Update of SWOT Cal/Val Activities in Canada

Alain Pietroniro, Daqing Yang, Daniel Peters, Chris Spence Environment and Climate Change Canada



SWOT–Canada:

Team, Partners, and key US Colleagues

ECCC

- Dr. Alain Pietroniro Water Survey of Canada
- Dr. Daqing Yang Water Science and Technology
- Dr. Dan Peters Water Science and Technology
- Dr. Vincent Fortin Atmospheric Science and Technology
- D. Stiff, J. Woodward, JM Fiset Engineers NHS
- Scott Hill, Corey Hein, Cody Garbutt, Tim Ma, Cuyler Onclin, Tom Carter and many others

U of Saskatchewan – Partnering with the GWF program, including Dr. John Pomeroy, Dr. Lawrence Martz and soon with Dr. Jay Famiglietti

CSA – Robert Saint-Jean – Program managers **Universite de Sherbrooke** – Dr. Robert Leconte, ing. and team

US Colleagues

- Dr. Larry Smith UCLA, Department of Geography
- Dr. Tamlin Pavelsky- Univ. of North Carolina, Dept. of Geology
- Dr. Colin Gleason University of Massachusetts, Civil Engineering
- Dr. Toby Minear NCAR

Session: OS-1B, Surface Water and Ocean Topography (SWOT)

Chair: Al Pietroniro; 10:20 - 12:00 Tuesday, 19th June, Selkirk_Marquis

•10:20: <u>SWOT contribution to improve the spatial knowledge of water levels and catchment inflows of Eastmain-1 reservoir</u>, Sébastien Langlois (Université de Sherbrooke), Robert Leconte (Université de Sherbrooke), Mélanie Trudel (Université de Sherbrooke), Gabriela Siles (Université de Sherbrooke)

•10:40: Assessment of the capabilities of the SWOT mission for improving the water balance of a large wetland complex Robert Leconte (Université de Sherbrooke), Mélanie Trudel (Université de Sherbrooke), Jean Bergeron (Université de Sherbrooke), Daniel Peters (Environment and Climate Change Canada), Al Pietroniro (Environment and Climate Change Canada), Sébastien Langlois (Université de Sherbrooke), Gabriela Siles (Université de Sherbrooke)
•11:00: Implications of SWOT Satellite for Research and Monitoring in Canada: A Case Study of the Peace-Athabasca Delta Region, Daniel Peters (Environment and Climate Change Canada), Donald Baird (Environment and Climate Change Canada), Jean Francois Cantin (Environment and Climate Change Canada), Jean-Michel Fiset (Environment and Climate Change Canada), Vincent Fortin (Environment and Climate Change Canada), Robert Leconte (Université de Sherbrooke), Olaf Niemann (university of Victoria), Al Pietroniro (Environment and Climate Change Canada), Robert Saint-Jean (Canadian Space Agency), Gabriela Siles (Université de Sherbrooke), Doug Stiff (Environment and Climate Change Canada), Rob Skelly (university of Victoria), Mélanie Trudel (Université de Sherbrooke), Daqing Yang (Water and Climate Impacts Research Centre)

•11:20: <u>Field validation and science synergy for the SWOT mission: lessons learned in the field</u>, Colin Gleason (University of Massachusetts)

•11:40: <u>2017 SWOT field compaign and data analysis for the Redberry Lake cal/val site</u>, Daqing Yang (Water and Climate Impacts Research Centre, ECCC), Alain Pietroniro (WSC, ECCC), Cuyler Onclin (NHRC, ECCC)

Session: OS-6A, Advances in remote sensing techniques for digital elevation modelling

Chair: Karl-Erich Lindenschmidt & Apurba Das, 5:20 - 17:00 Wednesday, 20th June, Montcalm-Marquis •16:20: <u>AirSWOT InSAR measurements of water surface elevations and hydraulic gradients over the Yukon Flats, Alaska</u>, Lincoln Pitcher (University of California Los Angeles), Tamlin Pavelsky (University of North Carolin, Chapel Hill), Laurence Smith (University of California Los Angeles), Delwyn Moller (Remote Sensing Solutions), Elizabeth Altenau (University of North Carolin, Chapel Hill), Sarah Cooley (Brown University), George Allen (University of North Carolin, Chapel Hill), Christine Lion (University of North Carolin, Chapel Hill), David Butman (University Of Washington)

Session: OS-7D, Water and Wetlands_5, Chair: Sarah Banks, 10:20 - 12:00 Thursday, 21st June, BIOL 124 •11:20: <u>Tracking fine-scale seasonal evolution of surface water extent in Northern Canada and Alaska using CubeSat</u> <u>imagery</u>, Sarah Cooley (Brown University), Laurence Smith (University of California), Lincoln Pitcher (University of California), Tamlin Pavelsky (University of North Carolina at Chapel Hill), Jonathan Ryan (UCLA)

Cal/Val Sites - Rivers and Lakes

River Sites

- Yes: Upper St. Laurent, North Saskatchewan River
- Yes Rainy-Namakan (sort of a river)
- Maybe : Artic Red/Mackenzie, Slave River



Lake Sites Redberry Lake, SK; St. Denis, SK, Baker Lake, NWT, Rainy-Namaken chain of lakes

> Science Sites PAD: Existing network of lake gauges in summer, implementation of a full 2-D model and reasonable network of gauges.

