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Solar and Human Activity Impact on High and Low Land River Flows

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Abstract

In the last two decades, in the Kosovo area, we have seen extraordinary climate changes and their consequences, such as flash floods, empty reservoirs, and forest burning. So, the objective of this article is to analyze the main drivers of climate change due to global warming, like Temperatures, Precipitation, River flows (TPQ), Human Activity (HA) on one side and the extraterritorial factor of sunspot number NS on the other side. The methodology of the approach is statistical, with trend detection, comparison, and calculation of significance for each factor. There are data in state institutions, daily and monthly, for TPQ from 1963–2022 and Sunspots from 1954–2006. Three Highland HL, two Lowland LL rivers, and two Temperature and Precipitation Meteorological stations were considered for analysis. For river LL1, the data needed to be completed, and correlation, calibration, and validation methods were applied to fill the gaps. Results indicate that sunspot numbers show a decrease of -18% from the average value, Temperature +24%, Precipitation +5%, HL1 flow -31%, HL2 -0.5%, HL3 -7.5%, LL1 -22%, and LL2 -13%. The significance of the impact of Sunspots on the air temperature approximates 75%, while the impact of human activity approximates 25%. This will be an excellent contribution to future water resource management plans.

Keywords: Sunspots; Temperatures; Precipitations; River-Flows; Trends.

1. Introduction

Our Climate is changing. We need drinkable food and energy-rich water. Every year, we have summer flash floods, forest burning, land use changes, dry reservoirs, and winter frontal floods, and we still don't have water resources management plans (for water protection and water use). The water Monitoring System is still getting consolidated (after the War of 1999). Without data and information, no plans, models, or predictions exist. So, the question is: which Hydroclimatic parameters change the climate? Which variables drive the climate? How do we predict the next drought and flood? Many authors have written scientific articles about climate changes and the relationship between climate drivers, trying to detect trends in hydroclimatic variables and the relationship between them. It is known to meteorologists that Solar activity and its sunspot number (N_S) are the first "Domino" that drives the Earth's Humidity; then come Ocean-Circulation models and air Temperature, Precipitation, and river Flows (TPQ). Can we predict droughts and floods? Can we find the relationship between them? From the literature, Stager et al. [1] concluded that if the sun-rainfall relationship persists in the future, then sunspot cycles can be used for long-term prediction of precipitation anomalies.

Laurenza et al. [2] have shown that the correlation between precipitation and solar activity in central Europe appears to be mostly positive, both statistically and by visual curve comparison, and a wavelet analysis of Germany's February precipitation confirms the presence of an ~11year cycle period from the mid-1920s to the mid2000s. The cycle appears to be weaker in the 1-2 decades before and after this period. Schmutz [3] studied that as solar irradiance variations have

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a global effect, there has to be a global climatic solar forcing impact. In the study of Ormaza-González et al., it seems that over the relatively short time scales of SS cycles, either on their initial ascending or end of descending phases, impacts on the studied indexes seem to be triggered or influenced. The cycle 25 started in December 2020; therefore, around 2023–2024, an El Niño event could occur according to these results. Schulte et al. [5] concluded that the correlation analysis detected statistically significant relationships between climate indices and streamflow that were similar for the three rivers.

Demaria et al. [6] studied changes in the annual cycle of precipitation that are likely to occur during the 21st century as winter precipitation increases and warmer temperatures reduce snow coverage across the entire domain, especially in the northern basins. While Maghrabi et al. [7] concluded that trends in rainfall in Saudi Arabia are affected by large-scale circulations and local factors, the effect of extra-terrestrial factors such as solar activity and its consequent effects on the climate may additionally play a potential role in affecting the pattern of rainfall in Saudi Arabia. Mwangi et al. [8] studied climate variability and human activities as the main drivers of change in watershed hydrology, and climate change was predicted to cause a moderate 16% and 15% increase in streamflow in the next 20 and 50 years, respectively. Some of them are contra. Lopes et al. [9] worked on changes in flow regime in the Incomati basin that are mostly driven by anthropogenic activities (e.g., irrigated agriculture, forestation, and dam operation) and not by climate change.

Garrousi et al. [10] studied the correlation between altitude and rainfall, between temperature and runoff, and between snowfall and runoff, which was found to be negative. Therefore, the role of climatic elements such as temperature, rainfall, and snowfall in the basin is quite tangible. I think that there are Sunspots on one side and Human activity on the other that drives climate change. Maghrabi et al. [11] concluded that the spectral and correlation results suggested that, with the expected effects of terrestrial and meteorological conditions on AV, long-term AV variations can also be related to solar activity and associated CR modulations. He et al. [12] indicated that annual, winter, and spring precipitation variabilities generally have an increasing tendency in every region. This implies the increasing frequency of precipitation extremes, which are also projected to occur throughout the 21st century with continuing warming expected. Almazroui et al. [13] found that the frequency of intense rainfall events is increasing for the majority of stations in Saudi Arabia, while the frequency of weak events is decreasing.

The objective of this article is to analyze the main drivers of climate change due to global warming, like Temperatures, Precipitation, River flows (TPQ), and Human Activity (HA) on one side and the extraterritorial factor of sunspot numbers (NS) on the other. The methodology of the approach is statistical, with trend detection, comparison, and calculation of significance for each factor. Through the examination of Temperature, Precipitation, and River flows (TPQ) along with Human Activity (HA) and sunspot numbers (NS), this study aims to gain valuable insights into their individual and collective impacts on climate change. The statistical analysis will enable policymakers and researchers to better understand these drivers and their interactions, offering essential information for developing effective strategies to manage climate change and mitigate its adverse effects.

2. Materials and Methods

2.1. Materials

Materials used in this article are taken from Pristina and Belgrade Hydro-meteorological institutions and similar regional institutions [14]. The last data issued on daily air temperature, precipitation, and river flows are from the years 2021 in Serbia [15], Slovenia [16], and Monte Negro [17], and the year 2020 in Kosovo [18]. There is also a gauging station that issued data for the year 2022. In the following Table 1, we are given the data on rivers taken in the study.

Table 1. Information on features of considered rivers

Type of river	River and Station Name	River Country	Yield altitude (m.a.s.l.)	Remark
HL1	Lim Brodarevo	M. Negro, Serbia	2500	Complete observed data
HL2	Ibar Batrage	M. Negro, Serbia, Kosovo	2000	Complete observed data
HL3(ML)	Raska, Raska	Serbia	1600	Complete observed data
LL1	Sitnica Nedakovc	Kosovo	800	Observed 1963-1998 correlated 1999 - 2021
LL2	Topljica Doljevac	Serbia	800	Complete observed data

Figure 1 shows the geography of Kosovo. In the study, are taken three High-land flows of average data are taken: HL1, HL2, and HL3, and two low-land flows of data: LL1, LL2, average temperature of Ferizaj City (578 m.a.s.l.), and the precipitation of Ferizaj and Raska City (1038 m.a.s.l.), on an annual timescale, for the time period 1963–1921. Sunspot number average annual data are taken from [19] for 1954–2006, while for 2007–2022, they were assumed (Figure 2). Observed data for river LL1 were not complete; therefore, by correlation, calibration, and validation with accurate data in the region, they were completed for the years 1999–2021.

