Inge Sandholt, Rasmus Fensholt, Michael Schultz Rasmussen and Kjeld Rasmussen

Monitoring natural resources in West Africa using ENVISAT data

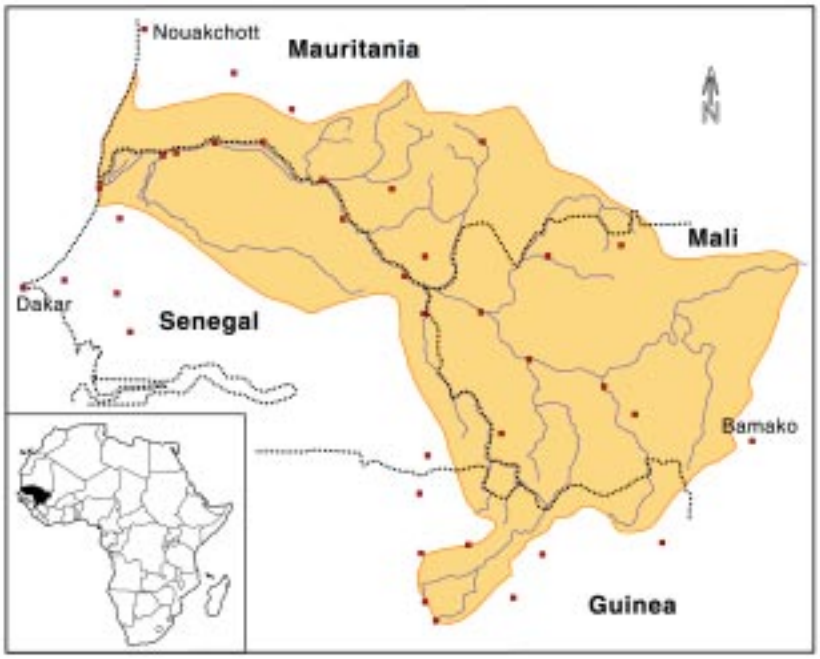

Figure 1: Map of the Senegal River basin and Senegal.

Inge Sandholt received the MSc. degree in physical geography from the University of Copenhagen in 1990, and the Ph.D. degree in statistics from the Royal Veterinarian and Agricultural University of Denmark in 1996. She is currently an associate professor in agricultural geography at the University of Copenhagen. Her main research interest is application of remote sensing in natural resource management and monitoring, in particular water resources and land use in Tropical Africa. She is the PI on a number of research projects within the above fields.

Rasmus Fensholt, is Ph.D. student at the Institute of Geography. Research areas: The assessment of Net Primary Production and agro-hydrological variables in Senegal using Remote Sensing. Using satellite data from two newly launched satellites; ENVISAT and TERRA MODIS, the possibilities of deriving an improved estimation of Net Primary Production will be evaluated. Scientific projects: Remote Sensing and Agro-Climatology. Teaching areas: Remote Sensing and GIS.

Michael Schultz Rasmussen is associate professor in geography at the University of Copenhagen. He is specialised in remote sensing and research areas are assessment of Net Primary Production, crop yields and mapping of the tropical rainforests as well as monitoring of the marine environment. MSR is the director of Geographic Resource Analysis & Science Ltd (GRAS), a company providing services within remote sensing, GIS and environmental monitoring.

Kjeld Rasmussen is associate professor in geography at the Institute of Geography. He has a masters degree in geophysics and a PhD in agricultural geography. Kjeld Rasmussen has specialized in agriculture and natural resource management in the tropics. He has been project coordinator of the "Fire In Trophical EcoSystems" project, the INTegration of EO data in distributed hydrological models" project and the long-term collaborative project with "Centre de Suivi Ecologique" in Dakar, Senegal.

Proper management of natural resources in developing countries requires that information on the state and changes in a range of biophysical parameters is available. In the drylands of Africa, management of scarce water and vegetation resources is of key importance, not the least in the light of the climatic changes/ fluctuations that have characterised this zone over the last decades and the profound impacts of these on the agricultural production and the natural ecosystems. Considering the spatial scale of the phenomena, the fact that they are trans-national in nature and that detection of changes over time scales from hours to decades is required, it is evident that use of Earth Observation (EO) data is the only realistic means of acquiring much of this information. Satellite data from various instruments, in particular NOAA AVHRR- and ERS2 SAR have been applied successfully in the monitoring of natural resources and environmental monitoring in West Africa within the context water-vegetation. Special emphasis has been put on vegetation, the hydrological cycle, the carbon cycle and on land use.

