Paper No. 365

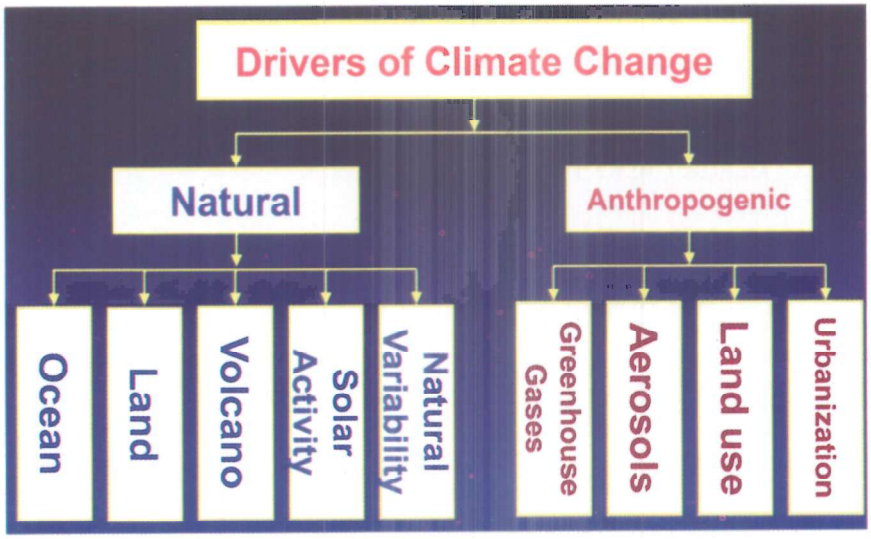
CLIMATE RESILIENT ADAPTATION TO CHANGING CLIMATE FOR SUSTAINABLE DEVELOPMENT IN PAKISTAN

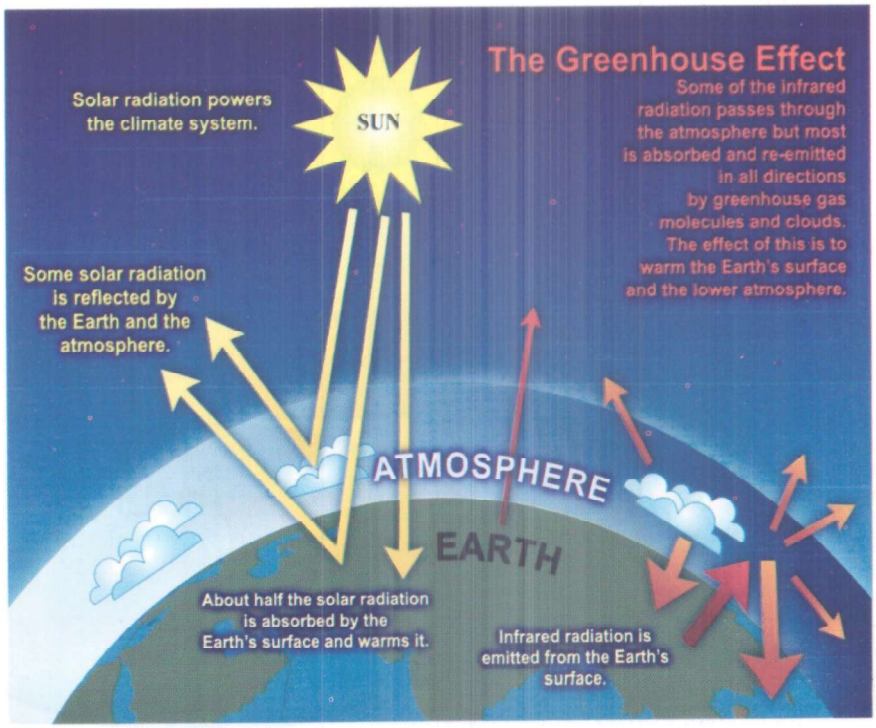
Ghulam Rasul

CLIMATE RESILIENT ADAPTATION TO CHANGING CLIMATE FOR SUSTAINABLE DEVELOPMENT IN PAKISTAN

By:

Ghulam Rasul[1]





