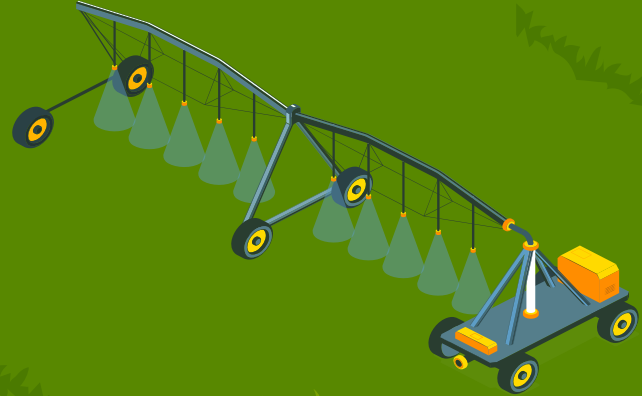


SoilVantage

Leveraging Earth Observation
Data for Informed Agricultural
Decision-Making

The Crop Dusters - Abtin Turing, JC Abanto,
Reid Playter, Aistis Meiklejohn, Daniel Saleh



Farming Should Be For Everyone

Unfortunately, there are certain barriers to starting and succeeding in farming.



Costly High-Tech Tools

Farming already involves significant upfront costs, and to maximize a farm's chances of success, there may be additional expenses for high-tech tools



Learning Curve

Most farmers inherit knowledge passed down for generations, so starting from scratch means there is a great deal to learn



Lack of Control

Even with the right knowledge, certain factors on a farm, like soil moisture levels, remain difficult to fully control, track, and predict

Why Is It Important to Control and Track Soil Moisture Levels?



Wilting Point

Plants can no longer extract water from the soil



~0-20%



Field Capacity

The upper limit before saturation



~20-80%

*depends on crop



Saturation Point

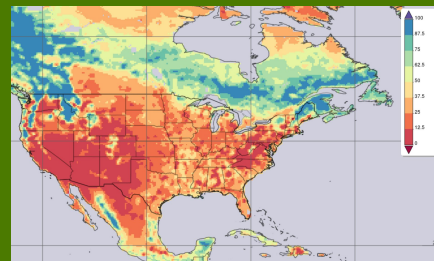
Can cause root rot and poor aeration



~80-100%

So We Made SoilVantage!

A machine learning model that gives every farmer the advantage of predicting the volumetric soil moisture percentage of their land.



Data Source	NASA's "Giovanni" which contains global daily volumetric soil moisture levels (%) (see above image)
Cleaned Data	1.5 million data points from North America spanning from October 2021 to present day
Explanatory Variables	Include longitude, latitude, and month to estimate volumetric soil moisture % for a specific area
Model	For spatial patterns to be recognized, we decided to use a random forest regression
Testing & Validation	Using grid search and 5-fold cross validation on our test set to tune our hyperparameters, we were able to attain a reasonable mean squared error and an R-squared value of 0.91
Accuracy	The model achieved an accuracy rate of 85% given a 7% soil moisture threshold

Soil Moisture Estimator

October



3359 Mississauga Rd, Mississauga, ON L5L 1C6, Canada

Estimate

The soil moisture estimate in the selected area is **51%**.



SoilVantage

The Crop Dusters

Irrigation Methods

Please Select Your Soil Type:



Sandy Soil

Large particles and pore spaces
Drains quickly
Can't retain moisture for long periods

Pros

- Warms up quickly in the spring
- Easy to cultivate and work with

Cons

- Dries out quickly
- Low nutrient retention



Silt Soil

Small particles
Stable moisture levels
Smooth texture

Pros

- Retains moisture longer than sandy soil
- Fairly fertile

Cons

- Prone to erosion when exposed to wind or rain
- May compact easily



Clay Soil

Tiny, tightly packed particles
Retains water the best
Poor drainage, leading to slow drying

Pros

- Needs less frequent watering
- High nutrient retention due to fine particles

Cons

- Can get waterlogged
- Hard to work with when wet or dry



Loam Soil

Balanced mix of sand, silt, and clay
Good drainage while retaining moisture
High fertility

Pros

- Ideal for most crops
- Retains nutrients well
- Easy to cultivate

Cons

- May need periodic irrigation adjustments depending on the sand, silt, and clay balance

Recommended irrigation methods for silt soil:

Recommended irrigation methods for sandy soil:

Drip Irrigation

The most suitable method for frequent, light irrigation. It delivers a slow and steady flow of water directly to the root zone, reducing water loss through evaporation or runoff. This allows the soil to absorb small amounts consistently, maintaining the desired moisture levels



Sprinkler Irrigation (With small amounts at frequent intervals)

If drip irrigation is not feasible, sprinklers can be adjusted to release water in short, frequent cycles. This method mimics light rainfall and can cover larger areas, though it is less precise compared to drip irrigation.

The Impact of SoilVantage

With farming easier than ever, we hope more small farms will start up and bring positive change



Promotes Healthier Eating

Increased access to locally grown, fresh produce can promote healthier eating habits within communities



Supports Environmental Sustainability

Locally produced plant-based foods reduce the supply chain length and are grown more sustainably



Improves Biodiversity and Soil Health

Diverse crops strengthen food systems by reducing risks from pests and climate change

How Far Could SoilVantage Go?

Further improvements could include:

- Training model on real-time/recent data to recognize climate change
- Curated suggestions based on specific crop and soil type
- A social feature for receiving/sharing help
- Other predictive features, such as precipitation or sunlight

The model may even be useful in areas beyond agriculture, such as:

- Predicting droughts and floods
- Conservation of wetlands
- Effective urban planning

