

Seasonal Hydro Meteorological outlook for Indus River Basin

(Jun-Sep, 2013)

Issued on Jun 25, 2013



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Seasonal weather outlook (Jun-Sep, 2013)

1. Introduction

A variety of methods including dynamical models, statistical methods, regional expert judgments and combination of them are being used to generate long-range weather forecast by the different climate prediction centers around the world. National Agromet Center (NAMC), Pakistan Meteorological Department adopts an ensemble approach to formulate seasonal weather outlook for south Asian countries included in South Asian Association for Regional Cooperation (SAARC) (on experimental basis), taking into consideration available products from major climate prediction centres by using Global Climate Models (GCMs).

This Climate Outlook developed for entire Indus Basin irrespective of national boundaries of neighboring countries. Thus, this product may differ from the official forecasts issued in those countries. Indus Basin seasonal (precipitation) outlook is predicted from ECHAM4 global climate models by using persisted sea surface temperature on 0000 Jun 01, 2013. Model is then tuned up by subtracting additional moisture from output. During validation of model, it was observed from past predictions by the model that it predicts above forecast than observed in the region. Therefore, to make the model forecast close to observation, a factor for each month has been calculated to compute subtraction of additional moisture.

Accuracy of Outlook seasonal weather mainly depend upon SST used in global climate models. Even with use of accurate SST, still is uncertainty in the climate forecast due to chaotic internal variability of the atmosphere. For further information concerning this and other guidance products, users are strongly advised to contact their National Meteorological Services.

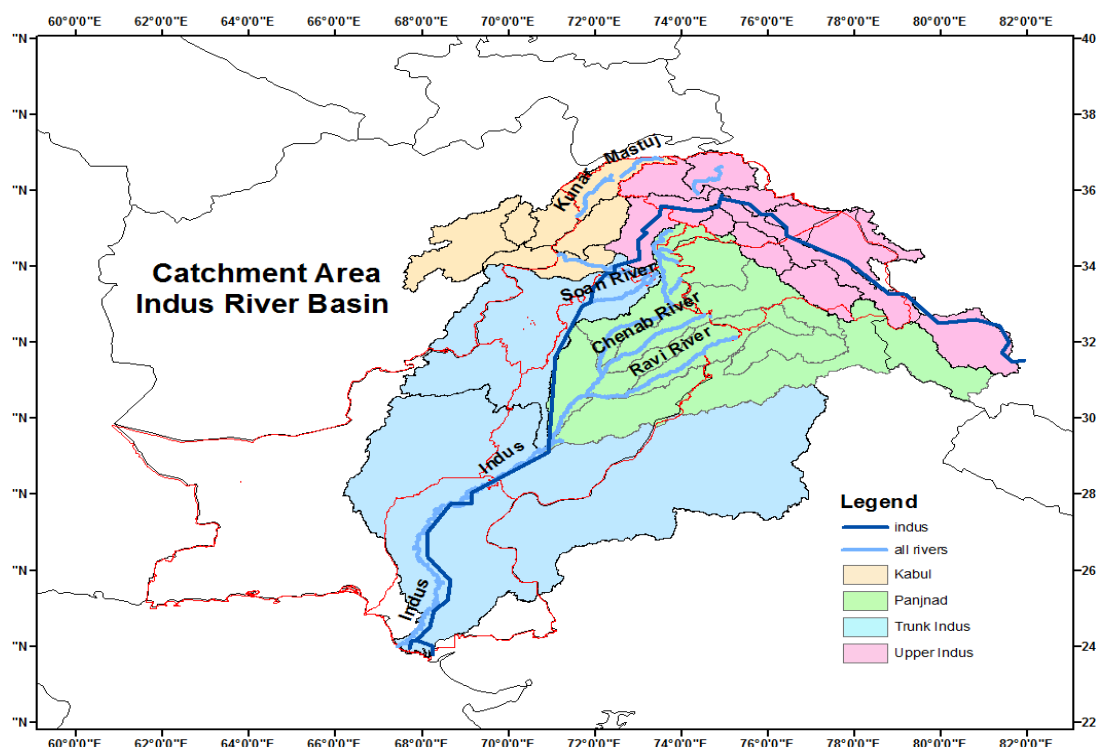
Acknowledgement: NAMC is gratefully acknowledges, the International Research Institute (IRI) for climate and Society for providing access of dynamical prediction of Global Climate Model ECHAM4P5, developed and operated by European Center for Medium-Range Weather Forecasts model's simulations and hindcast data to support the formulation of seasonal weather outlook of Pakistan. Special acknowledge to Dr. M. Benno Blumenthal by providing guidance and assistance for using IRI climate software. All the output graphics have been prepared by using IRI climate software.

