

The use of SAR images for agricultural applications in Argentina

Diego de Abelleira, Santiago Verón

INTA, Argentina



Instituto de Clima y Agua
CIRN

Introduction

Over agricultural systems SAR backscatter is a consequence of vegetation effects (water content and geometry) and soil effects (moisture and roughness).

Objectives:

Analyze the contribution of C and X band backscatter of vegetation structural parameters and soil moisture

Consider the factibility of the use of SAR for soil moisture and biomass parameters estimation.

Multitemporal analysis of X and C band SAR over soybean fields

Available data

SAR data: 9 TerraSAR X Stripmap (HH/VV) and 6 RADARSAT-2 FQP

Analyzed field variables:

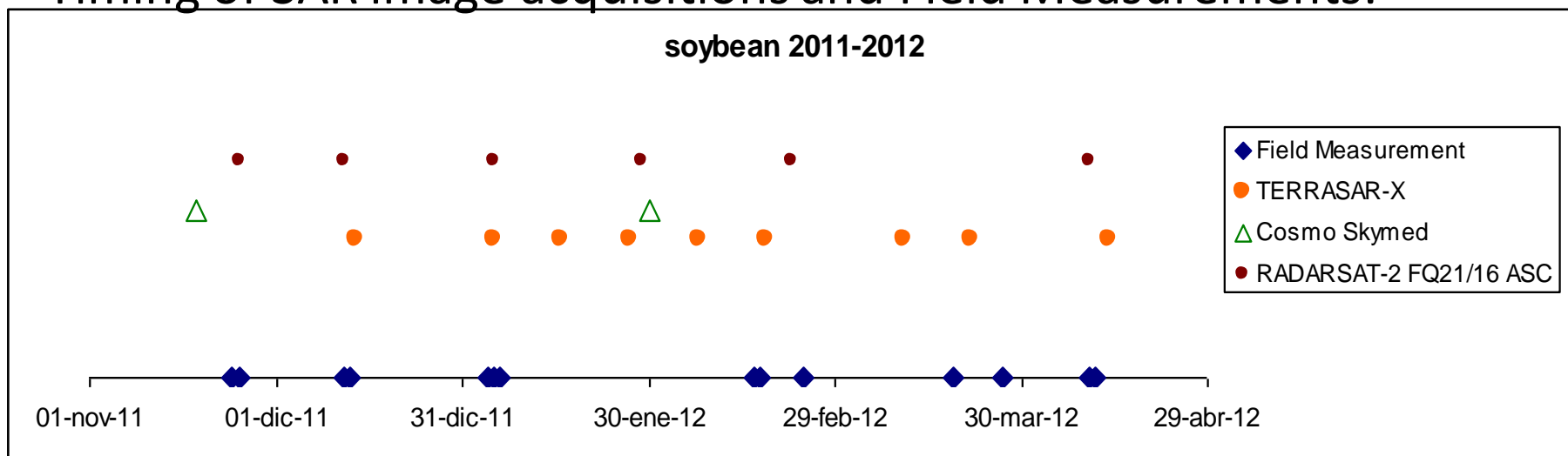
Wet and dry biomass (Kg Ha^{-1})

Vegetation Water Content (Kg Ha^{-1})

