Microsoft

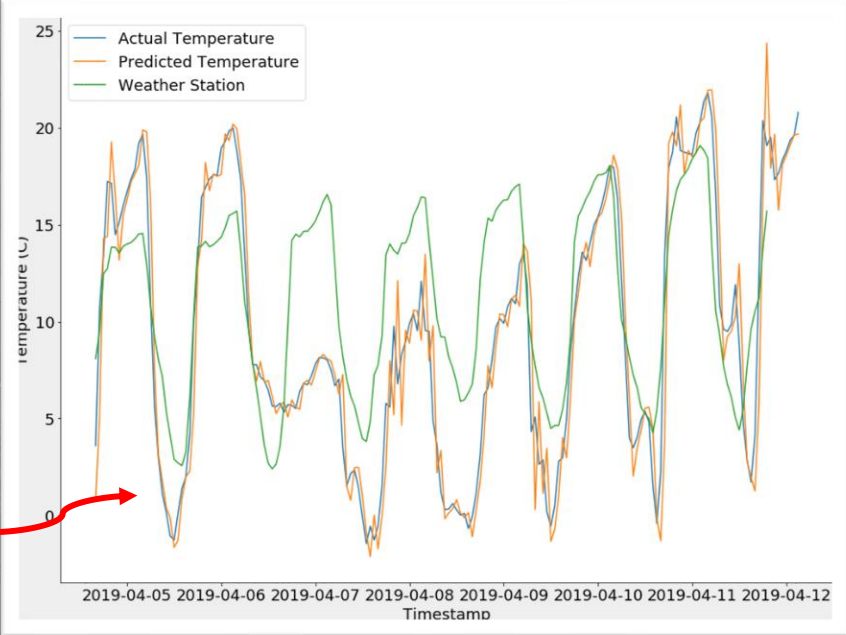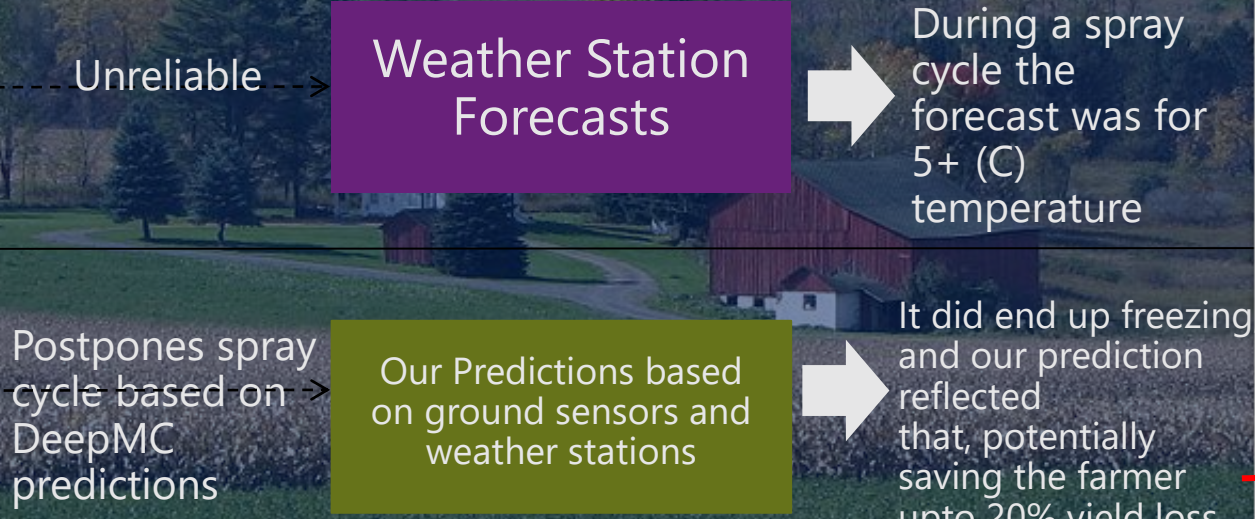# Sustainable Agricutlure - Augmenting Farmer Knowledge with AI

