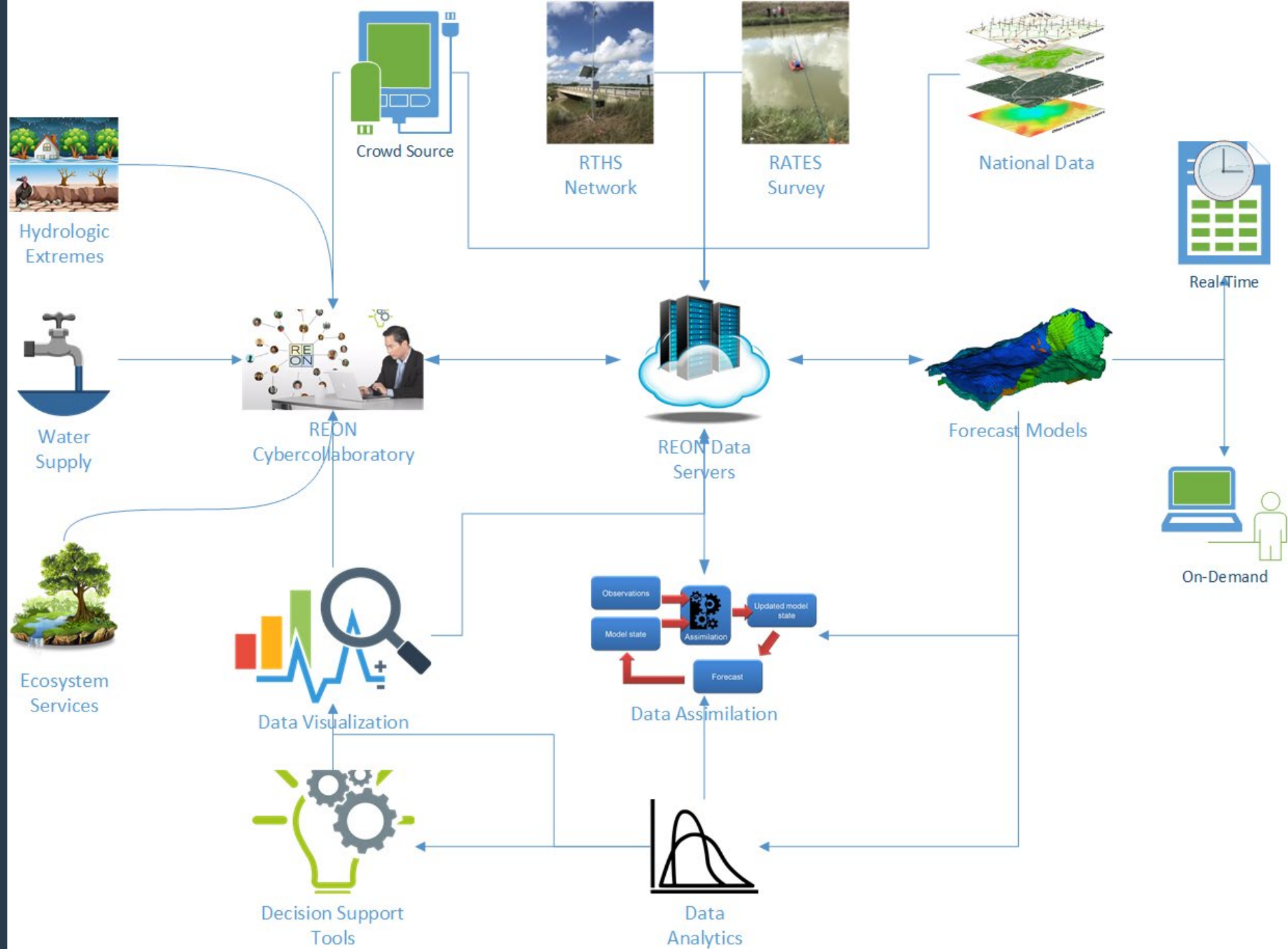


Operational Components





James Bonner

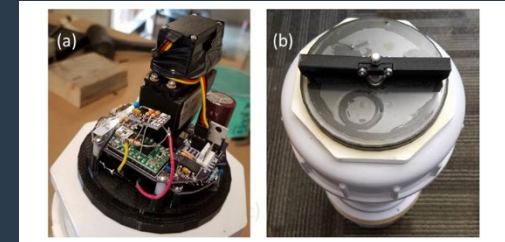
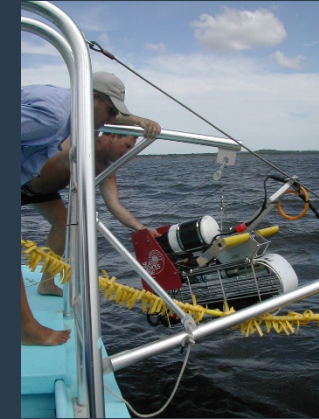
Founder - RATES

Professor – Texas A&M

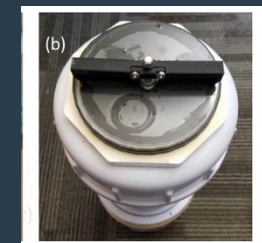
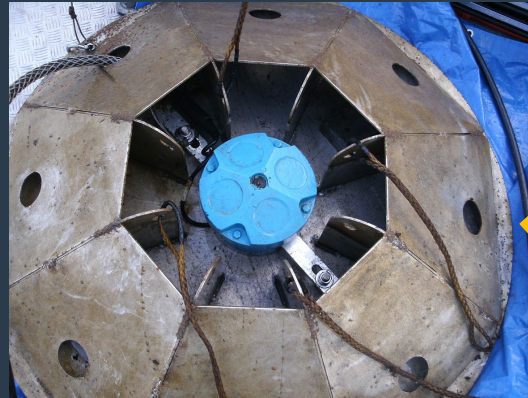