[1] Head Climate Change Program IUCN Pakistan

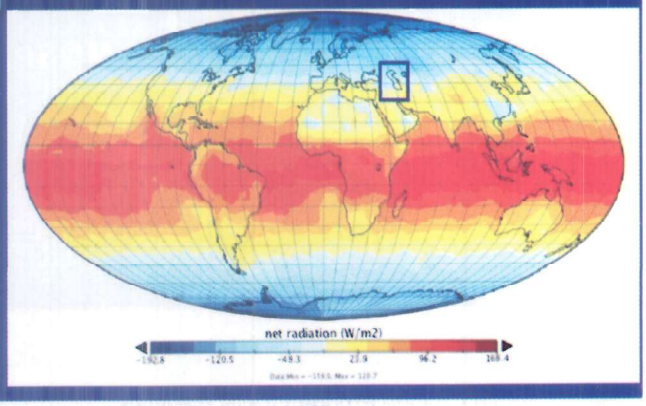
State of Global Climate in 2022

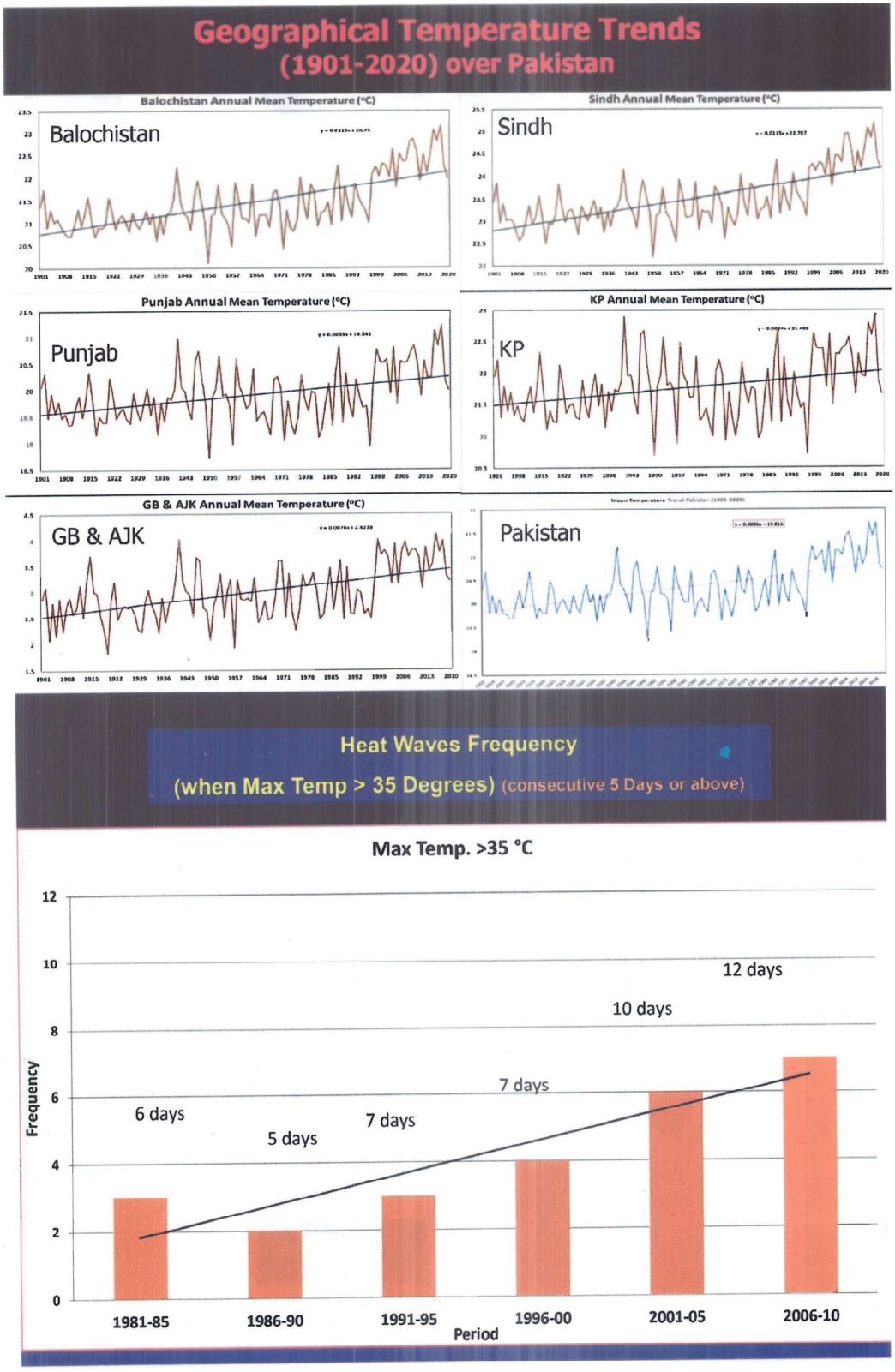
By WMO at COP 27

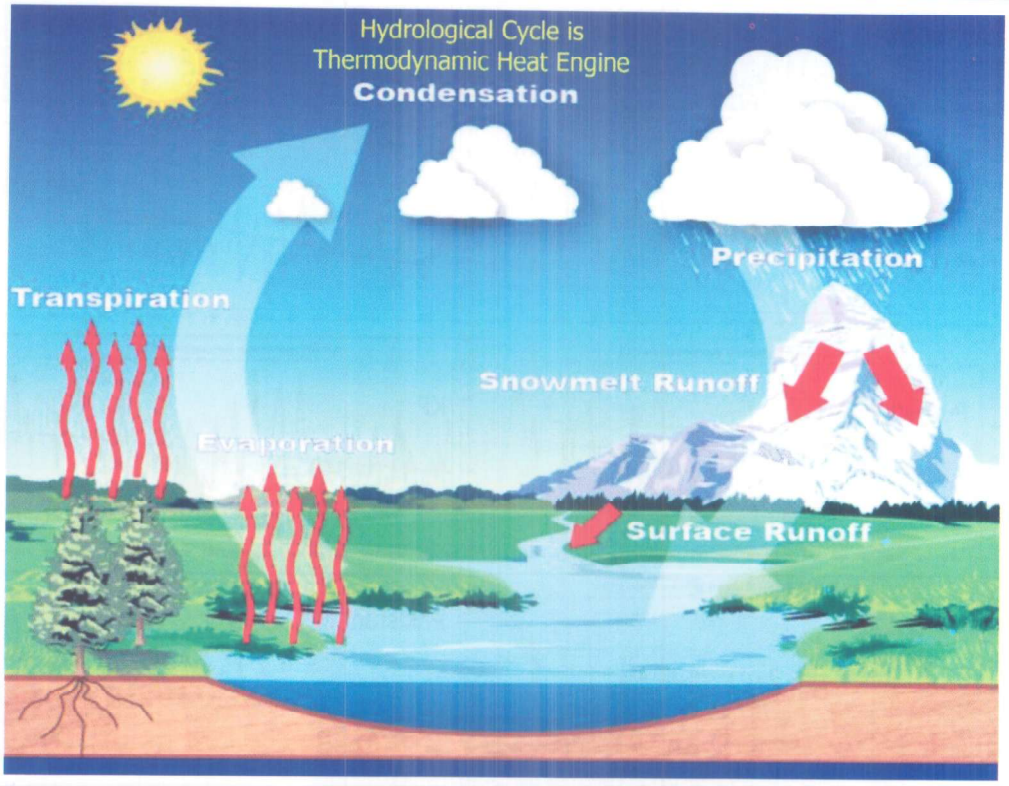
- **Past eight years are on track to be the warmest on record.**
- **Devastating floods, forest fires, drought, extreme heat waves in SA & Europe**
- **Rate of Sea Level rise has doubled since 1993. 10mm increase since Jan 2020.**
- **Global mean temperature has risen 1.2C above 1850-1900 average.**
- **A rare tripple-dip La~Nina continued through 2022.**

