

# A comparison of Spectro::lyser, YSI 6-Series, and Hydrolab Sondes

A scenic view of a lake with a forested shoreline and a cloudy sky. The water is calm, reflecting the sky and the surrounding greenery. There are several rocks in the water, and the forest on the left is dense with evergreen trees. The sky is filled with soft, grey clouds, and the overall atmosphere is serene and natural.

Is a network's integrity compromised when  
using multiple equipment manufacturers;  
or is diversity acceptable?



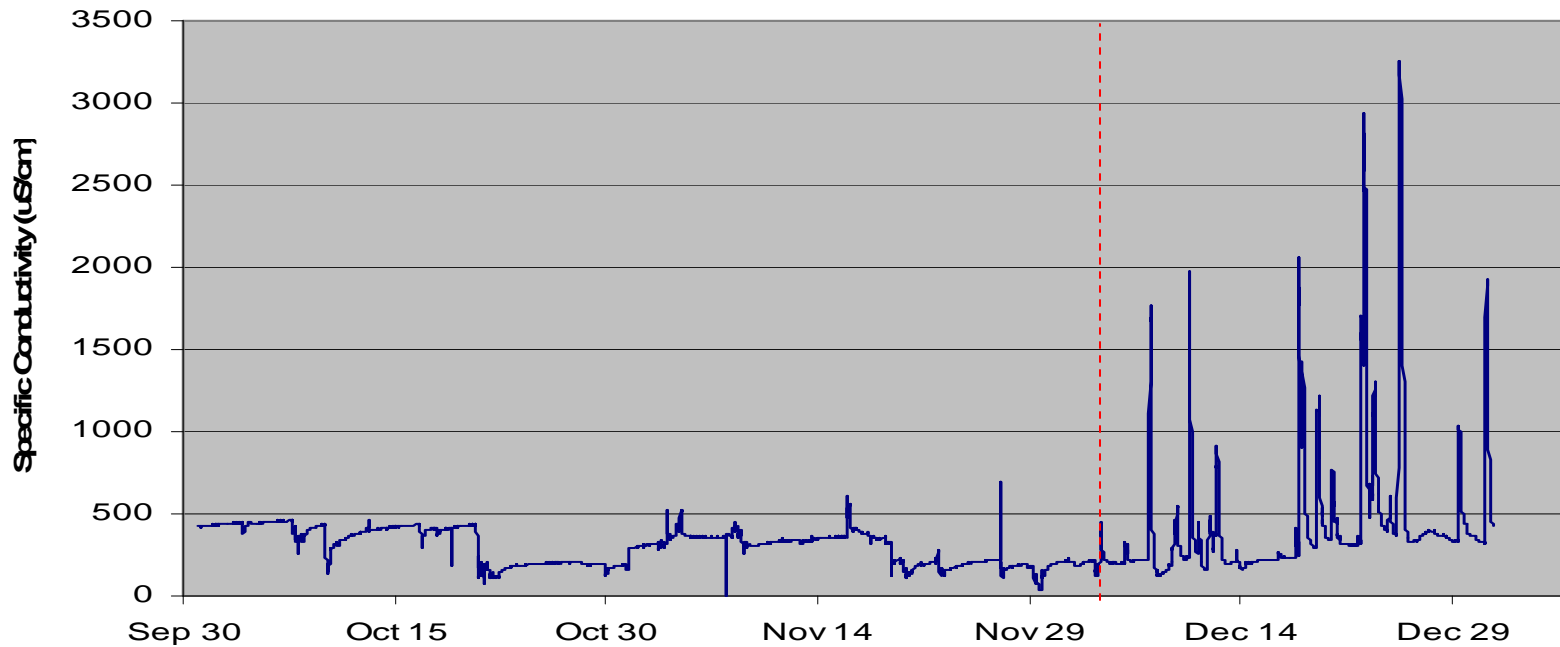
# Leary's Brook – Atypical Urban Stream



- ❖ 'Flashy' urban stream
- ❖ Impermeable surface runoff
  - O'Leary Industrial Park
  - Avalon Mall Parking lot
  - Surrounding roads



## Specific Conductivity at Leary's Brook from November 2008 to January 2009



### ❖ Storm runoff varies according to season

#### ➤ December 1<sup>st</sup> is the first day of Winter Shift

- 18 hour days
- More intensive road clearing
- More salt
  - Greater conductivity flux!

# Newfoundland and Labrador's Network

- ❖ Water Resources Management Division possesses:
  - Spectro::lyzers
  - Hydrolabs
  - YSI 6-Series
- ❖ Same destination, different routes
  - Firmware variation
  - Measurement methodology



# Instrument Parameters

## ❖ Hydrolab Datasonde 5x

- Temperature
- pH
- Specific Conductivity
- Total Dissolved Solids
- Dissolved Oxygen
- Turbidity
- Phycocyanin

## ❖ YSI 6-Series

- Temperature
- pH
- Specific Conductivity
- Total Dissolved Solids
- Dissolved Oxygen
- Turbidity
- Phycocyanin

# Instrument Parameters

## ❖ Scan Spectrolyser

- Turbidity
- Nitrate
- Total Organic Carbon
- Dissolved Organic Carbon

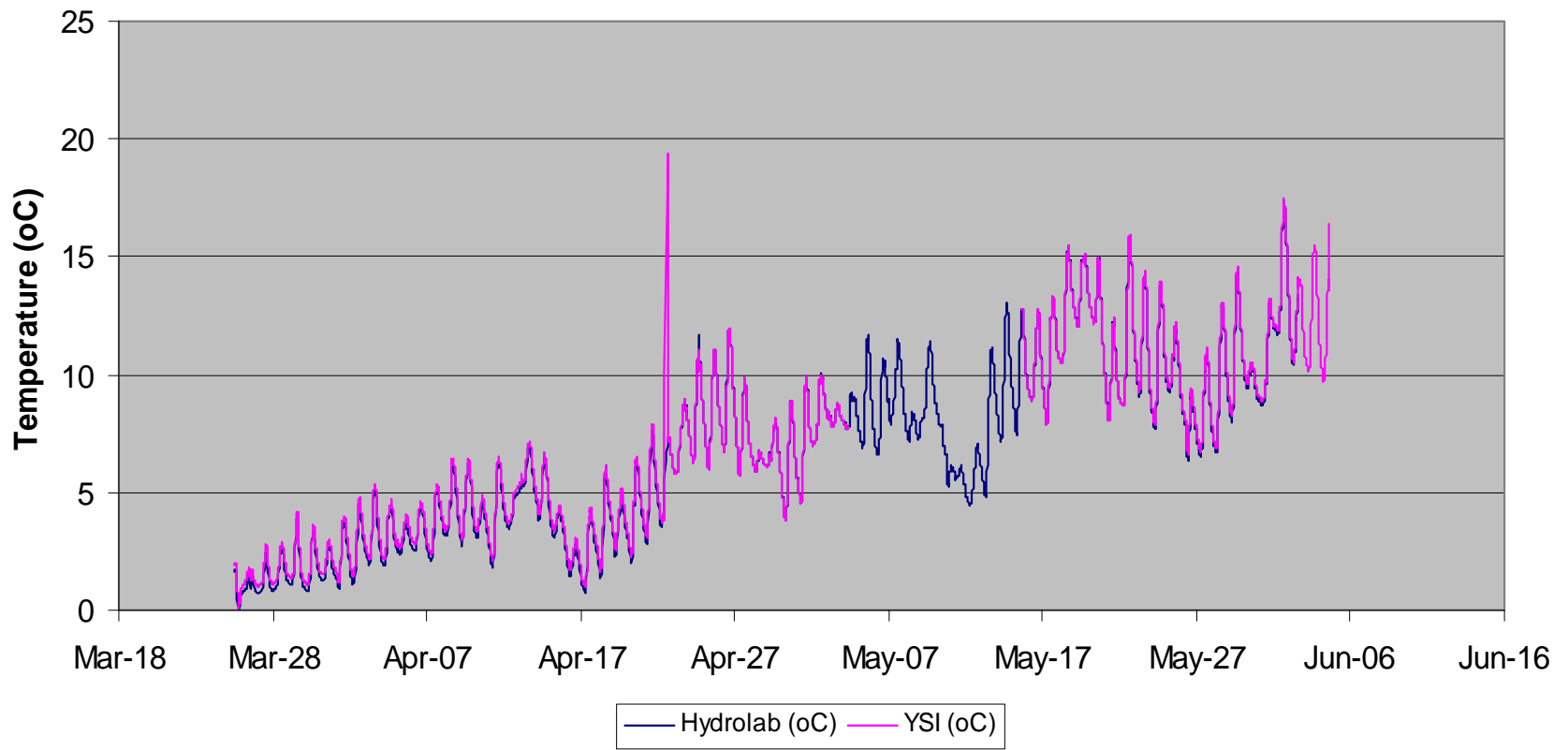
## ❖ Grab Samples

- pH
- Specific Conductivity
- Turbidity
- Nitrate
- Total Organic Carbon
- Dissolved Organic Carbon



