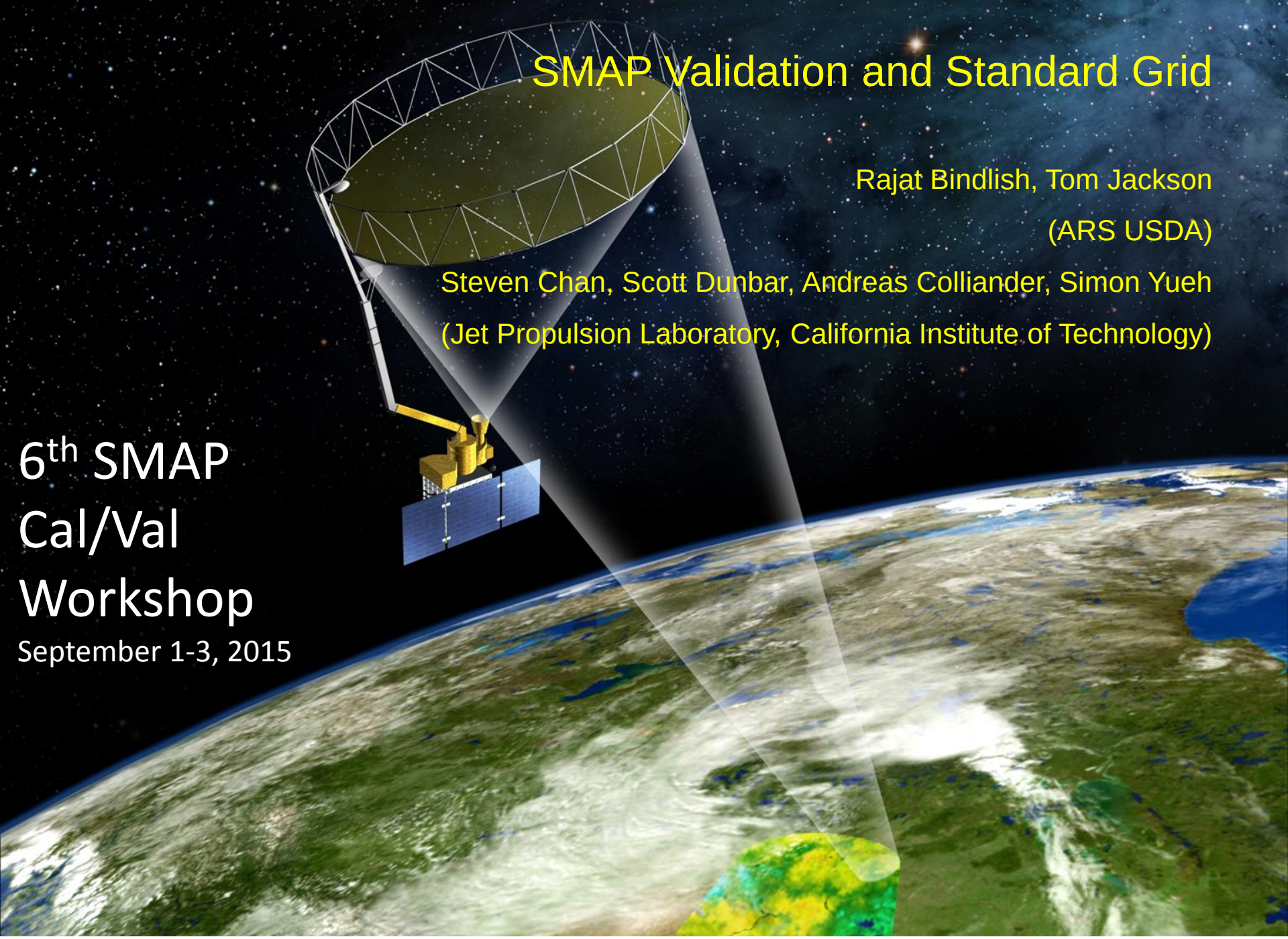
SMAP Validation and Standard Grid

Rajat Bindlish, Tom Jackson

(ARS USDA)

Steven Chan, Scott Dunbar, Andreas Colliander, Simon Yueh

(Jet Propulsion Laboratory, California Institute of Technology)



6th SMAP Cal/Val Workshop

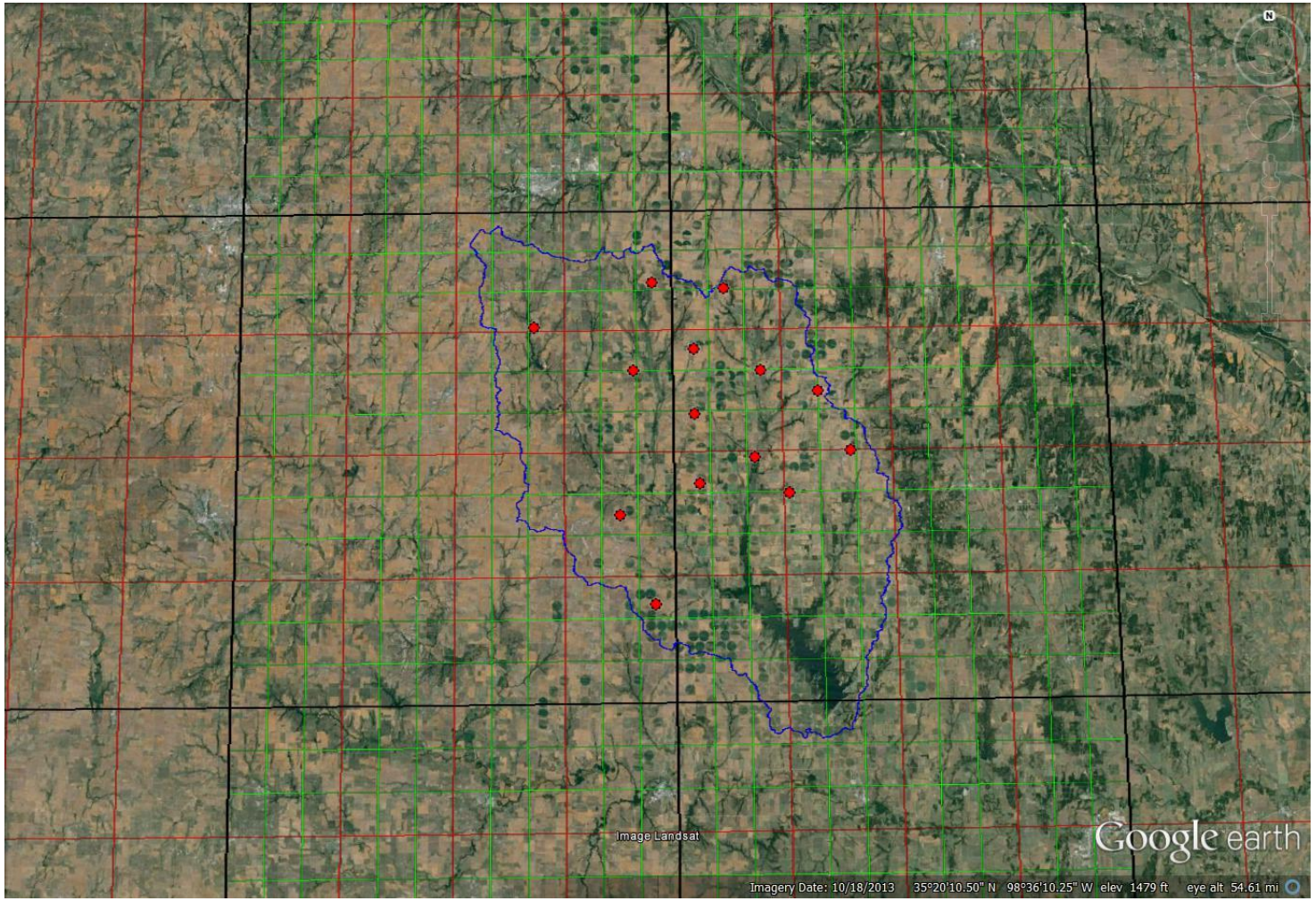
September 1-3, 2015

Copyright 2015. All rights reserved.

