Watershed moisture sensing in Jordan: Water in the Cloud

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World Wide Coverage - Hologram

1 – Beltsville, MD

2 – Amman, Jordan

3 – Bushland, TX

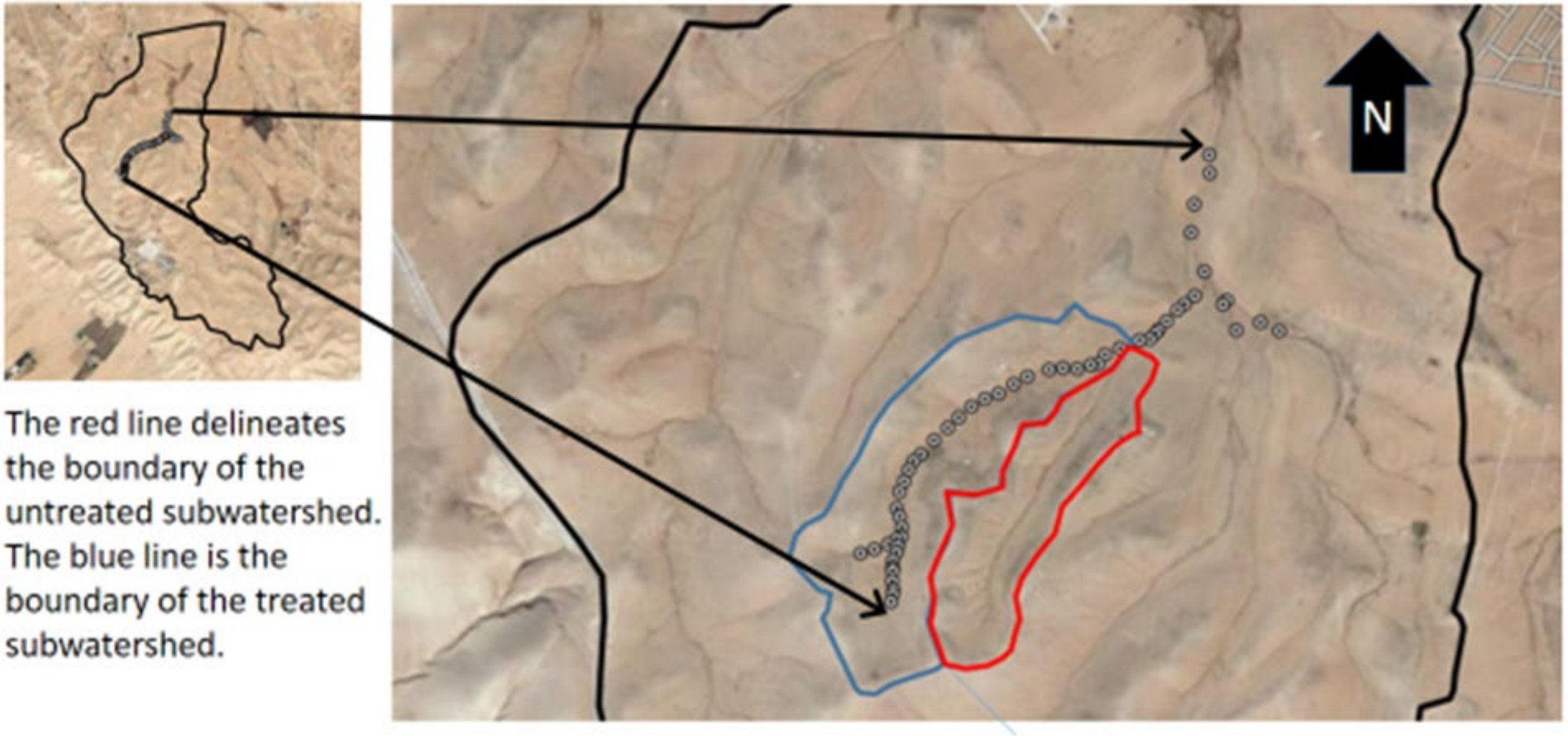
4 – Meridian, ID

global access to 196+ countries and 550 carriers

Jordan Watershed Rehabilitation

- ICARDA Benchmark Watershed at Majdiyyah near Amman, Jordan
  - Water and Livelihoods Initiative-ICARDA
- Joint with U.S. Forest Service, ICARDA, USDA ARS, National Centre for Agricultural Research, Jordan
- 953 ha
- Semi-arid to Arid
  - 260 mm mean
- Severely degraded rangeland

Paired watershed research approach



The red line delineates the boundary of the untreated subwatershed. The blue line is the boundary of the treated subwatershed.

