



Update on Cost-Effective Water Quality Monitoring Systems for Delaware

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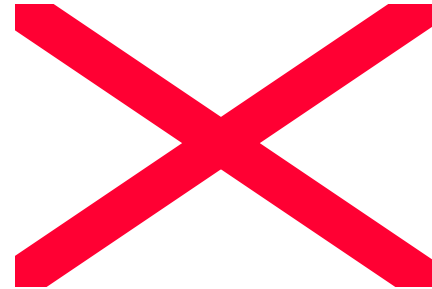
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Robin Tyler
Edythe Humphries
Mark Crane
DNREC



Project Overview

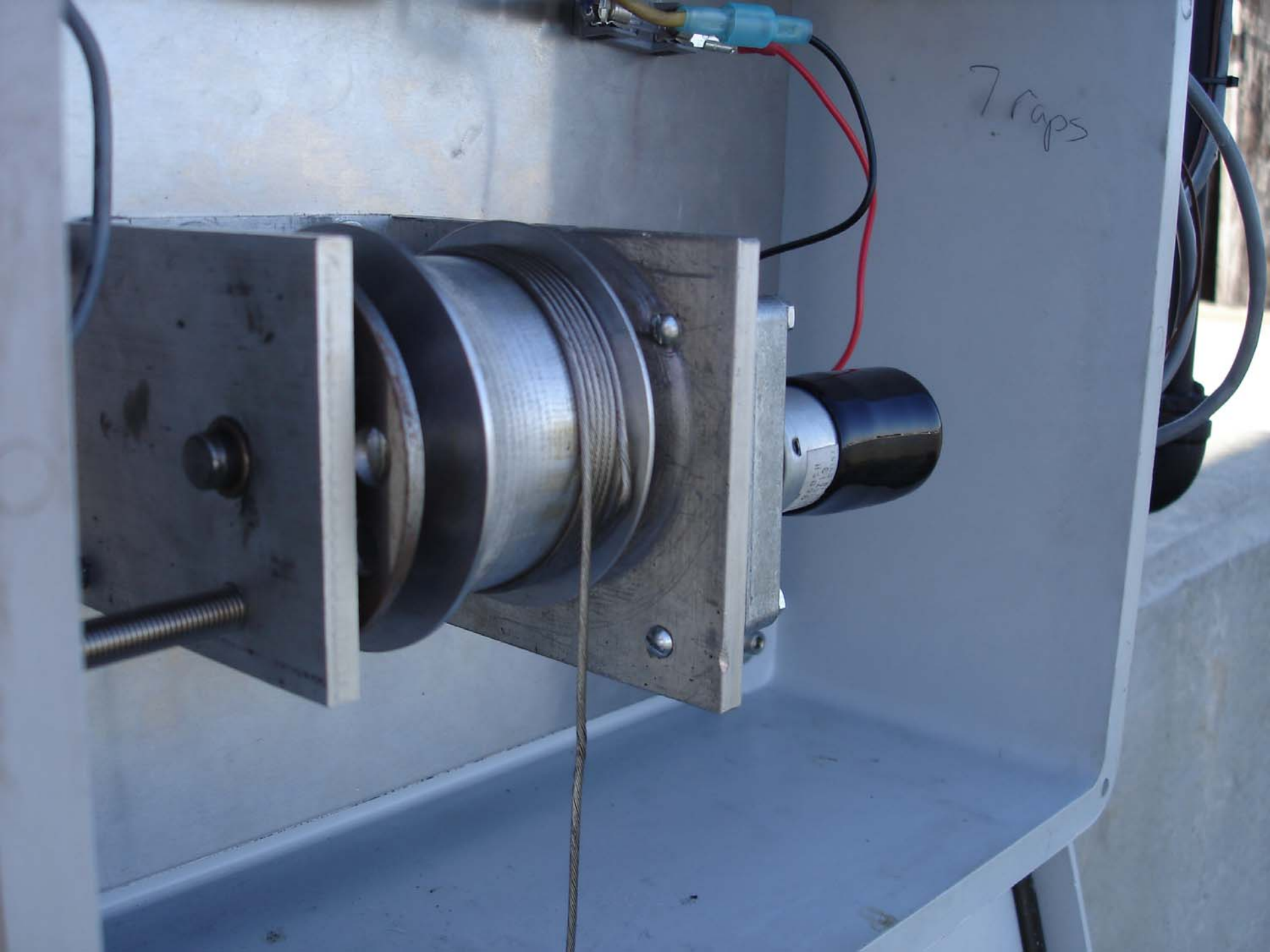
Real-Time Measurement & Transmission of Water Quality Data

