

**Attachment A: Response to Comments from Dr. S. Wells on Draft Calibration**

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June 22, 2015

To: Jean Marie Boyer, Christine Hawley, Hydros Consulting Inc.

From: Scott A. Wells



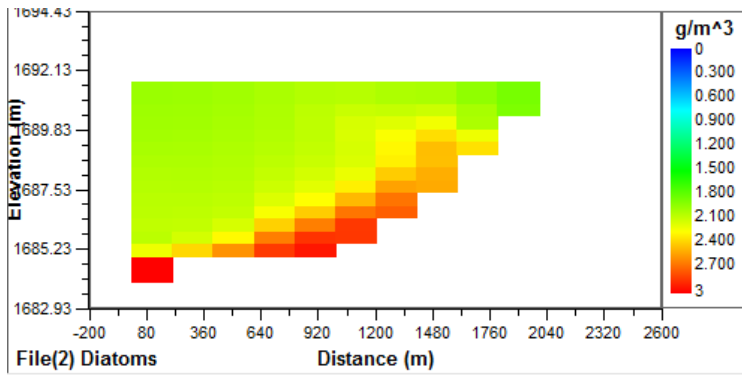
C: Craig Wolfe, GEI

Re: Peer review of Cherry Creek Reservoir model calibration

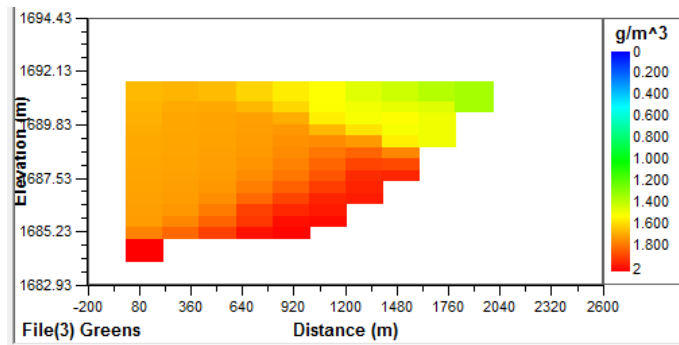
This memorandum summarizes the results of a meeting on June 22, 2015 in Boulder, Co, at the Hydros' office where the Cherry Creek Reservoir calibration was reviewed. Below are a list of possible areas to evaluate for model improvement. These areas may or may not affect the current state of the model calibration but may make the final model result more defensible, help in understanding the strengths and weaknesses of the model, and help us point to gaps in our understanding of the reservoir that additional field sampling can help reduce.

1. The current model uses the W2N turbulence closure scheme with a maximum value of  $A_z$  set to  $0.0001 \text{ m}^2/\text{s}$ . The recommended turbulence closure scheme is a more general formulation, the k-e turbulence model, specified as TKE, with a maximum value set to  $1.0 \text{ m}^2/\text{s}$ . Hence, one does not over-constrain possible vertical mixing with the lower limit to  $A_z$ .
2. Comparing field data of light extinction to model prediction of light extinction would be an important check on predicting light transmission as it affects algae growth.
3. With the large amount of particulate organic and inorganic matter in the reservoir, a comparison of TSS and VSS (which would be LPOM, RPOM, and total algae in the model) could affect the model's ability to predict dynamically the light extinction coefficient. This is especially true since the average inflow of ISS from Cherry Creek is over  $40 \text{ mg/l}$  with a peak of  $1600 \text{ mg/l}$ .
4. The low values of ASAT for the first 2 algae groups of  $20 \text{ W/m}^2$  seem low. There are cases where algae growth is concentrated at the bottom of the model perhaps by settling and the low value of ASAT.

Note the 'diatom' group model predicted growth in May of the first year with the unusual growth at the bottom of the reservoir (this is common in most years).



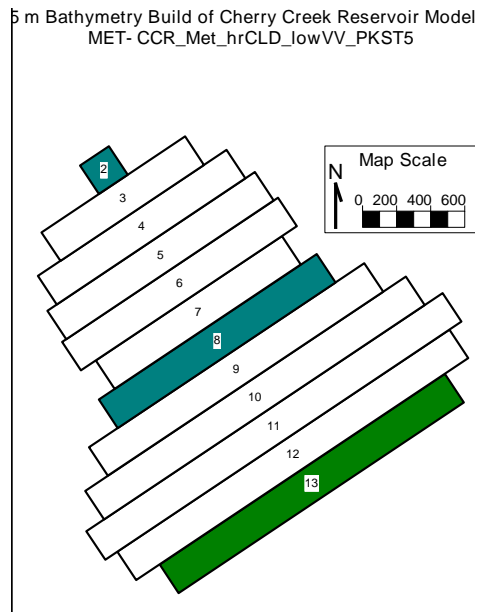
In April of the first year (Day 101.2) for the group called 'greens' also showed similar behavior:



This growth at the bottom may be due to too much light penetration and low values of ASAT or due to inflow density currents. I would encourage animating the various water quality parameters to make sure behavior is as intended.

5. pH was not modeled in this simulation but it can be a useful state variable since it helps verify aerobic sediment processes by closing the loop on a C balance. This may require looking at the boundary conditions for TIC and alkalinity that are currently constant over time.
6. The model computes TDS as a state variable. It was mentioned an increase in TDS has occurred over the last few years as a result of increased TDS from the tributaries. Were there comparisons to field data?
7. Aeration input (mass of O<sub>2</sub> delivered by the aerators) was calibrated to match dissolved oxygen profiles. A check should be made on the actual amount of oxygen delivered by the aeration system and whether the calibrated amount added seems reasonable.
8. During the fish kill in 2012 (?), C, N, and P were added to the aerobic sediments during this period. The amounts added should be checked to see if they are reasonable based on observations.
9. Zooplankton data collected in later years of the model calibration should be compared to field data for zooplankton during these years if zooplankton are used in the model. Even though there have been hypotheses for zooplankton productivity throughout the period of model calibration, the model should have zooplankton during the entire period of the model. It may be that some of the mortality functions of zooplankton (or for that matter algae) may be time dependent but are represented in the model as static values.

10. In addition to the extensive model-data comparisons presented (profiles and time series graphs), animations, contour plots and velocity vectors plots may be helpful to visualize the model predicted behavior of the reservoir.
11. The zero order and first order models are used for sediment impacts. Since the zero order SOD model is not predictive but varies only by temperature, one may want to experiment (if there are time/resources available) with the Version 4 model with the fully predictive SOD model. This will require turning off the zero and first order models.
12. Some documentation should be provided for the high ratio of refractory to labile organic matter coming into the model since it is currently set at 10% labile and 90% refractory.
13. The model grid bathymetry orientation angles are off by 180 degrees. This may affect how the lake responds to the wind.



14. Since biovolume species data exist, it would be useful to compare for different seasons model predicted species composition even though the groups may not be exactly aligned with the biovolume species data.
15. Since field data are collected at the outlet to Cherry Creek Reservoir, model predictions of outlet water quality and temperature could be compared to these field data. This provides a check on selective withdrawal of the model and the reservoir's water quality.
16. For performing sensitivity runs with the model, looking at the sensitivity of the model to wind or meteorological conditions (by varying WSC or using a different meteorological file such as from another site) and zero order SOD would be useful.
17. The low dissolved oxygen in the surface of the model during the early years seems to be related to too high SOD during these periods since the largest source/sink is SOD. Changing the reaeration coefficient and/or O2AG may not affect the under-prediction of dissolved oxygen since SOD dominated the oxygen balance (from what I recall seeing in the presentation).



18. Since you have made code changes, make sure you are using the exact settings for the Intel Visual Fortran compiler used to compile the release executable. Issues with precision of real numbers can greatly affect the model results.
19. It would also be helpful to report mean error in the error statistics in addition to your absolute mean error and RMS since this indicates bias.

In general, the calibration is well advanced and the work performed to date has been reasonable and has been moving in the right direction. Even though some of these items above may adjust the model calibration, it should not take too much of an effort to return to what had already seemed a reasonable calibration that is more defensible in understanding processes in the reservoir.

**Hydros is grateful to Dr. Wells for his thoughtful and insightful comments in review of the draft calibrated model. All comments were carefully considered. The process of resolving issues brought up in these comments led to important model improvements, resulting in a more defensible product. The following is a comment-by-comment response to items in the memorandum from Dr. Wells.**

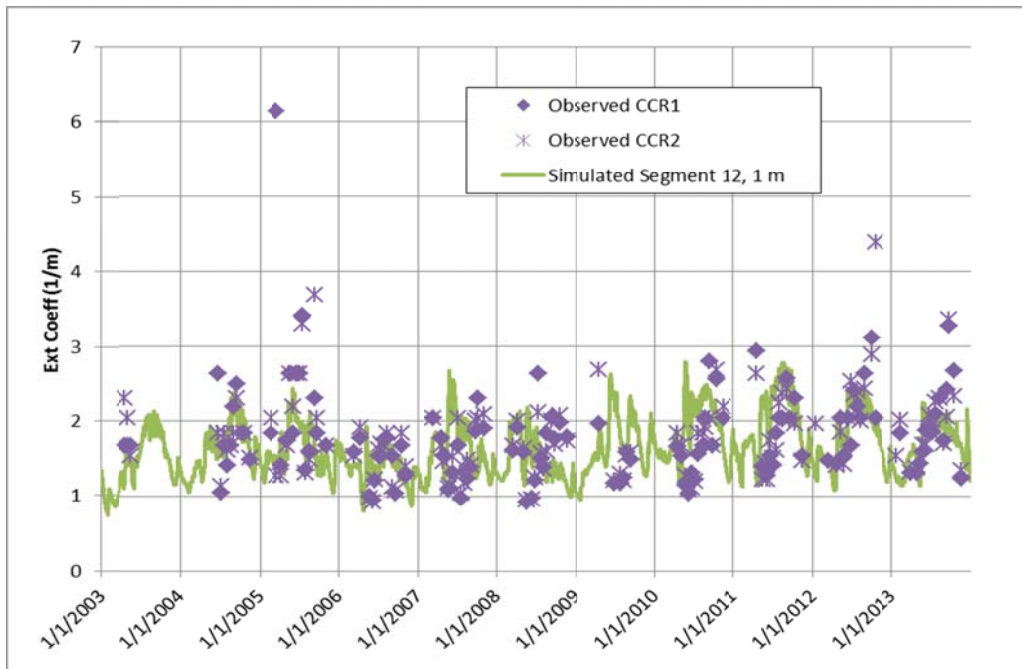
1. The current model uses the W2N turbulence closure scheme with a maximum value of  $A_z$  set to 0.0001  $m^2/s$ . The recommended turbulence closure scheme is a more general formulation, the k-e turbulence model, specified as TKE, with a maximum value set to 1.0  $m^2/s$ . Hence, one does not over-constrain possible vertical mixing with the lower limit to  $A_z$ .

The turbulence closure scheme has been changed to TKE with a maximum value set to 1.0  $m^2/s$ . The change to the simulation response was minimal.

2. Comparing field data of light extinction to model prediction of light extinction would be an important check on predicting light transmission as it affects algae growth.

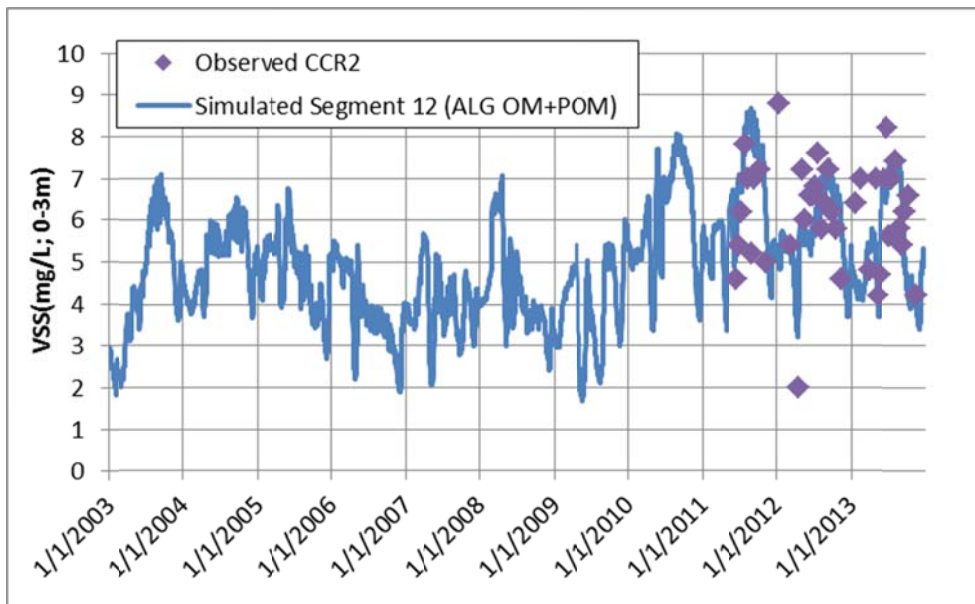
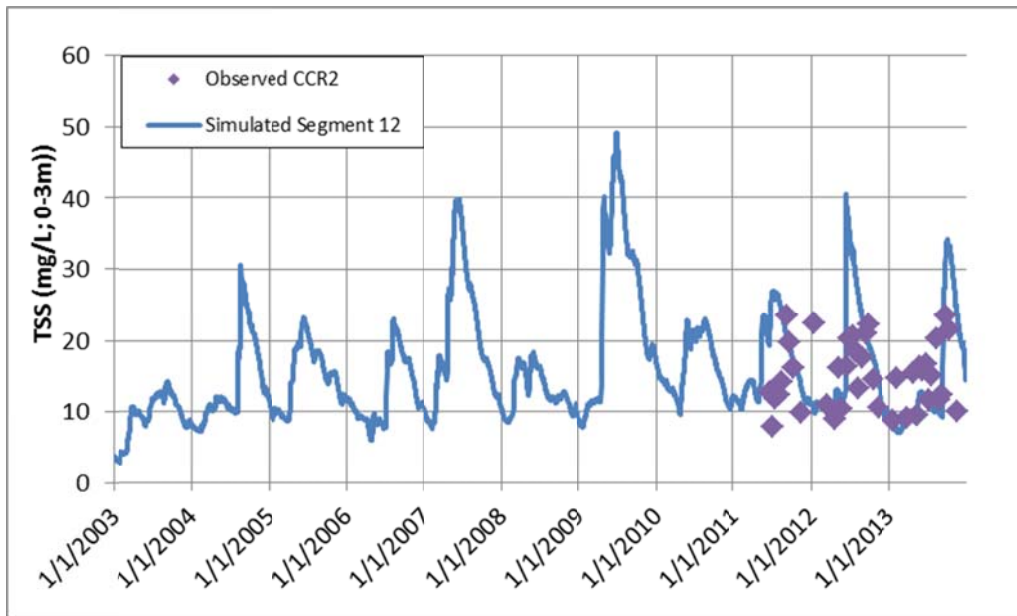
Thanks for this comment. It was valuable to make this comparison. The draft calibration model was exhibiting much greater light transmission than was observed in the field. Extinction values for algae, organic matter, and ISS were adjusted to better match observations. This adjustment required modifying wind sheltering and the calibration of the aerator mixing. Recalibration of algal settings was also necessary, including modifications to ASAT values and setting of Alg 3 (N-fixers) to a settling rate of zero. The resulting lowered ASAT values for Alg 3 and Alg 4 are expected to be reasonable, representing algae capable of growth in low light in this highly turbid system. The zero settling rate for Alg 3 is expected to be reasonable for this nitrogen-fixing cyanobacteria group, representing buoyancy capabilities. Negative settling rates were tried but did not provide improved results.

The resulting extinction rate at 1 m is plotted against the observed extinction rate in the reservoir in the figure below. Note, modeled extinction rates for 2 m, and 3 m show similar results to 1 m. A reasonable general match is now seen in model output.

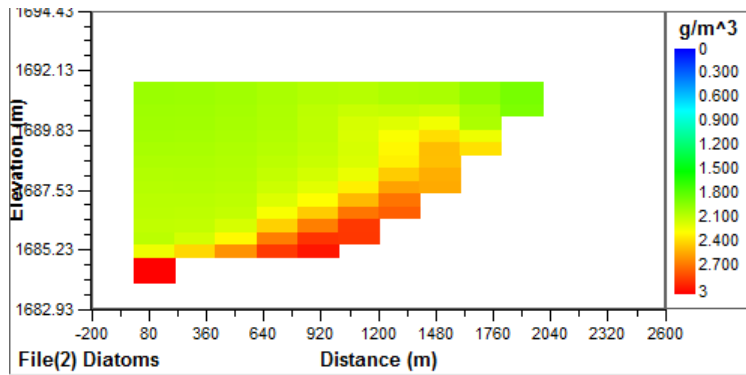


3. With the large amount of particulate organic and inorganic matter in the reservoir, a comparison of TSS and VSS (which would be LPOM, RPOM, and total algae in the model) could affect the model's ability to predict dynamically the light extinction coefficient. This is especially true since the average inflow of ISS from Cherry Creek is over 40 mg/l with a peak of 1600 mg/l.

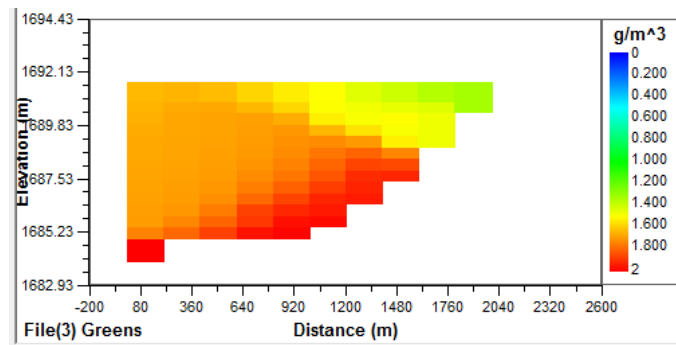
Thanks for this comment. As discussed at the meeting, TSS and VSS were not calibration targets in the modeling effort. TSS and VSS data in the reservoir are only available for the last few years of the simulation period. That said, it was useful to compare observed and simulated TSS and VSS. As a result of these comparisons, settling rates were decreased for the ISS group and POM to better match the range of observations. These adjustments also supported improving simulation of light extinction (discussed in Comment #2). The following plots present ISS and VSS, observed (sampled as a composite of the top 3 m in the reservoir) and simulated (also an average of top 3 meters).



4. The low values of ASAT for the first 2 algae groups of 20 W/m<sup>2</sup> seem low. There are cases where algae growth is concentrated at the bottom of the model perhaps by settling and the low value of ASAT. Note the 'diatom' group model predicted growth in May of the first year with the unusual growth at the bottom of the reservoir (this is common in most years).



In April of the first year (Day 101.2) for the group called 'greens' also showed similar behavior:

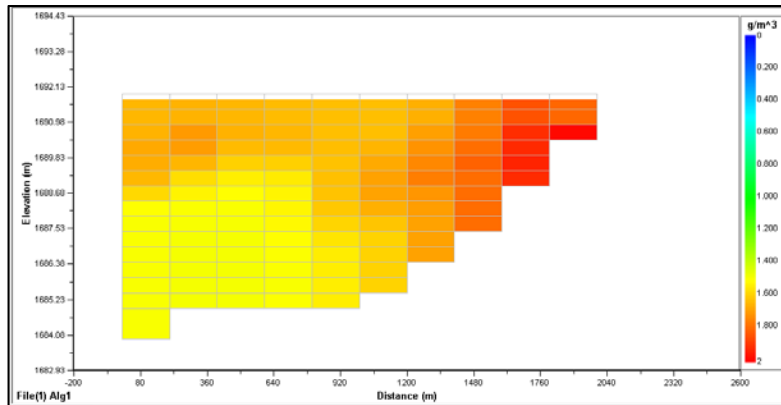


This growth at the bottom may be due to too much light penetration and low values of ASAT or due to inflow density currents. I would encourage animating the various water quality parameters to make sure behavior is as intended.

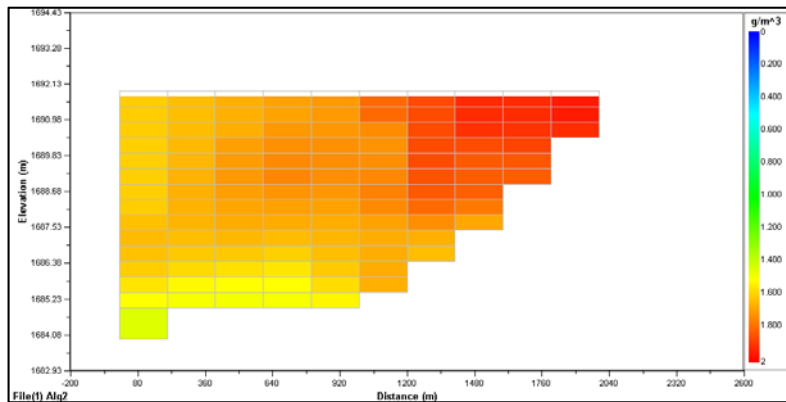
Animations have been reviewed as part of the updated calibration. The draft calibration low ASAT values for algal groups 1 and 2 have been increased, but still reflect relatively low-light growth capabilities. Data do not provide profile information for chlorophyll *a* to support or refute greater algal concentrations at depth at times. However, given the low transparency of the water, it was decided to increase ASAT values for these cooler-season algae to err on greater growth in the upper layers of the reservoir.

Plots for Alg1 and Alg 2 patterns (similar over the years) are shown below for the revised calibration for comparison with the original plots included in the comment.

Alg1 day 140:



Alg2 day 101:

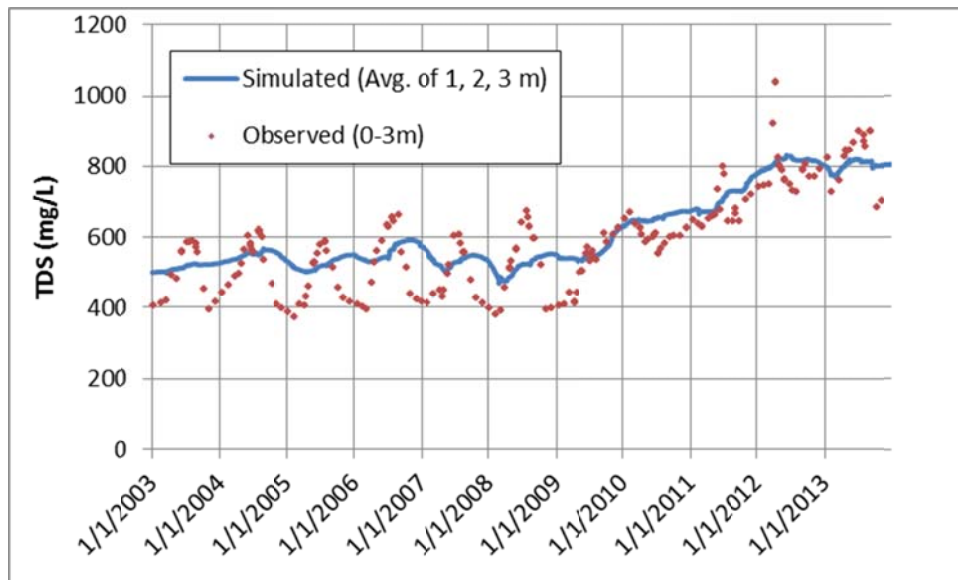


5. pH was not modeled in this simulation but it can be a useful state variable since it helps verify aerobic sediment processes by closing the loop on a C balance. This may require looking at the boundary conditions for TIC and alkalinity that are currently constant over time.

For the current modeling effort, simulation of pH has not been added. Boundary condition data for alkalinity were not available for input (data only collecting in 2001, prior to modeled years). TIC data are not available for any years. Likewise, pH data were only collected on inflows starting in 2008. Attempts to simulate pH could be considered for future model updates.

6. The model computes TDS as a state variable. It was mentioned an increase in TDS has occurred over the last few years as a result of increased TDS from the tributaries. Were there comparisons to field data?

The following figure compares simulated and observed TDS in the reservoir. The increased apparent in 2008 is apparent in the modeled results as well. Note: The same relationship ( $0.67 * Sp. Cond.$ ) used to convert observed conductivity to TDS for model input was used to convert in-reservoir observed conductivity to TDS for this comparison. Also note that specific conductivity data were not collected on the inflows until 2008. Inflows from 2003-2008 assumed in-reservoir concentrations at the time, likely damping the observed seasonal pattern.



7. Aeration input (mass of O<sub>2</sub> delivered by the aerators) was calibrated to match dissolved oxygen profiles. A check should be made on the actual amount of oxygen delivered by the aeration system and whether the calibrated amount added seems reasonable.

The aerators provide 200 to 250 cubic feet of air per minute (or 8,155 cubic meters per day). Assuming a density of air of 0.93 kg/m<sup>3</sup> at an altitude of 5,500 ft at 90°C (error on the side of high temperature to avoid overestimating the resulting mass), this corresponds to 7,584 kg of air per day. Assuming 23% oxygen, this equates to 1,744 kg oxygen per day. Since the aerators are distributed over four reservoir segments, this equates to a maximum potential of 436 kg/day of oxygen per segment, assuming an even distribution. The gradient driving oxygen out of the bubbles decreases with increasing elevation in the reservoir. Further, contact time is low in this relatively shallow system. A total of 200 kg/day of oxygen per segment was used in the modeling. This is a little less than half the maximum potential. The effect of this directly-added oxygen is minimal in the modeled response, as might be expected based on the depth of the reservoir.

8. During the fish kill in 2012 (?), C, N, and P were added to the aerobic sediments during this period. The amounts added should be checked to see if they are reasonable based on observations.

For the fish kill in 2012, it was assumed that 90% of the fish settled to the bottom of the reservoir, corresponding to roughly 5,000 fish. It was assumed that the average weight of the fish was 0.2 kg/fish, resulting in ~1,000 kg of settled dead fish. Assuming 850 acres of bottom surface (3.4E6 m<sup>2</sup>), this corresponds to 0.29 g OM per square meter. Assuming ~50 carbon:OM and the Redfield ratio (C:N:P = 106:16:1), the following increases in sediment compartment concentrations were applied: Carbon +0.14 g/m<sup>2</sup>, Nitrogen +0.02 g/m<sup>2</sup>, Phosphorus +0.001 g/m<sup>2</sup>.

9. Zooplankton data collected in later years of the model calibration should be compared to field data for zooplankton during these years if zooplankton are used in the model. Even though there have been

hypotheses for zooplankton productivity throughout the period of model calibration, the model should have zooplankton during the entire period of the model. It may be that some of the mortality functions of zooplankton (or for that matter algae) may be time dependent but are represented in the model as static values.

The role of zooplankton is expected to be minimal due to predation by gizzard shad and young walleye (personal communication with Dr. Brett Johnson [CSU], 2015 and Lewis et al., 2004). Based on this it seemed reasonable to simulate the small amount of pressure on the phytoplankton with slightly increased mortality rates in lieu of simulating highly suppressed zooplankton. Zooplankton with relatively low growth rates and high mortality and predation are simulated for 2005-2009, reflecting a possible small increase in their effect on zooplankton in those years. Another approach, as suggested, could be to simulate zooplankton throughout the period, decreasing their mortality from 2005-2007. Several simulations were conducted to simulate this, and it was decided, that this approach would require more time and budget than currently available to adjust algal mortality and appropriately minimize the role of zooplankton outside of the years of 2005 and 2007. This is being proposed as a future refinement.

Simulated zooplankton (2005-2009) were compared to observed zooplankton concentrations (2011-2013). The average simulated zooplankton concentration for 2005-2009 was 1.1 mg/L. Average observed zooplankton concentrations for 2011-2013 were 0.7 mg/L. The comparison, however, is considered imperfect, since Lewis et al. (2004) indicated that the dominant zooplankton for their study in Cherry Creek was a cyclopoid, *Diacyclops thomasi*, which is more likely to feed on protozoan than phytoplankton, citing Dobberfuhl et al. (1997). Therefore, fewer than 0.7 mg/L of zooplankton that fed on phytoplankton were likely present from 2011-2013.

Dobberfuhl, D.R., R. Miller, and J.J. Elser. 1997. Effects of a cyclopoid copepod (*Diacyclops thomasi*) on phytoplankton and the microbial food web. *Aquatic Microbial Ecology* 12: 29-37.

Lewis, W.M., Saunders, J.F., and McCutchan, J.H. 2004. Studies of Phytoplankton Response to Nutrient Enrichment in Cherry Creek Reservoir, Colorado. Prepared for Colorado Department of Public Health and Environment Water Quality Control Division. January 22, 2004.

10. In addition to the extensive model-data comparisons presented (profiles and time series graphs), animations, contour plots and velocity vectors plots may be helpful to visualize the model predicted behavior of the reservoir.

Agreed. We have been using additional output visualization tools.

11. The zero order and first order models are used for sediment impacts. Since the zero order SOD model is not predictive but varies only by temperature, one may want to experiment (if there are time/resources available) with the Version 4 model with the fully predictive SOD model. This will require turning off the zero and first order models.

Unfortunately, there is not sufficient time and budget to allow for simulation of the sediment diagenesis in Version 4 that you provided at the June 22 meeting. For reasons discussed in comment response 17,



this is expected to be an important part of future model refinements. That said, the current version of the model is considered a useful tool to help the authority improve its understanding of the system and direct future water quality management planning.

12. Some documentation should be provided for the high ratio of refractory to labile organic matter coming into the model since it is currently set at 10% labile and 90% refractory.

Degradability of the organic matter entering the reservoir has not been measured to our knowledge, so the assumption is largely speculative, based on the expected character of the inflowing organic matter. The organic matter entering the reservoir from the Cherry Creek watershed is expected to be characterized more by allochthonous organic carbon than autochthonous. A literature review presented by Hendrickson et al., (2002) states that the biodegradable percentage of organic matter in rivers dominated by allochthonous organic carbon has been observed between 7% to 25%, citing Sondergaard and Middelboe (1995) and Volk et al., (1997). This is attributed to the more refractory nature of more-humic autochthonous organic matter. Further, McLaughlin and Kaplan (2013) found a range of 8 to 17% labile organic matter in stream samples from storm runoff and baseflow condition (note: McLaughlin and Kaplan (2013) identified a higher fraction of “semi-labile constituents” [30 to 55%], noting a category between labile and refractory).

Billica and Oropeza (2009) report findings of humic substances dominating throughout the watershed in the Upper Cache la Poudre and Big Thompson River watersheds in northern Colorado. Those watershed samples included higher elevation runoff and wastewater treatment plant effluent.

We have seen other applications of W2 assume a 50-50 type of split on labile and refractory, often without clear justification, though such an assumption might be appropriate for some systems. A simulation applying a 50-50 labile-refractory split for inflowing organic matter was also performed to assess sensitivity to this assumption. The resulting chlorophyll *a* concentrations were only minimally different. The in-reservoir total organic carbon concentrations decreased, due to less refractory OM. Use of the 10-90 split provided a better match to the 2014 in-reservoir average TOC data. Based on this limited sensitivity and indication of in-reservoir TOC concentrations from the 2014 data, the 10-90 split was kept in the model. Unfortunately, TOC data are not available prior to 2014.

Billica, J.A. and J. Oropeza. 2010. 2009 Horsetooth Reservoir Water Quality Monitoring Program Report. Prepared for the City of Fort Collins Utilities. September 13, 2010.

Hendrickson, J., Trahan, N., Stecker, E., and Ouyang, Y. 2002. TMDL and PLRG Modeling of the Lower St. Johns River Tech. Report Series Volume 1: Calculation of External Load, May 2002. Pgs 13-15.

McLaughlin, C., and L. A. Kaplan (2013): Biological lability of dissolved organic carbon in stream water and contributing terrestrial sources. *Freshwater Science* 32(4). Pgs 1219-1230.

Sondergaard, M. and M. Middelboe. 1995. A Cross-System Analysis of Labile Dissolved Organic Carbon. *Marine Ecology Progress Series* 118. Pgs 283-294.

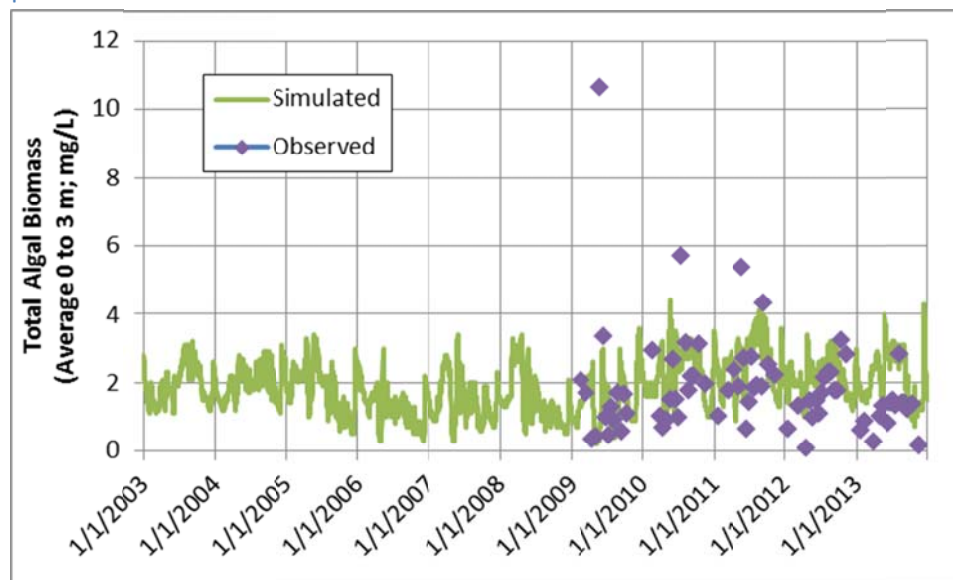
Volk, C.J., C.B. Volk and L.A. Kaplan. 1997. Chemical Composition of Biodegradable Dissolved Organic Matter in Streamwater. *Limnology and Oceanography* 42(1). Pgs 39-44.

13. The model grid bathymetry orientation angles are off by 180 degrees. This may affect how the lake responds to the wind.

Thanks! The grid orientation has been corrected. Because the error was a 180-degree error, and because of the shape of the reservoir, there were no significant changes to the simulation results when this change was made.

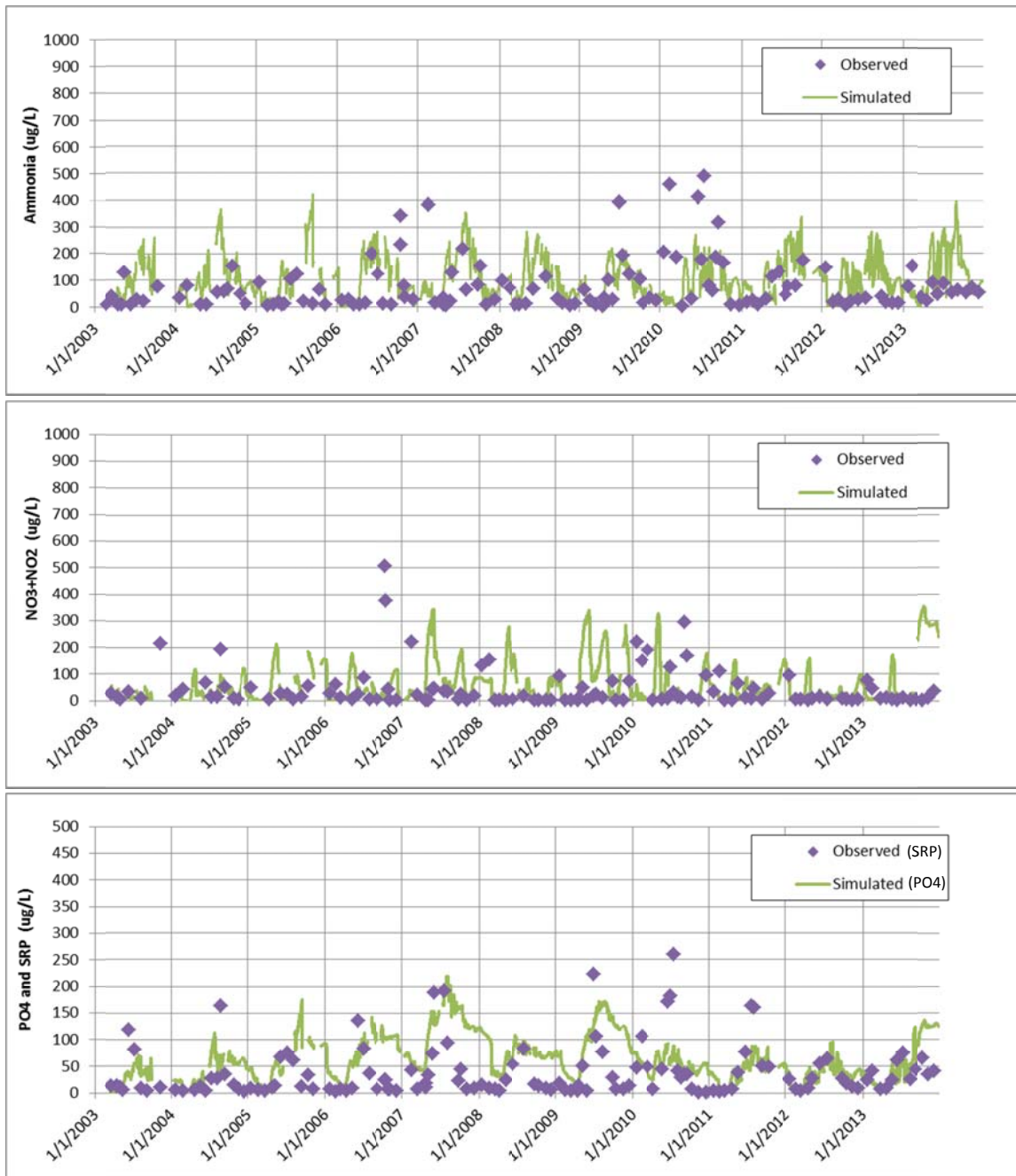
14. Since biovolume species data exist, it would be useful to compare for different seasons model predicted species composition even though the groups may not be exactly aligned with the biovolume species data.

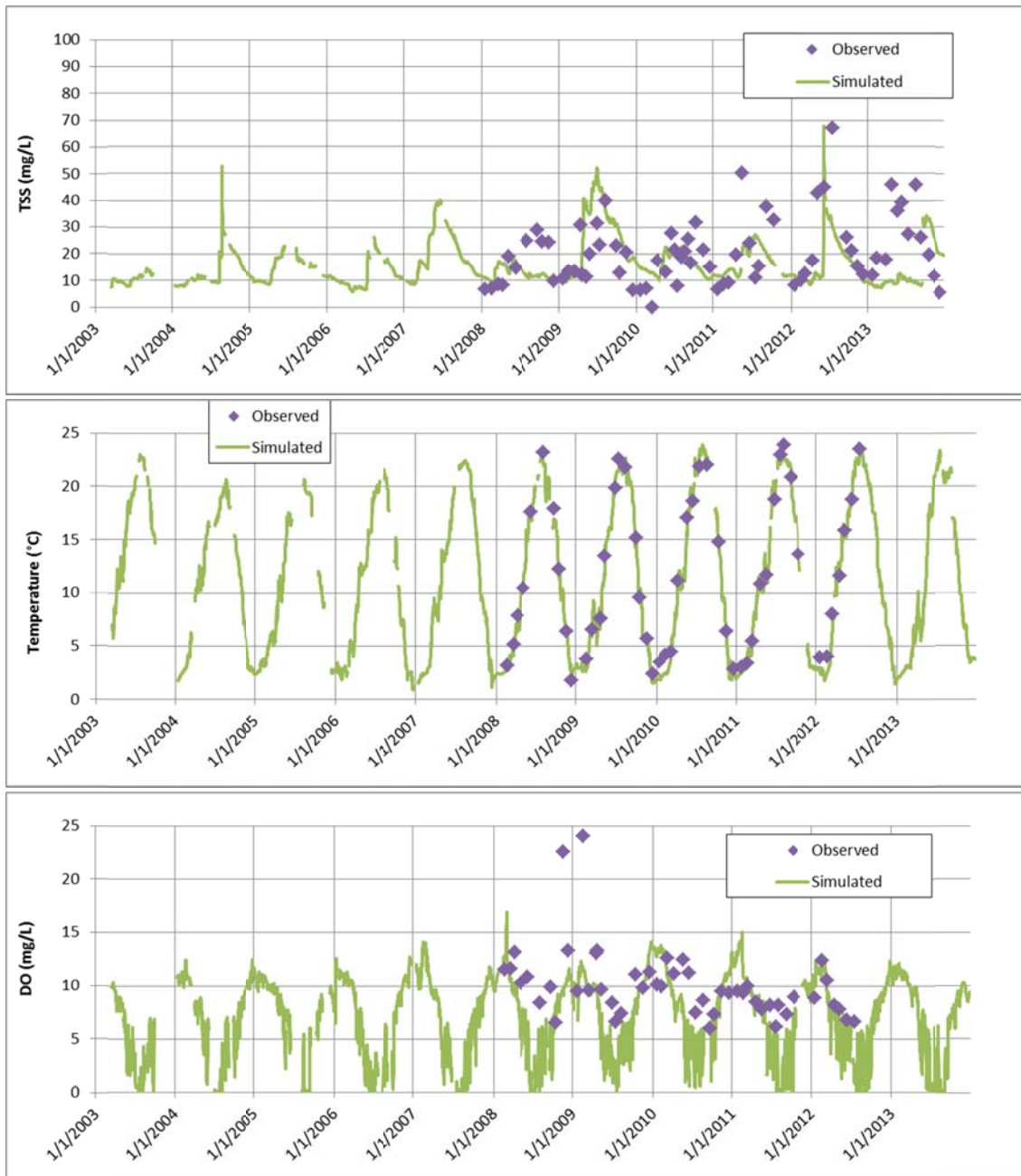
Because the species data do not separate consistently into the largely temperature-response-designated algal groups, a species-by-species plotting of biovolume response relative to algal groups is not expected to provide much additional understanding for the effort. Data show several species can be observed in significant quantities at very different temperatures in different years. This overlap in algal group response was considered reasonable considering the complexity of the observed record and the primary objective of simulating chlorophyll *a*. Based on this, the total observed algal biomass was plotted against the simulated algal concentration to see if simulation results were reasonable in this way. This plot is shown below.



15. Since field data are collected at the outlet to Cherry Creek Reservoir, model predictions of outlet water quality and temperature could be compared to these field data. This provides a check on selective withdrawal of the model and the reservoir’s water quality.

These have been compiled for simulated parameters sampled in the outflow (TSS, ammonia, NO<sub>3</sub>+NO<sub>2</sub>, PO<sub>4</sub>, temperature, and DO). The plots will be included in the detailed model documentation (Task 6), but are not included in the technical memo describing calibration. Therefore, the plots are provided here to support your review.

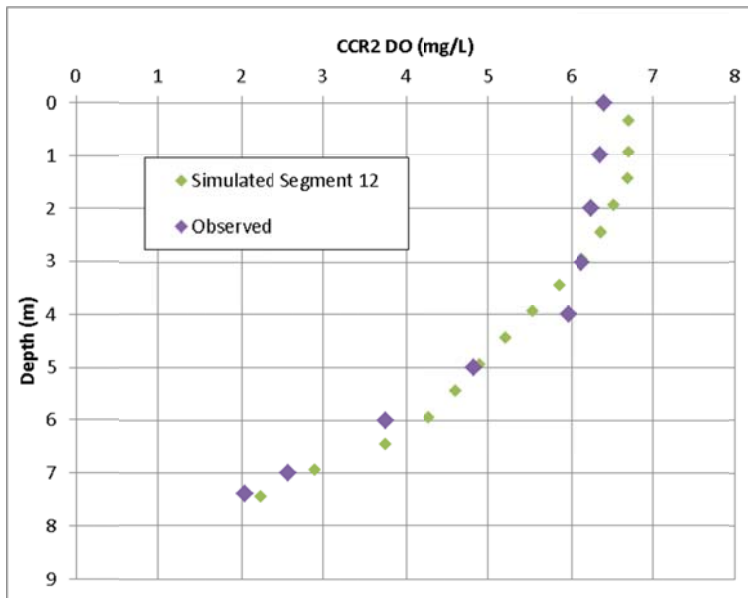




Simulated outflow water quality exhibits reasonable agreement for all of these parameters except DO. The simulated DO is consistently lower through the warmer months. This issue was explored further by adjusting the bottom elevation of the outflow works to simulate possible obstruction but sediment buildup. This did not provide a significant improvement.

The location of outflow sampling is very close to the outflow location, suggesting significant reaeration might not be expected. However, the data suggest otherwise. For example, the outflow observation on 8/11/09 was 7.4 mg/L DO. This is typical of observation at this time of year at the outlet location. A profile in the reservoir at CCR2 was also collected on this date.

There is a reasonable simulation match for DO for this profile, and even the observed data indicate all observations were below 7.4 mg/L. The profile is shown below.



Based on this (and other similar comparisons to observed in-reservoir data) and the well-calibrated thermal simulation, it appears that there must be some aeration between the outlet structure and the outflow sampling location. There is an elevation drop of 10 to 15 ft from the inlet at the bottom of the reservoir and the outflow point. Aeration is apparent in aerial images when water is being released (see example below). It is not clear how much aeration might be expected and whether this can explain the difference in the simulation results. A future refinement of the model could attempt to simulate this reaeration with W2 as a check on this assumption.



Oct 6, 2013 Satellite Image of Outlet Location Showing Some Aeration on Side of Release

16. For performing sensitivity runs with the model, looking at the sensitivity of the model to wind or meteorological conditions (by varying WSC or using a different meteorological file such as from another site) and zero order SOD would be useful.



To give an indication of model sensitivity to wind, one of the sensitivity runs will simulate no wind. Other runs could be conducted; however, with a limited # of sensitivity runs in the budget, only one wind simulation is planned.

17. The low dissolved oxygen in the surface of the model during the early years seems to be related to too high SOD during these periods since the largest source/sink is SOD. Changing the reaeration coefficient and/or O2AG may not affect the under-prediction of dissolved oxygen since SOD dominated the oxygen balance (from what I recall seeing in the presentation).

Based on the modeling and review of inflow data and in-reservoir water-quality data, there is no reason to expect a sharp change in SOD in 2010. We have done some additional investigation into the DO data. The magnitude of the difference in DO corresponds roughly to the difference that would be expected if the DO probe was not calibrated to the appropriate altitude (i.e., if mean sea level barometric pressure [which is what is usually reported in weather reports] was input during calibration of the probes without adjustment). We also noted other issues with the data indicating some QAQC problems, challenging the reliability of the some of the data. These include observations of extreme super-saturation (e.g., 180%+) without correspondingly high chlorophyll *a* concentrations (e.g., 15 ug/L). Widely varying DO concentrations at the top at CCR1 and CCR2 (12.5 mg/L DO vs. 6.6 mg/L DO; Note: these are in the same model segment), in spite of comparable chlorophyll *a* (6.4 ug/L Chl *a* and 9 ug/L Chl *a*, respectively). As noted in a previous comment response, there is also uncertainty about observed DO in the outflow data (possibly reflecting reaeration?). These issues are discussed in greater detail in the report.

With all of those concerns with the data noted, it is clearly acknowledged that there is persistent uncertainty in the DO simulation. SOD was reduced by more than half in calibration refinements since the June 22 meeting. The appropriate setting for SOD is difficult to determine given data uncertainty, but the lower SOD provided some improvement in calibration metrics. Additionally, there appears to be induced oxygen demand associated with the aerators that is not being simulated by the model. The model is simulating slightly higher DO at the bottom at CCR2 following start of aeration, but lower DO following aeration can be seen in the observed data. Continuous DO probes have been recommended (bottom, middle, top depths) to support future refinements. Future refinements to address this could involve sediment diagenesis modeling.

18. Since you have made code changes, make sure you are using the exact settings for the Intel Visual Fortran compiler used to compile the release executable. Issues with precision of real numbers can greatly affect the model results.

Following the recommended compiler settings in the release notes for W2 v 3.71, our modified version of the executable was compiled using double precision as the default for real variables, /O2 optimization, and the x64 Debug configuration.

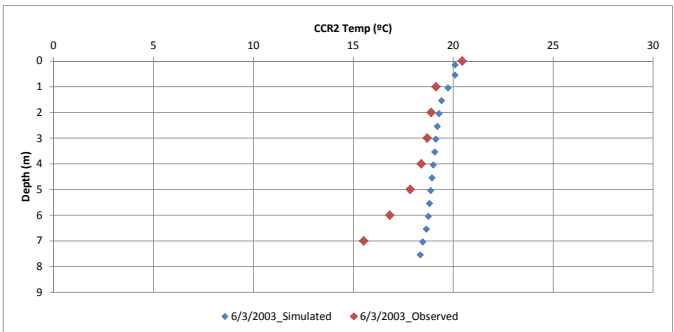
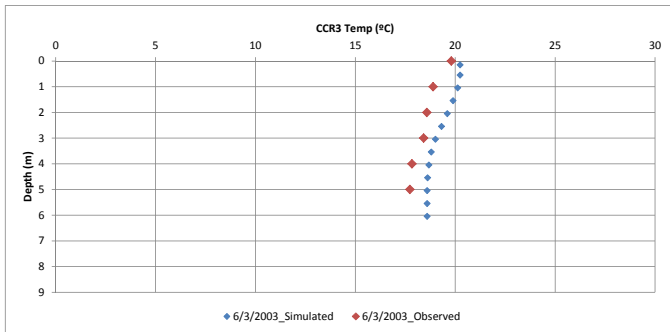
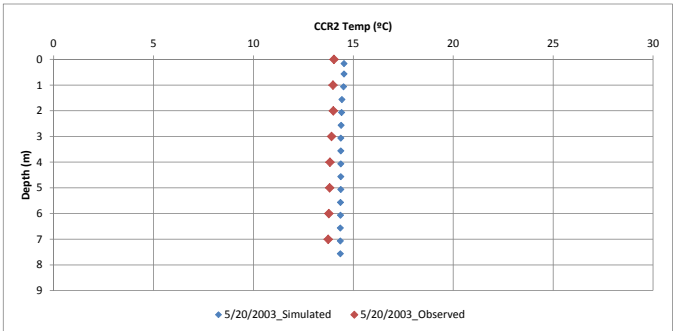
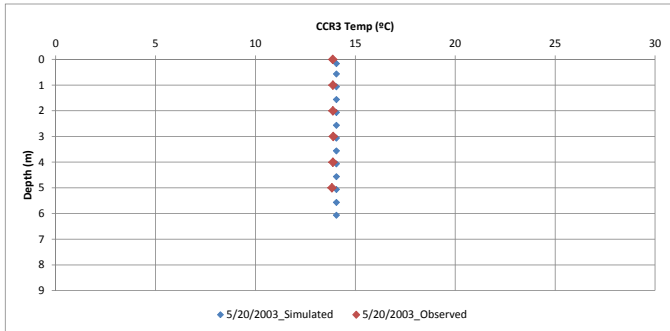
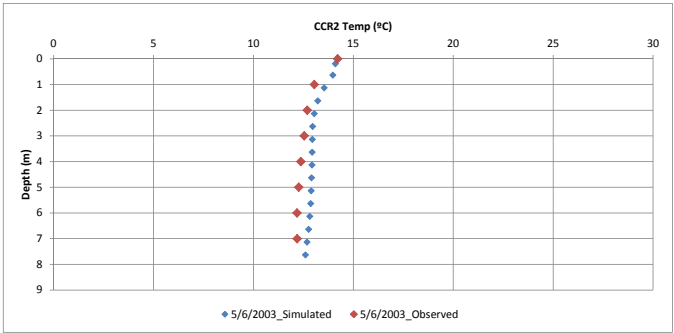
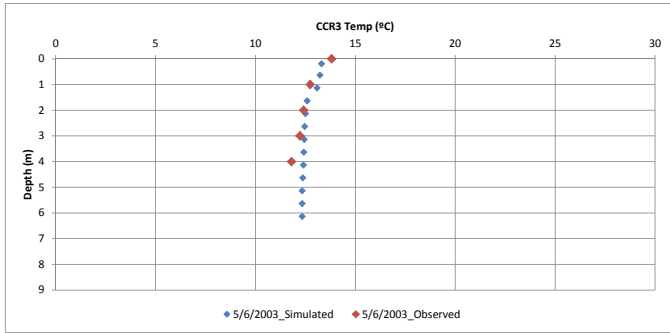
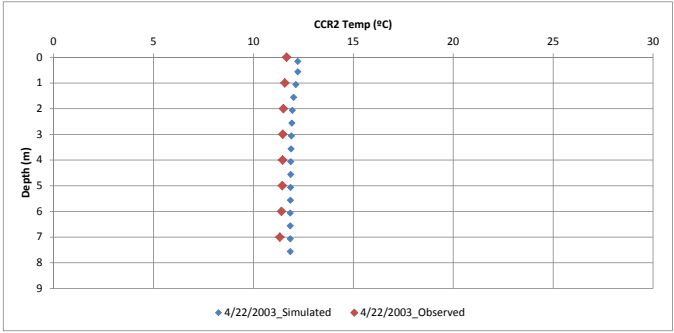
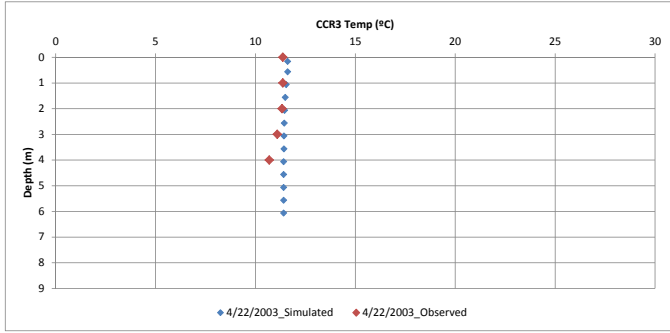
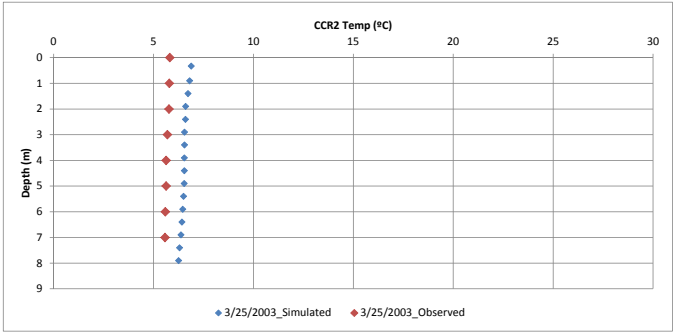
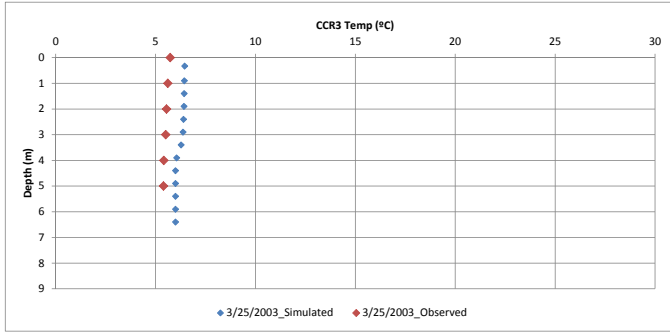
19. It would also be helpful to report mean error in the error statistics in addition to your absolute mean error and RMS since this indicates bias.

We will include mean error also to support review for bias.

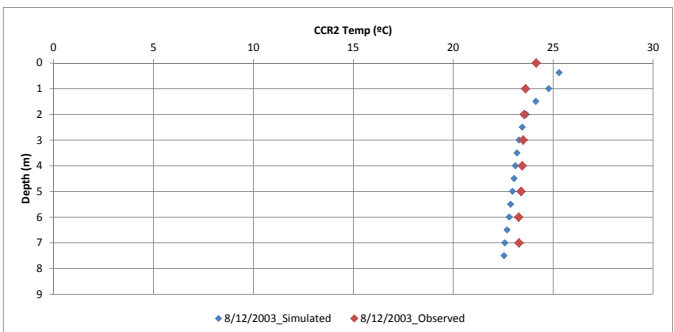
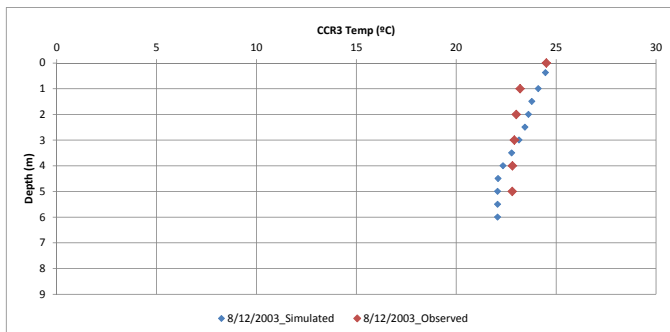
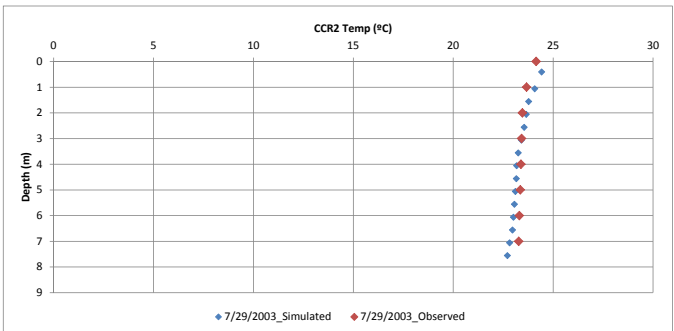
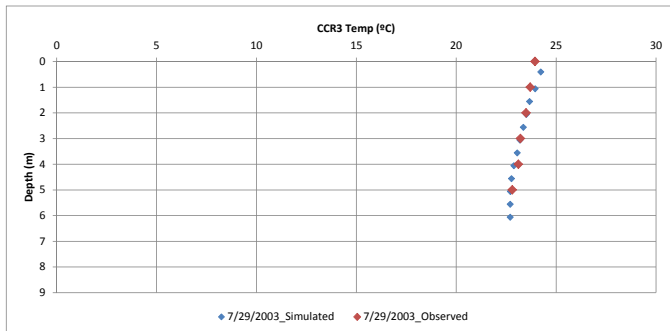
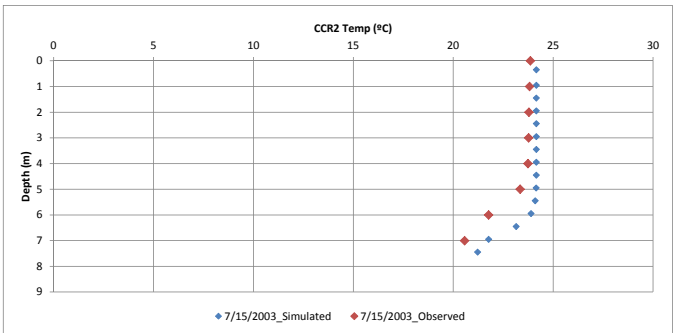
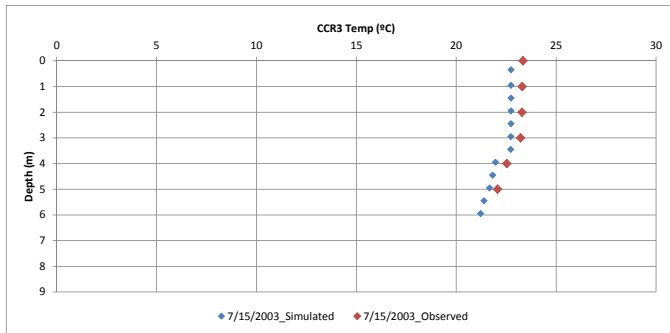
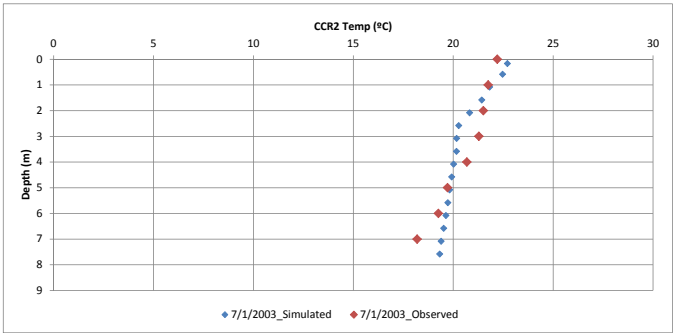
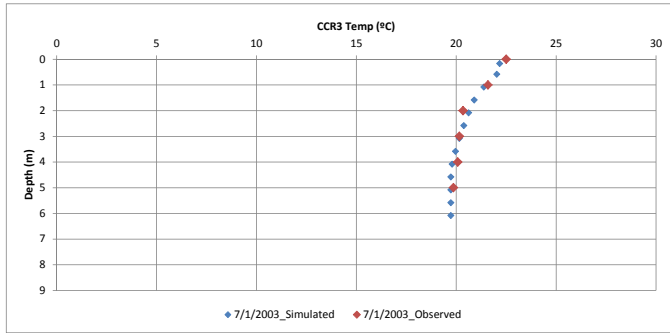
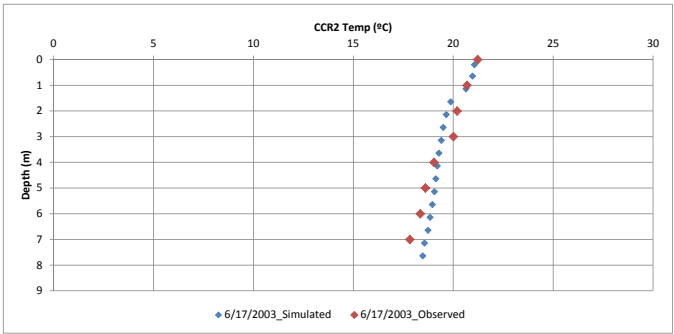
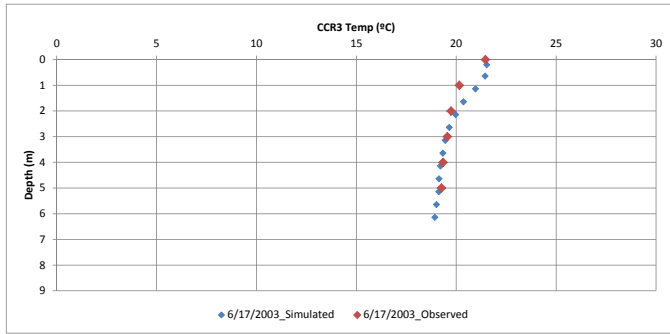
**Attachment B: Temperature Calibration: Observed and Simulated Results**

