Space for Agriculture: Opportunities to supporting a Competitive Agricultural sector in Canada

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Earth Observation helps AAFC to understand:

- The extent and diversity of Canada’s agricultural landscape.
- The current state and changes in this landscape and in agricultural production.

This will allow AAFC to provide leadership in the growth and development of a competitive, innovative and sustainable Canadian agriculture and agri-food sector.
Earth Observation Working for Agriculture

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

Decades of earth observation research at AAFC has 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.
- Harvest progress monitoring.
- Soil management (tillage, crop residue).
- Biomass production.
- Crop damage, disease and pests.
- Soil health.
EO-based data indicate “where”, “how much” and “how” agricultural land use changes.

Allows annual land use changes to be tracked between important cover types.
Opportunities (I): New Sensor Technologies

Advances in satellite and sensor engineering...

- Miniaturization of electronics.
- Large light-weight structures.
- Compact optics.
- Improved cooling.
- High-performance onboard computing.
- More efficient transmitters.

... will lead to launch of EO sensors with enhanced capabilities,...

- Technological advances coupled with the launch of satellite constellations will provide more frequent and cheaper EO data at fine spatial resolutions.
- Will allow temporal revisit times and IFOVs required for detailed mapping across a wide range of geographic extents (local to national).

... provide data continuity & long term data records, ...

- Long term data continuity is essential for monitoring and the creation of consistent and reliable historical records for anomaly detection.
- Important because users want ready-to-use data from sensors whose calibration is transparent to them.
Opportunities (I): New Sensor Technologies

... drive a new generation of scalable and spatially explicit agro-environmental (AE) indicators...

- Input data to create current agro-environmental metrics is limited by inconsistent data collection requires re-allocation of variables measured using different spatial frameworks.
- A new generation of spatially explicit and scalable indicators will use new EO data to provide national-scale, cost-effective, timely, accurate and scalable information at the producer level.

... and improve the output of process-based models.

- Spatially distributed process models use EO data to define initial conditions, drivers of processes, state variables and crop phenology.
- These models include many uncertainties and often use poorly known parameters to make their projections.
- Limitations can be addressed using EO data to provide spatially and temporally comprehensive information on environmental surfaces.
Opportunities (II): Data Processing Centralization

Data processing centralization...

- Government of Canada (GoC) Departments have variable capacity to deal with this growing volume of EO information (Data Cubes, Big Data).
- Centralized data centers will allow more efficient data processing under a GoC-wide solution, and meet the GoC’s current and future requirements, including those relating to geospatial and EO data.

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

- Data centres will allow applications and systems to be developed and tested before going live as well as live systems and applications.
- A few data centres with the capacity to process and store large volumes of complex data can house the supercomputing services for many GoC departments requiring scientific computing.
- Moving applications to the data, rather than data to the applications will become the norm.
Opportunities (III): Open Data and Information

Open data archives in Canada and elsewhere will improve access to data, products and services, ... 

- Let end users use information in ‘their way for their own purposes’ (but requires easy discovery, access and use of data).

... increase international collaboration, ... 

- G20 GEOGLAM “System of Systems” set up to improve information on crop status to reduce volatility of global markets and provide early warning to support food security worldwide (includes the Joint Experiment for Crop Assessment and Monitoring, JECAM).

... leading to globally consistent methods for data validation. 

- Validation methods often variable-dependent and determined by specific data availability for a place and time.
- Validation standards for higher-order EO products yet to be fully developed.
- Product validation using common standards is vital for meeting future needs of end users in agricultural sector.
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 Statistics Canada 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)

- Moving JECAM research from what works at one site to guidelines on what works at different sites globally. Will improve our capacity to monitor diverse landscapes, provide information to support decision making.