
بسم الله الرحمن الرحيم

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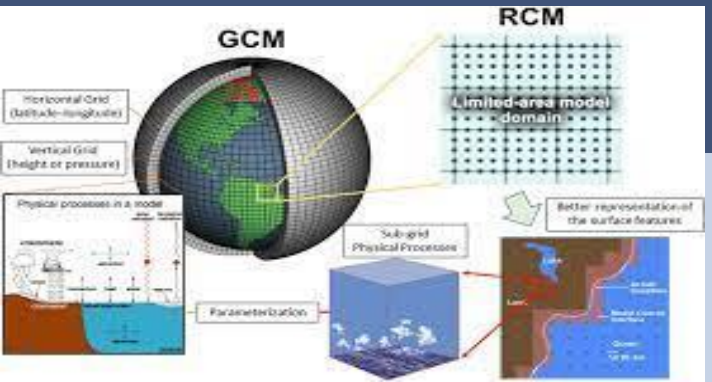
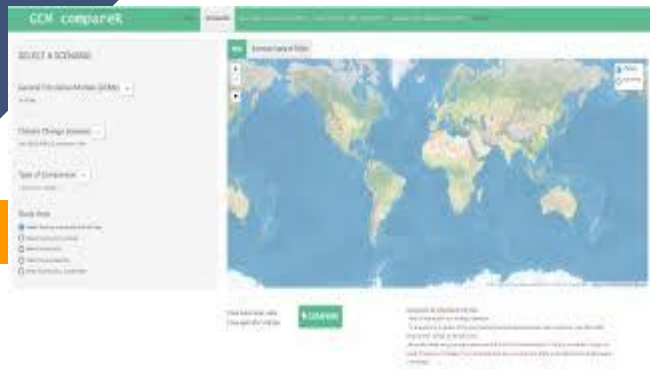
Proposed Research Title

Climate Change Impacts on Monsoon Flood situation in Pakistan





Introduction

- Every climatic parameters have its own importance in environment and its play an important role in hydrology **(Lehner et al .,2017)** .
- Global Warming can have important effect on climatic parameters **(Hoang et al., 2019)** .
- Water resources are expected to be increasingly challenging as a result of climate change.
- Understanding the interaction of climate and water resources can help scientists and policy makers to mitigate the negative effects of global warming by introducing proper water management scenarios **(Gao et al., 2018)**
- Assessment of these effect using the Global climate model **(Eyring et al .,2016)**

