

Spatial and Temporal variation of Precipitation over Himalayan Region

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Abstract

The diurnal variation of precipitation over the Tibetan Plateau was investigated with a focus on lakes. Over Tibetan Plateau there exist a lot of lakes with various area sizes. TRMM data of period (1998-2007) for June, July and August is used with 0.05 degree resolution. Local time of the maximum rainfall is correlated with topographic height over the Tibetan plateau. Lakes receives less rainfall than valleys, morning rainfall is seen more over the lakes. Strength of diurnal variation and local time of the maximum rainfall depends upon lake area size and steepness of slope surrounding the lakes.

Data and methods

TRMM 2A25 ,1998- 2007 (Jun-August) is used for precipitation data with resolution 0.05 X 0.05 degree, **Gtopo30** is used for surface topographic height with resolution 0.05X 0.05 degree **Strength of diurnal variation** is calculated as standard deviation of rain fraction (%) in 24 hours Rain certain flag is used for near surface rain. Frequency of rain and Rain conditioned rain rate are calculated from the data set.

Study Area

The study is focused on Tibetan Plateau [28.5-35N, 78-92E] .Detail study is done over [29-33N, 84-92E]. For details study of lakes fifteen lakes over [29-33N, 892E] is taken .

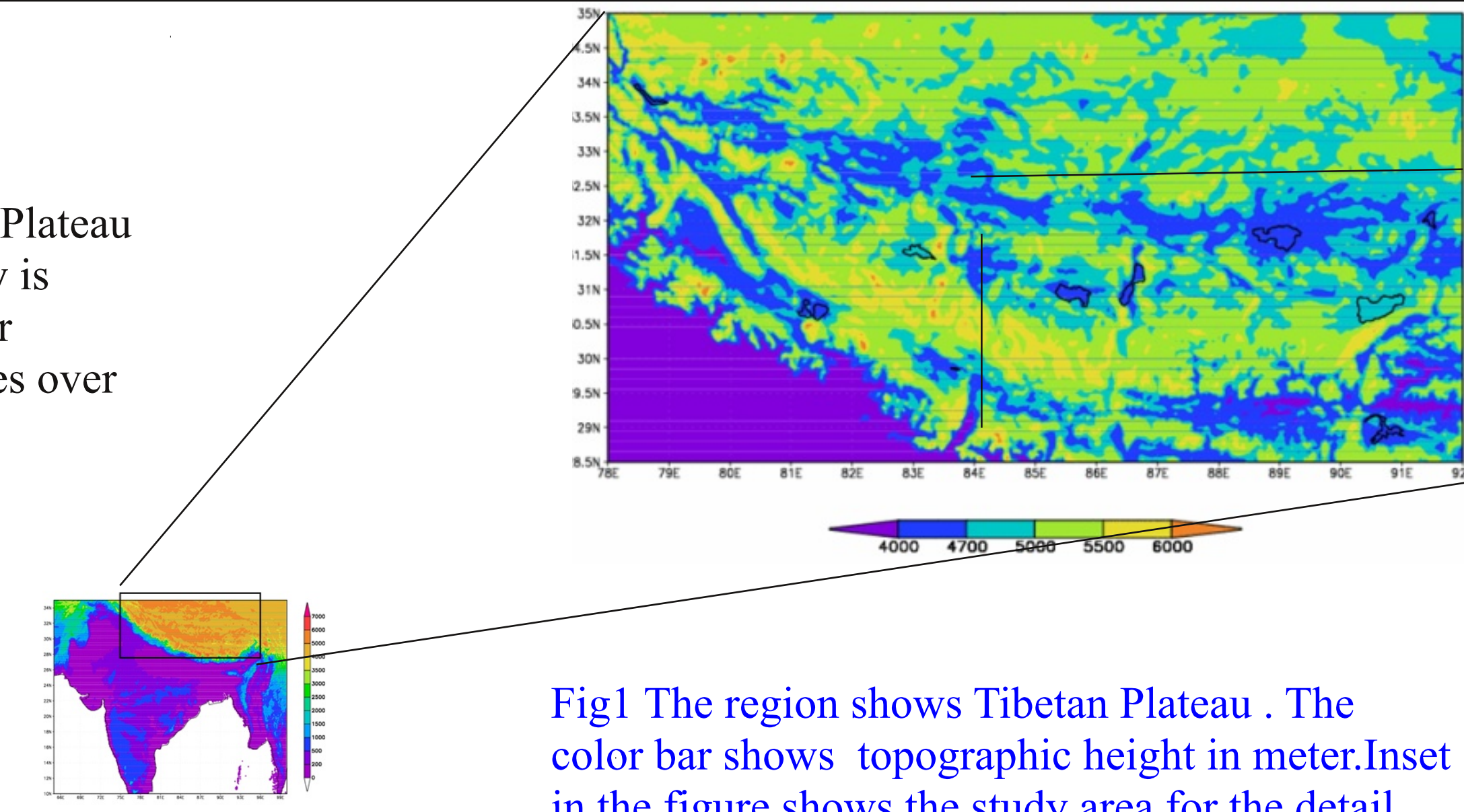


Fig1 The region shows Tibetan Plateau . The color bar shows topographic height in meter.Inset in the figure shows the study area for the detail

