

# Temporally Dynamic Representations of Continuous Monitor Data through Animated Graphing

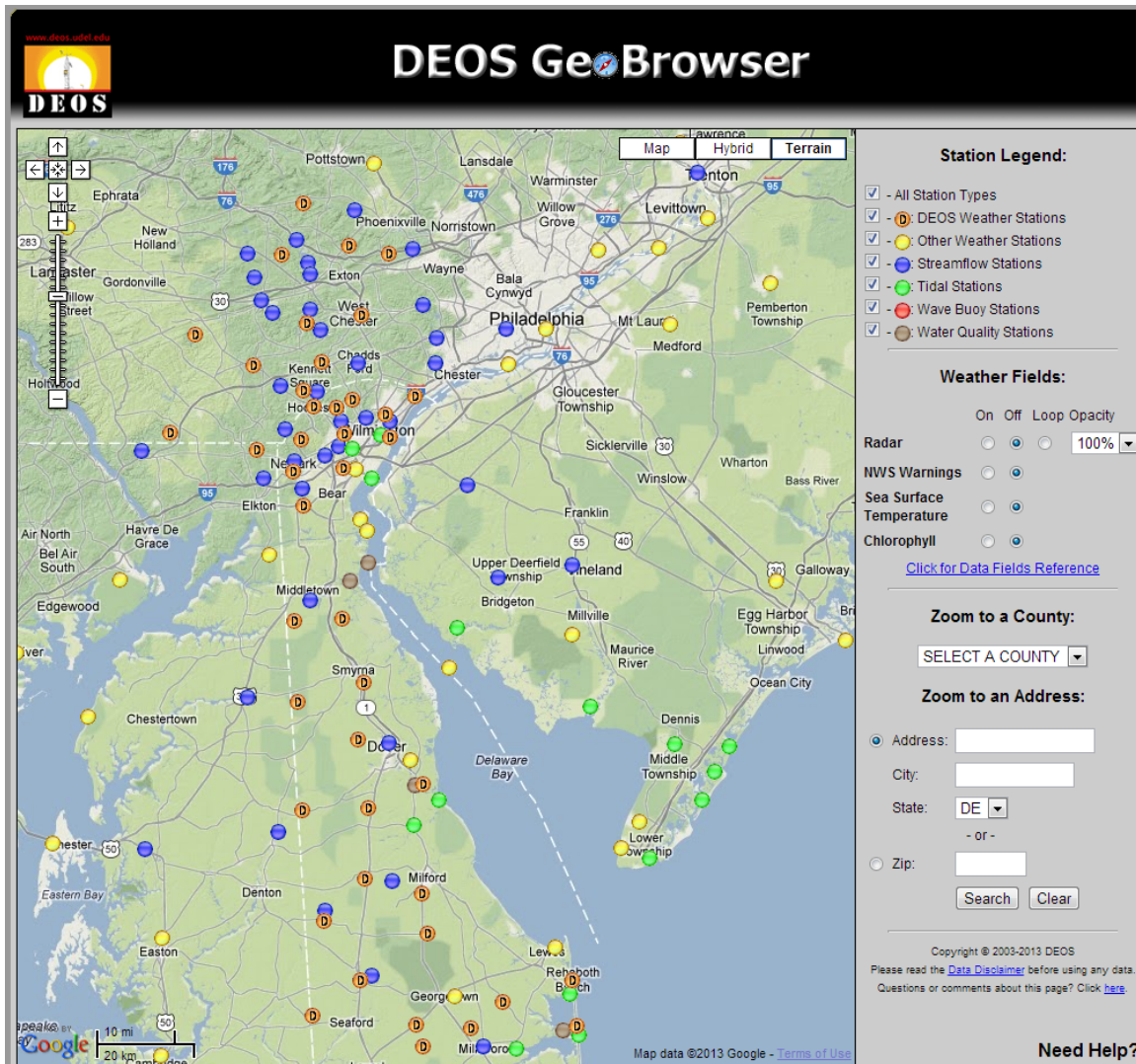
2013 Mid-Atlantic Conference of the  
American Water Resources Association  
West Windsor, NJ  
September 2013



**Delaware River Basin Commission**  
**DELAWARE • NEW JERSEY**  
**PENNSYLVANIA • NEW YORK**  
**UNITED STATES OF AMERICA**

John Yagecic, P.E.  
Supervisor, Standards & Assessment  
Delaware River Basin Commission

