HyMeX - EASTERN ADRIATIC TREND AND VARIABILITY ANALYSIS IN PRECIPITATION EXTREMES

Marjana Gajić-Čapka & Ksenija Cindrić

Meteorological and Hydrological Service of Croatia (DHMZ), Zagreb

e-mail: capka@cirus.dhz.hr, cindric@cirus.dhz.hr

1. Introduction

In the European region, significantly increased precipitation has been observed in northern Europe, where the frequency of heavy precipitation events has increased over the last 50 years (IPCC, 2007). Drying has been observed in the Mediterranean area, including southern Europe, with more intense and longer droughts.

The fact that precipitation change is highly variable regionally increased the need for more accurate regional and local precipitation change analysis to improve the analysis of impacts. Many of these impacts will be felt through extreme events. These increase a demand for determining from the observational record whether there have been significant changes in amount, frequency and intensity of extreme precipitation.

The joint CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI) has designed a system of indices and tools that enable a consistent approach to the monitoring, analysis and detection of changes in extremes of temperature and precipitation by countries and regions across the globe (Folland et al., 1999; Peterson et al., 2001; Klein Tank and Können, 2003; WMO, 2004). Latest developments include the use of extreme value theory to complement the descriptive indices of extremes, in order to evaluate the intensity and frequency of more rare events (Klein Tank et al., 2009).

This paper is oriented to the area of the Croatian eastern Adriatic coast which experience different precipitation regime from North to South due to its causes and local modification factors.

2. Data and Methods

- Seasonal and annual precipitation is analyzed for ***23*** rain gauge stations along the coast.
- Seven ***indices of precipitation extremes*** proposed by WMO (CCl and CLIVAR) are calculated using daily and multi-day precipitation data series from the available record period 1953 – 2009: **DD, SDII, R75%, R95%, R95%T, Rx1d, Rx5d**
- ***Trend*** for each station is estimated by means of Kendall's tau method and the statistical significance is tested using the non-parametric Mann-Kendall test. The overall significance is assessed by Monte Carlo method.
- The Standard Normal Homogeneity test (SNHT) (Alexandersson 1986) was applied to annual precipitation data. Reference time series are constructed as the mean precipitation series separately for Istrian peninsula, Kvarner bay and northern Dalmatia, and middle and southern Dalmatia. Two series are suspicous but there is no evidence in meta data.

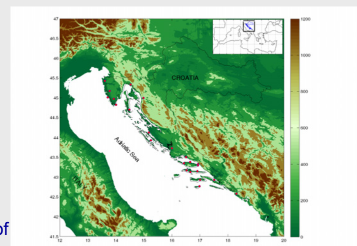
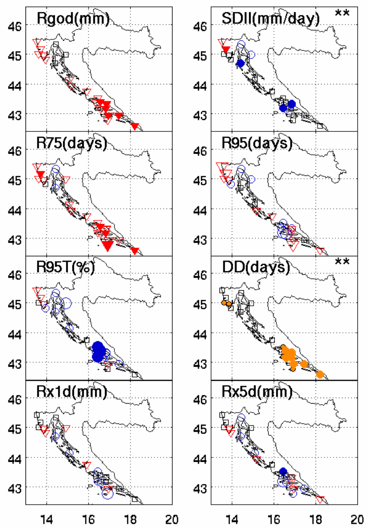


Figure 1. Study area

3. Results



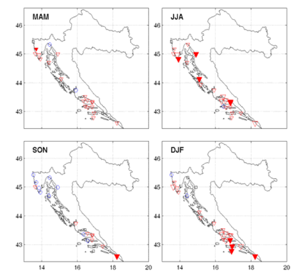


Figure 2. Decadal trends in seasonal precipitation amounts.

Figure 3. Decadal trends in annual (R) precipitation amounts and trends in seven indices of extremes.

Circles denote positive trend, triangles the negative one, whereas filled symbols means statistically significant trend. Three sizes of symbols are proportional to the absolute value of change per decade relative to the respective average value: 1–5%, 5–10% and >10%. Trends falling between ±1% are presented by squares. The cases that show field significance are marked by (**).