Great Lakes : NEMO model operational and some interests in assimilation

St. Laurent – H2D2 operational 2D model interest in assimilation



Water level changes in closed-basin lakes, Canadian prairies



1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020



Garth van der Kamp and John-Mark Davies, CWRA, in review



Redberry Lake and Biosphere Reserve

- UNESCO Biosphere Reserve (BR) research facility http://redberrylake.ca/whoweare/index.php
- long-term data/info of lake level and bathymetry
- Easy access all season, close to Saskatoon/NHRC
- AirSWOT flight target, under SWOT orbit, almost next to the N. Sask river SWOT site
- close link to WSTD/WHERD climate change study/program







2017 springsummer work

- Contact Redberry/BR for research permit/and access to private lands/ponds
- Collect past data, i.e. water level, water extent (Landsat/SAR data), and met/climate data, particularly wind effect on lake water surface slope
- Field trip(s) for site selections including ponds and lakes nearby
- Set up 3-4 water level sensors (pressure transducers/or SR50) around the lake, strings of water temp sensors in the lake, 1 met station on the island, another one on sailing camp and precip gauges, RTK survey from the bench marks
- Explore lake ET observations via met tower and evaporation pans
- Test out SWOT GPS water level floats and other equipment (i.e. UCLA/USGS)
- Intensive water level and slope measurements during AirSWOT flights (early July and mid Aug)
- Vegetation survey around the lake



Water elevation (m) & temp (C), at boat launch



Water surface elevation (m) at RBL shore





Water surface elevation (m) survey



Met. station on Gull Island



Met. data for summer 2017









Shoreline GPS survey 3 ponds, summer 17









Pond 3 from the drone









Water level survey at St. Denis Jul and Aug, 2017

July 7, 2017 Pond 1: 549.49 m Pond 26: 551.28 m Pond 66: 545.54 m

August 17, 2017 Pond 1: 549.33 m Pond 26: 551.15 m Pond 66: 545.42 m

All levels are orthometric elevations in CGVD2013

Lake/pond shoreline survey St. Denis, summer 2017



North Saskatchewan River





North Saskatchewan River Reach

- Total Length: ~45km but can be extended in either direction
- Width between 200 and 300 m
- Flow range from 200 to 200 CMS
- No major tributary inflows
- No controls
- WSC may install a permanent gauge around Petrofka bridge
- River slope is low
- Wind and vegetation effects?

Water surface elevation (m), N SK River, summer 2017











Water surface slope, N SK river, summer 2017

Slope: about 7m/45km, or 15cm/km







Landing Lake (Baker Creek) 62°33'24.06"N 114°24'14.57"W



All Baker Creek Water Levels have Orthometric Heights in CGVD2013



Vital Lake (Baker Creek)

62°35'37.92"N 114°26'11.13"W



All Baker Creek Water Levels have Orthometric Heights in CGVD2013





SWOT link to SMAP?

Wenqing Tang, Simon Yueh, Daqing Yang, Alexander Fore, Akiko Hayashi, Tong Lee, Severine Fouriner, Benjamin Holt, 2018: The potential and challenges of using SMAP SSS to monitor Arctic Ocean freshwater changes, *Remote Sensing*

Future plans

Redberry lake and nearby ponds (Yang et al)

- Met, hydro, and bathymetry data collections with CSA and EC funds
- 2017 summer data analyses to compare in-situ and Air-SWOT measurements, i.e. shoreline, size, and elevation
- Lake water budget and climate analyses to examine the long-term/recent changes
- Set-up/run the H2D2 hydrodynamic model to determine wind effect on WSE slope across the lake

St. Denis ponds (Spence et al)

- Met and hydro data collections with UofS and EC funds
- data exchange and analyses to compare in-situ and Air-SWOT measurements

N. SK River (Pietroniro et al)

- WSE, flow, bathymetry data exchange and analysis with US team
- Participation and contribution to algorithm development and testing
- Set up a WSC gauging station at the bridge or ferry?

• PAD (Peters/Leconte et al)

- Data collection and analysis
- H2d2 model run and test
- SAR for water extent
- Yellowknife lakes (Spence et al)
 - Field data collection via EC and GWF funds
 - 2017 summer data analysis and exchange, i.e, Air-swot data vs. in situ data
- Mackenzie delta (Marsh/Smith et al)
 - Lake and wetland work with GWF and ABoVE programs

Need more discussions within SWOT-C and with US groups



