



Environment
Canada

Environnement
Canada

Canada

Soil Moisture Mission: Canadian Interests, Needs, and Contributions

1. Modeling and assimilation
2. Cal-Val

*Soil Moisture Active-Passive
(SMAP) Mission*

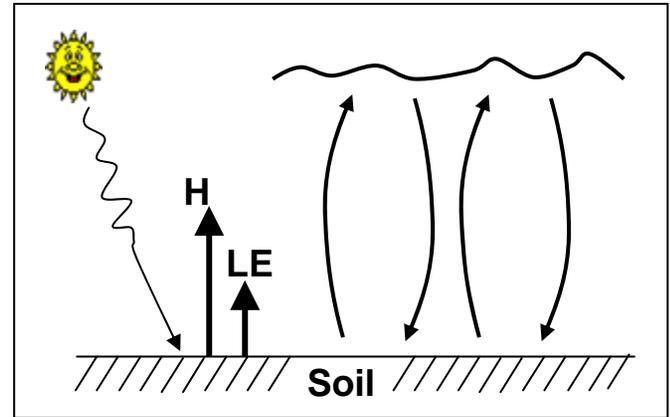
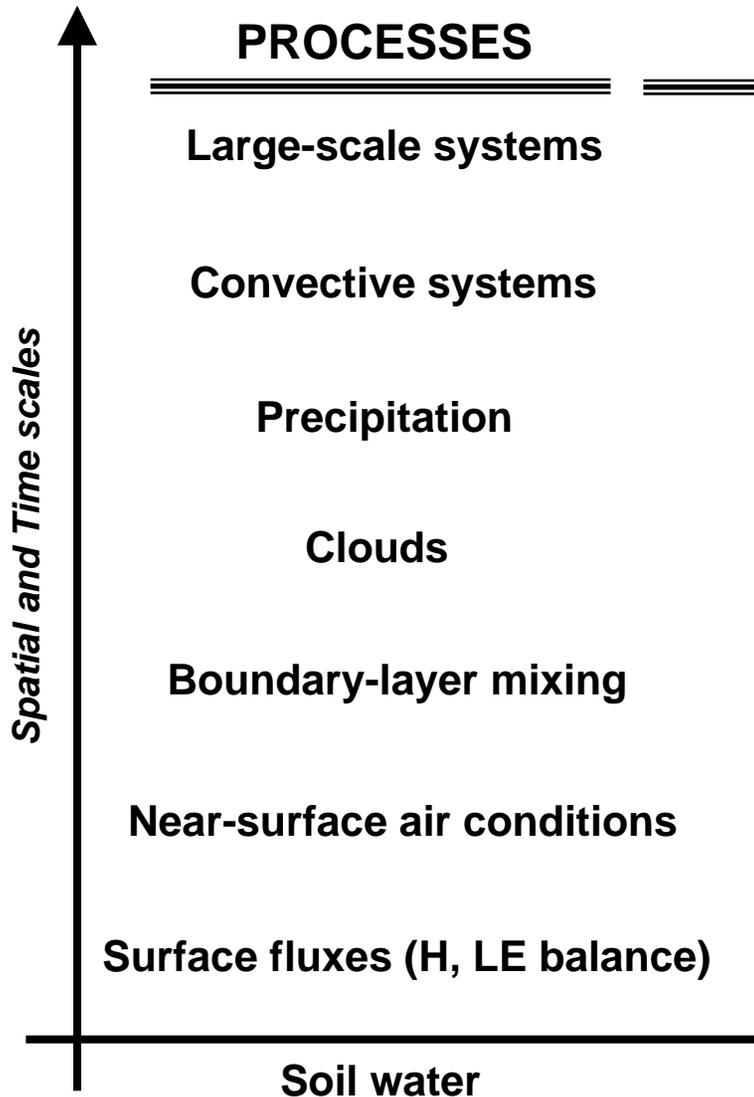
Hyatt Arlington, 9 July 2007

