Earth Observation at Agriculture and Agri-Food Canada: Research to Operations

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Challenges for the Canadian ag sector...

**Food Security:**
- How to feed a growing population in a sustainable way?
- Market price volatility: food prices are increasing worldwide due to changes in energy and water availability, climate risk.

**Environmentally Sustainable Food Production:**
- Energy, water, fertilizer/pesticide usage by agriculture.
- Greenhouse gas emissions from agricultural activities.
- Land conversion, loss of ecosystem goods and services.
- Consumer demands for sustainably grown foods, certification.

**Economic Sustainability of Agriculture:**
- Need to expand markets, develop new products.
- Costs of water, energy, fertilizers/pesticides against food prices.
- Impact of climate variability, disease.
… drive AAFC mandate and EO science…

- It is critical that AAFC geospatial science development be quickly moved outside of the research domain into operational application for targeting and implementing policy.

- As AAFC moves forward with this new capacity it needs to better align monitoring activities and strengthen interaction with policy/programs.

- New geospatial technology offer opportunities to improve the timeliness, scope, accuracy and integration of science, bringing more relevance to AAFC science and more science to AAFC’s policies and programs.

- Earth observation-based decision support that integrates airborne, satellite, in situ, and ground data collection networks are some of the geospatial technological keys to this future.

Earth Observation has the potential to provide timely “wall-to-wall” information to support AAFC programs and activities, either alone or integrated with other geospatial data.
... and determine AAFC EO requirements.
The Application of EO at AAFC

Vision: To understand the state of Canadian agricultural production from pre-planting conditions through to post harvest conditions.

Decades of EO research have led to the development of innovative agricultural monitoring capabilities that are, or close to being, operational:

- Crop type, area and condition.
- Snow cover, Soil moisture, Excessive wetness, Drought.
- Climate and weather related impacts on production.
- Crop yield forecasting.
- Sub-field level soil moisture modeling and monitoring.
- Harvest progress monitoring.
- Soil management (tillage, crop residue).
- Biomass and yield production.
- Crop damage, disease and pests.
- Soil health.
Who Are AAFC’s Clients?

**Primary:**
- Departmental (STB, MISB, SPB);
- Other Government of Canada Departments (AAFC, EC, STC, ...);
- Provinces (BC, AB, SK MB, ON, NS, ...);
- Commodity Groups (Canola, ...).

**Others:**
- Agri-Business;
- Non-Government Organizations (NGOs);
- Universities and research laboratories;
- International (GEOGLAM / JECAM).
Opportunities

Advances in satellite and sensor engineering will lead to:

- the launch of new EO instruments with enhanced capabilities;
- provide data continuity & long term data records;
- drive a new generation of scalable and spatially explicit agro-environmental (AE) indicators; and
- improve the output of process-based models.

Open data archives in Canada and elsewhere will:

- improve access to data, products and services;
- increase international collaboration; and
- lead to globally consistent methods for data product validation.

Data processing centralization will allow increased data volumes to be more quickly and efficiently acquired, processed and stored.
Data Cubes

The Data Cube Concept

- Cube approach is a way to manage EO data utilizing open source platform.
- Cubes are based on cloud computing to support an infinite number of applications, making it easier for users to access and use space-based data and allows efficient time-series analyses and data assimilation.
- Organizes 2D (Spatial) data temporally and spatially to allow flexible and efficient analysis of analysis-ready data (ARD).

An Proposed International Collaborative Hub (Cube)

- Under AAFC’s currently funded SAR Inter-comparison project (CSA-GRIP), an opportunity exists for CEOS to create a data cube for AAFC.
- Proposed cube will house data (in situ data, imagery, other) from Canadian and international test sites involved in experiment.
- The cube is being designed to advance international collaborations and related commitments regarding sharing EO agriculture research.
Future Directions

**Domestic: Accelerated Operationalization of R&D**

- Early season crop acreage estimates. Yield forecasting with crop area estimates will provide in-season crop production estimates. Supports:
  - Proactive programs (early warning);
  - Market access, competitiveness, in-season crop quality;
  - Producers, open market information to support management decisions.

- Improved yield forecasts linked to StatCan Surveys to provide more reliable productivity assessments at higher resolutions. Requires:
  - Soil Moisture Monitoring (integrated EO, in-situ and modeling);
  - Crop growth parameters (LAI, fPAR) and NRT crop condition assessment;
  - Harvest Monitoring.

- EO-based farm management information (e.g. on tillage type, timing and crop residue) supports indicators and market access issues.

**International: AAFC commitments to G20 (GEOGLAM)**

- Developing JECAM research to improve our capacity to monitor diverse landscapes, provide information to support decision making.
Thanks for listening!