

Newsletter n° 7 – June 2016

Historical data of high winds in the Vipava valley

➤ Introduction

Wind Risk project is being implemented with the contribution of the Civil Protection Financial Instrument of the European Union.

This newsletter will introduce a brief overview on the ready accessible and available sources on the high wind events and wind measurements in the history of Ajdovščina, in the project Wind Risk study case Ajdovščina area. It will demonstrate the importance of understanding the history and nature of occurrences of the high winds together with detailed wind measurements in order to better assess the vulnerability of the area and to improve wind risk preparedness of other similar EU areas.

In the project Wind Risk, study case of the Municipality of Ajdovščina, a major cause of high winds is *bora*. In order to improve the preparedness of local buildings, infrastructure, forests, transit and inhabitants of the area due to high bora wind, we will have a look of bora phenomena throughout the history. Darko Ogrin and Simona Kosmač pointed out the importance of the historical memory of high winds in the local area, especially the preservation of awareness that the events of strong bora wind are nothing unusual through the history.¹

Let's have a look at a local important figure Matija Vertovec who lived in the middle of the 19th century and wrote based on 42 years of experience that bora in the Vipava valley (Ajdovščina is situated in the middle of this valley) was the reason that the local inhabitants didn't get overconfident and took their place of living for granted, otherwise described as paradise.² Likewise, in 1960 A. Melik wrote: » [...] *Vipava bora has a really bad reputation. Because of it the winters are relatively cold and the sensitive vegetation does not tolerate it [...]*«. ³ He mentions also that bora is the cause of woodiness on some edges of Trnovska and Hrušica plateau. In fact, bora is in some places so strong that it makes it difficult for trees to grow and it also blows away and dries up the fertile soil.⁴ Furthermore, he claims that on the plateau peaks, where the chill air layers emerge, one can find glades or rare trees. On the peaks of the Trnovska plateau intensive mixing of air masses, warm and cold, dry and humid, in vertical or horizontal movement, often occur. Thus, sleet and freezing rain, frost and sudden thaw is common. Fact is that the area is located between the Mediterranean and continental climate. Here bora is born and starts to blow and it reaches its peak

¹ Adopted from: Darko Ogrin in Simona Kosmač: Valvasorjevi prikazi vremena in podnebja v Slavi vojvodine Kranjske, in: Razprave, Dela 40, 2013, p. 39-53 (Darko Ogrin and Simona Kosmač: Valvasor demonstrations of weather and climate in the Glory of the Duchy of Carniola, in: Discussions, Works 40, 2013.) and Darko Ogrin: Podnebje in izredni vremenski dogodki ob Tržaškem zalivu pred letom 1841, in: Geografski zbornik, 2012, p. 23-30. (Darko Ogrin: Climate and extreme weather events in Trieste Gulf before 1841, in: Geographic Codes 2012)

² Adopted from: Matija Vertovec: »Ipavska bórja«, in: Slovensko berilo za drugi gimnazialni razred, Ljubljana 1852, 114. (Matija Vertovec: Vipava bora, in: Slovenian tutorial for the second gymnasium grade, Ljubljana 1852)

³ Anton Melik: Slovensko Primorje, 1960, p. 420. (Anton Melik: Slovenian Littoral, 1960)

⁴ Adopted from: Melik, 427.

and full strength in the Vipava valley. He also pointed out that, because of the bora wind the spruces crowns are not branched on the northeastern side.⁵

