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3rd ClimEd Online Training on “Digital Tools and Datasets for Climate Change Education” 26 October – 12 November 2021

Hosts: University of Helsinki (UHEL, Helsinki, Finland) & Odessa State Environmental University (OSEN, Odessa, Ukraine)

Group A5:

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Kushchenko Liliia - *Odessa State Environmental University*,

ClimEd Main Themes for HWAs/Group Projects A5



Water Management climate info: air temperature; precipitation; duration of rainless periods; hydro info: maximum river flow; water temperature; minimum river flow; forecast info: heavy rain; extreme high and low temperatures; & other.

➤ **geographical region/ domain/ country of interest –**

Europe / Ukraine / **Kherson & Odessa & Kyiv**



➤ **existing or possible problem of concern/ interest -** Integrated water resources management is one of the items of the State Sustainable Development Strategy, in accordance with EU requirements. Therefore, a reliable quantitative assessment of the water fund will provide the basis for making the right decisions in water management.

A sound rationale for the relationship between runoff and climatic characteristics makes it possible to model and forecast the state of water resources in the future and not lead to their destruction, timely response and rational decision-making. According to the forecasts of domestic and foreign scientists, river runoff, especially in the south of Ukraine, may undergo significant changes, the manifestation of which is already observed in the absence of spring floods in recent years.

➤ **main aim and specific objectives of group project –** Using the database, analyze the spatio-temporal distribution of climatic characteristics of indicator cities, to use them in assessing the impact of climate change on water resources of Ukraine on the basis of models “climate-runoff”



➤ objectives

- ✓ Create an array of climate data for different time periods and intervals for 2 cities in southern Ukraine (Odessa, Kherson) to solve the problem of the project and the city of Kyiv to compare the dynamics of possible climate change in southern Ukraine in relation to northern Ukraine.
- ✓ Visualize changes and trends in key climatic characteristics
- ✓ Construct the observed values of air temperature, precipitation per year for 3 cities.
- ✓ Visualize the simulated values of annual values of air temperature, precipitation for Ukraine up to 2100.



➤ UN SDGs results of group project might correspond

GOAL 13:
TAKE URGENT ACTION TO
COMBAT CLIMATE
CHANGE AND ITS IMPACTS

GOAL 6:
ENSURE ACCESS TO
WATER AND
SANITATION FOR ALL

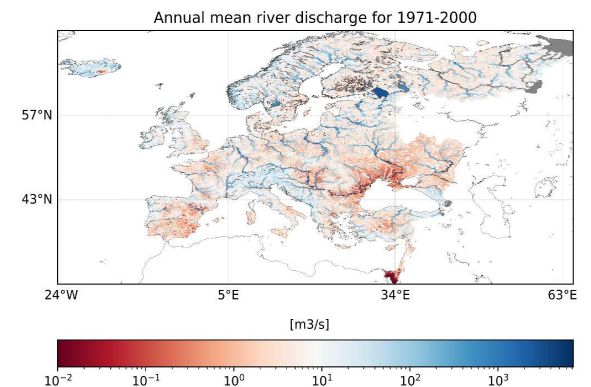


➤ variables/ parametrs which will be analysed

air temperature; precipitation and humidity;
warming stripes for the extended period 1979-2018;
the amount of runoff in 2021

➤ approach(s) and tools for visualisation and data analysis

histograms, point areas, surface areas, parallel coordinated areas

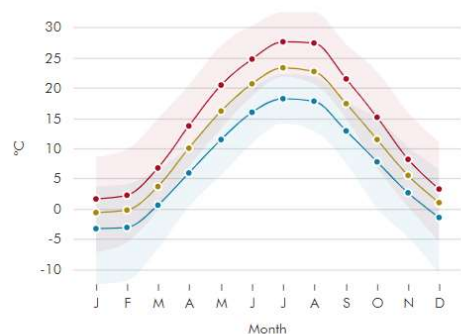
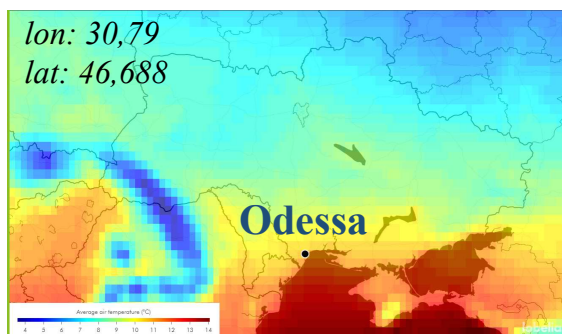


