Weather Data: It's Not Like Horseshoes and Hand Grenades

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Apollo and the Need for Environmental Data

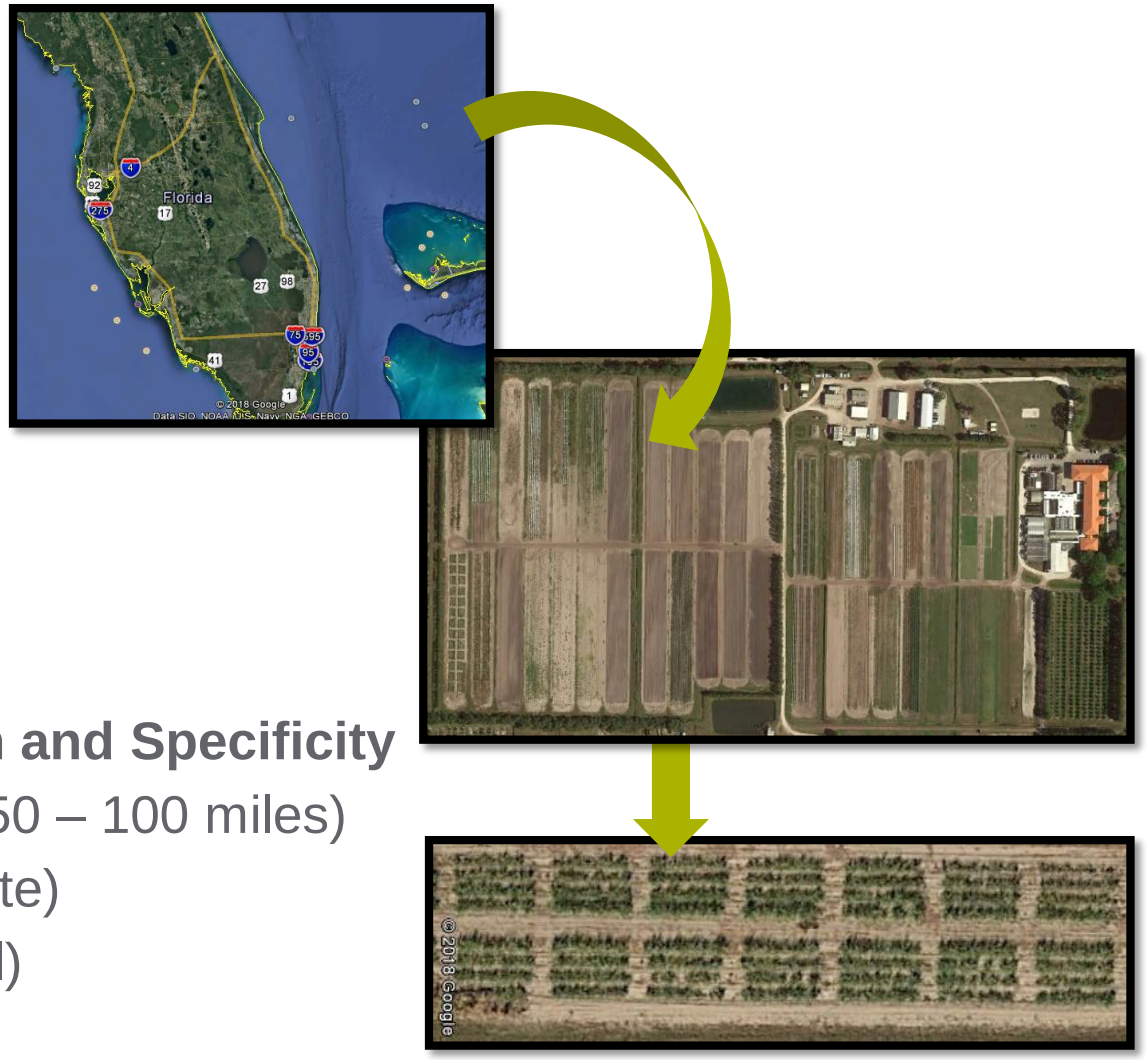
- Corn tolerance to Apollo was marginal in 2016
  - Selectivity was seemingly driven by the position of the herbicide in the soil
  - Speculated that cool, wet soil conditions or the ‘right’ amount of rainfall could cause unacceptable crop injury

