Reports from Cal/Val Partners

Feedback to Cal/Val Partners from Rehearsal

Valencia (ES)

- University of Valencia, Spain / SMOS
  - Ernesto Lopez-Baeza, A. Coll, R. Fernández, P. Salgado-Hernanz, A. Benlloch, E. Carbo, F. Mora
- SMOS
  - J.-P. Wigneron, Y. Kerr, M. Schwank
- ESA
  - T. Casal, M. Drusch, S. Mecklenburg
- SMAP
  - A. Colliander, T. Jackson
- Spanish Hydro-Met Agencies
  - T. Estrela, A. Fidalgo, O. Gabaldo, J. Tamayo

Contents

Valencia & Alacant Anchor Stations

(Most?) suitable area in Europe for validation of low spatial resolution remote sensing data and products

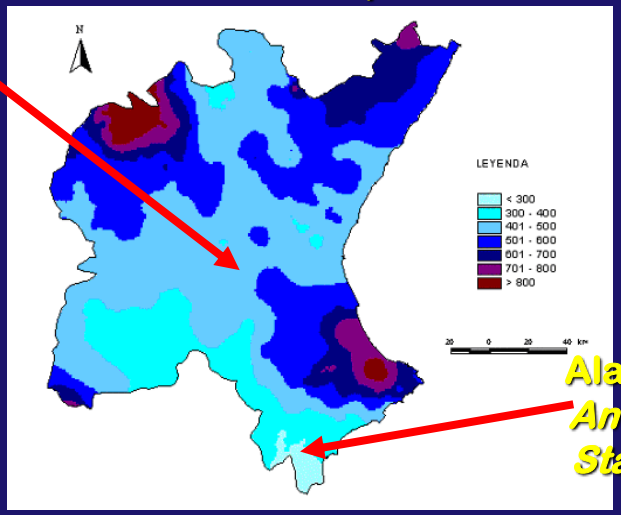
HR MERIS, 23 March 2002

VNIVERSITAT DE VALÈNCIA Facultat de Física
Dpto. Física de la Tierra
Grupo de Climatología Desde Satélites

Unión Europea

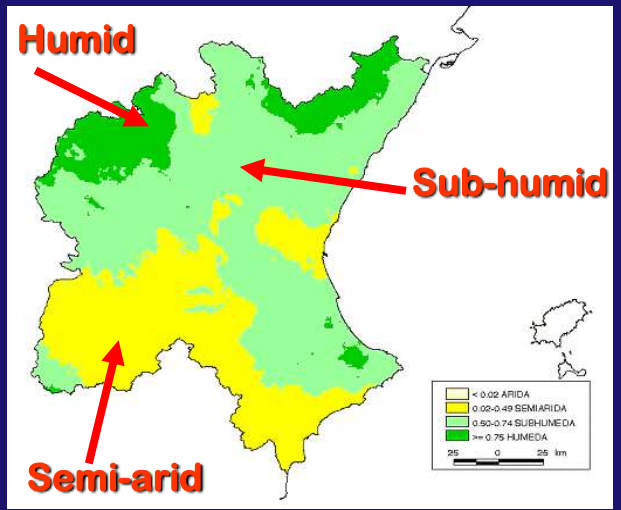
Annual Precipitation

Valencia *Anchor Station*

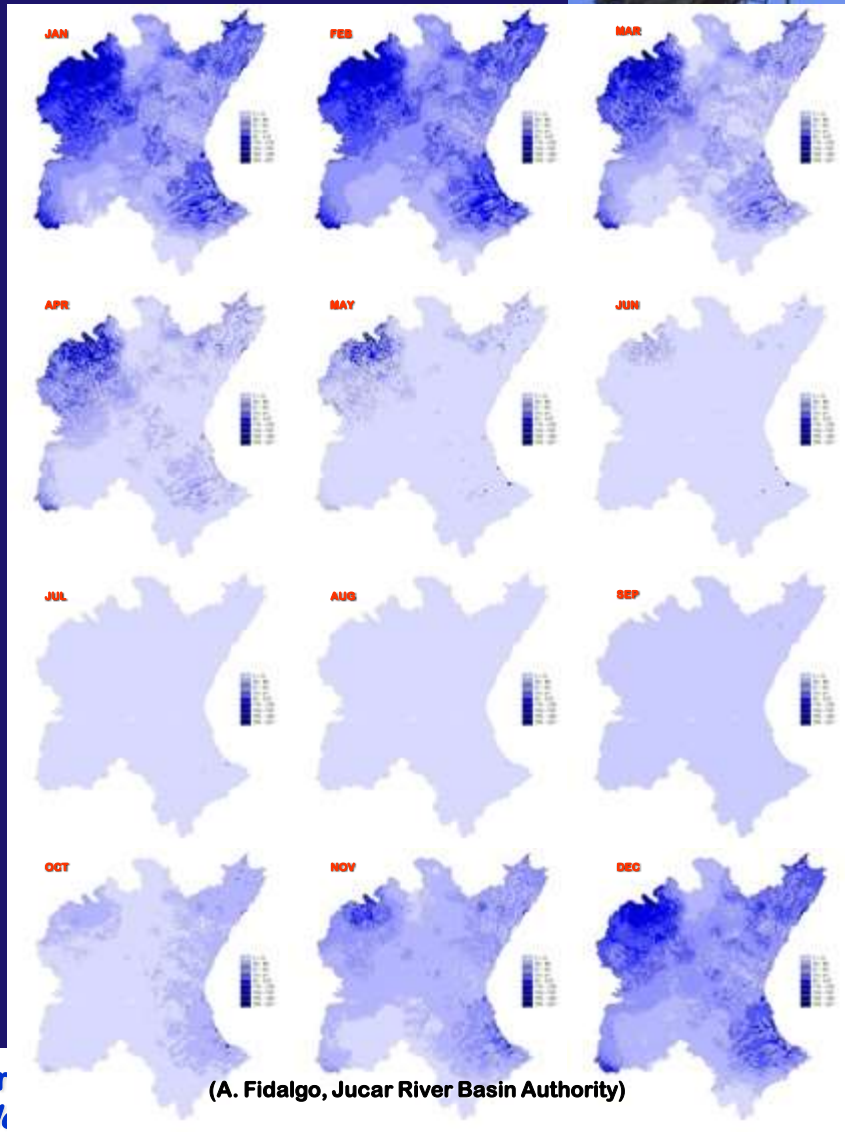


Alacant *Anchor Station*

UNESCO Climate Index P / ETP



Modelled monthly mean values of soil moisture content (0-20 cm depth) (1940 – 2001) (SIMPA)



(A. Fidalgo, Jucar River Basin Authority)

CA. Nov. 5-7, 2013

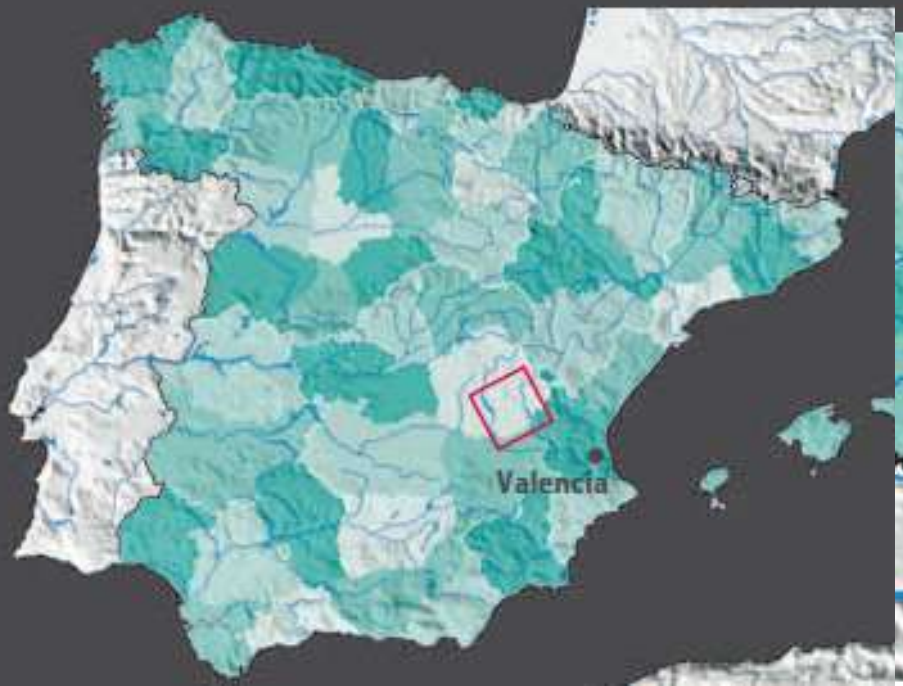
SMOS

SMOS Cal/Val Campaigns at Core Validation Sites

ESA

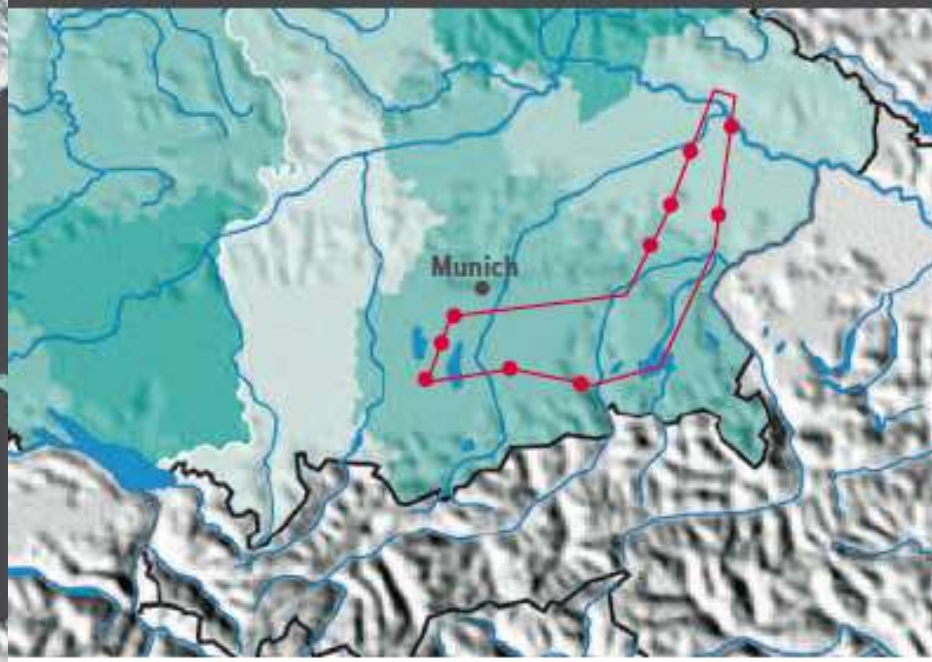
↓

ESA will focus its efforts for the validation of soil moisture data on two key sites: the Valencia Anchor Station and the Upper Danube Catchment. The Valencia Anchor Station (below) is a typical Mediterranean sparse vegetation ecosystem, mainly characterised by bare soil and limited vegetation. The vegetation consists mainly of vineyards, pine trees and shrub and is thus comparatively uniform with regard to hydrological parameters. The site is well instrumented and has been the location of other field campaigns (Ernesto Lopez, Univ. Valencia)



↓

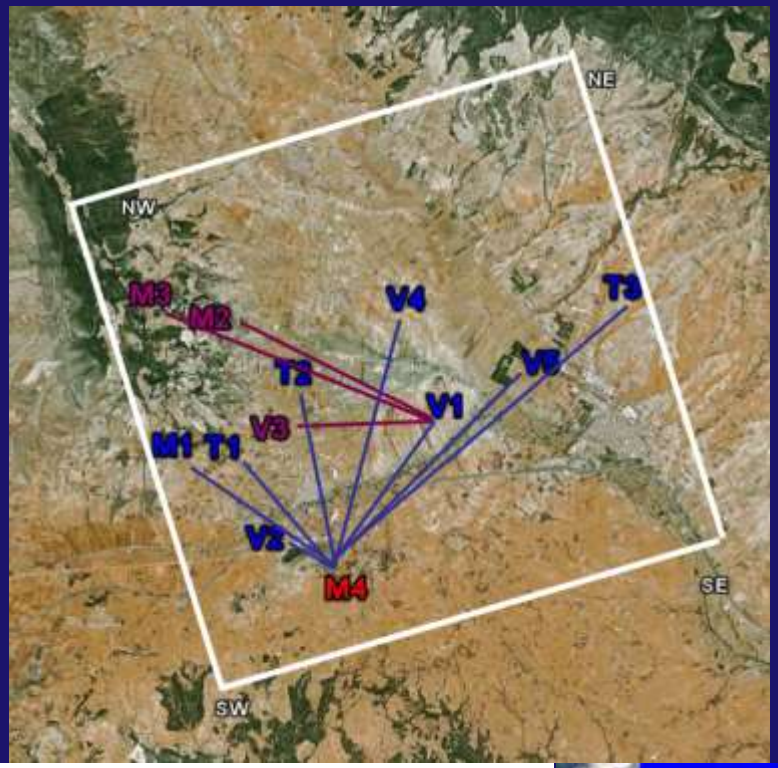
The Upper Danube Catchment in contrast is a typical temperate continental ecosystem covering an area of 77 000 km² in Germany. The map shows overflight track (red) for the SMOS dress rehearsal campaign in spring 2008. Dots are measurement stations (Alexander Loew, Univ. Munich)



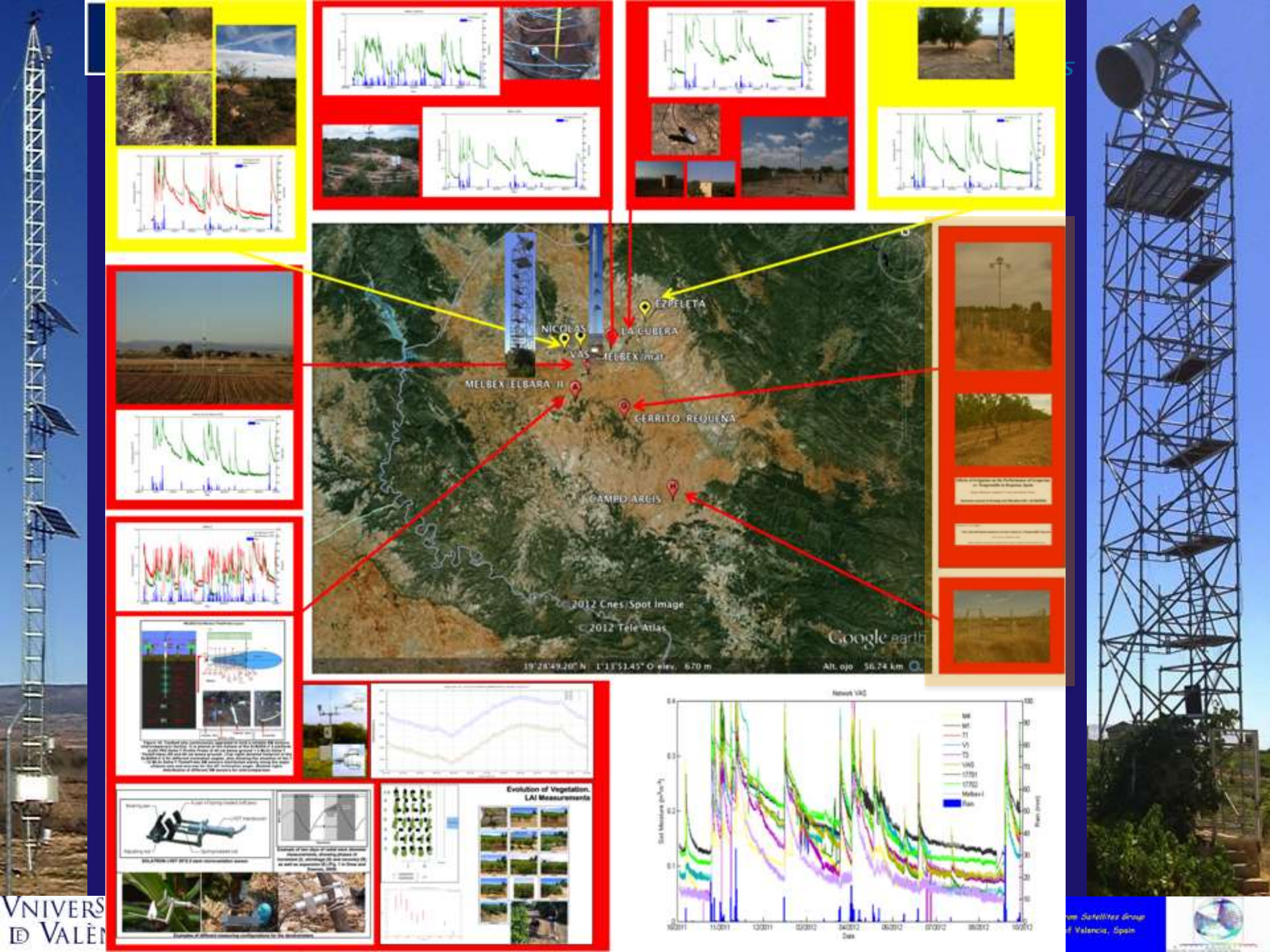
Free RFI over Spain … and over the VAS!!!

(ESA, 2010)

