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INVESTIGATION AND EVALUATION OF CARBON DIOXIDE EMISSIONS FROM SOIL IN NERIS REGIONAL PARK

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Abstract. Soils release around 20% of the total CO_2 content to the atmosphere; consequently, forest and agricultural ecosystems have a big influence on CO_2 balance. Until recently, the majority of CO_2 measurements of Lithuanian soils were either carried out under laboratory conditions or obtained by applying outdated research methods. CO_2 investigations in Neris Regional Park were carried out under field conditions during plant vegetation by using the CO_2 emission measuring instrument ADC BioScientific and soil chamber, the analysis system of which includes a metal collar of ~ 0.9 m^2 area. This infrared gas analysis system performs measurements within the range of 0–2000 ppm, with an error of 1 ppm. The emission's error is a mere ±2%. The system allows making reliable measurements within the temperature range of –5 °C to +50 °C.

Keywords: soil, total carbon, soil surveys, CO_2 emissions.

1. Introduction

Soil respiration rates vary significantly among major plant biomes, suggesting that the type of vegetation influences on the rate of soil respiration. However, correlations among climatic factors, vegetation distributions, and soil respiration rates make cause–effect arguments difficult. Vegetation may affect soil respiration by influencing soil microclimate and structure, the quantity of residues supplied to the soil, the quality of these residues, and the overall rate of root respiration.

Soil respiration is the key factor for understanding responses of terrestrial ecosystems to climate change. Agricultural ecosystems are an integral part of terrestrial ecosystems. Therefore, the agricultural influence on carbon emission and soil carbon sequestration is undoubted. Cropland amounts to about 12% of the earth's surface (Verma *et al.* 2005), and there is a general agreement that many agricultural ecosystems have the potential to sequester large amounts of C and support enhancing C sequestration in the soil (Freibauer *et al.* 2004; Smith 2004; Han *et al.* 2007; Kvasauskas, Baltrėnas 2009). However, C dynamics have been less studied in agricultural ecosystems as compared with other ecosystems. CO_2 flux from soil is a good indicator of the overall biological activity of the soil and is often used when studying the soil carbon cycle. Scientific and statistical studies state that controlling soil respiration and carbon (C) cycling are of particular interest because soils contain twice as much C as the atmosphere and three times as much as vegetation (Granier *et al.* 2000; Han *et al.* 2007; Horák and Šiška 2006; Baltrėnas *et al.* 2010). Soil respiration provides the main carbon efflux from terrestrial ecosystems to the atmosphere and is an important component of the global carbon balance (IPCC 1996; Buchmann 2000; Schlesinger and Andrews 2000).

Springtime soil surface respiration and soil vapour flux in different long-term agro-ecosystems, primarily at the soil surface or within a thin upper layer where the bulk of plant residues is concentrated (Rastogi *et al.* 2002). Therefore, detailed information on soil respiration and its controlling factors is critical for constraining the ecosystem C budget and for understanding the response of soils to changing land use and global climate change (Buchmann 2000; Tufekcioglu *et al.* 2001; Lee *et al.* 2004). *In situ*, soil respiration (CO_2 evolution) is a useful measure of relative biological activity (microbial, roots, and fauna) of contrasting sites or contrasting treatments applied to the same site (Coleman *et al.* 2002; Jankaitė 2009). Soil respiration (SR) largely determines the rate at which CO_2 passes from the soil surface into the atmosphere and is widely used as a measure of biological activity of soil. It includes both autotrophic (root respiration) and heterotrophic (microbial and faunal respiration) components, which contribute in varying proportions depending on site and season (Tóthová *et al.* 2007). The flux of CO_2 emitted from the soil surface to the atmosphere mainly originates from the respiration of roots as well as decomposition of root parts, soil organic matter and plant litter (Hanson *et al.* 2000; Hoogberg *et al.* 2001).

