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ASSESMENT OF FIRE WEATHER CONDITIONS IN BELARUS UNDER MODERN CLIMATE WARMING

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INTRODUCTION

The types of emergency situations associated with weather conditions include fires in forests, fields and peat deposits. Fires annually destroy and damage forests over large areas, which has a negative impact on the social and economic development of countries. A significant role in the occurrence of extensive fires is played by dry weather, stormy wind, etc. Currently, the fire weather condition can be estimated and predicted using various weather indices. *The purpose of this study is to assess the fire weather conditions over the territory of Belarus during the warm season (March-October) for the period 1990-2020.*

Fire hazard assessment in the National Hydrometeorological Service of Belarus

The complex indicator of forest fires (by N. A. Dichenkov) is calculated in the fire - hazardous period according to the formula:

$$\Gamma = \sum_{1}^{n} t\,(t-td), \text{ where}$$

Γ - complex indicator of forest fires;
t – temperature at 2 pm;
td – dew point at 2 pm;
n - the number of dry days, i.e. the number of days without precipitation or with a daily precipitation of less than 2.6 mm.
(t-td) – dew point deficiency.

Materials and methods

The fire weather condition in the region was estimated by using the monthly data of Canadian Fire Weather Index (FWI) obtained from daily values in Copernicus Database. There were used criteria FWI adapted for the European Forest Fire Information System (EFFIS).
The forest fire data for the study period was provided by the Republican Center for Emergency Management and Response. Each fire event was included fire location with the area of ignition, occurrence time and consequences of fire (damage).

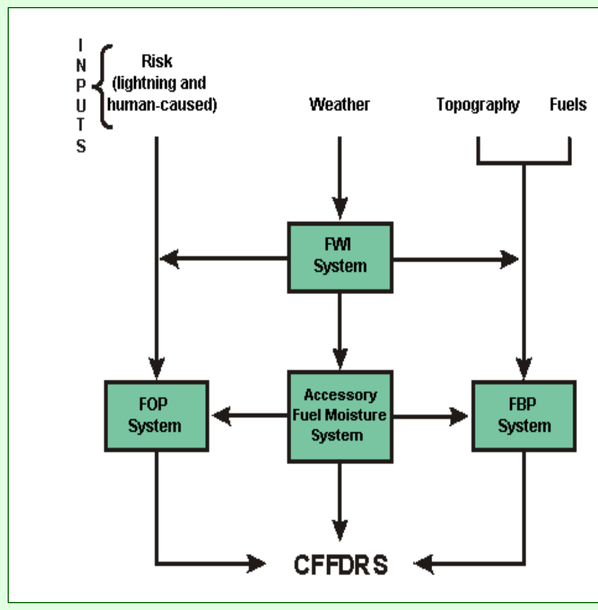
The Fire danger classes according to EFFIS and CFFDRS

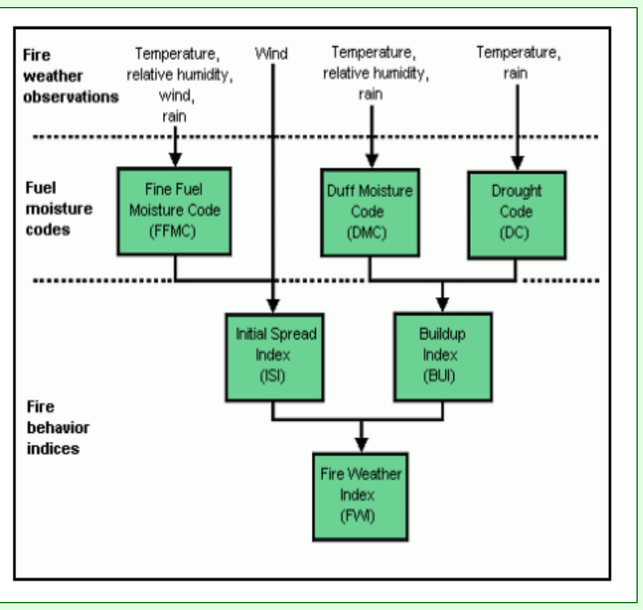
Hazard Rating	FWI CFFDRS	Hazard Rating	FWI EFFIS
Low	0-4	Very low	< 5.2
Moderate	5-10	Low	5.2 >= FWI < 11.2
High	11-18	Moderate	11.2 >= FWI < 21.3
Very High	19-29	High	21.3 >= FWI < 38.0
Extreme	30+	Very high	38.0 >= FWI < 50.0
		Extreme	FWI >= 50.0
		Very Extreme	FWI > 70.0

Components of Canadian Forest Fire Danger Rating System (CFFDRS)