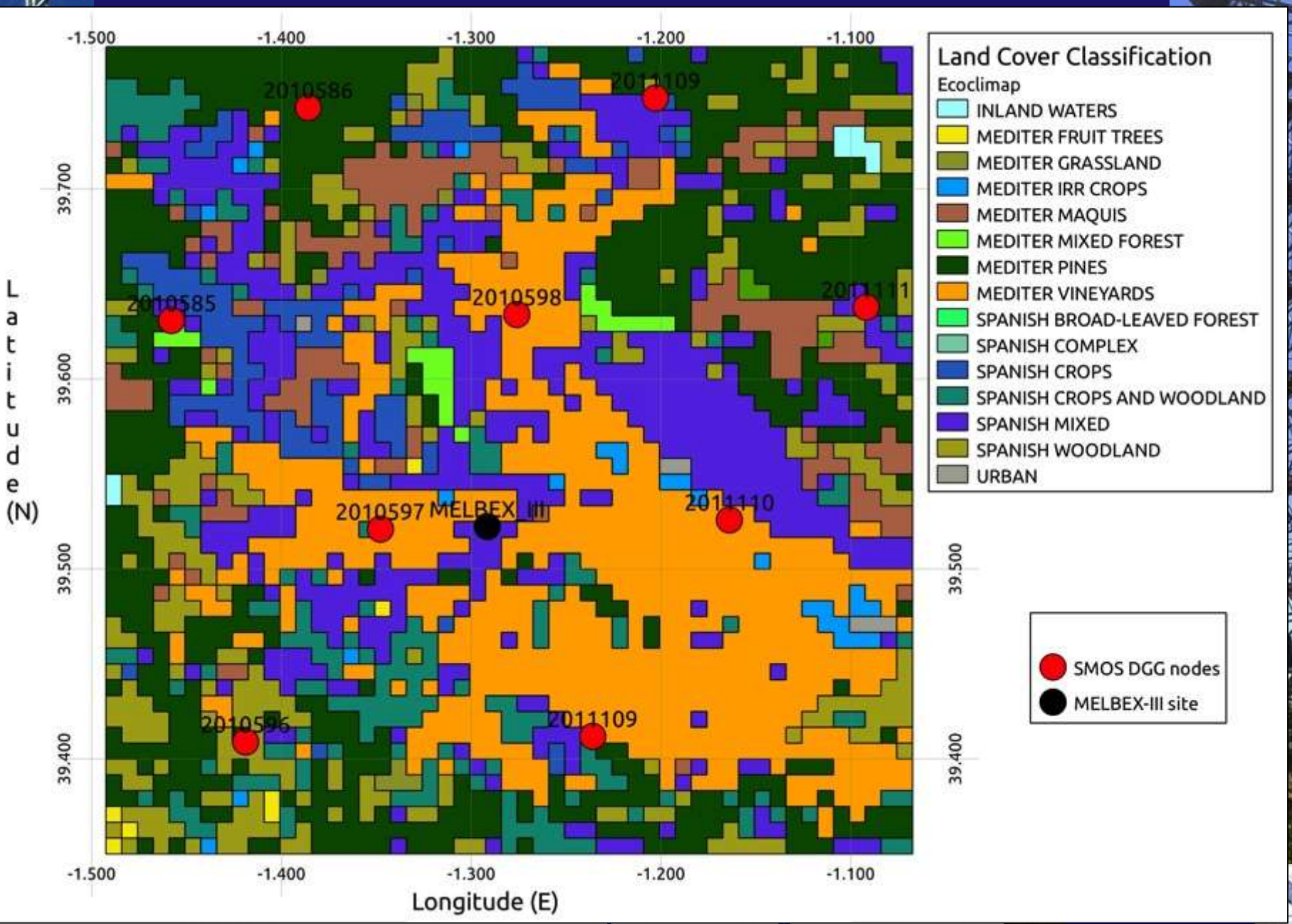
Valencia Anchor Station SM Network



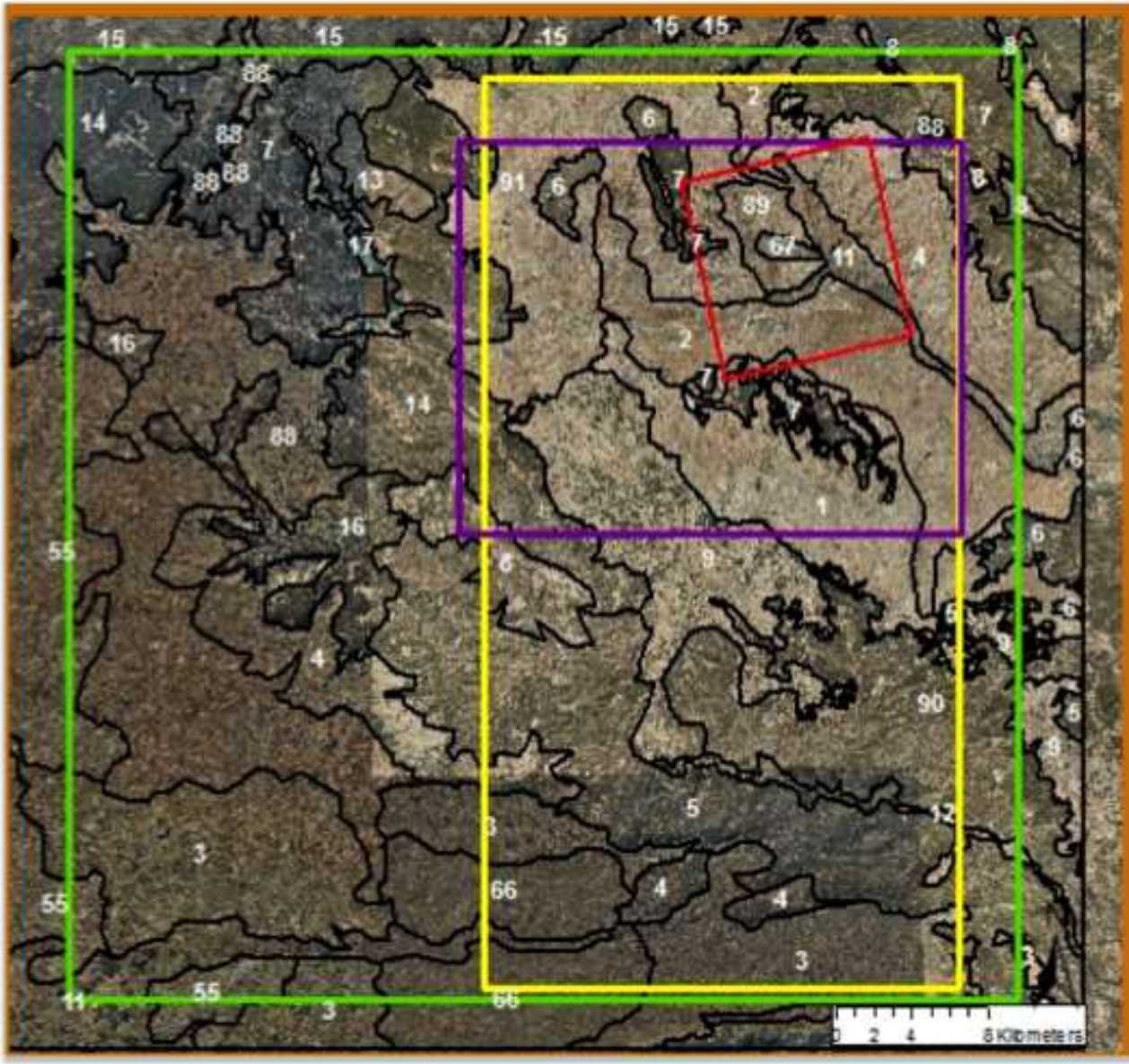
VNIVERSITAT DE VALÈNCIA Facultat de Física
Dpto. Física de la Tierra y Termodinámica
Grupo de Climatología Desde Satélites
Climatology from Satellites Group
University of Valencia, Spain


EZPELETA
NICOLAS
LA CUBERA
VAS
MELBEX ELBARA II
CERRITO REQUENA
CAMPO ARGIS
2012 Cnes/Spot Image
© 2012 Tele Atlas
Google earth
Evolution of Vegetation.
LAI Measurements

ECOCLIMAP Land Use Map



Homogeneous Hydro-phydsiological Units



3 Different and Complementary Sampling Approaches for the 3 VAS Validation Campaigns

50 x 50 km² area

10 x 10 km² central area (SVRC 2008)

CNES CAROLS'2009

ESA/CNES CAROLS' 2010

C. Antolin et al.

Modelling

previous, Silvia Juglea et al.: SurfEx-ISBA 2007-2010

Hydrol. Earth Syst. Sci., 14, 831–846, 2010
www.hydrol-earth-syst-sci.net/14/831/2010/
doi:10.5194/hess-14-831-2010

Hydrology and Earth System Sciences

Modelling soil moisture at SMOS scale by use of a SVAT model over the Valencia Anchor Station

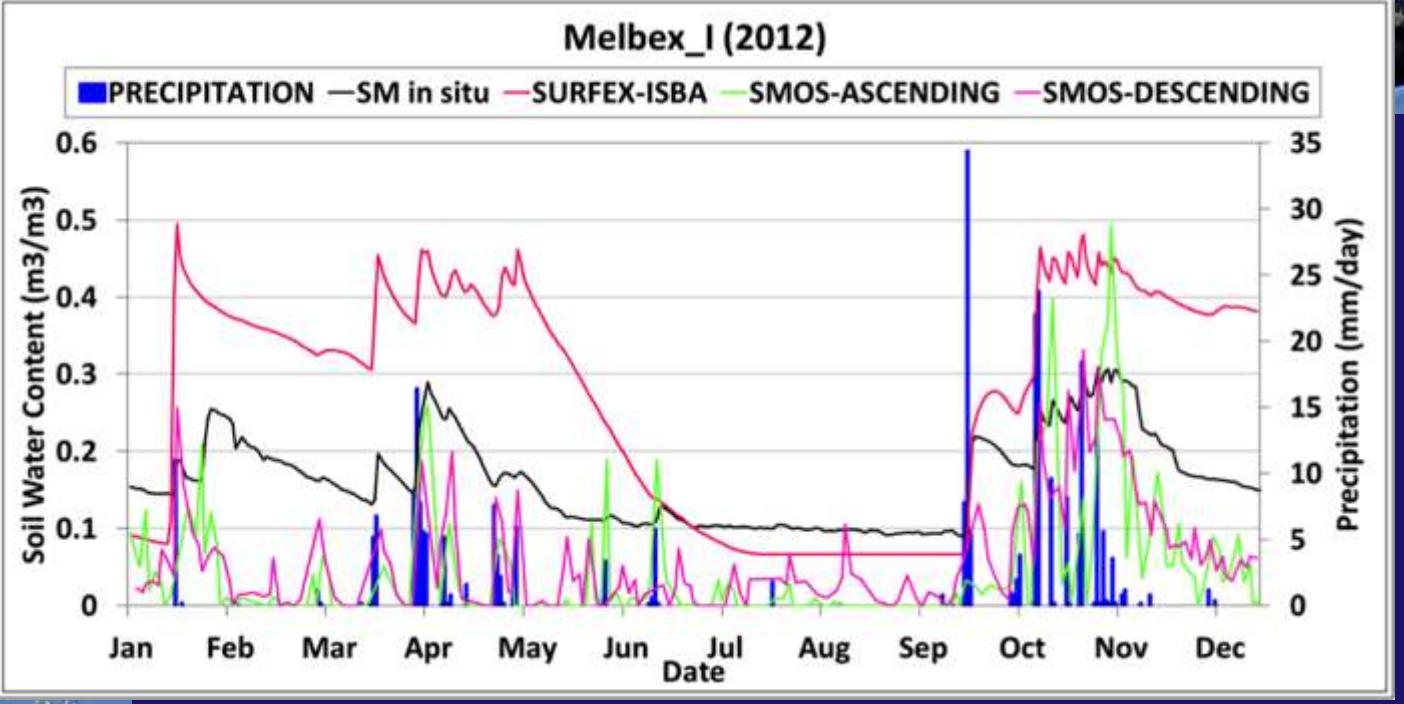
S. Juglea[1], Y. Kerr[1], A. Mialon[1], J.-P. Wigneron[2], E. Lopez-Baeza[3], A. Cano[3], A. Albitar[1], C. Millan-Scheiding[3,4], M. Carmen Antolin[4], and S. Delwart[5]

Hydrol. Earth Syst. Sci., 14, 1509–1525, 2010
www.hydrol-earth-syst-sci.net/14/1509/2010/
doi:10.5194/hess-14-1509-2010

Hydrology and Earth System Sciences

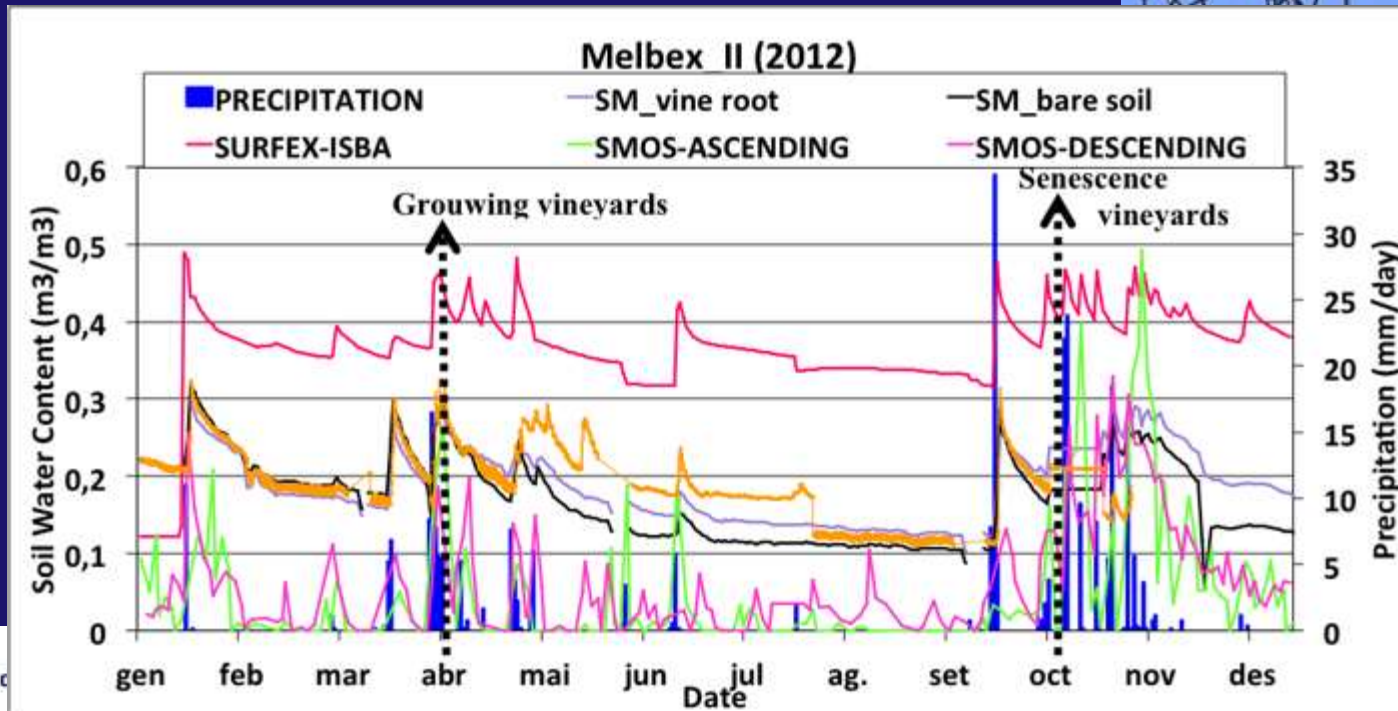
Soil moisture modelling of a SMOS pixel: interest of using the PERSIANN database over the Valencia Anchor Station

S. Juglea[1], Y. Kerr[1], A. Mialon[1], E. Lopez-Baeza[2], D. Braithwaite[3], and K. Hsu[3]



SurfEx-ISBA 2011 -

Amparo Coll et al., 2013



VNIVERSITAT D VALÈNCIA Facultat

4th SMAP Cal/Val WShop. Pasadena, CA. Nov. 5-7, 2013

MELBEX
Mediterranean Ecosystem L-band Characterisation Experiment

VNIVERSITAT D VALÈNCIA Facultat de Física

Dpto. Física de la Tierra y Termodinámica
Grupo de Climatología Desde Satélites

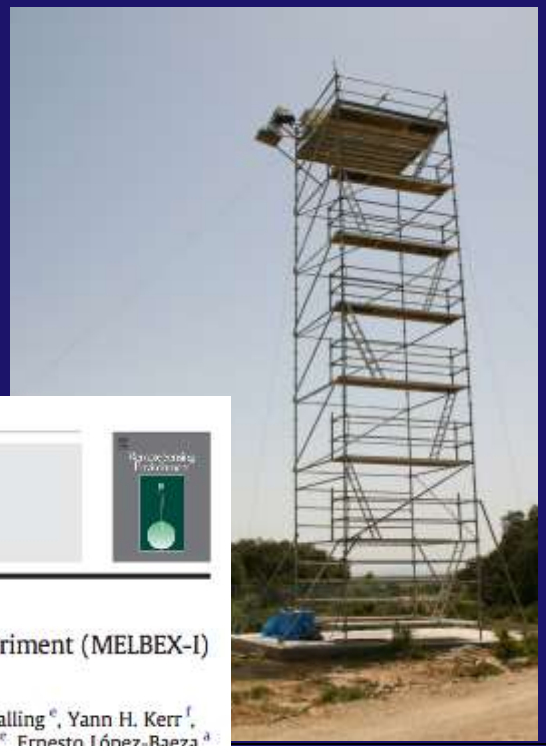
Climatology from Satellites Group
University of Valencia, Spain

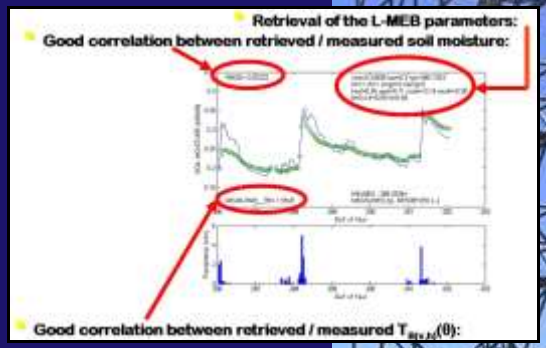
SMOS MELBEX (Mediterranean Ecosystem L-band Characterisation Experiment)

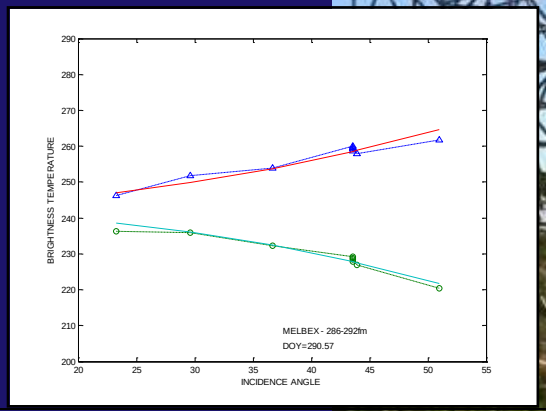
MELBEX-I

Matorral and Shrubs

Valencia Anchor Station, Jun. 2005 - Feb. 2006







Remote Sensing of Environment 114 (2010) 844–853

Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

The SMOS Mediterranean Ecosystem L-Band characterisation EXperiment (MELBEX-I) over natural shrubs

Aurelio Cano [a], Kauzar Saleh [b,*], Jean-Pierre Wigneron [c], Carmen Antolín [d], Jan E. Balling [e], Yann H. Kerr [f], Alain Kruszewski [c], Cristina Millán-Scheiding [d], Sten Schmidl Søbjærg [e], Niels Skou [e], Ernesto López-Baeza [a]

[a] Dept. de Física de la Tierra y Termodinamica, Facultat de Física, Universitat de Valencia, Spain
[b] Department of Geography, University of Cambridge, 2 Downing Place, Cambridge CB2 3EN, United Kingdom
[c] EPHYSE, INRA Centre Bordeaux-Aquitaine, France
[d] CIDE-CSIC-UV-GV, Spain
[e] DTU-Space, Danmarks Tekniske Universitet, Denmark
[f] CESBIO, France

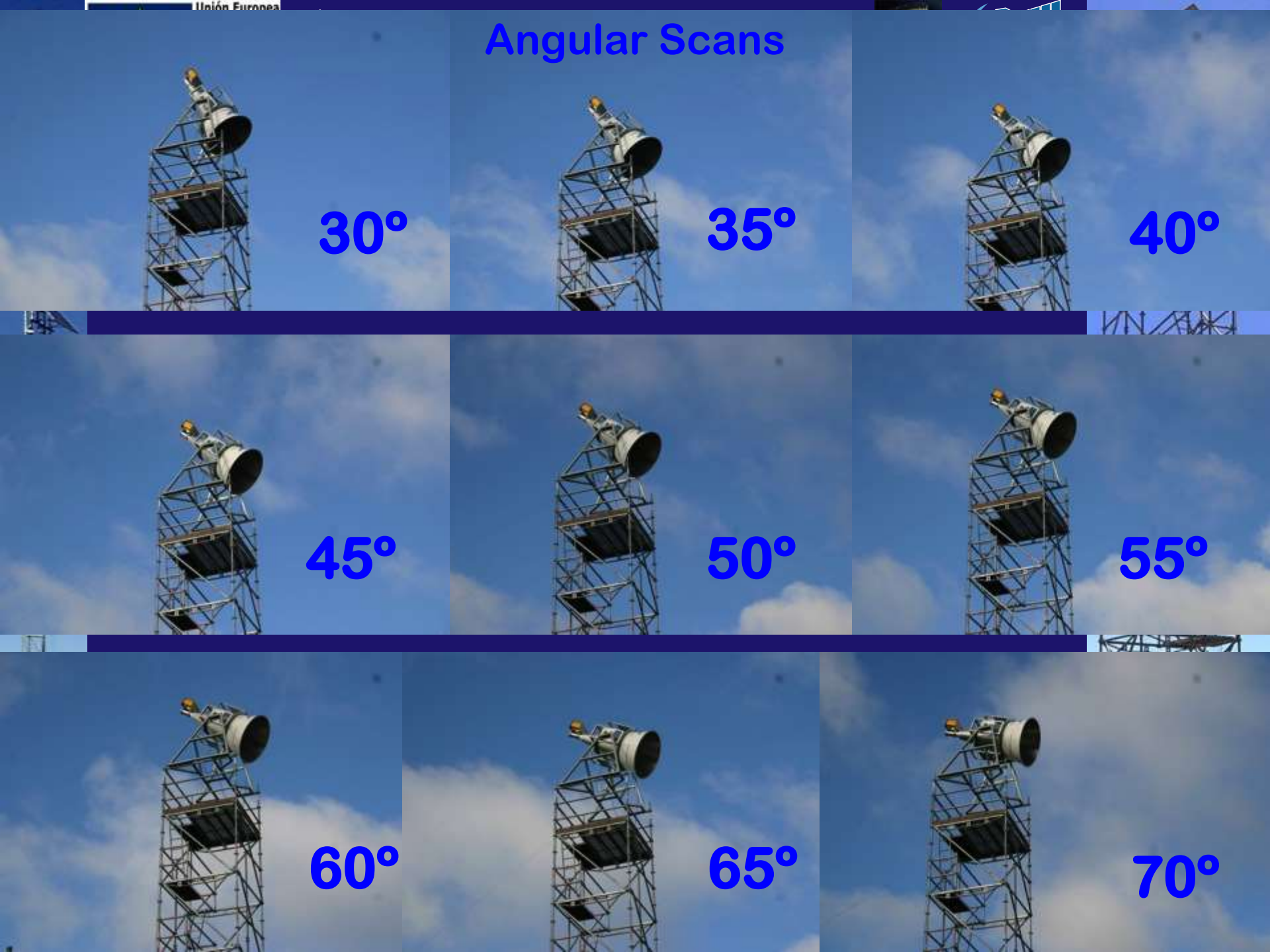
MELBEX-III SMOS Validation

Running Measurement Tasks (as of 23.09.09)