Soil respiration varies with vegetation and among major plant biomes. Respiration rates vary significantly among major biome types, and side-by-side comparisons of different plant communities frequently demonstrate differences in soil respiration rates. Such findings indicate that vegetation type is an important determinant of soil respiration rate, and therefore changes in vegetation have the potential to modify the response of soils to environmental change (Baltrėnas *et al.* 2010). No predictable differences in soil respiration were found between cropped and vegetation-free soils, forested and cropped soils, or grassland and cropped soils, possibly due to the diversity of crops and cropping systems included (Raich and Tufekcioglu 2000). The rates of soil respiration are highly dependent upon soil temperature and moisture conditions. These factors interact to affect the productivity of terrestrial ecosystems and the decomposition rate of soil organic matter, thereby driving the temporal variation of soil respiration (Raich and Tufekcioglu 2000; Wiseman and Seiler 2004; Horák and Šiška 2006). Soil respiration also exhibits high levels of spatial heterogeneity, especially across small spatial scales in forest, grassland and farmland ecosystems at different time scales (Xu and Qi 2001; Franklin and Mills 2003; Maestre and Cortina 2003). Methods in quantifying spatial variation in soil respiration are limited and proved to be difficult (Rayment and Jarvis 2000; Tang and Baldocchi 2005). The heterogeneity of vegetation coverage, root distribution, major environmental factors and soil properties contribute to the spatial variation of soil respiration (Xu and Qi 2001). Researchers use to scale up chamber measurements of soil respiration to the one-ecosystem and larger scales (Maestre and Cortina 2003; Reth *et al.* 2004). These chamber measurements typically use soil temperature, soil moisture as well as their interaction (Tang and Baldocchi 2005). Management practices can influence soil CO_2 emission and C content in cropland, which can contribute to the global warming. Shifting from the traditional management system to a more conservative system, including no-till (NT) and continuous cropping, could reduce CO_2 emissions during the cropping season. Soil management and organic amendments, such as animal manure and compost, can affect soil organic C pools, soil nutrients, and microbial environments and activities, which are some of the controlling factors in CO_2 emission (Ginting *et al.* 2003).

The aim of research is to determine the rate of carbon dioxide emissions from soils of different land use types. Obtained data are used to identify the correlation between the total carbon and carbon dioxide emissions from soil.

2. Methods for investigating carbon dioxide emissions from soil

Measurements were made with an ADC SRS-1000 measuring instrument, the operation of which is based on infrared absorption. Investigations of carbon dioxide emissions were carried out in Neris Regional Park (Fig. 1). Investigations were performed in three areas of different land use types: forest, grassland and cropped soil.

The main factors of carbon dioxide emissions are temperature, microorganism activity and humidity. Carbon dioxide emissions are also influenced by a plant vegetation period and time of the day, which appropriately changes over the period of plant vegetation.

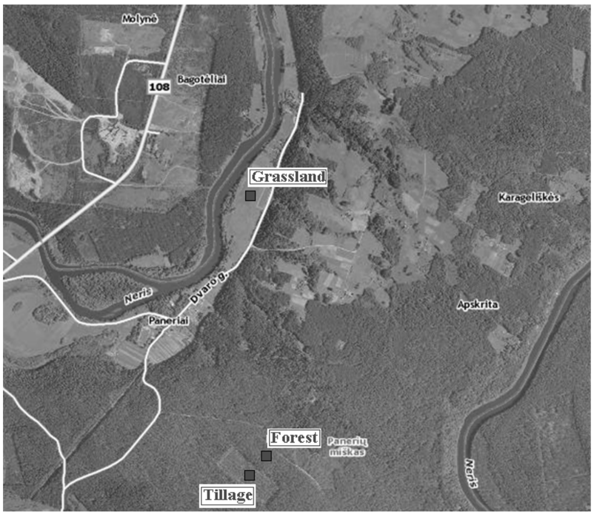

Fig. 1. Measurement places of carbon dioxide emissions from Neris Regional Park soil

The analyser SRS-1000 for measuring carbon dioxide emissions from soil consists of a console programming unit, a soil respiration chamber and a metal collar (Fig. 2). The highly accurate miniaturised CO_2 infrared gas analyser is housed directly adjacent to the soil chamber, ensuring the fastest possible response to gas exchanges in the soil.

Fig. 2. The analyser ADC SRS-1000 of carbon dioxide exchanges from soil

Once the desired site for analysis is selected, the programming unit and soil respiration chamber are connected. The metal collar is inserted into the desired measurement place and the chamber is positioned on it.

The collar has to be inserted perpendicularly to the soil. After insertion the collar has to be left for 20 minutes. The soil temperature sensor should be inserted nearby. It measures soil temperature at the depth of 5 cm. A telescopic pipe is inserted next to the device. The device needs to take atmospheric carbon dioxide from the height of 3 metres, while it sets its parameters to the zero position. The height of 3 metres ensures that the measurement is not influenced by a person who performs it. Each measurement takes 20–30 minutes of observing fluctuations in carbon dioxide emissions. Data are automatically recorded on a memory card.

