

Utilizing The Climate Model Data approach to assess the Future Scenarios of Meteorological Events Using Geo-Spatial Techniques

Presented By:

Jan Muhammad

Deputy Director-MET

E-mail: jan.muhammad@caapakistan.com.pk, jansolangi.met2009@gmail.com

Cell No. +92-336-3564464 (WhatsApp & Direct)

Objectives of Presentation

- Share research work
- How to use this work to save Asia Region as well as other connecting regions
- How to control future incoming Hazards (Forecasted Hazards) due to meteorological events

Meteorological Parameters

- Temperature
- Precipitation
- Humidity
- Wind speed
- Wind Direction
- Solar & Terrestrial Radiation
- Etc

Change in Meteorological Parameters

➤ *Decrease in rainfall:*

- Rapidly growth in population
- Built-up areas
- Air pollution
- Usage of pesticide in agriculture
- Uneven heating process
- Rapidly increases in transportation
- Deforestation
- Migrated plantation
- Water storage

➤ *Increase in temperatures:*

- Rapidly growth in population
- Built-up areas
- Air pollution
- Usage of pesticide in agriculture
- Uneven heating process
- Rapidly increases in transportation
- Deforestation
- Migrated plantation
- Water storage



Change in Meteorological Parameters & its effects



Men made activities effect on Meteorological Parameters, which highly disturbs to assess forecast



Important Points (Discusses during workshop)

- No accurate data source specially in developing countries of above mentioned man made activities which highly effect on the meteorological parameters and decreases the accuracy in forecasting.
- Need to be create MoU/SoP or need to development mechanism among these concerned organizations and meteorological organizations on International & National level to save our earth regarding data collection about anthropogenic activities and how to control these activities
- Need to be work on model by developing the standardized equation which help to calculate all these factors and its effect on meteorological parameters and identify auto-hazard zone when ratio crossing limit
- Forecasters must study these activities and to be issue forecast after observations actual condition of climate & above mentioned activities of the forecasted areas

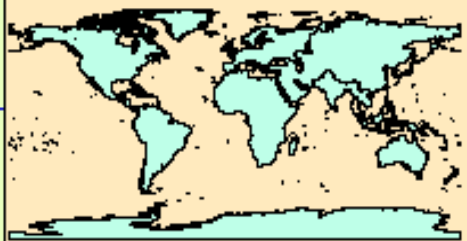
Man-Made Activities

- In developing countries, there is not authorized systems availability to collect data regarding man made activities
- These man made activities are highly disturbed on natural trend and intensity of meteorological events
- Major change factors observed due to sudden increase in the meteorological parameters such that temperature, rainfall events, heat waves observed since last ten years in region Sindh, Pakistan
- Uncontrolled man made activities are totally disturb climate of Sindh
- Urban cities of Sindh Province are highly effected-less amount of rainfall due to migrated plantation/pollution/uncontrolled population

SINDH



WORLD



ASIA



PAKISTAN



Fig.01- The map of Study Area.

GIS Data Format of Climate Models

- Graphic Interchange Format (GIF)
- Joint Photographic Experts Group (JPEG)
- Portable Network Graphics (PNG)
- Tagged Image File Format (TIFF)

Data Type's used to Asses Meteorological Events

• Climate Data

- Providing Regional Climates for Impacts Studies (PRECIS) Model Data
- Representative Concentration Pathways (RCPs) Data (RCP 4.5 & RCP8.5)
- Regional Climate Model (RegCM) Data
- National Center for Environmental Predication (NCEP) Data

Satellite Data

➤ **Landsat-4 & 5 (TM)**- This data used for calculating two indices namely Land Surface Temperature (LST) & Normalized Difference Vegetation Index (NDVI) which help to calculate vegetation cover and surface temperature respectively within study area

• Primary Data:

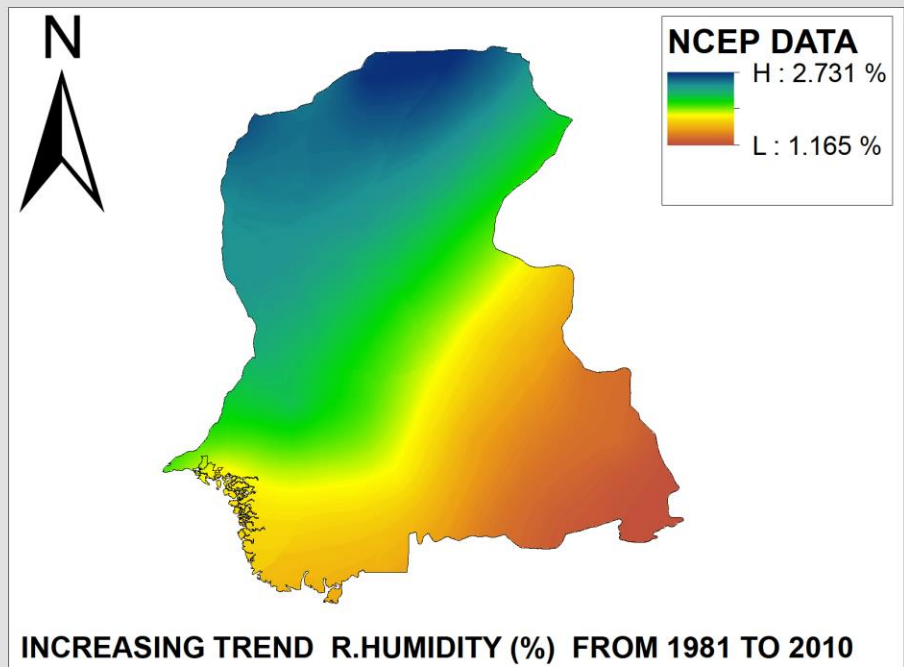
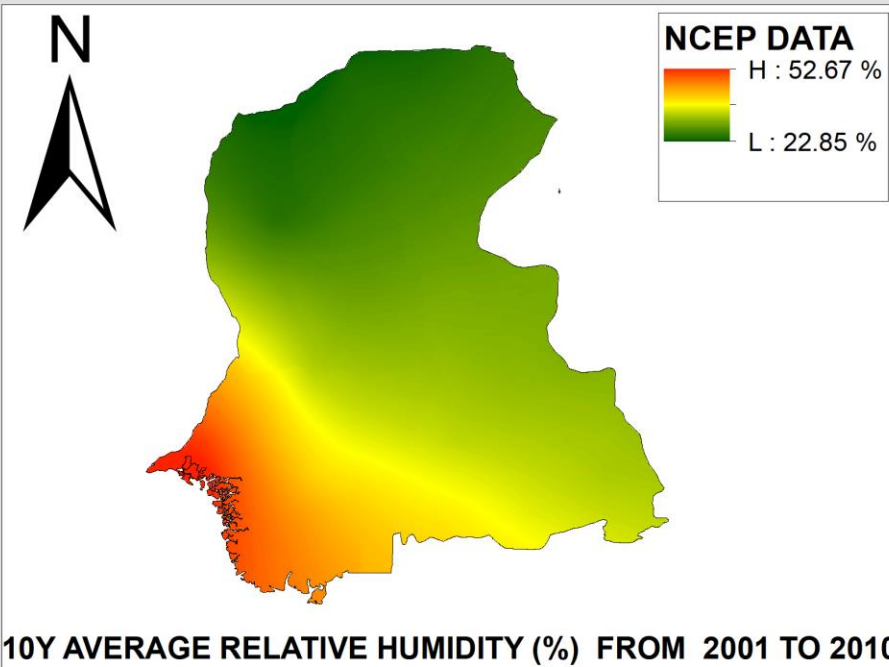
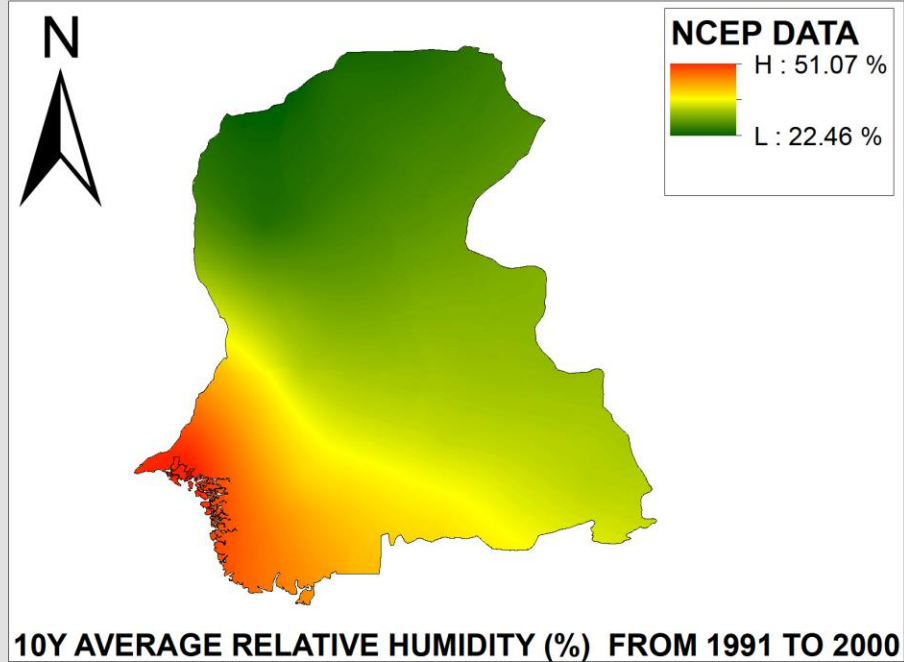
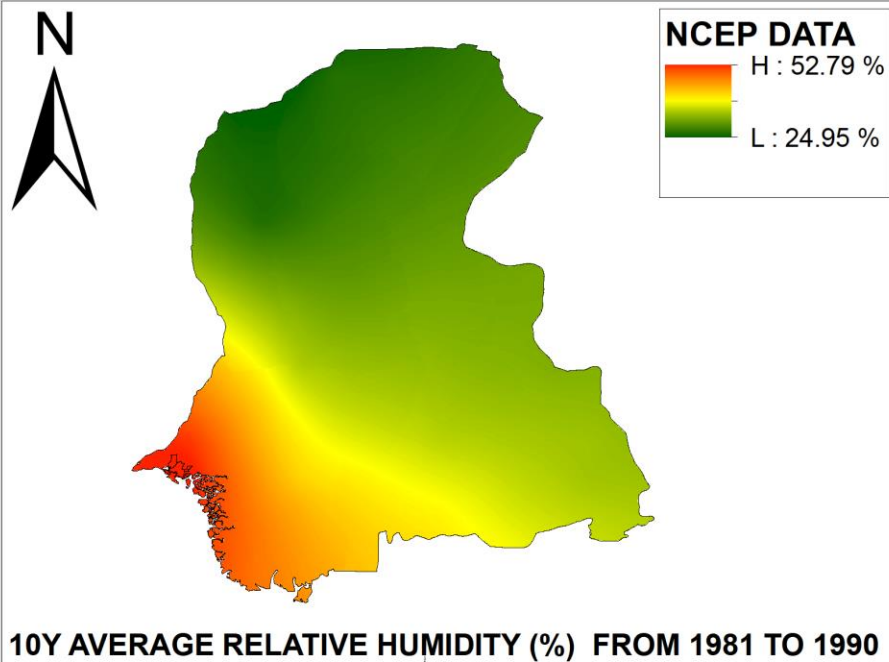
- PMD Observatories Data- This data used for verification of climate and satellite data

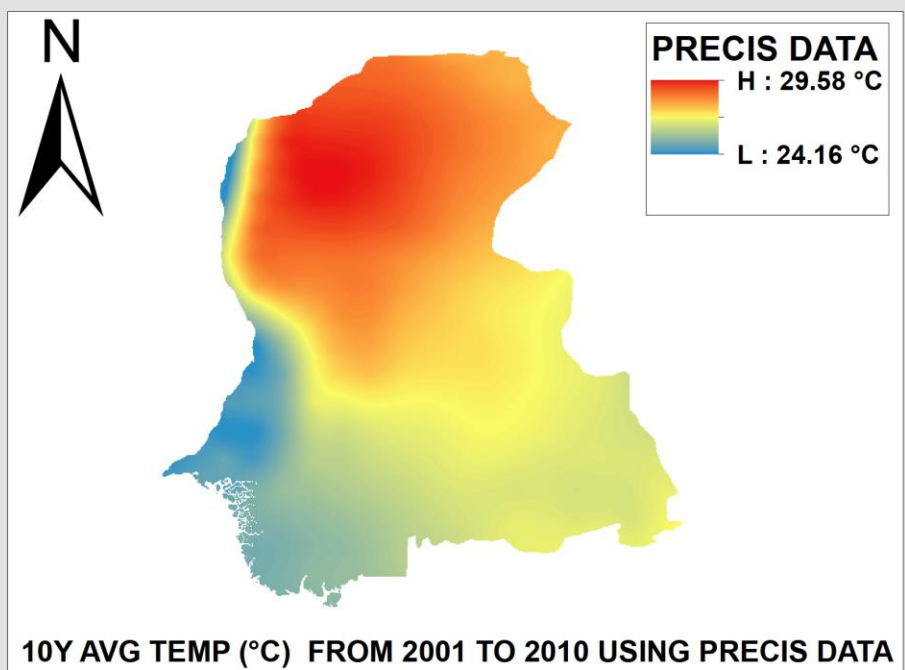
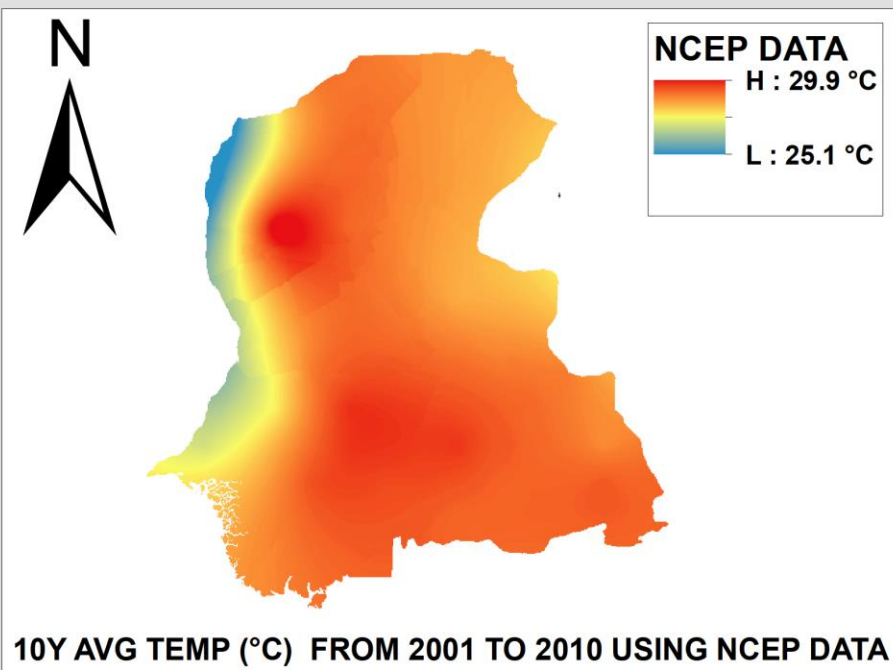
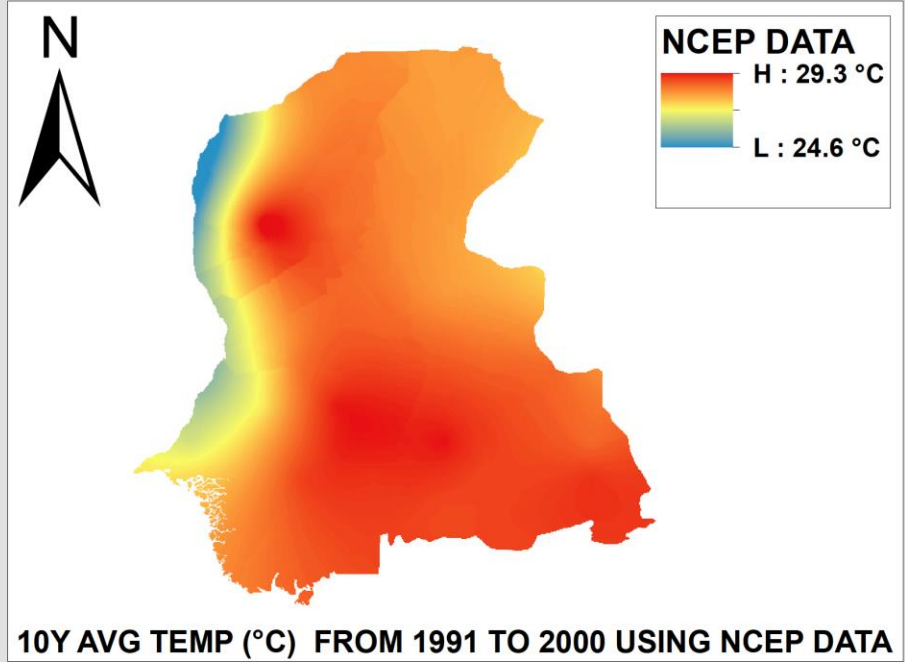
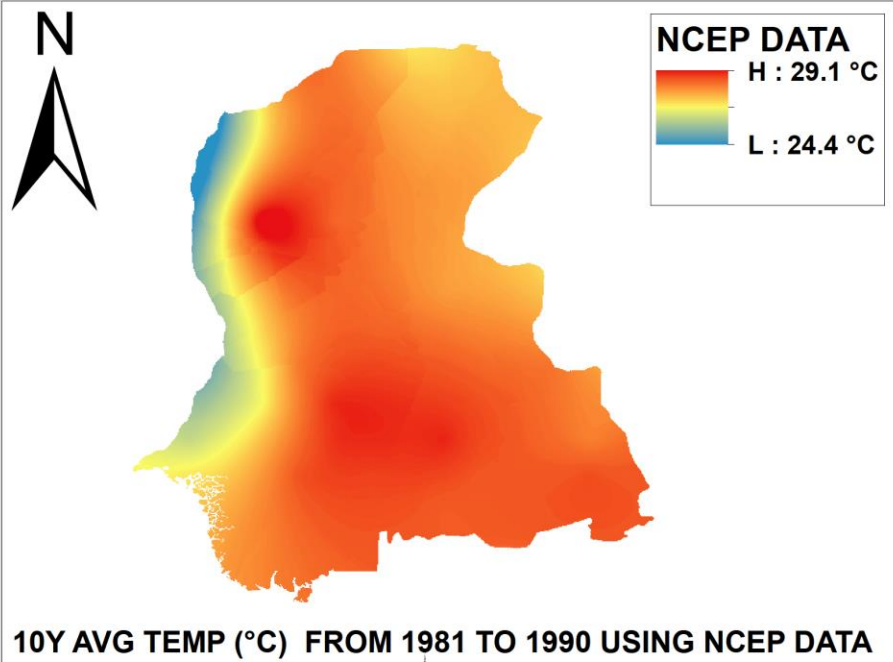
GEO-SPATIAL TECHNIQUES

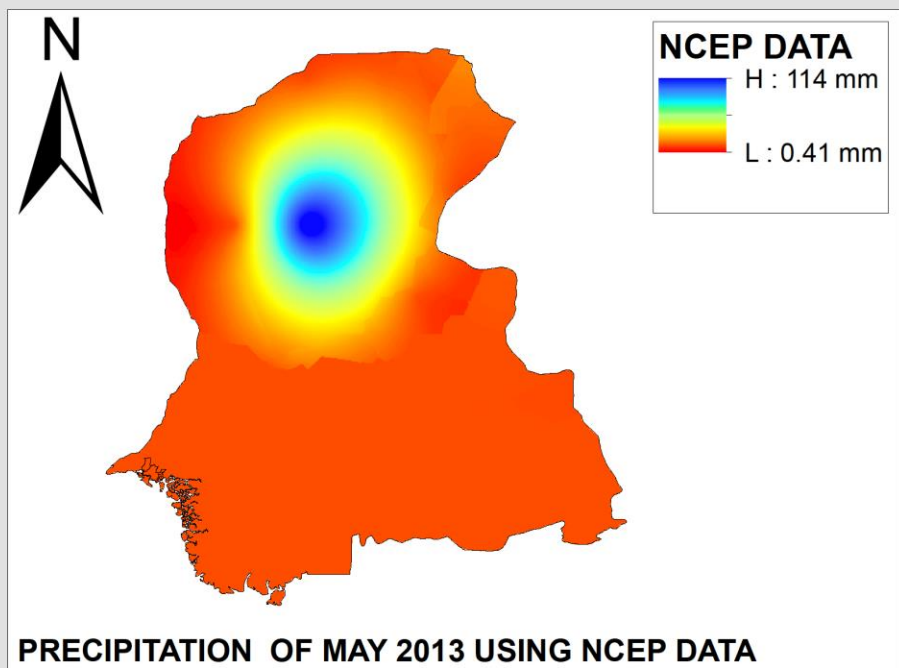
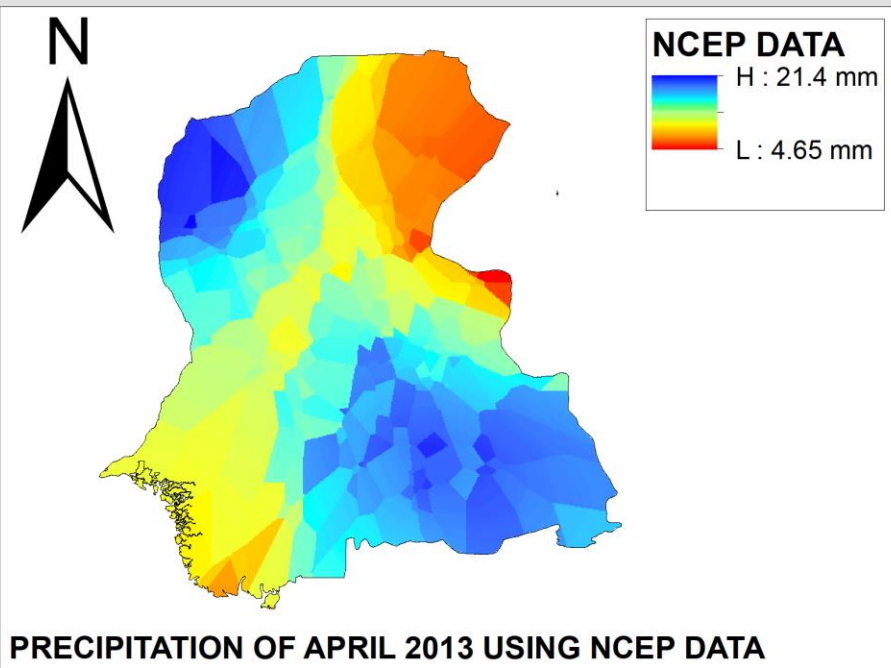
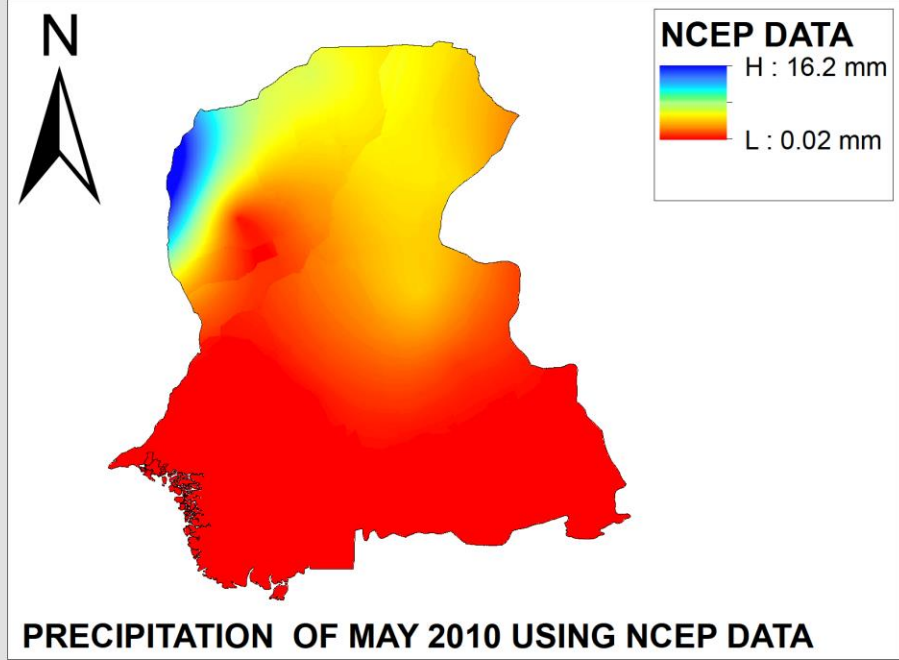
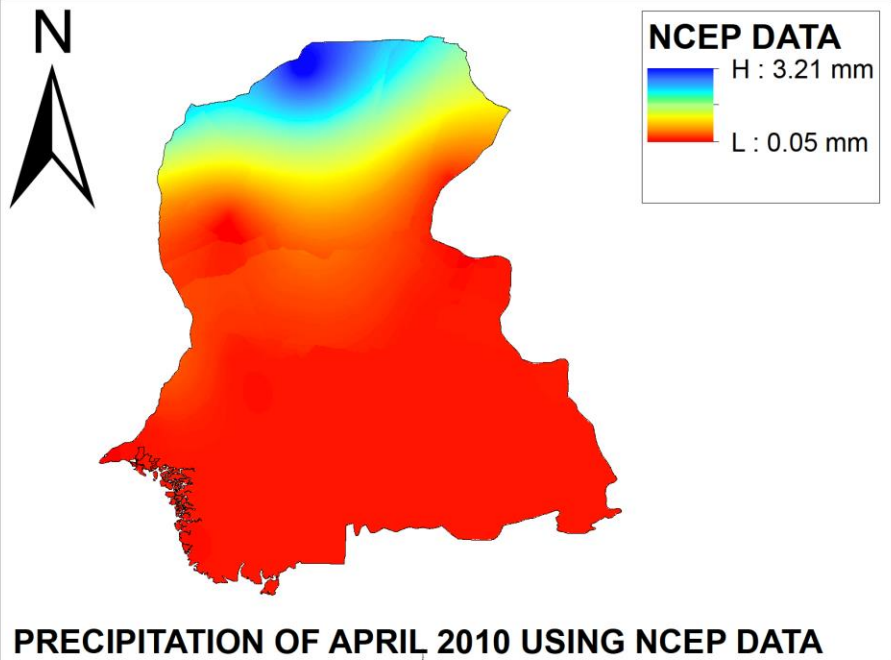
- This technology is becoming fundamental tools and techniques to understand, map and observe the complex interconnected natural as well as manmade systems
- Spatial Analyst-Spatial Interpolation is a method used to forecast the values of cells at position that not have sampled points
- Geo-statistical interpolation tools are totally depended on statistics and are utilized for more advanced prediction surface modeling such as Kriging
- Kriging is a powerful statistical interpolation method which used for many applications such as prediction of weather, climate change scenarios, environmental condition, health sciences, geochemistry and pollution modeling etc.

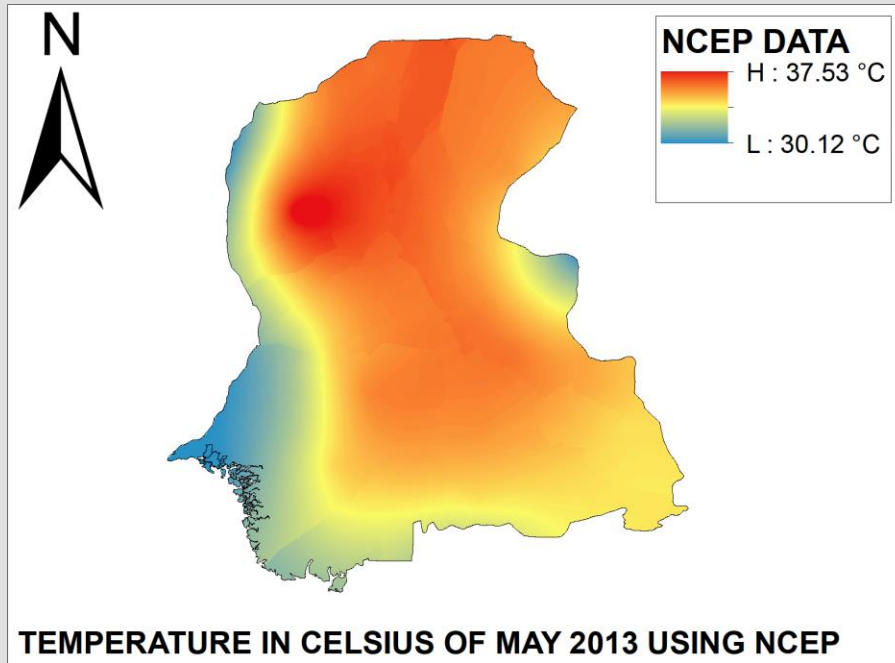
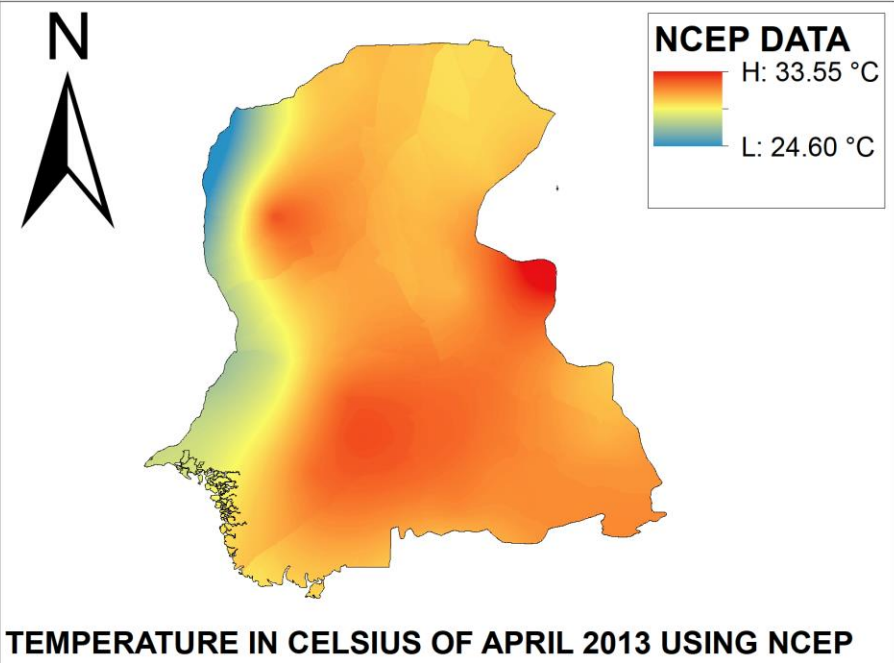
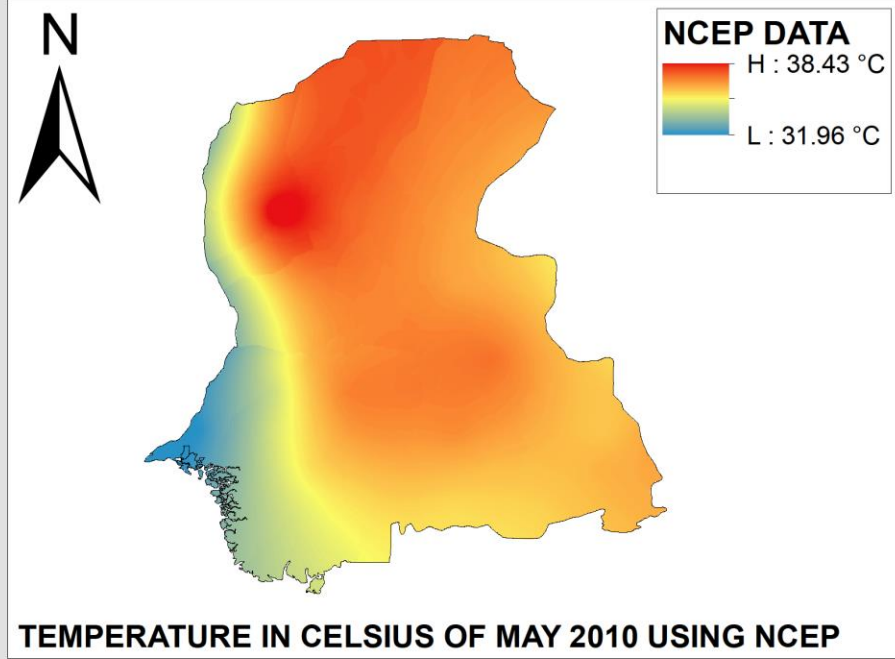
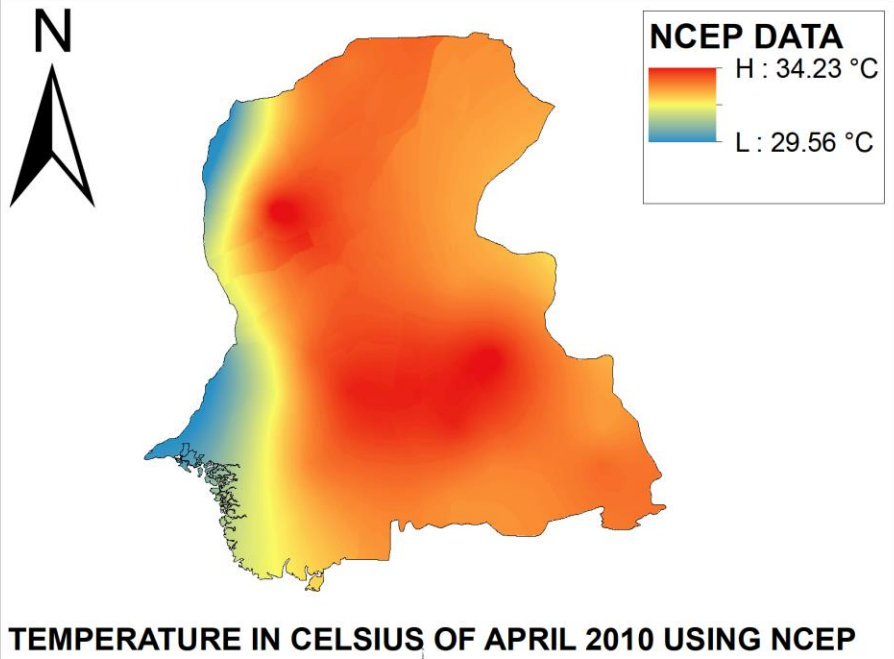
Primary Objectives

