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Data rescue of daily climate station-based observations across Europe

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ABSTRACT

In the framework of the project *"Integrated approach for the development across Europe of user oriented climate indicators for GFCS high-priority sectors: agriculture, disaster risk reduction, energy, health, water and tourism"* (INDECIS 2017-2020), around 610K climate station-based observations were rescued over European regions for the main climate variables (maximum and minimum temperature, rainfall, sunshine duration and snow depth) along the 20th century at daily scale. Rescued data will constitute, together with other gathered regional datasets, the INDECIS-Raw-Dataset, which will expand current European data coverage contained in the European Climate Assessment & Dataset (ECA&D).

An extensive examination of the ECA&D dataset was conducted to find spatial-temporal data gaps or stations with low percentage of daily data as prior candidates for data recovery in European regions. This exercise led us to focus our efforts on the Central European region and the Balkans. Digitizing was carried out by using a rigorous "key as you see" method, meaning that the digitizers type the values provided by data images, rather than using any coding system. Digitizers carefully cross-checked the typed values against original sources for the 10th, 20th and 30th day of each month to make sure that no days were skipped or repeated during the digitizing process. Monthly totals and statistical summaries were computed from transcribed data and were compared with monthly totals and summaries provided by data sources to check accuracy as preliminary quality control. The digitizing method and the quality control of the digitizing process applied in this study ensured an accurate data transcription according to the obtained statistics.

The daily dataset rescued in this study across Europe is available at: https://doi.pangaea.de/10.1594/PANGAEA.896957

1. INTRODUCTION

Meteorological observations in machine readable format are necessary to study observed climate variability and change and for the design of climate products and services, such as regional and global climate models, among others. Nowadays, the lack of climate data for particular regions or for specific historical periods is still affecting negatively climate products increasing the associated uncertainties (Brunet and Jones, 2011). For this reason, data rescue missions are still necessary, especially in developing countries and for pre-mid-20th century data since data stored in log-books or meteorological notebooks are at risk to be lost (WMO, 2016).

Several efforts in the last two decades included data rescue missions in order to enhance the quality and longevity of climate series and achieve a more accurate climate analysis. The European co-funded project entitled “Uncertainties in Ensembles of Regional ReAnalyses” (UERRA 2014-2017) is perhaps one of the most current projects which allocated a great human and economic resources for data rescue purposes. UERRA project allowed to recover around 8.8M of synoptic meteorological observations of the Essential Climate Variables (ECVs) across Europe and some regions of the Mediterranean basin for the period 1877-2012 (Ashcroft et al., 2018). The new high-quality UERRA dataset was submitted to the main global and regional climate data repositories (e.g. Meteorological Archival and Retrieval System - MARS Archive, European Climate Assessment and Dataset -ECA&D, International Surface Pressure Databank - ISPD -, among others) with the aim to improve model outputs of regional reanalysis and estimate more accurately the associated uncertainties.

On the other hand, the initiative undertaken by the Atmospheric Circulation Reconstructions over the Earth (ACRE, Allan et al., 2011) is in charge to coordinate data rescue activities at global scale. Main tasks are related with major data recovery, imaging and digitization of historical weather observations. The “Mediterranean Data Rescue” (MEDARE) initiative and the “Historical Instrumental Climatological Surface Time Series of The Greater Alpine Region” (HISTALP) are projects focused at regional scale (Auer et al., 2007; Brunet et al., 2014a, 2014b). MEDARE, coordinated by WMO, aims to develop, consolidate and progress climate data and metadata rescue activities across the Greater Mediterranean Region. In the HISTALP project, leaded by the Central Institute of Meteorology and Geodynamics in Austria (ZAMG), a regional database of monthly homogenized temperature, pressure, precipitation, sunshine and cloudiness records was developed from rescued historical climate records. Other initiatives are also carrying out at national scale leaded by National Meteorological and Hydrological Services (NMHSs), such as in Germany (Kaspar et al., 2015).

The European co-funded project INDECIS (*Integrated approach for the development across Europe of user oriented climate indicators for GFCS high-priority sectors: agriculture, disaster risk reduction, energy, health, water and tourism*), leaded by the Rovira i Virgili University (Tarragona, Spain), will develop user oriented climate indicators across Europe for the GFCS priority sectors (Water, Energy,

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Health, Agriculture and Food Security, Disaster Risk Reduction) plus Tourism. The project includes efforts in data rescue to expand current ECA&D dataset across the poorest climate data coverage over some European regions. This paper presents this process. Station-based climate observations were rescued over European sub-regions (mainly Central Europe and Balkans region) for the main climate variables (maximum and minimum temperature, rainfall, sunshine duration and snow depth) along the 20th century at daily scale. Rescued data will constitute, together with other gathered regional datasets, the newly INDECIS-Raw-Dataset, which will expand current European data coverage included in the ECA&D Dataset. INDECIS-Raw-Dataset will surely further improve the high quality climate products and services across Europe.

2. MATERIALS AND METHODS

This section describes the resources and methodology used in this study to develop data rescue efforts undertaken in the framework of the INDECIS Project. The first step consisted of identifying data gaps in ECA&D dataset in order to flag the poorest covered regions across Europe. Once identified, the undigitized existing data sources for these particular regions were located and classified. Then, a digitization plan was designed by making an inventory of the priority meteorological stations/periods to be rescued. Climate data was digitized and the metadata for each meteorological station was collected and stored for future quality control and homogenization purposes. Finally, a preliminary assessment of data rescued was undertaken to visualize the added value of DARE efforts by identifying climate extreme events.

2.1. Inspection of data gaps in ECA&D dataset

Data rescue efforts were designed to improve spatial and temporal data coverage of the ECA&D dataset. The variables of interest were maximum and minimum temperature (TX/TN), rainfall (RR), sunshine duration (SS) and snow depth (SD) at daily scale.
An extensive examination of ECA&D dataset (http://eca.knmi.nl/) was conducted to find spatial and temporal data gaps across Europe. This preliminary exercise provided us valuable information about which European sub-regions presented lower density of stations (Fig. 1). Regions located in eastern Europe showed the lowest spatial climate data coverage and larger temporal data gaps. In particular, the Balkans region (Croatia, Republic of Serbia, Montenegro, Bosnia and Herzegovina and Republic of Macedonia) was identified as a key region for data rescue missions while other sub-regions from Central Europe (mainly Czech and Slovak Republics), the Mediterranean basin (Italy, Greece and Turkey) also showed a serious lack of climate data coverage. Otherwise, regions with highest density of climate series were focused mainly in Germany, Slovenia, Scandinavia, the Netherlands, Switzerland, France and Great Britain.

2.2. Identification of undigitized data sources

Once European sub-regions with lower availability of spatial and temporal climate data coverage were located, the data sources of undigitized records were identified for these particular sub-regions.
The Croatian Meteorological and Hydrological Service (DHMZ located in Zagreb, Croatia) responded positively to our request and provided pdf files containing meteorological records directly scanned from original log-books.

In addition, other undigitized data sources were identified on-line thanks to the WMO MEDARE initiative and the UERRA project through the United States of America's National Oceanic and Atmospheric Administration/National Climatic Data Center (NOAA/NCDC) Climate Data Modernization Project (CDMP: http://docs.lib.noaa.gov/rescue/data_rescue_home.html) for European eastern regions, the Balkans and the Mediterranean basin (Ashcroft et al., 2018, Brunet et al., 2014a, 2014b). Synoptic station-based observations of atmospheric pressure, air temperature, wind speed and wind direction were already digitized at hourly scale under the UERRA project, but many other meteorological observations remained undigitized at daily scale. The INDECIS project represented a great opportunity to rescue all this amount of non-digitized daily data by using the same data sources already scanned.

Table 1 summarizes data sources obtained on-line through CDMP and also provided by the Croatian Meteorological and Hydrological Service depending on each European sub-region and for different periods along the 20th century and the first decade of the 21st century. All of these data sources were also stored in a central server due to heavy size and to avoid data loses.