The nominal area of soil chamber is 111 cm^2. The nominal capacity of soil chamber is 995 cm^3. If the chamber of the soil collar is inserted into soil, its effective used volume decreases. The actual capacity can be calculated by multiplying the depth of insertion into soil by soil area and deducting this figure from the total capacity. During investigations, the collar is inserted up to the marking. Therefore, the maximum capacity of the collar is 682.5 cm^3 (rounded to 682 cm^3). The total maximum analysed capacity is calculated upon adding soil chamber capacity and calculated collar capacity, which is equal to 1650 cm^3 (chamber's nominal area is 97.5 cm^2, and nominal capacity – 968 cm^3). The total capacity analysed during investigations with 2 centimetres from the collar limits left non-inserted is 1163 cm^3. When 2 cm remain non-inserted, the lost capacity is equal to 195 cm^3, while the analysed capacity is calculated by deducting the difference of 195 cm^3 from 968 cm^3.

The soil chamber accepts "standard" air and admits "analysed" air into the chamber in the same manner as in standard chambers. Air flux passing to the soil chamber is controlled by the function Uset on LCi/Pro configuration menu. The flux size can insignificantly vary during investigations at a limit of 200. Excess air is directed to the chamber while a pressure release valve ensures the maintenance of a normal air pressure within the chamber without disturbing gas exchange in the soil/air interaction.

Air temperature and humidity inside the chamber are controlled conventionally, i.e. with chamber's sensors T_{ch}, E_{an}, E_{ref}. Soil temperature is measured with a special soil temperature sensor, which is connected to the handle inlet. This sensor uses the same thermistors as a leaf temperature probe, which is distinguished by a low non-linear reaction which is compensated for by analyser's software.

During investigations the collar is inserted into the soil to the extent necessary for the elimination of the total soil diffusion. For example, if soil is loose, the collar is inserted as deep as possible. This is needed in order to reduce gas penetration through the soil and to ensure better support for the soil chamber. A measurement chamber is placed on the inserted collar. Once measurement is started, flux control calibration is carried out. This is important as the increased soil amount in the chamber can have an influence on the time of gas precipitation, especially at a low flux. If the time of precipitation is short, the obtained data may be inaccurate. Experiments confirmed that calibration produces the best results when the flux is set at 100 μmols s^{-1} and there is sufficient time for gas to precipitate at any flux rate value from 100 μmols s^{-1} and above. Calibration is repeated only when the flux rate is below 100 μmols s^{-1}.

Calculations done by the analyser are not adapted for the measurements of soil biomass respiration. Recalculations can be made on the basis of flux to chamber measurements using U, CO_2 concentration entering the chamber C_{ref}, and CO_2 concentration outgoing from the chamber C_{an}.

$$C_{an} - C_{ref} = \Delta C, \tag{1}$$

$$C_s = \Delta C \cdot Umol, \tag{2}$$

$$Umol = \frac{U}{10^6}, \tag{3}$$

where: C_{ref} – standard unit of CO_2 concentration [μmols s^{-1}]; C_{an} – unit of CO_2 analysis concentration [μmols s^{-1}]; U – flux to chamber [μmol s^{-1}].

3. Investigations of carbon dioxide in Neris Regional Park soils of different types of land use

Investigations were carried out in August and September. During measurements, the ambient air temperature varied from 8.7 to 18.6 °C. The analysis was aimed at evaluating the values of emissions and related factors. The major factors impacting carbon dioxide emissions are humidity, temperature, microorganism activity and soil type.

Other factors include the phase of plant vegetation and time of day.

Investigations were carried out at the standardised time for the entire period concerned, from 8:00 to 18:00 (Fig. 3).

