SMOS
Cal Val
A feed back

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And the SMOS team

3rd SMAP Cal/Val Workshop
November 15th 2012

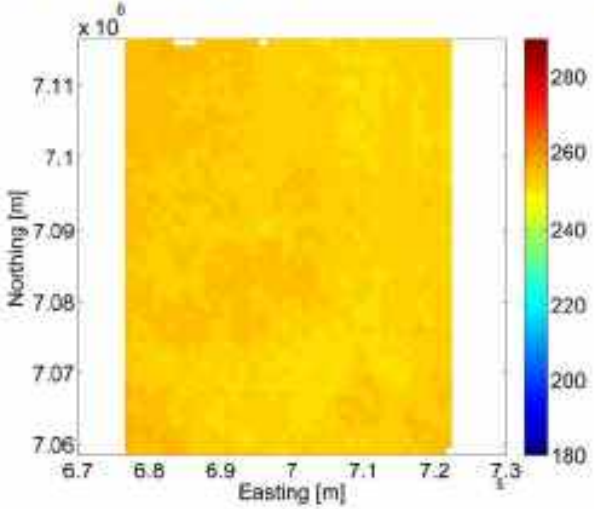
Frame

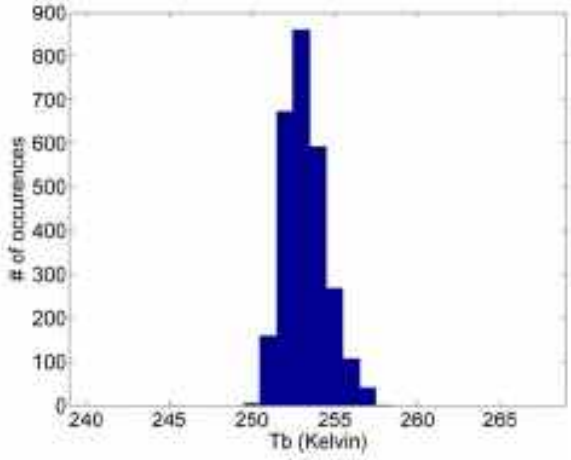
- Necessity to carry out a Cal/Val
  - Self obvious
- The case of SMOS
  - Main points
    - New instrument (2D Interferometry)
    - New measurements
    - Spatial and temporal sampling
  - Past experience
    - AMSR –E
    - …
- Comparisons with other data sets
  - ECMWF (usually too wet)
  - Other satellite data sets
  - Triple colocation ➔ advantages relative algorithms, detrimental to absolute value retrievals
  - But useful to see how algorithm behaves as a function of location

Calibration

- Need either
  - A large area fully and perfectly known and modelled
    - Does not exist
      - Spatial Heterogeneity
      - Temporal evolution
  - Or an area homogeneous and temporally very stable
    - Ocean
      - Wind speed, SST
    - Antarctica (dome Concordia)
    - Galactic pole
      - Need manoeuvres
  - Avoid using
    - Deserts → source of issues (see Walker and Rudiger, and others)
    - Forest not stable (see Ferrazzoli et al)
    - Greenland → strange behaviours