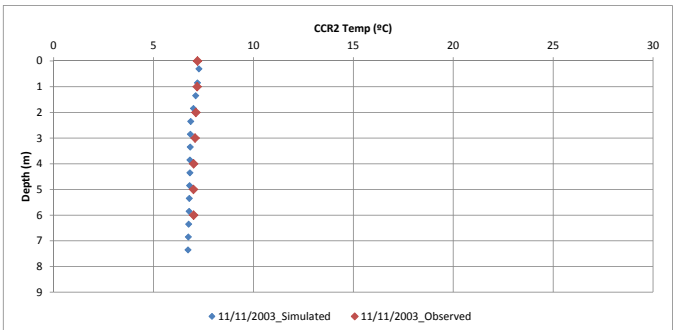
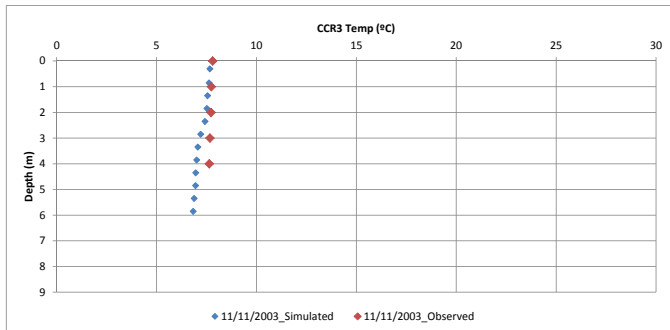
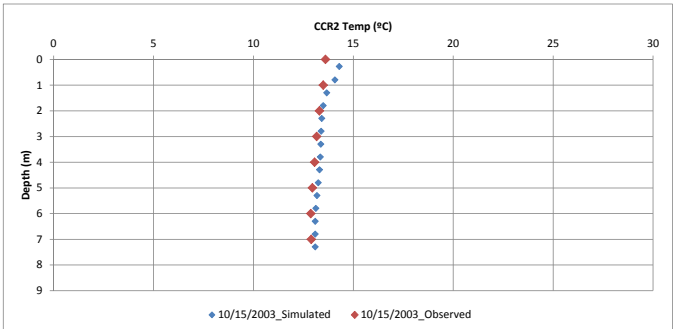
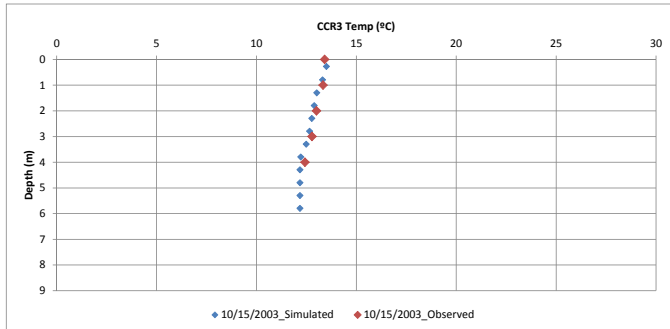
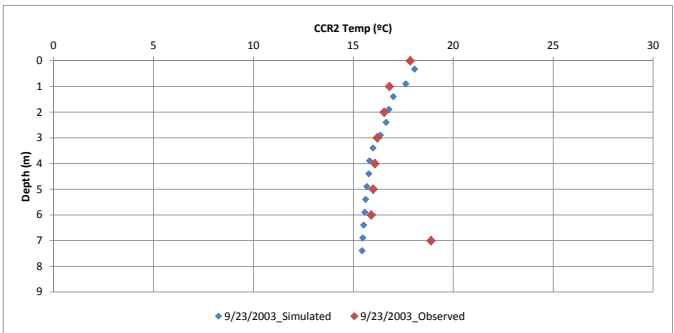
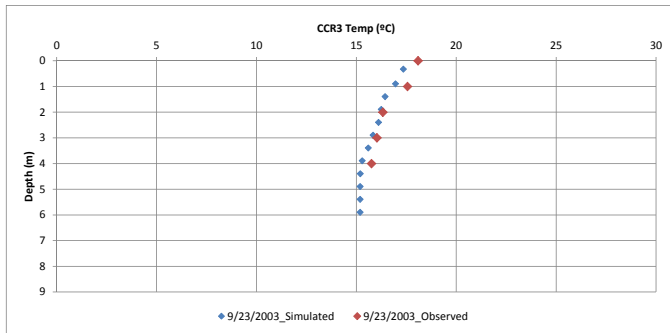
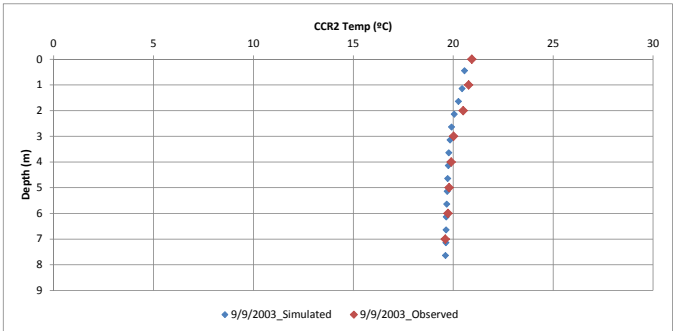
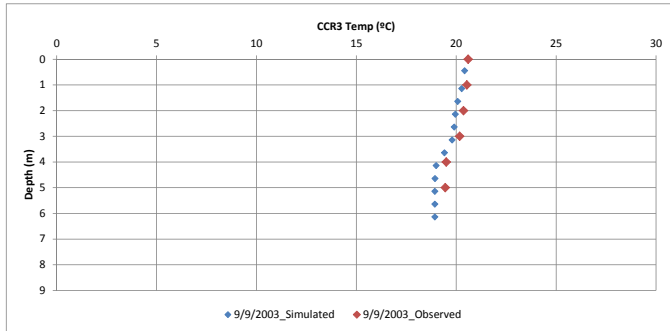
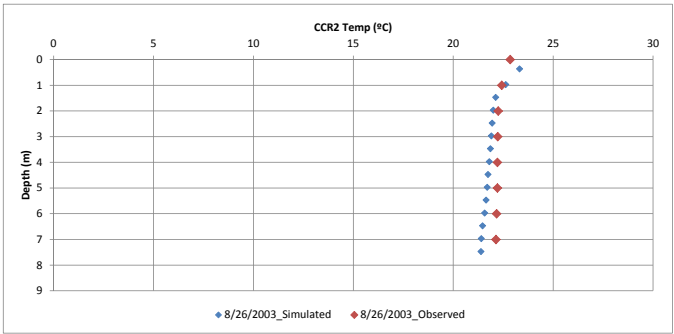
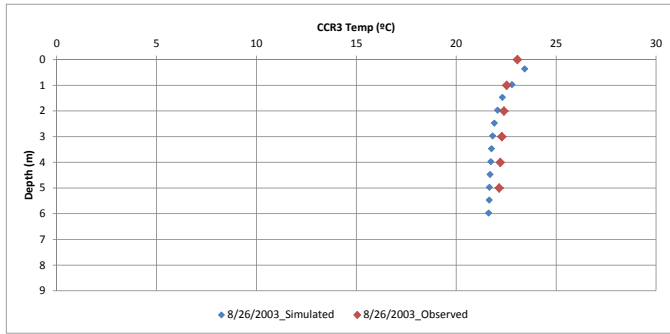
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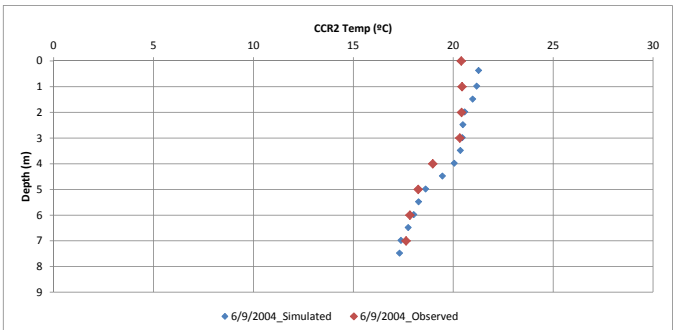
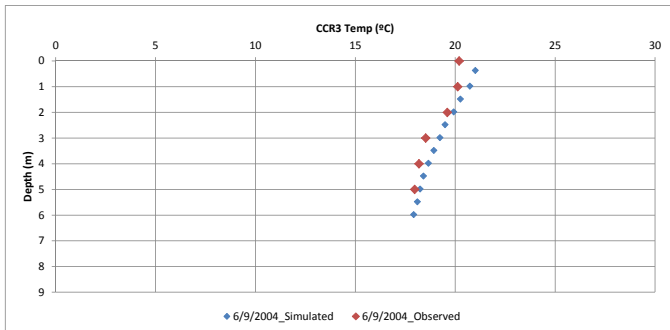
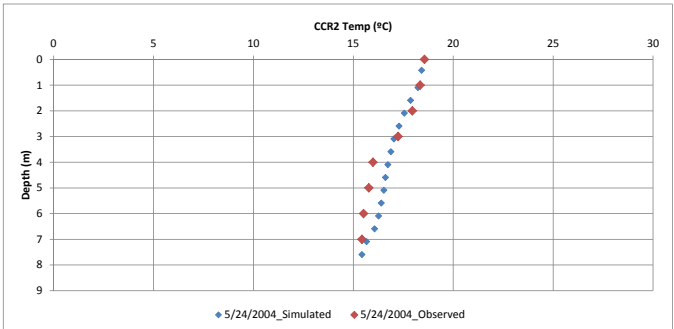
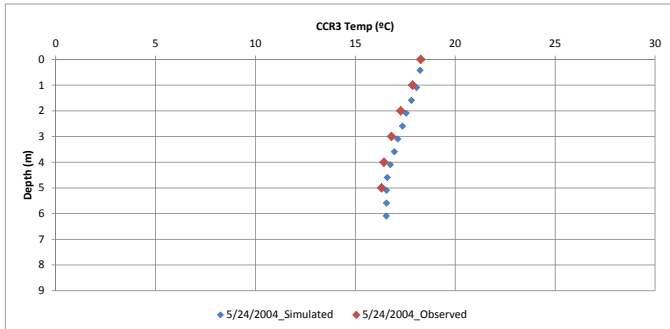
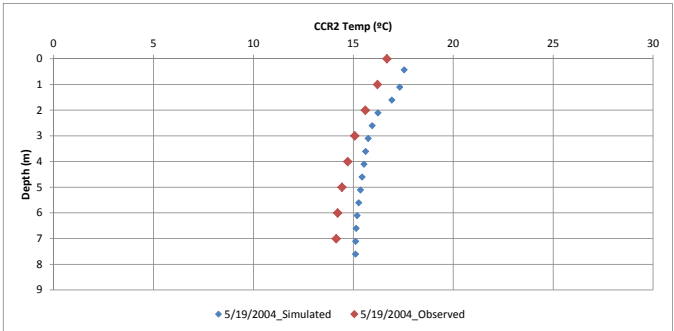
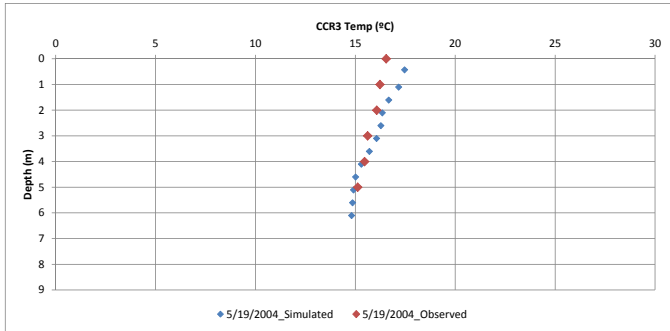
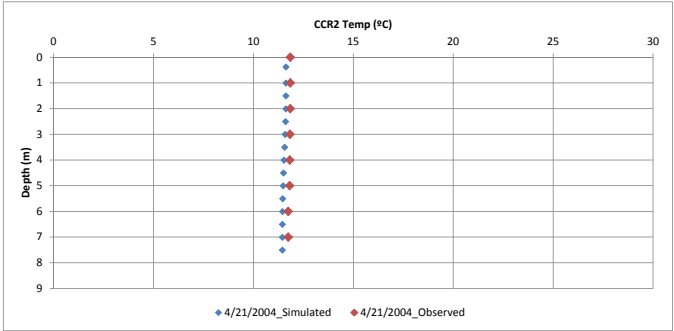
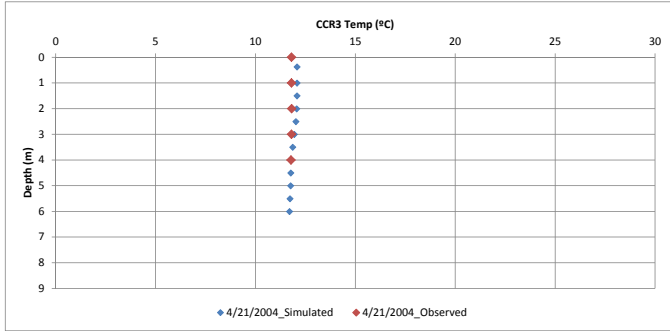
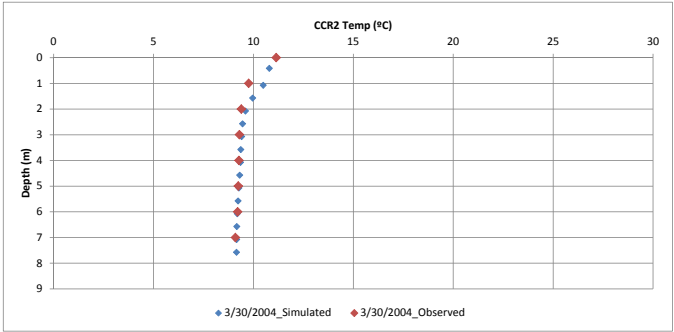
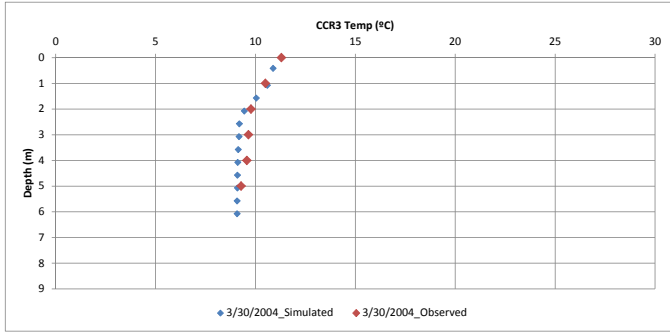
Temperature Profiles, CCR2 and CCR3	Pages 1-33
CCR2 Thermistor Data (1 m, 2 m, 3 m, 4 m, 5 m, 6 m, 7 m)	Pages 34-40
CCR2 Thermistor Top to Bottom Temperature Difference	Pages 41-42

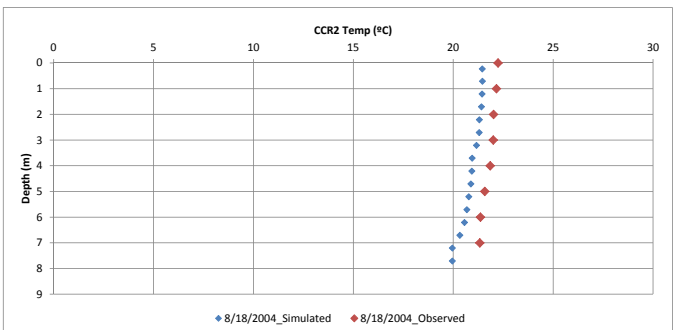
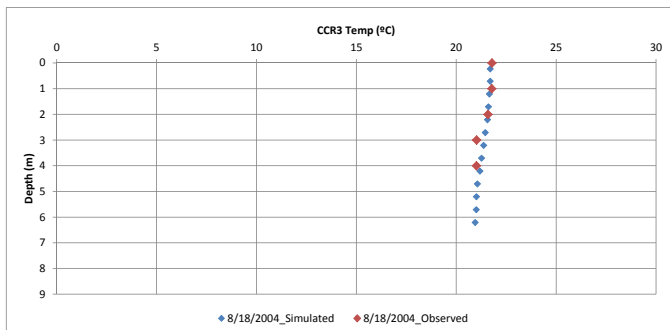
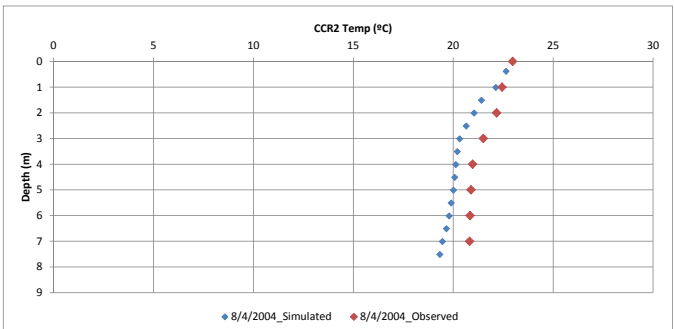
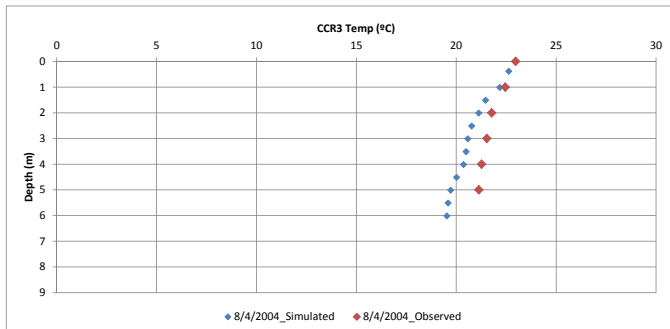
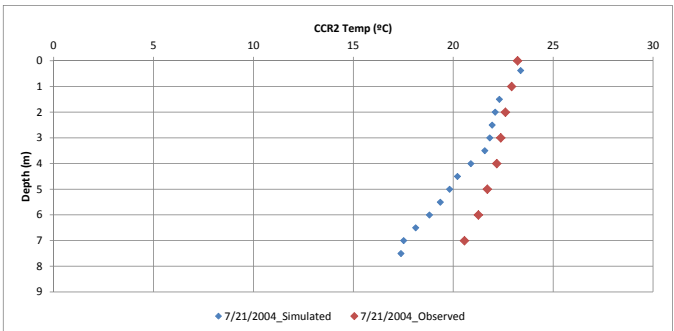
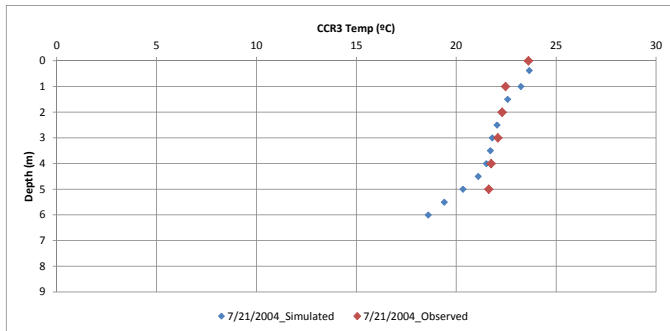
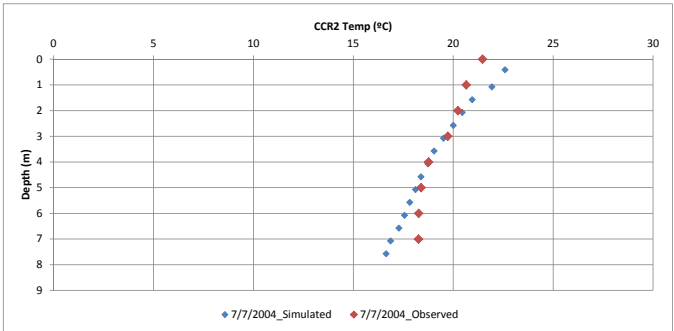
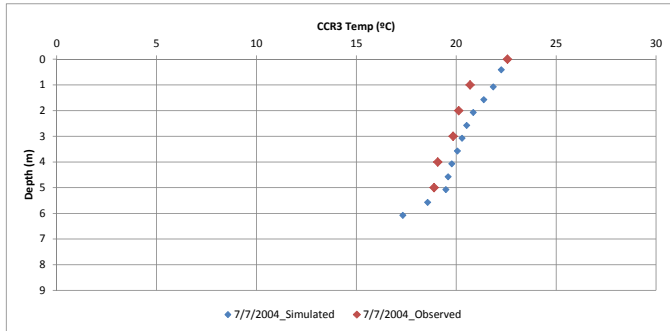
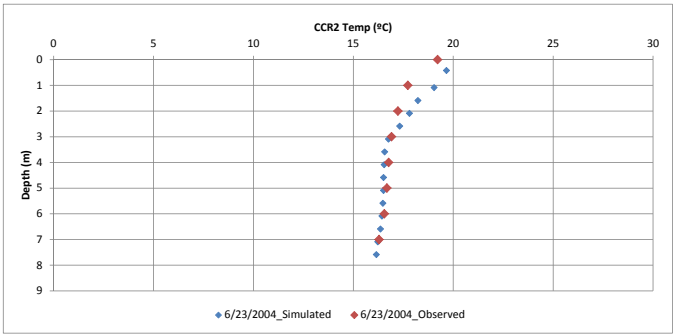
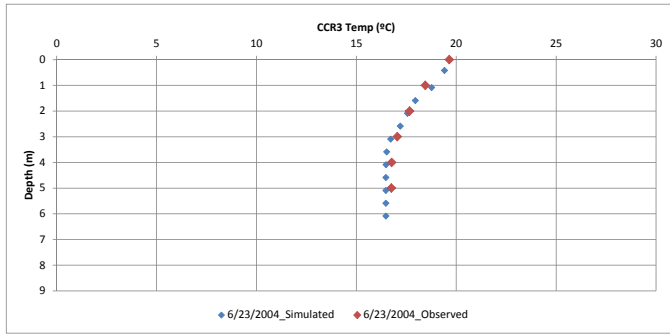


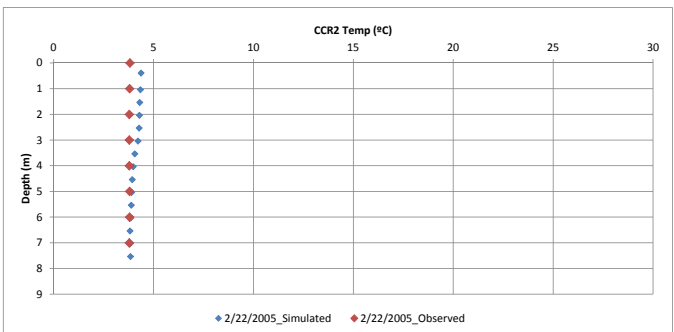
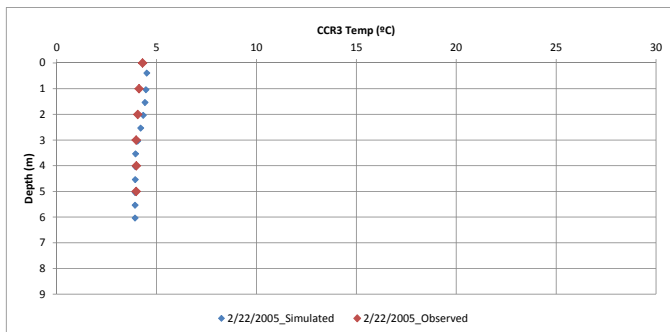
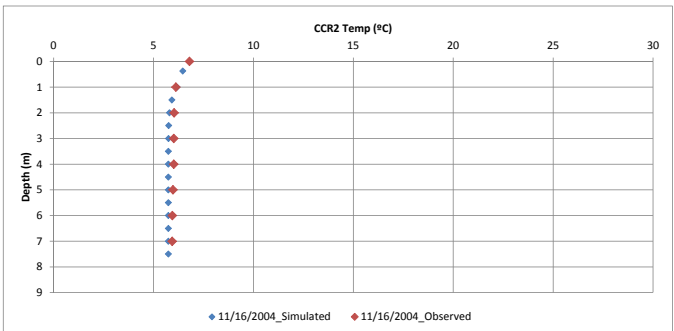
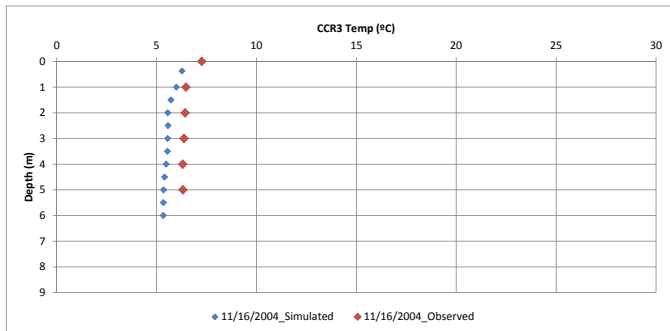
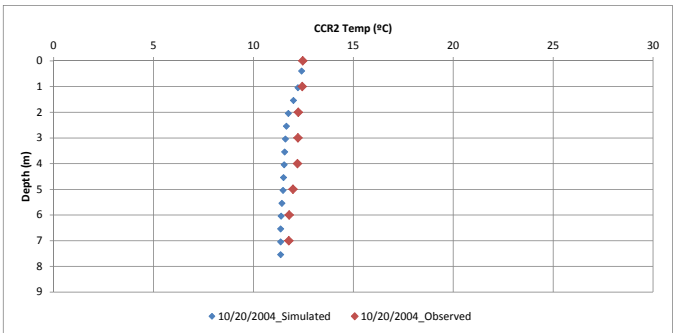
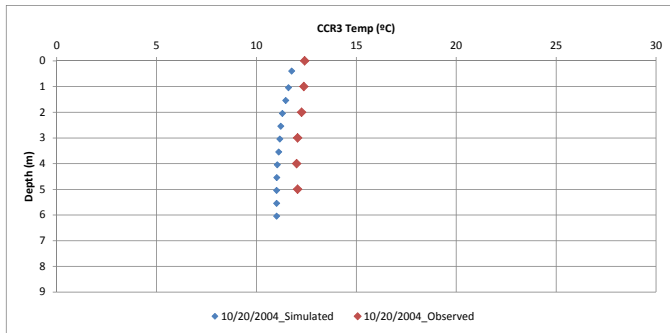
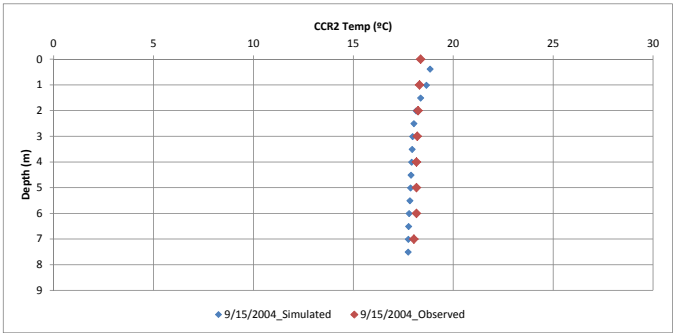
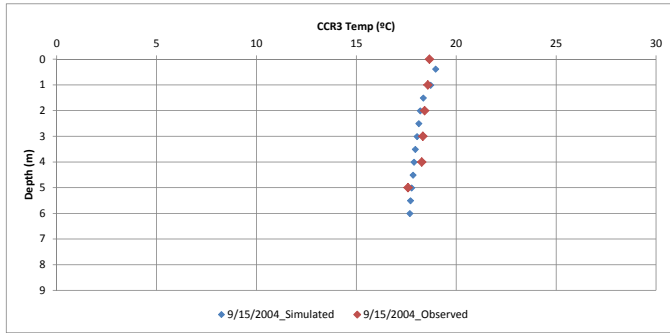
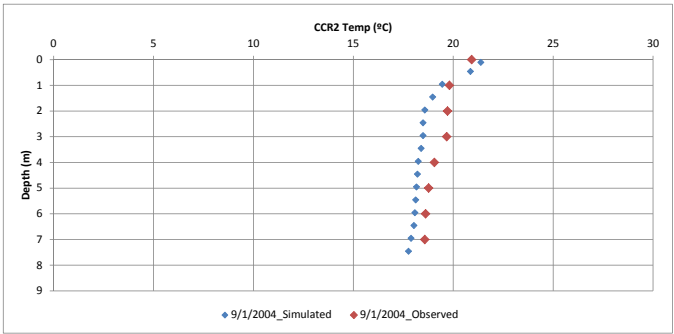
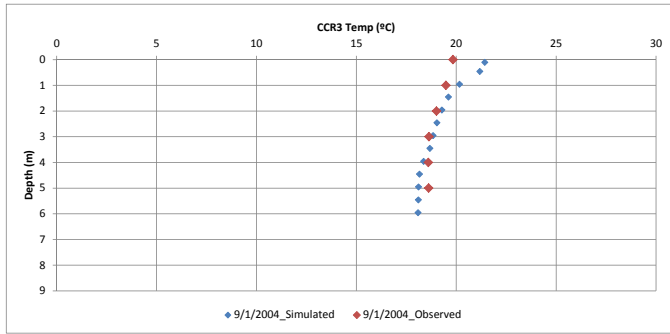


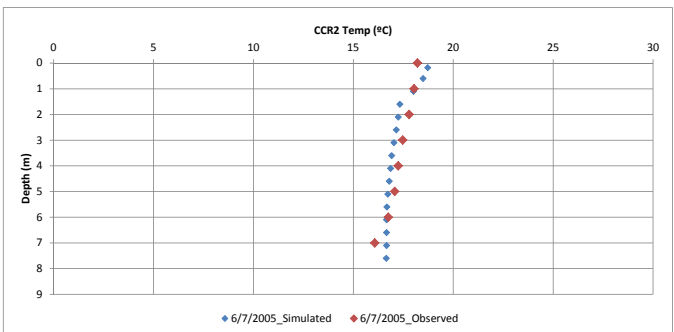
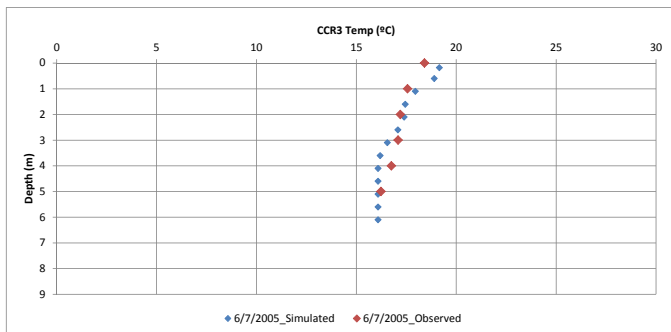
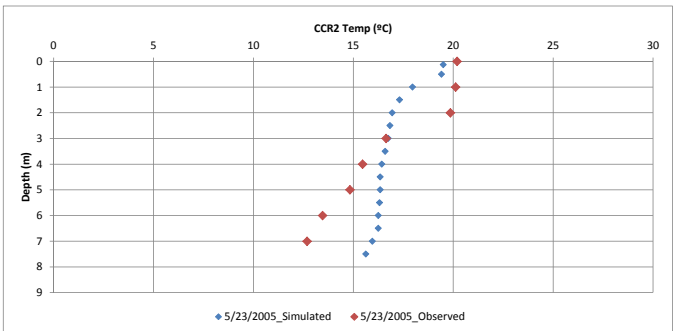
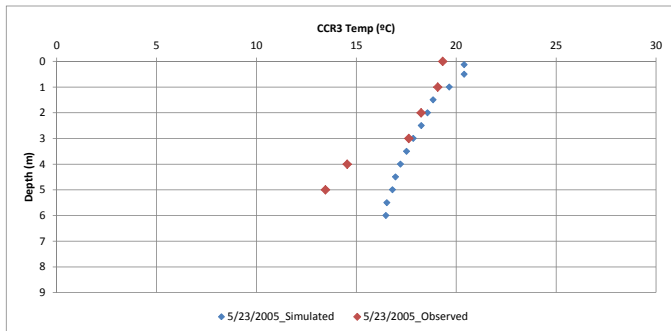
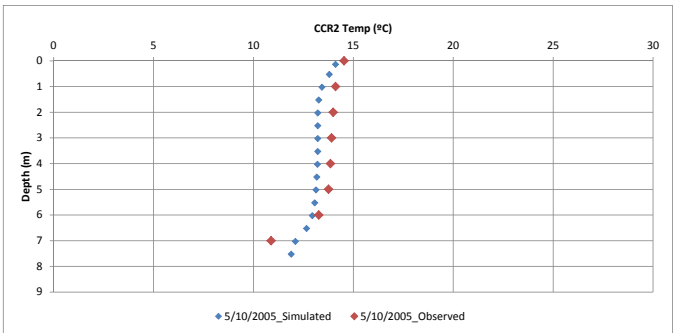
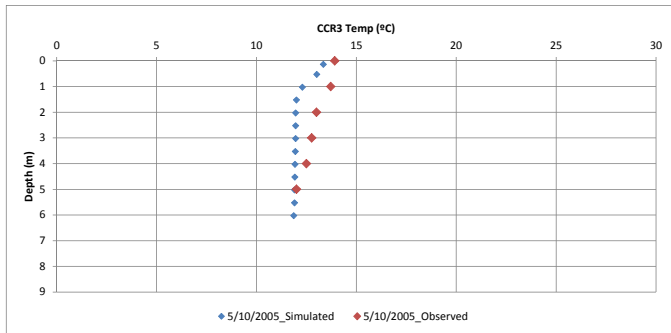
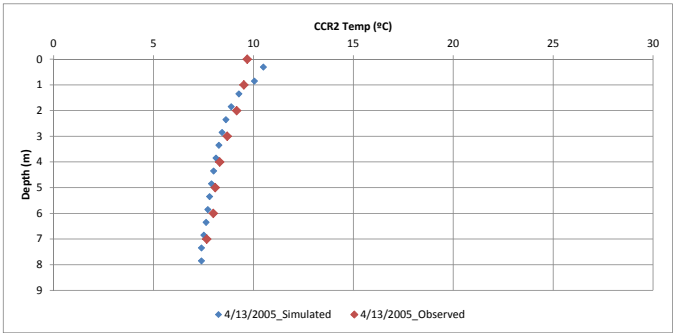
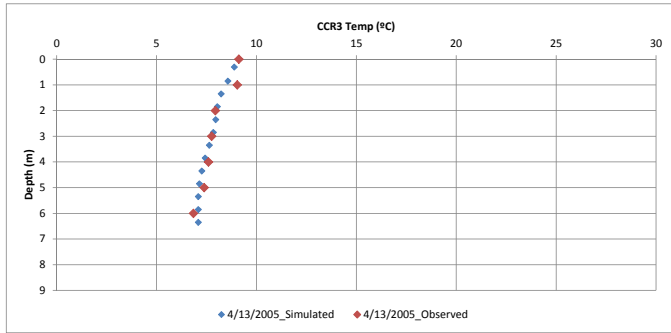
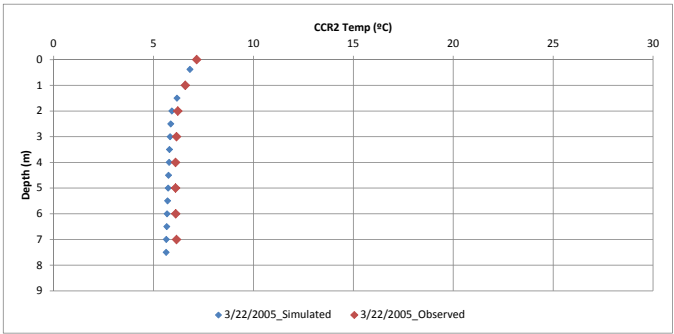
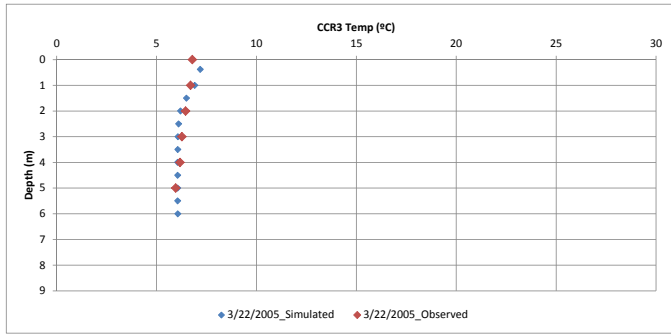


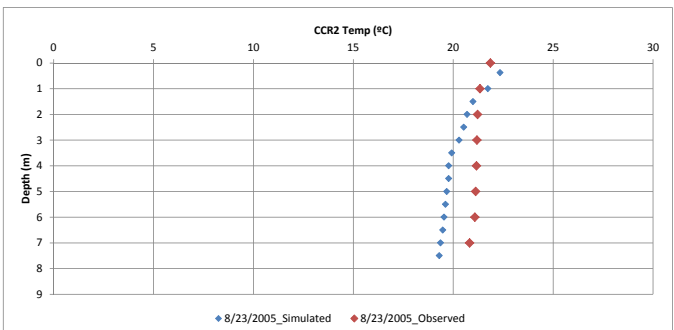
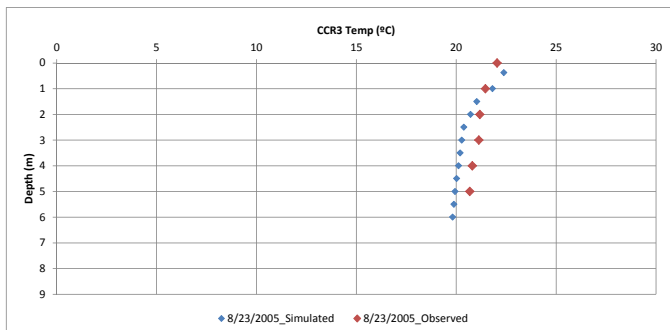
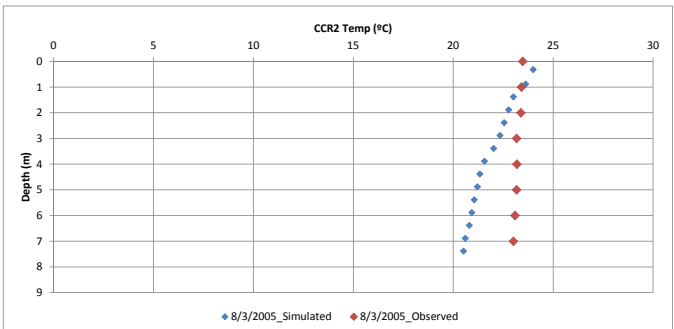
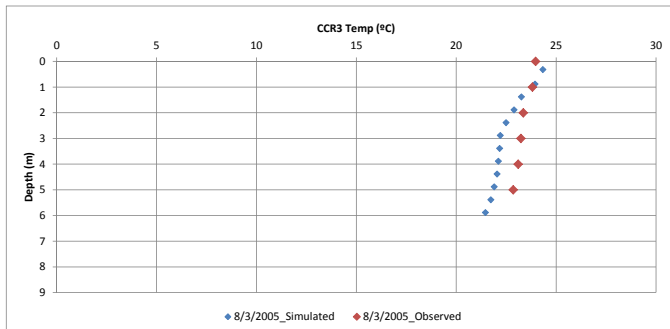
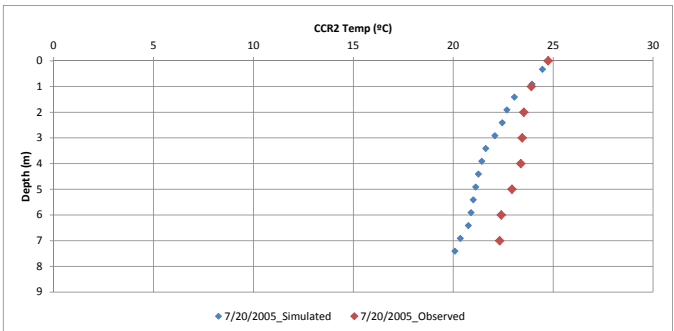
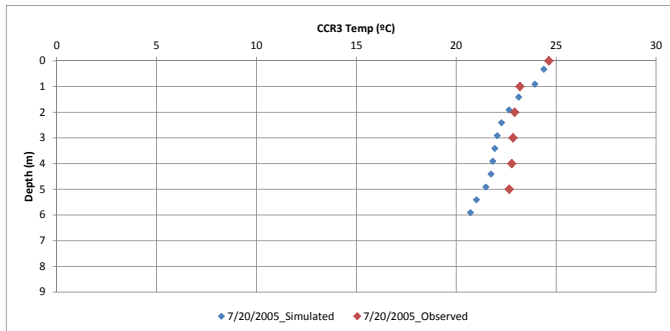
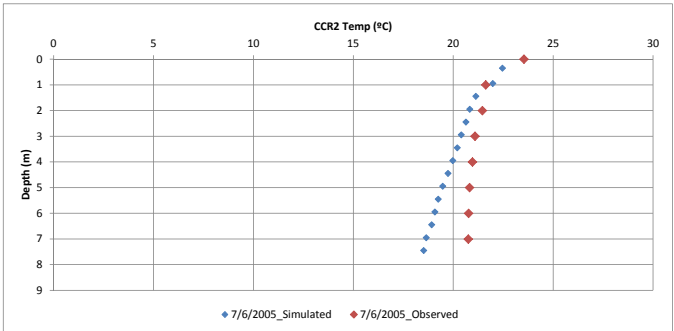
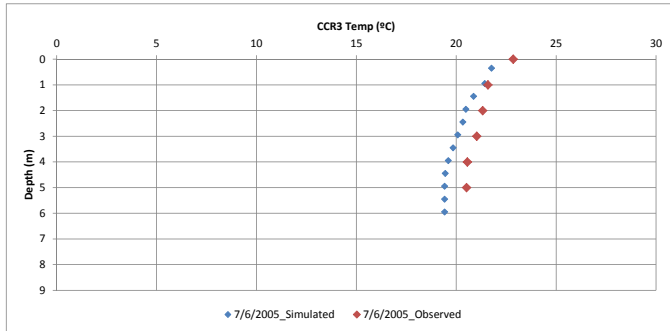
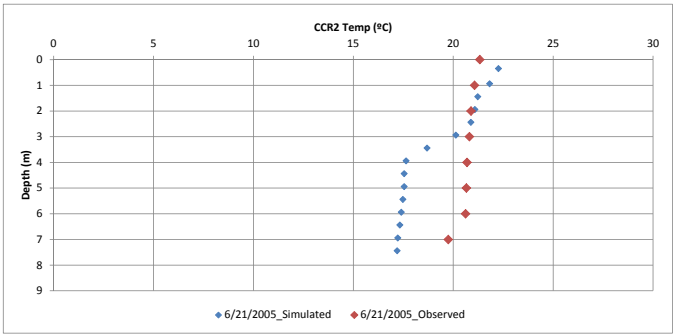
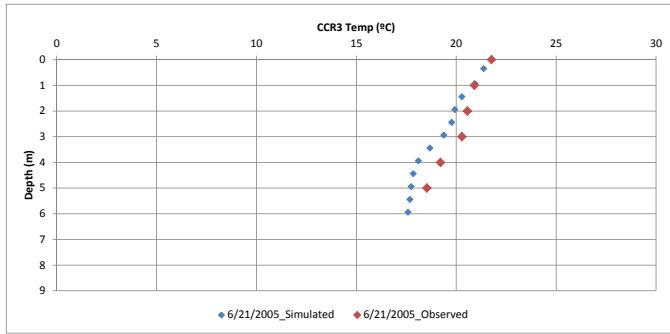


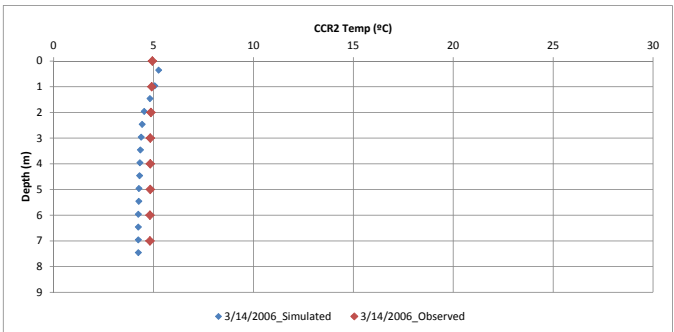
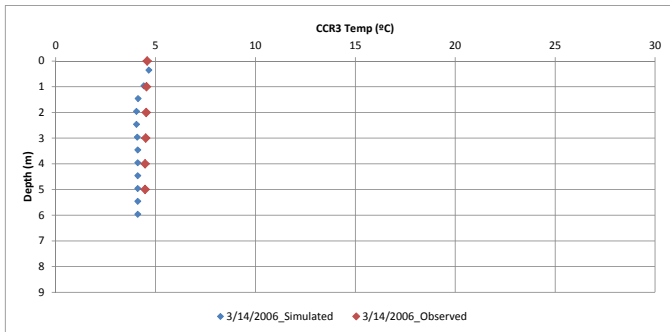
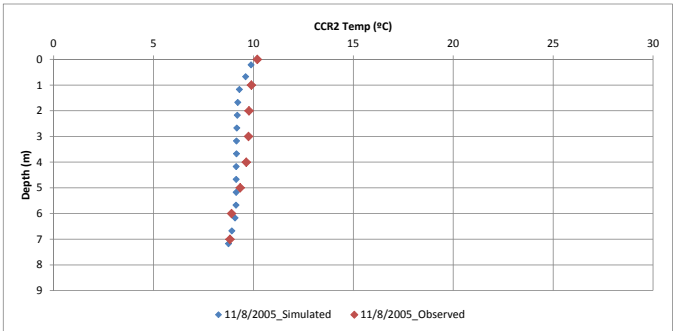
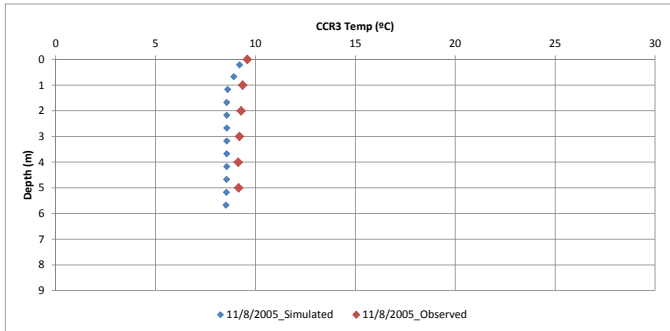
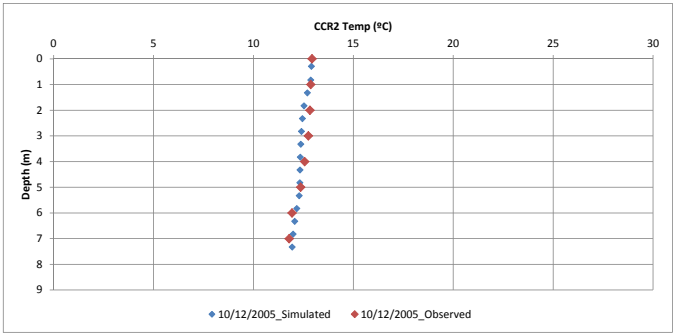
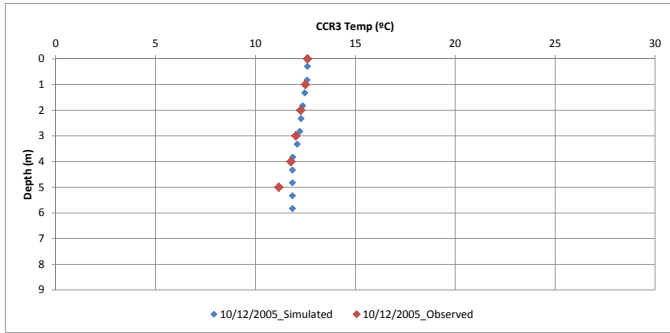
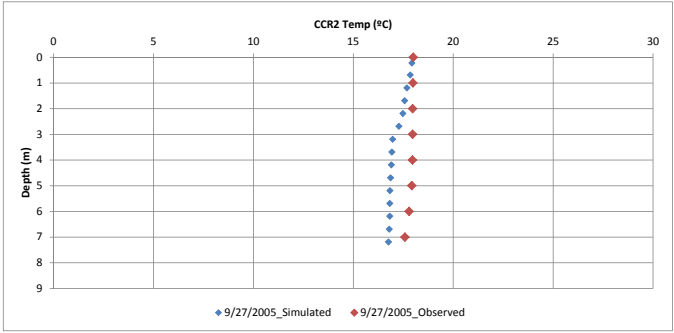
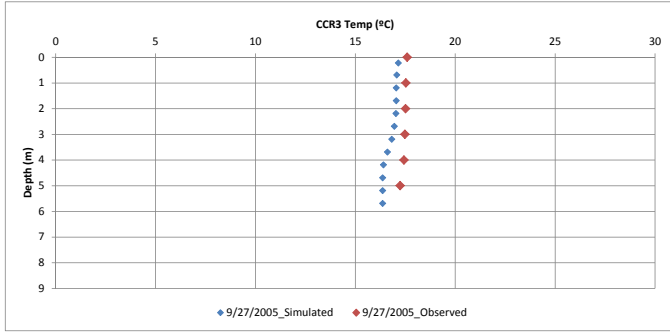
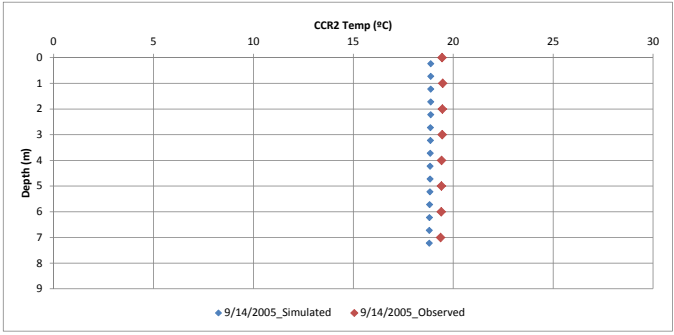
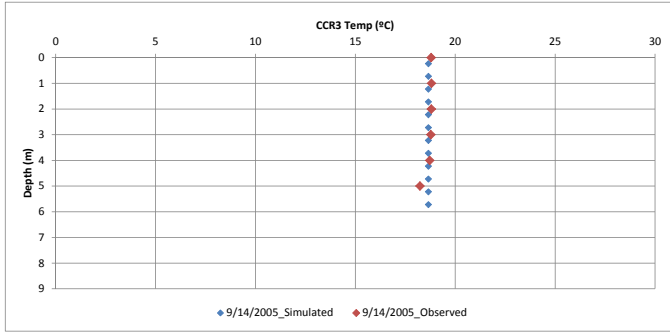




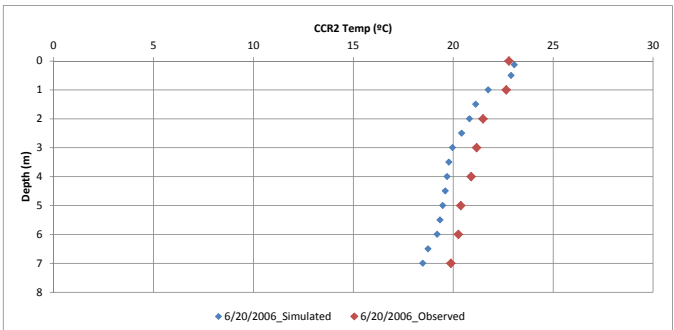
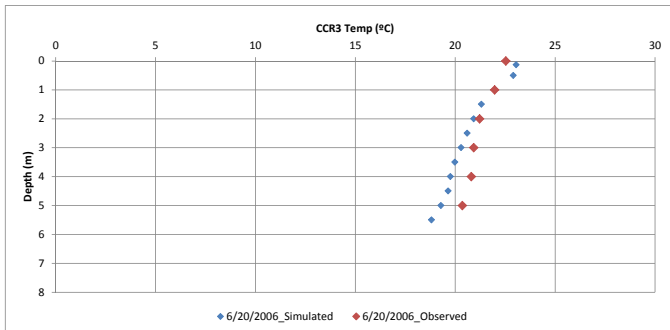
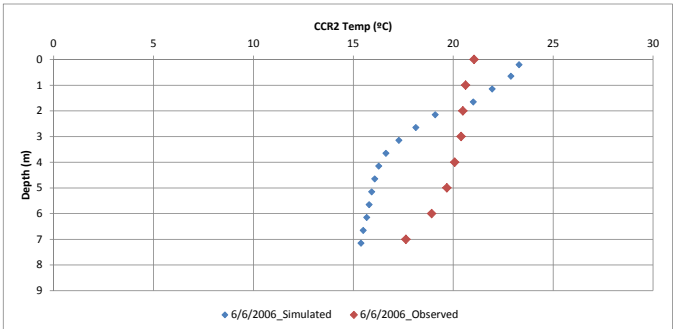
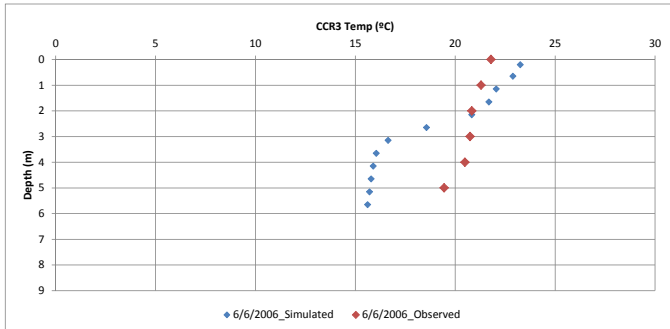
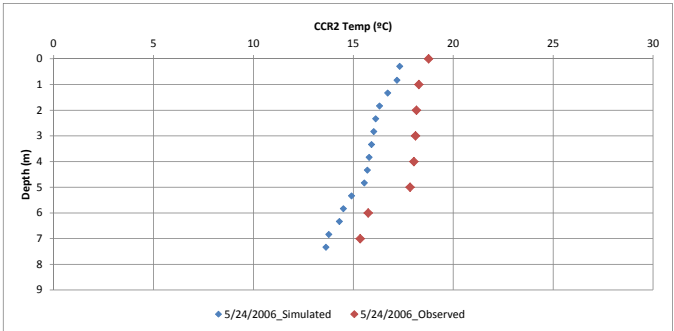
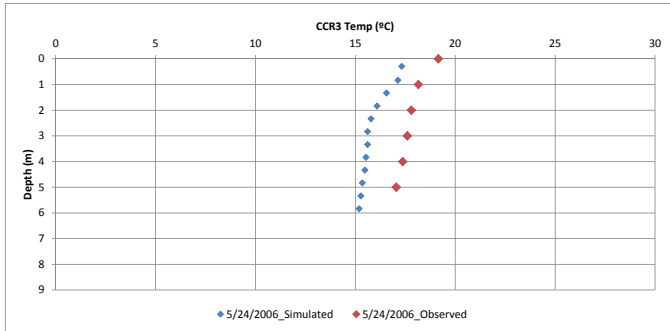
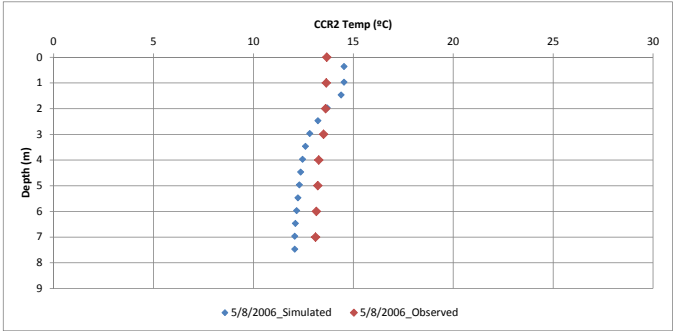
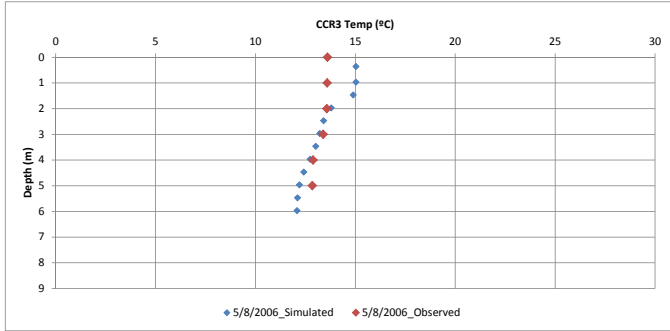
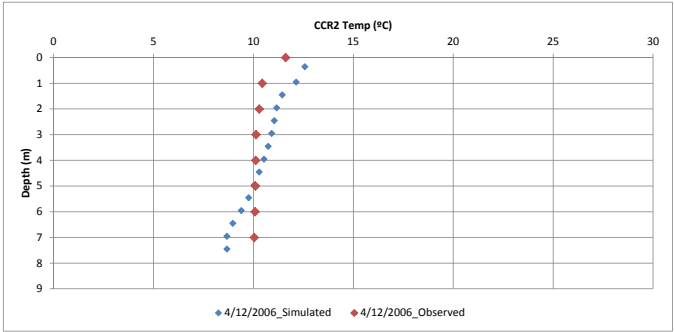
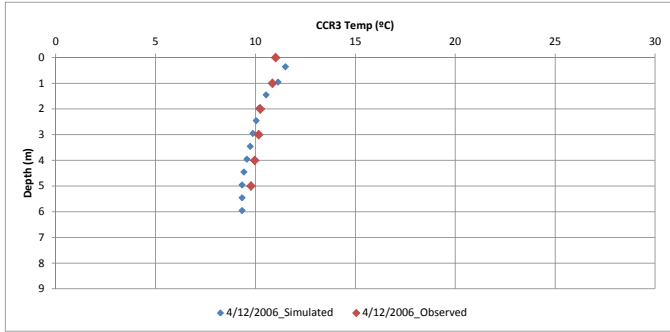


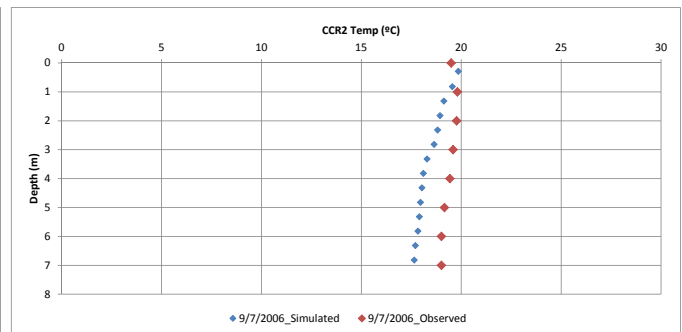
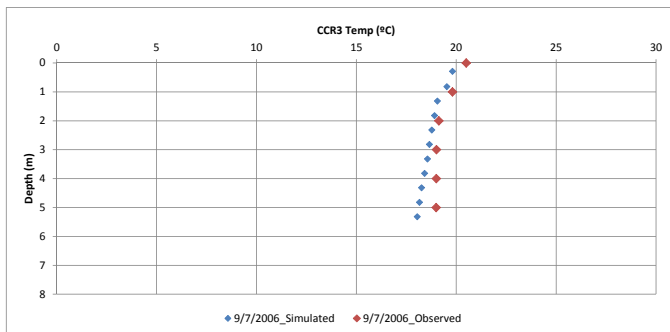
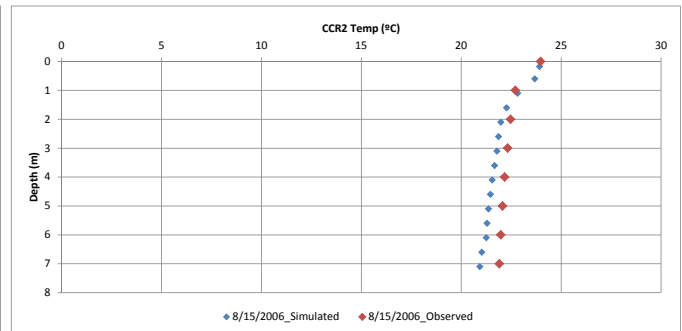
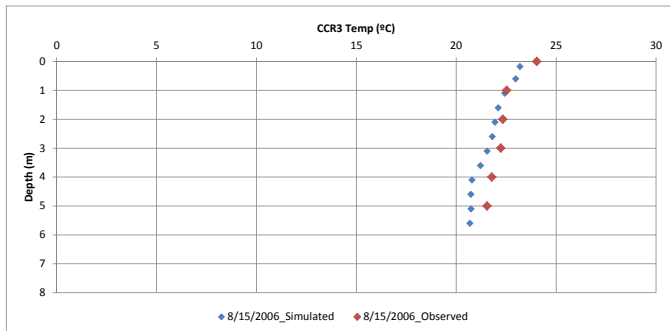
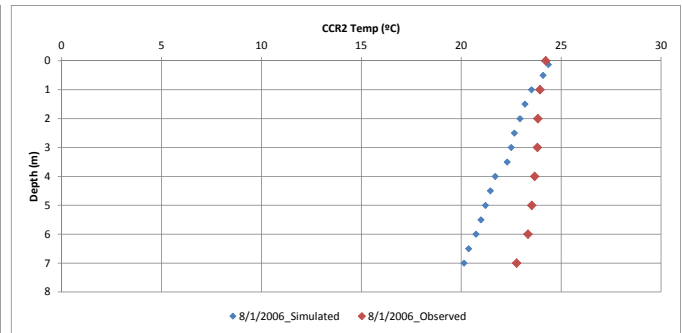
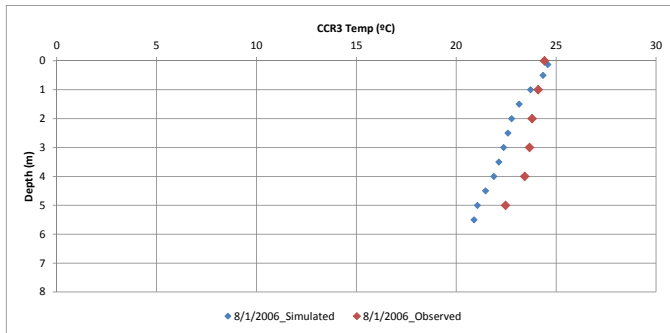
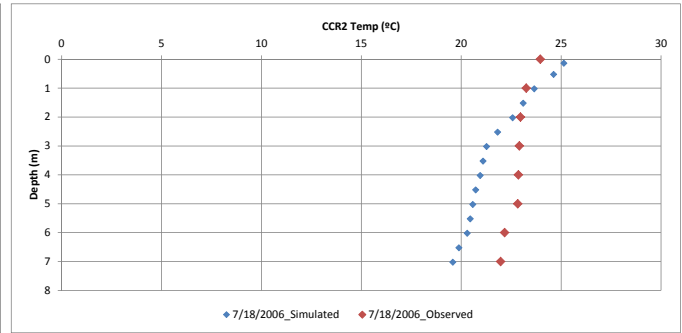
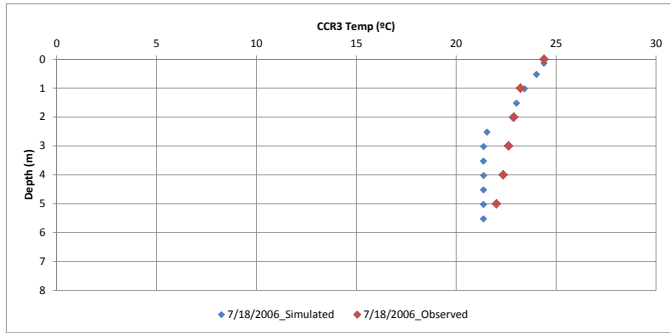
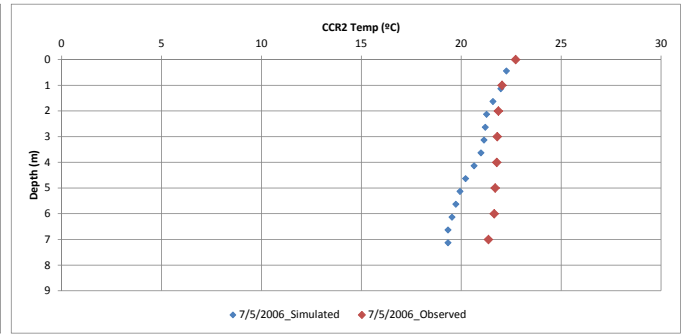
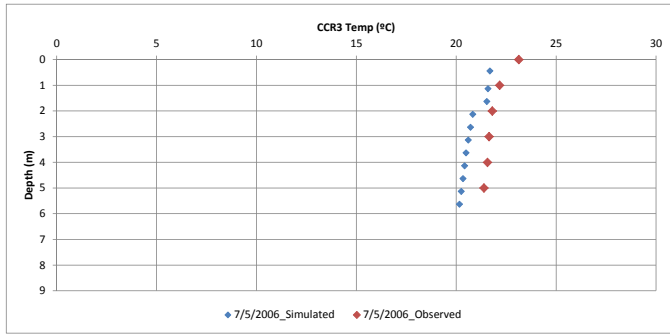


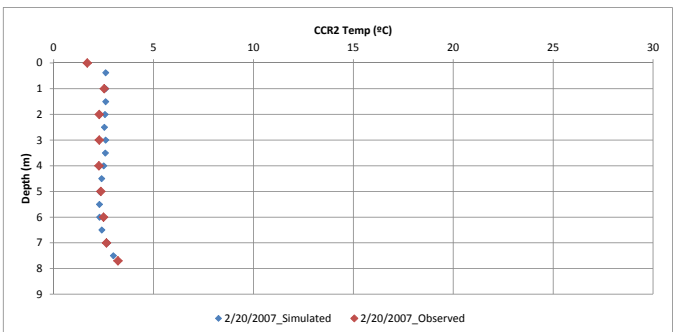
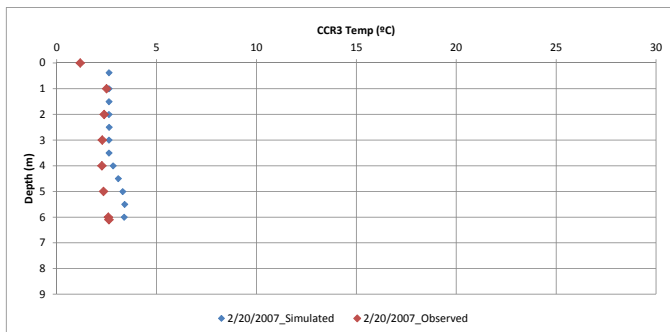
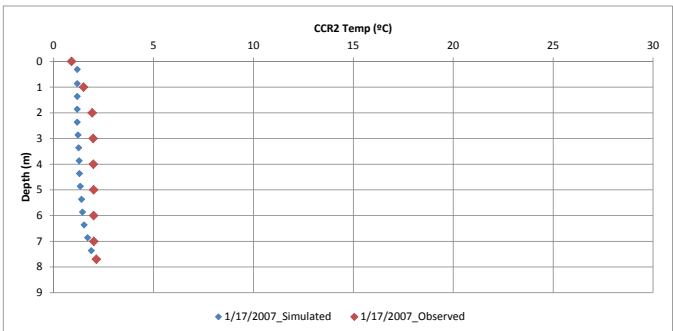
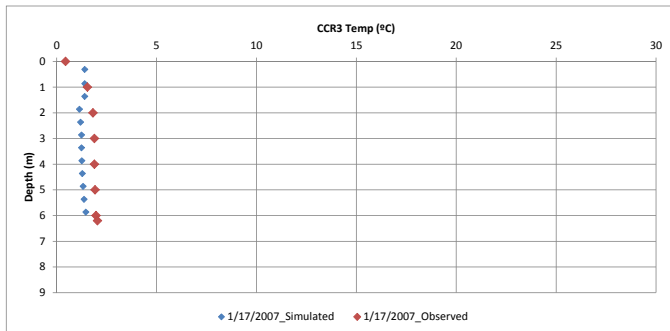
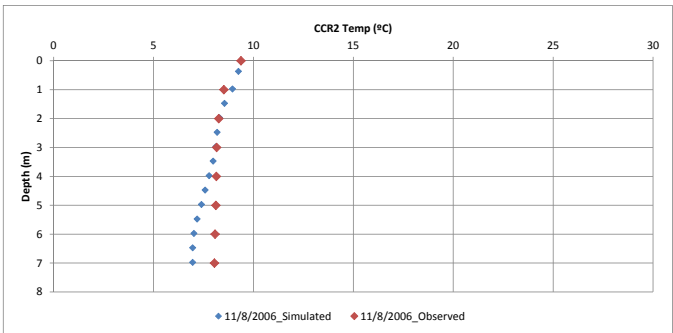
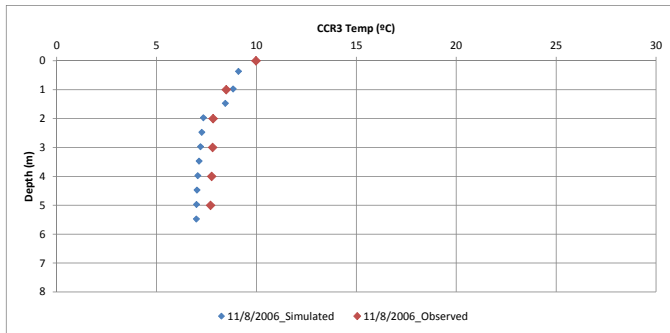
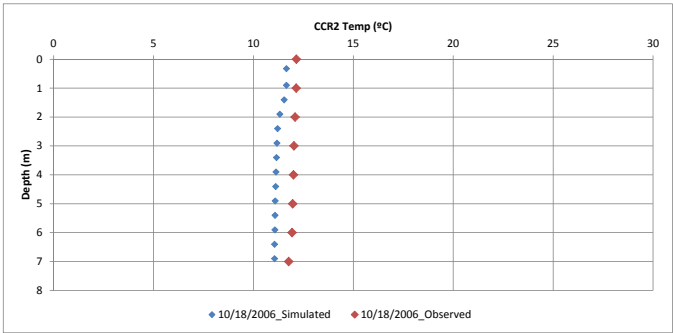
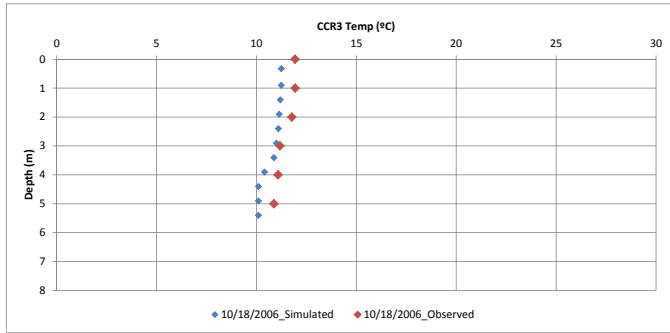
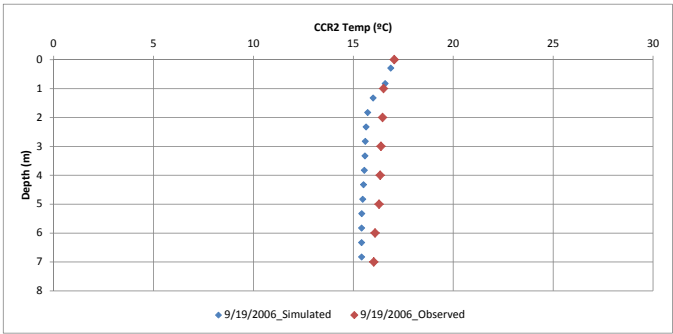
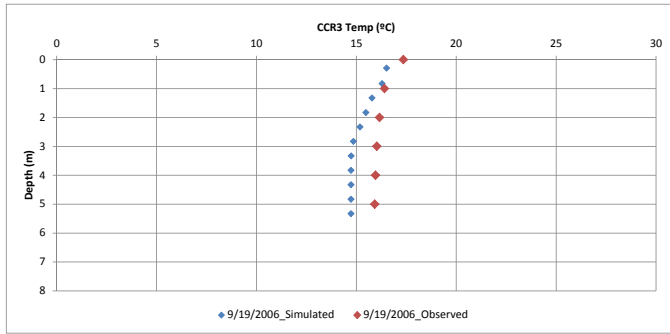


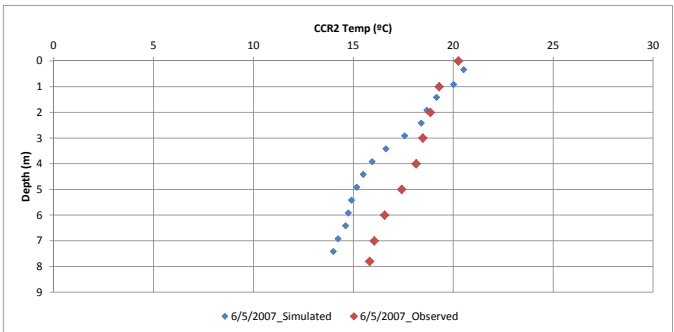
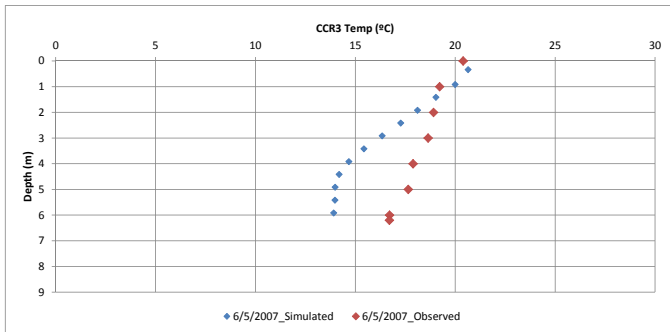
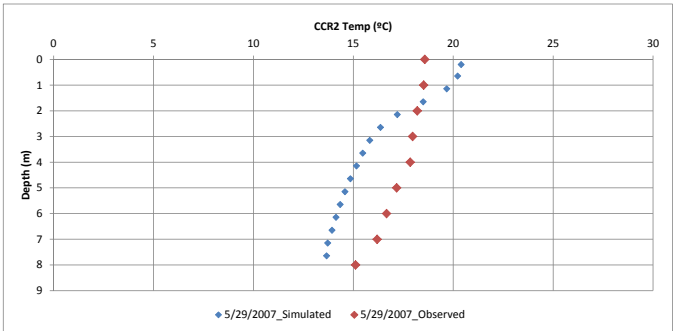
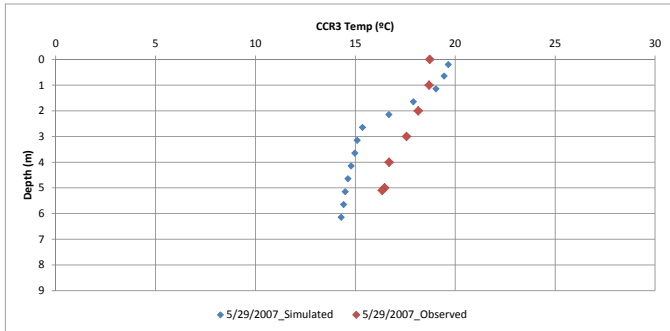
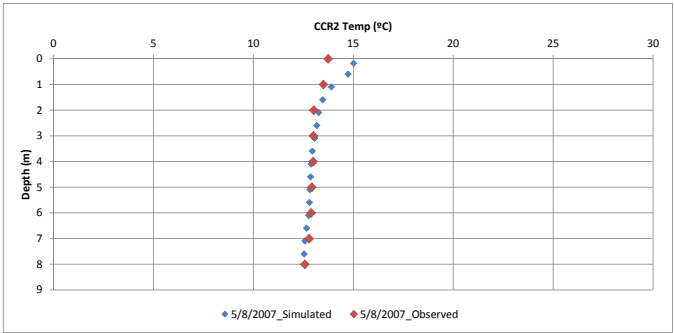
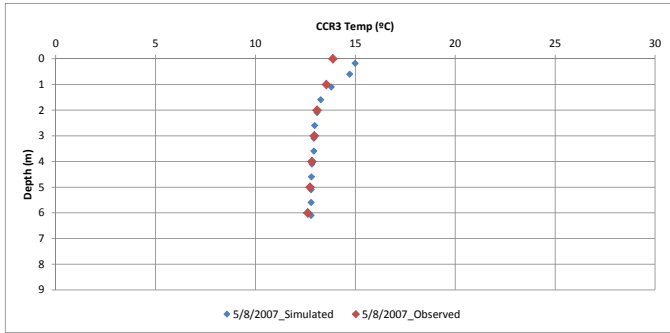
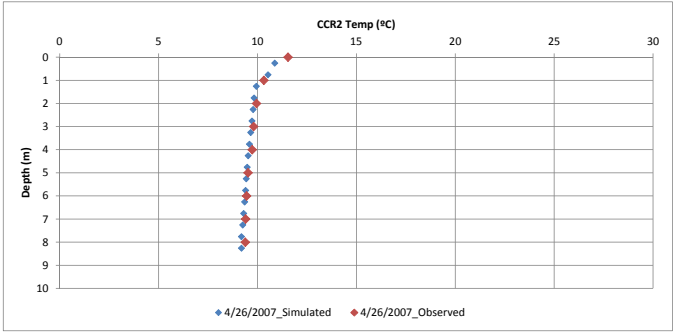
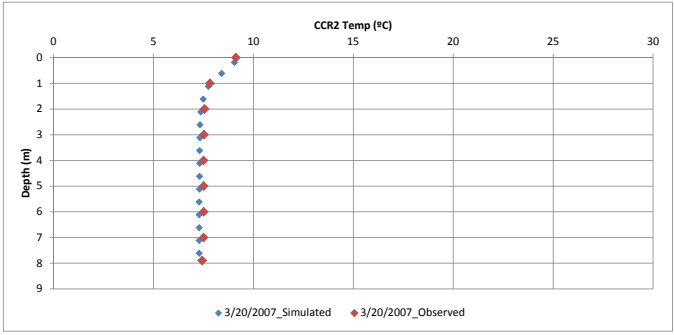
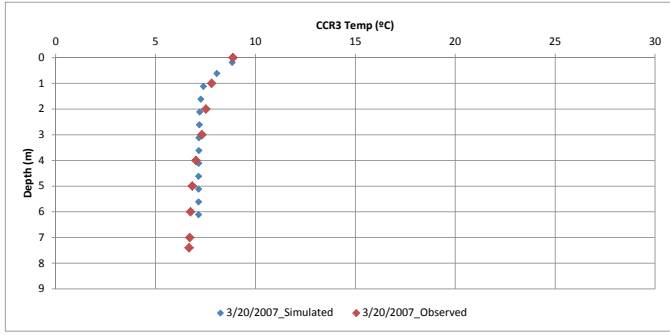


