Future wildfire conditions in Ukraine under the RCP 8.5 climate scenario

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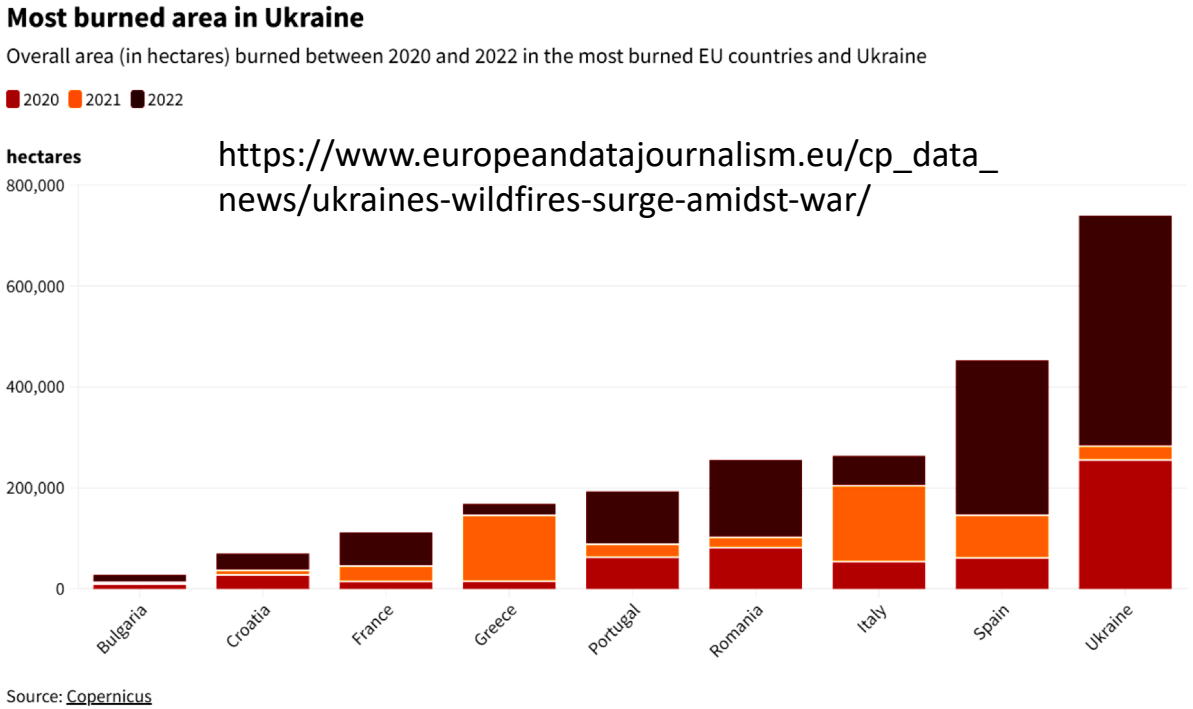
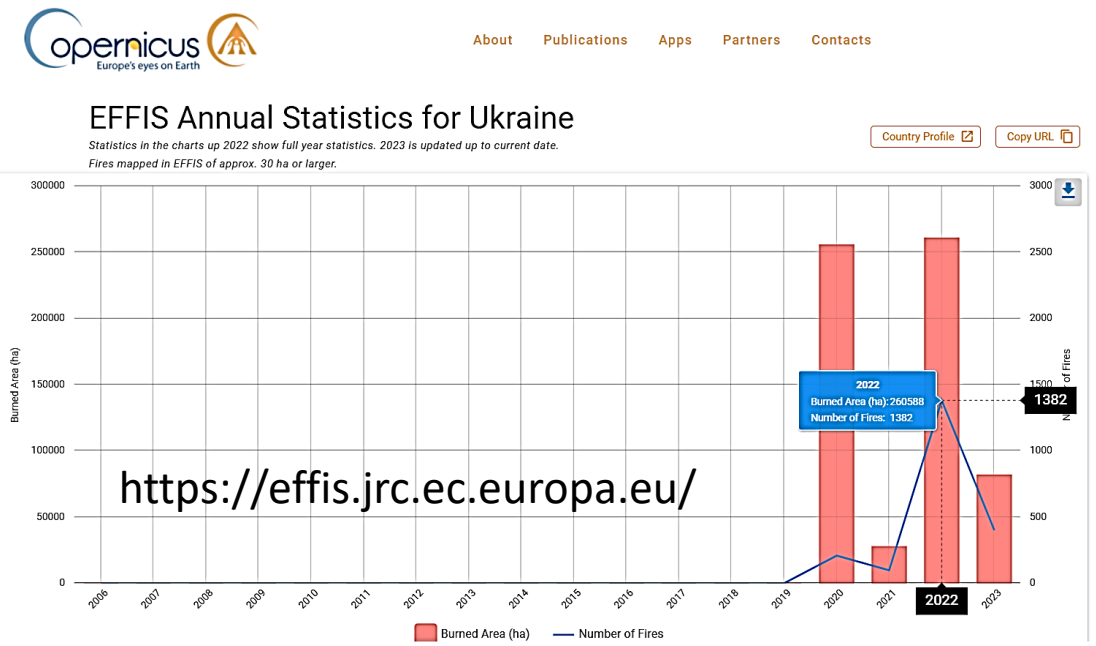
Introduction

- 18.5 % of Ukraine's territory is covered by forests.
- During 1990–2017 in the forest areas of the country about 106.8 thousand fires with a total area of 139.2 thousand hectares arose.
- In 2020, under severe drought, 209 forest fires occurred in Ukraine, most significant were in the Chernobyl zone in April.