Peeyush Kumar *
Andrew Nelson
Zerina Kapetanovic
Ranveer Chandra

A Farm Scenario

A specific case – Micro Climate Prediction for Nelson Farm

Herbicide Spraying In Spring

20% crop loss during freeze

No standard tool to get local temperature predictions

- - Unreliable - →

Weather Station Forecasts

During a spray cycle the forecast was for 5+ (C) temperature

Postpones spray cycle based on DeepMC predictions →

Our Predictions based on ground sensors and weather stations

It did end up freezing and our prediction reflected that, potentially saving the farmer upto 20% yield loss

Freeze Prediction

Data-driven agriculture

Precision agriculture has shown to:

Improves yield

Reduces cost

Ensures sustainability

NITROGEN
19ppm

Recommendation:
25ppm

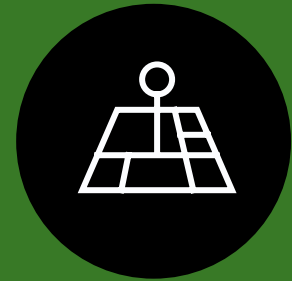# There are 4 problem areas hindering adoption

No connectivity
in fields

Reliability and
Replicability

Accuracy
of Predictions

Technology
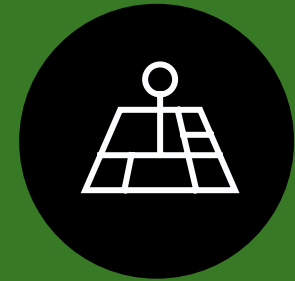Knowledge Gap

How we solve for them?

FarmBeats –
TV Whitespaces

Data fusion

State-of-the-art
Deep Learning
Achieving ~95%
accuracy

Operational
Sustainability

Micro-Climate Prediction Framework

Soil Moisture

Soil Temperature

Framework:
Microclimate weather forecasts based on sensors in the field and weather station forecasts

