Mapping Spatial Variation in Surface Moisture Using Reflective and Thermal ASTER Imagery for Southern Africa

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Goals

To evaluate the potential of ASTER imagery to map the variation of crop moisture in crop field of Sothern Africa.

Project Overview

An erratic pattern of rainfall and the higher rate of evaporation cause frequent droughts in southern Africa. Previous studies have shown that it is difficult to monitor droughts in real time by monitoring rainfall anomalies. Alternatively, a method to estimate the variation of surface crop moisture would be useful to help monitor droughts.

This research explored the potential of using Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) imagery to map the variation in moisture conditions in crop fields at a given time. ASTER imagery acquired on April 18, 2004 (i.e., around the harvesting time) near Pretoria, South Africa was used for this study.

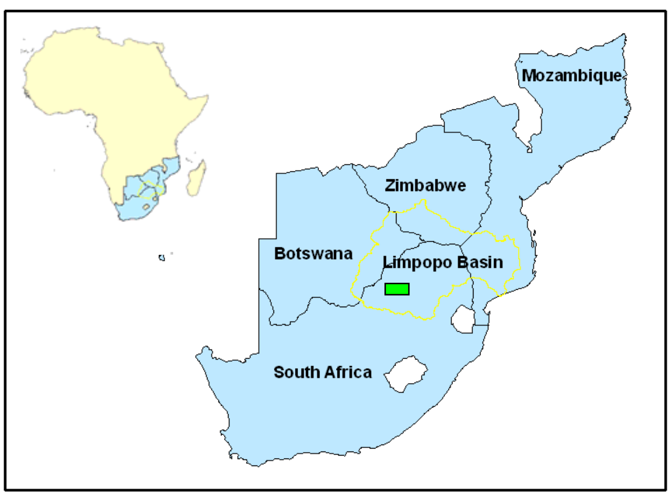

Figure 1. Location of study site

Five crop fields were selected in the study site (Figure 2). The crop fields were selected on the basis of assumed uniform growth of canopy within a single field. The selected crop fields were grouped into four zones.

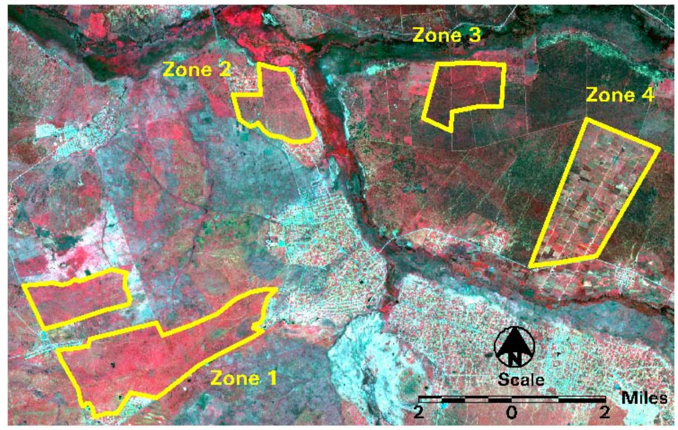

Figure 2. Selected crop zones shown in the ASTER imagery

Thermal and reflective data were combined and used in the Vegetation Index (VI) - Land Surface Temperature (LST) triangular method to map the relative variation in moisture conditions in the study area. Modified Soil Adjusted Vegetation Index (MSAVI) from the Visible and Near Infra Red (VNIR) bands and land surface temperature from the Thermal Infra Red (TIR) bands were used as VI and LST respectively.