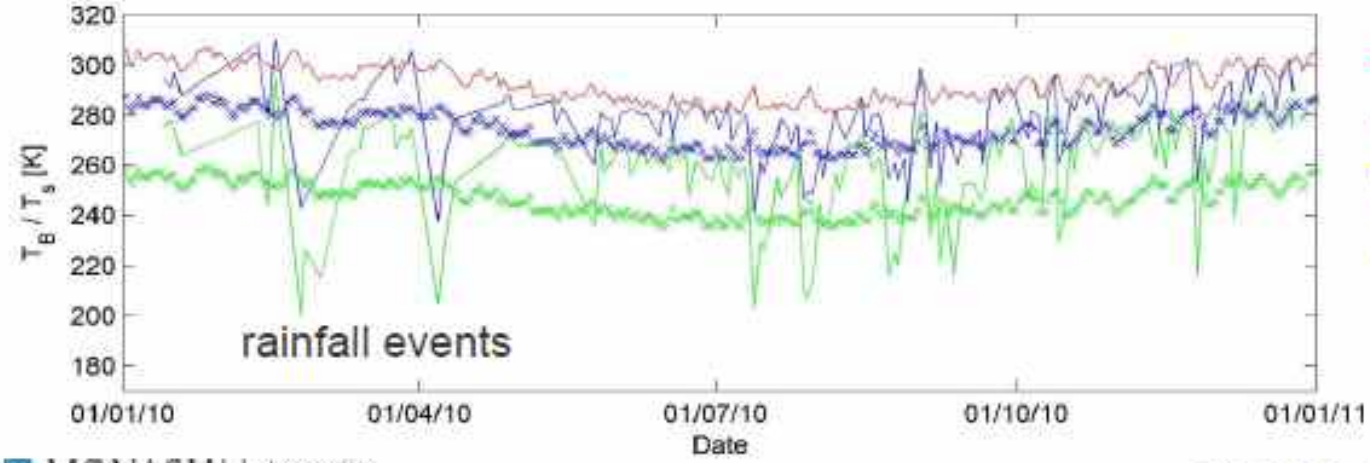
Vicarious calibration: Simpson Desert



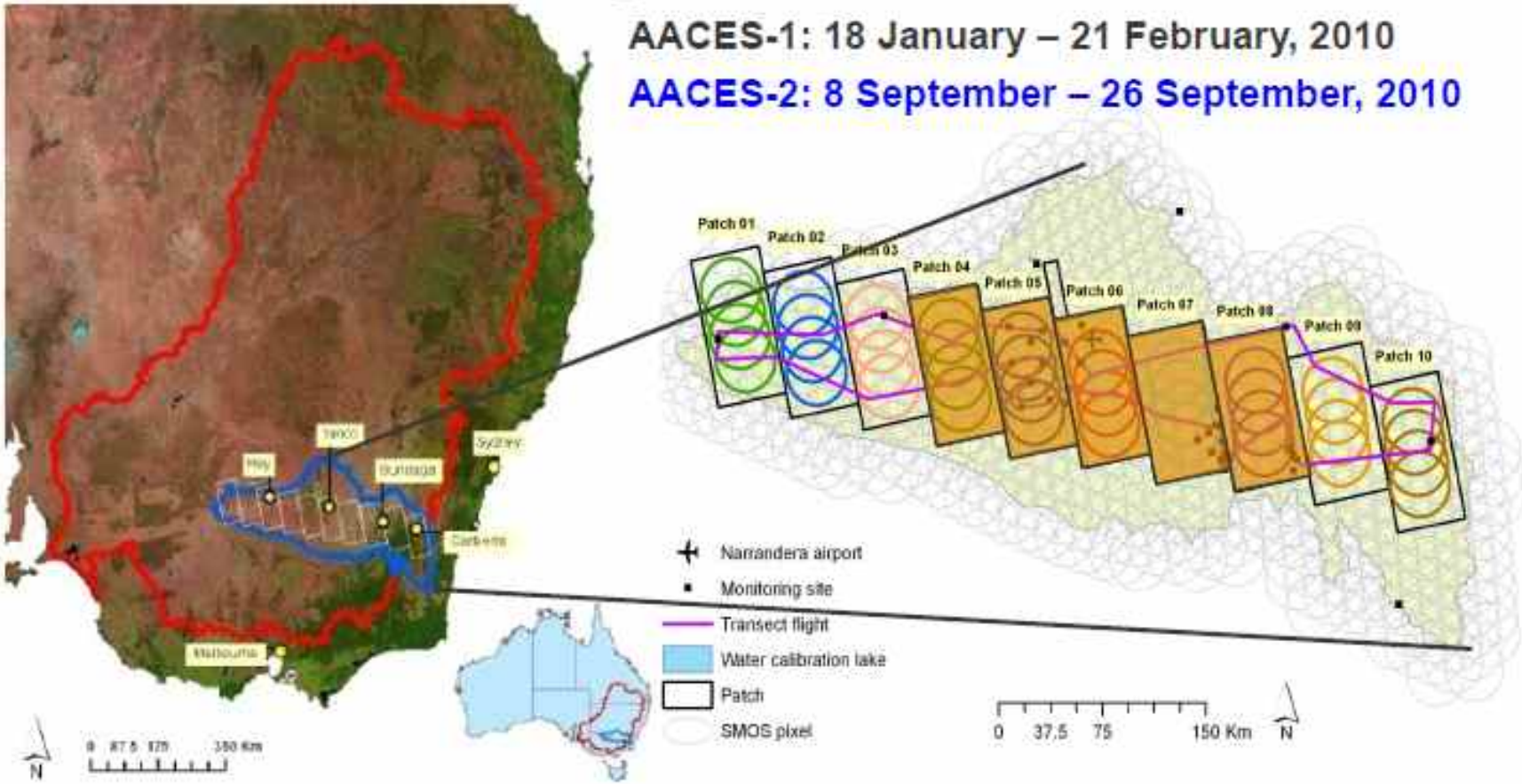


Standard Deviation
~1K

	RMSE	uRMSE	BIAS
V	13.3	10.1	8.8
H	21.9	13.4	17.3

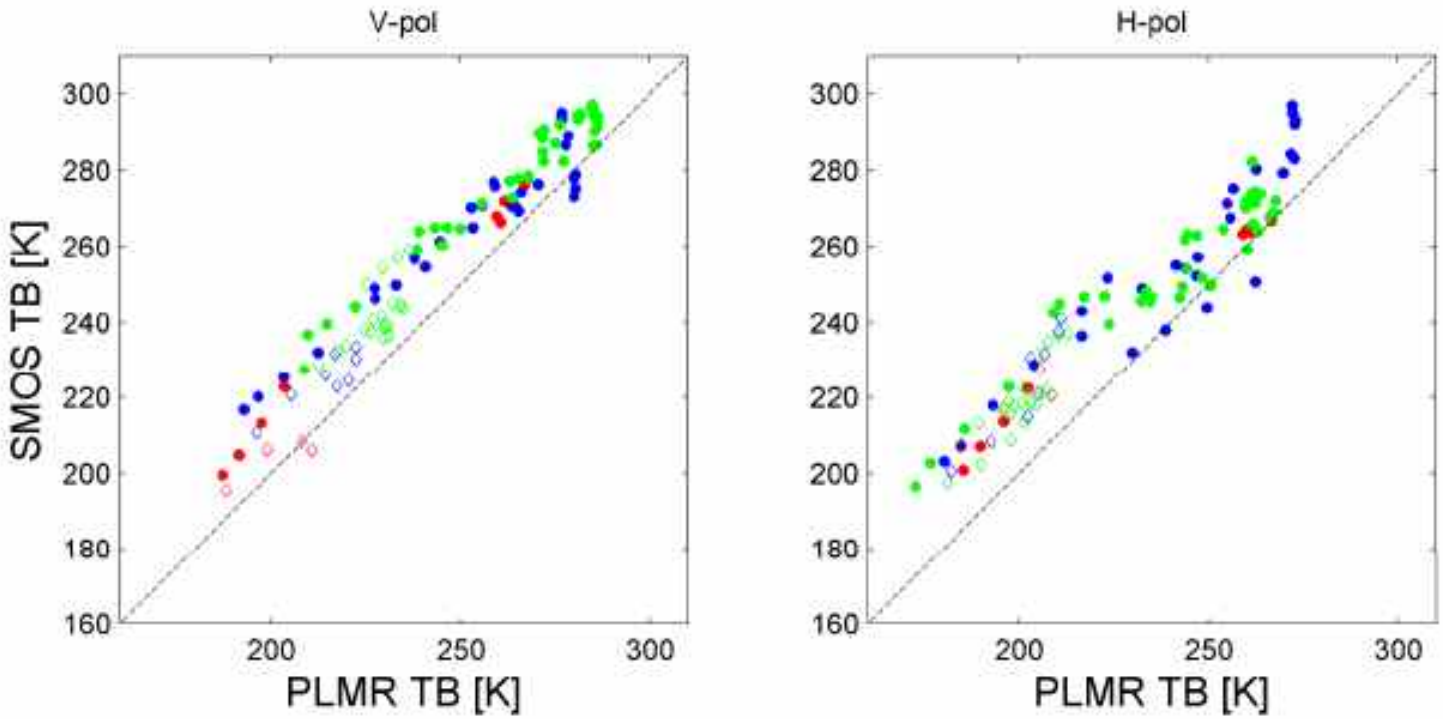


The Murrumbidgee catchment

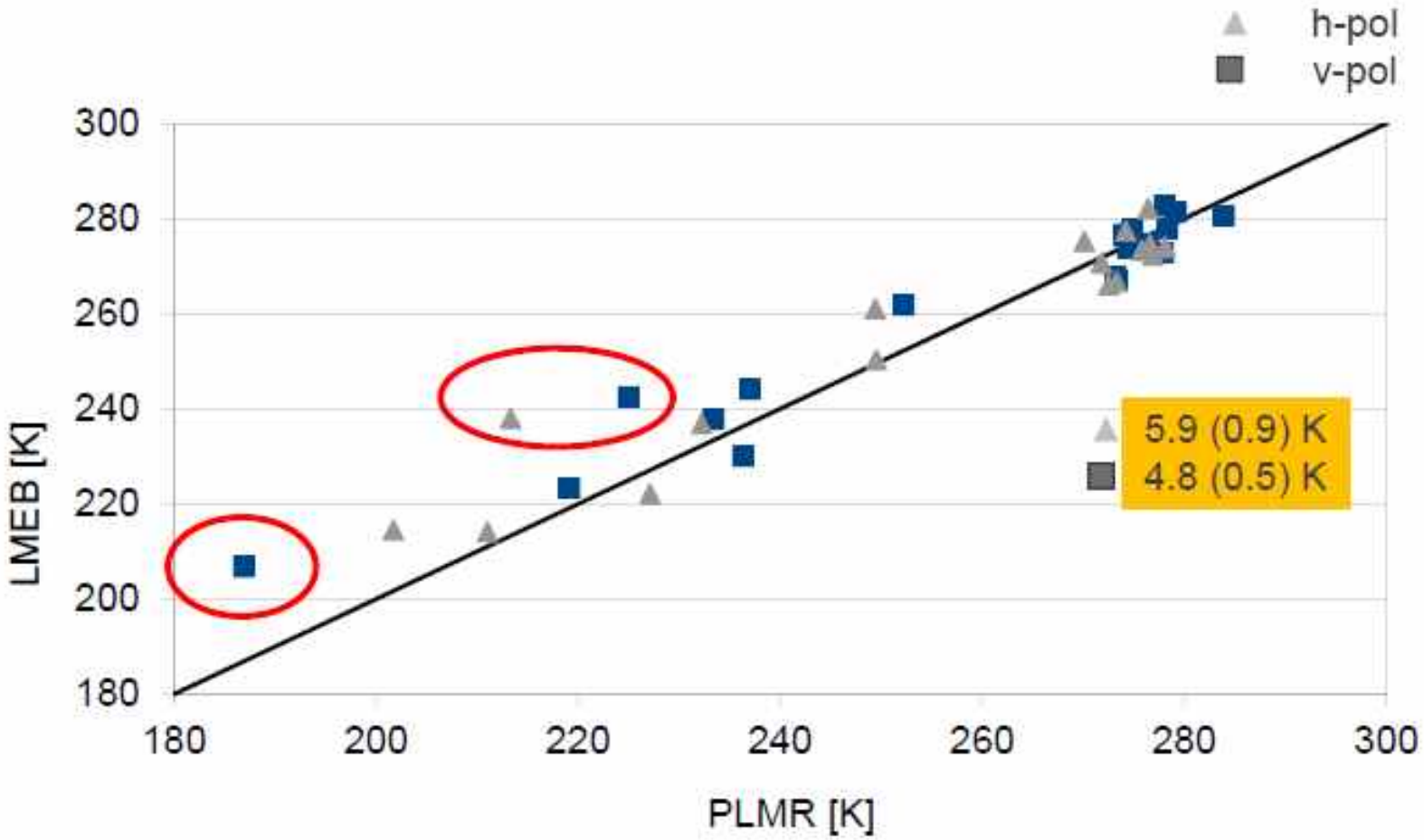


Level 1c Vali

Polarization	v-pol		h-pol	
Incidence angle	22°	38°	22°	38°
Bias [K]	8.2	9.0	11.3	11.7
RMSE [K]	10.8	10.7	12.6	13.6
	(bias corrected)			
RMSE [K]	7.1	5.9	5.5	7.0



