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Canadian Plan for SMAP



SMAP Canadian Workshop, Montreal Biosphere, October 2009

Stephane Belair

Science and Technology Branch,

Environment Canada



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SOIL MOISTURE and FREEZE/THAW MISSIONS and CANADA **an HISTORICAL PERSPECTIVE**

Active participation in NASA's ESSP mission Hydros from 2001 to 2005

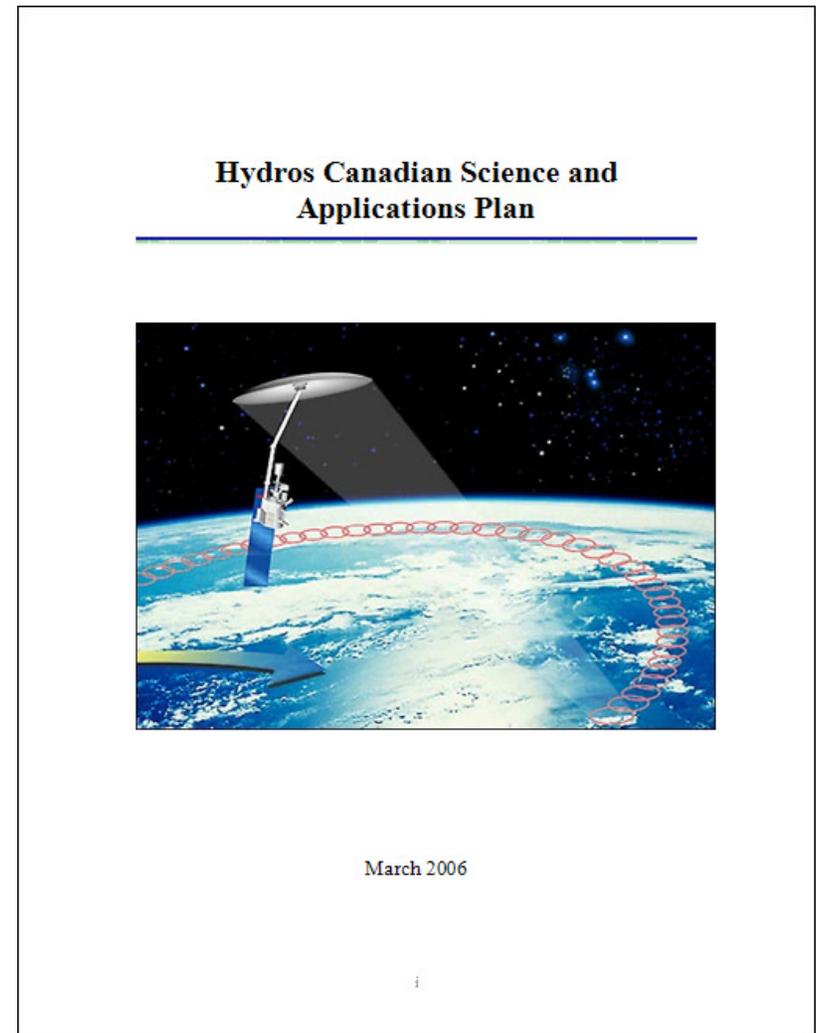
First workshop on Canadian cal-val for Hydros in 2005.

Canadian plan for science and applications was completed in 2006, a few months after the mission was dropped.

Since then, active participation and collaboration for SMOS (ESA's Soil Moisture and Ocean Salinity mission) for cal-val (field campaigns – Ramata Magagi; and land data assimilation – Stephane Belair)

Participation of Canadian scientists to SMAP preparatory meetings

Participation to SMAP science meetings



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CANADIAN ACTIVITIES RELATED TO SOIL MOISTURE and FREEZE / THAW

- ***CGEO initiative to improve soil moisture monitoring in Canada (working group involving people from AAFC, EC, and Stats Canada)***
- ***US-Canada GEO Bilateral Initiative (include testbed over US and Canadian Prairies for soil moisture extremes)***
- ***Drought Research Initiative (DRI)***
- ***Government internal projects: AAFC, EC, NRCan (CCRS) (several of these projects funded by CSA's Government Related Initiatives Program – GRIP)***
- ***Universities: Guelph University, Sherbrooke University, Laval University, University of Calgary, University of British Columbia, Ecole de Technologie Superieure***



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APPLICATIONS RELEVANT to CANADA (in alphabetical order)