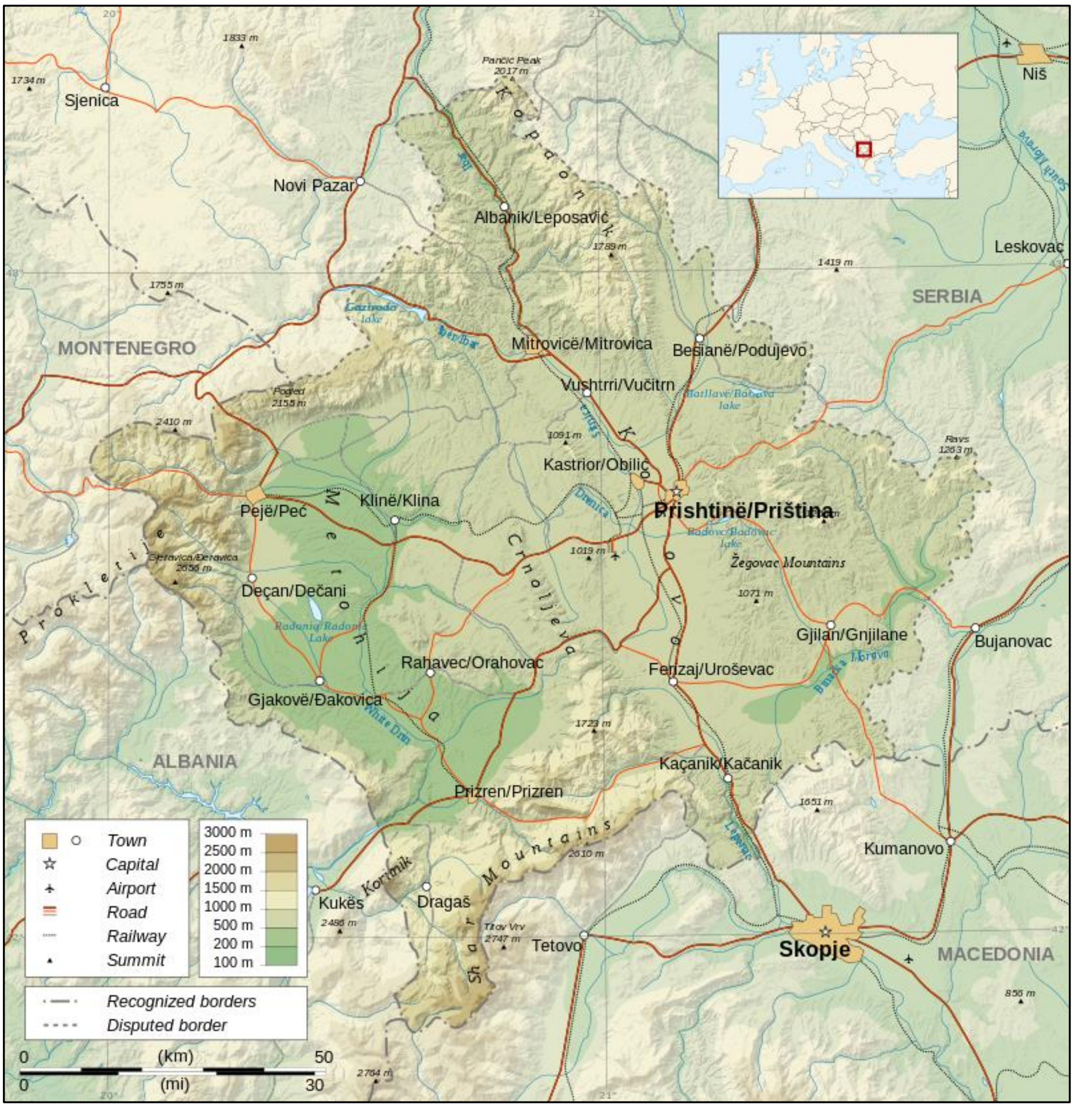


Figure 1. Geography of Kosovo

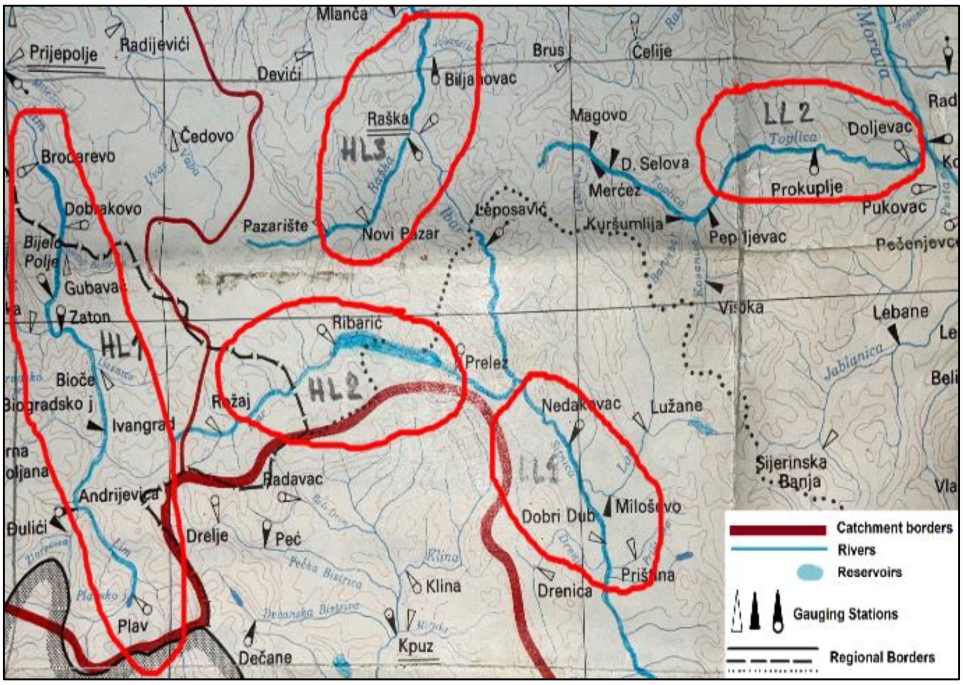


Figure 2. Hydro-meteorological map of rivers

2.2. Methodology

The methodology used in this article is from applying statistics in Hydrology. Initially, missing data were completed, which included correlation, calibration, and validation of long-term daily and annually average data of temperatures, precipitation, and flows. Then, charts of different time scales were drawn, for three basic physical parameters of clime (TPQ). By observing and comparing trends of Solar activity and TPQ, their impact and connections can be detected. There is also the application of the double mass method, where such changes in Hydro-meteorological parameters can be seen. The Black-Box model is good enough to obtain conclusions if the observed data are accurate.

$$x_o = \frac{\sum_i^n x_i}{n} \text{ where } x_o \text{ is average random event} \tag{1}$$

$$s_o = \sqrt{\frac{\sum(x_i - x_o)^2}{n}} = \frac{\sum|x_i - x_o|}{n} \text{ average deviation of random events} \tag{2}$$

$$c_v = \frac{s_o}{x_o} \text{ coefficient of variation of random events} \tag{3}$$

$$c_s = \frac{n}{(n-1)\cdot(n-2)} \cdot \sum\left(\frac{x_i - x_o}{s_o}\right)^3 \text{ coefficient of asymmetry of random events} \tag{4}$$

$$S_{REL} = \frac{x_i - x_o}{s_o} \text{ relative deviation of a random event} \tag{5}$$

Testing has been done by the Nash-Sutcliffe coefficient, and it is as follows:

$$R_{NS}^2 = 1 - \frac{\sum(Q_{OBS} - Q_{CORR})^2}{\sum(Q_{OBS} - Q_{AVE,OBS})^2} \quad \text{for i =1-365} \tag{6}$$

where is: R_{NS}^2 is a fitting quality indicator of observed and correlated hydrographs according to Nash – Sutcliffe, Q_{OBS} – observed flows, Q_{CORR} is correlated flows, Q_{AVE} is the average flow of observed flows.

In this case, the fitting quality indicator is 78%, which is very good quality compared to no data at all. Other fitting indicators will determine appropriate quality on a larger scale, such as fitting of averages, fitting of forms, and fitting of dry and wet seasons. Relative residuals for minimal, average, and maximal flows are:

dQ_{MIN} is 8% | dQ_{AVE} is 9% | dQ_{MAX} is -9% | $dQ_i is \frac{Q_{obs} - Q_{cor}}{Q_{obs}} \times 100$ (%)

The "Queen" parameter that concerns us is flow or discharge Q (m^3/s). Except by observation in the gauging station, it can also be obtained from the equation:

$$Q = P - E - G \tag{7}$$

Where, Q is surface flow and rapid underground flow (l/ (m^2 year)), Pis precipitation (l/ (m^2 year)), E is evaporation (l/ (m^2 year)), and G is slow underground flow and ground flow (l/ (m^2 year)).

All these parameters depend on two parameters: R_H – Relative humidity and T (^OC) Air Temperature. Relative Humidity depends on basic driving parameters, sunspots frequency N_S, which is random (at least doesn't depend on human activity), and Temperature. Temperature is more complex because it depends on many static-determined and dynamic-random parameters. The temperature depends from:

Where, α is Earth Position to Sun (season), determined relatively, φ is Latitude position, determined relatively, Z is Altitude level, determined, v_g is Ground cover – vegetation, determined and $RH_{G\&L}$ is Relative Humidity, Global and Local, random.

Figure 1, shows the flowchart of the research methodology through which the objectives of this study were achieved.

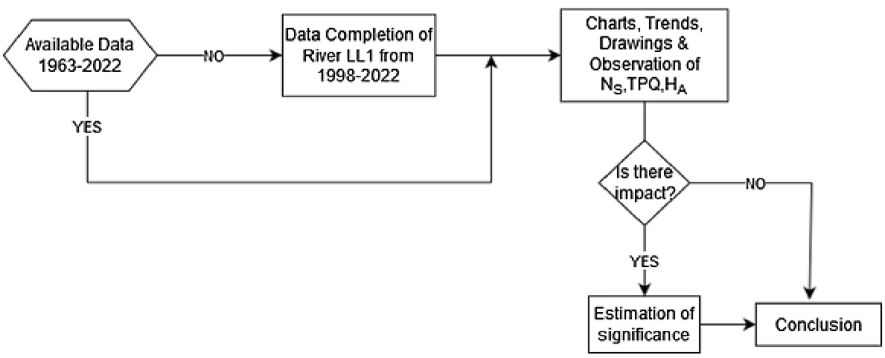


Figure 3. Flow chart of the methodology

3. Results and Discussion

A flow trend is a curve showing how a river's flow changes, falling or rising. It can be a linear, polynomial, exponential, or logarithmic function that best fits a random hydro-meteorological event. But for hydro-meteorological events, this is a more complex duty. First, it varies from many parameters, many of them determined, and at least one is random. The second problem is the time scale of the considered trend. As the number of sunspots and the periodicity change, we have increasing (brightening) and decreasing (dimming) trend development [20]. That is one side of the "rope" ("random action"). Another side is our planet and astronomical, geophysical, and geopolitical (human impact) conditions. This is a "determined reaction". Therefore, this is a very relative estimation. Usually, it takes 22 years for a sunspot cycloid (2π). A minimum of two circles of observed data are necessary to define a complex river flow trend.

Figure 4 shows the given temperatures for Ferizaj, a mid-land city, and Sjenica, a high-land city. Those are observed until 2020 and 2021 (officially), correlated for 2021 and 2022, and assumed for 2023. We can see an up-and-down relative oscillation since 1961 but an absolute increment since 1979. Temperatures have been rising for the last 40 years at all levels of altitude.