Rationale

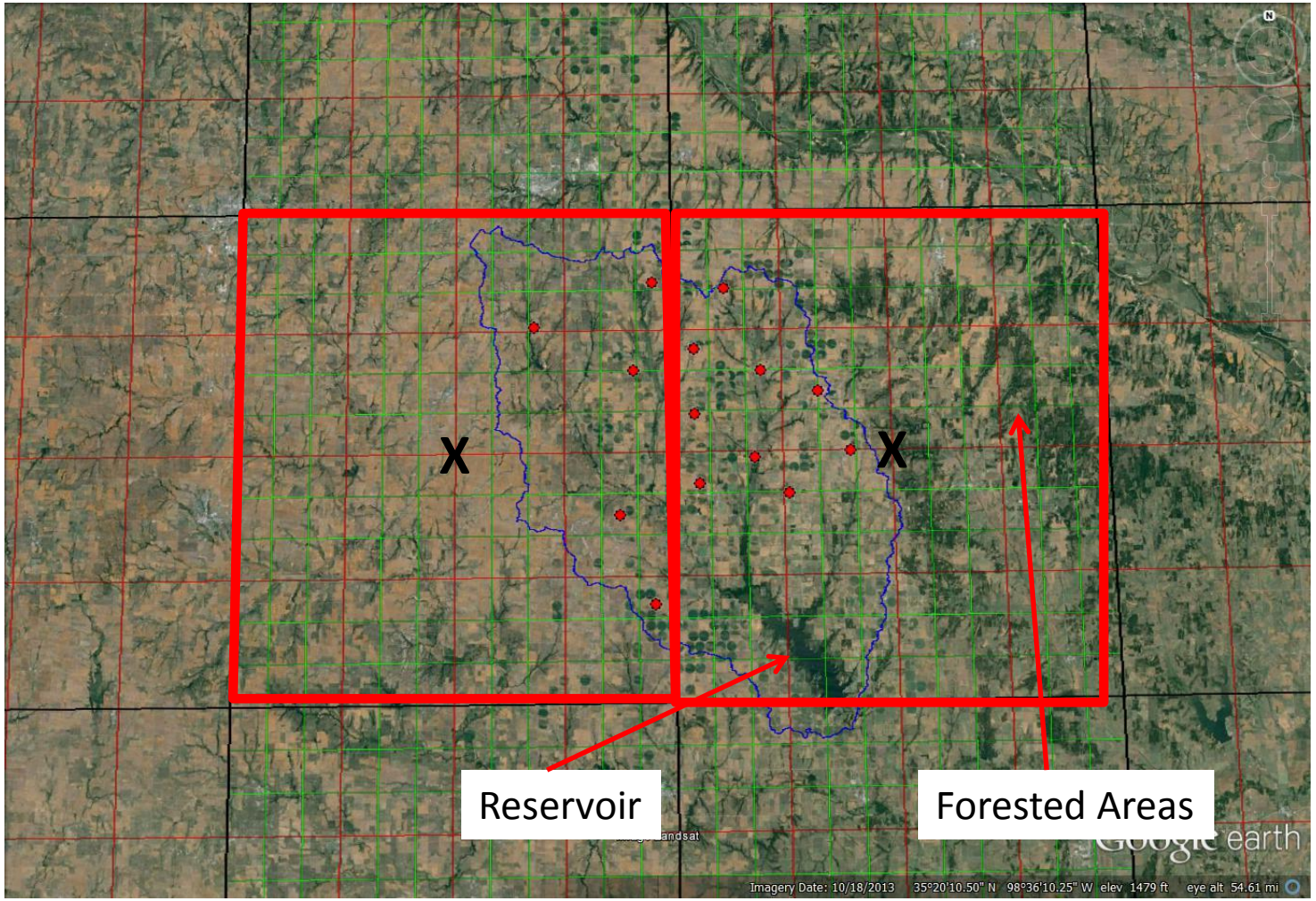
- Geo-location of the *in situ* data and SMAP data should be consistent with each other for validation
- SMAP data is on a fixed Earth grid (Ease2grid).
- *In situ* sensors are installed based on:
  - Location availability
  - Geographical considerations
  - Accessibility
  - Other factors
- Due to above factors there can be a geographical mismatch between the *in situ* observations and the SMAP grid

Fort Cobb Watershed



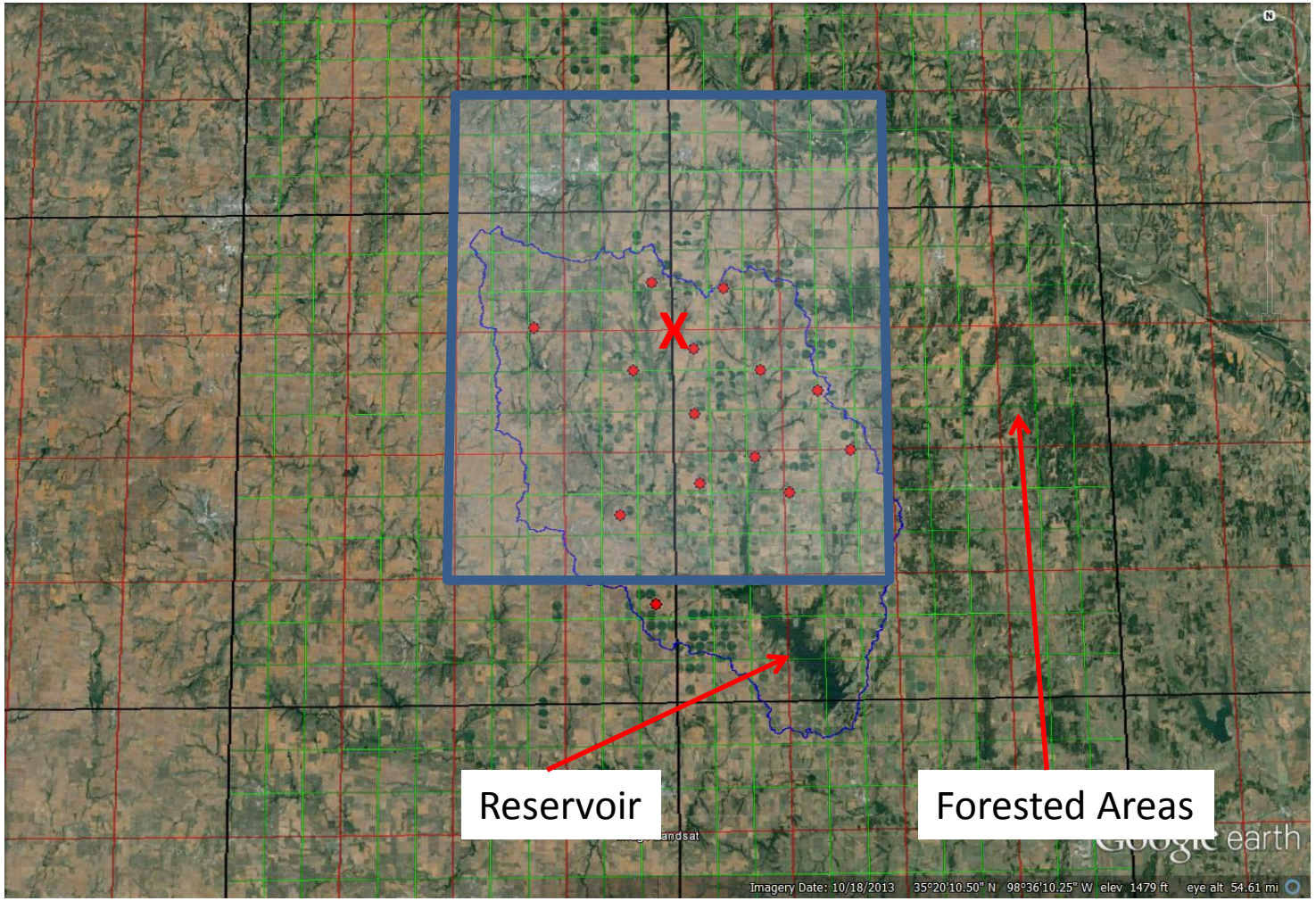
- 36 kmEZ2
- 9 km EZ2
- 3 km EZ2
- FC watershed
- *In situ* sites