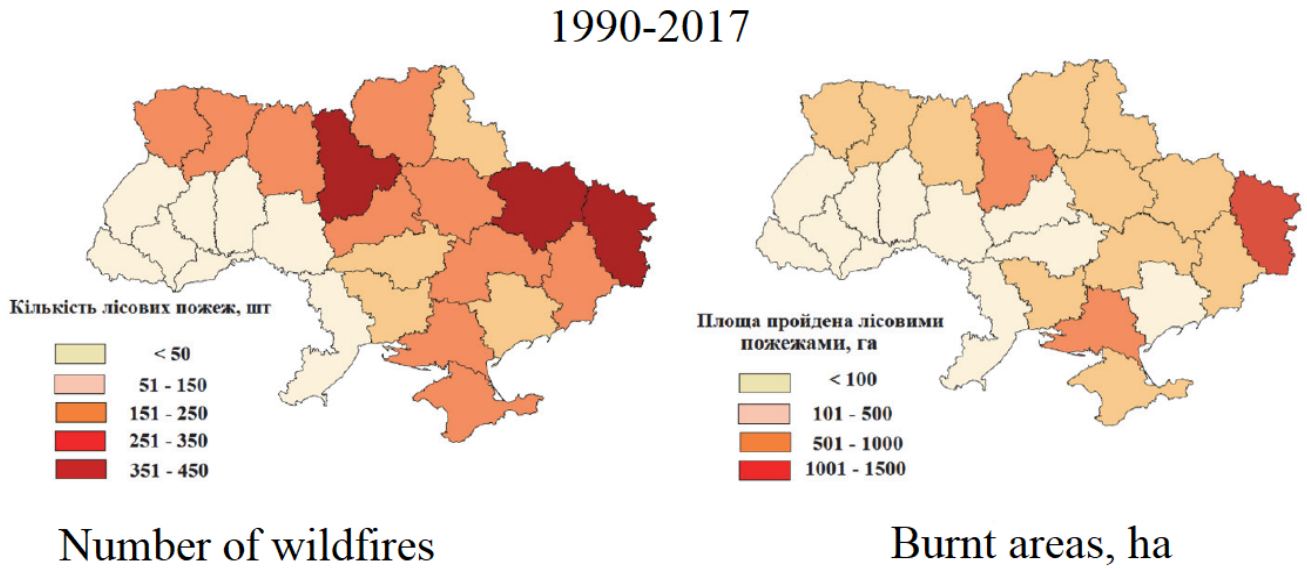
https://www.europeandatajournalism.eu/cp_data_news/ukraines-wildfires-surge-amidst-war/

Source: Copernicus



In 2022, most of the forest fires occurred in the military combat zone.

