



A collaborative project with Hancock High School, Kiln, MS

Stennis Space Center Salinity Drifter Project

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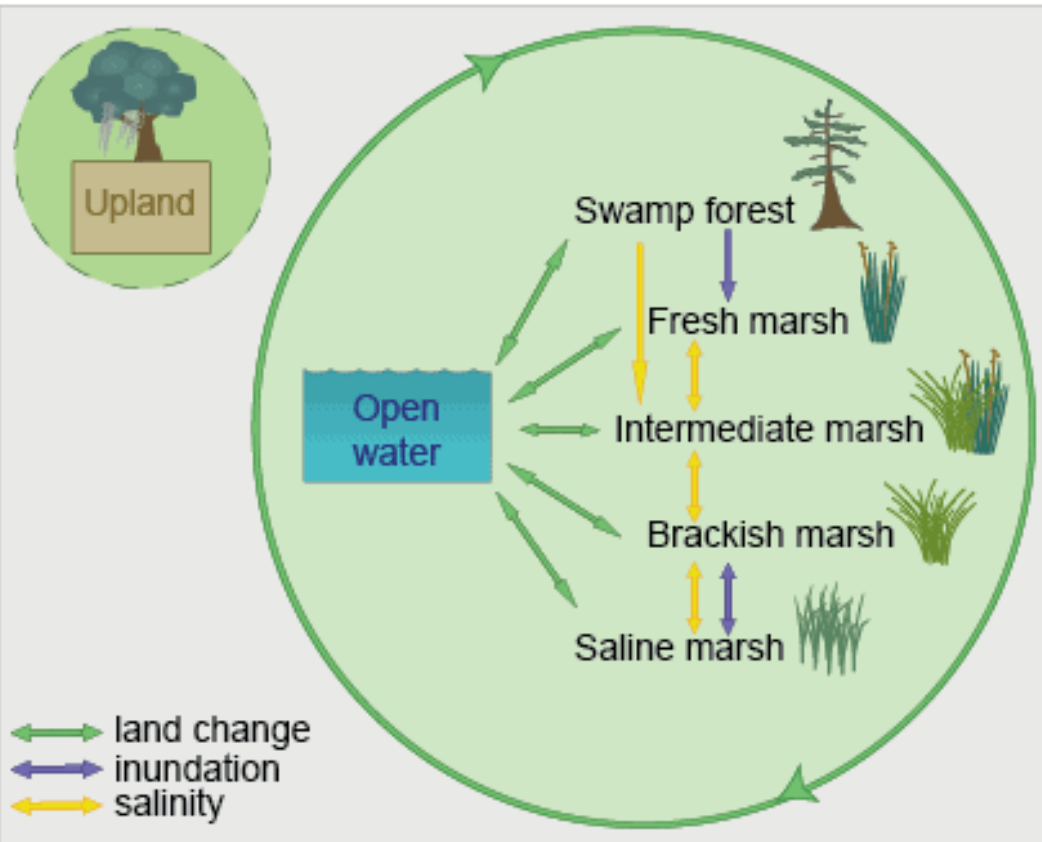
Background



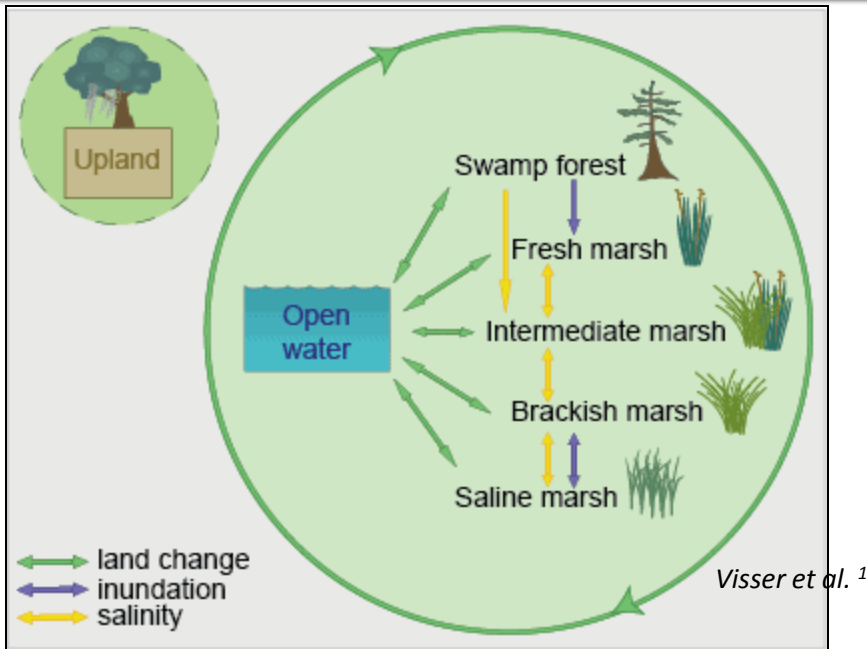
- Salinity is an important property of coastal waters:
 - The amount of salinity in coastal waters determines the types of vegetation and habitats for many species of birds, mammals, fish and shellfish.
 - Salinity changes can result from rising sea level, subsidence, storm surge, and erosion.
 - Changes in salinity can result in loss of vegetation, habitats and spawning grounds, as well as coastal erosion.



