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FieldKit in the Wild: Inexpensive, Open-Source Dataloggers for Field Measurement Operations

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FieldKit

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The technology that dominates the field of dataloggers for environmental sensing tends to cost multiple thousands of dollars, creating a large barrier to entry. The FieldKit datalogger aims to change that.

Introduction

The current landscape of environmental sensing systems tends towards either the expensive and high-end or the home-grown but possibly unreliable. The advantages of the former include long deployment times and high-precision data, while those of the latter include array deployments of many units and high reproducibility by citizen science groups. Several designs have been evaluated by the USGS[1,2,3,4] among others. The high-cost class includes sondes and other water quality monitoring systems (e.g. those by Xylem, Hydrolab, Eureka, etc.), while the low-cost class includes some of the open-source and closed-source designs put out by both academic labs and low-cost sensing system companies (e.g. Atlas Scientific, Public Lab, Seeed Studio, etc.)

	Calibration		Precision, Modalities & Spatial Diversity		Durability, Serviceability & Repair	
	Pros	**Cons**	**Pros**	**Cons**	**Pros**	**Cons**
HIGH COST	Usually well calibrated from the factory	Calibration is expensive and often overlooked	High precision measurements in multiple modalities	Equipment is dear, fragile, and not usually deployed in a spatially diverse array	Sometimes means high durability in harsh environments	Usually means non-modifiable, as well as proprietary
LOW COST	Easy to calibrate and adjust, when done	Calibration is usually not considered	Equipment is inexpensive to replace or modify, and to deploy across more space	Equipment is often imprecise	Usually highly serviceable and repairable	Usually not very durable

The goal of FieldKit is to fuse the best traits of both low- and high-cost instrumentation into a lower-cost, higher-precision, high-durability, modular, and calibrated design. Creating a means of deploying these reliably is an additional challenge, and proving them out directly next to known good high-cost systems makes this even more difficult.

Materials and Methods

In order to deploy FieldKit dataloggers, a few support items are needed. First, one needs a support structure of any form that provides a means of keeping the datalogger off the ground, oriented in such a way that water is shed off of it, while not infiltrating into the main body of the enclosure. The enclosure itself has a weatherproofness equivalent to an IP67 rating and uses cable glands to allow for electrical connections to remain watertight.

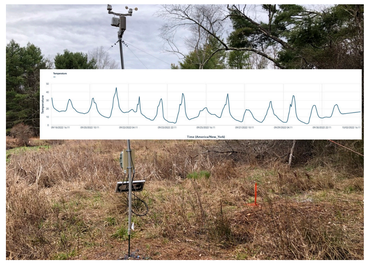
The plate at the bottom of the enclosure where the glands are mounted also has a rubber gasket clamped between it and the main body of the enclosure, and the enclosure lid is gasketed as well.

In order to mount the enclosure, various methods have been used. In some cases, band clamps (or hose clamps) have been used to hold the unit in place, as have bolts and wood screws. The most successful model to date seems to be using pieces of electrical strut and standard commercial-grade outdoor electrical equipment. This includes the use of weatherproof boxes and flexible conduit.

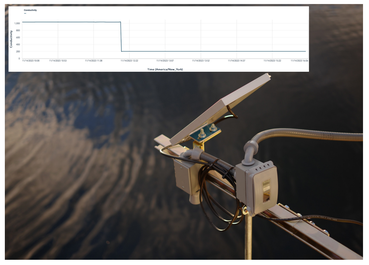
Results

FieldKit stations have been deployed from the forests of Cameroon to the urban canyons of Los Angeles. An increasing number of stations are now being codeployed with environmental sensing infrastructure, such as in the case of deployments which have been emplaced with weather stations at both the University of Minnesota and Cornell University. Stations have also been emplaced near experimental equipment being used by other labs, such as the Shaw lab at SUNY ESF and their field site in Hammond Hill State Forest in upstate NY. Finally, some stations, like the one in Brooklyn Bridge Park in New York City, are within the same section of a watershed as a USGS gauging station, which can be used as a point of comparison.

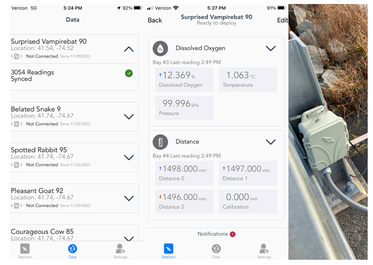
Codeployment of a FieldKit weather station in Minnesota showing relative humidity.



Temperature time series graph from a station on Black Brook in Forestburgh, NY.



Electrical conductivity time series over part of a station on the Basha Kill in Mamakating, NY.



Screenshots from the FieldKit app after connecting to the aforementioned station in Mamakating, NY.

Discussion

Through a series of internal projects and codeployments with external partners, the FieldKit datalogger platform has already undergone rigorous testing in many different environments. Through collaborative workshops and expedition deployments alike, the team is continuing to refine what deployments look like and what recommendations to make to those using the product. The team is also creating living documents at fieldkit.org/blog containing lessons learned and actively running a forum at community.fieldkit.org to support deployments of FieldKit hardware.

Conclusion

Putting FieldKits in the wild is an ongoing process, both internally and externally. The team has found some significant advantages in codeploying with other instrumentation in order to correlate readings and show that there are no significant differences between the FieldKit datalogger and other brands. In addition, the team actively develops and documents means of deployment for use by anyone online, as well as holding in-person deployment workshops within communities.

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Scan for FieldKit's GitLab

www.fieldkit.org