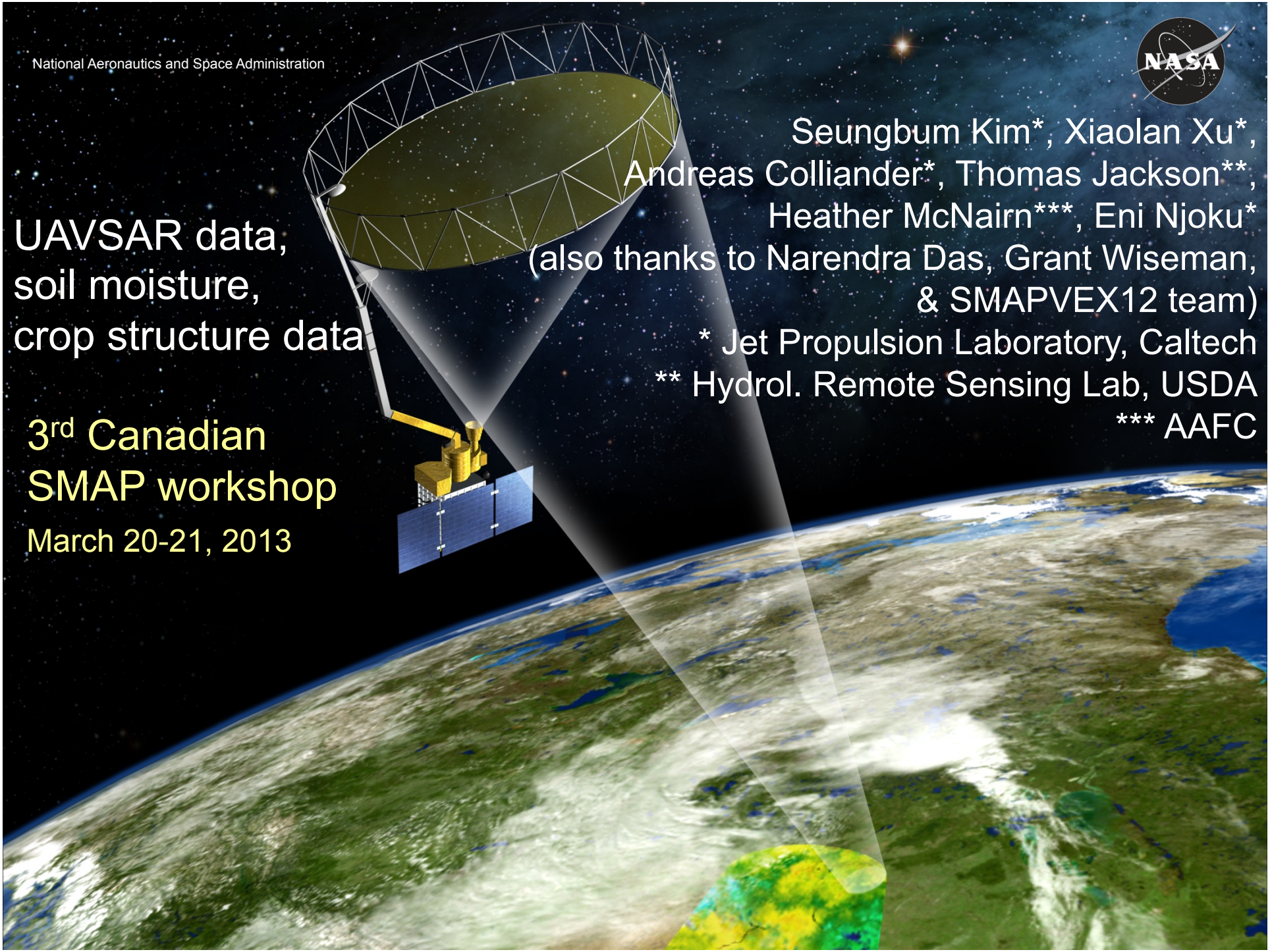
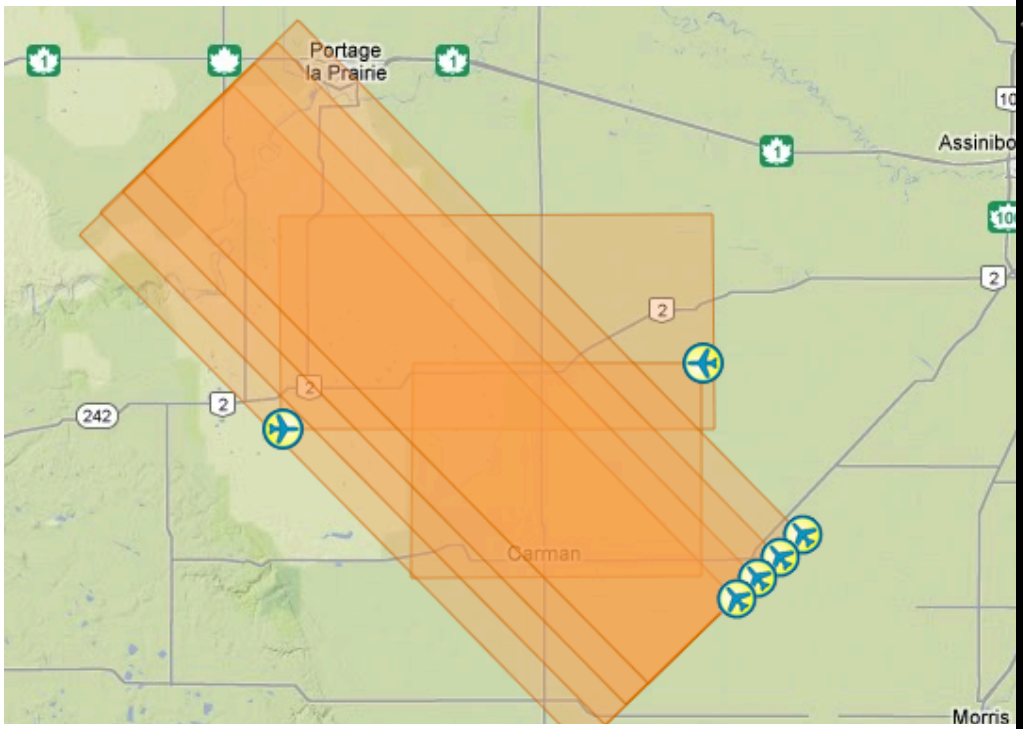
