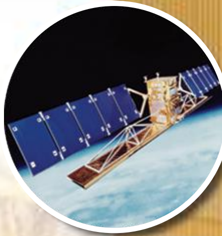
Agriculture and Agri-Food Canada   Agriculture et Agroalimentaire Canada



Real-time In-Situ Soil Monitoring for Agriculture (RISMA)

Canada

RISMA Team (Winnipeg Stations)

1. **Site Characterization, Sensor Installation and Maintenance**

Lead: Jarrett Powers, Nick Lyon, Tom Hansen

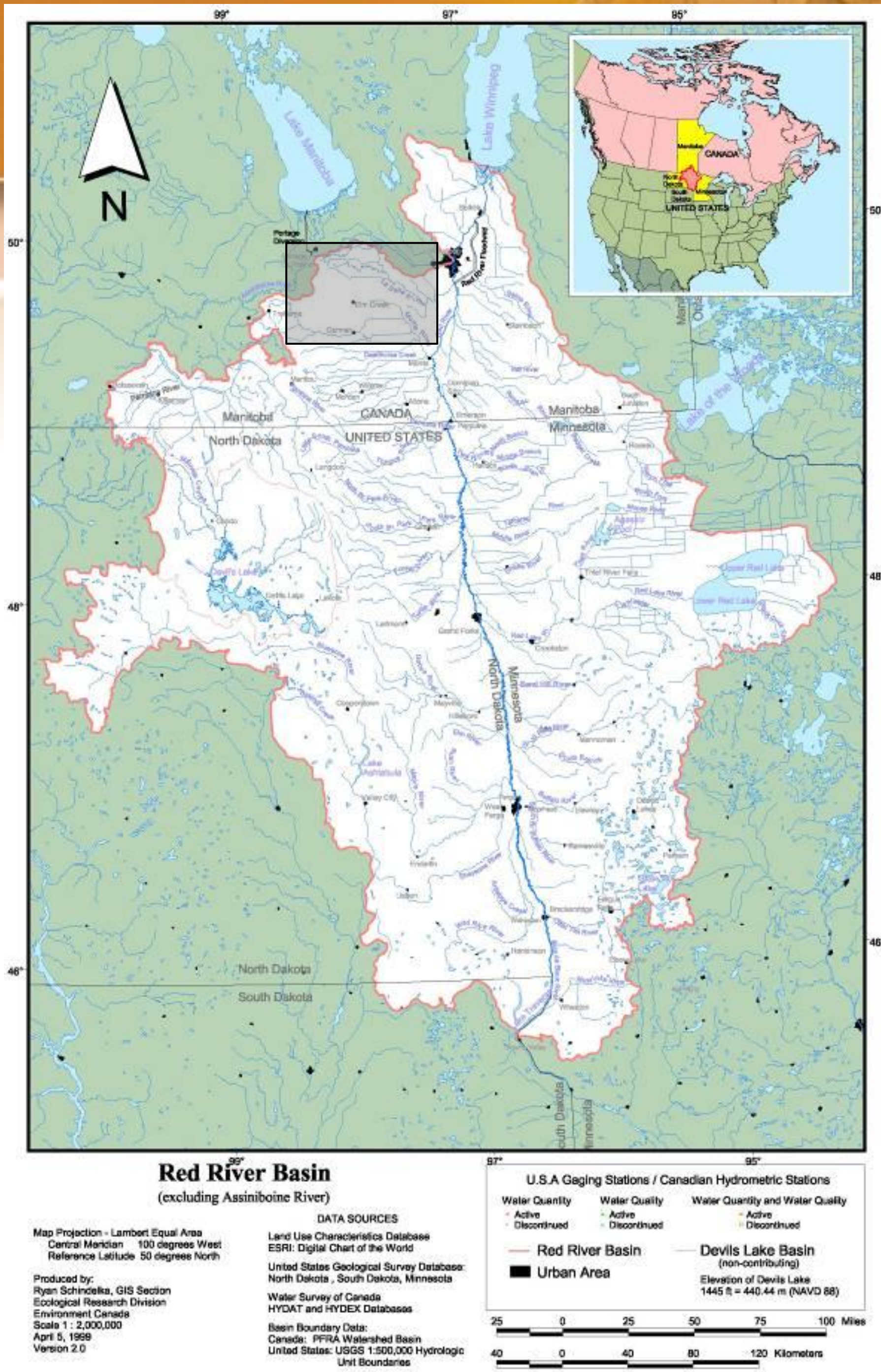
2. **Sensor Calibration**

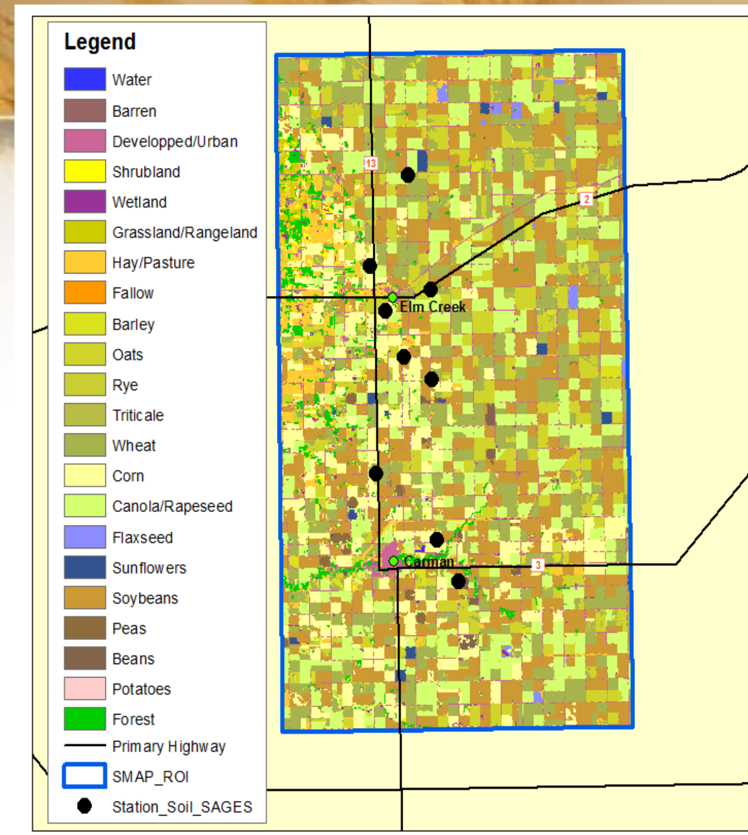