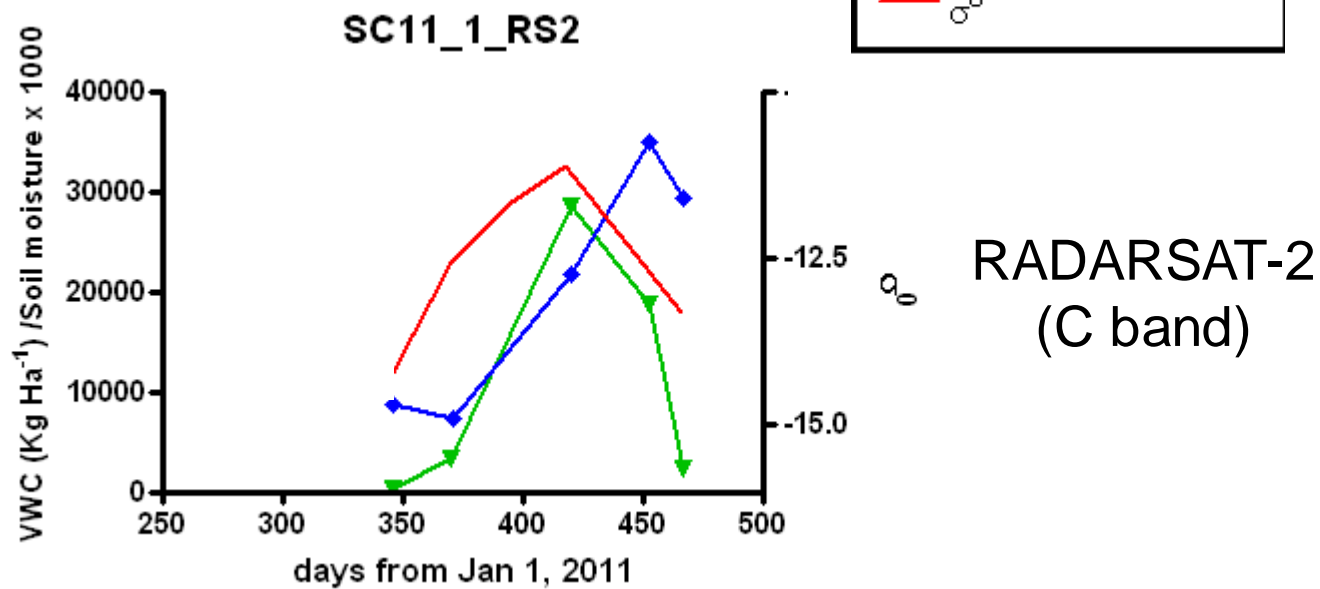
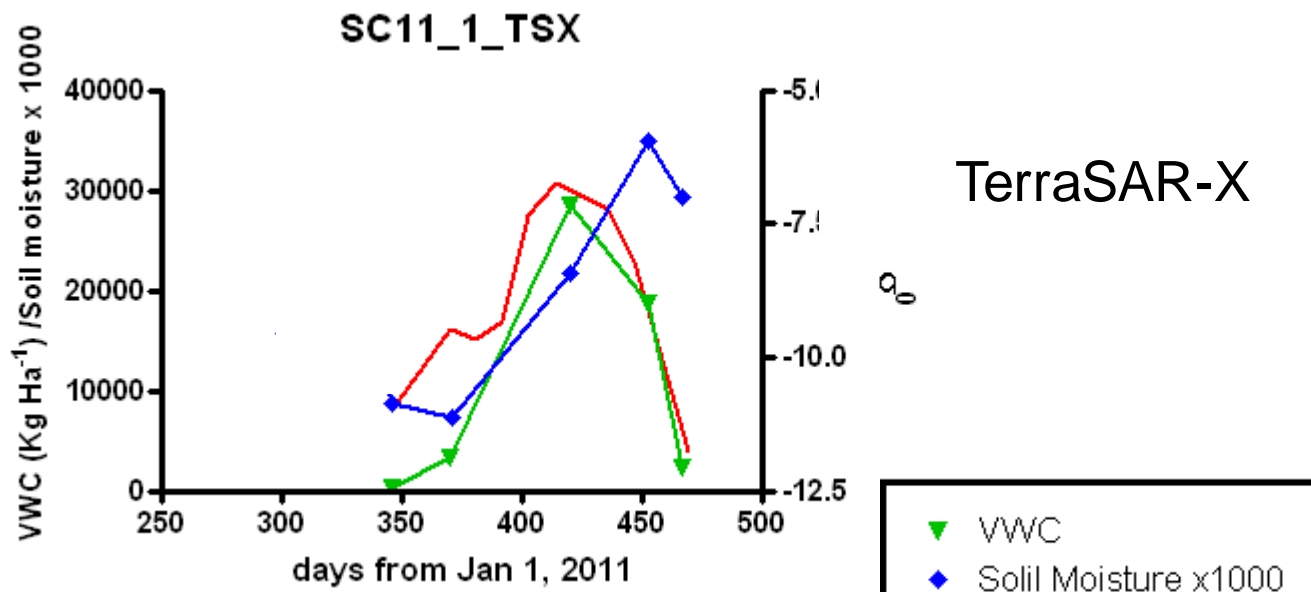
Soil Moisture (0-5 cm)

