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METEOROLOGICAL STATIONS NETWORK IN CROATIA AND WARS

Mreža meteoroloških postaja u Hrvatskoj i ratovi

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Abstract – The meteorological network in Croatia has been operating continuously since the middle of the 19 century. Wars, as signicifant historical events have a tendency to interrupt such continuity. This paper presents a diagram of the meteorological stations network development, since 1850 showing the decrease in the total number of meteorological stations during and after World War I, World War II and in the period of aggression on Croatia from 1991 to 1993. The impact of war in the period from 1991 to 1993 is presented in greater detail by a second diagram, showing an evident correlation between actual war activities and the lack of meteorological observations, damage to meteorological equipment and buildings. The horizontal and vertical distribution of meteorological stations within the meteorological network is shown for the year when the distribution was in accordance with criteria recomended by The World Meteorological Organization. If we compare the total number of meteorological stations on 31 December 1993 with the recommended optimum number of meteorological stations, (in accordance with WMO regulations) we can see that only 54.7 % stations were active. Compared to the total number of meteorological stations before the aggression (31 December 1990) 30.4 % stations were destroyed or incapacitated from 1991 to the end of 1993 by war activities. The direct damage (destroyed buildings and instruments of the basic meteorological network) amounts to more than US$ two million. Evidence has been collected from the participants to these events and original reports supplied by the Heads of meteorological stations are quoted. Photographs, diagrams, tables and data from our station catalogues have been used prepare this article. The period analysed ends on 31 December 1993.

Key word index: meteorological station, network, history, war, observation, destroy, damage, report

Sažetak – Mreža meteoroloških postaja u Hrvatskoj djeluje neprekidno od sredine 19. stoljeća. Ratovi kao veliki povijesni događaji uzrokuju prekide i narušavaju taj kontinuitet. Prikazan je dijagram razvoja mreže meteoroloških postaja od 1850. nadalje, iz kojega se očituje pad ukupnoga broja meteoroloških postaja za trajanja i nakon prvoga i drugoga svjetskoga rata, te u ratnim događajima nakon agresije na Hrvatsku 1991. Detaljnije je prikazan utjecaj rata u razdoblju od 1991. do kraja 1993. godine, praćenjem neobavljenih meteoroloških mjerenja i šteta nastalih na meteorološkoj opremi i objektima. Navedena je površinska i visinska raspodjela meteoroloških postaja za razdoblje kada je ta razdioba bila u suglasju s normama Svjetske meteorološke organizacije. U odnosu na optimalan broj meteoroloških postaja, prema normama WMO, sada ih radi samo 54,7%, a od 1991. do 31.12.1993. uništeno je ili onemogućeno u radu zbog rata 30,4% postaja. Direktne štete nastale uništavanjem objekata i instrumenata osnovne mreže meteoroloških postaja jesu više od 2 milijuna US$. Kao svjedočenja direktnih učesnika o događajima citirana su originalna izvješća voditelja meteoroloških postaja. Za izradu ove analize korištene su fotografije, dijagrami, tablice i podaci pohranjeni u katalogu meteoroloških postaja. Analizirano razdoblje završava s 31.12.1993.

Ključne riječi: meteorološka postaja, mreža, povijest, rat, motrenje, uništenje, šteta, izvješće

INTRODUCTION

During the Middle Ages there were some individual attempts at meteorological observations in Croatia and only later an observations were performed organized by establishing a network of meteorological stations with equipment and instruments made especially for this purpose.

With time, long-term meteorological series become cultural goods determining the characteristics and identity of nations and teritories. Croatia is one of the countries in which organized meteorological observations were achieved soon after the first organized observations in Europe, involving Croatian scientists of international reputation like Andrija Mohorovičić who discovered the "Moho" layer in seismology.

The quantity and quality of meteorological data depend on many factors and during centuries historcal events have often affected the number of meteorological stations.

This article is based on documents from the archives of the Meteorological and Hydrological Service of Croatia, and it had to be written to provide a real picture of the situation, because time distance tends to distort reality and can even change it into its opposite.

THE IIISTORY OF METEOROLOGICAL OBSERVATIONS IN CROATIA

Individual meteorological observations in Croatia were first performed at the end of the Midlle Ages. Between 1587 and 1599 the physician Santorio Santorio carried out observations of wind force and air temperature and humidity in the Croatian towns of Senj, Novi, Ozalj and Karlovac. Santorio designed special meteorological instruments for measuring temperature, wind and humidity more than half a century before the appearance of the first official thermometer (1641), and anemometer (1667), and two centuries before the first meteorological hygrometer (1783). As a follower of Hippocrates Santorio believed that climate is one of the most important factors for human health, and that was the reason why he devised these instruments and performed observations.

