Seasonal Climate Forecasting using Climate Predictability Tool (CPT)

A Collaborative Project..

Senaka Basnayake

Scientist – Theoretical Division

SAARC Meteorological Research Centre (SMRC)

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SAARC

Links to Met. Department Member State

- Afghan Meteorological Authority
- Bangladesh Meteorological Department (BMD)
- Meteorology Unit, Department of Energy (MTI) Bhutan
- India Meteorological Department (IMD),
- Department of Meteorology Maldives
- Department of Hydrology & Meteorology Nepal
- Pakistan Meteorological Department (PMD),
- Department of Meteorology Sri Lanka

Welcome to SMRC

Introduction to SMRC CLICK HERE

SAARC Meteorological Research Centre (SMRC)
Plot No. E-4/C, Agargaon
Sher-e-Bangla Nagar

Links

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- :: Bangladesh
- :: Bhutan
- :: India
- :: Maldives
- :: Nepal
- :: Pakistan
- :: Sri Lanka
- Weekly Sen
- W M O
- NOAA
- ECMWF
- IPCC
- NCMRWF
- NWS USA
- NEW Seasonal

Motivation….

- Seasonal climate forecasting, especially during monsoon seasons, is an utmost urgency for many important sectors such as agriculture, water resources, energy, health, etc.

Objective….

- To make seasonal climate forecasts for Sri Lanka and Bangladesh using CPT.

- It is hoped to extend this study to other SAARC regional countries.

SAARC Region

Collaborative Institutions:

- **SAARC Meteorological Research Centre (SMRC)**
- **Department of Meteorology, Sri Lanka (DMS)**
- **Bangladesh Meteorological Department (BMD)**
- **International Centre for Theoretical Physics (ICTP) &**
- **Seoul National University (SNU).**

Seasonal Forecasting for Sri Lanka

Topography map of Sri Lanka

Climatic Zones in Sri Lanka

Three Climatic Zones are identified based on Annual Precipitation

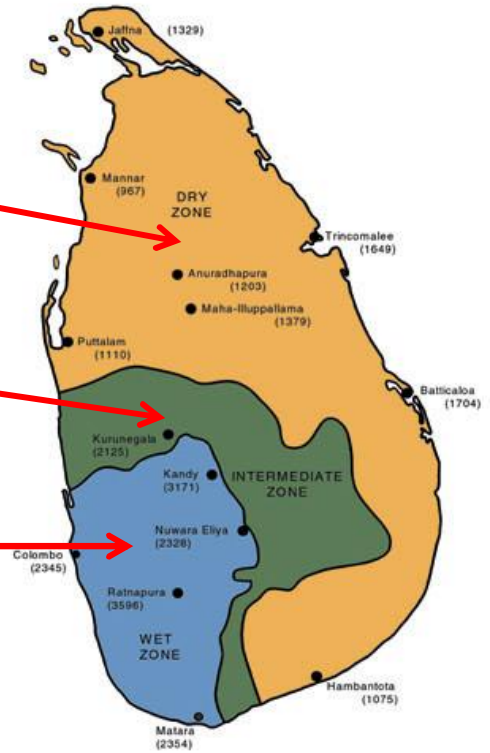
1750 mm >
(Dry Zone)

Between 1,750 mm and 2500 mm

(Intermediate Zone)

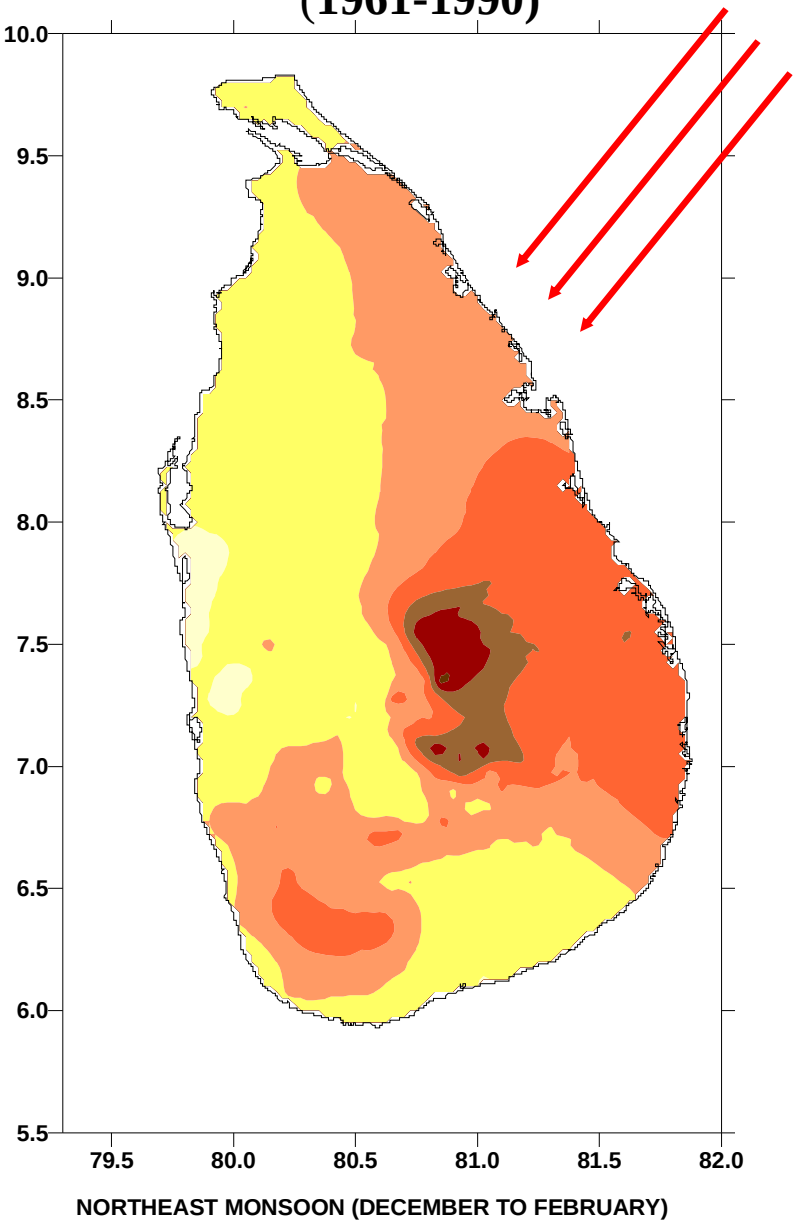
2500 mm <

(Wet Zone)



