

# SEVERE STORMS AND THEIR EFFECTS IN SUB-MEDITERRANEAN SLOVENIA FROM THE 14<sup>TH</sup> TO THE MID-19<sup>TH</sup> CENTURY

## NEVIHTNA NEURJA IN NJIHOVE POSLEDICE V SUBMEDITERANSKI SLOVENIJI OD 14. DO SREDE 19. STOLETJA

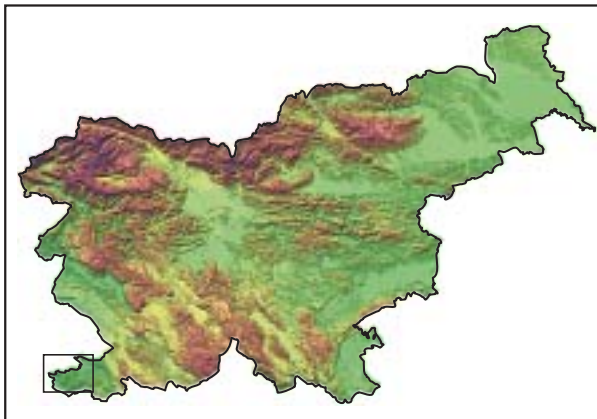
Darko Ogrin



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Rare natural phenomena in the Trieste Gulf – storm cloud with waterspout  
NW from Izola (29<sup>th</sup> December 2005, about 16:30).

Redek naravni pojav v Tržaškem zalivu – nevihtni oblak s trombo  
severozahodno od Izole (29. 12. 2005, okoli 16:30).



## **Severe storms and their effects in sub-Mediterranean Slovenia from the 14<sup>th</sup> to the mid-19<sup>th</sup> century**

UDC: 911.2:551.583.2(497.47)"13/18"

COBISS: 1.01

**ABSTRACT:** The paper presents an overview of severe storms and a reconstruction of periods with their reiterative occurrence in sub-Mediterranean Slovenia in the warm half of the year during the so-called pre-instrumental period. The data were gathered in secondary and tertiary historical sources, chronicles first and foremost. The presented chronology does not provide a complete reconstruction because of insufficient data, yet it offers a basic insight into the periods of frequenter occurrence of these phenomena. Outstanding are the 17<sup>th</sup> and the 18<sup>th</sup> centuries, especially their first halves whose weather conditions rank among the most unfavourable in the last millennium. In addition to severe winters with damages done by frosts, dry or too wet summers, 12 violent storms in the 17<sup>th</sup> century and 16 in the 18<sup>th</sup> century caused great damage and considerably aggravated the conditions of living. The occurrence of storms in the first halves of the 17<sup>th</sup> and the 18<sup>th</sup> centuries was equal to that at the end of the 20<sup>th</sup> century, when frequenter occurrence of such weather extremes is mainly believed to be caused by the general warming of the atmosphere. It is evident from the chronicle that the characteristics of severe storms and the kinds of resulting damage have not significantly changed until today. The only phenomenon that has not been recorded in the recent history of climate is such a sharp drop in temperature in the lower parts of the Primorska (Littoral) region during an August storm as to cause that snow fell, which, supposedly, happened in August 1710.

**KEYWORDS:** severe storms, weather disasters, climate variations, climate in the Holocene, sub-Mediterranean Slovenia

The article was submitted for publication on September 12, 2006.

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### **Contents**

1	Introduction	9
2	An outline of the predominant climatic features in sub-Mediterranean Slovenia	9
2.1	Violent storms in the last few decades	10
3	Methodology	11
4	Severe storms from 14 <sup>th</sup> to the mid-19 <sup>th</sup> century	11
4.1	Chronology of severe storms	11
4.2	Incidence of severe storms and their classification by types of damage caused	14
5	Conclusion	16
6	References	16

# 1 Introduction

Severe storms cause a lot of damage in Slovenia every summer. A great amount of precipitation that falls in a short time (more than 50 mm of rain can pour down in one hour, which in many a part is more than a half of the average monthly precipitation) can also be accompanied by hail as big as walnuts, stormy wind and thunderbolts. The sub-Mediterranean Slovenia is no exception with regard to this phenomenon; it belongs to the Slovenian regions with the highest frequency of occurrence of storms. According to Petkovšek (1987), it lies in the zone of more than 40 storms per year, stretching from Friuli across central Slovenia and continuing to Austrian Styria and Burgenland. Storm activity is the most intense in late spring and early summer. Only very violent storms occur as natural disasters; they are typical for their moving during their development (usually in the west-east direction) and they mainly occur along the cold front or as a storm-line (Vrhovec 2002).

Fortunately, the storm cells are spatially limited to only some tens of square kilometres, and the possibility is very small that an area be affected in two consecutive years or, even worse, several times in one year. However, it can happen from time to time. But from the viewpoint of storm hazards climatic conditions forecasts for the 21<sup>st</sup> century are alarming, anticipating parallel to the increase in temperatures also increased occurrence of extreme weather events, among them also heavy and severe storms. These forecasts refer both to the Mediterranean (Bolle 2003; Jeftic, Milliman, Sestini 1992) and to Slovenia (Anonymous 2001; Kajfež-Bogataj 2001; Kajfež-Bogataj, Bergant 2005) that lies at its margin and has some Mediterranean climatic features in its southwest part (Figure 1). In order to evaluate correctly the current changing of climate in view of the future climate forecasting, it is necessary to know well the present and the past climate conditions. It is only possible in this way to place correctly the higher frequency of occurrence of violent storms during a specified period (year, decade, or even century) within the climate-changing context, since these types of phenomena are by their very nature highly changeable in time and space. This is evident from the data for the time when measurements and weather observations were already reliable, and also from the records of weather events in pre-instrumental period without measurements.

The paper focuses on the presentation of severe storms in sub-Mediterranean Slovenia in the pre-instrumental period, i. e. prior to 1841, as far as historical sources render it possible. In 1841, a meteorological station began to operate in Trieste. This city is a good example of climatic conditions in the sub-Mediterranean Slovenia, its coastal part in particular; and the station's continuing data provide a good basis for the study of climate variations from the mid-19<sup>th</sup> century until today (e. g. Ogrin 2003). But for the study of climatic conditions in the time prior to the operation of this station we only have a very modest database. One of our purposes is to present a chronological overview of severe storms in the warm half of the year that reached the level of natural disasters and thus attracted the attention of chroniclers. The periods of higher frequency of occurrence of these phenomena are selected and classification of severe storms is made according to the types of damage they caused. Another purpose is to refresh the recollections of climate, because at the present exceptional weather events we come much too often upon the opinion that these are extraordinary events that have never happened before (»not even the oldest people remember something like this«) and that it must be the human who is responsible for them. Even a brief overview of the past weather and climatic events quickly reveals that our knowledge of the related history is insufficient.

## 2 An outline of the predominant climatic features in sub-mediterranean slovenia

Defined as sub-Mediterranean Slovenia is the lower southwest part of Slovenia whose landforms open towards the Trieste Gulf or to the Adriatic Sea, hence its climatic features are milder than those of the regions in inland Slovenia. The orographic barrier of the south Julian Alps and up to 1500-meter high Dinaric plateaux separates the areas with the prevailing features of Mediterranean climate from the rest of Slovenia whose climate is temperate continental or mountainous (Fig. 1). Characteristics of Mediterranean climate are combined with influences of continental and mountain climates, which results in slightly lower temperatures and greater amounts of precipitation than those of proper Mediterranean climate, and in

