4. OBSERVED CLIMATE AND CLIMATE CHANGE PROJECTIONS

4.1 INTRODUCTION

The State of Tamil Nadu is situated at the south-eastern extremity of the Indian Peninsula, bounded on the east by the Bay of Bengal, in the west by the Western Ghats and in the south by the Indian Ocean,and in the North West by Nellore and Chittoor districts of Andhra Pradesh and Kolar, Bangalore and Mysore districts of Karnataka. It has a coastal line of 922 km and land boundary of 1200 km. It lies between 8° 5´ and 13° 35´ N latitude and between 76° 15´ and 80° 20´ E longitude. The State can be divided into two natural divisions namely, the coastal plains and hilly western areas.The Palghat gap of Kerala about 25 km in width in the great western mountain wall is the only marked break to Tamil Nadu. The slopes of the Western Ghats are covered with heavy evergreen forests, that too presently being made grey rapidly with human intervention, thus making it susceptible to animal and human conflict.

The trend of drainage is from west to east into the Bay of Bengal. The river Cauvery rises from the Brahmagiri hill in Coorg district of Karnataka and passes across eastwards across the peninsula into the Bay of Bengal. The Ponnaiyar River rises from Kolar district of Karnataka runs across the State and falls into the sea north of Cuddalore. The Vaigai river from Western Ghats and passes across the State and finally falls into the Bay of Bengal, 16 km east of Ramanathapuram.

The proximity of sea influences the climate of the eastern and southern parts of the State whereas hilly orography and inland locations play important roles in modifying the climate over rest of the State.The western portions of the State and the portions bordering with Kerala have a marine climate with mild winters and moist summers and the remaining part of the State has a tropical savanna climate that is hot and seasonally dry.

Out of 13 million hectares of geographical area, about 7 million hectares of land is under cultivation. Of this 55 percent is irrigated and rest is rain fed/ dry land. Among all the States in India, ground water has been harnessed fully in this State. Tamil Nadu has been divided into seven agro climatic sub-zones, three agro ecological zones amd 16 sub agro-ecological zones. The agroclimatic zones are North Eastern zone, North Western zone, Western Zone, Cauvery Delta zone, the Southern zone, High rainfall zone and High Altitude and Hilly zone. The three agro-ecological zones are the hot semi arid eco-region with red loamy soil, hot sub humid to semi arid eco-region with coastal alluvium derived soils and hot humid eco-regions with red lateritic and alluvium derived soils. This classification helps in the suitable planning and should be made based on these boundaries.

4.2 OBSERVED CLIMATE

Rainfall Pattern

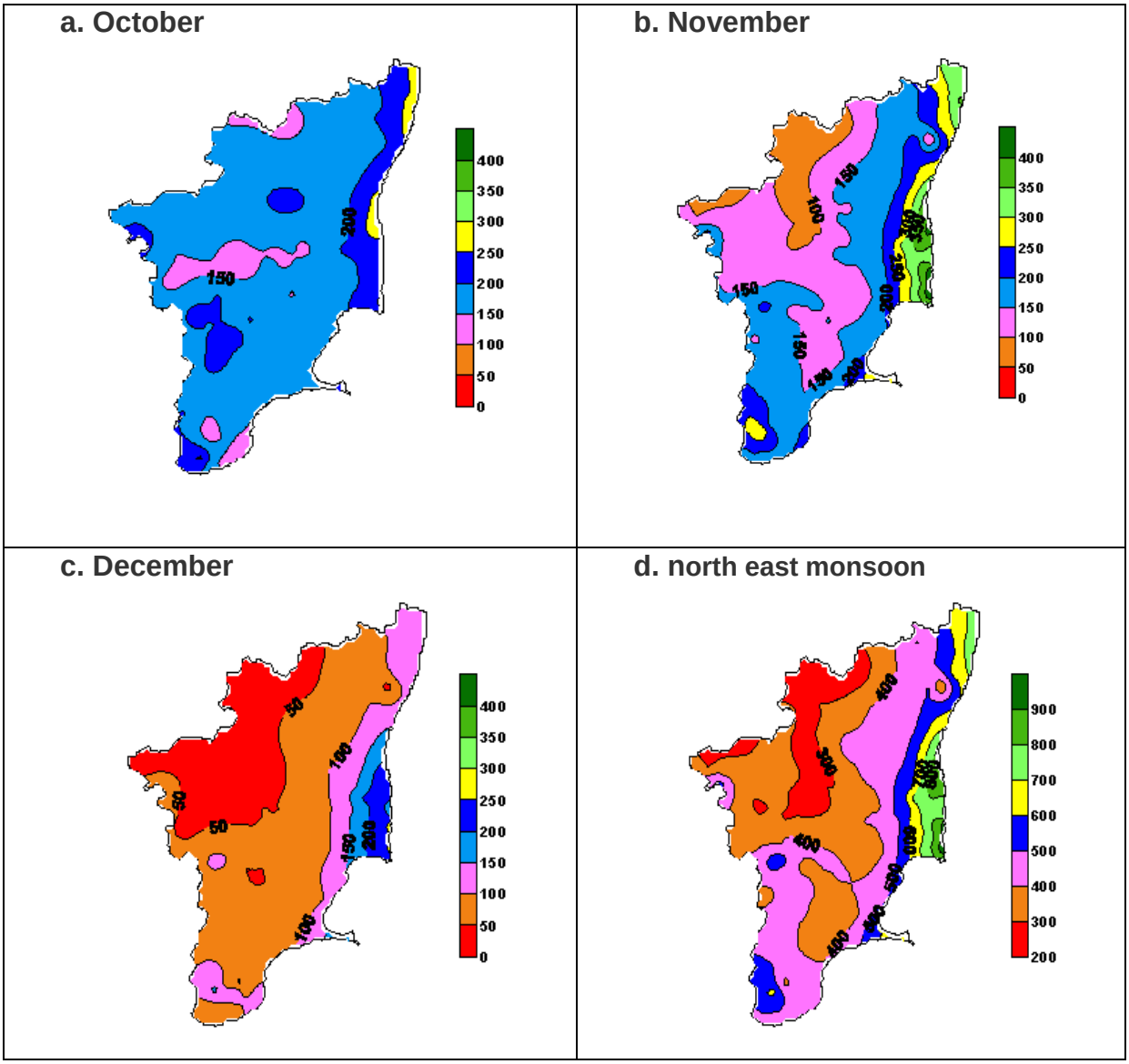
The State mainly receives its rainfall in three seasons, viz. south west monsoon, north east monsoon and pre monsoon season. The normal annual rainfall falling over the State is 958.4 mm. About 50 percent of the total annual average rainfall is received during north east monsoon, while about 31 percent is received during south west monsoon and the balance in the other seasons. The coastal districts receive about 65-75 percent of annual rainfall and interior districts get about 40-50 percent in this season. The percentage share of rainfall of different locations coastal/ inland / hilly stations for four seasons are given in the Table 4.1. The hilly regions in the west and hilly/ plain lands in north western half of the region receive major share from south west monsoon. Figure 4.1 shows the spatial pattern of rainfall during north east monsoon season.