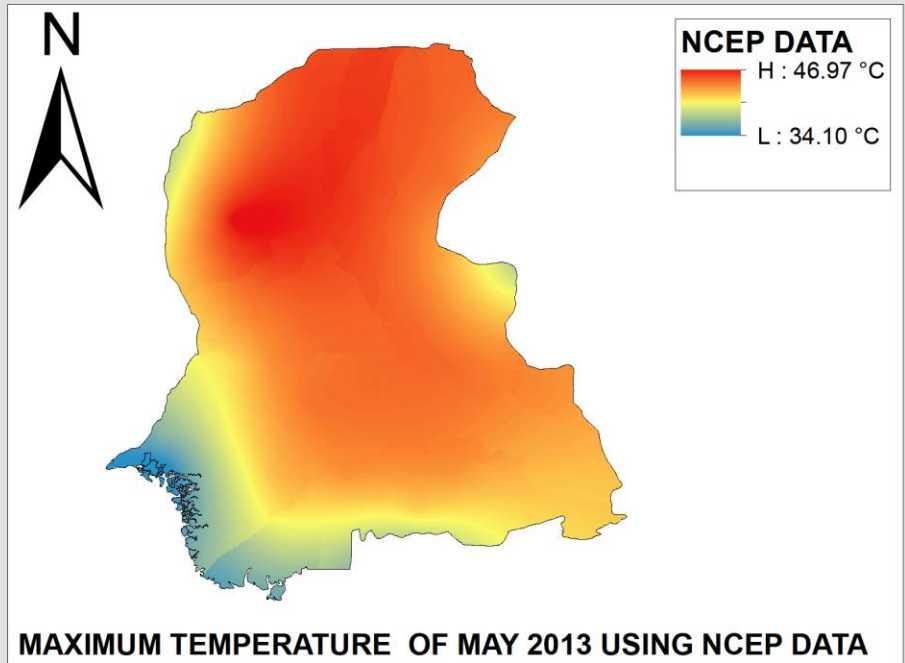
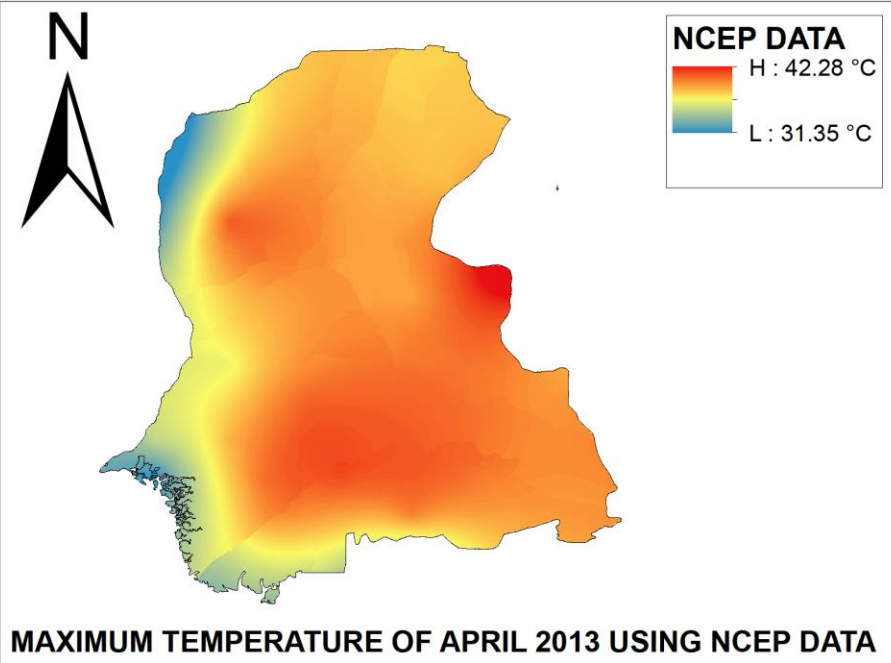
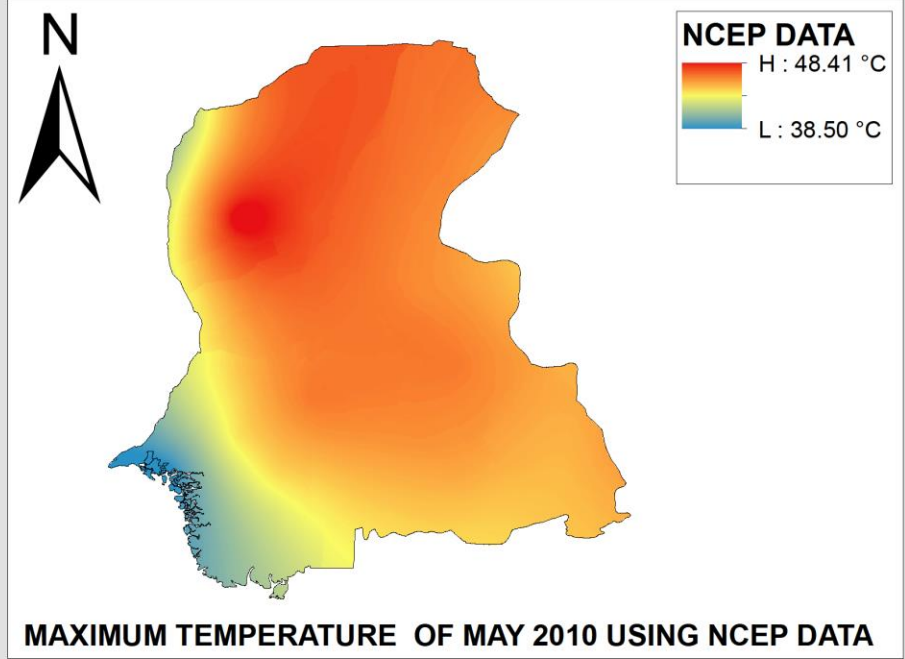
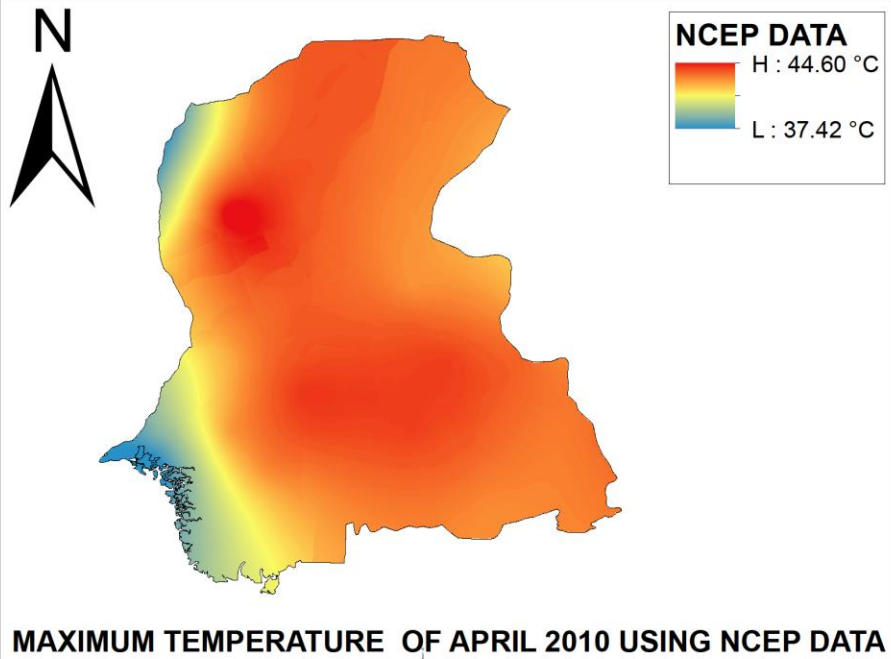
- To assess the meteorological parameters and analysis change scenarios for all districts of Sindh from baseline period to 2099
- To predict temperature & precipitation changes from 2010 to 2099
- To determine and identify less vegetated areas for all districts of Sindh
- To determine the risk prone areas where temperature highly increased in Sindh
- To assess and identify urbanization areas of Sindh province which highly effective of heat waves due to rapidly increase of temperature and relative humidity
- To identify more vulnerable areas with respect to meteorological drought condition of Sindh province

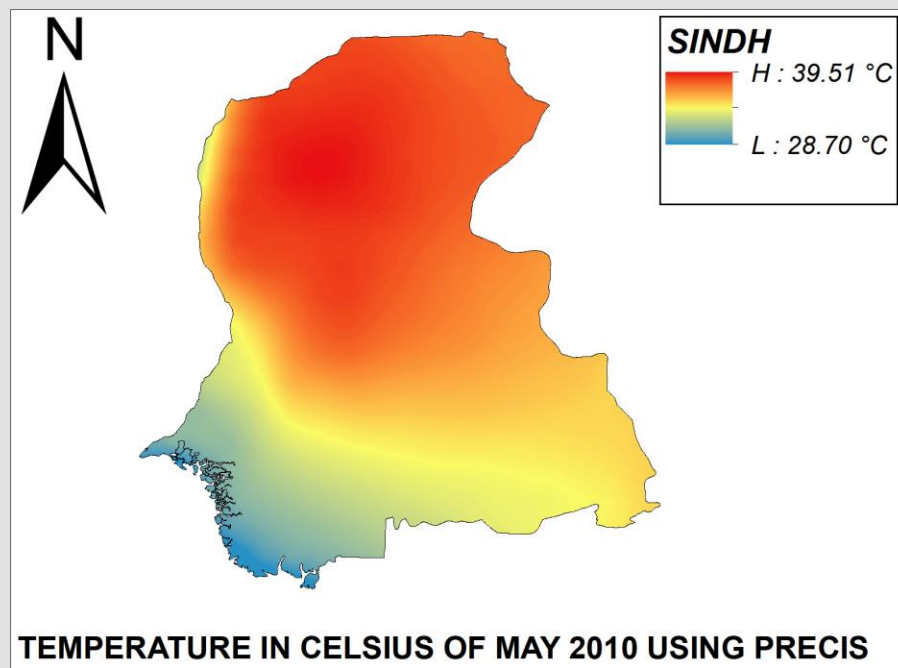
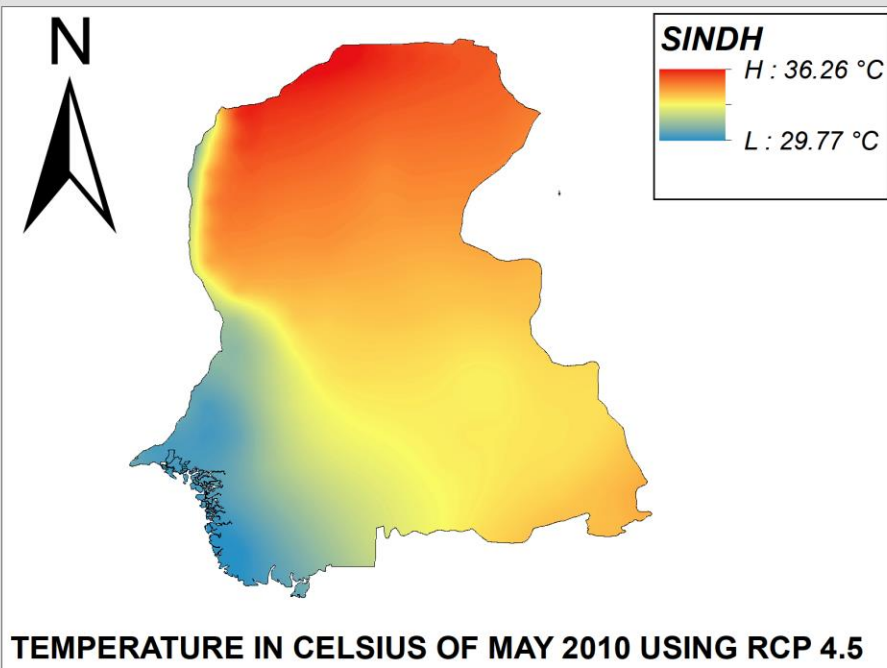
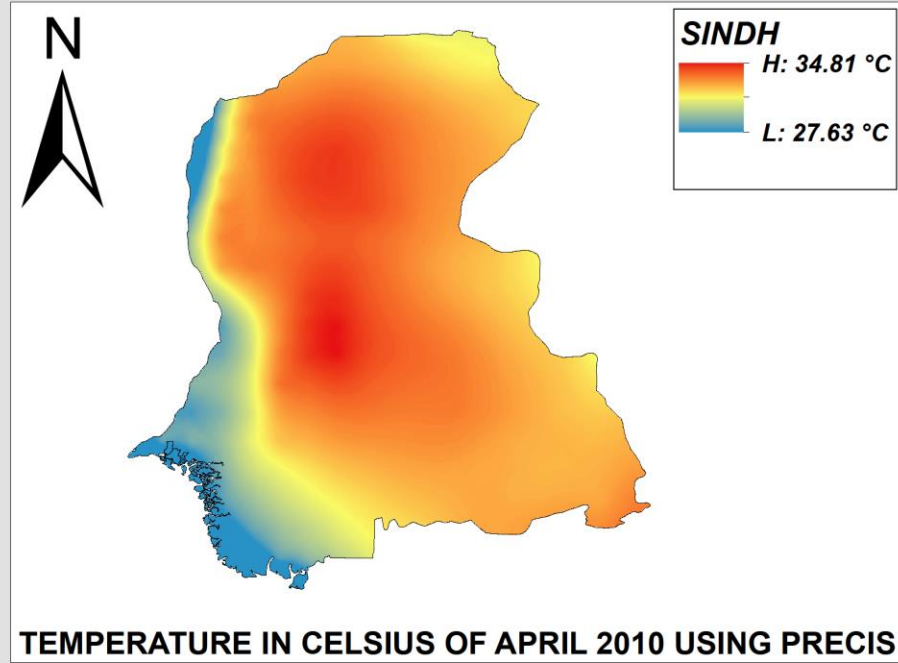
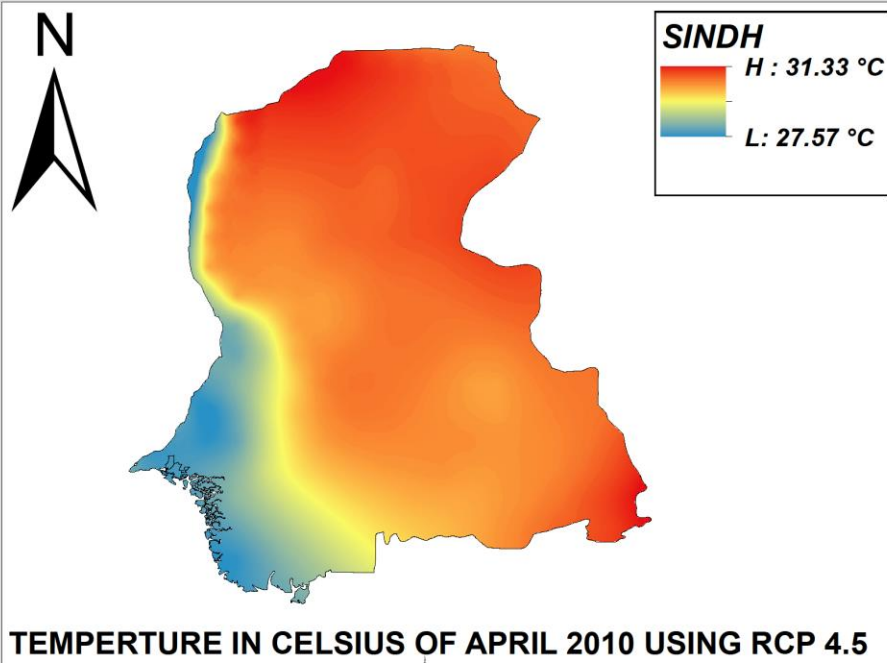


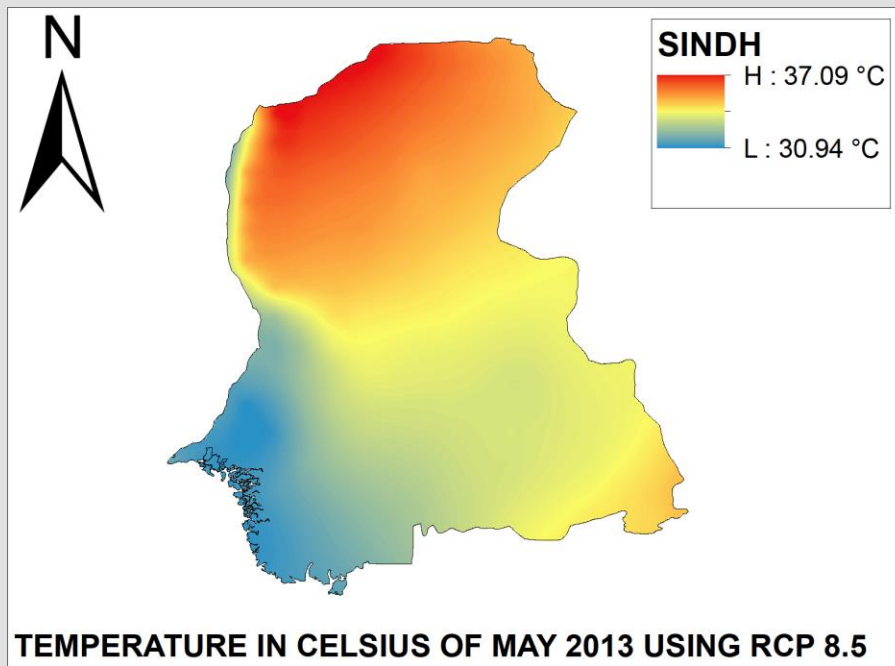
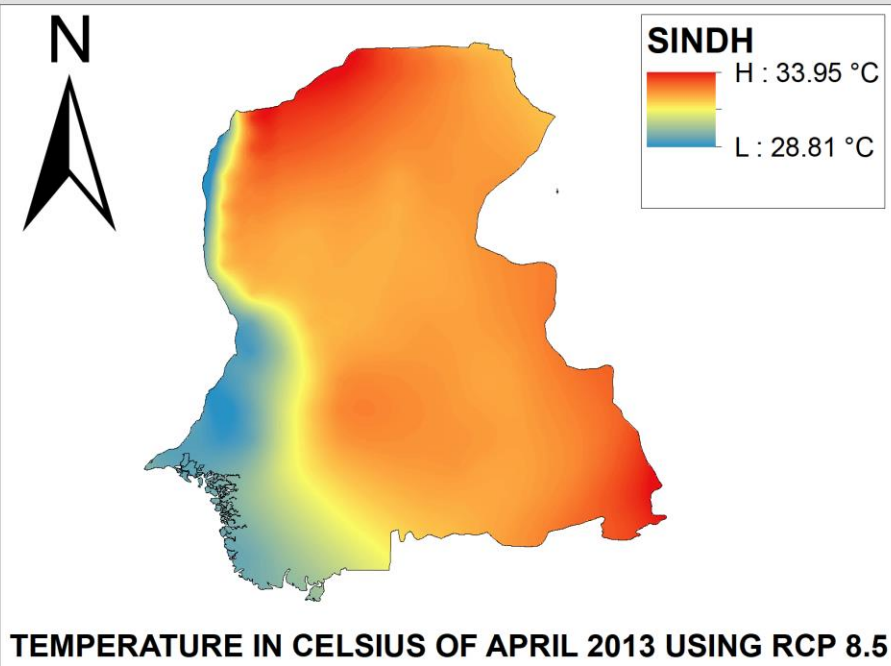
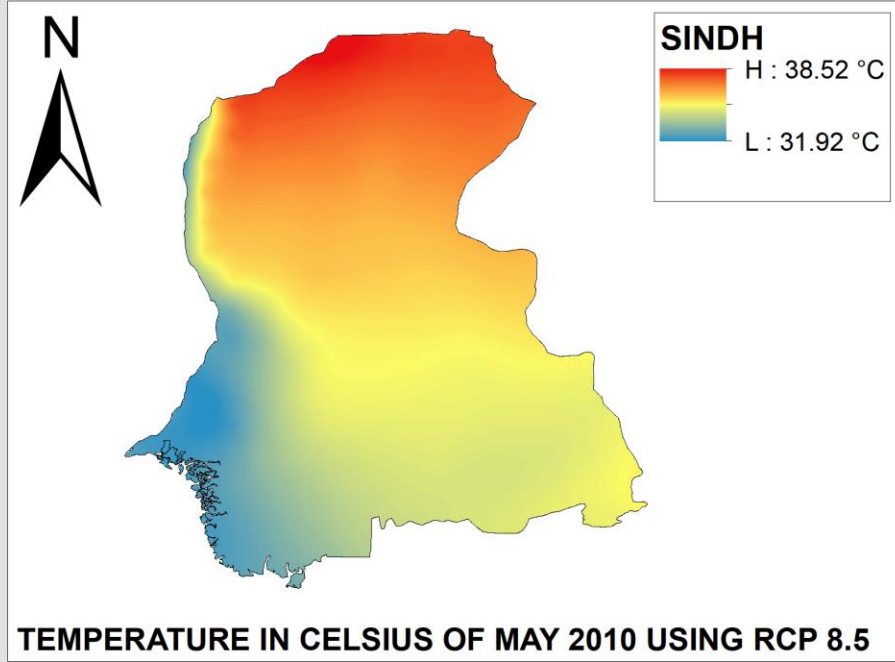
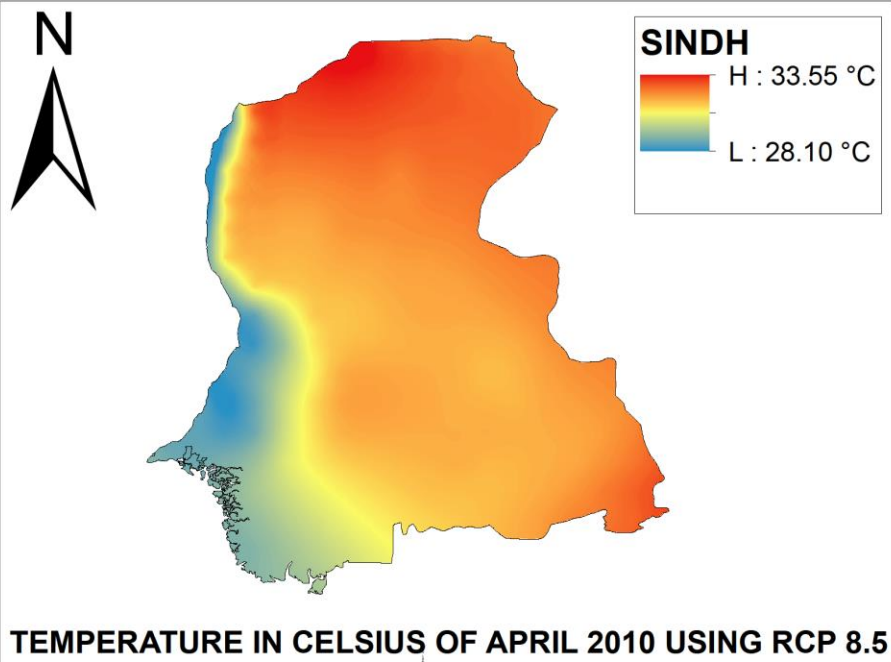


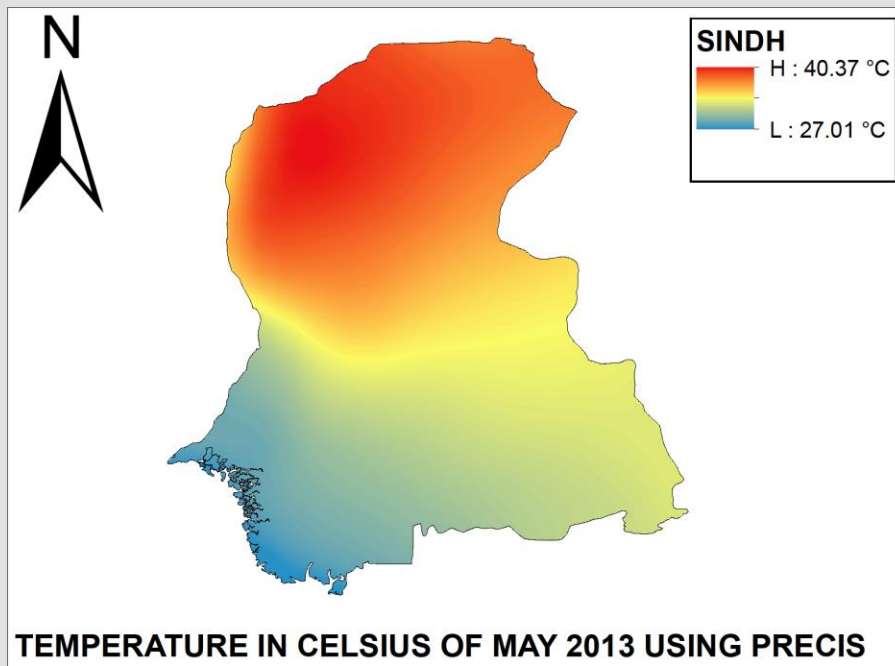
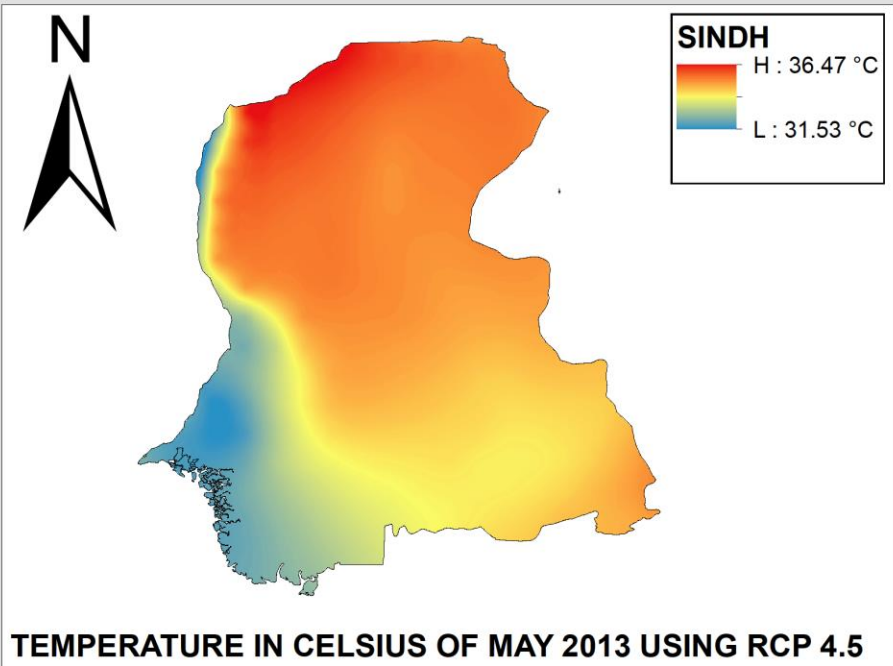
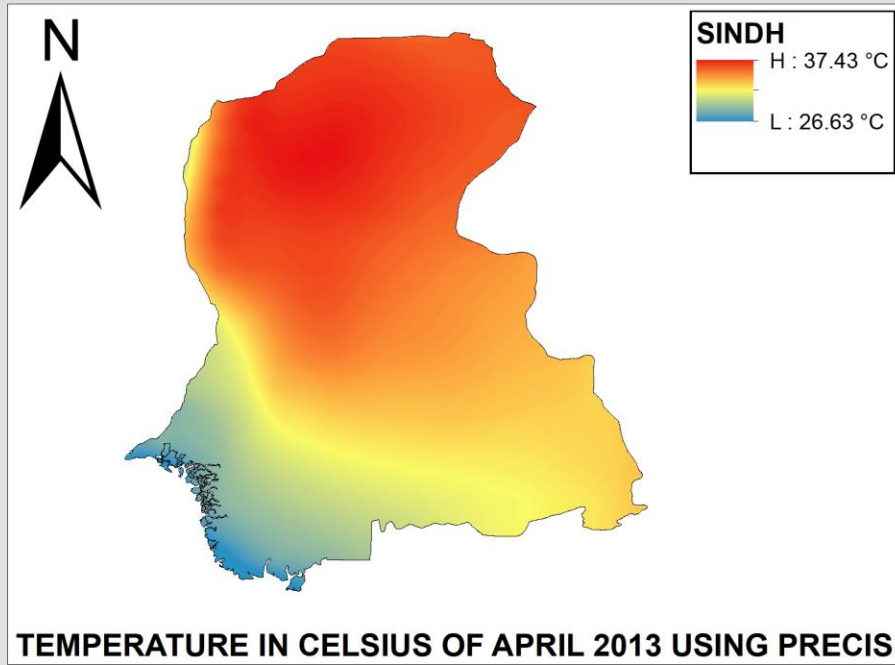
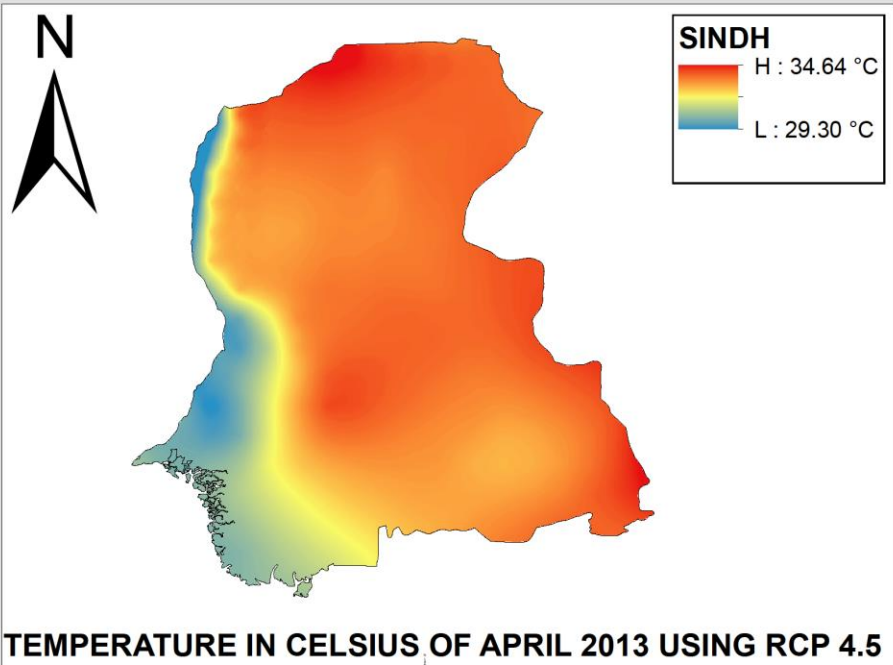


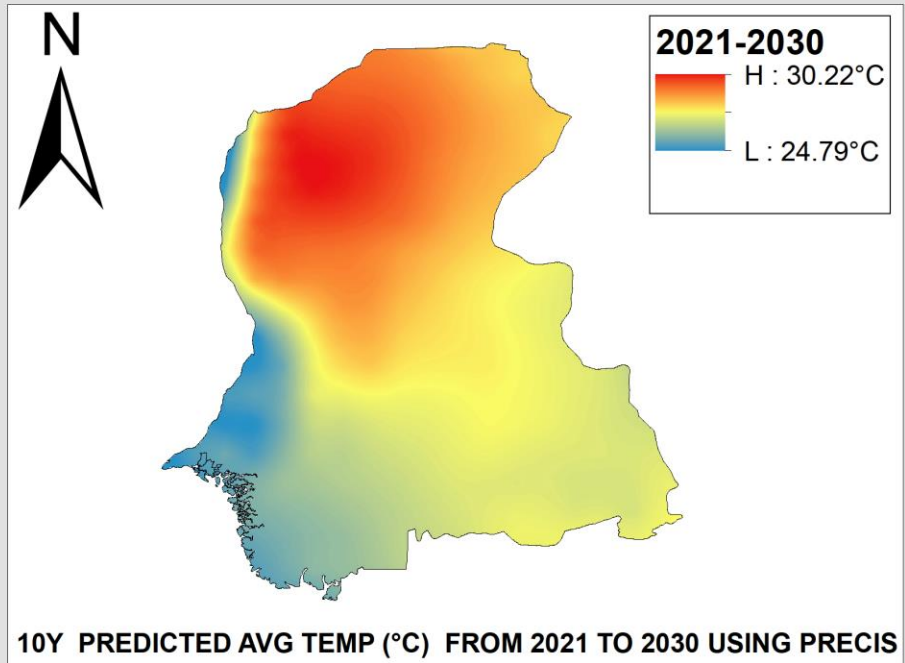
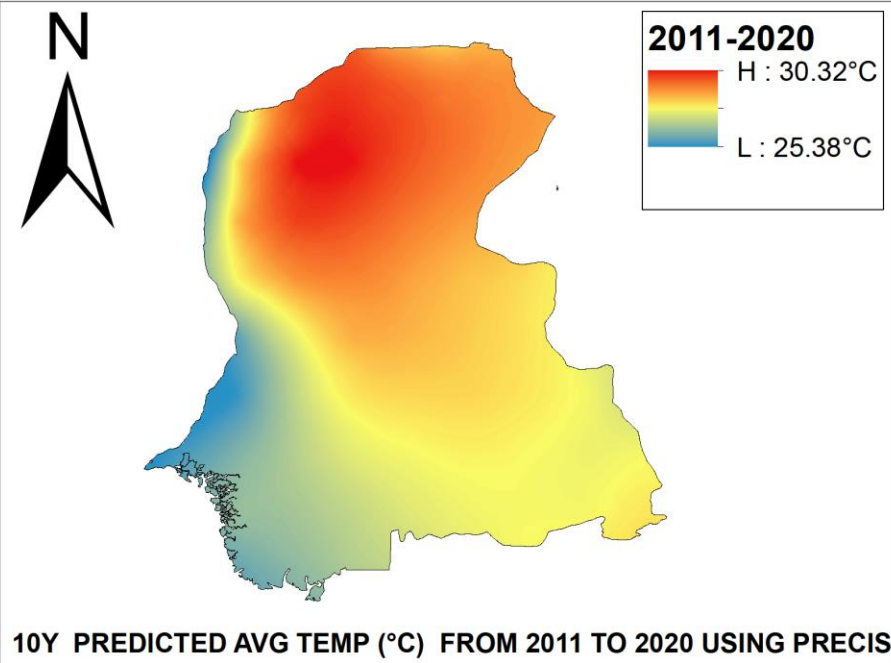
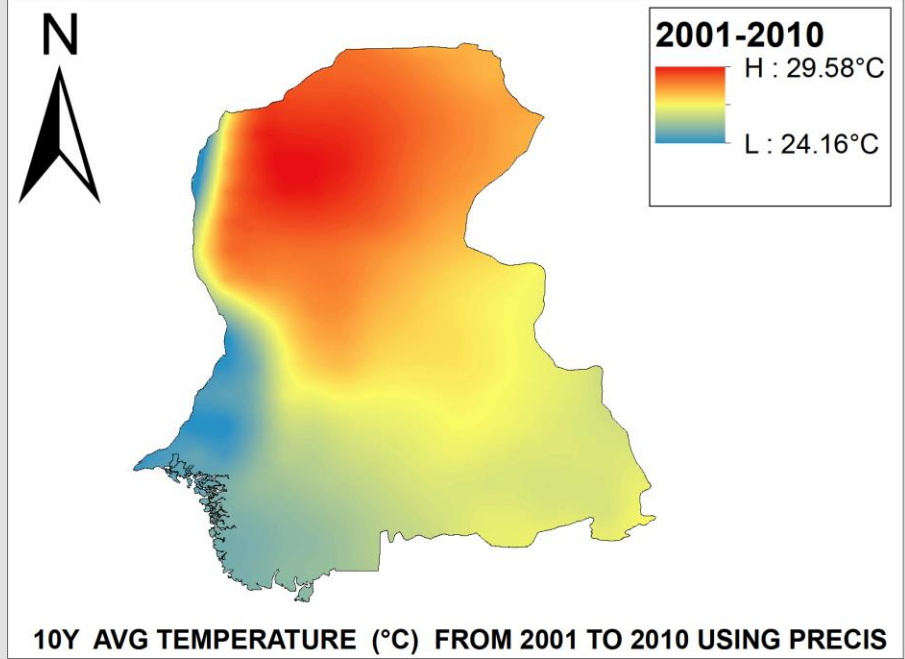
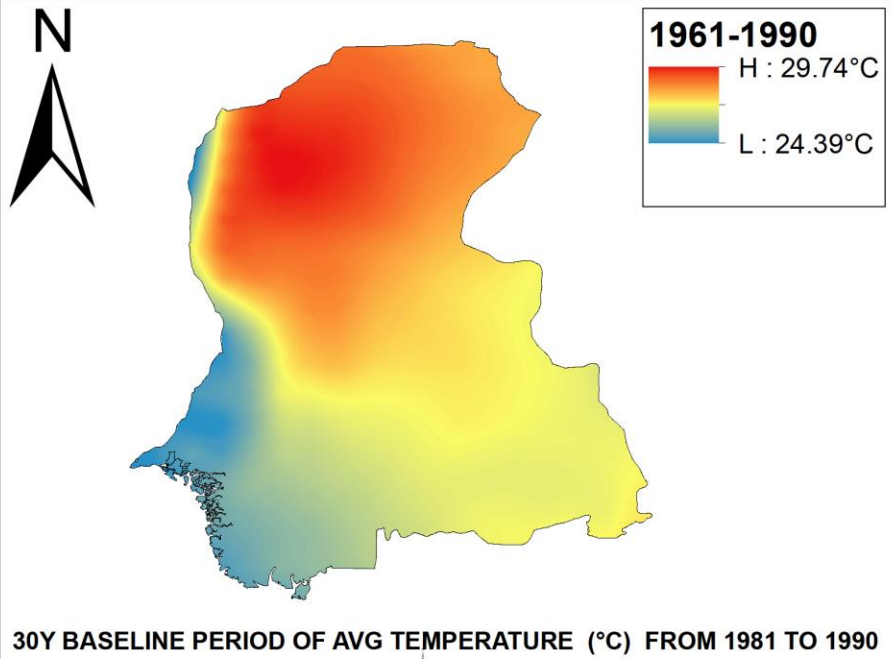


