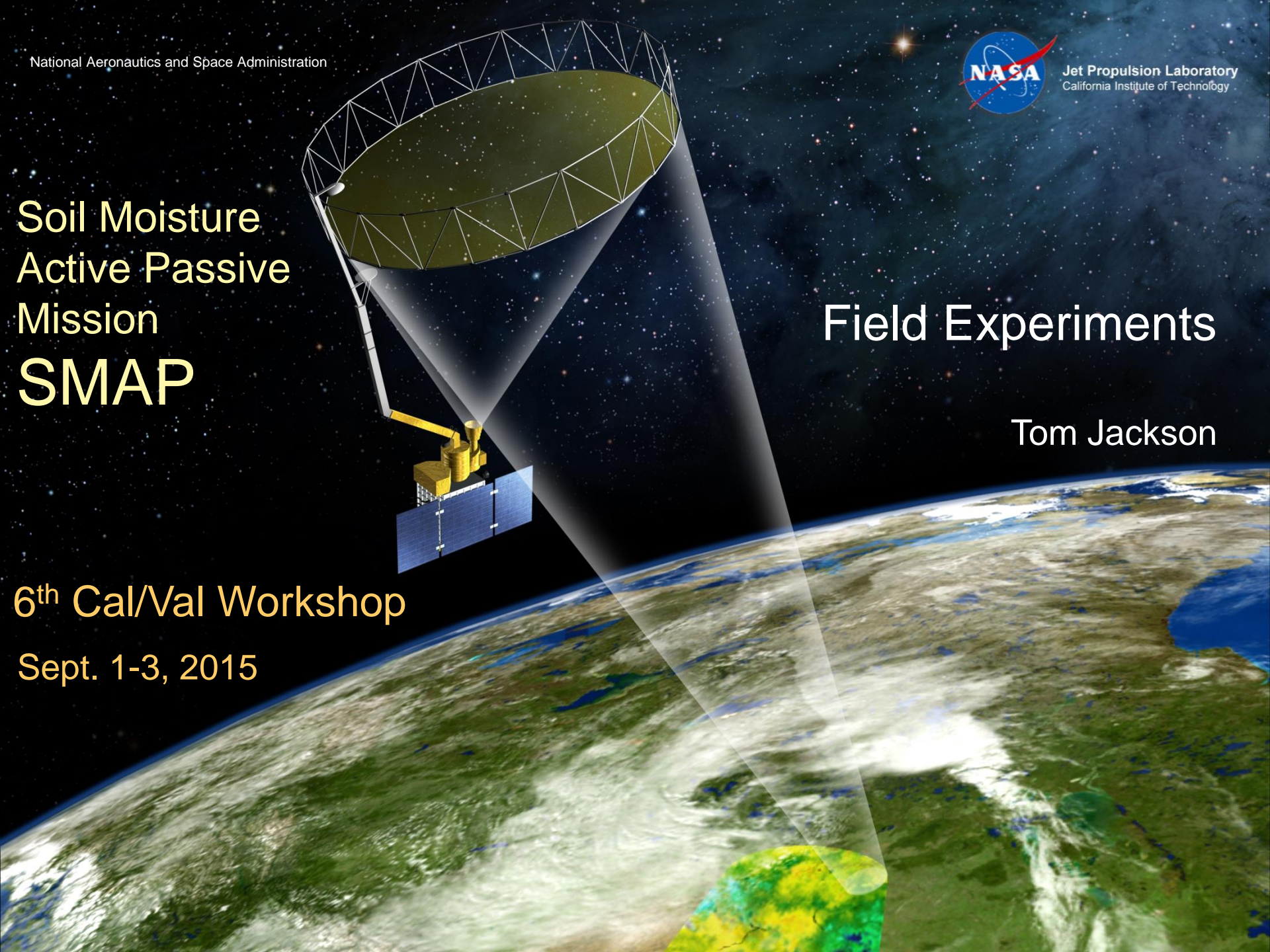National Aeronautics and Space Administration

