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Research Article

Radioecological modeling of the ^{131}I activity dynamics in the pasture vegetation of Mazovia in the year of the Chernobyl accident: Reconstruction, verification, reliability assessments*

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Abstract

A radioecological model, which is a system of linear differential equations describing the dynamics of the transport of ^{137}Cs and ^{131}I radionuclides along the food chain after their release into the atmosphere after the Chernobyl accident, was used to reconstruct "instrumental" data of the ^{131}I activities in the grass pastures in the central part of Mazovia. Four atmospheric models were used for the reconstruction: direct calculation, homogeneous cloud – inhomogeneous rainfall, inhomogeneous cloud – homogeneous rainfall, and a model with recalculation of the ^{137}Cs and ^{131}I activities in the atmosphere. The "instrumental" data were reconstructed based on data from direct measurements of the ^{131}I activity in lawn grass. It has been shown that the direct calculation and homogeneous cloud models lead to a better agreement of the calculated and reconstructed "instrumental" data than the inhomogeneous cloud model. The arithmetic mean ratio of the calculated and reconstructed "instrumental" data lie in a range of 0.84 to 0.95 for the direct calculation and homogeneous cloud models, and in a range of 1.7 to 3.0 for the inhomogeneous cloud model. The mean geometric deviation for all models is constant and equal to 1.7. Instrumental and reconstructed "instrumental" data show a significant decrease in the specific activity of ^{131}I in grass due to its wash-off by continuous rainfall, both during rainfall and after most of the deposition takes place. Due to this effect, the coefficient of the ^{131}I retention on grass in the form of the maximum activity ratio to the ^{137}Cs deposition density decreases from 34 to 1.4 m^2/kg while it increases from 1 to 29 kBq/m^2 as the result of the rainfall growth from 0 to 40 mm.

Keywords

Chernobyl accident, IAEA's EMRAS project, Warsaw scenario, agro-radioecological simulation model, radioactive cloud model, ^{137}Cs deposition densities, atmospheric ^{131}I forms, radioecological model verification

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Introduction

This paper is the fifth one in a series of papers (Vlasov et al. 2019a, 2019b, 2020a, 2020b) devoted to investigating the dynamics of the ^{137}Cs and ^{131}I radionuclide transport along the "*atmosphere – soil – vegetation – dairy cow body – human body*" food chain after the Chernobyl NPP disaster using a radioecological simulation model following a radiation accident with release of products into the atmosphere (Vlasov et al. 2013).

The purpose of the study is to implement the method for recalculating instrumental data on the dynamics of the radionuclide activity in grass vegetation of one type for vegetation of other types, specifically from lawn grass to pasture grass, to create a database for the dynamics of reconstructed instrumental and calculated data on the specific activities of ^{131}I in the cultivated pasture grass in the milk districts (the districts hereinafter) in Mazovia based on the example of the Warsaw Scenario data, and to estimate the statistical parameters of the calculated data ratios to the reconstructed instrumental data on the dairy cow green fodder in the above districts. The conclusions made earlier in (Vlasov et al. 2019a, 2019b, 2020a, 2020b) that the instrumental data on the dynamics of the ^{131}I activity in lawn grass relate to its perennial type were taken into account in generating the bank of mutually agreed data (atmosphere – rainfall for the fallout period – ^{137}Cs land fallout density – ^{131}I activity in pasture grass).

Materials and methods

The dynamics of the ^{131}I specific activity in the cultivated pasture grass in the milk districts in Mazovia is studied based on a radioecological simulation model after radiation accidents with release of products into the atmosphere (Vlasov 2013). The radioecological simulation model for the environmental transport of radioactive products released into the atmosphere after the Chernobyl accident is a system of linear differential equations with inhomogeneous time-dependent coefficients. The effective rates of 'dry' fallout and ^{137}Cs and ^{131}I fallout with rainfall ('wet' fallout), and the forms of the iodine existence in the atmosphere are used to describe the radionuclide deposition on land and vegetation surfaces. The coefficients of the radionuclide activity delay on vegetation depend on its biomass and decrease exponentially as the rainwater layer thickness on the vegetation leaf surface increases.

The Warsaw Scenario data for the 'iodine group' of the IAEA's EMRAS project are used as the initial data for the calculation model (Krajewski et al. 2008; Bartuskova et al. 2009; Zvonova et al. 2010; IAEA-TECDOC-1678 2012; Vlasov 2013).

