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Earth Observation Applications, Societal Challenges and Economic Benefits (5)

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APPLICATIONS OF NASA EARTH OBSERVATIONS FOR MONITORING SURFACE WATER AVAILABILITY FOR PASTORALISTS IN REMOTE REGIONS OF TAHOUA, NIGER

Abstract

Over the past thirty years, the increased availability of data from satellite-based sensors has greatly expanded our capacity to address pressing environmental issues in remote areas, where monitoring by traditional means is extremely difficult. One such region is the West African Sahel, where pastoralists and smallholder farmers rely on dispersed ephemeral ponds for hydrating their cattle and irrigating fields. As a scarce but essential resource, competition over access to water has contributed to conflict, and sometimes violence, between nomadic pastoralists searching for watering holes for their cattle and the more sedentary smallholder farmers relying on the same resources to irrigate crops. Although the roots of these conflicts are extremely complex, spanning local- to state-level politics, economics, and culture, an important component for facilitating peaceful natural resource management is better understanding the dynamics of these water bodies, including knowing the quantity of water available, the distribution of water bodies across the landscape, and the factors that determine the timing of a pond's filling and drying up.

This paper explores how NASA Earth Observations can be used to monitor the availability and distribution of surface water for pastoralists and smallholder farmers in the Tahoua Region of Niger. Thirty years of Landsat imagery were processed within Google Earth Engine to identify surface water, assess the spectral properties of individual ponds, and to evaluate annual and seasonal trends of their onset and disappearance. The responsiveness of surface water quantity to changes in precipitation was also assessed. Outputs include a thirty-year time series of surface water extent calibrated to the Sahelian ecozone, which allows for the inclusion of smaller more spectrally complex water bodies that are often absent from global surface water datasets, and seasonal and decadal surface water occurrence maps, which illustrate general patterns of surface water extent from 1986 - 2016. Our analysis suggests that changes in annual precipitation explain much of the variation in surface water extent (R-squared=0.862, p=0.0008), however other environmental variables and resource management practices also may be important contributing factors. The outputs, workflows, and scripts from this project will be transferred to representatives from AGHRYMET in Niamey, Niger, in order to facilitate improved resource management and to anticipate the need for conflict mitigation in the region.