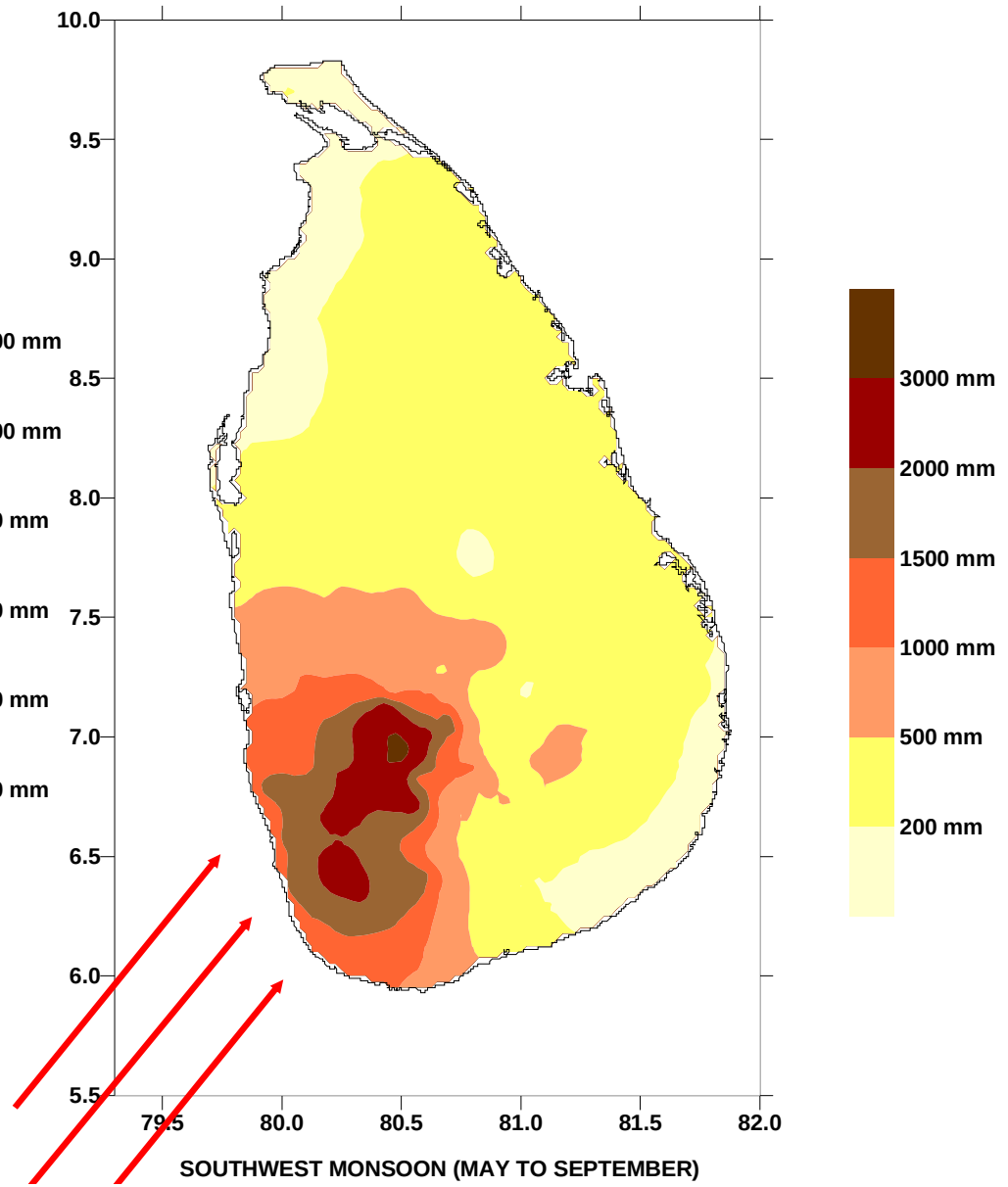
Northeast Monsoon

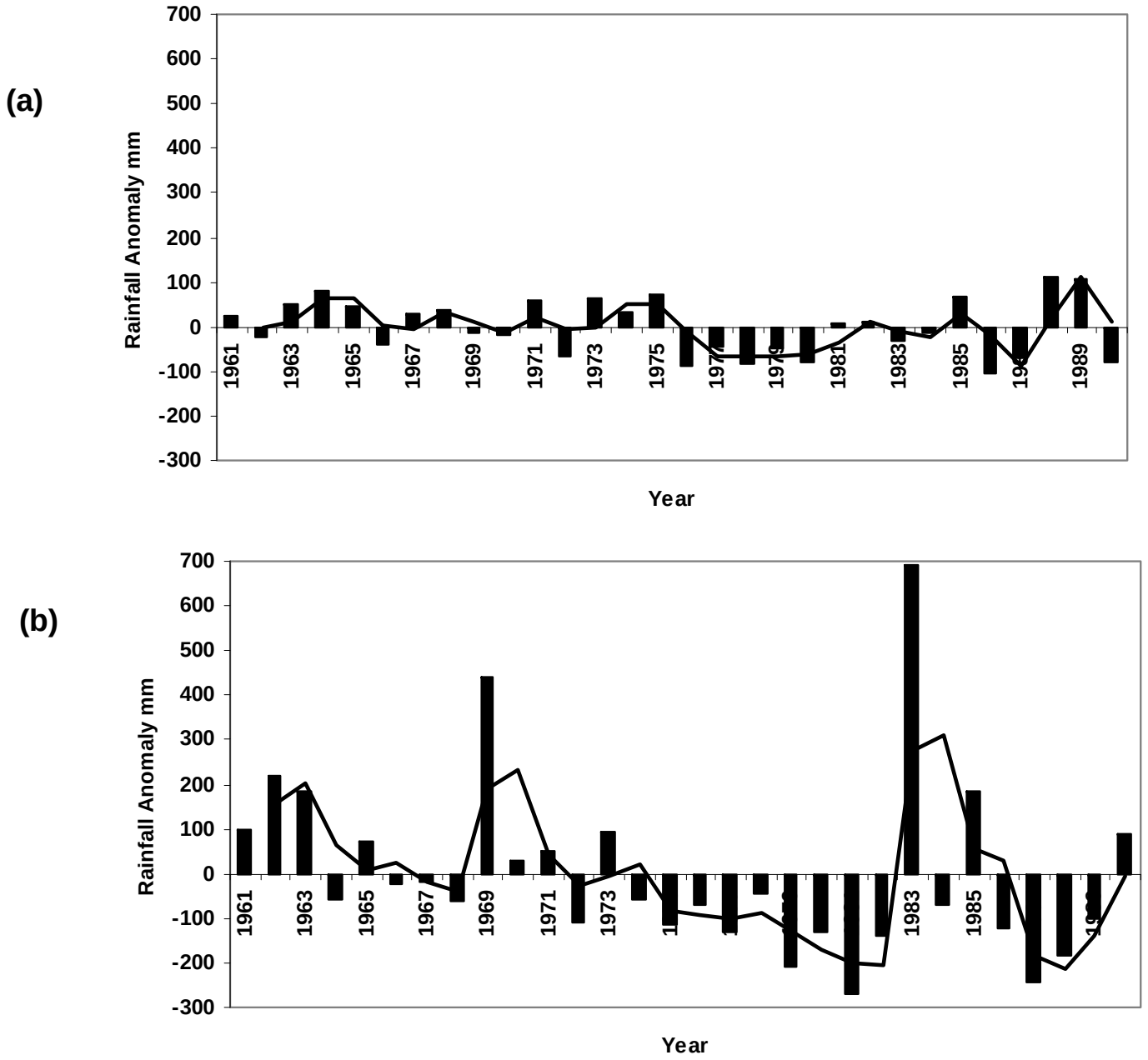
(1961-1990)



Southwest Monsoon

(1961-1990)





Temporal variation of All-Sri Lanka aerial rainfall (a) June-July-August (JJA) (b) December-January-February (DJF) with three year moving average.

Season	Coefficient of Variation of all Sri Lanka Rainfall	
	1931 – 1960	1961 - 1990
Northeast Monsoon (Dec. to Feb.)	31%	42%
First Inter-monsoon (Mar. to Apr.)	23%	27%
Southwest Monsoon (May. to Sep.)	21%	16%
Second Inter-monsoon (Oct. to Nov)	22%	23%
Annual (Jan. to Dec.)	12%	14%

The Coefficient of Variation of all-Sri Lanka Rainfall during the periods 1931-1960 and 1961-1990, (Chandrapala, 1997)

Station	Topographical Location	Coefficient of Variation (%)	
		1981 – 1990	1991 - 2000
Colombo	Low Country	21%	20%
Galle	Low Country	28%	12%
Ratnapura	Low Country	23%	15%
Kandy	Mid Country	21%	22%
Kenilworth	Mid Country	37%	17%
Talawakelle	Up Country	28%	21%
Nuwara-Eliya	Up Country	26%	13%

The Coefficient of Variation of southwest monsoon rainfall at selected stations in low, mid and up country regions during 1981-1990 and 1990-2000 periods

(Basnayake and Punyawardane, 2003)

CPT

Canonical Correlation Analysis (CCA)