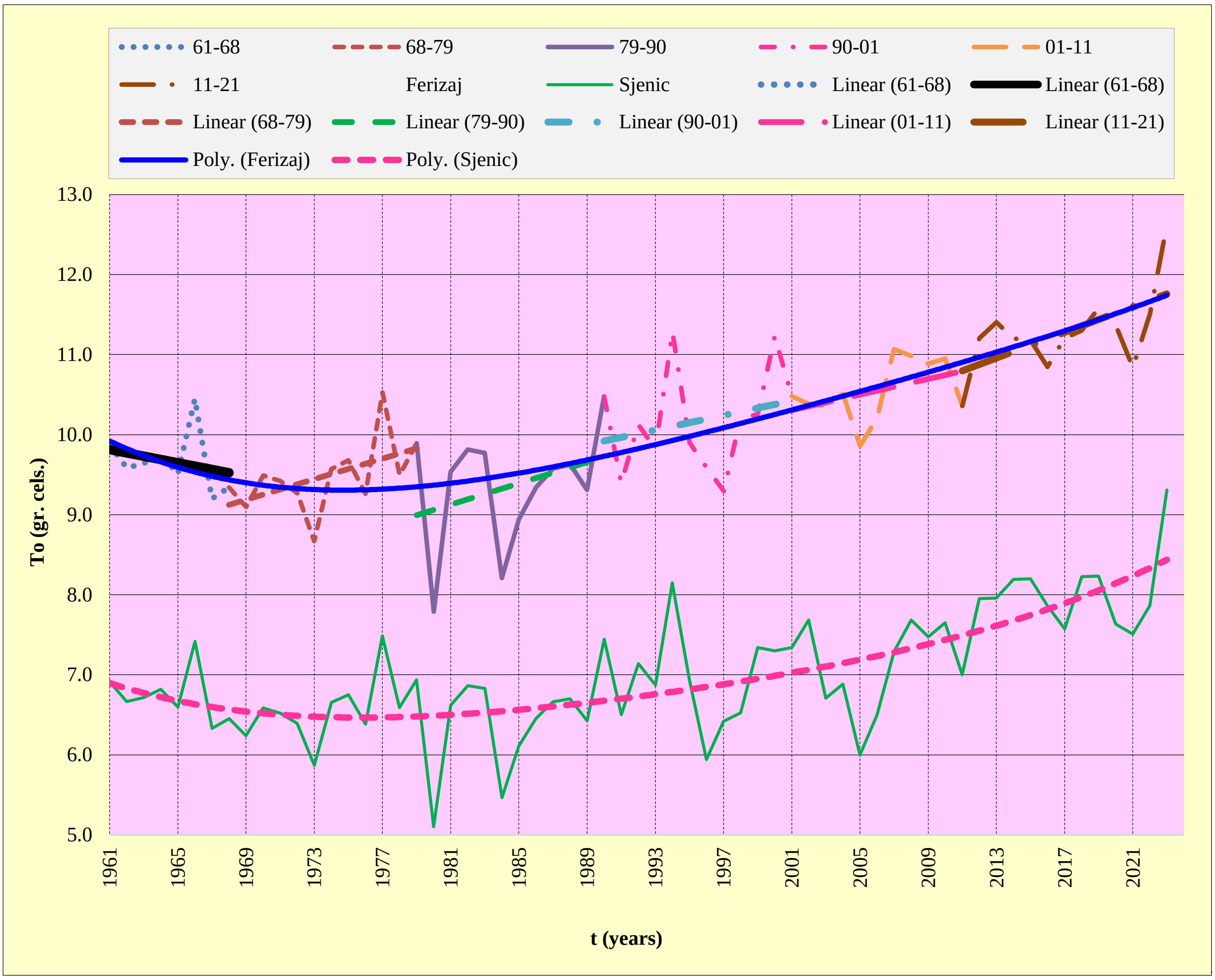


Figure 4. Long-term average annually temperatures and its linear and polynomial trends of Ferizaj (586 m) and R.C. Sjenica (1240 m) city

Figure 5 presents monthly precipitation for Ferizaj city station (579 m) and Kotlina Station (797 m) for the years 2016, 2018, and 2019 (official data). The first station is in a city that has faced rapid urbanization for the last 15 years. In the summer season (June, July, and August months), precipitation is more significant (continuous red line) than precipitation in the high-land Kotlinë station (blue dashed line), while in the winter and autumn seasons, precipitation is more significant in the high-land and non-urbanized stations of Kotlina. I may conclude that convective rainfall is increasing in intensity in the city and in the summer. One flash storm of 108 (lit/m^2)/hour happened in Ferizaj in May 2018.

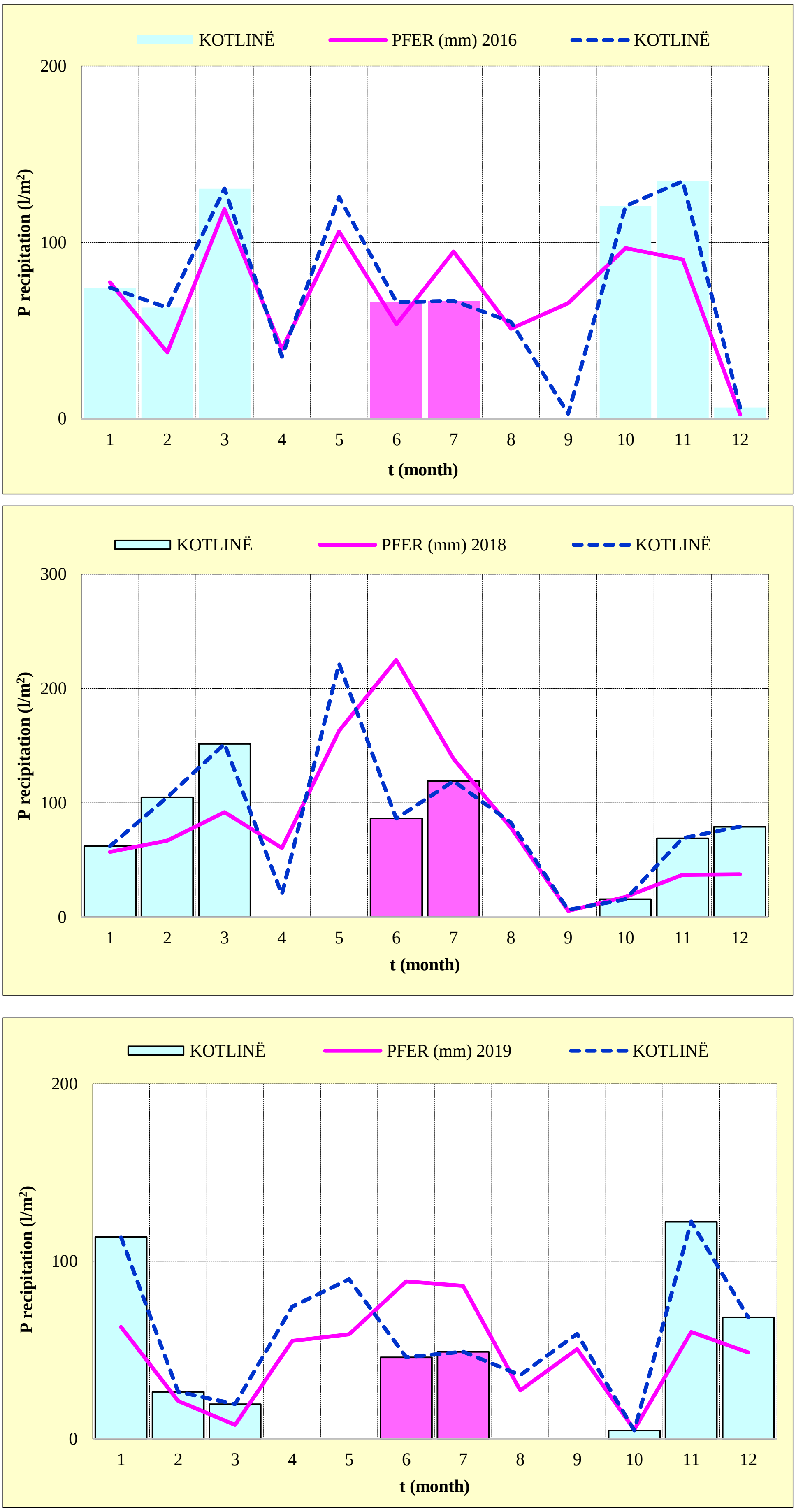


Figure 5. Summer and winter monthly precipitations for rapid urbanized city of Ferizaj (579 m) and for highland suburb station of Kotlina (797 m) for years a) 2016, b) 2018 and c) 2019 (official data)

Figure 6 presents long-term annual precipitations and their linear and polynomial trends at low-land Ferizaj (579 m) and high-land Sjenica (1038 m) rainfall stations, official data from 1947–2020 and 1958–2021. The year 2022 is correlated, and the year 2023 is assumed. In both stations, long-term polynomial trends show an increment of precipitation in the second Sun cycloid period. In the second high-land, normally urbanized city of the station, the linear brightening and dimming trends are not disturbed and have a weak change (Figure 6-b), while in the rapidly urbanized city, the linear trends have been disturbed in the last three decades (Figure 6-a). Precipitation values are in the absolute and relative ranges.