- Soil moisture and temperature sensors were implemented to address the following objectives:
  1. Use weather date to model injury from Apollo
  2. Investigate outliers in field trials

Environmental Variables Important for CP Trialing – Collected over the course of the trial

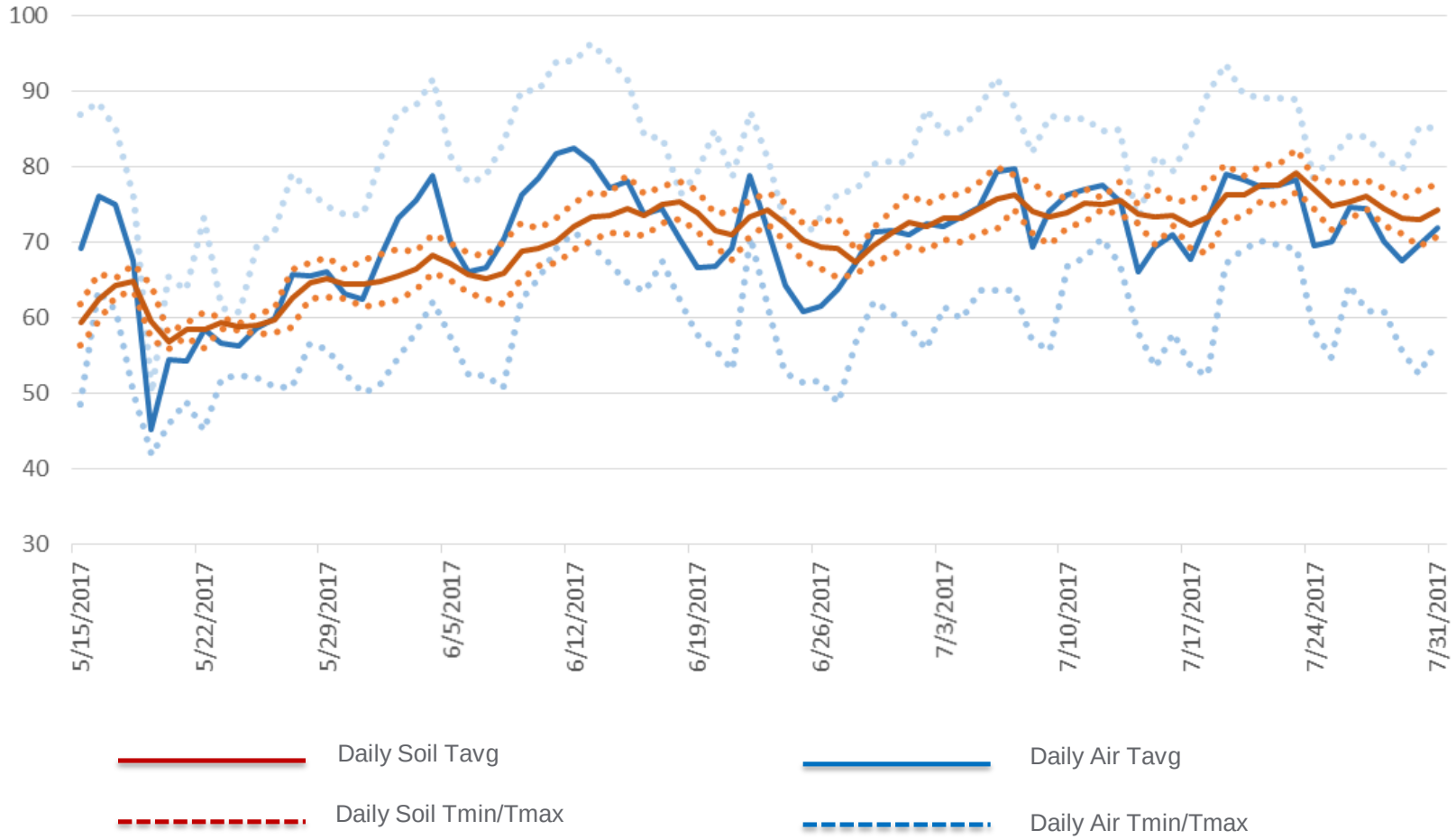
- **Types of data:**
  - Rainfall/Irrigation
  - Temperature
  - **Soil moisture**
  - **Soil temperature**
  - Leaf wetness
  - Relative humidity
  - ???

