

I A E A
Workshop on the Implementation of the International Radiation Monitoring Information System (IRMIS)

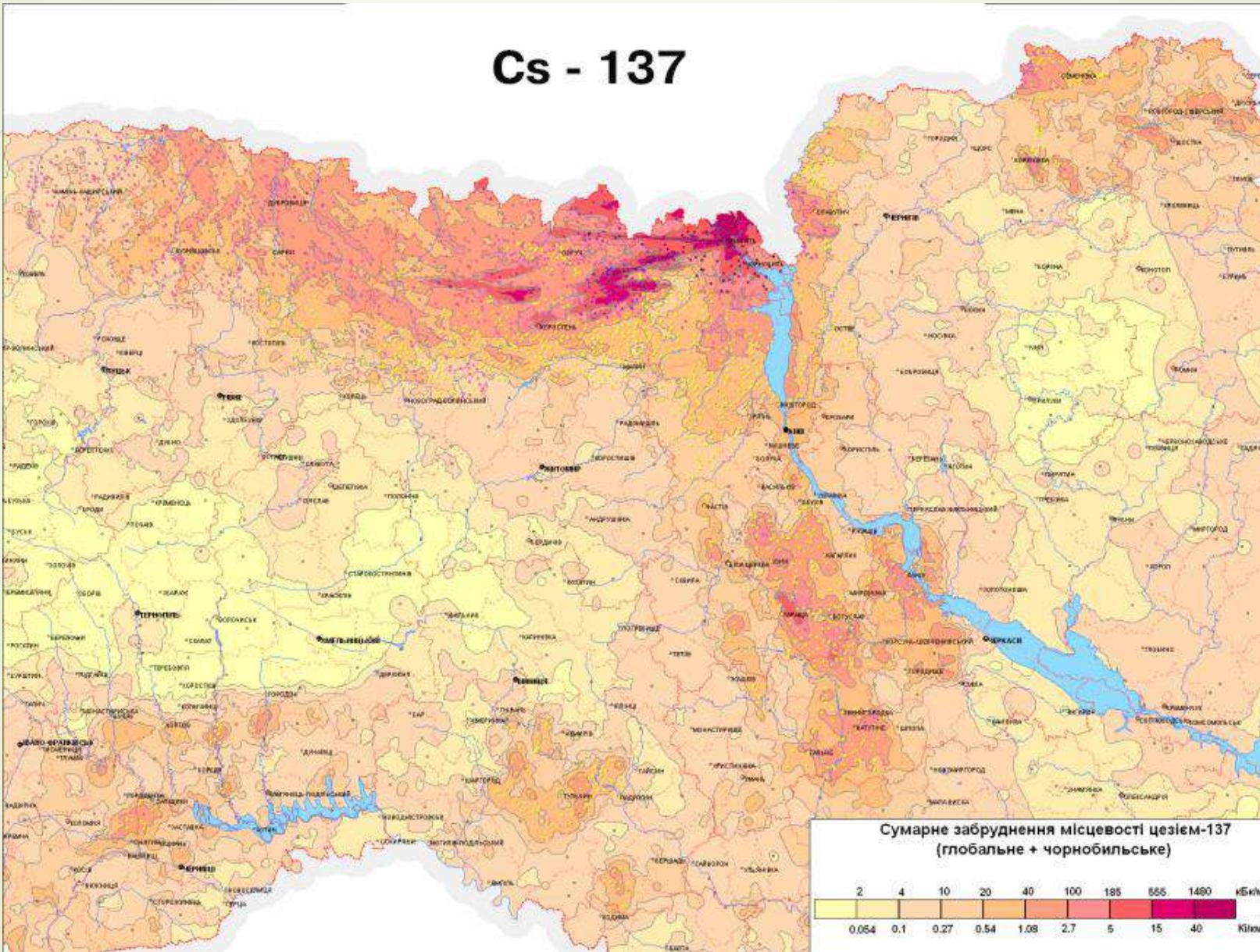
**Results of consequences of the fires on the radioactive
contamination territories of Kyiv and Zhytomyr regions according to
Hydrometeorological radiometrical network data**

Ukrainian Hydrometeorological Center

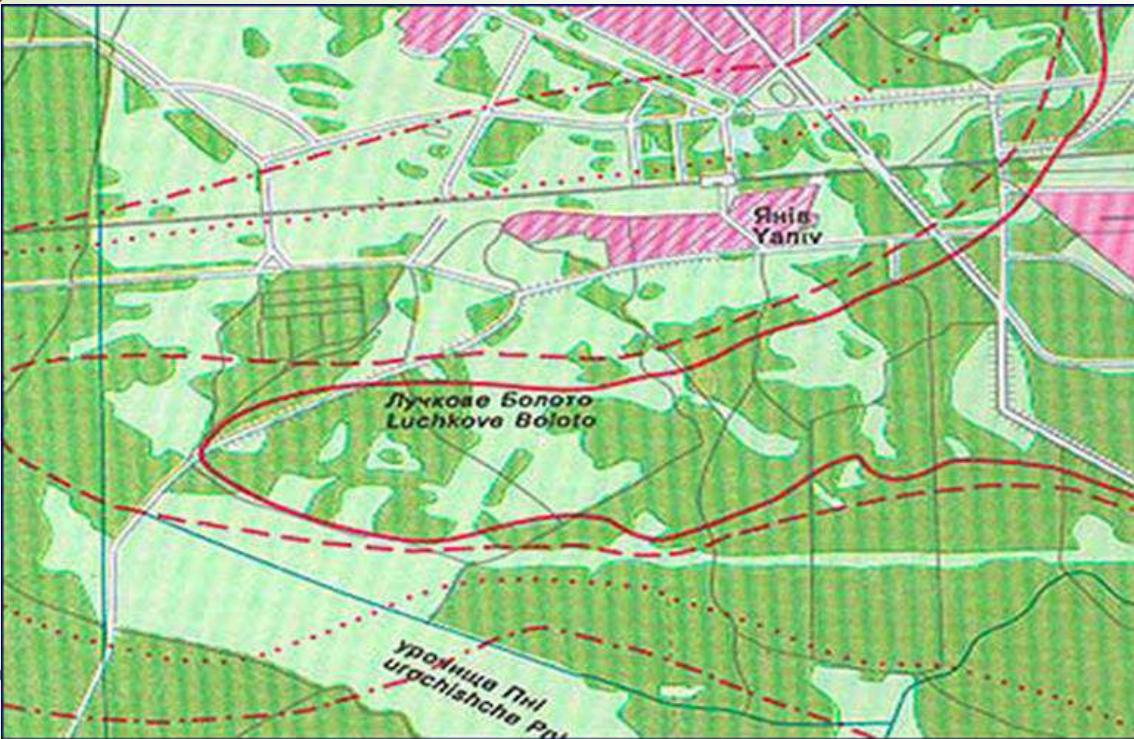
L. Tabachnyi, I. Kokot, I. Synitsyna

29.09.-01.10.2020

Radioactive contamination of Polissya (north part of the Ukraine)



Red Forest



The first zone of the "Red Forest" 45 sq. km (4,500 hectares), Dose 80-100 Gray,
100% of coniferous forest died

The second zone of the "Red Forest" 38 sq. km (3,800 hectares), Dose 10 - 80 Gray,
Up to 40% of coniferous forest died

