Good Practices for the Use and Interpretation of “Core Site” Validation Products

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Outline

• Importance of instrument calibration

• Use of field campaigns for understanding network scaling

• Sensors and potential sensor bias

• Use of sensors in freeze thaw calibration validation
Location of major in situ sampling networks in Canada.
Approach to In-Situ Instrument Calibration
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Several calibration experiments performed (e.g. Rowlandson et al. 2013) identified that factory calibration is $> 0.04$ VWC.

Dry down calibration of cores obtained from in-situ sensor sites is recommended (RMSE $< 0.02$ VWC) (Burns et al. 2014)

Example water content calibration equation (Site 1 - 5 cm depth soil sample):

$$y = 0.11x - 0.2519$$

$$R^2 = 0.9853$$
Approach to In-Situ Instrument Calibration

General Calibration Equation
Site Specific Calibration

Climate class: Cold (Dfb)
Landcover: Croplands

Soil texture:
S-%: 32
C-%: 23
BD: 1.22

L2_SM_P-BL (T11630-199): 2701-36-01 (Kenaston) (51.45, -106.46; -2364, -528)

Precip [mm/day]

0 75 150

VSM [m^3/m^3]

0 0.1 0.2 0.3 0.4

0405 0412 0419 0426 0503 0510 0517 0524 0531 0607 0614 0621 0628
Corroboration of network average to field data evaluated during CanEX-SM10. 60 fields sampled (48 measurements/field) across domain while network was operated.
Corroboration of network average to field data evaluated during SMAPVEX-12. 55 fields sampled (48 measurements/field) across domain while network was operated.
Previous work has suggested that at the radiometer footprint scale the network mean is adequate for representing the mean of the pixel (Rowlandson et al. 2015).

Comparison of network mean (line) to 48 measurements taken from ~60 individual fields. Bias between network and field measurements is less than 1% VWC.
Value of field Campaigns for Understanding Network Up-Scaling Approaches

Up-scaled AAFC network soil moisture compared to field-sampled data (~55 fields) over SMAPVEX12 (Adams et al. 2015)
Up-scaling agreement between $\theta_{\text{SMAPVEX12}}$ field-sampling and $\theta_{\text{SMAPVEX12}}$ dense network datasets, where $\theta_{\text{SMAPVEX12}}$ dense network is determined using arithmetic averaging, Temporal Stability, Inverse Distance Weighting, Kriging, and Theissen Polygons. Note: For determination of interpolation techniques a 36$^2$ km$^2$ footprint was centered on the SMAPVEX12 domain. (Adams et al. Submitted)
AAFC network level statistical moments compared between $\theta_{3.5-6.5\text{cm}}$ and $\theta_{0-5.7\text{cm}}$ measurement depths over 2012-13. Figure A shows the network mean. Figure B show comparison between network and field samples based on probe orientation.
Comparisons between SMOS Level 2 soil moisture product and up-scaled AAFC network soil moisture (m3m-3) over 2012-13.

Note that the vertically oriented probes (A) have lower RMSE values and higher correlation.
Issues with Calibration of Validation of Freeze Thaw Products using Hydra Probes

Variability of soil temperature and measured soil dielectric during a freeze thaw cycle at the surface and 5 cm depth (9 stations with sensors installed at 0cm Vertical, and 5cm over a 400m² region)

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\Delta(t) = \frac{\varepsilon_r'(t) - \varepsilon_r'_{fr}}{\varepsilon_r'_{th} - \varepsilon_r'_{fr}}
\]
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SMAPVEX12 field crew during training at the AAFC Regional Operations Centre in Winnipeg June 6th, 2012