Greenhouse gas emissions from the forest fire events in the Slovak Paradise National Park according to the IPCC methodology

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Abstract

The annual loss of biomass by burning has been evaluated according to the database of forest fire occurence. Biomass data have been calculated on the basis of information about the forest fire area, the average amount of herb and shrub biomass, and organic matter in a litter layer. The evaluation of forest tree biomass affected by the forest fire within the W-UI has been carried out only for the fire events where the documentation has been done properly and verified. The final results of the GHG emissions from forest fire events are presented for CO_2, CH_4, and N_2O emissions. The highest values occured in 1976 and 2000, resp. and they were connected with the two largest forest fire events, at all. Presented results well correspond with the values reported from the whole territory of Slovakia (Mindas 1998).

Introduction

Biomass burning is an important pathway in biogeochemical cycling of carbon, nitrogen, hydrogen, oxygen between the biosphere and the atmosphere. Forest fire represents one of the important sources of greenhouse gas (GHG) emissions due to biomass burning processes. During the process of biomass burning many gases are emitted into the atmosphere with direct (CO_2, CH_4, N_2O) or indirect (CO, NO_x) effects on radiation balance within the atmosphere.
Due to the expected climatic changes in Europe the increased forest fire risk could be a crucial factor of development of forest management not only in the Mediterranean region but also in other parts of Europe especially in some forest types (e.g. Pine forests) (McCarthy et al. 2001). This fact is an important also from the point of view of GHG emissions connected with biomass burning processes.

Methods

There are several possibilities how to calculate GHG emissions as the results of forest fire occurence, but IPCC methodology (1996) is the widely used especially on a national basis (UNFCCC 2002). As the IPCC methodology is commonly used for the calculations of GHG amounts released at forest fire events in Slovakia, we decided to use this methodology also for calculation of the GHG emission in the territory of the Slovak Paradise National Park (the experimental study area of the WARM Project in Slovakia). Calculations have been carried out according to the equations as follows:

Annual carbon release (kt C) =	Annual biomass loss by burning (kt) x fraction of biomass oxidized on-site x carbon content	(1)
CO2 emission (Gg) =	Annual carbon release (kt C) x 44/12	(2)
CH_4 emission (Gg) =	Annual carbon release (kt C) x 0.012 x 16/12	(3)
N_2O emission (Gg) =	Annual carbon release (kt C) x N/C x 0.007 x 44/28	(4)

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Required input data for the IPCC methodology are defined as follows: 1) Annual loss of biomass by burning, 2) Fraction of biomass oxidised on-site, 3) Carbon fraction of biomass, 4) Emission factors.

Results

More than 130 forest fire events within the W-UI of Slovak Paradise National Park during the period of 1976-2000 have been occurred. During the period 1976-2000. The average area affected by forest fire within the mentioned period has been about 2 hectares, and the largest area of forest fire event in 2000 has been 54.5 ha.
Estimation of total loss of biomass by burning has been based on the detailed documentation about the damage of forest tree species, type of the forest fire, forest fire photo documentation, affected forest units distribution, and site conditions. The results are presented in Fig. 1. During the mentioned period total loss of biomass by burning has been estimated as 3.9 kilotonnes of dry matter. The two largest annual values have been occurred in the years 1976 and 2000, respectivelly and have been connected with the two largest forest fire events. From the temporal changes of annual loss of biomass by burning resulted the increase of total biomass loss during the 90th.

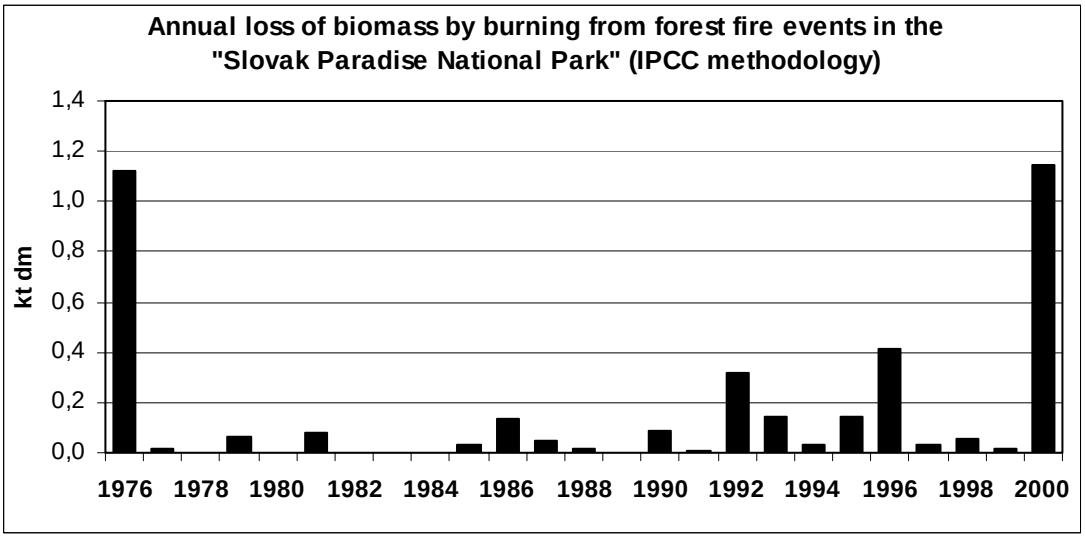

Figure 1 *Annual loss of biomass by burning from forest fire events in the „Slovak Paradise National Park“*

For the calculations of annual carbon release due to the burning processes the default values for the fraction of biomass oxidised on-site (=0.9) and the carbon content in biomass (=0.5) according to the IPCC methodology have been used. The results of annual carbon dioxide emissions from observed forest fire events are documented in Fig.2. During the period of 1976-2000 the total amount of carbon release represented the value of 1758 t of carbon what means the carbon dioxide emission of 6447 tonnes.