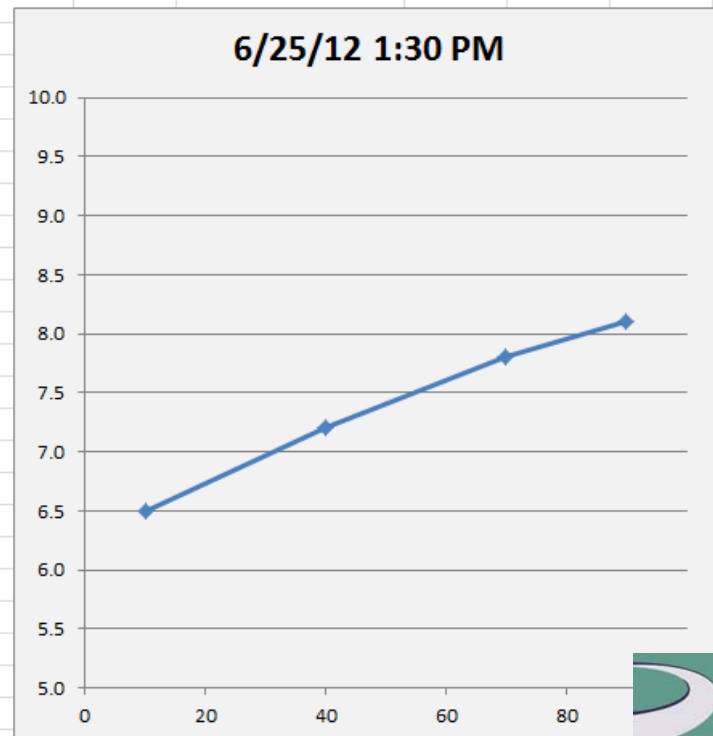
# Continuous Monitors in the Delaware Basin



- **USGS**
  - Flow and Stage
  - Water Quality
- **NOAA (PORTS)**
  - Water surface elevations
  - Salinity
  - Water Temperature
  - Current
  - Meteorology
- **NOAA (NWS)**
  - Hydrologic predictions
  - Quantitative precipitation forecasts

# 'Continuous' Monitor Data

	A	B	C	D	E	F	G	H	I	J	K
1											
2		Dissolved Oxygen (mg/L)						6/25/12 1:30 PM			
3	Date & Time	RM 90	RM 70	RM 40	RM 10		RM	DO (mg/L)			
4	6/25/12 12:00 AM	8.1	7.8	7.2	6.5		90	8.1			
5	6/25/12 12:30 AM	8	7.6	7.1	6.6		70	7.8			
6	6/25/12 1:00 AM	7.9	7.4	7.0	6.7		40	7.2			
7	6/25/12 1:30 AM	7.8	7.2	6.9	6.8		10	6.5			
8	6/25/12 2:00 AM	7.7	7	6.8	6.9						
9	6/25/12 2:30 AM	7.6	6.8	6.7	7						
10	6/25/12 3:00 AM	7.5	6.6	6.6	7.1						
11	6/25/12 3:30 AM	7.4	6.4	6.5	7.2						
12	6/25/12 4:00 AM	7.3	6.2	6.4	7.3						
13	6/25/12 4:30 AM	7.2	6	6.3	7.4						
14	6/25/12 5:00 AM	7.1	5.8	6.2	7.5						
15	6/25/12 5:30 AM	7	5.9	6.1	7.6						
16	6/25/12 6:00 AM	6.9	6	6.0	7.7						
17	6/25/12 6:30 AM	6.8	6.1	5.9	7.8						
18	6/25/12 7:00 AM	6.7	6.2	5.8	7.9						
19	6/25/12 7:30 AM	6.6	6.3	6.0	8						
20	6/25/12 8:00 AM	6.5	6.4	6.2	8.1						
21	6/25/12 8:30 AM	6.4	6.5	6.4	8.2						
22	6/25/12 9:00 AM	6.3	6.6	6.6	8.3						
23	6/25/12 9:30 AM	6.2	6.7	6.8	8.4						
24	6/25/12 10:00 AM	6.4	6.8	6.9	8.2						
25	6/25/12 10:30 AM	6.7	7.0	6.9	7.9						
26	6/25/12 11:00 AM	6.9	7.1	7.0	7.7						
27	6/25/12 11:30 AM	7.2	7.3	7.0	7.5						
28	6/25/12 12:00 PM	7.4	7.4	7.1	7.2						
29	6/25/12 12:30 PM	7.6	7.5	7.1	7.0						
30	6/25/12 1:00 PM	7.9	7.7	7.2	6.7						
31	6/25/12 1:30 PM	8.1	7.8	7.2	6.5						
32											
33											
34	Go										
35											