- Many researchers currently using YSI, Inc. *Data Sondes*
 - Integrated, multi-sensor, commercially available device.
 - Temperature, DO, pH, turbidity, salinity, etc.
 - Up to 15 parameters measured.
 - Serial communication
 - Not intended to integrate with other monitoring equipment and systems.
- Project Goals:
 - Whole-water column sampling
 - Real-time data transmission and display
 - Affordable

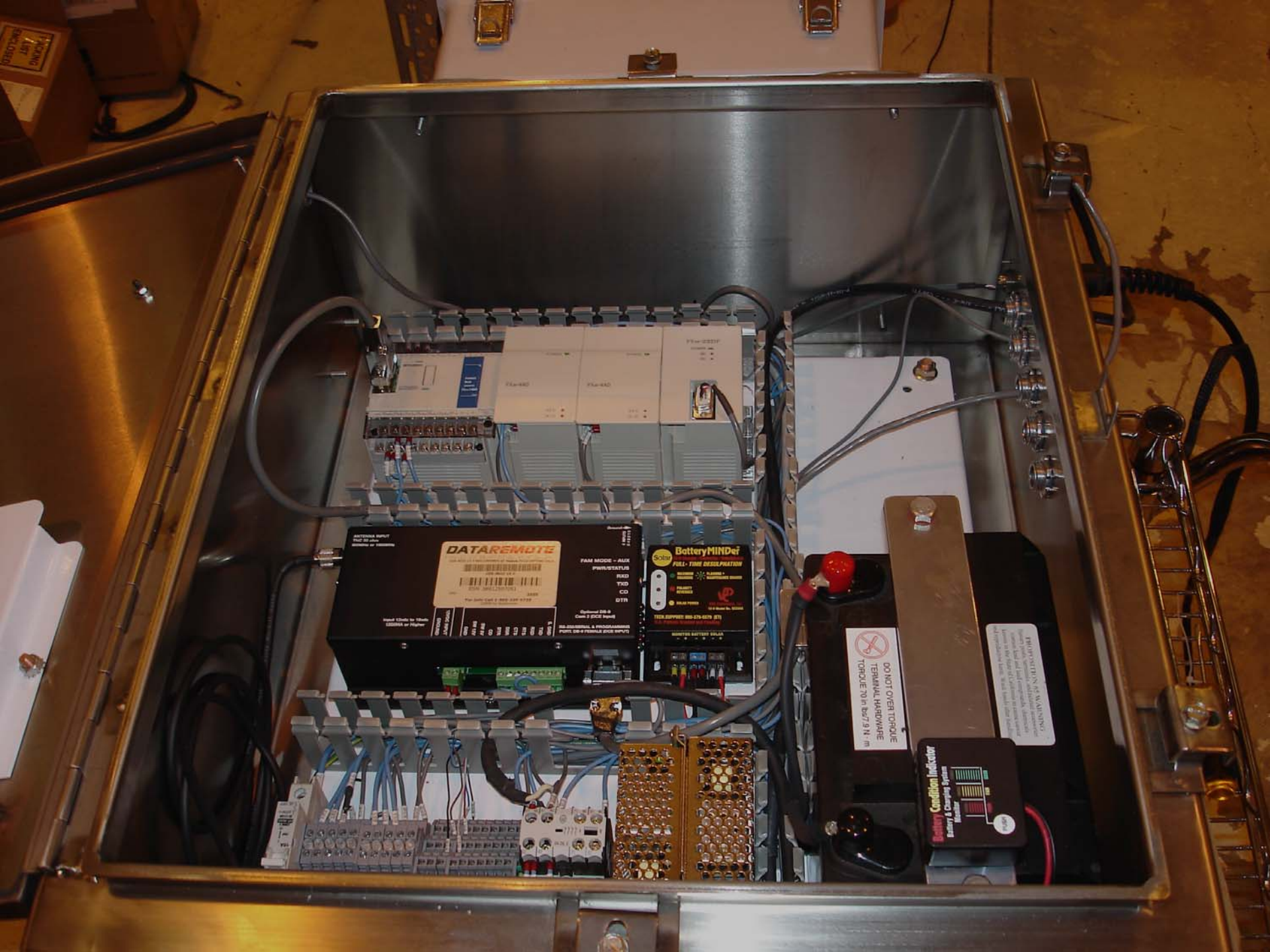








Traps





Transmission Information

Modem Number



2

Baud Rate



9600

STOP

Time since start (h:m:s)