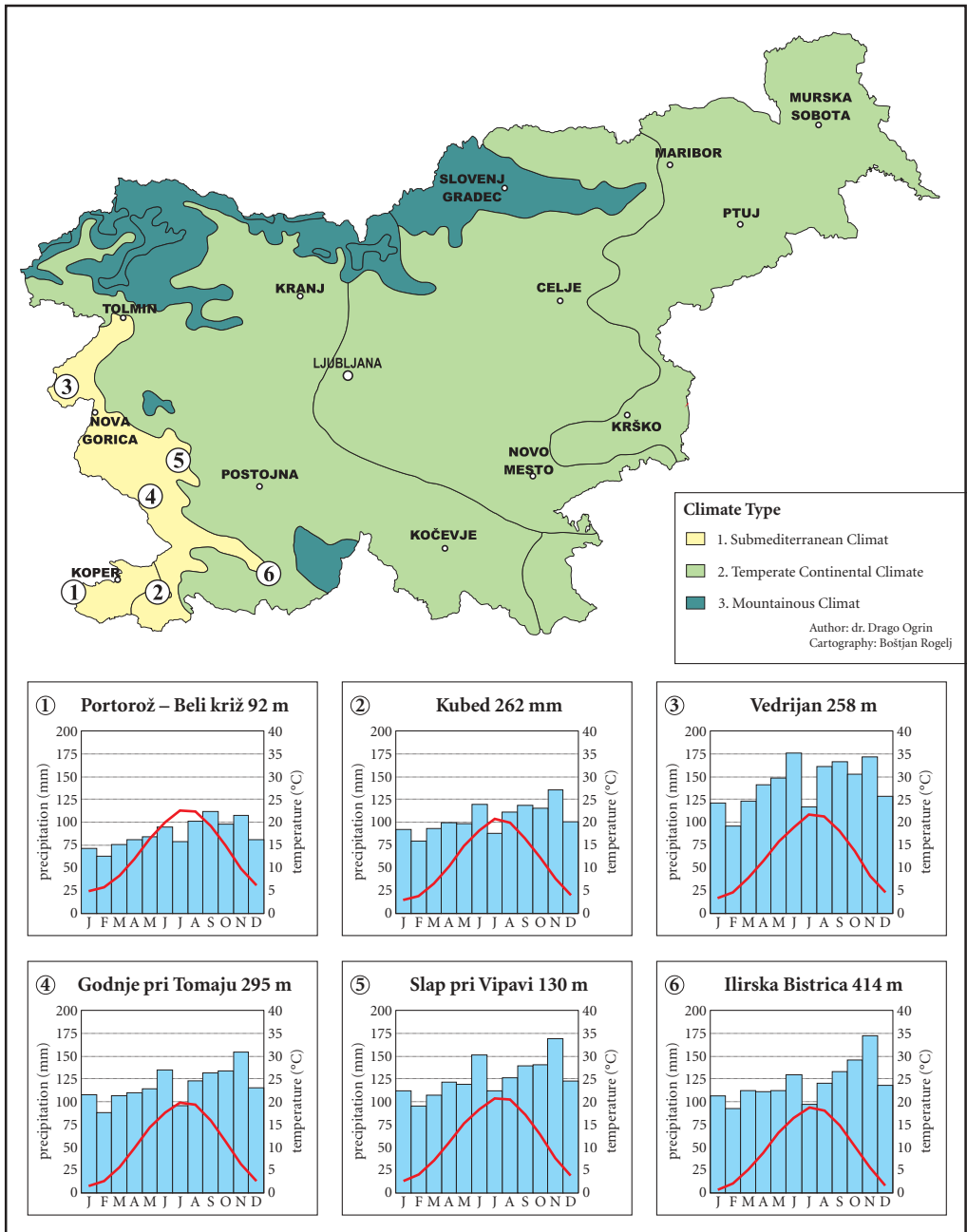


Figure 1: Climate types in Slovenia and climadiagrams for certain meteorological stations in sub-Mediterranean Slovenia.

modified precipitation regime. Hence, geographical and climatologic literature (e.g. Ogrin 1996; Gams 1998) defines this climate as mitigated Mediterranean or sub-Mediterranean climate, and the part of Slovenia with this climate as sub-Mediterranean Slovenia.

Typical of sub-Mediterranean Slovenia are positive mean temperatures in January, July temperatures exceeding 20°C, and 2000–2400 hours of insolation per year. Due to retention effect of the sea, autumn

temperatures are higher than those in spring. Precipitations amount to 1000 mm in the littoral zone and up to 1700 mm at the foot of orographic barriers and are rather evenly distributed throughout the year. Nevertheless, two maximum- and two minimum precipitation extremes are discernible, resulting from the combination of Mediterranean and continental climatic features. The majority of precipitation usually falls in autumn, i. e. in November or October, and the secondary maximum occurs at the turn of spring into summer, in June. Precipitation is the lowest at the turn of winter into spring (January, February, March) and in July and August (Ogrin 1996). The average annual potential evapotranspiration does not exceed the amount of precipitation, yet a deficit in humidity occurs in the warm half of the year due to high temperatures, in spite of the fact that 80 to 100 mm of precipitation fall also in the summer months (Pristov 1994).

## 2.1 Violent storms in the last few decades

The data on storms that are available in climatic statistics depend very much on the conscientiousness of observers at meteorological stations, positions of stations and proximity of noise generators. Even nowadays the observations are merely visual, although the observers should, by definition, record as a storm any thunder they hear. According to the data gathered, there are 25 to 50 storms per year on the average in sub-Mediterranean Slovenia. Storms occur most frequently in summer with more than a half of their total number. Due to the warm sea, above which the rising humid air freely develops into a storm cloud, they are rather frequent in the littoral zone also in autumn. In the inland, storms are more frequent in spring than in autumn. Along the coast, they more often occur at night, while in the inland in daytime, with the peak in the early afternoon. They are the least numerous in the winter, up to 5 per season on the average.

There is great variability in storms as to individual years. The long-term average can be exceeded by 50%, or it can be as much lower in individual years. They are most likely to occur in summer. According to the survey of natural and other disasters in Slovenia (journal *Ujma*, Nos. 9 to 17/18), at least in one of the areas in sub-Mediterranean Slovenia in the 1995–2004 decade a storm occurred that caused some damage, and violent storms causing greater damage occurred every few years.

In addition to hail and tempest wind, summer storms are temporarily also accompanied by small whirling tornados – waterspouts, which are a serious threat to smaller vessels in the sea, while in the land they pull out trees, uncover roofs and the like; fortunately, they only affect smaller areas. Kovač (2000) reports about the small tornado that developed on 29 July 1997 late in the afternoon above Grivče near Ajdovščina, and on its way it »swept away« a corn field at Lože, picked up four stacks of hay and damaged some vineyards.

## 3 Methodology

We tried to reconstruct, partly at least, severe storms and their consequences in sub-Mediterranean Slovenia in pre-instrumental period by means of composing a chronicle of exceptional weather events for sub-Mediterranean Slovenia (Ogrin 1994; Ogrin 1995), which was mainly compiled of data from secondary and tertiary historical sources. For the first half of the 19<sup>th</sup> century primary sources were also available of salt harvests in the Piran salt pans (PAK, unit Piran). The chronicle chiefly comprises the events in Istria, in Trieste and in the closer and broader hinterland of the Trieste Gulf, including the Kras and the region of Gorizia. Our chronology proceeds from the chronicle of weather events for Trieste, Istria and east Friuli, which was made by Braun (1934), who mainly based his work on the following sources: Jenner's annals for Trieste until the year 1846, Della Bonna's chronology of Gorizia until the year 1500, Scussa's annals for Trieste until the year 1695, and Kandler's annals for Trieste from 1695 to 1848, Ireneo della Croce's history of Trieste from 1000 to 1702, Mainati's chronicle of Trieste from the 11<sup>th</sup> to the beginning of the 19<sup>th</sup> century, Di Manzano's annals for Friuli, Biancini's chronicle of Rovinj (Rovigno) from 1760 to 1806 and Kert's weather diary for Trieste from 1815 to 1858.

We complemented Braun's chronicle with the sources that had not been taken into consideration by the author, e. g. Schiavuzzi's chronicle (1889) and the Fasti Istriani, a chronicle of events that had been regularly published in the newspaper *L'Istria* (1846–1852). We also made use of data from Dolničar's chronicle of Ljubljana 1660–1718 (Pučnik 1980) and from Valvasor's *The Glory of the Duchy of Carniola* (1984).