# Why animate continuous data?

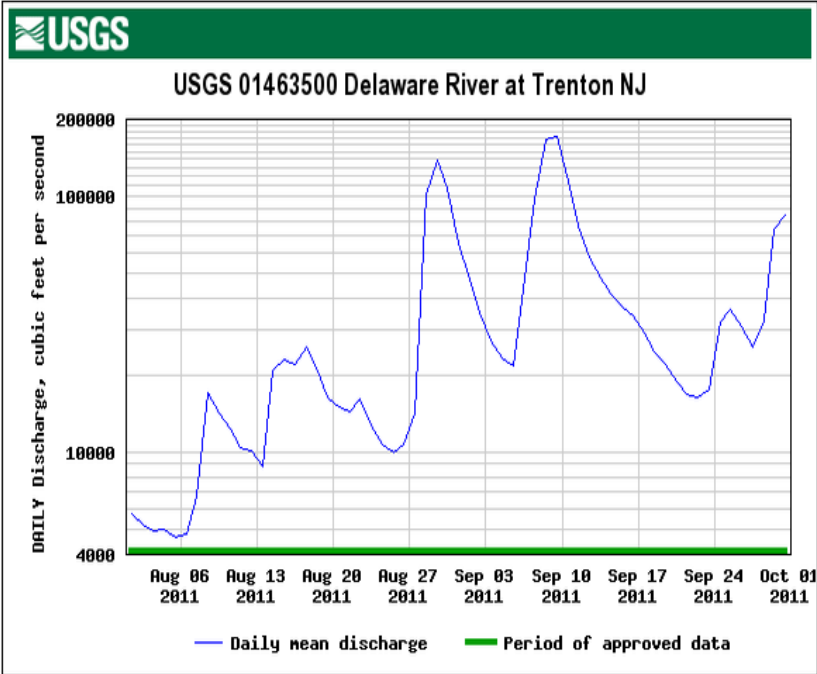
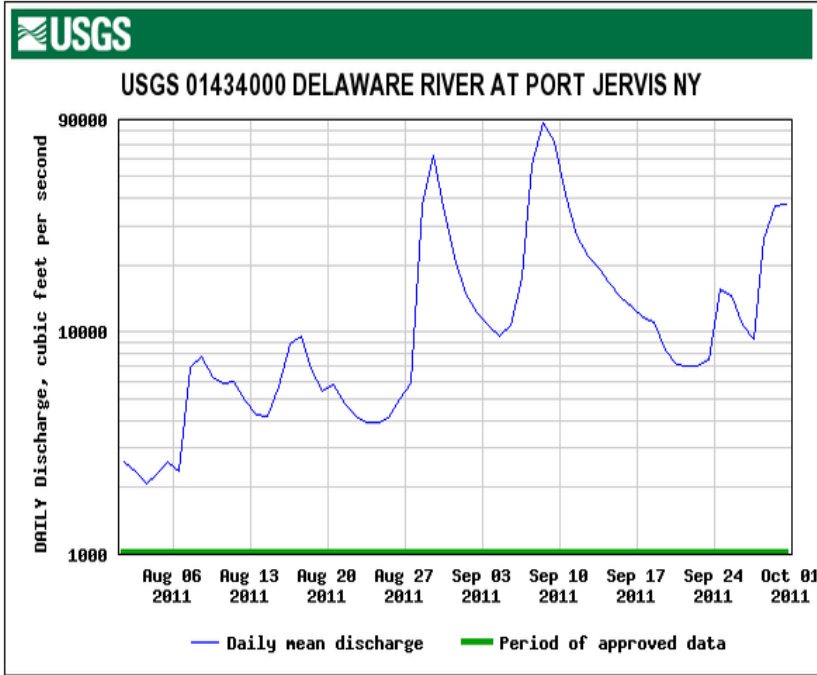
- More explicit representation of sequence;
- Immediately intuitive experience of very dense data sets;
- Combine and synchronize disparate data sets;
- Improved conceptual model of environmental processes;
- Templates facilitate processing of new data sets;

# Sequence

- USGS Gages
- Hurricane Irene and Tropical Storm Lee
- When was flood threshold exceeded at different gages?
- Text book flood wave?