Contour basins

- Made with Vallerani plow
- Spacing between contours maintains runoff in sheet flow mode – no rilling detected
- Discontinuous basins allow safe exit of water if filled

Vallerani basins

- Planted to atriplex and other species in 2016
- Note up and down slope furrows from previous barley planting

Gully plugs

- 55 rock gully plugs
- 37 in treated watershed

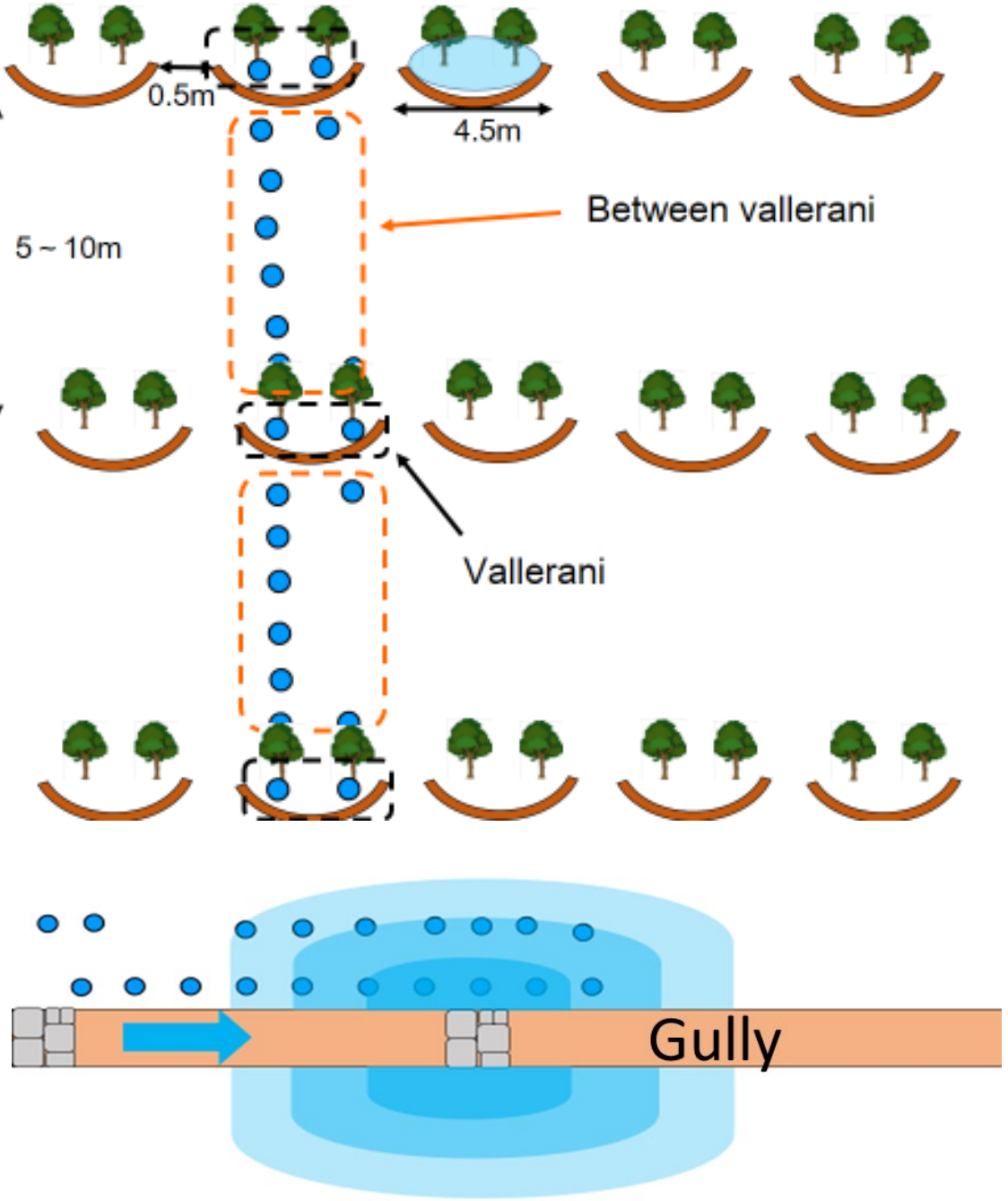
Designed to

1. Trap sediment,
2. Increase retention time and infiltration
3. Allow vegetation to take root

Gully plug effects

Extant measurements

- Trime access tubes in basins and interspaces
- Trime access tubes along gully
- Trapezoidal weir in gully
- Manual Trime readings done intermittently
- Weir readings on 5-min basis
- **NEED: Spatiotemporal water content data on smaller time and space increments**