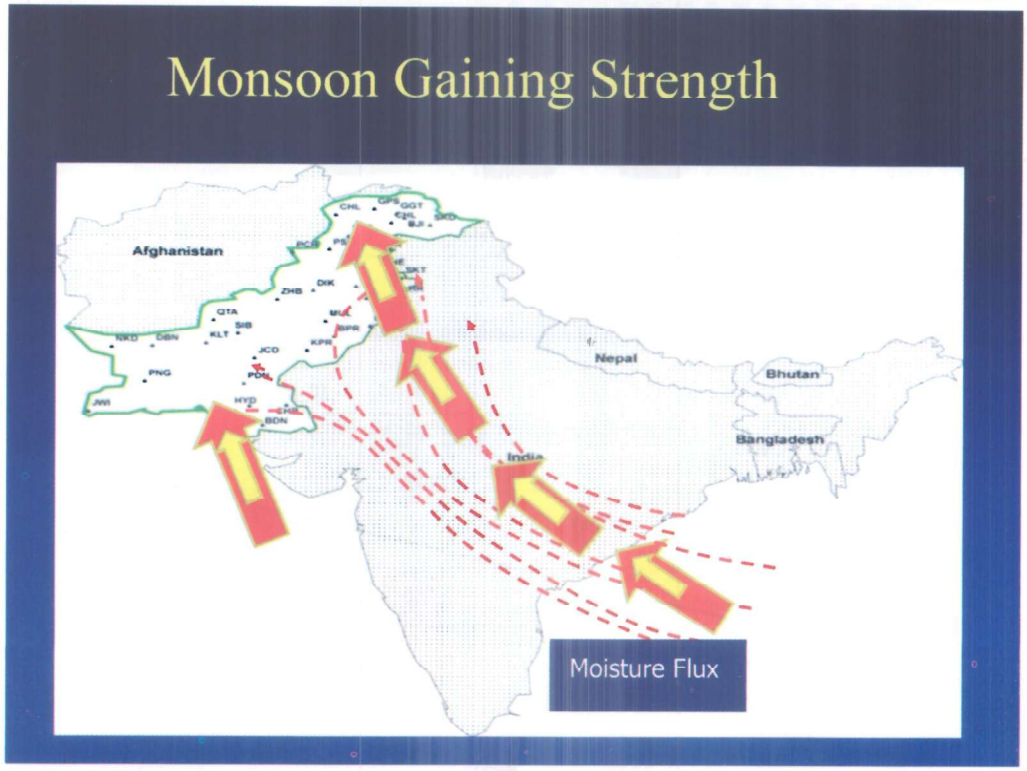
Climate Change in Pakistan

- Pakistan is very high on vulnerability scale
  - 135th in GHG Emissions
  - 8th most vulnerable nation to Climate Change Impacts **(Global Climate Risk Index 2021)**
- Geographical Location
  - Heat surplus zone
- Population
- Limited Capacity
- Infrastructure




Geographical Temperature Trends
(1901-2020) over Pakistan
Balochistan Annual Mean Temperature (°C)
Balochistan
Sindh Annual Mean Temperature (°C)
Sindh
Punjab Annual Mean Temperature (°C)
Punjab
KP Annual Mean Temperature (°C)
KP
GB & AJK Annual Mean Temperature (°C)
GB & AJK
Pakistan
Heat Waves Frequency
(when Max Temp > 35 Degrees) (consecutive 5 Days or above)
Max Temp. >35 °C
Frequency
Period
1981-85
1986-90
1991-95
1996-00
2001-05
2006-10
6 days
5 days
7 days
7 days
10 days
12 days


Hydrological Cycle is
Thermodynamic Heat Engine
Condensation
Precipitation
Transpiration
Snowmelt Runoff
Evaporation
Surface Runoff

