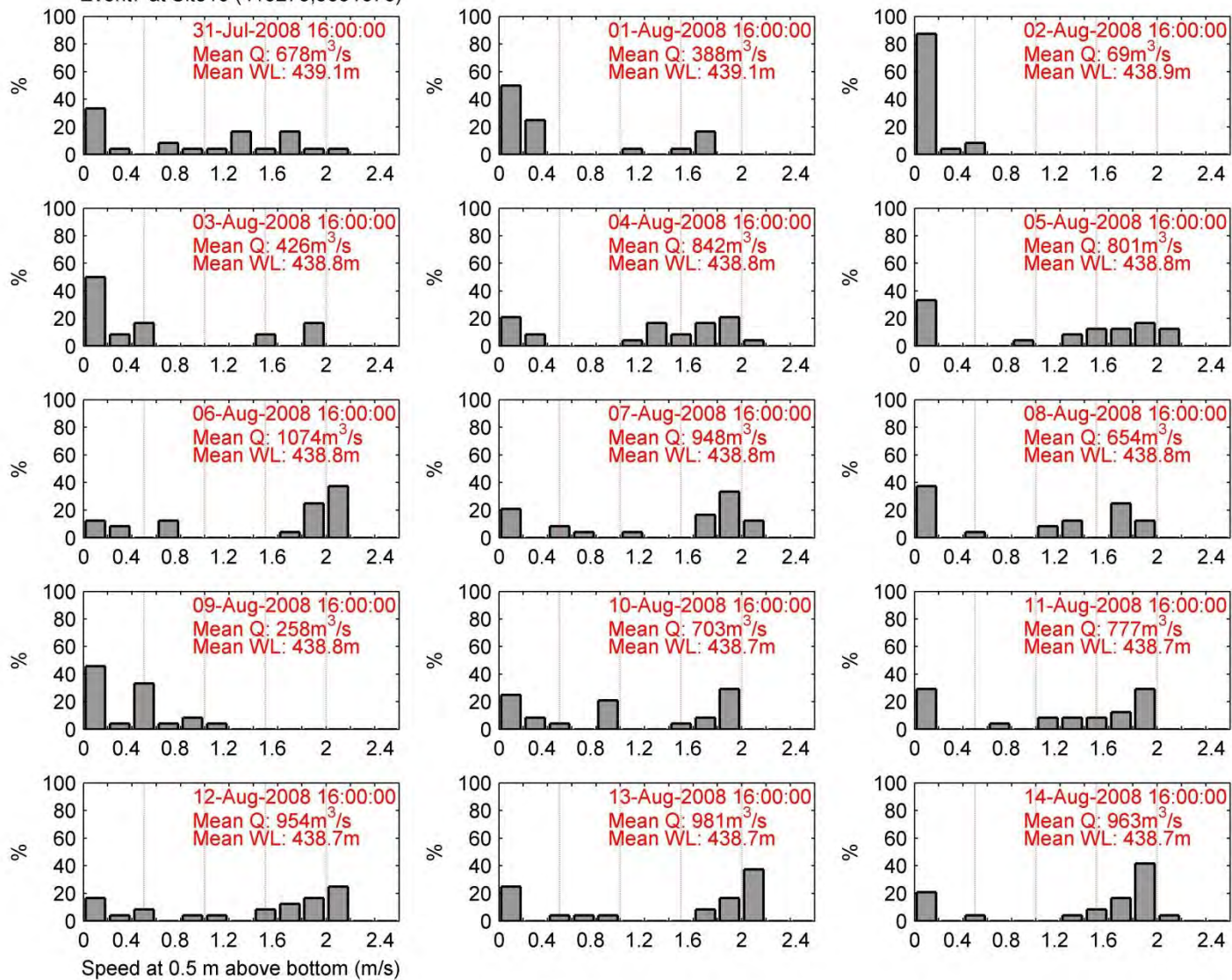




Event5 at Site8 (413320,5651695)

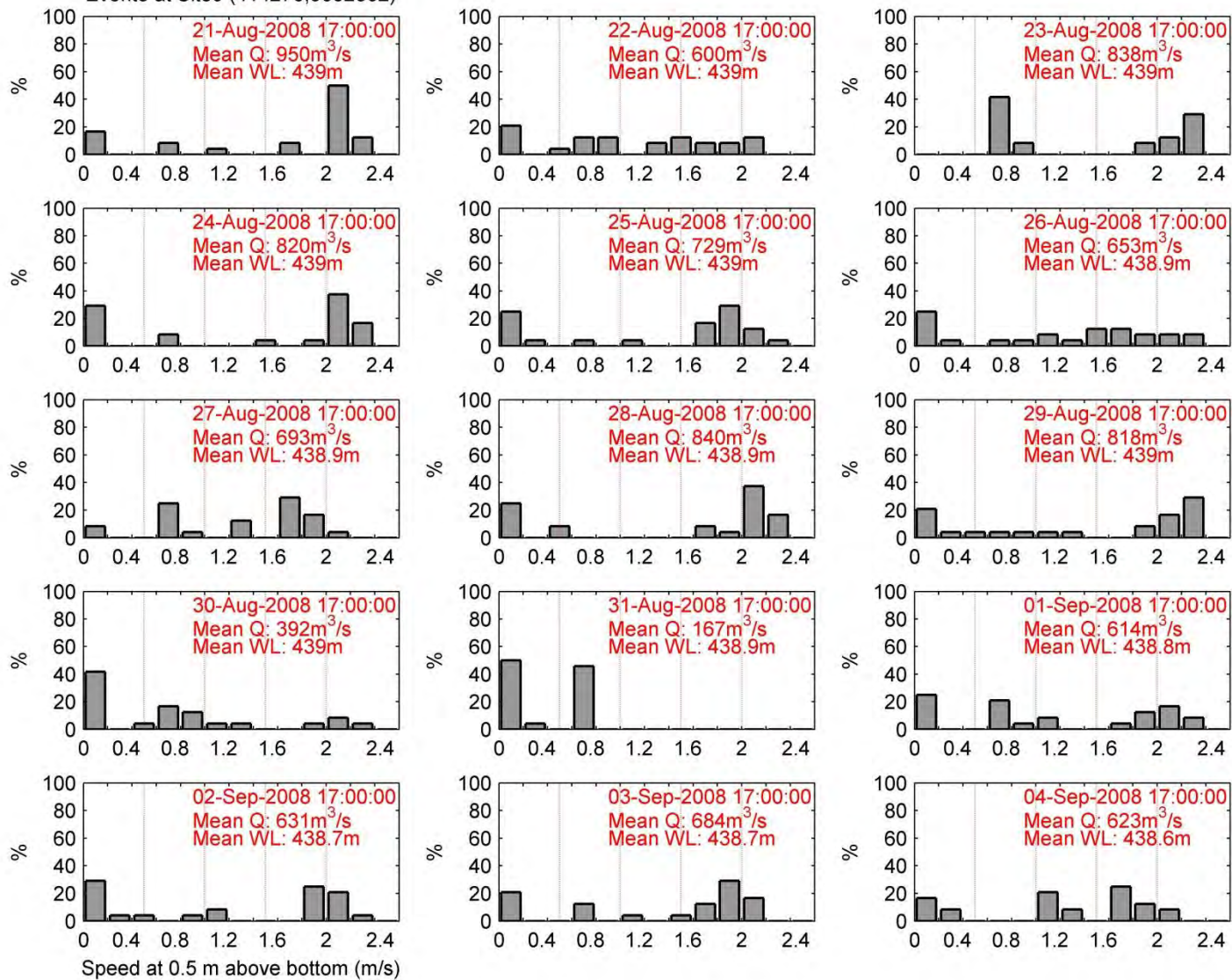


Event7 at Site10 (413275,5651676)

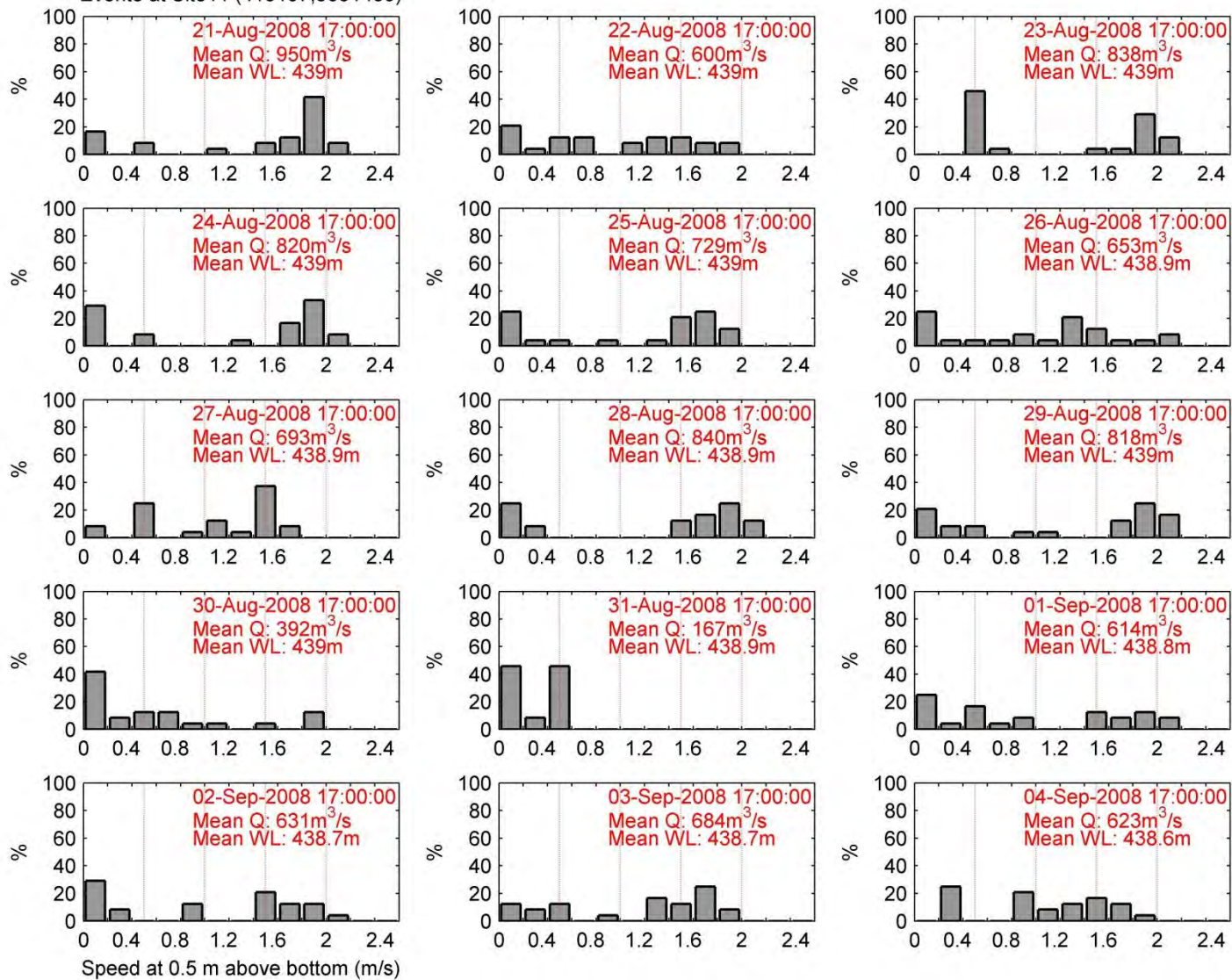




Event8 at Site9 (414276,5652502)

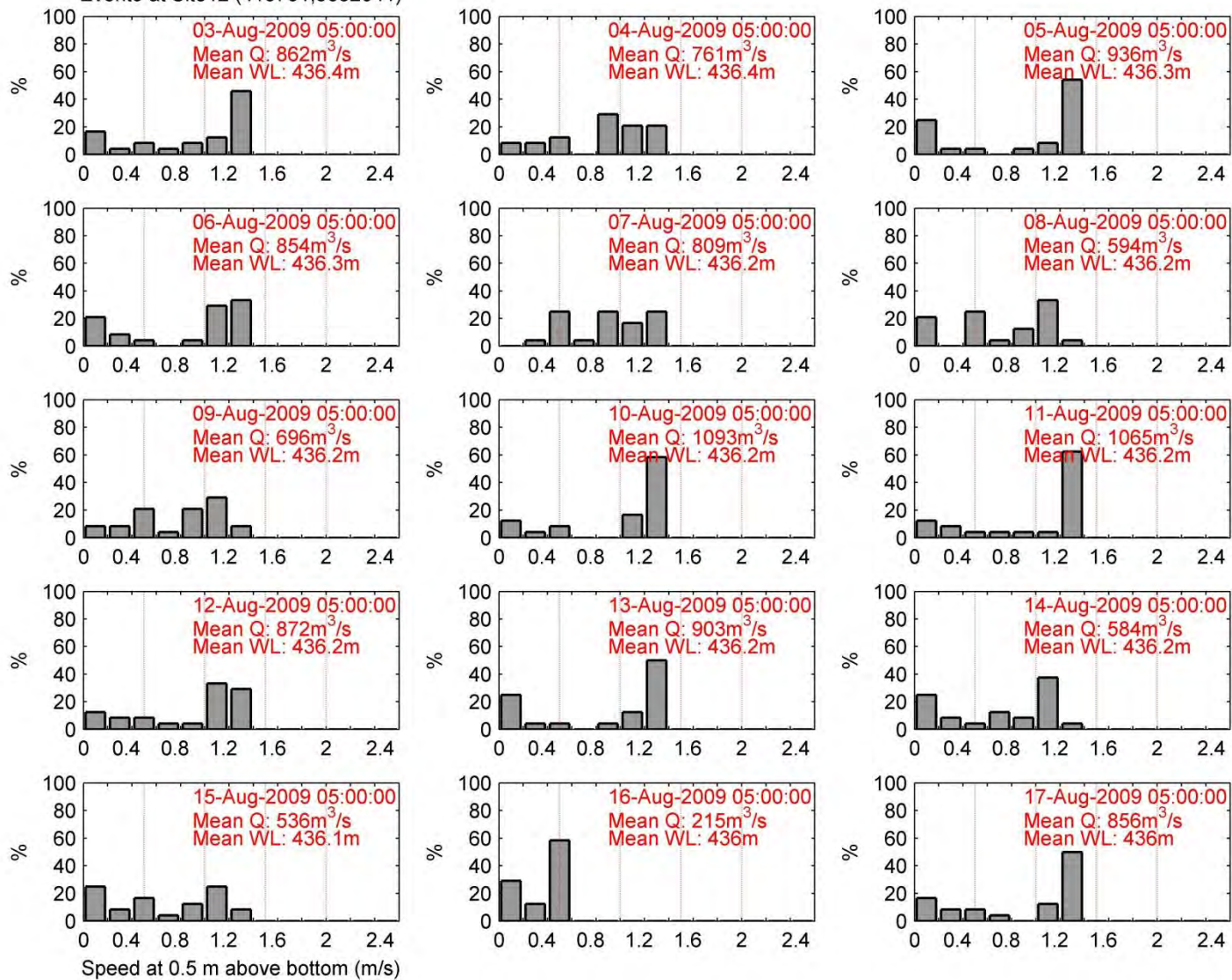


Event8 at Site11 (413197,5651459)

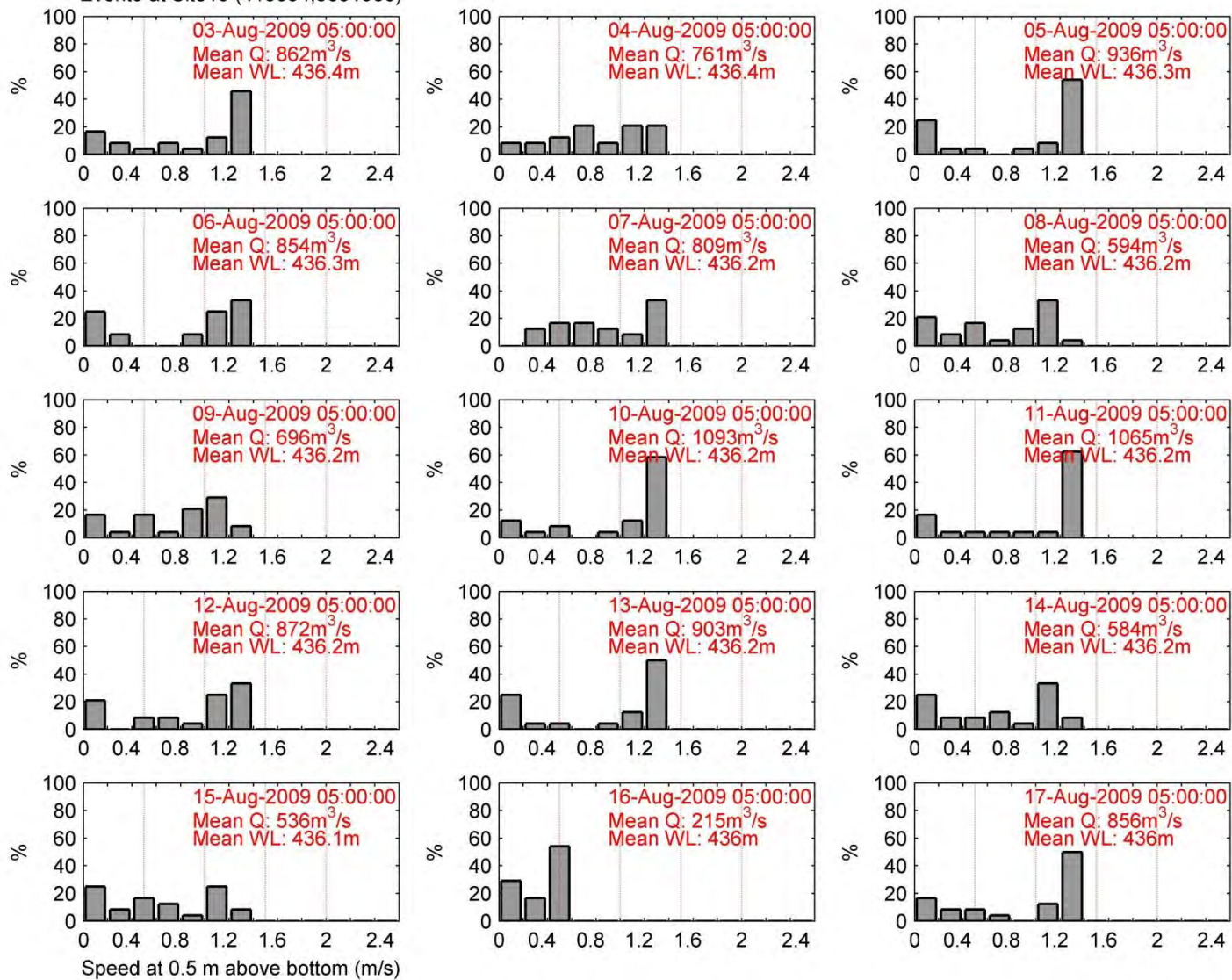




Event9 at Site12 (413731,5652041)

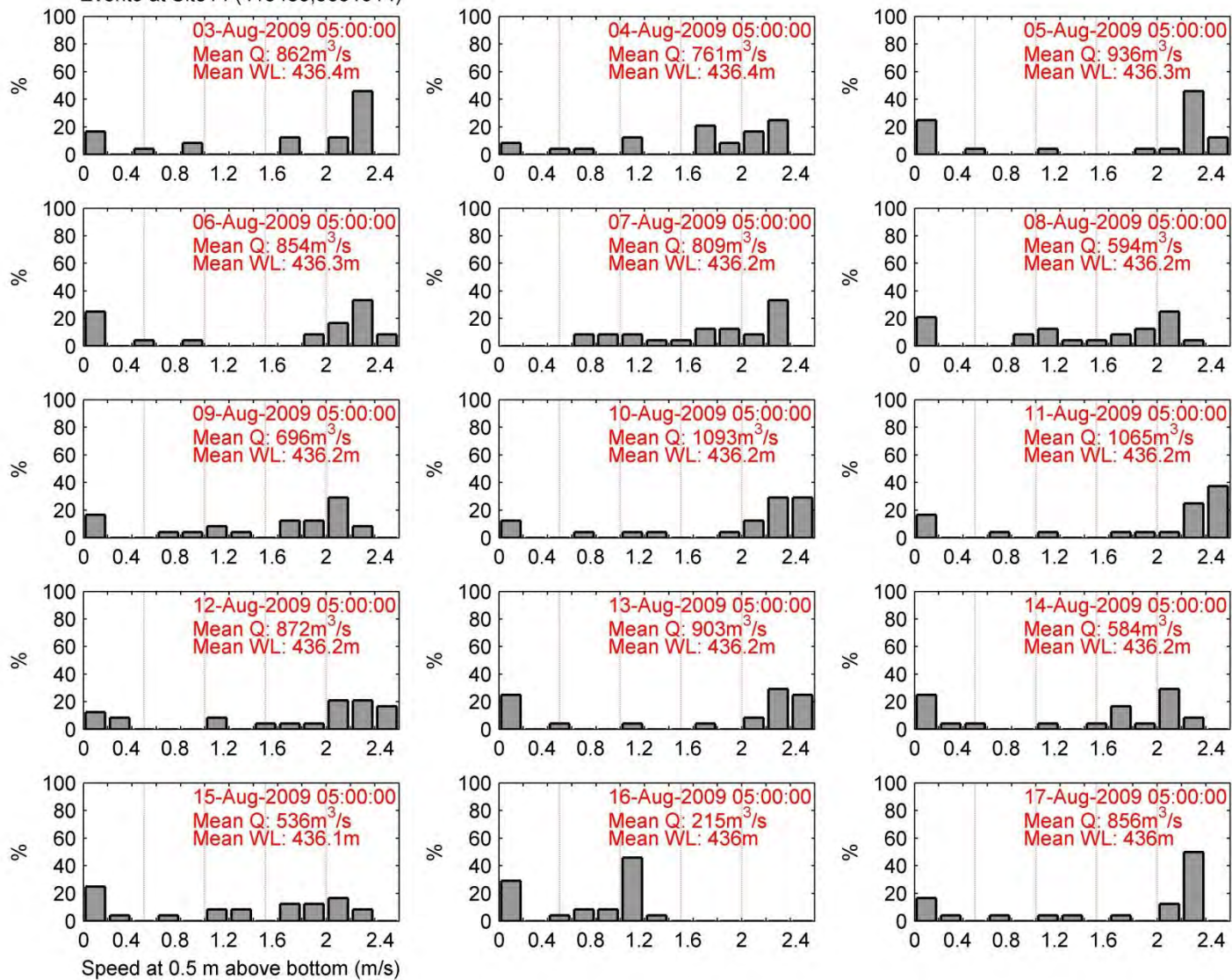


Event9 at Site13 (413634,5651966)

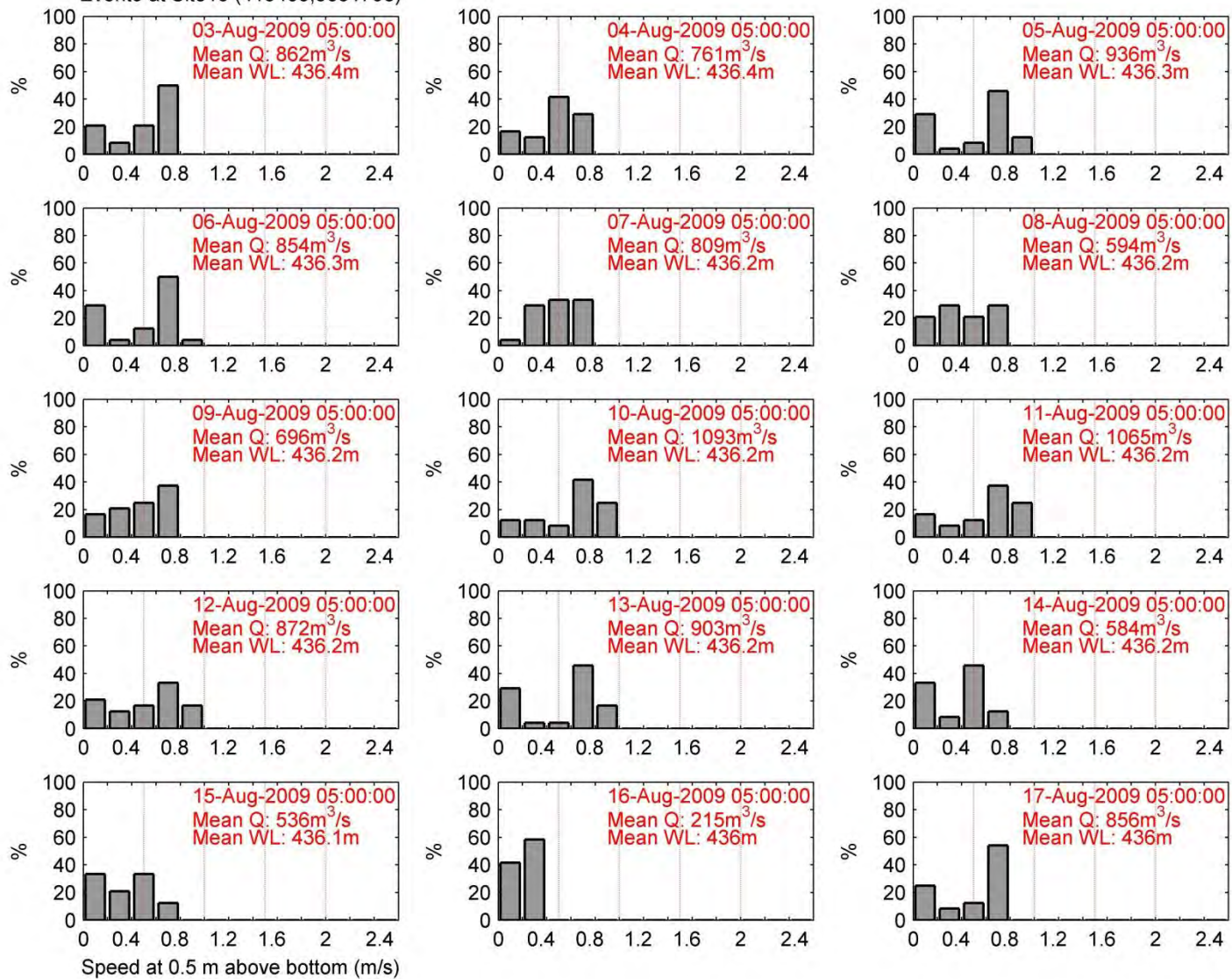




Event9 at Site14 (413483,5651914)

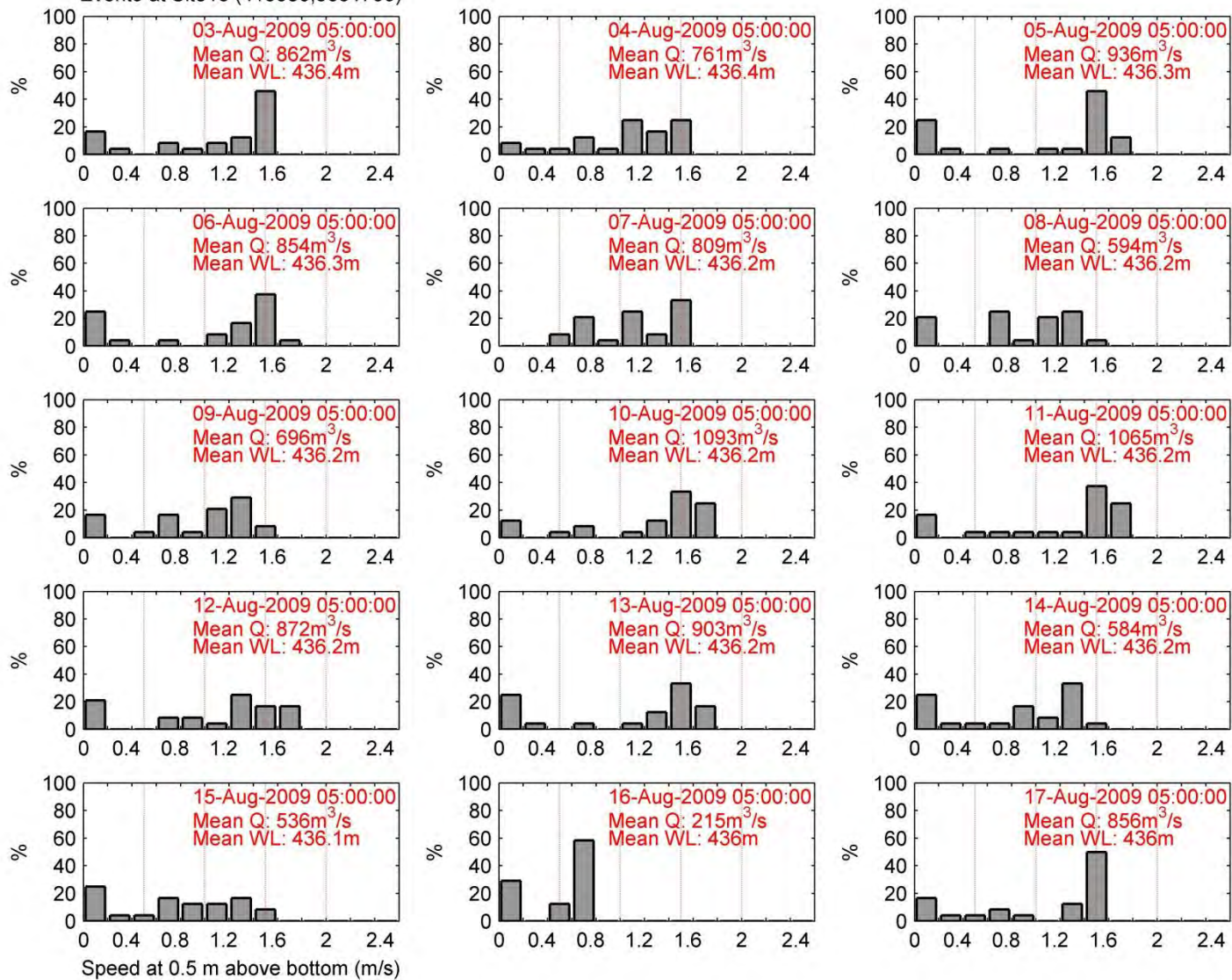


Event9 at Site15 (413403,5651798)

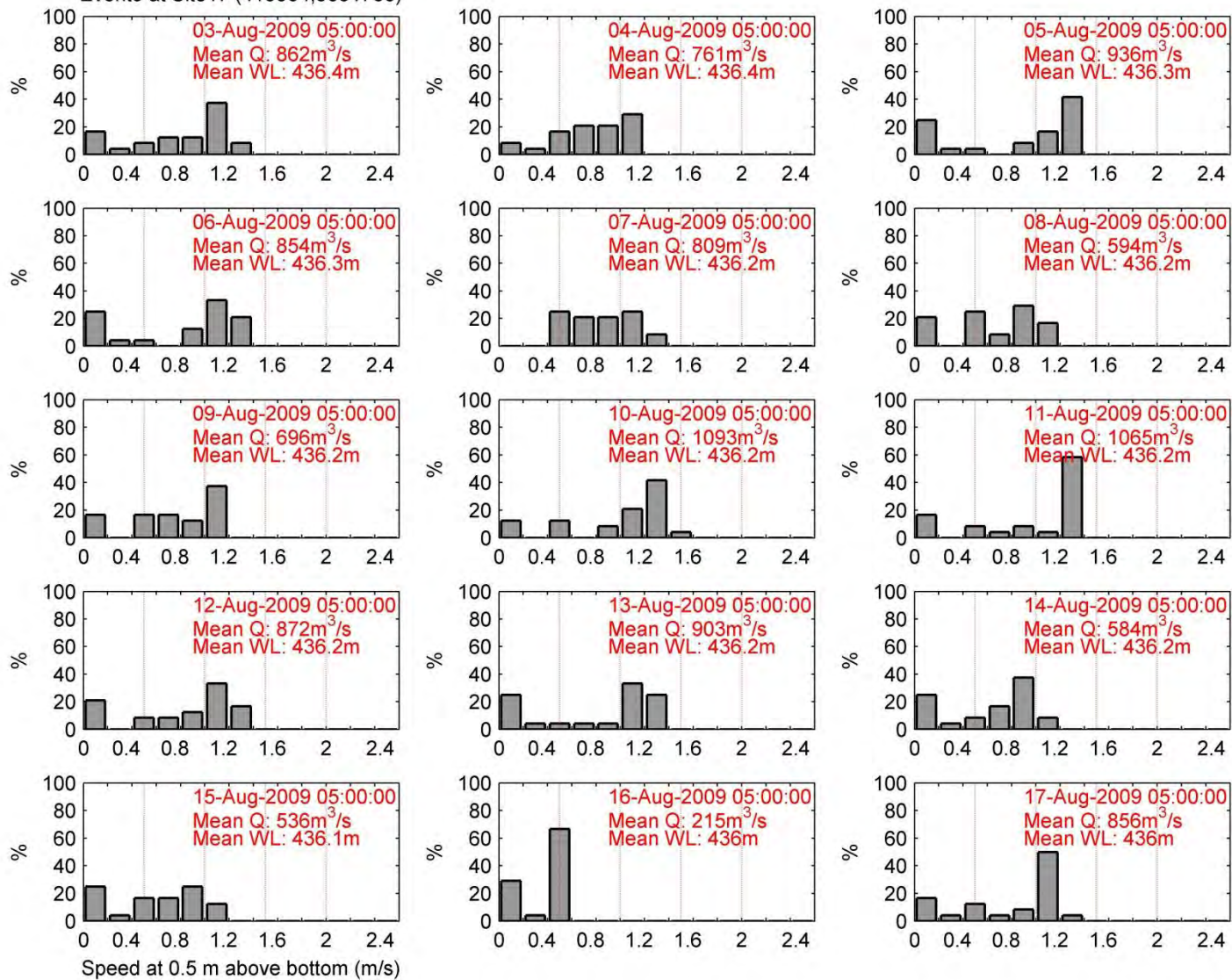




Event9 at Site16 (413380,5651799)