Habitat Switching Algorithm



Habitat Switching Module



Habitat switching between marsh types depends on salinity and inundation. The module simulates shifts in vegetative community type given long-term shifts in salinity and inundation due to restoration projects.

Switches at 1-year time step

Year 0 habitat	Intermediate marsh	Brackish marsh	Saline marsh
Fresh marsh	$s > 2.5$		
Intermediate marsh	$1 < s \leq 6$	$s > 6$	
Brackish marsh	$s \leq 6$	$6 < s \leq 15$ and $pfl \leq 85\%$	$s > 15$ or $s > 6$ and $pfl > 85\%$

Excerpt from table in Visser et al. ¹

s =average salinity (ppt) over the time step;
 pfl =average percentage inundation over the time step

¹ Visser, J.M., C. Kaiser, and A.B. Owens. 2008. Forecasting 50-years of Habitat Switching in Coastal Louisiana: No Increased Action & Preliminary Draft Master Plan, Vol. IV, Chapter 4. In Coastal Louisiana Ecosystem Assessment & Restoration (CLEAR) Program: A tool to support coastal restoration., edited by R. R. Twilley. Baton Rouge.

Salinity Estimates from Landsat For Sabine Calcasieu Basin










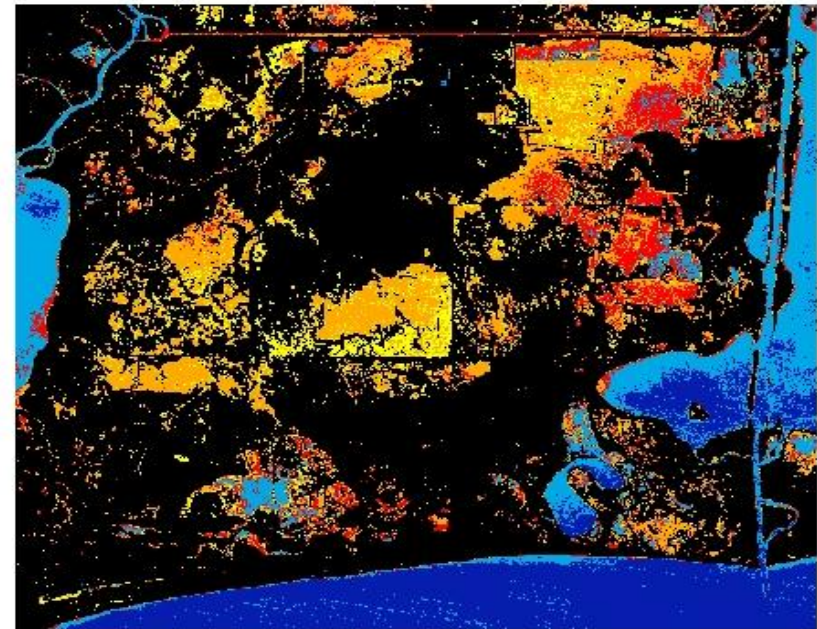
In-situ samples used to derive model
of salinity from Landsat image.