Fort Cobb Watershed



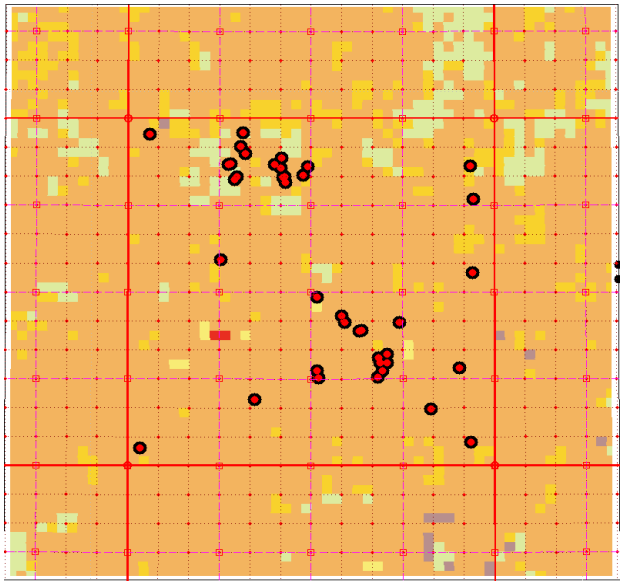
36 kmEZ2
9 km EZ2
3 km EZ2
FC watershed
In situ sites
X Grid Center

Fort Cobb Watershed

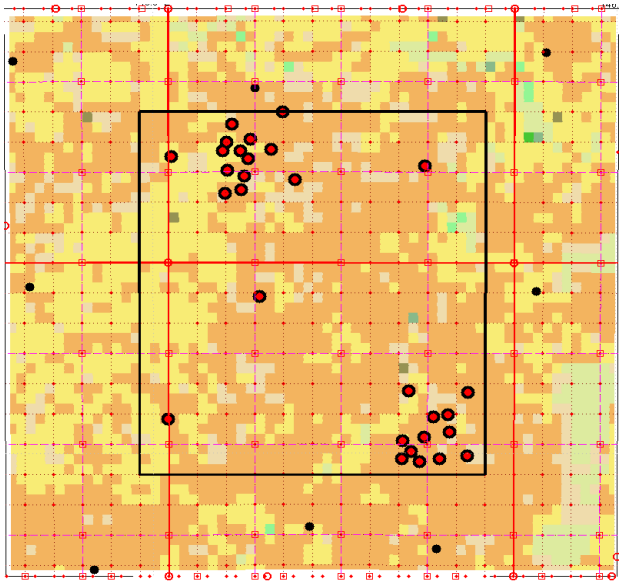


36 kmEZ2
9 km EZ2
3 km EZ2
FC watershed
In situ sites
X Grid Center

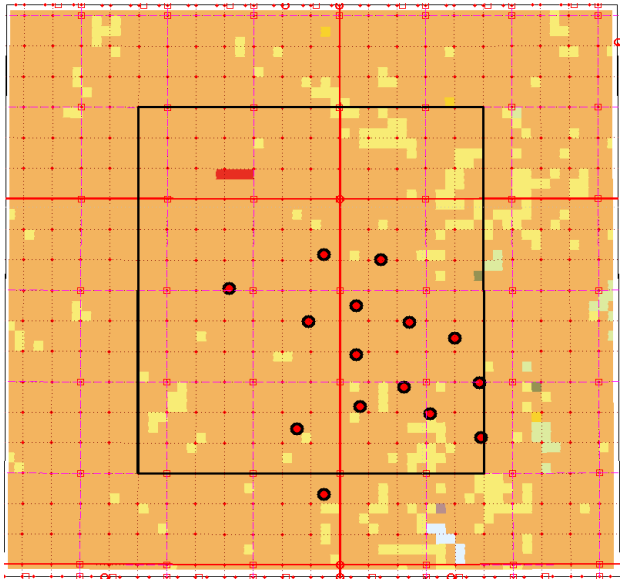
TxSON (Core Pixel)



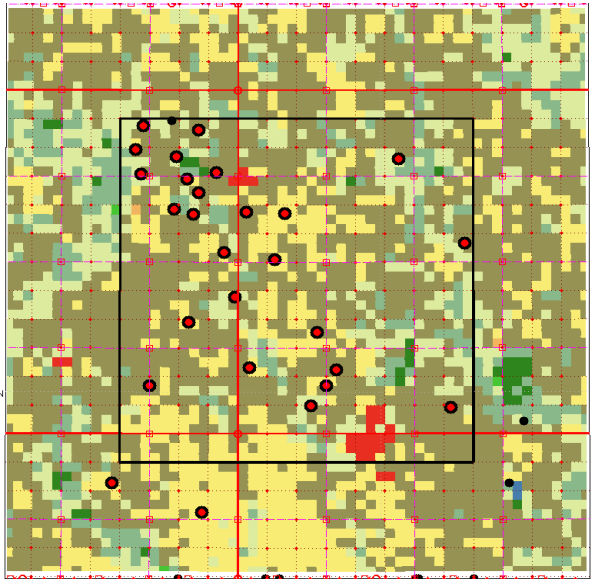
Yanco (Core Pixel)