Soil Moisture
Active Passive
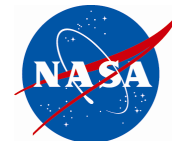Mission
SMAP

Field Experiments

Tom Jackson

6th Cal/Val Workshop

Sept. 1-3, 2015

6th SMAP Cal/Val Workshop Agenda-Day 3

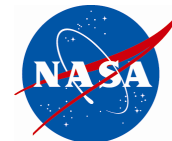| Thursday		
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0330	*Summary*	
0400	*End*	

L2-L4 Validation Methodologies

Methodology	Role
Core Validation Sites	Accurate estimates of products at matching scales for a limited set of conditions
Sparse Networks	One point in the grid cell for a wide range of conditions
Satellite Products	Estimates over a very wide range of conditions at matching scales
Model Products	Estimates over a very wide range of conditions at matching scales
Field Campaigns	Detailed estimates for a very limited set of conditions

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Aircraft Field Campaigns

- Experience has shown that the return on investment in field campaigns can be significantly increased by engaging other groups that can exploit the data set and enhance it with additional observations.

SMAPVEX15 Science Components

- SMAP Post-Launch Validation Aircraft-Based Field Campaign

- Validation of Global Precipitation Mission (GPM) Products

- ~~Multi-frequency Radar Study for AirMOSS and UAVSAR~~

- USDA ARS Long Term Agro-Ecosystem Research-Characterizing and Scaling Walnut Gulch

# SMAP Post-Launch Aircraft Experiments Science Objectives

- ~~Validate the entire L2_SM_AP algorithm process; scaling and radiative transfer~~

  - ~~*Key measurement: Higher resolution TB to validate the AP disaggregation*~~

- Investigate and resolve anomalous observations and products

- Understand the effects and contribution of heterogeneity on coarser resolution retrievals

- Evaluate the impact of known RFI sources on retrieval

- Correlative analysis of L1 product calibration and heterogeneity effects

SMAPVEX15 Design

- Considerations
  - *Region with spatially variable precipitation and a range of soil moisture conditions over short periods.*
  - *Supporting infrastructure in order to use fiscal and human resources efficiently*

- Selected: Walnut Gulch (AZ)
  - *Infrastructure: Extensive precip and soil moisture networks*
  - *Field campaign heritage (Monsoon'90 SMEX04 (NAME), ..)*
  - *Summer Monsoon*

- Time frame: August 2-18, 2015

WALNUT GULCH EXPERIMENTAL WATERSHED
MEAN MONTHLY PRECIPITATION
MEAN ANNUAL 13.76 in.(350 mm)
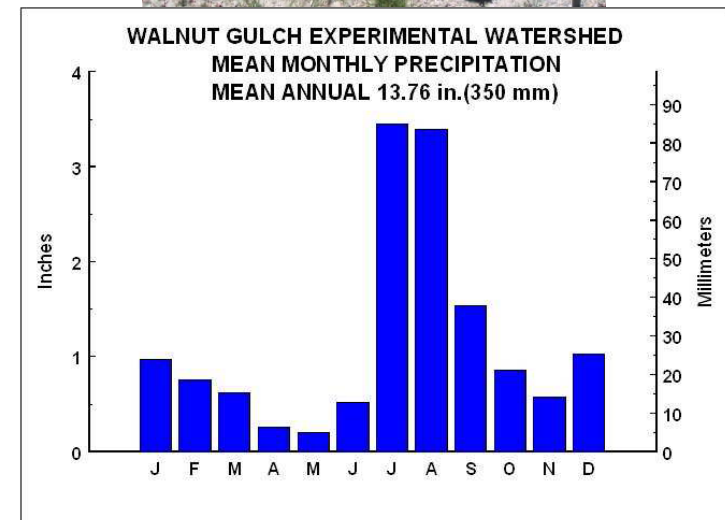
Climate class: Arid (BSk)
Landcover: Shrub open

Walnut Gulch (Core Pixel)

Soil texture:
S-%: 44
C-%: 19
BD: 1.34

L2_SM_P-BL (T11880-999): 1601-36-01 (Walnut Gulch) (31.68, -110.04; -2248, -1156)