04:39:50

Last transmission (h:m:s)

00:04:10

Number of data transmissions

10

- Waiting for call
- Modem Connected
- Hello
- Transmitting Data
- Getting Depth Info
- Getting Cycle Time
- Hanging Up
- Processing Data

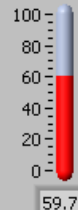
Platform Status

Platform Battery (V)



Cycle Time (min)
30

DO Sat



Total Depth (ft)
10

Delta (ft)
2

Most Recent Sonde Data

11/01/05 15:06:29	12.24	0.085	0.04	161.3	17.28	53.3	12.5
11/01/05 15:05:19	12.58	0.104	0.05	216.3	23.00	55.3	12.5
11/01/05 15:04:08	14.13	11.82	6.78	224.7	22.14	62.5	12.8
11/01/05 15:02:59	14.02	11.93	6.85	220.6	21.78	62.5	12.8
11/01/05 15:01:50	13.90	12.35	7.11	225.3	22.28	62.5	12.8
11/01/05 15:00:42	13.78	12.29	7.07	134.6	13.35	62.5	12.8

Depths (ft)

0
2
4
6
8
10

Previous Cycle Sonde Data

11/01/05 14:36:30	12.26	0.102	0.05	175.5	18.80	54.3	12.5
11/01/05 14:35:18	12.03	0.128	0.06	220.4	23.73	55.3	12.5
11/01/05 14:34:08	13.95	12.32	7.09	225.7	22.29	62.5	12.7
11/01/05 14:32:59	13.83	12.35	7.11	225.7	22.34	62.5	12.7
11/01/05 14:31:50	13.70	12.79	7.38	215.7	21.38	62.5	12.7
11/01/05 14:30:42	13.68	12.09	6.94	135.0	13.43	62.5	12.7

Depths (ft)

0
2
4
6
8
10

Weather Data

Air Temperature (C)
21.2

Wind Speed (MPH)
6

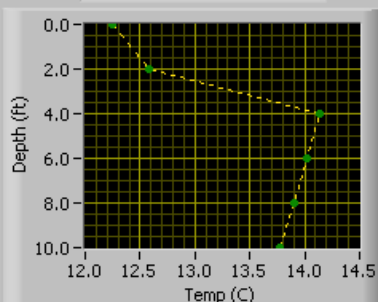
Relative Humidity (%)
27

Solar Intensity (W/sq meter)
716

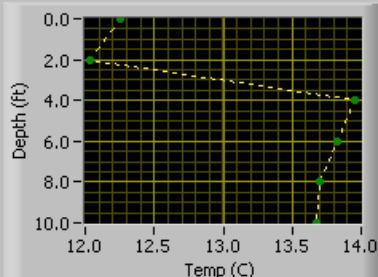
Spatial and Temporal Water Data

Current Sample Time (h:m:s)
15:06:29

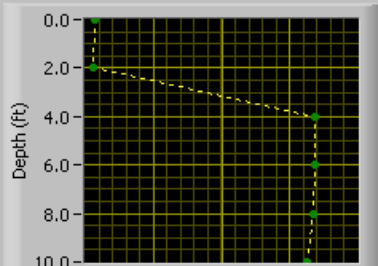
Temperature vs. Depth



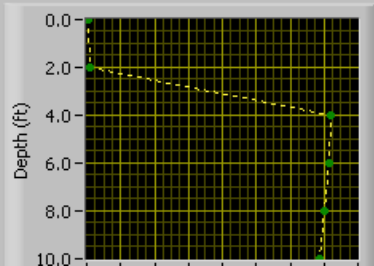
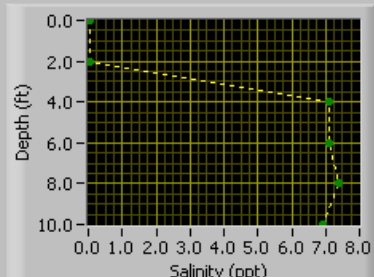
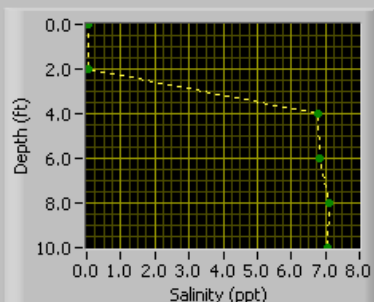
Previous Sample Time (h:m:s)
14:36:30