12 soybean fields

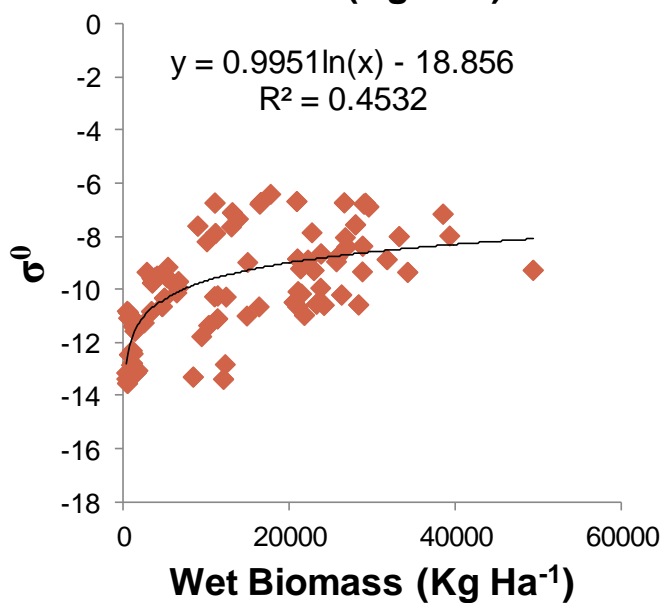
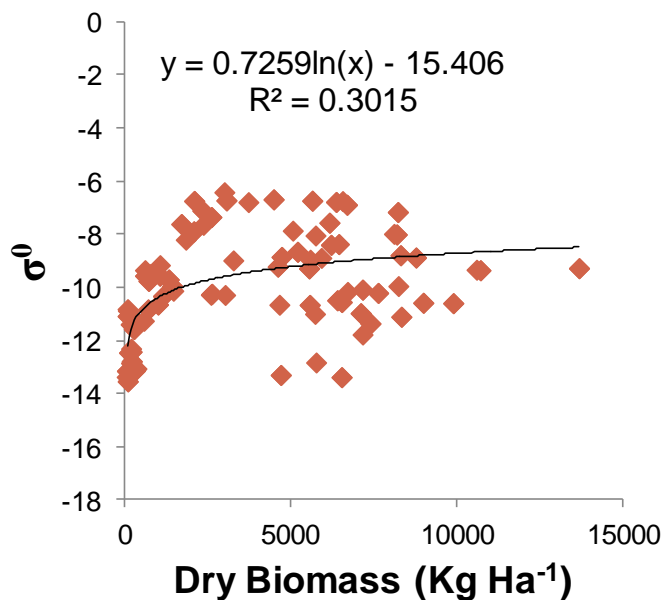
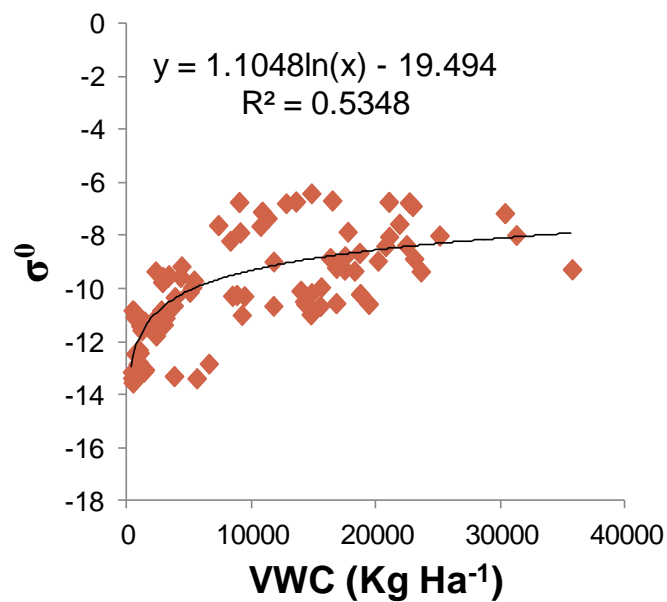
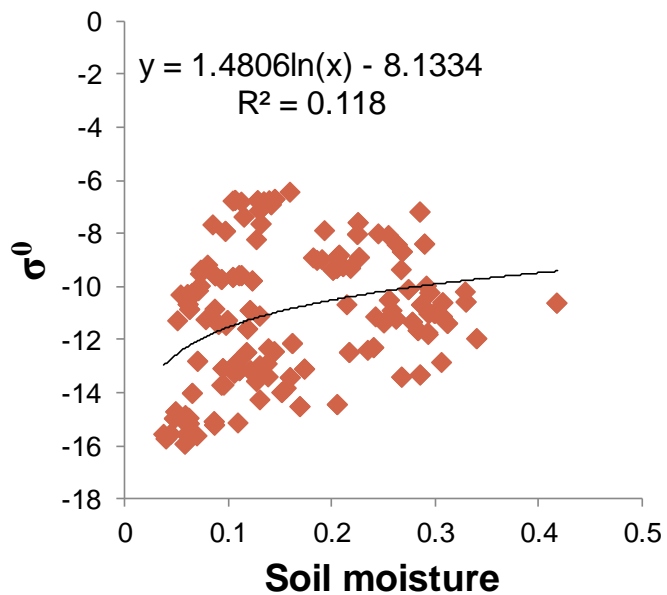
Timing of SAR image acquisitions and Field Measurements:



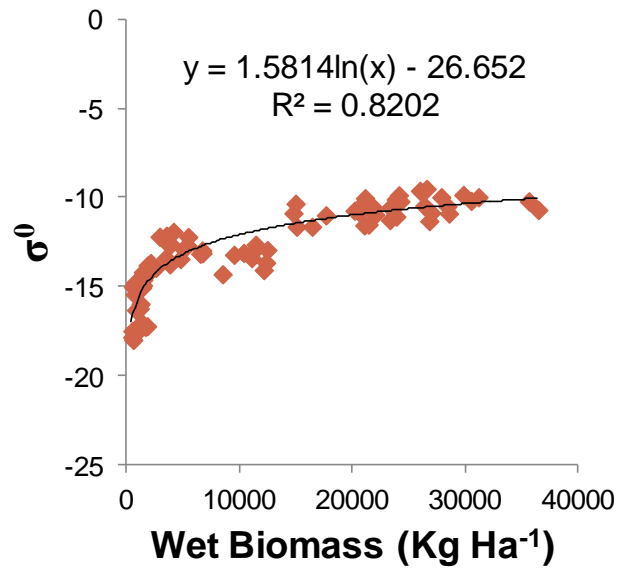
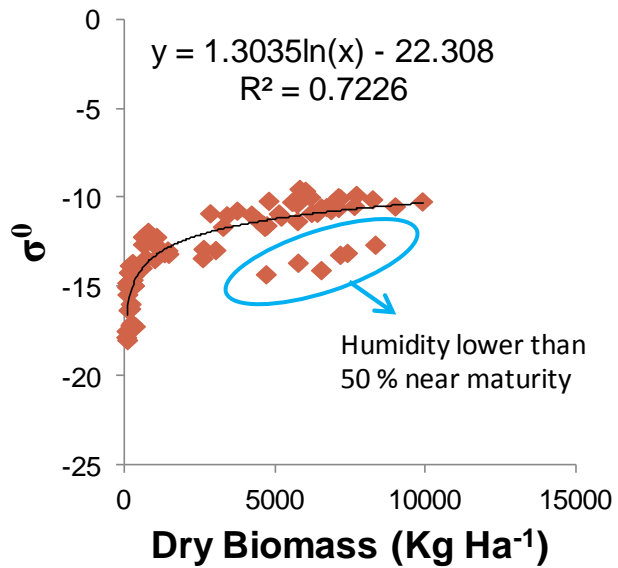
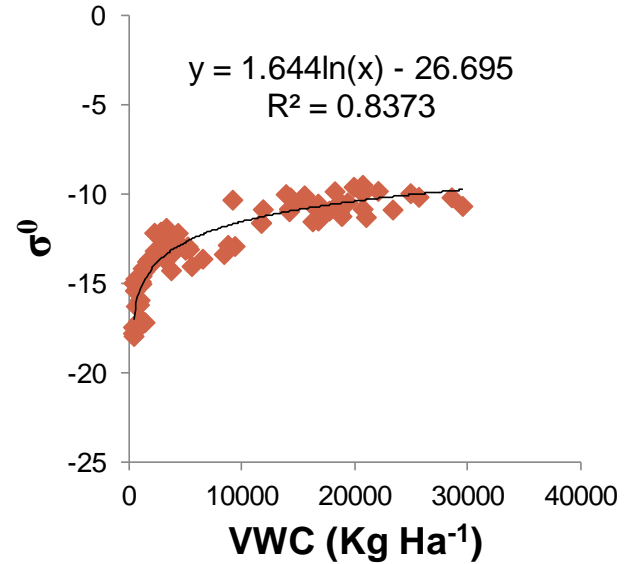
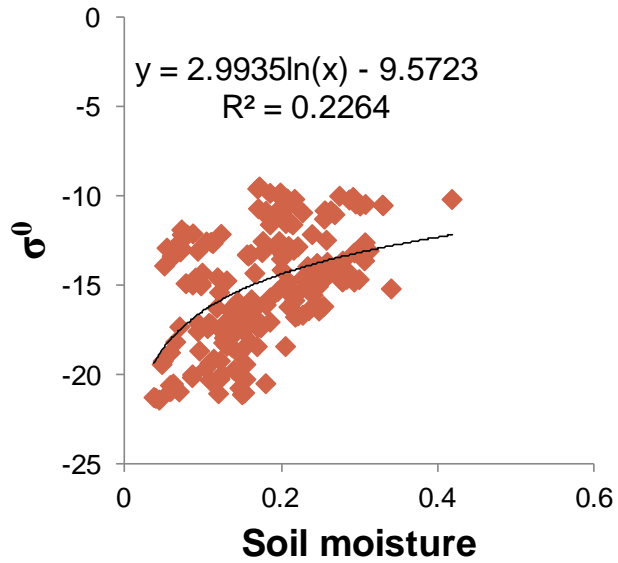
Temporal evolution of RADAR backscatter and measured variables over a soybean field