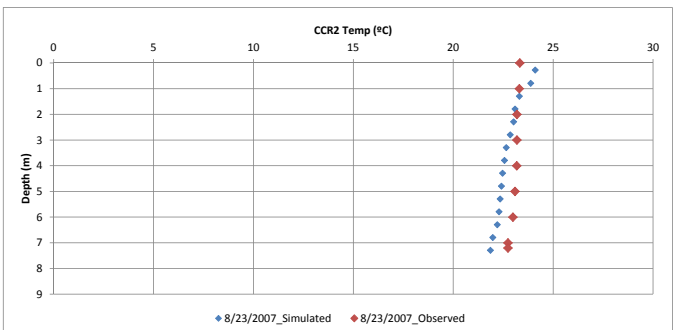
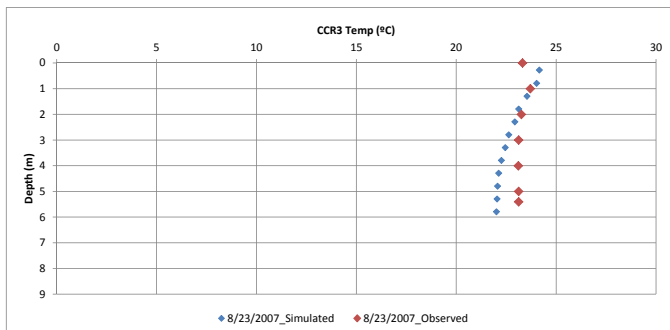
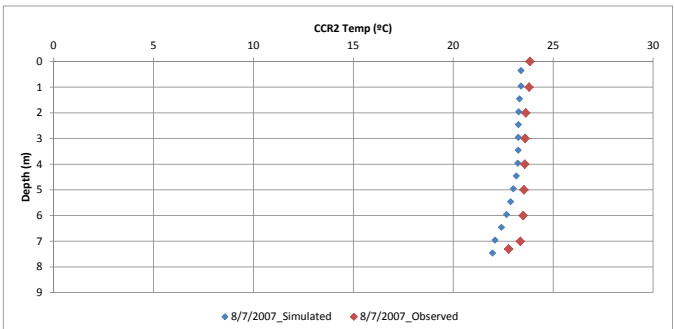
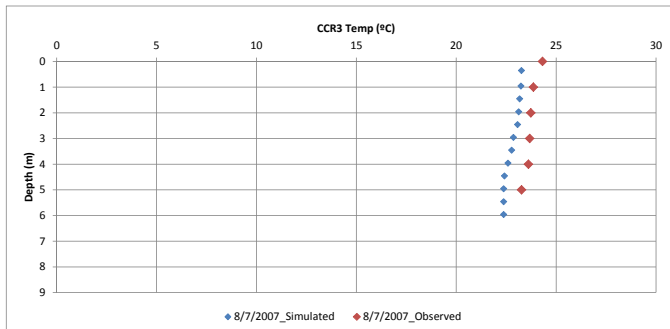
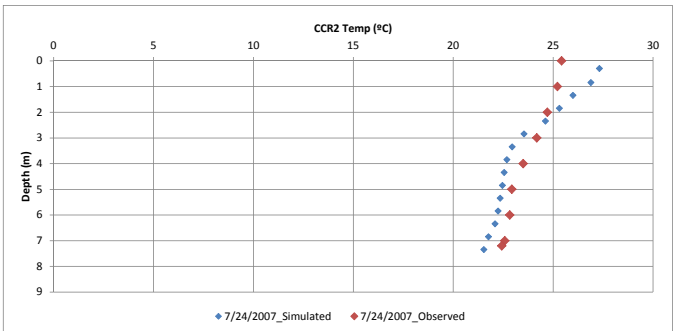
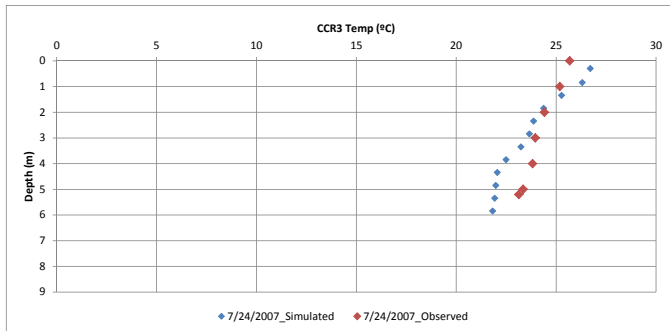
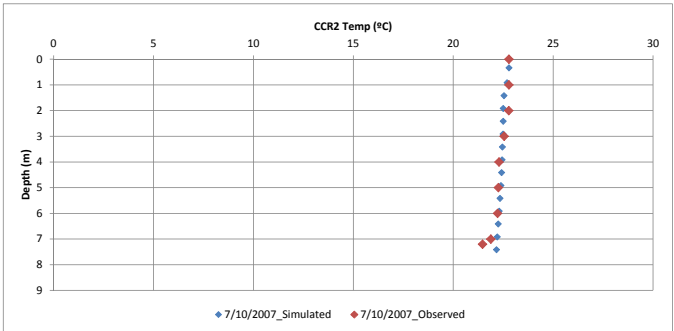
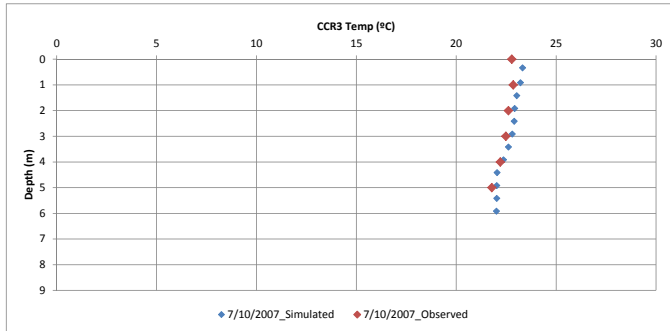
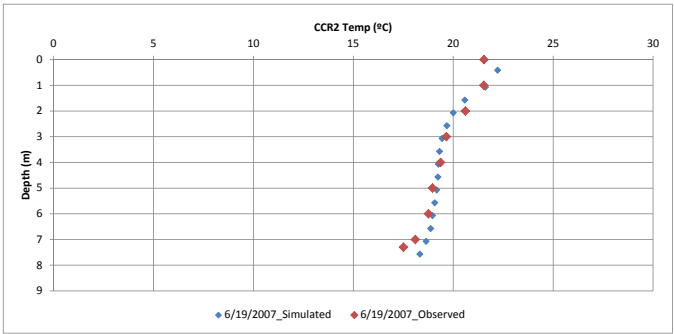
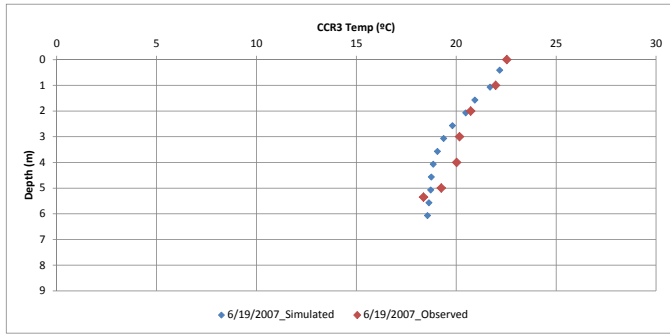


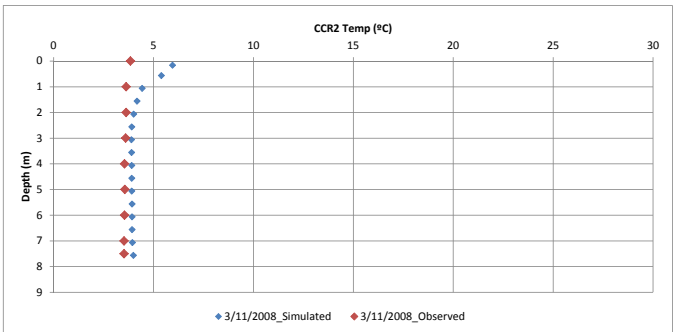
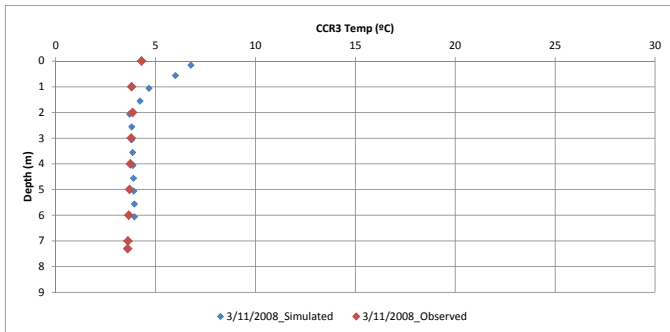
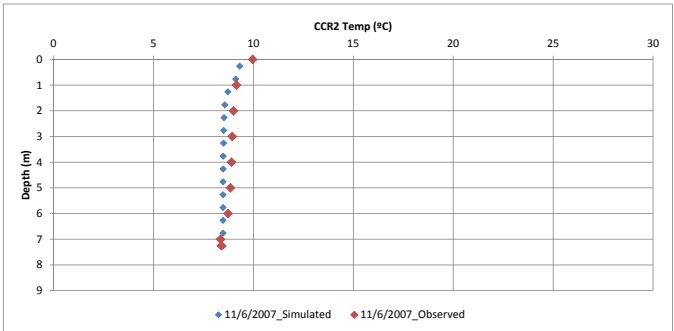
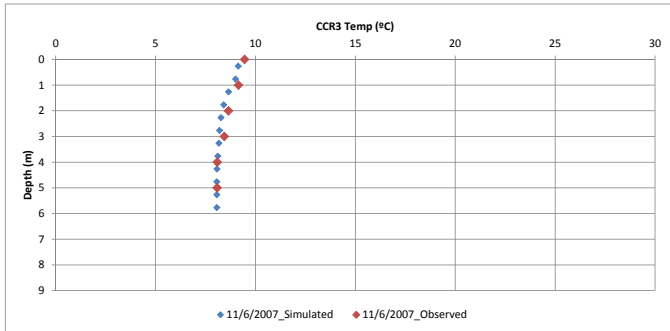
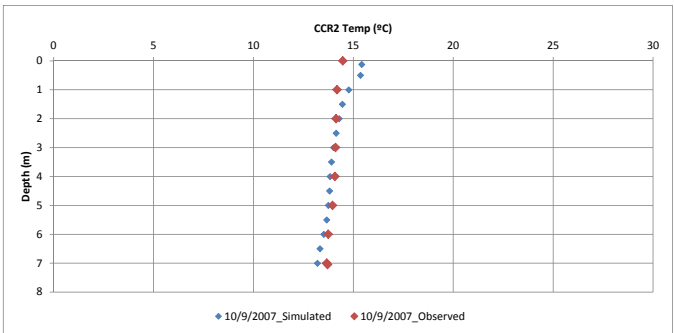
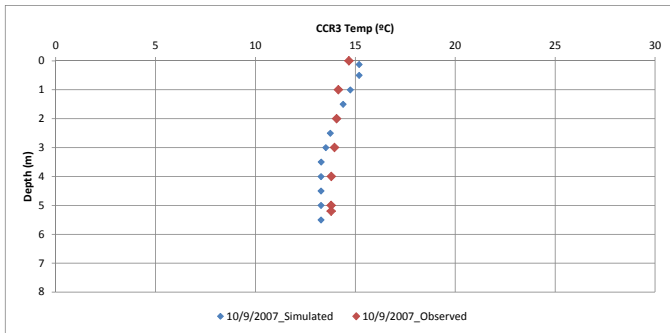
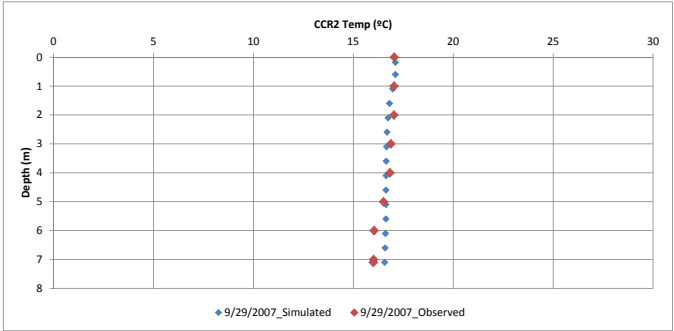
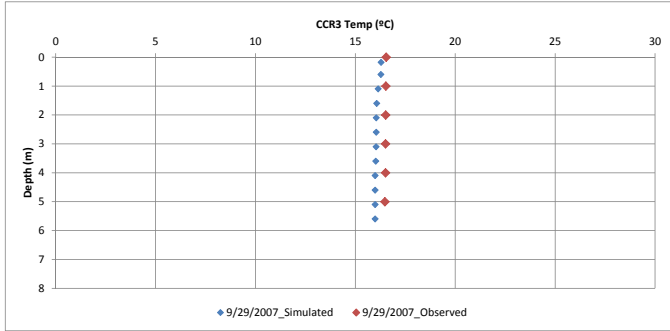
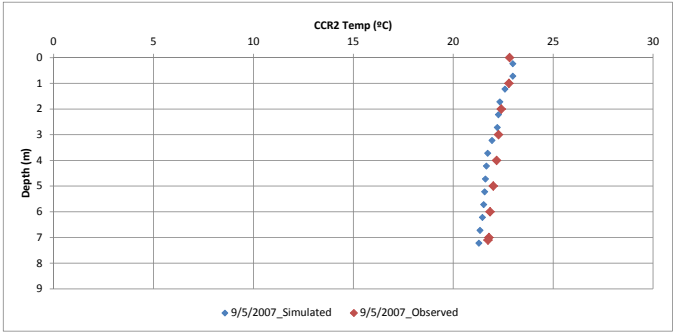
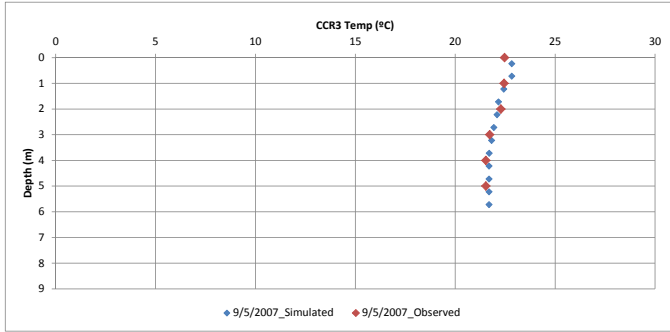


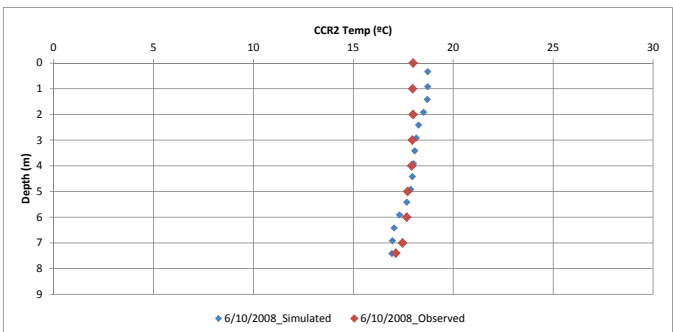
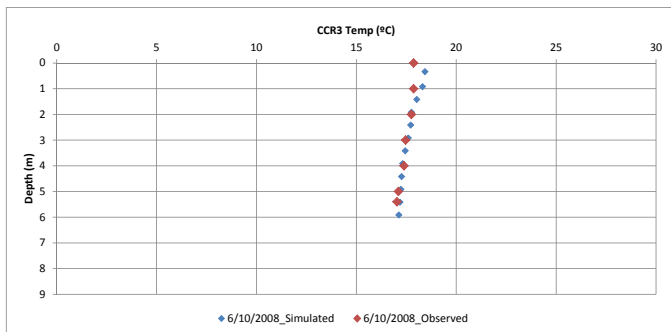
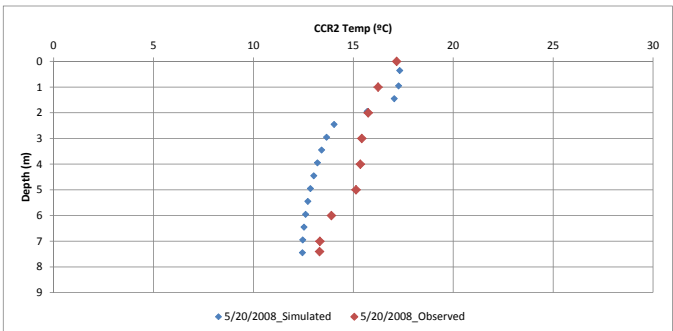
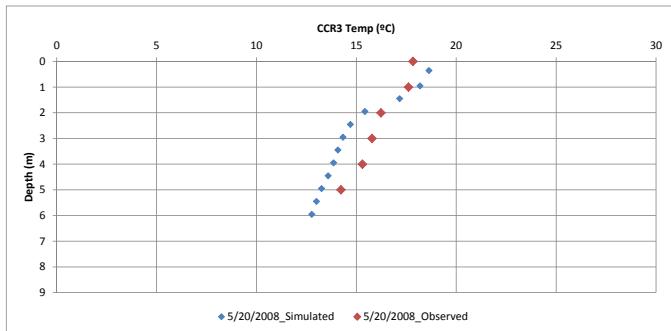
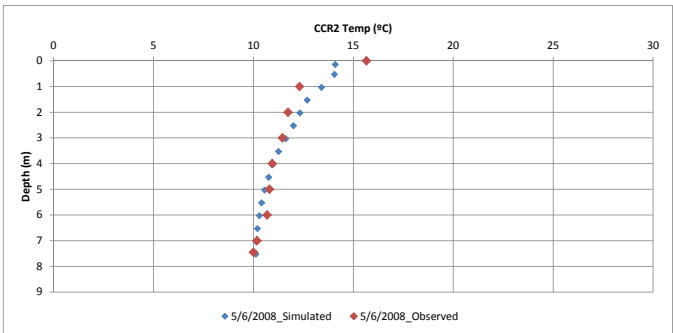
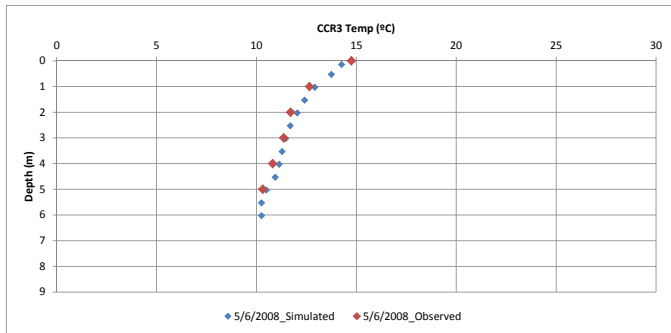
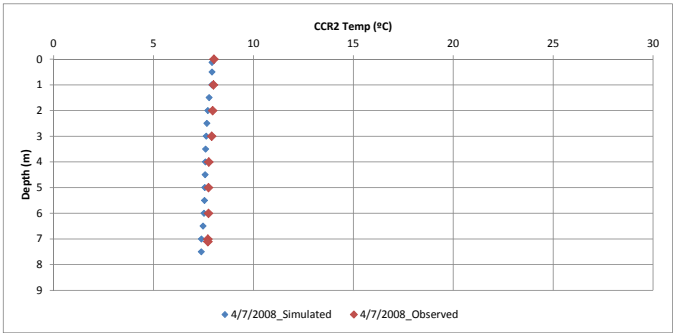
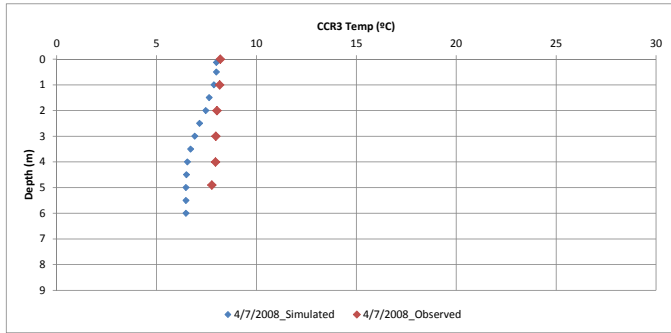
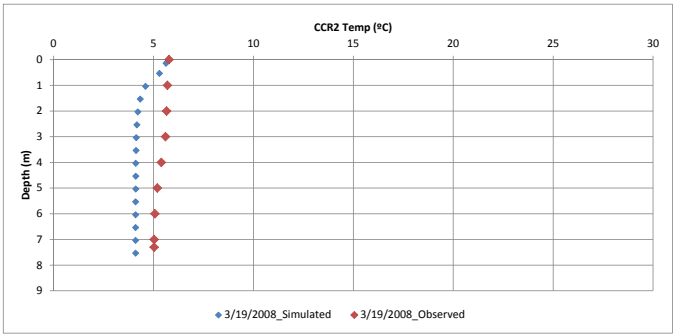
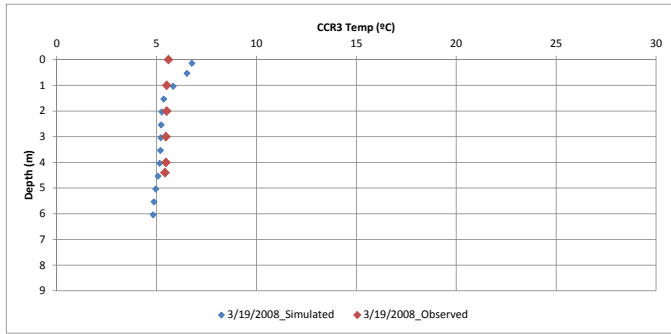


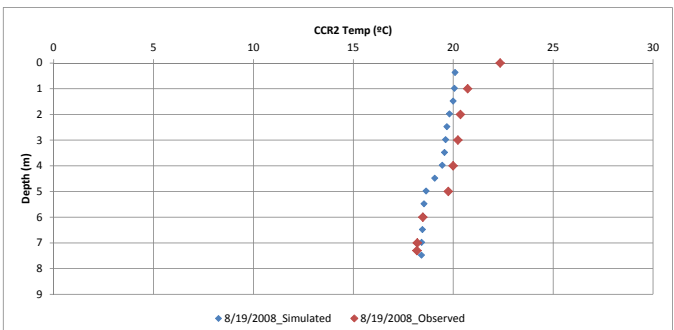
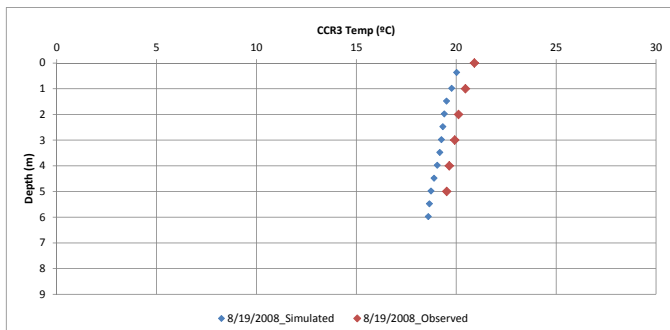
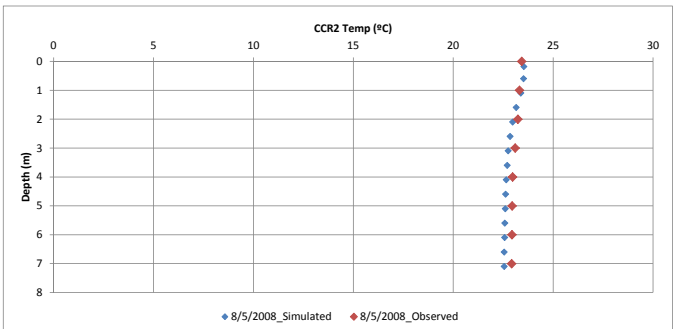
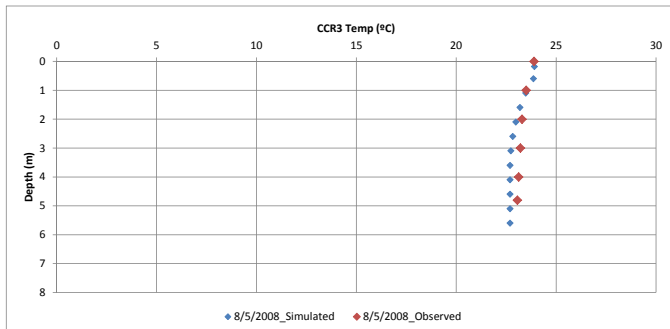
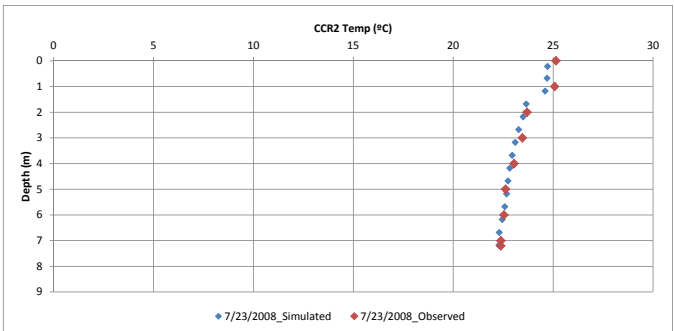
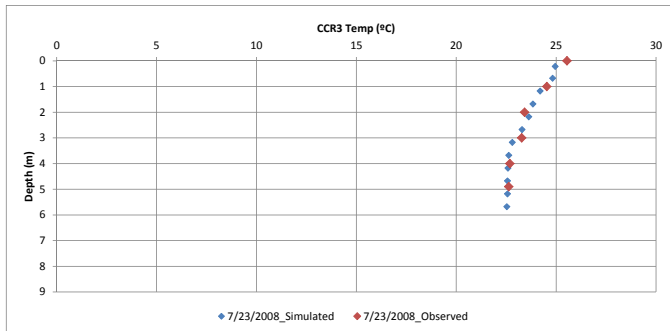
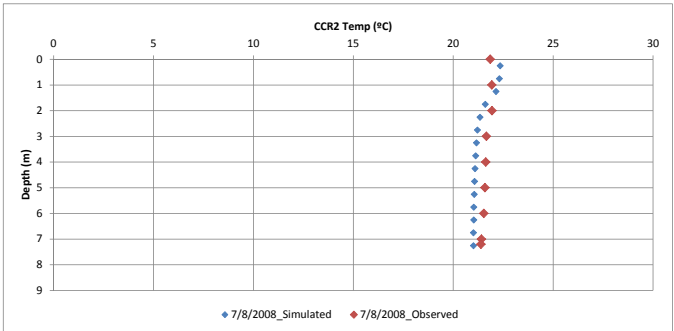
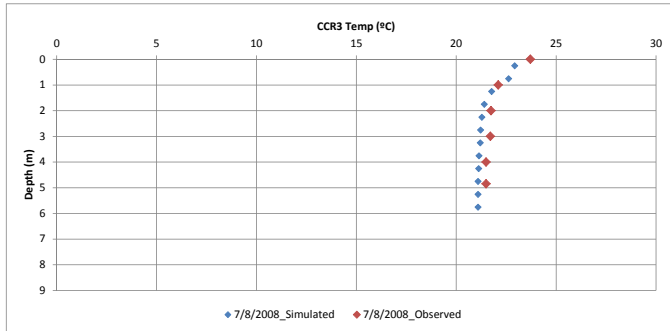
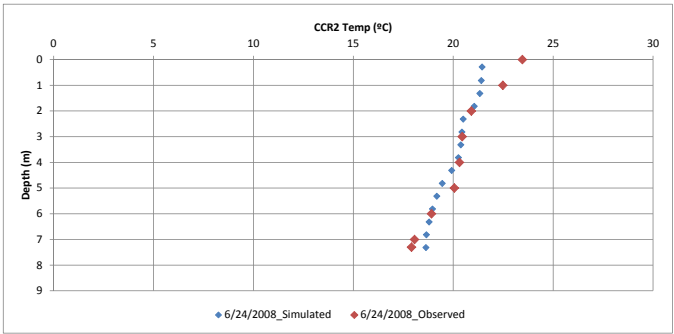
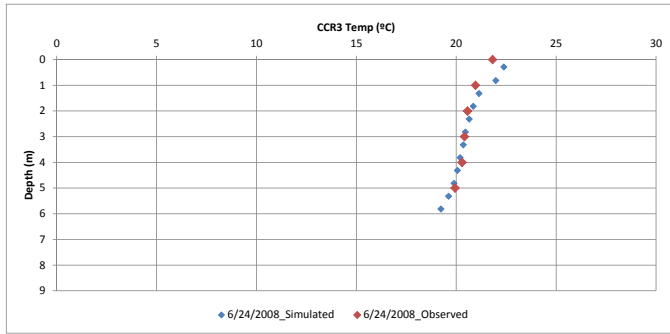




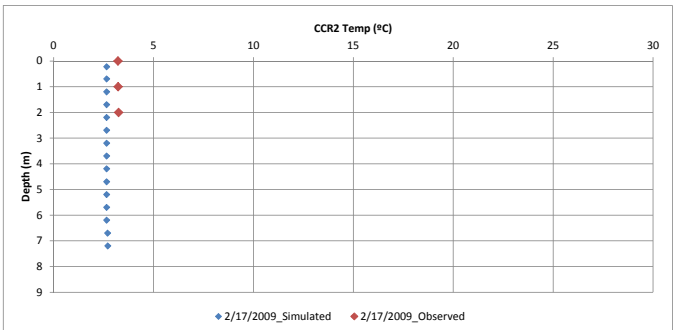
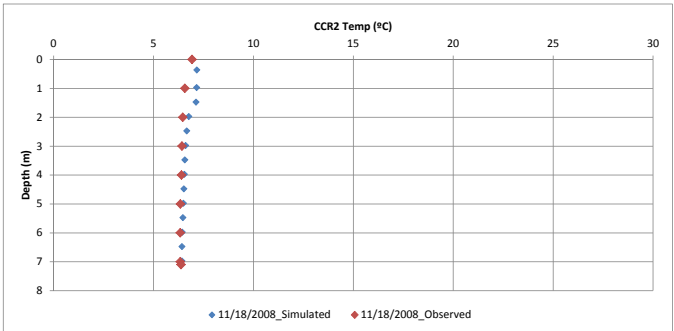
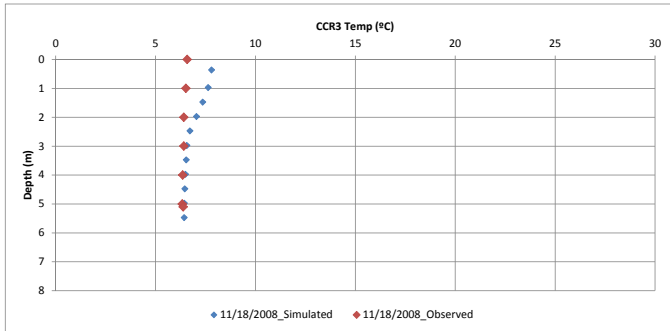
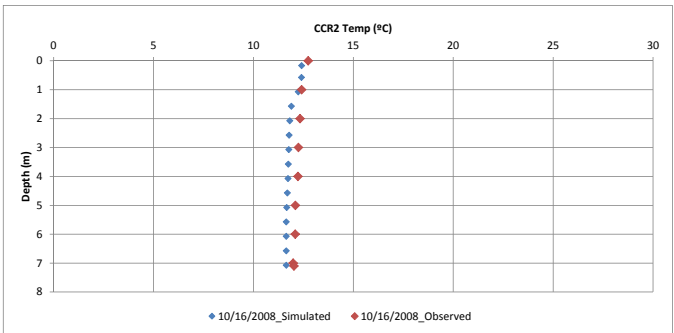
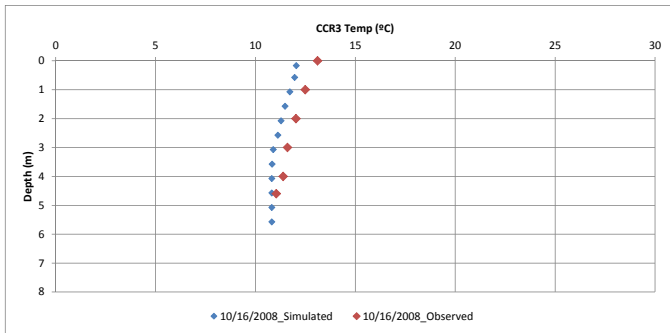
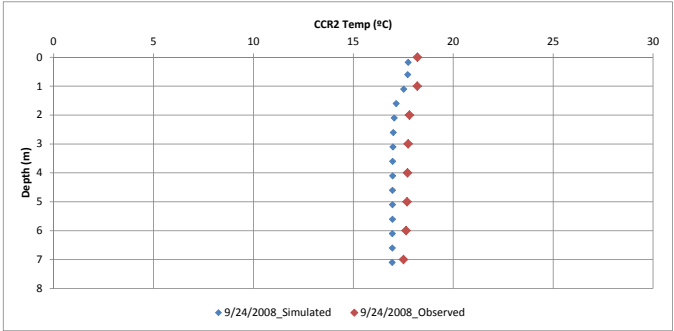
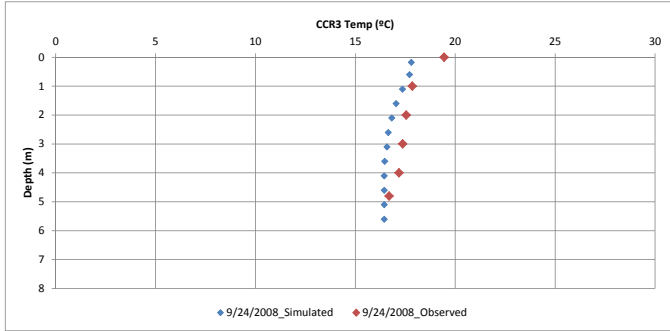
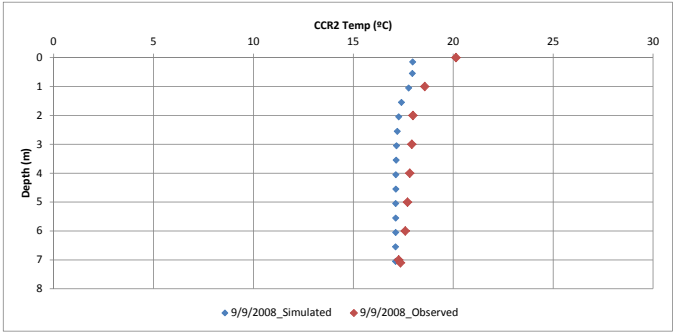
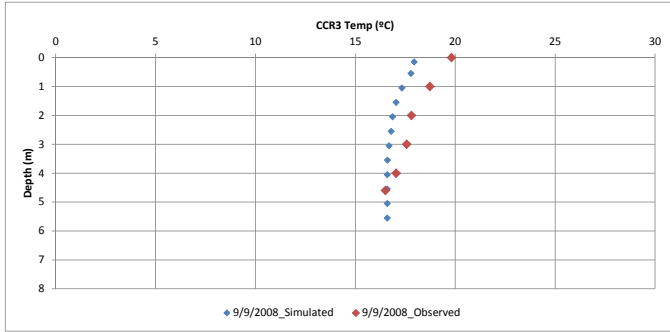


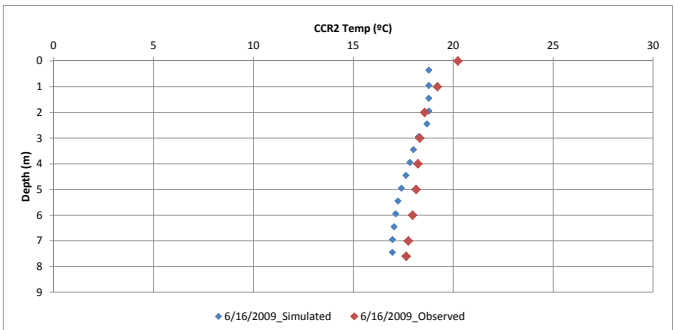
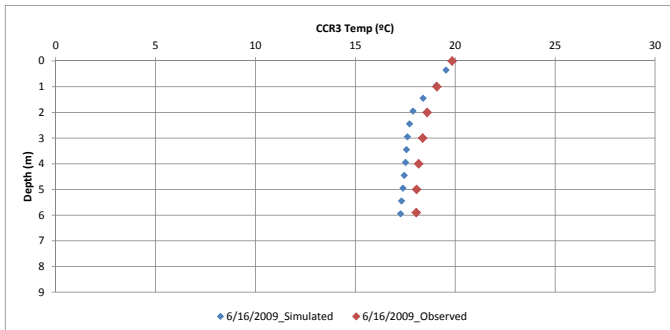
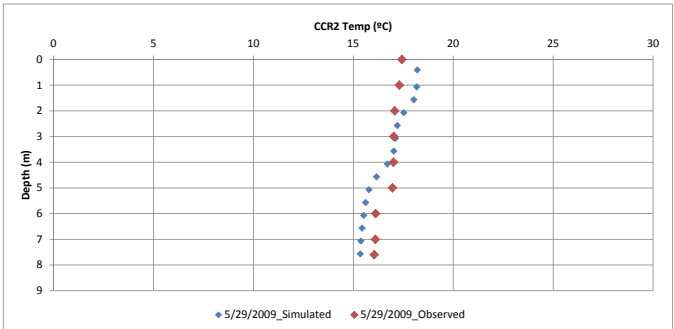
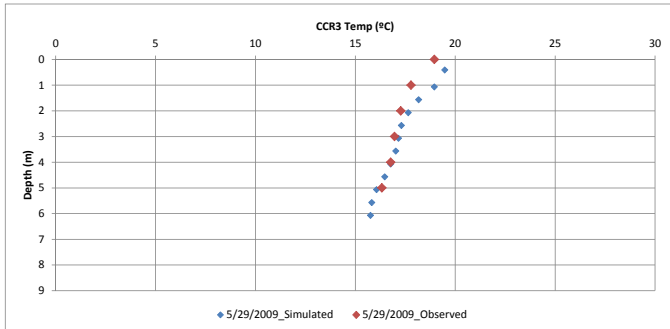
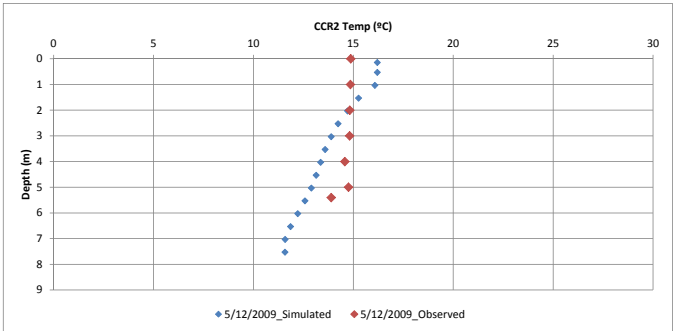
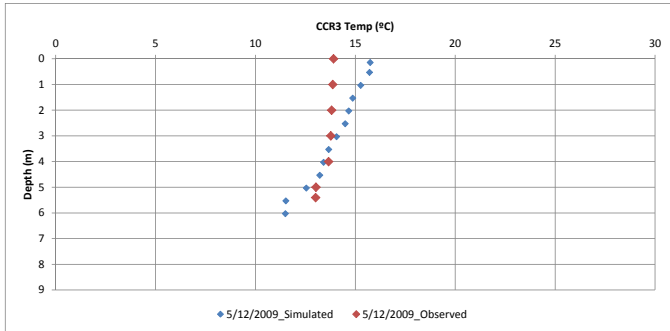
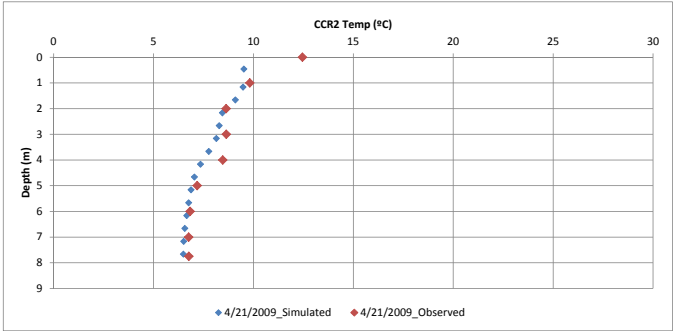
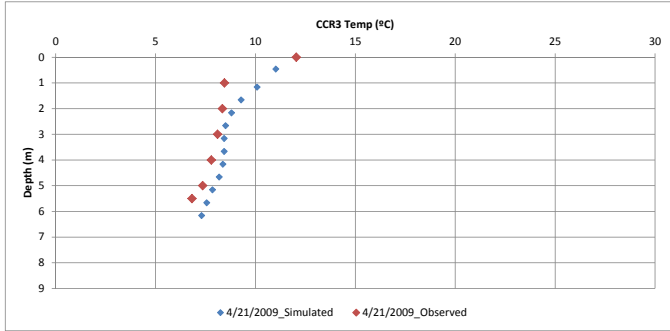
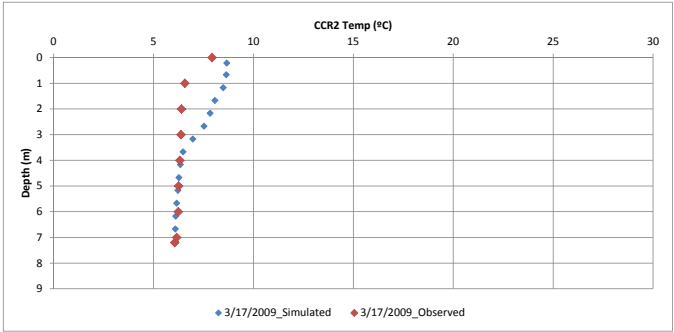
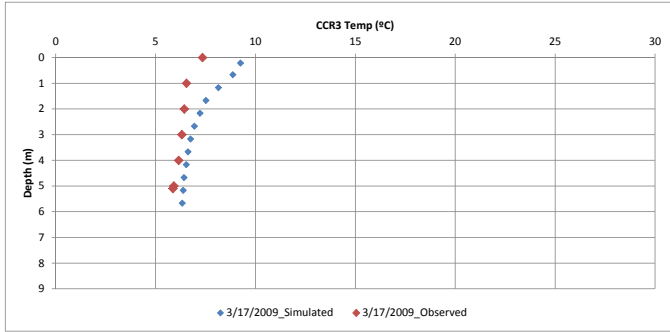


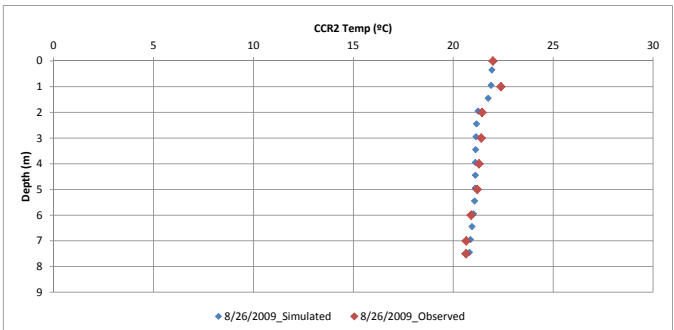
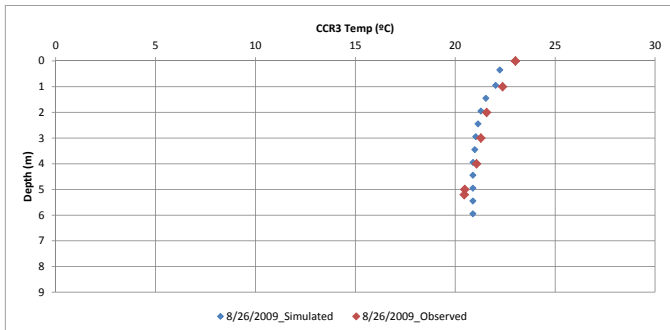
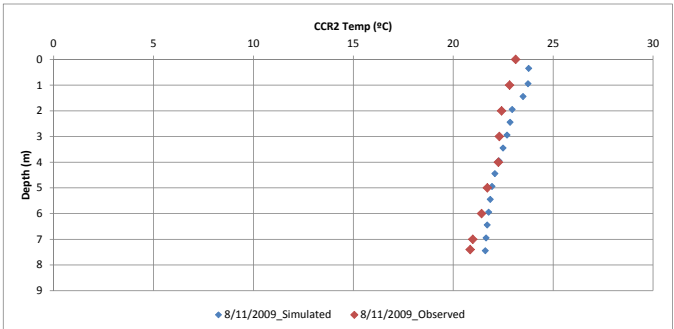
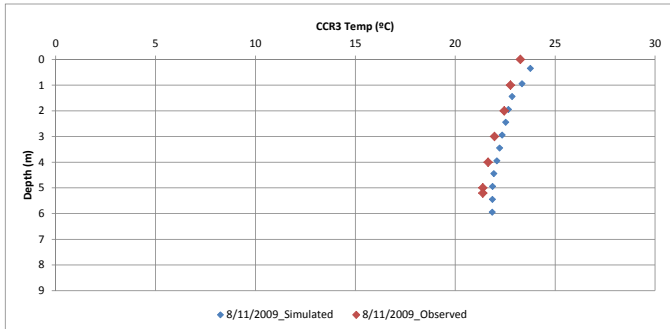
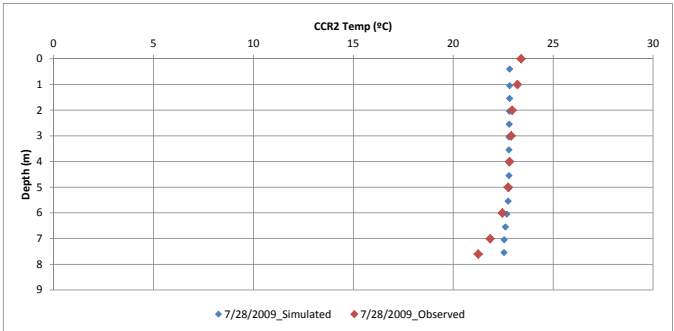
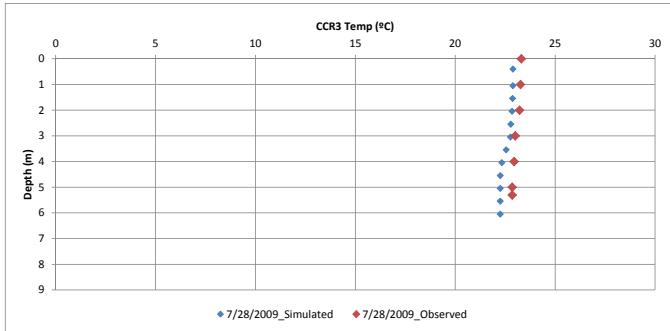
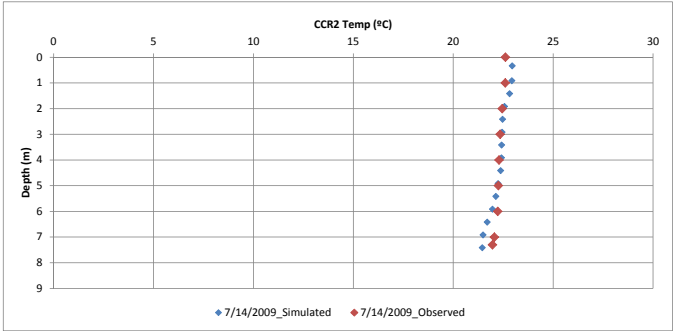
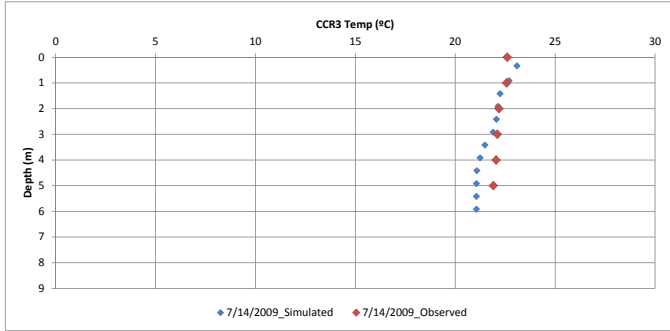
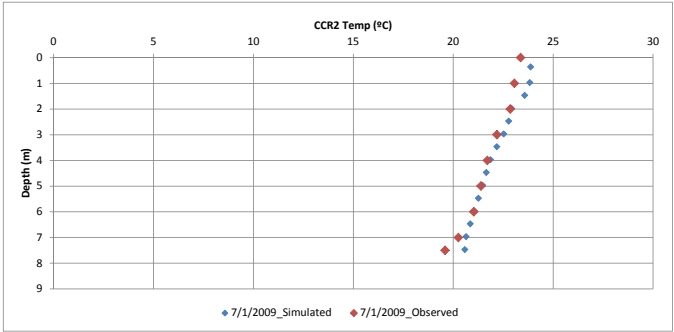
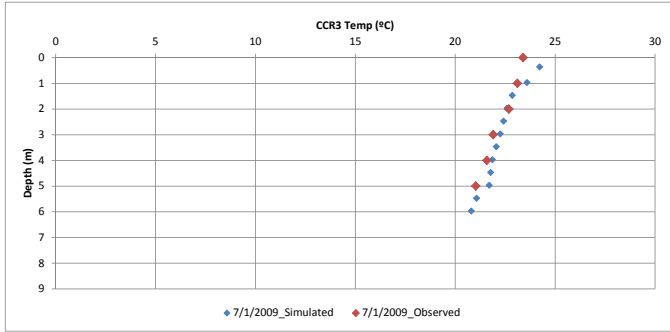


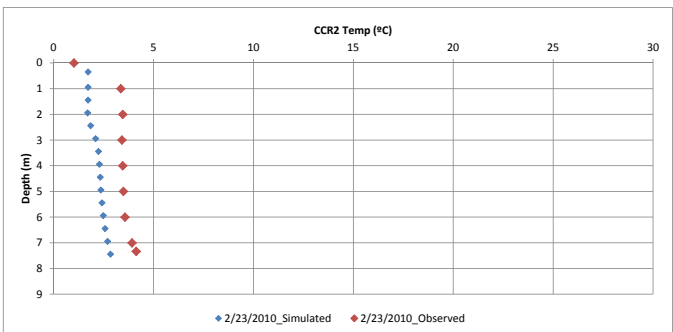
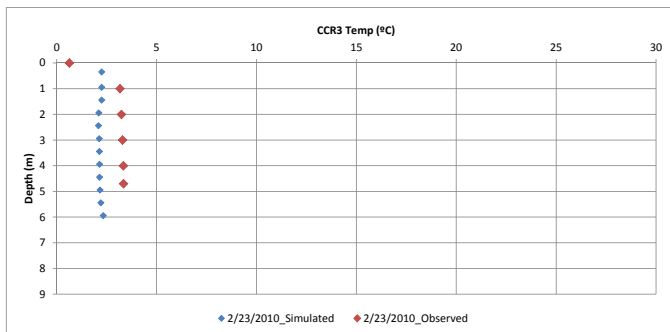
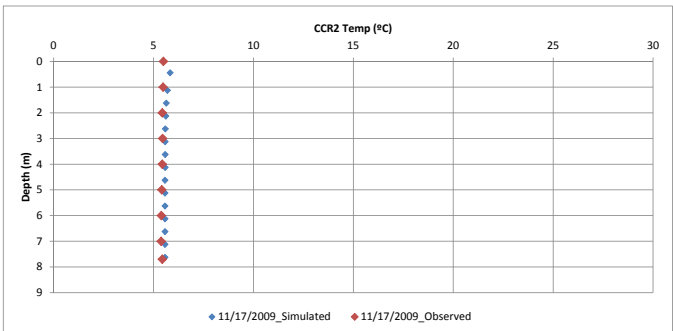
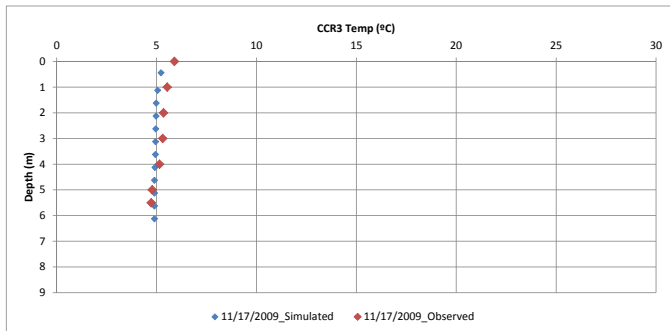
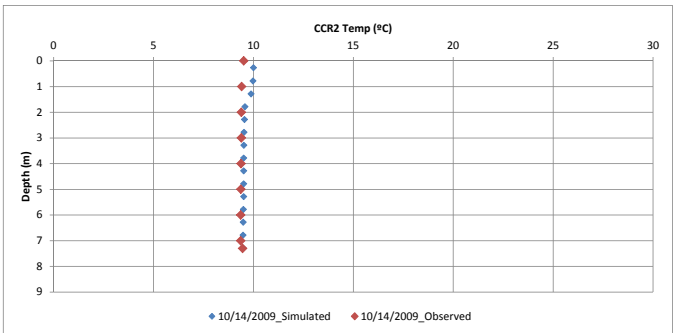
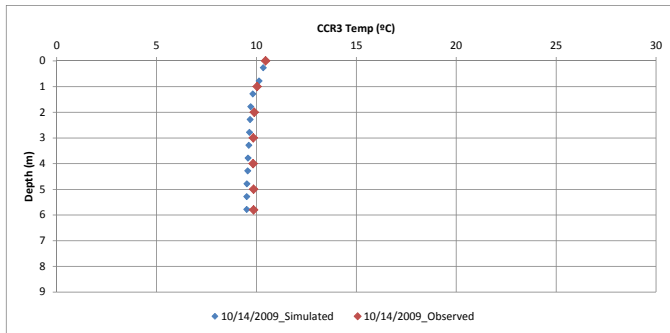
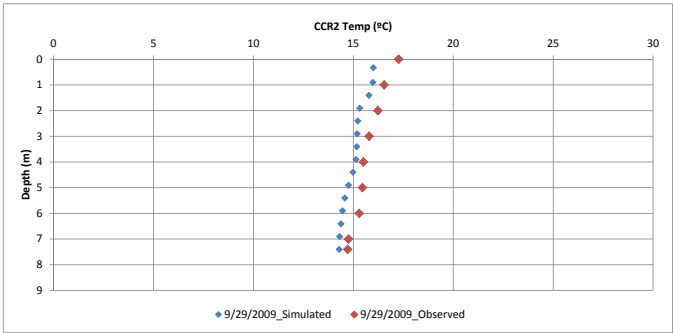
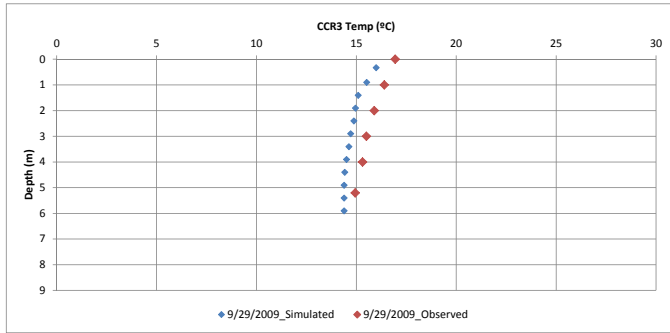
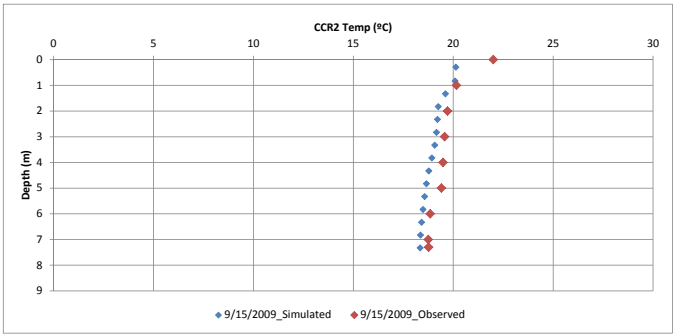
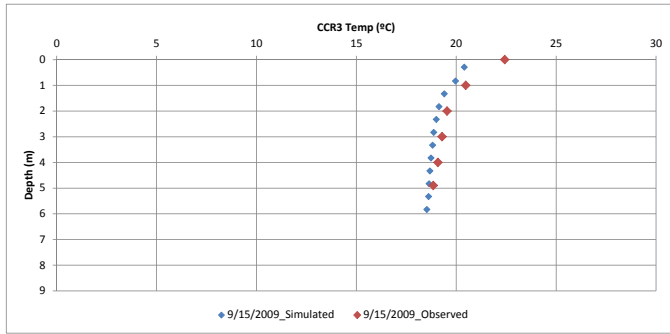


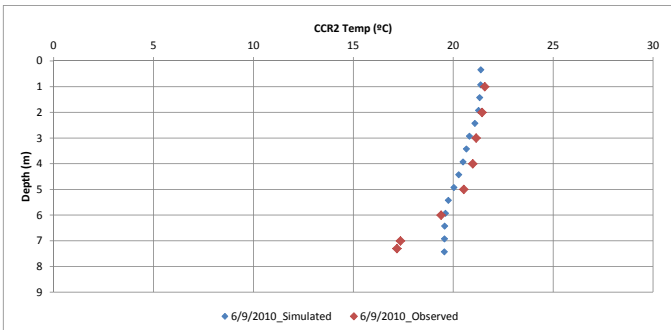
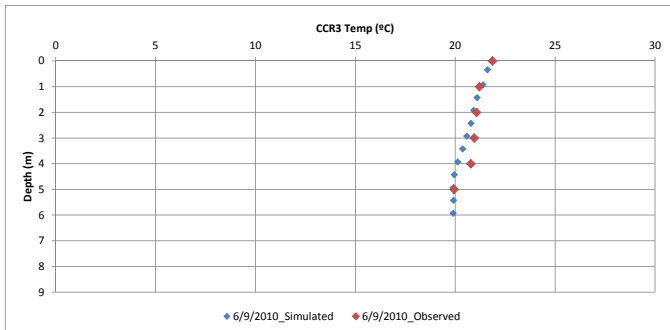
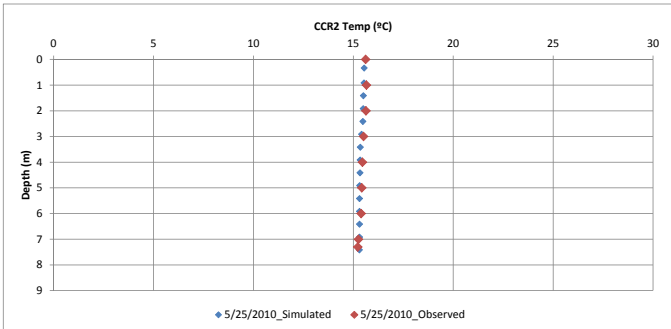
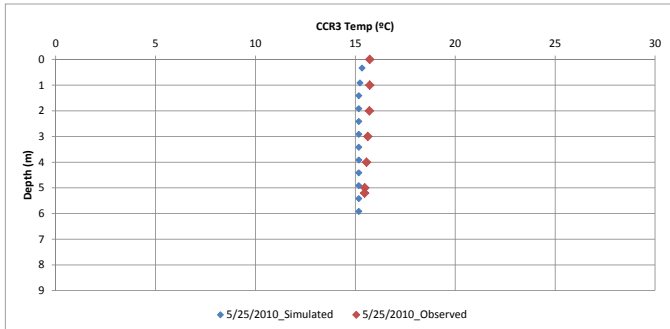
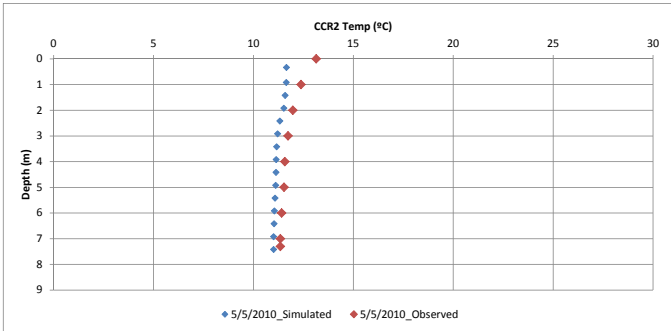
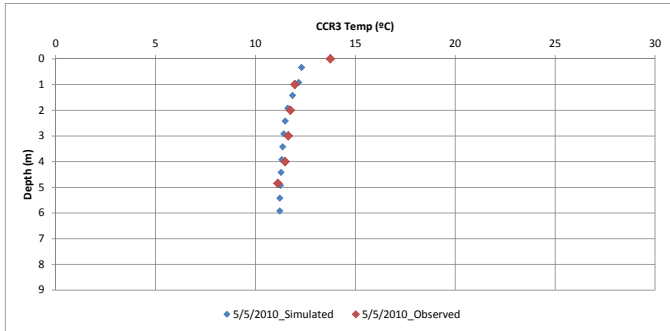
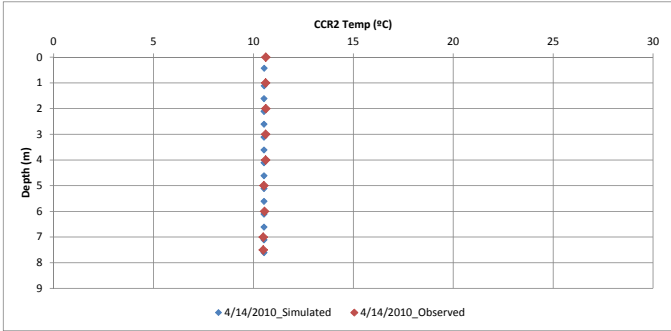
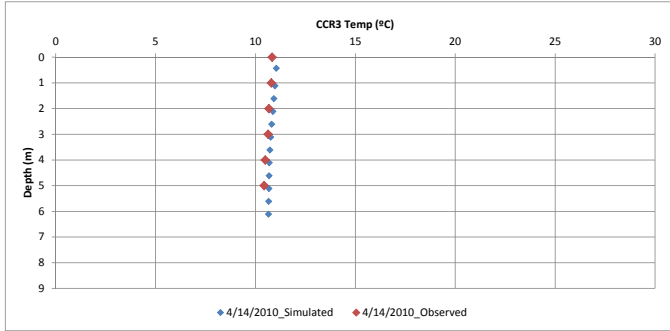
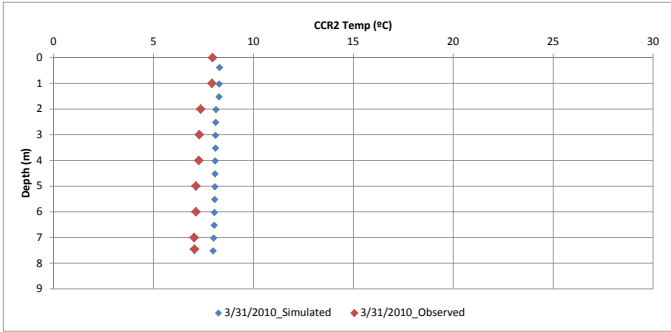
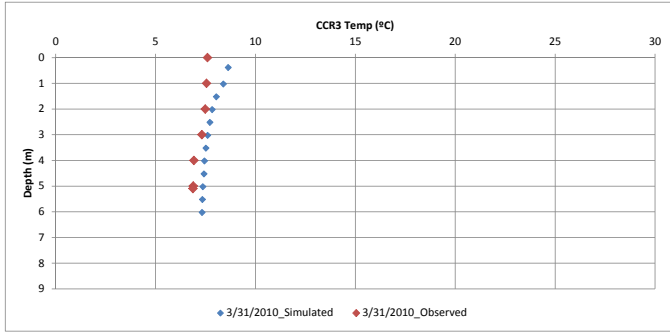


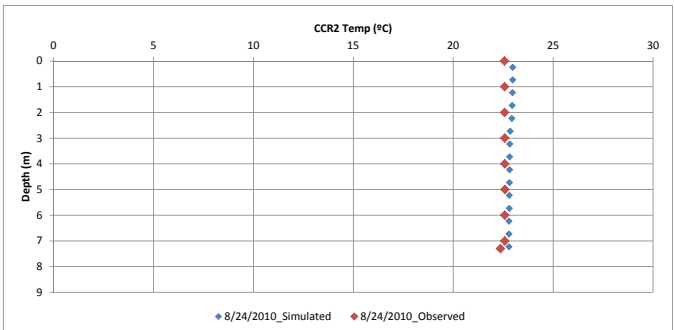
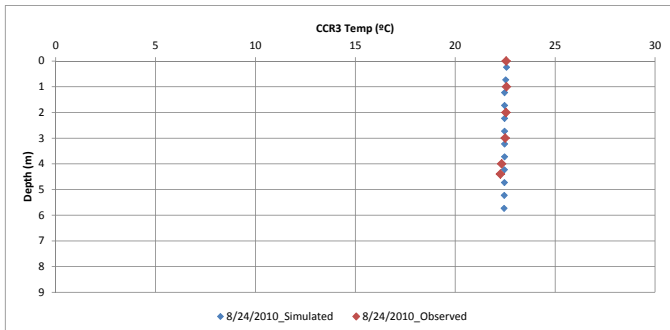
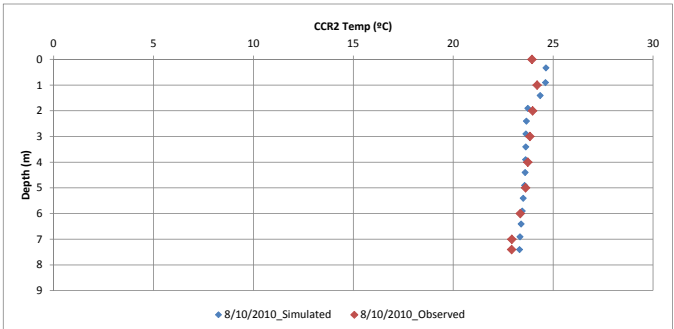
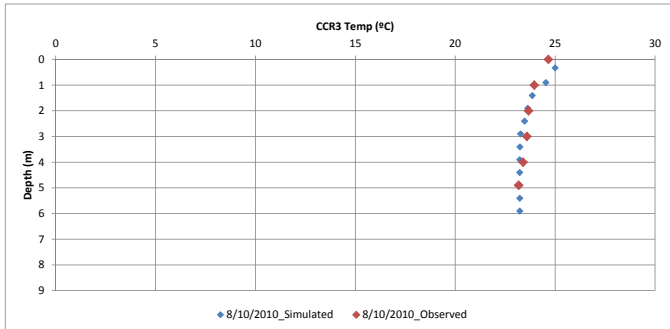
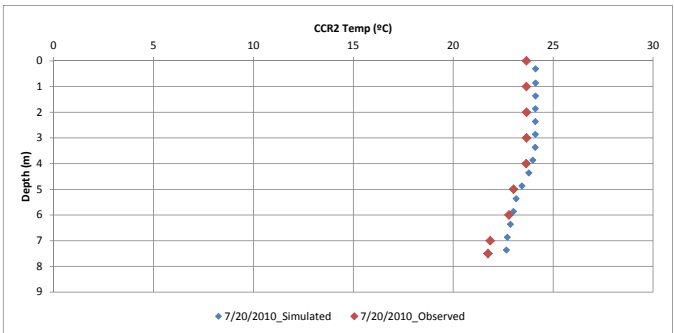
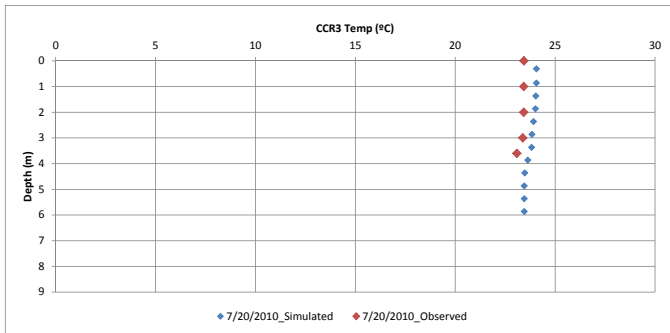
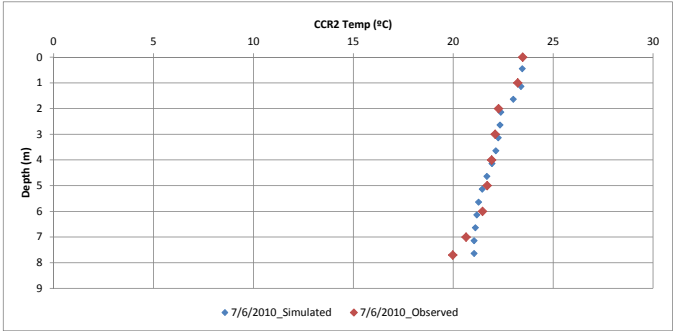
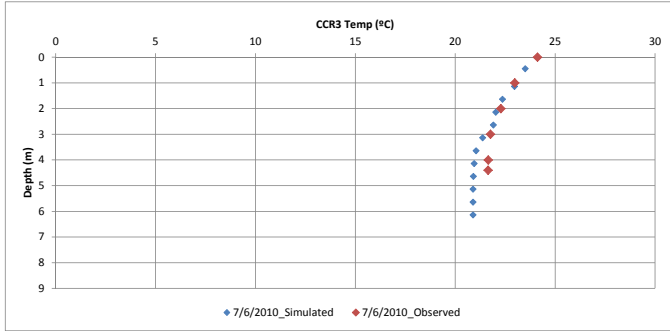
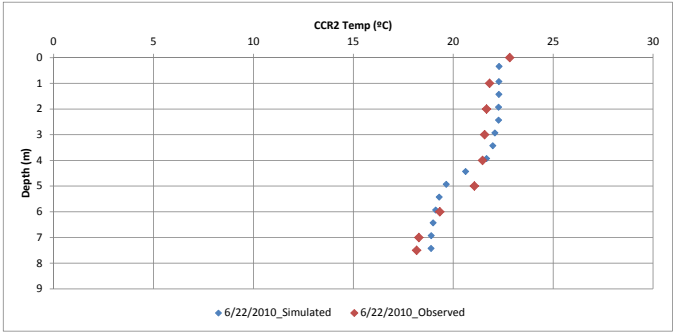
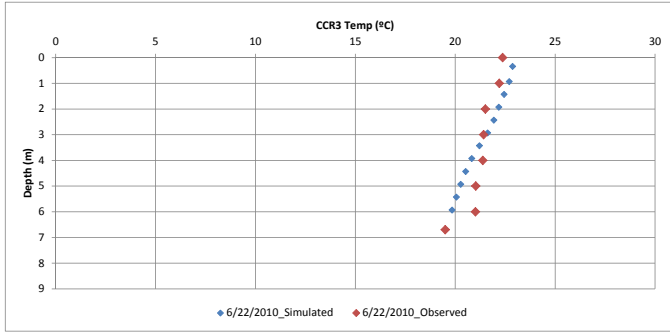