Tasks programmed from 22nd September 2009:

- sky calibration measurements (3,1 Mb/day)
  - every day at 23:55
  - at 150°
- angular scan measurements (167 Mb/day)
  - every day, every hour at 0 and 30 min
  - at 30° , 35° , 40° , 45° , 50° , 55° , 60° , 65° , 7
- fixed angle of 45° measurements (2,6 Mb/day)
  - every day, every hour at 5, 10, 15, 20, 25, 40, 45, 50 min
  - at 45°

Angular Scans

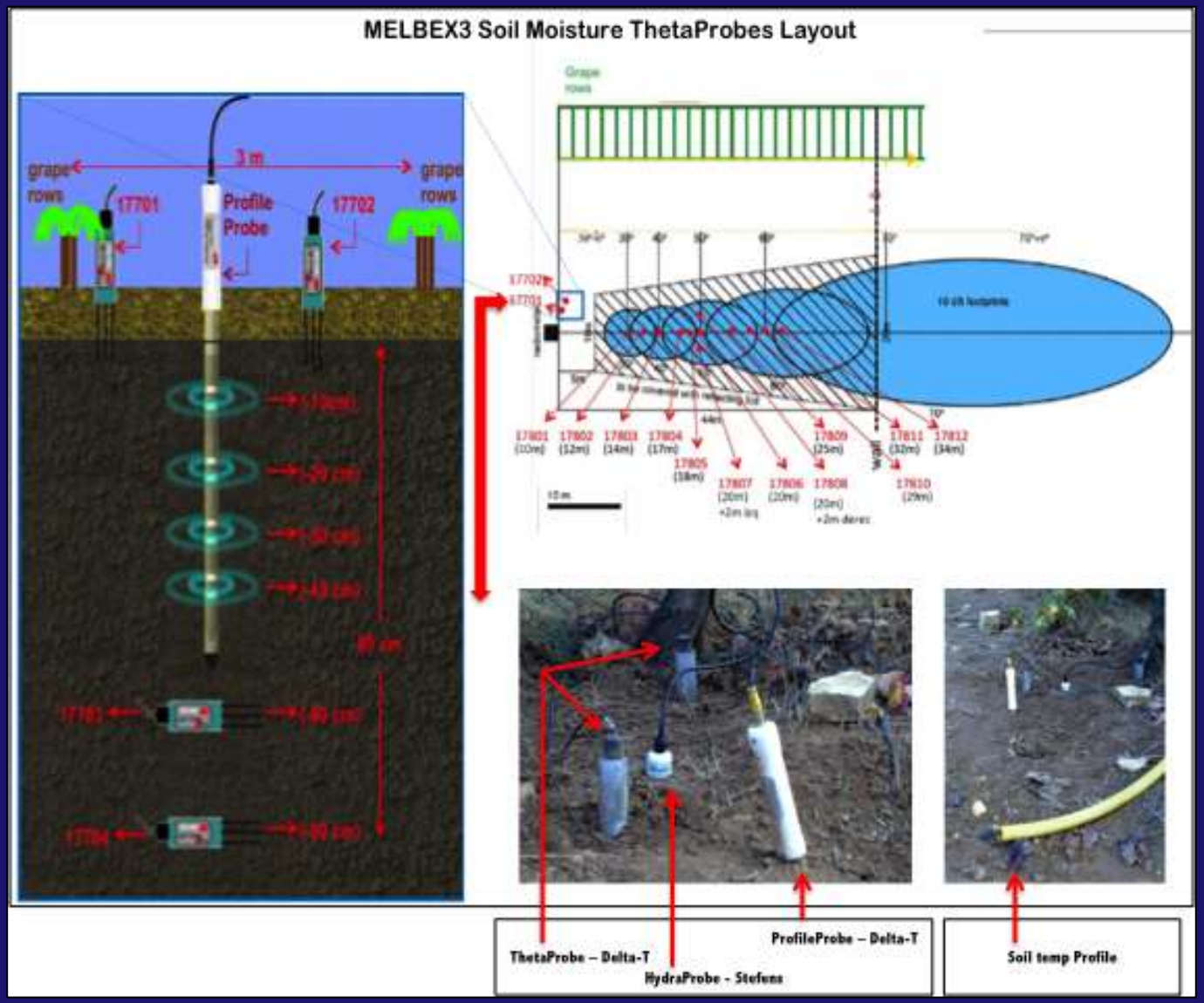


Analysis of the footprint

Height of the beam waste above ground: h ≈ 14 + 1 + 1.5 = 16.5 m

α = observation angle relative to nadir
a = half axes of the footprint along the plane of incidence (direction from the tower to the wall)
b = half axes of the footprint perpendicular to the plane of incidence (direction approx. parallel to the wall)
Dmin = min. distance from the root point of the antenna aperture (approx. end of tower) to the footprint ellipse
D = distance from the root point of the antenna aperture (approx. end of tower) to most sensitive part of the footprint (this does not correspond with the geometrical center of the footprint ellipse).
Dmax = max. distance from the root point of the antenna aperture (approx. end of tower) to the footprint ellipse
A = area of the ellipse

M. Schwank


MELBEX3 Soil Moisture ThetaProbes Layout
grape rows
3 m
grape rows
17701
Profile Probe
17702
17801 (10m)
17802 (12m)
17803 (14m)
17804 (17m)
17805 (18m)
17807 (20m)
17806 (20m)
17809 (25m)
17808 (20m)
17811 (32m)
17812 (34m)
17810 (29m)
ThetaProbe – Delta-T
HydraProbe - Stefens
ProfileProbe – Delta-T
Soil temp Profile

Surface Roughness

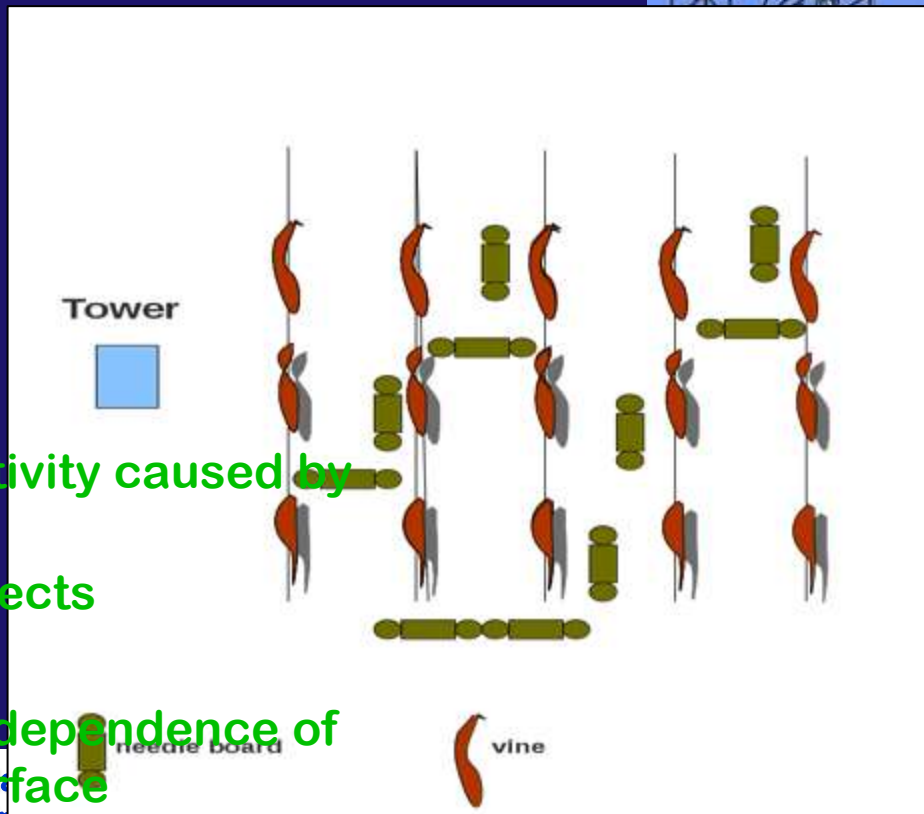
H_R = 0,06
Q_R = 0,0303
N_{RP} (p = H,V) = 0

Values for 2012
(Miernecki et al., 2013)

H_R → accounts for the decrease in reflectivity caused by soil roughness ($H_R \uparrow \Gamma_{GP} \downarrow$)

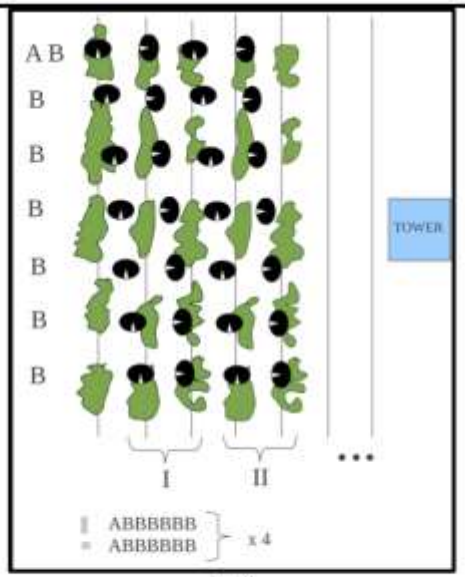
Q_R → accounts for polarization mixing effects ($Q_R \uparrow \ |\Gamma_{GV} - \Gamma_{GH}| \downarrow$)

N_{RP} → governs the change in the angular dependence of reflectivity caused by the rough surface



Leaf Area Index (LAI)

(a)



(b)

Figure 15. (a) LAI measurements (b) Measuring protocole

First Evaluations J.-P. Wigneron et al.

Remote Sensing of Environment 124 (2012) 26–37

Contents lists available at SciVerse ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

First evaluation of the simultaneous SMOS and ELBARA-II observations in the Mediterranean region

Jean-Pierre Wigneron [a,*], Mike Schwank [b], Ernesto Lopez Baeza [c], Yann Kerr [d], Nathalie Novello [a], Cristina Millan [c], Christophe Moisy [a], Philippe Richaume [d], Arnaud Mialon [d], Ahmad Al Bitar [d], Francois Cabot [d], Heather Lawrence [a], Dominique Guyon [a], Jean-Christophe Calvet [e], Jennifer P. Grant [f], Tania Casal [f], Patricia de Rosnay [g], Kauzar Saleh [h], Ali Mahmoodi [i], Steven Delwart [j], Susanne Mecklenburg [j]

High correlation between the ELBARA and SMOS L1C TB: R2 ~0.90

Good general agreement between SMOS L1C T_B and ELBARA T_B data (July-Dec, 2010)

Comparing ELBARA and SMOS L1C T_B

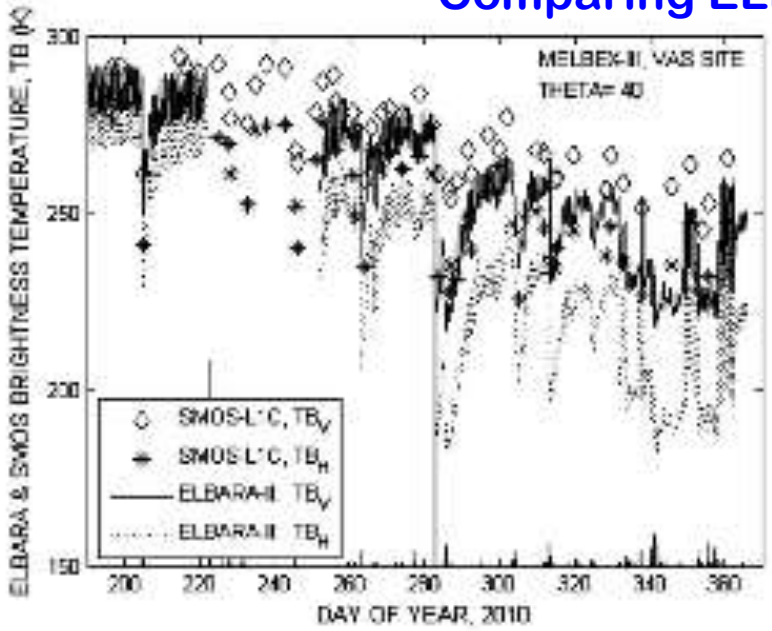
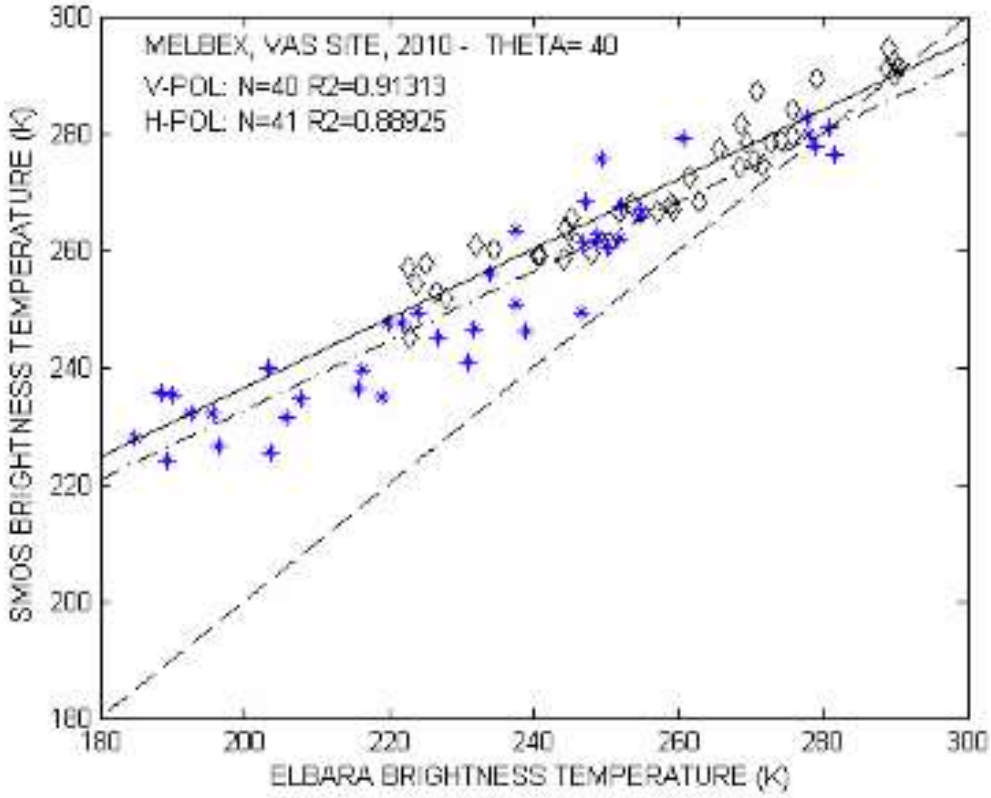


Fig. 6. Comparison between the time variations in the brightness temperatures measured by SMOS over the VAS site (at V (o) and H (*) polarizations) and by ELBARA-II over the M-III field; incidence angle $\theta = 40°$. The figure includes observations of ELBARA-II observations at morning (at ~6 am) and at evening (at ~6 pm), at a time very close to the SMOS overpasses over the VAS site so that the delay between the SMOS and ELBARA-II TB observations did not exceed 1 h.



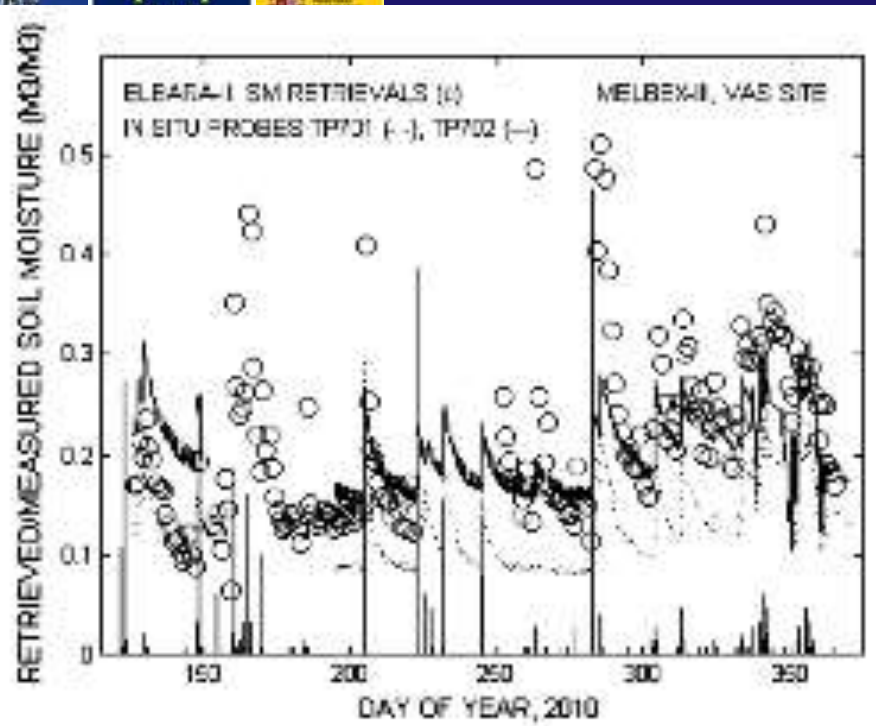


Fig. 8. Comparison in the time variations in the soil moisture SM (m^3/m^3, ○) retrieved from the ELBARA-II observations and in the measured in situ SM data from Theta probes (m^3/m^3) over the M-III vineyard. Precipitation data are represented by vertical lines (scaling factor 1/30). SM retrievals were carried out from TB observations made at 14:00 local time.

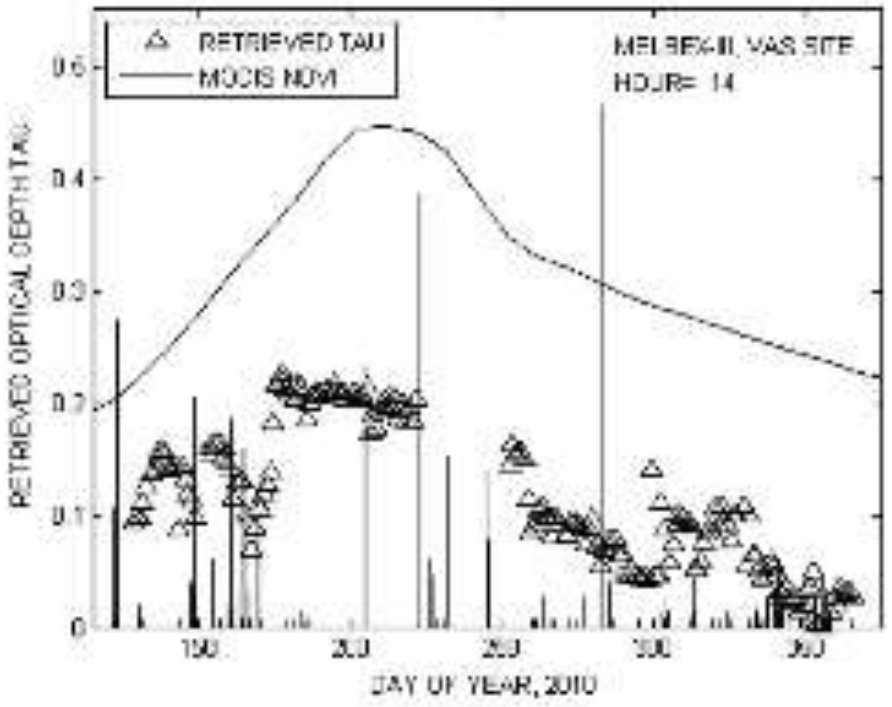


Fig. 9. Comparison in the time variations in the optical depth TAU (Δ) retrieved from the ELBARA-II observations and in the 'smoothed' NDVI vegetation index computed from MODIS observations at 250 m spatial resolution over the M-III vineyard. Precipitation data are represented by vertical lines (scaling factor 1/5). TAU retrievals were carried out from TB observations made at 14:00 local time.

