

# Emerging Agricultural Technologies

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# Gamma Ray Spectrometry (Radiometrics)



Credit: F.M. van Egmond et al., (2010)

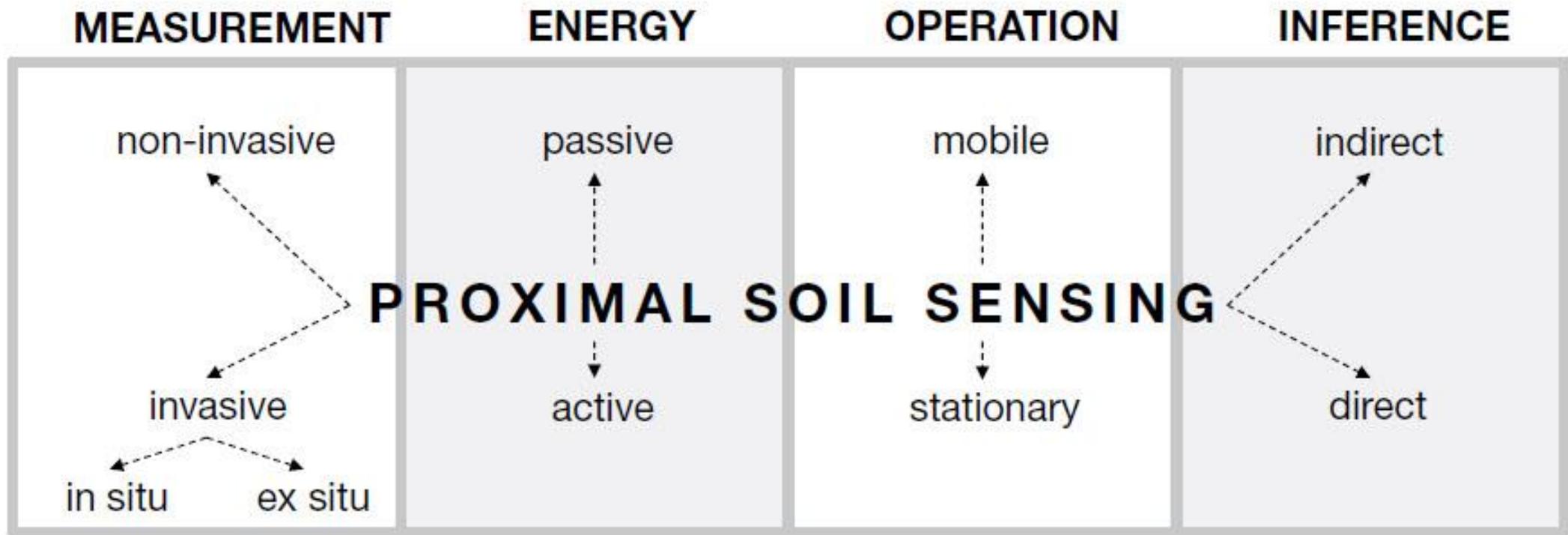
# Proximal Soil Sensors (PSS)



Credit: Paolo Storchi et al., (2015)

Proximal Soil Sensing can which is defined as a field based method of measurement that occurs 2 m or less above the soil surface.

(V.I. Adamchuk and R.A. Viscarra Rossel (2011))



Source: Viscarra Rossel *et al.*, 2011.

# Gamma Ray Spectrometer

## RS-700 Radiation Solutions (Gamma Ray Spectrometer)

- Non-invasive
- Active
- Mobile
- Indirect

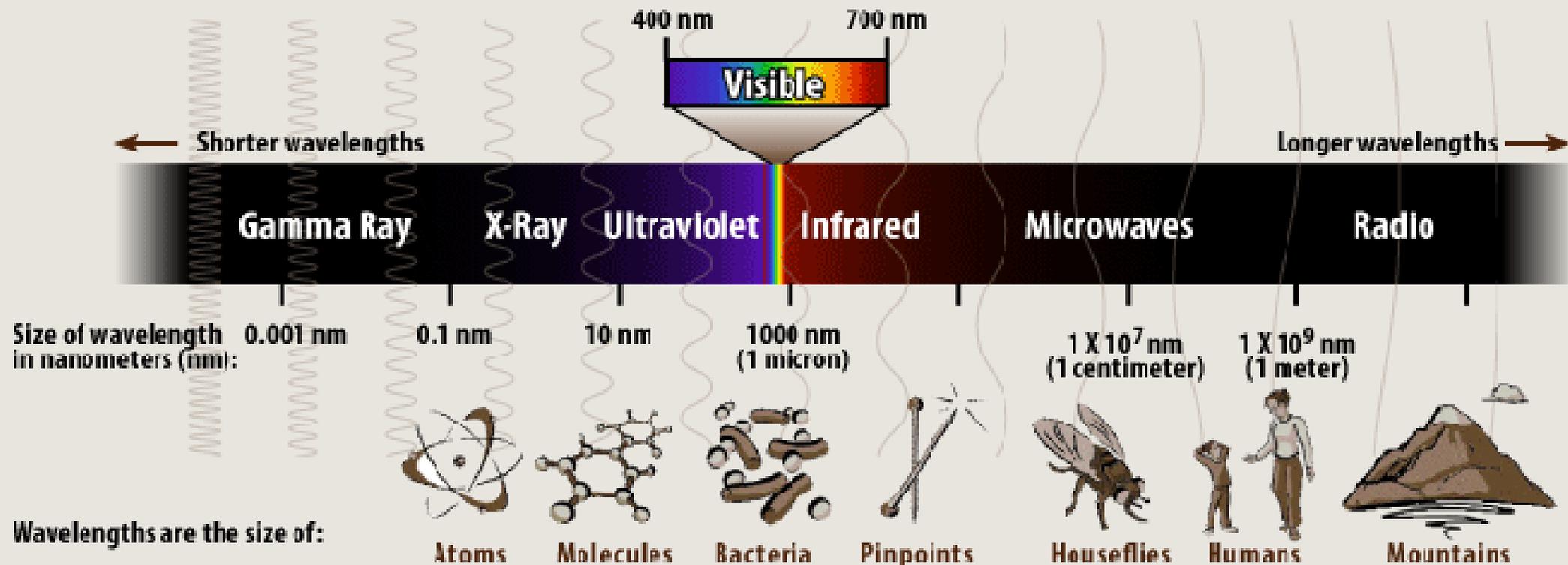


Source: Radiation Solutions Inc.

