



# Watershed moisture sensing in Jordan: Water in the Cloud

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Steve Evett<sup>1</sup>, Stefan Strohmeier<sup>2</sup>, Mira  
Haddad<sup>2</sup>, Harry Schomberg<sup>3</sup>, Alondra  
Thompson<sup>3</sup>, John Anderson<sup>4</sup>

<sup>1</sup> USDA ARS, Bushland, Texas, <sup>2</sup> ICARDA,  
Amman, Jordan, <sup>3</sup> USDA ARS, Beltsville,  
Maryland, <sup>4</sup> Acclima, Inc., Meridian, Idaho

# World Wide Coverage - Hologram

- 1 – Beltsville, MD
- 2 – Amman, Jordan
- 3 – Bushland, TX
- 4 – Meridian, ID

global access to 196+  
countries and 550  
carriers



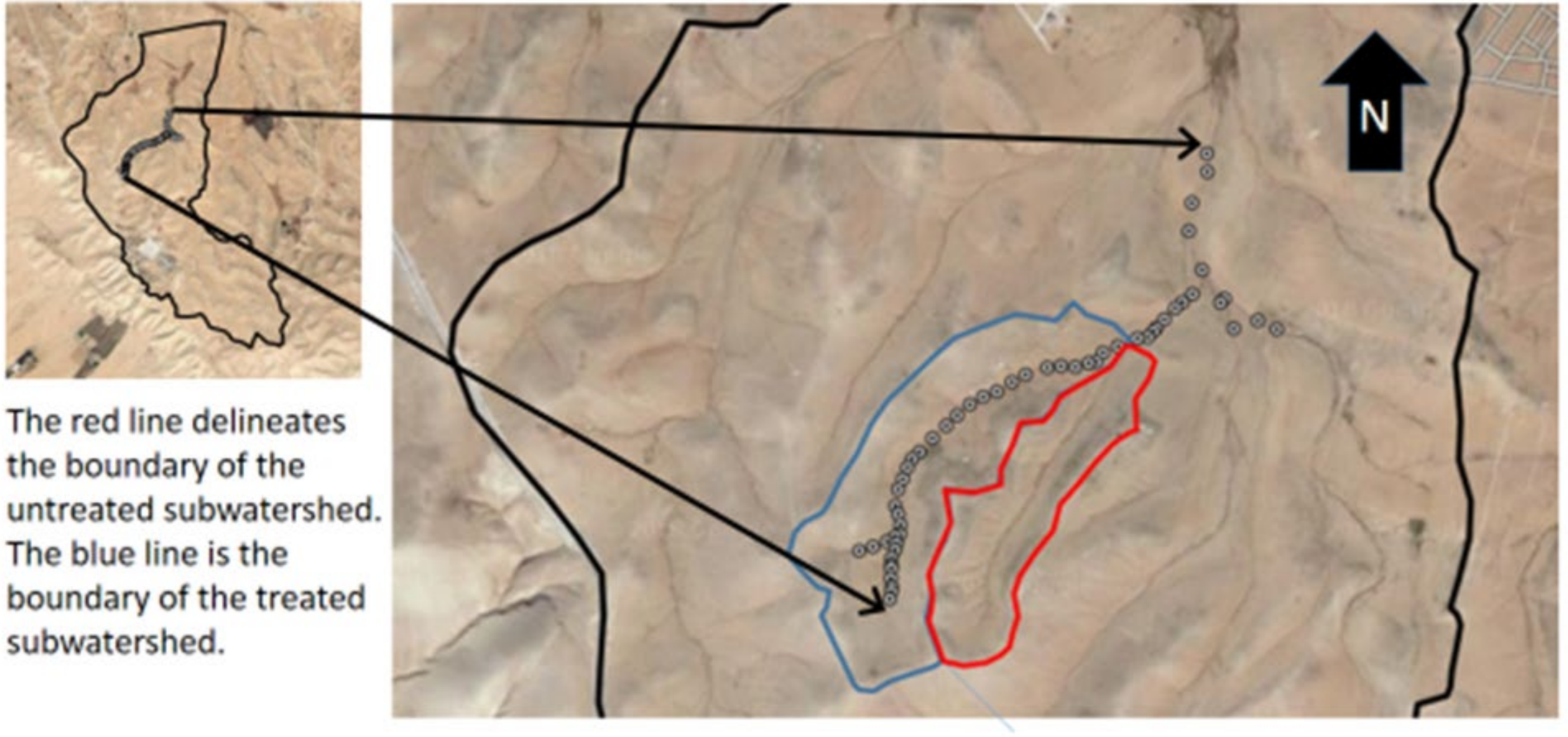
# Jordan Watershed Rehabilitation


- 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



An aerial photograph of a large, flat, brownish field. In the foreground and middle ground, there are numerous long, narrow, parallel basins or furrows dug into the soil, following the contours of the land. These are contour basins. In the background, there are some small structures and a line of trees on the horizon. A semi-transparent white circle is overlaid on the left side of the image, containing text.

