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ClimEd

Energy

Renewable Sources Energy Potential of Odessa Region

ClimEd Group A7:

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Main Advantages

The main advantage in the renewable energy industry is the elimination of excessive requirements during construction, since such facilities are not critical, technological disruptions in their operation do not entail socio-economic, environmental and other consequences for the population and socially significant facilities.

Main Stages of Realization

- International goals
- Data types
- Parameters
- Data sets
- Variables
- Approach and tools
- Expected results

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Research objectives

- Analysis of the energy potential of renewable energy facilities in Ukraine
- Analysis of technical parameters of electricity generation system implementation
- Selection of basic equipment, development of electrical circuits and formulation of technical and economic solutions based on the analysis of climatic characteristics of the region
- Development of a startup - wind farm project in the Odessa region

Objects of study

Processes of solar energy conversion radiation and wind into electricity

Subject of study

Technical parameters of solar-hydrogen and hydrogen-hydrogen systems implemented in the Odessa region

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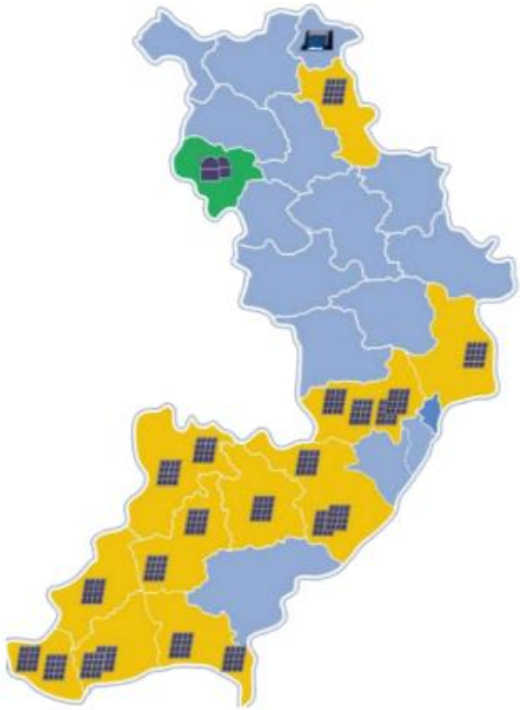
Climatic characteristics of the area

- The climate of the site is temperate-continental with moderately cold winters and long, sometimes dry, hot summers.
- The average annual air temperature is 4-7.7 ° C. Annual precipitation is 390-460 mm. The selected site is located in the steppe zone, evaporation significantly exceeds precipitation, especially in summer.
- Precipitation falls fairly evenly. As in the rest of the temperate zone, precipitation falls the most in the summer months, mainly due to the movement of the Sun along the ecliptic, its high position above the horizon stimulates the evaporation of moisture and the formation of rains and thunderstorms.
- The wettest months are June and July with a rainfall of 61 mm. The driest months are February-April. The reason for this is the low activity of cyclones and the lack of 7 more solar energy for the formation of convection. In March, precipitation averages 33 mm. Atmospheric drought is a relatively common phenomenon and can occur repeatedly throughout the year.
- Height above sea level ranges from 20 m in the coastal lowlands to 140 m on the border of Volyn-Podilska Upland. The average annual wind speed is 4.25 m / s. The average annual temperature is - (10.7) ° C. The coldest month is (-2.8) °C, the warmest is (27.0) ° C.

Preliminary study of the regional energy potential

Most of the solar power plants are located in the southern part of the region, hydropower plants and biogas energy are in the north.



Analysis of wind energy potential of the site

- Description of the area

- The area of the 11.75 MW WPP site in Odesa Oblast is 1.65 km^2, located between 6 settlements: Sanzheyka Village, Dalnyk Village, Molodizhne Village, Hrybika Village, Baraboy Village and Chornomorsk City. All points are included in the Odessa region. The distance from the edge of the site to the nearestthe boundaries of the settlement are more than 1 km. The nearest river (Baraboy River) is at a distance of 5 km to the site. The Black Sea is 3.6 km away

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Renewable sources energy potential Of Odessa Region (Wind)