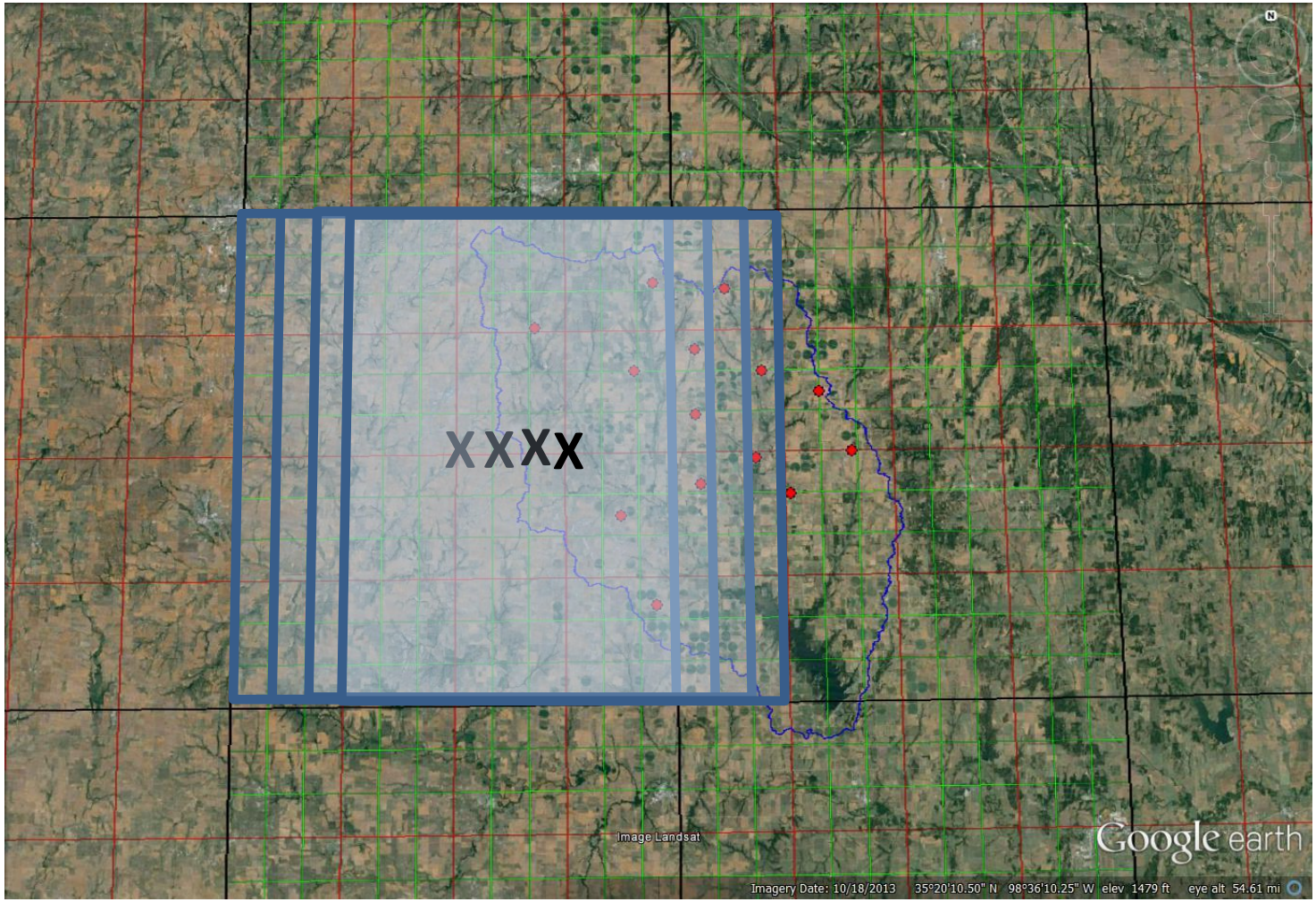
Fort Cobb (Core Pixel)



Little River (Core Pixel)



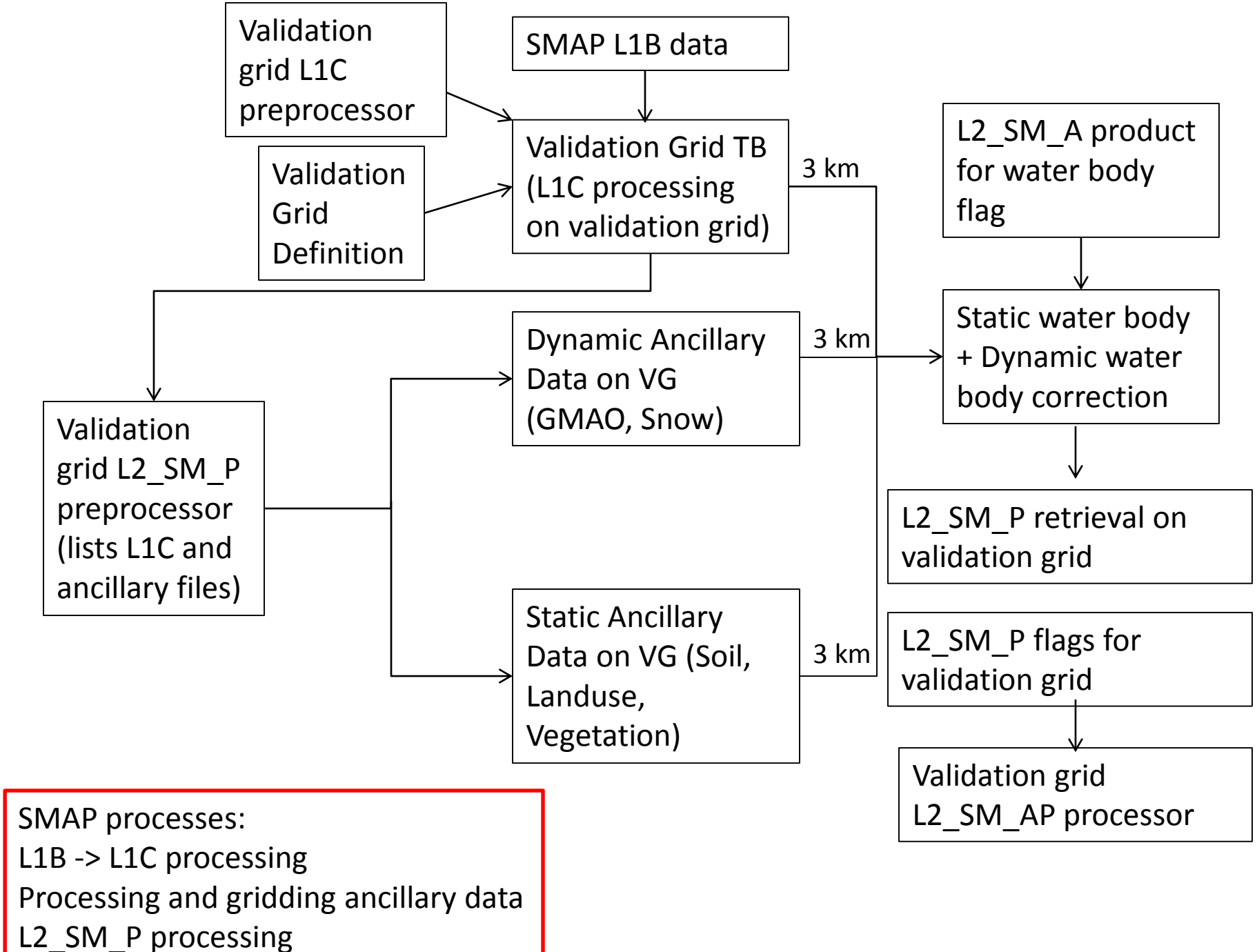
Fort Cobb Watershed - Methodology



- 36 kmEZ2
- 9 km EZ2
- 3 km EZ2
- FC watershed
- *In situ* sites
- X Grid Center

Validation Grid - Methodology

- SMAP Grid: No overlap between adjacent grid cells
  - Grid resolution – 36 km
  - Grid spacing – 36 km
- Validation Grid: Significant overlap between adjacent grid cells
  - Grid resolution – 36 km
  - Grid spacing – 3 km
- L2_SM_P Validation grid – 144 (12x12) times operational grid
- Max. geographical mismatch with *in situ* observations
  - SMAP grid – 75%
  - Validation grid – 8.33%


Validation grid L1C preprocessor
SMAP L1B data
Validation Grid Definition
Validation Grid TB (L1C processing on validation grid)
3 km
L2_SM_A product for water body flag
Static water body + Dynamic water body correction
Dynamic Ancillary Data on VG (GMAO, Snow)
3 km
Validation grid L2_SM_P preprocessor (lists L1C and ancillary files)
L2_SM_P retrieval on validation grid
Static Ancillary Data on VG (Soil, Landuse, Vegetation)
3 km
L2_SM_P flags for validation grid
Validation grid L2_SM_AP processor
SMAP processes:
L1B -> L1C processing
Processing and gridding ancillary data
L2_SM_P processing

