OUR FIFTEEN YEARS
IN THE GLOBE AT NIGHT PROGRAM

NAŠIH PETNAEST GODINA
U GLOBE AT NIGHT PROGRAMU

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Mentor: Olivera Tadić, globe teacher
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CROATIA
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Abstract:

Globe at Night is an international campaign to raise public awareness of the impact of light pollution.

We will process our data for the constellation Orion (15. years), in order to get an answer to the research question: **Is light pollution in the Labin region decreasing?**
The results show that the Labin region is moderately polluted with. In the last five years, there has been an increase in light pollution and a possible reason for this is the "explosion" of construction of tourist facilities especially in rural areas, and thus increasing the number of illuminated access roads.
Comparing our results with the available maps, we are happy that the sky over the Labin region is mostly **"good sky",** although there are "black spots" that need to be thought about and do everything to improve.
By regularly reporting to the local authorities, we believe that we are also a small "wheel" in the changes, so we will continue to work actively in this program.

Finally, Croatia, as a popular European tourist destination, apart from the sea and the sun, could offer visitors a unique starry night sky and preserve it as a natural heritage.

Sažetak

Globe at Night međunarodna je kampanja za podizanje svijesti javnosti o utjecaju svjetlosnog zagađenja.

Obradit ćemo naše podatke za zviježđe Orion prikupljenih u proteklih 15. godina, kako bismo dobili odgovor na istraživačko pitanje: **Smanjuje li se svjetlosno zagađenje na Labinštini?**
Rezultati pokazuju da je područje Labina umjereno zagađeno. U posljednjih pet godina zabilježen je porast svjetlosnog zagađenja, a mogući razlog tome je "eksplozija" izgradnje turističkih objekata, posebno u ruralnim područjima, a time i povećanje broja osvijetljenih pristupnih cesta.
Uspoređujući naše rezultate s dostupnim kartama, sretni smo što je nebo nad Labinom uglavnom **"dobro nebo",** iako postoje "crne mrlje" o kojima treba razmišljati i učiniti sve da se poboljšaju.
Redovitim izvještavanjem lokalnih vlasti, vjerujemo da smo i mi mali "kotačić" u promjenama, pa ćemo i dalje aktivno raditi na ovom programu.

Napokon, Hrvatska bi kao popularno europsko turističko odredište, osim mora i sunca, mogla posjetiteljima ponuditi jedinstveno zvjezdano noćno nebo i sačuvati ga kao prirodnu baštinu.

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1. Research Question and Hypothesis:

The information we have gathered in the past fifteen years of participation in the GLOBE AT NIGHT project indicates that the problem of light pollution is very serious and touches on the very essence of the functioning of the entire ecosystem, including man, and on the other hand - it is easily solved!

In the past fifteen years, more than 150 students from the GLOBE program and more than 700 other students (observers) of our school have participated in project activities.

Hypothesis: *c*an something be done, can people be persuaded to seriously consider the problem of excessive lighting of the sky and take appropriate protection measures?

We have believed for fifteen years that it can!!

As IVSS 2021 will focus on data analysis, we assumed that we can learn a lot from our data (more than 2000 measurements in the Globe program at night to monitor light pollution through the constellation Orion), so our research question is:

Is light pollution in the Labin region decreasing?

2. Introduction and Review of Literature:

Light pollution today is a global problem that is attributed to economic, astronomical, safety, but also health problems that affect humans and cause many adverse health effects. Light pollution is a newer term for the general public as opposed to water, soil or air pollution.
The most recognizable side effect of light pollution is the increase in skylight during the night, which is caused by excessive intensity of lighting use, and occurs due to the scattering of visible and invisible light (ultraviolet and infrared light) of natural or artificial origin on the environment.
Globe at Night is an international citizen-science campaign to raise public awareness of the impact of light pollution by inviting citizen-scientists to measure & submit their night sky brightness observations. (www.globeatnight.org)

In fifteen years, our database has grown to over several thousand, which confirms our status in the "Over 1000 Club status", which we achieved in 2014 and the confirmation in 2020 that we are the city with the most observations.

