

バングラデシュにおける 降水の日変化について

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今日の話

◆話題1

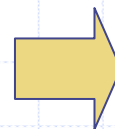
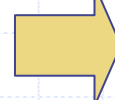
- バングラデシュの降水日変化パターン分布
- 上空の風との関係：夜間ジェットが存在

◆話題2

- 自記雨量計データを用いた、プレモンスーン・モンスーン期の降水パターン比較

◆話題3

- 雨量計の設置状況と今後



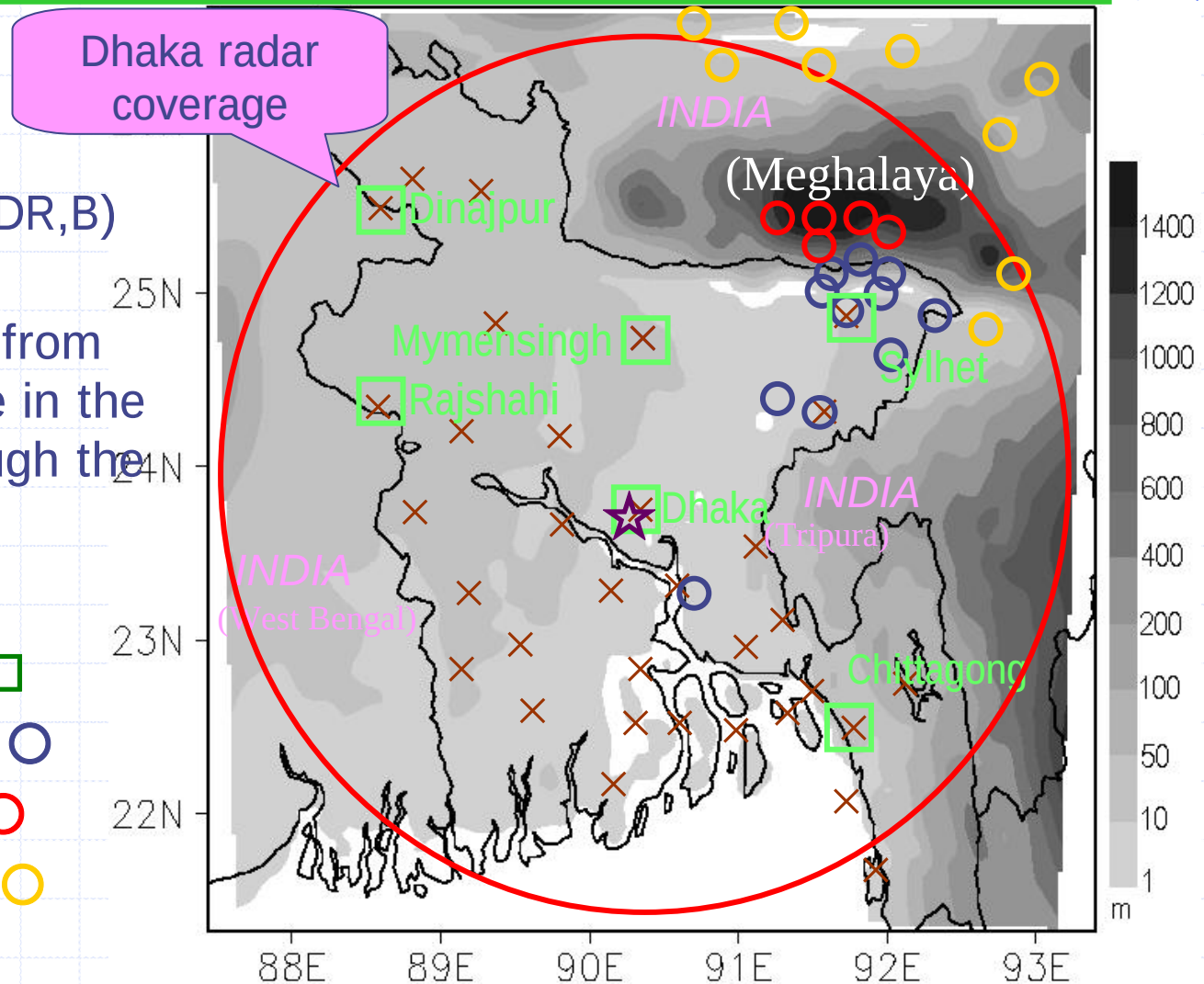
Locations of radar and raingauges

◆ AWS: ☆

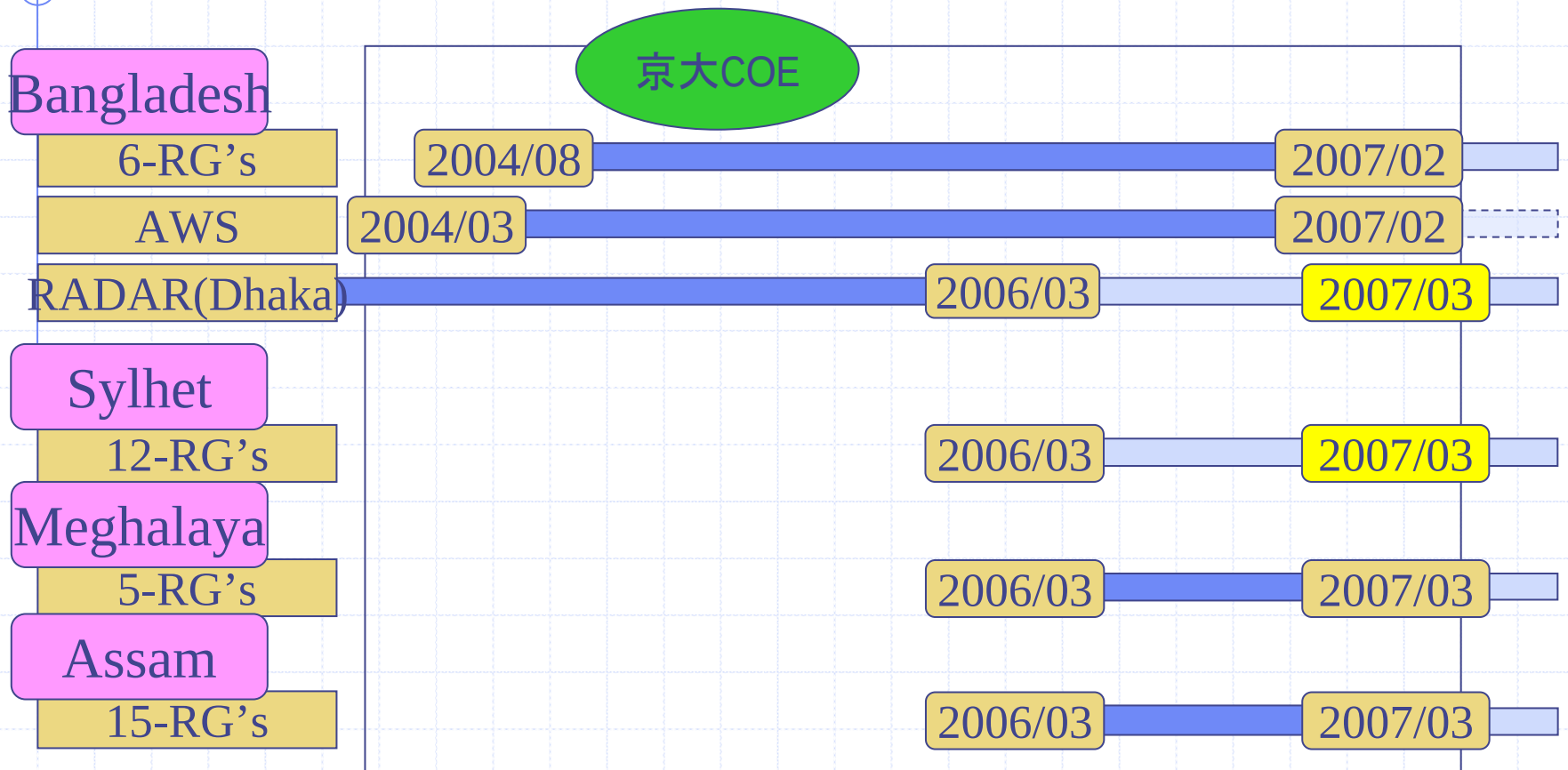
- Dhaka(ICDDR,B)
- Data are accessible from everywhere in the world through the network.

◆ Raingauges

- 6-gauges: □
- 12-gauges: ○
- 5-gauges: ●
- 15-gauges: ●



雨量計とAWSの設置・データ収集期間



今後

- ◆ 自記雨量計データ解析を進めていきたい
 - Sylhet域の詳細な降水・日変化パターン分布
 - Meghalayaの降水パターン
 - 降水強度の季節依存性
 - 降水の移動方向・降水量相関の距離依存性
 - Dhakaレーダーデータのキャリブレーション
 - Assam, Meghalaya, Bangladeshの比較

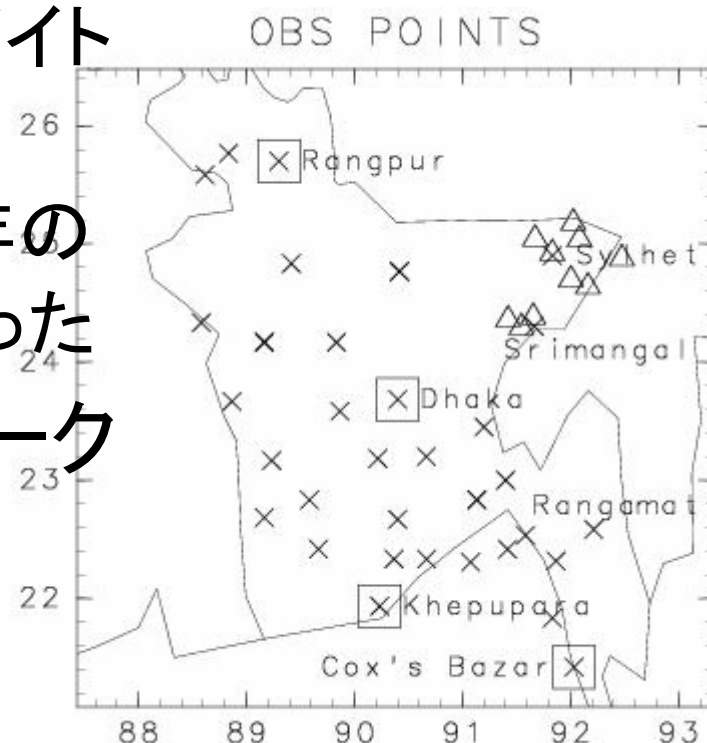
Terao et al. (2006/GRL)

地上雨量観測

■ BMD(気象局)データ ×印

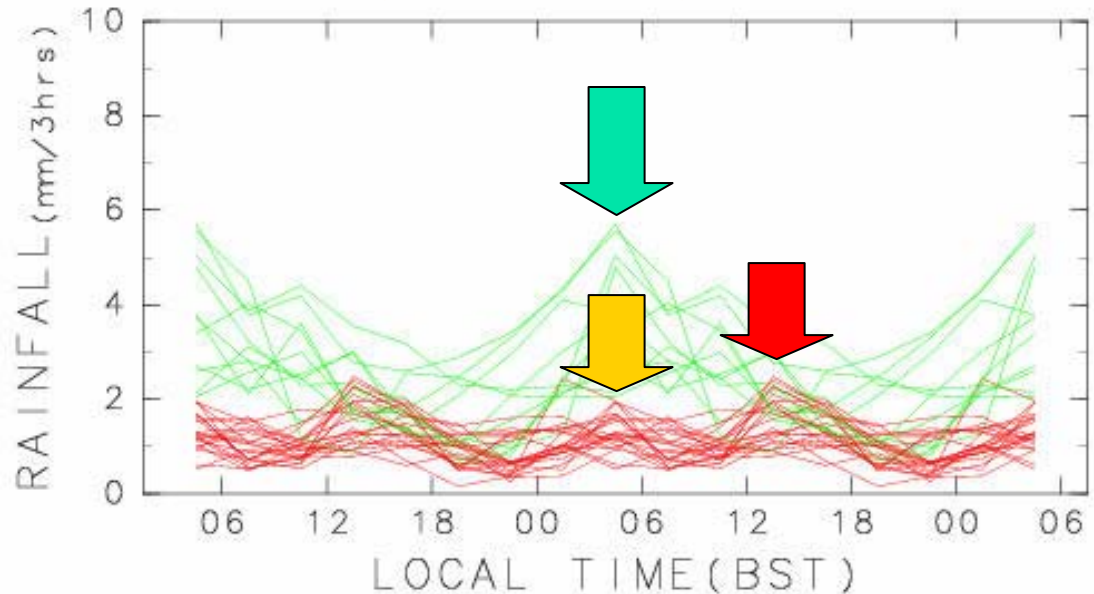
- 特別に学生にアルバイトで入力してもらった
- 原簿の束から2000年の分のデータを読みとった