Professor – Clarkson University (Potsdam, NY)

“99 % of the action happens in 1 % of the time”

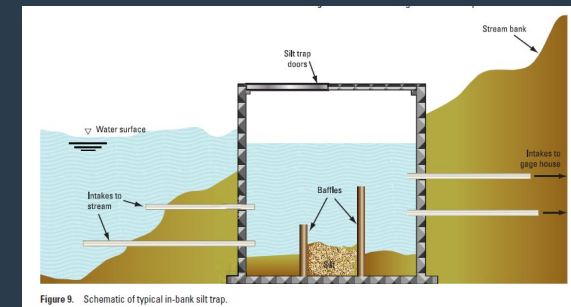
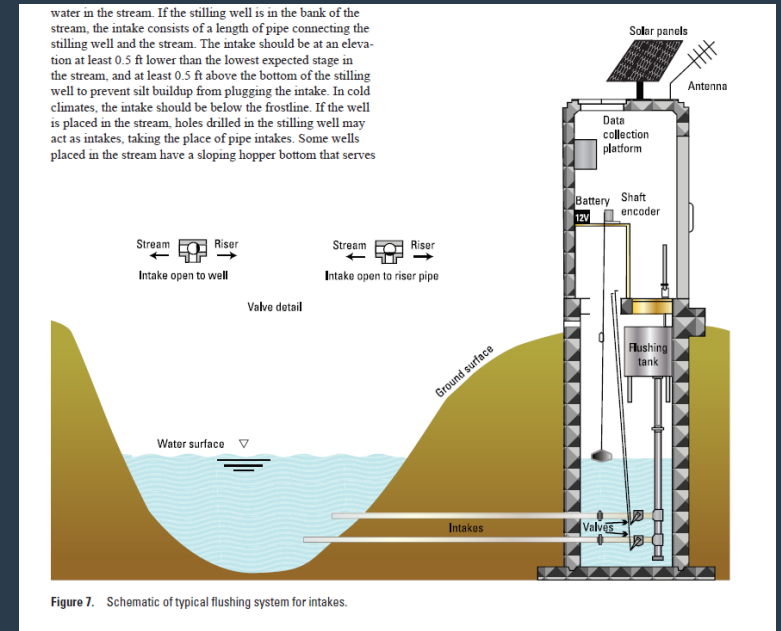
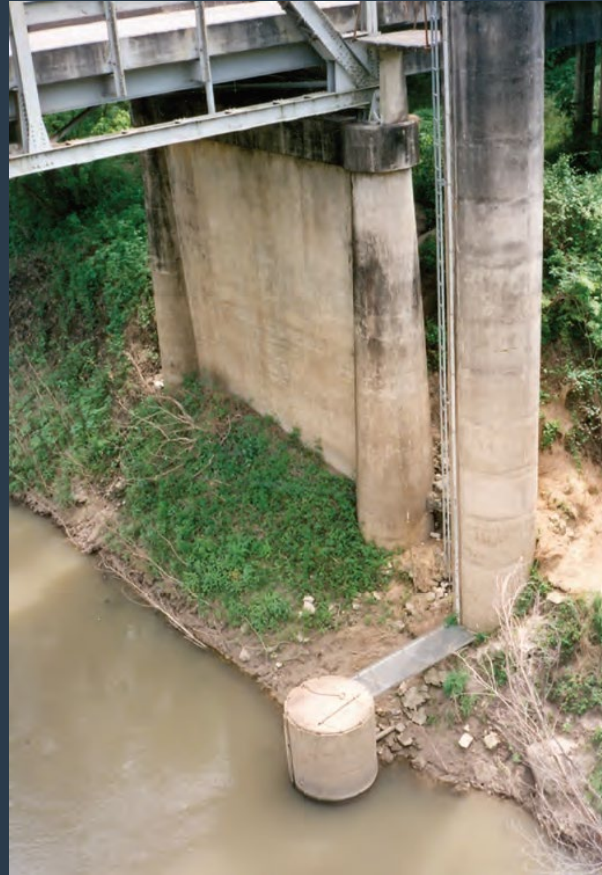
- NEED: Continuous, autonomous environmental monitoring
- Adequate Accuracy
- Reasonable Cost