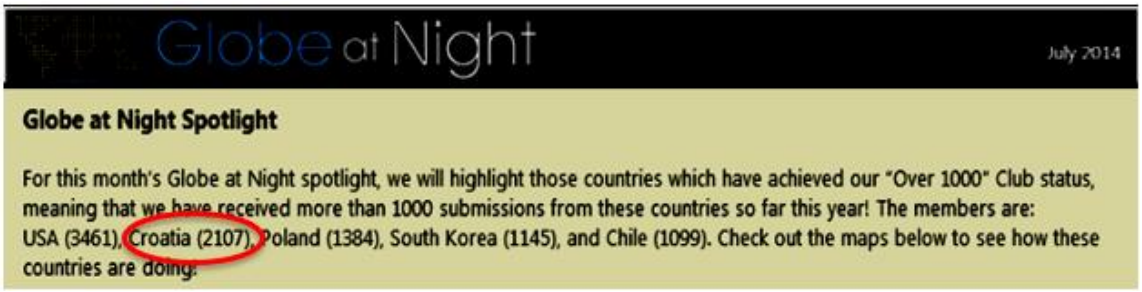
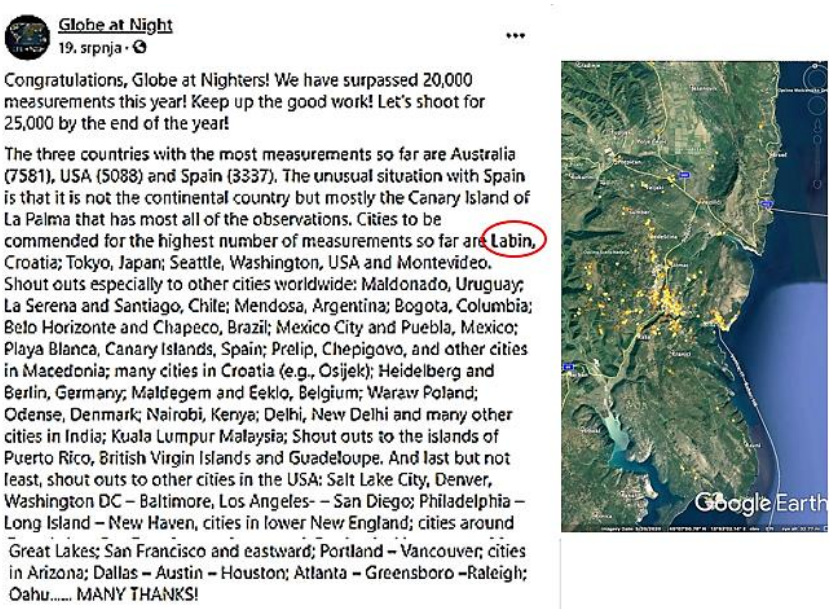


Figure 1.Club status 2014.
Source: www.globeatnight.org/



Since then, in addition to observing the constellations Orion, we have extended our observations to the constellations Leo, Pegasus and Gemini in order to have as much data as possible for the projection of the degree of light pollution in our area.

Figure 2. Club status 2020
Source: www.facebook.com/GLOBEatNight

3. Research Methods and Materials *(Including GLOBE Data!)*:

3.1. Downloading own data that has been entered into the Globe at night program for fifteen years: downloading maps and excel files as described in the **Globe at night protocols under 5.**

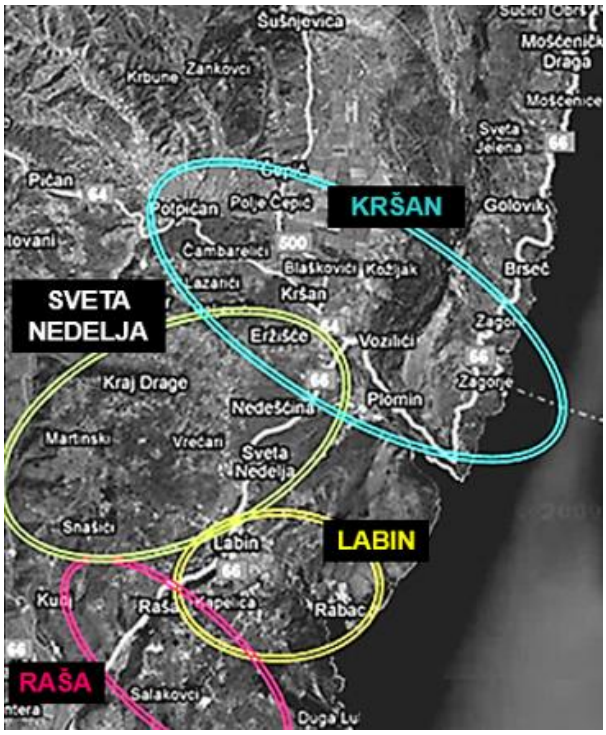


Figure 3. Location map
Source: Google maps and own processing

3.2. For 24 locations, arranged in four zones so as to include urban, rural, tourist and industrial zones, **geographical coordinates were determined,** and the sky on each location are observed by three observers each year in a given period of time and the mean values magnitudes for constellations Orion are entered into the Globe at night database

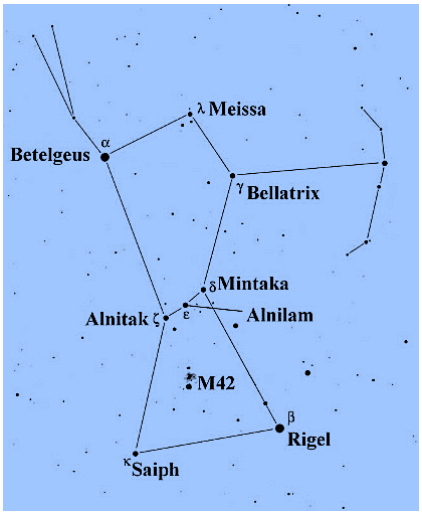


Figure 4. Constellation Orion
Source: www.zvjezdarnica.com

3.3. We will process our data collected for the constellation Orion that we have tracked for all 15 years by calculating the mean values of the magnitudes, making tabular and graphical representations to get an answer to the research question.

