Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Soil Moisture Monitoring at Agriculture and Agri-Food Canada

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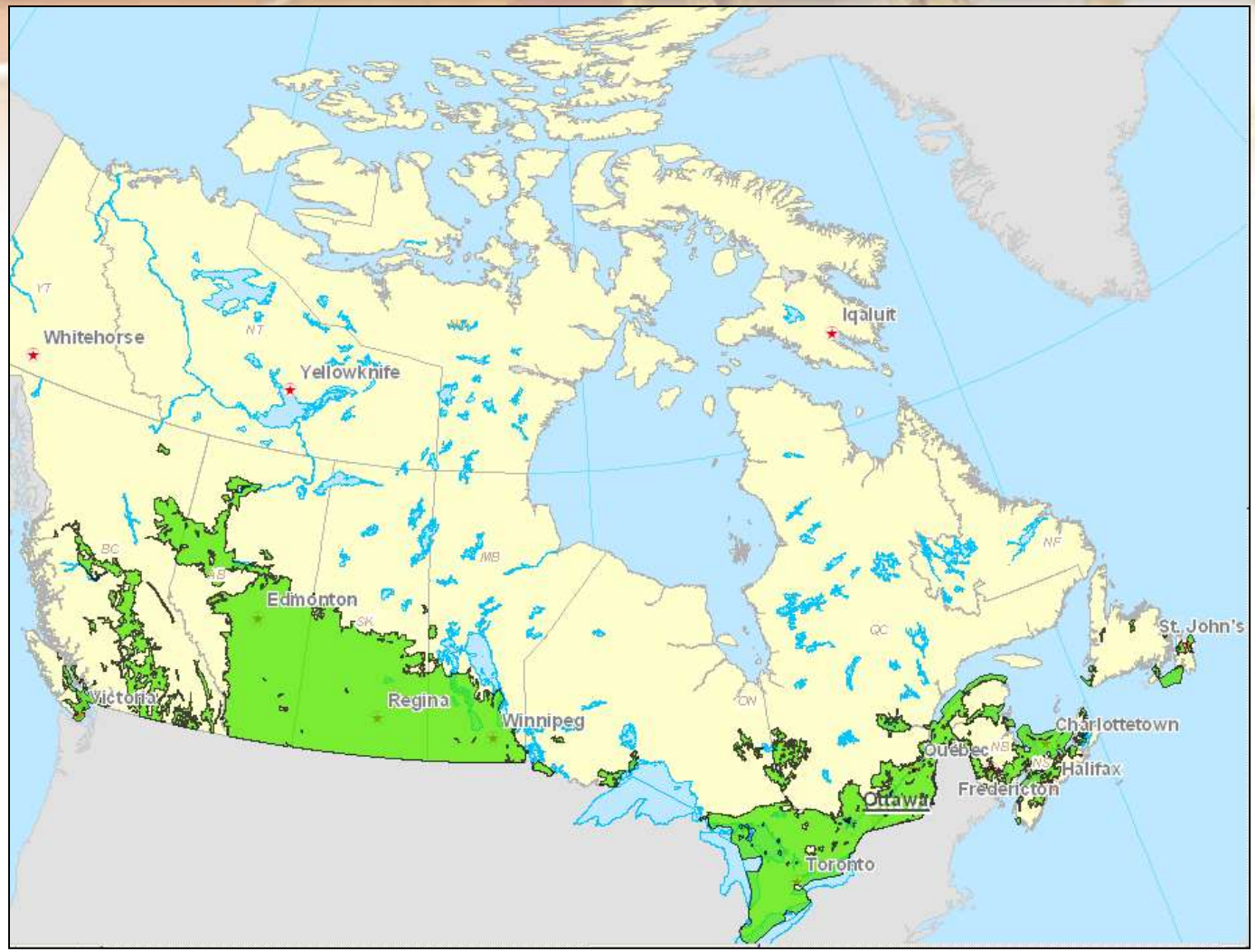
Canada

Agriculture and Agri-Food Sector in Canada

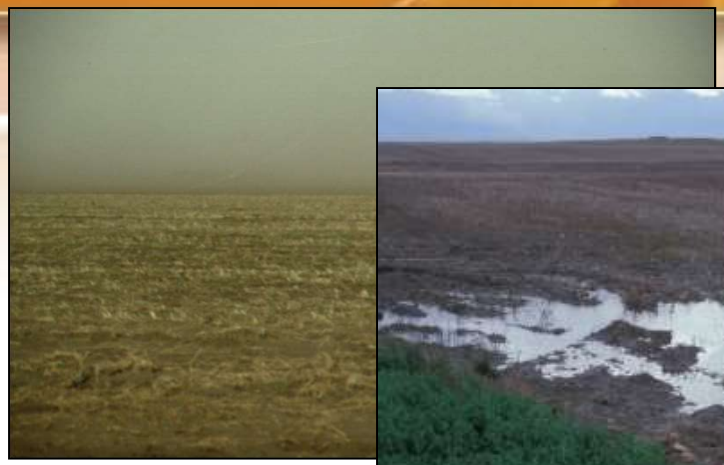


- 167 million acres of farmland
- 8.2% of GDP
- $352 billion in exports
- Government spending to support sector $8.4 billion annually

