Engaging K-12 Audiences through Hands-on Experiences and Data-based Activities

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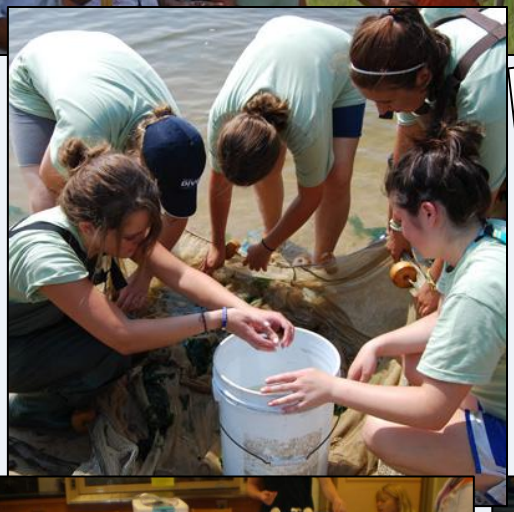
Credit: UD TIDE Camp

Program Example: *Coast Day*

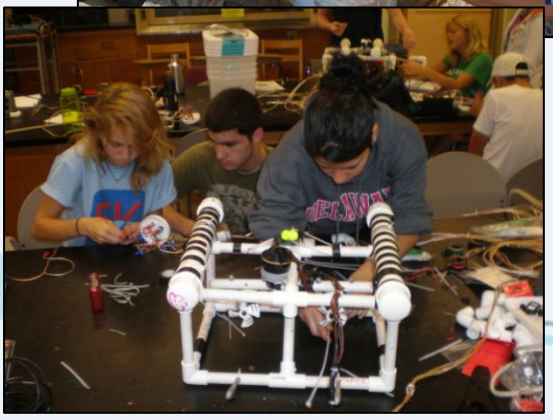
Coast Day™

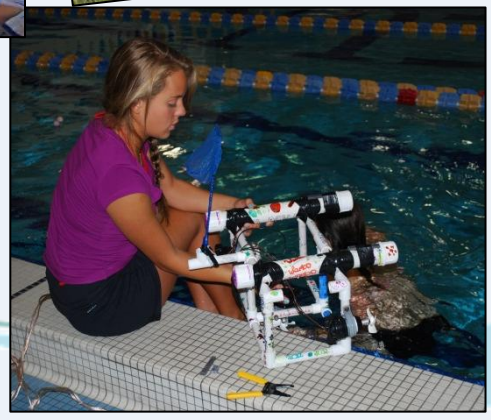
First Sunday in October!

Program Example: *UD TIDE Camp*

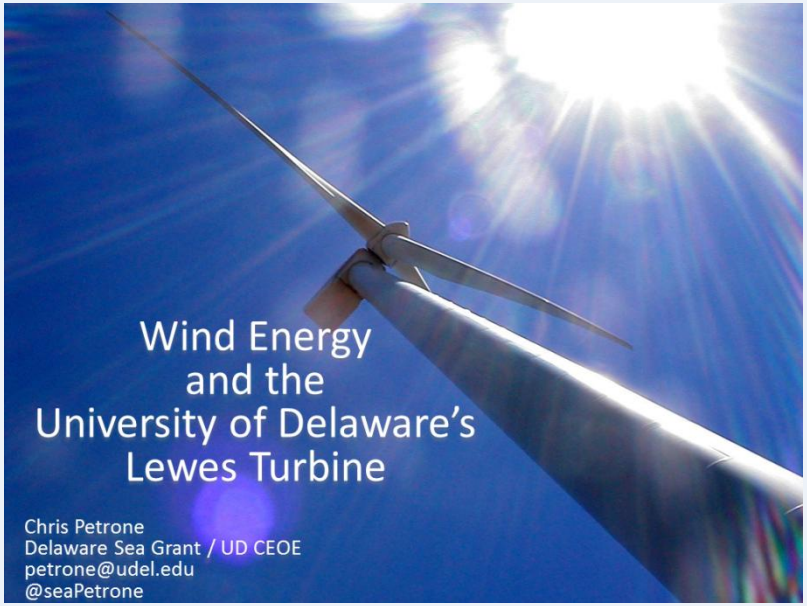


Credit: UD TIDE Camp

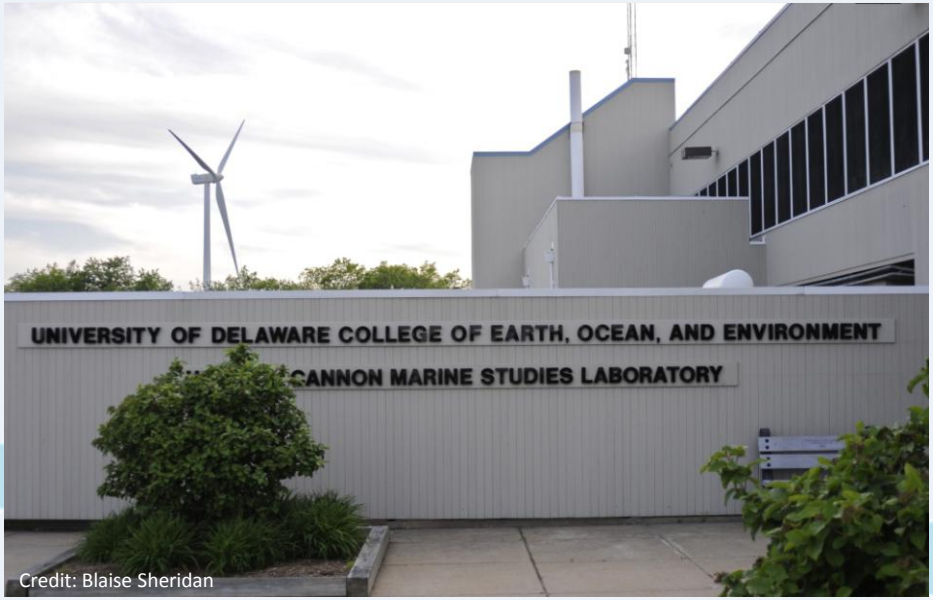




Program Example: Sharp *Campus Programs*

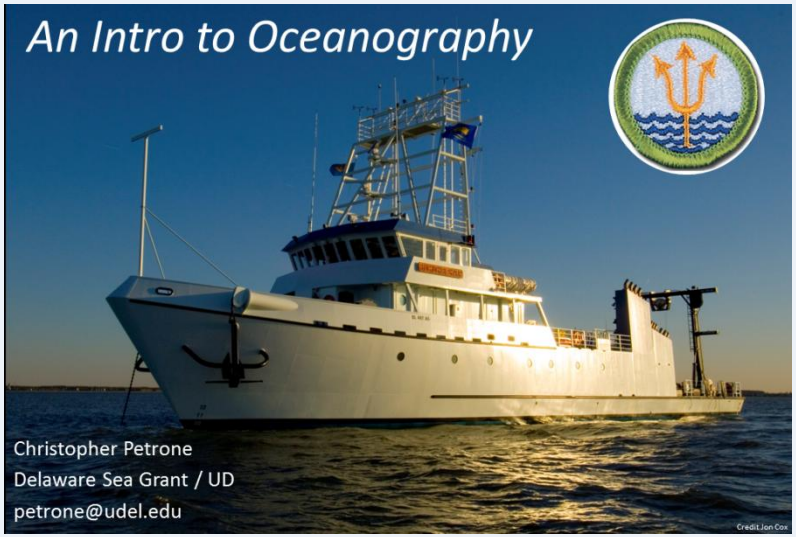


Credit: Brenna Goggin, Del Nature Society



Credit: Blaise Sheridan

Program Example: Sharp *Campus Programs*



Credit:FOSS

Credit: Moses-Karankawa Bayous Alliance

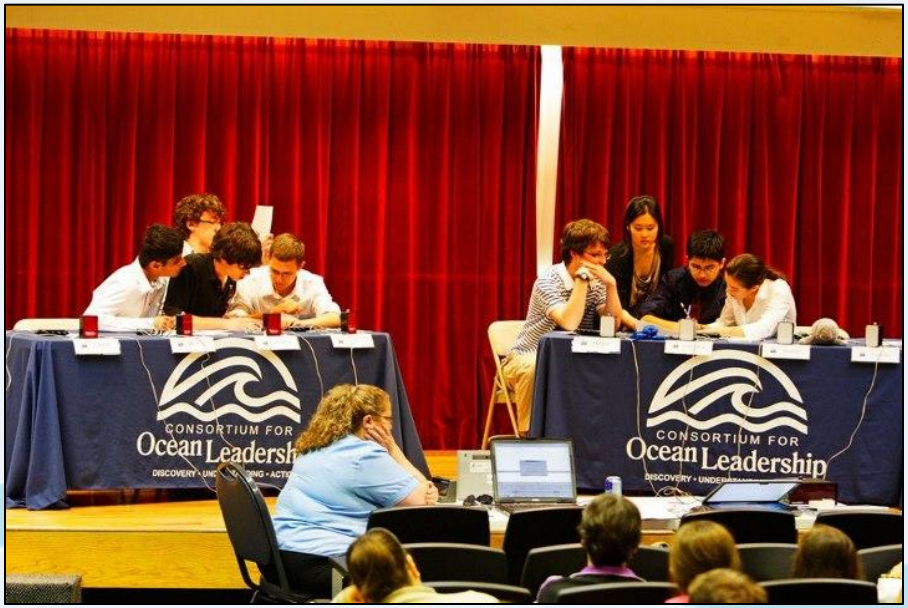
Credit: Fort Collins Museum & Discovery Science Center

