

Three decades of heat waves and extreme precipitation in Tirana

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Introduction

The last three decades have shown increasing of the extreme weather phenomenon in the Albanian territory, mainly extreme heat events and daily extreme precipitation. The capital city of Tirana, presents a high risk of extreme weather regarding the increased number and the severity becoming a serious issue to the citizens life and property, as the most populated city.

To better manage the impact of extreme weather and to minimize the losses, a better knowledge is needed about their past frequency and behaviour. For this reason, a detailed analysis of the main indices for both extreme weather phenomena was performed. Firstly, determination of the heat wave and daily precipitation as an extreme event was done by a threshold estimation method and some important indices of each phenomenon were estimated and analyzed in the long-terms period. Indices as frequency, duration, peak values and other extreme values were calculated based on the daily data of air temperatures and precipitation. Results reveal useful information that can be used to improve the risk reduction of heat waves and flooding in the urban areas.

Data used

Records of daily temperature and precipitation of Tirana for the period of 1990 – 2007 were available from the archives of the former Institute of Hydrometeorology of Albania (part of my work about thesis) while the data for the period 2008 up today were available from the AWS Network of Meteoalb Center, a private provider in Albania that offers climate data.

Methodology

There is no any unique concept to define the heat wave phenomena and its thermal extreme; different authors (Prieto et al, 2004; Diaz et al, 2005) use different criteria of heat wave definition in accord to their climate and geography of the area under the study.

Heat waves are phenomena of sudden and intense rise of air temperatures caused by the invasion of warm air masses toward a certain area in the case of Balkan Peninsula, the origin of the warm and dry air masses is mainly from the Africa's Sahara desert.

Differently from some authors who reveal that heat wave duration is short (Ayala & Olcina (2002), some studies of the last decades over Albania, present heat wave duration from 10 up to more than 15 consecutive days under the "invasion of African heat". In the actual study, the daily maximum temperatures should exceed with at least 5°C, for at least 5 consecutive days the monthly mean of daily maximum temperatures in order that an area may be considered in the heat wave conditions.

After temperature threshold estimation, four-key indices of heat waves were estimated and analyzed, starting with the heat wave frequency, duration, length, intensity and the peak values. Analyses were performed for Tirana city to have a full picture of the phenomenon trend and behavior, in the last three decades.