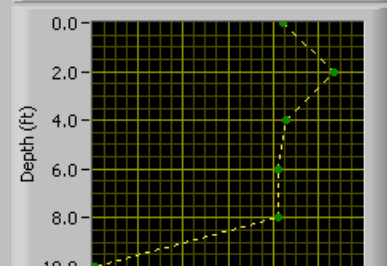
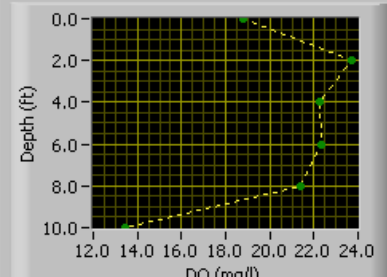
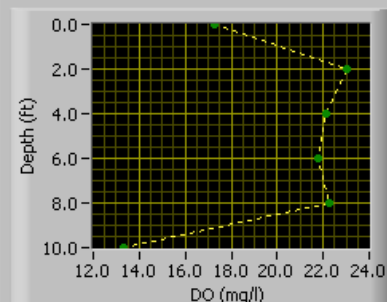
Previous Sample Time (h:m:s)
14:06:29

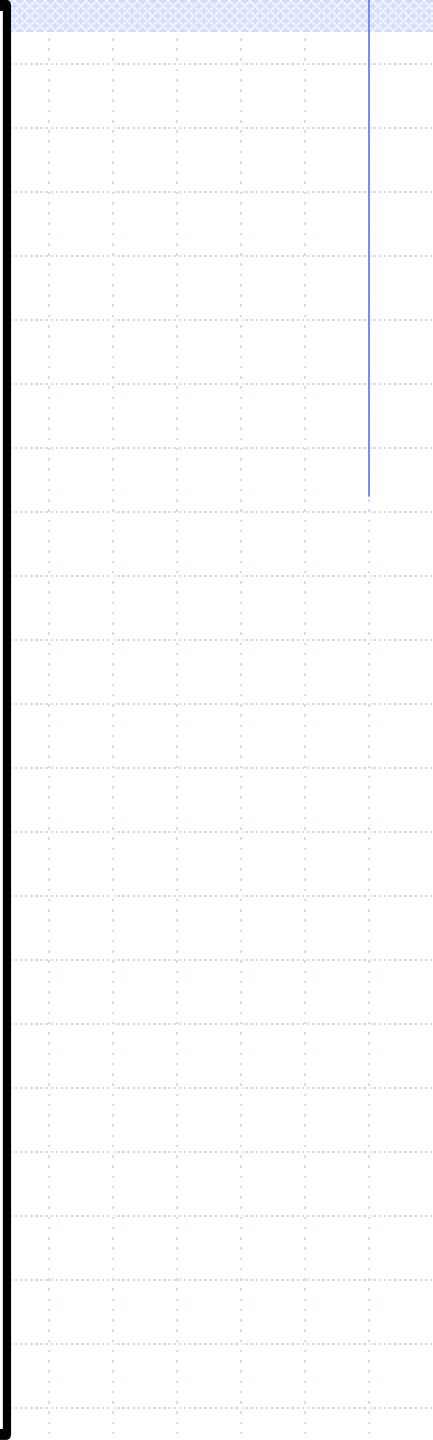


Salinity vs. Depth



DO vs Depth





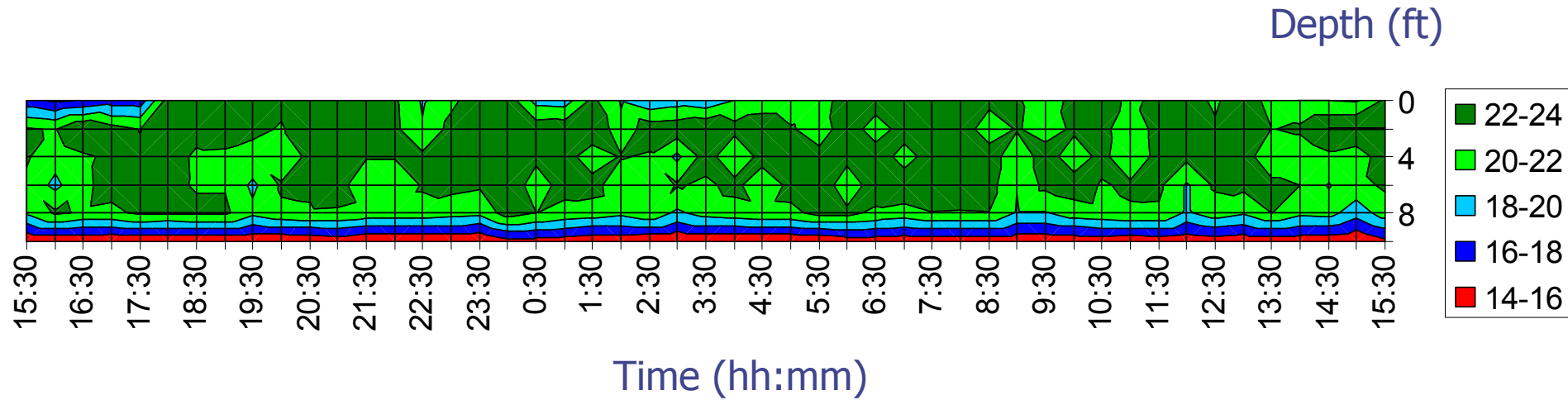




	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	Date	Time	Water Temp °C	Sp. Cond (mS/cm)	Salinity (ppt)	DO Sat (%)	DO (mg/l)	DO Charge	Battery	Depth (ft)	Air Temp °C	RH (%)	Wind Speed (MPH)	Solar Intensity (W/sqm)	
2	10/30/2005	11:06:20	9.1	0.2	0.1	206.9	23.8	55.3	12.4	0	14.8	50.7	15	883	
3	10/30/2005	11:05:08	11.5	20.6	12.3	183.3	18.5	62.5	12.6	2	14.8	50.7	15	883	
4	10/30/2005	11:03:57	11.5	21.5	12.9	182.9	18.4	62.5	12.6	4	14.8	50.7	15	883	
5	10/30/2005	11:02:46	11.5	14.9	8.7	204.7	21.1	62.5	12.6	6	14.8	50.7	15	883	
6	10/30/2005	11:01:35	11.5	14.6	8.5	205.0	21.2	62.5	12.6	8	14.8	50.7	15	883	
7	10/30/2005	11:00:25	11.6	14.2	8.2	168.2	17.4	62.5	12.6	10	14.8	50.7	15	883	
8	10/30/2005	11:36:17	8.5	0.2	0.1	187.5	21.9	54.3	12.5	0	15.0	50.0	11	941	
9	10/30/2005	11:35:05	11.5	15.0	8.8	207.1	21.4	62.5	12.7	2	15.0	50.0	11	941	
10	10/30/2005	11:33:55	11.4	15.0	8.7	204.9	21.2	62.5	12.7	4	15.0	50.0	11	941	
11	10/30/2005	11:32:45	11.4	14.7	8.6	200.3	20.7	62.5	12.7	6	15.0	50.0	11	941	
12	10/30/2005	11:31:35	11.4	14.6	8.5	204.6	21.2	62.5	12.7	8	15.0	50.0	11	941	