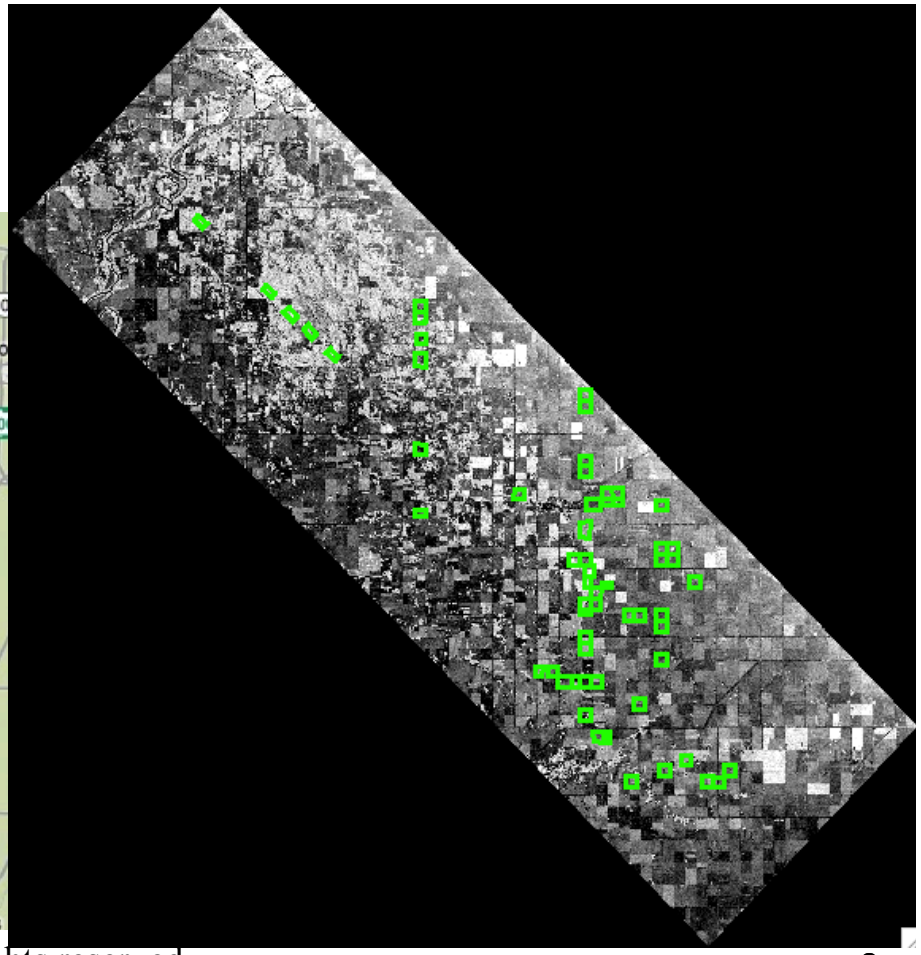