SMAPVEX15
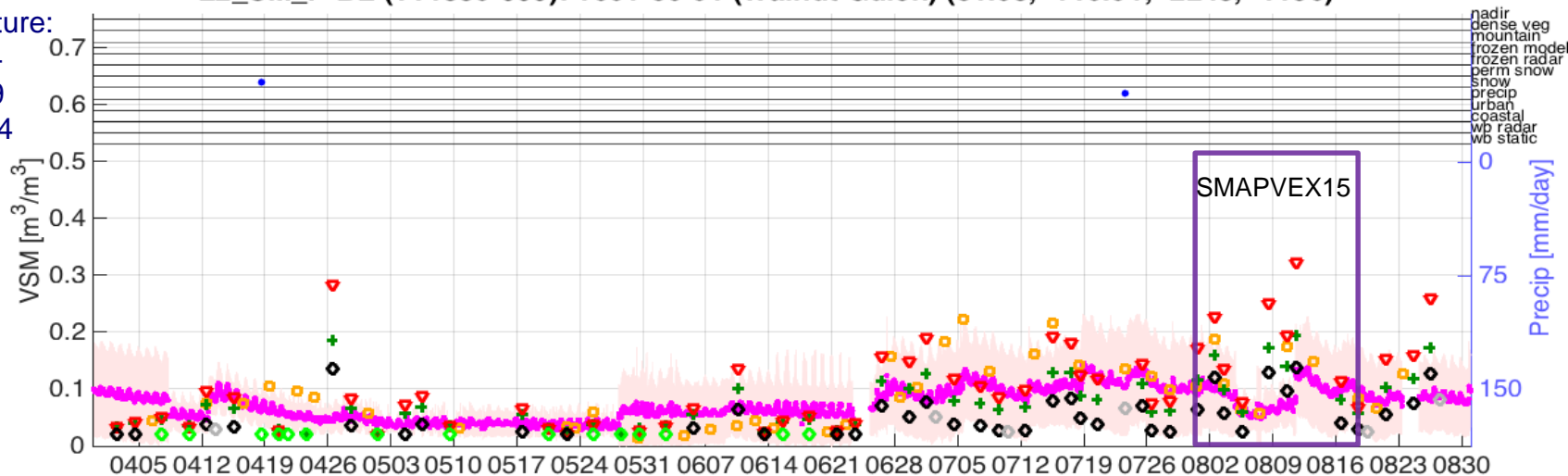
- In Situ
◇ SCA-H
+ SCA-V
▽ DCA
□ SMOS SM

ubRMSE: 0.038   RMSE : 0.045
Bias   : -0.024   R   : 0.238
ubRMSE: 0.025   RMSE : 0.029
Bias   : 0.014   R   : 0.307