L-MEB Predictions

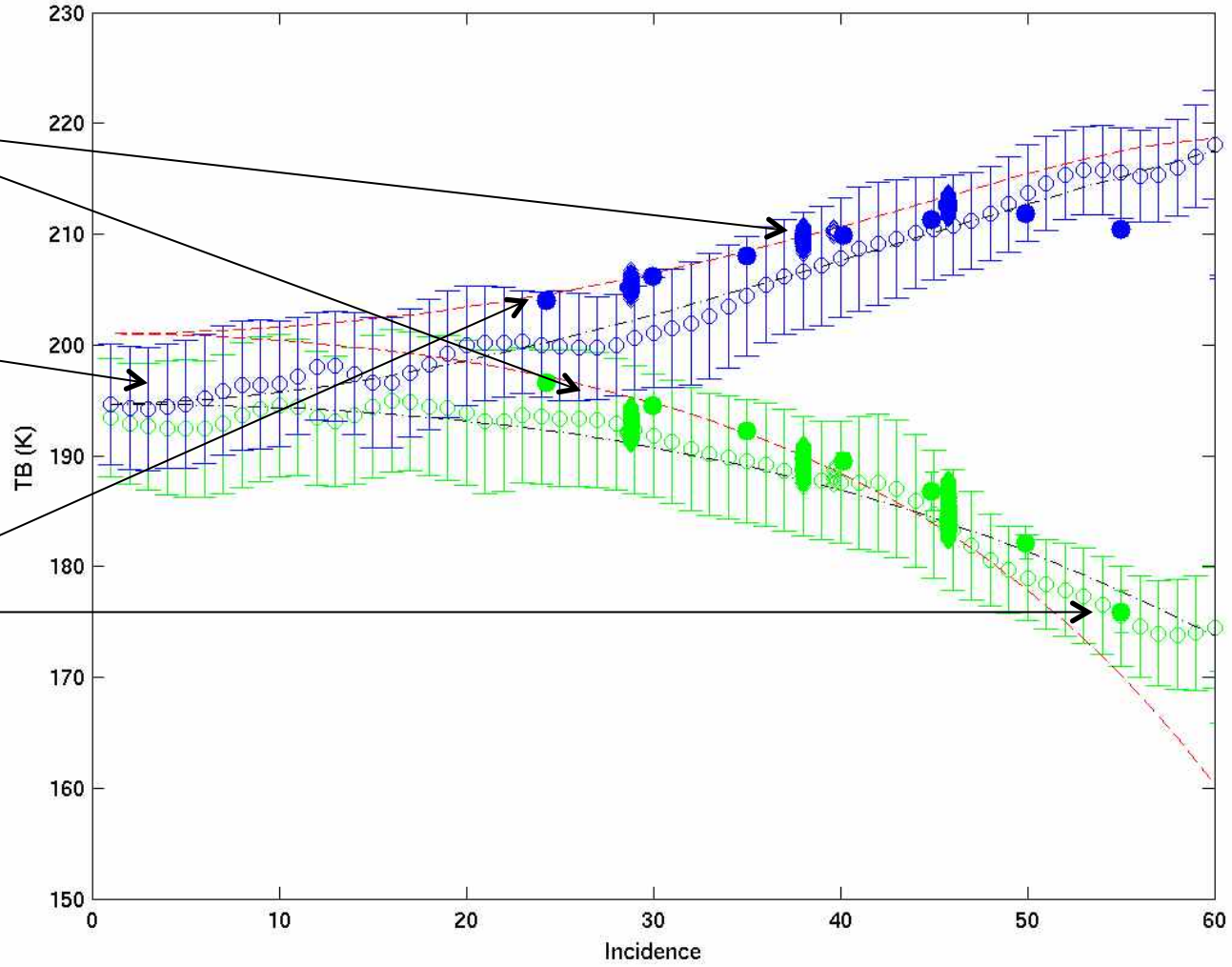


DOME C

Aquarius

SMOS Smoothed

DOMEX

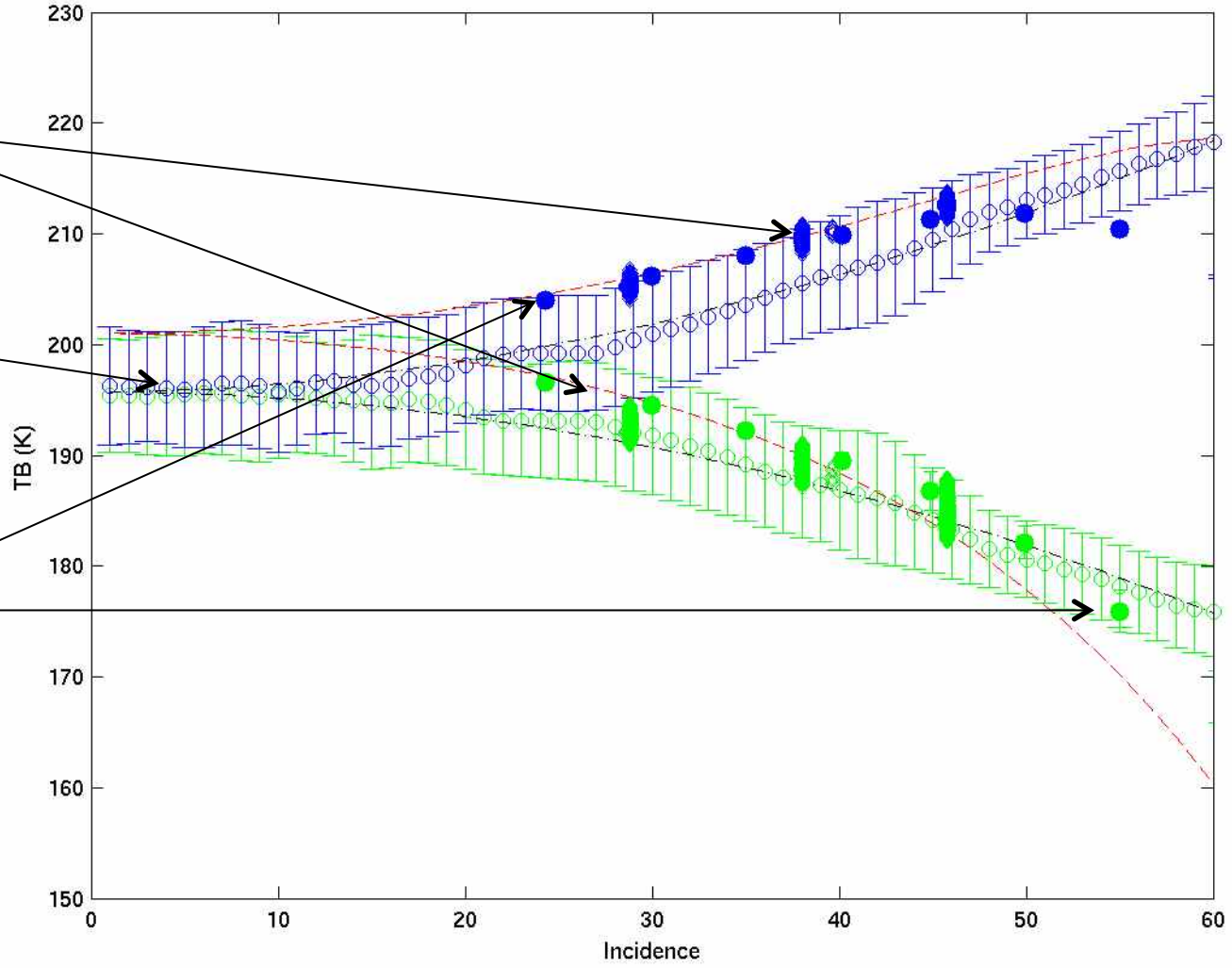


DOME C

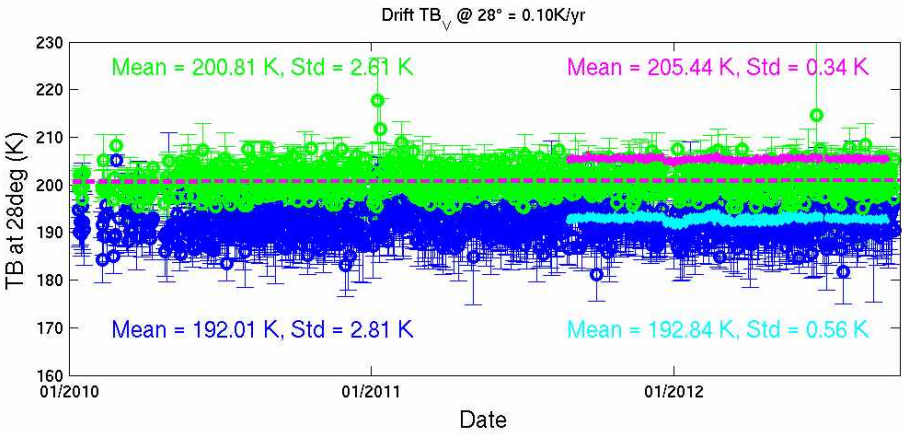
Aquarius

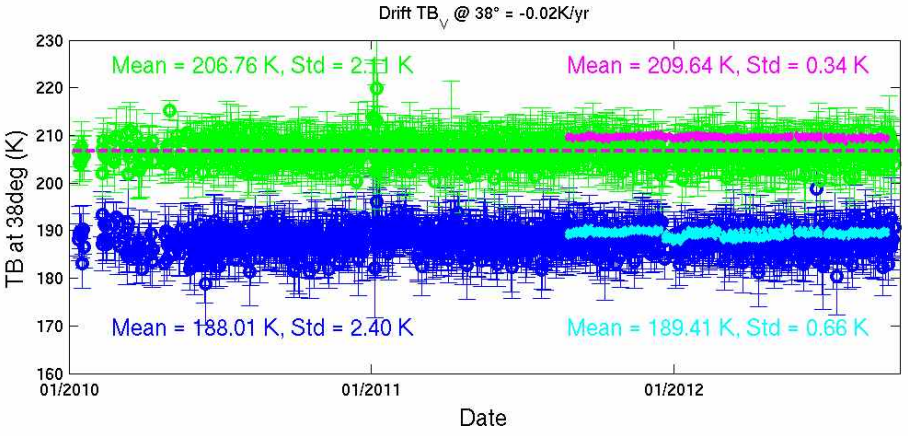
SMOS Smoothed

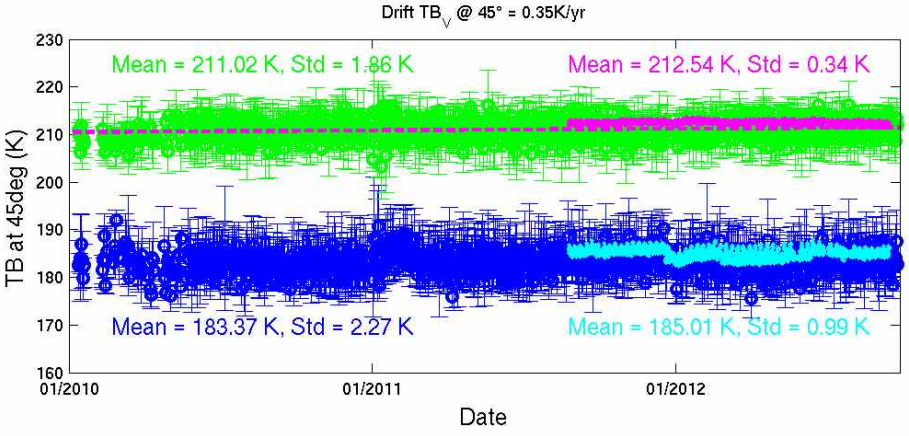
DOMEX



SMOS Aquarius





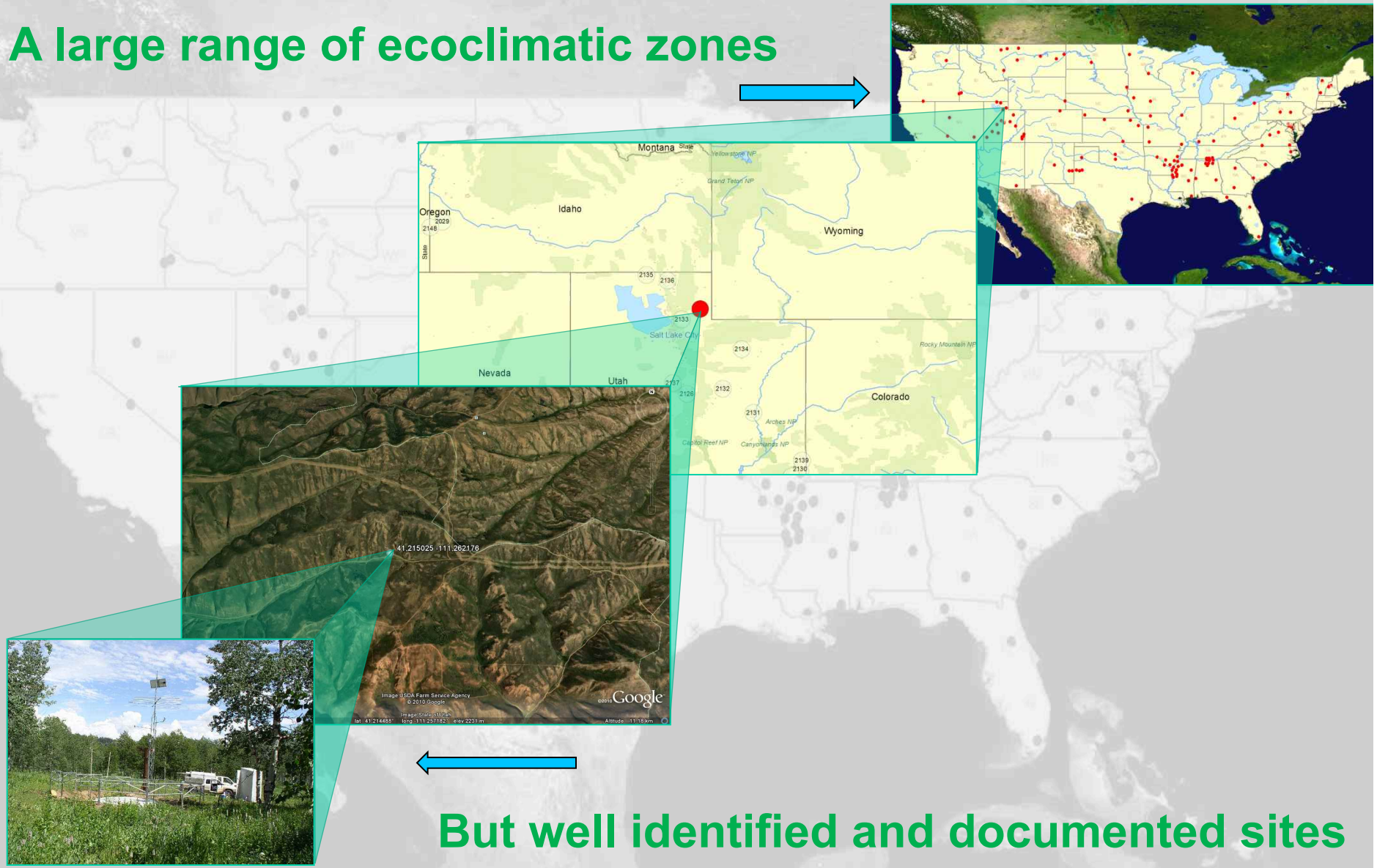


Rationale

- A/C campaigns
  - Expensive
  - One shot
  - Have to be prepared in long in advance
  - Often without flexibility
    - If rains all the time only wet conditions!
    - If launch delayed ….