GLOBE AT NIGHT PROTOCOLS:

1. ***www.globeatnight.org/6-steps.php***
   This page provides instructions for observing each constellation and the dates when the observation should be performed
2. ***www.globeatnight.org/magcharts***
   As the degree of visibility of stars is determined by magnitudes, magnitudes are explained here to assist observers.
3. ***www.globeatnight.org/webapp/***
   Measurements are entered here to enter the common database
4. ***www.globeatnight.org/maps.php***
   On this page are available maps and all the measurements over the past years all around world.
5. ***www.globeatnight.org/mapapp/***
   Globe at Night Regional Map Generator

   This map application allows you to map Globe at Night data points within a distance you specify around a city or an area of your choice. The resulting maps are bookmarkable and shareable.
   You can also download a CSV file of those data points that can be opened in Excel, or other spreadsheet.

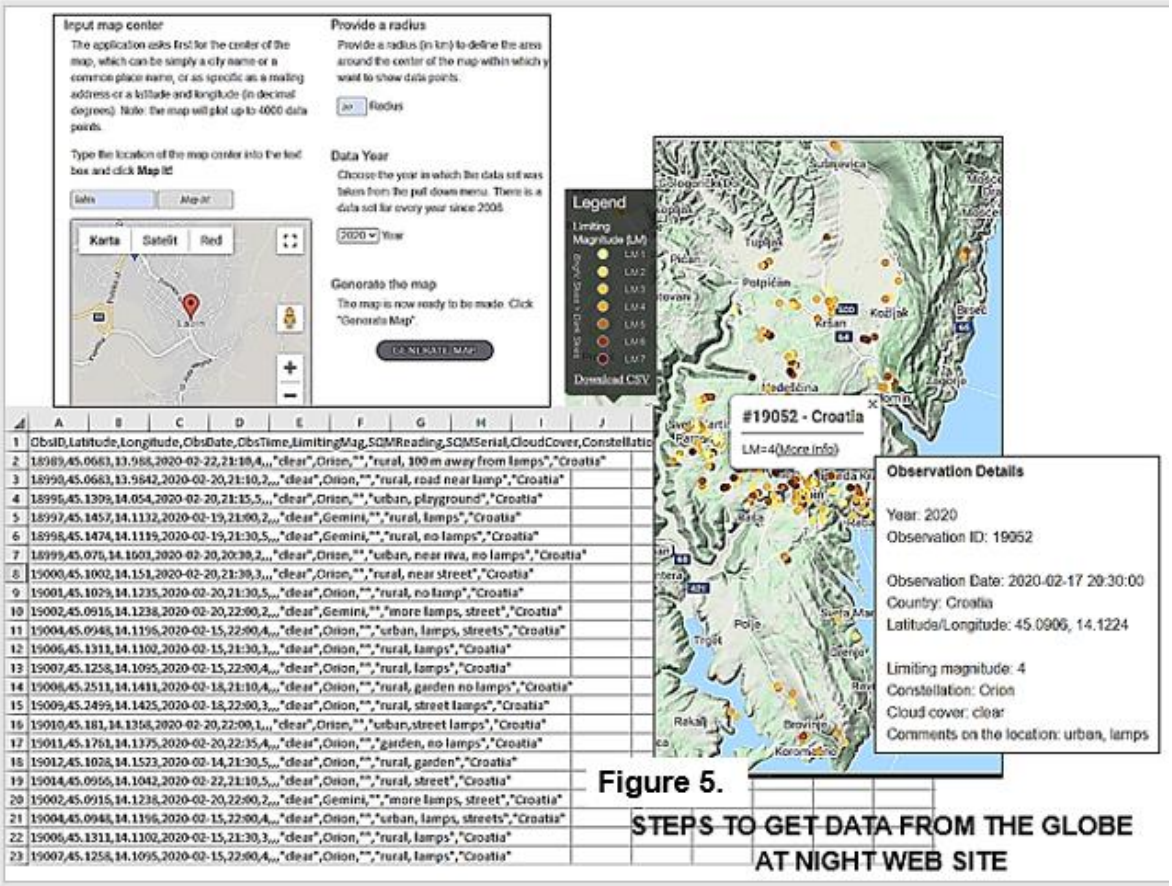


Figure 5.
STEPS TO GET DATA FROM THE GLOBE AT NIGHT WEB SITE

Source: www.globeatnight and self-made