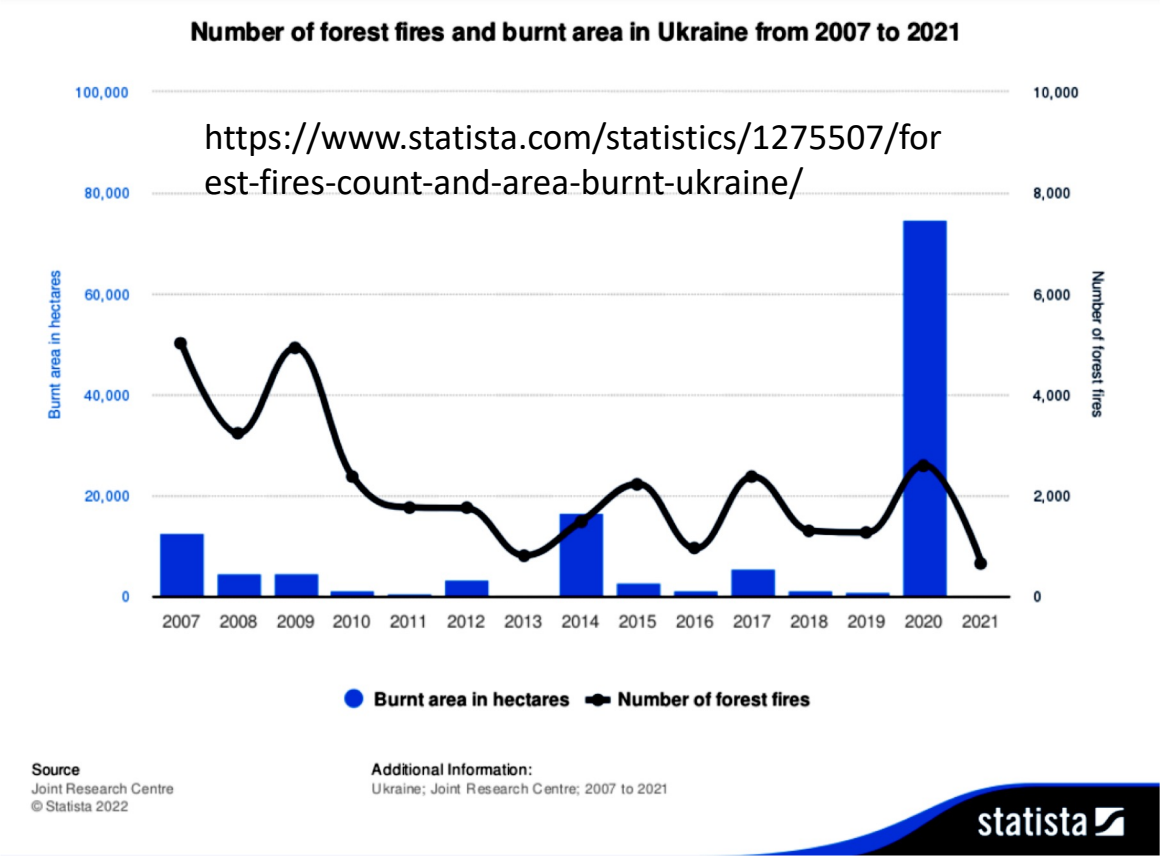
Current wildfire`s statistics



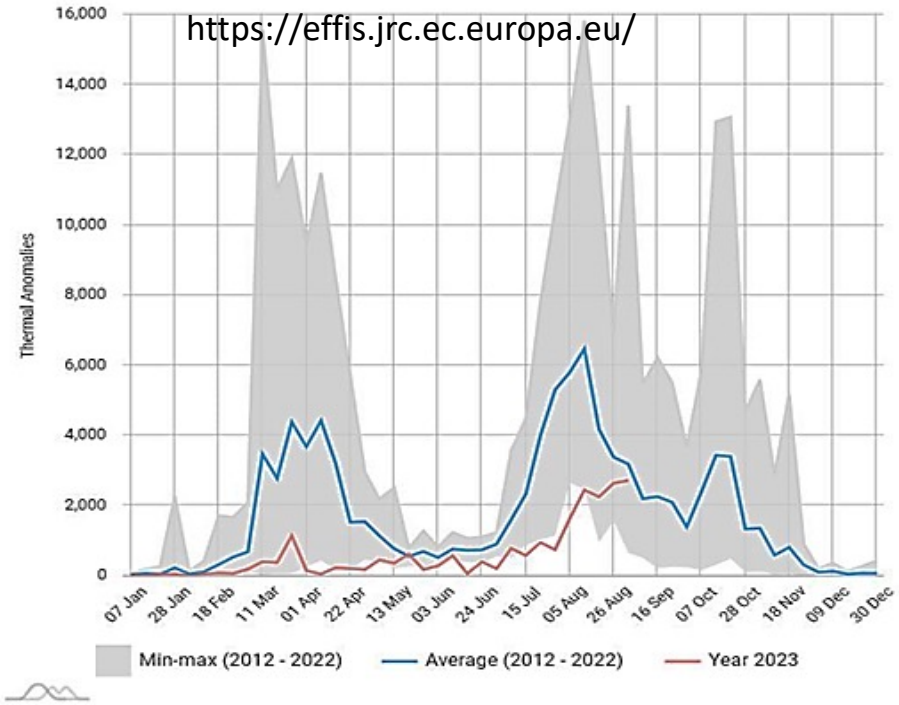
Zibtsev et al. (2019). DOI: 10.31548/forest2019.03.027

- The average annual number of wildfires ranges from 8-10 cases in the west regions (Vinnytsia, Ternopil', Chernivtsi) to more then 400 cases in the northern Steppe (Kyiv region > 700 cases).
- In most cases, fires are caused by forest visitors, as well as uncontrolled agricultural burnings.

- An analysis of the long-term dynamics of fires shows that forest fires in Ukraine are a sustainable phenomenon.