The chronicle of exceptional weather events in sub-Mediterranean Slovenia for the main part comprises the data about hydrological effects of weather (floods, drying up of brooks and wells), about the consequences in agriculture (good or bad harvests, early or belated blossoming or ripening), economic effects (shortages, changing of prices, famines) and direct weather effects (frosts, droughts, wetness, storms, tempests, and the like). The data for the period before the 16<sup>th</sup> century are scarce and they are also less reliable, while those for the 17<sup>th</sup>, 18<sup>th</sup> and 19<sup>th</sup> centuries are more abundant and they also overlap in two or more independent sources, which increases their reliability.

## 4 Severe storms from the 14<sup>th</sup> to the mid-19<sup>th</sup> century

### 4.1 Chronology of severe storms

The first report on a severe storm, which was accompanied by very heavy rains, was made for June 1324 and the next records refer to the end of the 15<sup>th</sup> century. The reports by Scussa, Ireneo and Mainati (Braun 1934) for 1488 and 1489 say that storms in these two years were very frequent and severe and they affected the Trieste region so much, »that anyone who had usually harvested 100 urns of wine in their orchards and fields then harvested hardly four. This resulted in shortages and nearly in a catastrophe, since the prices of wheat rose very high and the life was really hard.« A lot of damage was also done by a violent storm that affected the Trieste area and the Kras on 13 July 1563. Ireneo (Braun 1934) reports that many animals were killed and many trees and vines were left broken in the fields, which pushed the people to such poverty that they were forced to ask for help from the imperial government.

As to the occurrence of exceptional weather events in sub-Mediterranean Slovenia, the 17<sup>th</sup> and the 18<sup>th</sup> centuries were the worst in the last millennium. Among the numerous rigours of the weather that



Figure 2: A storm above the Gulf of Koper.

followed one another, there were 12 violent storms in the 17<sup>th</sup> century, accompanied also by hail. Very strong winds were recorded as many as 7-times, and even a smaller tornado in 1645. In 1687, unusual hail fell that was flat and curved (Table 1). All these disasters were further aggravated in 1644 by the invasion of grasshoppers that followed the great heat with extreme drought and, according to Scussa's report (Braun 1934; Rutar 1896), ate up everything, even fig leaves.

Table 1: Records of severe storms in the 17<sup>th</sup> century.

Year		Source
1617	On the evening of July 19 <sup>th</sup> , a storm raged accompanied by the garbin (southwesterly wind), rain, thunder, and lightning.	Ireneo, Mainati, Scussa (in Braun 1934)
1622	Hail destroyed almost all crops in Istria.	Schiavuzzi (1889)
1624	An hour before dawn on May 3 <sup>rd</sup> , lightning struck the belfry of St. Jošt Cathedral (San Giusto) in Trieste and started a major fire.	Ireneo, Mainati (in Braun 1934)
1644	Due to strong and frequent »garbin« winds, the sea flooded Piazza Vecchia square in Trieste all the way to the Rosary Church. The water level was so high at the Piazza Grande square that boats were able to float quietly on it. Damage to the city caused as a result of the flooded salt water, destroyed goods, the demolished saltworks dikes near city and saltworks in Škedenj and Žavljje, amounted to 1000 scudi.	Schiavuzzi (1889), Ireneo, Mainati, Scussa (in Braun 1934)
1645	In the early hour of the evening of January 29, 1645, a terrifying whirlwind, called »Typhon« in Latin, accompanied by a strong wind, thunder, and lightning raged over several areas in Trieste. In the valley of mills, the whirlwinds broke and uprooted many olives trees which lay on the ground in threes or fours side by side. This event caused great marveling even among the older inhabitants of the area, since they could not remember having seen or heard of anything similar.	Ireneo, Mainati (in Braun 1934)
1646	Large tempests erupted on the sea.	Schiavuzzi (1889)
1677	At six o'clock in the afternoon of September 10 <sup>th</sup> , very heavy rain with thick hail and strong winds fell for three consecutive hours causing massive damage in the Trieste area. The water levels rose to the height of a man and flooded the roads.	Ireneo, Mainati (in Braun 1934)
1683	July 11 <sup>th</sup> , a terrifying and strong levanter (a thunderstorm with easterly winds) caused great damage, especially on Sv. Vito hill where three quarters of the grapes were destroyed and the harvested wheat was scattered in the fields. In the Karst the storm uprooted many oak-trees, huge walnut trees, and other trees and caused great damage to fruit.	Ireneo, Mainati (in Braun 1934)
1687	At two o'clock in the afternoon of July 14 <sup>th</sup> , the Trieste area was struck by a terrible thunderstorm with hail stones the size of hazelnuts or eggs. Other hail stones were the size of half a scudo bent into the form of tube. This marvel, which has never been seen since in these areas, destroyed almost all the grapes and other fruit.	Ireneo, Mainati (in Braun 1934)
1688	Two hours before noon on October 10 <sup>th</sup> , a very heavy rain began falling in the Trieste area, lasting seven hours without ceasing, which appeared as if all the sluice gates in the sky had been flung open. The storming water, which had risen out of all proportion, broke down the Pondasserski bridge which had just been constructed, demolished part of the wall on the estate of Mr. Simonetti, and caused considerable damage to the neighbouring estates of the counts; the water then turned towards the bishop's estate where among other things it caused even more damage as it brought down walls, destroyed fields, vineyards, mills, houses, and all that stood in its path, not without the inevitable danger of drowning the many people who had climbed trees to escape death after the water level had reached five feet. The damage in the Trieste area was great everywhere, and one can not remember that our city had ever suffered such destruction by water, which damage they say surpassed fifty thousands ducats.	Ireneo, Mainati (in Braun 1934)
1690	Two strong thunderstorms struck Trieste. The one of April 2 <sup>nd</sup> damaged the belfry of St. Nikolai at Riborgo, broke the smaller bell and damaged the belfry of the hospital though not bell, damaged the roof with stones, broke a number of olive trees, and uprooted many others. The one of the evening of July 9 <sup>th</sup> which was accompanied by lightning and continuous thunder started a fire at two o'clock in the night in the armoury.	Ireneo, Mainati (in Braun 1934)
1691	From September 22 <sup>nd</sup> to November 24 <sup>th</sup> , the weather was very good, apart from the night of November 3 <sup>rd</sup> when a violent thunderstorm with bora damaged and broke several olive trees, especially in the Koper area where the damage reached more than four thousand ducats.	Ireneo (in Braun 1934)



Table 2: Records of selected severe storms in the 18<sup>th</sup> century.

Year		Source
1706	On August 5 <sup>th</sup> , a terrible thunderstorm caused damage to all fields in the country and in the Trieste area, denying people their crops.	Mainati (in Braun 1934)
1710	On August 5 <sup>th</sup> a terrible thunderstorm with whirlwind sand snow destroyed all the fields in a few hours, leaving the owners without any crops, which had been expected to be abundant. The country fell into poverty and three years of modest harvests followed.	Jenner (in Braun 1934)
1729	July 23: A tempest with a strong wind, rain, and hail raged through Gorizia, mostly affecting Brda. The wheat harvest was quite good, though there was a scarcity of other crops.	Di Manzano (in Braun 1934)
1734	From August 30 to September 3, a destructive wind blew over Trieste, destroying grapes and olive trees in the fields. Older people do not recall such strong winds in the past. In September, two tempests completely destroyed the grapes in the Trieste area, resulting in a poor grape harvest.	Jenner (in Braun 1934)
1735	May 22: A raging thunderstorm accompanied by lightning and heavy hail destroyed fields in Grignano, Buedo, and Tarstenicho and caused damage in the whole Trieste region. Winds and heavy rain also caused devastation. June 14: Toward noon, a storm with strong rain and thick hail destroyed parts of the fields in Žavljje, Pantanona, Sv. Barbara, and partly in Sesljan.	Scussa (in Braun 1934)
1739	August 6: Heavy rain starts at midday in Trieste followed by a severe tempest. One boat is sunk and a thick tree is uprooted near the steps of St. Just Church.	Scussa (in Braun 1934)
1747	On the night of October 2 <sup>nd</sup> rain accompanied by strong winds caused damage to fields, uprooted trees and olive trees, and destroyed trellises.	Scussa (in Braun 1934)
1748	On the night of September 2 there was heavy rain accompanied by hail. The high water level caused damage in the fields, mostly in Žavljje and at the saltworks.	Scussa (in Braun 1934)
1756	At six o'clock in the morning of October 16 <sup>th</sup> , a terrifying and extraordinary rain began which lasted until four in the afternoon. Streams and rivers in Trieste area were so full and so fast that their waters washed wagons of goods and iron into the sea, not to mention other damage estimated at nearly half a million forints.	Mainati (in Braun 1934)
1772	A stormy sea sank thirteen ships in Trieste.	Fasti Istriani
1795	After July 12 <sup>th</sup> , it rained heavily making it impossible to harvest. Heavy rain led to the flooding of the saltworks in Sečovlje, destroyed all the crops, and shifted the course of the Dragonja River.	Rutar 1896; Nicolich 1882

