Cloud Burst (Heavy Rain) Over Twin Cities Islamabad - Rawalpindi on 23rd July 2001,

By

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Introduction :

Rain events occur in Pakistan mainly due to two main weather patterns.

1. Western Disturbances (Winter Season) .
2. Tropical low pressure systems (Summer monsoon).

The case under investigation relates to summer monsoon which resulted exceptionally heavy rainfall of 620 mm over Islamabad and 335 mm over Rawalpindi in 12 Hours on 23rd July, 2001.

The special weather system (westerly low pressure wave) developed over north of Islamabad with central surface pressure 996 hpa.

The southwest moist monsoon current from the Arabian sea deflected into northern areas of the country.

As a result of the interaction of westerly low pressure wave and deflected moist southwest monsoon current, Intense amount of precipitation was recorded as given in the table.

Name of Station	Amount of rain (mm) recorded from				Total (mm)
	0000-0300 z	0300-0600 z	0600-0900 z	0900-1200 z	
Islamabad (Head Office)	42	132	400	46	620
Islamabad (Margalla Hills)	103	No Record	No Record	314	417
Islamabad (Airport)	Trace	06	65	99	170
Rawalpindi (Shamasabad)	04	83	200	48	335

Three hourly totals of rain recorded at four meteorological stations of Islamabad-Rawalpindi on 23 July 2001.

Data and Analysis :

Based on the actual parameters of pressure, temperature, dew point temperature and wind at twelve vertical data levels (1000, 925, 850, 700, 600, 500, 400, 300, 250, 200, 150 and 100 hpa) at 1x1 grid interval, the following analysis were carried out.

1. Isobaric analysis of surface pressure.
2. GPM analysis from 1000 hpa to 100 hpa.
3. Geostrophic vorticity.
4. Geostrophic thermal advection at 850 and 500 hpa.
5. Geostrophic vorticity advection .
6. Moisture advection at 850 and 700 hpa.

During the analysis, due consideration has been incorporated for the complex terian of Tibetan plateau, Karakarum, Himalayas and Hidu - Kush mountain ranges.

Results and Discussion:

Intense heating converted small scale system over northern parts of the country into a meso-scale severe weather system.
The responsible factors are stated as:

1: Active westerly trough over north of Afghanistan at 500hpa.
2: Very strong and moist deflected easterly currents.
3: The southwest flow of moist currents from North Arabian Sea.
4: Upper air convergence associated with positive vorticity.

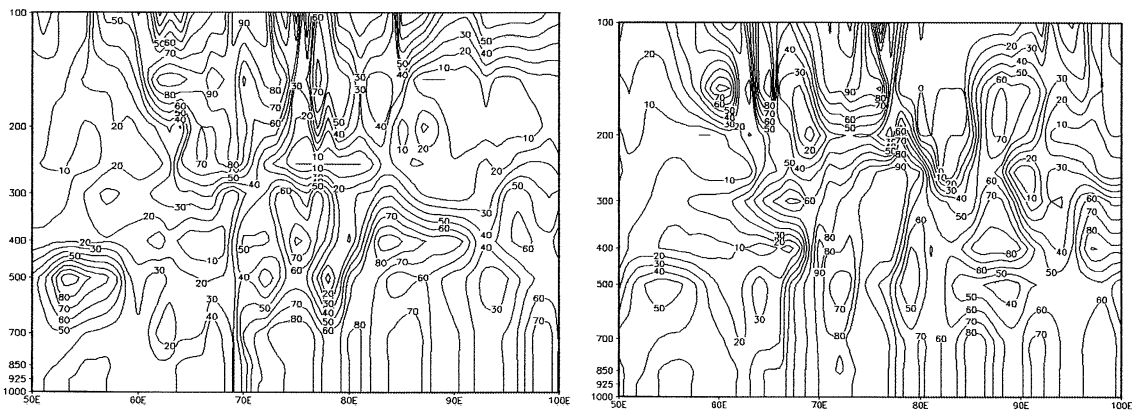
The trough of mid latitude westerlies over north of the country coupled with the monsoon axis, running almost parallel to the Himalayas and extending to northeastern part of Pakistan resulted considerable amount of precipitation.
The Sub-Tropical Ridge located over Tibetan Plateau caused advection of cold air over northern parts of Pakistan. Warm air beneath and cold air above, gave rise to vertical shear. The surface monsoon trough was force to move to the region of strong convergence and increased vorticity area.