The scenario presents the following set of initial data for 1986:

- specific activities of ^{137}Cs and ^{131}I (Fig. 1) and the forms of the ^{131}I existence in the atmosphere in the period between 12.5 am April 26 and 20.5 am June 2, in Warsaw measurements place (Fig. 2);
- 137Cs fallout densities for 33 settlements (milk farm locations) and statistical data on the structure of its fallout densities within 28 districts reconstructed using GIS technologies in the form of its minimum, maximum and average amounts of the 137Cs fallout;
- rainfall in the period between April 26 and May 16 (Fig. 1) and the yearly air temperature variation at 33 weather stations (Fig. 3) with an example at the weather station Warszawa Observer Astro in Warsaw;
- yields of vegetation of different types and dairy cow milk yield;
- results of measuring the specific activity of ^{131}I in lawn grass in the territory of the Warszawa Obserw Astr weather station in Warsaw for the period between May 3 and 18, 1986 (Fig. 4) (Gr1, Gr2): Gr1 – measurement, Gr2 – exponential interpolation;
- results of measuring the specific activity of ^{131}I in milk for five dairy farms (the farms hereinafter) and in 12 milk districts (the districts hereinafter) between April 28 and June 7, 1986 with the maximum number of measurements of 20 to 30 for four farms and with the number of measurements below five for all districts.

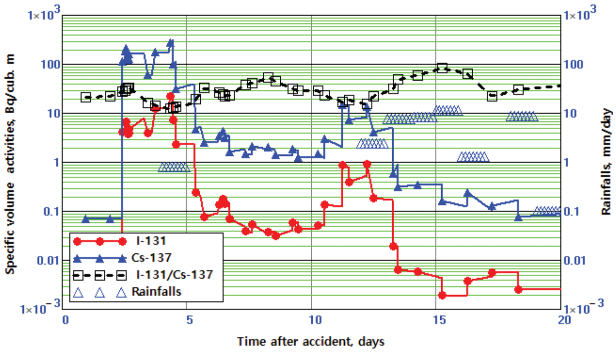

Figure 1. Dynamics of the ^{137}Cs and ^{131}I specific bulk activities in atmosphere and rainfall on Warszawa Observ Astr Weather Station with fallout density $\sigma_{CsDep} = 3.26$ kBq/m^2).

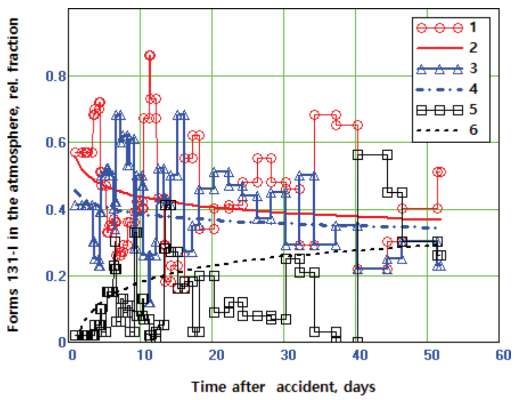

Figure 2. Dynamics of the ^{131}I forms in the atmosphere in the central part of Mazovia –the relative iodine fractions for the main fallout period of 2.5 to 5 days after the accident: 1 – aerosol form; 2 – interpolation (1); 3 – gaseous form; 4 – interpolation (3), 5 – organic form, 6 – interpolation (5).

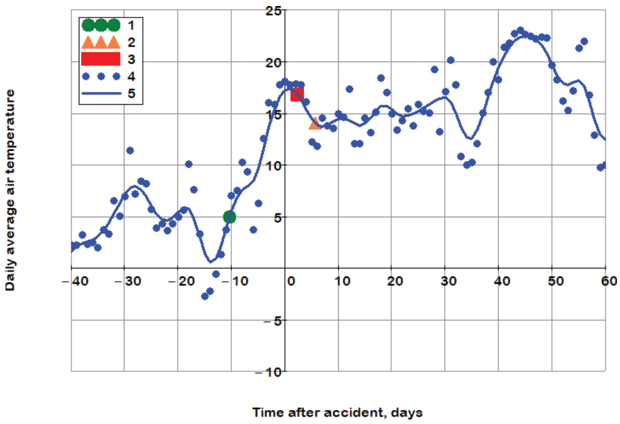

Figure 3. Ecological time parameters (1–3) and daily average air temperature (4, 5):1 – beginning of spring vegetation; 2 – beginning of the dairy cattle pasture season (t_pastc = 6 days); 3 – beginning of radioactive fallout (q_dep0 = 2.4 days); 4 – weather data; 5 – smoothed data (Mazovia, vegetation – cultivated pasture grass).