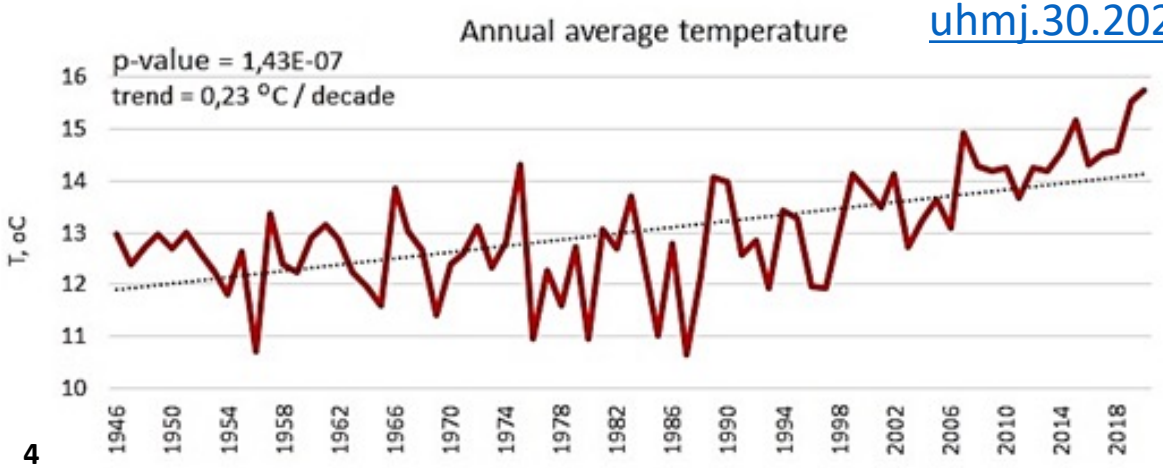


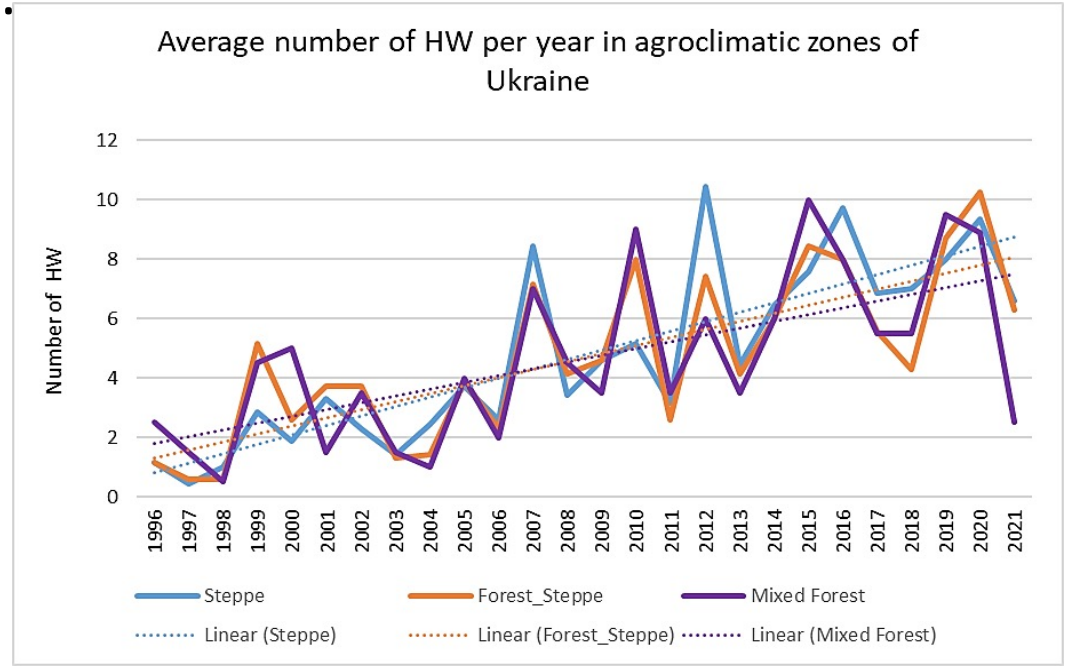
Weather condition and wildfires



- Frequency, intensity of wildfires and amount of burned areas depend on the current weather and climate conditions.
- In the seasonal distribution in Ukraine are three periods of maximum fire activity: spring (March-April) and summer (August) and autumn (October).
- The annual average temperature in Ukraine (as well as precipitation) has a positive long-term trend.
- The number of heat waves (HW) significantly increased during last 20 years.

Semenova I. (2022). https://doi.org/10.31481/uhmj.30.2022.03





Methods and data

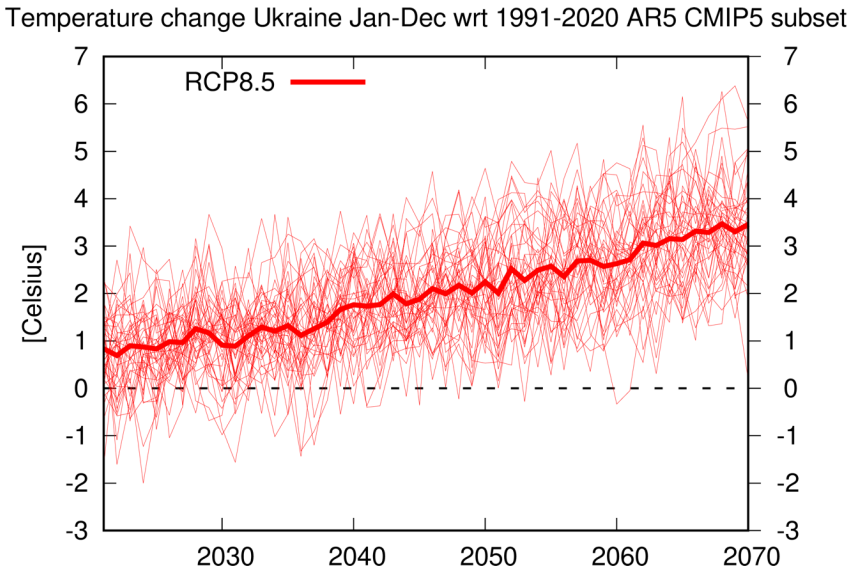
To analyse future fire weather conditions the Angström index (*AI*) was used:

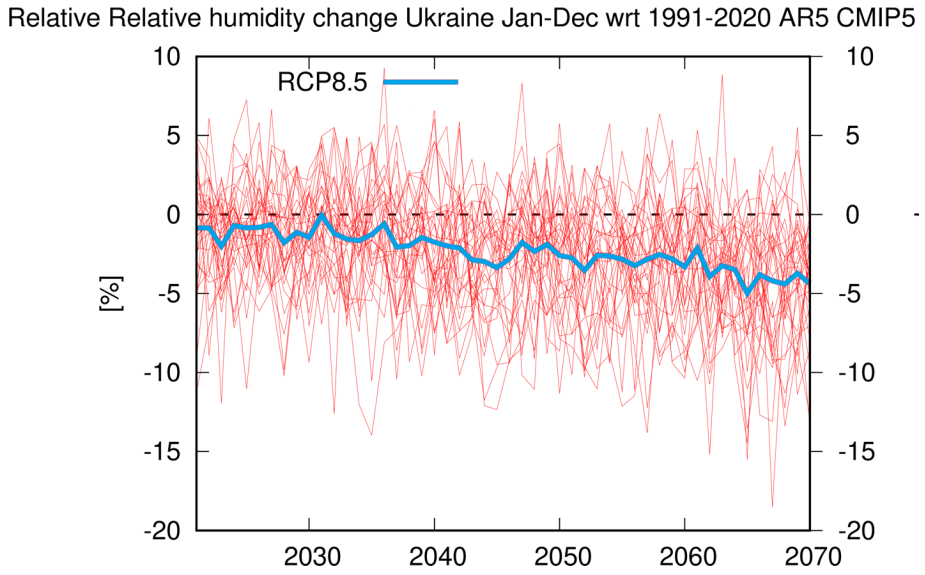
$$AI = \left(\frac{H_{13}}{20}\right) + \left(\frac{27 - T_{13}}{10}\right)$$

Index values	Interpretation
$AI > 4.0$	Fire occurrence unlikely
$4.0 < AI < 2.5$	Fire conditions unfavorable
$2.5 < AI < 2.0$	Fire conditions favorable
$AI < 2.0$	Fire occurrence very likely

where H_{13} is relative air humidity [%] and T_{13} is air temperature [°C] at 13:00.