Most of data sources obtained on-line through CDMP were secondary. Unfortunately, secondary data sources are more prominent to keep transcription errors than original data sources. Meteorological observations were handwritten especially in early-20th century while they are typed since 1960s and 70s. It is also worth to mention that the quality of scans was not always clear and readable and in some cases the meteorological records were hard to read increasing the probability to make transcription errors when digitizing.

Once data sources were thoroughly inspected, the digitization plan was designed taking into account the spatial-temporal data gaps previously found in ECA&D dataset. Thus, an inventory of candidate climate series to be rescued was created prioritizing those stations not included in ECA&D in order to increase climate data spatial coverage across Europe. Those undigitized periods for the already existing stations at ECA&D were also digitized to fill temporal data gaps, but not as a priority task.

A more detailed information about rescued climate series of the digitization plan can be found in Table 2, in which station metadata (e.g. station names, country, WMO code, latitude, longitude and altitude) and type of variables digitised for each station are shown. Rescued periods were variable across time covering the period 1949-2012 for the climate series located in the Balkans region and the period 1917-1968 for climate series in Central Europe.

2.3. Digitizing method

Before starting with the digitizing procedure, a deep inspection of data sources was necessary to familiarize with the general format, the structure of the data sheets and observations, the source language, the measurement units and other additional notes which can provide valuable climate information

(metadata). This preliminary inspection of data sources is able to avoid gross digitizing errors derived from some missing sheets for specific months, missing values or missing variables among others.
Figures 2, 3 and 4 show examples of the format and structure of scans obtained from various data sources. In particular, Fig. 2, scanned from original log-books provided by the DHMZ, shows daily rainfall and snow depth in Brodanci station (Croatia) due December 1983. It is a handwritten data source in which meteorological records are combined with meteorological symbols and other notes for metadata storage purposes. Figure 3, obtained on-line via CDMP, illustrates the structure of data sources for Central Europe stations. The variables of interest were maximum and minimum temperature, rainfall and snow depth at daily scale for Ceske Budejovice station (Czech Republic) due May 1960 in this case. Mainly typed values are shown with some station identifiers as metadata. Figure 4, also obtained on-line via CDMP, shows the structure and format of data sources for the Balkans region. The variables of interest were typed maximum and minimum temperature, rainfall, snow depth and sunshine duration at daily scale for Sarajevo station (Bosnia and Herzegovina) due July 1959.
Once all scans of data sources were thoroughly inspected, the digitizing process was set up. The digitizing method used in this study consisted of applying a rigorous "key as you see" approach, meaning that each digitizer was in charge to transcribe meteorological observations as were handwritten/typed in data sources, without using any system code, following the recommendations given by WMO (2016).
Digitization was done over a spreadsheet designed for data insertion by following the format of each variable in the hard copies. Half screen of the computer was used to read data from data sources and the other half for typing meteorological records in the spreadsheet (Fig. 5). The digitizers used real-time quality control strategies to minimize the instruction of erroneous values. They cross-checked the digitized values against data sources every 10^{th}, 20^{th} and 30^{th} for each month to check accuracy (to avoid repeated or skipped values). Also compared monthly totals and averages of digitized values with the monthly summaries provided in the hard copies, when they were available. Digitizing errors were reported in a specific template (Fig. 6) while corrections were applied by using a copy of the first series to preserve data traceability. The structure of the template used to document the preliminary quality control process can be found in Fig. 6. This template informs us about some basic station metadata (e.g. country, name of station and WMO/local code as identifier), the exact date and variable when a digitizing error was produced (year, month, day and variable), the original value (erroneous) and the replacement value (the correct one), the type of error (e.g. transcription error, source error, typing error…), the procedure applied (corrected or set to missing) and any other comments for a better understanding of the type of error or the final decision taken (e.g. hard to read, no sheet in data source, no station,…).
Obviously, this preliminary quality control was only applied to ensure that the digitizing procedure was correctly carried out, but a second and more sophisticate layer of quality control routines must be run to detect non-systematic errors hidden in climate data for future climate analysis (Aguilar et al., 2003; Venema et al., 2012).

2.4. Metadata collection

Data gaps and potential unexpected variations in data sources were also recorded in a metadata spreadsheet following the recommendations outlined by Aguilar et al. (2003).
Table 3 shows an example of a metadata template used for collecting additional notes for each station divided in six basic sections.
The first section was designed to acquire metadata from data sources including the title of the source, the period covered, the hosting, link (if any) to be found on-line and the variables. The second section was related to station identifiers (stations name, country, WMO code, latitude, longitude and altitude (m)) while the third one contained valuable information about variables (variable name, units, period and observing times). Section 4 was used to inform about special codes (e.g. code -99.9 for missing values, or code -3 for rainfall < 0.1mm among others). Section 5 was used to describe the dates or periods with missing values in data sources indicating the incident (e.g. no data for that station, hard to read values due to poor quality of scans, or no sheet for any reason). Finally, section 6 was used to identify changes in meteorological stations that could have an impact on observations, such as re-location of meteorological station, instrumental changes, among others. This particular information is useful to understand unexpected data behaviors or abrupt shifts for quality control and homogenization purposes.

2.5. Computation of climate extreme indices

Six of the 26 core climate extreme indices defined by the Expert Team on Climate Change Detection and Indices (ETCCDI) (Peterson et al., 2001) plus two specific drought indices were selected to be computed over Belgrade time-series for the whole period 1920-2017 to highlight, as example, the importance of DARE efforts in terms of identifying climate extreme events. ETCCDI indices are based on daily temperature values or daily precipitation amount. Some of them use fixed thresholds based on absolute values meanwhile others use percentiles of the relevant data series to make comparisons between different locations. The list of the 26 core ETCCDI indices and their definitions are available at: http://etccdi.pacificclimate.org/list_27_indices.shtml. For this preliminary assessment six ETCCDI indices were selected and computed at annual time scale to identify cold and dry years: TX10p, TN10p, FD, CSDI, PRCPTOT and CDD. TX10p and TN10p indices shows the percentage of days when TX and TN are lower than 10th percentile (cold days and cold nights) computed for the base-period 1961-1990. FD index reports the number of frost days (TN < 0ºC) per year meanwhile CSDI refers to the cold spell duration index identifying the annual account of days with at least six consecutive days when TN < 10th percentile. PRCPTOT index is the annual total precipitation in wet days and the CDD refers to the maximum number of consecutive days with RR < 1 mm.

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Two additional specific drought indices were also computed to identify major droughts in Belgrade series for the period 1920-2017. The most widely used Standardized Precipitation Index (SPI) (McKee et al., 1993) driven only by precipitation, and the Standardized Precipitation-Evapotranspiration Index (SPEI) (Vicente-Serrano et al., 2010), based on the difference between the precipitation and the reference evapotranspiration. Both drought indices were computed at the 6-month time scale to identify accumulated dry conditions across time. Reference evapotranspiration were calculated by using the Hargreaves algorithm (Hargreaves and Samani, 1985), which needs maximum and minimum temperature together with extraterrestrial solar radiation (performed from latitude and the day of the year). The calibration period was the longest period available for the Belgrade series (1920-2017) to compute both SPI and SPEI indices following the recommendations outlined by Beguería et al., (2014) and Trenberth et al., (2014).

3. RESULTS

This section describes the results derived from data rescue activities under the INDECIS project. After applying the digitizing method detailed in section 2.3, the results in terms of amount of digitized values and their spatial-temporal distribution are explained in this section. Results derived from the applied quality control of the digitizing procedure are described and a preliminary assessment of the rescued data is also carried out.