Table 4.1: Seasonal rainfall of selected stations in Tamil Nadu (Rainfall in cm)

Stations	Lat.	Long.	Percentage share of rainfall in various seasons			
			Winter	Pre monsoon	south west monsoon	north east monsoon
Meenambakkam	13.07	80.19	2.2	5.3	33.5	59.0
Nungambakkam	13.07	80.25	3.6	5.0	30.8	60.6
Vellore	12.92	79.15	3.0	10.1	46.1	40.8
Kanchipuram	12.83	79.72	2.9	7.0	43.7	46.4
Chengulpattu	12.70	79.95	3.1	5.6	38.4	53.0
Tiruvannamalai	12.23	79.08	3.9	10.8	43.7	41.6
Dharmapuri	12.13	78.18	2.3	18.9	42.4	36.4
Villupuram	11.93	79.50	4.0	7.3	38.3	50.3
Cuddalore	11.77	79.77	5.2	6.3	26.3	62.1
Salem	11.65	78.18	1.8	17.3	49.7	31.3
Ooty	11.40	76.73	2.7	20.6	45.9	30.9
Erode	11.35	77.67	3.3	20.2	35.2	41.3
Mettupalayam	11.30	76.25	7.8	21.4	19.4	51.4
Coimbatore	11.03	77.05	3.5	20.7	24.8	51.0
Karur	10.95	78.09	2.1	16.9	26.3	54.7
Tanjavur	10.78	79.13	5.7	11.1	34.1	49.2
Tiruchirapalli	10.77	78.72	3.8	15.0	35.2	45.9
Vedaranyam	10.37	79.85	21.5	8.4	13.6	56.5
Dindigul	10.35	77.97	4.8	16.2	29.7	49.3
Adiramapattinum	10.33	79.88	6.2	11.7	27.4	54.7
Kodaikanal	10.23	77.47	6.0	21.2	34.3	38.4
Madurai	9.92	78.12	1.9	12.6	37.0	48.5
Tondi	9.77	79.03	5.2	16.2	16.3	62.3
Virudhunagar	9.68	77.97	4.5	20.0	29.0	46.5
Tuticorin	8.80	78.15	8.0	17.7	5.4	68.9
Palayamkottai	8.73	77.75	9.8	18.4	9.7	62.1
Tiruchendur	8.50	78.12	12.1	12.7	3.3	71.8
Kanyakumari	8.08	77.05	3.6	17.5	29.1	49.8
Tamil Nadu			**4.3**	**13.1**	**31.9**	**50.7**

Source: http://www.tn.gov.in/dept.st/climate and rainfall.pdf

Figure 4.1: Rainfall over Tamil Nadu during a) October b) November, c) December and during d) north east monsoon season



Source:http://mapsof.net/map/hydrographic-rainfall-map-tamil-nadu

Spatial distribution of the rainfall received over Tamil Nadu is highly variable. Rainfall over coastal areas is more and decreases in the inland areas since the rainfall causing systems are forming over Bay of Bengal and moving towards the coast of Tamil Nadu. Also the rainfall over northern end is more than the southern locations. It is probably due to the maximum rainfall zones in the north eastern sectors. Orography of the rainfall process also plays an important role in the spatial distribution of rainfall.

The windward (eastern) sides of the Eastern Ghats are having more rainfall than the leeward (western) side. The total amount of rainfall in the season is not constant and have inter seasonal and intra seasonal variability due to formation/ non-formation of rain causing mechanisms and their movements. If they move in

north westerly or westerly direction, the systems cause more rainfall than when they re-curve or move in northerly direction The coefficient of variation of annual rainfall is less than 25 percent over the central part except over the coastal area north of latitude 10° N and extreme southern part where the coefficient may even exceed 30 percent.