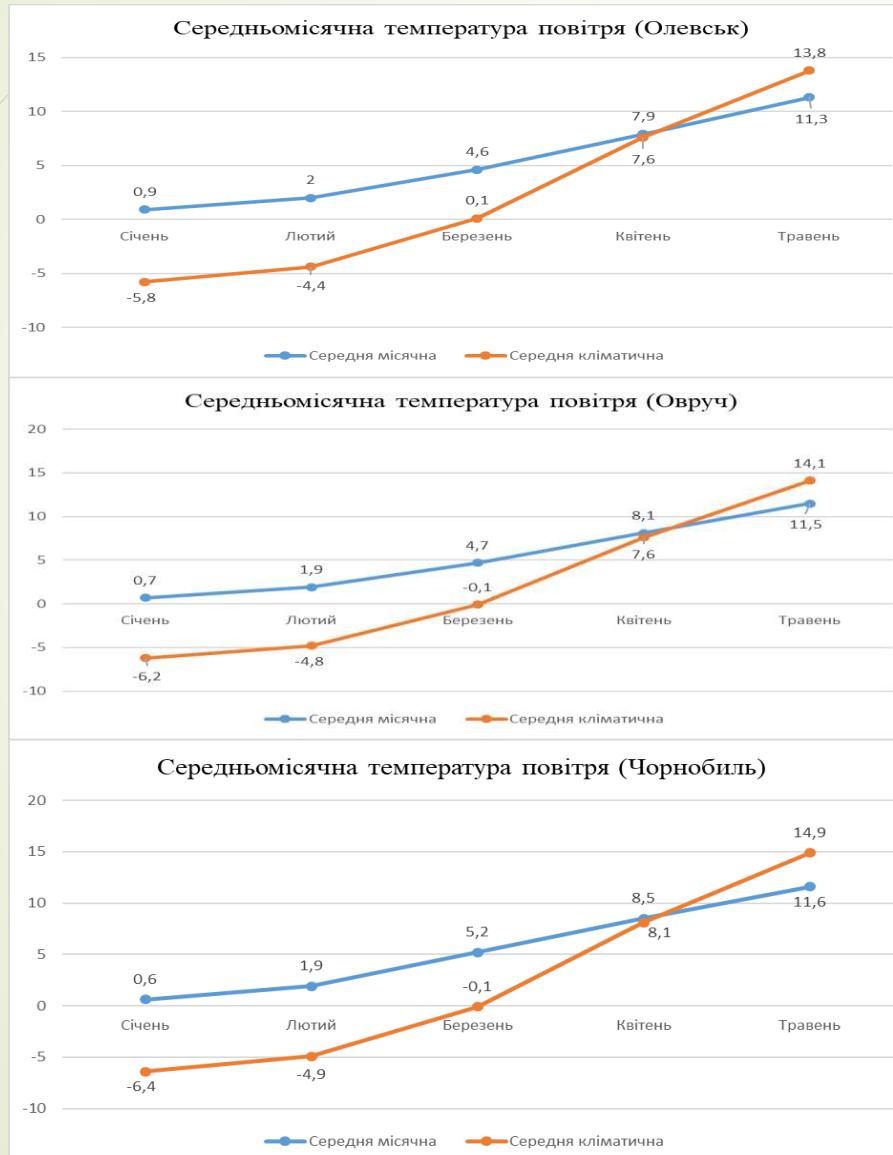
The third zone of the "Red Forest" - "yellowed forest" 433 sq. km (43,300 ha), Dose 4-5 Gray,
Coniferous forest has remained viable

Share of total ^{137}Cs activity in components of forest ecosystems in different types of forest and vegetation conditions (% of total contamination)

Ecosystem component	Proportion of total ecosystem ^{137}Cs activity, %	
	<i>Fresh sub-bor</i>	<i>Damp sub-dubrava</i>
Timber stand	8,5	2,9
<i>Timber</i>	4,6	1,7
<i>Bark</i>	2,4	0,9
<i>Branches</i>	1,3	0,2
<i>Needles</i>	0,2	0,1
Regrowth	0,1	0,3
Herb and shrub layer	0,7	0,1
Forest floor (Ao)	33,7	17,8
<i>Leaf horizon (AoL)</i>	0,1	0,1
<i>Fermentation horizon (AoF)</i>	12,8	6,1
<i>Humus horizon (AoH)</i>	20,8	11,6
Mineral soil (0–30 cm)	57,0	78,9
0–2 cm	39,8	47,1
2–10 cm	10,4	27,5
10–20 cm	5,0	3,5
21–30 cm	1,8	0,8

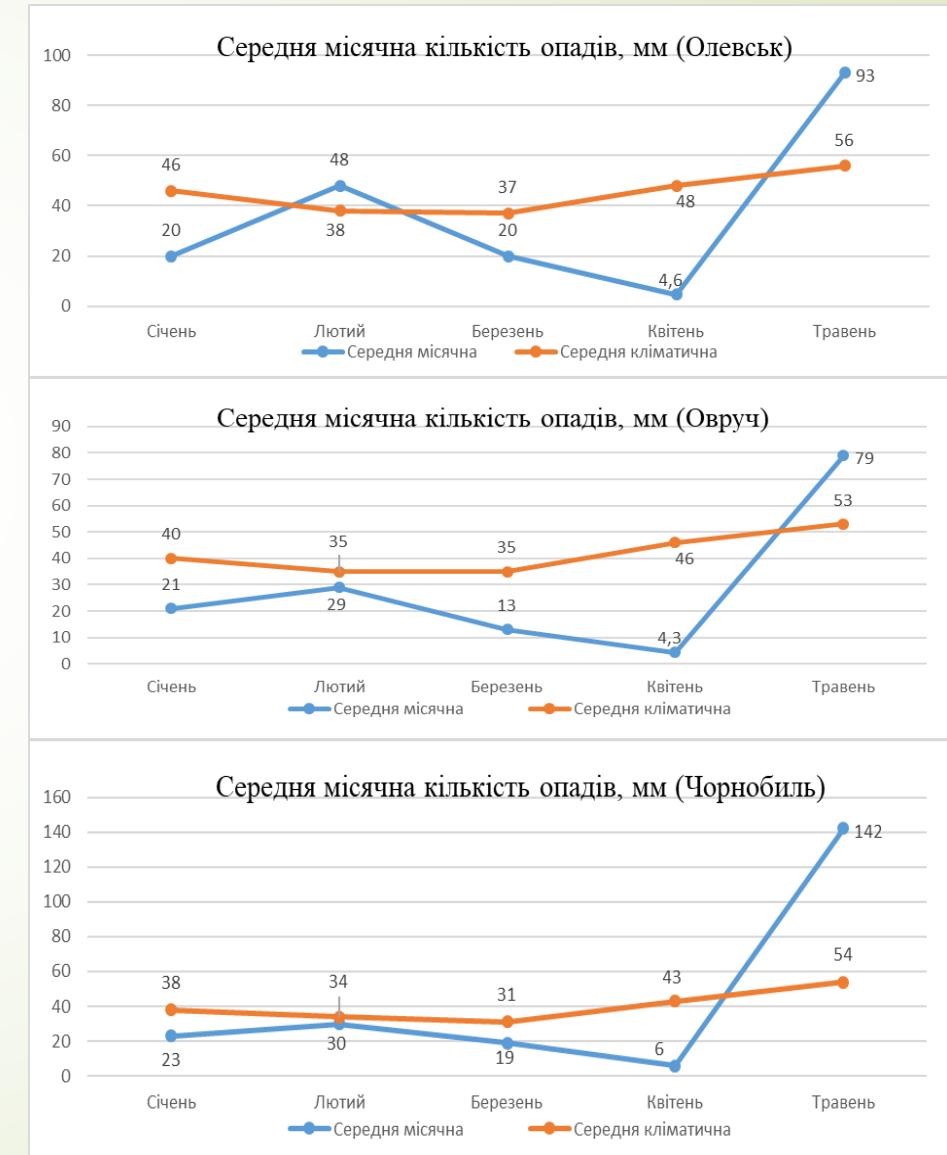
Average monthly temperature [C°]

