ARPA FVG

agenzia regionale per la protezione dell'ambiente del Friuli Venezia Giulia

proESOF TOWARDS TRIESTE 2020 EUROSCIENCE OPEN FORUM

Sistema Nazionale per la Protezione dell'Ambiente

Unione Meteorologica del Friuli Venezia Giulia ONLUS

Liceo Scientifico Galilei - Trieste

STRONG WIND EVENTS, TRADITIONAL BUILDING SOLUTIONS, ADAPTATION TO CLIMATE CHANGE: LEARNING FROM THE PAST TO EDUCATE FOR THE FUTURE

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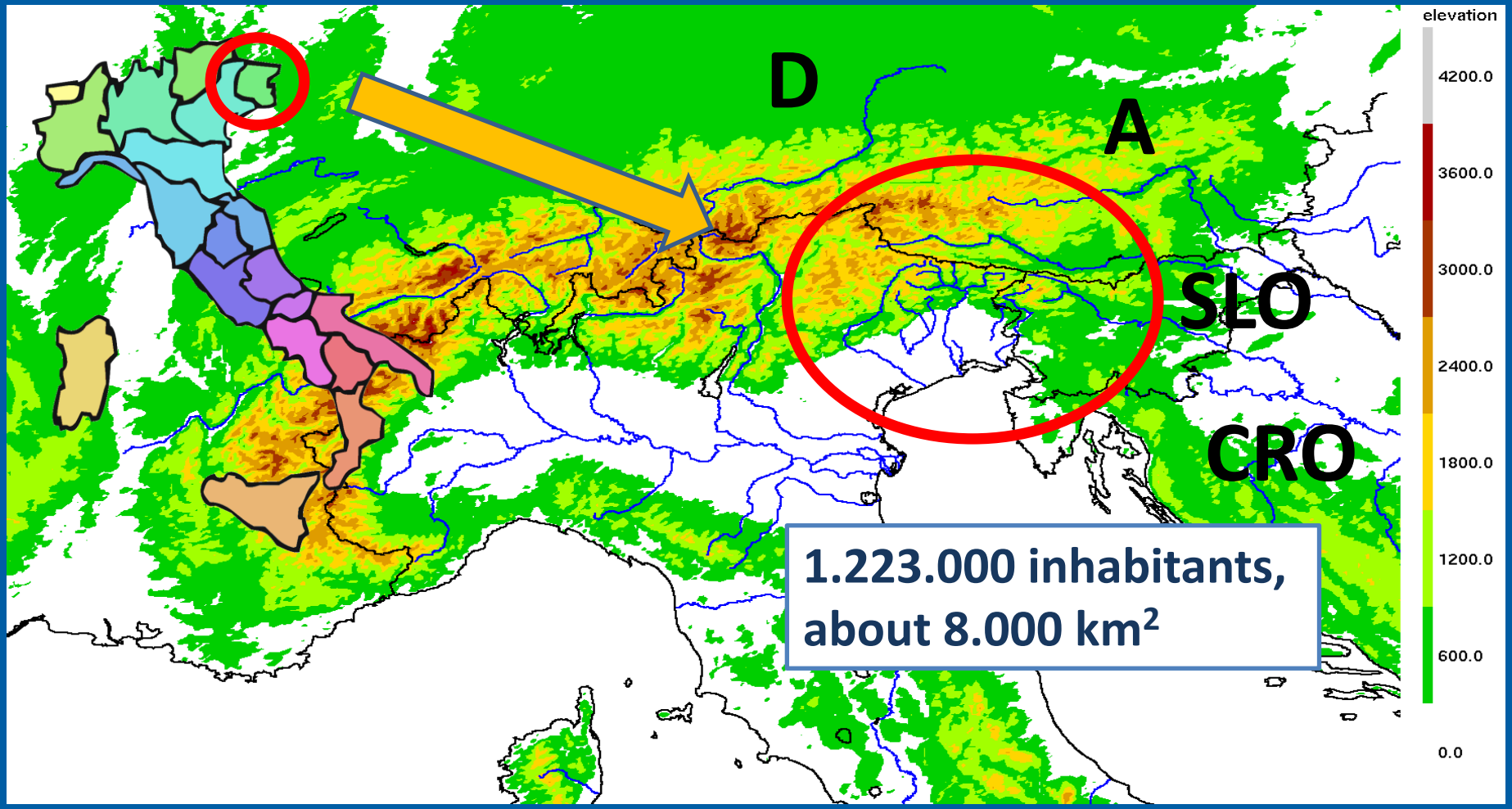
& S. Fumich + 27 students, Liceo S. G. Galilei (Trieste)

Italy

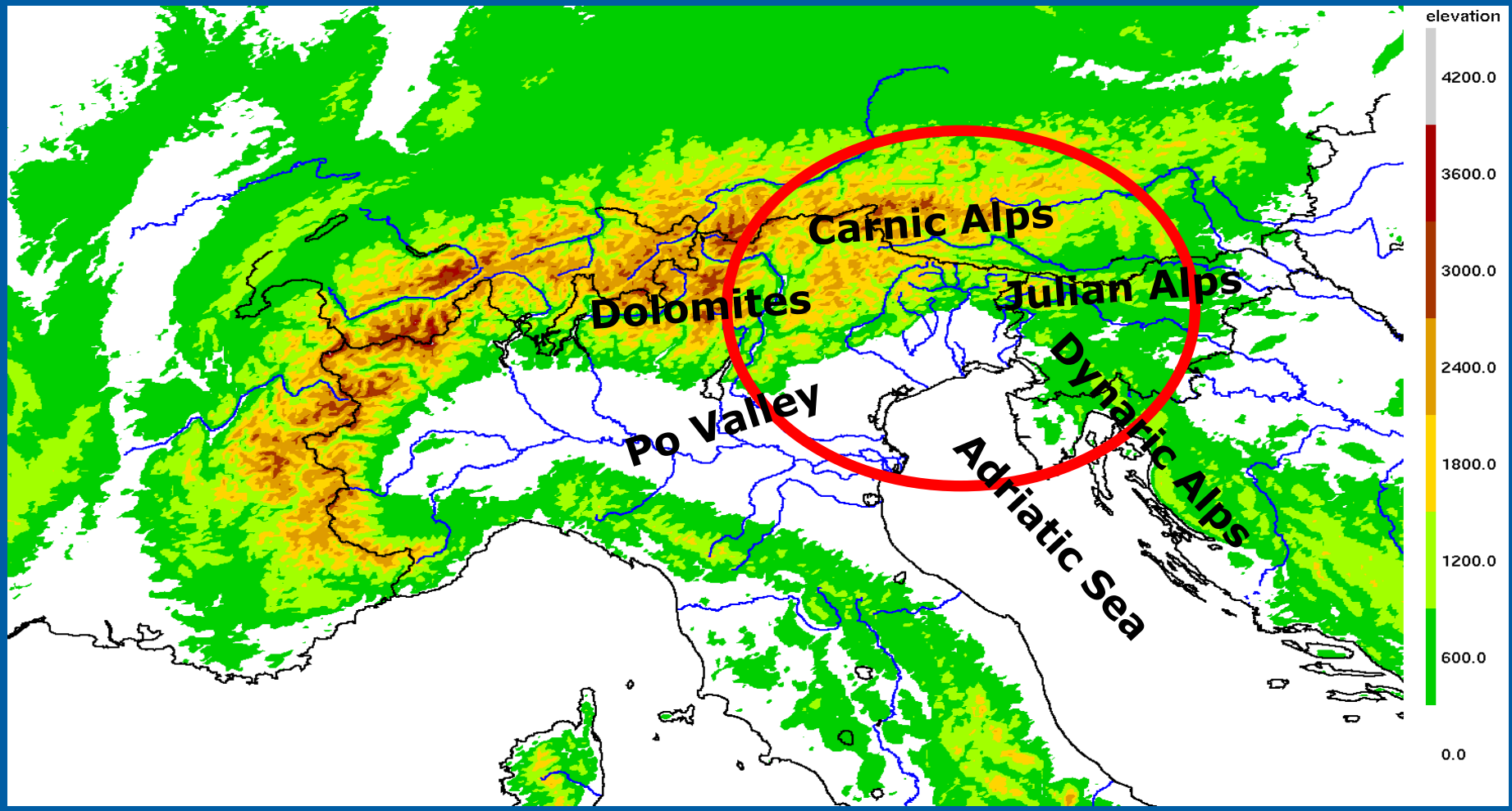
The context: Friuli Venezia Giulia - Italy

Friuli Venezia Giulia is a crossroads from several points of view:
Geographical - Climatological - Meteorological - Linguistic – Ethnical – Cultural



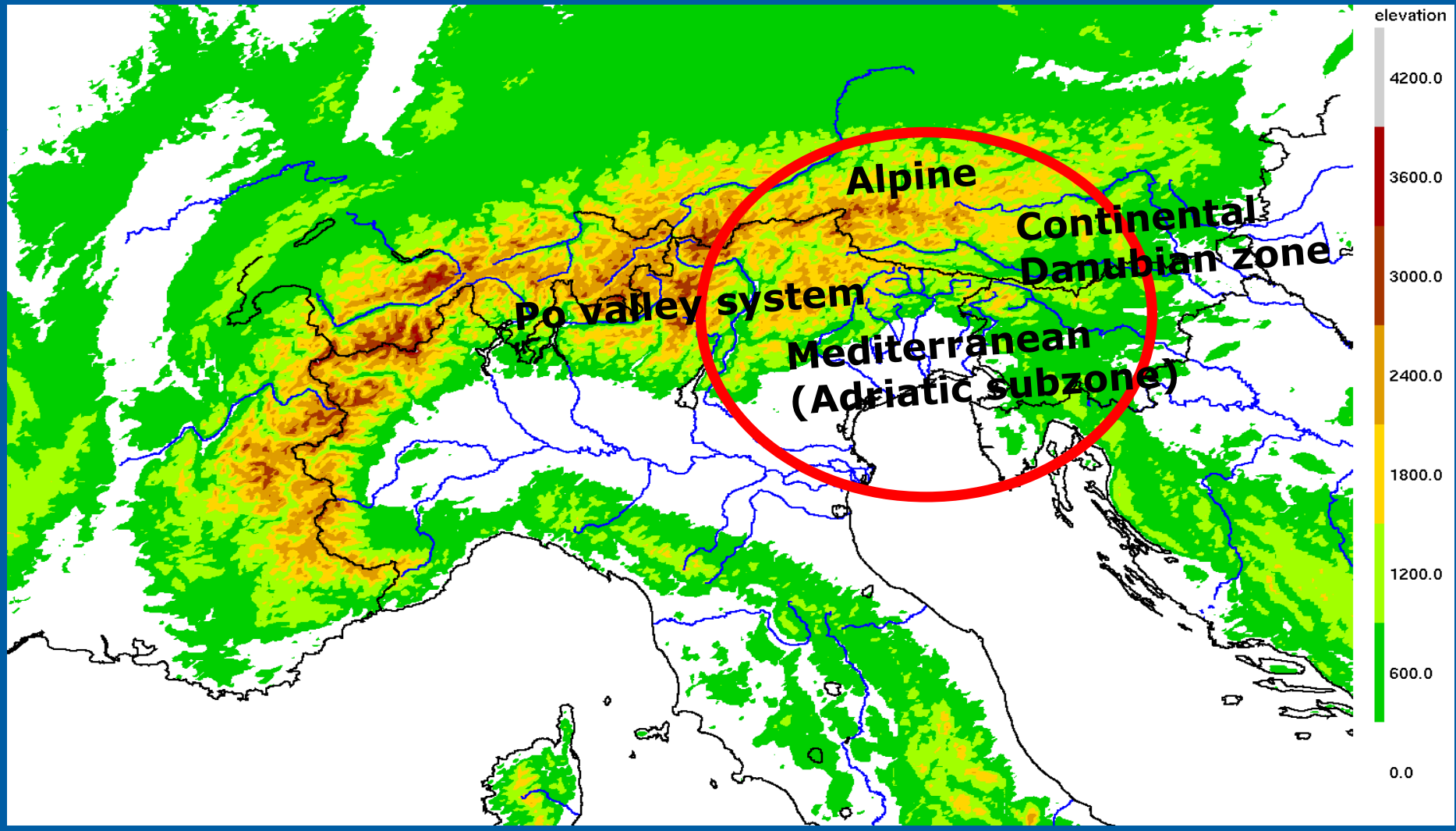
The context: Friuli Venezia Giulia region

