STATISTICAL ANALYSIS OF LAND SURFACE PROCESSES AND ROLE OF CONVECTION IN THE VARIATION OF TROPOPAUSE HEIGHT ABOVE RANCHI REGION

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Abstract: In this paper it has been tried to study the statistical aspect of the influence of land surface processes over convection in the atmosphere and what is the role of convection in the variation of tropopause. The area under study is Ranchi (23°42'N, 85°33'E), located in the eastern part of India. We used three types of source of data which are (i) data obtained through LATAMOS, (ii) AWS data and (iii) radiosonde data. Slow as well as fast response logarithmic wind profile data were collected from our existing set-up from 2008-2011, whereas radiosonde data of monsoon and pre-monsoon seasons have been used for the present study. Land surface processes include the complex interactions (including biophysical, hydrological and bio-geochemical interactions) between the land and the atmosphere at micro and meso-scales. Land surface conditions (including terrain, soil, land-use, soil moisture, albedo) affect the partition of surface radiation flux into latent and sensible heat flux, which in turn affects the deep convection initiation and development. We have selected net solar radiation, surface heat flux, temperature, humidity, pressure, wind velocity and wind direction as our parameters and established interrelationship among land surface processes, convection and variation of tropopause height by using statisitical correlation. MATLAB and Excel have been used for calculation and graph plotting.

Keywords: Convection, Correlation co-efficient, Radiosonde, Sonic sensible heat flux, Tropopause.

Introduction: In our day to day life, we feel change in weather conditions. Sometime, it is rainy day, some other time it is very hot. Solar radiations that come to the earth affect the atmosphere a lot. Our study is confined to find the relation between weather parameters and convection and then the impact on the tropopause height. We know that air is a poor conductor of heat. So conduction alone is not significant in the transfer of heat energy. Convection is the process in which heat energy is transferred through the movements of air itself. Air, heated by contact with the warm earth surface, expands and becomes less dense. The lighter air is displaced upward by cooler, heavier air and a convectional circulation is established with both horizontal and vertical components. Thus, temperature difference between earth's surface and the atmosphere above it is an important factor that influences the rate of convection. For our study, we have used data of the month May and June 2011. The source of data is the observatory in BIT campus. Both radiosonde and MBLM data have been used for the study. We have focused mainly on sonic sensible heat flux, temperature, height of tropopause obtained from sonde data and precipitation data.

Methodology: We have tried to find the correlation between the following:

(i) Surface heat flux and the height of tropopause.

(ii) Surface heat flux and the amount of rain.

(iii) Sensible heat flux and mean of the temperatures between upper and lower boundaries of tropopause.

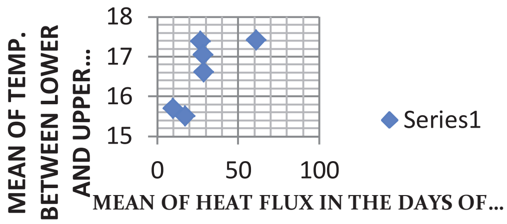
We have used data of the month May and June of the year 2011.

At first, we found the height of tropopause by using the property of temperature inversion. Then we calculated the mean temperature of so found tropopause layer. Then we calculated the mean of sonic sensible heat flux from the data generated by our AWS tower. It gives flux data of every 30 minutes. Finally, by using MATLAB, we calculated correlation coefficients according to the need of our objectives. We used excel to draw the graph showing these correlations.

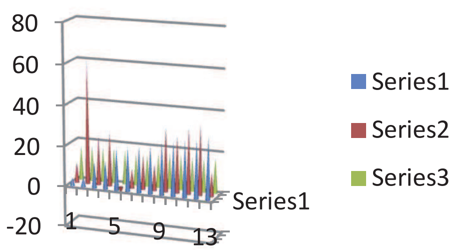
The following table shows the variation of tropopause in the month June 2011:

Mean of heat flux (May 2011)	Mean temp. in between boundaries of tropopause(c)
18.04	-72.32
60.88	-74.89
24.71	-74.82
25.46	-74.22
24.22	-73.21
26.46	-73.15
39.57	-73.24
24.22	-74
9.77	-71.23
17.16	-71.09
28.07	-76.35
32.52	-72.48

Comparison of mean heat flux and mean temperature of tropopause layer:



The following graph shows three dimensional comparison among days of and adjacent to rainfall, mean heat flux and height of tropopause:



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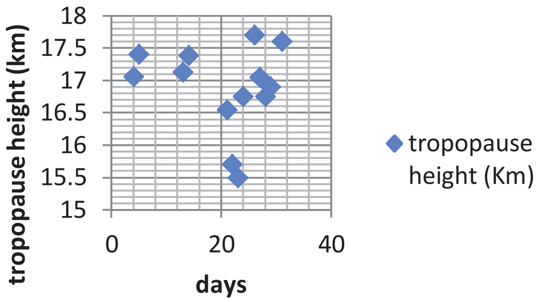
MAY 2011:

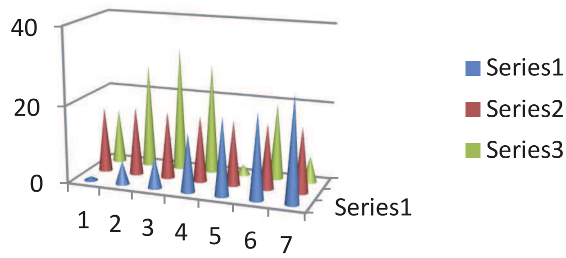
Days of rainfall and adjacent to rainfall	Mean heat flux	tropopause height (Km)
4	10.04	17.06
5	60.88	17.41
13	24.22	17.13
14	26.46	17.39
21	-3.52	16.54
22	9.77	15.7
23	17.16	15.5
24	13.02	16.75
26	31.94	17.7
27	28.07	17.05
28	32.52	16.75
29	34.4	16.9
31	11.99	17.6

MAY 2011

tropopause height in rainy and adjacent days



Mean heat flux and tropopause height in rainy and adjacent days in June 2011



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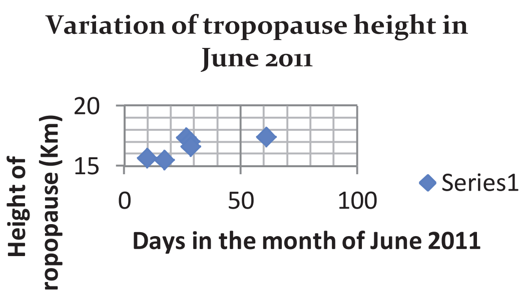

Discussion and Conclusion: As can be seen in the figures above and our calculation also indicates that surface heat flux and the height of tropopause are positively correlated. Also the correlationcoefficient of mean heat flux and rain amount in June 2011 shows that heat flux and rain amount are negatively correlated as the correlation coefficient is – 0.7023.

References:

1. Daytime boundary layer behavior over eastern region (per-humid climate) and western regions (semi-arid climate) of India: a case study.

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