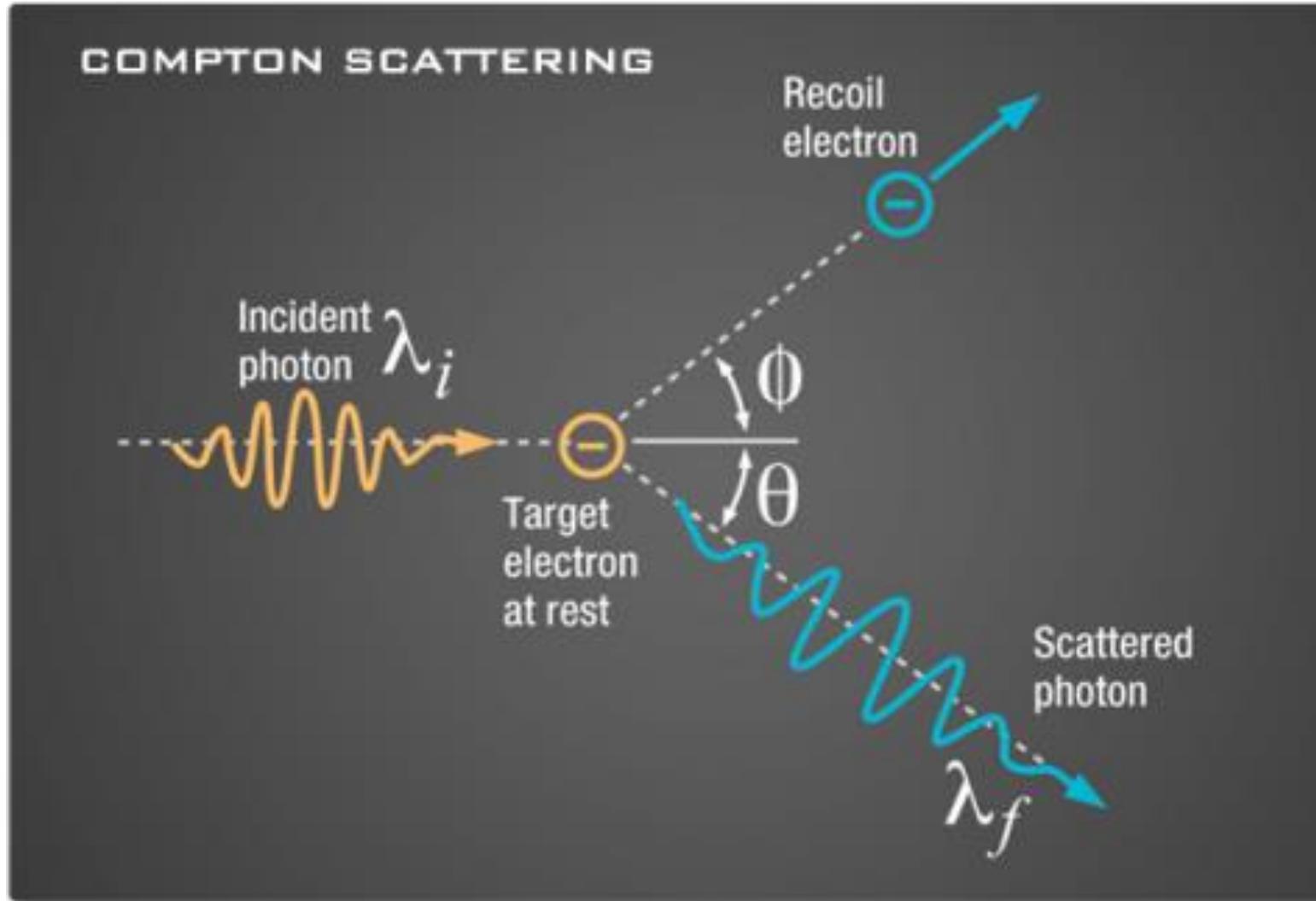
# How does it work?