{for M Olevs'k, M Ovruch, M Chornobyl';



Average monthly rainfall [mm]

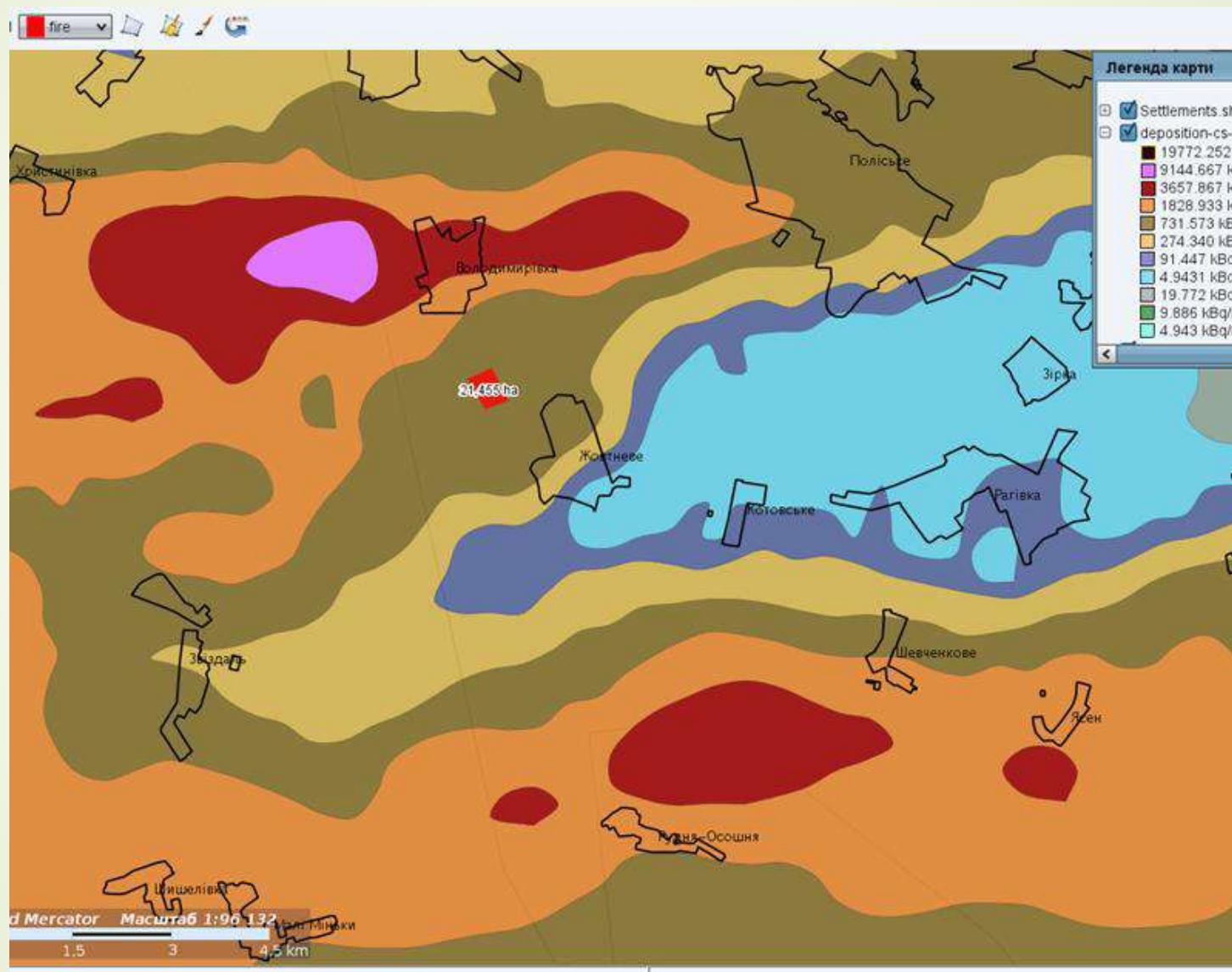
— average monthly; — climatic norm



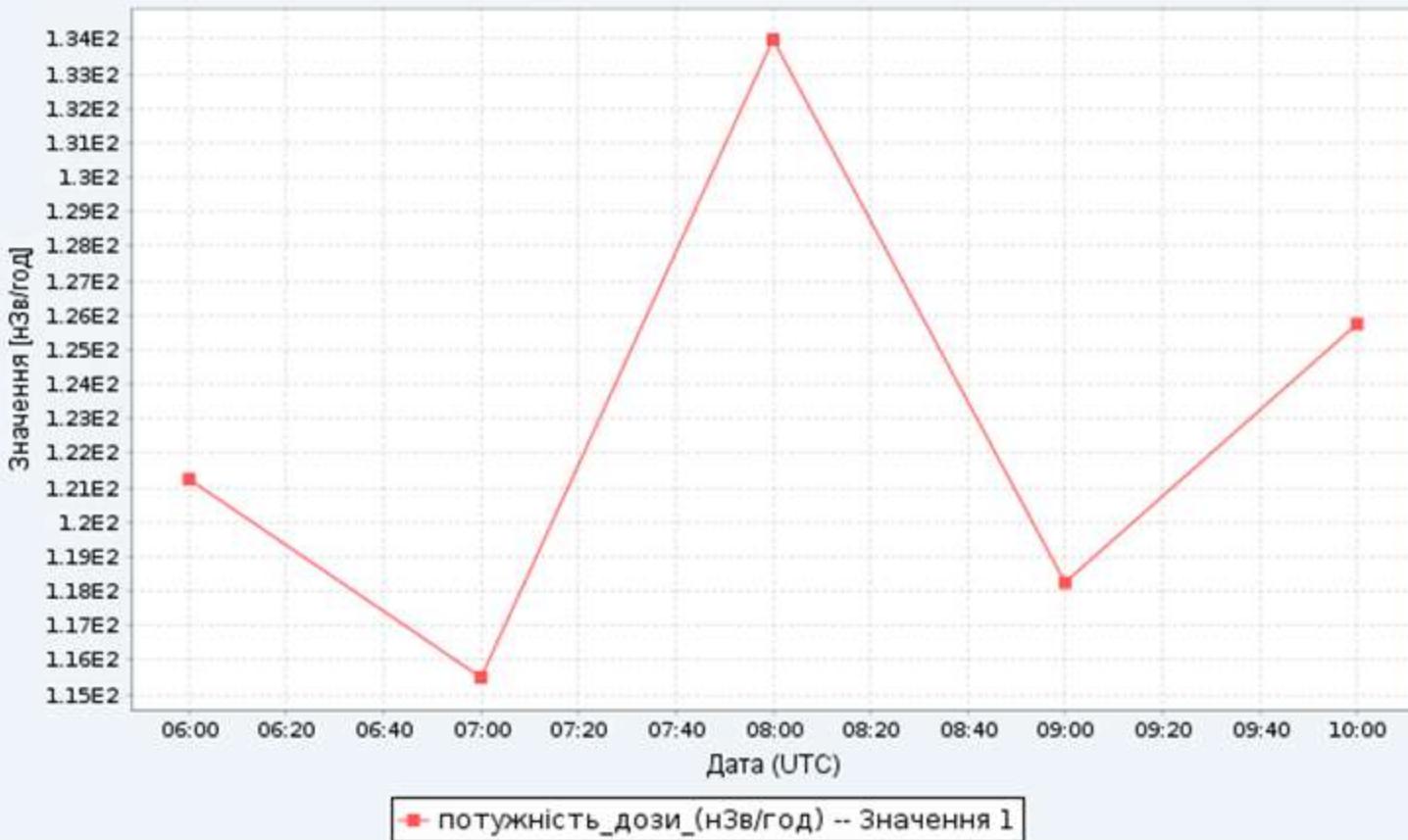
Network of radiometric observations of the National Hydrometeorological Service of Ukraine