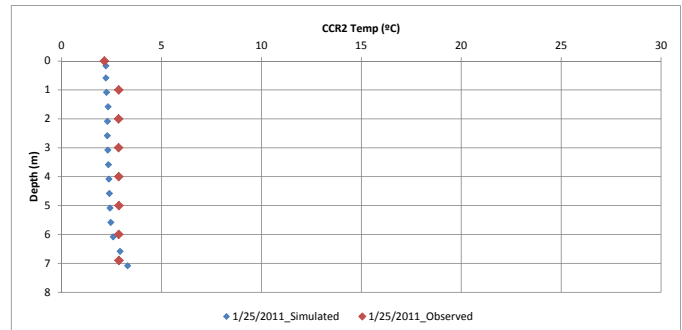
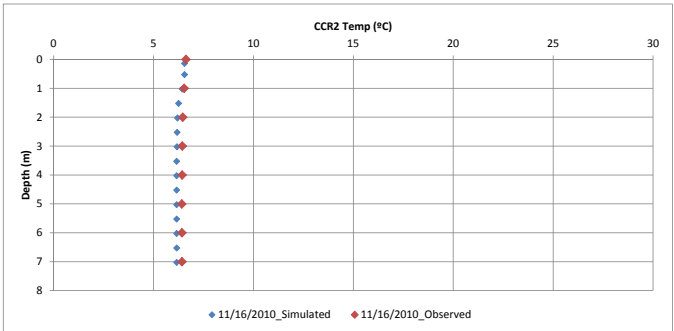
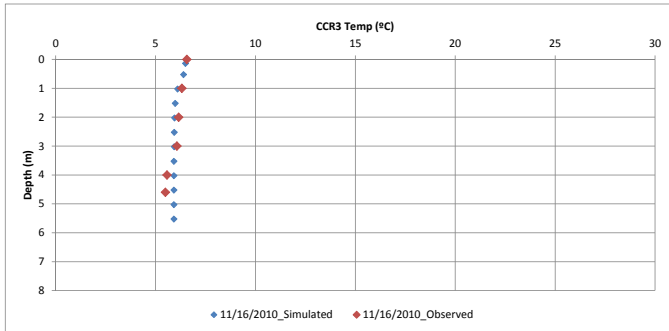
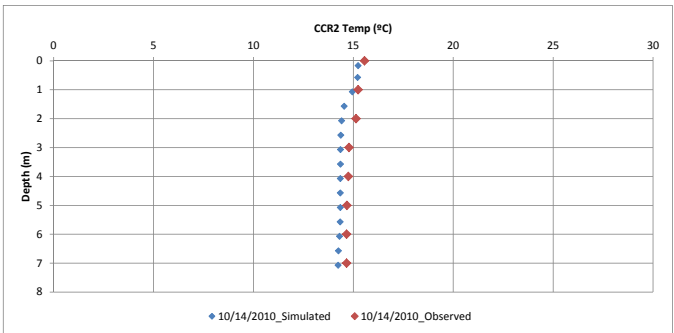
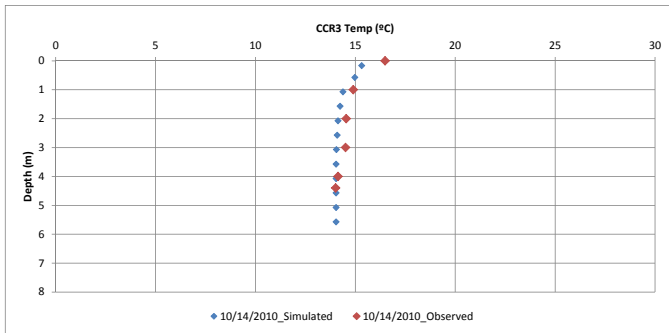
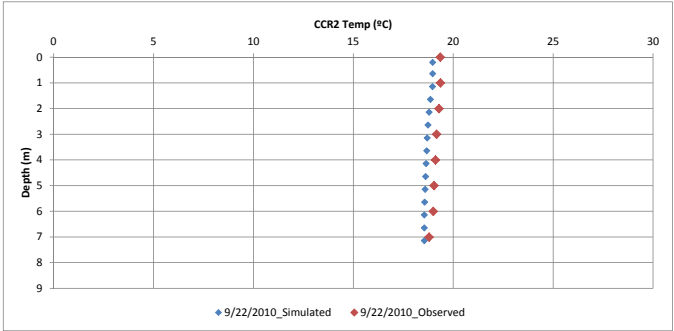
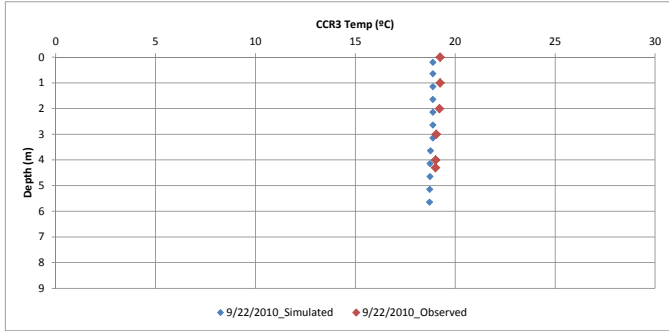
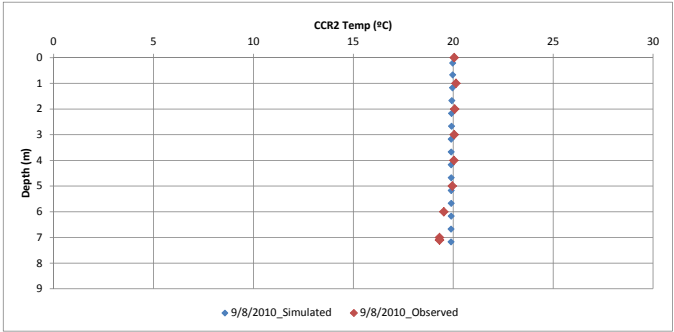
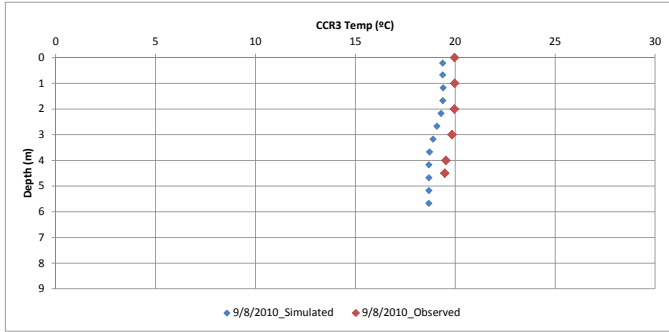


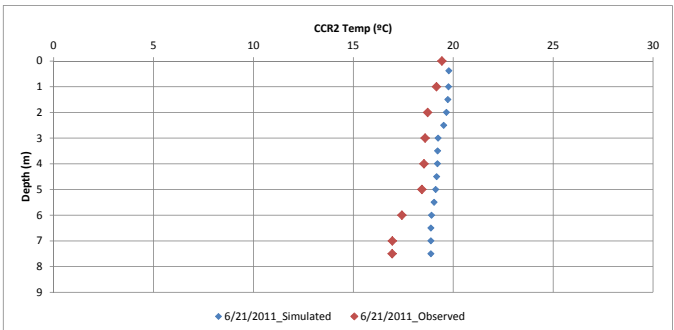
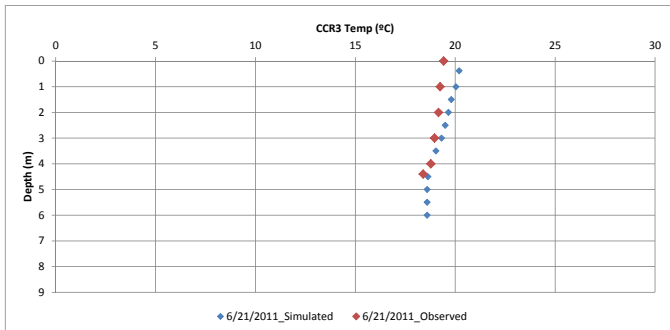
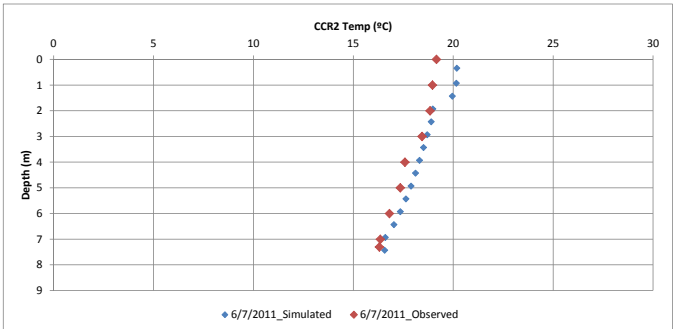
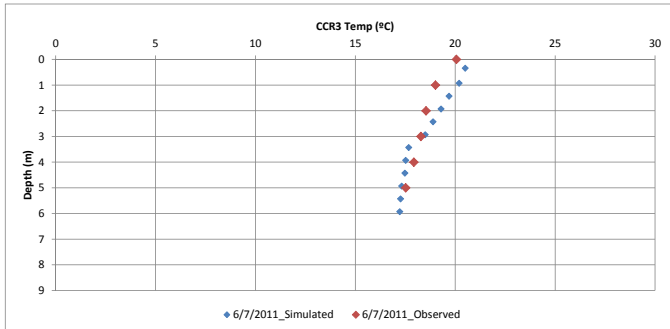
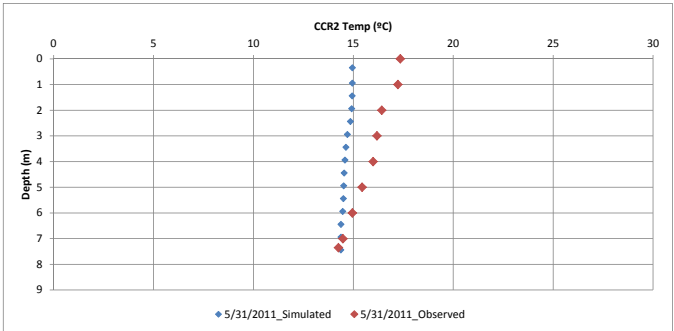
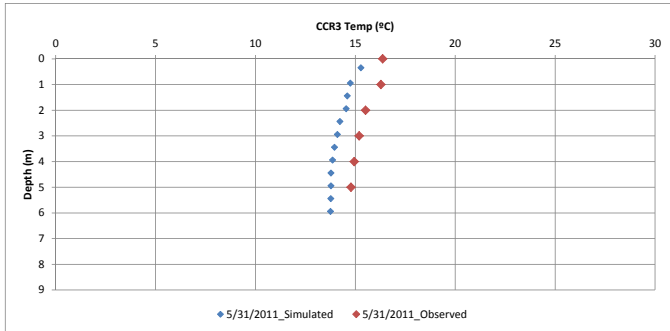
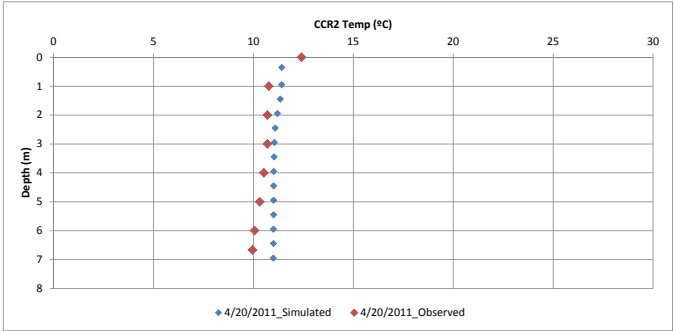
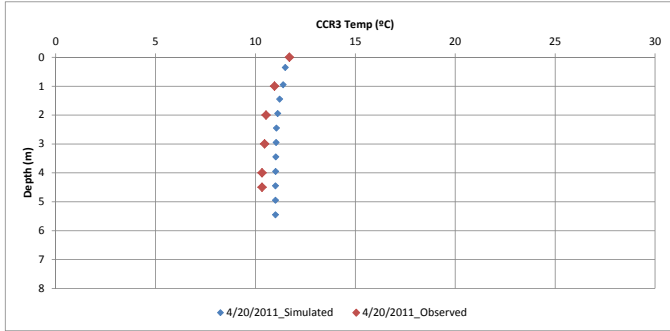
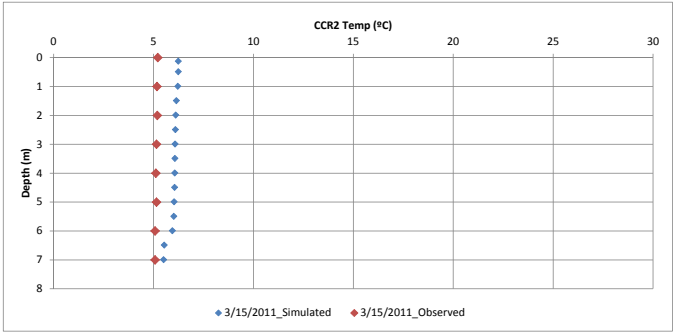
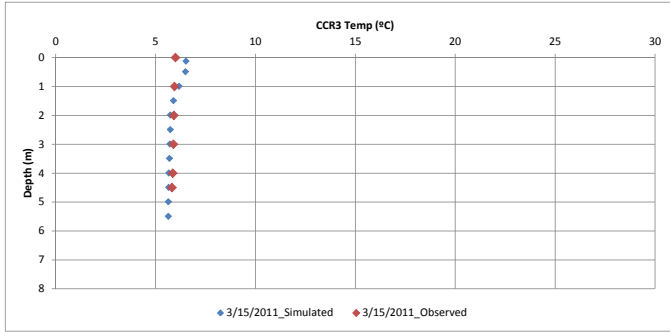




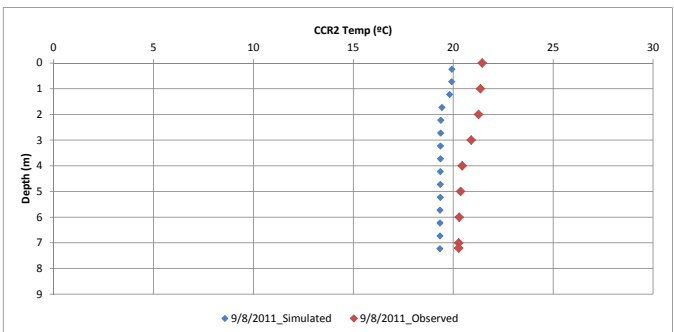
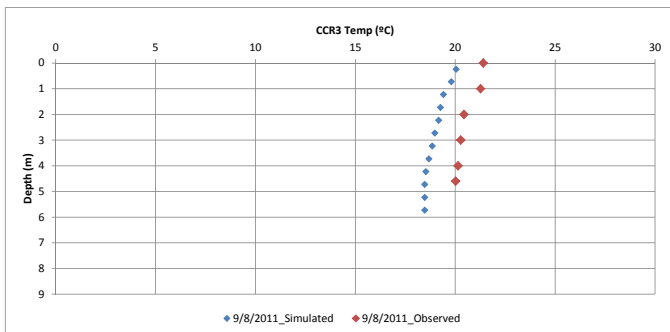
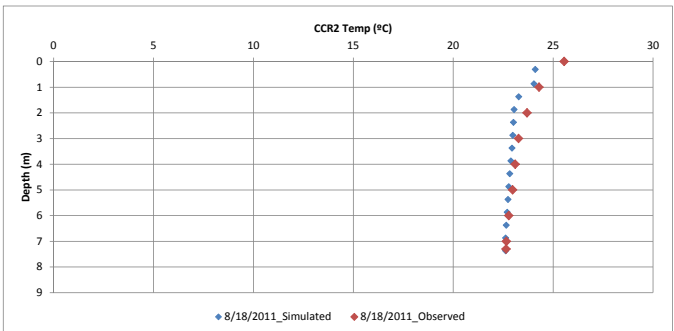
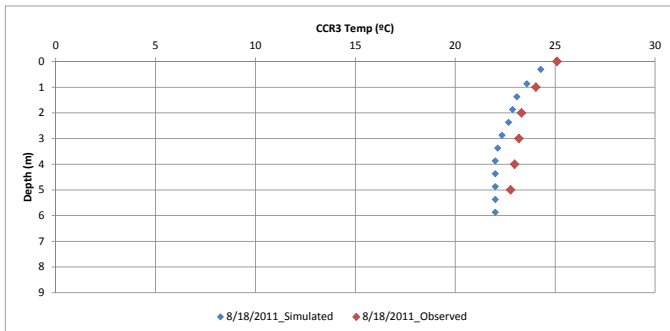
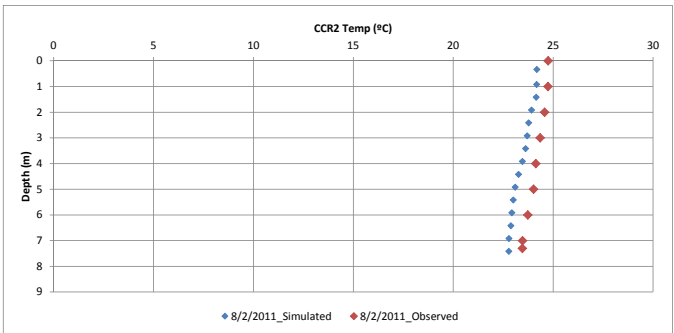
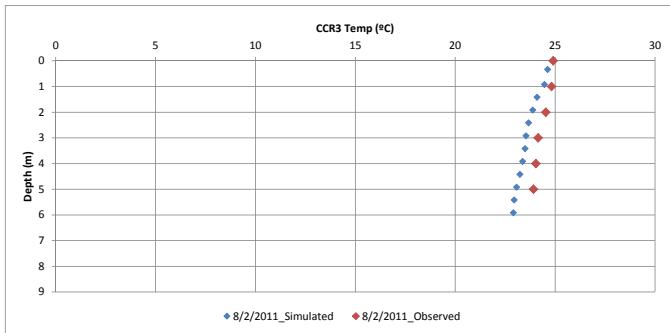
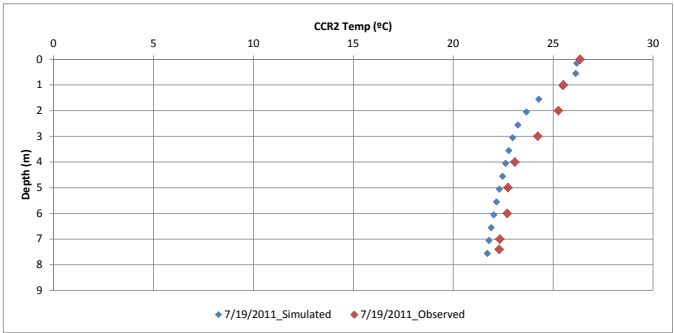
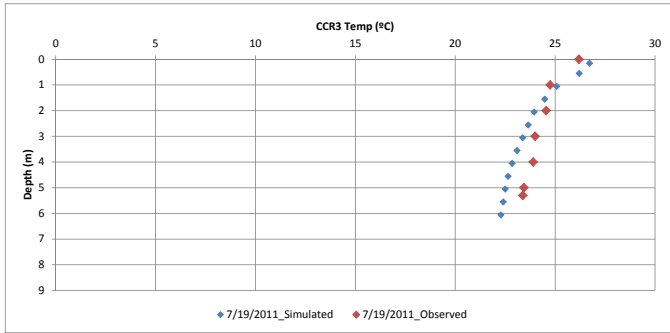
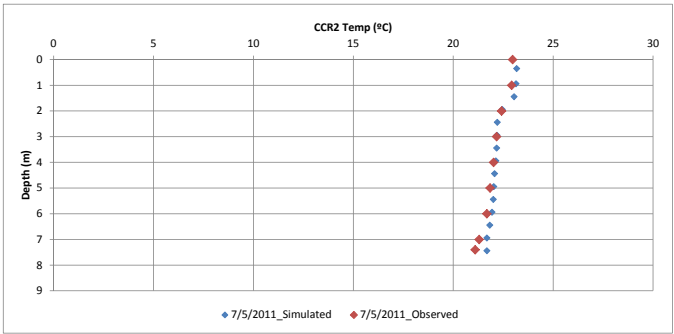
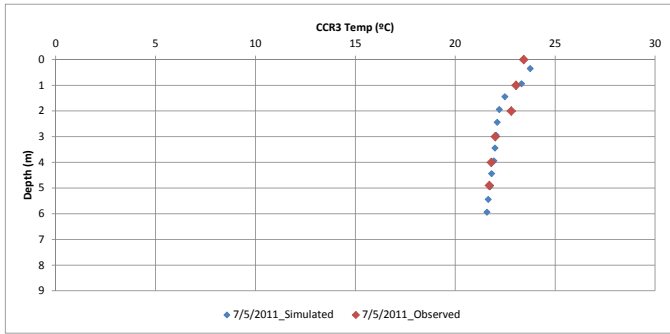


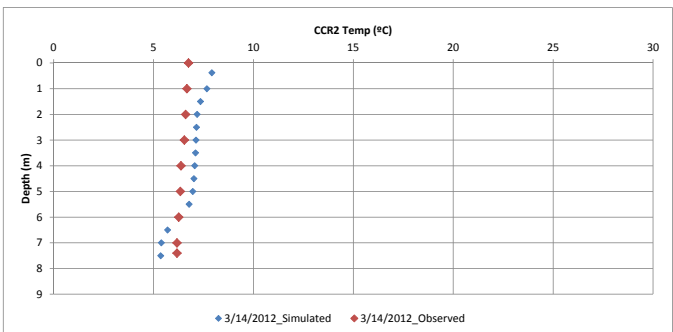
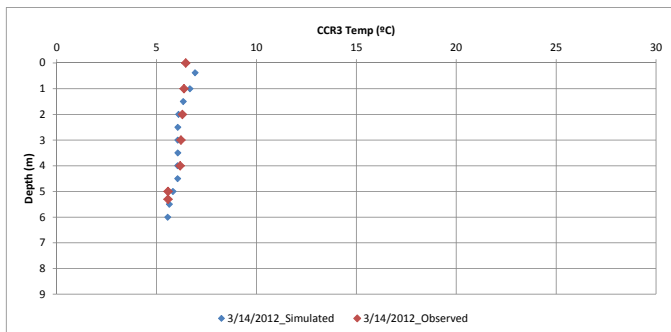
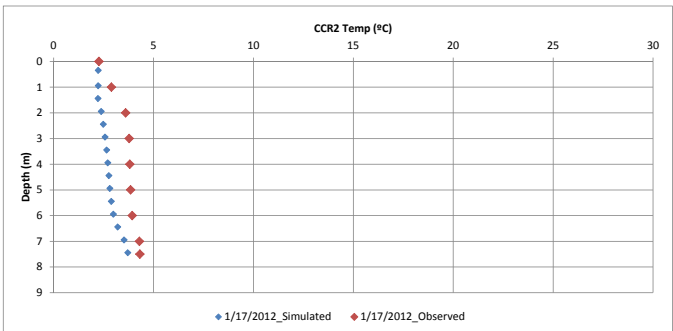
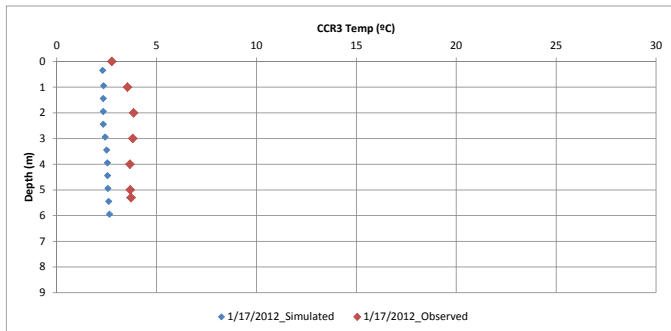
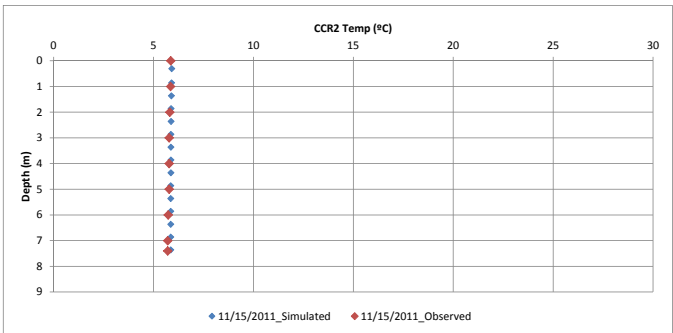
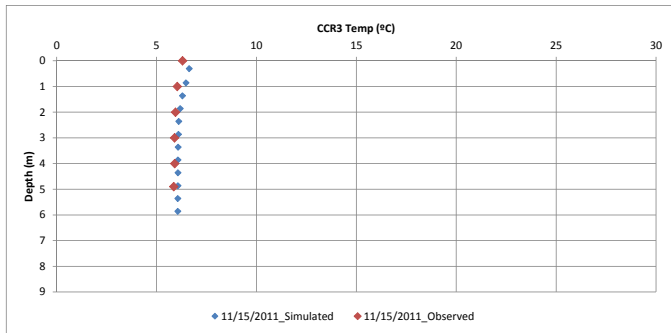
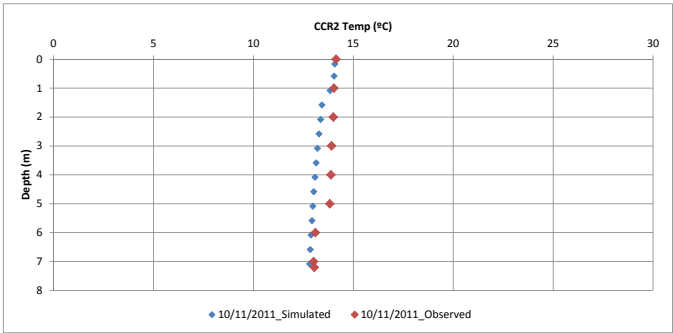
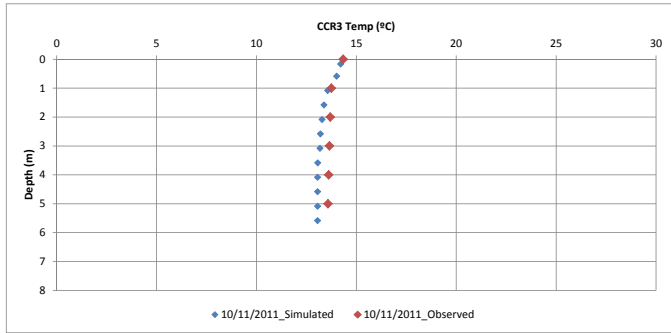
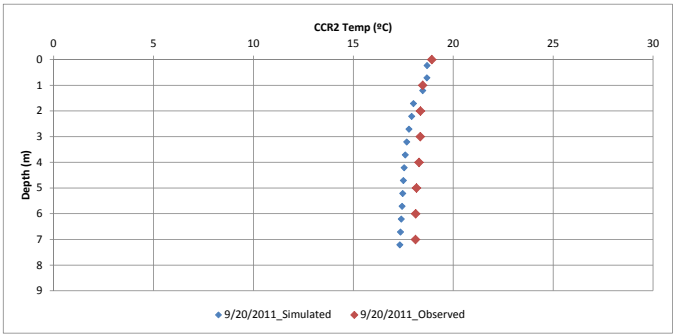
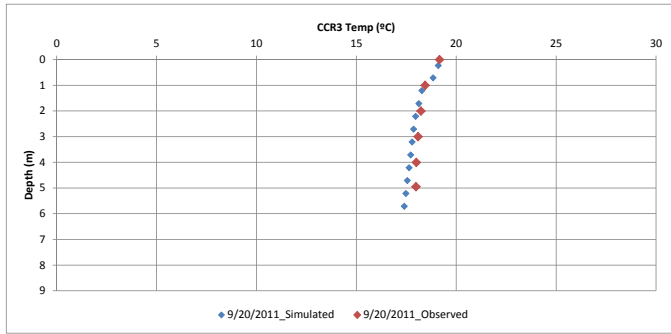


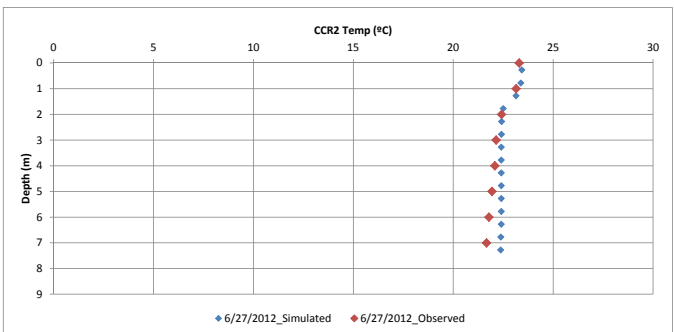
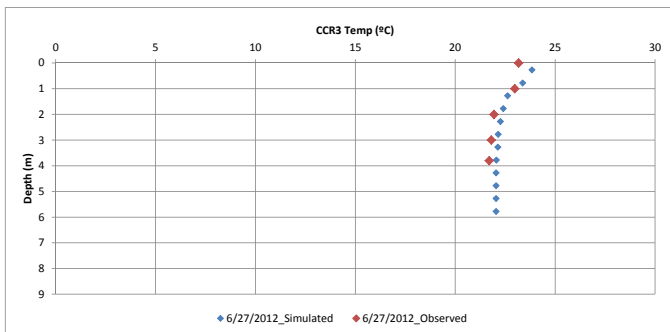
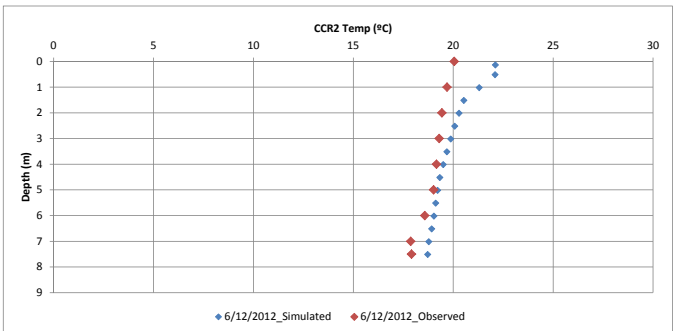
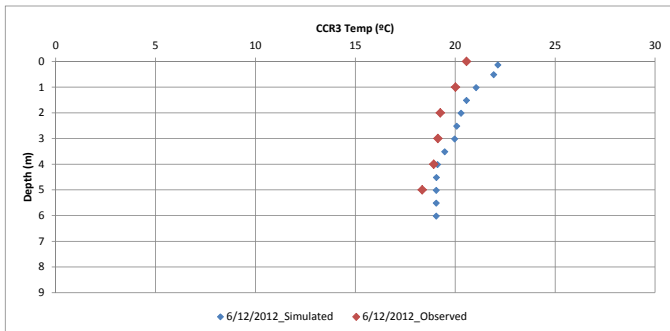
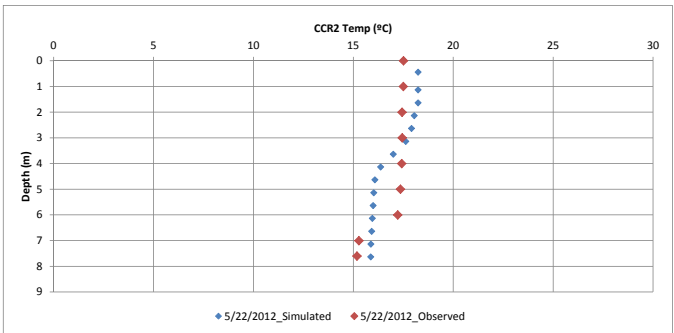
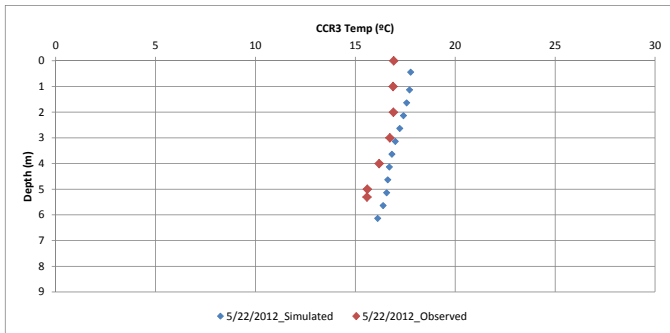
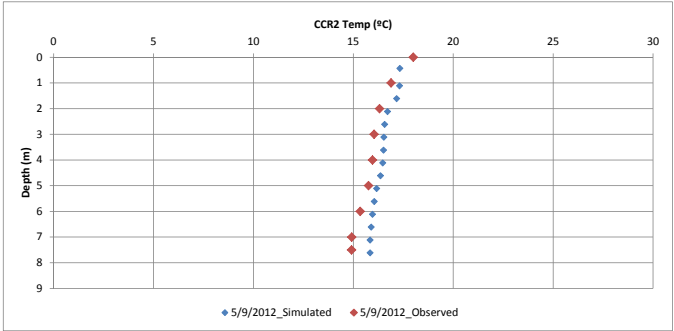
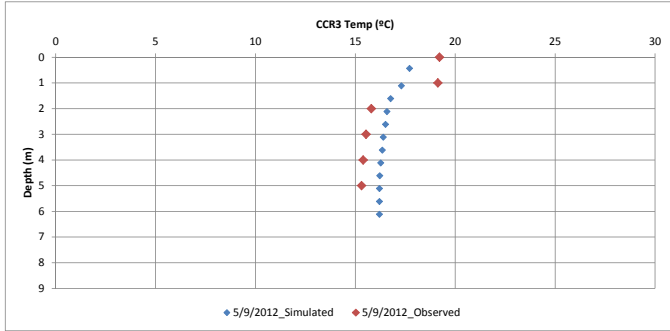
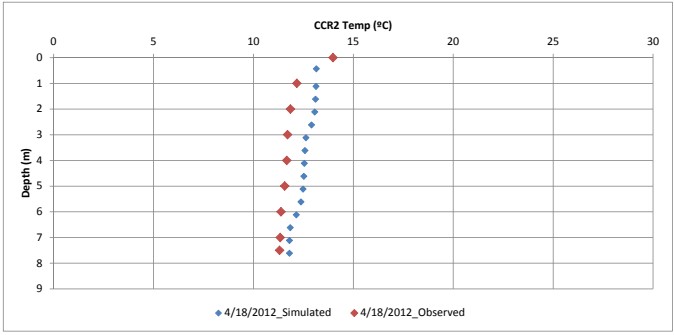
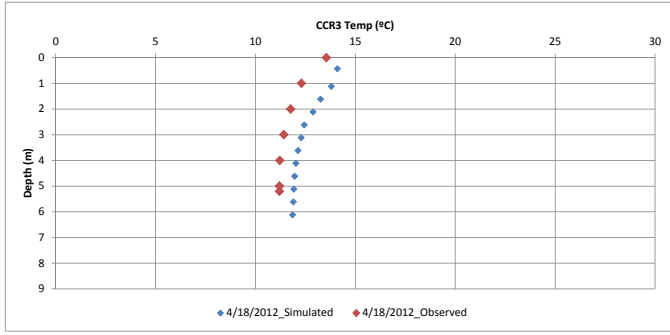


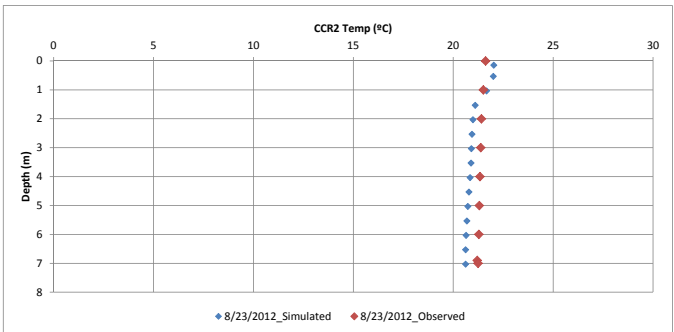
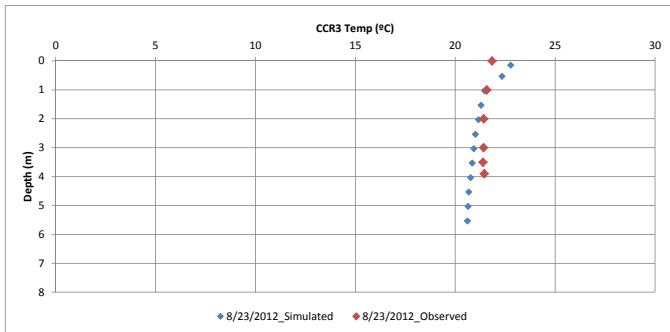
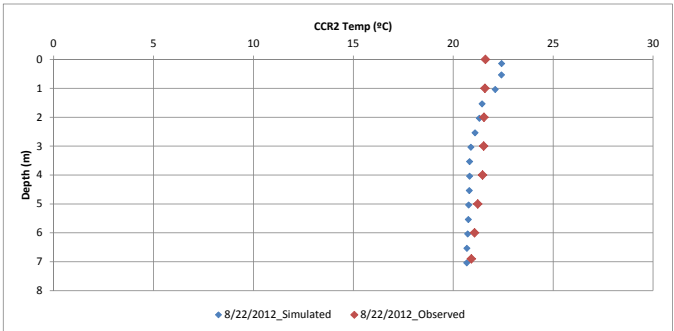
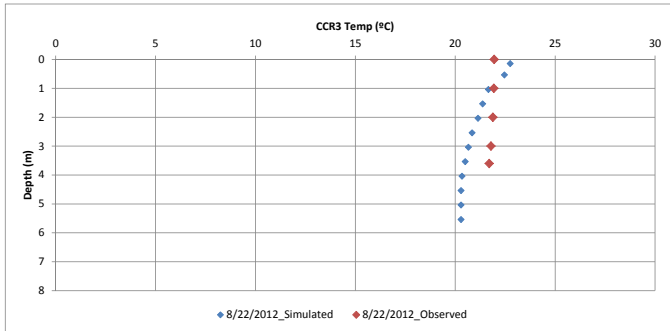
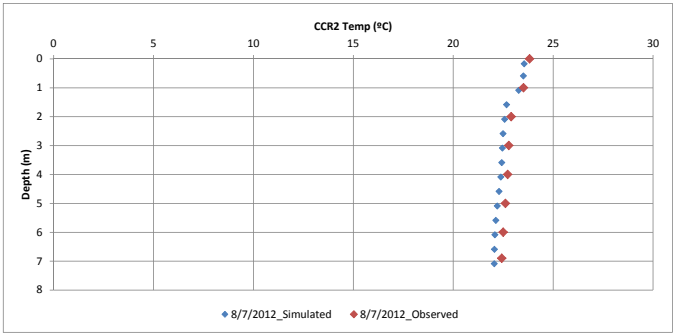
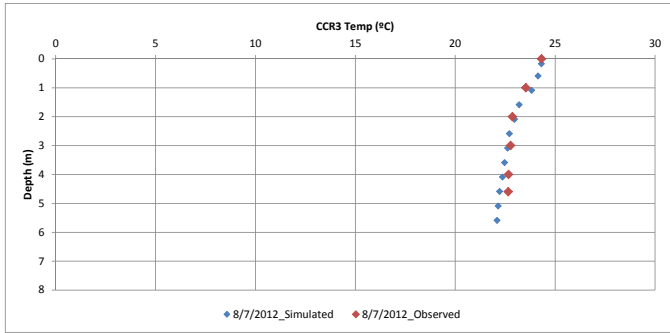
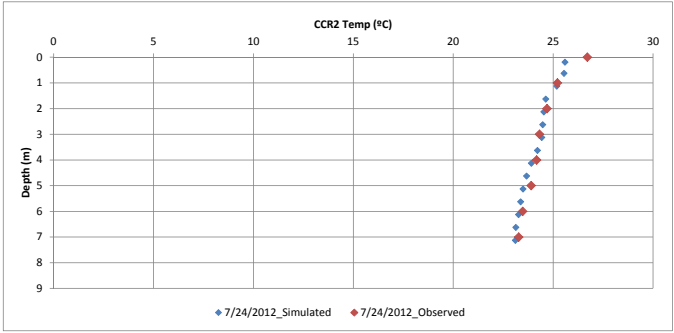
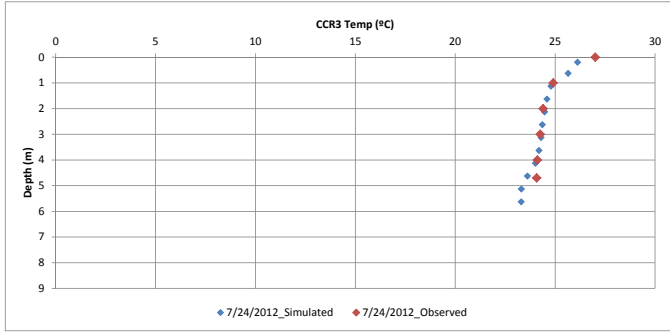
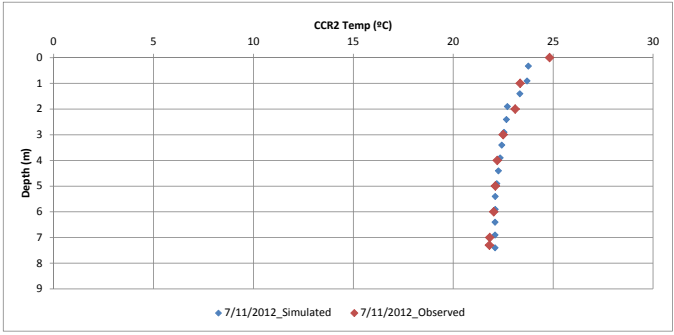
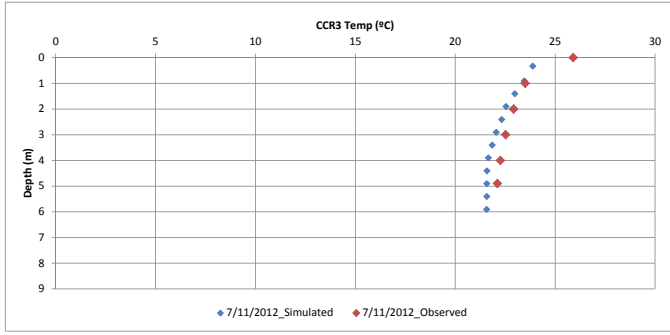


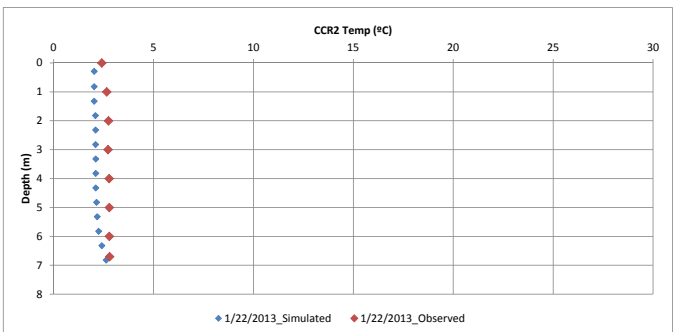
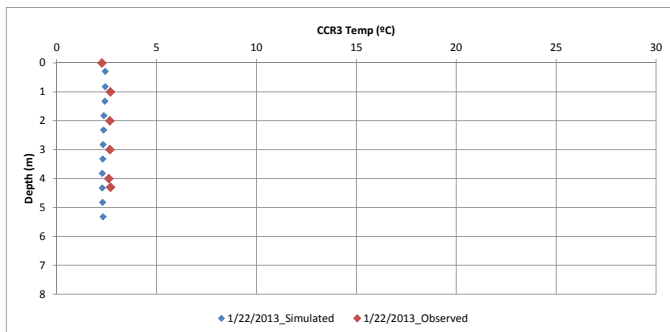
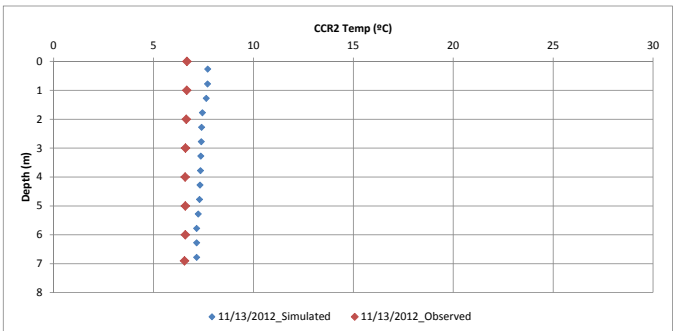
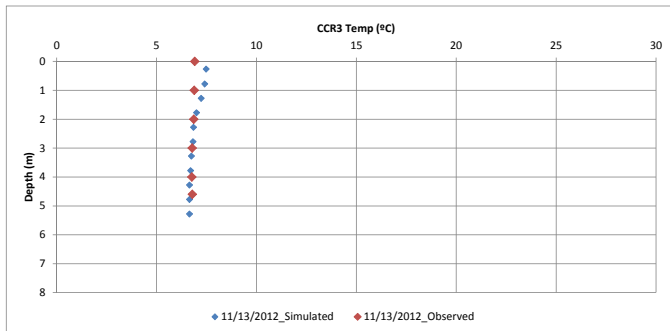
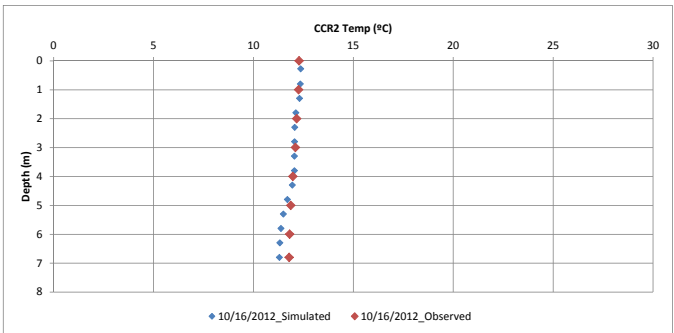
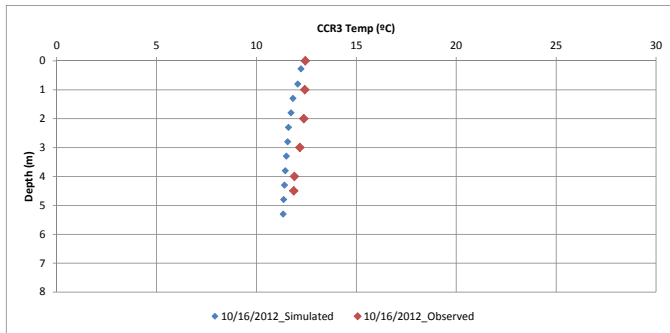
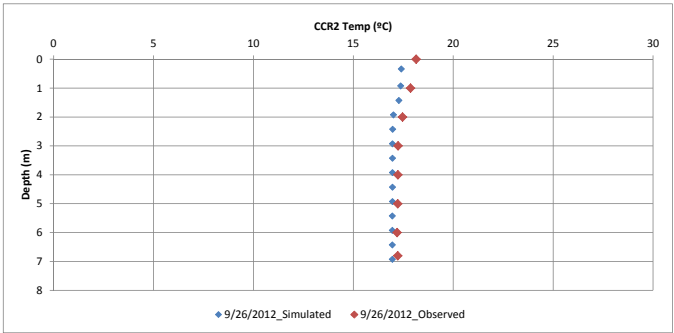
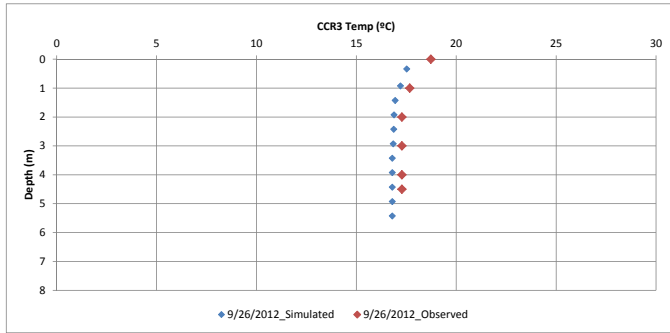
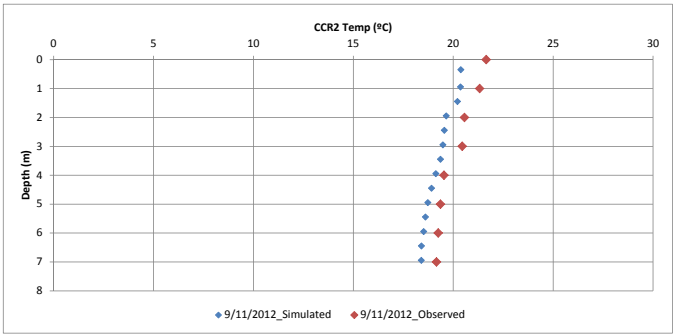
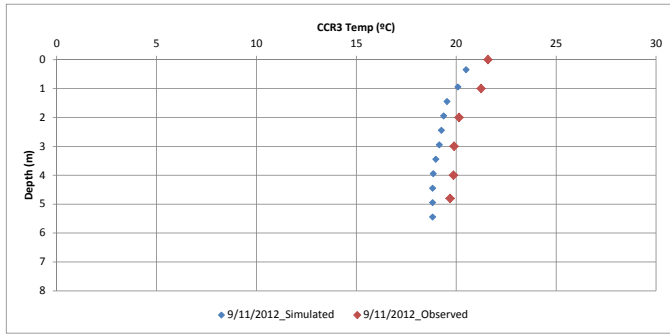


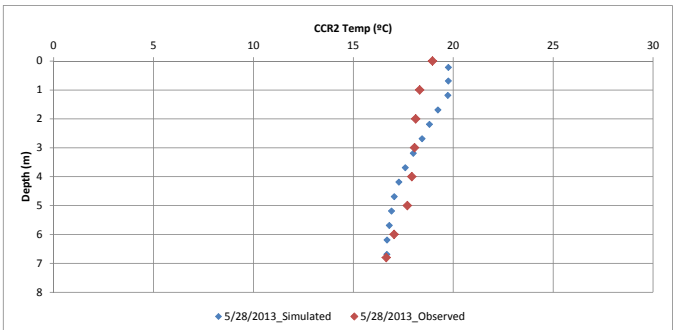
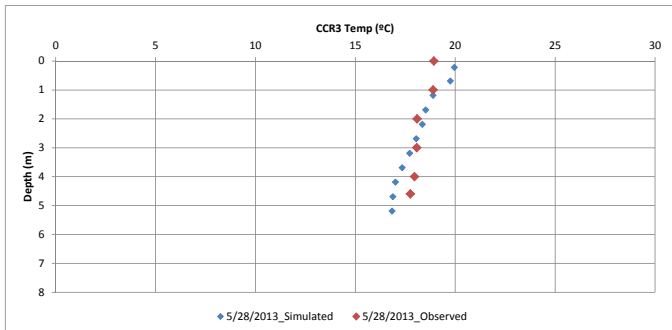
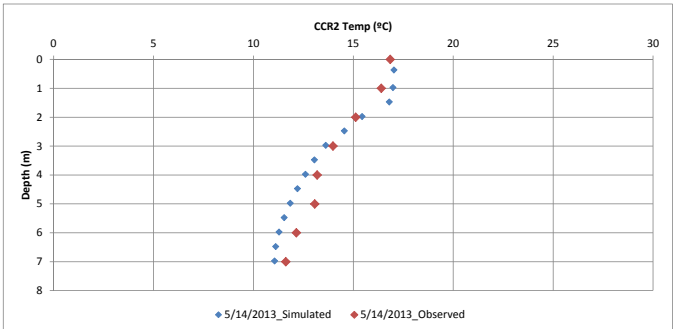
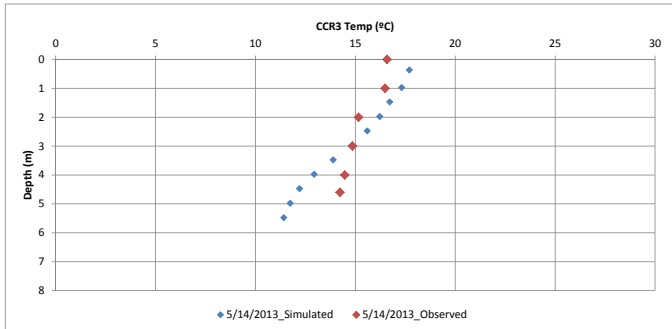
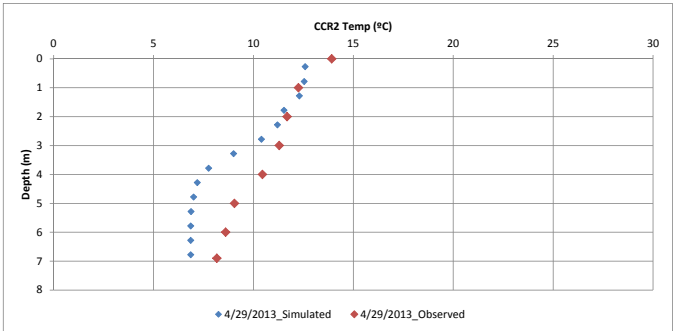
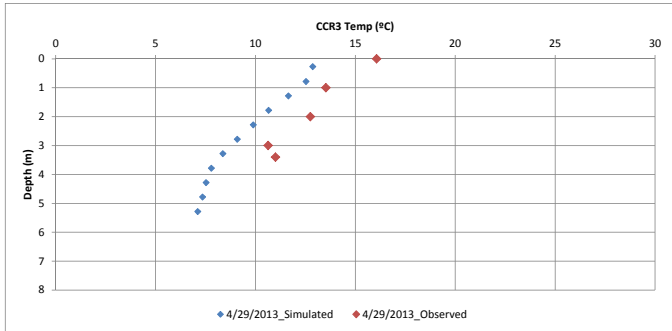
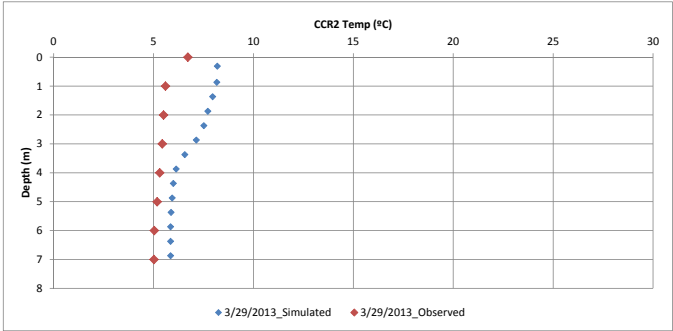
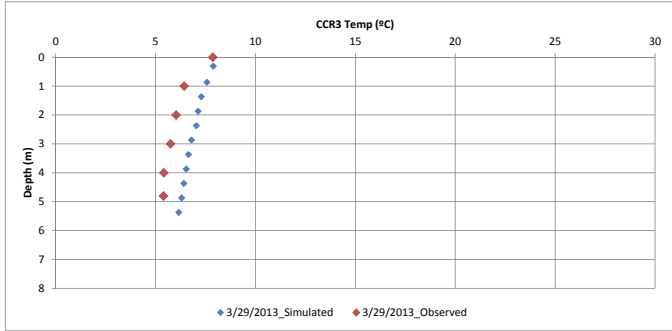
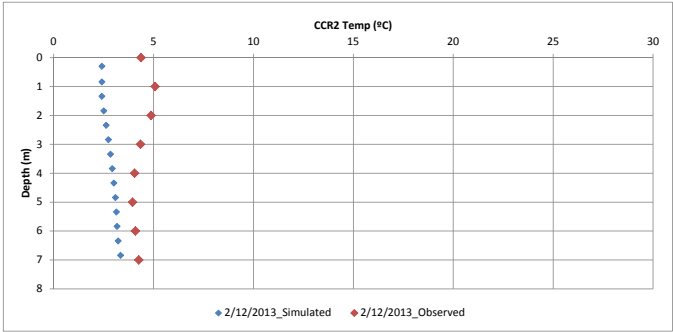


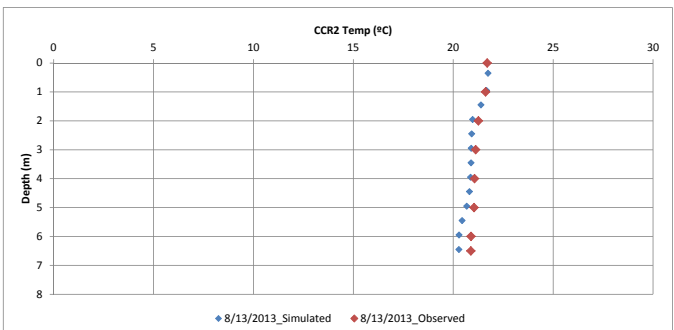
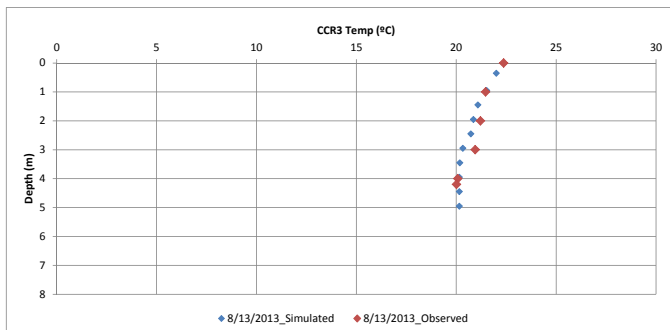
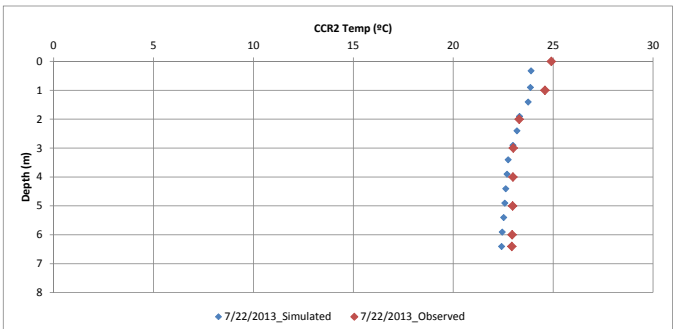
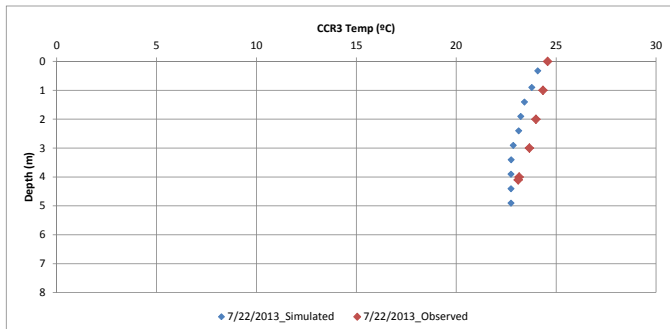
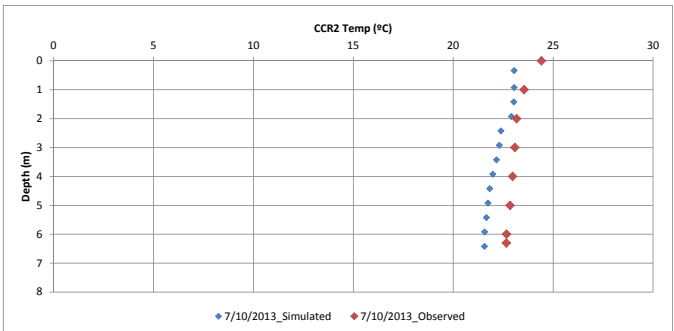
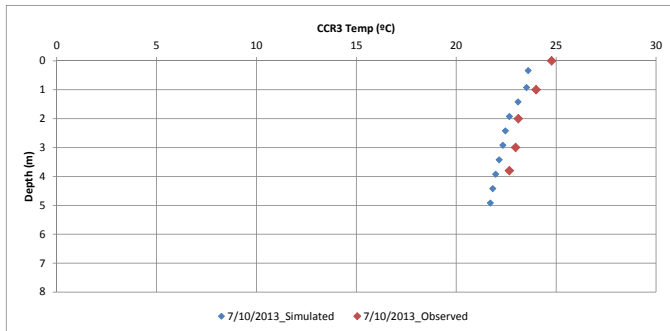
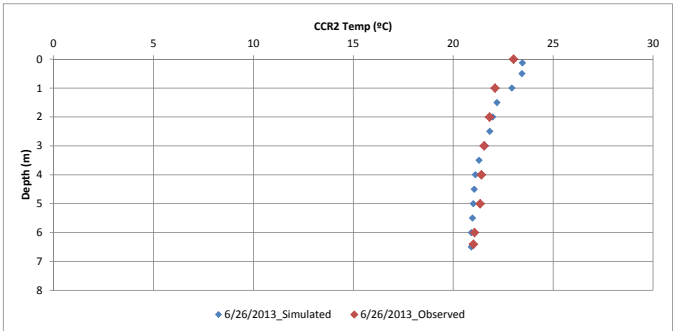
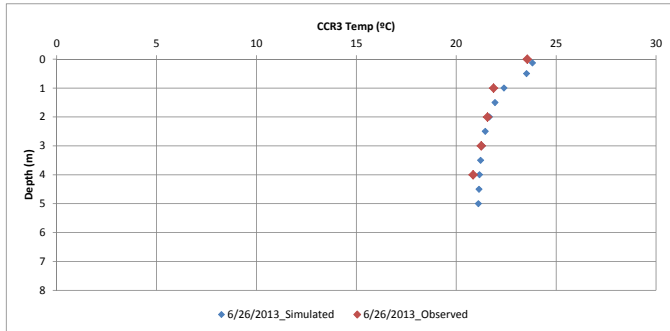
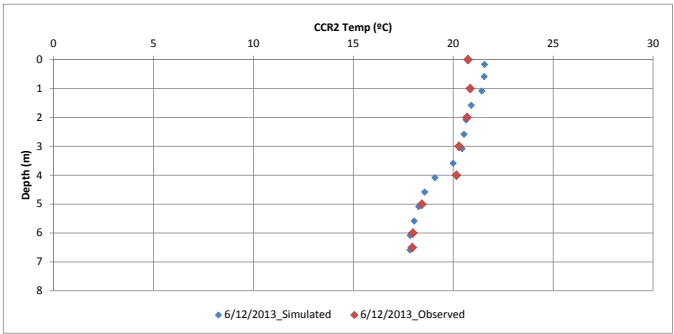
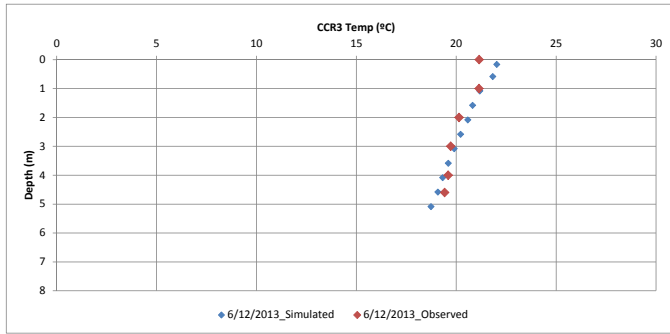


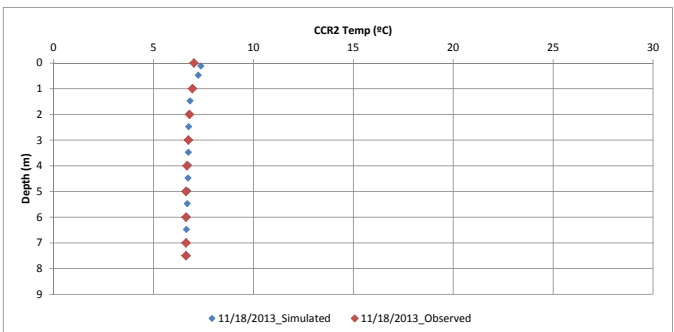
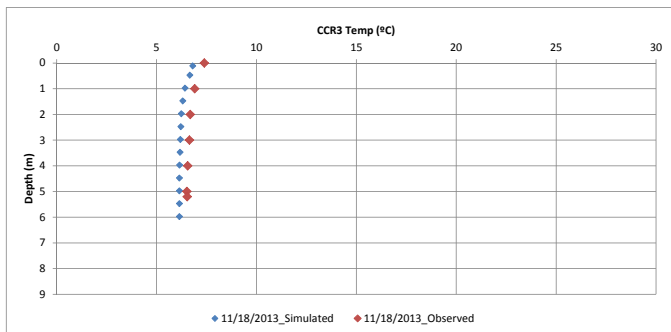
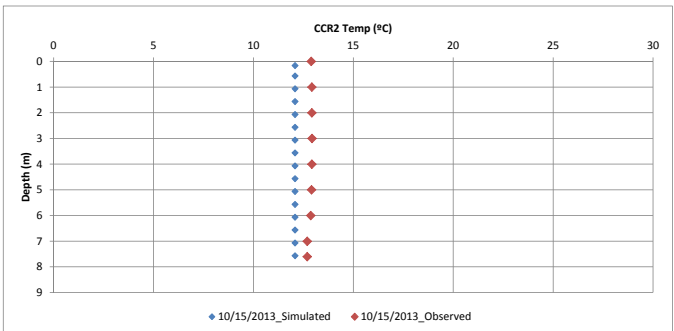
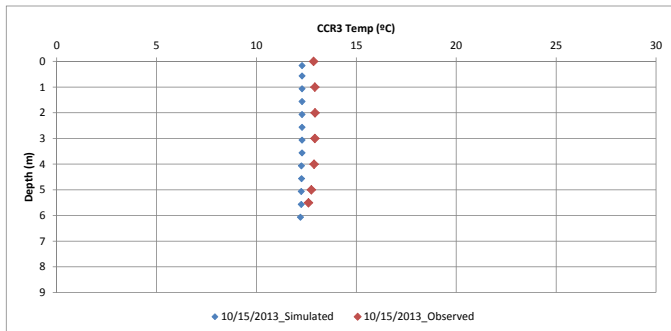
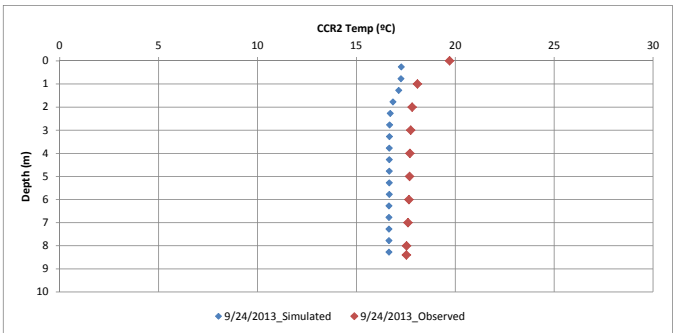
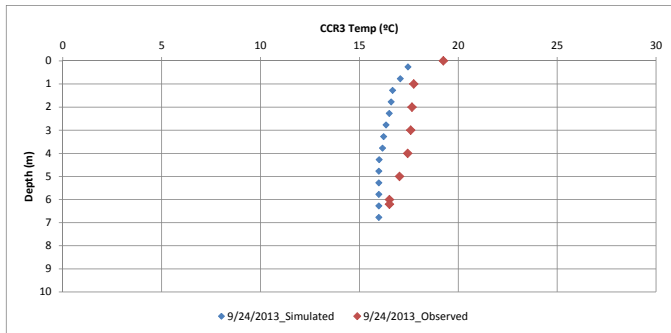
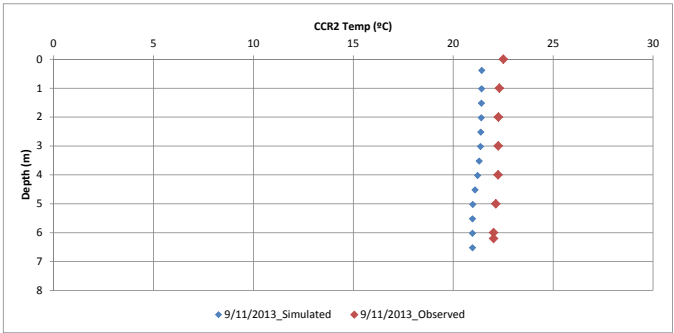
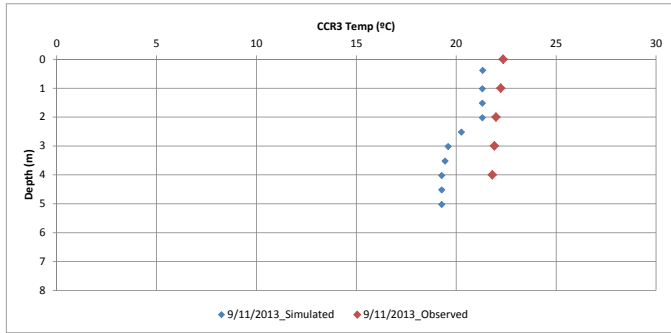
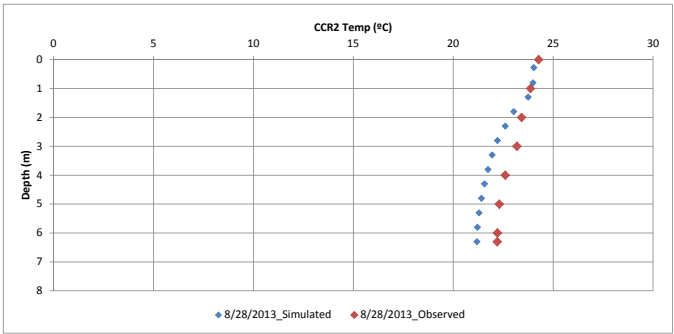
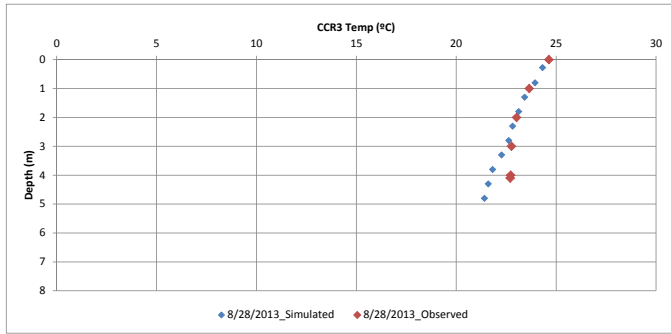