A review study carried out by Jain and Kumar (2012), indicates that the annual rainfall has increased by +8.5 percent and +4.4 percent in the Cauvery river basins and the river basins north to Cauvery river basin in Tamil Nadu respectively in the last 100 years with respect to the average rainfall during this period. The river basins that are in the south of the Cauvery river basin have experienced decrease in annual rainfall by -9.8 percent.. An analysis of annual rainy days indicates that there is no change in the Cauvery basin in the last 100 year period. However, the river basins north and south of the Cauvery basins have experienced decreasing trend by -3.6 percent and -32.3 per cent. The quantified changes in annual rainfall and number of rainy days is indicated in Table 4.2 at annual and seasonal levels.

Table 4.2: Changes in annual and seasonal rainfall and in number of rainy days in the last 100 yrs

Basin	Annual		Premonsoon		Monsoon		Post Monsoon		Winter	
	R f	RD	R f	RD	R f	RD	R f	RD	R f	RD
EF1[1]	0.044	-0.032	-0.345	-0.032	-0.214	-0.047	0.659	0.000	0.197	0.000
Cauvery	0.879	0.000	-0.563	0.000	0.075	0.028	1.748	0.050	0.024	0.000
EF2[2]	-0.950	-0.333	-0.800	-0.143	-0.500	-0.125	0.491	0.000	-0.246	-0.032
Rf: Rainfall in (mm/yr); **RD:**Rainy days (Days/yr)										

[1]EF2- East flowing river basins that are north of the Cauvery river Basin
[2] EF – East flowing river basins that are South of Cauvery river Basin

Temperature

In general, the maximum temperature rarely exceeds 43° C and the minimum temperature rarely falls down below 18° C. The mean annual temperature is 28.2°C in the plains and 15.2°C in the hills. The temperature is minimum in the month of December with 24.7°C and maximum in May with 37.3°C. Soil temperature data available for a few places indicate a range from 30.7°C to 32.3°C in the plains and around 14.4°C in the hills. On the basis of temperature, the coastal plain (Aduthurai) is classified as hyper-thermic (very hot), northern part (Coimbatore) and southern part (Kovilpatty) are iso-hyperthermic (steadily very hot) and hill area (Uthagamandalam) is iso-mesic (steadily cold).

Annamalai et al (2011), based on their study on temperature over Cauvery basin of Tamil Nadu reported that the average year to year variation in surface temperature lies in the range about 0.4° C with few years warmer or cooler by 0.8°C. Based on the technique of deducting the long time forced component (trend), the temperature series in both the seasons clearly indicates a warming tendency. For the period from 1951 to 2008, the warming is of the order of 0.7 to 0.8°C and this is above the natural variability. One difference is that, while the warming is gradual during south west monsoon season, it appears to occur abruptly during north wast

monsson season. Balasubramanian et al (1994) based on their analysis of the prevailed temperature in Coimbatore from 1962 to 1992 found that there was decadal variability in maximum and minimum temperature and this was on the rise level up to 0.1 to 2.7° C.

Monsoons Onset and Withdrawals

The normal onset of southwest monsoon over Tamil Nadu is predicted to take place on 1st June with a standard deviation(SD) of 7.4 days (based on data of 1901-2011). During the last 31 years (1981-2011) period, however, the normal date has advanced by a day with SD of 6 days. The earliest onset is 11th May and the late onset is 18th June. Based on the linear trend analysis, it was found that the onset is advanced by one day in every 20 years period (1901-2011).

The north east monsoon sets in over Tamil Nadu on 20th October (based on 1901-2000). The earliest onset is 4th October and late onset is 11th November. In 75 percent of years, the onset of north east monsoon took place between 13th October and 27th October. In 8 percent of years, the monsoon onset was found in November month (Asokan,2011). Northeast monsoon withdraws from Tamil Nadu on 30th December with SD of 14 days. In 51 percent of the years, the withdrawal is between 14th December and 4th January. In 2 percent of the years the withdrawal took place in November itself. In 40 percent of the years, the withdrawal occurred in January month. Table 4.3 give the onset dates of south west and north east monsoons over Tamil Nadu during 1990-2011 including percent of departure. The early or late onset does not have any bearing on the monsoon performance.

Table 4.3: Onset dates and total rainfall during south west (SW) and north east (NE) monsoons between 1990-2011*

Year	Onset dates		SW monsoon rainfall (mm)			NE monsoon rainfall (mm)		
	SW monsoon	NE monsoon	Actual	Normal	Percentage departure	Actual	Normal	Percentage departure
1990	19th May	19th Oct	270	312	-13	468	483	-3
1991	02nd Jun	20th Oct	388	341	+13	488	477	+2
1992	05th Jun	2nd Nov	345	331	+4	514	470	+9
1993	28th May	20th Oct	312	330	-6	784	479	+64
1994	08th Jun	18th Oct	252	326	-23	534	478	+12
1995	03rd Jun	23rd Oct	351	327	8	260	479	-46
1996	09th Jun	11th Oct	497	329	+51	595	477	+24
1997	01st Jun	13th Oct	298	326	-9	810	478	+70
1998	02nd Jun	28th Oct	341	327	+4	627	478	+30
1999	28th May	21st Oct	201	321	-37	517	483	+7
2000	01st Jun	2nd Nov	315	324	-3	346	483	-28
2001	23rd May	16th Oct	263	324	-19	382	483	-21
2002	29th May	25th Oct	179	323	-45	395	469	-16
2003	08th Jun	19th Oct	346	316	+7	435	469	-7
2004	18th May	18th Oct	347	316	+10	435	432	+1
2005	05th Jun	12th Oct	295	316	-7	773	432	+79
2006	26th May	19th Oct	249	316	-21	497	432	+15
2007	28th May	22nd Oct	339	316	+7	521	432	+21
2008	31st May	15th Oct	324	316	+3	564	432	+31
2009	23rd May	29th Oct	316	316	0	488	432	+12
2010	31st May	29th Oct	351	316	+21	613	432	+42
2011	29th May	24th Oct	301	321	-6	542	442	+23