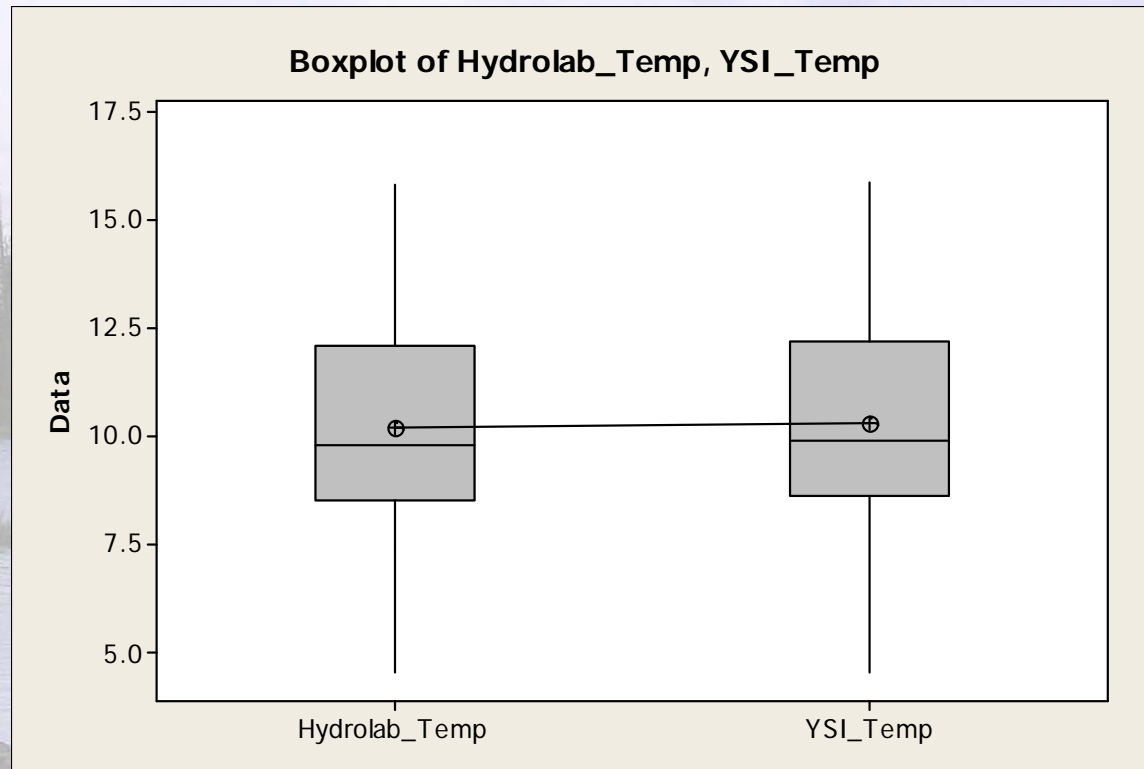
# Temperature

Temperature at Leary's Brook from March to June, 2009



	<i>Hydrolab_Temp</i>	<i>YSI_Temp</i>
Hydrolab_Temp	1	
YSI_Temp	0.999142354	1

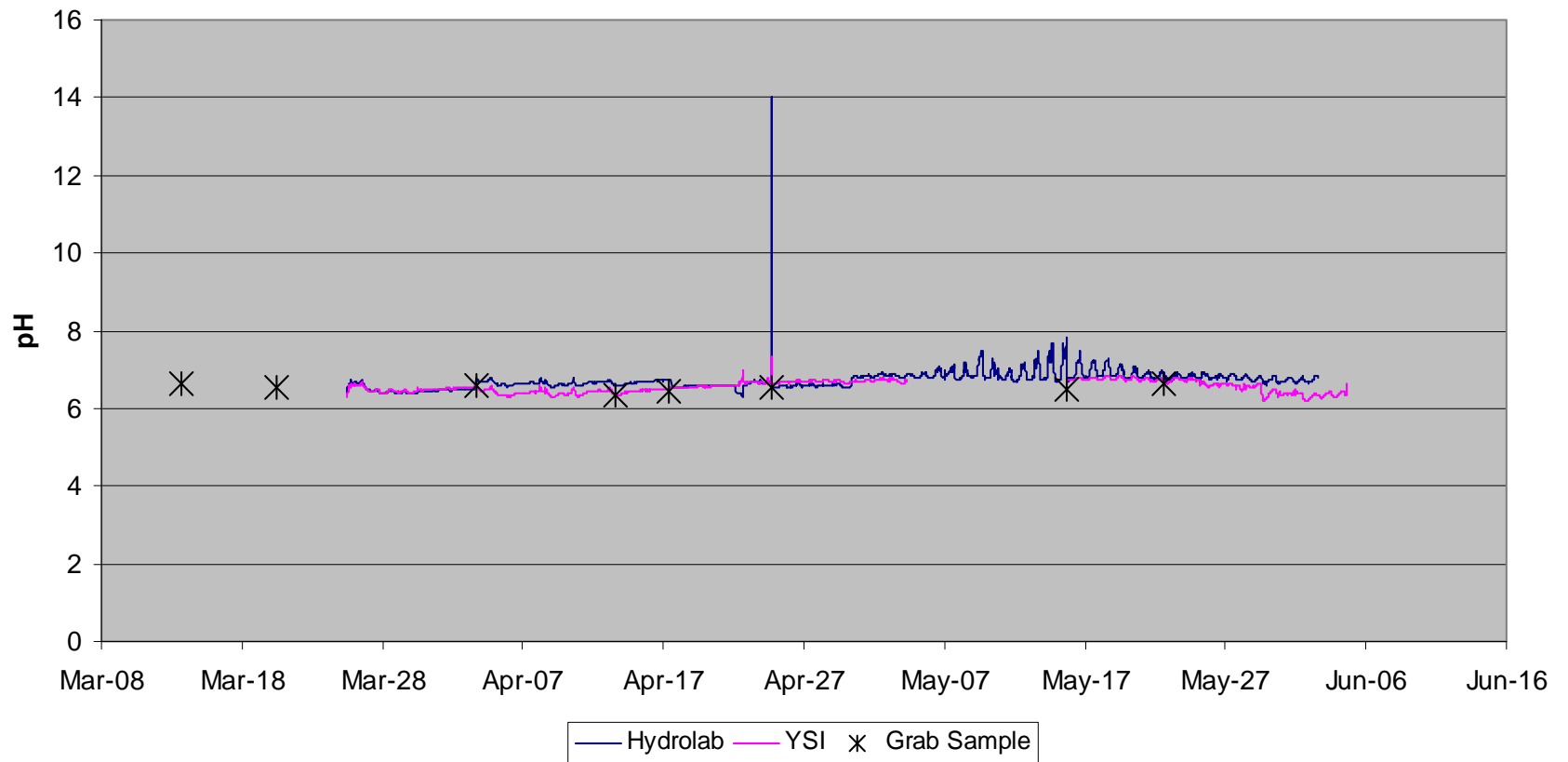
# Temperature



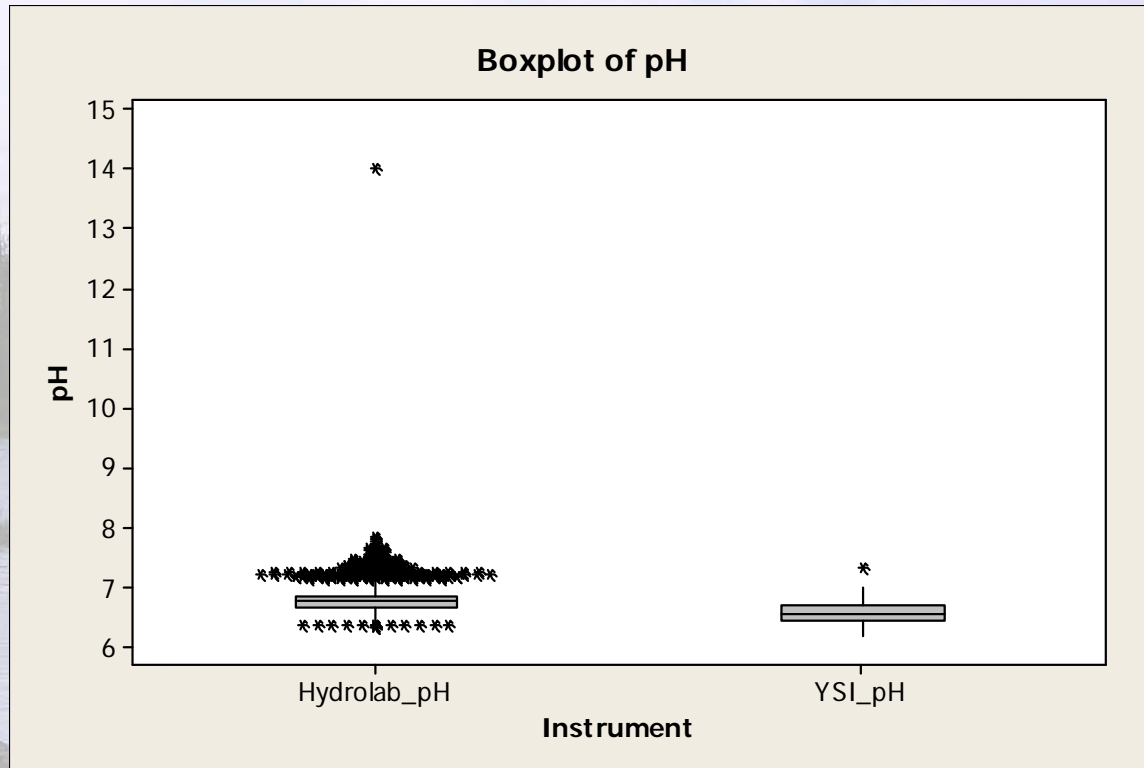


# pH

pH at Leary's Brook from March to June, 2009



# pH





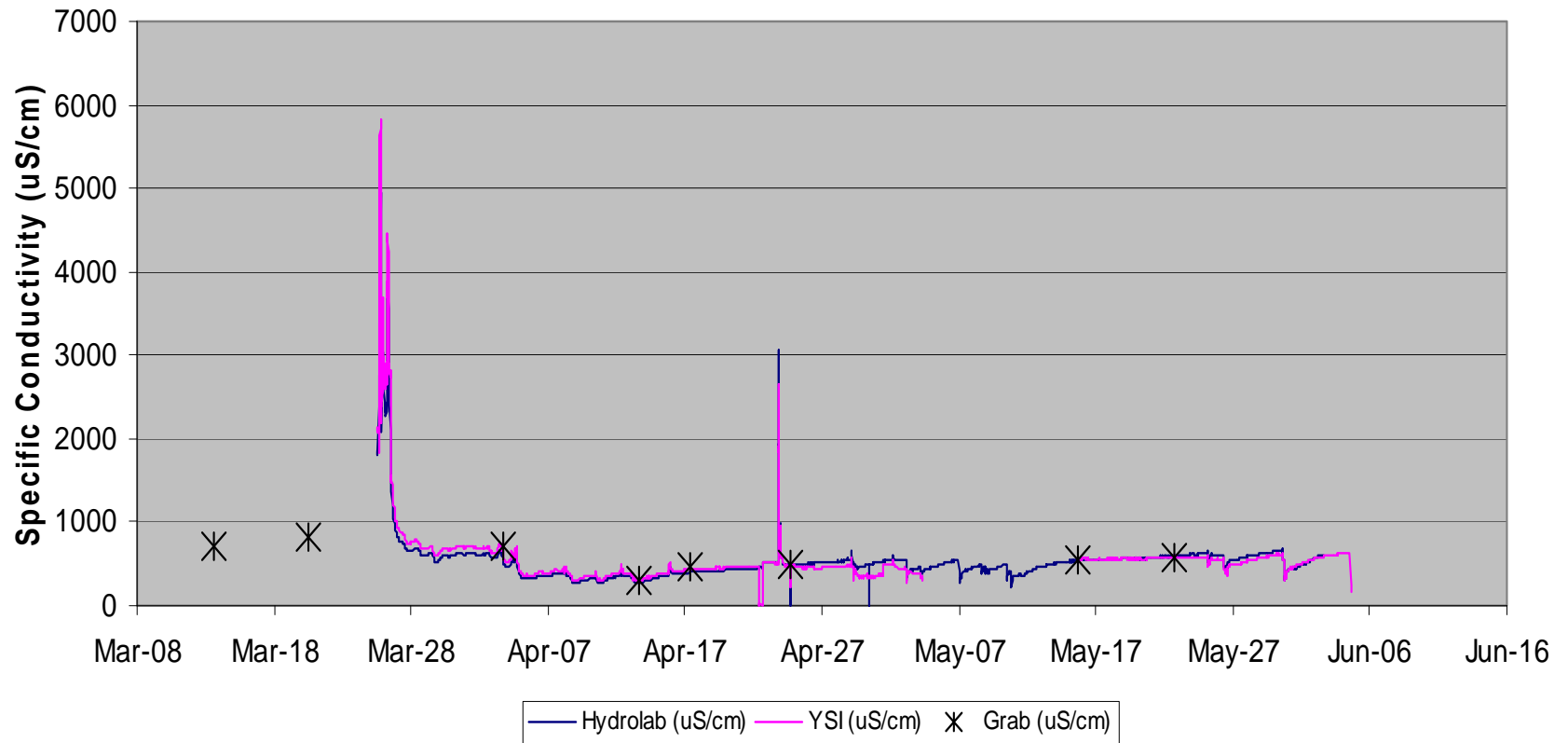
# pH

<b>pH_grab Sample</b>	<b>YSI_pH</b>	<b>Error</b>	<b>Square</b>	<b>Mean</b>	<b>RMSE</b>
6.59	6.57	0.02	0.0004	0.00745	0.086
6.33	6.36	0.03	0.0009		
6.46	6.51	0.05	0.0025		
6.56	6.68	0.12	0.0144		
6.47	6.63	0.16	0.0256		
6.65	6.68	0.03	0.0009		

<b>pH_grab Sample</b>	<b>Hydrolab_pH</b>	<b>Error</b>	<b>Square</b>	<b>Mean</b>	<b>RMSE</b>
6.59	6.78	0.19	0.0361	0.326933	0.572
6.33	6.67	0.34	0.1156		
6.46	6.75	0.29	0.0841		
6.56	6.6	0.04	0.0016		
6.47	7.78	1.31	1.7161		
6.65	6.74	0.09	0.0081		