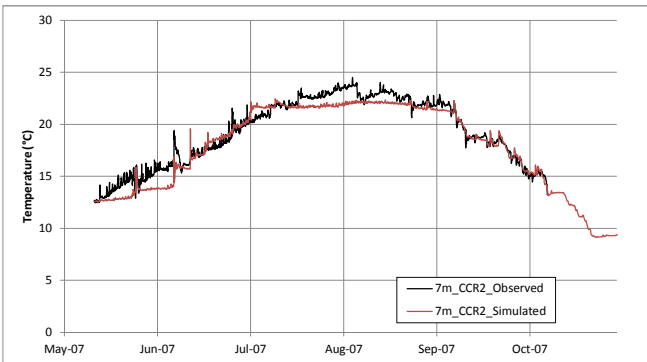
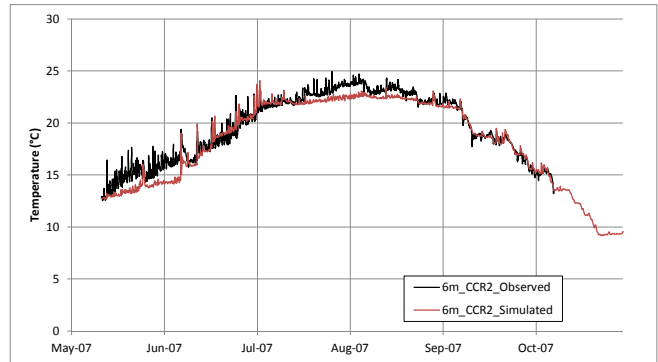
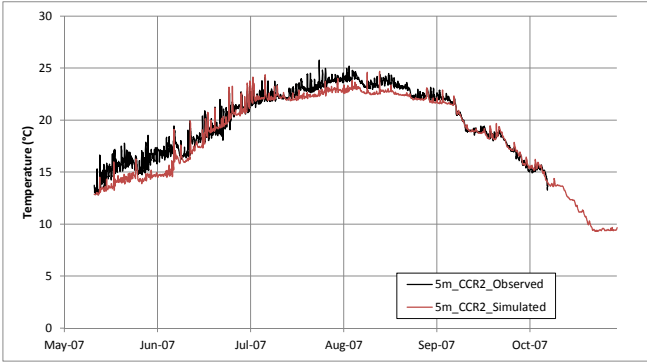
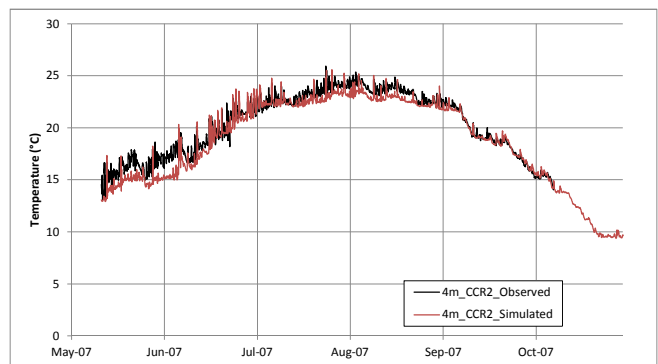
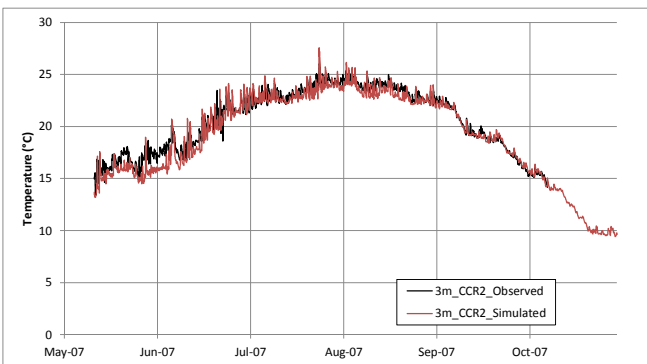
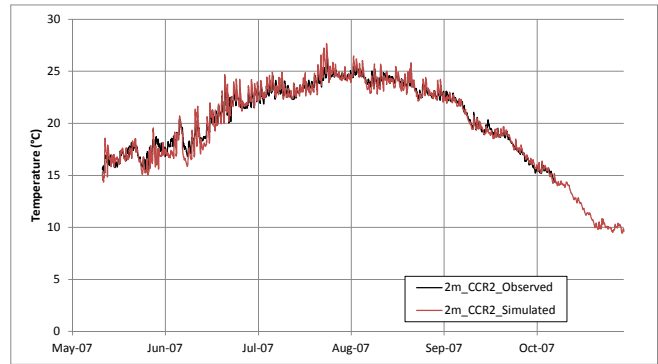
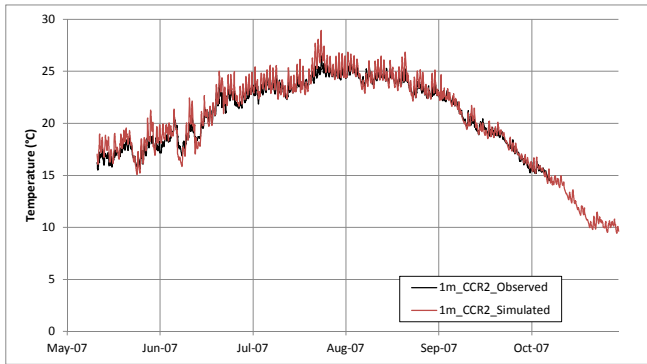


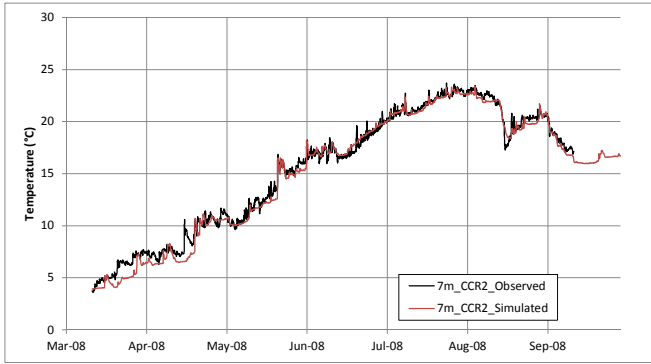
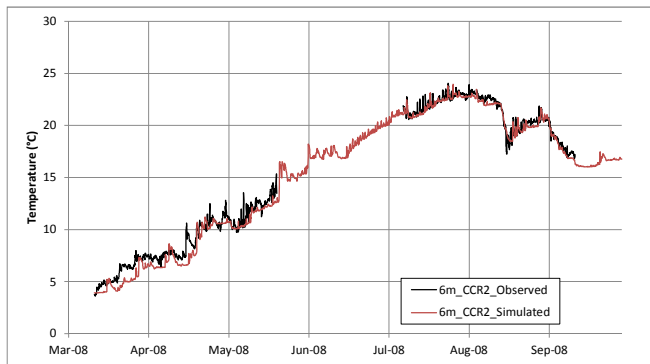
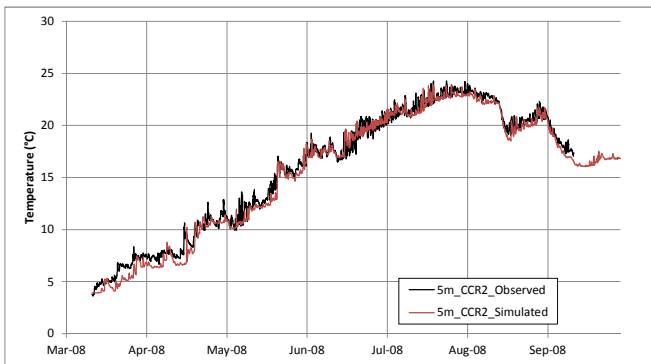
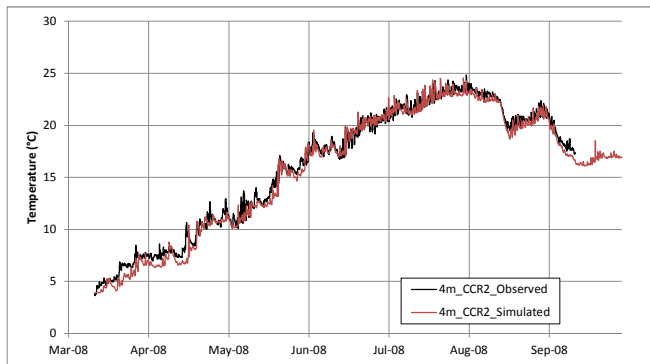
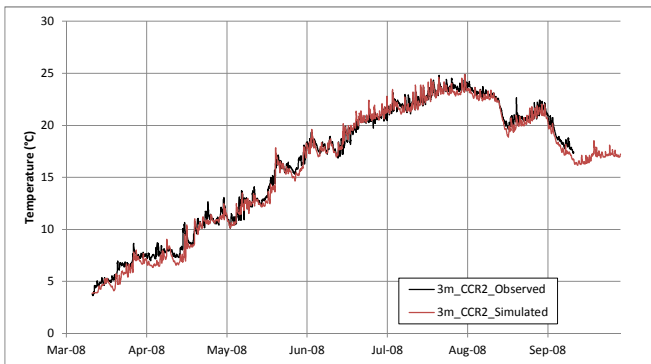
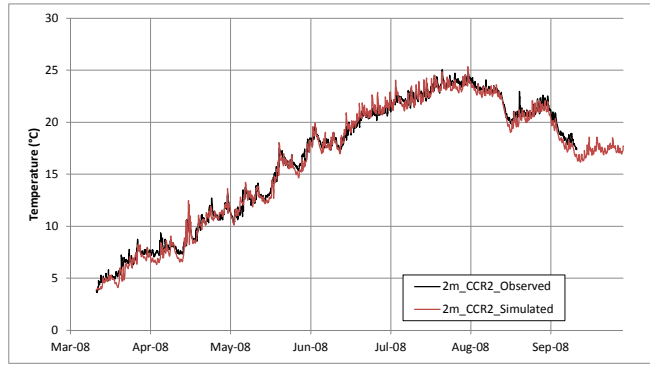
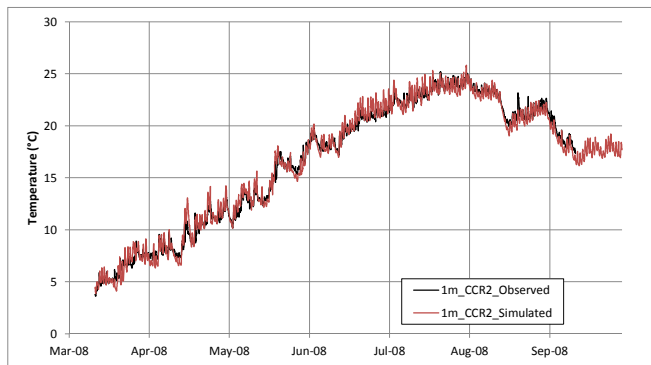


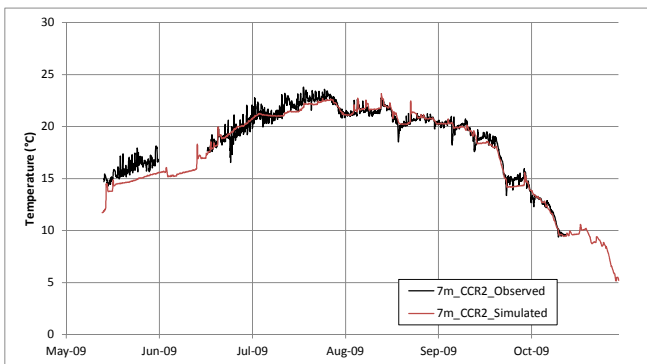
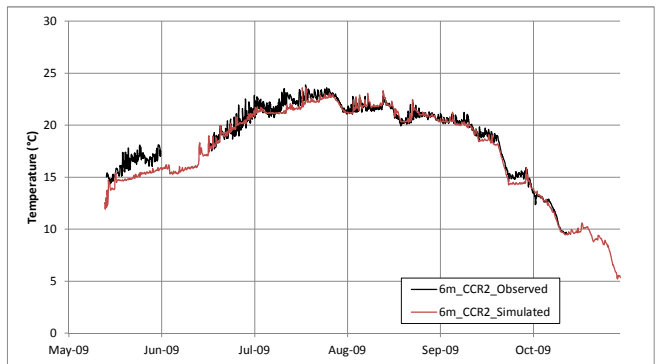
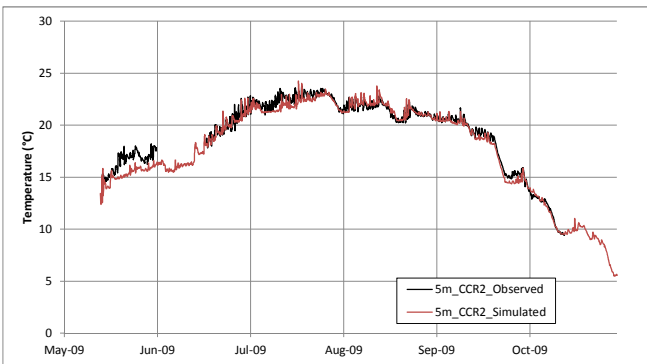
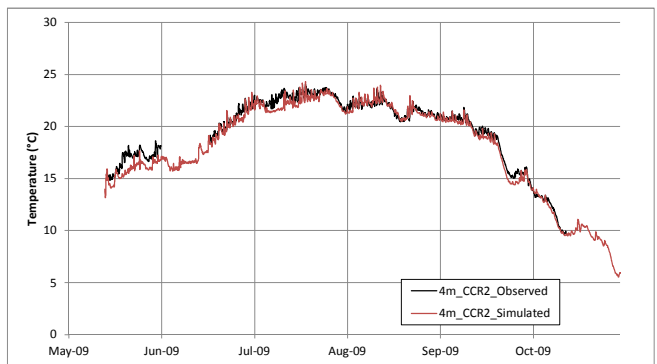
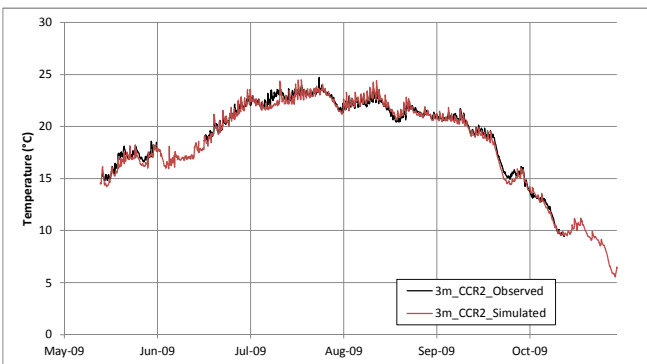
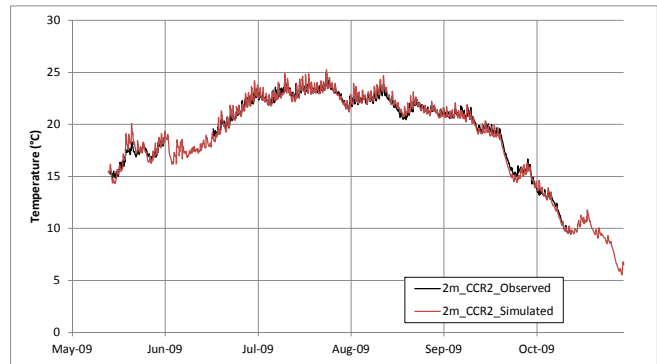
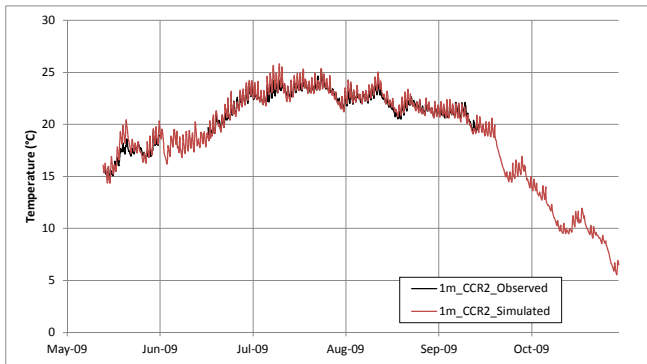


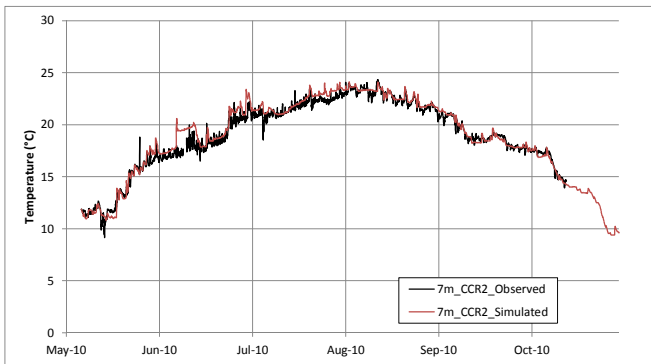
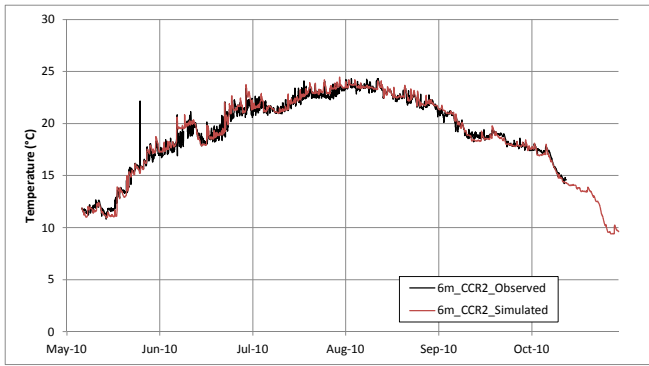
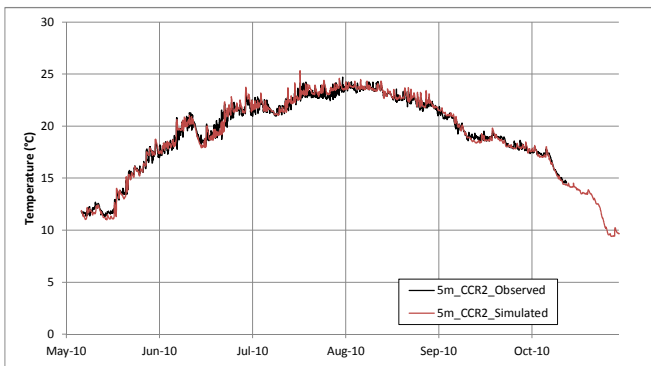
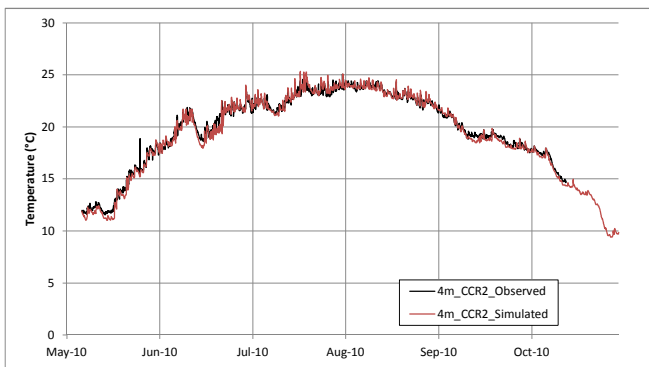
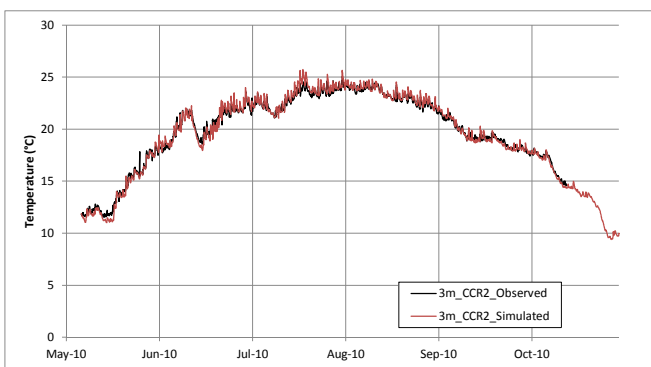
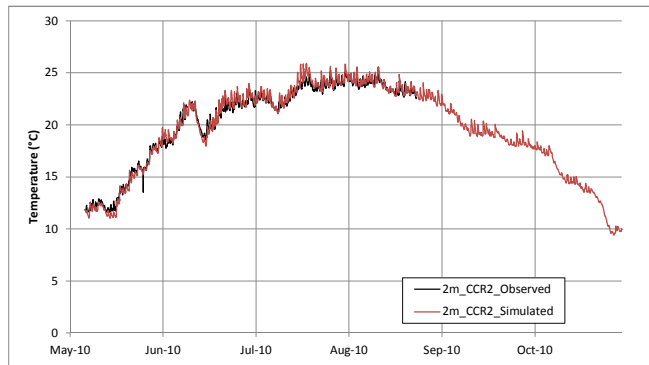
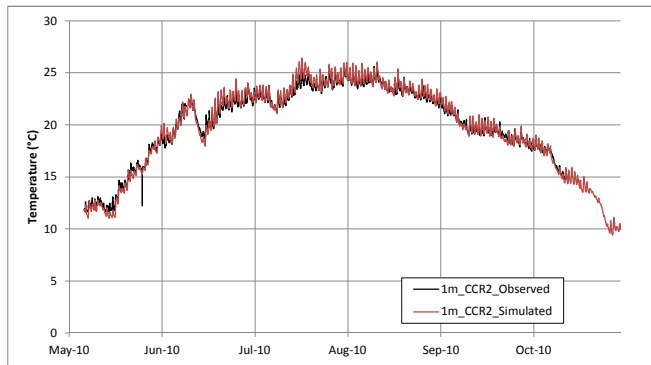


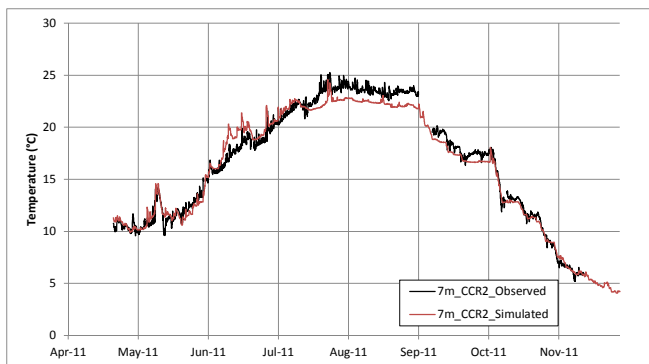
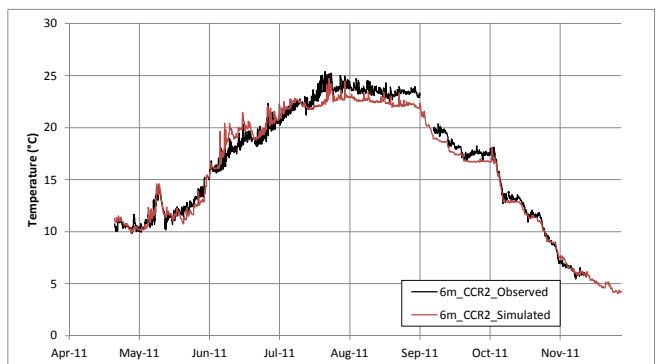
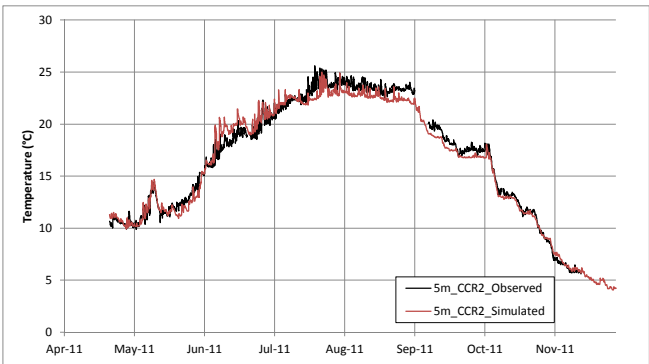
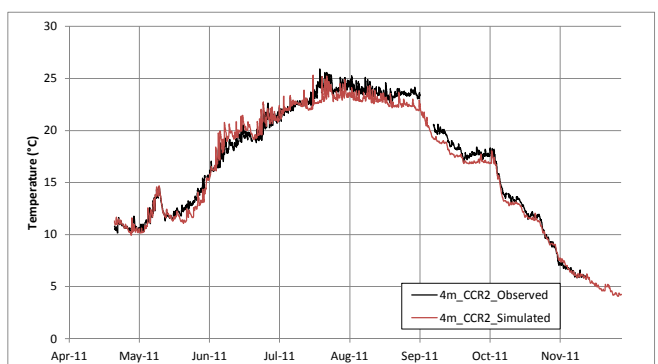
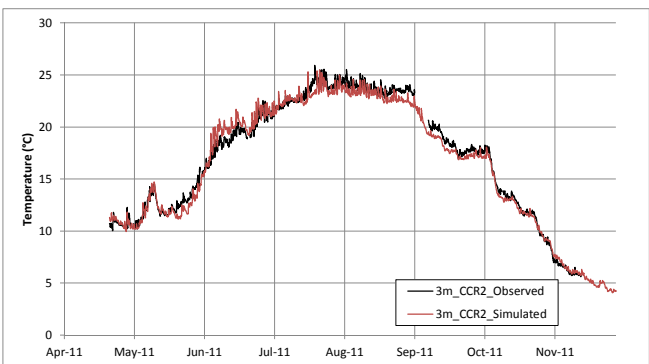
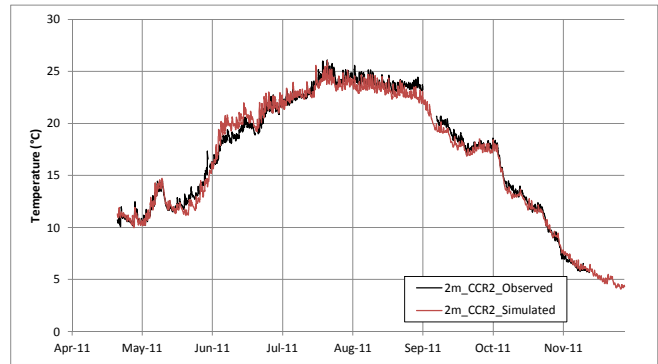
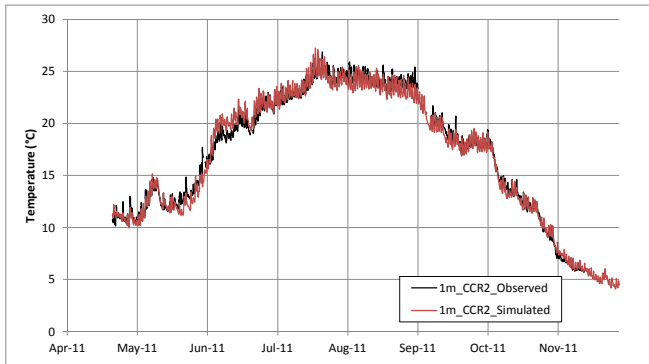


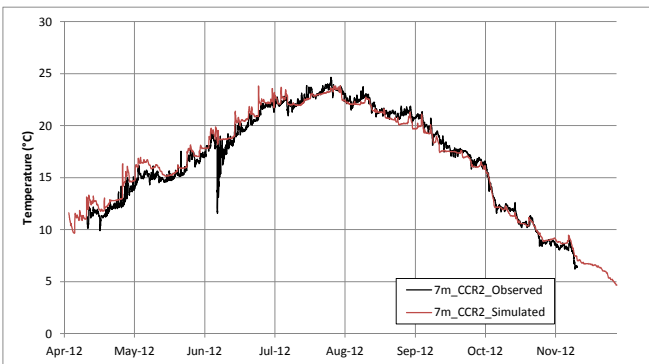
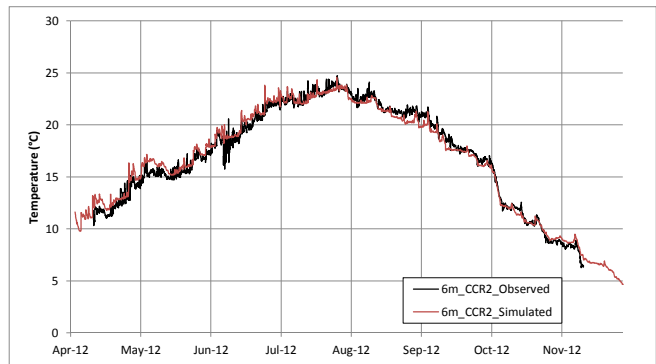
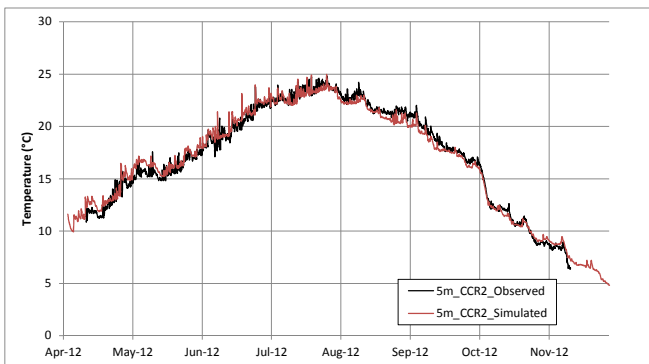
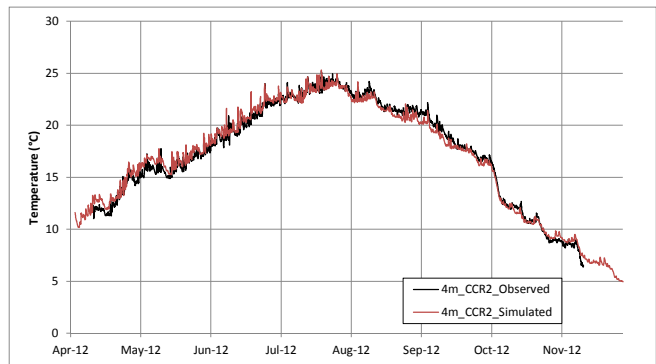
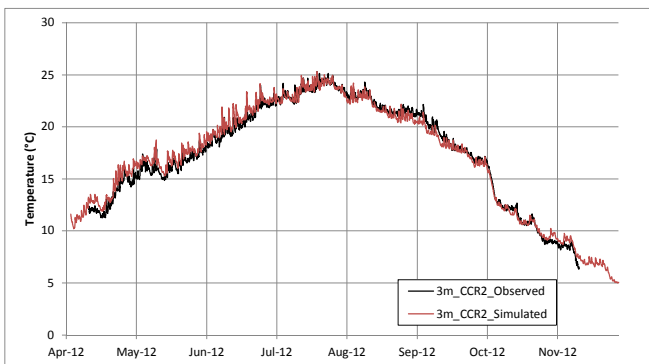
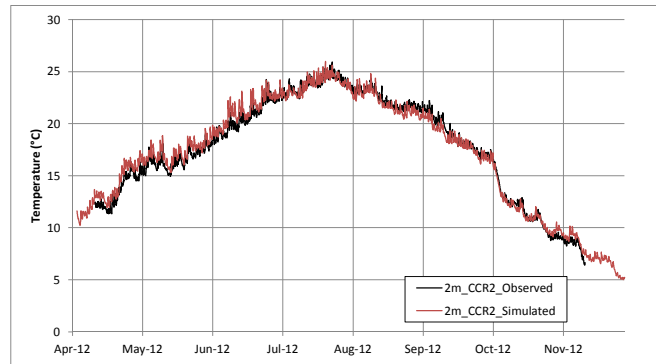
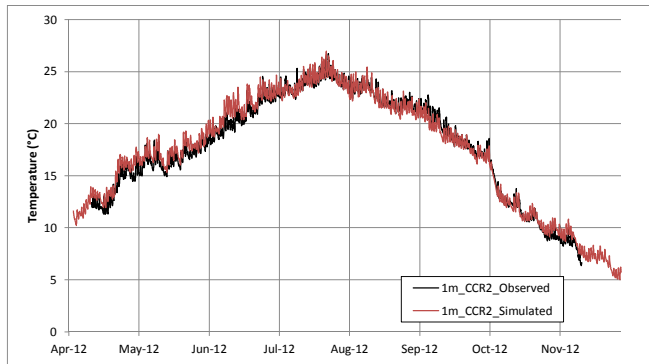


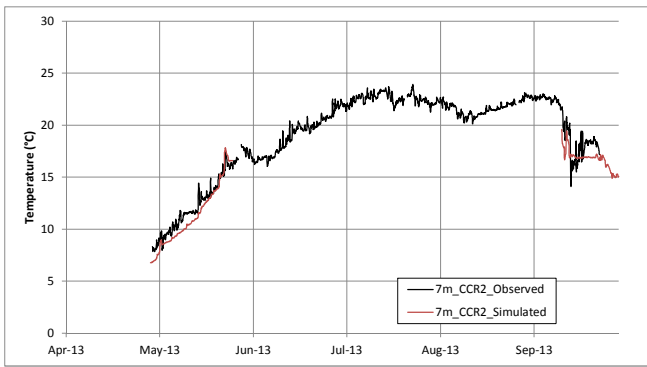
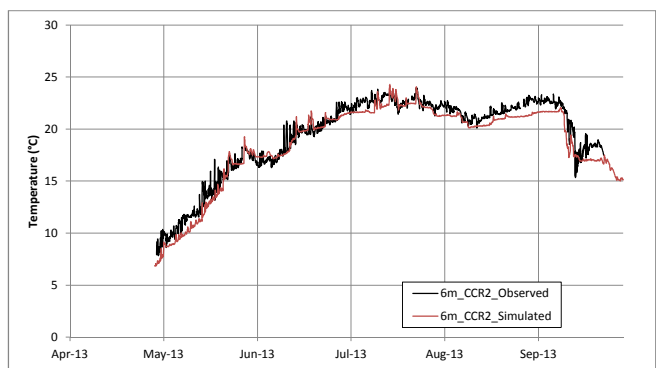
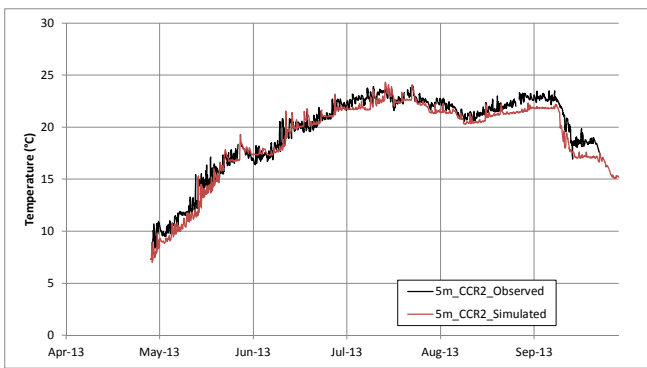
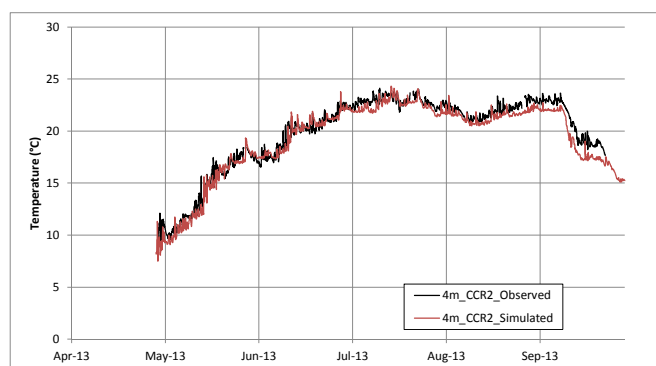
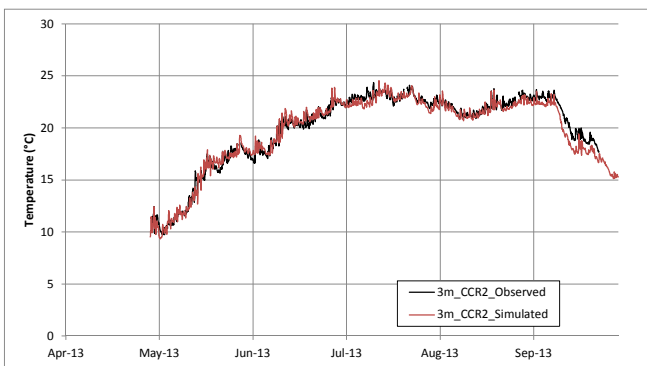
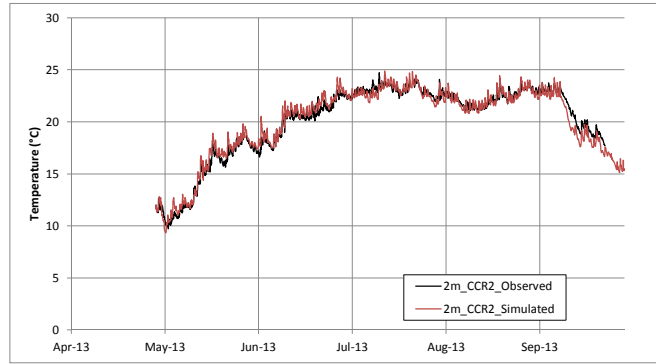
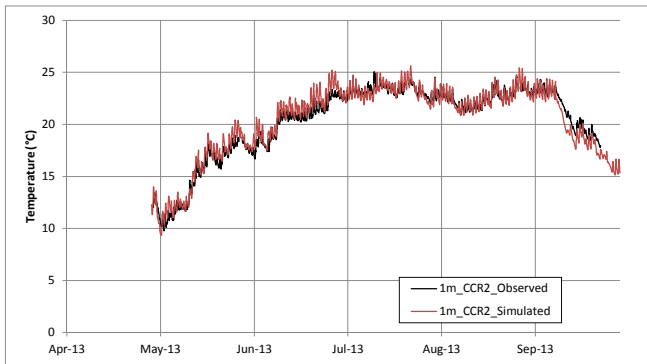


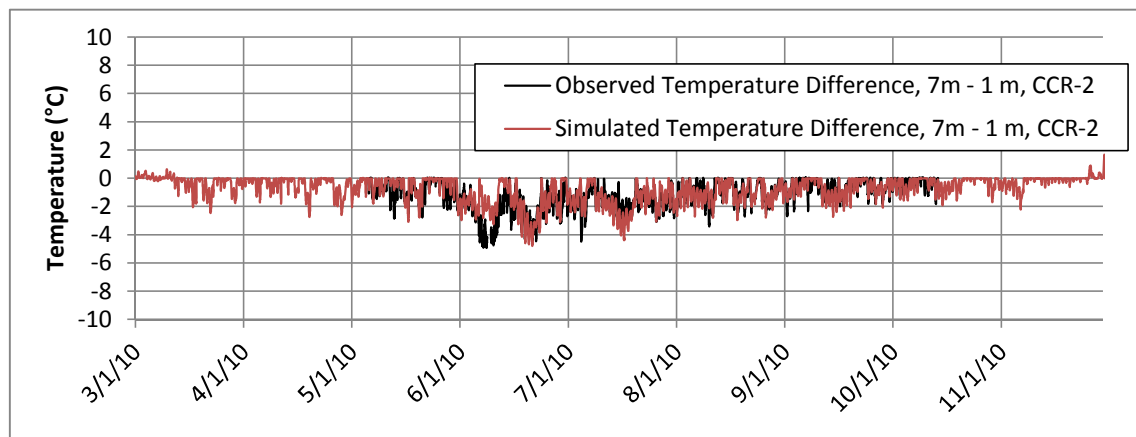
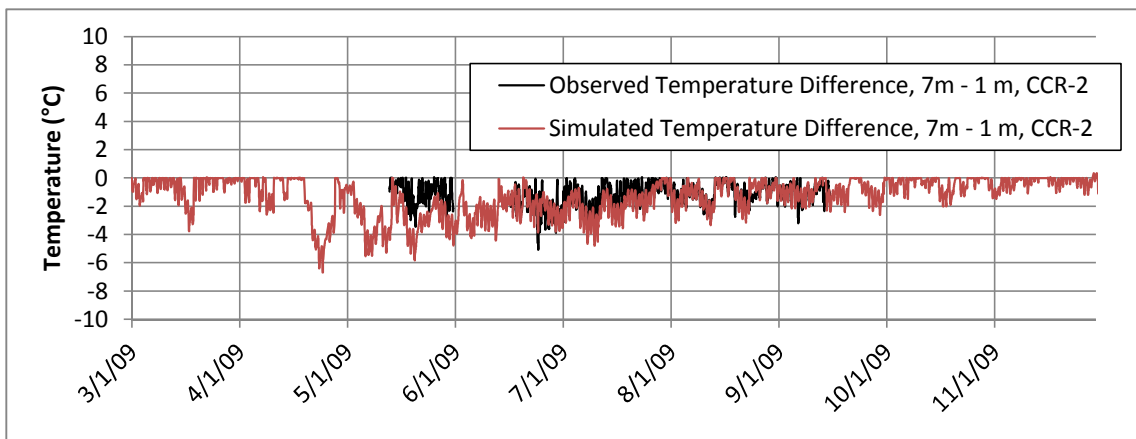
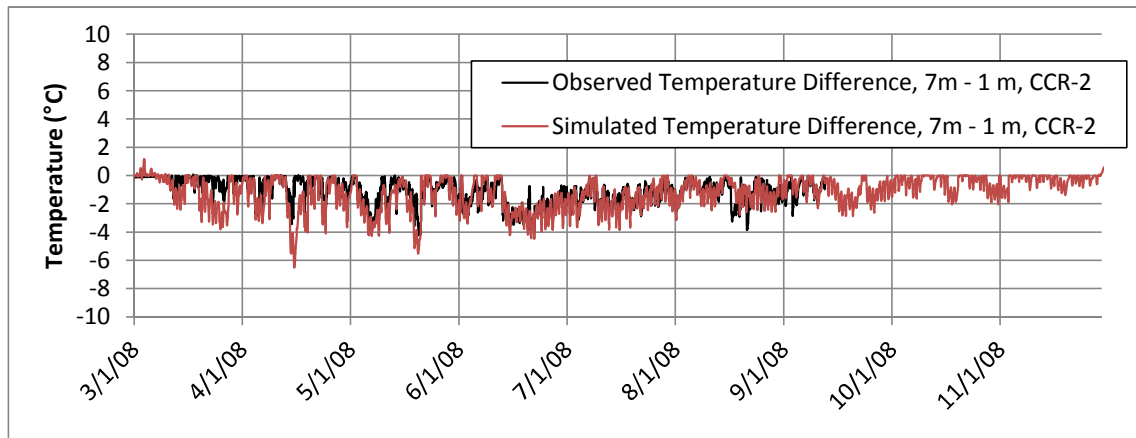
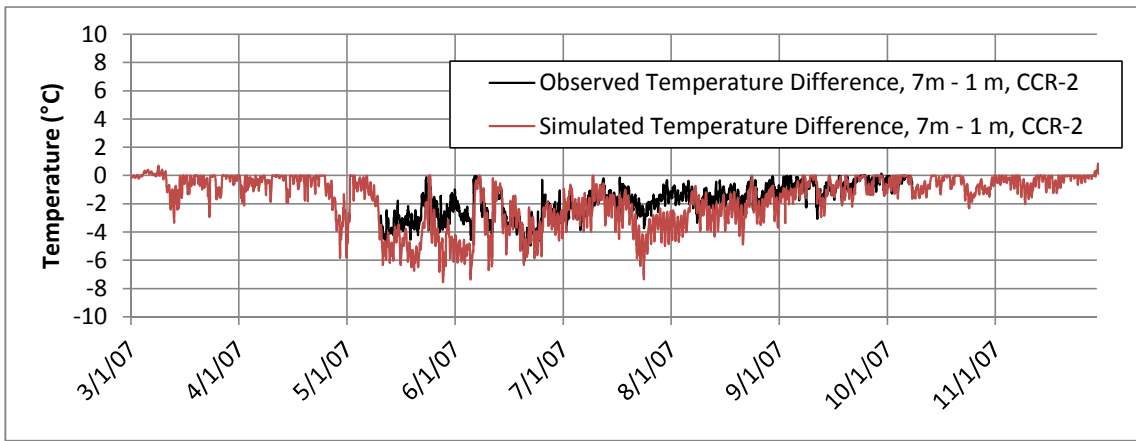




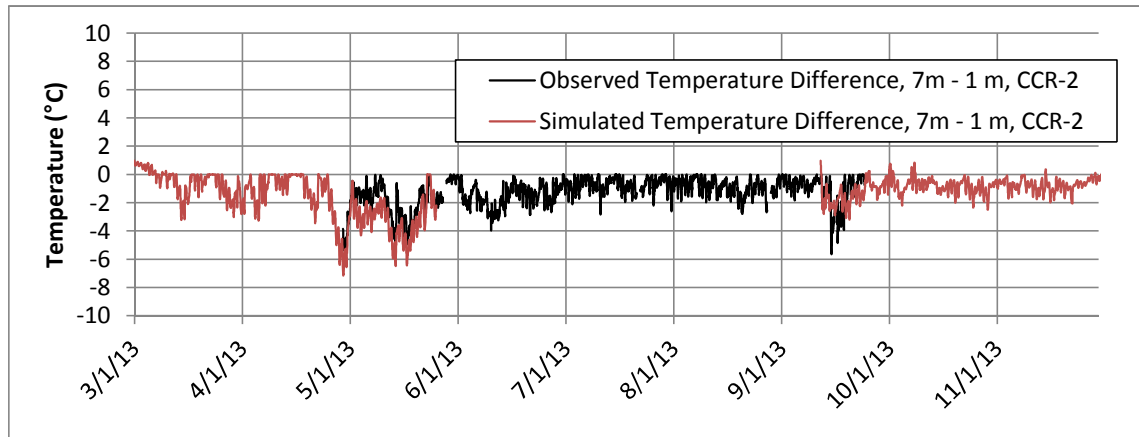
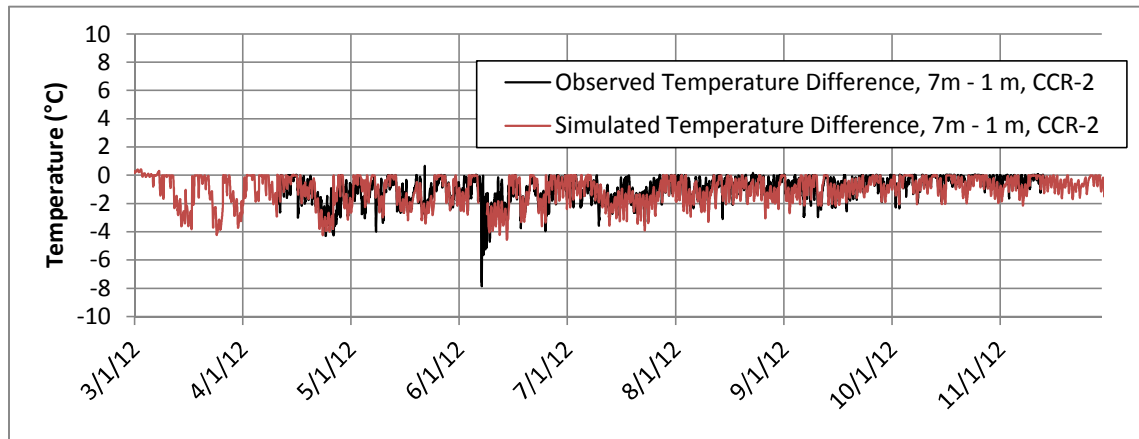
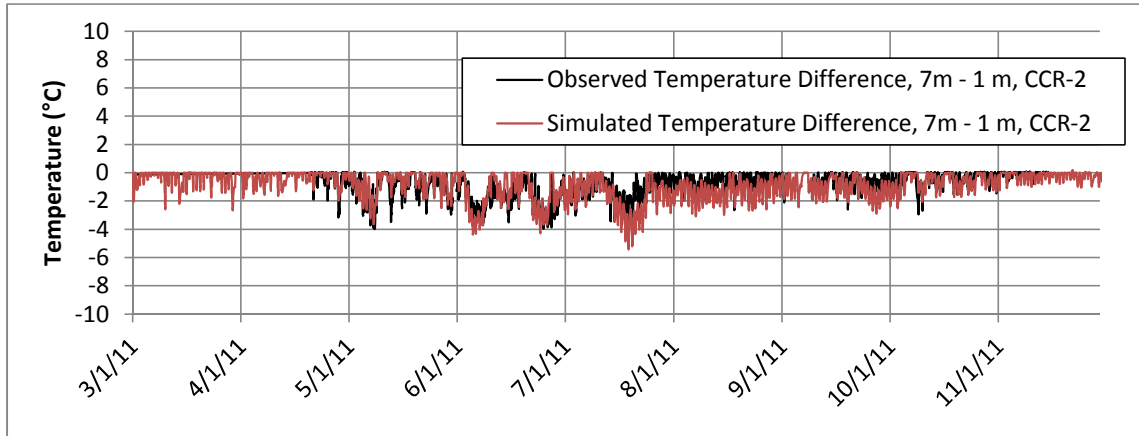




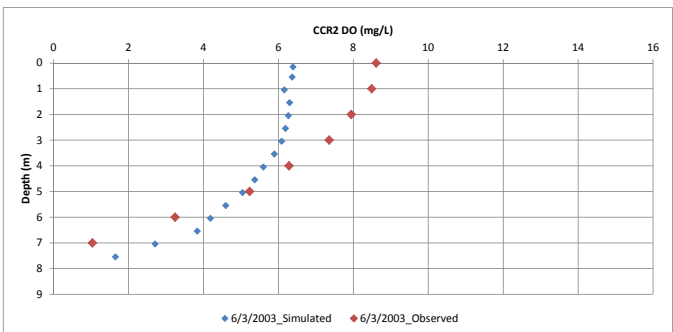
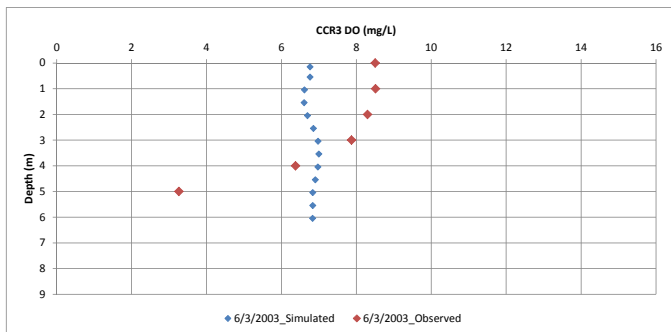
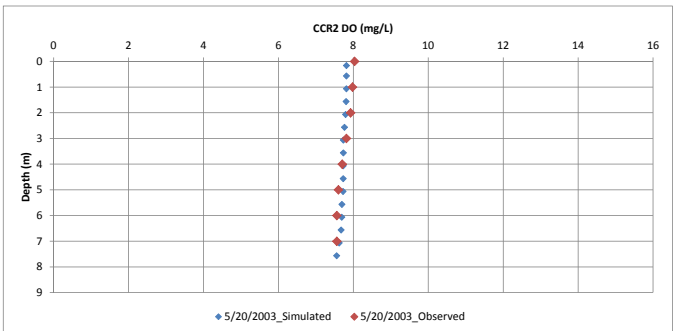
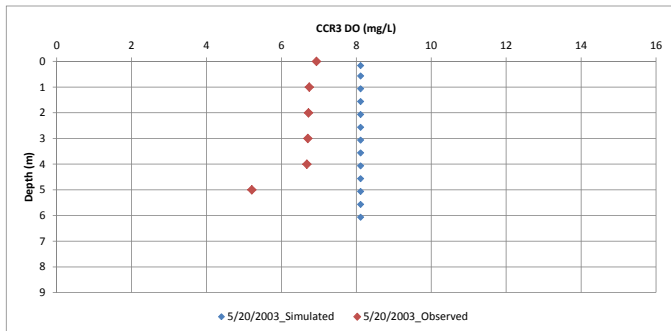
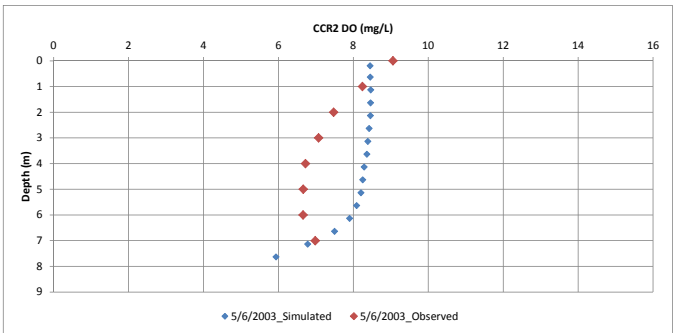
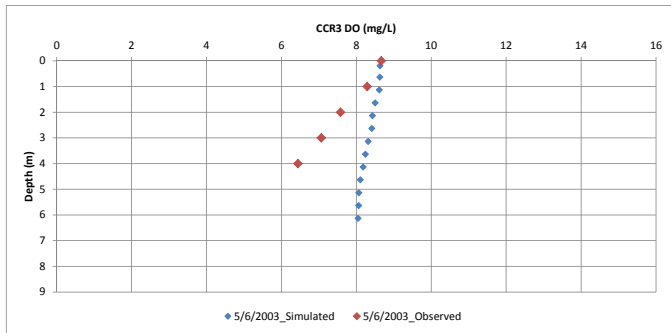
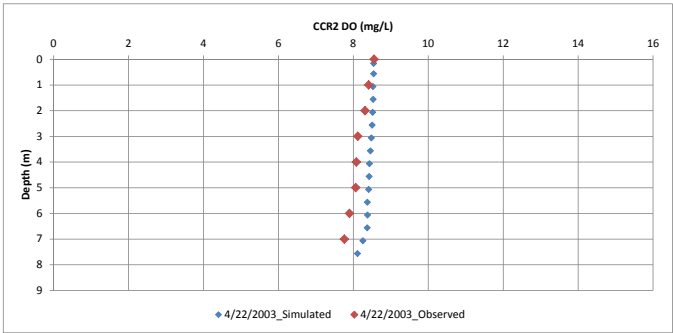
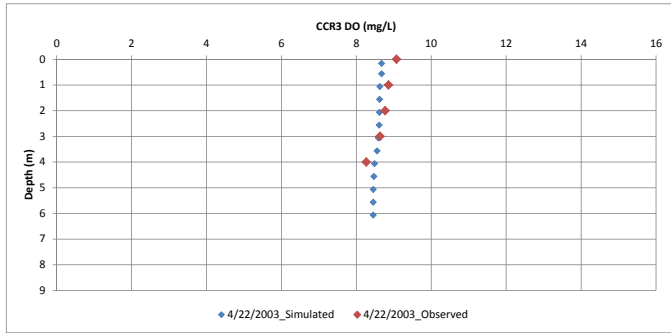
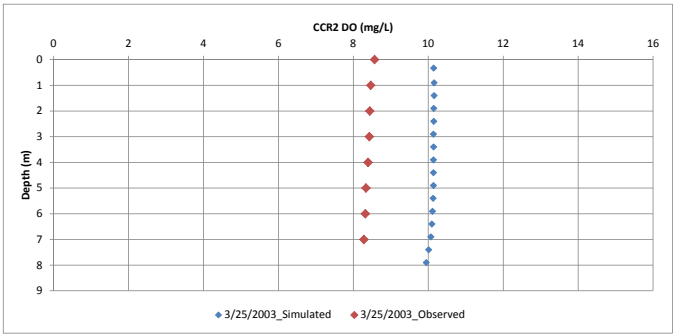
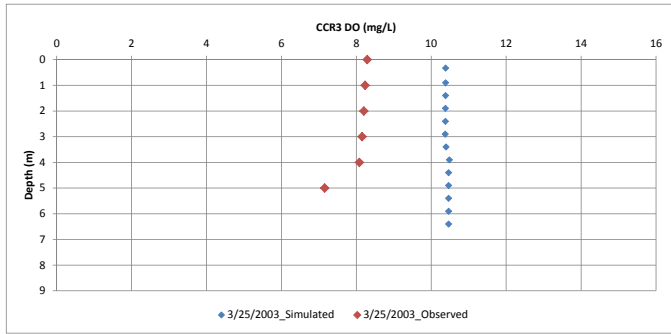


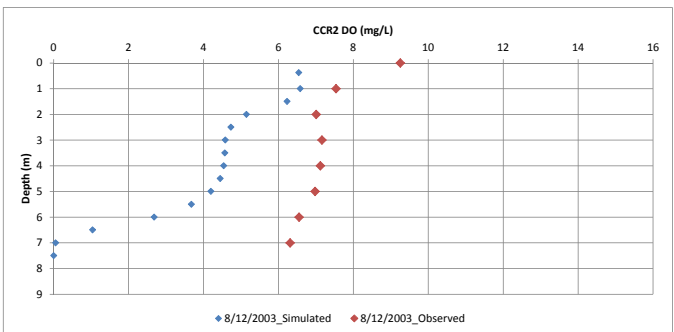
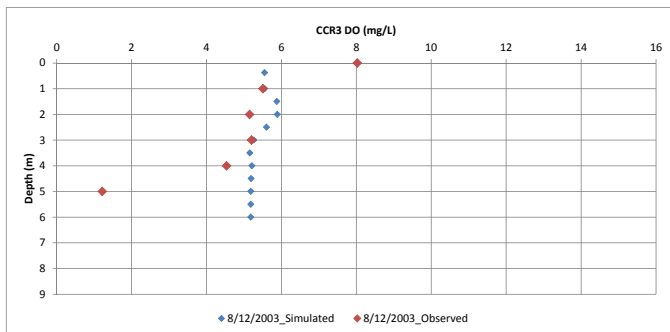
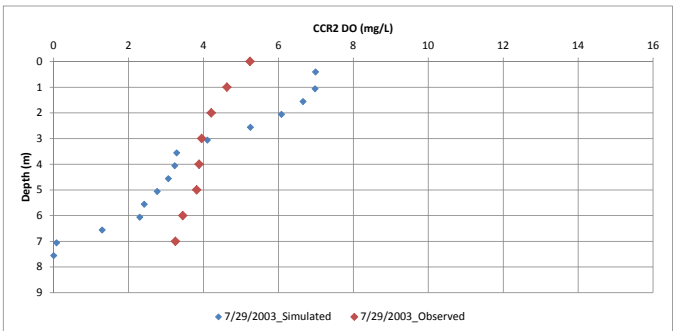
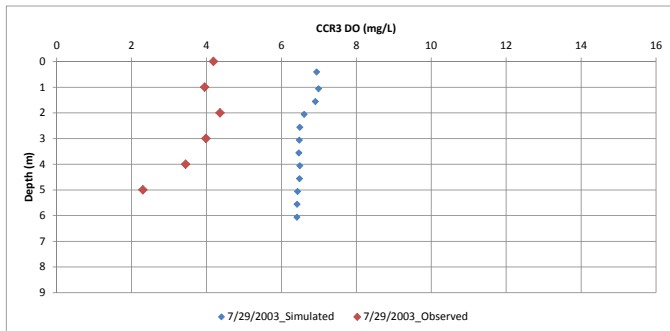
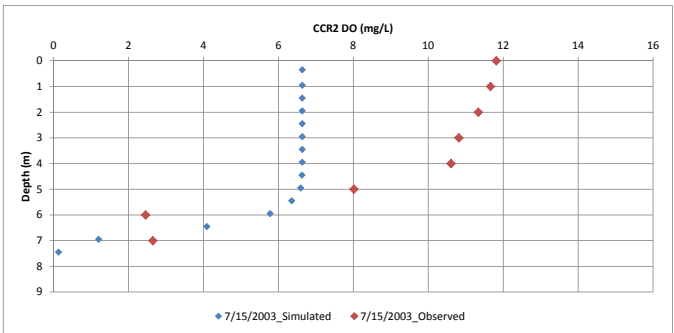
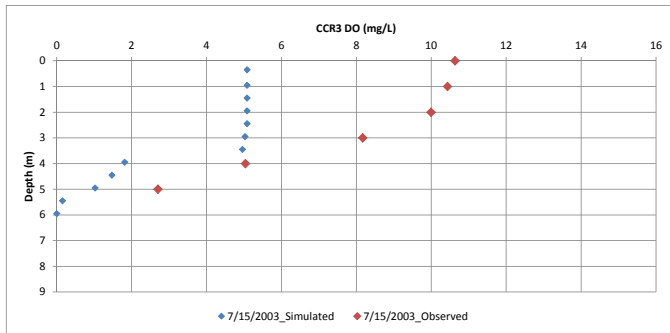
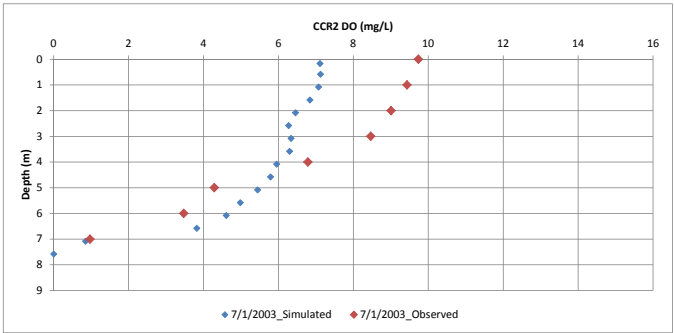
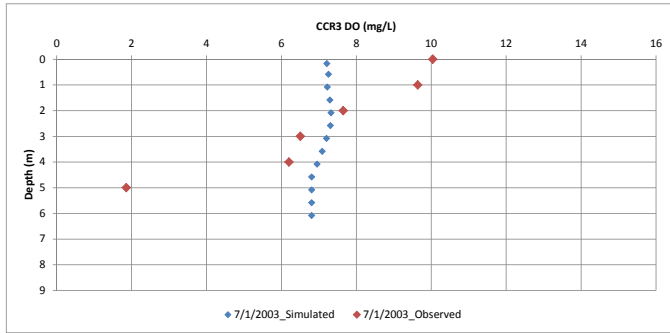
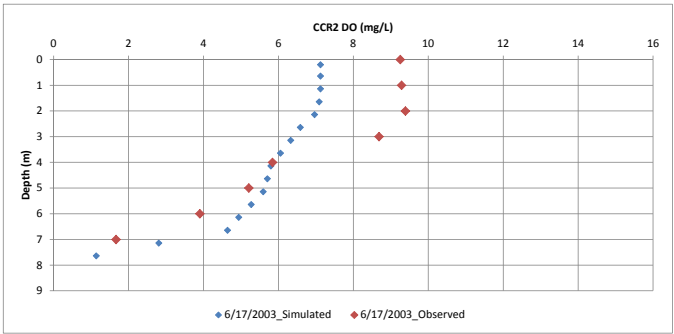
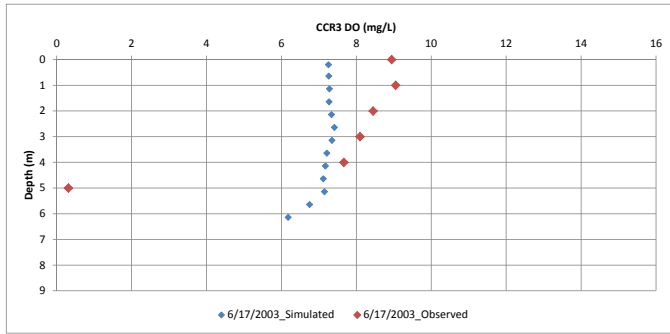