# 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

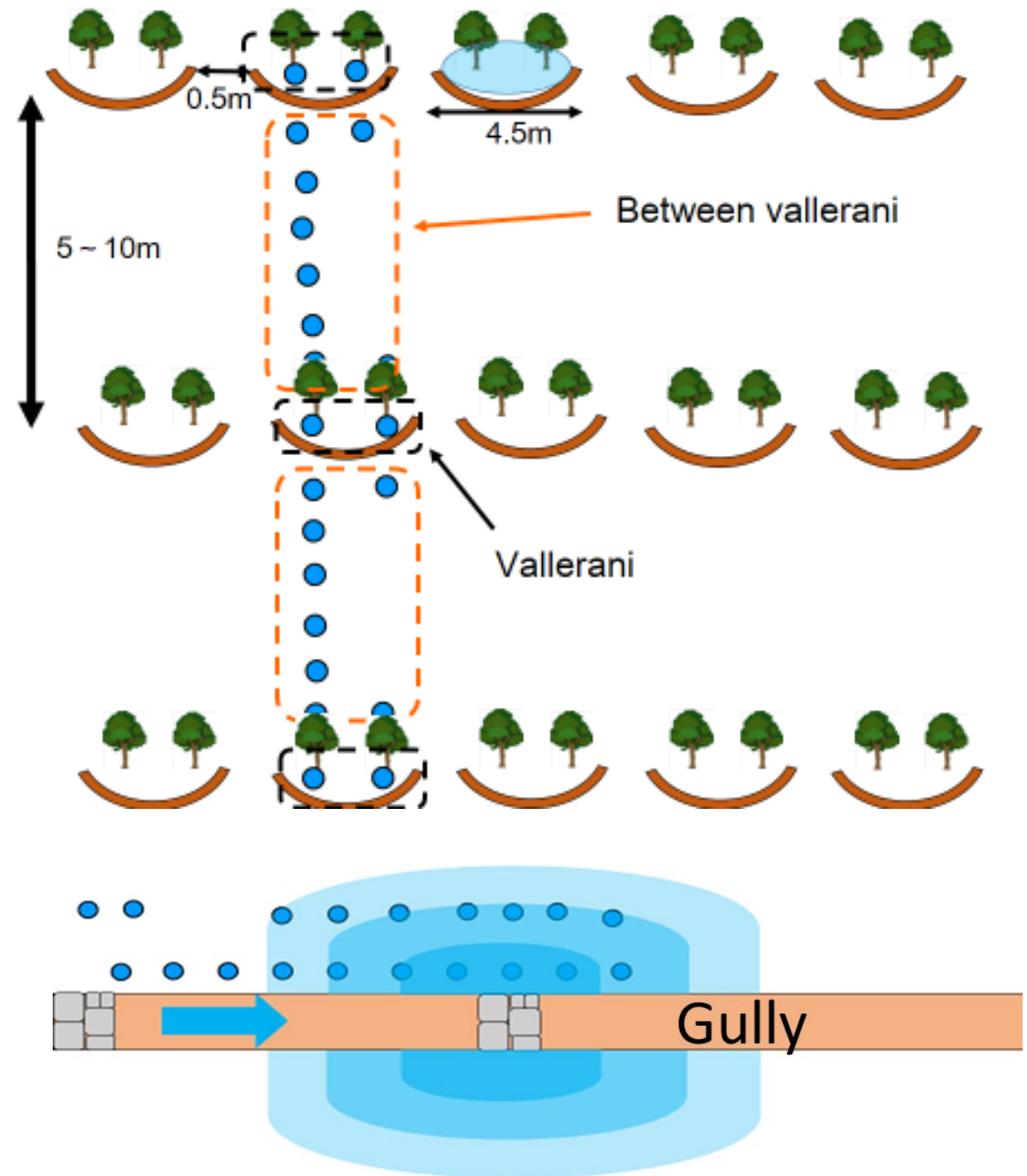
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# Extant measurements