Why EO Agri-Environmental Monitoring

- Trend towards “place-based” policies that need site specific, geospatial information
- Growing need for performance evaluation of programs and value for money
- Increasing need to report for international fora (climate change)
- Declining government resources requires a need to better target programs and policies
- ***Requirement for reliable, regular information for science-based decision making***

Soil Moisture Extremes



2002
Saskatchewan

2006 Manitoba

2009 Alberta

2011 Saskatchewan

- *Too much or too little water to support agricultural productivity*

Impact of Soil Moisture Extremes

- **Extreme Wetness**
  - the ability to access and work soil on fields
  - decreased crop yield and quality
  - potential for an increase in weed, pest and disease
  - long term damage to soil physical structure and biochemical properties
  - 2006- 2008 Crop Cover Protection Plan (Agriculture Canada): $ 88 million compensation paid to farmers across Canada for fields too wet to seed
  - 2010: $44 million in compensation for excess soil moisture in Prairies
  - 2011: 6 million acres unseeded in Prairies due to excess moisture
- **Extreme Dryness (Drought)**
  - loss of crop productivity during key growth stages leads to a reduction in yield
  - proliferation of pests
  - increased soil erosion
  - 2001/2002 drought on the Canadian prairies alone resulted in $5.8 billion in agricultural losses

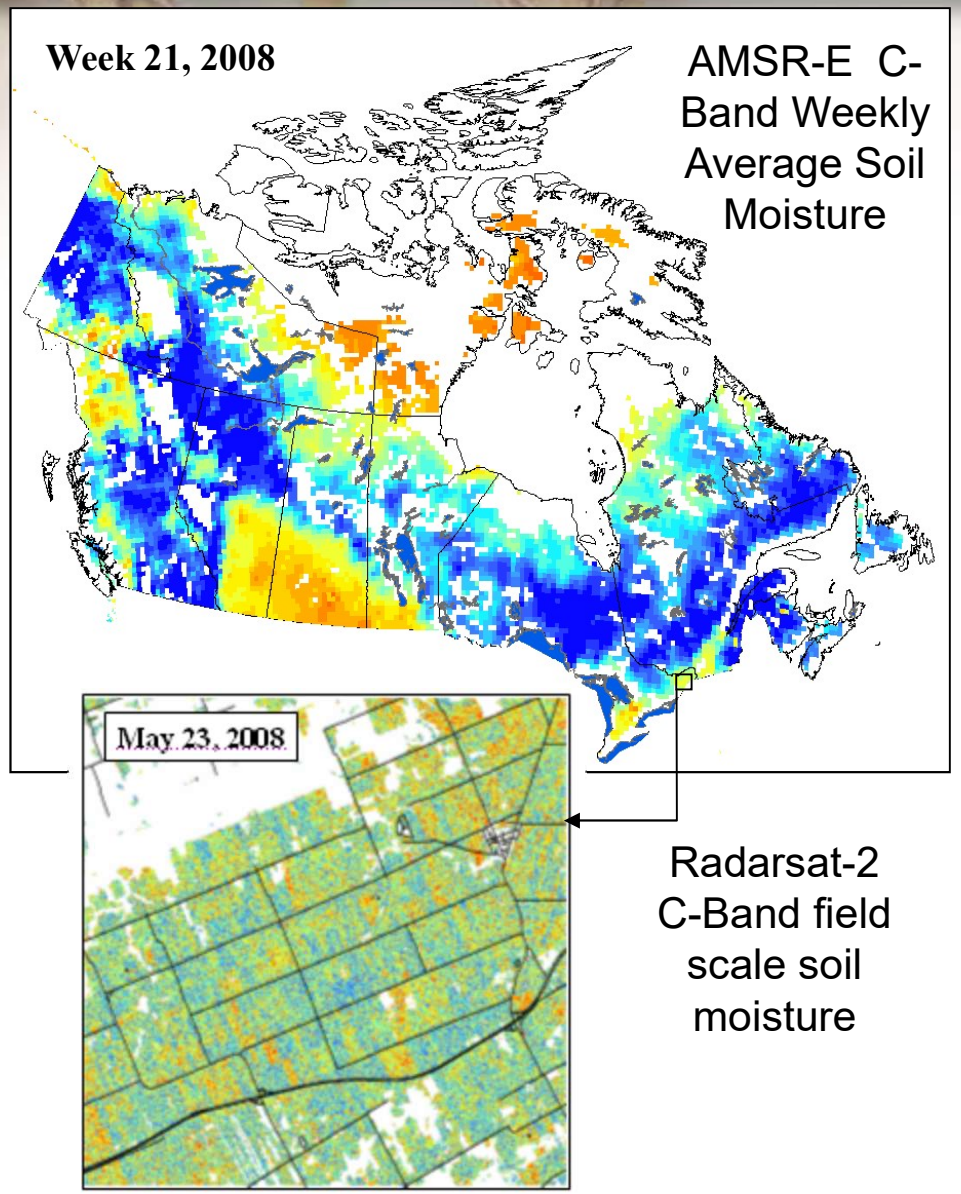
AAFC Soil Moisture Information Needs

Soil moisture information helps to better prepare and respond to disasters:

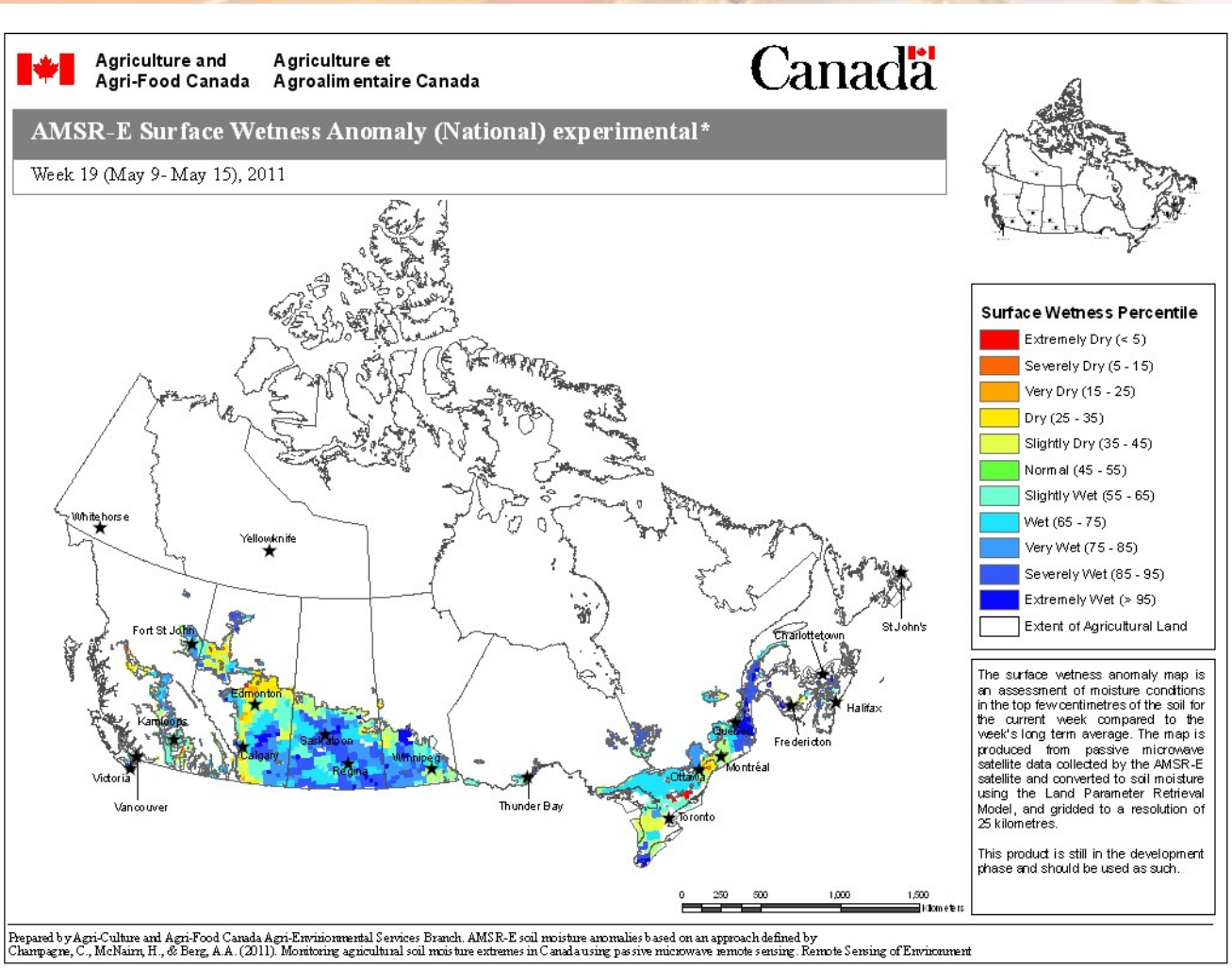
- National Drought Model/Canadian Drought Monitor
- Regional Yield Modelling
- Live Stock Tax Deferral Program
- Climate Production Risk Committee
- Input to disaster relief (Agri-Recovery Programs)

Earth Observation Methods Development: Surface Soil Moisture

- Passive Microwave
  - Validation of brightness temperature retrieval models
  - Calculation of soil moisture anomalies over the growing season
  - Evaluation of new L-Band sensors (SMOS, SMAP)
  - Scaling surface to root zone through assimilation of EO with land surface models (collaboration with Environment Canada and the University of Guelph)
- Active Microwave
  - Testing, validation and adaptation of backscatter retrieval models (IEM, Dubois, Oh)
  - Focus on bare soil (spring and fall) conditions