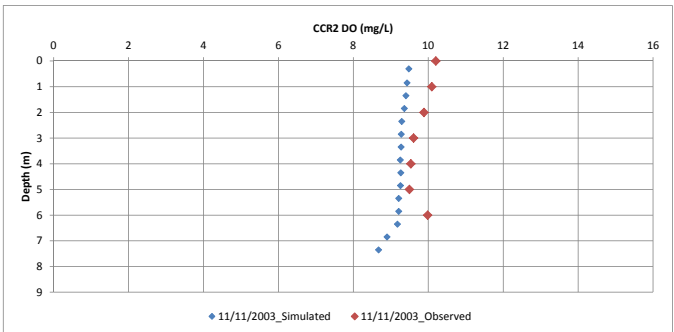
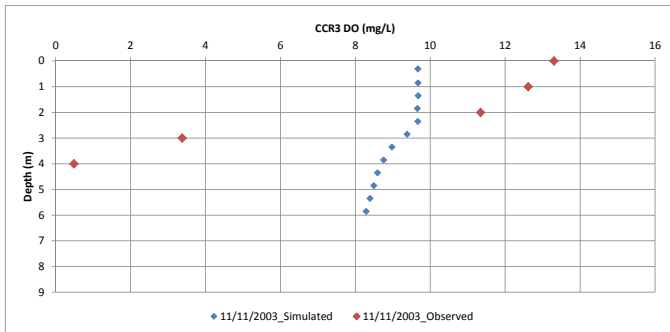
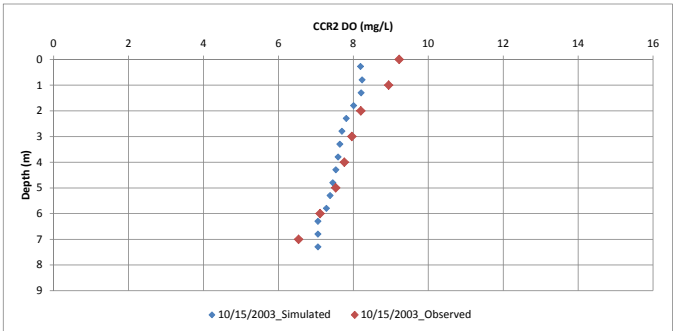
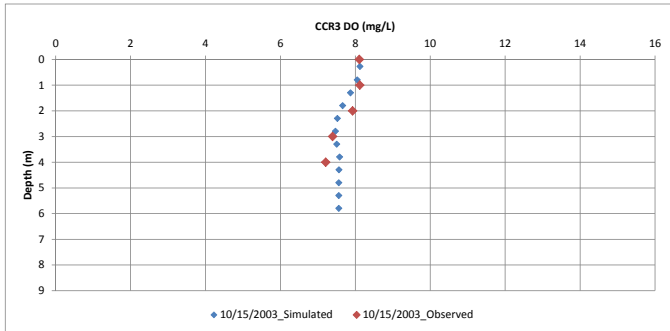
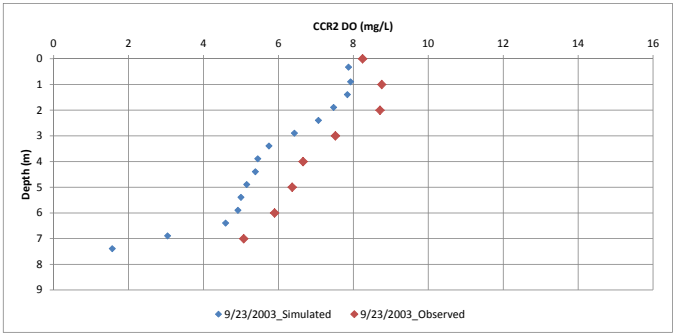
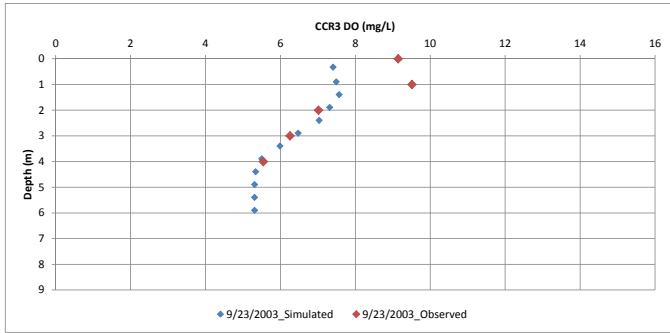
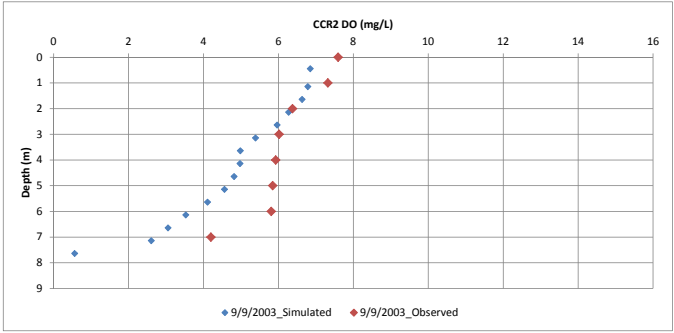
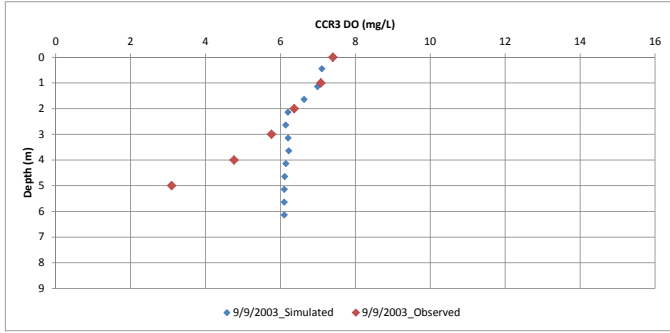
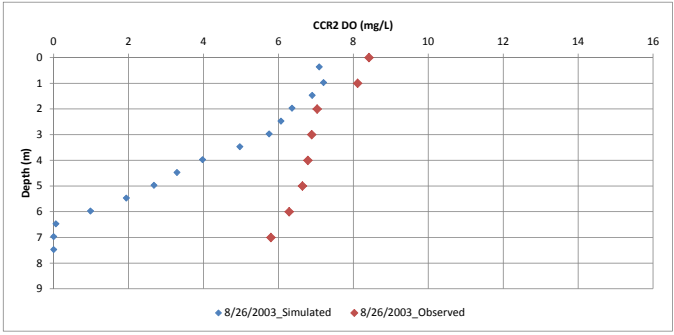
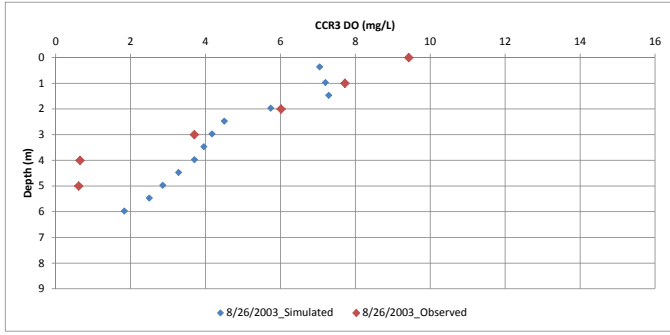


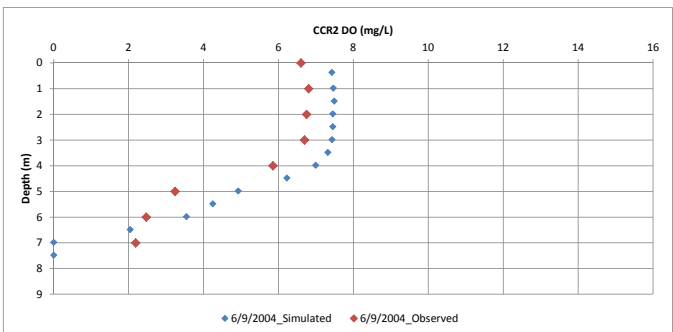
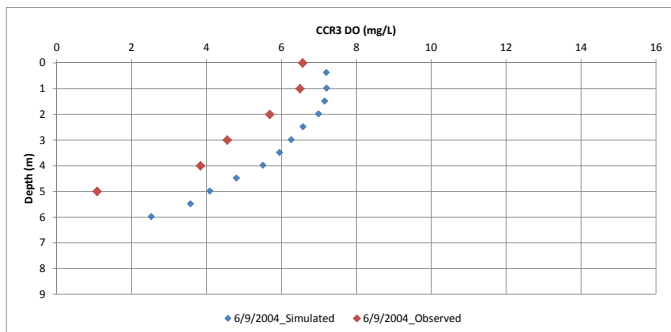
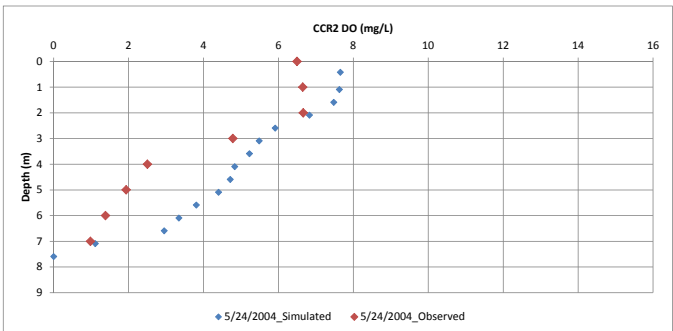
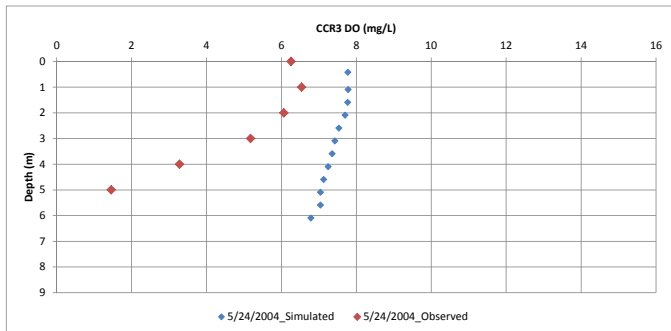
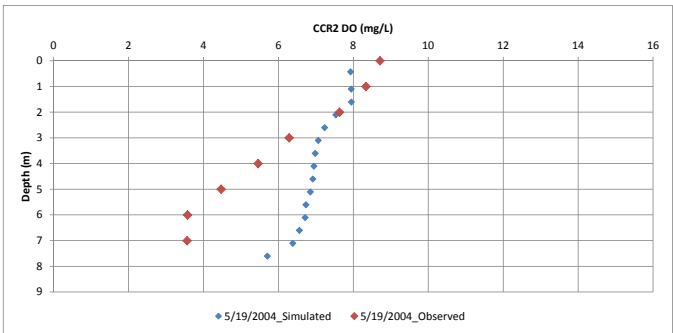
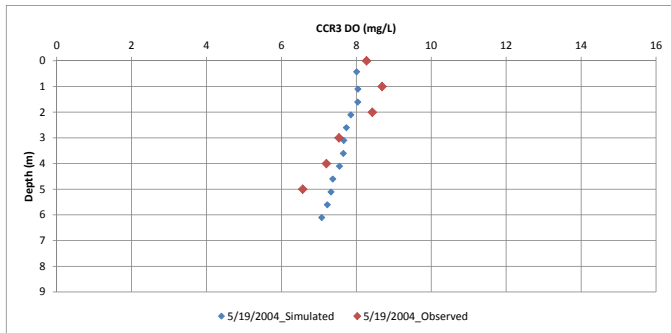
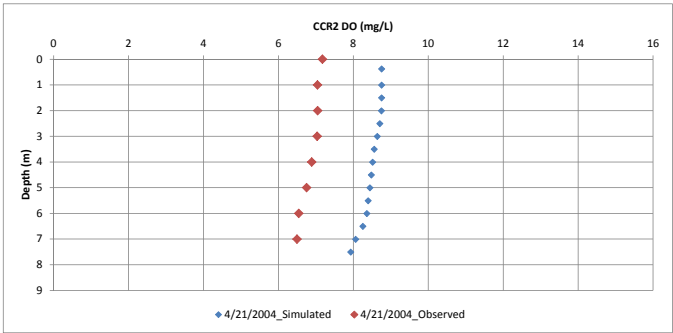
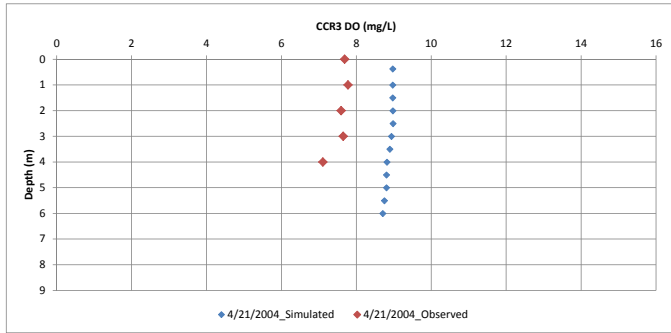
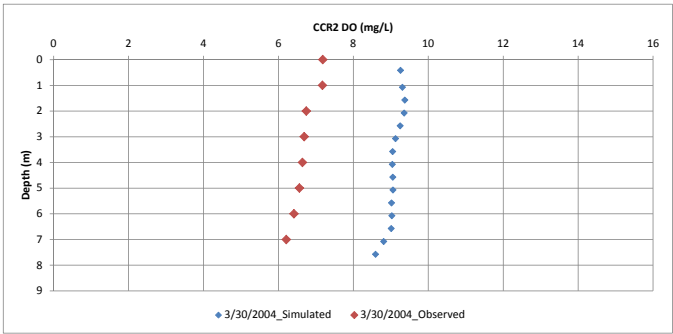
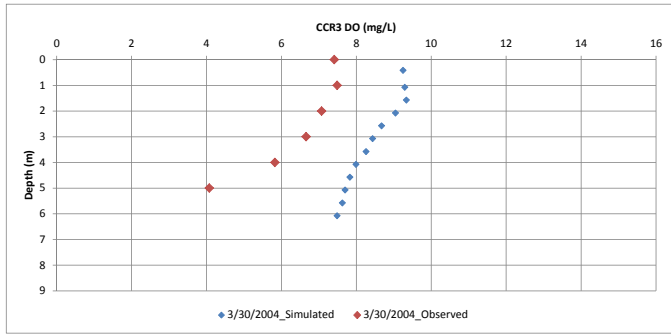


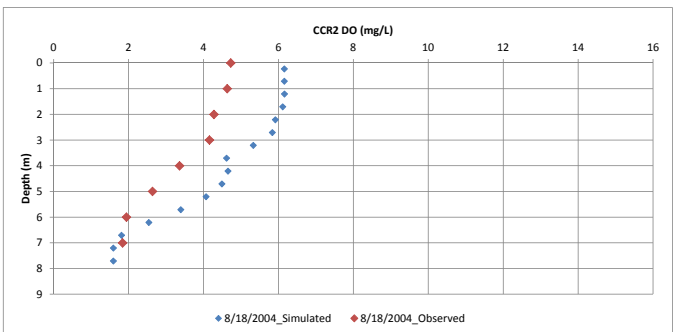
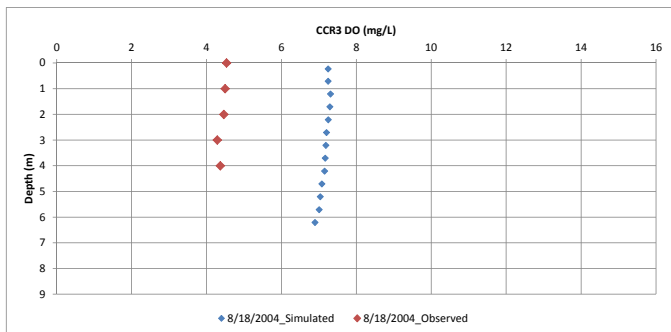
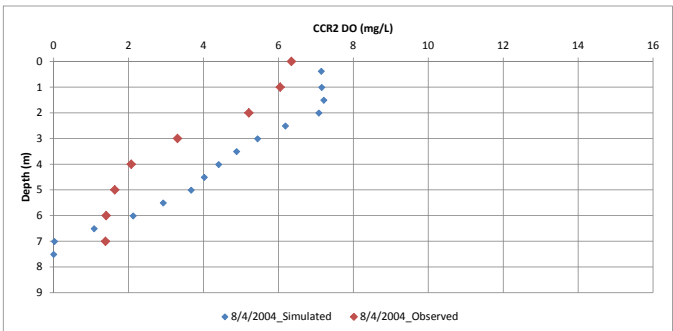
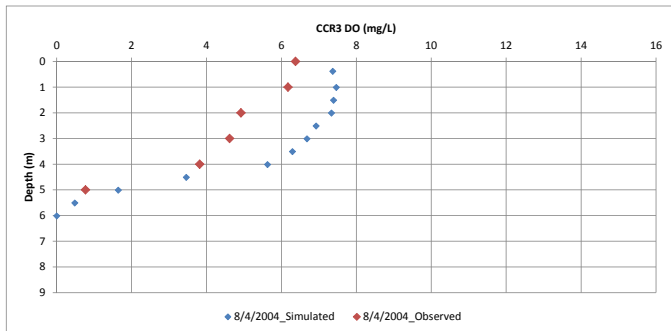
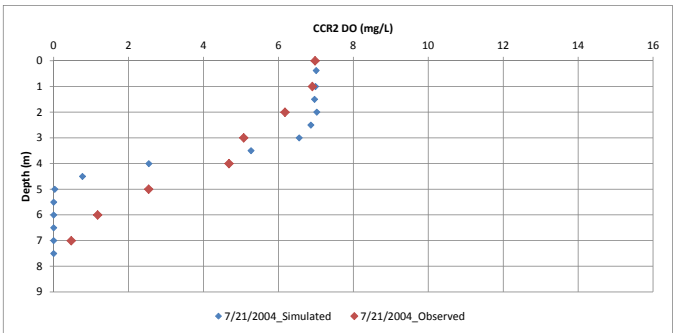
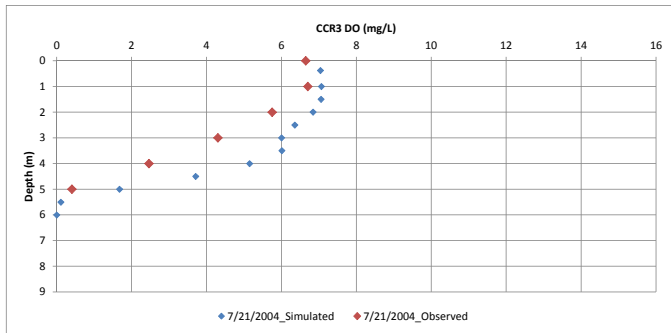
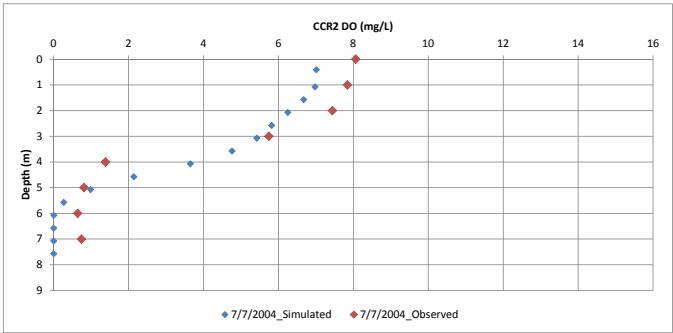
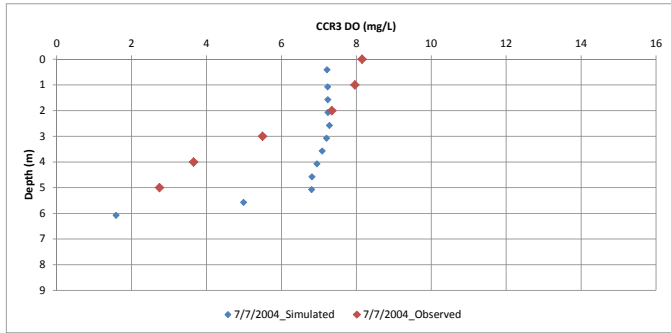
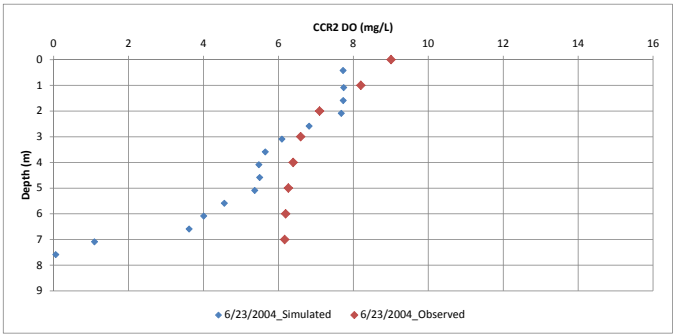
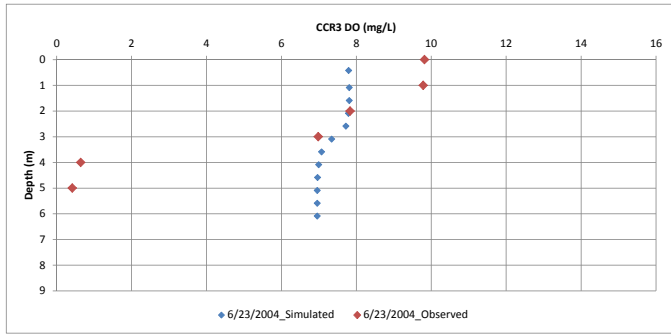
**Attachment C: Dissolved Oxygen Profiles: Observed and Simulated Results**

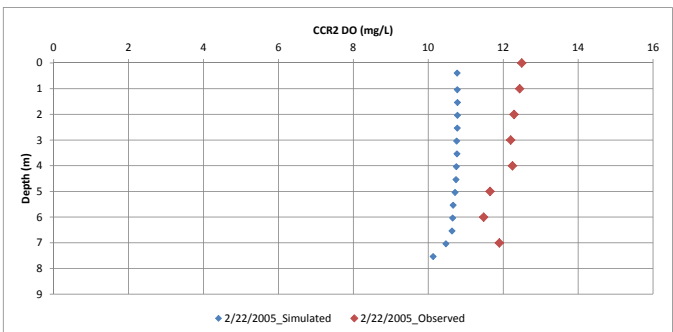
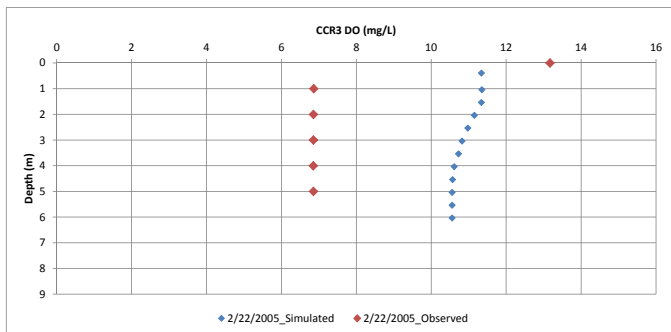
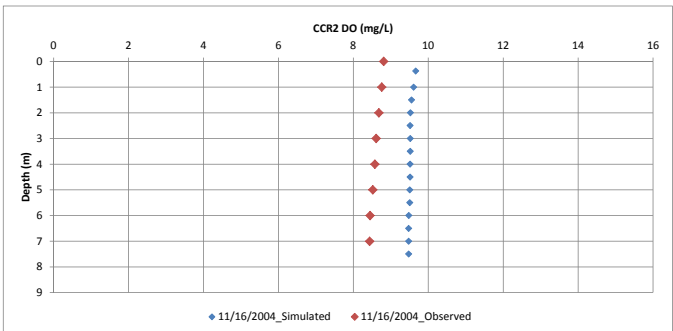
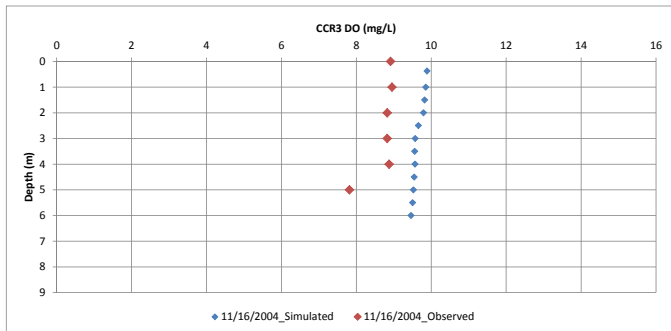
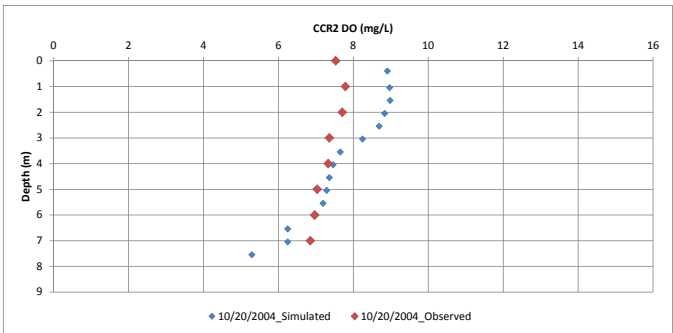
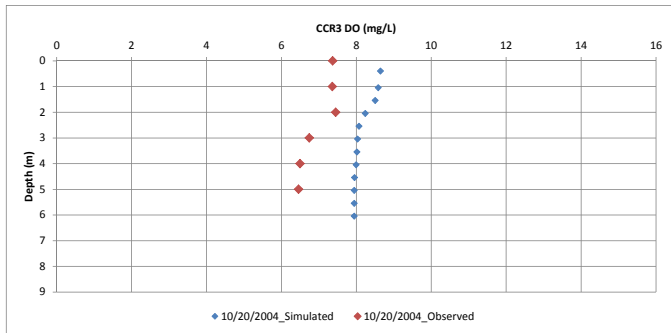
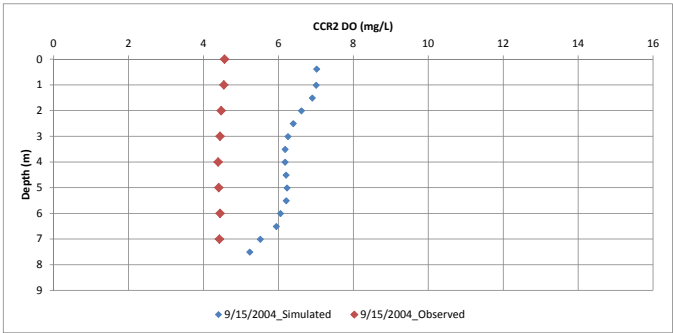
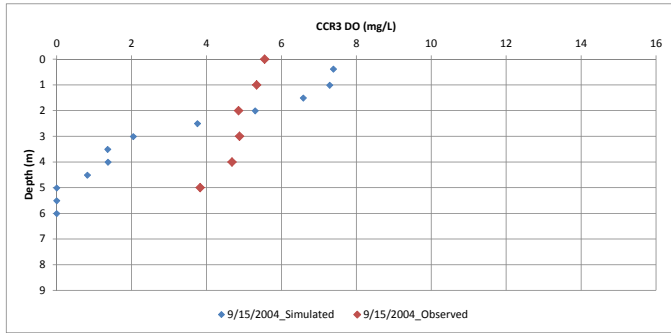
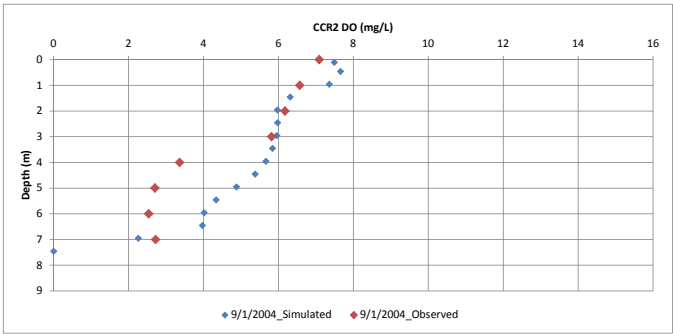
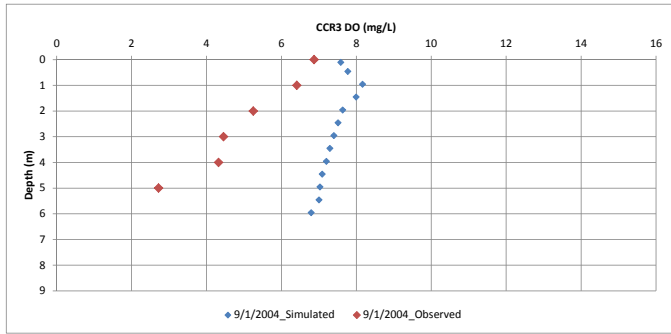




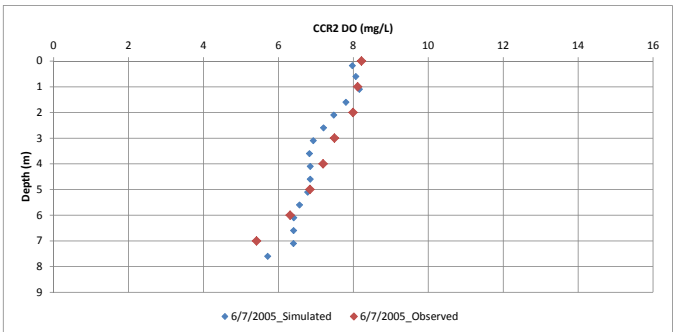
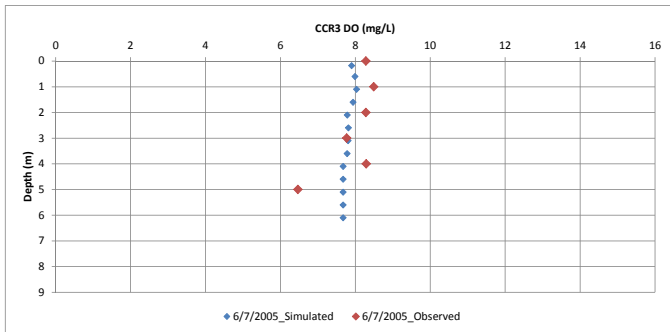
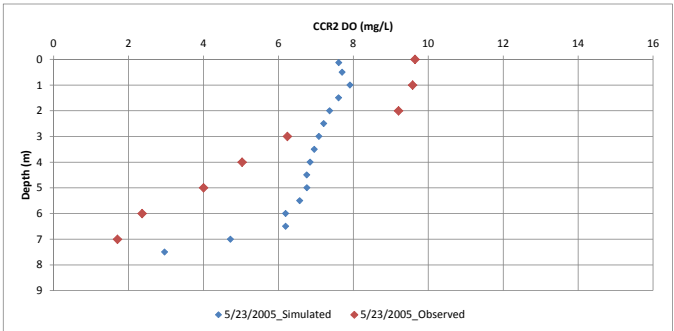
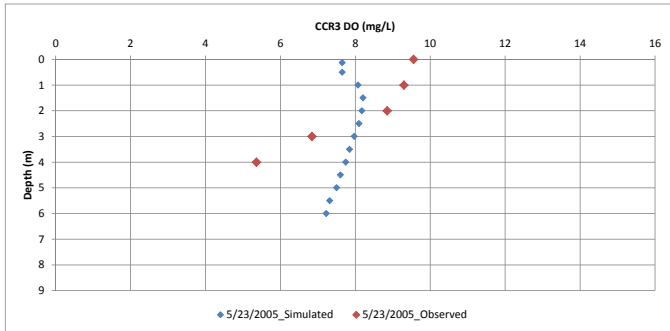
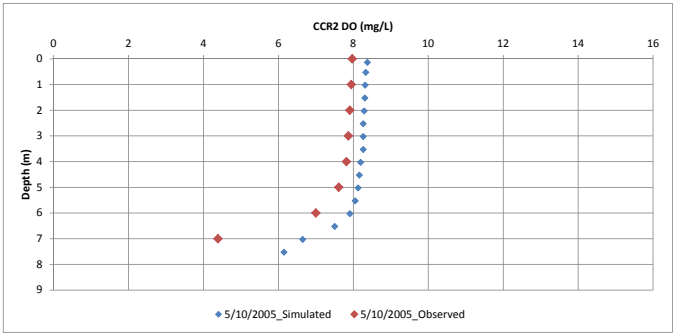
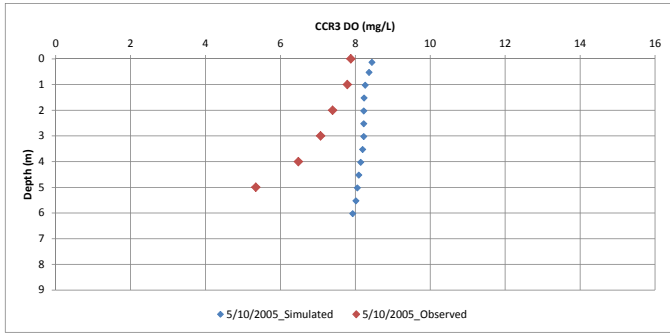
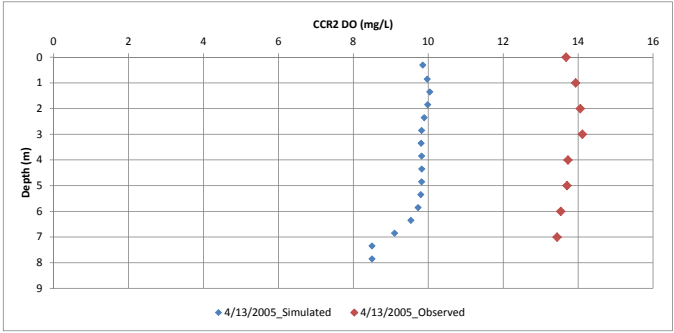
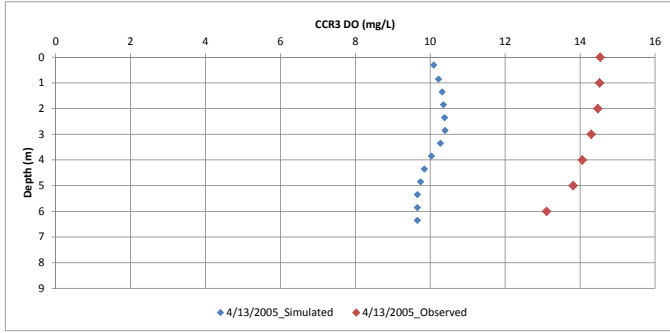
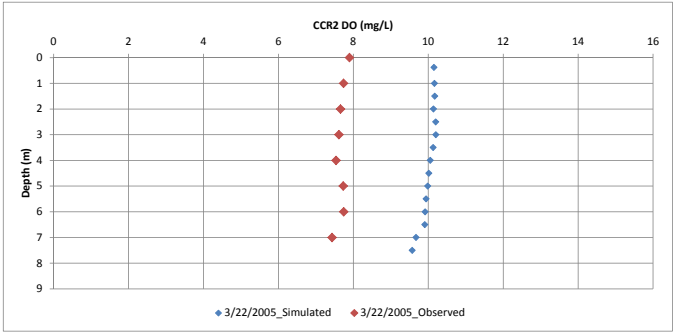
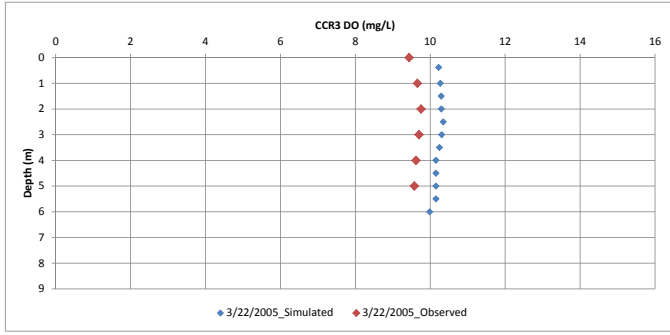


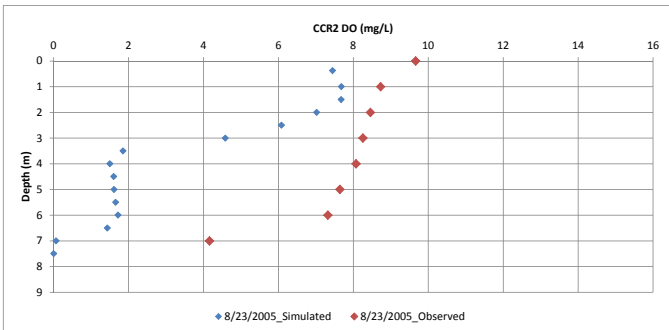
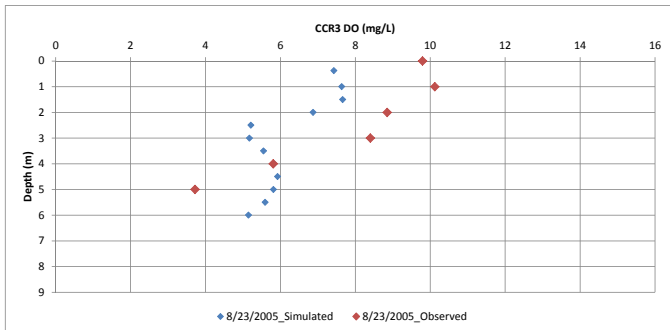
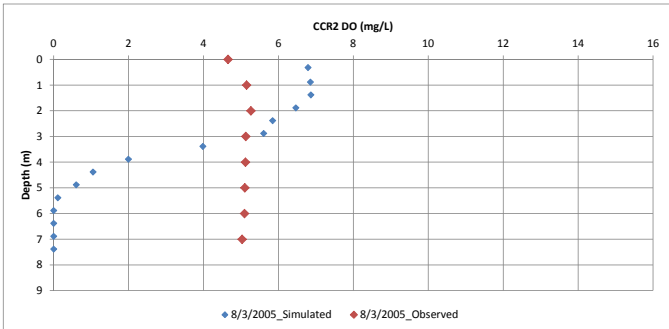
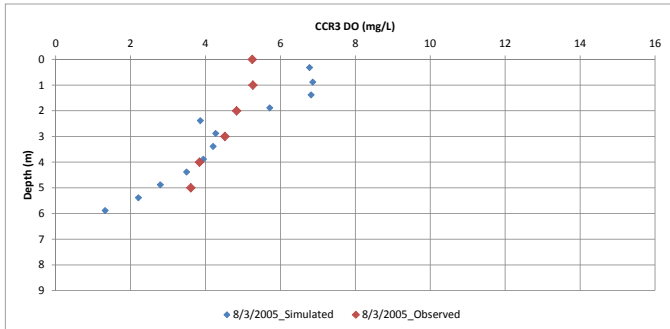
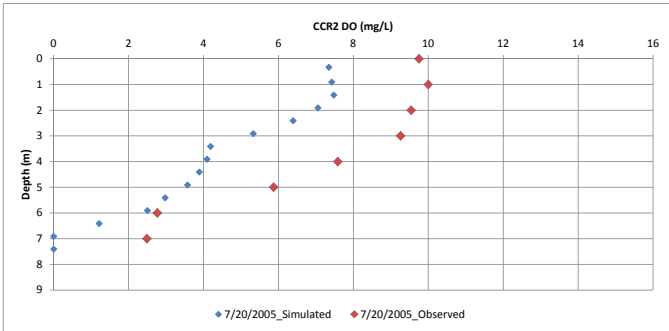
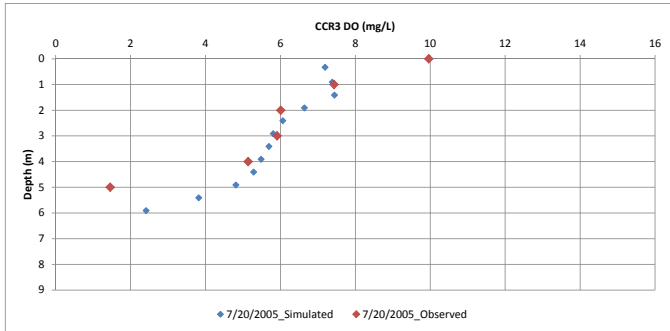
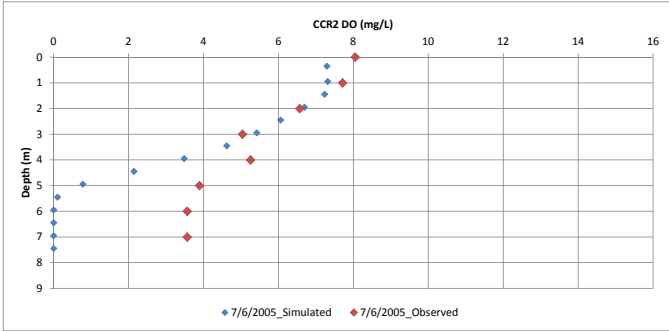
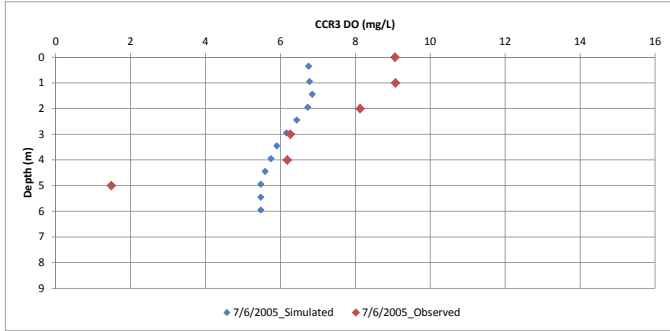
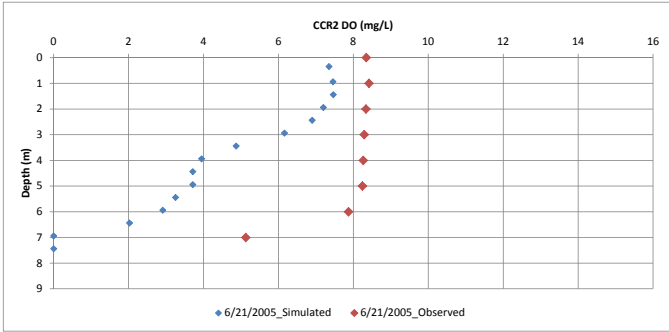
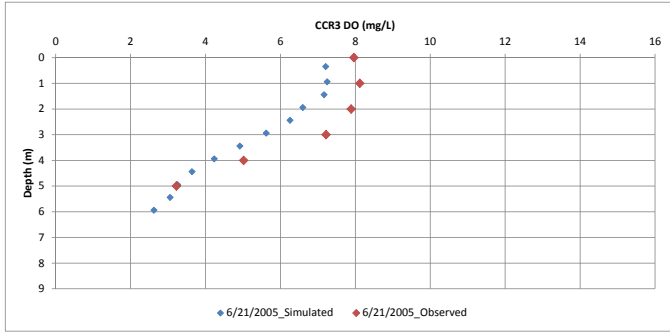


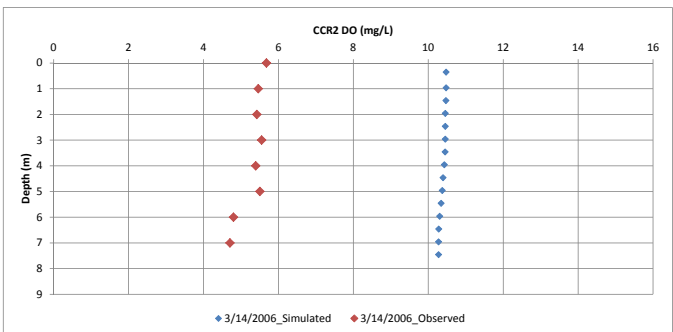
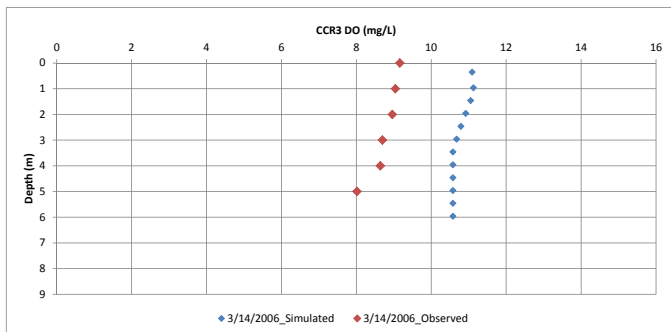
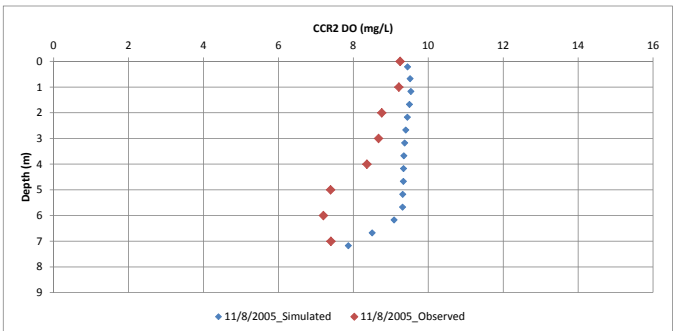
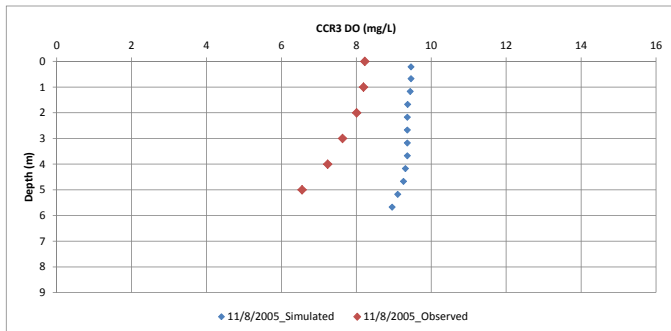
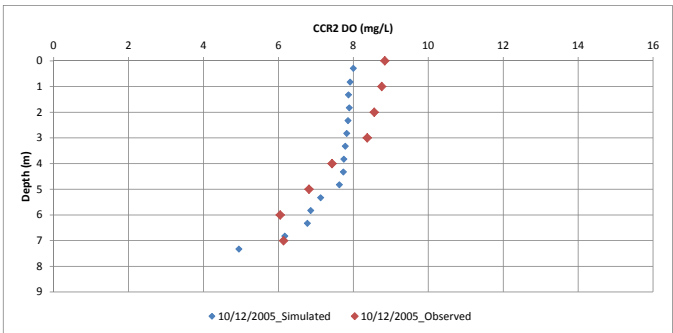
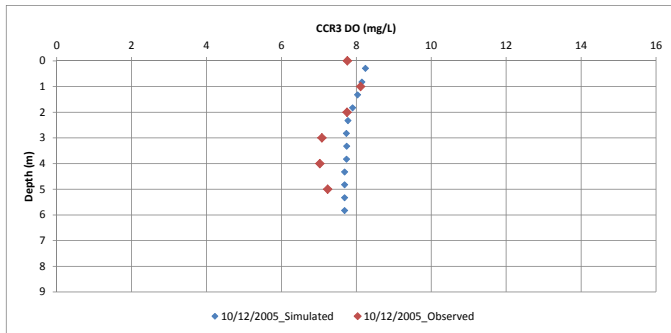
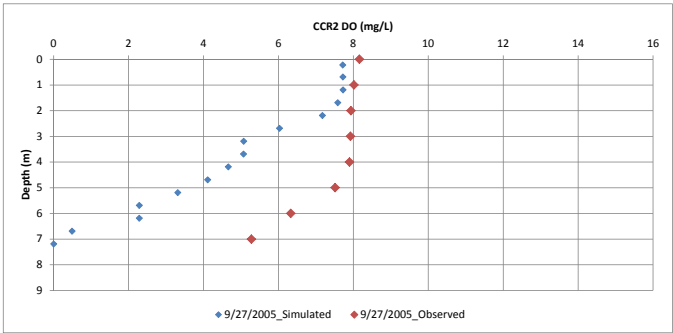
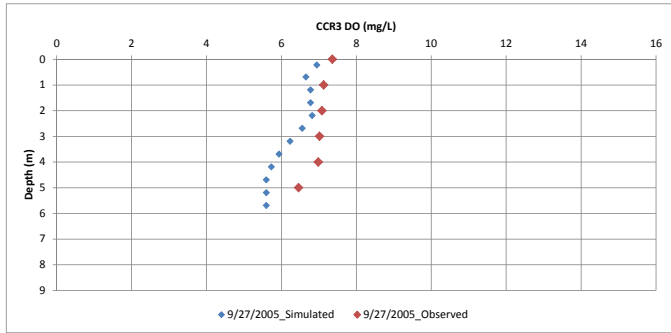
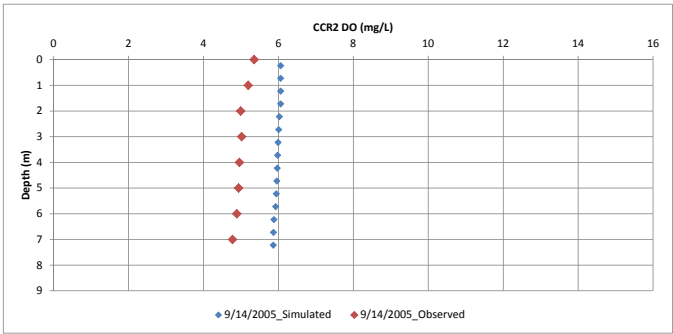
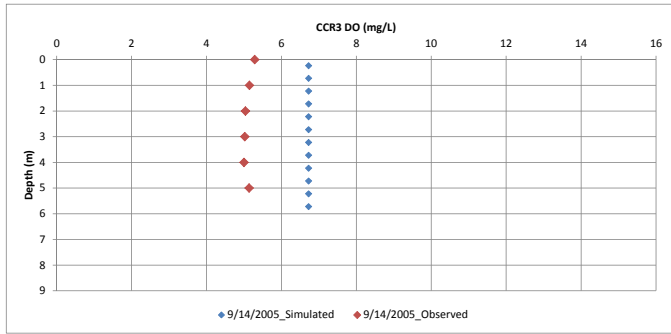


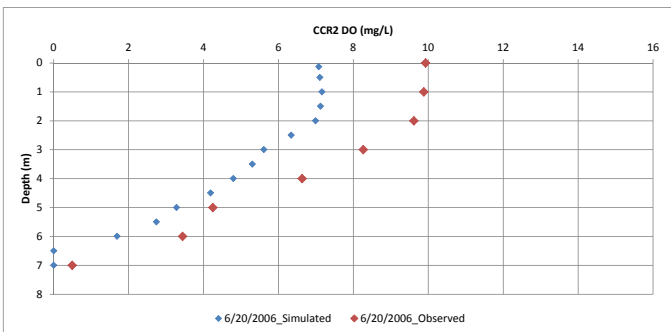
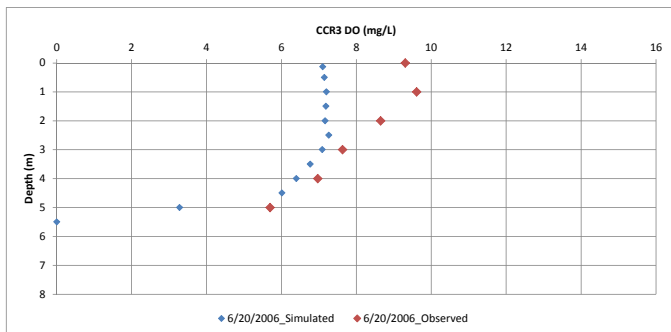
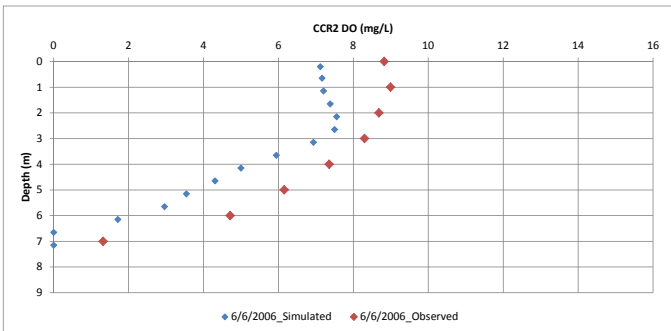
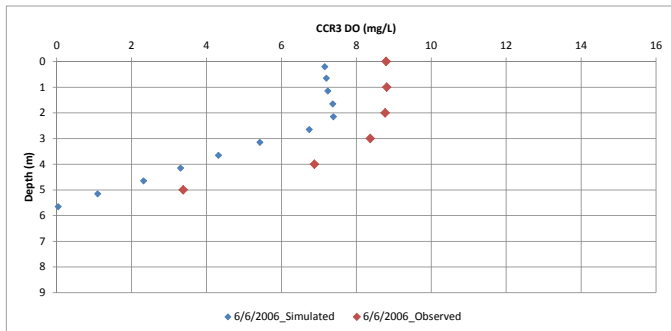
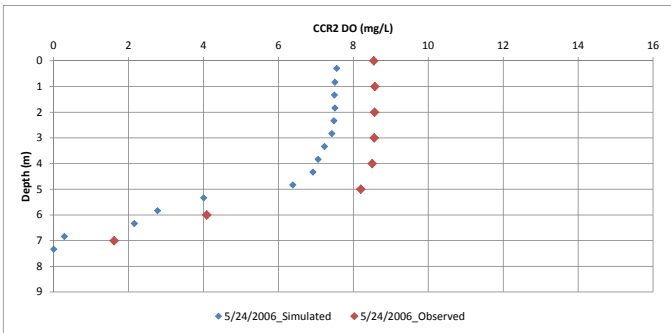
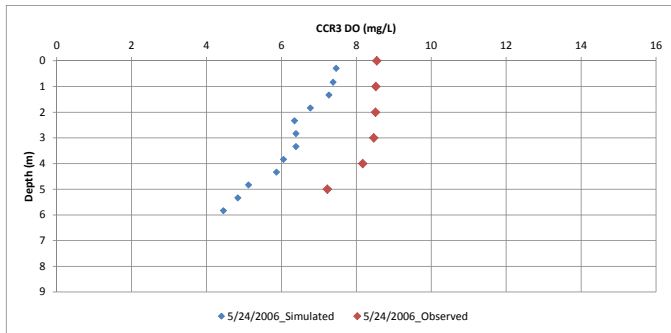
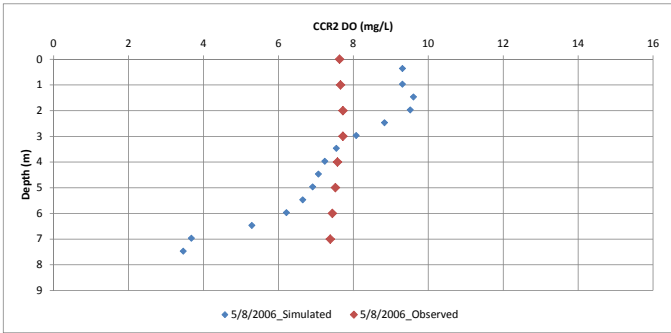
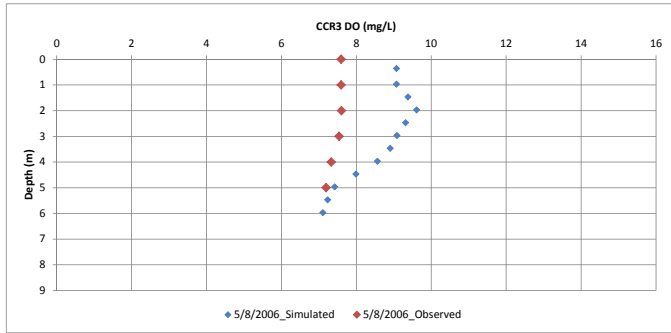
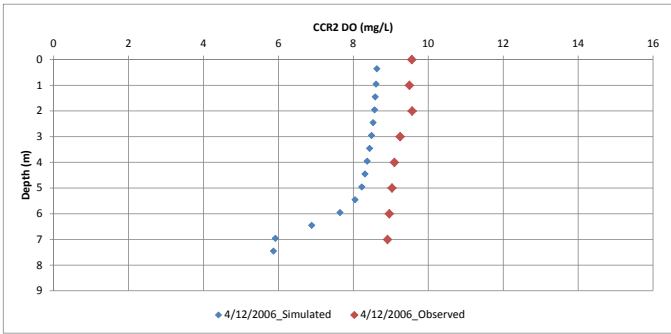
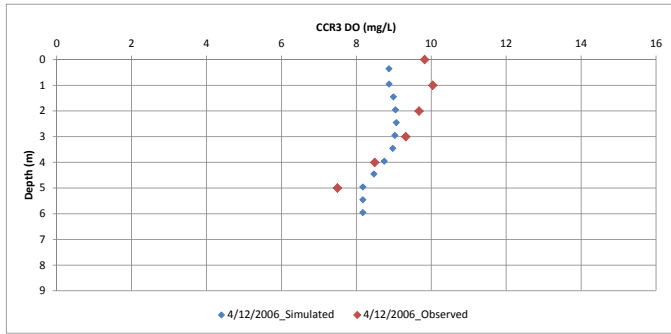


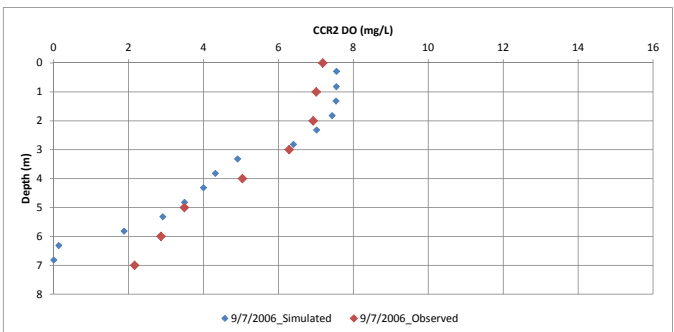
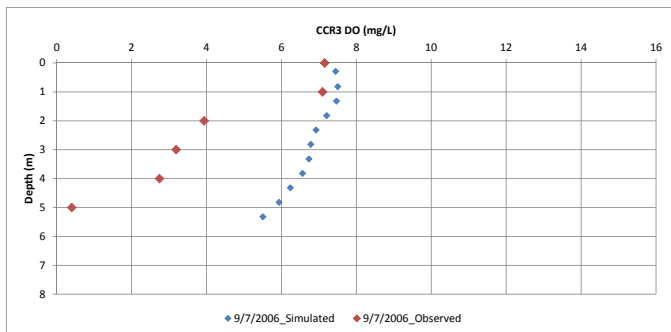
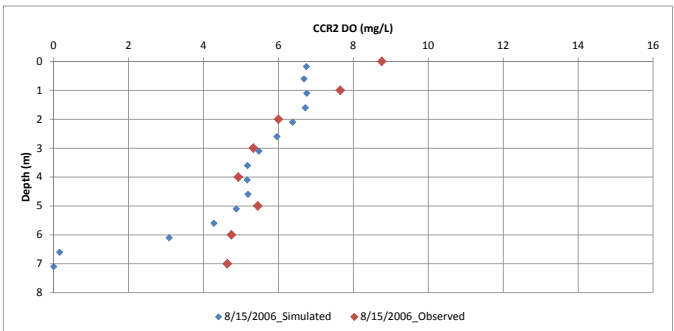
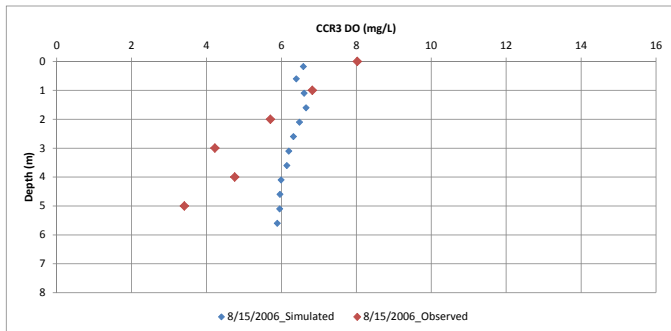
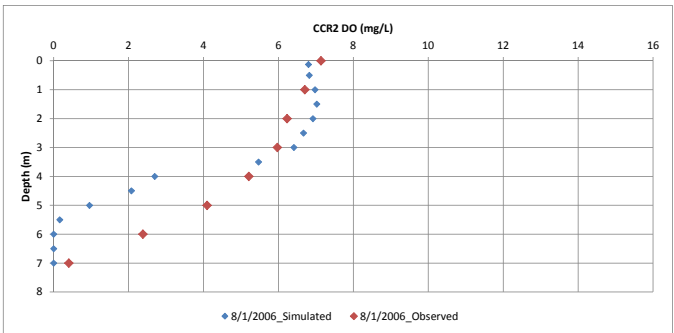
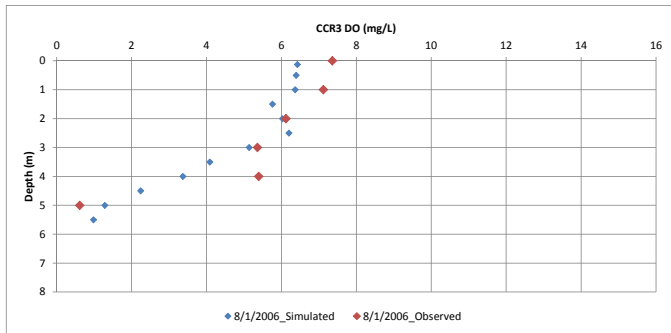
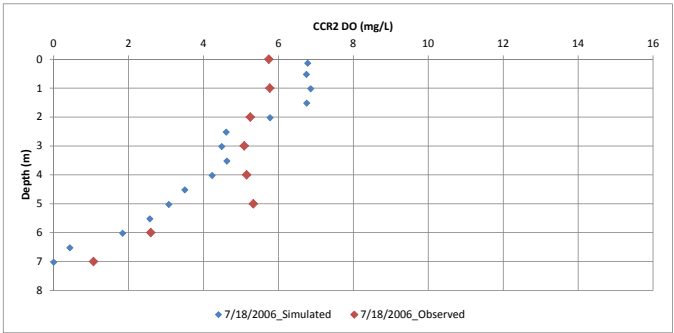
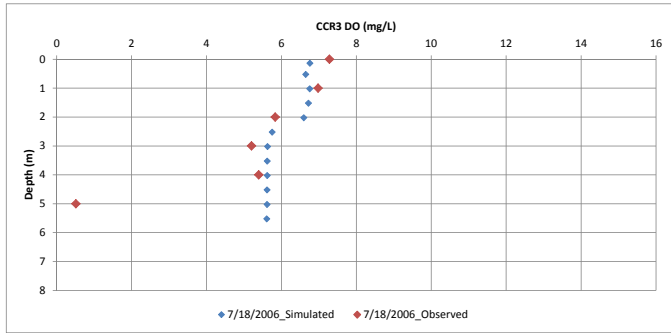
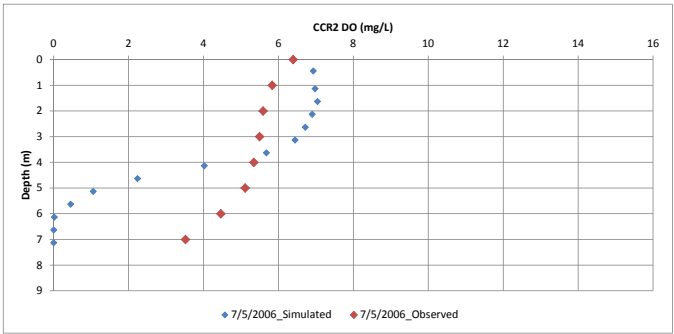
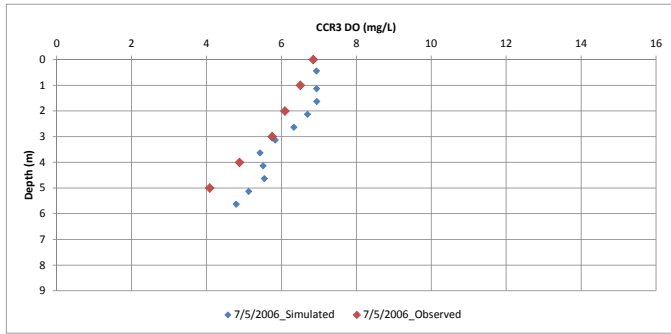


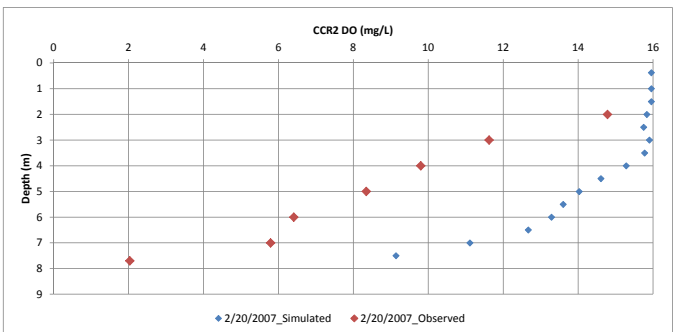
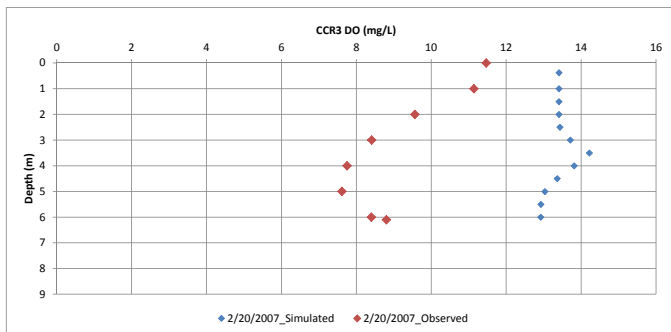
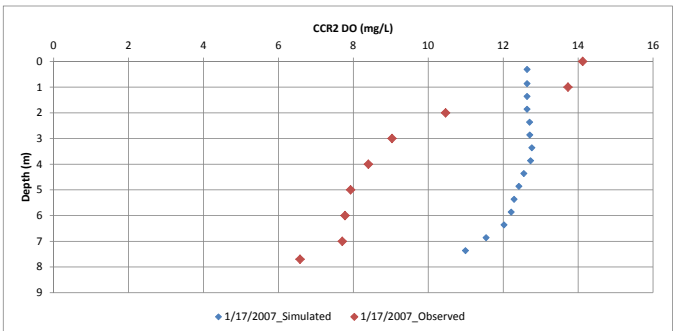
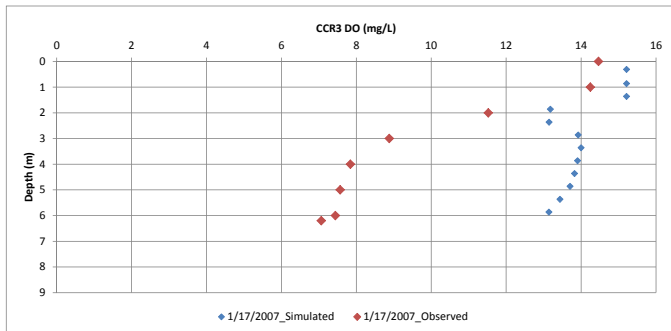
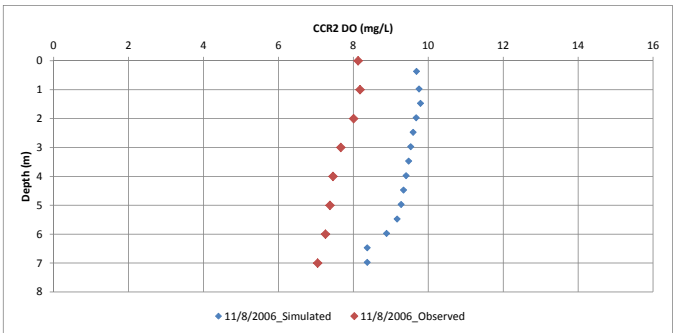
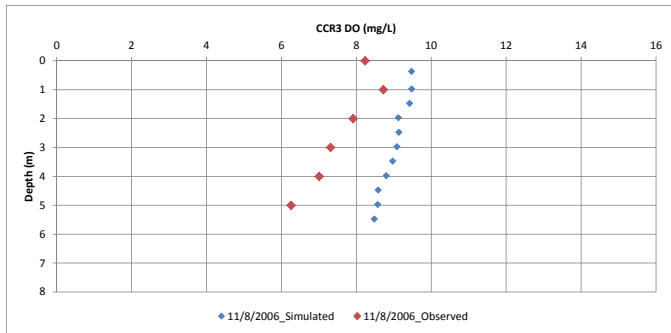
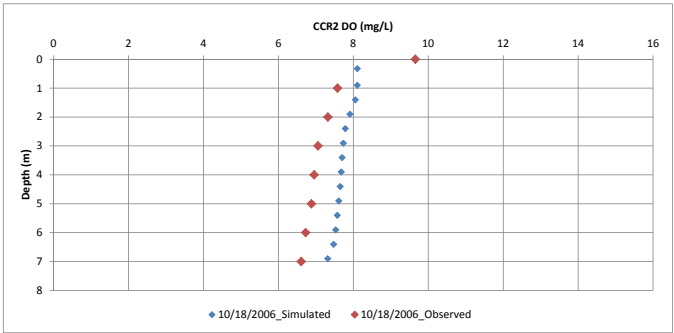
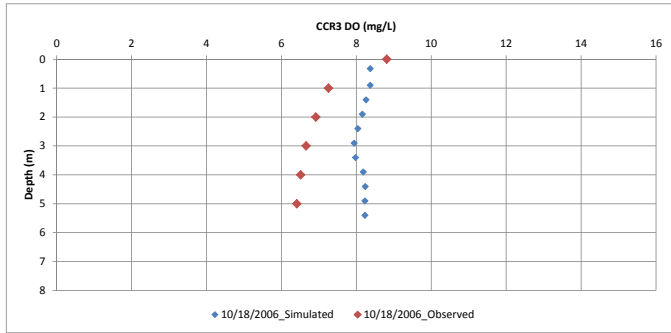
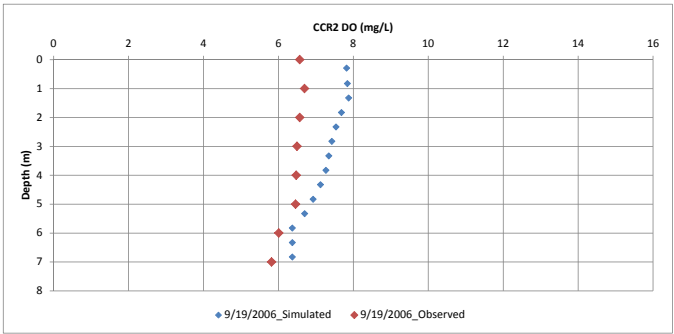
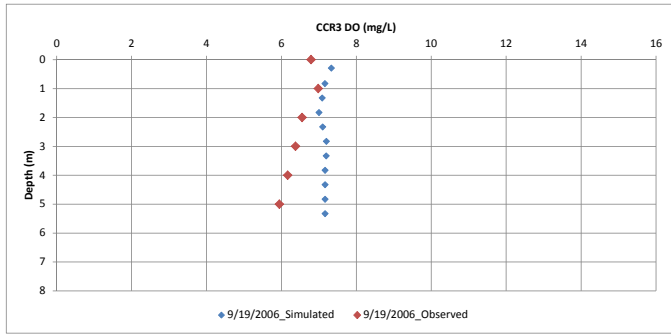