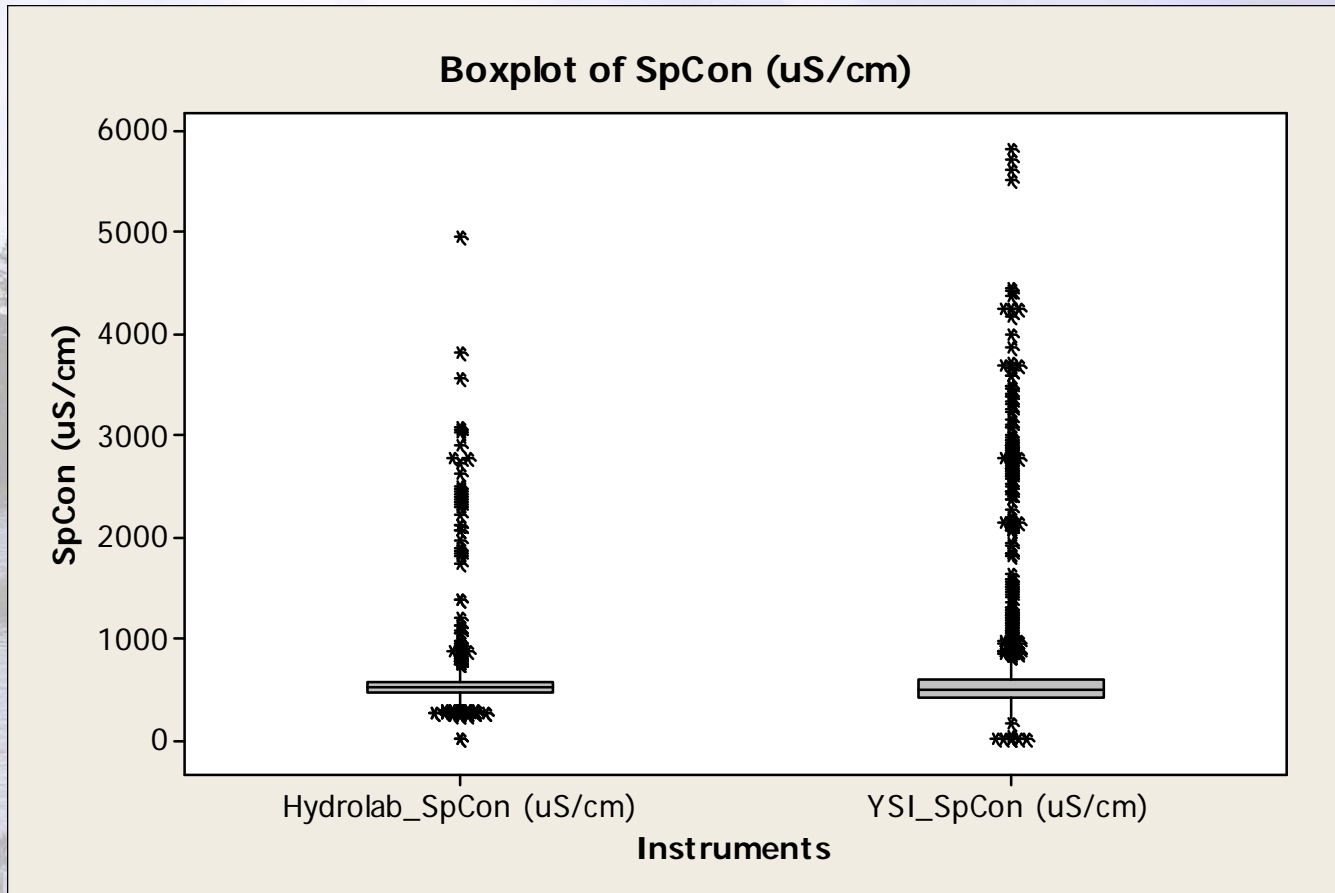
# Specific Conductivity

Specific Conductivity at Leary's Brook from March to June, 2009





# Specific Conductivity



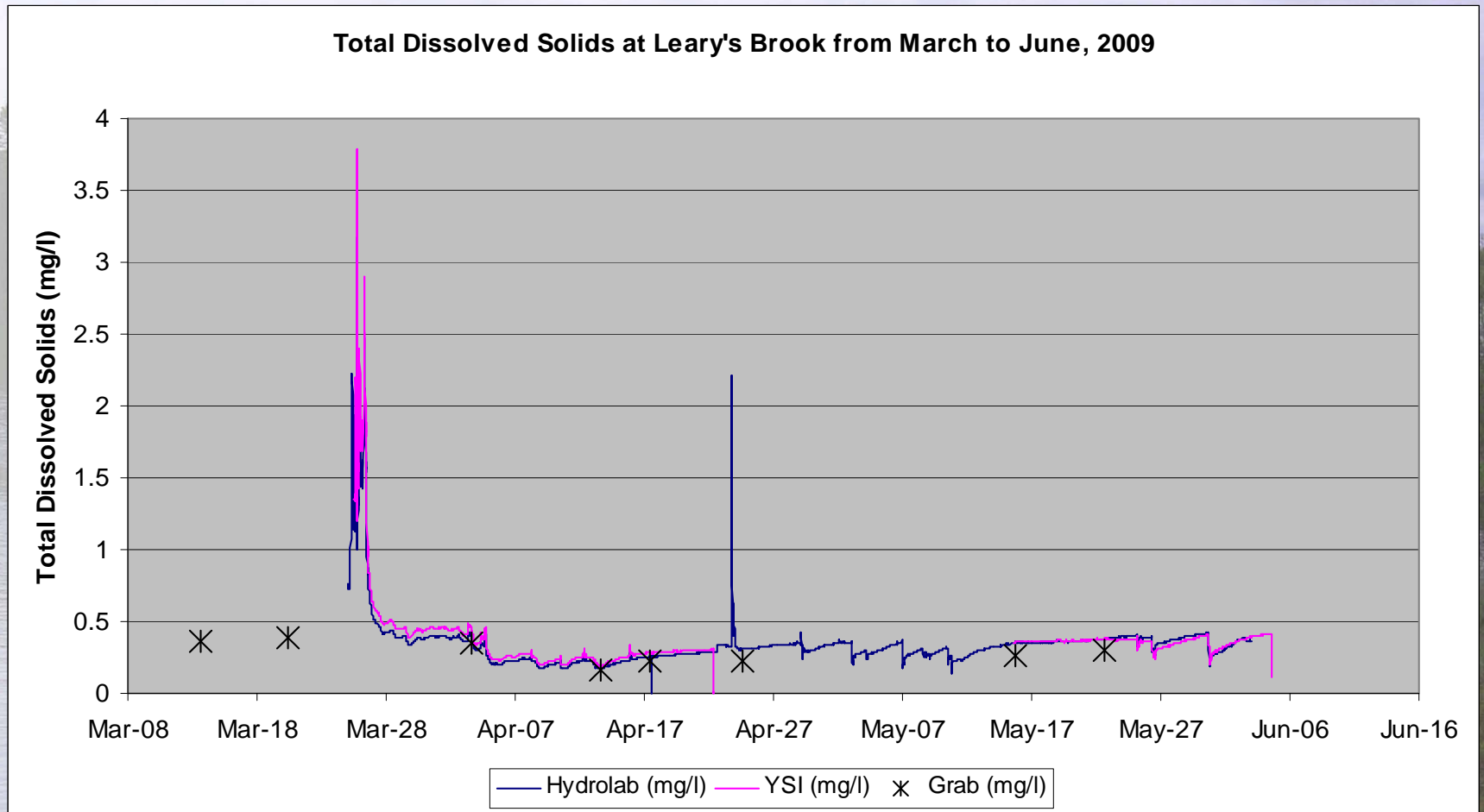
# Specific Conductivity

SpCon (uS/cm)_Grab	Hydrolab_SpCon	Error	Square	Mean	RMSE
700	546	154	23716.00	5180.50	71.98
310	269	41	1681.00		
470	398	72	5184.00		
500	482	18	324.00		
550	547	3	9.00		
580	593	13	169.00		