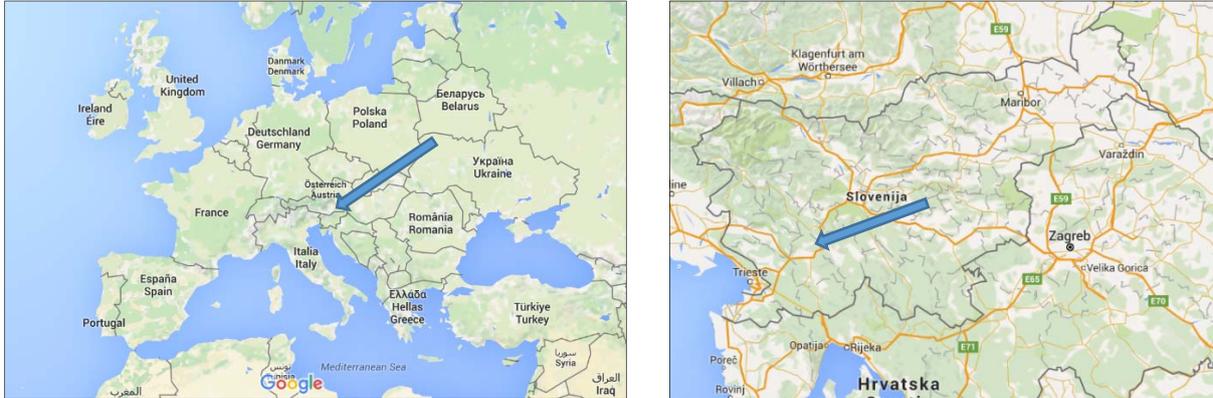


Figure 1: Slovenia on the EU map⁶

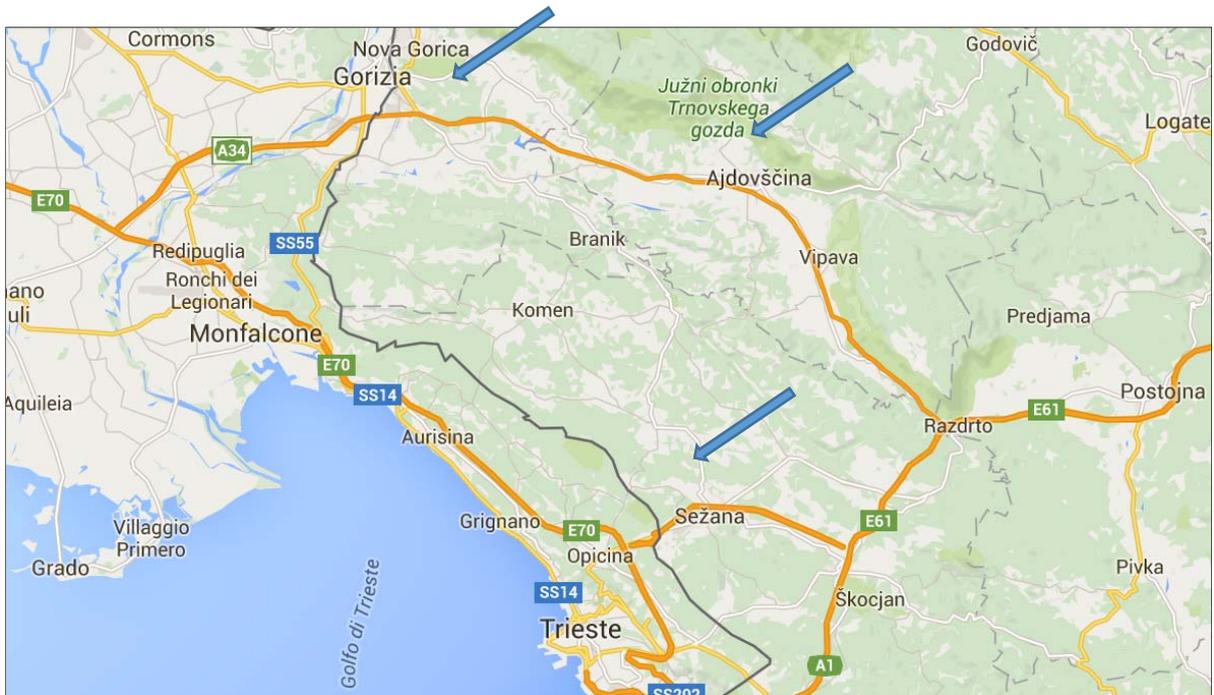


Figure 2: Gorizia, Ajdovščina and Vipava valley and Trieste gulf area on the map of Slovenia⁷

⁵ Adopted from: Melik, 427.

⁶ Google map.

⁷ Google map.

1. Chronology of high winds in Vipava valley

1.1. 15th and 16th century

An overview of the chronology of the high wind occurrences in the Vipava valley throughout the history before the systematic wind measurements, was prepared from already available studies by authors like Darko Ogrin, Zdravko Petkovšek, Simona Kosmač and others. These studies were based on chronicles of extraordinary events, which allow at least some reconstructions. However, since they do not focus only on the Vipava valley, we will begin with the examples from the broader Primorska area (North Jadran region, Trieste area and its Gulf, east Friuli, Karst plateau, Gorizia region, etc.). We believe that the presented high wind events had at least some direct or indirect impact also on Ajdovščina area. Ogrin claims that before 16th century, data on high winds in the broader Primorska and north Jadran region are less reliable and they represent simplified or even superstitious descriptions.⁸ He describes events:

- *“On the eve of St. Anthony the Abbot, January 16, 1441, in Trieste, harsh and cruel fate has risen with snow, cold and wind so strong that due to collapsing or uprooting almost all the olive trees in this territory were destroyed,”* (G. Braun according to Ireneo in Mainati).⁹ *“Between January 16 and 20, 1441, in Trieste, bora raged together with snow,”* (A. Tamaro).¹⁰
- For years 1488 and 1489 D.V. Scussa stated: *“In both years in Trieste, furious violent storms raged. Where people normally produced 100 urn units of wine, only 4 urn units in those two years were produced. Life was very difficult.”*¹¹
- *“Severe storm on July 13, 1563, covering Trieste and whole Karst area, unnecessarily killed many animals in the fields and broke trees and grapevines and pushed people in such a desperate state that they had to ask for help from the imperial power.”* (Braun according to Ireneo, Mainati in Jenner), (D.V. Scussa).¹²

Wind Risk project is one of the selected projects under 2014 call for proposals of the Civil Protection Financial Instrument. Kick off meeting for projects managers took place in Brussels on 20 January 2015.