➤ results

- ✓ As a result of work on the project, the climatic characteristics of 3 indicator cities (Odessa, Kherson and Kyiv) were analyzed. The average annual air temperature for Odessa and Kherson is 11 degrees Celsius, and for Kyiv - 8 degrees Celsius. The amplitude of oscillations is about 24 degrees.
- ✓ Warming stripes for the extended period 1979-2018 for Odessa are typical at the level of 8.5 - 12.5 degrees, for Kherson - 8.0-11.9 degrees and for Kyiv - 5.8-9.9 degrees. You can note positive trends in the data series.
- ✓ The average annual rainfall in Odessa is 455 mm, in Kherson 476 mm and in Kyiv 709 mm.
- ✓ The average annual humidity is 72-73% for Odessa and Kherson and 77% for Kyiv.
- ✓ The graphs based on data from Copernicus show a low runoff in 2021 in both the south and north of Ukraine
- ✓ The trend of surface air temperature in 3 cities is at the level of 0.06-0.08.
- ✓ With the help of Climate Explorer, the possible values of air temperature and precipitation were modeled in two scenarios. The average annual air temperature in the rcp 2.6 scenario will increase by 1 degree, and in the rcp 4.6 scenario by 2 degrees. And no precipitation data are available for our indicator cities.

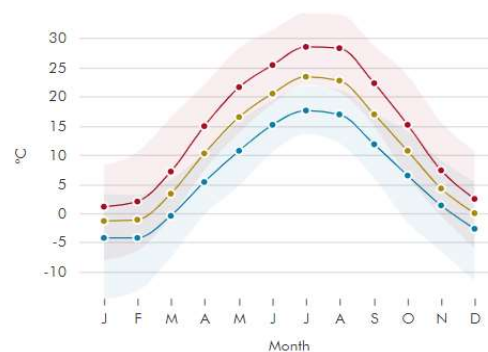
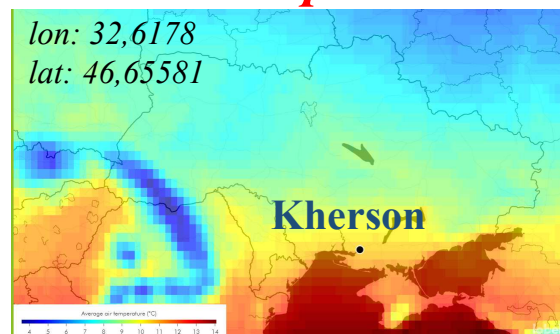
Climatic data make it possible to model the possible state of rivers in the future according to different models and scenarios. Examples can be seen on the slide. Also having data of climatic characteristics can be defined Streamflow drought index (SDI) Standardized precipitation index (SPI) Agricultural Standardised Precipitation Index (aSPI)

Air temperature



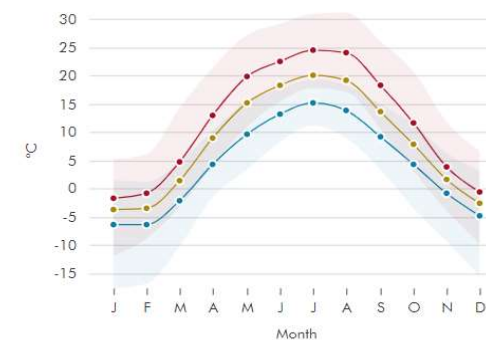
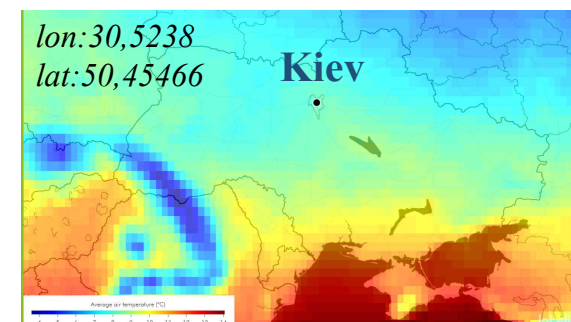
- Monthly average of daily maximum
- Monthly min/max of daily maximum
- Monthly average of daily average
- Monthly average of daily minimum
- Monthly min/max of daily minimum

Monthly average temperatures range from -0.7 °C (January) to 23 °C (July). Yearly average temperature is 11 °C.