In the 18<sup>th</sup> century, chroniclers registered 16 severe storms that had the extent of a natural disaster, and 11 of them occurred in the first half of the century. The most curious seem to be the storm of 5 August 1710 (Table 2) that occurred most likely in the Trieste region, when together with strong whirling wind snow was falling too, if the record of Jenner is to be trusted (possible influence on the report by the Church holiday of S. Maria della Neve, which is celebrated on August 5 in memory of a legendary summer snow-fall on the Esquiline hill in Rome in early Christian era, indicating the site for a church to be built to the Holy Virgin; now better known as S. Maria Maggiore). Prevailing are the reports about strong winds during storms that plucked out trees. In 1756 and 1795, so abundant rain fell during the storms that the streams began to flood, even the Dragonja which due to downpours of 12 July 1795 changed its course and flooded the salt pans of Sečovlje. The weather in Trieste and its surroundings was extremely unfavourable in 1734 and 1735: the spring drought of 1734 was followed by stormy weather in August, which destroyed crops, and the next year, hail ravaged the area two times in succession. It should be underlined that as many as 18 severe winters with frosts and 9 droughts occurred in the 18<sup>th</sup> century, when the wider area of the Trieste Gulf was affected by a big weather disaster every two to three years on the average.

In the first half of the 19<sup>th</sup> century, chroniclers recorded four severe storms, causing either big or small damage, which all ravaged over Trieste and its surroundings. Mainati reports on a powerful downpour of 12 September 1802, between 3 and 7 p. m., which resulted in floods in lower-lying parts of the town and in the fields in its surroundings. Kandler mentions heavy rains in 1815 that caused a lot of troubles. According to Kert's records, two violent storms occurred, one on 26 August 1834 when hail ravaged the area together with heavy rains, and another on 25 August 1847 when a tempest began soon after the midnight, »which lasted, with its continuous lightning, thundering and heavy rains, all until the daybreak. Water broke into the houses, damaged some roads, houses, the Greek cemetery and other things.«





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Figure 3: Vineyard after a hailstorm in the surroundings of Krži on the Kras.

#### 4.2 Incidence of severe storms and their classification by types of damage caused

The presented chronology shows that outstanding in sub-Mediterranean Slovenia as to greater incidence were the 17<sup>th</sup> and the 18<sup>th</sup> centuries, especially their first halves. It was the time of the little ice age in Europe that was typical for great variability in weather in addition to general lower temperatures, winter temperatures in particular. Besides frequent damages done by frosts – to vines and olive trees in particular – and violent storms the standard of living in Istria and sub-Mediterranean Slovenia in this time grew even worse either because of droughts or because of very wet years with floods. There were 12 violent storms in the 17<sup>th</sup> century that reached the level of a natural disaster; 7 of them occurred in the first half of the century, and as many as 6 of them between 1677 and 1691. Besides by violent storms, the first half of the century was also marked by 4 hard frosts, 2 droughts and an invasion of grasshoppers. As a consequence, there were general high costs of living, shortage and famine due to which various epidemics spread, plague in particular. Impaired was the social standing of the population that in Istria first began to stagnate and later on declined (Darovec 2004). True »waste lands« appeared there in which, in the Venetian part of Istria, people from elsewhere were settled.

The circumstances in the 18<sup>th</sup> century were even worse, when 16 violent storms occurred in the discussed area, and as many as 11 of them in the first half of the century. The standard of living was further lowered by 11 damages caused by severe frosts, 6 very dry years, 4 wet years and two invasions of grasshoppers (1720 and 1741), which, according to Di Manzano (Braun 1934) caused a real devastation on the Kras. Weather conditions caused shortages and famine in this century too; due to a severe frost in 1782, 5 soldiers on guard duty in Trieste and some carting people from Carniola froze to death (Biancini, in Braun 1934).

The assessment of the significance of 12 or 16 violent storms per century can be obtained through the comparison to the 20<sup>th</sup> century, its second half in particular, when the incidence of such events supposedly began to increase due to general warming of the atmosphere. Methodologically adequate comparison is offered by the »Kronika izrednih vremenskih dogodkov v 20. stoletju« (Chronicle of exceptional weather events in the 20<sup>th</sup> century) (Trontelj 1997), complemented for the last three years of the

century with the data from the magazine *Ujma* (Šipec 1999; Šipec 2001). However, it should be stressed that the incidence of sources for the last half of the century is rather high and, having been registered by official services, they are more reliable; recorded are also less violent storms, which would have probably not entered the annals in the past. Registered in both of the two sources are 12 violent storms in sub-Mediterranean Slovenia in the 20<sup>th</sup> century that reached the level of a natural disaster. Only one record refers to the first half of the century, while all the rest refer to the second half. The incidence increases particularly after 1985, when practically each year a severe storm is registered for sub-Mediterranean Slovenia, except for the last three years of the century, when no severe storm with resultant damage occurred. The reason why one violent storm alone is stated for the first half of the century lies in the historical development and in the rather limited access for the author of the chronicle to the sources for the west half of Slovenia that was under the Italian occupation for most of the first half of the century.

The damage done by severe storms in the past does not differ significantly from the damage in the present. Recorded in more than 20 cases is damage in agriculture as the result of hail, of wind that broke fruit trees, vines and olive trees, and wheat and grapes fell off due to gusts of stormy winds. Mentioned in 10 cases along the coast of the Trieste Gulf is damage caused by stormy sea, high waves and strong wind (sunken, capsized and thrown-ashore vessels, damaged coast and built structures along the coast). Added to this damage can also be the damage to salt pans (7 records), caused on the one hand by the sea, and on the other by the high waters from the inland. Practically no damage is done to salt pans in the present, since most of the former salt pans have by now been abandoned, and the existing ones have been successfully protected by means of barriers. Torrential flooding of salt pans has ceased thanks to smaller water abundance of streams, which is due to thicker vegetation cover in the catchment area. In 10 cases damage is mentioned that was caused by overflows from riverbeds and changes of river courses, which happens very rarely nowadays. The least frequent (6-times) are records about buildings that caught fire caused by strokes of lightning, and about other damages on built structures and natural vegetation broken by wind.

## 5 Conclusion

The presented chronology of violent storms in the past centuries is not complete and does not provide a complete reconstruction of occurrence of this type of weather disaster because of deficient data. Nevertheless, it enables an insight into the general trend of this phenomenon in sub-Mediterranean Slovenia and the determination of the periods in which these phenomena were more frequent and reached, as to the costs of damage caused, the level of natural disasters or even catastrophes. The 17<sup>th</sup> and 18<sup>th</sup> centuries were undoubtedly such periods, particularly their first halves, when besides storms also some other weather-caused natural disasters occurred quite often, so that the inhabitants, who mainly depended on the self-subsistent agriculture, could not recover for several years after some consecutive severe rigours of the weather. Considering the number and accessibility of the sources about that time, we hazard a conclusion that the frequency of violent storms in that time was comparable to the incidence towards the end of the 20<sup>th</sup> century, when severe storms were ever more frequent. According to the majority of researchers, this phenomenon is supposed to be a human-generated consequence of emitting greenhouse gases and of the resulting global warming of the atmosphere. However, parallel to these explanations, we should not disregard the fact that such concentrations occurred already in the past when the human impact on the atmosphere was not so strong. The characteristics of storms and the type of damage they cause have not significantly changed since then, only the shifts of streams and bigger damages to salt pans have ceased.

