Coordination and Sharing of Data to Calibrate and Validate Synthetic Aperture Radar Data and <u>Geophysical Products</u>

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What is the need

- Sharing of existing and new bio and geophysical data
  - To measure and improve the performance of algorithms used to create higher level products
  - To measure the performance of different algorithms using the same data

- Super or mega-sites
  - Many already exist but need to be discoverable by the community
  - Could facilitate collection of "standardized" bio and geophysical measurements
  - These sites should represent the diversity of global ecosystems and environments

Developing Robust Methods
## Example from AAFC Research Team (crop type and condition using SAR)

Research led by AAFC

Research led by collaborators

Data collected; needs research

Example of Benefits
Crop Type and Condition

Crop Type Classification
Random Forest
RADARSAT + Sentinel-1

Leaf Area Index
Water Cloud Model compared to Support Vector Machine
RADARSAT + Sentinel-1
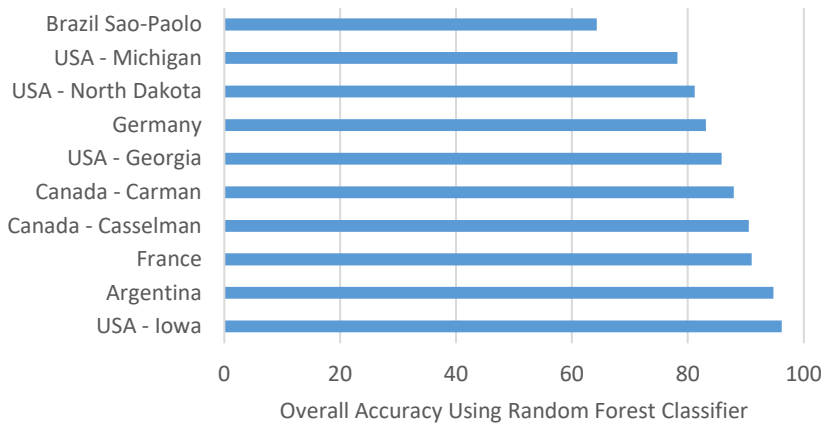
Dingle Robertson, L., Davidson, A.M., McNairn, H., Hosseini, M., Mitchell, S., de Abelleyra, D., Verón, S., le Maire, G., Planells, M., Valero, S., Ahmadian, N., Coffin, A., Bosch, D., Cosh, M.H., Basso, B., and Saliendra, N. (2020). C-Band synthetic aperture radar (SAR) imagery for the classification of diverse cropping systems, International Journal of Remote Sensing, 41: 9628-9649.
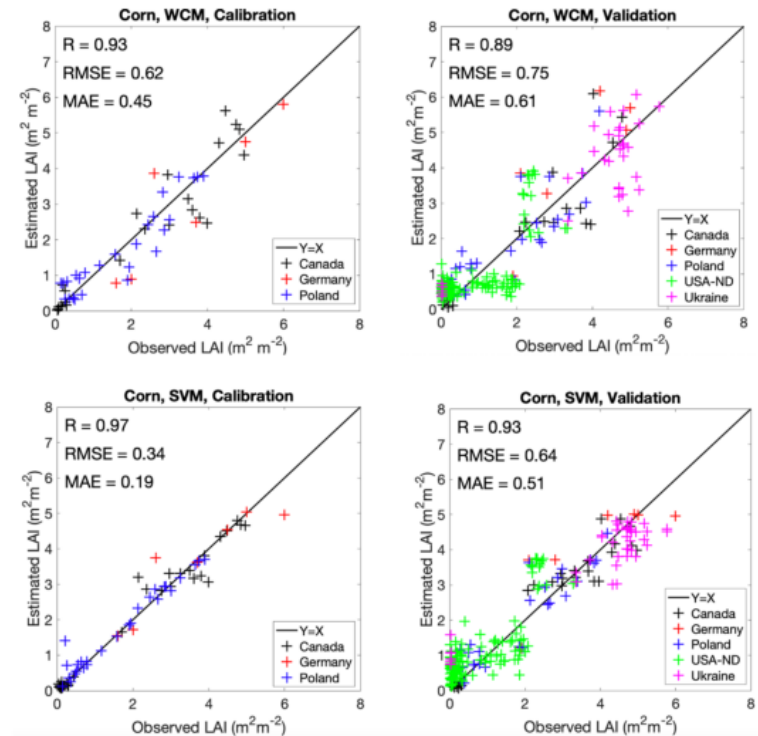
Hosseini, M., McNairn, H., Mitchell, S., Dingle Robertson, L., Davidson, D., Ahmadian, N., Bhattacharya, A., Borg, E., Conrad, C., Dabrowska-Zielinska, K., de Abelleyra, D., Gurdak, R., Kumar, V., Kussul, N., Mandal, D., Rao, Y.S., Saliendra, N., Shelestov, A., Spengler, D., Veron, S.R., Homayouni, S., and Becker-Reshef, I. (2021). A comparison between support vector machine and water cloud model for estimating crop leaf area index, Remote Sensing, 13, 1348, doi:10.3390/rs13071348.