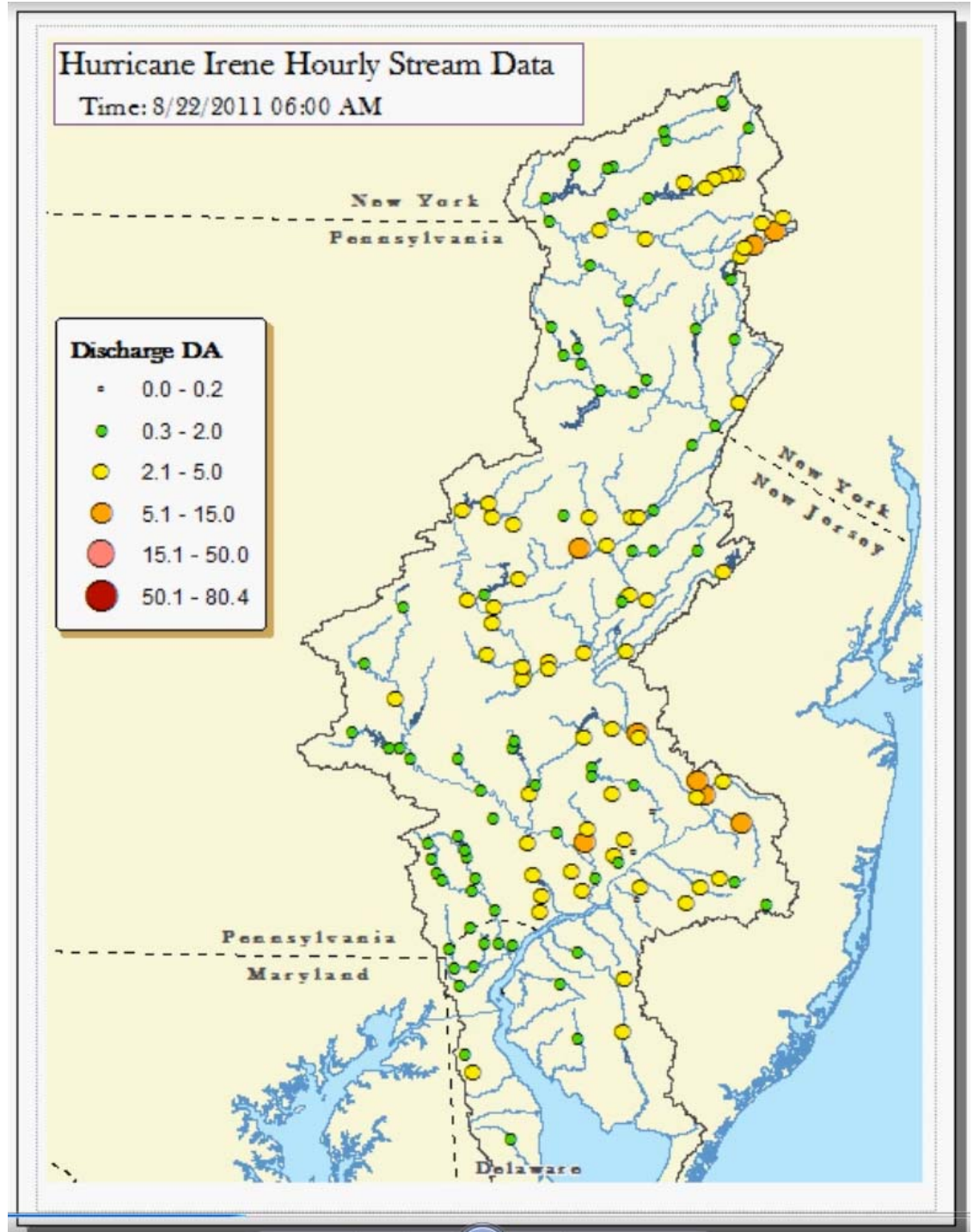
Video Link



# Sequence (whole basin)

- Automated program that pulls and processes data from all the gages in the basin.