■ JICA雨量計ネットワークのデータ △印



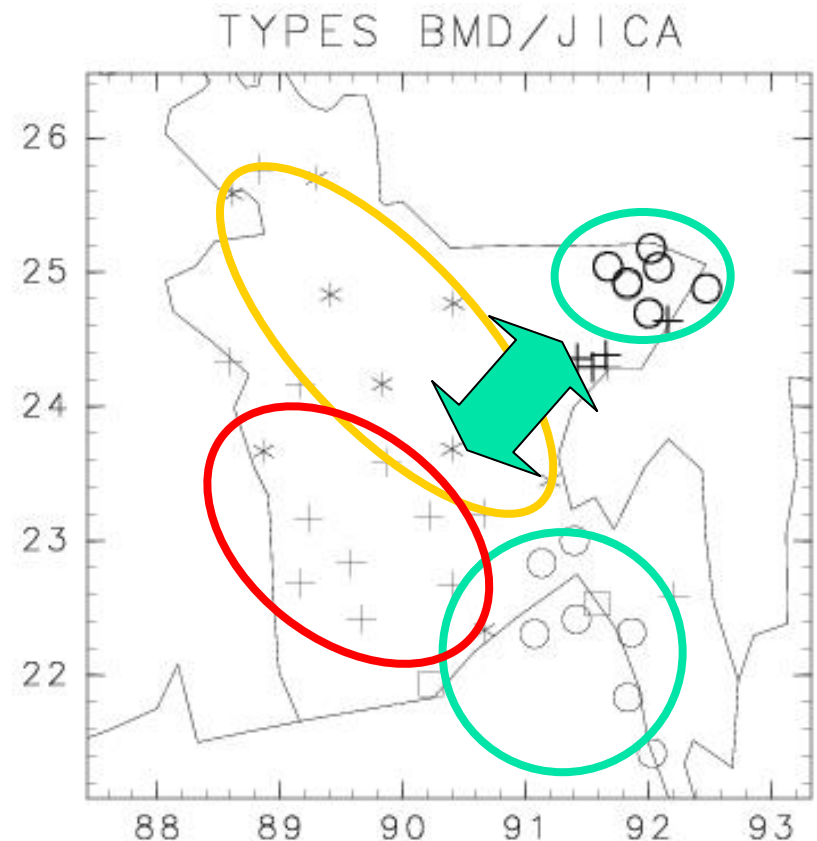
降水日変化パターンの分類

- クラスター分析＋単純な指標による分類
 - 降水量平均以上＋**深夜**にピーク
 - 降水量平均以下＋**深夜から早朝に／午後に**ピーク

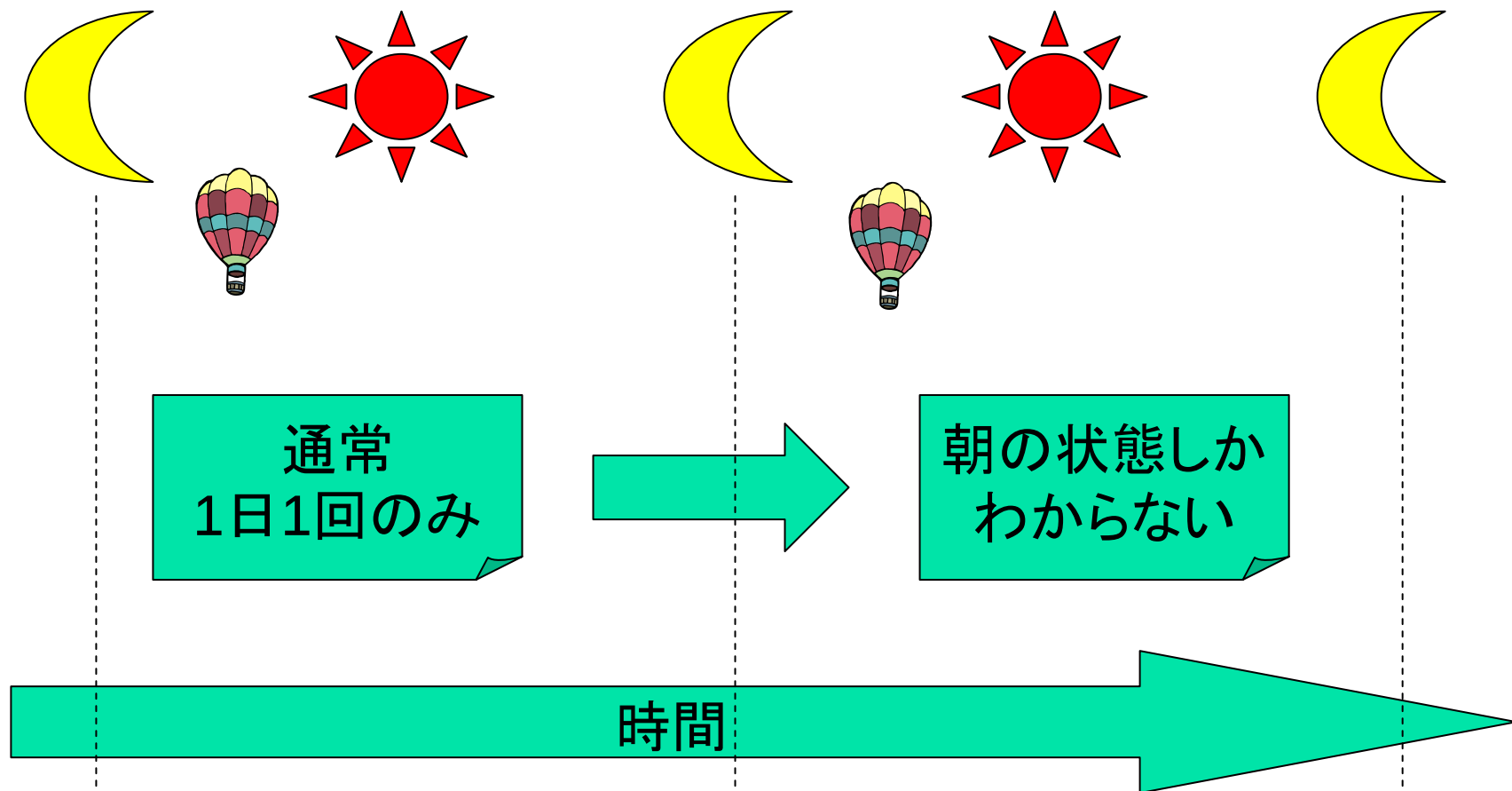


日変化パターンの地理分布

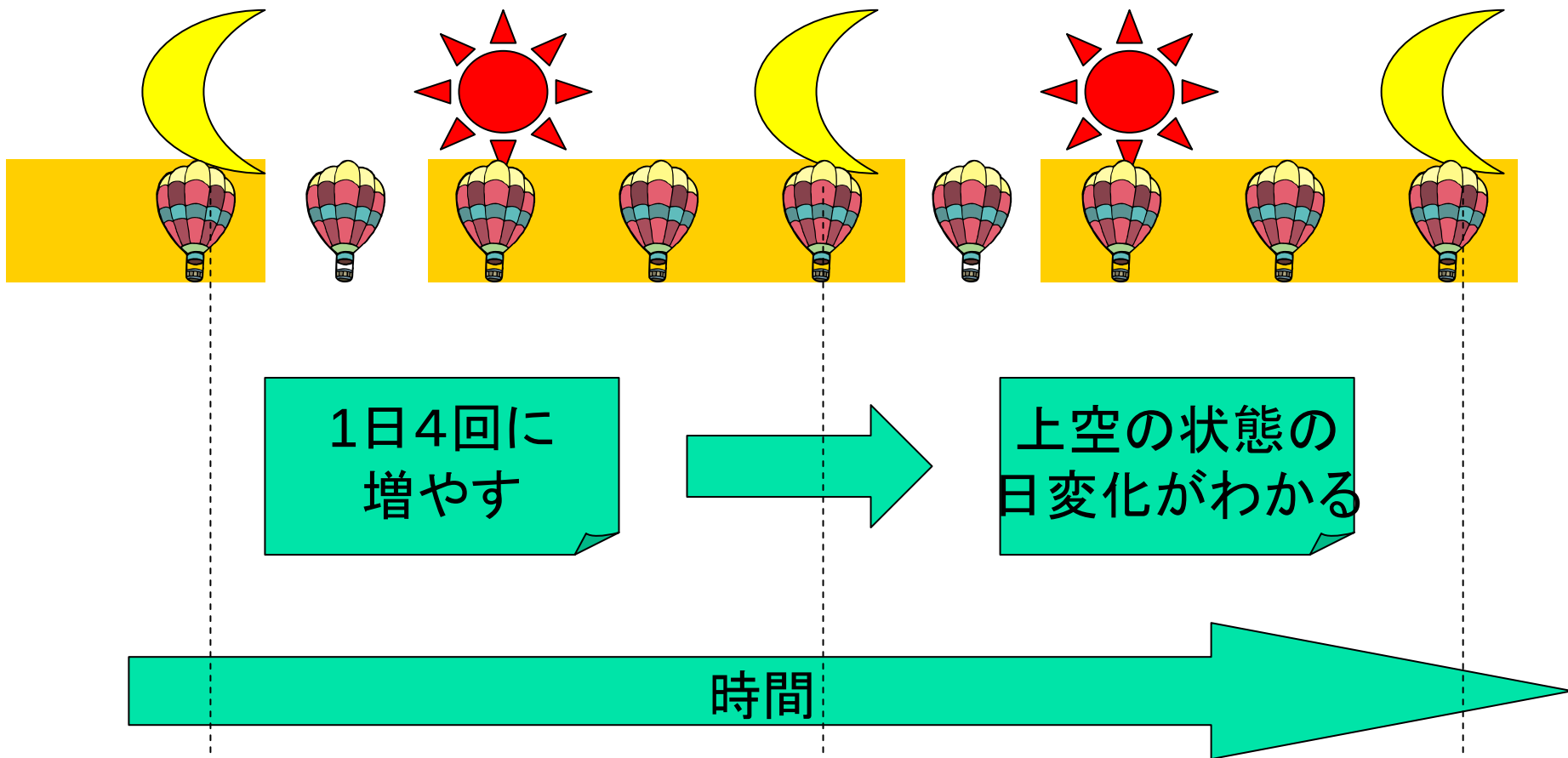
- 北東部と南東部は多雨深夜～早朝型
- 南西部：午後型
- 北部：深夜型



ダッカの高層気象観測事情

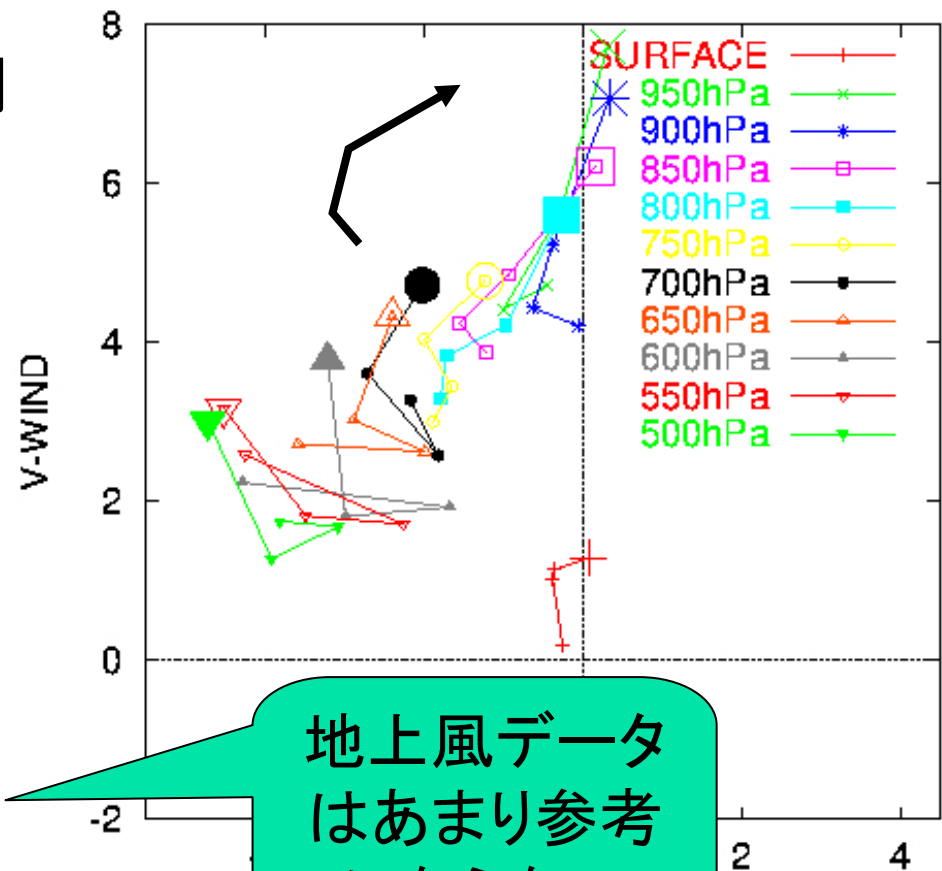


特別強化観測の実施



ダッカ上空の風の日変化

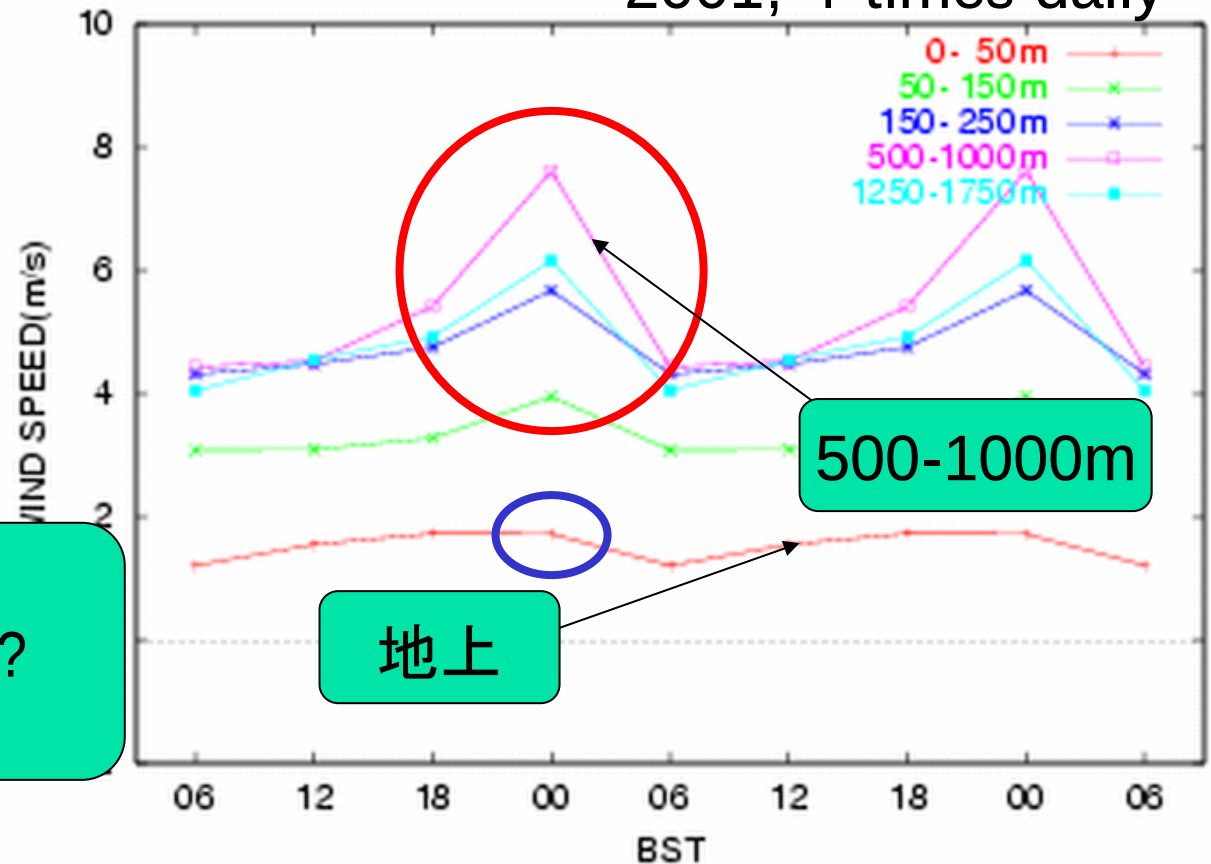
- 夜間に特徴的な風向
風速の変化
 - 風速増加
 - 時計回り
- 地上の風の特徴
 - 朝(06BST)風速減少
 - 接地境界層の影響が顕著
 - 上空の風の特徴と異なる



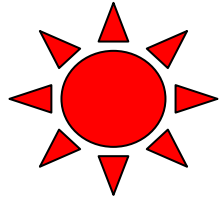
風速はどこが一番強いのか

