Journal of Applied Meteorology and Climatology
Article: pp. 97–111 |

Satellite-Based Actual Evapotranspiration over Drying Semiarid Terrain in West Africa

D. Schüttemeyer[a], Ch. Schillings[b], A. F. Moene[c], and H. A. R. de Bruin[c]

a. Meteorology and Air Quality Group, Wageningen University, Wageningen, Netherlands
b. Institut für Technische Thermodynamik, Deutsches Zentrum für Luft- und Raumfahrt (DLR-Stuttgart), Stuttgart, Germany
c. Meteorology and Air Quality Group, Wageningen University, Wageningen, Netherlands

ABSTRACT

A simple satellite-based algorithm for estimating actual evaporation based on Makkink's equation is applied to a seasonal cycle in 2002 at three test sites in Ghana, West Africa: at a location in the humid tropical southern region and two in the drier northern region. The required input for the algorithm is incoming solar radiation, air temperature at standard level, and the green-vegetation fraction. These data are obtained from Meteorological Satellite (Meteosat) and Moderate-Resolution Imaging Spectroradiometer (MODIS) images. The observation period includes the rapid wet-to-dry transition after the wet season. Incoming solar radiation and air temperature are validated against local measurements at the three sites. It is found that the incoming solar radiation obtained from Meteosat corresponds well with the measurements. For air temperature from Meteosat data, the diurnal cycle is realistically reproduced but is in need of a bias correction. The algorithm output is compared with the evapotranspiration data obtained from hourly large-aperture scintillometer observations and simultaneous "in situ" measurements of net radiation and soil heat flux. It is found that the actual evapotranspiration can be monitored using the modified Makkink method, with daily mean errors of between 5% and 35% of measured evapotranspiration and a seasonal error smaller than 5%. Furthermore, it appears that the algorithm realistically describes the daily cycle of evapotranspiration.

Manuscript received 25 January 2005, in final form 29 March 2006

DOI: 10.1175/JAM2444.1