Classification of average, below average and above average

- Below Average (Blw. Ave) < -10 %,
- Average precipitation range (Ave) = -10 to +10 %,
- Above Average (Abv.Ave) > +10 %

Note: Average precipitation is computed by using Global Precipitation Climatology Centre (GPCC) gridded data by resolution (0.5x0.5°) latitude by longitude

2. Map and brief of Indus river Basin and its sub region tributaries



Indus River basin is main basin in Asia. It originates from China at an elevation of 5500 m. The catchment area contains seven of the world's highest peaks after Mount Everest. The river is 3200 m long. The total inflow from China in the Indus river basin is estimated at 181.62 km³. Total inflow from Afghanistan to Pakistan in the Indus basin is estimated at 21.5 km³, 15.5 km³ from the Kabul river (of which 10 km³ come from Kunar river, which first enters Afghanistan from Pakistan and then flows back to Pakistan after joining the Kabul river) and 6 km³ from other tributaries (Pansjir, Gomal, Margo, Shamal, Kuram). The mean annual inflow into Pakistan from India through the western tributaries comprising the Jhelum and the Chenab (considering the Indus Water Treaty) amounts to 170.27 km³. The mean annual natural inflow into Pakistan through the eastern rivers (the Ravi, the Beas and the Sutlej) is estimated at 11.1 km³. The flow in the Indus river depends on the season, it decreases during the winter and floods the banks during the monsoons.

The Indus river has two main tributaries, the Kabul (Upper Indus and Kabul) on the right bank and the Panjnad on the left. The Panjnad is the flow resulting from five main rivers: the Jhelum and Chenab, known as the western rivers with the Indus river, and the Ravi, Beas and Sutlej, known as the eastern rivers.

This hydro-meteorological climate outlook is developed keeping in view the needs of water managers, authorities engaged in DRM, agriculture and power sector who are directly concerned to changes in precipitation patterns in Indus Basin. **Experts from related fields are encouraged for feedback so that the climate outlook may further fine-tuned as per societal needs.**

This outlook will be updated regularly on 10th of every month for next three months.

3. Synoptic situation

- No significant change in location, convergence areas, strength and movement of **Jet stream (zonal winds at 200 hPa)** during current month from normal. Intensity of zonal winds is expected to be slightly above than normal over extreme northern parts of Himalayas region.
- Geo-potential height at 500 hPa over the region follows normal patterns with less intensity during start of the season and will gradually weaken with time
- No significant change is expected in Surface temperature pattern from normal (1982-2010) during Jun, 2013 over the country.
- Surface temperature pattern is expected on higher side than normal (1982-2010) during during Jun and slightly above normal during July, Normal during August and September over the region.
- North Atlantic Oscillation (NAO) is slightly in positive phase (nearly zero) and may cause to shift western disturbances towards north during coming months. (Data source: CPU, monthly mean index)
- Most of the set of dynamical and statistical models predict neutral conditions of ENSO for the Jun-Jul-Aug (JJA). During Mid May the observed ENSO conditions in the slightly on negative side (La Nina) ENSO condition. The SST Seasonal weather outlook (Jun-Sep, 2013) anomaly in the Nino3.4 regions during recent period is -0.2.

http://iri.columbia.edu/climate/ENSO/currentinfo/SST_table.html

- Probability outlook: La Nina (26%), Neutral (67%) and El Nino (07 %) during Jun –Jul-Aug season
- Arabian Sea Surface Temperatures are normal.
- Bay of Bengal Sea Surface Temperatures are slightly below than normal over western coast.

4. Seasonal weather outlook (June-Aug, 2013)

4.1. Summary

Normal to below normal surface runoff water is expected during the season (JJAS)

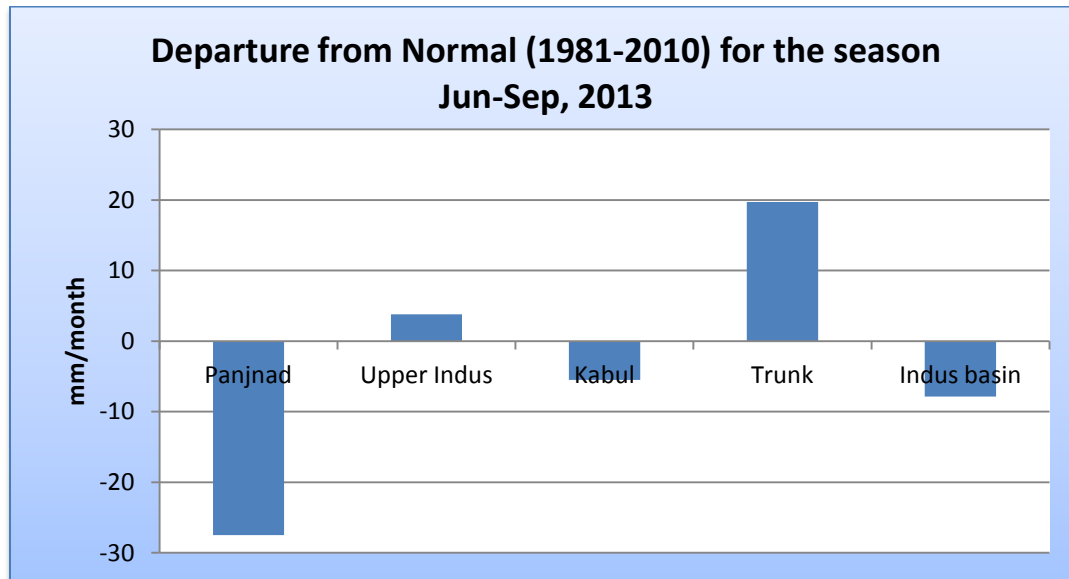
Synthesis of the latest model forecasts for Jun-to-Sep 2013 (JJAS), current synoptic situation and regional weather expert's judgment indicates that normal to below normal surface runoff water is expected during the predicted season with significantly below over eastern rivers and above normal over northern portion of Indus river. Above normal day temperature over the northern parts of the country would play an important role to enhance surface runoff water in the Indus River.