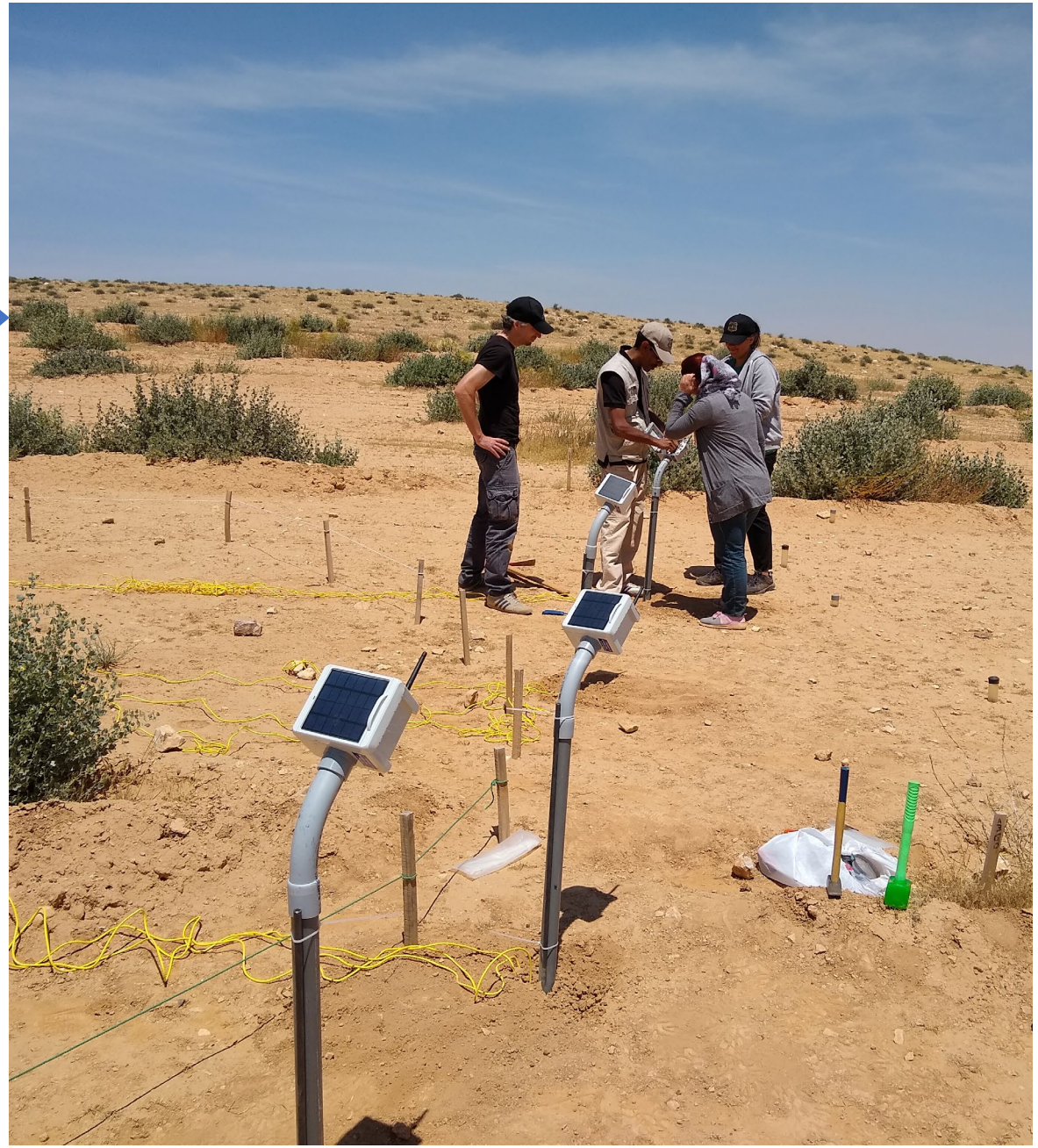


Spatiotemporal water content monitoring

- Vertical profiles of TDR-315L sensors installed horizontally in basins and interspaces
- Data checked with Sensor Reader. Sensor addresses assigned using node
- Wireless nodes and gateway designed by ARS Beltsville, converted to commercial product by Acclima, Inc., Meridian, ID
- Wired (SDI-12) sensors to four nodes
- One gateway receives data from the four nodes on an hourly basis and transmits data to Hologram web site via cellular network using Hologram SIM and local (Zain) cellular service