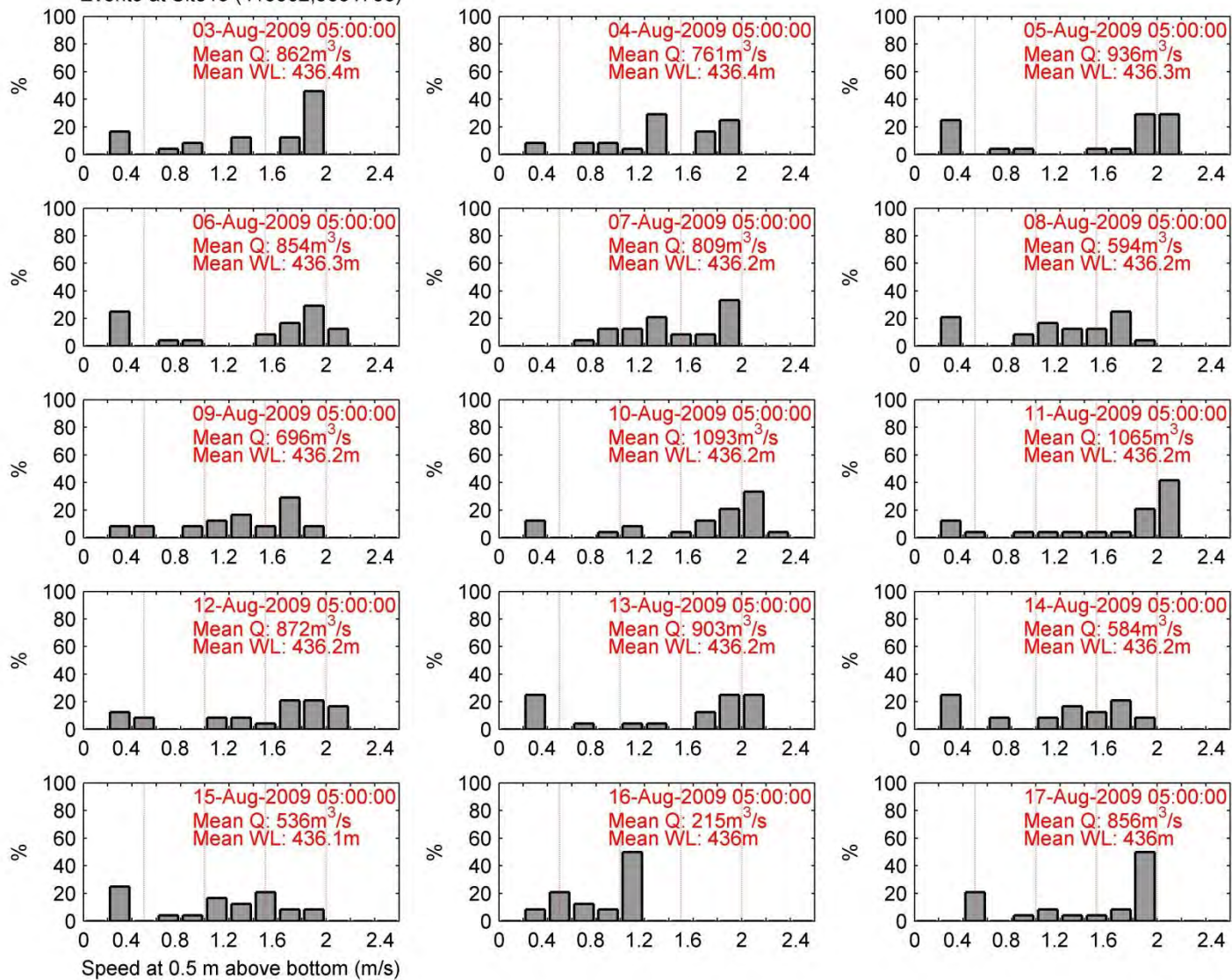


Event9 at Site17 (413364,5651766)

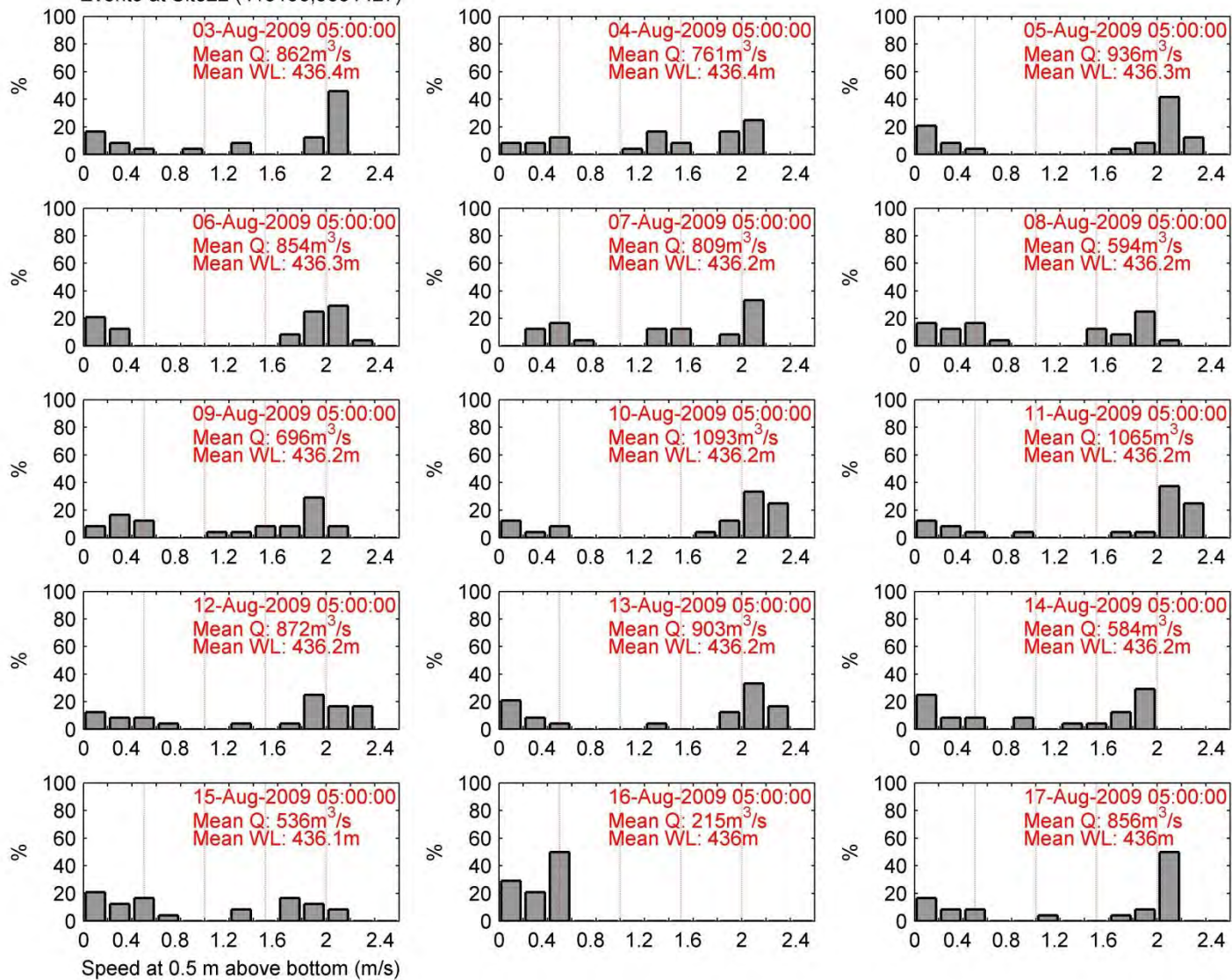




Event9 at Site19 (413302,5651733)

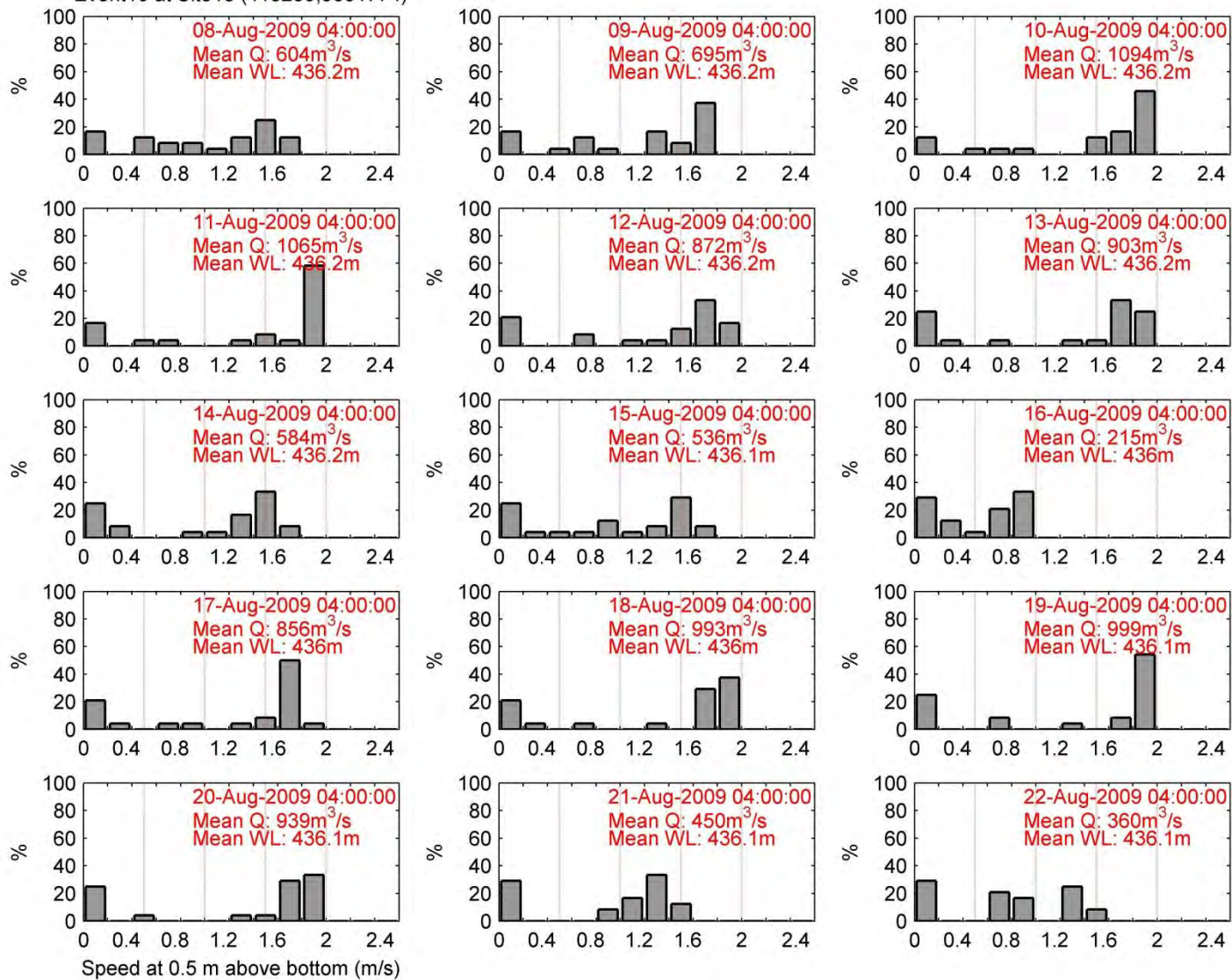


Event9 at Site22 (413196,5651427)

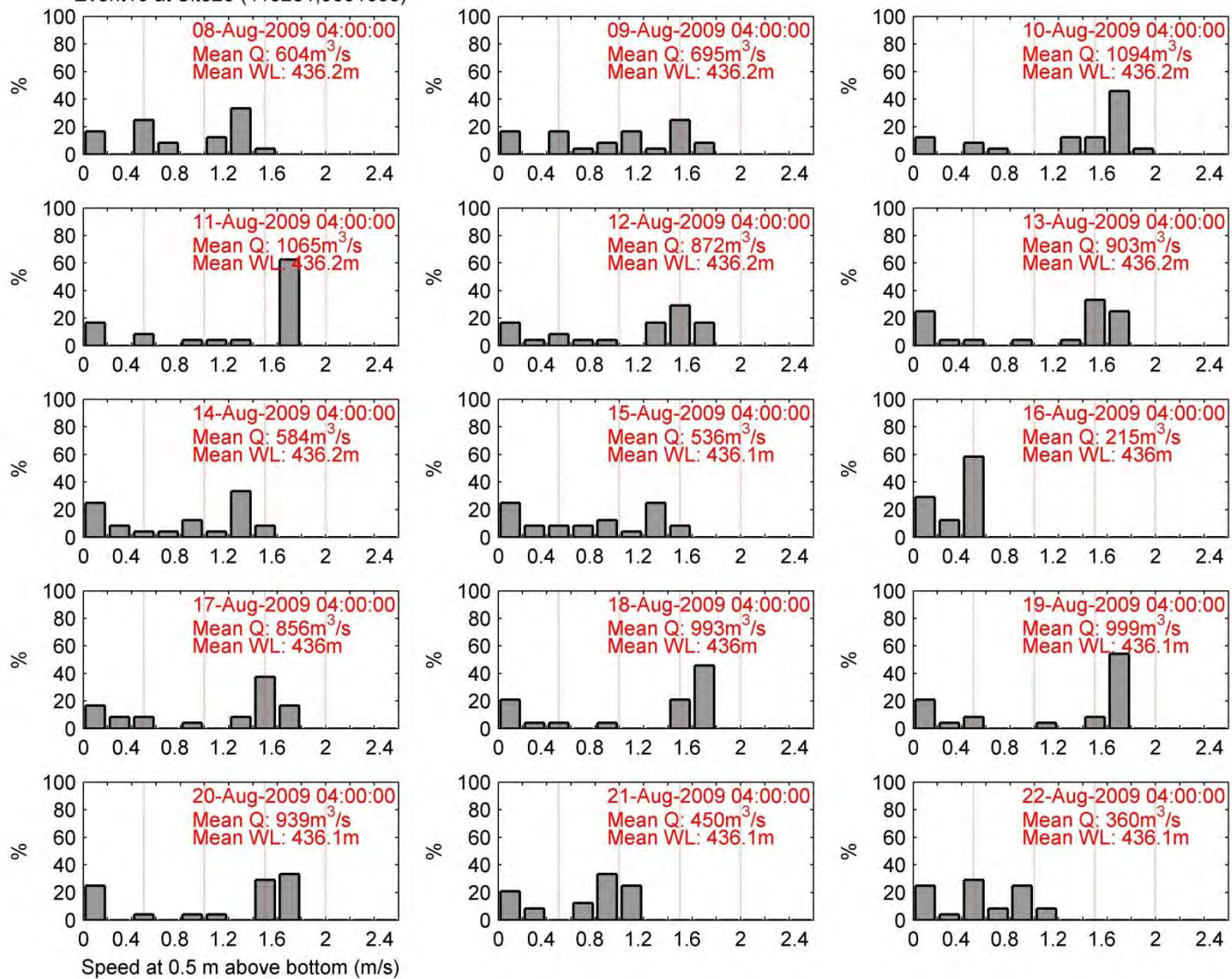




Event10 at Site18 (413259,5651774)

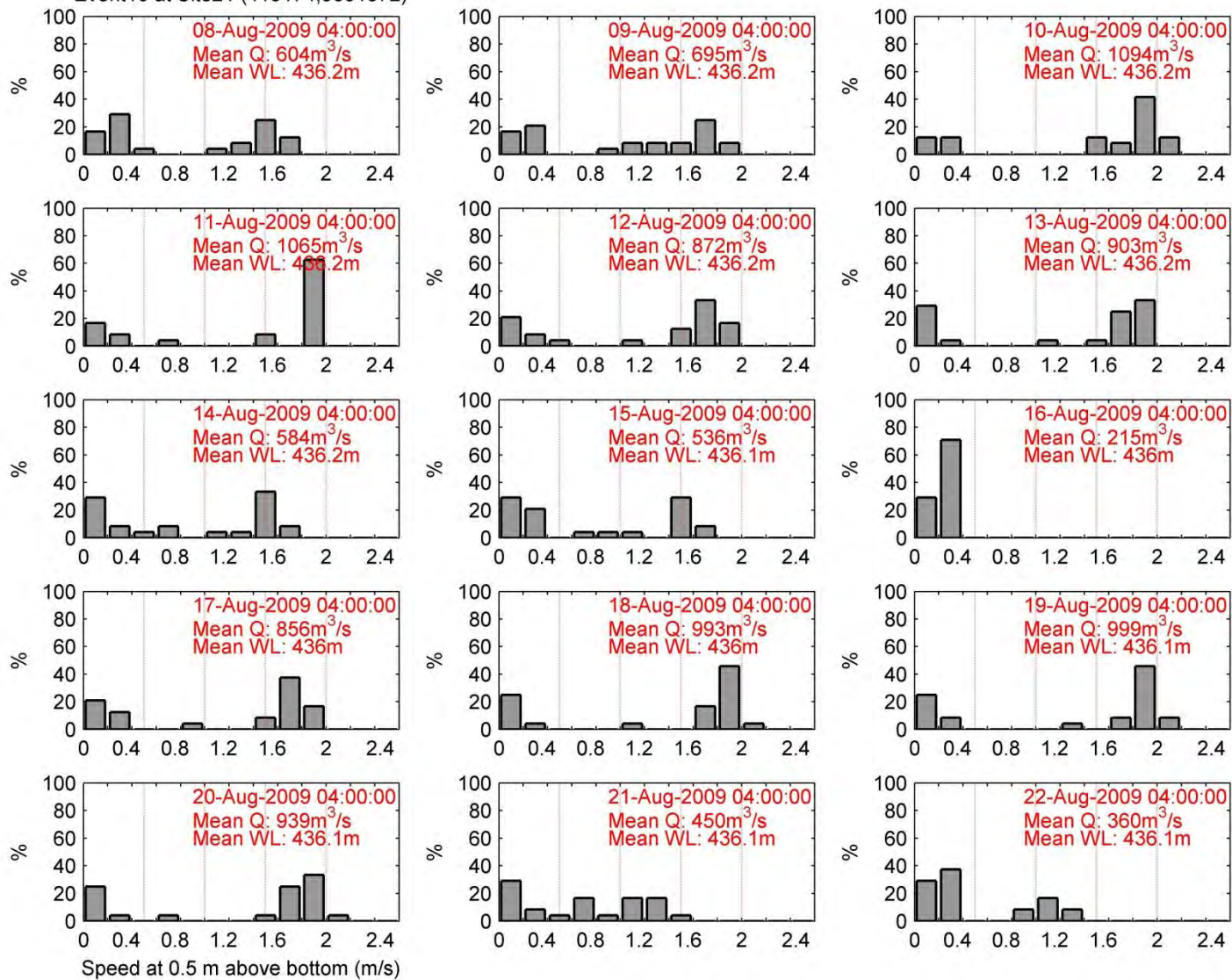


Event10 at Site20 (413281,5651633)

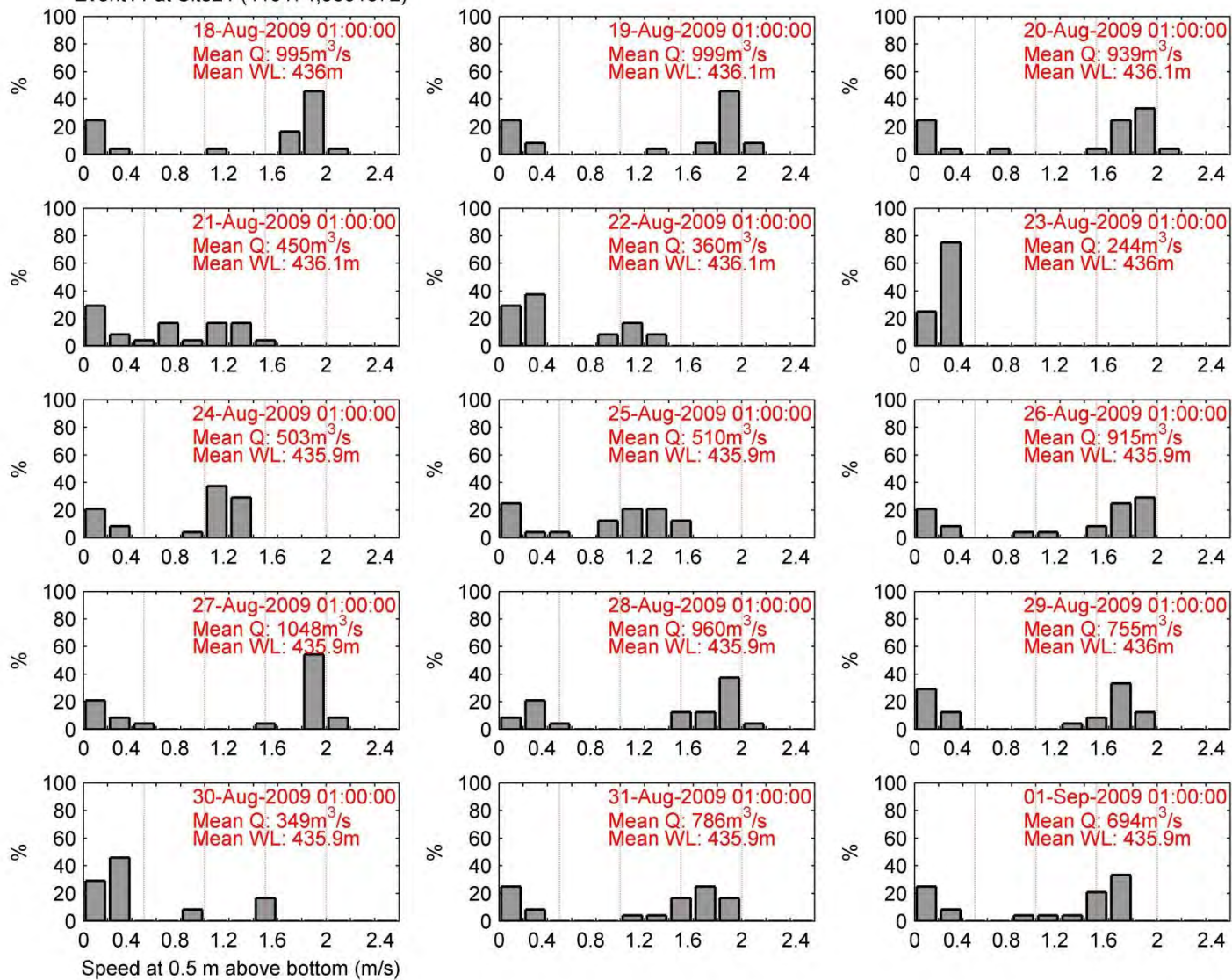




Event10 at Site21 (413174,5651372)

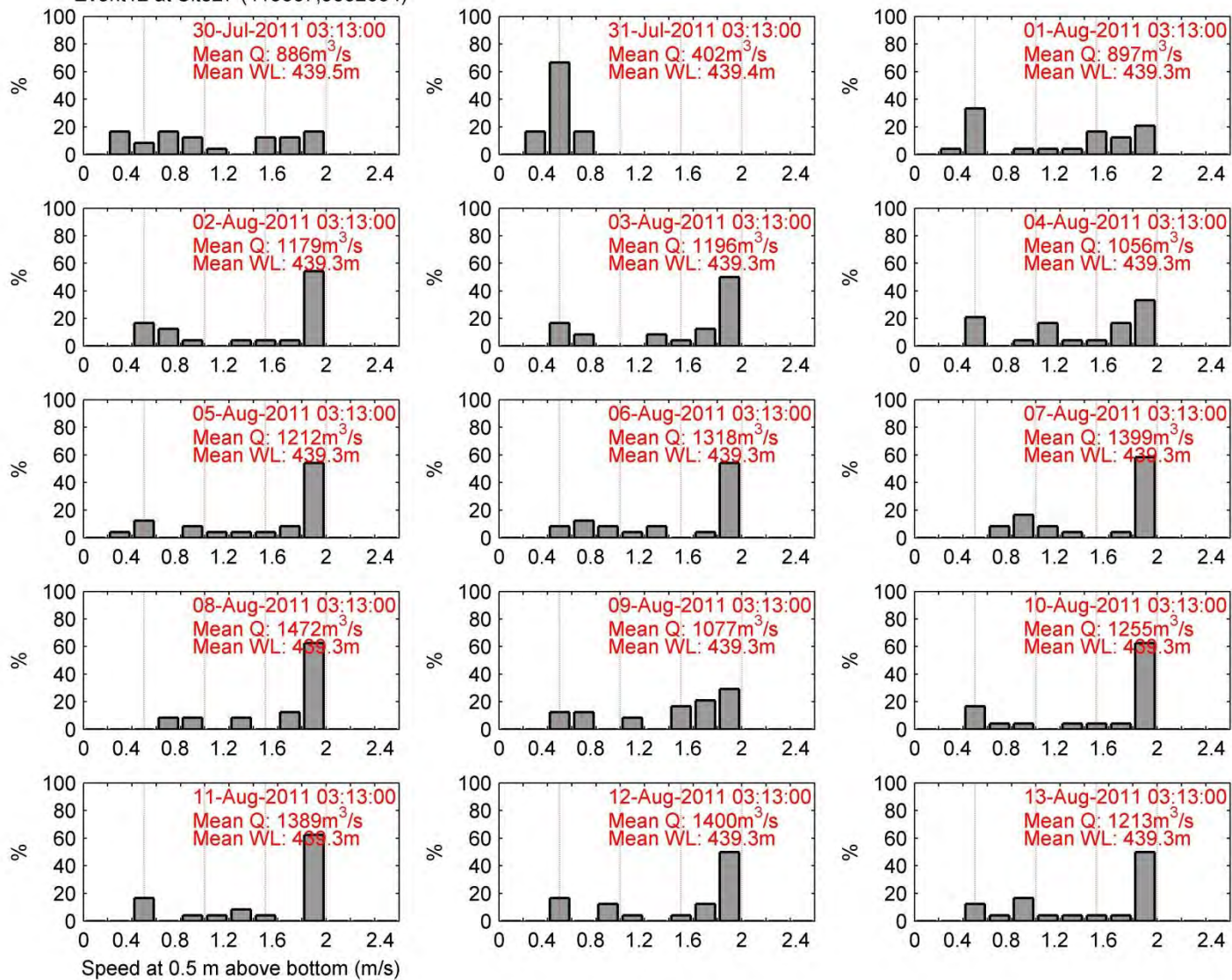


Event11 at Site21 (413174,5651372)

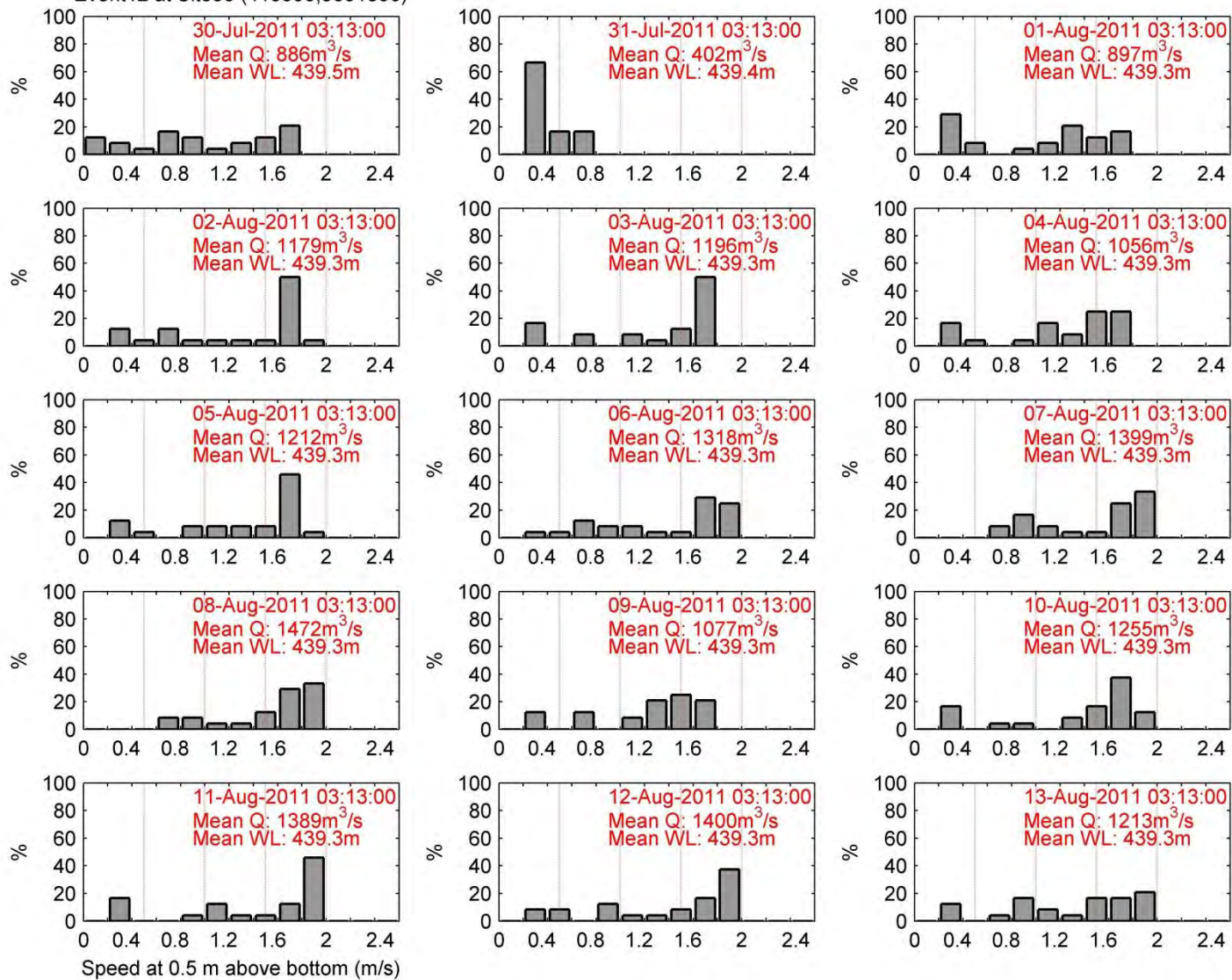




Event12 at Site27 (413667,5652034)

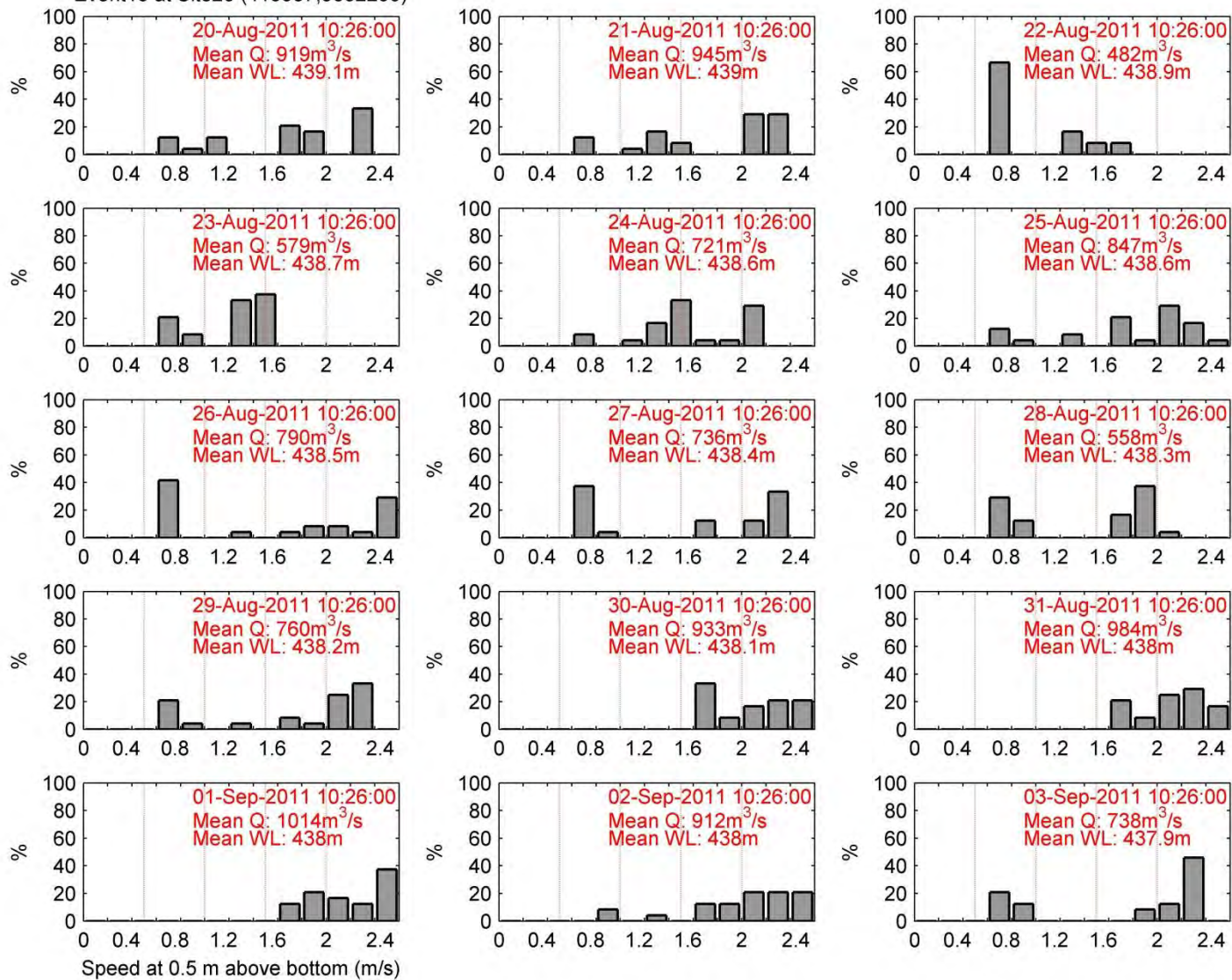


Event12 at Site30 (413395,5651830)

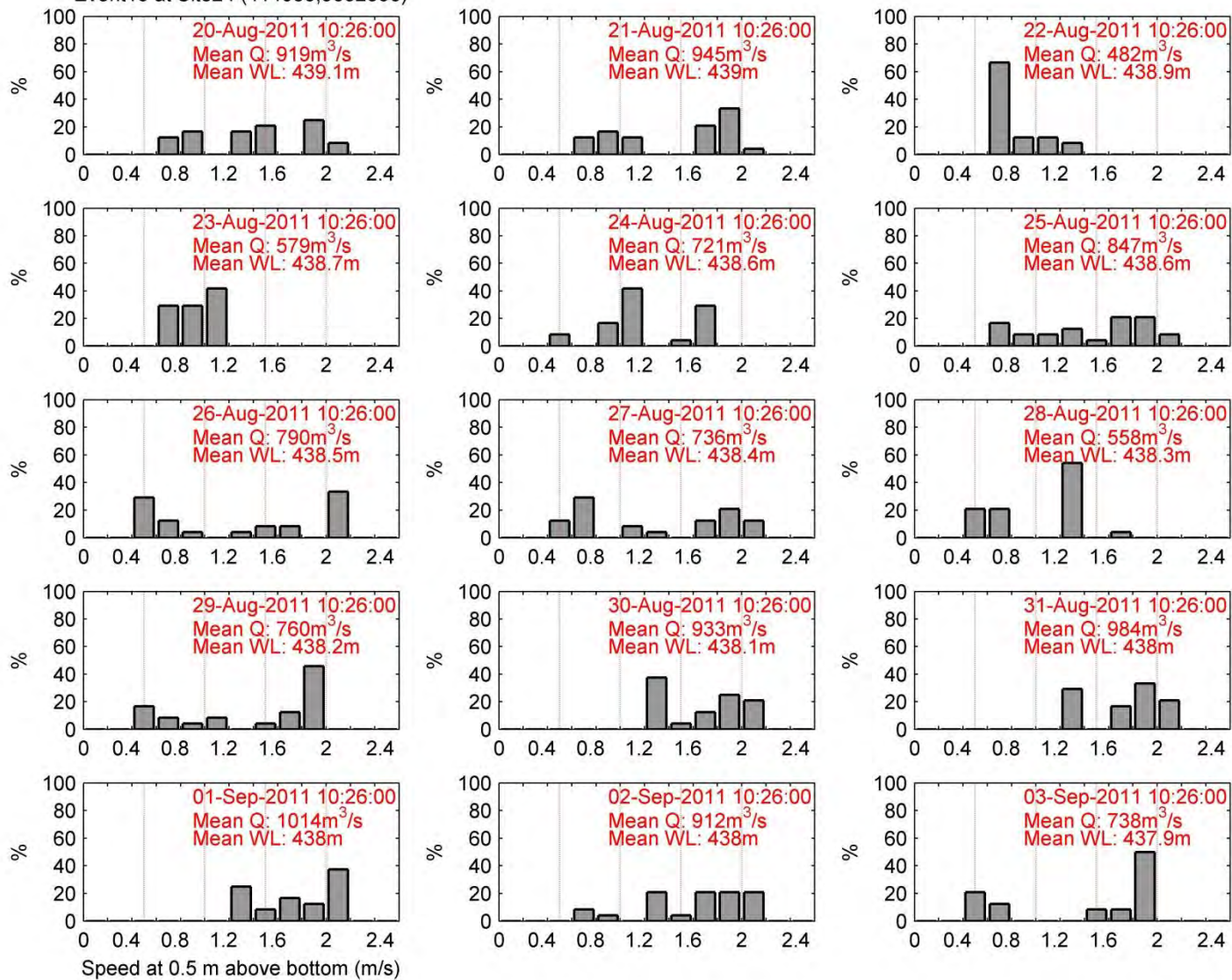




Event13 at Site23 (413957,5652299)