- 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**




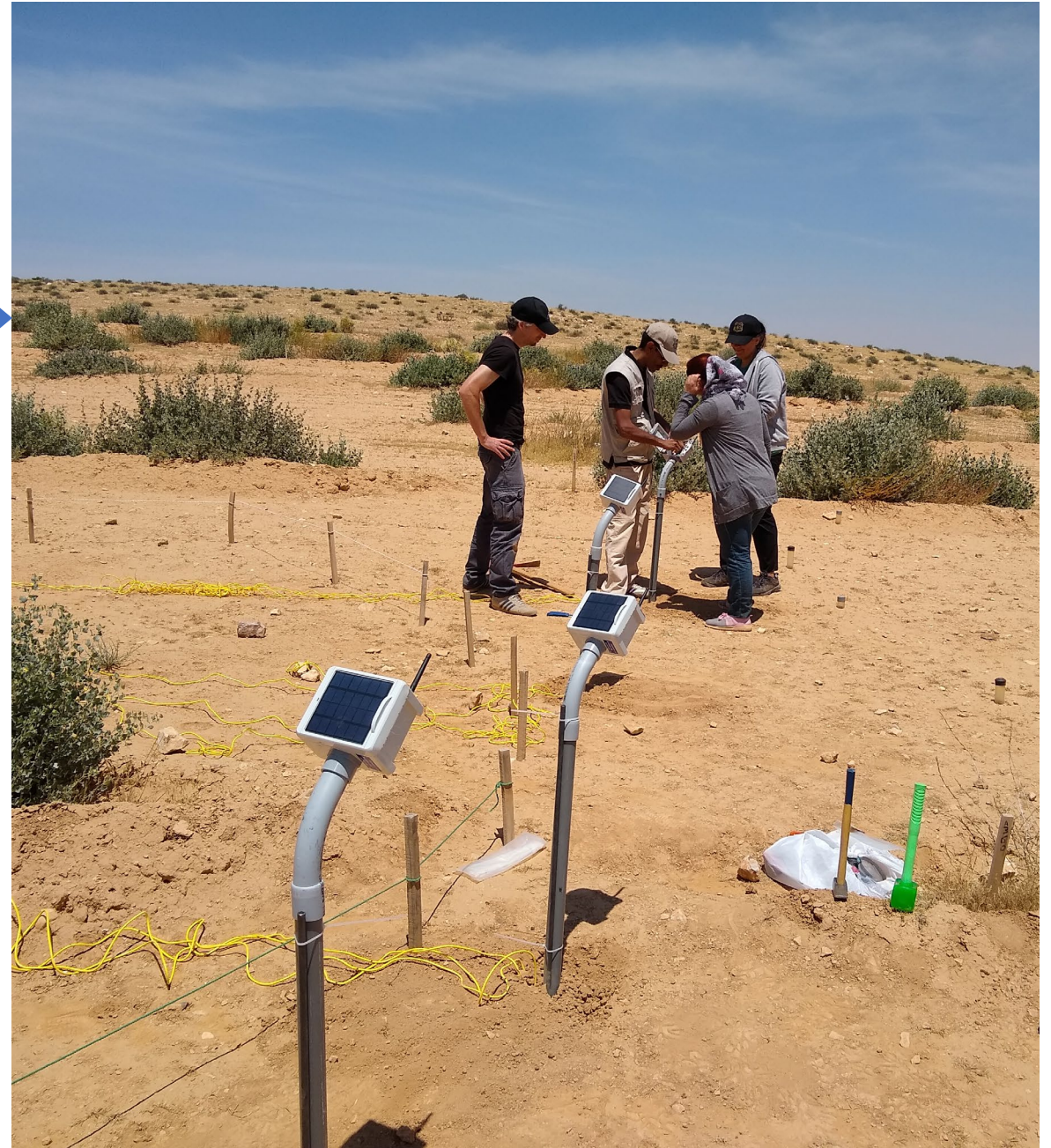
# Spatiotemporal water content monitoring