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## **Nevihтна neurja in njihove posledice v submediteranski Sloveniji od 14. do srede 19. stoletja**

UDK: 911.2:551.583.2(497.47)"13/18"

COBISS: 1.01

**IZVLEČEK:** V prispevku je prikazan pregled nevihtnih neurij in rekonstrukcija obdobj s pogostejšim pojavljanjem le-teh v submediteranski Sloveniji v topli polovici leta v t. i. pred instrumentalnem obdobju. Podatki so pridobljeni iz sekundarnih in terciarnih zgodovinskih virov, predvsem kronik. Predstavljena kronologija ne omogoča popolne rekonstrukcije, ker je podatkov premalo, nudi pa osnovni vpogled v obdobja z zgotovitvijo teh pojavov. Izstopata 17. in 18. stoletje, zlasti prvi polovici, ki spadata med vremensko najneugodnejši v zadnjem tisočletju. Ostrim zimam s pozebami, sušnim in premokrim poletjem se je v 17. stoletju pridružilo 12 in v 18. stoletju 16 večjih neurij, ki so povzročila veliko škodo in zelo poslabšala življenjske razmere. Pogostost neurij je bila v prvi polovici 17. in 18. stoletja na ravni konca 20. stoletja, ko večjo pojavnost teh vremenskih ekstremov večinoma povezujemo s splošnim ogrevanjem ozračja. Iz kronike je razvidno, da se značilnosti neurij in vrsta škode, ki so jo povzročila, do današnjih časov nista bistveno spremenili. Edino, kar novejša klimatska zgodovina ni zabeležila je, da bi se ob avgustovski nevihti v nižjih delih Primorske tako ohladilo, da bi snežilo, kakor se je baje zgodilo avgusta 1710.

**KLJUČNE BESEDE:** Nevihтна neurja, vremenske ujme, variiranje podnebja, podnebje v holocenu, submediteranska Slovenija

Uredništvo je prejelo prispevek 12. septembra 2006.

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### **Vsebina**

1	Uvod	19
2	Oris glavnih podnebnih značilnosti submediteranske Slovenije	19
2.1	Nevihтна neurja v zadnjih desetletjih	20
3	Metodologija	20
4	Nevihтна neurja od 14. do srede 19. stoletja	21
4.1	Kronologija neurij	21
4.2	Pogostost nevihtnih neurij in njihova klasifikacija po vrsti škode	23
5	Sklep	23
6	Viri in literatura	24

## 1 Uvod

Vsako poletje povzročijo nevihtna neurja v Sloveniji veliko škode. Veliko količino padavin, ki pade v kratkem času (v eni uri se lahko zlije tudi več kot 50 mm dežja, kar je marsikje več kot polovica padavin povprečno namočenega meseca), lahko spremlja še kot oreh velika toča, viharen veter in udari strele. Submediteranska Slovenija pri tem ni izjema, saj spada med slovenske pokrajine, kjer je nevihtna pogostost med največjimi. Po Petkovšku (1987) leži v pasu z več kot 40 neviht letno, ki se vleče iz Furlanije in nadaljuje čez osrednjo Slovenijo na avstrijsko Štajersko in Gradiščansko. Nevihtna aktivnost je najizrazitejša v pozni pomladi in zgodnjem poletju. Kot naravna nesreča (nevihtna neurja) se pojavljajo le zelo močne nevihte, za katere je značilno, da se med svojim razvojem premikajo (ponavadi v smeri od zahoda proti vzhodu) in se večinoma pojavljajo ob hladnih frontah ali kot nevihtna linija (Vrhovec 2002).

Sreča v nesreči je prostorska omejenost nevihtnih celic na nekaj 10 km<sup>2</sup> in zelo majhna verjetnost, da bo neko območje prizadeto v dveh zaporednih letih ali celo večkrat v enem letu. Vendar se tudi to dogaja. Z vidika ogroženosti pa zbuja skrb scenariji podnebnih razmer za 21. stoletje, ki napovedujejo, da bo naraščanje temperature spremljala tudi večja pogostost ekstremnih vremenskih dogodkov, med njimi tudi močnih neviht z neurji. Te napovedi veljajo tako za Sredozemlje (Bolle 2003; Jeftić, Milliman, Sestini 1992), kakor tudi za Slovenijo (Anonymous 2001; Kajfež-Bogataj 2001; Kajfež-Bogataj, Bergant 2005), ki leži na njegovem obrobju in ima na JZ nekatere sredozemske podnebne poteze (slika 1). Za pravilno ovrednotenje trenutnega spreminjanja podnebja z vidika napovedi bodočega podnebja je nujno poznavanje sedanjih in preteklih podnebnih razmer. Le tako namreč morebitno večjo pogostost neurij v določenem času (letu, desetletju ali celo stoletju) pravilno umestimo v kontekst spreminjanja podnebja, saj so tovrstni pojavi v času in prostoru že po svoji naravi zelo spremenljivi. To nam kažejo podatki za čas, ko imamo zanesljive meritve in opazovanja vremena, prav tako tudi zapisi vremenskih dogodkov v pred instrumentalnem obdobju, ko teh meritev še ni bilo.

V prispevku se bomo osredotočili na problem osvetlitve nevihtnih neurij v submediteranski Sloveniji v pred instrumentalnem obdobju, to je pred letom 1841, kolikor nam to dopuščajo historični viri. Leta 1841 je namreč začela delovati meteorološka postaja v Trstu, ki je dober reprezentant podnebnih razmer submediteranske Slovenije, še posebej njenega obalnega dela, njeni kontinuirani podatki pa dajejo dobro osnovo za študij variacij podnebja od srede 19. stoletja do današnjih dni (npr. Ogrin 2003). Za sedaj pa imamo zelo skromno podatkovno bazo za študij razmer v času pred začetkom delovanja te postaje. Eden od namenov prispevka je zato podati kronološki pregled neurij v topli polovici leta, ki so dosegla raven naravnih nesreč in so kot taka pritegnila pozornost kronistov. Izdvojena so obdobja z večjimi zgostitvami teh pojavov in narejena klasifikacija neurij po vrsti škode. Drugi naš namen je okrepitev podnebnega spomina. Tudi zato, ker se ob sedanjih izrednih vremenskih dogodkih vse prepogosto srečujemo z mnenji, da so nekaj izrednega, kar se v preteklosti še ni zgodilo (»kaj takega ne pomnijo niti najstarejši prebivalci«) in da je zanje prav gotovo kriv človek. Že površen pregled preteklega vremenskega in podnebnega dogajanja pa nam hitro razkrije, da je naše poznavanje tovrstne zgodovine pomanjkljivo.

## 2 Oris glavnih podnebnih značilnosti submediteranske Slovenije

Z imenom submediteranska Slovenija označujemo nižji JZ del Slovenije, ki je reliefno odprt proti Tržaškemu zalivu oziroma Jadranskemu morju in ima zato milejše klimatske poteze v primerjavi s pokrajinami v notranjosti Slovenije. Orografska pregrada južnih Julijskih Alp in do 1500 m visokih dinarskih planot razmejuje pokrajine, v katerih še prevladujejo poteze mediteranskega podnebja, od ostale Slovenije, ki ima zmerno kontinentalno oziroma gorsko podnebje (slika 1). Značilnosti mediteranskega podnebja se prepletajo z vplivi celinskega in gorskega podnebja, kar se kaže v nekoliko nižjih temperaturah in več padavinah kot pri pravem mediteranskem podnebnju ter modificiranem padavinskem režimu. V geografski in klimatološki literaturi (npr. Ogrin 1996; Gams 1998) zato to podnebje označujemo za omiljeno mediteransko oziroma submediteransko, območje Slovenije, ki ima to podnebje, pa submediteranska Slovenija.

