This is a comprehensive manuscript which discuss the environmental flows and droughts in the entire Indus basin in Pakistan. Overall manuscript is well written, figures and results are well presented and conclusions are valuable. However, the quality of manuscript needs to be further improved, here are few comments which may be useful in this regards.

Authors are thankful to the reviewer for the positive feedback and valuable comments. All the comments are considered carefully, and the manuscript are revised accordingly. Response to each comment is given below in blue color.

1. In abstract section authors concluded " The alterations are subject to several factors, including climate change, seasonality of the river flow, land use changes, topography, and anthropogenic activities" which type of analysis have been performed to reach these conclusions which seems to be generic.

Response: This conclusion has been made based on the results from our recently paper under review. However, no such analyses are carried out in this manuscript to support this claim. Therefore, the statement has been removed from the abstract.

2. In the Introduction section authors stated "The Indus River basin is one of the typical basins facing substantial climate and land use changes, resulting in limited water availability". However, no references have been added to support this statement authors should state which part of the Indus basin has faced serious land use and climate changes?

Response: References are added to support this statement.

"The Indus River basin is one of the typical and most depleted basins due to substantial climate and land use changes, resulting in limited water availability (Azmat et al., 2019; Immerzeel et al., 2010; Laghari et al., 2012; Sharma et al., 2010). Upper Indus Basin (UIB) is the hotspot for climate change, whereas Middle Indus Basin (MIB) and Lower Indus Basin (LIB) are dependent on the availability of water from UIB. Several studies have reported an increase in future precipitation and temperature (Forsythe et al., 2014; Nepal and Shrestha 2015; Rajbhandari et al., 2015); however, Shahid and Rahman (2021) reported that the findings in most of the studies are not consistent with global trends due to a number of reasons".

Azmat, M., Wahab, A., Huggel, C., Qamar, M.U., Hussain, E., Ahmad, S. and Waheed, A.: Climatic and hydrological projections to changing climate under CORDEX-South Asia experiments over the Karakoram-Hindukush-Himalayan water towers. Sci. Total Environ., 703, p.135010, 2019.

Forsythe, N.; Fowler, H.J.; Blenkinsop, S.; Burton, A.; Kilsby, C.G.; Archer, D.R.; Harpham, C.; Hashmi, M.Z.: Application of a stochastic weather generator to assess climate change impacts in a semi-arid climate: The Upper Indus Basin. J. Hydrol. 517, 1019–1034, 2014.

Immerzeel, W.W., Van Beek, L.P. and Bierkens, M.F.: Climate change will affect the Asian water towers. Sci., 328(5984), pp.1382-1385, 2010.

Laghari, A.N., Vanham, D. and Rauch, W.: The Indus basin in the framework of current and future water resources management. Hydrol. Earth Sys. Sci., 16(4), pp.1063-1083, 2012.

Nepal, S., Shrestha, A.B.: Impact of climate change on the hydrological regime of the Indus, Ganges and Brahmaputra river basins: a review of the literature. Int. J. Water Res. Devel. 31, 201–218, 2015.

Rajbhandari, R.; Shrestha, A.B.; Kulkarni, A.; Patwardhan, S.K.; Bajracharya, S.R.: Projected changes in climate over the Indus river basin using a high resolution regional climate model (PRECIS). Clim. Dyn. 44, 339–357, 2015.

Shahid, M. and Rahman, K.U.: Identifying the annual and seasonal trends of hydrological and climatic variables in the Indus Basin Pakistan. Asia-Pacific J. Atmos. Sci., 57, pp.191-205, 2021.

Sharma, B., Amarasinghe, U., Xueliang, C., de Condappa, D., Shah, T., Mukherji, A., Bharati, L., Ambili, G., Qureshi, A., Pant, D. and Xenarios, S.: The Indus and the Ganges: river basins under extreme pressure. Water Int., 35(5), pp.493-521, 2010.

3. How did the authors categorize the flow data into extreme low flow and low flow?

Response: The Indicators of Hydrologic Alterations (IHA) usually consists of a total 67 parameters, which are grouped into IHA parameters (33) and Environmental Flow Components (EFCs) (34). The EFCs are grouped into five major categories, (i) low flows, (ii) extreme low flows, (iii) high flow pulses, (iv) small floods, and (v) high floods. The detailed information about the IHA parameters and EFCs are available in user manual (*https://www.conservationgateway.org/Documents/IHAV7.pdf*).

Since the flow in rivers are minimum during the drought period; therefore, this study considered on the extreme low flow (ELF) and low flow (LF) components from the five major EFC classes to understand the impact of drought (i.e., threshold that triggers the ELF and LF) on EF.