* data includes TamilNadu and Puducherry

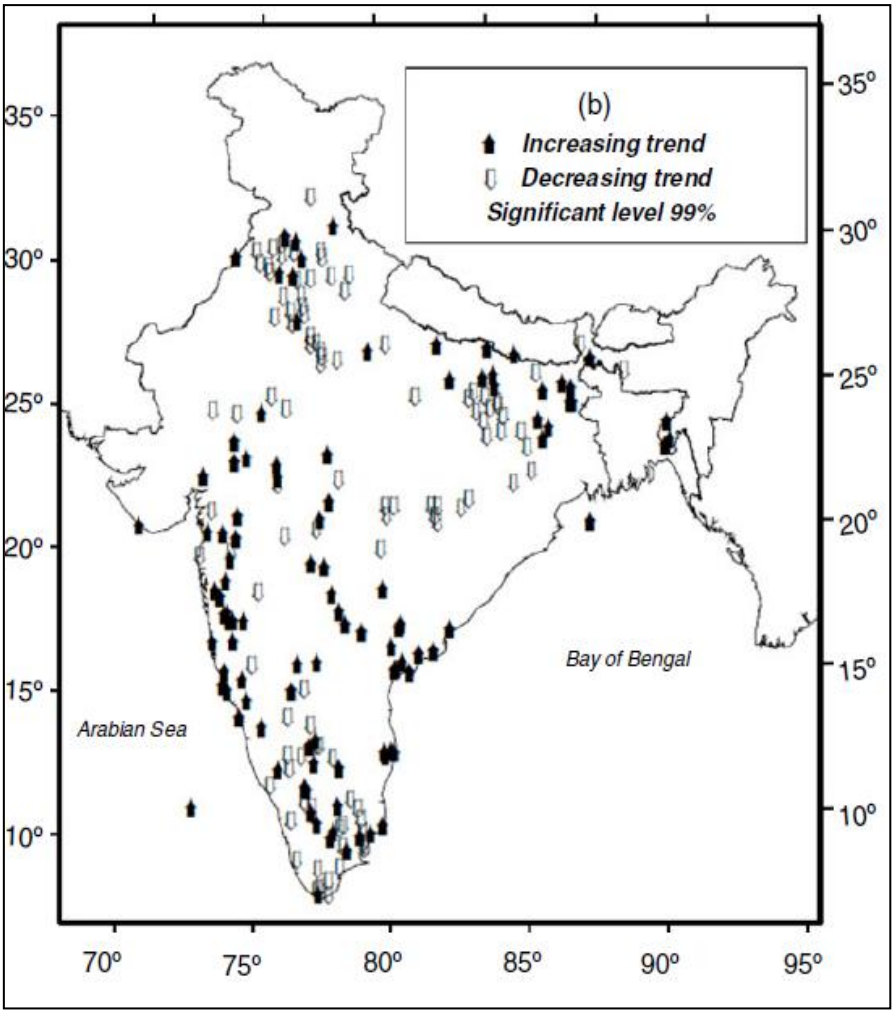
Extreme Rainfall

Long term studies carried out by Guhathakurta et al (2011), for the period 1901-2005, indicate, that Tamil Nadu is experiencing more dry days than wet days every year. However, there has been a significant increase in heavy precipitation events as indicated in the recordings of the IMD (India Meteorological Department) observing stations in the State (Figure 4.2).

Increase in one day extreme rainfall events of the order of 5 to 10 cm has been observed along the northern coast of the State.In rest of the State, the extreme rainfall event has increased by less than 5 cm or less.

The analysis of 25 year return period of rainfall shows a large variation from 10cm in the western parts of Tamil Nadu to 25 cm and more in the northern and central coastal regions of the State.

Figure 4.2: Stations with significant increasing/decreasing trends in one day extreme rainfall