- 500-1000m付近に極大

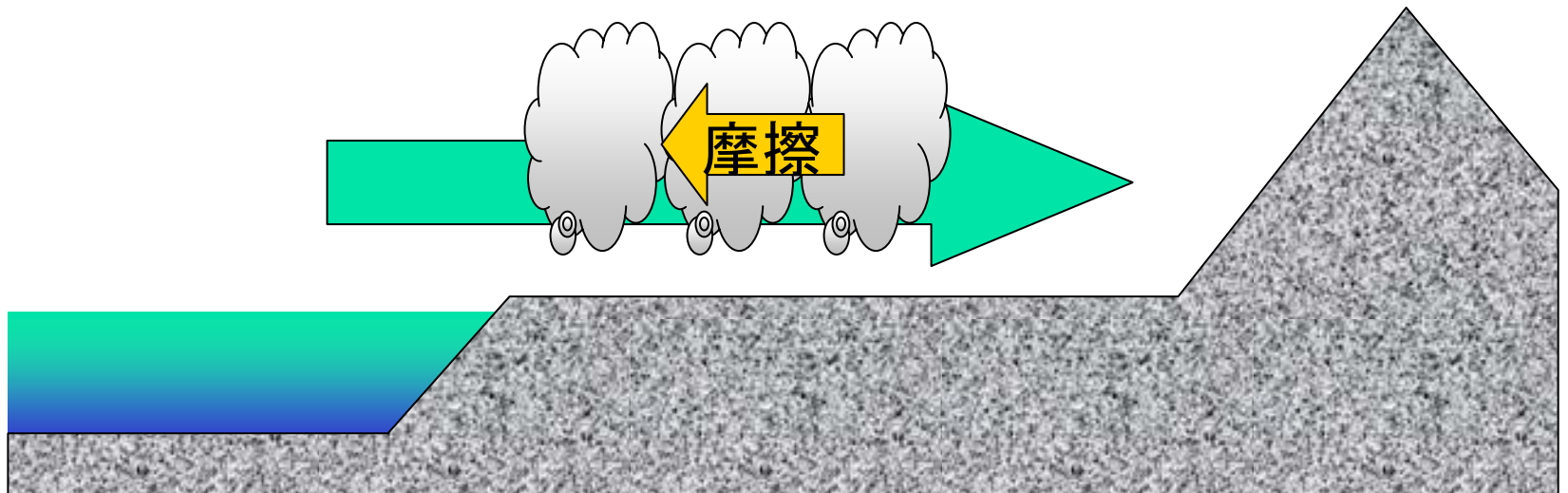
Rawin-sonde
2001, 4-times daily



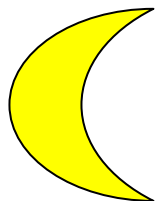
Nocturnal Jet と雨



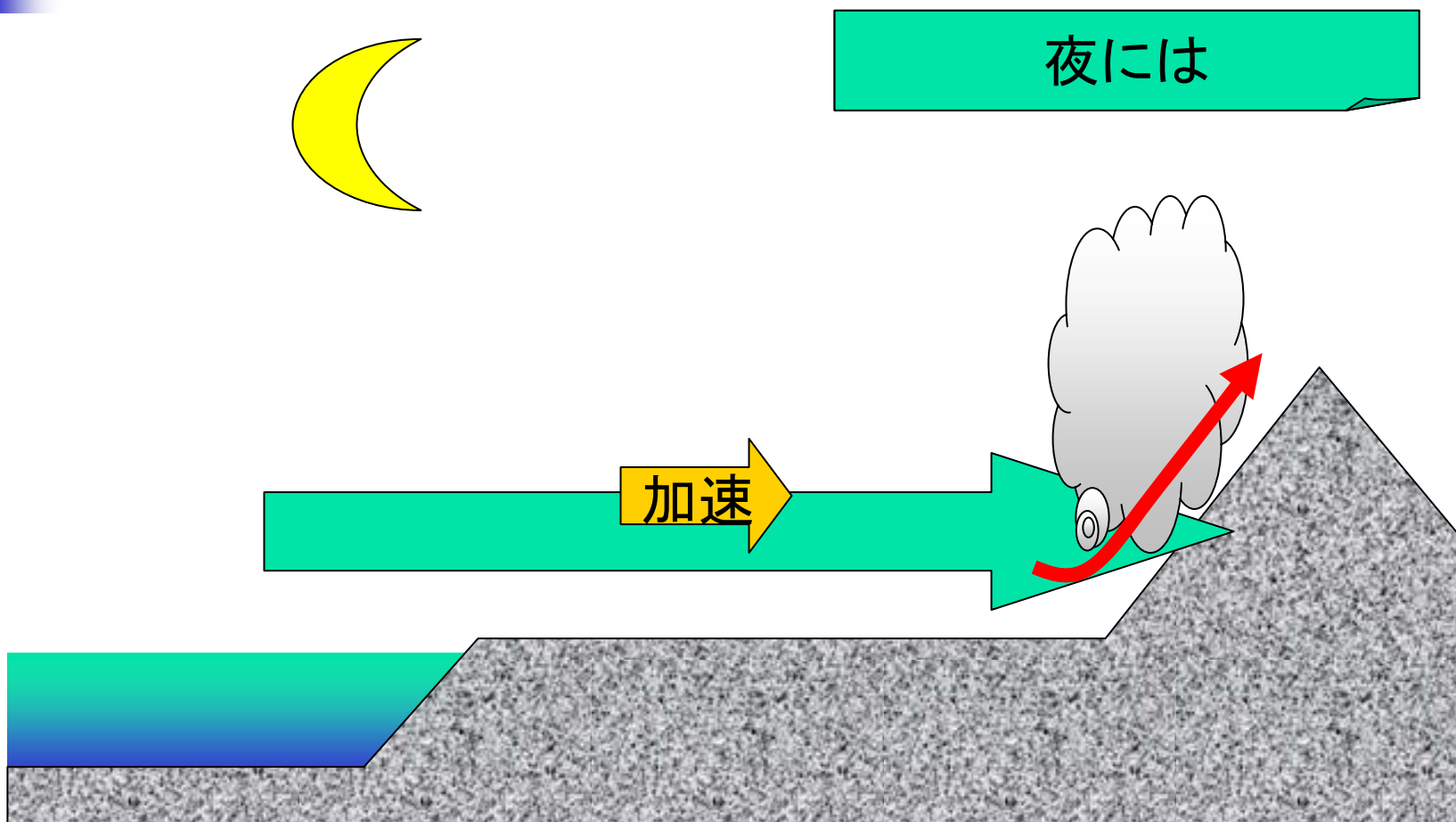
昼には



Nocturnal Jet と雨

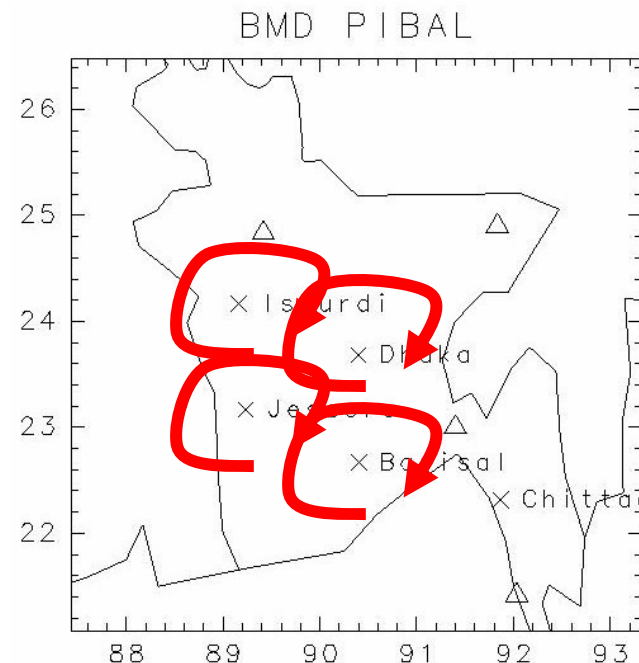
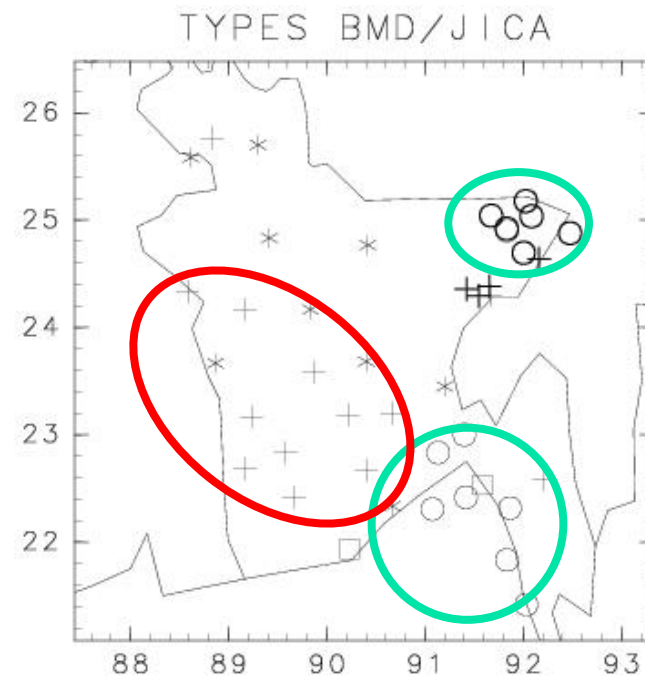


夜には



まとめると

- バングラデシュの雨の日変化パターン
 - 北東部・南東部:大雨＋深夜雨型
 - 中部・南西部:昼雨型
- Nocturnal Jet 的な風が吹いている
 - 夜の北東部の大雨の原因かもしれない





Terao et al. (2007/JND)

Convection: 17/18 July 2001

A typical pattern of the diurnal variation will be shown using Dhaka RADAR data.