Geographical crossroads

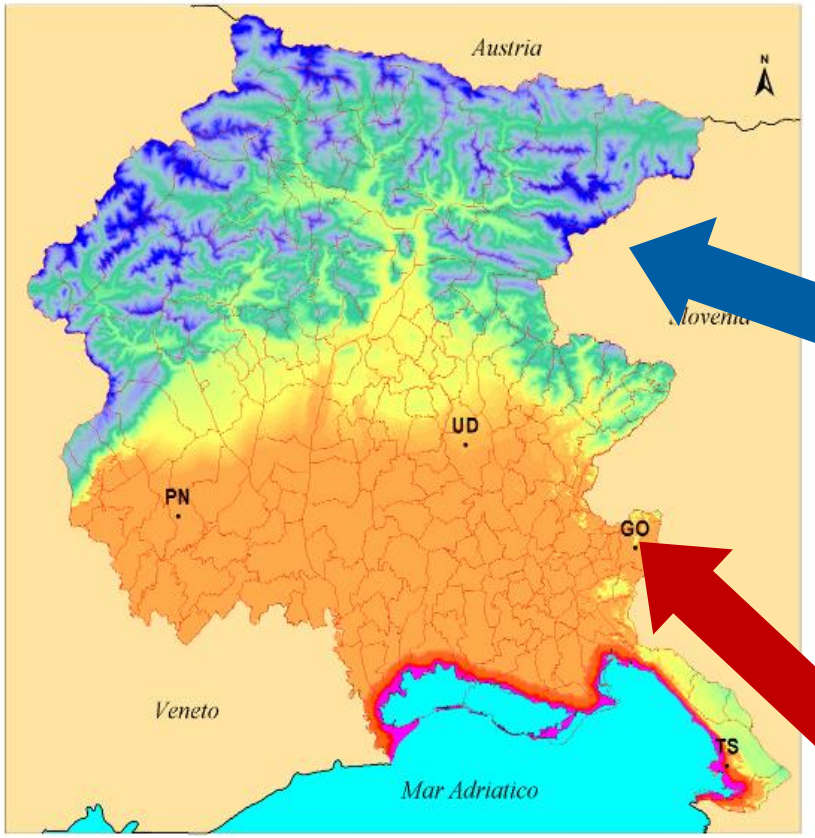


The context: Friuli Venezia Giulia region

Climatological crossroads



A wide range of climatic conditions



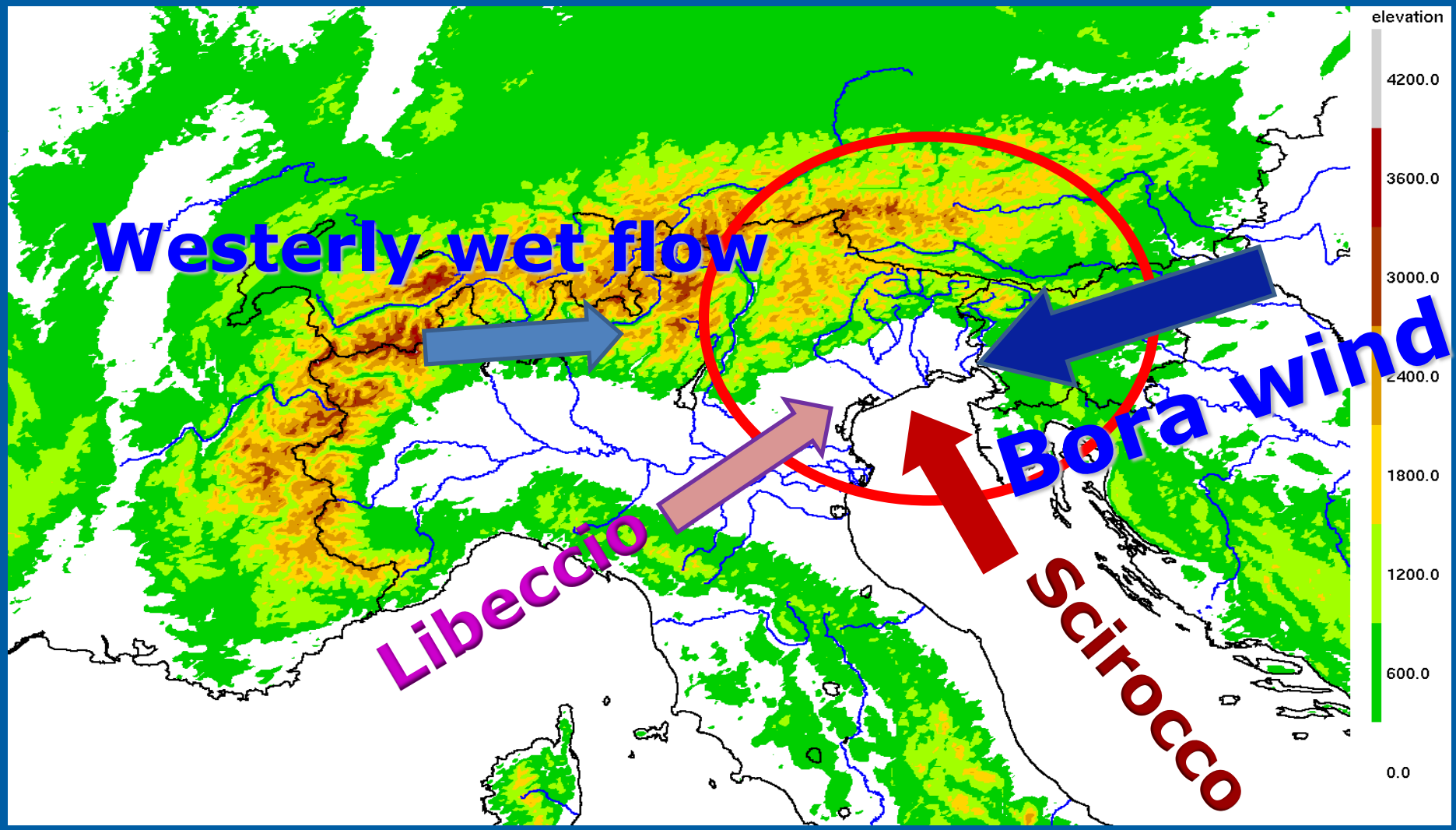
Yearly mean temperature

Winter record -49°C (Julian Alps Slovenija, close to the border)

Summer record + 40°C near Gorizia

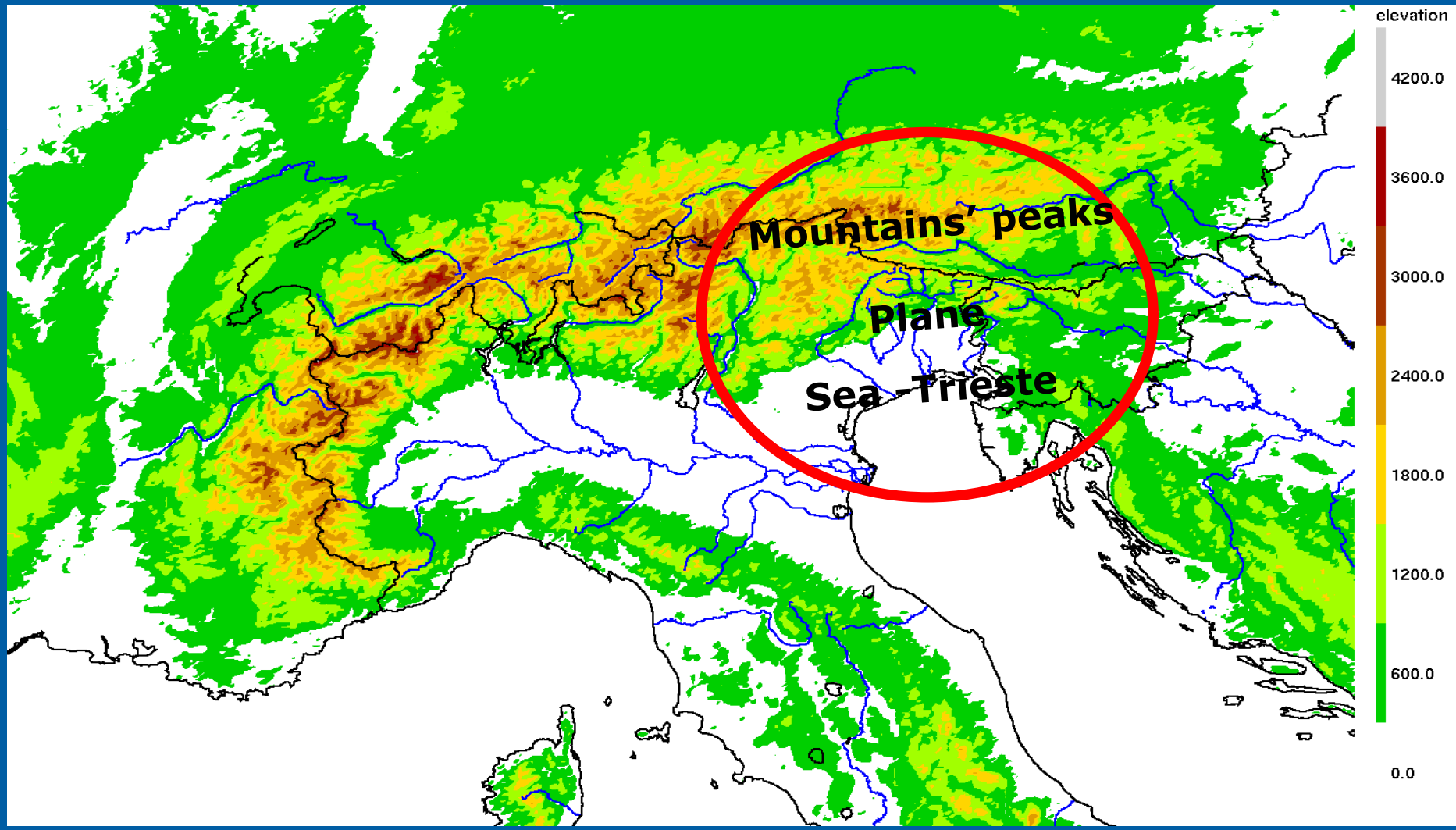
The context: Friuli Venezia Giulia region