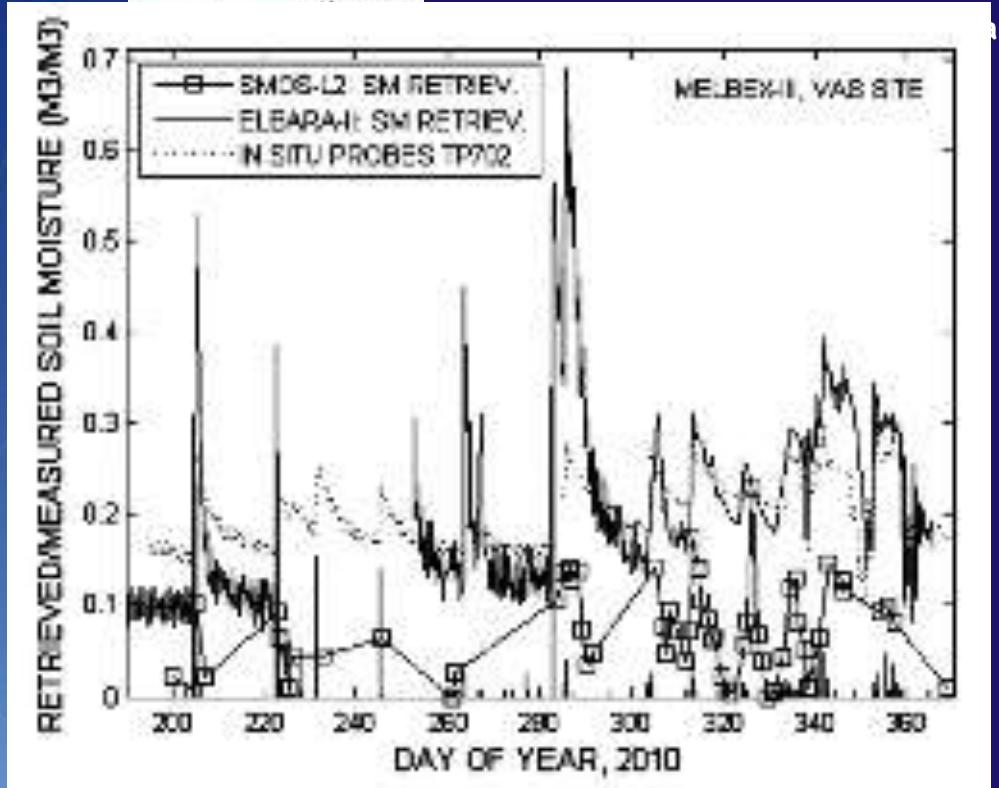
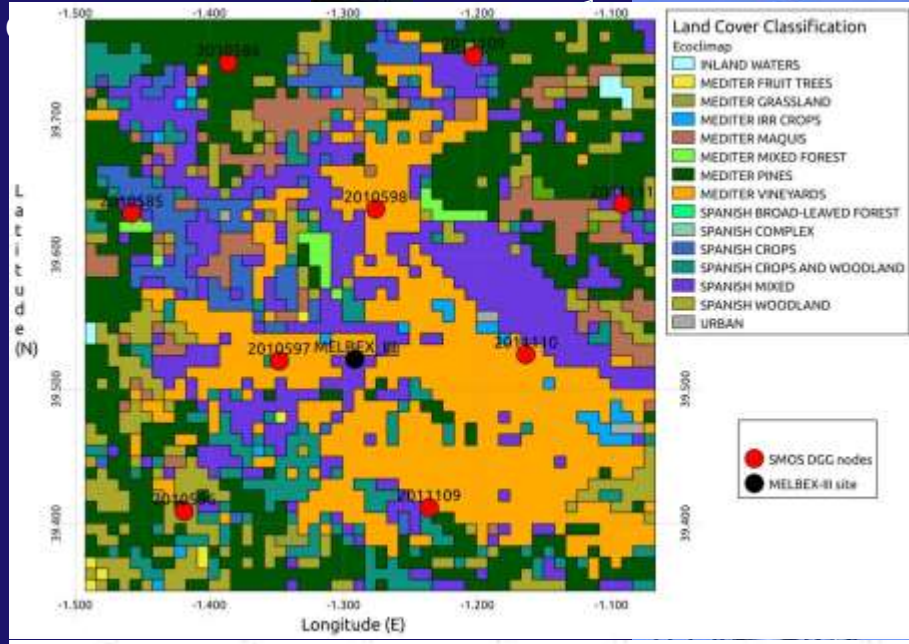


Fig. 10. Comparison in the time variations in SM (m^3/m^3) from Level 2 products (□), ELBARA-II retrievals and in situ measurements (TP702) over the M-III vineyard. Precipitation data are represented by vertical lines (scaling factor 1/10). The SM retrievals made from ELBARA-II were carried out from TB observations made each day and every 3 h from 0:00 to 24:00 local time.



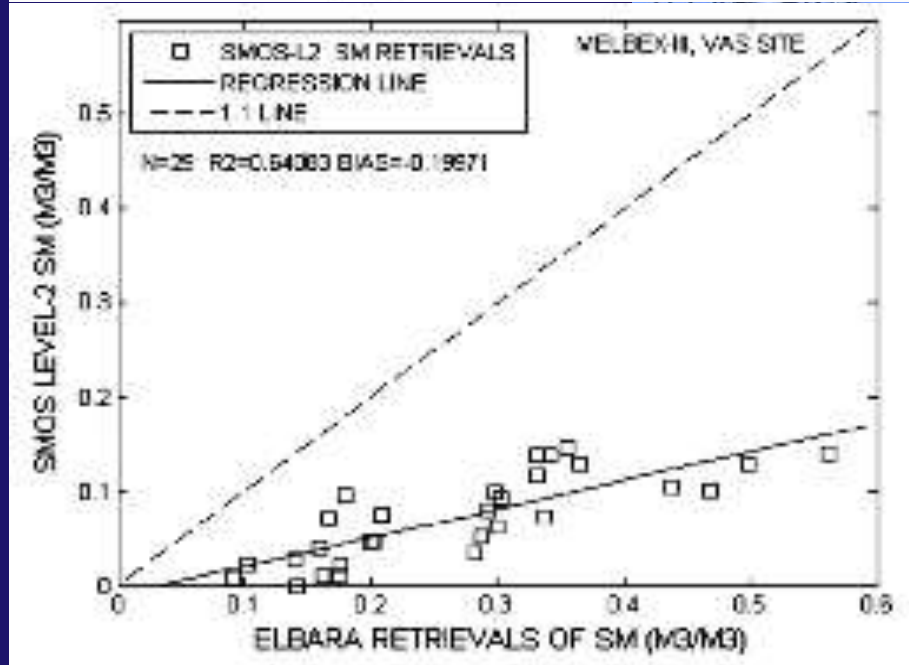


Fig. 11. Comparison of SM values (m^3/m^3) obtained from Level 2 products and ELBARA-II retrievals over the M-III vineyard in 2010. The figure includes ELBARA-II retrievals at morning (at ~6 am) and at evening (at ~6 pm) and the delay between the SMOS and ELBARA-II SM retrievals is lower than 1 h.

-SMOS-L2 and ELBARA retrievals

-good correlation (R2 ~0.64)

-However: a large bias, especially in wet conditions (!)

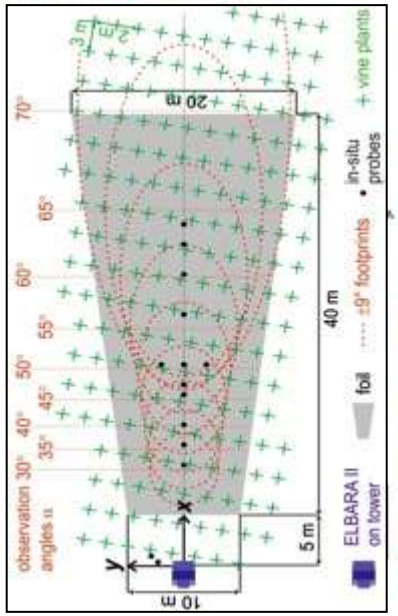
L-band Radiative Properties of Vines (M. Schwank et al.)

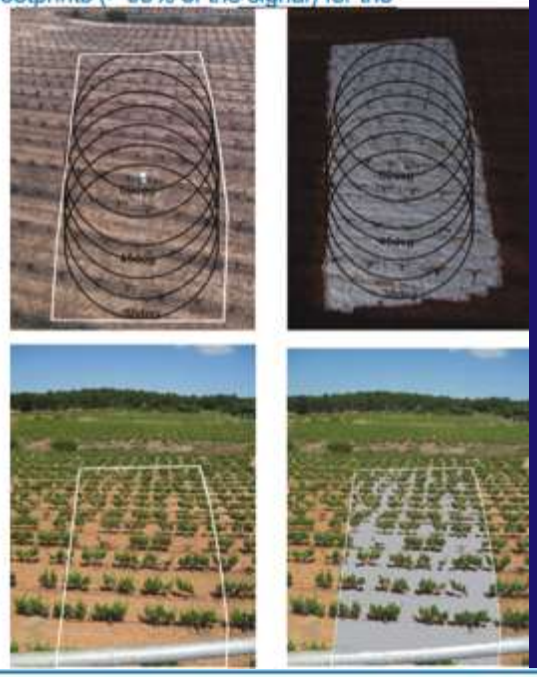
IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, VOL. 50, NO. 5, MAY 2012 1587

L-Band Radiative Properties of Vine Vegetation at the MELBEX III SMOS Cal/Val Site

Mike Schwank, Jean-Pierre Wigneron, *Senior Member, IEEE*, Ernesto López-Baeza, Ingo Völksch, Christian Mätzler, *Senior Member, IEEE*, and Yann H. Kerr, *Senior Member, IEEE*

Approximately 650m² of aluminum foil have been placed on the ground
The covered area comprises the -10dB footprints (> 95% of the signal) for the observation angles 30° - 60°.





Comparison between nadir optical depths from ELBARA II and estimates from in-situ data.

Vegetation state:	τ_{NAD} ELBARA II ($0 \le \omega^{p,q} \le 0.1$)	VWC_{STOCK} [kg m^{-2}]	$\tau_{NAD\_Stock} = b_{lit.} \cdot VWC_{STOCK}$ $0.10 \le b_{lit.} \le 0.12$
Winter	0.101 – 0.112	0.33 – 0.5	0.033 – 0.06
Summer	0.160 – 0.177	1.63 – 1.8	0.163 – 0.216

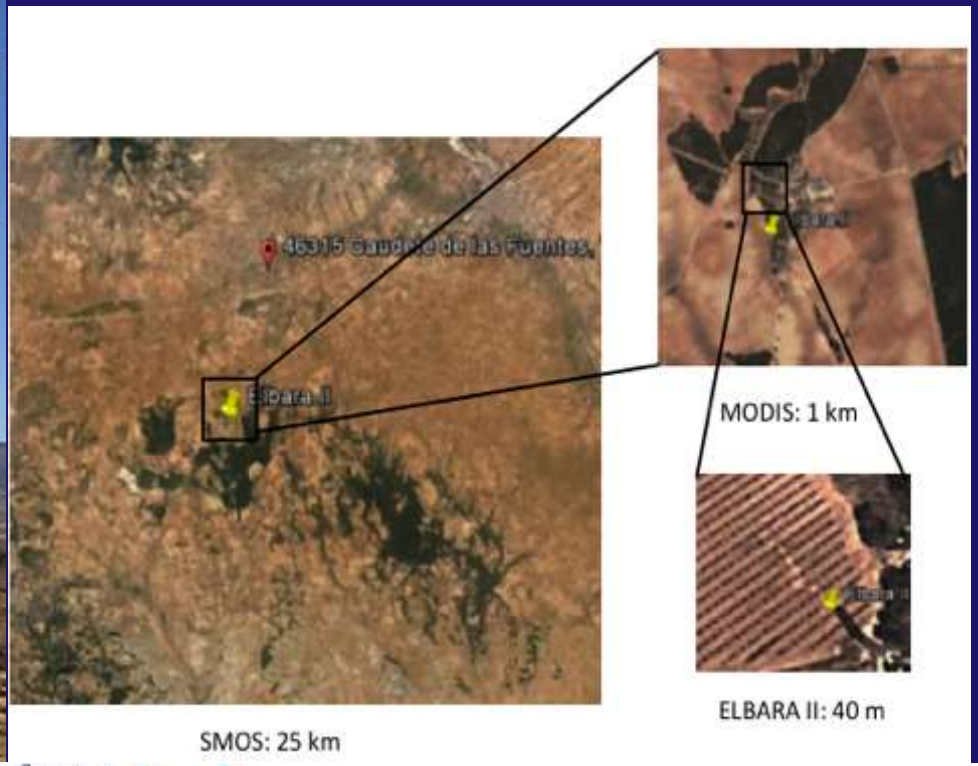
Winter state:

$\tau_{NAD\ ELBARAII} \approx 2 \times \tau_{NAD\_Stock} \Leftrightarrow b_{ELBARAII} \approx 2 \times b_{lit.}$

Summer state:

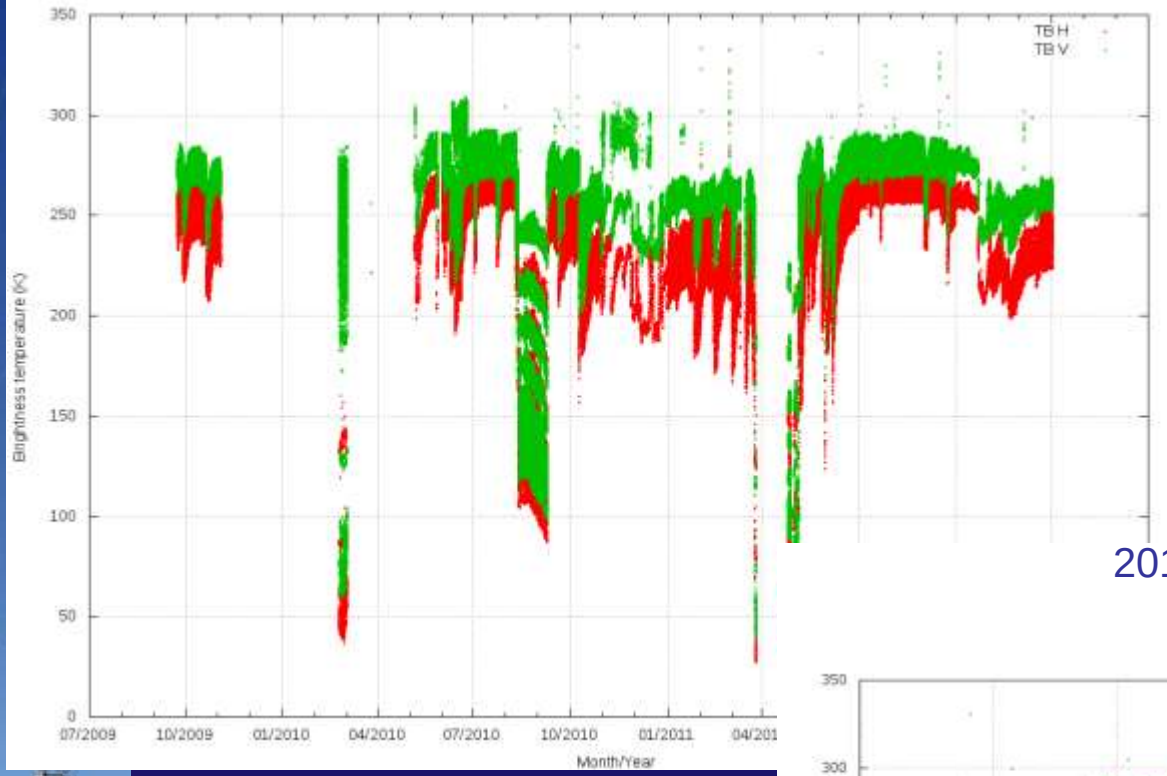
$\tau_{NAD\ ELBARAII} \approx \tau_{NAD\_Stock} \Leftrightarrow b_{ELBARAII} \approx b_{lit.}$

Long-term ELBARA-II Assistance to SMOS Land Products and Algorithm Validation (M. Miernecki, R. Fernandez, et al.)



VNIVERSITAT D VALÈNCIA Facultat de Física
Dpto. Física de la Tierra y Termodinámica
Grupo de Climatología Desde Satélites
Climatology from Satellites Group
University of Valencia, Spain

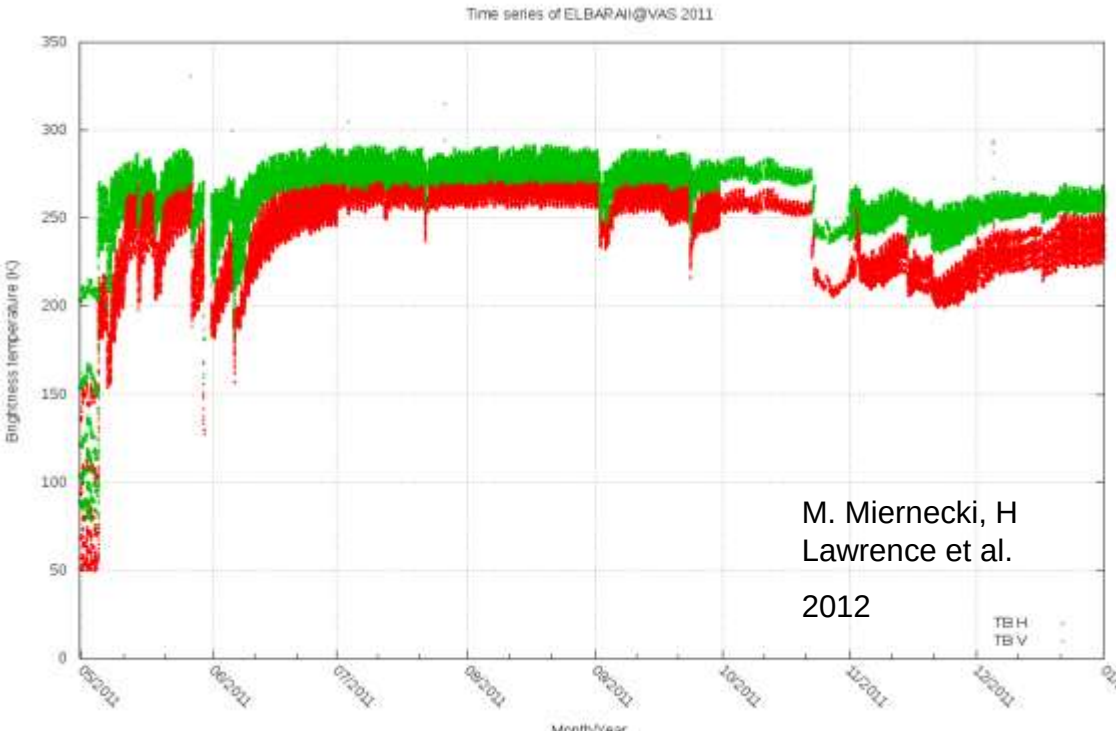
2010-2011-ELBARA Time series



-7, 2013

SMOS

2011-ELBARA Time series



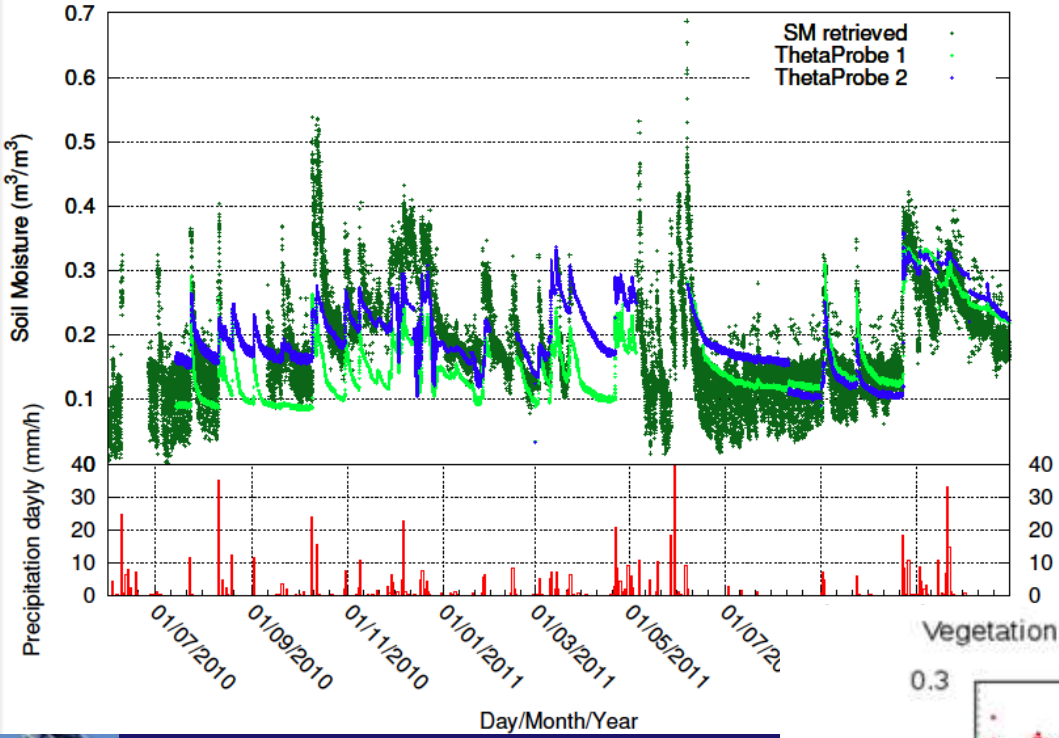
M. Miernecki, H Lawrence et al.