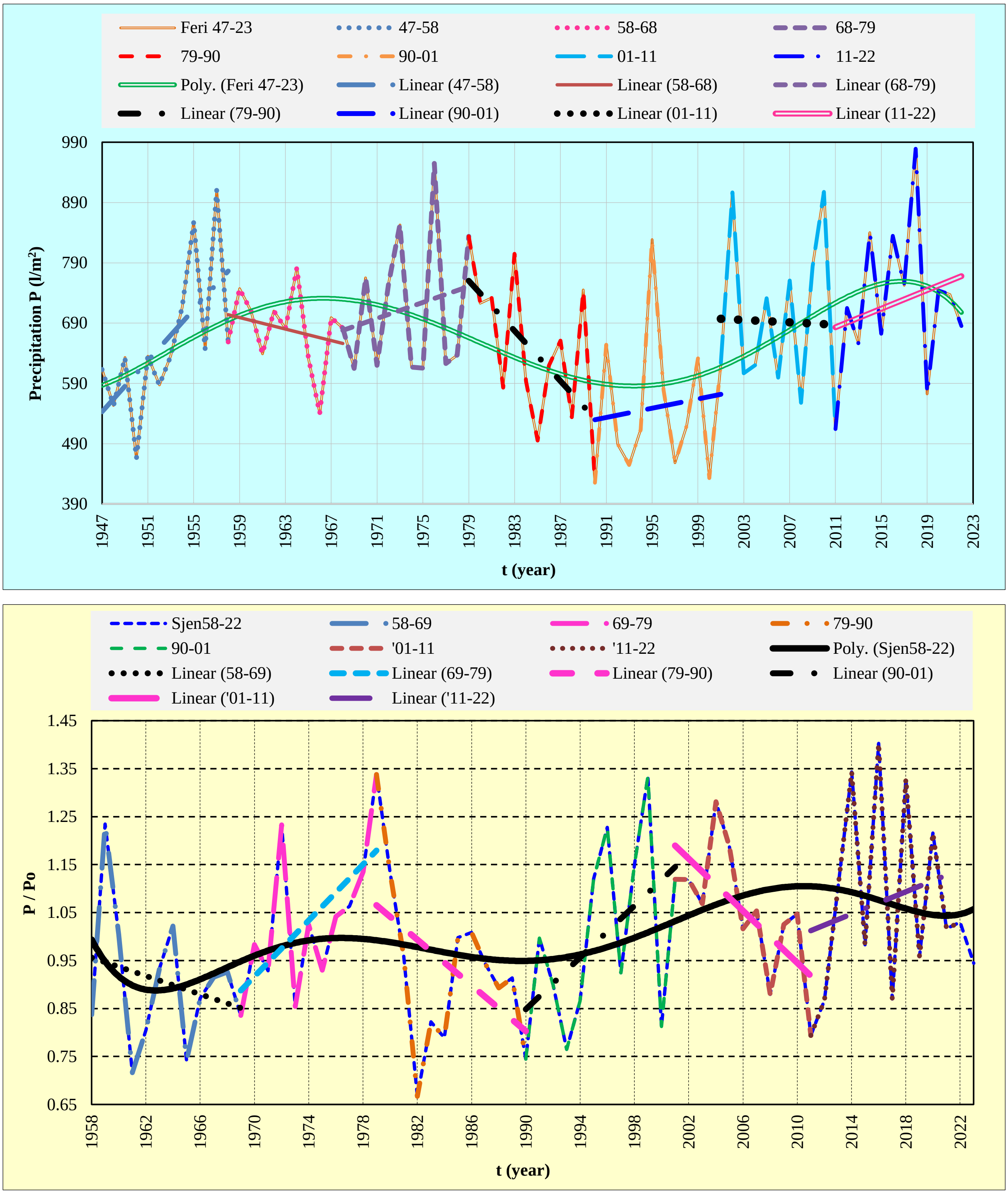
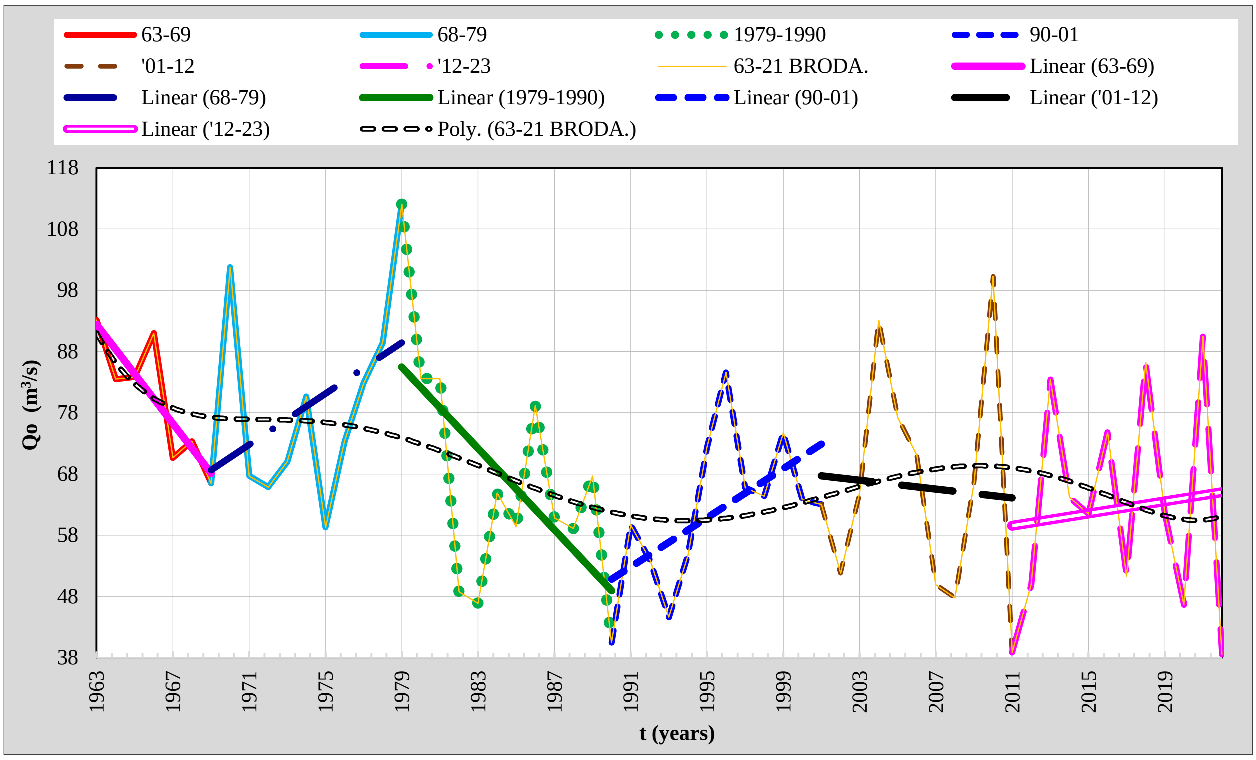


Figure 6. Long-term annual precipitation of Ferizaj city 1947-2020, of Sjenica 1958-2021 and its linear and polynomial trends

Figure 7 presents long-term annual flow hydrographs of high-land river HL1 of the observed period 1963-2021 and long-term annual flow hydrographs of high-land river HL2 of the observed period 1963-2021. River HL1, during its whole observation period, shows certain trend decrement. Linear brightening and dimming trends closely follow Sunspot activity, except for the trend of the period 2001-2022, which deviates (the dimming period of Sunspots and probably a combination with the Human impact). River HL2 shows little decrement and disturbance of linear trends in the last three decades.



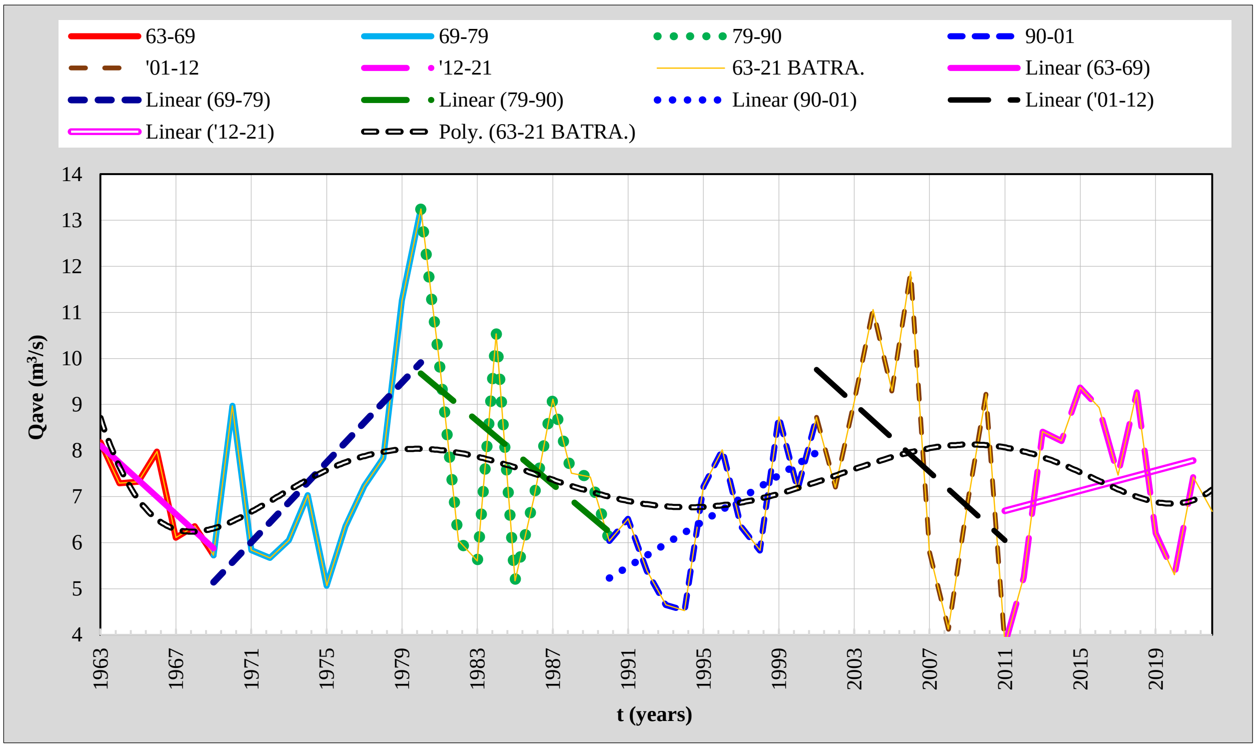


Figure 7. High-land HL1 and HL2 annual average river flows linear and polynomial trends of 1963-2021

Polynomial trends show a flow decrement, except for the last decade, which shows an increment of flow. Linear brightening and dimming trends closely follow Sunspot activity, except for the trend of the period 2001–2012, which is out of order, probably because of forest burning in the very hot 2007 year [21]. Figure 8 shows long-term annual flow hydrographs of the high-land river HL3 of the observed period 1963–2021 and the low-land river LL1 of the observed period 1960–2021. The whole-period polynomial flow trend of HL3 shows less increment. Linear brightening and dimming trends closely follow Sunspot activity, except for the trend of the period 1990–2021.