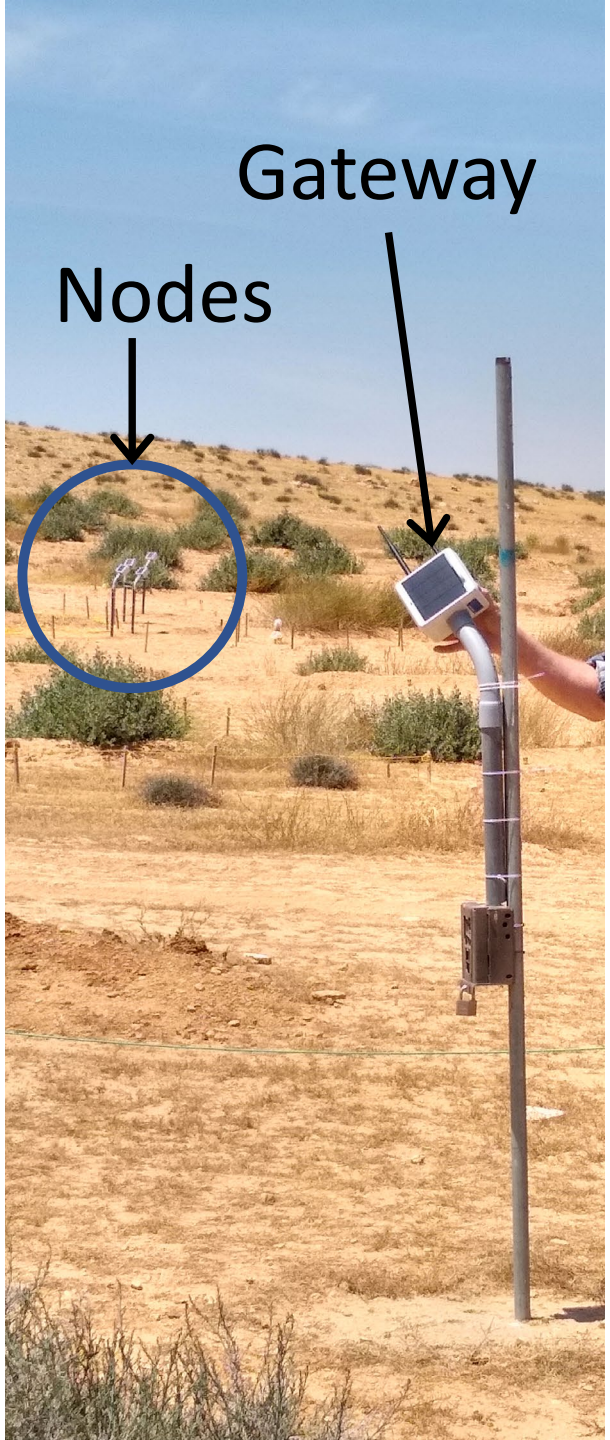
System installation

- Finishing the 4th node
- Running wires into a node

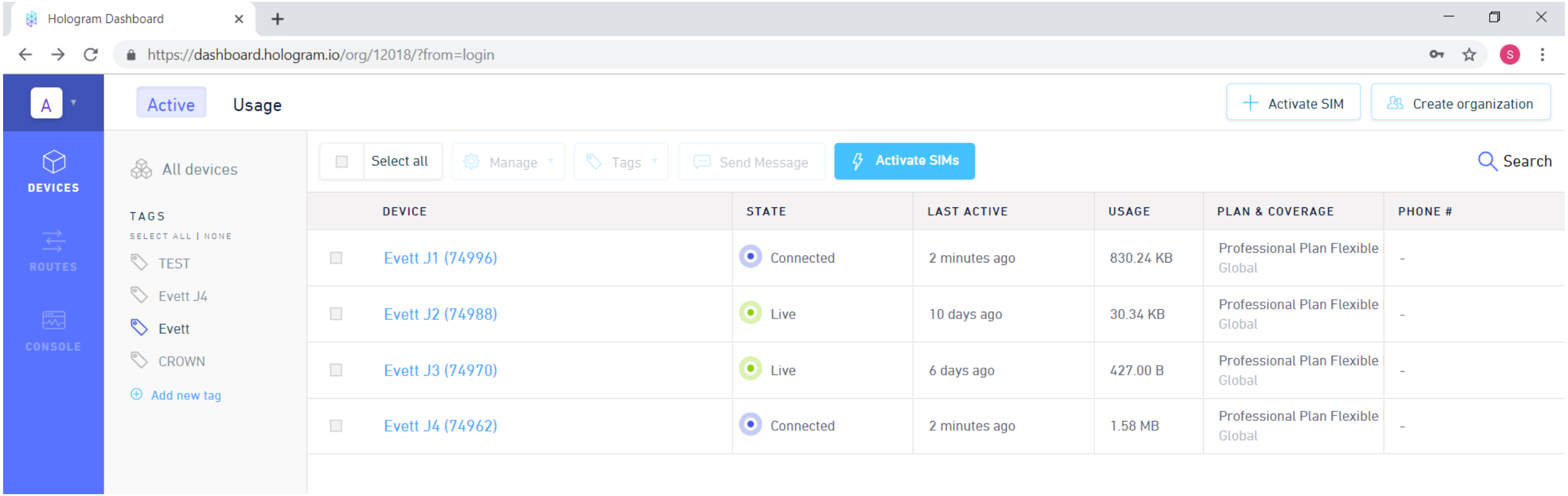


Completed installation

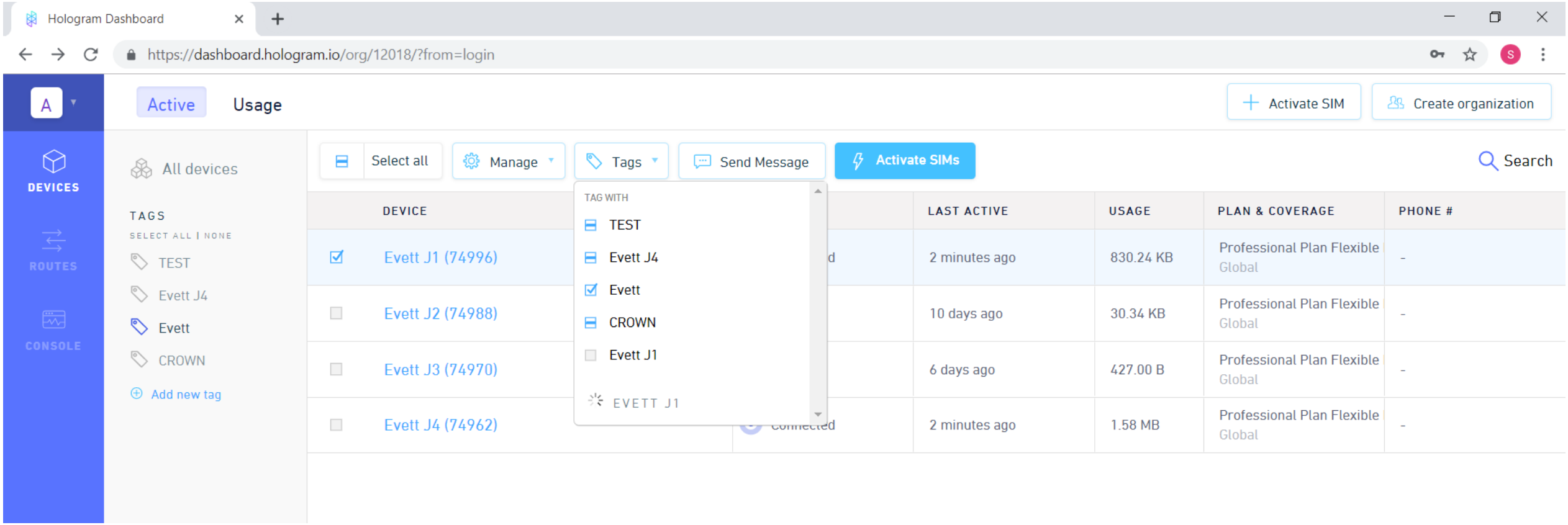
The team! 10 May 2019, Majdiyya, Jordan

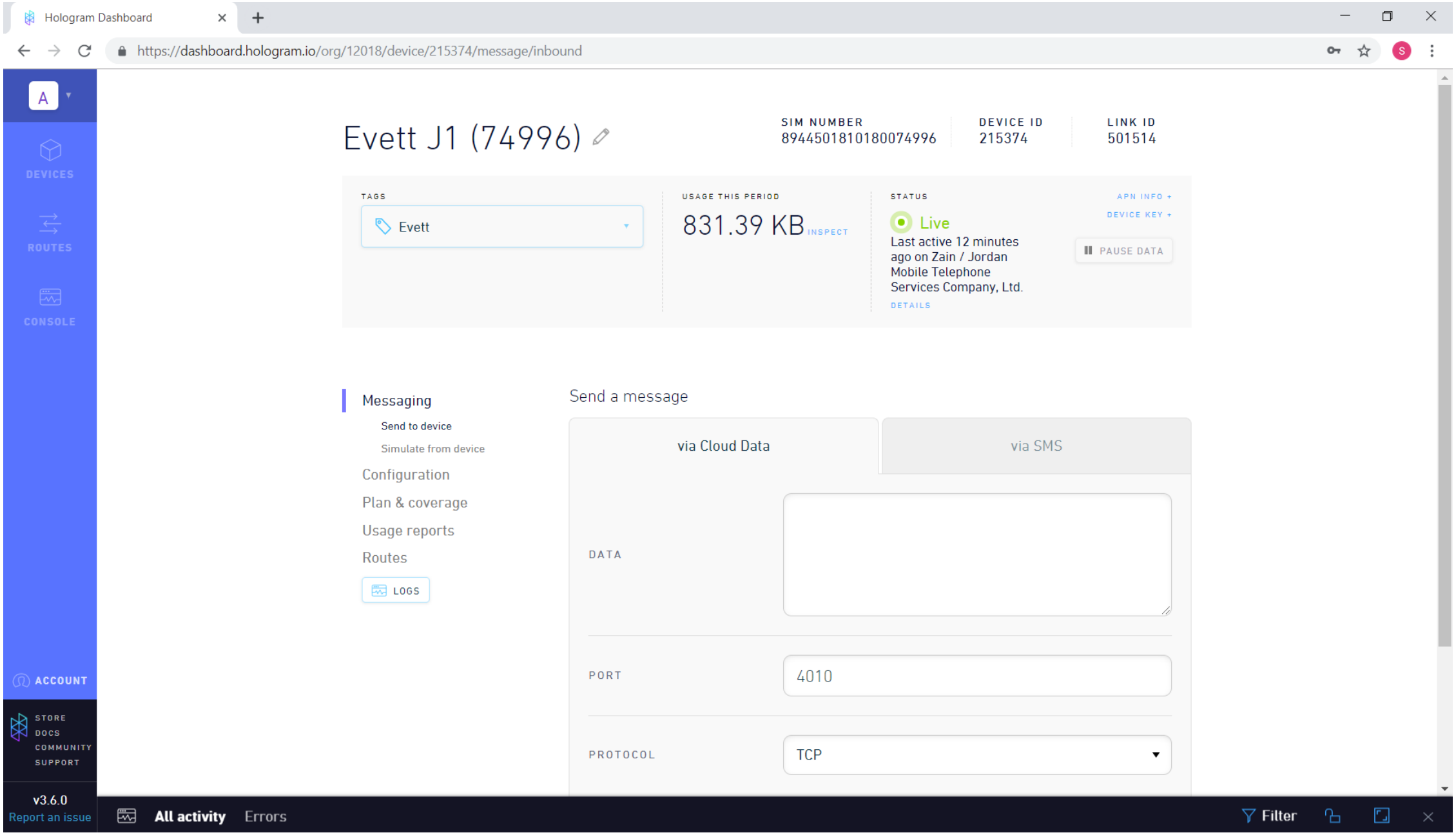


Data in the Cloud – Hologram Dashboard



Gateway in Jordan – Adding Tag for Evett J1




Hologram Dashboard
https://dashboard.hologram.io/org/12018/device/215374/message/inbound
DEVICES
ROUTES
CONSOLE
ACCOUNT
STORE
DOCS
COMMUNITY
SUPPORT
v3.6.0
Report an issue
Evett J1 (74996)
SIM NUMBER
8944501810180074996
DEVICE ID
215374
LINK ID
501514
TAGS
Evett
USAGE THIS PERIOD
831.39 KB
INSPECT
STATUS
Live
Last active 12 minutes ago on Zain / Jordan Mobile Telephone Services Company, Ltd.
DETAILS
APN INFO
DEVICE KEY
PAUSE DATA
Messaging
Send to device
Simulate from device
Configuration
Plan & coverage
Usage reports
Routes
LOGS
Send a message
via Cloud Data
via SMS
DATA
PORT
4010
PROTOCOL
TCP
All activity
Errors
Filter