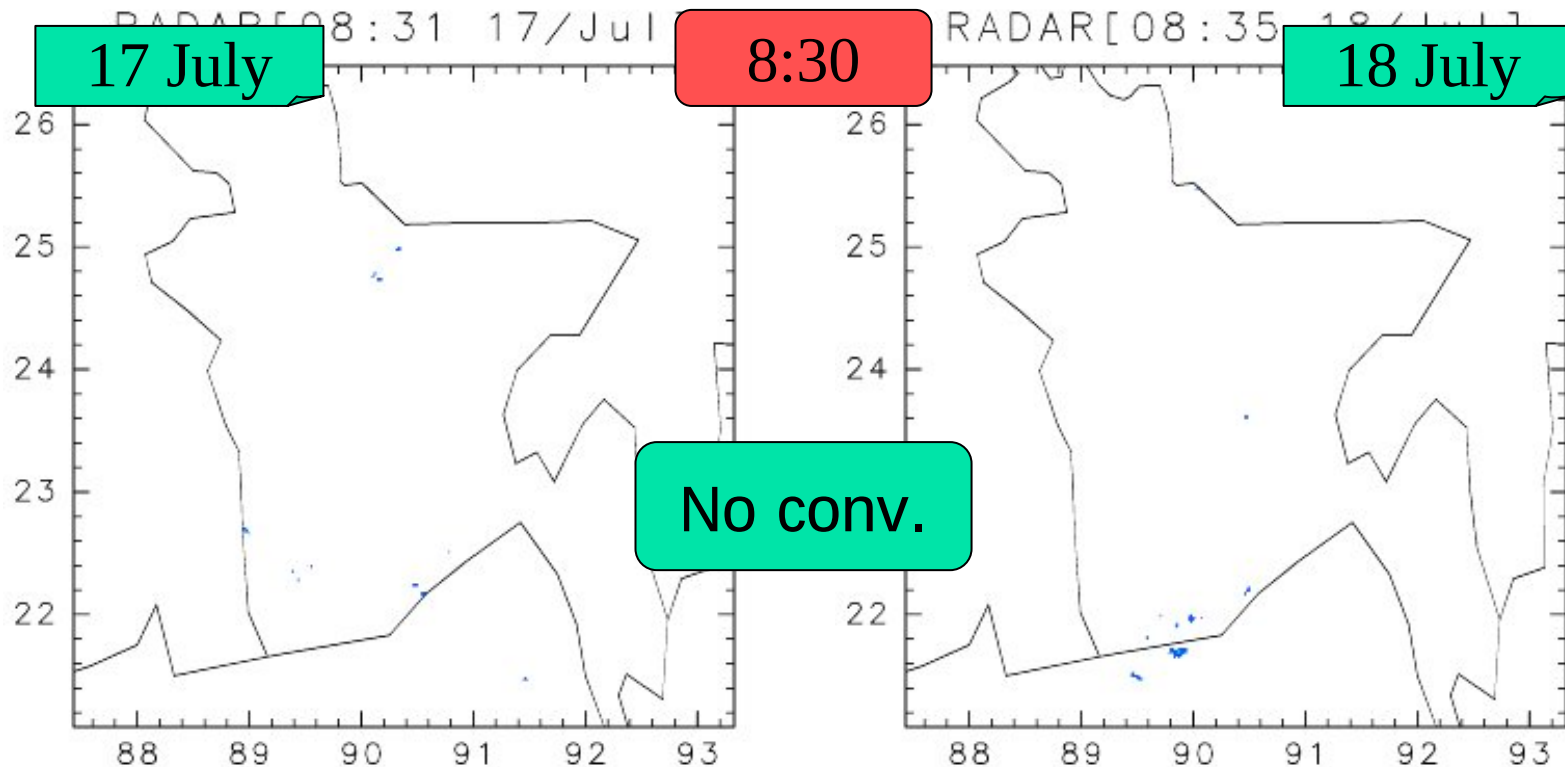
17 July

18 July

8:30, 11:30, 14:30, 17:30, 20:30, and 23:30

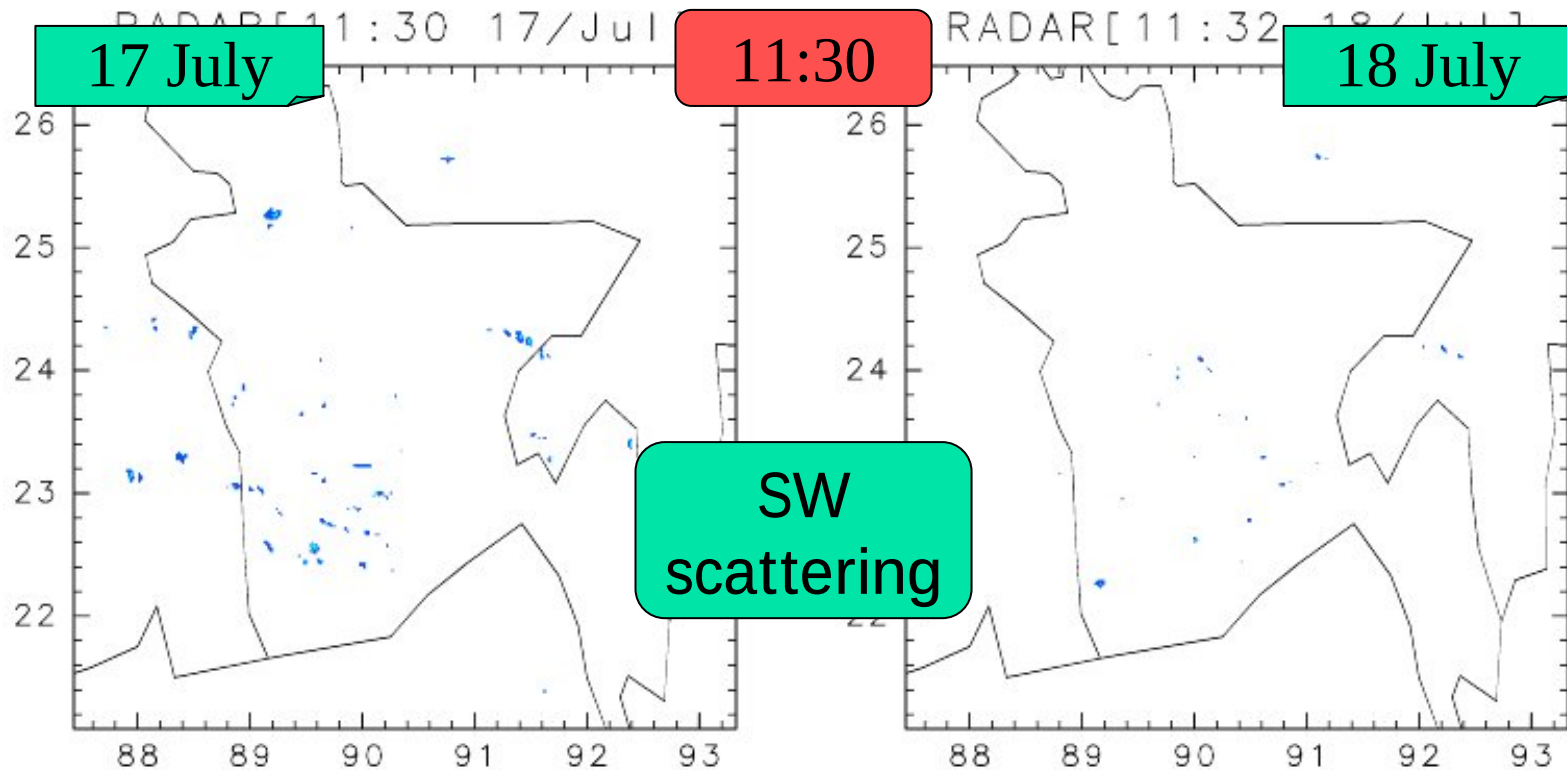
Convection: 17/18 July 2001

A typical pattern of the diurnal variation will be shown using Dhaka RADAR data.



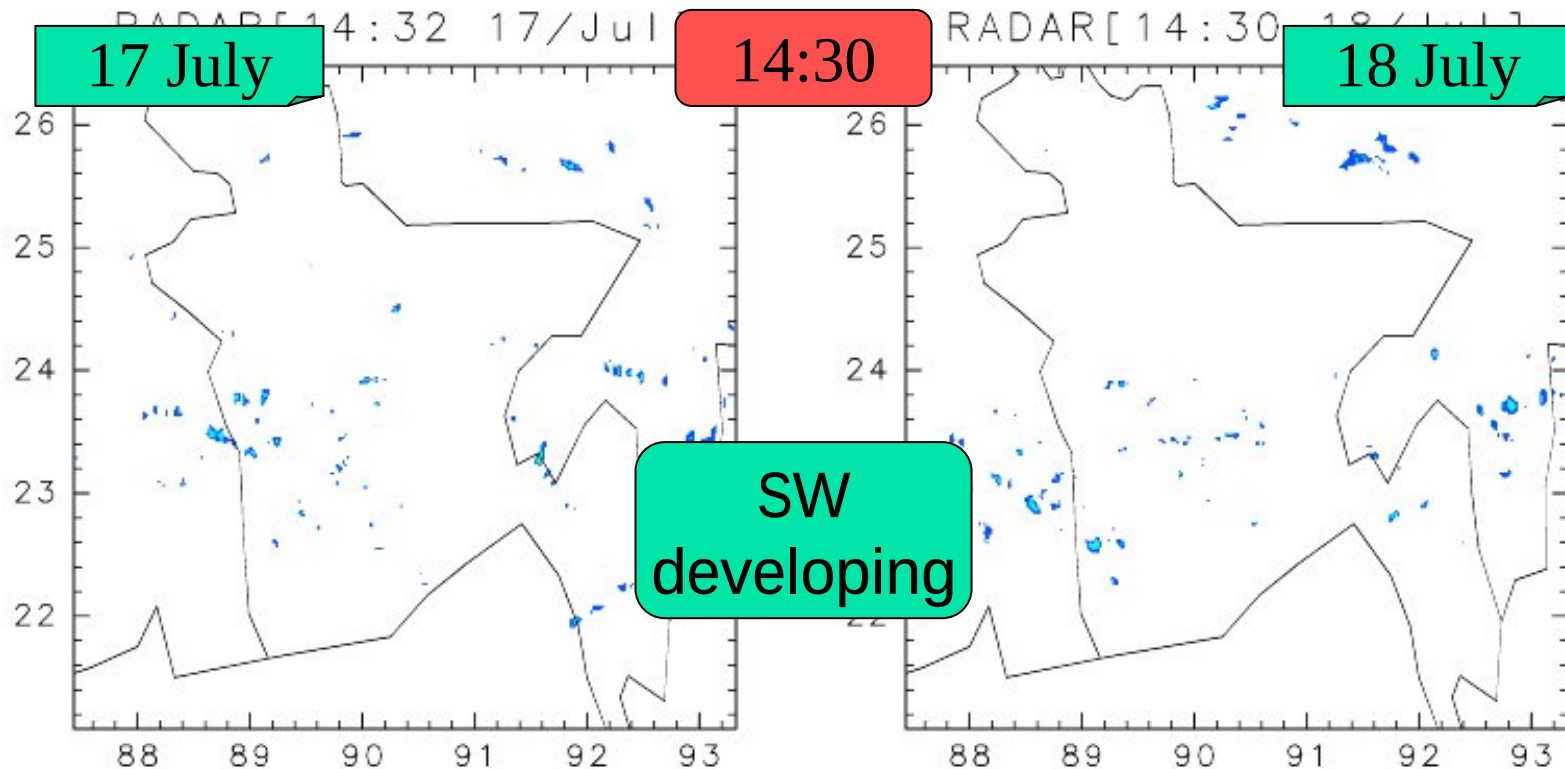
Convection: 17/18 July 2001

A typical pattern of the diurnal variation will be shown using Dhaka RADAR data.



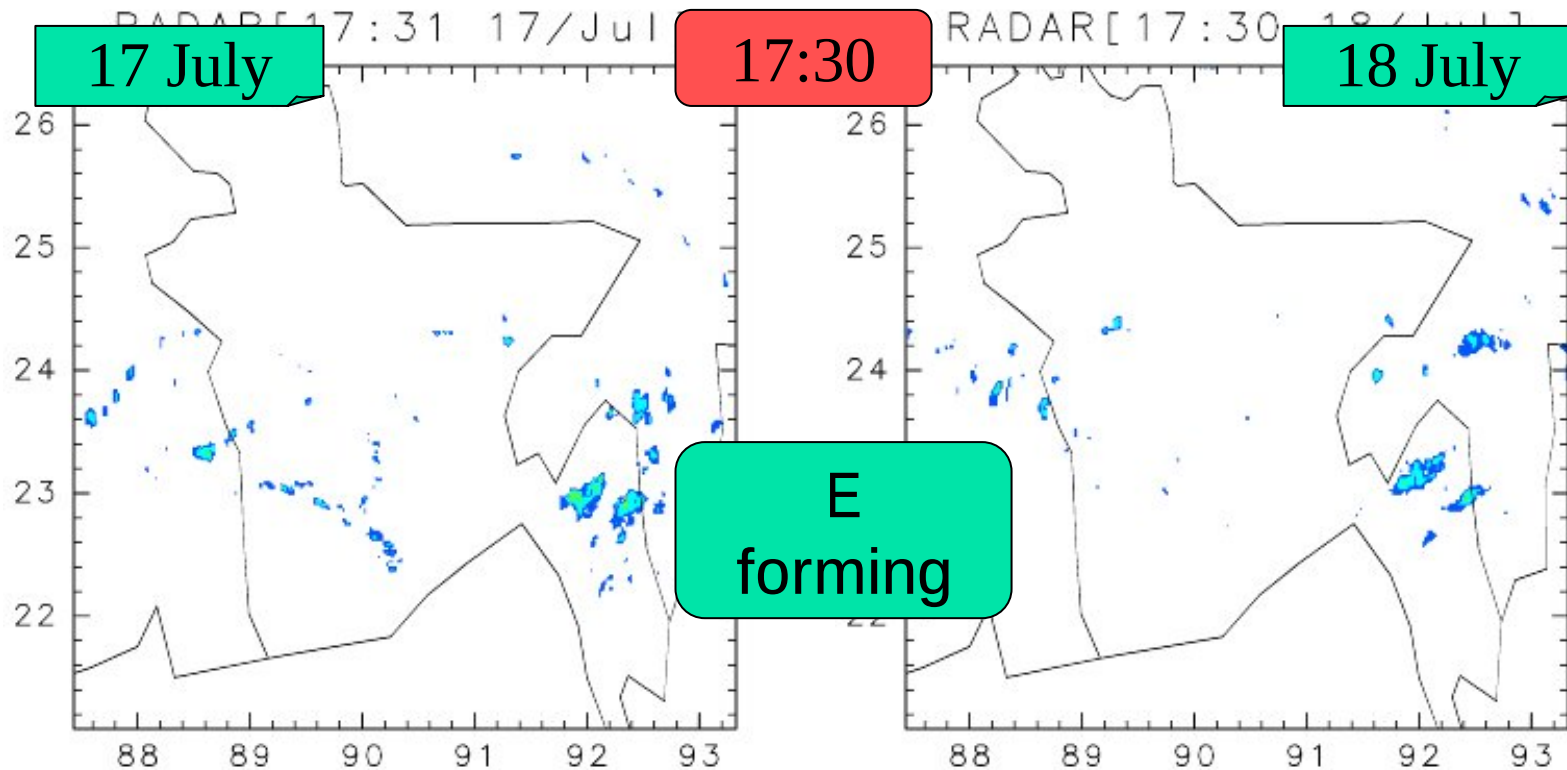
Convection: 17/18 July 2001

A typical pattern of the diurnal variation will be shown using Dhaka RADAR data.