Legend

Analyst approximation

<VALUE>

	Fresh (negatives)
	Land
	0 - 4.5 Fresh
	4.5 - 9.5 Oligohaline
	9.5 - 12.5 Mesohaline
	12.5 - 17.5 Polyhaline
	> 17.5 Euhaline



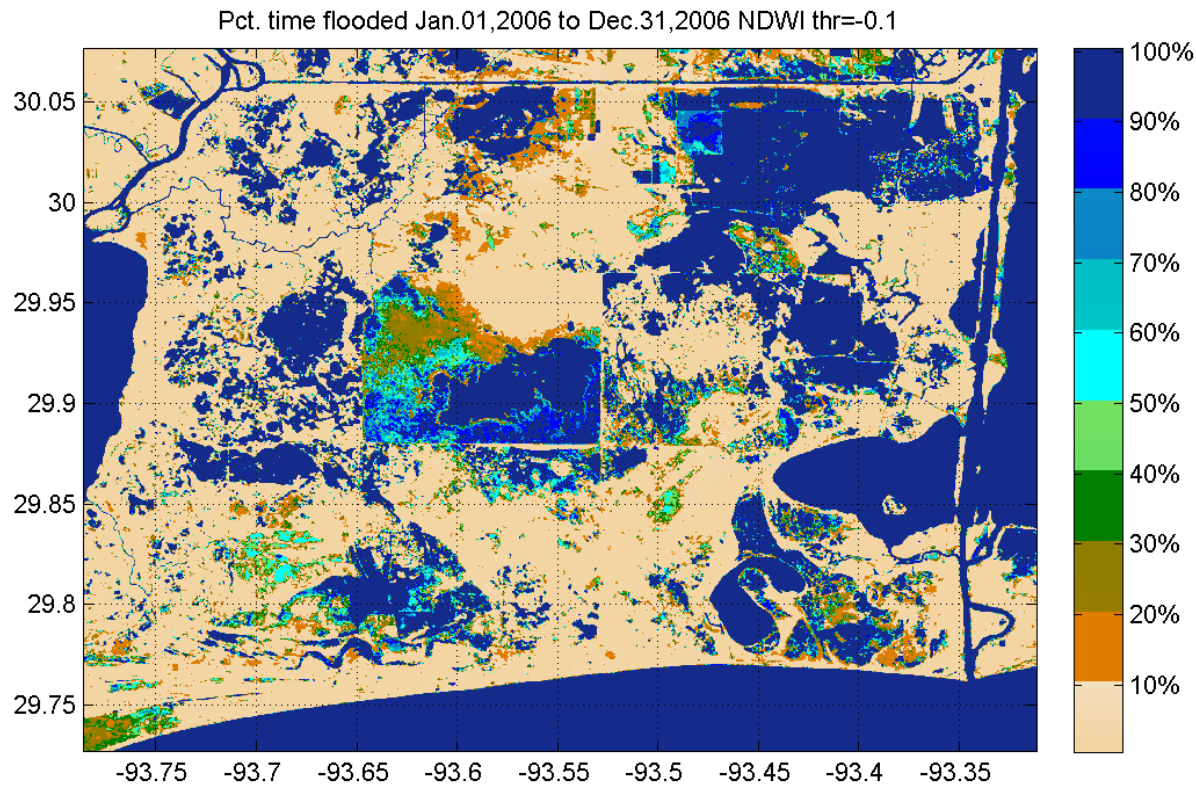
Variables: NDVI, McFeeters, Julian Day

$R^2 = 0.84$

N = 42 (dropped 6 outliers)

Dark Object Subtraction

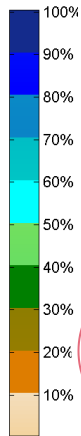
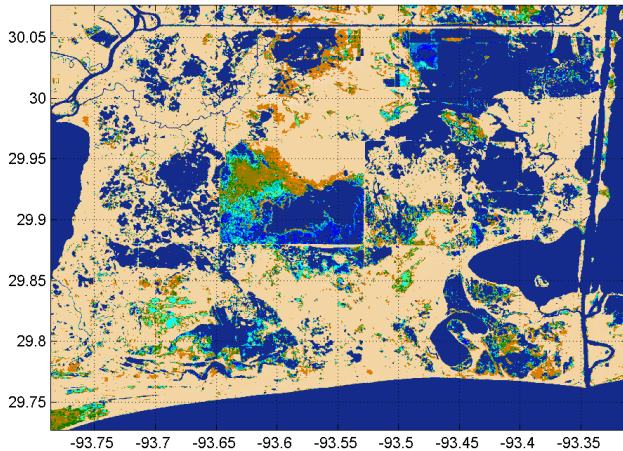
Percent of time inundated in 2006