Results and Discussion

General Characteristics

Topographic map

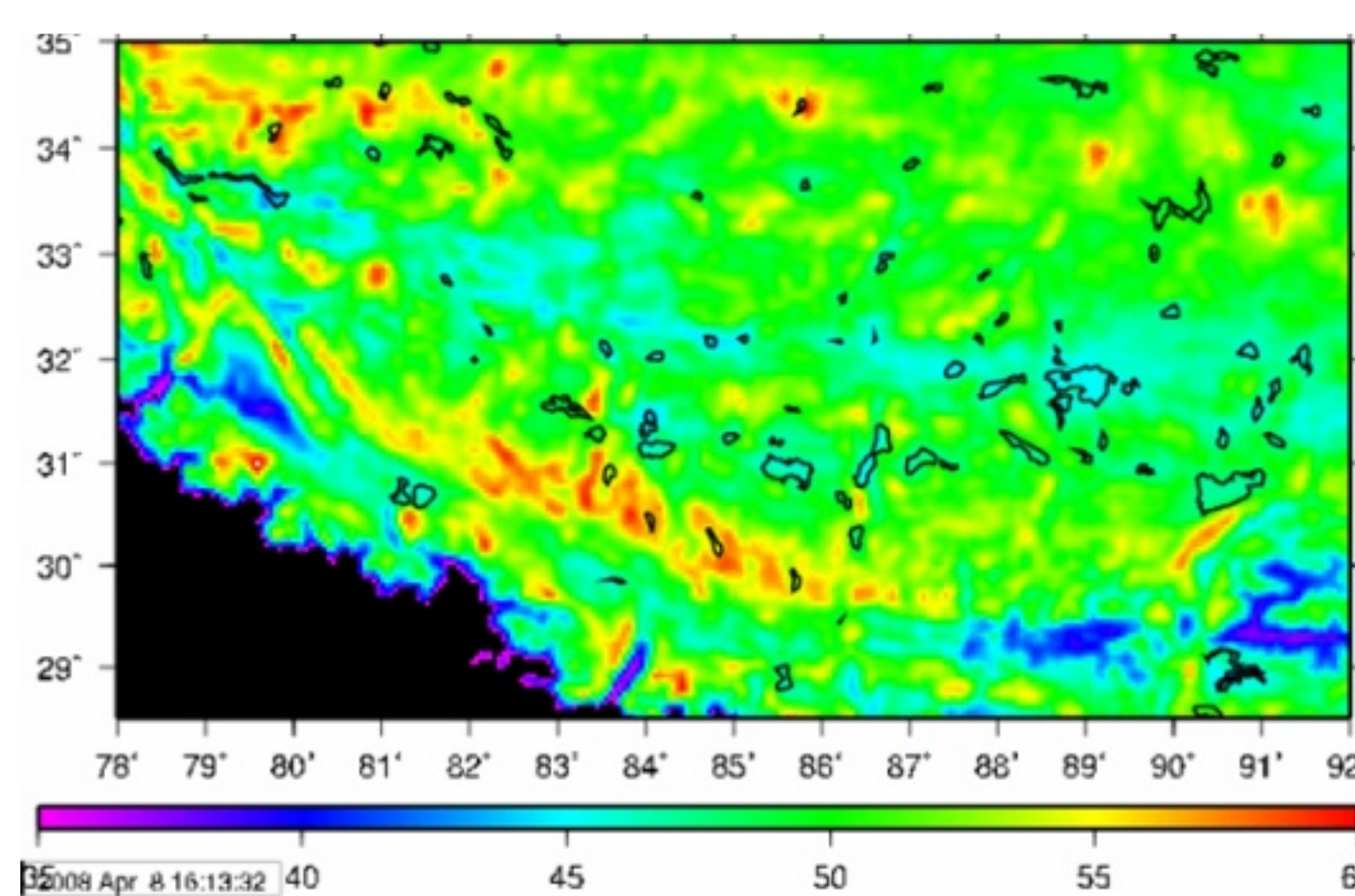


Fig 2 The topographic map of the region. color bar shows topographic height in 100 m.