- Monthly average of daily maximum
- Monthly min/max of daily maximum
- Monthly average of daily average
- Monthly average of daily minimum
- Monthly min/max of daily minimum

Monthly average temperatures range from -1.4 °C (January) to 23 °C (July). Yearly average temperature is 11 °C.



- Monthly average of daily maximum
- Monthly min/max of daily maximum
- Monthly average of daily average
- Monthly average of daily minimum
- Monthly min/max of daily minimum

Monthly average temperatures range from -3.8 °C (January) to 20 °C (July). Yearly average temperature is 8 °C.

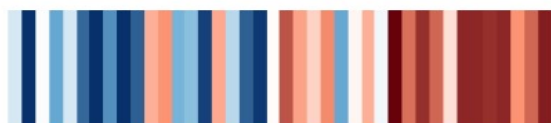


RESULTS

Warming stripes for the extended period 1979-2018



Odessa

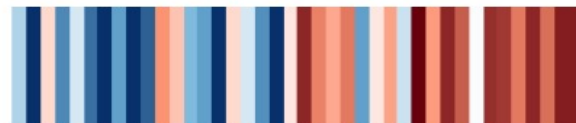


Trend equation

$$y = 0,0595x - 107,86$$

$$R^2 = 0,4904$$

Kherson



$$y = 0,0607x - 110,65$$

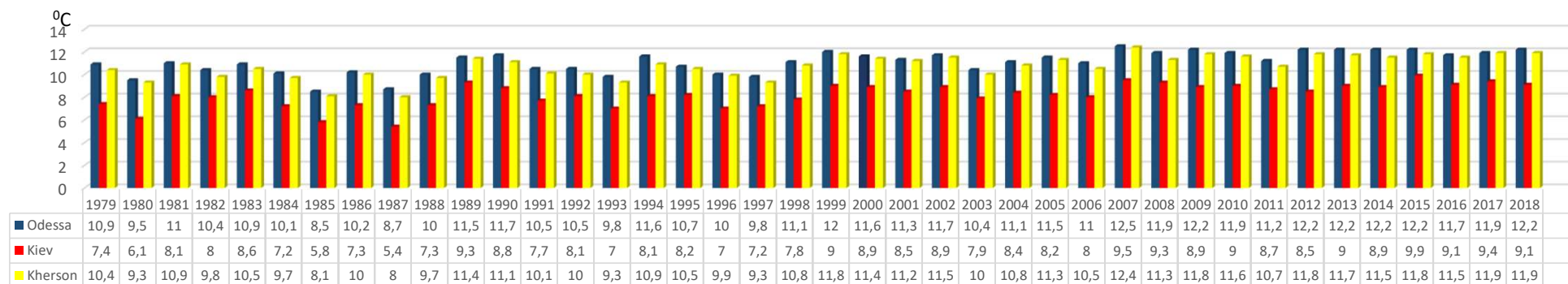
$$R^2 = 0,4683$$

Kiev

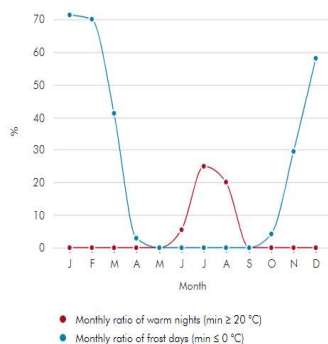


$$y = 0,0583x - 108,4$$

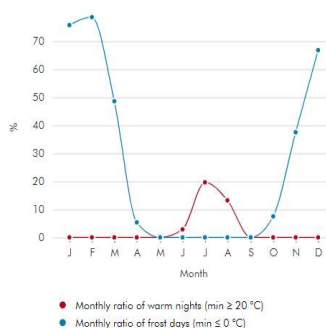
$$R^2 = 0,4459$$



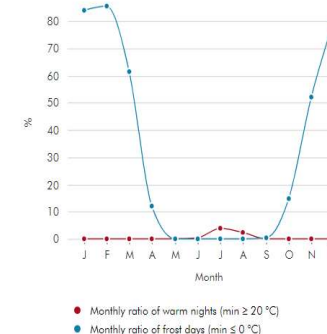
■ Odessa ■ Kiev ■ Kherson



Warm nights (night temperature ≥ 20 °C) occur 4.3% of the year.
Frost days (night temperature ≤ 0 °C) occur 23% of the year.