One of the first April fires in the exclusion zone on April 2-4 (in an area with cesium-137 levels of about 20 Curie / km²)



chppr0, Поліське КПП



Operating mode of the radiometric network of the National Hydrometeorological Service of Ukraine during fires (for radiation control of air pollution)

<i>Operating mode</i>	<i>Observation time [number of days]</i>	<i>The first interval sampling time (per day)</i>	<i>The second time sampling period (per day)</i>	<i>Total duration sampling [hour]</i>
<i>Routine</i>	<i>3</i>	<i>09 -12</i>	<i>21-24</i>	<i>18</i>
<i>Increased readiness</i>	<i>1</i>	<i>12-18</i>	<i>00-06</i>	<i>12</i>

The results of gamma-spectrometric analysis of samples of atmospheric aerosols in the surface layer of air

Aspiration post	Observation date	Air volume (m3)	Volume activity of radionuclides (mBq / m3)				
			Be-7	Bi-214	Bi-212	Cs-137	K-40
Odeca 0.001-0.003	3-6.04.20	54828	4.7	<0.023	<0.11	<0.014	<0.092
	6-9.04.20	55116	5.0	<0.015	<0.10	<0.018	<0.18
	9-12.04.20	51876	5.4	0.042	<0.079	0.048	<0.14
	12-15.04.20	55692	3.9	<0.027	<0.073	0.077	<0.09
	15-18.04.20	55656	5.2	<0.024	<0.073	<0.01	<0.11
	18-21.04.20	53568	5.1	<0.023	<0.094	<0.017	0
	21-24.04.20	54036	3.0	0.047	<0.12	0.025	<0.15
	24-27.04.20	52704	5.7	<0.016	<0.095	<0.012	<0.13
	27-30.04.20	53820	5.6	<0.023	<0.093	<0.012	<0.094

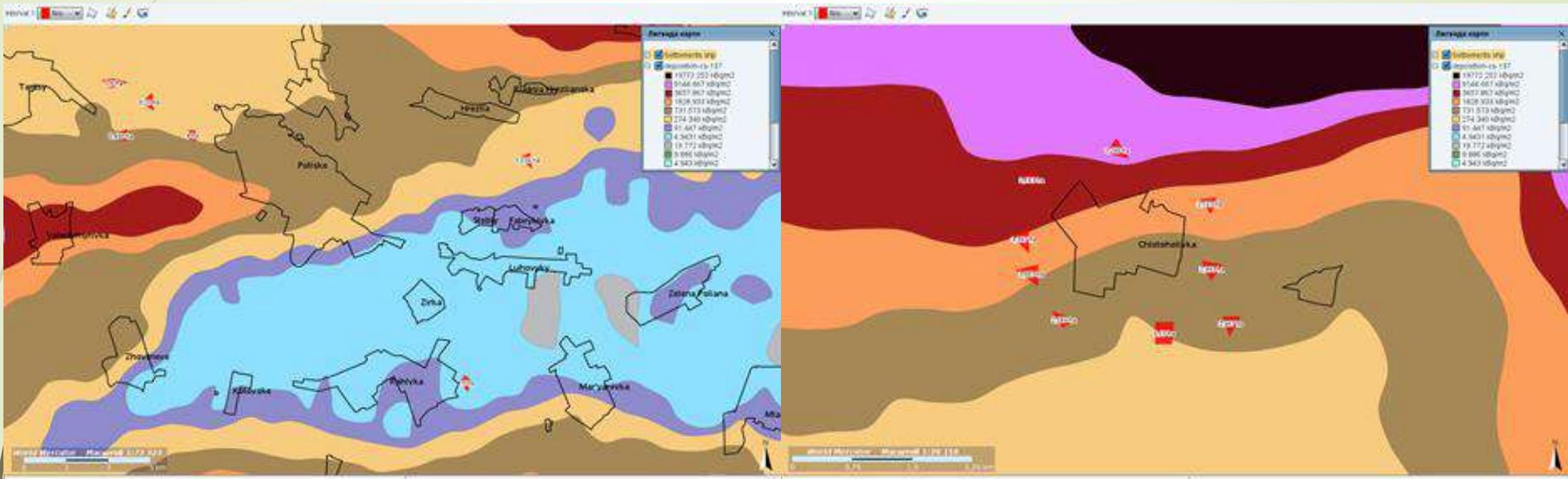
Aspiration post	Observation date	Air volume (m3)	<i>Volume activity of radionuclides (mBq / m3)</i>				
			<i>Be-7</i>	<i>Bi-214</i>	<i>Bi-212</i>	<i>Cs-137</i>	<i>K-40</i>
<i>Баришівка</i> 0.002-0.006	11-14.04.20	41040	5.7	<0.023	<0.23	0.045	<0.22
	14-17.04.20	43560	4.8	<0.02	<0.15	0.19	0.27
	17-20.04.20	39960	1.9	0.093	96	0.17	<0.23
	20-23.04.20	45360	2.0	0.68	<0.11	0.29	<0.11
	23-26.04.20	40320	5.0	<0.015	<0.12	0.036	<0.097
	26-29.04.20	42480	4.9	0.12	<0.13	0.034	<0.097

Aspiration post	Observation date	Air volume (m3)	<i>Volume activity of radionuclides (mBq / m3)</i>				
			<i>Be-7</i>	<i>Bi-214</i>	<i>Bi-212</i>	<i>Cs-137</i>	<i>K-40</i>
<i>Chornobyl</i> 0.007-0.051	4-7.04.20	37800	2.5	<0.014	<0.1	0.033	<0.033
	7-10.04.20	37080	4.0	<0.025	<0.02	0.38	<0.1
	10-13.04.20	31800	2.9	<0.045	<0.094	0.29	<0.26
	13-16.04.20	36000	2.2	<0.023	<0.02	0.066	<0.17
	16-19.04.20	27720	3.8	<0.068	<0.21	1.130	<0.22
	19-22.04.20	29520	2.5	<0.04	<0.25	0.13	<0.21
	22-25.04.20	33480	5.2	<0.027	<0.18	0.129	<0.15
	25-28.04.20	36360	7.2	<0.027	<0.11	0.098	<0.14
	28-01.05.20	34920	5.8	<0.045	<0.23	0.057	<0.21