    - Time required to have access to data
- Launch date important
  - scheduled for June but ended up November 2nd ➔ winter in Europe:
    - Frozen soils
    - Little vegetation
    - ➔ Australia!
- Ground networks
  - Always available but representativity sometimes questionable as well as QC
  - Sometimes delay to have access to data

SCAN network

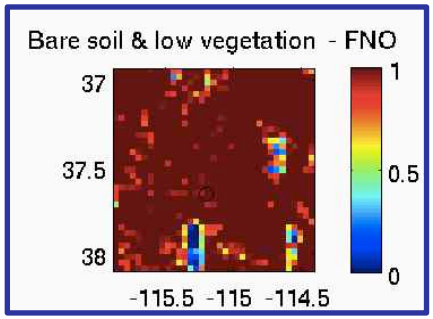
A large range of ecoclimatic zones

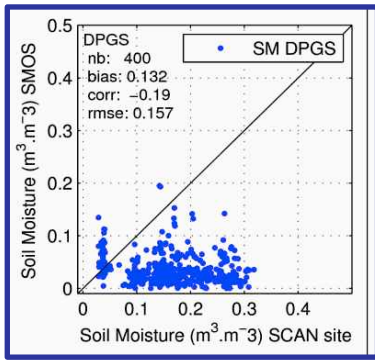


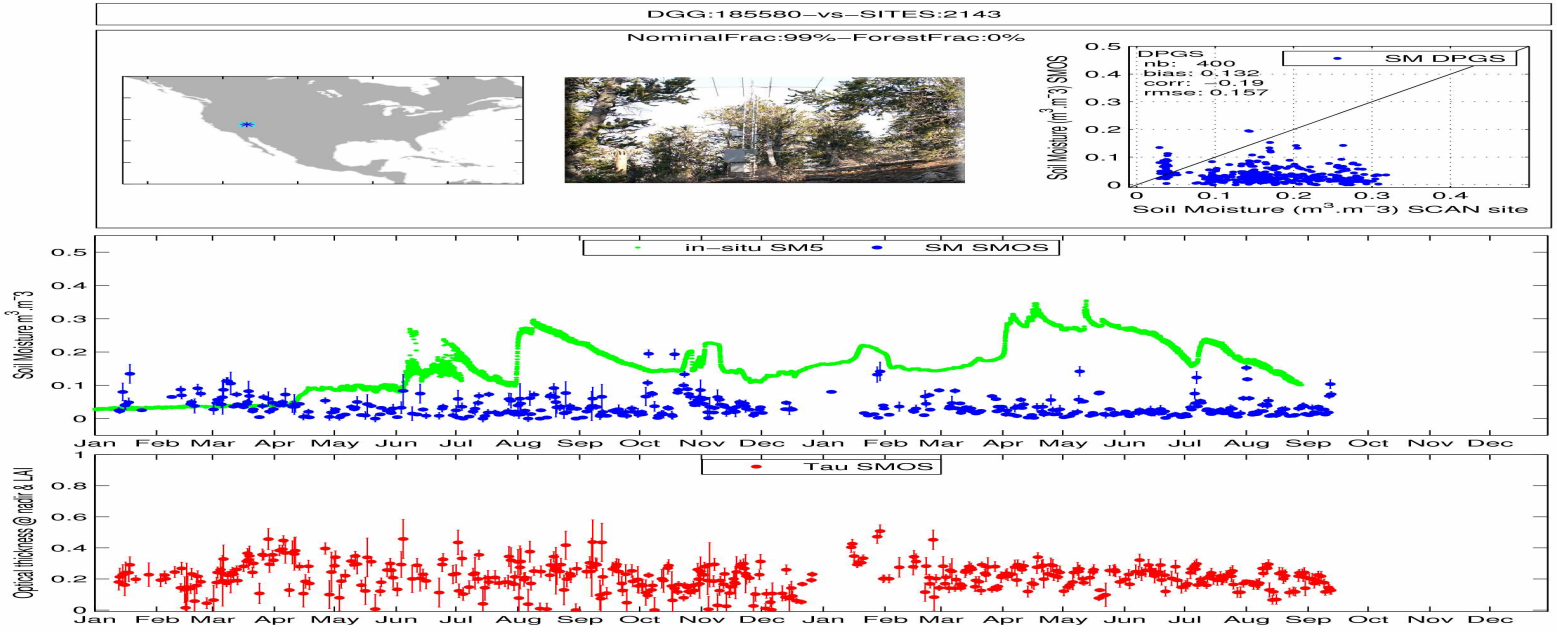
But well identified and documented sites