RHS Base Station



Stilling Wells—Required for float sensors



Submersible Pressure Sensors for measuring Depth/ Stage/ Elevation

- **Vented Sensors**

- Differential - Directly report gauge pressure
- Require vented cable
 - Higher cost
 - Must be kept dry

$$D(t) = \frac{P_{gauge}(t)}{g \times \rho_w(t)}$$

$$S(t) = D(t) + s_{offset}$$

- **Non-Vented Sensors**

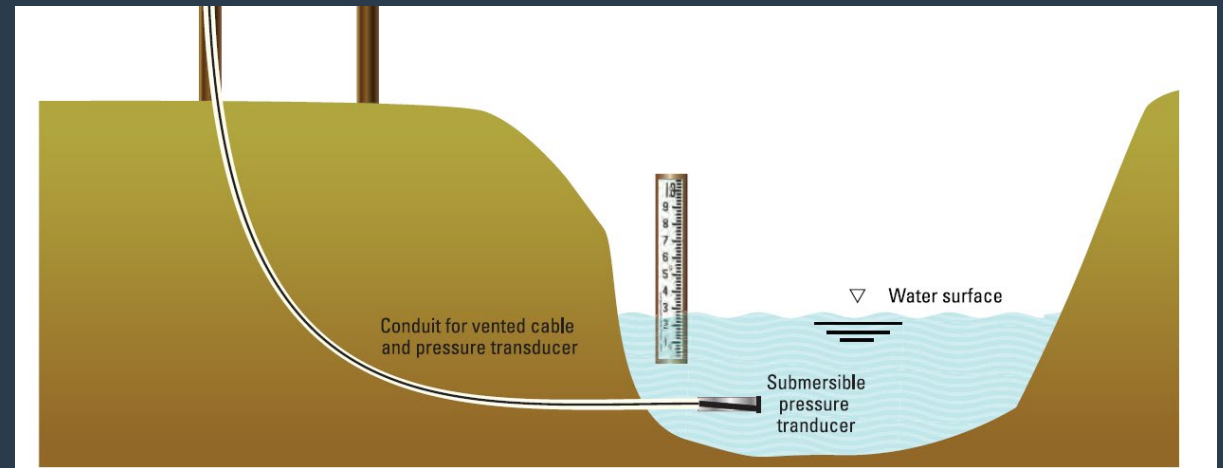
- Need local air pressure to obtain gauge pressure
 - And need pressure offset correction
- Lower costs than vented sensors
- Allows wet-mateable connectors