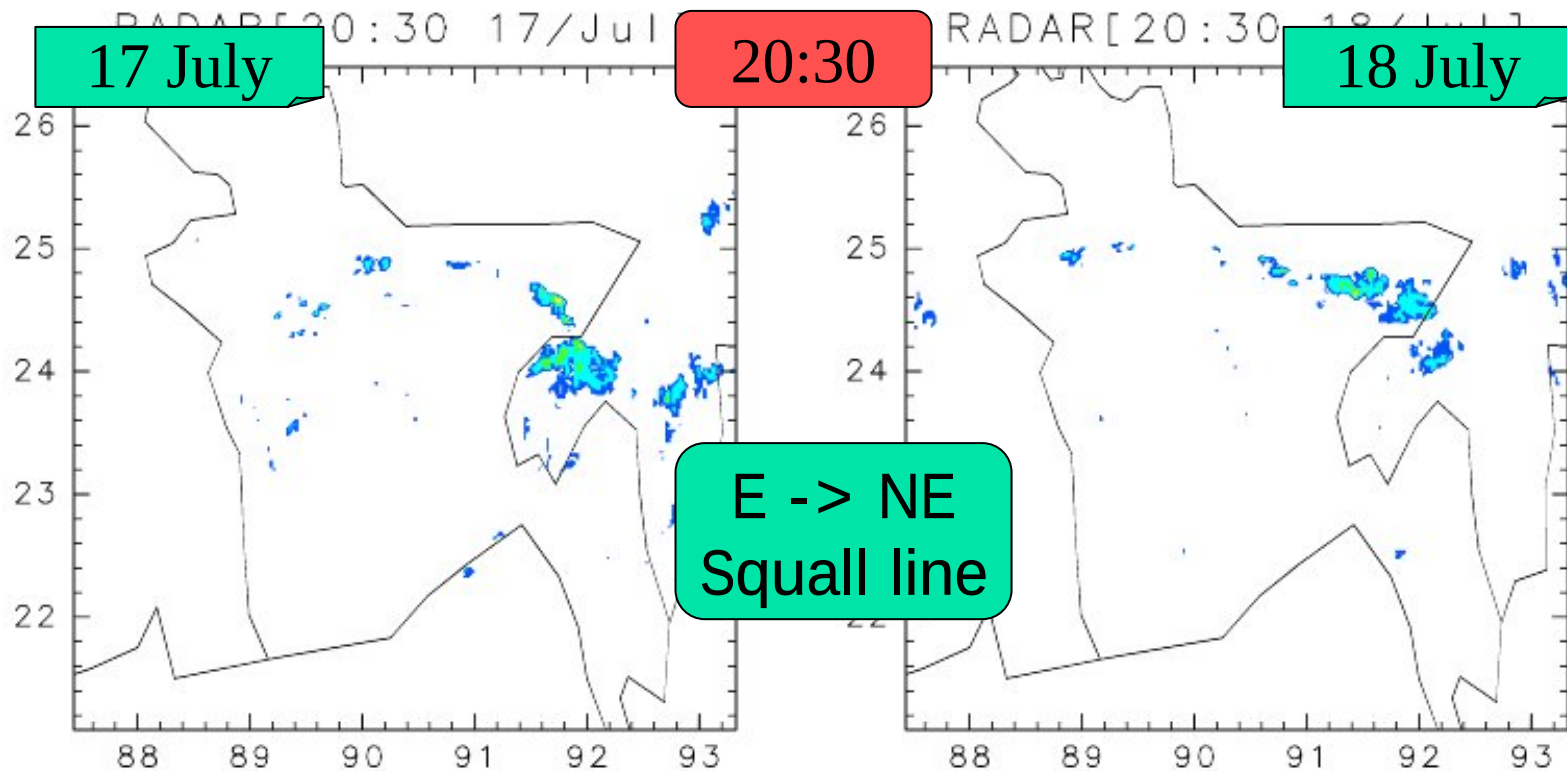
Convection: 17/18 July 2001

A typical pattern of the diurnal variation will be shown using Dhaka RADAR data.



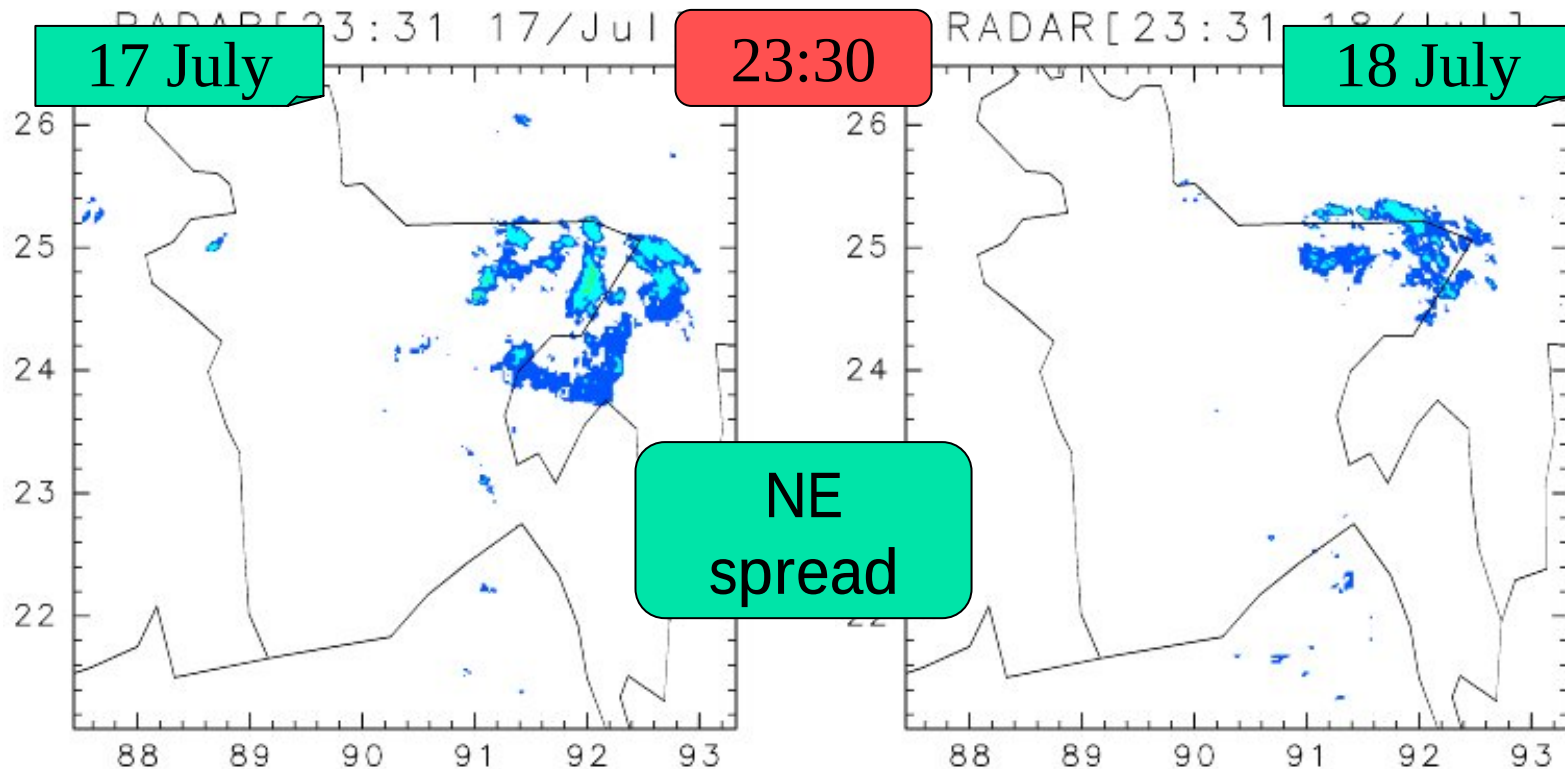
Convection: 17/18 July 2001

A typical pattern of the diurnal variation will be shown using Dhaka RADAR data.



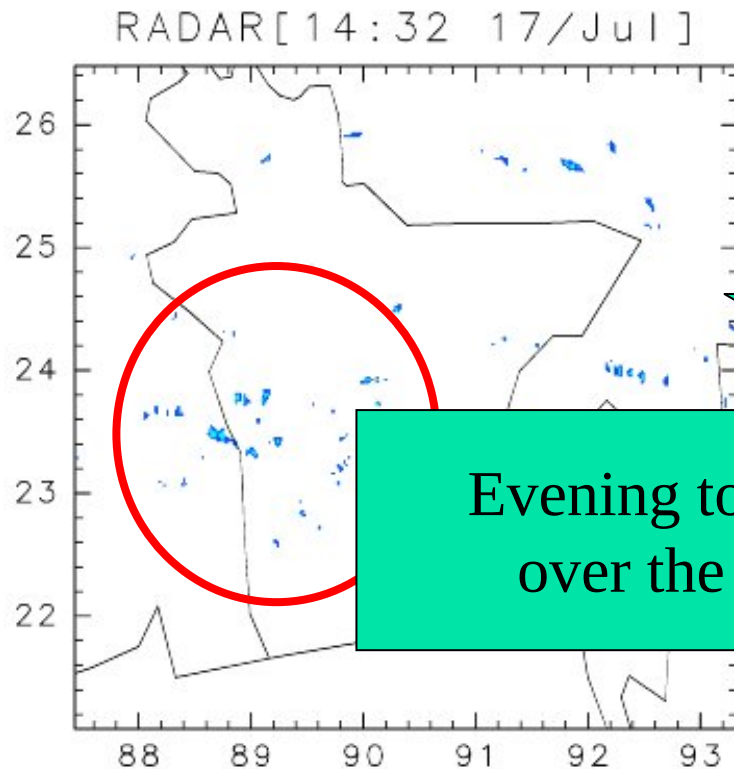
Convection: 17/18 July 2001

A typical pattern of the diurnal variation will be shown using Dhaka RADAR data.