Program Example: *National Ocean Sciences Bowl*

NATIONAL OCEAN SCIENCES BOWL


Credit: NOSB

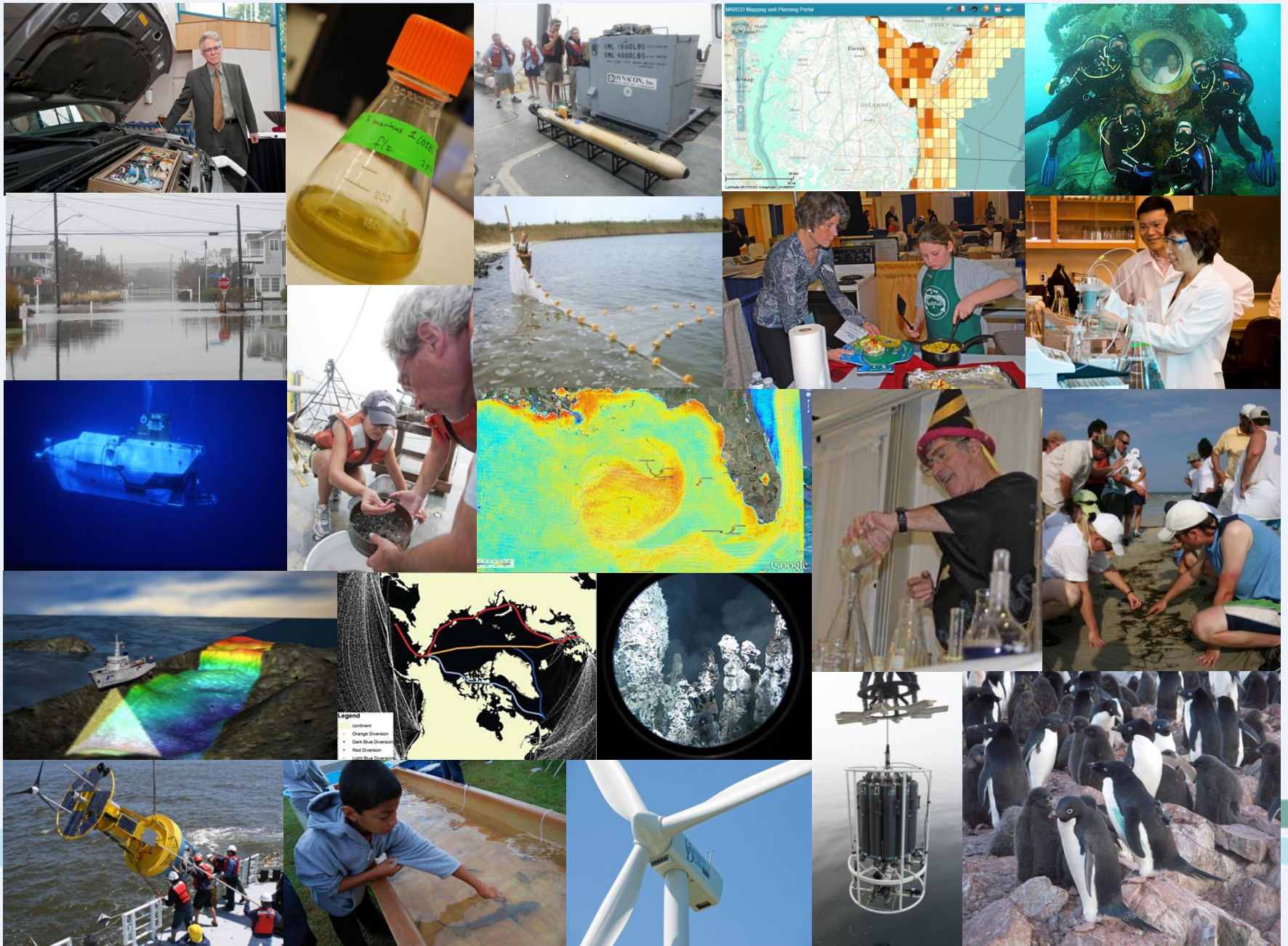
Chesapeake Bay Bowl
February 2014
Lewes, DE-area
chesapeakebaybowl.org



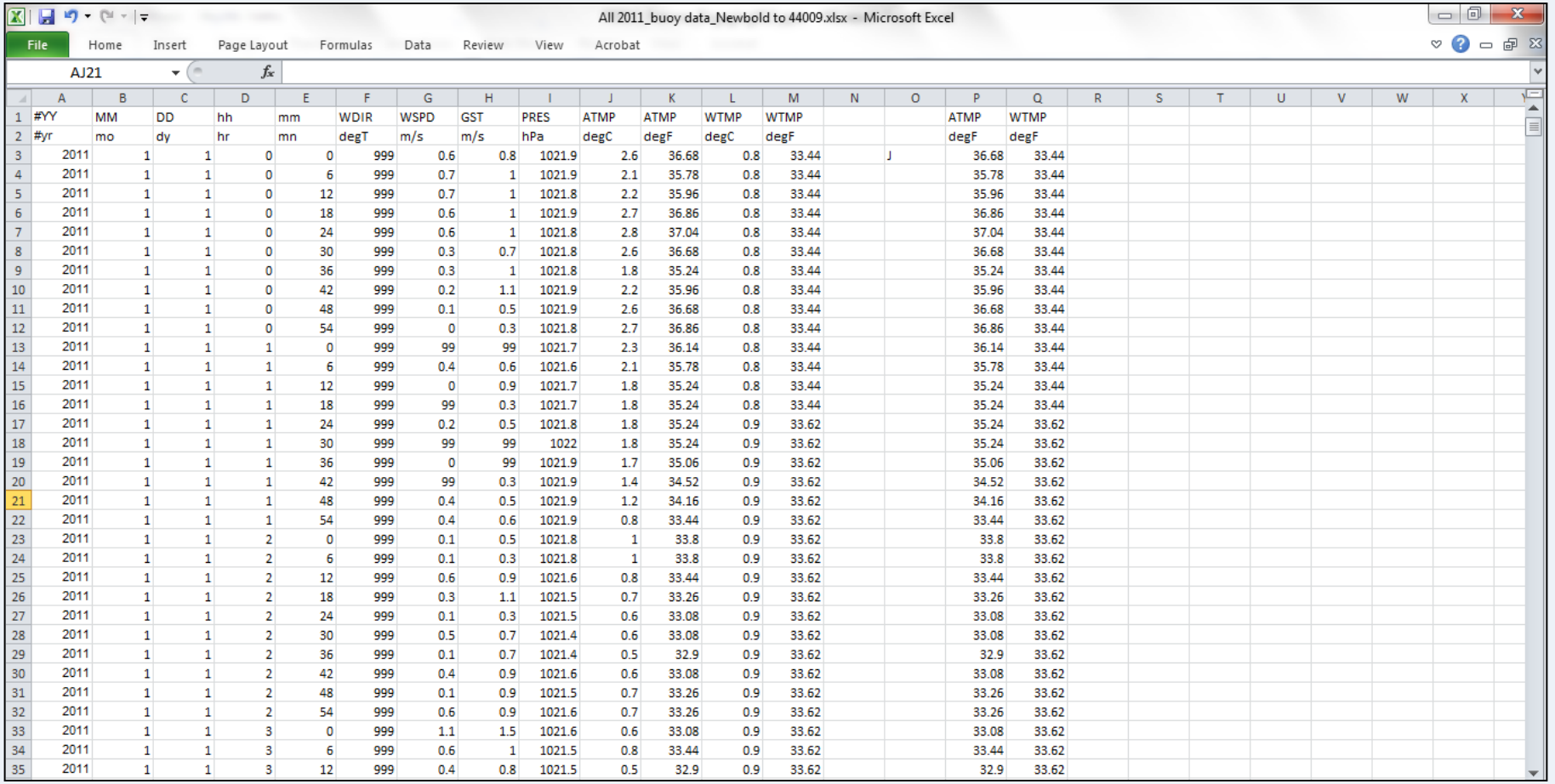
Credit: NOSB


Credit: Carol Hopper Brill

Program Example: *Marine Careers*



Data-based activities


All 2011_buoy data_Newbold to 44009.xlsx - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Acrobat

