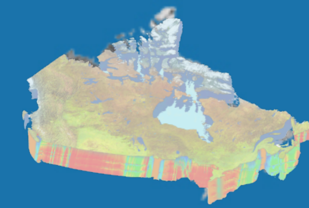

Proposed Spectral Image Simulations of the Mer Bleue Arctic Surrogate Study Site (MBASSS) With ISDASv2

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Canada

Content

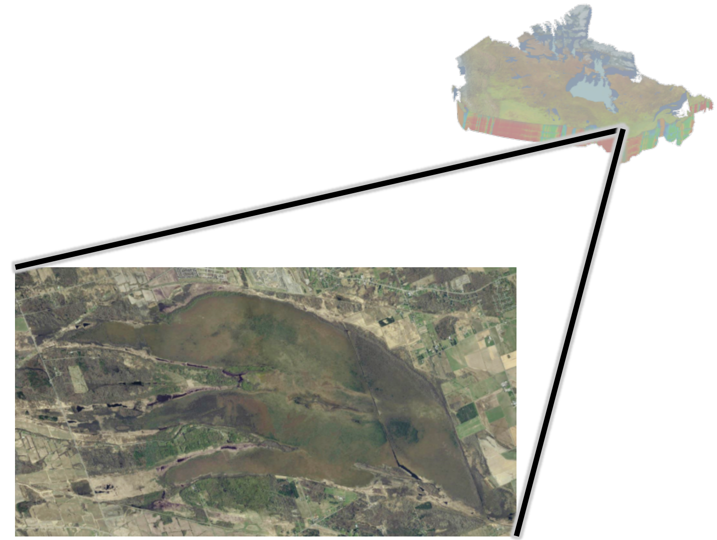
- Quick introduction/motivation
- Mer Bleue Bog Overview
- Simulation roles
- Simulation capacity and application
- Process to move forward
- Final comments

Motivation

- Wetlands perform several valued functions
  - Storing/purifying water
  - Recharging aquifers
  - Retaining nutrients in floodplains
  - Storing carbon
  - Mine waste filtration
  - Sensitive habitat for many species.
- Canada's arctic wetlands contain sensitive habitats that are impacted by climate change and by the exploitation of natural resources.
- Wetlands are 14% of Canada's landmass providing 20% of the global wetlands inventory.
- Region is remote, with often with little or inadequate access.
- Limited snow-free periods, limited solar illumination periods.

- Advance spectral techniques support monitoring of these regions.

Location



Mer Bleue Bog (45.30°N, 75.61°W).

- Located in Ottawa, Canada.
- A designated conservation area protected by the National Capital Commission (NCC)
- Designated a Wetland of International Significance under the Ramsar Convention in 1995.
- Representative of northern boreal peatlands (Lafeur et al., 2001)
  - Complete ground cover of sphagnum mosses with a shrub canopy dominated by ericaceous shrubs, with secondary communities of deciduous shrubs, discontinuous patches of black spruce and larch.
- Easily accessible and well protected local opportunity to monitor and study biophysical characteristics of northern peatlands.

Motivation

"Need for data compatibility and data interoperability.

→ Formulate requirements for validation of Arctic/high-latitude data products."

- Bojan R. Bojkov, ESA/ESRIN

"Stimulate the use of remote sensing technology into the resource sector.

→ Quantitative data confidence is critical."

- Dennis Nazarenko, LOOKNorth

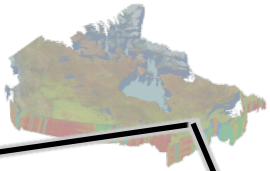
"The appetite for EO space data by government departments is constantly growing and becoming more diversified.

→ Provide robust, repeatable, and reliable observations over long time-scales and large spatial-scales."