Lead: Jessika L'Heureux and Rotimi Ojo (University of Manitoba)

3. **Near Real Time Data Delivery**

Lead: Jessika L’Heureux, Xiaoyuan Geng, Patrick Rollin, Jarrett Powers, Steve Liang (University of Calgary)

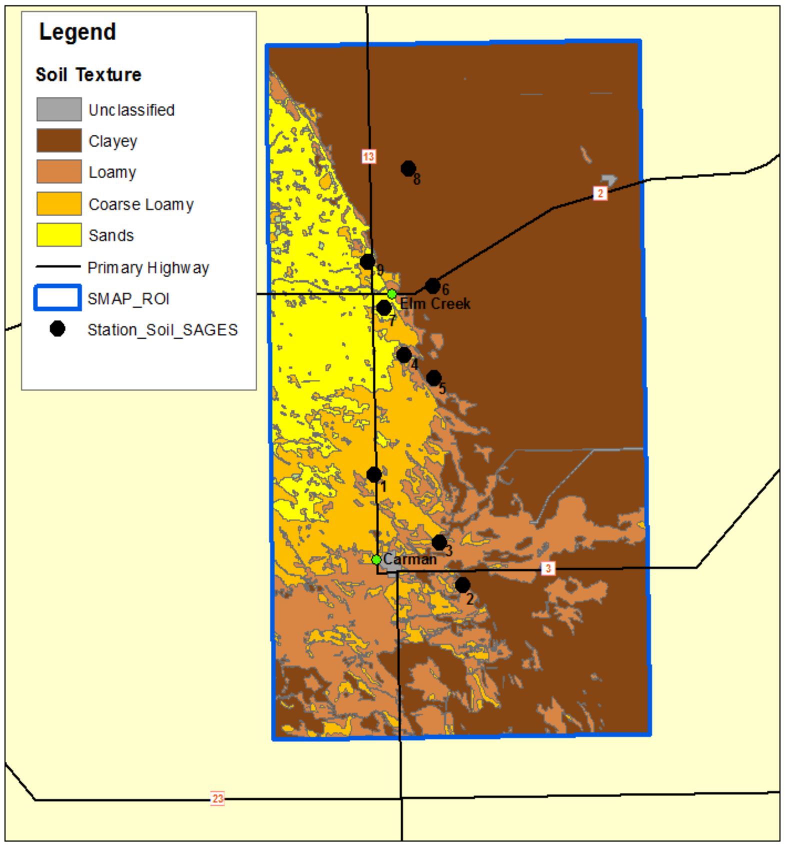
Team: Allan Howard, Heather McNairn, Craig Smith (Environment Canada), Anna Pacheco, Amine Merzouki, Catherine Champagne, Paul Bullock (University of Manitoba), John Fitzmaurice