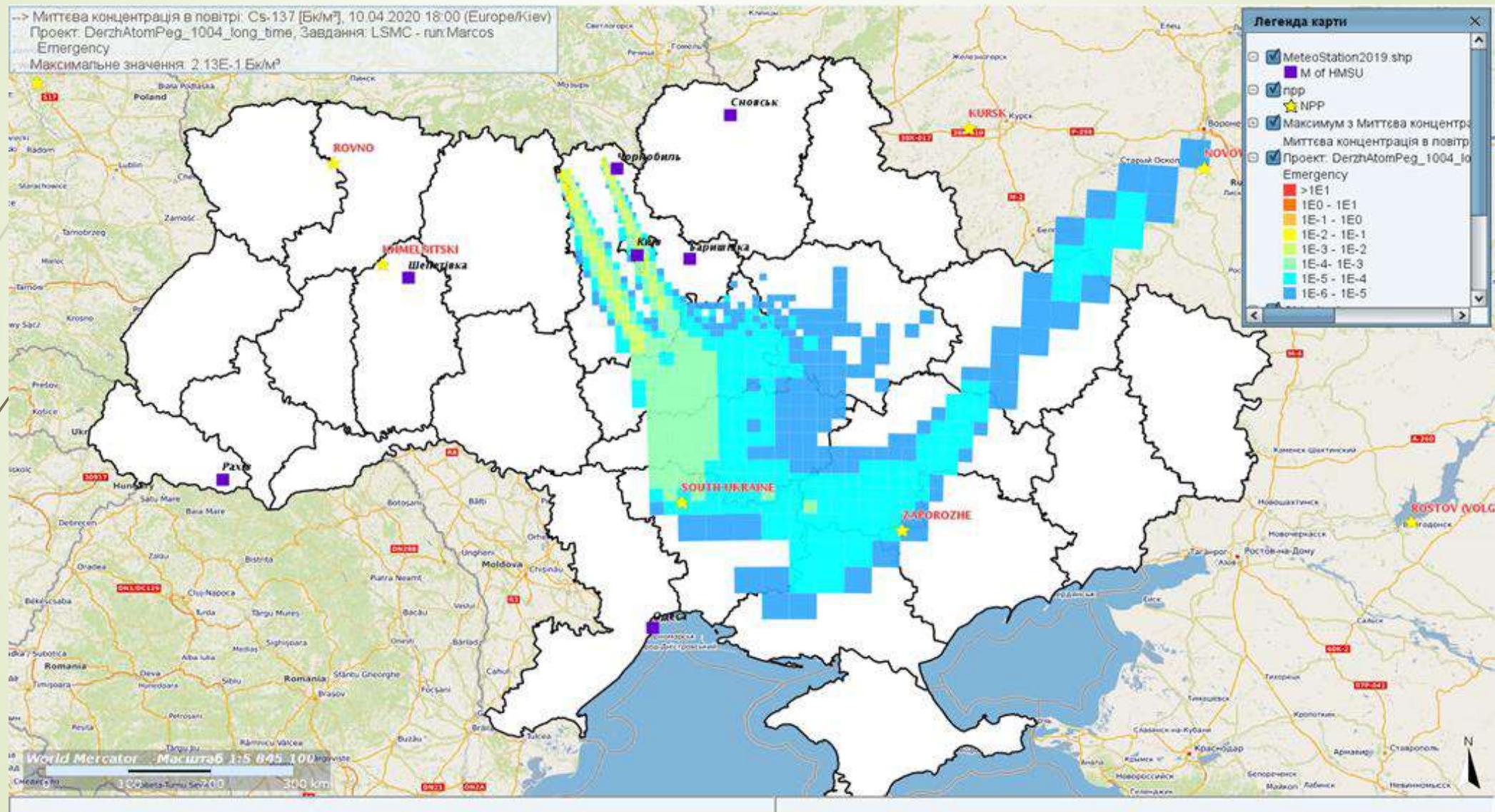
Aspiration post	Observation date	Air volume (m3)	<i>Volume activity of radionuclides (mBq / m3)</i>				
			<i>Be-7</i>	<i>Bi-214</i>	<i>Bi-212</i>	<i>Cs-137</i>	<i>K-40</i>
<i>Сновськ</i> 0.002-0.010	3-6.04.20	43920	4.0	<0.019	<0.11	<0.018	<0.14
	6-9.04.20	43920	2.7	<0.027	<0.092	<0.018	<0.17
	9-12.04.20	44280	3.4	<0.027	<0.13	0.052	<0.11
	12-15.04.20	45360	3.5	<0.015	<0.089	0.041	<0.14
	15-18.04.20	38520	3.7	0.065	<0.021	0.103	0.39
	18-21.04.20	46440	1.2	0.075	<0.11	<0.02	<0.11
	21-24.04.20	43920	3.4	0.067	<0.13	0.028	<0.11

Aspiration post	Observation date	Air volume (m3)	Volume activity of radionuclides (mBq / m3)				
			Be-7	Bi-214	Bi-212	Cs-137	K-40
Kyiv 0,002-0,013	07-08.04.20	27160	6.2	1.9	85.6	<0.14	<1.8
	08-09.04.20	25040	5.8	1.5	41.4	0.29	<1.15
	09-10.04.20	27240	7.4	2.6	<11	<0.14	<1.5
	10-11.04.20	27280	4.1	<0.05	<0.4	0.70	<0.27
	11-12.04.20	27640	2.7	<0.055	38.6	0.17	<0.38
	12-13.04.20	28280	6.4	<0.3	161	<0.18	<2.0
	13-14.04.20	27400	<2.0	<0.36	187	<0.19	<2.3
	14-15.04.20	28680	6.1	0.62	37.7	<0.08	<0.95
	15-16.04.20	26580	3.0	<0.078	4.1	0.076	<0.66
	17-18.04.20	27520	2.7	<0.033	<0.24	0.114	<0.66
	18-19.04.20	27520	2.0	<0.053	60	0.124	<0.3
	19-20.04.20	28440	3.5	<0.065	34.6	0.078	<0.38
	20-21 04.20	28680	1.4	<0.097	21.8	<0.073	<0.8
	21-22 04.20	28720	4.5	0.88	43	<0.096	<0.93

Fires that occurred on April 9-10, 2020 in the western and central parts of the exclusion zone