National Aeronautics and Space Administration
NASA
UAVSAR data,
soil moisture,
crop structure data
3rd Canadian
SMAP workshop
March 20-21, 2013
Seungbum Kim*, Xiaolan Xu*,
Andreas Colliander*, Thomas Jackson**,
Heather McNairn***, Eni Njoku*
(also thanks to Narendra Das, Grant Wiseman,
& SMAPVEX12 team)
* Jet Propulsion Laboratory, Caltech
** Hydrol. Remote Sensing Lab, USDA
*** AAFC

UAVSAR postprocessing

- Incidence angle normalization to 40degs
  - The original incidence angle ranges from 25 to 60 degs
- Removing heterogeneous (man-made) structures
- Matchup with in situ data



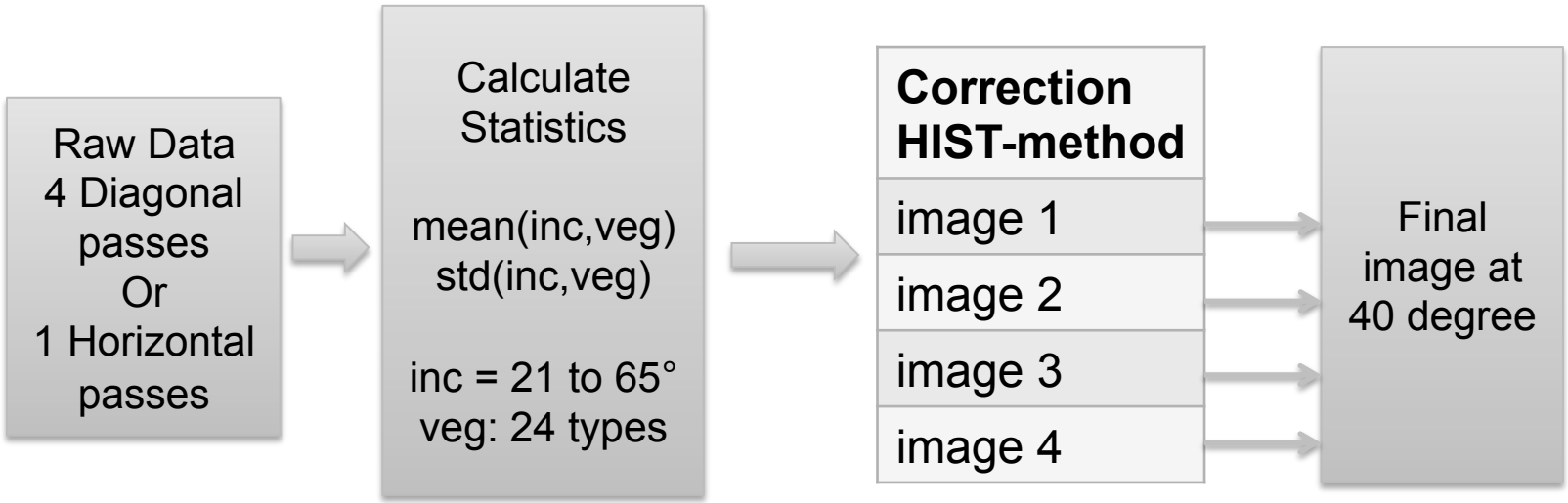


UAVSAR Availability

flight #	31603	31604	31605	31606	09002	27002	PALS
6/17	Y	Y	Y	Y	Y	Y	Y
6/19	Y	Y	Y	Y			
6/22	Y	Y	Y	Y	Y	Y	Y
6/23	Y	Y	Y	Y	Y	Y	
6/25	Y	Y	Y	Y	Y	Y	Y
6/27	Y	Y	Y	Y	Y	Y	Y
6/29	Y	Y	Y	Y	Y	Y	Y
7/3						Y	Y
7/5	Y	Y	Y	Y	Y	Y	Y
7/8	Y	Y	Y	Y	Y	Y	Y
7/10	Y	Y	Y	Y	Y	Y	Y
7/13	Y	Y	Y	Y	Y	Y	Y
7/14		Y	Y	Y	Y	Y	Y
7/17	Y	Y	Y	Y	Y	Y	Y