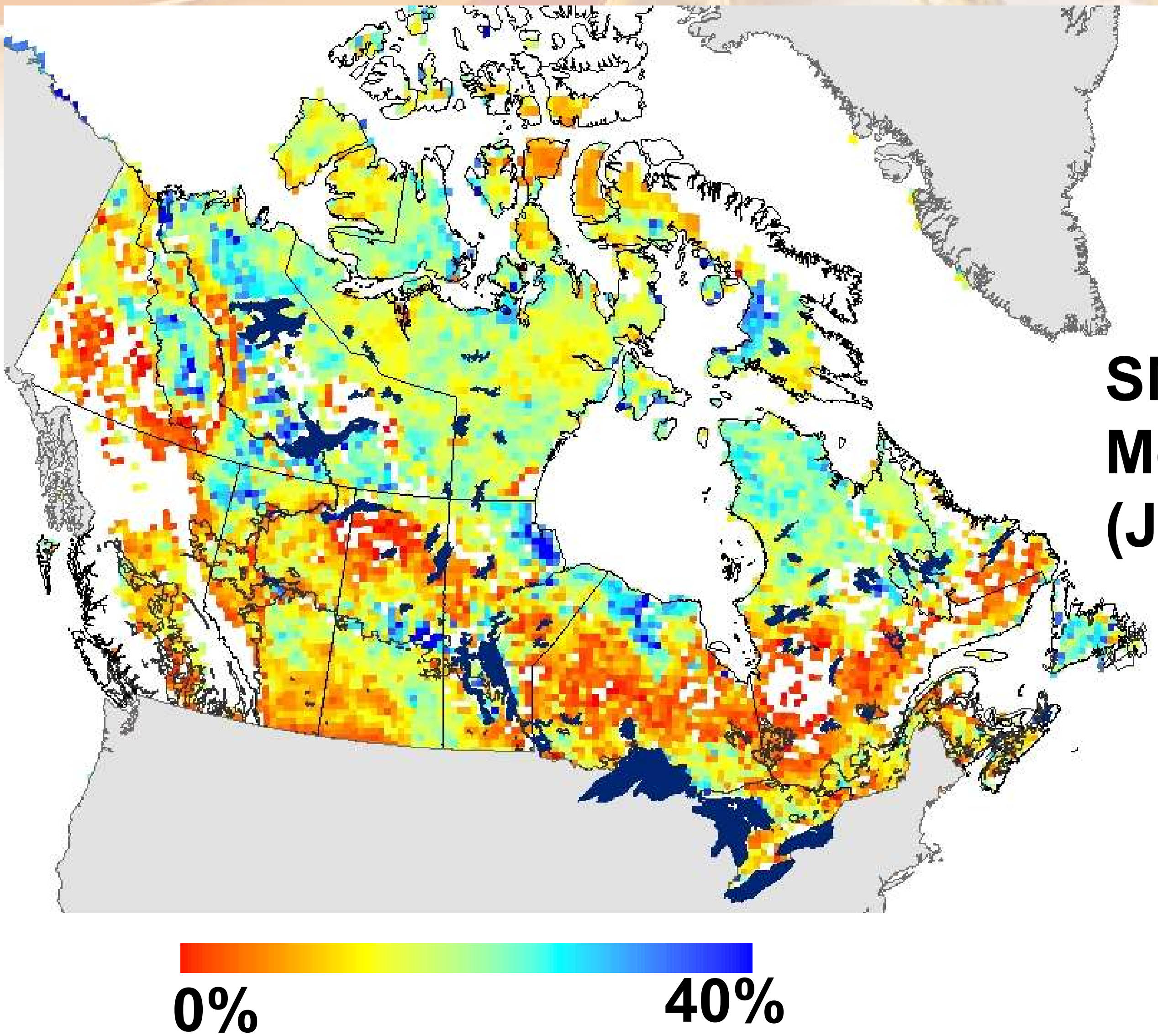


Passive Microwave Soil Moisture and Anomalies



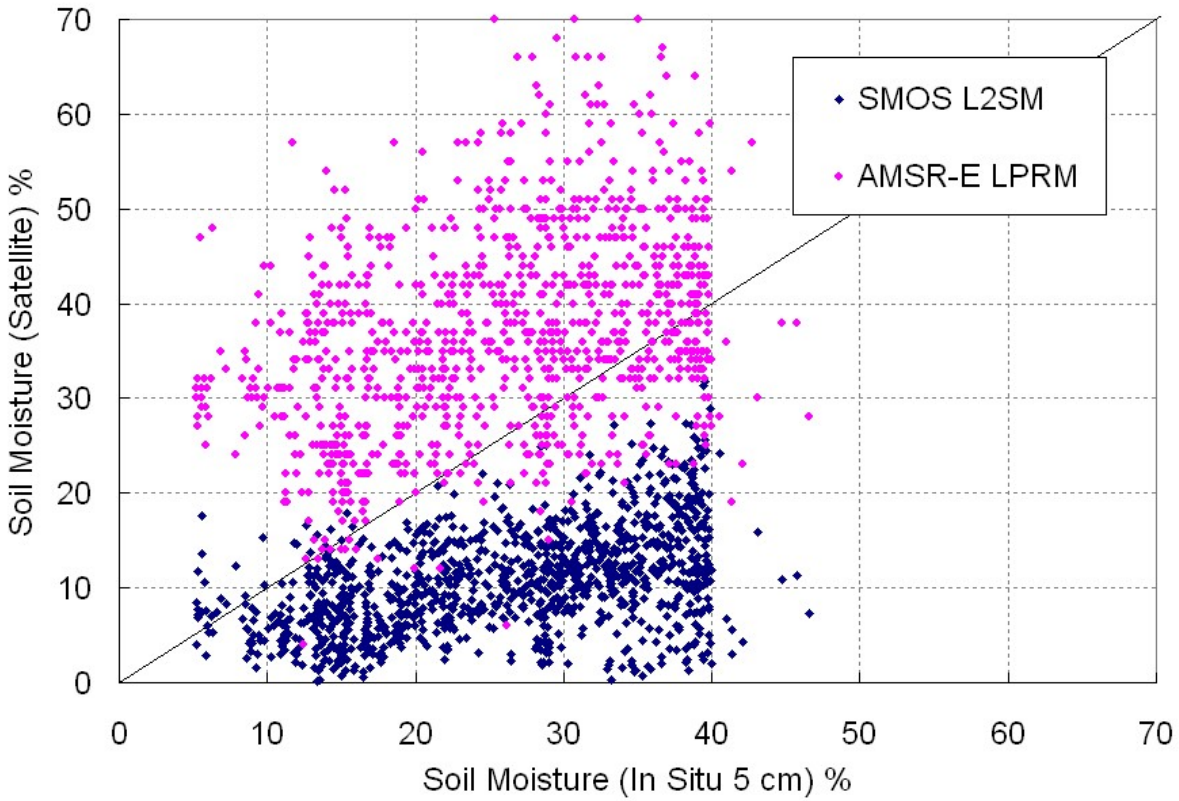
- Weekly and monthly surface soil moisture and soil moisture anomalies from AMSR-E satellite derived soil moisture (2002 – present, April to November)
- Continued evaluation against in situ and drought monitoring indices to better quantify and correct errors

