Geophysical Research Abstracts,
Vol. 11, EGU2009-2720, 2009
EGU General Assembly 2009

Applications of a linearized land-atmosphere model to SVAT modelling and remote-sensing

P. Gentine (1), D. Entekhabi (1), and J. Polcher (2)

(1) Massachusetts Institute of Technology, Cambridge, 02139 MA, USA, (2) Centre National de la Recherche Scientifique, Paris, France

The present study refreshes and improves the work first introduced by Lettau (1951). A linearized land-atmosphere model, forced by times series of incoming radiation at the land-surface, is solved analytically. With this model, the profiles of temperature and heat fluxes in the soil and the Atmospheric Boundary Layer (ABL) can be expressed in terms of temporal Fourier series. Moreover the surface variables (temperature, specific humidity, surface fluxes) are also derived analytically and are expressed as functions of both surface parameters (friction velocity, vegetation height, aerodynamic resistance, stomatal conductance) and frequency of the forcing of incoming radiation.

This original approach has several advantages. The model only requires very little data to perform well (time series of incoming radiation at the land-surface, mean daily specific humidity and potential temperature at any given height) and allows theoretically studying the temporal and spectral response of a coupled land-atmosphere system to any forcing of incoming radiation at the land-surface. The diurnal evolution of the ABL and the soil temperature and flux profiles will be emphasized, as well as their dependency on the frequency of the forcing. This will theoretically highlight the existence and diurnal behavior of the Surface and Mixed-Layer.

Moreover, this model is shown to be helpful for the conception of remote-sensing tools and for the use of data assimilation. The spectral analysis of the coupling between the land and the atmosphere helps investigate the relevance of the sensor measurements, according to the temporal resolution of the sensor as well as the penetration depth of its electromagnetic wave. This will give insight on the appropriate variables for the data assimilation, in conjunction with land-surface models (Soil Vegetation Atmopshere Transfer models). Moreover guidelines for the collection of remotely sensed data can be obtained through this simple model.

The model will also be used to analyse the diurnal and (temporal) spectral dependency of surface variables, as well as the energy partitioning at the land-surface. In particular the Evaporative Fraction (EF) and Bowen Ratio diurnal shapes are explained as function of weather and surface conditions. EF is shown to remain a diurnal constant under restricting conditions and its application in conjonction with remote sensing is discussed. Moreover, the EF pseudo-constant asymptotical value is given as function of surface parameters.

Future improvements of the model will be discussed in the final part of the study.