Alg	ubRMSE	Bias	RMSE	R
SCA-H	0.038	-0.024	0.045	0.238
SCA-V	0.040	0.005	0.041	0.471
DCA	0.066	0.035	0.075	0.461
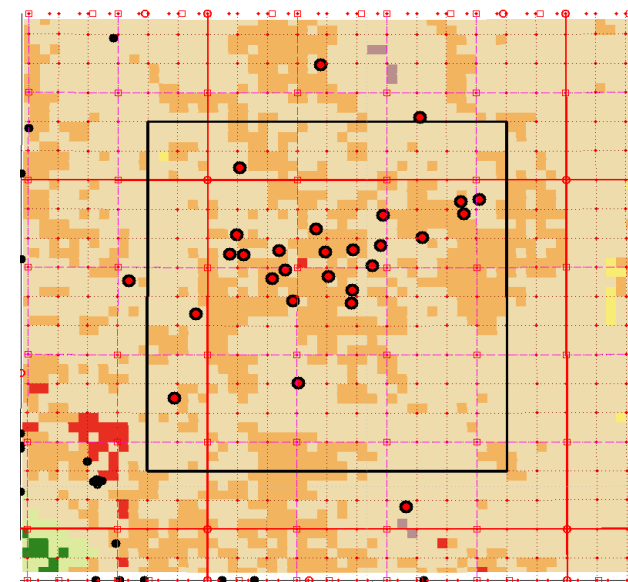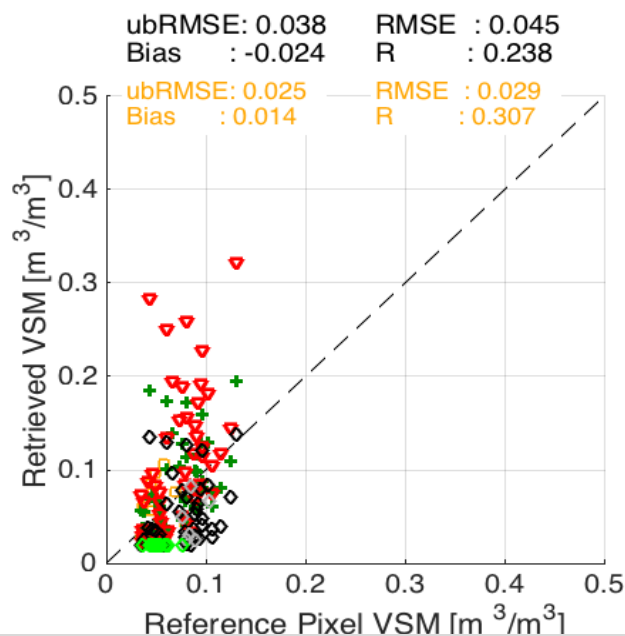
Black: Use recommended [Retrieval Quality Flag bit(0)=0]
Gray: Retrieval attempted and succeeded but use not recommended [bit(0)=1, bit(1)=0, bit(2)=0]
Green: Retrieval attempted but failed [bit(0)=1, bit(1)=0, bit(2)=1]
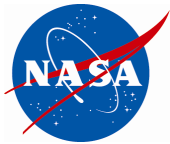Cyan: Retrieval not attempted [bit(0)=1, bit(1)=1]

Not for public release or redistribution. This document has been reviewed and determined not to contain export controlled technical data.