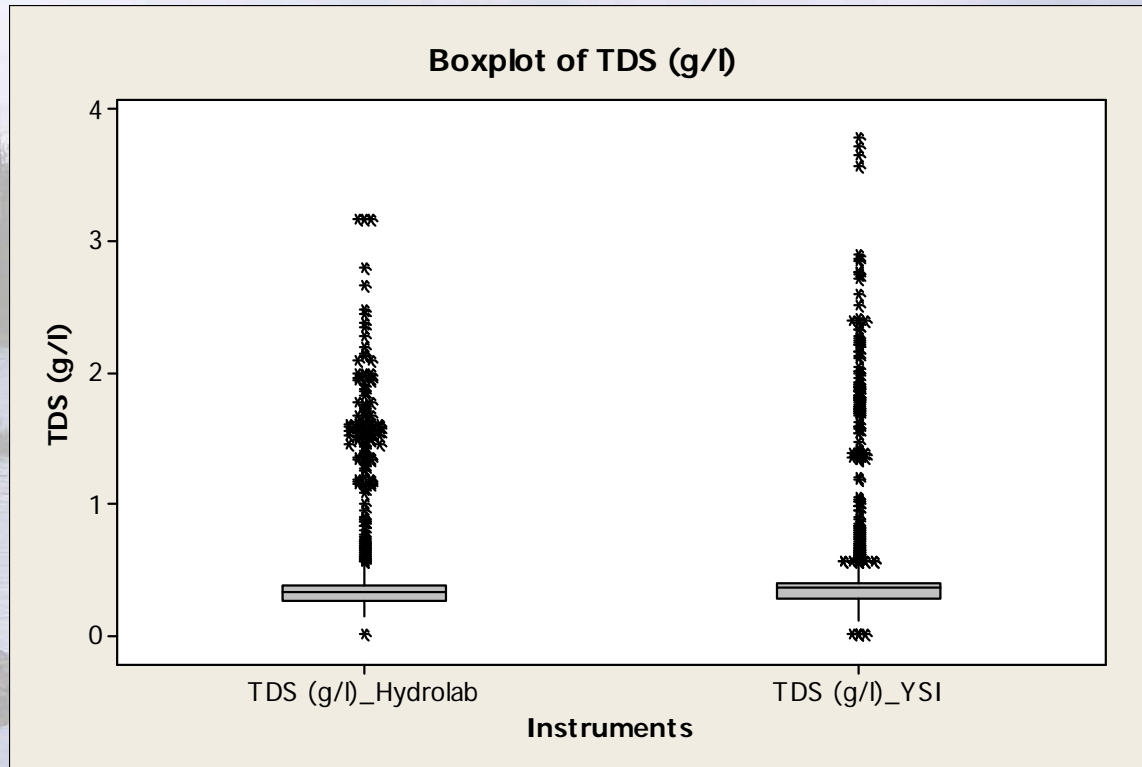
SpCon (uS/cm)_Grab	YSI_SpCon	Error	Square	Mean	RMSE
700	639	61	3721.00	904.83	30.08
310	294	16	256.00		
470	436	34	1156.00		
500	484	16	256.00		
550	548	2	4.00		
580	586	6	36.00		



# Total Dissolved Solids



# Total Dissolved Solids





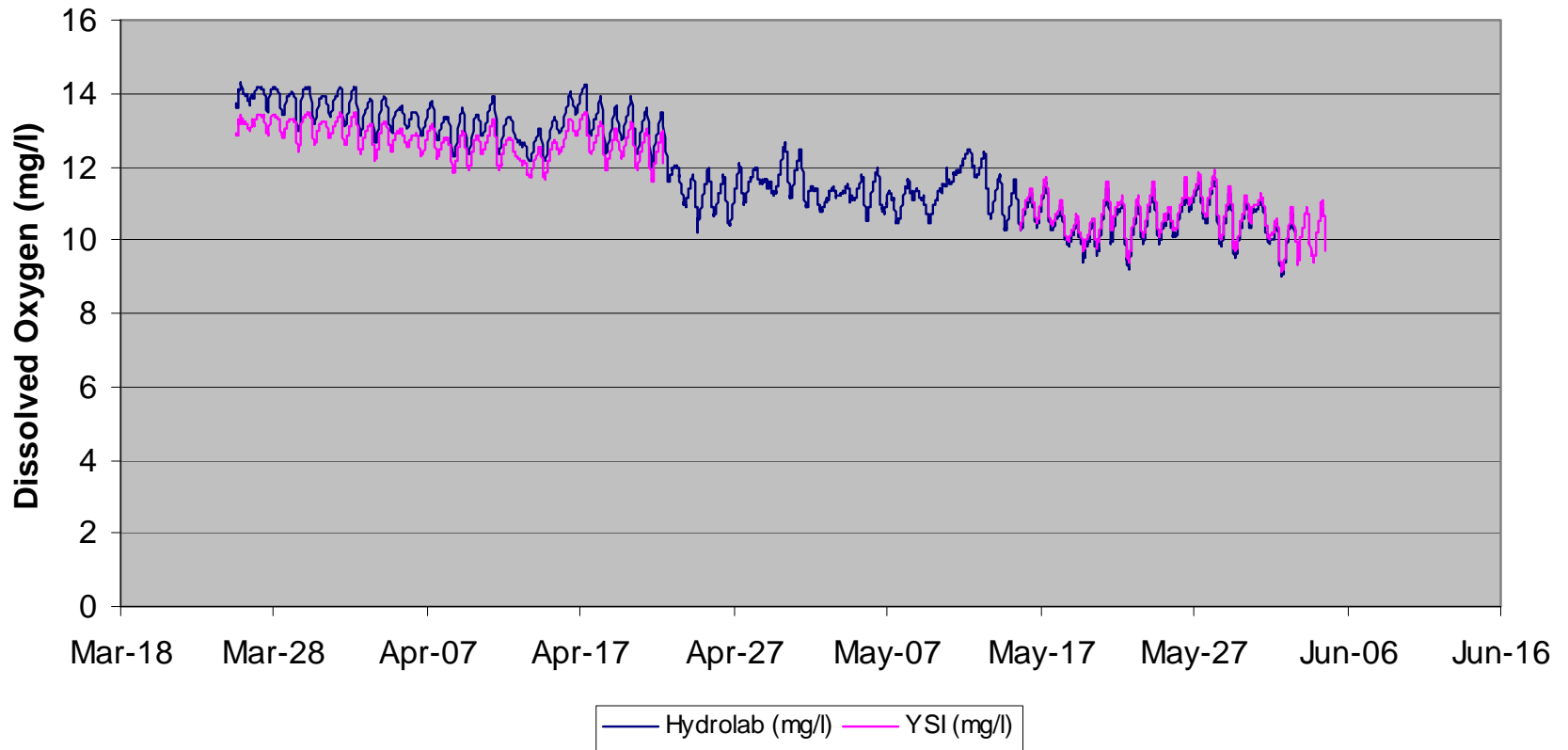
# Total Dissolved Solids

TDS (g/l)_Grab	Hydrolab_TDS	Error	Square	Mean	RMSE
0.348	0.362	0.014	0.000196	0.003016	0.05492176
0.161	0.171	0.01	0.0001		
0.231	0.255	0.024	0.000576		
0.224					
0.259	0.35	0.091	0.008281		
0.3	0.377	0.077	0.005929		

TDS (g/l)_Grab	YSI_TDS	Error	Square	Mean	RMSE
0.348	0.416	0.068	0.004624	0.004861	0.069718
0.161	0.191	0.03	0.0009		
0.231	0.284	0.053	0.002809		
0.224					
0.259	0.356	0.097	0.009409		
0.3	0.381	0.081	0.006561		