Hologram Dashboard

https://dashboard.hologram.io/org/12018/?drawer=full&from=login

A

DEVICES

ROUTES

CONSOLE

ACCOUNT

STORE
DOCS
COMMUNITY
SUPPORT

v3.6.0
Report an issue

All activity | Errors

Filter

Evett J4

Most recent logs

Search by topics published

	DATA	TOPICS	
Message sent from Evett J4 (74962) KEY	NEL04~4.09~17.25~12~6.59~2019-5-19_15:00:00_UTC~0~31.7~26.6~17.9~478~2760~1~28.9~22.3~15.9~443~2983~2~36.3~28.1~21.5~586~2681~3~35.7~26.7~21.0~586~2761	NE1 DATA 6 more...	May 19 2019, 10:05:45 SIMULATE VIEW RAW
Message sent from Evett J4 (74962) KEY	NEL03~4.07~18.75~70~6.59~2019-5-19_15:00:00_UTC~4~32.0~26.6~18.1~474~2696~a~36.5~24.7~21.7~599~2712	NE1 DATA 6 more...	May 19 2019, 10:05:42 SIMULATE VIEW RAW
Message sent from Evett J4 (74962) KEY	NEL02~4.18~17.75~12~6.59~2019-5-19_15:00:00_UTC~5~40.6~31.7~25.4~796~2982~6~40.5~26.4~25.3~773~2903~7~40.8~24.9~25.5~814~3028~8~40.3~30.2~25.2~816~3079	NE1 DATA 6 more...	May 19 2019, 10:05:39 SIMULATE VIEW RAW
Message sent from Evett J4 (74962) KEY	NEL01~4.08~18.00~6~6.58~2019-5-19_15:00:00_UTC~4~42.9~20.9~26.9~808~2824	NE1 DATA 6 more...	May 19 2019, 10:05:36 SIMULATE VIEW RAW
Message sent from Evett J4 (74962) KEY	NEL04~4.09~16.25~6~6.59~2019-5-19_14:45:00_UTC~0~31.5~24.6~17.7~468~2736~1~29.0~20.6~15.9~439~2946~2~36.3~26.3~21.5~588~2690~3~36.4~24.9~21.6~586~2667	NE1 DATA 6 more...	May 19 2019, 10:05:33 SIMULATE VIEW RAW
	DATA	TOPICS	May 19 2019, 10:05:30