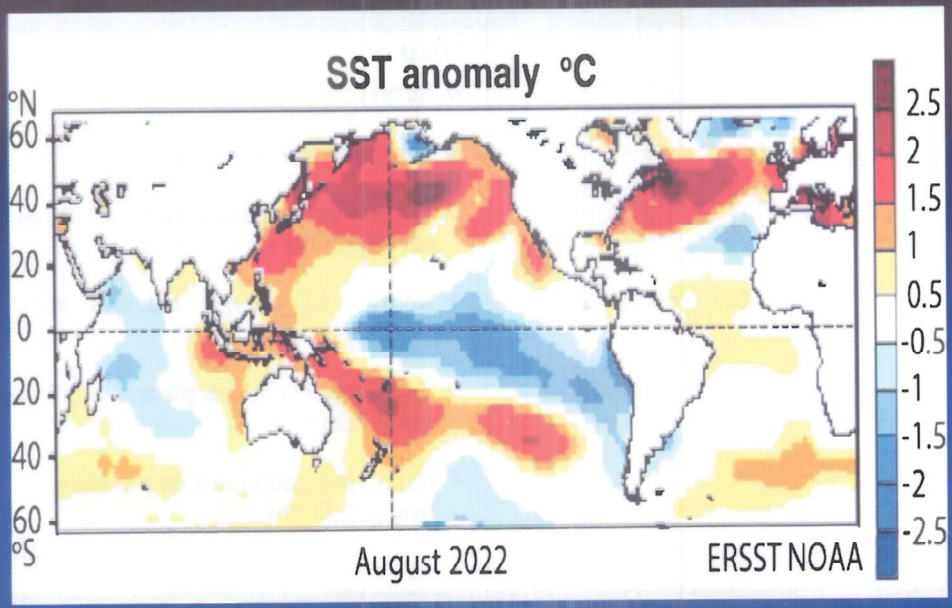

Monsoon Gaining Strength
Afghanistan
Nepal
Bhutan
Bangladesh
India
Moisture Flux

Overview of the Extreme Climate Events in Pakistan over the last 25 years

- Strong El~Nino event of 1997-98 triggered four years long drought affecting Balochistan, Sindh, South Punjab and lower KP.
- In a dry year 2001, a cloudburst event produced the heaviest downpour of 620mm in only 10 hours in Rawalpindi-Islamabad.
- In 2005 snowmelt flood generated flooding in the Indus River under dry conditions.
- In 2010, Pakistan experienced the worst flooding in the Indus River due to heavy rains upstream.
- Severe heat wave in 2015 took more than 2000 human lives.
- Recurring GLOF events from Shishper Glacier in 2018 destroyed the infrastructure downstream.

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In 2022, we are entered into a third year of a La Niña event, in which cool waters dominate the central and eastern tropical Pacific



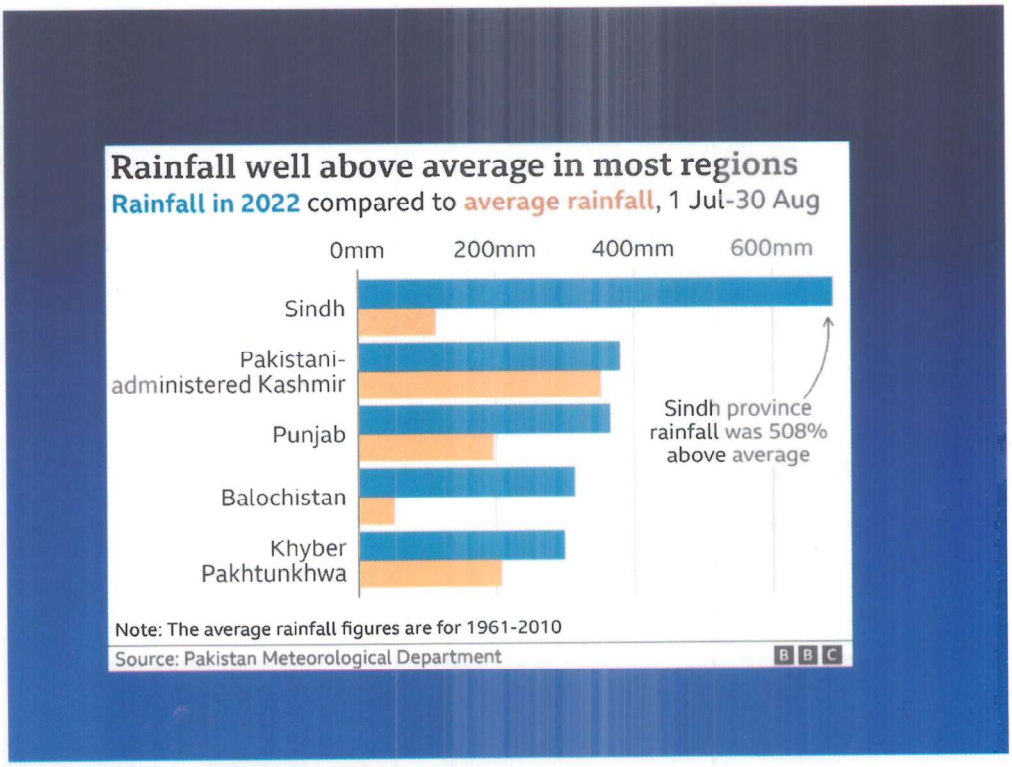
Hilights of Year 2022

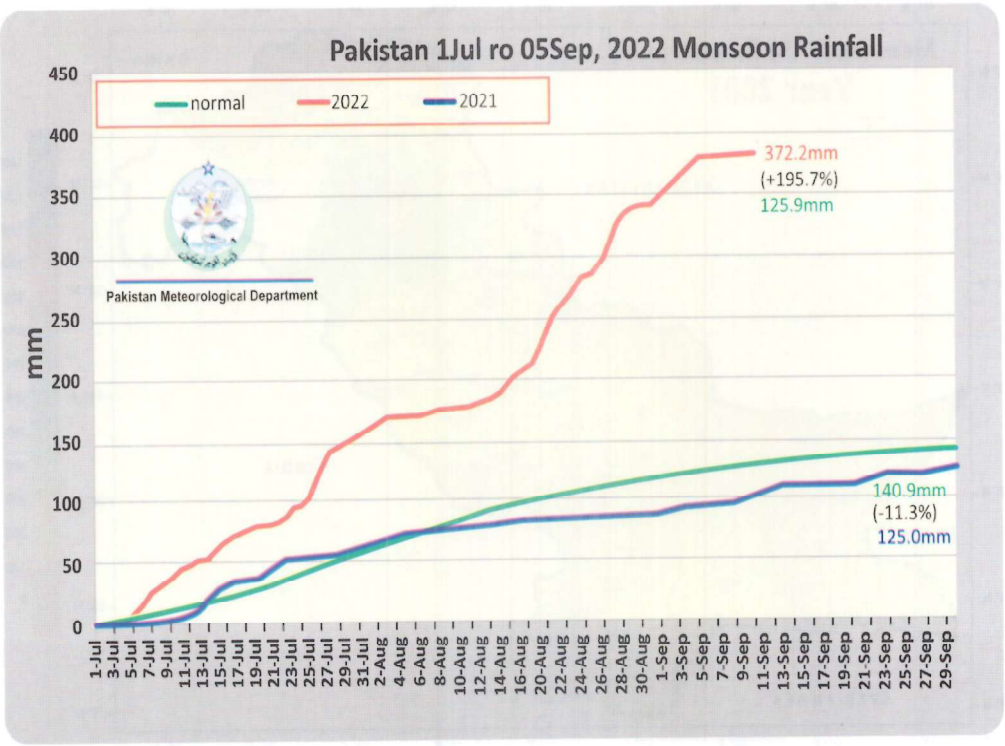
- Extended winter with record heavy snowfall over HKH
- Spring disappeared and surging temperatures crossed the historic records in April and May
- High temperatures in early summer accelerated melting process triggering a sequence of GLOF events
- Severe heat created a deep low pressure as Heat Low which attracted strong moisture influx fro the Arabian Sea resulting in early monsoon onset
- Interaction of westerlies and monsoonal currents over Balochistan produced persistent heavy downpour in the lower half of the country
- First time Southern Half of the country received more rainfall than Northern half