STEPHANE BELAIR

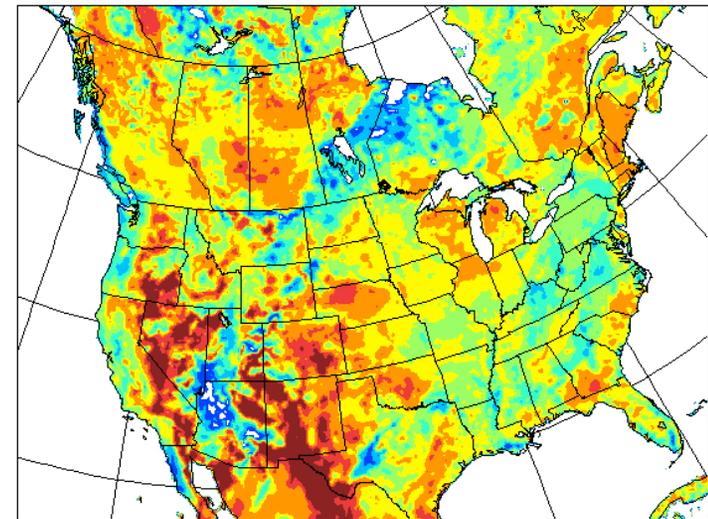
Meteorological Research Division



Soil Moisture and NWP: Environment Canada's Traditional Needs

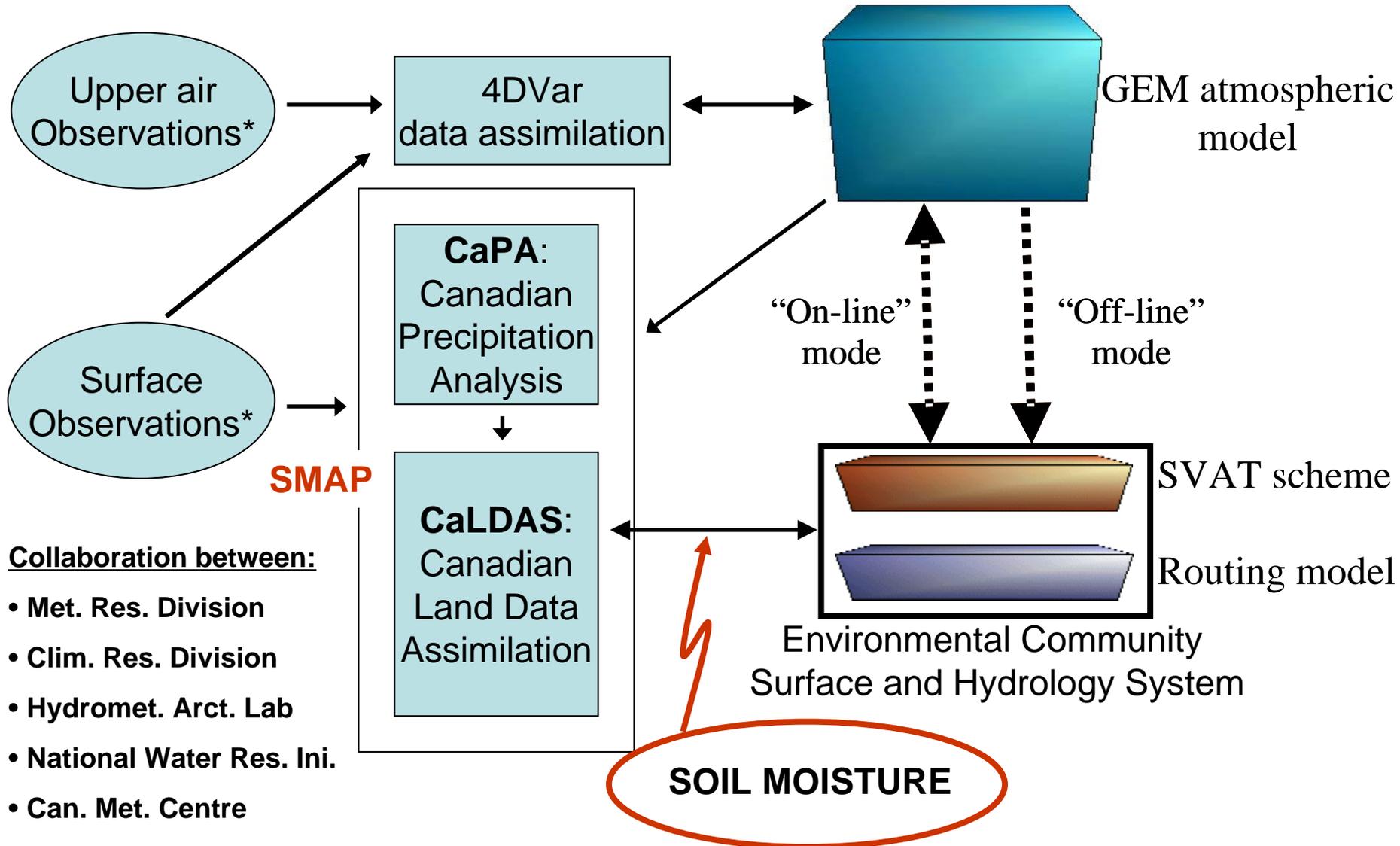


Near surface soil moisture



(valid at 1200 UTC 22 October 2004)

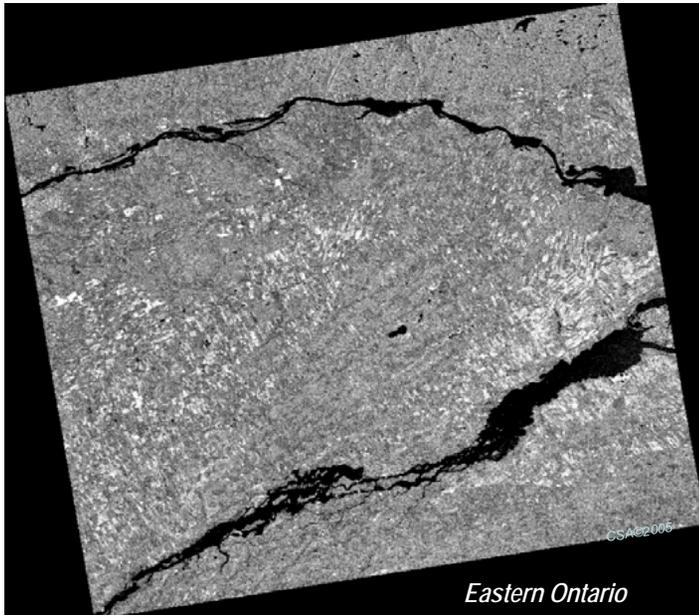
Environment Canada's Environmental Prediction System Including Hydrology



Closer Collaboration Between Environment Canada and Agriculture Canada

AAFC's needs related to soil moisture:

- Drought monitoring
 - Optimal irrigation scheduling
 - Water availability
 - Precision farming
-



**RADARSAT-1 Standard Beam Mode S6 HH-
Polarization Ascending Orbit
17-Oct-2005**

(courtesy of H. McNairn)

Environment Canada

- Modeling and data assimilation
- NWP forecasting suite
- Operational prediction center

Agriculture and Agri-Food Canada

- Expertise in remote sensing (mostly SAR)
- Soil moisture monitoring
- Loads of ancillary data

Emerging Topics: Urban Meteorology, Air Quality, and Emergency Response

Depending on characteristics of cities (size, geometry, thermal properties, ...), soil moisture in surrounding areas can have a dominant impact on the evolution of the urban well-mixed layer – this has a direct influence on the transport and mixing of materials in the atmosphere.