The ENVISAT project

IGUC is the lead institution on a ESA-PI project on ENVISAT data, and the work will be a continuation of extensive research already done with current EO data. The project aims at identifying, estimating and validating important variables related to vegetation status and hydrology in a semi-arid ecosystem. This will be done by applying state of the art EO data and algorithms on ENVISAT data and by developing and testing new methods. Ultimately the variables will be used in hydrological modelling and in net primary production models. The area of interest covers the Senegal River basin, and the northern part of Senegal has been selected to act as a special test area, with in situ data collection (Figure 1). Synergy effects of the ENVISAT, MODIS and NOAA AVHRR data will be exploited in order to obtain information on the water and vegetation status of the surface through modelling of plant water stress, soil moisture, Leaf Area Index, the amount of absorbed radiation used for photosynthesis by plants (fAPAR and APAR)).

Vegetation

Leaf Area Index and fAPAR will be modeled using remotely sensed vegetation indices [Govaerts et al., 1999]. The PI project will take advantage of the improved quality of the spectral information in MERIS with its narrower bands and the reduced sensitivity to the atmosphere in comparison with AVHRR. Results from a field campaign in 2001 indicates, that the dynamic range of the MERIS VI is much larger than in AVHRR data, and that a linear relationship between fAPAR and the MERIS Vegetation Index can be exploited (Figure 2).

Surface moisture

Plant water stress and soil moisture status will be modelled using the surface temperature/ vegetation dryness index (TVDI) [Sandholt et al., 2002]. It will be tested if the dryness index originally based on NOAA AVHRR can be further refined by inclusion of data from MERIS and AATSR.

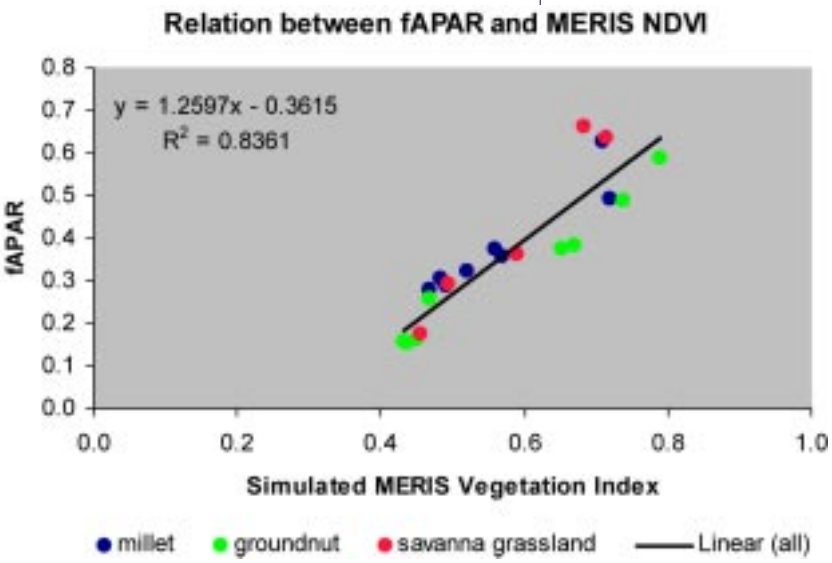

Figure 2: Results from a field campaign in 2001 indicates that a relation between the MERIS vegetation Index and fAPAR for various surface types exists, which is a necessary starting point when modelling Net Primary Production.

Field Work

Field work will be conducted in order to collect a reference data set for the EO data. A number of automatic masts equipped with sensors to measure spectral reflectance of vegetation, surface temperature and soil moisture will be established in the Ferlo of Senegal. The field work will provide a time series of vegetation indices comparable to satellite derived indices, and relations between the variables will be analysed.

Acknowledgements

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References

[Govaerts et al., 1999]Govaerts, Y. M., Verstraete, M. M., Pinty, B., and Gobron, N. (1999). *Designing optimal spectral indices: a feasibility and proof of concept study.* International Journal of Remote Sensing, 20(9):1853-1873.

[Sandholt et al., 2002] Sandholt, I., Rasmussen, K., and Andersen, J. (2002). *A simple interpretation of the surface temperature/vegetation index space for assessment of soil moisture status.* Remote Sensing of Environment, 79(2-3):213-224.

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