4.2. Seasonal surface runoff water outlook:

Surface runoff water in the Indus river basin including Upper Indus, Kabul, Panjnad and Trunk Indus has been predicted on the basis of expected rainfall in the catchment areas of Indus basin and above normal day temperature in the region during predicted season. The main points of water availability outlook are as under:-

- Synoptic situation and model seasonal outlook shows that enough surface runoff water is likely over catchment areas of main reservoir (Terbala dam). No short fall of surface runoff water is likely during the season in Terbala dam.
- Short fall of surface runoff water in the catchment areas of Mangla dam is expected during the season.
- Surface runoff water in the Ravi river will be slightly on higher side during the month of September
- Average surface runoff water is expected in Upper Indus, Kabul and Indus river Basin as a whole.
- Below average surface runoff water is expected in Panjnad basin with significantly low over the eastern rivers (the Ravi and the Sutlej) and average over the western rivers (the Jhelum and the Chenab)
- Above normal surface runoff water is expected over Trunk Indus basin due to above normal rainfall in southern Punjab, Sindh and southern Khaberpaktunkwa (KP)
- Surface runoff water in Indus Basin will gradually increase during predicted season
- Urban / flash flooding over southern parts of the country can't be ruled out.

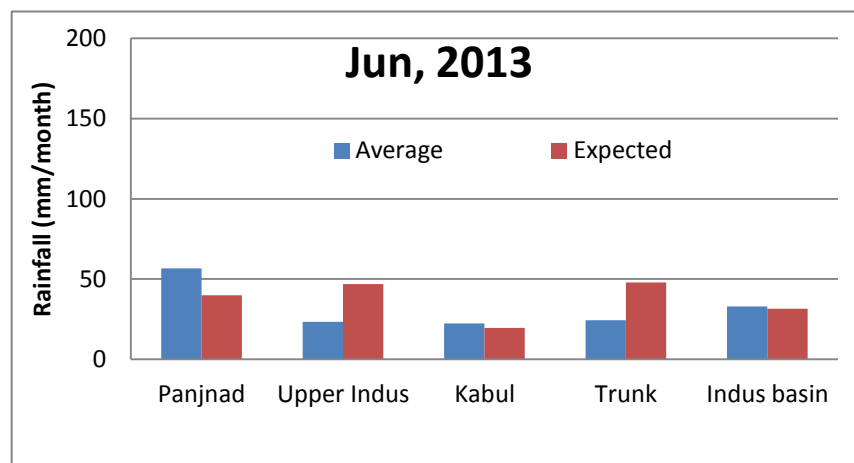
Seasonal weather outlook (Jun-Sep, 2013)



Note: Departure of Area-weighted rainfall of Indus Basin and its sub-region has been computed by subtracting ECHAM predicted monthly/seasonally rainfall from GPCC of corresponding month/season.