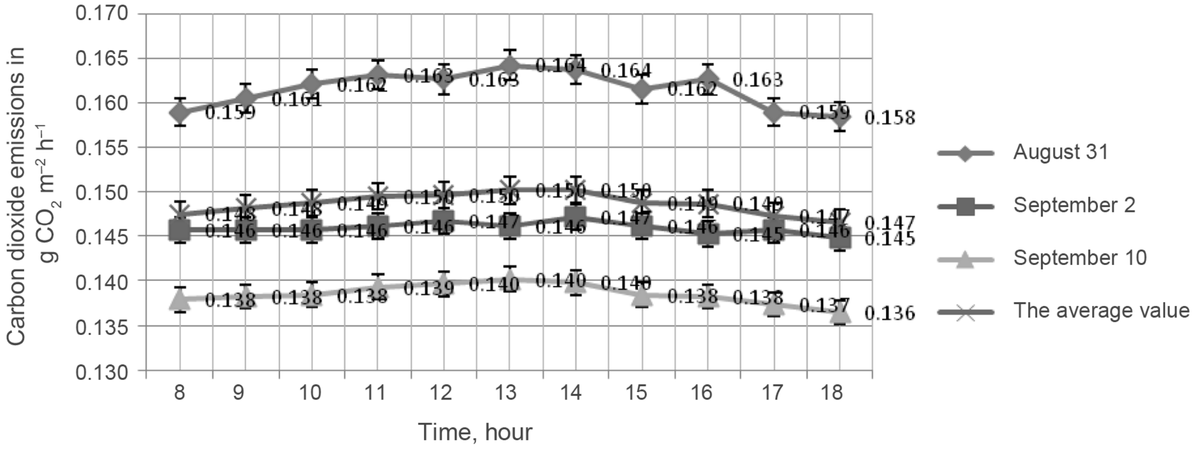

Fig. 3. CO_2 emissions from grassland soil during daytime

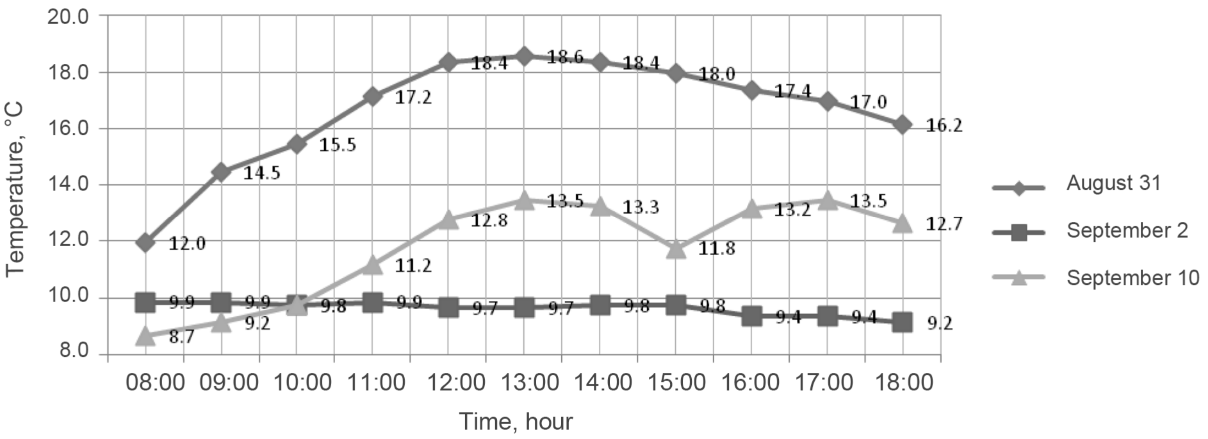

Fig. 4. Change of ambient air temperature during investigations of carbon dioxide emissions from soil

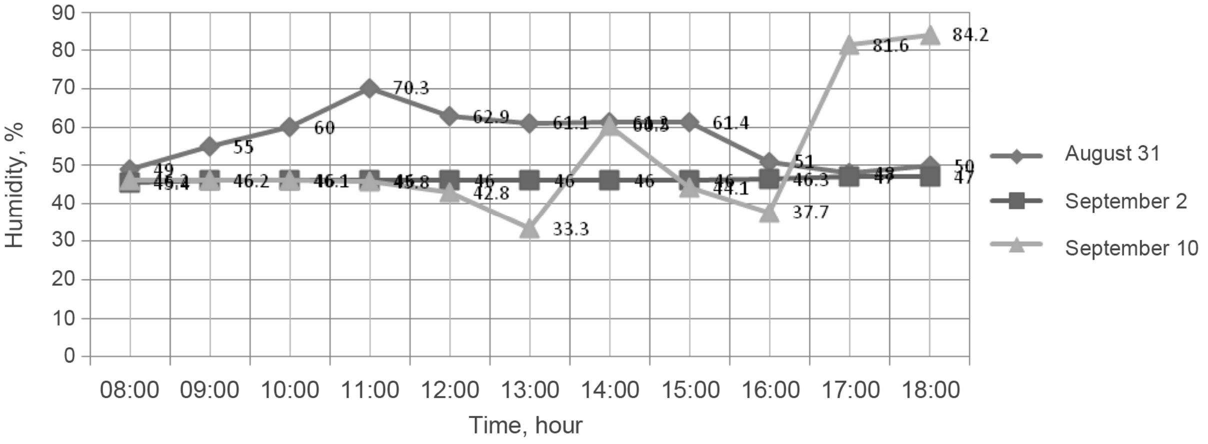

Fig. 5. Change of ambient air humidity during investigations of carbon dioxide emissions from soil

In grassland soil, measurements of carbon dioxide were carried out in area C (Fig. 4). During measurements the ambient air temperature varied from 8.7 to 18 °C. There was low cloudiness and no rain during the measurement. The highest ambient air temperature reached 18.6 °C The highest carbon dioxide emissions were also recorded in that period and varied in the range of 0.163 to 0.162 g CO_2 $m^{-2}h^{-1}$. At 8:00 carbon dioxide emissions increased from 0.159 g CO_2 $m^{-2}h^{-1}$ (31 August). Carbon dioxide emissions recorded in the evening were equal to 0.158 g CO_2 $m^{-2}h^{-1}$. The difference between the morning and evening emissions was around 0.001 g CO_2 $m^{-2}h^{-1}$.