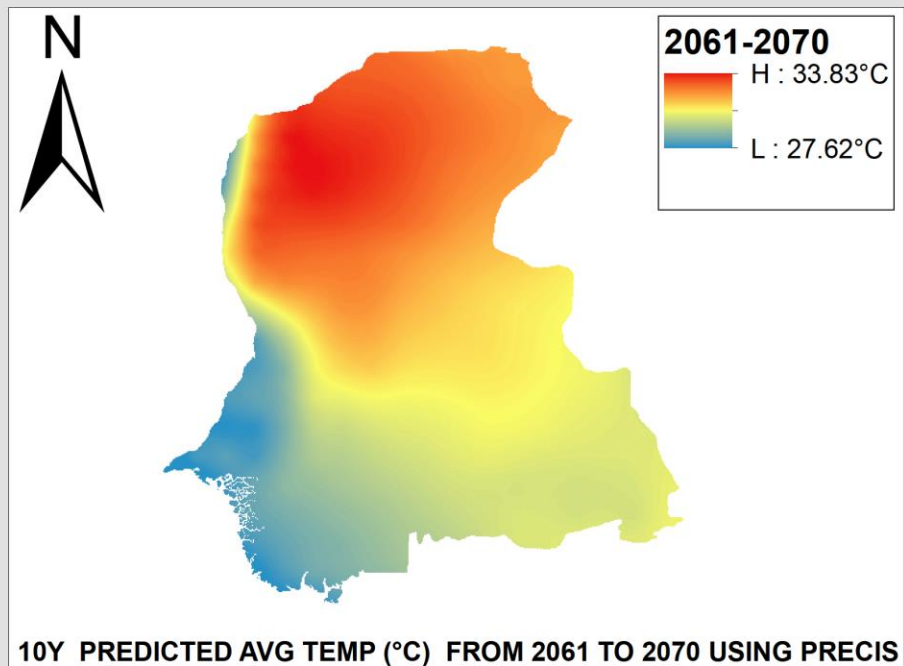
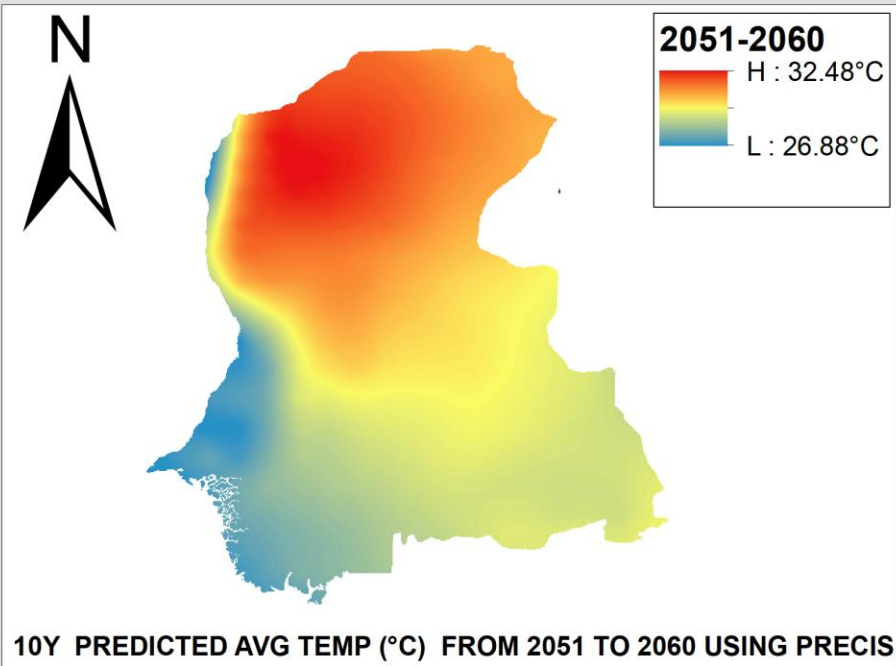
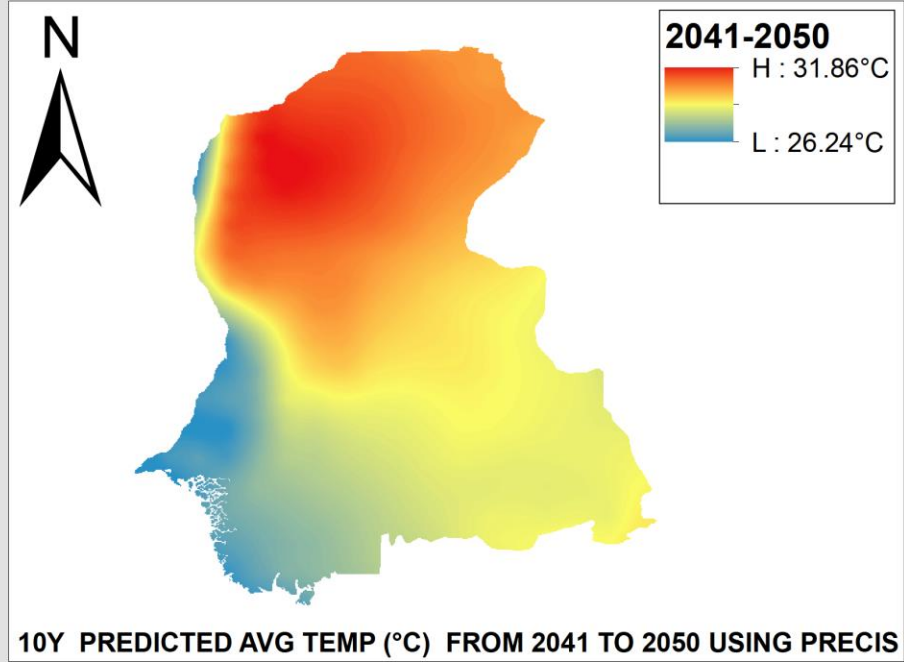
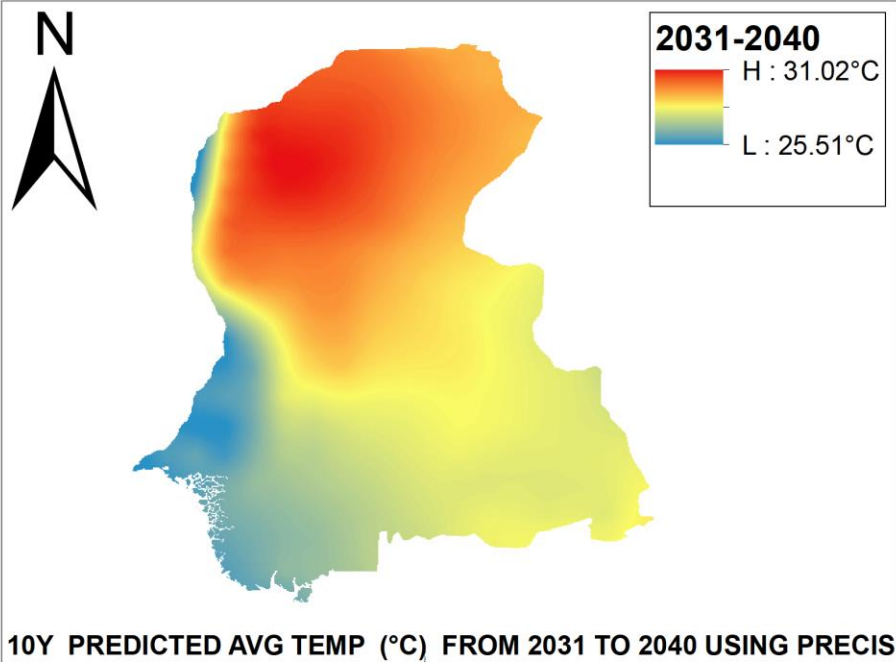


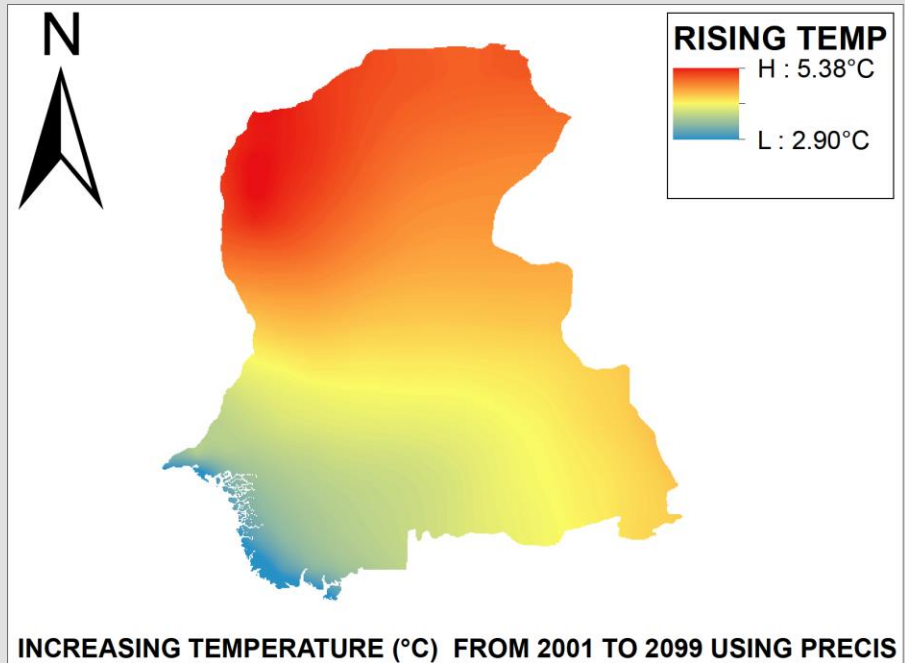
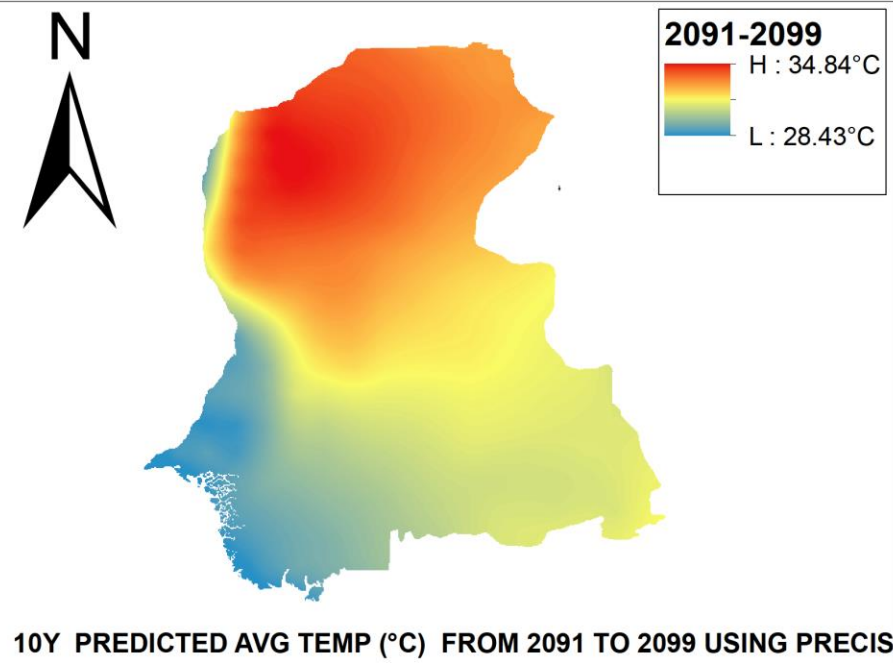
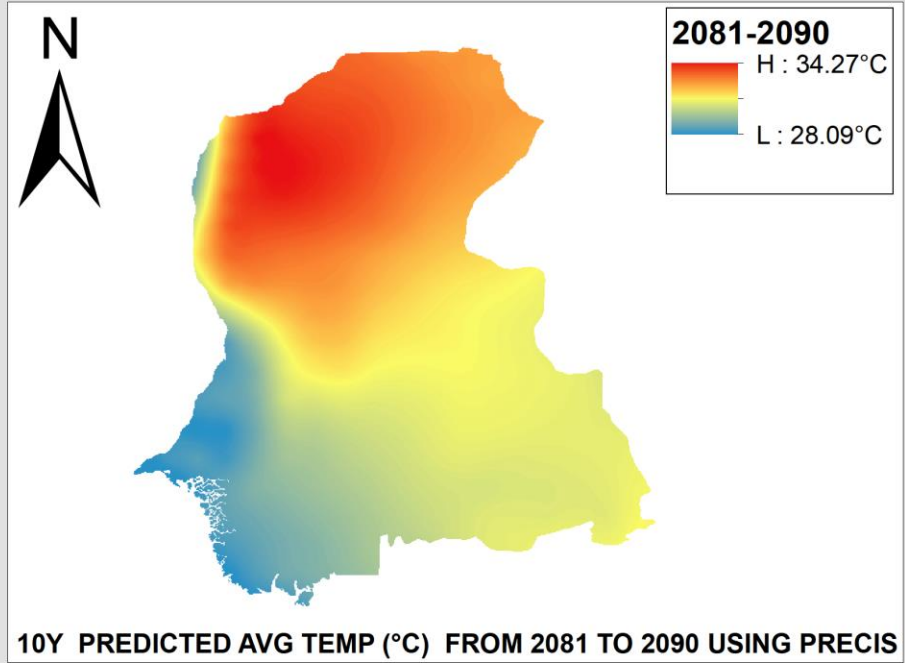
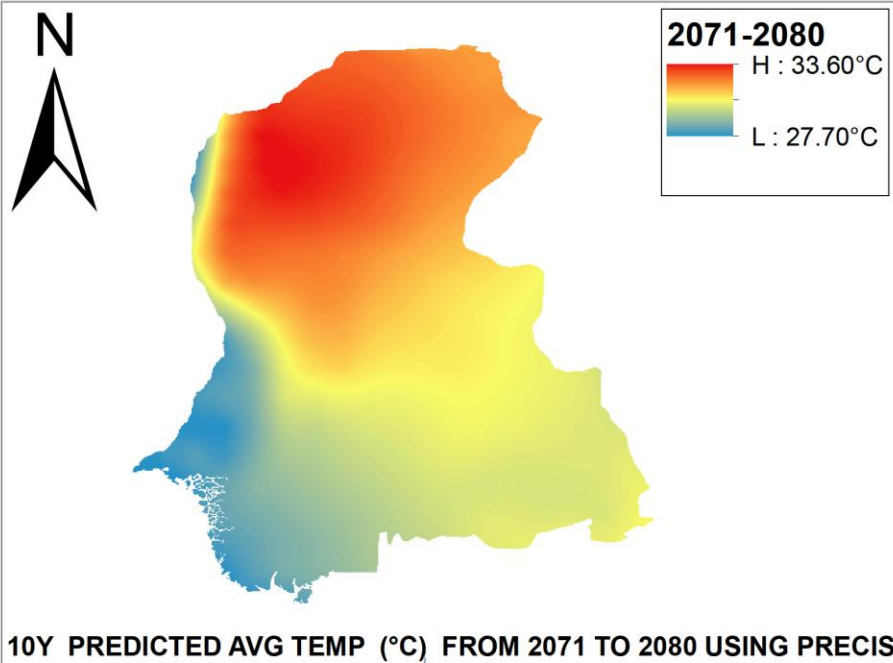




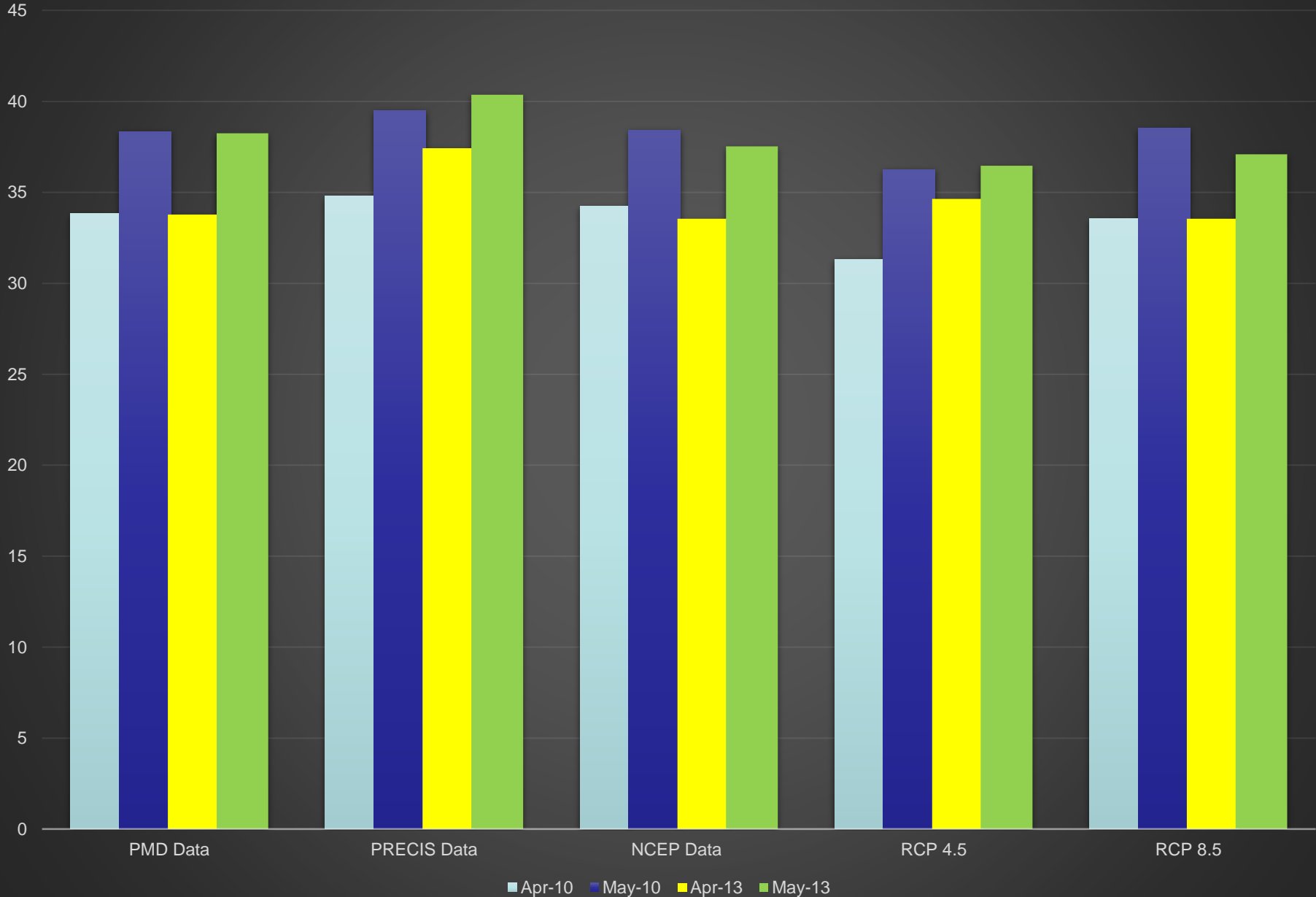






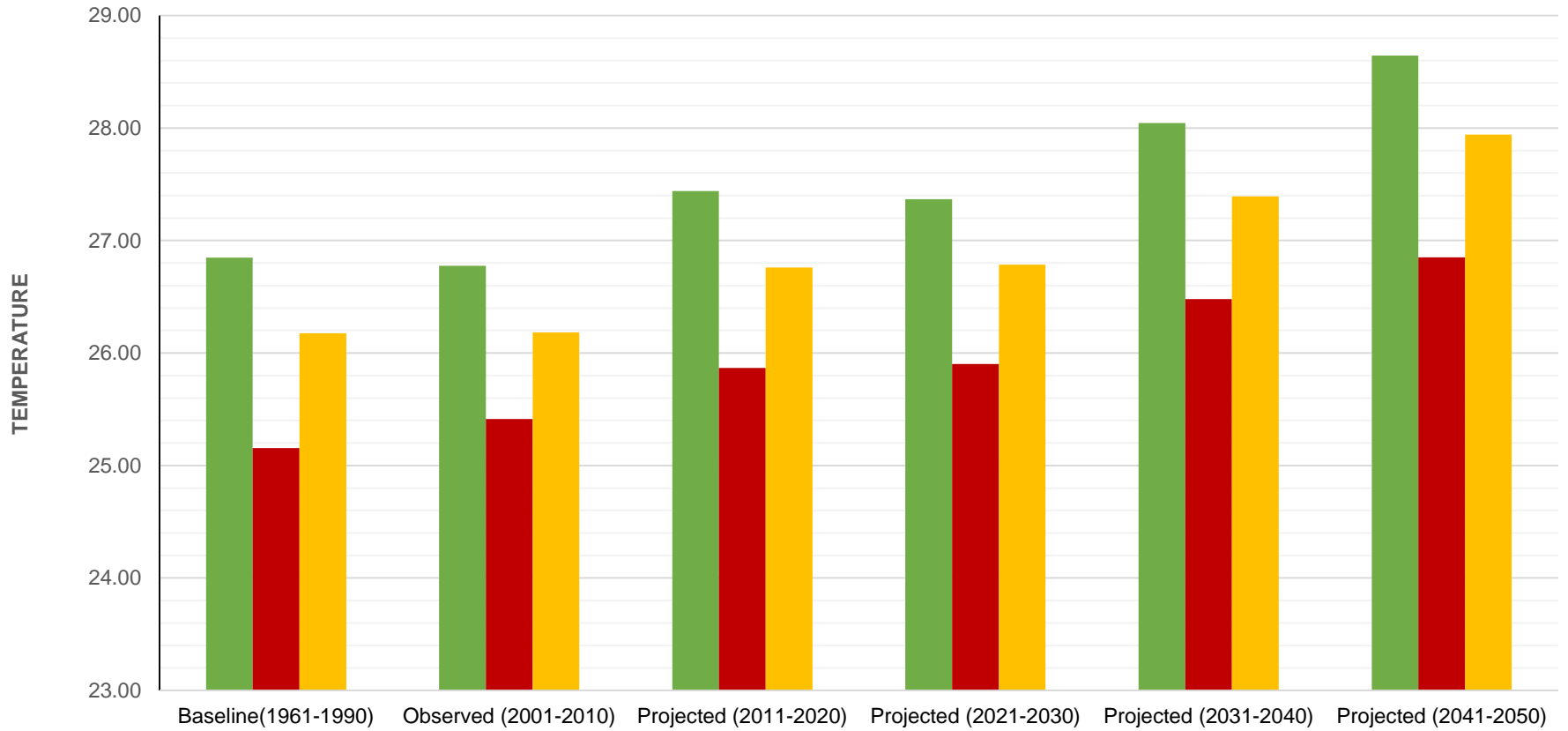


HIGH TEMPERATURE LIMITs



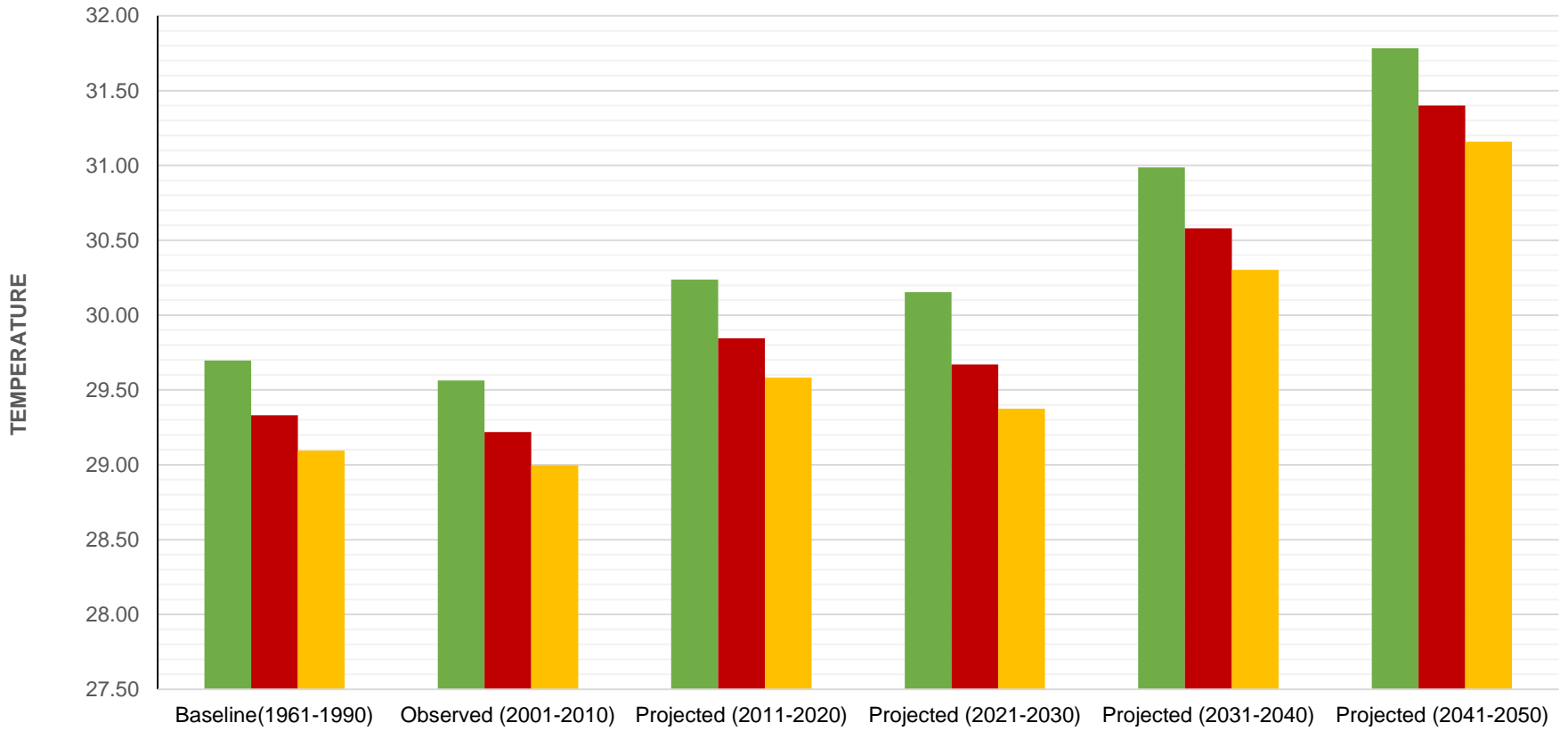
Temperature (Model Data)

■ Badin ■ Karachi A/P ■ Thatta



Temperature (Model Data)

Larkana Sukkar Rohri



LST & NDVI IMAGES OF KARACHI

LST_2010

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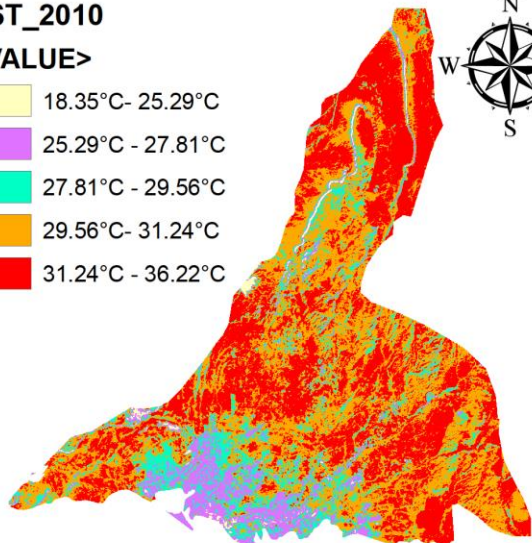
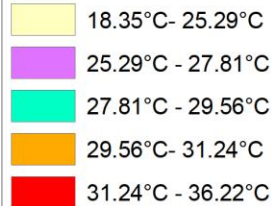


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LST_2000

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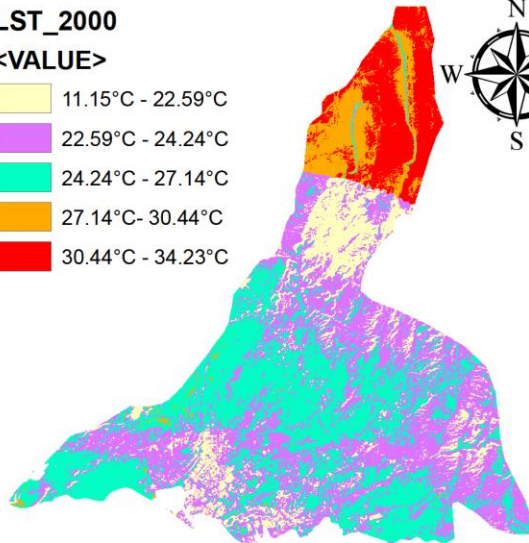
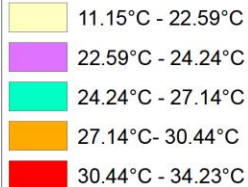


Figure: No.02 (b)

LST_1995

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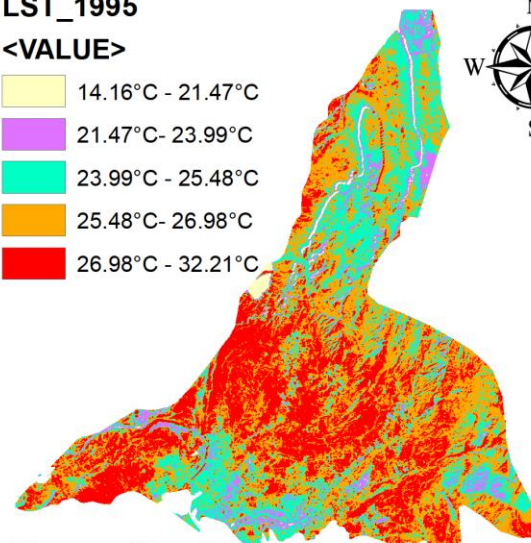
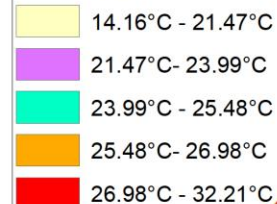


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NDVI_2010

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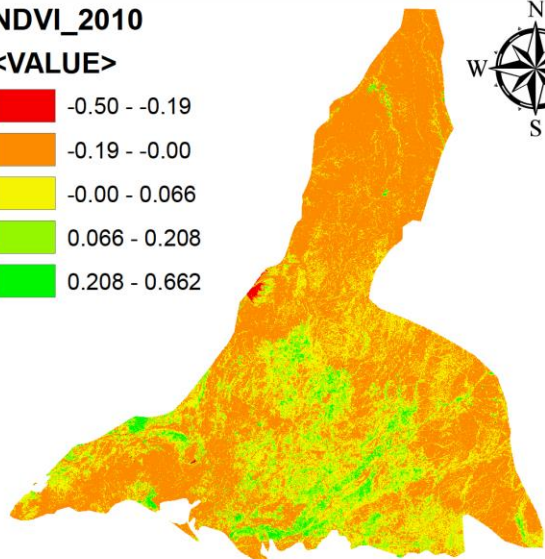


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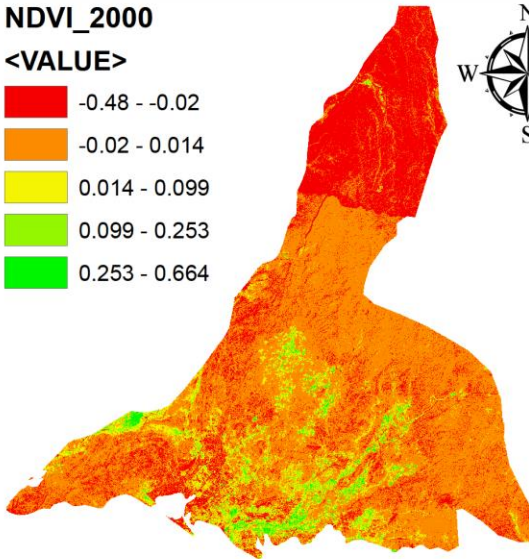
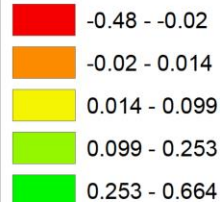


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NDVI_1995

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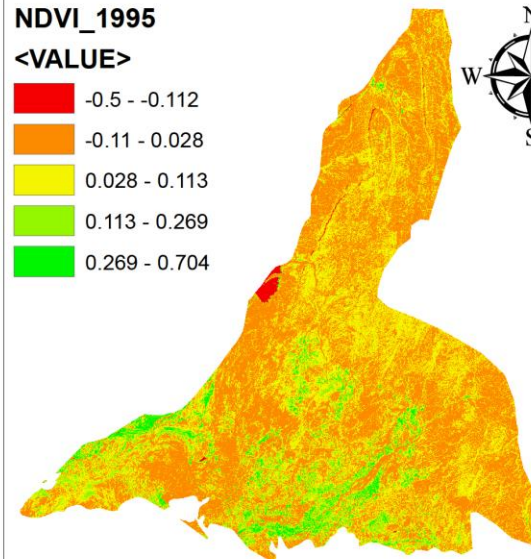
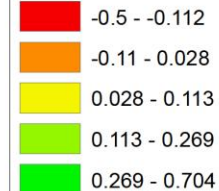


Figure:No.02 (f)

Fig.02-LST & NDVI Images for the Months of Feb 2010, Feb 2000 & Feb 1995 respectively

LST & NDVI IMAGES OF THATTA

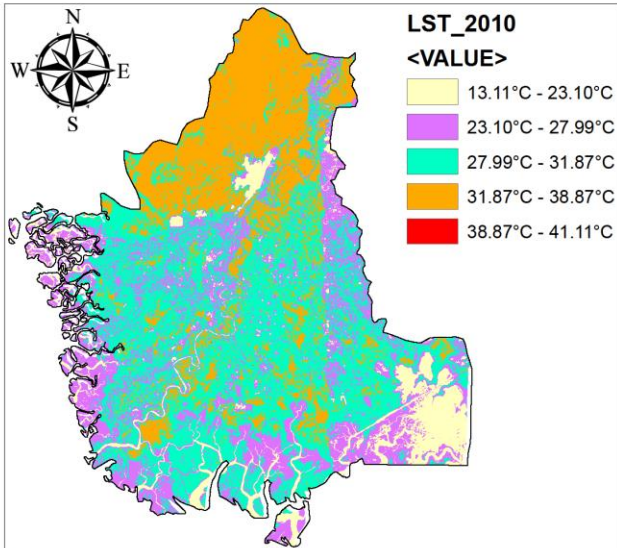


Figure:No.07 (a)

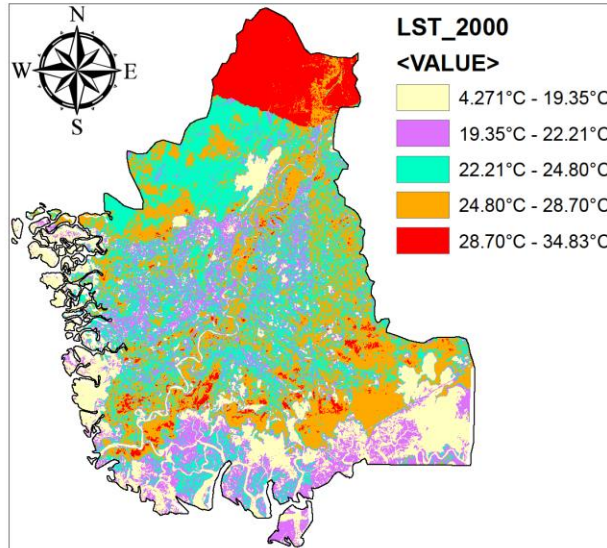


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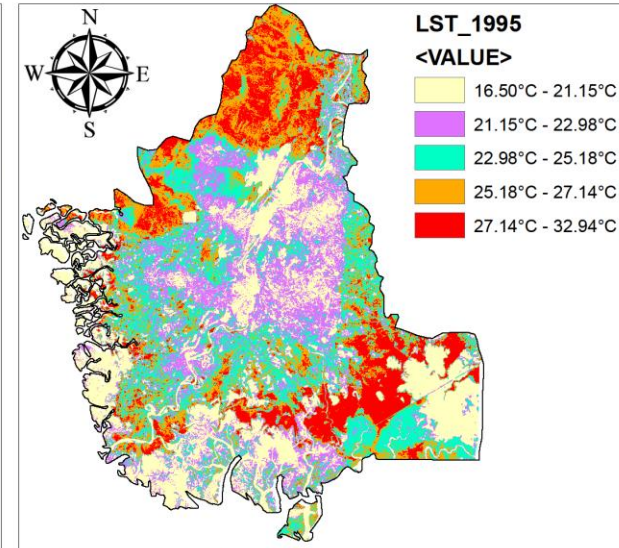


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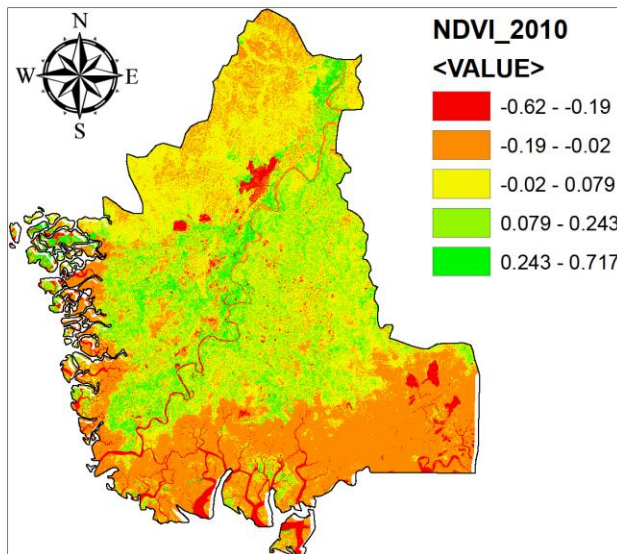