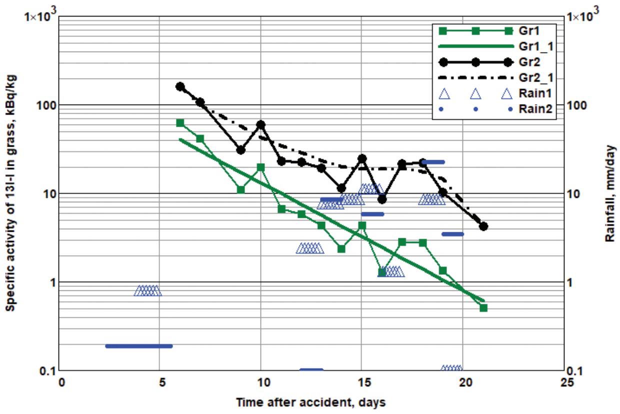

Figure 4. Direct and its instrumental data on the ^{131}I activity in lawn grass (Gr1, Gr1_1) with weather data on rainfall at the Warsaw Observ Astr weather station, the Warsaw Area (Rain1), and reconstructed "instrumental" data for pasture grass in the county Ostrolecki (Gr2, Gr2_1) with rainfall at the Myzsyniec weather station, the Ostroleka Area (Rain2): Gr1 – instrumental data; Gr1_1 – exponential interpolation Gr1; Gr2 – reconstructed "instrumental" data; Gr2_1 – nonlinear interpolation (Gr2).

The dynamics of the ^{131}I activity in grass was reconstructed based on the following four models of the atmosphere:

- **direct calculation model** – the data on the ^{137}Cs activity in the atmosphere over the area and weather data on the rainfall for the period of the main fallout at the weather stations nearest to settlements and within the districts are used to calculate the ^{137}Cs fallout density in settlements and the dynamics of the ^{131}I specific activities in pasture vegetation; the ratio of the calculated to instrumental ^{137}Cs fallout density is used as the normalizing factor for adjusting the ^{137}Cs and ^{131}I activities in the atmosphere over the given settlement in the heterogeneous cloud model; the effective rainfall of the constant intensity in the main fallout period is reconstructed based on instrumental ^{137}Cs fallout density data for the given settlement and the calculated dependence of the ^{137}Cs fallout densities on effective rainfall; effective rainfall is used in the heterogeneous cloud model;
- **homogeneous cloud – heterogeneous rainfall model** – similar specific bulk activities of radionuclides in the atmosphere over the region – effective rainfall of the constant intensity in the main fallout period for settlements calculated based on the direct calculation model;
- **heterogeneous cloud – homogeneous rainfall model** – the heterogeneous cloud region includes all settlements around the nearest weather station for each settlement in the region – the data from this weather station on the rainfall for the main fallout period; the normalizing factor for adjusting the ^{137}Cs and ^{131}I activities in the atmosphere over each settlement is calculated in the direct calculation model.
- **a model with recalculation of radionuclide activities in the atmosphere over the Ostroleka Area** – recalculation is done proportionally to the value of the ratio of the minimum ^{137}Cs fallout density in the area to the density of its dry fallout.

The following system of milk and dairy food production exists in Mazovia: the farms are united into districts; each district has its own center for receiving milk from the farms which includes milk receiving tanks; tank trucks further deliver milk to dairy plants united into milk areas (the areas hereinafter). All these scenarios are presented for two areas: the Warsaw Milk Area and the Ostroleka Milk Area. Milk samples were taken from tanks at the milk receiving centers in the districts and from vessels at the farms where milk from all cows was received.

There are two visible peaks in the dynamics of the ^{131}I and ^{137}Cs activities in the atmosphere (see Fig. 1): 2.4 to 5.3 and 10.5 to 13.5 days after the accident. Most of the fallout took place in the period of peak 1 with a double maximum of the ^{131}I activities in the atmosphere (200 Bq/m^3 on the 2.6 day and 315 Bq/m^3 on the 4.4 day).