Typical Diurnal Variation

Morning to afternoon: Scattering convections over the south western part of Bangladesh



Evening to Midnight: Organized convections over the north eastern part of Bangladesh

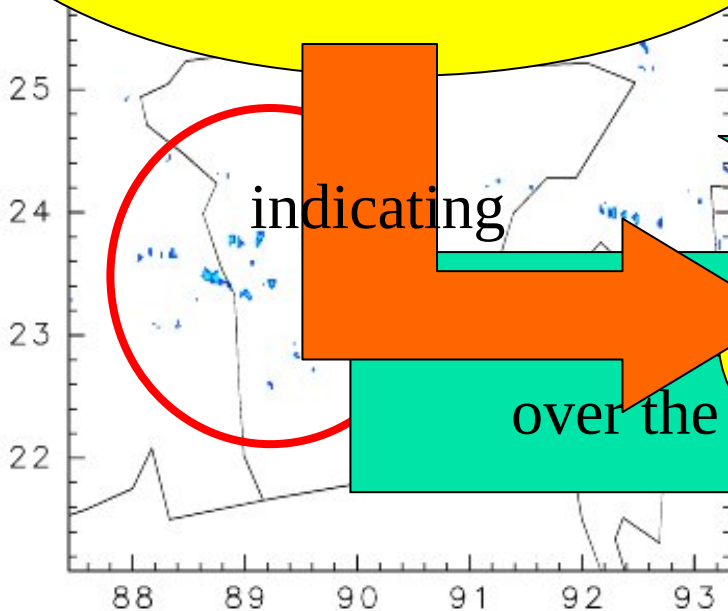
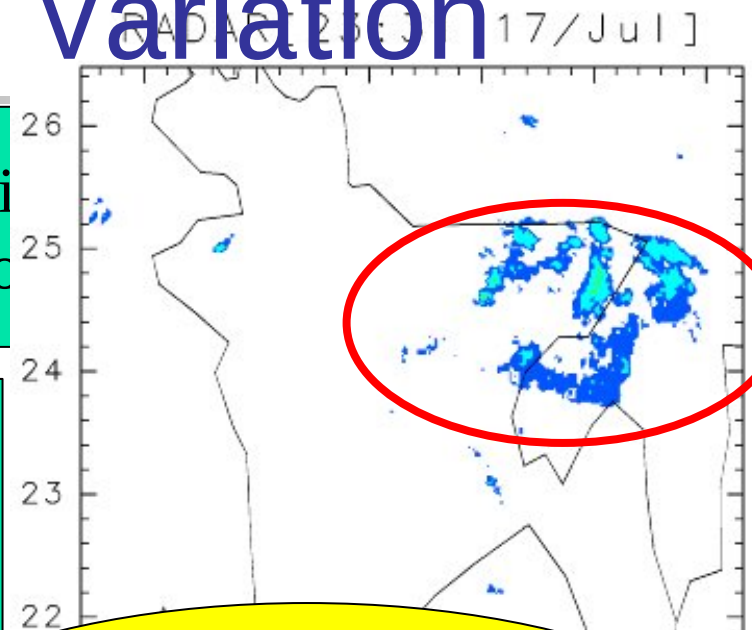
Typical Diurnal Variation

Patterns are **strikingly similar** for these two days, 17 and 18 July 2001

indicating

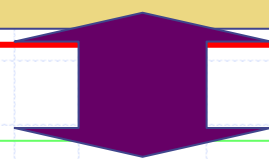
over the

This pattern may appeared under some physical necessity



Introduction

BMD observation:
manual / 3-hourly



- ◆ Bangladesh is one of the heaviest rainfall areas.
- ◆ Meso-scale characteristics
 - Diurnal variations. Midnight-early morning peak is found in northeastern part of the country (Ohsawa et al. 2001). Mechanism unknown.
 - Pre-monsoon meso-scale disturbances.
- ◆ We should use
 - Instruments with higher temporal resolutions.

- ◆ AWS and raingauges
 - AWS at Dhaka
 - Automatic raingauges: 6
 - Almost one year obs.
- ◆ Some results is shown today.
 - Characteristics of Pre-monsoon rainfall
 - ◆ -> A
 - Diurnal variations
 - ◆ -> B
 - AWS obs. case study.
 - ◆ -> C

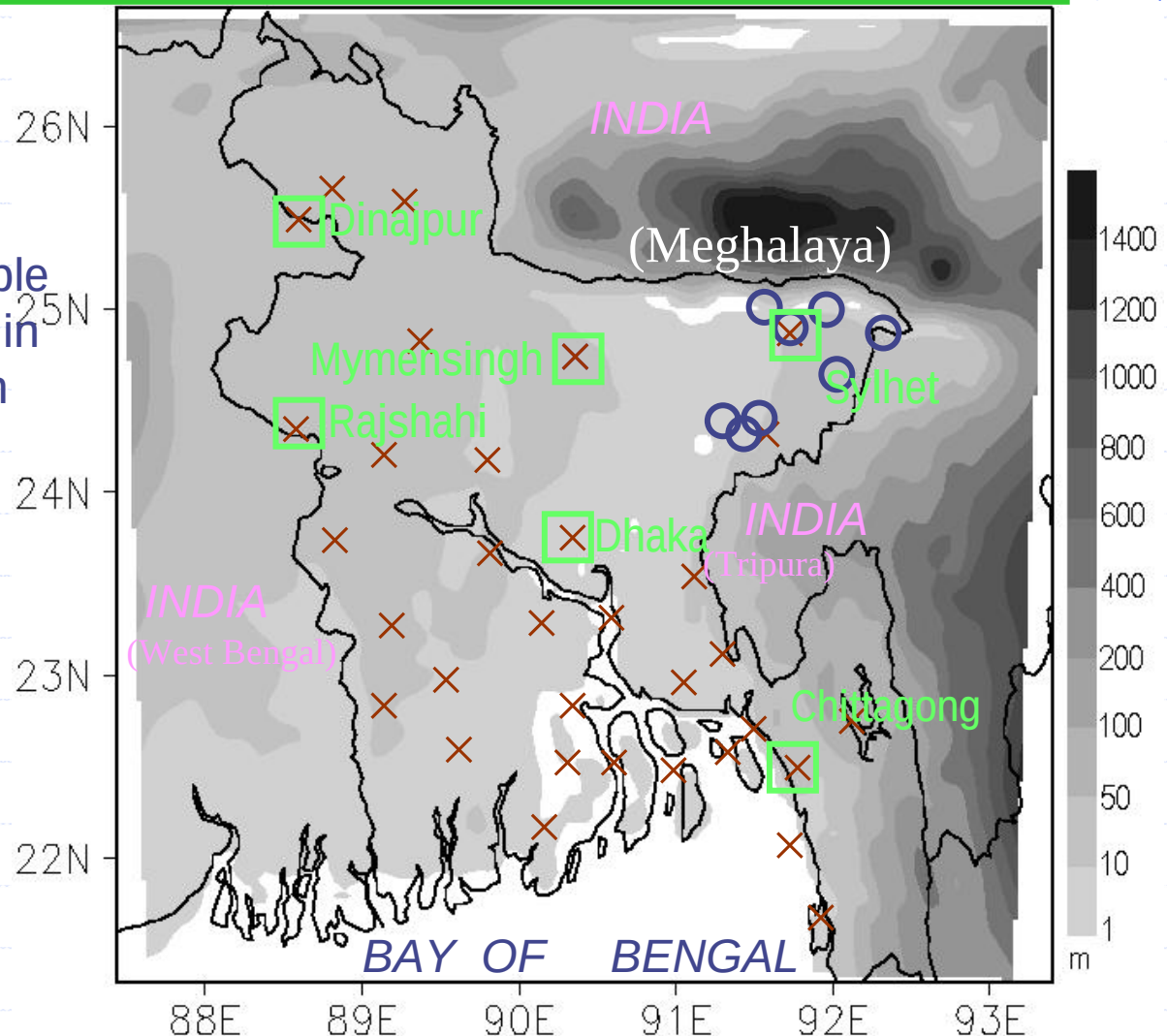
Locations of AWS and raingauges

◆ AWS

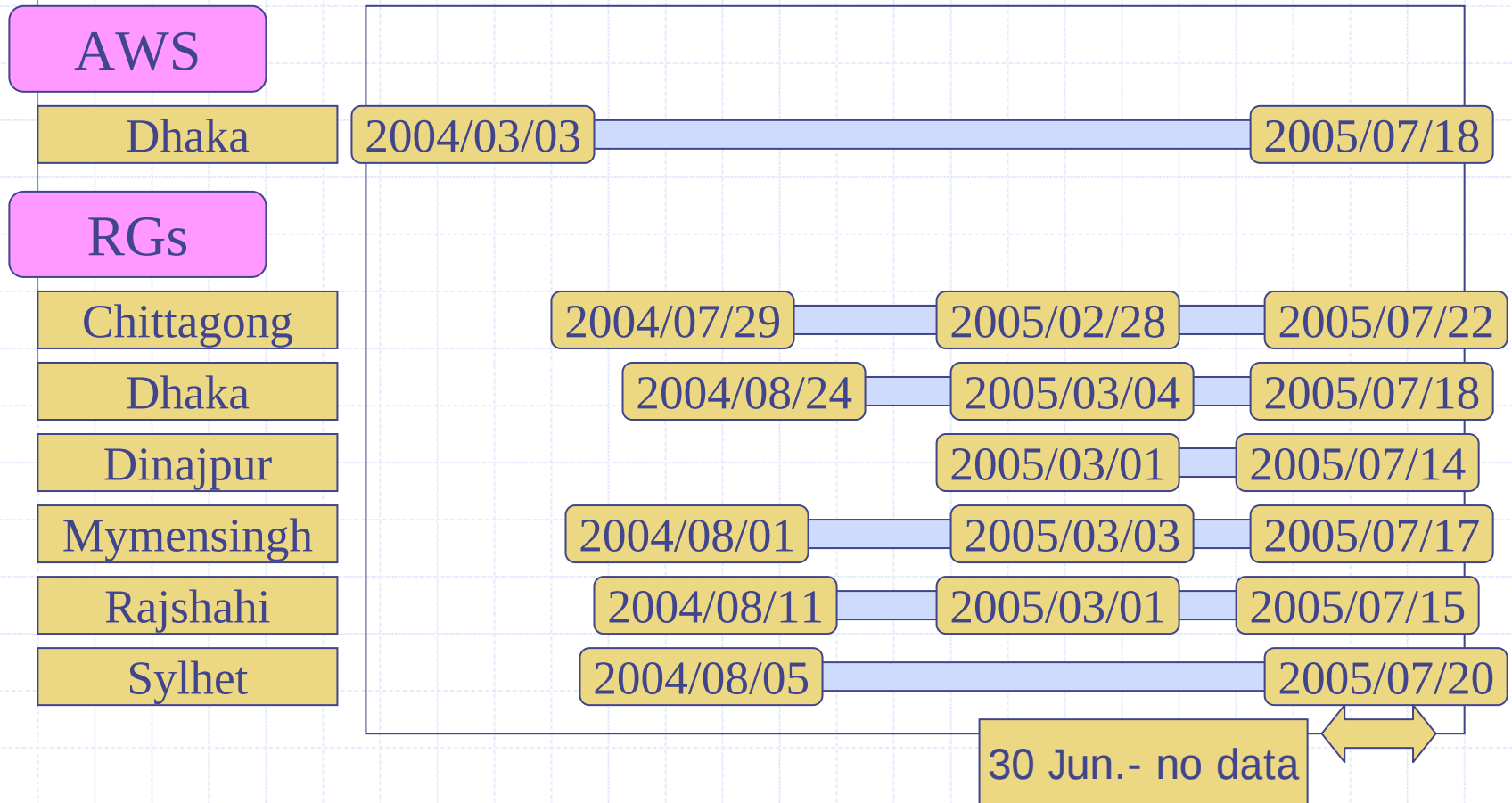
- Dhaka(ICDDR,B)
- Data are accessible from everywhere in the world through the network.

◆ Raingauges

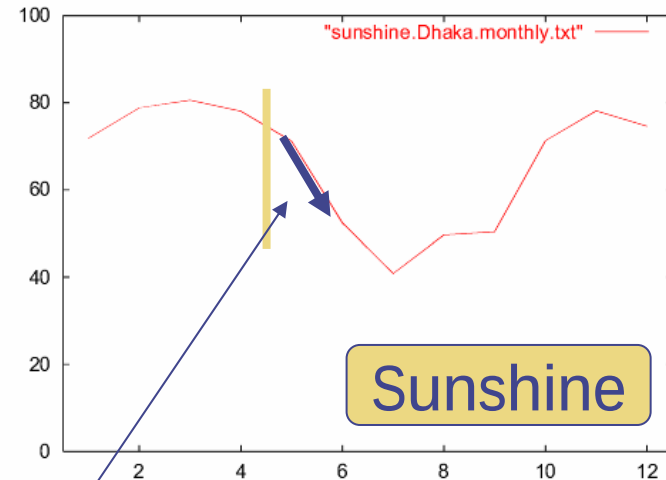
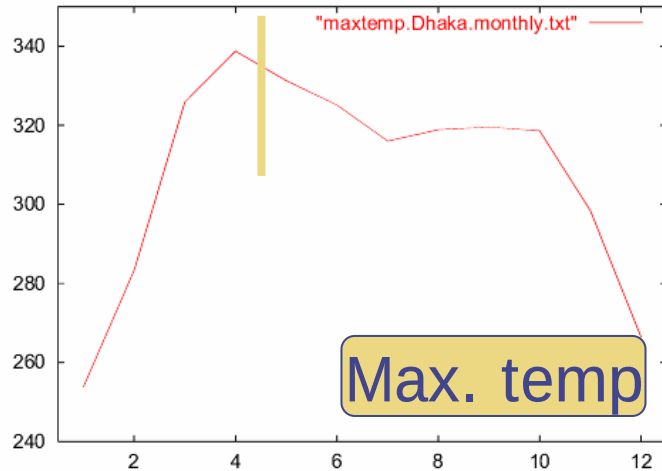
- 6-locations: □
- 0.5mm tipping buckets
- Raingauges are installed in BMD observatories



Obs. time table of AWS and RGs.