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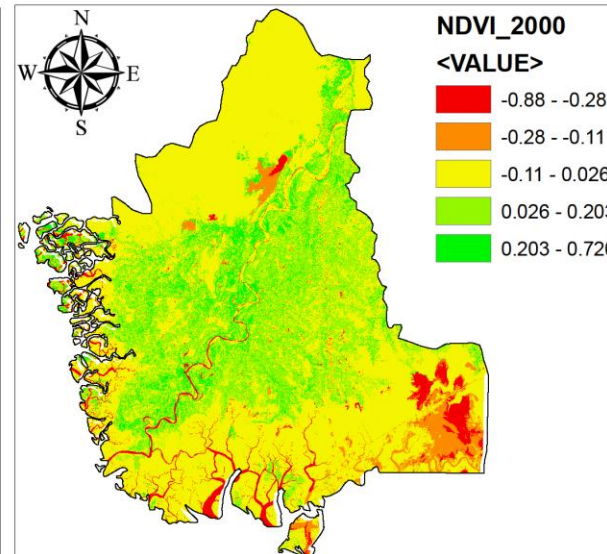


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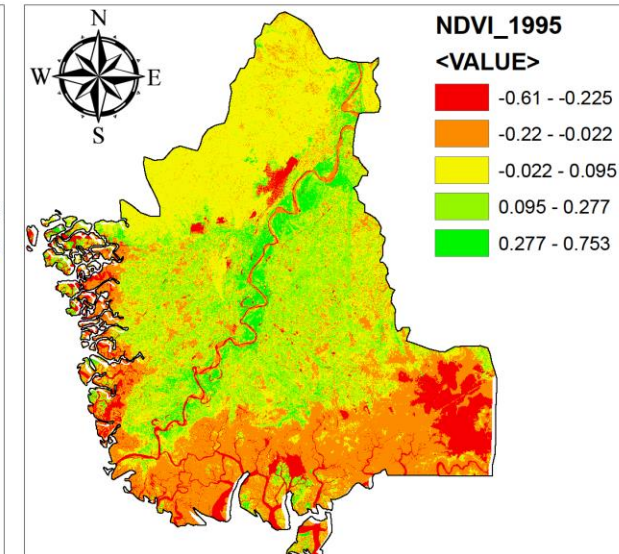


Figure:No.07 (f)

Fig.07-LST & NDVI Images for the Months of Feb 2010, Feb 2000 & Feb 1995 respectively

SUMMARY

- Temperature and rainfall are the major meteorological parameters which help to calculate the future meteorological events
- Same procedure can be applied using climate model data, calculate other parameters like as pressure, relative humidity, wind speed & direction for more accuracy to assess the meteorological parameters
- Overall analysis that Sindh province will be faced lot of meteorological events namely drought condition and heat waves
- Drought condition will be highly faced eastern part of Sindh
- Heat waves will be major disaster (Meteorological events) in specially coastal belt cities Karachi, Thatta and Badin
- Karachi is the major city of Sindh, will be faced high heat waves as compared with other cities of Sindh because now a days Karachi climate is totally unbalanced due to man made activities like as pollution, industrial waste, water storage, high population, migrated plantation, loss of natural friendly climatic vegetations & less amount of rainfall

SUMMARY

- District of Central Sindh including North Sindh will be faced high temperatures with low humidity
- These areas feeling temperature (Heat Index) will be below 50°C
- As per detail analysis of these climate data models, Karachi will be major area of Sindh where can't survive after three years because temperature rapidly increases with high humidity
- Majority districts will be faced drought due to low amount of rainfall in future

IMPACT BASED FORECAST & WARNING SYSTEM IN PAKISTAN

OBJECTIVES & RESPONSIBILITIES OF PMD

- To ensure timely issue of different types of weather/flood forecasts, warnings and advisories to the National News Media and concerned functionaries



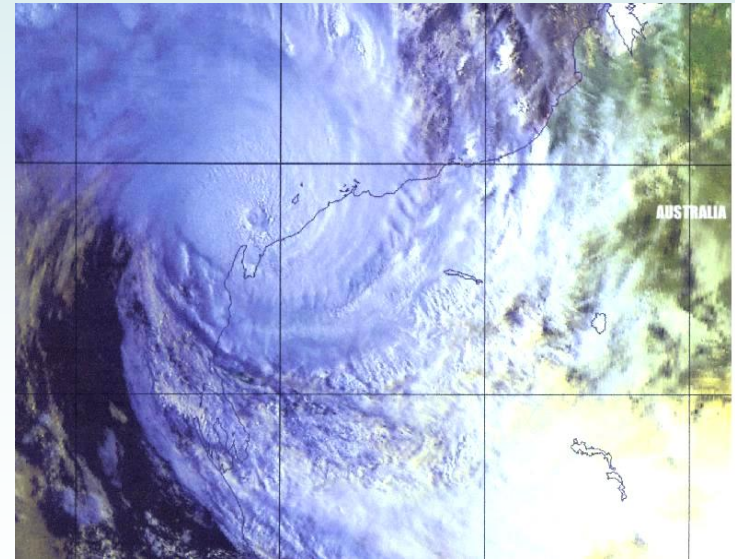
OBJECTIVES & RESPONSIBILITIES OF PMD

- **Safety of civil aviation operations, VVIP flights and marine activities**



OBJECTIVES & RESPONSIBILITIES OF PMD

- Mitigation of disasters due to Meteorological, Hydrological & Geophysical Phenomena such as Tropical Cyclones, Heavy Rains, Floods & Earthquakes etc



OBJECTIVES & RESPONSIBILITIES OF PMD

- **Socio-Economic Development of the country based on climatic and agro-climatic potentials of different areas.**
- **Boosting-up of Agricultural Productivity of the country by providing agro-met services to the farming community.**
- **To investigate the behavior of the atmosphere and exploiting this knowledge for short and long term weather predictions**





MAIN AREAS OF OPERATION

- 1. AVIATION METEOROLOGICAL SERVICES**
- 2. HYDRO-METEOROLOGICAL SERVICES AND FLOOD FORECASTING**
- 3. AGRO-METEOROLOGICAL SERVICES**
- 4. CLIMATOLOGICAL SERVICES**
- 5. GEOPHYSICAL AND SEISMOLOGICAL SERVICES**
- 6. WEATHER FORECASTING SERVICES TO PUBLIC THROUGH ELECTRONIC & PRINT NEWS MEDIA**
- 7. ASTRONOMICAL INFORMATION SERVICES**
- 8. MET-FORECAST FOR MOUNTAINEERING EXPEDITION**
- 9. MARINE METEOROLOGICAL SERVICES**

LINKAGE TO OTHER MINISTRIES

AVIATION METEOROLOGICAL SERVICES

CABINATE DIVISION

FLOOD FORECASTING SERVICES

MINISTRY OF WATER & POWER

AGROMETEOROLOGICAL SERVICES

MINISTRY OF AGRICULTURE

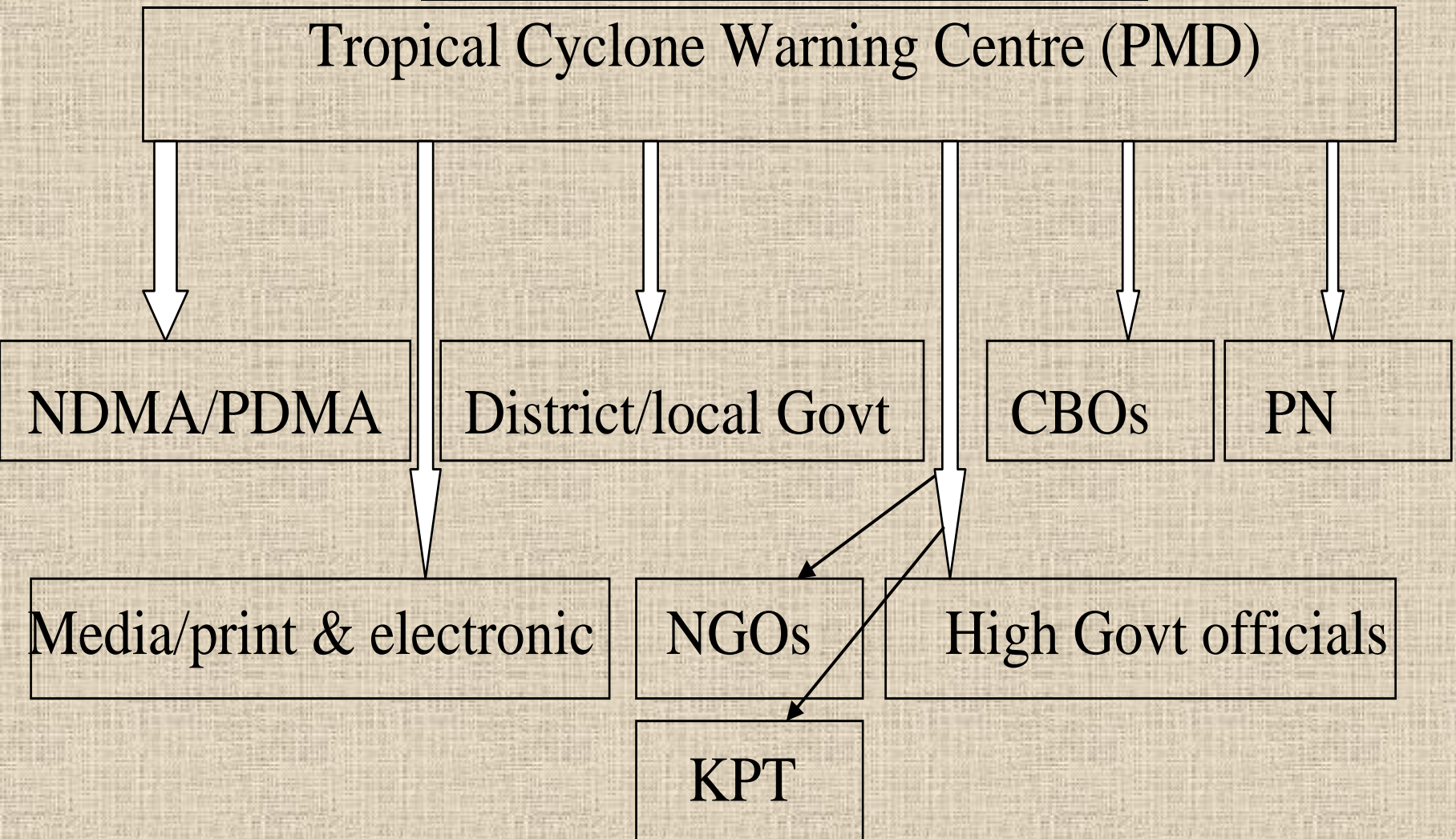
R & D & RENEWABLE ENERGY RESOURCES

MINISTRY OF SCIENCE & TECHNOLOGY

FORECASTING & CLIMATOLOGY

PLANNING DIVISION & DISASTER MITIGATION ORGANIZATIONS

Information Flow



1. AVIATION METEOROLOGICAL SERVICES

a) Objectives

i. Safety

ii. Economy

b) Products Supplied For Aviation Users

- **Upper Levels Wind Charts**
- **Significant Weather Prognostic Charts**
- **METAR (Current Weather)**
- **SPECI (Special Weather Report)**
- **TAFORs (Terminal Aerodrome FORecast)**
- **ROFOR (ROute FORecast)**
- **SIGMET (SIGnificant METeorological informations)**
- **Volmet Broadcast**

HYDROMETEOROLOGICAL SERVICES AND FLOOD FORECASTING

Flood Forecasting Division (FFD) Lahore is a specialized unit of PMD for this purpose.

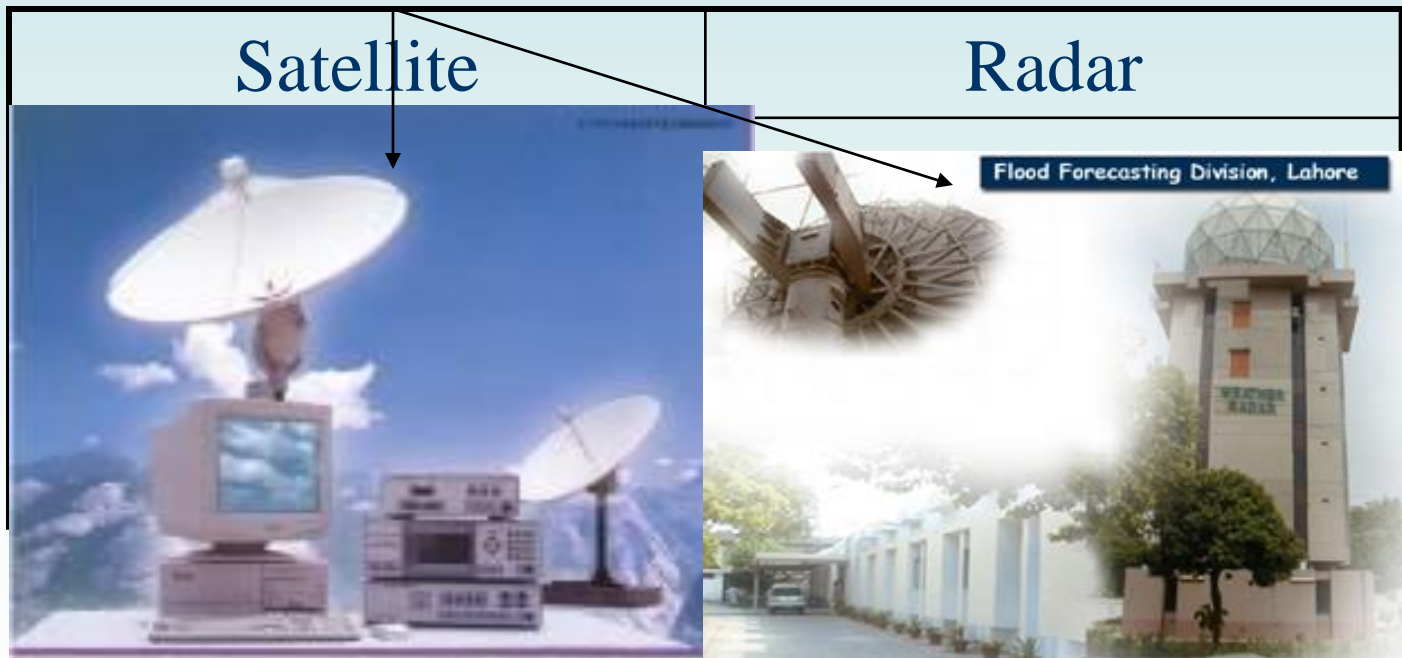
- **Responsibilities**
 - i. **Flood Forecasting**
 - ii. **River stream flow forecasting**
 - iii. **Water Management at Dams specially during Monsoon**

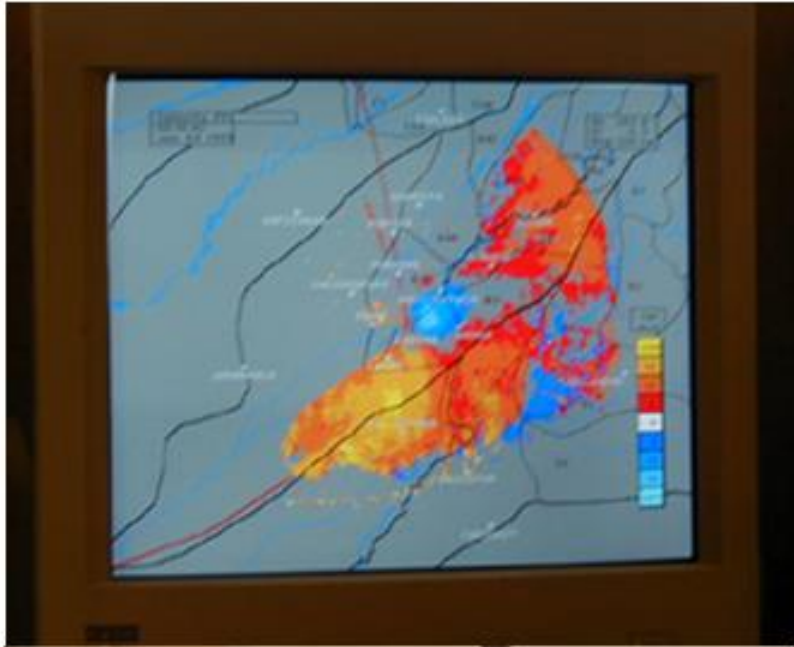
Flood Forecasting System in Pakistan Meteorological Department

- **10-cm Doppler Radar at (FFD) Lahore**
- **QPM Radar at Sialkot**
- **Nationwide Network of Weather Surveillance Radars.**
- **Satellite Ground Station**
- **Computer Models**
- **Meteorological Analysis Centre**

REMOTE SENSING

REMOTE SENSING of the rainfall amounts from upper catchments of rivers as input data to the rainfall-runoff models is done through





Radar Control Room, Lahore



Hydrometeorological Data available on PMD Website

- Dams Flow
- Hydrological Data
- Rainfall
- Historical Peaks

AGRO-METEOROLOGICAL SERVICES

- i. Rain Predictions**
- ii. Frost Predictions**
- iii. Soil Moisture Information**
- iv. Time of Crop Sowing/Harvesting**
- v. Spraying of Pesticides on Crops**
- vi. Water Requirement of Crops**
- vii. Heat Wave and Cold Wave Forecast**
- viii. Special Weather Advisories for Farmers**
- ix. Monthly Agromet Bulletin of Pakistan**
- ix. Research on Regional Basis in Collaboration with Agriculture Research Institutions.**

AGROMET NETWORK

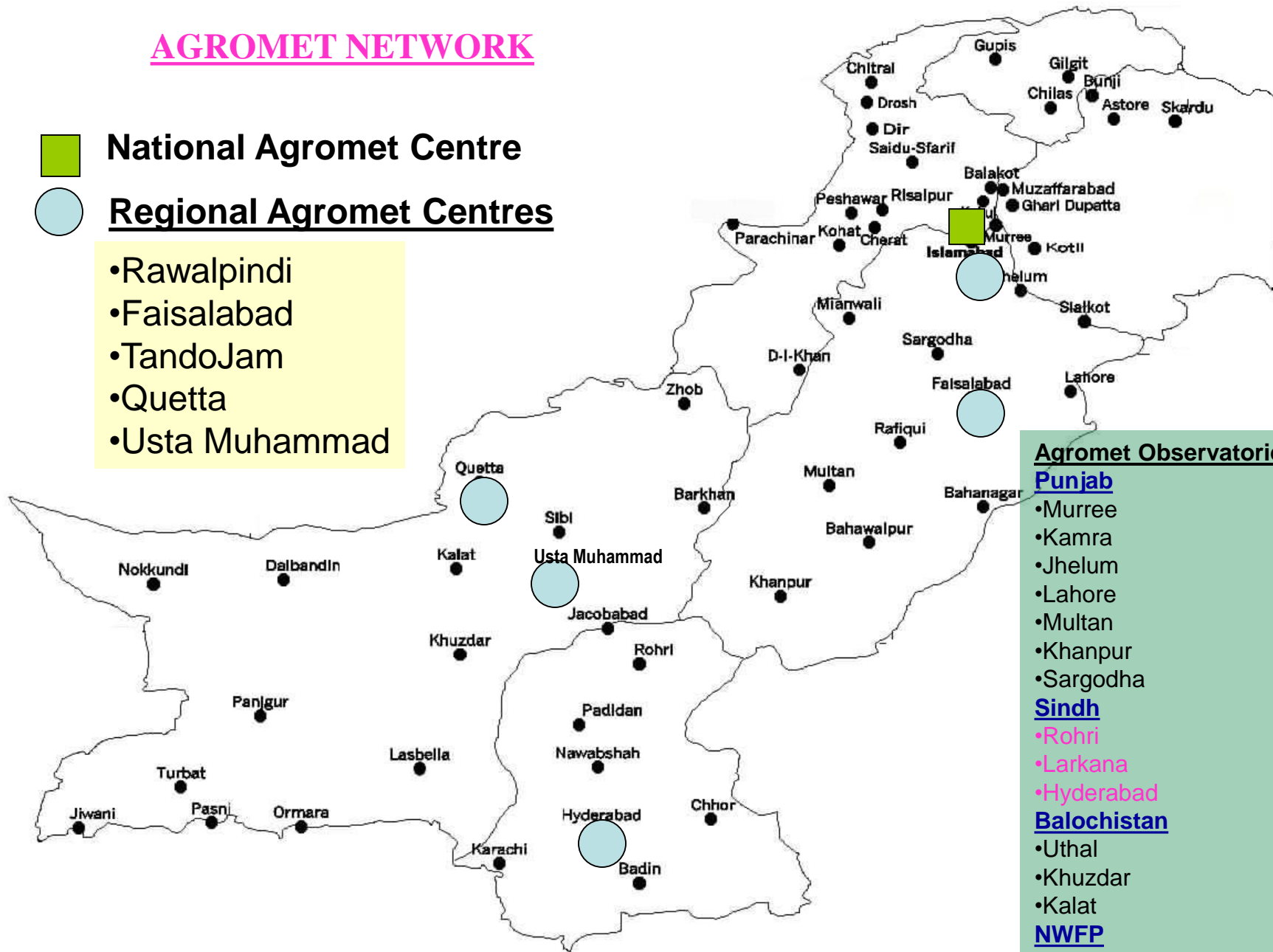


National Agromet Centre



Regional Agromet Centres

- Rawalpindi
- Faisalabad
- TandoJam
- Quetta
- Usta Muhammad



Agromet Observatories

Punjab

- Murree
- Kamra
- Jhelum
- Lahore
- Multan
- Khanpur
- Sargodha

Sindh

- Rohri
- Larkana
- Hyderabad

Balochistan

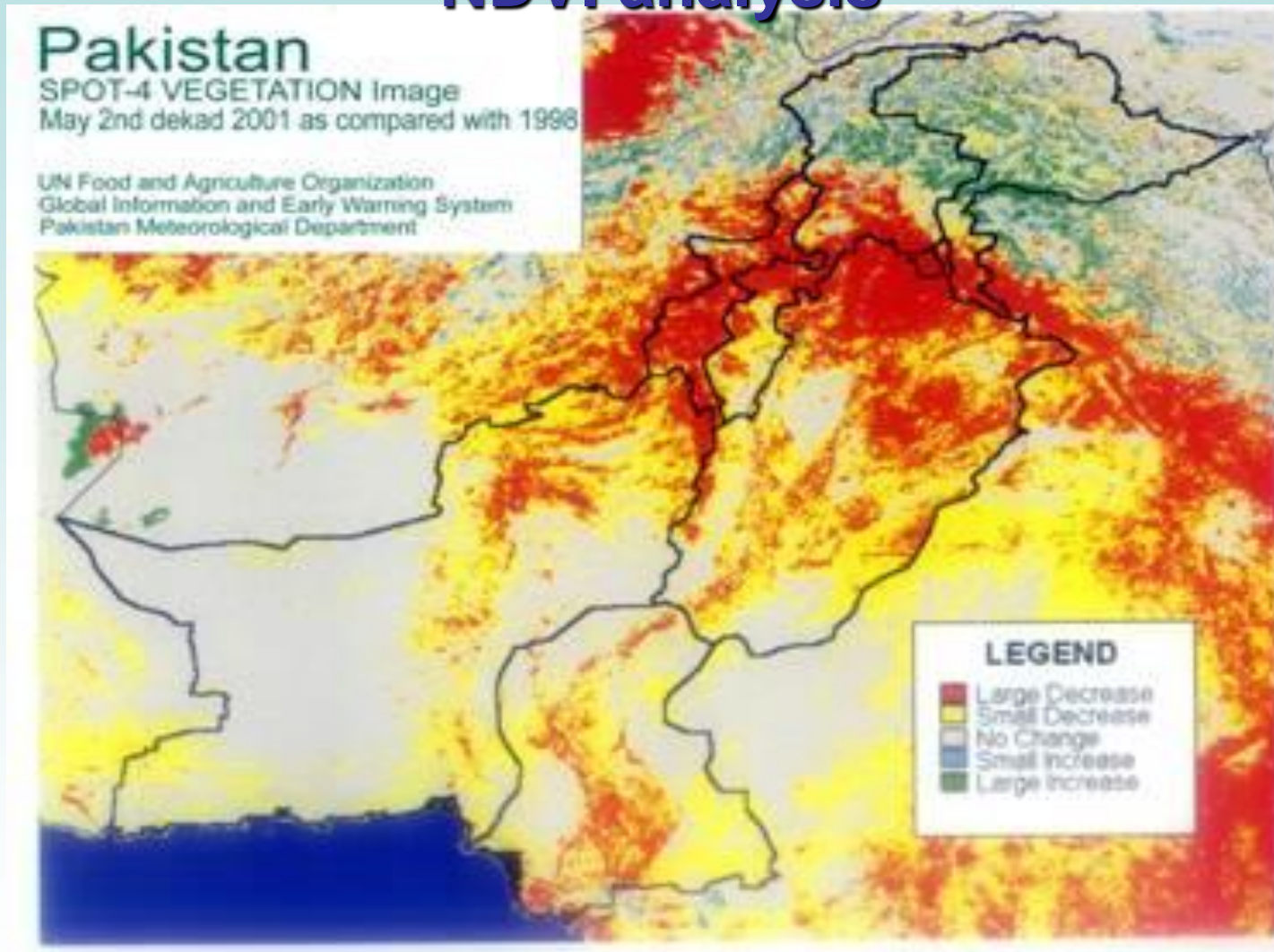
- Uthal
- Khuzdar
- Kalat

NWFP

- DIKhan
- Peshawar

AGRO-METEOROLOGICAL SERVICES

NDVI analysis



CLIMATOLOGICAL SERVICES

- i. Study of Climatic Indicators & Global Warming
- ii. El-Nino & La-Nina effects on Pakistan's Weather & Climate
- iii. Environmental Pollution and Ozone Monitoring
- iv. Climatological information for National Development Projects

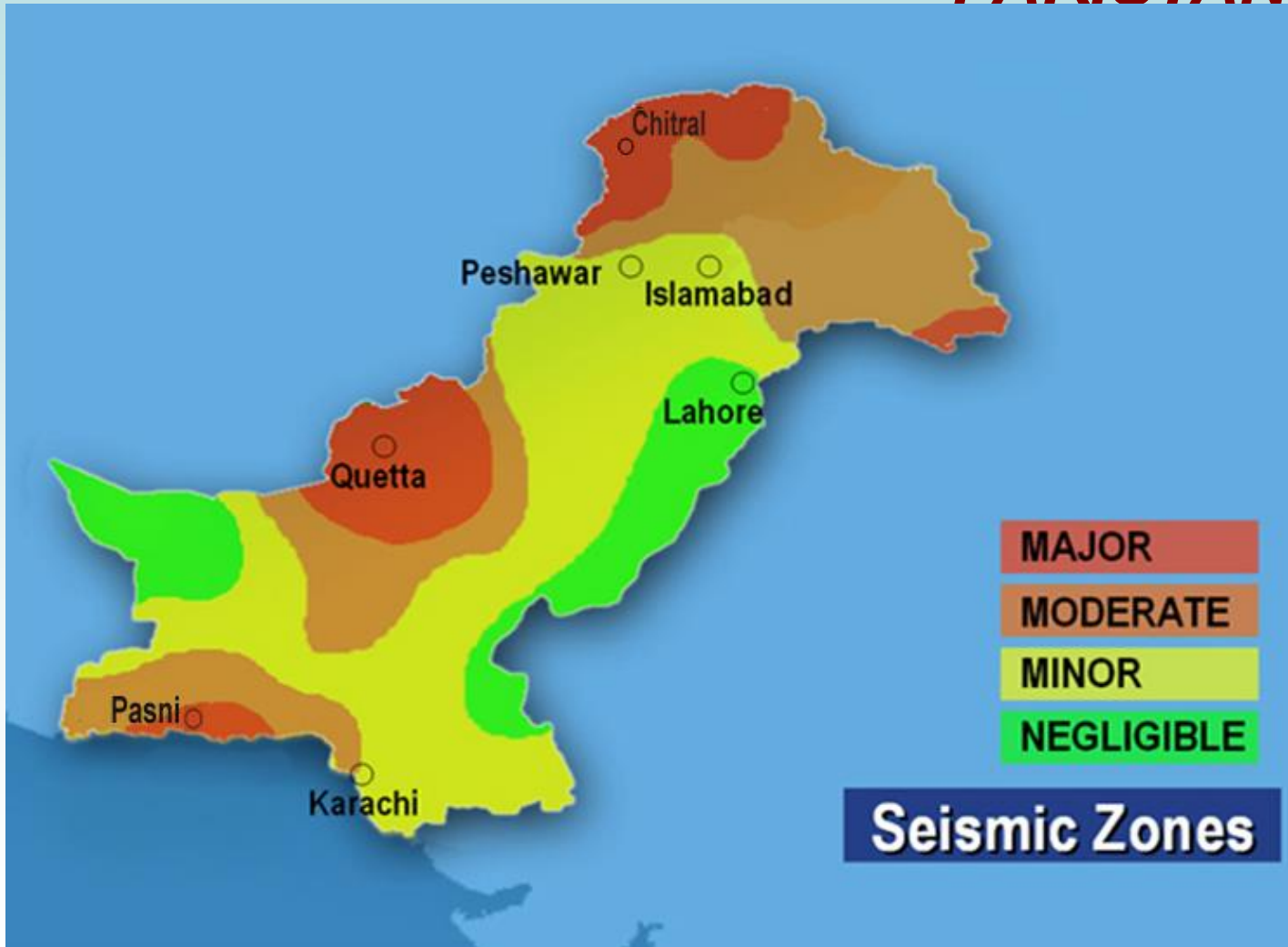
Examples:

- Location of Pakistan Steel Mill
- Tunnel in Northern Area
- Water Level in Lakes & Rivers
- Design for Dams, Motorways, Roads
- Feasibility of industrial Projects

GEOPHYSICAL & SEISMOLOGICAL SERVICES

- i. Earthquakes Monitoring**
- ii. Monitoring of Nuclear Explosion in the Region**
- iii. Building Sector**
- iv. Solar / Magnetic Storms & Related Phenomena**

PAKISTAN





National Seismic Control Room



Marine Meteorological Service

PMD-Area of responsibilities under GMDSS

(Global Maritime Distress & Safety System)

- Forecast is issued twice daily through INMARSAT Coastal Station Perth, Australia for the ships already in sea.
- Warnings when the port is threatened.
- Sea Bulletins for fisheries broadcast by Radio

6. WEATHER FORECASTING SERVICES TO PUBLIC

- i. Next 24 hour Weather Forecast**
- ii. Next 2-3 days Weather Forecast for Farmers**
- iii. Weekly Weather Forecast**
- iv. Seasonal Weather Prediction**

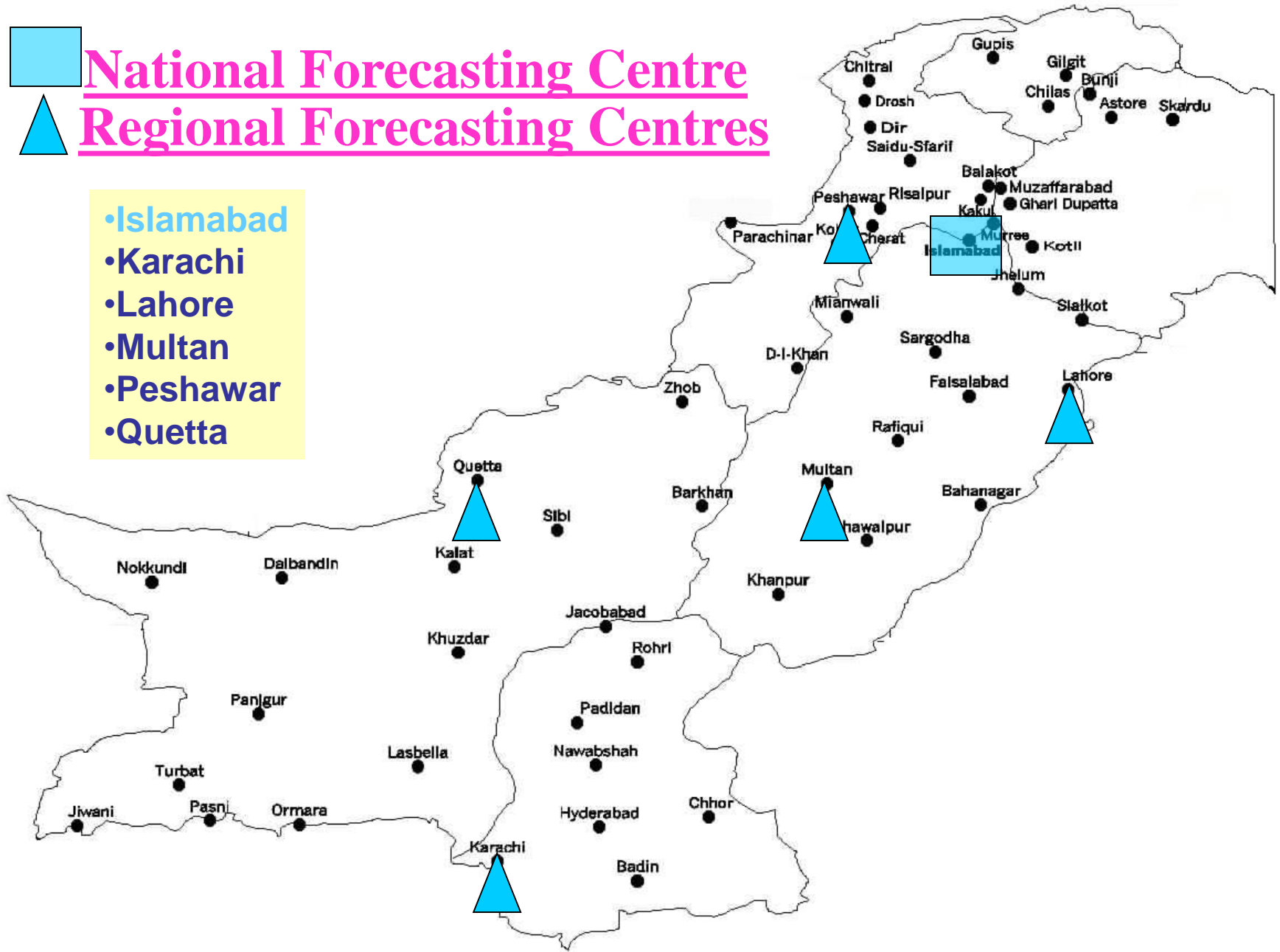


National Forecasting Centre



Regional Forecasting Centres

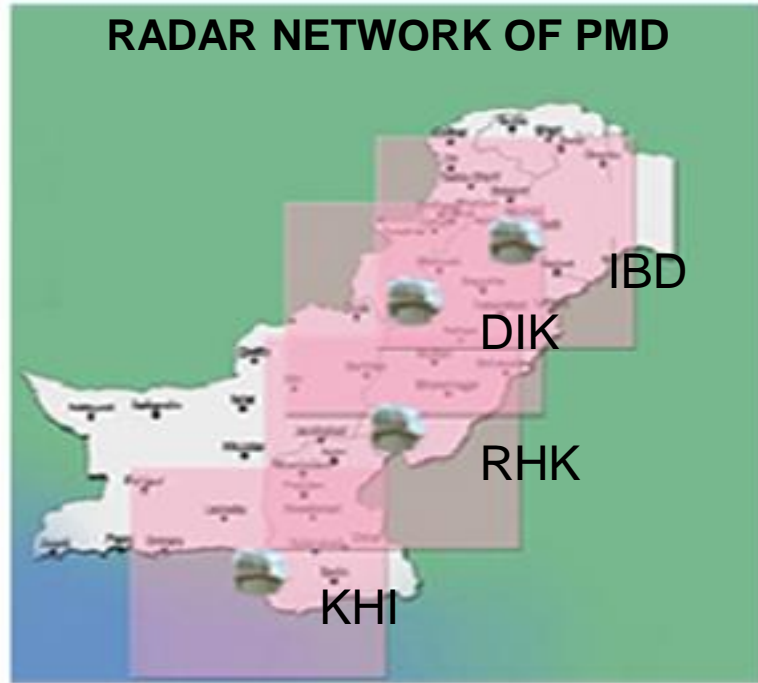
- Islamabad
- Karachi
- Lahore
- Multan
- Peshawar
- Quetta