5. Monthly outlook

5.1. June, 2013

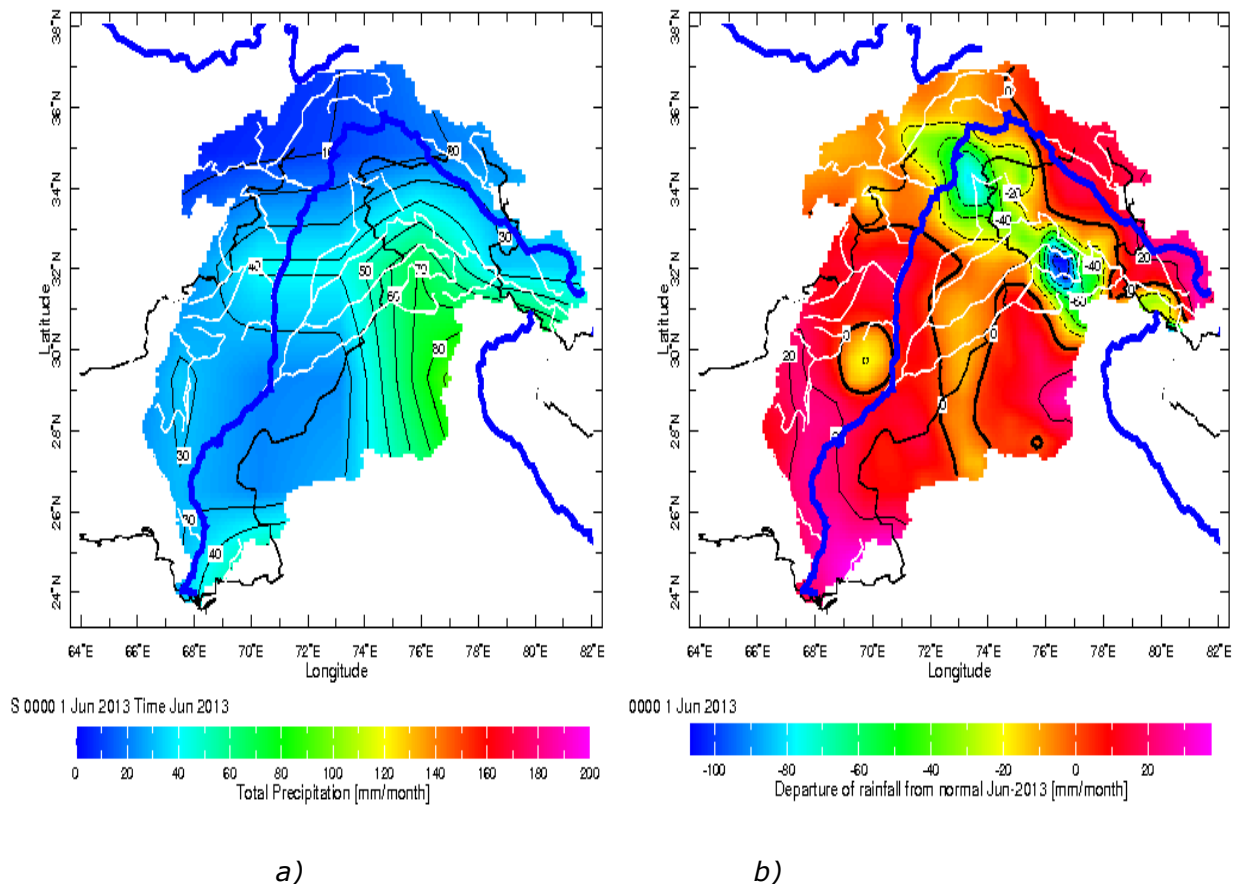


Comparison of expected and average rainfall over catchment area of Indus and its sub-regions

Indus Basin: Normal rainfall is expected over catchment area of Indus basin indicates normal surface runoff water in the rivers. As day temperature expected above normal specially northern region indicates above normal surface runoff will be expected especially in the Indus river.

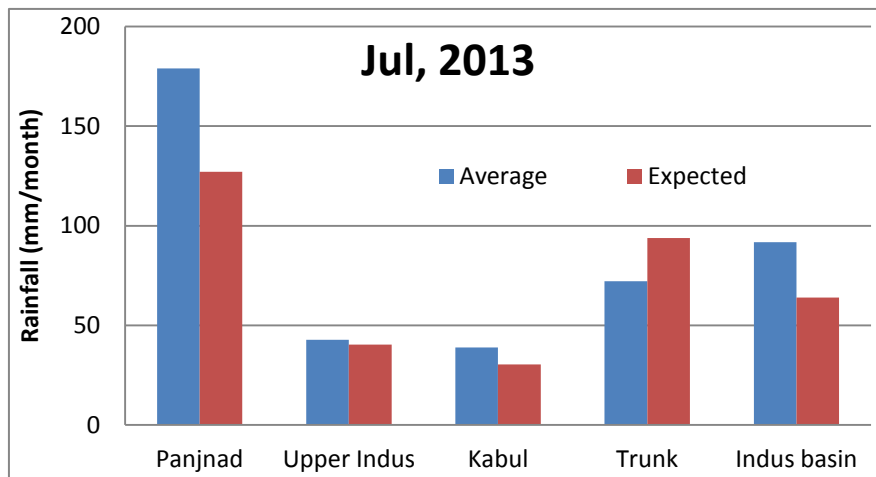
Seasonal weather outlook (Jun-Sep, 2013)

- **Upper Indus:** Temperature play an important role to melt ice and snow from the glaciers causes increase in the discharge water in the Indus basin. As a result riverine flooding can be expected in the Indus river. More discharge water in the river will allow to fill Terbela dam on expected time.
- **Kabul:** Average surface runoff water is expected in the Kabul river. No indication of any strong weather system from west.
- **Panjnad:** The catchment is under influence of less rainfall during June but with higher day temperature will give normal discharge flow in western rivers of Panjnad (the Jhelum and the Chenab). However less surface runoff water is expected in the eastern rivers of Panjnad (the Ravi and the Sutlej)
- **Trunk Indus:** Above normal rainfall over southern parts of the country as well in the catchment areas of trunk cause increases surface runoff water in the trunk especially in Kotli borage during june.



Spatial distribution of a) expected rainfall and b) departure from normal rainfall during June, 2013