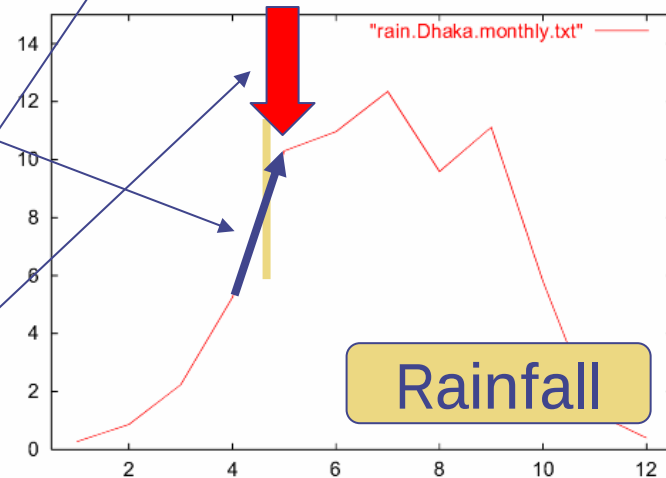


Seasonal march in Bangladesh

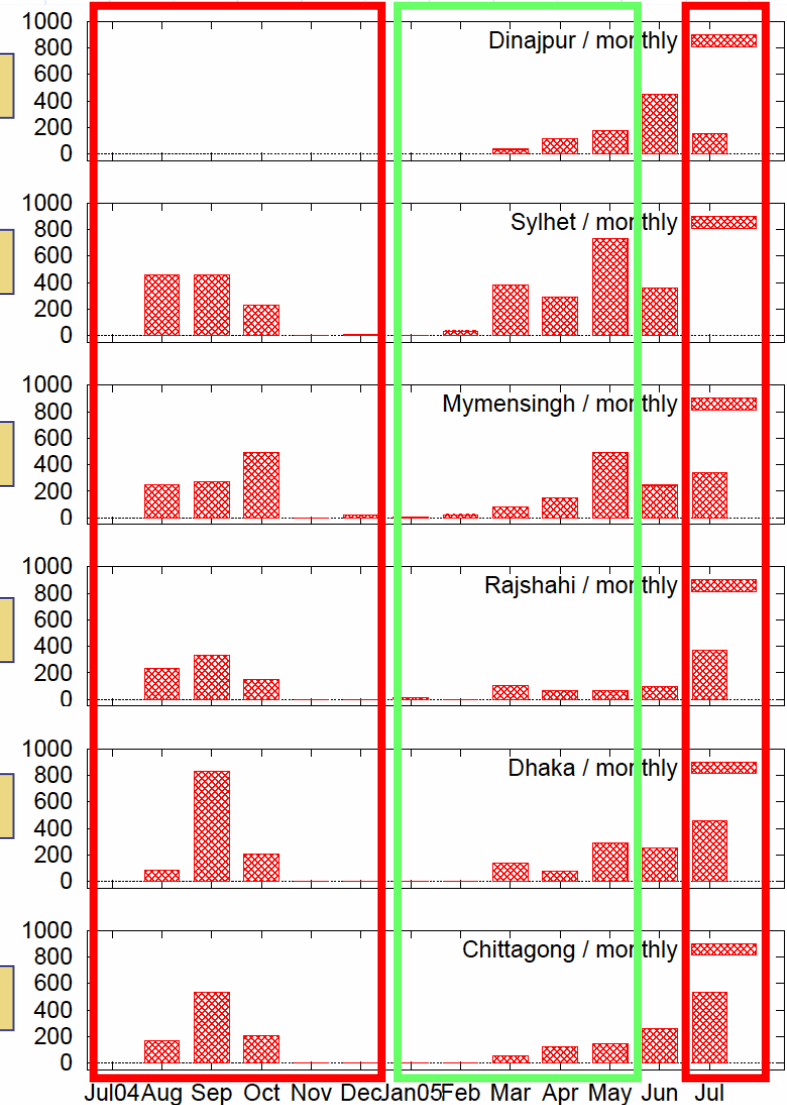
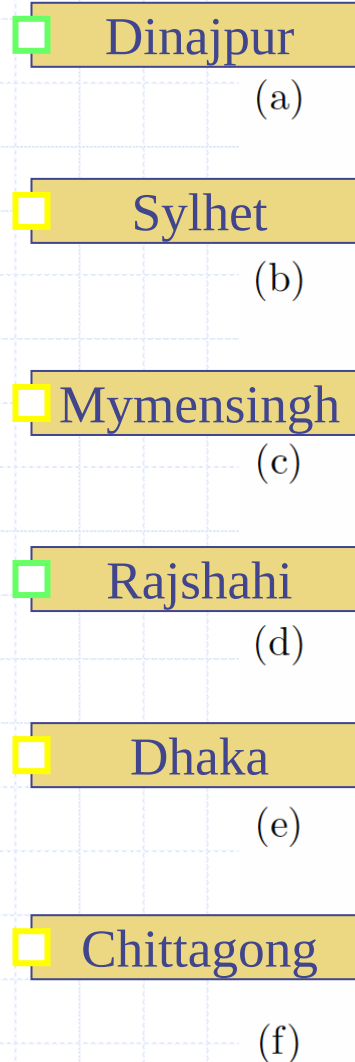


1980-1999/Dhaka
Rain inc.: Apr-→May
Sunshine dec.: May-→Jun.

Pre-monsoon rainfall
in May



- ◆ Pre-monsoon
 - Jan.->May
- ◆ Mature monsoon
 - Jul.->Dec.
- ◆ Pre-monsoon rain.
 - Northeast>West



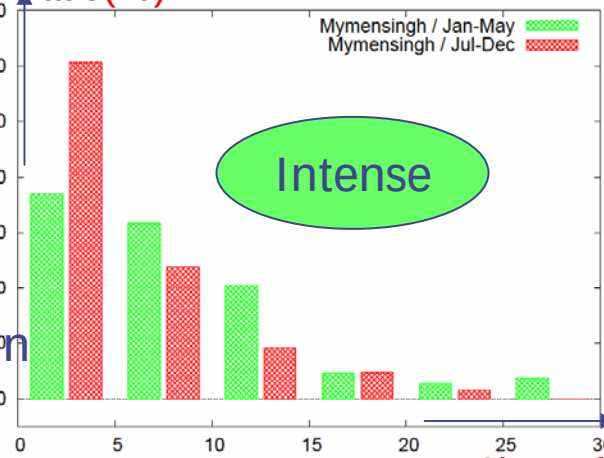
Pre-monsoon and mature monsoon [1]

Rainfall Intensity Histograms

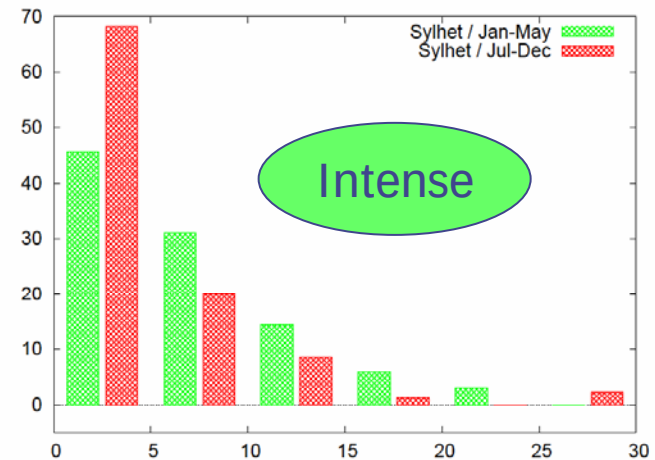
10-min rainfall

- Short intense downpower
 - Pre > mature monsoon.
 - $\geq 5\text{mm}/10\text{min}$ exceeds 50% of total rain.

Contribution ratio(%)



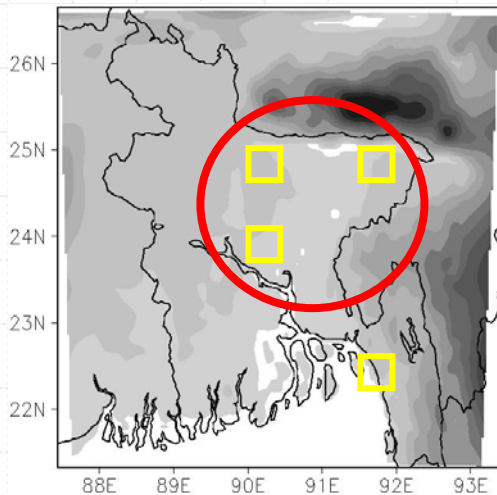
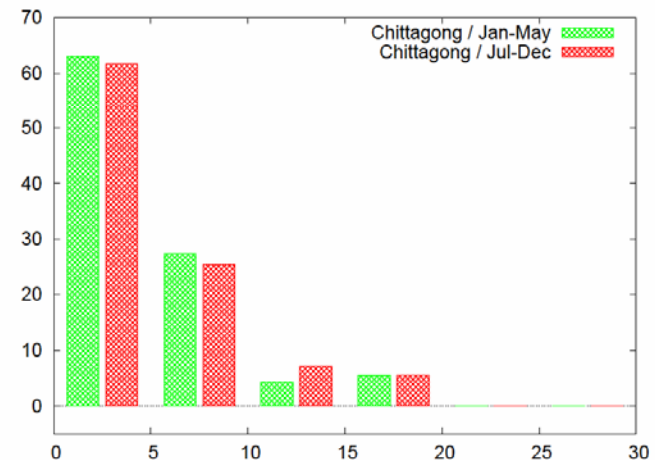
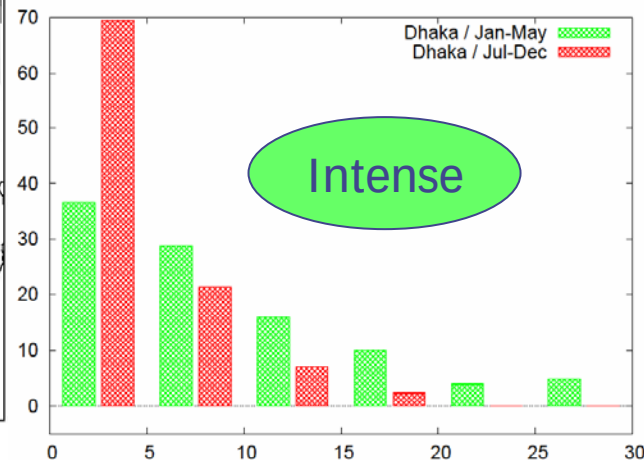
(b)



Class of Rainfall Intensity

(c)

(d)

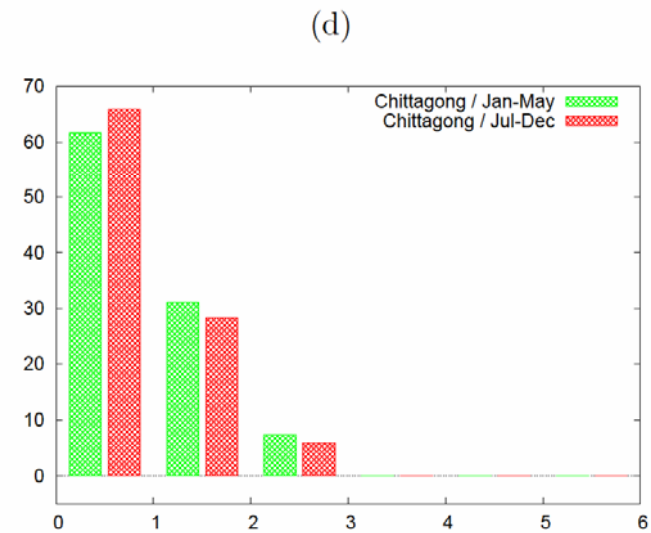
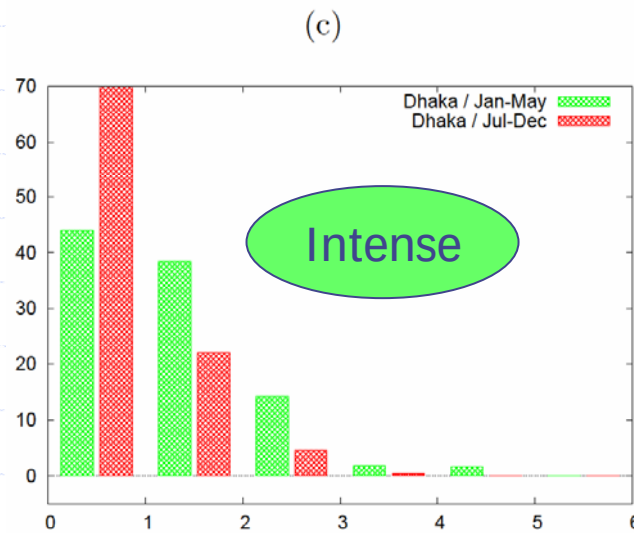
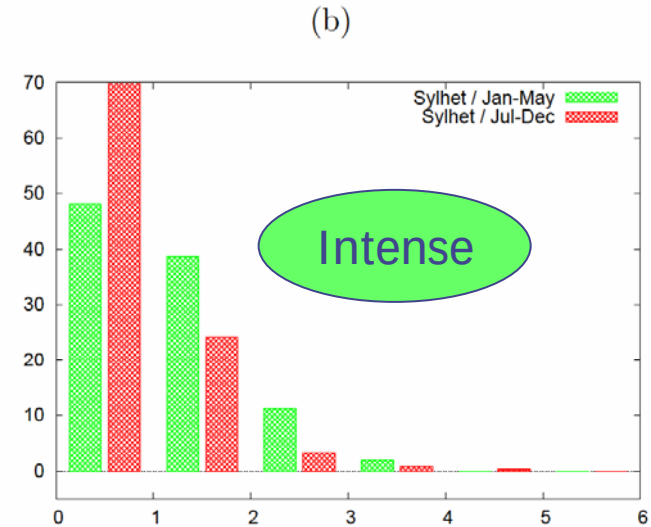
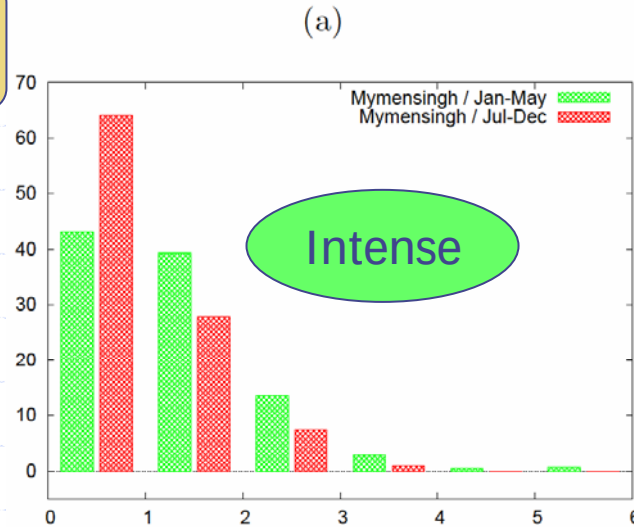


Pre-monsoon and mature monsoon [1]

Rainfall intensity

1-min rainfall

- Almost same results as 10-min rainfall.