13	10/30/2005	11:30:25	11.4	14.3	8.4	168.3	17.4	62.5	12.7	10	15.0	50.0	11	941	
14	10/30/2005	12:06:15	8.9	0.2	0.1	152.5	17.7	54.3	12.5	0	15.2	45.5	16	974	
15	10/30/2005	12:05:04	11.5	15.0	8.7	201.7	20.8	62.5	12.7	2	15.2	45.5	16	974	
16	10/30/2005	12:03:55	11.5	14.8	8.6	204.4	21.1	62.5	12.7	4	15.2	45.5	16	974	
17	10/30/2005	12:02:46	11.4	14.7	8.6	202.2	20.9	62.5	12.7	6	15.2	45.5	16	974	
18	10/30/2005	12:01:36	11.4	14.4	8.4	206.4	21.4	62.5	12.7	8	15.2	45.5	16	974	
19	10/30/2005	12:00:26	11.4	14.1	8.2	164.4	17.1	62.5	12.7	10	15.2	45.5	16	974	
20	10/30/2005	12:36:13	9.0	0.1	0.1	149.2	17.2	54.3	12.6	0	15.7	44.7	13	979	
21	10/30/2005	12:35:02	11.3	1.4	0.7	225.8	24.6	61.4	12.8	2	15.7	44.7	13	979	
22	10/30/2005	12:33:53	11.4	14.7	8.6	204.0	21.1	62.5	12.8	4	15.7	44.7	13	979	
23	10/30/2005	12:32:44	11.4	14.6	8.5	202.0	20.9	62.5	12.8	6	15.7	44.7	13	979	
24	10/30/2005	12:31:34	11.4	14.5	8.4	207.1	21.4	62.5	12.8	8	15.7	44.7	13	979	
25	10/30/2005	12:30:25	11.5	14.0	8.2	168.3	17.5	62.5	12.8	10	15.7	44.7	13	979	
26	10/30/2005	13:06:14	9.5	0.1	0.1	150.9	17.2	54.3	12.6	0	16.6	44.9	10	968	
27	10/30/2005	13:05:03	10.7	0.6	0.3	215.7	23.9	58.4	12.9	2	16.6	44.9	10	968	
28	10/30/2005	13:03:54	11.3	12.7	7.3	198.6	20.8	62.5	12.9	4	16.6	44.9	10	968	
29	10/30/2005	13:02:45	11.4	12.6	7.3	180.8	18.9	62.5	12.9	6	16.6	44.9	10	968	