- 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

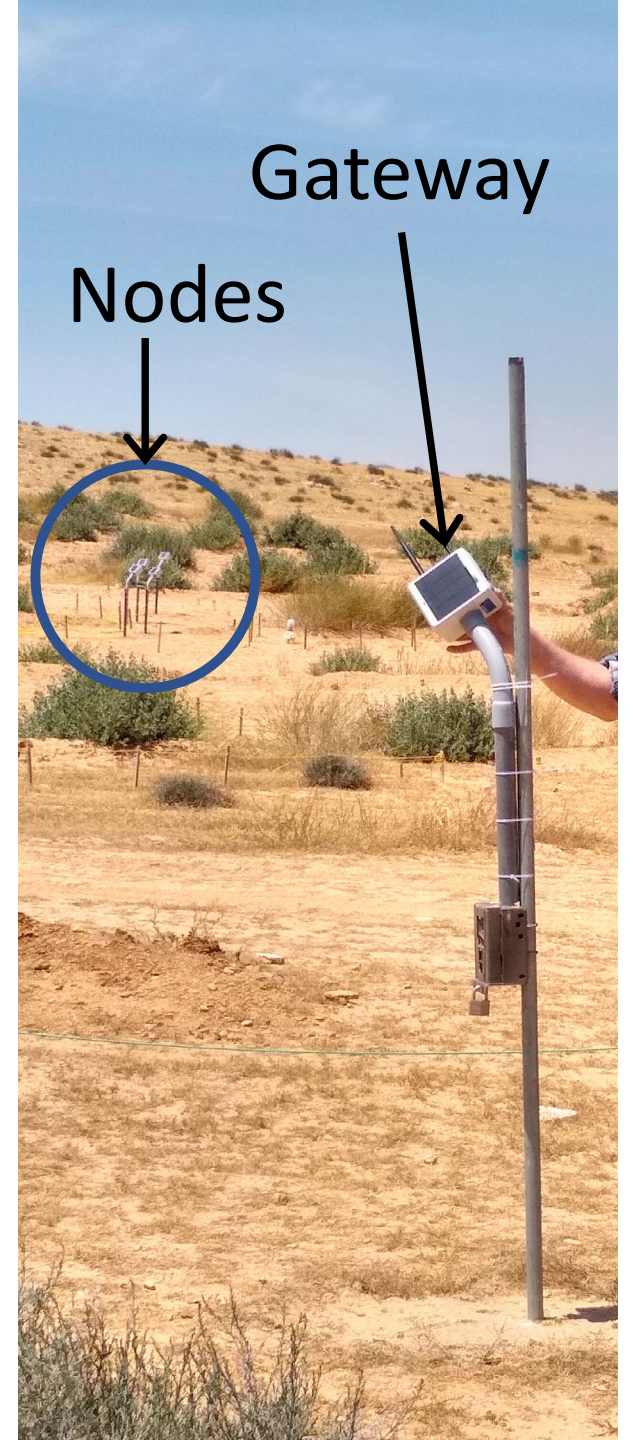
- Finishing the 4<sup>th</sup> node 
- Running wires into a node





# Completed installation

The team! 10 May 2019, Majdiyya, Jordan



# Data in the Cloud – Hologram Dashboard

Hologram Dashboard

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

A

DEVICES

ROUTES

CONSOLE

Active Usage

Activate SIM

Create organization

All devices

TAGS

SELECT ALL | NONE

TEST

Evett J4

Evett

CROWN

Add new tag





Select all

Manage

Tags

Send Message

Activate SIMs

DEVICE	STATE	LAST ACTIVE	USAGE	PLAN & COVERAGE	PHONE #
<input type="checkbox"/> <a href="#">Evett J1 (74996)</a>	 Connected	2 minutes ago	830.24 KB	Professional Plan Flexible Global	-
<input type="checkbox"/> <a href="#">Evett J2 (74988)</a>	 Live	10 days ago	30.34 KB	Professional Plan Flexible Global	-
<input type="checkbox"/> <a href="#">Evett J3 (74970)</a>	 Live	6 days ago	427.00 B	Professional Plan Flexible Global	-
<input type="checkbox"/> <a href="#">Evett J4 (74962)</a>	 Connected	2 minutes ago	1.58 MB	Professional Plan Flexible Global	-

Search



# Gateway in Jordan – Adding Tag for Evett J1

Hologram Dashboard

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

Active Usage

+ Activate SIM Create organization

DEVICES

ROUTES

CONSOLE

All devices

TAGS  
SELECT ALL | NONE

TEST

Evett J4

Evett

CROWN

+ Add new tag

Select all Manage Tags Send Message Activate SIMs

Search

DEVICE	LAST ACTIVE	USAGE	PLAN & COVERAGE	PHONE #
<input checked="" type="checkbox"/> Evett J1 (74996)	2 minutes ago	830.24 KB	Professional Plan Flexible Global	-
<input type="checkbox"/> Evett J2 (74988)	10 days ago	30.34 KB	Professional Plan Flexible Global	-
<input type="checkbox"/> Evett J3 (74970)	6 days ago	427.00 B	Professional Plan Flexible Global	-
<input type="checkbox"/> Evett J4 (74962)	2 minutes ago	1.58 MB	Professional Plan Flexible Global	-

TAG WITH

- TEST
- Evett J4
- Evett
- CROWN
- Evett J1
- EVETT J1





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

KEY

Message sent from **Evett J4**  
(74962)

DATA

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

TOPICS

NE1

DATA

6 more...