For the calculation ***AI*** the high-resolution regional climate model's data from the framework of the CORDEX (RCM is MPI-CSC-REMO2009) was used.

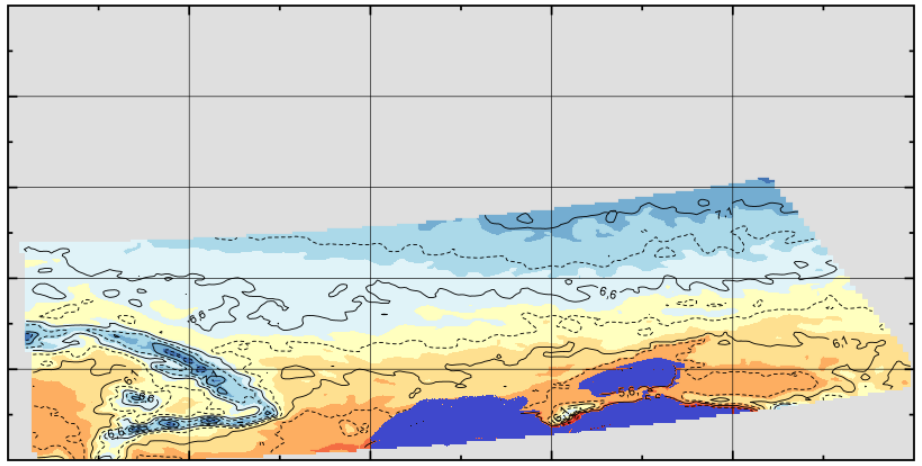




KNMI Climate Change Atlas
https://climexp.knmi.nl/plot_atlas_form.py

AI seasonal distribution in 2021-2070

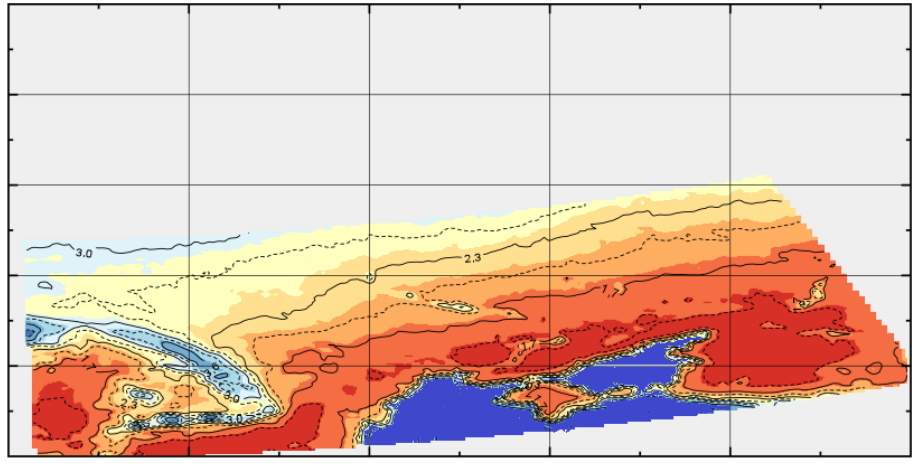
Mean AI in winter 2021-2070



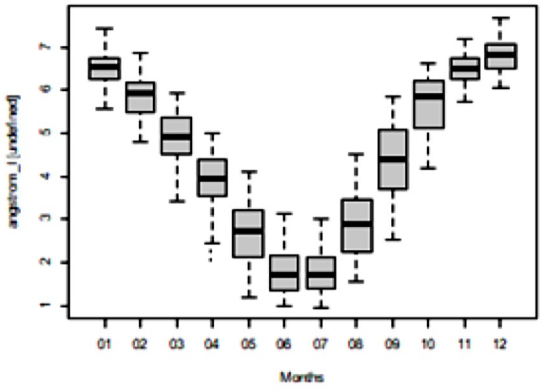
Data Min = 5,1, Max = 7,6

A clearly defined seasonal course: max *AI* in winter and autumn, min *AI* in summer and spring.