TerraSAR-X VV polarization soybean fields



RADARSAT-2 VV polarization soybean fields



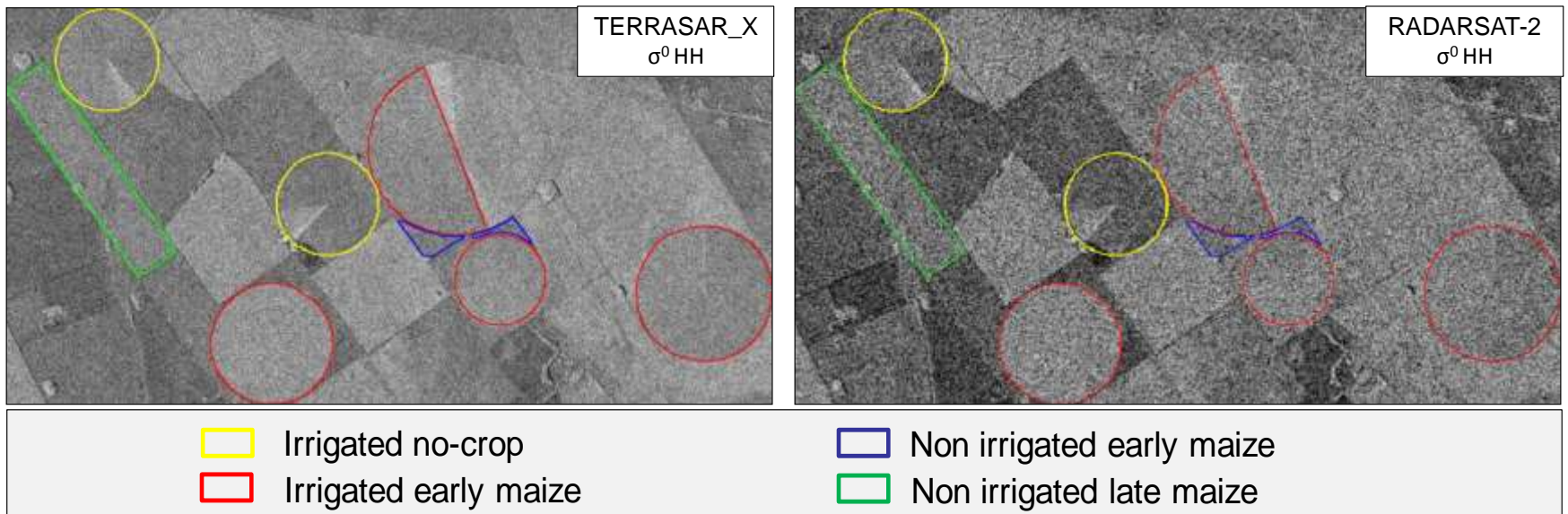
Summary Determination Coefficients (r^2)