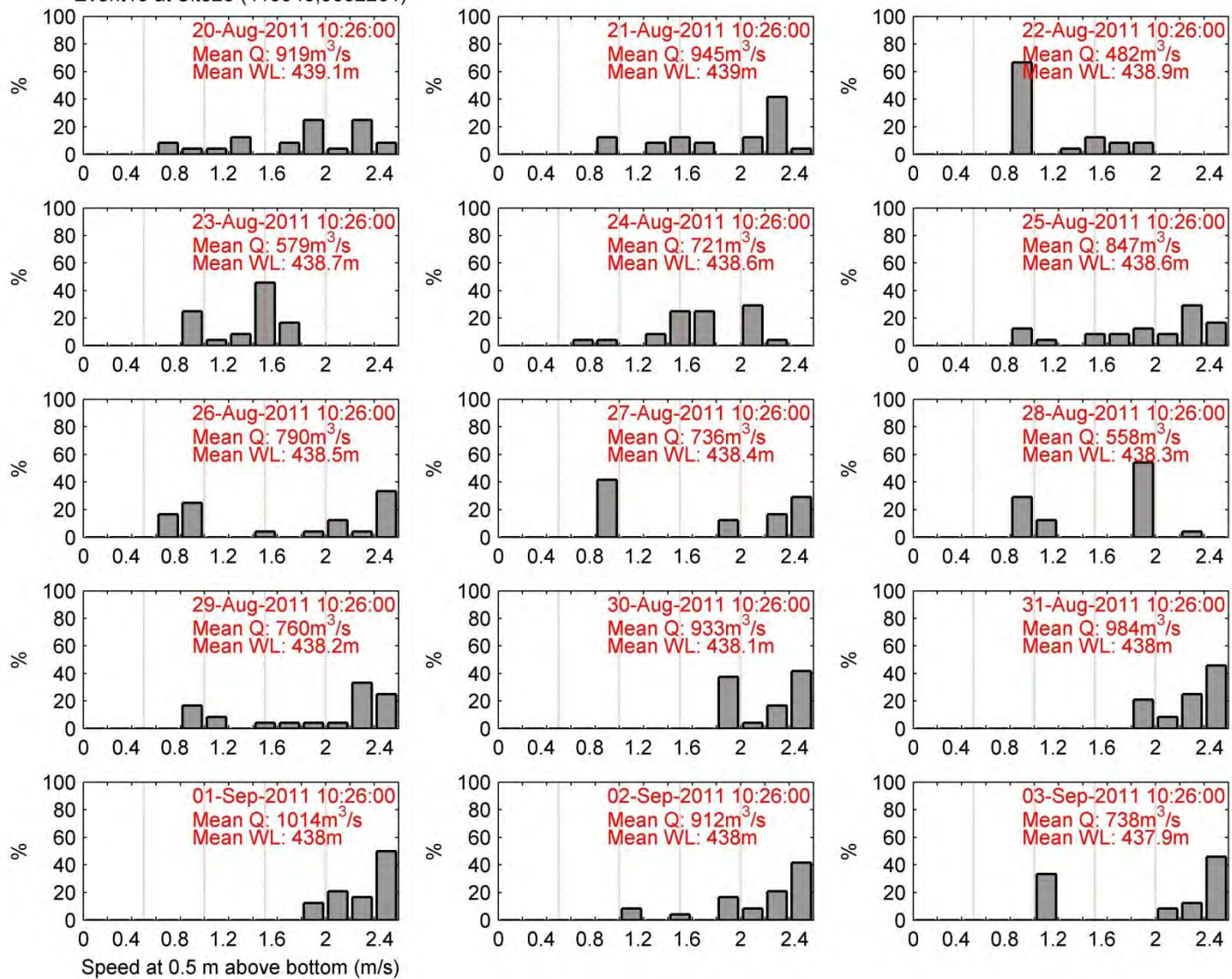


Event13 at Site24 (414083,5652336)

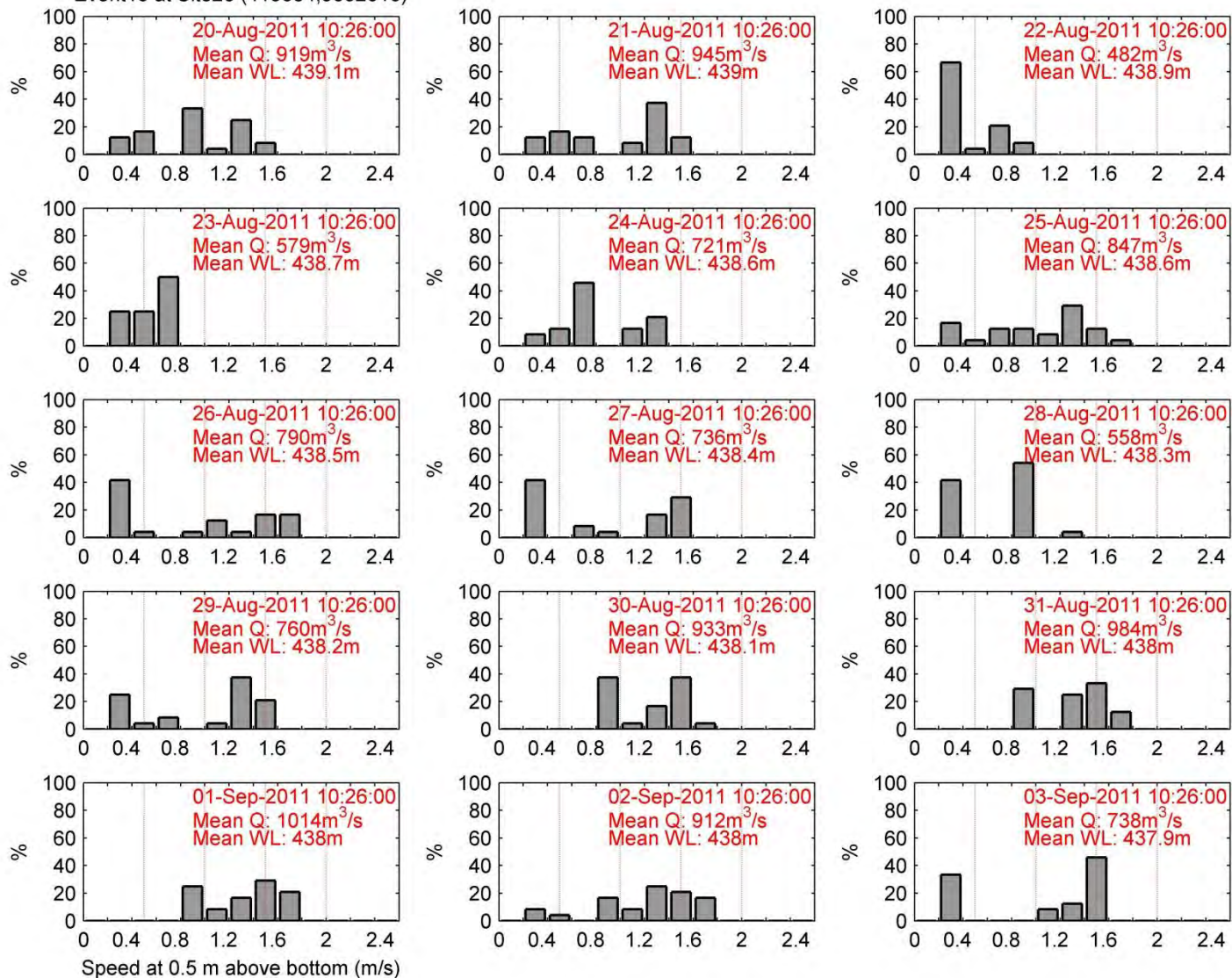




Event13 at Site25 (413945,5652261)

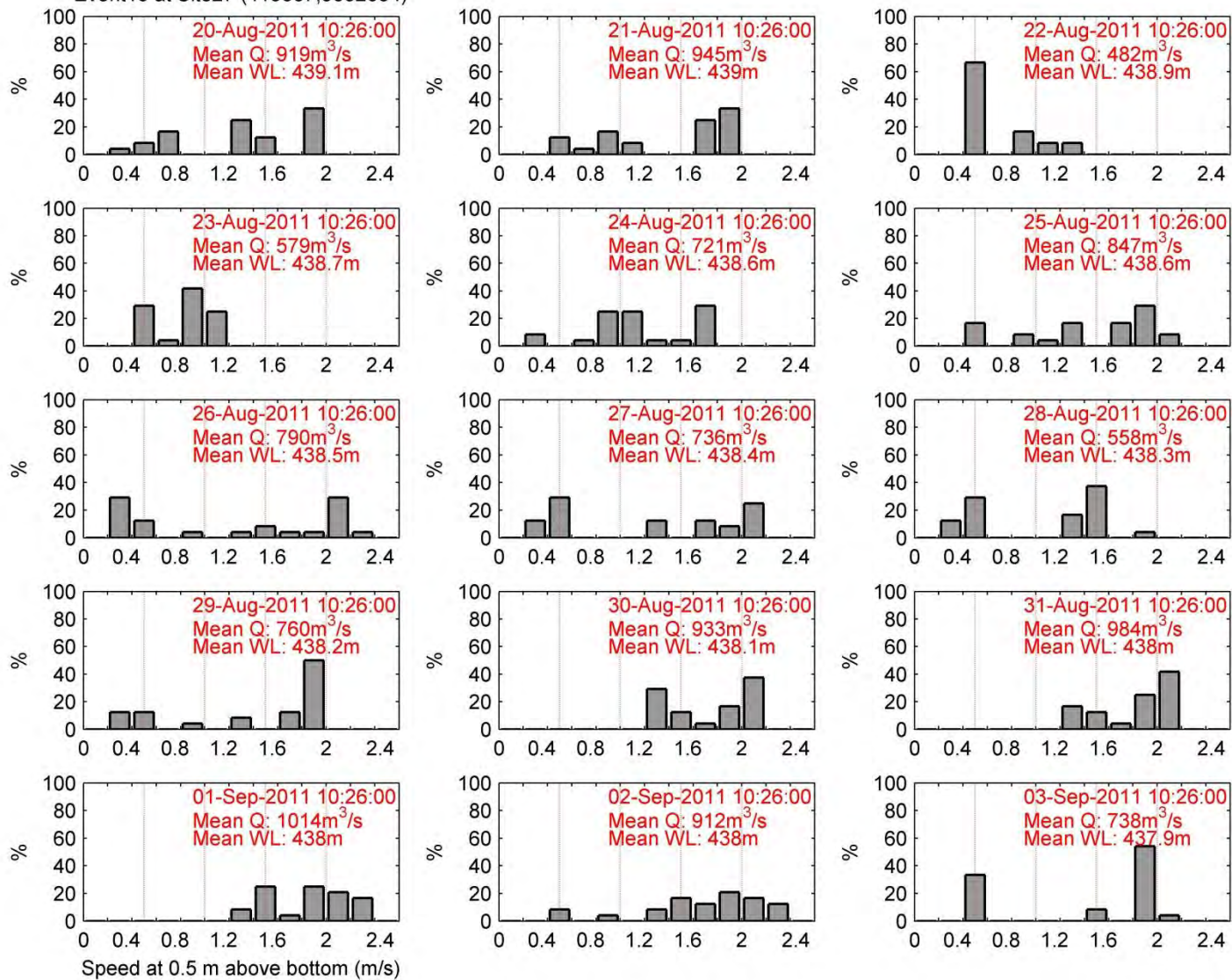


Event13 at Site26 (413684,5652016)

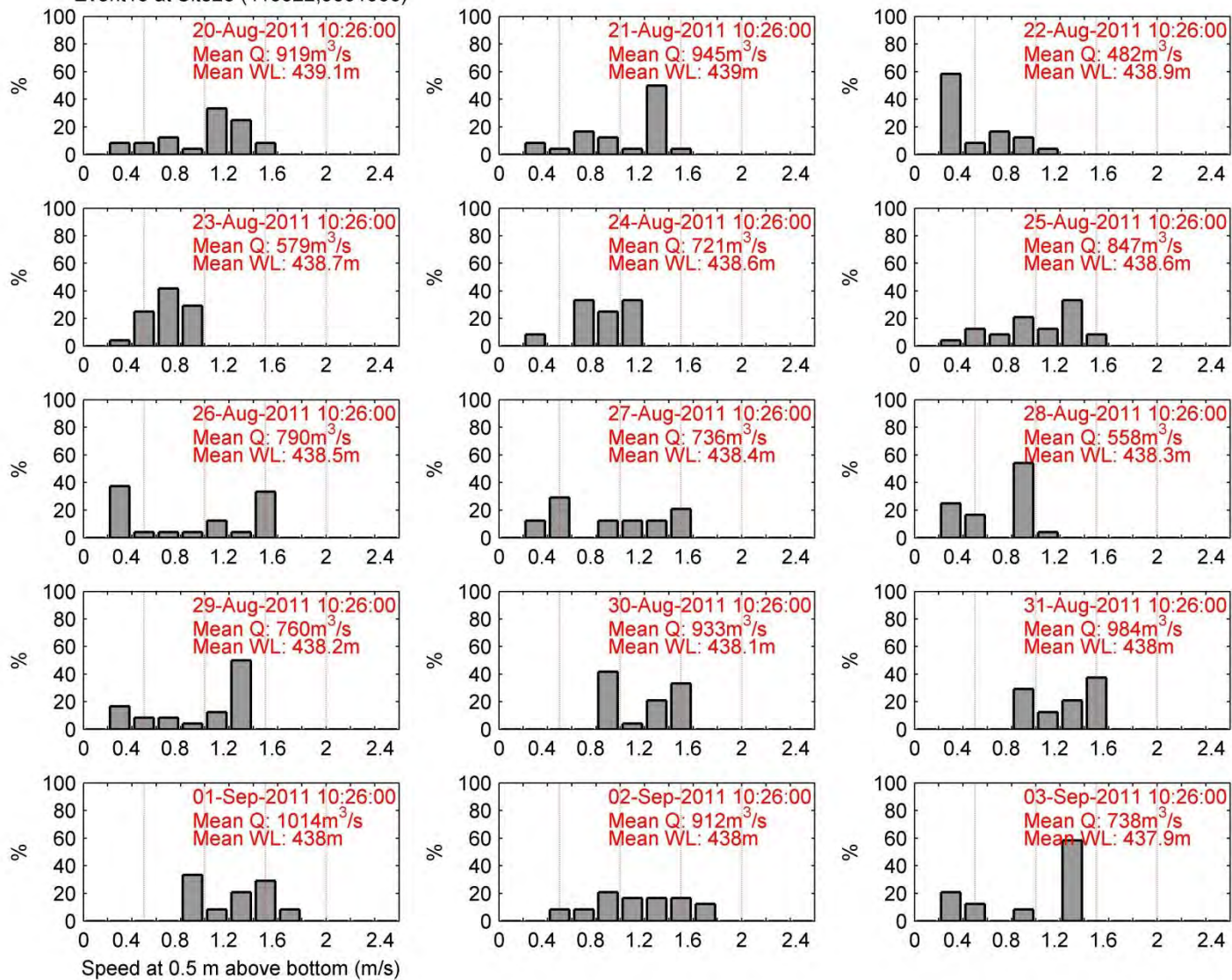




Event13 at Site27 (413667,5652034)

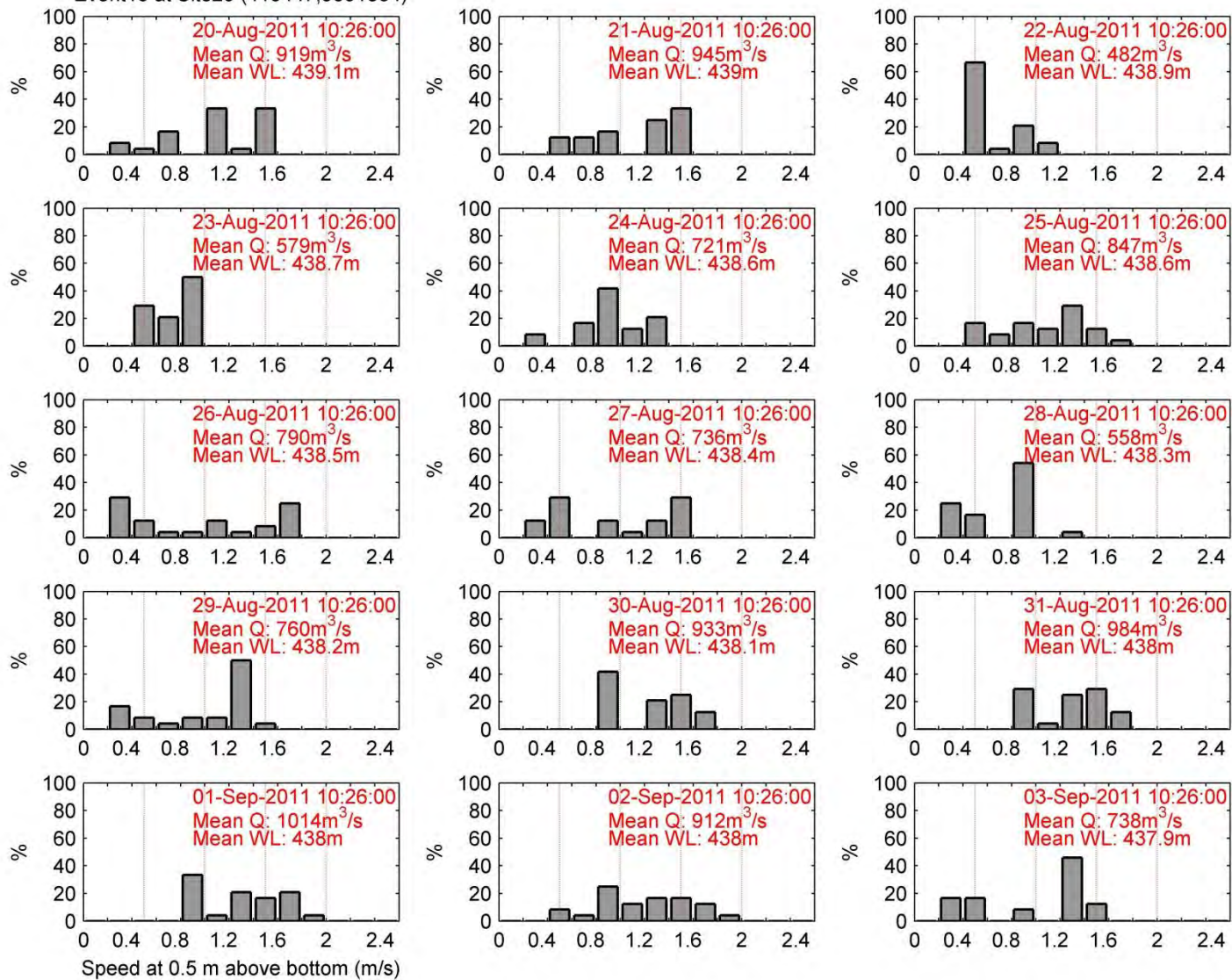


Event13 at Site28 (413522,5651906)



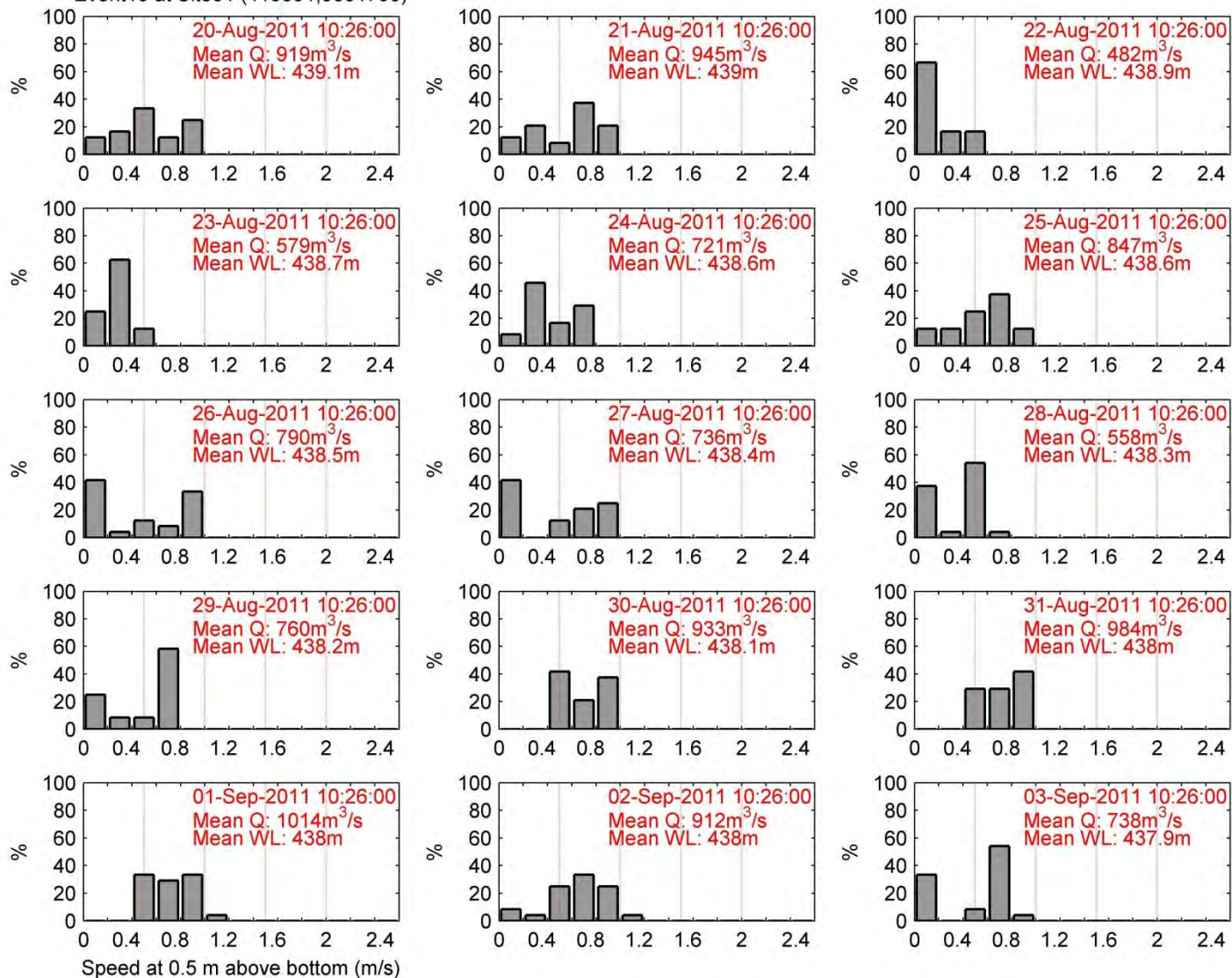


Event13 at Site29 (413447,5651864)

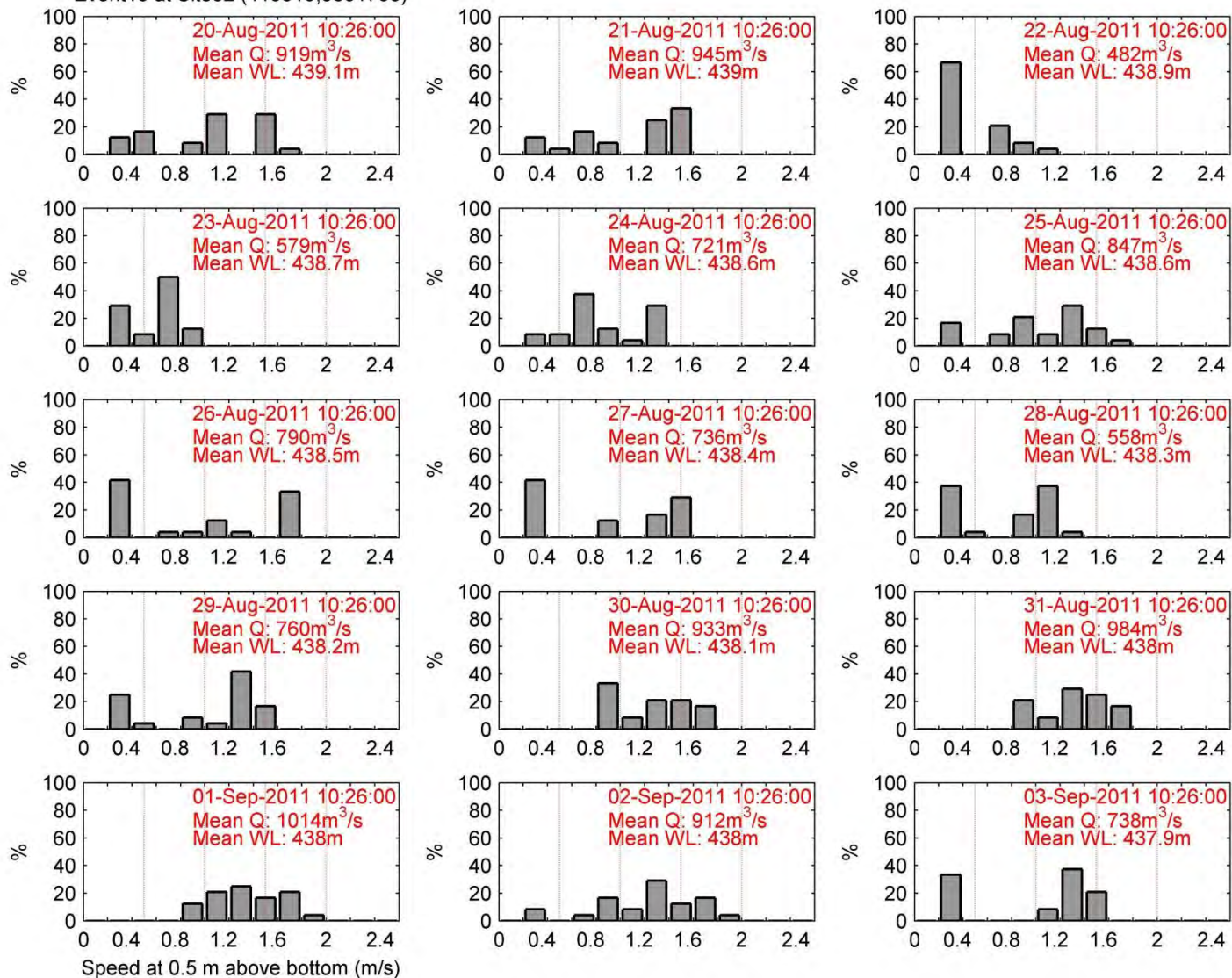




Event13 at Site31 (413391,5651795)

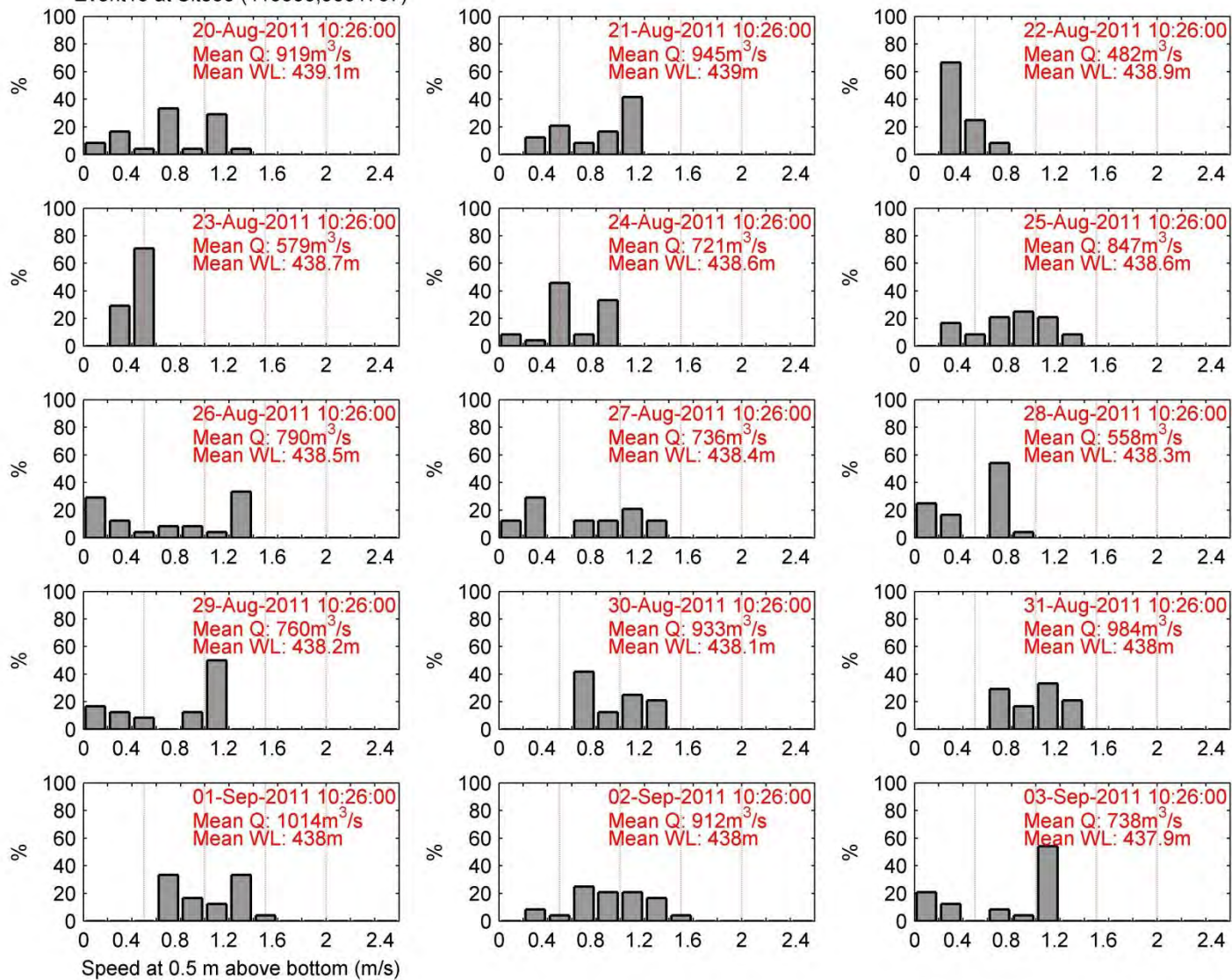


Event13 at Site32 (413319,5651733)



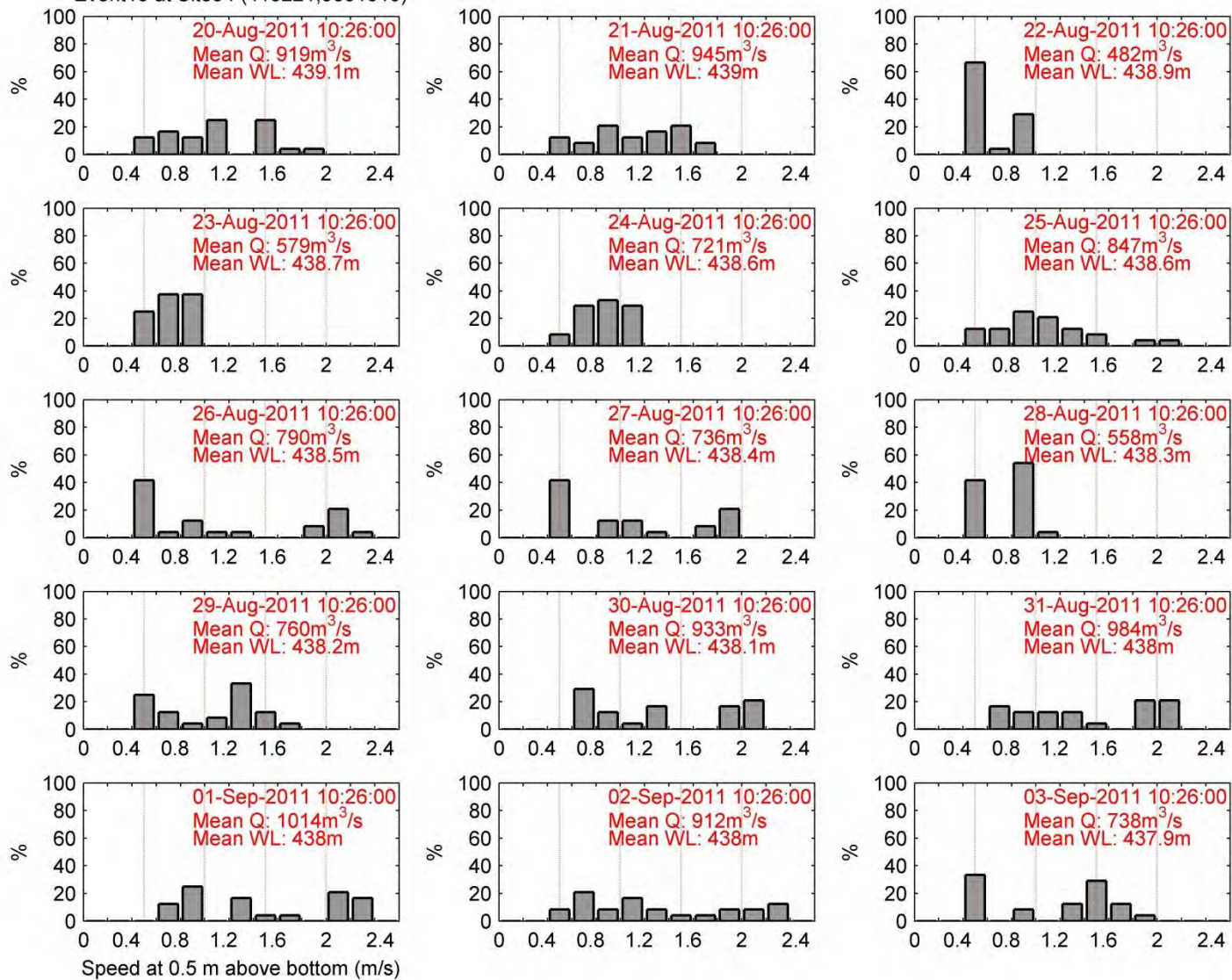


Event13 at Site33 (413353,5651757)