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Comparison of 2010 and 2022

2022	2010
❖ Weaker La~Nina for last 3 years	❖ Strong La~Nina only in 2010
❖ Prolonged and colder winter	❖ Short and warmer winter
❖ Record heat centered over Pakistan in early summer	❖ Hotter than avarage May-June but heat centered over Central Asia
❖ Southern wing was more active than the northern one	❖ Northern wing of monsoon was active
❖ Monsoon incursion and westerly waves interacted over southern Pakistan.	❖ Such interaction took place over KP and north Punjab
❖ Strong influx crossed high mountains	❖ Strong monsoon reached the higher height in Chitral

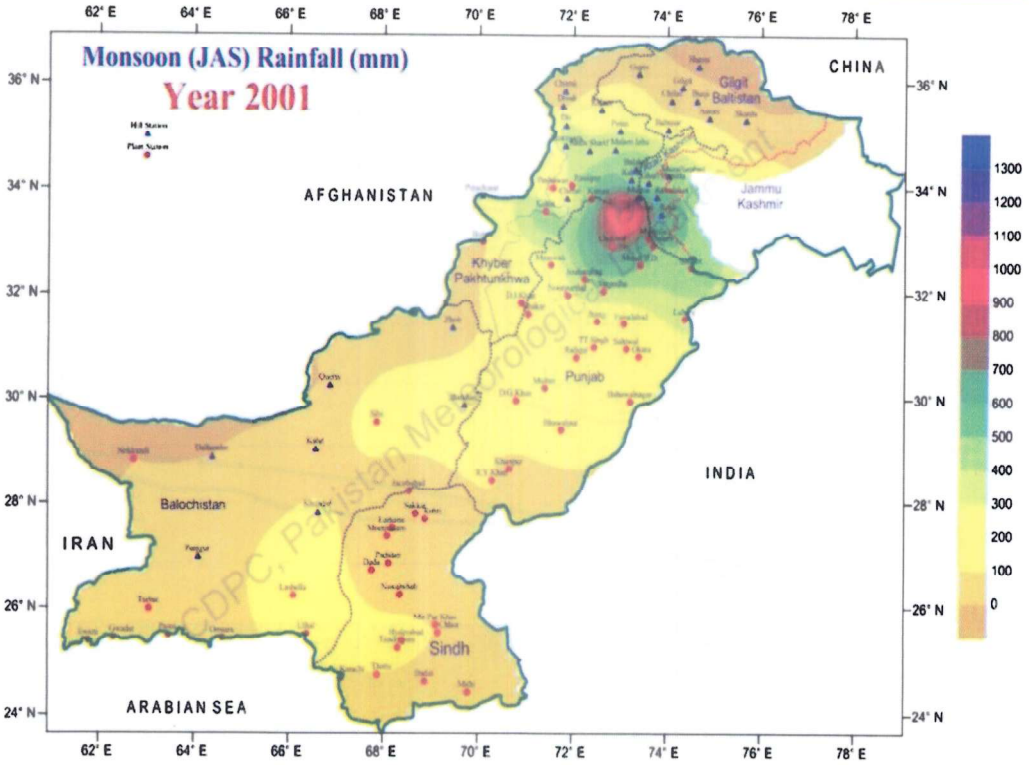

Rainfall well above average in most regions
Rainfall in 2022 compared to average rainfall, 1 Jul-30 Aug
0mm
200mm
400mm
600mm
Sindh
Pakistani-administered Kashmir
Punjab
Balochistan
Khyber Pakhtunkhwa
Sindh province rainfall was 508% above average
Note: The average rainfall figures are for 1961-2010
Source: Pakistan Meteorological Department
BBC


Pakistan 1Jul ro 05Sep, 2022 Monsoon Rainfall
normal
2022
2021
372.2mm
(+195.7%)
125.9mm
140.9mm
(-11.3%)
125.0mm
Pakistan Meteorological Department
mm
450
400
350
300
250
200
150
100
50
0
1-Jul
3-Jul
5-Jul
7-Jul
9-Jul
11-Jul
13-Jul
15-Jul
17-Jul
19-Jul
21-Jul
23-Jul
25-Jul
27-Jul
29-Jul
31-Jul
2-Aug
4-Aug
6-Aug
8-Aug
10-Aug
12-Aug
14-Aug
16-Aug
20-Aug
22-Aug
24-Aug
26-Aug
28-Aug
30-Aug
1-Sep
3-Sep
5-Sep
7-Sep
9-Sep
11-Sep
13-Sep
15-Sep
17-Sep
19-Sep
21-Sep
23-Sep
25-Sep
27-Sep
29-Sep