4. Results:

4.1. MEASUREMENT MAPS

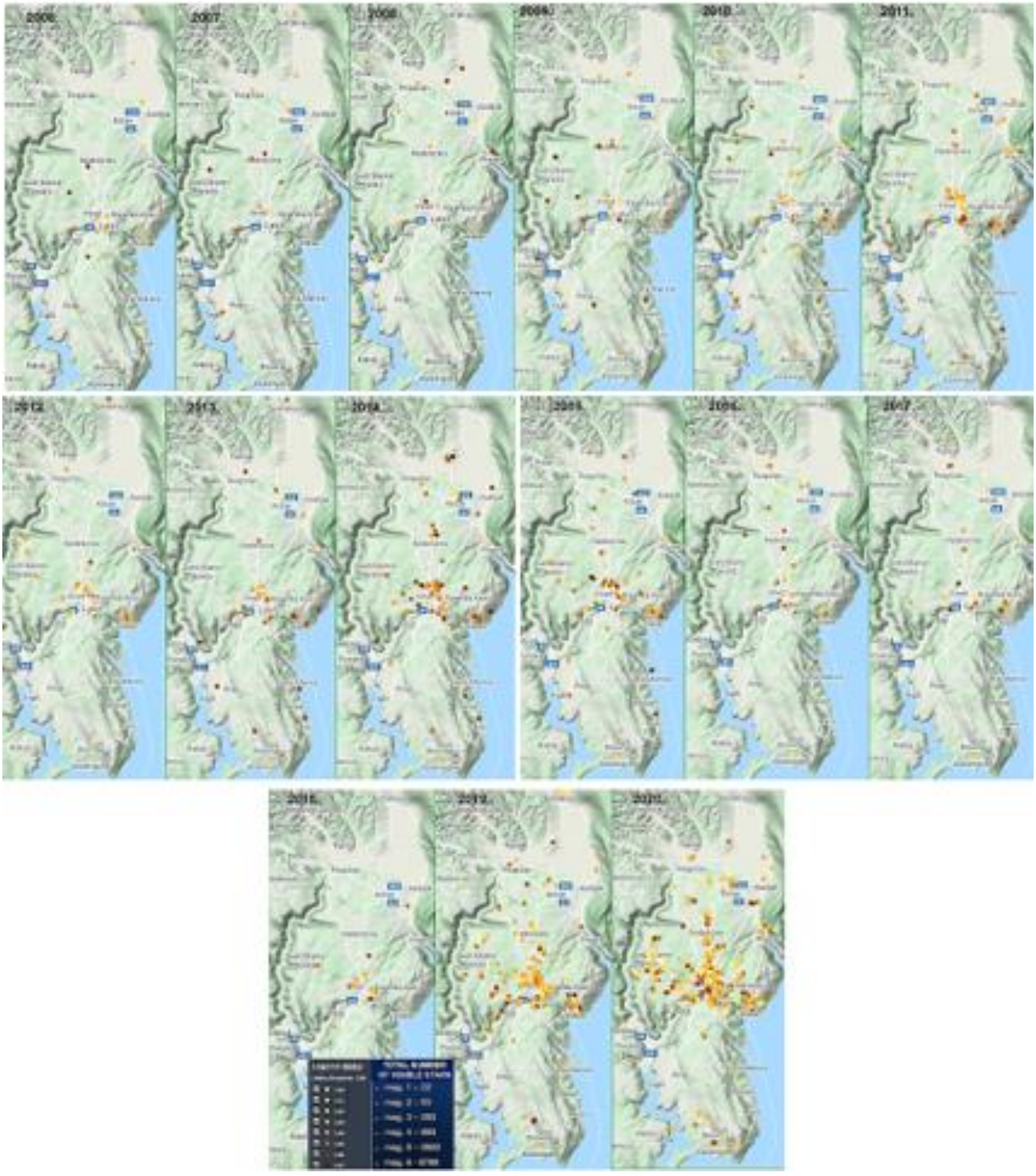


Figure 6. Measurement maps
Source: www.globeatnight.org/mapapp/

4.2. DESCRIPTION OF LOCATIONS AND GEOGRAPHICAL COORDINATES

Table 1. Description of locations with geographical coordinates

LOCATIONS	LATITUDE- N	LONGITUDE- E	DESCRIPTION OF LOCATIONS
LABIN			
STARI GRAD	45,08000	14,12000	City, 11,642 inhabitants, of which 6,893 live in the urban settlement. It covers an area of 72 km² and includes 17 settlements. No major industrial plants, no highways. Nearby is the tourist resort Rabac.
PODLABIN	45,08000	14,11000	
RABAC	45,07940	14,15750	
RABAC OBALA	45,07900	14,17000	
STARCI	45,09000	14,11000	
VINEŽ	45,09810	14,10690	
KATURE	45,09500	14,11970	
KRANJCI	45,06000	14,12000	
STRMAC	45,11780	14,13000	
RAŠA			
RAŠA	45,08030	14,07890	An old mining settlement with about 3000 inhabitants. It covers an area of 80 km² and includes 23 mostly rural settlements. The main road Rijeka-Pula passes through the area of the municipality. The ITV MOST RAŠA lime factory and the HOLCIM cement plant are nearby.
MOST RAŠA	45,05000	14,03000	
TRGET	45,02250	14,05610	