August 9, 2015
Looking East from Tombstone
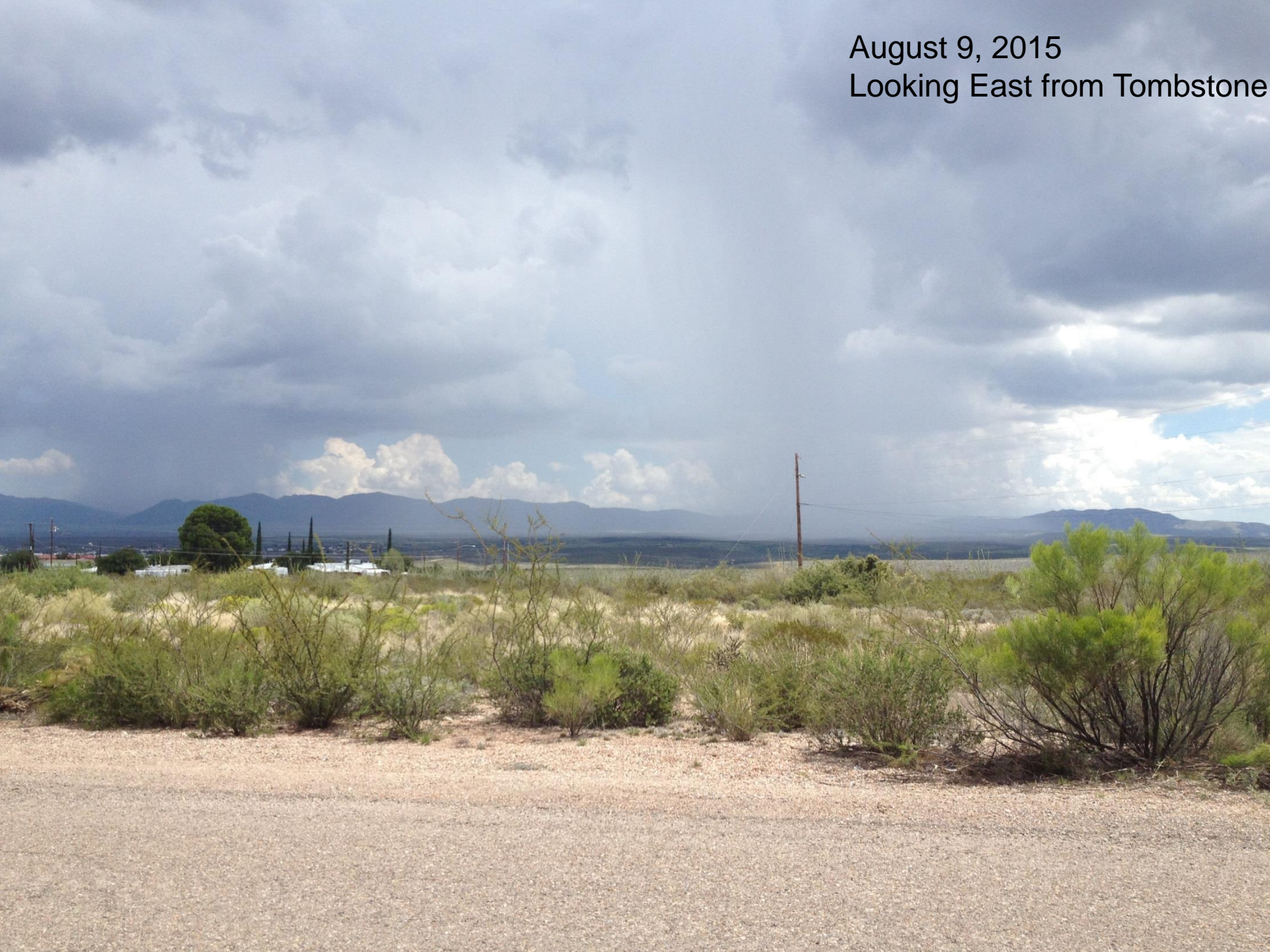
SMAPVEX 15 Calendar

June 21	22	23 Install Temp SM	24	25 TELECON	26	27
28	29	30	July 1 Install Temp Precip	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16 TELECON	17	18
19 L8W	20	21	22	23	24	25
26	27 IGARSS	28 L8E IGARSS	29 IGARSS	30 IGARSS	31 IGARSS TEAMS ARRIVE PALS to Tuscon	August 1 Team Training
2 PALS 1	3	4 L8W	5 PALS 2	6	7	8 PALS 3 AirMOSS 1 Rover 1
9	10 PALS 4 AirMOSS 2 Rover 2	11	12	13 L8E PALS 5 AirMOSS 3 Rover 3	14	15
16 PALS 6 AirMOSS 4	17	18 PALS 7 AirMOSS 5	19	20 L8W	21	22
23	24	25	26	27	28	29 L8E
30	31 Remove Temp Precip	Sept 1 SMAP C/V Workshop	2 SMAP C/V Workshop	3 SMAP C/V Workshop	4	5

SMAPVEX15 Key Features

- Ground-based (M. Cosh)
  - *Soil moisture*
  - *Precipitation*
  - *Ancillary*
- Aircraft-based (A. Colliander)
  - *PALS*
  - *AirMOSS*
- Model-based products (W. Crow/E. Wood)