AJ21

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	#YY	MM	DD	hh	mm	WDIR	WSPD	GST	PRES	ATMP	ATMP	WTMP	WTMP			ATMP	WTMP							
2	#yr	mo	dy	hr	mn	degT	m/s	m/s	hPa	degC	degF	degC	degF			degF	degF							
3	2011	1	1	0	0	999	0.6	0.8	1021.9	2.6	36.68	0.8	33.44		J	36.68	33.44							
4	2011	1	1	0	6	999	0.7	1	1021.9	2.1	35.78	0.8	33.44			35.78	33.44							
5	2011	1	1	0	12	999	0.7	1	1021.8	2.2	35.96	0.8	33.44			35.96	33.44							
6	2011	1	1	0	18	999	0.6	1	1021.9	2.7	36.86	0.8	33.44			36.86	33.44							
7	2011	1	1	0	24	999	0.6	1	1021.8	2.8	37.04	0.8	33.44			37.04	33.44							
8	2011	1	1	0	30	999	0.3	0.7	1021.8	2.6	36.68	0.8	33.44			36.68	33.44							
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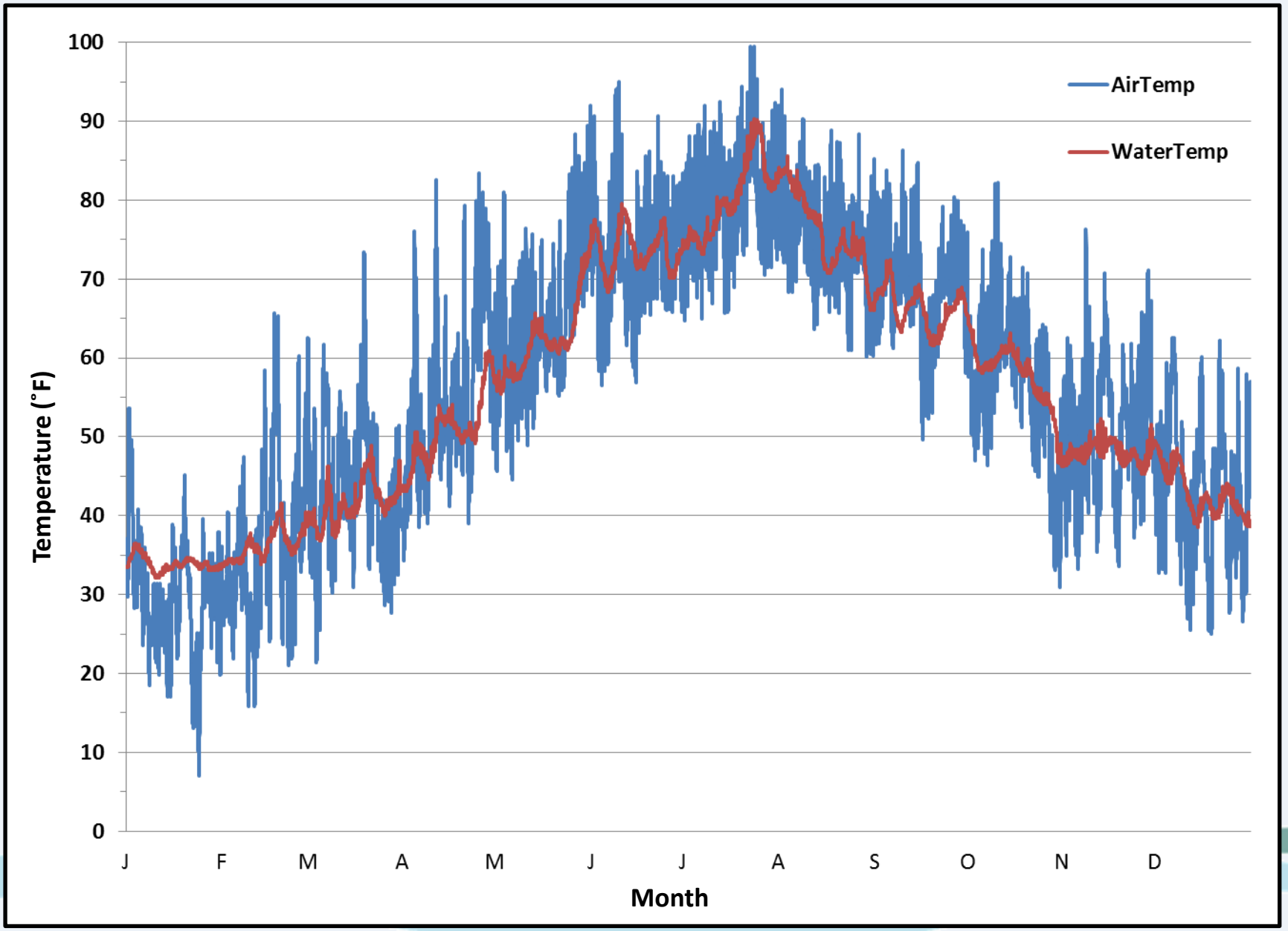
10	2011	1	1	0	42	999	0.2	1.1	1021.9	2.2	35.96	0.8	33.44			35.96	33.44							
11	2011	1	1	0	48	999	0.1	0.5	1021.9	2.6	36.68	0.8	33.44			36.68	33.44							
12	2011	1	1	0	54	999	0	0.3	1021.8	2.7	36.86	0.8	33.44			36.86	33.44							
13	2011	1	1	1	0	999	99	99	1021.7	2.3	36.14	0.8	33.44			36.14	33.44							
14	2011	1	1	1	6	999	0.4	0.6	1021.6	2.1	35.78	0.8	33.44			35.78	33.44							
15	2011	1	1	1	12	999	0	0.9	1021.7	1.8	35.24	0.8	33.44			35.24	33.44							
16	2011	1	1	1	18	999	99	0.3	1021.7	1.8	35.24	0.8	33.44			35.24	33.44							
17	2011	1	1	1	24	999	0.2	0.5	1021.8	1.8	35.24	0.9	33.62			35.24	33.62							
18	2011	1	1	1	30	999	99	99	1022	1.8	35.24	0.9	33.62			35.24	33.62							
19	2011	1	1	1	36	999	0	99	1021.9	1.7	35.06	0.9	33.62			35.06	33.62							
20	2011	1	1	1	42	999	99	0.3	1021.9	1.4	34.52	0.9	33.62			34.52	33.62							
21	2011	1	1	1	48	999	0.4	0.5	1021.9	1.2	34.16	0.9	33.62			34.16	33.62							
22	2011	1	1	1	54	999	0.4	0.6	1021.9	0.8	33.44	0.9	33.62			33.44	33.62							
23	2011	1	1	2	0	999	0.1	0.5	1021.8	1	33.8	0.9	33.62			33.8	33.62							
24	2011	1	1	2	6	999	0.1	0.3	1021.8	1	33.8	0.9	33.62			33.8	33.62							
25	2011	1	1	2	12	999	0.6	0.9	1021.6	0.8	33.44	0.9	33.62			33.44	33.62							
26	2011	1	1	2	18	999	0.3	1.1	1021.5	0.7	33.26	0.9	33.62			33.26	33.62							
27	2011	1	1	2	24	999	0.1	0.3	1021.5	0.6	33.08	0.9	33.62			33.08	33.62							
28	2011	1	1	2	30	999	0.5	0.7	1021.4	0.6	33.08	0.9	33.62			33.08	33.62							
29	2011	1	1	2	36	999	0.1	0.7	1021.4	0.5	32.9	0.9	33.62			32.9	33.62							
30	2011	1	1	2	42	999	0.4	0.9	1021.6	0.6	33.08	0.9	33.62			33.08	33.62							
31	2011	1	1	2	48	999	0.1	0.9	1021.5	0.7	33.26	0.9	33.62			33.26	33.62							
32	2011	1	1	2	54	999	0.6	0.9	1021.6	0.7	33.26	0.9	33.62			33.26	33.62							
33	2011	1	1	3	0	999	1.1	1.5	1021.6	0.6	33.08	0.9	33.62			33.08	33.62							
34	2011	1	1	3	6	999	0.6	1	1021.5	0.8	33.44	0.9	33.62			33.44	33.62							
35	2011	1	1	3	12	999	0.4	0.8	1021.5	0.5	32.9	0.9	33.62			32.9	33.62							