Canadian projects:

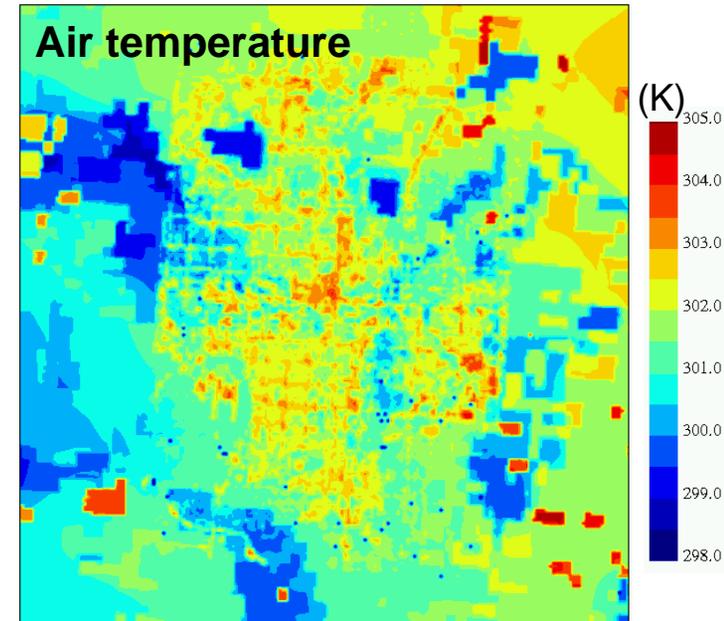
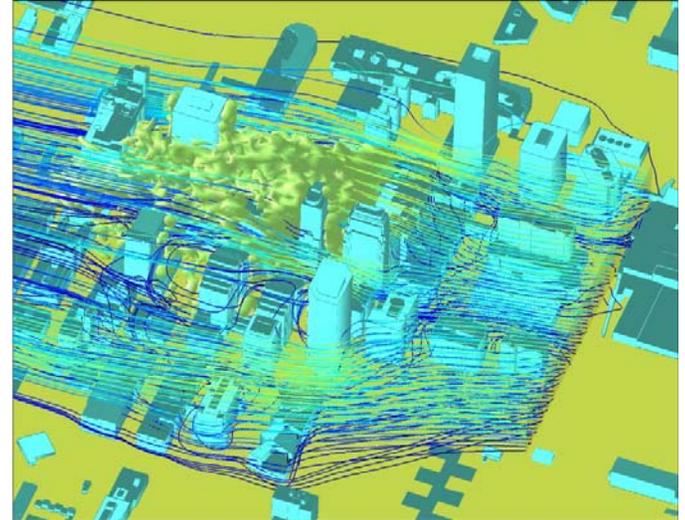
Chemical-Biological-Radioactive-Nuclear Research and Technology Initiative (CRTI)

- Environment Canada
- Dept. of National Defence
- University of Waterloo
- University of Alberta

Environmental Prediction in Canadian Cities (Canadian Foundation for Climate and Atmospheric Sciences)

- Environment Canada
- University of British Columbia
- University of Western Ontario

Joint Urban 2003, Oklahoma City



Best Estimation of Soil Moisture: Strategy

In-situ

- Profile information
- Direct measurement
- but** ▪ Sparse networks
- Local heterogeneity

Remote-sensing

- Only mean to get global or continental soil moisture measurements
- Representative of a certain area
- but** ▪ Transfer models (emission, backscatter)
- Thin layer of soil
- Effect of vegetation and roughness

Screen-level

- Widespread measurements
- High-frequency
- but** ▪ Not a measure of soil moisture
- Not uniformly distributed