Meteorological crossroads



The wind in Friuli Venezia Giulia region

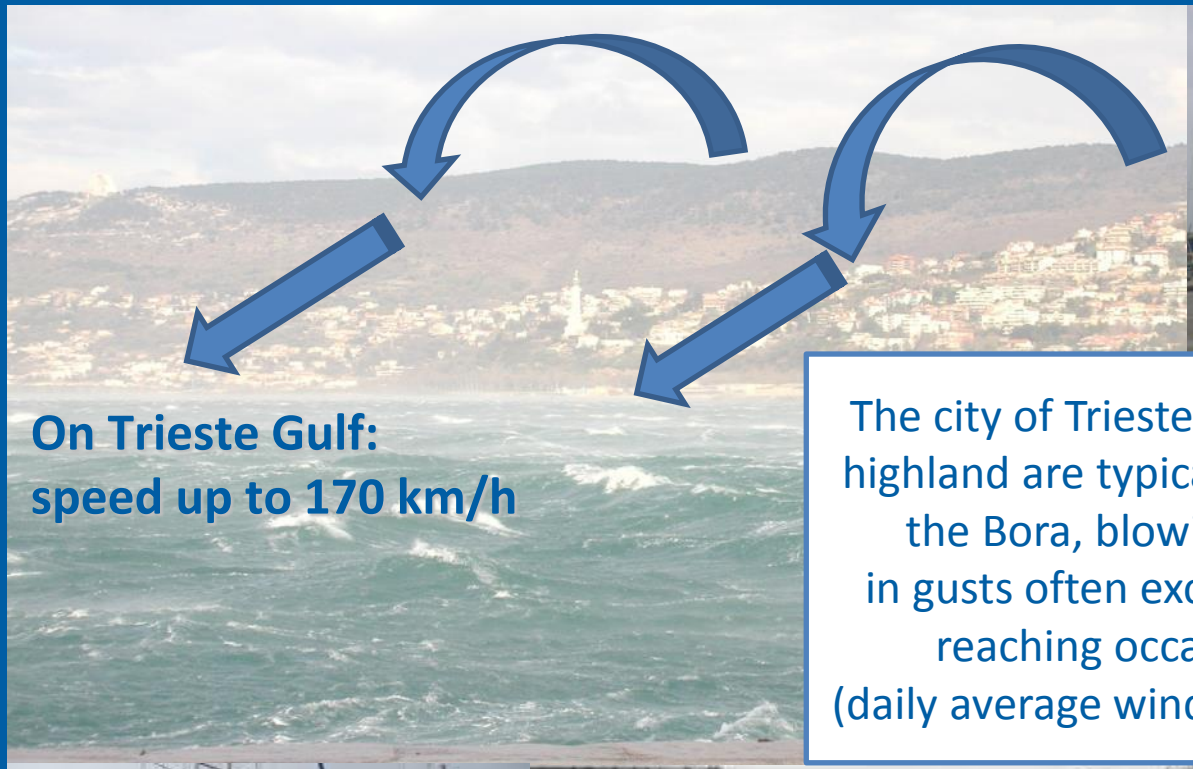
We'll see some climatological wind statistics, comparing winds at sea level (Trieste) and on mountains' peaks



wind expertise of Trieste

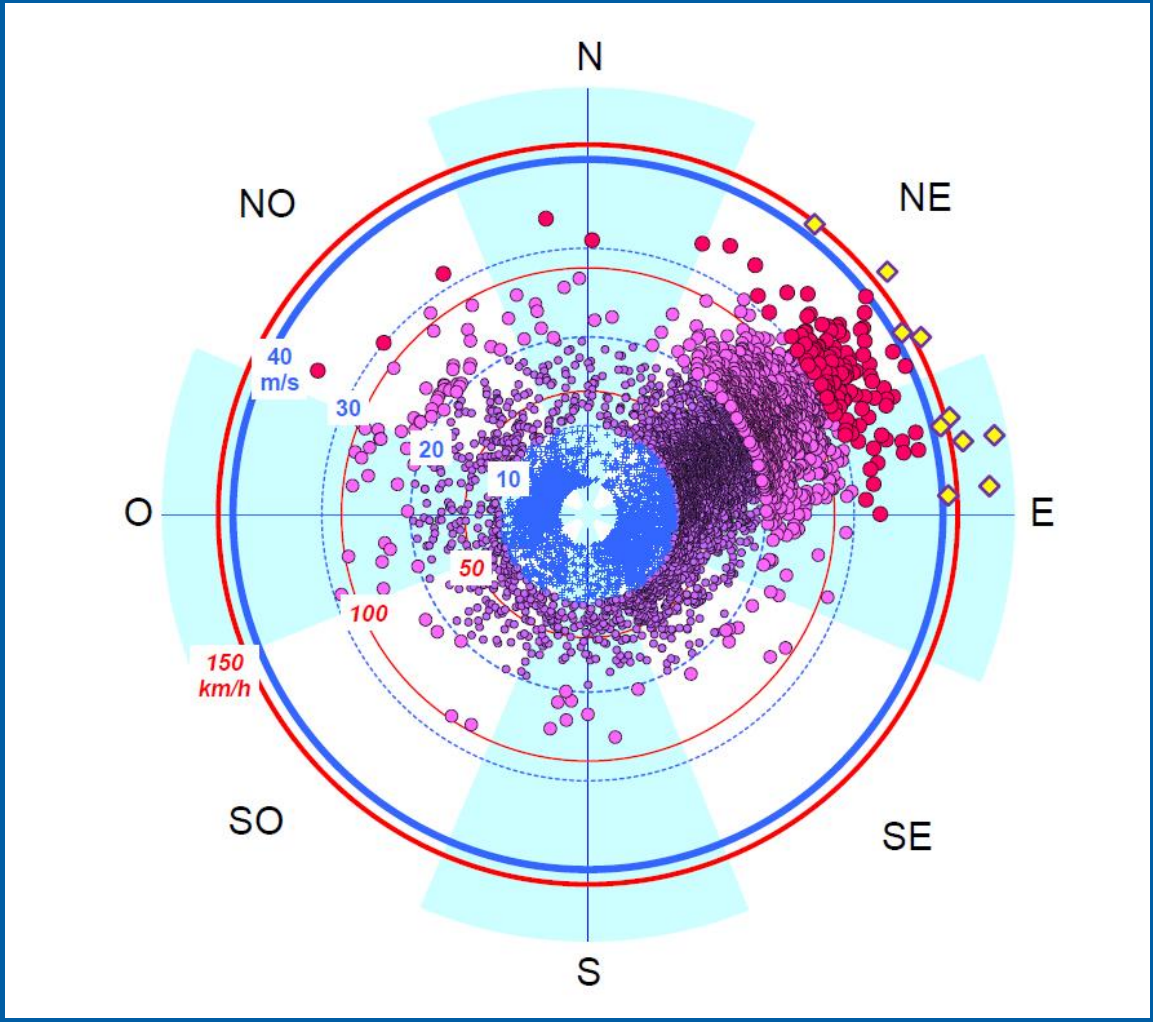
**(see youtube: maltempo in Italia la bora a Trieste
Istituto Luce Cinecittà)**

Bora wind in Trieste (winter)



The city of Trieste and the surrounding Carso highland are typically swept by a strong wind, the Bora, blowing from east-north-east in gusts often exceeding 110-120 km/h and reaching occasionally 160-170 km/h (daily average wind speed about 80-100 km/h)

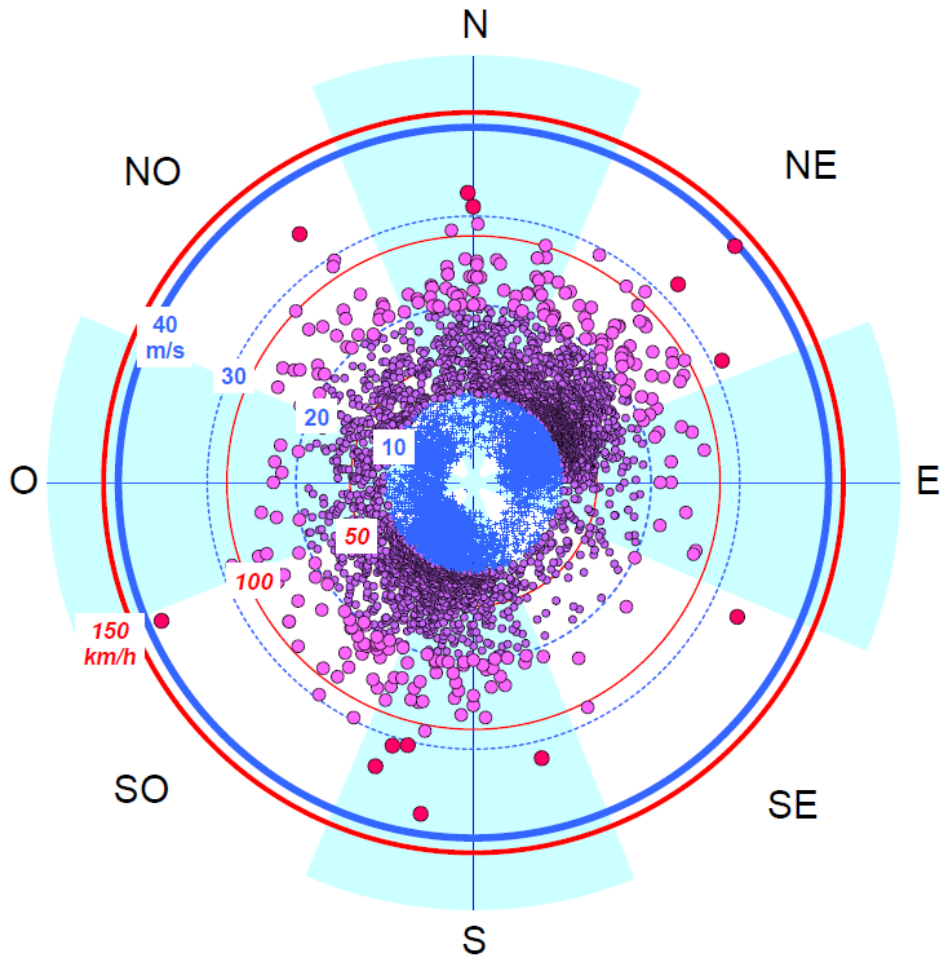
Wind gusts in Trieste: mostly Bora



Maximum speed wind gusts: distribution in the octants

- maximum daily gust 0.5-10 m/s
- maximum daily gust 10-20 m/s
- maximum daily gust 20-30 m/s
- maximum daily gust 30-40 m/s
- maximum daily gust over 40 m/s

Wind gusts at M. Zoncolan (1750 m msl)



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- maximum daily gust over 40 m/s

Is the wind changing?