Baseline and Option Algorithms

Algorithms	Status	Input Fields	Output Field(s)
SCA-H	Baseline	TBH, soil temperature, soil texture, NDVI	Soil moisture
SCA-V	Option	TBV, soil temperature, soil texture, NDVI	Soil moisture
DCA	Option	TBH, TBV, soil temperature, soil texture	Soil moisture, tau
MPRA	Option	TBH, TBV, soil temperature, soil texture	Soil moisture, tau

Validation Grid product

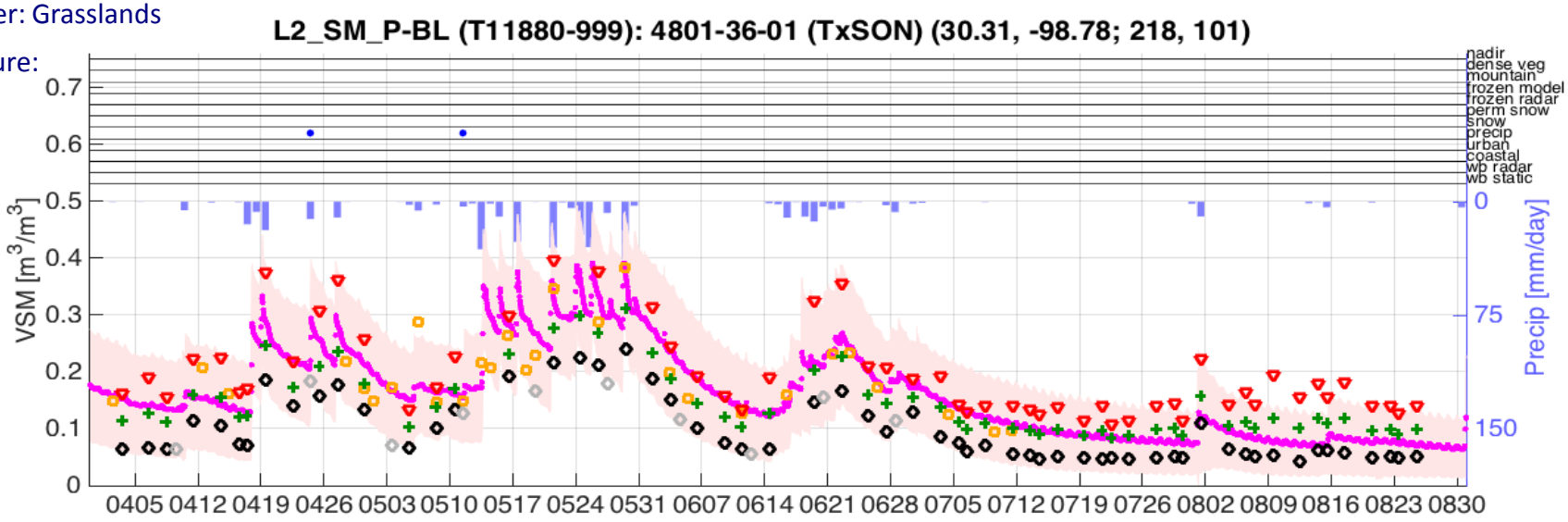
- Builds on the operational SMAP code
- Minimal changes to the individual modules
  - Critical for ensuring both operational and validation processors use the same code/rules
- Possible to verify the consistency between the operational and validation grid outputs
- VG is run on a continuous basis and provides the data for SMAP L2SMP cal/val analysis

Climate class: Temperate (Cfa)
Landcover: Grasslands

Soil texture:
S-%: 33
C-%: 33
BD: 1.42

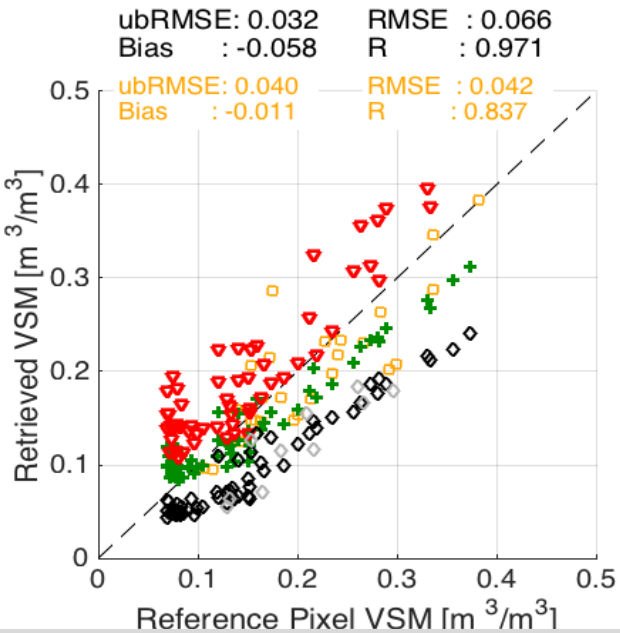
TxSON (Candidate Pixel)

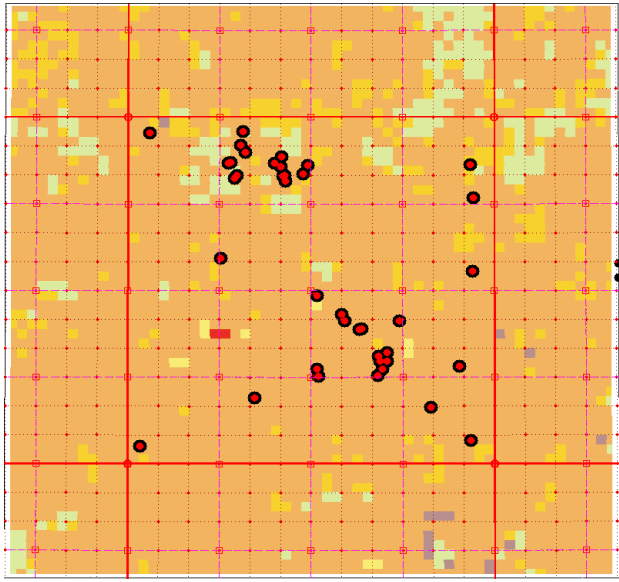
Jet Propulsion Laboratory
California Institute of Technology



- In Situ
- SCA-H
- SCA-V
- DCA
- SMOS SM

Alg	ubRMSE	Bias	RMSE	R
SCA-H	0.032	-0.058	0.066	0.971
SCA-V	0.031	-0.010	0.032	0.962
DCA	0.033	0.048	0.058	0.904