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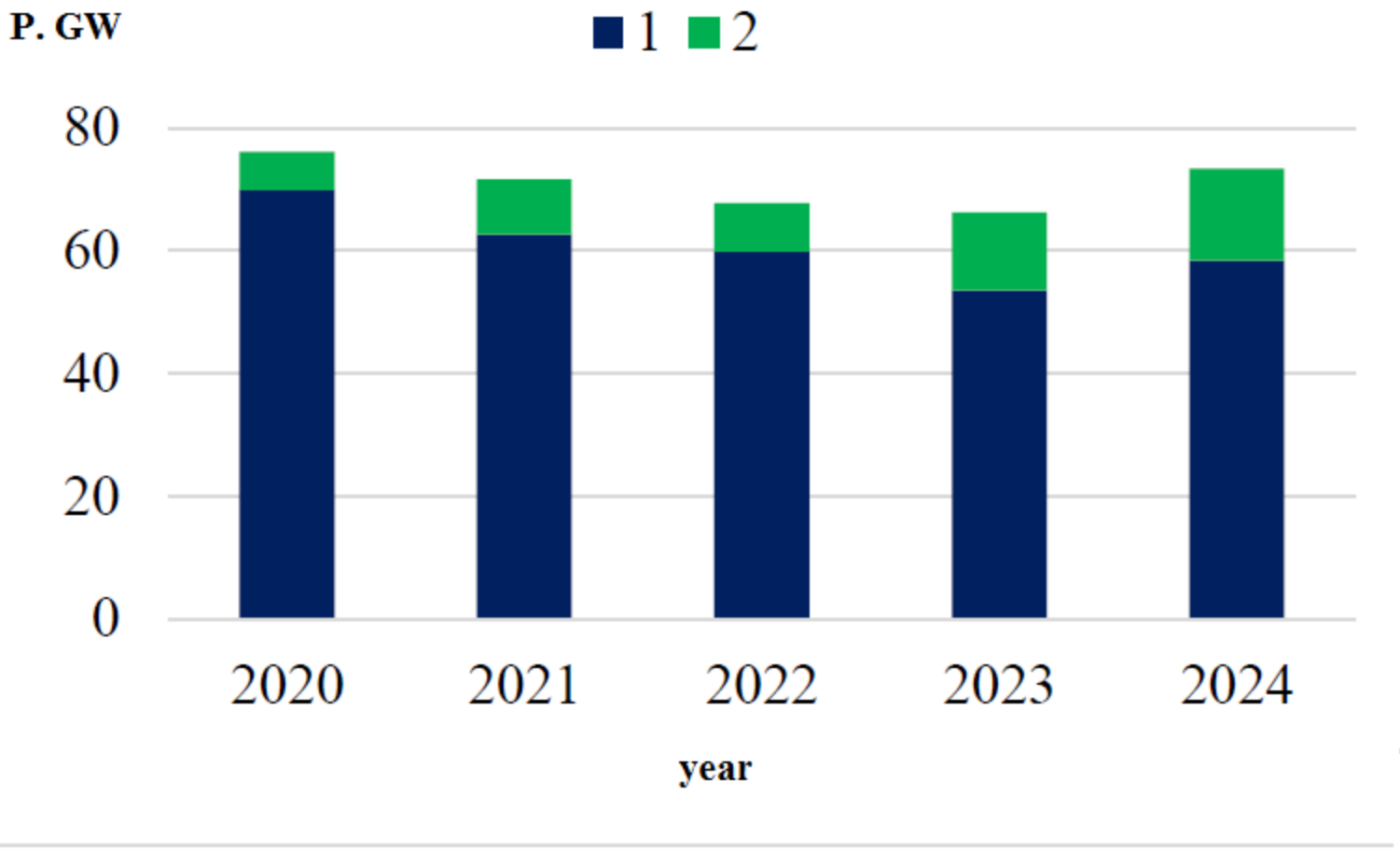
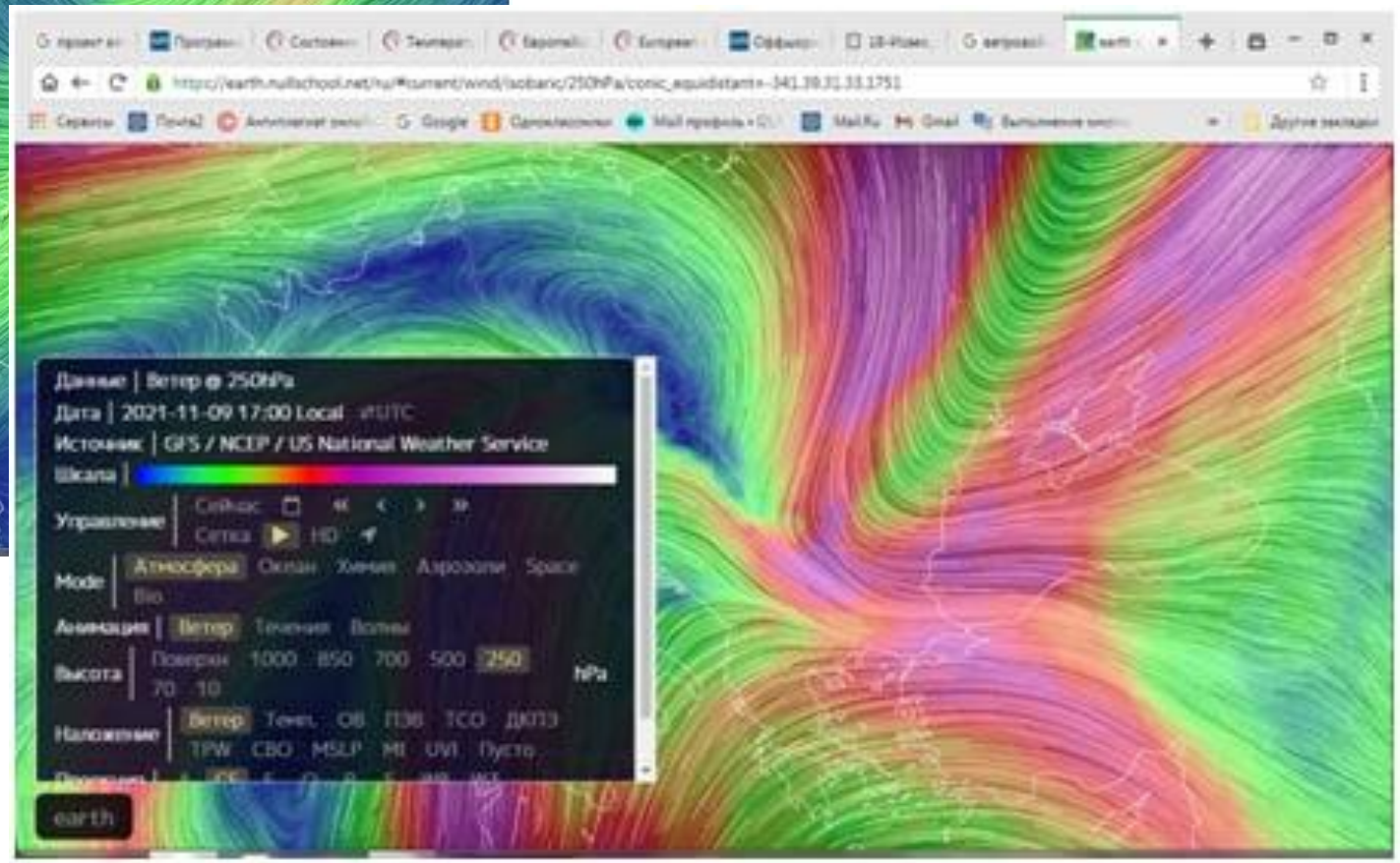
Forecasting the growth of the installed capacity of wind farms: 1 - ground type; 2 - offshore type



The forecast of the world wind energy market is growing every year and today averages 4 percent. Over the next five years, new wind farms with a capacity of more than 355 GW are expected to be installed. This is more than 71 GW of new plants each year until 2024.