**LAND DATA
ASSIMILATION**

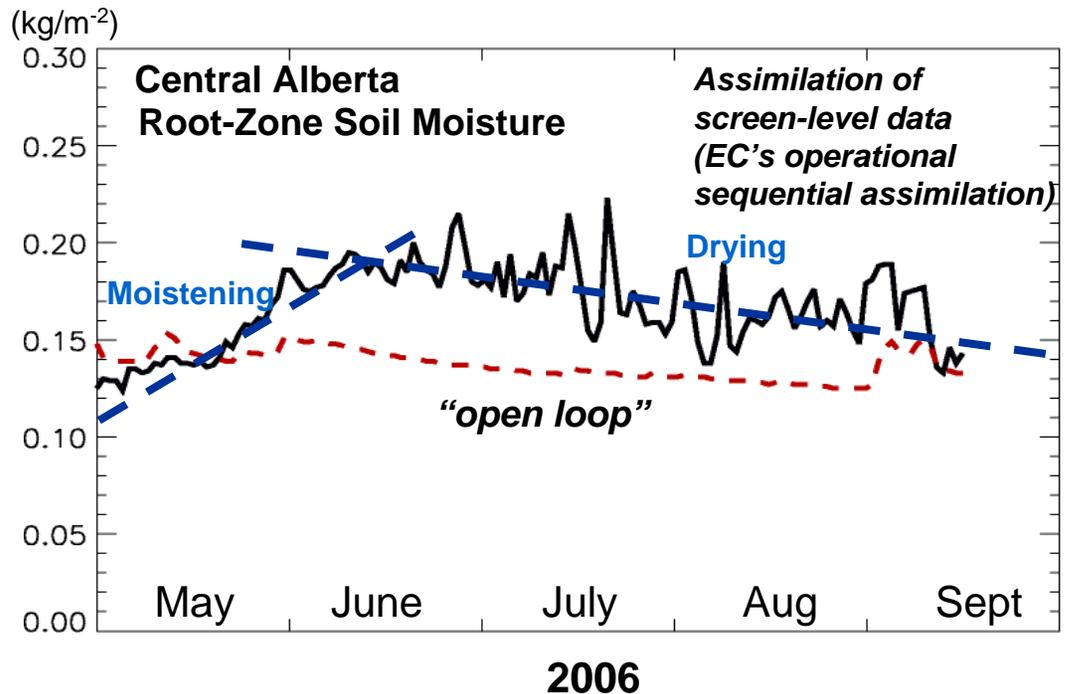
Models

- Physically-based evolution of soil moisture
- High-resolution
- Profile information
- but** ▪ Not an observation
- Errors from process representation, forcing, and geophysical fields

**SOIL MOISTURE
ANALYSIS**

Challenges for Soil Moisture Assimilation

- Ancillary data, geophysical information (soil texture, vegetation)
- Atmospheric forcing (precipitation most important)
- Error specification for each type of data (model, obs)
- Consistency between low-level air characteristics and soil moisture