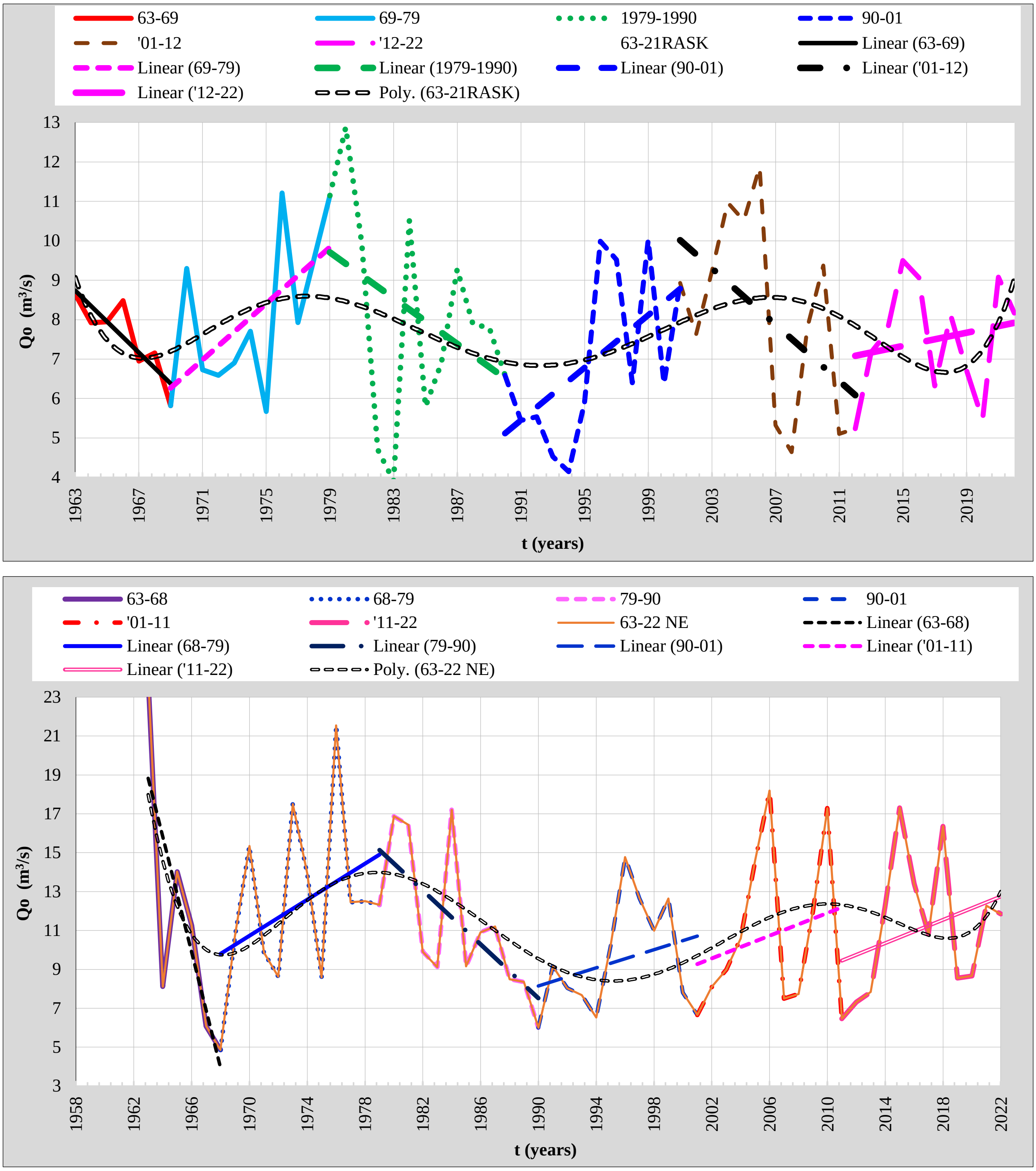


Figure 8. High-land HL3 and low-land LL1 river flows linear and polynomial trends of 1963-2021 and 1960-2021

The river LL1 is very difficult to explain. Processed flow data is officially from 1963–1998. After that year, data are correlated and validated up to the 2021 year because, for this period, the hydro-meteorological institution is given only depth data H (cm) but not flows. The main part of this river passes through an urbanized area with many sewage discharges, so over the last five years, it has shown very high levels of water and very often causes floods during the summer season (convective rainfalls) and during the winter (frontal precipitations). I expect that in the next five years we will face flash floods during the summer and heavy floods from frontal precipitation during the winter. Some deviation can also be found in Figure 11-b of the Double mass method (later on). If we focus on what we have in Figure 8-b, the long-term polynomial trend shows a decrement in flows, while the linear trend of the 2001–2012 period shows a strong deviation (sewage discharge, convective rainfall "flash" storms, and winter precipitation).

Figure 9 presents a long-term annual flow hydrograph of Lowland River LL2 for the observed period of 1963–2021. This is a Low-land River in the region, similar to the LL1 river mentioned above but without rapid urbanization and sewage discharges. The long-term polynomial trend shows little decrement, while the linear trends of sunspot periodicity from 2000 to 2010 show a deviation from the "saw" form. It must be because of global warming.

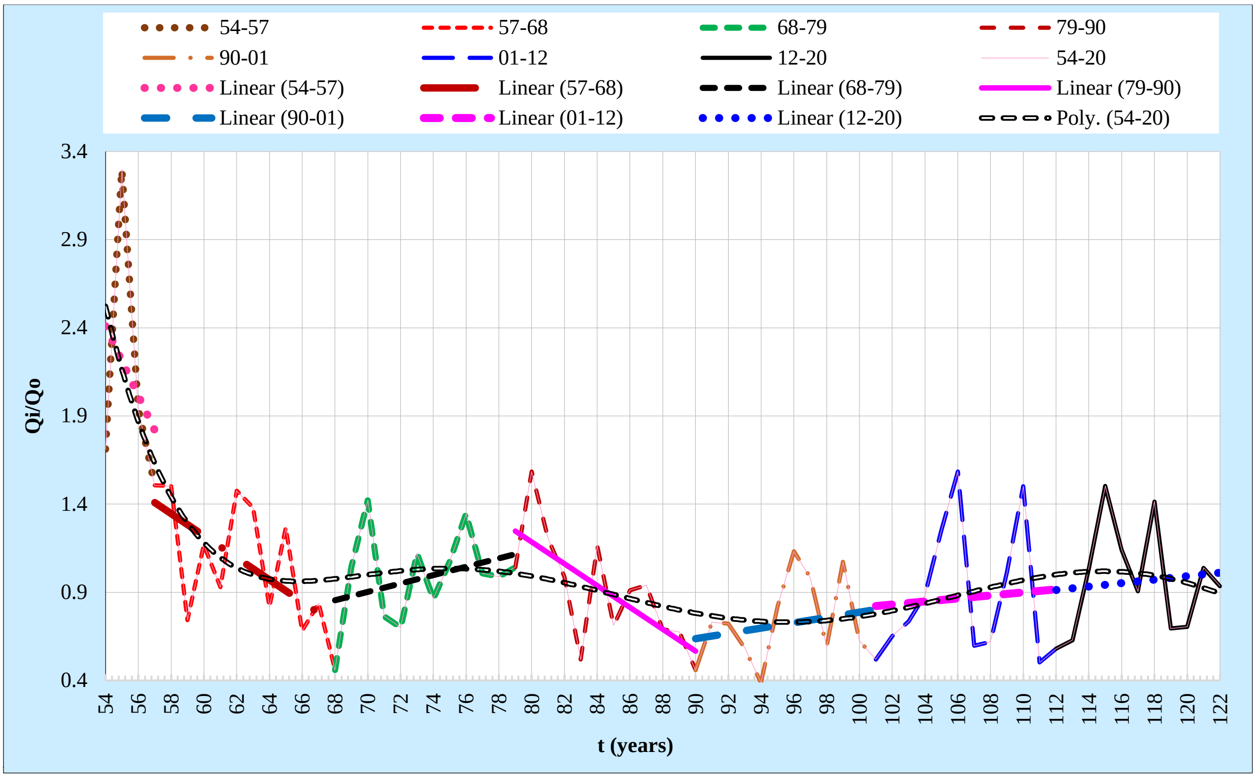
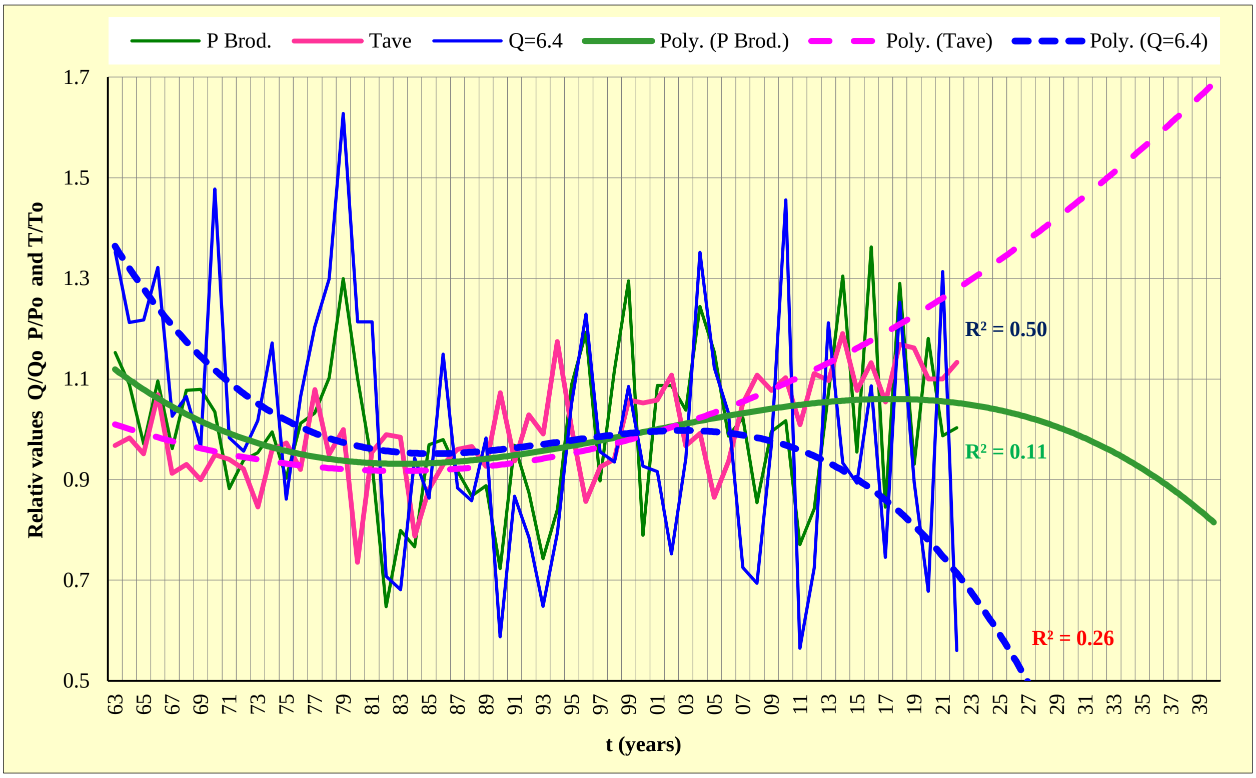