PALS also flew on 6/7, 6/12, 6/15, 7/19

Correction Flow Chart *



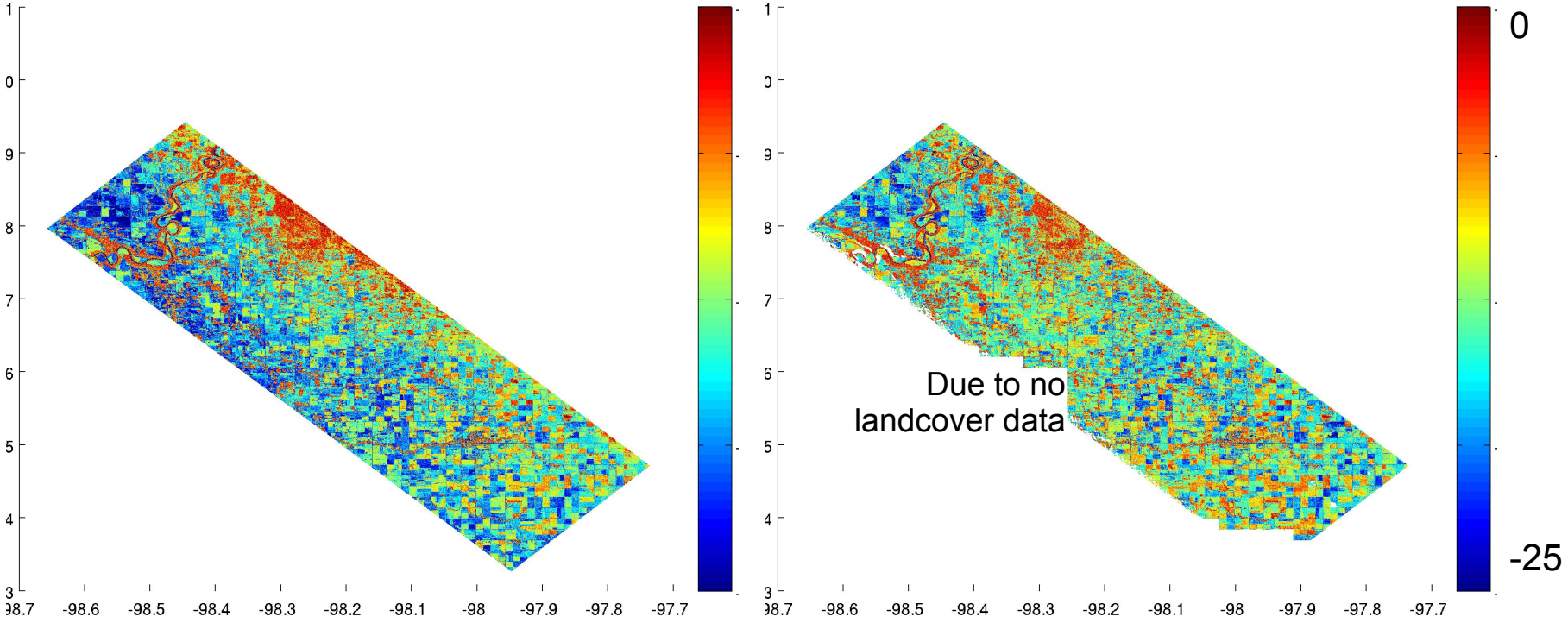
For each pixel

$$\sigma_{norm,VC} = \bar{\sigma}_{40,VC} + \hat{\sigma}_{40,VC} \cdot \frac{\sigma_{raw\_inc,VC} - \bar{\sigma}_{raw\_inc,VC}}{\hat{\sigma}_{raw\_inc,VC}}$$

*Mladenova, I. E.; Jackson, T. J.; Bindlish, R.; Hensley, S.; , "Incidence Angle Normalization of Radar Backscatter Data," Geoscience and Remote Sensing, IEEE Transactions on , vol.PP, no.99, pp.1-14, 0