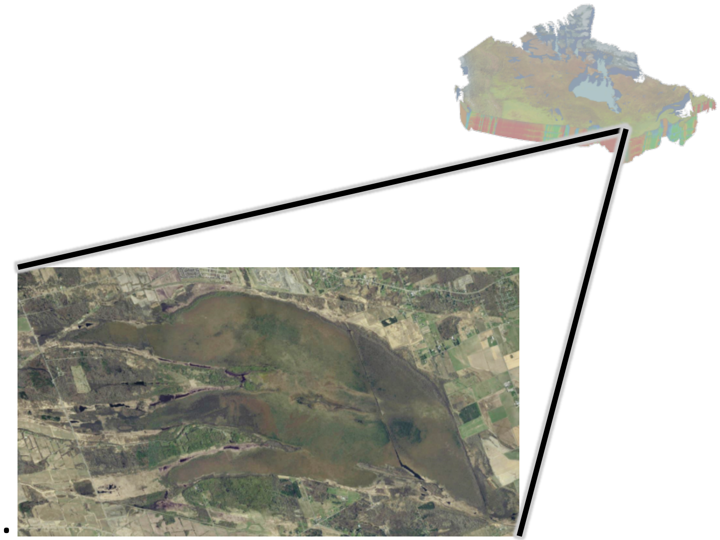
- Yves Vrevier, CSA

Location

Mer Bleue Bog (45.30°N, 75.61°W).



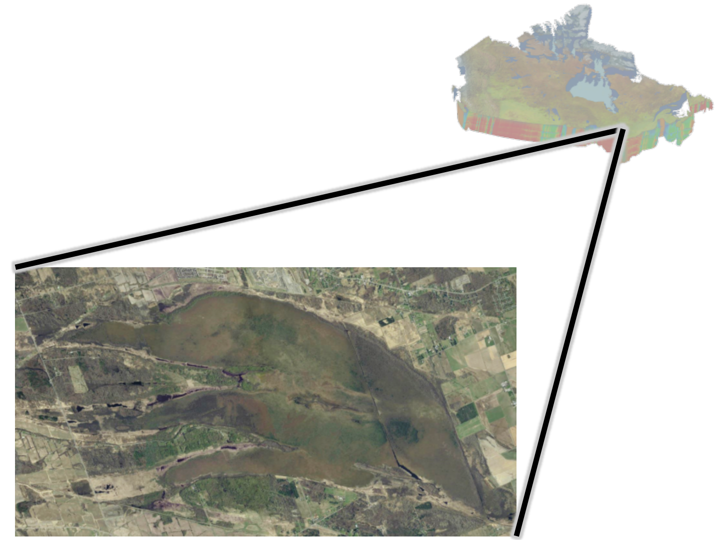
Simulations



Why?

- ➢ Evaluate and prepare for regular multi-sensor space-borne optical acquisitions of Canada's arctic.
  - ➢ To handle both spectral and spatial information.
  - ➢ Support continuity between sensors
  - ➢ Advance our capacity to interpret and disseminate information (less empirical → more physical)
- ➢ Support initiatives like GEODE (Canadian Federal Geoanalytics Earth Observation Data Environment), a central EO data repository and analysis environment.
  - ➢ Emergency response, resource management, environmental processes and mitigation monitoring.

Simulations



"Best Practice…"

- ➢ Support continuity between sensors
  - ➢ Information products between sensors are often advertised as "good agreement".
  - ➢ Value of understanding why not "perfect agreement"
  - ➢ Differences in sensor characteristics can equate to different sensitivities, dynamic range, and even applicability of an application.
- ➢ Simulation lets us evaluate models.
  - ➢ If we can simulate what the sensor observes using models, we can examine the efficacy of the model. (highlighted by Salomon Eliasson with cloud models)
  - ➢ *"Nothing happens in contradiction to nature, only in contradiction to what we know of it. And that's a place to start."* – Dana Scully, X-Files