Forecast for JJA 2008

GCM Fields – SNU – Tier 1

Predictor – SST

Predictands – Aerial RF:-

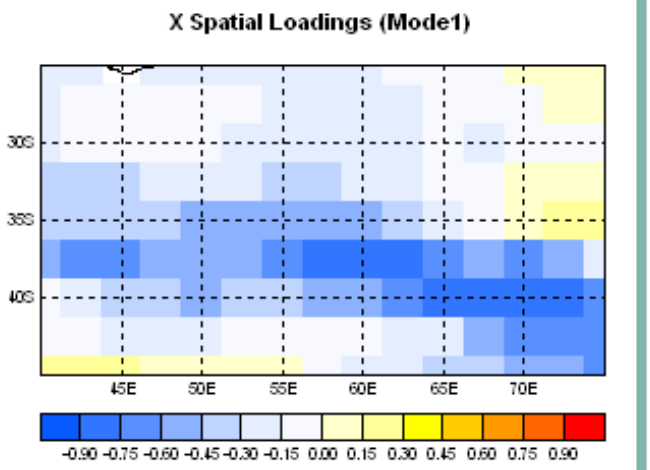
All-Sri Lanka,

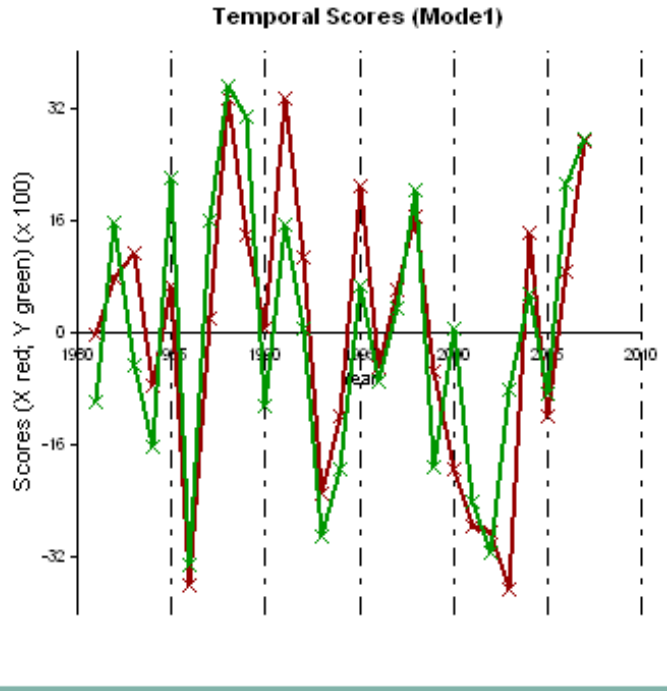
9 Districts,

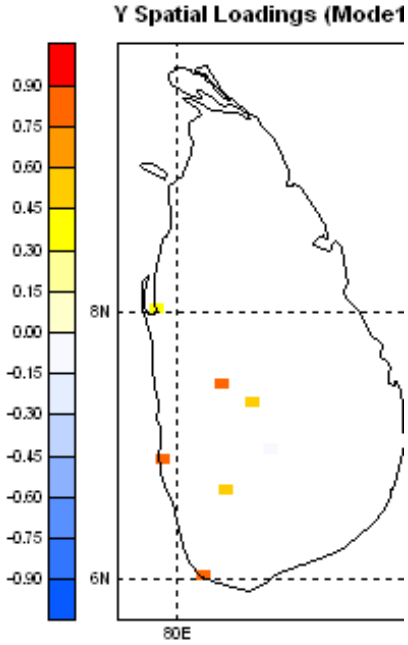
Stations

JJA - 1981 – 2007

mode: 1 Canonical correlation: 0.8132

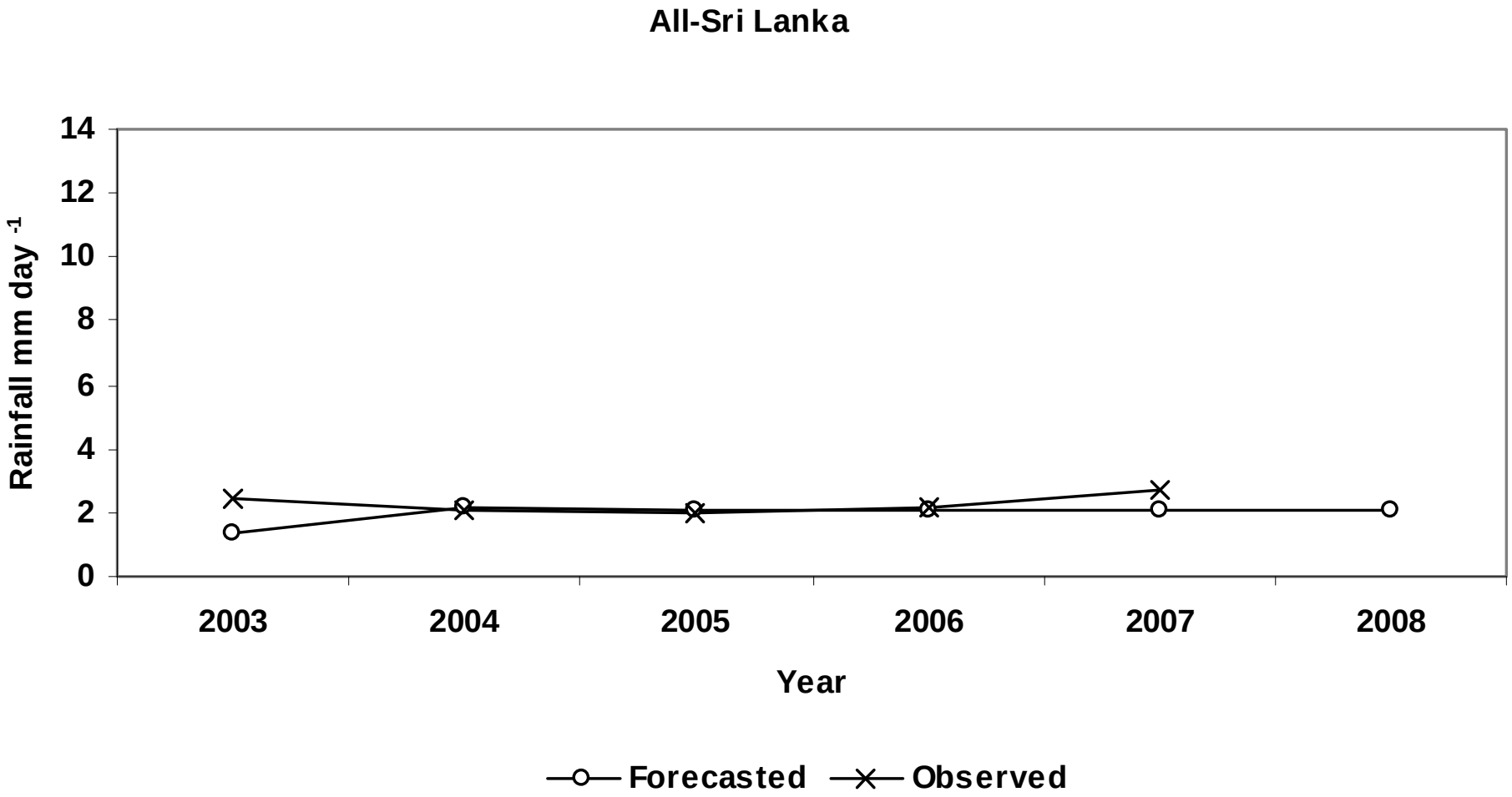


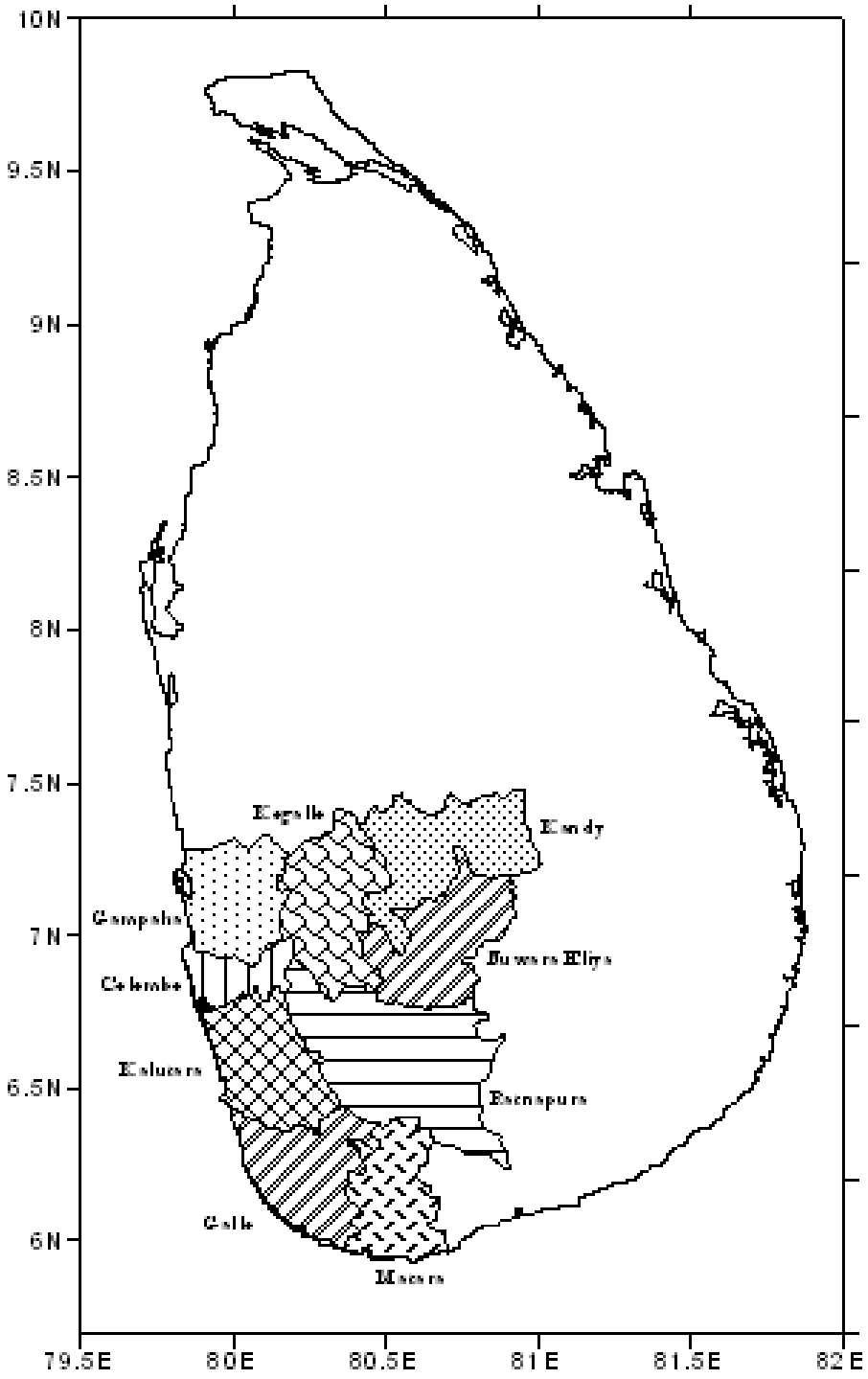





```
          5     5      1        0.325          5     2      2        0.416
          5     5      2        0.352          5     2      2        0.416
          5     5      2        0.352          5     2      2        0.413
          5     5      3        0.418          5     5      3        0.418
Constructing model using full training period (1981 to 2007) ...
Identifying categories ...
Done!
```

	Pearson's correlation	RMSE	Hit Score	Bias	Mean absolute error	P value at 95% confidence level	2008-JJA forecast mm/day	Probability of occurrence (%)
All-Sri Lanka	0.5773	0.57	48.15	0.00	0.49	0.0020	2.0	49 (*BN)
*BN = Below Normal								





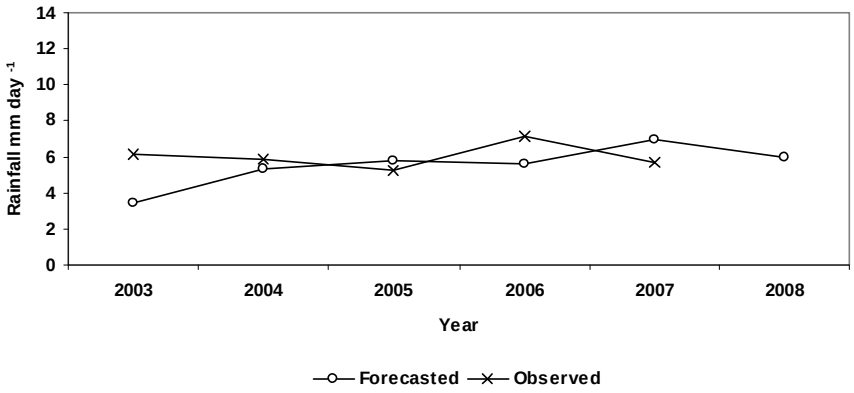