Evaluation of L-Band Data



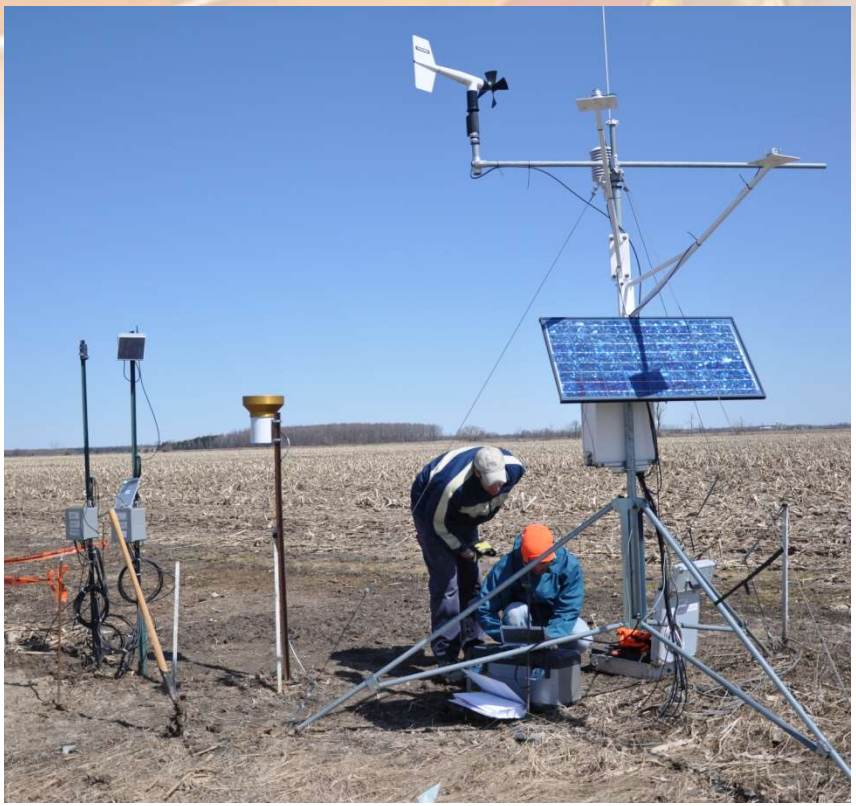
SMOS Level 2 Soil Moisture Week 30 (July 25 to 31)

Evaluation of L-Band Passive Microwave



- 1 month comparison of in-situ and passive microwave surface soil moisture for July-August 2011
- SMOS soil moisture too dry, AMSR-E soil moisture too wet