Such low change in carbon dioxide emissions is impacted by humidity, ambient air temperature and wind speed. In the presence of excess humidity, part of carbon dioxide dissolves in inserted water. Temperature has a direct influence on gas solubility in water and the coefficient of its expansion. The speed of wind impacts on the surface gas density. In the presence of a strong wind gas inter-mixing is more intensive. As carbon dioxide is heavier than air, carbon dioxide evaporates more intensively in the presence of a strong wind. Atmospheric pressure also impacts on gas distribution in soil. When atmospheric pressure is low, gas accumulates and when atmospheric pressure is increased, gas diffusion takes place. Temperature also has an influence on the content of carbon dioxide in soil. When it falls, activity of microorganisms slows down or even discontinues. In this sense, humidity plays an important role as its excess also slows down activity of microorganisms. As data of Curve 1 demonstrate, atmospheric humidity was quite high during the measurement (Fig. 5). From 11:00 to 15:00 the quantity of ambient air humidity was close to that, which was evaluated as the probability of rain. The recorded soil humidity hardly made 22.6%. As measurements were made in the autumn season when climate is boreal, the amount of precipitation was by 1.6 times above evaporation. Substances were leached out and carried away in large quantities. In autumn in particular, water evaporation is equal to or below precipitation passing into the soil.

Investigations carried out on the next day showed the average carbon dioxide emission of 0.146 g CO_2 $m^{-2}h^{-1}$ (2 September, Fig. 6). Obviously, the content of carbon dioxide emissions decreased compared to the first-day measurements, 0.016 g CO_2 $m^{-2}h^{-1}$. On the second day ambient air temperature was lower, 9.2–9.9 °C. The soil humidity recorded on the second day was 12.8%. The highest emissions of carbon dioxide, 0.160 g CO_2 $m^{-2}h^{-1}$, were identified at 13:00–16:00. It was intermittently cloudy without rain during the measurements. Ambient air temperature varied from 8.7–13.5 °C (10 September). Values of the obtained data were very low compared to Curves 1 and 2. The average value of carbon dioxide emissions was 0.142 g CO_2 $m^{-2}h^{-1}$. It was raining on the day before measurements. During measurements, the sky was overcast and a short rain fell. During investigations, soil humidity was 25.1%. The highest emissions of carbon dioxide amounting from 0.142 to 0.146 g CO_2 $m^{-2}h^{-1}$, were recorded in the period between 13:00 and 15:00. The performed investigation shows the dependence of ambient air temperature on the content of carbon dioxide emissions from soil. Analysis of the obtained data also determined that soil humidity had highly reduced carbon dioxide emissions. When the humidity of the analysed soil area was 22.6%, the average carbon dioxide emissions amounted to 0.162 g CO_2 $m^{-2}h^{-1}$, while at 25.1% humidity – 0.139 g CO_2 $m^{-2}h^{-1}$. When soil humidity increased by 1.1 times, carbon dioxide emissions decreased by 1.2 times. The curve of average values shows the average contents of carbon dioxide emissions, which varied from 0.147 g CO_2 $m^{-2}h^{-1}$ to 0.150 g CO_2 $m^{-2}h^{-1}$ during investigations.