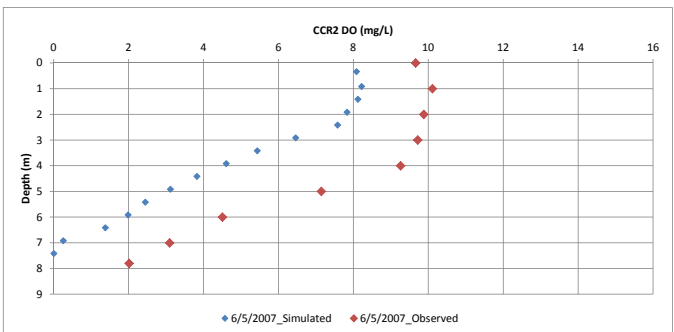
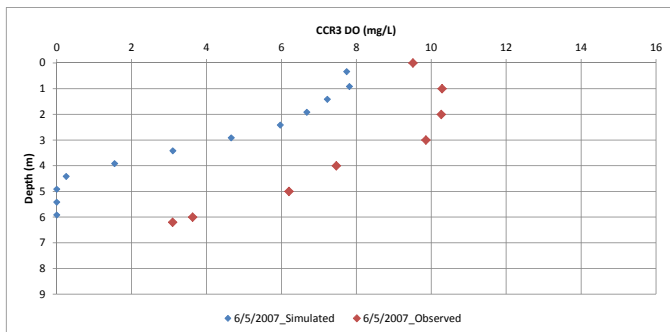
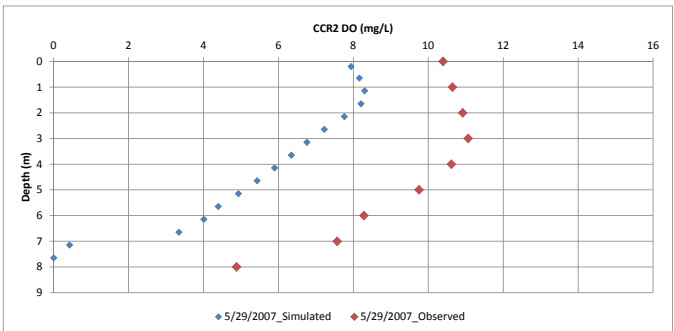
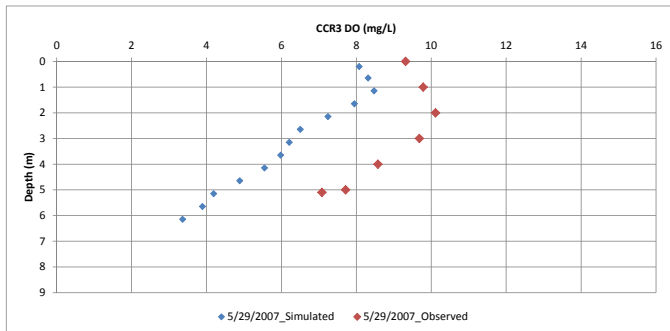
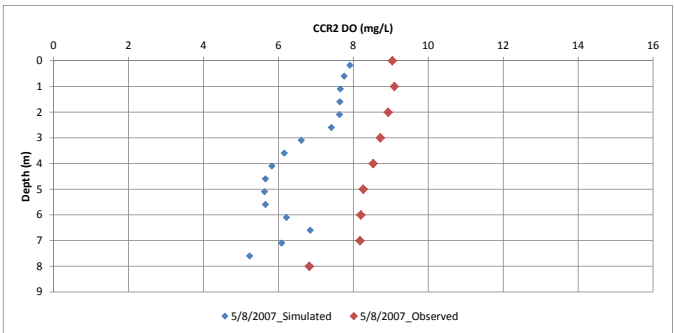
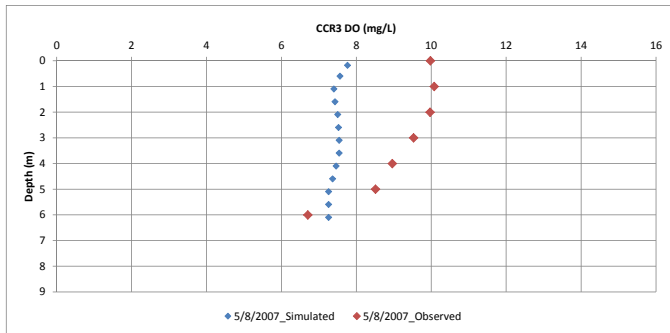
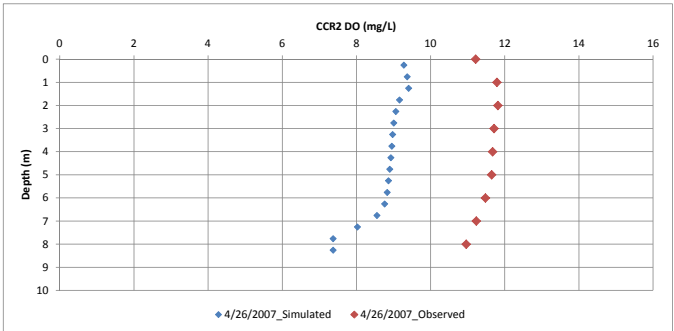
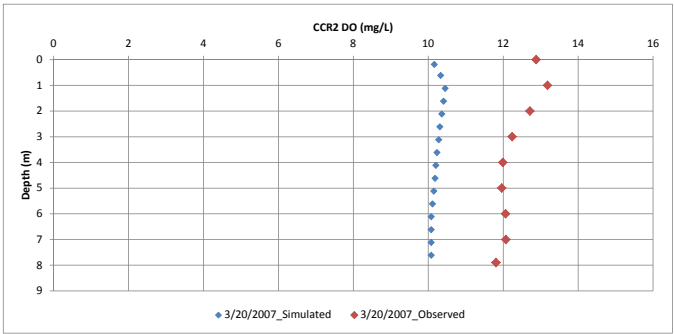
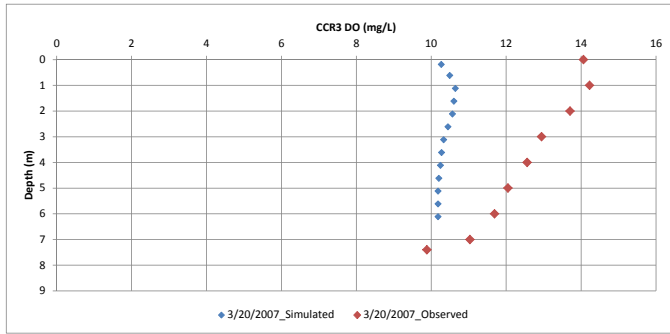


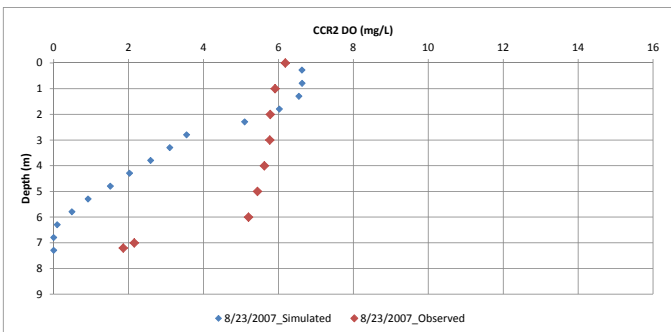
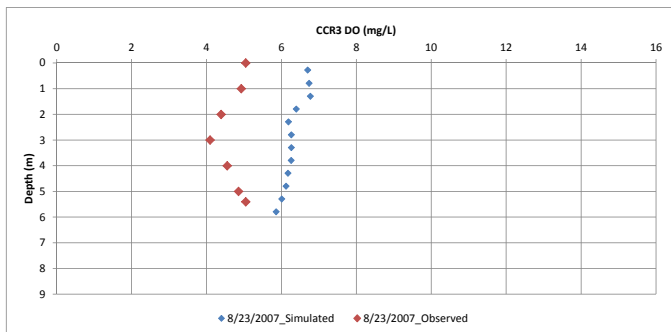
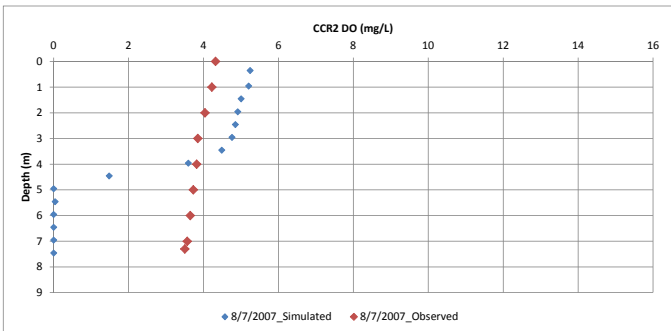
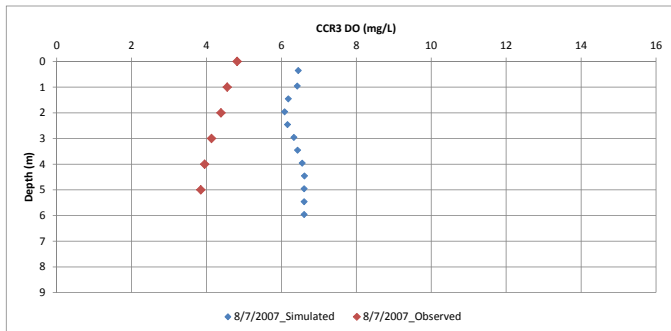
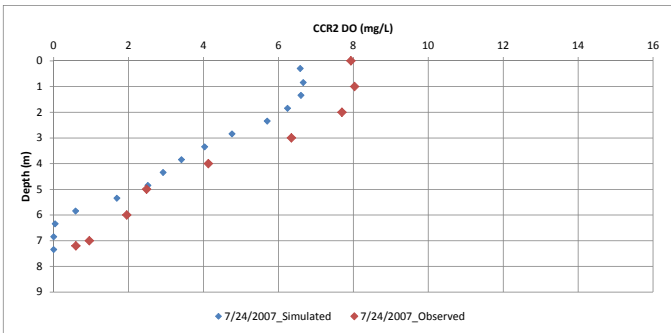
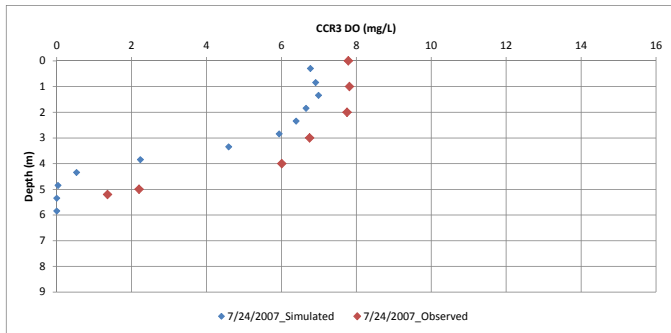
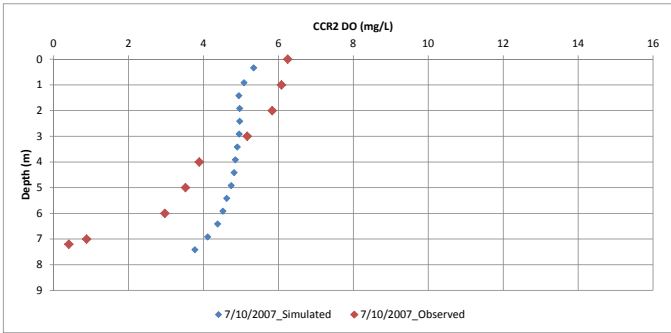
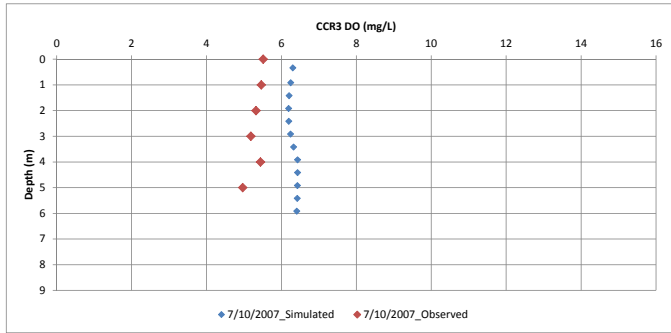
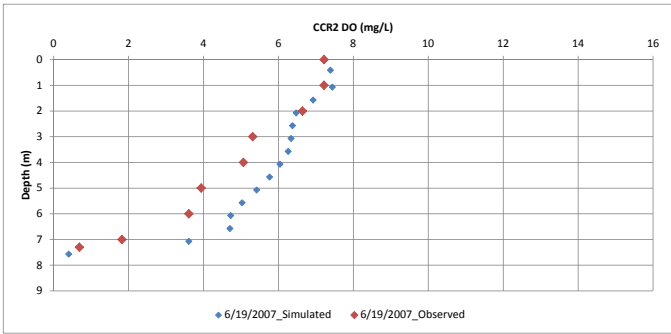
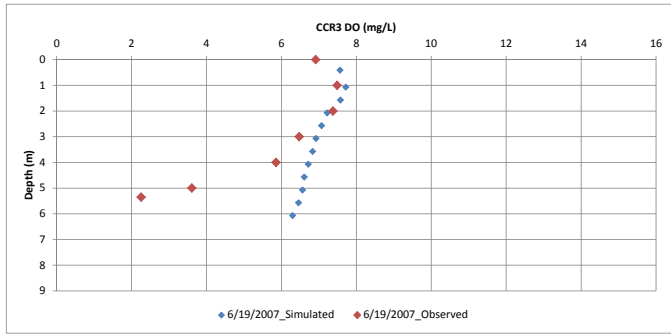




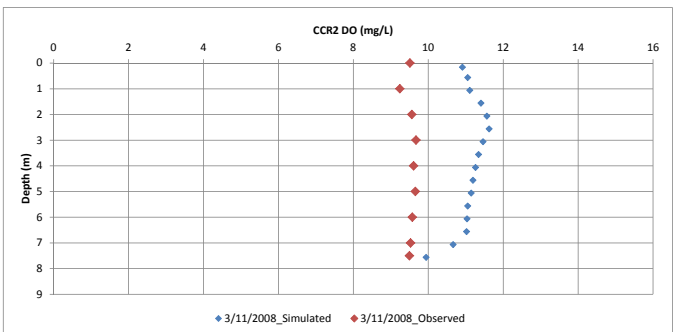
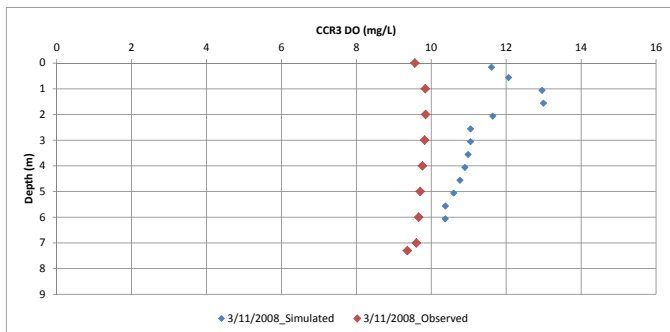
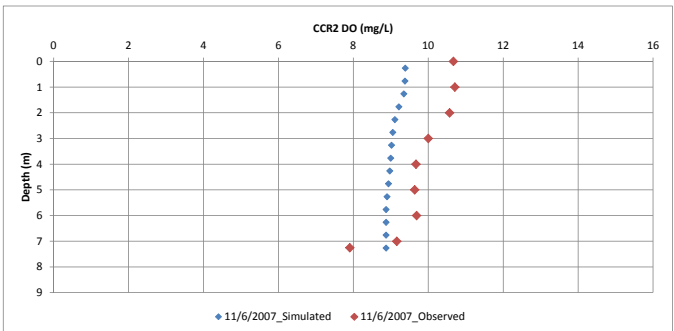
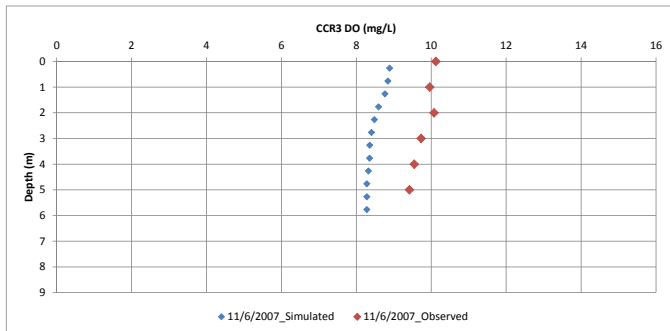
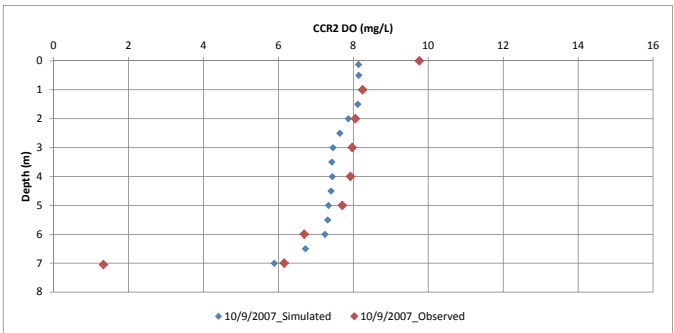
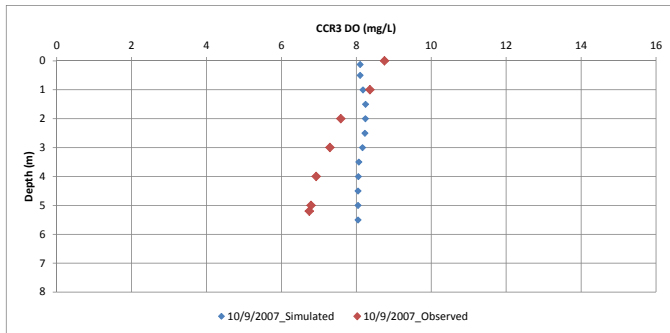
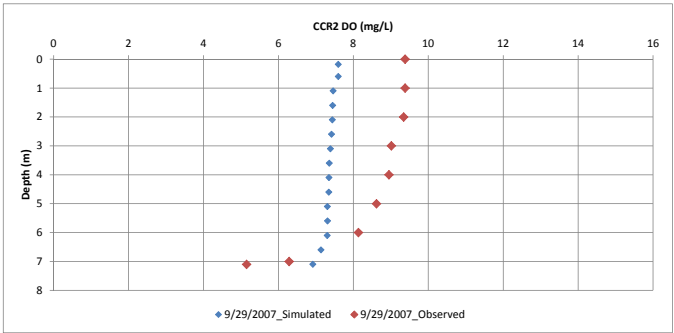
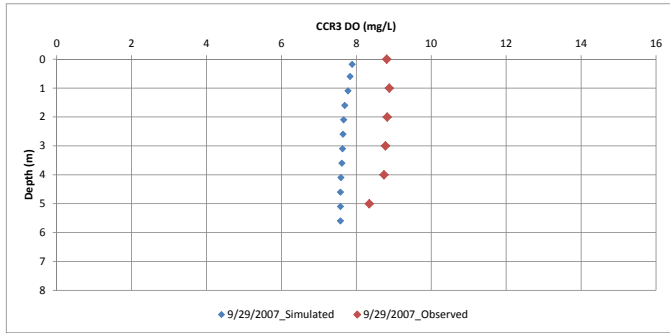
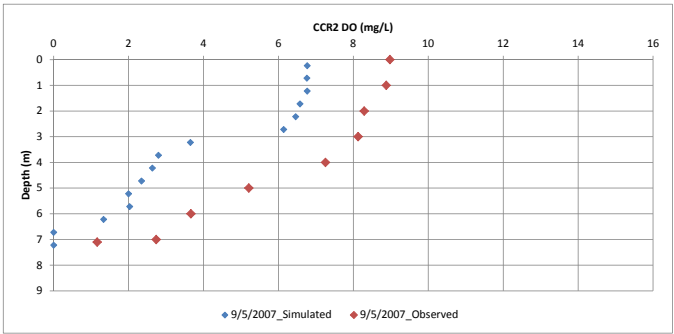
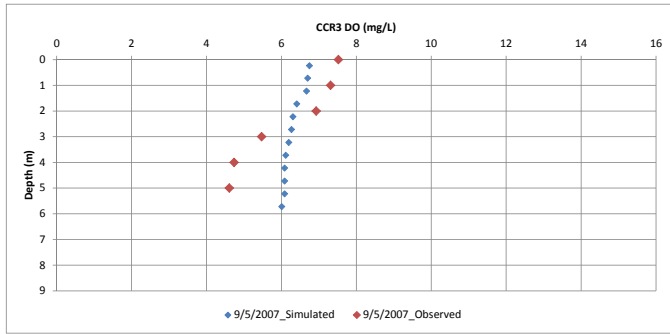


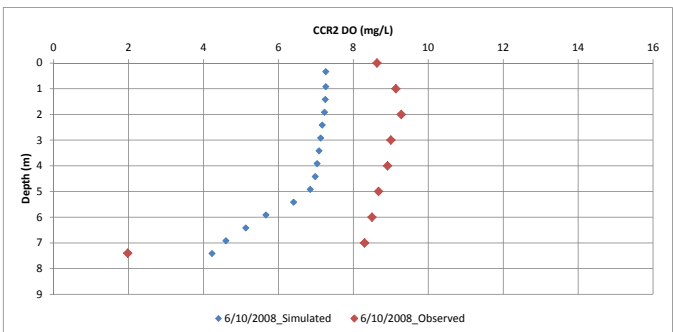
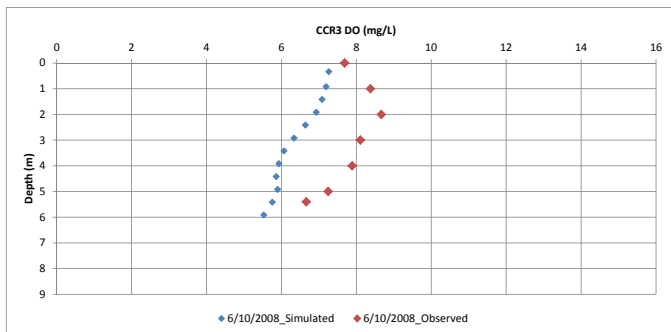
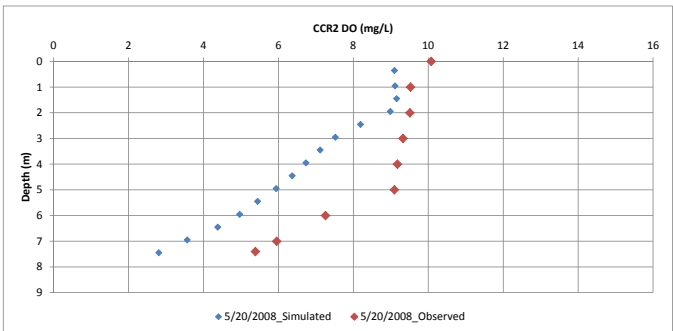
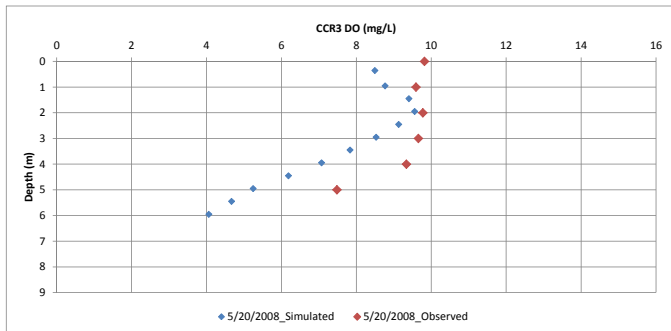
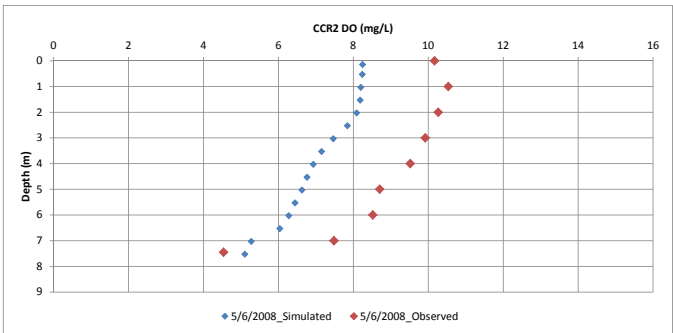
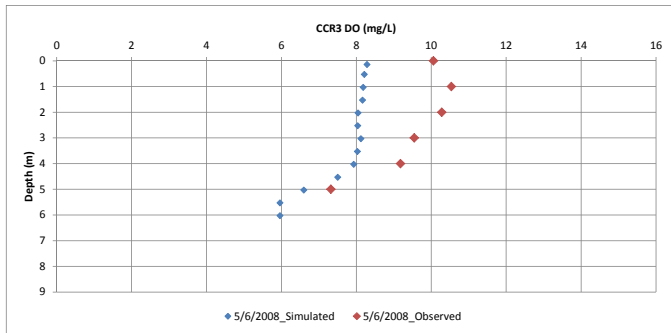
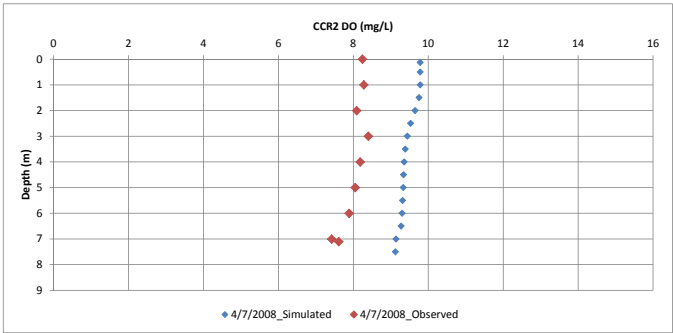
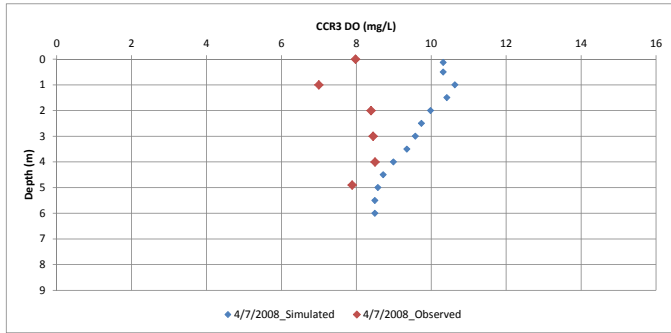
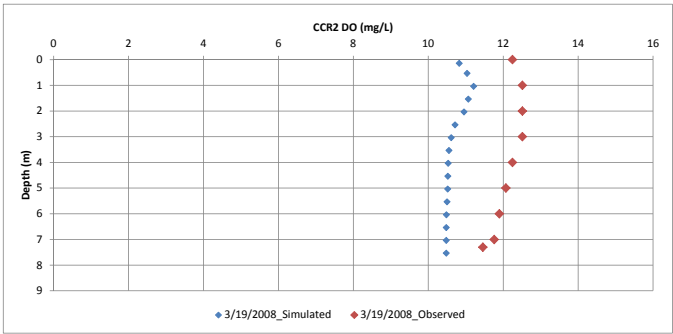
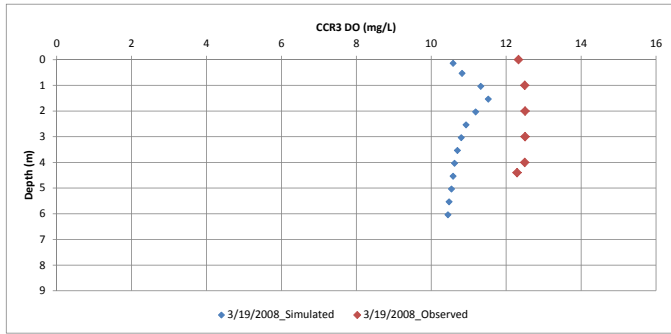


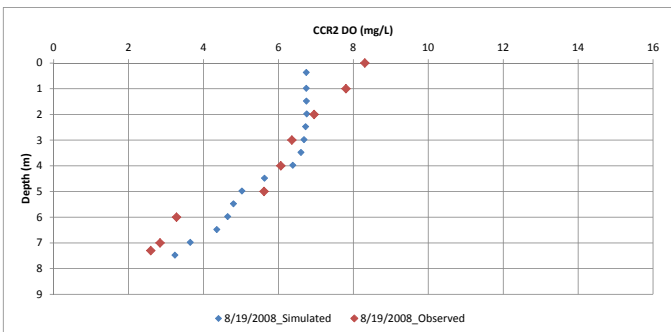
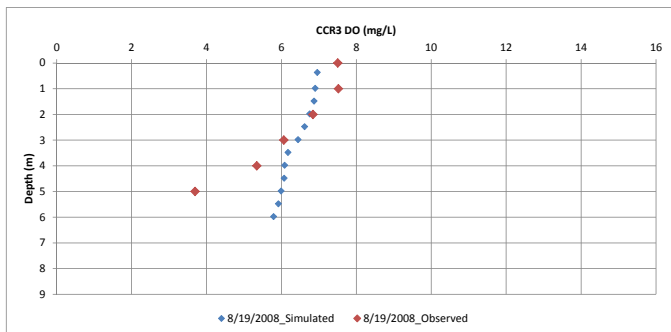
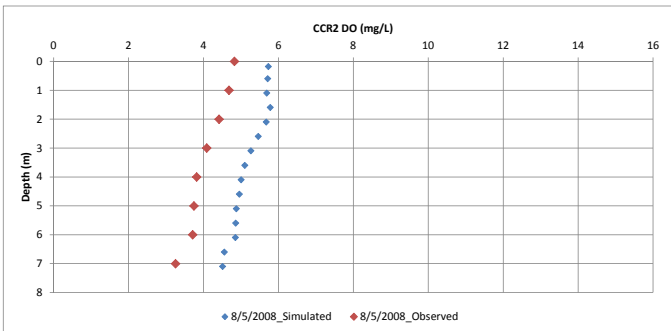
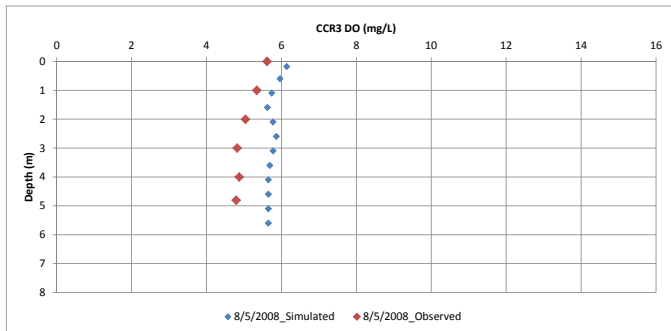
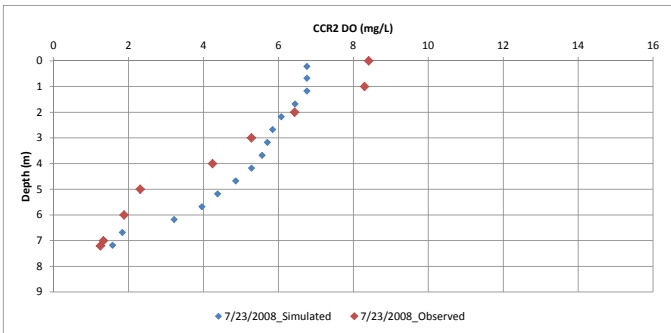
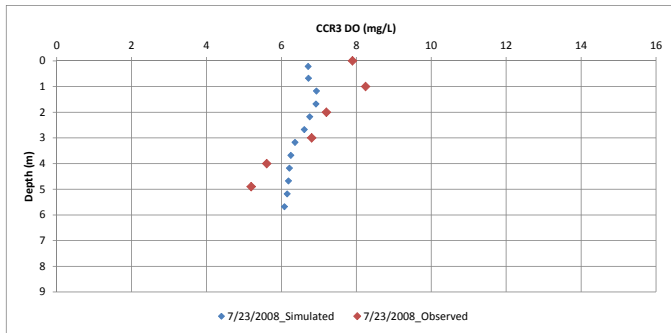
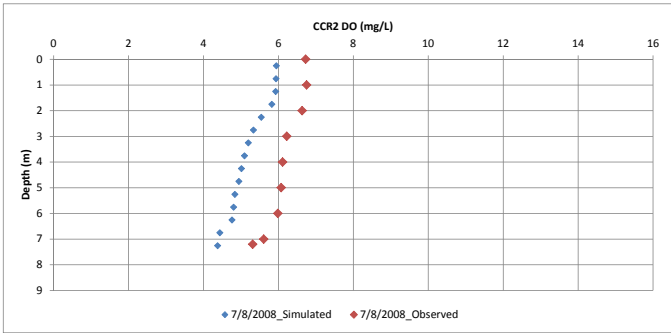
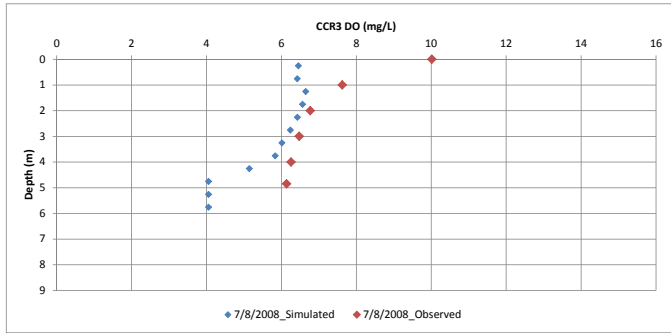
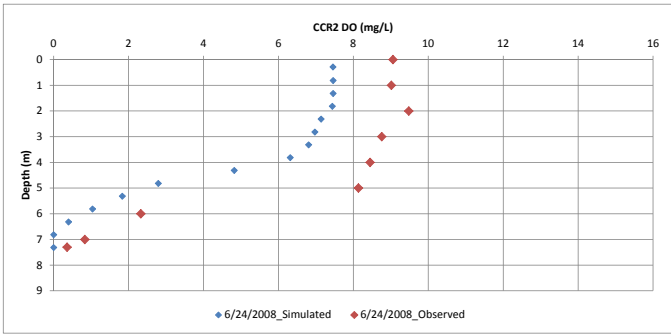
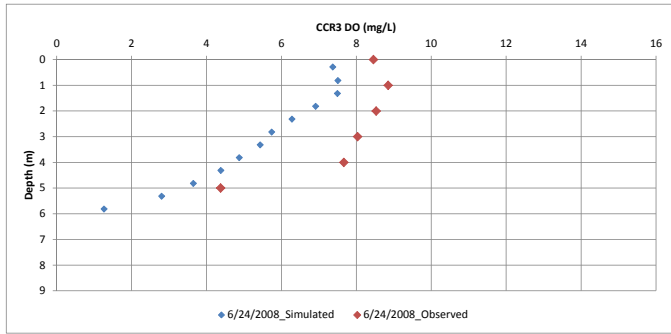


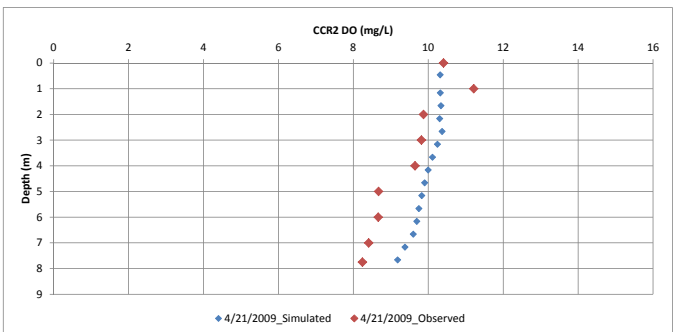
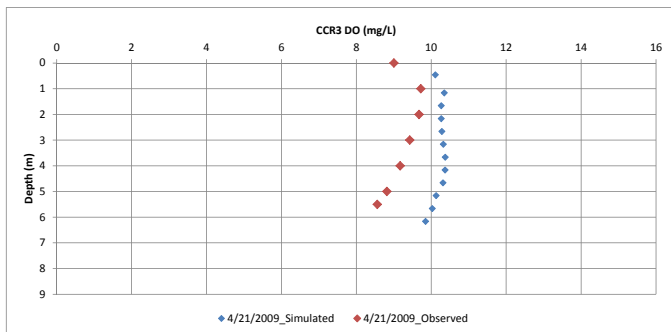
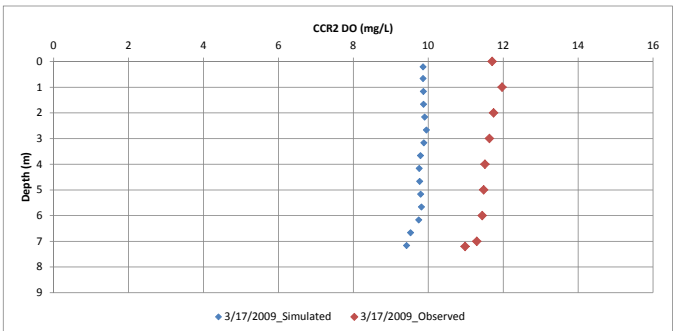
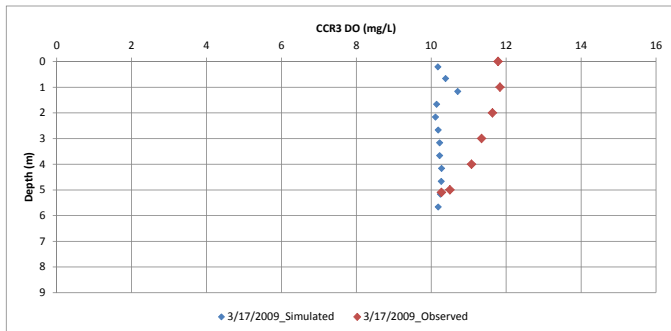
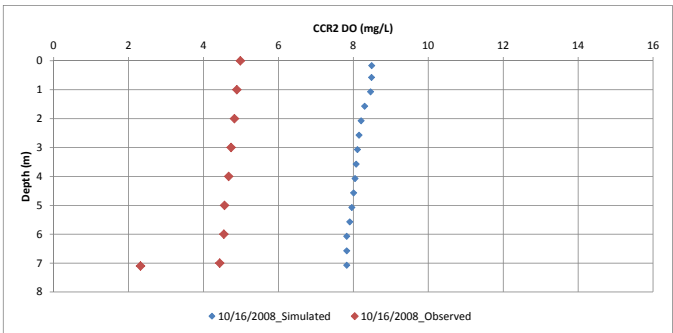
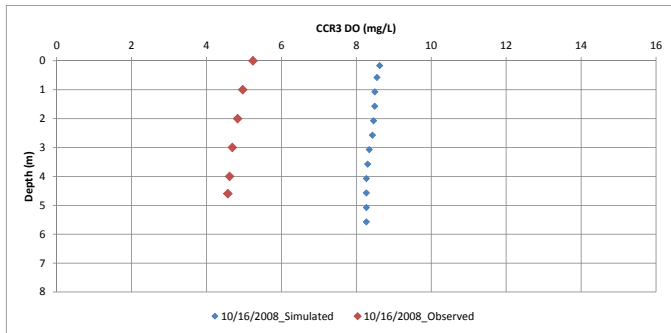
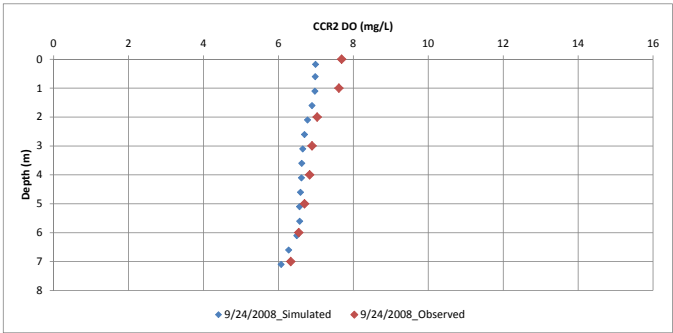
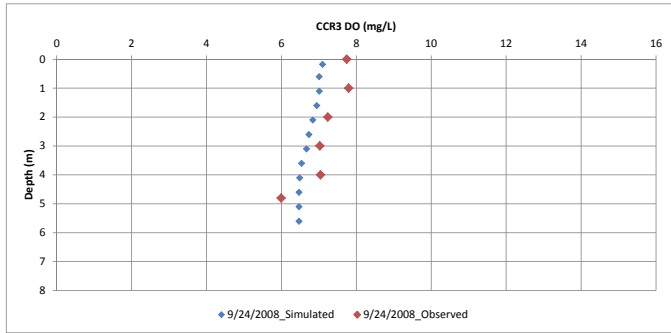
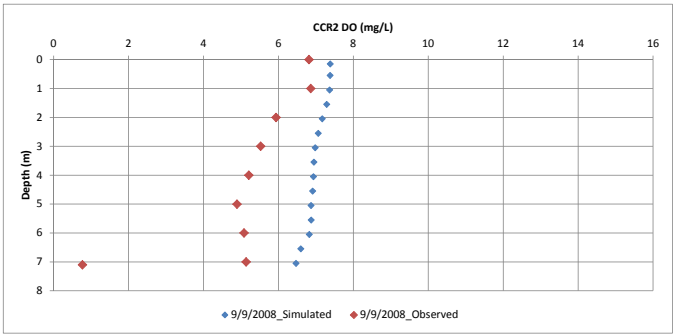
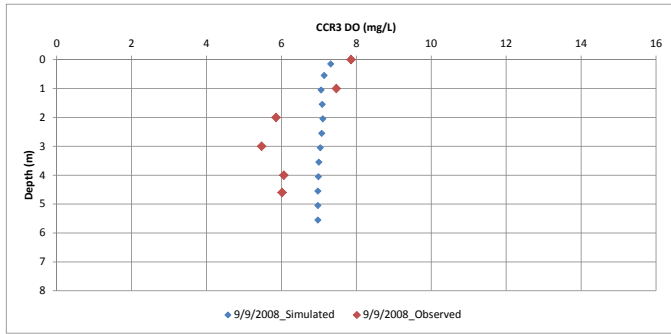


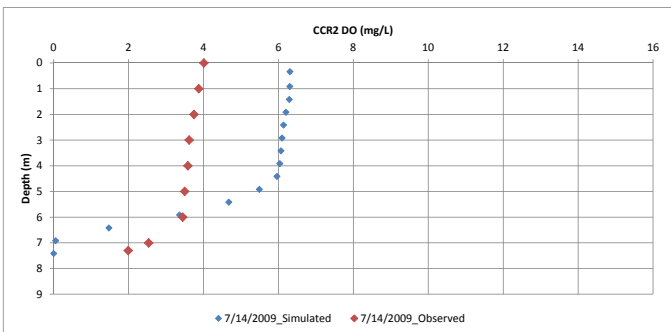
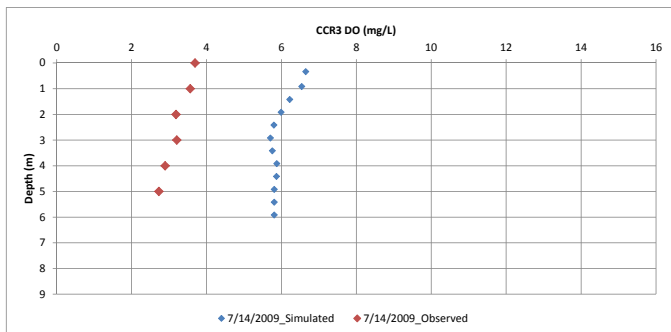
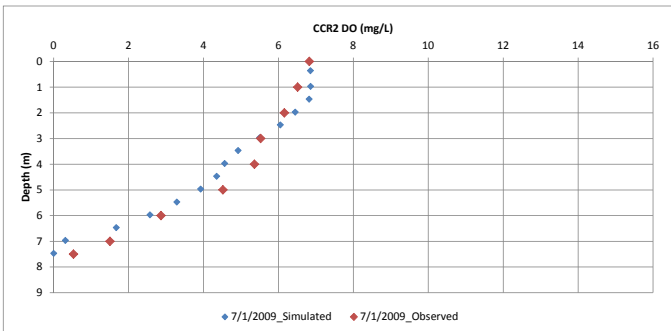
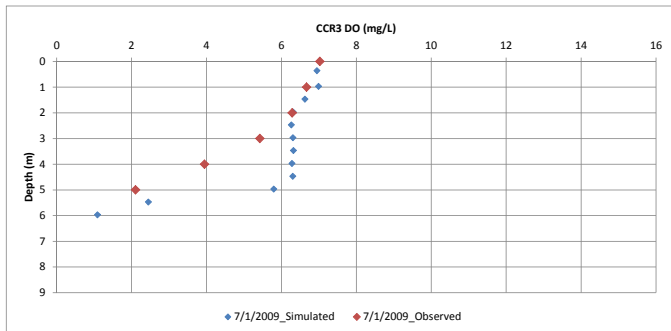
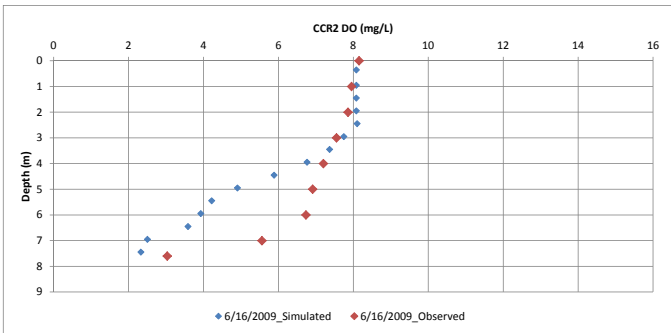
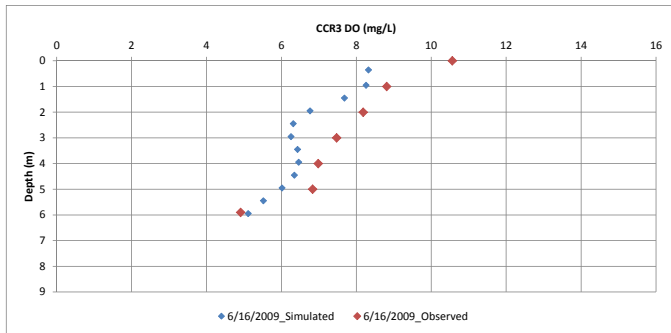
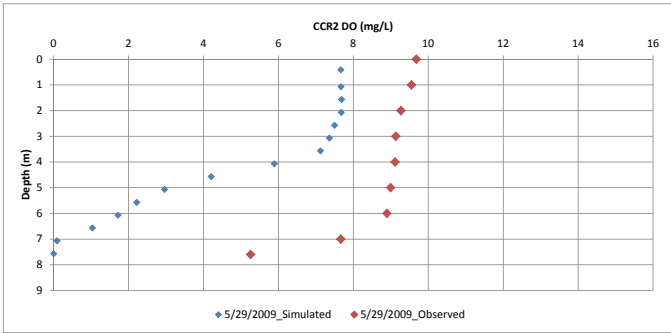
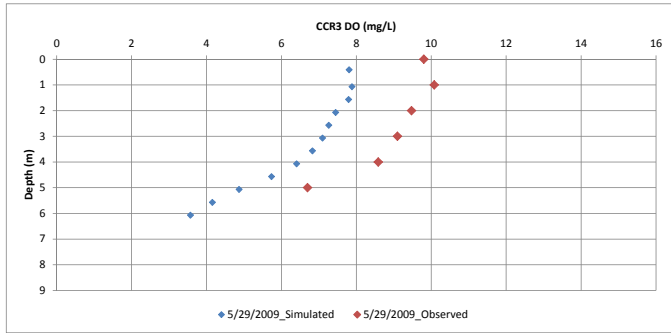
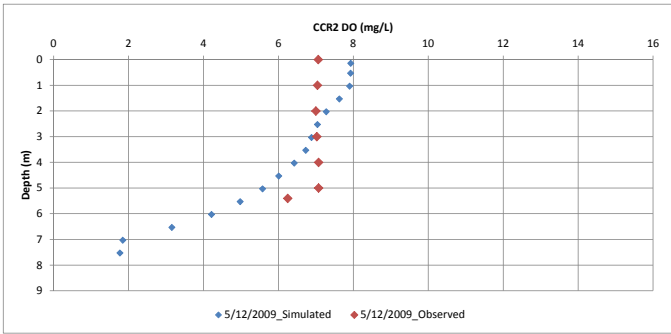
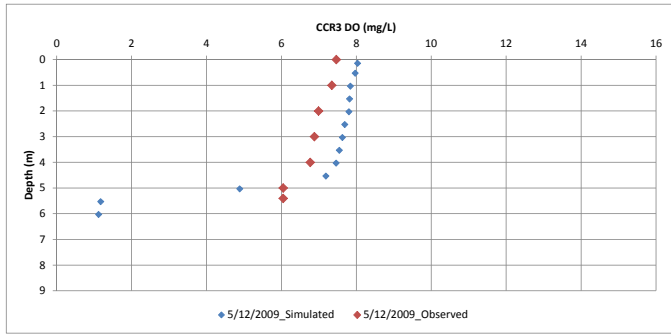


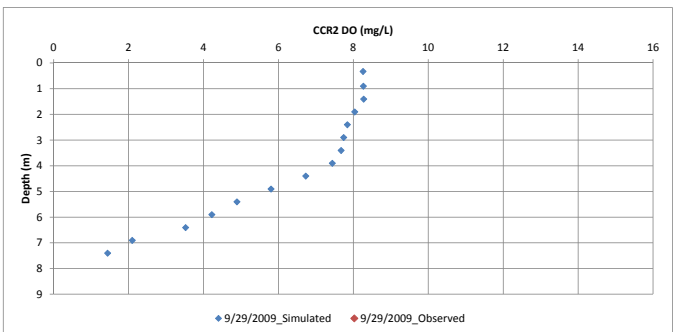
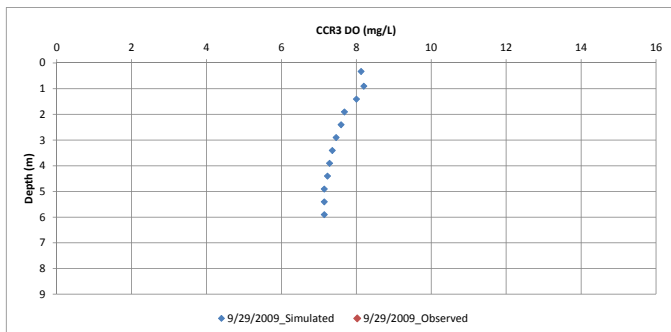
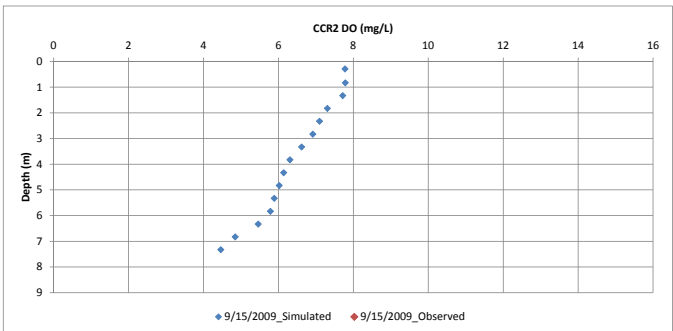
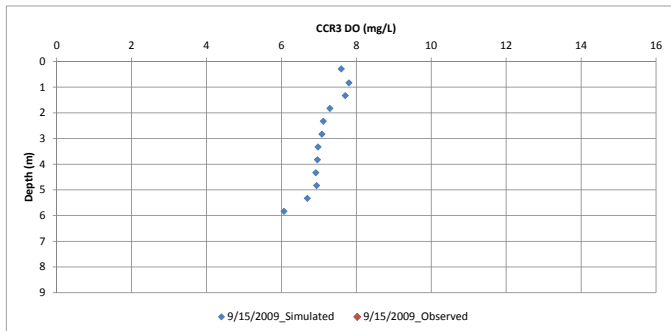
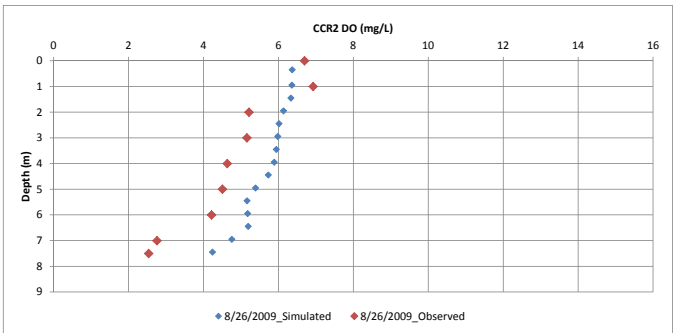
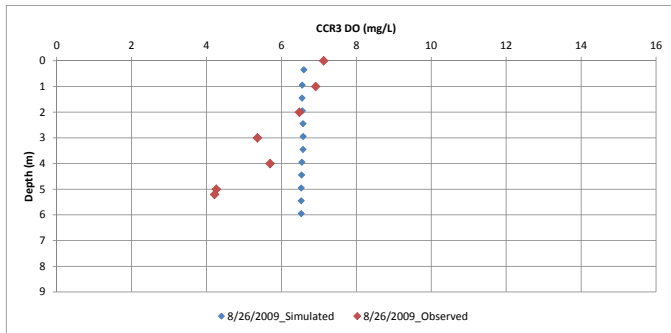
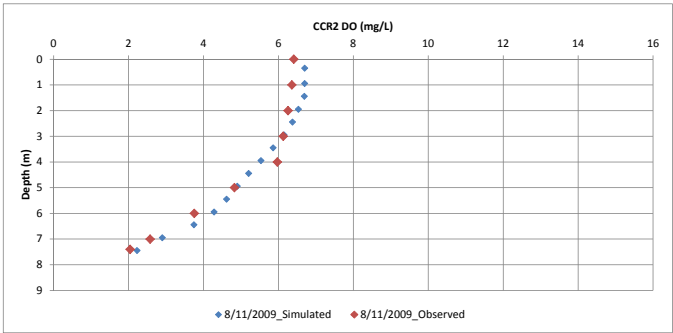
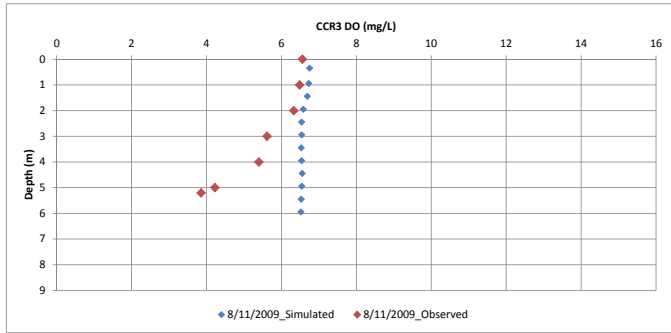
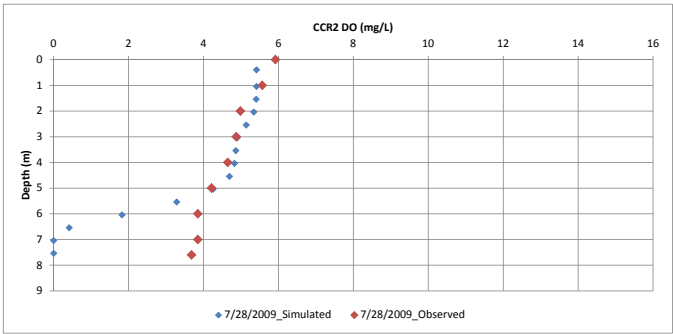
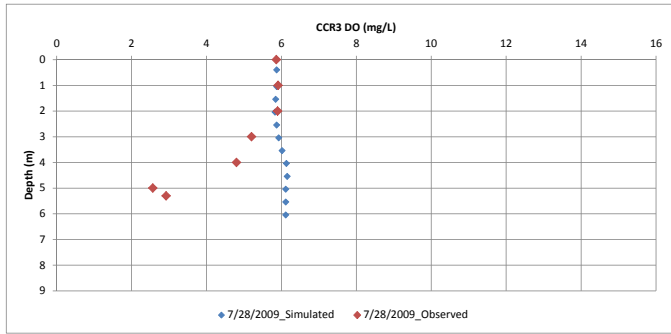


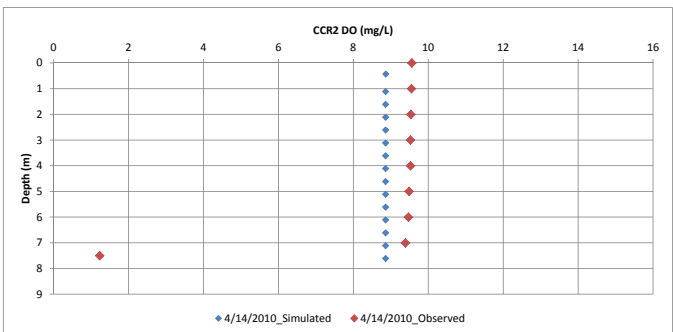
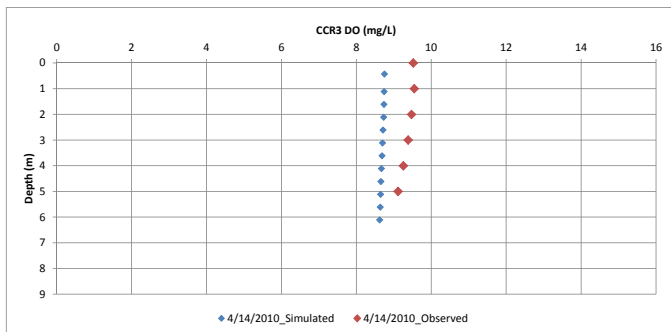
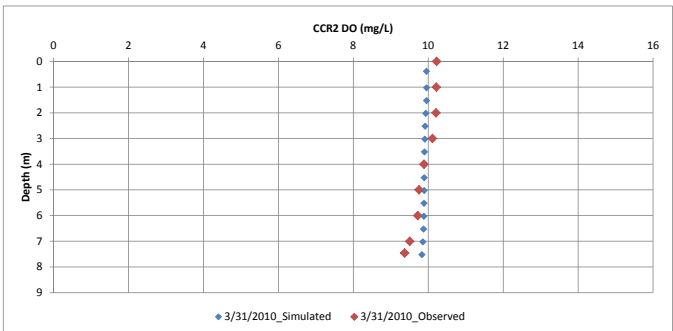
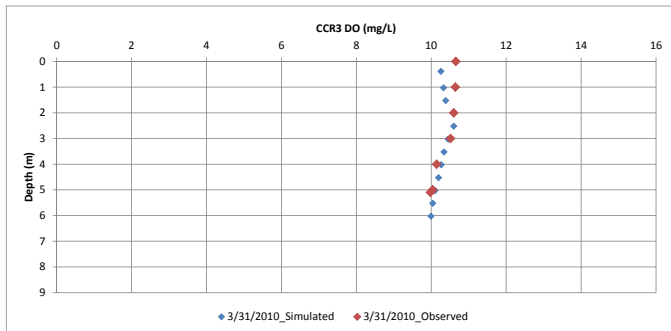
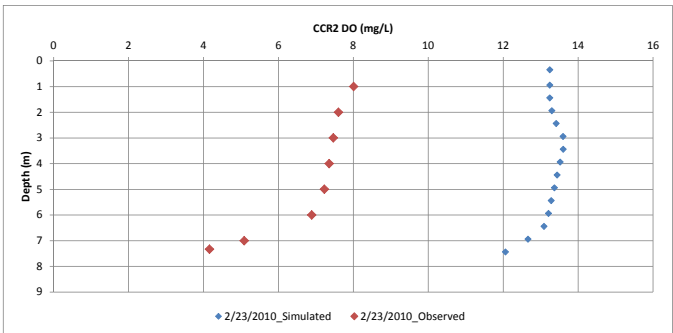
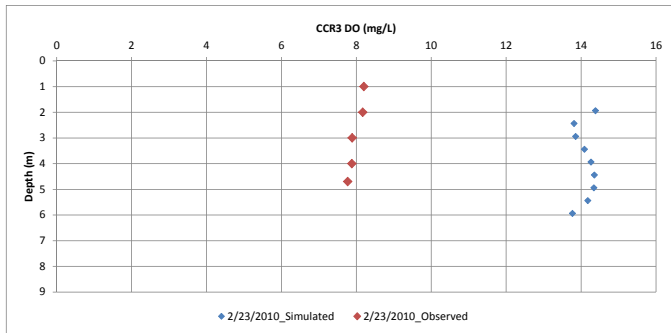
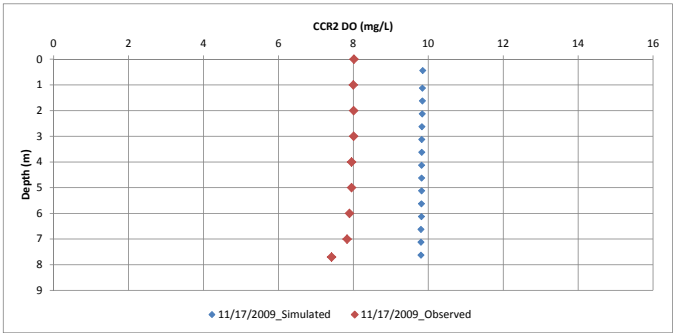
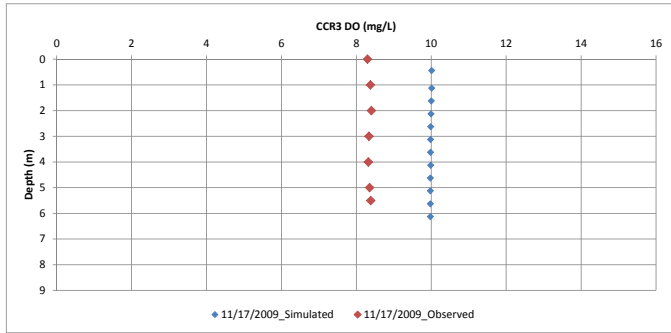
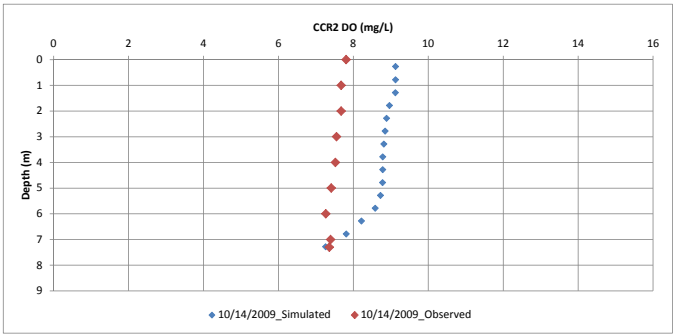
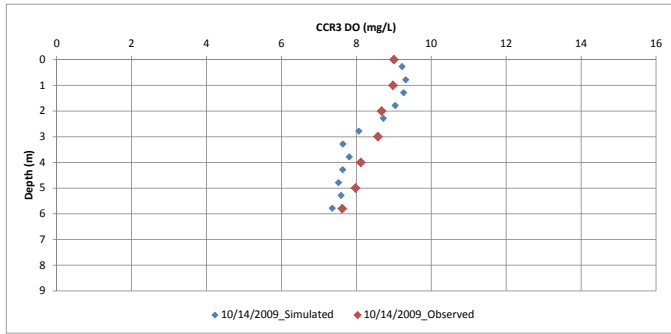


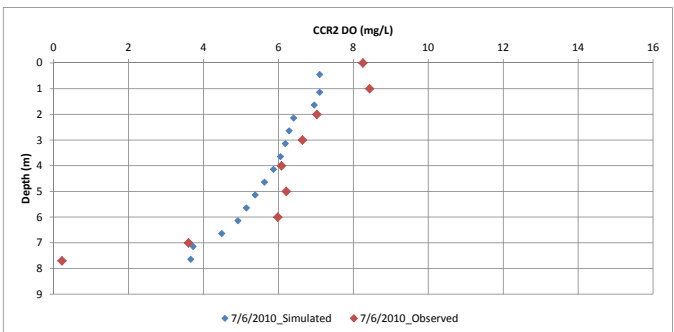
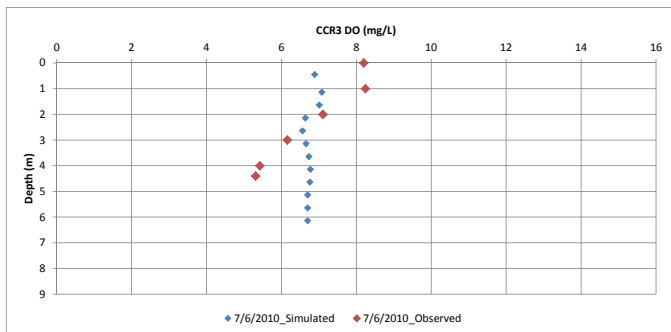
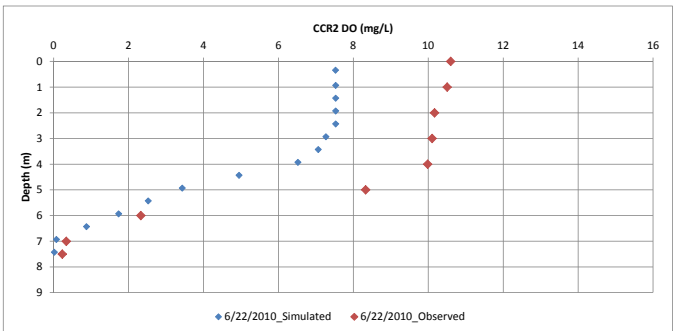
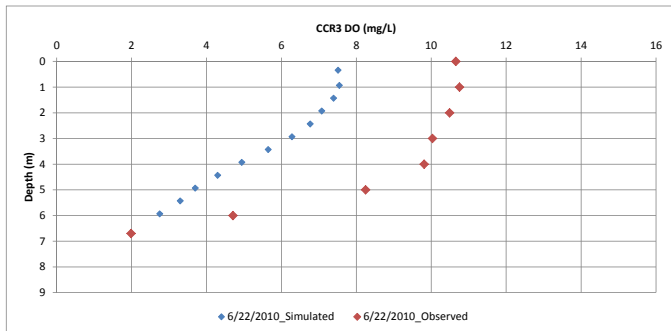
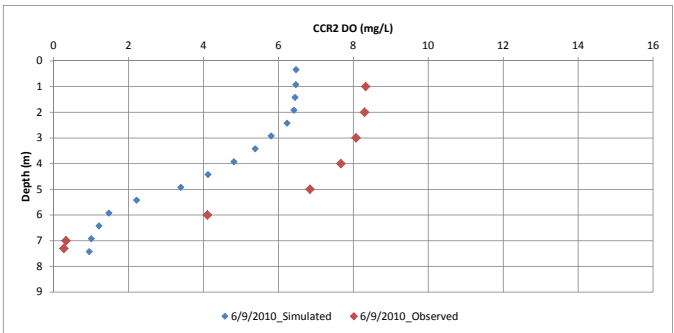
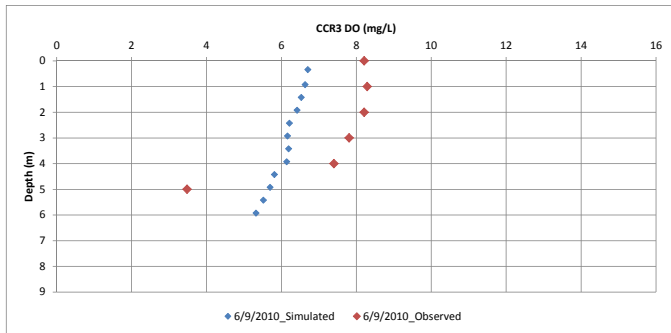
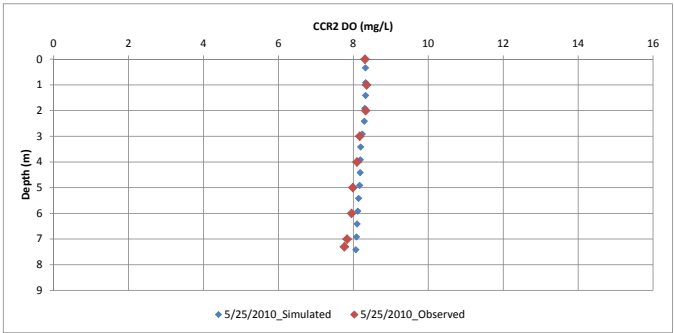
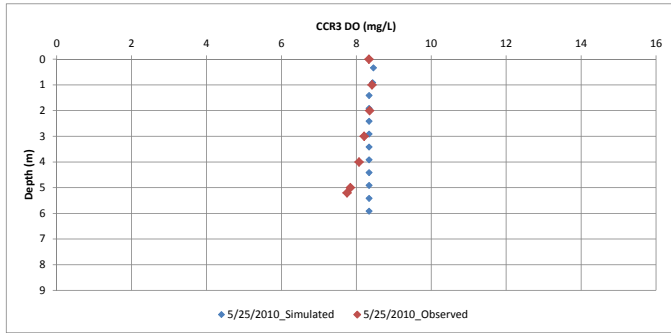
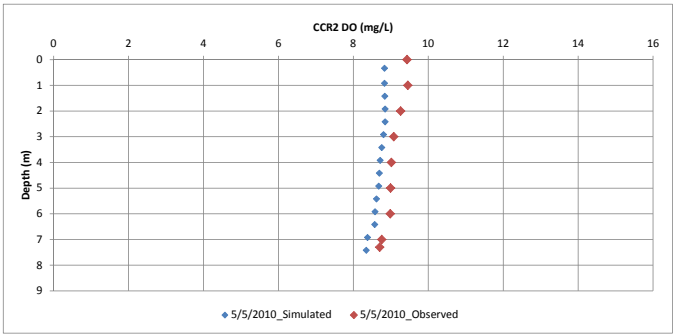
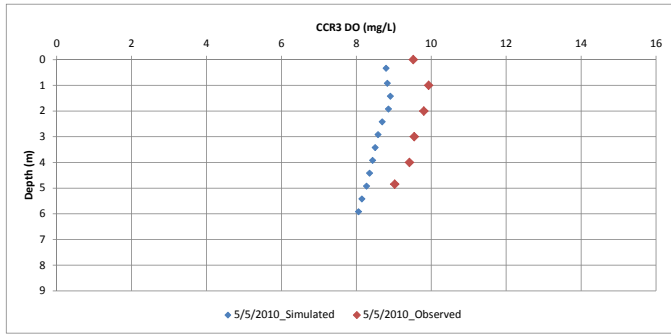