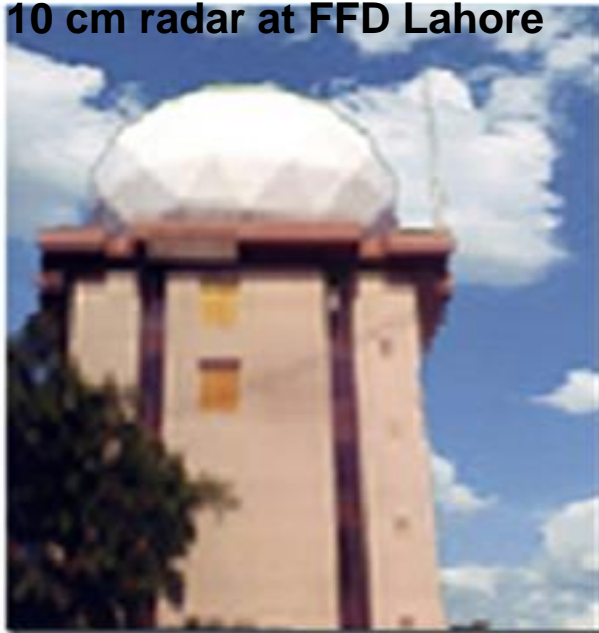
5 cm radar at Islamabad



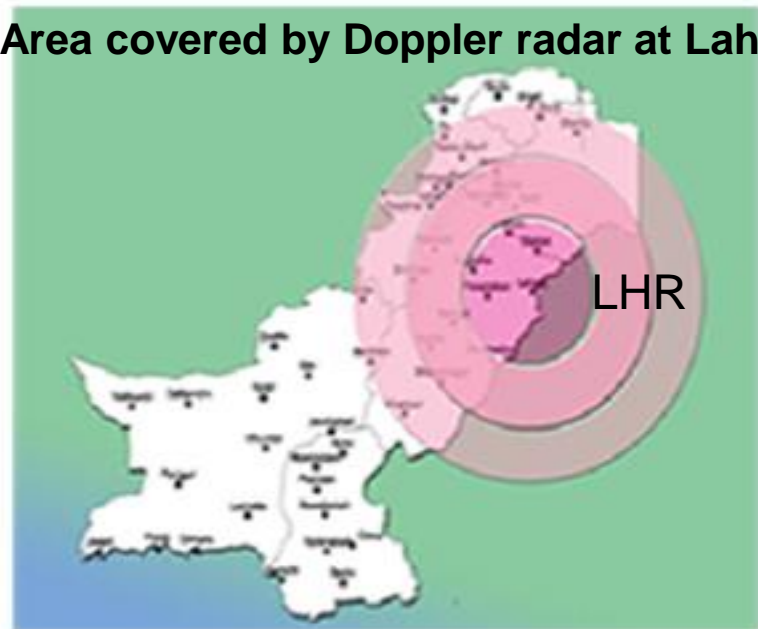
RADAR NETWORK OF PMD



10 cm radar at FFD Lahore



Area covered by Doppler radar at Lahore



CURRENT DEVELOPMENT PROJECTS

- 1. Wind Power Potential Survey in Northern Areas of the Country.**
- 2. Drought/Environment monitoring and early warning system in Pakistan**
- 3. Flood Forecasting & Warning System on Lai Nullah Basin in Islamabad-Rawalpindi**
- 4. Up-gradation & Modernization of Seismic Network of Pakistan**
- 5. Installation of Doppler Radar at Mangla**
- 6. Additional Met. Observatories to cater national needs.**
- 7. Upgradation of Weather Surveillance Radar at Sialkot**
- 8. Upgradation of Doppler Radar at Lahore**

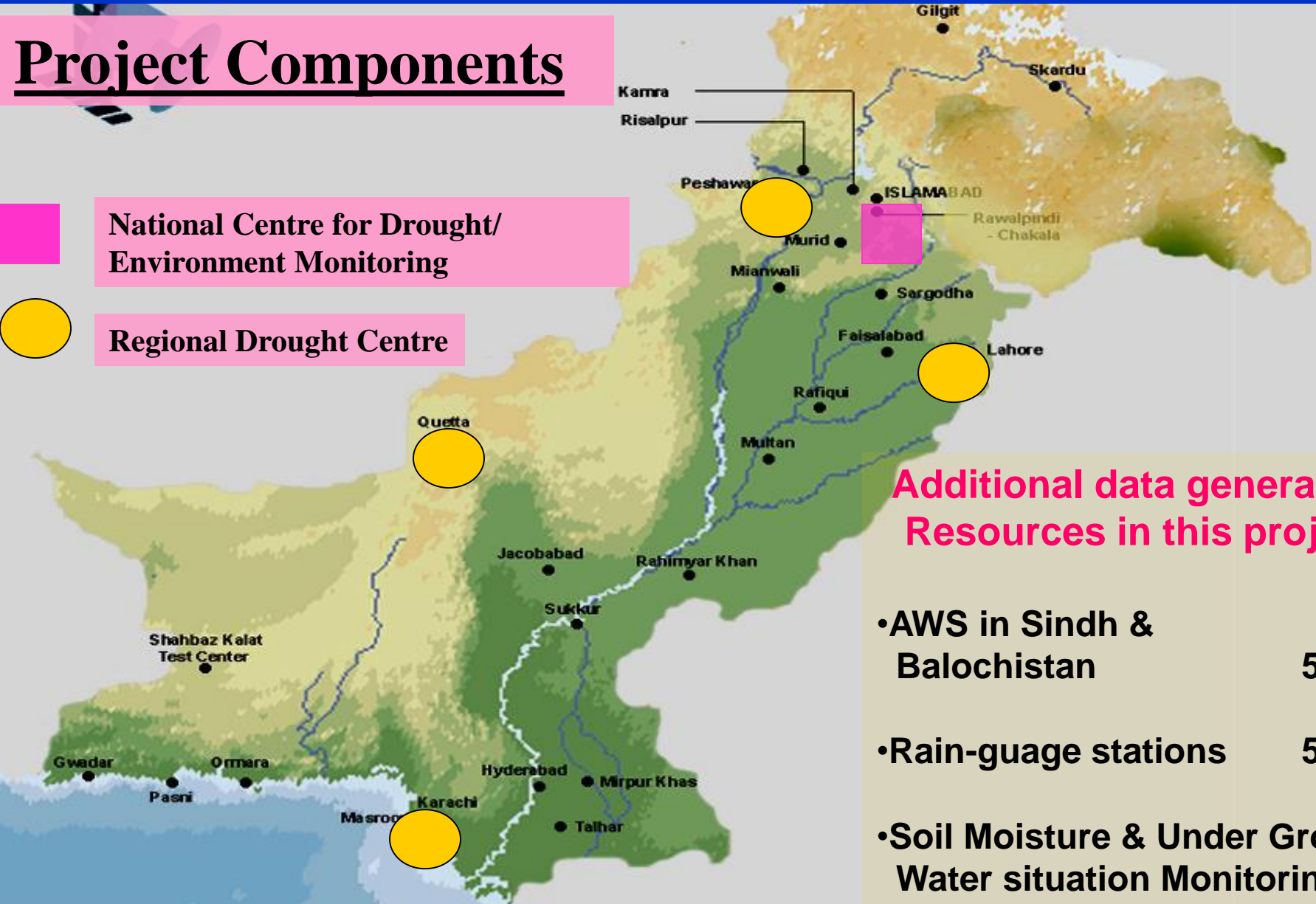
A large green circle is centered on a light blue background. Inside the circle, the text "Drought/Environment monitoring and early warning system in Pakistan" is written in a pink, sans-serif font, arranged in five lines.

Drought/Environment
monitoring and early
warning system
in Pakistan

Drought/Environment Monitoring & Early Warning Centre

Project Components

-  National Centre for Drought/Environment Monitoring
-  Regional Drought Centre



Additional data generation Resources in this project

- AWS in Sindh & Balochistan 50
- Rain-guage stations 500
- Soil Moisture & Under Ground Water situation Monitoring

OBJECTIVES OF THE PROJECT

- 1. Serve as a hub for the collection, consolidation and analysis of drought related data from all possible sources in the country**
- 2. Prepare and issue weekly drought monitors & moisture stresses in different regions of country based on various indices.**
- 3. Advising government agencies on drought related matters including drought declaration.**
- 4. Conduct research in drought related issues and develop statistical models for improved drought prediction.**

**Flood Forecasting
&
Warning System
on Lai Nullah Basin
in Islamabad-Rawalpindi
(With the financial assistance of JICA)**

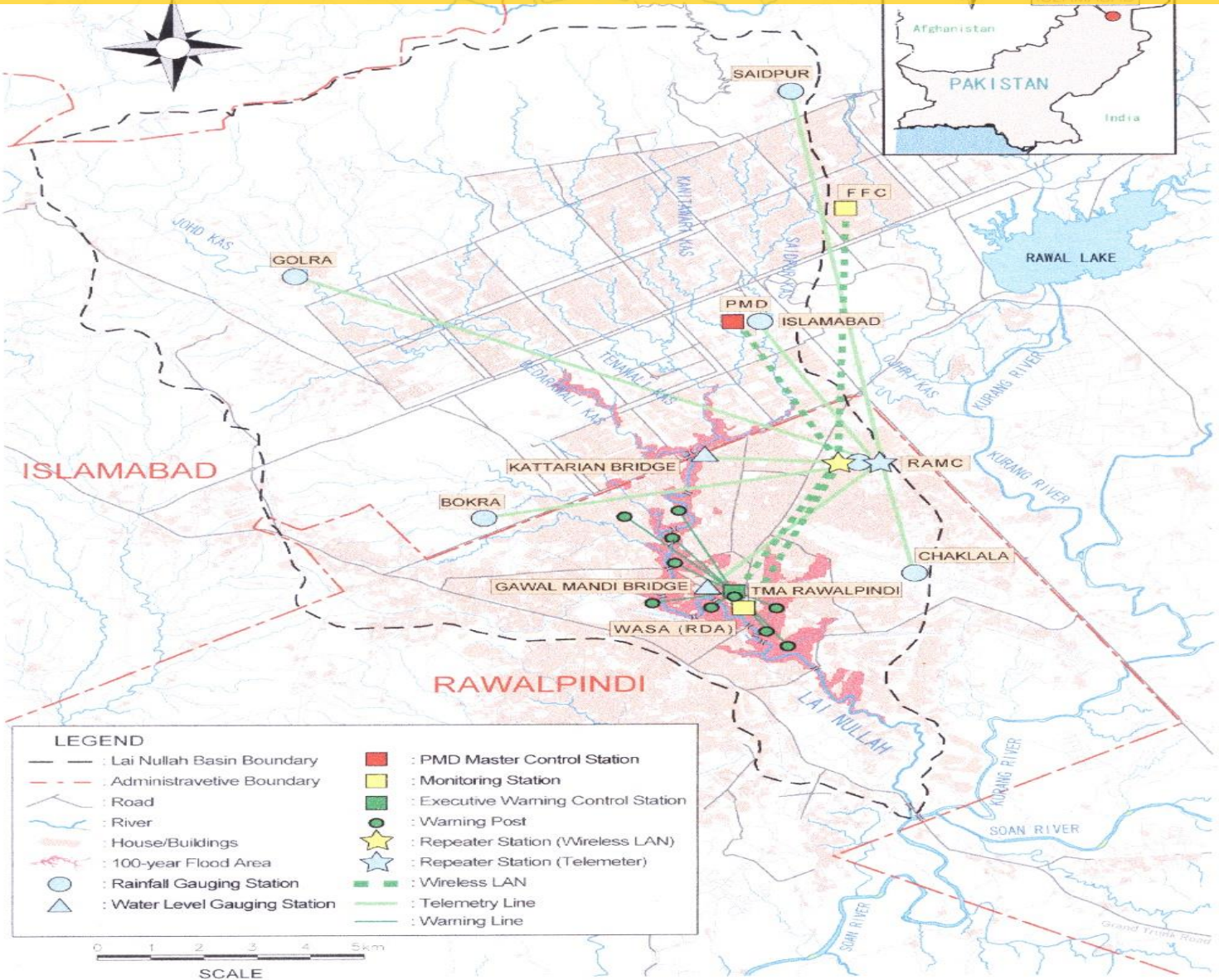
OBJECTIVES OF THE PROJECT

The project aims;

- ▶ Providing Accurate Forecasting & Early Warning with Flood Forecast lead time of one to two hours.
- ▶ Public Warning System for the twin cities

On completion, it would contribute to the reduction of flood damages; specially prevention of loss of human lives in Islamabad-Rawalpindi.

LAI NULLAH PROJECT PLAN



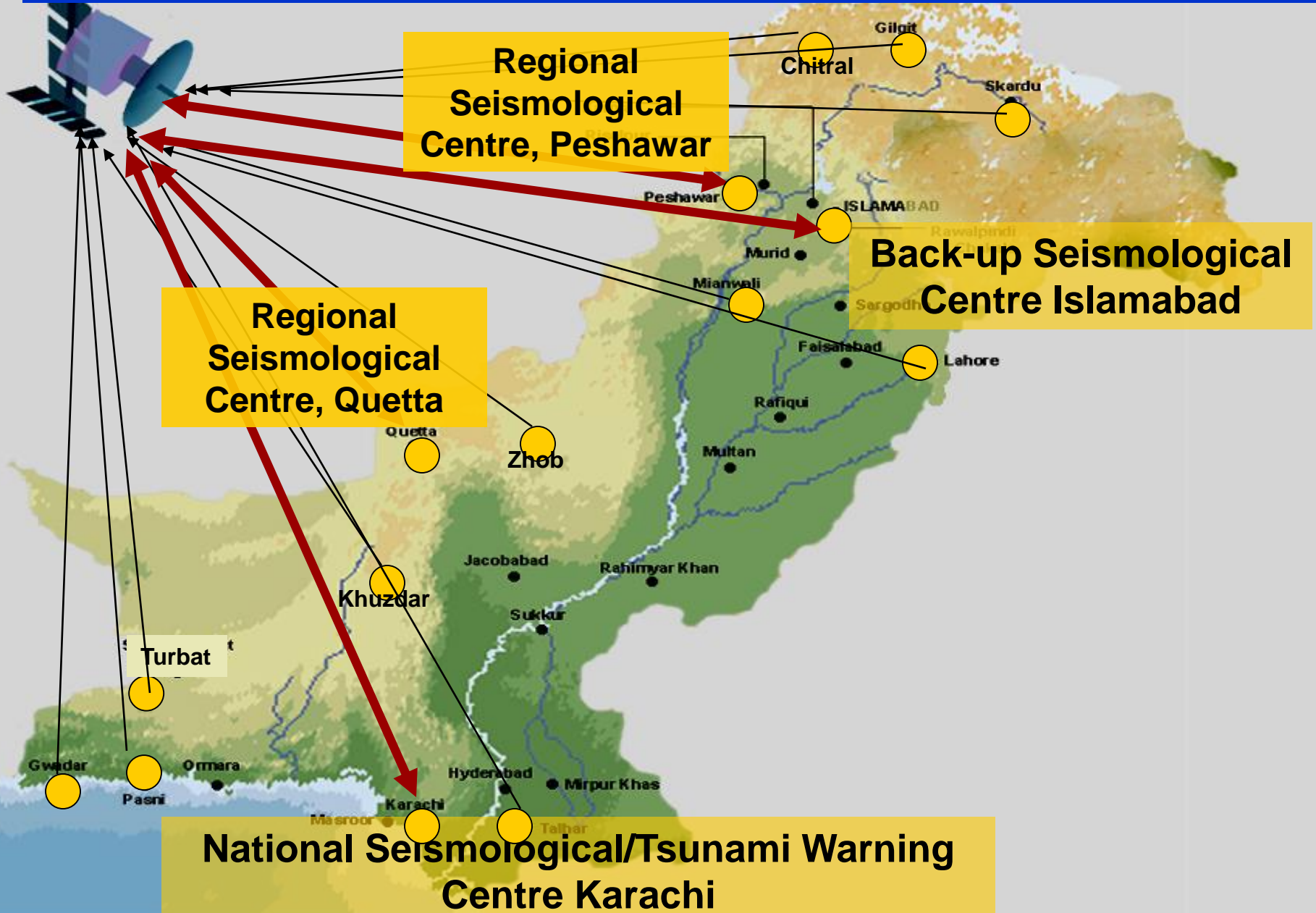
Project Site

**Up-gradation
&
Modernization
of Seismic Network
of Pakistan**

OBJECTIVES OF THE PROJECT

1. **Improved Seismological Services to enhance our capacity in fulfilling our national/ international commitments & obligations.**
2. **Generate seismological and strong motion data (ground surface acceleration) to facilitate in devising building code for the country on micro-scale.**
3. **Existing and future seismic data so generated to serve as data-bank for the promotion & safety of our socio-economic activities especially the housing and Insurance industries.**
4. **Above all, it will provide sufficient lead time in issuing necessary alerts / warnings against possible impending Tsunami disasters facilitating concerned govt. functionaries to undertake coordinated disaster preparedness and mitigation activities.**

Up-gradation & Strengthening of National Seismological Network for Pakistan



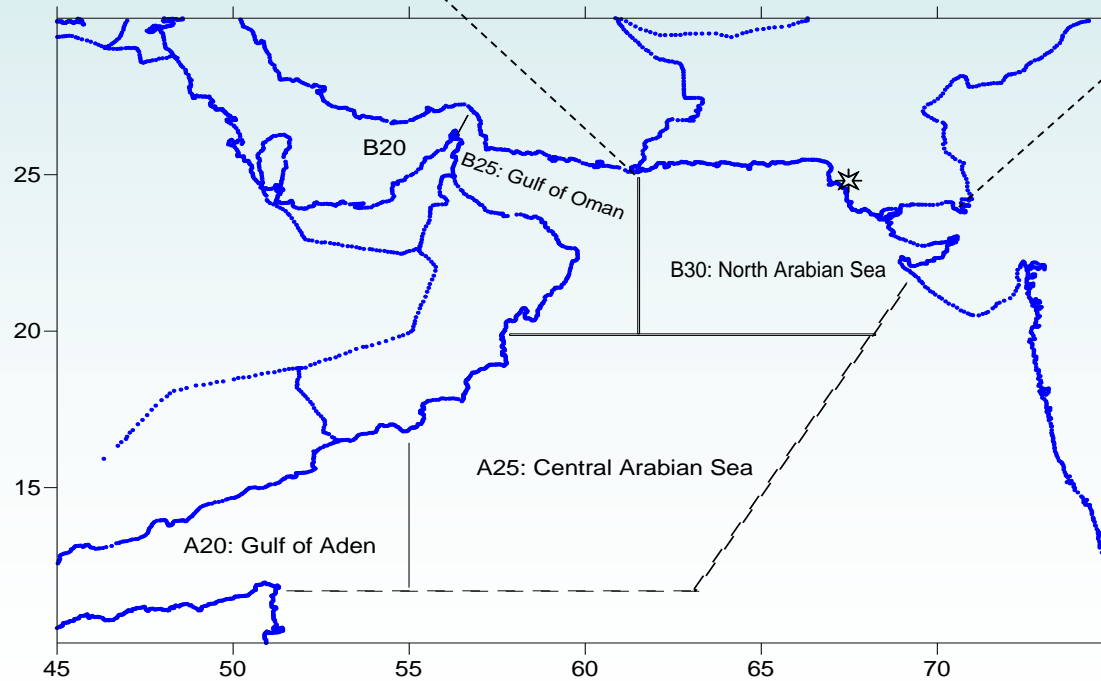
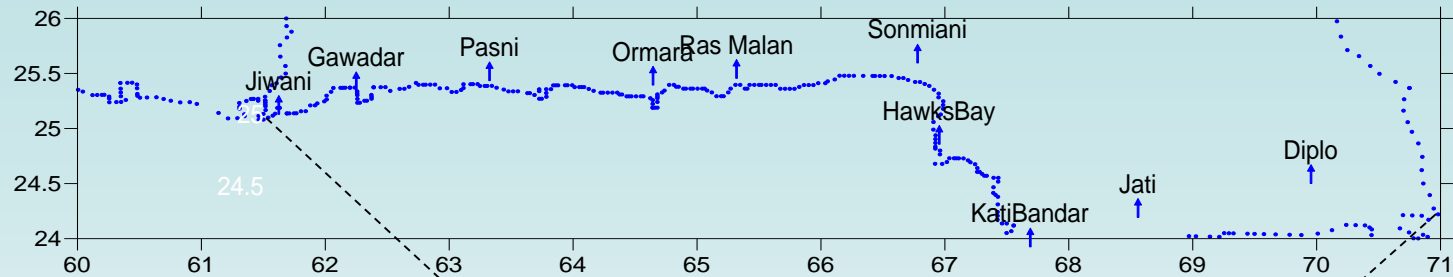
PMD Efforts to equip with latest Technology

- **Doppler Radar at Lahore for Flood Forecasting**
- **Establishment of Country-Wide V-Sat Network for speedy data communication.**
- **Tethresonde Equipment for upper air data**
- **High Resolution Satellite receiving Station for Snow/Vegetation Index**
- **High Speed Servers for Climate Research activities**

UNITS FOR WARNING SYSTEM

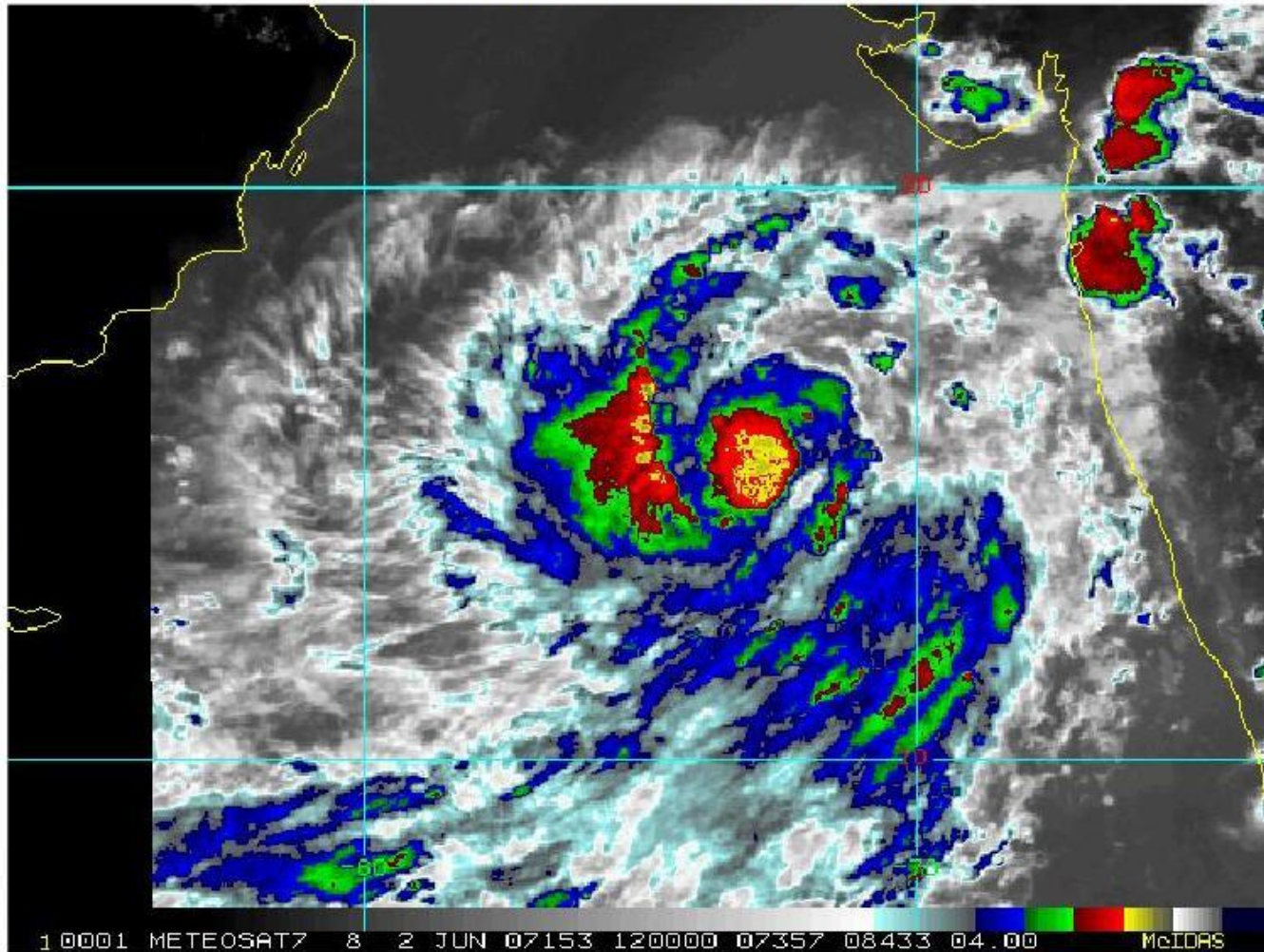
- **Severe Weather Warning Centre**
- **Marine Weather Forecasting Center**
- **Tropical Cyclone Warning Centre**
- **Numerical Weather Prediction Centre**
- **Modernization of Met. Data Communication Network**
- **Flood Forecasting Center**

Location of Automatic Weather Observing Stations



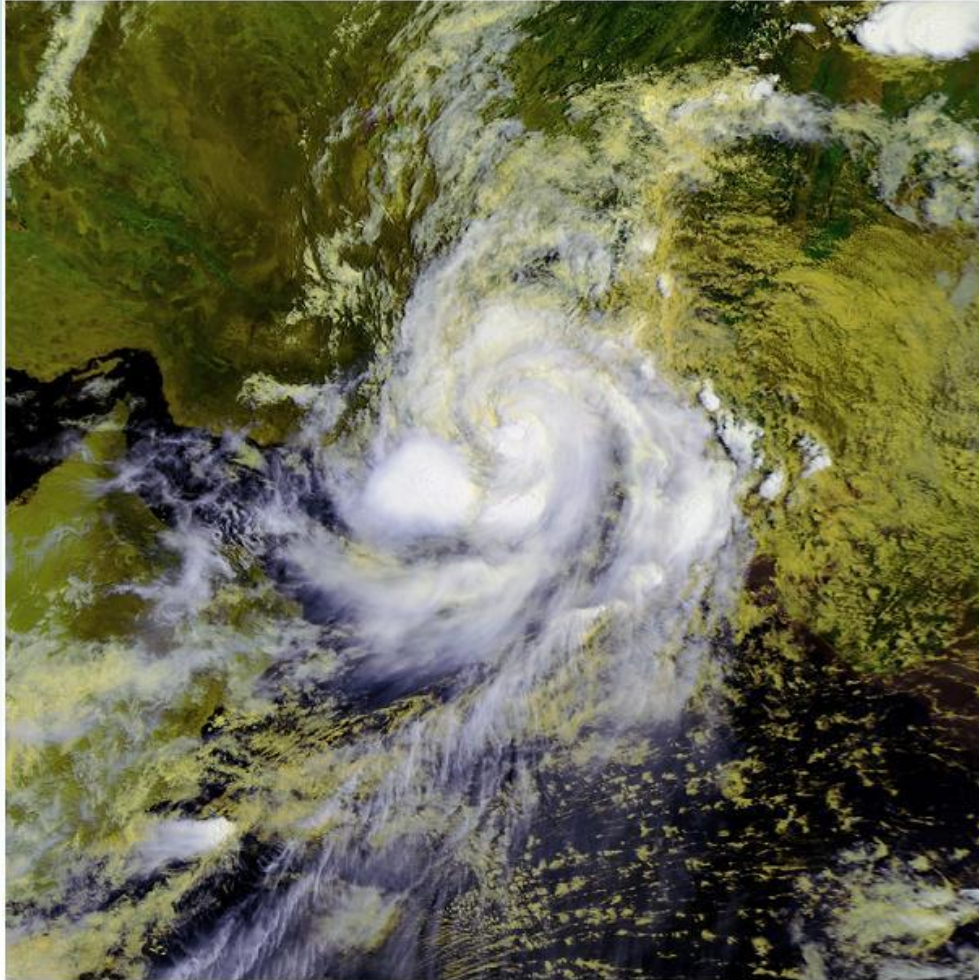
- ↑ Automatic Weather Stations
- ★ Data Reception Center, TCWC, Karachi

Pak Met Deptt - Tropical Cyclone Warning Centre, Karachi



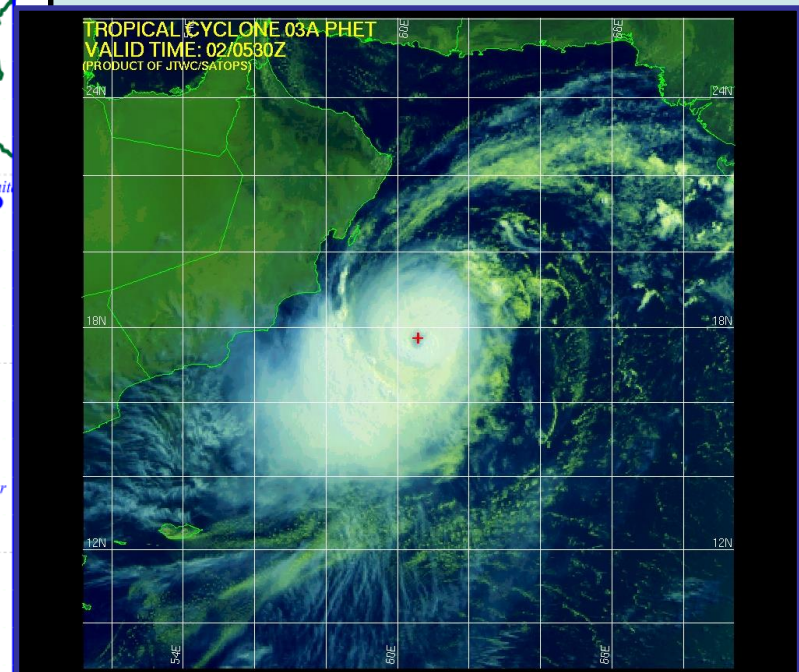
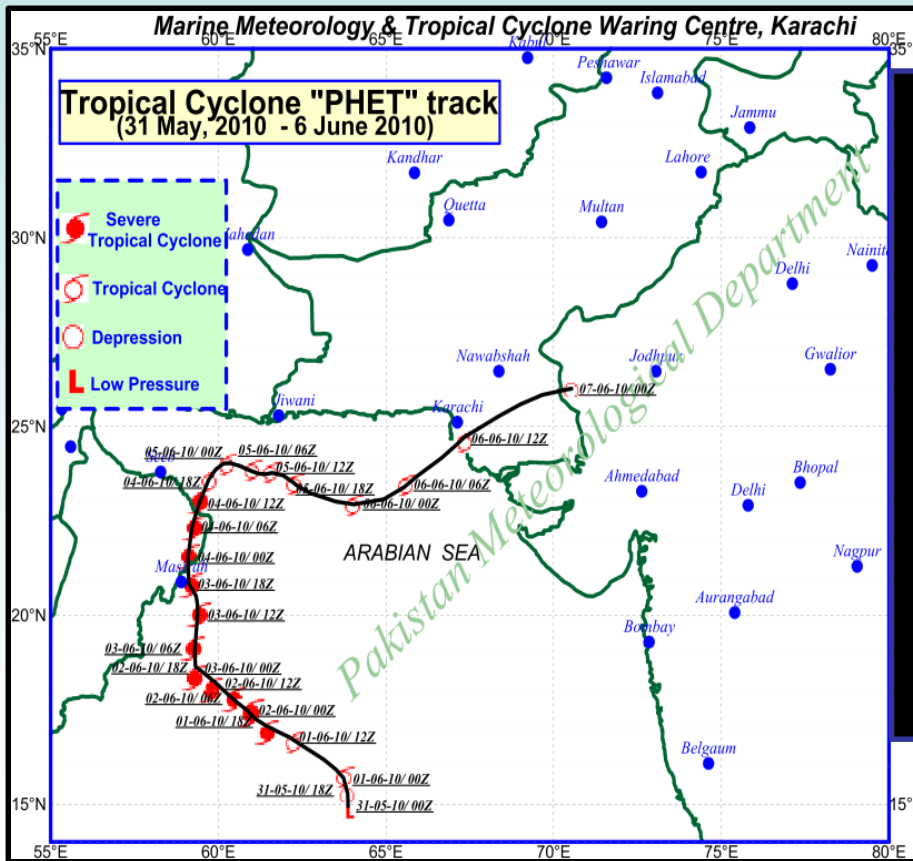
2 June/1200 UTC: IR-Satellite Imagery depicting the clouds organization for potential Cyclone development which later proved to be. The green and red colours showing very cold cloud tops, indicative of very severe thunderstorm activity around LLCC.

Pak Met Deptt - Tropical Cyclone Warning Centre, Karachi



TC Yemyin, near its landfall, as predicted by PMD, over Balochistan coast.

TC-PHET (June 2010)



Satellite imagery of TC Phet, June 2/0530Z

WMO lauds PMD services for Phet early warning

Our economic correspondent

ISLAMABAD: World Metrological Organization (WMO) acknowledged the performance of Pakistan Meteorological Department regarding the tropical cyclone 'Phet' saying its timeliness and accuracy of the early warning had contributed a lot to minimizing the adverse impact on human lives and property in Pakistan.

The World Metrological Organization in its letter written on June 8, 2010 appreciated the performance of MET office for its accuracy in early warning and predictions of 'Phet' that struck Oman and later Pakistan coast and the early warning of the MET Office actually played pivotal role in reducing the adverse impact of the storm on human lives and property damages.

The letter written by Jaser Rabadi, PhD WMO Representative for West Asia to Dr Qamar-uz-Zaman Chaudhry, Director General Pakistan Meteorological Department says that the early prediction of re-curling towards Pakistan of Phet was also noteworthy.

Jaser Rabadi also reveals that WMO Office for West Asia kept a close watch on the early warning and predictions issued by the Pakistan Meteorological Department (PMD) regarding tropical cyclone "Phet" and found that the timeliness and accuracy of the early warning of this storm issued by PMD, in addition to the proper delivery of these warnings to the appropriate authorities, had greatly contributed to minimizing its adverse impact on human lives and property in the country.

However, Arshad H Abbasi, an expert on water issue when contacted for comments said during last decade Pakistan Meteorological Department (MET) had transformed into an organization that established a sense of delivery, which the nation needed.

"Pakistan MET Department has created a vision to help direct the change effort and develop strategies for achieving for vision. Above all MET department has earned achievements despite minimum financial resources," he said.

"Credit goes to Dr Qamar-uz-Zaman Chaudhry, Director General PMD and his brigade which is providing excellent meteorological expertise and professional services in support of national economic development and for the safety and benefit of the community," he maintained.