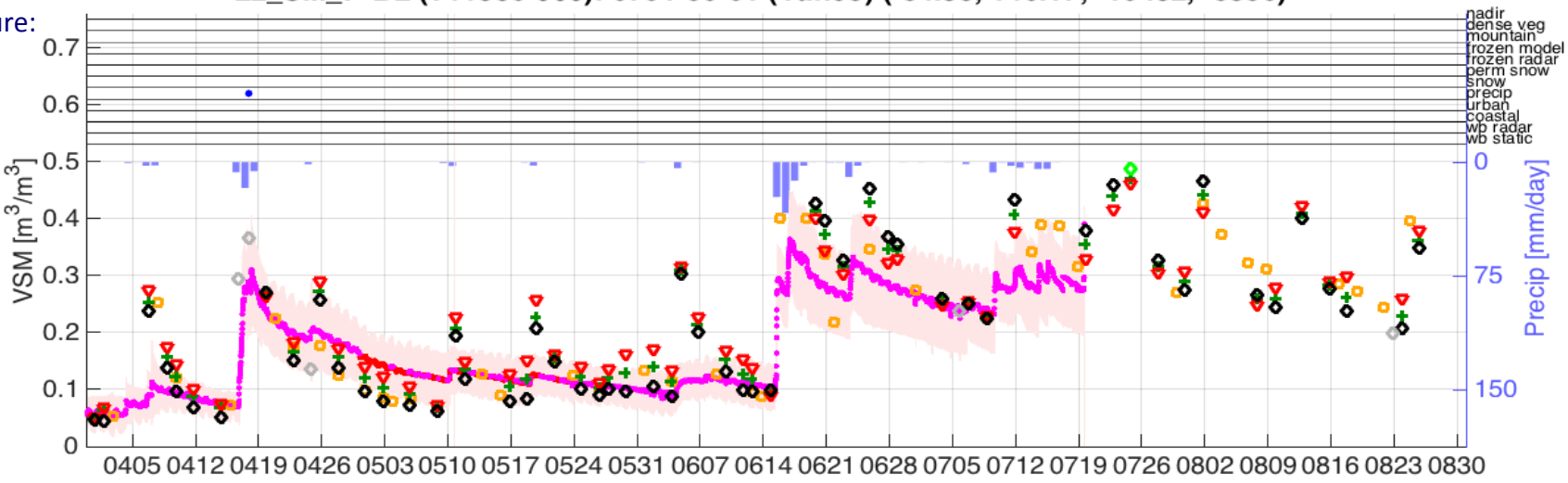
Black: Use recommended [Retrieval Quality Flag bit(0)=0]
Gray: Retrieval attempted and succeeded but use not recommended [bit(0)=1, bit(1)=0, bit(2)=0]
Green: Retrieval attempted but failed [bit(0)=1, bit(1)=0, bit(2)=1]
Cyan: Retrieval not attempted [bit(0)=1, bit(1)=1]

Climate class: Arid (BSk)
Landcover: Grasslands

Yanco (Core Pixel)

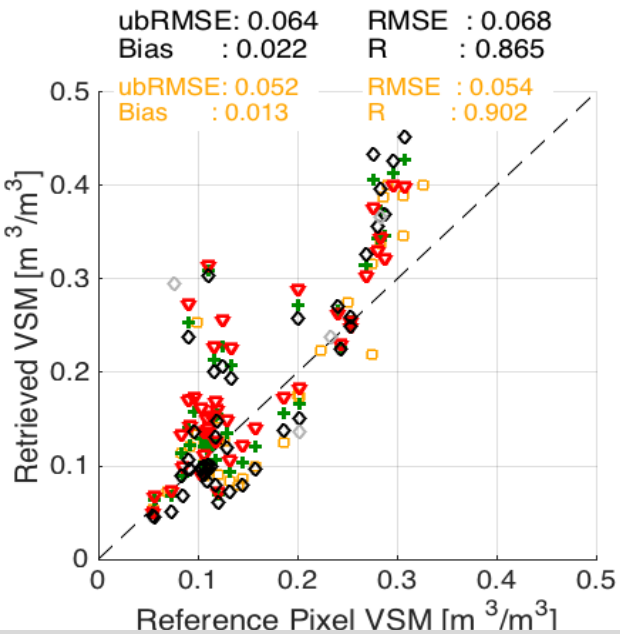
Jet Propulsion Laboratory
California Institute of Technology

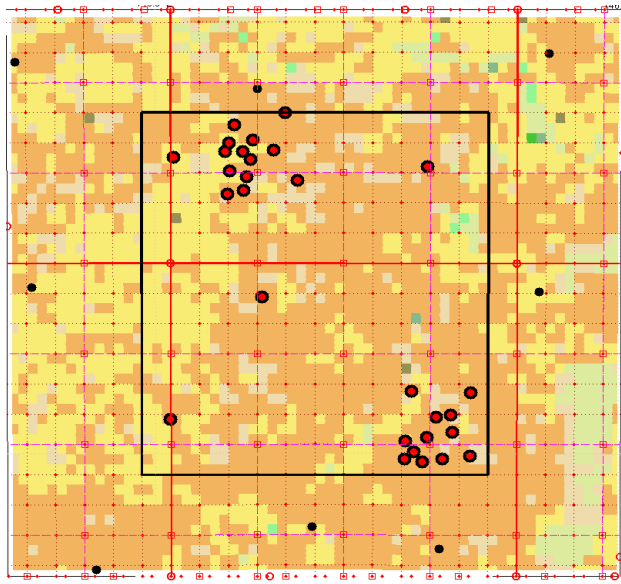
Soil texture:
S-%: 43
C-%: 38
BD: 1.33



- In Situ
- SCA-H
- SCA-V
- DCA
- SMOS SM

Alg	ubRMSE	Bias	RMSE	R
SCA-H	0.064	0.022	0.068	0.865
SCA-V	0.056	0.033	0.065	0.851
DCA	0.054	0.041	0.068	0.818





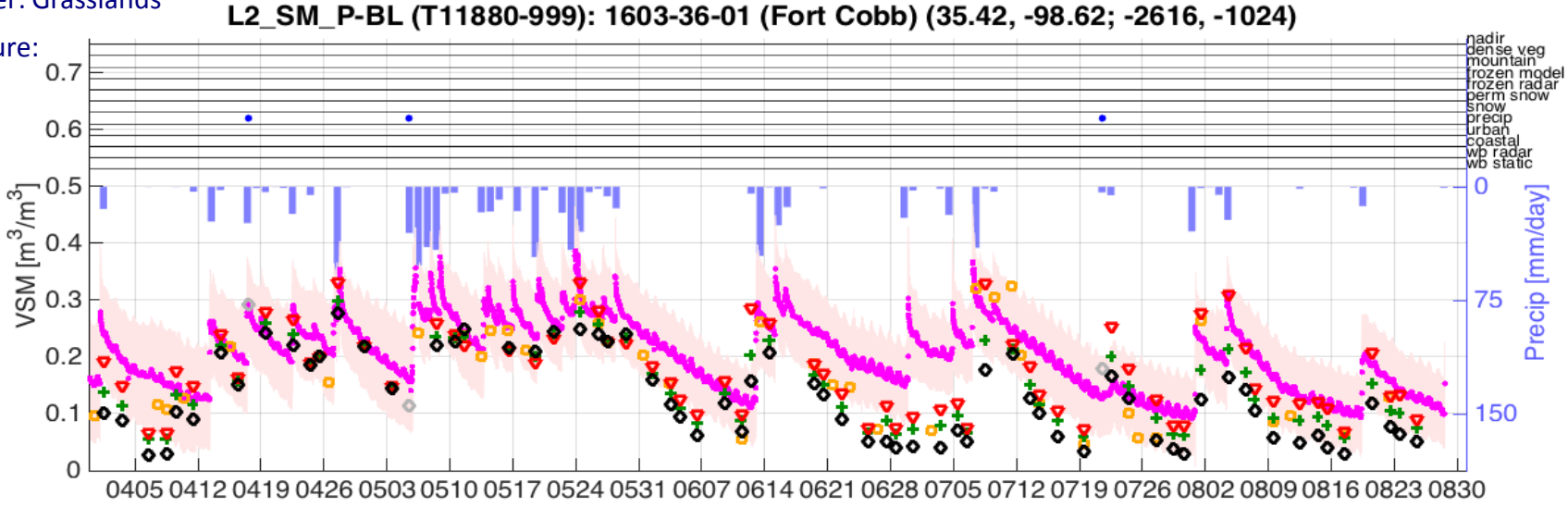
Black: Use recommended [Retrieval Quality Flag bit(0)=0]
Gray: Retrieval attempted and succeeded but use not recommended [bit(0)=1, bit(1)=0, bit(2)=0]
Green: Retrieval attempted but failed [bit(0)=1, bit(1)=0, bit(2)=1]
Cyan: Retrieval not attempted [bit(0)=1, bit(1)=1]

