STUDY ON THE INFLUENCE OF DROUGHT TO CROP GROWTH BASED ON SAR REMOTE SENSING

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ABSTRACT

This paper investigates the relationship between synthetic aperture radar (SAR) backscattering measurements and crop growth parameters in drought. It aims to define strategies for retrieve algorithms using SAR to monitor crop growth in semi-arid area where drought usually occurs.

SAR sensors have an inherent advantage over optical sensors due to their ability to penetrate cloud cover leading to nearly all-weather acquisition capabilities, in spite of the multi-spectral images are more sensitive to crop variables. Many experimental activities have been carried out to investigate the sensitivity of the backscattered signal phase to crop parameters using SAR techniques, such as Leaf Area Index (LAI), biomass and height. The microwave response of crop is a function of various factors – soil roughness, soil moisture, crop water content (CWC), crop geometry, crop biomass, etc. It is significant to the optimization of management when drought is evaluated promptly.

It is well known that crop growth is influenced by genetic characteristics of the crop, soil properties, weather and crop management information. The most changeable factor is weather, in which precipitation is mainly concerned, especially in semi-arid area. For cereal crops, biomass or LAI near the flowering stage is closely related to final grain yield. In a drought, the crop biomass, LAI, geometry will change, which will response to the backscattering coefficient. So it is possible to get the relations between SAR and crop growth. The dependence of the backscattered signal intensity to the soil moisture is widely documented in the literature. However, few works has been done concerning the sensitivity of signal phase to crop drought monitoring.

The study area was located in an intensive agricultural zone mainly composed of wheat and maize in North China. Precipitation, soil moisture, biomass, dry weight, and canopy structure were collected based on Matera site and intensively sampling during the 2008 growing season. Polarimetric SAR of Radasat-2 (C-band) were ordered over the study area at significant phenological stages. Several studies have showed that dual-polarizations indexes were sensitive to crop growth and less sensitive to soil moisture variations. Polarimetric SAR would reveal the relations more properly. In anticipation, the radar sensitivity to biophysical parameters should be strongly related to drought. Studies demonstrated that C-band radar data with high incidence angle are sensitive to crop biomass. Bivariate correlation results based on the linear regression of crop variables against backscattering are different among Matera

sites, although the fields are similar besides drought. These results suggested that it is possible to develop certain retrieve algorithms to build relationship between drought and crop growth.

When the canopy cover is low at the beginning of crop growing season, the temporal variation of the backscattering coefficient is mainly driven by soil moisture change. The depolarization ratio using high incidence angle (35 to 45) provides the highest sensitivity to crop growth and the minimum effect of soil moisture change. Polarimetric index appears to be well suited for crop growth monitoring. This will lead to define the configurations (polarization and incidence angles) maximizing the sensitivity to crop growth and reducing the impact of the soil moisture on the signal.

The backscattering intensity is a function of the geometry and the dielectric properties of crop. In the growing season, the crop height and water content is changing, so it is difficult to decompose drought factors. But, it is well known that soil moisture and CWC have strong correlation with σ^0. If soil moisture and CWC could be converted to drought index (DI). It will be easier to develop an empirical algorithm between σ^0 and DI other than soil moisture, CWC and σ^0. Drought usually take place in larger scale compared to other factors, such as soil variation, crop character, management, etc. This will make it convenient to assess drought to crop growth from field level to wide-area.