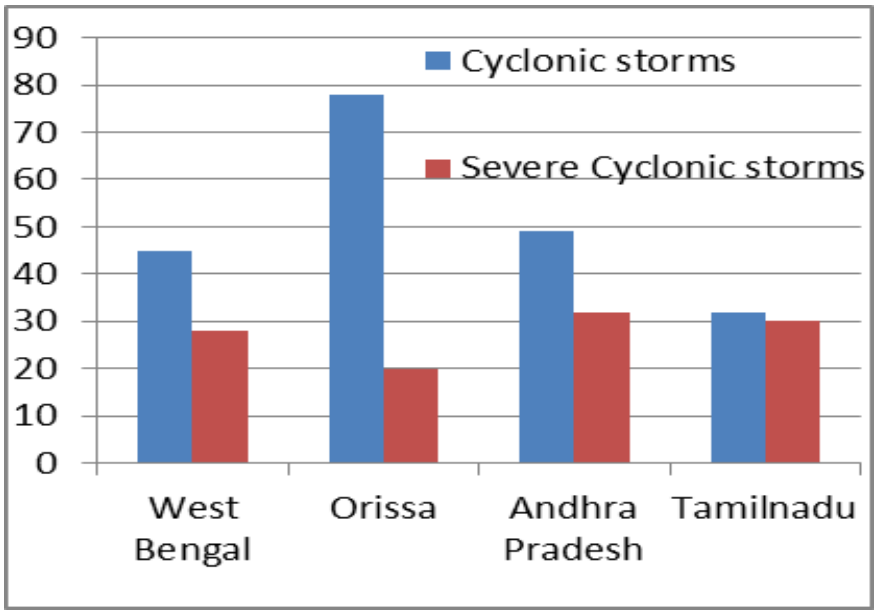
Cyclones

Situated along the eastern coast of India, Tamil Nadu has been hit by about 32 cyclonic storms between 1891 to 2006 of which 30 were severe cyclonic storms. The total number of cyclonic storms hitting the Tamil Nadu coast increased to 44 by 2011. A sharp increase by 37.5 percent between 2006 and 2011.

Maximum number of cyclonic storms tend to cross over north Tamil Nadu coast in the post monsoon season. No cyclonic disturbances crossed Tamil Nadu coast during monsoon season (June-September).The number of storms that crossed north Tamil Nadu coast is four times more than that crossed south Tamil Nadu coast during pre monsoon months during this period. Only three cyclonic disturbances crossed Tamil Nadu coast during winter months (Figure 4.3).

Linear trend analysis based on two different periods 1891- 2011 for winter, pre monsoon, monsoon, post monsoon and annual frequency shows that the formation of cyclonic disturbances in the Bay of Bengal (BOB) during winter and post monsoon months (October-February) shows an increasing trend while a decreasing trend is seen during the monsoon months (June–September).There is an increasing trend in the number of severe cyclonic storms to form in BOB in pre monsoon months (March–May) during same period.

Figure 4.3: Number of cyclonic storms crossing eastern coastal states in India between 1891 and 2006



Source: IMD (www.imd.gov.in/section/nhac/dynamic/cyclone.htm1)

Sea level rise

The mean sea level rise trend off the Chennai coast is 0.32 mm/year, estimated with a 95 percent confidence interval of ±0.37 mm/year based on monthly mean sea level data for the period 1916 to 2008 which is equivalent to a change of 0.10 feet in 100 year (http://tidesandcurrents.noaa.gov/sltrends/).

4.3 CLIMATE PROJECTION

The following section gives the projections of temperature and precipitation based on UK Met Office Hadley Centre regional climate model PRECIS with boundary data inputs from 6 out of 17- member perturbed-physics ensemble (HadCM3Q0-Q16, known as 'QUMP').The model was run at CCC&AR, Anna University at a spatial resolution of 25 km x 25 km and the GHG emission drivers are generated by the IPCC A1B SRES scenario (Box 4.1).

Box 4.1: About PRECIS and A1B Scenario

PRECIS is based on the UK Met Office Hadley Centre's regional climate modelling system (HadCM3). It has been ported to run on a work station (under Linux) with a simple user interface, so that experiments can easily be set up over any region.

For further details see http://www.metoffice.gov.uk/precis.

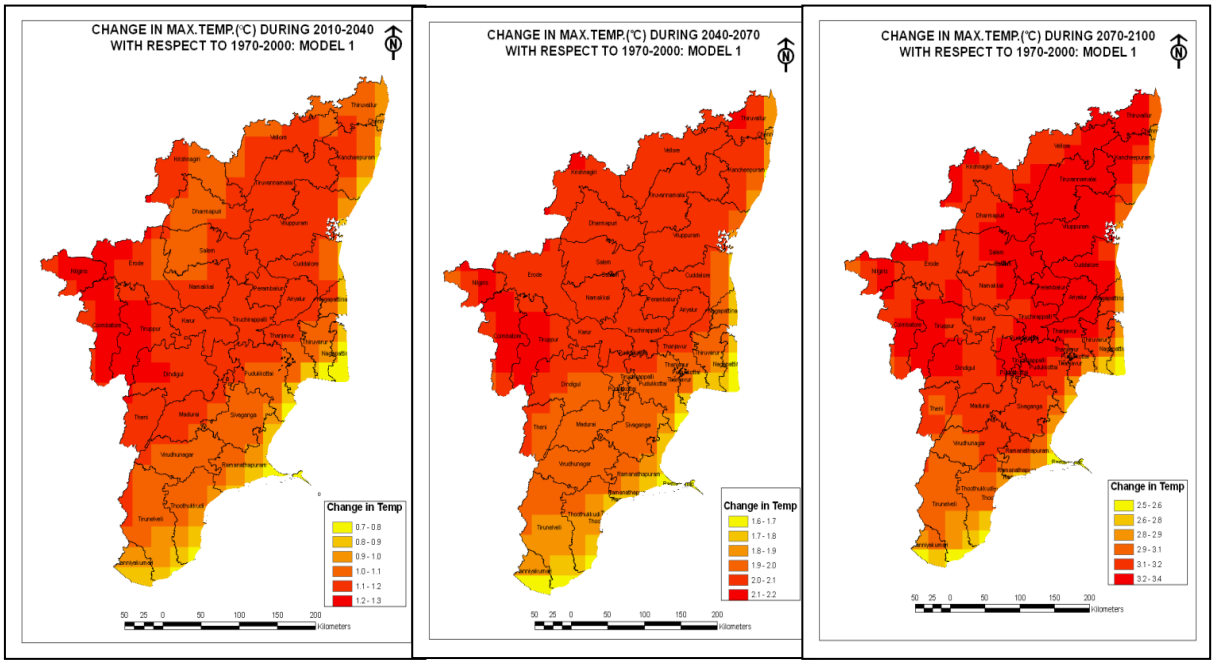
The IPCC A1B SRES scenario is a socio economic scenario that refers to a future world of very rapid economic growth, and rapid introduction of new and more efficient technologies. Major underlying themes are economic and cultural convergence and capacity building, with a substantial reduction in regional differences in per capita income. For further details see IPCC, Special report on Emission Scenarios (SRES), 2000.