Warm nights (night temperature ≥ 20 °C) occur 3% of the year.
Frost days (night temperature ≤ 0 °C) occur 27% of the year.



Warm nights (night temperature ≥ 20 °C) occur 0.5% of the year.
Frost days (night temperature ≤ 0 °C) occur 33% of the year.

11/12/2021

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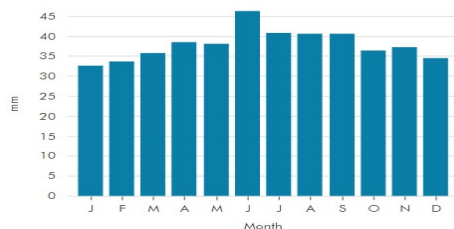


RESULTS

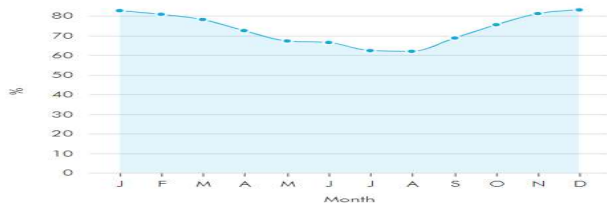
Precipitation and humidity



Odessa

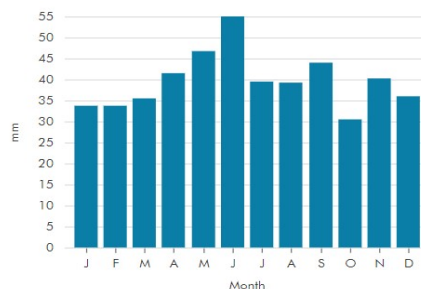


Monthly precipitation values range from 33 mm (January) to 46 mm (June).
Average yearly precipitation is 455 mm.

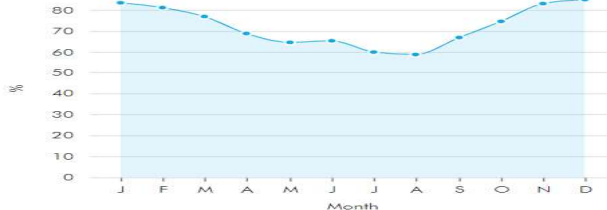


Relative humidity ranges from 62% (August) to 83% (December) (monthly average).
Yearly average humidity is 73%.

Kherson

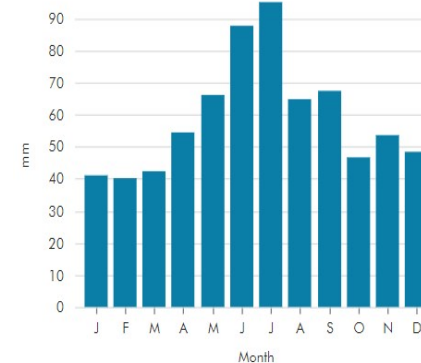


Monthly precipitation values range from 31 mm (October) to 55 mm (June).
Average yearly precipitation is 476 mm.



Relative humidity ranges from 59% (August) to 85% (December) (monthly average).
Yearly average humidity is 72%.

Kiev



Monthly precipitation values range from 40 mm (February) to 95 mm (July).
Average yearly precipitation is 709 mm.



Relative humidity ranges from 66% (May) to 87% (December) (monthly average).
Yearly average humidity is 77%.



RESULTS



Home Search Datasets Applications Your requests Toolbox Support Live

Applications Data Documentation

Search for app or example

your workspace

Runoff

12 Calculate regional mean and anomalies-2

21 Calculate regional mean and anomalies-1

21 Calculate regional mean and anomalies

31 Calculate trends

00 Hello World

01 Retrieve data

02 Plot map

03 Extract time series and plot graph

11 Calculate time mean and standard deviation

12 Calculate climatologies

21 Calculate regional mean and anomalies

31 Calculate trends

41 Calculate GDD

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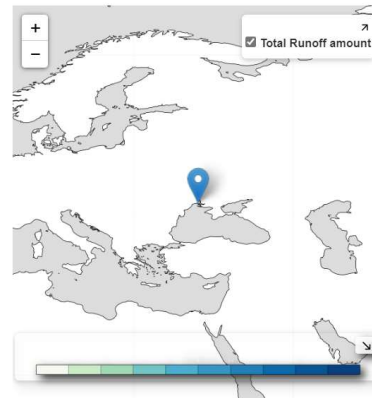
21 Calculate regional mean and anomalies