Za submediteransko Slovenijo so značilne pozitivne povprečne januarske temperature, julijske temperature višje od 20 °C in 2000 do 2400 ur s soncem na leto. Zaradi zadrževalnega učinka morja so jesenske temperature višje od spomladanskih. Padavin je od 1000 mm ob obali, do 1700 mm ob vznožju reliefnih pregrad in so relativno enakomerno razporejene preko leta. Kljub temu pa sta opazna dva viška in dva

niža padavin, ki sta posledica prepletanja mediteranskih in celinskih podnebnih značilnosti. Običajno pade največ padavin v jeseni, novembra ali oktobra, sekundarni višek je na prehodu pomladi v poletje v juniju. Najmanj padavin je na prehodu zime v pomlad (januar, februar, marec) ter v juliju ter avgustu (Ogrin 1996). V letnem povprečju potencialna evapotranspiracija ne presega količine padavin, se pa v topli polovici leta zaradi visokih temperatur pojavlja vlažnostni deficit in to kljub temu, da v povprečju pade tudi v poletnih mesecih od 80 do 100 mm padavin (Pristov 1994).

Slika 1: Podnebni tipi v Sloveniji in klimogrami za nekatere meteorološke postaje v submediteranski Sloveniji. Glej angleški del prispevka.

## 2.1 Nevihtna neurja v zadnjih desetletjih

Podatki o nevihtah, ki nam jih nudijo klimatske statistike, so zelo odvisni od vestnosti opazovalcev na meteoroloških postajah, lege postaje in tudi bližine povzročiteljev hrupa. Opazovanja so še vedno zgolj vizualna, po definiciji pa bi moral opazovalec zabeležiti kot nevihto že vsak blisk in grom. Po zbranih podatkih je v submediteranski Sloveniji povprečno od 25 do 50 neviht na leto. Nevihte so najpogostejše poleti, ko jih je več kot polovica. V obalnem pasu so zaradi toplega morja, nad katerim se dvigajo in vlažen zrak lahko razvije v nevihtni oblak, razmeroma pogoste tudi v jeseni. V notranjosti so nevihte bolj kot jeseni pogoste spomladi. Ob obali so pogostejše v nočnem času, v notranjosti pa podnevi, z viškom v zgodnjih popoldanskih urah. Najmanj jih je pozimi, v povprečju do 5 na sezono.

Variabilnost neviht med leti je velika. V posameznih letih je lahko dolgoletno povprečje preseženo za 50 %, ali pa jih je za prav toliko manj. Najbolj so zanesljive poleti. Po pregledih naravnih in drugih nesreč v Sloveniji v reviji *Ujma* (št. 9 do 17/18) se je v desetletju 1995–2004 v submediteranski Sloveniji vsaj v eni njenih pokrajin pojavila kakšna nevihta, ki je povzročila vsaj nekaj škode, večja neurja z večjo škodo pa so se pojavila vsakih nekaj let.

Razen toče in viharnega vetra spremljajo občasno poletna neurja tudi manjši vrtnčasti tornadi (trombe), ki predstavljajo na morju resno nevarnost manjšim plovilom, na kopnem pa rujejo drevje, odkrivajo strehe ipd., na srečo pa prizadenejo le manjša območja. O trombi, ki se je razvila 29. julija 1997 pozno popoldan nad Grivčami pri Ajdovščini in je na svoji poti na Ložah »počistila« njiivo koruze in pobrala štiri ri kope sena ter poškodovala nekaj vinogradov, poroča Kovač (2000).

## 3 Metodologija

Neurja in njihove posledice v submediteranski Sloveniji v predinstrumentalnem obdobju smo vsaj delno poskusili rekonstruirati s pomočjo kronike izrednih vremenskih dogodkov za submediteransko Slovenijo (Ogrin 1994; Ogrin 1995), ki smo jo sestavili večinoma na podlagi sekundarnih in terciarnih zgodovinskih virov. Za prvo polovico 19. stoletja pa tudi s pomočjo primarnih virov o proizvodnji soli v Piranskih solinah (PAK, enota Piran). Kronika zajema prvenstveno dogodke v Istri, v Trstu in ožjem in širšem zaledju Tržaškega zaliva, vključno s Krasom in Goriško. Izhodišče za oblikovanje naše kronologije je bila kronika vremenskih dogodkov, ki jo je za Trst, Istro in vzhodno Furlanijo sestavil Braun (1934). Braunovi glavni viri so bili *annali Jennerja za Trst do leta 1846*, *kronologija Gorice Della Bonne do leta 1500*, *Tržaški anali Scusse do leta 1695* in *Kandlerja od 1695 do 1848*, *zgodovina Trsta Ireneoja della Croceja od leta 1000 do leta 1702*, *tržaška kronika Mainatija od 11. stoletja do začetka 19. stoletja*, *anali Di Manzana za Furlanijo*, *kronika Rovinja Biancinija od leta 1760 do 1806* in *Kertov vremenski dnevnik za Trst od leta 1815 do 1858*.

Braunovo kroniko smo dopolnili z viri, ki jih avtor ni upošteval, npr. s kroniko Schiavuzzija (1889) in »Fasti Istriani«, kroniko dogodkov, ki je izhajala v časopisu »L'Istria« (1846–1852). Črpali smo tudi iz Dolničarjeve ljubljanske kronike 1660–1718 (Pučnik 1980) in iz Valvasorjeve »Slave Vojvodine Kranjske« (1984).

Kronika izrednih vremenskih dogodkov za submediteransko Slovenijo vsebuje predvsem podatke o hidroloških učinkih vremena (poplave, presihanje studencev in vodnjakov), posledicah za kmetijstvo (dobre in slabe letine, zgodnje in zapoznelo cvetenje ali zorenje), ekonomskih učinkih (pomanjkanja, spreminjanje cen, lakote) in neposrednih vremenskih učinkih (zmrzali, suše, moče, neurja, viharji ipd.). Podatkov za obdobje do 16. stoletja je malo, manj so tudi zanesljivi. Več jih je za 17., 18. in 19. stoletje, ko se po dveh ali več neodvisnih virih tudi pokrivajo, kar povečuje njihovo zanesljivost.



## 4 Nevihтна neurja od 14. do srede 19. stoletja

### 4.1 Kronologija neurij

Prvo poročilo o hudi nevihti, ki jo je spremljalo zelo obilno deževje, je za junij 1324. Naslednji zapisi so za konec 15. stoletja. Za leti 1488 in 1489 so Scussa, Ireneo in Mainati zapisali (v Braun 1934), da so bile obe leti nevihte zelo pogoste in hude ter da so prizadele Tržaško tako, »... da je vsakdo, ki je v vinogradih in na njivah običajno pridelal 100 urn vina, pridelal komaj 4. To je privedlo do pomanjkanja in skoraj uničenja, saj se je pšenica zelo podražila in življenje je bilo oteženo ...«. Veliko škode je povzročilo tudi neurje, ki je 13. julija 1563 prizadelo Tržaško in Kras. Ireneo (v Braun 1934) poroča, da je bilo na poljih pobitih mnogo živali in polomljenih veliko dreves in trt, kar je ljudstvo spravilo v tako bedno stanje, da je moralo za pomoč prositi cesarsko oblast.

Preglednica 1: Zapisi o nevihtnih neurjih v 17. stoletju.

