THE GPS AND RADIOMETRIC JOINT OBSERVATIONS EXPERIMENT AT THE REMEDHUS SITE (ZAMORA-SALAMANCA REGION, SPAIN)

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1. INTRODUCTION

The increasing interest of the scientific community in soil moisture mapping at global scale, with which climate and hydrologic models could be improved, has lead to the proposal of ESA's Soil Moisture and Ocean Salinity (SMOS) [1], and NASA's Soil Moisture Active and Passive (SMAP) [2]. After launch, both missions will need an intensive Cal/Val of soil moisture products and, thus, in situ data concurrent with the observations will be necessary. The REMEDHUS soil moisture network in the semi-arid sector of the Duero basin, Spain, has been selected as a Cal/Val site for SMOS and has been proposed as a potential site also for SMAP. REMEDHUS has an area of 40 km $\times$ 30 km, close to SMOS field-of-view, and it has an almost homogeneous land cover (80% crops).

This paper presents the GPS and RAdiometric Joint Observations one-year experiment (GRAJO), which is being carried out from November 2008 at REMEDHUS. At the plot-scale, the goal is to jointly use radiometry and GPS-reflectometry data to study: (i) the influence of the vegetation on the retrieval of geophysical parameters, and (ii) to characterise the roughness factor. A complimentary activity at medium-scale is presented in [3] regarding the land brightness temperature simulator of the REMEDHUS site, and the disaggregation and soil moisture retrieval algorithms to estimate soil moisture from airbone radiometric measurements.

2. MATERIALS AND METHODS

2.1. Experiment Site

The experiment site is located in a farm within the REMEDHUS network located at Vadillo de la Guareña, Zamora, Spain (41.18°N, 5.22°W, 716 m altitude). Figure 1(a) shows a diagram of the site, which consists of three 4 m $\times$ 10 m plots of grass, bare soil, and barley which are oriented West, North, and East respectively. The bare soil plot will be periodically ploughed to reproduce a wide range of roughness conditions.

2.2. Radiometric and GNSS-R measurements

The UPC L-band Automatic Radiometer (LAURA) and the Interference- Pattern GPS Reflectometer (IP-GPS-R) have been mounted at the top of a 3 m high scaffolded structure installed in the centre of the site (see Fig. 1). Radiometric data is continuously acquired by the full-polarimetric, Dicke radiometer LAURA, which has a working frequency of 1.4135 GHz [4]. From a height of 5.5 m above ground, LAURA's observation position at each of the three plots varies from 25°to 65°from nadir, in 5°steps. Cold and hot load calibrations are performed approximately every two hours using the sky and a microwave absorber as cold and hot load targets, respectively. The IP-GPS-R reflectometre is mounted at a height of 3 m above ground, and is composed of a GPS receiver pointing at the horizon. Measurements of the GPS signal power of the interferent signal between the direct signal and that reflected at the barley plot are collected and provide a way to estimate soil moisture and topography [5]. Both instruments can be left unattended and controlled via internet using a Hispasat connection. Moreover, airborne measurements of REMEDHUS will be acquired from Spring 2009 on using the radiometer ARIEL (Airbone Radiometer at L-band).

2.3. Ground-truth measurements

At the plot-scale, two Hydraprobes have been installed at 5 cm depth at each of the three plots to register the soil moisture and temperature every 30 min. Moreover, a soil moisture and temperature profile is acquired every 30 min using Hydraprobes installed at 5, 25, 50, and 100

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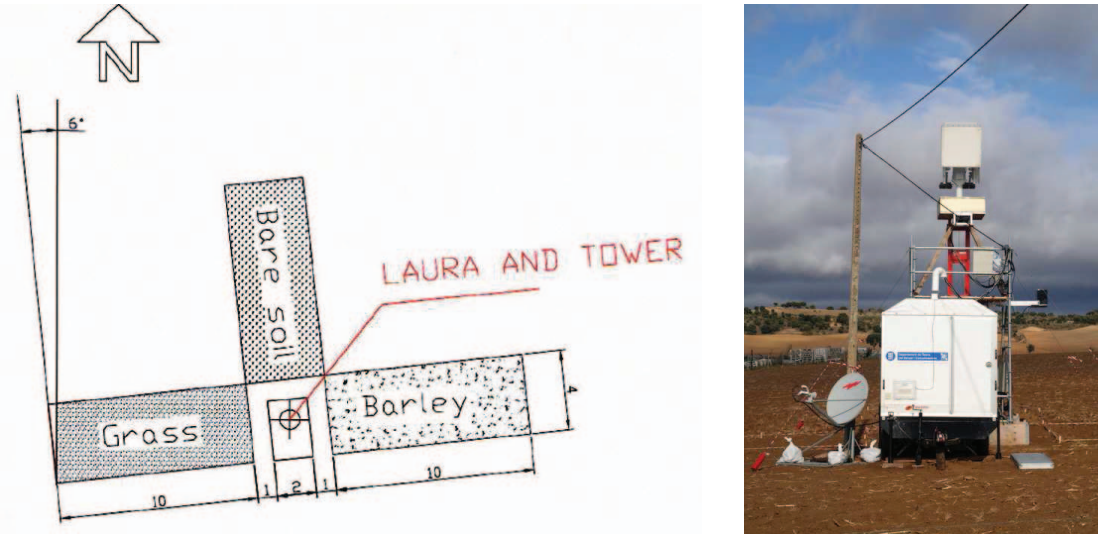

(a) (b)

Fig. 1. (a) Diagram of the site. (b) The LAURA radiometer and the IP-GPS-R reflectometre are installed in the top of a tower. A parabolic antenna is used for the connection to the Internet using Hispasat.

cm. Soil roughness will be measured on a monthly basis using a GS200 3D laser scanner and close-range photogrammetry device. Once the vegetation will start growing, destructive measurements of VWC and LAI, vegetation temperature with IR thermometer, measurements of NDVI, and biomass will be acquired. A weather station located at the site registers the relative air humidity, the air temperature, the wind speed and wind speed direction, the global radiation, and precipitation every 10 min.

The site is also near one of the 23 soil moisture stations constituting the REMEDHUS network. Each of them has four TDR probes at 5, 25, 50 and 100 cm depth, and one Hydraprobe at 5 cm. These data will also be used during SMOS cal/val activities at the site and in the soil moisture retrieval simulator of REMEDHUS which has been implemented by the UPC [3].

3. CONCLUSIONS

The long-term experiment GRAJO will cover a wide range of aspects dealing with land emission at L-band and GNSS-R: (i) Temporal evolution of emissivity versus the observation angle, soil moisture, roughness, and vegetation, (ii) soil moisture retrieval using multi-angular radiometric information, and (iii) soil moisture maps using GPS-R, and intercomparison with ARIEL's measurements. The field experiment will be described and some preliminary results will be presented at the conference.

4. REFERENCES

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