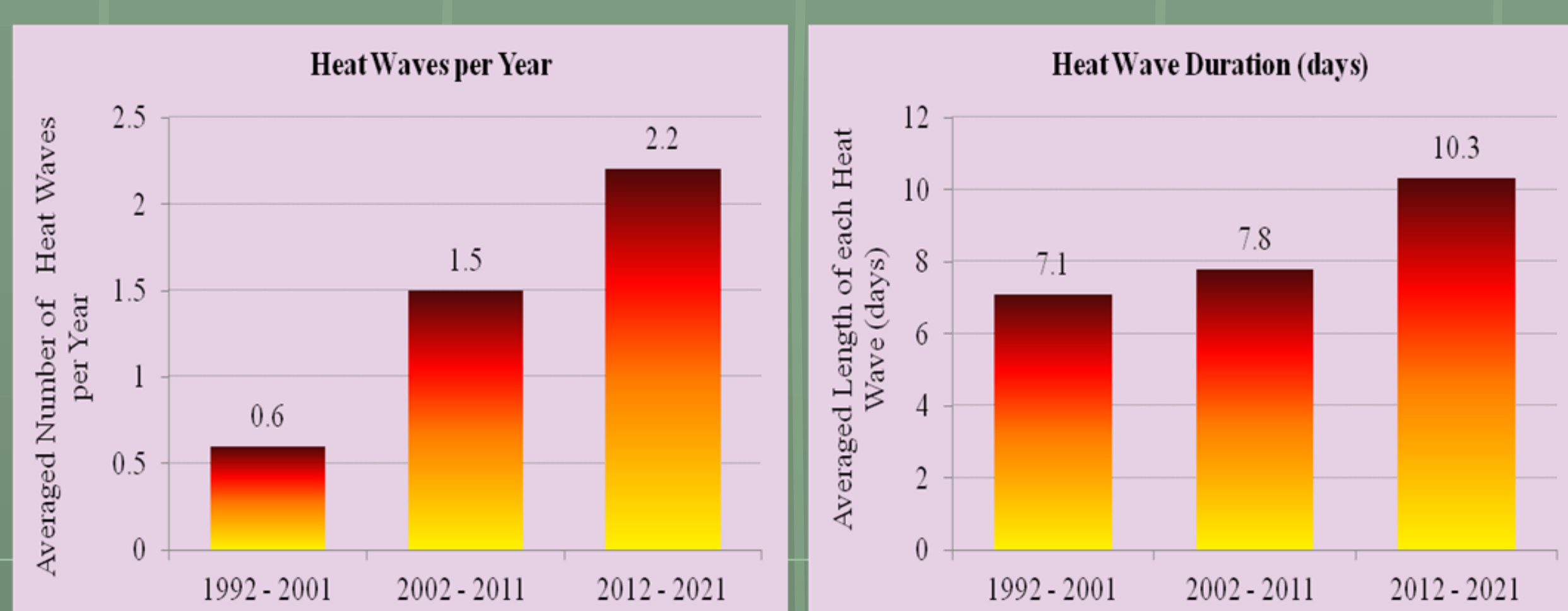
Methodology

Regarding to the phenomena of daily extreme precipitation, a very popular issue among authors, many studies were performed and presented results give information for many different aspects of the precipitation nature.

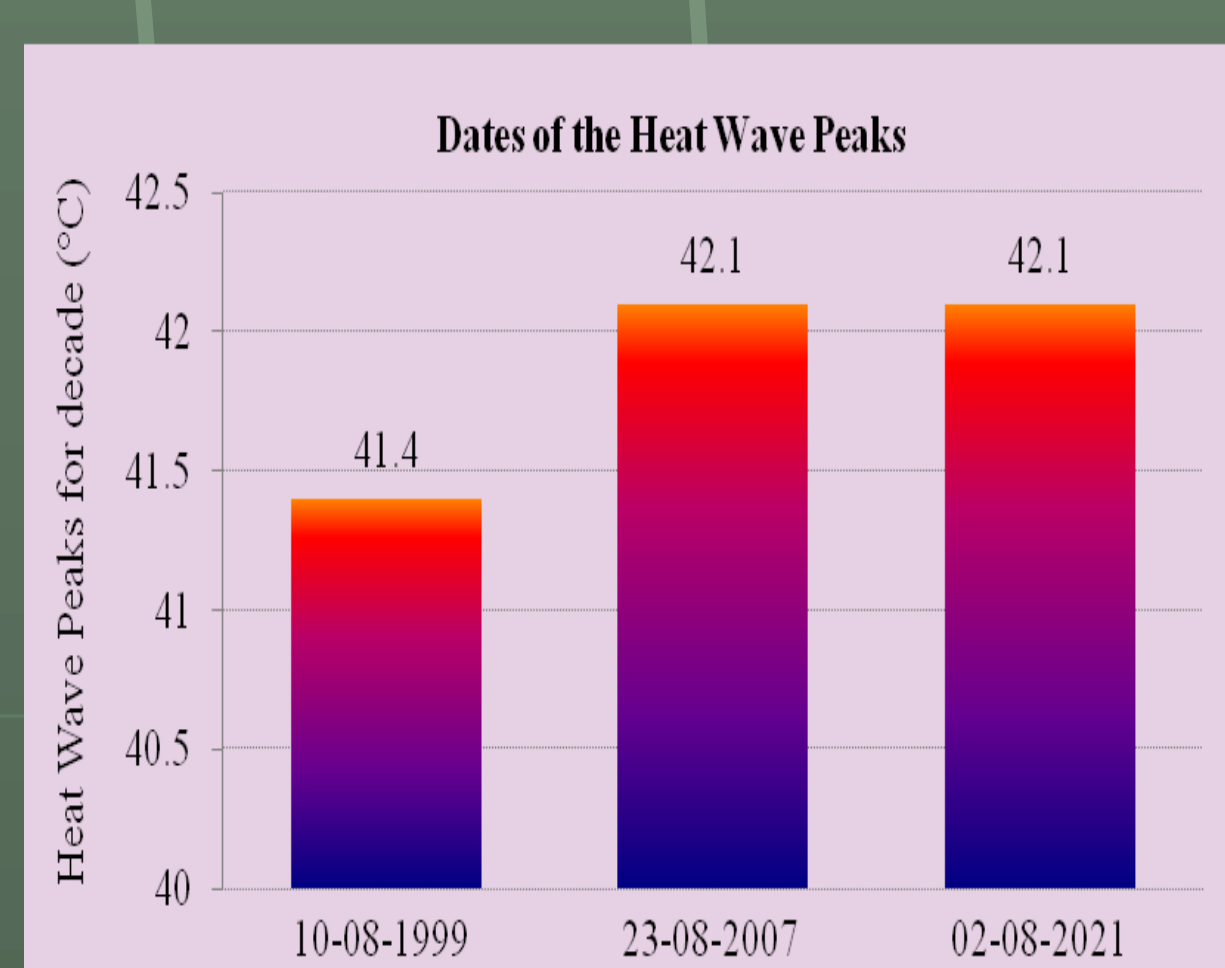
In this study, the focus stands on the estimation and on the analyses of some from the main extreme precipitation indices , for the same period of 1992 – 2021. The selected extreme precipitation indices were defined as:

- SDII – Simple daily intensity index is the ratio of TOTP to the number of wet days
- CWD – consecutive wet days is the maximum number of days when $P > 1$ mm
- PRCPTOT – Annual total precipitation during all wet days of $P > 1$ mm
- RX1day – is the annual maximum of 1-day precipitation (in mm)
- R100mm – is the number of days per year with TOTP ≥ 100 mm
- R150mm – is the number of days per year with TOTP ≥ 150 mm

Both the above phenomena were analysed for the last three decades in order to capture the fullest possible potential range of the variation in the multi-annual heat wave and daily extreme precipitation to reveal signals for the future picture of Tirana city.



Graph 1 – Variation of the 4-key indices of the heat waves during the period 1992 – 2021



Graph 2 – Variation of the heat wave peak values during the period 1992 – 2021

Graph 1: The 4-graphs picture presents a clear change in all analyzed indices during the period of 1992 – 2021. From the first decade up to the second decade, the HWF per year results 2.5 times higher and also the last decade shows a HWF of 1.46 higher, than previous one.

Looking at the HWD index, there is also an increasing in the number of consecutive days of heat waves; along the analyzed period, the HDI changes from 7.1 up to 10.3 days in the last decade.

Regarding the HWS, from the first to the third decade, the index increased respectively by 2.8 and 1.5 days while the variation of the HWI presents a change of 0.3°C, from the first to the last decade.

Graph 2: The heat wave peak value that defines the highest daily temperatures recorded for each heat wave, each year presents a change of 0.7°C from the first to the second decade; no changes to the last one.

Graph 3: The graphs show that all precipitation indices has a decreasing rate during the second decade and a increasing trend for the last decade.