Video  
Link

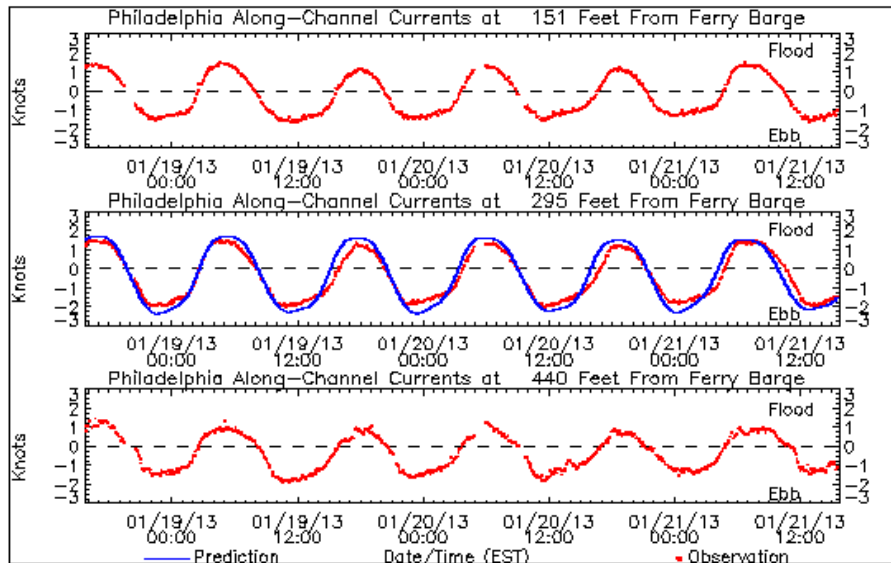
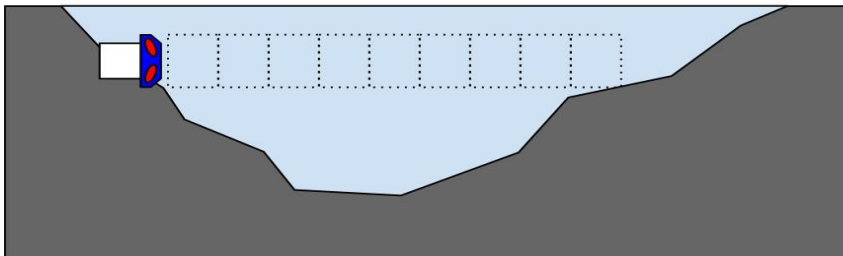


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# Intuitive experience of dense data

## NOAA-PORTS

### Side-Looking ADCP at Philadelphia



NOAA TIDES & CURRENTS

Home Products Programs Partnerships Education Help

\*\*\*\*\* PRELIMINARY DATA \*\*\*\*\*

THIS RAW DATA HAS NOT BEEN SUBJECT TO THE NATIONAL OCEAN SERVICE'S QUALITY CONTROL OR QUALITY ASSURANCE PROCEDURES AND DOES NOT MEET THE CRITERIA AND STANDARDS OF OFFICIAL NATIONAL OCEAN SERVICE DATA. IT IS RELEASED FOR LIMITED PUBLIC USE AS PRELIMINARY DATA TO BE USED ONLY WITH APPROPRIATE CAUTION.

\*\*\*\*\* PRELIMINARY DATA \*\*\*\*\*

CD - Calendar date (year/month/day)  
 T - Time (hour:minute)  
 TZ - Timezone  
 CS - Current speed (knots)  
 DR - Current direction (true degree)  
 AV - Along channel current velocity (knots)  
 CV - Cross channel current velocity (knots)

\*\* NOTE \*\*  
 A variable that has its data fields filled with "9"s, indicates that data was not collected for that sample period.  
 \*\*\*\*\*