Sometimes ground data not representative of the area

Closest site is not the most representative: Site is forested and surface is nominal







Comparison with site 2143, the surface is 99% nominal but the site is in forested area.

(Al Bitar et al., 2011), (Al Bitar et al. 2012)

The SMOS approach

- Rely on good quality validated networks (US watersheds)
  - Worked very well
- Rely on some ground sites
  - Well known, and monitored
  - With a radiometer
  - Representative or with tools to expand to 50 km resolution
    - Uniform (Dome C)
    - Spatialised (Valencia Anchor Site or Danube Upper Basin)
  - This did not work so well
- Rely on A/C campaigns
  - Australia
    - Worked poorly during the commissioning phase (SMOS data access from ESA) but most useful after
  - Europe
    - Not much yield

Soil moisture retrieval validation

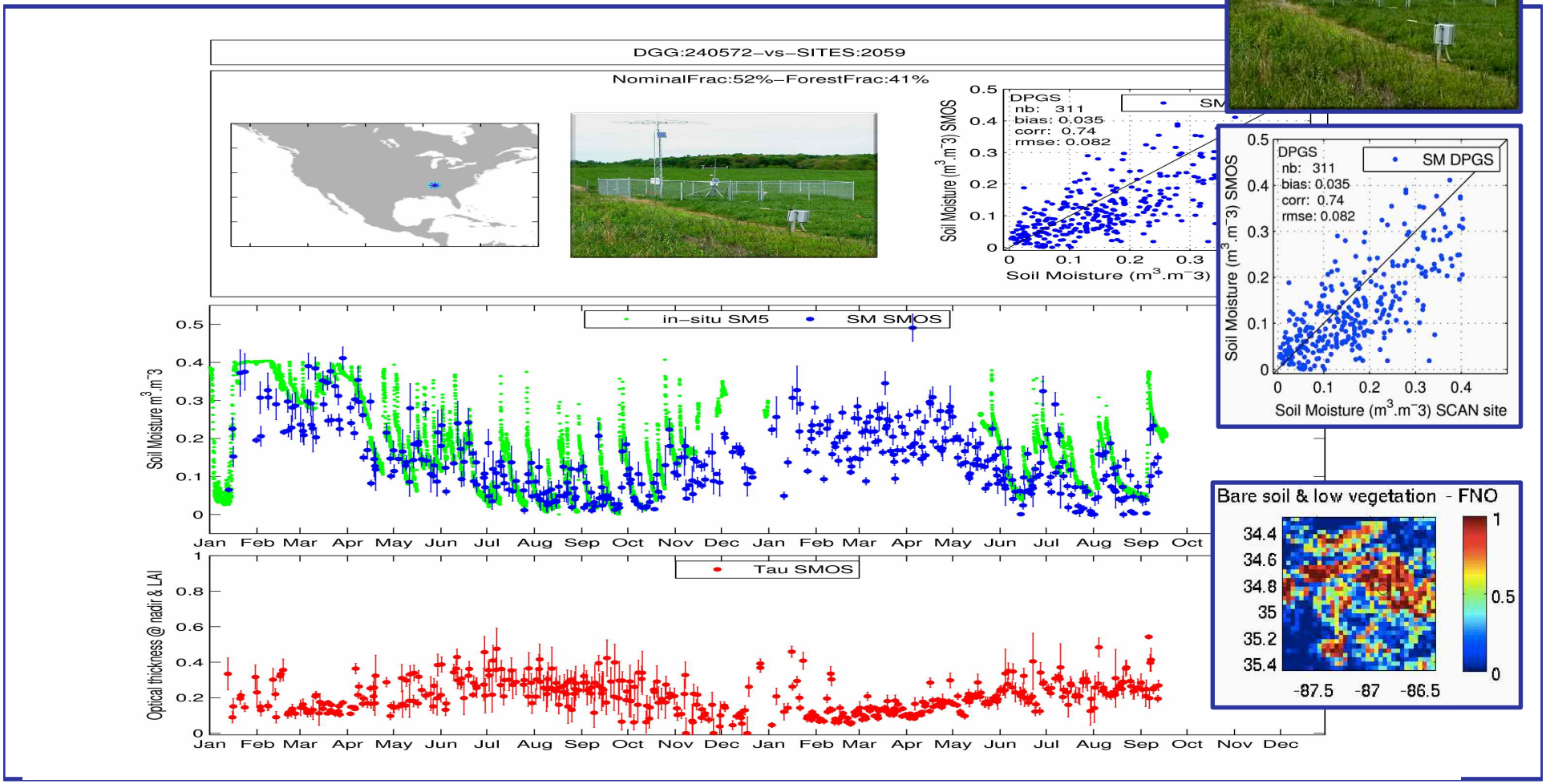
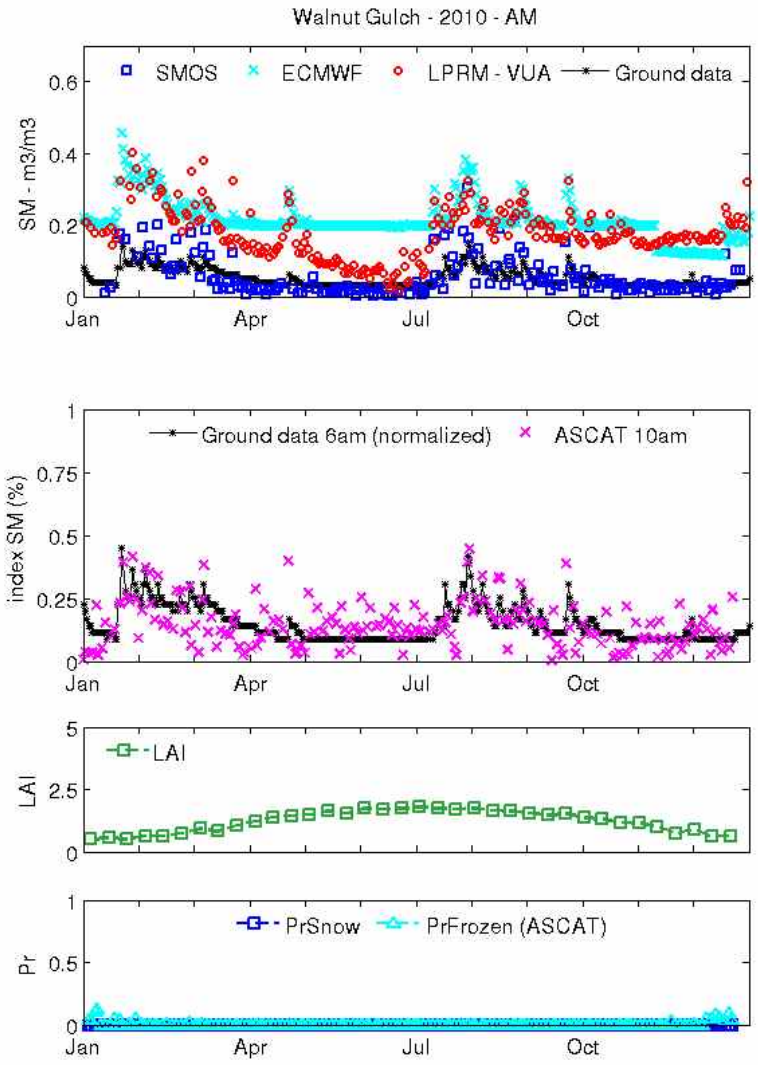
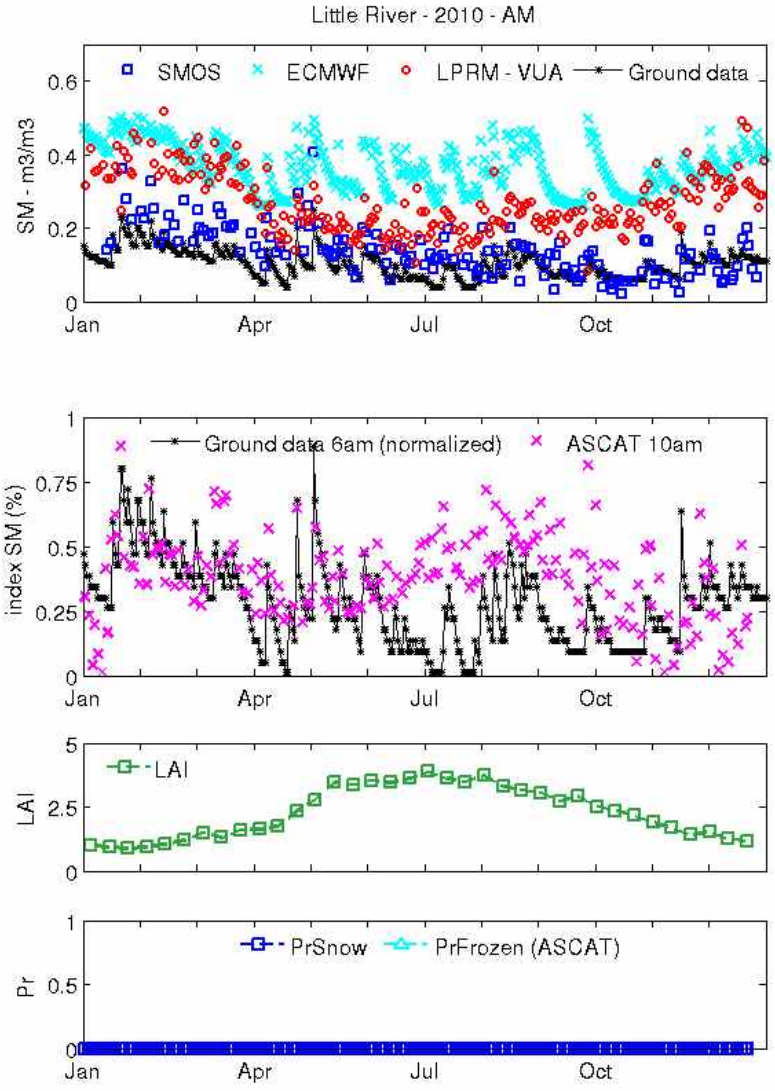