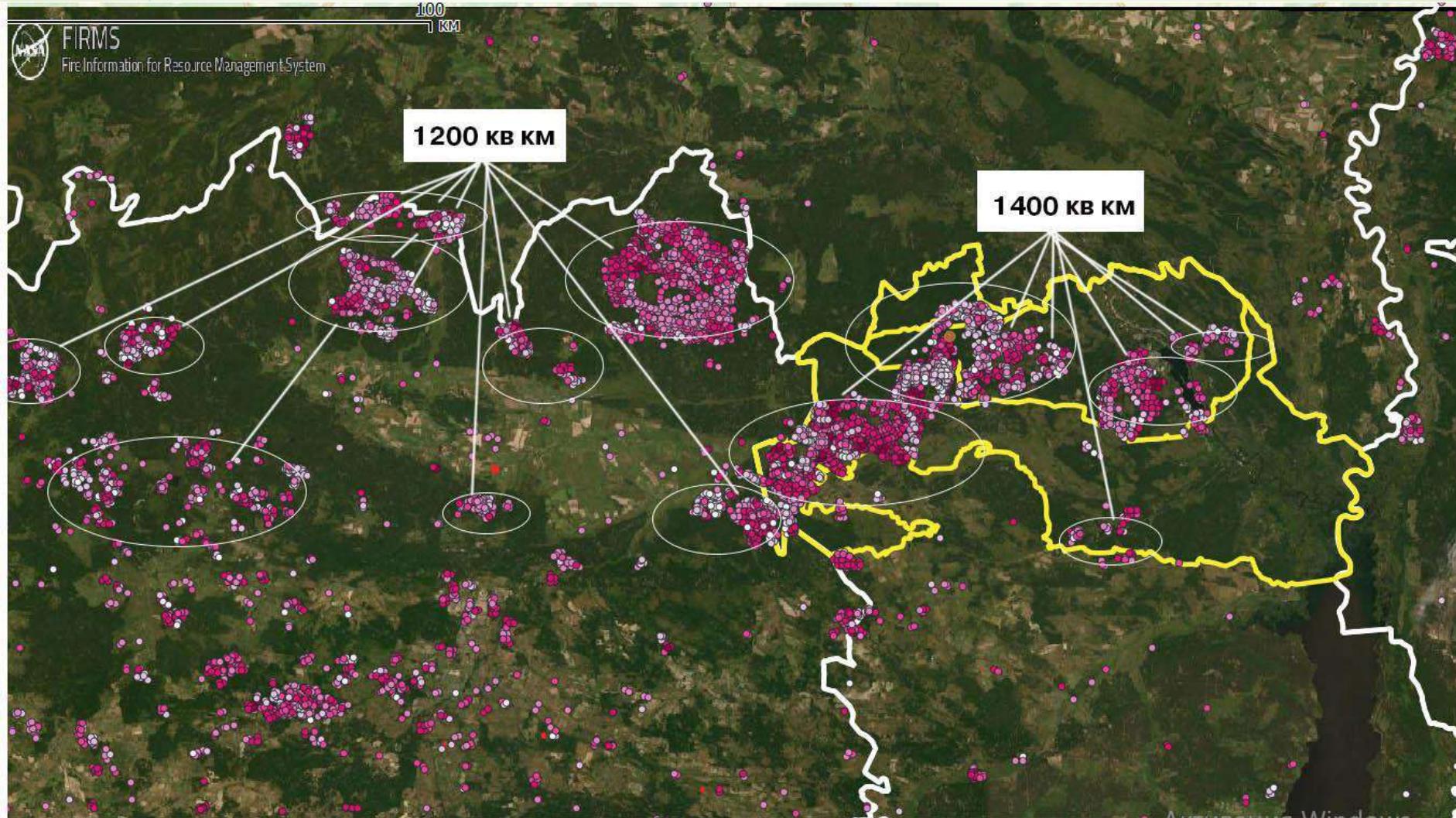
The results of modeling the distribution of combustion products from fires that occurred on April 9-10, 2020 in the exclusion zone



Comparison of the simulation results and the measured values of the volumetric activity of cesium-137 in the lower layer of atmospheric air due to fires in the exclusion zone on April 9-10, 2020

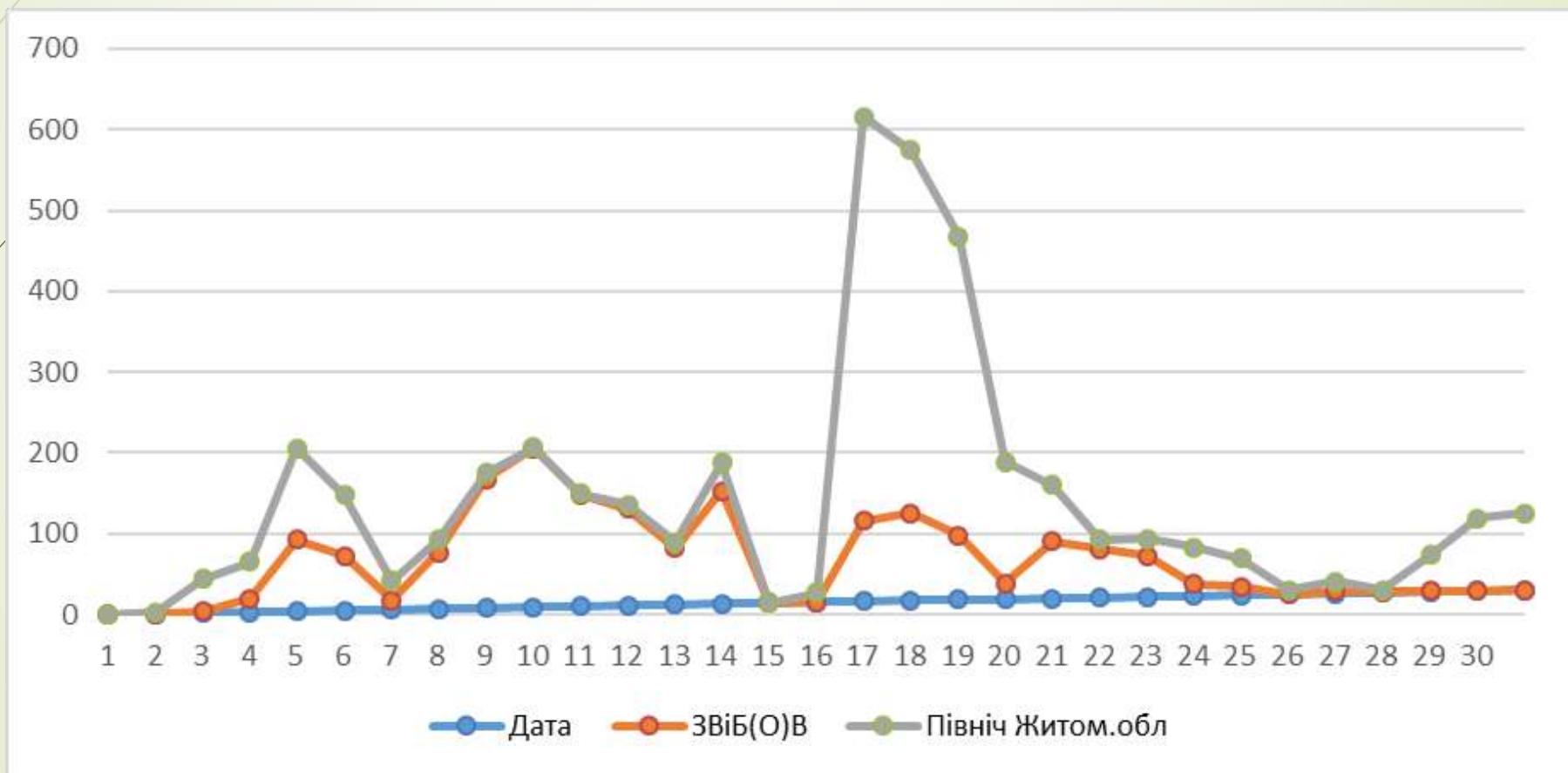
Observation point	Start of sampling	Finish of sampling	Volumetric activity	
			microBq*m ⁻³	
			calculated	measured
Kyiv	10.04.2020	11.04.2020	726	700
	11.04.2020	12.04.2020	261	170
Baryshivka	11.04.2020	14.04.2020	26	45
Odessa	09.04.2020	12.04.2020	42	48
Snovs'k	09.04.2020	12.04.2020	49	2
Chornobyl	07.04.2020	10.04.2020	518	380
	10.04.2020	13.04.2020	454	290

Map-scheme of thermal anomalies (areas covered by fire) that took place in the period from 3 to 30 April in the areas contaminated by the Chernobyl accident in 1986.