SMAPVEX15 Post-Launch Validation Aircraft-Based Field Campaign
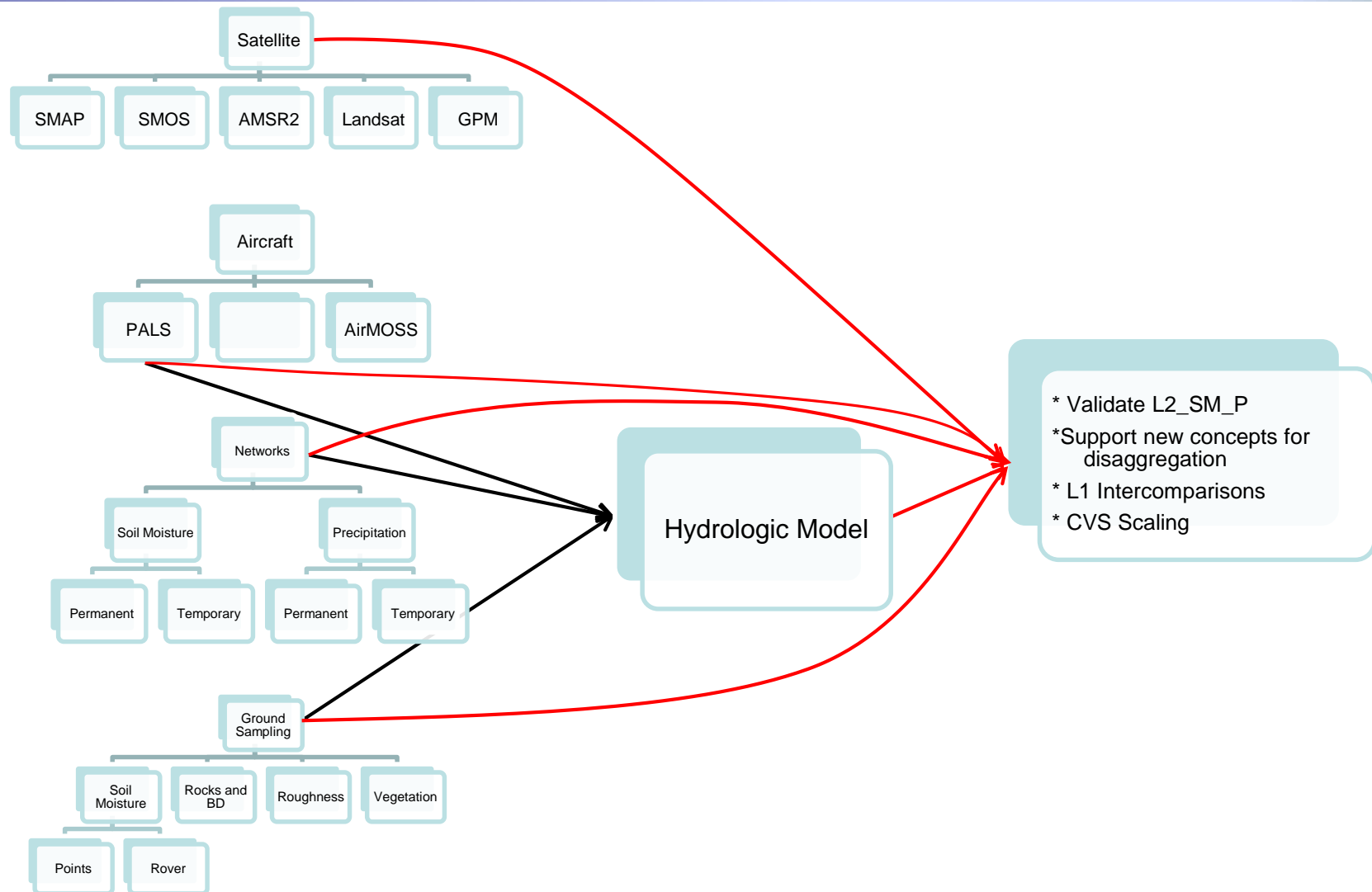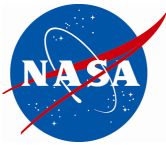
SMAPVEX15 Product Schedule

| Step	Due	Responsible
Data collection	8/18/15	M. Cosh/A. Colliander
GSM/BD/VWC processing	9/18/15	M. Cosh
In situ calibration	10/1/15	M. Cosh
VG upscaling	11/1/15	M. Cosh
Ancillary data bases	10/1/15	TBD
Precip data base integration	10/1/15	W. Crow/D. Gochis
TB and sigma0 products	9/18/15	A. Colliander/S. Yueh
PALS-based soil moisture	11/1/15	A. Colliander
Model-based soil moisture	12/1/15	E. Wood/W. Crow
Analyses	1/1/16	All
Report	2/1/16	All
Archive at NSIDC	2/1/16	M. Cosh/A. Colliander