https://www.ipcc.ch/pdf/special-reports/spm/sres-en.pdf).

Temperature Projections

Maximum Temperature: The maximum temperature over Tamil Nadu is projected to increase by 1.0^0C, 2.0^0C and 3.1^0C for the periods 2010-2040, 2040-2070, 2070-2100 respectively with reference to the baseline 1970-2000 (Table 4.4). District wise changes (Figure 4.4) indicate a general maximum increase of about 3.4^0C over the North western districts of Nilgiris, Coimbatore, Tiruppur and western parts of Dindigul District at the end of the century. The minimum increase of about 0.7^0C is seen along the eastern parts of coastal districts particularly over Kanyakumari, Nagapattinam, Tirunelveli and Ramanathapuram.

Figure 4.4: Change in maximum temperature (^{0}C) projections for 2010-2040, 2040-2070, 2070-2100 with reference to baseline (1970-2000).



(Source:Centre for Climate Change and Adaptation Research (CCCAR),Anna University,Chennai)

Table 4.4: District wise projected change in maximum temperature in ^{0}C with reference to 1970-2000

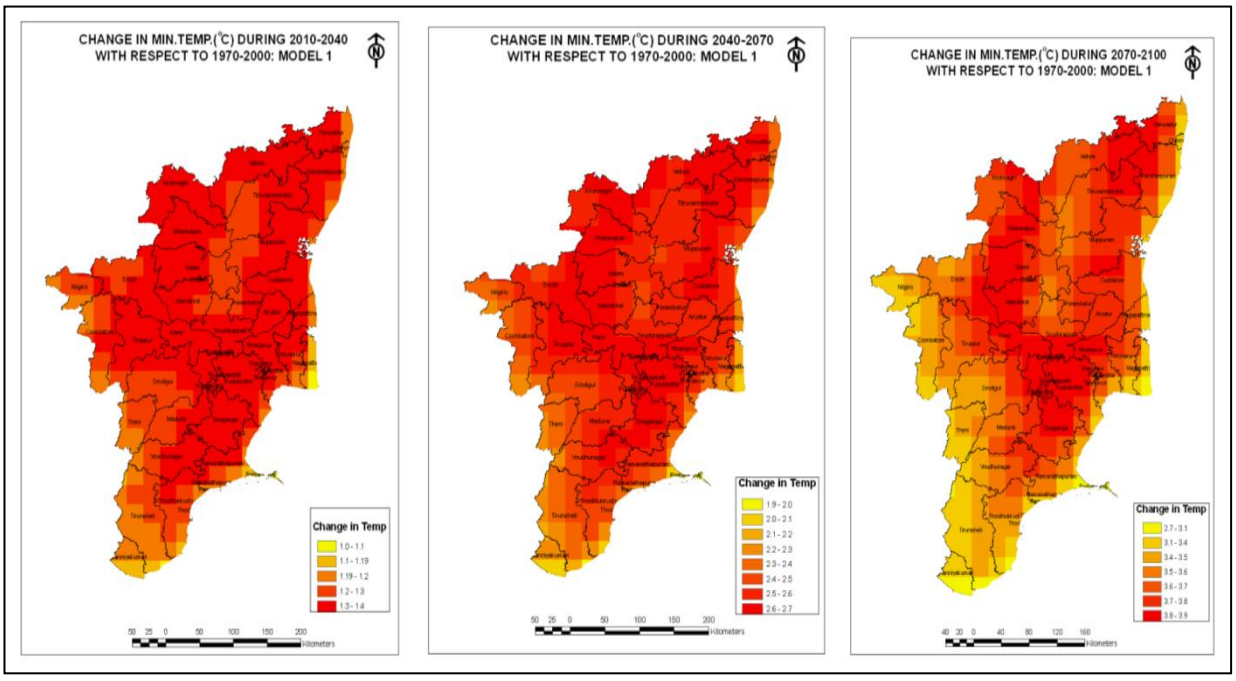
District Name	Change in maximum temperature in ^{0}C with reference to 1970-2000		
	2010-2040	2040-2070	2070-2100
Ariyalur	1.1	1.9	3.1
Chennai	1.0	2.0	3.1
Coimbatore	1.3	1.9	3.1
Cuddalore	1.1	2.0	3.2
Dharmapuri	1.1	2.0	3.2
Dindigul	1.2	2.1	3.3
Erode	1.2	2.0	3.2
Kancheepuram	1.1	1.8	3.0
Kanyakumari	1.0	1.7	2.7
Karur	1.2	2.1	2.3
Krishnagiri	1.2	2.0	3.2
Madurai	1.2	1.8	3.0
Nagapattinam	1.0	1.6	2.7
Namakkal	1.2	2.0	3.2
Nilgiris	1.3	2.1	3.2
Perambalur	1.2	2.0	3.3
Pudukkottai	1.0	1.7	2.9
Ramanathpuram	0.9	1.6	2.7
Salem	1.2	1.9	3.2
Sivaganga	1.1	1.9	2.7
Thanjavur	1.0	1.8	2.9
Theni	1.2	2.1	3.3