Sensor	Polarization	Soil Moisture	VWC	Dry Biomass	Wet Biomass
TerraSAR-X	HH	0.12	0.50	0.28	0.43
	VV	0.12	0.53	0.30	0.45
RADARSAT-2	HH	0.28	0.76	0.62	0.74
	HV	0.18	0.83	0.73	0.81
	VV	0.23	0.84	0.72	0.82

Comparison of “simultaneous”
acquisitions of X and C band SAR over
maize and bare soil fields

SAR data acquired on January 5, 2012:

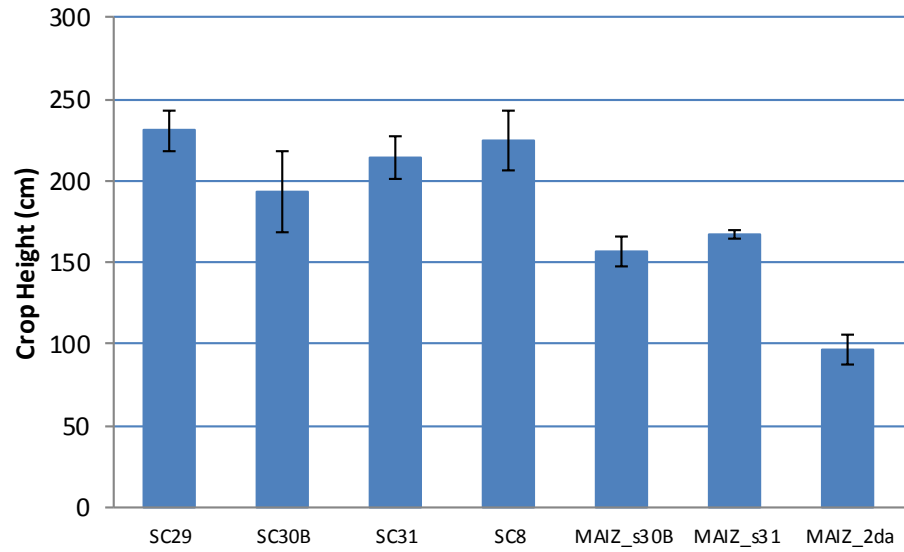
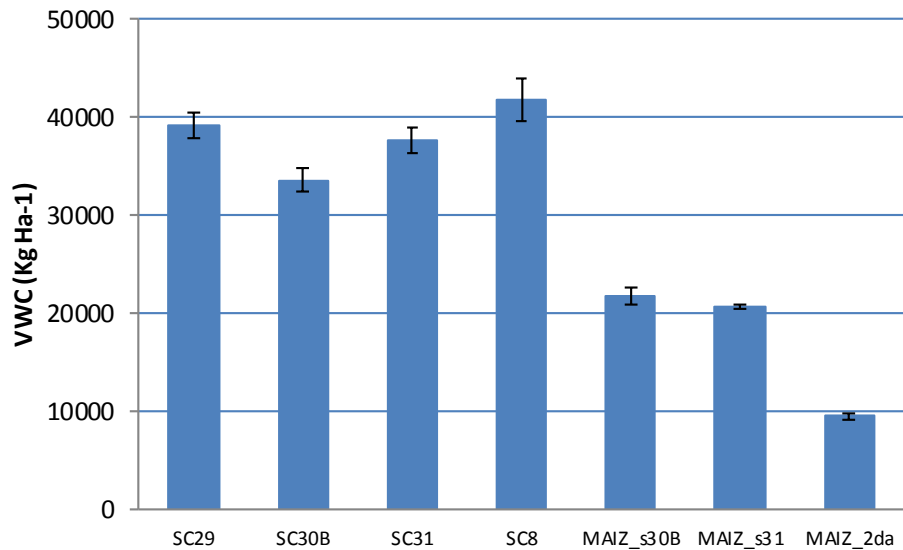
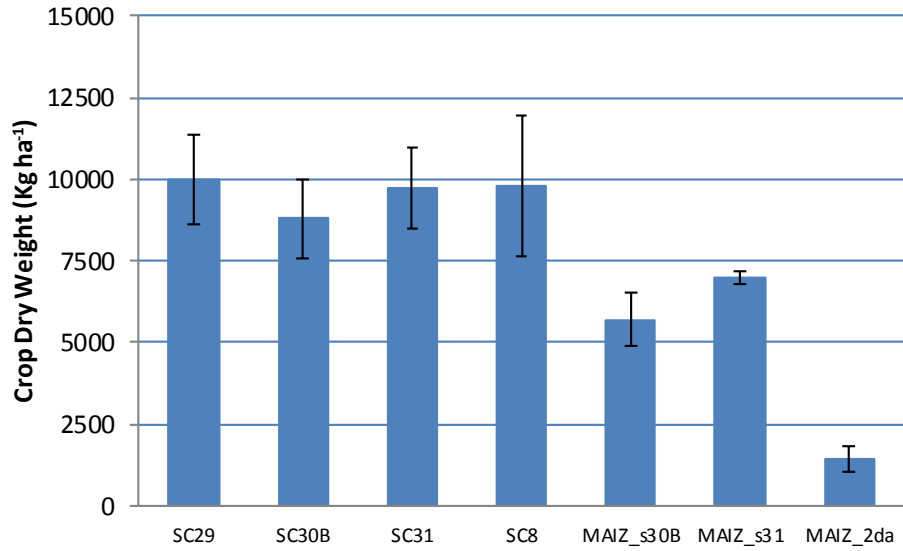
Platform	Band	Acquisition time (UTM)	Mode	Inc. angle	Pixel size (m)
TerraSAR-X	X	22:31:48	Dual (HH,VV)	41°	2.43
RADARSAT-2	C	22:49:39	Fine Quad Pol	31.6°	7.22