2011 Air and Water Temperature from NOAA Station: Newbold, PA



Air and Water Temperature 1-7 April, 2011 from NOAA Station: Newbold, PA

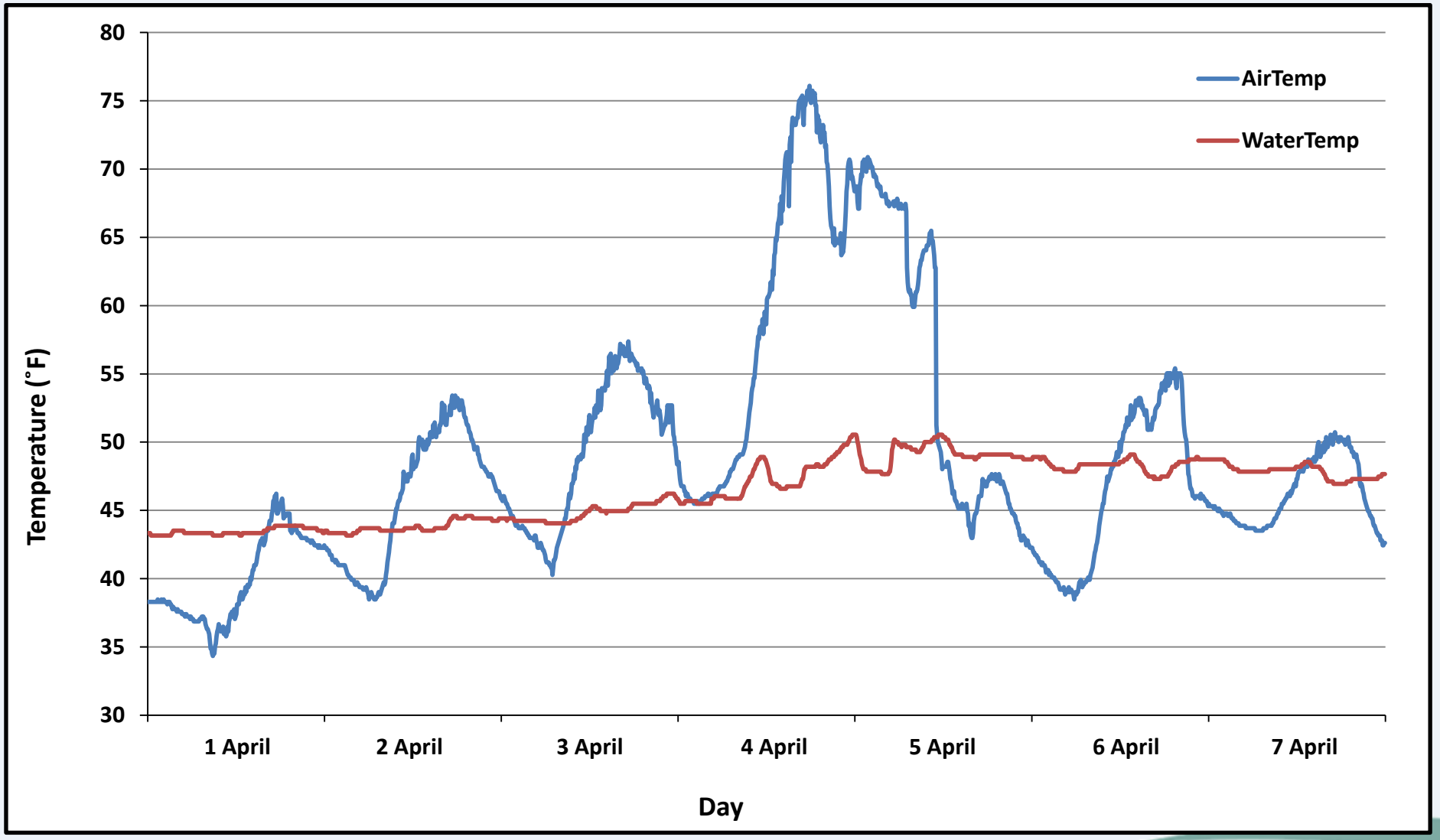