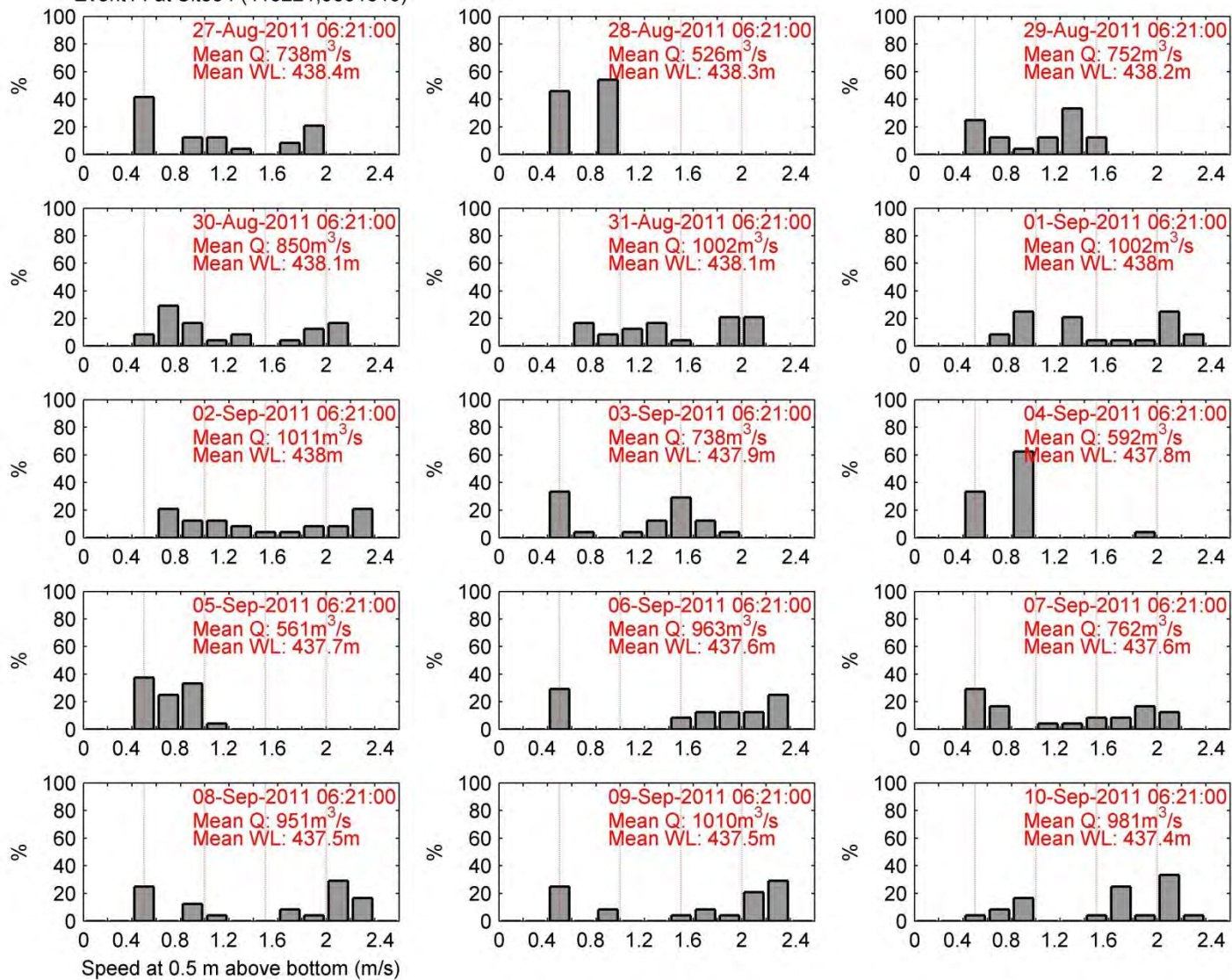




Event13 at Site34 (413221,5651519)



Event14 at Site34 (413221,5651519)

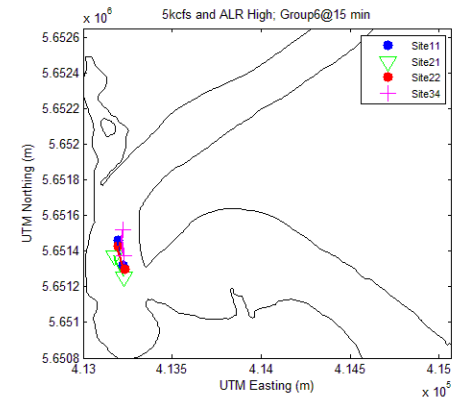
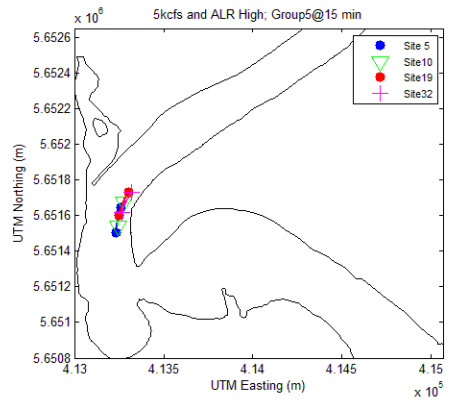
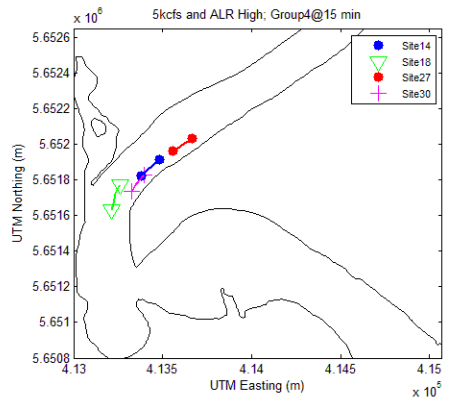
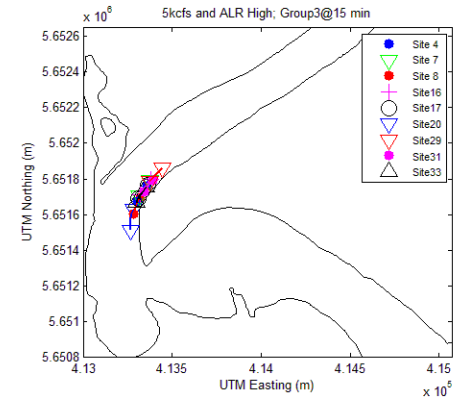
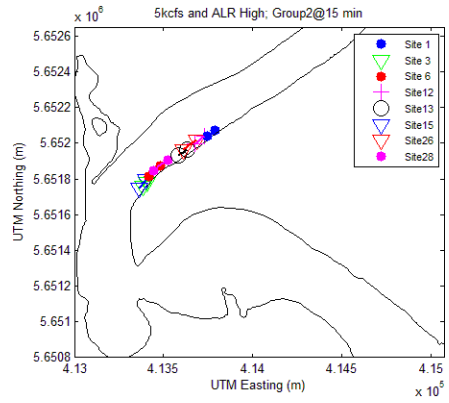
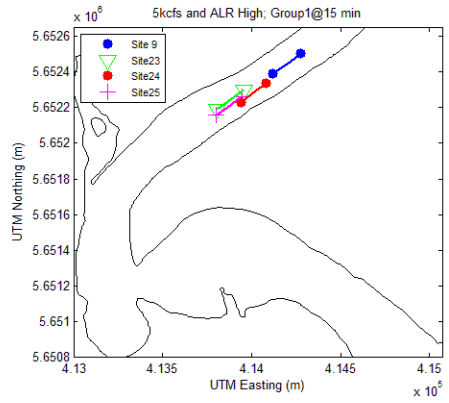


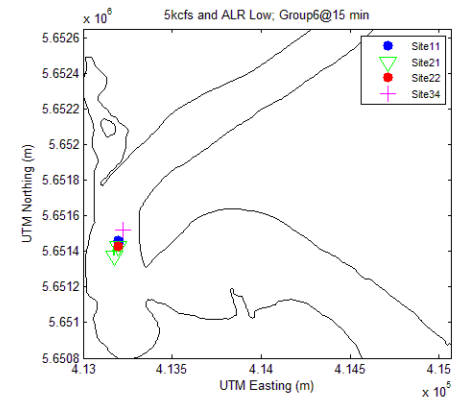
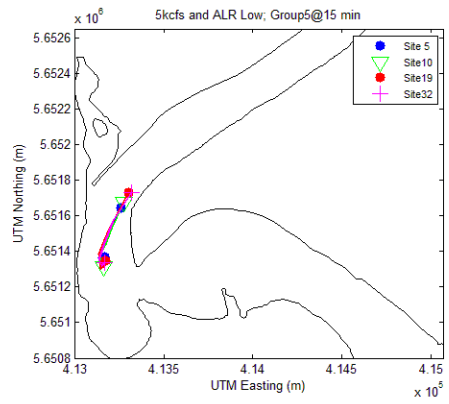
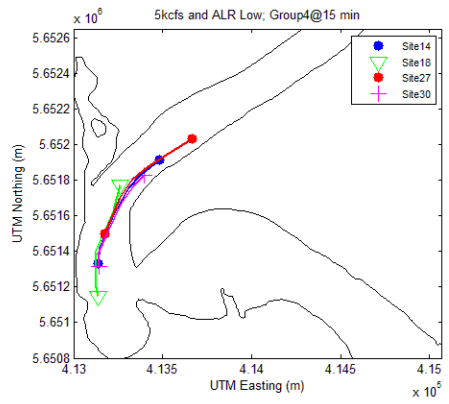
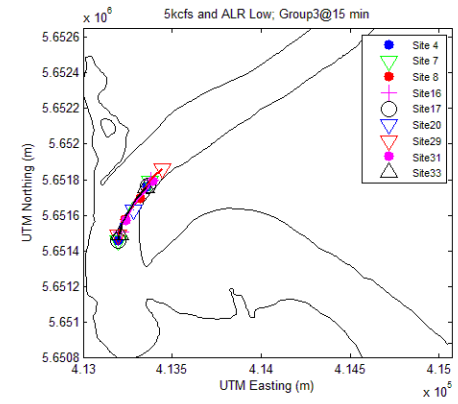
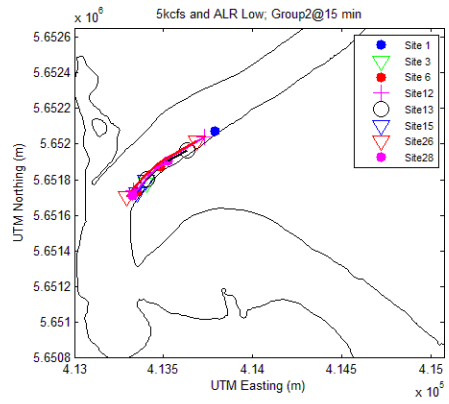
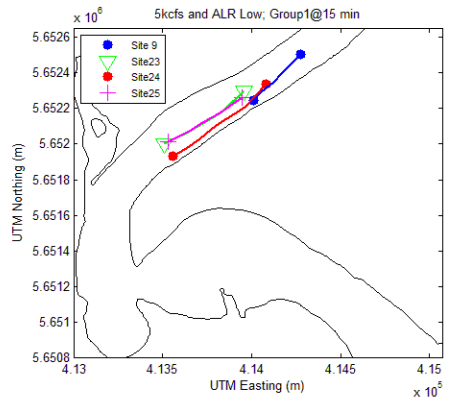
**Appendix C: Downstream drift patterns of White Sturgeon larvae “released” at the 34 selected egg mat sites at different flow regimes and ALR levels.**



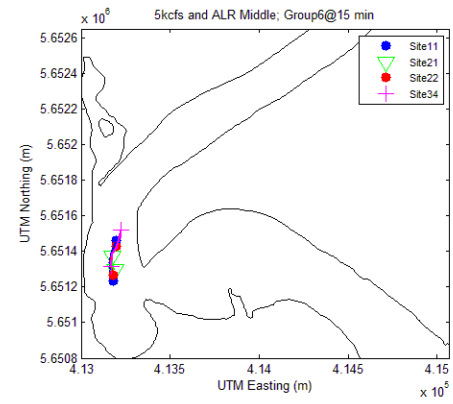
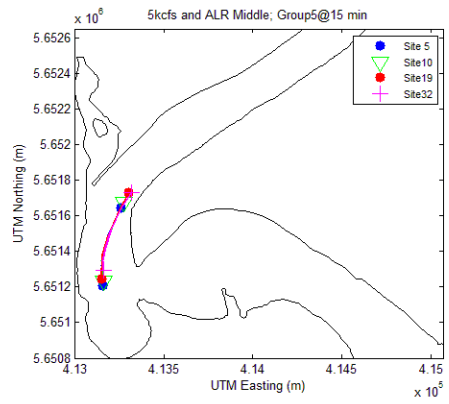
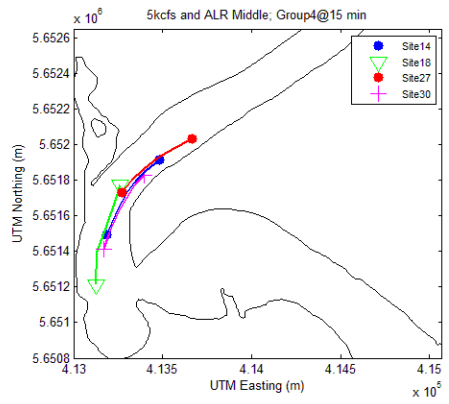
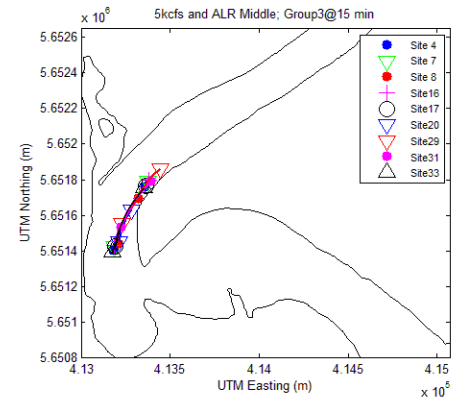
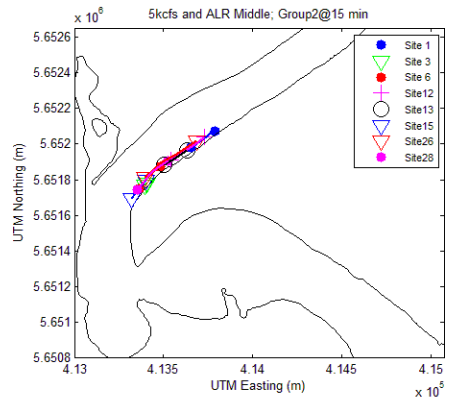
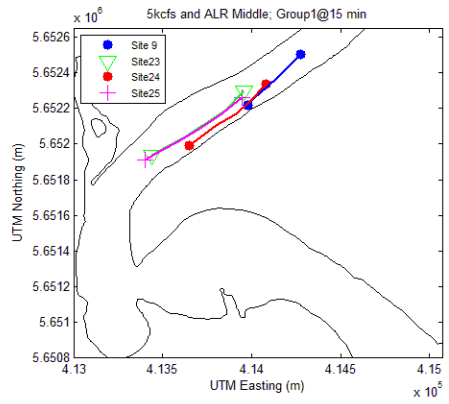
**Appendix C: Downstream drift patterns of White Sturgeon larvae “released” at the 34 selected egg mat sites at different flow regimes and ALR levels.**

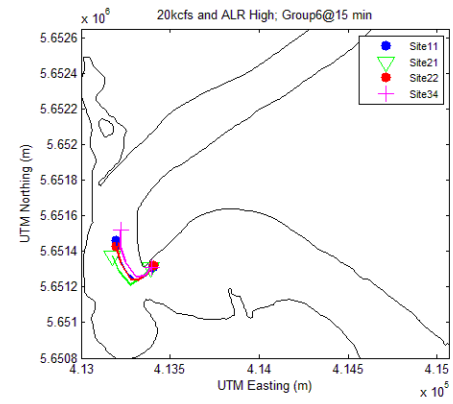
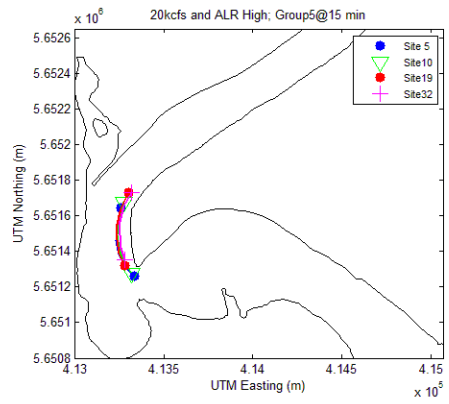
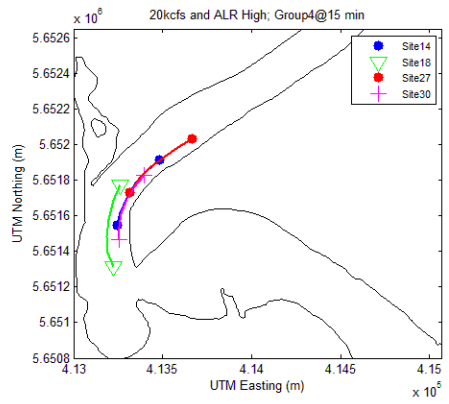
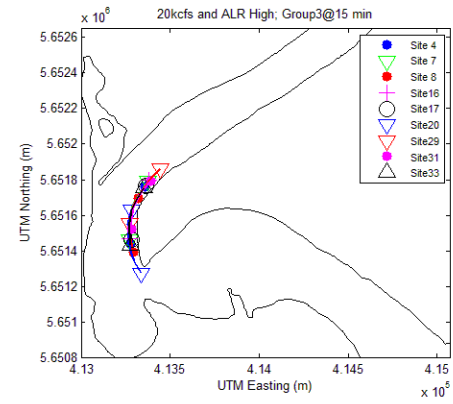
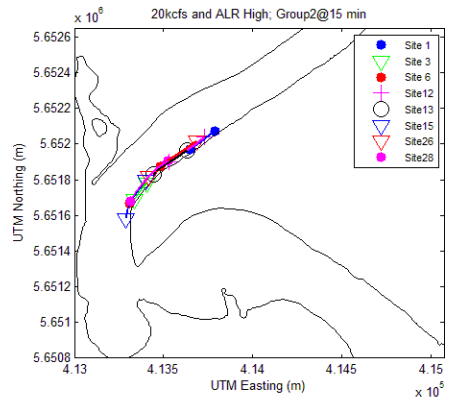
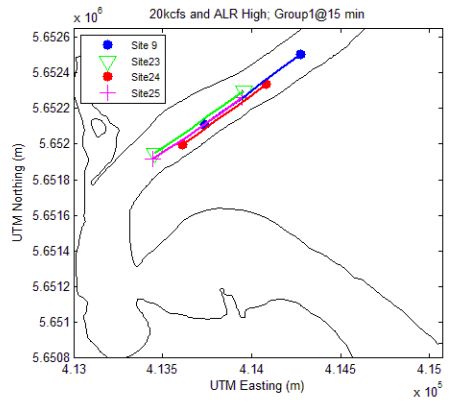
(1) Locations and tracks of the particles at 15 minutes after releasing

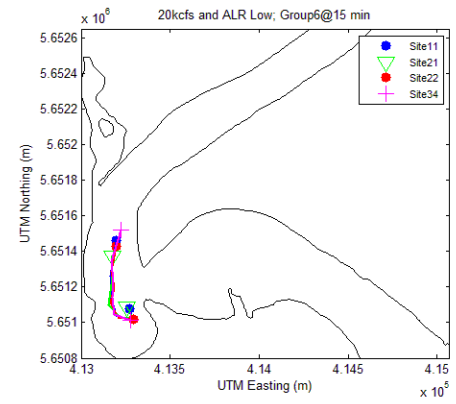
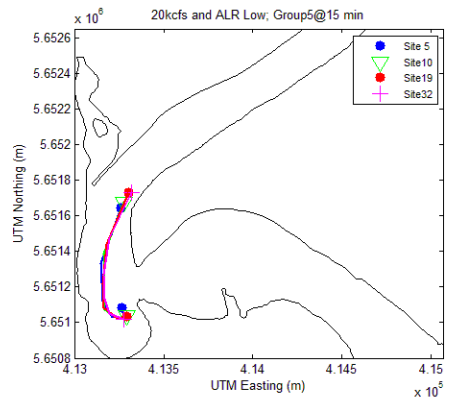
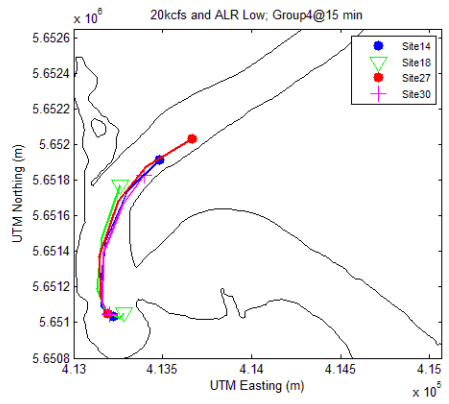
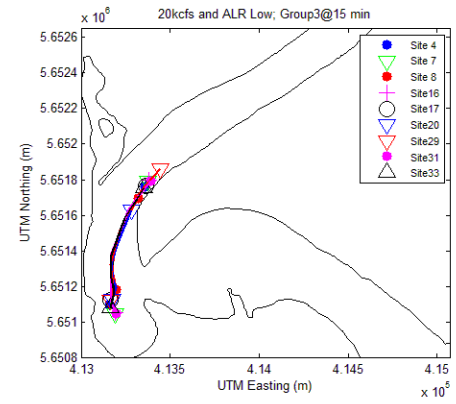
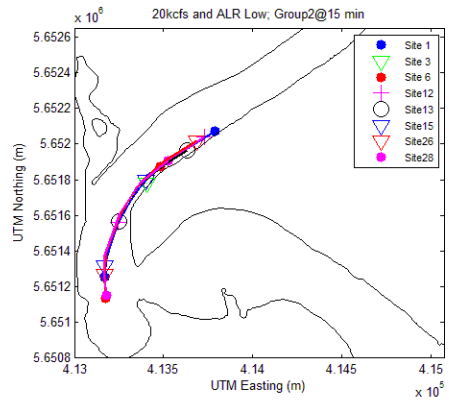
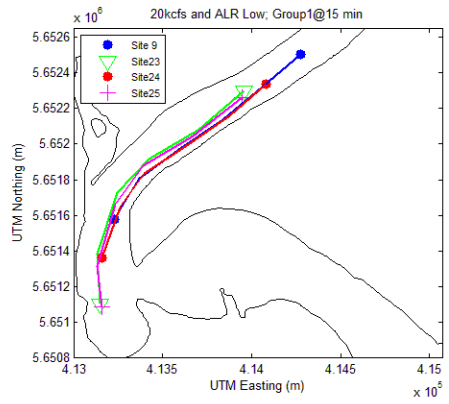




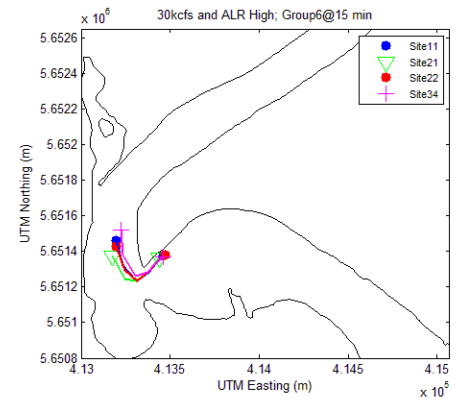
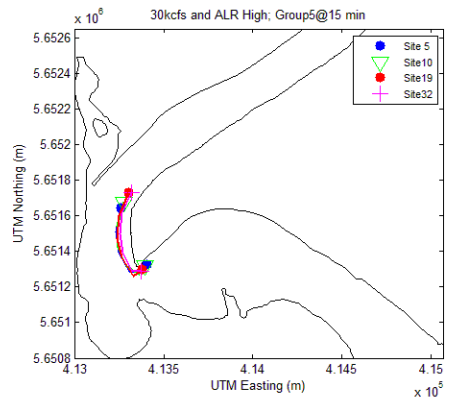
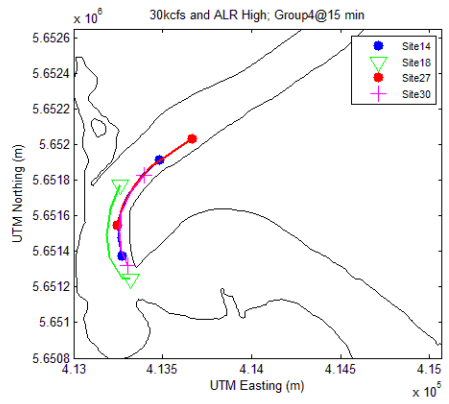
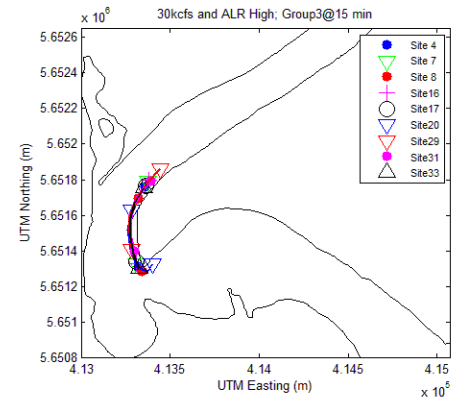
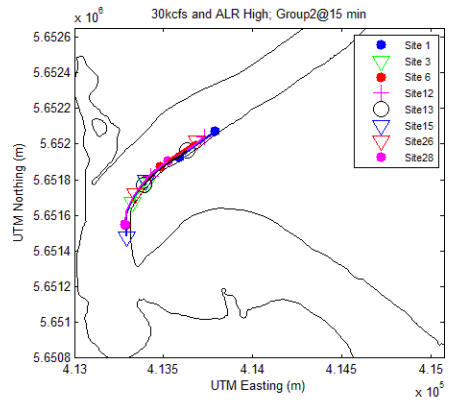
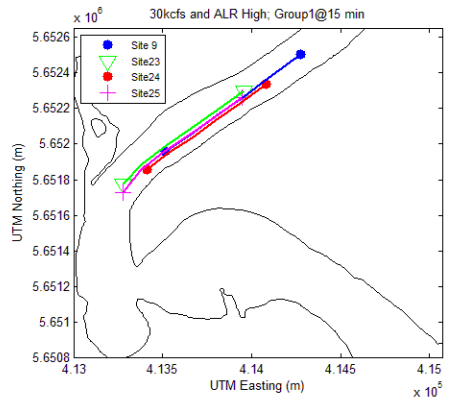


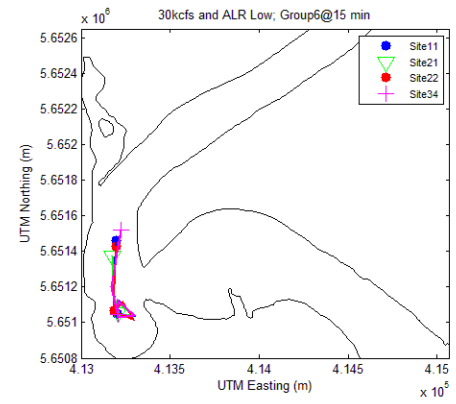
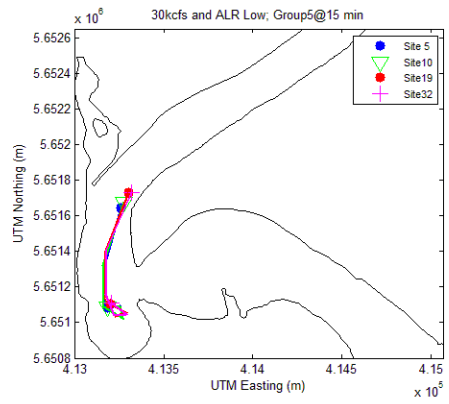
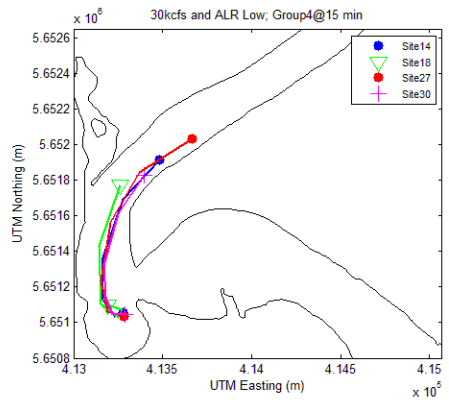
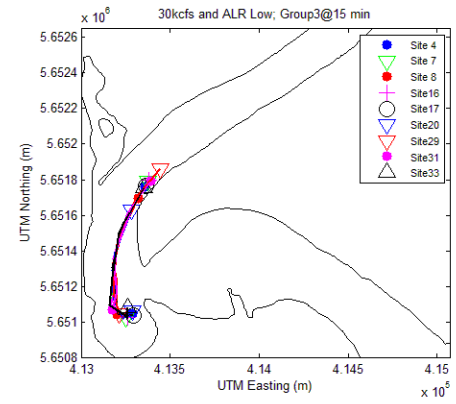
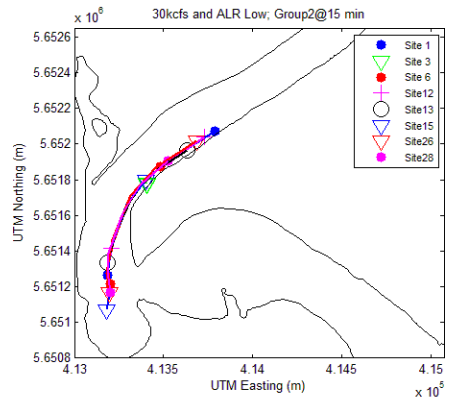
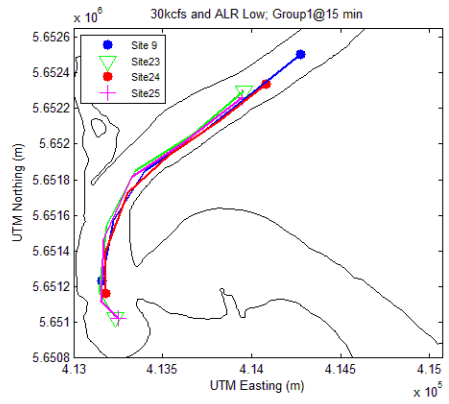


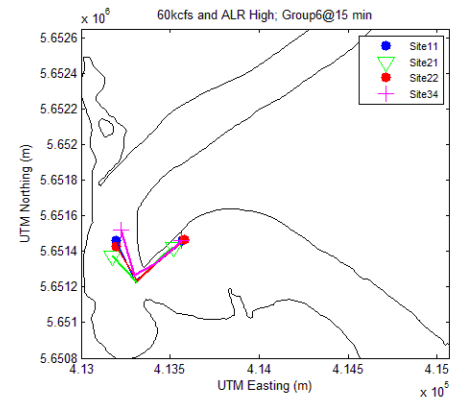
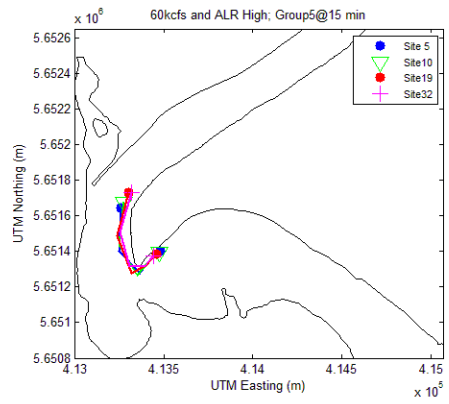
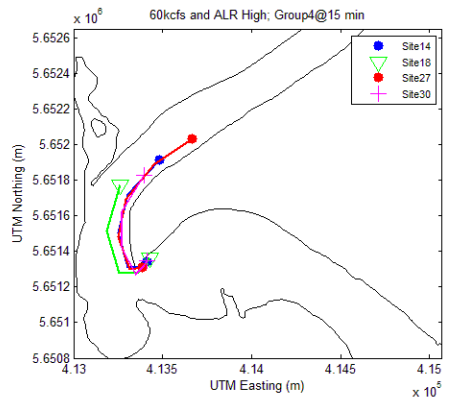
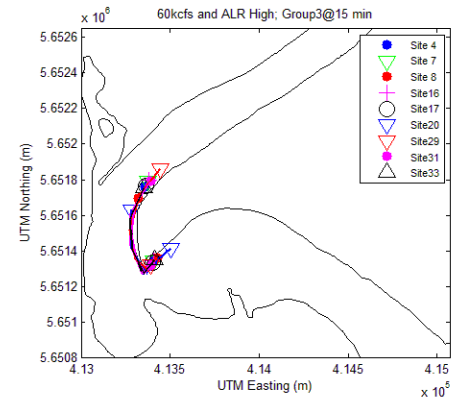
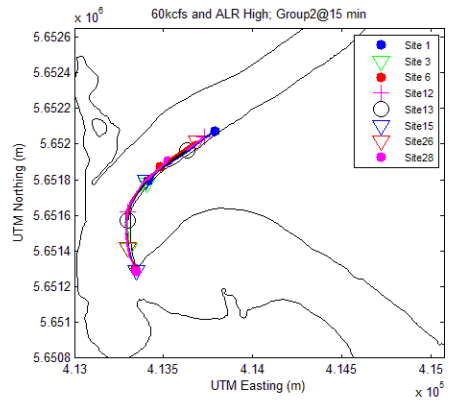
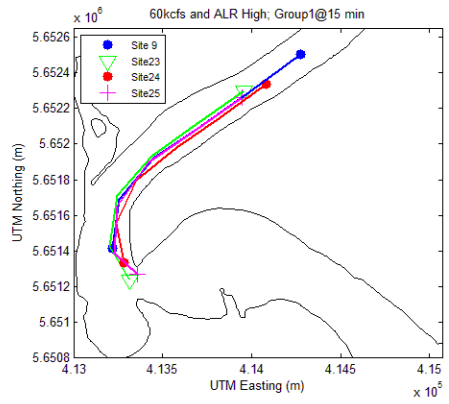