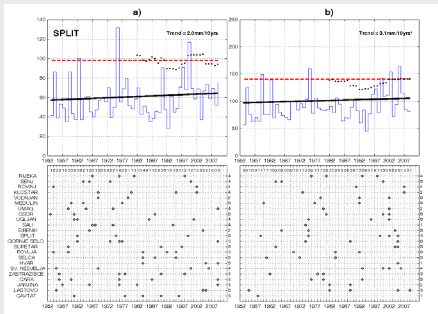
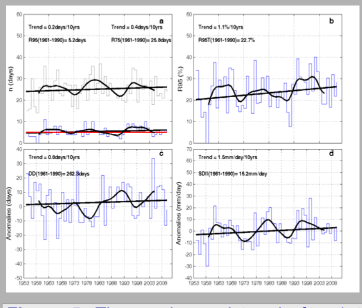


Figure 4. Time series (*top row*) and annual number of exceedence of x20 (*bottom row*) of annual **a)** 1-day maxima and **b)** 5-day maxima in Split. The black line indicates linear trend and red dashed line indicates the 20-year return value (x20) estimated from the fitted GEV distribution. Black points denote 20-year return values for 50-year moving periods.

RIJEKA



SPLIT

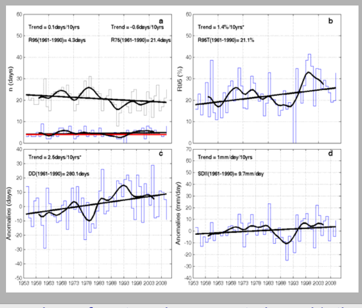


Figure 5. Time series and trends for a) the number of wet and very wet days, b) the percentage of annual total due to very wet days, c) anomalies of the number of dry days and d) anomalies of simple daily precipitation intensity. Anomalies are calculated with respect to 1961-1990 average. Bolded curve represents related 11-year binomial moving averages and trends. Asterisk denotes trend significant at the 5% level.

4. Conclusions

- Since the middle of 20th century a general decrease in annual precipitation is found, becoming stronger from north to south. It is mainly forced by the summer and winter trends.
- Overall significant increase in the frequency of dry days in the southern Adriatic is accompanied by significant decrease in the frequency of wet days.
- According to the daily intensity index, heterogeneous sign in trend dominates over the analysed area.
- In spite the total precipitation decrease, part of annual precipitation amount coming from very wet days has increased.
- The 1-day and 5-day annual maxima showed large interannual variability. They do not indicate grouping during the last decades that can eventually point at the possible recent decadal trend that are often reported. The estimates of 20-year return values calculated for 30-year moving periods indicate a strong influence of the upper outliers.

References

Alexandersson , H. (1986) : A homogeneity test applied to precipitation data. J Climate 6: 661–675

Coles, S. (2001): An Introduction to Statistical Modelling of Extreme Values. Springer, London, 208 pp.

Faragó, T., Katz, R.W. (1990): Extremes and Design Values in Climatology. World Meteorological Organisation, WMO-TD-No. 386, WCAP-No.14, pp 46.

Folland, C.K., Horton, B. and Scholfield, P. (Eds) (1999): Report of WMO Working Group on Climate Change detection Task Group on climate change indices, Bracknell, Berks, UK, 1-3 september 1998. WMO-TD No. 930, WCDMP No. 37.

Klein Tank, A.M.G. and Können, G.P. (2003): Trends in indices of daily temperature and precipitation extremes in Europe, 1946-99. Journal of Climate, 16, 3665-3680.

Klein Tank, A.M.G., Zwiers, F.W. and Zhang, X. (2009): Guidelines on Analysis of extremes in a changing climate in support of informed decisions for adaptation. World Meteorological Organisation, WMO-TD No. 1500, WCDMP-No.72, 52 pp.

Peterson, T. C., Folland, C., Gruza, G., Hogg, W., Mokssit, A. and Plummer, N. (2001): *Report on the activities of the Working Group on Climate Change Detection and Related Rapporteurs 1998-2001*. World Meteorological Organisation Rep. WMO-TD No. 1071, WCDMP-No. 47, Geneva, Switzerland, 143 pp.

WMO (2004): Report of the CCl/CLIVAR expert team on climate change detection, monitoring and indices (ETCCDMI), WCDMP - No. 54