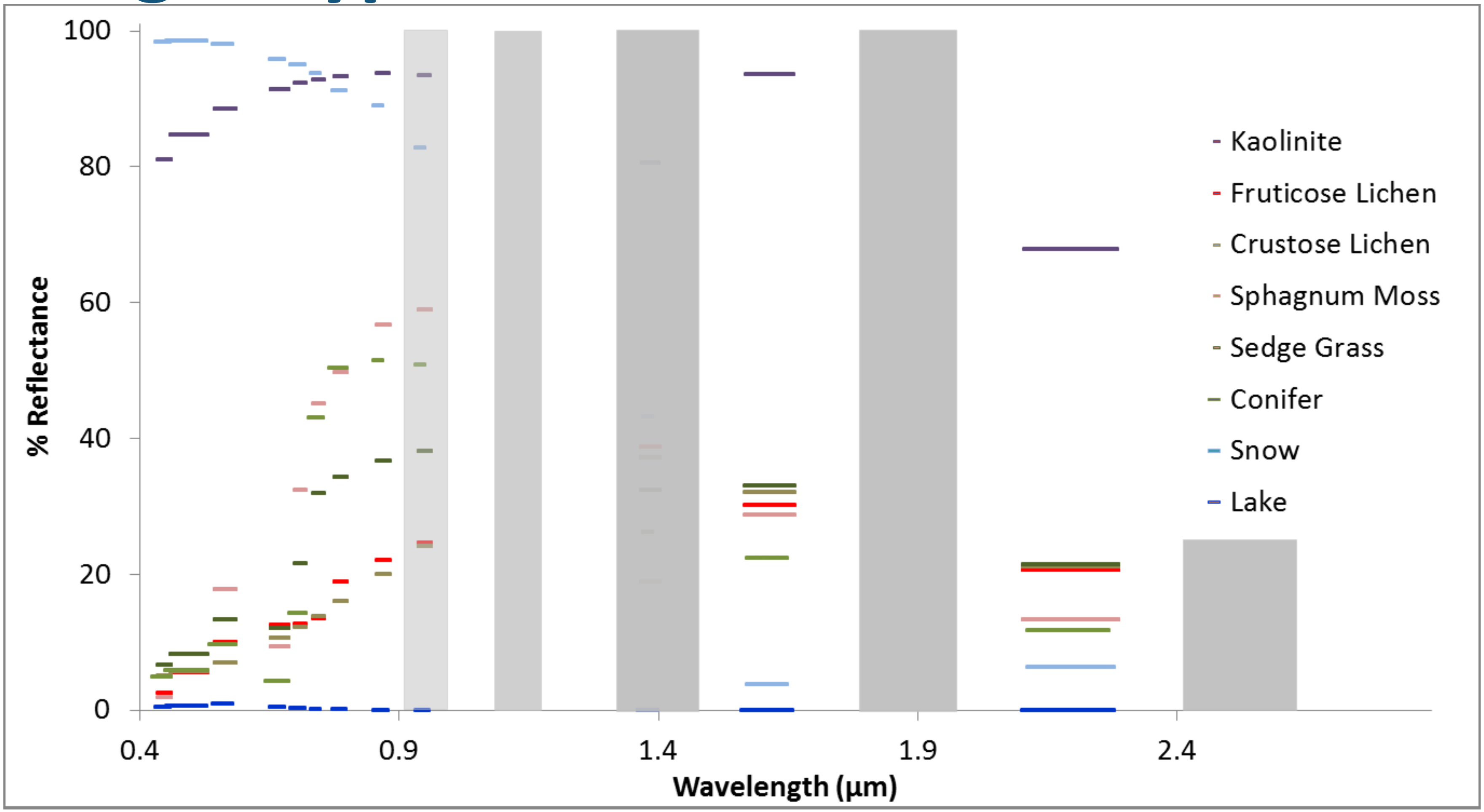
A few Missions – At a Glance

SENSOR	EO-1 Hyperion (U.S.A.)	Proba-1 CHRIS (ESA)	Landsat-8 (USA)	Sentinel-2 (ESA)	EnMAP (DLR)	HISUI (Japan proposed)	HyspIRI (U.S.A proposed)	WaterSAT (Canada Proposed)	CHM Constellation (Canada Proposed)	SHALOM (ITA/ISR proposed)
Proposed Launch	2000 Launched	2001 Launched	2013 Launched	2013 Launched	≥2017	≥2019	≥2020	≥2020	≥2020	≥2020
Bandwidth Coverage	VNIR + SWIR	VNIR	VNIR + SWIR	VNIR + SWIR	VNIR + SWIR	VNIR + SWIR	VNIR + SWIR + ~4–12 µm T	VNIR	VNIR (+ SWIR Band?)	VNIR + SWIR
Spatial Resolution	30 m	17 m	30 m	10 – 60 m	30 m	15 – 30 m	60 m H; 45m T	~ 100 m	≤30 m	???
Spectral Resolution	~ 11 nm	~ 10 nm	20 - 180 nm (9 bands, not contiguous)	15 - 180 nm (13 bands, not contiguous)	6.5 - 10 nm	10 – 12 nm	10 nm H; .08 - .54 µm T	~ 5-10 nm	~ 5-10 nm	???
Swath	7.5 km	560 km	180 km	30 – 60 km	30 km	30 km H 90 km M	~145 km H 400 - 600 km T	~ 250 km	~ 250 km X 3	???