Rain amount

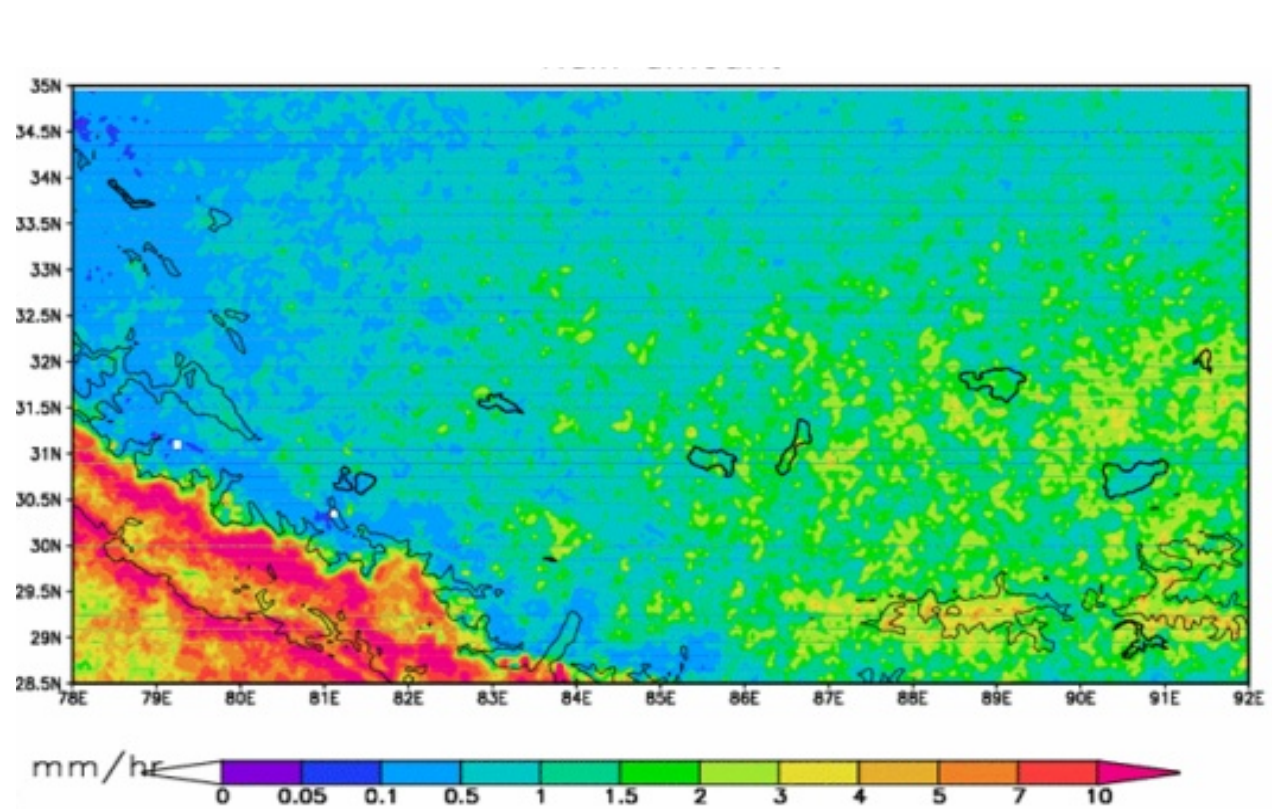


Fig 3 Rainfall amount . Color bar shows rainfall amount in mm/day

Frequency of rainfall

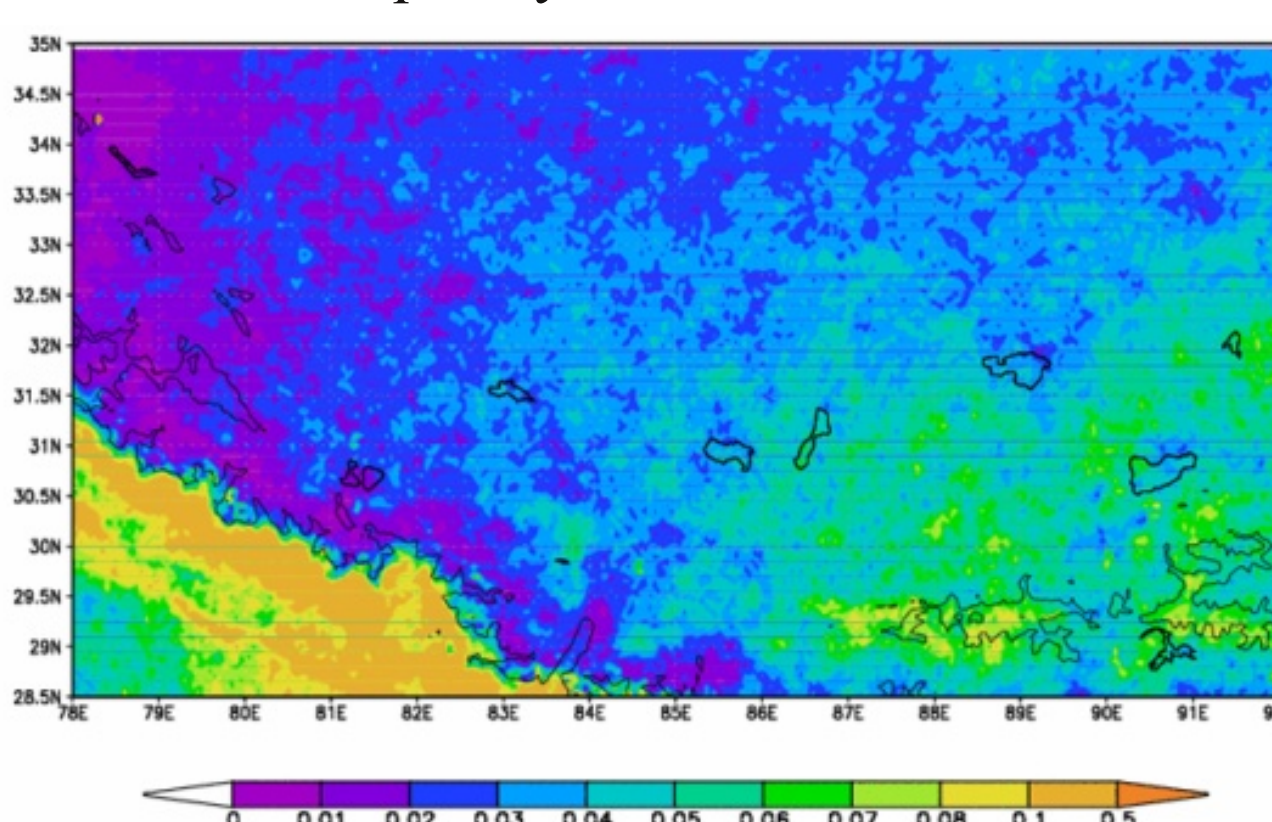


Fig 4 Frequency of rainfall .color bar shows fraction .

Rain conditioned rain rate

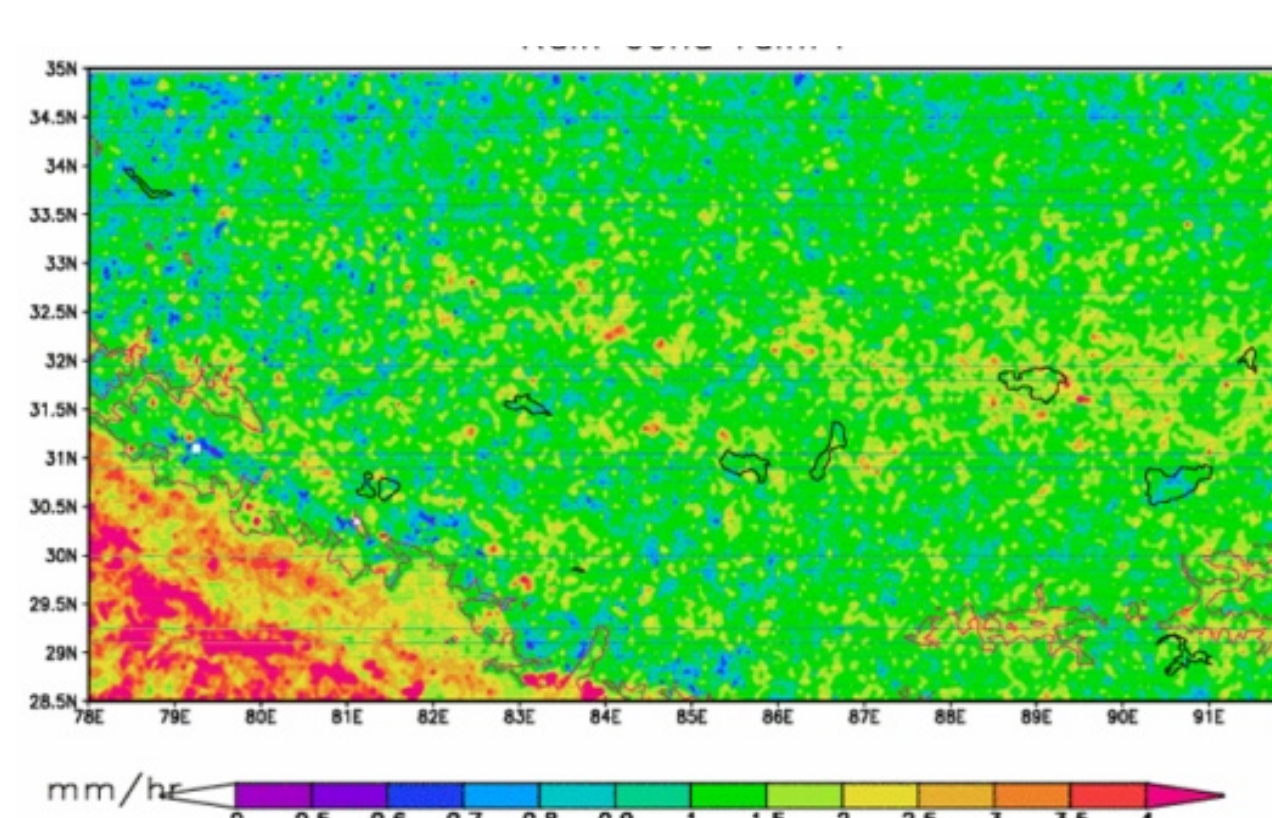


Fig 5 Rain conditioned rain rate . Color bar shows rain conditioned rain rate mm/hr