# Dissolved Oxygen

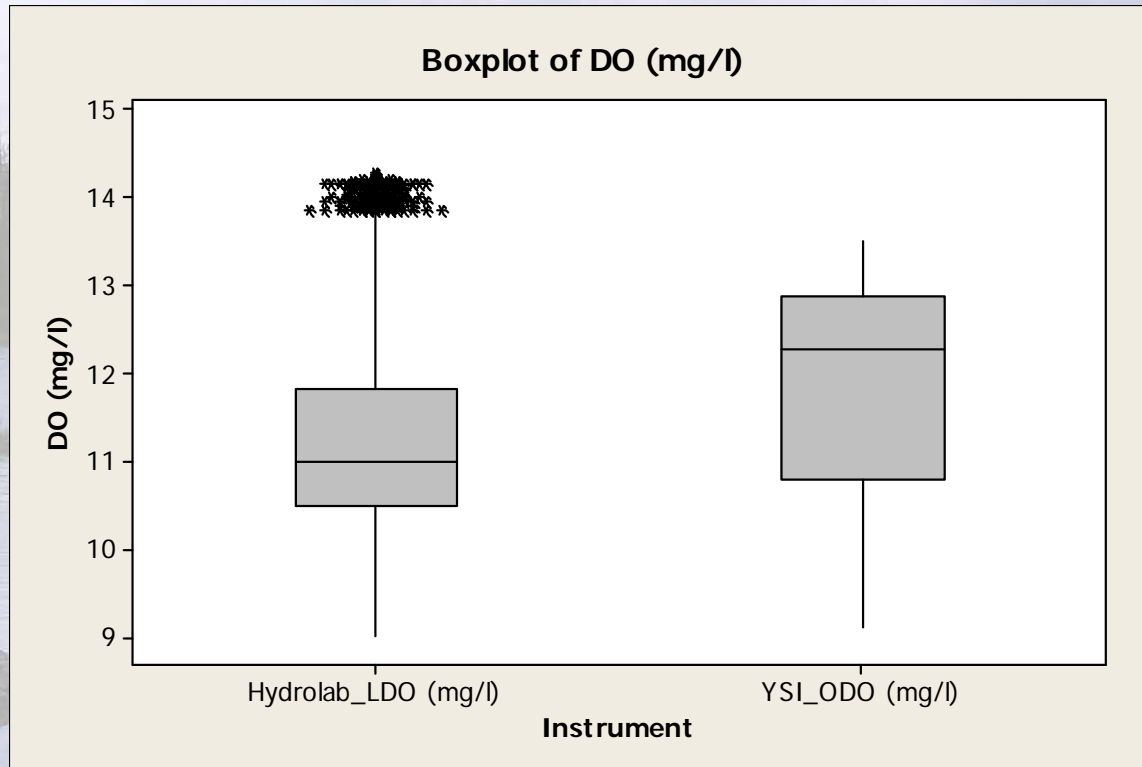
Dissolved Oxygen at Leary's Brook from March to June, 2009



	<i>YSI DO mg/l</i>	<i>Hydrolab DO mg/l</i>
<i>YSI DO mg/l</i>	1	
<i>Hydrolab DO mg/l</i>	0.996421334	1