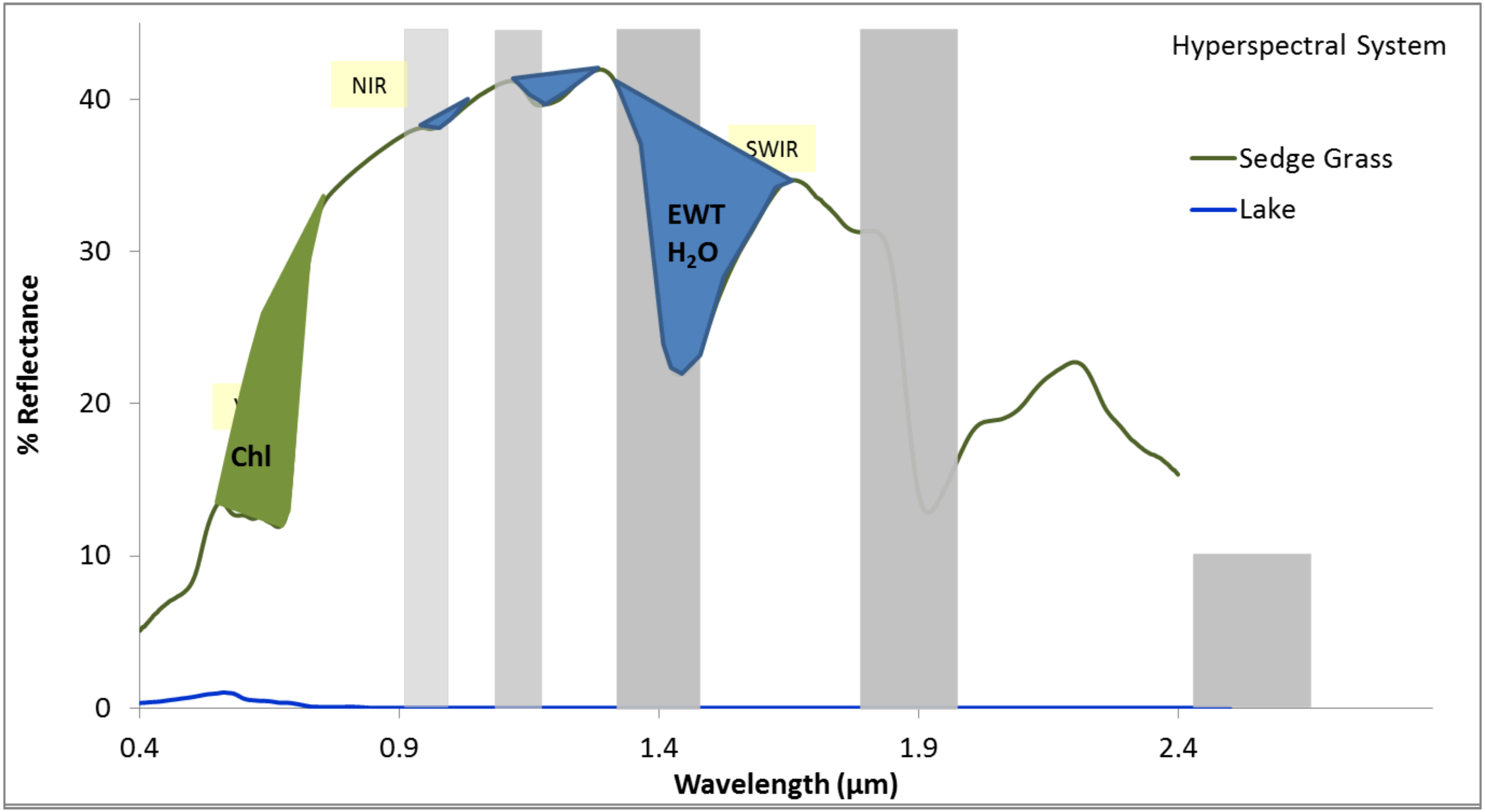
Baseline Values – To be revisited to match technological innovation with user applications

WaterSAT : http://www.asc-csa.gc.ca/eng/media/backgrounders/2014/0429.asp
CHM Constellation : http://www.mdacorporation.com/corporate/news/pr/pr2014042301.cfm