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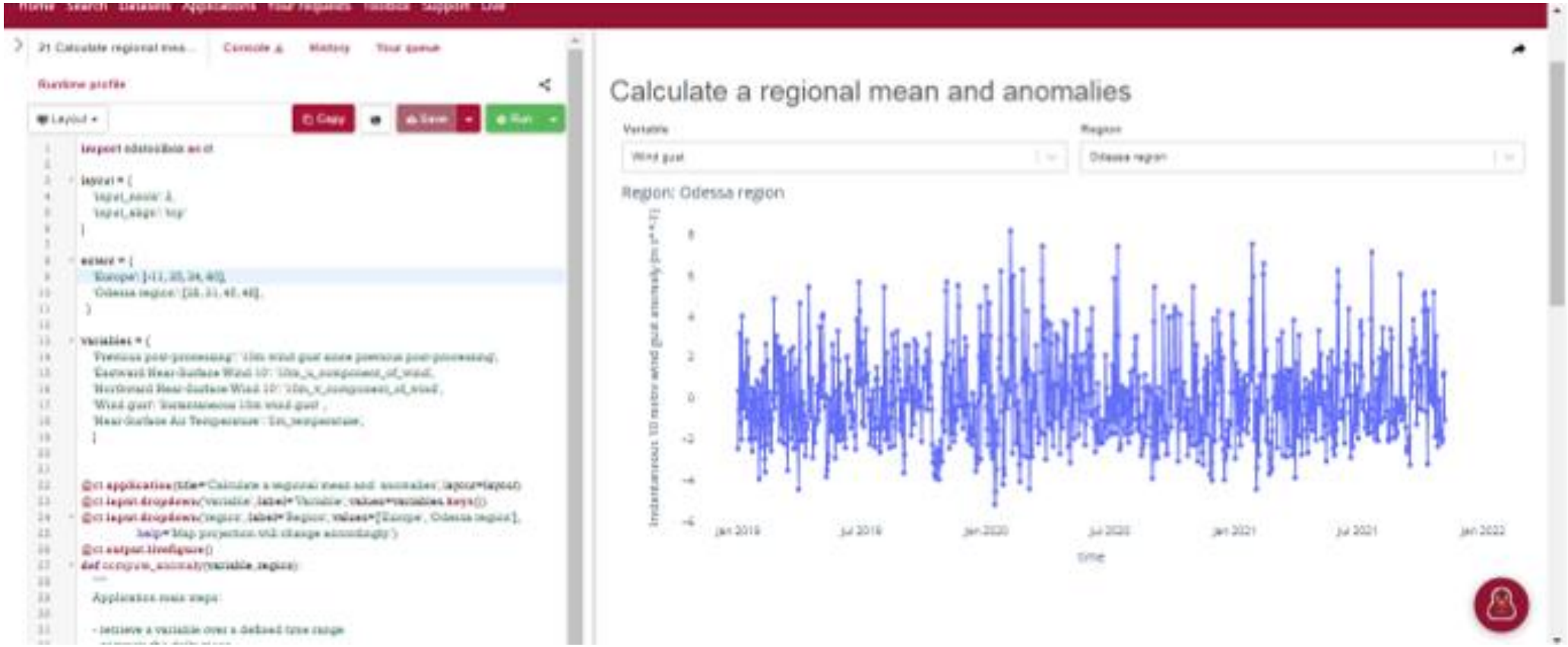
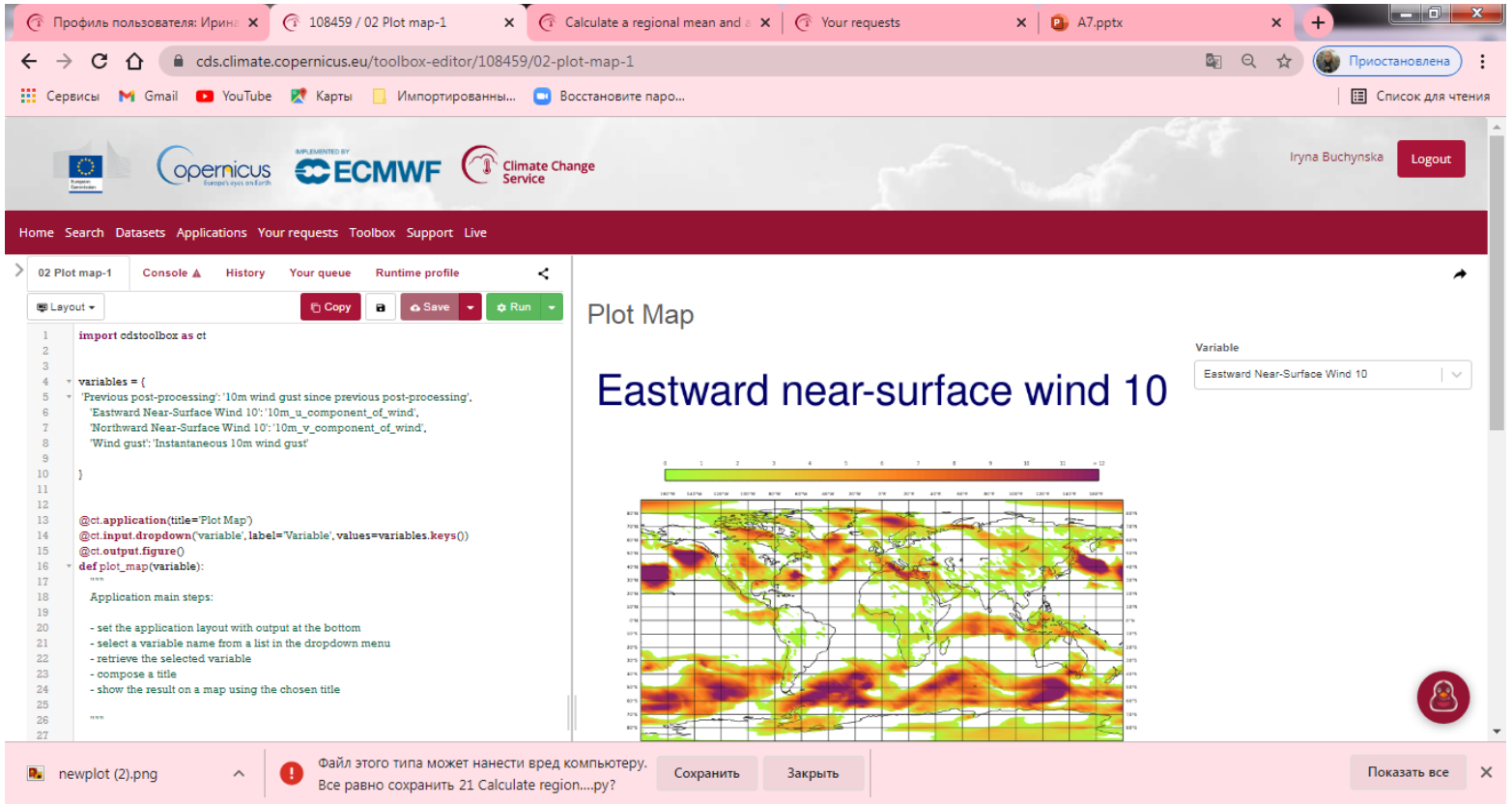