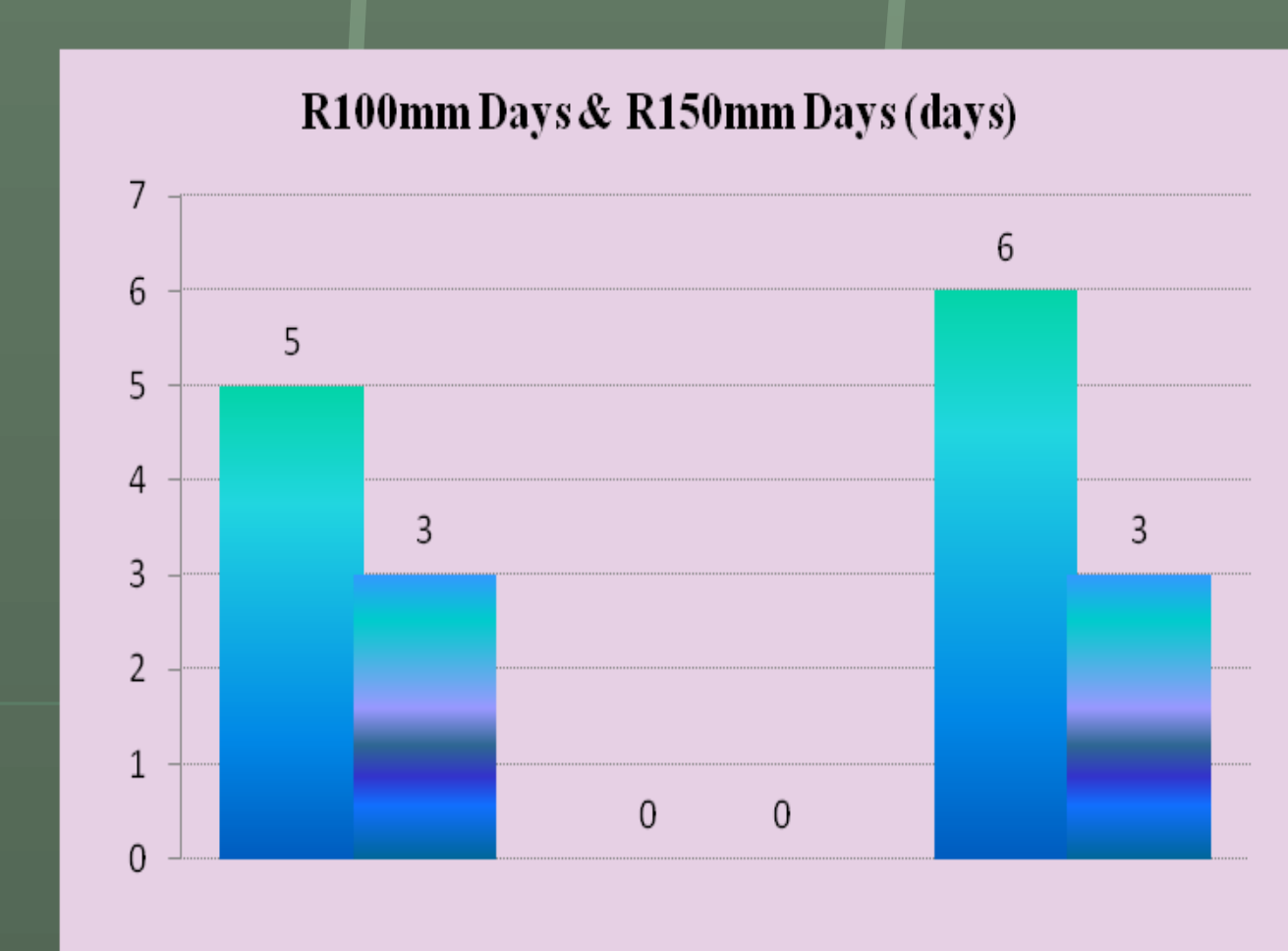
Concretely, the ratio of annual total amounts of precipitation to the number of wet days or shortly the SDII index has decreased during the second decade.

The graph presents the same picture of changes for the indices of the maximum number of consecutive precipitation days CWD, the annual maximum of 1-day precipitation RX1day and the annual total precipitation during the rainy days PRCPTOT.

Graph 4: The changes of the number of days per year with extreme daily precipitation of more than 100 mm or more than 150 mm follows the same trend as other precipitation indices.



Graph 3 – Variation of the main extreme daily precipitation indices during 1992 – 2021



Graph 4 – Number of days with extreme daily precipitation (100mm, 150mm)

Conclusions

All the results about heat wave analyses for Tirana of the last three decades reveal a clear increasing of the heat wave's four indices.

Heat wave frequency, heat wave duration, heat wave length season and intensity are increased in the last three decades.

There is a very clear change in the thermal extreme value from the end of the last century to the beginning of our century.

The extreme daily precipitation during the last three decades in Tirana has changes in many aspects.

There is a high variation on the wet days, in the annual precipitation amounts and in the daily maximums of precipitation during the last three decades.

The precipitation behavior for Tirana has changed , mainly during our century.

References

- Frich, P. A. L. V., Alexander, L. V., Della-Marta, P. M., Gleason, B., Haylock, M., Tank, A. K., & Peterson, T. (2002). Observed coherent changes in climatic extremes during the second half of the twentieth century. *Climate research*, 19(3), 193-212.
- Perkins, S. E., & Alexander, L. V. (2013). On the Measurement of Heat Waves, *Journal of Climate*, 26(13), 4500-4517. Retrieved May 29, 2022
- Radinović, D., & Čurić, M. (2012). Criteria for heat and cold wave duration indexes. *Theoretical and applied climatology*, 107(3), 505-510.
- Karl, T.R., N. Nicholls, and A. Ghazi. 1999. *CLIVAR/GCOS/WMO workshop on indices and indicators for climate extremes: Workshop summary*, Weather and Climate Extremes, 42, 3-7
- Peterson, T.C., et al. 2001. *Report on the Activities of the Working Group on Climate Change Detection and Related Reporters 1998-2001*, WMO, Rep. WCDMP-47, WMO-TD 1071, Geneva, Switzerland, 143pp. Download (PDF from clivar.org):
- Zhang, X., et al. 2005. *Avoiding Inhomogeneity in Percentile-Based Indices of Temperature Extremes*, J. Climate, 18, 1641-1651

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