Problem

- ✓ Due to increase of Population

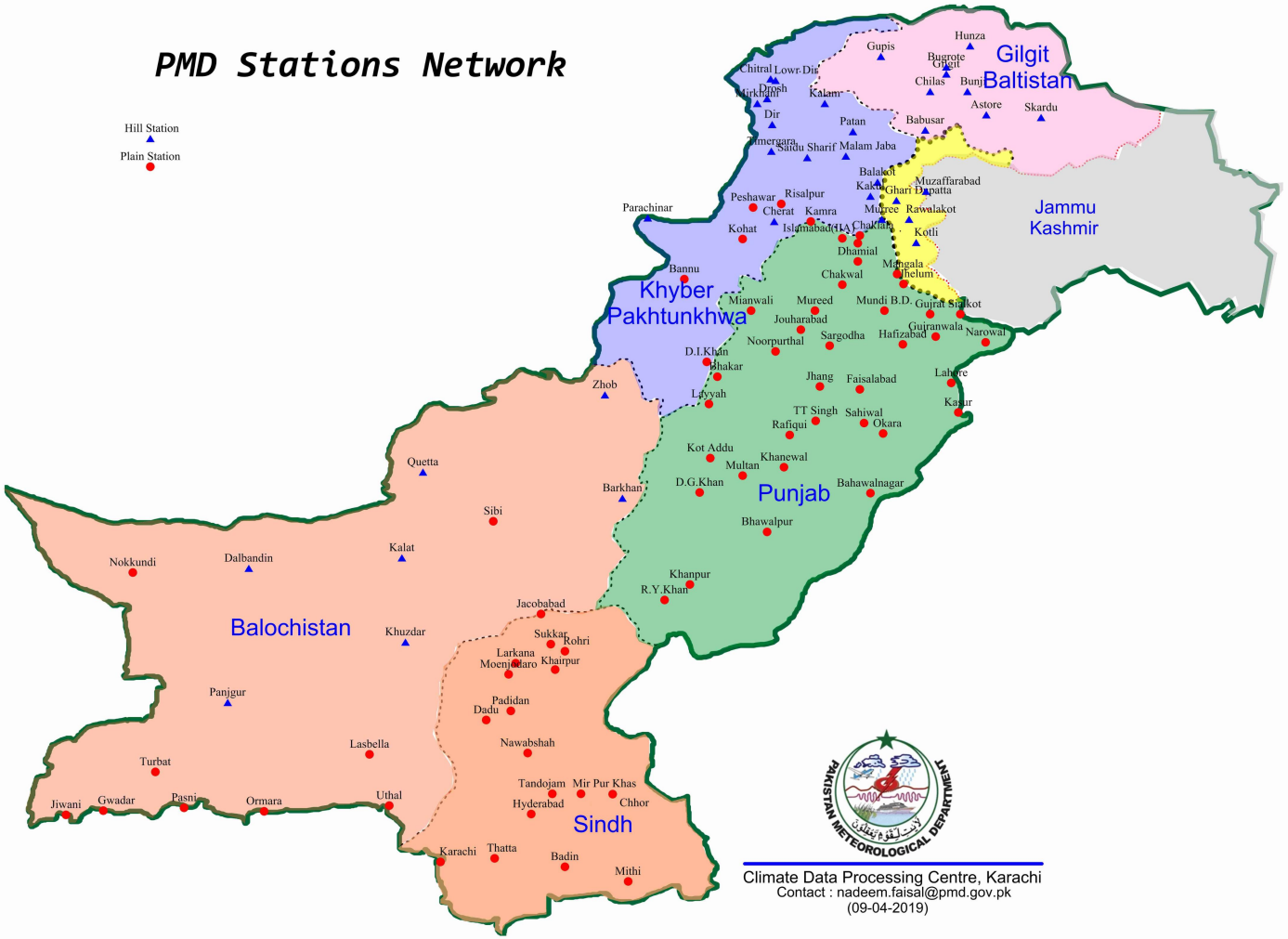
- ✓ Increase of Industrialization
- ✓ Energy Use
- ✓ Agricultural Practices
- ✓ Deforestation
- ✓ Consumer Practices
- ✓ Transport
- ✓ Pollution
- ✓ Resource Extraction

- ✓ Rising temperature
- ✓ Rising Sea levels
- ✓ Unpredictable weather patterns
- ✓ Increasing in extreme weather events
- ✓ Land degradation

- ✓ Water Shortage
- ✓ Global food Issue
- ✓ Melting the Snow
- ✓ Cause the flood

MATERIALS & METHODOLOGY

PMD Stations Network



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(09-04-2019)

Based on change in projected climate mean

- Dry-Cold : 10th percentile both T and P
- Warm-Wet: 90th percentile both T and P
- Warm-Dry : 90th percentile T and 10th percentile P
- Cold-Wet: 10th percentile T and 90th percentile P

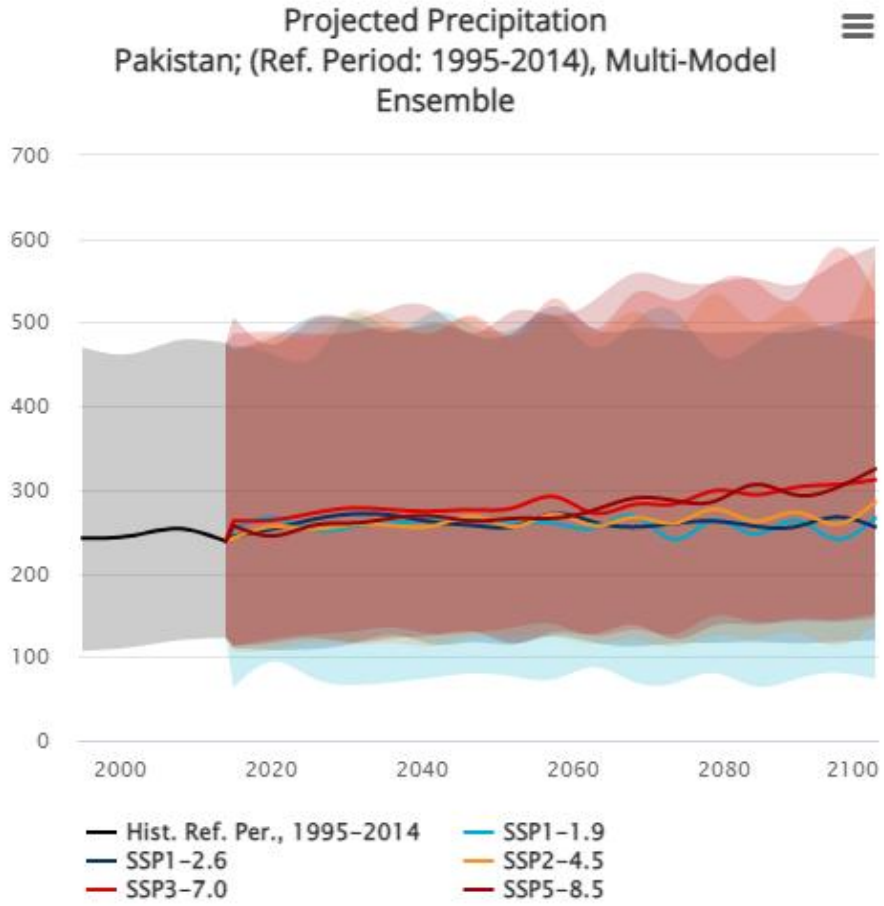
Based on change in projected climate extreme