Organized networks of meteorological stations started in Europe after 1781 when the famous Societas Meteorologica Palatina was founded in Mannheim. Following this encouragement, observations started also in Croatia. The oldest instrument data available are for winter 1829/1830 in Zagreb and they were published in the city newspaper of that time.

The same newspaper regularly published meteorological data in 1841 and 1842: temperature, air pressure, wind direction and wind force measured three times a day, at 5 a.m., 1 p.m., and 8 pm. CET (Central European Time).

In the middle of the 19th century a number of European countries started establishing special state networks of meteorological stations with the purpose of measuring, observing and organizing data collection. In 1848 the Central meteorological office in Vienna published the first Meteorological Yearbook for the Austrio-Hungarian empire which soon afterwards included were meteorological data measured in the then Croatian towns: Dubrovnik 1851, Zavalje near Bihać 1852, Stara Gradiška and Zagreb 1853, Zadar and Zemun 1854, Korčula 1855, Vis 1857, Hvar 1858, Osijek, Split and Varaždin 1859. and Rijeka 1860. The number of meteorological stations increased very rapidly from 1860 to 1900. This is shown in Table 1.

In the year 1900 on the teritory of Croatia (the then Kingdom of Croatia, Slavonia and Dalmatia) there were 146 meteorological stations, out of which 88 were precipitation stations. The then joint network of meteorological stations under Croatian authority included a number of meteorological stations which are not in Croatia any more: Budva, Crkvice, Goli Vrh, Goražda, Hercegnovi, Jankov Vrh, Kosmač, Kotor, Perast, Risan, Sutomore, Sv. Križ, Tivat, Vermač, Zavalje, Hopovo, Kupinovo, Martinci, Petrovaradin, Srijemski Karlovci, Srijemska Mitrovica, Zemun.

Such relatively good meteorological measurement coverage lasted till World War I. In the period from 1918 to 1941, there were several paralel independent meteorological networks on Croatian territory (the Ministry of Civil Engineering, the Navy, Aviation and Meteorological Observatory in Belgrade with headquarters outside Croatia and the Geophysical Institute in Zagreb with headquarters in Croatia), so that meteorological data were not processed at the same place according to one accepted method, and a lot of data were lost. Today, except for the network operated by the Geophysical Institute in Zagreb, there is no complete documentation about observations during this period. Also observations were not carried out according to identical rules and regulations, which generated incompatible data from the start.

In the period from 1941 to 1945 both civil and military networks of meteorological stations were operated, but because of the war, there were many problems with their maintenance.

After World War II in the period from 1947 to 1955, the network of meteorological stations in Croatia was under the authority of the Hydrometeorological Service of the Republic of Croatia, and it was developed in accordance with the rules and regulations of the World Meteorological Organization following the World Meteorological Organization Convention in 1952.

As in all other parts of Croatian national life in this period there was a permanent tendency towards controlling the network of meteorological stations outside Croatia, or – at least, towards organising several independent networks of meteorological stations on the teritory of Croatia.

Table 1. The number of meteorological stations in Croatia in the 19th century

Tablica 1. Broj meteoroloških postaja na području Hrvatske u 19. stoljeću

Year	Total number of stations	Number of precipitation stations
1851	1	–
1856	4	–
1861	4	–
1866	7	–
1871	14	–
1876	18	3
1881	30	12
1886	56	12
1891	67	35
1896	120	75
1990	146	88

In the period from 1947 to 1952, the meteorological stations on the Adriatic coast were not under the direct authority of the Croatian Meteorological Service, and the same applies to the meteorological stations at Croatian airports in the period from 1974 to 1990. There were many attempts to administratively separate meteorological stations. The last proposal (in 1988) was that all meteorological stations in the Croatian part of the Adriatic coast should become independent from the authority of the Croatian Meteorological Service.

Croatia became an independent country on 8 October 1991, a member of the United Nations on 22 May 1992 and a member of the World Meteorological Organization on 9 November 1992. Since then Croatia has organized an indenpendent State Meteorological and Hydrological Service with a single, common network of meteorological stations throughout its territory.

After World War II meteorological stations were classified according to their programmes of observations: Main Meteorological Stations (MMS), with instruments registering data and with professional observers, Climatological Stations, with observations at 7 a.m., 2 p.m. and 9 p.m. MLT (Mean Local Time), with unchanged observation hours since 1861 and Precipitation Stations, with measurements of precipitation amounts at 7 a.m. MCT (Mean Central European Time) and observations of meteorological phenomena during the day.

