Using GPS reflections to monitor soil moisture and vegetation

xenon.colorado.edu/reflections/GPS_reflections/PBO_H2O.html

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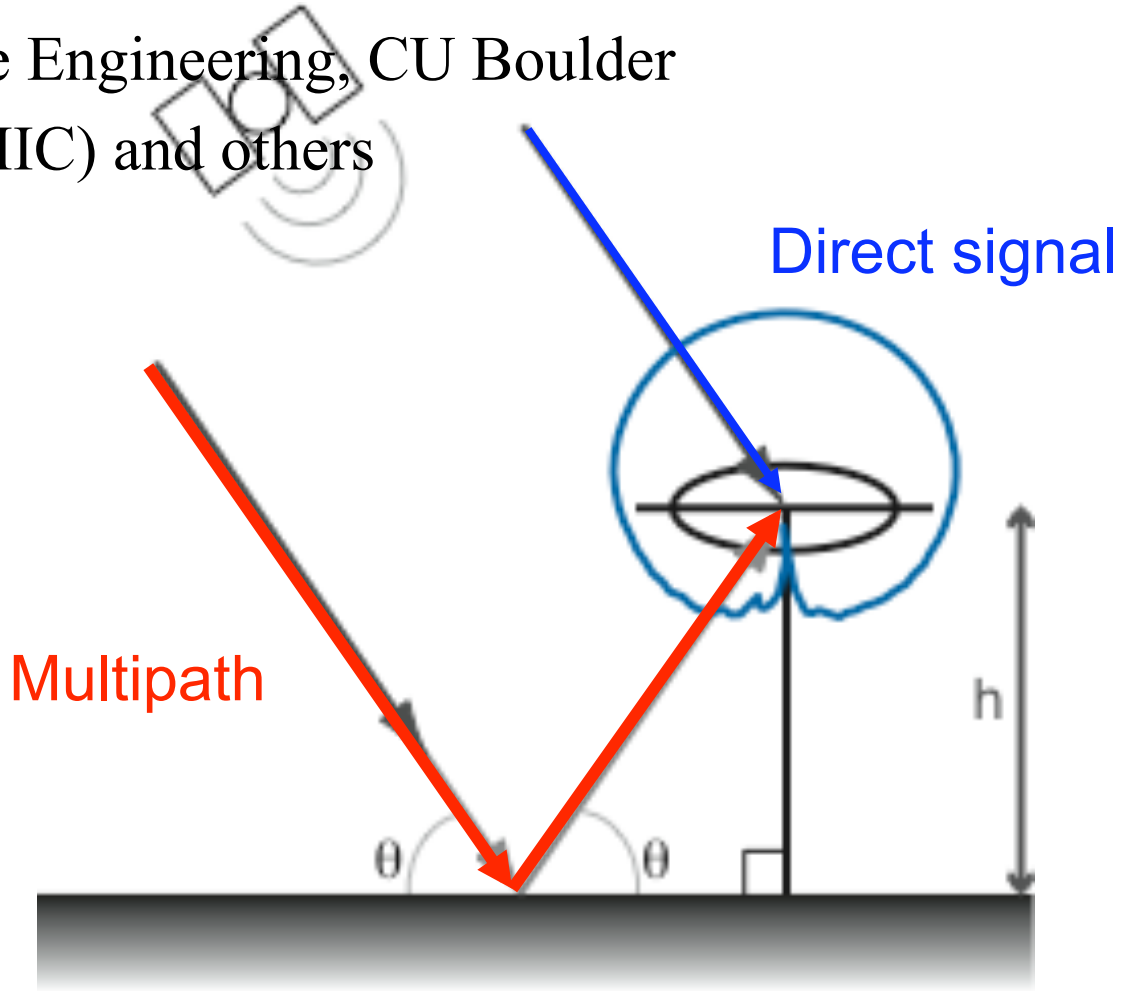
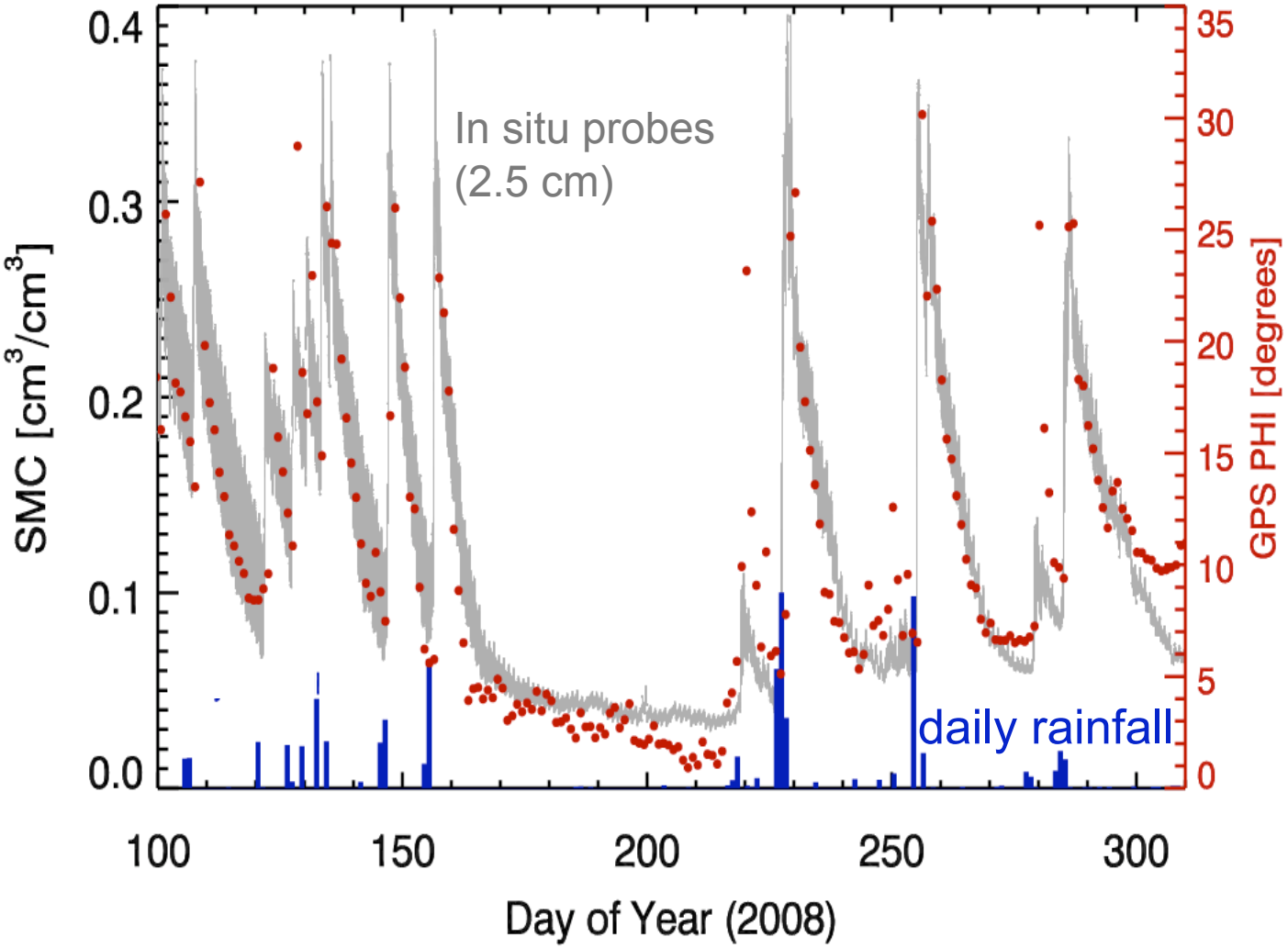
Sevilleta and Niwot LTERs



