GNSS-R DELAY-DOPPLER MAPS OVER LAND: PRELIMINARY RESULTS OF THE GRAJO FIELD EXPERIMENT

E. Valencia[1], A. Camps[1,2], M. Vall-llossera[1,2], A. Monerris[1,2], X. Bosch-Lluis[1], N. Rodriguez-Alvarez[1], I. Ramos-Perez[1], J. F. Marchan-Hernandez[1], J. Martínez-Fernández[3], N. Sánchez-Martín[3], C. Pérez-Gutiérrez[3]

[1] Remote Sensing Lab, Dpt. Teoria del Senyal i Comunicacions, Universitat Politècnica de Catalunya and IEEC-CRAE/UPC, c/ Jordi Girona 1-3, D3, E-08034 Barcelona
[2] SMOS-BEC and IEEC-CRAE/UPC, Barcelona, Spain
[3] CIALE/USal, Salamanca, Spain

E-mail: valencia@tsc.upc.edu

The ESA's SMOS mission [1] has been recently launched to provide global soil moisture maps to improve climate and hydrologic models. This mission needs an intensive calibration and validation (CAL/VAL) of the soil moisture products and thus, in-situ data collocated with the space-borne measurements are needed. In this framework, the long-term field experiment GPS and Radiometric Joint Observations (GRAJO) is being undertaken since November 2008 until the end of the Commissioning Phase [2].

The main purpose of the GRAJO field experiment is to jointly use radiometry and GNSS-Reflectometry (GNSS-R) to study the effect of vegetation and soil surface roughness on soil moisture retrievals. This experiment is carried out at the REMEDHUS (Red de Medición de la Humedad del Suelo) site which is a soil moisture measurement network that has been selected as a secondary CAL/VAL site for SMOS. REMEDHUS covers a 40 x 30 km^2 area located at the Duero basin, Zamora, Spain, and has a continental and semiarid climate, with cold winters and warm summers (12ºC annual mean temperature and 400 mm mean rainfall). The GRAJO experiment includes two type of activities: 1) long-term observations to study the evolution of the geophysical parameters and the farming over a full-year; 2) short-term experiment, to intensively test the effect of soil moisture and roughness on the brightness temperature measurements and GPS-reflectometry data by intentionally changing these soil parameters.

The GRAJO field experiment includes LAURA: a ground-based L-band radiometer [3], and SMIGOL: an Interference Pattern Technique (IPT) GPS reflectometer [4]. During the intensive experiment carried out in July 2009, the griPAU [5] instrument has also been deployed in the field. The griPAU instrument is a GNSS-R receiver that computes in real time the Delay-Doppler Map (DDM) equation [6]: one complex DDM every 1 ms that can then be averaged coherently and incoherently at user's wish. This instrument has been already used in a field experiment over the ocean surface for sea-state determination and sea surface salinity (SSS) retrieval purposes [7].

The DDM contains information about both the scattering geometry, and the scattering surface itself. Therefore, soil moisture is a key parameter determining the scattering coefficient of the measured surface, and to less extent soil surface roughness and vegetation. The measured DDMs will be presented in different irrigation conditions and will be compared to the theoretical predictions. It is expected that soil moisture retrievals will benefit from radiometric and reflectometric data.

REFERENCES:

[1] "SMOS: ESA's Water Mission, brochure BR-224", June 2004.

[2] A. Monerris, N. Rodriguez-Alvarez, M. Vall-llossera et al. "The GPS And Radiometric Joint Observations Experiment at the REMEDHUS Site (Zamora-Salamanca Region, Spain)", *Proceedings of the IGARSS 2009*, (CD-ROM), Cape Town, South Africa.

[3] A. Camps et al. "The WISE 2000 and 2001 field experiments in support of the SMOS mission: sea surface L-band brightness temperature observations and their application to sea surface salinity retrieval", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 42, pp. 804-823, 2004

[4] N. Rodriguez-Alvarez, X. Bosch-Lluis, A. Camps et al. "Soil Moisture Retrieval Using GNSS-R Techniques: Experimental Results Over a Bare Soil Field", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 47, 11, pp. 3616-3624, 2009

[5] E. Valencia, A. Camps, J.F. Marchan-Hernandez, X. Bosch-Lluis, N. Rodriguez-Alvarez, I. Ramos-Perez, "Advanced architectures for real time Delay-Doppler Map GNSS-Reflectometer: the GPS Reflectometer Instrument for PAU (griPAU)", *Journal of Advances on Space Research,* submitted October 2009

[6] V.U. Zavorotny, A.G. Voronovich, "Scattering of GPS Signals from the Ocean with Wind Remote Sensing Application", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 35 (3), pp. 951-964, March 2000

[7] E. Valencia, J.F. Marchan-Hernandez, A. Camps et al. "Experimental relationship between the sea brightness temperature and the GNSS-R Delay-Doppler Maps: Preliminary results of the ALBATROSS field experiments", Proceedings of the IEEE International Geoscience And Remote Sensing Symposium 2009, (CD-ROM), Cape Town, South Africa.