Spectral Signatures of Different Target Types



Spectral Signatures and Spectral Indices



General Processing Scheme – ISDASv2

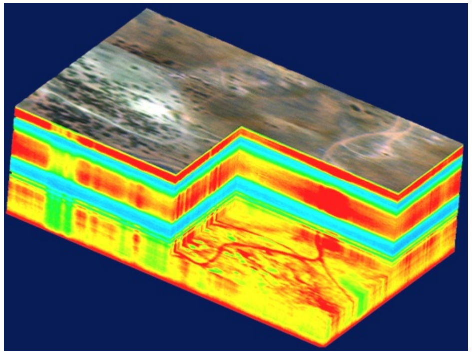
At-Sensor Imagery

Data Preprocessing

Information Extraction

Information

Observed Data Cube



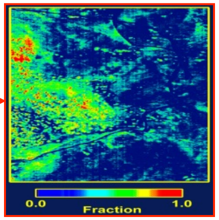
Assess and Calibrate for Sensor/Calibration/Platform Artefacts (Noise, Smile, Keystone, Offsets)

Correct for Atmospheric Influences

At-Surface Reflectance Information Extraction

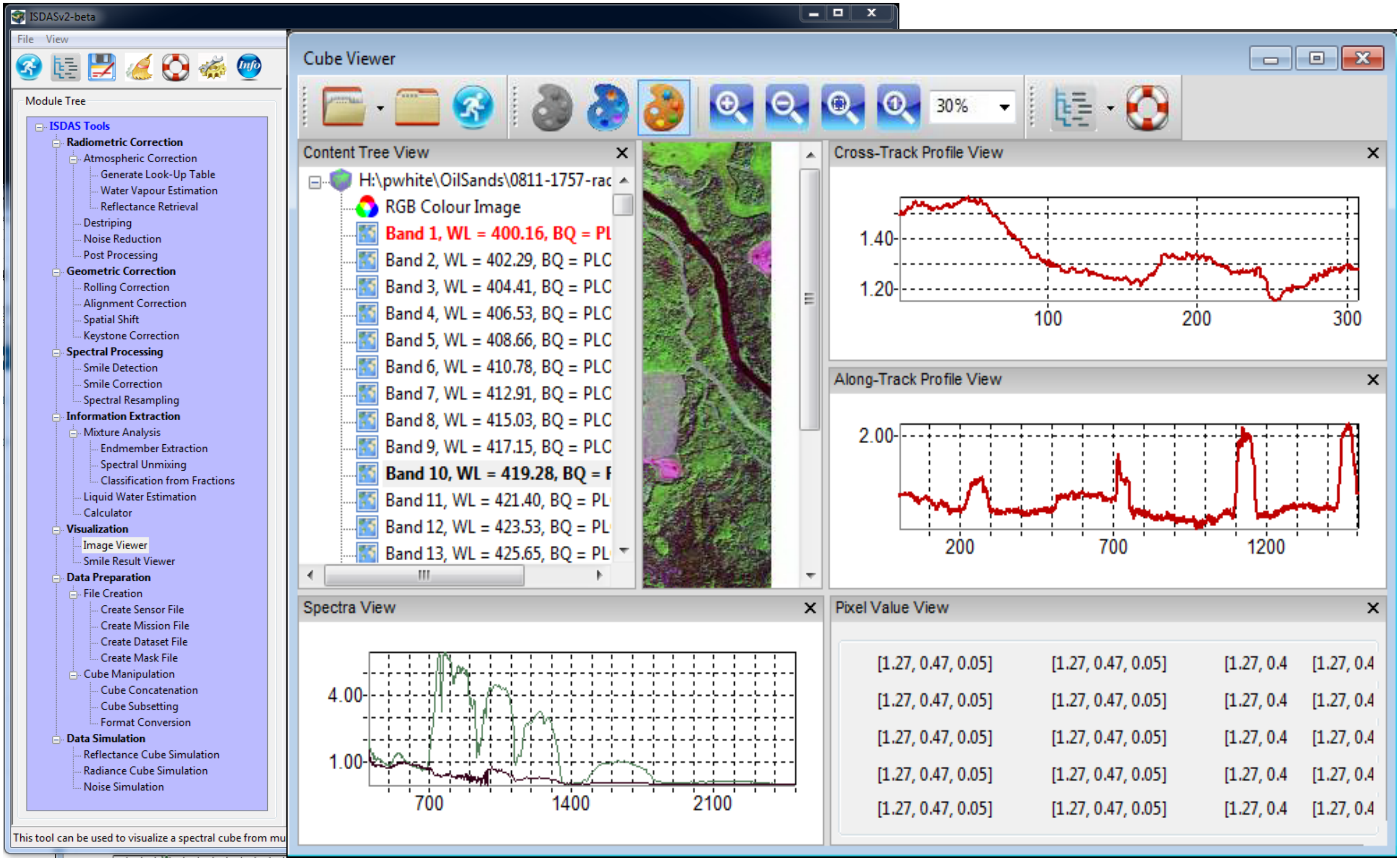
Spectral Library

Information Product



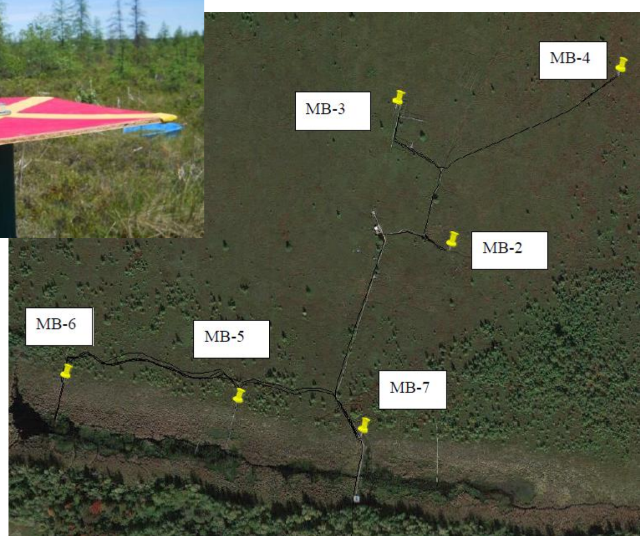
All arrows are in both directions.

ISDASv2 - Data Visualization



Mapping Microtopography: Geodetic and UAV surveys

- High Precision GPS survey from 6 targets on "stable" platforms over Mer Bleue bog. 3D measurements for 24 hours at sub-cm accuracy (Ashtech Zxtreme receivers + NRCan precision point processing).
- Stream gauges and water level meters.
- Aerial photography from various UAVs (Phantom 2 + Spyder PX8). 3D structures are estimated from 2D image sequences -"Structure from Motion" SfM .