In cropped soil area, carbon dioxide emissions varied in the range of 0.301 g CO_2 $m^{-2}h^{-1}$ to 0.312 g CO_2 $m^{-2}h^{-1}$ (31 August, Fig. 6). During investigations the ambient air temperature varied from 12 to 18.6 °C. However, carbon dioxide emissions in cropped soil do not change as in case with grassland soil. The determined emissions from cropped soil were equal. The highest carbon dioxide emissions were determined in the period between 11:00 and 14:00. The contents of carbon dioxide varied in the range of 0.31 g CO_2 $m^{-2}h^{-1}$ to 0.312 g CO_2 $m^{-2}h^{-1}$. The determined morning content of carbon dioxide emission was 0.302 g CO_2 $m^{-2}h^{-1}$, while the evening content – 0.301 g CO_2 $m^{-2}h^{-1}$. During the experiment, soil humidity was 8.6%. Curve 2 shows the measurement data of the next day when ambient air temperature was lower ranging from 9.2 to 9.9 °C. A similar was soil humidity – 8.4%. The highest emissions of carbon dioxide, 0.309 g CO_2 $m^{-2}h^{-1}$, were determined between 11:00 and 15:00. There was a minor difference between carbon dioxide emissions identified in the morning and in the evening – from 0.306 g CO_2 $m^{-2}h^{-1}$ in the morning to 0.304 g CO_2 $m^{-2}h^{-1}$ in the evening. When the soil got soaked, CO_2 emissions decreased in half. The depth of soil soaking reached around 8 cm. Here, the highest carbon dioxide emissions were determined in the period between 12:00 and 14:00. As measurements made in the morning and in the evening show, carbon dioxide emissions varied within narrow limits, from 0.178 g CO_2 $m^{-2}h^{-1}$ in the morning to 0.173 g CO_2 $m^{-2}h^{-1}$ evening. Soil humidity stood at 11.2%. Just like in the case of grassland soil, carbon dioxide emissions were significantly decreasing with increasing humidity. Carbon dioxide emission from cropped soil was, on the average, by 1.9 times higher than from grassland soil.

Emissions of carbon dioxide from forest soil were researched in a mixed forest area with prevailing conifers. The forest was not thinned, and the locality is quite hilly with a dense hydrographic network. Investigations of the total carbon content in soil showed significant content differences, which, among other potential factors, were determined by the planar erosion of water. Here, carbon dioxide exchanges within soils can be influenced by a surface forest leaf-litter and therefore it was removed from soil before performing measurements. It did not rain for several days before the experiment and soil therefore was not soaked during measurements. Data recorded during daytime were distinguished by their stability: carbon dioxide emissions varied in the range of 0.259 g CO_2 $m^{-2}h^{-1}$ to 0.262 g CO_2 $m^{-2}h^{-1}$ (Fig. 7). The most active emission, 0.266 g CO_2 $m^{-2}h^{-1}$, was recorded between 13:00 and 15:00. The determined humidity of the analysed soil at 12–18.6 °C was 5.2%. Investigations were carried out at the ambient air temperature of 9.2–9.9 °C and soil humidity of 5.3%. Carbon dioxide emissions at a lower temperature of ambient air compared to the data of 31 August. The data obtained during the investigations of 2 September changed from 0.158 g CO_2 $m^{-2}h^{-1}$ to 0.164 g CO_2 $m^{-2}h^{-1}$ in the course of investigations. However, the increase of carbon dioxide emissions was recorded in the period from 8:00 to 12:00. The existing carbon dioxide emissions increased by 0.004 g CO_2 $m^{-2}h^{-1}$. The investigations of carbon dioxide emissions carried out on 10 September showed that their values changed from 0.145 g CO_2 $m^{-2}h^{-1}$ to 0.147 g CO_2 $m^{-2}h^{-1}$ during the day. The highest emissions of carbon dioxide, 0.146 g CO_2 $m^{-2}h^{-1}$, were recorded in the period from 13:00 to 15:00. In summary, it can be stated that temperature was the major factor impacting carbon dioxide emissions. The average emissions of carbon dioxide changed from 0.148 g CO_2 $m^{-2}h^{-1}$ to 0.147 g CO_2 $m^{-2}h^{-1}$.

