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Monitoring of small reservoirs monthly storage using Envisat ASAR, SPOT and ALOS imagery in the Upper East Region of Ghana

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Abstract

The availability of water in small reservoirs in semi-arid regions increases the coping capacity of the inhabitants against shocks produced from rainfall variations and drought. In the Upper East region of Ghana, rain-fed and irrigated agriculture and fishing are the socio-economic backbone of society. The importance of small reservoirs especially during droughts for the local population in this region can therefore not be over estimated. These reservoirs capture excess runoff from late May to early October (rainy season) and make the water available from November through early May (dry season).

The efficient management and use of the water stored in these reservoirs will have a very positive socio-economic impact on the livelihoods of the inhabitants. One of the key elements in managing scarce resources such as this is to determine the availability and demand for the resource so that it can be allocated efficiently and effectively in space and time. For small reservoirs, their water level or storage capacity needs to

be correctly estimated and this has to be done either with ground data or by remote sensing. Previous studies have been undertaken to delineate these reservoirs by remote sensing using Landsat and Envisat ASAR imagery in 2005 and 2006 respectively. This was quite successful especially in the Upper East region of Ghana, West Africa. With these satellite images, it was possible to determine the number, spatial distribution, and storage volumes of the reservoirs for effective water management and reservoir planning.

The quality of the determination of surface areas and storage volumes is greatly affected by cloud cover, wind, and floating vegetation. This paper explains to what extent inaccuracies caused by weather and vegetation can be reduced by using newly available radar images from ALOS. This was verified on a large scale with ground truth data and SPOT images. The results obtained show that small reservoirs could be accurately delineated on a monthly basis on a regional scale with an accuracy of over 95%.