Meteorological stations on Croatian territory have collected long series of meteorological data. These data are not only data for meteorological use but they are also part of the Croatian cultural inheritance, because they show a continuity in the care for public well-being.

METEOROLOGICAL OBSERVATIONS AND WARS

The presence of observer has always been unavoidable in meteorological observations and measurements, and even today automatic weather stations are not sufficient and observers are required for certain weather phenomena like cloudiness and visibility.

War made it impossible to maintain the continuity of observations either by obstructing the observers' work or by directly damaging the instruments and buildings of meteorological stations. Figure 1 shows the total number of meteorological stations in Croatia in the period 1852 – 1993.

There were three instances when the number of meteorological stations reached its minimum: in the periods from 1910 to 1925, from 1940 to 1949 and from 1990 to 1993. These are the periods of World War I, World War II, and the agression on Croatia starting in 1991 and still continuing. The reconstruction of the network of meteorological stations did not start immediately after the war. The decrease in the number of meteorological stations after World War I lasted until 1927, and after World War II until 1949.

Taking into account the distribution within the network of meteorological stations in Croatia, which was calculated by the method of optimal interpolation and taking into account the existing meteorological stations with long historical series of data, it is evident that the horizontal distribution of meteorological stations was satisfying at the time, while the vertical distribution was not because the number of station in the altitude zones above 200 m was insufficient.

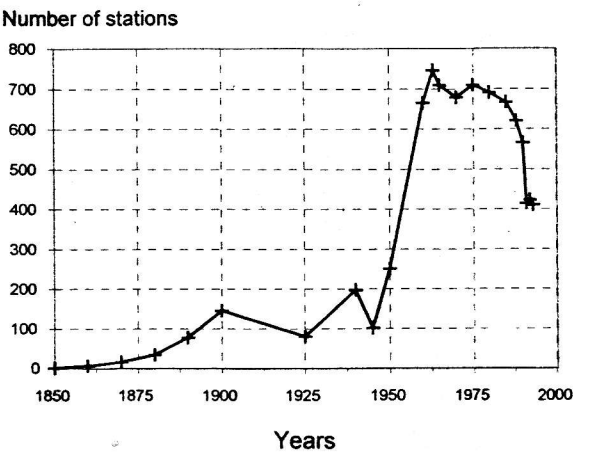

Figure 1. The total number of meteorological stations in Croatia, in the period 1851 - 1993.

Slika 1. Ukupan broj meteoroloških postaja u Hrvatskoj, razdoblje 1851 - 1993.

Table 2. The number of meteorological stations, the average area (km^2) of particular stations and the average distance (km) between stations in 1977.

Tablica 2. Broj meteoroloških postaja i prosječna površina koju pokriva pojedina postaja u km^2, te prosječna udaljenost između postaja u km – stanje 1977. godine.

Type of station	Number of stations	Average area per station, km^2	Distance between stations, km
Main meteorological stations	22	2570	50.7
Climatological station	119	400	20.0
Precipitation station	612	90	9.5

Table 3. The distribution of meteorological stations in relation to altitude zones, expressed in percentage of the total number of stations in 1977.

Tablica 3. Raspored meteoroloških postaja po visinskim zonama izražen u postotcima od ukupnog broja meteoroloških postaja, stanje 1977. godine.

	Altitude, m							
Type of station	0–200	201–400	401–600	601–800	801–1000	1001–1300	1301–1600	>1600
MMS	83	8	4	–	4	–	1	–
CLS	70	13	5	5	4	1	2	1
PRS	61	19	9	6	3	1	1	1
PA	53	20	10	7	6	3	0.8	0.2

MMS – Main meteorological station — Glavna meteorološka postaja – MMS
CLS – Climatological station — Klimatološka postaja – CLS
PRS – Precipitation station — Kišomjerna postaja – PRS
PA – Percentage of area out of total area of Croatia — Postotak područja – PA

Table 4. The number of meteorological stations of the basic network in Croatia, 1978–1993, the situation on 31 December of every year.

Tablica 4. Broj meteoroloških postaja osnovne mreže u Hrvatskoj, razdoblje 1978–1993, stanje na 31. prosinca svake godine.

