RADIATION BUDGET DATA SETS FOR MONSOON STUDIES

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1. Introduction:

Monsoons are driven by the release of latent energy, which in turn comes from a surplus of radiant energy to evaporate surface water. The role of net radiation in providing the energy for rain which is sustained over a region for an extended period has been investigated by Neelin and Held (1987), Srinivasan and Smith (1996) and Srinivasan (2001). The air which flows from the clouds, following the release of the latent energy and the consequent precipitation, must then descend to allow more air to rise to continue the rain. This outflow air can only descend by radiating away its potential energy. Monsoons are a part of a heat engine for which the heat source is the absorbed insolation and the heat sink is the radiation emitted by the atmosphere. In order to understand monsoons, it is necessary to study the effect of radiation on the energetics of the processes. This paper describes radiation data sets which are available for the investigation of these processes. First, instruments are discussed which are presently operating to produce measurements of radiation, and then archived radiation data are described which can be used to study the recent historical record. In particular, these radiation data will be very useful for the African Monsoon Multidisciplinary Analyses program.

2. Current data

The Clouds and Earth Radiant System (CERES) project provides radiative fluxes at the “top of the atmosphere (TOA), at the surface and divergence of radiative flux within the atmosphere (Wielicki et al., 1996). CERES instruments have operated aboard the Terra spacecraft since March 2000 and aboard the Aqua spacecraft since June 2002. Each spacecraft is in a Sun-synchronous orbit and gives global coverage each day. The Terra crosses the Equator going north at 2230 hours local time and the Aqua Equator-crossing time is 1330. The data products include pixel level radiances, instantaneous fluxes averaged over a 1^o latitude by 1^o longitude grid, and daily and monthly average fluxes. In addition, data from other instruments aboard these spacecraft are used with CERES data to compute the surface radiation fluxes (upward and downward shortwave and longwave components) and radiation fluxes at different levels within the atmosphere (Wielicki et al, 1998). These data products enable one to study conveniently the radiation fluxes at various space and time scales. These data are available from the Langley Atmospheric Sciences Data Center (ASDC) and may be accessed at: http://eosweb.larc.nasa.gov.

The CERES instruments have the capability that one can program the azimuth of the scan plane to follow a prescribed pattern. Thus, as the spacecraft flies near a given site, the CERES can turn in azimuth so as to observe the site from a number of orbital positions (Szewczyk and Priestley, 2003; Szewczyk et al., 2004). This capability is quite useful for supporting field studies of atmospheric processes.

The Geostationary Earth Radiation Budget (GERB) instrument (Harries et al., 2000; Mueller et al., 1999) aboard the first MeteoSat Second Generation (MSG-1) spacecraft has recently become operational. This instrument is located near 0^o longitude over the Equator and has an excellent view of Africa. It provides a map of longwave and shortwave fluxes over the Earth disc every 15 minutes. Data from this instrument will be invaluable for studying the strong diurnal cycles over the tropical convective regions, where absorbed solar radiative flux provides moisture which interacts in complex processes on a short time scale to produce

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convection. GERB data together with SEVIRI (Scanning Enhanced Visible and InfraRed Imager) data will provide a comprehensive view of the dynamics of these processes.

3. Historical Data Base

The Earth Radiation Budget Experiment (ERBE) scanning radiometer provided radiative fluxes at the "top of the atmosphere" for five years beginning in November 1984. These data were used to produce daily radiation maps at a resolution of 2.5^o in latitude and longitude. A nonscanning radiometer produced a 15-year data set, but at lower resolution: monthly-mean maps at 5^o resolution.

The first CERES instrument flew aboard the Tropical Rainfall Measuring Mission and operated from January until September 1998. Other instruments aboard this spacecraft include the precipitation radar and the Visible and Infrared Scanning Radiometer, which give simultaneous measurements of rainfall, surface temperature, cloud cover, etc.

The Surface Radiation Budget Project has produced a 12-year data set for the period July 1983 through October 1995, covering the globe with a quasi-equal are grid which is 1 degree latitude by 1 degree longitude at the Equator. This data set includes upward, downward and net solar and longwave radiation.

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