May 19 2019, 10:05:45

SIMULATE

VIEW RAW

KEY

Message sent from **Evett J4**  
(74962)

DATA

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

TOPICS

NE1

DATA

6 more...

May 19 2019, 10:05:42

SIMULATE

VIEW RAW

KEY

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(74962)

DATA

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TOPICS

NE1

DATA

6 more...

May 19 2019, 10:05:39

SIMULATE

VIEW RAW

KEY

Message sent from **Evett J4**  
(74962)

DATA

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TOPICS

NE1

DATA

6 more...

May 19 2019, 10:05:36

SIMULATE

VIEW RAW

KEY

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(74962)

DATA

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TOPICS

NE1

DATA

6 more...

May 19 2019, 10:05:33

SIMULATE

VIEW RAW

KEY

Message sent from **Evett J4**  
(74962)

DATA

TOPICS

May 19 2019, 10:05:30

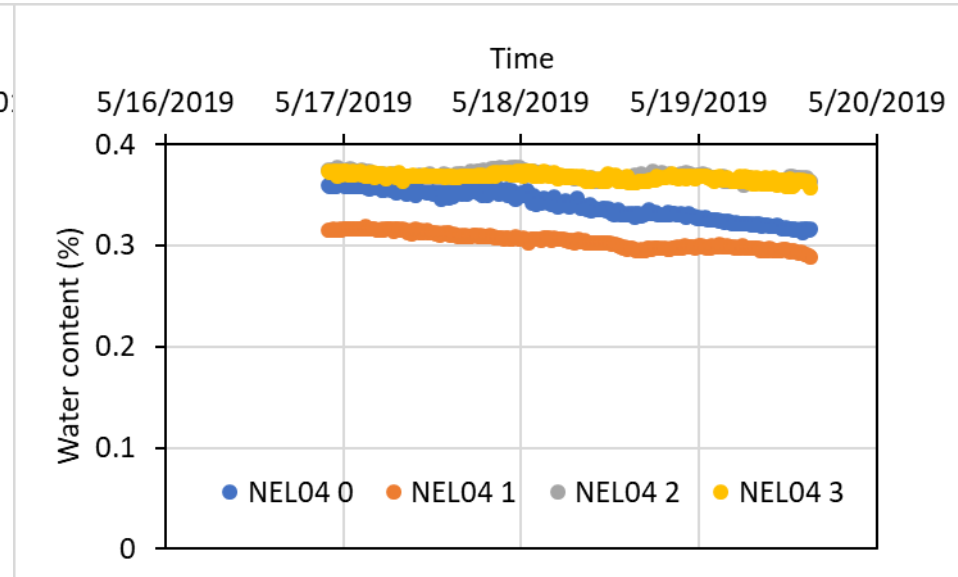
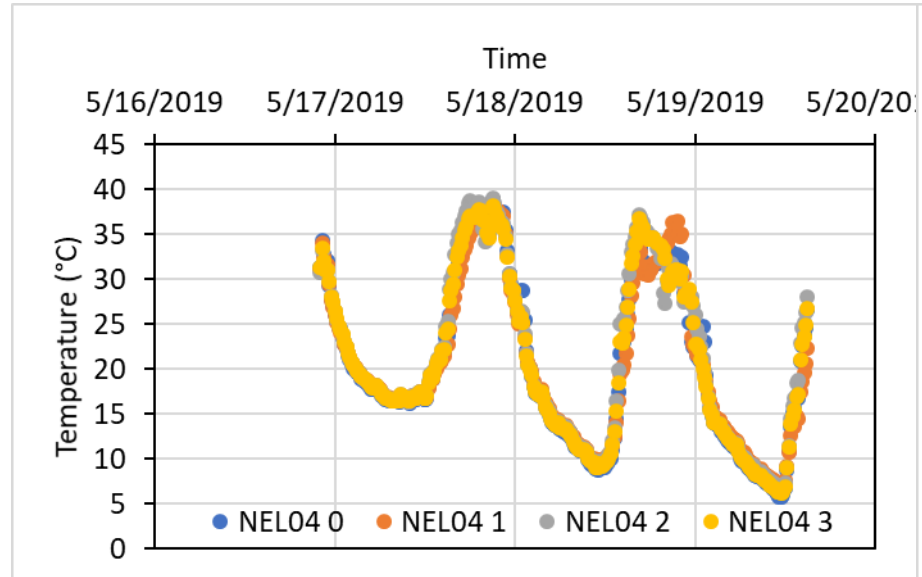
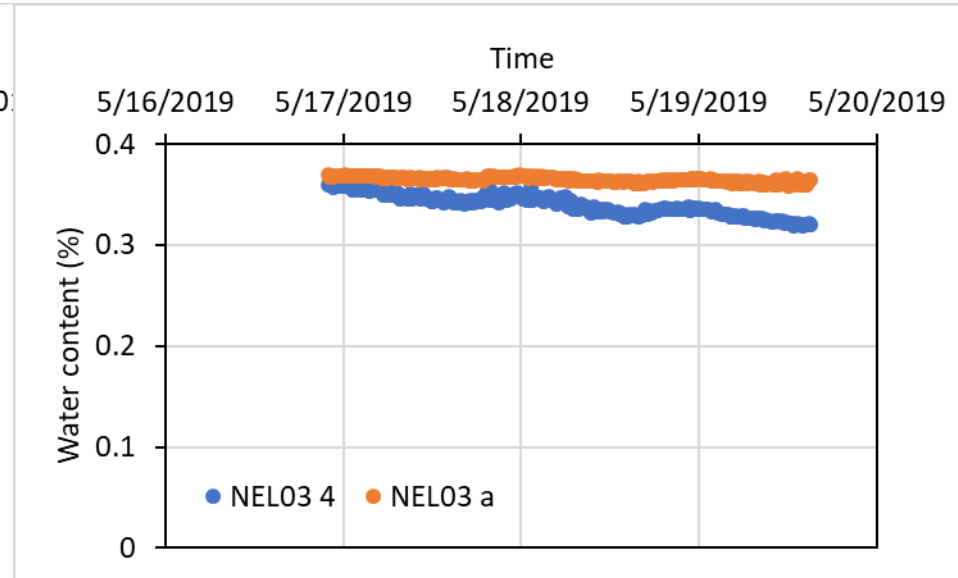
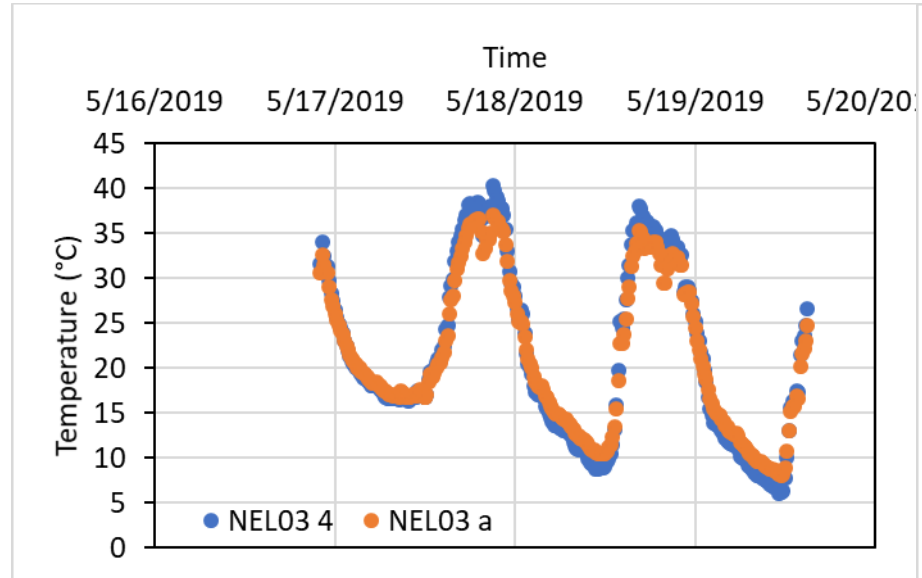
# Data from the Cloud

Nodes NEL03 and NEL04 at Bushland

Sensors installed vertically into surface

Two sensors on NEL03

Four sensors on NEL04







# Summary

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- 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.



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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?

[steve.evett@ars.usda.gov](mailto:steve.evett@ars.usda.gov)