Landsat Estimates of Persistent Flooding and Salinity as Potential Inputs to Habitat Switching Module



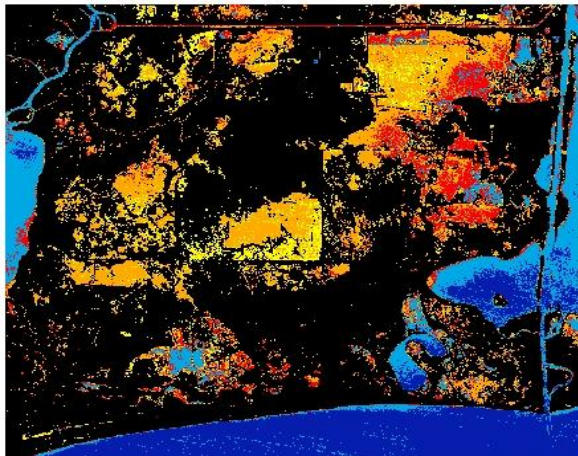
Pct. time flooded Jan.01,2006 to Dec.31,2006 NDWI thr=-0.1



Percent Inundation



Salinity



Habitat Switching Module

Year habitat	0	Inter- mediate marsh	Brackish marsh	Saline marsh
Fresh marsh		$s > 2.5$	Example: if salinity is greater than 2.5 ppt for one year, fresh marsh vegetation will change to intermediate marsh vegetation $s > 6$	
Inter- mediate marsh		$1 < s \leq 6$		
Brackish marsh		$s \leq 6$	$6 < s \leq 15$ and $pfl \leq 85\%$	$s > 15$ or $s > 6$ and $pfl > 85\%$

s=average salinity (ppt) over the time step; *pfl*=average percentage inundation over the time step

Habitat switching between marsh types depends on salinity and inundation. The module simulates shifts in vegetative community type given long-term shifts in salinity and inundation due to restoration projects.