District Name	Change in maximum temperature in ^{0}C with reference to 1970-2000		
	2010-2040	2040-2070	2070-2100
Thiruvallur	1.1	1.6	2.8
Thiruvannamalai	1.2	2.0	3.2
Thiruvarur	1.0	1.1	2.3
Thoothukudi	1.0	1.8	2.8
Trichy	1.2	2.0	3.3
Tirunelveli	1.0	1.8	3.0
Tiruppur	1.2	2.2	3.4
Vellore	1.1	1.9	3.2
Villupuram	1.1	2.1	3.4
Virudhunagar	1.1	1.9	3.1

Minimum temperature projections: Projections of minimum temperature over Tamil Nadu as a whole for 2010-2040, 2040-2070, 2070-2100 with reference to baseline 1970-2000 indicates that it is likely to increase by 1.1 ^{0}C, 2.4 ^{0}C and 3.5 ^{0}C respectively (Table 4.5).

District wise changes (Figure 4.5) indicate generally lesser changes over the western parts and close to the coast. A general rise in temperature is seen ranging from 1^{0}C to 1.5^{0}C for the period 2010 to 2040 and between 2^{0}C to 2.6 ^{0}C for the period 2040-2070 and between 2.7^{0}C to 3.8 ^{0}C for the period between 2070 to 2100. The southern districts Kanyakumari and Tirunelvelli show minimum increase, while the central interior districts Karur, Tiruppur, and Namakkal show maximum increase in the minimum temperature.

Figure 4.5: Change in min. Temperature (^{0}C) projections for 2010-2040, 2040-2070, 2070-2100 reference to baseline (1970-2000) *



*(Source:CCCAR,Anna university,Chennai)

Table 4.5: District wise change in minimum temperature in ^{0}C with reference to 1970-2000

District Name	Change in minimum temperature in ^{0}C with reference to 1970-2000		
	2010-2040	2040-2070	2070-2100
Ariyalur	1.4	2.6	3.7
Chennai	1.1	2.2	3.2
Coimbatore	1.2	2.3	3.3
Cuddalore	1	2.2	3.3
Dharmapuri	1.2	2.4	3.6
Dindigul	1.1	2.3	3.4
Erode	1.3	2.6	3.7
Kancheepuram	1	2.2	3.3
Kanyakumari	0.8	1.8	2.7
Karur	1.5	2.6	3.8
Krishnagiri	1.3	2.5	3.6
Madurai	1	2.2	3.3
Nagapattinam	1.1	2.2	3.2
Namakkal	1.3	2.5	3.7
Nilgiri	1.2	2.3	3.3
Perambalur	1.1	2.3	3.5
Pudukkottai	1.1	2.3	3.3
Ramanathpuram	1.1	2.2	3.2
Salem	1.2	2.4	3.6
Sivaganga	1.1	2.4	3.5
Thanjavur	1	2.1	3.3
Theni	1	2.2	3.2
Thiruvallur	1.1	2.2	3.3
Thiruvannamalai	1.3	2.5	3.6
Thiruvarur	1.1	2.2	3.3
Thoothukudi	1.1	2.2	3.1
Trichy	1.2	2.4	3.6
Tirunelveli	0.55	1.65	2.65
Tiruppur	1.42	2.62	3.62
Vellore	1.3	2.6	3.7
Villupuram	0.9	2.1	3.1
Virudhunagar	0.85	1.95	2.95

(Source:Centre for Climate Change and Adaptation Research,Anna University,Chennai)

Rainfall Projections

Annual Rainfall: The rainfall projection indicates a slight decrease of about 50 mm by end of the century (2070-2100) with reference to the baseline (Fig.4.6). However district wise projection indicates variant distribution which has given in Table 4.6.

Seasonal Rainfall: South west and north east monsoons being principal rainy seasons, analyses have been carried out for these two seasons.North east monsoon may experience more intense rainfall when compared to south west monsoon by end of the century.

Table 4.6 : District wise percentage change in annual rainfall with reference to 1970-2000

Districts	2010-2040	2040-2070	2070-2100
Ariyalur	-6	-7	-3
Chennai	-9	-14	-4
Coimbatore	-3	4	6
Cuddalore	-6	-6	3
Dharmapuri	-5	-4	-3
Dindigul	-4	-3	1
Erode	-6	-6	0
Kancheepuram	-8	-12	-3
Kanyakumari	6	11	6
Karur	-3	-3	-2
Krishnagiri	-4	-5	-2
Madurai	-2	0	1
Nagapattinam	-7	-5	3
Namakkal	-4	0	-3
Nilgiri	-3	5	7
Perambalur	-6	-6	-3
Pudukkottai	-6	-1	9
Ramanathpuram	-4	2	9
Salem	-4	-1	-3
Sivaganga	-4	-2	4
Thanjavur	-6	-1	7
Theni	-7	0	4
Thiruvallur	-6	-13	-5
Thiruvannamalai	-6	-11	-7
Thiruvarur	-7	-2	8
Thoothukudi	-1	8	19
Trichy	-5	-2	-2
Tirunelveli	1	6	6
Tiruppur	-7	-3	2
Vellore	-6	-11	-6
Villupuram	-7	-9	1
Virudhunagar	-7	1	7