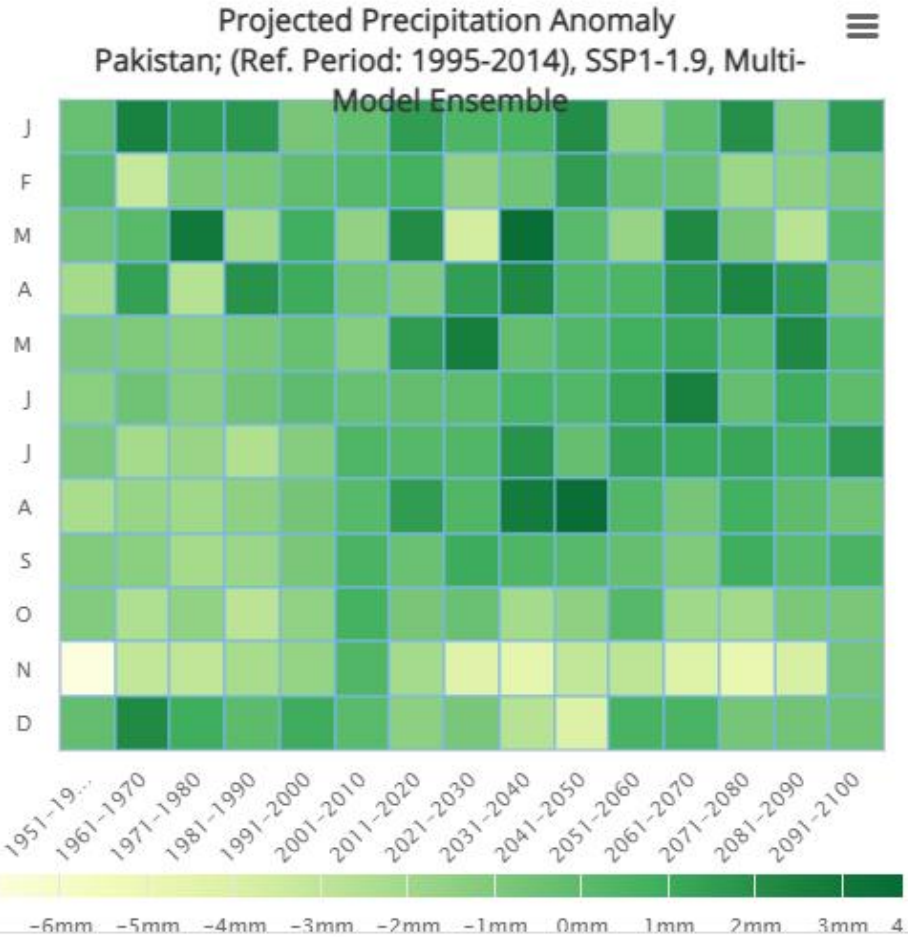
- Dry-Cold : CSDI and CDD
- Warm-Wet: CSDI and R99pTOT
- Warm-Dry : WSDI and CDD
- Cold Wet: WSDI and R99pTOT

RClimDex software package was used to calculate ETCCDI indices,

ID	Indicator name	Definitions	Units
WSDI	Warm Spell Duration Indicator	Annual count of days with at least 6 consecutive days when TX >90TH percentile	Days
CDD	Consecutive Dry Days	Maximum number of consecutive days with RR<1mm	Days
CSDI	Cold Spell Duration Indicator	Annual count of days with at least 6 consecutive days when TX <90TH percentile	Days
R99p	Extremely wet days	Annual Total Precipitation when RR>99TH percentile	mm