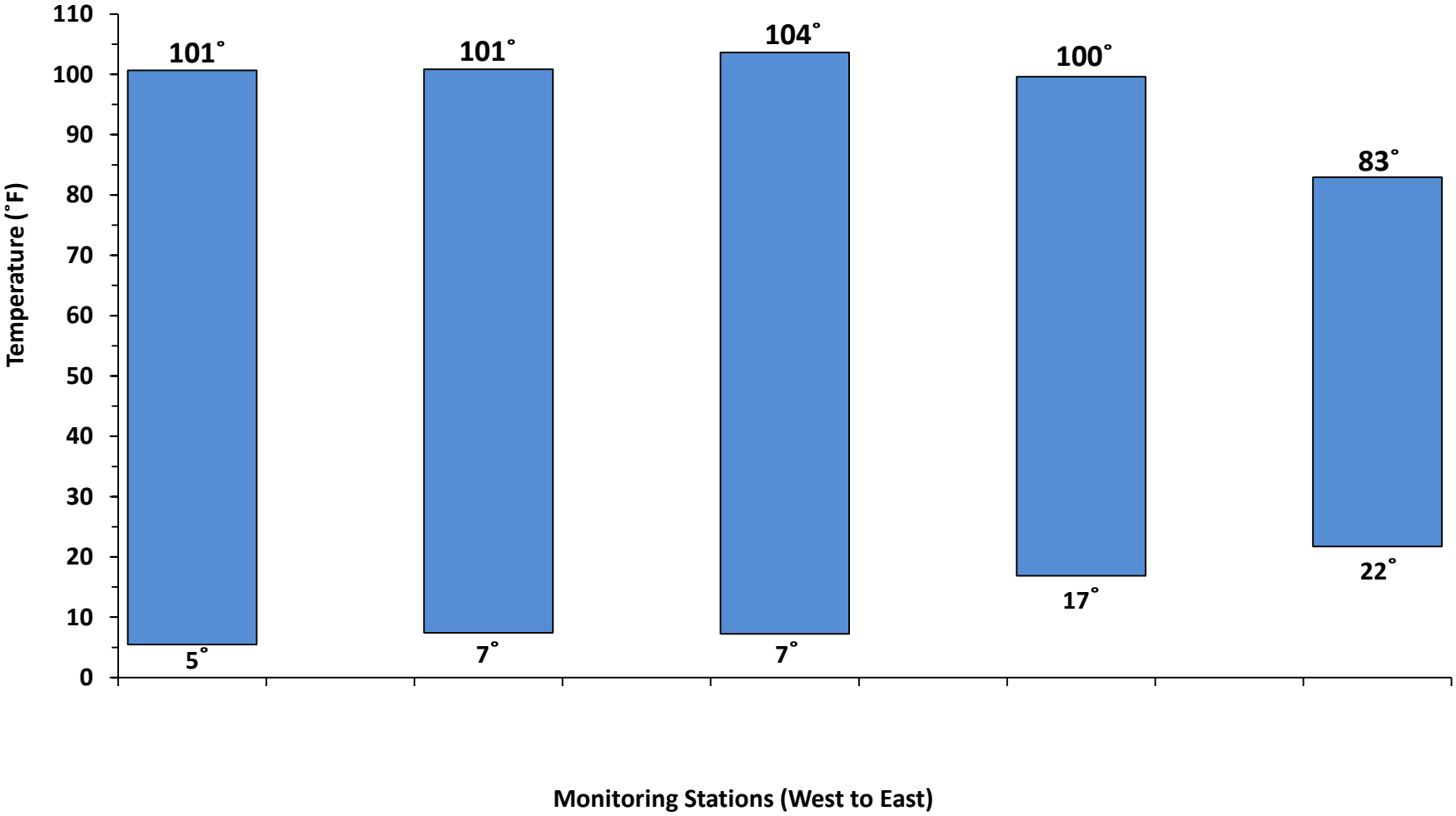
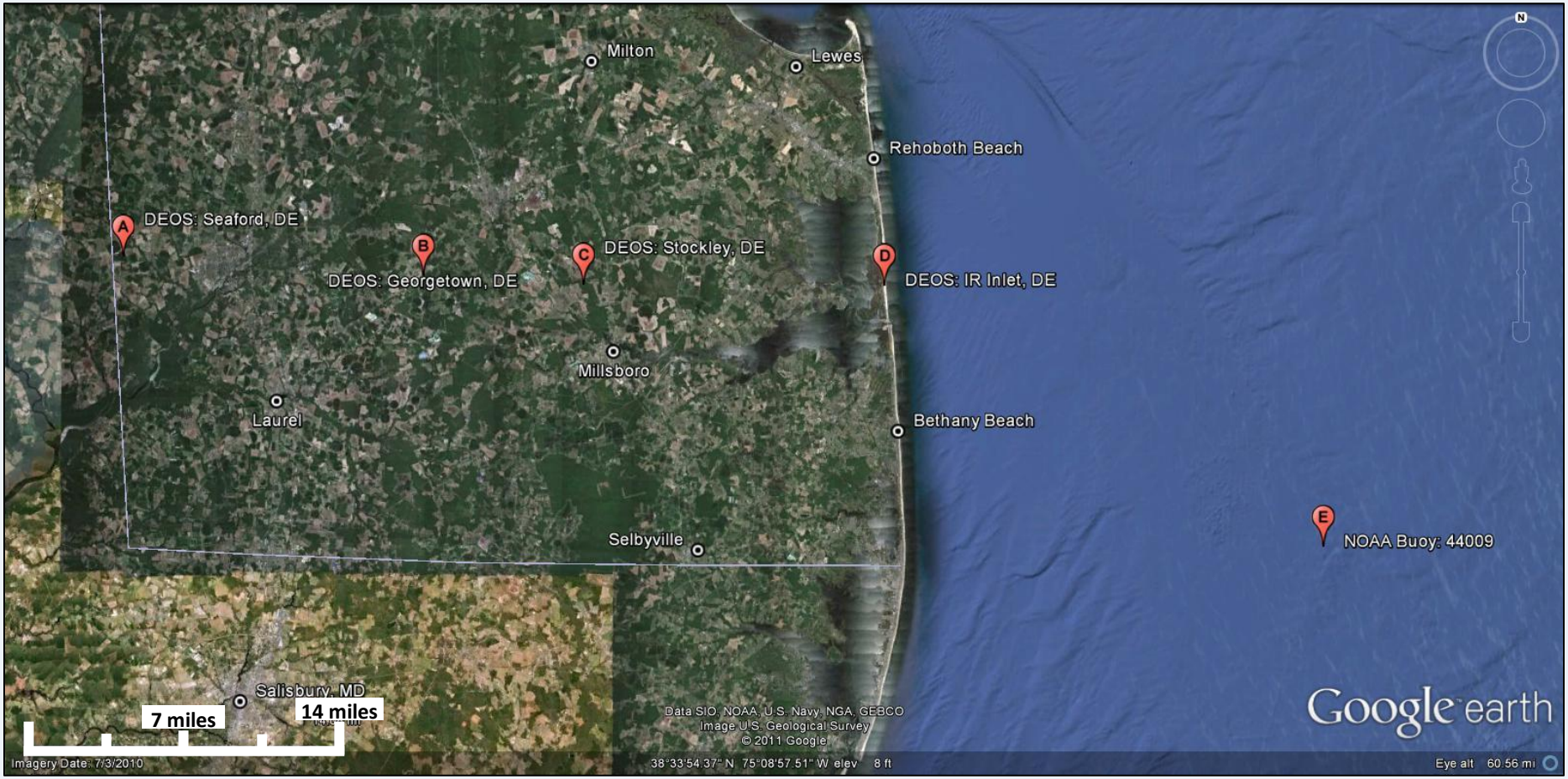
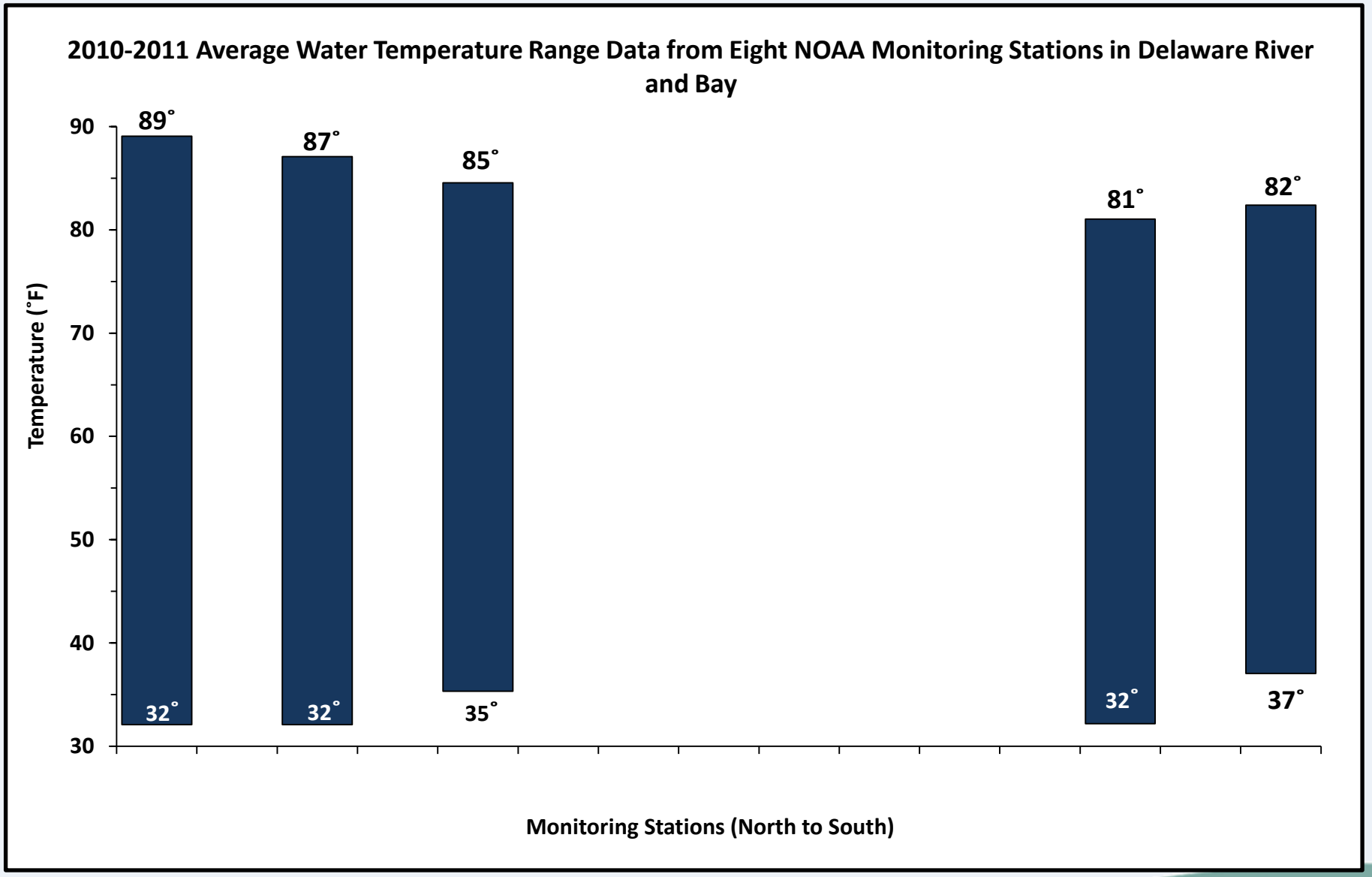
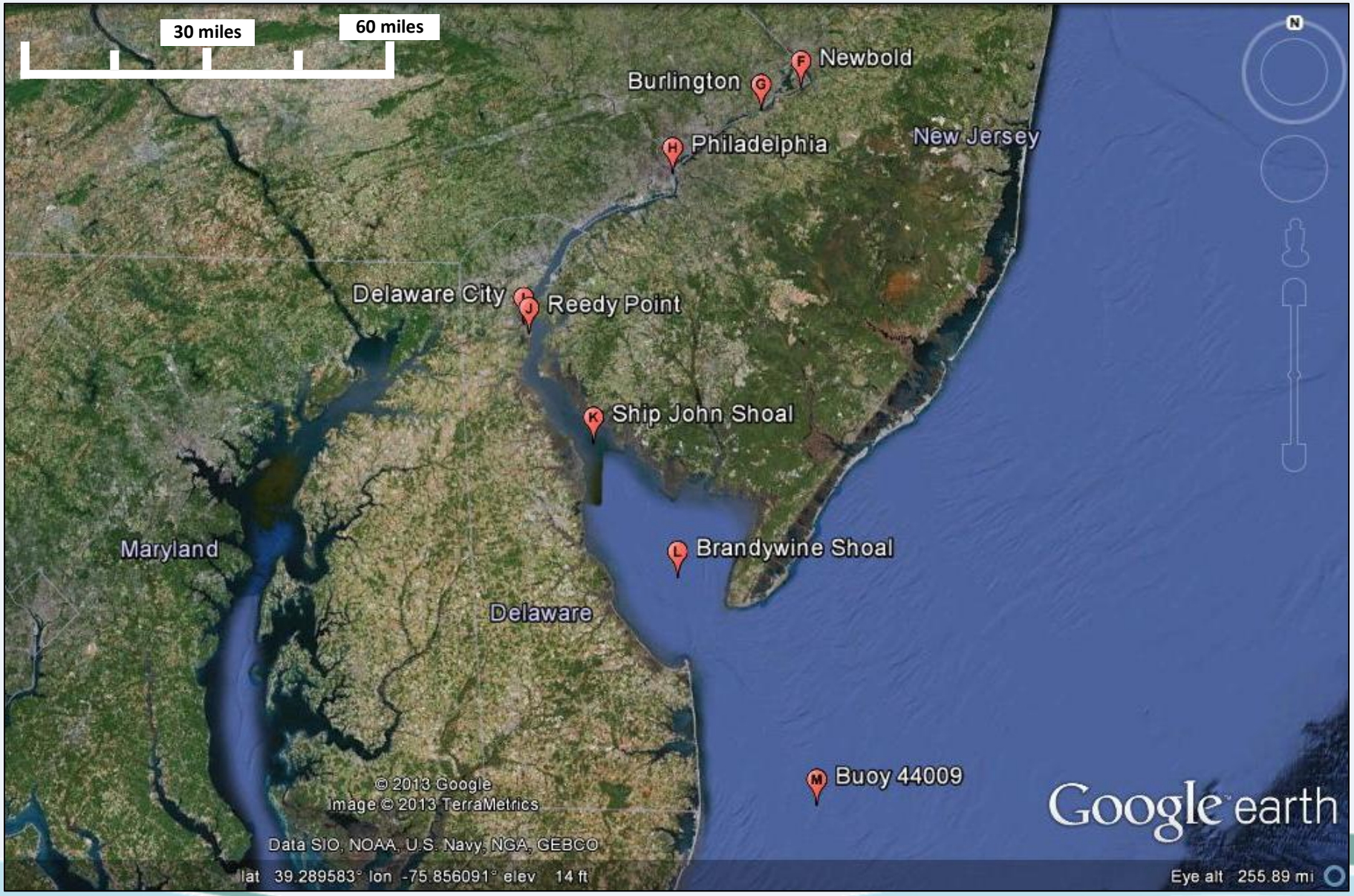