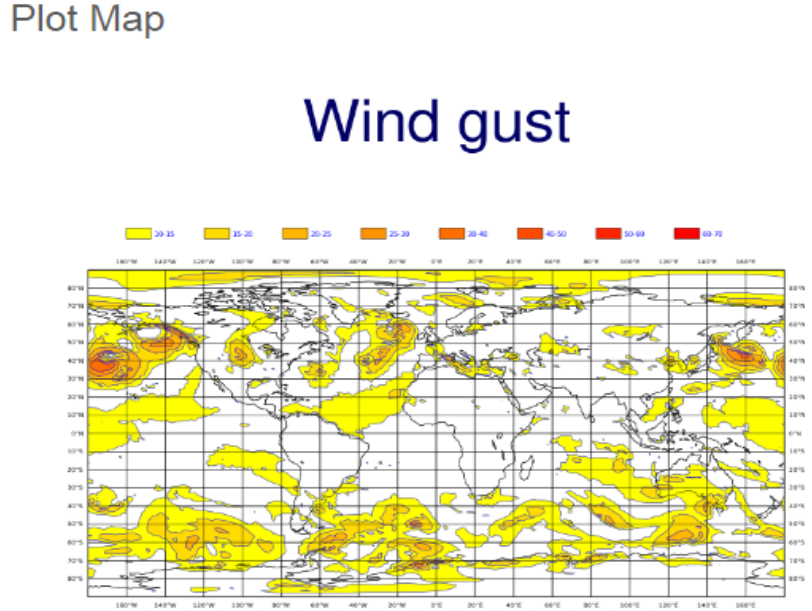
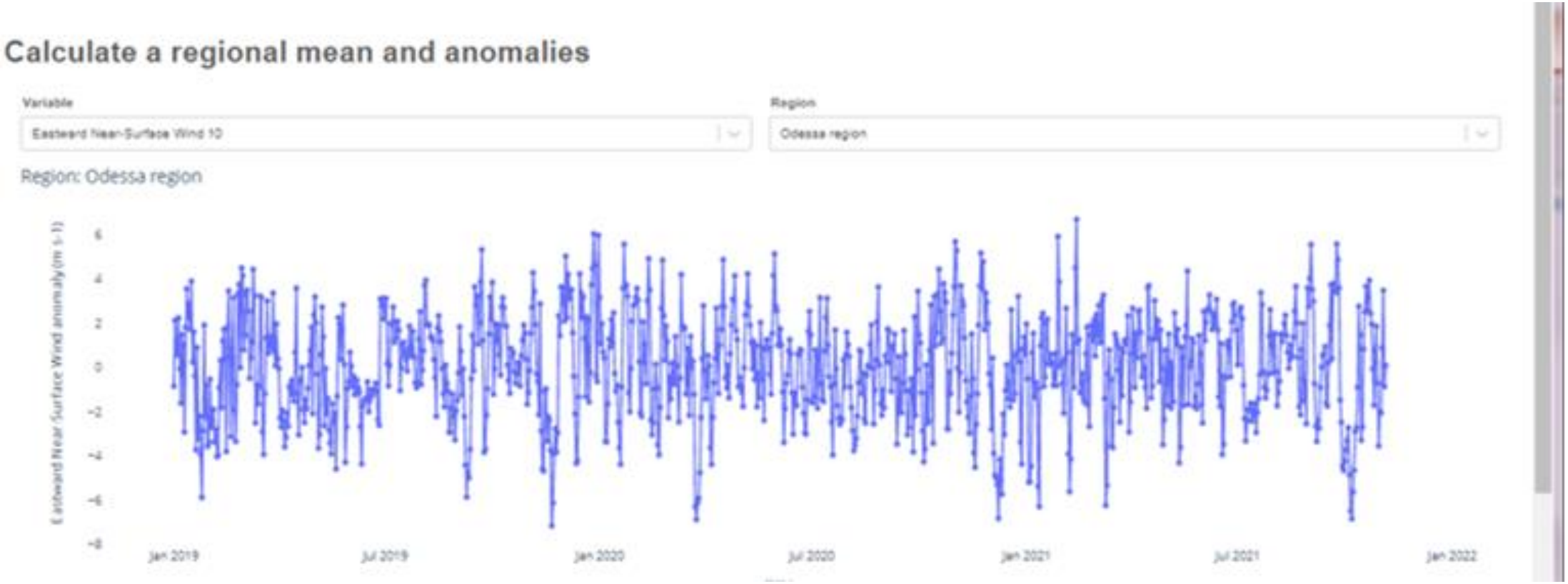
Regional mean and anomalies