2012

VNIVERSITAT D VALÈNCIA Facultat de Física

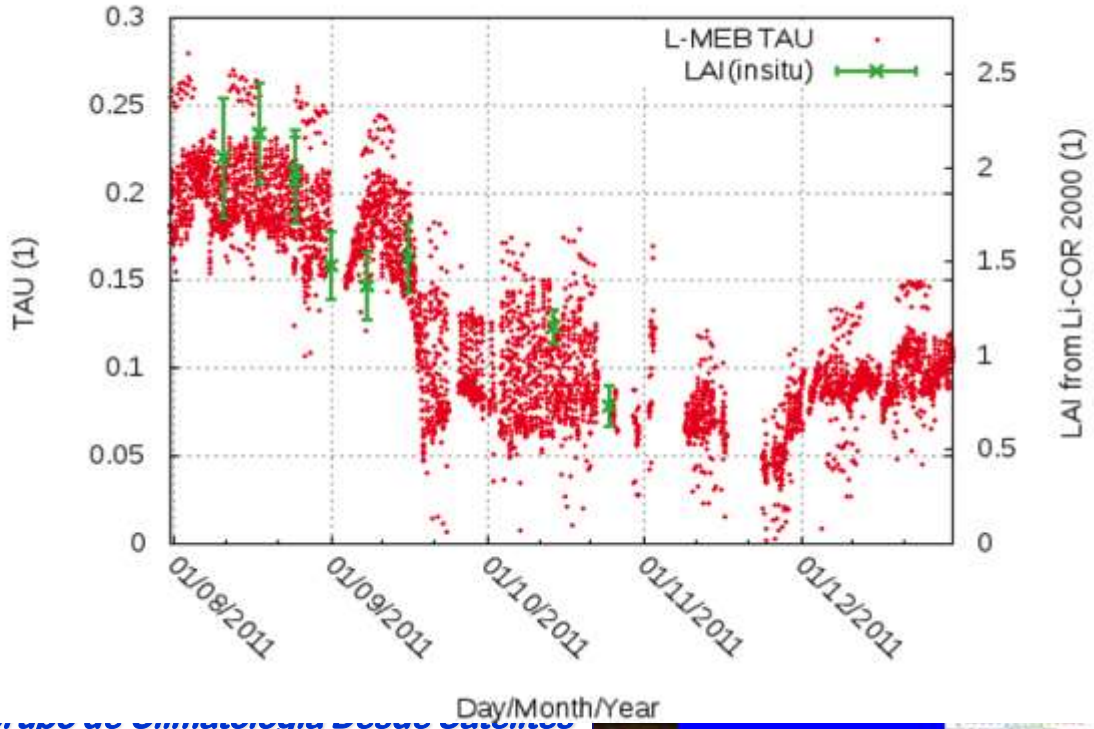
. 5-7, 2013

SMOS



M. Miernecki et al., 2012

Vegetation optical depth retrieved with L-MEB, from MELBEX3@VAS



VNIVERSITAT D VALÈNCIA Facultat de Física

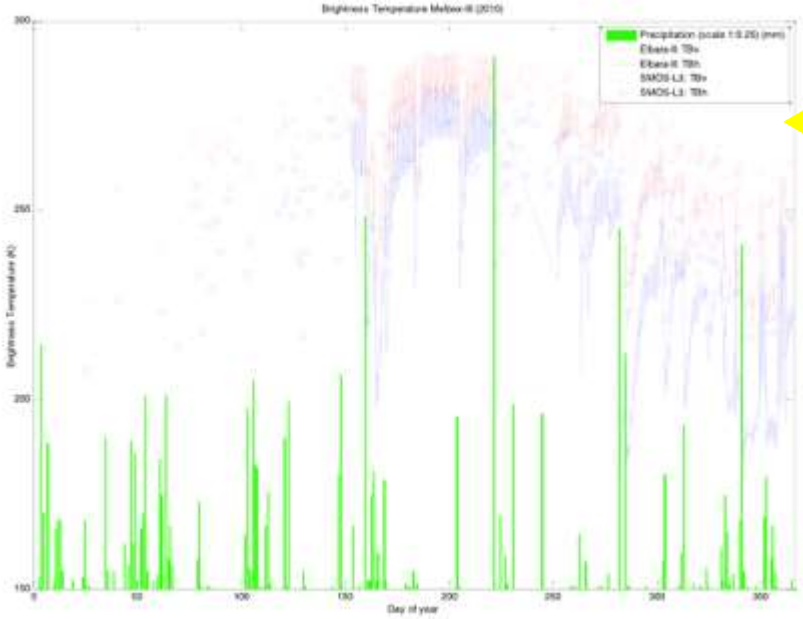
Dp

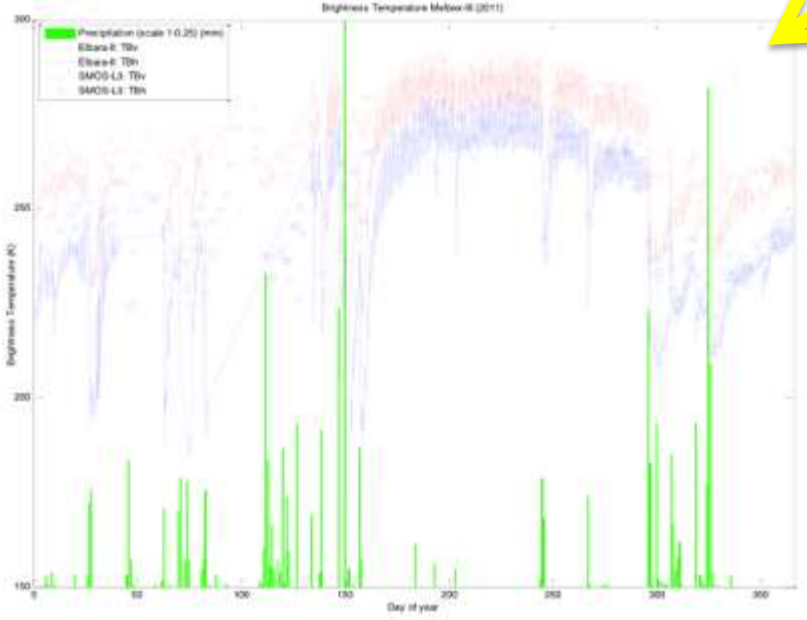
ELBARA-II T_Bs

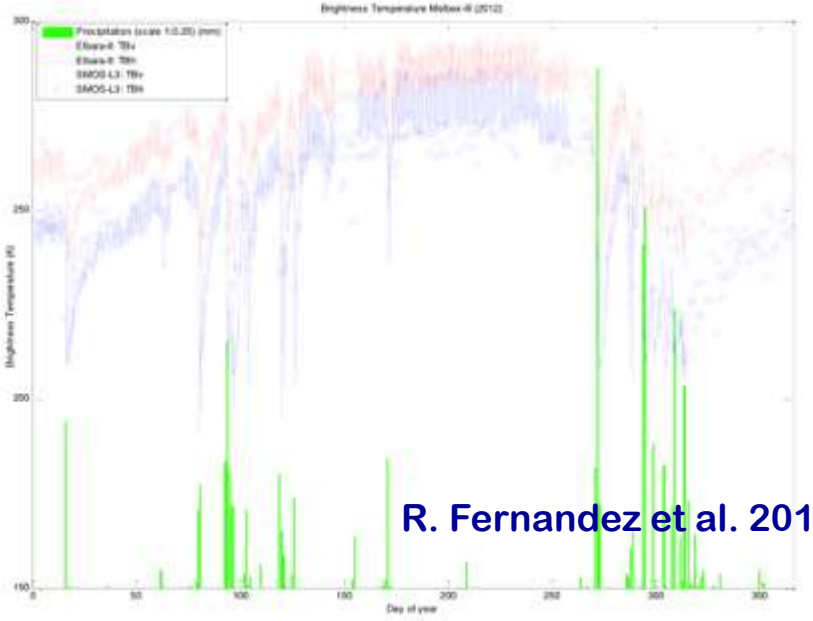
2010

2011

2012



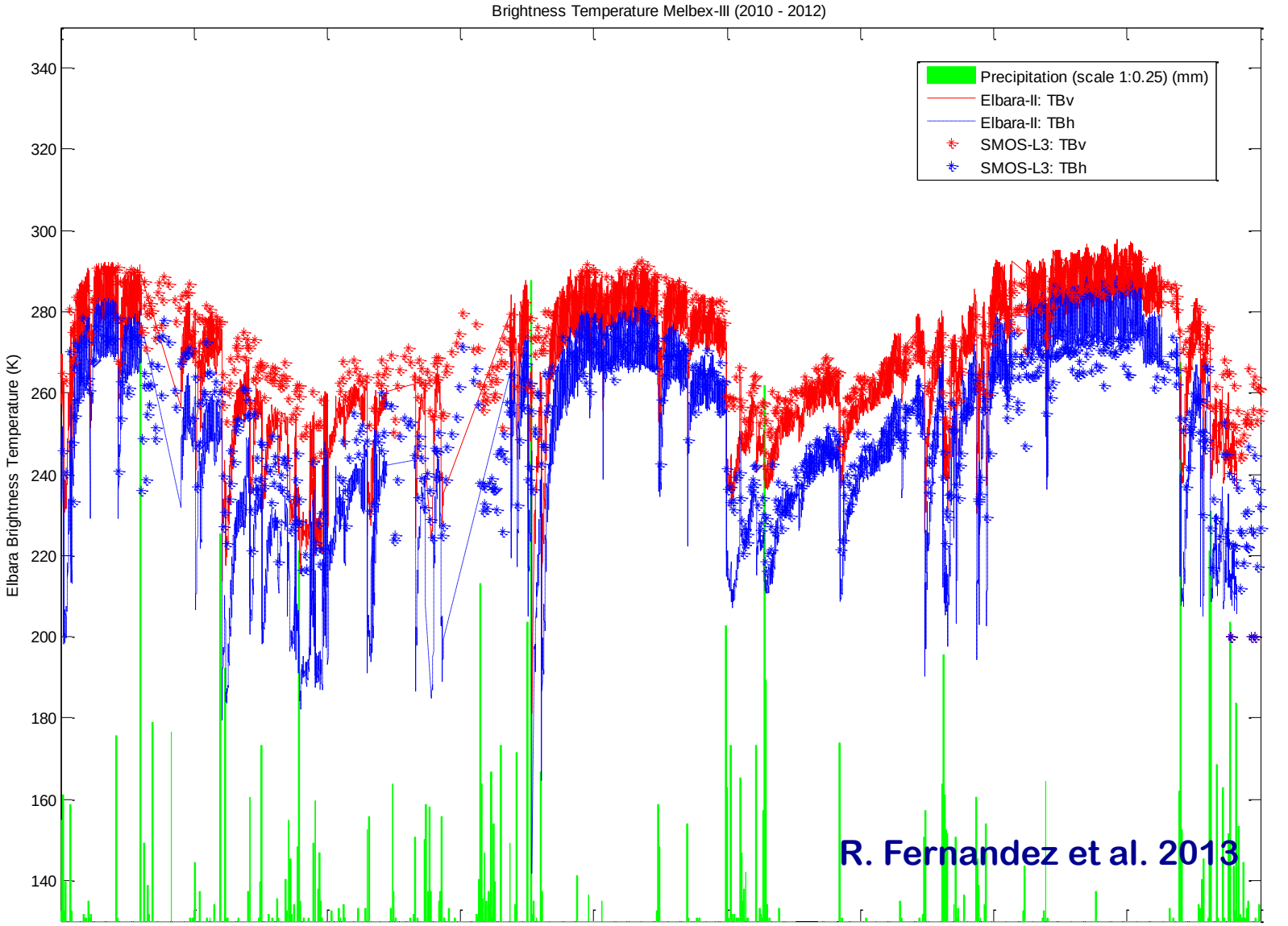




R. Fernandez et al. 2013

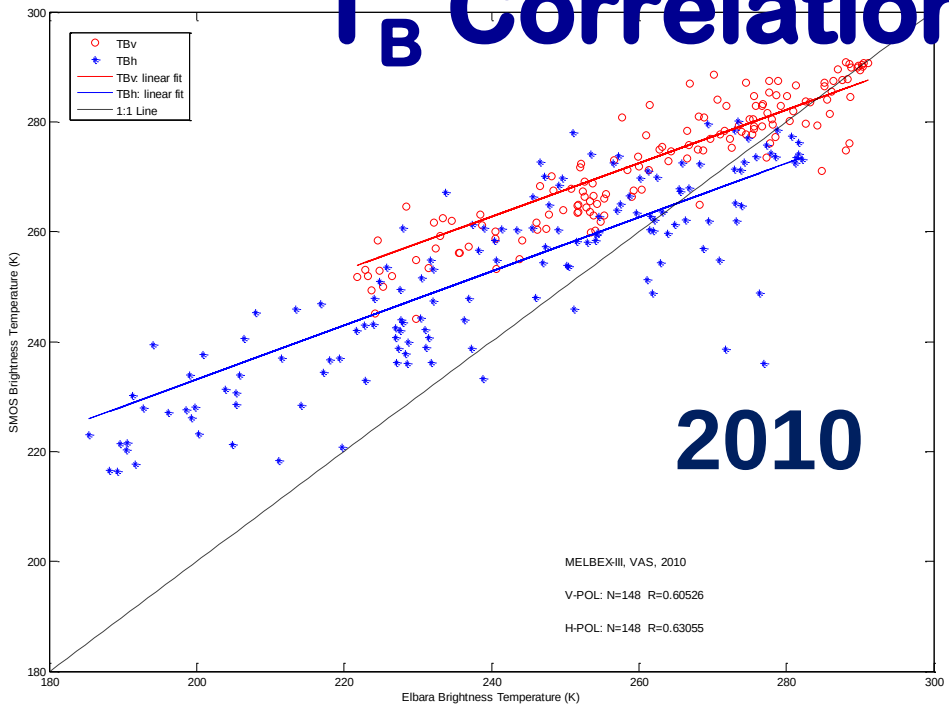
ELBARA-II

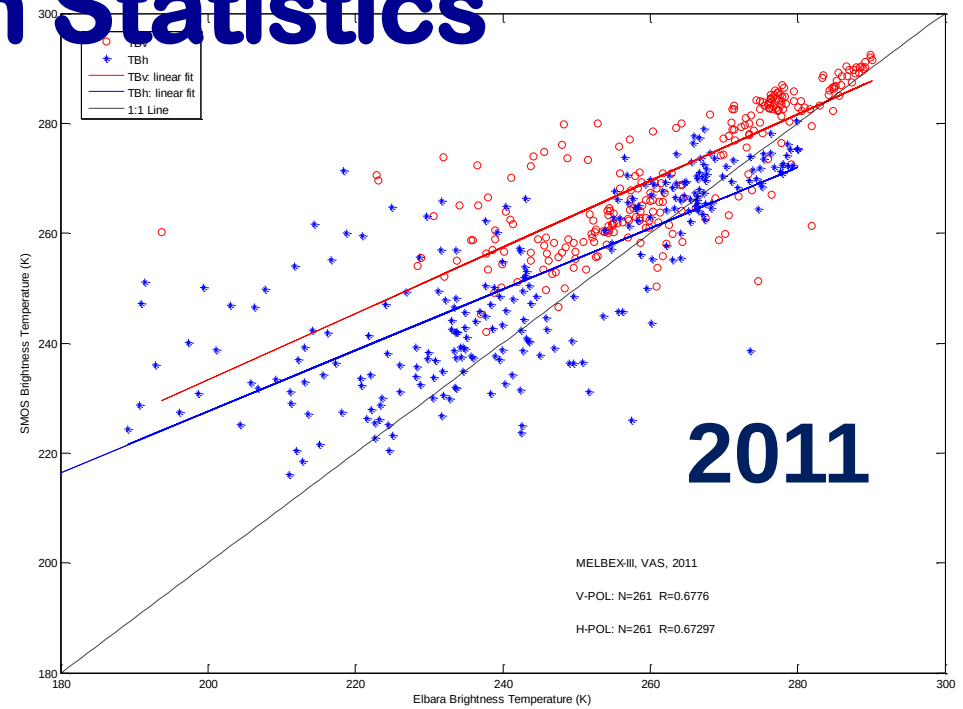
T_B (2010 - 2012) @ VAS

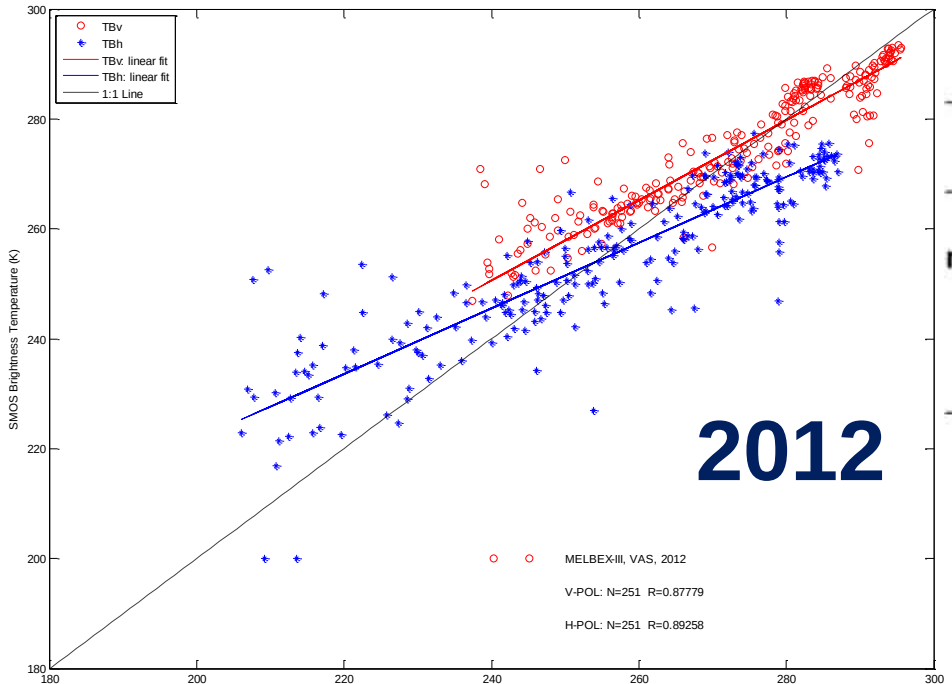


R. Fernandez et al. 2013

T_B Correlation Statistics







	2010		2011		2012	
Polarization	H	V	H	V	H	V
no. of measurements	148	148	251	251	251	251
Bias [K]	12	11	8	8	-1,1	1,9
R	0,63	0,61	0,67	0,68	0,89	0,88
RMSE [K]	25	20	19	15	11	8