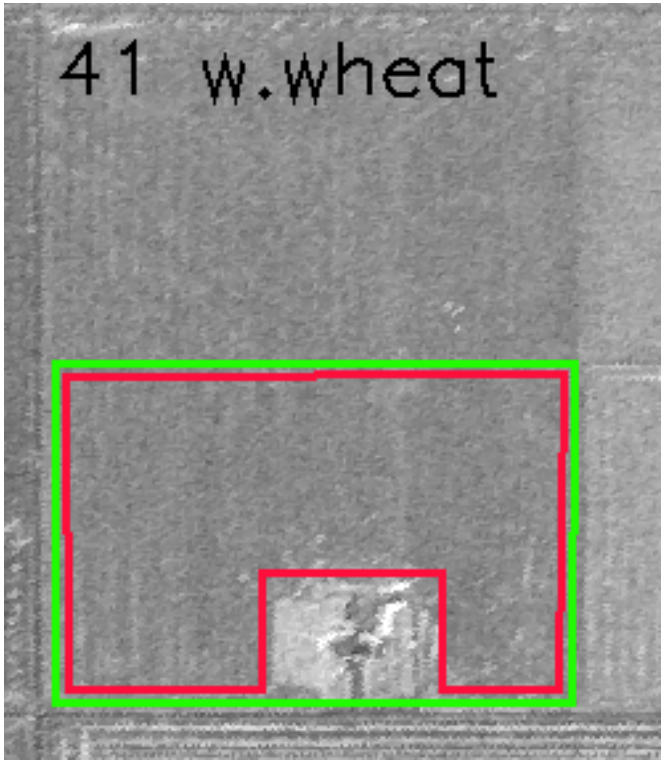
Incidence angle normalization

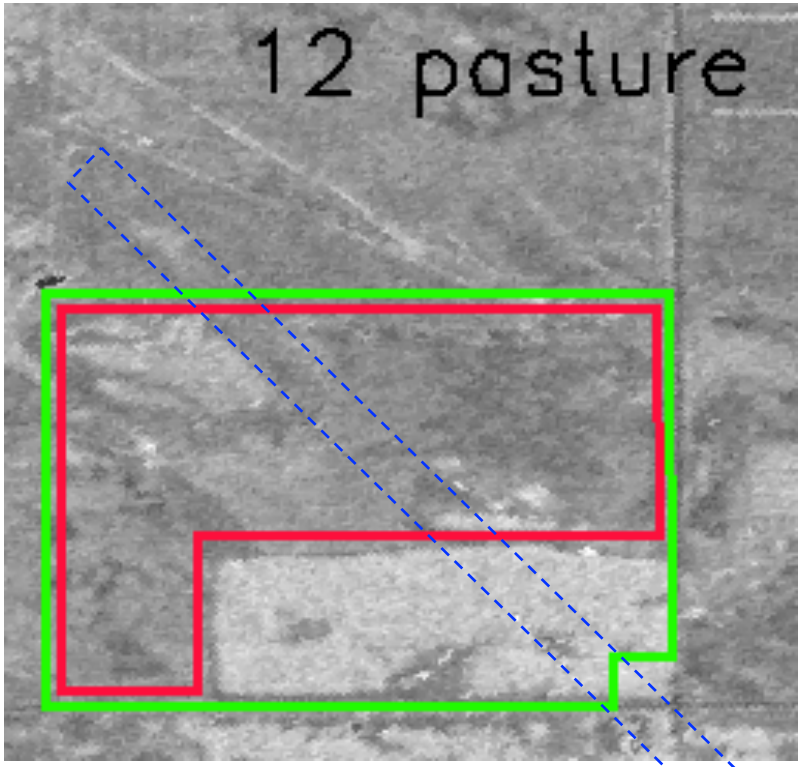
- Raw Data
- Corrected Data



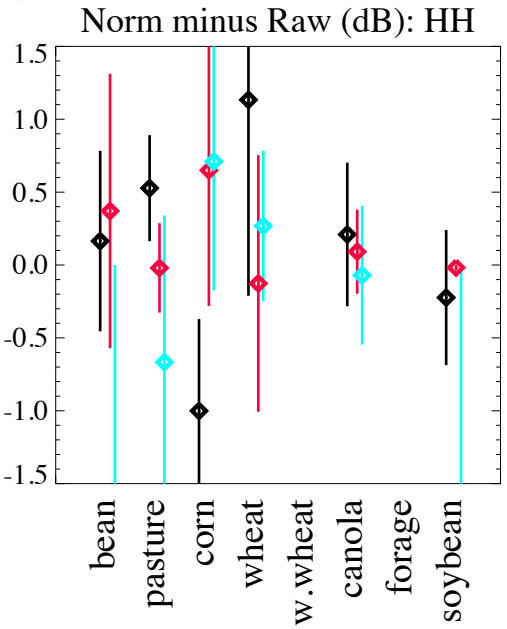
Filtering heterogeneous objects

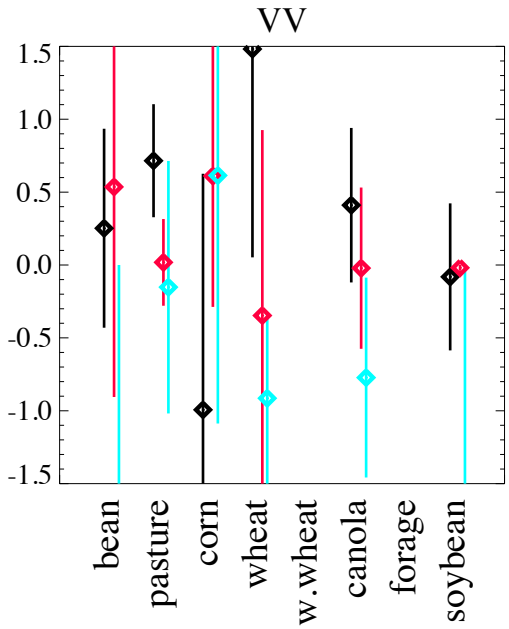
- Green and red polygons are the field boundaries before and after the filtering, respectively. The number is the field ID.
- The normalization accuracy is assessed with overlapping passes using the 40deg strip (40 +/-0.5).