Relation between Rain conditioned rain rate and frequency of rainfall

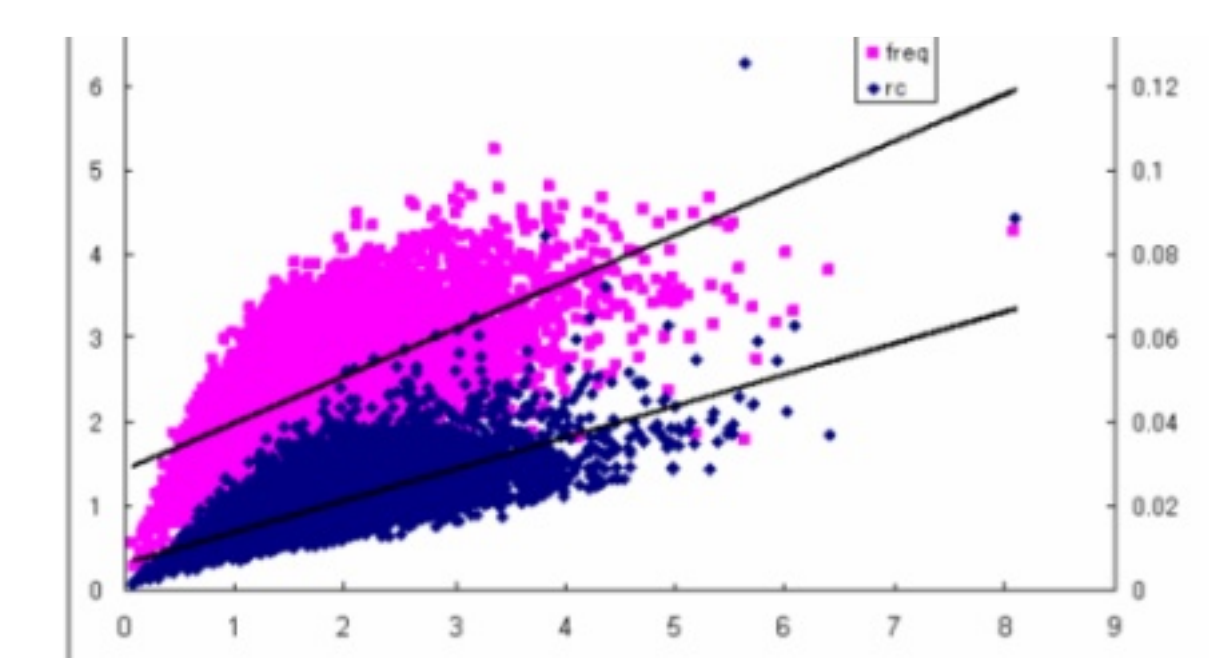


Fig 6. Relation between frequency of rainfall (blue dot) and rain conditioned rain rate (pink dot)

Diurnal Variation

RF (0-12)LT - (12-24)LT

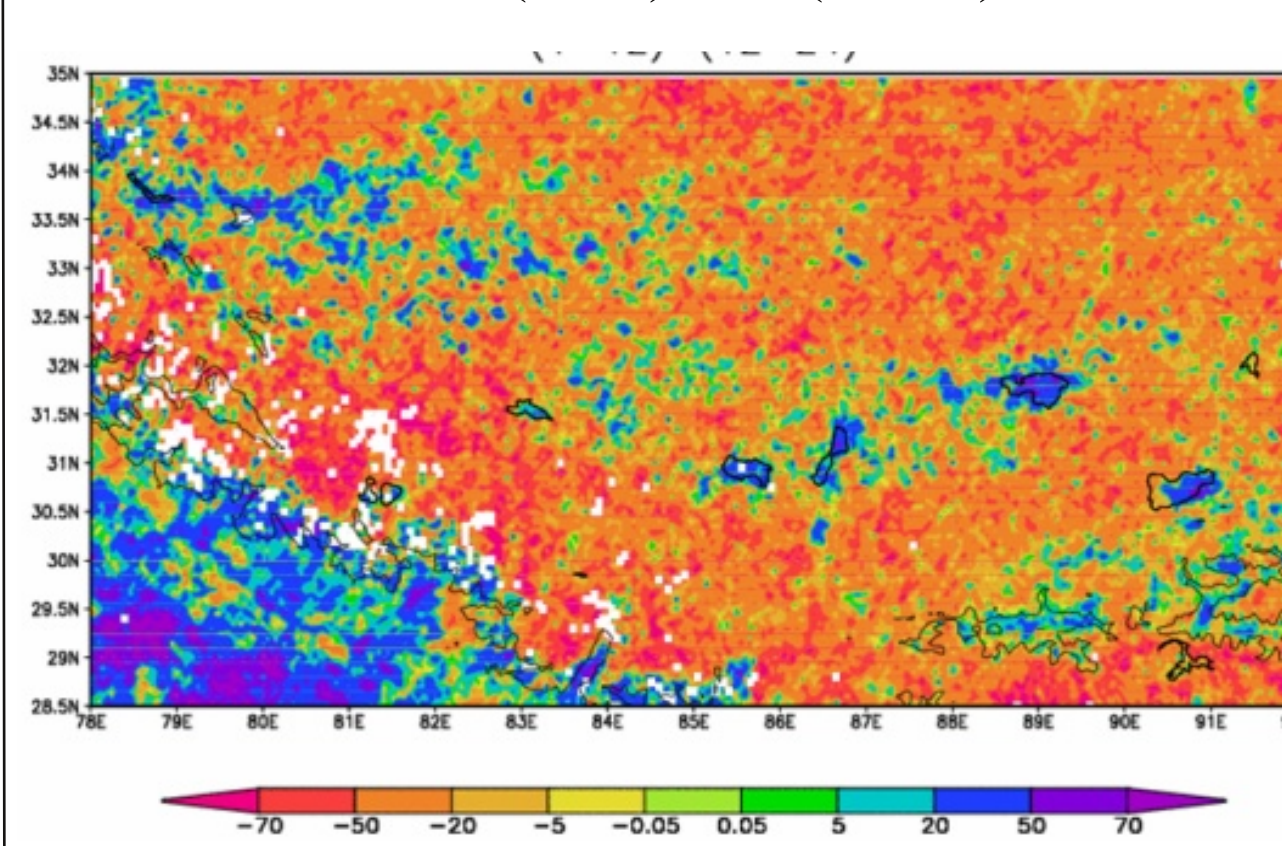


Fig 7 Rain fraction difference during (0-12)LT and (12- 24) LT. The color bar shows differences between two periods.