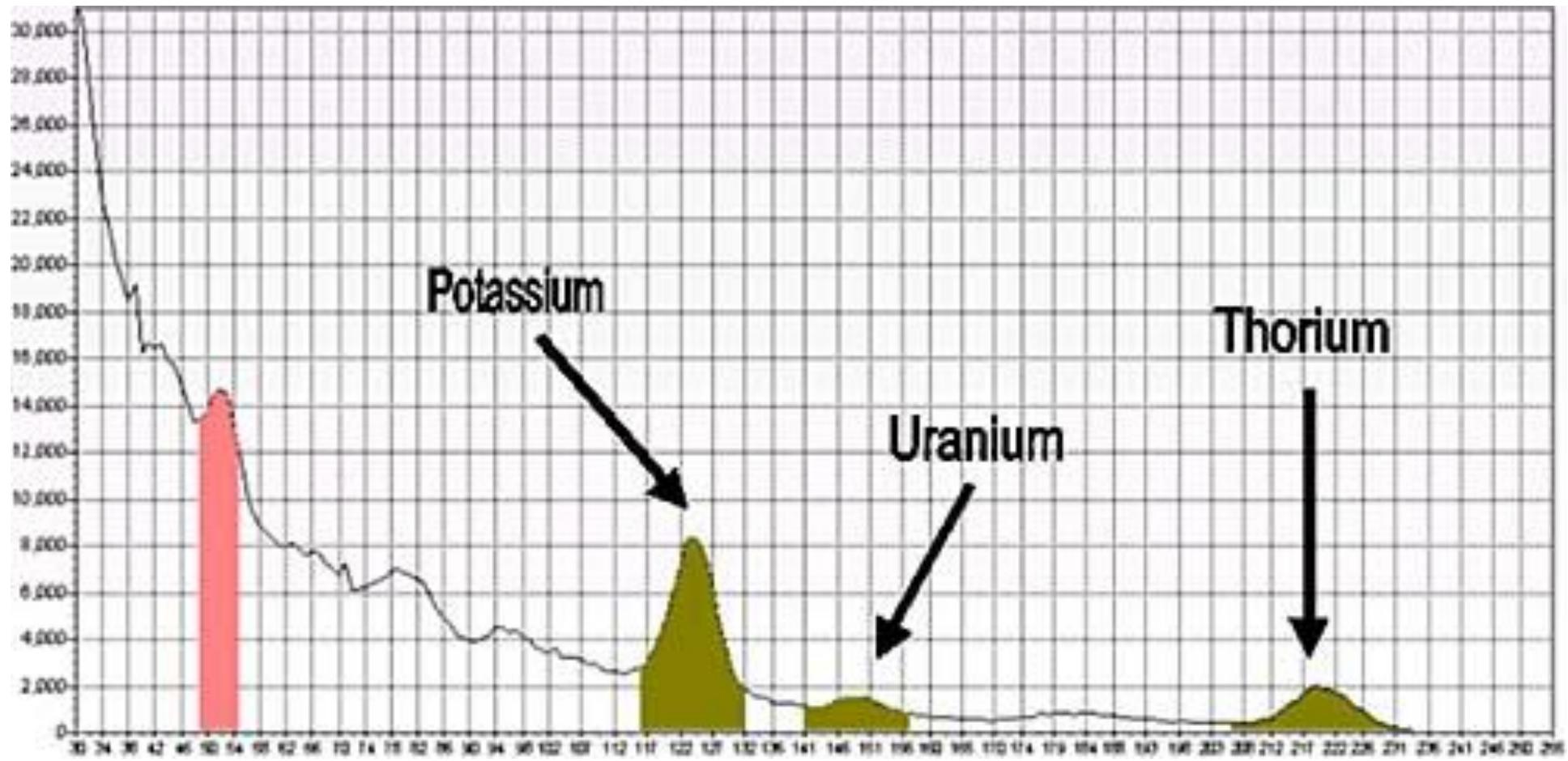
## The Electromagnetic Spectrum

The electromagnetic spectrum is made up of light of many different wavelengths. Most wavelengths are invisible to us. In fact, our eyes can only detect the small portion of the spectrum between 400 and 700 nanometers. We call these wavelengths "visible light."



# How does it work?

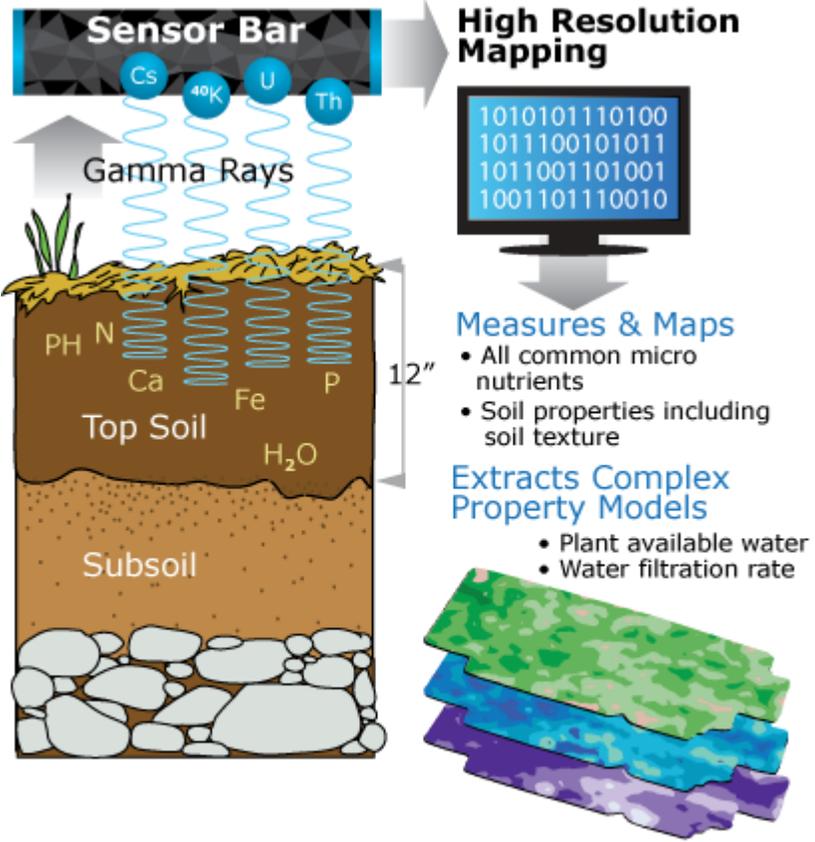




Source: Agriculture Victoria

Soil property	EM SPECTRUM							
		$\gamma$ -rays	X-ray	DRS	Microwave / Radar	Acoustic / Radio	EMI	Electro-chemical
carbon			GOOD				SOME	
nutrients		OK	SOME				SOME	GOOD
elements	GOOD	GOOD	some					
pH			OK					GOOD
CEC			GOOD					
salinity/sodicity							GOOD	OK
water	GOOD		GOOD	GOOD	OK		SOME	
bulk density	GOOD		SOME	SOME	SOME			OK
strength/compaction				SOME	OK			OK
clay, silt, sand	OK		GOOD			SOME	OK	
colour			GOOD					
soil depth				GOOD	SOME			+
mineralogy	OK	GOOD	GOOD					