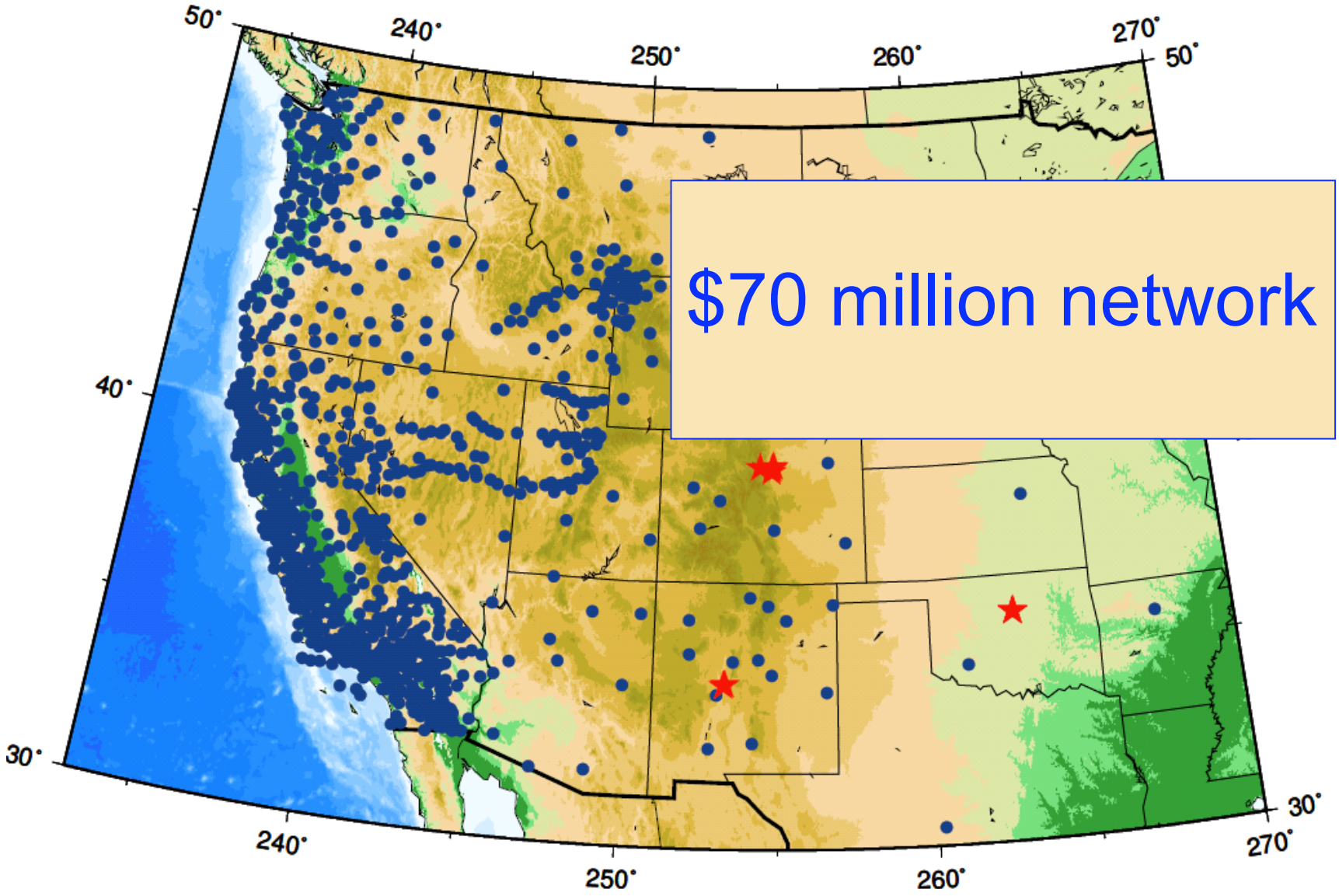
Soil moisture fluctuations

Marshall, Colorado



Larson, Small, Gutmann, Braun, Zavorotny, and Bilich, GPS Multipath and Its Relation to Near-Surface Soil Moisture Content, *IEEE J-STARS*, 2010