During the first part of the meeting, the Committee representatives provided statistics and practical administrative, financial and legal issues regarding project management and implementation. Afterwards also the Wind Risk project manager, Mr. Goran Turk from University of Ljubljana, held a 10-minute presentation of the project. He focused on the project study areas affected by strong winds and storms (i.e. North Rhine-Westphalia, Central Dalmatia and Ajdovščina), explained the

⁸ Adopted from: D. Ogrin: Darko Ogrin: Sever storms and their effects in sub-mediterranean Slovenia from the 14th to the mid-19th century, Acta geographica Slovenica, 47-I, 2007, p. 11-12.

⁹ Adopted from: D. Ogrin: Darko Ogrin: Podnebje Slovenske Istre, Knjižnica Annales, Koper 1995, p. 287. (Darko Ogrin: Slovenian Istria Climate, Library Annales, Koper 1995)

¹⁰ Adopted from: D. Ogrin: Podnebje Slovenske Istre, 1995, 287.

¹¹ Adopted from: D. Ogrin: Podnebje Slovenske Istre, 1995, 288.

¹² Adopted from: D. Ogrin: Podnebje Slovenske Istre, 1995, 289.

necessity to start addressing wind issues and clarified the Wind Risk Project contents, including its objectives, actions and expected results.

1.2. 17th and 18th century

For the 17th and 18th century, there are already more data on high winds. Ogrin claims that some data: *“from two or more independent sources even overlap, which increases their reliability.”*¹³ Interesting is the fact that in 1645 Ogrin mentions even a small tornado¹⁴ in Trieste, while for the 18th century the chronicles give more data about the severe storms. Ogrin presents these events:

- July 19, 1617: on the evening a storm occurred together with garbin (southwest wind), rain, thunder, and lightning (Ireneo, Mainati, Scussa in Braun 1934)¹⁵;
- October 25, 1644: strong garbin in Trieste rippled the sea which flooded the church of Saint Rosary and saltworks. The assessed damage was 1000 scudi (D.V.Scussa). Severe storms broke out on the sea (B. Schiavuzzi)¹⁶. *»Due to strong and frequent »garbin« winds, the sea flooded Piazza Vecchia square in Trieste all the way to the St. 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 saltwork dykes near city and saltworks in Škedenj and Žavlje, amounted to 1000 scudi»* (Schiavuzzi (1889), Ireneo in Braun 1934)¹⁷;
- January 29, 1645: in the »valley of mills« near Trieste a severe storm with high wind occurred and uprooted many trees (D.V. Scussa). A tremendous thunderstorm evolved called »šijon«, which initiated overflowing of the seawater over the coast far across the city (S. Rutar)¹⁸. *»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 admiration 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)¹⁹;
- September 28, 1660: high Bora wind started to blow in Trieste (D. V. Scussa)²⁰.
- Year 1677: *»At six o'clock in the afternoon of September 10th, very heavy rain with thick hail and high winds fell for three consecutive hours causing massive damage in the Trieste area.*

¹³ Ogrin: Darko Ogrin: Dry and wet years in sub-mediterranean Slovenia from the 14th to the mid-19th century, Geographica 37, 2002, p.57.

¹⁴ Adapted from: Ogrin: Podnebjje 2012, 29.

¹⁵ Adapted from: Ogrin: Severe storms 2007, 13.

¹⁶ Adapted from: Ogrin: Podnebjje Slovenske 1995, 290.

¹⁷ Ogrin: Severe storms 2007, 13.

¹⁸ Adapted from: Ogrin: Podnebjje Slovenske 1995, 290.

¹⁹ Ogrin: Severe storms 2007, 13.

²⁰ Adapted from: Ogrin: Podnebjje Slovenske 1995, 291.