Eastward Near-Surface Wind 10'



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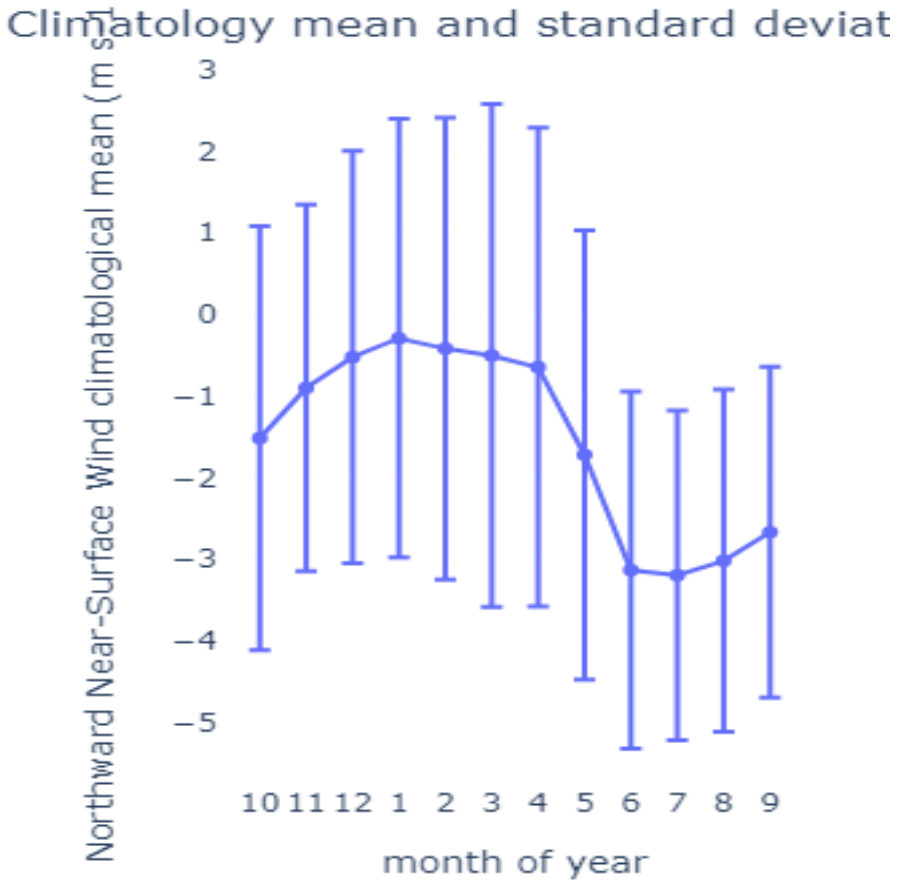
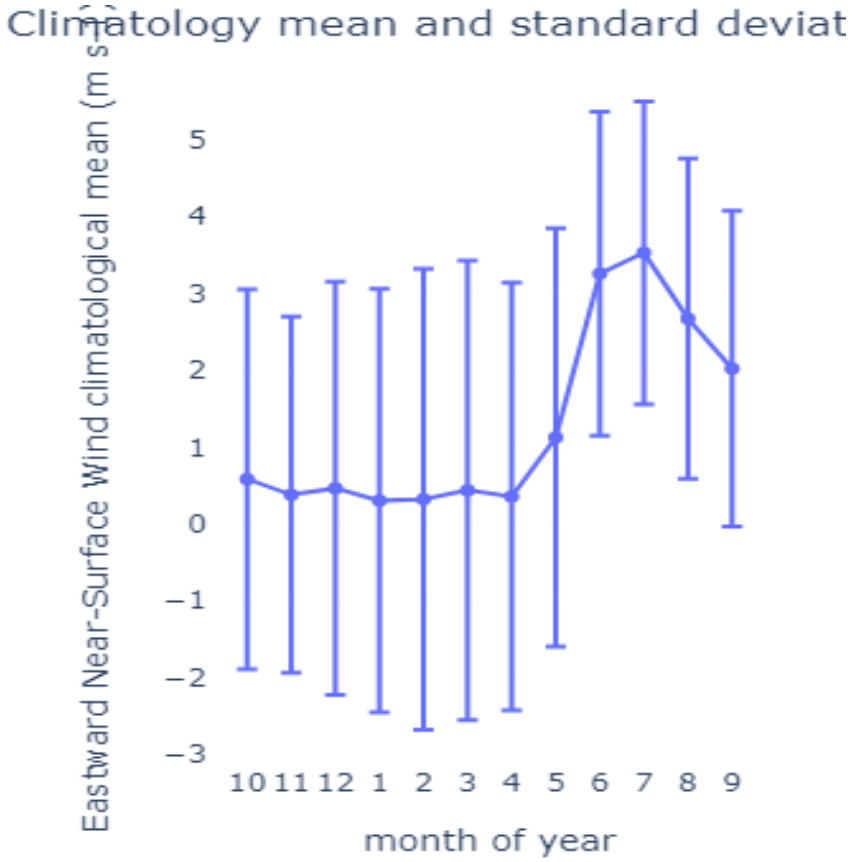
Average monthly speed, m / s

	01.2021	02.2021	03.2021	04.2021	05.2021	06.2021	06.2021	08.2021	09.2021	10.2021	11.2021	12.2021
Average monthly speed, m / s	4,4	4,5	4,7	4,5	4,3	4,0	3,8	3,6	3,6	3,8	4,4	4,4

Climatology mean and standard deviation





Comparative table of wind turbines

Parameter		Siemens	Enercon	Goldwind
Model		SWT-2,3-108	E-103 EP2	GW 109/2500
Wind turbine class		IEC IIB	IEC IIIA	IEC IIIA
Rated power	kW	2300	2350	2500
Minimum operating wind speed	m/s	3,0	2,5	3,0
Nominal operating wind speed	m/s	11,0	34,0	25,0
Operating temperature range	°C	-30 - +40	-20 + +45	-20 + +45
Rotor diameter	m	108	103	109
Support height	m	80	78- 138 (98)	90-120
Specific power	W/m^2	251,5	282,0	262,7|