# SOILOPTIX® High Definition Top Soil Mapping



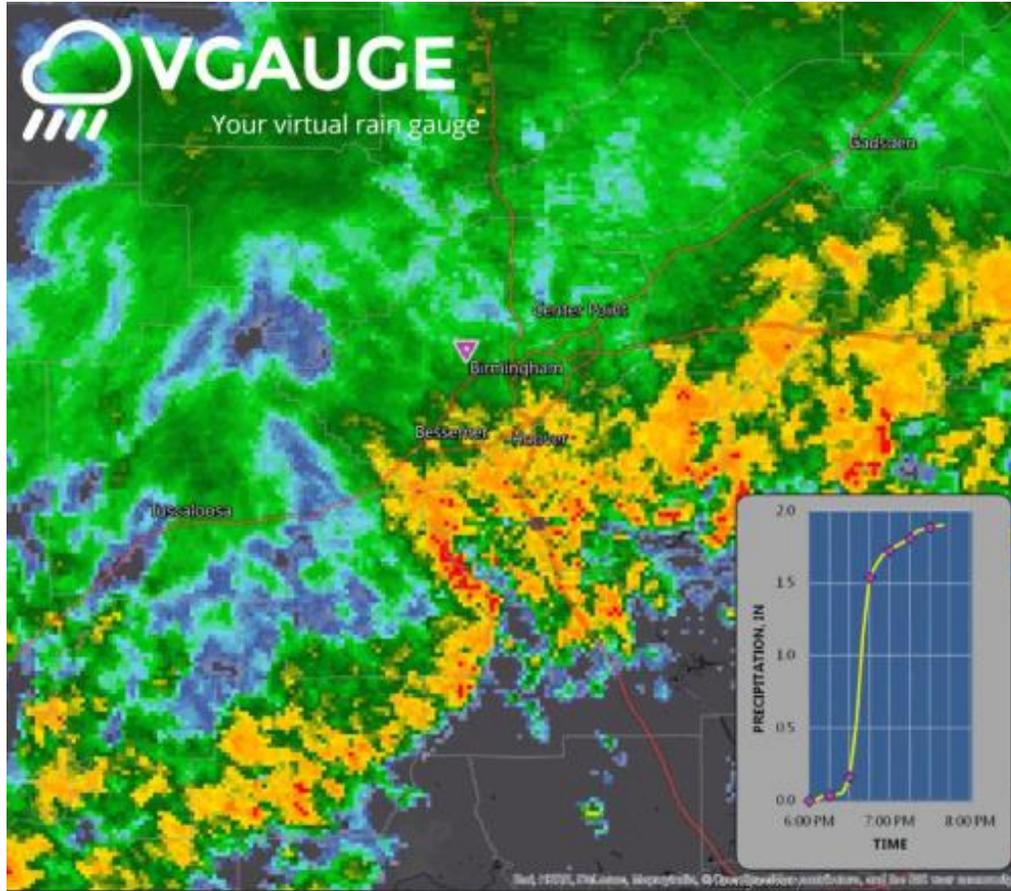
Layers developed to date...

Category	Property	Value/Unit
<b>Texture</b>	Clay	Sand
	Loam	Silt
<b>Macro Nutrients</b>	Calcium	pH
	Calcium Base Saturation	Phosphorus - Bicarb
	Calcium-Magnesium Ratio	Phosphorus - Bray
	Cation Exchange Capacity	Potassium
	Magnesium	Potassium Base Saturation
	Magnesium Base Saturation	Potassium Magnesium Ratio
	Organic Matter	
<b>Micro Nutrients</b>	Aluminum	Nitrate as N
	Boron	Sodium
	Copper	Sulfur
	Iron	Zinc
	Manganese	
<b>Complex Models</b>	Bulk Density	Plant Available Water
	Hydraulic Conductivity	
		Elevation

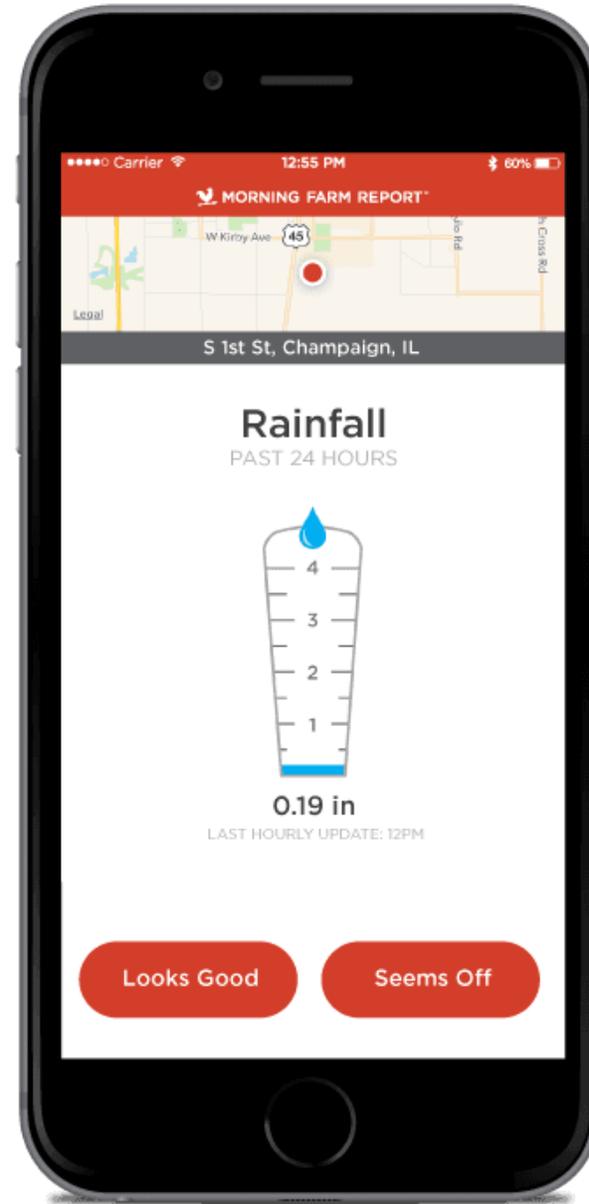
**Maximize Seeding & Input Performance**  
 335 pts/acre compared to standard 1-2 pts/acre