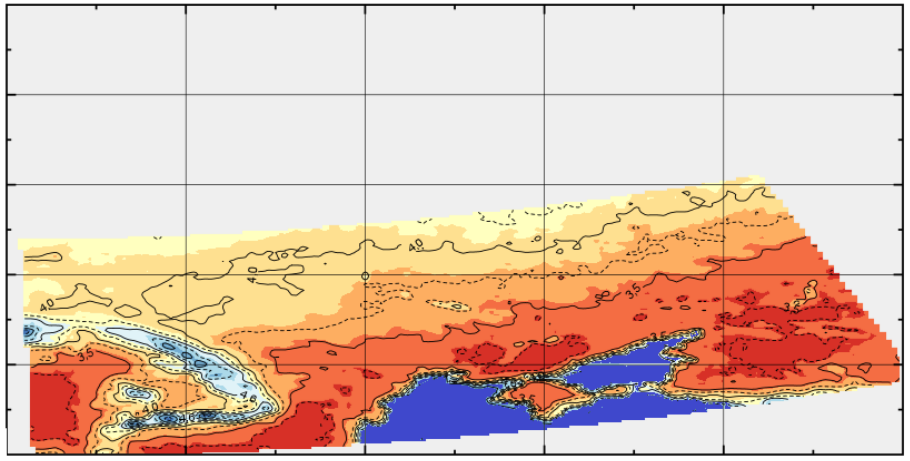
Mean AI in summer 2021-2070



Data Min = 1,0, Max = 4,3



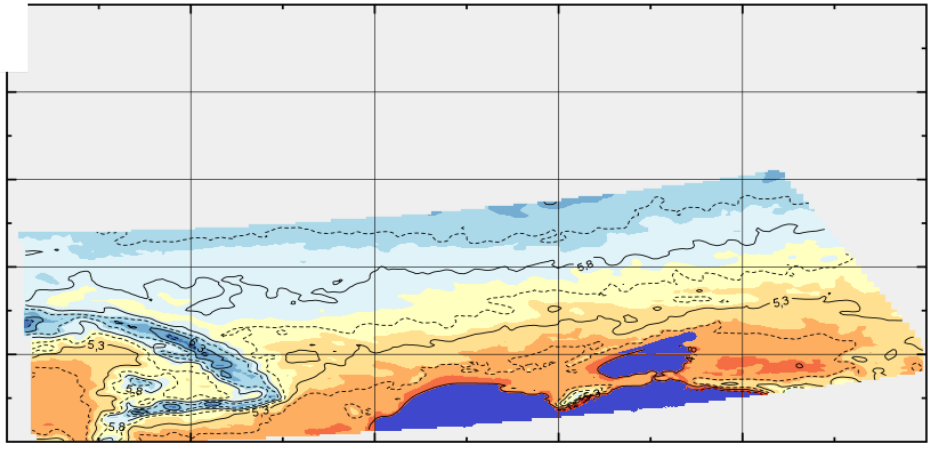
Mean AI in spring 2021-2070



Data Min = 2,9, Max = 5,7

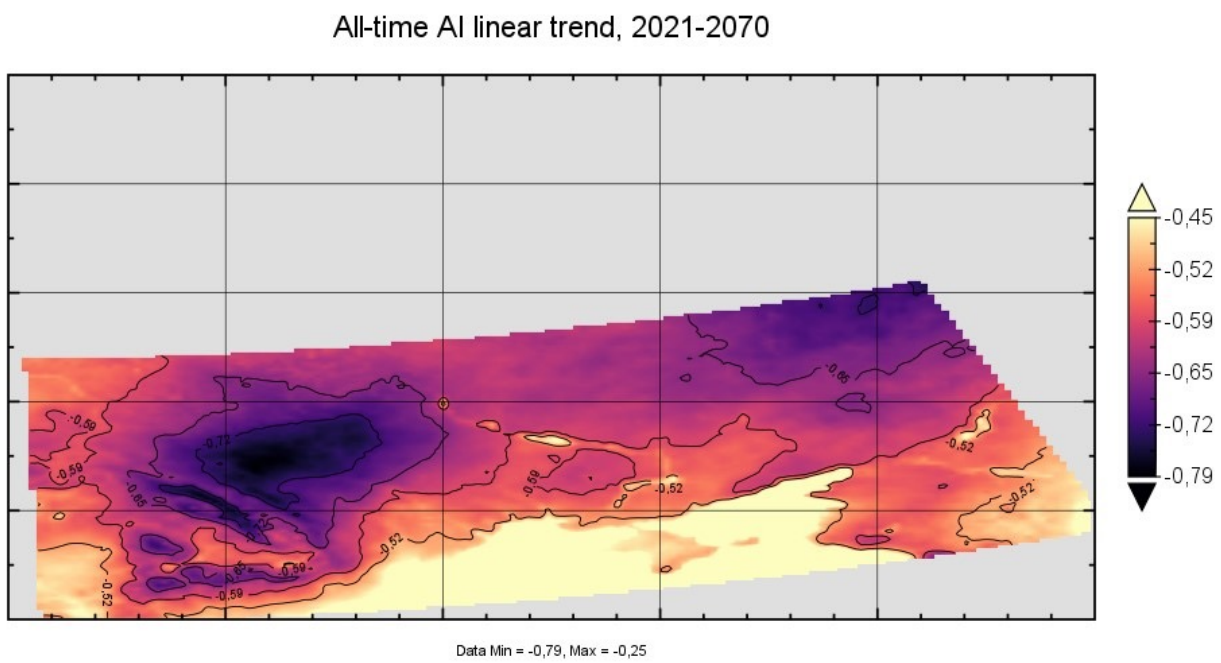
AI has a quasi-zonal distribution with the minimum in the southern steppe, and the maximum the north of the forest-steppe and mixed forests.