Use existing GPS receivers in PBO network to study soil moisture, vegetation, snow



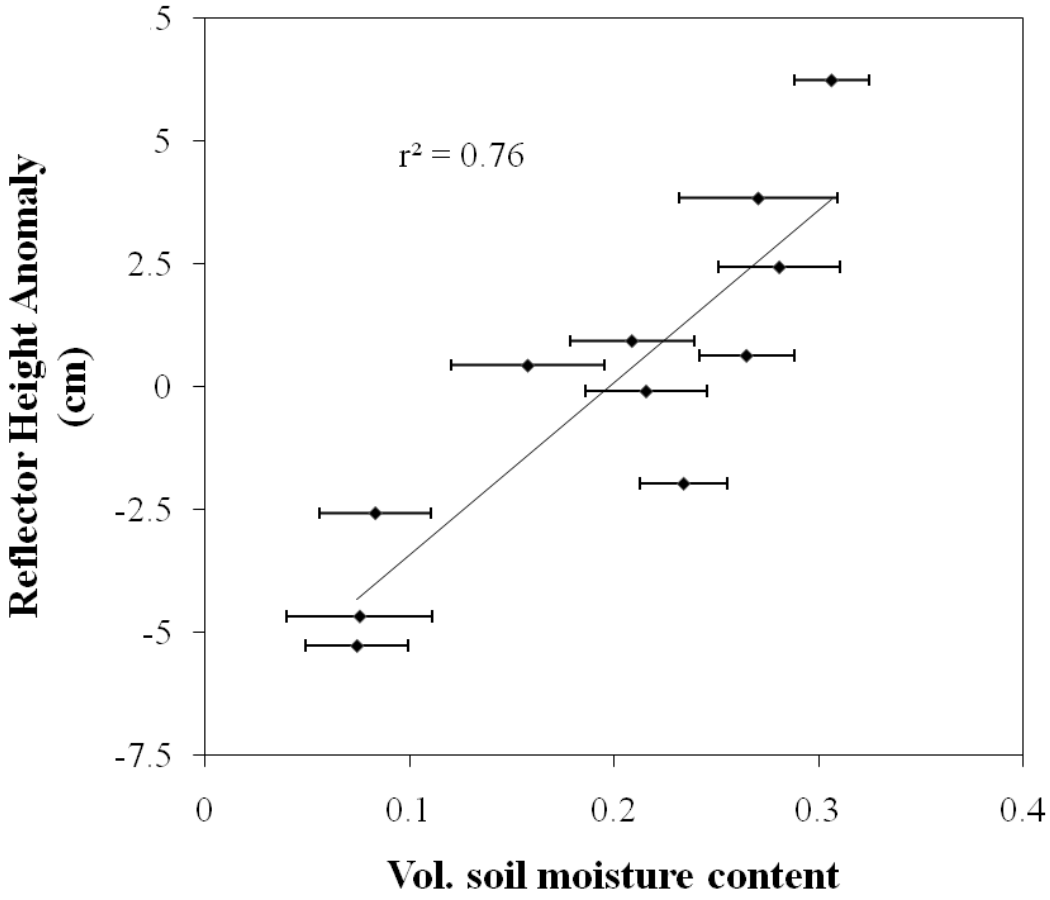
Use NSF's PBO Network

- Extensive network(s) exists
- Data freely available
- Same frequency as SMAP
- "large" sampling footprint
- Good site distribution

- Antennas suppress multipath
- Sensitivity to >1 variable
- Site conditions vary

9 test sites: Identical GPS and hydrology infrastructure and gravimetric and vegetation sampling