- **Data Collection Location and Specificity**
  - Regional level (within 50 – 100 miles)
  - Site level (at the trial site)
  - Trial level (within a trial)



An Example of Comparability of Air Temp vs Soil Temp

Air temperature is not a good proxy for soil temperature!



Data Source: ND Agricultural Weather Network

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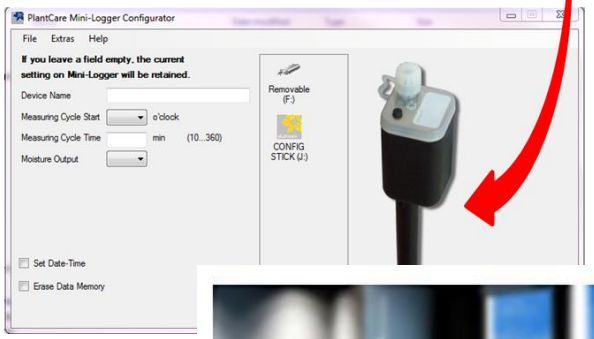
The Problem: Environmental Data Capture Hardware/Software Challenges

- **Portability:** Chasing pests in remote locations… has to “work off the grid”

- **Usability:** Software requires a HelpDesk ticket
  - Potential solutions:
    - Portal apps
    - Bluetooth
    - ???

- **Power supply:** need devices that can be powered in remote locations for months
  - Potential solutions:
    - Battery, solar

Data upload /download cable with USB interface incl. 2 USB Sticks



A Solution for Soil Moisture and Temperature

- PlantCare™ Soil Probes
  - Record **soil moisture** and **soil temperature**
  - Durable and simple to launch
  - Use portal app, no software required
  - Novel soil moisture recording
    - **micro-thermal measuring**: cooling time is measured, which allows a statement about the water content of the soil
    - **Output**: relative moisture percentage (%)

- Weed Control APOLLO trials: 116 probes, three protocols

- Seed Care Pythium trials: ~60 probes, two protocols; excluded from this analysis

Data upload /download cable with USB interface incl. 2 USB Sticks

Patent for soil moisture probe: http://www.google.sr/patents/US8001990

2017 Process for Soil Probes

Loggers were **launched and shipped** from a **central locations**

⇩

Scientist **placed** loggers in the appropriate trial and plot at planting

⇩

Scientist **removed** loggers at the appropriate time as per instructions and shipped loggers back to central location.