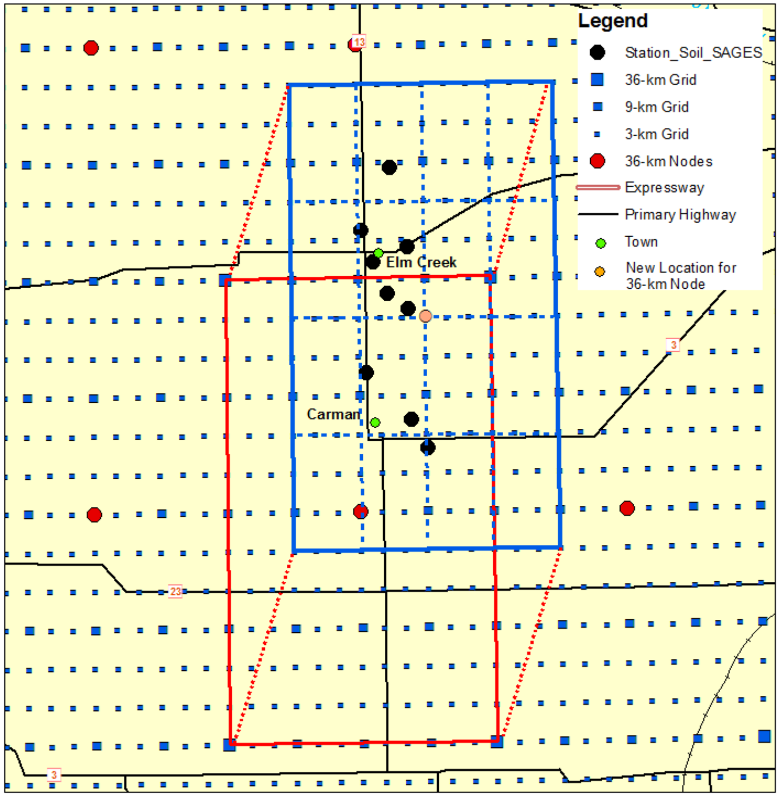




- 80km southwest of Winnipeg (Manitoba) in the La Salle and Boyne River watershed, in Canada's Prairie/Boreal Plain Ecozone
- distinct soil texture divide between heavy clays/clay loams to the east, and lighter sandy/sandy loam soils to the west
- stations located at the edge of annually cropped agricultural fields (cereals, canola, corn, soybeans)

SMAP Grid Cell



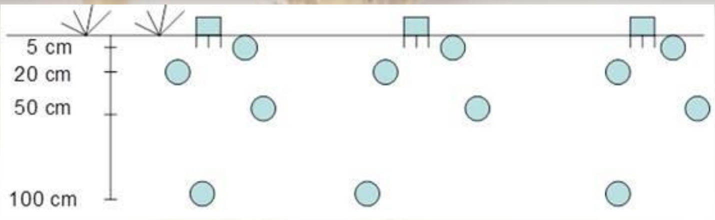


RISMA Network	Soil Texture
Station 1	Coarse Loamy
Station 2	Loamy
Station 3	Loamy
Station 4	Coarse Loamy
Station 5	Clayey
Station 6	Clayey
Station 7	Sands
Station 8	Clayey
Station 9	Sands

- red polygon delineates the original location of the SMAP processing pixel
- blue polygon is shifted processing pixel to maximize coverage of RISMA stations

Approach to representing the SMAP product

- Measurement Depths: 15 probes per station
- 3 at each depth: 5, 20, 50, 100 cm; <u>3 vertical measuring 0-5 cm</u>
- 0-5 cm probes will be removed to "till" and re-inserted; regular maintenance to ensure contact with soil



- Stations are at edge of field, but probes cabled 10-30m into field
- Site is hand-seeded as per crop planted in field
- Regular maintenance/spraying
- Hand harvested coincident with field harvest