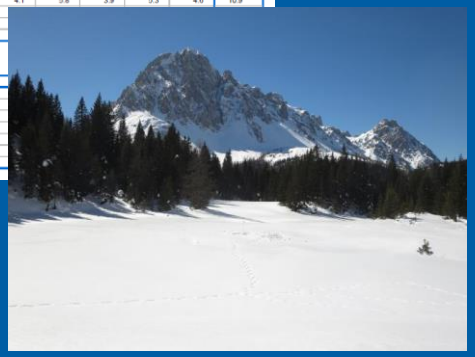
m/s	gen	feb	mar	apr	mag	giu	lug	ago	set	ott	nov	dic	anno
1994				12.2	9.0							19.7	
1995	16.8	9.1	15.7	9.0	9.2	17.4	11.2	11.4	7.9	9.5	7.6	23.2	23.2
1996	15.8	16.1	14.4	14.6	6.9	12.0	9.2	10.6	13.6	12.9	9.5	18.5	18.5
1997	15.3	7.0	10.0	18.3	10.5	7.2	4.4	8.1	16.0	18.5	14.0	11.9	18.5
1998	15.1	17.0	10.2	7.8	10.4	7.7	9.7	15.3	8.5	11.1	20.4	18.5	20.4
1999	7.8	15.3	10.2	14.1	11.5	10.1	10.8	12.7	7.1	14.4	17.5	16.2	17.5
2000	12.1	7.3	5.8	5.3	8.9	11.1	8.0	9.9	7.4	11.9	9.5	13.0	13.0
2001	19.0	13.7	15.2	11.9	8.2	9.5	8.6	14.4	8.8	5.3	17.3	19.6	19.6
2002	9.7	17.2	9.2	14.5	8.5	11.6	9.6	6.0	14.5	8.5	9.3	18.3	18.3
2003	19.3	18.8	9.1	15.6	11.8	4.7	9.4	9.0	11.7	12.0	12.0	12.7	19.3
2004	15.3	16.1	14.9	16.2	8.4	14.3	10.0	8.0	14.2	14.6	11.8	9.8	16.2
2005	16.2	10.9	11.7	21.0	9.7	8.3	7.3	10.3	19.5	14.8	14.3	16.4	21.0
2006	16.4	11.4	11.0									12.9	16.4
2007	10.9	7.8	12.7									7.3	17.3
2008	8.3	8.6	19.8									16.1	19.8
2009	15.6	8.1	11.9									18.6	18.6
2010	13.0	13.7	21.0									15.7	21.0
2011	16.7	12.5	21.0									8.5	21.0
2012	15.5	22.3	11.3									12.0	22.3
2013	14.0	14.8	18.8									18.8	18.8
2014	12.8	11.2	13.3									13.9	13.9
2015	10.2	21.5	13.0									19.8	21.5
2016		17.4	17.3									19.3	17.4
2017	23.8	14.7	6.7									16.8	23.8
2018		19.8	14.5									15.2	19.8
2019	15.2	12.1											

Statistiche

m/s	gen	feb	mar	apr	mag	giu	lug	ago	set	ott	nov	dic	anno
Media 1994-2019	9.5	9.1	9.5	8.6	7.1	6.9	6.2	6.4	7.7	8.0	9.1	9.3	13.1
Min	5.1	5.4	6.3	6.6	4.7	3.8	4.4	4.1	5.8	3.9	5.3	4.6	10.9
Max	16.7	17.4	14.9	12.0	9.8	10.8	9.7						
Dev.st	2.5	2.6	2.4	1.4	1.2	1.7	1.2						
Numero	24	24	23	23	23	22	24						

Percentili

m/s	gen	feb	mar	apr	mag	giu	lug
5 %	5.8	5.8	7.1	6.9	5.5	4.2	4.5
10 %	6.8	6.2	7.2	7.0	5.7	5.2	4.9
25 %	8.0	7.2	7.7	7.6	6.2	5.8	5.6
50 %	9.3	8.7	8.8	8.4	7.3	6.6	6.2
75 %	11.0	9.9	11.2	9.5	8.0	8.2	6.4
90 %	12.3	13.2	12.7	10.1	9.1	8.9	7.7
95 %	12.9	14.4	14.3	11.6	9.8	9.3	8.2



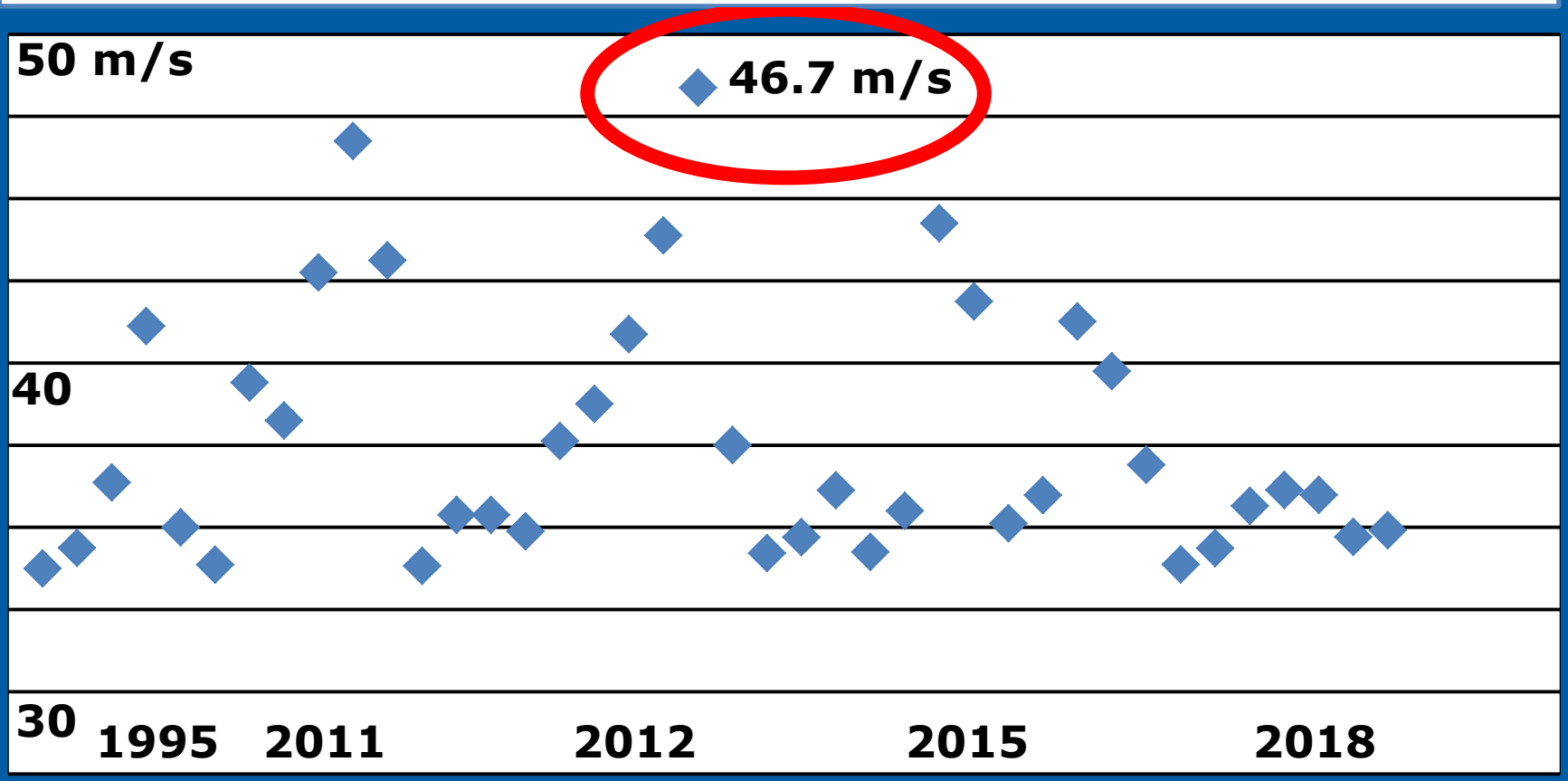
Considering 1994-2018 statistics, there are some signs of change, both in Trieste and on mountains' peaks.

Daily mean wind speed: most of the highest values were recorded after 2010.

Daily maximum wind speed: return periods of very strong wind gusts events are getting shorter (in the last ten years about 3 events were recorded, which were previously expected to occur every 30-50 years)

Variable intensity and increasing frequency of strong wind gusts in Trieste

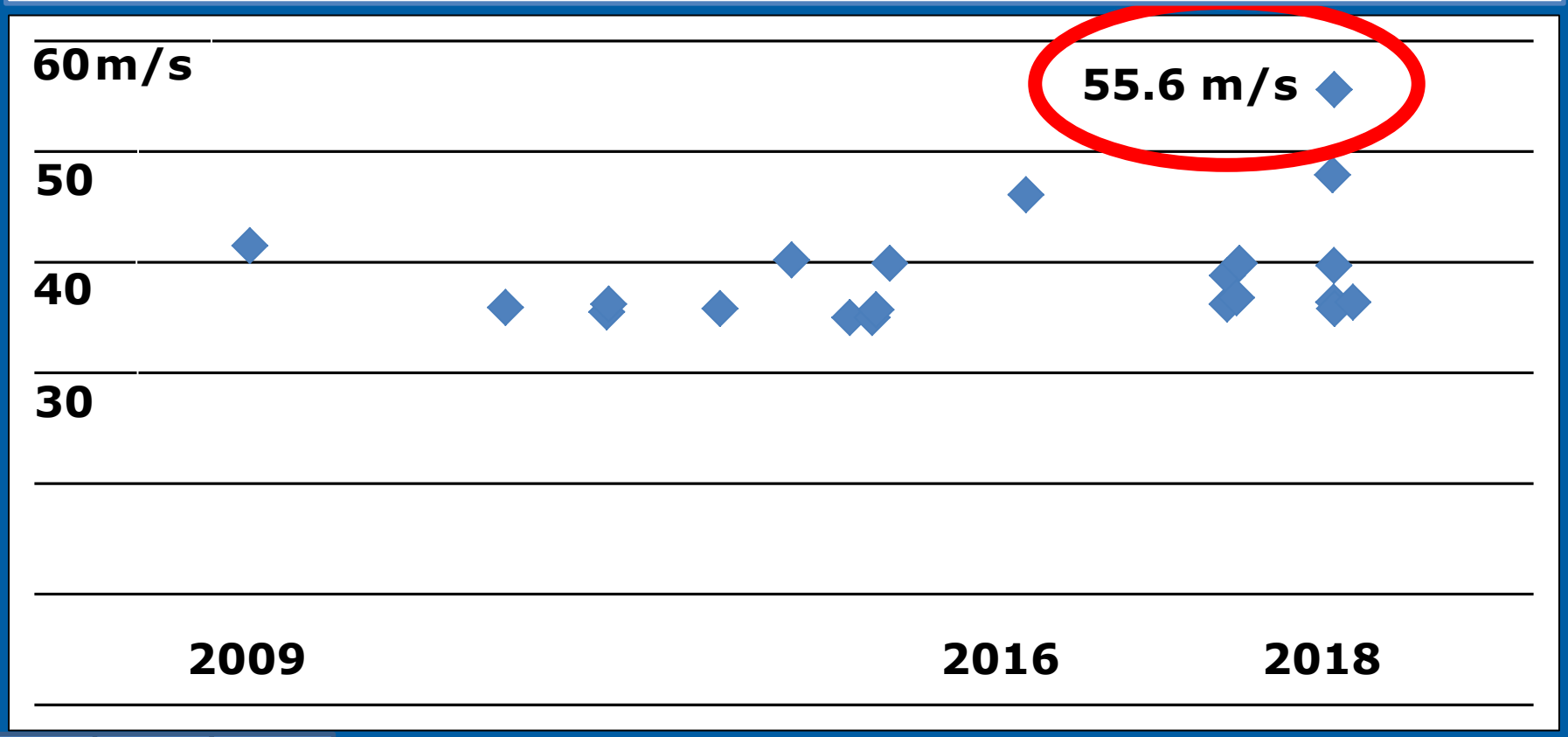
wind gusts over 35 m/s (24 years data)
at Trieste measuring station, sea level