4. Various data qualities issues have been reported regarding the hydrological and meteorological datasets of the Indus basin. How authors addressed the missing datasets and which type of analysis have been performed to check the data quality?

Response: Data in Pakistan (Indus Basin) is usually manually collected by Pakistan Meteorology Department (PMD) and Water and Power Development Authority (WAPDA). Therefore, the collected data has several issues, including errors due to personal and instrumental errors, splashing due to climate, errors due to winds, topography, etc. These errors result in poor quality and missing data. The initial attempts are made by PMD and WAPDA to rectify the data following the standard code of WMO-N issued by the World Meteorological Organization. Besides, we have also performed data quality tests including the kurtosis and skewness methods to check the data quality, and the missing data is filled by zero-order methods following Rahman et al. (2018).

5. On which basis authors have done the demarcation of the indus basin into UIB, MIB and LIB?

Response: The demarcation of the Indus Basin into UIB, MIB, and LIB is done following Aftab et al., (2022), Rajbhandari et al., (2015), and Shahid et al., (2021).

Aftab, F., Zafar, M., Hajana, M.I. and Ahmad, W.: A novel gas sands characterization and improved depositional modeling of the Cretaceous Sembar Formation, Lower Indus Basin, Pakistan. Front. Earth Sci., 10, p.1039605, 2022.

Rajbhandari, R.; Shrestha, A.B.; Kulkarni, A.; Patwardhan, S.K.; Bajracharya, S.R.: Projected changes in climate over the Indus river basin using a high resolution regional climate model (PRECIS). Clim. Dyn. 44, 339–357, 2015.

Shahid, M., Rahman, K.U., Haider, S., Gabriel, H.F., Khan, A.J., Pham, Q.B., Mohammadi, B., Linh, N.T.T. and Anh, D.T.: Assessing the potential and hydrological usefulness of the CHIRPS precipitation dataset over a complex topography in Pakistan. Hydrol. Sci. J., 66(11), pp.1664-1684, 2021.

6. Various studies have been performed to understand the drought in the Indus basin Authors can open the scholar and search from key word droughts in Indus basin. However, no discussion has been performed to compare the results of this study with literature. Discussing the results with previous studies will be useful for readers and this manuscript has potential to be extended for a brief discussion.

Response: A detailed discussion section is added to the manuscript following the recommendations of reviewer. However, there is no such studies available in literature that identified the drought severity causing low flow and extreme low flow in the rivers, and quantified the impact of drought on environmental flow:

Pakistan has been added to the list of water-stressed countries due to water scarcity issues under severe climate change and land use change scenarios. However, it is relatively difficult to precisely assess the impact of climate change on water availability in the Indus Basin because of uncertainties due to topographic complexity, local changes in climate that influence the natural glacial and snow melt process, glacial retreat, and shifts in precipitation pattern (Janjua et al., 2021). The UIB contributes approximately 45% of the flow to the main rivers in Indus Basin, suggesting the high vulnerability of glacial melt to climate change and results in a 40% of surge in riverine flow (Janjua et al., 2021). However, on the long run, the average flows in the main tributaries of the Indus Basin are reduced by almost 60% (Briscoe and Qamar, 2006). This reduction in river flow is mainly associated with the global warming, i.e., the evapotranspiration is likely to increase significantly in the irrigated areas of the Indus Basin resulting in the increase of water demand for irrigation (National Research Council, 2012). The Indus Basin (Pakistan) receives highest magnitude of precipitation (50%-60%) during the monsoon season that results in approximately 85% of the annual discharge in the Indus Basin, which will be significantly altered in a couple of decades due to climate change (National Research Council, 2012).

Extreme events, i.e., droughts and floods resulted due to climate change has tested the inhabitants of the Indus Basin in a number of ways. Pakistan is an agricultural country, where the economic development depends on sustainable agricultural production (Rahman et al., 2023b). Besides the direct impact of droughts on agricultural productivity, the droughts also cause significant reduction in surface water availability and consequently the irrigation water supply. The estimated water consumption by municipal and industrial sectors in Pakistan is approximately 5.3 km^3, which is projected to increase to 14 km^3 by 2025 (Condon et al., 2014). Therefore, there will be limited available water for irrigation purpose and will significantly impact the water availability in rivers and in turn the sustainable EFs.