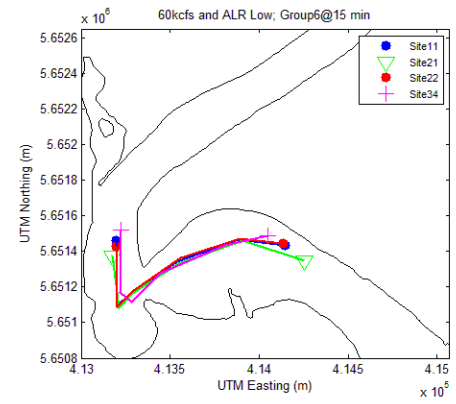
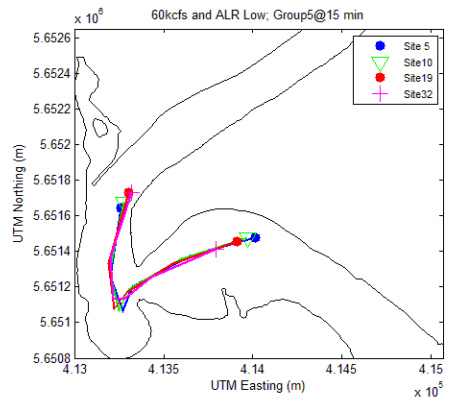
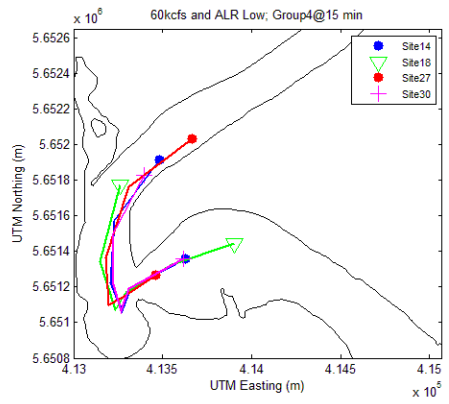
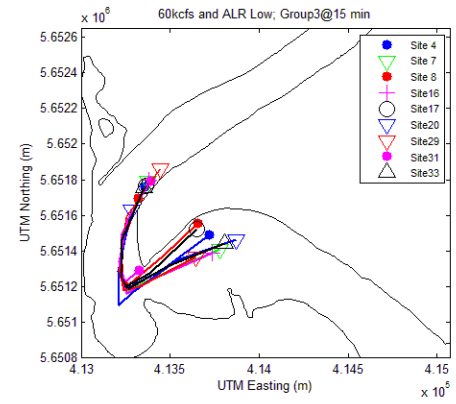
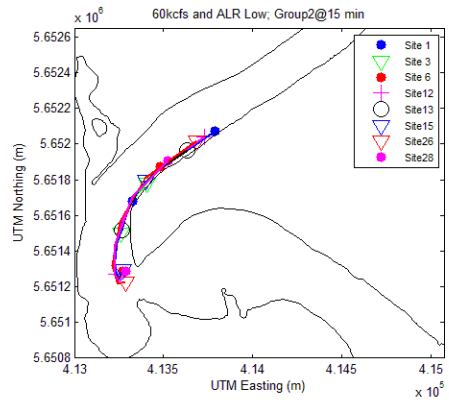
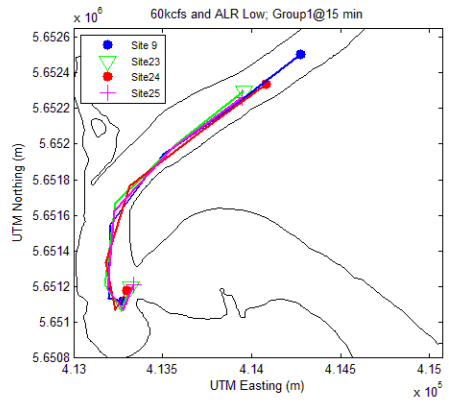


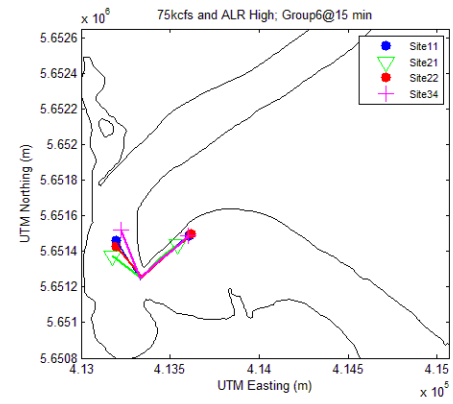
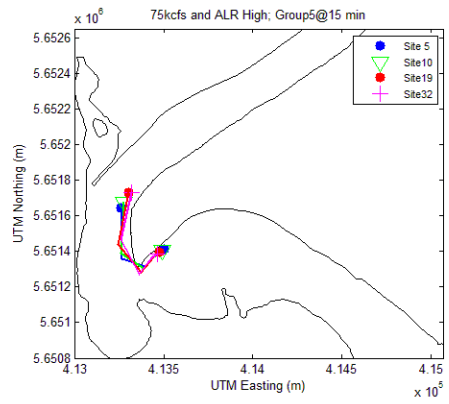
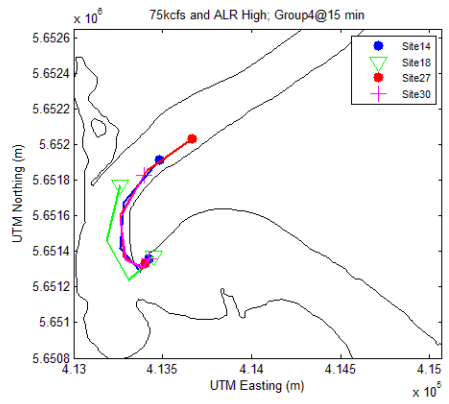
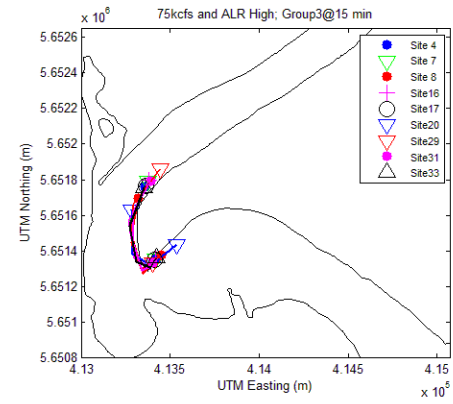
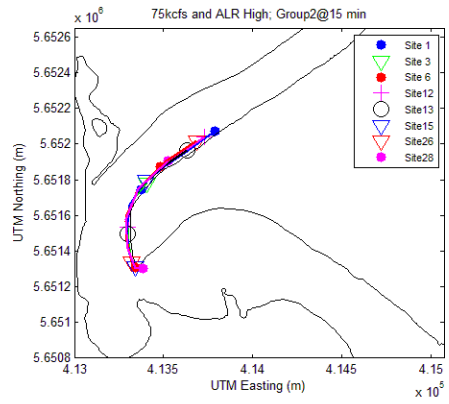
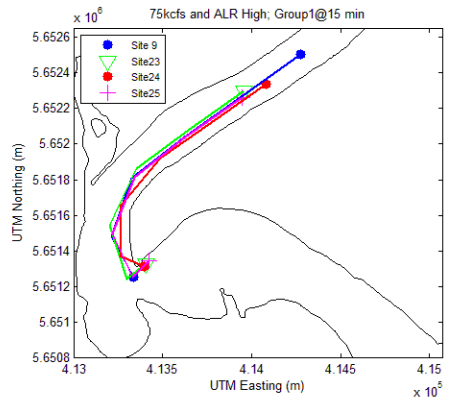


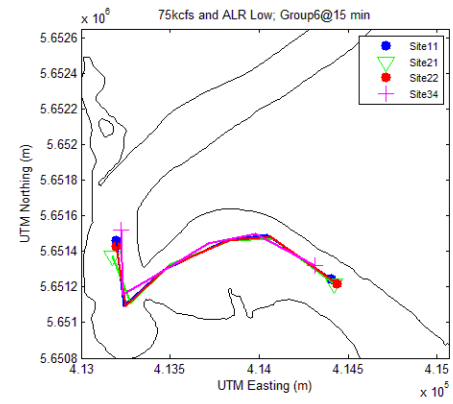
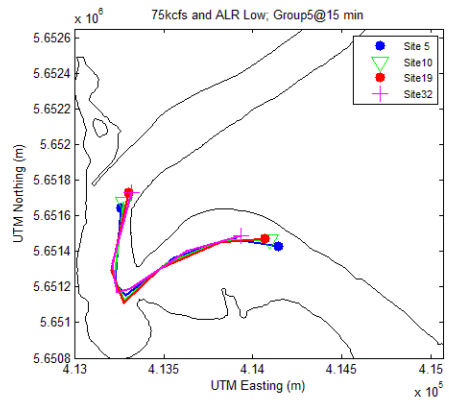
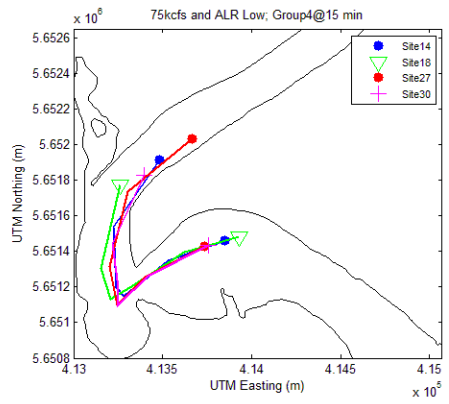
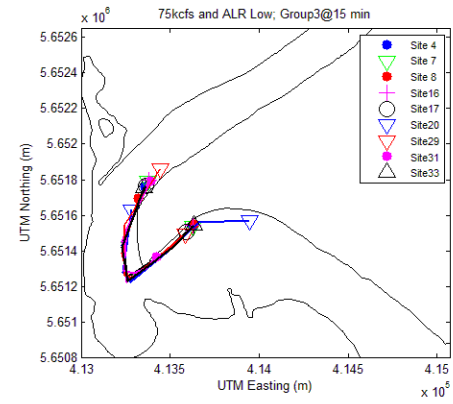
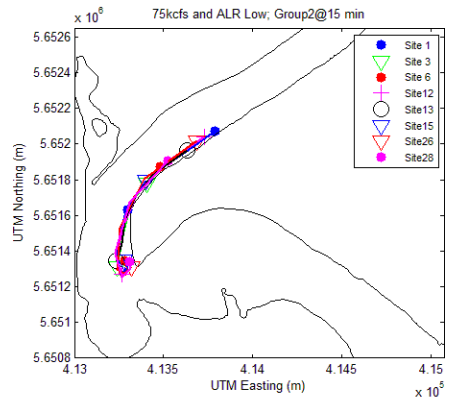
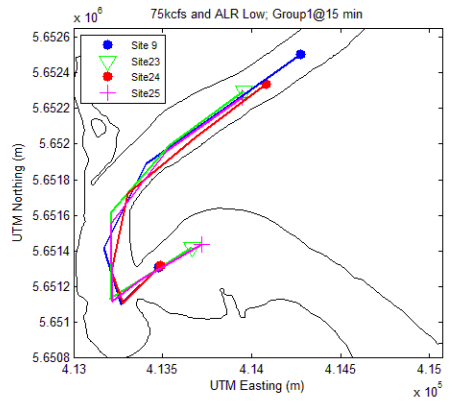


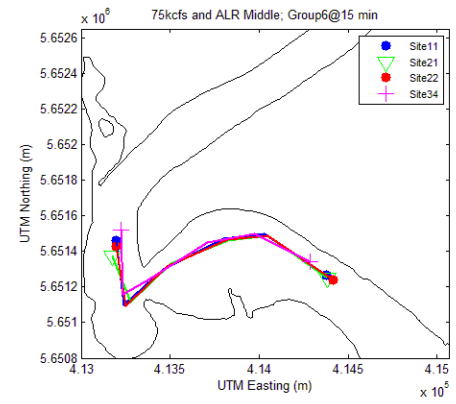
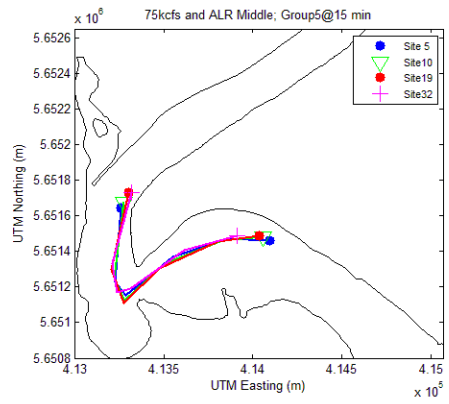
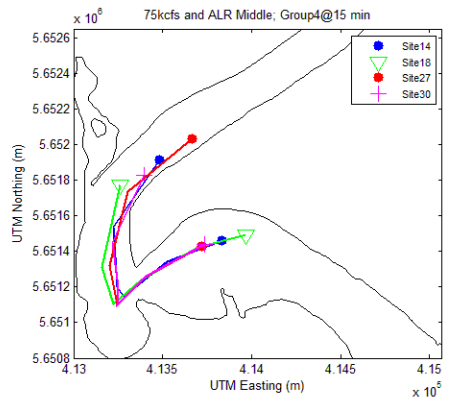
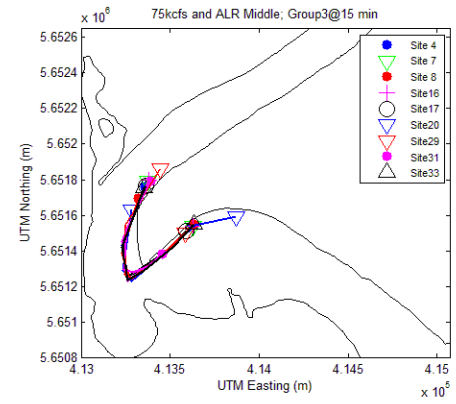
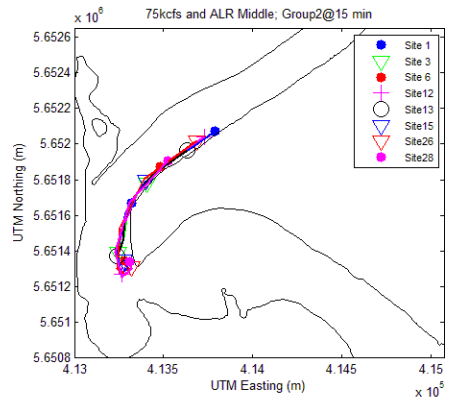
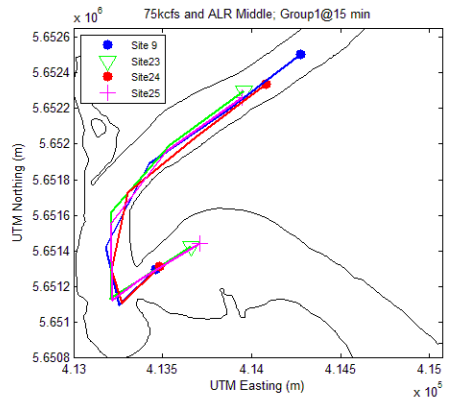






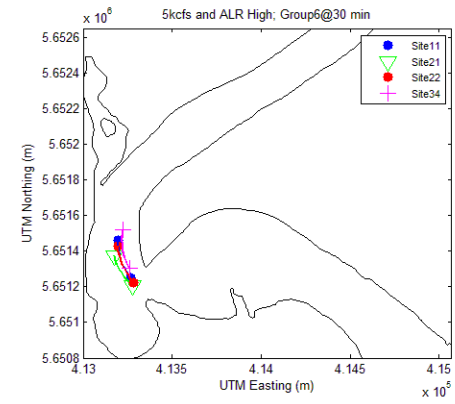
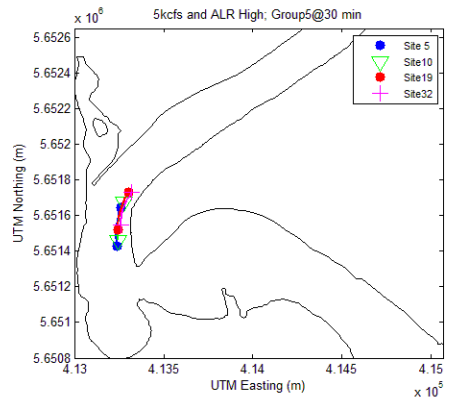
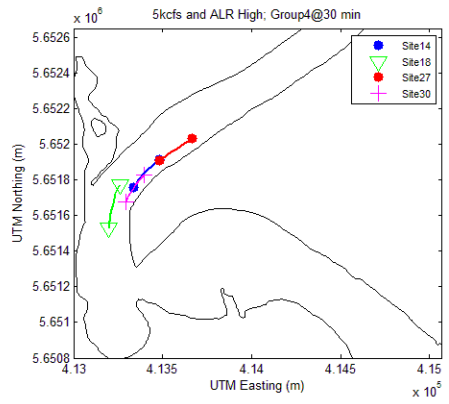
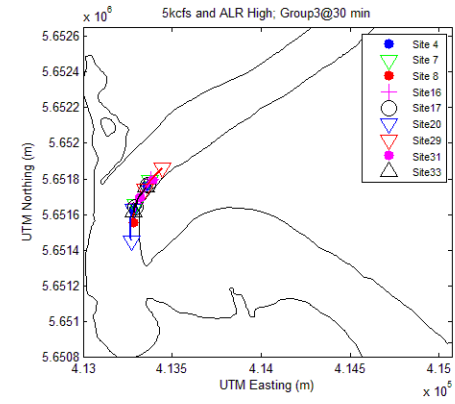
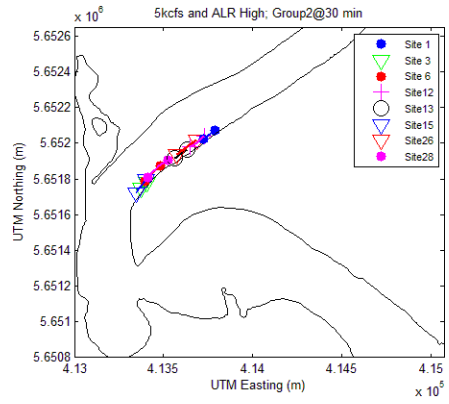
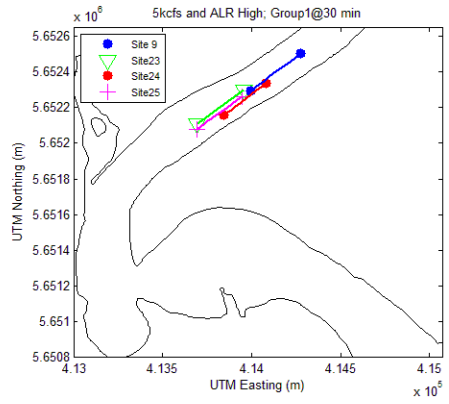


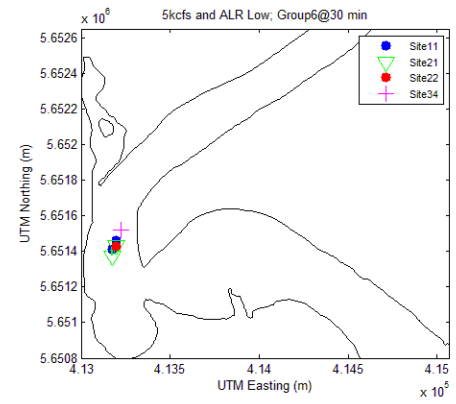
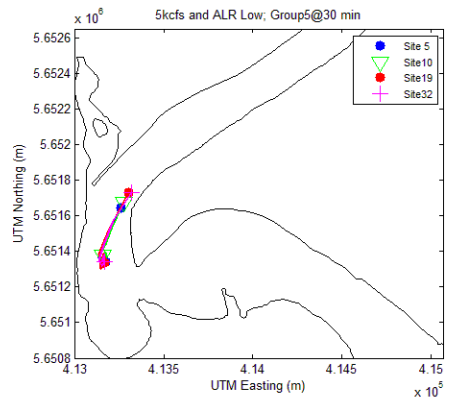
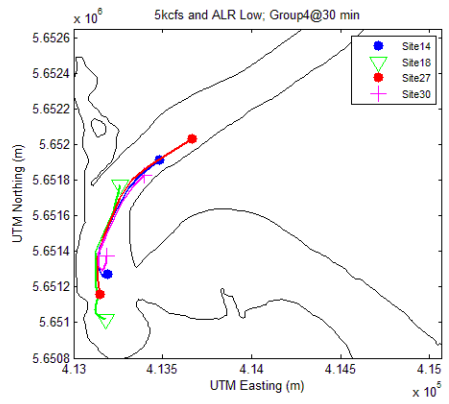
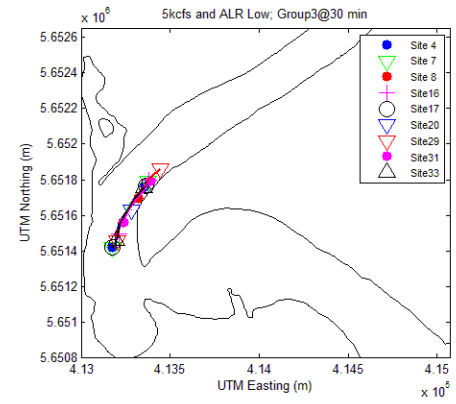
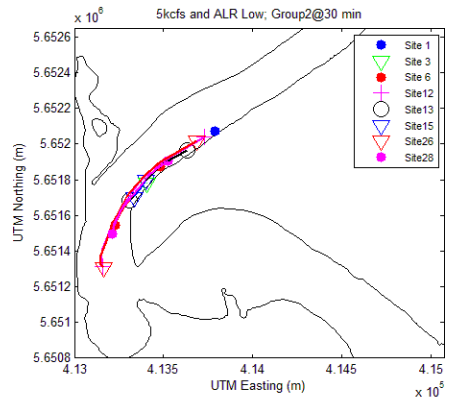
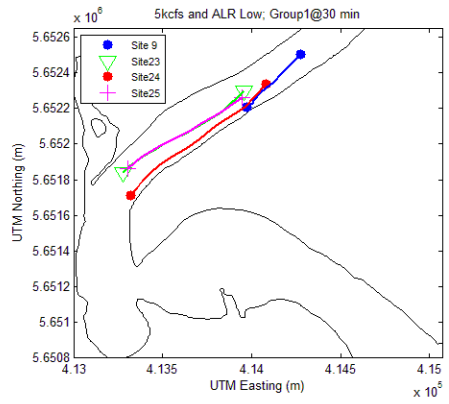


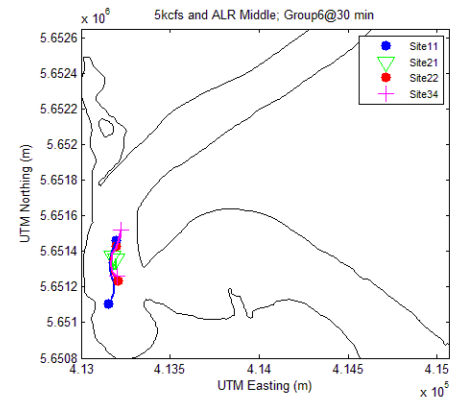
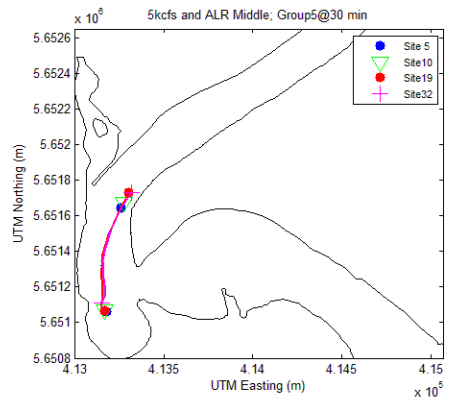
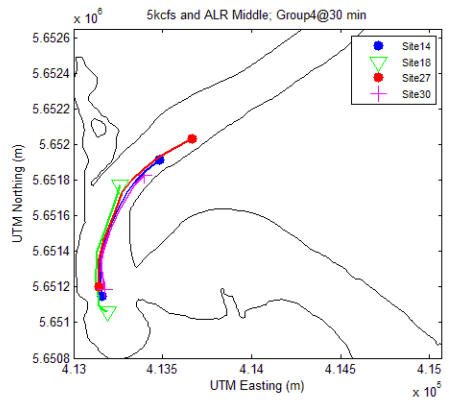
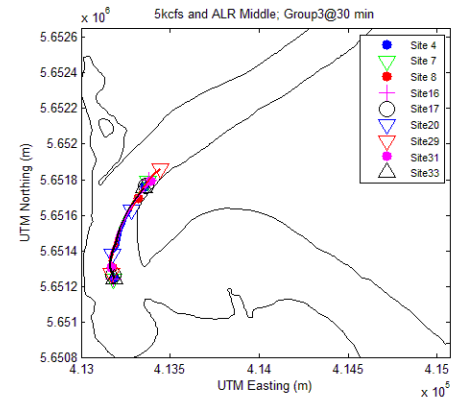
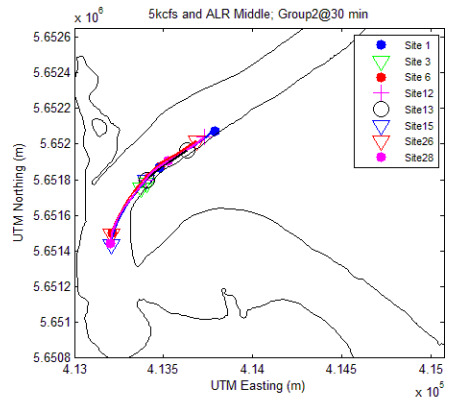
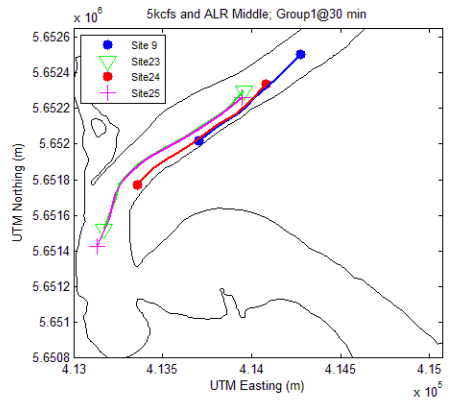


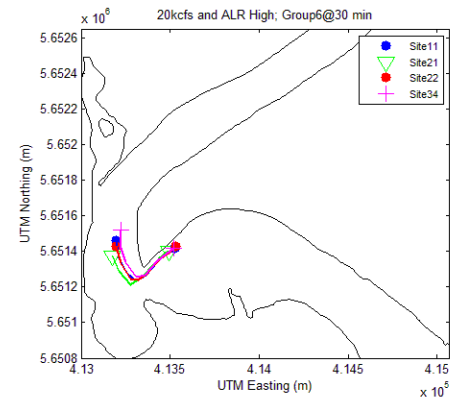
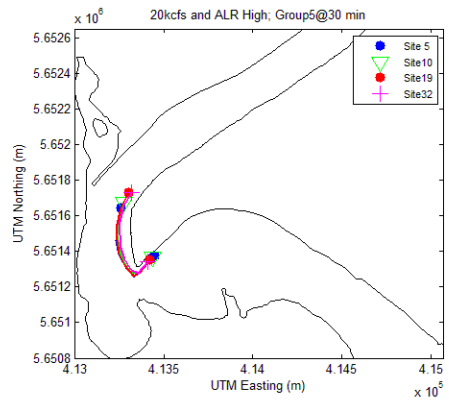
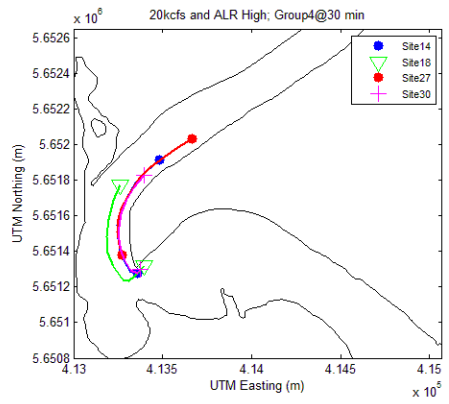
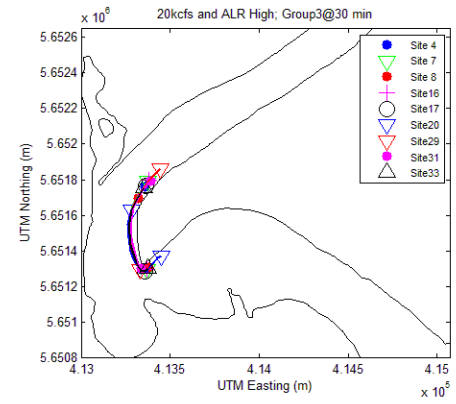
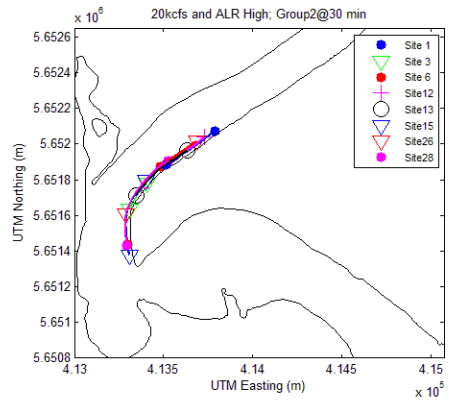
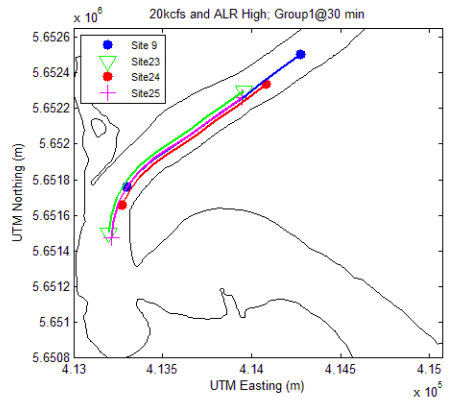


(2) Locations and tracks of the particles at 30 minutes after releasing

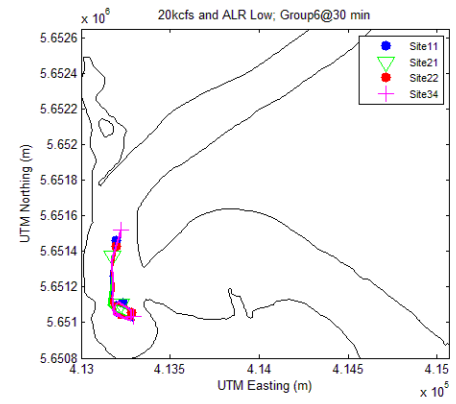
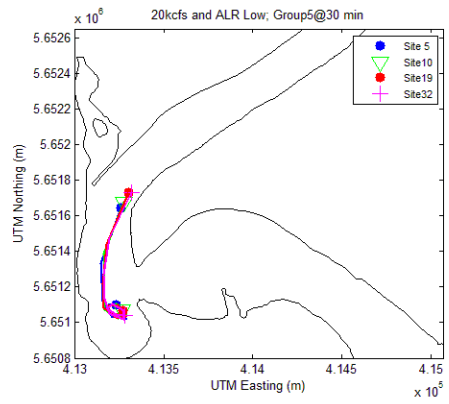
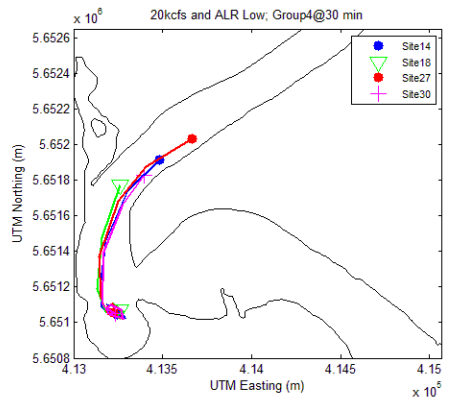
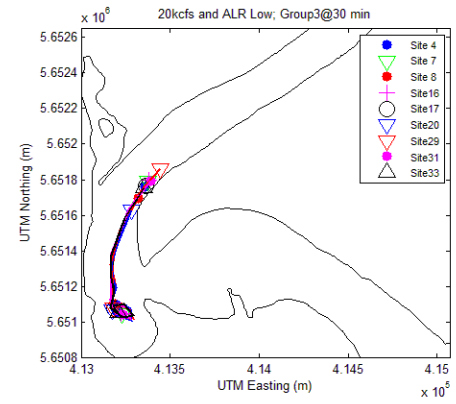
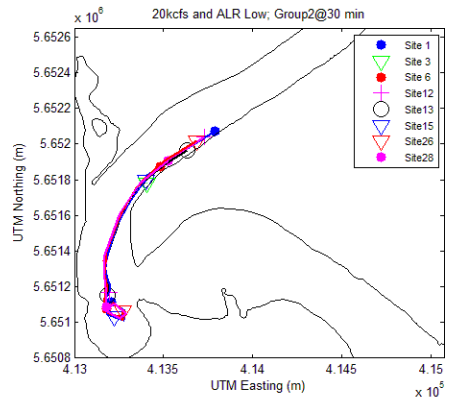
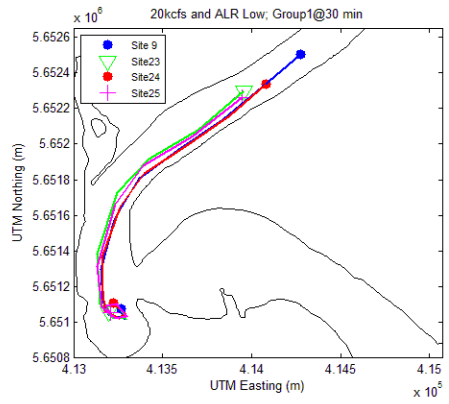


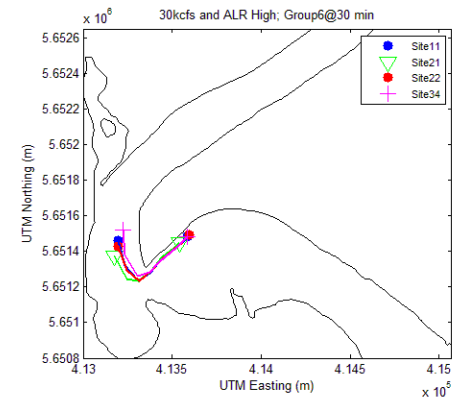
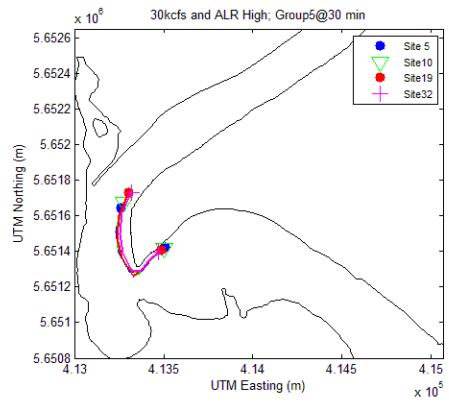
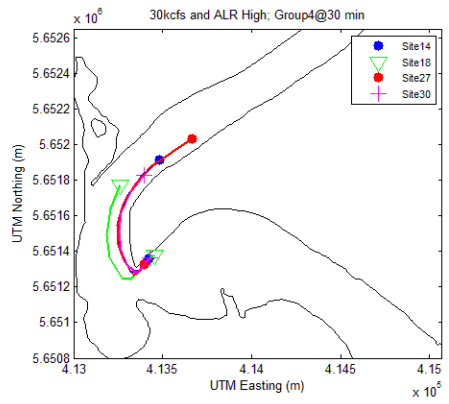
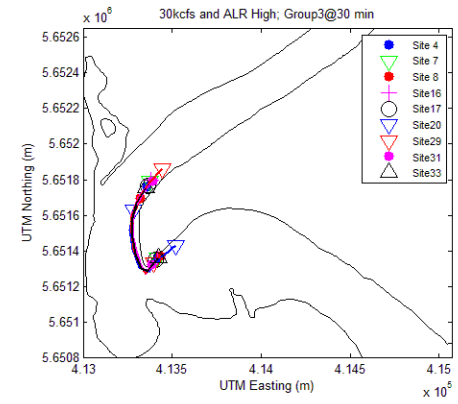
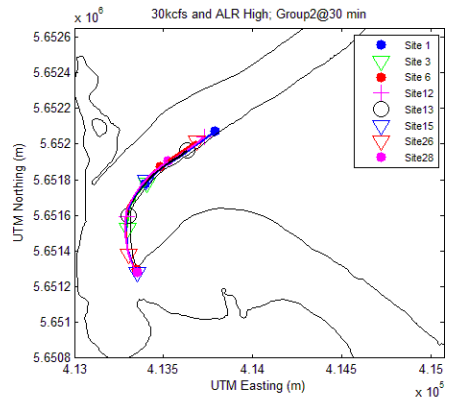
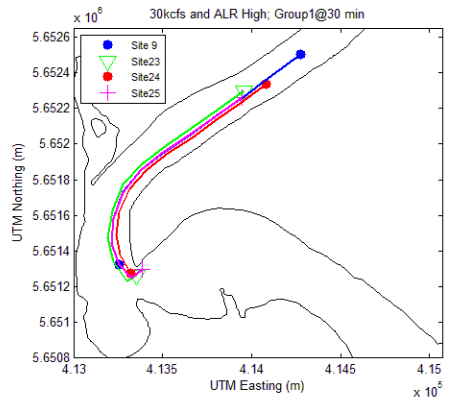


