

## Use of Multi-temporal and Multi-polarisation Radar data for Epidemiology:

### a case study in the Ferlo region, Senegal

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During the rainy season, the abundance of mosquitoes over the Ferlo Region (Senegal) is linked to the spatio-temporal evolution, the vegetation cover and the turbidity of temporary ponds. They create a variable environment where mosquitoes can contribute to diffusion and transmission of diseases. A previous work [1] assessed the use of optical SPOT-5 high-resolution images (~ 10m spatial resolution), which allowed for detailed assessment of spatio-temporal evolution of ponds. New developments have assessed the use of SAR images to help for epidemiologic survey of Ferlo region [3].

In 2007, two ascending TerraSAR-X SpotLight images were acquired in Dual-Pol HH and VV, on Dec. 19<sup>th</sup> and Dec. 30<sup>th</sup> 2007 in addition to some mono-polarization images. Preliminary results [3] showed that the Dual-Pol mode of TerraSAR-X is useful to map humid areas around the ponds that appear during the rainy seasons. Such areas are expected to play a key role in the mosquito thriving. Detection of water is not sufficient to detect all the risk areas. Wet soil may also welcome mosquito eggs. For this reason, polarimetry brings very valuable information to update risk maps.

The two dual-polarimetry images acquired in 2007 have shown great potential even though they were taken at the very end of the rainy season. That is why further acquisitions were planned in 2008 during the wet season. Six descendant Stripmap HH images in interferometric conditions every 11 days and five Stripmap Dual-Pol HH/VV and VV/VH with two different incidence, in ascending and descending pass, have been acquired. These new images give us a very good dataset to continue the research on moisture characterization through dual polarization.

The purpose of this work is to assess the complementarity and the added-value of partial polarimetric data with respects to optical data, especially to track the residual moisture once small ponds have disappeared at the end of the rainy season. In this respect, several studies are carried out: 1- Assessment of X band HH and VV radiometry to detect small ponds and humid areas. 2 – Assessment of polarimetric indices extracted from HH-VV partial polarimetric acquisitions [2] to separate roughness from moisture effects, and subsequently to delineate areas of various moisture content.

The comparison of different methods allowing the retrieval of soil roughness and moisture is made. In particular, two methods based on the Dubois model [4] on one hand and the Oh model [5] on the other hand are assessed.

Past studies have shown that both vegetation and soil roughness and moisture play a significant role in the radar response over Sahelian regions. It is proposed to use the potential of the different polarisation configurations to derive the contribution of the vegetation in order to estimate more accurately the soil parameters, which are the subject of the present study. Roughness maps are thus computed. The temporal evolution of this parameter is studied to determine how the soil moisture evolve in time. The results are discussed in the light of radar data acquired with high temporal repetitivity by the Quikscat scatterometer, which allows a better understanding of the seasonal variations of the concerned surface parameters. The comparison to optical analysis for SPOT-5 data driven on the same area (with extensive ground truth) is also conducted.

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