INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC GEOCONFERENCES SGEM 2016

28 June - 6 July 2016, Albena Co., Bulgaria

# SOME CHARACTERISTICS OF MAXIMUM ANNUAL AND SEASONAL QUANTITIES OF RAINFALL REGISTERED IN 24 HOURS IN ROMANIA

**Traian Tudose**[1] , Lecturer Dr., **Adina-Eliza Croitoru**[1] , Assoc. Prof. Dr. , **Gabriela Victoria Harpa**[1] , PhD Student , **Sabina Andreea Scripcă**[1] , Master Student
[1]"Babeş-Bolyai" University, Faculty of Geography, **Romania**

## Introduction

24-hour precipitation amount allows better the identification of synoptic conditions of rainfalls and their frequency analysis (Wallis et all, 2007). Frequency analysis permits calculation of probability of occurrence, as well as the statistical probability of recording higher values (Haidu, 2002).

The present study is dedicated to the frequency analyses of annual maximum 24-hour precipitation amounts and to the synoptic conditions generating them.

## Research

- the annual and seasonal maximum 24-hour precipitation amount derived from daily precipitation data sets from ECADataset (Klein et all, 2002), recorded in 23 weather stations in Romania (Fig. 1), over a 55-year period (1961-2015) was used. The weather stations altitudes is between 3 and 661 m.

- data sets were tested using trend and homogeneity distribution test at 0.01 significance level provided by XLSTAT software (Wijngaard et al. , 2003);

- the frequency analysis of minimum and maximum annual 24-hour precipitation amount was done using HYFRAN software (Haidu, 2002) at significance level of 0.05.

- the equation that describes best the variation and spatial homogeneity are:

Gumbel $f(x)=\frac{1}{\alpha}\exp\left[-\frac{x-u}{\alpha}-\exp\left(-\frac{x-u}{\alpha}\right)\right]$ (1), Log-Pearson type III $f(x)=\frac{\alpha^{\lambda}}{x\Gamma(\lambda)}(\ln x-m)^{\lambda-1}e^{-\alpha(\ln x-m)}$ (2),

and Lognormal $f(x)=\frac{1}{x\sigma\sqrt{2\pi}}\exp\left\{-\frac{[\ln x-\mu]^2}{2\sigma^2}\right\}$ (3); Where: $\alpha,\lambda,m,\sigma,\mu,u-$ Estimated parameters

- the atmospheric circulation type was determined using HYSPLIT model (Draxler, Rolph, 2012) using a simple air parcel 48-hour backward trajectory option in order to identify the direction of the influx and the origin of the air masses in the studied area (Suwała, 2013).

## Results

Absolute annual maximum 24-hour precipitation amount varies between 65.3 mm (Deva) and 224.0 mm (Drobeta Tr. Severin). The lowest quantities were registered in the Western and Central Romania (generally, under 100 mm), and the highest in east and southeast part of the country. Seasonally, the highest values are recorded during summer and spring, while in the winter they are often below 50 mm.

The return period of the absolute minimum rainfall quantities fallen in 24 hours are between 1.0002 and 1.032 years (Table 1), and for the absolute maximum amounts, between 37 and 387 years.

Eight trajectories of air influx were found, reclassified into 4 atmospheric types: Type 1: southern and southwestern influx, Type 2 – western influx, Type 3 – northern and northwestern influx, and Type 4 – eastern, southeastern, and northeastern influx.

The annual average frequency of air circulation types is as follows: Type 1 - 42.2%)(Fig. 2a); Type 2 - 25.5%)(Fig. 2b); Type 3 – 23.7% (Fig. 2c) and Type 4 - 7.4% (Fig. 2d).

In summer, the highest rainfall quantities are generated by the warm and humid air advection (Type 1), air instability due to thermal convection (Type 2) and the presence of cold fronts coming from the Northern and Northwestern Europe (Type 3). The rest of the seasons are characterized by low frequencies of the four circulation types, but it stands out Type 1, especially for spring and summer, determined by warm and moist air advection through the Mediterranean cyclones.

## Conclusion

- annual maximum 24-hour precipitation amounts have the lowest values in the Western and Central Romania, and the highest in the east and southeast of the country. The highest seasonal quantities of precipitation occur in summer and autumn, while in winter, they have never exceeded 50 mm;

- the return period of the absolute annual minimum rainfall quantities fallen in 24 hours occurs yearly, with a probability of not exceeding less than 3.1%; the return period for the absolute annual maximum rainfall quantities is between 37 and 387 years; the values over 300 years were calculated for Southeastern Romania.

- Type 1 of atmospheric circulation generating warm and moist air advection has the highest seasonal frequency; Type 3 has the highest frequency in summer and generates cold air advection associated with cold atmospheric fronts; Type 2 has a similar seasonal distribution with less importance in spring, and Type 4 has the highest frequency in summer, missing during winter.

## Acknowledgements

This research was partially developed under the framework of the research grant *Extreme weather events related to air temperature and precipitation in Romania* (project code: PN-II-RU-TE-2014-4-0736), funded by the Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI) in Romania.
The authors acknowledge the daily precipitation data provided by European Climate Assessment& Dataset project (Klein Tank *et al*., 2002), and *Meteomanz* data base.