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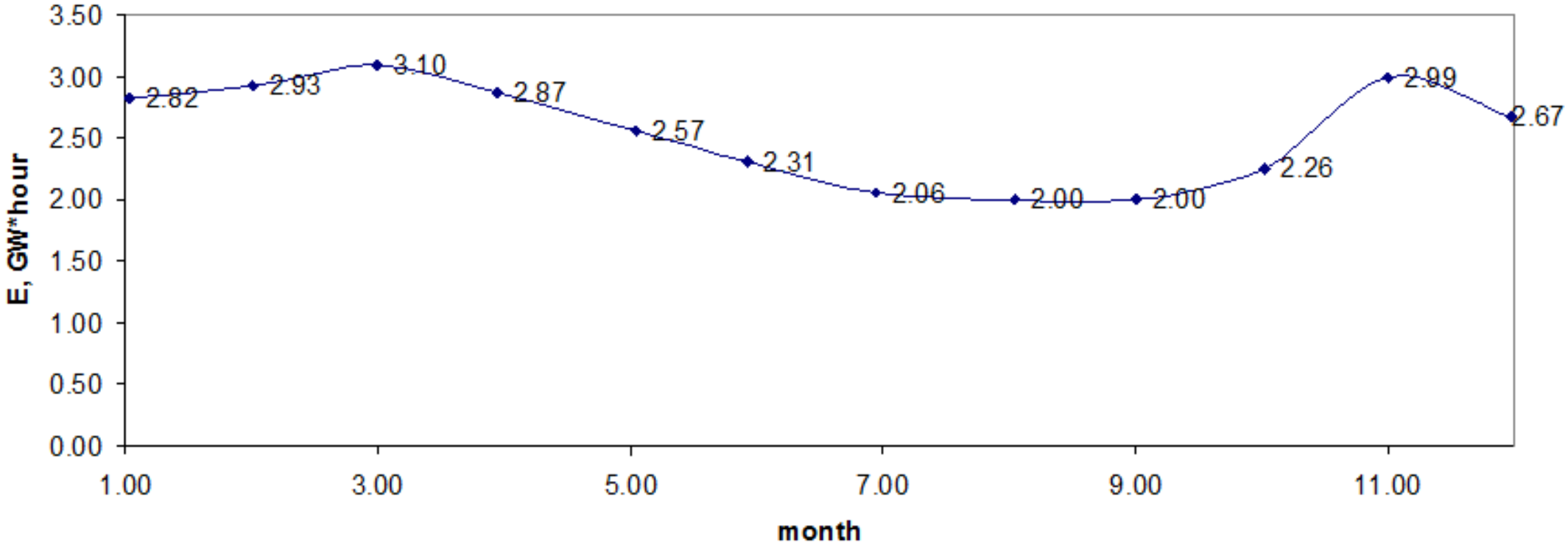
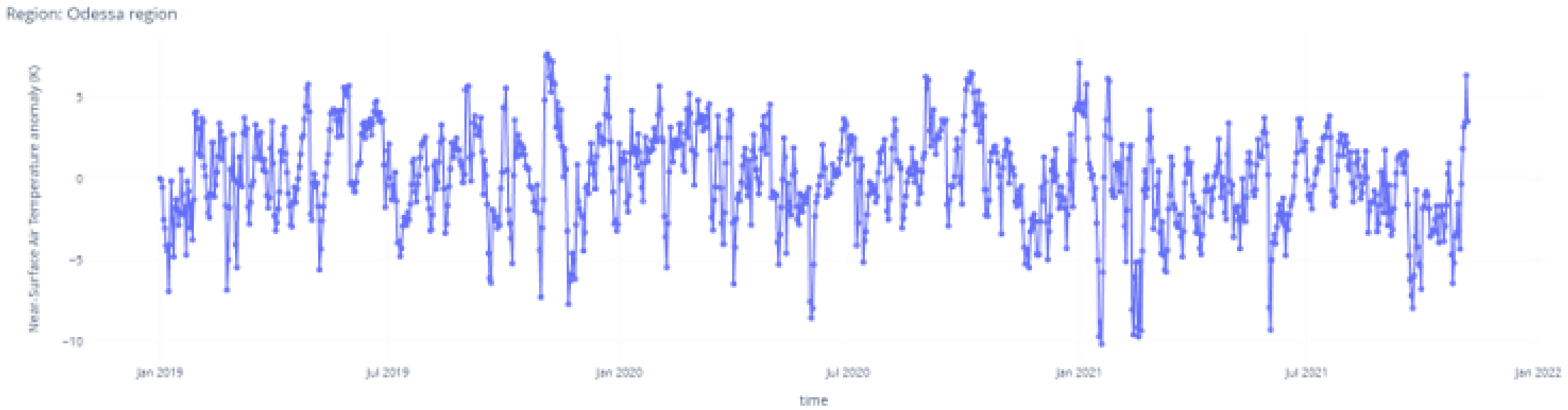
Projected electricity generation in our wind farm during the year