Given that the integrals of the volume activity of ^{131}I increased to 92% and the activity of ^{137}Cs increased to 96% for the period of the first peak, this period, 2.4–5.3 days, was accepted as the time of main fallouts.

In the main fallout period, rainfall took place at two weather stations: Warszawa Obserw Astr (0.8 mm) and Brinow (7.3 mm). There was no rainfall in the period of peak 1 at all other weather stations. The maximum activity of ^{131}I in the atmosphere in the period of peak 2 was an order of magnitude smaller and amounted to 15 Bq/m^3. According to weather data, heavy rainfall with a daily intensity of 10 to 15 mm was recorded between May 13 and 18 at all weather stations in both areas that captured the beginning of peak 2 (see Fig. 1).

Results and discussion

The dynamics of the ^{131}I activity in the pasture vegetation of the milk farms was reconstructed using data on the ^{137}Cs fallout densities for the settlements where they were located, and, for districts, using the average values of the ^{137}Cs fallout within them.

At the initial stage, the data from measuring the specific activity of ^{131}I in lawn grass at the Warszawa Obserw Astr weather station using the method proposed in Vlasov et al. 2020a were recalculated against instrumental data for the cultivated pasture grass at the farms and in the districts where milk samples were taken for radiometric examination. Such recalculation was done from the instrumental and calculated database for the lawn grass radiometry location to the database for the pasture grass at the location of the calculated farm or district. The database comprised the following datasets:

- instrumental data on the ^{137}Cs fallout densities for settlements, average ^{137}Cs fallout densities within milk districts, and weather data on the rainfall at the weather stations;
- instrumental data on the specific activities of ^{131}I in lawn grass at the Warszawa Obserw Astr weather station (see Fig. 4: Gr1 – measurement, Gr2 – exponential interpolation (Gr1), calculated data on the dynamics of the lawn grass biomass in settlements and the cultivated pasture grass in the milk districts.

The instrumental data on the specific activities of ^{131}I in pasture grass for all farms and districts in both areas were reconstructed based on the direct calculation model, and for the Ostroleka Area, additionally, based on the model with recalculation of the ^{137}Cs and ^{131}I activities in the atmosphere.

The basis for such recalculation was a comparison of data on the mutual location of the Warsaw Area and the Ostroleka Area in the central part of Mazovia and the Chernobyl NPP.

Mazovia is at a comparatively close distance from the ChNPP. Therefore, quite expectable is a non-uniform distribution of the ChNPP emission products in the atmosphere over comparatively large portions of its territory, such as spatially separated Warsaw Area and Ostroleka Area. It can be added that the dimensions of these areas are two times and a half to three times smaller than the dimensions of Mazovia as such and seven to nine times smaller than their distances from the ChNPP. This permits to suggest that, on the one hand, differences are possible in the values of the radionuclide activities in the atmosphere over the territory of each area and that, on the other hand, their spatial distribution is uniform. This suggestion was verified (Vlasov et al. 2019a) based on analyzing and generalizing calculated and instrumental data on the structure of the ^{137}Cs fallout for settlements and districts. It was found that the densities of the ^{137}Cs dry fallout reconstructed based on the direct calculation model for the Warsaw Area amount to σ_{dry} = 1.2 kBq/m^2, which practically coincides with the minimum ^{137}Cs fallout density for settlements within this area (1.3 kBq/m^2). At the same time, the minimum density of the ^{137}Cs fallout for the Ostroleka Area was much larger (3.24 kBq/m^2). This is 2.7 times larger than the dry fallout density estimated based on the direct calculation model. And the spread in the maximum to minimum ^{137}Cs fallout density ratios for the Warsaw Area (with rainfall in the main fallout period) is equal to 7.7, and the ^{137}Cs dry fallout density within the Ostroleka Area is practically homogeneous with the minimum spread being 2.1. Therefore, one more atmosphere model was added to the three base calculation models with recalculation of the ^{137}Cs activity in the cloud by way of increasing by a factor of 2.7 the ^{137}Cs activities in the atmosphere over the Ostroleka Area, with the relative shares of the iodine existence forms and the ^{131}I and ^{137}Cs activity ratios having been preserved. An additional independent verification of the feasibility of this atmosphere model is expected to be undertaken when comparing the calculated and instrumental data on the ^{131}I activity in milk in this area.