Source: SoilOptix

# Virtual Rain Gauges

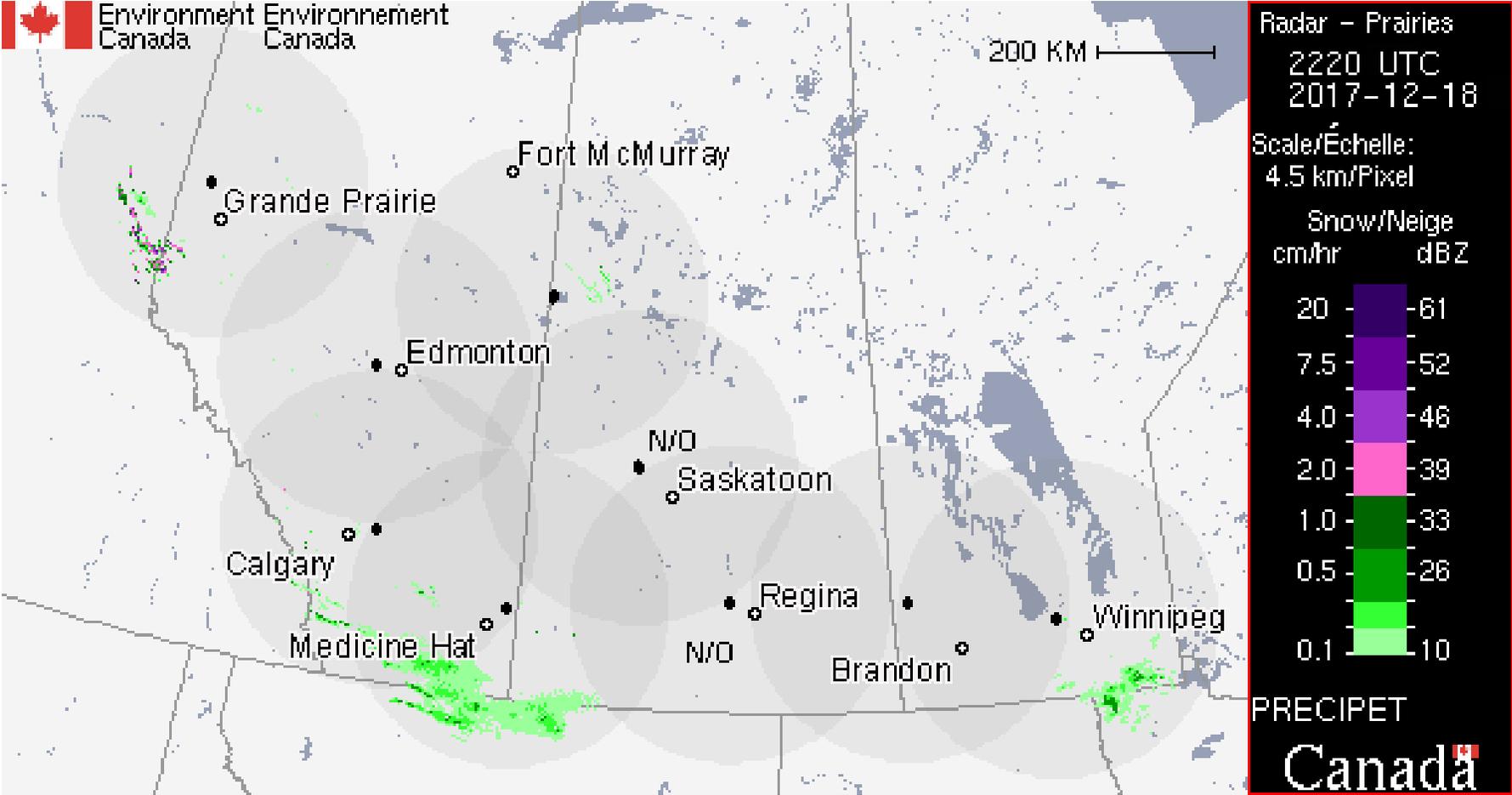


Source: Schoel Consulting Engineers



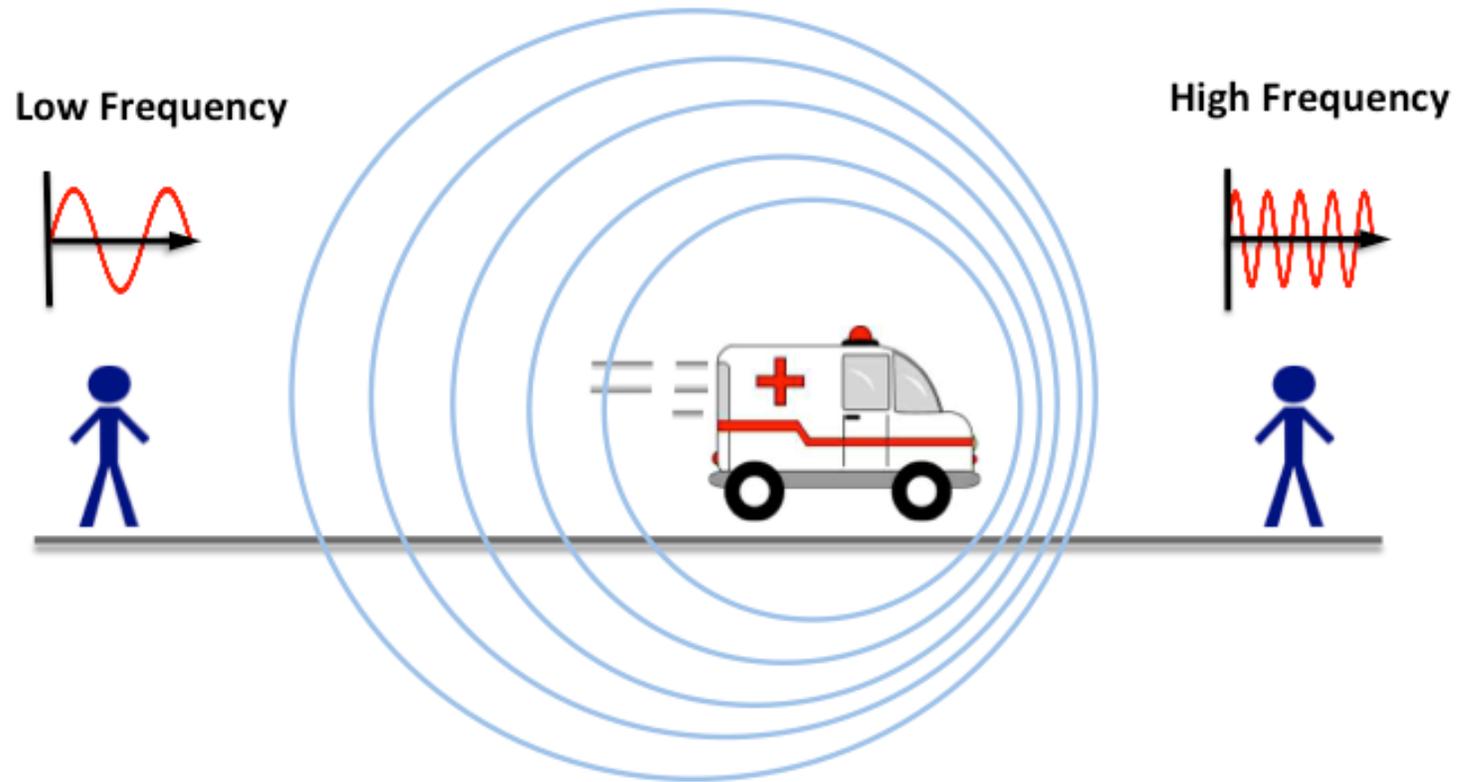
Source: Agribble

# Current Doppler Radar Locations in Western Canada



Source: Government of Canada - Weather

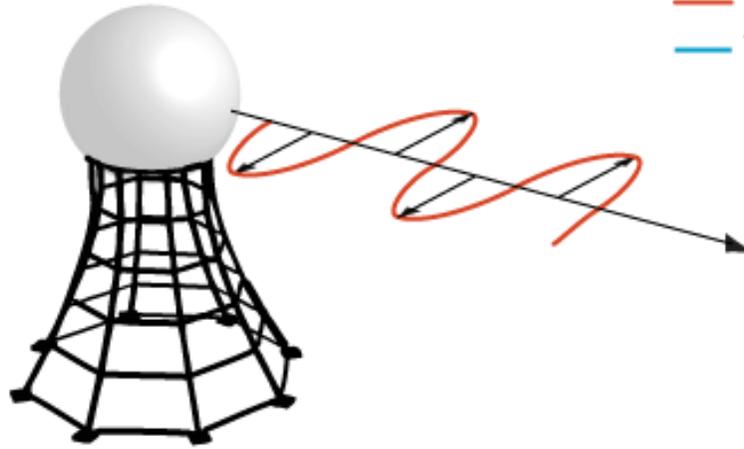
# Doppler Effect



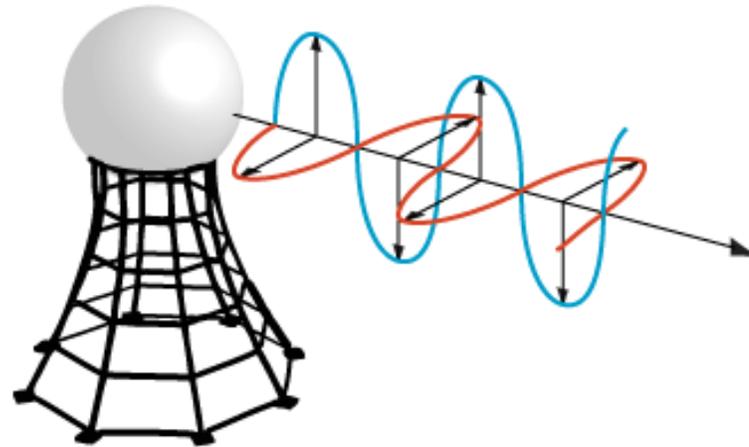
# Dual Polarization Radar

## KEY

- Horizontal electric field wave
- Vertical electric field wave



Current radars (non-polarization)