The area of the territory passed in the fire of the skin day at April 2020

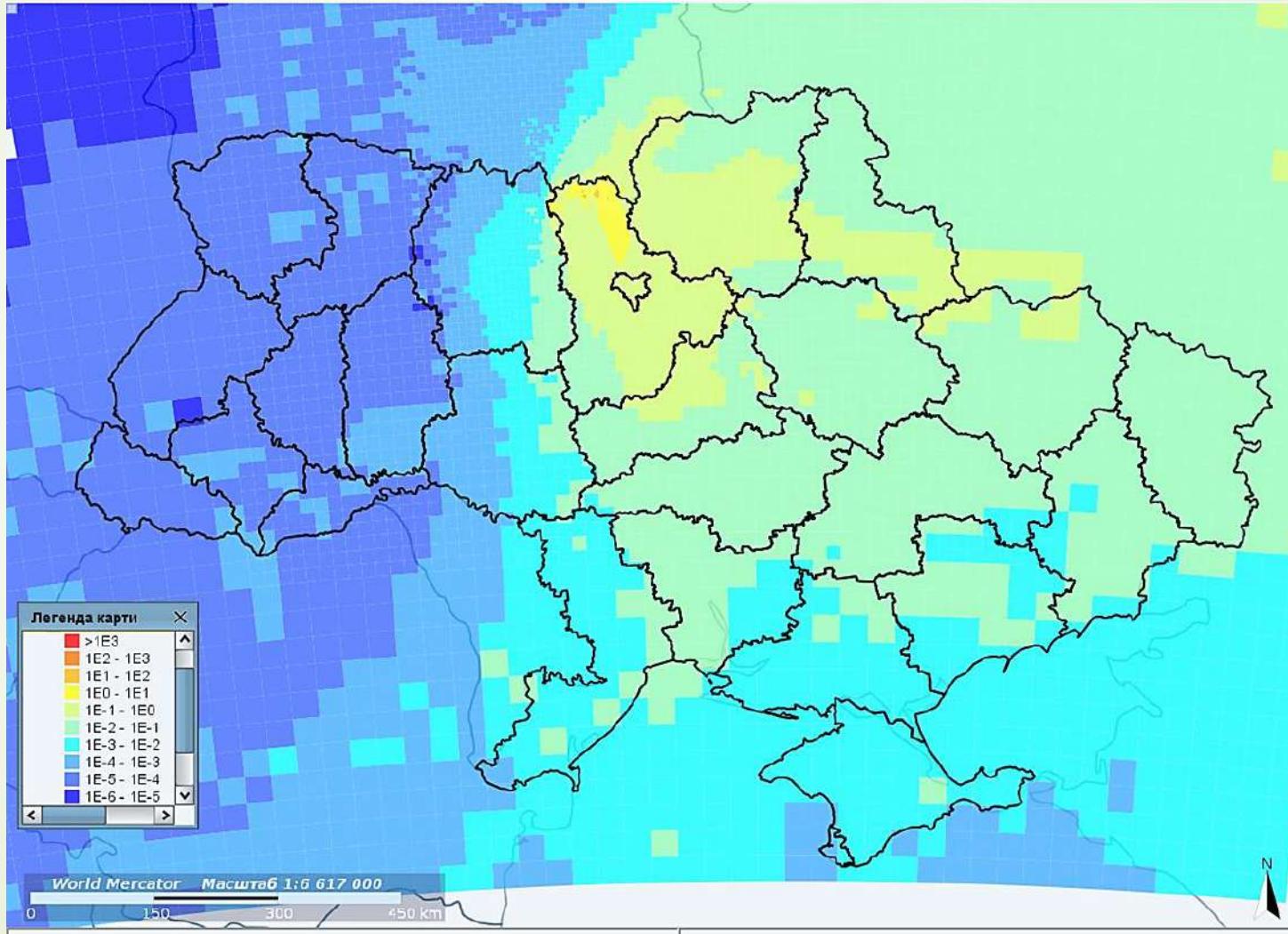
(Orange line – Exclusion zone; Green line – Zhytomyr region)



Some general characteristics of the consequences of fires in Polissya in April 2020

<i>Time interval of fires (UTC)</i>	<i>The area was destroyed by fire [ha]</i>	<i>Contamination territory by ^{137}Cs [$\kappa\text{Bq}/\text{m}^2$]</i>	<i>Summury activity of release [GBq]</i>
	<i>Exclusion zone</i>		^{137}Cs
03/04/20 18:00 - 11/04/20 18:00	45000	4,94 - 9144	130 - 190
11/04/20 18:00 - 16/04/20 18:00	25000	4,94 - 19772	320 - 450
16/04/20 18:00 - 20/04/20 18:00	30000	4,94-1828	80 - 120
20/04/20 18:00 - 30/04/20 18:00	5000	4,94-3657	70 - 100
In general	140000		600 - 860
	Zhytomyr region.		
15/04/20 00:00 - 20/04/20 00:00	44500	10-150	60 - 85

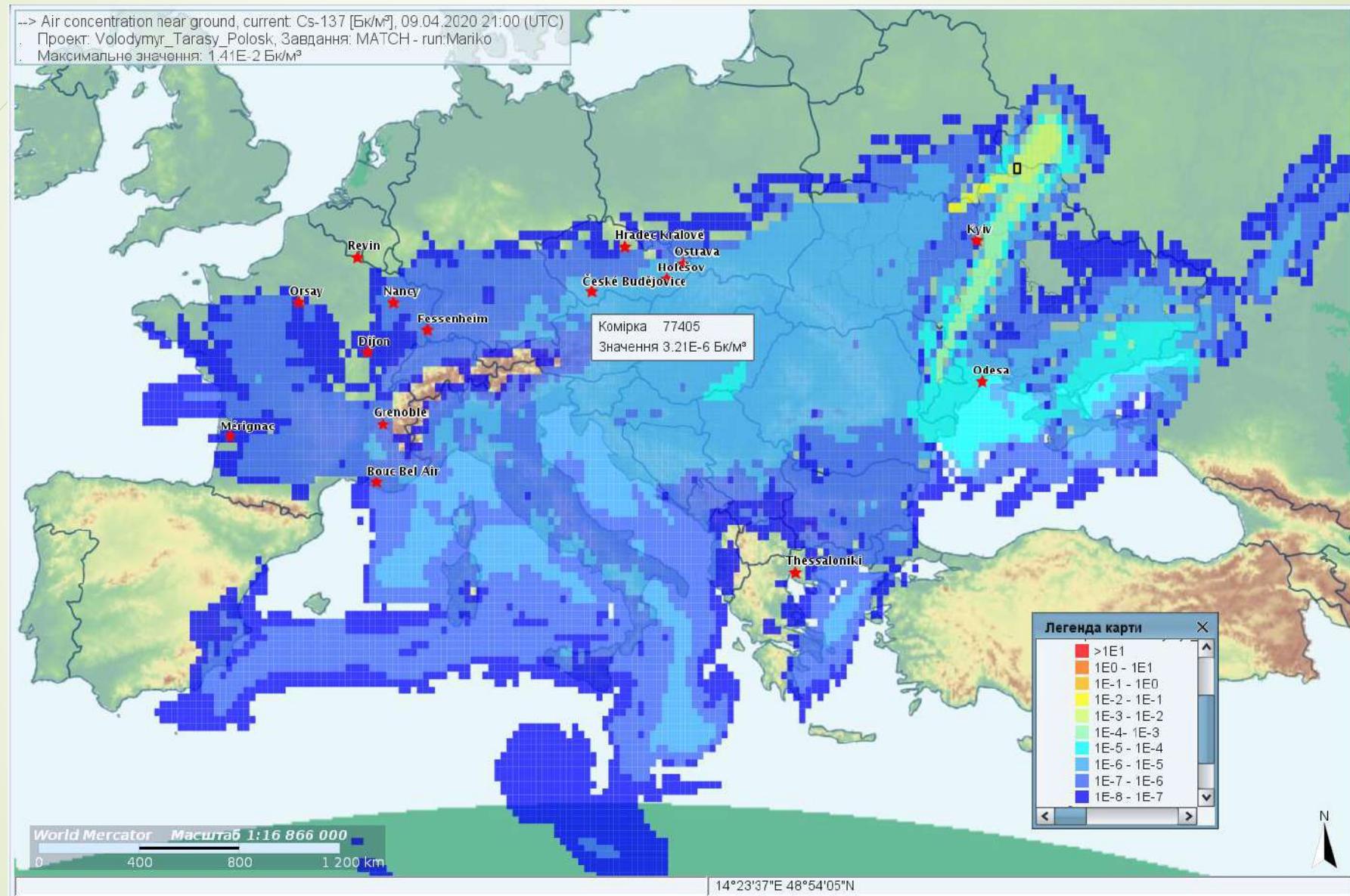
Additional total ground surface contamination Cs - 137 caused by fires [Bq/m²]