Selected Districts for JJA forecast

JJA forecast for Districts

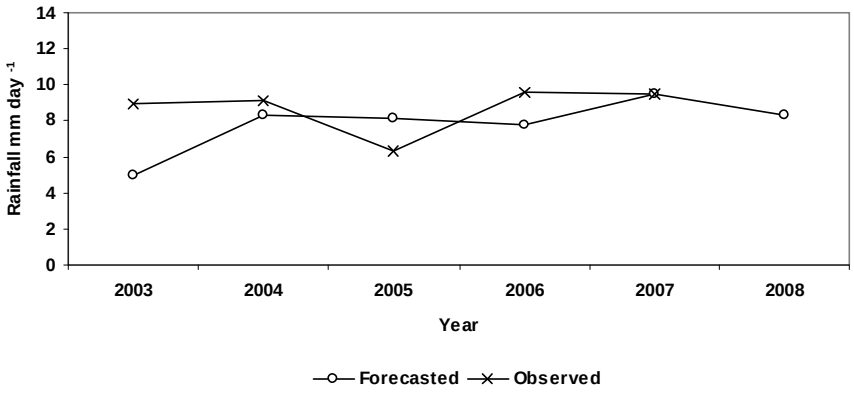
	Pearson's correlation	RMSE	Hit Score	Bias	Mean absolute error	P value at 95% confidence level	2008-JJA forecast mm/day	Probability of occurrence %
Colombo	**0.7460**	**1.33**	**48.15**	**-0.01**	**1.09**	**0.0000**	**6.0**	**37 (*AN)**
Kalutara	**0.7088**	**1.75**	**48.15**	**+0.01**	**1.44**	**0.0000**	**8.3**	**40 (*N)**
Galle	**0.6600**	**1.86**	**48.15**	**+0.02**	**1.54**	**0.0000**	**7.3**	**40 (*N)**
Matara	**0.5633**	**1.72**	**55.56**	**+0.03**	**1.38**	**0.0000**	**4.8**	**55 (*BN)**
Gampaha	**0.6166**	**1.32**	**51.85**	**-0.03**	**1.10**	**0.0000**	**4.6**	**38 (*BN)**
Kegalle	**0.6585**	**1.95**	**62.96**	**-0.05**	**1.56**	**0.0000**	**7.8**	**56 (*BN)**
Ratnapura	**0.6748**	**1.11**	**62.96**	**-0.04**	**0.92**	**0.0000**	**6.2**	**52 (*BN)**
Kandy	**0.4822**	**1.38**	**62.96**	**0.00**	**1.04**	**0.0020**	**2.9**	**66 (*BN)**
Nuwara Eliya	**0.5737**	**1.70**	**51.85**	**-0.02**	**1.35**	**0.0000**	**5.9**	**70 (*BN)**

