Alcantara Initiative : International R&D Studies

Change Detection Using Interferometric and Polarimetric Signatures in Argentina

Executive Summary

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Executive Summary

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M. O'Sullivan	ESA	1
M. Thibeault	CONAE	1

Table of Contents

1 INTRODUCTION

1.1 Scope

This document provides the executive summary of the ALCANTARA Project on Change Detection using Polarimetric and Interferometric signatures in Argentina.

1.2 Project Background and Objectives

The ALCANTARA Project comes in support to the CONAE SAOCOM Project. The objective of this project is to accomplish a breakthrough in the development of algorithms and associated tools for change detection in Argentina, the core domain of focus being agriculture.

2 DOCUMENTS

2.1 Applicable Documents

The following documents are applicable and are referred to as [AD**] in the text :

[AD01] ESA ITT Ref. AO/1-8486/15/F/MOS
[AD02] CSL Proposal Ref. CSL-OFF-ESA-16020
[AD03] ESA ContractNo 4000117286/16/F/MOS
[AD04] Minutes of Negociation Meeting Ref. MT-CSL-ALC-16001

2.2 Reference Documents

The following documents contain supporting information and are referred to as [RD**] in the text :

[RD01] D. J. Dadamia, M. Thibeault, M. Palomeque, C. Barbier, M. Kirkove, and M. W.J. Davidson, “Change Detection Using Interferometric and Polarimetric Signatures in Argentina”, PolInSAR 2017 Conference, Frascati, January 2017.

[RD02] D. J. Dadamia, M. Thibeault, M. Palomeque, C. Barbier, M. Kirkove, and M. W.J. Davidson, “Unsupervised Polarimetric Classification Approach Evaluated for Agricultural Crops at Pampean Region”, IEEE Trans. Geosci. Remote Sens., submitted (2017)

3 ACRONYMS AND ABBREVIATIONS

ALOS	Advanced Land Observing Satellite
API	Antecedent Precipitation Index
CIS	CSL InSAR Suite
CONAE	COmisión Nacional de Actividades Espaciales

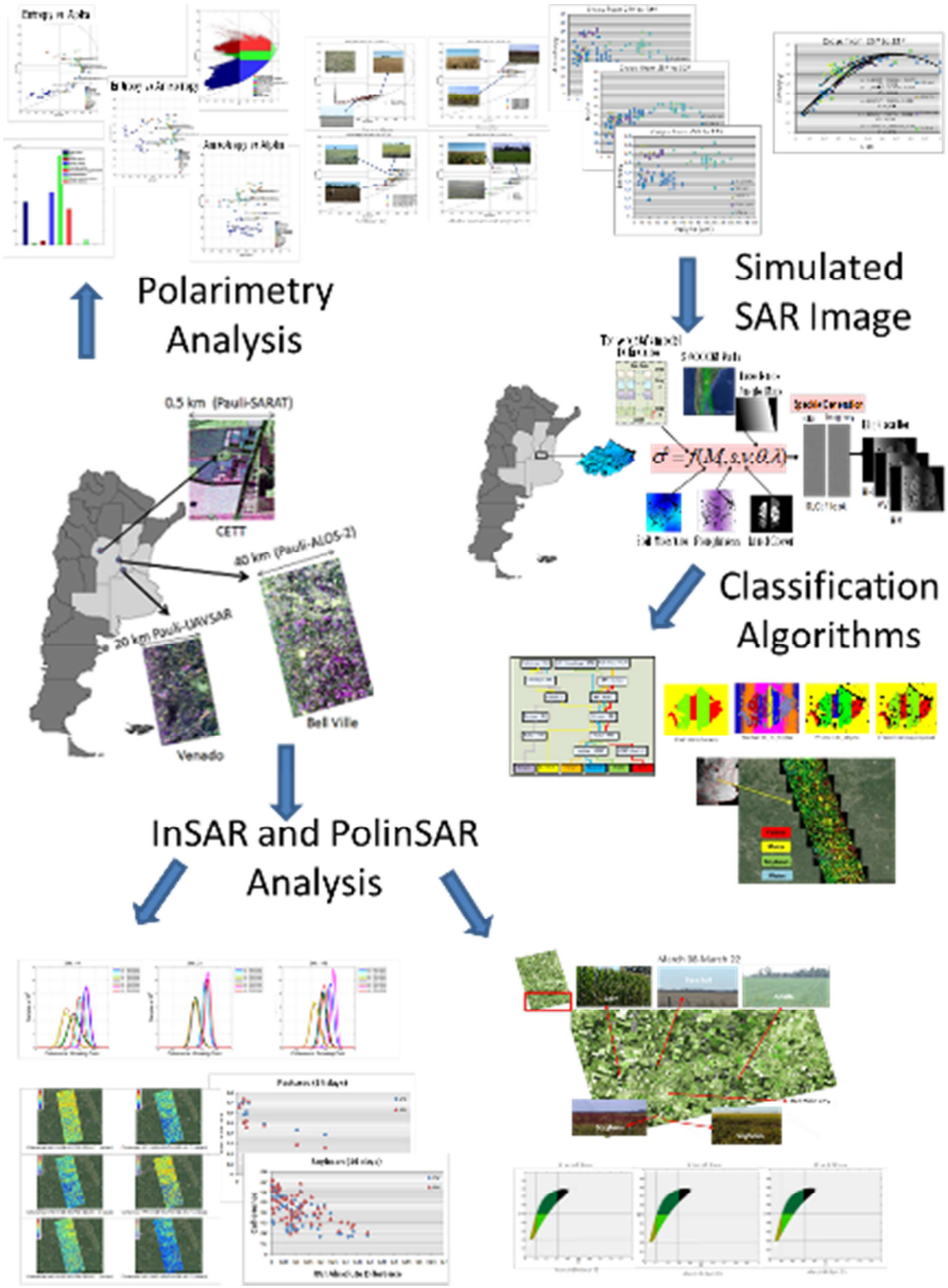
CSL	Centre Spatial de Liège
COSMO	COnstellation of small Satellites for the Mediterranean basin Observation
DEM	Digital Elevation Model
DInSAR	Differential Interferometric SAR
EO	Earth Observation
ESA	European Space Agency
IDW	Inverse Distance Weighted
InSAR	Interferometric SAR
ITT	Invitation To Tender
JAXA	Japan Aerospace Exploration Agency
JPL	Jet Propulsion Laboratory
NASA	National Aeronautics and Space Administration
PolSAR	Polarimetric SAR
PolInSAR	Polarimetric Interferometric SAR
RVI	Radar Vegetation Index
SAR	Synthetic Aperture Radar
SRTM	Shuttle Radar Topography Mission
SLC	Single-Look Complex
SNAP	Sentinel Application Platform
SOW	Statement Of Work
TBD	To Be Defined
TBC	To Be Confirmed
TBR	To Be Reviewed
TBW	To Be Written
ULg	Université de Liège
UAVSAR	Uninhabited Aerial Vehicle Synthetic Aperture Radar
WBS	Work Breakdown Structure
WP	Work Package