The water levels rose to the height of a man and flooded the roads.” (Ireneo, Mainati in Braun 1934)²¹;

- November 21, 1682: high bora wind in Trieste (G. Braun according to Ireneo in Mainati)²²,
- Year 1683: *“July 11th, a terrifying and strong levanter (a thunderstorm with easterly winds) caused great damage, especially on St. 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)²³;*
- Year 1684: it started with such severe and extreme cold that even the oldest inhabitants of Trieste do not recall. On January 29 high bora wind began, which constantly blew up to March 4. It was accompanied by a lot of snow which was blown through the air by bora wind and fallen to the ground as fine flour etc. (G. Braun according to Ireneo in Mainati)²⁴.
- Year 1689: In this year also a prominent Slovenian figure Janez Vajkard Valvasor wrote that during the winters in the Karst plateau an unbelievable strong wind called Bora blows overturning horses and people, and is most common between Trieste and Senožeč²⁵;

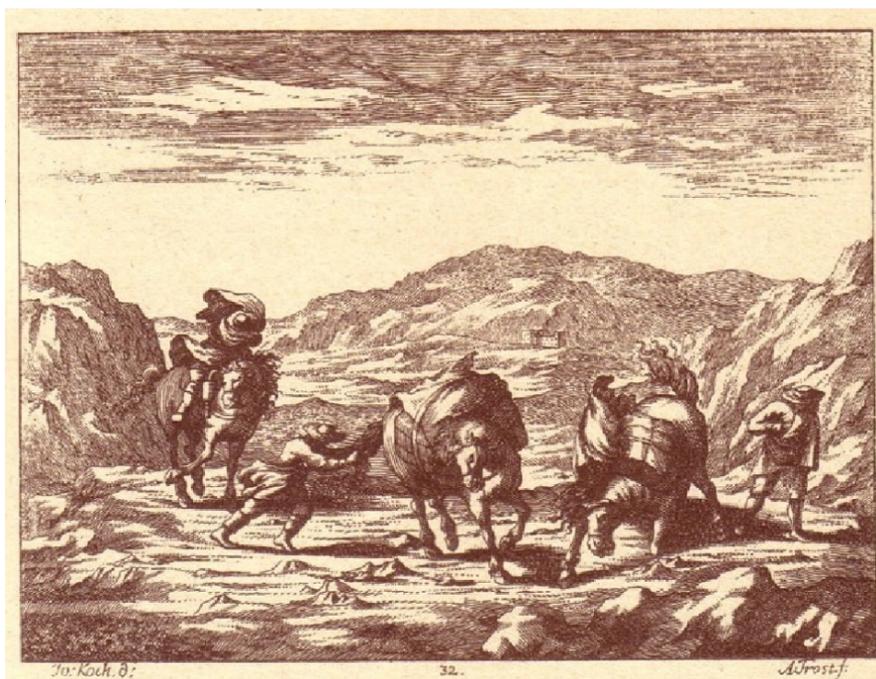


Figure 3: Severe cold, which was in early 1684 accompanied by long-term strong bora²⁶

²¹ Ogrin: Sever storms 2007, 13.

²² Adapted from: Ogrin: Podnebjje Slovenske 1995, 291.

²³ Ogrin: Sever storms 2007, 13.

²⁴ Adapted from: Ogrin: Podnebjje Slovenske 1995, 291-2.

²⁵ Adapted from: Zdravko Petkovšek: Burja v Sloveniji in nekoliko južneje, Slovensko meteorološko društvo, 2004, p. 255. (Zdravko Petkovšek: Bora Winds in Slovenia and further south, Slovenian Meteorological Society, 2004)

- February 8, 1690, in Trieste a high Bora wind blew. (G. Braun according to Ireneo in Mainati; the same as D.V. Scussa)²⁷;
- Between September 22 and November 24, 1691, the weather was very nice, the exception was the third day of the same month, when wrathful storm with Bora winds occurred during the night and damaged and broke a number of olive trees, etc. (G. Braun according to Ireneo)²⁸;
- Year 1706: *»The year was wet and the south wind blew constantly. On August 5, a terrible thunderstorm caused great damage in the Trieste area, denying people their crops.»* (Dolničar, Mainati)²⁹;
- Year 1710: *»On August 5, 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)³⁰;
- Year 1711: *»The year was extraordinary wet, more that the oldest inhabitants could recall from the past. The south wind dominated almost all year and it always rained, apart from some time during summer,»* (Dolničar)³¹;
- July 23, 1729: storm with high winds, rain and hail occurred in Gorizia region, which especially affected »Brda« hills. (G. Braun according to Di Manzano)³²;
- Year 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 high winds in the past.»* (G. Braun according to D. V. Scussa). *»In September, two tempests completely destroyed the grapes in the Trieste area, resulting in a poor grape harvest.»* (G. Braun according to Jenner)³³;
- May 22, 1735: *»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 Žavlje, Pantanona, St. Barbara, and partly in Sesljan.»* (Scussa in Braun).³⁴
- Between January 9 and 13, 1738: extreme cold with wind and frozen snow that changes everything in the Trieste city and in the fields into ice. Olives are covered with ice and they

²⁶ Ogrin: Podnebje 2012, 25.