Salinity Data

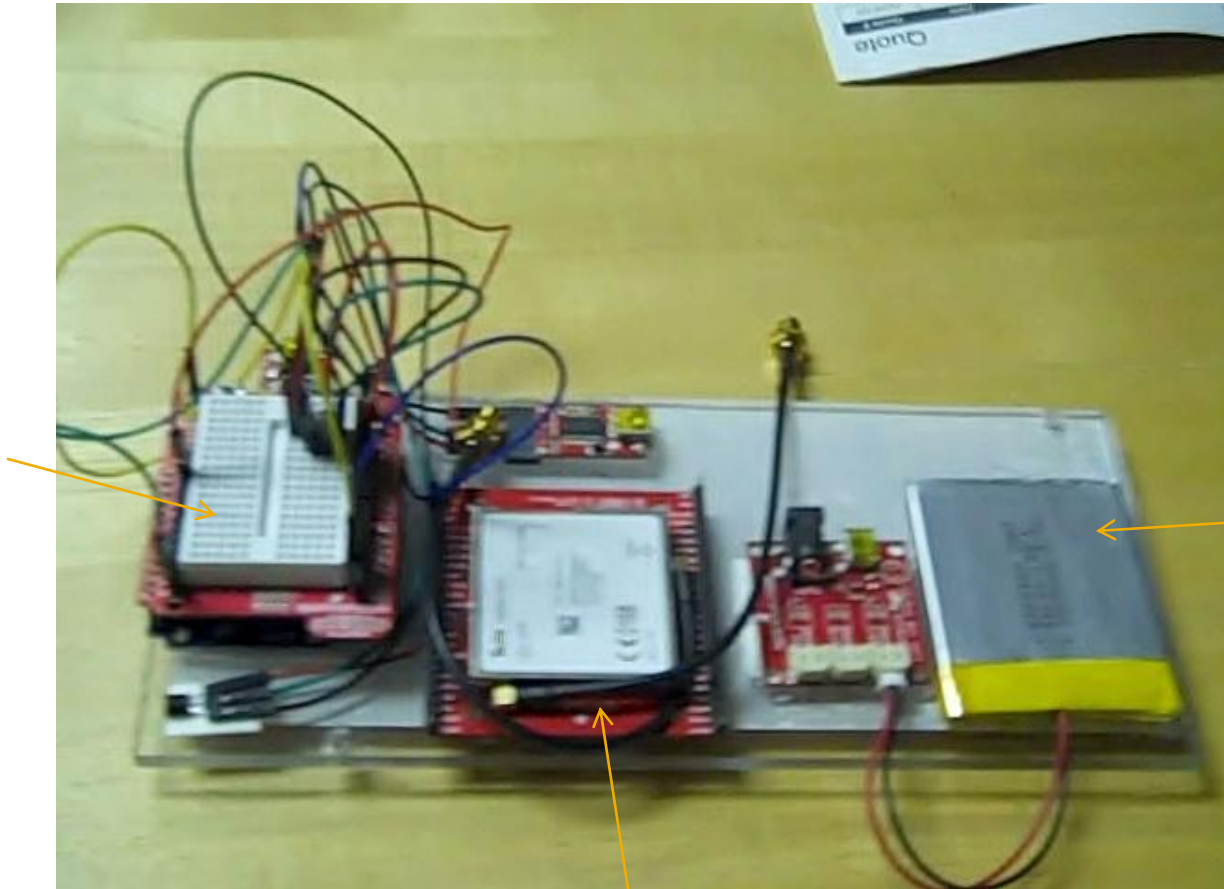


- Salinity modeling requires ground truth salinity, which is scarce
- The NASA Office of the Center Director for Stennis Space Center funded a pilot project to design a low-cost salinity measuring system that high-school students could build and monitor.
- The salinity values are fed to NASA's website via a cellular modem and the internet for use by NASA scientists.