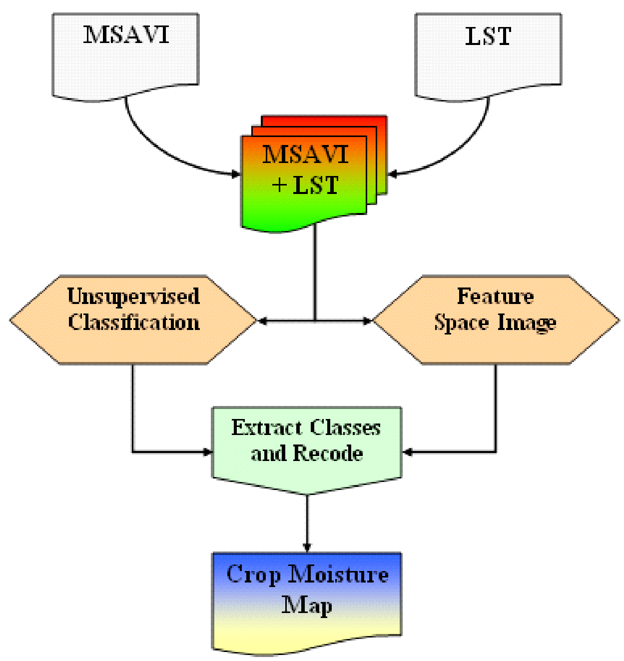

Figure 3. Crop moisture mapping model

The crop moisture maps obtained from the VI-LST triangle model were compared with the crop moisture maps obtained by Normalized Differential Water Index (NDWI) method, South African Development Community (SADC) precipitation data and US Geological Survey regional Water Requirement Satisfaction Index (WRSI) to evaluate the model's efficiency.

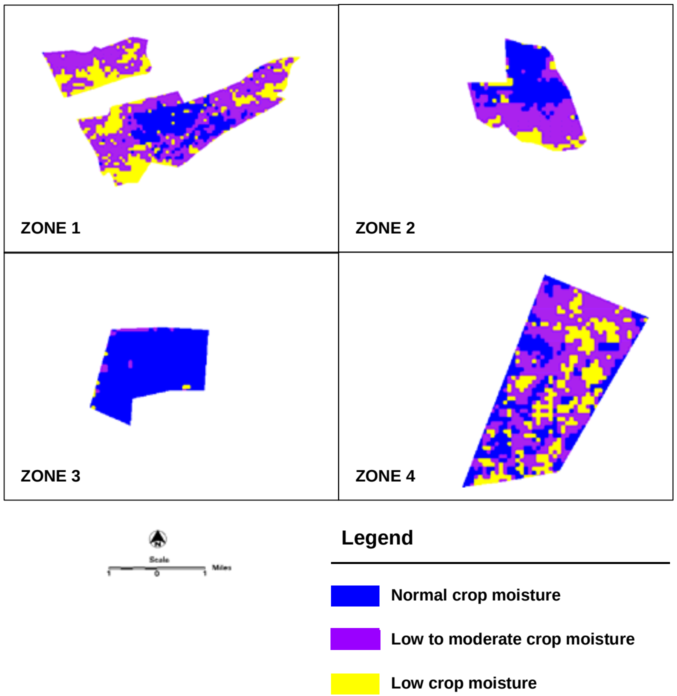

Figure 4. Classified crop moisture imagery

Conclusions

The results of the analyses of this research indicate that crop moisture can be estimated using ASTER imagery. The MSAVI-LST Triangular method (using ASTER VNIR and TIR bands) has potential to estimate crop moisture variation more accurately than NDWI method (using ASTER VNIR and SWIR bands).

Field data related to crop moisture may help to calibrate the method for more precise result, and suitable microwave imagery can be used to compare the results obtained from optical imagery.

Impacts

This research demonstrate that remote sensing techniques can be successfully used to develop model to map the relative variation in crop moisture of a crop field and this model can used as a substitute of Crop Moisture Index (CMI) for drought monitoring in Sothern Africa regime.

The Crop Moisture Index (CMI) is an indicator of soil moisture in the topsoil. It uses a meteorological approach to monitor crop condition weekly. It was designed to evaluate the short-term moisture conditions across major crop-producing regions and responds rapidly to changing conditions.

CMI can be used to determine the potential for short term drought in this area; however, one must collect data for sixteen variables to calculate CMI. CMI is not widely used because of the large amounts of data required.

Collaborators

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