Figure 9. Low-land LL2 river flows linear and polynomial trends of 1960-2021

Figure 10 presents a chart of the relative values of long-term annual average temperatures T (° C), flows Q (m3/s), and annual sum of precipitation P (l/m^2)/year for high-land rivers HL1, HL2, HL3, and LL1. Trends are drawn for the period 1963–2021. There is also a prediction period up to 2040. For high-land rivers, rapid increments of temperature, moderate increments of precipitation, and rapid decrements of river flows can be seen. On the contrary, for the Lowland River LL1, the opposite can be seen. Moderate temperature increments, much precipitation, and significant flow increments will appear in the next decade and a half. Also presented are trends with an extension to the year 2040.



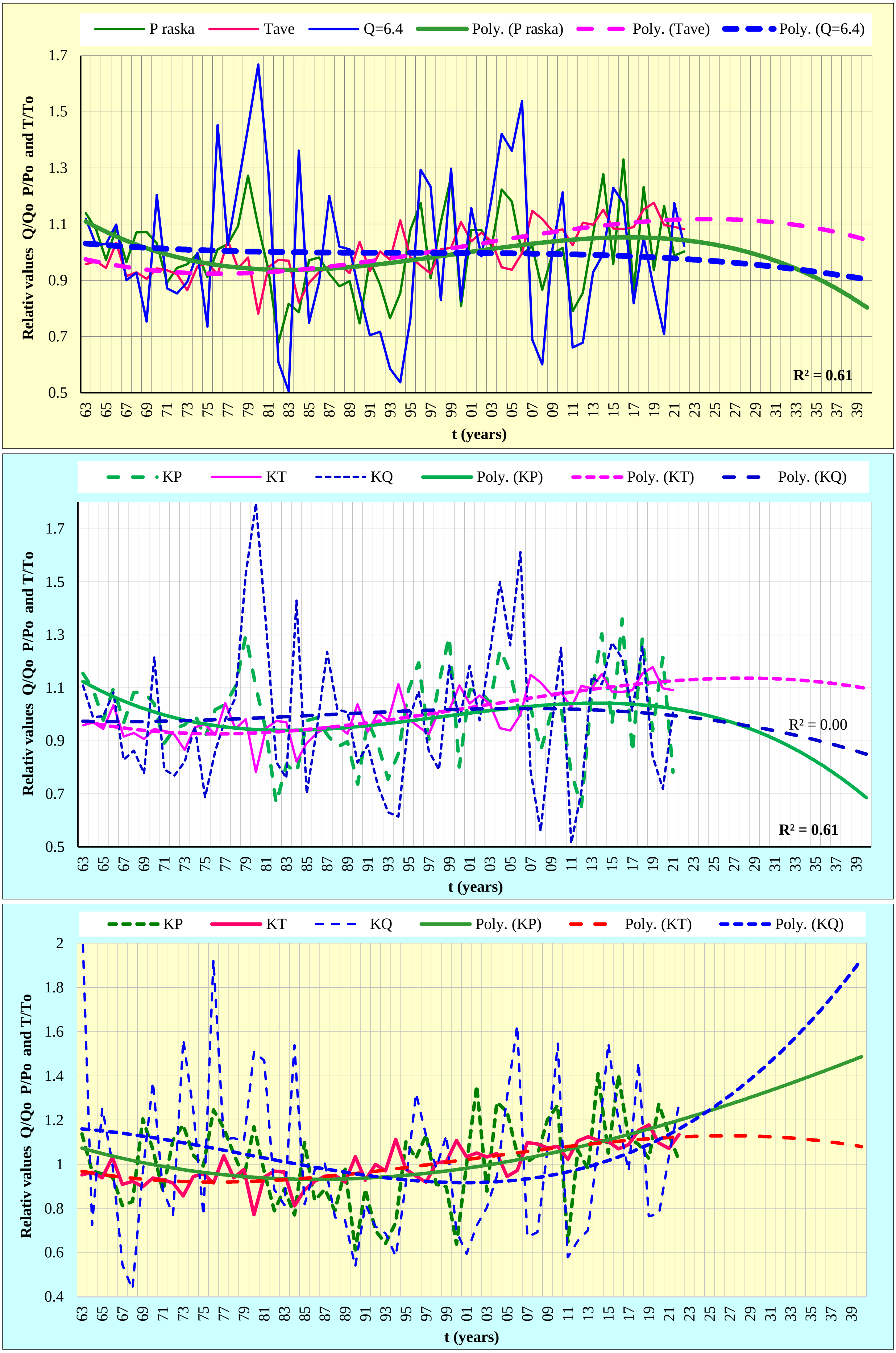


Figure 10. a) HL1, b) HL2, c) HL3 and d) LL1 rivers long-term annual average charts of Temperatures(°C), Flows Q(m³/s), and annual sum of Precipitation ((l/m²)/year)

Figure 11-a presents a chart and trend of long-term annual average temperatures, flows, and annual precipitations for Low-land River LL2, for the period of observation 1963–2021 and prediction to 2040. Results are opposite for high-land rivers. A moderate increment of temperatures, an average increment of precipitation, and a rapid increment of river flows can be seen. It is true according to Thermodynamic principles, but in practice, it must also be so. In Figure 11-b, the double mass method is given for any impact on the river's flow, temporary or permanent, reversible or irreversible. This is a very practical method of checking the observed data. The brown dashed arrow shows the appearance of the global warming impact of the year 1988, and the blue dot arrow shows the appearance of rapid urbanization. The red line arrow shows the deviation of Highland River flows as a consequence of forest burning in 2007 [21].