The results from reconstructing the activities of ^{131}I in the pasture grass in the Ostrolecki district of the Ostroleka Area using the cloud recalculation model (Fig. 4: Gr3 – reconstruction, Gr4 – nonlinear interpolation (Gr3) show that that they differ greatly from the direct measurement data on the ^{131}I activities in lawn grass (Gr1 – measurement, Gr2 – exponential interpolation (Gr1)) both in terms of their absolute values and their time-dependent variation rates.

The results of calculating the dynamics of the ^{131}I activity in the pasture grass in the Piski district for the atmosphere model with the cloud recalculation (Ostroleka Area) are shown in Fig. 5 which takes into account the exponential reduction rates for the ^{131}I activity in grass in a time interval of 6 to 18 days for reconstructed (l_m = 0.19 day^{-1}) and calculated (l_c = 0.21 day^{-1}) data.

The average density of the ^{137}Cs fallout in this district (3.8 kBq/m^2) practically coincides as well with the recalculated density of dry fallout in this area (3.24 kBq/m^2). Therefore, the calculation results based on all three models for this district: direct calculation (calculated to instrumental data ratio, $\mu 1$ = 0.88), homogeneous cloud ($\mu 2$ = 1.06), and heterogeneous cloud ($\mu 3$ = 0.92), coincide with an accuracy of up to 12% and are close to the ideal value of 1.

The figure also presents the results of a similar direct calculation for the ^{131}I activity in grass for the cloud without recalculation of the ^{137}Cs and ^{131}I activities in the atmosphere (Fig. 5, Gr3). The calculated specific activities of ^{131}I in grass for this option are 2.7 times smaller than the instrumental data. It can be seen from Fig. 5 that the calculated model provides quite a satisfactory reproduction of both the maximum values and the dynamics of the ^{131}I activity decay in grass with the spread of the calculated to instrumental data ratio values equaling 0.9 to 1.15. Its exponential reduction rate values for calculated (λ_m) and instrumental (λ_c) data also practically coincide.

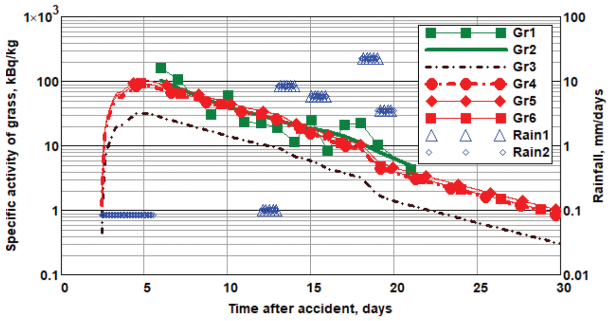

Figure 5. Dynamics of reconstructed "instrumental" and calculated data of the ^{131}I specific activity in cultivated pasture grass and rainfall in the Piski district, the Ostroleka Area (exponential reduction rates for instrumental ($l_m = 0.19$ day^{-1}) and calculated ($l_c = 0.21$ day^{-1}) data for the ^{131}I specific activity in grass). Data options for the ^{131}I activity in pasture grass: Gr1 – reconstructed "instrumental" data for the cloud with recalculation; Gr2 – nonlinear interpolation of Gr1; Gr3 – reconstructed "instrumental" data for the cloud with instrumental data; Gr4 – direct calculation model; Gr5 – heterogeneous cloud model; Gr6 – homogeneous cloud model. Rainfall: Rain1 – weather data; Rain2 – reconstruction in an interval of 2.4 to 5.5 days after the accident for the cloud with recalculation.

There is an effect observed in all calculated and reconstructed instrumental data with a significant daily rainfall (10 to 20 mm) for an increased reduction rate of the ^{131}I specific activity in pasture grass as compared with its value for time periods without rainfall smaller than (6–13) days and larger than 20 days. A more detailed option of considering this effect is presented for the Brinow bis farm in Fig. 6 and in Table 1.