Impact:
Knowing microclimate enables better modeling of plant diseases, planning farm operations, imcreasing crop yield, etc.
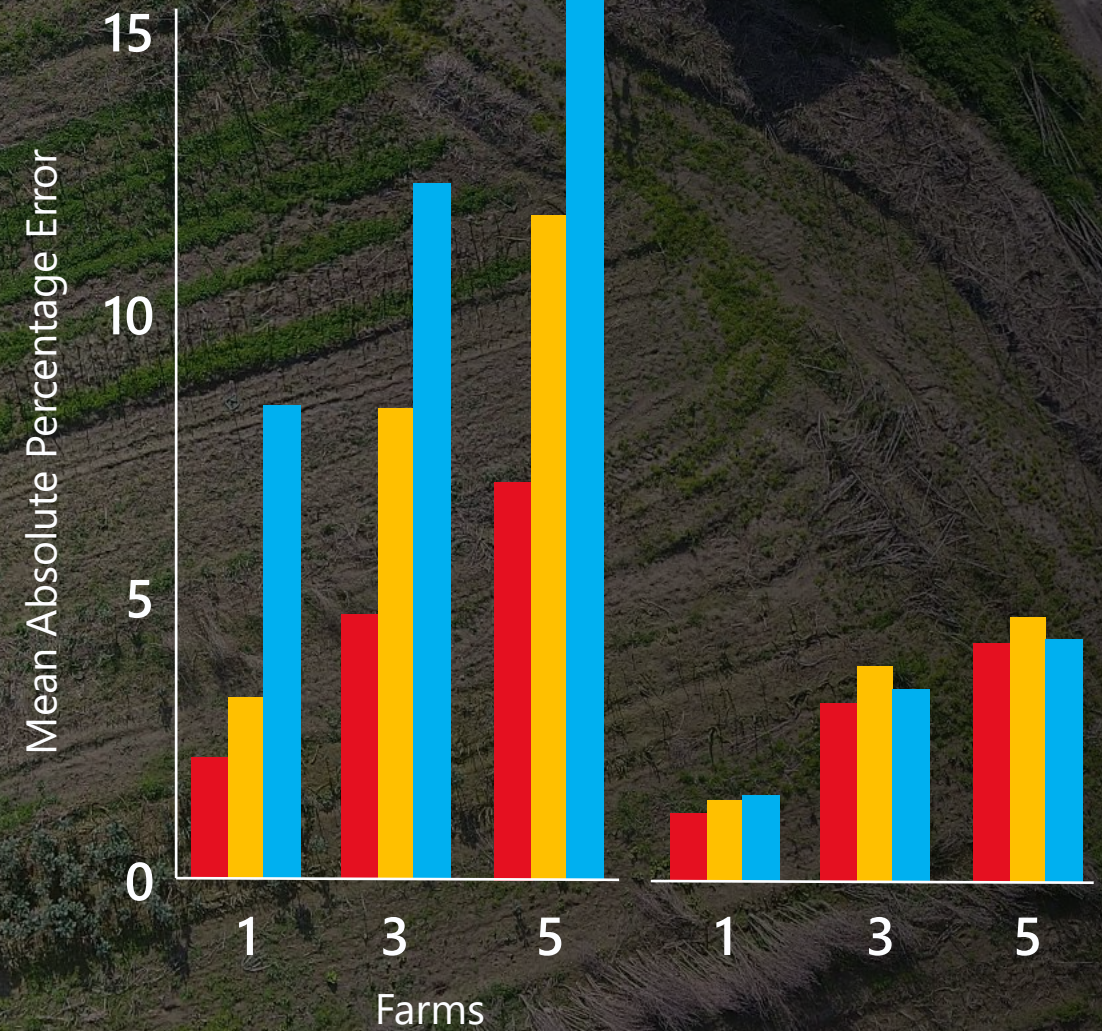
Problem Addressed:
Weather station forecasts are not accurate and reliable for many farm operations
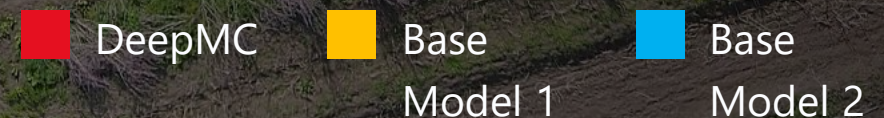
Results:
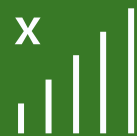Accurate forecasting results with average accuracy of more than 95%.

*The **lower the error,** the better the prediction.

Mean Absolute Percentage Error

Farms

DeepMC

Base Model 1

Base Model 2

System that enables seamless data collection and connectivity solution for agriculture

FarmBeats

Deployment

Deployments in several locations

Farm sizes range from 0.5 – 9000 acres

Sensors:

- FarmBeats sensor boxes with soil moisture, temperature, wind speed/direction sensors, etc.
- DJI Drones
- IP Cameras to capture IR imagery as well as monitoring

Cloud Components

Connectivity - TV Whitespaces

Scenario 1 - Spraying Herbicide: Micro-temperature predictions

- Nelson Farm in Palouse region of eastern Washington State

- Grows wheat, lentils, peas, garbanzo beans, and canola.