3.1. Spatial-temporal distribution of rescued observations

A total of 610K daily observations were rescued in the INDECIS project for maximum and minimum temperature (in ºC), rainfall (in mm), sunshine duration (in hours) and snow depth (in cm) across Central Europe and the Balkans region along really variable periods along the 20th century (Coll et al., 2019). Figure 7 shows the spatial distribution of the 25 rescued climate series located in 7 European countries: 11 climate series in Czech Republic, 5 in Slovak Republic, 3 in Republic of Serbia, two in Bosnia and Herzegovina, two more climate series in Republic of Macedonia, one in Croatia and the last one in Montenegro (see also Table 4). The 25 climate series will be included in the INDECIS-Raw-Dataset (together with gathered series obtained from other regionals datasets and not described in this study).
Table 4 shows a summary of number of rescued stations and total amount of digitised values for each country. Rescued variables and periods are also described. Maximum and minimum temperature, rainfall and snow depth were the rescued variables in Czech and Slovak Republic, while sunshine duration was also included in the Balkans region (except in Croatia, where only rainfall and snow depth were digitized). Digitizing periods were extended from 1917 to 1968 in Czech Republic and 1919-1968 in Slovak Republic. In the Balkans region, digitizing periods focused on 1920-2012 in the Republic of Serbia, 1949-1960 in Bosnia and Herzegovina, 1949-1984 in both Montenegro and Republic of Macedonia and, finally, the period 1930-1990 was digitized in Croatia. Nevertheless, these common periods were really variable among stations. More details about particular periods for each station can be found recovering Table 2.
Figures 8 and 9 show the total amount of digitized values for each country and for each variable, respectively. The largest amount of digitized values corresponds to stations in the Czech Republic, which nearly 250K values were rescued. Follow Slovak Republic with greater than 110K values, Republic of Serbia with more than 85K values and Montenegro with nearly 65K values. Finally, the total amount of digitized observations was lower in Croatia, Republic of Macedonia and in Bosnia and Herzegovina due to the short length of digitizing periods, multiple data gaps and less variables to be digitized (e.g. in Croatia).
A total of nearly 260K values were rescued in both maximum (TX) and minimum (TN) temperature (Fig. 9) meanwhile close to 160K values and greater than 150K values were rescued related to rainfall (RR)

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and snow depth (SD), respectively. In less proportion, greater than 40K values were rescued related to sunshine duration (SS). The main differences among the amount of digitized values for each variable depended basically on the availability (or not) of such variables in the data sources.

3.2. Quality Control

The quality control of the digitizing process was applied to all climate series rescued in the INDECIS Project. Monthly totals and sums provided by data sources (in most of the cases) were accurately cross-checked with monthly totals and sums computed from digitized data. Results demonstrated that the errors occurred during the digitizing process represented only the 0,6% of the total amount of digitized values, which highlights the accuracy and high standards of the process and ensures the transmission of ready-to-use data series. Most of errors occurred due to hard to read records (around 76% of errors; Fig. 10). The main cause was the low quality of particular sheets in the scanned data sources. The second cause of errors was variable confusion or, what means the same, column confusion in data sources (around 17% of errors). In those cases, the digitizer did not realize that they were typing the wrong variable. This could be solved by using templates that exactly match data sources with spreadsheets. Finally, the 7% of errors were typing errors produced during the digitizing process (e.g. type 104,5 ºC instead 10,5 ºC). All errors found in the preliminary quality control of the digitizing process were successfully corrected or were set to missing in the cases that a new value could not be offered.
The 25 new climate series will be incorporated to the INDECIS-Raw-Dataset and submitted for addition into the ECA&D Dataset. Thus, the spatial-temporal climate coverage will surely improve in Central Europe and in the Balkans region. More exhaustive quality control routines are strongly recommended to find non-systematic errors together with the application of some homogenization tests to ensure the high quality of the new dataset to be used for future climate analysis.

3.3. Preliminary assessment of rescued data

In this section, we intend to visualize the effects of data rescue and explain the impact of data rescue over climate series. No need to say that the solid climatological conclusions cannot be drawn from them, as the data has not been assessed for homogeneity, but the benefits of data rescue are highlighted.
For example, Fig. 11 shows the evolution of daily maximum (TX) minimum (TN) temperature and precipitation (RR) at Belgrade station (Republic of Serbia) for the period 1920-2017. Data rescue efforts allowed to extend 15 years back to 1936 creating a long-term time series of almost 100 years of records. Focusing on the rescued period (blue line), extreme cold temperatures can be identified in 1922, 1935, but especially in 1929. In particular, February 1929 was extremely cold in Belgrade reaching temperatures on record in both maximum and minimum temperature for the whole time series. Minimum temperature

reached -25,5ºC and maximum temperature did not exceed -18,5ºC in a particular day. The evolution of precipitation (Fig. 11) for the rescued period 1920-1935 shows dry conditions in 1920-1921, 1923 and 1928 meanwhile wet conditions were predominant in 1924-1927 and 1931-1933.

Data rescue efforts extend climatological analysis to the past. Even though the Belgrade series shown in Fig. 11 are neither quality controlled and homogenized, the calculation of some ETCCDI indices (Peterson et al., 2001) plus two specific drought indices (SPI and SPEI) suggests some climate features that could not be studied before this DARE effort. For example, in the cold 1929 year (Fig. 12) or the dry event experienced in 1920-1921 in Belgrade (Fig. 13).

According to these indices (Fig. 12) 1929 is identified as a cold year, with a high percentage (> 20%) of cold days (TX10p) and nights (TN10p), over 100 frost days (FD) and 55 days singled out as part of a cold spell (CSDI). The mentioned cold spell occurred in February 1929 and was general over most of Europe being the coldest month on record in Poland (Sirocko et al., 2012). The Rhine river was frozen in Germany taking into account that only occurred it six times during the 20th century and the canals were also frozen in Venice according to the Meteorological Magazine published for the UK Meteorological Office in March 1929.

Figure 13 shows the PRCPTOT, SPI 6-month, SPEI 6-month and CDD indices computed over the Belgrade rescued time series for the period 1920-2017. These specific extreme indices were selected to identify the dry event occurred in 1920-1921. Annual precipitation amount (PRCPTOT index) was low in 1920 compared with other years of the time series (< 500 mm) and the consecutive dry days index (CDD) shows that there was a period with more than 40 days with precipitation less than 1 mm. The computation of additional drought indices such as SPI 6-month and SPEI 6-month allowed to identify the driest event of the whole Belgrade series reaching maximum severity in 1921. This drought event not only affected a particular European region, but most of European countries suffered severe dry conditions during several months between years 1920 and 1923 (Hanel et al., 2018). In fact, West Europe was in serious drought during 1920 and 1921, which was reported by the "Townsville Daily Bulletin" in July 1921. High pressure systems from the Azores remained stuck for almost the entire year, leading to clear skies and dire shortages of rain. Most rivers in France were below the lowest records in 50 years, the mountain torrents in Switzerland were not a third of their usual volume and the dry sequence lasted 86 consecutive days for most of Britain.

4. DATA AVAILABILITY

The daily dataset rescued in this study across Europe is available at the PANGAEA repository: https://doi.pangaea.de/10.1594/PANGAEA.896957

5. SUMMARY AND CONCLUSIONS

In the framework of the INDECIS Project, some human and economic resources were allocated for data rescue activities across Europe in order to enhance the quality in the already existing climate products and services. This study deeply describes all the process carried out: from the identification of data gaps in ECA&D dataset and the inspection of undigitized data sources to the digitizing process together with the accurate documentation of data and metadata, including also the corrections derived from digitizing errors.

The process of identifying data gaps, the inspection of data sources to be rescued and the preparation of aforementioned data sources was actually a time consuming task (Brönninnmann, 2006). In particular, several hours of work and human resources were needed during the manual-keying digitizing process. For this reason, it was crucial to design and implement an effective and reliable digitizing method to obtain the final high-quality climate dataset avoiding extra-costs.

Some recommendations are available to guide experts involved in data rescue projects or initiatives. In this line, Brönninnmann (2006) designed a digitizing guide for climate data describing the use of technologies based on optical character recognition (OCR) technologies or based on speech recognition techniques to be faster in the digitizing procedure. Nevertheless, the study demonstrated that the manual-keying digitizing process was the most efficient method in terms of agility, reduction of transcription errors and post-process time consuming. The World Meteorological Organization supported this statement (WMO, 2016) recommending the use of OCRs only in a certain data sources, since human eye is still more effective transcribing handwritten data sources.

Nowadays, the most effective method of digitization is double or triple-keying data by using templates that match with format of original data sources (WMO, 2016). Despite this, the final economic cost is remarkably higher and most of projects cannot assume this extra cost. Simple manual-keying with an effective quality control during and at the end of the digitization process resulted the better balance between costs and data quality of rescued datasets knowing that some issues to solve already exist (Ashcroft et al., 2018).

