Geophysical Research Abstracts,
Vol. 11, EGU2009-10586-1, 2009
EGU General Assembly 2009

Impact of the monsoon on downwelling surface radiative fluxes across West Africa : an evaluation of ECMWF-IFS and satellite estimates with ground measurements

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Land-atmosphere exchanges are key for both land and atmospheric processes, and are affected by various feedback loops between these processes. This study focusses on downwelling surface radiation fluxes (DSRF), which represent a major forcing for land surface models (LSM) as well as a challenge for atmospheric models. Besides seasonal insolation, DSRF depend on such characteristics as cloud coverage and type, air temperature and humidity, and atmospheric aerosols. Flux estimations are provided from model or remote-sensing (RS) estimates, at space resolutions of several kms to several tens of kms. Direct observation in the field can be made by networks of point measurements. In West Africa, very few ground data have so far been available, hence little validation of model or RS estimates has yet been undertaken. In this region, radiative fluxes are strongly impacted by the West African monsoon (WAM) processes and by dust events of considerable importance, which are still insufficiently understood and modelled. As part of the AMMA programme (African monsoon multidisciplinary analyses), a network of surface flux data, including radiation components, was installed along a latitudinal transect across West Africa, making possible the comparison of available DSRF estimates with this new in-situ data. Such evaluation is key both for ensuring adequate forcing of LSMs such as those involved in the AMMA LSM intercomparison project (ALMIP), and for validating of atmospheric models and RS retrieval algorithms.

In the AMMA surface flux network, 3 stations in Benin (∼9.8°N), 4 in Niger (∼13.5°N), and 4 in Mali (between 15.3 and 17°N) provide DSRF data. In this communication, results are presented for 2006, the year of AMMA's special observation periods. Seasonal, latitudinal and intra-site variability is highlighted and discussed. If DSRF variations are generally consistent with the solar course during the first months in the year, this relationship degrades when the WAM sets in. Thus the WAM stands as a major actor in shaping the seasonal cycle of DSRF. It is found to affect shortwave and longwave downwelling fluxes in distinct ways across latitude, from the more cloudy Soudanian zone up to the margins of the Sahara in the northern Sahel. In-situ DSRF data are compared with estimated values from the ECMWF-IFS and from the ALMIP database (corresponding to LAND-SAF satellite estimates) at each site. The pre-monsoon period is especially investigated, as it is characterized by the occurrence of numerous dust events, squall lines, a rise in atmospheric humidity, and cloud coverage. These conditions favour errors in DSRF estimates.