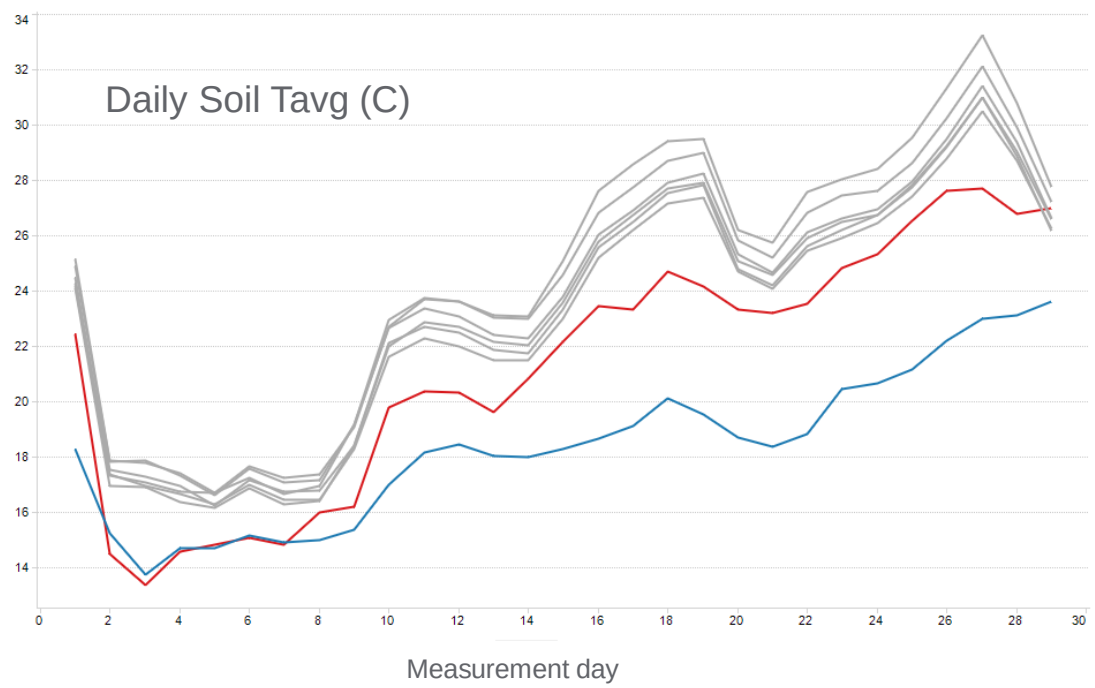
⇩

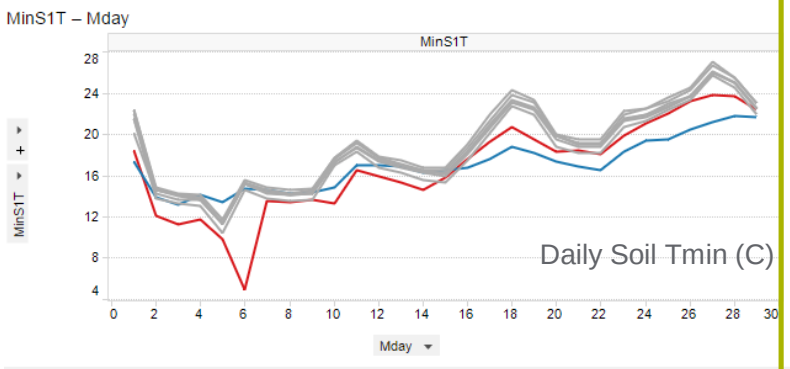
Data **downloaded** and **compiled** at **central locations**.

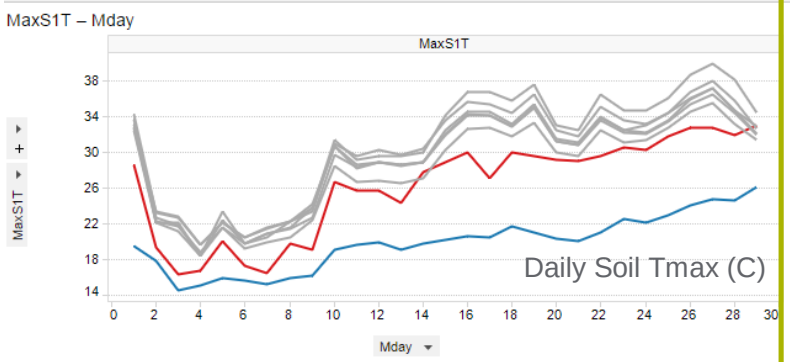
**22 minutes per logger for entire process*

Trials in IL (Silt Clay Loam)

- Ref Data ISWS* (bare - 4 in)
- Ref Data ISWS* (sod - 4 in)
- 6 probes (WC096 to WC101) (3 in)