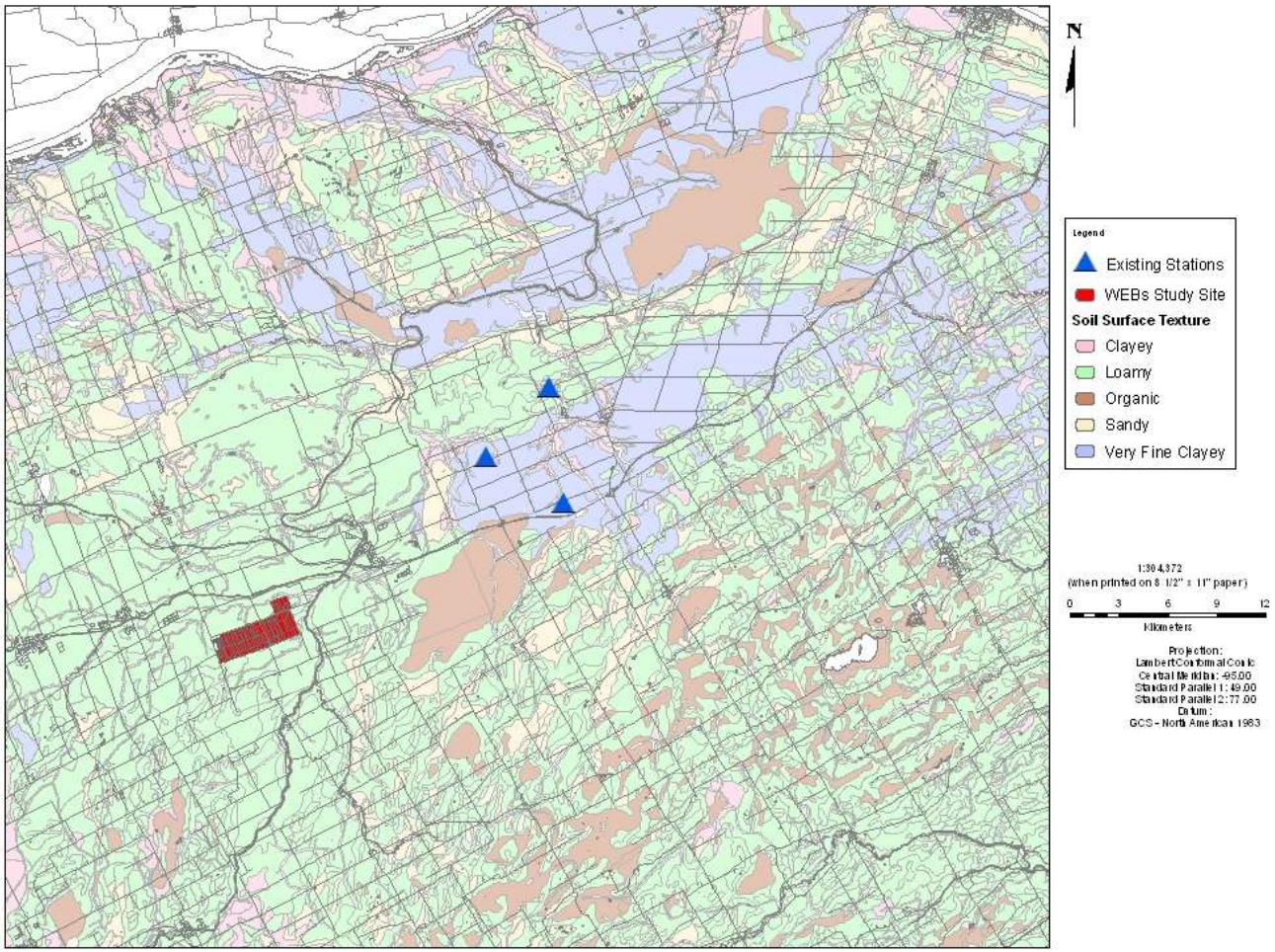
Long-term Validation of Satellite Soil Moisture Data Sets, Integrated Soil Moisture Monitoring



- Development and maintenance of in situ monitoring sites for satellite and model soil moisture validation
- Three pilot networks:
  - Casselman Ontario (R&D)
  - Brunkild Manitoba
  - Kenaston Saskatchewan (partnership with EC, UofG, UofS)
- Piloting of near real time data collection and distribution through (sensor web approach)

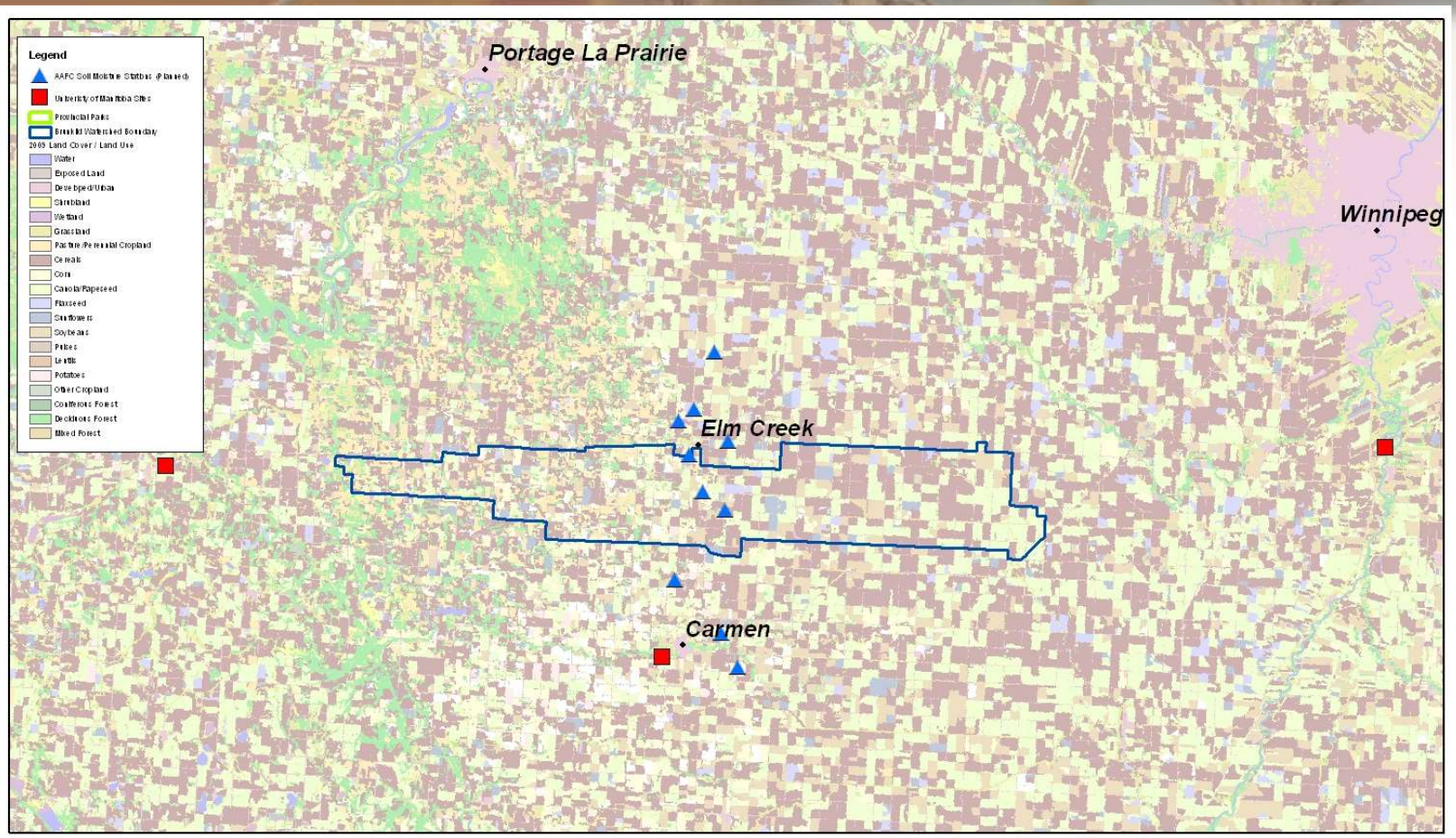
Casselman Soil Moisture Monitoring Network