PMD
Pakistan Meteorological Department



Redistribution of Precipitation (Seasonal Shift) in Pakistan

&

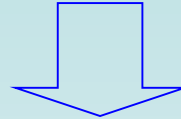
Super Flood in Pakistan-2010



PMD

Pakistan Meteorological Department

SERVICES



Meteorology

Hydrology

Agro-meteorology/Drought

Seismology



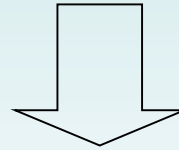
Weather Forecasting System of PMD



Data

Technique

Skill



Short Range Weather Forecasts
(24 – 48 Hrs): accuracy 90%

Medium Range Weather Forecasts
(1 – 2 weeks): accuracy 70-80%

Long Range/Seasonal Weather Forecasts
(1 – 6 Months): Poor

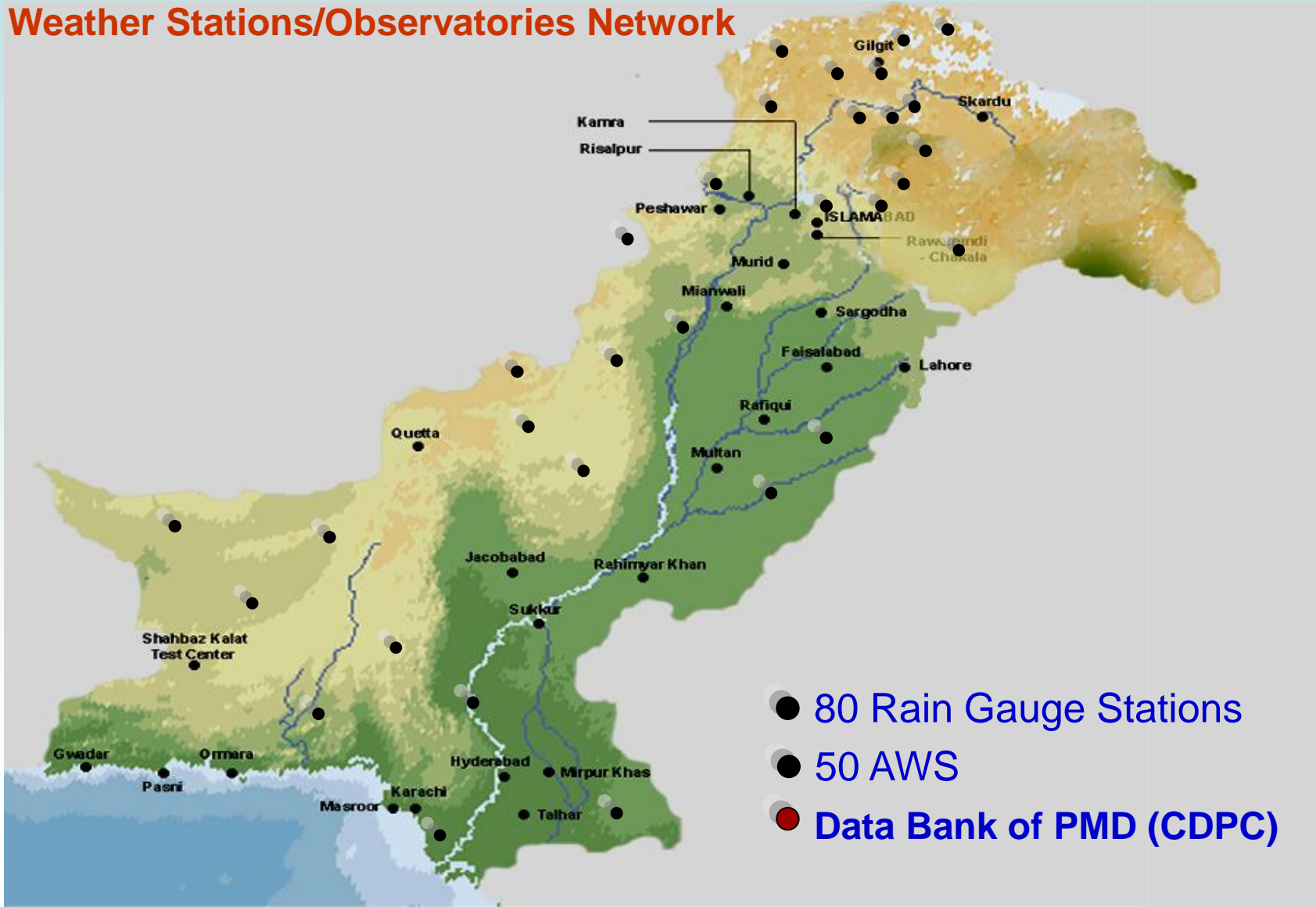


Weather Forecasting System of PMD



DATA

Weather Stations/Observatories Network





Weather Forecasting System of PMD



DATA

Radar Network of PMD



Doppler Radars

1- Lahore

2- Mangla



QPM Radar

1- Sialkot



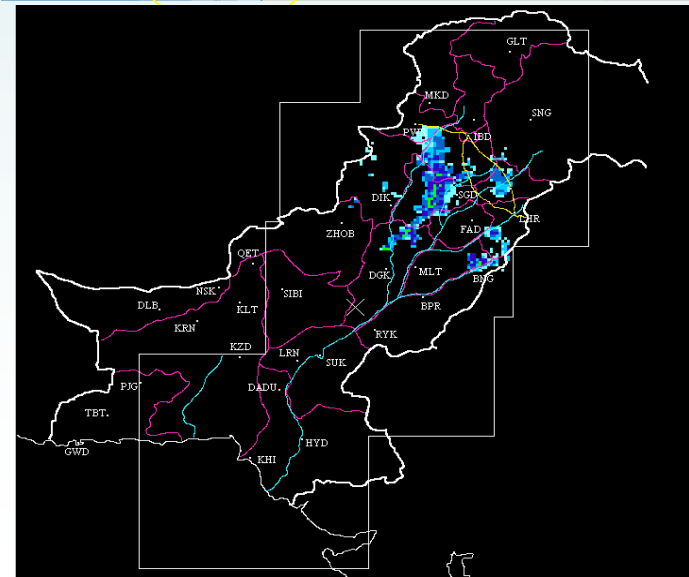
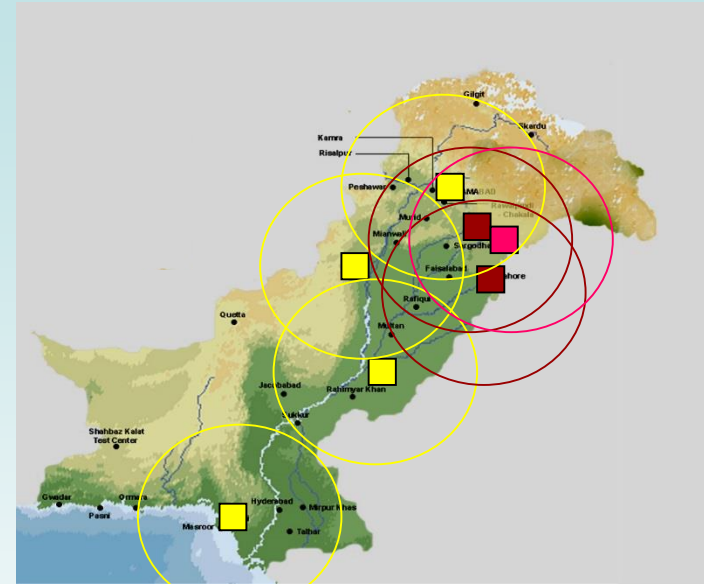
Wx. Surveillance Radars

1- Islamabad

3- D.I.Khan

4- Rahim Yar Khan

4- Karachi





Weather Forecasting System of PMD



DATA

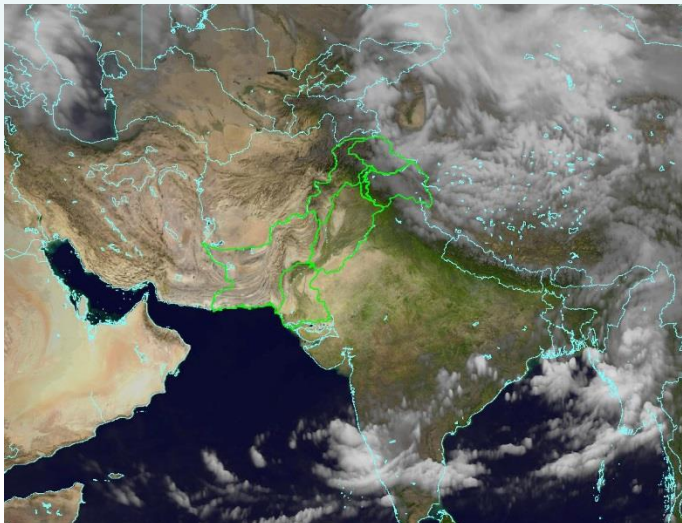
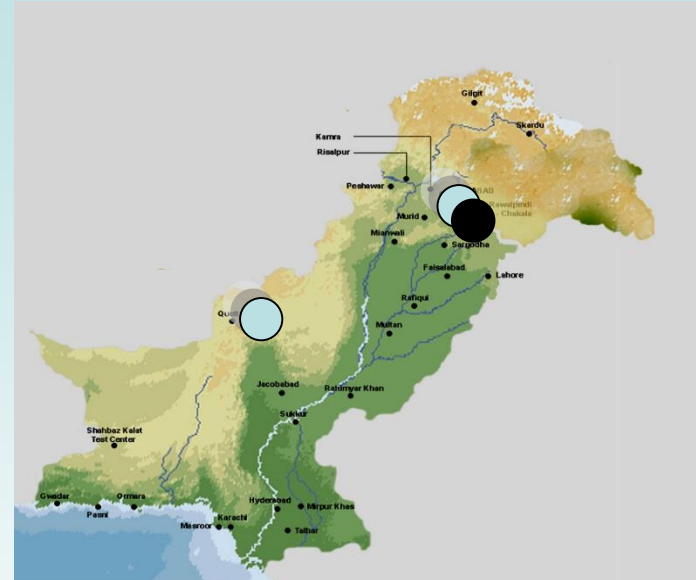
Satellite Ground Stations of PMD

○ HRPT

- 1- Islamabad
- 2- Quetta

● FY-2 E/D

- 1- Islamabad





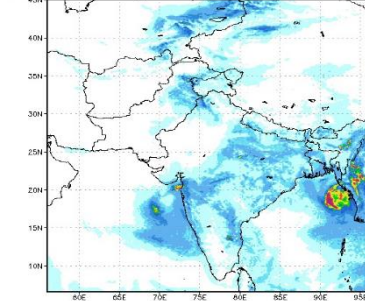
Weather Forecasting System of PMD

Products: Weather Forecasts

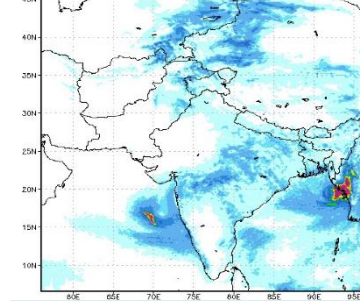


Rain

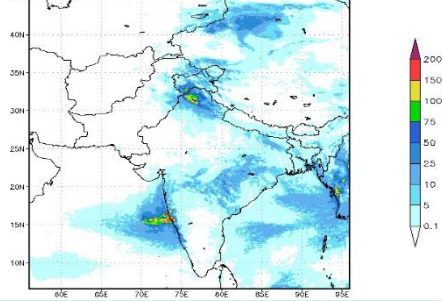
Daily Total Precipitation(mm) 21/OCT/2010 00Z



Daily Total Precipitation(mm) 22/OCT/2010 00Z

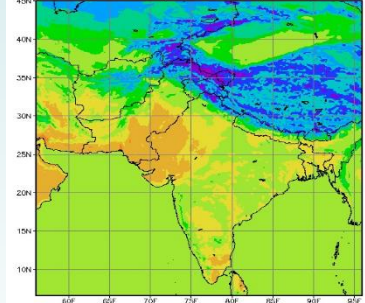


Daily Total Precipitation(mm) 23/OCT/2010 00Z

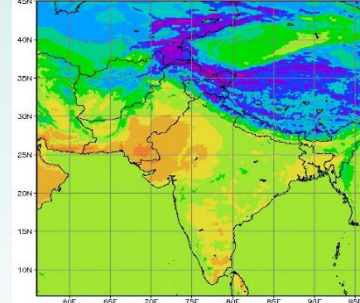


Temps

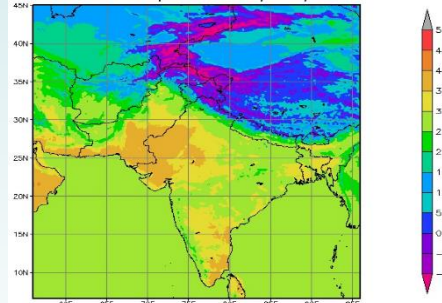
Maximum Temperature 20/OCT/2010



Maximum Temperature 21/OCT/2010

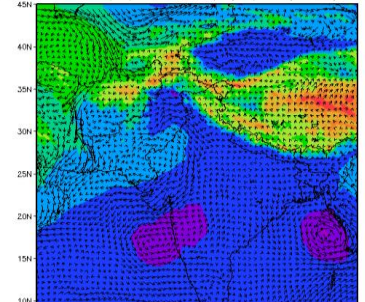


Maximum Temperature 22/OCT/2010

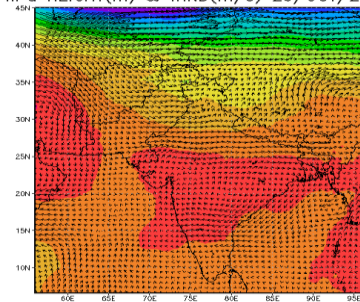


Winds

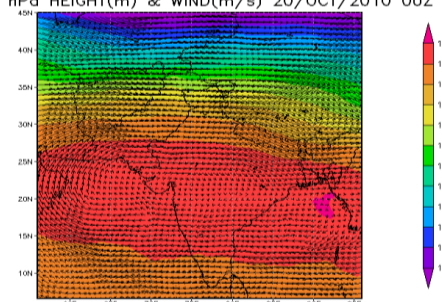
850 hPa HEIGHT(m) & WIND(m/s) 20/OCT/2010 00Z



500 hPa HEIGHT(m) & WIND(m/s) 20/OCT/2010 00Z



200 hPa HEIGHT(m) & WIND(m/s) 20/OCT/2010 00Z



Weather Forecasting System of PMD

Information on Website



Pakistan Meteorological Department
Government of Pakistan



Mainly dry we

About PMD
Mission and Vision
Services
Address Book

Met Observatories
Climate of Pakistan
Climate Data
Astronomical Data
Historical Events

Events in Pictures/Videos

Training and Courses
Youth Corner (MET. Edu.)

PMD Projects

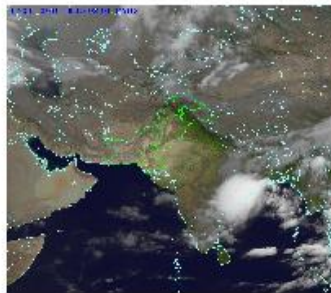
Journal of Meteorology

Jobs

Tender

Contact

webmaster



Pakistan Weather

National Forecast, Cities Forecast
Weekly, Seasonal Outlook

Aviation Products

Aviation Weather Charts, NMCC Charts
Metars, Tafors

Drought Monitoring

Current Drought Situation/Monitoring
Soil Moisture Analysis/Advisory

Marine Weather

Tides, Wave Height, Wind speed
Coastal Areas Forecast, SST

Research Activities

R&D, NWP Products, Publications
Pollen Count, Pak.Jrn.of Meteorology

Satellite/Radar Images

Pakistan, Asia, Global Satellite Images
Radar Network

Flood Update

Flood Forecasts, Dams Flows
GIS Maps, Rainfall/Temperature

Farmer's Weather

Farmers Forecasts, Agromet Bulletins
Crop Vegetation Index, Crops Report

Earthquake Information

Recent Earthquakes, Seismic Reports
Seismic Monitoring Network

Synoptic Data

Daily Synoptic Data Browsing
Surface/Upper Air Met Data

Minimum Te



Daily Weather Report for Electronic & Print Media
Weather Advisory/Press Release

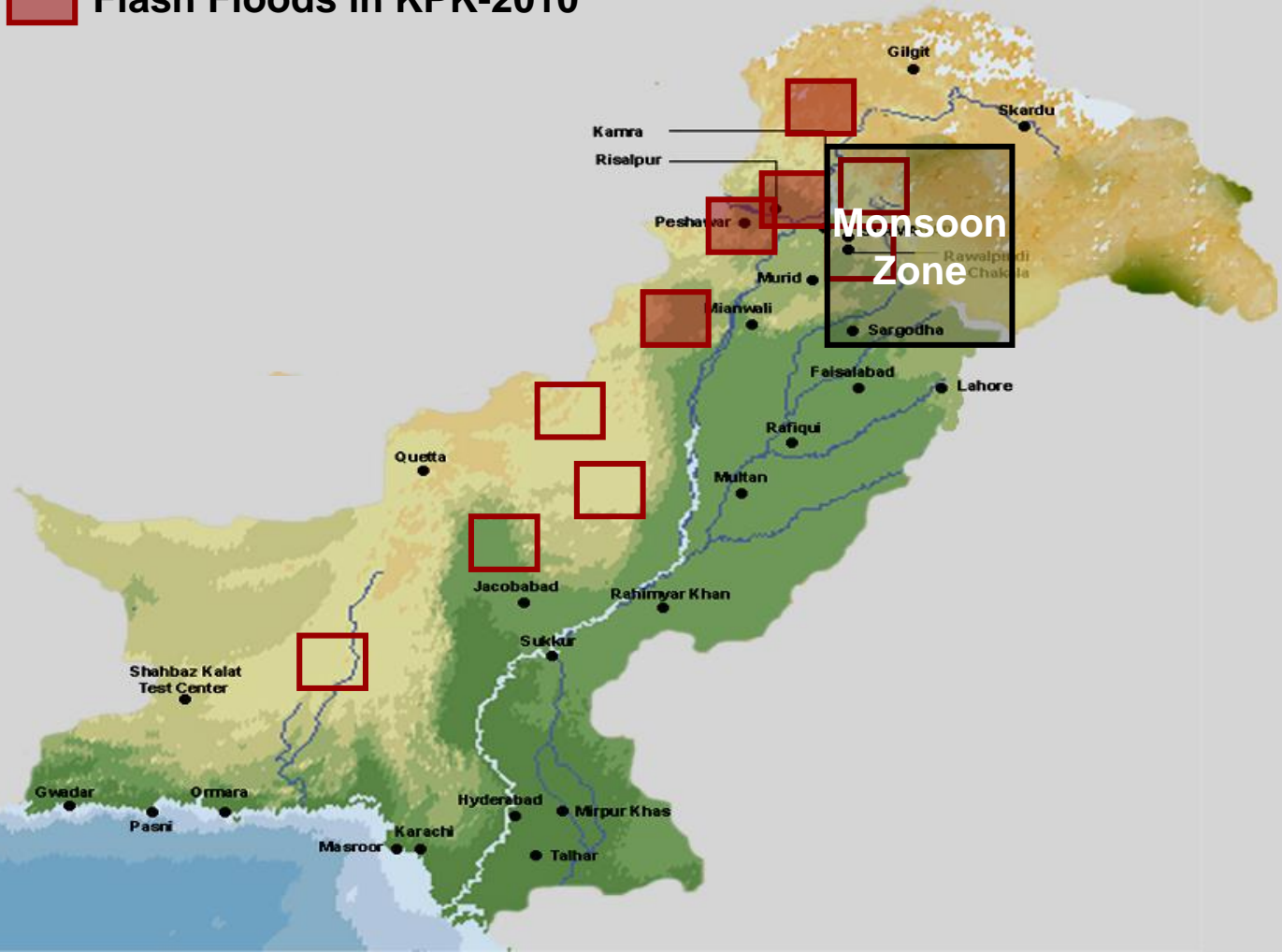
Latest Earthquake
Cyclone Update
Pollen Count
Latest News

Climate: Rainfall Distribution

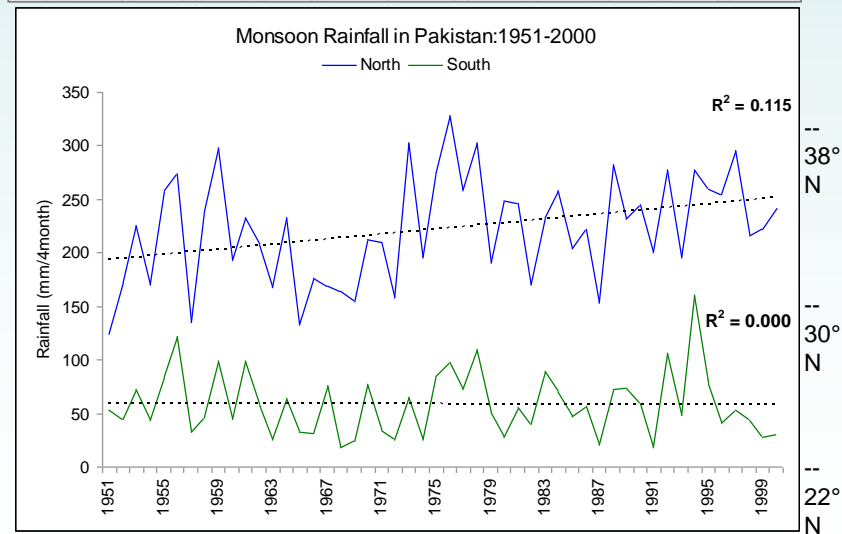
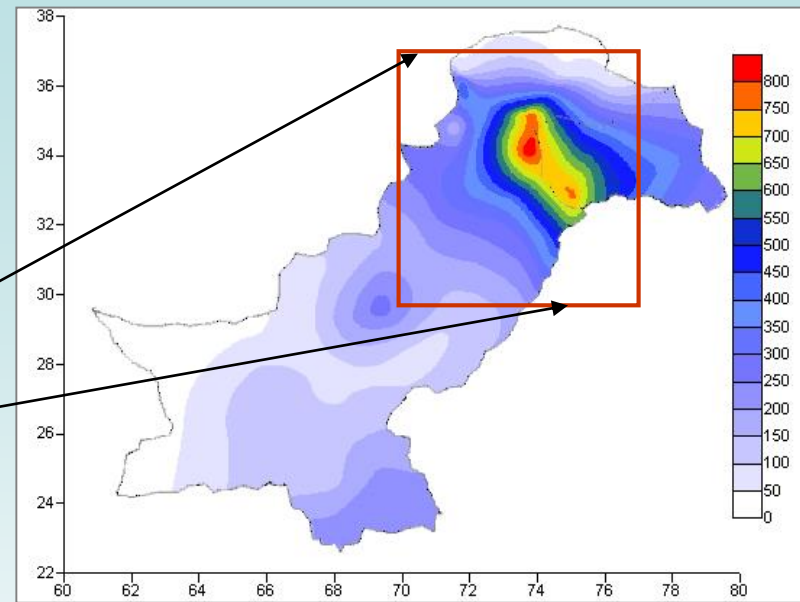
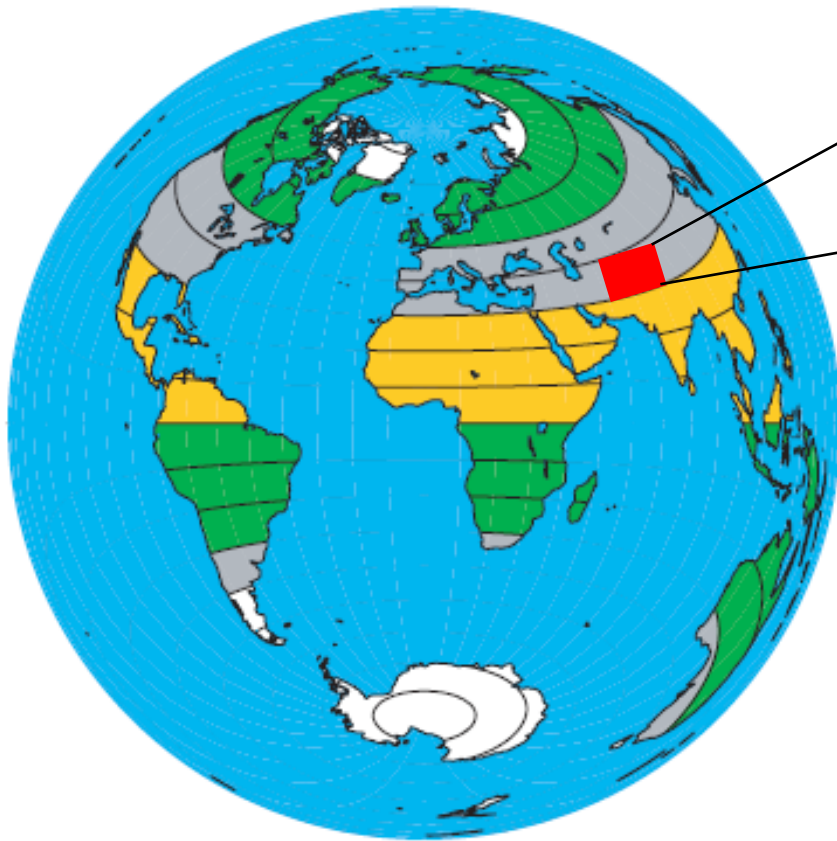
Extreme Rainfall



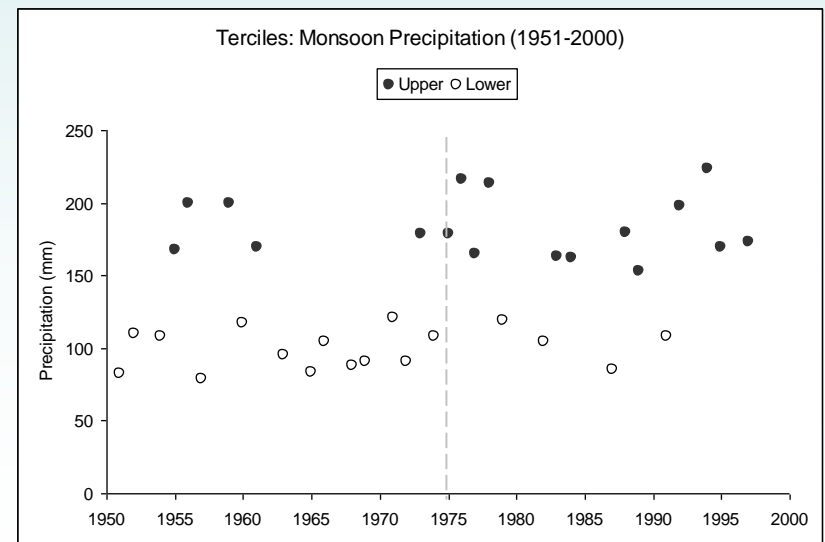
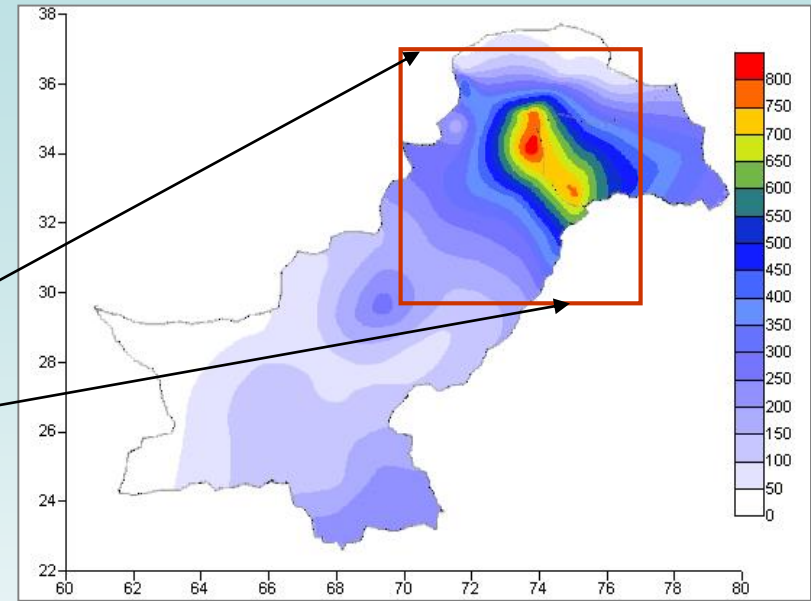
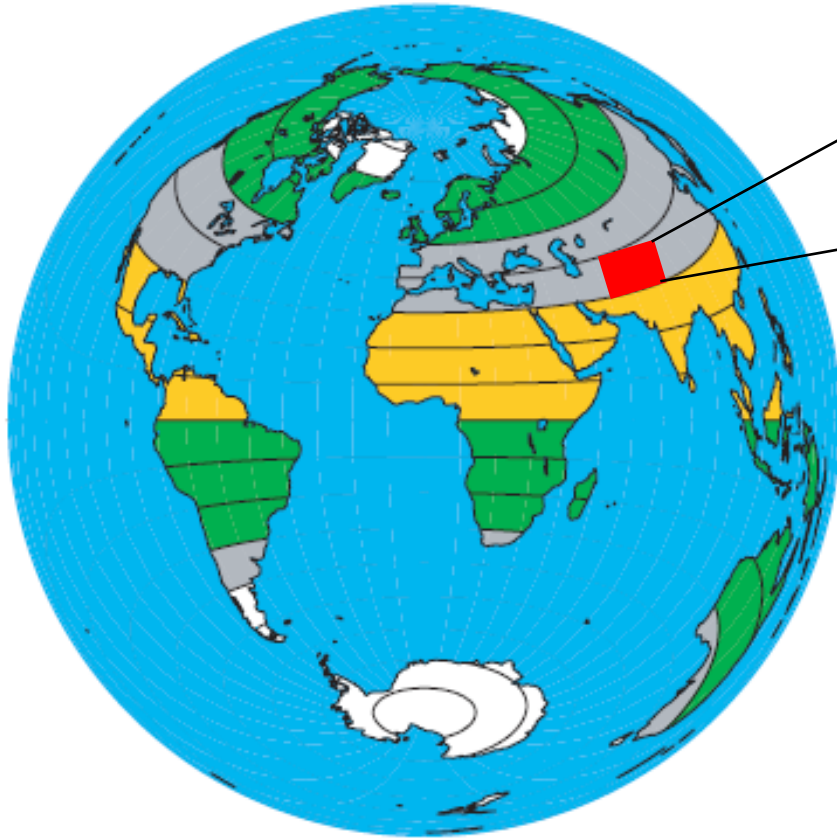
-  Flash Floods
-  Flash Floods in KPK-2010



Latitudinal Redistribution of Precipitation in Pakistan

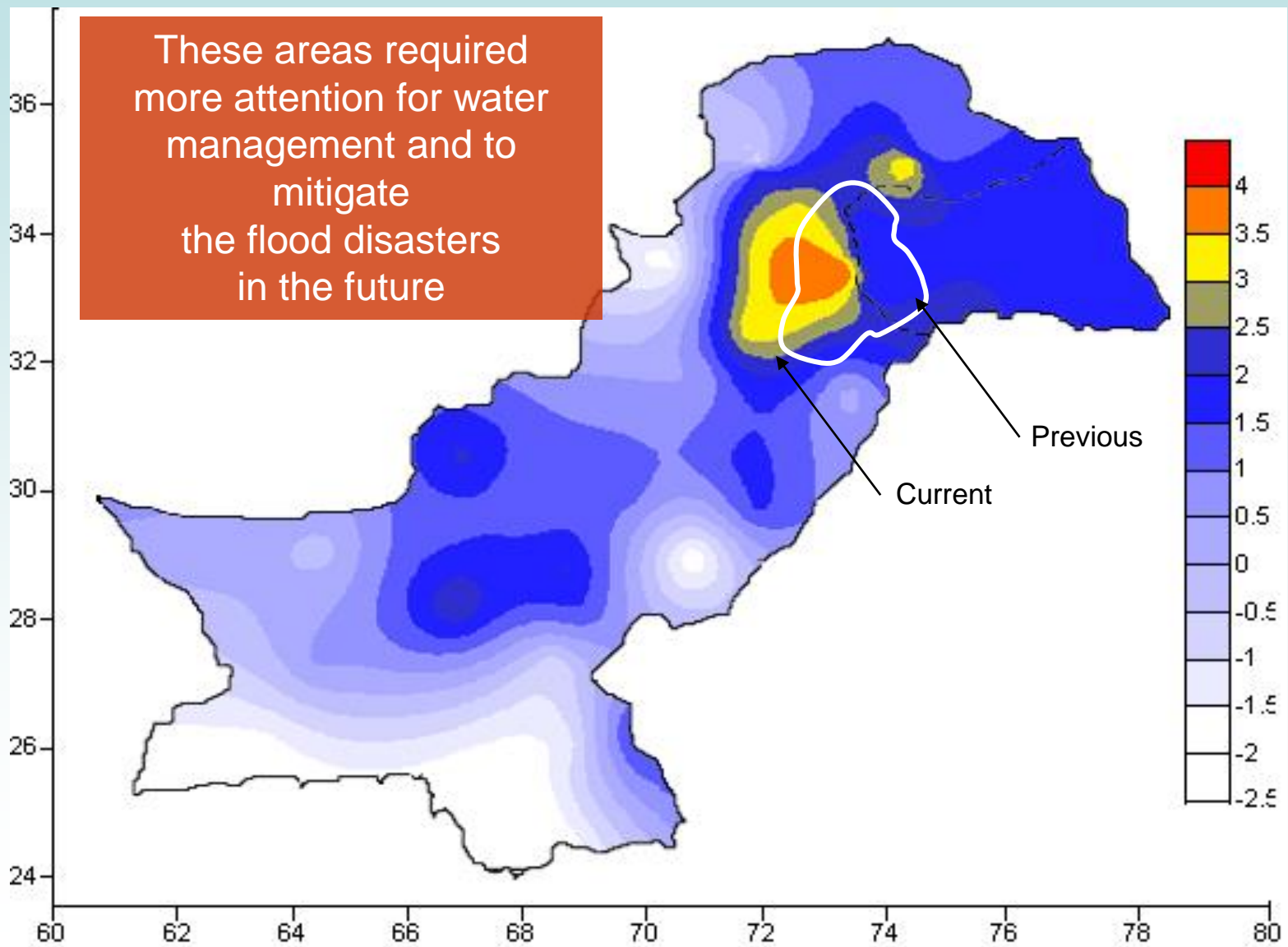


Latitudinal Redistribution of Precipitation in Pakistan



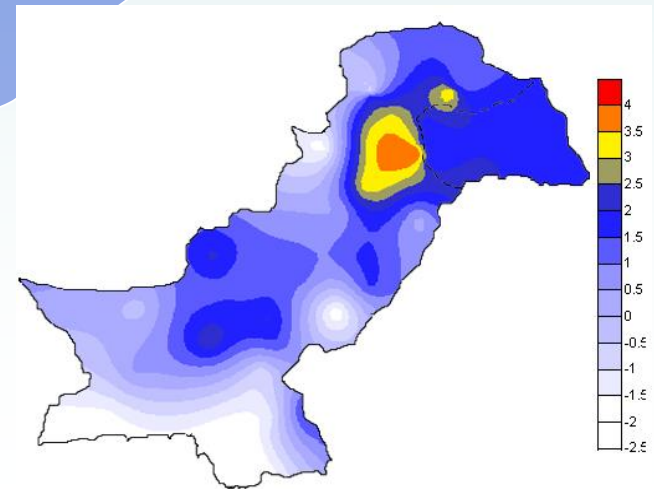
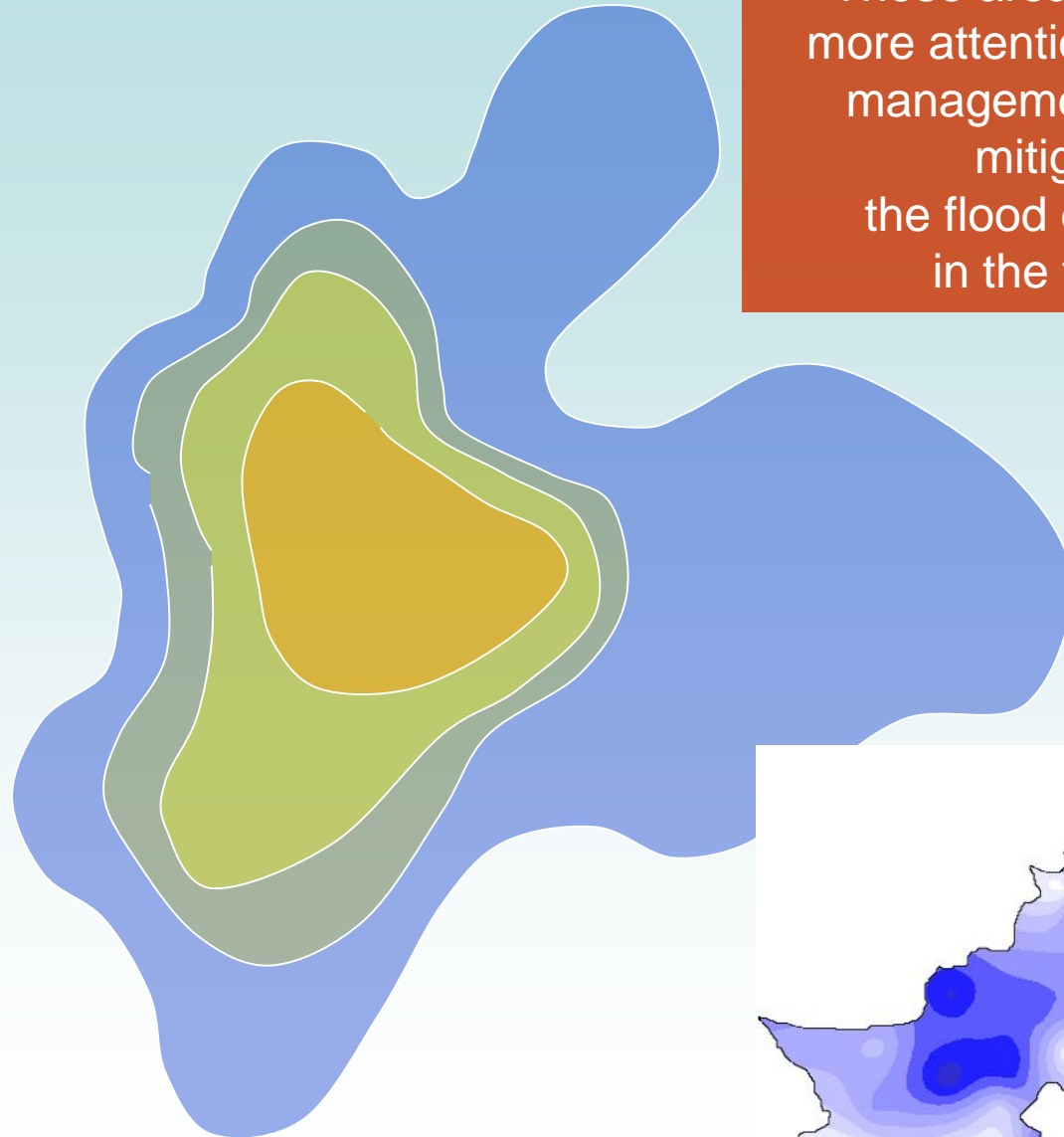
Latitudinal Redistribution of Precipitation in Pakistan