Conclusion:

Strong convection produced a low pressure area in northeastern parts of Pakistan which was fed by moisture through monsoon incursion. Significant increase in vorticity and convergence fields was noticed. The trough of mid-latitude westerly located over northwest Afghanistan and cold air advection aloft due to westward shifting of STH triggered its intensity to develop as severe meso-scale system. Producing heavy downpour, first it moved southward and then southeastward following increasing vorticity trend in the convergence field.

The results of the analysis are being summarized in the following figures.

Synoptic Situation :



(a) (b)

Fig.1 (a) & (b) are vertical profiles of relative humidity at 0000UTC on 22 and 23 July 2001 respectively. Relative humidity increased by 15-20% along 73°E longitude during 24 hours.

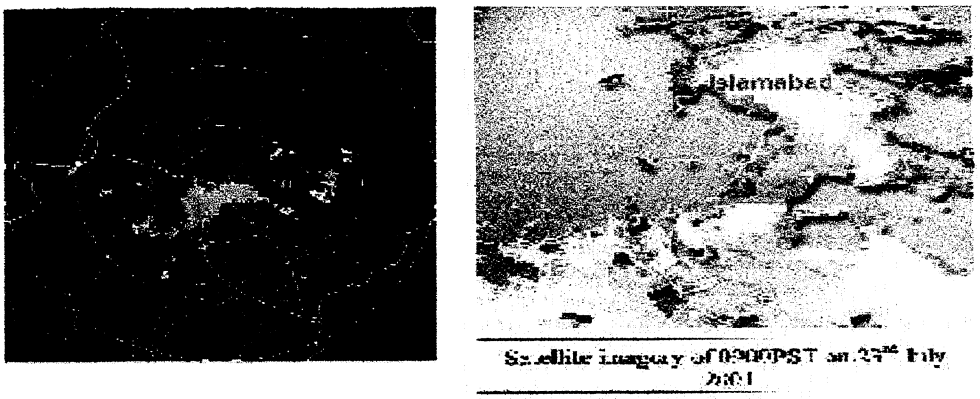
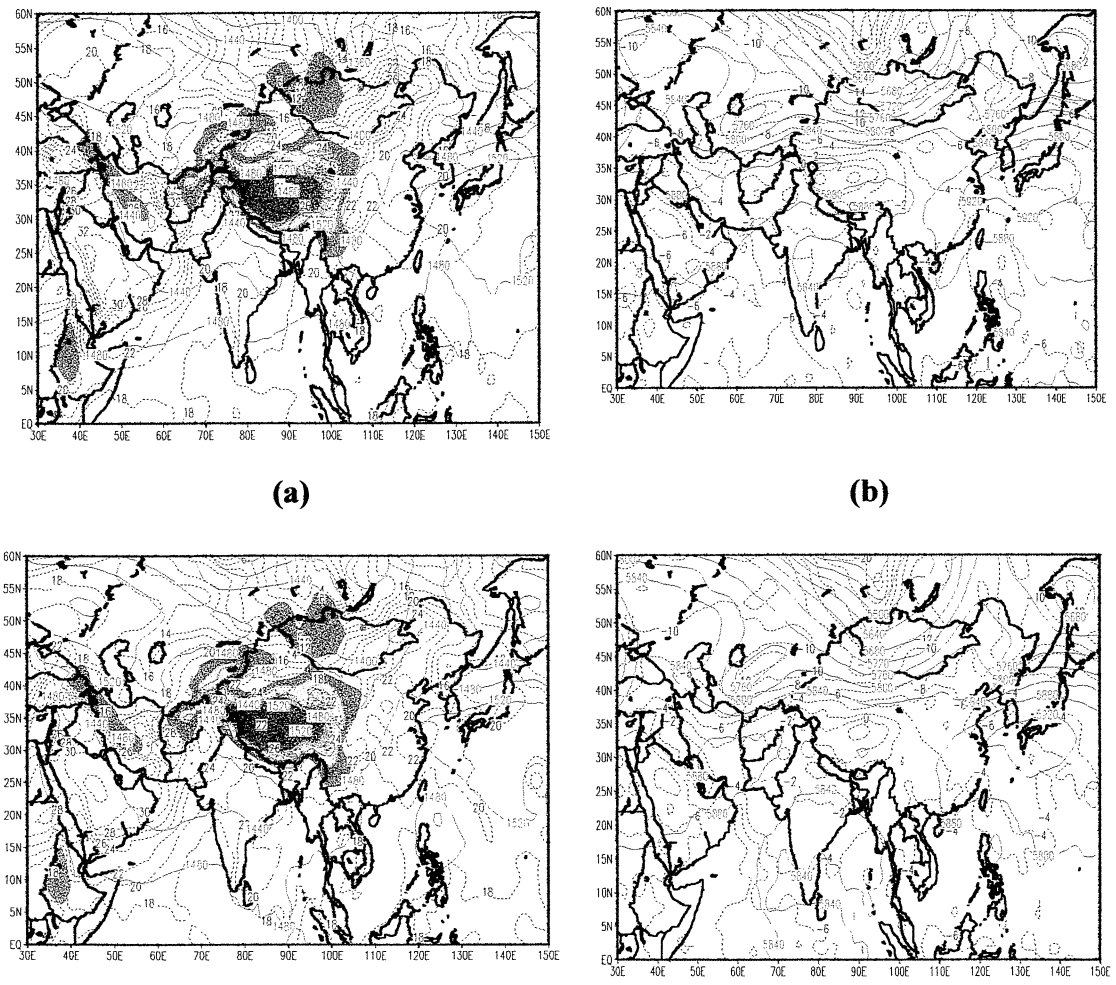