New dual-pol radars (polarization)



(Photo courtesy of Environment and Climate Change Canada)

## DOPPLER RADAR

120 km coverage range

Horizontal pulse of energy creates one-dimensional images

Unable to distinguish between different types of precipitation

Can detect rotation in the atmosphere to better help infer when tornadoes may be forming

## SELEX ES RADAR

240 km coverage range

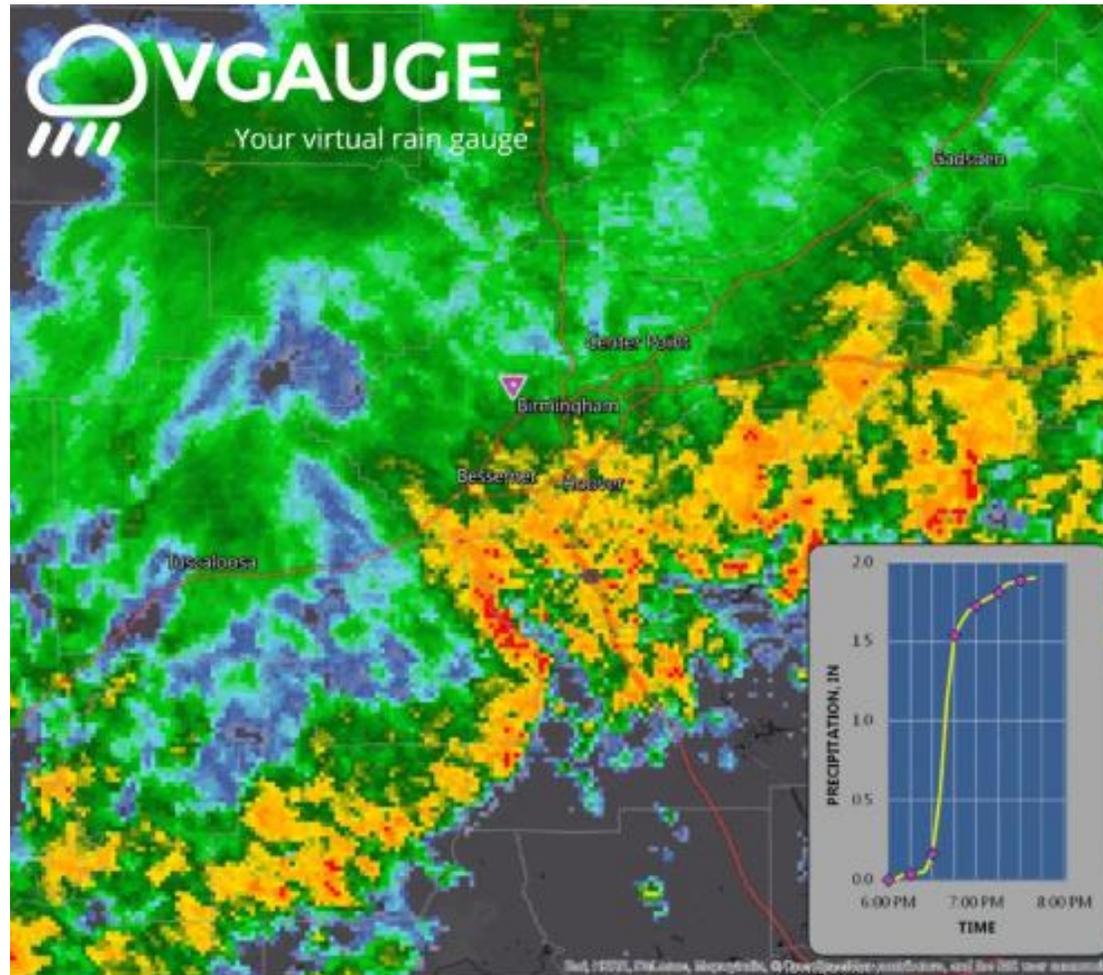
Two-fold energy pulse sends and receives horizontal and vertical pulses of energy which create two-dimensional images