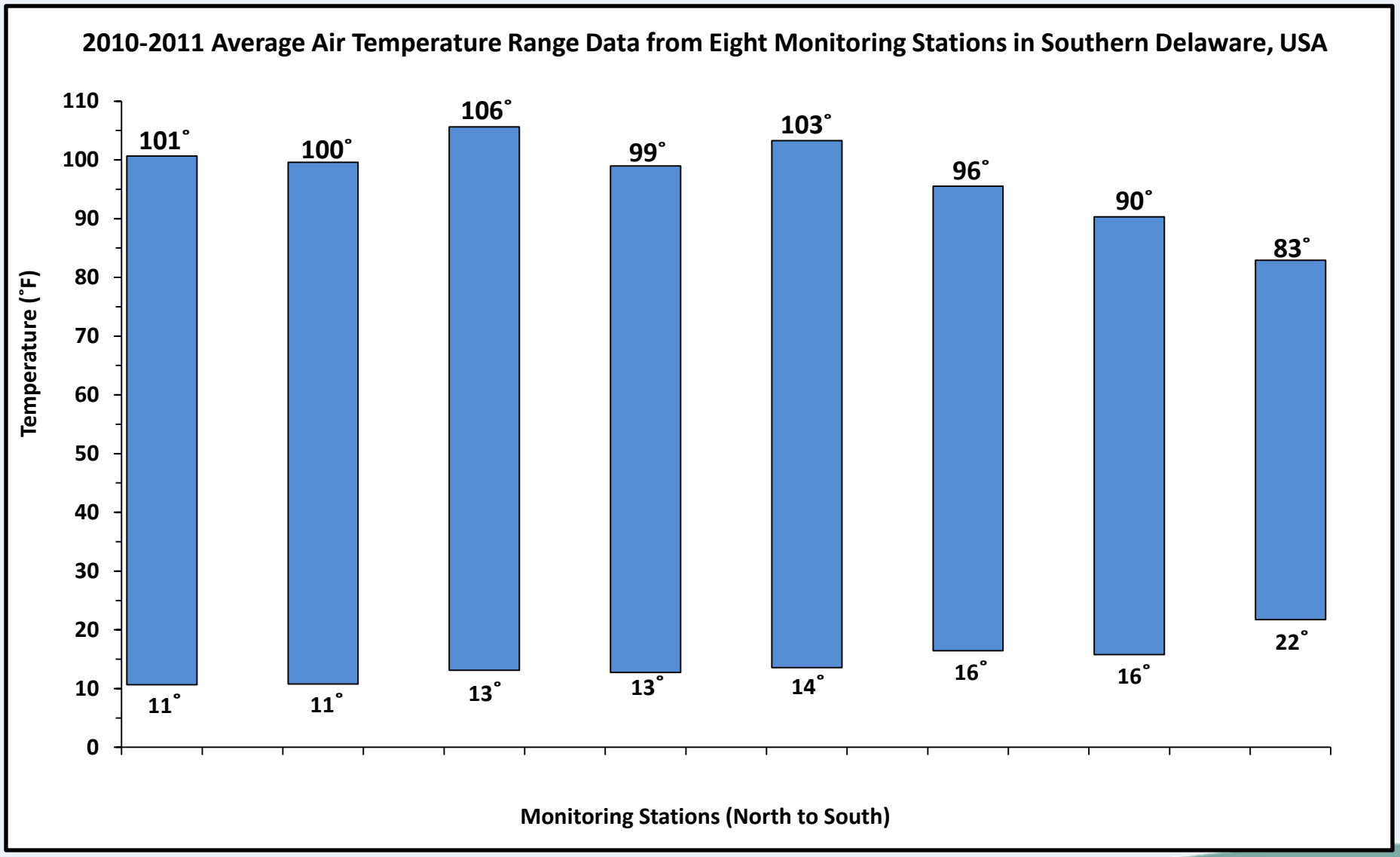
Figure 2a. 2010-2011 Average Air Temperature Range Data from Five Monitoring Stations in Southern Delaware, USA




Milton
Lewes
Rehoboth Beach
DEOS: Seaford, DE
DEOS: Georgetown, DE
DEOS: Stockley, DE
DEOS: IR Inlet, DE
Millsboro
Laurel
Bethany Beach
Selbyville
NOAA Buoy: 44009
Salisbury, MD
7 miles
14 miles
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image U.S. Geological Survey
© 2011 Google
Google earth
Imagery Date: 7/3/2010
38°33'54.37" N 75°08'57.51" W elev 8 ft
Eye alt 60.56 mi


2010-2011 Average Water Temperature Range Data from Eight NOAA Monitoring Stations in Delaware River and Bay
Temperature (˚F)
90
80
70
60
50
40
30
89˚
32˚
87˚
32˚
85˚
35˚
81˚
32˚
82˚
37˚
Monitoring Stations (North to South)


30 miles
60 miles
Newbold
Burlington
Philadelphia
New Jersey
Delaware City
Reedy Point
Ship John Shoal
Brandywine Shoal
Maryland
Delaware
Buoy 44009
© 2013 Google
Image © 2013 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
lat 39.289583° lon -75.856091° elev 14 ft
Eye alt 255.89 mi
Google earth


2010-2011 Average Air Temperature Range Data from Eight Monitoring Stations in Southern Delaware, USA
Temperature (˚F)
110
100
90
80
70
60
50
40
30
20
10
0
101˚
11˚
100˚
11˚
106˚
13˚
99˚
13˚
103˚
14˚
96˚
16˚
90˚
16˚
83˚
22˚
Monitoring Stations (North to South)

Delaware Sea Grant Data Activity

Can't Take the Heat?

Grade Level: 6-12

Lesson Time: 45 minutes

Required Materials:

- Ruler
- Maps of monitoring stations
- Blank graphs
- Graphs of air and water temp from monitoring stations
- Graph of Newbold air vs. water temperature
- Computer with internet access or print outs of real-time data
- Student worksheet

STEM Connections

Science – Density; Meteorology; Climatology; Human impact; Interpreting graphs
Technology – Archived and real-time data from environmental observing systems
Engineering – Land use; Coastal development
Math – Creating graphs

Delaware Science Content Standards

Grades 6-8		*Grades 9-12*
1.1.A	5.2.H	1.1.A
1.1.C	5.2.I	1.1.D
1.2.A	5.2.J	1.2.A
2.1.E	5.3.A	8.3.B
5.1.B	8.3.A	8.3.C
5.2.F	8.3.C	

Related Topics

weather, climate, properties of water, land use, sustainable development, human impact, heat island effect

written by Christopher Petrone, Delaware Sea Grant, University of Delaware College of Earth, Ocean, and Environment

This activity has been modified from the original *Can't Take the Heat?* to include observing system data from Delaware. For the Virginia version, please visit www.marine-ed.org/bridge/heatcapacity.htm

Summary

Why does coffee take so long to cool down? Why is ocean water sometimes the warmest when the average daily air temperature starts to drop? How can buoys help us explore these questions? In this hands-on introduction to heat capacity students explore the concept and its effects on our daily lives. Students use ocean observing system data to investigate why water acts as a thermal buffer and the practical applications this has.