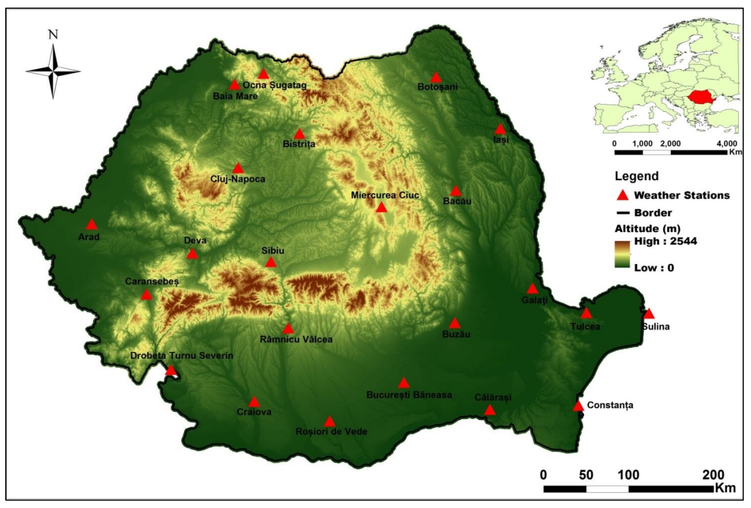


Fig. 1. Weather stations location in Romania

Table 1. The return period of absolute maximum and minimum rainfall quantities registered in 24 hours and the probability of not exceeding

| Weather station | Return period (Min., Max.) and probability of not exceeding (q) | | | |
|---|---|---|---|---|
| | Min. (yrs.) | q (%) | Max. (yrs.) | q (%) |
| Arad | 1.013 | 1.28 | 56.0 | 98.21 |
| Caransebeş | 1.0056 | 0.56 | 122.0 | 99.18 |
| Baia Mare | 1.0024 | 0.24 | 279.5 | 99.64 |
| Ocna Şugatag | 1.0168 | 1.65 | 65.5 | 98.47 |
| Bistriţa | 1.023 | 2.25 | 124.0 | 99.19 |
| Cluj-Napoca | 1.0065 | 0.65 | 91.5 | 98.91 |
| Deva | 1.008 | 0.79 | 87.0 | 98.85 |
| Miercurea Ciuc | 1.0175 | 1.72 | 155.0 | 99.35 |
| Sibiu | 1.0038 | 0.38 | 37.0 | 97.30 |
| Bacău | 1.0042 | 0.42 | 83.0 | 98.80 |
| Botoşani | 1.0051 | 0.51 | 71.0 | 98.59 |
| Galaţi | 1.0002 | 0.02 | 90.2 | 98.89 |
| Iaşi | 1.0101 | 1.00 | 64.8 | 98.46 |
| Tulcea | 1.02 | 1.96 | 387.0 | 99.74 |
| Constanţa | 1.024 | 2.34 | 351.0 | 99.72 |
| Sulina | 1.019 | 1.86 | 62.0 | 98.39 |
| Călăraşi | 1.025 | 2.44 | 51.0 | 98.04 |
| Bucharest-Băneasa | 1.0075 | 0.74 | 122.0 | 99.18 |
| Buzău | 1.0094 | 0.93 | 172.0 | 99.42 |
| Craiova | 1.032 | 3.10 | 41.1 | 97.57 |
| Drobeta Tr. Severin | 1.001 | 1.00 | 192.0 | 99.48 |
| Râmicu Vâlcea | 1.0085 | 0.84 | 102.0 | 99.02 |
| Roşiori de Vede | 1.0099 | 0.98 | 65.5 | 98.47 |

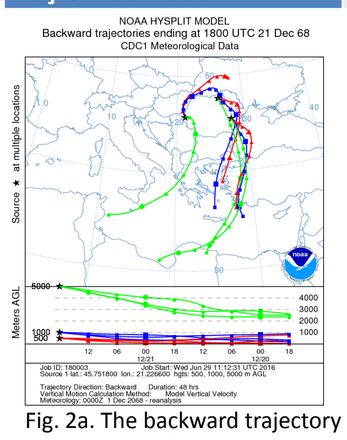


Fig. 2a. The backward trajectory computed for Type 1

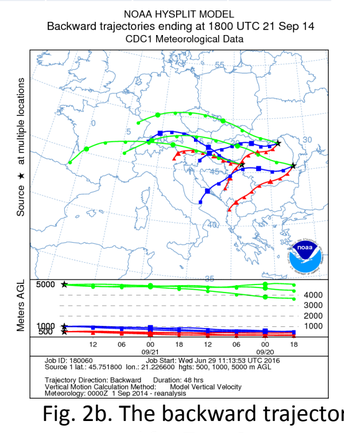


Fig. 2b. The backward trajectory computed for Type 2

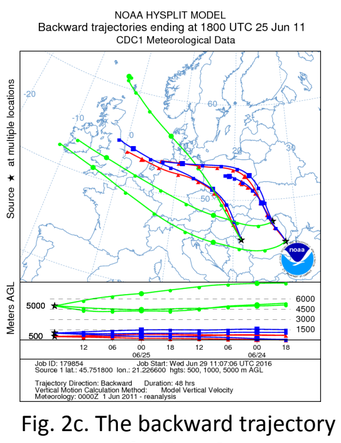


Fig. 2c. The backward trajectory computed for Type 3

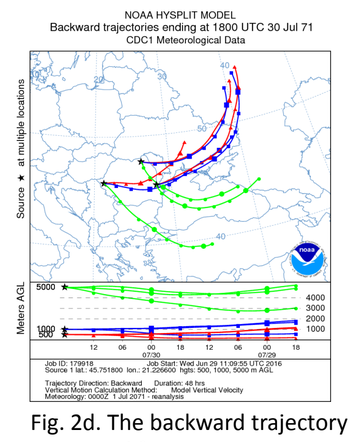


Fig. 2d. The backward trajectory computed for Type 4