TRGET LUKA	45,01640	14,06500	
KOROMAČNO	44,98060	14,12220	
SVETA NEDELJA			
NEDEŠĆINA	45,14000	14,11190	Rural settlement with about 2000 inhabitants. It covers an area of 60 km² and includes 22 settlements. There are no main roads. There are no major industrial plants.
MARKOĆI	45,12750	14,05110	
SANTALEZI	45,13610	14,09780	
ŠUMBER	45,16722	14,07750	
MARIĆI	45,12750	14,05100	
KRŠAN			
KRŠAN	45,17361	14,13888	Rural settlement with about 3000 inhabitants. It covers an area of 60 km² and includes 24 settlements. The main road Rijeka-Pazin passes through the area of the municipality. Nearby is the industrial zone, the mineral wool factory ROCKWOOL and TE PLOMIN.
POTPIĆAN	45,18890	14,09810	
PLOMIN LUKA	45,13611	14,18055	
VOZILIĆI	45,15666	14,15750	
ČEPIĆ	45,19055	14,13083	

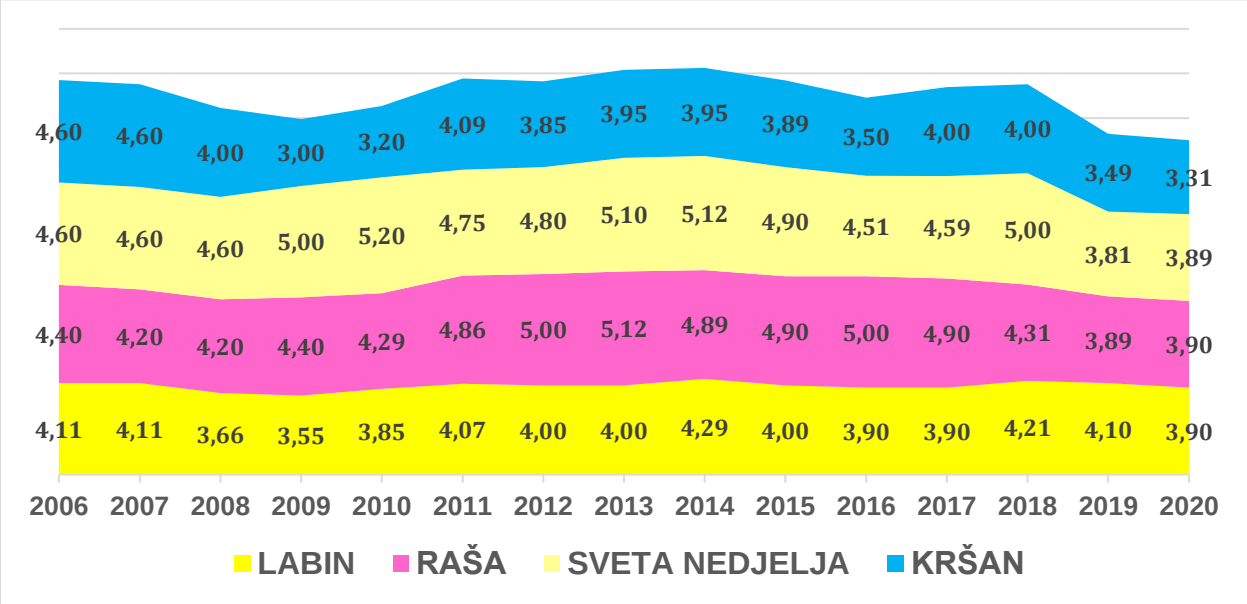
4.3. MEAN VALUES OF MAGNITUDE

Magnitude values range from 0 - the stars are not visible to 7- visible more than 8,000 stars. When looking at the sky, the darker the sky, the more distant stars you can see, hence the limiting magnitude is greater. And this indicates less light pollution!

