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Spatiotemporal variability of convective available potential energy over Ukraine and fire weather

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Objectives

The study examines the features of spatial and temporal distribution of convective available potential energy (CAPE) in different regions of Ukraine in the warm season (April-October) for period 2000-2020, as well as the statistical relationship of this parameter with the fire weather index (FWI).

Data and Methods

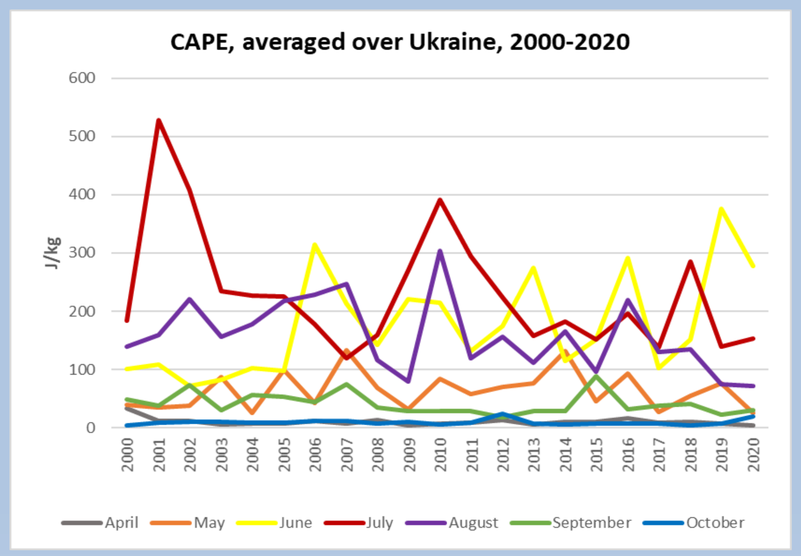
Average monthly fields of CAPE and FWI values based on daily data of ERA5 reanalysis (at 00, 06, 12, 18 UTC) were obtained from Copernicus Climate Data Store (https://cds.climate.copernicus.eu/cdsapp#!/home).

CAPE seasonal variability

CAPE values have a clear seasonal course, with a rapid increase in average monthly values from April to May and weak growth rates in subsequent months. The maximum monthly average CAPE values in all regions are observed in July: from 171 J/kg in the east to 306 J/kg in the south of the country. In August, CAPE decreases everywhere, especially in the north and center of Ukraine (up to 40%). The minimum monthly average CAPE values are noted in October, while in all regions, except for the southern ones, the CAPE values are less than in April.

Monthly mean CAPE averaged the regions

Month	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
April	7,5	8,0	8,9	8,7	13,2	8,9
May	64,2	81,1	49,5	57,1	69,3	59,4
June	209,8	265,1	129,9	147,6	176,1	136,8
July	295,8	306,3	171,3	227,6	236,1	233,8
August	201,5	279,2	83,5	90,1	145,1	92,8
September	52,6	66,1	29,5	18,3	22,2	16,3
October	12,0	9,0	6,2	6,2	7,7	6,6



The increase in monthly mean CAPE values in early summer (May-June) suggests an increase in the probability of more precipitation sum in these months. In the second half of summer (July-August), on the contrary, negative CAPE trends prevailed, so the total potential of convective precipitation also decreased, which is confirmed by trends in dry conditions (e.g. *Semenova, 2021*). At the beginning of the warm period (April) and at the end (September-October), the CAPE trends are significantly less intense and heterogeneous in space, which does not affect the change in the precipitation regime in these months.

Pearson's ***r*** between CAPE and FWI

Month	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
April	-0,39	-0,47	-0,49	-0,45	-0,42	-0,48
May	0,17	0,18	-0,02	0,07	-0,12	0,00
June	-0,03	0,09	-0,25	-0,13	-0,31	-0,27
July	-0,22	-0,01	-0,33	-0,20	-0,11	-0,15
August	-0,37	-0,26	-0,40	-0,32	-0,34	-0,21
September	0,02	-0,13	-0,61	-0,19	0,13	-0,22
October	0,04	-0,01	-0,55	-0,56	-0,53	-0,71

The statistic reletionship between CAPE and FWI

In most regions the closest inverse relationship between the parameters is observed in April (Pearson's *r* is -0.39,…-0.49) and October (*r* is -0.55,…-0.71, except for the southwest). In the southeast of the country, significant correlation coefficients (-0.33,…-0.61) were noted in all months except May and June.

The statistical relationship is very weak in most regions in May, June, July and September. High monthly average values of CAPE, in general, characterize a higher probability of precipitation, which should lead to a decrease in fire hazard. However, in summer, due to intense heating of the ground, the frequency in emergence of conditions for the realization of convective instability is much higher than in the spring-autumn period, which leads to a decrease in the decisive role of this parameter in the formation of fire hazardous weather conditions (*Semenova and Sumak, 2022*).