30	10/30/2005	13:01:36	11.6	13.2	7.6	205.9	21.4	62.5	12.8	8	16.6	44.9	10	968	
31	10/30/2005	13:00:26	11.6	12.9	7.5	168.1	17.5	62.5	12.9	10	16.6	44.9	10	968	
32	10/30/2005	13:36:13	9.3	0.1	0.1	149.1	17.1	54.3	12.7	0	17.1	44.0	8	933	
33	10/30/2005	13:35:02	10.0	0.2	0.1	222.3	25.1	55.3	12.8	2	17.1	44.0	8	933	
34	10/30/2005	13:33:53	11.0	11.2	6.4	200.0	21.2	61.4	12.9	4	17.1	44.0	8	933	
35	10/30/2005	13:32:44	11.3	12.0	6.9	204.3	21.4	62.5	12.9	6	17.1	44.0	8	933	
36	10/30/2005	13:31:35	11.6	13.5	7.8	207.5	21.5	62.5	12.9	8	17.1	44.0	8	933	
37	10/30/2005	13:30:26	11.6	13.2	7.6	170.2	17.7	62.5	12.9	10	17.1	44.0	8	933	
38	10/30/2005	14:06:12	9.6	0.1	0.0	142.9	16.3	54.3	12.7	0	17.5	39.7	6	877	
39	10/30/2005	14:05:02	10.8	0.2	0.1	222.0	24.6	54.3	12.9	2	17.5	39.7	6	877	
40	10/30/2005	14:03:53	11.0	10.0	5.7	192.8	20.5	61.4	12.9	4	17.5	39.7	6	877	
41	10/30/2005	14:02:45	11.3	11.8	6.8	180.4	18.9	62.5	12.9	6	17.5	39.7	6	877	
42	10/30/2005	14:01:35	11.9	13.3	7.7	207.5	21.4	62.5	12.9	8	17.5	39.7	6	877	
43	10/30/2005	14:00:26	11.8	13.2	7.6	171.3	17.7	62.5	12.9	10	17.5	39.7	6	877	
44	10/30/2005	14:36:14	9.8	0.1	0.0	140.8	16.0	53.3	12.7	0	17.5	37.2	15	813	
45	10/30/2005	14:35:03	11.0	2.0	1.0	208.2	22.8	60.4	13	2	17.5	37.2	15	813	
46	10/30/2005	14:33:53	11.1	9.6	5.4	194.0	20.6	61.4	12.9	4	17.5	37.2	15	813	

Typical Result

Dissolved Oxygen



Summary

What we know so far . . .