Table 2. Mean values of magnitude

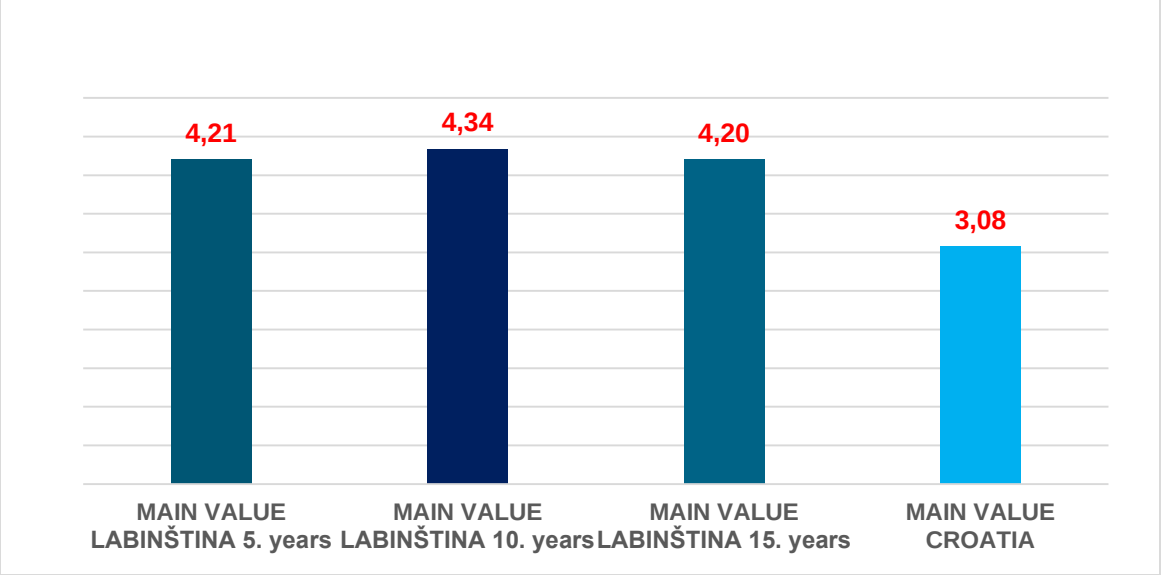
YEAR	LABIN	RAŠA	SVETA NEDELJA	KRŠAN
2006	4,11	4,40	4,60	4,60
2007	4,11	4,20	4,60	4,60
2008	3,66	4,20	4,60	4,00
2009	3,55	4,40	5,00	3,00
2010	3,85	4,29	5,20	3,20
MEAN VALUES (5. yr)	3,86	4,29	4,80	3,88
MEAN VALUES LABINŠTINA (5. yr)	4,21			
2011	4,07	4,86	4,75	4,09
2012	4,00	5,00	4,80	3,85
2013	4,00	5,12	5,10	3,95
2014	4,29	4,89	5,12	3,95
2015	4,00	4,90	4,90	3,89
MEAN VALUES (10. yr)	3,92	4,63	4,88	3,93
MEAN VALUES LABINŠTINA (10. yr)	4,34			
2016.	3,90	5,0	4,51	3,50
2017.	3,90	4,90	4,59	4,00
2018.	4,21	4,31	5,0	4,00
2019.	4,10	3,89	3,81	3,49
2020.	3,90	3,90	3,89	3,31
MEAN VALUES (15. yr)	3,98	4,28	4,70	3,84
MEAN VALUES LABINŠTINA (15. yr)	4,20			
MEAN VALUESS CROATIA	3,08			

4.4. GRAPHIC DISPLAY



Graph 1. Mean value of magnitude

5. Discussion:



Graph 2. Comparison of mean values

Unfortunately, the answer to the research question is:
Light pollution in the Labin region has increased in the past five years.

In the last five years there has been an increase in light pollution and a possible reason for this is the "explosion" of construction of tourist and catering facilities in the Labin region, especially in rural areas (hotels, camps and holiday homes), and thus increasing the number illuminated access roads.

The results show that the Labin region is moderately polluted with light.

Comparing our results with the available maps, we are happy that the sky over Istria and thus over the Labin region is mostly **"good sky",** although there are "black spots" to think about and do everything to improve the situation.