40 events (mostly Bora wind), no significative trend for increasing values, but increasing number of events: 13 from 1995 to 2011, 27 from 2012 to 2018)

Increasing frequency and intensity of strong wind gusts on mountain peaks

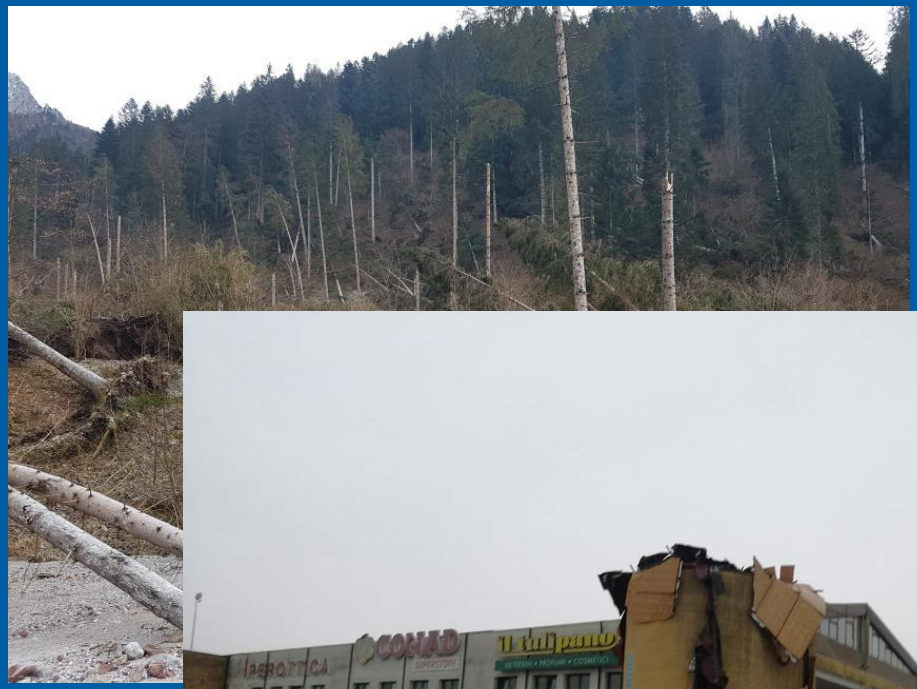
wind gusts over 35 m/s (10 years data)
at the top of Monte Rest, 1781 m msl

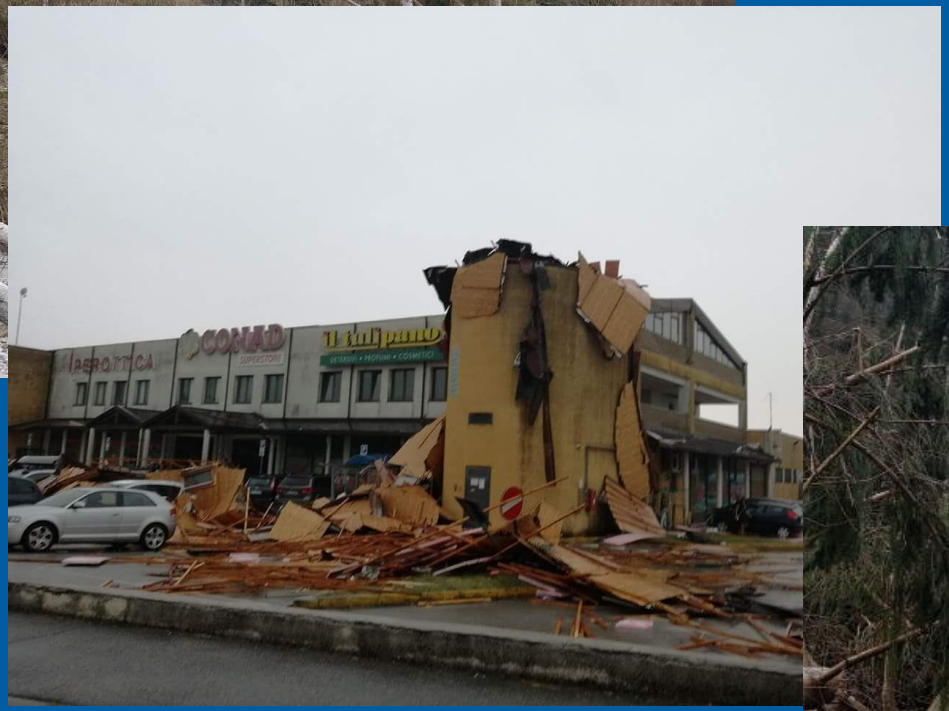


21 events (3 in 2015 1 in 2016, 2 in 2017, 8 in 2018)
Increasing events' number and increasing wind speed

..but near strong wind causes damages

Strong wind damages in Friuli Venezia Giulia





In recent years there have been particularly serious and extended wind damages

Educating to climate change in a local changing climate

Communication and education are a key factor in climate change mitigation and adaptation policies, both on global and on a local scale

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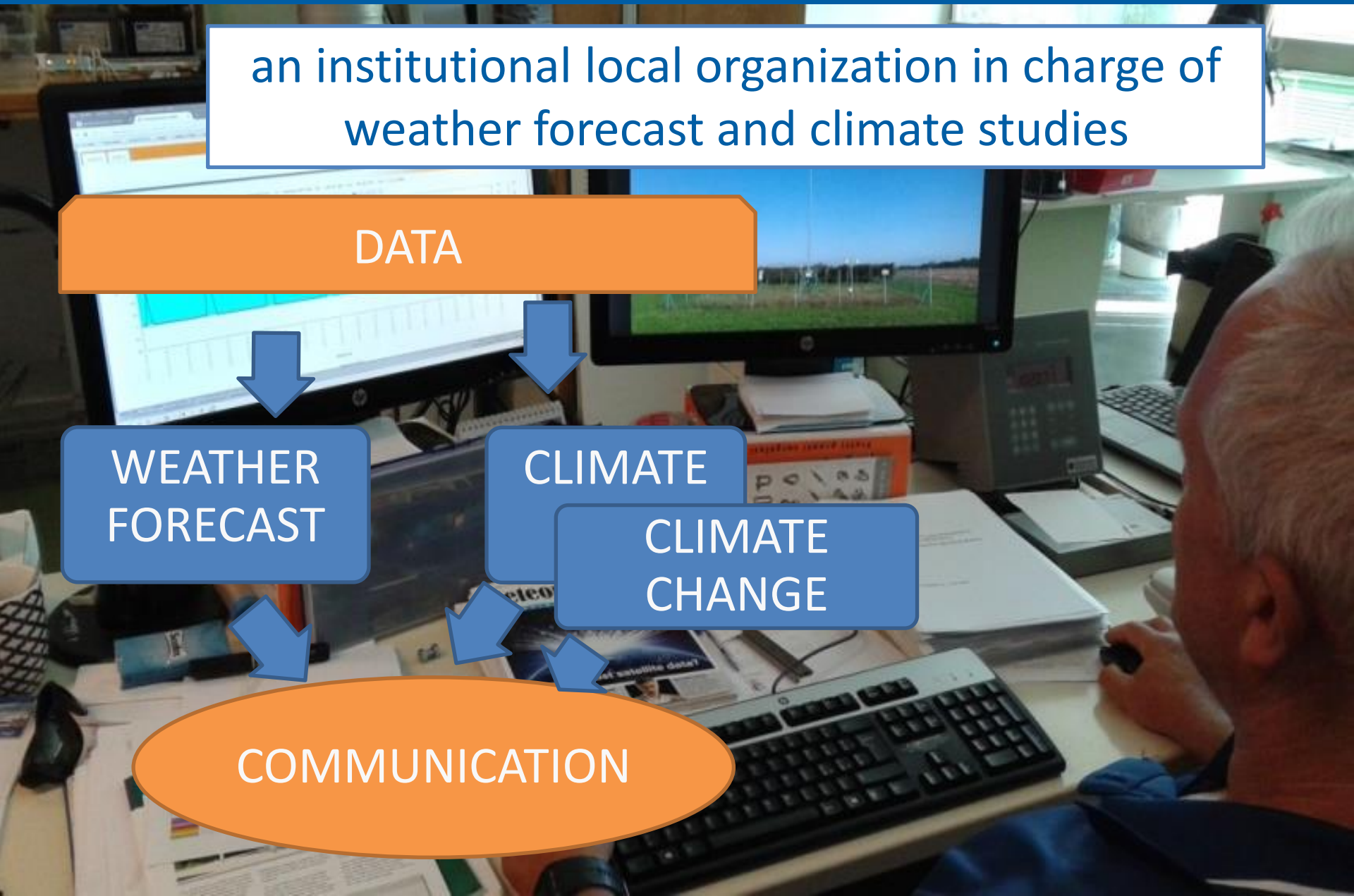
Regional Meteorological Observatory



25 years of weather and climate communication and education in Friuli Venezia Giulia

In Friuli Venezia Giulia
ARPA - OSMER
has been carrying out communication and educational activities regarding weather science and climate since the early nineties.