Example of Benefits
Soil Moisture

Soil Moisture
SMOSAR, Sentinel-1
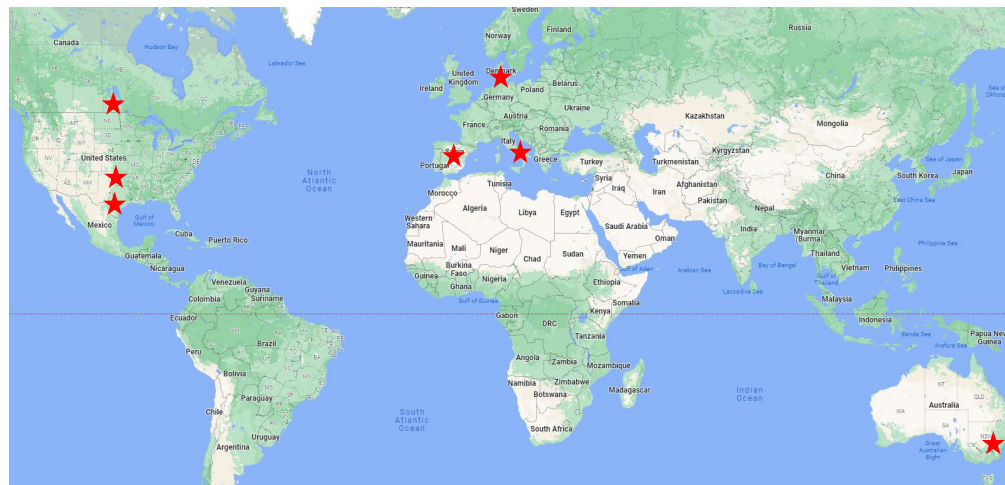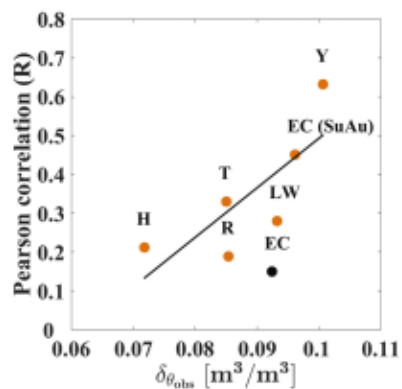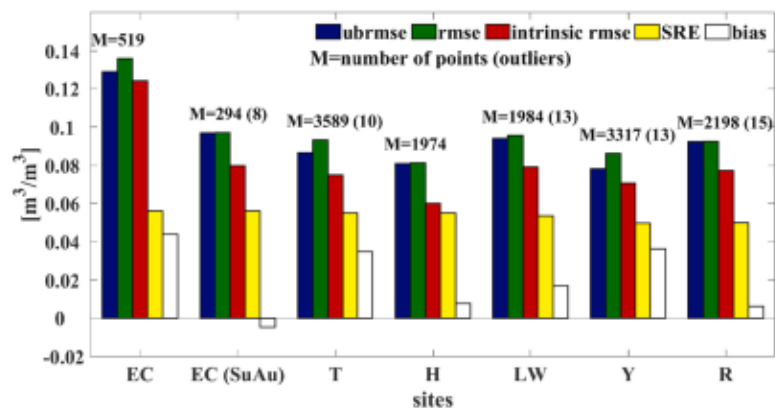
Balenzano, A., Mattia, F., Satalino, G., Lovergine, F.P., Palmisano, D., Peng, J., Marzahn, P., Wegmüller, U., Cartus, O., Dabrowska-Zielińska, K., Musial, J.P., Davidson, M.W.J., Pauwels, V.R.N., Cosh, M.H., McNairn, H., Johnson, J.T., Walker, J.P., Yueh, S.H., Entekhabi, D., Kerr, Y.H., and Jackson, T.J. (2021). Sentinel-1 soil moisture at 1km resolution: a validation study, Remote Sensing of Environment, 263, doi: doi.org/10.1016/j.rse.2021.112554.