Structure of FWI System

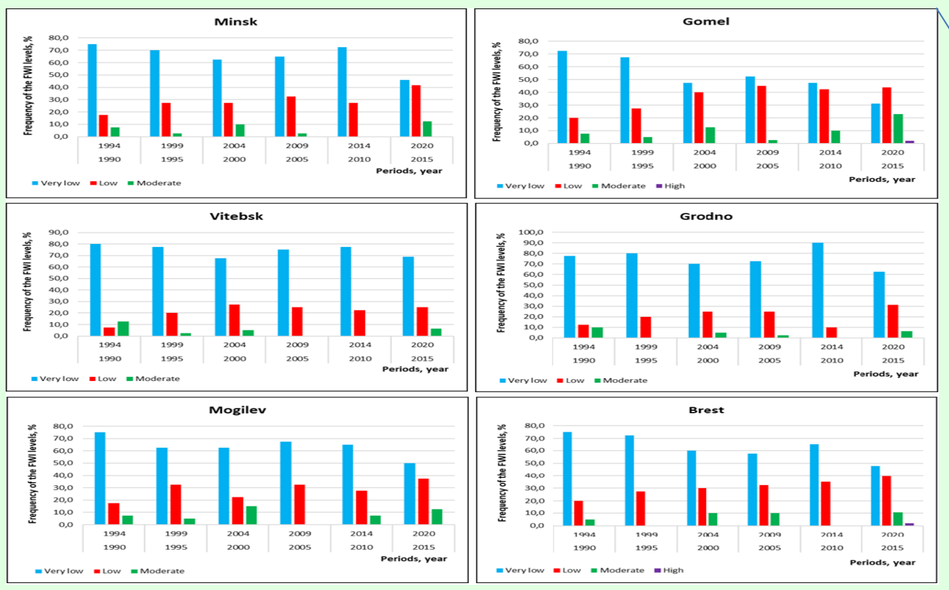
The amount of precipitation for 10 days	THE FIRE DANGER LEVEL (according N. A. Dichenkov)				
	1	2	3	4	5
	non-burnability of forests	Low burning of forests	Medium burning of forests	High burning of forests	Extreme burning of forests
Indicators of forests burning					
10 (3-14)	< 150	151-500	501-4000	4001-10000	10000 и >
20 (15-25)	<250	251-600	601-4000	4001-10000	10000 и >
26 and more	<350	351-700	701-4000	4001-10000	10000 и >





Monthly values of the FWI for the regions of Belarus for the period 1990-2020

Region	Month							
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Vitebsk	3.1	5.6	5.6	4.7	5.6	3.4	1.4	0.6
Grodno	3.2	5.3	5.6	5.0	6.0	3.8	1.8	0.9
Minsk	4.1	6.0	6.6	5.6	7.0	4.9	2.3	1.2
Mogilev	4.0	6.0	6.8	5.7	7.3	4.9	2.2	1.1
Brest	4.0	6.1	6.4	5.9	7.5	5.1	2.6	1.5
Gomel	4.7	7.2	8.3	6.7	8.5	6.5	2.9	1.5



At the beginning of the period, in 1990-1994, the very low level of FWI prevailed from 80% of cases in the Vitebsk region to 73% in the Gomel region. In the next five-year period, the repeatability of FWI in the low category increased from 20 to 40%. In the last decade, the repeatability of the middle level of FWI has increased to 10-23%, only in the Vitebsk and Grodno regions a very low and low level of FWI prevailed. The high level of FWI was observed only in period 2015-2020 over the south of Belarus (Brest and Gomel regions) with a low frequency of 2 %.

The lowest seasonal average (March-October) values of the FWI were observed in the northern and north-western regions of the country – in the Vitebsk and Grodno regions (3.7-3.9), the highest – in the south-east of the country (Gomel region), with index values reaching 5.8, which corresponds to a low level of FWI.
The seasonal course of the FWI is characterized by increasing the average monthly values of the index from March to May (from the very low to the low category of FWI), but in June, a decrease of FWI values was observed in all regions of the republic. In July, the index values increased and reached a maximum in all regions – within the low level of FWI (6…9). From August to October, there was a gradual decrease of the average monthly values of index.

Analysis of the dynamics of the FWI anomalies showed that in all regions of Belarus the months with negative FWI anomalies generally were dominated during the study period, but in some years the positive FWI anomalies were prevailed: 2002, 2007, 2011, 2014-2015, and in the period from 2018 to 2020.

SUMMARY

The obtained dynamics of the FWI indicates significant changes in the temperature and precipitation regime of the territory of Belarus in recent decades, increasing the likelihood of fires in ecosystems. The increase in the frequency of higher levels of fire danger weather occurs primarily in the southern areas of Belarus. The FWI well reflect favorable weather conditions for the occurrence and spread of wildfires. Thus, the FWI can be recommended as an alternative to existing national fire weather assessment methods due to the high level of physical content of this parameter.

References

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