Year	Total number of stations					Year	Total number of stations				
	All	Main	CL	PR	STG		All	Main	CL	PR	STG
1978	707	31	126	522	28	1986	654	37	113	468	36
1979	708	33	125	522	28	1987	638	37	106	459	36
1980	691	35	125	503	28	1988	621	37	105	443	36
1981	686	35	123	500	28	1989	589	37	97	419	36
1982	695	35	130	502	28	1990	566	38	97	395	36
1983	688	35	130	496	27	1991	414	28	64	303	19
1984	683	35	125	492	31	1992	423	36	75	294	18
1985	667	37	115	484	31	1993	410	37	73	280	20

CL – climatological stations — klimatološke postaje – CL
PR – precipitation stations — kišomjerne postaje – PR
STG – store gauges — totalizatori – STG

This war which started in 1991, changed this distribution.

Figure 2 shows the number of meteorological stations for the period 1947–1993. The network of meteorological stations was built in the period from 1947 to 1956. In the period from 1956 to 1979 the number of meteorological stations was almost optimal and almost constant. From 1979 to 1988 there is a slow decrease in the number of meteorological stations because of financial and organizational difficulties. The period immediately before the war and the period during the war shows a drastic decrease in the number of meteorological stations.

Table 4 shows the number of meteorological stations in the period 1978–1993 including storegauges (stations for the measurement of yearly amounts of precipitation).

The correlation between war events and the working of meteorological stations is evident from Figure 3 which shows the change in the number of meteorological stations for every month in the period 1990–1993. The data have been taken from the monthly observation diaries.

Some of these monthly observation diaries were several months late which means that in some months the amount of data available was remarkably below the availability shown in Figure 3.

The tables and figures confirm that the largest decrease in observations took place during the strongest escalation of the aggression from April 1991 to January 1992. The total number of meteorological stations kept decreasing to the end of 1993.

Compared to the optimal number of meteorological stations, according to the criteria of the World eteorological Organization, in December 1993 only 54.7 % stations were active. Compared to total number of meteorological stations on 31 December 1989, before the start of the aggression, only 69.6 % stations worked on 31 December 1993, which means that during the war 30.4 % stations were destroyed or occupied. Since 1991 almost one fourth of Croatian territory has been occupied and the situation has remained unchanged since 31 December 1993.

When speaking about types of meteorological stations, the analysis shows:

Main Meteorological Stations (MMS)

Those are stations with professional staff, reporting meteorological data via SYNOP messages, and sending monthly diaries of meteorological data.

The main method of making work at MMS impossible is by obstructing the physical presence of professional observers who are then unable to perform their tasks, and by directly destroying instruments and buildings.

From August 1991 there have been many cases when messages could not be reported because of air alerts (military airplanes), general danger alerts (mortars and guns), sniperists and the collapsing of radio and telephone systems.

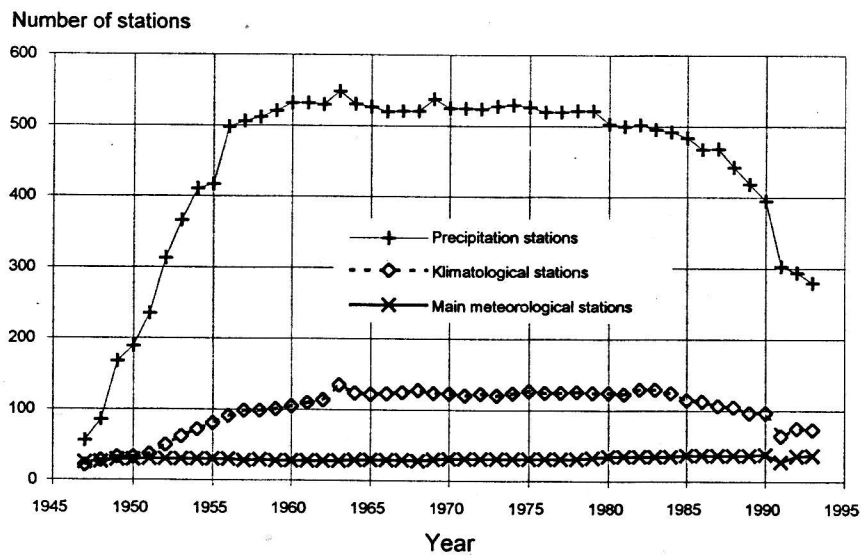

Figure 2. The network of meteorological stations in Croatia, 1947 - 1993.

Slika 2. Mreža meteoroloŠdkih postaja u Hrvatskoj, razdoblje 1947 - 1993.