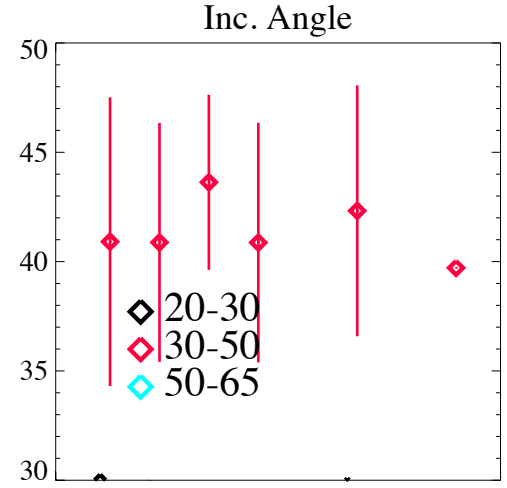


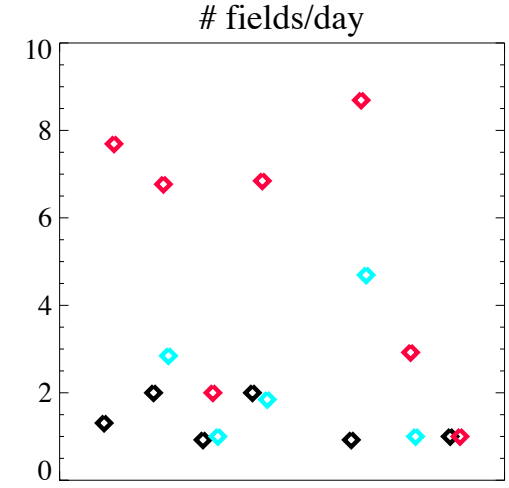


Normalization: QA - quantitative



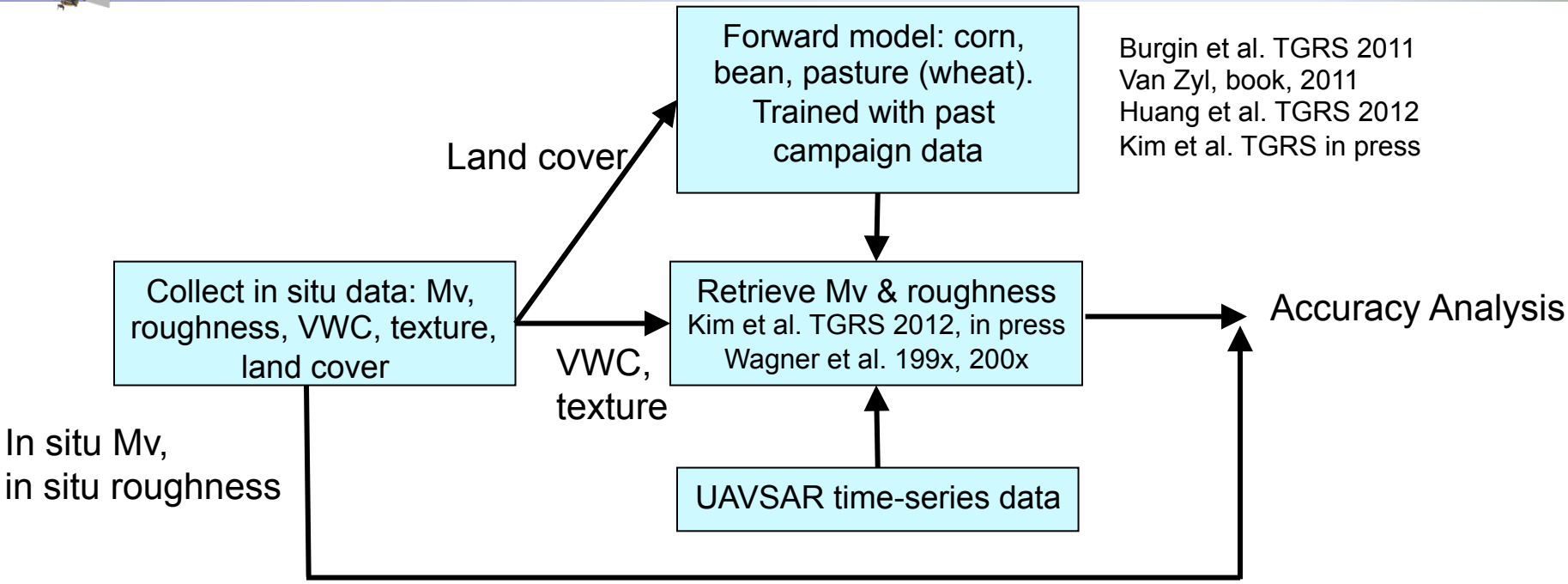




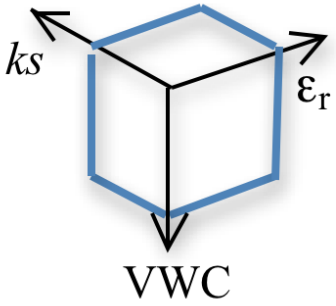


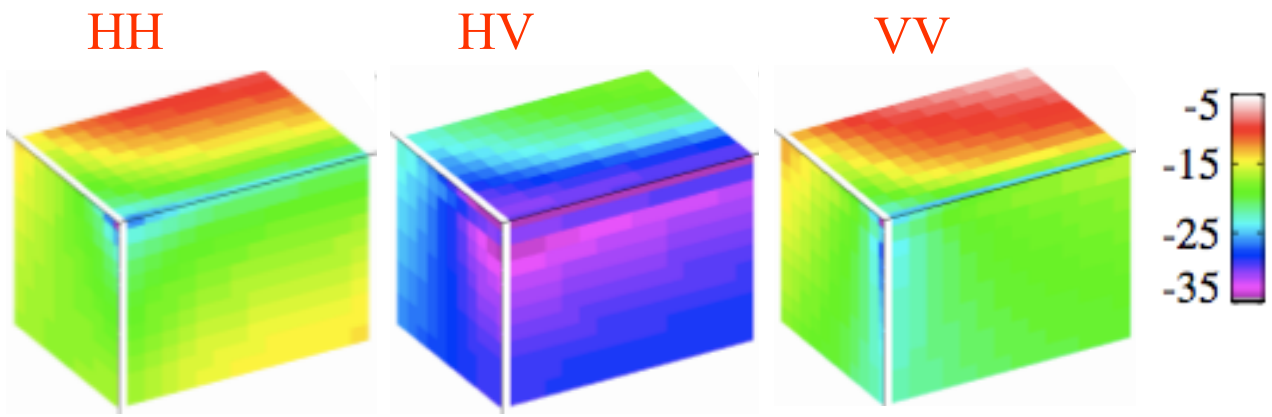
- QA was performed per each field, then compiled over each crop class where there are more than one fields belonging to the class.
- The error is < 1dB rmse (bean, corn, wheat, canola)
  - Forage, winter wheat, soybean: too few samples
- 30-50deg strip offers at least 1 field per crop class per day → enabling soil moisture analysis with 30-50deg strip only.
- HV needs further work