²⁷ Adapted from: Ogrin: Podnebje Slovenske 1995, 293.

²⁸ Adapted from: Ogrin: Podnebje Slovenske 1995, 293.

²⁹ Ogrin: Dry and wet 2002, 60.

³⁰ Ogrin: Sever storms 2007, 14.

³¹ Ogrin: Dry and wet 2002, 60.

³² Adapted from: Ogrin: Podnebje Slovenske 1995, 295.

³³ Adopted from: Ogrin: Podnebje Slovenske 1995, 295.

³⁴ Ogrin: Sever storms 2007, 14.

suffer. As far as people recall, this kind of weather occurred also in year 1709. (G. Braun according to D.V. Scussa)³⁵;

- August 6, 1739: At noon began heavy rain in Trieste which was followed by a severe sea storm. One ship sank and a strong, thick tree was uprooted next to the stairways of the church of St. Giusto. (G. Braun according to D.V. Scussa)³⁶;
- Year 1747: *“On the night of October 2 rain accompanied by strong winds caused damage to fields, uprooted trees and olive trees, and destroyed trellises.”* (Scussa in Braun 1934)³⁷.

From the year 1779 on, **first meteorological observations and measurements** began in Trieste, which could be also relevant for Ajdovščina area. Unfortunately, only the data from 1841 on are preserved.³⁸ Systematic observations and measurements of precipitation in Gorizia began in 1781, in 1784 in Tolmin and in 1785 in Piran. Interesting fact is, that the oldest preserved meteorological measurements are monthly rainfall sums measured in Piran from 1786.³⁹ In Ljubljana in 1824 weather measurements began, but all the data till 1850 are lost.⁴⁰ However, we have to add that all these measurements are incomplete.⁴¹

1.3. 19th century

- In years 1802 and 1803: After two and more months of the constant wind “Sirocco” in the night from January 11 to 12, 1803, suddenly a wind started to blow from the east or northeast, with the well-known name “Tramontana”. Wind was accompanied by a strong whirl of snow, it was very cold (G. Braun according to Kert)⁴²;
- January 11, 1803: due to bora wind eight large ships sank (A. Tamaro)⁴³;
- From the end of December 1814 till the end of January 1815: in Trieste there was an extreme cold weather with a lot of snow, ice and high bora wind (G. Braun according to Kert)⁴⁴;
- December 26, 1833: in Trieste at 13:30 high »Tramontana« wind caused huge damage, five boats, one ship and many of small wooden vessels sank (G. Braun according to Kert)⁴⁵;

³⁵ Adapted from: Ogrin: Podnebje Slovenske 1995, 296.

³⁶ Adapted from: Ogrin: Podnebje Slovenske 1995, 296.

³⁷ Ogrin: Sever storms 2007, 14.

³⁸ Adapted from: Predlog zakona o meteorološki dejavnosti, prva obravnava, 24.6.2004, p.2 (Draft on meteorological activities law, 24.6.2004.)

³⁹ Mojca Dolinar, Mateja Nadbath, Zorko Vičar, Gregor Vertačnik, Boris Pavčič: Spreminjanje podnebja v Sloveniji, in: Okolje se spreminja, Podnebna spremenljivost Slovenije in njen vpliv na vodno okolje, Ljubljana 2010, p.18. Internet:

http://www.arso.gov.si/o%20agenciji/knji%C5%BEnica/publikacije/Okolje_se%20spreminja.pdf, 30.5.2016.

(Mojca Dolinar, Mateja Nadbath, Zorko Vičar, Gregor Vertačnik, Boris Pavčič: Changing Climate in Slovenia and its impact on the aquatic environment, Ljubljana 2010. Internet:

http://www.arso.gov.si/o%20agenciji/knji%C5%BEnica/publikacije/Okolje_se%20spreminja.pdf, 30.5.2016)

⁴⁰ http://www.arso.gov.si/o%20agenciji/knji%C5%BEnica/publikacije/Okolje_se%20spreminja.pdf, 2010, p.17.

⁴¹ http://www.arso.gov.si/o%20agenciji/knji%C5%BEnica/publikacije/Okolje_se%20spreminja.pdf, 2010, p.17.

⁴² Adopted from: Ogrin: Podnebje Slovenske 1995, 298.

⁴³ Adopted from: Ogrin: Podnebje Slovenske 1995, 298.

⁴⁴ Adapted from: Ogrin: Podnebje Slovenske 1995, 298-9.