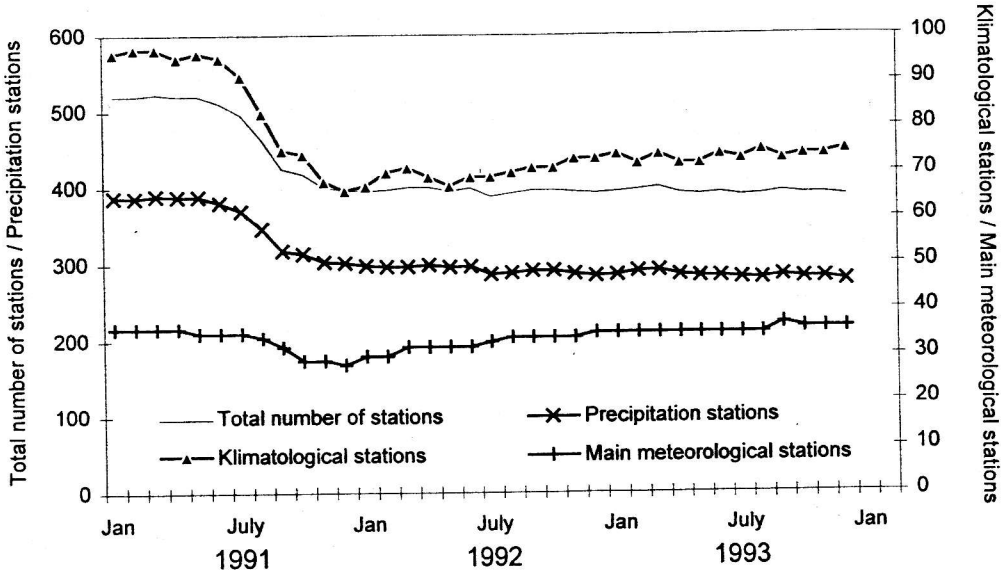

Figure 3. The meteorological stations of the basic network in Croatia in the period 1989–1993

Slika 3. Meteorološke postaje osnovne mreže u Hrvatskoj u razdoblju 1984–1994, po mjesecima

The lack of meteorological observations reached its peak in 1991, when 26.3 % MMS were out of use, all the airport meteorological stations being under direct authority from Belgrade and MMSs 13209 Osijek-Klisa (airport), 13232 Knin, 13227 Gračac, having been occupied.

In August 1991, war activities forced the meteorological stations Slavonski Brod and Split-Marjan to interrupt pilot balloon measurements.

Climatological Stations

At those stations observations are performed by non-professionall observers. In 1991 compared to 1989, 34.1 % meteorological stations did not work. A year later the situation grew slightly better because refugee observers returned to some stations and some stations were renewed. A large number of climatological stations is now on occuppied territory and admission to theses stations is impossible.

Precipitation Stations

The MMSs and climatological stations reached the smallest number of operative stations in 1991. The number of precipitation stations tended to decrease until 31 December 1993. On this date, there were only 280 precipitation stations in operation, or 34.2 % less than in 1989.

Non-professional observers are usually people of different professions, which in most cases have performed meteorological observations for more than 10 years, and they love this job.

Observers at both climatological and precipitation stations showed that they were willing to perform observations even in very difficult conditions.

The diagrams in this article are a document of the impossibility of performing observations. It is known that in meteorology a missed observation can never be compensated and those data lost in the war since 1991 are and will be valuable evidence in history in the same way as a amount of lost data was for the periods of World War I and World War II.

When the telecommunication installations, were destroyed the inclusion of meteorological messages from Croatia into the international transmission network was connected with many difficulties. The quality of meteorological data has essentially worsened because of the impossibility of regular maintanance and control of meteorological stations and instruments.

DAMAGES ON METEOROLOGICAL EQUIPMENT AND BUILDINGS

One of the main reasons for the decrease in the quantity of available data is the damage caused to the infrastructure necessary to perform observations.

Damage to meteorological station buildings is the result of direct attacks by aeroplanes and guns. The buildings and meteorological instrument sites of MMSs at Gospić, Karlovac, Slavonski Brod, Dubrovnik, Osijek–Zeleno Polje, RC Osijek–Čepin, Zagreb–Maksimir, Varaždin and Daruvar were directly shoted.

Because of impossibile working conditions, the MMS at Slavonski Brod changed the site of its meteorological observation station eight times, and the MMS

Osijek three times. The MMS Gračac has been occuppied from May 1991, the MMS Knin from August 1991, and airport meteorological station Osijek-Klisa, from August 1991. The meteorological stations at the Zadar-Zemunik and Dubrovnik-ćilipi airports were occupied temporarily, for about six months.

According to data received so far, the following equipment has been completely destroyed:more than 70 meteorological shelters, more than 400 thermometers of all kinds, more than 80 recording instruments (thermographs, hygrographs, barographs, ombrographs, anemographs) more than 200 precipitation stations.