In summary, a total of 25 climate series (610K daily observations) were rescued in this study for 7 countries of the Central Europe and the Balkans region along the 20th century by using the manual-keying digitizing method together with a preliminary quality control of the digitizing procedure (Coll et al., 2019). Climate variables of interest were maximum and minimum temperature, rainfall, sunshine duration and snow depth. The aforementioned rescued climate series will be included in the newly INDECIS-Raw-Dataset, which will be automatically ingested by the ECA&D Dataset to fill the spatial-temporal data gaps previously identified across Europe.

Rescued dataset will be submitted to more rigorous quality control routines to detect non-systematic errors (Aguilar et al., 2003) together with some homogenisation tests (Venema et al., 2012) to ensure a high-quality and homogeneous data to be used by the international research community to design and implement new climate products and services.

Future European climate analysis will be benefited of DARE efforts undertaken in this study such as increasing the reliability of long-term climate trends or identifying historical climate extremes among others.

6. AUTHOR CONTRIBUTION

Joan Ramon Coll: Searcher of undigitised data sources, developer of data inventories, in charge of the manual digitization process (typing), extreme indices computation and analysis and manuscript preparation.

Gerard van der Schrier: Everything related to ECA&D management: Inventory of digitised stations/periods, provider of digitised data and ECA&D data gaps inspection).

Enric Aguilar: Designer of the digitization plan, supervisor of the digitization process and quality control and paper structure designer.

Dubravka Rasol: Scanning and providing undigitized data for the Balkan region.

Roberto Coscarelli: Supervisor of the extreme indices analysis and detection of extreme events and also paper reviewer.

Andrés Bishop: In charge of quality control process of digitization.

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The authors declare that they have no conflict of interest.

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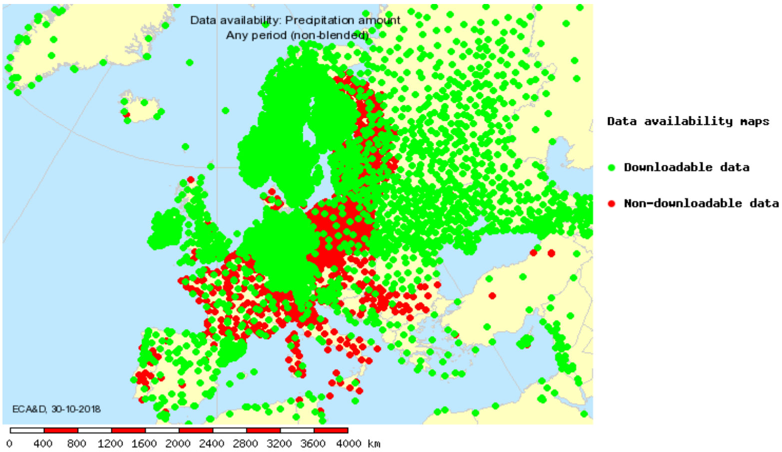

Fig. 1: Spatial distribution of meteorological stations in ECA&D (precipitation as example) across Europe in 2018. Downloadable stations are in green and non-downloadable stations in red.

Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2019-6
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Earth System Science Data
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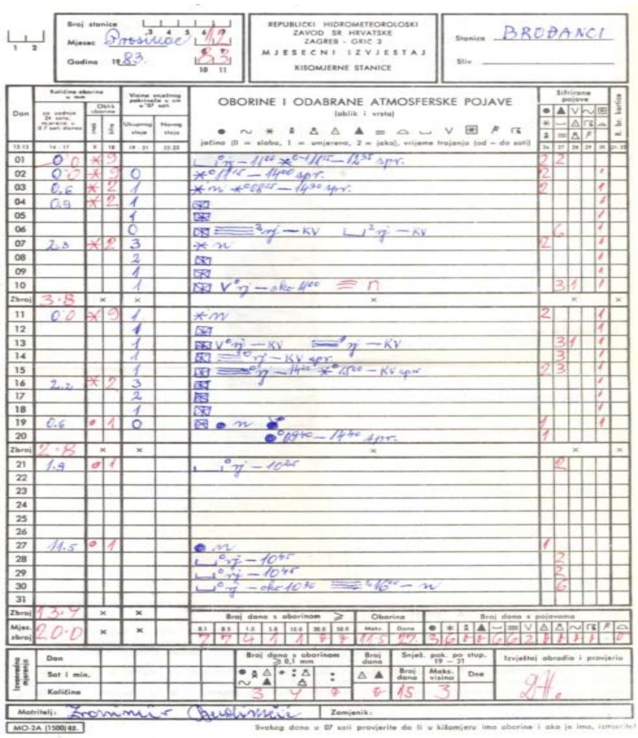

Fig. 2: Structure of original log-books (scans) provided by the Croatian Meteorological Service; Brodanci station (Croatia), December 1983.

Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2019-6
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Discussion started: 21 January 2019

Open Access Earth System Science Data Discussions

ČESKÉ BUDĚJOVICE H = 387 m / 388 m b. Bc = + 0,14 započteno appliquée Gc = + 0,14 započteno appliquée KVĚTEN / MAI 1960