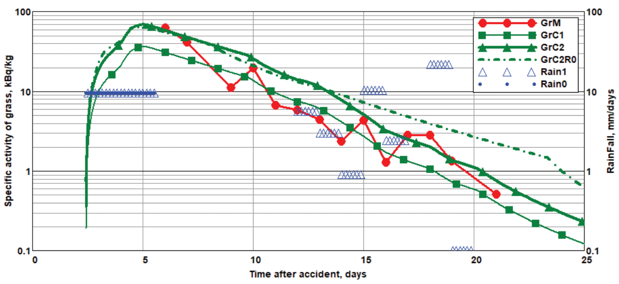

Figure 6. Dynamics of reconstructed "instrumental" and calculated data of the ^{131}I specific activity in the cultivated pasture grass taking into account and without taking into account the rainfall after 10 days: GrM – ("instrumental" data for the homogeneous cloud); GrC1 – weather data on rainfall intensity (Rain1) ("instrumental" data - homogeneous cloud); GrC2 – weather data on rainfall intensity (calculation - heterogeneous cloud); GrC2R0 – weather data – Rain0 (calculation - heterogeneous cloud); Rain1 – rainfall intensity - weather data); Rain0 – effective rainfall intensity, homogeneous cloud model.

Table 1. Reduction rates of the 131I specific activity in grass taking into account and without taking into account the rainfall after the main fallout end

Data	Rainfall not taken into account (1)	Rainfall taken into account (2)	(2) / (1)
Measurement	1.15	1.25	1.09
Calculation	1.17	1.39	1.19
Calculation / Measurement	1.02	1.11	1.09

These present reconstructed instrumental data (Gr1), their nonlinear interpolation (Gr2) and calculated data for the heterogeneous cloud models taking into account (Gr3) and without taking into account the rainfall after the main fallout end (Gr4). The reduction rates of the calculated and reconstructed instrumental data on ^{131}I in pasture grass during calculations taking into account and without taking into account the rainfall after the end of the main fallout for times larger than six days given in Table 1, show them to agree fairly satisfactorily both for the whole of the instrumental data series (see Fig. 6), and for the reduction rates of the ^{131}I activities in grass (see Table 1).

Of interest are the results of comparing the calculations for the ^{131}I activities in grass, the ^{137}Cs fallout densities and rainfall for settlements based on the direct calculation model (Fig. 6, GrC1), and the homogeneous cloud model (Fig. 6, GrC2), presented in Fig. 6 and in Table 2. As the rainfall increases from 7.3 mm/day for a time of 4 to 5 days based on weather data, and to 30 mm for a time of 2.5 to 5.5 days based on the homogeneous cloud model, the calculated density of the ^{137}Cs fallout for settlements increases by a factor of 3.4 (column σ_{dep}), the specific activity of ^{131}I in grass decreasing, contrarily, by a factor of 1.86 (column Q_{max}). We also note a noticeable change in the shape of the time dependence of grass activity near the maximum on insert in the picture to Fig. 6, due to a significant difference in rainfalls during of the main fallout period for direct calculation and homogeneous clouds models.

Table 2. For calculated data analysis for the Brinow bis farm

Farm	Brinow bis	Model	σ_{dep}, kBq/m^2	Rainfall*, mm	m	Q_{max}, kBq/kg
Weather station	Brinow	Direct calculation	6.92	7.3	0.87	54.8
σ_{dep}	22.7	Heterogeneous cloud	22.7	7.3	2.49	155.9
Rainfall*, mm	7.3	Homogeneous cloud	23.6	30	0.46	29.4

* – Rainfall for the main fallout time (2.5 to 5.5) days after the accident m – calculation/measurement ratio; Q_{max} – maximum activity of grass.

This result is the direct reflection of the physics of the activity delay on the vegetation leaf surface during fallout with rainfall. As continuous rainfall increases, the rate of the rainwater deposition on the vegetation leaf surface decreases rapidly, and stops entirely, starting from its particular value, due to all newly fallen moisture flowing down on the ground. Such dynamics is confirmed by scenario calculations in which the rainfall for the main fallout period increased from 0 to 40 mm (Fig. 7), from which it can be seen that the maximum activity of ^{131}I in grass grows with the rainfall increase to 15 mm, and starts to decrease in the event of a heavy rainfall.

Here, the time to achieving the maximum activity decreases monotonously with the rainfall growth, but exceeds all the same the time for the ^{131}I second activity maximum to occur in the atmosphere.