RF (0-12)LT - (12-24)LT

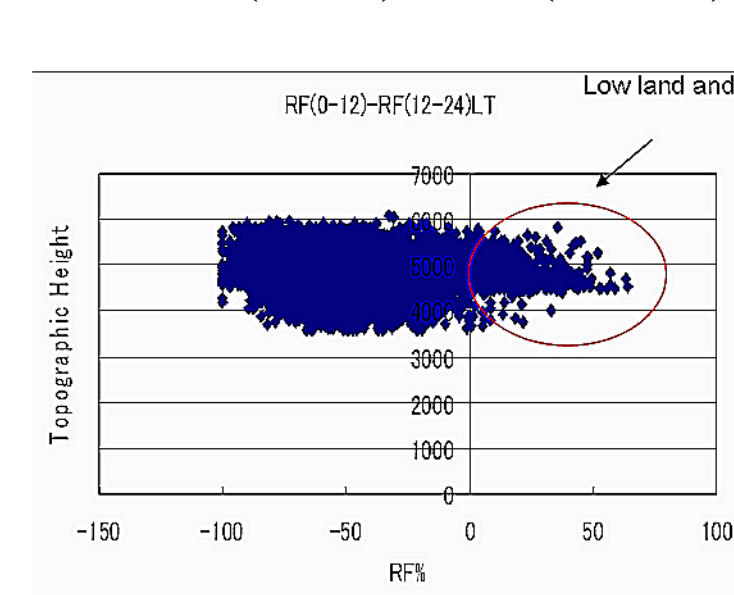


Fig 8. Rain Fraction difference between (0-12)LT-(12-24)LT. Circle indicates Rain fraction over low land and lakes.

Peak Rain time(0-12LT)