August, 2022 Area-Weighted Rainfall

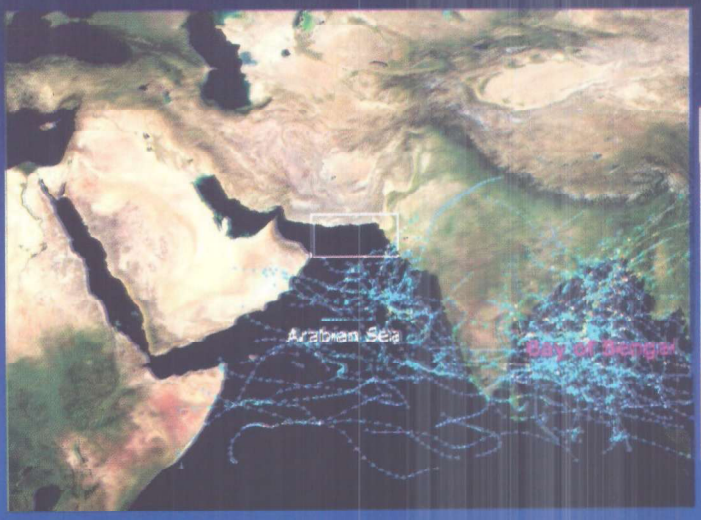
	Rank (of 62)	Normal (mm)	Average (mm)	Departure (percent)	Comment
Pakistan	62	56.2	192.7	243	1st highest (previous record 116.7 mm in 2020)
Azad Jammu & Kashmir	34	150.7	146.1	-3	29th highest (record 308.2 mm in 1997)
Balochistan	62	22.4	154.9	590	1st highest (previous record 83.3 mm in 2020)
Gilgit Baltistan	61	16.7	55.7	233	2nd highest (record 89.1 mm in 1997)
Khyber Pakhtunkhwa	59	103.6	163.9	58	4th highest (record 225.4 mm in 2010)
Punjab	53	93.3	141.7	52	10th highest (record 282.6 mm in 1973)
Sindh	62	53.6	442.8	726	1st highest (previous record 247.9 mm in 2020)

[RANK RANGES FROM 1 (LOWEST) TO 62 (HIGHEST)]



Tropical Cyclones

Tracks vs. Inensity
1985-2005

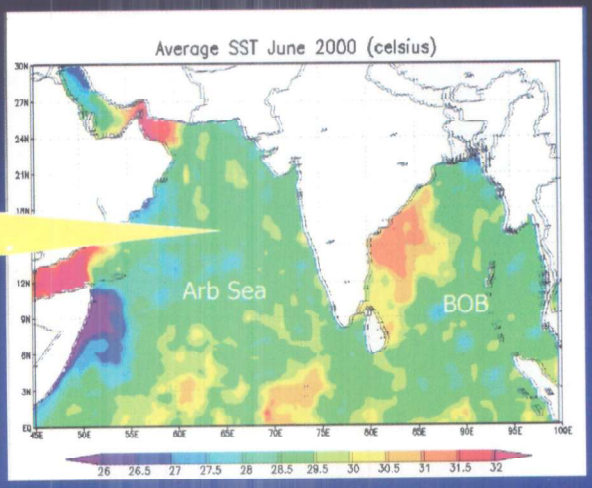


Tropical Cyclone Intensity Classification

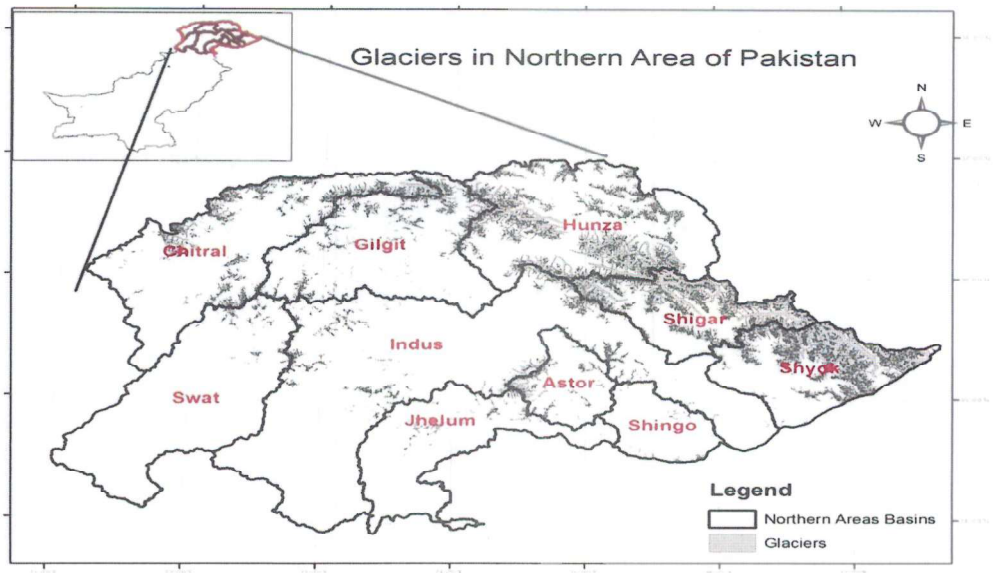
Category	Wind speed (3-min)
Depression	≤27 (≤51)
Deep Depression	28–33 (52–61)
Cyclonic Storm	34–47 (62–87)
Severe Cyclonic Storm	48–63 (88–117)
Very Severe Cyclonic Storm	64–119 (118–221)
Super Cyclonic Storm	≥120 (≥222)