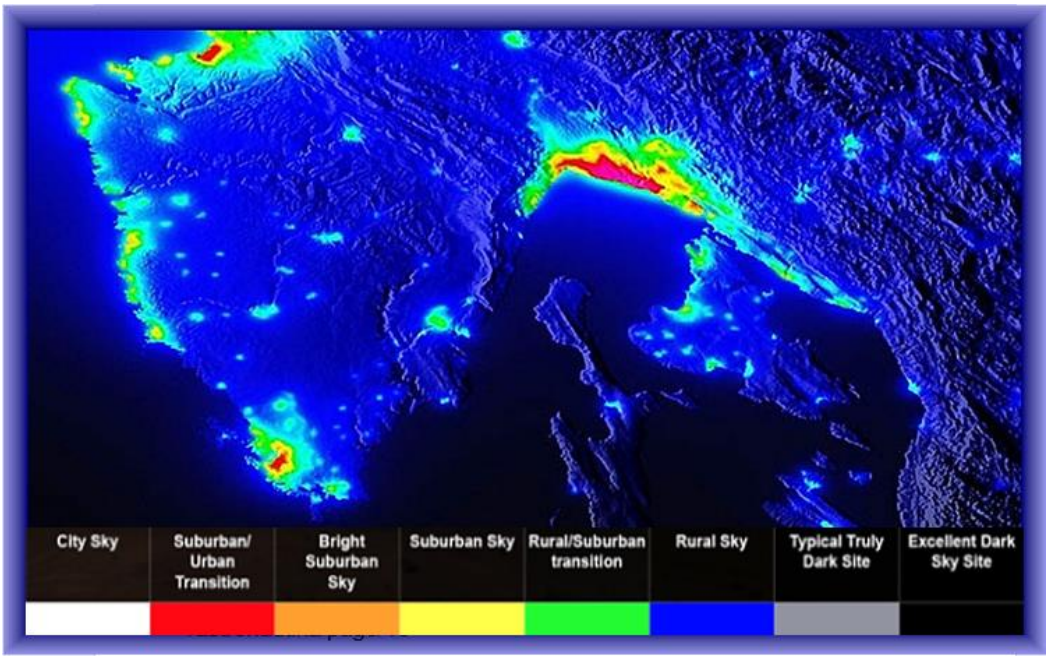


Figure 7. Light pollution of Istria
Source:www.astronautika.com/a3c2/category/astronautika/page/16

6. Conclusion:

In the Republic of Croatia, a new Law on Protection against Light Pollution has been adopted (OG 14/19 of April 1, 2019) which, in addition to defining the problem, for the first time gives the possibility to report light pollution to the state inspectorate using the form at the link dirh.gov.hr/podnosenje-prijava/83, so we believe that more citizens will be involved thus enable the solution of "black spots" and the reduction of light pollution.

By regularly reporting to the local authorities on our results, we believe that we are also a small "wheel" in the changes, so we will continue to work actively in this program.

Figure 8. Press releases
Source: labinstina.info/
www.labin.com/
www.radiolabin.hr/
www.labin.hr/

Follow the UN Resolution of 1992, which requires member states to preserve the night, starry sky for present and future generations in its full beauty, to make the entire planet an area with a preserved night and night starry sky, a place where the stars are seen!

Finally, Croatia, as a popular European tourist destination, apart from the sea and the sun, could offer visitors a unique starry night sky and preserve it as a natural heritage.

6.1. ACTIVITIES WITH THE OBJECTIVE OF EDUCATION AND IMPROVEMENT OF THE CURRENT SITUATION

- We regularly publish our results in the media and on the project website in order to sensitized a larger number of people on our Planet.

PROGRAM "GLOBE AT NIGHT", SREDNJA ŠKOLA LABIN

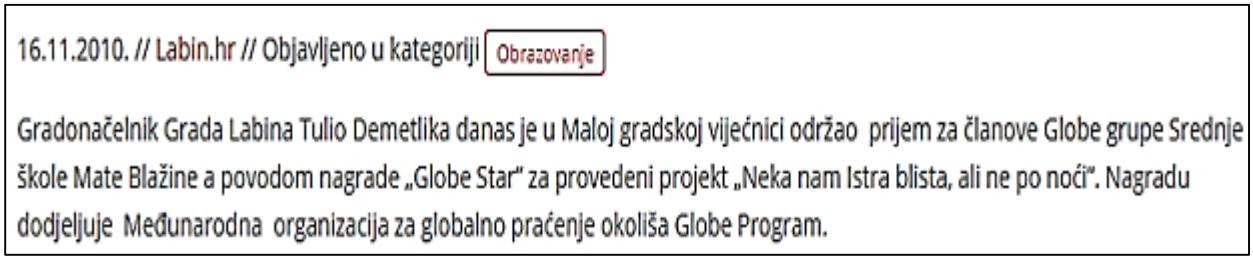
By Mira Hrvatin January 21, 2015 Analize

analiza, Globe, projekti, škole, svjetlosno onečišćenje

Od 2006. godine međunarodni GLOBE PROGRAM poziva učenike diljem svijeta da sudjeluju u GLOBE AT NIGHT projektu, globalnoj kampanji za mjerenje svjetline neba noću. GLOBE program posebno je zainteresiran za projekte koji su od interesa za obrazovanje zajednice. Učenički radovi nude obilje mogućnosti i mogu biti inspirativni za učenike diljem svijeta. Globe zvijezda za

Figure 9. Press releases
Source: www.ekorasvjeta.net

- As part of the international cooperation between the CITY OF LABIN and our school, there are GLOBE AT NIGHT protocols were presented at several gatherings with the desire to involve our friends in these activities in order to warn as many young people as possible about the problem of light pollution.