Field measurements between 3 hours of acq.:

- Crop Wet and Dry biomass
- Crop Height
- Gravimetric soil moisture (0 - 5 cm)

MAIZE MEASUREMENTS



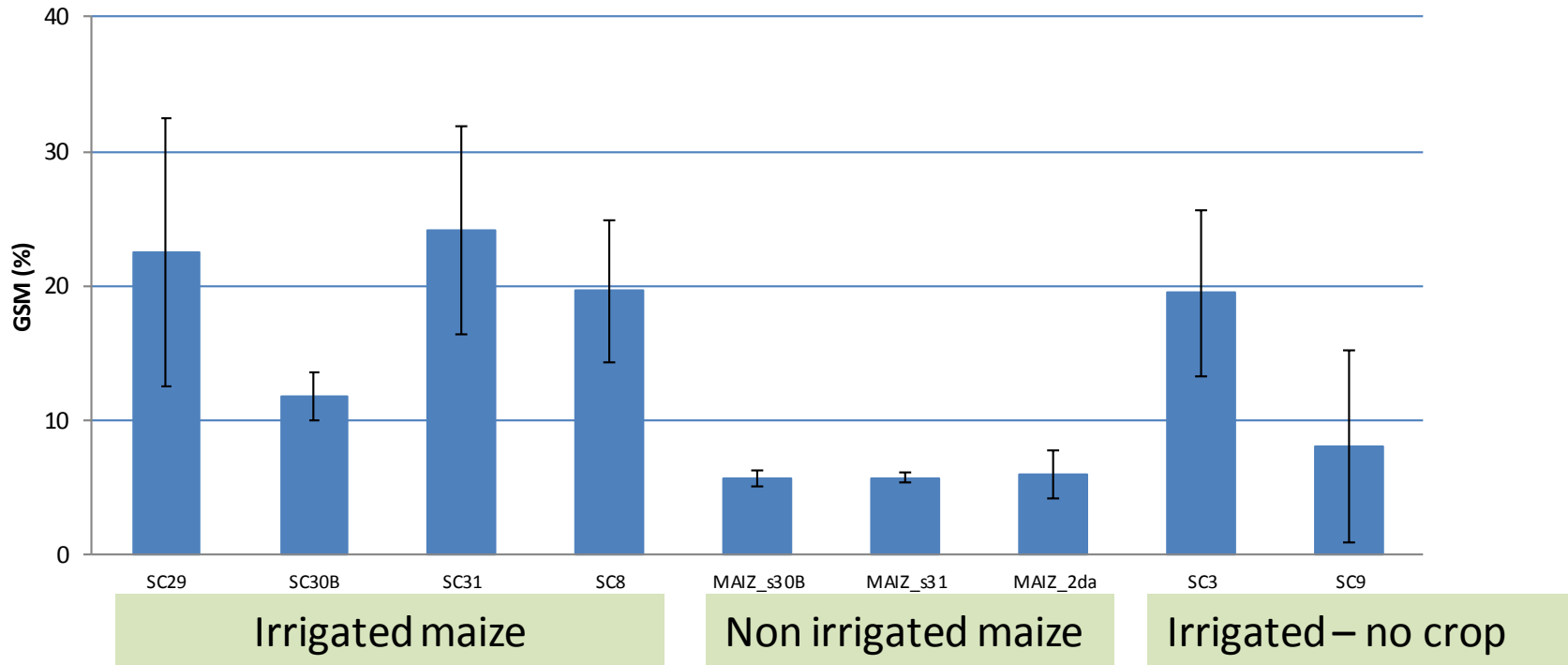
Irrigated maize

Non irrigated maize

Irrigated maize

Non irrigated maize

SOIL MOISTURE MEASUREMENTS

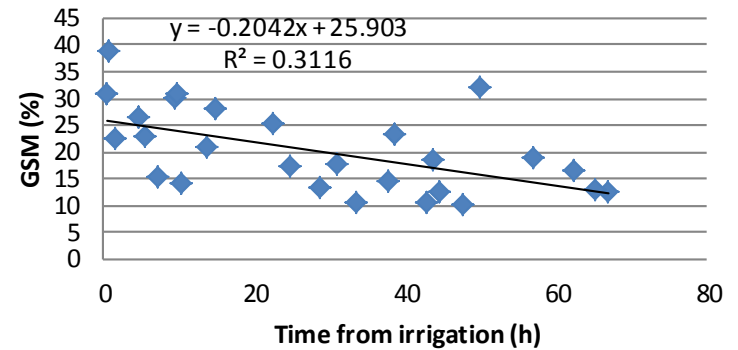


MAIZE BIOPHYSICAL VARIABLES

Satellite	Radar index	Crop Height	Dry Weight	VWC
TerraSAR-X	σ^0 HH	0.14	0.12	0.13
	σ^0 VV	0.16	0.12	0.19
	Alpha	0.00	0.00	0.00
	Anisotropy	0.01	0.00	0.00
	Cloude Entropy	0.01	0.00	0.00
	Shannon Entropy	0.18	0.16	0.23
	number of observations	39	40	40
RADARSAT-2	σ^0 HH	0.05	0.03	0.05
	σ^0 VH	0.05	0.06	0.05
	σ^0 VV	0.18	0.16	0.25
	Alpha	0.01	0.01	0.00
	Anisotropy	0.00	0.00	0.00
	Cloude Entropy	0.12	0.11	0.13
	Shannon Entropy	0.16	0.15	0.23
	Freeman-Durden Surface	0.02	0.03	0.01
	Freeman-Durden Volumetric	0.15	0.15	0.16
	Freeman-Durden Double Bounce	0.02	0.01	0.01
Number of observations	39	40	40	

SOIL MOISTURE

Satellite	Radar index	Bare soil	Maize
TerraSAR-X	σ^0 HH	0.35	0.34
	σ^0 VV	0.42	0.21