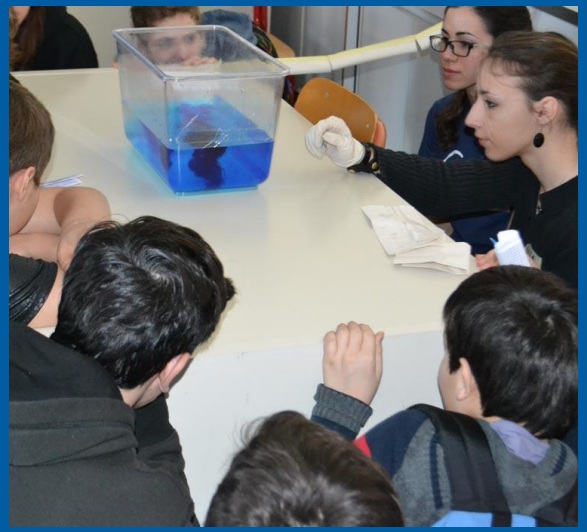
These involve both formal education and informal education contexts

weather and climate education in schools

Besides usual “lessons”,
interactive educational experiences
(often involving peer-tutoring)
have been developed through
collaborations with local schools

Peer-tutoring experiences

Each year: WMO *World Meteorological Day* at Liceo «Galilei» in Trieste



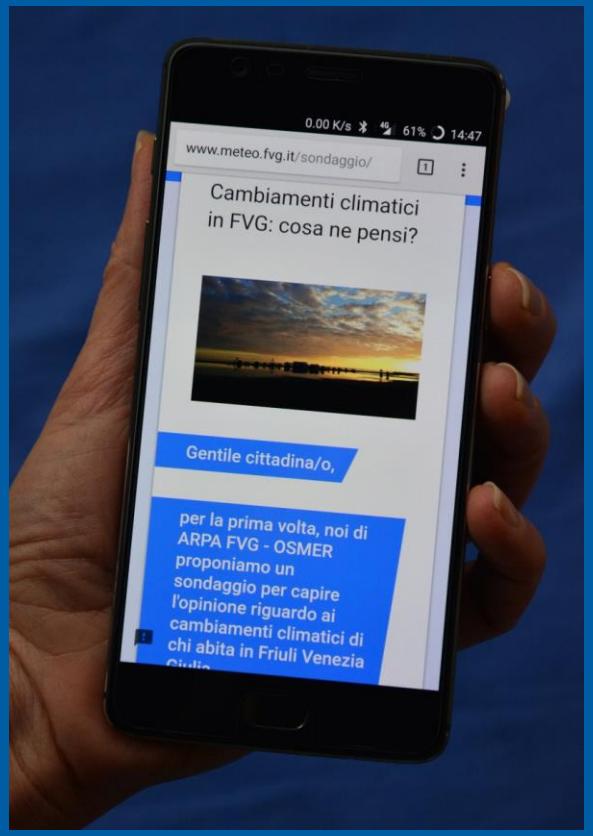
A group of volunteers ("older" students, 17-19 years old) act as tutors:

after being trained
in meteorology and climatology,
they carry out hands-on exhibits about meteorological instruments (thermometer, hygrometer, barometer, anemometer, rain gages, etc.) and specific games, to better understand some concepts, like density of fluids and the greenhouse effect.

Investigating knowledge, perception and attitudes towards climate change among high school students

In 2018 a new educational experience was carried out .

High school students of Liceo Galilei (Trieste) were involved in promoting an on-line survey about climate change among their peers.



The on-line survey among Liceo Galilei students: highlights

High school students (trained as "tutors") were involved:

- in adapting a questionnaire that had previously been delivered to the general population;
- in promoting the survey among their peers.

"Operation survey" was supported by the school:

all teachers were informed and pupils were allowed to fill in the questionnaire during school hours

620 **respondents** answered the on-line questionnaire, which was kept as short and "attractive" as possible.

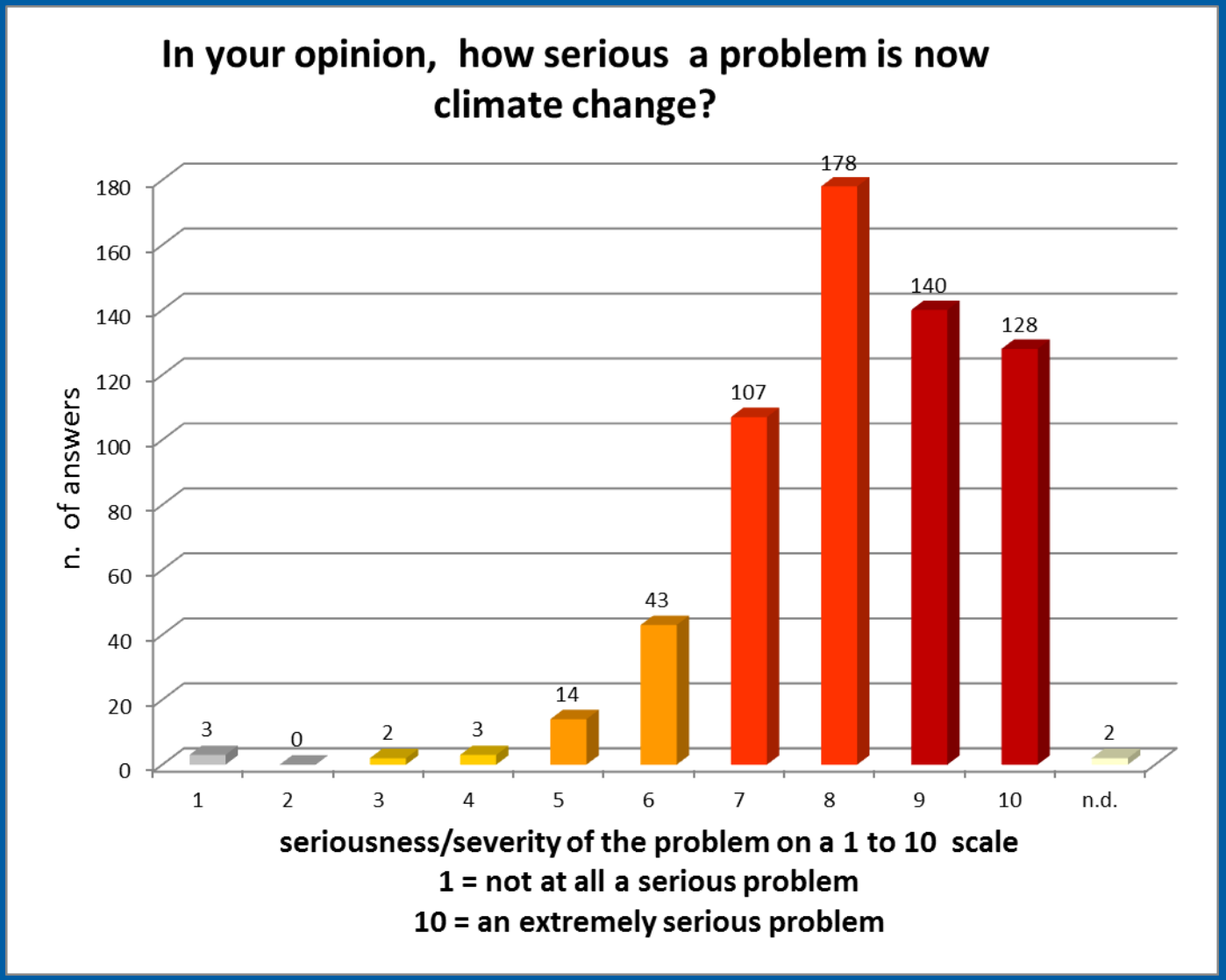
The **results:** interesting, presented at school during the 2019 WMO Day