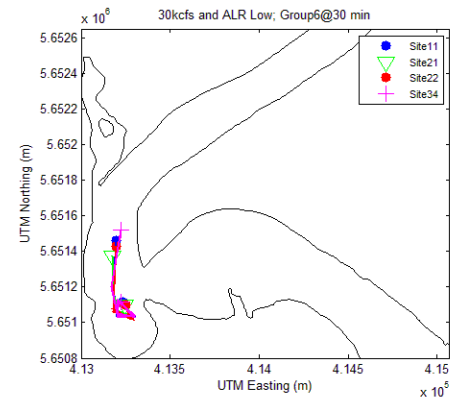
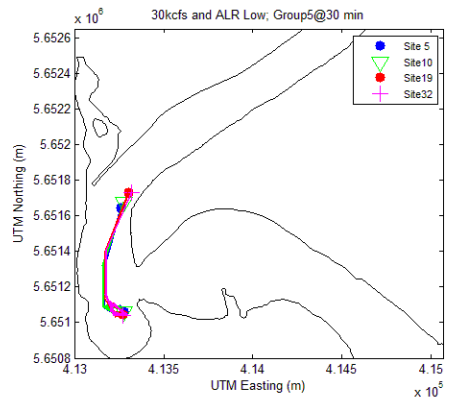
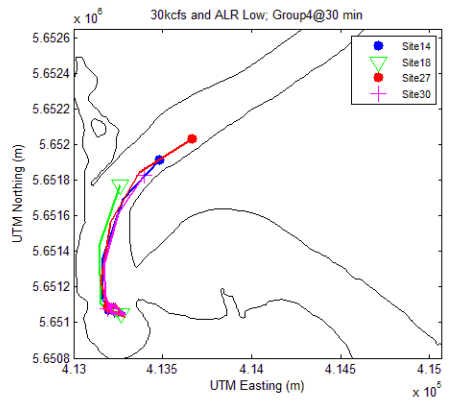
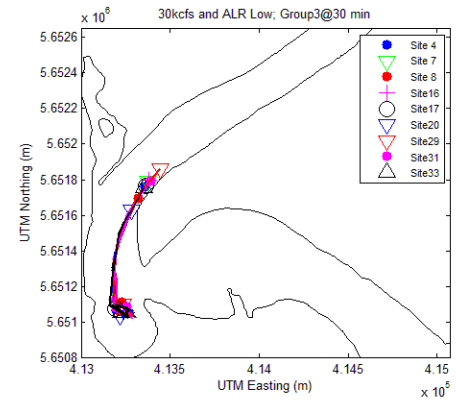
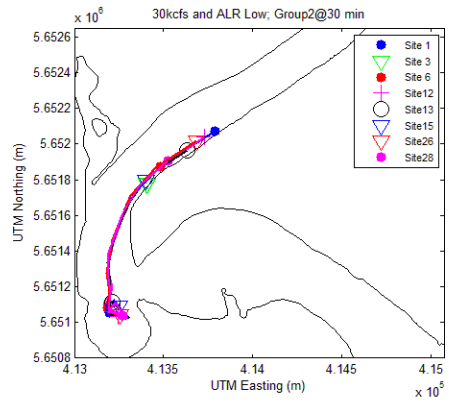
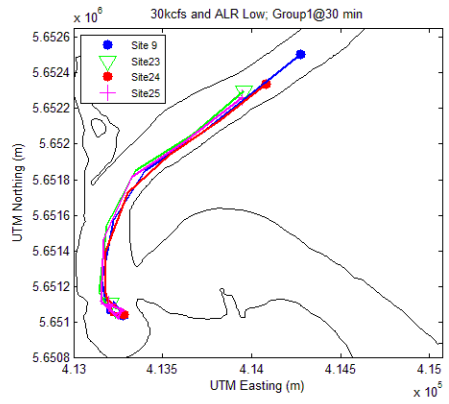


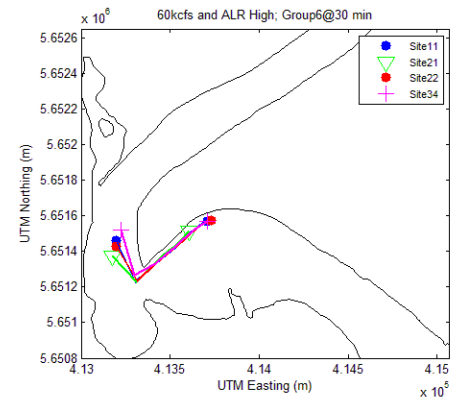
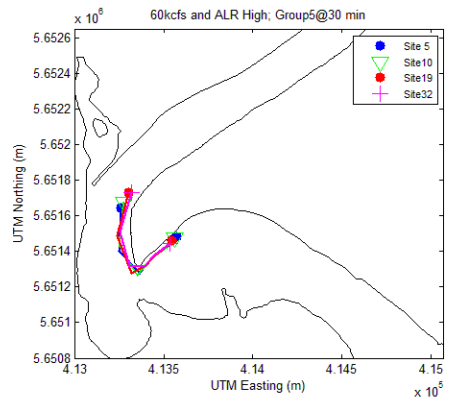
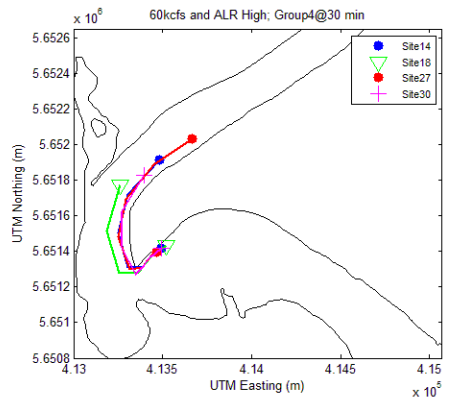
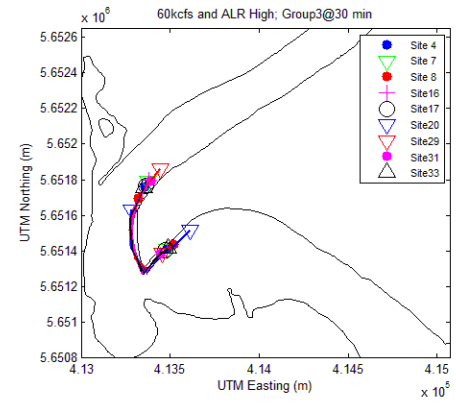
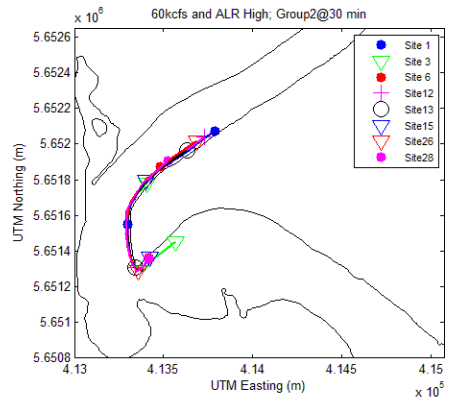
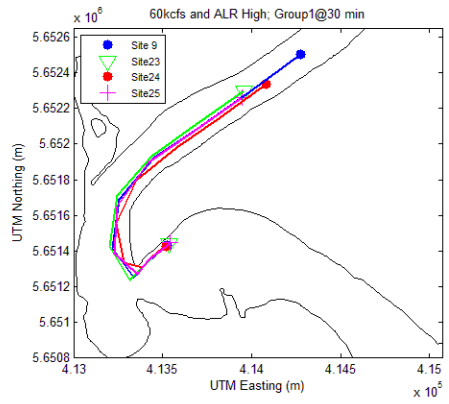




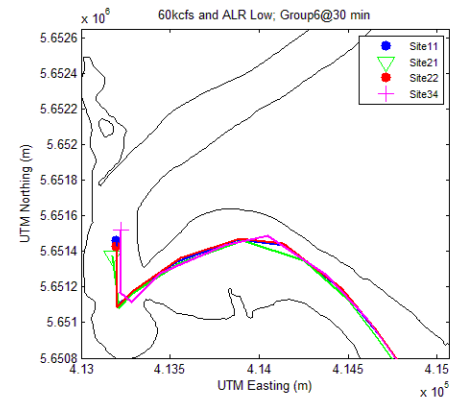
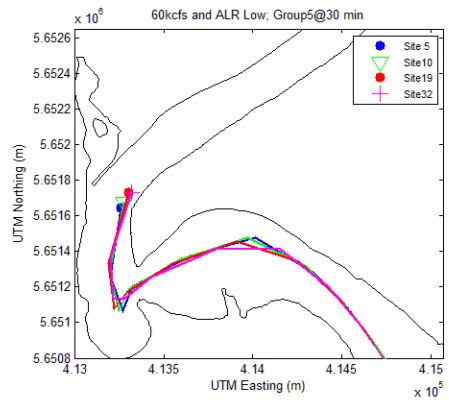
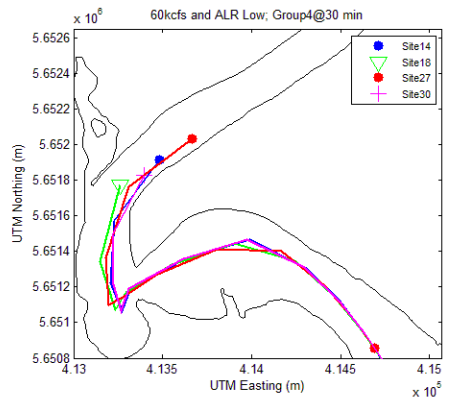
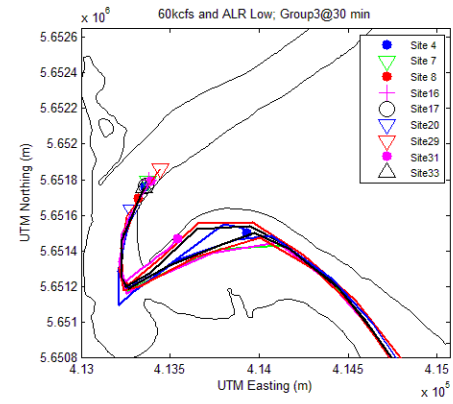
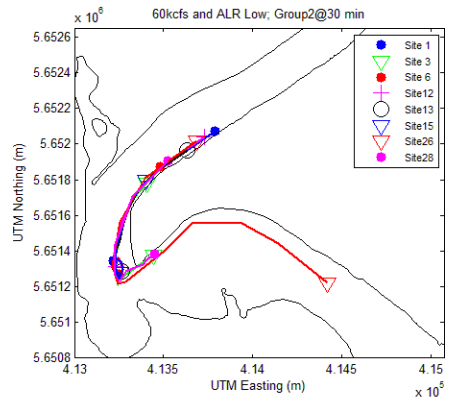
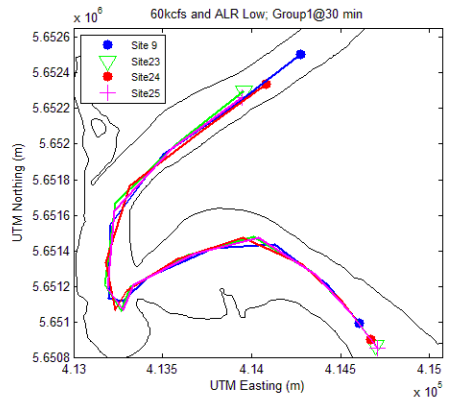


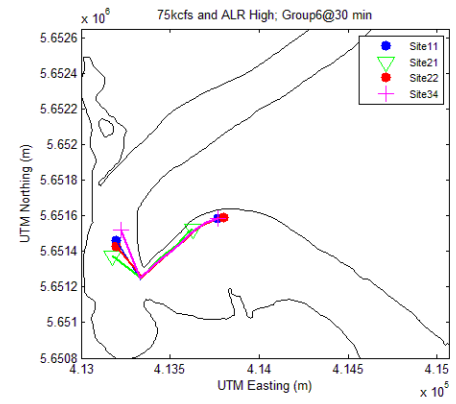
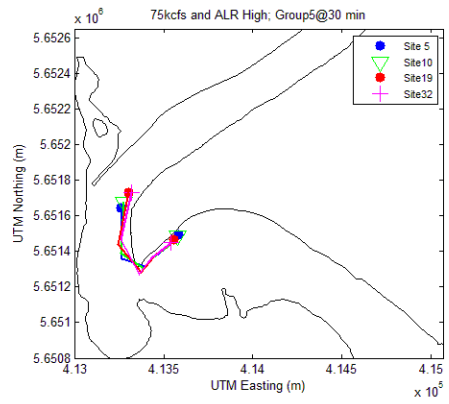
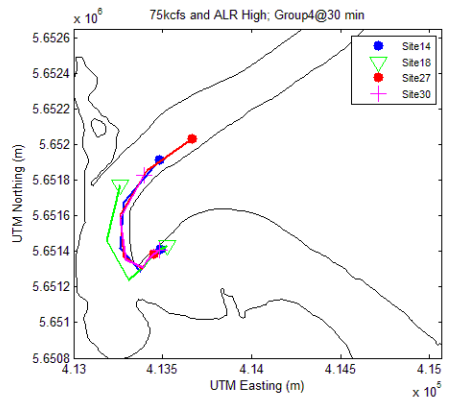
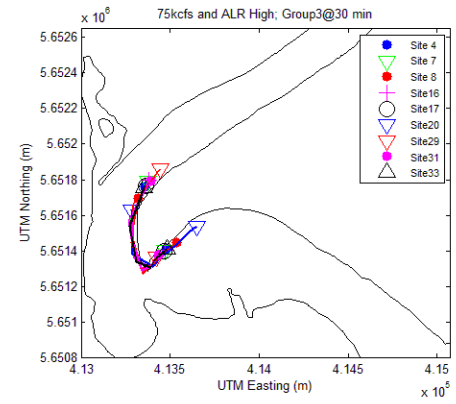
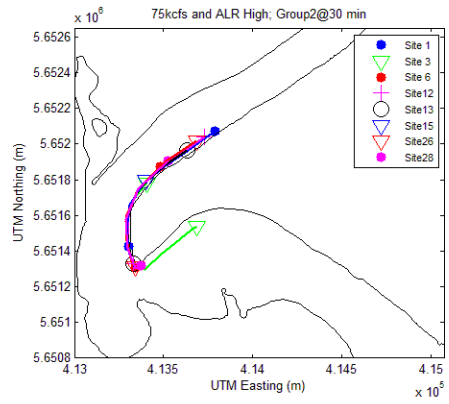
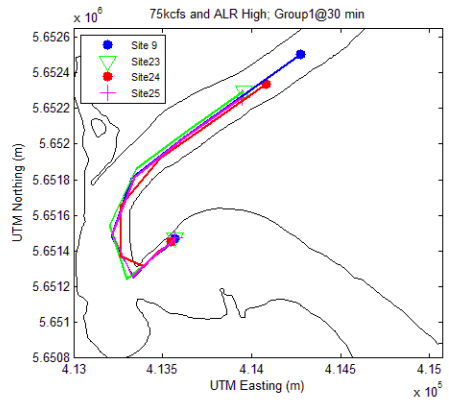


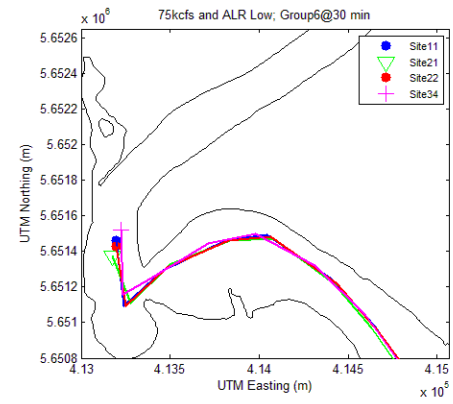
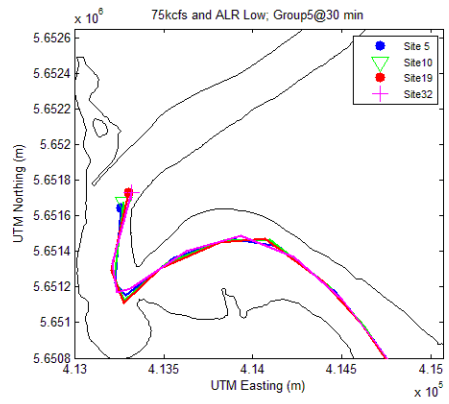
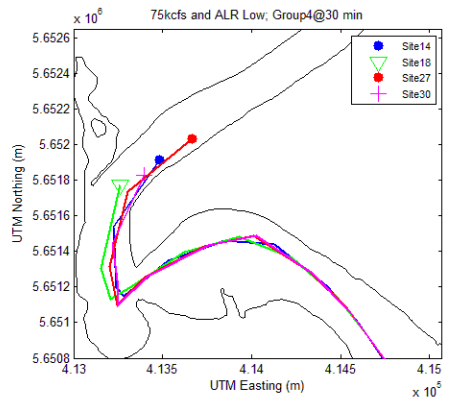
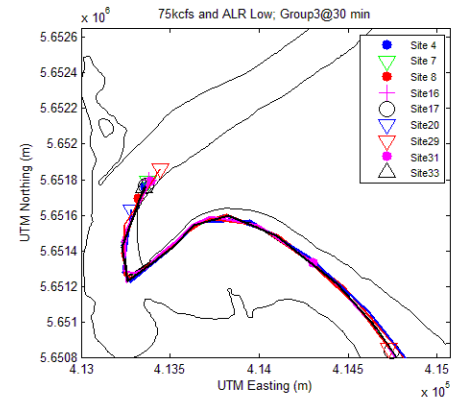
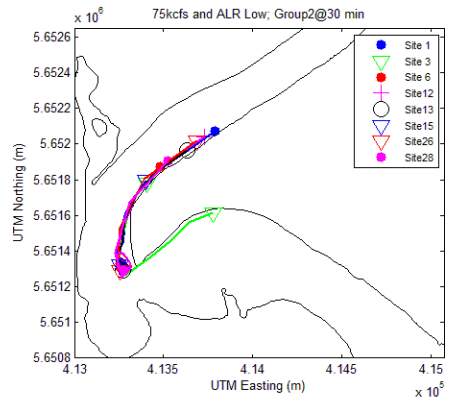
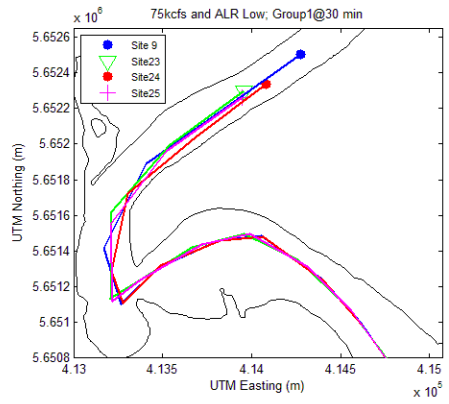


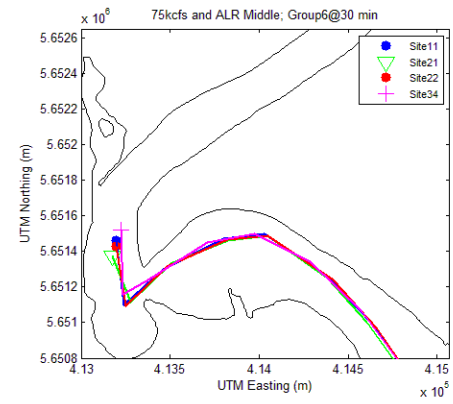
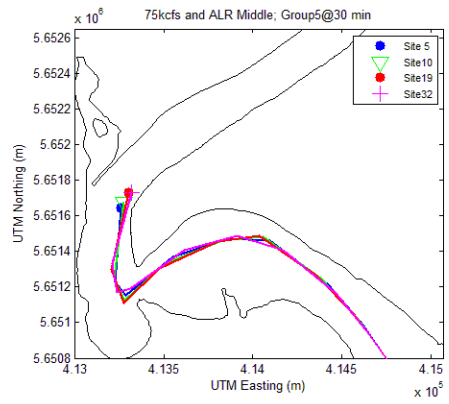
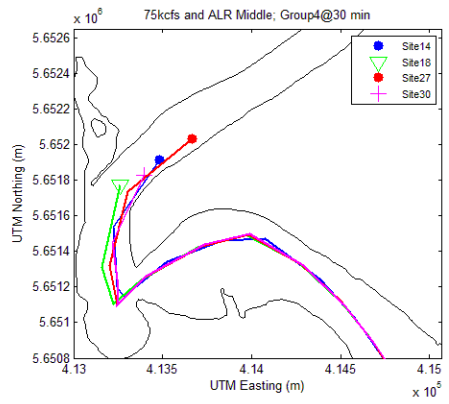
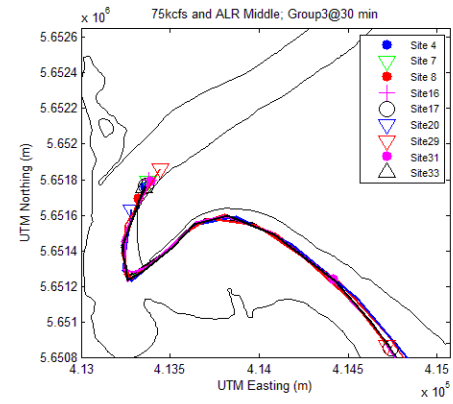
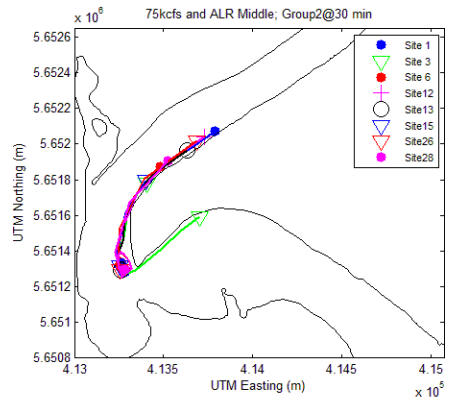
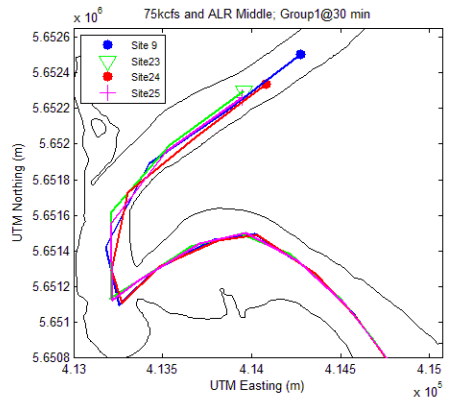






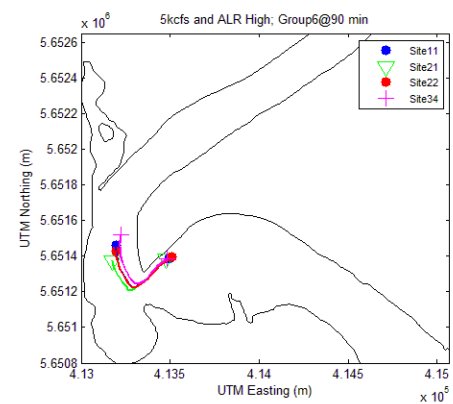
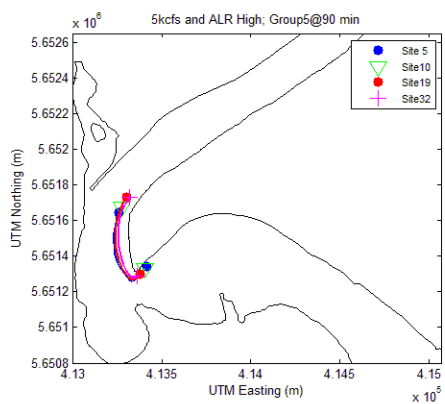
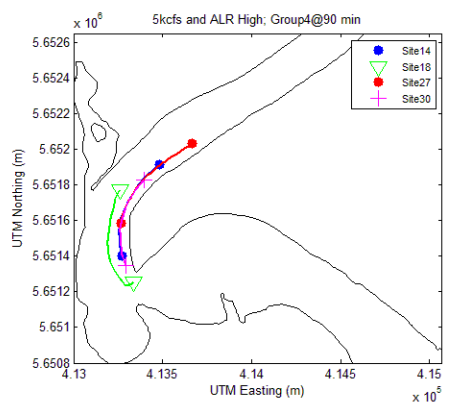
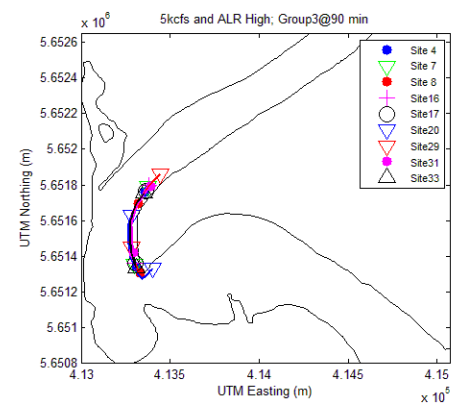
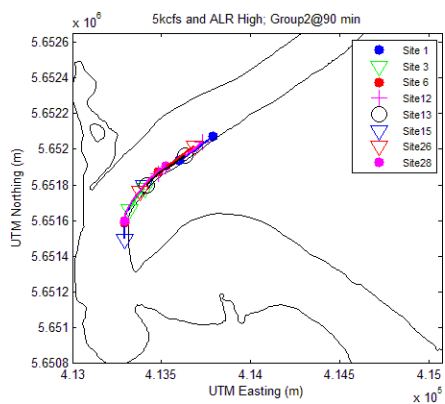
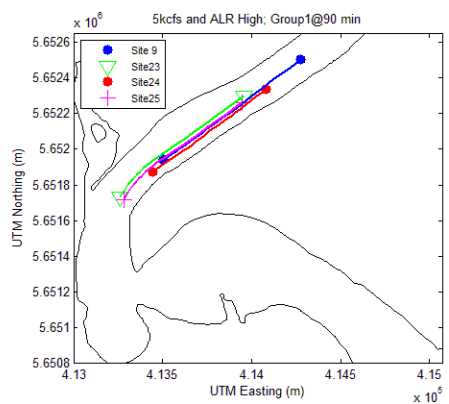


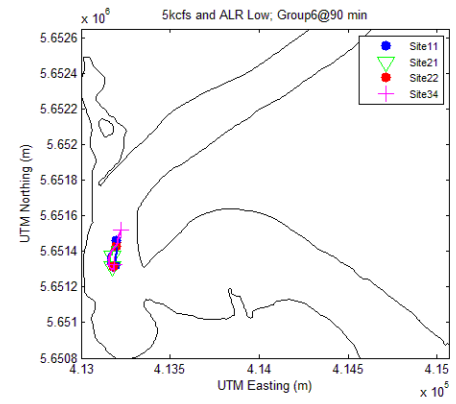
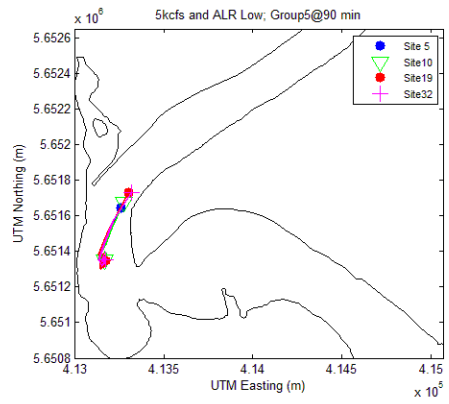
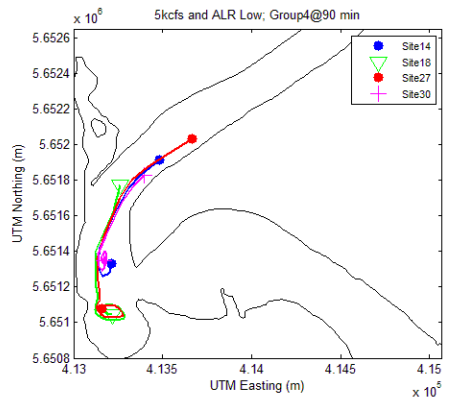
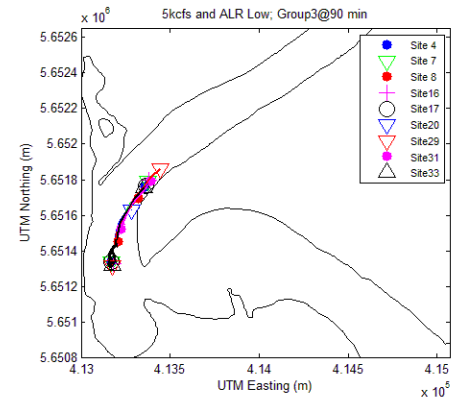
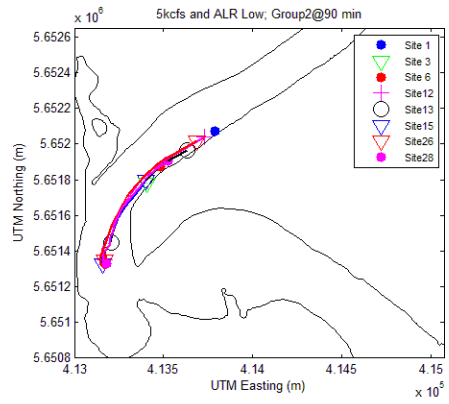
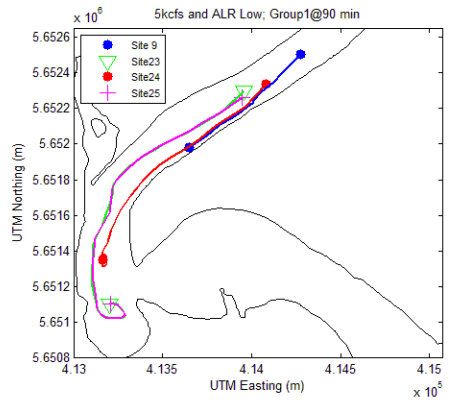


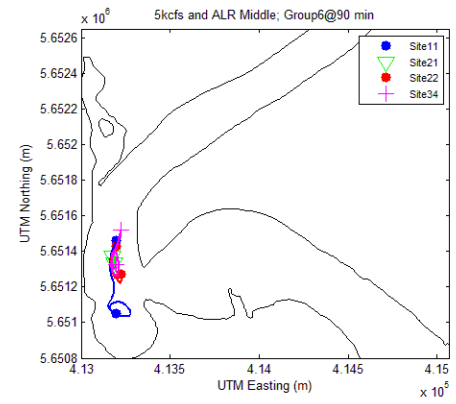
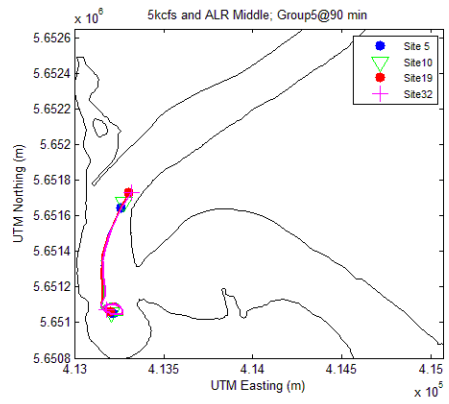
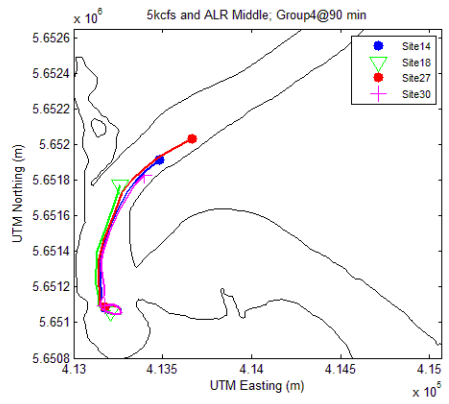
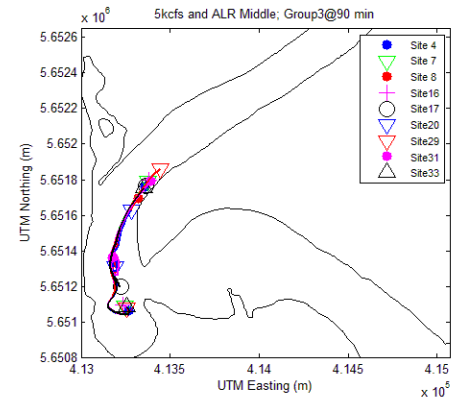
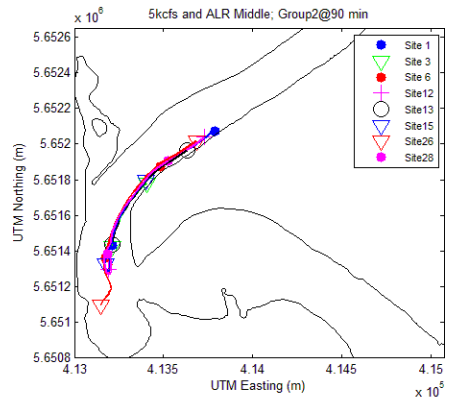
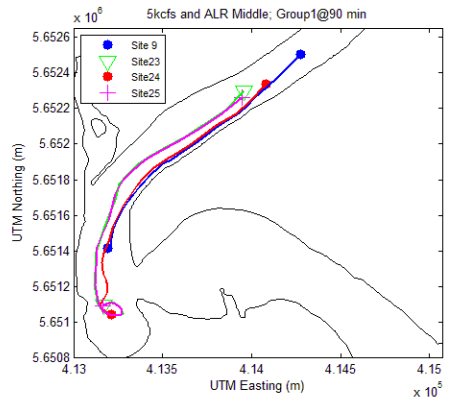