Scientific Themes	Description
<i>Air quality and emergency response</i>	Soil moisture is a determining factor for surface evaporation and transpiration. It influences the evolution of the daytime well-mixed boundary layer which modulates pollutants concentration. Research on the impact of urban and natural surfaces on the boundary layer (and on air quality) over populated areas is still in its very early stages.
<i>Agriculture</i>	Soil moisture products (from retrievals or from data assimilation systems) will improve detection, monitoring, and prediction of extreme events, such as droughts and floods. It will also provide information on water availability for plant productivity and potential yield. Freeze/thaw transition maps are also of interest to the agriculture community.
<i>Arctic and northern regions</i>	The short revisit time in Northern regions will make it possible for SMAP to provide frequent estimates of sea-ice edge and sea-ice type in Canadian waters, at 1-3 km resolution. Estimation of freeze/thaw state is also of interest for Northern studies (e.g., freeze/thaw line, permafrost).
<i>Hydrology (include floods and landslides)</i>	Soil moisture and freeze/thaw state are important variables that influence surface runoff and baseflow currents in hydrological models. It is thus a crucial factor in the prediction of floods. Soil saturation also has an impact on the stability of slopes and lead to landslides.
<i>Weather and climate prediction</i>	Soil moisture has a significant impact on weather numerical prediction and on short-range climate prediction (e.g., low-level air characteristics, precipitation), through its control on surface energy budget and on the evolution of the boundary layer. Freeze/thaw state of the soil greatly influences the carbon cycle, also a primary element of climate predictions.



OBJECTIVES of this WORKSHOP

The objective of this Workshop is to develop a consolidated plan for the Canadian participation to the SMAP mission that would address the needs of different Canadian Government Departments and the Academia, to evaluate the impact of the proposed Canadian participation in the mission, and to devise synergies among different international efforts towards a better understanding of the water and carbon cycles and their impact on weather and climate.



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MAIN ASPECTS of CANADIAN PLAN

1) Calibration and validation of SMAP observations and retrieval algorithms

2) Applications of SMAP data (soil moisture and freeze/thaw retrievals, land data assimilation)



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CALIBRATION - VALIDATION MAIN OBJECTIVES

Contribute to the calibration and validation of SMAP soil moisture and freeze/thaw observations and retrievals by acquiring and processing experimental data over areas with ecosystems and climatic conditions typical to Canada. This contribution will be achieved by maintaining or establishing a few core validation sites and by conducting field campaigns with airborne or surface-based L-band remote sensing.



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CALIBRATION – VALIDATION: CORE VALIDATION SITES PRESENTATIONS

Soil moisture network in Southern Ontario and Saskatchewan

Aaron Berg, University of Guelph

High-resolution soil moisture network in Saskatchewan

Alain Pietroniro / Brenda Toth, Environment Canada

The BOREAS project

Anne Walker, Environment Canada

Canadian flux sites for forests and peatlands

Hank Margolis, Laval University



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CALIBRATION – VALIDATION: CORE VALIDATION SITES

QUESTIONS / ISSUES

- Requirements for soil moisture and freeze / thaw core validation sites (period of activity, nesting strategy, vertical profiles, ...)
- Existing networks (as is or with required modifications)
- Should we target other areas (climate and ecosystems)
- External (international) contributions ?
- Other opportunities ? (e.g., AAFC supersite)
- Links with SMOS cal-val
- Access to SMOS, AMSR, Aquarius, PALSAR and RADARSAT data?
- Scientific research related with in-situ measurements (upscaling, evaluation metrics, relation with topography and with soil characteristics, ...)



CALIBRATION – VALIDATION: FIELD EXPERIMENTS PRESENTATIONS

SMOS Canadian field campaign in 2010

Ramata Magagi, Sherbrooke University

Possible airborne activities

Anne Walker, Environment Canada



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CALIBRATION – VALIDATION: FIELD EXPERIMENTS

QUESTIONS / ISSUES

- Synergy with SMOS-related activities (e.g., 2010 field campaign)
- Available tower and airborne L-band sensor systems in Canada? Compatibility with SMAP instrument configuration?
- Opportunities for external (international) contributors
- Pre-launch (how soon) and post-launch campaigns
- Campaigns for soil moisture and freeze / thaw
- US – Canada cross border campaign ?



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RESEARCH, DEVELOPMENT, and APPLICATIONS

MAIN OBJECTIVES

- ***Improve environmental predictions by including and evaluating the impact of SMAP data in governmental and academic prediction and analysis systems:*** Both passive and active data will be introduced into the Canadian Land Data Assimilation System (CaLDAS) currently being developed at Environment Canada. Their impact on numerical environmental prediction will be evaluated. Remote sensing data from SMAP could also be evaluated in the context of AAFC's operational assessment of crops and soils in Canada.
- ***Improve retrievals of soil moisture and freeze / thaw state:*** Algorithms will be developed to optimally combine SMAP passive and active data with other Earth Observations data (e.g., C-band SAR) to retrieve soil moisture and the freeze / thaw state.



