POTENTIALS FOR DETECTING CANOPY WATER STRESS USING GEOSTATIONARY MSG-SEVIRI DATA

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Water scarcity limits vegetation growth over 40 per cent of Earth's vegetated surfaces and water is the single most important limiting factor for global vegetation growth. In the 1970s and 80s the semi-arid zone of Africa suffered from a severe prolonged drought and in first 5 years of the new millennium a second severe drought period has hit the East African part of the Sahelian region. In perspective of global climate change, climate variability is projected to increase and drought conditions to be more frequent and severe. Given the relevance of limited water resources, it is of outmost importance to develop capacities for improved drought monitoring. Earth Observation (EO) remains the only viable means for systematically monitoring the different aspects of vegetation water stress on a regional, continental or global scale and is thus a critical component of famine and drought early warning systems. However, the use of conventional polar orbiting environmental satellite-based (POES) information is limited owing to the low temporal sampling frequency of the EO systems. Together with persistent cloud cover especially during the critical crop growing season for instance in the semi-arid zone of Africa this often results in data gaps and spurious short-term variability in vegetation time-series. With the launch of the geostationary Meteosat Second Generation (MSG) satellite with its Spinning Enhanced Visible and Infrared Imager (SEVIRI), unprecedented data for scientific exploration of natural resources including vegetation drought stress are now available. SEVIRI measures every 15 minutes radiation in 12 spectral wavebands whereof three are specifically suited for vegetation studies: the red, the near-infrared (NIR) and shortwave-infrared (SWIR) bands centered at 635, 810 and 1640 nm, respectively. GOES-R ABI with similar spectral bands is expected to be launched in 2014 enabling geostationary-based vegetation monitoring of the continents of North and South America.

The aim of this study is to assess the potentials of using high temporal resolution geostationary MSG-SEVIRI data for drought related vegetation stress monitoring. Numerous studies have shown that changes in water content in plant tissues have a large effect on the leaf and canopy reflectance in the SWIR (1300–2500 nm) spectral region whereas the NIR range (700–1300) is mainly affected by structural characteristics. Algorithms and indices based on these spectral regions are therefore potentially useful to monitor water stress in vegetation, but the signal from POES data have shown to be influenced by day-to-day variations in the sensor view angle. It is therefore expected that the fixed viewing geometry from MSG-SEVIRI combined with the possibility of studying the diurnal behavior of surface reflectances and stress indices will provide an interesting alternative to conventional POES based drought monitoring. Daily stress indices based on SEVIRI NIR and SWIR reflectances are compared with time series of in situ measurements for the growing season of the Dahra

test site located in the semi-arid northern part of Senegal 2005–2008 (15 minutes sampling interval). Measurements of energy fluxes (Qe), rainfall and soil moisture conducted at the Dahra field site were used as a reference and indicator of water stress.

With the very high temporal data sampling frequency and consequently an increased probability of producing cloud free data for a short time composite period, it is expected to substantially improve various applications of satellite based natural resource management with MSG-SEVIRI observations, including crop condition monitoring, vulnerability assessment and food security monitoring in near real-time.

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