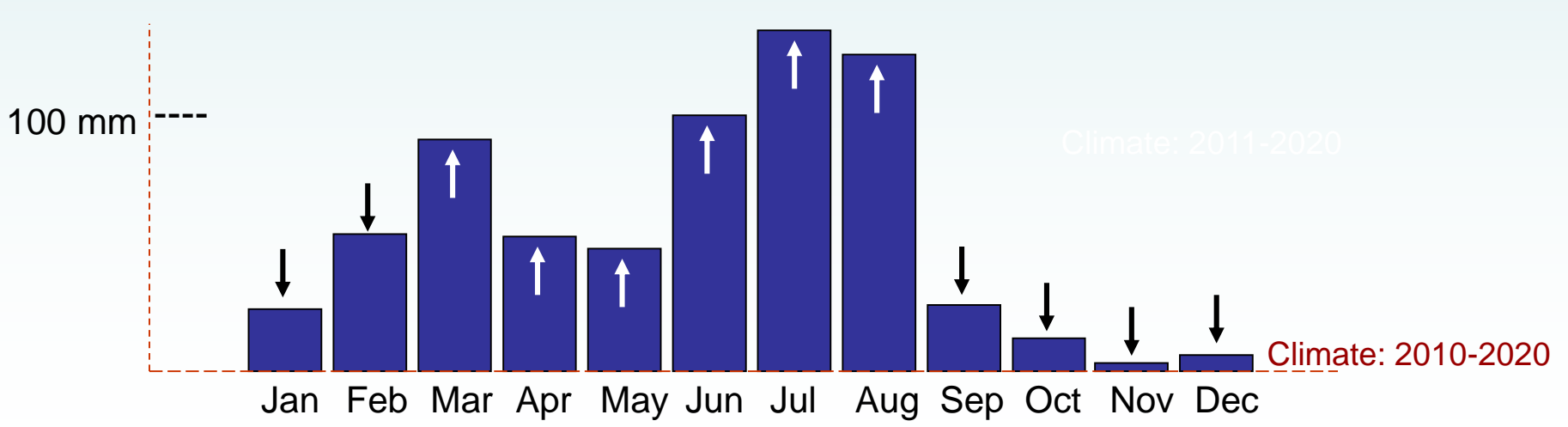
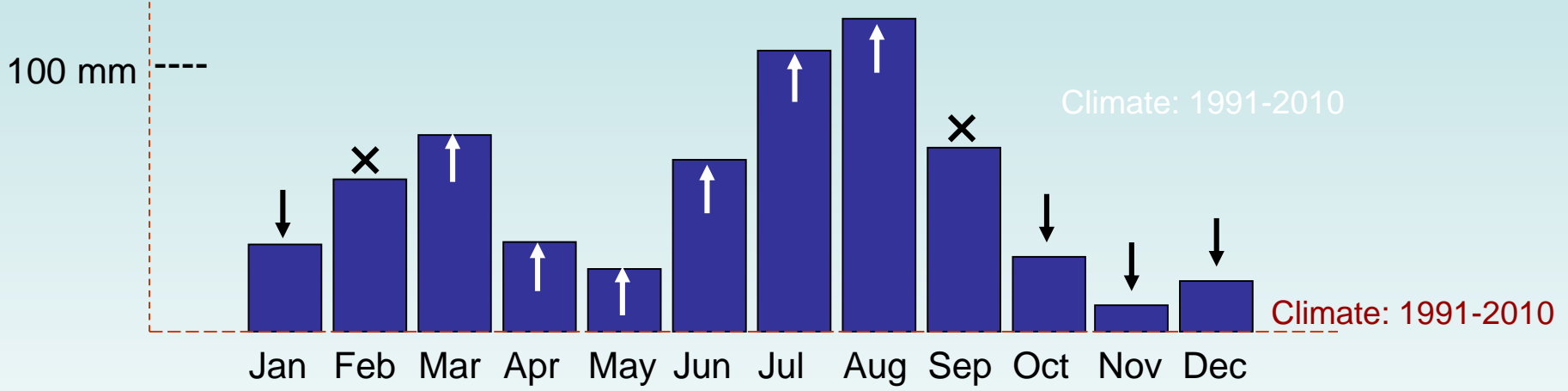
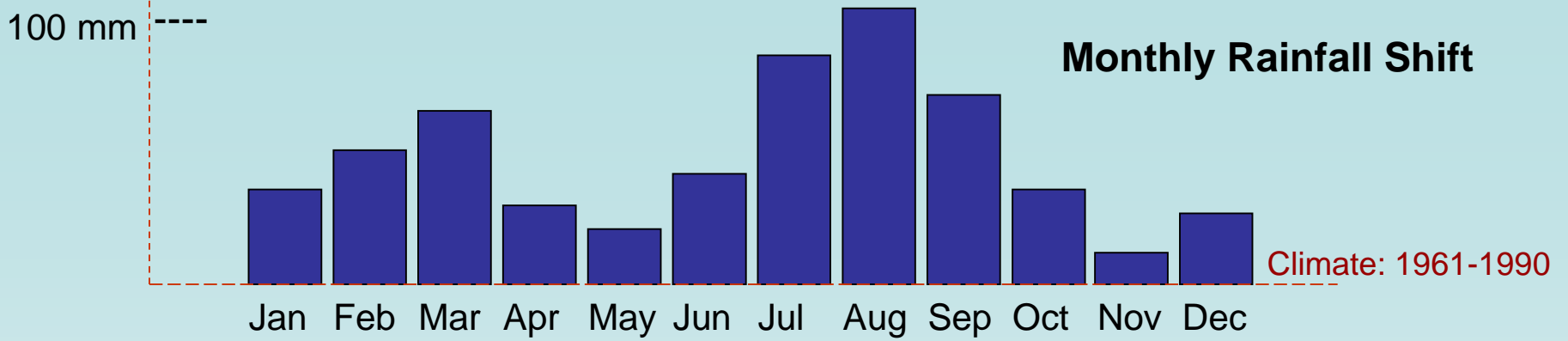
Monsoon Precipitation Shift (80-100 km West)



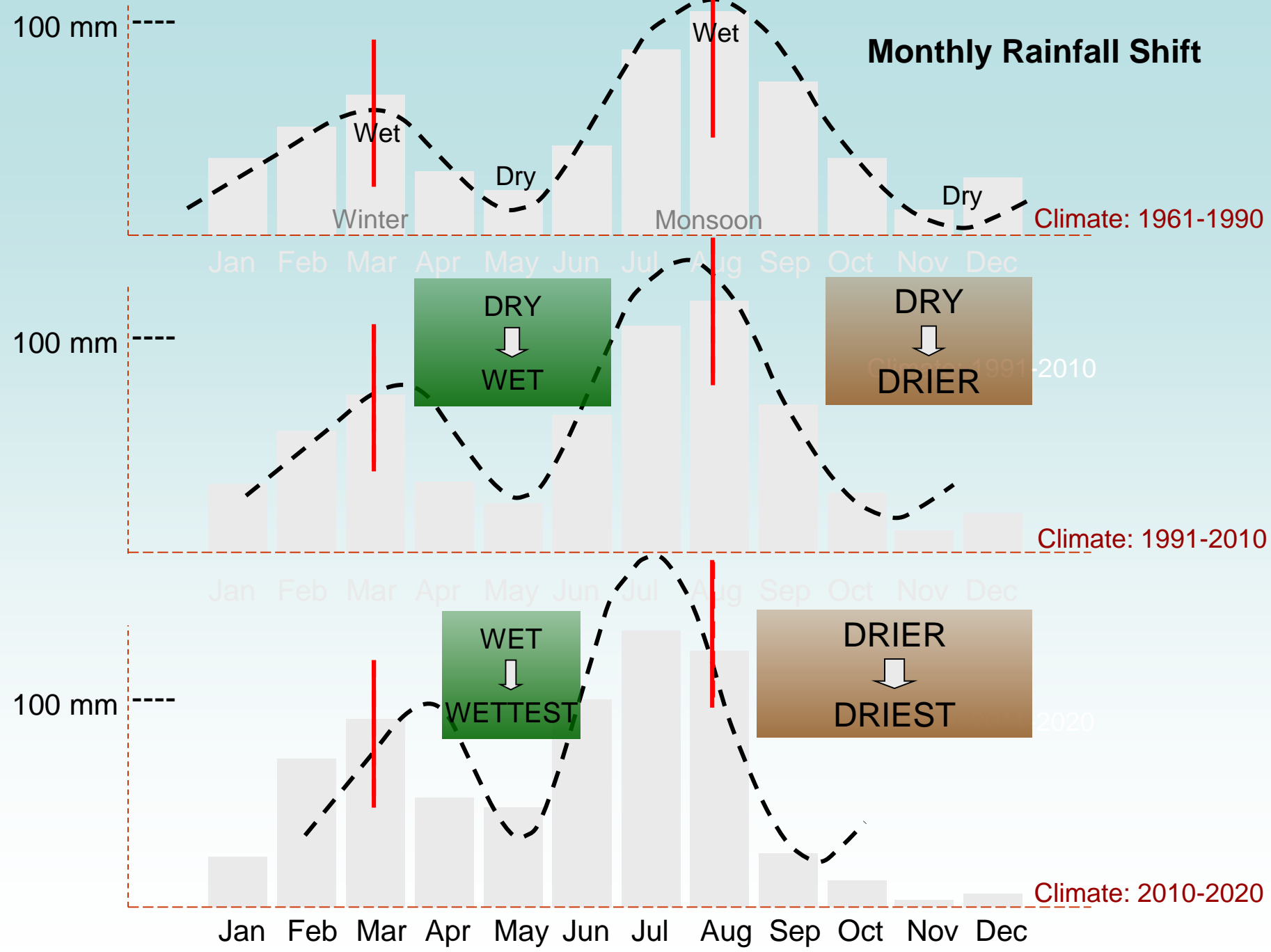
Monsoonal Rain Shift

These areas required more attention for water management and to mitigate the flood disasters in the future

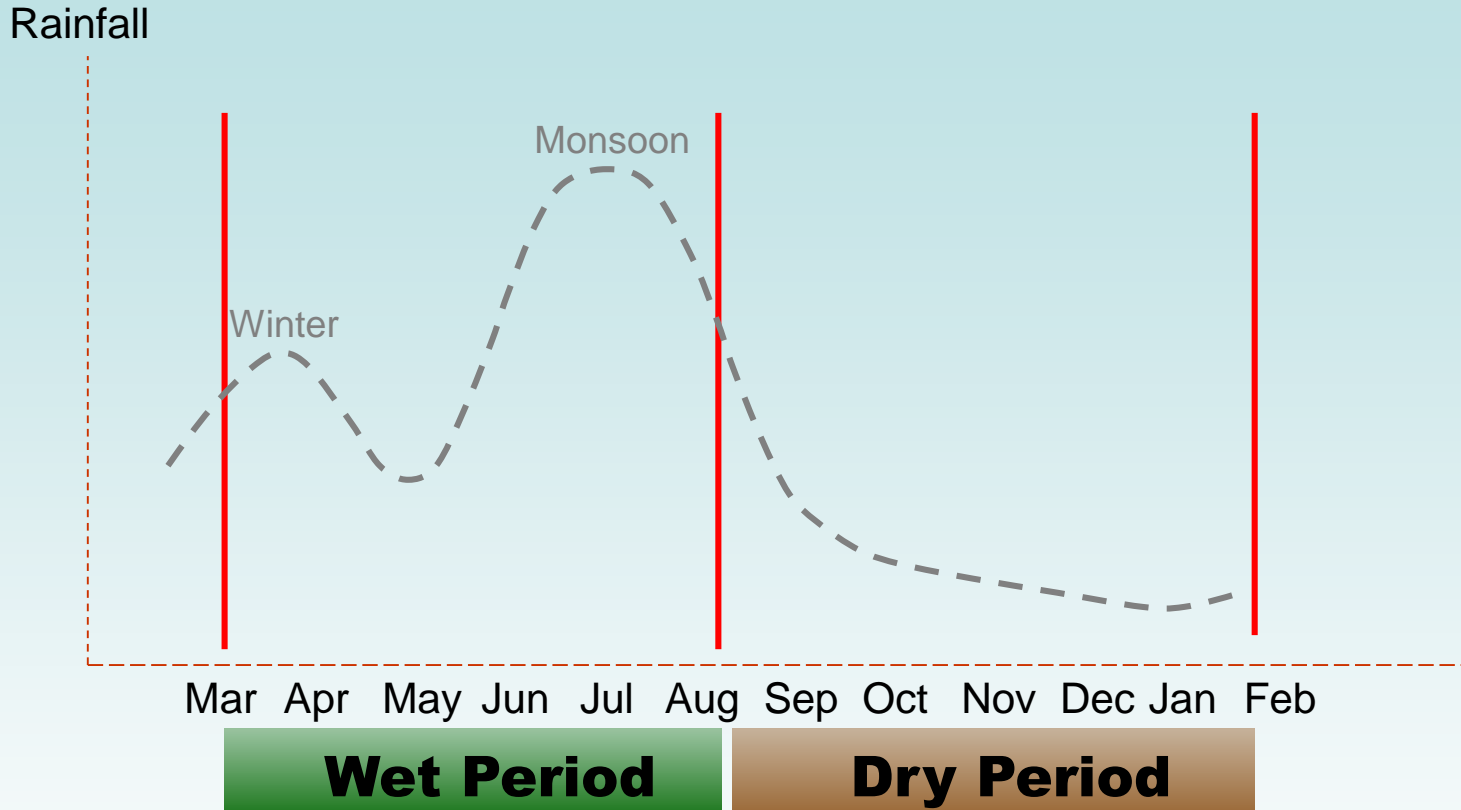




Monthly Rainfall Shift



Projected Climate: 2020 - 2030



6 Months (Mar – Aug)..... Wet Window

6 Months (Sep – Feb)..... Dry Window

Latitudinal Redistribution of Precipitation in Pakistan

Due to significant increase in SEASONAL and ANNUAL Precipitation in Pakistan, and the WESTWARD SHIFT (80-100 km) of Monsoonal Rainfall;

1- Rainfall over the Catchment Areas of Eastern Rivers has decreased (moved away).

2- The Probability of occurrence of Heavy Rainfall Events, leading to FLASH FLOODS/FLOODS, would be HIGH over western rivers instead of eastern rivers of Pakistan in the future.

3- Northwest Pakistan (Central parts of KPK & North-western parts of Punjab) are Extremely Vulnerable to Flash Floods/Floods.

Pakistan Super Flood: 2010

SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan



UN Secretary General Ban Ki-moon visits Sultan Colony, an Internally Displaced Persons' camp, in Punjab on 15 August 2010 in Multan. UN described the disaster as unprecedented, with over a third of the country under water (Evan Schneider/UN via Getty Images)

SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan



Army helicopter evacuates stranded villagers in Nowshera, Pakistan on Friday, 30 July 2010. Boats & helicopters struggled to reach hundreds of thousands of villagers cut off by floods in northwest region, this has been the deadliest disaster to hit the region since 1929

SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan



Flood victims evacuate their villages in Sukkur, Sindh province following days of heavy rain

SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan



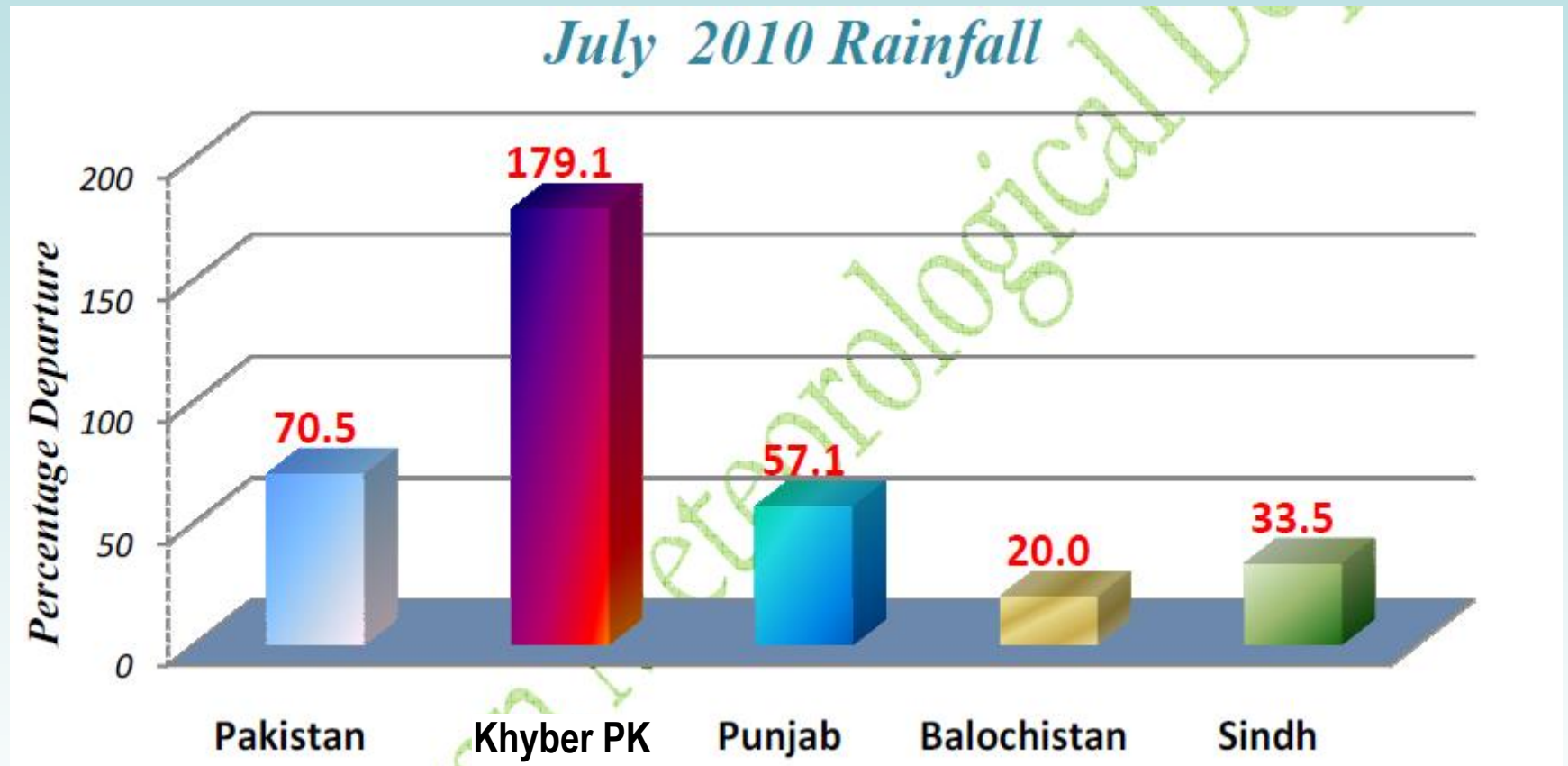
An aerial view shows a damaged bridge washed out by the floods in Ghazi, 5 August 2010 (REUTERS)

SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan



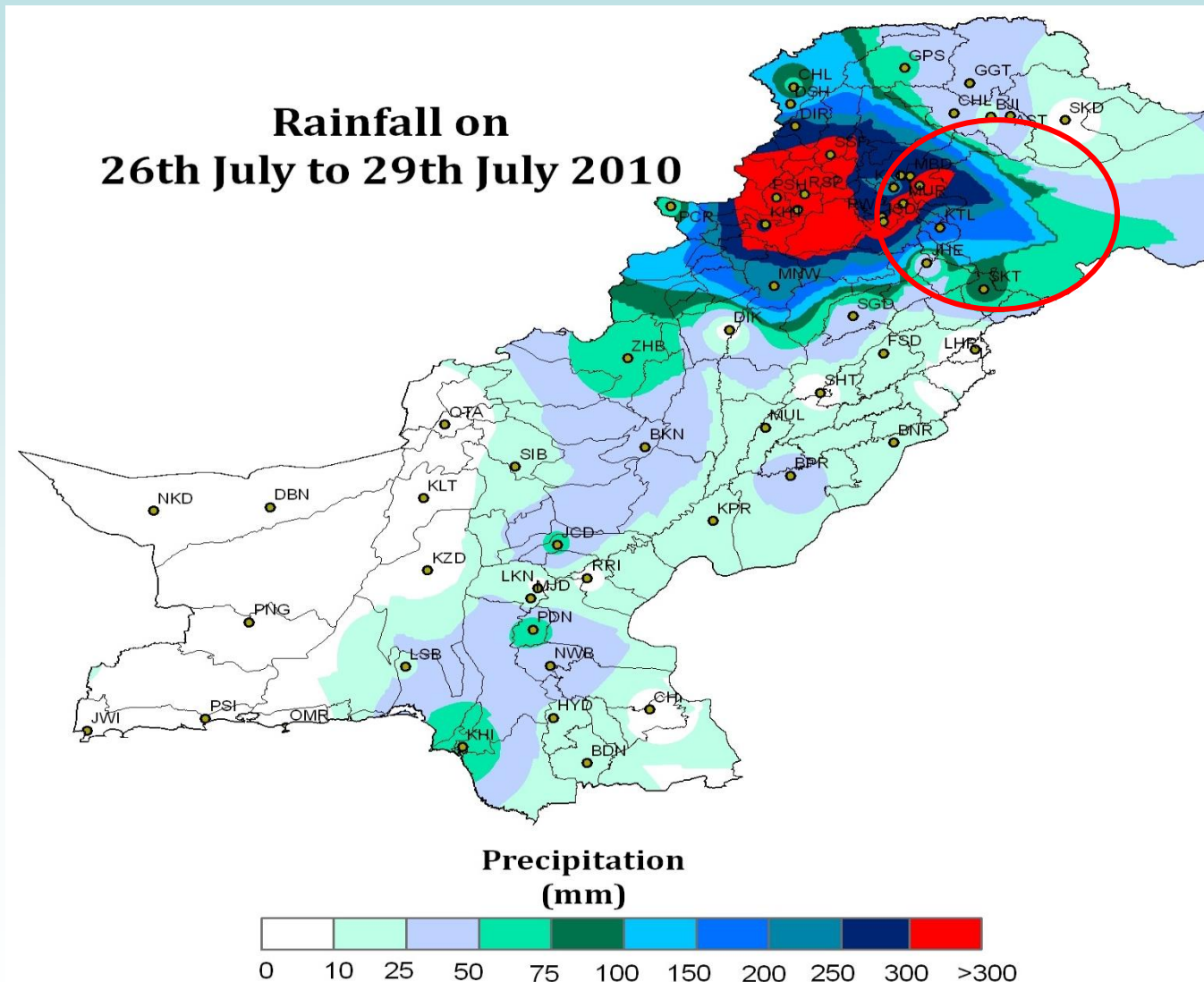
Survivors walk in the flooded area of Baseera village, Multan, on 10 August 2010. (Arif Ali/AFP/Getty Images)

SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan



**Pakistan received 70.5 % above Normal rainfall in the month of July, 2010
Khyber Pakhtoonkhwa received 179.1% above Normal rainfall in July, 2010**

SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan



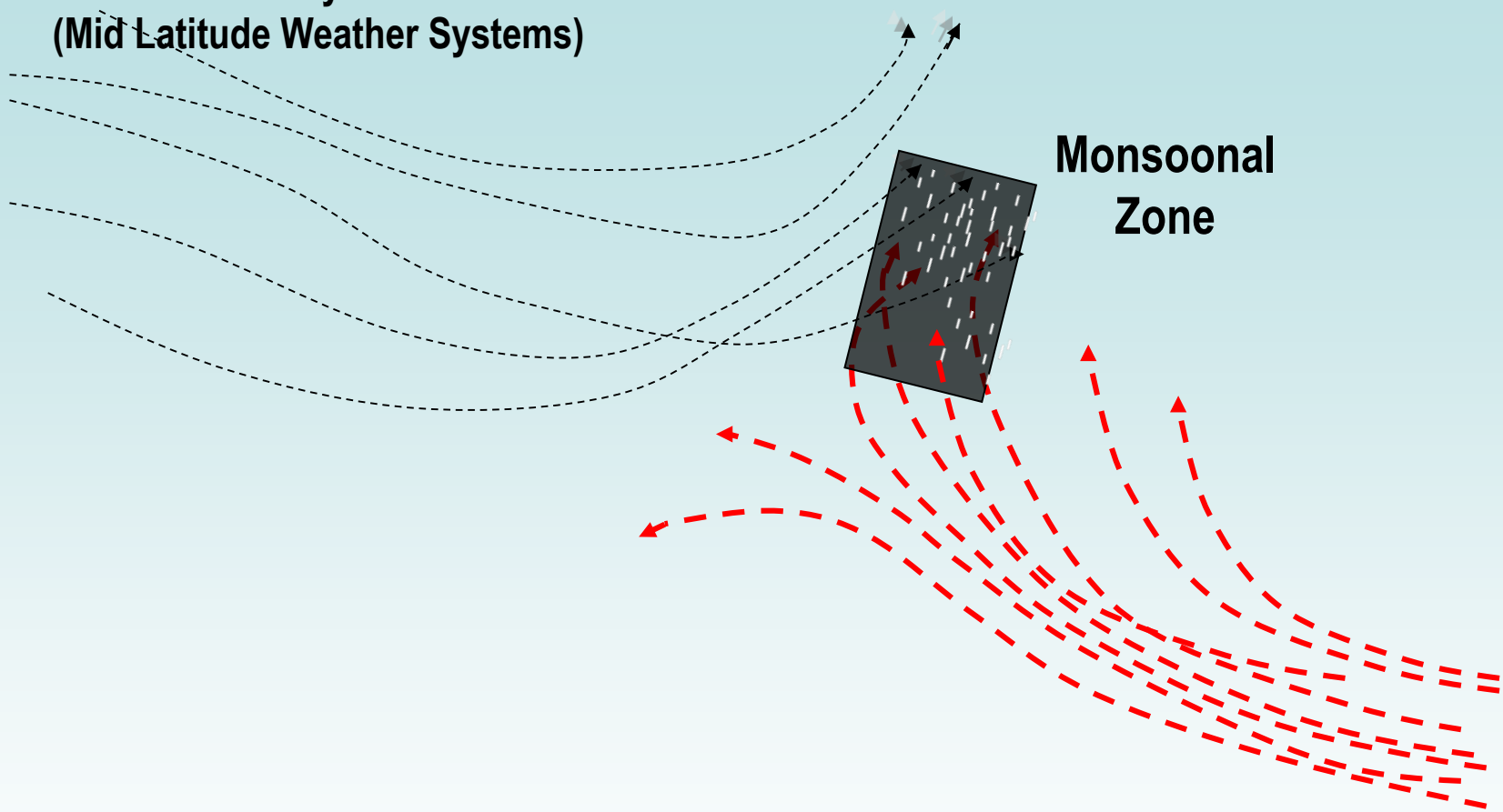
Source: Pakistan Meteorological Department

SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan

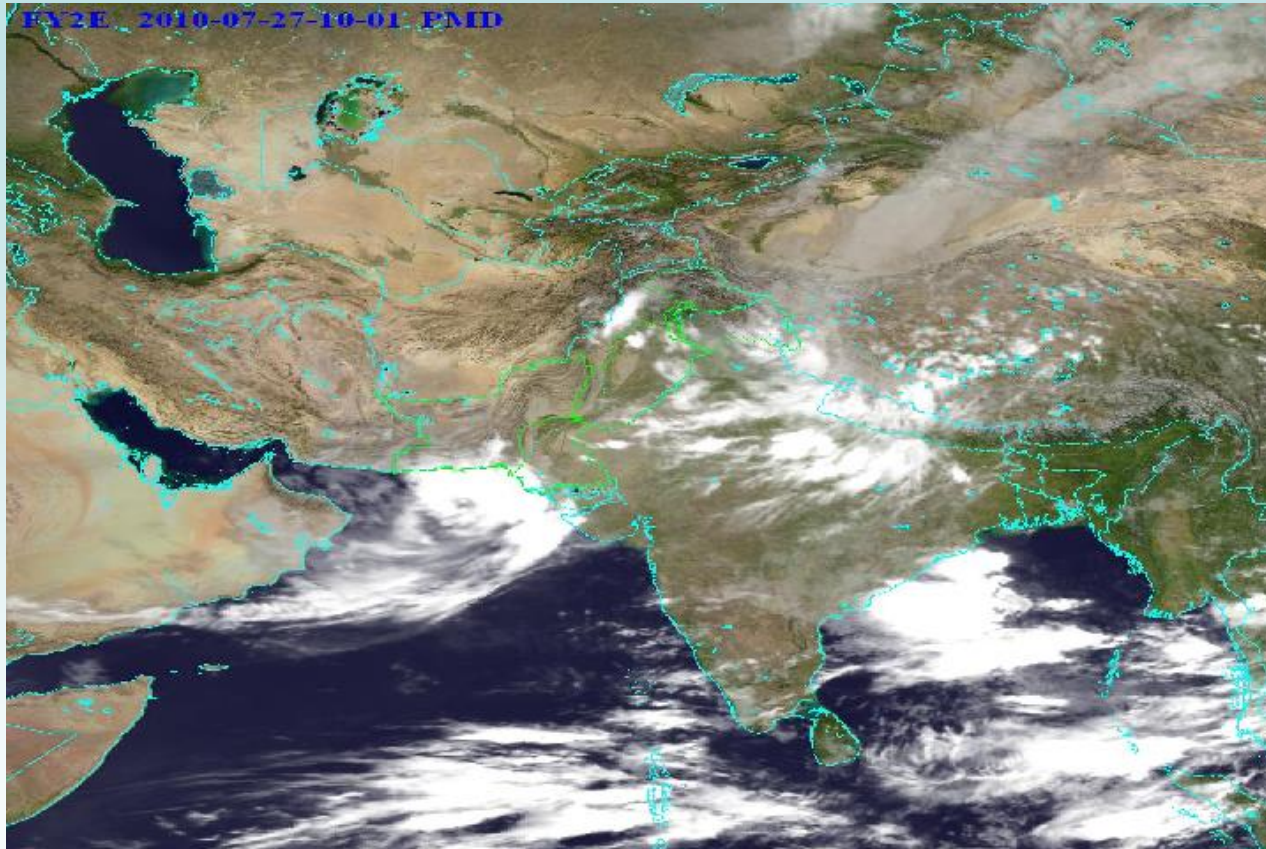
**Westerly Wave
(Mid Latitude Weather Systems)**

**Monsoonal
Zone**

Monsoon



SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan

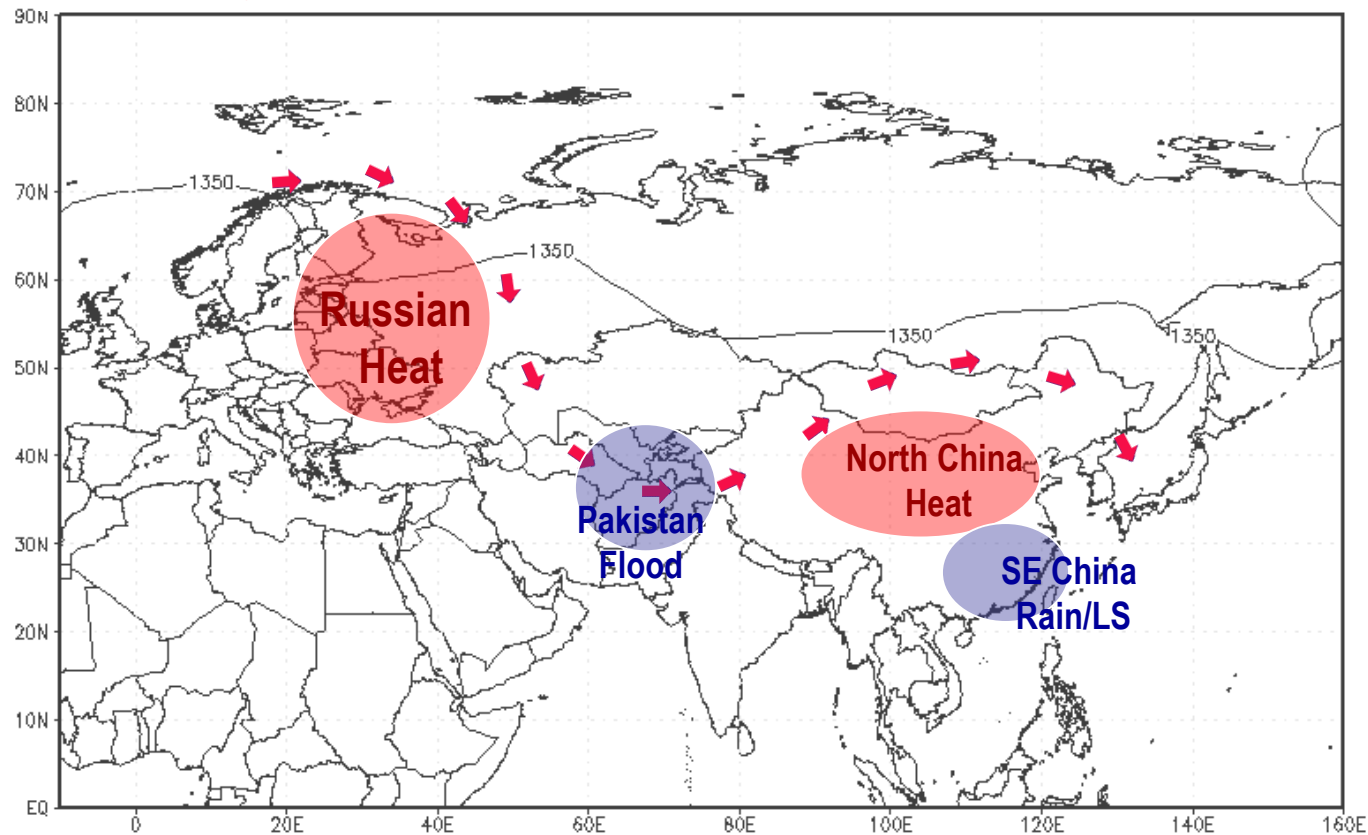


Very Heavy Rainfall occurred due to INTERACTION of 2 Weather Systems (Westerly Wave & Monsoonal Wave) over NW Pakistan.

SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan

July 2010: Disasters in Asia

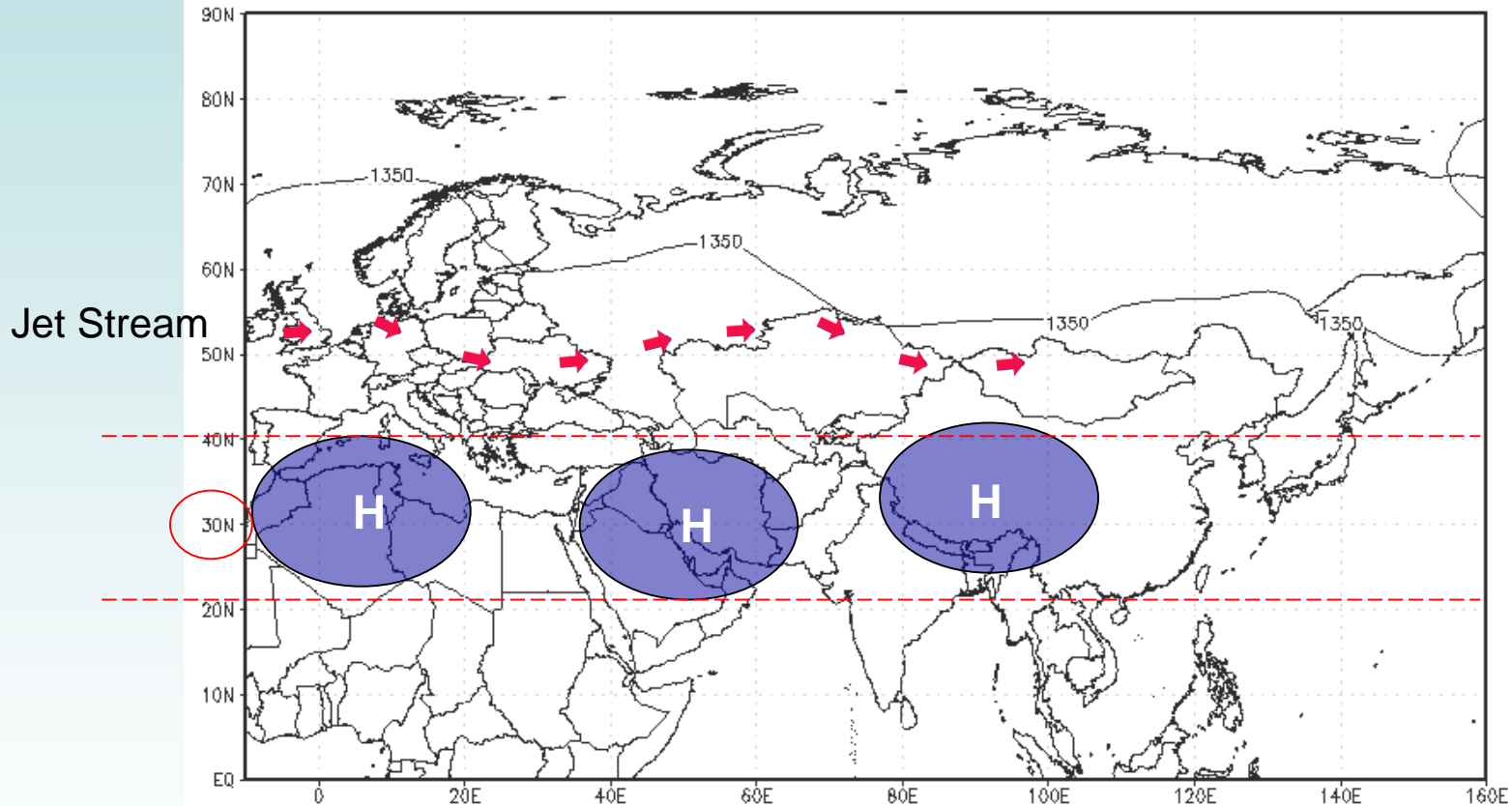
Super Flood (July, 2010) of Pakistan, Extreme HEAT over Russia and Heavy Rains/Landslides over SE China were INTERLINKED.