Climate class: Temperate (Cfa)
Landcover: Grasslands

Fort Cobb (Core Pixel)

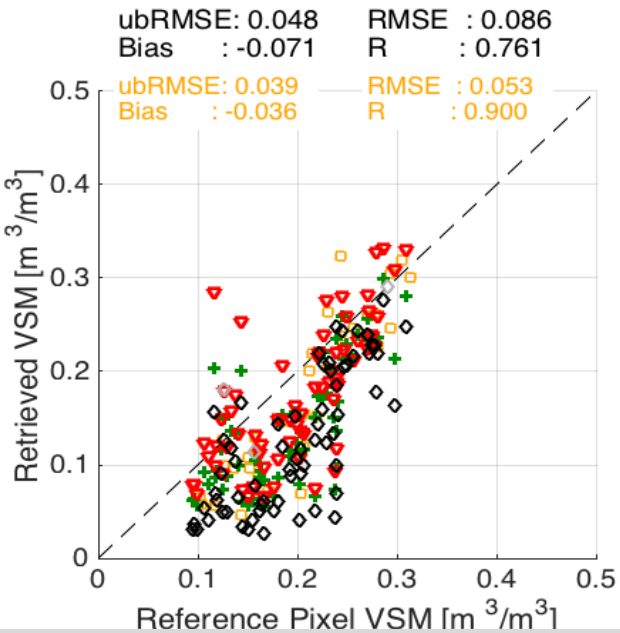
Jet Propulsion Laboratory
California Institute of Technology

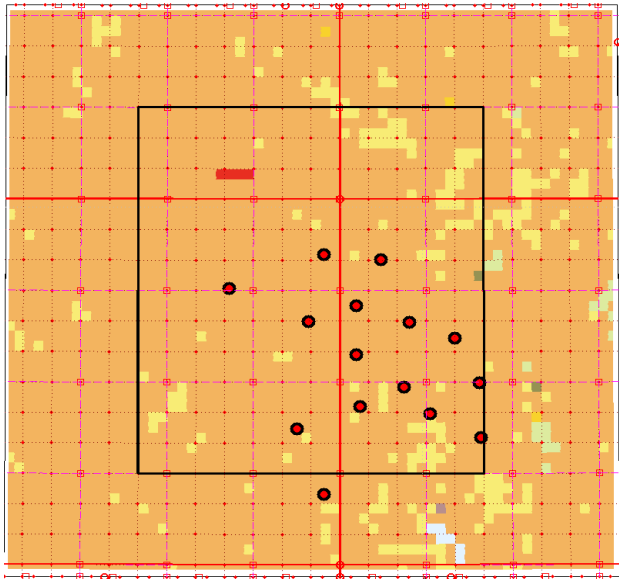
Soil texture:
S-%: 35
C-%: 18
BD: 1.44



In Situ
SCA-H
SCA-V
DCA
SMOS SM

Alg	ubRMSE	Bias	RMSE	R
SCA-H	0.048	-0.071	0.086	0.761
SCA-V	0.044	-0.049	0.066	0.758
DCA	0.053	-0.025	0.058	0.699

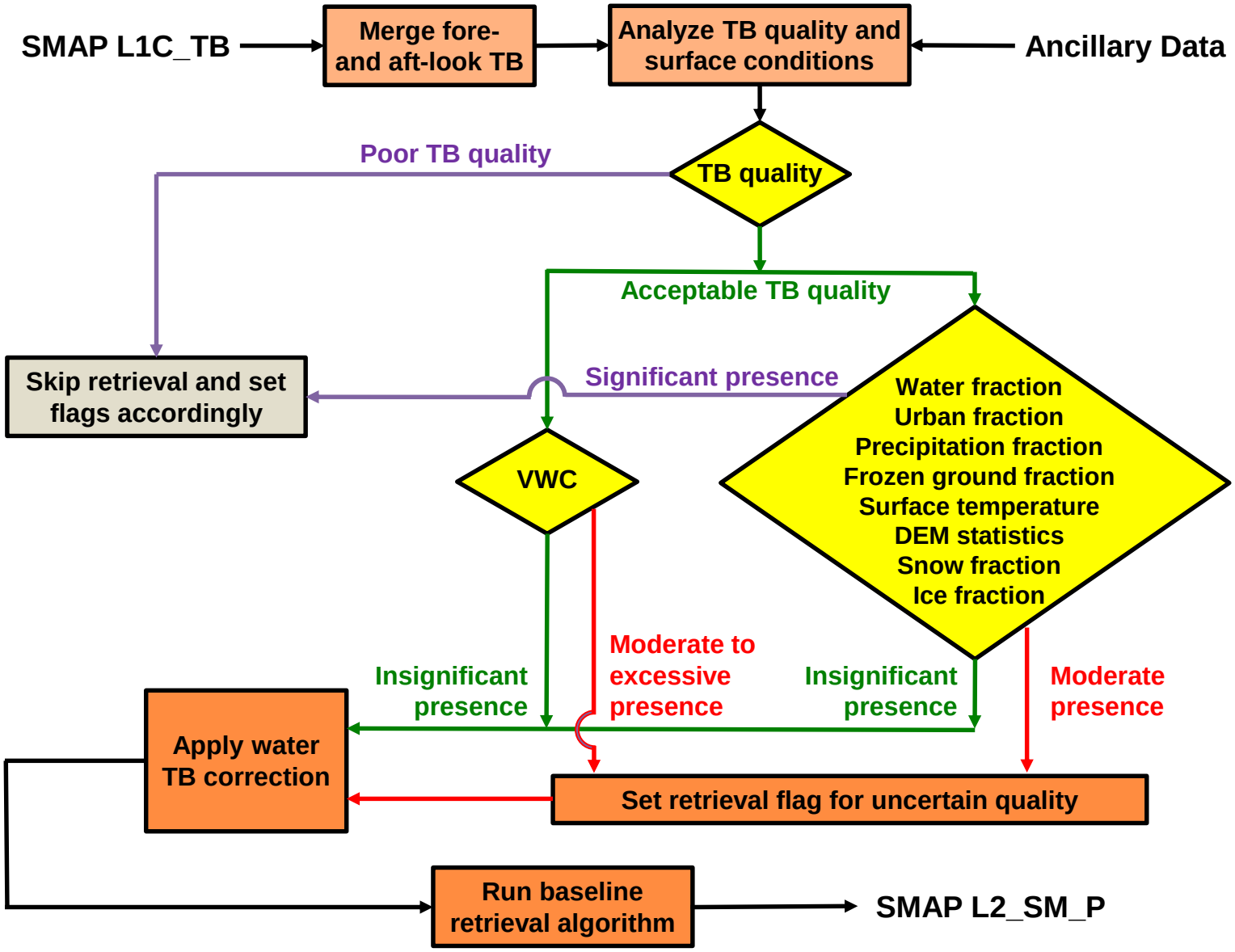




Black: Use recommended [Retrieval Quality Flag bit(0)=0]
Gray: Retrieval attempted and succeeded but use not recommended [bit(0)=1, bit(1)=0, bit(2)=0]
Green: Retrieval attempted but failed [bit(0)=1, bit(1)=0, bit(2)=1]
Cyan: Retrieval not attempted [bit(0)=1, bit(1)=1]

Questions?