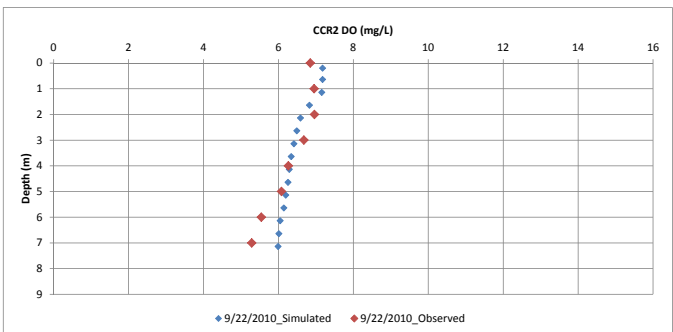
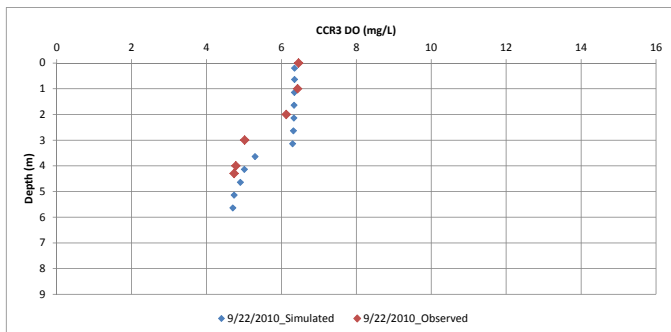
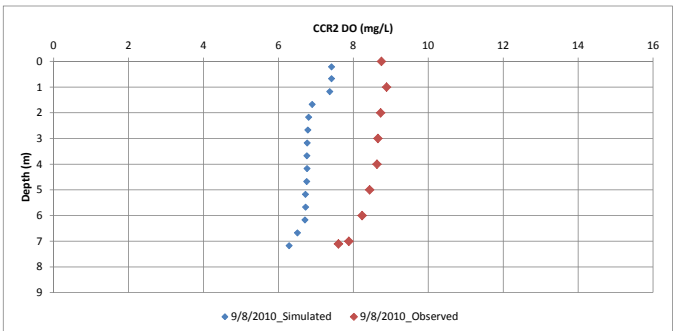
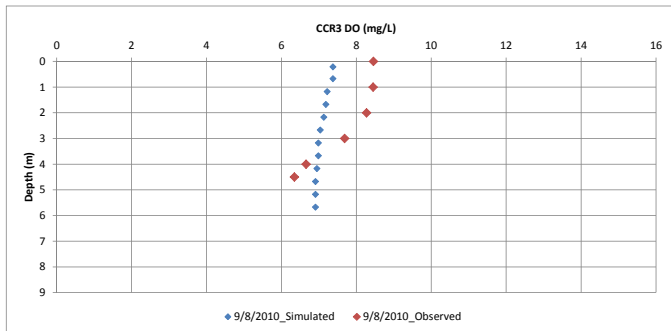
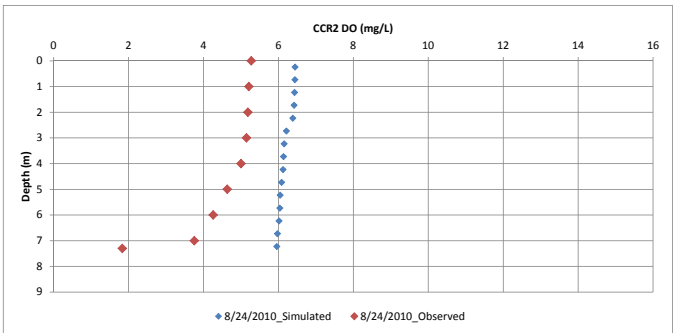
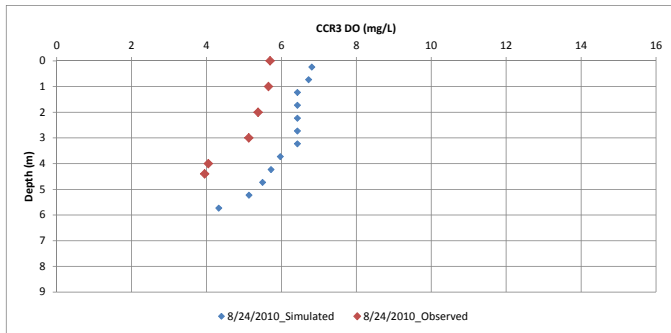
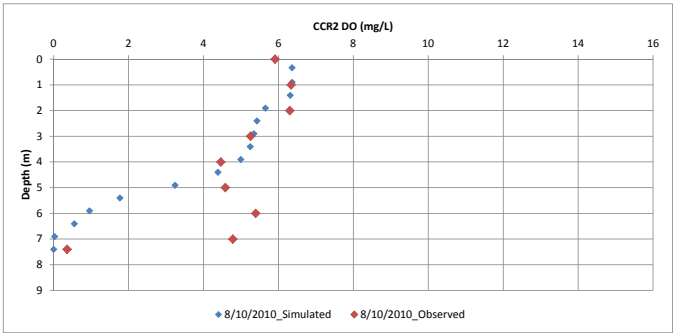
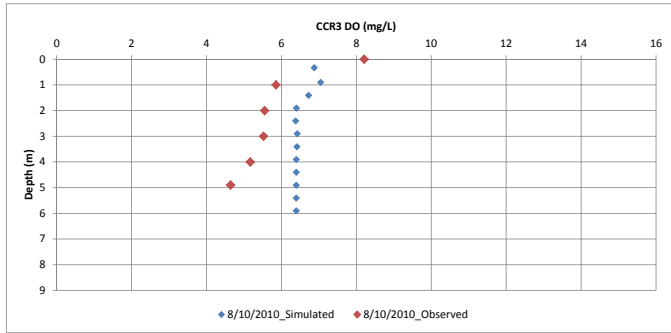
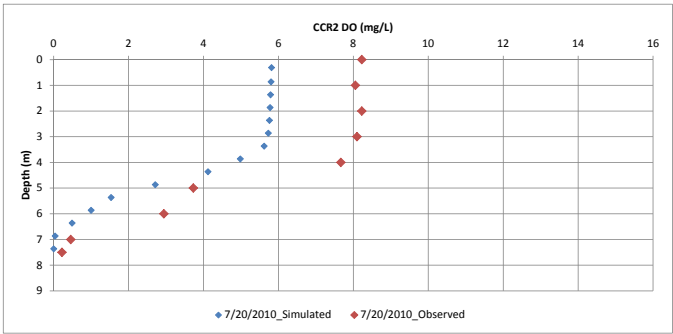
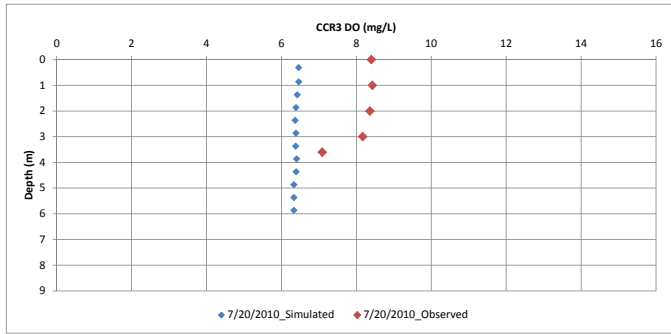


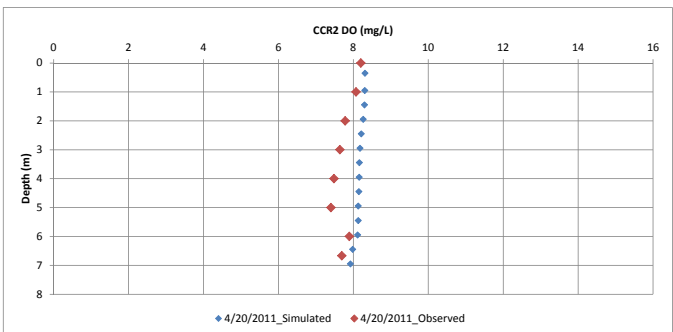
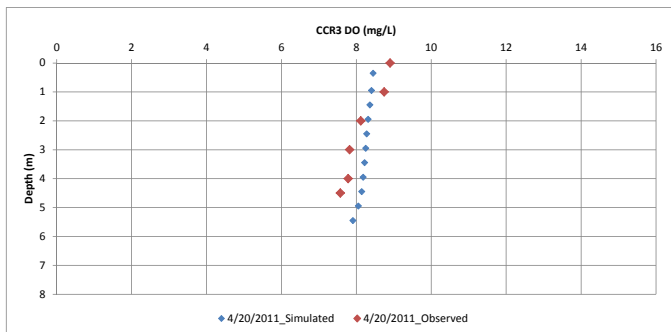
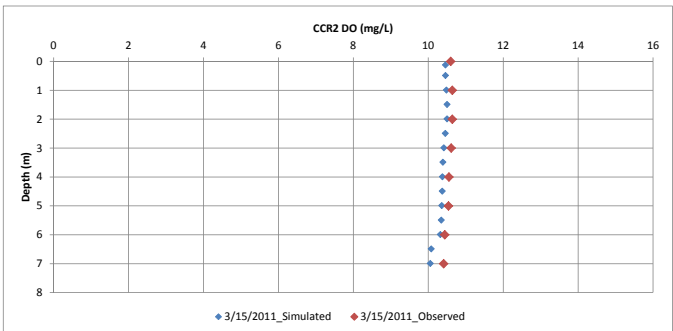
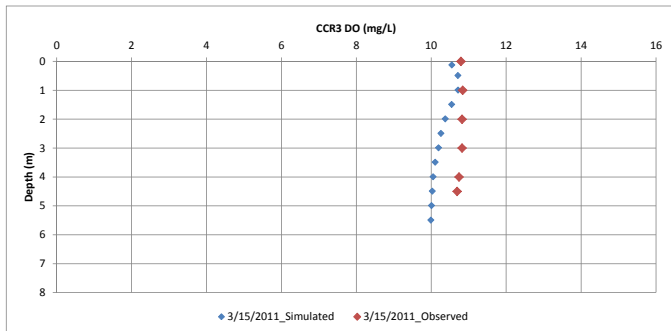
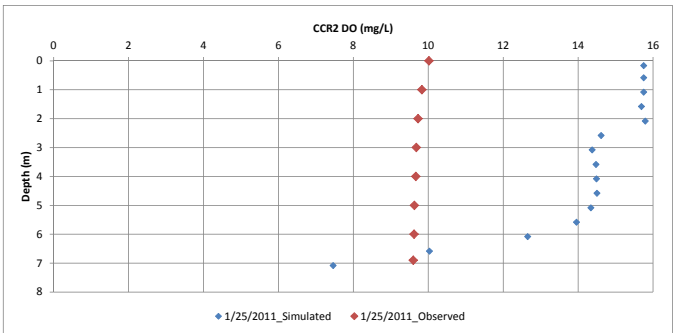
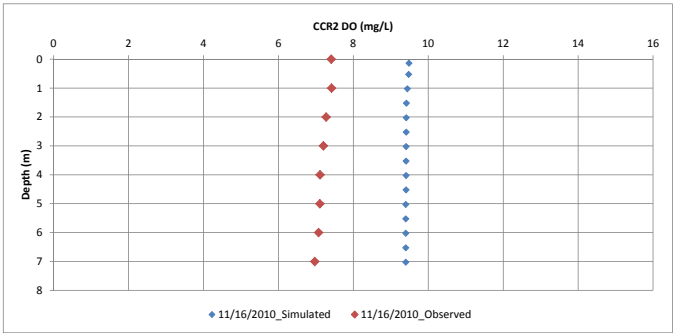
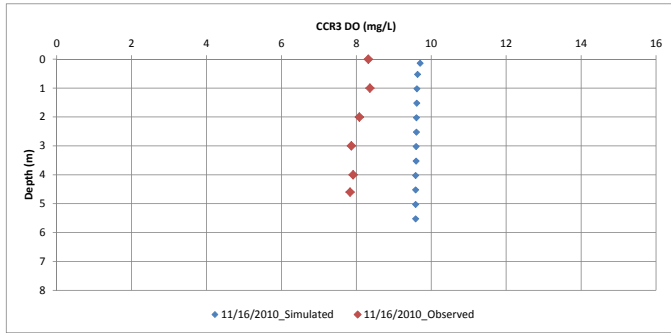
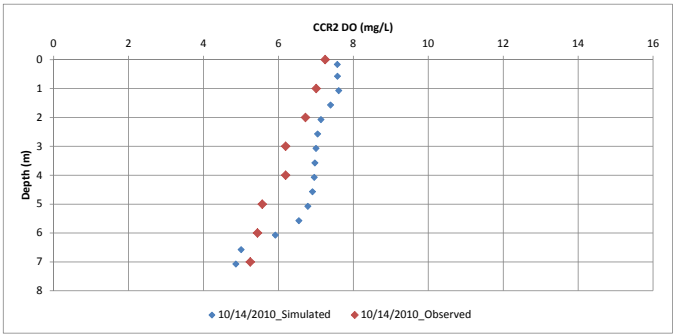
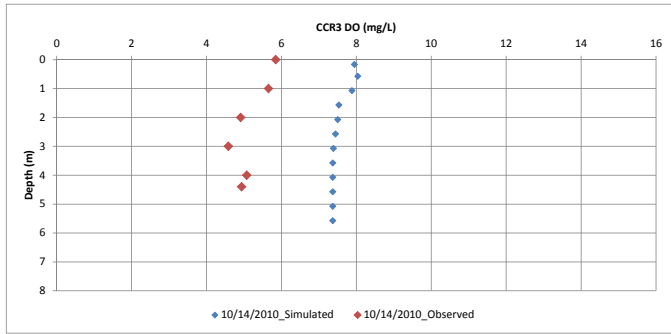


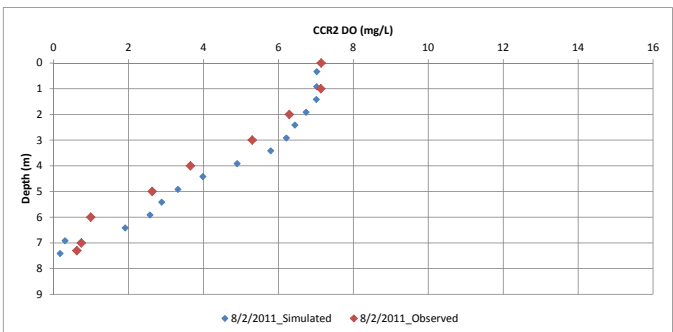
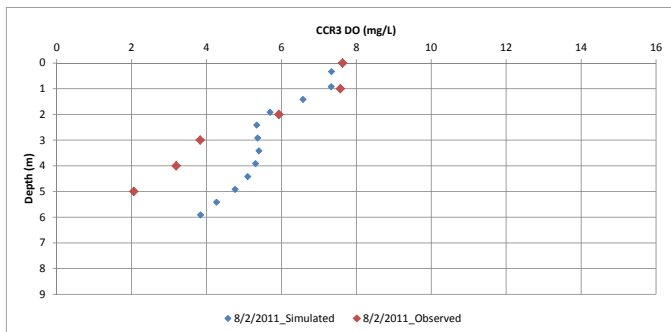
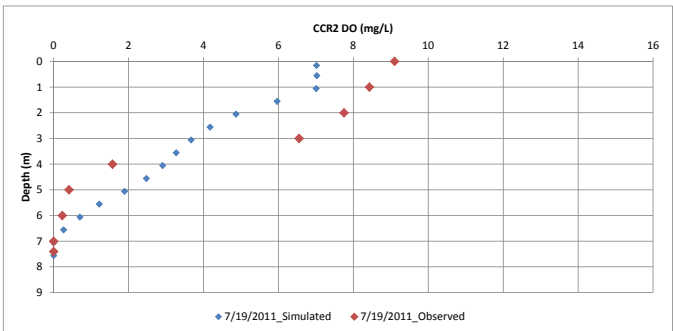
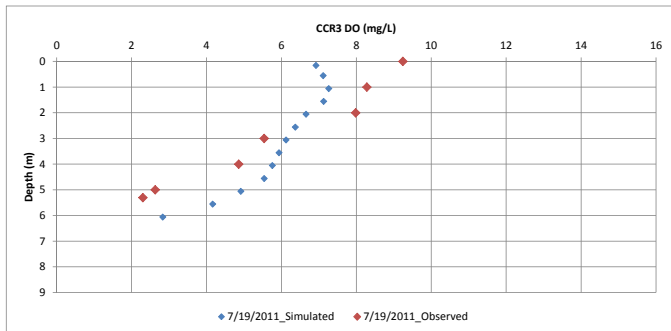
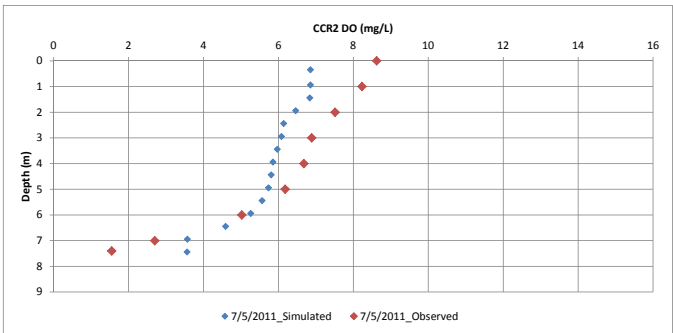
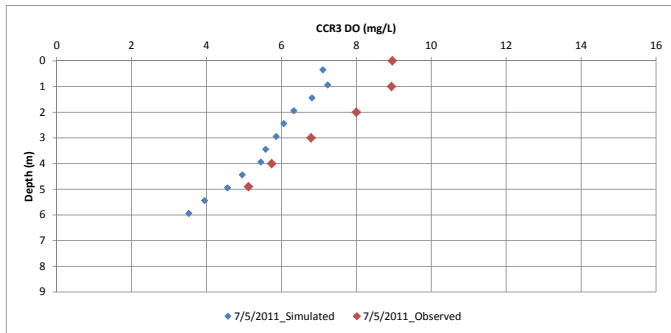
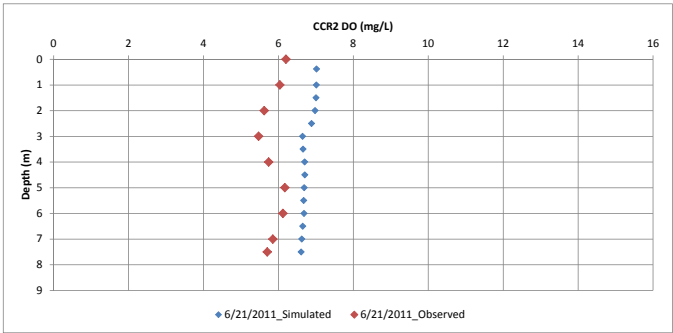
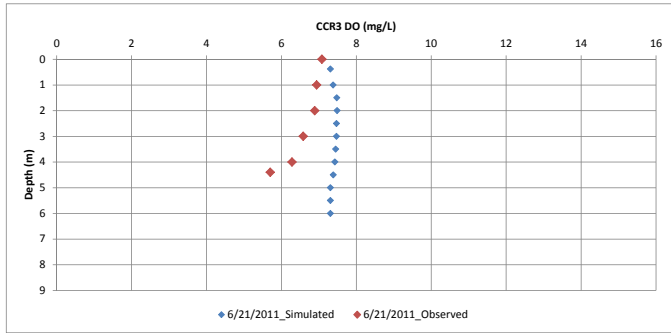
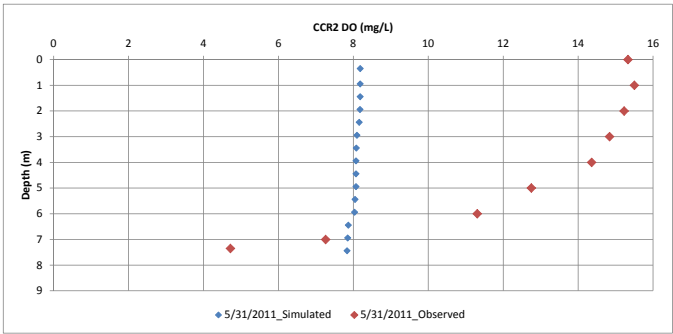
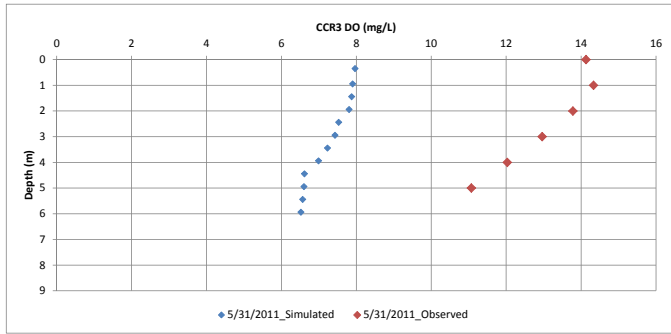


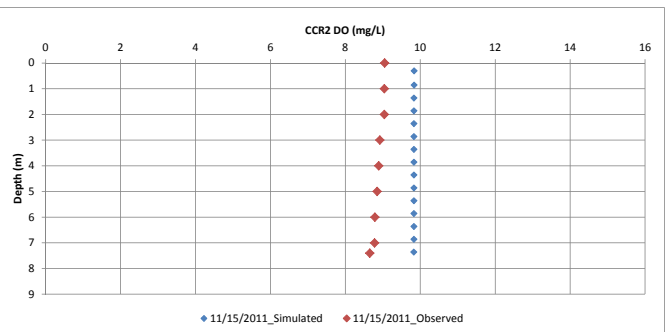
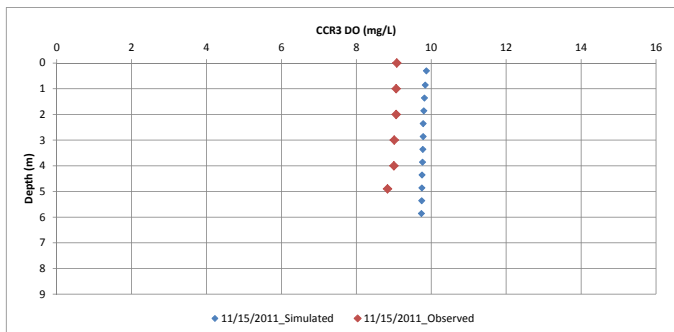
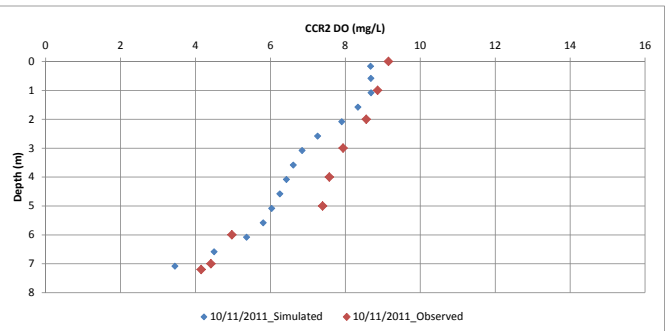
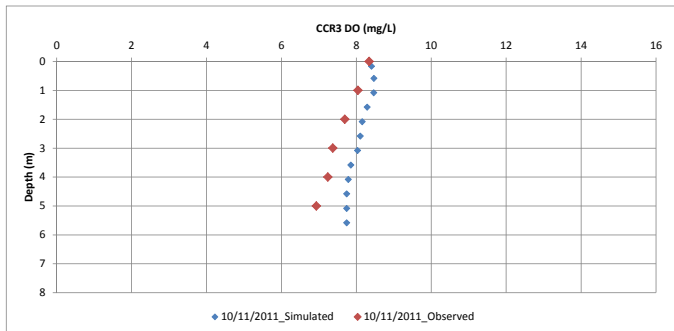
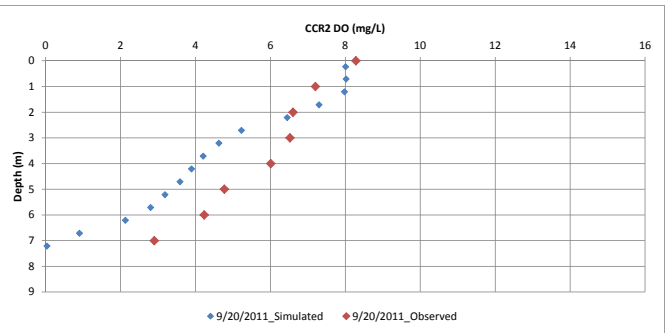
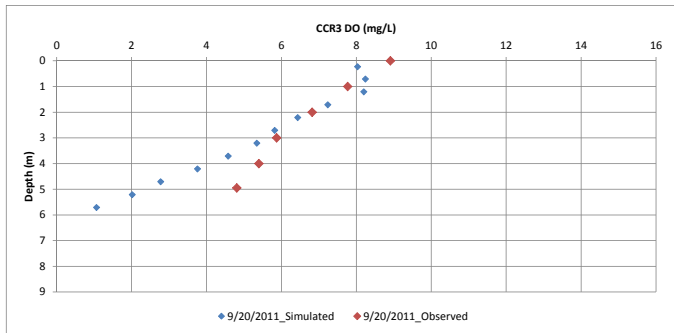
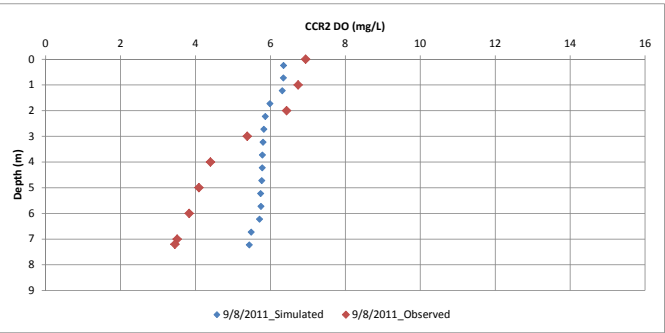
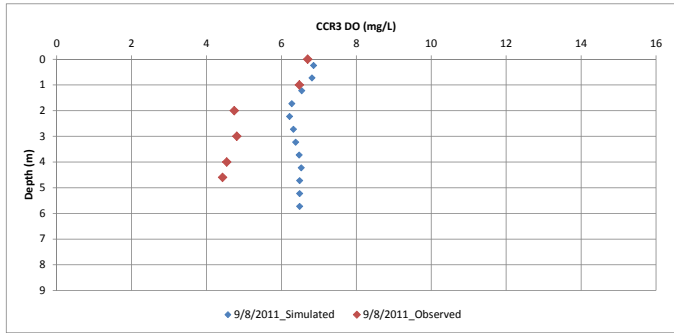
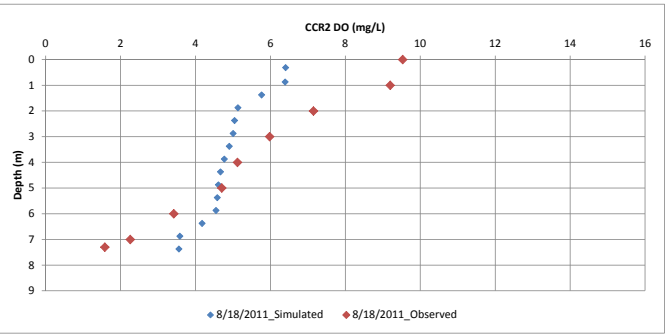
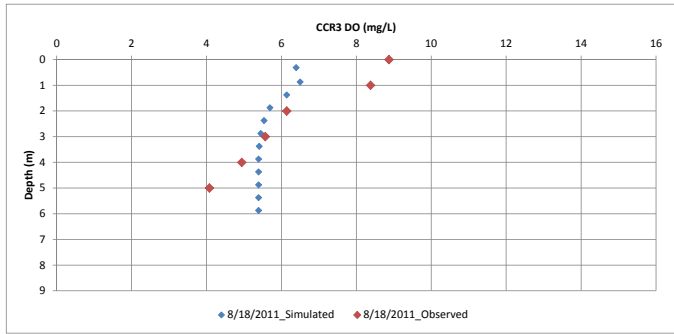


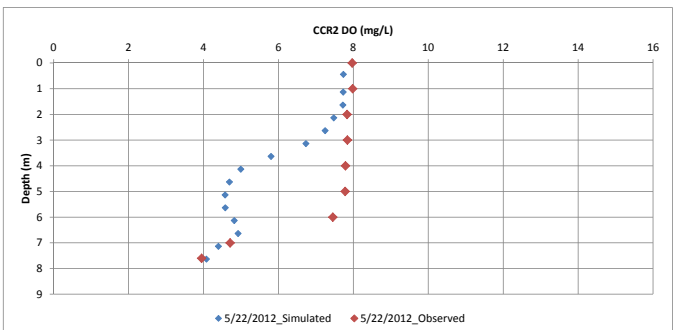
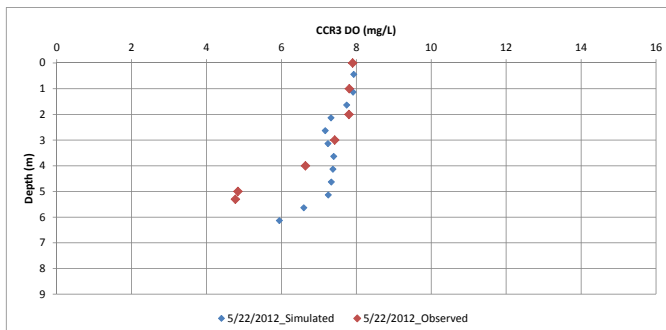
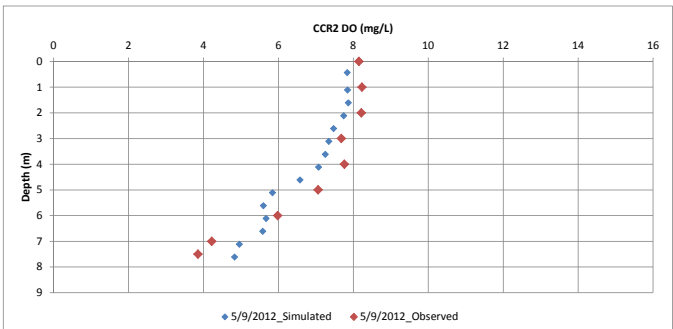
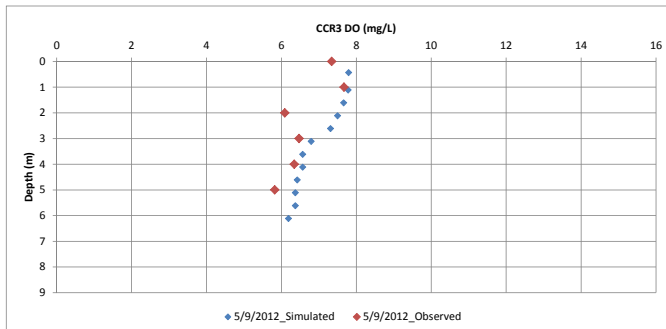
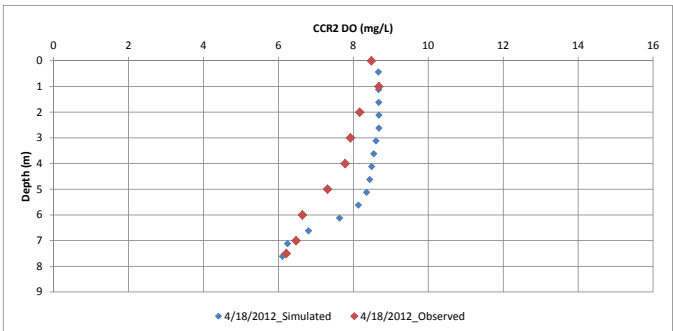
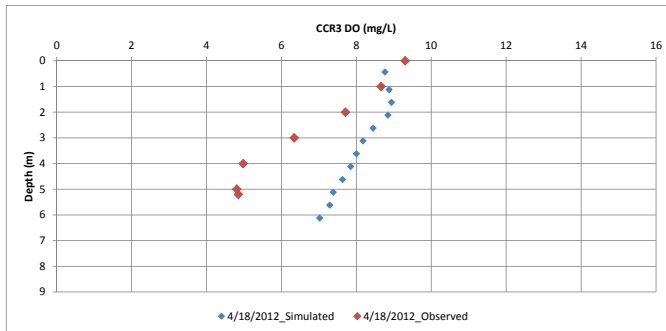
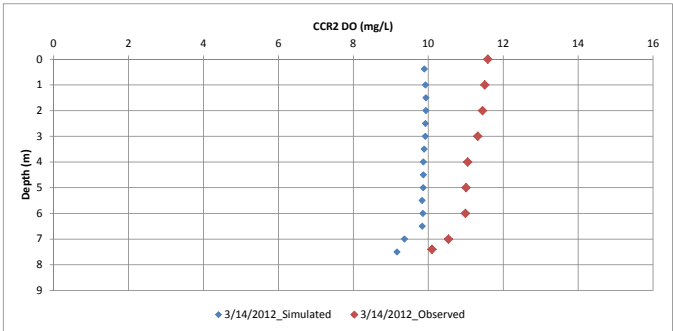
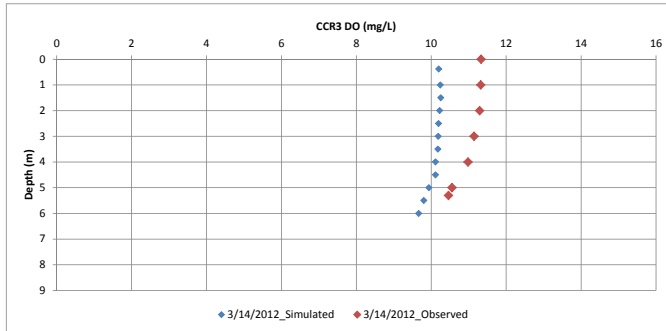
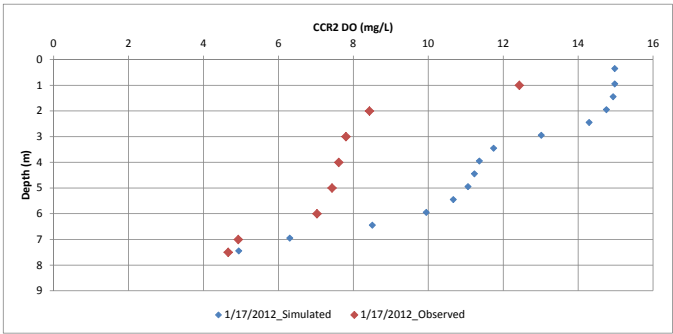
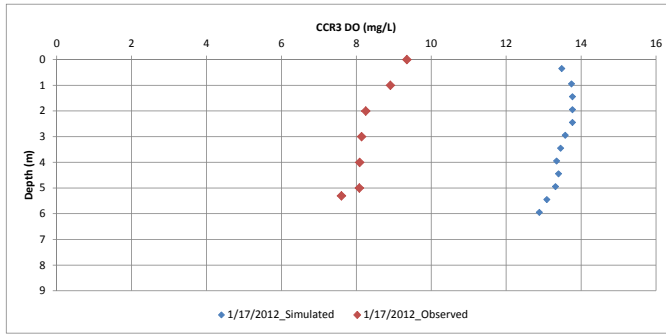


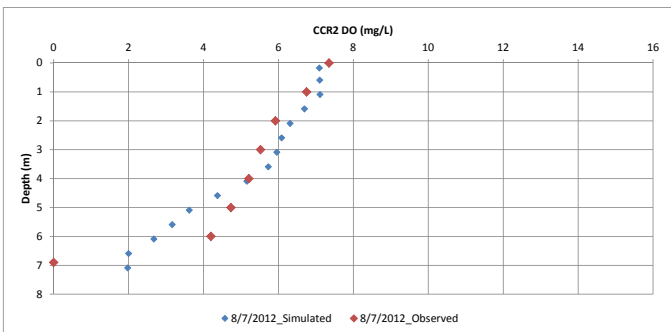
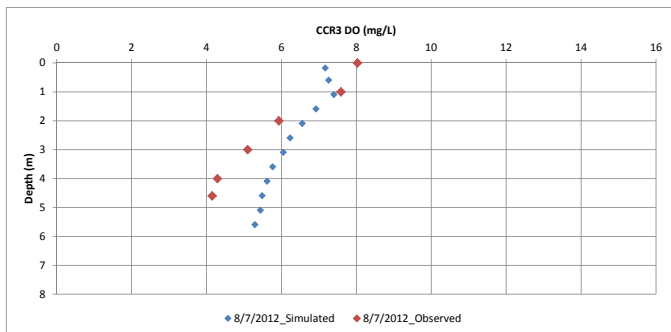
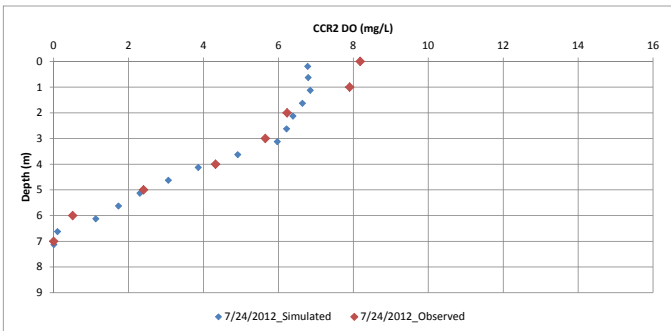
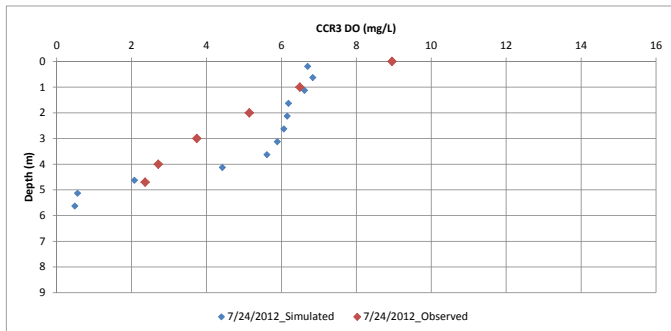
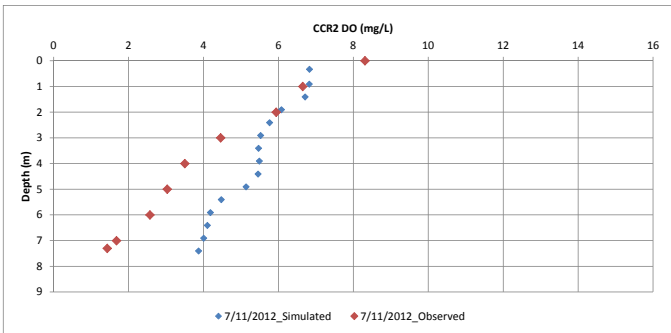
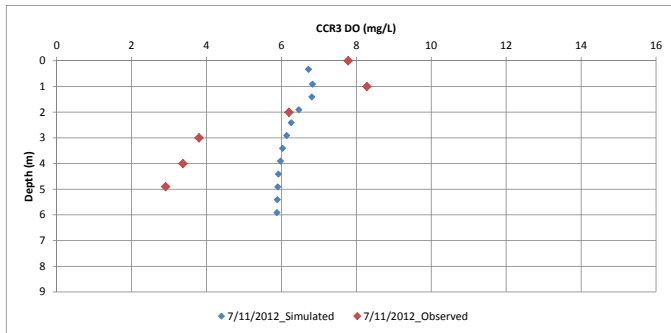
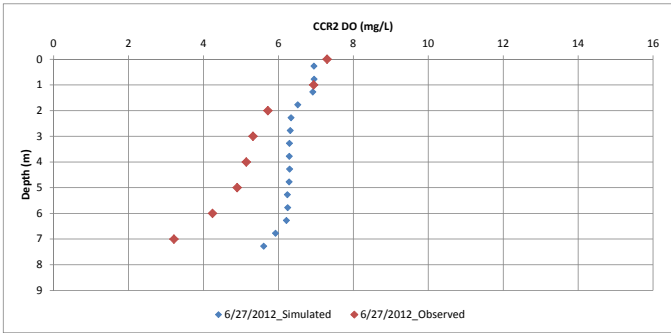
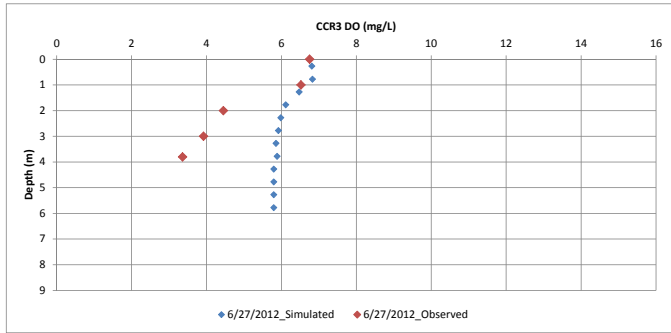
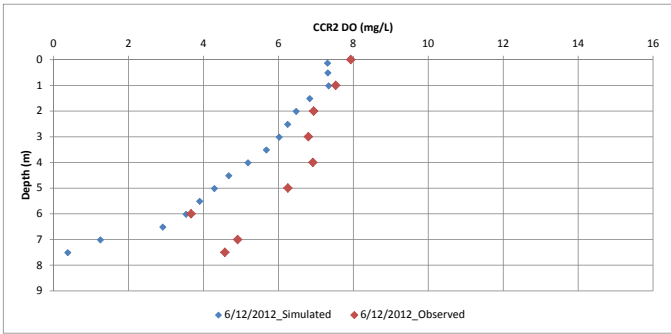
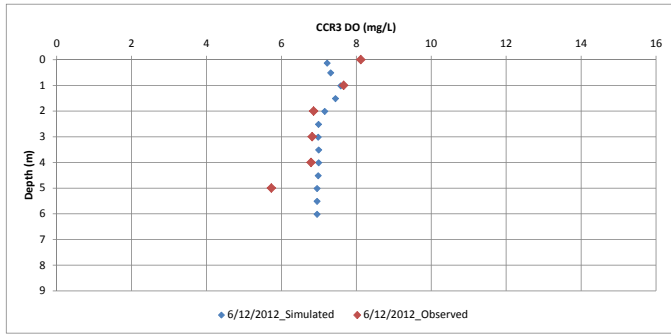


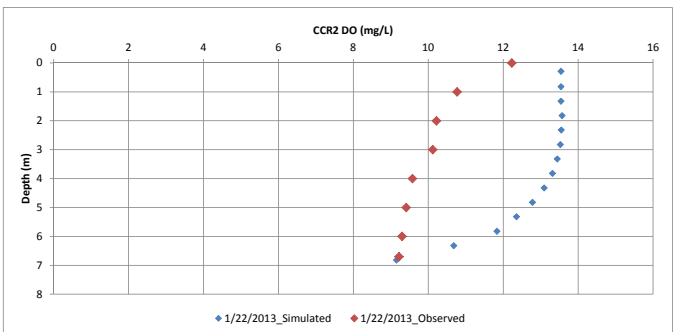
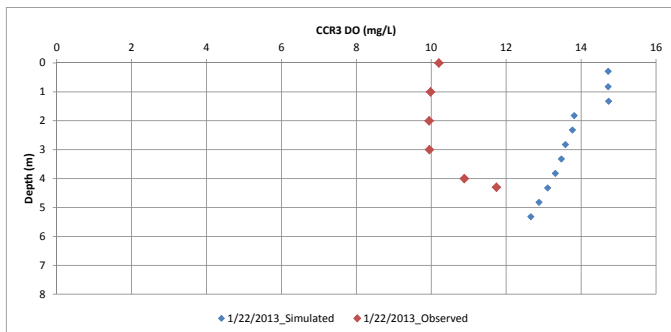
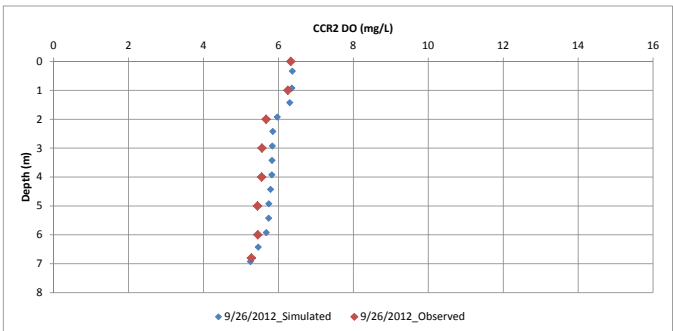
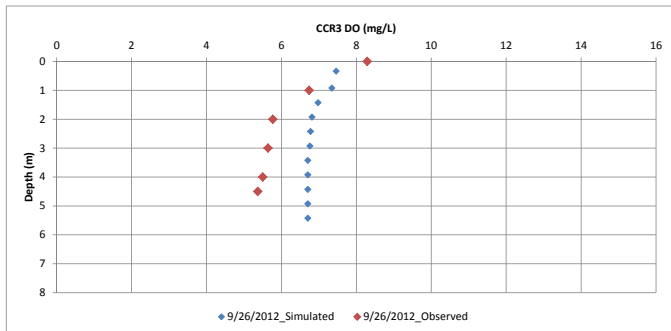
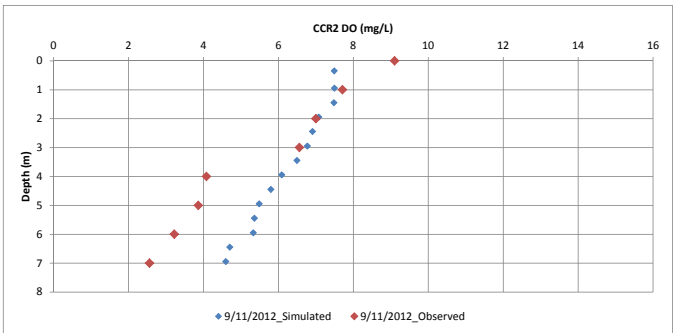
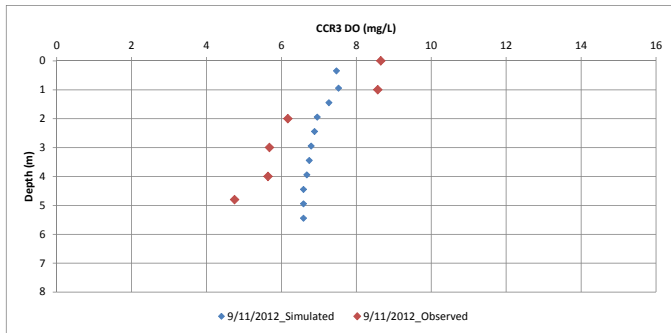
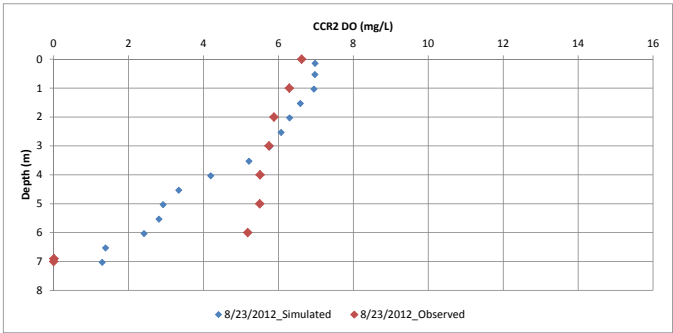
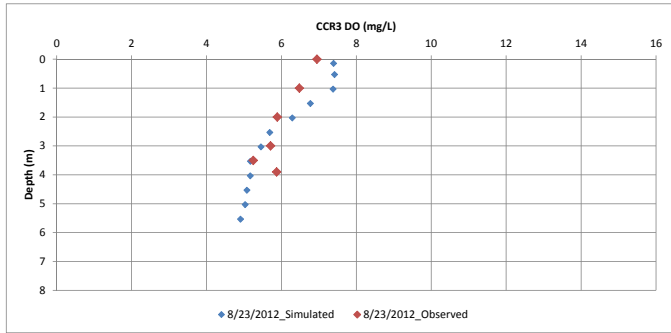
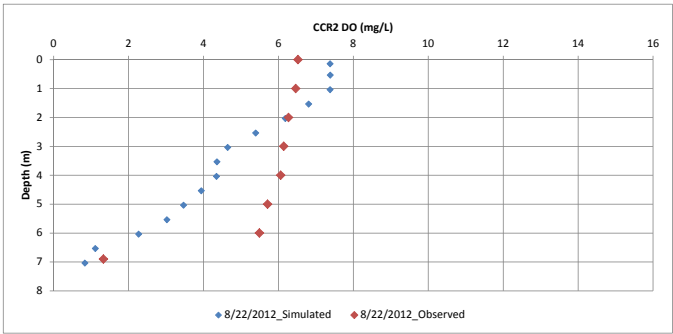
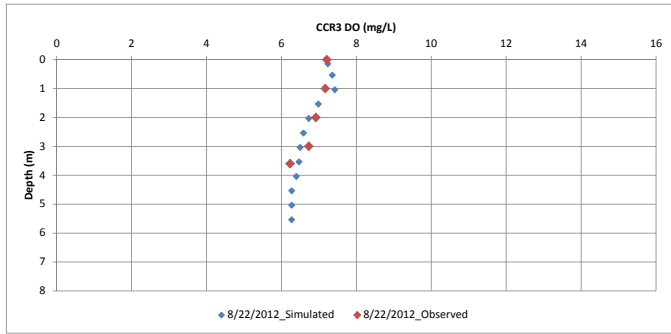


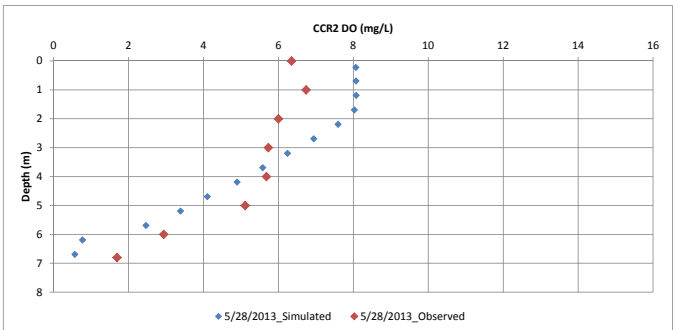
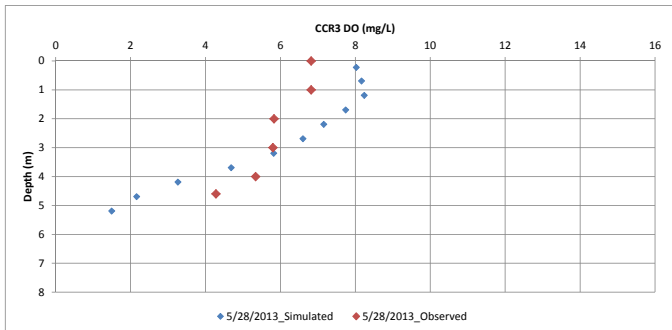
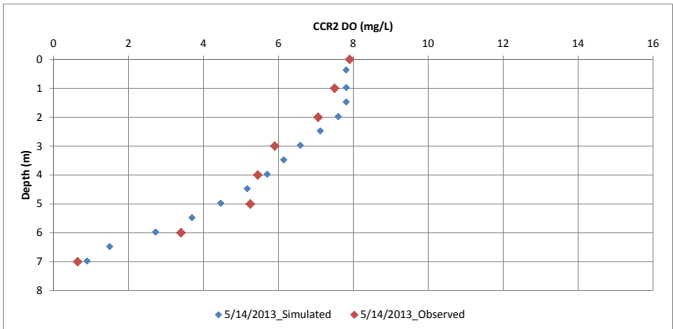
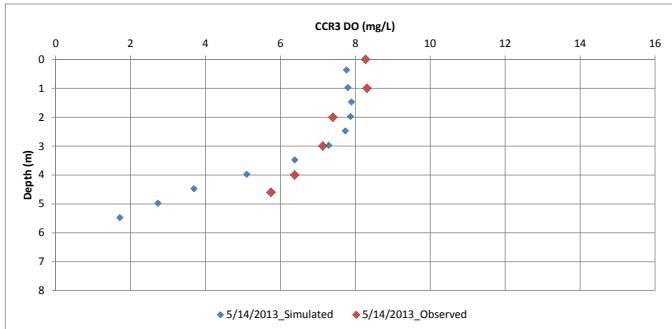
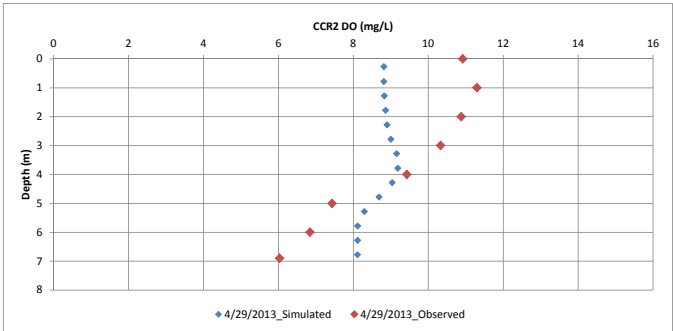
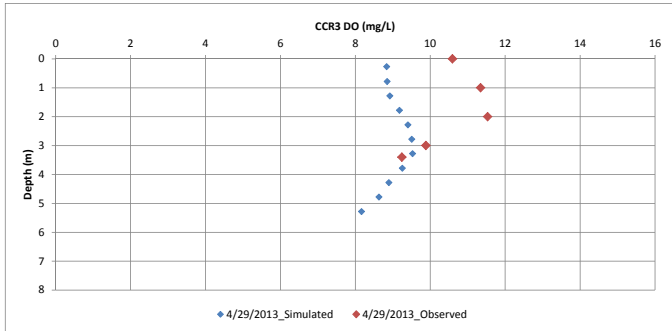
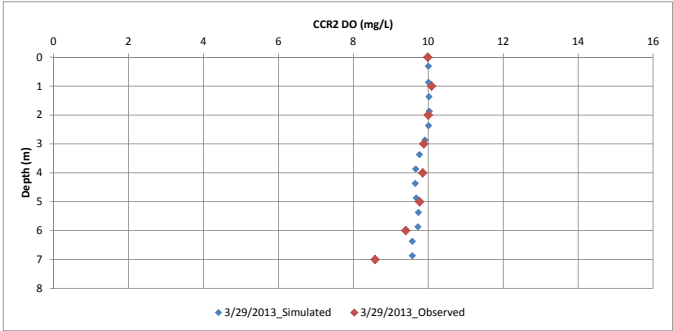
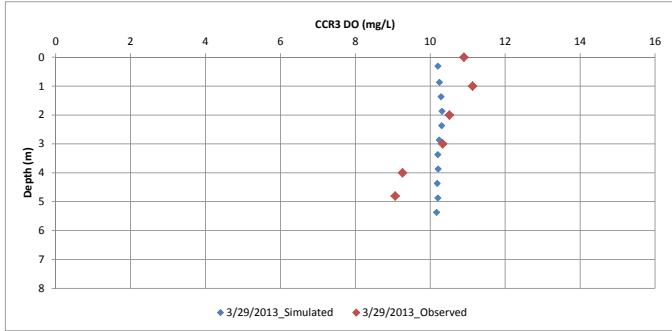
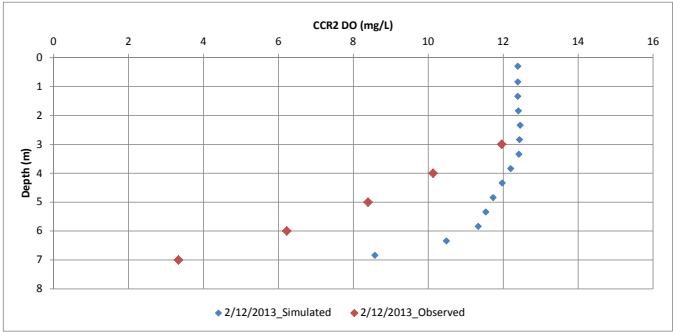




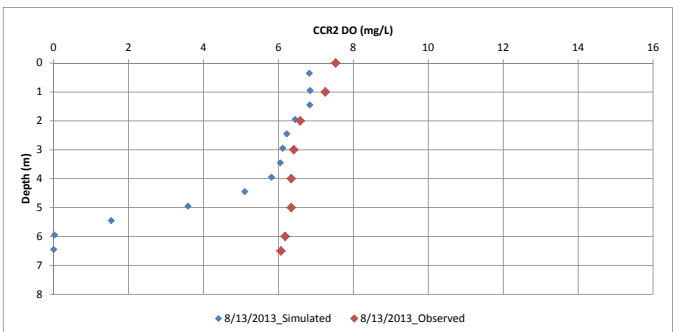
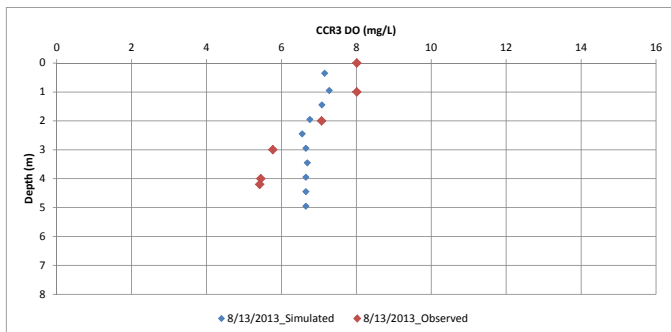
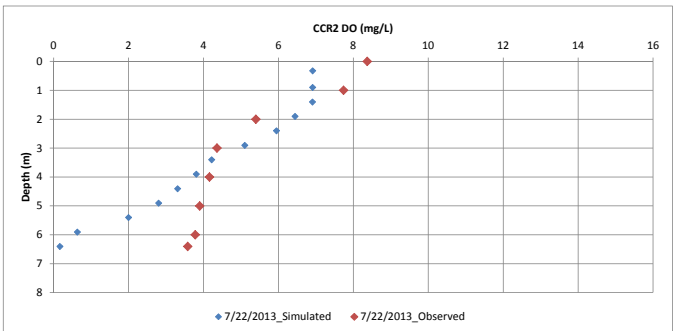
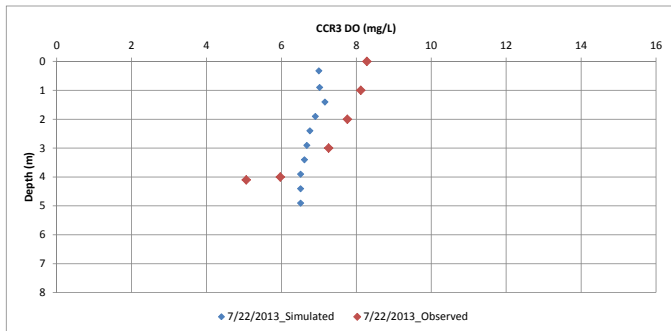
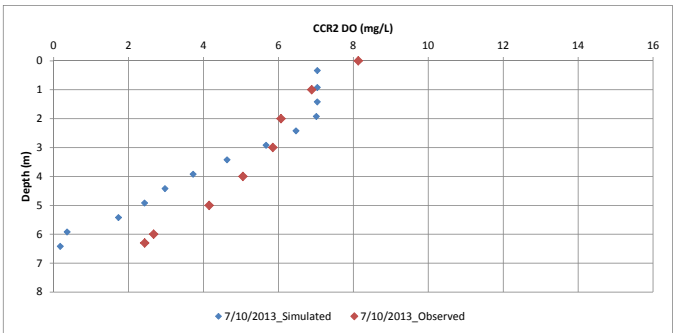
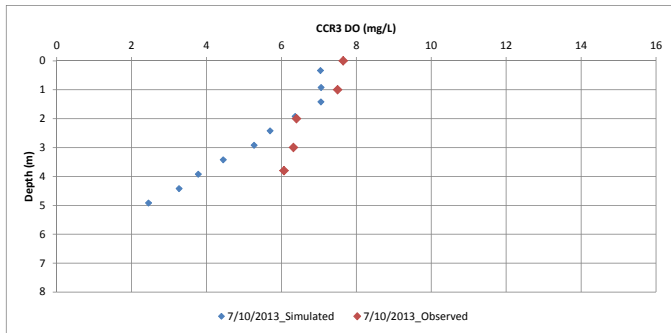
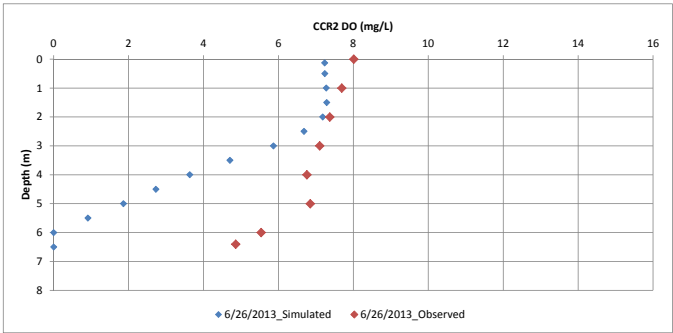
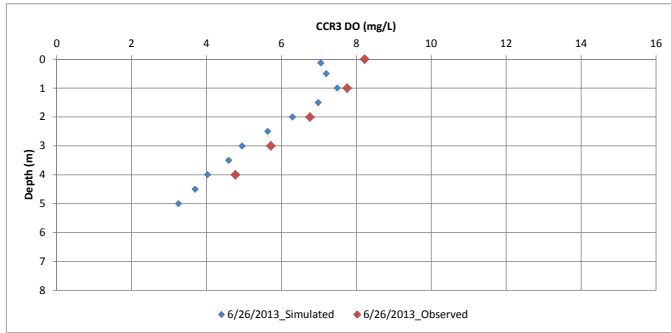
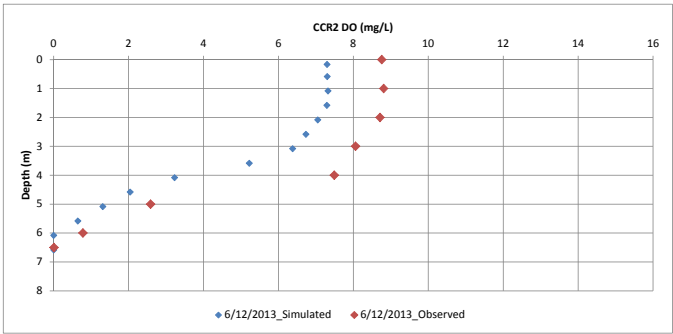
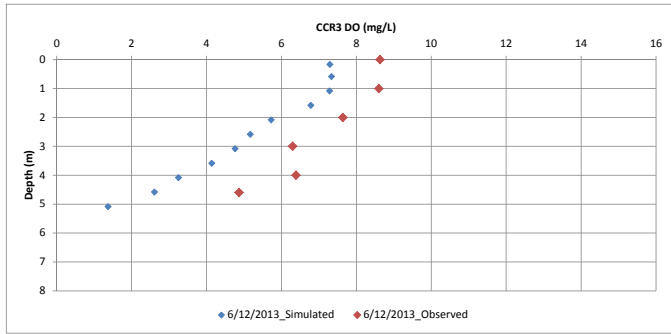


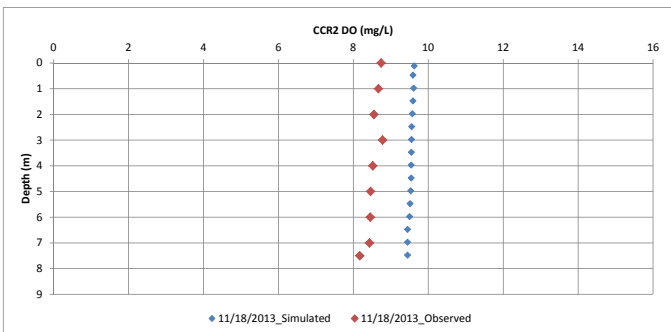
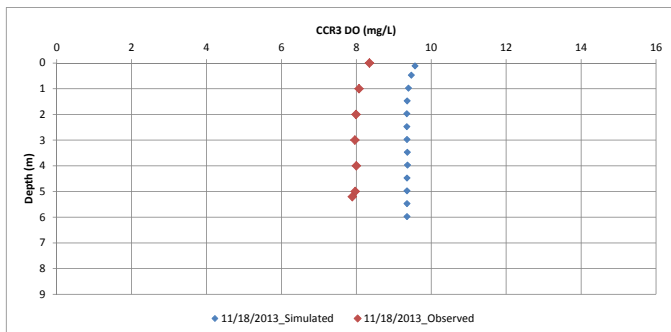
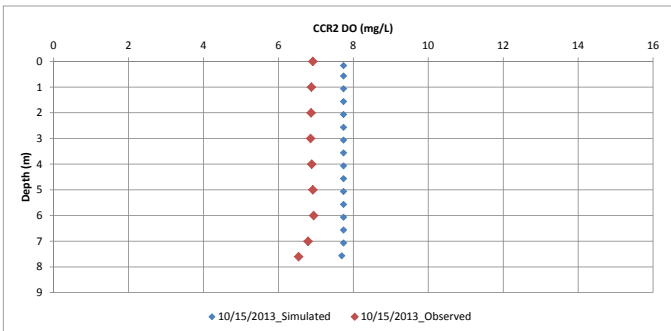
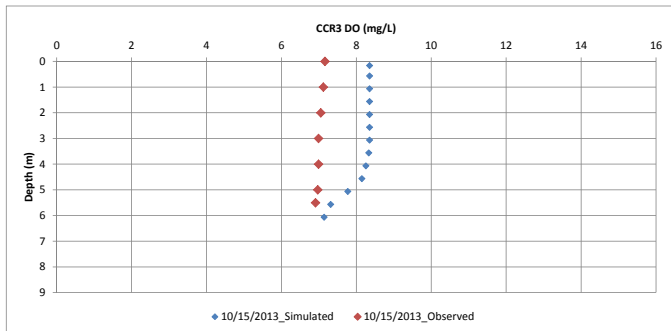
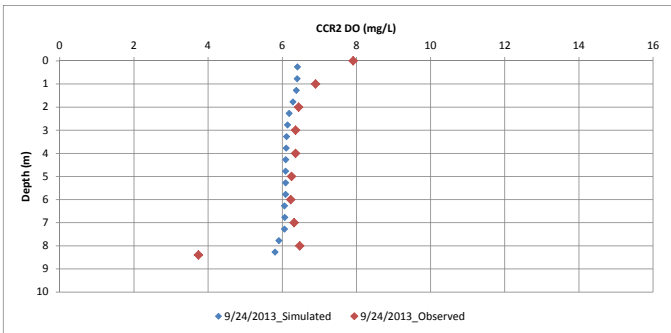
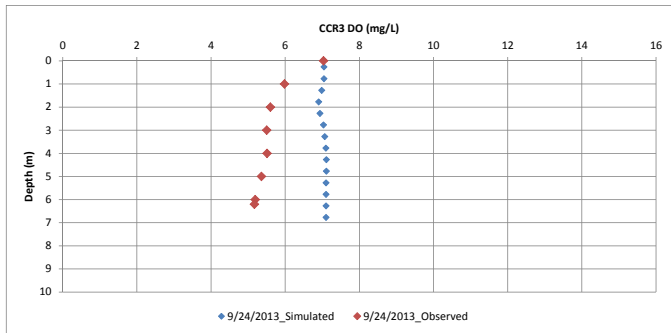
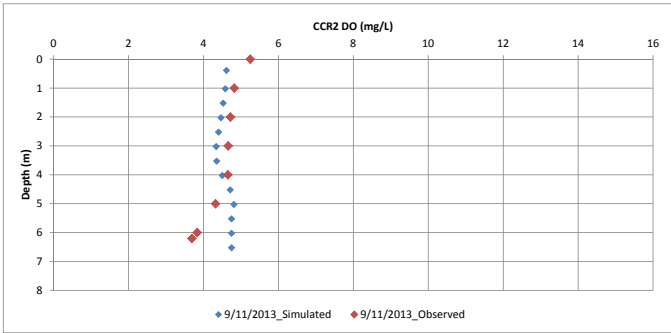
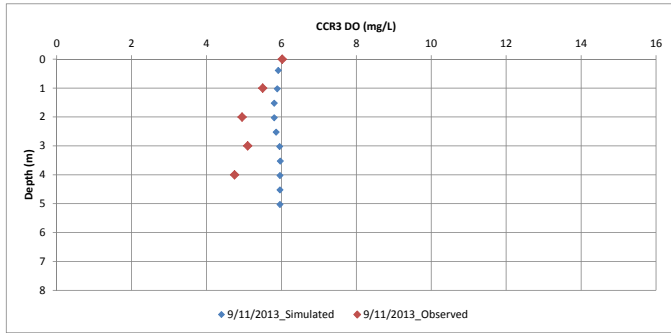
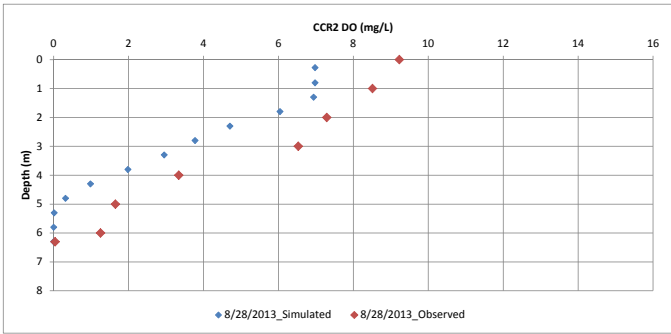
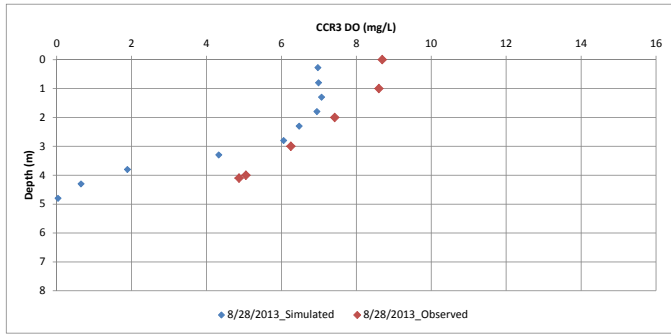












**Attachment C: Dissolved Oxygen Profiles: Observed and Simulated Results**