More detailed data in Fig. 8 show that the maximum activity of ^{131}I in grass grows from 38 to 48 kBq/kg as the rainfall for the main fallout period increases from 0 to 10

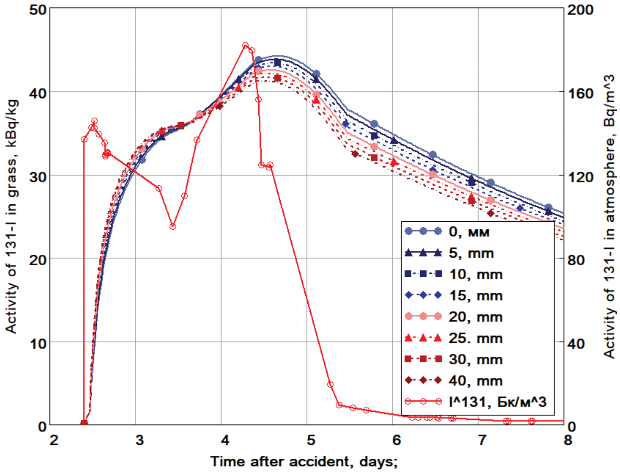

Figure 7. Scenario option for dependences of calculated data on the ^{131}I specific activity in the cultivated pasture grass at the Brinow bis farm, the Warsaw Area, on rainfall of 0 to 40 mm in the main fallout period (beginning of radioactive fallout q_dep0 = 2.4 days; beginning of rainfall q_rain0 = 2.5 days; end of rainfall q_rain1 = 5.5 days).

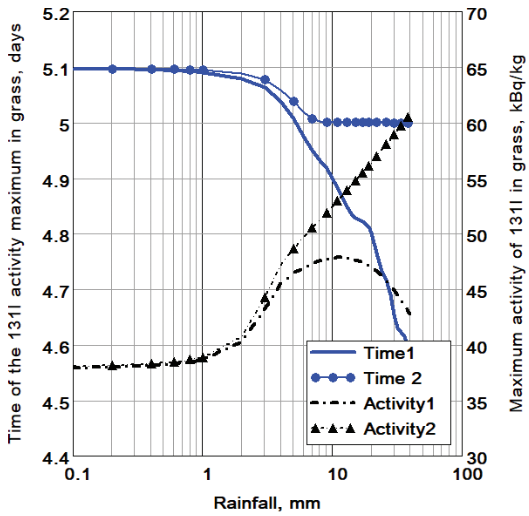

Figure 8. Scenario calculation for the dependence of time and maximum activity of ^{131}I on grass as a ratio of its maximum activity to the density of fallout from rainfall taking into account (Time1, Activity1) and without taking into account (Time2, Activity2) the self-cleaning of grass in the main fallout period (beginning of radioactive fallout q_dep0 = 2.4 days; beginning of rainfall q_rain0 = 2.5 days; end of rainfall q_rain1 = 5.5 days). Brinow bis farm, Warsaw Area.

to 15 mm; as its grows further to 40 mm, their activity decreases to 42 kBq/kg.

The time of the ^{131}I activity maximum in grass is small, but it decreases continuously as rainfall grows: from 5.1 days in the event of dry fallout to 4.5 days with a rainfall of 40 mm, but, all the same, more time of the ^{131}I second activity maximum in the atmosphere remains (Fig. 7).

The dependence of the ^{131}I maximum activity in grass on the amount of rainfall for the main fallout period has the maximum with a rainfall of 10 to 15 mm. It follows from the data in Fig. 7 that for times larger than 4.4 days, the specific bulk activity of ^{131}I in the atmosphere starts to decrease rapidly. Due to this, as the rainfall increases (with a rainfall larger than 20 mm in this case), the rate of the ^{131}I activity deposition on the grass surface becomes smaller than its wash-off rate. As a result, the maximum activity value starts to decrease as the rainfall grows (see Fig. 8).

The coefficient of delay (ratio of the maximum ^{131}I specific activity in grass to the ^{137}Cs fallout density) is also decreasing rapidly from 34 to 1.4 m^2/kg as the rainfall grows from 0 to 40 mm.

It follows from the radionuclide transport physics that there is a directly proportional dependence between the maximum radionuclide activities in all its series elements of the food chain. With this taken into account, disparity d^{CM}_{grf} in the form of the ratio of the calculated specific activities of ^{131}I to instrumental data in pasture grass within the region of their maximum values can be used to adjust the calculated data for milk based on the relation:

$$q^{Ccor}_{milk}(t) = q^{C}_{milk}(t) \,/\, d^{CM}_{grf}, \qquad (1)$$

where $q^{C}_{milk}(t)$ and $q^{Ccor}_{milk}(t)$ are the direct and adjusted calculated specific activities of radionuclides in milk.