* Reference data from ISWS; 80km southwest

ILLINOIS
Illinois State Water Survey
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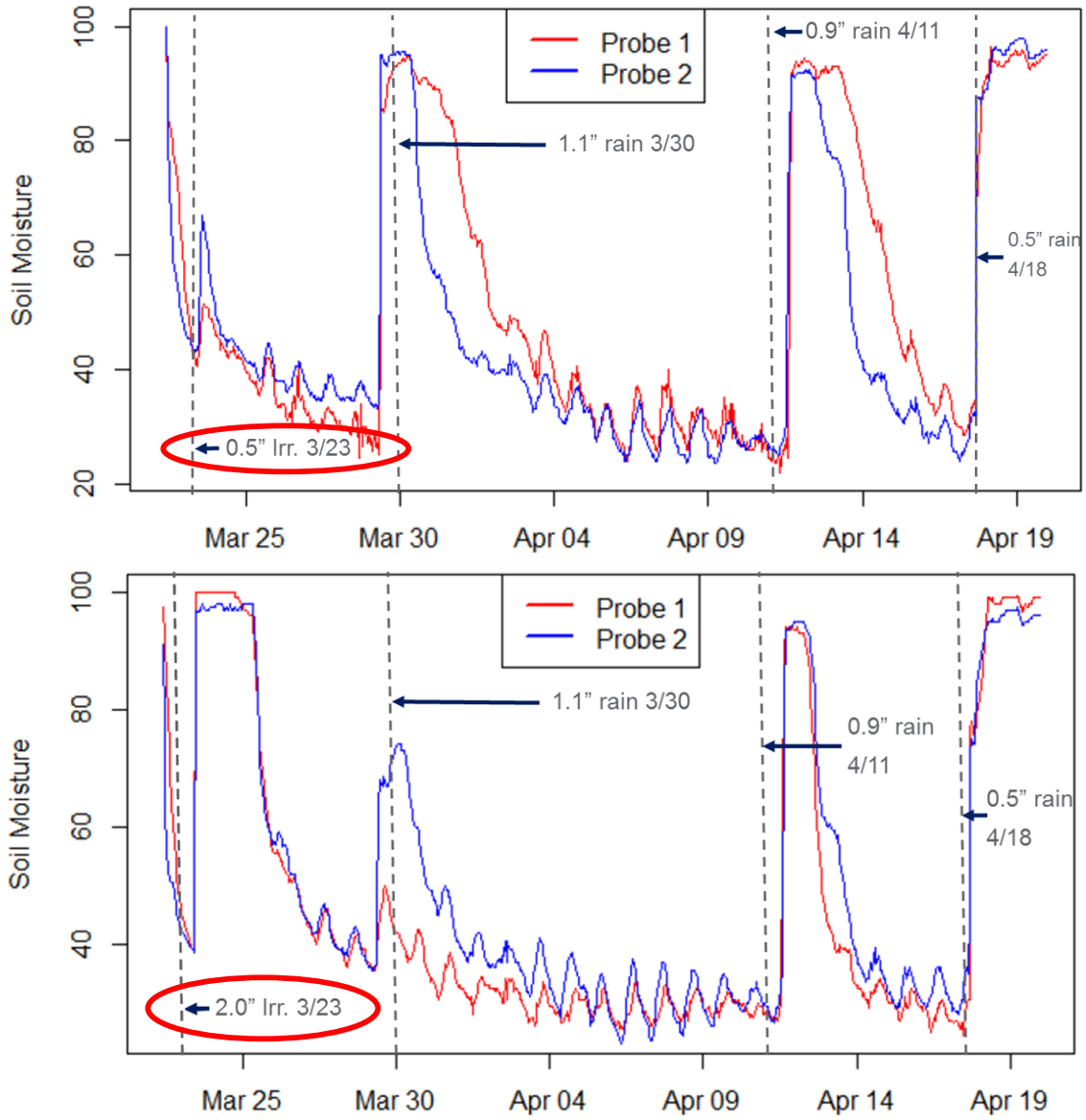
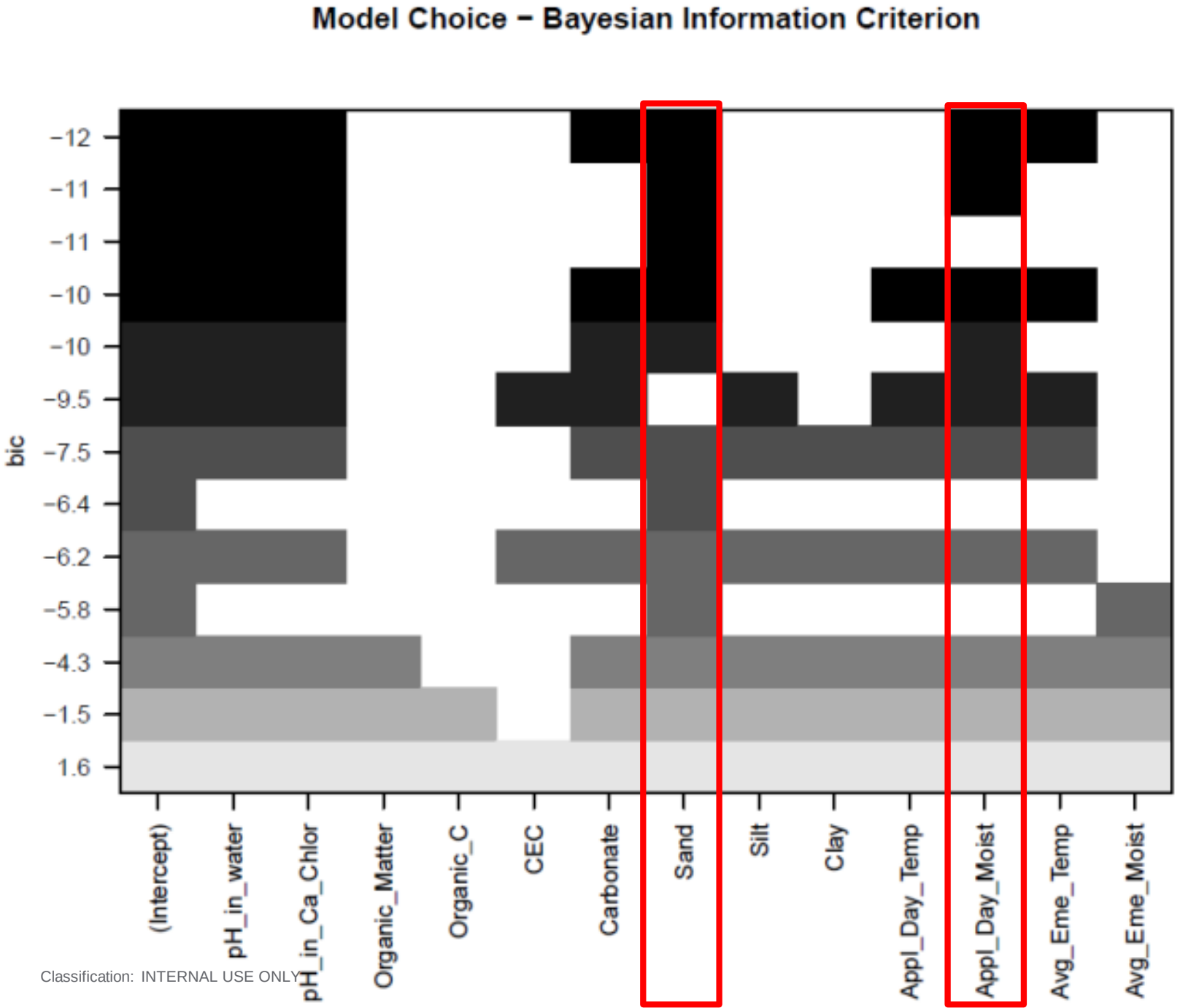
Soil Moisture (Eure) HAP008-2017US