- If not managed this way, not representative of field (as per station 8 (farmer is certified seed grower and did not want another variety of soybeans planted around the probes)

Landscape and photos






Approach to Calibration

- At time of installation, soil cores collected for all depths in order to develop site specific calibration and for particle size analysis

- In 2012-2013, evaluated multiple approaches
  - Bellingham (“factory” calibration using texture classes)
  - Site specific lab calibration: calibration curves developed during lab dry down experiments with cores collected at installation
  - Regional calibration (Rotimi Ojo)
    - field-derived calibrations from 13 permanent sites located within or close to RISMA site
    - sites installed in 2009 and 2010 with a total of 326 calibration points divided into coarse (< 20% clay), medium (20 – 40% clay) and fine soils (> 40% clay)
    - linear model of hydra probe versus field measured (surface only)
  - Based on consensus from calibration team, first order calibration applies station-site specific (lab) curves to clays and regional (Ojo) model to lighter sandy and loam soils

- 2013, U of Manitoba and AAFC collected additional soil cores at all sites (2-3 samples at 5, 20 and 50 cm 9 times over the season). Take undisturbed cores near stations and insert hydraprobe into the core to get RDC reading.

Approach to Up-scaling

Approach is a simple weighted average based on area representation of soil texture

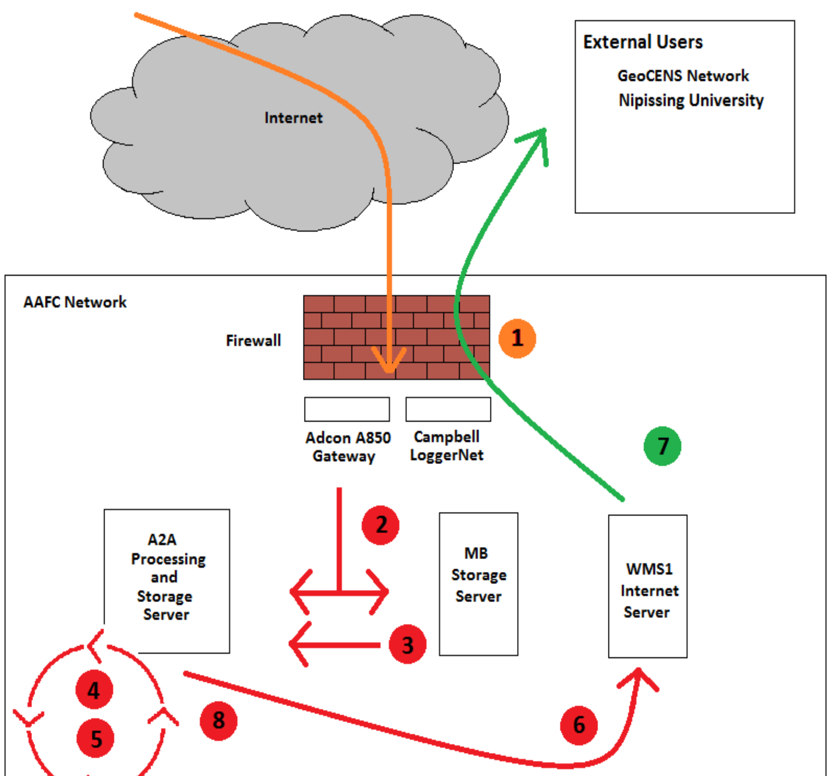
In-situ Mv (SMAP pixel) =
$$(C_{imv} \times 47.55) + (L_{imv} \times 32.32) + (CL_{imv} \times 8.93) + (S_{imv} \times 11.20),$$

where C_{imv}, L_{imv}, CL_{imv}, and S_{imv} are the averages of the in-situ soil moisture for the clayey, loamey, coarse loamey, and sandy in-situ stations, respectively.