Soil moisture retrieval: method

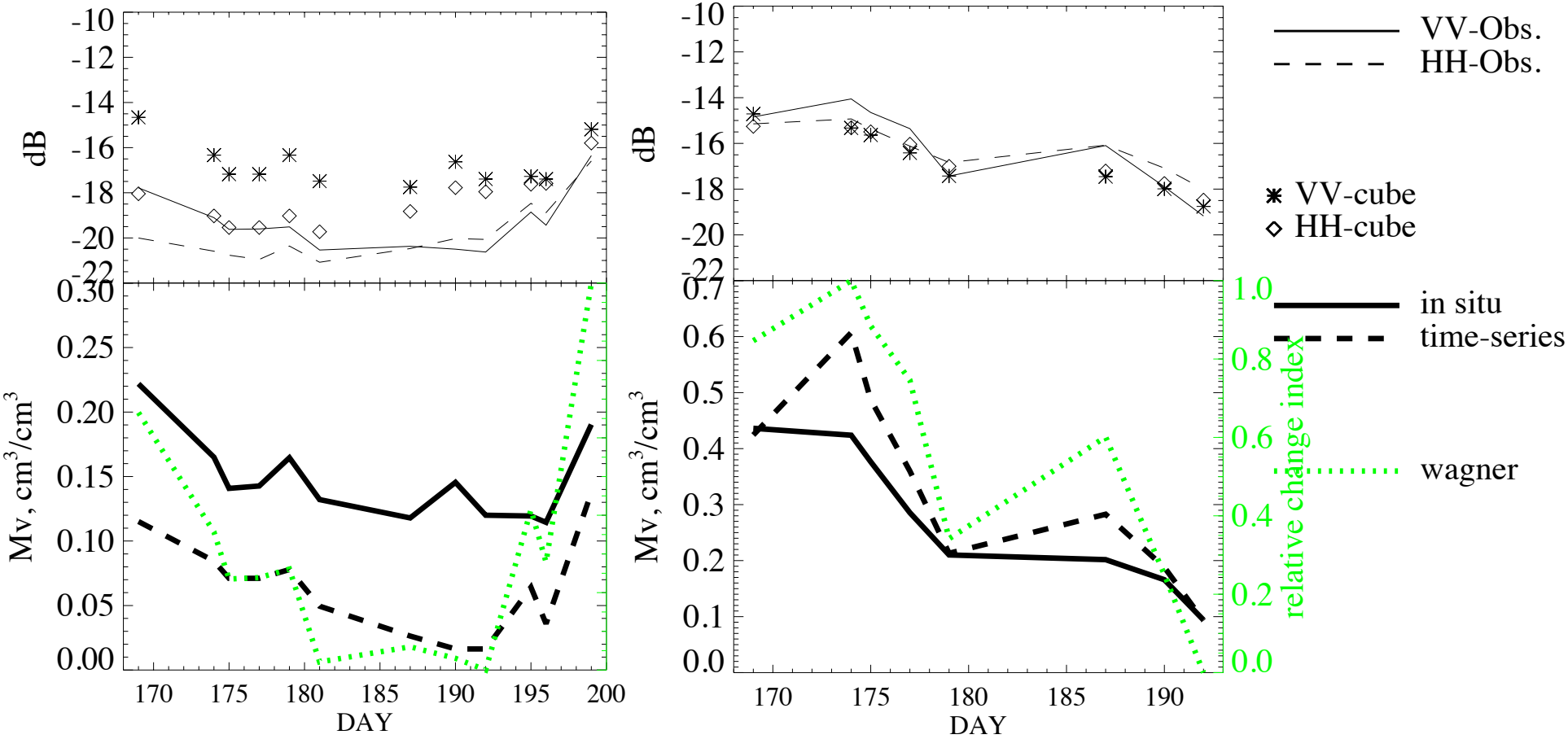


Burgin et al. TGRS 2011
Van Zyl, book, 2011
Huang et al. TGRS 2012
Kim et al. TGRS in press