4 APPLICABILITY

This document is the deliverable Executive Summary of the ALCANTARA project as specified in the ESA Statement Of Work [AD01] and well as in the ESA-CSL Contract [AD03].

5 EXECUTIVE SUMMARY

Picture:



Motivation:

This Study comes in support to the CONAE SAOCOM Project. The objective of this project is to accomplish a breakthrough in the development of algorithms and associated tools for change detection in Argentina, the core domain of focus being agriculture.

Methodology:

L-band SAR is suitable for monitoring agricultural processes, particularly soil moisture, while at higher frequencies the backscattering of soil is attenuated by vegetation. Several studies also demonstrated that L-band radar signatures contain important information about crop classification and biomass.

We investigated the sensitivity and temporal evolution of polarimetric parameters for agricultural targets in study areas selected in Argentina within the SAOCOM Project. We carried out a study of the polarimetric signature of different targets, and a multi-temporal, spatial and angular analysis of these parameters. The field campaign information was used to simulate SAR images and implement a temporal evolution algorithm for classification in agricultural fields. A classification algorithm was implemented over the simulated SAR images and compared with the Wishart classification. It was then was successfully implemented over ALOS-PALSAR-2 and UAVSAR images. A study of interferometric coherence over agricultural fields, ending with PolinSAR analysis over the same fields, was done.

Results:

- Sensitivity of polarimetric parameters to incidence angle changes for agricultural target (bare soil, fallow and crops).
- The response of polarimetric parameters for changes of soil moisture and crop height, it is not uniform and depends on type of target.
- The Radar Vegetation Index is related with entropy changes for crops, following a quadratic relationship regardless of incident angle. The coherence (HH and VV) decreases with RVI increases in pastures and soybean.
- PolInsar analysis shows, for crops, using the optimized channels, a distribution preferably with a single mechanism scattering where are dominated by low coherence.

Publications:

1. D. J. Dadamia, M. Thibeault, M. Palomeque, C. Barbier, M. Kirkove, and M. W.J. Davidson, “Change Detection Using Interferometric and Polarimetric Signatures in Argentina”, PolInSAR 2017 Conference, Frascati, January 2017.

2. D. J. Dadamia, M. Thibeault, M. Palomeque, C. Barbier, M. Kirkove, and M. W.J. Davidson, “Unsupervised Polarimetric Classification Approach Evaluated for Agricultural Crops at Pampean Region”, IEEE Trans. Geosci. Remote Sens., submitted (2017).

Highlights:

The statistical properties of the polarimetric backscatter behavior over agricultural areas allowed us to develop a classification methodology based on the temporal evolution of the polarimetric parameters which was the result of the target decomposition proposed by Cloude et.al. This process involves time-dependent decision trees and it was implemented on SAR simulated images with better results than the obtained with the Whishart classification. Preliminary results on UAVSAR and ALOS-Palsar-2 images show a Kappa coefficient larger than 0.67 with an accuracy bigger than 73%.