5.2. July, 2013

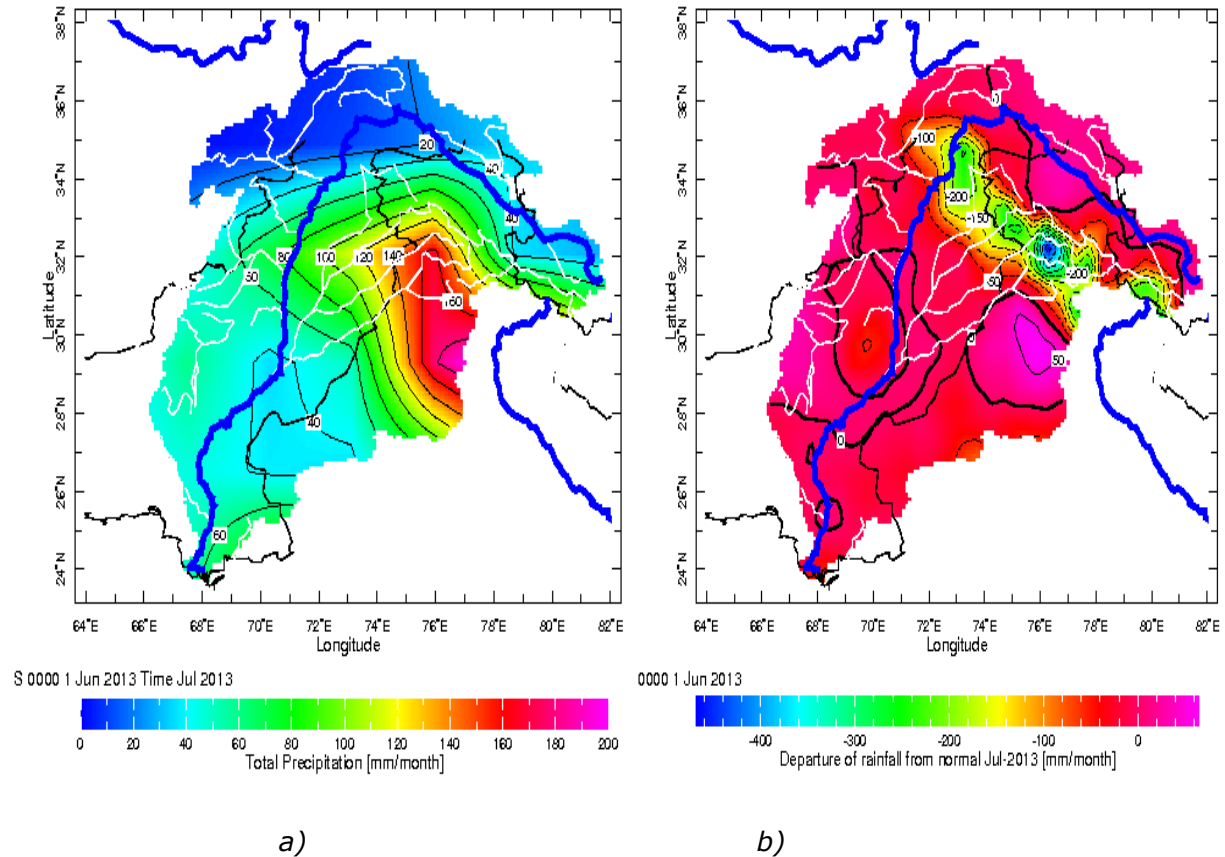


Comparison of expected and average rainfall over catchment area of Indus and its sub-regions

Indus Basin: Below Normal rainfall is expected over catchment area of Indus basin that would result below normal surface runoff water in the rivers. However day temperature is expected above normal over northern region would cause increased inflows in the river.

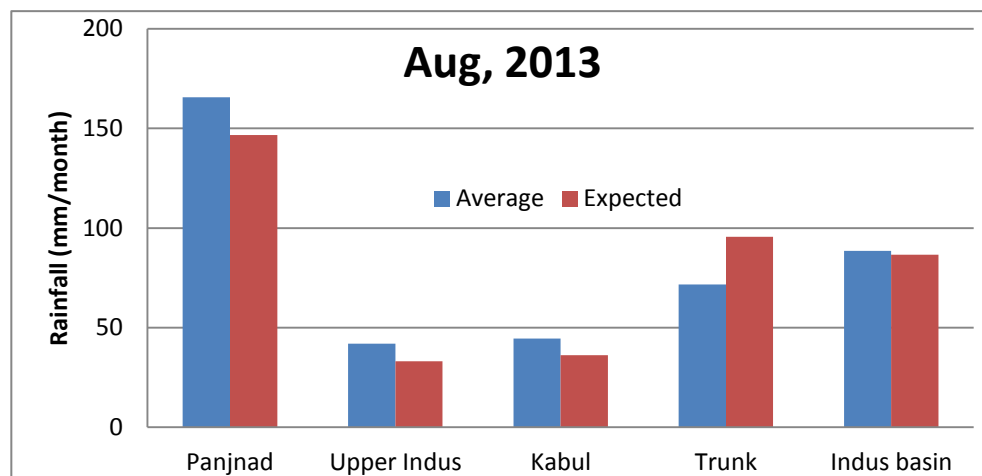
- **Upper Indus:** Normal rainfall is expected over catchment of Upper Indus. In addition melting snow/ ice may increase surface runoff water in the upper Indus tributaries. Riverine flooding can not be ignored in Indus river during July.
- **Kabul:** Below average surface runoff water is expected in the Kabul river and no chances of any strong weather system from west during July.
- **Panjnad:** The catchment would be under influence of less rainfall during July but with higher day temperature would give normal discharge flow in western rivers of Panjnad (the Jhelum and the Chenab). However less surface runoff water is expected in the eastern rivers of Panjnad (the Ravi and the Sutlej).
- **Trunk Indus:** Above normal rainfall over southern parts of the country as well in the catchment areas of trunk cause increases surface runoff water in the trunk especially at Kotri barrage during July.