Activity Use

This activity can be used as part of a:

- Properties of water unit
- Human impacts and/or weather & climate unit in Environmental Science
- Density unit

Objectives

After completing this activity, students will be able to:

- Analyze graphs of air and water temperature
- Create graphs of temperature range
- Describe difference in the heat capacities of air and water
- Explain the practical applications of water's high heat capacity

Vocabulary

heat capacity, specific heat, thermal buffer, trend

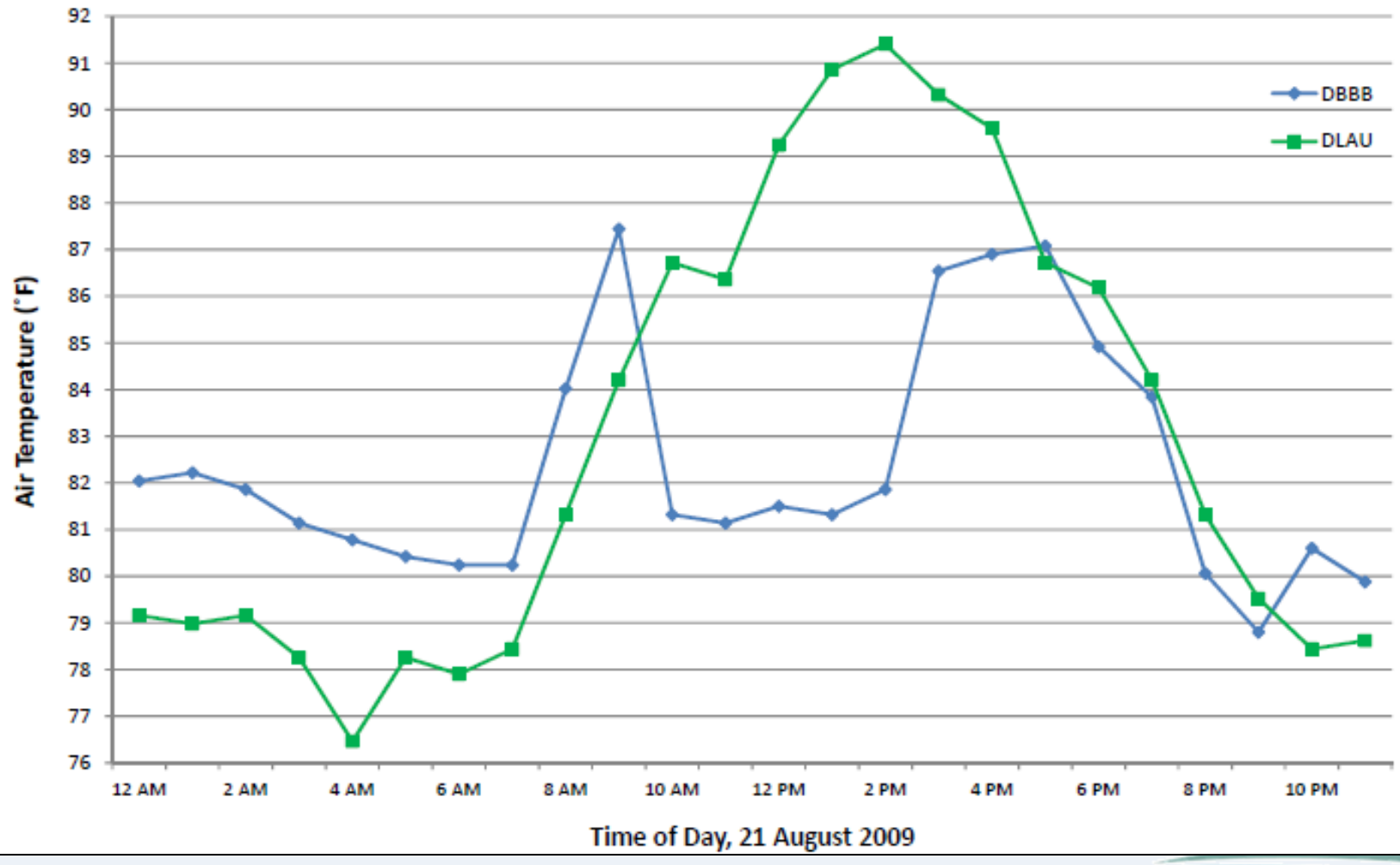
Invitation

Imagine it's the beginning of fall. School has been back in session for a few weeks and the temperature is beginning to cool as autumn quickly approaches. At dinner one night, your parents surprise you with a trip to the beach for the weekend. Normally, if it were summer, this would be great news—hot sun and the refreshing ocean water! Unfortunately, the beach is not located in one of those areas that stay warm year-round. So how much fun will this weekend be if you cannot swim in the ocean!?

The weekend finally arrives and you find yourself in your bathing suit standing inches from the breaking waves. The air temperature is in the mid-70s, but you're at the beach, so you must brave the coldest of water temperatures to get your money's-worth out of the trip. Finally, you take a deep breath, grit your teeth and run full speed into the water expecting it to feel like the Arctic the instant it touches your skin.

Sea Breeze

Figure 5. Air temperature data from DEOS stations DBBB and DLAU on 21 August 2009.

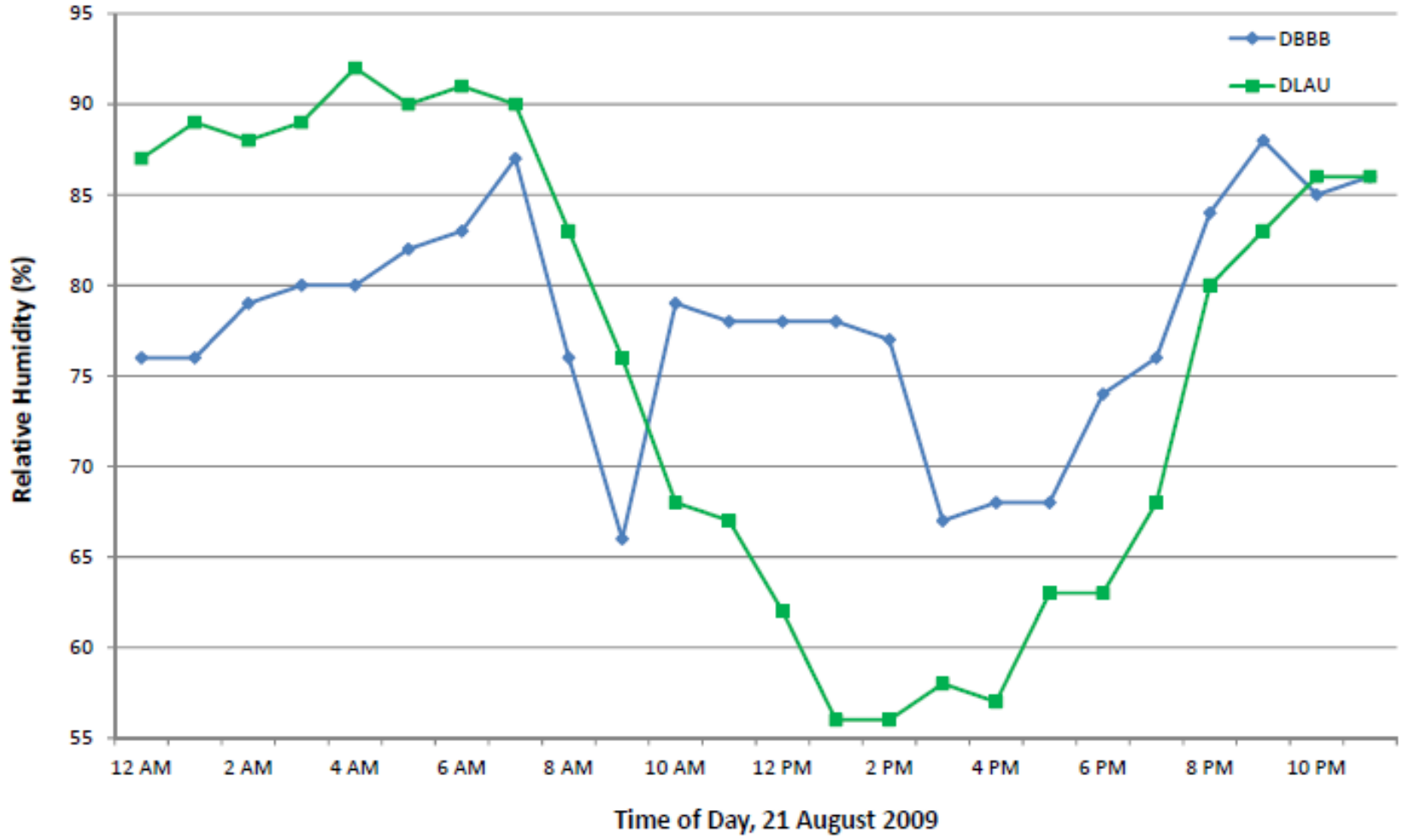


www.deseagrant.org/education/resources/SeabreezeActivity

DEOS

Sea Breeze

Figure 6. Relative humidity data from DEOS stations DBBB and DLAU on 21 August 2009.