- August 26, 1834: In Trieste a severe storm with hail destroyed a large number of roofs of private and public houses and churches. This was the reason that the rain managed to reach also in the lower floors of houses causing unpredictable damage by destroying furniture, library, archives and other (G. Braun according to Kert)⁴⁶;
- August 25, 1847: In Trieste after midnight a huge storm with constant lightning and heavy rain began and lasted till sunrise. Houses were flooded, excess water damaged roads, arcades, houses, walls, Greek cemetery etc. (G. Braun according to Kert)⁴⁷.

In 1848 regular meteorological service began to operate, when Central Institute for Meteorology and Geomagnetism was founded in Wien.⁴⁸ It introduced a unified meteorological network for the whole Austrian Empire⁴⁹, thus including Slovenian territory. In Ljubljana in 1850 systematic measurements and recordings of temperature and precipitation began in Ljubljana.⁵⁰ Two years later, in 1852, systematic measurements of air temperature and precipitation according to Paris lines followed⁵¹ in Ljubljana, which included cloudiness observations and assessment of strength and direction of the wind.⁵²

In 1852 local prominent personality Matija Vertovec, which we mentioned already in the introduction of this newsletter, illustrated bora wind in Vipava valley and its problems. Based on his descriptions we can get a picture also on vulnerability parameters that our project Wind Risk is focusing, namely: population, infrastructure, transport, buildings and forests. He writes:

- *“most accidents occur on the roads, because there is no wagon big and heavy enough, that bora could not overturn”⁵³;*
- *“if it is mostly snowing from “Zastava” air masses, high bora wind is sweeping clean the snow stacking it in several sheltered places in the valley and creating snowdrifts, which are not easy to shovel while bora blows”⁵⁴; “Sometimes bora blows past the church windows at such speed, that [...] it opens and breaks the window glasses”⁵⁵;*

⁴⁵ Adapted from: Ogrin: Podnebje Slovenske 1995, 299.

⁴⁶ Adapted by: Ogrin: Podnebje Slovenske 1995, 299 - 300.

⁴⁷ Adopted from: Ogrin: Podnebje Slovenske 1995, 300.

⁴⁸ Predlog zakona o meteorološki dejavnosti, prva obravnava, 24.6.2004, p.3.

⁴⁹ http://www.arso.gov.si/o%20agenciji/knji%C5%BEnica/publikacije/Okolje_se%20spreminja.pdf, 2010, p.17.

⁵⁰ http://www.arso.gov.si/o%20agenciji/knji%C5%BEnica/publikacije/Okolje_se%20spreminja.pdf, 2010, p.17.

⁵¹ http://www.arso.gov.si/o%20agenciji/knji%C5%BEnica/publikacije/Okolje_se%20spreminja.pdf, 2010, p.17.

⁵² Mojca Dolinar, Mateja Nadbath, Zorko Vičar, Gregor Vertačnik, Boris Pavčič: Zgodovina podnebnih podatkov v Sloveniji, 2008. p. 4. Internet: <http://www.ing.unitn.it/~foralps/Brochure/FORALPS%20brosura%20SLO.pdf>, 10.6.2016. (Mojca Dolinar, Mateja Nadbath, Zorko Vičar, Gregor Vertačnik, Boris Pavčič: The history of climate data in Slovenia, 2008. Internet: <http://www.ing.unitn.it/~foralps/Brochure/FORALPS%20brosura%20SLO.pdf>, 10.6.2016)

⁵³ Vertovec, 117.

⁵⁴ Vertovec, 115.

⁵⁵ Vertovec, 116.

- *“[...] all the trees [...] are turned towards southwest; oak [...], is twisted and has cracks because of bora wind, thus it cannot be used for making “dogs” (dogs are parts of wine barrels, added by PV) [...]”⁵⁶;*
- *“when the bora wind is blowing extremely strong, it happens that roofing together with stones on them are being blown away, and if this would fall on someone, he or she would be immediately dead”⁵⁷;*
- *“if high bora suddenly occurs it could happen that underdressed traveller would freeze to death”.⁵⁸*

Likewise, we can have a look of the way the local newspaper “Soča” (1871-1915), published in Gorizia, depicts bora wind with main focus on project Wind Risk vulnerability parameters (population, infrastructure, transport, buildings and forests). Soča published:

- *“Bora was blowing in Gorizia region for a week, in our mountains several trees were uprooted and overturned and there was a lot of damage on the roofs”⁵⁹;*
- *“In the end of the previous week, through all the Vipava valley bora was blowing strong. People could not reach nearby places, such as Cesta or Vipava, when they wanted. It occurred several times that they had to wait till bora at least a little bit calmed down. Wagons needed to be hold down by assistants in order not to be overturned by bora wind. During all this an accident happened on the 10th of this month in Šturje. Already one day before bora overturned a long wagon (called “škripalo”) owned by a carpenter from Ribnica while carrying his dry wooden goods for sale, but without any special damage so that the man could together with his wagon continue his way. But on the next day bora met him on the same spot and once again overturned his wagon, this time running over a man named Tonče from Griža who could not save himself in the right time and so he died on the spot. Until bora wind only teases, let it be, but when it starts to threaten people’s lives in this way, it is all too much.”⁶⁰*
- *“Neighbours couldn’t reach each other, because of strong bora wind blew like nothing people have experienced before or at least not in a long time. Roofing and heavy stones were falling from roofs.”⁶¹*
- *“Last year the bora wind was so strong that it destroyed the wooden bridge over Grajšek near St. Križ, and they had to build a new one... ”⁶²;*
- *“Aunt” Bora is mercilessly blowing over the Nanos and Čaven plateau”⁶³;*
- *“Bora collapsed the walls of the boilerhouse in Ajdovščina”⁶⁴;*

⁵⁶ Vertovec, 117.

⁵⁷ Vertovec, 116.

⁵⁸ Vertovec, 114.

⁵⁹ Soča, letnik 11, št. 3, 15.01.1881, p. 4.

⁶⁰ Soča, letnik 17, št. 4. 21.01.1887, p. 4.

⁶¹ Soča, letnik 21. št. 2. 09.01.1891, p. 3.

⁶² Soča, letnik 28. št. 36. 06.05.1898, p. 2.

⁶³ Soča, letnik 29. št. 103. 27.12.1899, p. 2.

⁶⁴ Soča, letnik 32. št. 65. 07.06.1902, p. 2.

- *“Early yesterday morning terrifying bora wind was blowing over the whole Vipava valley. There was a lot of damage, especially on vines and fruit trees. All along the way to Vipava lay many uprooted trees.”⁶⁵*



Figure 4: Cover page of the local newspaper “Soča” (1871-1915)⁶⁶

By the end of the 19th Century there were 85 meteorological stations on the territory of today Slovenia.⁶⁷ Consequently, the number of weather studies based on the data obtained through the meteorological stations rapidly increased. Likewise, Ogrin mentions monographies and studies, which includes winds from the broader area of Vipava valley such as Trieste, Italy, Istria (Poreč and Pula), Croatia, Wien, Austria, etc.⁶⁸

1.4. From 20th century to present

In the year 1918, the Austro-Hungarian Empire collapsed. The area of today’s Slovenia divided to two parts. The eastern part of Slovenia became a part of the Kingdom of Serbs, Croats and Slovenes and later in 1929 Kingdom of Yugoslavia. In that area the Institute for Meteorology and Geodynamics was established at the University in Ljubljana. Together with the General Weather Inspection, Hydrographic department, the Institute was in charge of the placement of meteorological stations and their observations in the Slovenian territory. The western part of Slovenia, including Vipava valley, became a part of Italy. Therefore, the Ministry of Agriculture and Forestry, Central Bureau of Meteorology and Geophysics headquarters in Rome, was in charge for placement and maintenance of meteorological stations in Primorska area. The precipitation stations were managed separately by the Ministry of Public Works, Department of Water in Venice.⁶⁹ The weather data from meteorological stations, which could only be applied for the reconstruction of the first half of the 20th

⁶⁵ Soča, letnik 39. št. 88. 05.08.1909, p. 3.

⁶⁶ <http://www.dlib.si/>, 15.6. 2016.

⁶⁷ http://www.arso.gov.si/o%20agenciji/knji%C5%BEnica/publikacije/Okolje_se%20spreminja.pdf, 2010, p.18.

⁶⁸ Adopted from: Ogrin: Podnebje Slovenske 1995, 33.

⁶⁹ <http://www.ing.unitn.it/~foralps/Brochure/FORALPS%20brosura%20SLO.pdf>: 2008. p.7

century, introduced the increase in studies and analyses on weather thematic also concerning our study area, done by Biel 1927; Cumin 1927 and 1929; Gerosa 1933; Braun 1934⁷⁰ (with significant importance for Gorizia and Eastern Friuli); etc. Before the Second World War there were very few technical or innovative records on bora thematic. For example, Polli (1943 and 1956) kept some records for the territory of Trieste gulf and nearby Karst area.⁷¹ One example is from October 25, 1935 stating that bora was so strong that it blew away a part of the roofing leaving the building of a district court archive unprotected from natural disasters. The source points out not only on the urgency of the damaged roof restoration but also on the risk of the entire roofing being blown away by fierce bora.⁷²

From the end of the Second World War until the end of the year 1991 the Hydrometeorological Institute of the Republic of Slovenia was part of the Federal Hydrometeorological Institute. In the year 1947 a Weather Forecast service according to the synoptic method was established.⁷³ In the year 1940 the number of weather stations in Slovenia increased to 183 and even more to 200 in 1950. The highest number of the weather stations in Slovenia was in year 1977 when it reached 347, out of which 103 were climatological and 244 precipitation stations.⁷⁴ Parallel to the rapid development of the meteorology also the growth on the wind researches, studies and findings began.⁷⁵ Several important works dealing with bora high winds were produced by various authors, such us: Paradiž 1957; Yoshino 1976⁷⁶; etc.