The same procedure can be applied as well to adjusting the calculated data for the dynamics of the radionuclide intake into the human body along the food chain and estimating its internal exposure doses.

Since the series of instrumental data for the specific activities of ^{131}I in lawn grass was obtained only in the interval of its activity decrease, quantity d^{CM}_{grf} for pasture grass was estimated based on two data samples:

- option A – for the entire series of instrumental data;
- option B – a reduced series for the region of the maximum values in the series (6 to 9 days).

The proximity to unity of the absolute values of the mean geometrical ratio of calculated data to instrumental data makes it possible to evaluate in option A the capabilities of the simulation model for reproducing the dynamics of instrumental data in their entire time interval. In option B, the values of this ratio, with their significant differences from unity, can be used as adjusting factors when reconstructing the milk contamination dynamics and further, along the chain, when reconstructing the human internal exposure doses.

The calculation results show that the calculated activities of ^{131}I in pasture grass, based on the direct calculation and homogeneous cloud models, agree well with the instrumental data recalculated from perennial lawn grass (Table 3). For the entire series of instrumental data and for the option with instrumental data of the radionuclide activity in the atmosphere without recalculation, the spread of the calculation/measurement ratio is equal to (0.86–0.98) and (0.89–0.95) for the option with their recalculation. For the heterogeneous cloud model, this ratio is much greater than unity and the spread is broader and equals to a value between 1.6 and 3.0.

Table 3. Mean geometrical values of σ_G and standard deviation sG for the calculated data ratio to instrumental data on the 131I specific activities in pasture grass for the entire data time sample

Milk area		Warsaw Area		Ostroleka Area	
Cloud model		Direct data		Direct data	Data with recalculation
Vegetation		Lawn grass	Pasture grass	Pasture grass	Pasture grass
μ_G	Direct calculation	0.88	0.84	0.92	0.89
	Heterogeneous cloud	1.66	2.74	2.99	1.08
	Homogeneous cloud	0.86	0.89	0.98	0.95
σ_G	Standard deviation	1.69	1.65	1.69	1.69

Therefore, the direct calculation and homogeneous cloud models lead to a fairly satisfactory agreement of the calculated and instrumental data on the specific activity of ^{131}I in pasture grass recalculated from perennial lawn grass, with the geometrical mean values of the average and standard geometrical deviations equaling 0.8 and 2 respectively.

Conclusions

Recalculation of actual instrumental data for the specific activities of ^{131}I from perennial lawn grass to reconstructed instrumental data for cultivated pasture grass leads to a better agreement with the calculated data than recalculation from annual lawn grass.

The instrumental data reduction rate, equal to 0.21 day^{-1}, practically coincides with the calculated data reduction rate for perennial lawn grass equal to 0.23 day^{-1}.

The dependence of the maximum activity of ^{131}I in grass on the amount of rainfall for the main fallout period reaches the maximum with a rainfall of 10 to 15 mm. The time for the ^{131}I activity maximum to occur is small but decreases continuously as the rainfall grows from 5.1 days in the event of dry fallout to 4.5 days with a rainfall of 40 mm.

The coefficient of the ^{131}I delay on grass (ratio of the ^{131}I maximum specific activity to the ^{137}Cs fallout density) decreases from 34 to 1.4 m^2/kg as the rainfall in the main fallout period increases from 0 to 40 mm.

For perennial lawn grass, the spread of the calculation/measurement ratios for the entire series of reconstructed instrumental data for both areas is the same and lies in a range of 1.0 to 1.3.

For the series of instrumental data in the region of their maximum values, the range of the calculation/measurement ratios is close to unity (0.7 to 0.8), and this ratio is much smaller than unity and is equal to 0.4 on the average for the annual lawn grass option.

The standard mean geometrical deviation of the calculated data ratio to reconstructed instrumental data for all calculation models is practically constant and lies in a range of 1.6 to 1.7.

It is proposed that the obtained values of the calculated data ratio to instrumental data for the specific activities of ^{131}I in pasture grass in the region of their maximum values be used to adjust the dynamics of the calculated ^{131}I activities in milk in the central part of Mazovia.

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