Due to ENSO-Cycle, the displacement (northward shift) of Subtropical HIGHS perturbed the Jet Stream, leading to Extreme Weather in Asia in July, 2010.

SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan

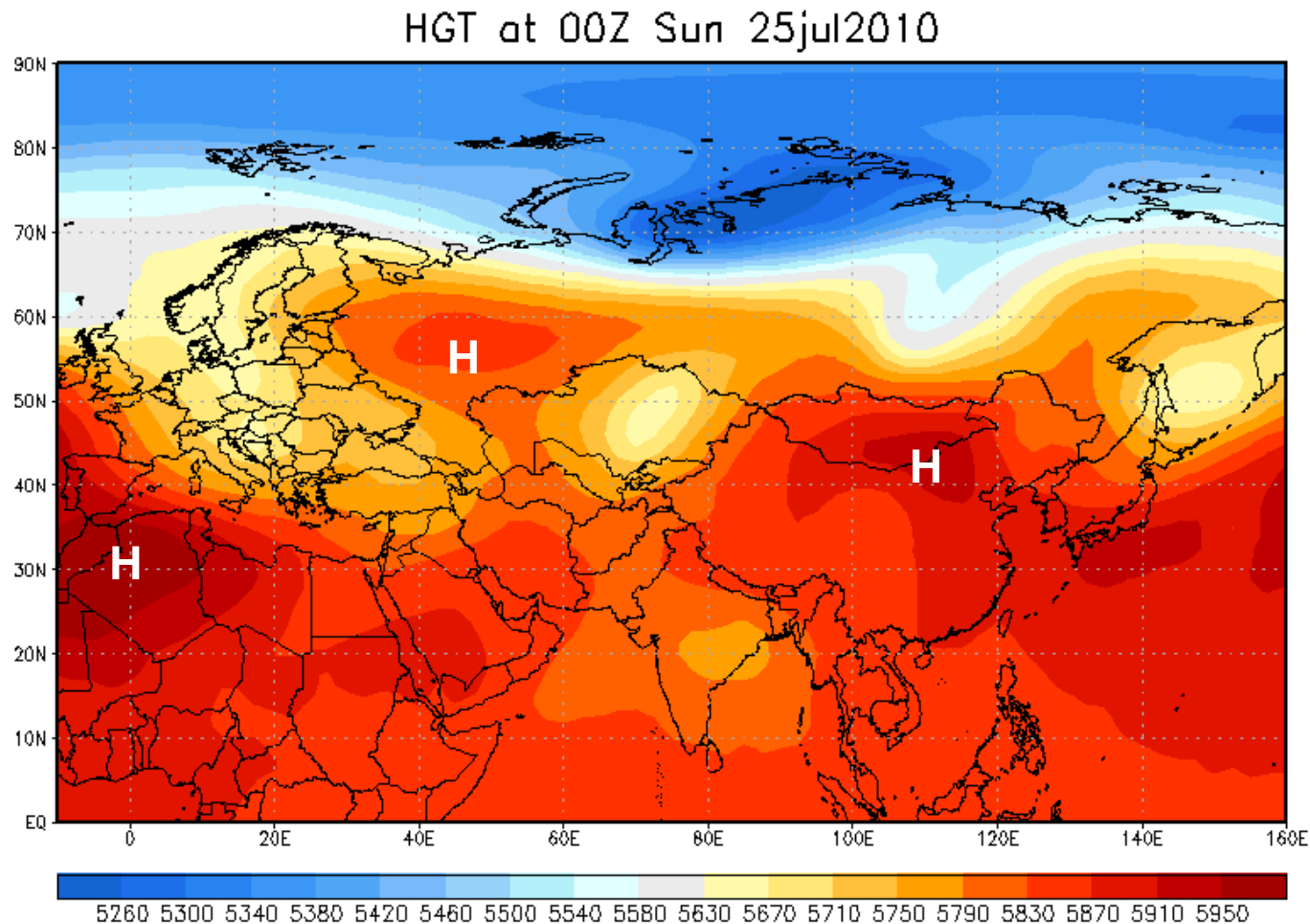
Post Analysis of Subtropical Highs (Ridge): 500 mb



Subtropical HIGHS
(cause of stable/normal climate)

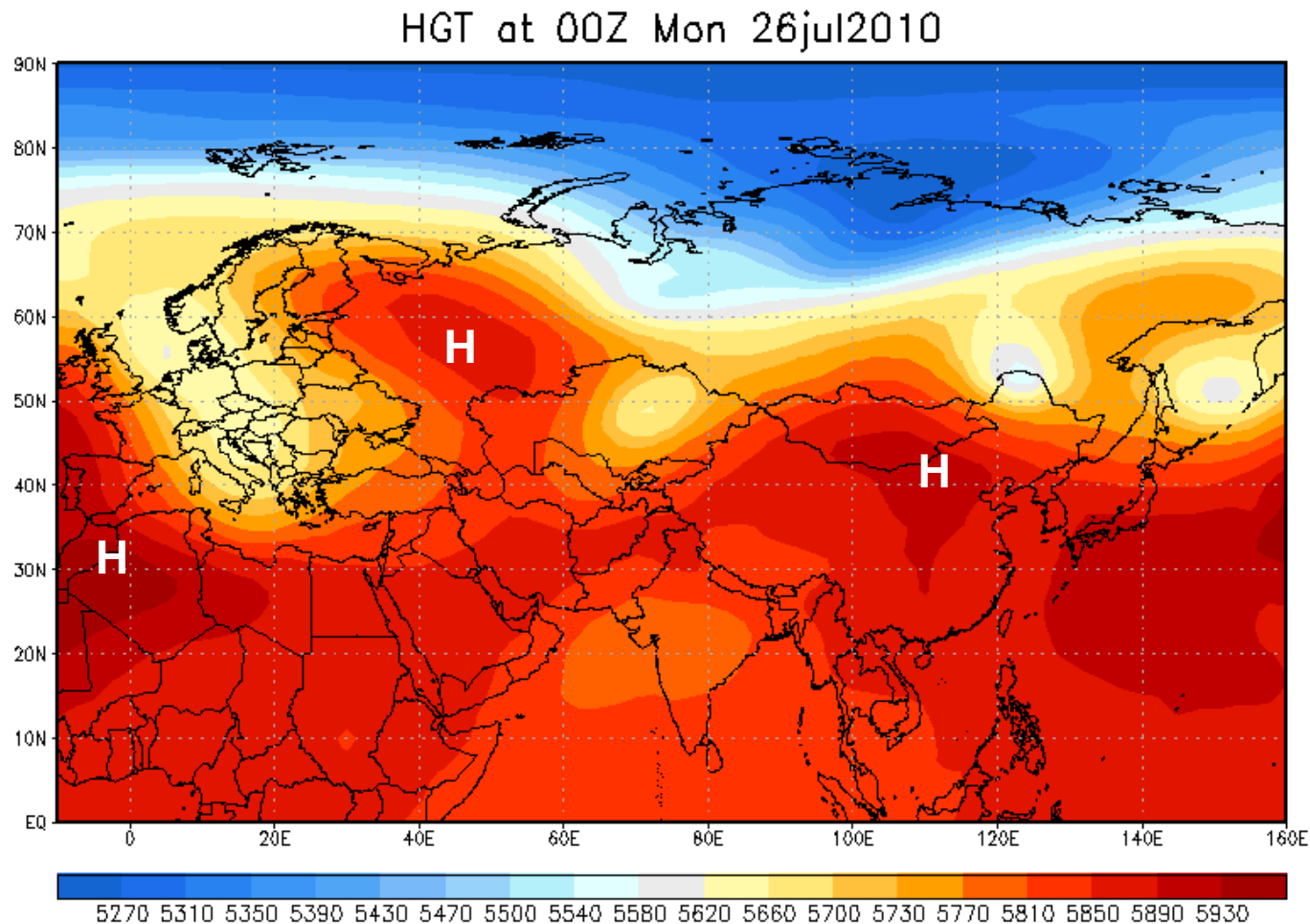
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Post Analysis of Subtropical Highs (Ridge): 500 mb



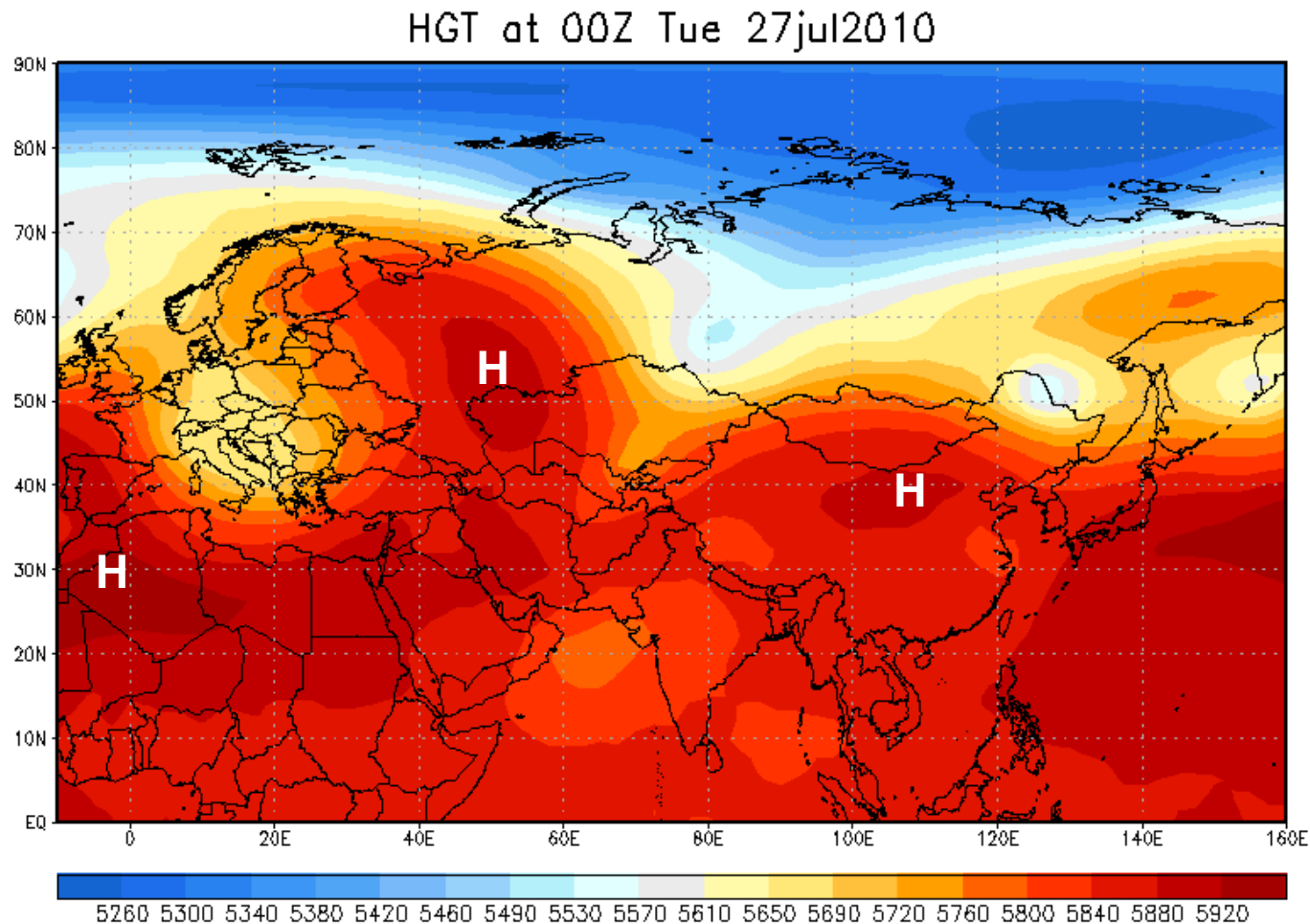
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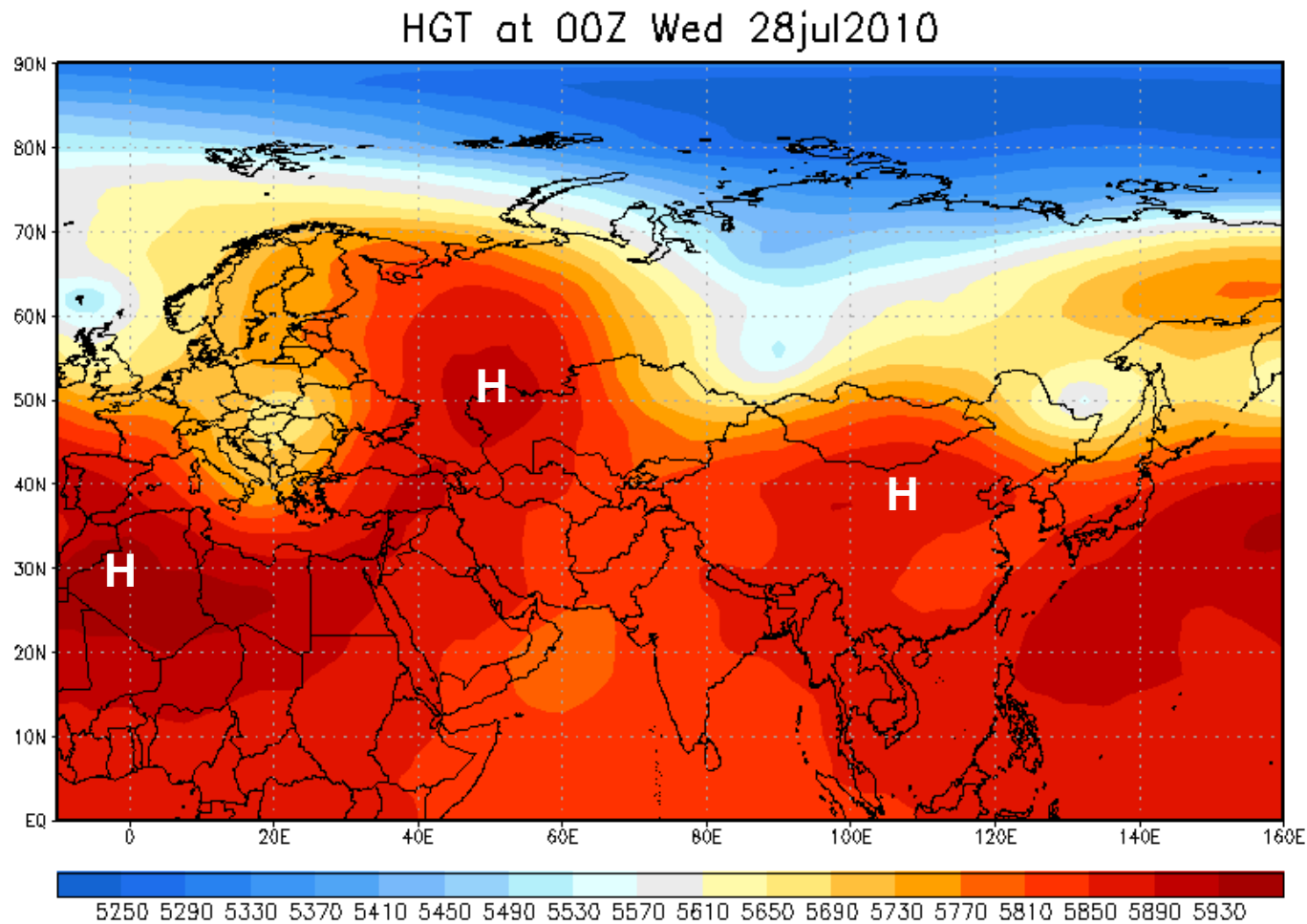
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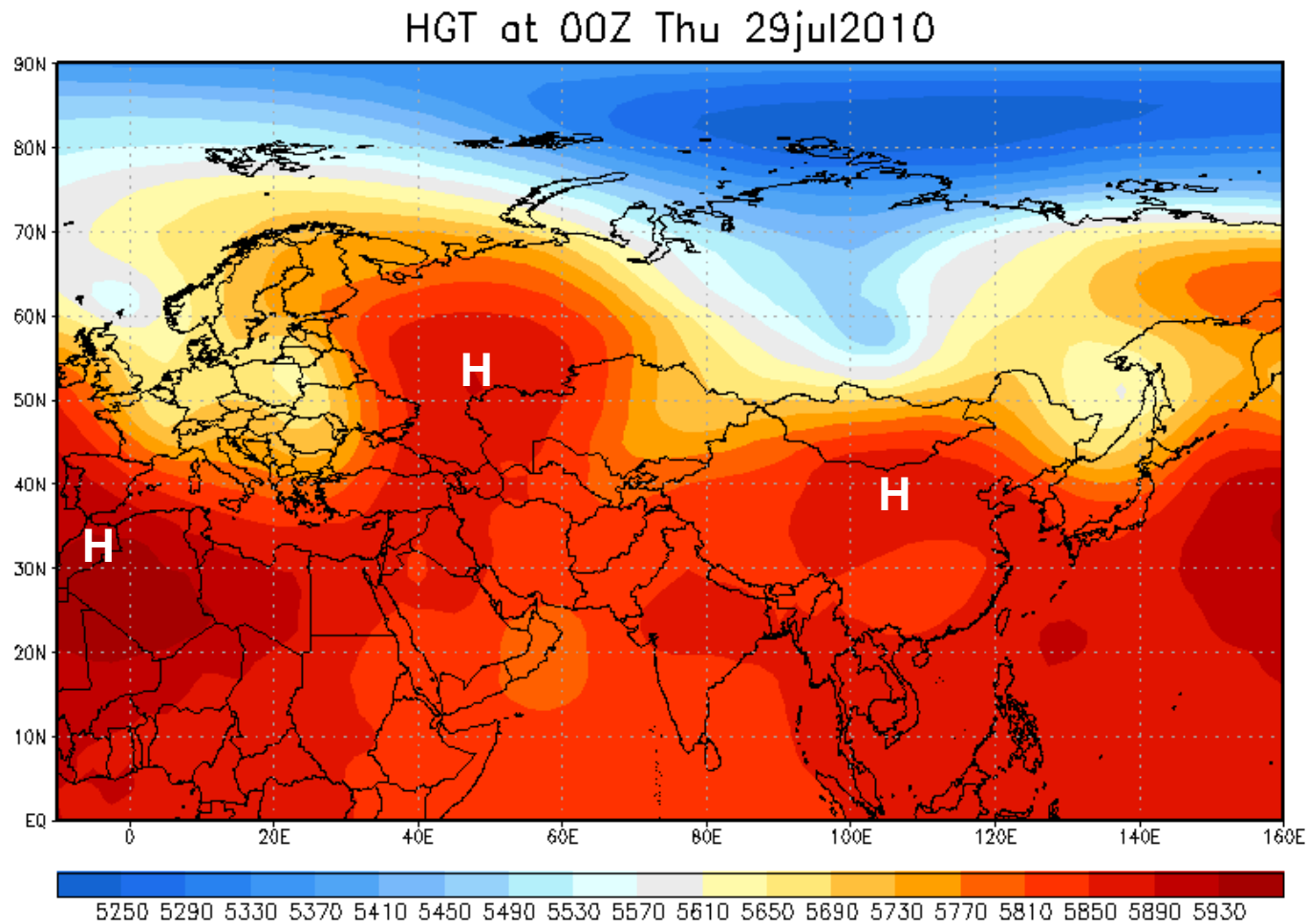
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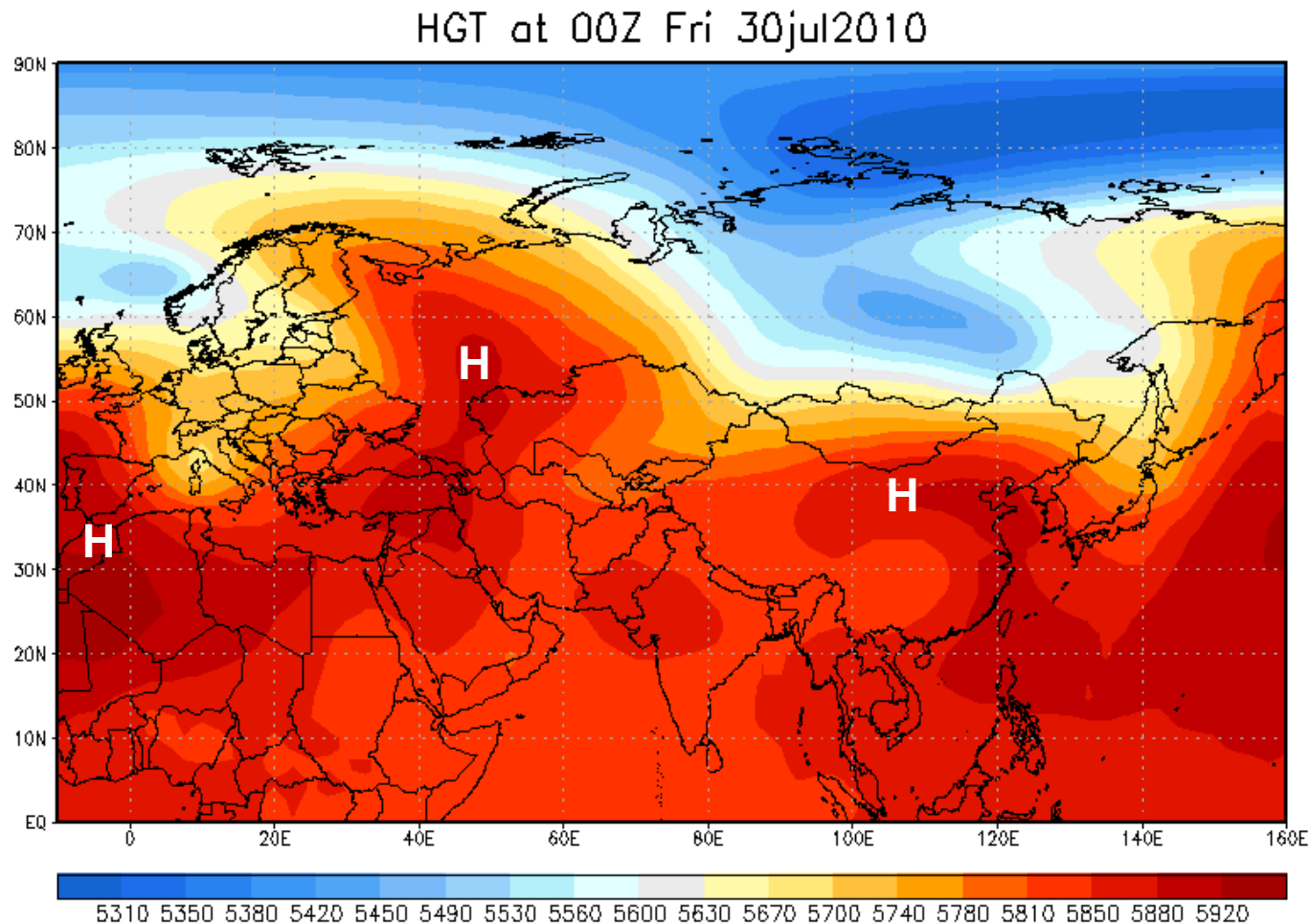
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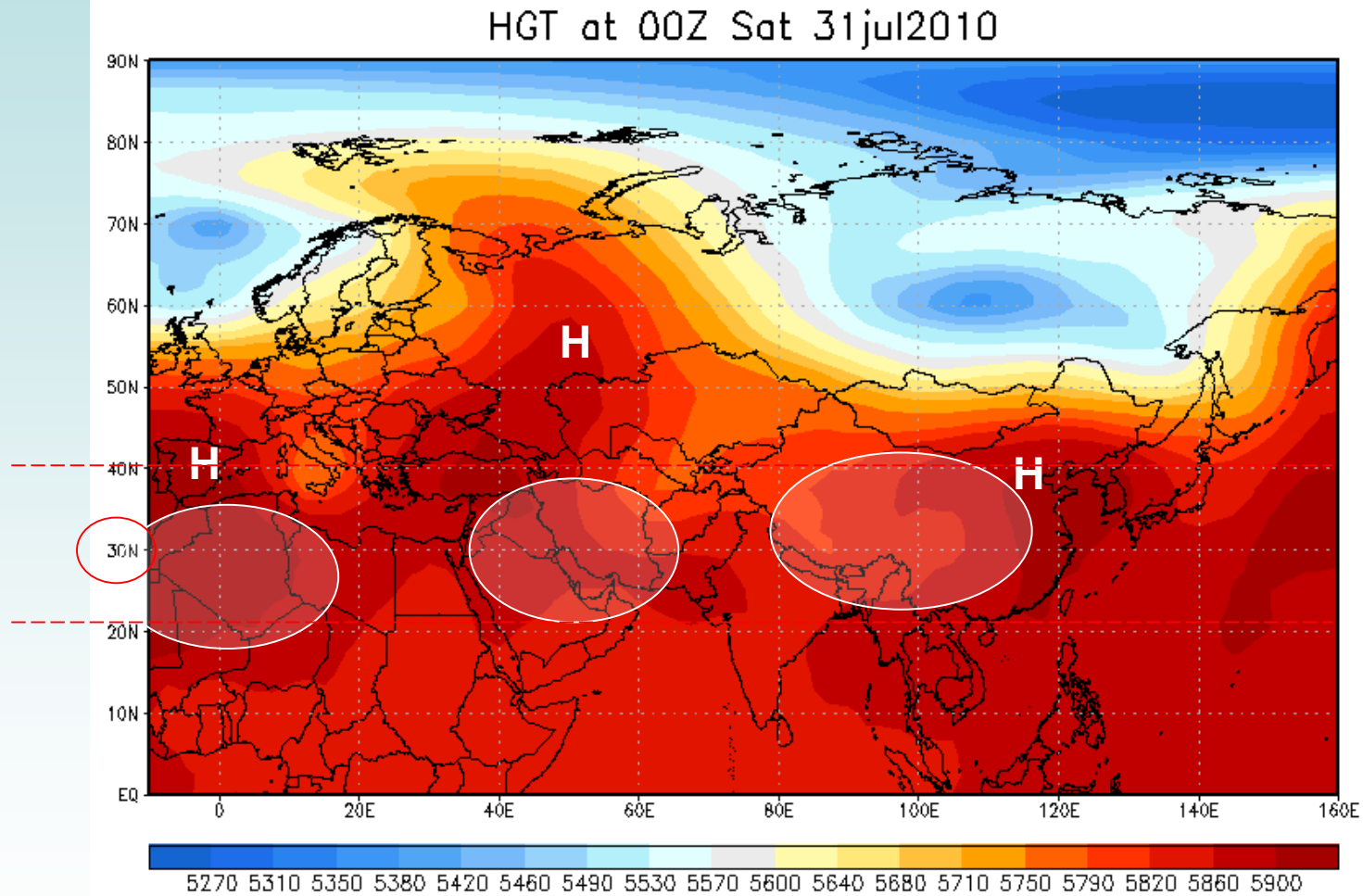
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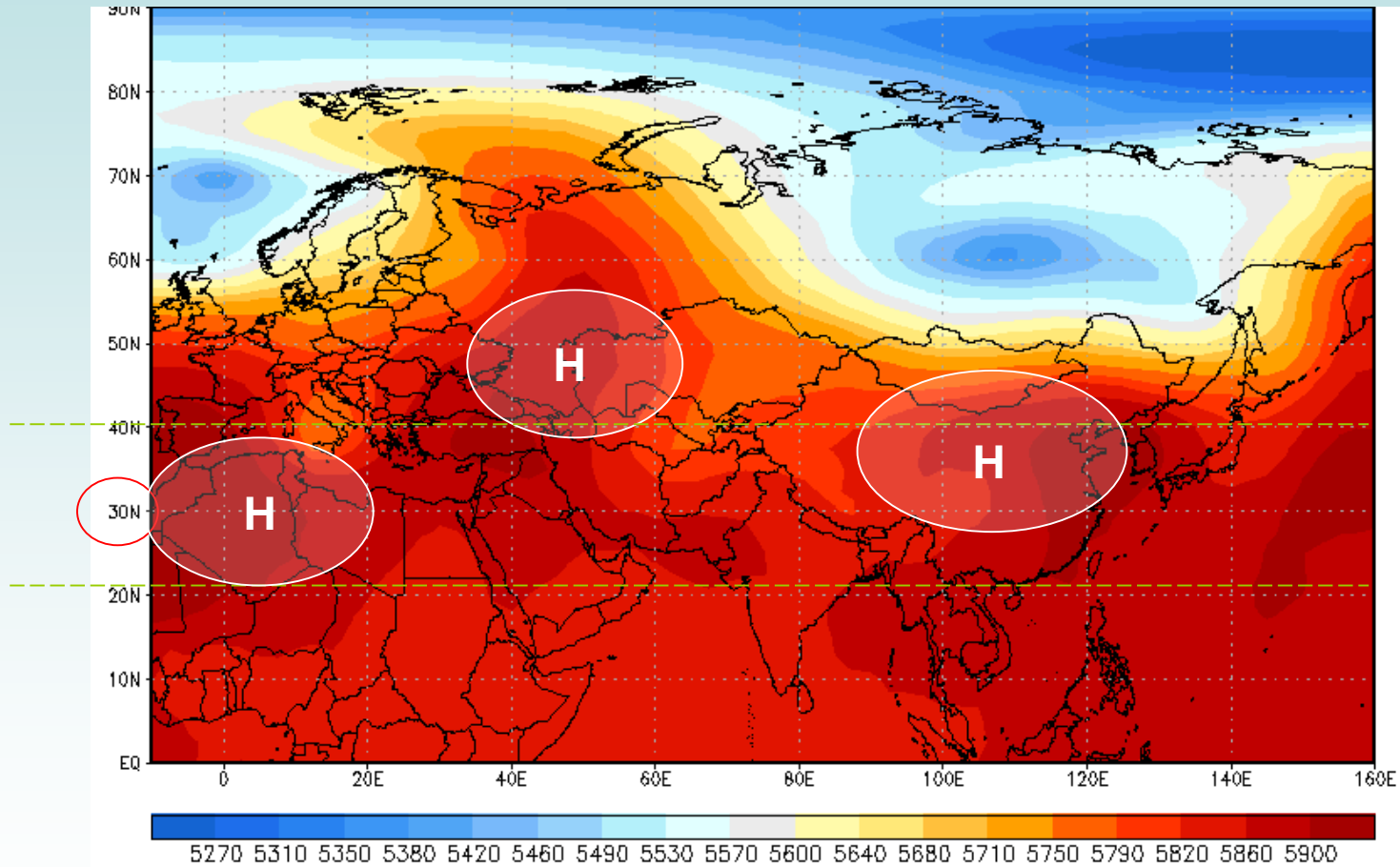
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Post Analysis of Subtropical Highs (Ridge): 500 mb

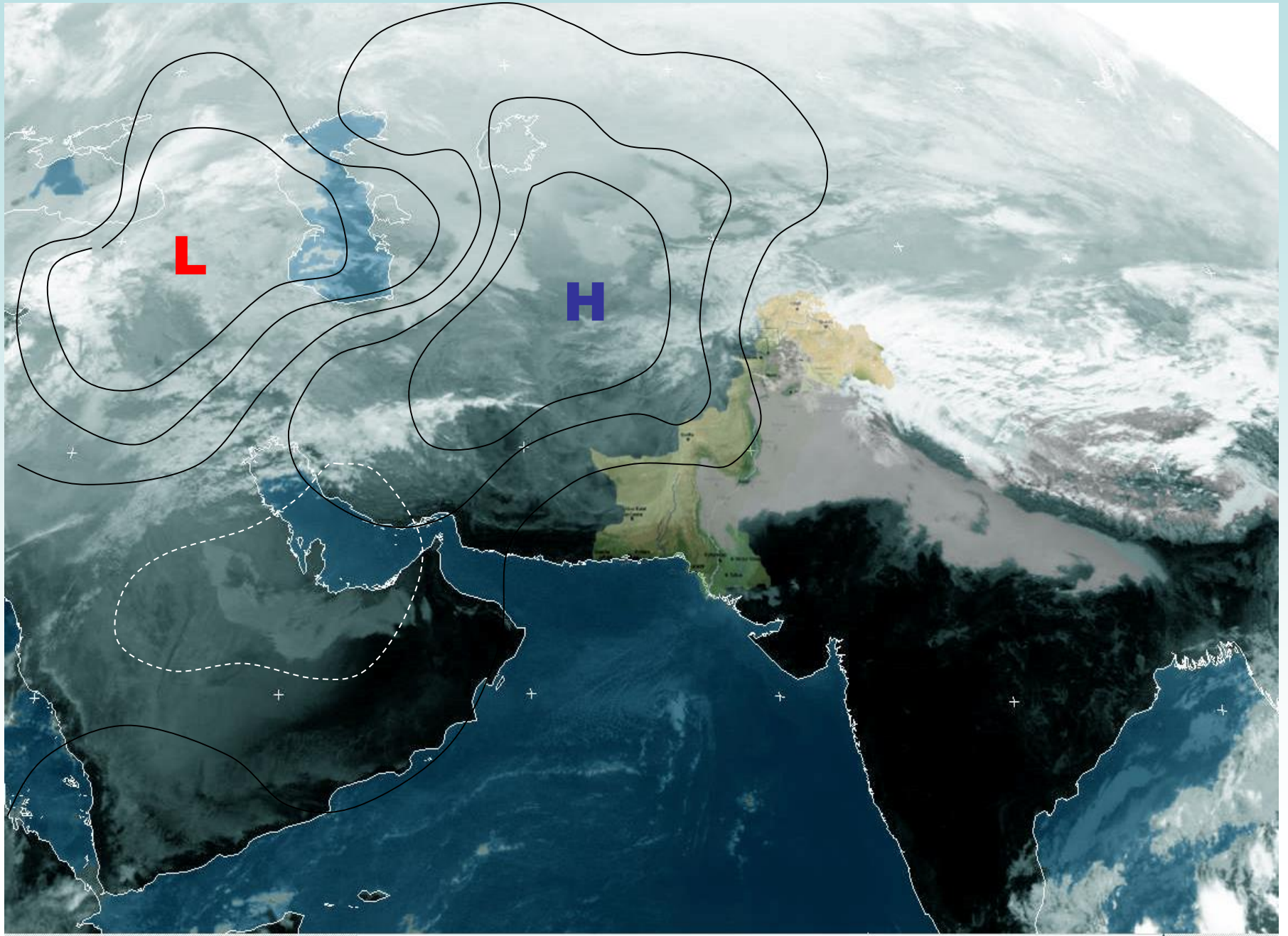


SUPER FLOOD (2010) in Pakistan: Very Heavy Rainfall Over NW Pakistan

Winter: 2010/2011 - Subtropical Highs (Ridge): 500 mb



Winter 2011: Cold & Dry with Dense Fog



The Displacement of Sub-Tropical HIGHS, due to current ENSO Cycle (La-Nina episode) caused;

- 1- Extreme Rainfall over NW Pakistan during Monsoon Season (2010)
- 2- Deficient Rainfall & Extreme Cold/Fog over Pakistan during Current Winter Season.

It is difficult to present an overall indication of the potential impacts of Climate Change in Pakistan. However, the occurrence of recent Extreme Events such as Flood-2010, Deficient Rainfall in Winter and Current Dense and Prolonged Fog are enough to get an **Alarming-Attention** about a possible Climate Change in Pakistan, having direct and large impacts on several sectors of the society.



**THANK YOU
FOR
YOUR
ATTENTION!
ANY QUESTIONS?**