- Prototype device still in service.
- Hardware costs less than expected. (\$4,000)
- Power consumption higher than expected.
- Real-time data transmission and whole water column sampling systems robust.
- YSI *Data Sonde* the weak link . . .
- The platform provides users the ability to remotely troubleshoot problems with the sonde.
- May need to consider building an additional device used for all sonde deployments:
 - Simple communication device
 - Facilitate remote dialog with data sondes
 - Allows for remote troubleshooting

Transmission Information

Modem Number

2

Baud Rate

9600

Time since start (h:m:s)

47:48:13

Last transmission (h:m:s)

00:00:20

Number of data transmissions

91

STOP

- ☐ Waiting for call
- ☐ Modem Connected
- ☐ Hello
- ☐ Transmitting Data
- ☐ Getting Depth Info
- ☐ Getting Cycle Time
- ☐ Hanging Up
- ☐ Processing Data

Platform Status

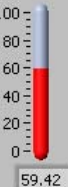
Platform Battery (V)



Cycle Time (min)

30

DO Sat



Total Depth (ft)

10

Delta (ft)

2

Weather Data

Air Temperature (C)

19.1

Wind Speed (MPH)

3

Relative Humidity (%)

37

Solar Intensity (W/sq meter)

708

Most Recent Sonde Data

11/03/05 15:06:43	10.97	0.122	0.06	165.6	18.27	53.3	12.5
11/03/05 15:05:33	11.39	0.137	0.06	191.8	20.95	54.3	12.5
11/03/05 15:04:22	13.45	17.27	10.21	226.0	22.13	62.5	12.7
11/03/05 15:03:13	13.47	16.91	9.98	206.3	20.23	62.5	12.7
11/03/05 15:02:04	13.46	17.28	10.21	210.3	20.59	62.5	12.7
11/03/05 15:00:56	13.59	17.49	10.35	143.5	13.99	61.4	12.7

Depths (ft)

0
2
4
6
8
10

Previous Cycle Sonde Data

11/03/05 14:36:43	11.33	0.113	0.05	165.9	18.15	53.3	12.5
11/03/05 14:35:32	12.70	0.167	0.08	249.8	26.49	57.4	12.7
11/03/05 14:34:23	13.64	16.72	9.86	229.1	22.39	62.5	12.7
11/03/05 14:33:14	13.56	16.95	10.00	217.6	21.28	62.5	12.7
11/03/05 14:32:05	13.51	16.92	9.98	206.8	20.25	62.5	12.7
11/03/05 14:30:57	13.47	17.53	10.37	140.1	13.69	61.4	12.7

Depths (ft)

0
2
4
6
8
10

Spatial and Temporal Water Data

Current Sample Time (h:m:s)

15:06:43

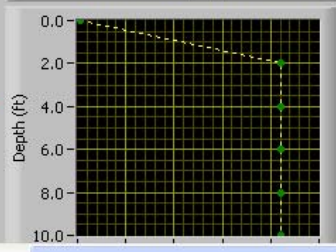
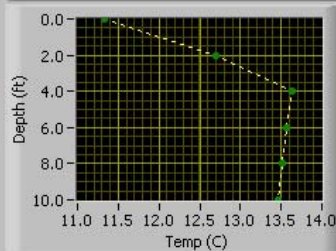
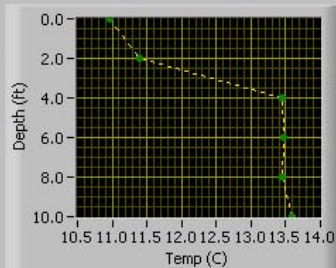
Previous Sample Time (h:m:s)

14:36:43

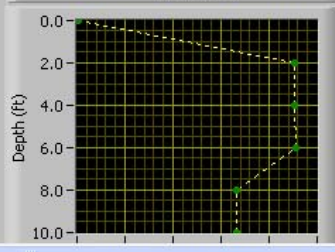
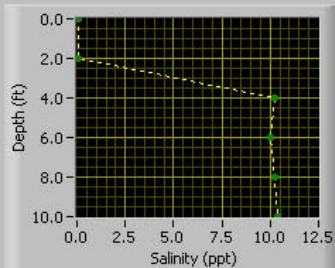
Previous Sample Time (h:m:s)