Potential Area for 50 km Soil Moisture Sampling Site



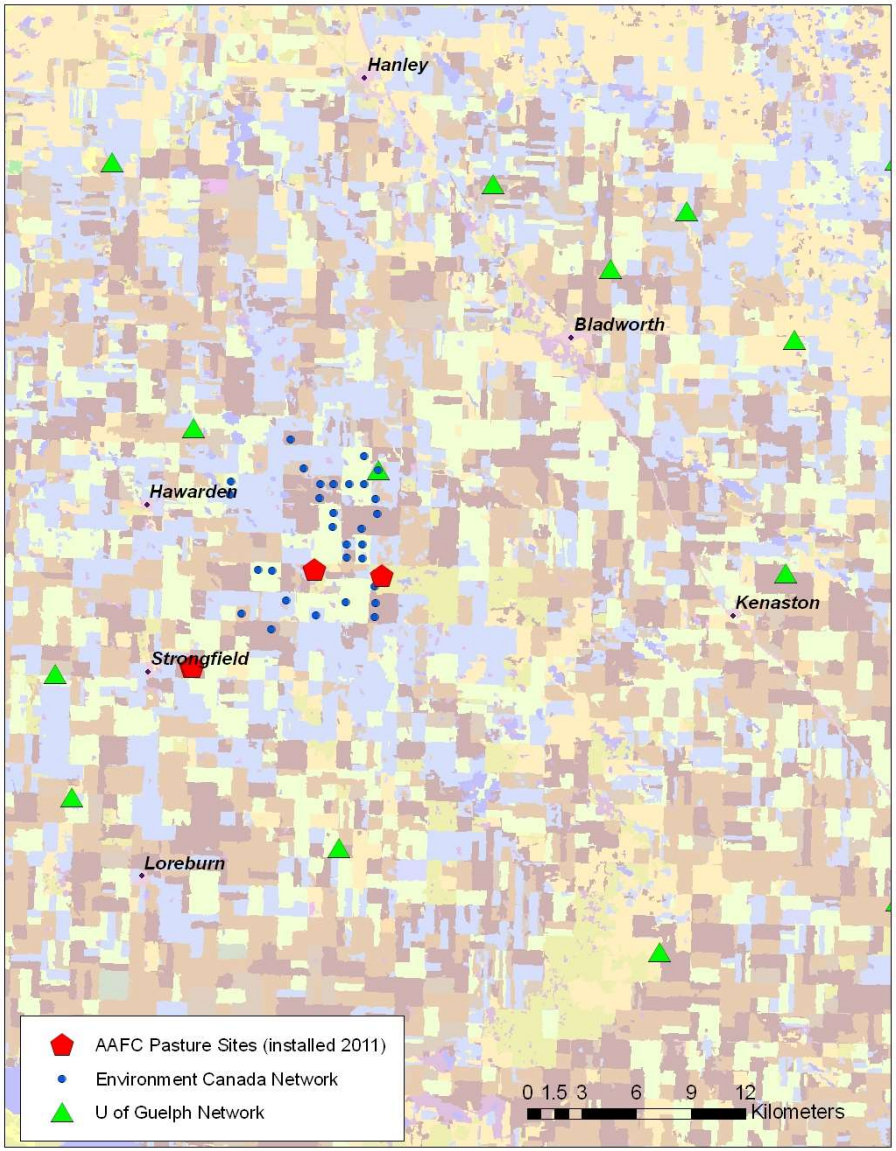
- 3 installed stations measuring precip, soil moisture, soil temperature at 5, 20 & 50 cm depths
- 4 more stations to be installed Fall 2011 to capture soil variability
- R&D site for evaluating soil moisture retrieval models from active microwave satellites, testing sensor web technology

Brunkild Manitoba Monitoring Site



- Sub-watershed in Red River basin selected to capture greatest variability in soil properties over a small area to test landscape approached to integrated SM monitoring
- Site will be used as a validation site for NASA SMAP mission with a 6 week field campaign in 2012