RESEARCH, DEVELOPMENT, and APPLICATIONS **PRESENTATIONS**

Retrievals of land surface temperature under snow and snow water equivalent using 10, 19, and 37 Ghz brightness temperatures

Alain Royer, **Alexandre Langlois**, Jacqueline Kohn, Ally Touré, and Kalifa Goita, CARTEL, Sherbrooke University

Remote sensing of soil moisture and soil freeze/thaw at INRS

Monique Bernier and Karem Chokmani (Université Laval)

SMAP's active radar sensor for monitoring soil moisture to support agricultural risk mitigation

Heather McNairn, Agriculture and Agri-Food Canada

CCRS soil moisture and freeze/thaw activities

Francois Charbonneau, Alexander Trichtchenko, Shusen Wang, Brian Briscoe (Canadian Centre for Remote Sensing)

Inclusion of SMAP data in the Canadian Land Data Assimilation System and data impact studies on numerical weather and hydrology predictions

Marco Carrera and Stéphane Bélair, Environment Canada



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RESEARCH, DEVELOPMENT, and APPLICATIONS

QUESTIONS / ISSUES

- Systematic use of SMAP data in other Canadian institutions – government or others (e.g., Canadian Ice Centre, Statistics Canada, Canadian Forest Service)?
- Links / participation to SMAP Applications Working Group
- Other R&D projects for the improvement of soil moisture and freeze / thaw retrievals using SMAP data, alone or in conjunction with other sensors?
- Links / participation to SMAP Algorithms Working Group



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PARTICIPANTS to this MEETING

Canadian Government

Environment Canada	9	}	27
Canadian Space Agency	8		
Agriculture and Agri-Food Canada	5		
Canadian Centre for Remote Sensing	3		
Canadian Ice Centre	1		

Canadian Universities

Guelph	2	}	14
Sherbrooke	3		
Laval	3		
Memorial	1		
Calgary	2		
UBC	1		
Ecole de Technologie Superieure	2		

US Government

US Dept. of Agriculture	1	}	8
NASA and JPL	6		

US Universities

MIT	1	}	2
Florida	1		

Others (CGEO and Industry)

3	3
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A FEW TECHNICALITIES

Coffee breaks AM and PM

Lunch provided for both days (or you can go to the Helene de Champlain restaurant)

Today, free visit of the Biosphere (~ 20 min, optional of course) – followed by a group photo (because tomorrow it will rain !)

Taxi for those who want to go directly to airport

“Green” policy of the Biosphere

... and don't get lost on the Islands or at the Casino ...

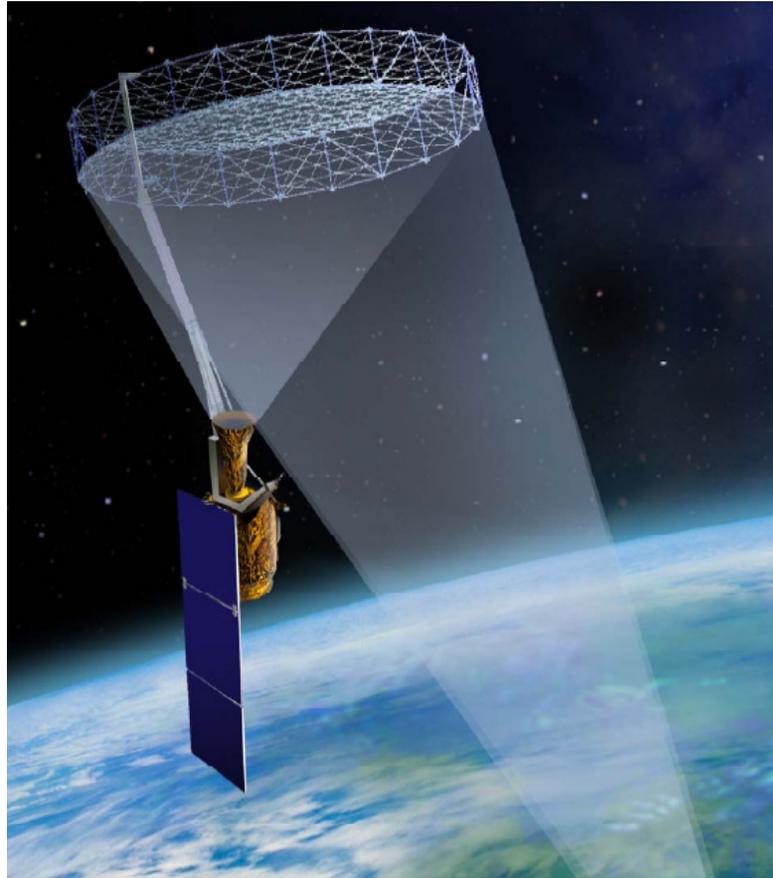


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THANK YOU for your ATTENTION



and GOOD WORKSHOP !



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