Precipitation

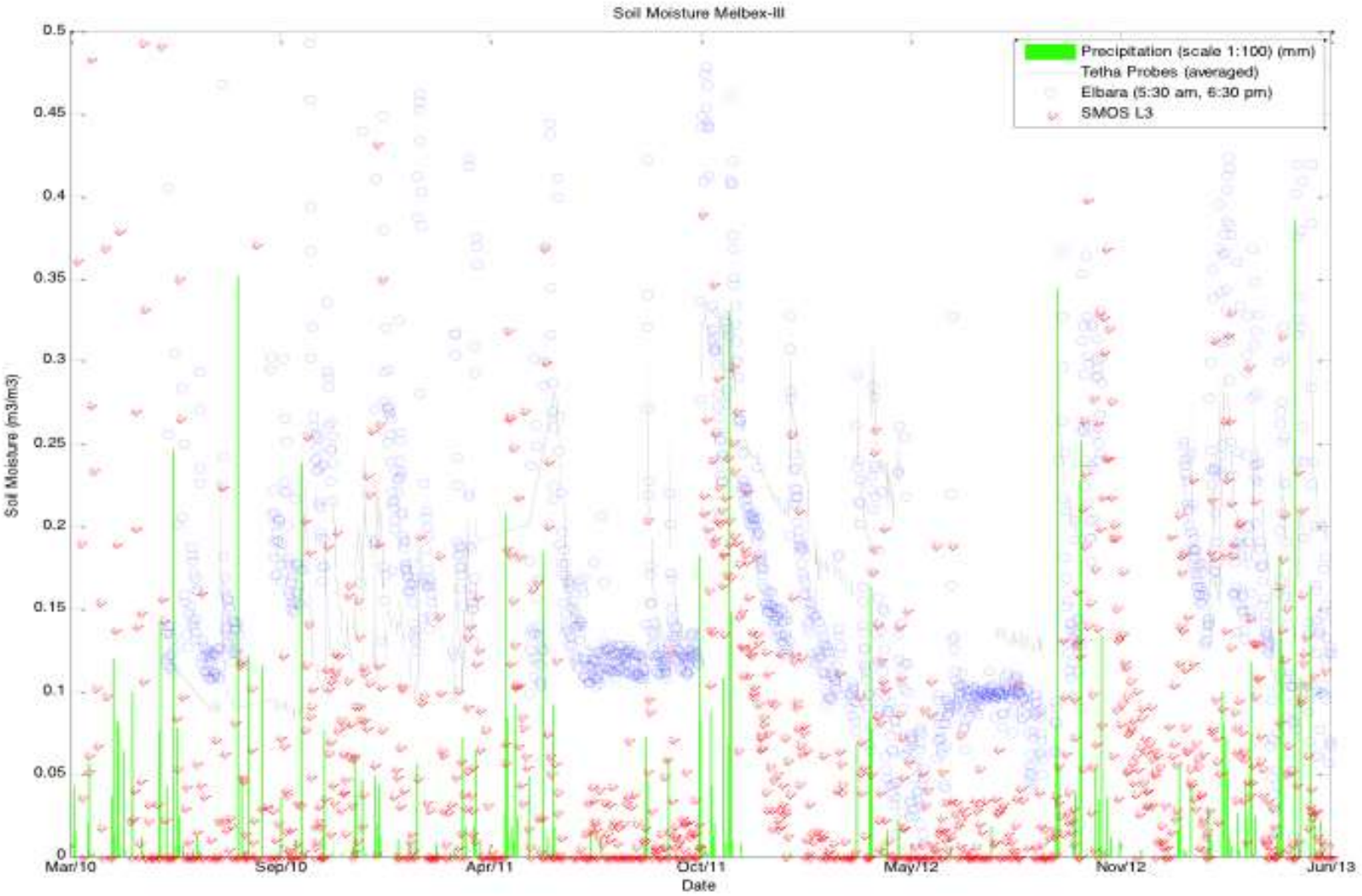
2010: 538,20 mm

2011: 375,20 mm

2012: 294,20 mm

SMOS

ELBARA-II



SM Correlation Statistics

	2010		2011		2012	
Orbit	Ascending (5:30 am)	Descending (6:30 pm)	Ascending (5:30 am)	Descending (6:30 pm)	Ascending (5:30 am)	Descending (6:30 pm)
N0 of measurements	77	102	164	166	135	143
Bias[m^3/m^3]	-0,29	-0,22	-0,16	-0,15	-0,11	-0,07
R	0,42	0,52	0,45	0,36	0,50	0,78
RMSE [m^3/m^3]	0,4	0,3	0,23	0,23	0,14	0,08

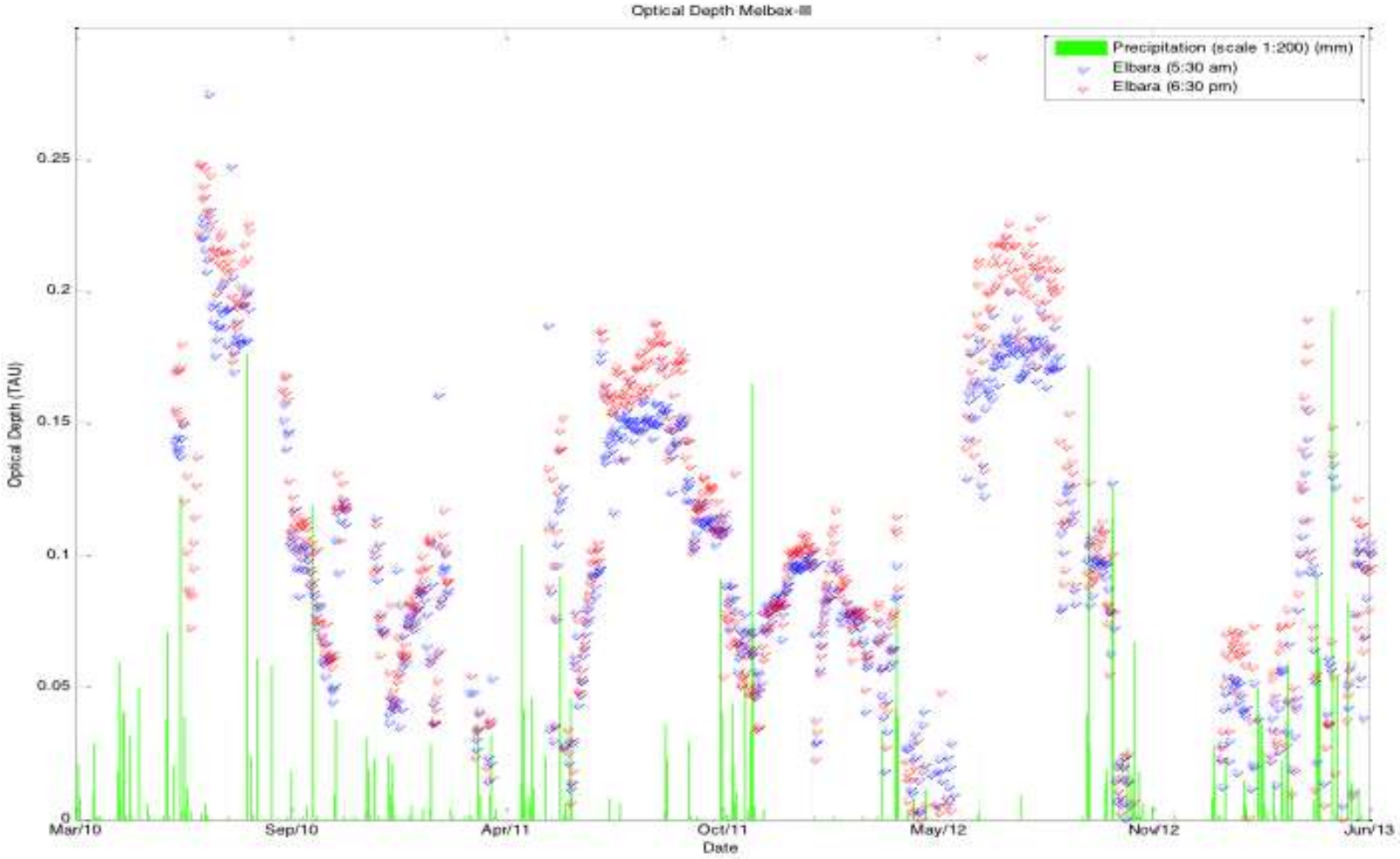
Precipitation

2010: 538,20 mm

2011: 375,20 mm

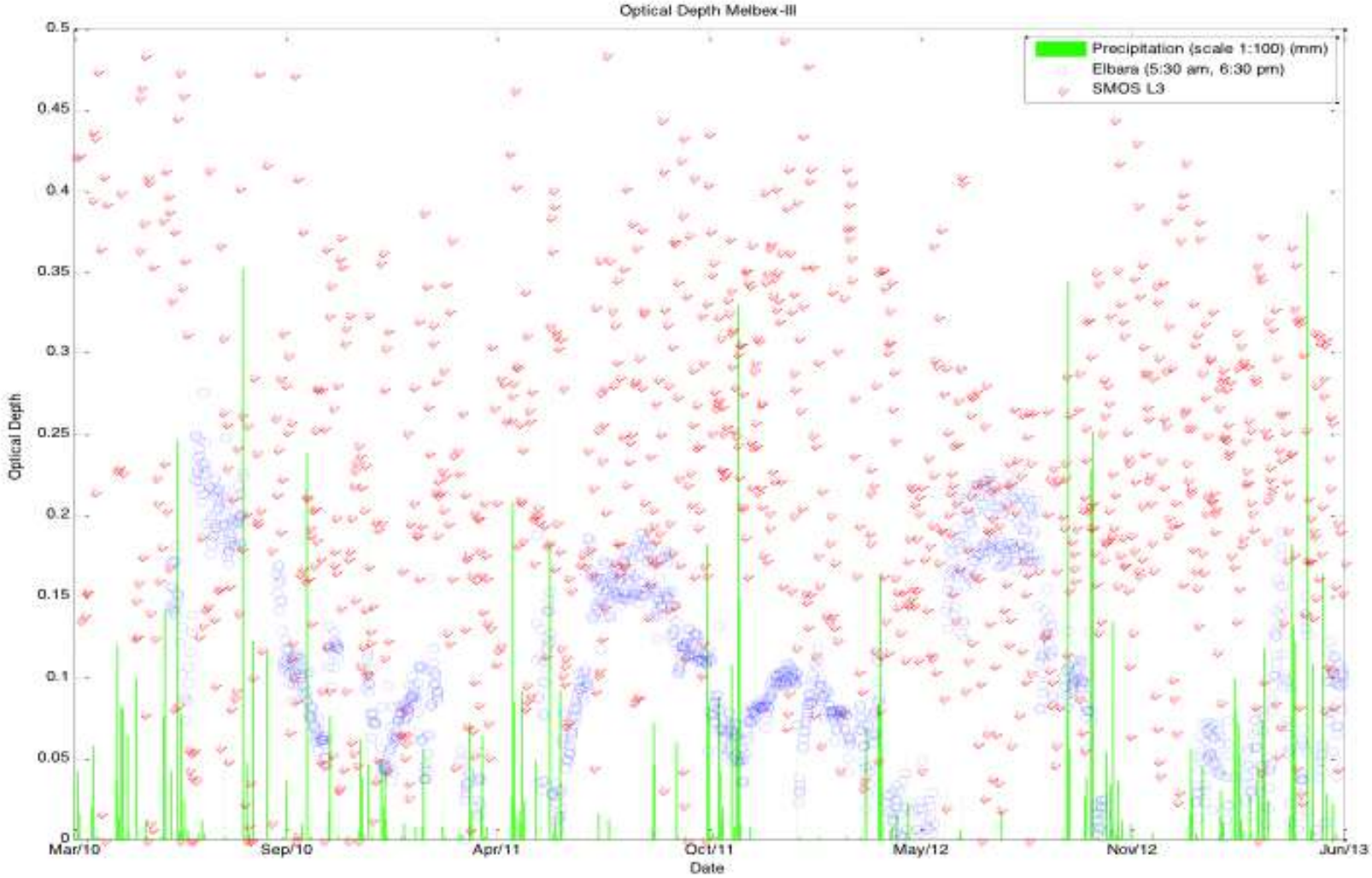
2012: 294,20 mm

ELBARA-II
TAU (2010 - 2012) @ VAS



ELBARA-II

TAU (2010 - 2012) @ VAS



TAU Correlation Statistics

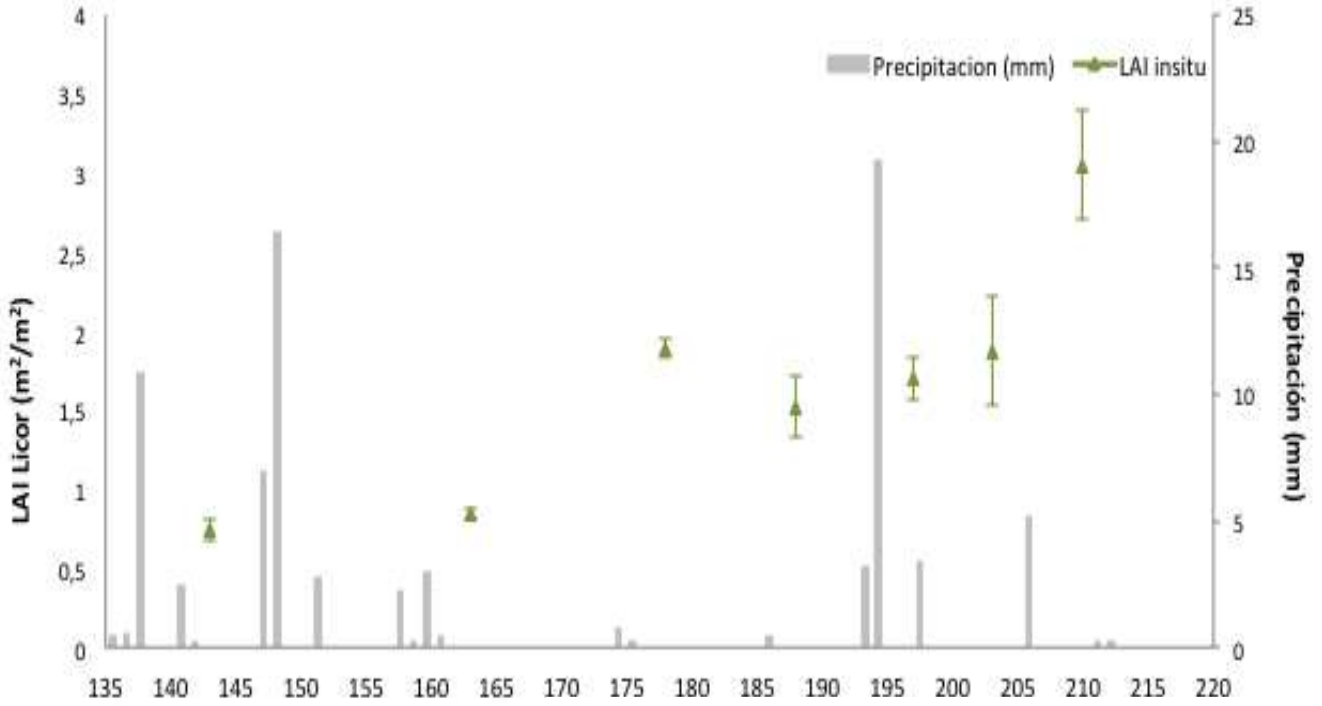
	2010		2011		2012	
Orbit	Ascending (5:30 am)	Descending (6:30 pm)	Ascending (5:30 am)	Descending (6:30 pm)	Ascending (5:30 am)	Descending (6:30 pm)
No. of measurements	77	102	164	166	135	143
Bias	0,03	0,10	0,15	0,13	0,13	0,10
R	-0,03	0,16	0,08	0,24	-0,27	-0,10
RMSE	0,13	0,18	0,19	0,16	0,19	0,16