Kenaston Saskatchewan Soil Moisture Network

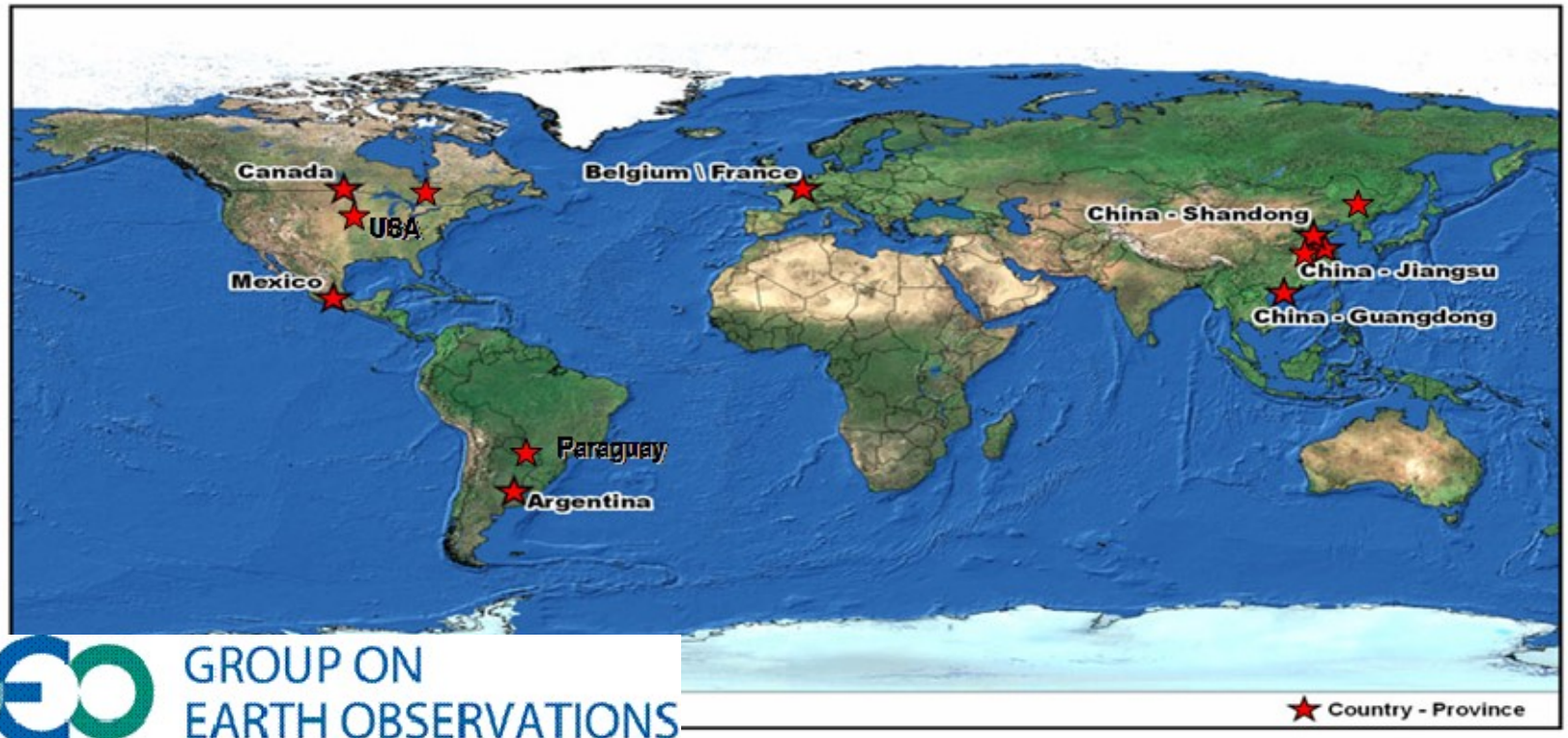


- Established by Environment Canada and the University of Guelph in 2007 for satellite and land surface model validation
- Consists of nested networks: 10km grid with 23 stations, 60km area with additional 16 stations
- AAFC added four stations in 2011 to collect soil moisture, temperature and precipitation at pasture sites

Joint Experiment for Crop Assessment and Monitoring (JECAM)

Sites:

- JECAM activities are being undertaken at a series of study sites which represent the world's main cropping systems and agricultural practices.
- 12 sites currently exist. Additional sites will be added to meet science objectives and ensure all major crop systems are addressed
- Establish best practices for global agricultural monitoring



GROUP ON EARTH OBSERVATIONS

SMAP Early Adopters Evaluation Plan

- Examine level 2 and level 3 soil moisture data sets
  - Technical process of incorporating data sets into existing processing streams
  - Added benefits of increased spatial resolution with demonstration data sets
- Evaluation of SAR soil moisture retrieval from SMAP
  - Use L1C Backscatter and incorporate into calibrated IEM model
- *Evaluation of calibrated SM retrieval methods from brightness temperature*

Next Steps

- Technical modification of processing streams
  - No foreseeable problems
- Evaluation of retrieved soil moisture against expected ranges for calibration sites
- Evaluation of SMAP level 2&3 soil moisture and production of demonstration products for regional staff evaluation
- Trial run of IEM on L1C backscatter

  -incidence angle information?

  -fore/aft backscatter (multi-angle?)