Leto	Opis pojava	Vir
1617	19. julija zvečer se je razvijalo neurje z garbinom (JZ veter), dežjem, grmenjem in bliskanjem.	Ireneo, Mainati, Scussa (v Braun 1934)
1622	Toča je v Istri uničila skoraj ves pridelek.	Schiavuzzi (1889)
1624	Eno uro pred zoro je 3. maja strela zadela zvonik katedrale sv. Jošta v Trstu in zanelila hud požar.	Ireneo, Mainati (v Braun 1934)
1644	Zaradi pogostih in močnih garbinov je morje v Trstu na trgu Piazza Vecchia poplavilo vse do cerkve Rožnega venca. Na trgu Piazza Grande je bila voda tako visoka, da so v njej mirno plavale barke. Škoda je v mestu zaradi poplavljenih solj, uničenega blaga, porušenih nasipov v solinah v bližini mesta in solin v Škednju in Žavljah znašala 1000 skudov. Izbruhnili so veliki viharji na morju.	Schiavuzzi (1889), Ireneo, Mainati, Scussa (v Braun 1934)
1645	V zgodnjem večeru 29. januarja 1645 se je v več krajih Biscia bova, ljudsko v Trstu sionara, dvignil zastrašujoč vrtinčast vihar, imenovan Typhon v latinščini, ki ga je spremljal močan veter, grmenje in bliskanje. V dolini mlinov je s svojimi vrtinci polomil in izruval veliko oljčnih dreves, ki so tri ali štiri eno ob drugem ležale na tleh. Temu so se izredno čudili tudi tamkajšnji najstarejši prebivalci, kajti kolikor so pomnili, niso še nikoli videli ali slišali o čem podobnem.	Ireneo, Mainati (v Braun 1934)
1646	Izbruhnili so veliki viharji na morju.	Schiavuzzi (1889)
1677	10. september: Ob šestih popoldne je tri ure zaporedoma padal zelo močan dež z debelo točo in močnim vetrom, tako da je bila na Tržaškem velika škoda. Vode so narasle do višine človeka in poplavile ceste.	Ireneo, Mainati (v Braun 1934)
1683	11. julija je na Tržaškem grozna in močna levantera (nevihta z vzhodnim vetrom) povzročila veliko škodo, še zlasti na hribu sv. Vita, kjer so bili od štirih deležev grozdja trije potolčeni na tla in že požeta pšenica razgubljena po poljih. Na Krasu je izrula korenine mnogih hrastov, ogromnih orehov in drugih dreves ter povzročila veliko škodo na plodovih.	Ireneo, Mainati (v Braun 1934)
1687	14. julija, drugo uro popoldan, je Tržaško zajela huda nevihta s točo podobno lešnikom ali jajcem. Druga zrna so bila velikosti polovice skuda, zavihanega v obliki cevke. Čudež kakršnega niso nikoli več videli v teh krajih, je uničil skoraj vse grozdje in drugo sadje.	Ireneo, Mainati (v Braun 1934)
1688	Desetega oktobra, dve uri pred opoldnevom, je začelo na Tržaškem tako močno deževati in je lilo sedem ur nepretrgoma, da se je zdelo, da so vse zapornice na nebu odprte. Divjanje voda, ki so prekomerno narasle, je podrla Pondasserski most, zrušilo del zidu na posestvu gospoda Simonettija in prizadejalo znatno škodo bližnjim gospodom grofom; nato se je voda usmerila proti škofovedu posestvu in na njem ter tudi drugod povzročila še posebej veliko škodo, saj je rušila zidove, uničila njive, vinograde, mlane, hiše in vse, kar ji je prišlo na pot, ne brez očitne nevarnosti, da se utopijo mnogi ljudje, ki so se, da bi ušli smrti, ko je voda preseгла višino petih čevljev, zatekli na drevesa. Škoda na Tržaškem je bila povsod ogromna in ne pomni se, da bi naše mesto zaradi vode kdajkoli doživelo takšno uničenje, čigar škoda je, pravijo, preseгла petdeset tisoč dukatov.	Ireneo, Mainati (v Braun 1934)
1690	Dve srditi nevihti sta prizadeli Trst. Ena 2. aprila, ki je poškodovala zvonik sv. Miklavža pri Riborgu, razbila mali zvon in poškodovala zvonik bolnišnice, s kamenjem poškodovala streho, polomila številne oljke, mnoge pa izruvala. Druga, 9. julija zvečer, je z bliski in nenehnim grmenjem s streljo, ob dveh ponoči zanelila požar v skladišču orožja.	Ireneo (v Braun 1934)
1691	Od 22. septembra do 24. novembra je bilo zelo lepo vreme, razen tretjega v tem mesecu, ko je ponoči srdita nevihta z burjo poškodovala in polomila številne oljke, še zlasti na Koprskem, kjer je škoda znašala preko štiri tisoč dukatov. Zjutraj je v Trstu in nad Krasom snežilo z drobnim dežjem.	Ireneo (v Braun 1934)



Za submediteransko Slovenijo veljata, glede na pogostost izrednih vremenskih dogodkov, 17. in 18. stoletje za eni vremensko najneugodnejših v zadnjem tisočletju. Vrstile so se številne vremenske ujme, med katerimi je bilo v 17. stoletju 12 nevihtnih neurij, ki jih je spremljala tudi toča. Kar 7 krat so bili zabeleženi zelo močni vetrovi, leta 1645 tudi manjši tornado. Leta 1687 je padala nenavadna ploščata in zakrivljena toča (tabela 1). Vsem tem nesrečam se je leta 1644 pridružila še invazija kobilic, ki so sledile hudi vročini z izredno sušo in so po poročilu Scusse (v Braun 1934; tudi Rutar 1896) pojedle celo figove liste.

V 18. stoletju so kronisti zabeležili 16 nevihtnih pojavov, ki so imeli razsežnost naravne nesreče, od tega kar 11 v prvi polovici stoletja. Verjetno najbolj nenavadna je bila nevihta 5. avgusta 1710 (tabela 2), po vsej verjetnosti na Tržaškem, ko je ob močnem vrtinčastem vetru, če je verjeti zapisu Jennerja, tudi snežilo. Prevladujejo poročila o močnih vetrovih ob nevihtah, ki so ruvali drevje. Leta 1756 in 1795 je ob nevihtah padlo toliko dežja, da so vodotoki poplavljali, tudi Dragonja, ki je zaradi nalivov 12. julija 1795 spremenila tok in preplavila Sečoveljske soline. V Trstu in okolici je bilo zelo neugodno vreme leta 1734 in 1735, saj je spomladanski suši 1734 v avgustu sledilo viharo vreme, ki je uničilo pridelke, naslednje leto pa je dvakrat zaporedoma pustošila toča. Izpostaviti je potrebno, da je bilo v 18. stoletju kar 18 zelo ostrih zim s pozebami in 9 suš. V tem stoletju so širše območje Tržaškega zaliva večje vremenske nesreče prizadele v povprečju vsako drugo do tretje leto.

Slika 2: Nevihna nad Koprskim zalivom.  
Glej angleški del prispevka.

Preglednica 2: Zapisi o izbranih nevihtnih neurjih v 18. stoletju.

Leto	Opis pojava	Vir
1706	5. avgusta je grozna nevihta povzročila škodo na vseh poljih v okraju in na Tržaškem in odvzela pridelek ljudem.	Mainati (v Braun 1934)
1710	5. avgusta je grozna nevihta z vrtinci in snegom v nekaj urah uničila vsa polja, tako da so lastniki ostali brez pridelka, za katerega je kazalo, da bo obilen. Deželo je pahnila v revščino in minila so tri leta s skromno letino.	Jenner (v Braun 1934)
1729	23. julija je na Goriškem divjal vihar z močnim vetrom, dežjem in točo, ki je še zlasti prizadela Brda. Letina pšenice je bila še kar dobra, primanjkovalo pa je drugih pridelkov.	Di Manzano (v Braun 1934)
1734	Od 30. avgusta do 3. septembra je pihal v Trstu uničujoč veter, ki je na poljih uničil grozdje in oljke. Stari ljudje ne pomnijo tako močnega vetra. Septembra sta dva viharja v tržaški okolici povsem uničila grozdje, zato je bila letina skromna.	Jenner (v Braun 1934)
1735	22. maja je divje neurje z bliskanjem, grmenjem in hudo točo uničilo polja v Grignanu, Buedu in Tarstenichu, prizadelo pa je celotno tržaško pokrajino. Razdejanje je povzročil tudi veter in veliko dežja. Proti poldnevu 14. junija je vihar z močnim dežjem in debelo točo uničil del polj v Žavljah, Pantanolu, Sv. Barbari in delno v Sesljanu.	Scussa (v Braun 1934)
1739	Opoldne 6. avgusta je začelo v Trstu močno deževati in potem se je razvnel hud morski vihar. Potopil je eno ladjo in izruval debelo drevo blizu stopnišča cerkve sv. Justa.	Scussa (v Braun 1934)
1747	2. oktobra ponoči je bil dež z močnim vetrom, ki je povzročil škodo na poljih, izruval drevesa in oljke, uničil latnike.	Scussa (v Braun 1934)
1748	2. septembra ponoči je močno deževalo s točo. Visoke vode so povzročile škodo na poljih, največ v Žavljah in v solinah.	Scussa (v Braun 1934)
1756	16. oktobra je bila strašna in izjemna ploha, ki se je začela ob šestih zjutraj in trajala vse do štirih popoldne. Potoki in reke na Tržaškem so bili tako polni, da so njihove vode odnesle v morje vozove blaga in železja, če ne naštevamo drugo škodo, izračunano na približno pol milijona forintov.	Mainati (v Braun 1934)
1772	Viharno morje je v Trstu potopilo trinajst ladij.	Fasti Istriani
1795	Po 12. juliju je padlo veliko dežja, ki je onemogočil žetev. Zaradi nalivov je voda preplavila Sečoveljske soline in uničila vso žetev soli, premaknil se je tudi tok Dragonje.	Rutar 1896; Nicolich 1882