Precipitation

2010: 538,20 mm

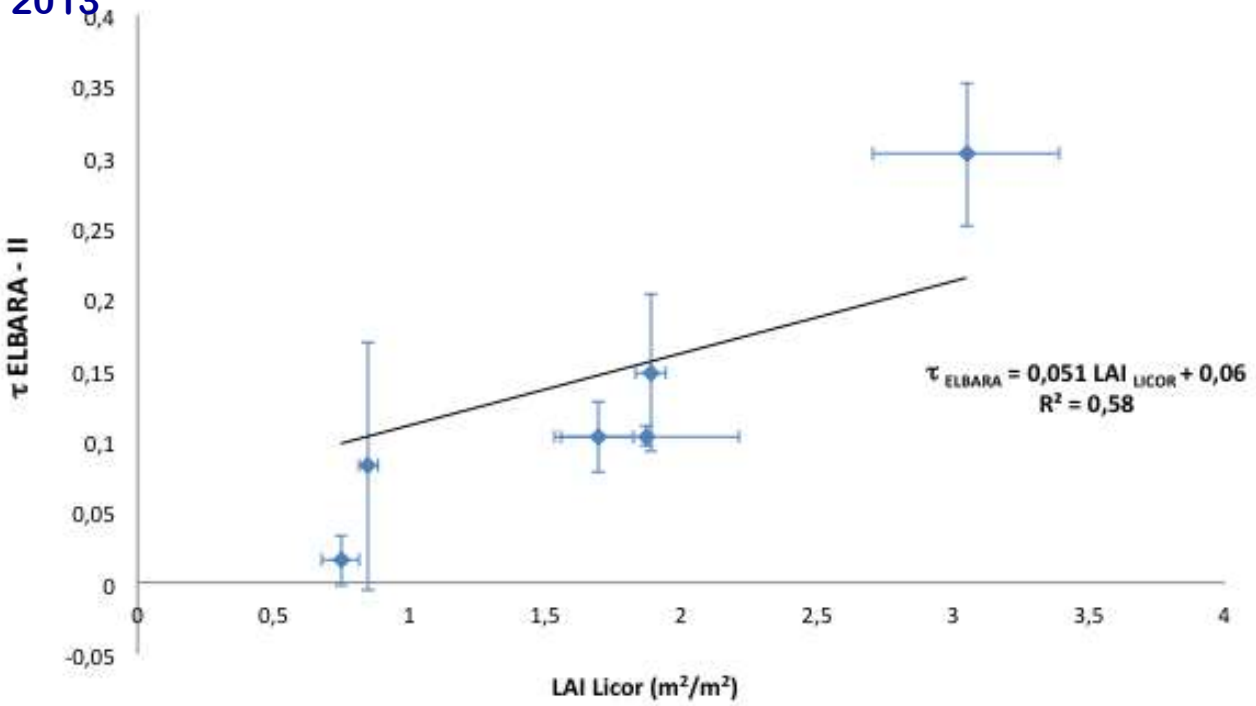
2011: 375,20 mm

2012: 294,20 mm



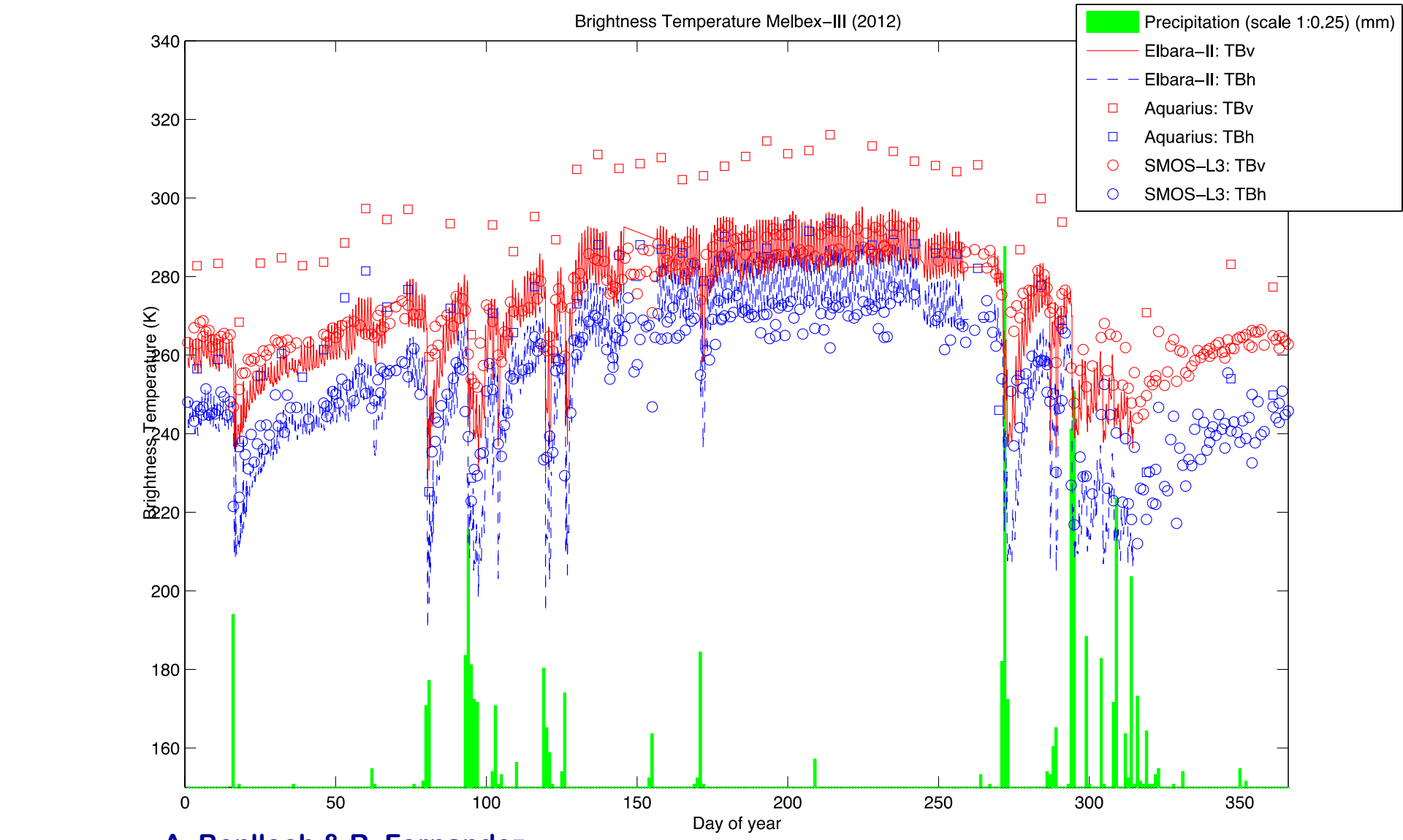
P. Salgado et al. 2013

Leaf Area Index (LAI) vs ELBARA-II TAU



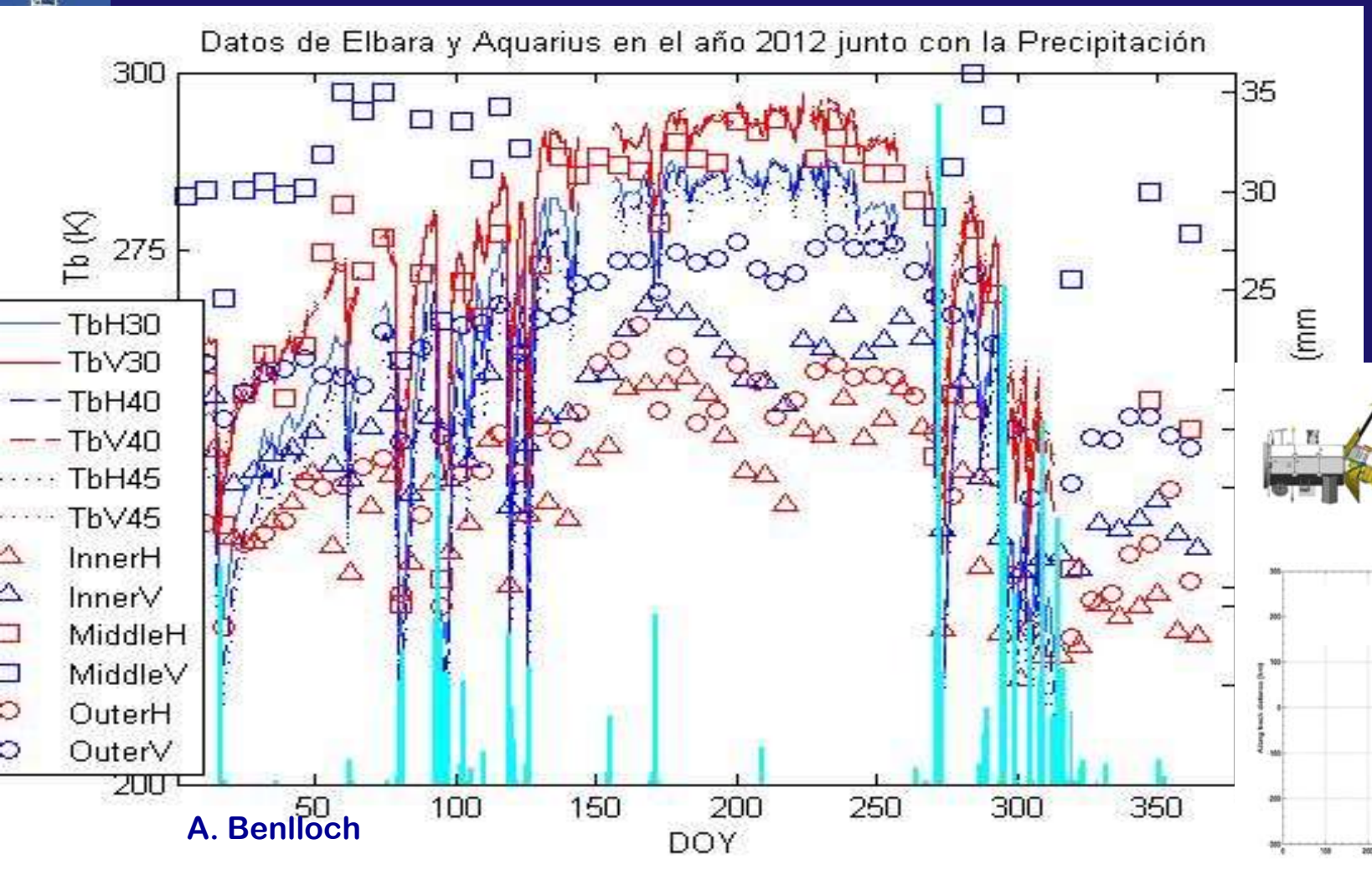
VNIVERSITAT D VALÈNCIA Facultat de F

ELBARA-II + AQUARIUS + SMOS

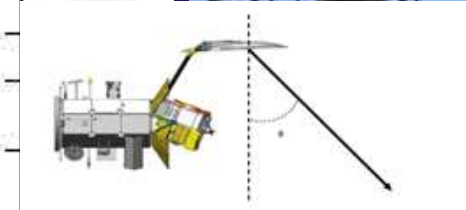


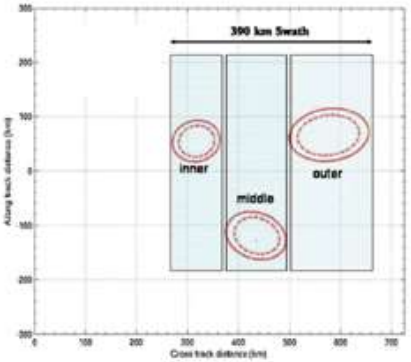
A. Benlloch & R. Fernandez

ELBARA-II + AQUARIUS + SMOS



A. Benlloch





SMOS

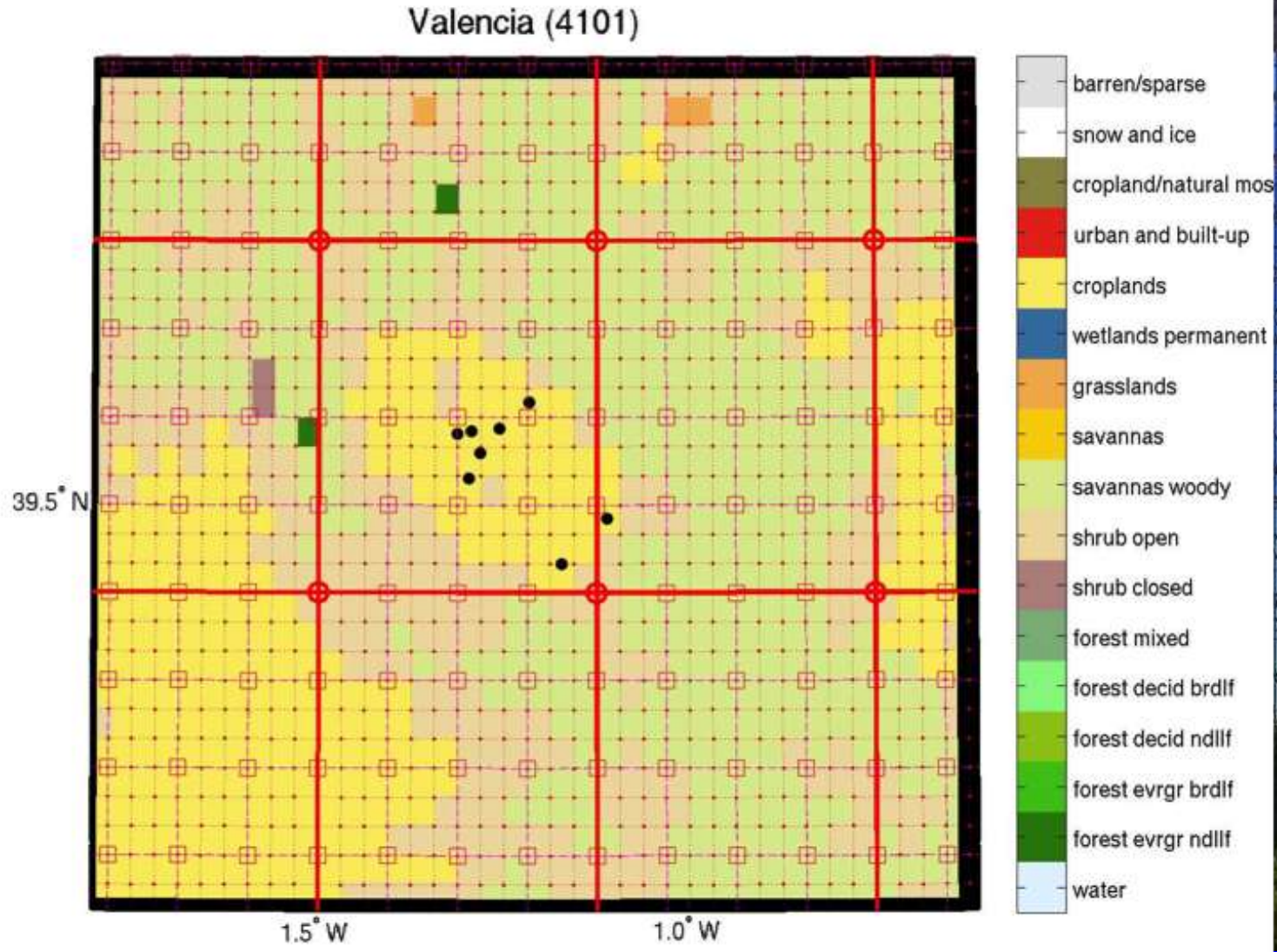
SMAP Cal/Val Rehearsal Phase I

VNIVERSITAT DE VALÈNCIA Facultat de Física

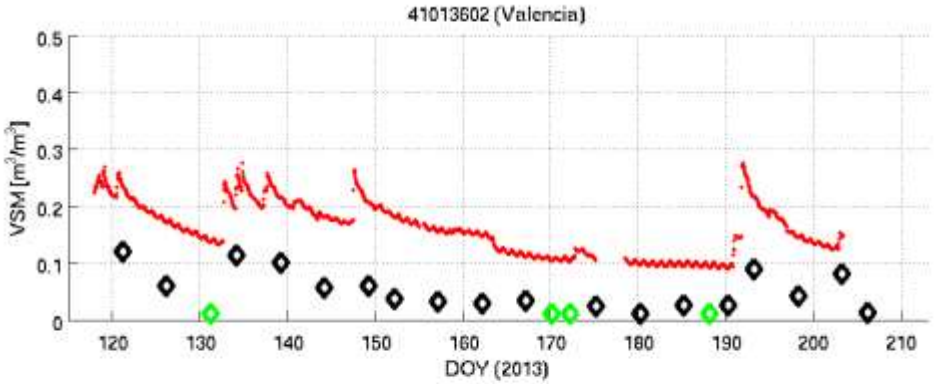
Dpto. Física de la Tierra y Termodinámica
Grupo de Climatología Desde Satélites

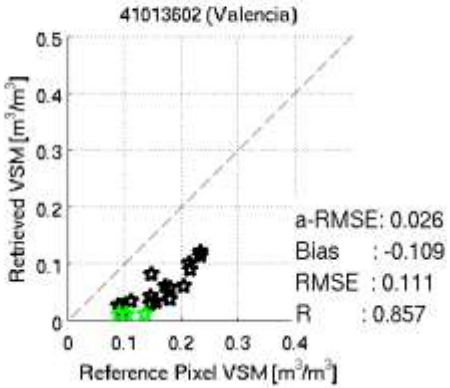
Climatology from Satellites Group
University of Valencia, Spain

SMAP



A. Colliander, SMAP

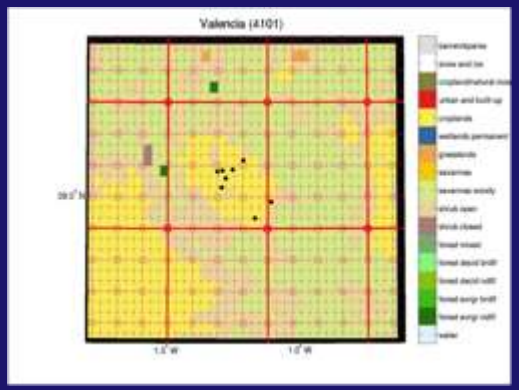


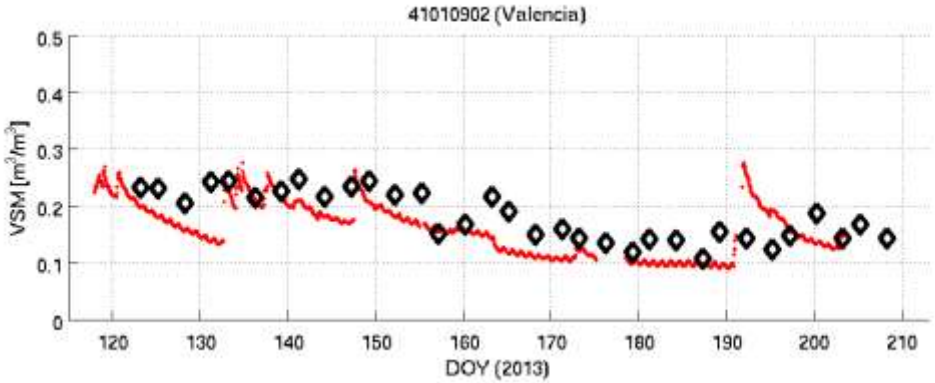


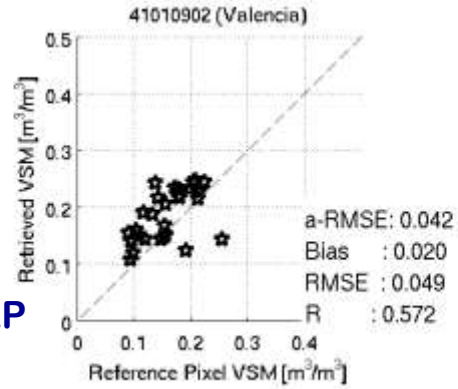
ov. 5-7, 2013

SMOS

SMAP

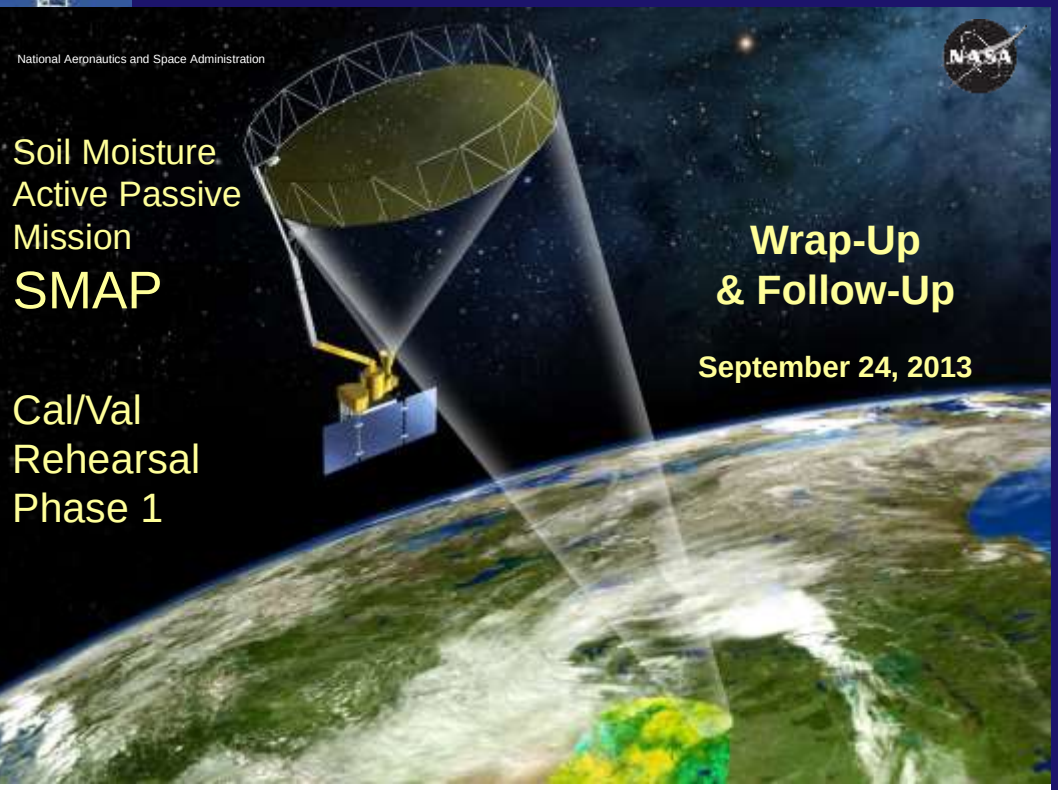






A. Colliander, SMAP

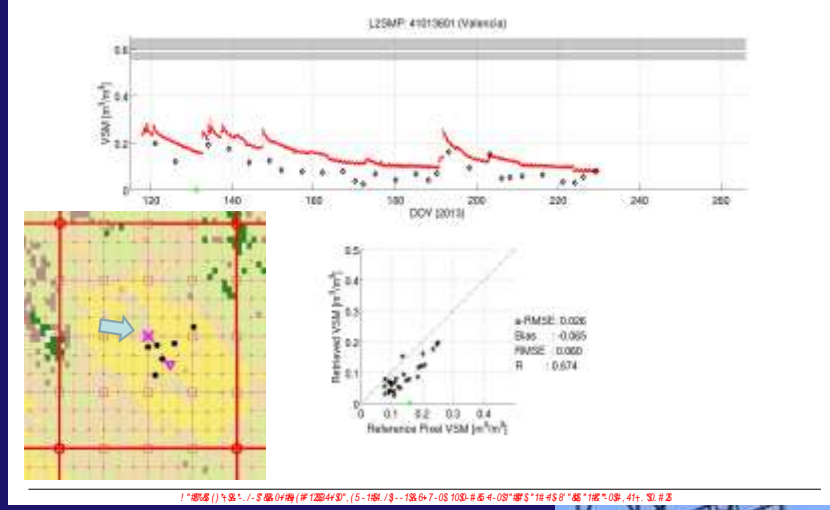
SMAP



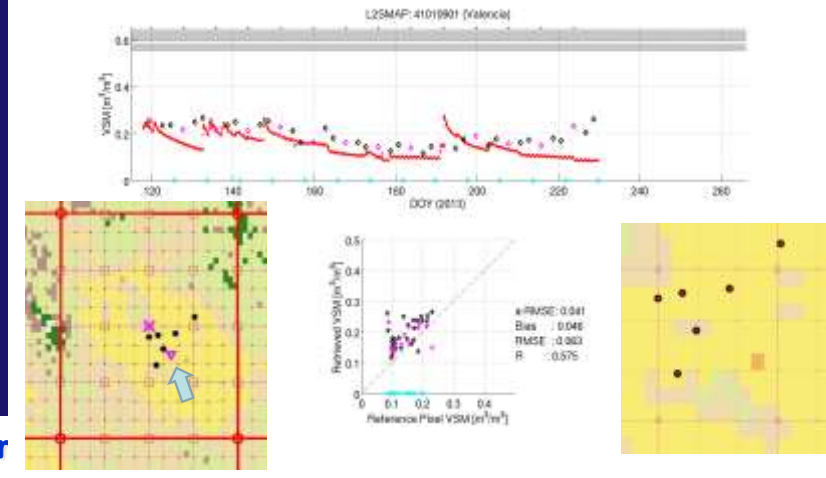
A. Colliander, SMAP

VNIVERSITAT DE VALÈNCIA Facultat de Física
Dpto. Física de la Tierr
Grupo de Climatolo