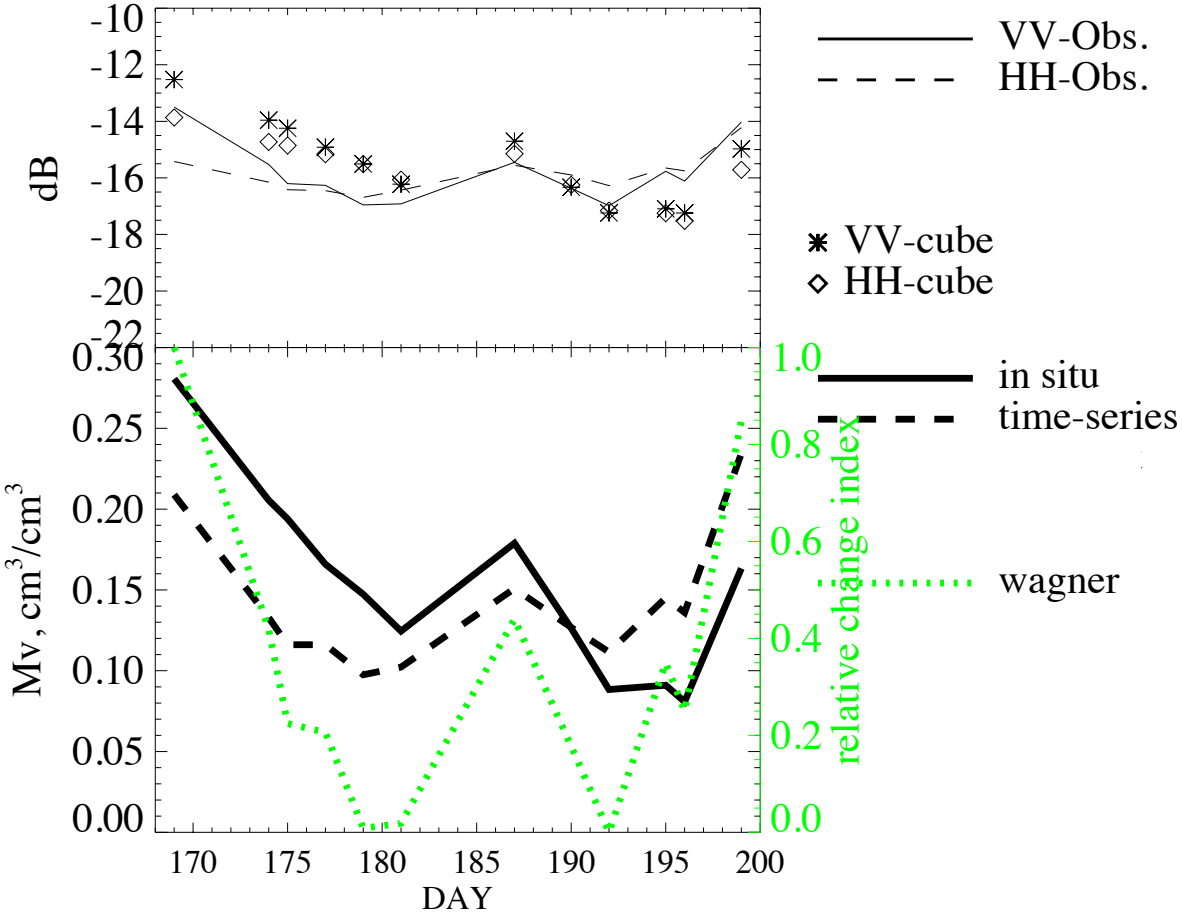
Soil moisture retrieval (preliminary)



Pasture field, VWC ~ 0.3 kg/m2
Mv RMSE: 0.086, mean Δ: -0.084
r (time-series), r(Wagner): 0.81, 0.71

Wheat field: VWC = 1.7 to 2.5 kg/m2
Mv RMSE: 0.086, mean Δ: -0.058
r (time-series), r(Wagner): 0.94, 0.94

Soil moisture retrieval (cont)



Bean field: VWC=0.1 to 1.9 kg/m2
Mv RMSE: 0.053, mean Δ: -0.013
r (time-series) r(Wagner): 0.45, 0.66

- Corn's Mv retrieval needs more work (mostly on forward model side)
- Forward model quality
  - Wheat: immature
  - Pasture: mature
  - Soybean, corn: medium
  - Canola: future

[McNairn et al. in prep]

Summary and plans

- UAVSAR
  - Normalization error is smaller than 1dB rmse (co-pol)
  - Removed heterogeneous objects
  - More than one passes were very useful
  - HV normalization needs work:
    - when to put into archive? HH/VV only or HH/VV/HV?
- Soil moisture retrieval
  - Reasonable retrievals with an rmse of ~0.05 cm3/cm3 (individual field; need to improve mean error)
  - Keep improving forward models
- Crop structure data
  - In progress
  - Will be used to improve forward models

Thanks for hosting the workshop!

backup

Crop structure measurements

- Objectives
  - Help understand radar response
- Measreuments
  - Complete characterization of geometry of crops
    - Length: plant, stalk, branch, leaf
    - Angle: stalk, branch, leaf
    - Diameter or thickness: stalk, branch, leaf
    - Density or number: stalk, branch, leaf
  - Collocated & coincident VWC measurements
  - Fast-growing crops were sampled more frequently
- Status
  - Geometry data are complete
  - Some glitches in dry weight records (missing records and mislabels)
- Plan
  - Cross-compare between vegetation teams' VWC and structure team's VWC, as a QC

Crop Structure Sampling Dates

- Some missing VWC values for structure samples.
- Plan to calibrate the structure data using 'Vege Team' VWC
- Augment week-long gaps in Vege Team VWC

week-long gaps

week-long gaps