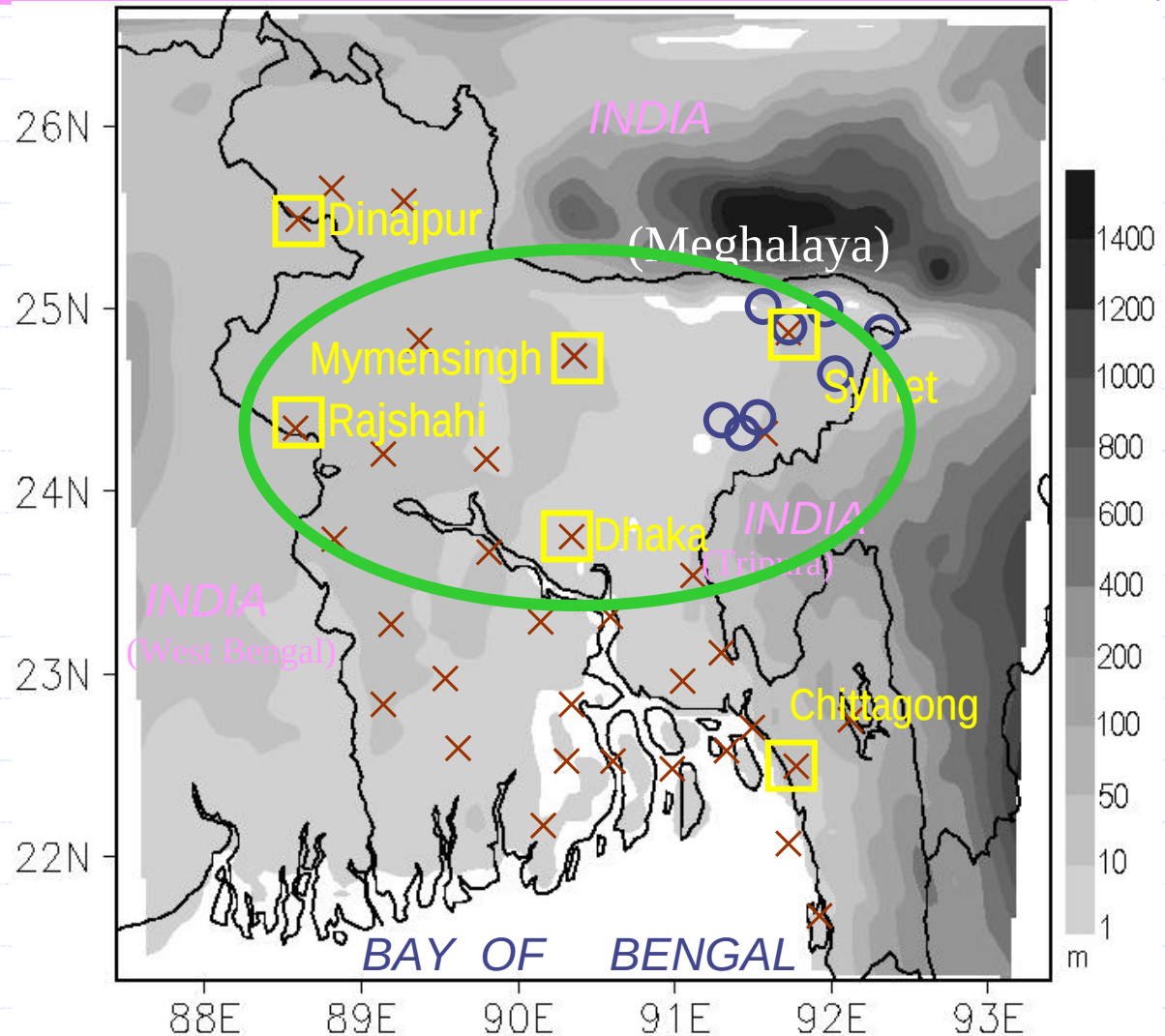


Pre-monsoon and mature monsoon [1]

Rainfall intensity

Summary

- ◆ Intense rain in pre-monsoon
 - $\geq 5\text{mm}/10\text{min}$ exceeds 50% of total rain
 - $\geq 1\text{mm}/\text{min}$ exceeds 50% of total rain



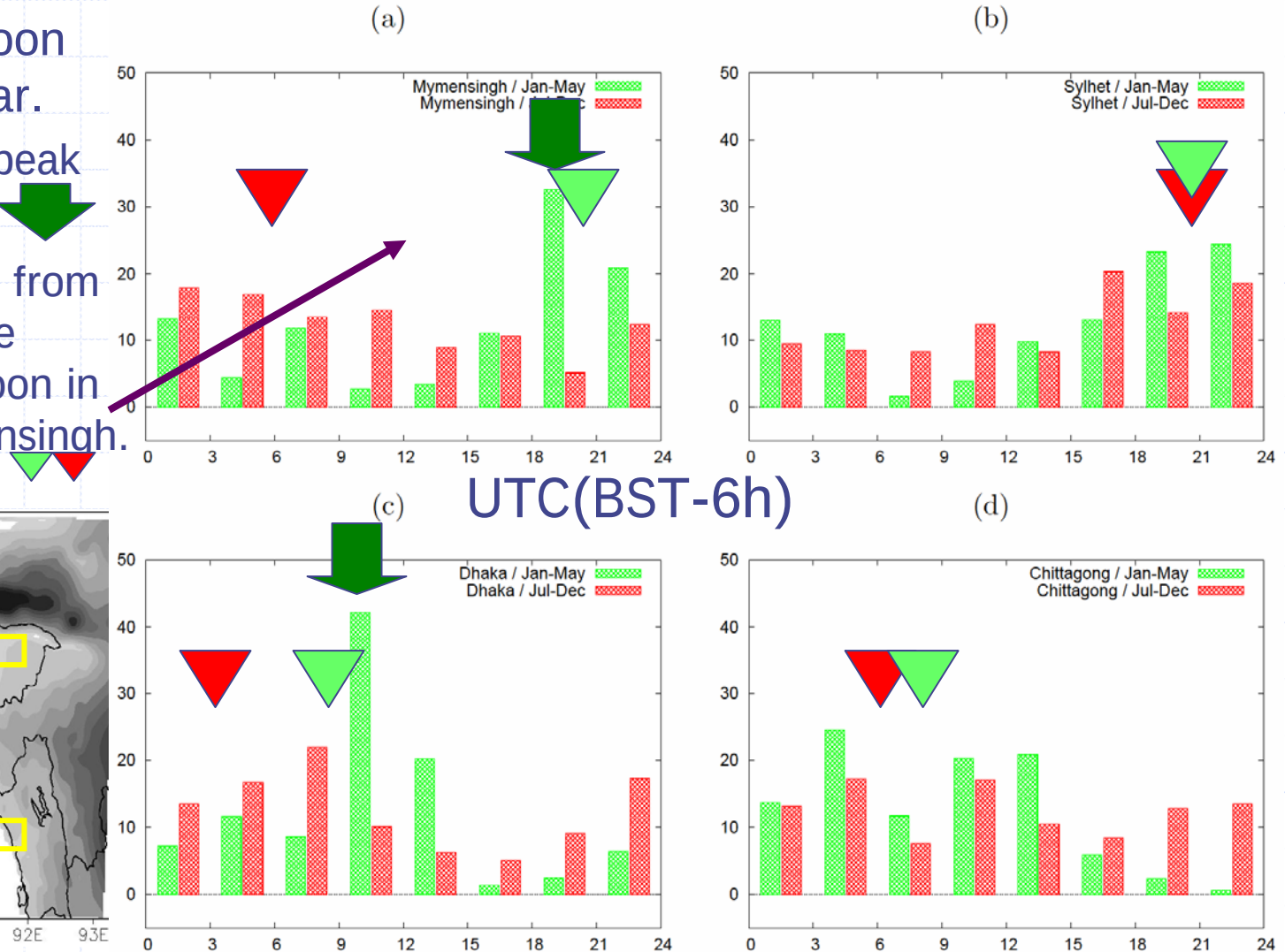
B

Pre-monsoon and mature monsoon [2]

Diurnal variations

◆ Premonsoon diurnal var.

- Clear peak
- differs from mature monsoon in Mymensingh.



Pre-monsoon and mature monsoon [2]

Diurnal variations

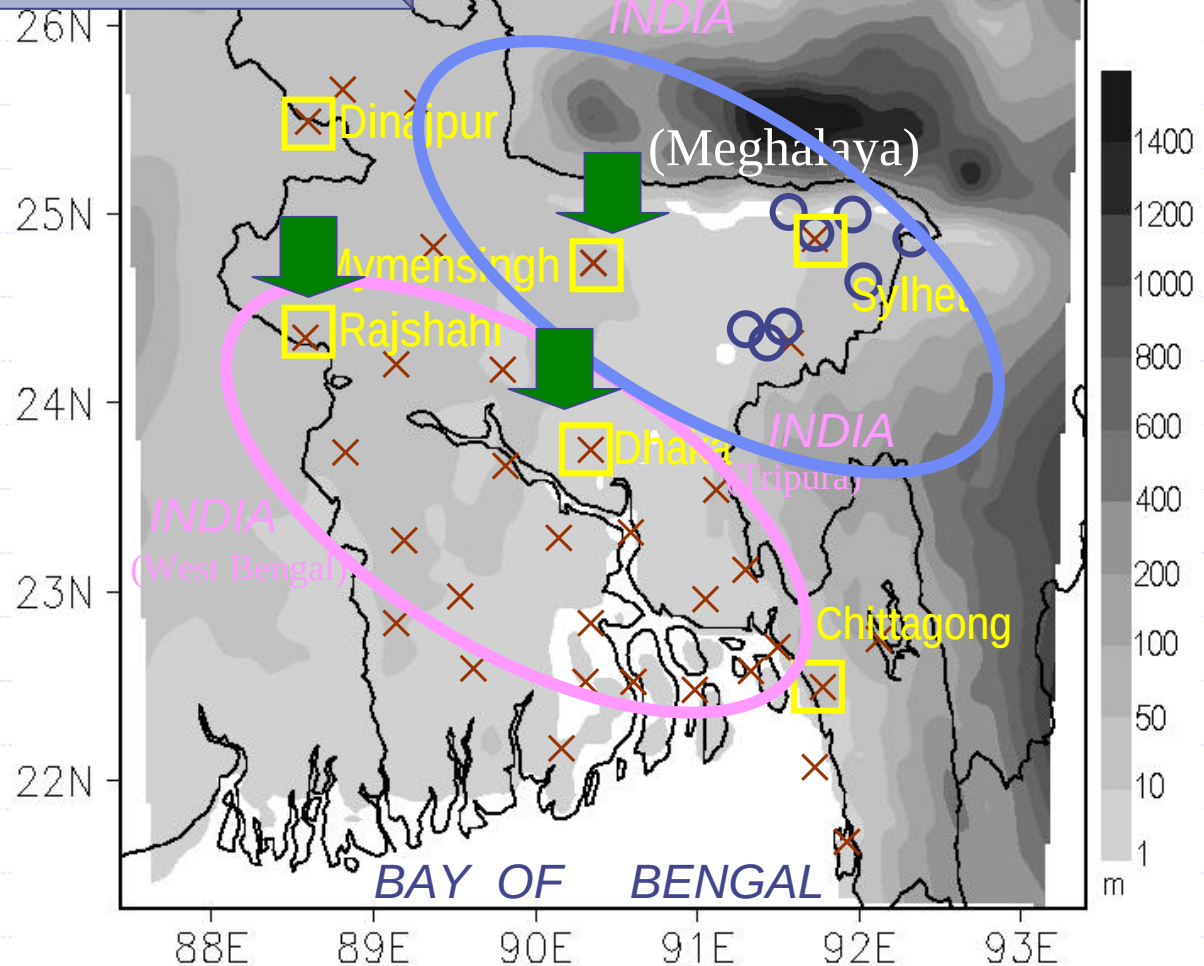
Summary I

◆ Diurnal variations in pre-monsoon

- Central part: afternoon peak.
- Northern part: Midnight-early morning peak.
- Clear peak is found mainly in western part.



Pre-monsoon



Pre-monsoon and mature monsoon [2]

Diurnal variations

Summary II

◆ Diurnal variations in mature monsoon

- Central part: daytime peak
- NE part: midnight-early morning peak
- Mymensingh is also in daytime peak area.

mature monsoon