16.11.2010. // Labin.hr // Objavljeno u kategoriji Obrazovanje

Gradonačelnik Grada Labina Tulio Demetlika danas je u Maloj gradskoj vijećnici održao prijem za članove Globe grupe Srednje škole Mate Blažine a povodom nagrade „Globe Star" za provedeni projekt „Neka nam Istra blista, ali ne po noći". Nagradu dodjeljuje Međunarodna organizacija za globalno praćenje okoliša Globe Program.

Figure 10. With the mayor
Source: www.labin.hr/

- We have encouraged some more GLOBE schools in Croatia and in Northern Macedonia (Prilep) to join the measurements and the result is visible on the map https://www.globeatnight.org/maps.php
- This year, our members encouraged their fellow citizens to join the Globe at Night program "Adopt a Street", so light pollution was monitored in 110 streets, which can be seen at www.globeatnight.org/Labin/

Our work has been recognized since:

THE GLOBE PROGRAM

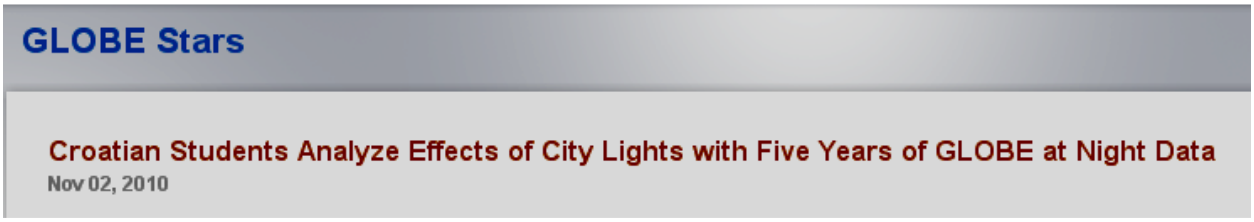


Figure 11. Globe star
Source: www.globe.gov

INTERNATIONAL COMMUNITIES

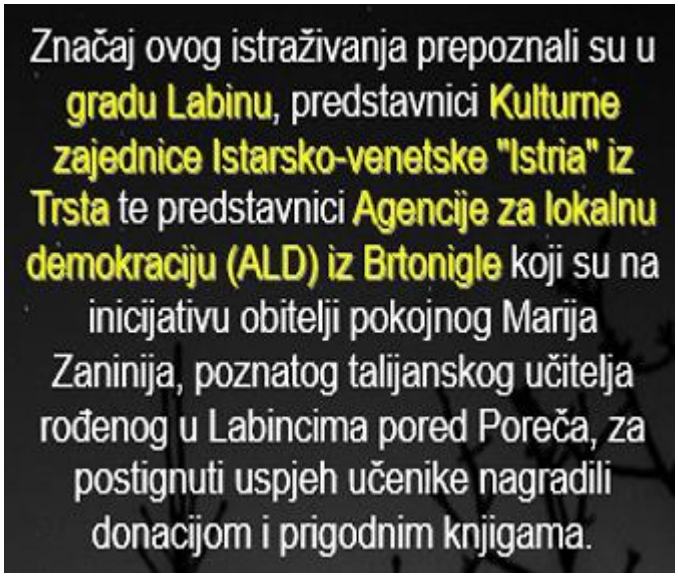


Figure 12. Award "Istria" Trieste
Source: www.labin.hr/

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www.radiolabin.hr/ (date of access 25.01.2021.)
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8. Acknowledgements

¬ We thank the members of our group and other students for their dedicated work on the project during fifteen years.

¬ We thank our mentor Olivera Tadić, Globe teacher & teacher mentor, graduate engineer of chemical technology, who has been working on environmental issues for 15 years, for her support.

9. (Optional) Badge Descriptions/Justifications:

- Be a **Collaborator**

Through fifteen years of work, the members of our group have achieved cooperation with other students of our school, with students of other schools from Croatia and with the school Orde Chopela Prilep, Northern Macedonia with the aim of collecting as many measurements as possible.

- Be a **Data Scientist**

In fifteen years, our database has grown to over several thousand, which confirms our status in the "Over 1000 Club status", which we achieved in 2014 and the confirmation in 2020 that we are the city with the most observations. We analyze our database every year and regularly inform the local government about the results in order to encourage them to take certain actions that would improve the situation in our area.

- **Make an Impact**

This year, our members encouraged citizens to join the program through the Globe at Night activity "Adopt a Street" program 2020 (www.globeatnight.org/Labin/).

Through regular media coverage over the past fifteen years, we have prompted a series of changes aimed at reducing light pollution in our area (see figure 8., 9. and 10.).

We also cooperated with the portal Ekorasvjeta.net, a website of a civic initiative aimed at informing the public about the issue of light pollution - in general, but also with specific examples in Croatia and neighboring countries with the aim of educating the public about how to have quality lighting at night which at the same time will not endanger human health, plant and animal ecosystem and traffic safety (www.ekorasvjeta.net/).