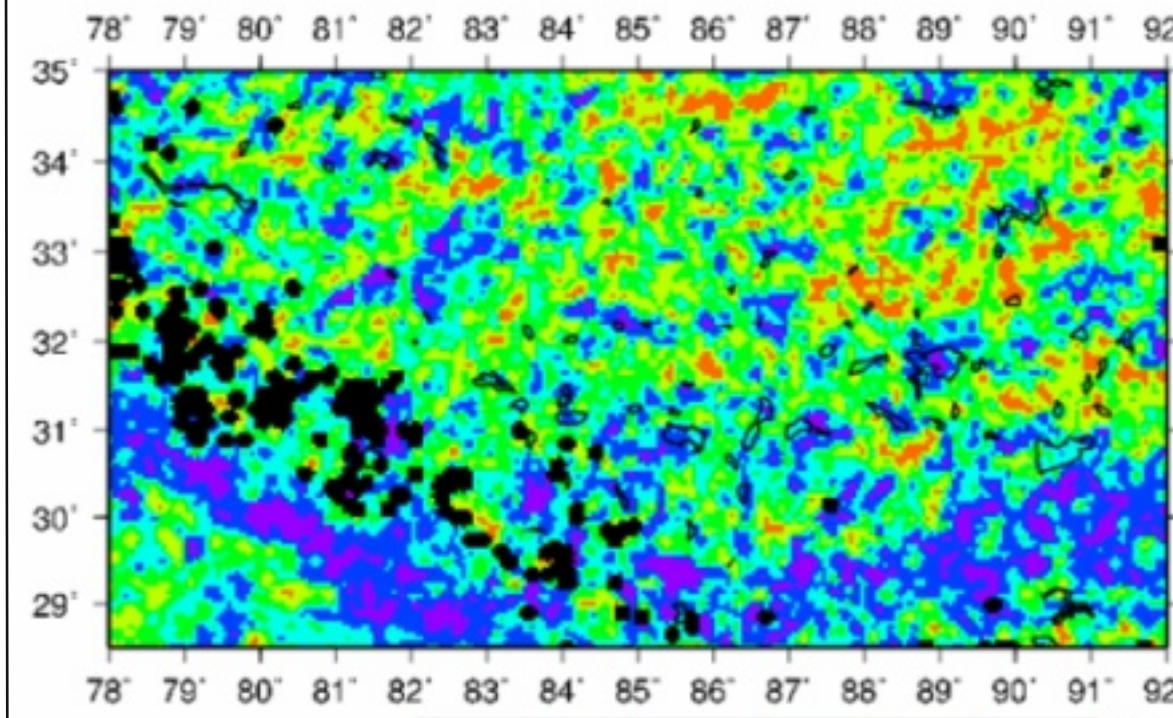


Fig 9 Maximum rain time during period (0-12)LT. Color bar shows time in hour

Peak Rain time (12-24)LT

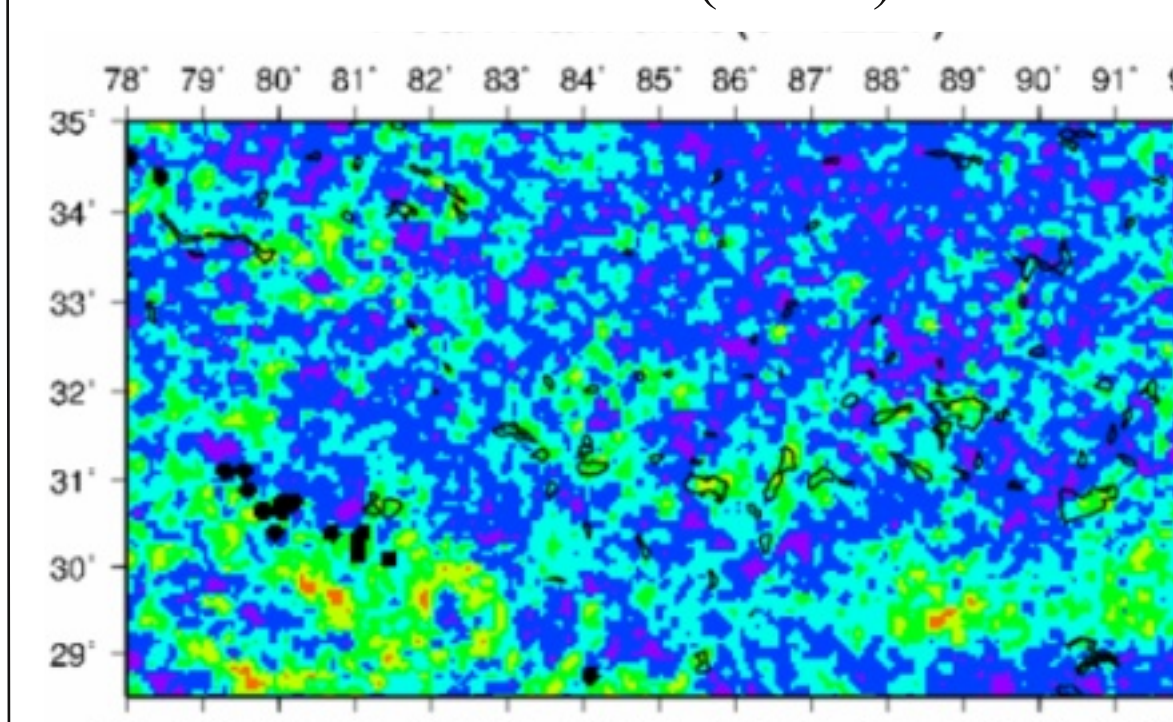
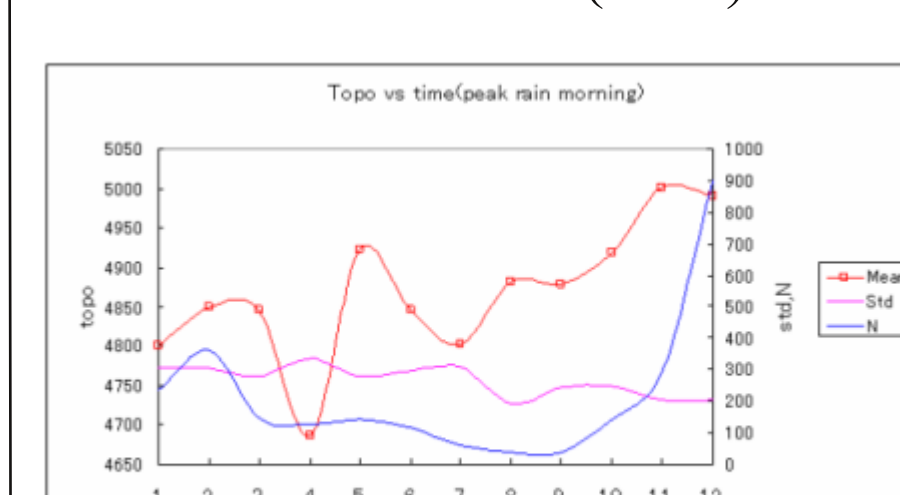


Fig 10 Maximum rain time during period (12-24)LT. Color bar shows time in hour

Peak Rain time (0-12)LT



Peak Rain time (12-24)LT

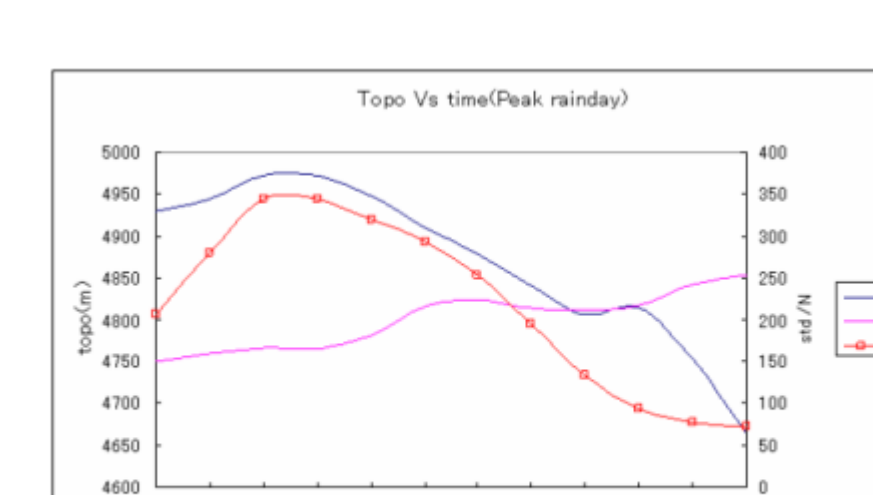


Fig11. shows trend of mean peak rain during (0-12) LT and (12-24) (red line), standard deviation(pink line) and number of rainfall during the period (blue line)

Diurnal Variation over lakes

RF (3-9)LT - (15-21)LT

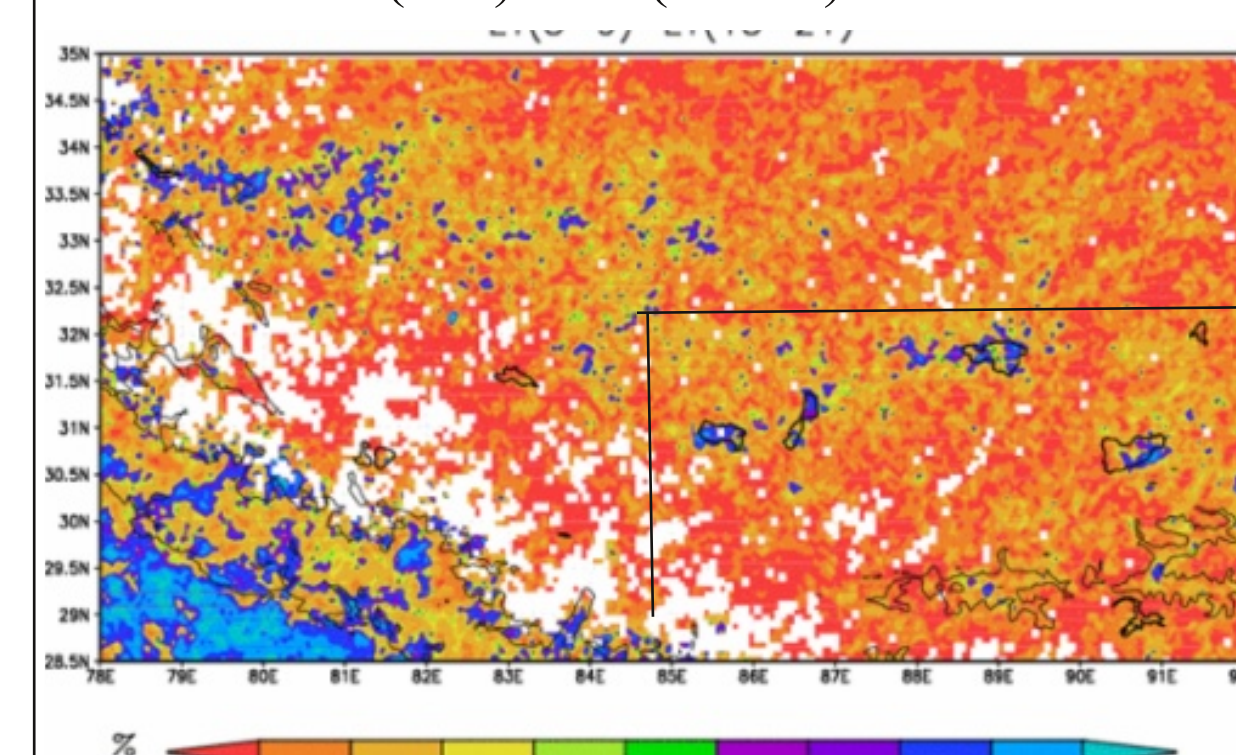


Fig 12. Rain Fraction difference between (3-9)LT-(15-21)LT. color bar shows rain fraction differences in percentage