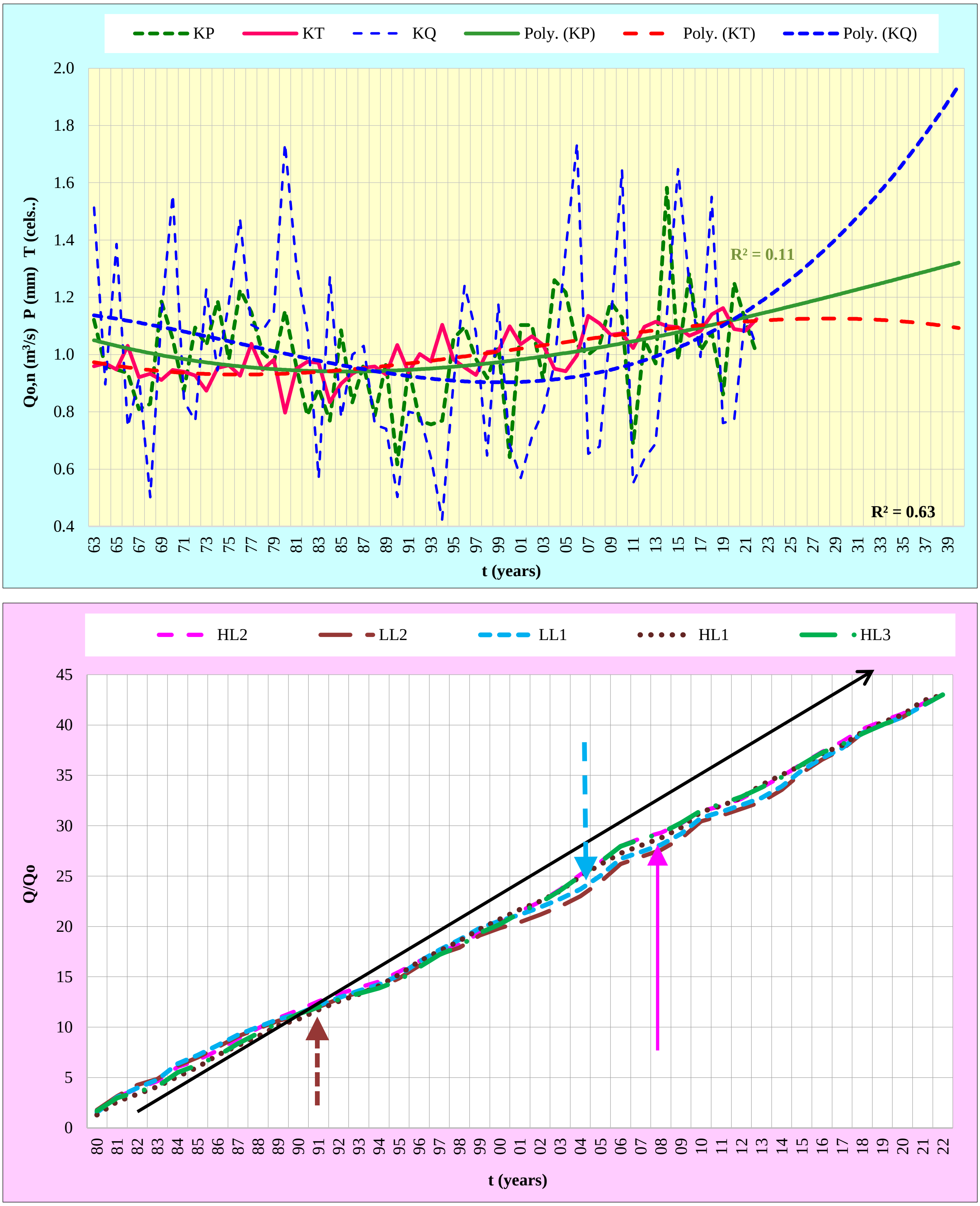


Figure 11. a) LL2 river long-term annual average charts of Temperatures (°C), Flow Q (m^3/s), and annual sum of Precipitation ((l/m^2)/year). b) Application of double mass method on five considered High-land and Low-land rivers, and impact of global warming, rapid urbanization and forest burning.

In Figures 12-a and 12-b, relative values are presented for the polynomial and linear trends of Sunspots, Ferizaj city temperature, and precipitation, as well as the trends of considered High-land and Low-land rivers, for the period of 1963–2023. All of them are officially observed annually, except for the assumption of the year 2023. Also, sunspot numbers for the period 1954–2006 were taken from Alexander [19], while for 2007–2023 they are assumed. As shown in Figure 12-b, the sunspot trend in this period shows a -18% decrease, the temperature trend of Ferizaj city shows a +24% increase, and the precipitation trend of Ferizaj city shows a +5% increase. The HL1 river flow trend shows the highest decrease of -31% in flow. It is a very high mountain, non-urbanized, and less impacted river, and its difference with Sunspots number decrease is -13%. Snow precipitation shifts slowly to rain precipitation (by warming). The HL2 river flow trend shows a small decrement of -0.5%, but compared with Sunspots, it shows an absolute difference of +17.5%. It is not affected by human activity and is close to the sea. The HL3 river flow trend shows a decrement of -7.5%, but compared with Sunspots, it shows an absolute difference of +10.5%. It is not affected by human activity but flows toward the continental region. The LL1 river flow trend shows a decrement of -22%, but compared with Sunspots, it shows an absolute difference of -4%. It is strongly affected by human activity. Because data from the last 22 years are correlated, in practice, the average flow must be bigger by 15%, with a trend decrement of -29%. The LL2 river flow trend shows a decrement of -13%, but compared with Sunspots, it shows an absolute difference of +5%. It is little affected by human activity.

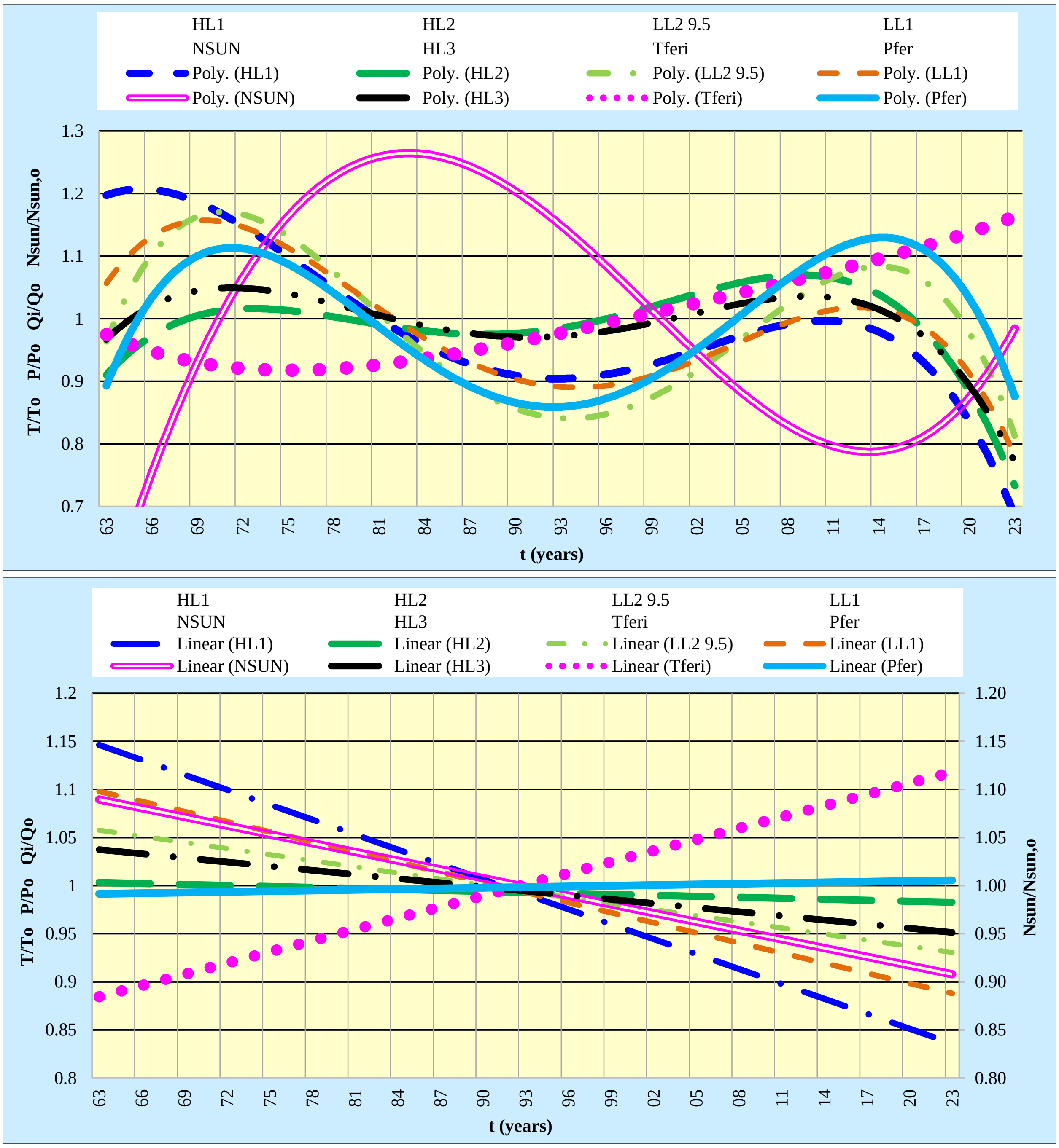


Figure 12. Polynomial and linear trends of relative average of Sun-spots, temperature, precipitation of Ferizaj city, and of considered High-land and Low-land of river flow, for time period 1963-2022

Table 2 presents long-time-scale 1963–2022 changes in relative averages of Sunspots, Temperatures, precipitation, and high- and Low-land River Flows in the Kosovo area and Region. Temperature change is +75% driven by Sunspots (N_S) and +25% by Human activity (H_{ACT}), Precipitation is -44% by N_S and +56% by H_{ACT}, HL1 is -58% by N_S and -42% by H_{ACT}, HL2 is -51% by N_S and +49% by H_{ACT}, HL3 is -62% by N_S and +38% by H_{ACT}, LL1 is -82% by N_S and -18% by H_{ACT}, and LL2 is -79% by N_S and +21% by H_{ACT}.