The maximum value of 65 Bq/m² is the location of the Exclusion zone

The spread of Cs-137 due to fires in the SW over the territory of Europe in April 2020. Current concentration in the surface layer of the atmosphere [Bq/m³].

(Valid at 4/9/20 9:00 PM (UTC))



Comparison of measured and calculated values of volumetric activity of Cs-137 in the atmosphere over Europe

Country	Place	Time of sampling start	Time of sampling finish	Volume activity ¹³⁷ Cs [microBq/m ³]	
				measured	simulated
France	Bouc Bel Air	04/04/2020	10/04/2020	1,16 ± 0,22	1,71
	Dijon	06/04/2020	10/04/2020	0,59 ± 0,12	0,71
	Mérignac	07/04/2020	14/04/2020	0,622 ± 0,11	0,09
	Cadarache	06/04/2020	14/04/2020	1,31 ± 0,24	-
	Fessenheim	06/04/2020	13/04/2020	0,51 ± 0,20	1,01
	Grenoble	06/04/2020	14/04/2020	0,92 ± 0,25	1,17
	Nancy	07/04/2020	14/04/2020	< 2,60	1,03
	Saint-Alban	06/04/2020	13/04/2020	0,74 ± 0,22	-
Czech Republic	České Budějovice	07/04/2020	14/04/2020	1,84	3,21
	Holešov	06/04/2020	13/04/2020	3,75	3,16
	Hradec Králové	06/04/2020	14/04/2020	3,22	1,93
	Ostrava	06/04/2020	13/04/2020	2,85	2,5
Ukraine	Kyiv	09/04/2020	10/04/2020	<140	75
	Odessa	09/04/2020	12/04/2020	48	42

Conclusion

Elaboration of conditions of development of emergencies with real radiation threats, even with low risks of negative radiological consequences for the population, which were fires in the radioactively contaminated territory of Ukraine in April 2020, for the Center for Forecasting the Consequences of Radiation Accidents was an extremely important task for:

- checking the readiness of the National Hydrometeorological Service to respond to such emergencies in terms of organizing the provision of the population and emergency response authorities with up-to-date and prognostic information on the radiological consequences of emergencies;
- JRODOS DSS testing as a tool to assess the radiological consequences of emergencies at a level adequate to the real factors of radiation influence to the environment, population and wildlife.



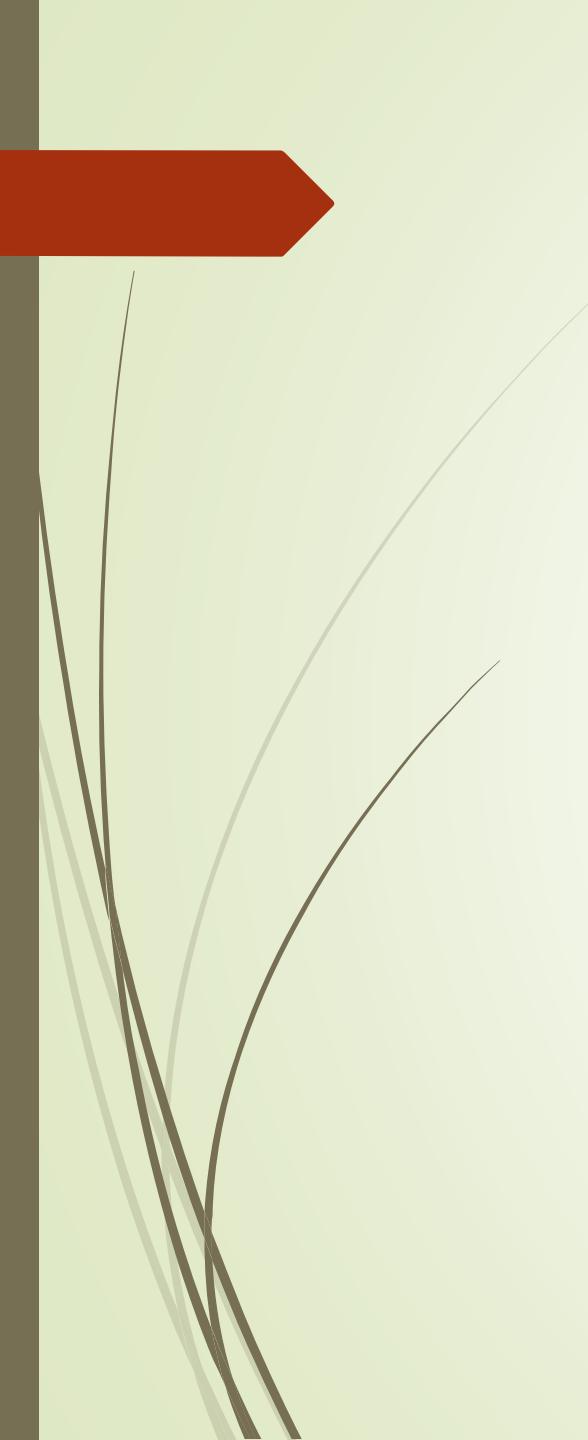
Summing up this presentation, it is necessary to say:

First:

It should be noted that the simulation results depend entirely on the quality of the global meteorological forecast and may differ for specific regions depending on the specific features of the development of atmospheric processes in this region. Therefore, the final assessment of the negative impact of the radiological consequences of an emergency should be determined only on the basis of their direct instrumental confirmation;

Second:

The greatest burden during the elimination of fires in radioactively contaminated areas of Ukraine fell on the shoulders of firefighters of the State Emergency Service of Ukraine and radiological services of the State Enterprise "Ecocenter", subordinated to the Chernobyl Exclusion Zone Administration, accompanied firefighters on the line of fire and assessed the daily dose of additional radiation of firefighters who participated in liquidation of the fire in the Exclusion Zone and they all deserve our sincere gratitude for the daily hard and important work.



Thank you for attention!