- **Concerns for both types**

- Drift over time
- Fouling of pressure membrane

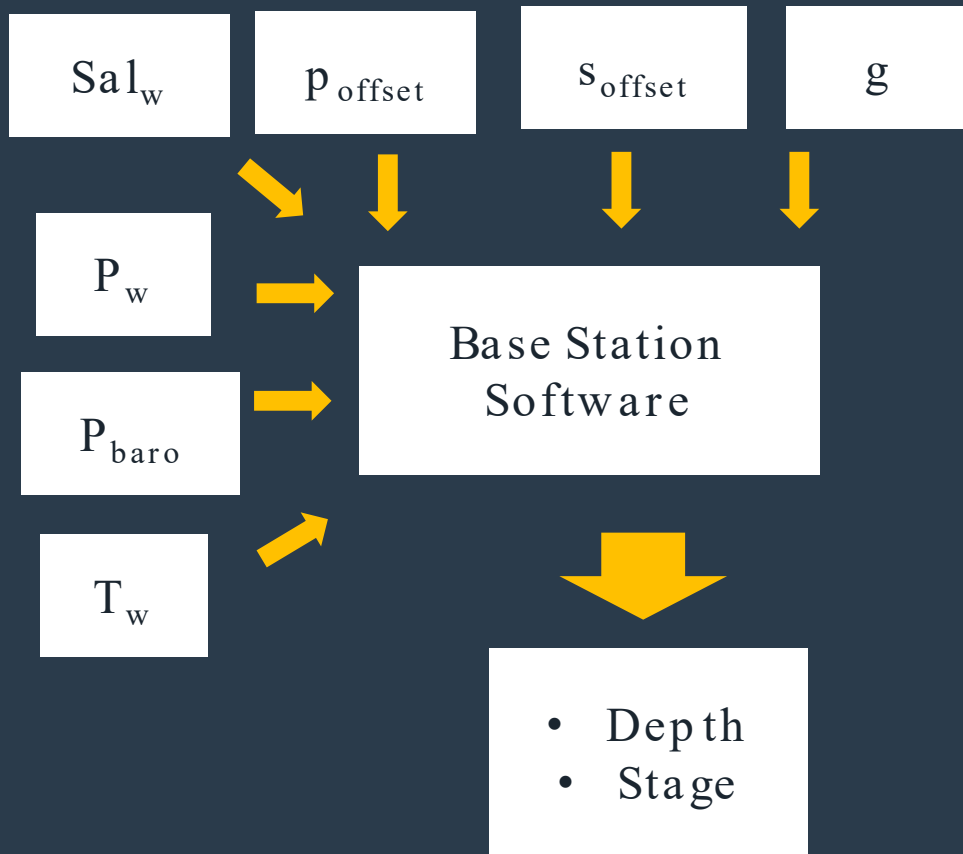
- **Many submersible pressure sensors fail to meet the USGS standard accuracy of ± 0.01 ft**

- This accuracy is required for streamflow gaging (Sauer and Turnipseed , USGS 3-A7, 2010)