Fig 2. Time series over site 2059 with filtering for Percentage of RFI < 30%, SM_DQX < 0.07 and Tau_DQX<0.15.

(Al Bitar et al., 2011), (Al Bitar et al. 2012)

US Watershed





D. Leroux, T Jackson

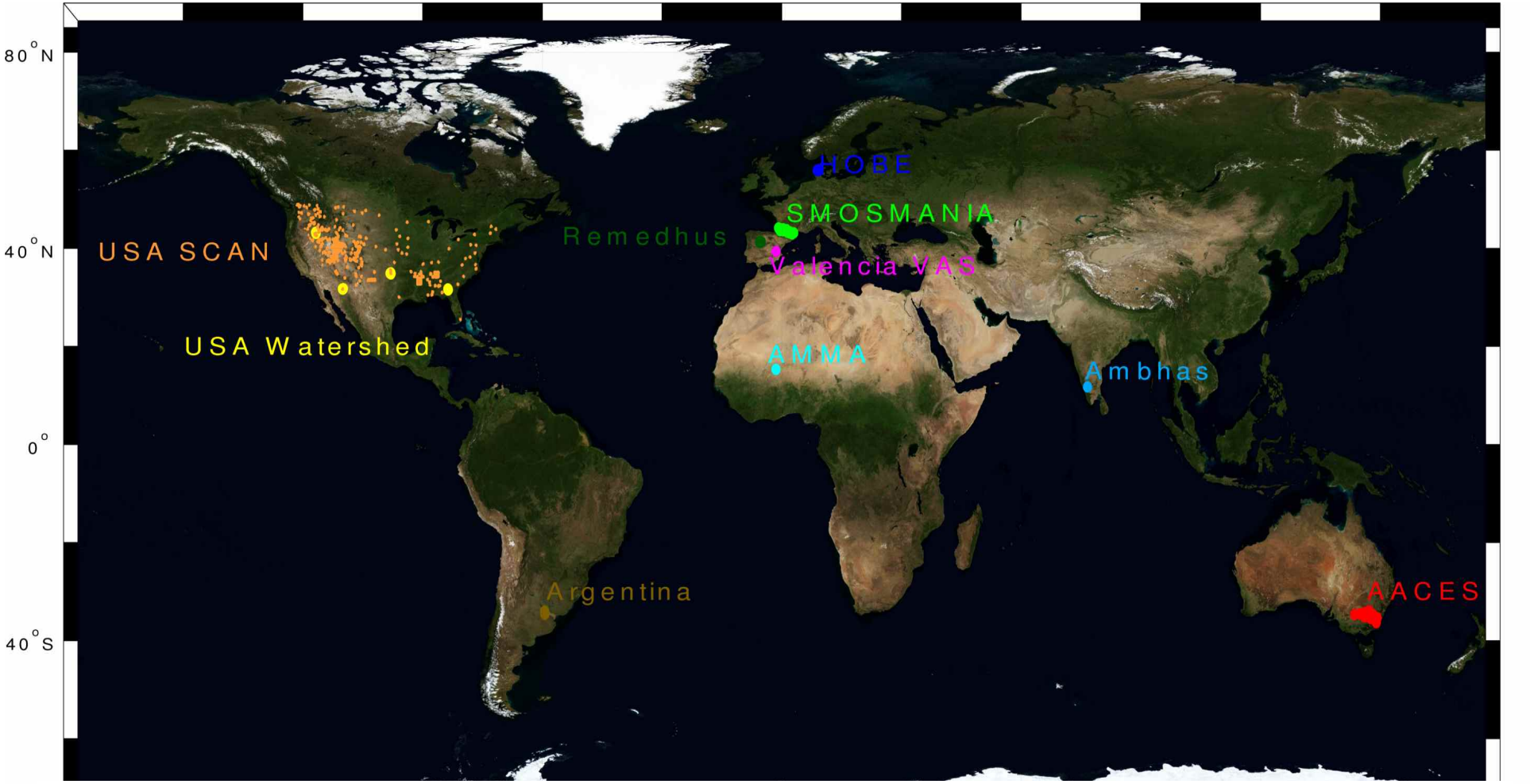
Representative of SMAP/ SMOS pixels

Use of Cal Val Teams

- ESA selection process
- Covered most of the available Ecosystems / climate
- Not really funded (only access to data)
- Disappointing outcome
  - Some very active and efficient
  - Some active but little or no feed back to the project
  - Some no return at all, activity questionable
- Users need to know how to use the data !

- And remember some basics between antenna beam coverage, 3dB beam width and sampling!

Different ecosystems and surface conditions (A. Mialon)



D. Leroux, S. Bircher, J. Grant, H. Lawrence, S.K. Tomer, A. Al Bitar, F. Cabot. Ph. Richaume, Th. Pellarin, JP Wigneron

Collaborations : T. Jackson, E. Lopez, M. Sekhar, J. Walker, E. Wood, T. Pellarin, etc….