31 Calculate trends

41 Calculate GDD

```
1 import cdtoolbox as ct
2
3
4 # Define a child function printing the clicked coordinates
5 @ct.child()
6 @ct.output.livefigure()
7 def child_app(location, runoff):
8     # Get lat and lon from the clicked on map location
9     lat, lon = location['lat'], location['lon']
10
11     # Extract data at the selected location
12     data_sel = ct.geo.extract_point(runoff, lon=lon, lat=lat)
13
14     # Create a line plot of the selected time series
15     fig = ct.chart.line(
16         data_sel,
17         layout_kwargs={'yaxis': {'title': 'runoff'}}
18     )
19     return fig
20
21
22 @ct.application(title='Dynamic map with click on map', fullscreen=True)
23 # Define a livemap output launching the "child_app" application when the map is
24 # clicked
25 @ct.output.livemap(click_on_map=child_app)
26 def application():
27     # Retrieve a variable over a defined time range
28     runoff = ct.catalogue.retrieve(
29         'reanalysis-eras5-single-levels-monthly-means',
30         {
31             'variable': 'runoff',
32             'product_type': 'reanalysis',
33             'year': 2021,
34             'month': [
35                 '01', '02', '03', '04', '05', '06',
36                 '07', '08', '09', '10', '11', '12'
37             ],
38             'day': list(range(1, 32)),
39             'time': ['12:00'],
40             'grid': ['1', '1']
41         }
42     )
```