***BN=Below Normal *N=Normal *AN-Above Normal**

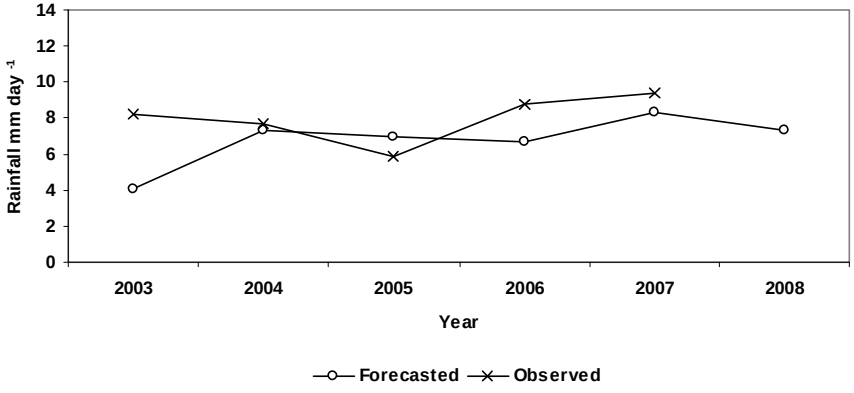
Colombo District



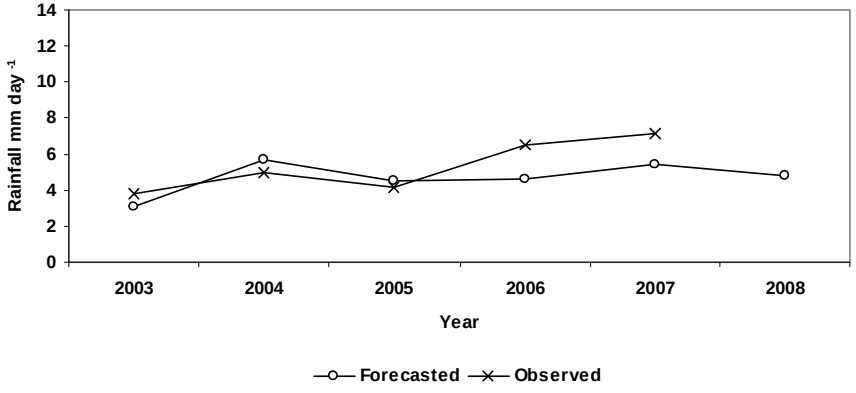
Kalutara District



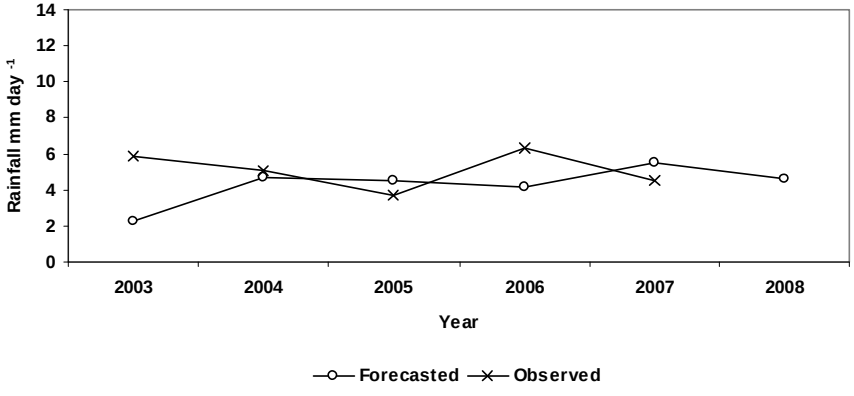
Galle District



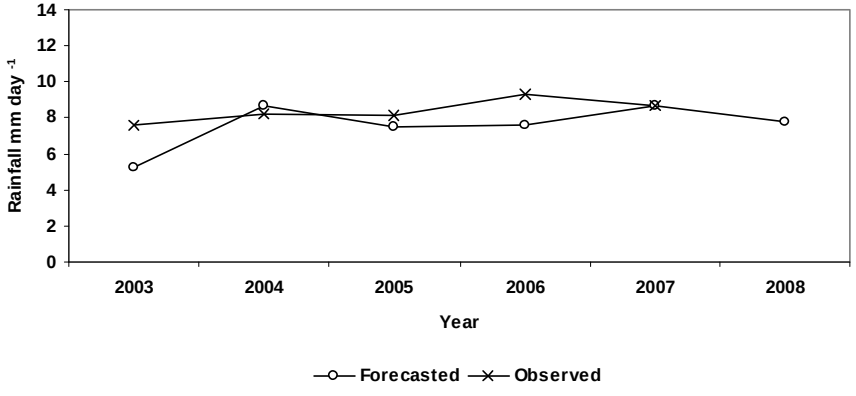
Matara District



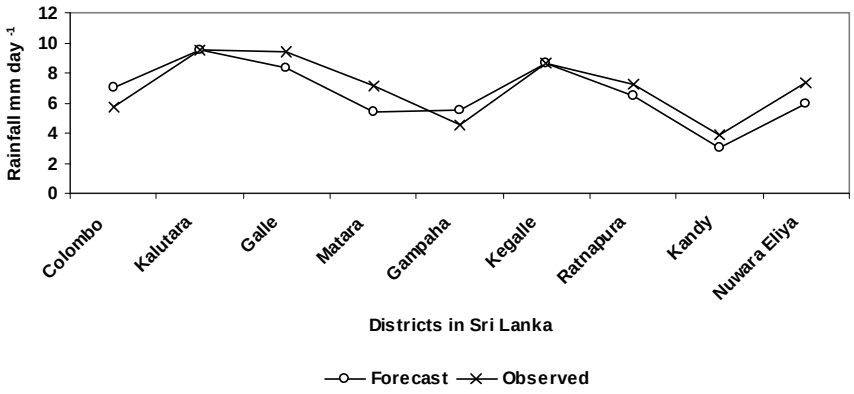
Gampaha District



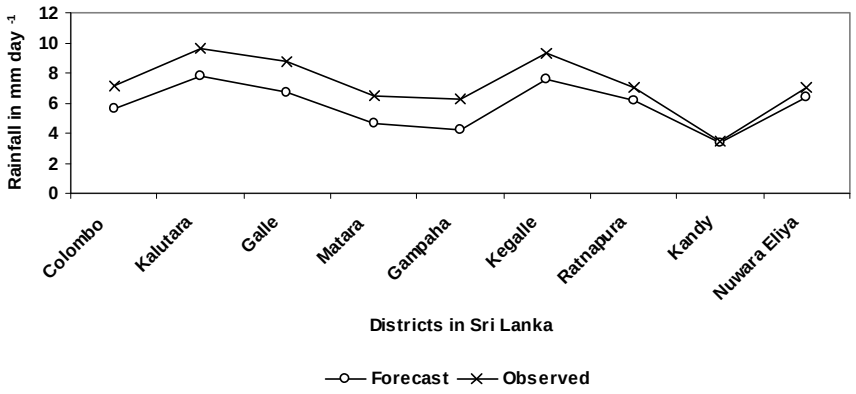
Kegalle District



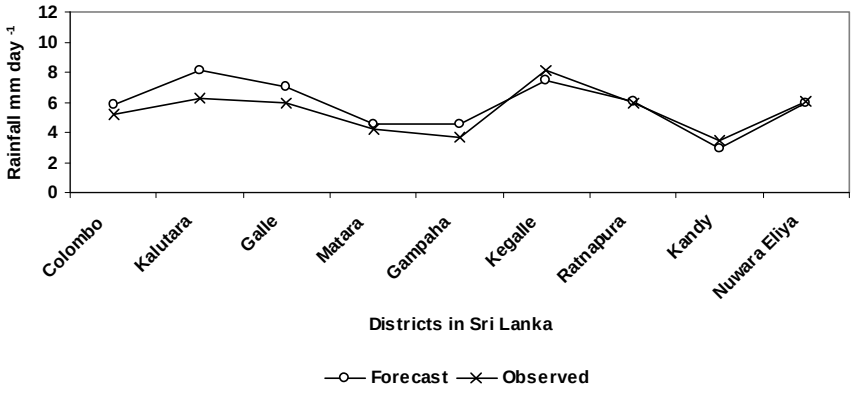
2007



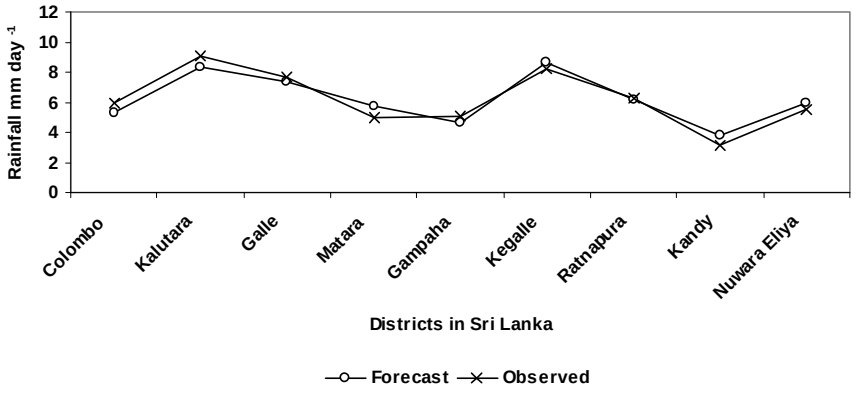
2006



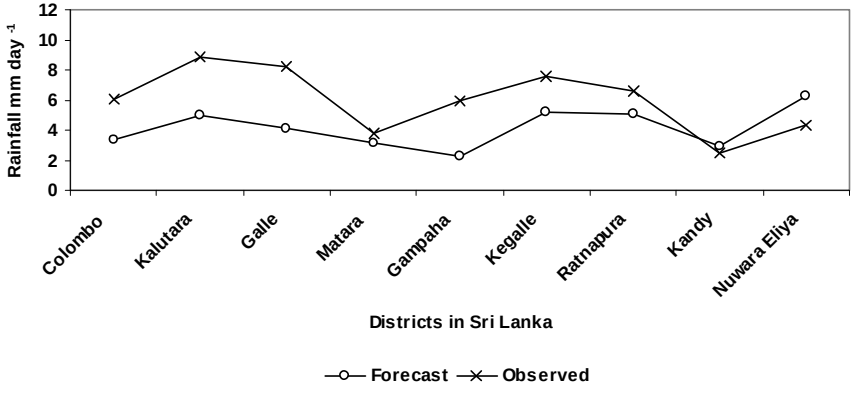
2005



2004



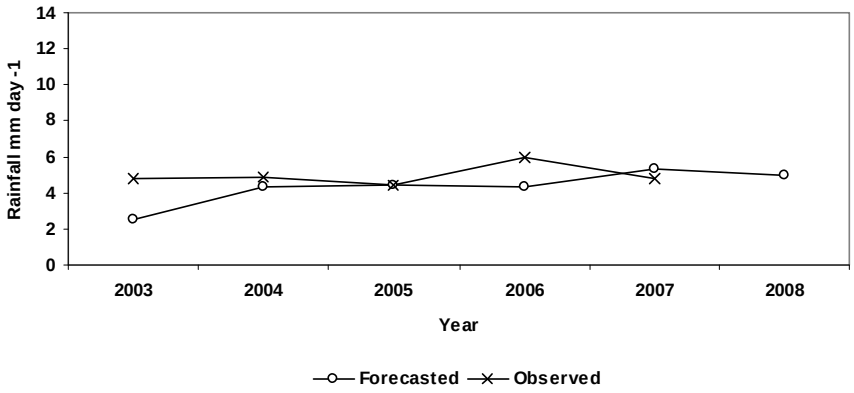
2003