- Weather station forecasts are less accurate due to hilly terrain

- Farmer consults DeepMC for temperature predictions for specific locations to plan logistics and operations for spraying herbicide
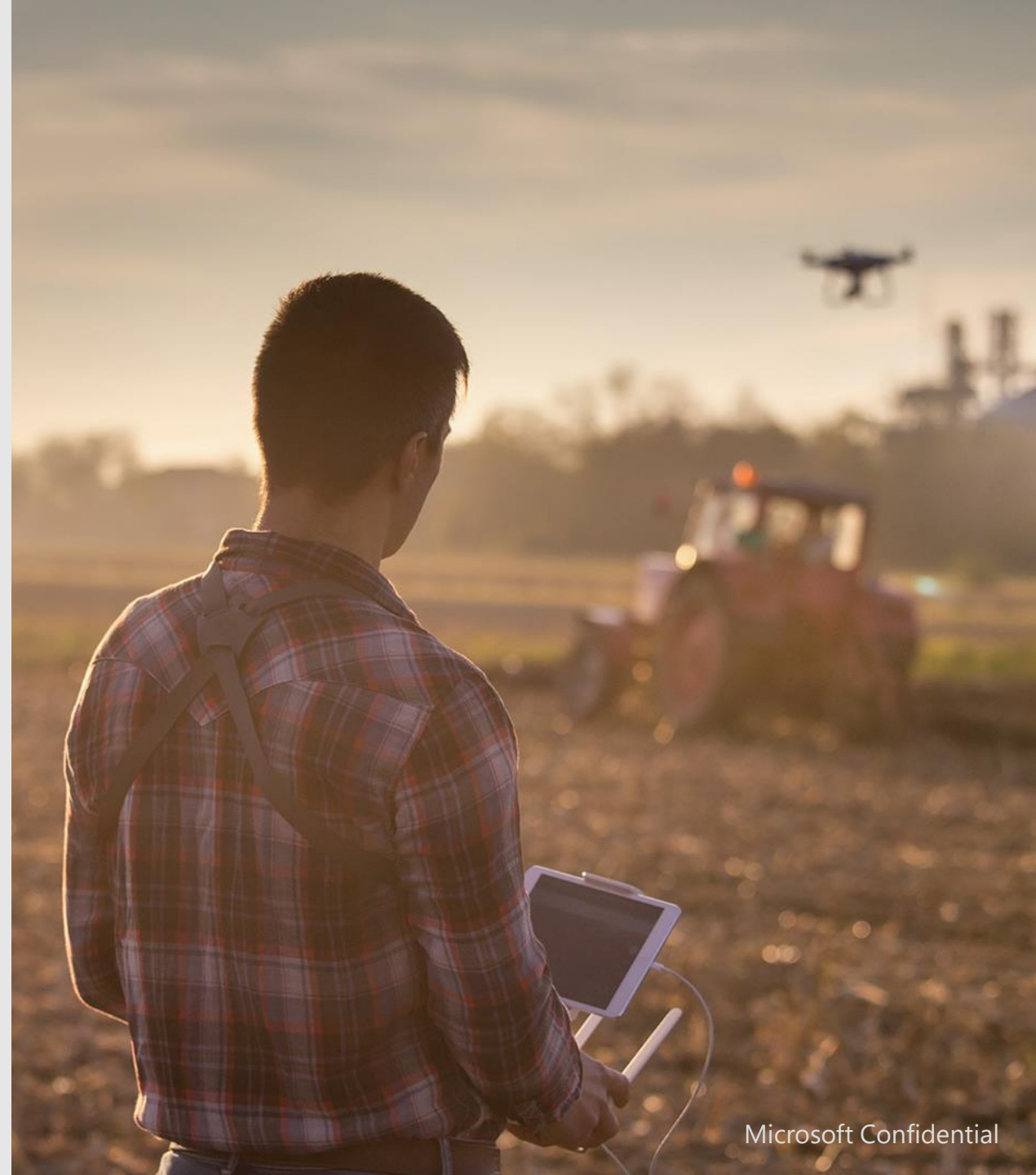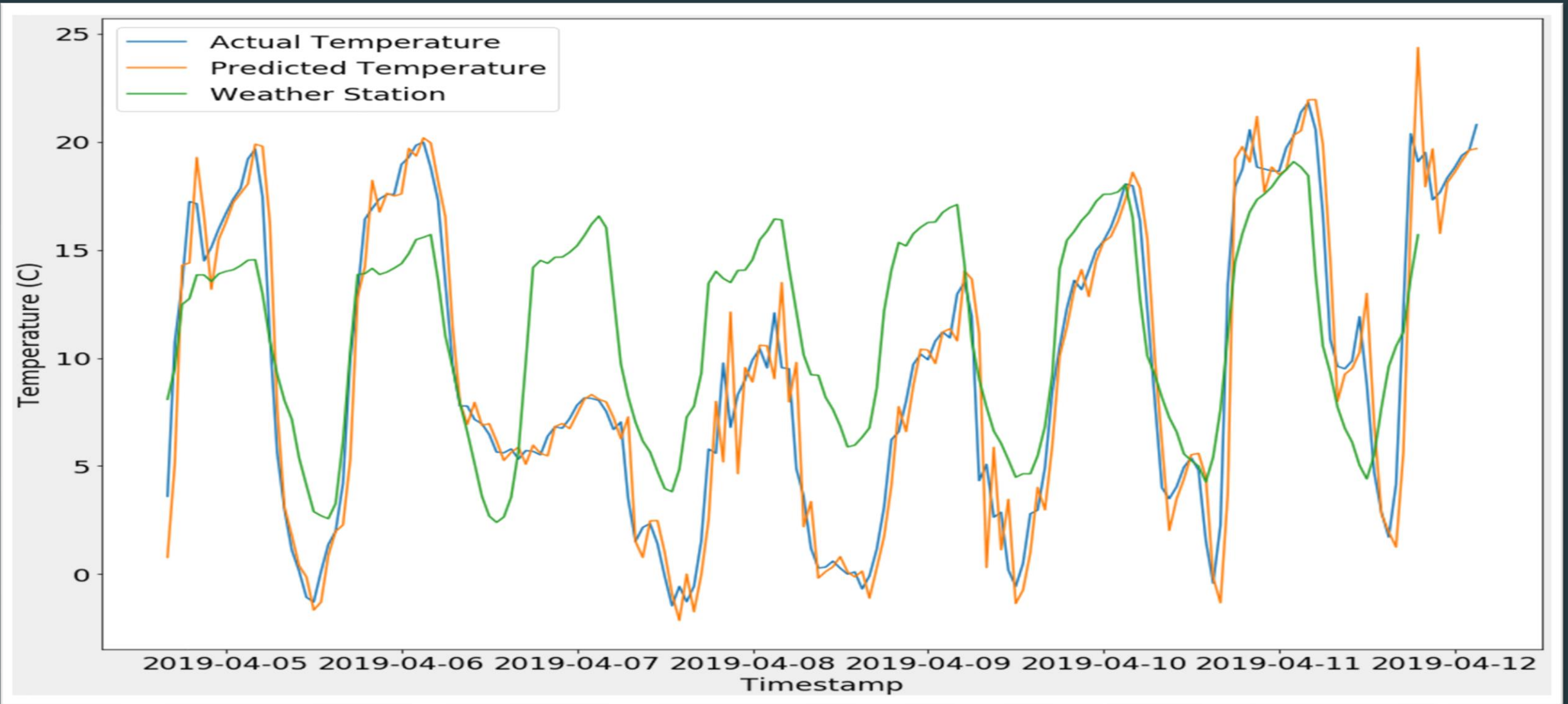
FarmBeats Deployment