Extended range will help monitor neighbouring areas in case the case of outages

Better track incoming extreme weather in advance



[Photo courtesy of Leonardo S.p.A]





- **Maintenance**

Maintenance free – it's all on your phone.

- **Alerts**

Custom notifications – set alerts to be sent to your phone if a predetermined rainfall exceeds desired amount.

- **Radar Based Rainfall**

Radar (Dual-pol) based information.

- **Forecast**

VGauge can be your on-site weatherman, providing alerts if the forecast rainfall triggers a custom notification

- **Reporting**

Precipitation reports are provided following a rainfall event. Monthly reports are also provided that include the daily precipitation totals for the month.



# VGauge

Your virtual rain gauge

## SERVICE SETUP AND PAYMENT

Please complete the information in the fields below to setup your VGauge service. If you would like to sign-up multiple sites, please email [vgauge@schoel.com](mailto:vgauge@schoel.com).

AMOUNT

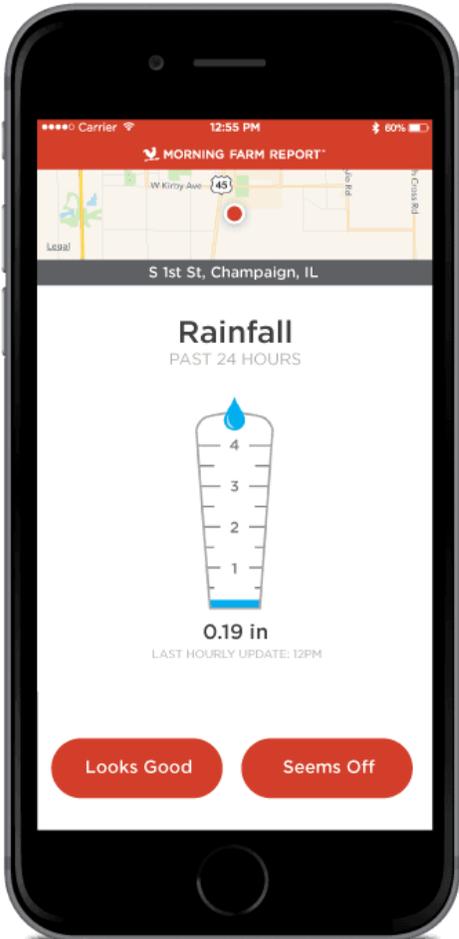
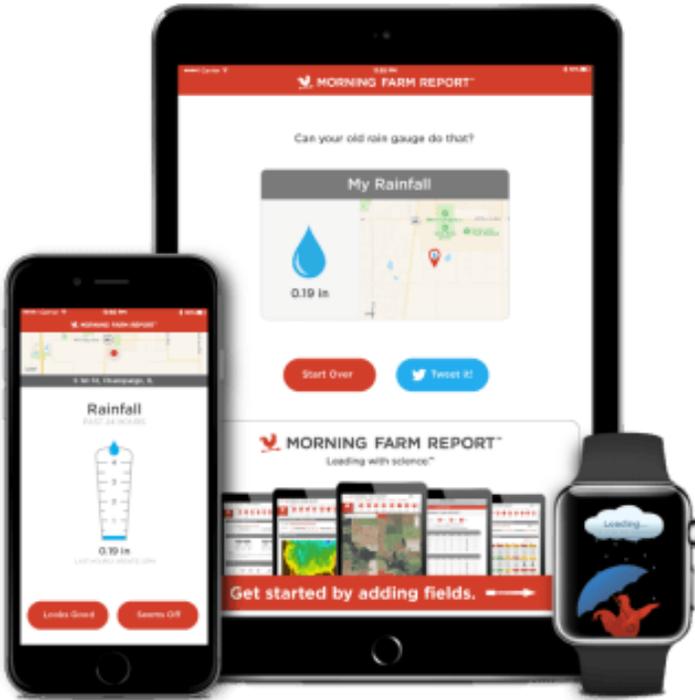
**\$35.00**

Monthly Monitoring Fee

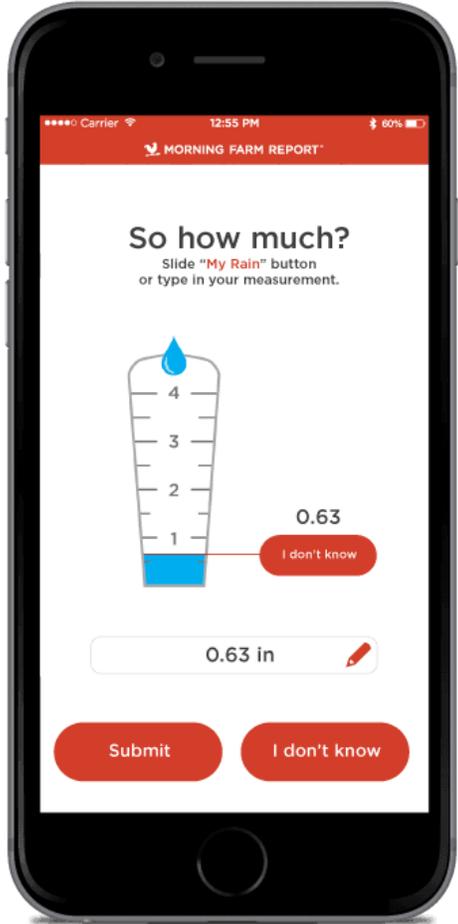
+ \$300.00 at checkout — One-time Setup Fee