- Problems related to scales (obs, forcing, model) and heterogeneity

Calibration / Validation

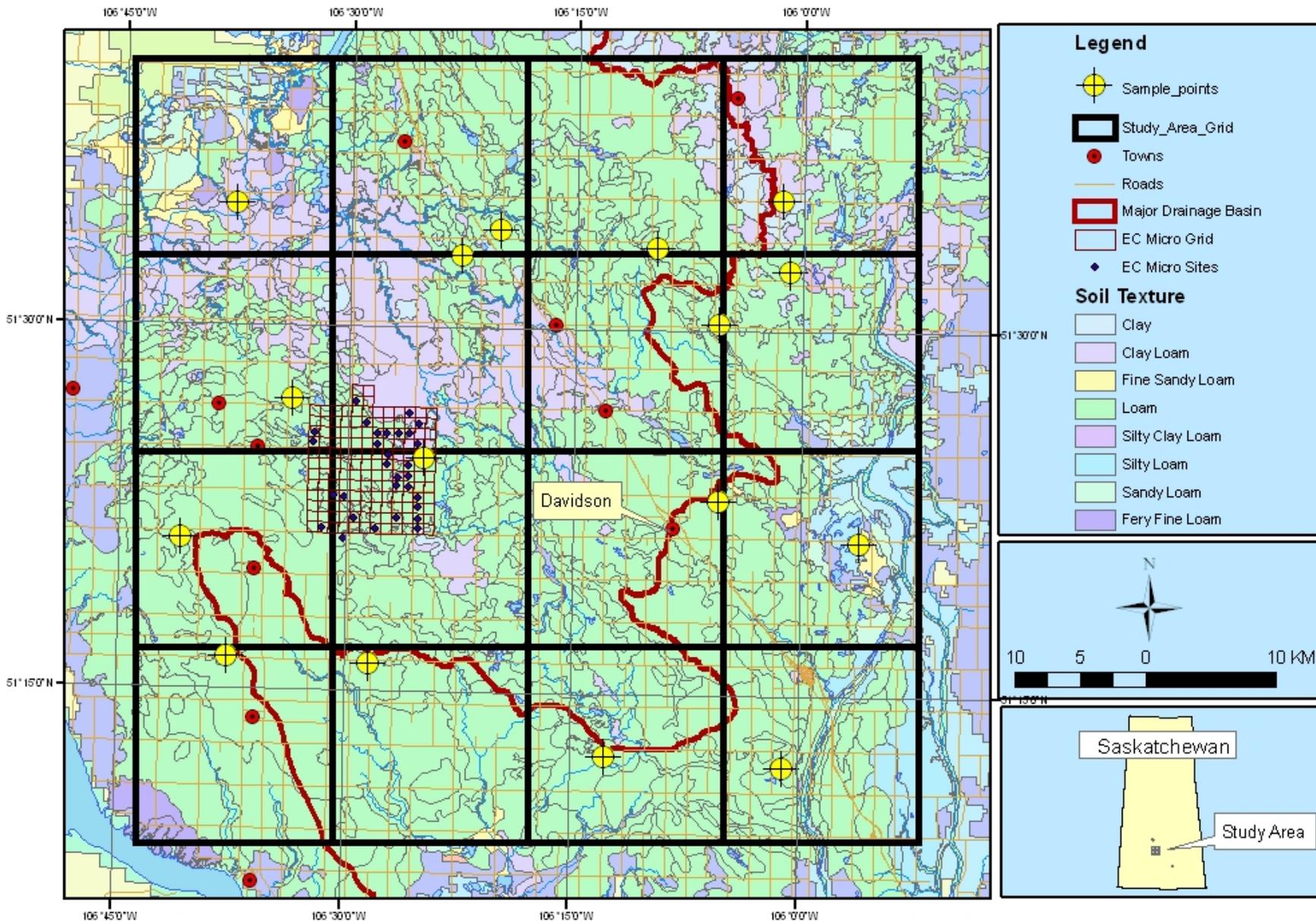
- **In-situ observations**

- Outlook-Davidson network (Saskatchewan) – A. Berg (U. of Guelph)
- Southern Ontario network – A. Berg (U. of Guelph)
- Alberta Agriculture and Food DroughtNet Network
- EC's climate reference sites (possibilities of soil moisture measurements for about 120 stations)
- Boreal Ecosystem Research and Monitoring Sites (BERMS)

- **Airborne remote-sensing**

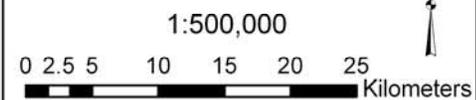
- EC L-band's radiometer (TBC)

Outlook/Davidson Soil Moisture Network



(courtesy of A. Berg)