Some results:
SERIOUSNESS OF THE PROBLEM

seriousness/severity of the problem on a 1 to 10 scale

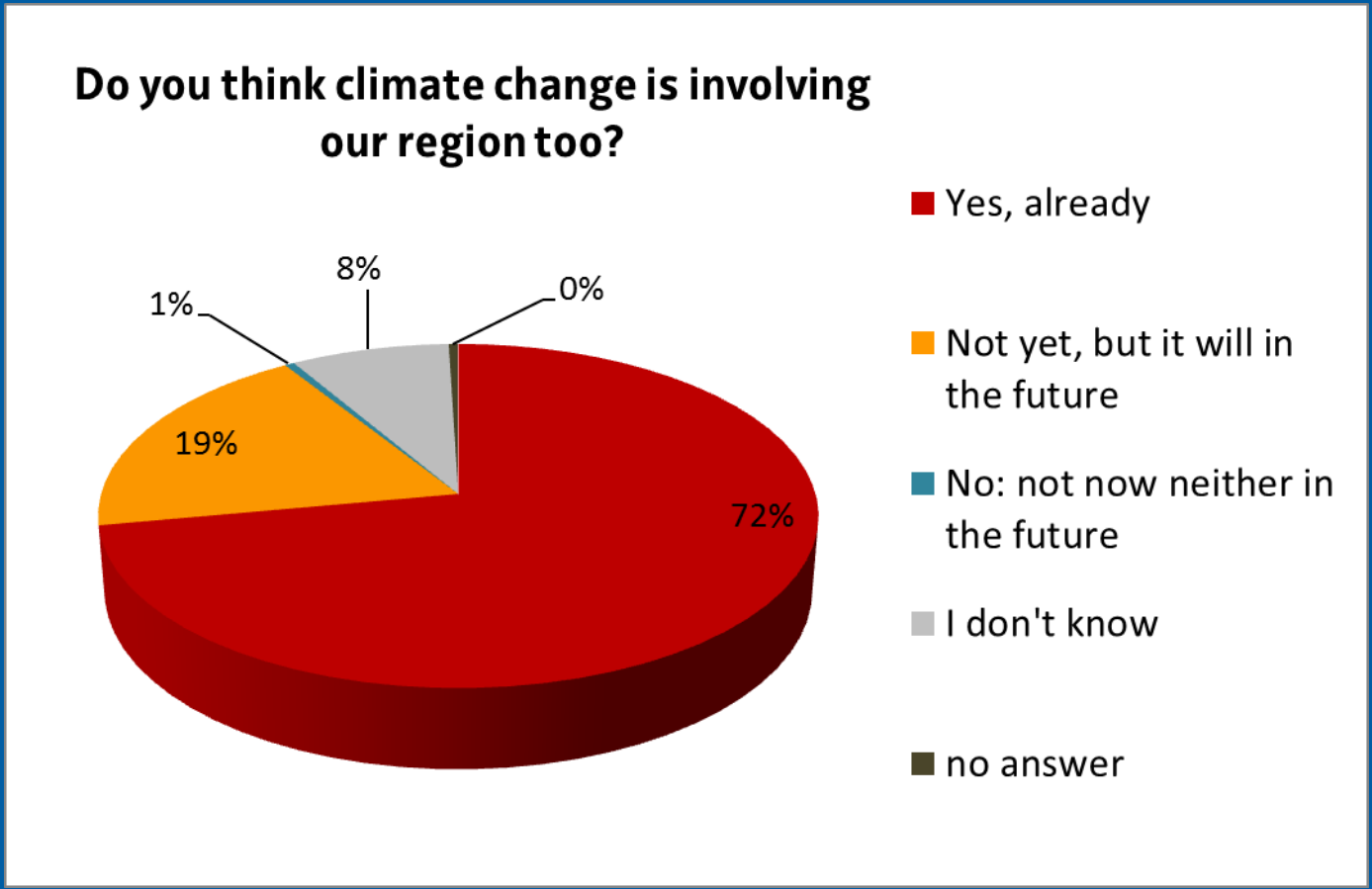
1 = not at all a serious problem

10 = an extremely serious problem



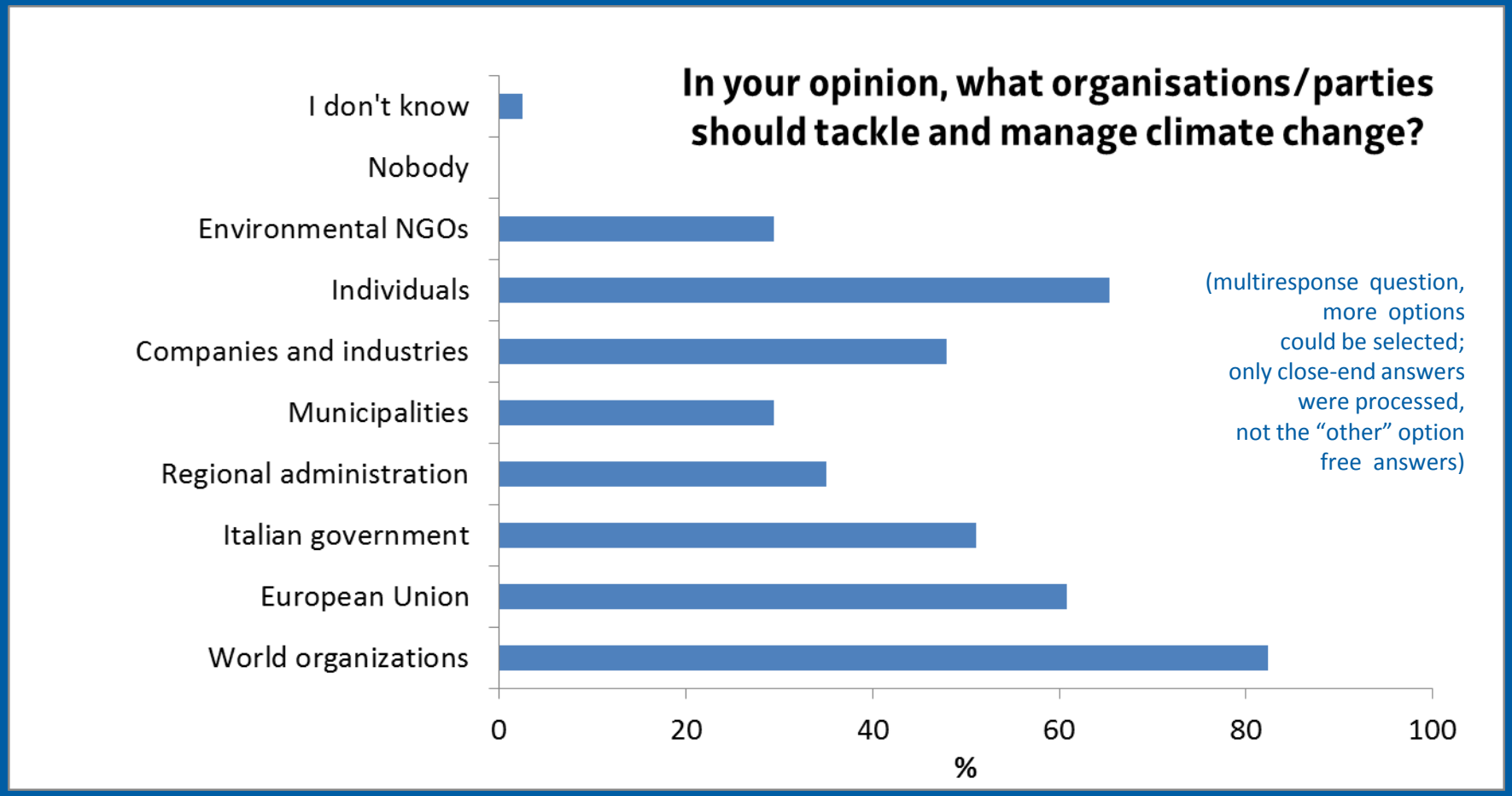
620 respondents

Some results:
CLOSENESS OF THE ISSUE



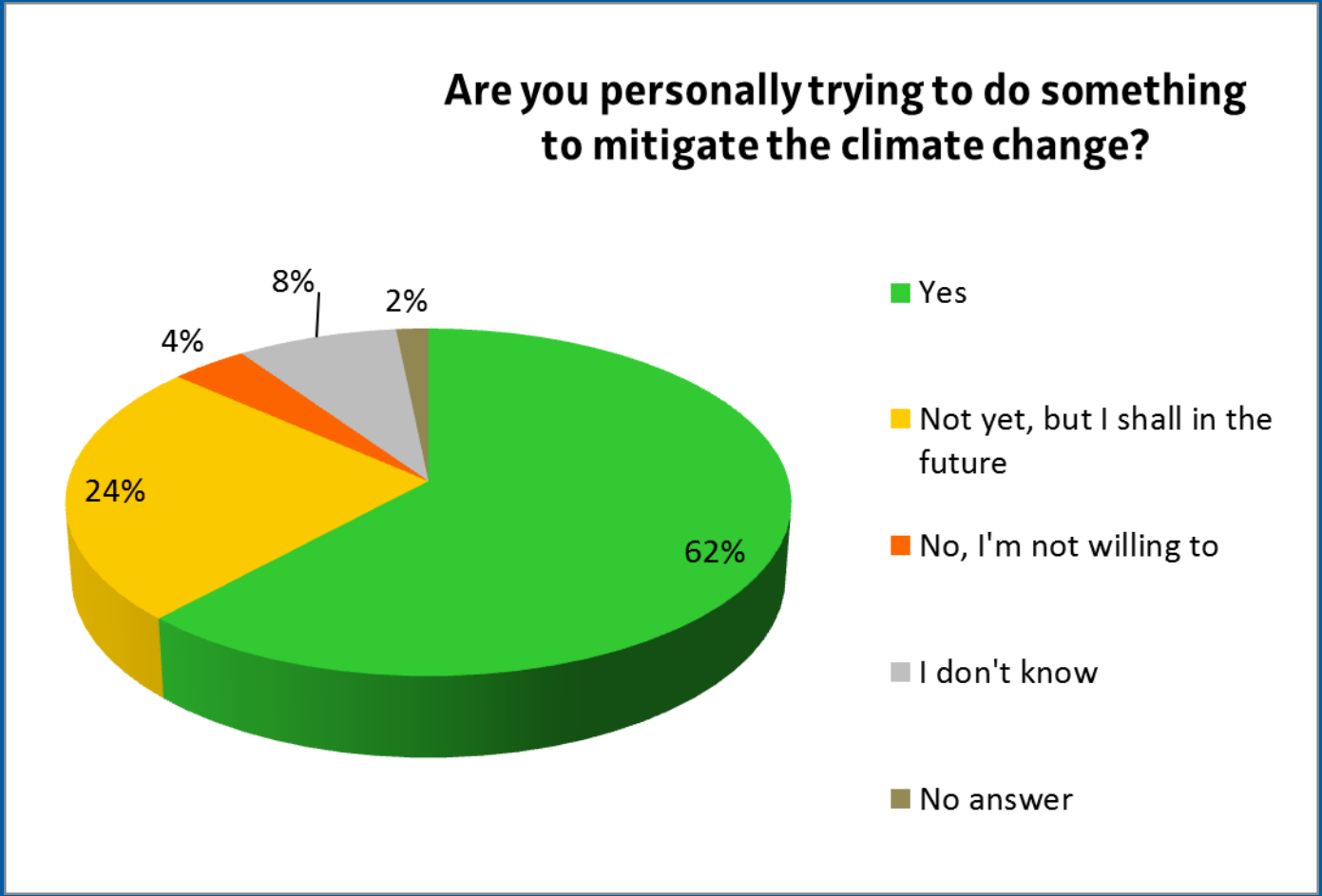
620 respondents

Some results:
WHO SHOULD TACKLE THE ISSUE?



620 respondents

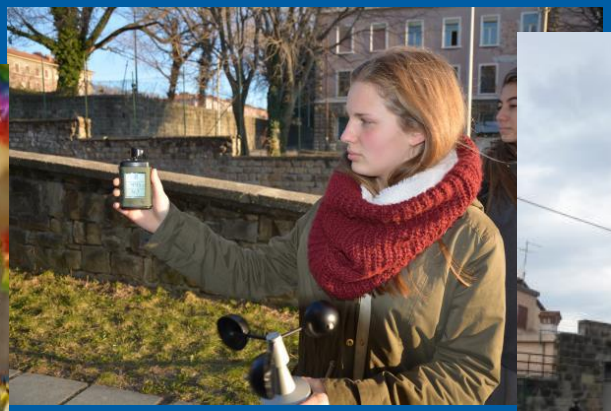
Some results:
TAKING ACTION PERSONALLY



620 respondents

A new educational experience in 2019: «Learning from the past, adapting to the future»

Liceo Galilei's students were involved
in educational activities about the wind and
in investigating traditional solutions to resist strong wind events



Bora Museum experience in Trieste

Adapting to strong winds: lessons from the past in Trieste area

Over the centuries, people living in the area developed spontaneous architectures and building techniques in order to resist strong winds (mostly the Bora)

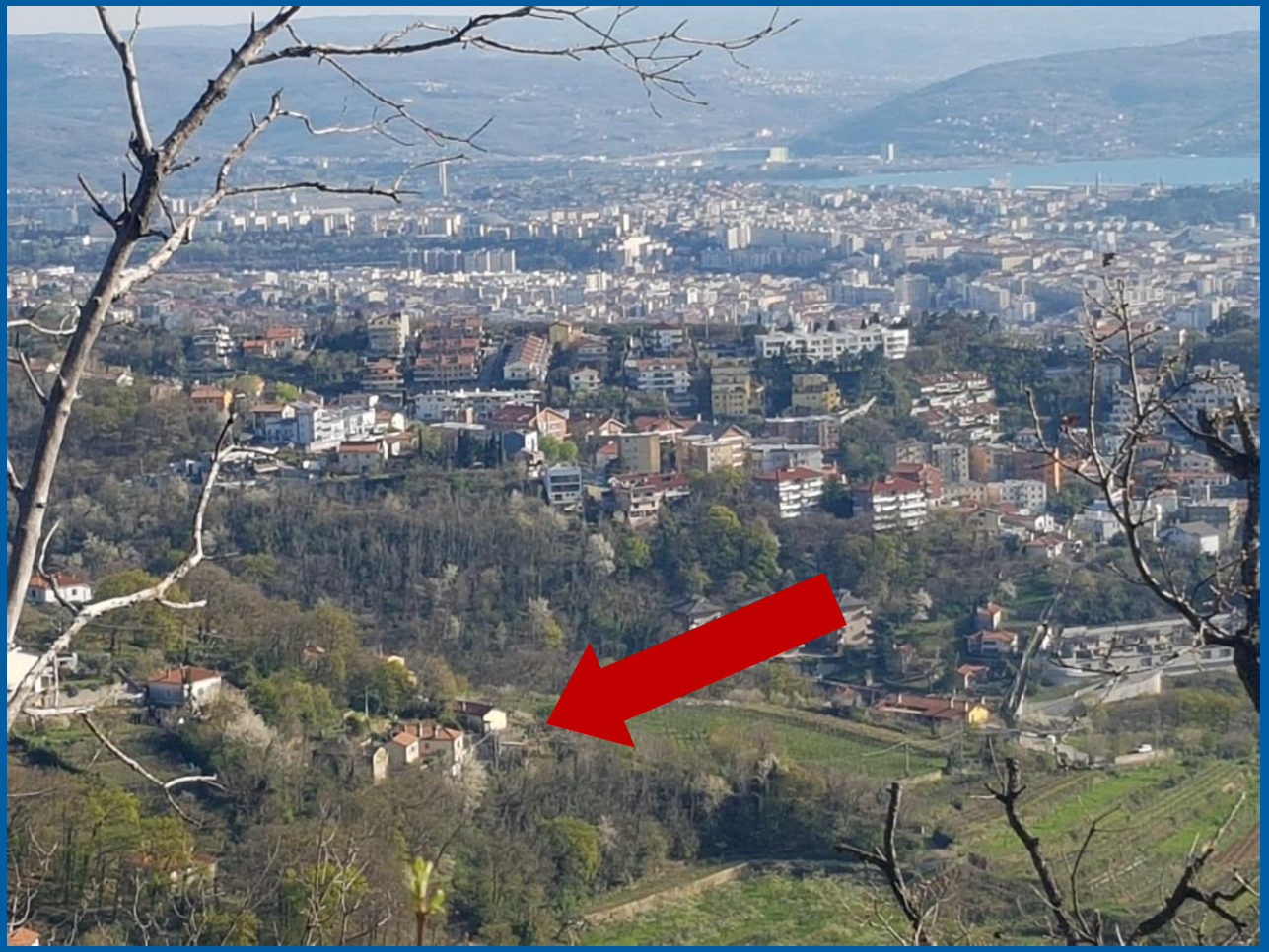



Harbour & buildings, technical solutions from the past:
roof protection, chimneypots, rain gutter, windows, handrails, road signs…