STATION NAME: Philadelphia (db0301)  
 Observed Current

Bin 11 at 151 Feet From Ferry Barge

CD	T	TZ	CS	DR	AV	CV
2013/01/18 15:46	EST		1.24	4	1.24	-0.07
2013/01/18 15:52	EST		1.33	5	1.33	-0.05
2013/01/18 15:58	EST		1.35	4	1.34	-0.07
2013/01/18 16:10	EST		1.37	5	1.37	-0.05
2013/01/18 16:22	EST		1.42	5	1.42	-0.05
2013/01/18 16:28	EST		1.33	3	1.33	-0.09
2013/01/18 16:34	EST		1.38	4	1.38	-0.07
2013/01/18 16:40	EST		1.44	6	1.44	-0.03
2013/01/18 16:46	EST		1.44	4	1.44	-0.08
2013/01/18 16:58	EST		1.38	3	1.37	-0.10
2013/01/18 17:04	EST		1.27	5	1.26	-0.04
2013/01/18 17:10	EST		1.31	4	1.31	-0.07
2013/01/18 17:16	EST		1.34	4	1.34	-0.07
2013/01/18 17:22	EST		1.27	5	1.27	-0.04
2013/01/18 17:28	EST		1.24	6	1.24	-0.02
2013/01/18 17:34	EST		1.28	5	1.27	-0.04
2013/01/18 17:40	EST		1.21	5	1.21	-0.04
2013/01/18 17:52	EST		1.26	3	1.26	-0.09
2013/01/18 17:58	EST		1.07	4	1.07	-0.06
2013/01/18 18:04	EST		1.10	5	1.10	-0.04

[Video Link](#)