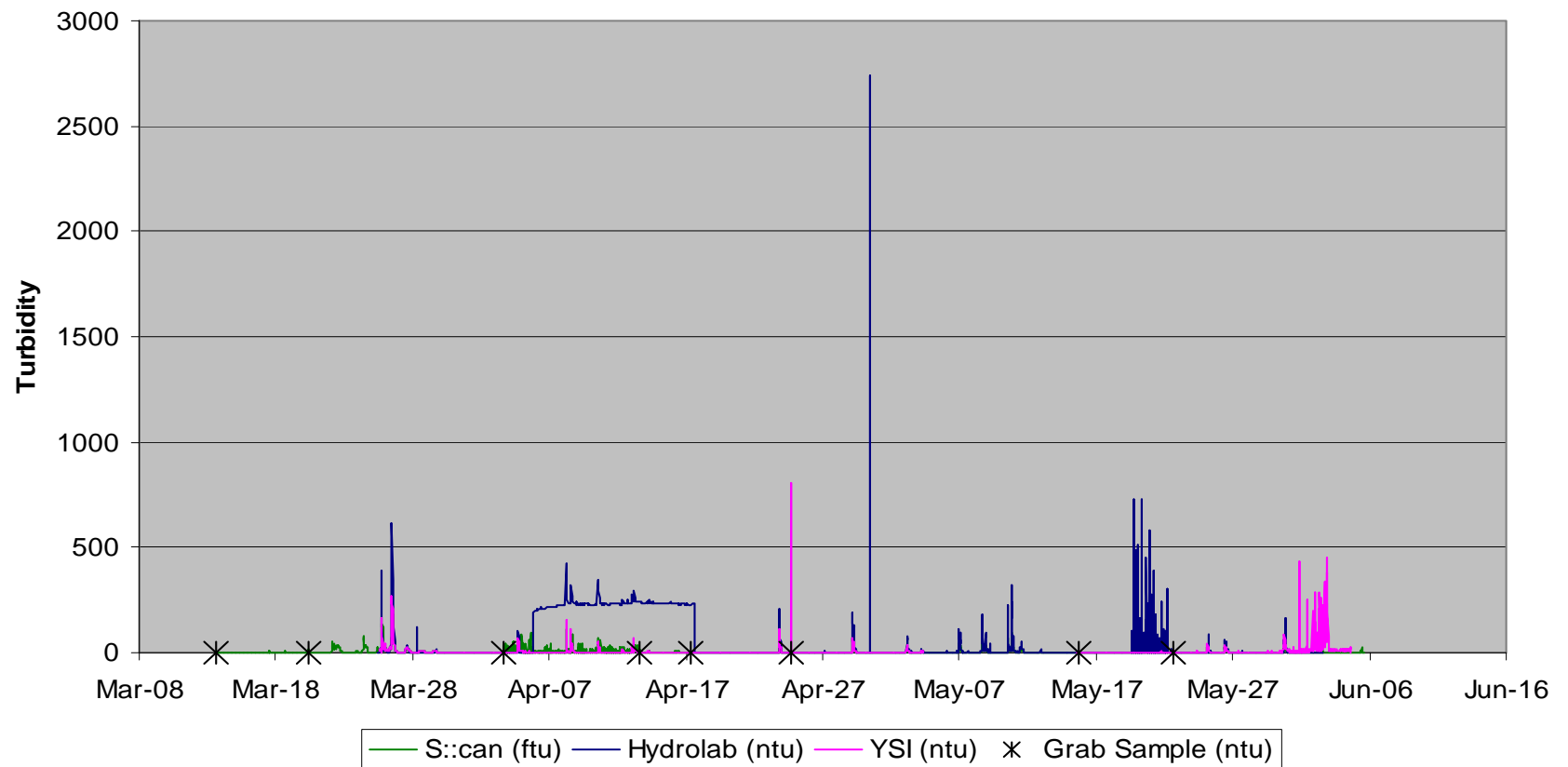


# Dissolved Oxygen



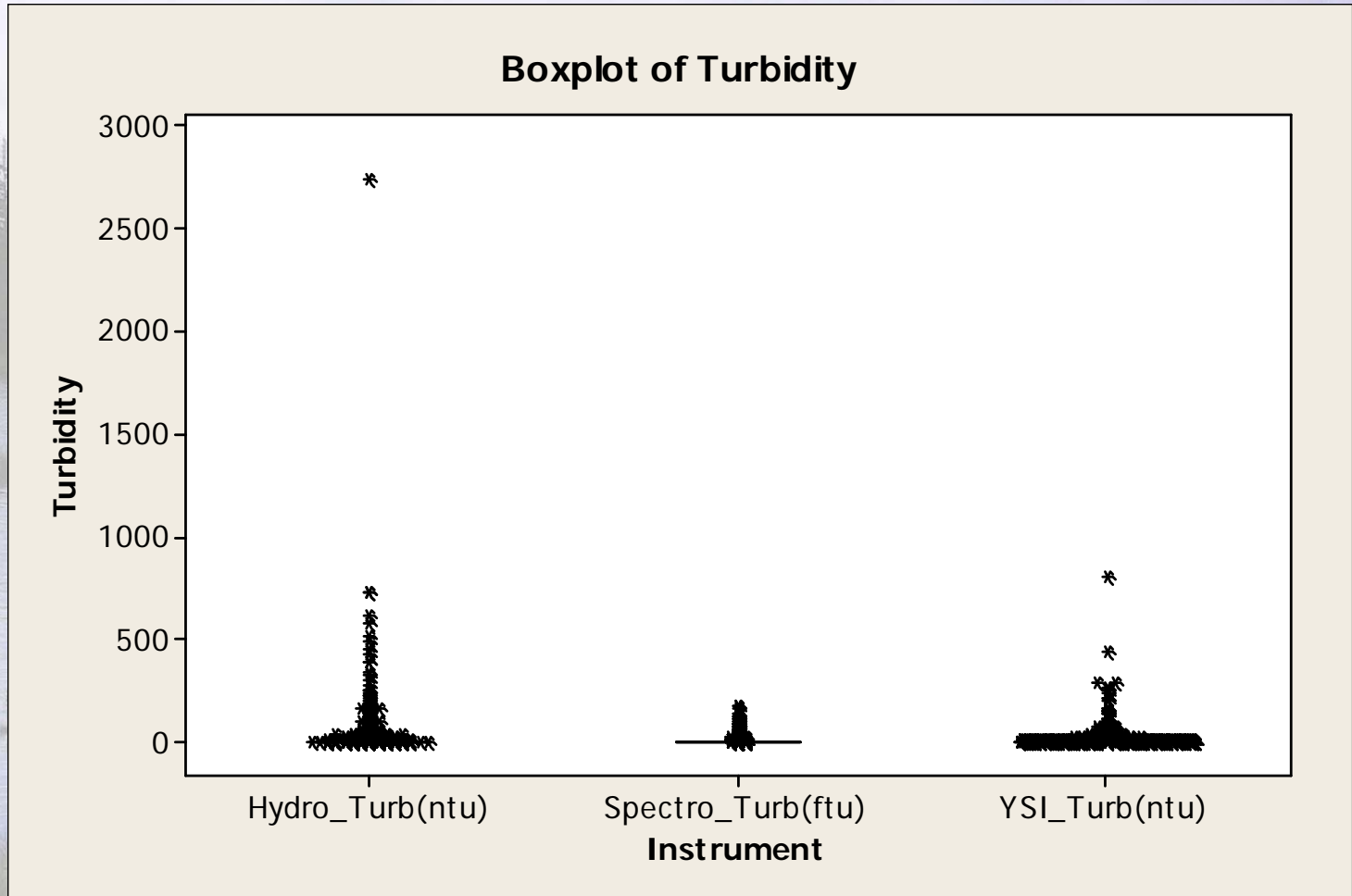
# Turbidity

Turbidity at Leary's Brook from March to June, 2009





# Turbidity



# Turbidity

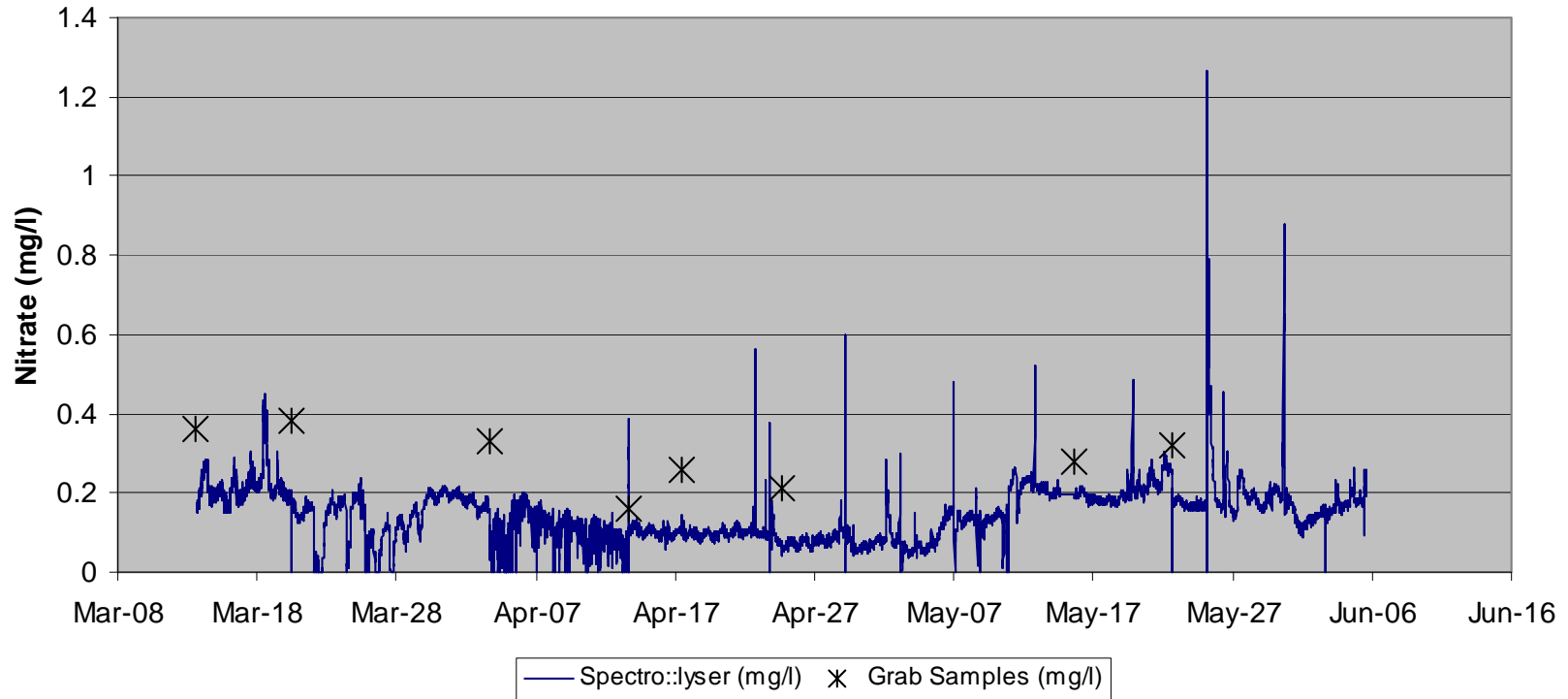
Turbidity_Grab Sample (ntu)	Turbidity_Hydrolab (ntu)	Error	Square	Mean	RMSE
0.1					<b>3.41</b>
0.8					
0.6	4.79	4.19	17.56	11.63	
0.6	6.92	6.32	39.94		
0.2					
0.4	0	0.4	0.16		
0.7	0	0.7	0.49		
0.1	0	0.1	0.01		

Turbidity_Grab Sample (ntu)	Turbidity_Spectrolyser (ftu)	Error	Square	Mean	RMSE
0.1					<b>3.59</b>
0.8					
0.6	8.403	7.803	60.89	12.86	
0.6	1.667	1.067	1.14		
0.2					
0.4	1.68	1.28	1.64		
0.7	1.281	0.581	0.34		
0.1	0.66	0.56	0.31		

Turbidity_Grab Sample (ntu)	Turbidity_YSI (ntu)	Error	Square	Mean	RMSE
0.1					<b>2.32</b>
0.8					
0.6	5.1	4.5	20.25	5.38	
0.6	1.7	1.1	1.21		
0.2					
0.4	2	1.6	2.56		
0.7	2	1.3	1.69		
0.1	1.2	1.1	1.21		