(Source:Centre for Climate Change and Adaptation Research,Anna University,Chennai)

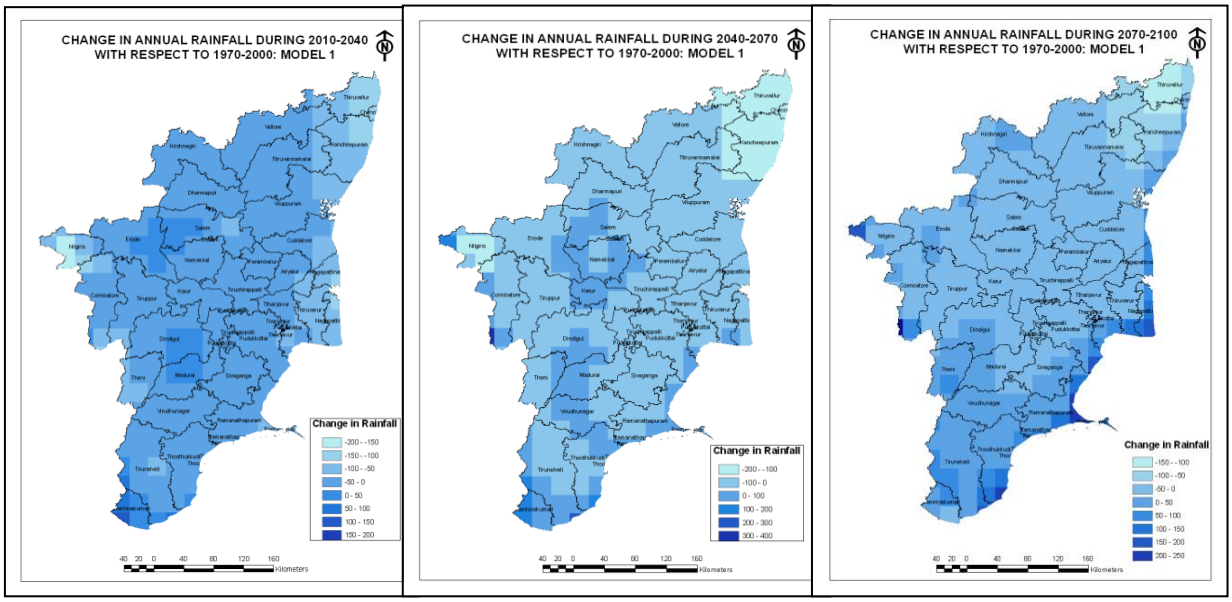
Cyclone Projections

The Climate Change and India: a 4X4 assessment: a sectoral and regional analysis for 2030's report published by the MoEF&CC,GoI in 2010, concludes, that in future, the number of cyclones hitting the eastern Indian coast including Tamil Nadu is likely to reduce, however, the intensity i.e., the wind speed of the cyclones may increase.

Projected sea level rise

Using CLIM SYSTEM - a model used for predicting sea level rise, with climate inputs from various GCMs(Global climate model).It is projected that by the end of the century i.e. by 2100 the sea level may rise of Tamil Nadu coast is likely to range from 0.19 m to a maximum of 0.73 m. See table below (Table 4.7)

Figure 4.6: Change in annual rainfall (mm) projections for 2010-2040, 2040-2070 and 2070-2100 with reference to baseline (1970-2000) *



*(Source:CCCAR, Anna university)

Table 4.7: Projection of sea level rise based on different IPCC SRES scenarios

IPCC SRES Scenarios[3]	GLOBAL PROJECTIONS 2100	REGIONAL PROJECTIONS 2100	
		1.097 m	1.252 m
B1	0.18 to 0.38m	0.19 to 0.41m	0.22 to 0.47m
B2	0.20 to 0.43m	0.21 to 0.47m	0.25 to 0.53m
A1B	0.21 to 0.48m	0.23 to 0.52m	0.26 to 0.60m
AIT	0.20 to 0.45m	0.21 to 0.49m	0.25 to 0.56m
A2	0.23 to 0.51m	0.25 to 0.55m	0.28 to 0.63m
AIF1	0.26 to 0.59m	0.28 to 0.64m	0.32 to 0.73m

[3] (https://www.ipcc.ch/pdf/special-reports/spm/sres-en.pdf)

4.4 CONCLUSION

Observations indicate that along with the rise in temperature, the total annual rainfall is decreasing in the State, both during the south west monsoon and north east monsoon. There is a distinct interannual variability and spatial variability in rainfall across the State, with the western and southern part of the State receiving maximum rainfall.

The projections are made, using PRECIS A1B scenario concluded that there is likely to be an decrease in rainfall in 2070s by about 1 to 9 percent with reference to the baseline rainfall (1970-2000).The maximum temperature is also likely to increase by about 3.1^0 C.However, as there is likely to be very high spatial variability, therefore catching water where it falls and either transferring it to water starved areas or catching the sparse rainfall in these areas will be a challenge.