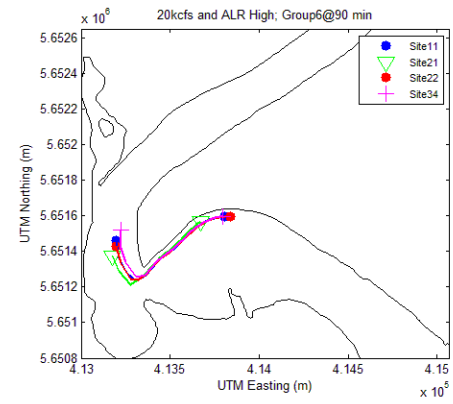
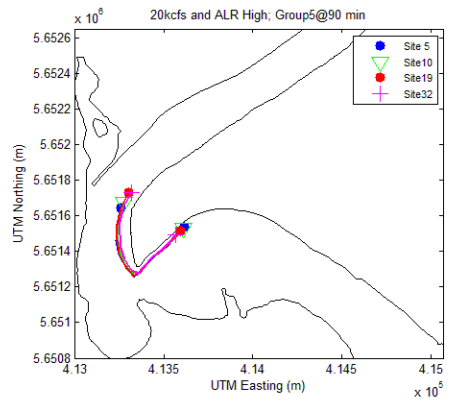
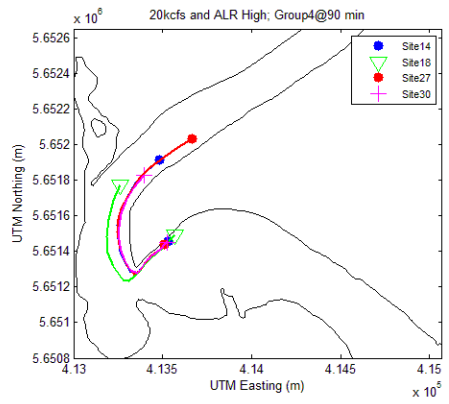
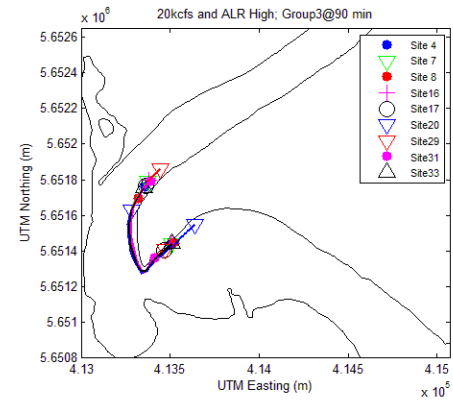
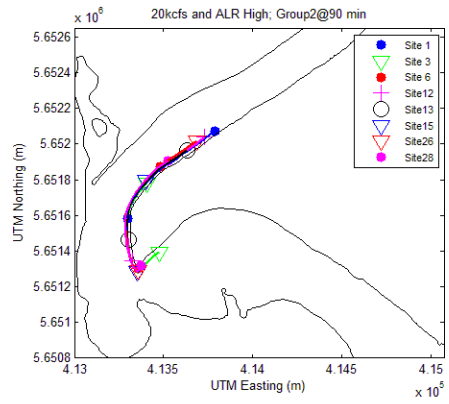
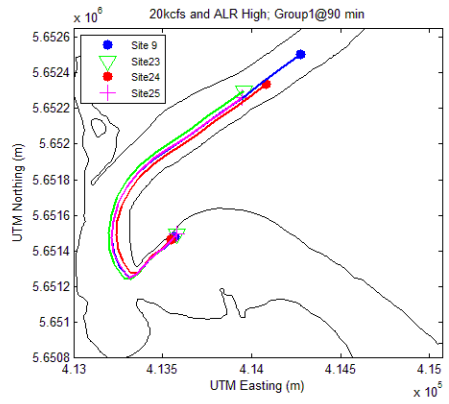


### (3) Locations and tracks of the particles at 90 minutes after releasing

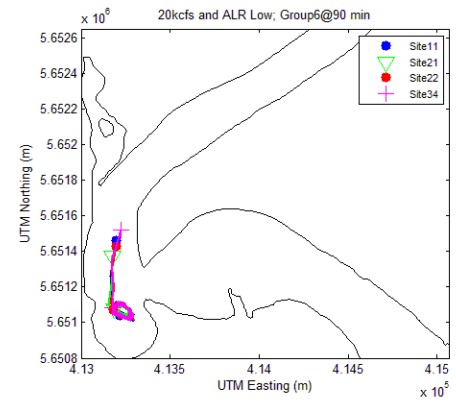
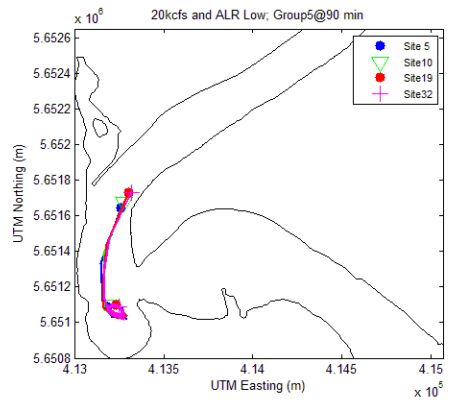
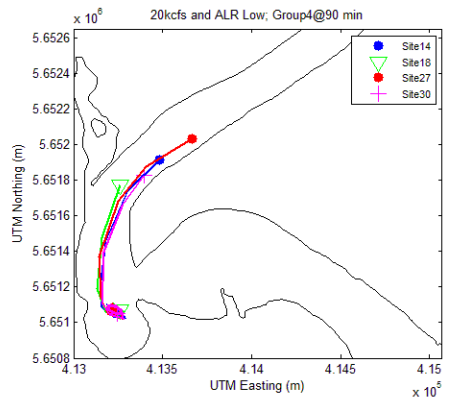
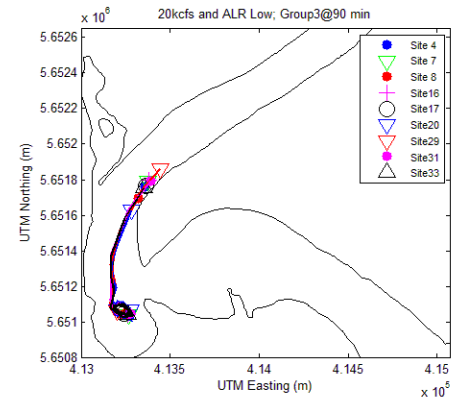
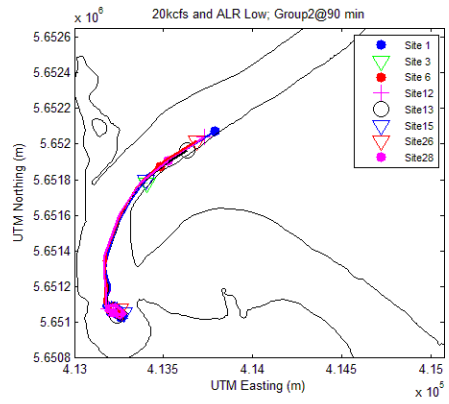
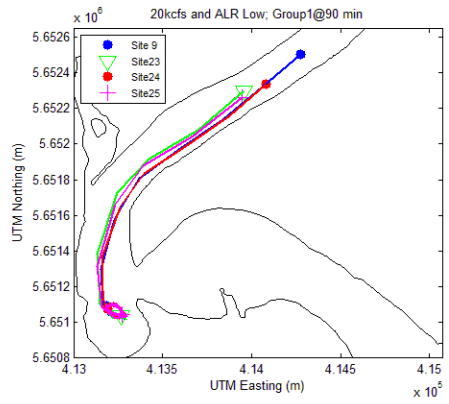


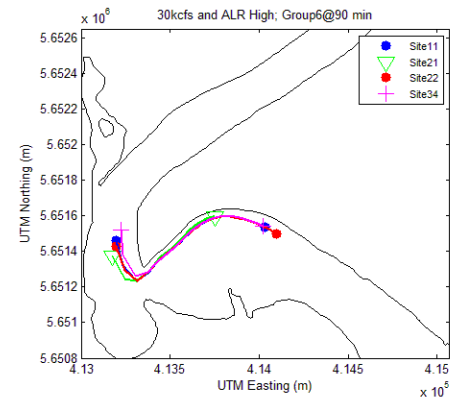
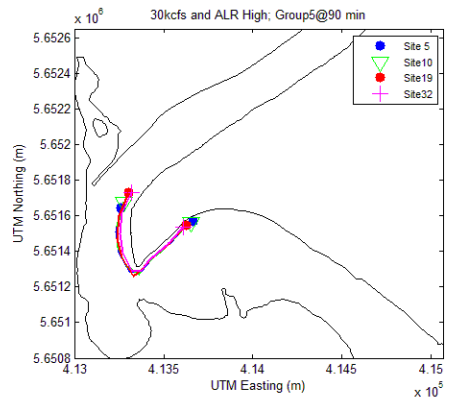
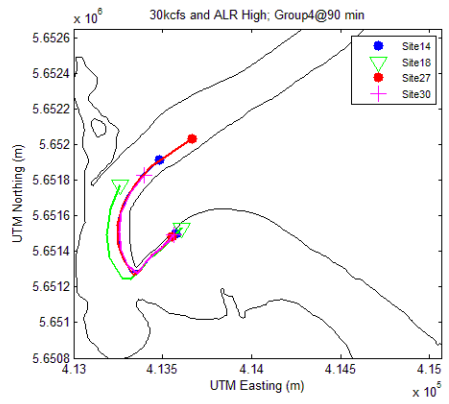
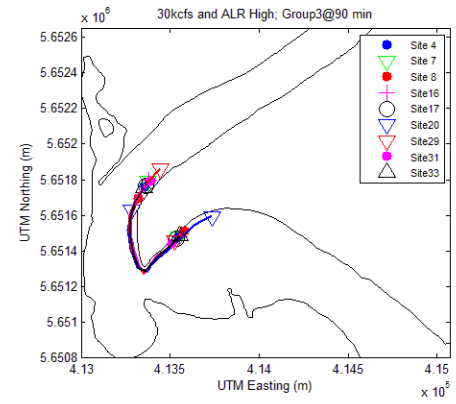
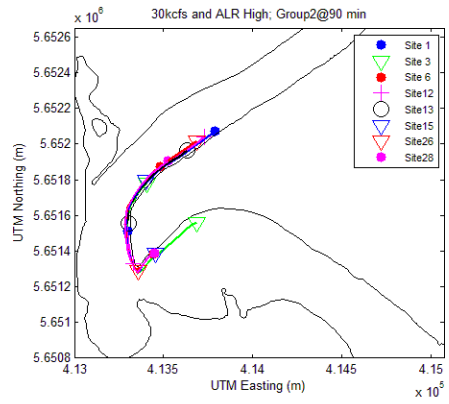
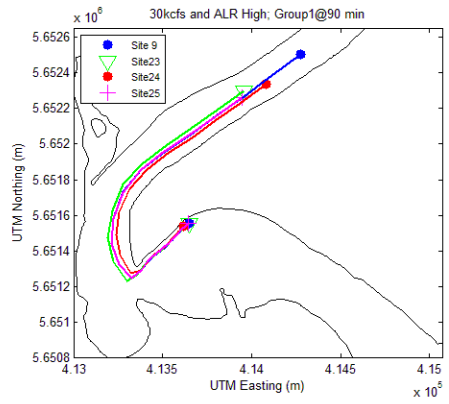


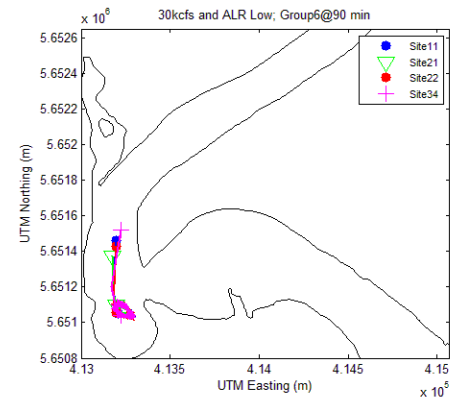
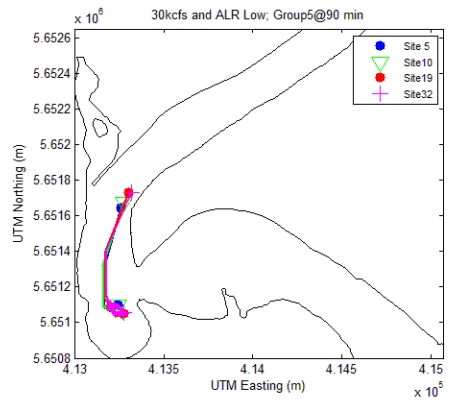
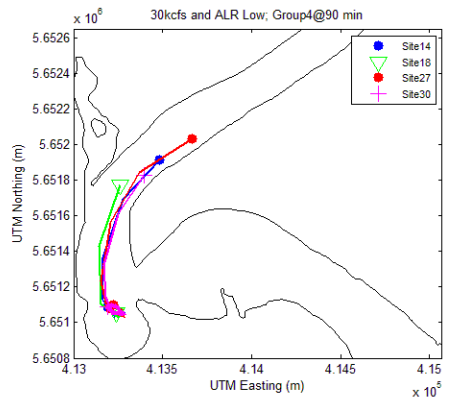
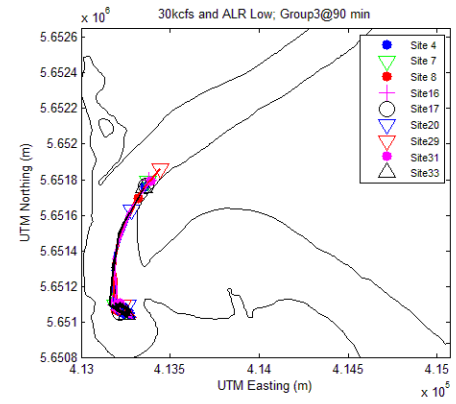
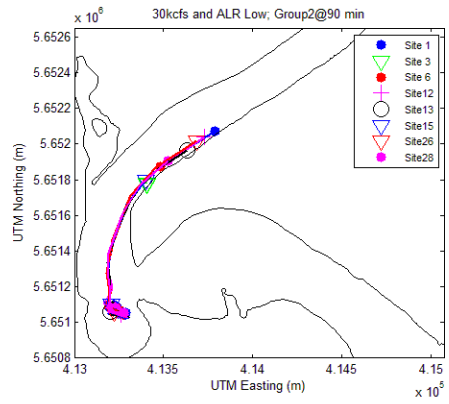
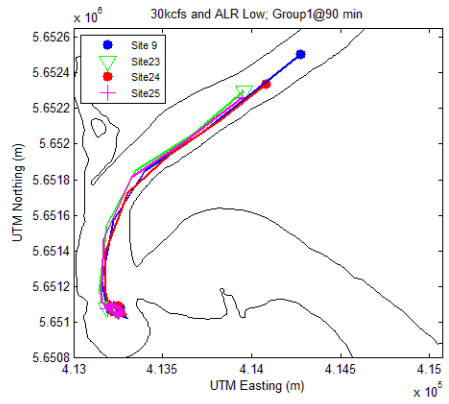


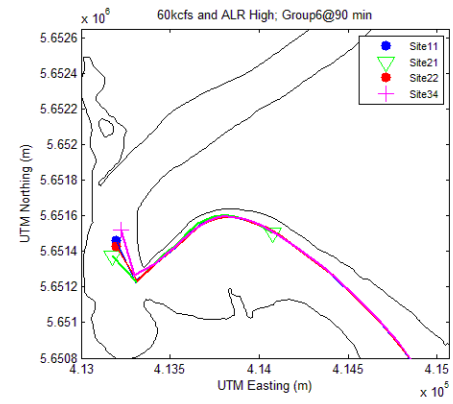
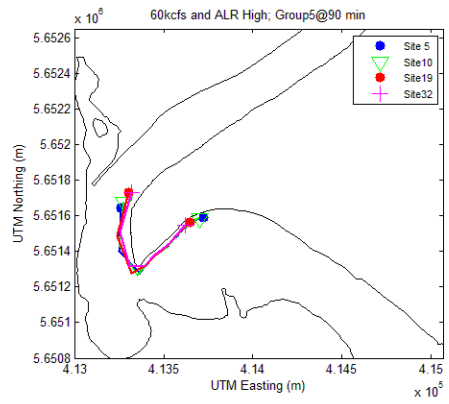
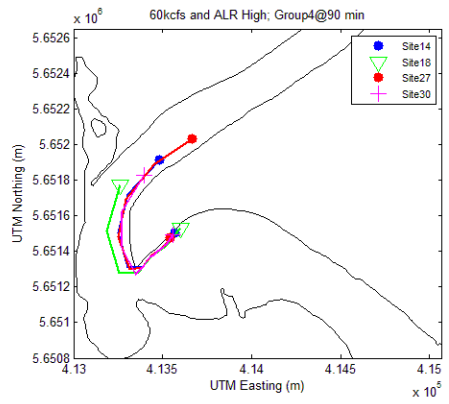
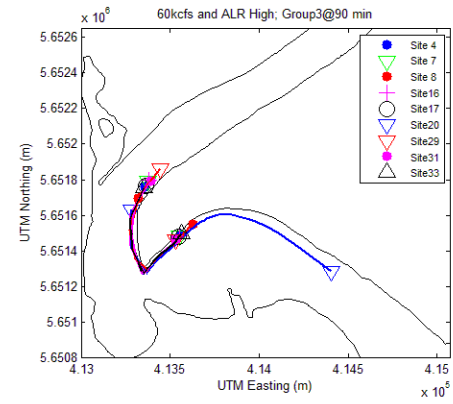
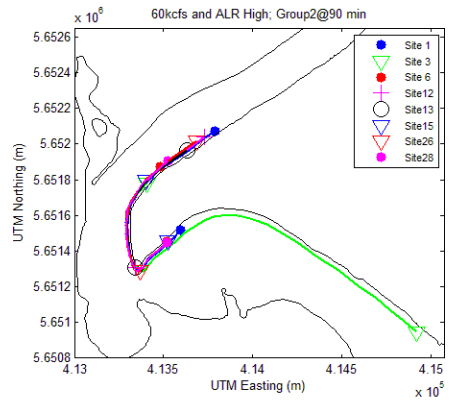
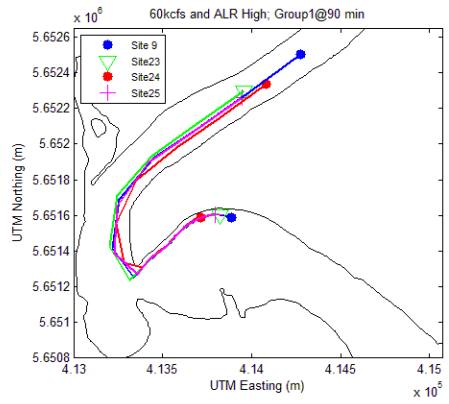




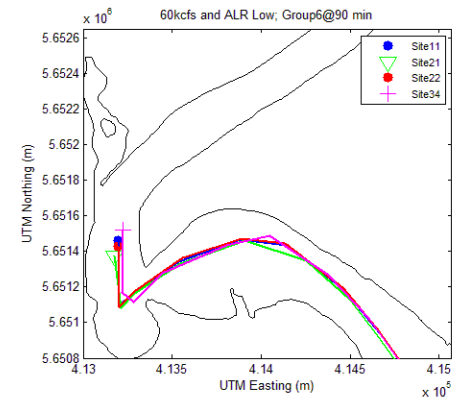
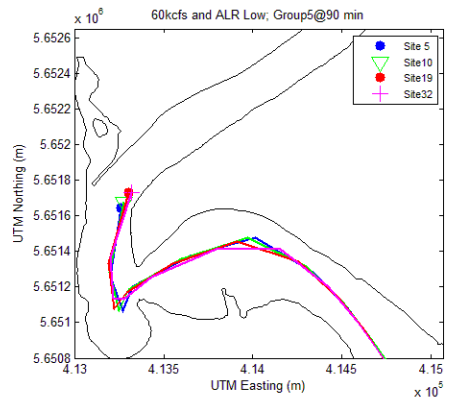
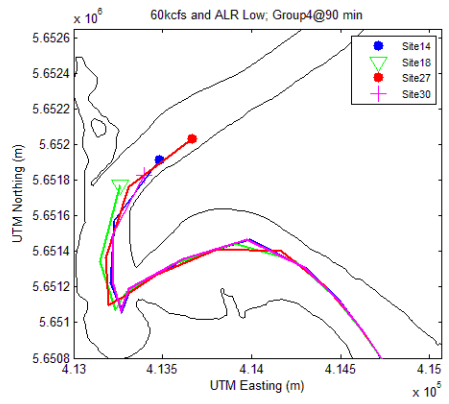
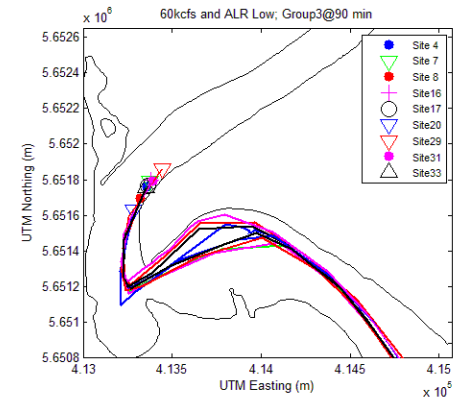
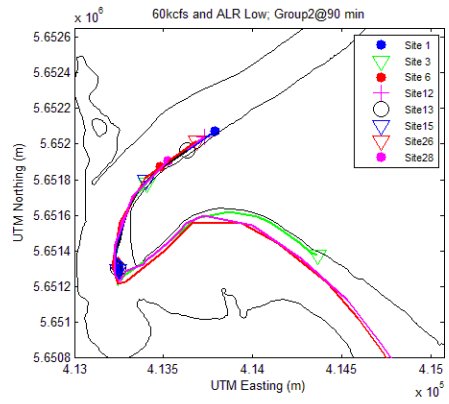
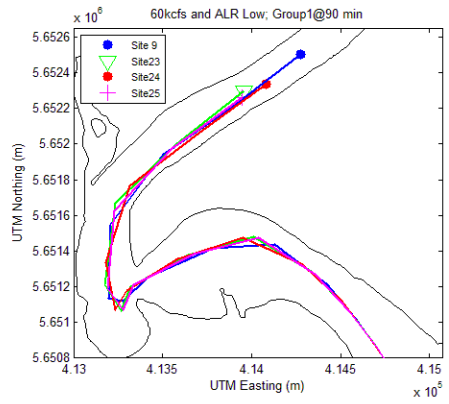


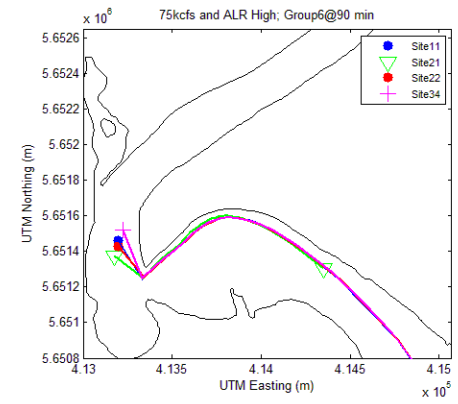
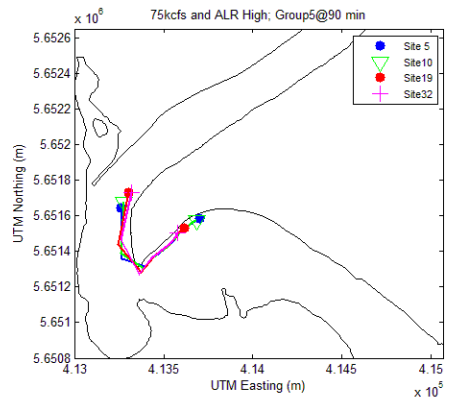
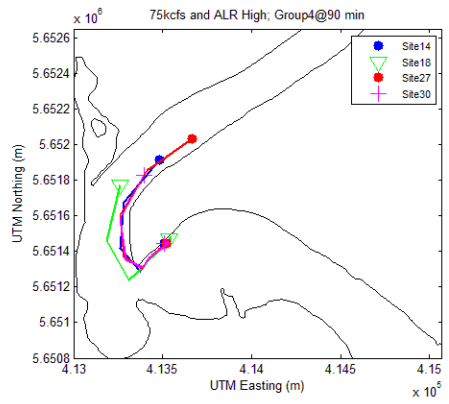
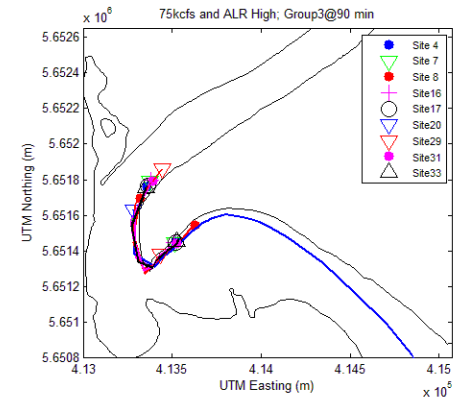
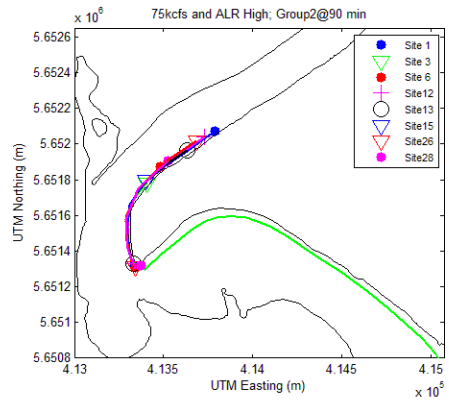
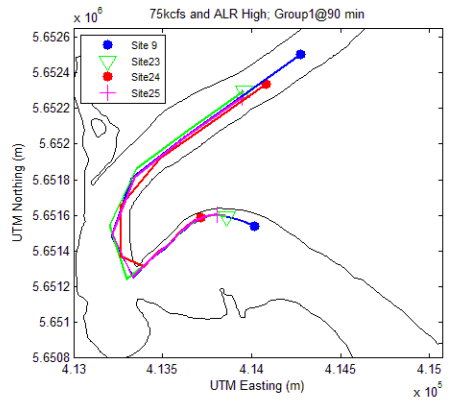


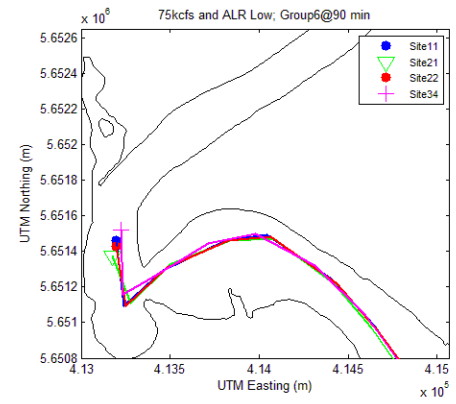
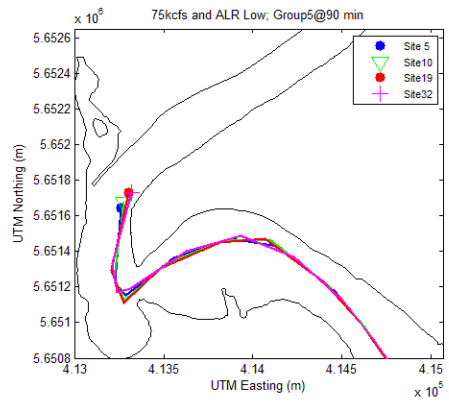
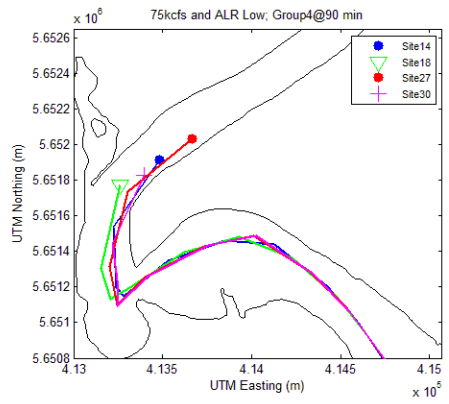
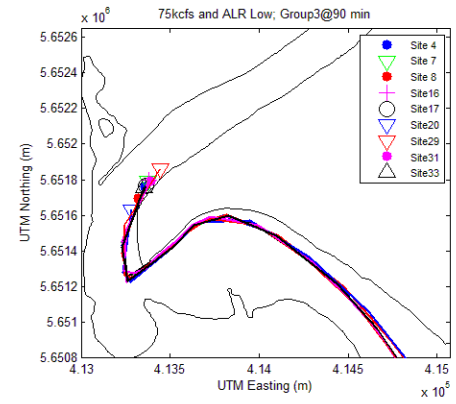
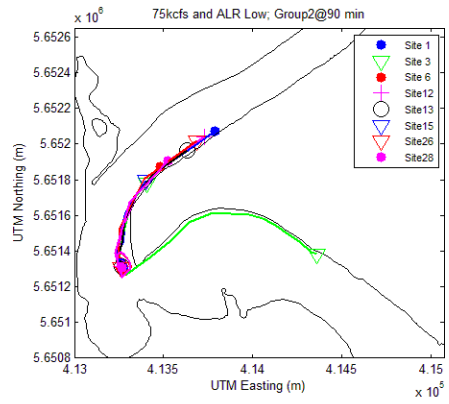
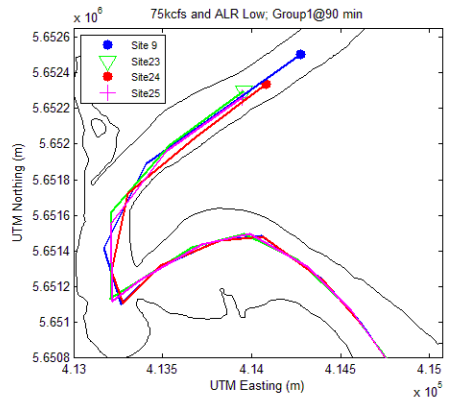


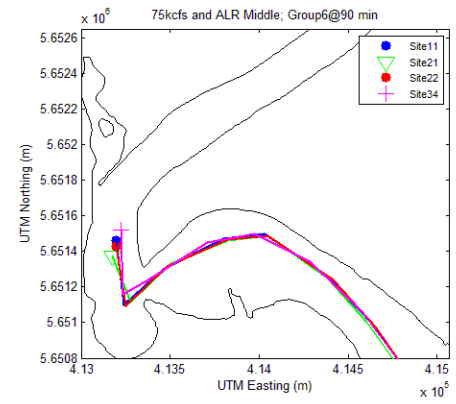
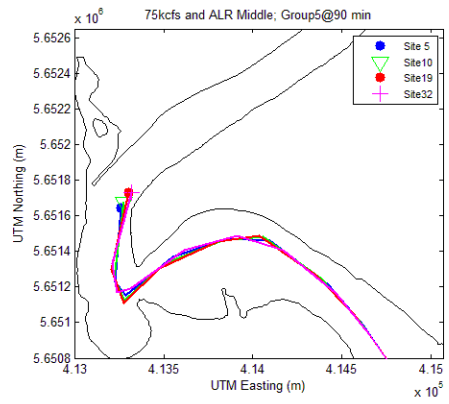
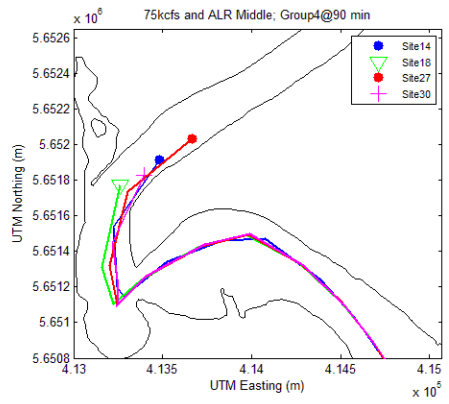
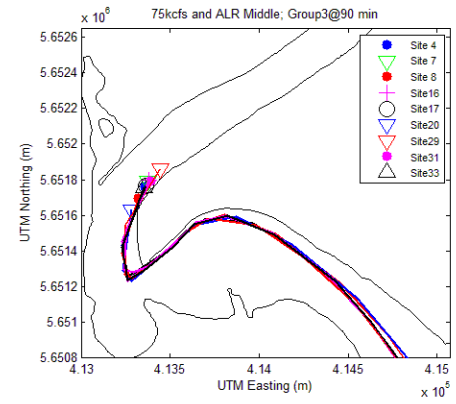
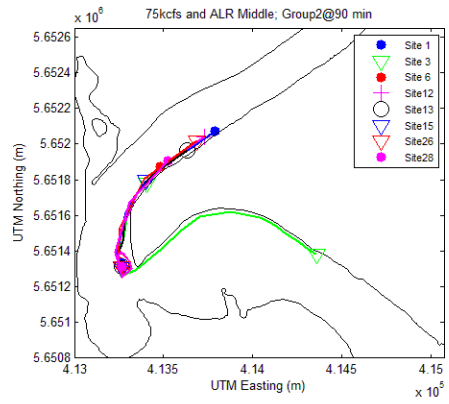
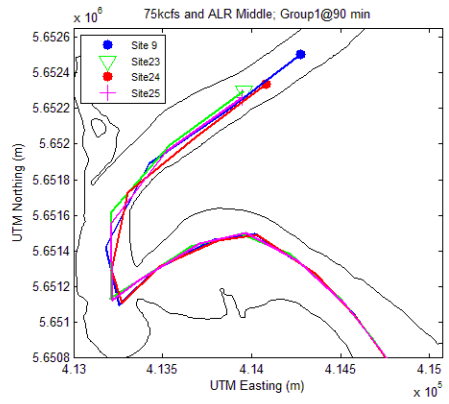






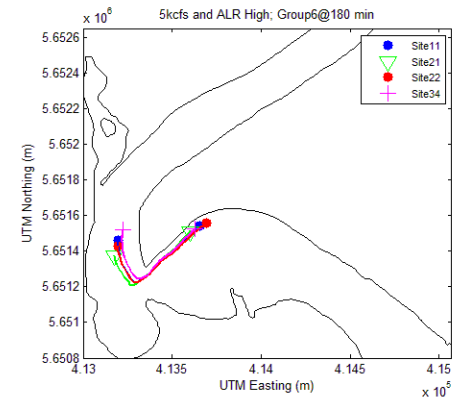
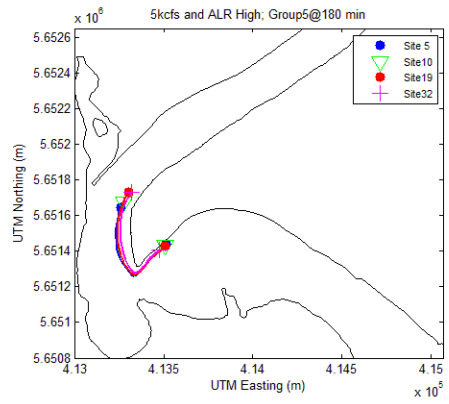
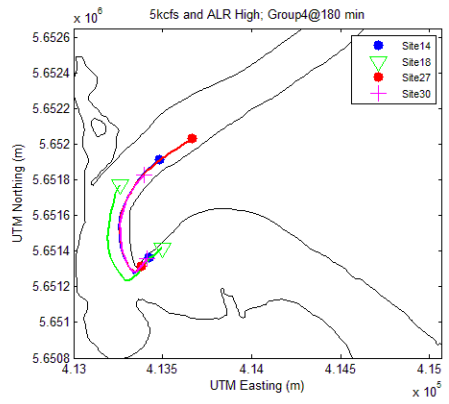
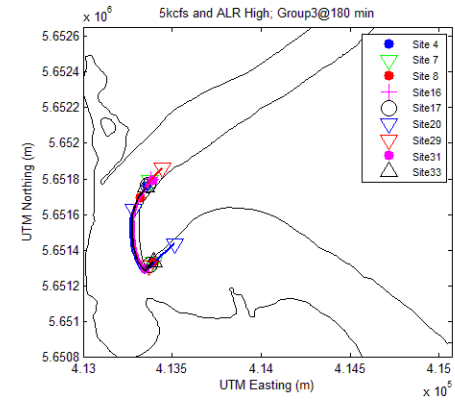
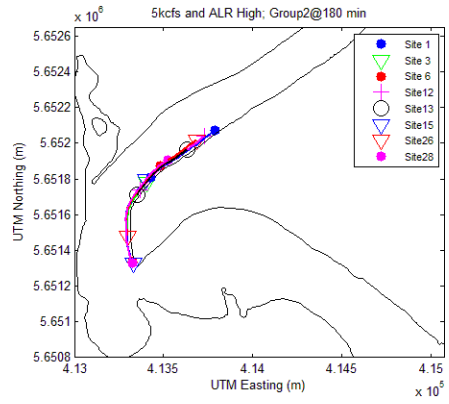
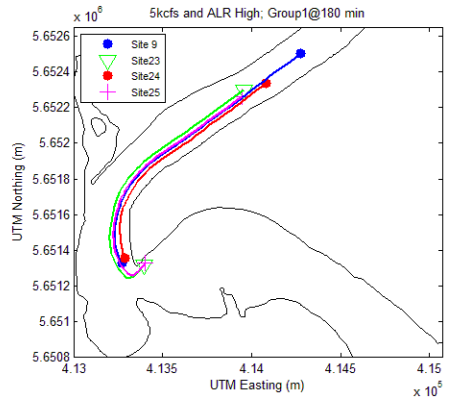