Seasonal weather outlook (Jun-Sep, 2013)



Spatial distribution of a) expected rainfall and b) departure from normal rainfall during July, 2013

5.3. August, 2013

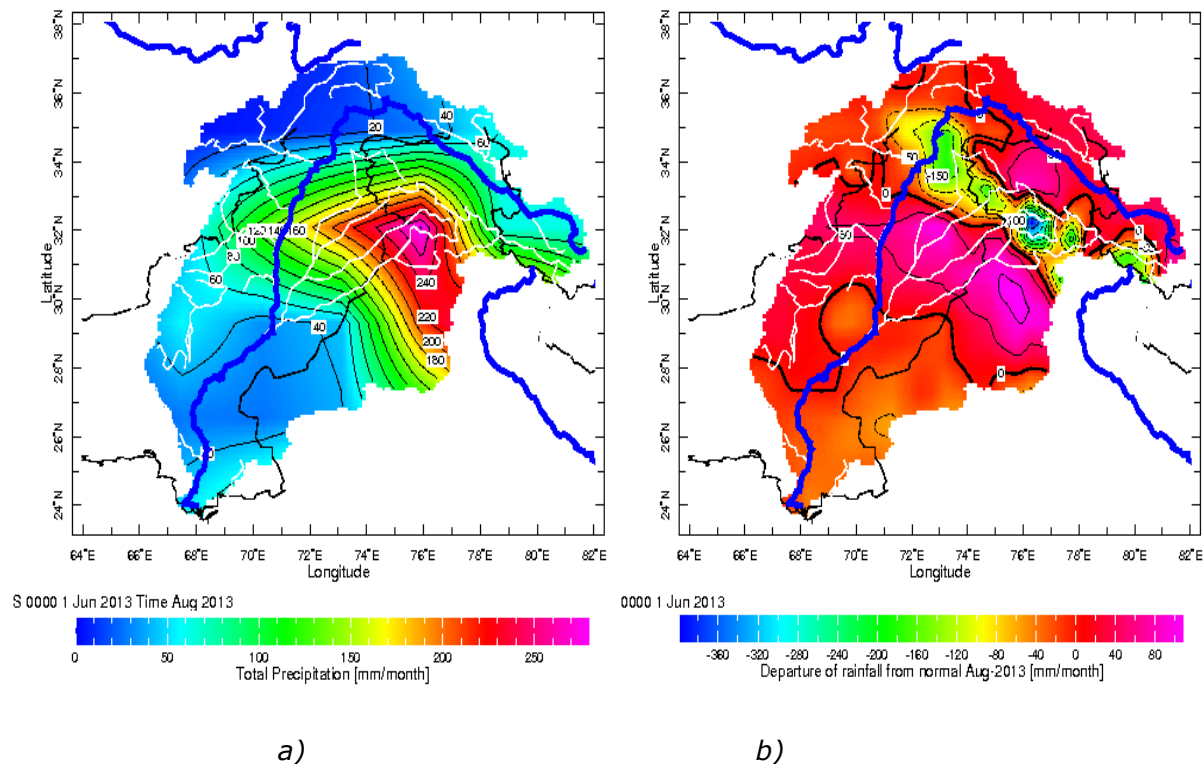


Comparison of expected and average rainfall over catchment area of Indus and its sub-regions

Seasonal weather outlook (Jun-Sep, 2013)

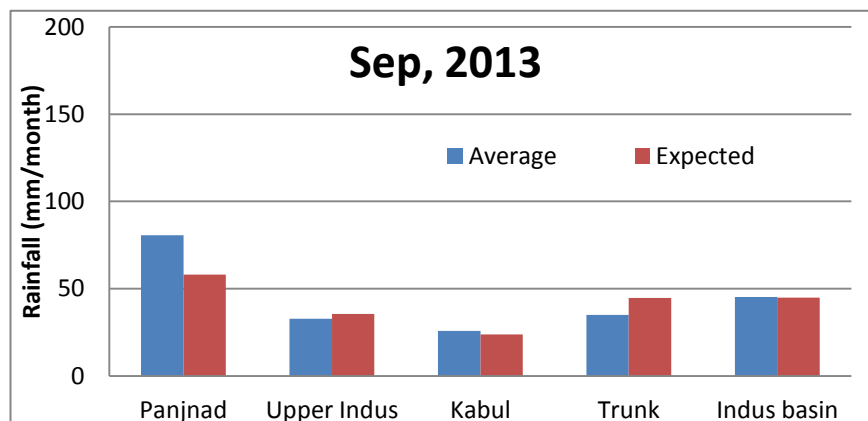
Indus Basin: Normal rainfall is expected over Indus basin indicates normal runoff water in the rivers. No shortfall of water would be observed in the water reservoirs during August. Better water management would lead to fill Tarbela reservoir as per schedule.

- **Upper Indus:** Normal rainfall is expected over catchment of Upper Indus. Water flow in the Indus will be expected as normal. Above normal rainfall will increase surface runoff level over northern areas rivers such as Konar and Swat rivers.
- **Kabul:** Normal rainfall in the catchment areas is likely that would generate normal flow in the kabul river.
- **Panjnad:** Below normal rainfall in the catchment would cause below normal surface runoff in western rivers. More surface runoff water is expected over eastern rivers (the Ravi and the Sutlej) and would be beneficial for communities living on the bank of the rivers. This would give positive impact on the agricultural land in the region.
- **Trunk Indus:** Above normal rainfall over southern parts of the country and in the foothills of Suliman rainges will increase water flow in the trunk Indus. Above normal water flow is expected in the trunk especially at Kotri barrage during August.