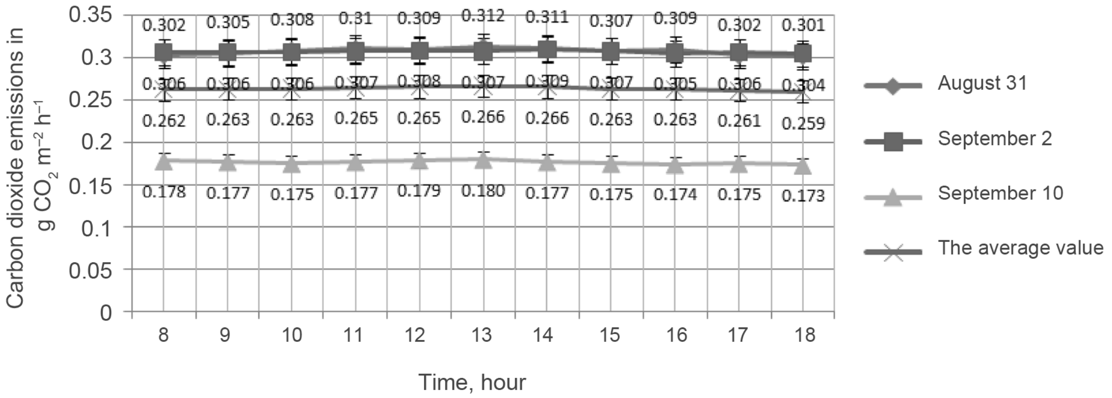

Fig. 6. CO_2 emission in cropped soil during daytime

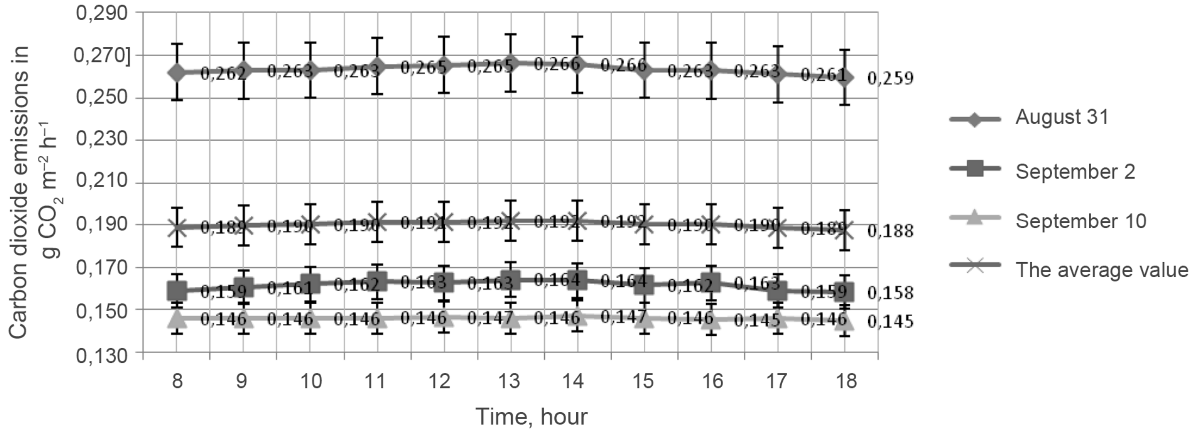

Fig. 7. CO_2 emissions from forest soil during daytime

Table 1. Correlation of coefficients of carbon dioxide emission between ambient air temperature and relative air humidity

Carbon dioxide emissions, g CO_2 $m^{-2}h^{-1}$		Air temperature, C^0			Ambient relative air humidity, %		
		31 August	2 September	10 September	31 August	2 September	10 September
Grassland soil	31 August	–0.74	–	–	–0.37	–	–
	2 September	–	0.30	–	–	–0.54	–
	10 September	–	–	–0.54	–	–	–0.14
Arable soil	31 August	0.65	–	–	0.77	–	–
	2 September	–	0.61	–	–	–0.48	–
	10 September	–	–	–0.44	–	–	–0.55
Forest soil	31 August	0.65	–	–	0.78	–	–
	2 September	–	0.65	–	–	–0.51	–
	10 September	–	–	–0.58	–	–	–0.56

The biggest change in carbon dioxide emissions, 0.150 g CO_2 $m^{-2}h^{-1}$, was identified between 11:00 and 15:00. In nearly all the cases analysed, the emission of carbon dioxide during the day, from 8:00 to 18:00, changed within a small interval.

The performed correlation analysis of the data shows a reliable correlation between the measurements of carbon dioxide emissions from grassland soil and ambient temperature. During the measurements, the correlation coefficient R was –0.74. Correlation between relative air humidity and carbon dioxide emissions was poor, while the correlation coefficient of the measurement was –0.37. On 2 September, the correlation coefficient of carbon dioxide emission was –0.3, while that with relative ambient humidity was –0.54. On 10 September, carbon dioxide emissions correlated with ambient air temperature at –0.54, while with ambient relative humidity – at a mere –0.14.

As regards the grassland soil, the lowest correlation of data was recorded with the relative humidity of the ambient air (Table 1). Data reached the average correlation between carbon dioxide emissions and ambient air temperature only on 10 September, and on 2 September – between carbon dioxide emissions and ambient relative humidity. In the case of the cropped soil, the strongest coefficients of correlation were obtained through comparison of data between carbon dioxide emissions and ambient temperature in both August and September days. However, there was a weak correlation between relative ambient humidity and carbon dioxide emissions, with the exception of the August data. The September data showed a weak correlation between carbon dioxide emissions and relative ambient humidity. A similar situation was also noticed in the forest soil. The strongest correlations of carbon dioxide emissions with ambient air temperature were recorded on 31 August and 2 September. The 10 September data showed the average correlation amounting to –0.58 between carbon dioxide emissions and ambient temperature. The strongest correlation of –0.78 was between ambient air relative humidity and the data of carbon dioxide emissions obtained in August. In the meantime the September data showed a weak correlation of around 0.54. Statistical analysis of the data was carried out with the software Statistica 7.0.