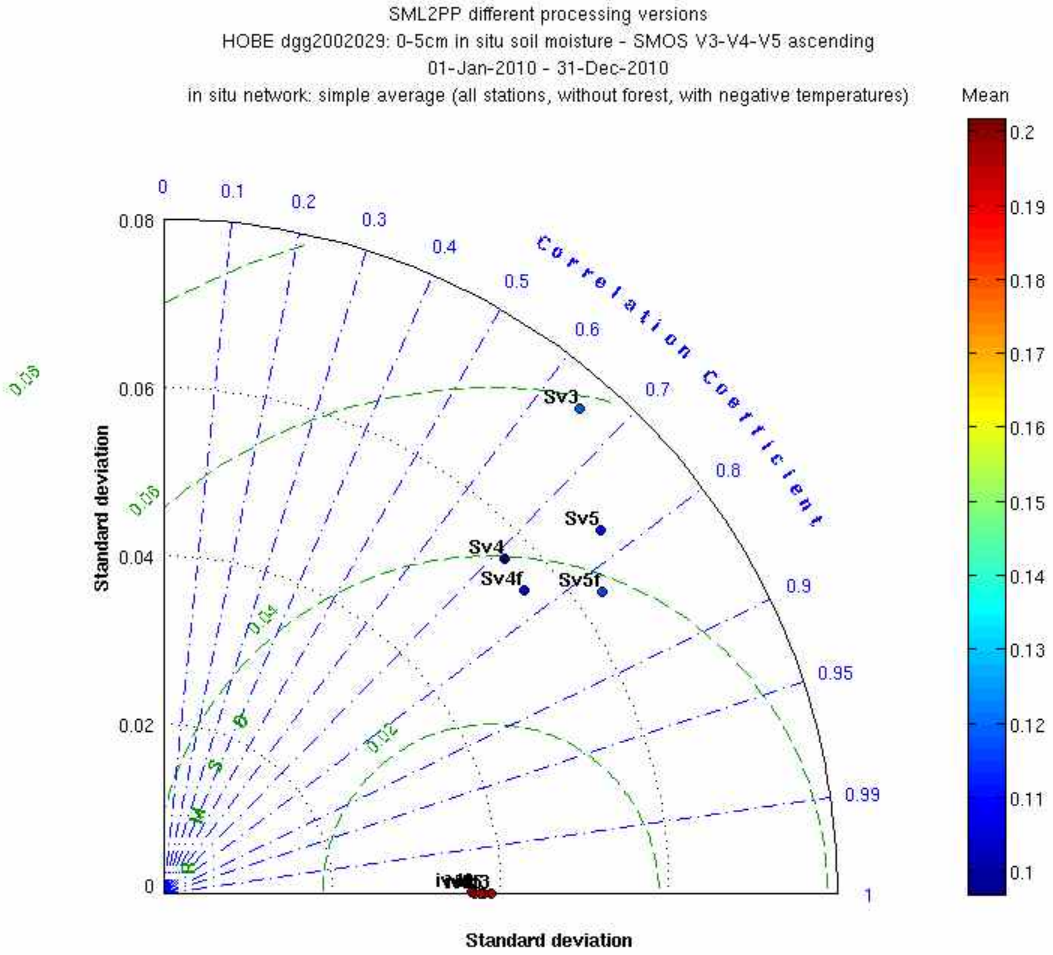
Lessons learnt on relying upon cal/val teams

- One to one relationships
  - need to interact closely between Satellite retrieval group and ground data team
  - Ability to analyse and criticise both data asets
- Utilise reliable collaborations
  - People who will deliver and interact
- Have to have man power and common projects
  - Otherwise not much will come out
- Collaborating with other satellite cal val teams most efficient (AMSR-E, Aquarius, …)
- Access to ground data is never granted!

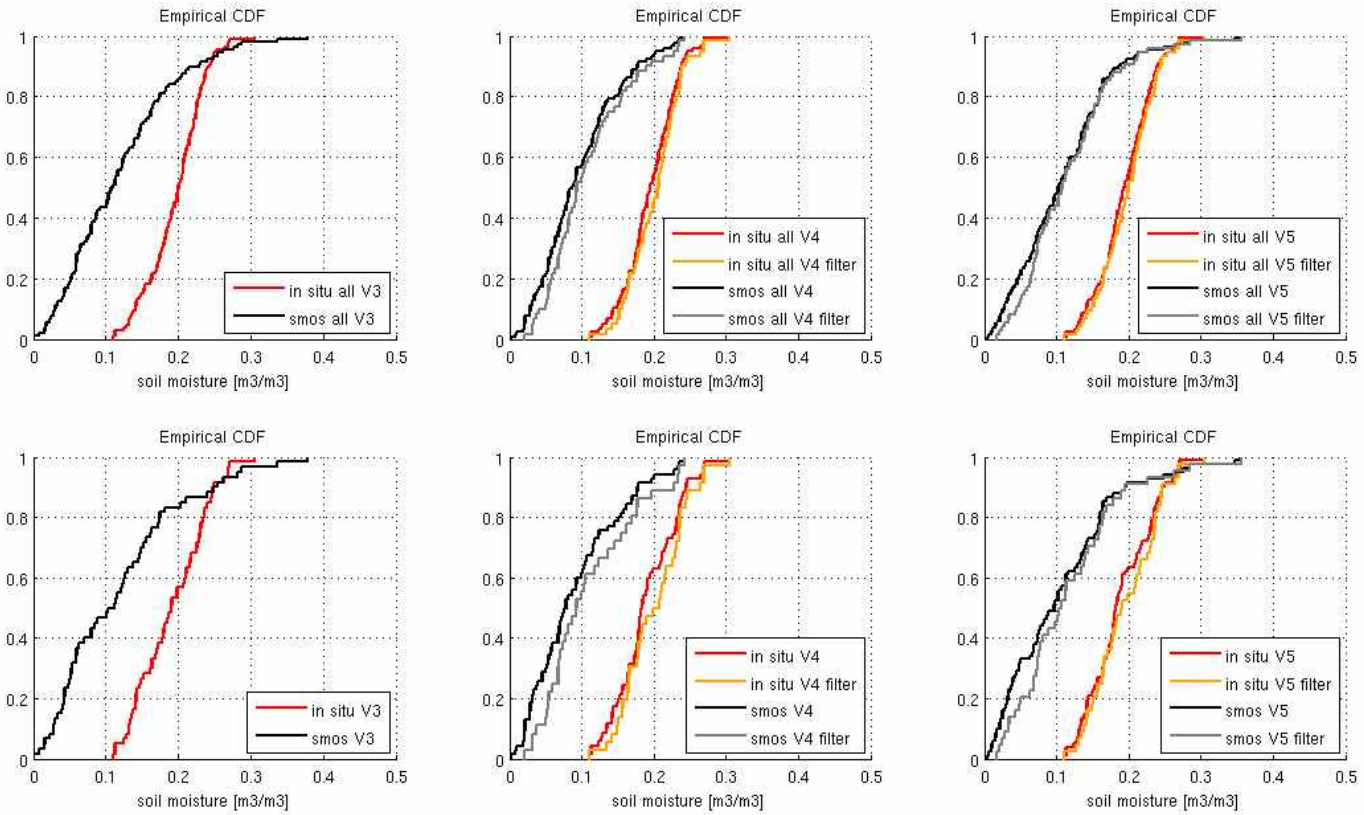
Choice of metrics

- Need to relate efficiently ground and satellite (s) data sets
- Need to see in one all the characteristics:
  - RMS,
  - Correlation
  - Bias
  - Centred RMS
    - Use of Taylor's diagram
  - CDF to access quality as a function of position within range

HOBE (SB) bias or mean as colour code

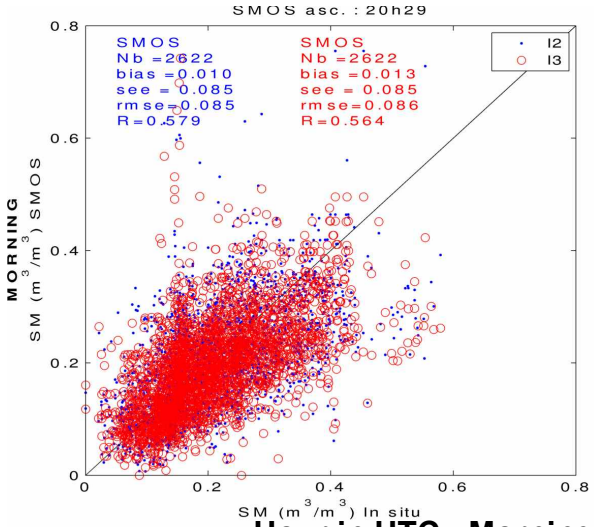


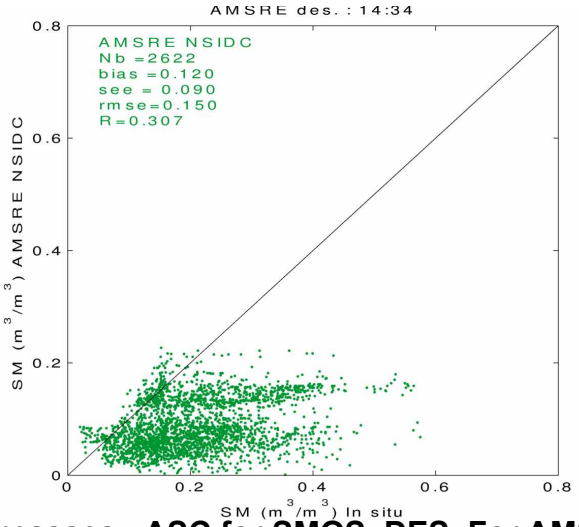
HOBE (SB)