A TVWS deployment on Nelson farm

FarmBeats sensors on Nelson farm
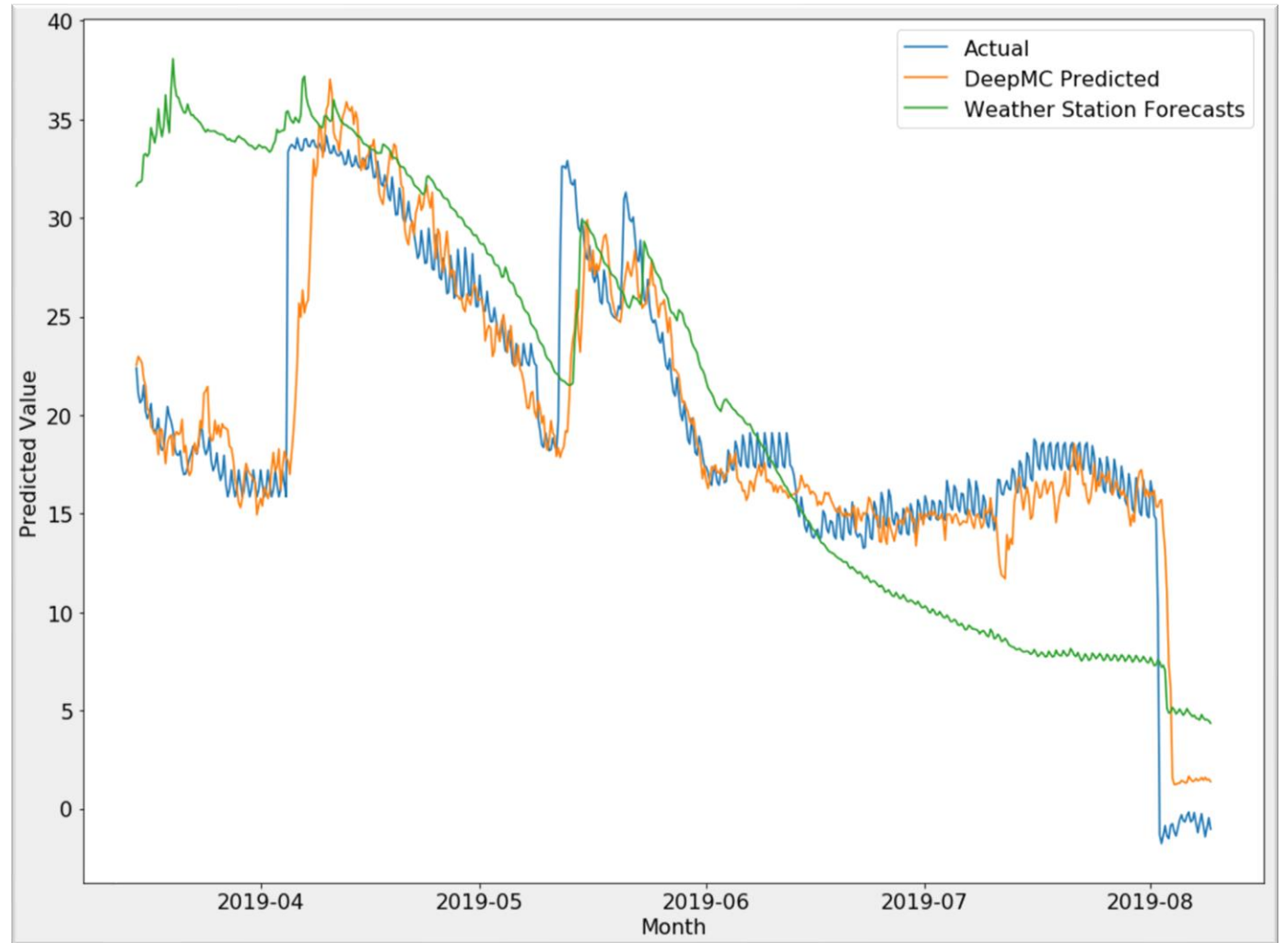
Micro-temperature Forecast

Scenario 2 - Phenotyping Research: Micro Soil-Moisture Predictions

- The producer is experimenting with different growing techniques for vine tomatoes

- Susceptible to rot with high soil-moisture values w/o trellises

- The producer uses DeepMC for advisory on micro-soil-moisture conditions.

Micro-Soil Moisture Predictions

Scenario 3 - Greenhouse control: Micro-humidity predictions

- The producer is storing garbanzo beans inside a grain tank

- Uses fans to pull air from outside, regulating temperatures inside

- The fan control depends on immediate humidity levels in the air outside.

- The producer uses DeepMC for advisory on micro-humidity conditions.

Sustainability and Promoting Intake – Precision Agriculture

Research

IoT, Cloud, Satellite, AI
Indoor Farming
Simulations

Environmental

Less Chemical Application
Better Monitoring
Water Management

Operational

Partnership Driven Model
Cost Factor
Training: Student Kits (Future Farmers of America)

Impact – Testimonials

The ability to quickly apply the results that AI models produce is a great advantage....

Farmers are already working during all available sunlight, any time savings allows the farmer more time to tend to their crops which usually allows for higher yield potential ...

It has allowed for larger scale testing of different farming techniques that have improved farming practices in terms of profitability, sustainability, and sometimes both.