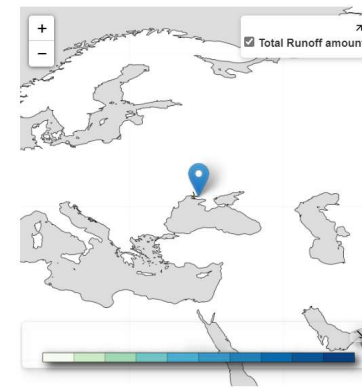
Odessa



Position: 46.75°N, 31.5°E



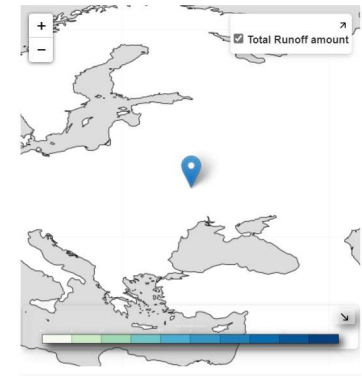
Kherson



Position: 46.5°N, 32.5°E



Kiev



Position: 50.25°N, 30°E

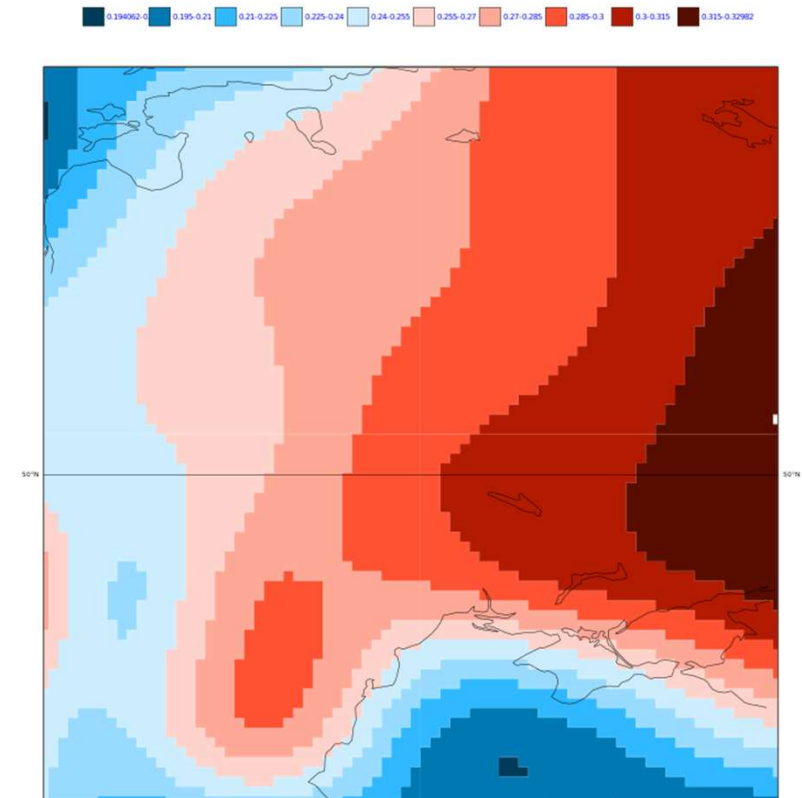
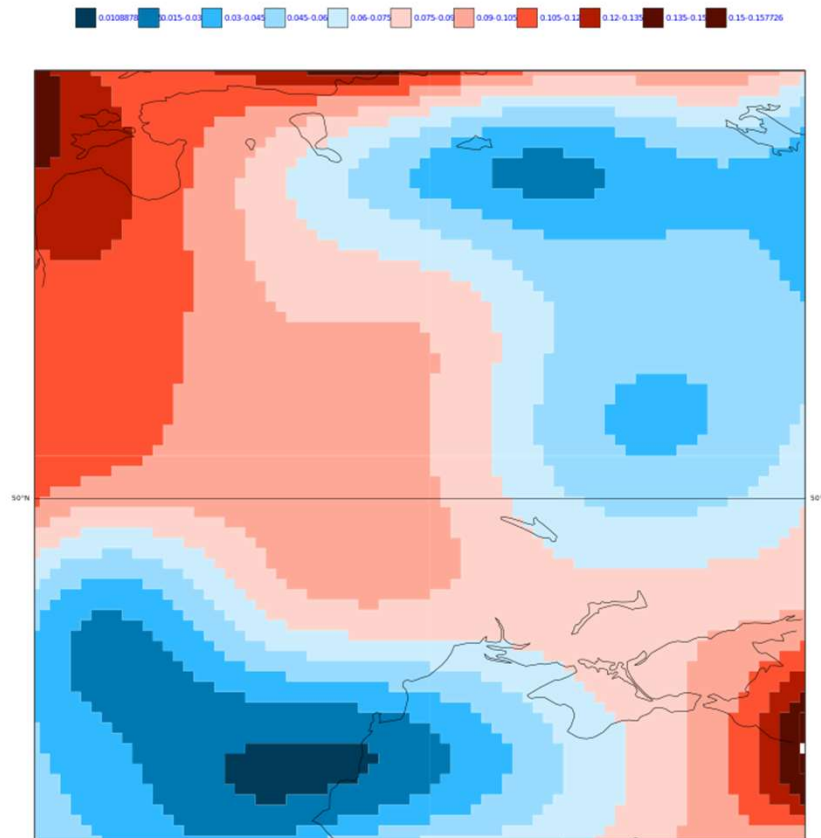




RESULTS

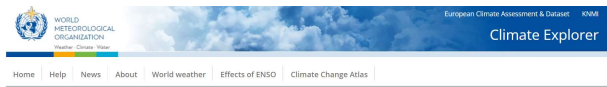
surface air temperature trend (K

temperature trend standard dev





RESULTS



Select a region

Type: ☐ IPCC WG1 ☐ IPBES ☒ countries ☐ place ☐ box

Country:

Select a season

Season: First month length months

Select a dataset and variable

Dataset:

Variable:

☒ absolute ☐ relative changes are shown

Output: ☒ map ☐ time series

Map options

Scenario:

Measure:

Reference period:

Future period:

Mean/percentiles:

Select a region

Type: ☐ IPCC WG1 ☐ IPBES ☒ countries ☐ place ☐ box

Country:

Select a season

Season: First month length months

Select a dataset and variable

Dataset:

Variable:

☒ absolute ☐ relative changes are shown

Output: ☒ map ☐ time series

Map options

Scenario:

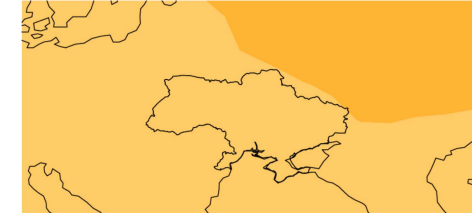
Measure:

Reference period:

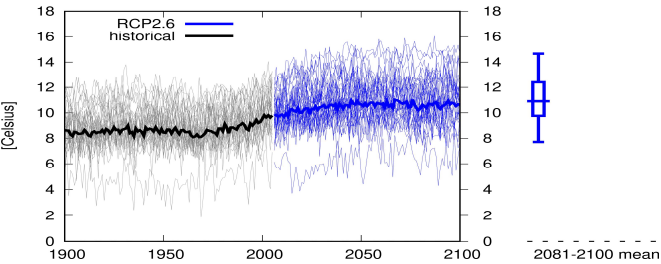
Future period:

Mean/percentiles:

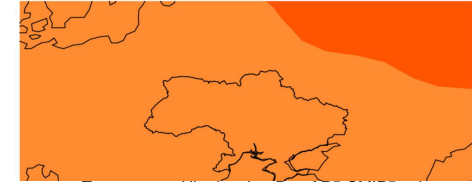
mean rcp26 temperature 2081-2100 minus 1986-2005 Jan-Dec AR5 CMIP5 subset



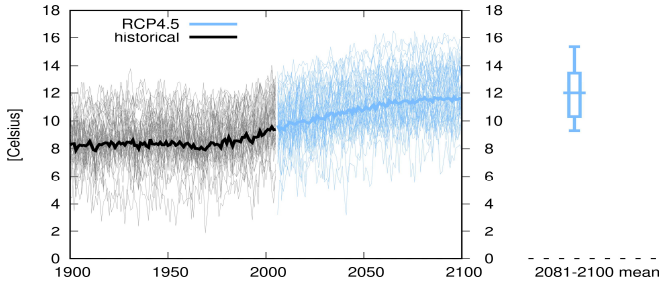
Temperature Ukraine Jan-Dec AR5 CMIP5 subset



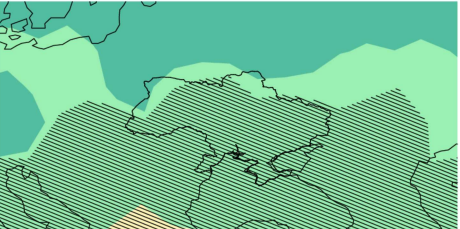
mean rcp45 temperature 2081-2100 minus 1986-2005 Jan-Dec AR5 CMIP5 subset



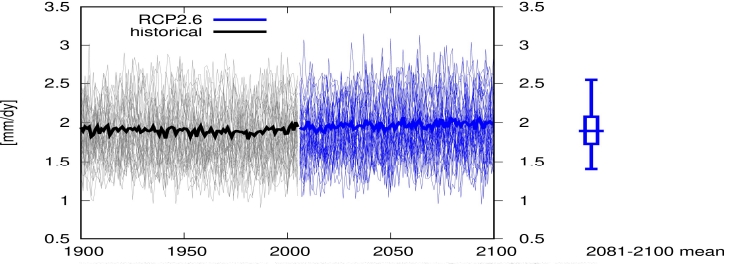
Temperature Ukraine Jan-Dec AR5 CMIP5 subset



mean rcp26 precipitation 2081-2100 minus 1986-2005 Jan-Dec AR5 CMIP5 subset



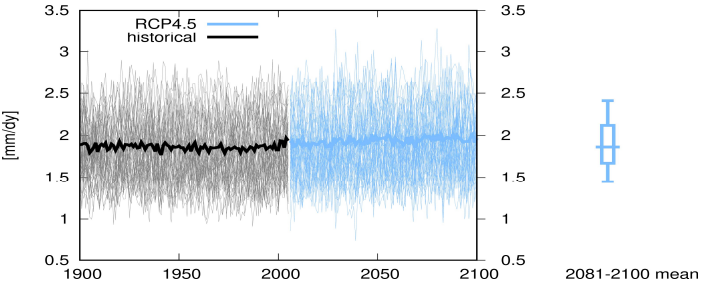
Precipitation Ukraine Jan-Dec AR5 CMIP5 subset



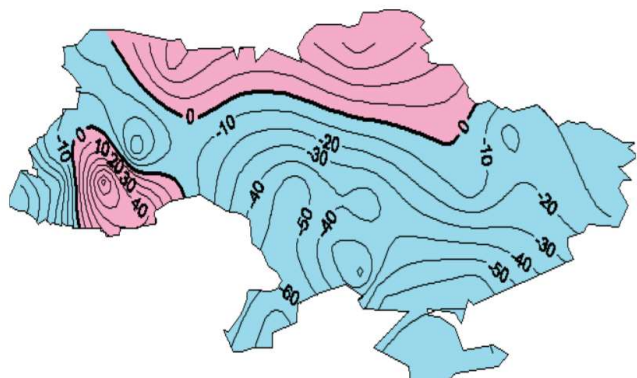
mean rcp45 precipitation 2081-2100 minus 1986-2005 Jan-Dec AR5 CMIP5 subset