Datum – Date	Tlak vzduchu (0° C-mm) Pression atmosphérique P 7h	14h	21h	Teplota vzduchu Température de l'air °C T 7h	14h	21h	Průměr D.	Max.	Min.	Vlhkost poměrná Humidité relative % U 7h	14h	21h	Prům. D.	Směr a síla větru Direction et force du vent DF 7h	14h	21h	Dohlednost Visibilité V 14h	Oblačnost Nébulosité N 7h	14h	21h	Srážky mm Eau tombée R 7h	Sněhová pokrývka Couche de neige
1.	724,7	723,8	725,7	4,4	8,3	4,9	5,6	10,5	3,4	80	66	92	79	W 1	NNW 1	– 0	16	9^{2}	9^{2}	10^{2}	7,6	.
2.	28,4	29,3	31,4	4,8	9,0	3,4	5,2	9,1	2,0	67	46	76	63	NW 3	NNW 2	NW 1	25	5^{1}	7^{1}	3^{1}	0,0	.
3.	33,5	33,8	34,2	2,7	12,0	5,4	6,4	13,4	-1,9	69	35	75	60	NW 1	W 1	W 1	12	1^{0}	2^{1}	0	.	.
4.	35,3	32,5	32,4	3,2	16,5	10,9	10,4	16,9	-1,0	76	33	53	54	– 0	ESE 3	SE 2	17	4^{1}	5^{1}	10^{1}	.	.
5.	33,3	31,5	32,6	6,3	16,2	9,0	10,1	16,6	3,6	83	37	86	69	W 2	ESE 2	W 1	18	8^{1}	8^{1}	7^{1}	.	.
6.	27,4	30,2	30,4	5,3	18,0	12,3	12,0	18,6	3,5	91	29	40	53	– 0	W 3	NE 2	20	10^{1}	5^{1}	0	.	.
7.	31,4	30,3	31,0	6,4	17,6	12,9	12,4	18,3	2,0	79	34	69	61	W 1	NE 2	– 0	25	0	8^{1}	8^{1}	.	.
8.	30,5	28,8	28,5	6,6	16,1	11,7	11,5	16,5	4,1	88	54	84	75	NW 1	W 1	E 4	16	7^{1}	8^{1}	8^{1}	0,0	.
9.	28,4	28,7	28,6	9,4	12,7	10,6	10,8	13,4	8,8	80	65	80	75	– 0	SE 1	S 1	18	10^{2}	10^{2}	9^{2}	.	.
10.	28,8	28,2	28,9	8,8	17,1	10,5	11,7	18,0	6,7	88	52	100	80	NE 1	NW 1	– 0	18	10^{2}	5^{1}	10^{2}	20,0	.
11.	28,3	27,9	27,2	9,6	19,8	15,2	15,0	20,9	8,8	98	43	64	68	W 1	E 1	E 1	7	10^{2}	8^{1}	2^{1}	.	.
12.	28,0	27,2	27,2	9,8	21,2	15,9	15,8	22,1	6,2	84	42	66	64	W 1	SE I	SE 1	8	1^{0}	3^{1}	9^{1}	.	.
13.	27,9	26,4	26,4	15,0	22,4	15,8	17,2	23,1	9,5	68	46	74	63	E 1	E 1	SE 1	15	5^{1}	9^{1}	10^{2}	1,6	.
14.	27,5	29,7	29,8	12,8	17,2	13,2	14,1	18,4	11,8	88	68	80	79	E 1	SE 2	SE 2	10	8^{1}	6^{1}	2^{1}	.	.
15.	30,0	30,4	29,6	10,6	16,1	13,8	13,6	19,3	10,5	93	69	74	79	E 3	ESE 3	ESE 1	15	10^{1}	5^{1}	1^{0}	.	.
16.	29,5	27,4	26,6	13,7	21,9	16,8	17,3	24,3	10,1	79	65	75	73	NW 1	E 1	E 1	18	5^{1}	4^{1}	0	0,6	.
17.	27,1	25,0	25,1	11,9	24,6	17,3	17,8	26,8	9,8	89	46	91	75	SE 1	W 1	– 0	35	5^{1}	6^{1}	5^{1}	4,9	.
18.	25,8	22,9	21,1	15,4	27,8	21,2	21,4	28,0	12,0	83	37	70	63	– 0	– 0	SE 1	18	0	0	4^{1}	.	.
19.	22,0	20,5	24,0	21,4	28,1	14,9	19,8	28,8	14,9	59	33	77	56	W 1	SW 2	N 1	16	4^{1}	5^{1}	6^{1}	3,6	.
20.	24,1	24,2	25,1	11,8	18,3	12,3	13,7	20,1	10,3	91	63	90	81	SW 1	W 1	– 0	12	10^{1}	8^{1}	10^{1}	3,6	.
21.	27,0	25,6	26,6	14,2	16,8	12,2	13,8	19,5	10,6	73	69	96	79	WSW 2	E 1	E 1	12	9^{1}	9^{1}	8^{1}	5,7	.
22.	26,1	24,3	26,0	13,1	14,2	12,0	13,3	21,0	10,4	73	90	93	85	SW 1	W 1	– 0	8	6^{1}	10^{1}	10^{1}	55,5	.
23.	28,8	29,5	30,6	11,4	16,1	11,1	12,4	16,9	10,5	88	59	92	80	W 2	W 2	S 1	12	10^{1}	5^{1}	2^{1}	1,8	.
24.	31,2	29,5	28,7	11,2	20,3	15,7	15,7	21,5	6,7	79	46	79	68	S 2	S 1	S 1	20	0	7^{1}	9^{1}	3,2	.
25.	35,1	35,1	35,4	9,9	15,2	10,8	11,7	16,4	8,3	62	43	71	59	N 2	W 2	W 1	20	8^{1}	0	3^{1}	.	.
26.	34,8	31,2	32,7	10,6	15,7	7,2	10,2	15,8	4,2	71	41	89	67	– 0	W 3	W 1	18	1^{0}	4^{1}	3^{1}	2,4	.
27.	31,7	31,9	32,2	7,8	14,9	9,5	10,4	15,6	4,1	83	48	88	73	W 1	NW 1	– 0	25	6^{1}	5^{1}	0	.	.
28.	31,3	29,8	29,5	13,7	17,8	12,4	14,1	20,0	7,2	77	42	85	68	– 0	NW 1	– 0	18	0	0	0	.	.
29.	30,2	29,1	29,0	8,4	20,2	15,2	14,8	20,4	5,0	81	42	64	62	– 0	NNE 1	NE 1	16	0	5^{1}	9^{1}	.	.
30.	29,7	29,6	30,5	11,8	13,0	11,5	12,0	15,5	9,4	76	85	87	83	NW 2	SW 1	– 0	8	10^{1}	10^{1}	10^{1}	0,3	.
31.	31,8	31,9	32,3	11,7	19,6	15,8	15,7	21,1	10,6	86	[illegible]	83	77	NW 2	W 1	SE 1	8	10^{1}	8^{1}	9^{1}	.	.
Ø	726,12	725,36	725,78	10,19	17,57	12,30	13,09	18,93	7,16	80	51	79	70	1,1	1,5	0,9	—	5,9	5,9	5,7	Σ 109,8	—

Fig. 3: Structure of data sources (scans) for Central Europe stations: Ceske Budejovice station (Czech Republic), May 1960.

JUL 1959 SARAJEVO

φ = 43° 52′N λ = 18°26′E Gr. Δ G = + 1h 14 min. *Br. st. 272*

Dan	Vazdušni pritisa P mm 7	14	21	Temperatura vazduha T °C 7	14	21	Sred. (Dies)	Max	Min	Min. 5 cm	Pritisak vodene pare e m 7	14	21	Relativna vlažnost U % 7	14	21	Sred. (Dies)	Pravac i jačina vetra D. F (0—12) 7	14	21
1	705.8	708.1	709.4	12.1	12.2	11.6	11.9	15.0	10.5	10.0	8.9	9.9	2.7	85	93	85	88	NW 1	SW 1	WSW 1
2	10.3	09.3	09.7	11.4	16.2	13.2	13.5	17.3	10.1	9.8	9.6	10.5	10.8	95	76	95	89	WNW 2	W 3	NNW 1
3	09.2	08.7	08.9	12.8	18.4	14.2	14.9	19.0	11.0	9.7	10.8	10.0	11.1	98	64	92	85	SE 1	N 3	SE 1
4	07.9	07.8	09.6	14.8	19.2	15.0	16.0	20.6	12.2	11.0	10.7	10.5	11.1	85	64	87	79	NE 1	WSW 4	SW 2
5	10.4	10.7	10.6	14.2	18.8	16.2	16.4	20.9	13.1	12.4	11.6	12.3	11.1	96	76	84	85	— 0	WNW 2	SE 2
6	10.2	08.8	09.4	15.7	23.4	18.0	18.8	24.8	13.6	12.8	11.4	11.9	11.9	85	55	77	72	— 0	W 3	ENE 2
7	10.5	10.4	11.3	15.4	18.0	15.4	16.0	23.5	13.1	12.4	11.0	11.4	11.8	84	74	90	83	SE 2	NNW 2	SSW 2
8	12.0	11.6	12.6	14.8	21.2	17.3	17.6	23.8	14.2	14.1	12.4	11.8	10.9	98	62	74	78	WSW 1	NNE 4	WNW 2
9	12.1	10.3	10.9	14.4	24.6	19.1	19.3	26.0	11.4	10.7	10.5	10.6	12.0	86	46	72	68	ESE 2	ENE 3	E 2
10	10.9	09.5	09.3	16.0	25.3	19.6	20.1	27.0	13.2	12.2	11.1	12.2	12.2	82	51	72	68	SE 2	WNW 2	E 2
11	09.6	07.9	08.1	16.5	25.6	21.4	21.2	28.3	13.9	12.7	11.2	14.3	13.0	80	59	69	69	ESE 2	NNW 2	E 2
12	08.5	07.4	07.5	17.6	18.8	18.2	18.2	26.7	15.0	14.0	12.1	12.6	14.2	81	78	91	83	ESE 1	ESE 3	SW 1
13	06.6	05.3	05.9	17.2	23.8	19.0	19.8	25.4	14.9	13.9	12.9	10.2	11.3	88	47	68	68	WSW 1	ESE 1	NE 2
14	06.4	05.2	05.4	15.4	22.8	19.4	19.2	24.5	14.3	13.2	12.1	14.2	15.7	92	68	93	84	WNW 2	W 1	NNW 1
15	04.5	03.1	03.8	18.7	27.6	19.8	21.5	28.6	16.1	14.7	14.3	12.8	13.2	88	46	77	70	ENE 2	SW 2	E 3
16	02.6	03.2	04.7	17.8	16.5	17.9	17.5	26.4	16.1	15.0	13.8	12.3	14.8	91	87	96	91	W 2	ENE 3	W 1
17	06.6	07.4	08.7	16.4	16.8	15.6	16.1	18.0	15.4	15.4	12.6	13.0	11.8	90	90	89	90	W 2	WNW 3	W 2
18	07.4	07.0	07.2	15.4	17.4	16.0	16.2	18.9	14.8	14.8	10.5	11.2	11.6	80	75	85	80	WNW 2	NNW 2	— 0
19	07.1	05.9	07.2	15.2	22.6	17.0	18.0	23.4	14.3	14.4	11.6	12.8	12.3	90	63	85	79	W 1	WNW 3	E 2
20	06.4	05.3	05.9	16.2	22.6	19.2	19.3	24.6	14.8	14.0	12.5	12.8	13.2	90	62	80	77	WNW 1	W 2	W 2
21	05.4	04.4	05.7	16.8	22.8	18.0	18.9	24.2	15.9	16.0	13.2	13.5	14.9	92	65	96	84	W 2	SW 3	WSW 1
22	05.9	05.5	06.2	17.1	22.4	17.1	18.4	24.2	16.7	16.6	14.2	14.4	13.8	97	71	94	87	NW 2	ESE 2	E 2
23	06.9	07.2	07.3	16.6	18.7	17.8	17.7	22.8	15.7	15.4	13.9	14.1	13.0	98	87	85	90	— 0	E 1	ENE 2
24	08.0	07.0	06.6	14.4	25.6	18.6	19.3	27.0	13.8	13.1	12.0	12.2	12.0	98	50	75	74	ESE 1	WSW 1	ESE 2
25	06.3	05.9	06.8	16.8	23.1	16.7	18.3	25.3	15.0	14.2	12.0	14.4	12.9	84	68	90	81	WSW 2	ESE 2	E 2
26	07.1	05.6	06.1	15.2	24.3	19.4	19.6	25.8	14.3	13.7	11.9	11.1	13.8	92	49	81	74	ESE 1	WSW 1	WSW 1
27	06.8	06.3	07.1	17.2	23.6	17.8	19.1	25.2	14.8	14.1	13.0	12.6	12.0	89	58	79	75	SE 2	WNW 2	ESE 2
28	07.9	06.9	06.6	15.6	25.2	19.6	20.0	26.3	13.3	12.8	11.4	13.0	11.3	86	54	66	69	ESE 2	W 2	ESE 2
29	05.3	03.4	03.6	16.0	28.6	21.1	21.7	29.2	13.7	13.1	11.5	11.4	12.1	85	39	65	63	ESE 2	W 2	E 1
30	03.6	02.7	03.4	19.2	30.6	25.2	25.0	31.2	16.2	15.1	11.2	12.3	19.1	67	37	37	47	E 2	S 3	S 2
31	05.2	03.9	03.8	19.7	29.6	21.0	22.8	30.0	16.2	15.2	11.5	10.6	13.2	67	34	71	57	E 2	WNW 3	NNW 2
Mes. sred.	707.6	706.8	707.4	15.9	22.1	17.9	18.4	24.3	14.1	13.4	11.9	12.2	12.4	87.7	62.8	80.6	77.0	1.5	2.3	1.7