Table 2. Summarized changes in % of relative averages of Sunspots number NS Hydro-meteorological variables TPQ, of High and Low-land rivers and change significance in %, of Earth (Human) impact

Climatic drivers	$\Delta_{TOT.}$ (% of average)	$\Delta_{SUN.}$ (% of average)	$\Delta_{HUM.} = \Delta_{TOT.} \pm \Delta_{SUN}$ (% of average)	$\Delta_{HUM.}$ (%$\Delta_{TOT.}$)
N_{SUN}	**-18↘**	-18	0	0%
T	**+24↗**	-18↗	+6↗	25%
P	**+5↗**	-18↘	+23↗	56%
Q_{HL1}	**-31↘**	-18↘	-13↘	42%
Q_{HL2}	**-0.5↘**	-18↘	+17.5↗	49%
Q_{HL3}	**-7.5↘**	-18↘	+10.5↗	38%
Q_{LL1}	**-22↘**	-18↘	-4↘	18%
Q_{LL2}	**-13↘**	-18↘	+5↗	21%

In Figure 13, in 1968 and 1979, the maximum sunspot number correlated well with Precipitation and Flows while anticorrelating with Temperature. For those two Schwabe cycles, 1957–1968 and 1968–1979, the Temperature is always anticorrelated with precipitation and Flows. The last three Solar Schwabe cycles are not followed by Precipitation and Flows. This is also detected by Laurenz et al. [2] ("A wavelet analysis of Germany's February precipitation confirms the presence of an ~11year cycle period from the mid-1920s to the mid-2000s. The cycle appears to be weaker in the 1-2 decades before and after this period"). For this time, there is a lag time of Flows for 2-4 years (Laurenz et al. [2]; Ormaza-Gonzalez et al. [4]). Therefore, from Figures 12.a, 13, and Table 2, the sunspot number and River Flow trends are decreasing, Precipitation shows a moderate increase, and Temperature is increasing by 24% of the relative average (triggered 75% by Solar and 25% by Human activity). Plavšić et al. [22] have detected a significant decreasing trend of the Lim River at station Brodarevo (HL1 river in this article) from 1925-2008. Mwangi et al. [18], predicted a 16% and 15% increase in streamflow in the next 20 and 50 years, respectively. The year 1980 shows the best correlation between Sunspots ↗ (2.38*65.2), ↗Precipitation (1.09*684), ↗River Flows (HL1 1.22*68.9, HL2 1.80*7.3, HL3 1.65*7.7, LL1 1.50*11.3, LL2 1.75*9.5) and anticorrelation of Temperatures ↘ (0.77*10.1).

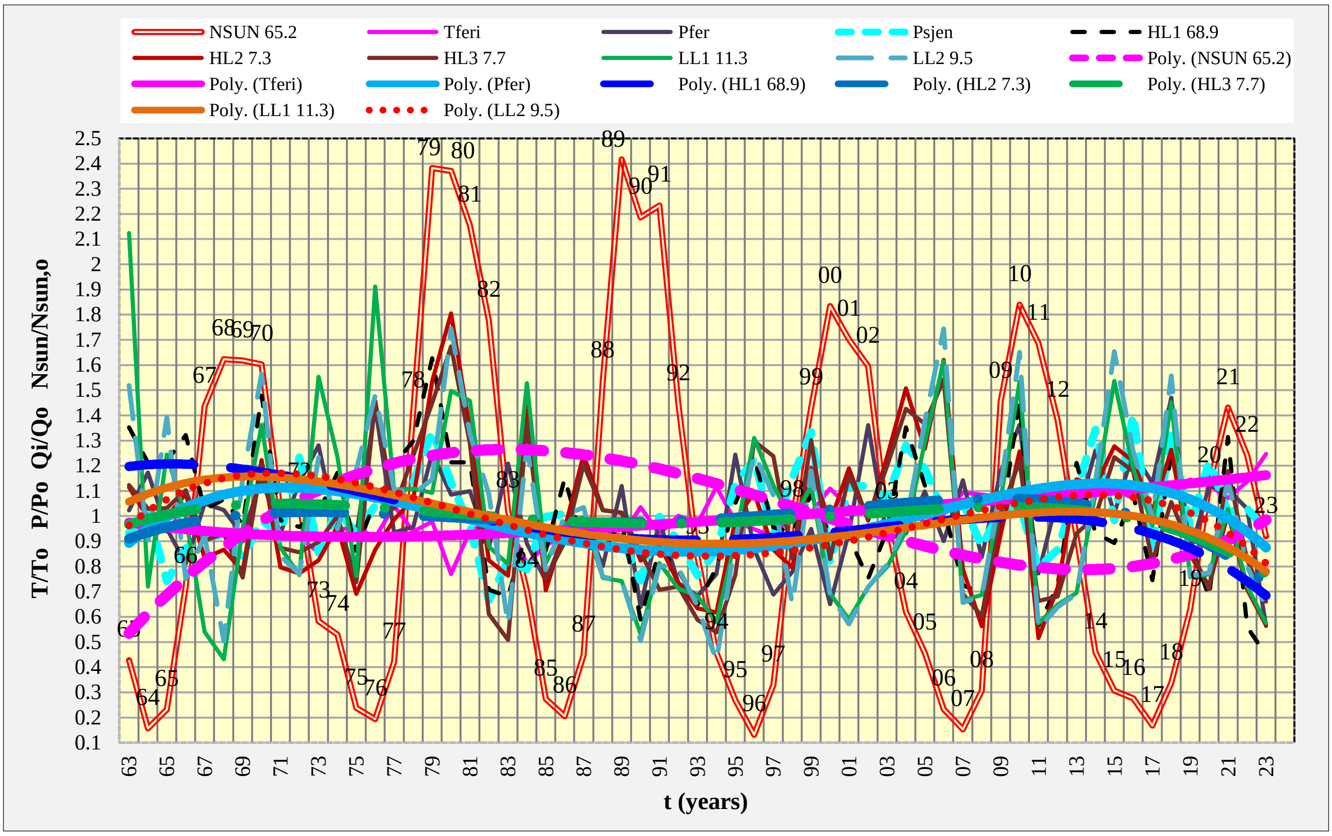


Figure 13. All together, Long-term Average Annual Relative value of Sunspots Temperatures Precipitations and Flows (NS, T, P, HL1, HL2, HL3, LL1, LL2), for time-period 1963 – 2022

This implies that in the future, we will have averages only "*good on paper*" but extremized (harmful) water resources. Being a very complex problem on a Spatial and Temporal scale for many Study fields like Hydrology, Meteorology, and statistics in an undeveloped country with many issues from the past, this article could be very useful for the further development of water resources plans and models. The primary limitations will be the lack of continuous accurate observation of Hydro-meteorological data, Institutional Human Resources, and awareness of the importance of water.

4. Conclusions

According to basic knowledge of Meteorology, three main factors cause water evaporation in the air:

- Sunspots, as a large-scale (Global) generator of atmospheric humidity, cause lower temperatures, large amounts of precipitation, and higher river flows (years 1958, 1969, 1980, 1989, 1999, 2010, and 2021);
- Sunspots, as a large-scale (Global) generator of atmospheric humidity, cause lower temperatures, large amounts of precipitation, and higher river flows (years 1958, 1969, 1980, 1989, 1999, 2010, and 2021);
- On the other side, the sun's Radiation, as a smaller (local) scale generator of atmospheric humidity, causes higher temperatures, less precipitation (convective storm summer rainfalls), and, of course, lower river basin flows;
- Human activity, by industrial digesting, concreting vegetable cover, forest burning, fossil-origin burnings, urbanization, wars, etc., is a smaller (Local) generator of atmospheric humidity. This factor, combined with the above-mentioned second factor, causes convective rainfalls (urban "flash" storm floods, which were only 5% of annual precipitations before two decades and now are advancing towards 15% and more of whole-year precipitation).

Sunspot activity has its brightening and dimming regime, but for the observed period, it shows a certain decrease in sunspot number, hereby an Earth temperature increment DT_S. The earth temperature of the observed place and time shows an absolute increment due to Sun Radiation and Human impact activity: $DT_{TOT.} = DT_S + DT_{HUM}$., thereby decreasing snow precipitation, increasing rain precipitation (frontal and convective), increasing Evaporation, and decreasing Flow. The precipitation trend is increasing and decreasing as follows: Snow precipitation is decreasing in cities as well as in Highland. The frontal type of precipitation is increasing in the Highlands and decreasing in the Lowlands, and Convective precipitation is increasing in urbanized areas.

The flows of High-land rivers, as a consequence of temperature and precipitation changes, are going drier, especially those further from water bodies. Lowland rivers show moderate increment (those that are urbanized show rapid increment). Practice and theory are "two ways" that should lead to the same result. The black box model is very practical for the preliminary study of similar problems. The same results can be obtained by the very complex theories of hydrodynamics and thermodynamics. The second formula of Equation 2 I haven't seen before in Literature. Heating is driving the water, but Sunspot's heating significance seems to be 75%, while Human activity's impact on heating significance is 25% of the relative average.

The traditional correlation of Hydroclimatic variables with Sunspots is weakening. Also, Spatial and Temporal distributions are disturbed. River flows are decreasing by around -18% for Low-land rivers and around -30%, for High-land rivers. Precipitations are increased for a total of +5% (-18% by Solar signal and +23% by Human activity) of the relative average. In the last five decades, the temperature trend has only increased by +24% of the relative long-term annual average. Lack of more quantitative and qualitative monitoring data on sunspots and TPQ, as well as a lack of strong institutional support, would be the main limitations. This research will encourage water resource engineers and planners to project and predict the future. This article helps water engineers understand, detect trends, predict droughts and floods, and better design water resource management plans. Now, we are at the top of the Sun's cycloid, so we will face earthquakes and frontal precipitation's floods. In the next few years, we are entering the dimming phase of Sunspots, and we will face droughts and urban flash storms of very high intensity (>150 l/m^2)/hour. All we can do is undo what we have done and go back to Gaussian Normality, Newtonian Equilibrium, and Darwinian Continuity of Living.

5. Declarations

5.1. Data Availability Statement

The data presented in this study are available in the article.

5.2. Funding

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5.4. Conflicts of Interest

The author declares no conflict of interest.

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