🔄 Recurs monthly starting in 7 days

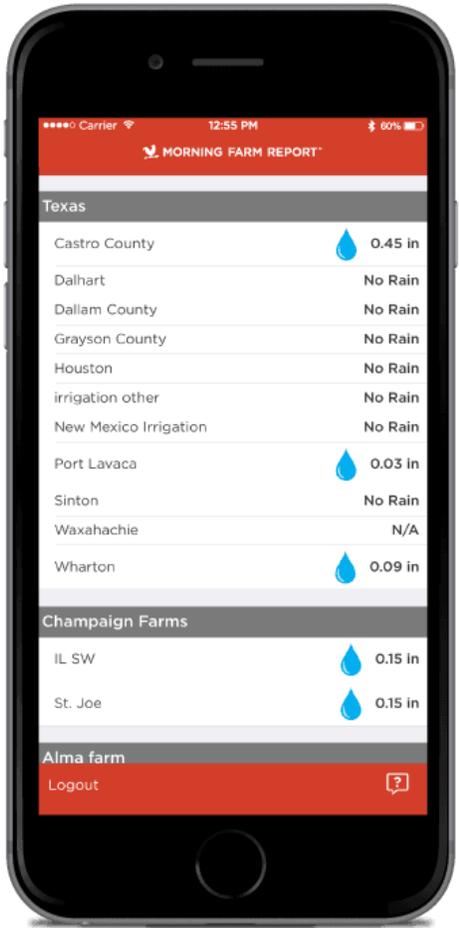
# Pocket Rain Gauge



**Instant Rainfall**  
Find out how much it rained at your location in the last 24 hours. Data are updated every hour and represent the previous 24 hours.

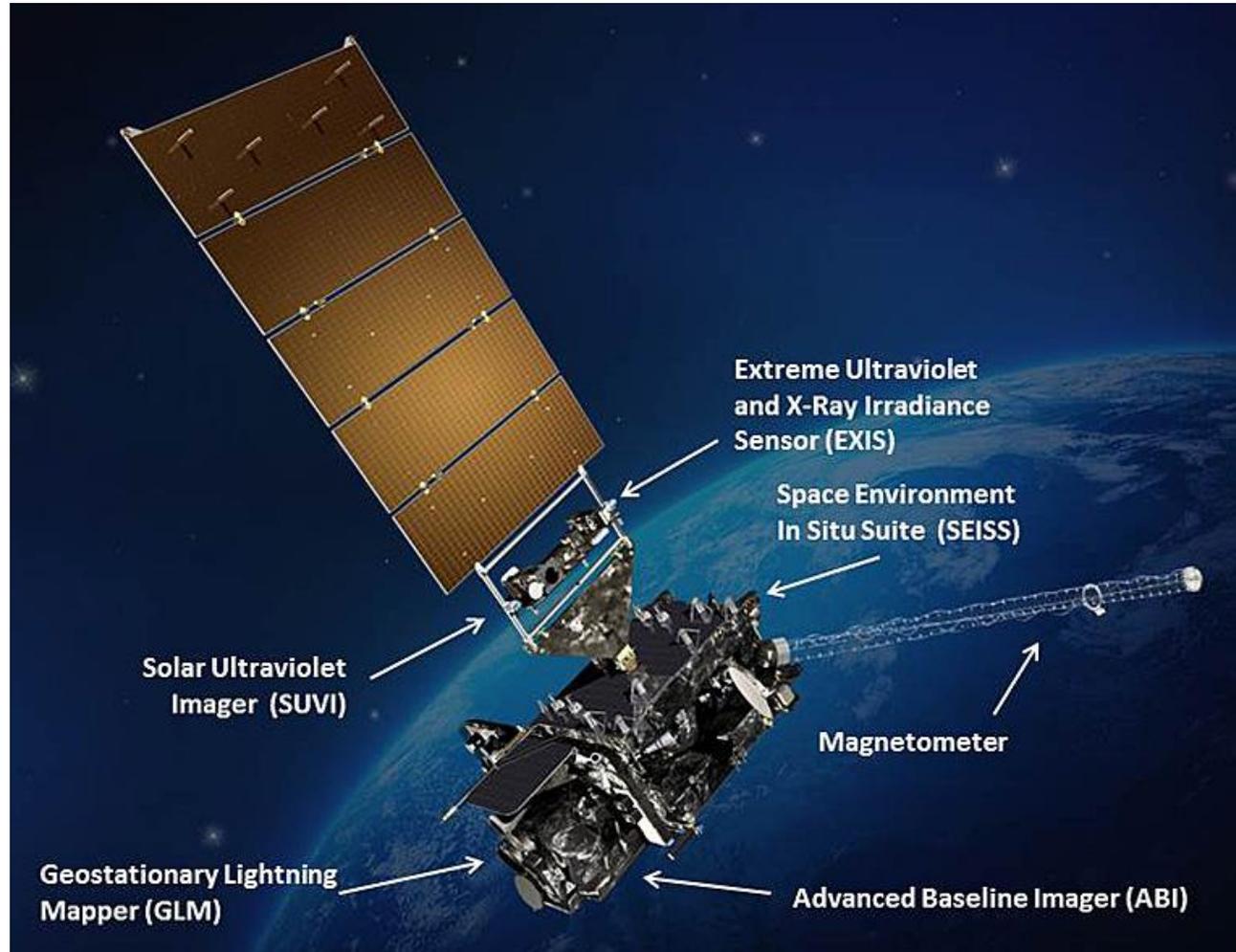


**User Feedback**  
Let us know if we're right, or submit your own measurement if we're off. Feedback helps us improve our results.



**Multiple Locations**  
Check rainfall on every field and anywhere rainfall matters to you. Link **Pocket Rain Gauge™** to your **Morning Farm Report®** account and get started





Source: Both images NOAA

Thank-You