Spatial distribution of a) expected rainfall and b) departure from normal rainfall during August, 2013

5.4. September, 2013

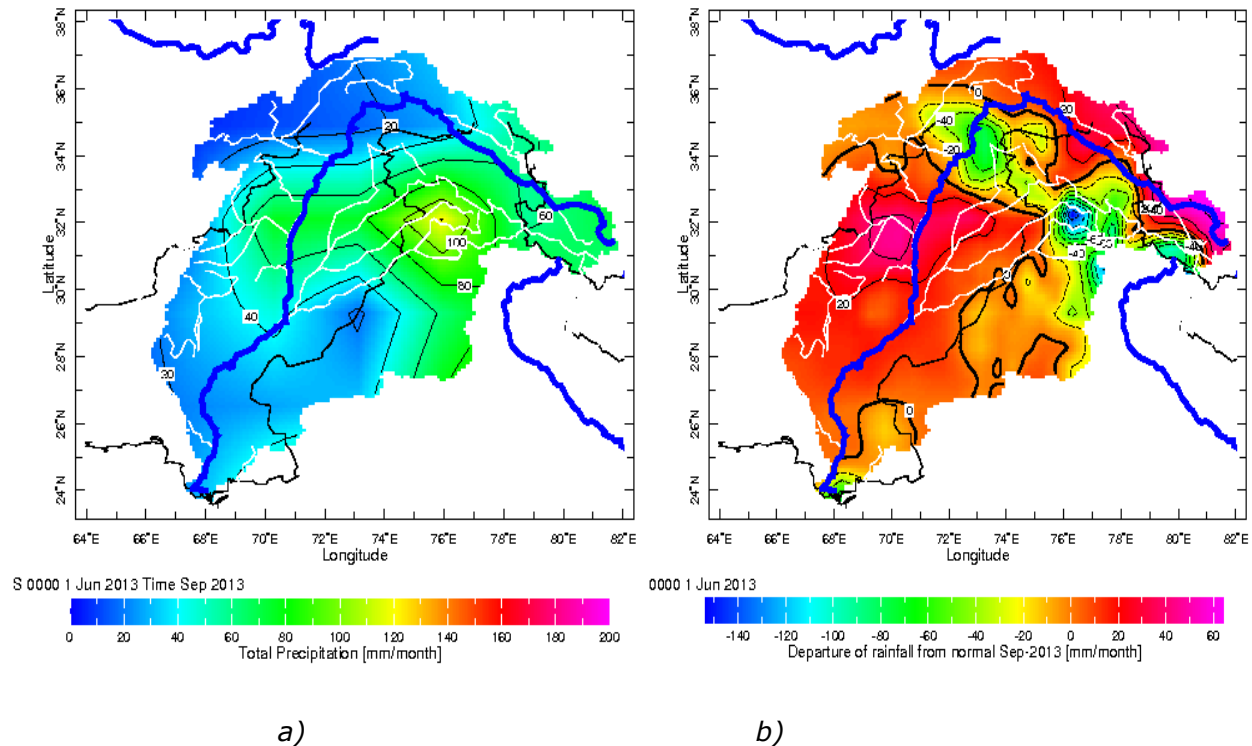


Comparison of expected and average rainfall over catchment area of Indus and its sub-regions

Indus Basin: Normal rainfall is expected over catchment area of Indus basin that would lead to normal surface runoff water in the rivers.

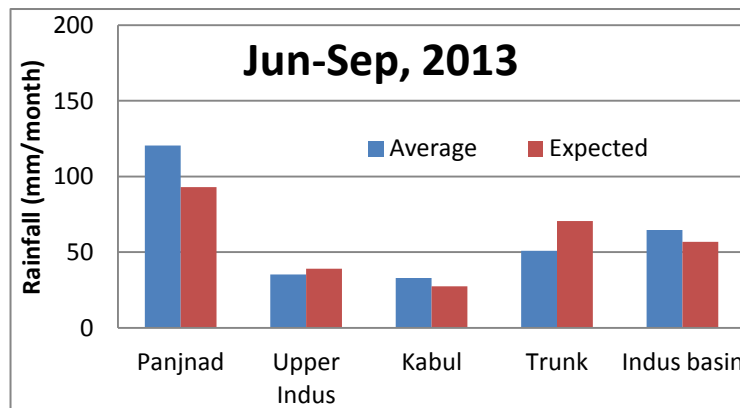
- **Upper Indus:** Above normal rainfall is expected over catchment of Upper Indus and would help increase in water flow in the Indus river and its tributaries. As a result, above normal runoff would occur over northern areas rivers.
- **Kabul:** Normal rainfall in the catchment will give normal flow water in Kabul river.
- **Panjnad:** Below normal rainfall in the catchment areas would lead to below normal surface runoff in western as well as eastern rivers. Surface water flow level will rise in lower bank of the rivers. More surface runoff water is expected over eastern rivers. This would give positive impact on the agricultural land in the southern Punjab.
- **Trunk Indus:** Above normal rainfall over southern parts of the country as well in the catchment areas of trunk cause increased surface runoff water in the trunk. This surface water will give positive impact on rabi season crop in the Sindh province.