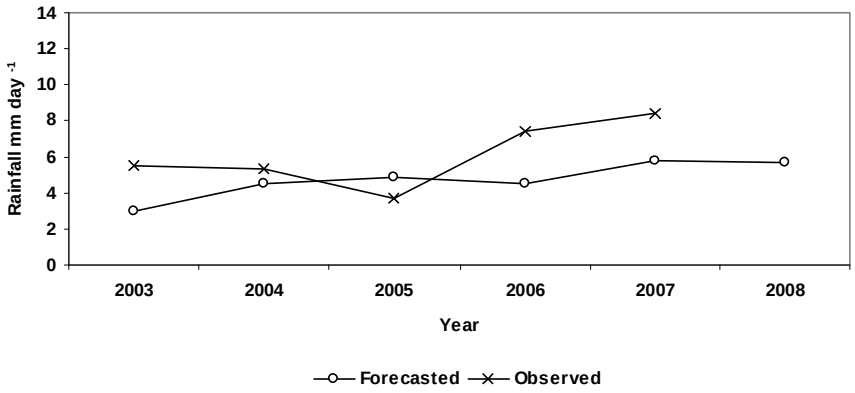
JJA forecast for meteorological stations

	Pearson's correlation	RMSE	Hit Score	Bias	Mean absolute error	P value at 95% Confidence level	2008 JJA forecast mm/day	Probability of occurrence %
Colombo	0.6675	1.06	66.67	0.02	0.83	0.0000	5.0	48 (*AN)
Galle	0.5446	1.47	55.56	0.00	1.17	0.0040	5.7	51 (*AN)
Kandy	0.3349	1.14	44.44	0.02	0.94	0.0620	2.9	60 (*BN)
Ratnapura	0.4781	1.95	66.67	-0.14	1.36	0.0100	9.3	45 (*BN)
Kurunegala	0.6294	1.10	62.96	0.03	0.92	0.0000	3.0	42 (*BN)
Nuwara Eliya	0.2045	3.04	44.44	-0.03	2.03	0.1460	3.0	65 (*BN)
*BN=Below Normal *N=normal *AN=Above Normal								