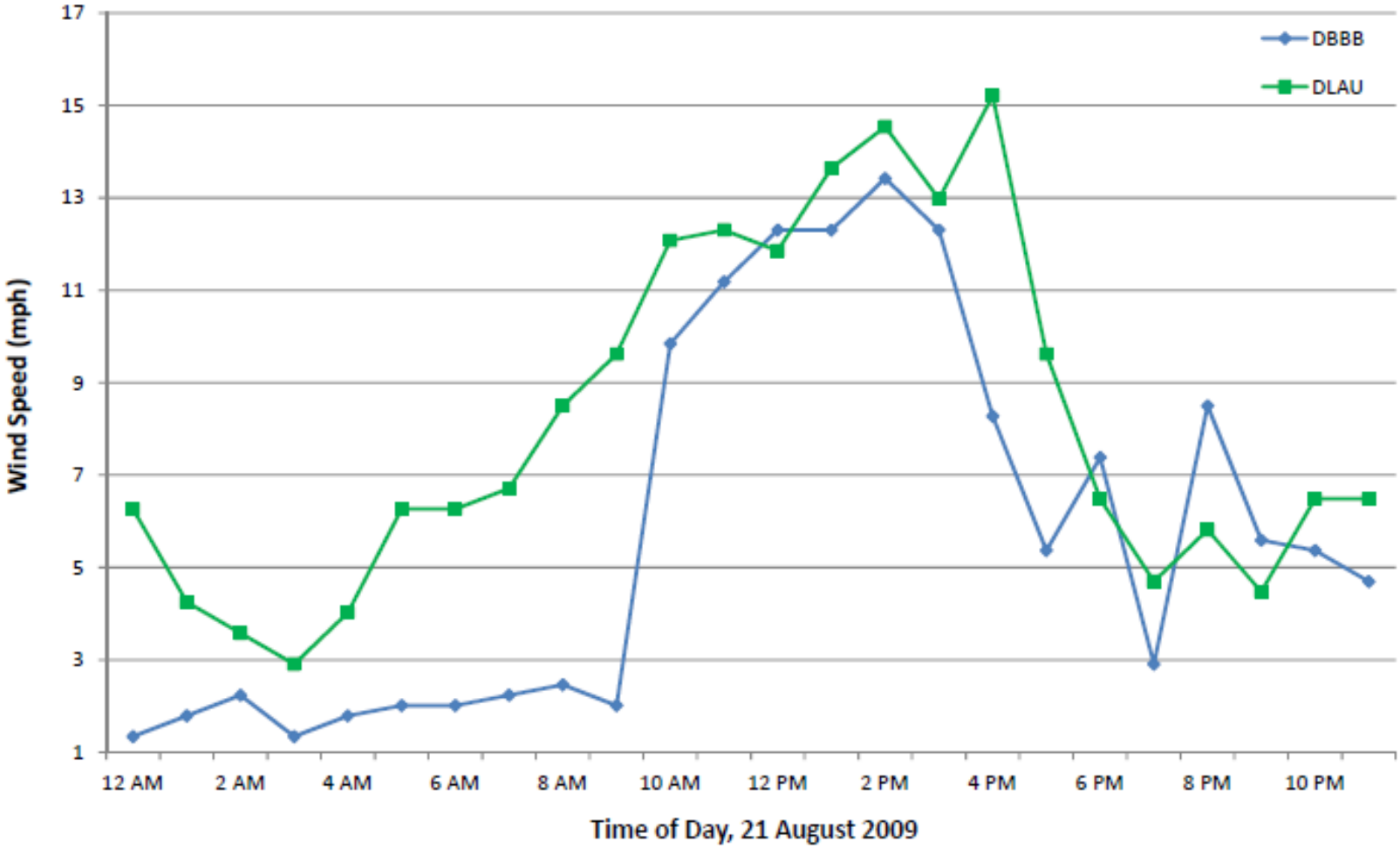


www.deseagrant.org/education/resources/SeabreezeActivity

DEOS

Sea Breeze

Figure 7. Wind speed data from DEOS stations DBBB and DLAU on 21 August 2009.

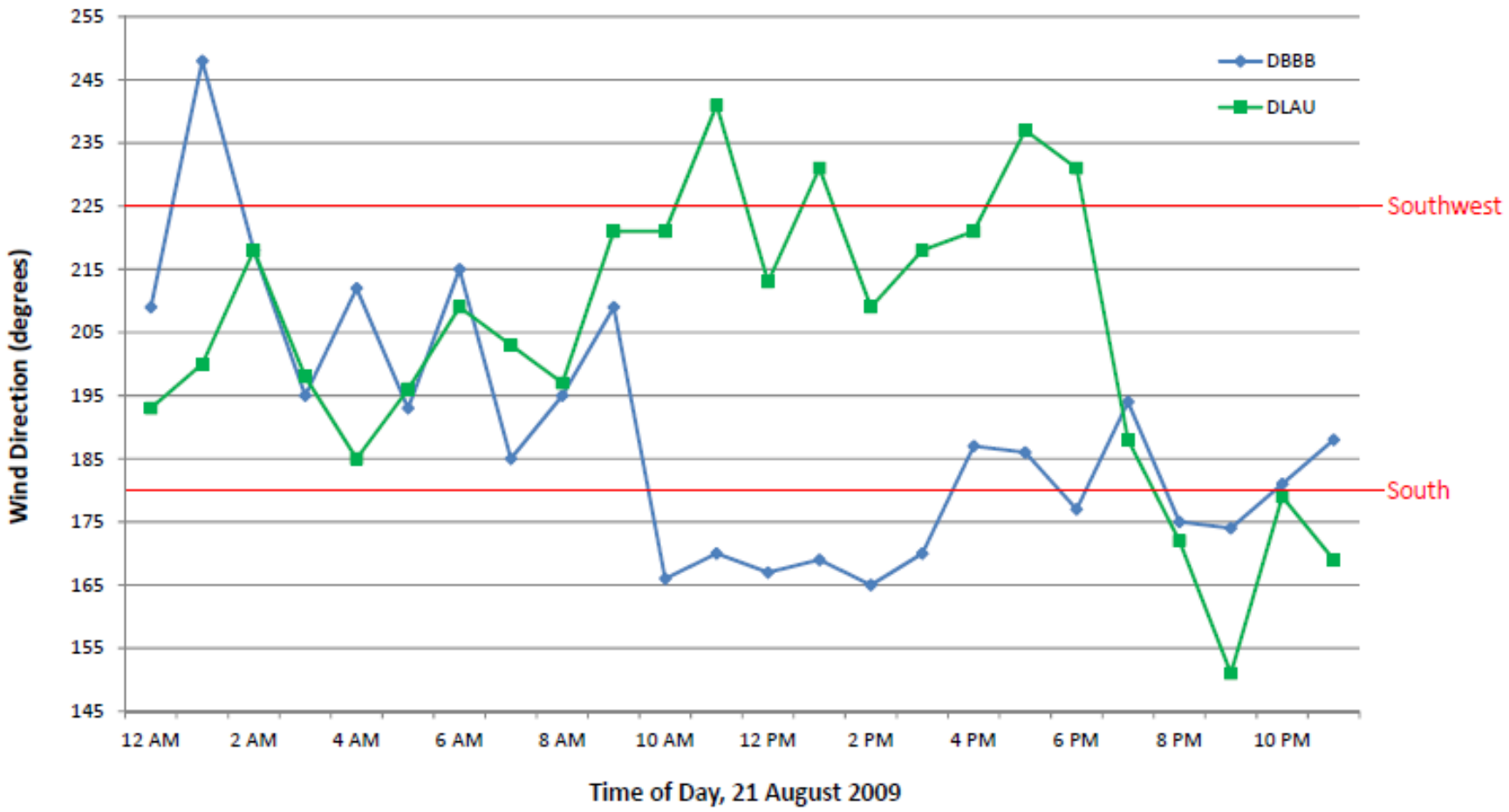


www.deseagrant.org/education/resources/SeabreezeActivity

DEOS

Sea Breeze

Figure 8. Wind direction data from DEOS stations DBBB and DLAU on 21 August 2009.



www.deseagrant.org/education/resources/SeabreezeActivity

Types of good face-to-face programs:

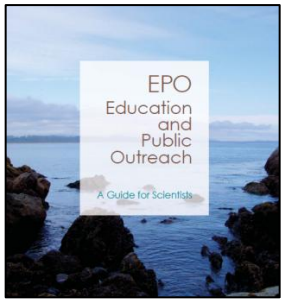
- Online/virtual field trip (live or asynchronous)
- Research experience internships (students/teachers)
- Citizen (student) science projects
- Clubs
- **Camps**
- **Festivals**
- **In-classroom programs**
- **Classroom-supplement (on site) program**
- Service projects
- Competition/contests
- **Boy/Girl Scout badges**

Traits of good face-to-face programs:

- Fun
- Interactive
- Student-driven (at least in part)
- Hands-on/active
- Positive
- Clear/understandable
- Inspiring
- Includes a call to action

Resources

- An experienced educator
- The Oceanography Society EPO Guide
  www.tos.org/epo_guide



- COSEE-NOW *Broader Impact Wizard*
  http://coseenow.net/wizard

COSEE
CENTERS FOR OCEAN SCIENCES EDUCATION EXCELLENCE

- JA Harrison, et al 2009
  Developing and Implementing an Effective Public Outreach Program

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