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Short Communication

Surface layer simulation of semi arid region of India using LASPEX-97 data

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The physical processes near the land surface interface are very important not only in energy balance studies of crops but also in atmospheric boundary layer studies. The land surface parameters are inter-related. World wide field experiments such as HAPEX (Andre et al, 1986) and FIFE (Sellers et al., 1992) etc. were conducted to generate data set to understand the land surface processes on local, regional and global scale (Rao, 2001).

In India, the Land Surface Processes Experiment over Sabarmati river Basin (LASPEX-97) an interdisciplinary, multi-institutional experiment funded by the Department of Science and Technology, Govt. of India was conducted during 1997-98 at five stations (Anand, Khandha, Derol, Sanand and Arnej) of western India which are 35 to 125 km apart from each other having relatively homogeneous uniform terrain between latitudes 22°02' to 23°04'N and longitudes 72°15' to 73°45'E with elevation ranging from 28 to 85m above mean sea level(Rao, 2001). In the present study, interrelationship among various parameters such as incoming and reflected short wave radiation, net short wave and net long wave radiation, soil temperatures at surface, air temperature at 1m heights, and other surface layer parameters viz. friction velocity, albedo using statistical techniques for LASPEX-97 data set have been developed. Positive and significant correlations were found between exchange coefficient for the momentum and acrodynamic resistance 0.99, between air temperatures 0.81. Negative correlations were found between air temperature and roughness length (-0.77), stability parameter (-0.51), Richardson number (-0.35) and very high negative correlation with soil temperature at 100 cm depth (-0.92). Net radiation was positively and highly significant with incoming short wave radiation (0.99). Using significant correlations among the parameters, simple regressions as well as multiple regression equations were developed (Table 1). It may be seen that the models explained 91 to 99% variations in surface parameters. However, the variation in roughness length (z_o) and aerodynamic resistance (r_a) were explained slightly less, though highly significant (R^2 = 0.84 & R^2 = 0.77 respectively).

The prediction equation for air temperature using surface temperature

Table 1: Prediction equation for land surface parameters using Regression model

Model No.	Prediction equations	R^2
1	ST = 1.4719AT-10.3663	0.98**
2	AT = 2.12WS+0.39ST-0.01SW+0.06NLW+10.14	0.99**
3	Rn = 0.79NSW-1.07NLW-0.33	0.99**
4	NLW = 4.93ST+0.017SW-2.34	0.98**
5	FV = 5.57Ri-10.35Zo-0.18	0.96**
6	z_0 = -0.22WS+0.14Ri+0.38	0.91**
7	Km = 0.52WS-0.11Ri-0.03	0.84**
8	ζ = 0.02WS+0.06Ri-0.04	0.95**
9	r_a = 1.10WS+6.09Zo-1.87	0.77**

Where: ST= surface temperature, AT=air temperature, Rn=Net radiation, SW=Shortwave radiation, NLW=Net longwave radiation, NSW=Net shortwave radiation, WS=Wind speed, Ri=Richardson number, FV=Friction velocity, z_0=Roughness length, Km=Exchange coefficient for momentum, r_a=Aerodynamic resistance, æ = Shear stress

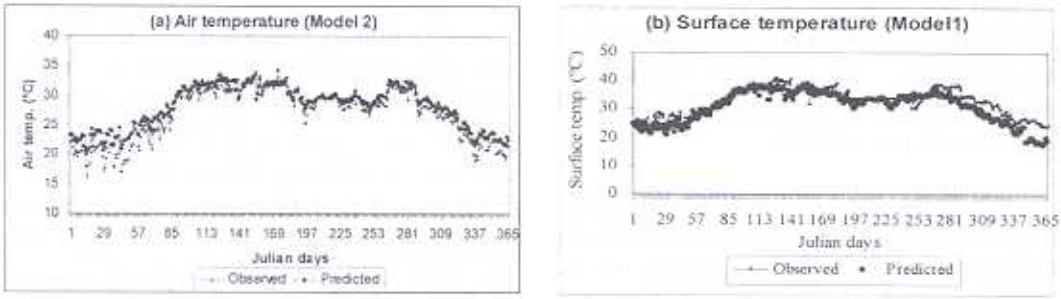

Fig.1: Daily observed and predicted (a) air and (b) soil temperature for Anand station

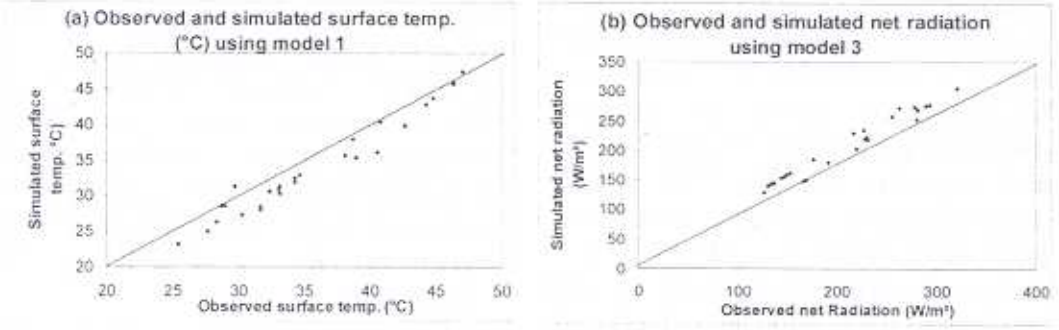

Fig.2: Observed and simulated surface temperature and net long wave radiation using different models

alone and surface temperature and incoming shortwave radiation were well fitted. Similarly, the regression equation for surface temperature using air temperature and net long wave both, and net long wave alone may be recommended for the prediction of surface temperature.

The predicted air and surface temperatures by the model was compared with the observed data of Anand station which was found well fitted. The models were validated with independent data sets. The observed and simulated parameters were found to be close to 1:1 line (Fig.2).

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