RATSWELL (Surface Water Elevation/ Level) System

- Target accuracy: ± 0.01 ft



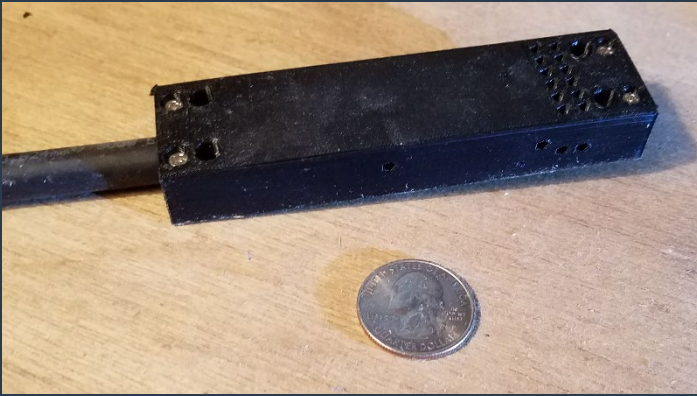
Actual Conditions		LT400 (Default)		LT400 (SWELL)	
Actual Stage (ft)	Water Temperature (°C)	Reported Stage (ft)	Stage Error (ft)	Reported Stage (ft)	Stage Error (ft)
2.00	11.80	1.985	-0.020	1.981	-0.020
4.00	11.80	3.990	-0.010	3.987	-0.010
6.00	11.80	5.988	-0.010	5.986	-0.010
8.00	11.80	7.978	-0.020	7.978	-0.020
2.00	17.50	1.995	-0.010	1.992	-0.010
4.00	17.50	3.988	-0.010	3.987	-0.010
6.00	17.50	5.991	-0.010	5.994	-0.010
8.00	17.50	7.985	-0.020	7.990	-0.010
2.00	24.50	2.000	0.000	2.000	0.000
4.00	24.50	3.994	-0.010	3.999	-0.000
6.00	24.50	5.983	-0.020	5.993	-0.010
8.00	24.50	7.981	-0.020	7.996	-0.000
2.00	32.50	1.991	-0.010	1.995	-0.010
4.00	32.50	3.977	-0.020	3.990	-0.010
6.00	32.50	5.964	-0.040	5.986	-0.010
8.00	32.50	7.960	-0.040	7.992	-0.010

Pressure Correction Only

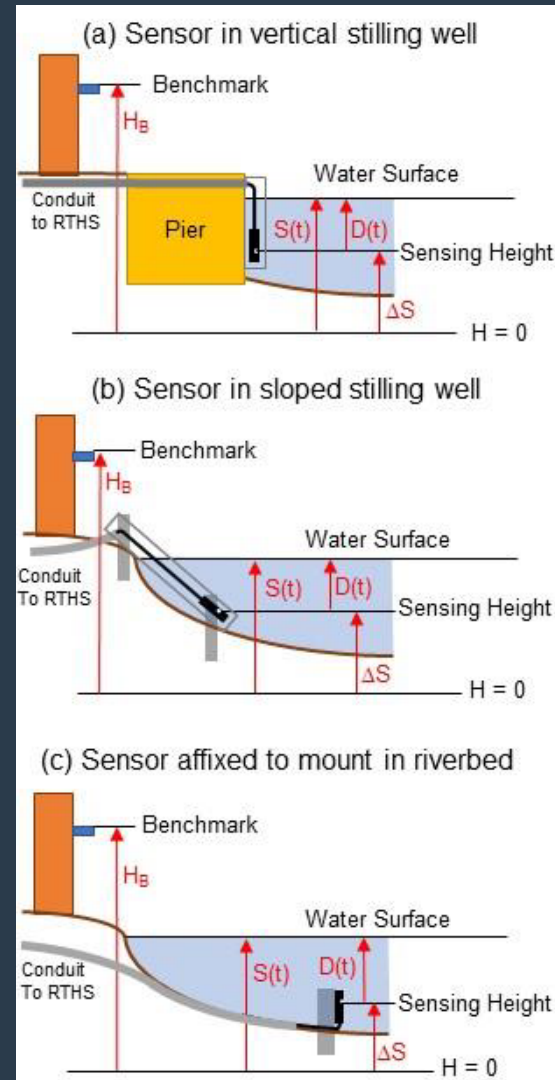
Full SWELL Correction

Source: Kirkey et al, J. Env. Informatics Let., 4(2), 80-87 (2020)

RATES Designed Non-vented Depth/Stage Sensor



- Designed for:
Accuracy
Cost
Versatility



Source: Kirkey et al, J. Env.
Informatics Let., 4(2), 80-87
(2020)



River & Estuary Observation Network

Operational Components