Destruction spread all over Croatia: MMS Varaždin was damaged by bombing from military airplane, the Meteorological and Aerological observatory Zagreb-Maksimir by mortar fire from the local baracks of the former Yugoslav Army, the MMS Gospić, MMS Karlovac, MMS Dubrovnik and MMS Zadar came under attack of Serbian rebels from the occupied territory under the control of UNPROFOR.

The photographs on Figures 4 and 5 show the damage resulting from direct shots to the meteorological instrument sites of the MMS Varaždin and the building of the MMS Gospić.

Calculations show that the damage only to the basic network of meteorological stations amounts to US $2.5 million. Other parts of the Meteorological and Hydrological Service, inffered much greater damage.

STATEMENTS FROM THE HEADS OF METEOROLOGICAL STATIONS

In early 1992 the heads of the MMSs were requested by circular letter, to answer a questionnaire on work conditions and damages from aggresor actions during 1991. We are quoting their answers in their original form:

MMS DARUVAR

Although left with only two professional meteorological observers during 1991 we managed to accomplish a complete 24-hour programme (at least five professional observers are necessary for this programme). During the entire period from August 1991 till January 1992, we kept working during alarms and under mortar attacks, reporting more frequent than usualy. In winter we worked in a cold room because all the window-panes had been destroyed already in the first attack. When there was shooting from heavy firearms in the vicinity of the meteorological instrument site, we removed the thermometers from the meteorological shelter later returned them to perform the necessary observations.

MMS DUBROVNIK

Although Dubrovnik came under attack on 1st October 1991 work was never interrupted. We could not remain at the meteorological station for a longe time, we could only carry out observations and then run away. There was no electric current, telephone connections were damaged, but we kept reporting. We evacuated the archive of meteorological data because of security. We kept comming to the meteorological station under abnormal conditions. Not far away from the station there were war ships and the chetniks were on the surronding hills. Sniperists were shooting, mortar shells exploding, there was lack of electric current, water, food, heating, and the temperature was below zero degrees Celsius, but as you can our efforts were worth the trouble, and there was no interruption of work at our station. We hope the tasks have been successfully completed, and if you have any remarks, let us know.

After the period to which the report relates (1991) the building of MMS Dubrovnik has been shot down by the enemy.

MMS GOSPIĆ

Since 30 August 1991 at 01.15 a.m., when Gospić came under mortar attack, the meteorological station has been working under difficult circumstances. The station stopped reporting messages 7 September 1991 because of lack of electric current and telephone. When possible, messages were sent from the Post office. Electric current was restored to part of the building by the end of October, and with extended cables we could periodically report messages. Electric current was reconnected on 20 January 1992, and the telephone line on 27 December 1991.

Not for a day did the station remain without observers. Here are some of the days when the station was in great danger:

3 August 1991 – the first attack on the town, mortar shells hit the fence of the station,

17 September 1991 – the entrance to the building was hit by mortar shell and around 11 a.m. a military airplane attacked the northeastern wing of the building,

24 September 1991 – a mortar shell fell some ten meters from the building,

17 and 19 October 1991 – mortar attacks and military airplanes attacks in the vicinity of the station,

24 October 1991 – about 2 p.m. mortar shells destroyed a hygrograph,

25 October 1991 – a maximum thermometer was damaged by bomb fragments, and

25 December 1991 – the first mortar shell fell six meters from the southwestern wing, the second fell ten meters to the east of the building entrance the third eight meters from the second building entrance, and the fourth on the roof of a neighbouring building; extensive damage to the station building and instruments.

During 1992 and 1993 the MMS Gospić was bombarded many times.

MMS KARLOVAC

There were many problems in maintaining regular work at the station because the town of Karlovac and the MMP were continuously targeted by the Serbs.