4. Conclusions

1. The performed analysis of the quantities of carbon dioxide emissions from soils of different types of land use showed changes in carbon dioxide emissions. As the obtained data provide, the greatest carbon dioxide emissions are from cropped soil – 0.263 g CO_2 $m^{-2}h^{-1}$, followed by 0.149 g CO_2 $m^{-2}h^{-1}$ from grassland soil and 0.139 g CO_2 $m^{-2}h^{-1}$ from forest soil. Investigations were carried out under identical atmospheric conditions and in the same sites of total carbon investigation.

2. Carbon dioxide emissions from soil are directly dependent on ambient air temperature. Investigations determined the following carbon dioxide emissions at a

temperature of 12–18.6 °C: 0.162 g CO_2 $m^{-2}h^{-1}$ from grassland soil, 0.307 g CO_2 $m^{-2}h^{-1}$ from cropped soil and 0.263 g CO_2 $m^{-2}h^{-1}$ from forest soil. The respective results obtained at a temperature of 9.2 to 9.9 °C are: 0.146 g CO_2 $m^{-2}h^{-1}$ from grassland soil, 0.306 g CO_2 $m^{-2}h^{-1}$ from cropped soil and 0.162 g CO_2 $m^{-2}h^{-1}$ from forest soil. Data of the performed investigations show that carbon dioxide emissions decreased from 1.1 to 1.6 times when temperature dropped from 18.6 to 9.9 °C.

3. Investigations of carbon dioxide emissions from soils of different types of land use have determined that carbon dioxide emissions can be lower as a result of soil humidity. As determined during the investigations, when soil humidity in grassland soil increased by 1.1 times carbon dioxide emissions decreased by 1.2 times. When the humidity of cropped soil rose by 1.4 times, carbon dioxide emissions fell by 1.7 times. When the humidity of forest soil increased by 1.4 times, carbon dioxide emissions fell by 1.8 times.

4. The performed analysis of data correlation shows the best correlation between carbon dioxide emissions and ambient air temperature R = 0.57. The correlation of carbon dioxide emissions with relative ambient humidity is moderate or poor R = 0.52.

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ANGLIES DVIDEGINIO EMISIJŲ IŠ DIRVOŽEMIO NERIES REGIONINIAME PARKE TYRIMAI IR VERTINIMAS

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Santrauka

Apie 20 % viso CO_2 kiekio, patenkančio į atmosferą, išskiria dirvožemiai, todėl miškų bei agroekosistemos daro nemažą įtaką CO_2 balansui. Lietuvoje iki pastarųjų metų dirvožemio CO_2 matavimai daugeliu atveju buvo atliekami laboratorinėmis sąlygomis, arba duomenys surinkti taikant senstelėjusius tyrimų metodus. CO_2 tyrimai Neries regioniniame parke atlikti lauko sąlygomis augalų vegetacijos metu matuojant *ADC BioScientific* CO_2 emisijos matuokliu. Šios infraraudonųjų spindulių dujų analizavimo sistemos skalė 0–2000 ppm, paklaida 1 ppm. Emisijos paklaida tesudaro ±2 %. Matavimai šiuo prietaisu patikimi –5–+50 °C temperatūroje.

Reikšminiai žodžiai: dirvožemis, bendroji anglis, dirvožemio tyrimai, anglies dioksido emisijos.

ИССЛЕДОВАНИЕ И ОЦЕНКА ВЫБРОСОВ ДВУОКИСИ УГЛЕРОДА ИЗ ПОЧВЫ В РЕГИОНАЛЬНОМ ПАРКЕ «НЕРИС»

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Резюме

Около 20% CO_2 от общего объема попадает в атмосферу из почвы, поэтому столь велико влияние лесов и агроэкосистем на баланс CO_2. В Литве измерения эмиссий CO_2 с поверхности почв проводились в лабораторных условиях либо применялись старые методы исследования. В региональном парке «Нерис» эмиссии CO_2 с поверхности почв измерялись новым прибором *ADC BioScientific*. Для исследований применялся прибор с системой инфракрасного газового анализа по шкале от 0 до 2000 частей на миллион. Выбросы учитывались с погрешностью ±2%. Устройство позволяет надежно измерять эмиссии CO_2 в диапазоне температур от –5 °C до +50 °C.

Ключевые слова: почва, общее количество углерода, исследования почвы, выбросы двуокиси углерода.

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