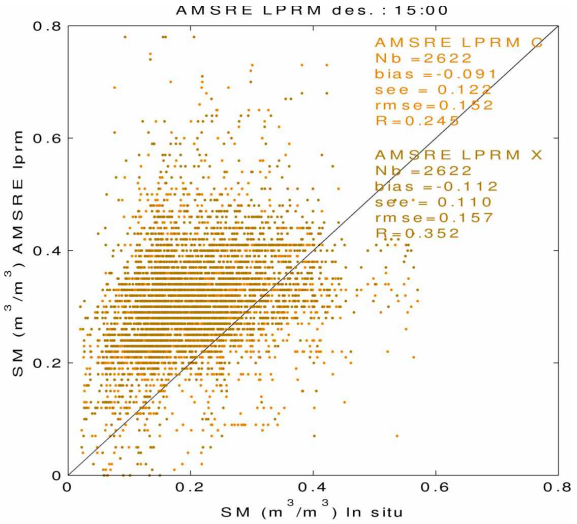

Empirical CDF
in situ all V3
smos all V3
soil moisture [m3/m3]
Empirical CDF
in situ all V4
in situ all V4 filter
smos all V4
smos all V4 filter
soil moisture [m3/m3]
Empirical CDF
in situ all V5
in situ all V5 filter
smos all V5
smos all V5 filter
soil moisture [m3/m3]
Empirical CDF
in situ V3
smos V3
soil moisture [m3/m3]
Empirical CDF
in situ V4
in situ V4 filter
smos V4
smos V4 filter
soil moisture [m3/m3]
Empirical CDF
in situ V5
in situ V5 filter
smos V5
smos V5 filter
soil moisture [m3/m3]

Comparison Soil moisture, Australia (Mialon and Rudiger)

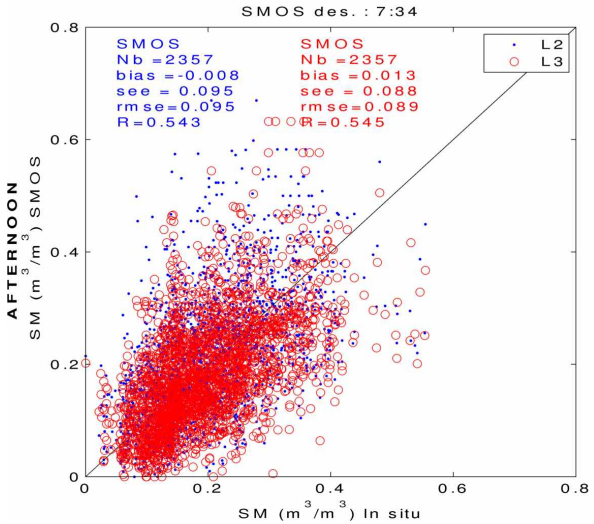
- Period → June 2010 - 2011
- L2 V5
- L3 (equivalent V4)
- AMSR-E NSIDC
- AMSR-E LPRM algorithm, C band
- AMSR-E LPRM algorithm, X band

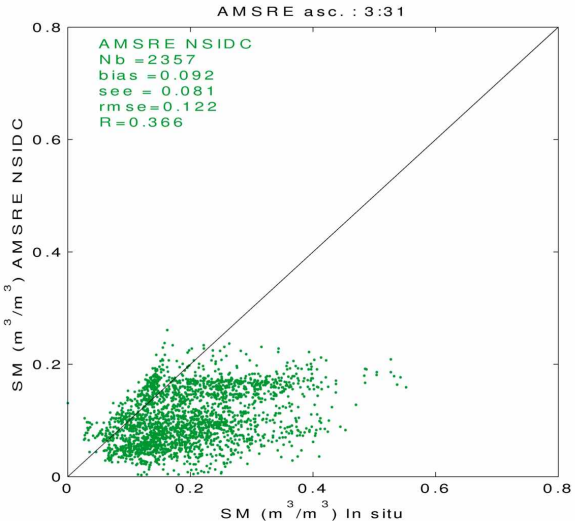


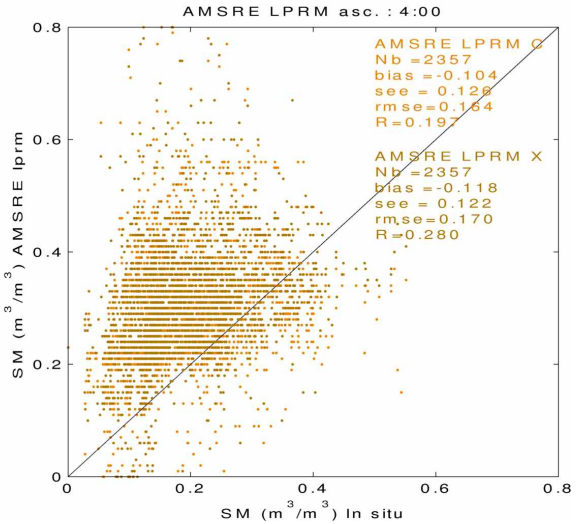




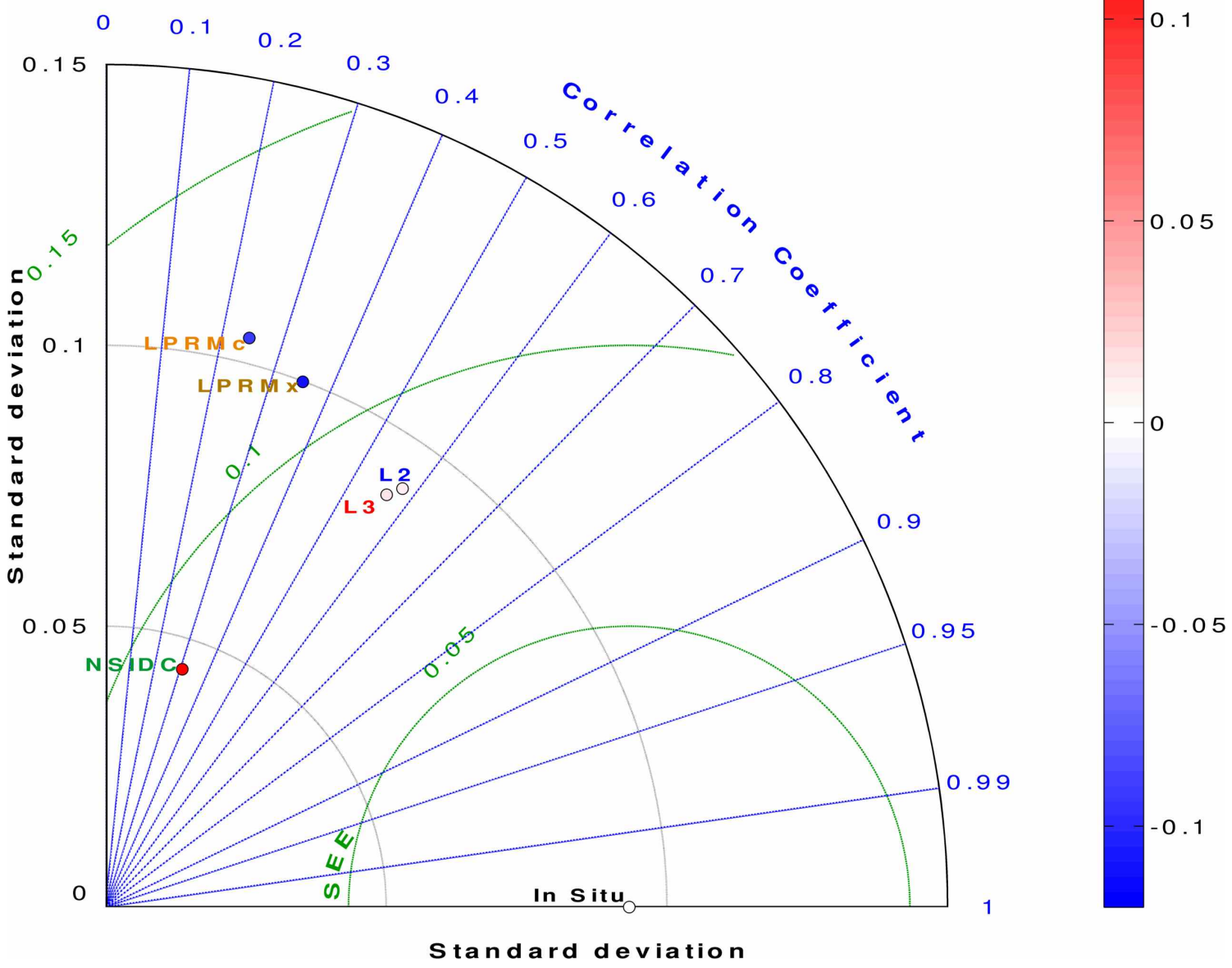
Hour in UTC : Morning overpasses : ASC for SMOS, DES. For AMSRE
Afternoon overpasses : DES for SMOS, ASC. For AMSRE







Morning


Correlation Coefficient
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0.95
0.99
1
Standard deviation
0.15
0.1
0.05
0
RMSE
0.15
0.1
0.05
LPRMc
LPRMx
L2
L3
NSIDC
In Situ
Standard deviation
Bias
0.1
0.05
0
-0.05
-0.1

Conclusions

- Lessons learnt
  - Plan in advance
  - Ground data is not “truth” (i.e., error of 8-10% in most cases)
  - Rely on well designed networks preferably with historical background and track record (to avoid bad experiences)
  - A/C campaigns very tricky