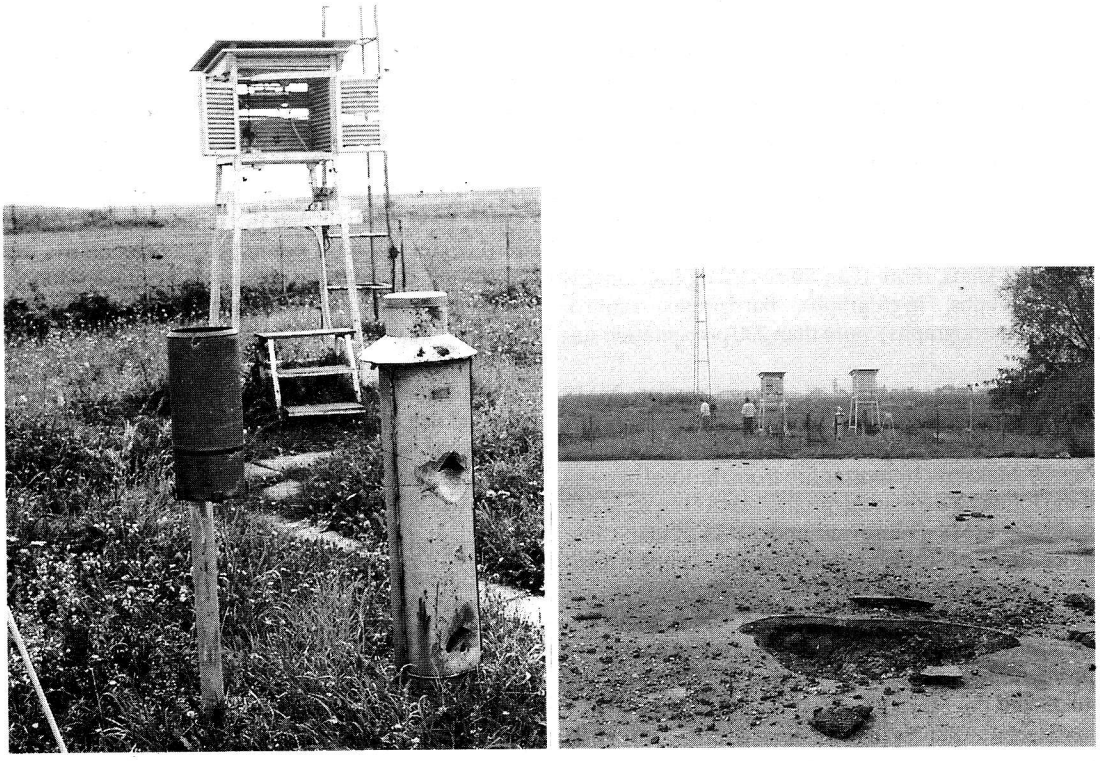

Figure 4. The site of meteorological instruments in Varaždin after the bombardment on 21 September 1991.

Slika 4. Meteorološki krug u Varaždinu nakon bombardiranja 21. 9. 1991.

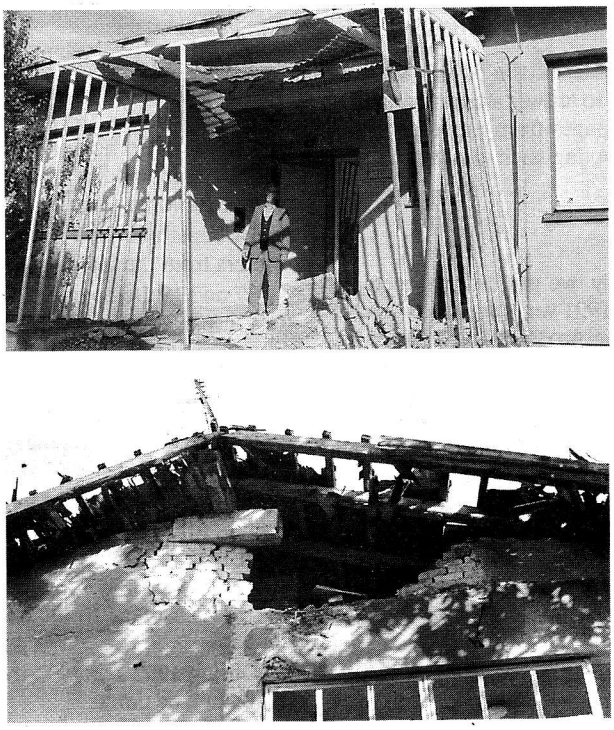

Figure 5. Damage to the building entrance at the Main Meteorological station Gospić, after the mortar atack on 17 Septeber 1991 (above), and to the northeastern part of the building (below), after bombardment 17 September 1991.

Slika 5. Oštećenje ulaza u zgradu Glavne meteorološke postaje Gospić nakon napada iz minobacača 17.9.1991, (iznad) i sjeveroistočnog dijela zgrade (ispod) nakon avionskog bombardiranja 17.9.1991.

The town was bombarded many times. The meteorological shelter with instruments in front of the bank was destroyed. Durig 1991 and until the middle of 1992 a retired observer kept working. Because of continuos bombing observations were made in life-threatening conditions and for this period the only observations available are on registration tracks. By mid–1992, the site for meteorological instruments were removed to the other part of town called Gaza, where a new station building was under construction already before the war. This place is only 300 meters from the enemy. Arrival on the work was life-threatening, nobody knew when a new atack would start. These new buildings were shot three times and hardly damaged. During air raids and general alarms, observations were impossible, and we only handled the registration instruments.