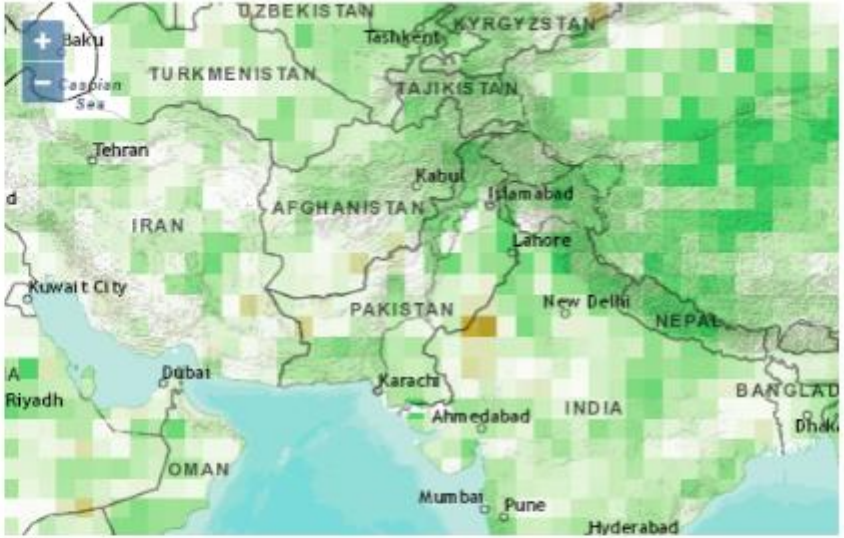
Region	01 to 26 August, 2022 Rainfall		
	normal (mm)	actual (mm)	Deviation (%)
Pakistan	50.4	176.8	251
Azad J&K	129.3	129.2	0
Balochistan	20.9	129.7	522
Gilgit-B	12.4	40.1	225
Khyber-PK	92.9	143.0	54
Punjab	82.5	133.3	62
Sindh	50.0	442.5	784


Projected Precipitation
Pakistan; (Ref. Period: 1995-2014), Multi-Model Ensemble
700
600
500
400
300
200
100
0
2000
2020
2040
2060
2080
2100
Hist. Ref. Per., 1995–2014
SSP1–2.6
SSP3–7.0
SSP1–1.9
SSP2–4.5
SSP5–8.5


Projected Precipitation Anomaly
Pakistan; (Ref. Period: 1995-2014), SSP1-1.9, Multi-Model Ensemble
J
F
M
A
M
J
J
A
S
O
N
D
1951–19…
1961–1970
1971–1980
1981–1990
1991–2000
2001–2010
2011–2020
2021–2030
2031–2040
2041–2050
2051–2060
2061–2070
2071–2080
2081–2090
2091–2100
−6mm
−5mm
−4mm
−3mm
−2mm
−1mm
0mm
1mm
2mm
3mm
4

5-yr Event; SSP1-1.9; Global; 2010-2039 (center 2025)

5-yr Event; SSP1-1.9; Pakistan; 2010-2039 (center 2025)



YEAR

Largest 1-Day Precipitation for Pakistan

Return Levels, Historical: 1985-2014 (center 2000) (mm)																	
Event	5-yr			10-yr			20-yr			25-yr			50-yr			100-yr		
	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th
Historical	19.95	32.94	53.17	25.12	41.06	68.42	30.55	50.34	85.97	32.24	53.77	91.76	38.09	65.71	111.56	44.56	79.24	140.57

Return Period, Historical: 1985-2014 (center 2000) (years)															
Event	25mm			50mm			100mm			150mm			200mm		
	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th
Historical	0.97	3.16	11.90	4.27	28.62	377.27	92.60	852.68	6584.30	330.36	3160.90	10321.03	792.62	4680.28	11719.28

Annual Exceedance Probability, Historical: 1985-2014 (center 2000) (occurrence/year)																
Event	25mm			50mm			100mm			150mm			200mm			
	10^{th}	median	90^{th}	10^{th}	median	90^{th}	10^{th}	median	90^{th}	10^{th}	median	90^{th}	10^{th}	median	90^{th}	
Historical	0.19	0.62	1.41	0.02	0.08	0.32	0.00	0.01	0.04	0.00	0.00	0.02	0.00	0.00	0.01	