Prototyping the System



Arduino



Battery
Charger

Cellular modem and GPS

System as packaged for field tests



PVC casing

→
Solar panel

Salinity Probe and Casing



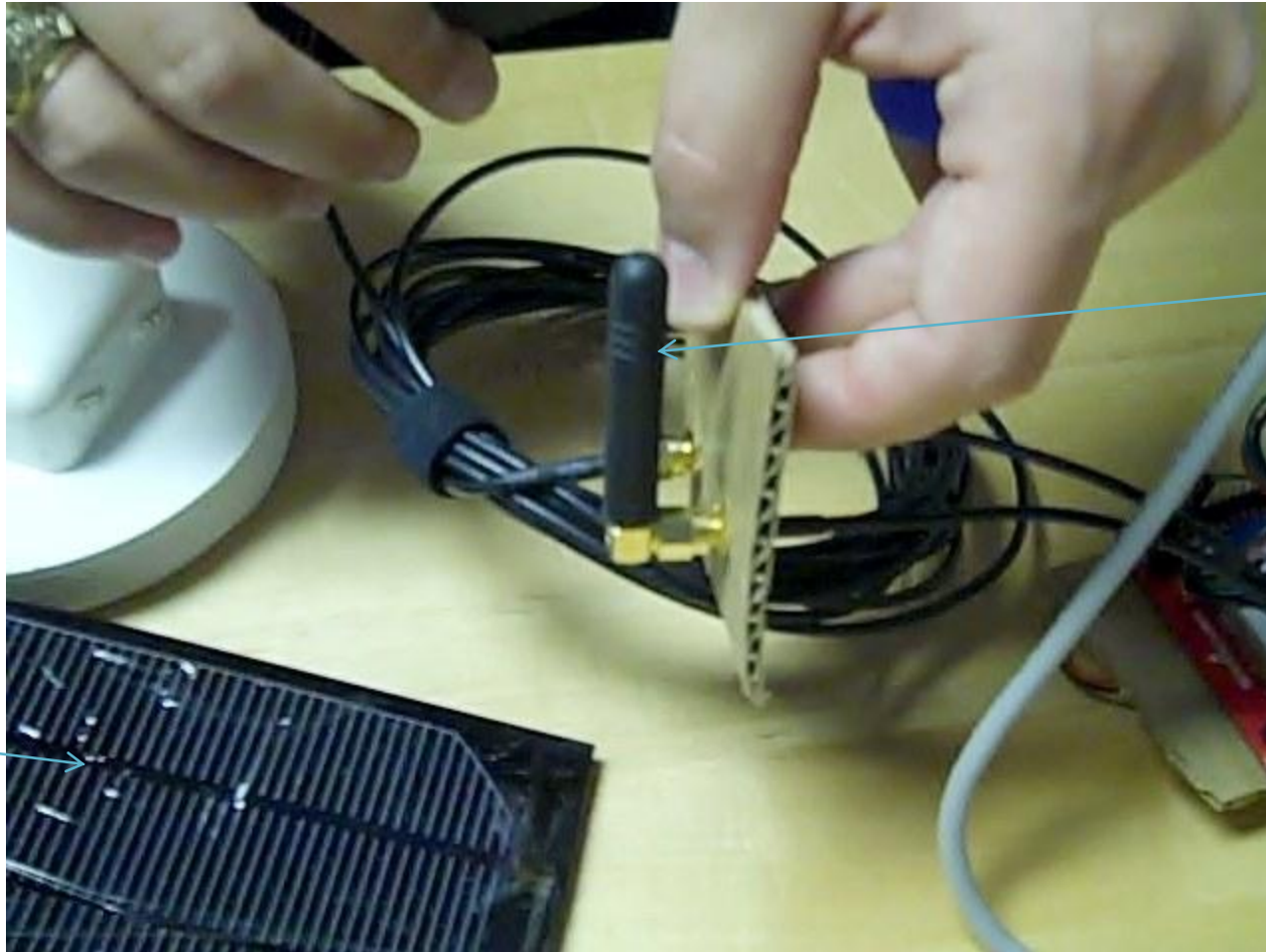
← Salinity probe

Opening for water flow



Tip of salinity probe is exposed to water through small opening.

Cellular antenna used to transmit data



Cellular antenna

Solar panel

Preparing to launch



Left: Mark Turowski, design engineer with Jacobs Technology, prepares to launch the buoy.

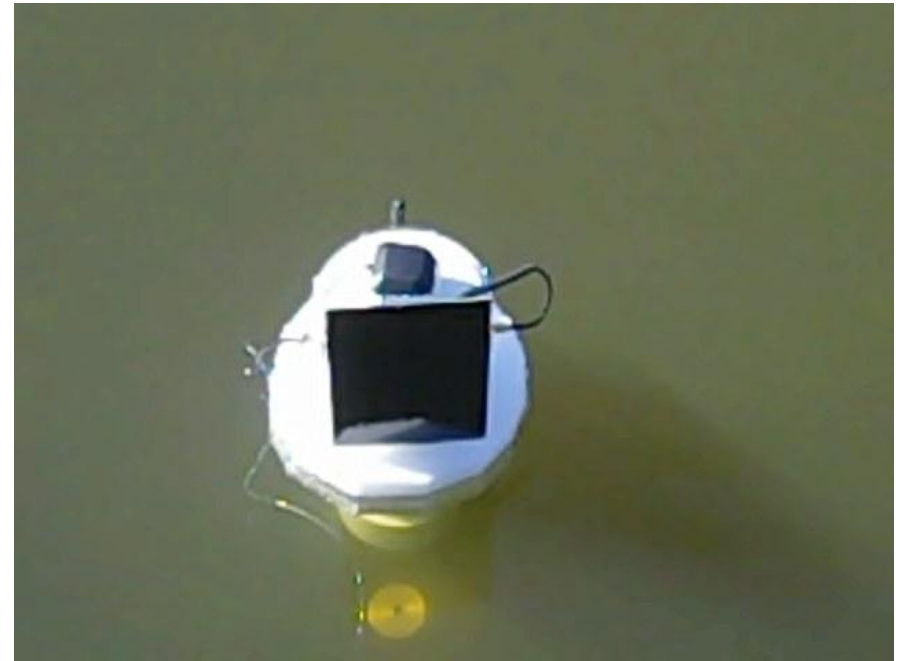
Right top: Solar panel is mounted vertically to collect solar reflections off the water (specular reflection). Solar power is used to charge the battery.

Right bottom: Weight is affixed to bottom to help keep unit in upright position.

System is launched in the Pearl River at Stennis Space Center



System is lowered into the water from the pier; it is tethered with fishing line.