RF (3-9)LT - (15-21)LT

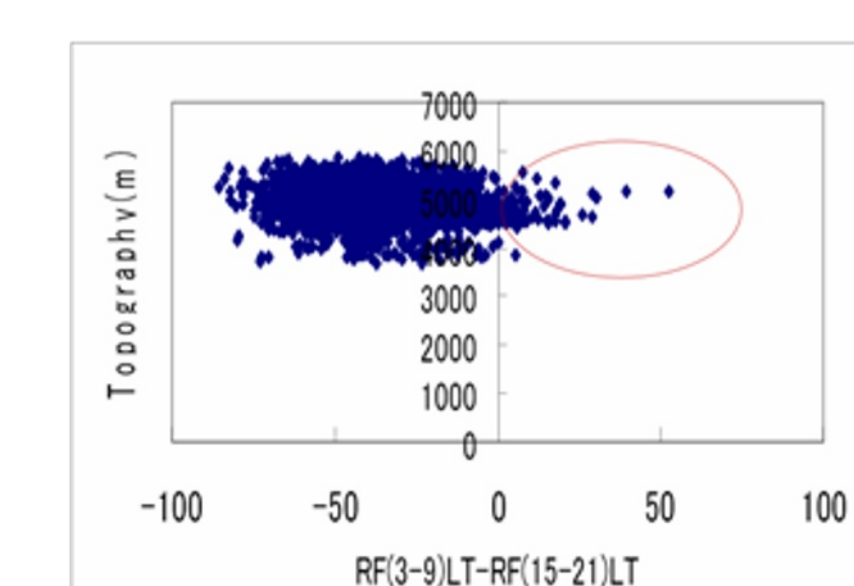


Fig 13. Rain Fraction difference between (3-9)LT-(15-21)LT over [29-33][84-92] Marked circle indicates Rain fraction over lakes

Lakes over region [23-33, 84-92]

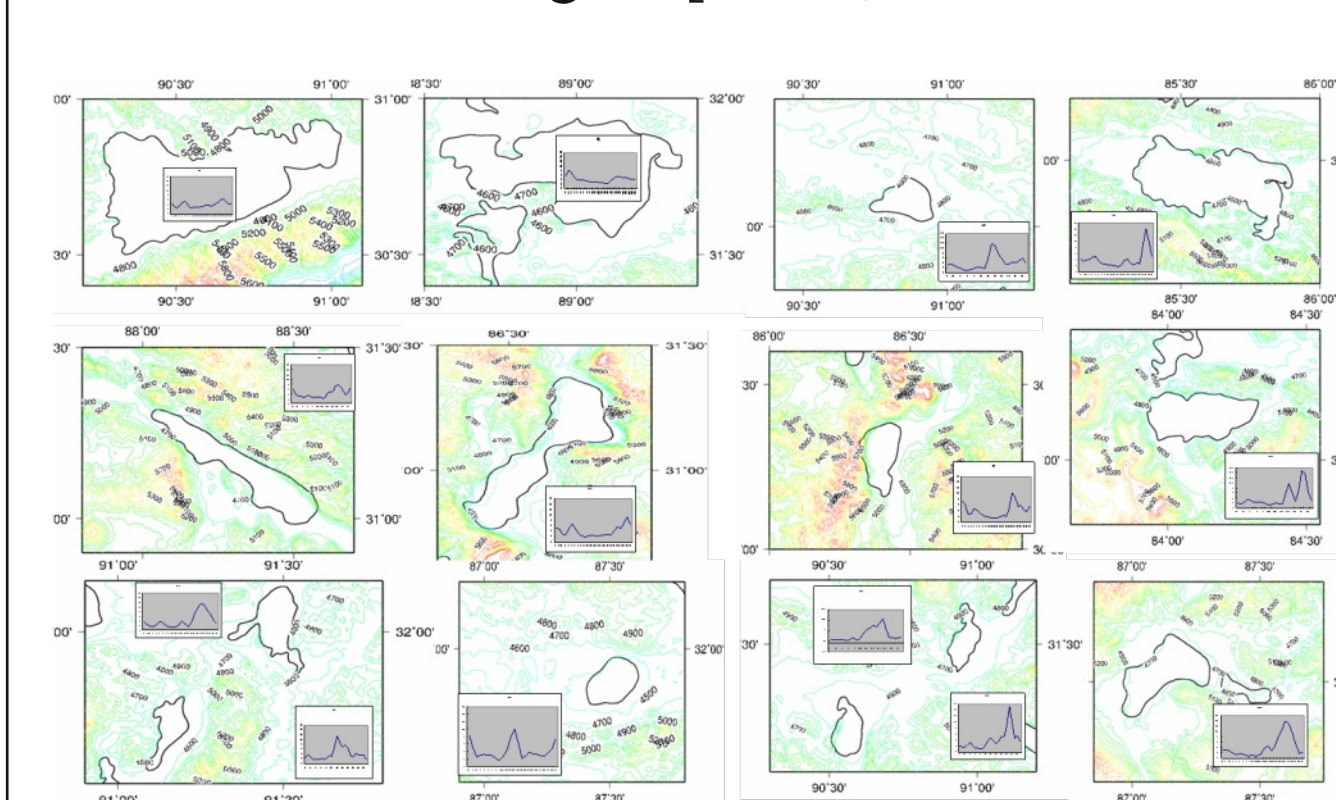


Fig 14 Lakes over Tibetan plateau. Inset shows diurnal variation of Rain fraction .