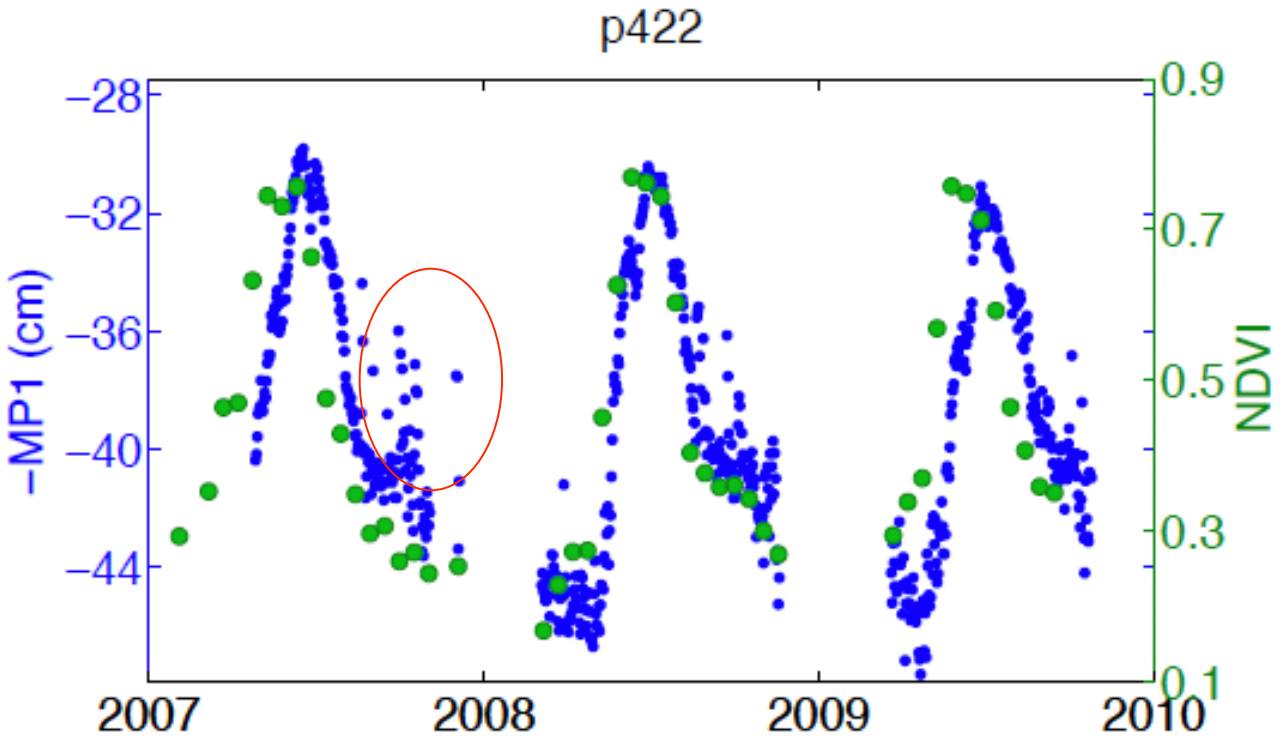
ISST Site A: 2010



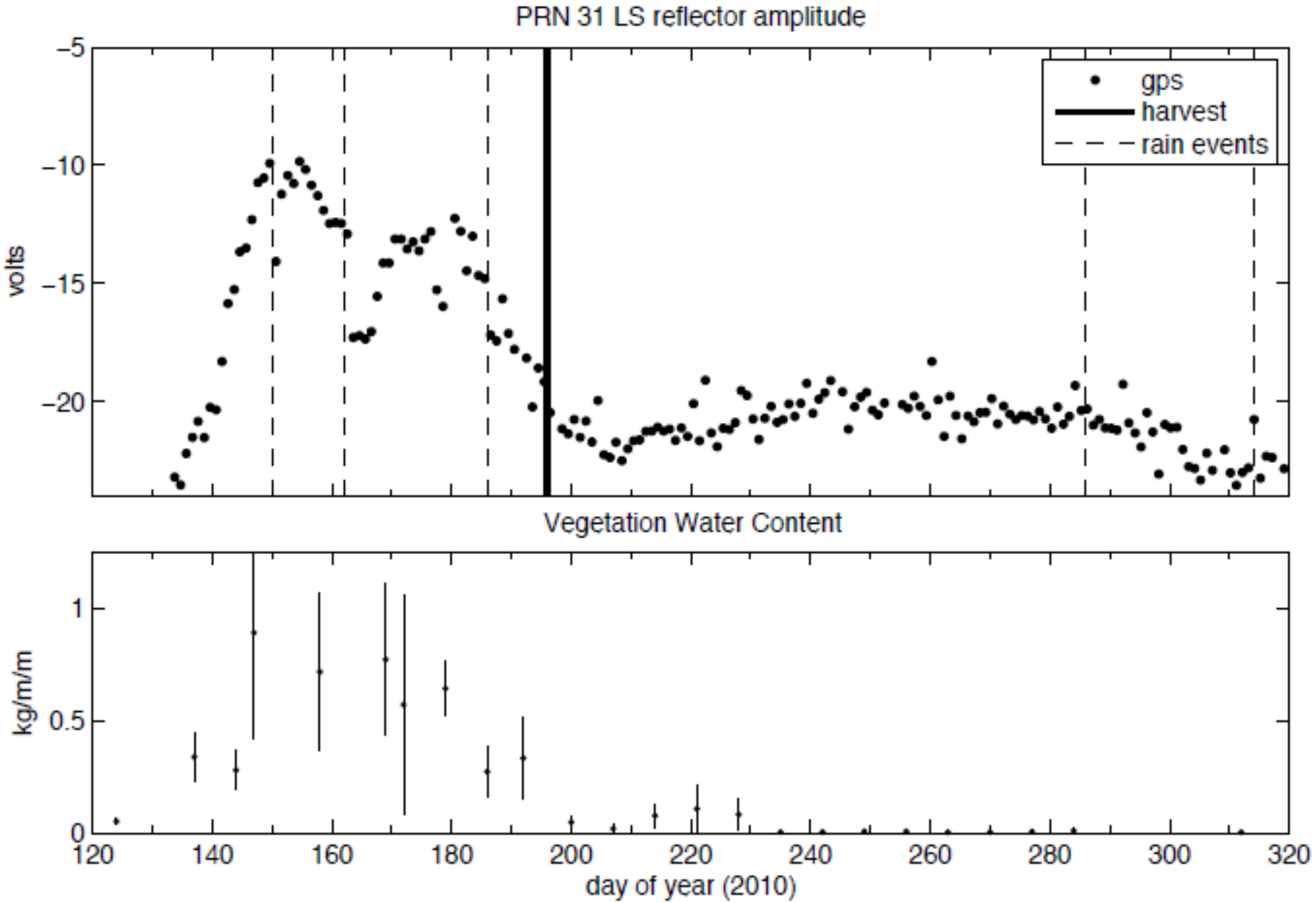
Comparison to optical remote sensing

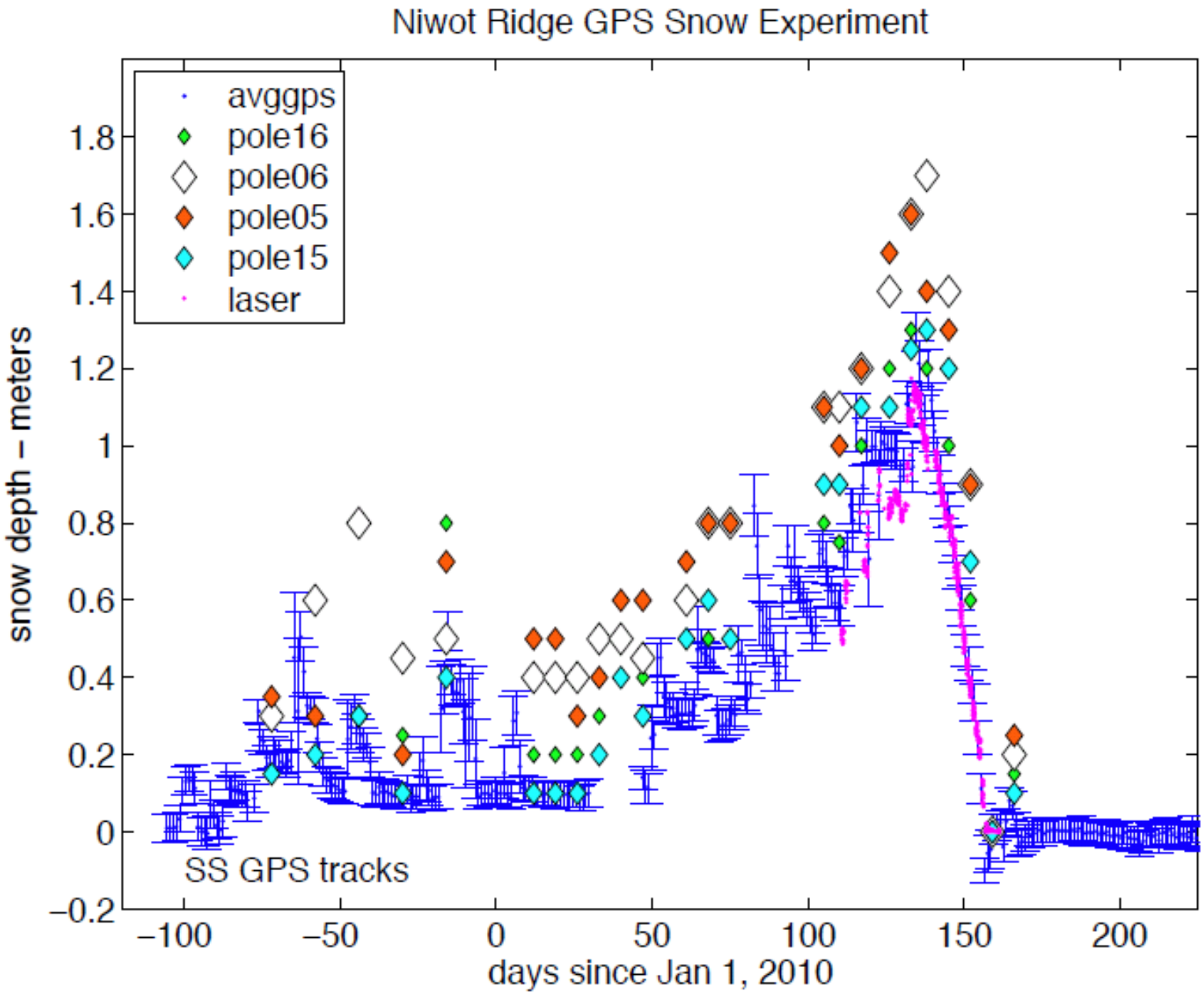
Small, E.E., K.M. Larson, and J. J. Braun, Sensing Vegetation Growth Using Reflected GPS Signals, Geophys. Res. Lett. *37*, L12401, doi:10.1029/2010GL042951, 2010

Foothill, Idaho
P422



Sensing vegetation: winter wheat site




Niwot Ridge GPS Snow Experiment
avggps
pole16
pole06
pole05
pole15
laser
snow depth – meters
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
−0.2
−100
−50
0
50
100
150
200
days since Jan 1, 2010
SS GPS tracks

Status of products

Vegetation

Time series of relative vegetation amount

Scaling to absolute amount (kg m^{-2})

Soil Moisture

Rank SNR data, estimate errors

Scale to absolute soil moisture