Comparison of Sea Surface Temperature for Bay of Bengal and Arabian Sea (2000 - 2007)

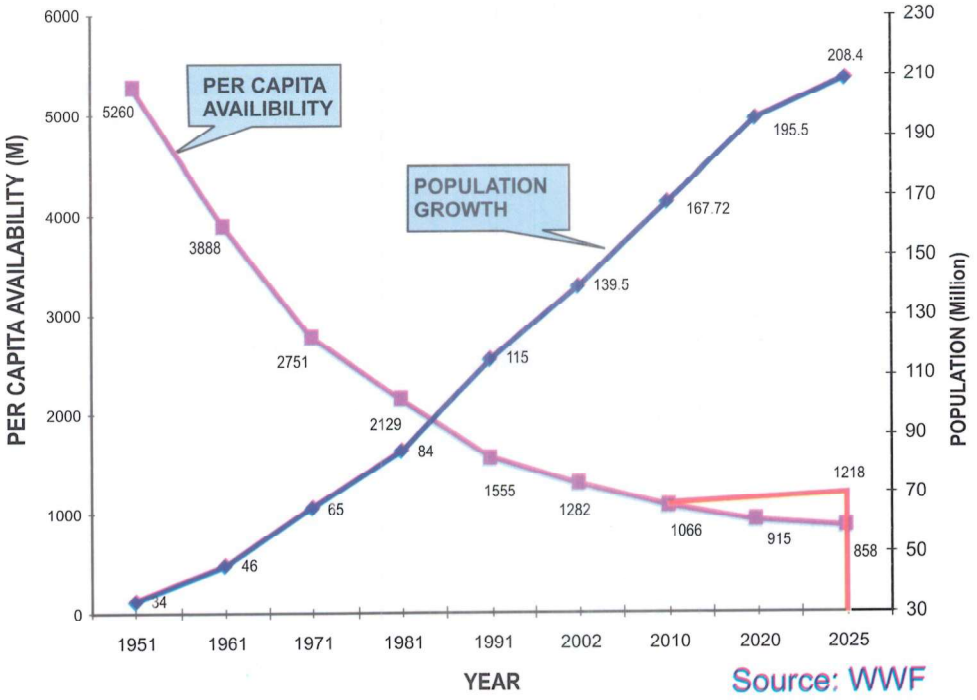
Arabian sea is showing higher SST values compared to Bay of Bengal since 2000



Number of Glaciers	Area of Glaciers (km2)	Volume of Ice (km3)	Ranges
7259	11780	2066	Himalaya Karakoram Hindukush