System floating in the river. GPS antenna and solar panel are visible

Data are transmitted to Twitter by cell phone modem every 15 minutes



Twitter / turows16

Twitter / turows16

Contents:	date	time	latitude	longitude	conductivity	temperature (C)
turows16:	161110,	164835.000,	3020.9080N,	08938.4532W,	2307.3521,	19.9276
Today, November 16, 2010, 31 minutes ago →						
turows16: 161110,164835.000,3020.9080N,08938.4532W,2307.3521,19.9276						
turows16:	161110,	163351.470,	3020.9089N,	08938.4524W,	2330.9580,	19.8509
Today, November 16, 2010, 45 minutes ago →						
turows16: 161110,163351.470,3020.9089N,08938.4524W,2330.9580,19.8509						
turows16:	161110,	161909.000,	3020.9074N,	08938.4517W,	2214.1279,	19.6975
Today, November 16, 2010, 1 hour ago →						
turows16: 161110,161909.000,3020.9074N,08938.4517W,2214.1279,19.6975						
turows16:	161110,	160433.381,	3020.9068N,	08938.4524W,	2214.1279,	19.6208
Today, November 16, 2010, 1 hour ago →						
turows16: 161110,160433.381,3020.9068N,08938.4524W,2214.1279,19.6208						

Google Spreadsheet is used to import the data from the Twitter feed and to compute salinity (from conductivity) and display charts of salinity and temperature.



Google docs Salinity Feed Anyone with the link Saved seconds ago Saved Share

File Edit View Insert Format Form (0) Tools Help maria.t.kalcic is viewing

Formula: Show all formulas

	A	Y	AD	AH	AI	AJ	AK	AL	AM	AN	AO
1											
3	Sample Date	Local Sample Time	Latitude	Longitude	Temperature (C)	Salinity (ppt)					
4	Tue, 16 Nov 2010	10:48:35	30.3485	89.6409	19.93	0.0167					
5	Tue, 16 Nov 2010	10:33:51.5	30.3485	89.6409	19.85	0.0170					
6	Tue, 16 Nov 2010	10:19:9	30.3485	89.6409	19.70	0.0168					
7	Tue, 16 Nov 2010	10:4:33.4	30.3484	89.6409	19.62	0.0170					
8	Tue, 16 Nov 2010	9:49:51.9	30.3485	89.6409	19.54	0.0173					
9	Tue, 16 Nov 2010	9:35:11	30.3485	89.6409	19.47	0.0176					
10	Tue, 16 Nov 2010	9:20:38	30.3485	89.6409	19.39	0.0176					
11	Tue, 16 Nov 2010	9:6:4.4	30.3484	89.6409	19.24	0.0175					
12	Tue, 16 Nov 2010	8:51:21.6	30.3485	89.6409	19.24	0.0183					
13	Tue, 16 Nov 2010	8:36:42	30.3484	89.6409	19.08	0.0179					
14	Tue, 16 Nov 2010	8:22:9	30.3484	89.6409	19.24	0.0183					
15	Tue, 16 Nov 2010	8:7:35	30.3484	89.6409	19.47	0.0189					
16	Tue, 16 Nov 2010	7:52:52.3	30.3485	89.6408	19.47	0.0189					
17	Tue, 16 Nov 2010	7:38:8	30.3484	89.6409	19.54	0.0188					
18	Tue, 16 Nov 2010	7:23:35	30.3485	89.6409	19.54	0.0189					
19	Tue, 16 Nov 2010	7:8:52.9	30.3485	89.6408	19.54	0.0188					
20	Tue, 16 Nov 2010	6:54:10	30.3484	89.6409	19.54	0.0188					
21	Tue, 16 Nov 2010	6:39:37	30.3484	89.6409	19.54	0.0188					
22	Tue, 16 Nov 2010	6:25:3.4	30.3484	89.6409	19.54	0.0188					
23	Tue, 16 Nov 2010	6:10:21.9	30.3485	89.6409	19.54	0.0190					
24											
25											
26											
27											

Salinity (ppt)

Salinity (ppt)

Temperature (degrees Celsius)

Temperature (degrees Celsius)

12/22/2010 17

Results are uploaded to NASA's Applied Science and Technology Project Office Webpage



Applied Science & Technology
Project Office



ASTPO

Webpage to be inserted here