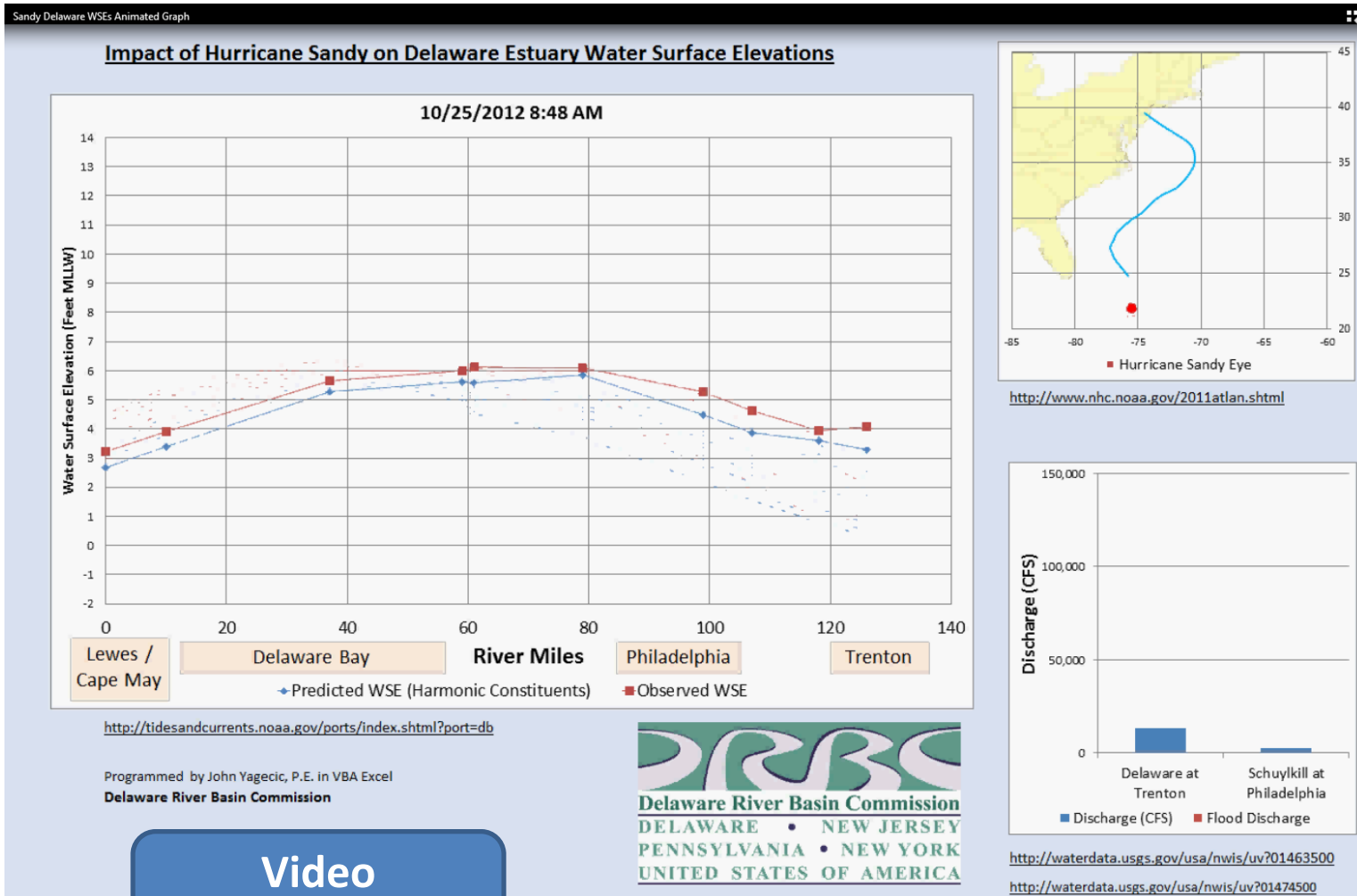
# The process for these images

- Uses VBA Excel;
  - the programming language behind MS Excel;
- 1. Create a static graph;
- 2. Read the data into arrays;
- 3. Step through the arrays, reading data back into the spreadsheet cells corresponding to the graph, updating the graph at each step;
- 4. Capture video using a shareware video screen capture utility.

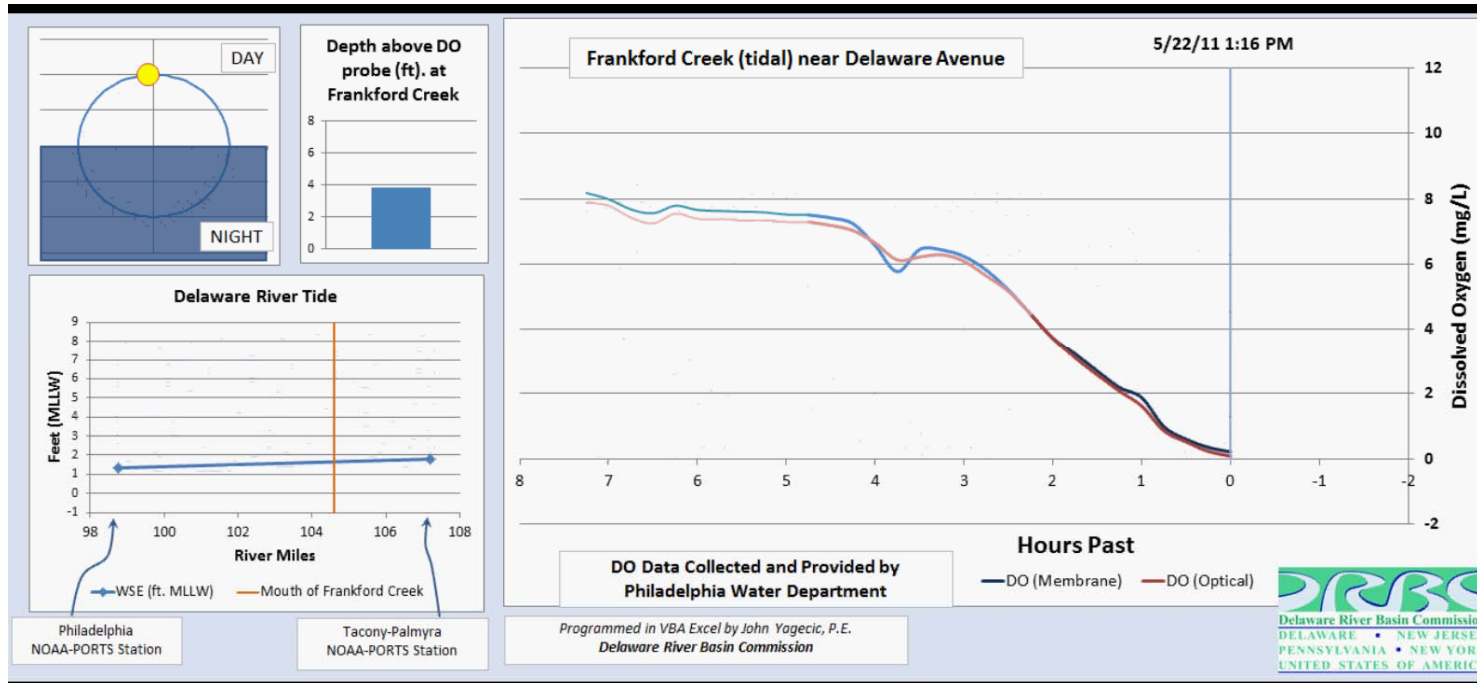


# Improved Conceptual Model of Environmental Processes

## Water Surface Elevations During Hurricane Sandy



# Synchronization of Disparate Data Sets



- Dissolved Oxygen measurements – Philadelphia Water Department;
- Tidal Elevations – NOAA PORTS
- Daily sunrise, sunset, solar noon

Video  
Link

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## Questions?

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