V prvi polovici 19. stoletja so kronisti zabeležili štiri nevihtna neurja, ki so povzročila večjo ali manjšo škodo, vsa so se razbesnela nad Trstom in okolico. Mainati poroča, da je bil 12. septembra 1802 med 15. in 19. uro močan naliv, zaradi katerega so bili poplavljeni nižinski deli mesta in polja v okolici. Kandler omenja velika deževja, ki so povzročila več nevšečnosti, leta 1815. Po Kertovih zabeležbah sta bili hudi uri 26. avgusta 1834, ko je ob močnem deževju pustošila tudi toča in 25. avgusta 1847, ko se je po polnoči začel vihar, »ki je z nenehnim bliskanjem, grmenjem in močnim dežjem trajal vse do dne. Voda je vdrla v hiše, poškovala nekaj cest, hiš, grško pokopališče in drugo«.

## 4.2 Pogostost nevihtnih neurij in njihova klasifikacija po vrsti škode

Iz predstavljene kronologije je razvidno, da v submediteranski Sloveniji po večji pogostosti neurij izstopata 17. in 18. stoletje, še posebej prvi polovici stoletij. To je v evropskem prostoru čas male ledene dobe, za katero je značilna razen nižjih, predvsem zimskih temperatur, tudi večja vremenska variabilnost. Razen pogostih pozeb, predvsem trt in oljk, ter neurij, so življenjske razmere v Istri in submediteranski Sloveniji v tem času poslabševale še suše in tudi zelo mokra leta s poplavami. V 17. stoletju je bilo 12 neurij, ki so dosegla raven naravnih nesreč, od tega 7 v prvi polovici stoletja in kar 6 med leti 1677–1691. Ob neurjih so prvo polovico stoletja zaznamovale še 4 hude pozebe, 2 suši in napad kobilic. Posledica je bila splošna draginja, pomanjkanje in lakota, zaradi česar so se vrstile tudi epidemije boleznih, predvsem kuge. Poslabšal se je socialni položaj prebivalstva, ki je po Darovcu (2004) v Istri začelo najprej stagnirati, nato nazadovati. Nastajale so prave »pustote« na katere so v beneškem delu Istre prebivalstvo naseljevali od drugod.

Še hužše so bile razmere v 18. stoletju, ko je bilo na obravnavanem območju 16 večjih neurij, od tega kar 11 v prvi polovici stoletja. Življenjske razmere je v prvi polovici stoletja poslabševalo še 11 pozeb, 6 zelo sušnih let, 4 mokra leta in dva napada kobilic (1720 in 1741), ki so po Di Manzanu (v Braun 1934), na Krasu povzročile pravo razdejanje. Vremenske razmere so tudi v tem stoletju povzročile pomanjkanje in lakoto, zaradi mraza je leta 1782 v Trstu zmrznilo 5 vojakov na straži in nekaj Kranjcev, ki so vozili vozove (Biancini, v Braun 1934).

Oceno o pomenu 12 oziroma 16 neurij na stoletje nam da primerjava z 20. stoletjem, še posebej njegovo drugo polovico, ko naj bi se pogostost teh dogodkov začela povečevati zaradi splošnega ogrevanja ozračja. Metodološko ustrezno primerjavo nam nudi Kronika izrednih vremenskih dogodkov v 20. stoletju (Trontelj 1997), dopolnjena za zadnja tri leta stoletja s podatki v reviji Ujma (Šipec 1999; 2001). Poudariti pa velja, da je za zadnjega pol stoletja gostota virov večja in so bolj zanesljivi, saj zanje skrbijo uradne službe ter so zabeležena tudi manjša neurja, ki v preteklosti verjetno ne bi zašla v anale. Po obeh virih je bilo v submediteranskem delu Slovenije v 20. stoletju 12 neurij, ki so dosegle raven naravnih nesreč. Na prvo polovico stoletja se nanaša le ena zabeležba, vse ostale na drugo polovico. Pogostost se poveča zlasti po letu 1985, ko beležimo v submediteranskem delu Slovenije praktično vsako leto kako večje neurje, razen v zadnjih treh letih stoletja, ko ni bilo večjih neurij in škod povezanih z njimi. Razlog, da je za prvo polovico stoletja navedeno le eno neurje, verjetno tiči v zgodovinskem razvoju in avtorju kronike manjši dostopnosti virov za zahodno polovico Slovenije, ki je bila večji del prve polovice stoletja pod italijansko okupacijo.

Škoda, ki so jo nevihtna neurja povzročala v preteklosti, se bistveno ne razlikuje od današnje. Zapisi v več kot 20 primerih omenjajo škodo v kmetijstvu kot posledico toče, vetrolomov sadnega drevja, trt in oljk ter osutja pšenice in grozdja zaradi vetrovnega piša ob nevihtah. Ob obali Tržaškega zaliva v 10 primerih omenjajo škodo, do katere je prišlo zaradi viharnega morja, visokega valovanja in močnega vetra (potopljena, prevrnjena in na obalo vržena plovila, poškodbe obale in objektov na obali). Tej škodi lahko prištejemo tudi poškodbe solin (7 omemb), ki jih je na eni strani povzročilo morje, na drugi pa tudi visoke vode iz zaledja. Poškodb solin v današnjem času praktično ni več, saj je večina nekdanjih solin opuščanih, oziroma so obstoječe uspeli dobro zaščititi z obrambnimi zidovi. Razlog, da ni hudurniškega preplavljanja solin, je tudi manjša vodnatost vodotokov zaradi večje poraščenosti vodozbirnega zaledja. V 10 primerih je navedena škoda zaradi razlitja voda iz strug in premaknitev strug vodotokov, kar je danes tudi redkost. Najmanjkrat (po 6 krat) so omenjeni požari na objektih zaradi udarov strele in ostale poškodbe zidanih objektov ter vetrolomi naravne vegetacije.

Slika 3: Vinograd po toči v okolici Križa na Krasu.  
Glej angleški del prispevka.

## 5 Sklep

Predstavljena kronologija nevihtnih neurij v preteklih stoletjih ni popolna in ne omogoča popolne rekonstrukcije pojavljanja te vremenske nesreče, ker je premalo podatkov. Omogoča pa vpogled v splošen trend tega pojava v submediteranski Sloveniji in izločitev obdobji, ko so bili ti pojavi pogostejši in so dosegali glede na višino povzročene škode raven naravnih nesreč ali celo katastrof. Eno takih obdobji je bilo prav gotovo 17. in 18. stoletje, še posebej obe prvi polovici, ko so bile ob nevihtnih neurjih pogoste tudi ostale

vremenske naravne nesreče in si prebivalstvo, ki je bilo večinoma odvisno od samooskrbnega kmetijstva, po nekaj zaporednih hudih ujmah ni opomoglo več let. Glede na gostoto in dostopnost virov iz tedanjega časa si upamo trditi, da je bila pogostost neurij tedaj primerljiva s koncem 20. stoletja, ko so postajala vedno pogostejša. Po mnenju večine raziskovalcev naj bi bilo to posledica človekovega emitiranja toplotnih plinov in globalnega segrevanja ozračja. Ob teh razlagah pa ne smemo prezreti, da so se take zgotovitve pojavljale tudi v preteklosti, ko človekov vpliv na podnebje še ni bil tako velik. Značilnosti neviht in vrsta škode, ki so jo povzročale, se do današnjih časov niso bistveno spremenile, praktično ni več le premaknitev vodotokov in večjih poškodb solin.

## 6 Literatura

Glej angleški del prispevka.