Seasonal weather outlook (Jun-Sep, 2013)



Spatial distribution of a) expected rainfall and b) departure from normal rainfall during September, 2013

5.2. Seasonally (Jun-Sep, 2013)

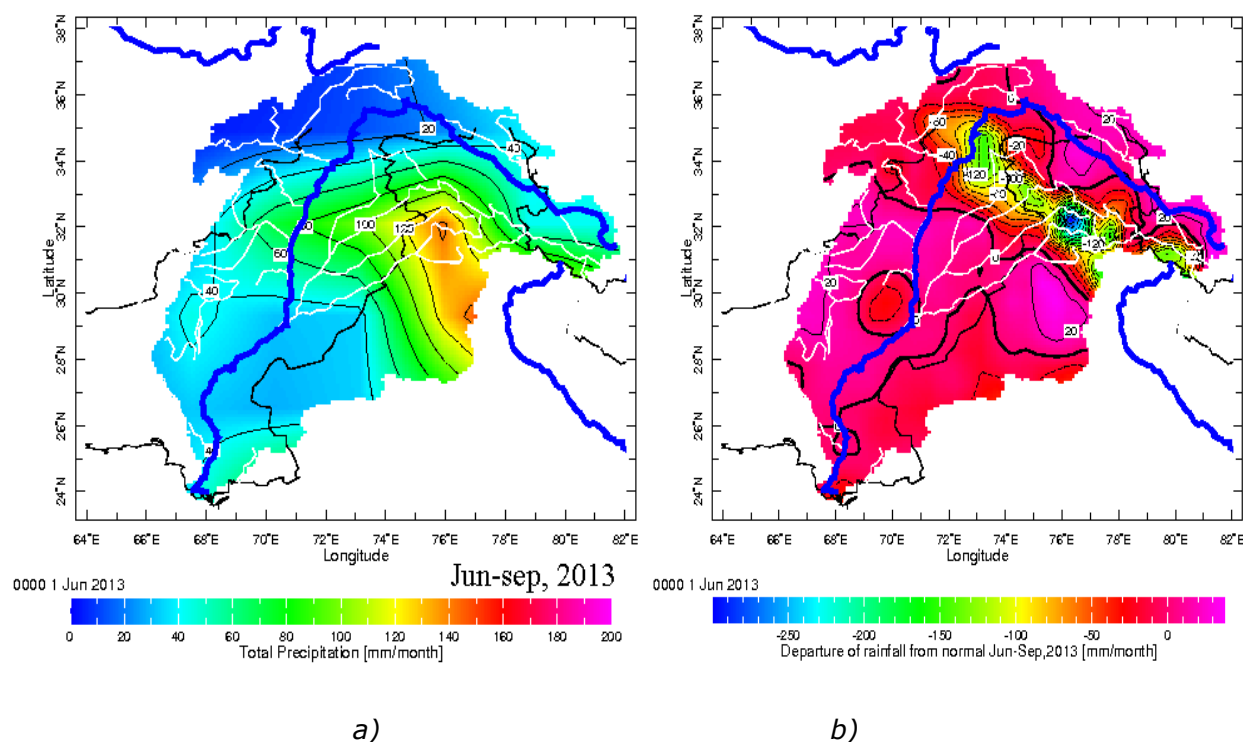


Comparison of expected and average rainfall over catchment area of Indus and its sub-regions September, 2013

Indus Basin: As a whole, Below Normal rainfall is expected over catchment area of Indus basin and may yield below normal surface runoff water in the rivers. However day temperature is expected above normal over northern region would help increase snow melt component in the river. As such, no shortfall of surface runoff likely in the main reservoir (Terbela).

Seasonal weather outlook (Jun-Sep, 2013)

- **Upper Indus:** Normal rainfall is expected over catchment of Upper Indus. In addition melting of snow/ ice may increase surface runoff water in the rivers.
- **Kabul:** Average surface runoff water is expected in the Kabul river during the predicted season. No short fall is likely from kabul river during the season.
- **Panjnad:** The catchment is under influence of less rainfall during the season that would lead to below normal surface runoff in the catchment of Panjnad. Short fall of surface runoff is likely in all the rivers (the Jhelum, the Chenab, the Ravi, and the Sutlej).
- **Trunk Indus:** Above normal rainfall over southern parts of the country as well in the catchment areas of trunk cause increased surface runoff water in the trunk region during the season. That surface runoff water would give positive impact on agriculture in the southern parts of the country.



Spatial distribution of a) expected rainfall and b) departure from normal rainfall during

Note: Research wing of NAMC is regularly monitoring variation in synoptic situation of the globe and using different global climate models regional weather prediction data for preparation of this weather outlook. Seasonal weather outlook for SAARC region will be issued 10th of every month with three months in advance weather outlook. Latest seasonal weather summary can be downloaded from NAMC web site mentioned below: <http://namc.pmd.gov.pk/>