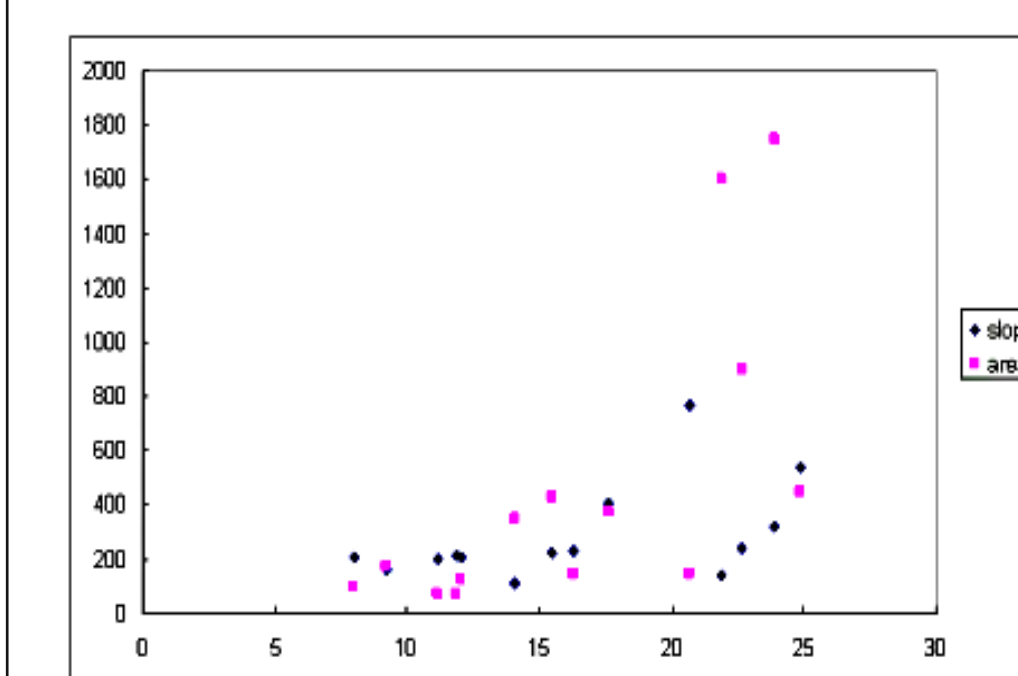


Fig 15 Rain fraction during (3-9) verses area of lakes and steepness of slope around lakes

Strength of diurnal variation VS are and steepness

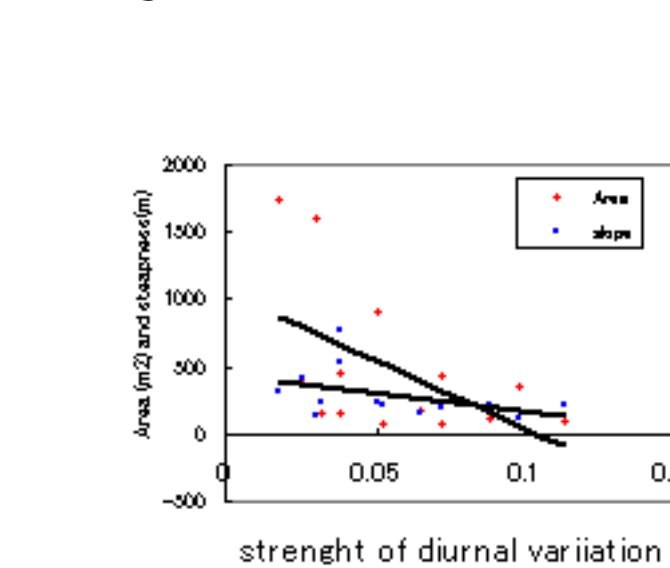


Fig 16. Strength of diurnal variation verses area of lakes and steepness of slope around lakes.

Peak rain time VS area and steepness

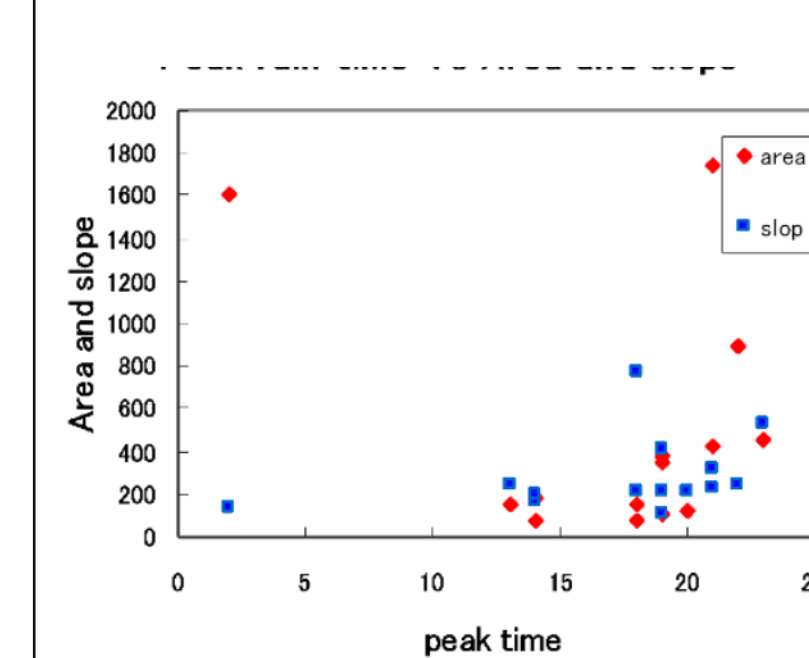


Fig 17 Peak rain time verses area of lakes and steepness of slope around lakes

Fig 7 resembles with topographic map.Low land and lakes of the Tibetan plateau receive more rainfall during late night to morning period(0-12)LT while mountainside and ridge of mountain receives more rainfall afternoon to night period (12-24)LT. Scatter diagram over region [fig 8] also resembles with it. Fig 9 and 10 also resemble with the Fig 7.

During morning period (3-9) rainfall concentrates mostly over lakes [Fig 12] contrasting valleys and mountainside. Scatter diagram [Fig 13] also shows similar result. While studying only over lakes, it is found that total rain fraction during the period depends upon size and steepness around lakes [Fig 15]. Strength of diurnal variation [Fig 16] increases with increase of area of lakes and steepness of slope around lakes. Peak rain time delays as the size of lake increase [Fig 17]

Main Conclusions

- Over the Tibetan Plateau most of the places has afternoon/evening peak of rainfall but most of the low land and lakes have late night peak. Height of the maximum precipitation increases from late night to noon (0-12)LT and decreases from noon to late night (12-24)LT.
- Morning Rain fraction (3-9)LT appears more over lakes (>200km²) contrasting to valleys and mountainsides. This is due to high frequency of rainfall over the period.
- The strength of diurnal variation and maximum rainfall time depends upon area size of lake and steepness of slope around lakes.