L2_SM_P Processing Flow



Ancillary Data

Ancillary Data	Grid Res	Temporal Res	Data Source
Permanent water fraction	3 km	Static	MODIS
Transient water fraction	3 km	Half orbit	L2SMA
Freeze/thaw fraction	3 km	Half orbit	L2SMA
Distance to significant water bodies	36 km	Static	MODIS
Urban fraction	3 km	Static	GRUMP
DEM slope standard deviation	3 km	Static	GMTED
Soil texture	3 km	Static	HWSD
Land cover classification	3 km	Static	MODIS
NDVI	3 km	Climatology	MODIS
Snow fraction	9 km	Daily	IMS
Rain intensity	9 km	3 hourly	GEOS-5
Soil temperature	9 km	1 hourly	GEOS-5

Ancillary Data

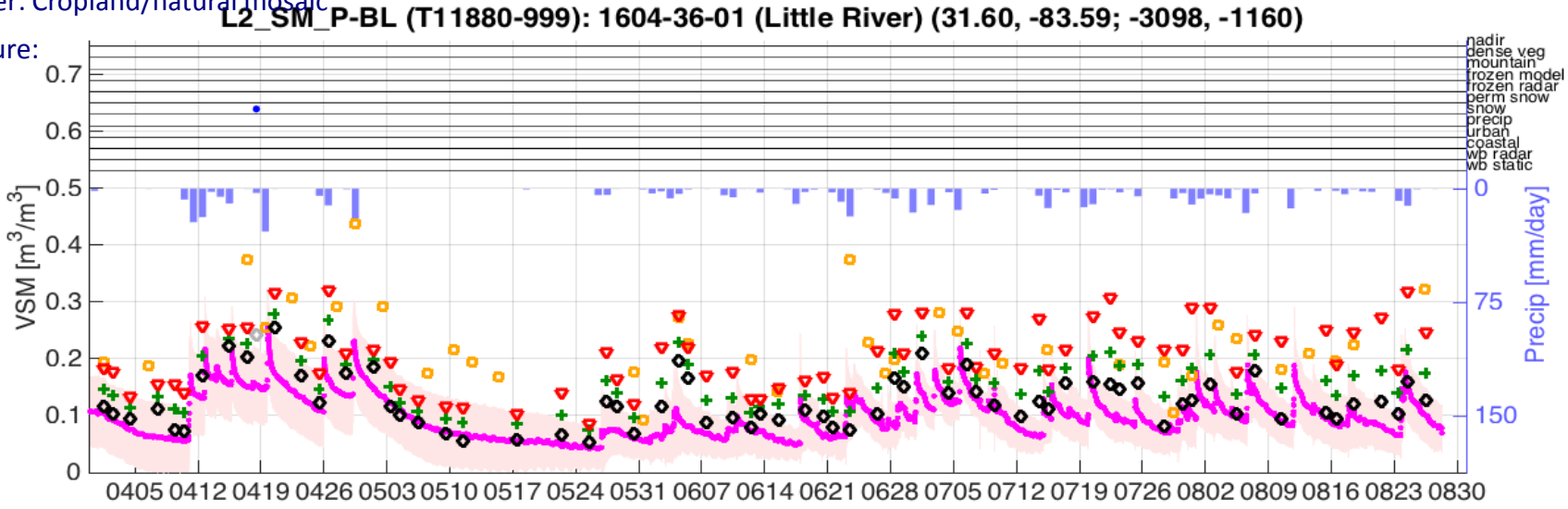
Ancillary Data	Grid Res	Temporal Res	Data Source
Permanent water fraction	3 km	Static	MODIS
Transient water fraction	3 km	Half orbit	L2SMA
Freeze/thaw fraction	3 km	Half orbit	L2SMA
Distance to significant water bodies	36 km	Static	MODIS
Urban fraction	3 km	Static	GRUMP
DEM slope standard deviation	3 km	Static	GMTED
Soil texture	3 km	Static	HWSD
Land cover classification	3 km	Static	MODIS
NDVI	3 km	Climatology	MODIS
Snow fraction	9 km	Daily	IMS
Rain intensity	9 km	3 hourly	GEOS-5
Soil temperature	9 km	1 hourly	GEOS-5

Climate class: Temperate (Cfa)
Landcover: Cropland/natural mosaic

Little River (Core Pixel)

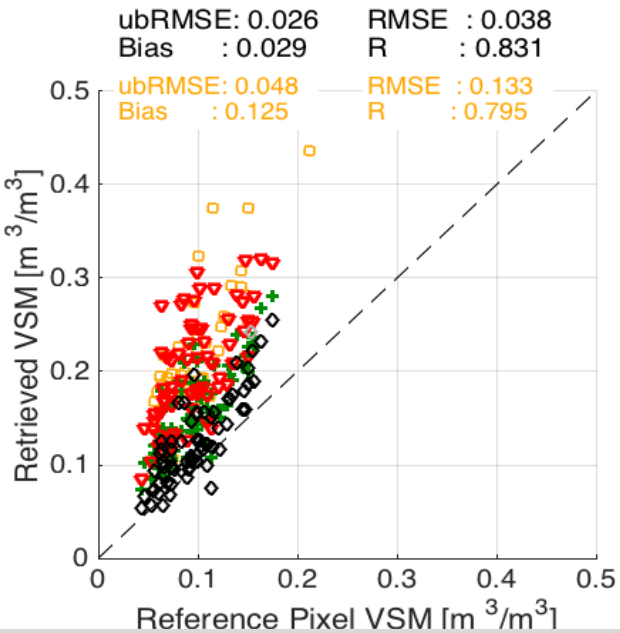
Jet Propulsion Laboratory
California Institute of Technology

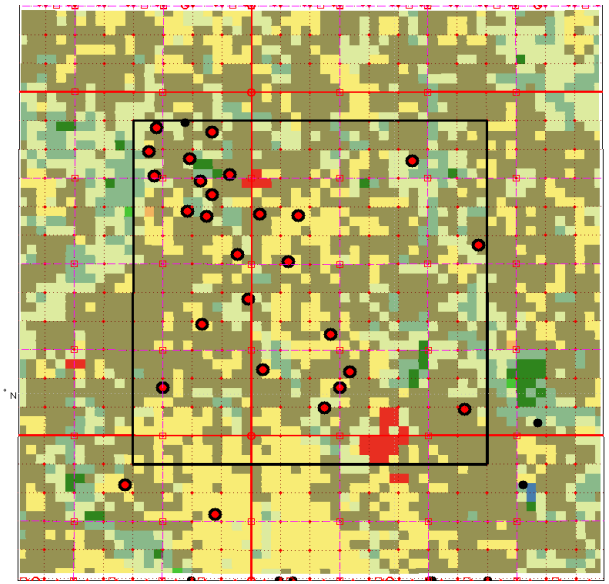
Soil texture:
S-%: 80
C-%: 7
BD: 1.47



- In Situ
- SCA-H
- SCA-V
- DCA
- SMOS SM

Alg	ubRMSE	Bias	RMSE	R
SCA-H	0.026	0.029	0.038	0.831
SCA-V	0.027	0.062	0.068	0.800
DCA	0.045	0.107	0.116	0.656





Black: Use recommended [Retrieval Quality Flag bit(0)=0]
Gray: Retrieval attempted and succeeded but use not recommended [bit(0)=1, bit(1)=0, bit(2)=0]
Green: Retrieval attempted but failed [bit(0)=1, bit(1)=0, bit(2)=1]
Cyan: Retrieval not attempted [bit(0)=1, bit(1)=1]