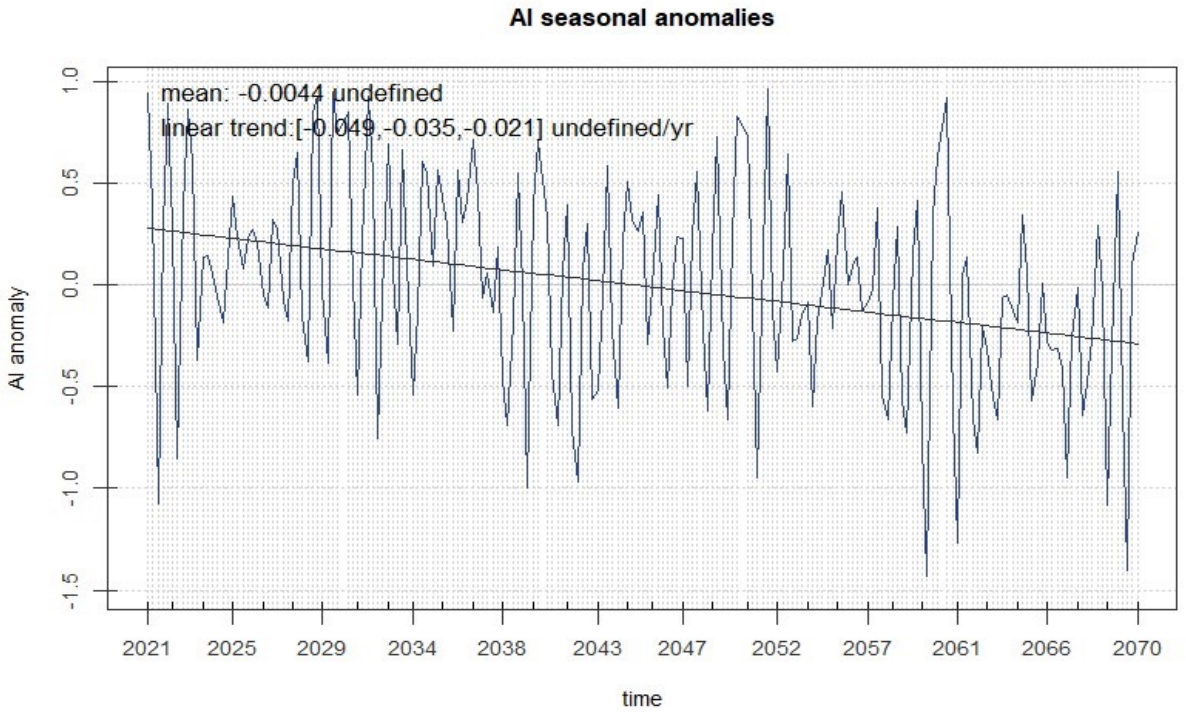
Mean AI in autumn 2021-2070



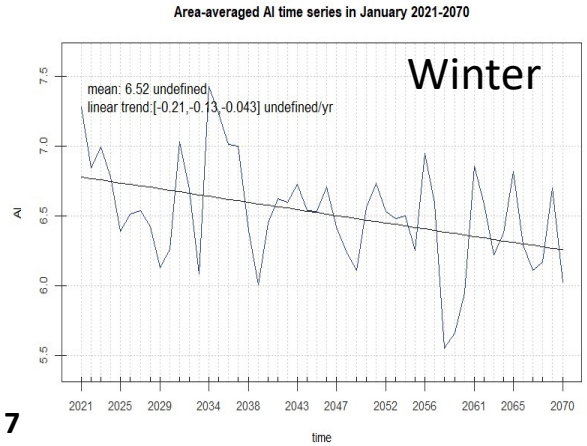
Data Min = 4,3, Max = 6,8

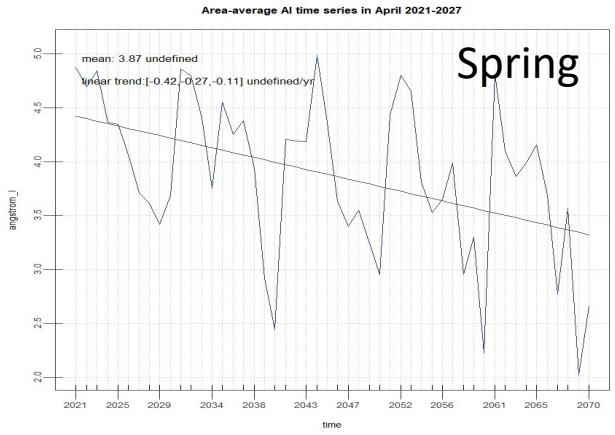
AI anomalies and trends

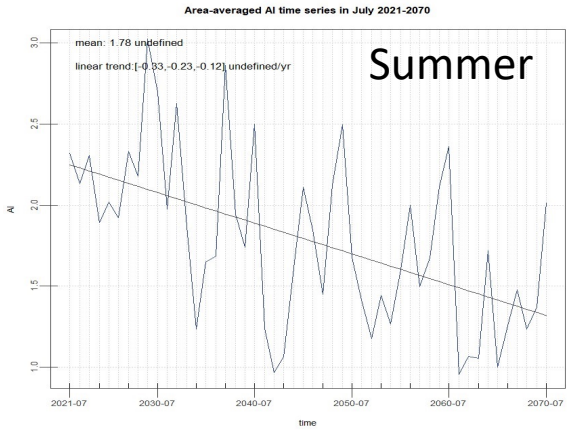


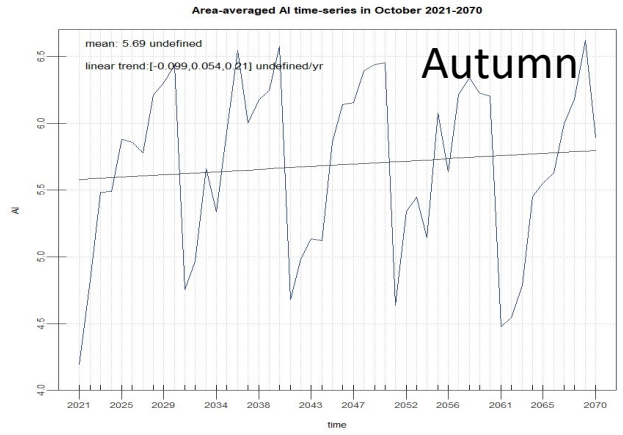


The AI time series shows the expected decrease in AI values in all seasons except autumn.