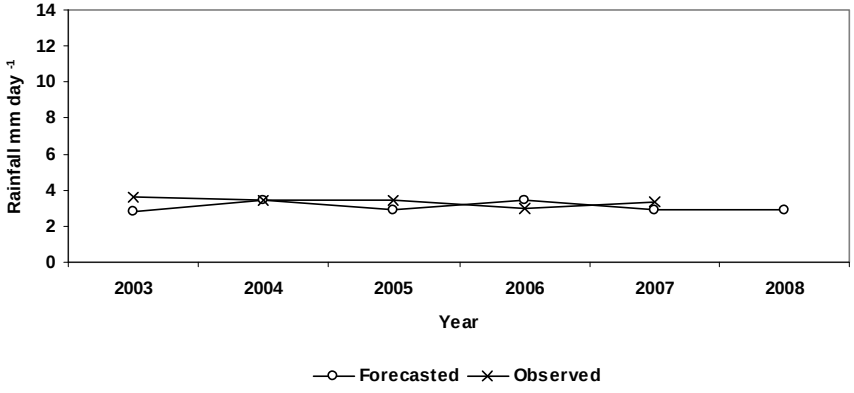
Colombo meteorological station



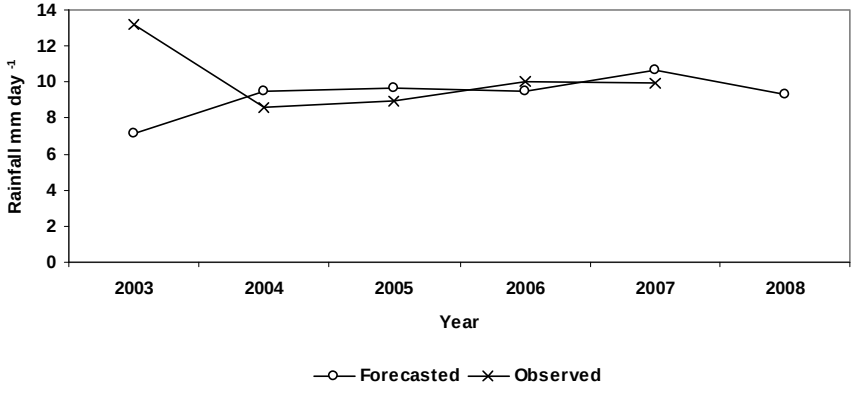
Galle meteorological station



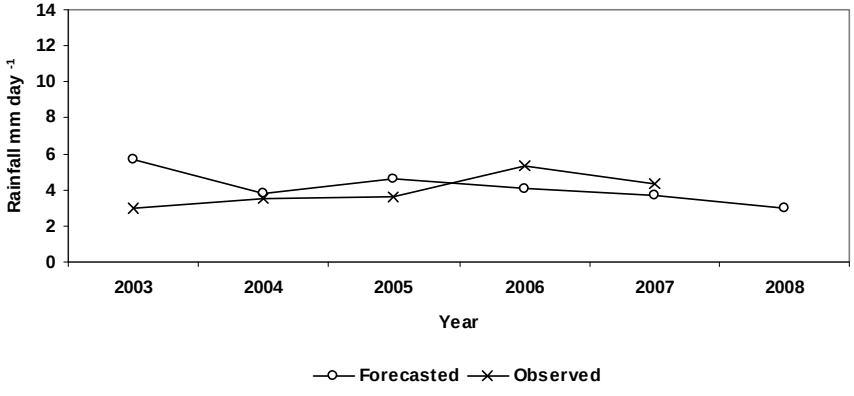
Kandy meteorological station



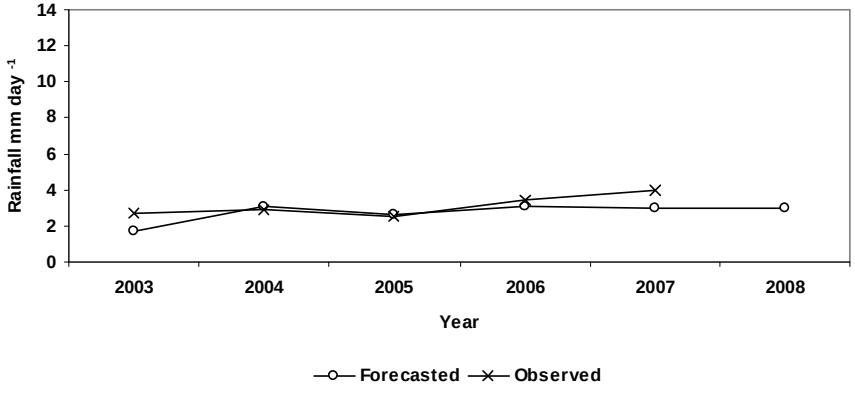
Ratnapura meteorological station



Nuwara Eliya meteorological station



Kurunegala meteorological station



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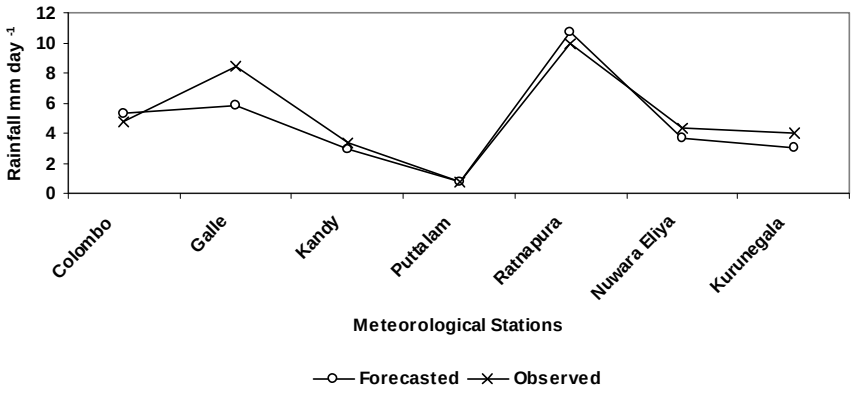

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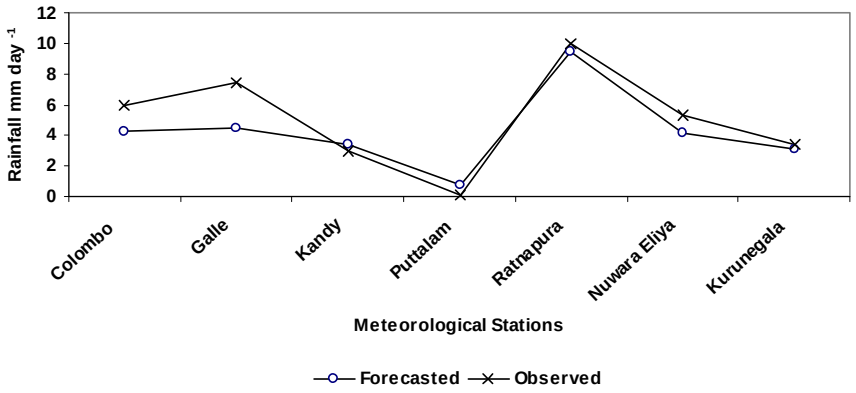

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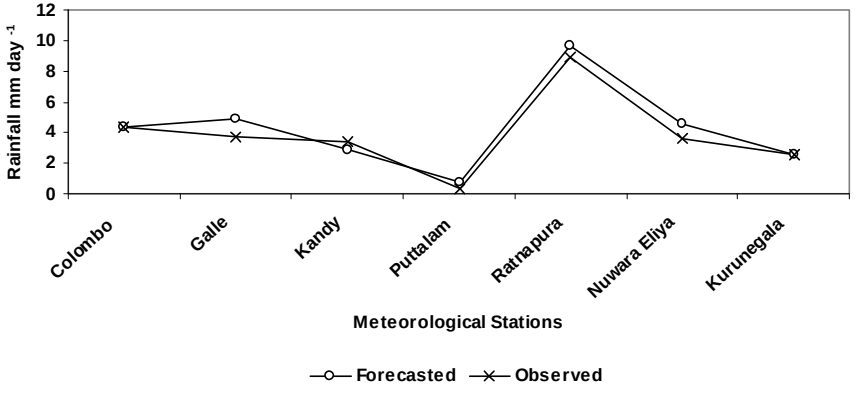

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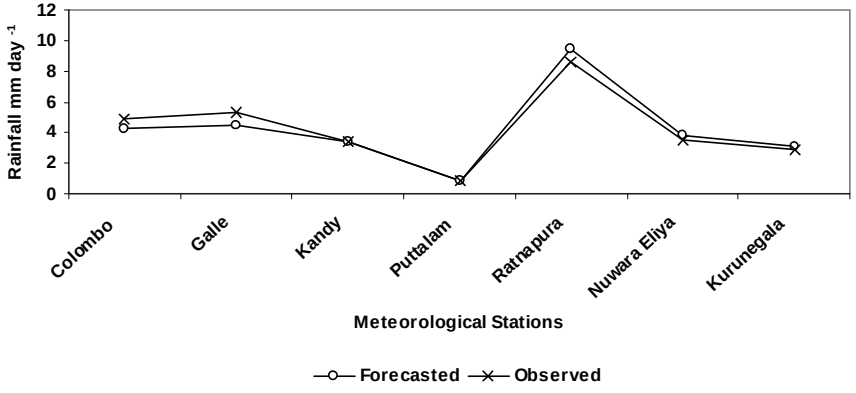

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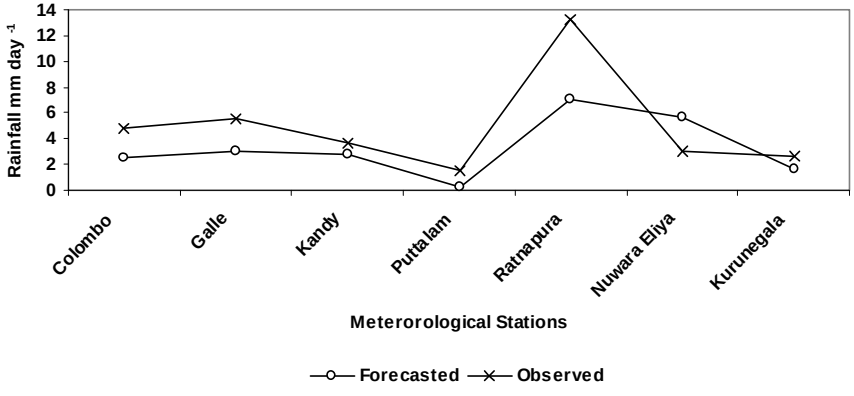