Fig. 4: Structure of data sources (scans) for the Balkans region: Sarajevo station (Bosnia & Herzegovina), July 1959.

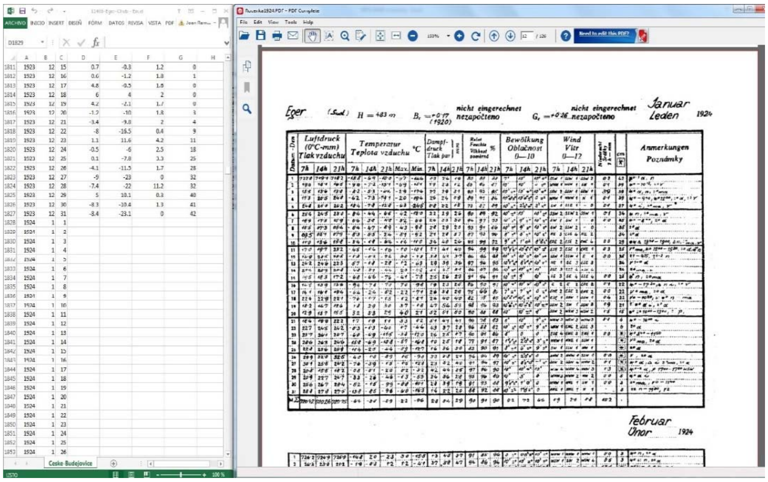

Fig. 5: Example of the manual-keying data transcription method used during the digitization process; from scanned data sources (right) to digital spreadsheets (left).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	country	station name	code	Year	Month	Day	Element	Original value	Replacement value	Detection test	Type of error	Procedure	Comments	
2	Croatia	Brodanci	5080	1931	2	27	RR	0	0,2	Visual checking	Transcription	corrected	Dificulties to be read	
3	Croatia	Brodanci	5080	1931	2	28	RR	0	4,6	Visual checking	Transcription	corrected	Dificulties to be read	
4	Croatia	Brodanci	5080	1931	10	21	RR	4	4,9	Visual checking	Transcription	corrected	Dificulties to be read	
5	Croatia	Brodanci	5080	1931	10	27	RR	3	3,9	Visual checking	Transcription	corrected	Dificulties to be read	
6	Croatia	Brodanci	5080	1931	12	10	RR	1	0,9	Visual checking	Transcription	corrected	Dificulties to be read	
7	Croatia	Brodanci	5080	1933	1	25	RR	3,4	3,7	Visual checking	Transcription	corrected	Dificulties to be read	
8	Croatia	Brodanci	5080	1933	2	23	RR	5,9	5,1	Visual checking	Transcription	corrected	Dificulties to be read	
9	Croatia	Brodanci	5080	1933	3	7	RR	0,2	0,6	Visual checking	Transcription	corrected	Dificulties to be read	
10	Croatia	Brodanci	5080	1933	6	29	RR	2,5	2,8	Visual checking	Transcription	corrected	Dificulties to be read	
11	Croatia	Brodanci	5080	1933	8	2	RR	1,5	1,6	Visual checking	Transcription	corrected	Dificulties to be read	
12	Croatia	Brodanci	5080	1933	10	14	RR	0,9	6,9	Visual checking	Transcription	corrected	Dificulties to be read	
13	Croatia	Brodanci	5080	1934	6	12	RR	4	4,9	Visual checking	Transcription	corrected	Dificulties to be read	
14	Croatia	Brodanci	5080	1936	5	27	RR	2,2	12,2	Visual checking	Source error	corrected	Typing error	
15	Croatia	Brodanci	5080	1936	7	4	RR	37,3	37,1	Visual checking	Transcription	corrected	Dificulties to be read	
16	Croatia	Brodanci	5080	1936	10	2	RR	10,8	10,3	Visual checking	Transcription	corrected	Dificulties to be read	
17	Croatia	Brodanci	5080	1937	2	18	RR	0,8	0,07	Visual checking	Transcription	corrected	Dificulties to be read	
18	Croatia	Brodanci	5080	1938	11	1	RR	3	3,3	Visual checking	Transcription	corrected	Dificulties to be read	
19	Croatia	Brodanci	5080	1939	6	28	RR	19,8	19,3	Visual checking	Transcription	corrected	Dificulties to be read	
20	Croatia	Brodanci	5080	1939	9	22	RR	2,6	9,2	Visual checking	Transcription	corrected	Typing error	
21	Croatia	Brodanci	5080	1939	10	28	RR	2,5	2,8	Visual checking	Transcription	corrected	Dificulties to be read	
22	Croatia	Brodanci	5080	1940	2	1	RR	2,8	2,9	Visual checking	Transcription	corrected	Dificulties to be read	

Fig. 6: Template used to report the quality control of the digitization process.