Further Testing of SMOSAR in Canada

Controlled Tile Drainage
Dr. David Lapen (AAFC)
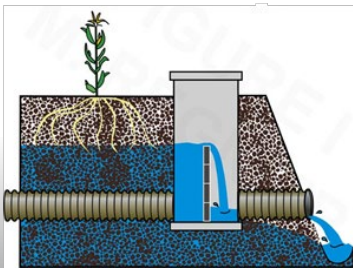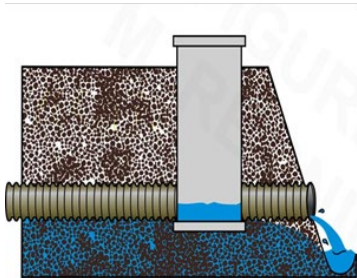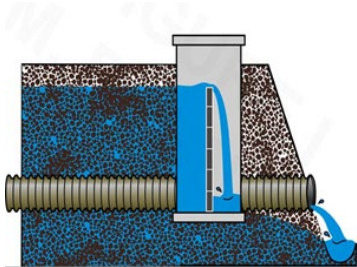
Rod Bonnett (president of the Canadian Federation of Agriculture):
"Canada is one of the few countries where climate change may create some opportunities for growing crops in northern latitudes."

In one zone of clay soil stretching from Cochrane, Ontario to Abitibi Country in neighbouring Quebec province, climate change could bring 10 million acres (about 4 million hectares) of new farmland – an area larger than Belgium – into production[1]

Soil moisture map by SMOSAR on 2018/07/30

Estimates of surface soil moisture using the SMOSAR and Sentinel-1

Soil moisture [m³/m³]
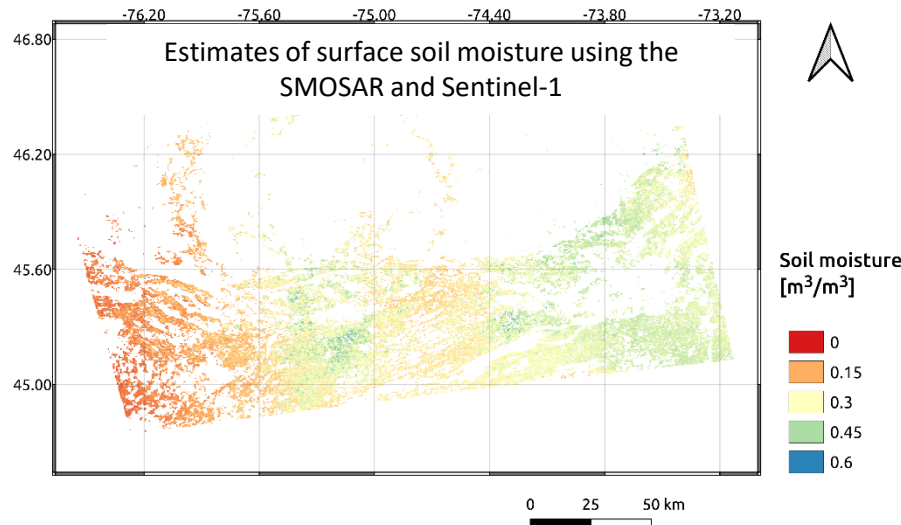
Map produced by Dr. Andrea Scott, University of Waterloo

[1]In Canada, climate change could open new farmland to the plow, Chris Arsenault, Thomson Reuters Foundation, 24 September 2017

Examples of Sharing In Situ Data

	SMAPVEX cal/val experiments	JECAM-SAR experiment	International Soil Moisture Network
Lead	Jet Propulsion Lab	Agriculture and Agri-Food Canada	TU Wien, Vienna
Approach	Signed agreement outlined what & how data will be provided, including cal standards	Best effort basis	Link with existing networks (in Canada, RISMA led by AAFC)
Data sharing	Data held for 2 years to protect grad students, then publically available	Agreement to share amongst JECAM collaborators	Open
Where is data	nsidc.org/	On AAFC computers	ismn.geo.tuwien.ac.at/en/
What I liked	- well described standards and expectations - agreement signed by managers (a higher level commitment)	- able to test algorithms on data not collected with same protocol (more reflective of reality)	- low incremental investment by contributors - collection and reporting of statistics of usage
What I did not like	- very taxing on existing resources (1-2 years of planning)	- hodge podge of data (some good, some not)	- relies on existing project-based funding
Funding	In Canada: AAFC, CSA, ECCC to support students, field work, equipment/supply procurement etc.	Required dedicated AAFC hires to manage collaboration (funded by CSA)	In Canada: Project based (AAFC funds)

Questions on how to move forward

- Explicit expectations on how data are collected (SMAPVEX example) or best effort (JECAM-SAR example)?

- What are the benefit to collaborators and how do we articulate these?

- How do we protect data needed for graduate students?

- How and where do we host data or links to data?

- How do we resource this effort? - collation of data (gathering, QC, metadata) and creating access requires dedicated resources