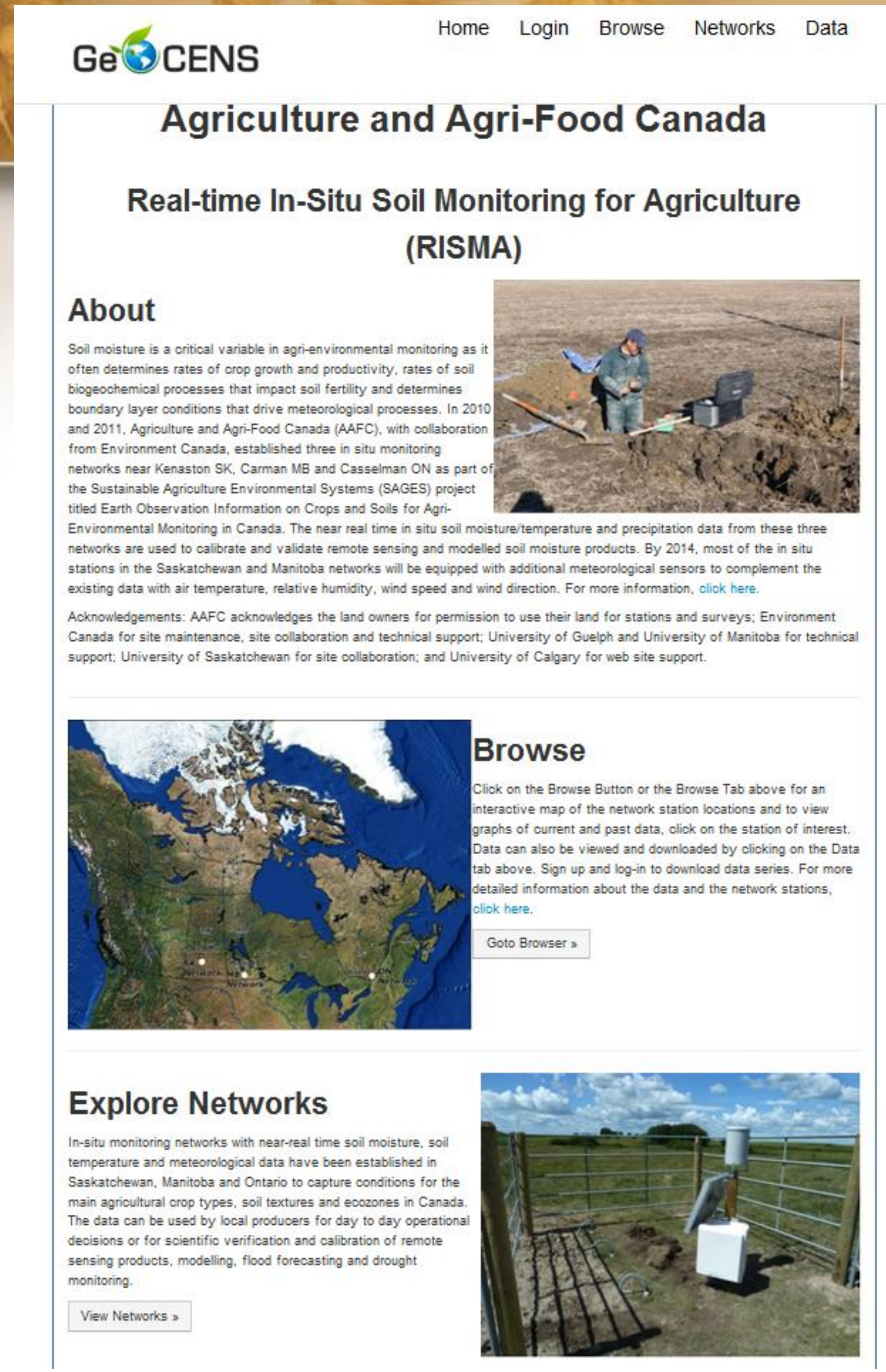
Soil Texture Type	Soil Moisture Average Equation Symbol	In-situ Stations	Percent Area Equation Symbol	Re-calibrated Percent Area
Unclassified				
Rock				
Clayey	C_{imv}	5-6-8	C_a	47.55
Loamy	L_{imv}	2-3	L_a	32.32
Coarse Loamy	CL_{imv}	1-4	CL_a	8.93
Sands	S_{imv}	7-9	S_a	11.20
Organic				