Fig.2 Radar and satellite images showing an intense cloud cluster around Islamabad-Rwalpindi.

Height and Temperature :

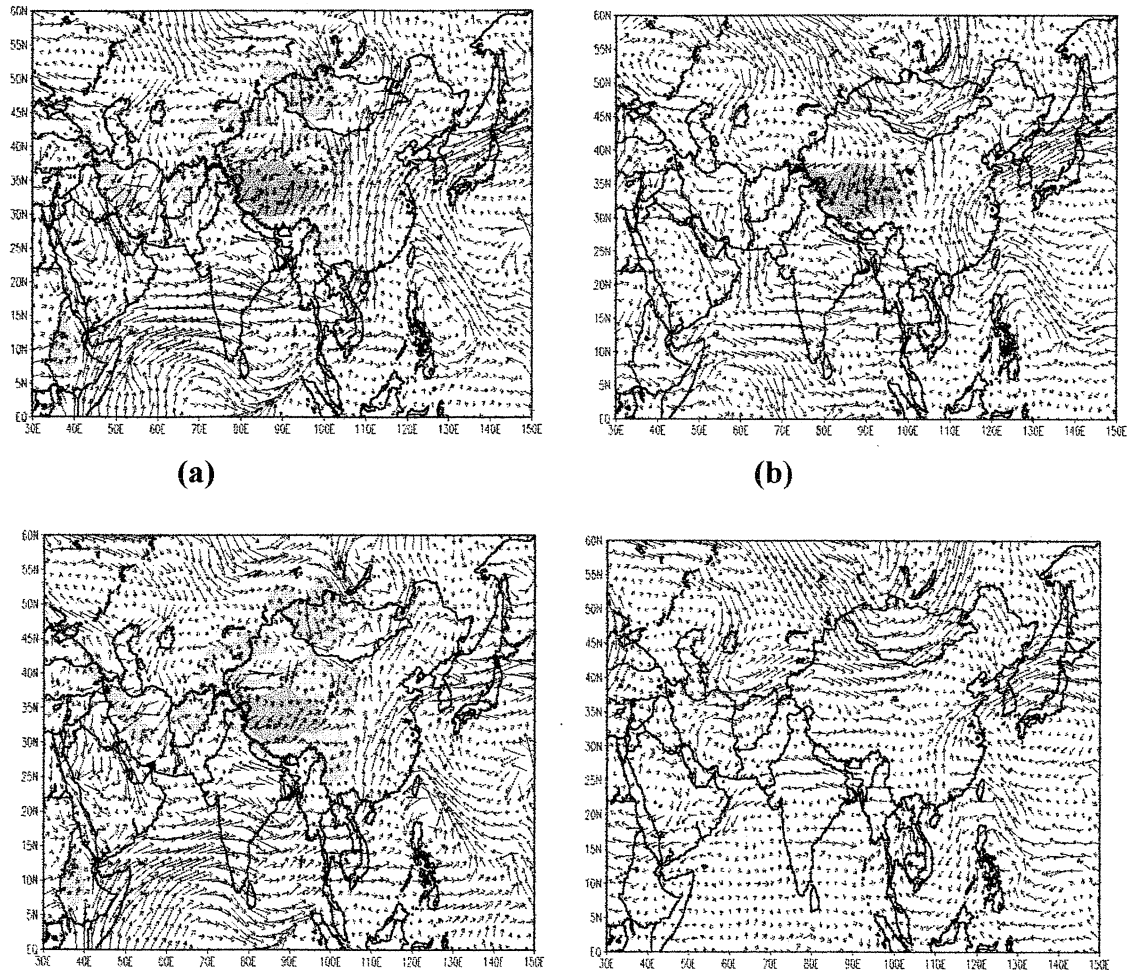


(a) (b)

(c) (d)

Fig.3 (a) & (b) show height and temperature at 850hPa and 500hPa on 22 July 2001 at 1800 UTC while (c) and (d) represent same parameters at same level on the following day at 0000UTC when rain started.

Wind Field:

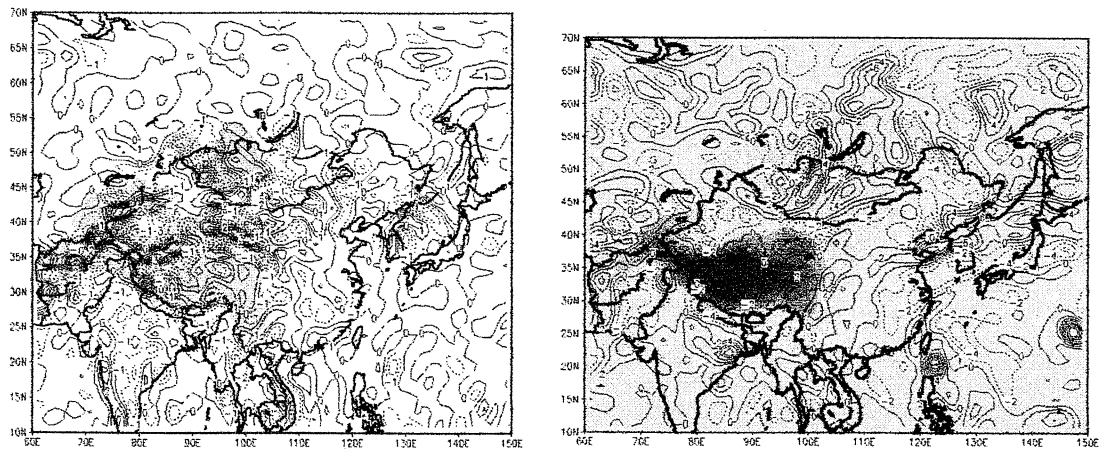


(a) (b)

(c) (d)

Fig 4 (a) & (b) depict the wind pattern at 850hPa and 700hPa on 22 July 2001 at 1200UTC respectively. Incursion of moisture laden monsoon winds is clear from 850hPa (c) and 500hPa (d) as on 23 July 2001 at 0000UTC.

Convergence and Vorticity Field :



(a) (b)

Fig 5 (a) Convergence at 850hPa is shown by dotted lines on 23 July 2000 at 0000UTC. In (b) positive vorticity is represented by solid lines at 700hPa on 23 July 2001 at 0000 UTC.