The Bora «door»

Bora wind comes from east-northeast through the lowest valico in the Alps

Adaptation examples: old buildings and building sites

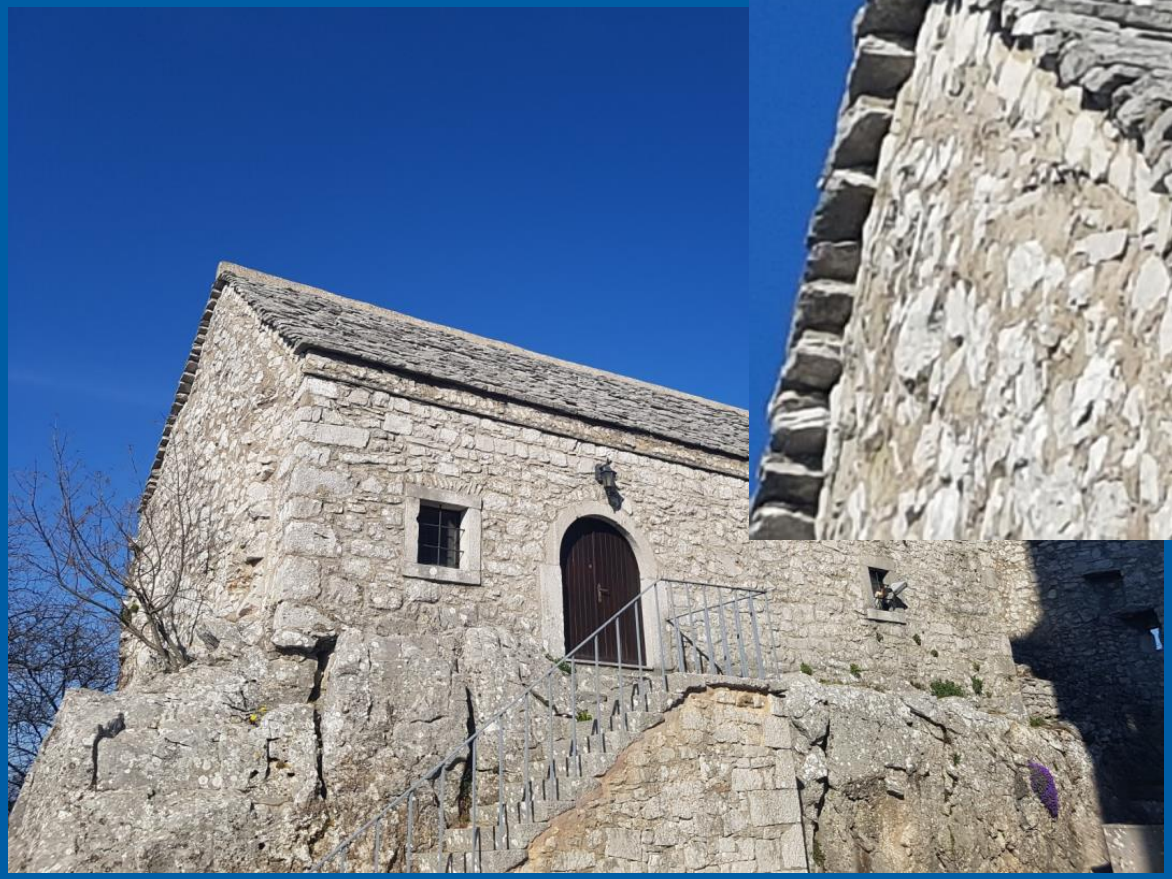


Old buildings were small and
building sites were sheltered from the strongest wind (Bora)

Adaptation examples: the harbour

The harbour's site is naturally sheltered from the Bora.
Long sea walls protect it from sea winds and storm tides

Adaptation examples: old buildings



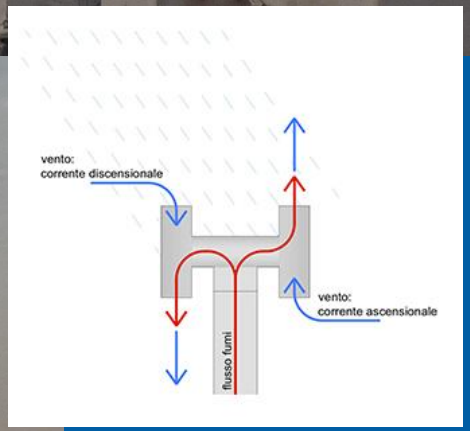
Stone roofs
and
stone gutters

Adaptation examples: roofs protection

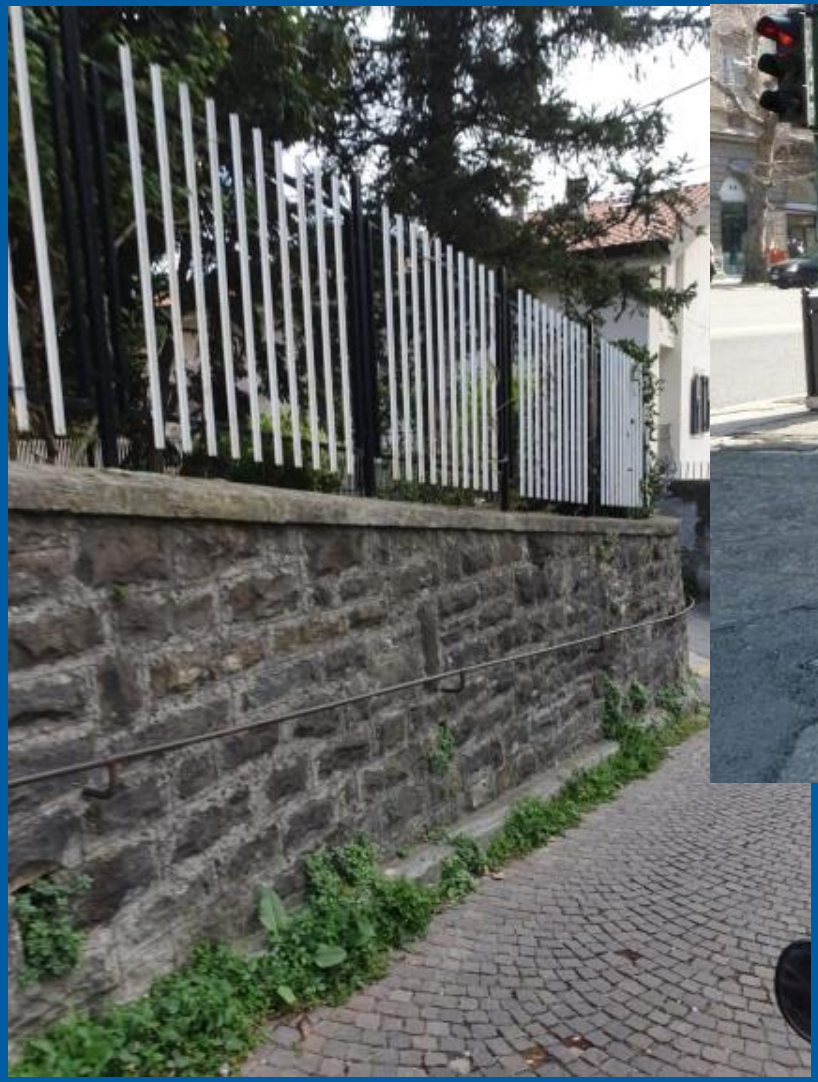
Stones on the tiles to prevent them from being ripped off by the wind

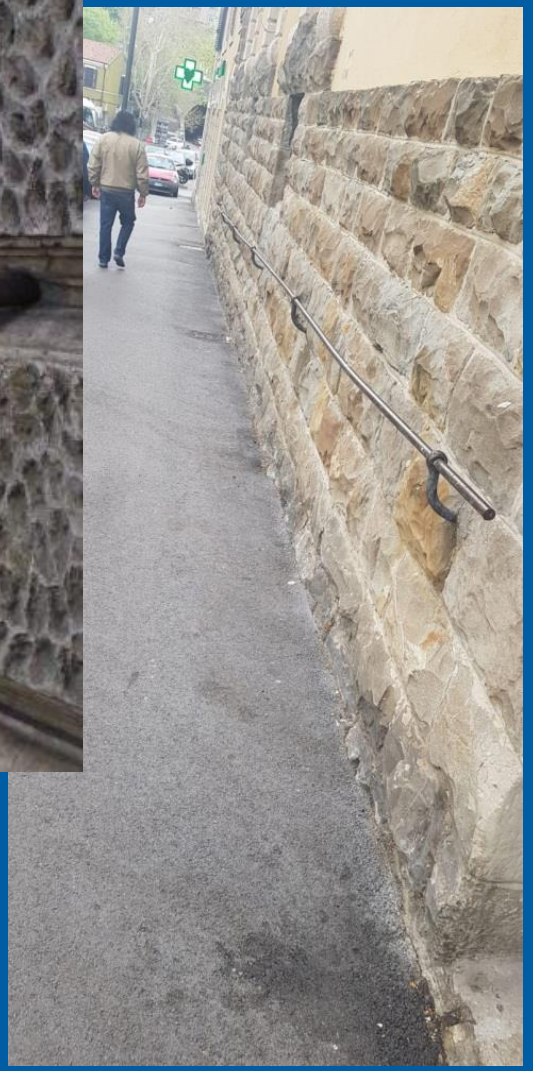
Adaptation examples: chimneypots

"Trieste" chimneypots are designed to be efficient in strong wind conditions



Adaptation examples: street handrails help people during strong wind days





Adaptation examples: traffic lights and road signs

Road signs' supports are reinforced and traffic lights are lower than usual to resist strong wind gusts

Adaptation examples: reinforced road signs

Some remarks, so far

This experience is still in progress:

it is helping students to become aware of the importance of adapting to the local climate and, increasingly, to a changing climate.

Identifying adaptive solutions to resist strong wind events may provide cues for discussing possible adaptation measures that might be taken also in other areas, which in the past were not familiar with strong wind events

"All that is not given or donated to young generation, is lost… Give always; give a smile, an understanding, a pardon, listening; our intelligence, our will, our availability; our experiences, capabilities. Give: this is the word that can't give us respite"

Chiara Lubich

ARPA FVG - struttura OSMER e GRN

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