13:36:47

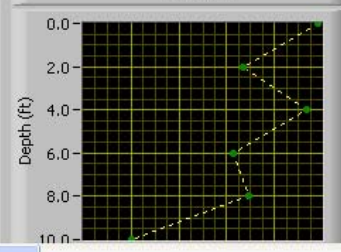
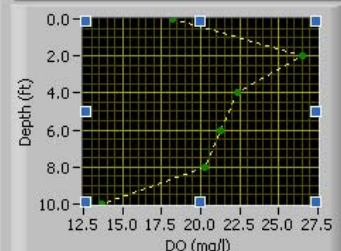
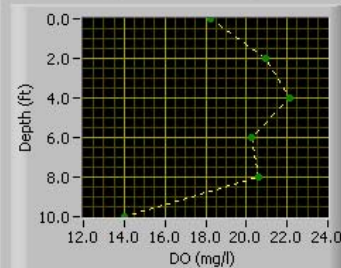
Temperature vs. Depth



Salinity vs. Depth

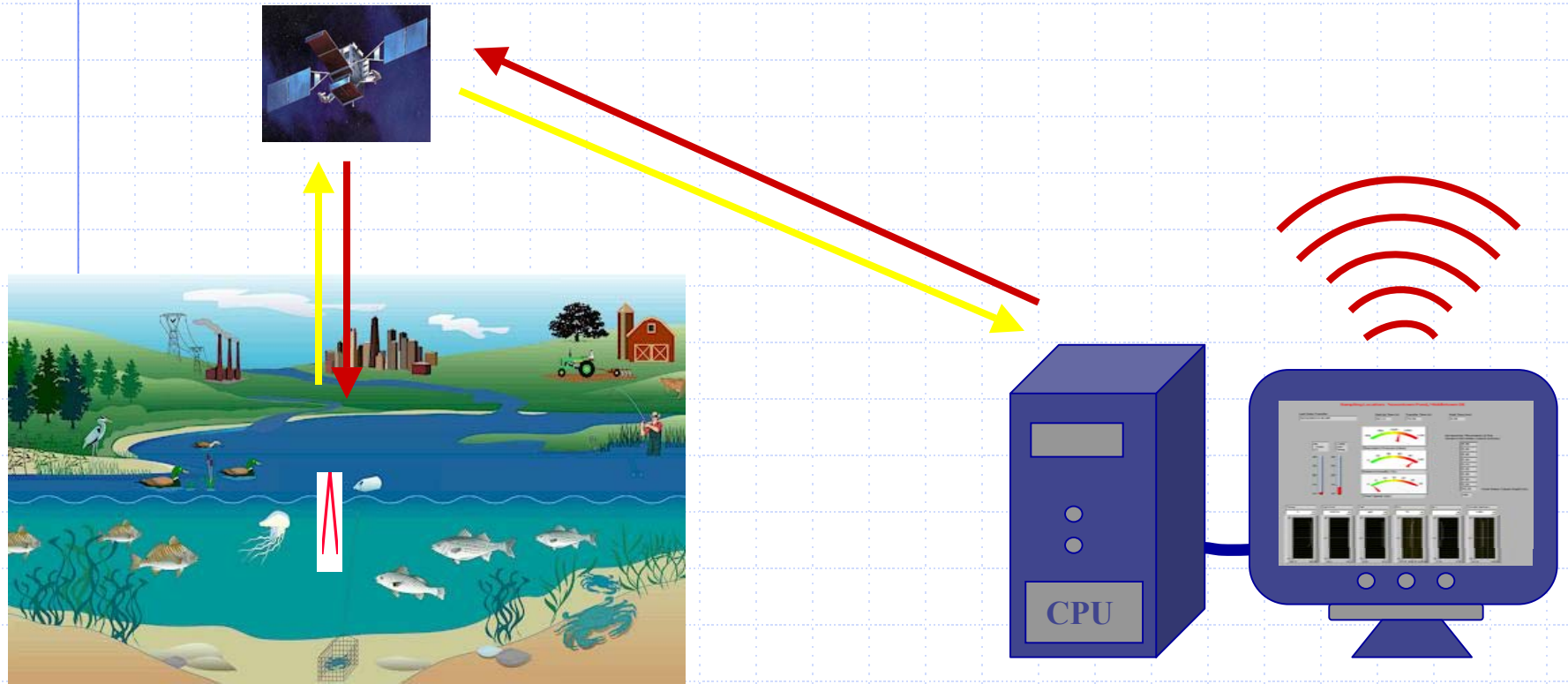


DO vs Depth



Vision:

Real-Time Interactive Monitoring Systems



Host Computer and Web
Server in Newark