The Indus Basin Irrigation System (IBIS) irrigates approximately 150,000 km^2 out of 190,000 km^2 of cultivated crop area in the Indus Basin (Ahmad, 2005), resulting in the deterioration of environmental water and the Indus delta ecosystem because of lack of sustainable minimum flow in the riverine system (Janjua et al., 2021). The conditions required for minimum flow in rivers becomes more critical during the drought periods; for instance, the difference between water demand and supply was 20% during the 2000–2002 drought period (Briscoe, 2006). Keeping in view the worse condition of EF in the Indus Basin, it was suggested by the experts in 2005 that we should sustain a minimum flow of 141.58 m^3/s in the Indus River from Kotri Barrage to the sea (González et al., 2005). Due to the extensive withdrawal of surface water from the rivers by the IBIS, it was decided to ensure a 30 km^3 of cumulative flow for a period of 5 years in the Indus River (González et al., 2005).

Beside the water withdrawal through IBIS, drought has significant contributions in reducing the flow in rivers of the Indus Basin (Rahman et al., 2023a). The persistent meteorological drought reduces the water availability in river flows, which then ultimately translates into insufficient release of EF (Pena-Guerrero et al., 2020). The frequency and intensity of drought in the Indus Basin has been increased substantially in the recent decades, which resulted in high variability in meteorological and hydrological droughts. Rahman et al. (2023a) propagated drought from one catchment to another in a systematic approach using the principal component analysis (PCA) to understand the variability in both meteorological and hydrological droughts. Results showed high variability in hydrological droughts compared to meteorological droughts in most of the catchments in the Indus Basin. In other words, most of the catchments experience a decrease in river flow associated with meteorological drought and thus depicting that drought is one of the major threats to sustainable ecosystem and EF.

Very few studies have assessed the impact of drought (meteorological) on EF. For instance, Młyński et al. (2021) have studied the impact of drought (Standardized Precipitation Index, SPI) on EF across mountainous catchments in Poland. The study reported that drought has the potential to alter the EF, whereas the alterations in EF are dependent on several factors such as topography (slope), local climate and hydrogeological conditions. However, the impact of drought on EFs is yet to be investigated in details; therefore, this study is first of its kind that evaluated the impact of drought on EF under two distinct scenarios: i) drought severity that causes LFs and ELFs in the rivers, and ii) the months where drought caused LF and ELF. Keeping in view the importance of maintaining minimum flow in rivers and frequent severe drought events in the Indus Basin, the relationship between drought and EF in the Indus Basin should further be investigated in more details. Overall, results obtained in this study will help the policy makers to devise a plan for the sustainable management of EF in the Indus Basin.

Ahmad, S.: Water balance and evapotranspiration. In: J. Briscoe, ed. Pakistan's Water Economy: Running Dry. Oxford University Press, Oxford, 2005.

Briscoe, J. and Qamar, U.: Pakistan's water economy: running dry. The World Bank, 2006.

Condon, M., Kriens, D., Lohani, A. and Sattar, E.: Challenge and response in the Indus Basin. Water Policy, 16(S1), pp.58-86, 2006.

González, F. J., Basson, T. and Schultz, B.: Final Report of IPOE for Review of Studies on Water Escapages Below Kotri Barrage, 2005.

Janjua, S., Hassan, I., Muhammad, S., Ahmed, S. and Ahmed, A.: Water management in Pakistan's Indus Basin: challenges and opportunities. Water Pol., 23(6), pp.1329-1343, 2021.

Młyński, D., Wałęga, A. and Kuriqi, A.: Influence of meteorological drought on environmental flows in mountain catchments. Ecol. Ind., 133, p.108460, 2021.

National Research Council.: Himalayan Glaciers: Climate Change, Water Resources, and Water Security. National Academic Press, Washington DC, 2012.

Peña-Guerrero, M.D., Nauditt, A., Muñoz-Robles, C., Ribbe, L. and Meza, F.: Drought impacts on water quality and potential implications for agricultural production in the Maipo River Basin, Central Chile. Hydrol. Sci. J., 65(6), pp.1005-1021, 2020.

Rahman, Khalil Ur, Anwar Hussain, Nuaman Ejaz, Songhao Shang, Khaled S. Balkhair, Kaleem Ullah Jan Khan, Mahmood Alam Khan, and Naeem Ur Rehman.: Analysis of production and economic losses of cash crops under variable drought: A case study from Punjab province of Pakistan. Int. J. Disas. Risk Red. 85, 103507, 2023b.

Ur Rahman, K., Shang, S., Balkhair, K. and Nusrat, A.: Catchment-Scale Drought Propagation Assessment in the Indus Basin of Pakistan Using a Combined Approach of Principal Components and Wavelet Analyses. J. Hydrometeorol., 24(4), pp.601-624, 2023a.

7. I have some minor comments regarding use of abbreviations which are unnecessary, should be reduced and must be explained at first use e.g. In abstract section authors should explain EFs before first use.

Response: Corrected as suggested. The term EF is already explained in the first line of the abstract before its use.