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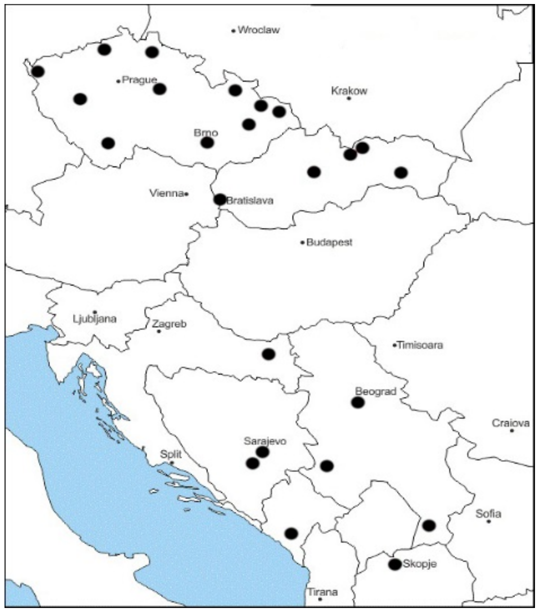

Fig. 7: Spatial distribution of rescued stations

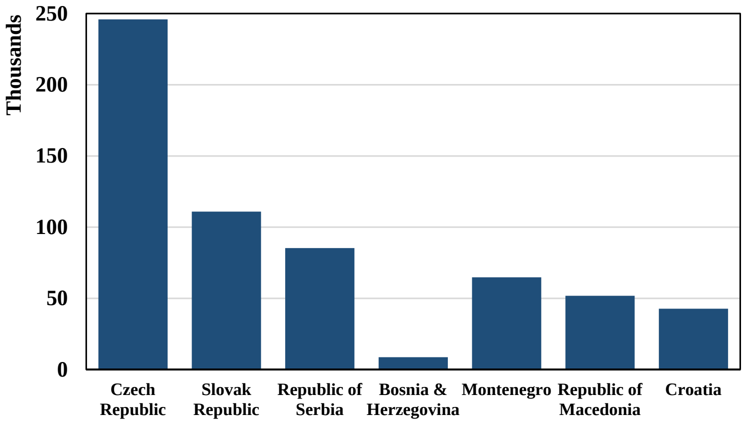

Fig. 8: Total amount of digitized values (in thousands) by countries

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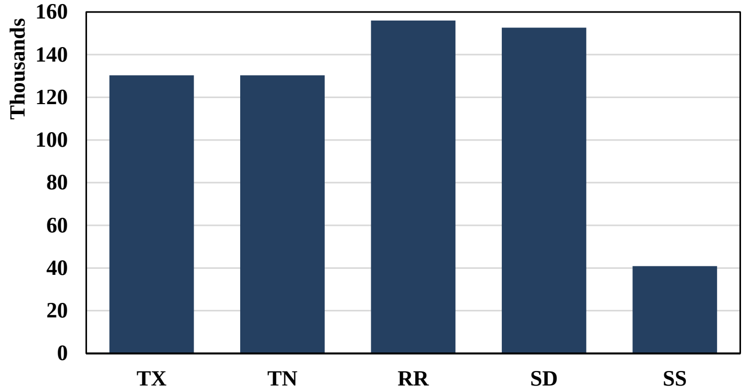

Fig. 9: Total amount of digitized values (in thousands) by variables

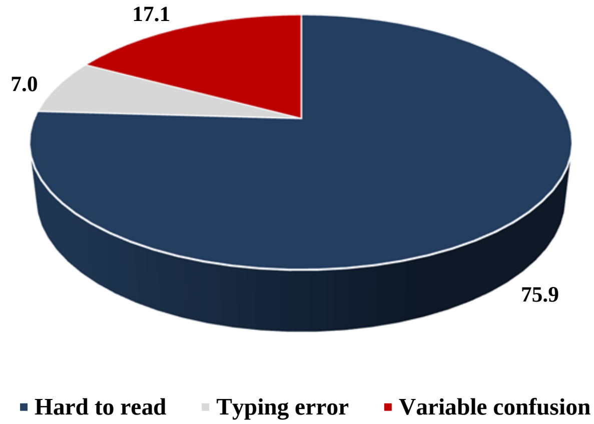

Figure 10: Percentage of type of errors found after the quality control of the digitizing procedure.

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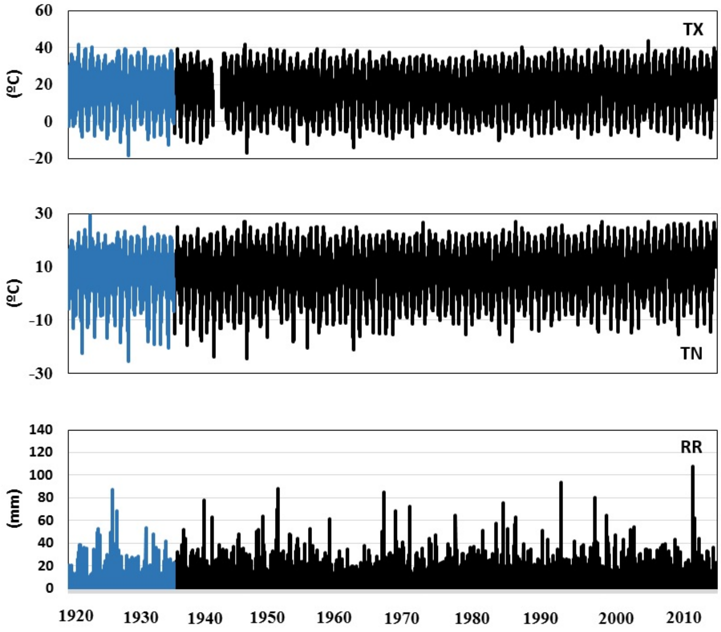

Figure 11: Evolution of daily maximum (TX) minimum (TN) temperature and precipitation (RR) at Belgrade station (Republic of Serbia) for the period 1920-2017. The period 1920-1935 was rescued in this study (blue line) meanwhile the period 1936-2017 was obtained from ECA&D Dataset (dark line).

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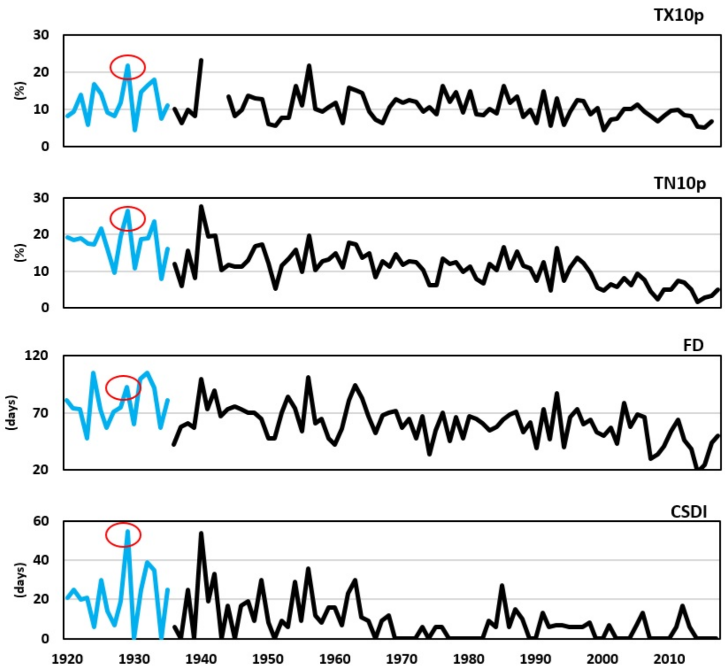

Figure 12: Time series of TX10p, TN10p, FD and CSDI extreme indices at Belgrade station (Republic of Serbia) for the period 1920-2017. The period 1920-1935 was rescued in this study (blue line) meanwhile the period 1936-2017 was obtained from ECA&D Dataset (dark line). Red circle shows a climatic extreme (cold year) identified in 1929.

