Estimation of Surface Albedo Increase During the Eighties Sahel Drought from Meteosat Observations

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The Sahel region of Africa has been experiencing a severe drought that culminated in the mid-eighties. As a natural response, persistent dry conditions are responsible for a degradation of the vegetation cover leading to an increase in surface albedo. The magnitude of this albedo response to precipitation changes remains largely unknown. The study presents a first attempt to directly quantify the surface albedo increase resulting from the mid-eighties Sahel drought from space observations. More than two decades of observations have been acquired by six different radiometers onboard the Meteosat First Generation satellite series. The duration of the corresponding historical archive makes these observations attractive for the monitoring of seasonal surface albedo changes in West Africa. Geostationary observations are potentially adapted to derive such information as the frequent cycle of acquisition can be used to document the anisotropy of the surface and therefore surface albedo. A robust and conservative estimation of the derived product accuracy and reliability is implemented. This product error estimation can subsequently be used for assessment of the significance of observed changes. The comparison of mid-eighties surface albedo with current values, shows a significant increase resulting from the drought. Regions particularly affected by the 1980s drought are located mostly in a narrow band of about 2 º–3 º width along 16 ºN running from 18 ºW to 20 ºE. Within this geographical area, surface albedo changes are not homogeneous and the largest differences might locally exceed 0.15, whereas other places remained almost unaffected. It is expected that the results presented here will provide useful information for the validation of dynamical coupled land-atmosphere models, as suggested by many authors. The results also demonstrate the contribution of archived observations from operational geostationary meteorological satellites to quantify land-atmosphere feedback mechanisms on a multidecadal basis.

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