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Quantitative Comparison of Time Series Similarity Measures for Mapping and Detecting Changes in NDVI Time Series

S. Lhermitte (1), J. Verbesselt (2), W.W. Verstraeten (1) and P. Coppin (1)

(1) M3-BIORES - Department Biosystems - KULeuven, Leuven, Belgium, (2) CSIRO Forest Biosciences, Clayton South, Australia (stefaan.lhermitte@biw.kuleuven.be - tel.: +32 16 329750; fax: +32 16329760)

Time series of remote sensing imagery have been shown useful in providing information on ecosystem dynamics and vegetation processes. The development of effective methodologies to analyze time series of satellite imagery is therefore one of the most important issues in the understanding of temporal dynamics of vegetation cover, certainly with the ever increasing amount of time series data. Several methods and algorithms have already been developed based on satellite-based biophysically meaningful variables, such as vegetation indices whose behavior follows annual cycles of vegetation growth. These applied methods often employ time series similarity as the basis for clustering time series or discriminating between temporal differences. Before applying these methods it is however of crucial importance to completely understand the temporal properties of the time series under study and the characteristics of the similarity measures used. The presented research therefore focused on some specific characteristics of time series vegetation indices, such as amplitude-time scaling and translation, noise effects and computational properties such as data dependence and incremental properties. Moreover, it provides a theoretical and practical comparison of the most commonly used similarity measures. The theoretical comparison focused on the specific properties of each time series similarity measure to provide a valuable basis for identifying, monitoring and classifying vegetation dynamics. Emphasis was on the typical characteristics of each similarity measure in relation to the specific characteristics of time series vegetation indices. Finally, the similarity measures were

evaluated in a practical example based on 5 year artificial time series derived from the SPOT Vegetation data set. This practical example illustrated the properties of each similarity measure. Moreover, the example demonstrated (i) the difference between measures that account for time series correlation and (ii) the importance of understanding the properties of the time series and their associated noise before applying similarity measures. Without this knowledge, possibly wrong assumptions are made, and the discrimination power may severely decrease. The practical example illustrated moreover the useful properties of Fk-distance criterion, which is most robust to differences introduced by noise, time scaling and translation effects. Hence, information related to temporal vegetation characteristics can be separated from noise originating from atmospheric and viewing angle effects, cloud contamination, and other types of high frequency factors.