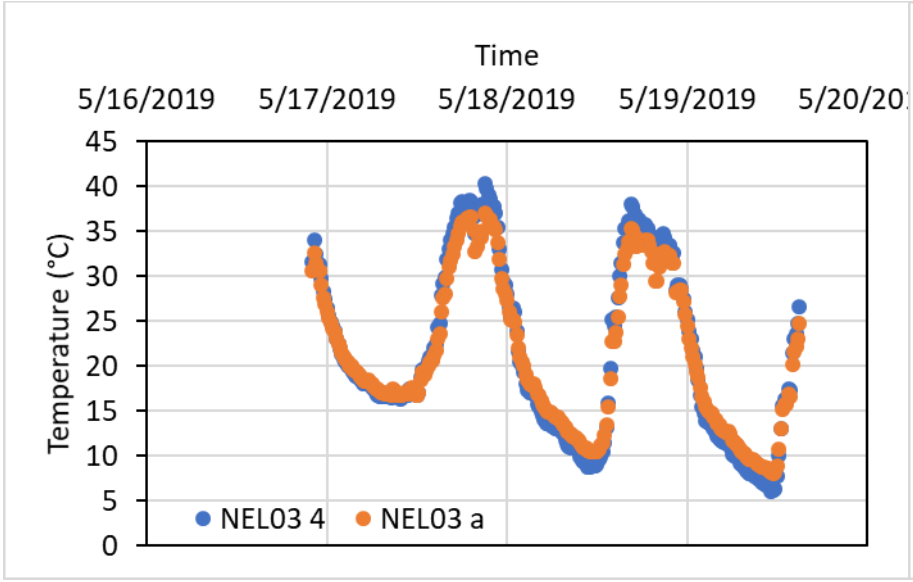
Data from the Cloud

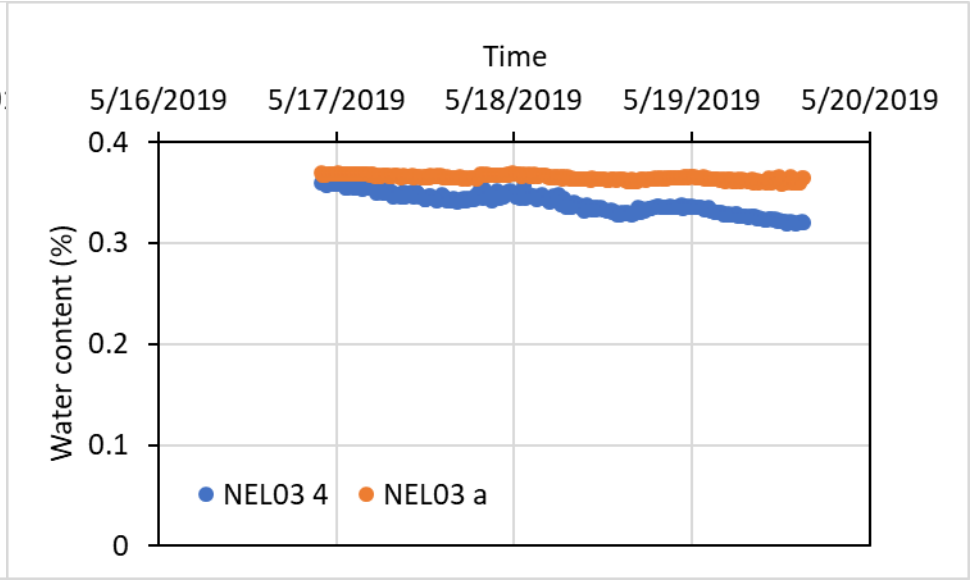
Nodes NEL03 and NEL04 at Bushland

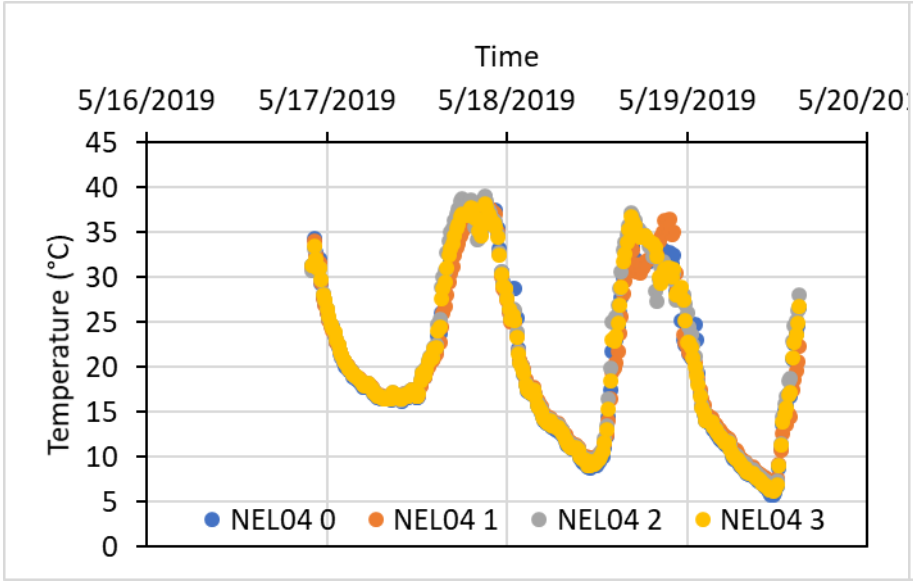
Sensors installed vertically into surface

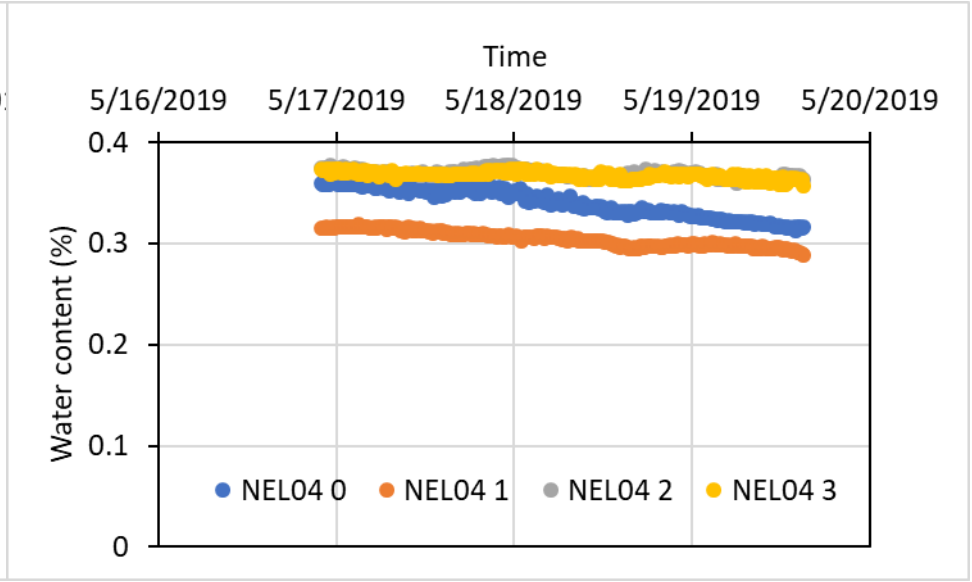
Two sensors on NEL03

Four sensors on NEL04









Summary

- The Internet-of-Things (IoT) approach to sensor systems is already being applied in many industrial settings and increasingly for agricultural field operations (e.g., Kohanbash et al., 2013).
- The LoRa based node and gateway system for soil water sensor data acquisition and wireless telemetry described here provides an effective, low-cost, solar-powered solution for delivering data to the Internet Cloud.
- Anyone with access rights can access the URL.
- For irrigation decision support systems such as ISSCADA, this provides a data access solution that fits well with the underlying wireless in-field and multiple field communications concept.
- This allows user interaction with a data-laden interface on a remote cellular telephone, tablet or other computer that communicates with a single or with multiple systems for both control and data acquisition.

Acknowledgments & Disclosures

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  - CRADA #: 58-3K95-0-1455-M, “A Sensor-Feedback-Based Supervisory Control and Data Acquisition System for Variable Rate Irrigation Decision Support”, with Valmont Industries, Inc., Valley NE
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Thank you – Questions?

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