After the independence of the Republic of Slovenia, in 1991, the Hydrometeorological Institute of the Republic of Slovenia lasted till 2003, when Slovenian Environment Agency (ARSO) was founded. In overall, the meteorological services are available in Slovenia for almost 150 years. Nowadays, Slovenian Environment Agency is dealing with operational meteorology as well as with systematic measurements of weather data for the purpose of weather studies.⁷⁷ ARSO provides and illustrates the observations of wind speed and direction together with its consequences from the year 1961 on, based on five different measurement types and observations from:

- climate and precipitation stations, where the observer records high and stormy wind. These data are very subjective and depend on the observers' attention and their assessment of wind power;
- climate observation stations, the observer records wind strength three times per day (at 7, 14 and 21 o'clock). At the beginning the wind strength was assessed according to the effect of wind on the surrounding area (in Bofor units), afterwards some stations recorded even with manual anemometer. Data from these measurements on the average speed are available on web archive: <http://meteo.arso.gov.si/>, while the data dealing with the wind speed and direction for all three time periods are in ARSO archive. These data are also subjective. Fact is

⁷⁰ Adopted from: Ogrin: Podnebje Slovenske 1995, 36-41.

⁷¹ Petkovšek, 255.

⁷² PANG 24, t. e. 17, 1935, a.e. 135, kat. 17

⁷³ Ogrin: Podnebje Slovenske 1995,64-65.

⁷⁴ Adopted from:

http://www.arso.gov.si/o%20agenciji/knji%C5%BEnica/publikacije/Okolje_se%20spreminja.pdf: 2010, p.18.

⁷⁵ Petkovšek, 255.

⁷⁶ Ogrin: Podnebje Slovenske 1995, 52.

⁷⁷ Adopted from: Predlog zakona o meteorološki dejavnosti, prva obravnava, 24.6.2004, p. 2

that in Slovenia, before the middle of the nineties, there were no federal measurements on wind speed. The wind speed was measured only three times per day, which is far to less to be able to conclude facts about the weather conditions for the whole day. And before that ARSO concluded the predictions about the wind speed based on the effects on the surrounding area according to Beaufort scale;

- maksimetres, which were in use in the late 70s and 80s. They measured daily maximum wind gusts mainly in the coastal part of Slovenia;
- shorter, few months long or several years long measurements of wind speed and direction in the late 70s and 80s and at the beginning of the 90s. These data were obtained each hour; the wind direction was marked according to 32 or 36 sky directions;
- automatic stations, from the beginnings of the 90s until today. These data on average speed and its direction are mostly half-hourly, newer are each 10 minutes. Federal measurements are available from the introduction of automatic stations. Still there are problems with making conclusions, especially because of the short time of measurements and too rare network of stations. All these mentioned data cannot be properly homogenized. ARSO came across difficulties caused by relocation of station sites, changing of instruments, changing the height of measurement, etc. We can find those data on the internet site of ARSO archive available on: <http://meteo.arso.gov.si/met/sl/app/webmet/#webmet==8Sdwx2bhR2cv0WZ0V2bvEGcw9ydlJWbIR3LwVnaz9SYtVmYh9icIFGbt9SaulGdugXbsx3cs9mdl5WahxXYyNGapZXZ8tHZv1WYp5mOnMHbvZXZulWYnwCchJXYtVGdJnOn0UQQdSf%3b>.

Within the Wind Risk prevention project, in addition to ARSO measurements of wind, an independent specialized measurement system for winds has been set up in Ajdovščina. The WindMaster Pro anemometer from GILL Instrument measures bora wind characteristics in detail and gathers information about measurements of wind speed and direction. The readings are also used as an alarm system for local civil protection service which alerts them immediately after average wind speed or wind gusts exceed specific limits.

➤ **Summery and conclusion**

The presented chronology on the high wind events and its measurements in the history of the project Wind Risk study case Ajdovščina area does not cover the entire and complete historical climatic reconstruction. The collected material only presents some general overview and a basic insight into the evolution of high wind measurements in the area. Furthermore, it sets a base for a more detailed and comprehensive research with an even profounder investigation into archival documents. Nevertheless, the presented chronology emphasizes the importance of understanding the history of the high winds together with wind measurements in order to better assess the vulnerability and to improve wind risk preparedness in EU.