$$E_{total} = \sum_{i-1}^{12} E_{WPPmonth\ i} = 30.77\,GW \cdot hour$$

Near-Surface Air Temperature



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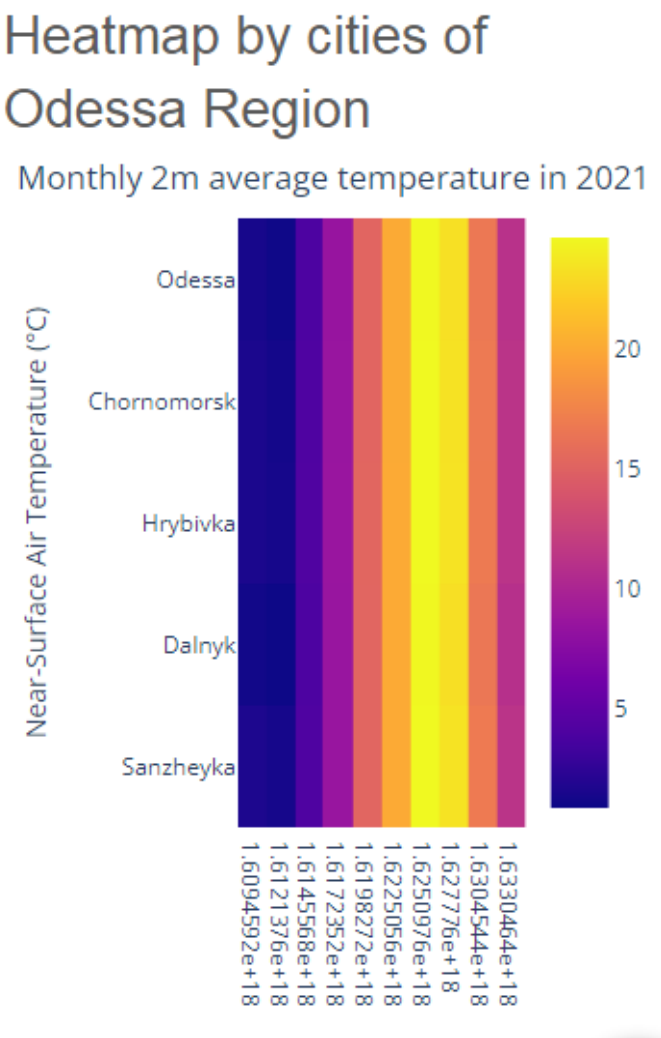
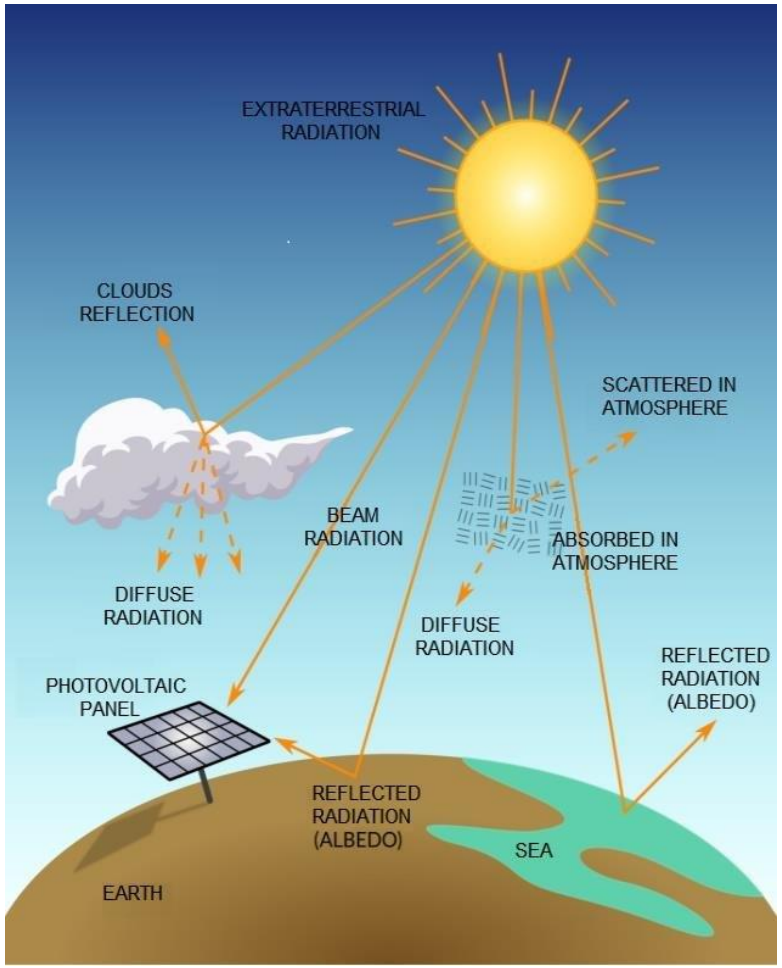
Heatmap by cities of Odessa Region

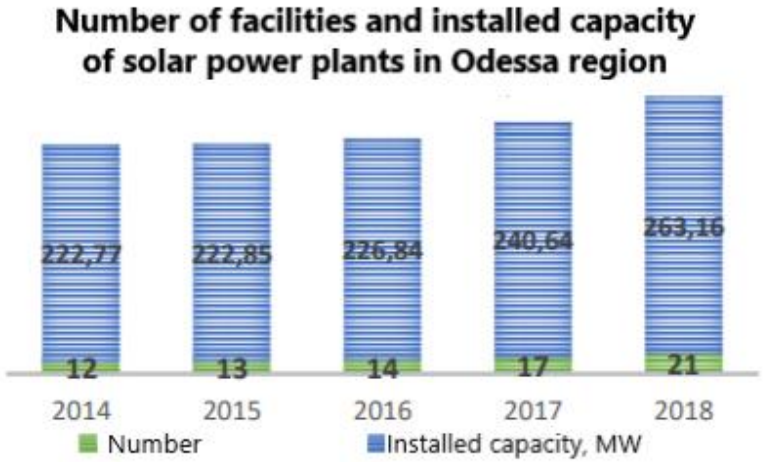
Layout ▾ | Copy | Save ▾ | Run ▾

```
1   from collections import OrderedDict
2   import cdstoolbox as ct
3
4   # Define dictionary of cities to extract data from
5   cities = OrderedDict({
6       'Sanzheyka': {'lat': 46.13, 'lon': 30.36 },
7       'Dalnyk': {'lat': 46.27,'lon': 30.33},
8       'Hrybivka': {'lat': 46.12, 'lon': 30.33},
9       'Chornomorsk': {'lat': 46.18,'lon': 30.39},
10      'Odessa': {'lat': 46.29,'lon': 30.44},
11  })
12
13  # Define label, latitude and longitude lists
14  city_labels = list(cities.keys())
15  lats = [cities[k]['lat'] for k in cities.keys()]
16  lons = [cities[k]['lon'] for k in cities.keys()]
17
18  # Initialise the application
19  @ct.application(title='Heatmap by cities of Odessa Region')
20  # Define a livefigure output for the application
21  @ct.output.livefigure()
22  def application():
23      """Define a function that extracts monthly average Near Surface Air
    Temperature for five predefined cities and plot them on a heatmap.
24
25      Application main steps:
26
27      - retrieve temperature gridded data
```



Solar energy





From 2014 to 2018, the number of solar power plant producers in the Odessa region increased almost 2 times, and capacity 1.2 times.