MMS MAKARSKA

There were periods when coming to the station was dangerous because of airplane attacks, especially in the periods when airplanes frequently bombarded the TV transmitter on the Biokovo mountain.

MMS OGULIN

The first general and air alarms were on 15 September 1991 at 9.10 p.m., and these alarm continued with shorter inerruption till 15 January 1992. The station worked continuously thanks to the self-denial and courage of both observers who performed all the climatological and synoptic observations disregarding alarms and black-outs.

MMS OSIJEK

The repeated bombardment of Osijek reflected on the work of the MMS Osijek which was situated in the part of town called Zeleno Polje, in the front line of war operations. At the start of the agression, from 18 August to 17 October 1991, observatios at this location were performed in life-threatening conditions.Every time people went to make observations they had to pass sniperists who were only six hundred meters away. For this reason, on 17 October 1991, the station was removed to a new location in the part of town called Ćepin, and when Ćepin was also bombed, measurements were stopped on 3 January 1992 and resumed only on 16 February 1992, when the station was removed out of Osijek (Donji Miholjac). Observations started again on 16 February 1992 at Osijek Sport Aiport near Ćepin, with the joint effort of the staff of MMS Osijek–Zeleno Polje and the airport meteorological station Osijek–Klisa, previously occupied by Chetniks.

MMS PLOČE

During the war,we did not change the site of meteorological observations, although at one moment we thought we should. On the 14 and 15 September 1991 there was real danger from the Yugoslav war ships atacking the oil terminals near the meteorological station. Because of air and general alarm on 15 September 1991 there was no observer at the station.

MMS RIJEKA

During 1991 work at the MMS was continuous. There was a shorter interruption on the days with air alert (7 November 1991, 2 January 1992, and 3 January 1992).

MMS SLAVONSKI BROD

Because of the frequent overflying of military airplanes and night alarms, pilot-baloon and night observations were interrupted on 2 September 1991. After two unsuccessful Serbian attacks on Slavonski Brod, on 15 and 16 September 1991 there was a new attack, which resulted in big damage from mortar shells. All the instruments were damaged and we stopped making night observations. In the period from 1991 to 1993 the station was moved eight times, and the site of meteorological instruments and meteorological shelters was destroyed twice.

MMS ŠIBENIK

During the war on this site all observatios and measurements were carried out regularly. The messages were not reported because of air alerts and general danger alarms or because of destroyed PTT connections. All meteorological data were prepared and sent, although sometimes late. Work continued although we were one observer short, and under unbelievably hard war conditions. Some measurements were practically done while shell fragments were exploding around.

MMS VARAŽDIN

On the 17 September 1991 the town was attacked and, obviously, observations had to be interrupted from 3 p.m. to 9 p.m.. On 18 September 1991 we could not come to work as the town was blocked, and the attack continued. In this period we did not observe, but we collected the data later from registered diagrams. On the 21 September 1991 a military air plane hit the site of meteorological instruments. The meteorological shelter with all the thermometers, ombrograph, evaporation pan, anemograph and the fence of the site for meteorological instruments was destroyed .

MMS ZADAR

The meteorological station did not change location, although it should we. We reported messages between alarms, when we had the opportunity, because the first shelter was 200 m away. We changed the diagrams of the registering instruments and handled data as possible.

MMS ZAGREB GRIČ

The Observatory worked without interruption, even during the air alarms from 17 September 1991 to 25 November 1991. We worked every day without interruption from 6.30 a.m. to 9 p.m., including non-work-

ing days, because we slept at the Observatory, to prevent late arrivals or non-arrivals.

CONCLUSION

Meteorology and the Meteorological Service in Croatia were established at the same time as in other European countries, and there are many long series of meteorological data in the Croatian archives.

We intended to show the events which have strongly influenced the work of the basic network of meteorological stations in Croatia. These data may be used in the future and they are also important in the history of the Meteorological Stations. Meteorological data are the base of all research and we need to give it adequate attention.

The reports by the Heads of meteorological stations indicate that they were faced with very dangerous situations, and also that our professional and non-professional observers are conscious of the significance of meteorological data which made them perform their tasks very responsibly and even in life-threatening conditions.

The network of meteorological stations in Croatia is seriously damaged and we certainly need to do our outmost to restore the level of observations, keep pace with professional requirements and introduce new technological equipment.

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