ALCANTARA INITIATIVE: INTERNATIONAL R&D STUDIES
ESA Alcantara studies in the scope of the 'ESA SAOCOM-CS programme in Earth Observation',
Monitoring of land-related processes in South America using multi-parameter SAR: Soil and vegetation monitoring in Pampas

Executive Summary

Authors: Paolo Ferrazzoli (1), Mario Alberto Acuña (3), Fabio Fascetti (2), Nazzareno Pierdicca (2), Leila Guerriero (1)

(1) DICII, University of Rome Tor Vergata,
Via del Politecnico 1, 00133, Rome, Italy

(2) DIET, La Sapienza University,
Via Eudossiana 18, 00184 Rome, Italy

(3) Instituto de Altos Estudios Espaciales 'Mario Gulich', CONAE – Comisión Nacional de Actividades Espaciales,
Avenida Paseo Colón 751 – 1063 Buenos Aires, Argentina

Research Centre Contact:
Paolo Ferrazzoli
Tel: +39 06 72597420
Fax Number +39 06 72597460
e-mail: paolo.ferrazzoli@uniroma2.it

ESA study manager: Malcolm Davidson
Tel: +31715655957
Fax: +31715655675
e-mail: Malcolm.Davidson@esa.int

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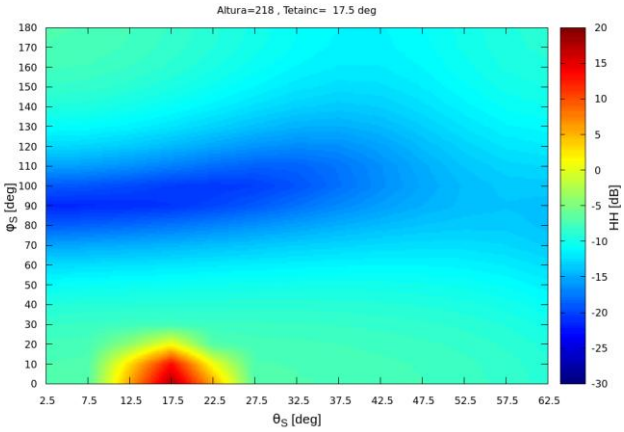
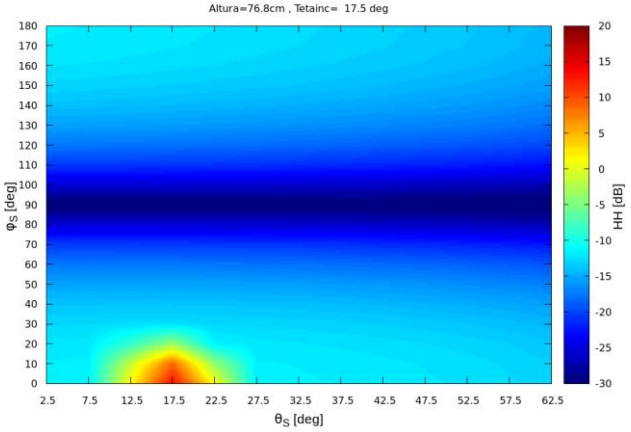
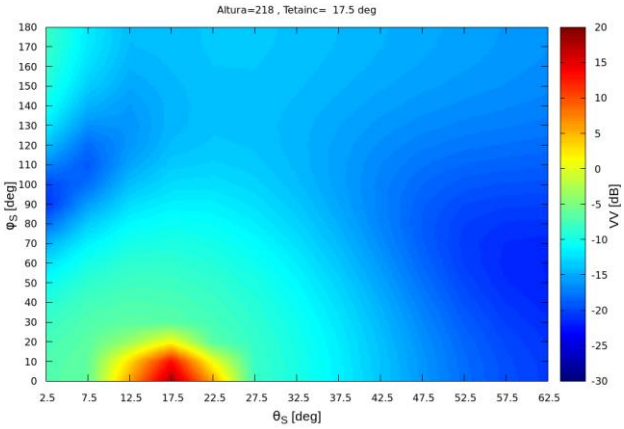


MAIZE HH



SOYBEANS HH



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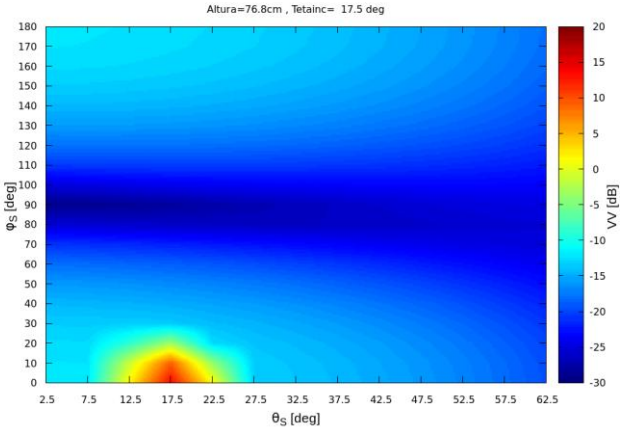

SOYBEANS VV

Motivation

The forthcoming launch of SAOCOM satellites will make multitemporal L band signatures available. To take benefit from this opportunity, this study analyzes and models L band signatures of typical Argentinean crops, and proposes an algorithm able to retrieve soil moisture.

Methodology

Three important crops extensively present in Pampas are considered: Maize, soybeans and wheat. For each crop, the multi-angular and multi-polarization backscattering coefficient at L band is modelled using previously available software and detailed ground measurements collected in Argentinean reference fields. Simulations results are compared against experimental data collected by L band SARAT radar in Argentina and PALS radar in the US. Model simulations are extended to represent bistatic scattering coefficients. For bare soil and wheat, a multitemporal retrieval algorithm of soil moisture is applied to SARAT signatures. In the case of wheat, the retrieval algorithm corrects for vegetation effects with the aid of model simulations. An effect of soil anisotropy has been observed, affecting the retrieval performances. Using a methodology similar to L band, backscattering of wheat is also modelled at X band, and results are compared against multitemporal signatures collected by COSMO-SKYMED over fields of Pampas.

Results

- At L band and for HH and VV polarization, vegetation growth produces the dominant increase of different scattering processes, depending on crop geometry: Soil-stem double bounce for maize, volume scattering for soybeans, weak soil attenuation for wheat. Therefore, an appropriate representation of crop geometry is important.
- The multitemporal algorithm can retrieve soil moisture with good accuracy, provided the effects of soil roughness and vegetation cover are calibrated. To this aim, the coefficients of the simple Water Cloud model can be calibrated using a detailed electromagnetic model.
- A major problem can be represented by field rows, particularly when the azimuth direction of the incident wave is parallel or perpendicular. Bistatic observations can help to detect this critical issue.
- Wheat backscattering is driven by soil moisture at L band, and by vegetation variables at X band. Multifrequency observations can be effective in retrieving soil and vegetation parameters simultaneously.

Highlights

At L band, soil moisture can be retrieved with good accuracy even in presence of developed wheat fields, provided vegetation effects are corrected. To this aim, a simple water cloud model can be calibrated with the aid of a detailed discrete model, including multiple scattering. Knowledge of vegetation variables can benefit from near simultaneous availability of X band signatures, which are mostly dependent on vegetation.
Contribution from bistatic imaging to correct row effect shall be investigated.