Indirect Methods of Estimating Leaf Area Index (LAI) in Broadcast-seeded Paddy Rice Fields

E. Erten[1], N. Musaoglu[2]

For the monitoring of rice, which is one of the major crops consumed worldwide, remote sensing is becoming popular technology, eliminating time consuming, expensive and complex field surveys. In rice monitoring, Leaf Area Index (LAI) is one of the most important biophysical attributes that characterizes the phenological growth stage, yield and health conditions. In this context, its monitoring with remote sensing tools is of great interest and has been studied extensively. In this work, LAI estimation of paddy rice fields located in northeast Turkey was analyzed using optical and radar sensors, specifically Landsat 8 OLI-derived NDVI, radar polarized backscattering values from TerraSAR-X (HH, VV) and Sentinel-1 (HV, VV).

The area chosen for the study was one of the largest rice cropping areas in Turkey. In this region, the agricultural fields are owner dependent, i.e., there are time shifts between seeding days among neighboring fields. The topography is flat, and the sowing method is broadcasting, implying random seeding instead of regular straight-row seeding (Erten et al., 2015). The single season rice cultivation cycle occurs from late May to early October.

A total of 8 paddy rice fields were selected from this agricultural land. An overview of the selected fields is shown in Figure 1. A detailed field survey was conducted at 4 independent points per field on August 28, 2015, and also when the crops had reached the reproductive stage. LAI, vegetation height and fraction of photosynthetically active radiation (fAPAR) were obtained by hemispherical photographs acquired at nadir with a CI-110 Plant Canopy Analyzer.

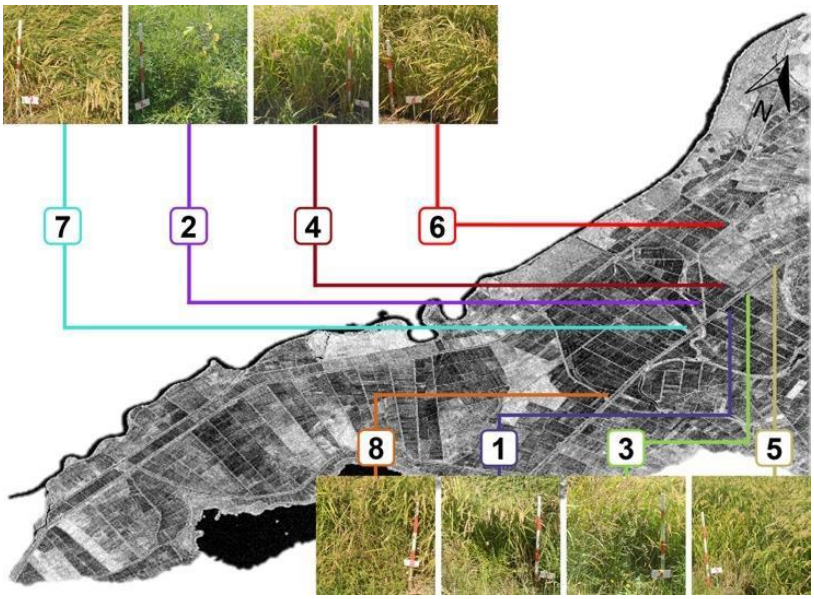

Figure 1. VV polarized TerraSAR-X acquisition taken on July 2, 2014 over the study area. Photographs depicting the condition of the paddy fields were taken on the day of the field measurements.

[1]Esra Erten, Assoc. Professor, Geomatic Engineering Department, Istanbul Technical University, Istanbul, Turkey; [2]Nebiye Musaoglu, Professor, Geomatic Engineering Department, Istanbul Technical University, Istanbul, Turkey. Corresponding author: N. Musaoglu, email: musaoglune@itu.edu.tr.

Figure 2 summarizes the means and standard deviations of backscattering values in dB for each polarimetric acquisition, and NDVI values for the Landsat acquisitions, which were the only inputs for estimating the LAI values. The colors of the bubbles are associated with the fields shown in Figure 1.

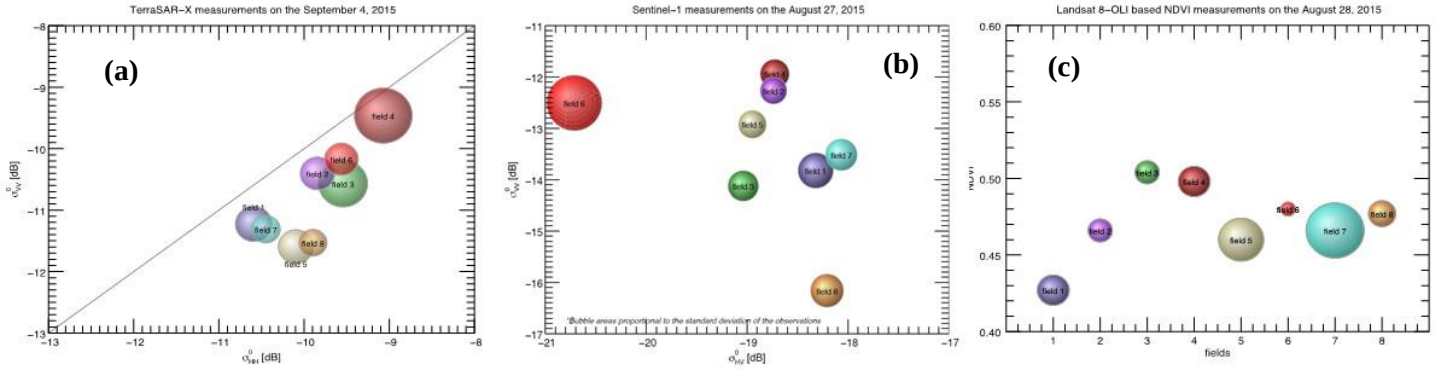

Figure 2. Scatter-plot of the intensity values transformed to σ^0 for TerraSAR-X (a), and Sentinel-1 C-band (b) acquisitions. NDVI values for each field (c). The area of the bubbles is proportional to the standard deviation of the variables as observed by averaging the total number of samples for each field.

After obtaining these initial indirect measurements, for the complete study the following works will be implemented and presented:

- The effect of architecture of the crops on the correlation between space-borne and *in-situ* LAI measurements will be investigated in depth by accounting for other *in-situ* measurements, such as leaf width, leaf length, stem diameter, etc.
- To reduce uncertainties in LAI estimations, backscattering and PolInSAR inversions will be taken into account by coupling with NDVI measurements.

References

Erten, E., C. Rossi, and O. Yuzugullu. 2015. Polarization impact in TanDEM-X data over vertical-oriented vegetation: The paddy-rice case study. IEEE Geosci. & Rem. Sens. Ltrs. 12(7): 1501-1505.