0.5in precipitation
between application and emergence

2in precipitation
between application and emergence

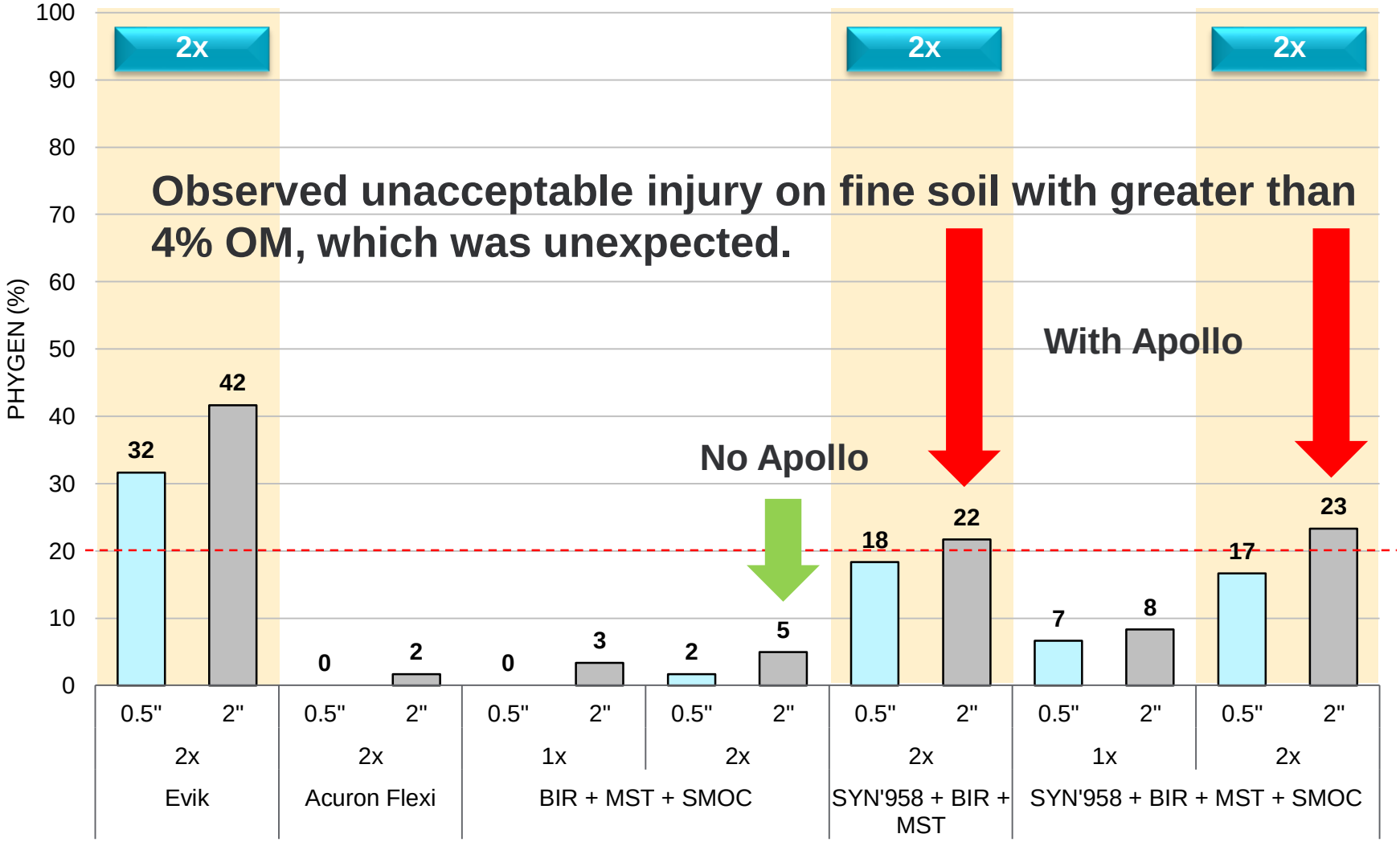


Soil Texture –Clay Loam (34% sand, 44% silt, 22% clay)