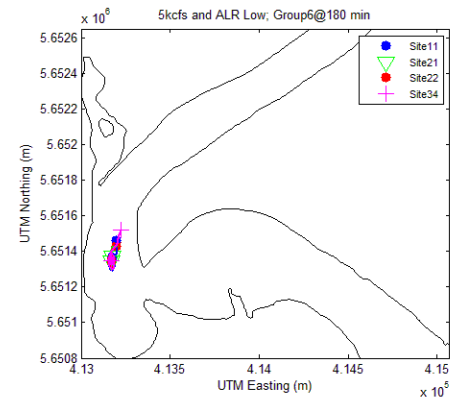
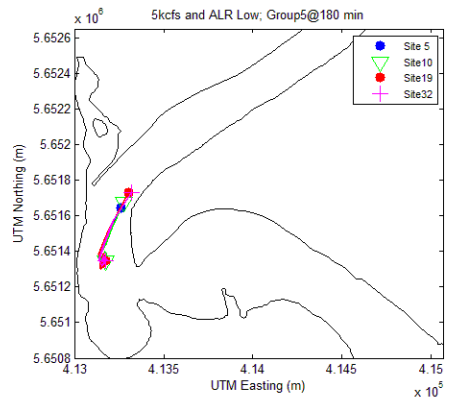
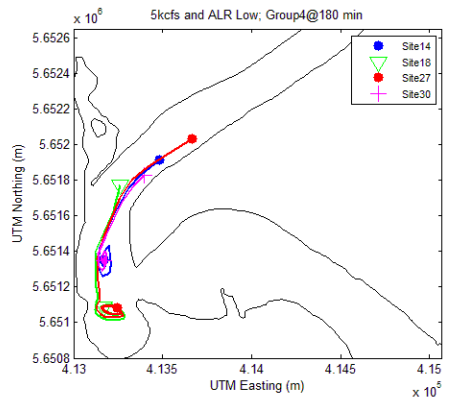
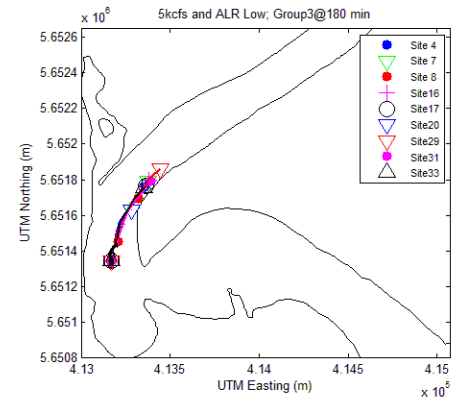
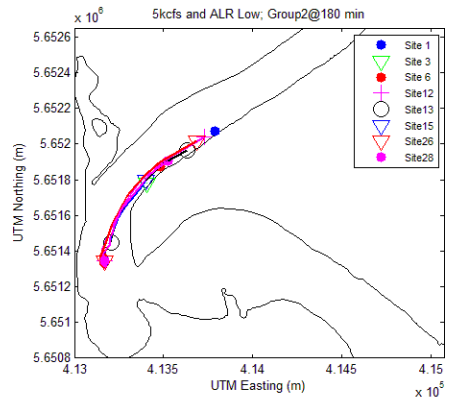
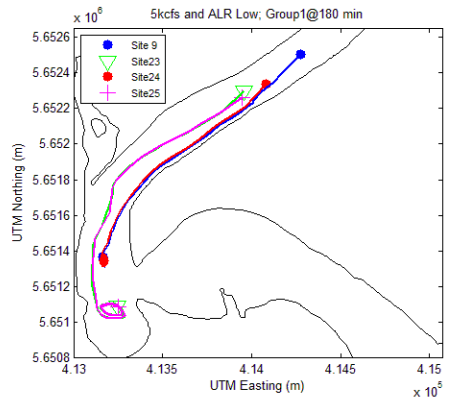


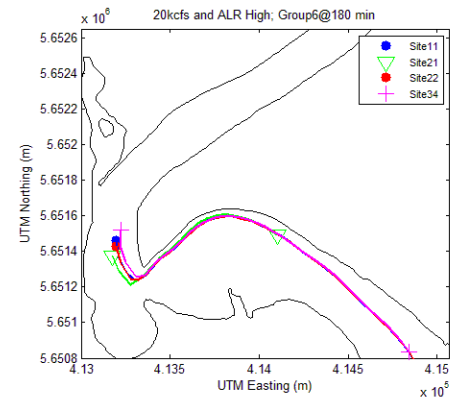
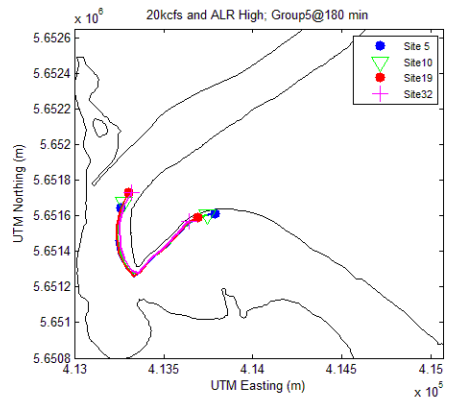
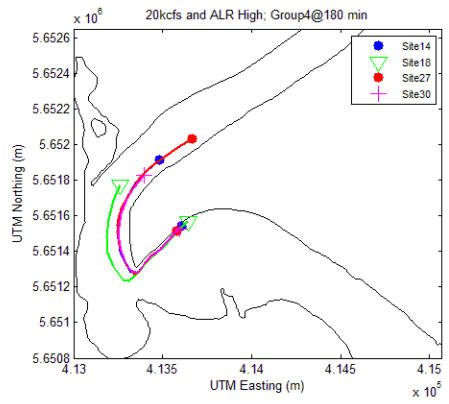
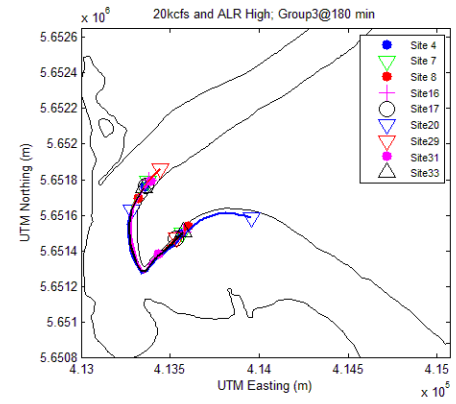
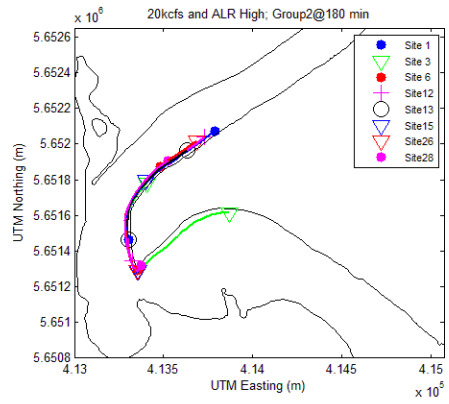
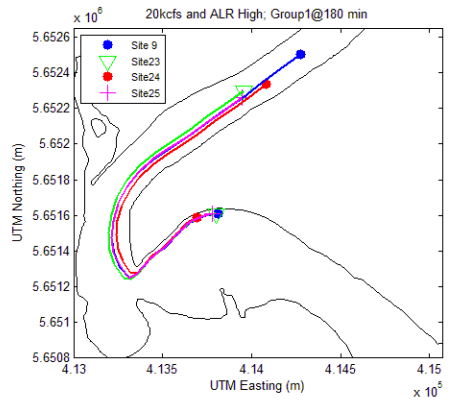


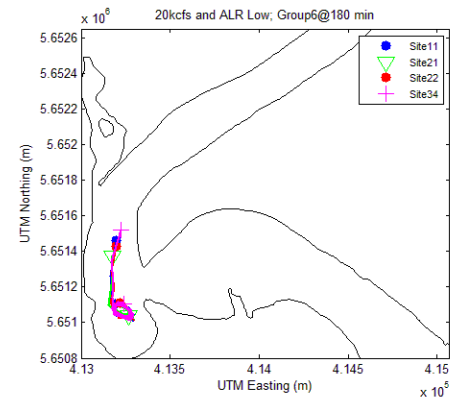
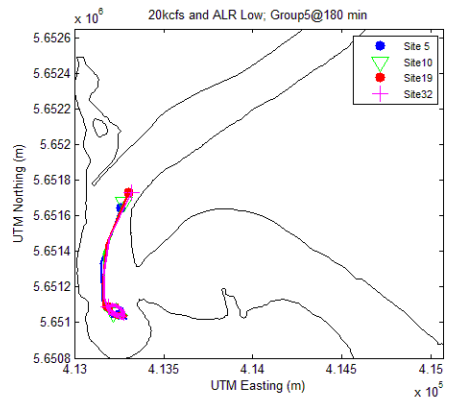
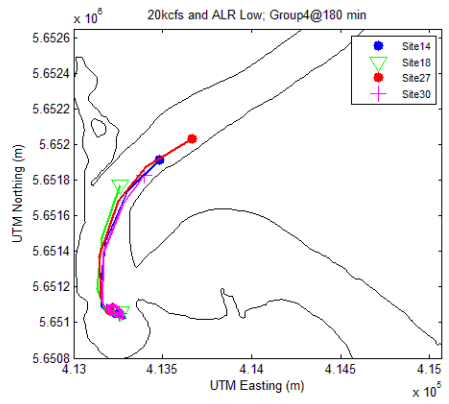
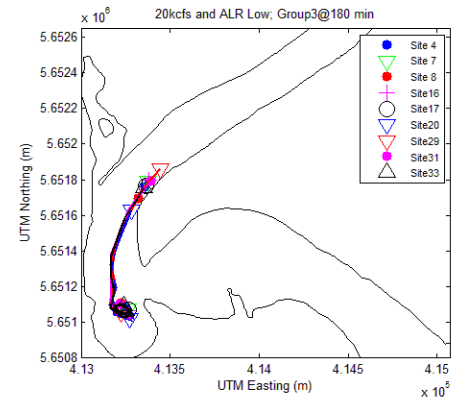
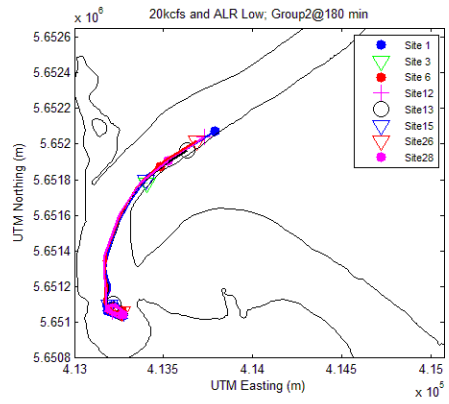
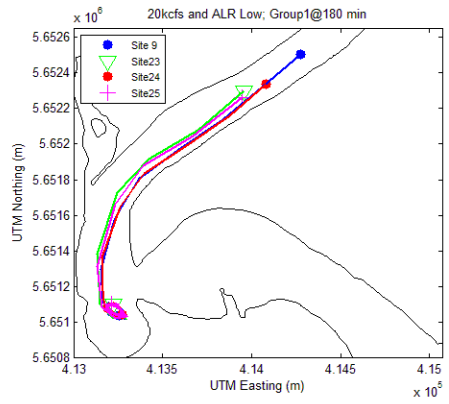


(4) Locations and tracks of the particles at 180 minutes after releasing

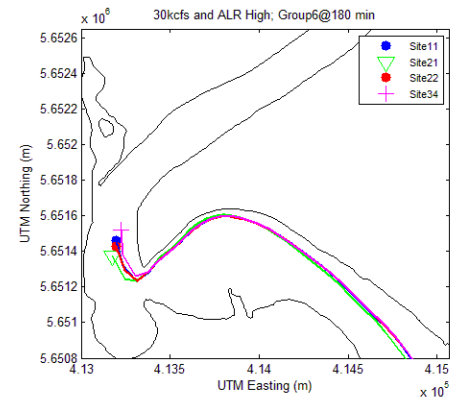
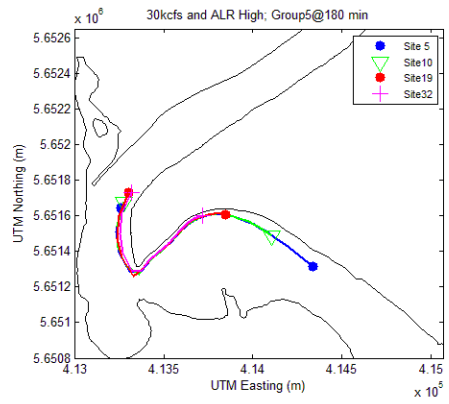
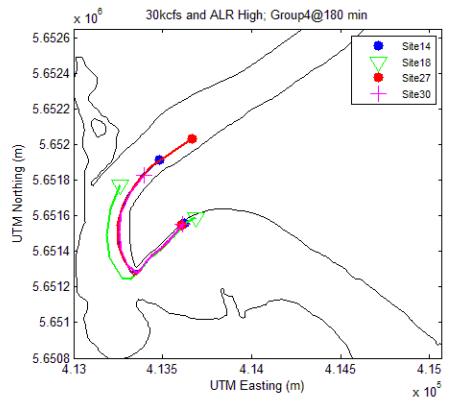
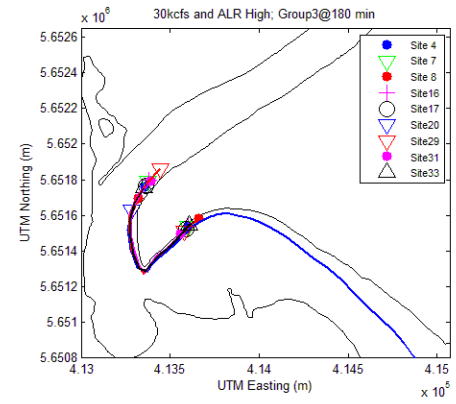
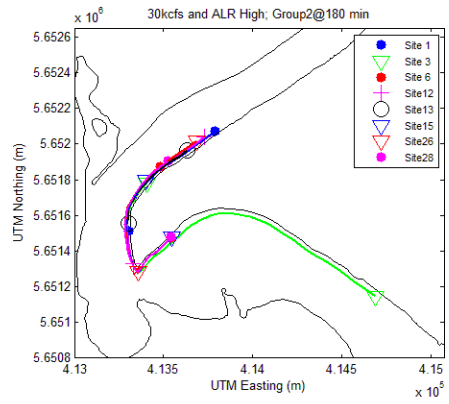
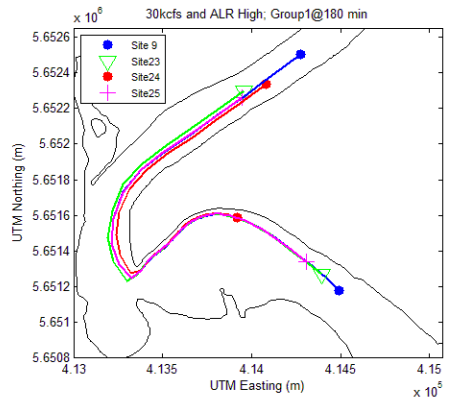


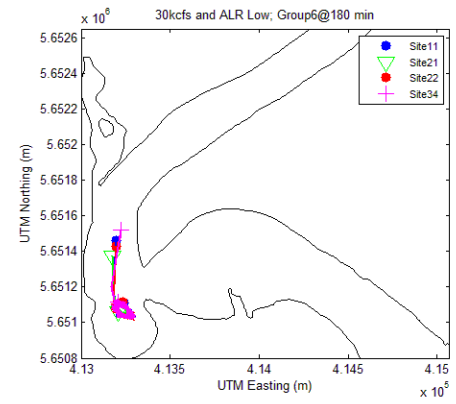
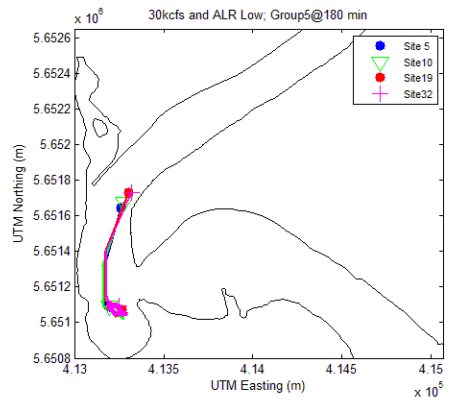
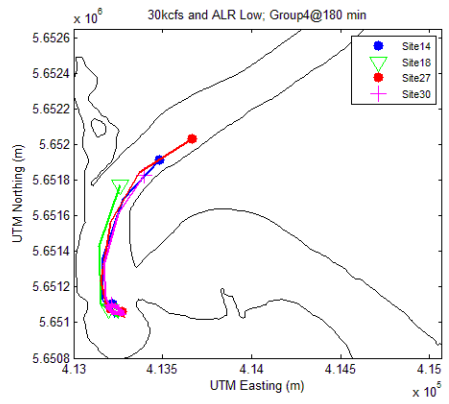
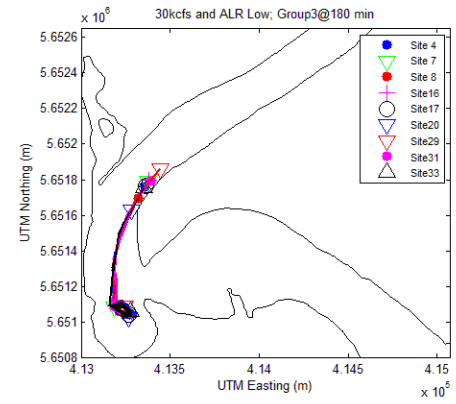
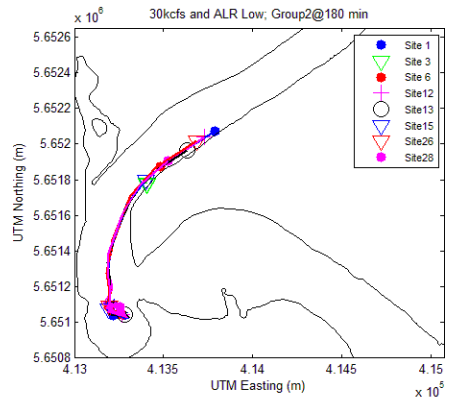
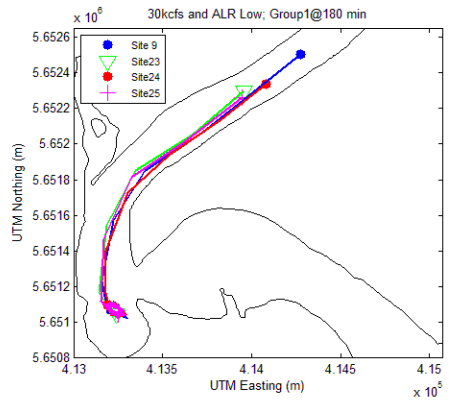


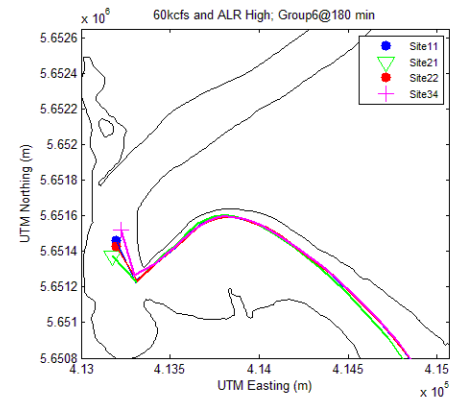
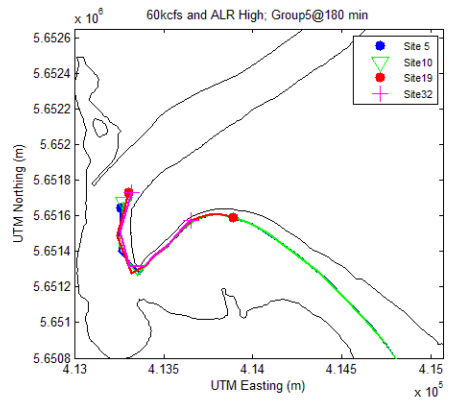
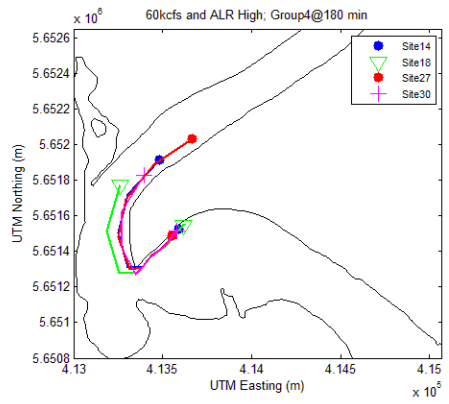
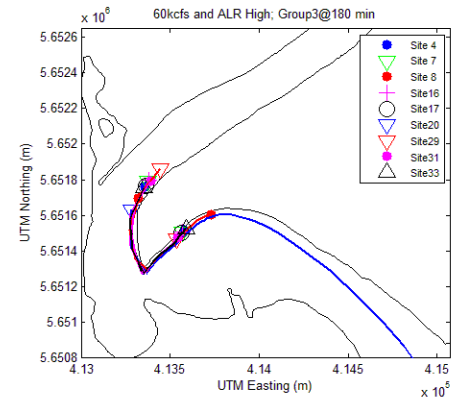
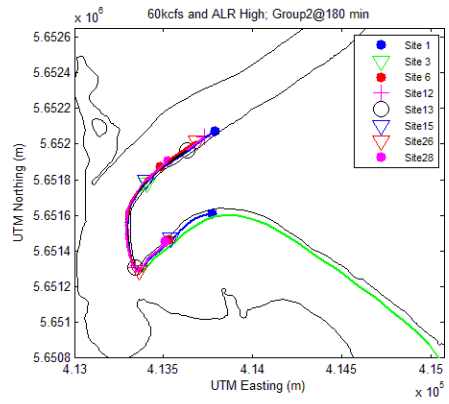
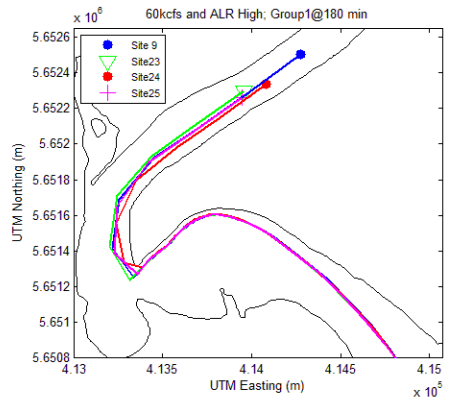


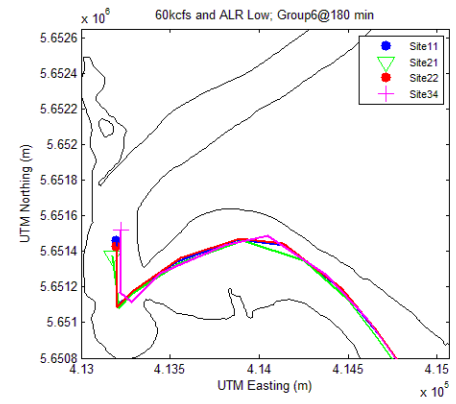
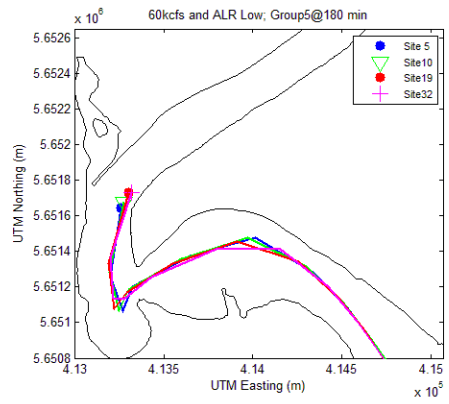
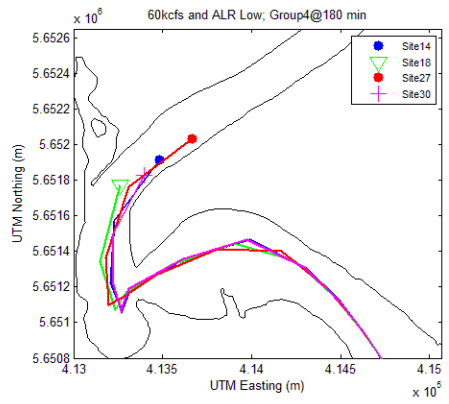
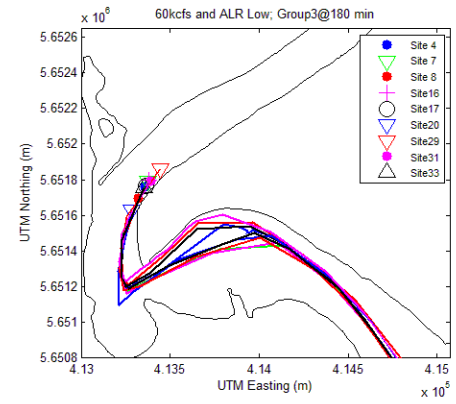
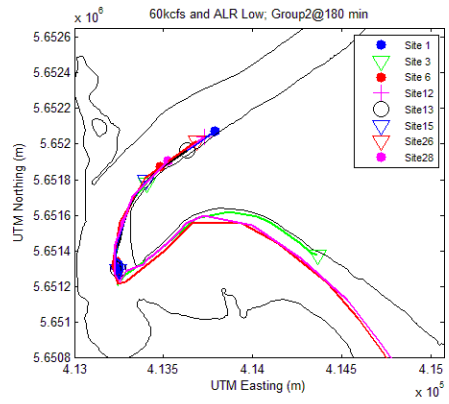
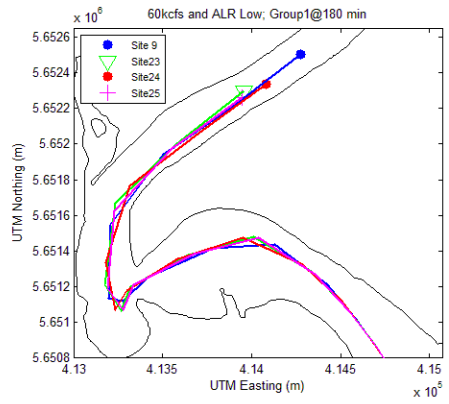




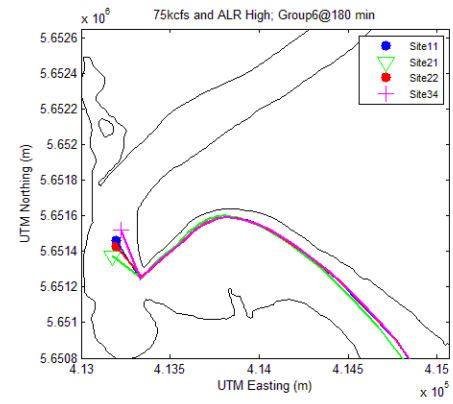
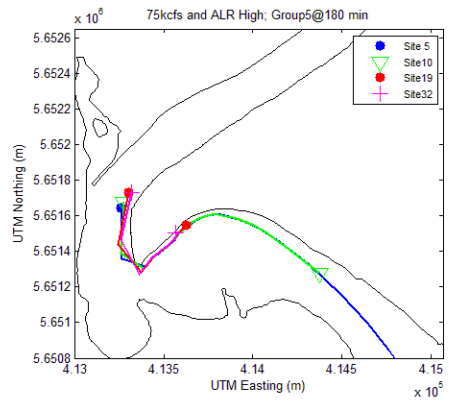
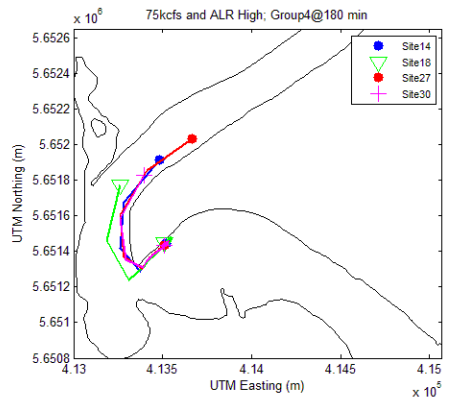
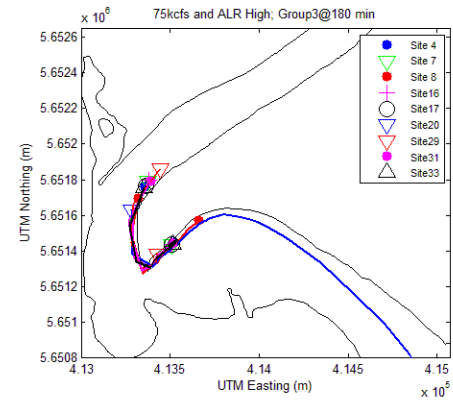
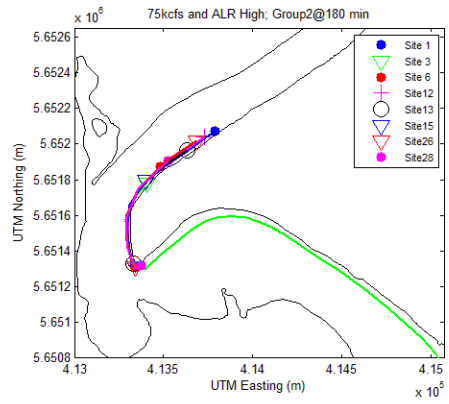
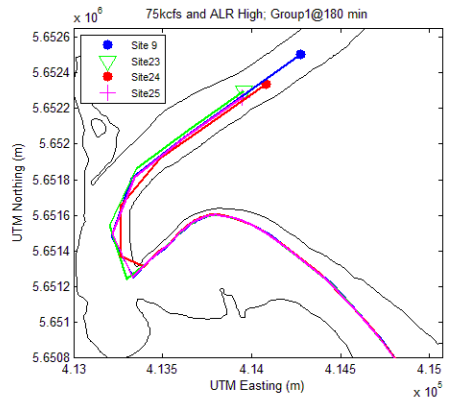


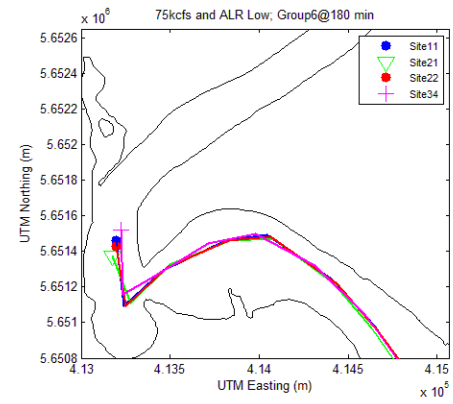
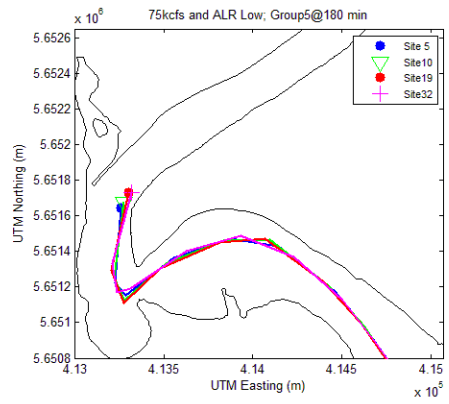
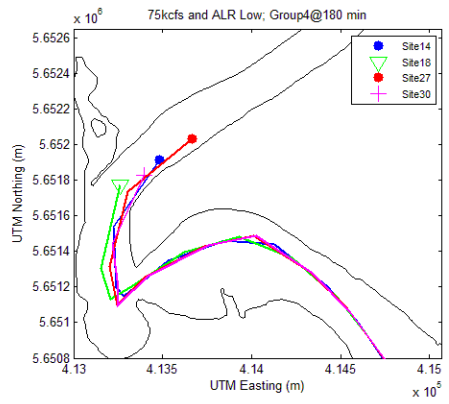
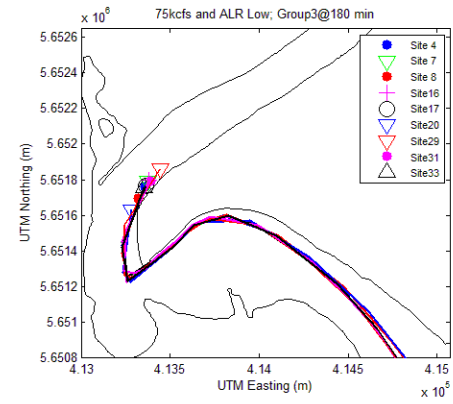
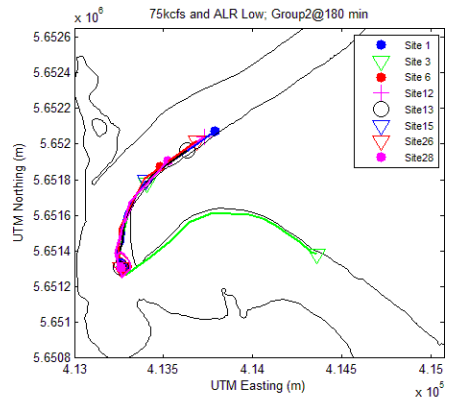
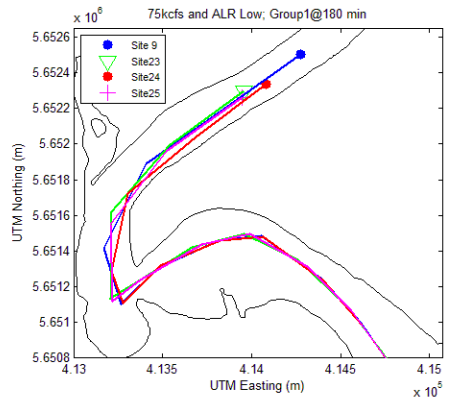












At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

[solutions@golder.com](mailto:solutions@golder.com)  
[www.golder.com](http://www.golder.com)

**Golder Associates Ltd.**  
**201 Columbia Avenue**  
**Castlegar, British Columbia, V1N 1A8**  
**Canada**  
**T: +1 (250) 365 0344**