# Nitrate

Nitrate at Leary's Brook from March to June, 2009

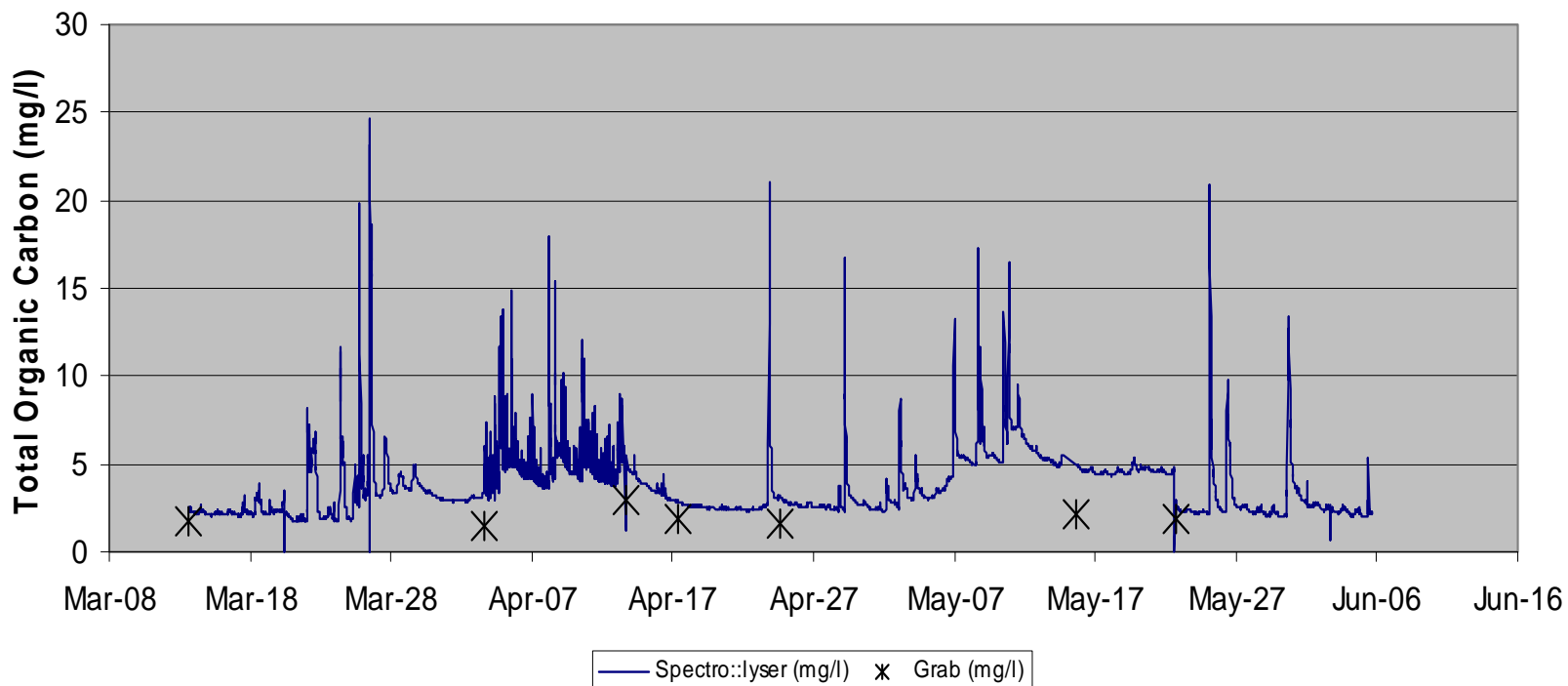


Grab_NO3 (mg/l)	Spectro::lyser_NO3	Error	Square	Mean	RMSE
0.36	0.166	0.194	0.037636	0.029356	0.171
0.38	0.186	0.194	0.037636		
0.33	0.076	0.254	0.064516		
0.16	0	0.16	0.0256		
0.26	0.096	0.164	0.026896		
0.21	0.057	0.153	0.023409		
0.28	0.196	0.084	0.007056		
0.32	0.21	0.11	0.0121		



# Total Organic Carbon

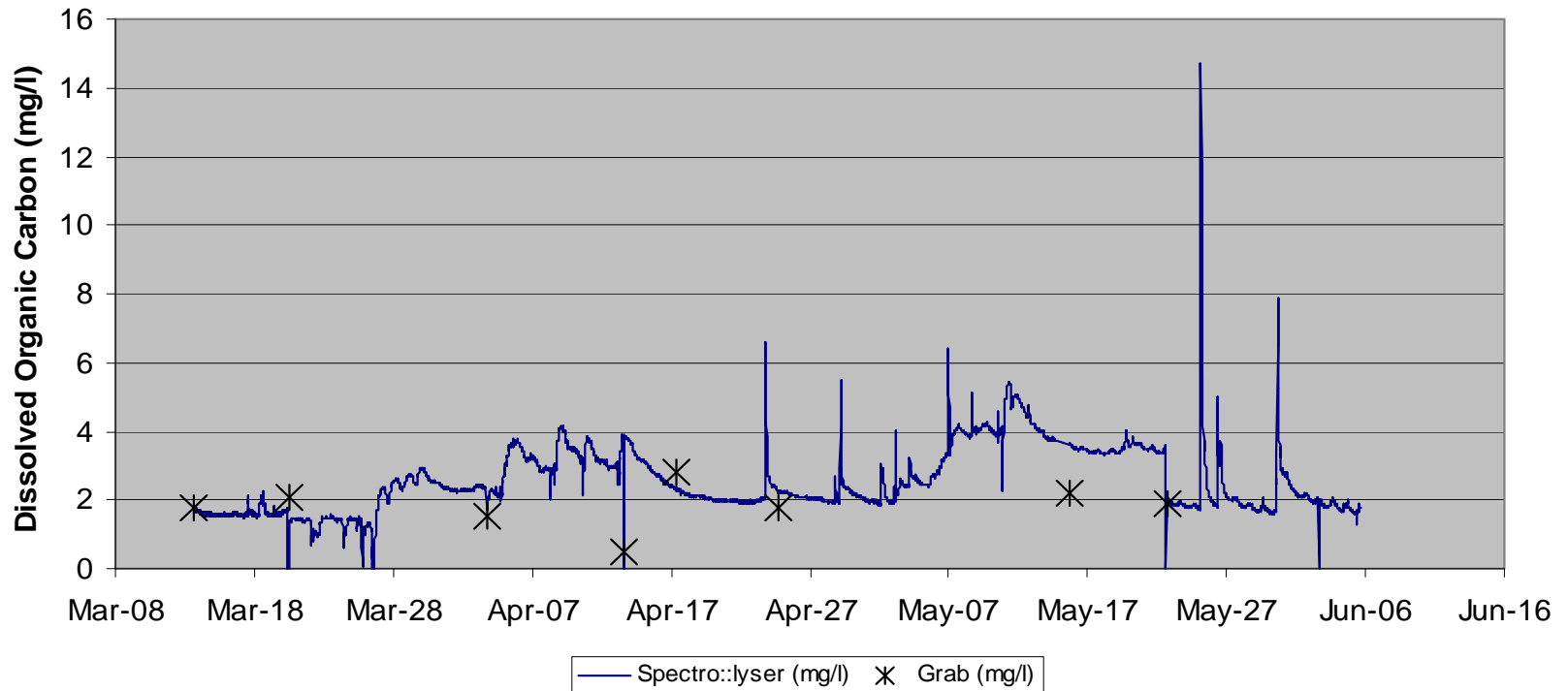
Total Organic Carbon at Leary's Brook from march to June, 2009



Grab_TOC (mg/l)	Spectro_TOC	Error	Square	Mean	RMSE
1.8	1.76	0.04	0.0016	4.03998	2.01
1.5	4.686	3.186	10.1506		
3	1.185	1.815	3.294225		
1.9	2.81	0.91	0.8281		
1.6	3.121	1.521	2.313441		
2.1	5.449	3.349	11.2158		
1.9	2.59	0.69	0.4761		

# Dissolved Organic Carbon

Dissolved Organic Carbon at Leary's Brook from March to June, 2009



Grab_DOC (mg/l)	Spectro::lyser_DOC	Error	Square	Mean	RMSE
1.8	1.76	0.04	0.0016	0.462107375	0.67978
2.1	1.382	0.718	0.515524		
1.5	1.774	0.274	0.075076		
0.5	0	0.5	0.25		
2.8	2.305	0.495	0.245025		
1.8	2.228	0.428	0.183184		
2.2	3.753	1.553	2.411809		
1.9	2.021	0.121	0.014641		

# Conclusions

- ❖ A major assumption:
  - Grab samples report the true value of each parameter
- ❖ RMSE is an indicator of accuracy:
  - Known values versus modelled values
- ❖ Caution must be used:
  - RMSE values are derived from  $<10$  samples



# Conclusions

- ❖ RMSE Differences can distort perceptions
  - Spectro::lyser, Hydrolab, and YSI are in close agreement
  - A quick glance at a time-series plot indicates different sondes are comparable
- ❖ Accuracy is important, but perfection is not sought
  - Most important: change of variable over time