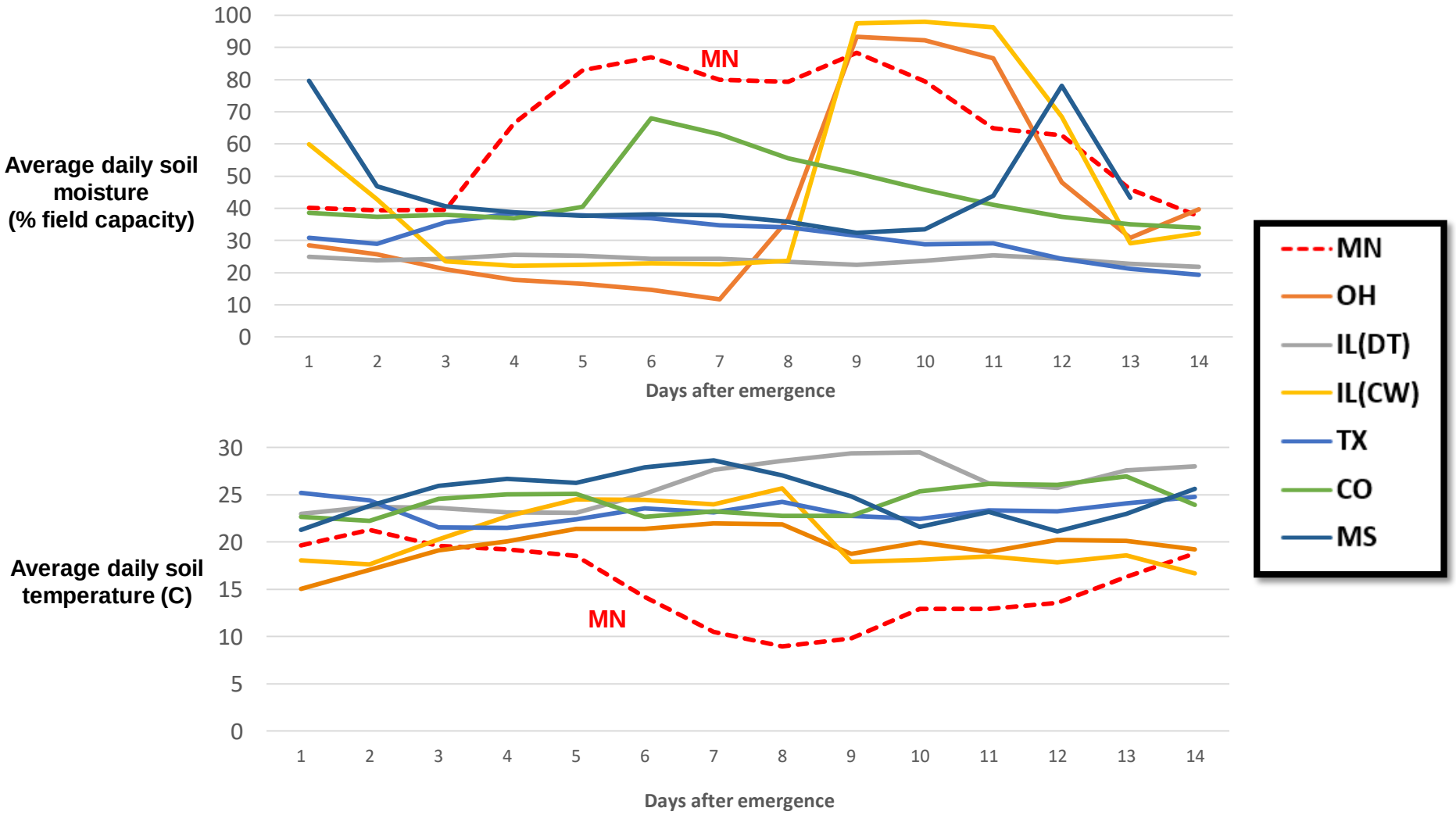


Max PHYGEN - Minnesota

TRIAL STATE	SOIL TEXTURE	% Sand	% Silt	% Clay	% OM	Soil pH	CEC
MN	CLAY-LOAM	28	40	32	4.2	6.5	17.1



Soil Moisture and Temperature Probe Comparison of Trials Conducted in Fine Soils with Greater than 2% OM



PHYGEN 28DAT

*Corn was in the cold for 14DAE, then moved to the greenhouse until pictures were taken at 28DAE

Untreated

BIR/MST/SMOC

Apollo 600gai

Apollo/BIR/MST/SMOC

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Conclusions

- Accurate, site level and trial level environmental data can help us make better decisions about our pipeline
- Technology is available to more easily capture better site level and trial level data
- Where do we go from here?

Questions for discussion:

1. *What types of environmental data need to be collected at the site or trial level?*
2. *What types of trials require site level or trial level environmental data?*
3. *Are there other challenges with environmental data collection that were not covered?*
4. *Are there other technologies that could improve our environmental data collection? (i.e. Bluetooth, low frequencies radio waves)*
5. *Do we see value in the soil moisture and temperature probes and how can we improve?*

Environmental Variables Important for CP Trialing – Collected over the course of the trial

Envir. Factor	Collection level
Air temperature	
Rainfall/Irrigation	
Soil Moisture	
Soil Temperature	
Leaf Wetness	
Relative humidity	
???	
???	

1) Regional level

(50 to 100miles from the trial)

2) Site level

3) Trial level