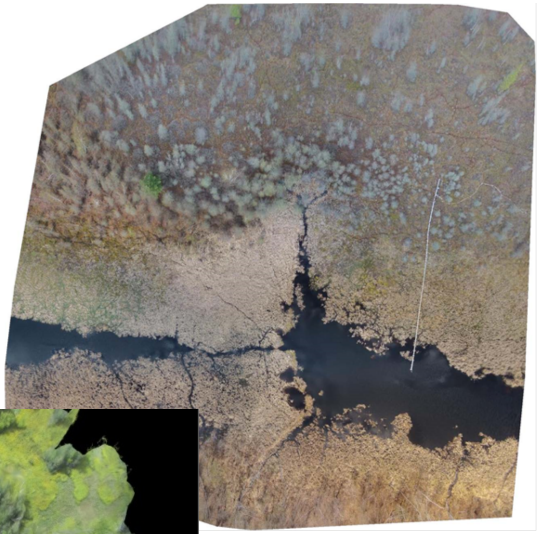
Mapping landcover

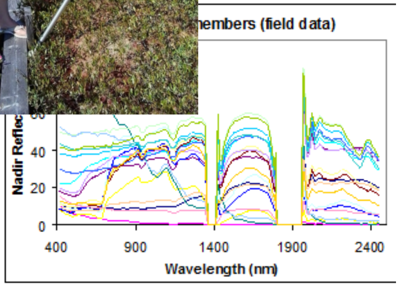
- Aerial photography

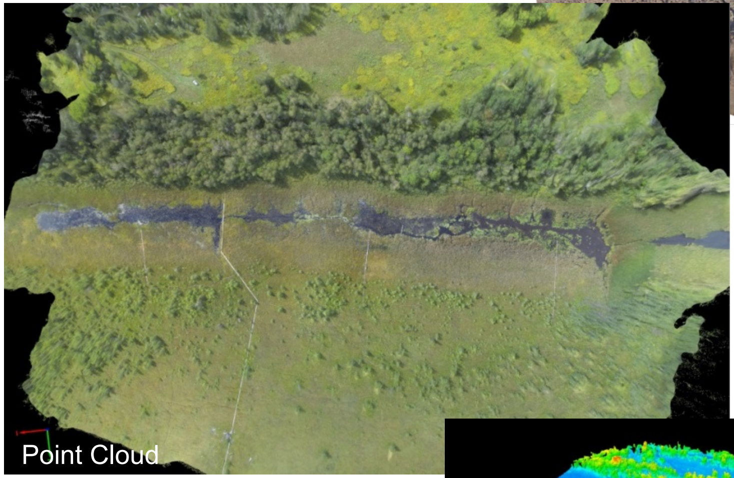
  →

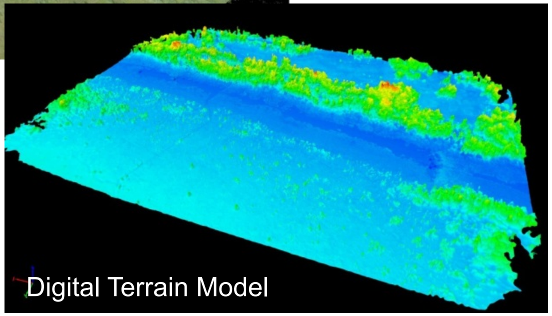
  Orthomosaic, point cloud (DTM)