	Alpha	0.03	0.00
	Anisotropy	0.00	0.00
	Cloude Entropy	0.00	0.00
	Shannon Entropy	0.62	0.48
	number of observations	34	40
RADARSAT-2	σ^0 HH	0.55	0.12
	σ^0 VH	0.38	0.06
	σ^0 VV	0.55	0.28
	Alpha	0.08	0.00
	Anisotropy	0.00	0.00
	Cloude Entropy	0.10	0.05
	Shannon Entropy	0.80	0.50
	Freeman Durden Surface	0.70	0.04
	Freeman Durden Volumetric	0.54	0.29
	Freeman Durden Double Bounce	0.31	0.01
Number of observations	34	40	



Summary & Discussion

- RS-2 showed high correlation to soybean VWC but some saturation effects were observed near 10 Tn Ha^{-1} .
- SAR C and X bands showed no sensitivity to maize VWC from 9,5 to 38 Tn /ha.
- RS2 and TSX were quite sensitive to soil moisture, mostly over bare soils.
- How easy is to differentiate early and late maize from SAR? (2,2 vs. 1 m height). Optimum acquisition timing?
- VWC is the main structural variable derived from SAR, but dry weight is the most useful variable for yield estimation

Acknowledgements

- SOAR JECAM Project 5095 (Canadian Space Agency - CSA)
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