4101 – Valencia
3601



4101 – Valencia
0901: L2SM



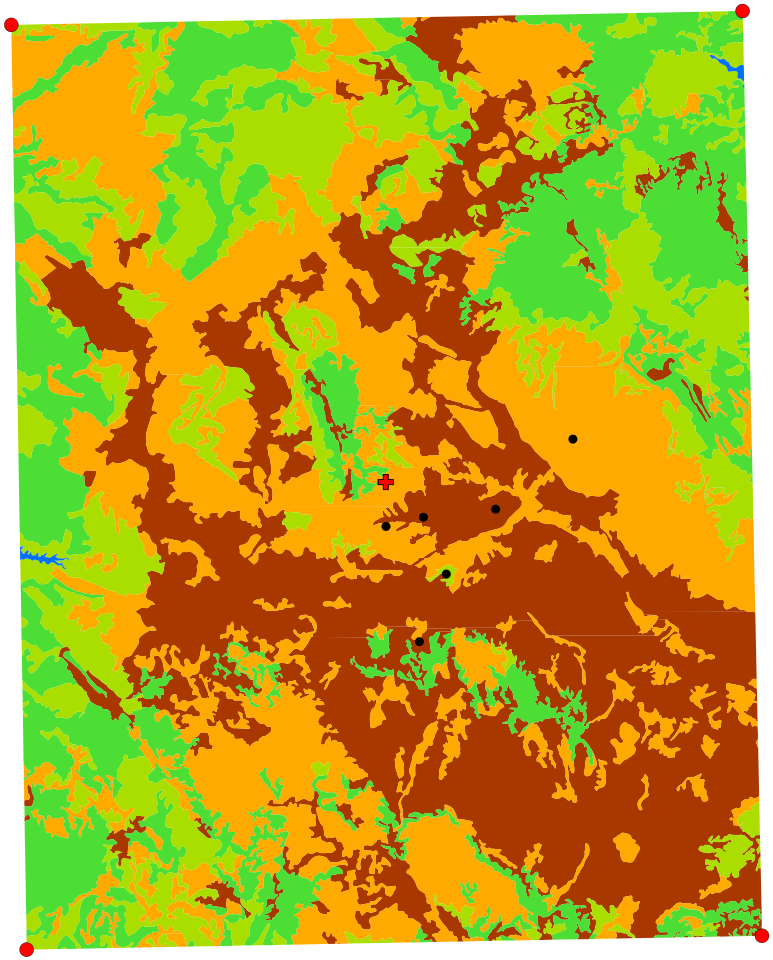
SMAP Cal/Val Rehearsal Phase II

VNIVERSITAT DE VALÈNCIA Facultat de Física

Dpto. Física de la Tierra y Termodinámica
Grupo de Climatología Desde Satélites

Climatology from Satellites Group
University of Valencia, Spain

SMAP



Land Uses
36-km Grid

Legend

- 36_nodes_UTM_ETRS89
- 36_corners_UTM_ETRS89
- Stations_UTM

usos36_final

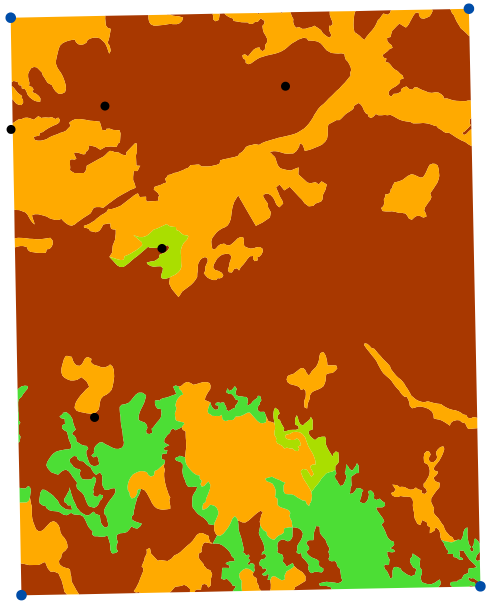
- Bosque mixto
- Frutales
- Láminas de agua
- Matorral boscoso de transición
- Viñedos

1:200.000

Coordinate System: ETRS 1989 UTM Zone 30N
Projection: Transverse Mercator
Datum: ETRS 1989

SMAP

Land Uses
09-km Grid

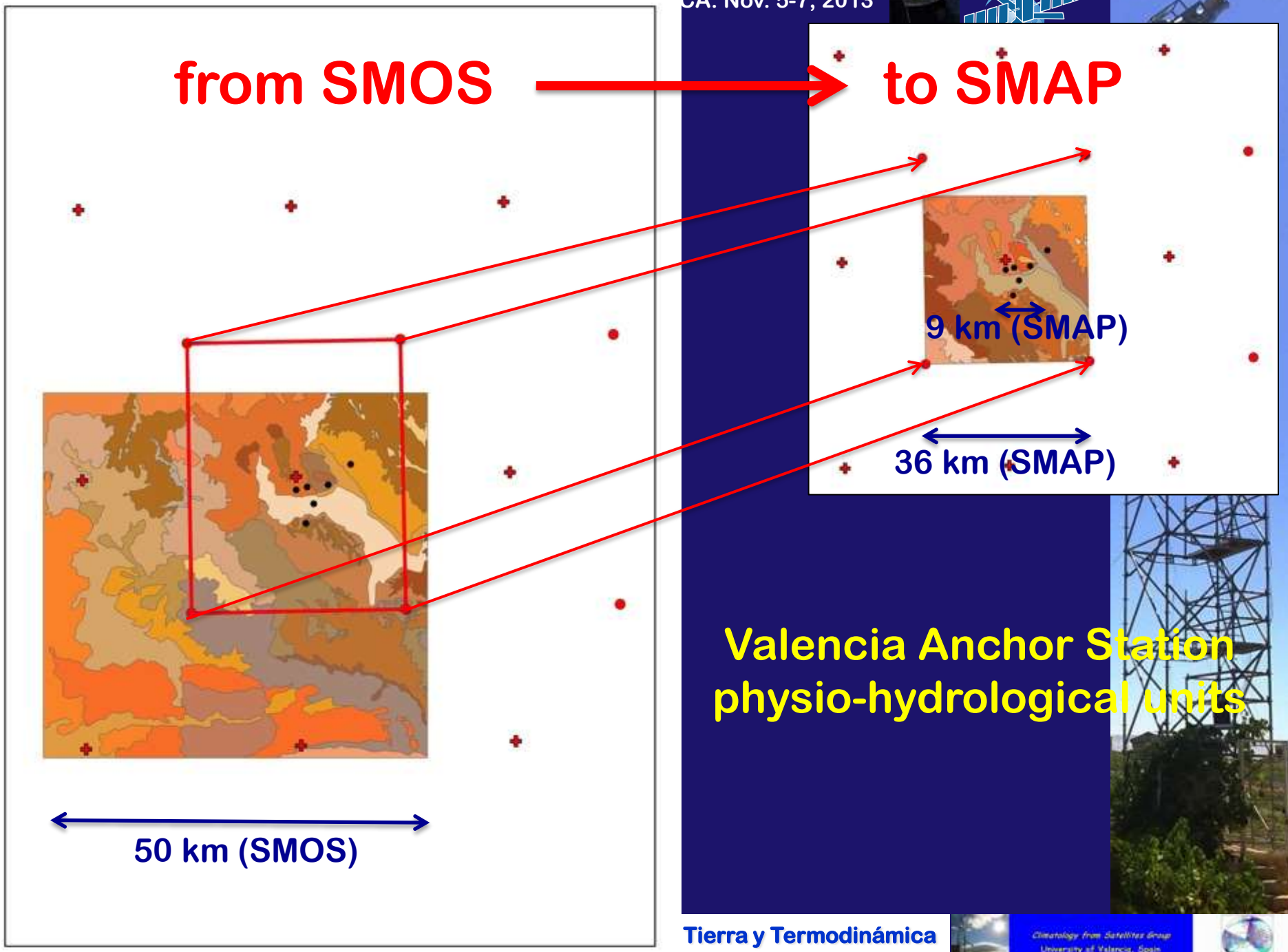


Legend

- 09_corners_UTM_ETRS89
- Stations_UTM
- Bosque mixto
- Frutales
- Láminas de agua
- Matorral boscoso de transición
- Viñedos

1:80.000

Coordinate System: ETRS 1989 UTM Zone 30N
Projection: Transverse Mercator
Datum: ETRS 1989


from SMOS
to SMAP
9 km (SMAP)
36 km (SMAP)
50 km (SMOS)
Valencia Anchor Station
physio-hydrological units

Nov. 5-7, 2013

SMOS

Towards an accurate es of w ba

Ca
Ed

rra y T
logía Desde Satélites

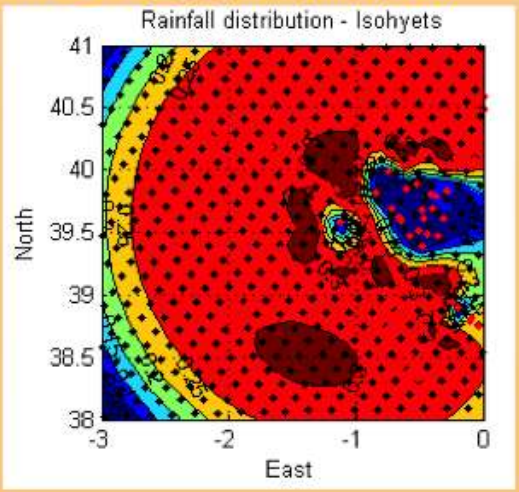
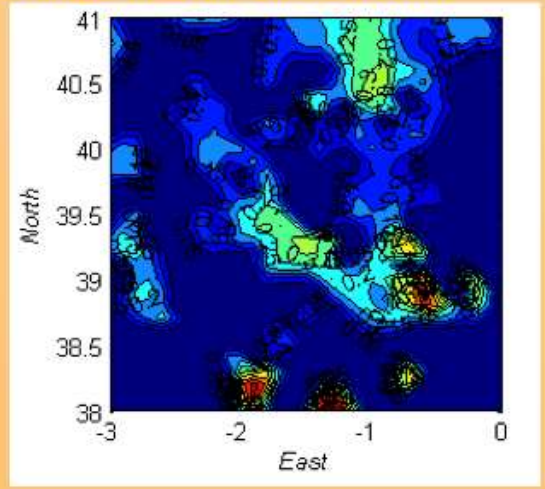
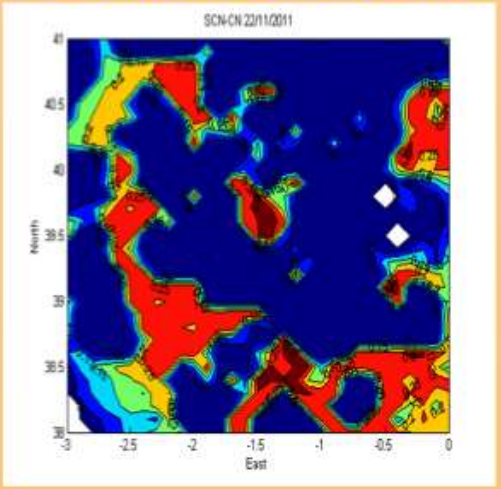
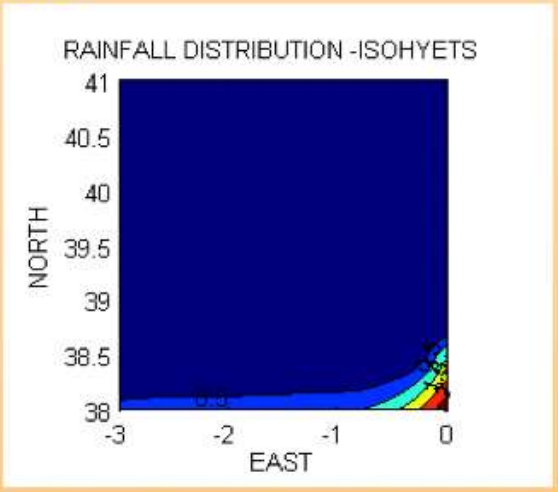
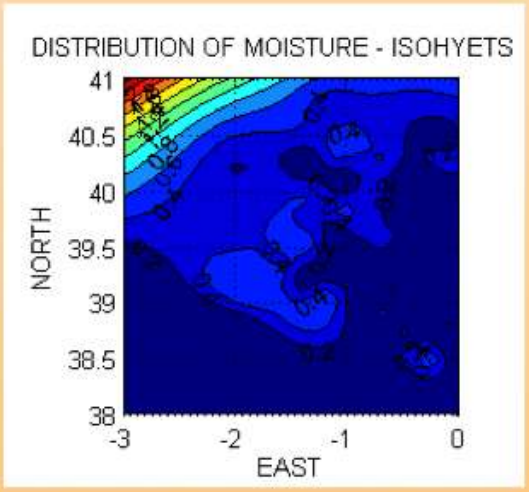
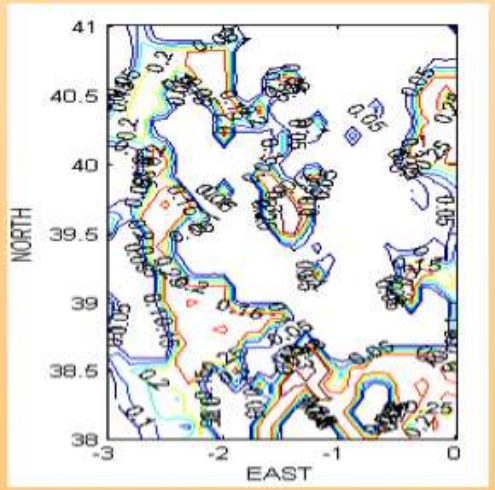
SMOS

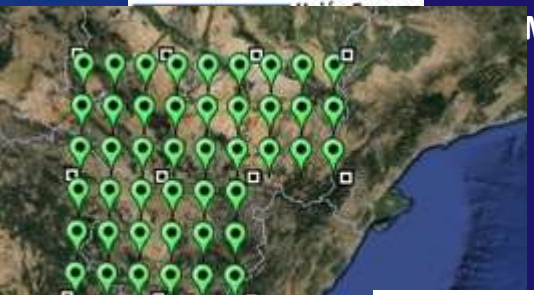
Recent Applications of SMOS Observations in our Region

VNIVERSITAT DE VALÈNCIA Facultat de Física

Dpto. Física de la Tierra y Termodinámica
Grupo de Climatología Desde Satélites

Climatology from Satellites Group
University of Valencia, Spain

Rainfall	SMOS	SCS-CN
Event: 22/11/2011 Rainfall (Input)	**Event: 22/11/2011-SMOS (Input)**	**Event: 22/11/2011- SCS-CN (Output)**
		
Event: 28/09/2012 6:00 am Rainfall (input)	**Event: 28/09/2012 6:00 am SMOS (input)**	**Event: 28/09/2012 6:00 am SCS-CN (input)**
		

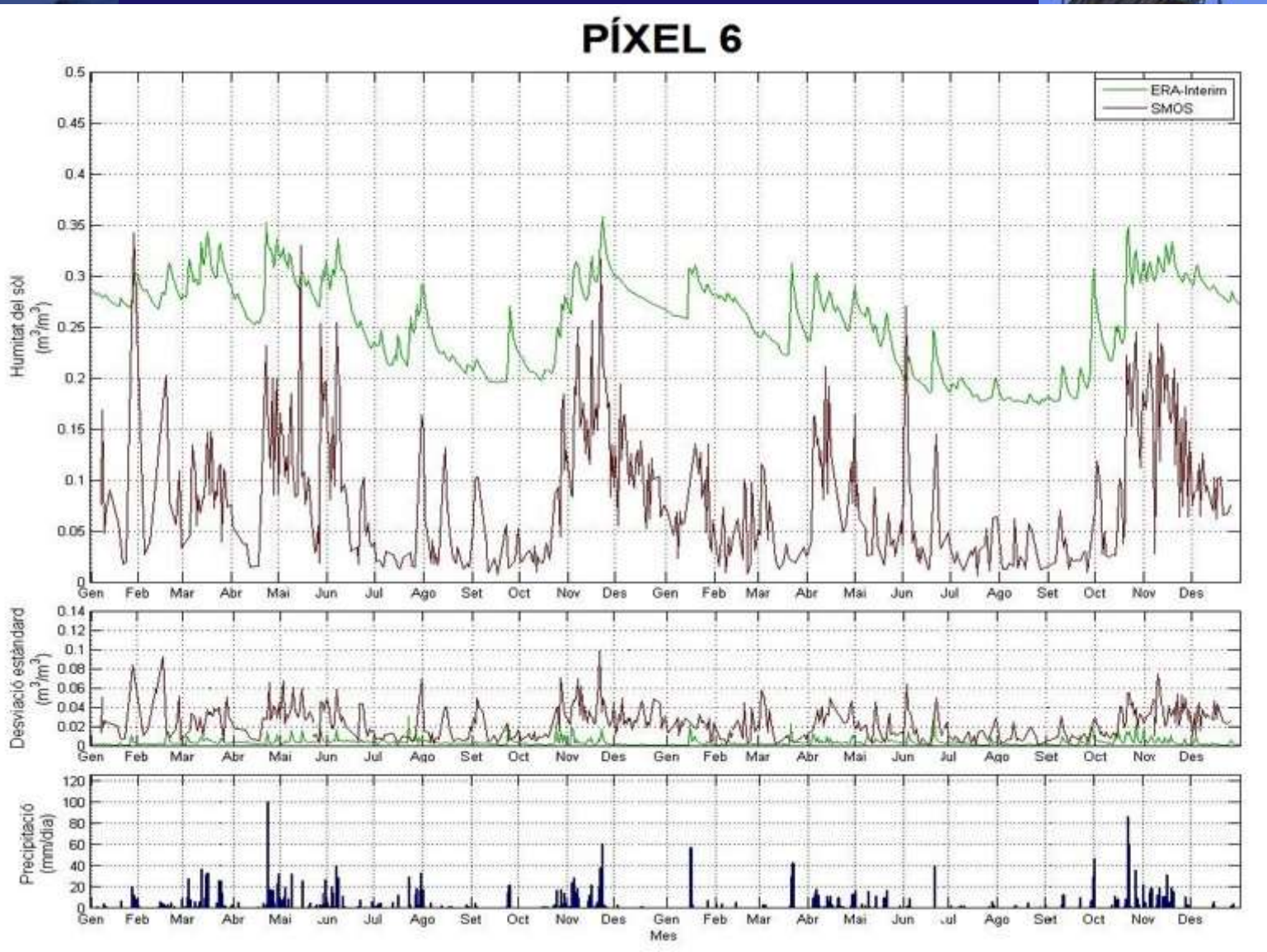


SMOS

ERA-INTERIM vs SMOS Comparison (2011-2012)

Pau Benetó

VNIVERSITAT DE VALÈNCIA



Conclusions

- Capability of the Valencia Anchor Station for low-spatial resolution Cal/Val activities (GERB, CERES, SMOS, SMAP, SENTINEL-3)

- Core validation site for SMOS
  - land products
    - long-term validation with ELBARA-II
      - SM
      - TAU → VWC
      - SMOS Level 2 processor

- *Contributing site* for SMAP

- **Singular validation site by combining ELBARA-II + eddy-covariance + appropriate network** given the reasonable homogeneous characteristics of the area at that scale

Acknowledgment

- Spanish Research Programme on Space, Ministry for Economy & Competitiveness
- General Directorate for Climate Change, Dept. for Environment, Water, Town Planning and Housing, Regional Gov. of the Valencian Autonomous Community
- European Space Agency (ESA) (SMOS)
- National Aeronautics and Space Administration (NASA)
- Centre National d'Etudes Spatiales (CNES)

- Jucar River Basin Authority. Office for Hydrological Planning
- Irrigation Technology Service, Valencian Institute for Agricultural Research
- Spanish Meteorological State Agency of Spain (AEMet)

- Iranzo Wine Cellars, Caudete de las Fuentes
- Utiel Wine Cellars and Vineyards Utiel
- La Cubera Wine Cellar, Utiel
- Nicolas Guaita, Rafael Giménez, Roberto Garcia, Caudete de las Fuentes

thank you for your attention

backup

CA. Nov. 5-7, 2013

SMOS

VNIVERSITAT D VALÈNCIA Facultat de Física

Dpto. Físic

Grupo d