SMAP Post-Launch Aircraft Experiments Science Objectives

- Investigate and resolve anomalous observations and products

- Understand the effects and contribution of heterogeneity on coarser resolution retrievals

- Evaluate the impact of known RFI sources on retrieval

- Correlative analysis of L1 product calibration and heterogeneity effects

- *Improving up-scaling functions for CVS*

- *??? New disaggregation approaches*

- *Regional application support*
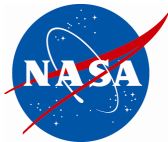
Soil Moisture

Long Time Series	Snapshots	Mix (Baseline)

- Manitoba/Iowa
- Option A: Continuous
  - *June 15-August 1, 2016*
- Option B: Split
  - *May 15—June 1, and*
    July 1-15, August 15-30, 2016
- SMAPVEX12 provided and excellent rehearsal

- Core Validation Sites (TBD)
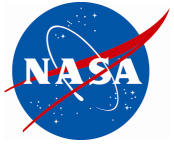- Two flights over each site
- July 15-August 30, 2015

- Subset of Core Validation Sites (3)
- Six flights over each (~2 weeks)
- July 15-August 30, 2016

Post-Launch SMAPVEX16: Where?

|	LR	MB	SF
Infrastructure	M	H	L
Vegetation Range	M	H	H
SM Range	M	H	H
Seasonal Limitations	L	M	M
Cost Sharing	L	H	L
Heritage	M	H	L

SMAPVEX16 Baseline

- Duration: 30 days (8-10 days for each site)
- Flight hours: 100 (70 for science and 30 for test flights and transit.)
- Two Aircrafts: PALS on DC-3 and UAVSAR on G3 (TBD)
- Three sites: each site will cover 36 km x 36 km based on
  - *atch-up of in situ and retrievals*
  - *Key site*
  - *Strong science plan*
  - *……………...*

SMAPVEX16 Time Line

- Minimum time for SMAP data assessment: through NA summer season 2015

- First assessment and candidate targets at Cal/Val Workshop (Sept. 2015)

  – *New mission priorities?*

- Initiate experiment planning Nov. 2015

- Field campaign July-August 2016
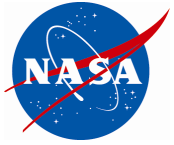
SMAPVEX16+ Ideas?

- Forest sites
  - *Consider challenges of capturing variability of SM and VWC*
  - *Global importance of the conditions/site*
- New disaggregation approaches
  - *Sentinel –challenge to design*
  - *TIR/VIR*
- New regional applications
  - *Crop yield*
  - *Drought*
  - *Floods*
  - *Hurricane land fall*
- Addressing new products (VWC/Tau, …)

SMAPVEX16+ Ideas?

- One of the least studied vegetation types is forests
- Not all forests are the same: most important? Priorities?
- Difficult domains to work in
- Should have the potential to be a CVS
- Resources?
- Timeline?
- Proposal
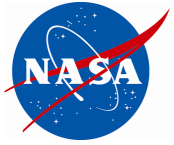
SMAPVEX18: Amazon Basin

- One of the largest spatial domains in images

- Although we have stated that conditions there exceed the retrieval threshold for VWC, we are retrieving soil moisture (It makes global maps look a lot better!).