STUDY AREA AND INSTRUMENTATION SITES



Legend

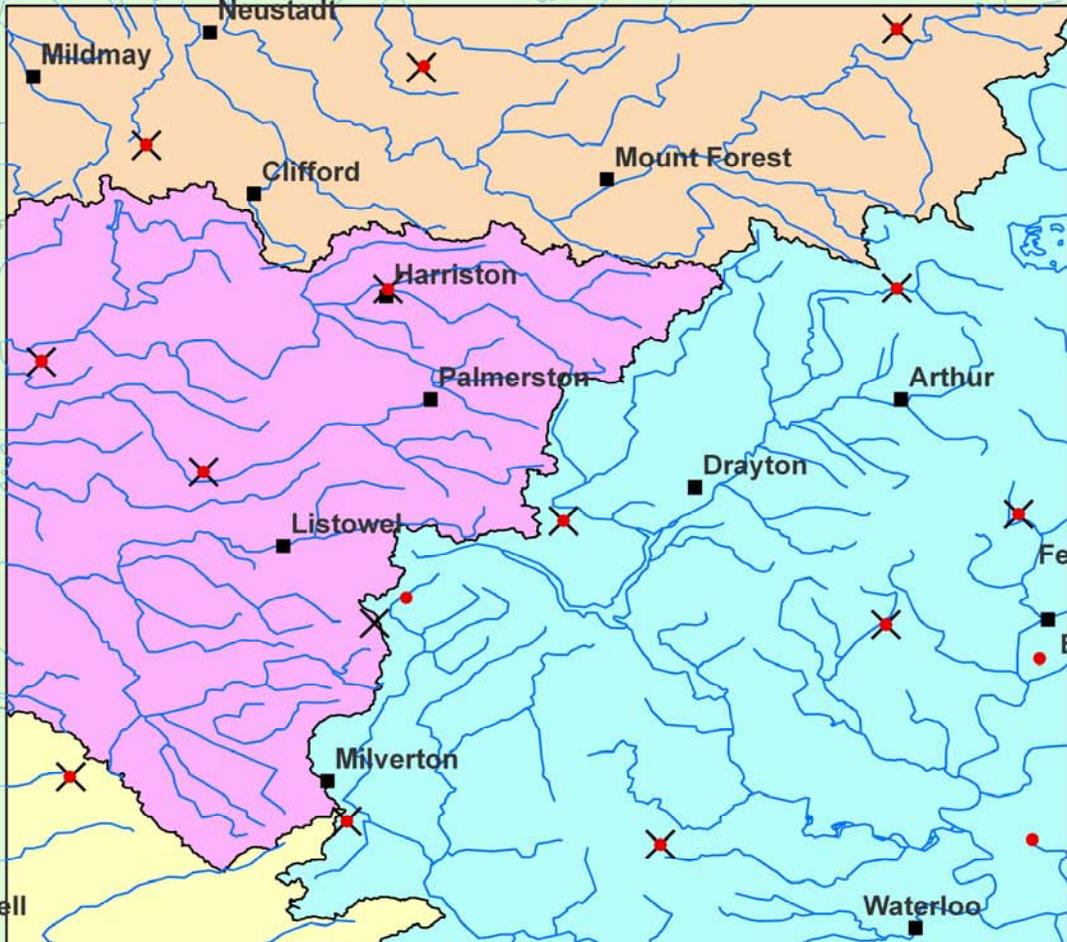
- Study Sites
 - ✕ Agricorp Rain Gauges
 - Cities/Towns
 - Rivers
- ### Watersheds
- Saugeen River
 - Grand River
 - Maitland River
 - Thames River

KEY MAP OF SOUTHERN ONTARIO



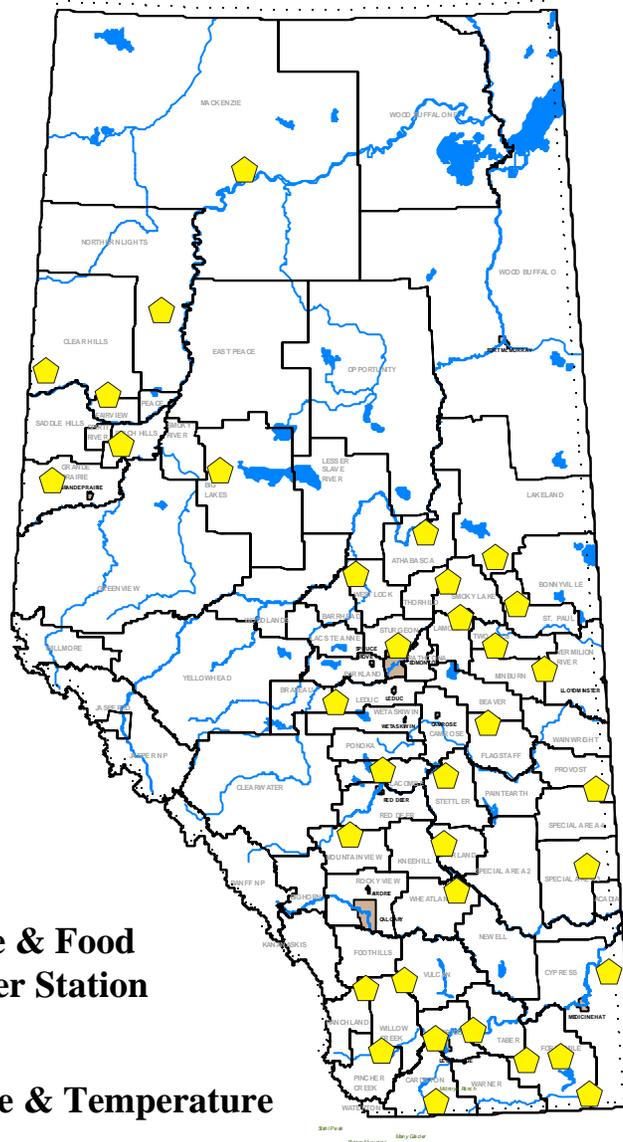
Data Sources:

- Agricorp (2006)
- Ontario Ministry of Natural Resources (2005)
- Ontario Ministry of Agriculture, Food and Rural Affairs (2004)



(courtesy of A. Berg)

Alberta Network



**Alberta Agriculture & Food
DroughtNet Weather Station
Network: 2002**

 **Soil Moisture & Temperature**

(courtesy of Alan Howard)

The Canadian “Soil Moisture” Community

Environment Canada

Belair
Deblonde
Pietroniero
Walker

Canadian Space Agency

Girard
Piekutowski

Canadian Centre for Remote Sensing

Pultz
Charbonneau

Agriculture and Agri-Food Canada

McNairn
Howard

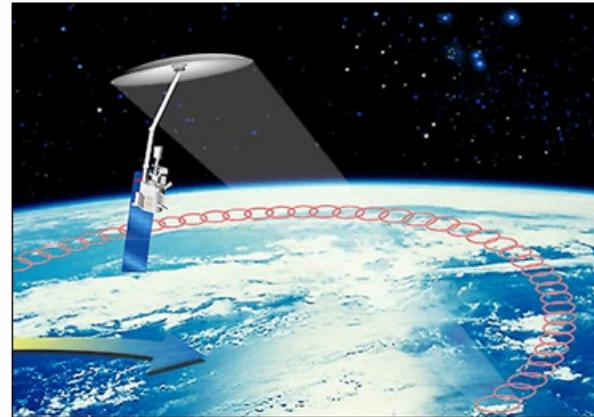
Statistics Canada

Reichert

Universities

Berg (*Guelph*)
Duguay (*Waterloo*)
Bernier (*INRS*)
Pomeroy (*Saskatchewan*)
Magagi (*Sherbrooke*)

Hydros Canadian Science and Applications Plan



March 2006

The Hydros Partners

-  Principal Investigator & Science & Science Operations



Jet Propulsion Laboratory
California Institute of Technology

- - Project Management
 - Project Scientist
 - System Engineering
 - Instrument Management
 - Radar Electronics
 - Reflector-Boom Assembly (Harris or Northrop Grumman - NGC Astro)
 - Spacecraft Bus & Operations (General Dynamics - Spectrum Astro)

-  (GSFC)
 - Project Scientist & Science
 - Radiometer Electronics
 - Science Operations

-  Antenna RF System Engineering
 - Antenna Feed Assembly
 - Radar processor and L1 data processing
 - Science Support for Cal/Val and Analysis

-  Launch contribution (STP)

CSA partnership in SMAP?

- Would build on investments already made in Hydros.
- Opportunity to serve other government departments (Environment Canada, Agriculture Canada, Natural Resources Canada, provinces) for high priority topic.
- Strong science interest from Canadian university researchers.
- Would build on experience gained with SMOS.
- Would Canadian role be same as for Hydros?
- What timeline and mechanism for SMAP to advance in US?