Linear trends in monthly mean CAPE

In **April,** negative trends prevailed over most regions of the country, a decrease in CAPE most noticeable in the eastern, southern, southwestern regions. In the western part are tendencies close to zero or a slight increase in CAPE.

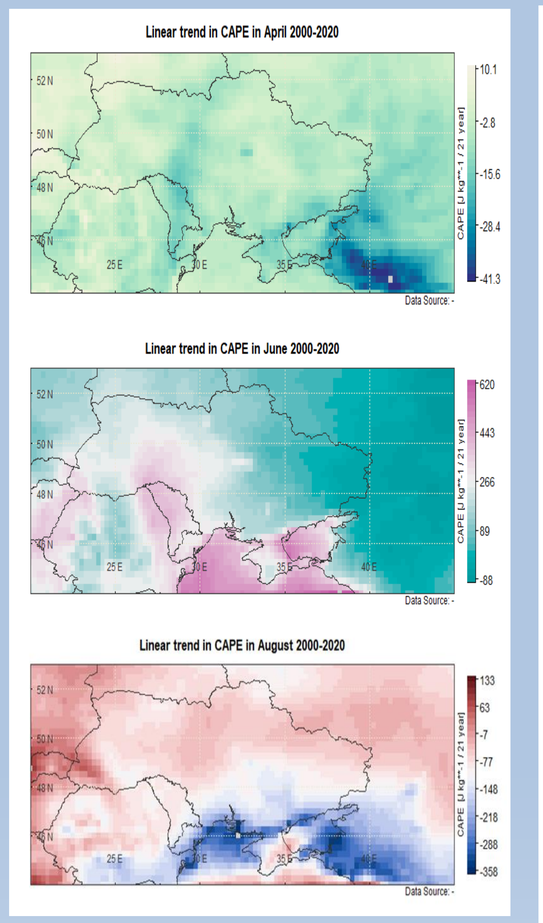
In **May**, in most of the territory of Ukraine, there was an increase in CAPE, and in the southern regions. In the western regions, on the contrary, CAPE decreased with almost the same intensity.

In **June**, negative trends in CAPE were observed only in the east of the country; positive trends prevailed in the rest of the territory, with the highest values in the southwestern and western regions.

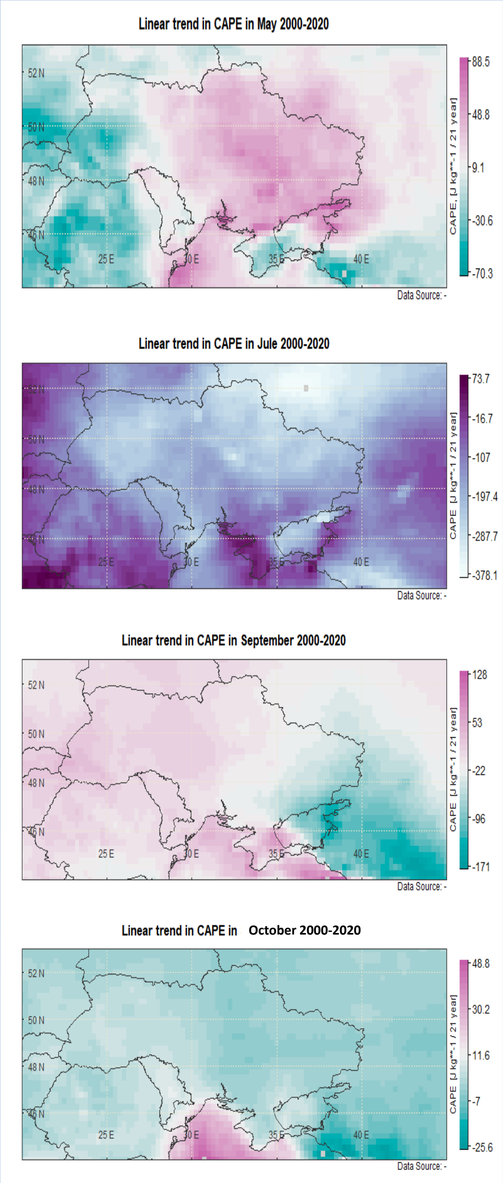
In **July**, negative trends in CAPE were observed throughout the country, with the greatest decrease occurred in the northeastern, southwest and in some western regions.

In **August**, in most regions of Ukraine, negative trends in CAPE were observed, while in the south, the largest decrease was noted on the coast of the Black and Azov Seas. In the northern regions, in some places in the center, as well as in Transcarpathia, slight positive trends in CAPE prevailed.

In **September**, positive CAPE trends were observed throughout the western half of Ukraine and in the south, in the central regions they were close to zero, and in the eastern regions trends were negative.



In **October**, in the eastern half of Ukraine, there were small negative trends in CAPE. In the western half and southwest edge, the CAPE trends were close to zero or slightly positive.



References

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