Geophysical Research Abstracts
Vol. 12, EGU2010-4643, 2010
EGU General Assembly 2010

Quantification of Ecological Changes by Remote Sensing

Gerbert J. Roerink and Matthijs H.G.I. Danes
Alterra, Wageningen UR, Wageningen, Netherlands (gerbert.roerink@wur.nl)

During the recent year there is a growing interest for ecological trends and conditions. Satellite images are very suitable to monitor the ecological conditions as they are sensitive to vegetation properties, provide for objective information on a regular basis and have a complete land surface coverage. However, up to now monitoring of the vegetation properties with remote sensing is done qualitatively only, i.e. the land cover is classified in several classes and changes between years are monitored. In this way, quantitative changes within a certain land cover class cannot be monitored, like for example start of the growing season or maximum vegetation peak.

This paper describes a method to overcome these shortcomings. The method is based upon quantification of the plant phenology by a time series analysis of satellite images. The HANTS time series algorithm is applied to MODIS 16-days-max-NDVI composite images of the Netherlands in the years 2003 (relatively dry and cold winter) and 2007 (relatively wet). This algorithm considers only the most significant frequencies expected to be present in the time profiles, and applies a least squares curve fitting procedure based on harmonic components (cosines). For each frequency the amplitude and phase of the cosine function is determined during an iterative procedure. Input data points that have a large positive or negative deviation from the current curve are removed by assigning a weight of zero to them. After recalculation of the coefficients on the basis of the remaining points, the procedure is repeated until the maximum error is acceptable or the number of remaining points has become too small. The resulting amplitude and phase values describe in a quantitative way the plant phenology.

The next step is to subtract the amplitude and phase values from the two considered years. Agricultural areas are masked as their land cover is changing frequently by definition due to the rotating cropping systems at agricultural fields. The remaining natural areas are examined in detail. The differences are the result from weather conditions, human interventions and other causes, like for example plant disease or forest fires. Weather conditions are responsible for the overall trend in differences: the average NDVI was lower in 2003 (less precipitation), the annual amplitude was higher in 2003 (colder winter), and annual phase started later in 2003 (colder winter). However, extreme differences are detected as well. Examples of these so-called "hot-spots" are investigated in detail with aerial photography from 2003 and 2006. In most cases human interventions, like forest cutting, giving agricultural lands back to nature or removal of shrubs, can be indentified as main explanation for the hot-spots. However, in some cases the explanation is less easy, which is however also the strength of the method. The described method is able to detect quantitatively ecological or environmental changes with complete land surface coverage and has the potential to monitor land surface with its vegetation dynamics in an operational way.