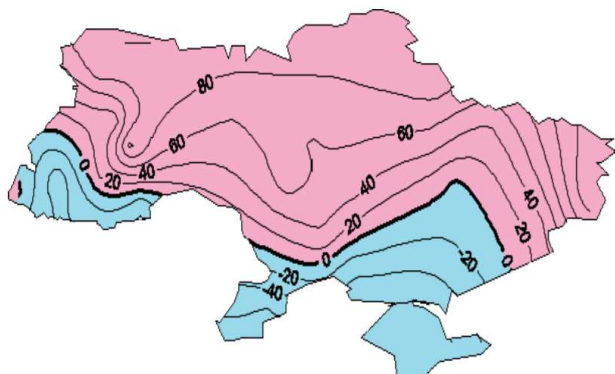
Precipitation Ukraine Jan-Dec AR5 CMIP5 subset



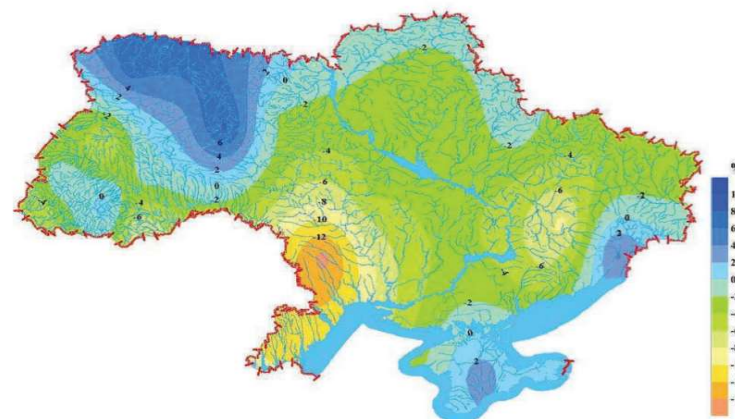
RESULTS



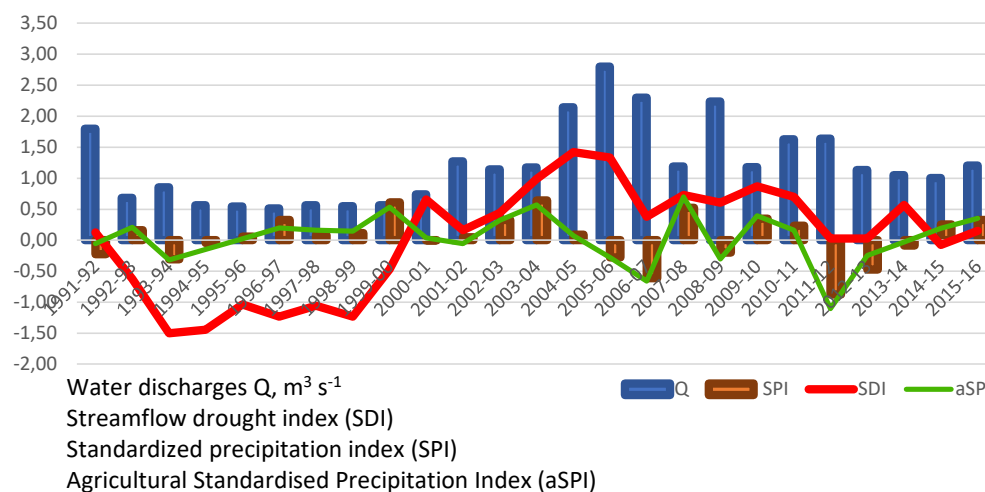
Spatial distribution of relative deviations (%) of annual climatic runoff norms for the period 2031–2050 in comparison with the data before 1989 (scenario A1B) [Authors Loboda N.S., Bozhok Yu.V.]



Spatial distribution of relative deviations (%) of annual climatic runoff norms for period 2031–2050 compared to data before 1989 (scenario A2) [Authors Loboda N.S., Bozhok Yu.V.]



Possible future changes in the average annual water runoff (%) of rivers of Ukraine for the period 2031–2050 relative to the base period 1991–2010 according to the RCM, scenario A1B [Author Gorbacheva L.O.]





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Thank you!

