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Let's Solve Water

Non-Contact Water Level Sensor Measurements at the Mekong Delta

ELIMINATING NOISY RADAR WATER LEVEL DATA CAUSED BY TURBULENCE AND SURFACE WAVES

Project Challenges

Non-contact water level sensors measure the distance to water surface. The primary monitoring advantage these instruments have is that there is no fouling or wear on the sensors which occurs with measurement technologies that are installed within the water such as submerged pressure sensors.

However at sites that have turbulent water, or sites that have wind that causes wave action, noisy data points are caused by the radar tracking the peaks and troughs of a wave. The more wave action, the bigger the spread between the high and low water level of a wave.

At a site on the lower Mekong delta, this was a particularly challenging issue. The low maintenance requirements of the radar instrument was desirable since the location was remote; however, construction of a stilling well required significant capital investment and was not an option.

Fig. 1. Waves induced by wind and boat traffic on the lower Mekong River

Solution

The YSI WaterLOG Nile Radar Level Sensor has settings that the user can adjust to try to minimize or eliminate these noisy data points caused by wave action. These include increasing the averaging time for a measurement, or through the use of **181s or 361s standard deviation measurement - the "NOAA" 3 minute and 6 minute measurement modes.** A specific Nile SDI12 string is used to command the radar to make these measurements, aM1! and aC1!.

Fig. 2. Installation of Nile Radar Water Level Sensor

Using these measurement modes, the Nile will report back the following values for each measurement:

i) Mean Stage
ii) Standard Deviation
iii) Number of outlier data points discarded
iv) Number of good values
v) Battery Voltage (for 361s C1! command only)

This provides the user not only a very robust measurement method to counter turbulent and wavy conditions but also continuous data QA/QC record.

Fig. 3. The WaterLOG Nile

The "NOAA" 3-minute Mode Measurement (aM1!)
Technical Detail

The Nile internally performs the following measurement sequence for SDI-12 command aM1!:

1. Makes 181 measurements at a precise 1 second interval.
2. Computes the standard deviation for the data set.
3. Multiplies the standard deviation by 3 to obtain a High and Low outlier threshold.
4. Sifts through the data set and discards data points above and below the outlier thresholds.
5. Computes the standard deviation again for the data set with the outliers removed.

The standard deviation is computed as follows:

1. Compute the mean for the data set
2. Compute the deviation by subtracting the mean from each value
3. Square each individual deviation
4. Divide by one less than the sample size
5. Take the square root

The "aM1"command response is "0185" (184 seconds, 5-parameters). The sensor buffer will contain 4 parameters; mean stage, standard deviation, number of outliers discarded, number of good values, and battery voltage.

Fig. 4. MEKONG RIVER: Although the measurement footprint (highlighted in red) was subject to turbulent water and waves caused by vessels and wind, the Nile radar using the 181second measurement protocol is able to collect accurate and consistent data.

Fig. 6. View from the river to the monitoring station

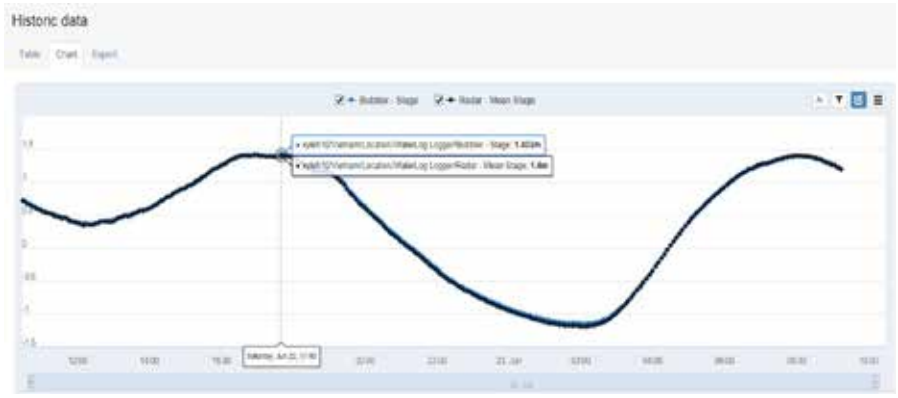


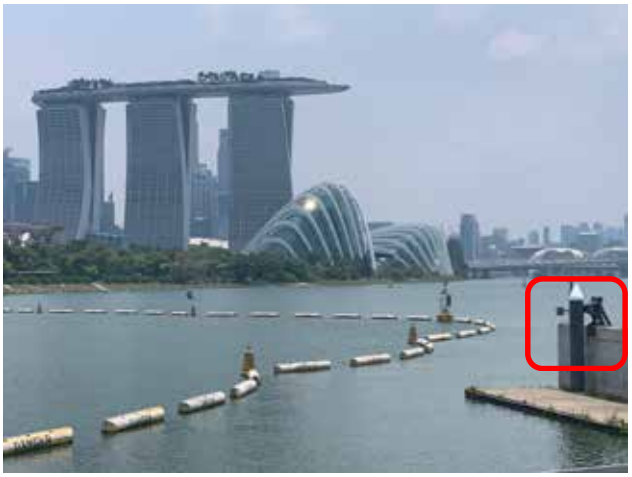
Fig. 4. Nile Data comparison to pressure sensor at wavy and turbulent site, Mekong River

The Nile radar installed in the Mekong River was able to overcome challenging site conditions due to the measurment method and in-built processing unique to the Nile.
The Nile 502/504/517 make up the Nile series of radar water level sensors with ranges from 20m to 70m. They also feature a rugged and innovative design which was built for extreme environmental conditions.

TAIWAN: The Central Weather Bureau Taiwan (CWBT) operates tide gauges throughout Taiwan with sea level observations used for both operational and modelling purposes.
https://www.xylem-analytics.asia/media/pdfs/app-note-waterlog-nile-cwbt-taiwan.pdf

SINGAPORE: Singapore Cable Car uses a Nile Radar level sensor to monitor the height of the cable car cabins above mean sea level at Sentosa Singapore. The Singapore Cruise Centre is located nearby and has two berths of 310 metres and 270 metres handling international cruise ships with a height limit of 52 metres - thus continuous air gap monitoring is critical. The Storm3 Data Logger processes the data which is sent by radio to the control room.

SINGAPORE: Nile Radar level sensors installed upstream and downstream of the Marina Barrage measuring real time tide and reservoir levels.



Learn more about the YSI WaterLOG Nile Radar Level Sensor

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