- If we are supplying a product…we need to validate. There are no data sets that exist to validate soil moisture retrievals under these conditions.
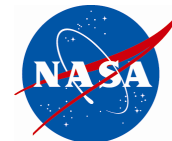

SMAP L2_SM_P Soil Moisture
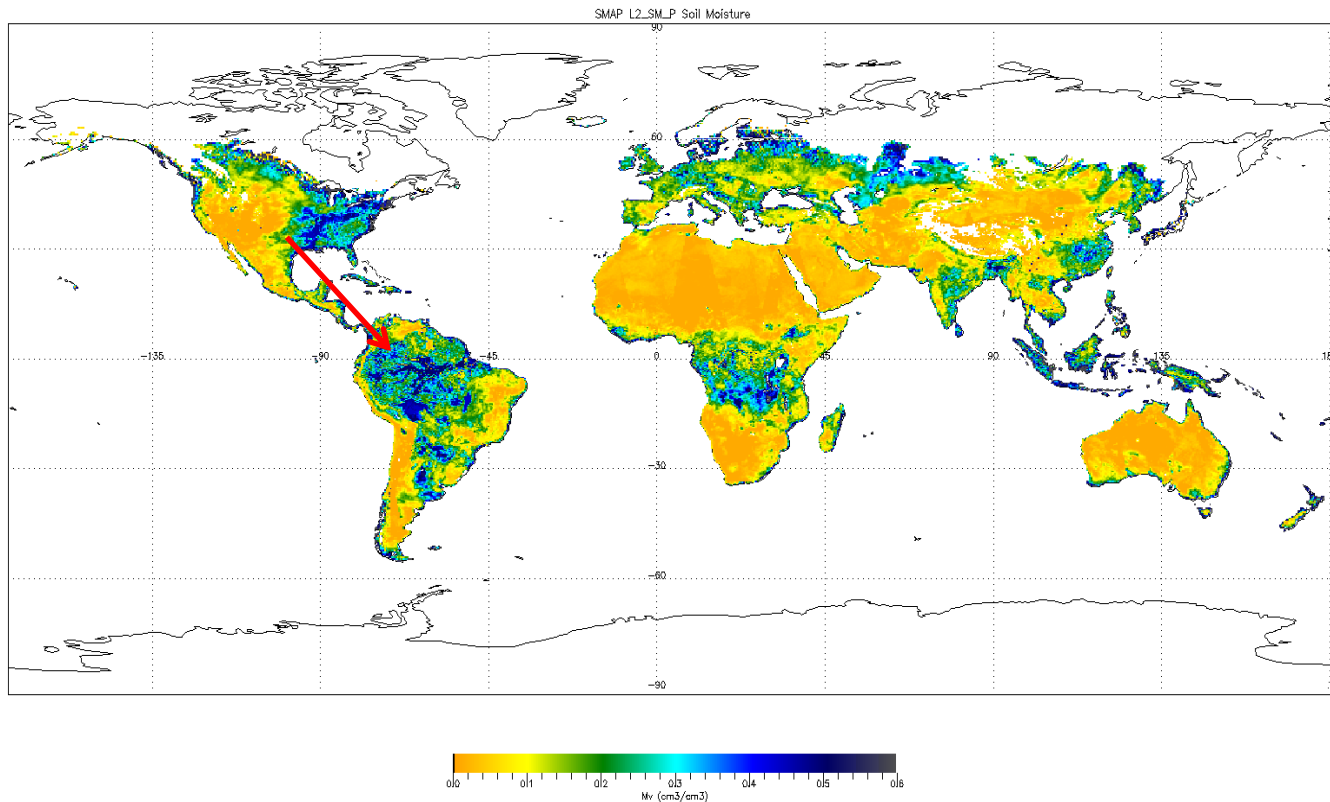
SMAPVEX18: Amazon Basin

- Concept
  - *PALS deployment for two weeks for two seasons (wet Dec-May and dry June-Nov). Choose several diverse sites and fly each two times.*
  - *Temporal variability during each period is not necessary, the stability over time is desired.*
  - *Spatial variability within a site is desired.*
  - *Coverage of SMAP grids with a resolution <3 km.*
- Aircraft logistics will be a challenge.
- Ground observations
  - *Critical and will be THE major problem.*
  - *In country collaboration is required.*
  - *Linkages exist but $ support for this effort is probably not available*
  - *Exploit existing efforts and temporary stations*
- Scoping and feasibility (minimum 2-years planning)
  - ☑ *Discussion with NiSAR and SWOT ST and HQ about interest*
  - ☑ *Contact INPE scientists*

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