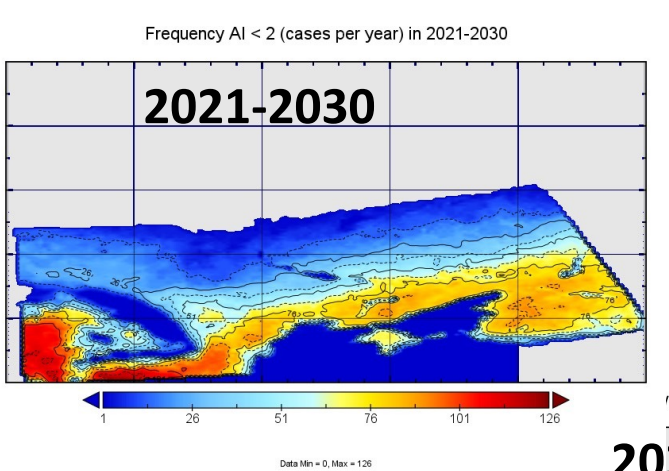




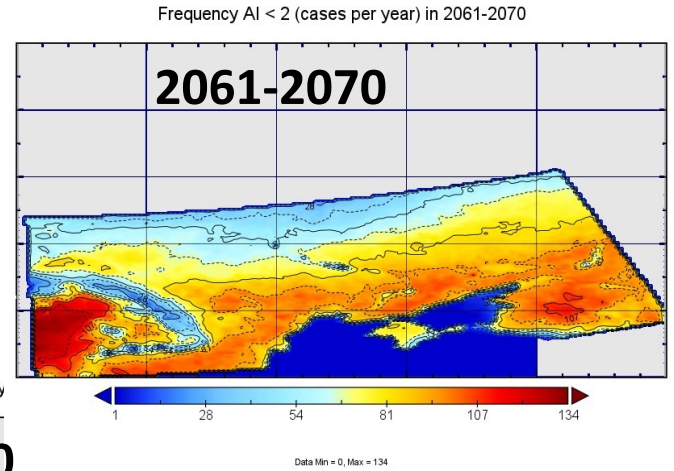


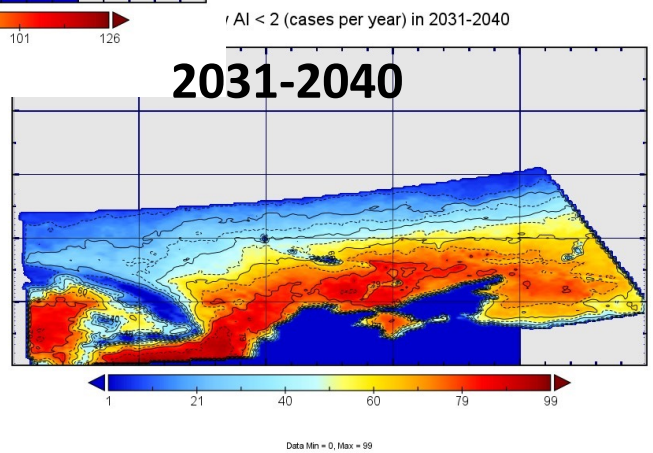


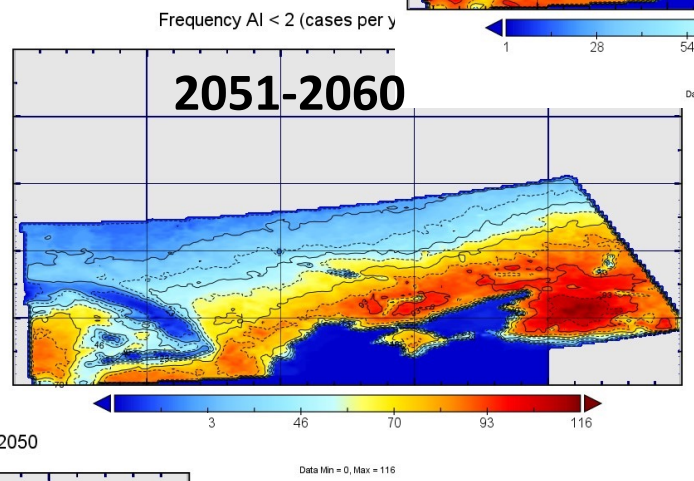
Frequency of days with high fire danger level *AI* < 2 (days per year)

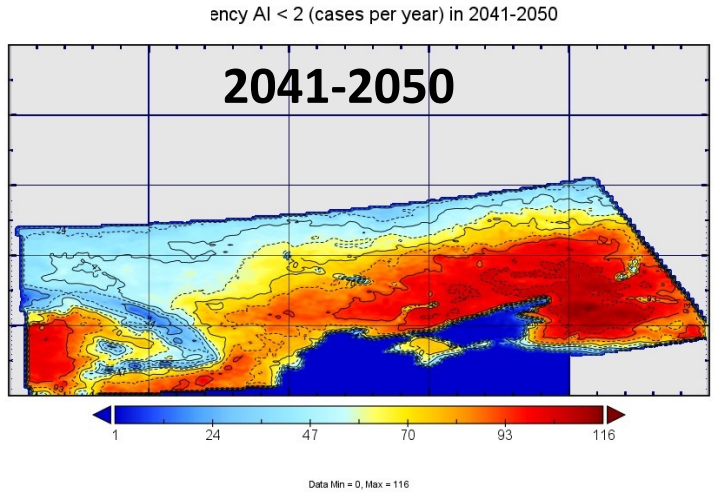


Maximum frequency
from **70-85** days/year to **110-115** days/year









Maximum number of days with AI < 2 is expected in the southern steppe all times.

In 2041-2050 the maximum affected area with AI < 2 is expected throughout Ukraine).

Summary and conclusion

- According to projections, climate change to make wildfires more frequent and intense both in global and regional level.
- A simple Angström index based on air temperature and relative humidity is suitable for determining the impact of climate change on fire weather conditions.
- The projected temperature and humidity conditions in Ukraine under the most severe scenario of RCP8.5 will contribute to significant increase in the annual number of days with high level fire danger, especially in spring a