Future Return Period, 2010-2039 (center 2025) (years)																		
Event	5-yr			10-yr			20-yr			25-yr			50-yr			100-yr		
	10^{th}	median	90^{th}	10^{th}	median	90^{th}	10^{th}	median	90^{th}	10^{th}	median	90^{th}	10^{th}	median	90^{th}	10^{th}	median	90^{th}
SSP1-1.9	2.64	4.38	6.84	4.60	8.74	15.69	7.92	17.37	37.20	9.40	21.76	49.80	15.99	43.49	129.54	26.81	88.10	376.00
SSP1-2.6	2.68	4.09	6.57	4.70	7.97	14.81	8.19	15.60	34.85	9.74	19.41	46.40	16.48	37.94	118.44	27.88	74.56	327.02
SSP2-4.5	2.69	4.14	7.07	4.78	8.08	16.46	8.24	15.85	38.76	9.79	19.66	51.40	16.62	38.91	129.42	27.74	77.05	348.04
SSP3-7.0	2.71	4.14	6.43	4.75	8.30	14.23	8.18	16.72	32.95	9.70	20.94	44.37	16.41	41.96	118.17	27.68	84.26	336.40
SSP5-8.5	2.70	4.20	6.64	4.66	8.16	14.78	7.93	15.78	34.18	9.38	19.53	45.02	15.63	38.19	109.51	25.61	74.14	285.23

Future Return Period, 2035-2064 (center 2050) (years)																	
Event	5-yr			10-yr			20-yr			25-yr			50-yr			100-yr		
	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th
SSP1-1.9	2.63	4.35	6.46	4.53	8.56	14.36	7.53	17.24	33.01	8.82	21.57	43.64	14.27	43.78	110.33	22.78	89.15	325.50
SSP1-2.6	2.30	3.73	6.24	3.94	7.14	13.96	6.60	13.55	32.45	7.76	16.79	43.16	12.79	32.41	109.25	20.83	62.94	286.00
SSP2-4.5	2.35	3.77	6.33	3.99	7.32	14.08	6.67	14.06	33.13	7.80	17.34	44.17	12.73	33.69	111.19	20.58	66.21	299.26
SSP3-7.0	2.27	3.61	5.98	3.93	6.88	13.17	6.64	13.21	30.49	7.82	16.31	40.51	12.99	31.91	102.91	21.34	62.42	289.50
SSP5-8.5	2.21	3.61	5.90	3.71	6.81	12.77	6.16	12.93	29.18	7.23	15.89	38.43	11.84	30.80	93.06	18.99	59.09	238.30

Future Return Period, 2060-2089 (center 2075) (years)																		
Event	5-yr			10-yr			20-yr			25-yr			50-yr			100-yr		
	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th
SSP1-1.9	2.54	4.50	8.02	4.34	9.03	19.92	7.22	18.02	47.61	8.48	22.59	65.79	13.86	44.92	188.44	22.50	91.74	597.50
SSP1-2.6	2.27	3.65	6.31	3.78	6.94	14.05	6.29	13.27	32.91	7.34	16.32	43.88	11.59	31.21	113.71	18.03	60.10	331.00
SSP2-4.5	2.18	3.38	6.12	3.59	6.37	13.21	5.79	12.13	29.85	6.72	14.92	39.34	10.58	28.30	95.80	16.37	53.94	243.82
SSP3-7.0	1.78	2.95	5.17	2.93	5.48	10.77	4.73	10.19	23.19	5.46	12.47	29.80	8.49	23.56	67.33	13.12	44.08	163.56
SSP5-8.5	1.57	2.76	5.31	2.55	4.97	10.61	3.97	9.05	22.16	4.55	11.00	28.71	6.88	20.33	69.09	10.18	37.38	174.04

Future Return Period, 2070-2099 (center 2085) (years)																	
Event	5-yr			10-yr			20-yr			25-yr			50-yr			100-yr	
	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th	10th	median	90th
SSP1-1.9	2.58	4.73	7.80	4.47	9.34	18.44	7.59	19.04	46.60	8.99	23.98	64.36	14.97	49.05	186.64	24.72	102.24	592.99
SSP1-2.6	2.34	3.73	6.47	4.01	7.06	14.37	6.66	13.50	33.12	7.85	16.67	43.76	12.91	32.10	110.73	20.66	61.83	306.63
SSP2-4.5	2.06	3.33	5.96	3.44	6.27	13.13	5.63	11.86	30.59	6.52	14.56	40.64	10.29	27.71	102.16	15.93	53.08	274.19
SSP3-7.0	1.67	2.71	4.62	2.72	4.95	9.54	4.29	9.15	20.86	4.96	11.18	27.01	7.62	20.37	61.07	11.72	37.53	154.57
SSP5-8.5	1.43	2.45	4.50	2.26	4.35	8.93	3.47	7.75	18.64	3.97	9.33	23.77	6.01	16.84	53.14	8.82	30.64	129.33

THANKS!

Any questions?