Data Access

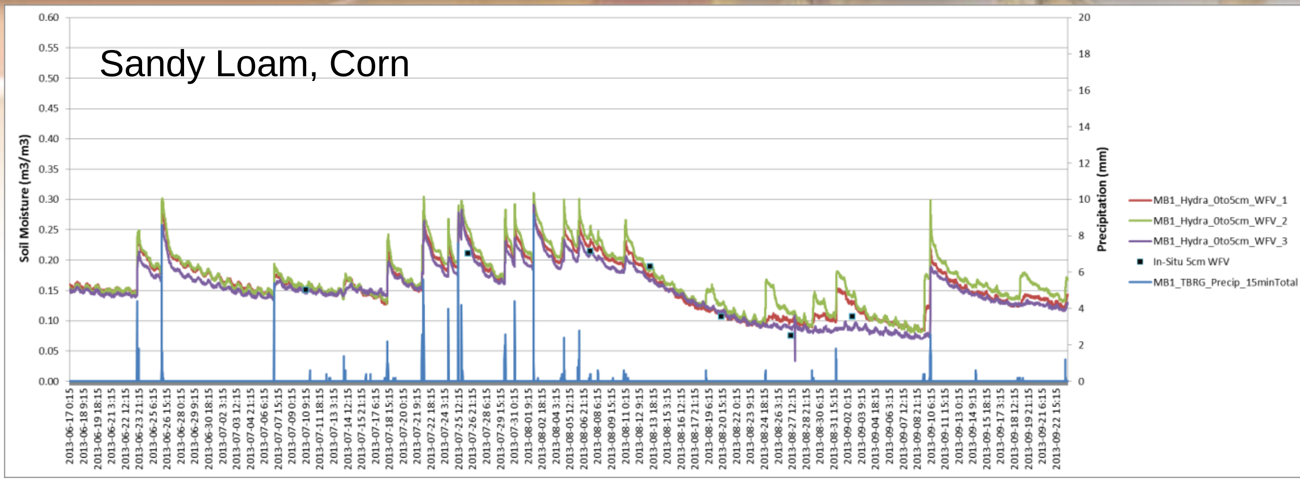
Windows Server Task Scheduler (called every hour):
3 – Data pulled to a location on the AAFC server for processing
4 – Sensor Measurement Calibration applied
5 – Soil Moisture Calibration Quality Control performed
6 – Data uploaded to WMS1 outfacing internet server
7 – Data pulled by "External Users" by building URLs from specified log file parameters

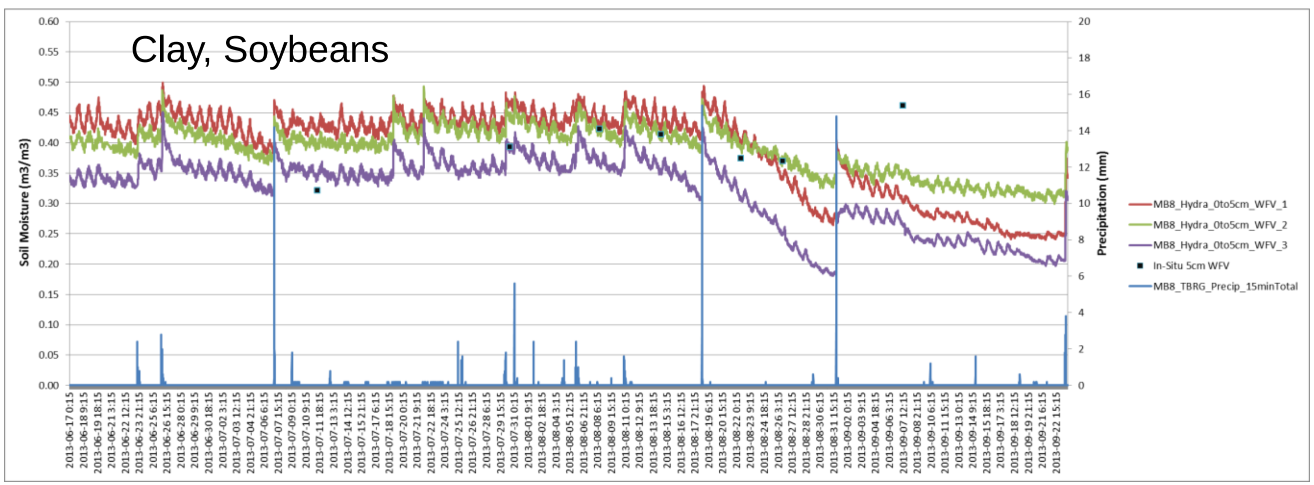


From: Patrick Rollin, AAFC



Sample Data





Issues encountered

- heavy clays (up to 70%) and suspected high salinity causing noise especially at depth (are large part of landscape and must be addressed)
- sensor malfunction, but with 3 sensors have redundancy
- variability among sensors (is this representative of site variability; sunlight and shaded soils due to crop; uptake of water by crops)
- some sensors get “stuck” not responding to rain events; others affected by large cracks?