- Field Spectrometry

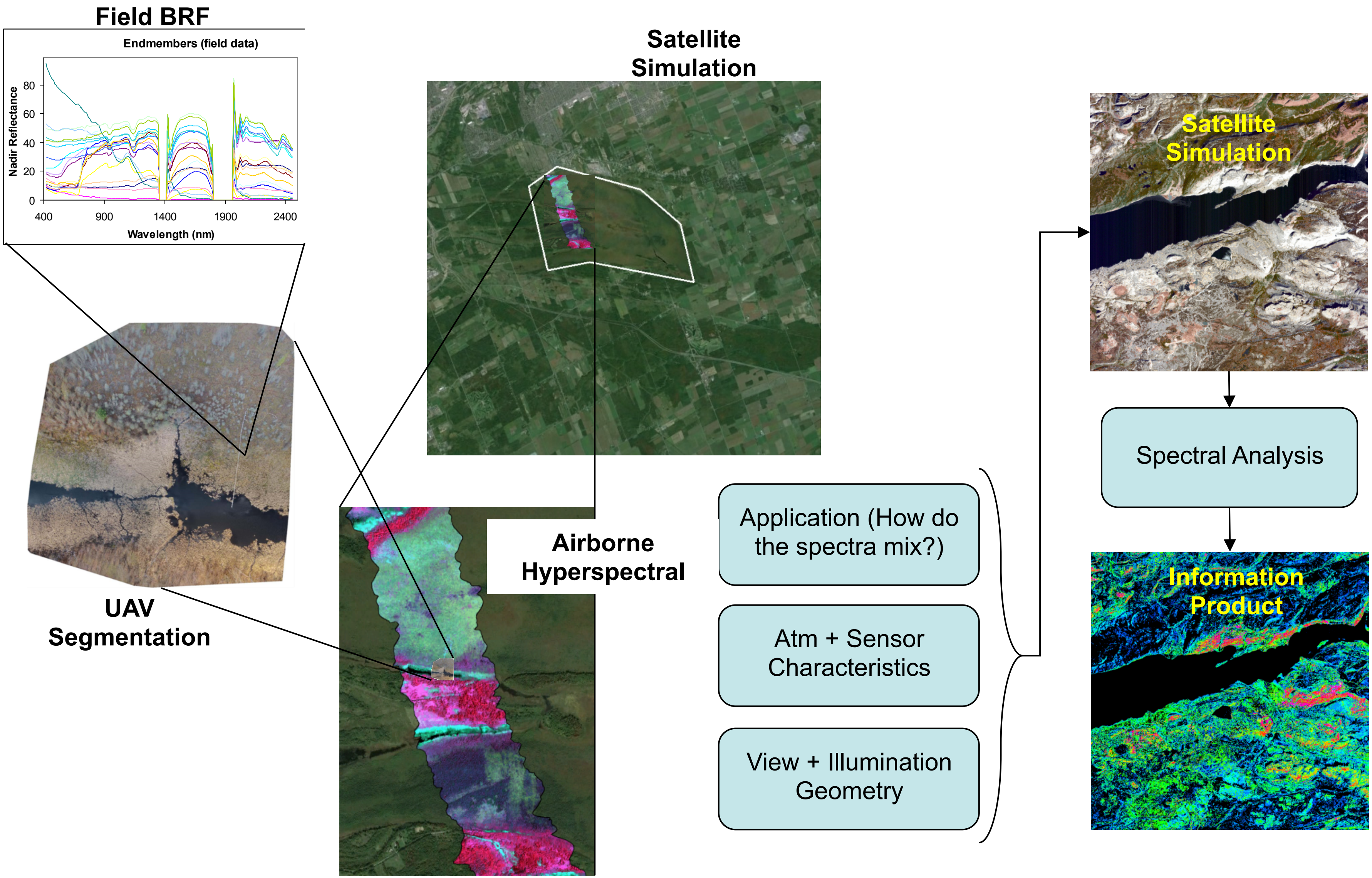






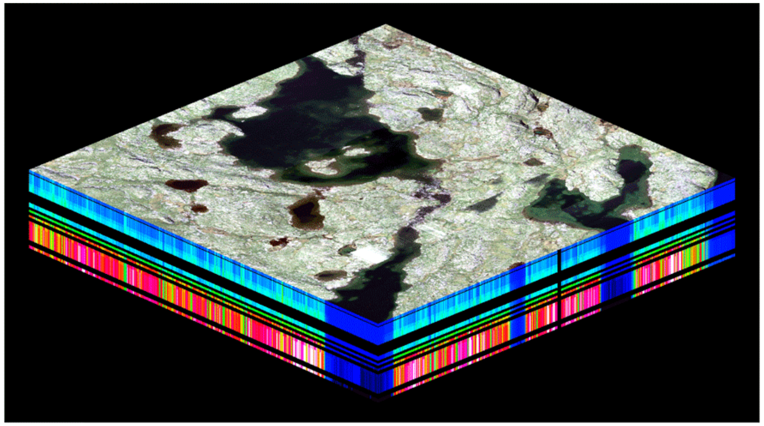


Sensor Simulation – Step-by-Step

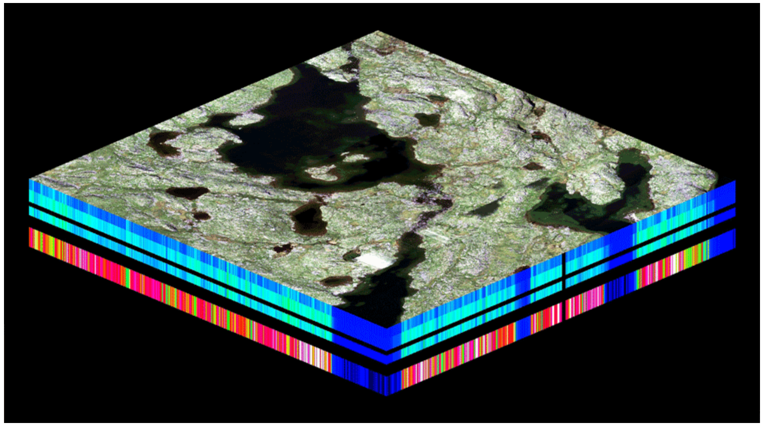


Simulation

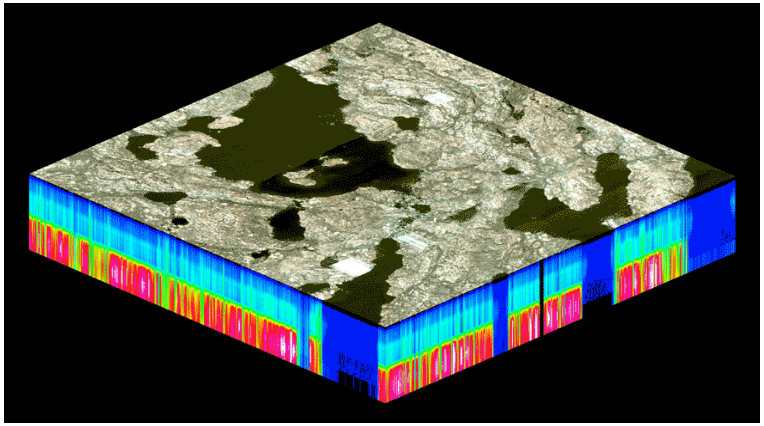
- Relate the application to the sensor
- Cross-sensor migration



Simulated Sentinel-2 bands



Simulated Landsat bands



Simulated EnMAP bands

Thank you for your attention.

We would like to thank the APVE-I Workshop for bring our local community together on this topic, with a special thanks to Françoise Labonté, FLC, and Bojan Bojkov, ESA/ESRIN for their enthusiasm and support as we developed the MBASSS Project.

We would also like to acknowledge the MBPO (Mer Bleue Peatlands Observatory) for their support and discussions as we develop and engage our MBASSS campaigns.

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