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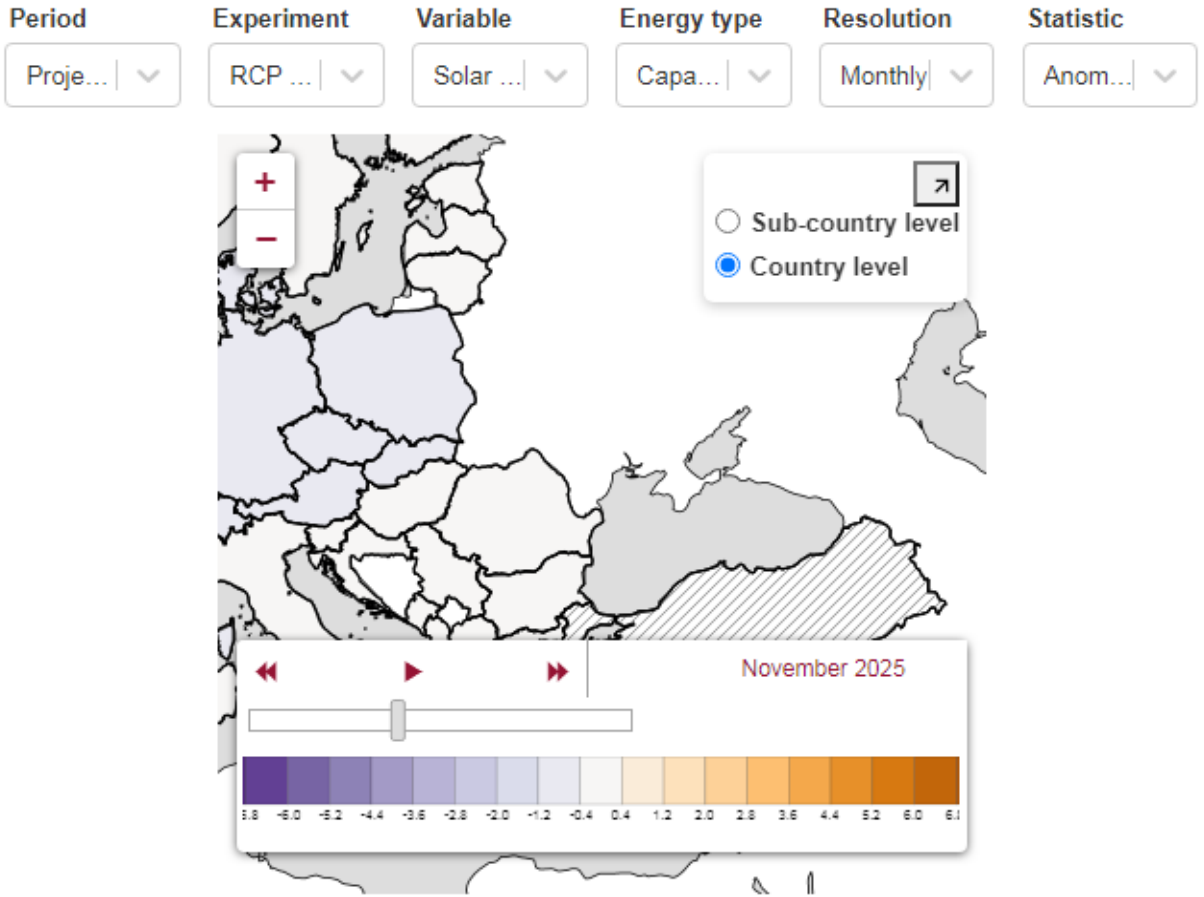
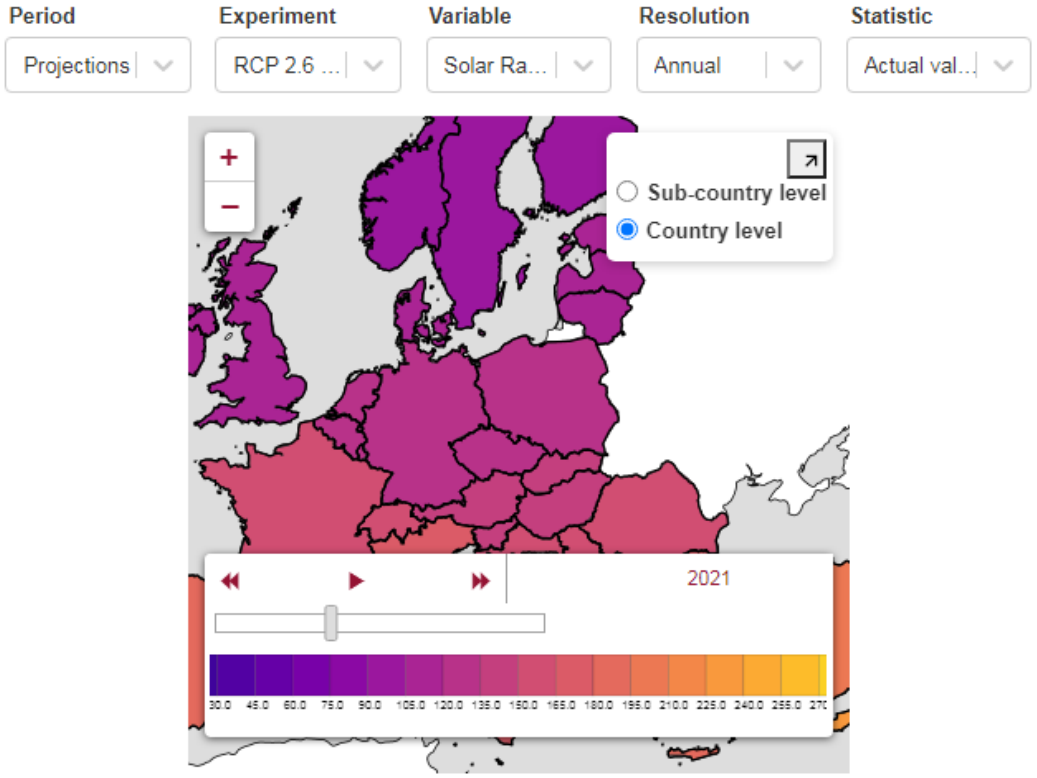
European energy and climate data





Conclusions

- According to the data of climatic characteristics for the Odessa region the forecasted values of wind potential are established.
- The capacity of the design wind power plant is calculated. A comparative analysis of modern wind turbines has been made.
- An energy audit of the territory of Europe was conducted.
- The need to create databases on the level of solar radiation for the territory of Ukraine has been established.

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Thank you!