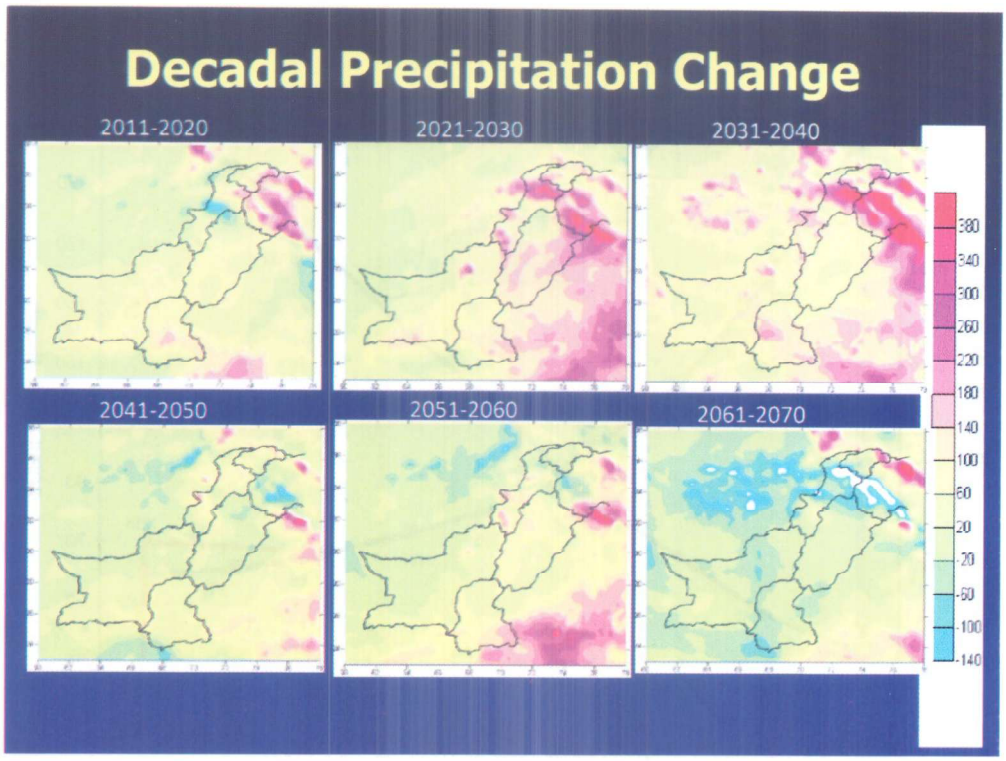


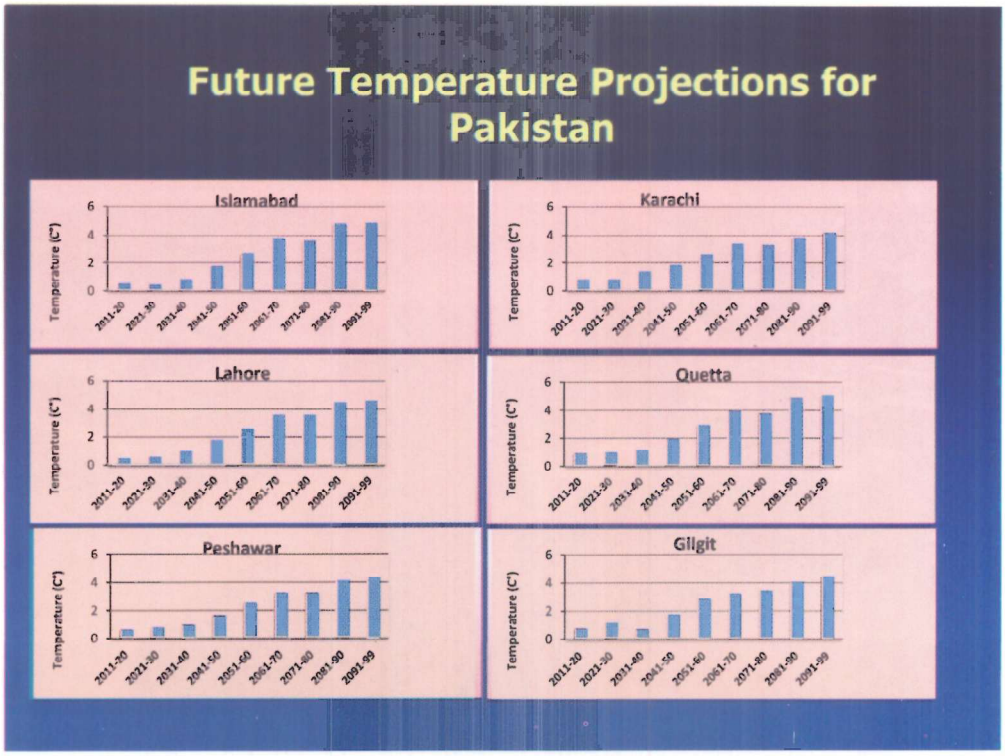




Water Wastage due to Flash Floods/Urban Flooding



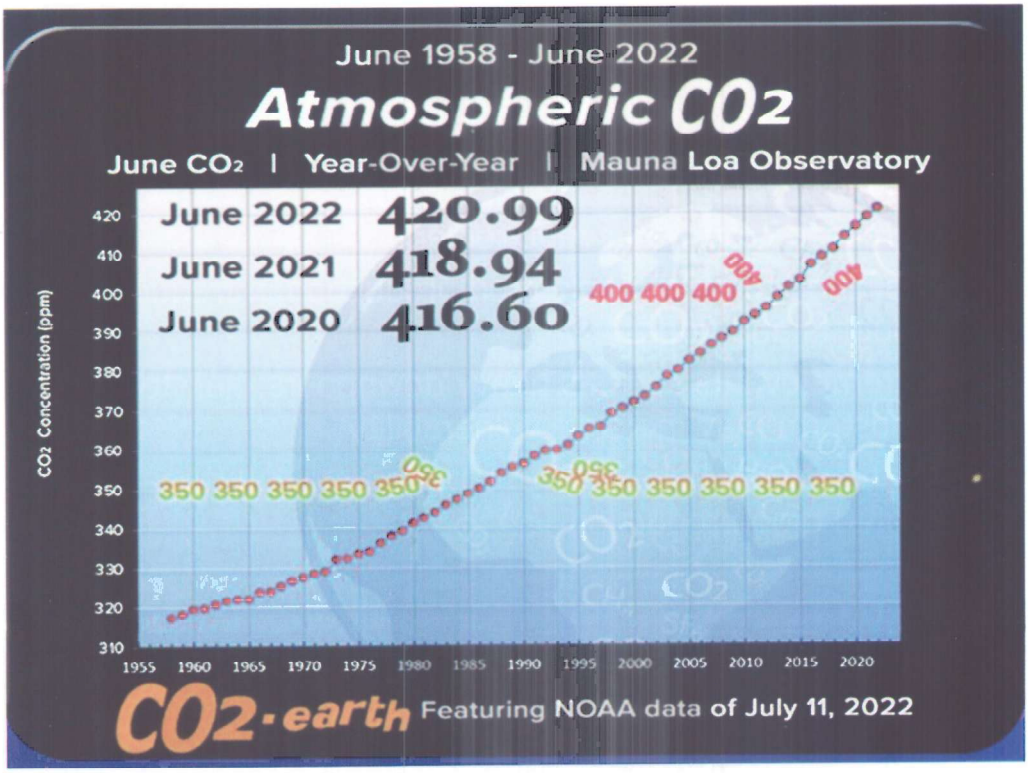

Decadal Precipitation Change
2011-2020
2021-2030
2031-2040
2041-2050
2051-2060
2061-2070
380
340
300
260
220
180
140
100
60
20
-20
-60
-100
-140


Future Temperature Projections for Pakistan
Islamabad
Karachi
Lahore
Quetta
Peshawar
Gilgit
Temperature (C°)
0
2
4
6
2011-20
2021-30
2031-40
2041-50
2051-60
2061-70
2071-80
2081-90
2091-99

Paris Climate Agreement 2015

The Paris Agreement is **a legally binding international treaty on climate change**. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016.

Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.



Water Security-Major Concerns

- Highly Variable inflows due to increased variability of monsoon and winter precipitation.
- Increased Frequency of droughts and floods
- Higher irrigation demand and less water available.
- Shrinking Glaciers have serious implications for sustainable water supply.

Food Security-Major Concerns

- Reduced crop and livestock productivity due to heat stress
- Increased crop water requirement
- Challenge to sustainable food production in frequent droughts and floods.
- Extreme events such as heavy downpours, hailstorm, windstorm may increase vulnerability
- Erratic rainfall behaviour at sowing time is a threat to rainfed crop production