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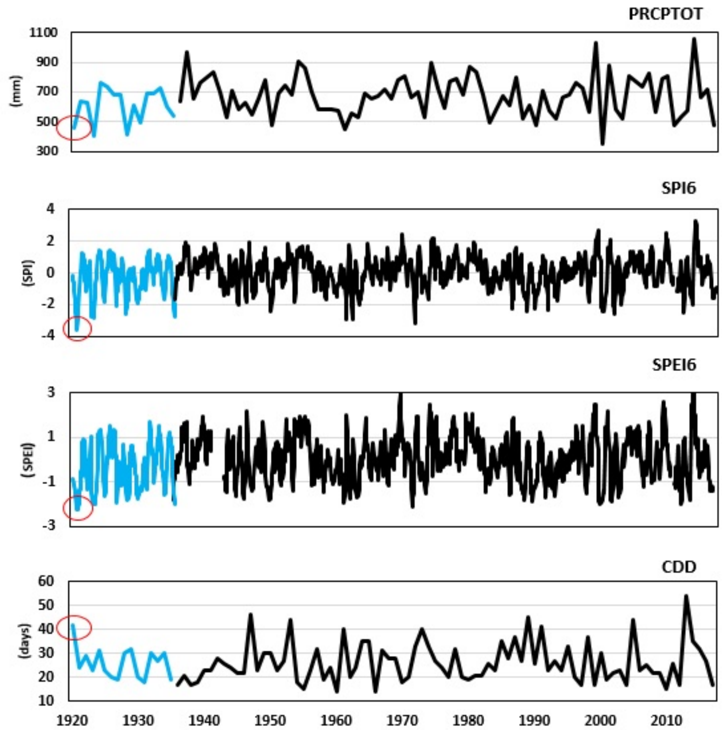

564
565 **Figure 13**: Time series of PRCPTOT, SPI 6-month, SPEI 6-month and CDD extreme indices at Belgrade
566 station (Republic of Serbia) for the period 1920-2017. The period 1920-1935 was rescued in this study
567 (blue line) meanwhile the period 1936-2017 was obtained from ECA&D Dataset (dark line). Red circle
568 shows a climatic extreme (dry years) identified in 1920-1921.
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Table 1: Documental data sources used for data rescue purposes.

Region	Documental Source	Period
Central Europe	Rocenka povetrnostnich posoro vani site statniho ustavu meteorologickeho.	1916-1946
	Rocenka povetrnostnich pozorovani meteorologickeho stanie Republiky Ceskoslovenshe.	1948-1968
	Rocenka povetrnostnych pozorovani observtoria na Lomnickom Stite.	1940-1974
Balkans Region	Izvestaj meteoroloske opservatorije u Beogradu.	1920-1945
	Resultati osmatranija u Beogradu.	1946-1950
	Meteoroloski godisnjak. I.	1949-2012
	Scans from original log-books provided by the Croatian Meteorological and Hydrological Service (DHMZ)	1930-1990

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Table 2: Rescued data included in the INDECIS-Raw-Dataset. Specific metadata such as country, WMO code, station name, latitude, longitude, altitude and digitizing period are also shown. Digitized variables are maximum (TX) and minimum (TN) temperature, rainfall (RR), snow depth (SD) and sunshine duration (SS).

Country	WMO code	Station Name	Lat. N	Lon. E	Alt. (m)	Variables	Digitizing period
Czech Republic	11542	Ceske Budejovice	48°58'00"	14°28'00"	389	TX/TN/RR/SD	1917-1938
	11748	Prerov	49°28'00"	17°27'00"	214	TX/TN/RR/SD	1917-1952
	11406	Eger/Cheb	50°05'00"	12°24'00"	483	TX/TN/RR/SD	1919-1936
	11763	Troppau/ Opava	49°56'00'	17°53'00"	268	TX/TN/RR/SD	1917-1937
	11461	Teplitz-Schnonau	50°39'00"	13°48'00"	229	TX/TN/RR/SD	1917-1936
	11446	Plzen	49°44'00"	13°80'00"	357	TX/TN/RR/SD	1948-1953
	99999	Turnov	50°36'00"	15°10'00"	280	TX/TN/RR/SD	1948-1951
	11721	Brno-Kvetna	49°12'00"	16°34'00"	233	TX/TN/RR/SD	1948-1968
	11735	Praded	50°05'00"	17°14'00"	1490	TX/TN/RR/SD	1948-1957
	11622	Caslav-Filipor	49°54'00"	15°24'00"	252	TX/TN/RR/SD	1946-1960
	99999	Frycovice	49°41'00"	18°13'00"	274	TX/TN/RR/SD	1946-1953
Slovak Republic	99999	O.-Gyalla/ Stara Dala	47°53'00"	18°12'00"	120	TX/TN/RR/SD	1919-1937
	99999	St. Smokovec	49°08'00"	20°13'00"	1018	TX/TN/RR/SD	1921-1937
	11814	Bratislava-Trnavaka	48°10'00"	17°08'00"	139	TX/TN/RR/SD	1946-1968
	11931	Skalnate Pleso	49°12'00"	20°55'00"	1778	TX/TN/RR/SD	1946-1960
	11968	Kosice	48°42'00"	21°16'00"	206	TX/TN/RR/SD	1946-1950
Republic of Serbia	13274	Belgrade	44°48'00"	20°28'00"	132	TX/TN/RR	1920-1935
	13367	Zlatibor	43°44'00"	19°43'00"	1028	TX/TN/RR/SD/SS	1992-2012
	13489	Vranje	42°33'00"	21°55'00"	432	TX/TN/RR/SD/SS	1999-2012
Bosnia & Herzegovina	13353	Sarajevo	43°52'00"	18°26'00"	630	SD/SS	1949-1960
	13352	Bjelasnica	43°43'00"	18°16'00"	2067	SD/SS	1953-1960
Montenegro	13462	Titograd/ Podgorica	42°26'00"	19°17'00"	52	TX/TN/RR/SD/SS	1949-1984
Republic of Macedonia	13491	Skopje	41°59'00"	21°28'00"	240	TX/TN/RR/SD/SS	1949-1972
	13586	Skopje (Petrovac)	41°58'00"	21°39'00"	238	RR/SD/SS	1974-1984
Croatia	5080	Brodanci	45°32'33"	18°27'26"	92	RR/SD	1930-1990

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Table 3: Metadata collection by using specific templates

Metadata on data sources			
Title of the source: Meteoroloski godisnjak. I			
Period covered by the source: 1949-1978			
Available at: CDMP-NOAA: http://library.noaa.gov/Collections/Digital-Documents/Foreign-Climate-Data-Home			
Variables included: Maximum and minimum temperature, rainfall and snow depth			
Station Identifiers			
Station Name:	Ceske Budejovice	***WMO code:***	11542
Country:	Czech Republic	***Altitude (m):***	389
Latitude:	48º58'00"	***Longitude:***	14º28'00"
Variables Metadata			
Variable	***Units***	***Period***	***Observing times***
Max. Temperature (TX)	(ºC)	1917-1938	Daily
Min. Temperature (TN)	(ºC)	1917-1938	Daily
Rainfall (RR)	(mm)	1917-1938	7am
Snow depth (SD)	(cm)	1917-1938	7am
Special Codes			
Variable	***Code***	***Description***	
TX/TN/RR/SD	-99,9	Missing value	
Rainfall	-3	Rainfall < 0.1mm	
Rainfall	-4	Cumulative precipitation	
Snow depth	0,1	Snow traces on the soil	
Missing values and/or periods			
Dates/Periods		***Incident***	
from 01/01/1919 to 31/07/1919		*No data*	
from 16/02/1921 to 31/05/1921		*Hard to read*	
from 25/03/1928 to 31/03/1928		*Hard to read*	
from 01/02/1931 to 31/03/1931		*No data*	
Station Metadata (if available)			
Period of the incidence		***Type of incidence***	
December 1929		Instrument changes: Thermometer	

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Table 4: Summary of number of rescued stations and total amount of digitized values for each country and period. Variables are maximum (TX) and minimum (TN) temperature, rainfall (RR), snow depth (SD) and sunshine duration (SS).

Country	Nº stations	Variables	Period	Total digitized	%
Czech Republic	11	TX/TN/RR/SD	1917-1968	245935	40,3
Slovak Republic	5	TX/TN/RR/SD	1919-1968	110873	18,2
Republic of Serbia	4	TX/TN/RR/SD/SS	1920-2012	85343	14,0
Bosnia & Herzegovina	1	TX/TN/RR/SD/SS	1949-1960	8642	1,4
Montenegro	1	TX/TN/RR/SD/SS	1949-1984	64816	10,6
Republic of Macedonia	2	TX/TN/RR/SD/SS	1949-1984	51836	8,5
Croatia	1	RR/SD	1930-1990	42709	7,0