CPT

Canonical Correlation Analysis (CCA)

Forecast for August 2008

Predictor – Observed SST over

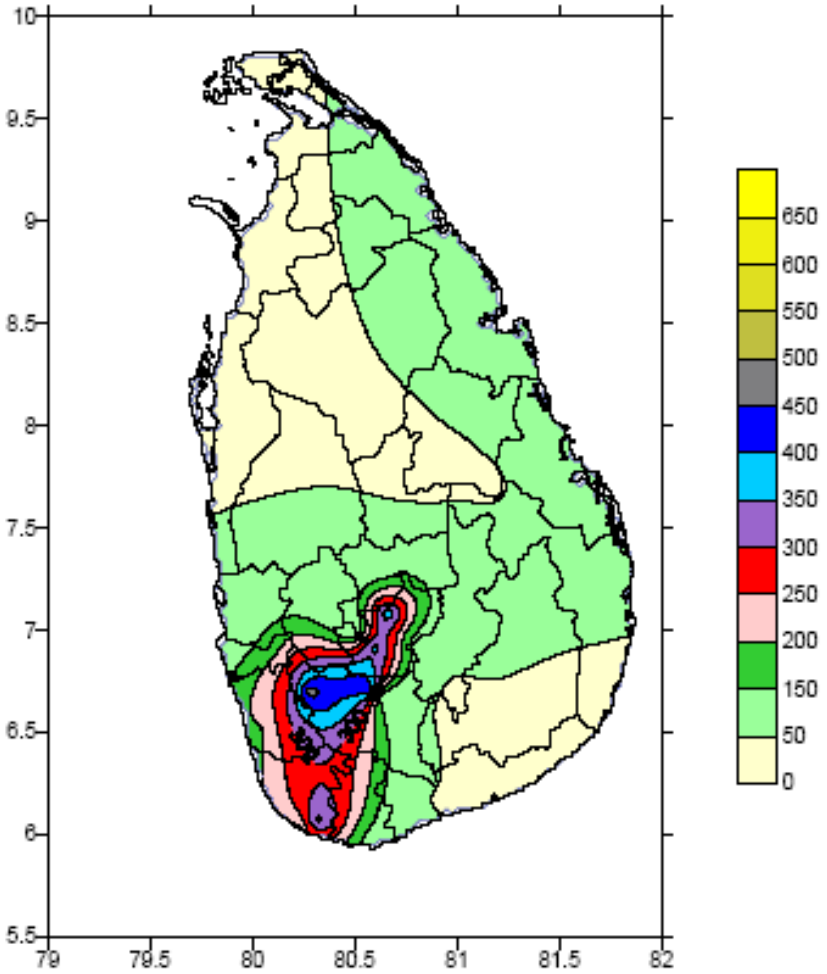
Nino 3.4 region (June 2008)

Predictands – Station RF

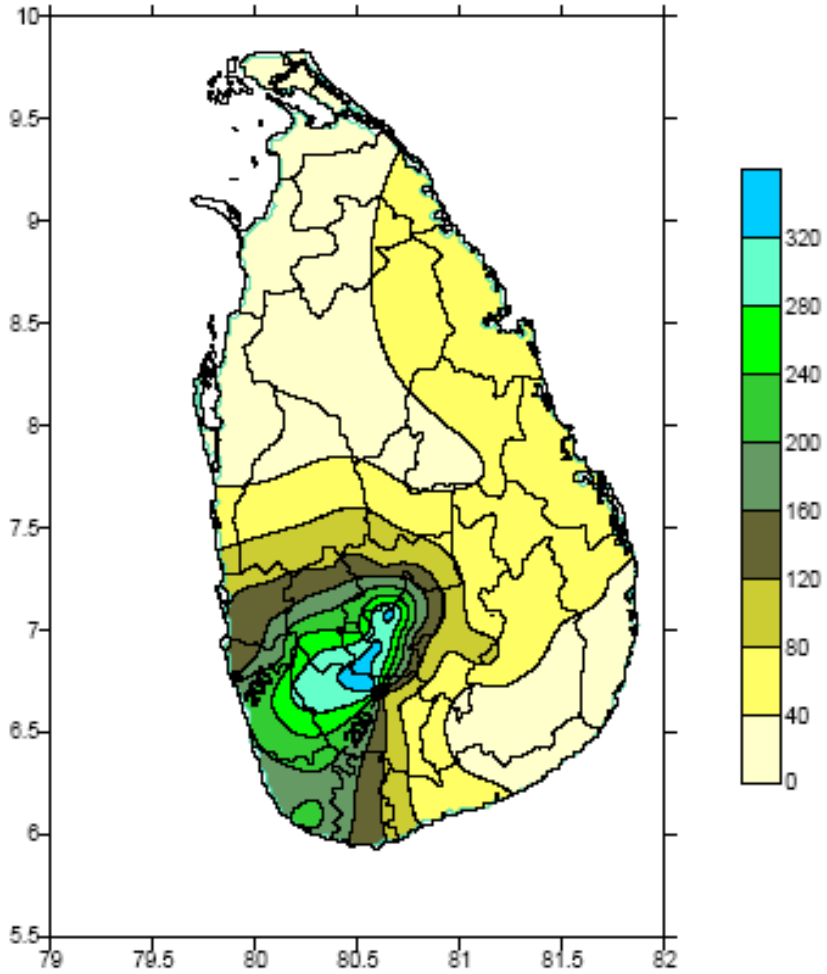
Rainfall Forecast - August 2008

District	Prediction (Station)-mm [* Predicted Probability (%)] AN – Above Normal, N – Near Normal, BN – Below Normal			
Colombo	Colombo 120 50% N* *[Avg:119.5]*	Hanwella 200 51% AN* *[Avg:-]*	Awissawella 221 50% BN* *[Avg:251.8]*	Angoda 118 46% BN* *[Avg:124.3]*
Hambantota	Hambantota 45 46% BN* *[Avg:56.3]*	Ambalantota 48 48% BN* *[Avg:59.6]*	Angunukola... 47 43% AN* *[Avg:-]*	Yala 14 50% N* *[Avg:19.2]*
Rathnapura	Balangoda 112 68% AN* *[Avg:96.7]*	Aluppola 434 68% AN* *[Avg:335.7]*	Galtura 476 60% AN* *[Avg:310.2]*	Ratnapura 410 65% AN* *[Avg:304.1]*
Galle	Galle 189 59% N* *[Avg:185.9]*	Baddegama 246 61% N* *[Avg:-]*	Labuduwa 224 60% N* *[Avg:239.4]*	-
Kaluthara	Clyde 228 56% N* *[Avg:230.6]*	Halwatura 317 43% AN* *[Avg:298.5]*	Neboda 252 46% AN* *[Avg:-]*	Vincent 157 52% BN* *[Avg:203.2]*
Matara	Denagama 125 62% AN* *[Avg:109.4]*	Kekanadura 127 64% N* *[Avg:139.1]*	Deniyaya 205 67% AN* *[Avg:-]*	Telijjawila 63 67% BN* *[Avg:-]*
Nuwara Eliya	Nuwara Eliya 155 48% N* *[Avg:161.0]*	Kotagala 367 46% AN* *[Avg:-]*	Ginigathena 629 45% BN* *[Avg:-]*	Katukitula 388 46% AN* *[Avg:-]*

Predicted Rainfall – August 2008



Average Rainfall – August 2008



Concluding Remarks..

- **CPT has shown some skills in forecasting JJA & monthly rainfall in Sri Lanka**
- **Forecasting skill in JJA is higher than DJF, as the variability of DJF > JJA**
- **Limitations: allows only one predictor at a time**

Acknowledgement ..

ICTP

SNU

Dr. Jin Ho Yoo

Prof. In-Sik Kang & Team

Thank You

Rainfall Anomaly – August 2008