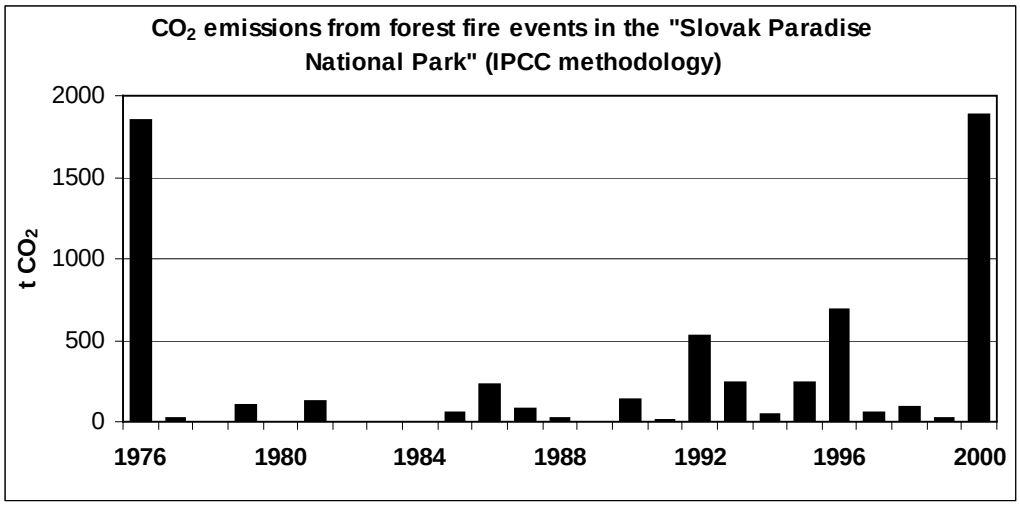

Figure 2 *Annual carbon dioxide emissions from forest fire events in the „Slovak Paradise National Park“*

Calculation of the methane emission has been based on the values of total carbon release and the emission ratio for open burning (=0.012) (IPCC 1996). The results of annual methane emissions from forest fire events are documented in Fig.3. During the whole period of 1976-2000 the total amount of methane emission has been 28 tonnes.

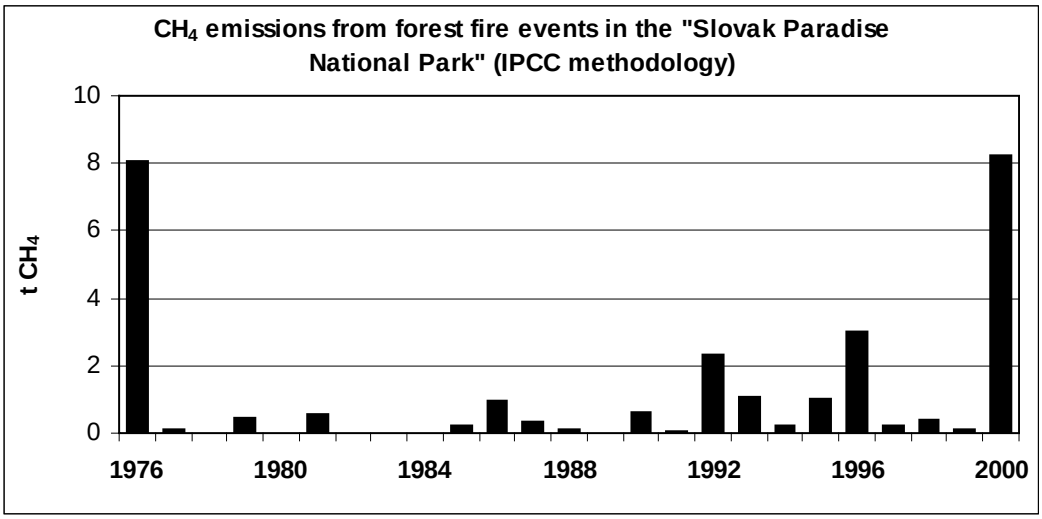

Figure 3 *Annual methane emissions from forest fire events in the „Slovak Paradise National Park“*

Calculation of the nitrous oxide emission has been based on the values of total carbon release and the emission ratio for open burning (=0.007) (IPCC 1996). The results of annual nitrous oxide emissions from forest fire events are documented in Fig.4. During the whole period of 1976-2000 the total amount of methane emission has been 0.4 tonnes.

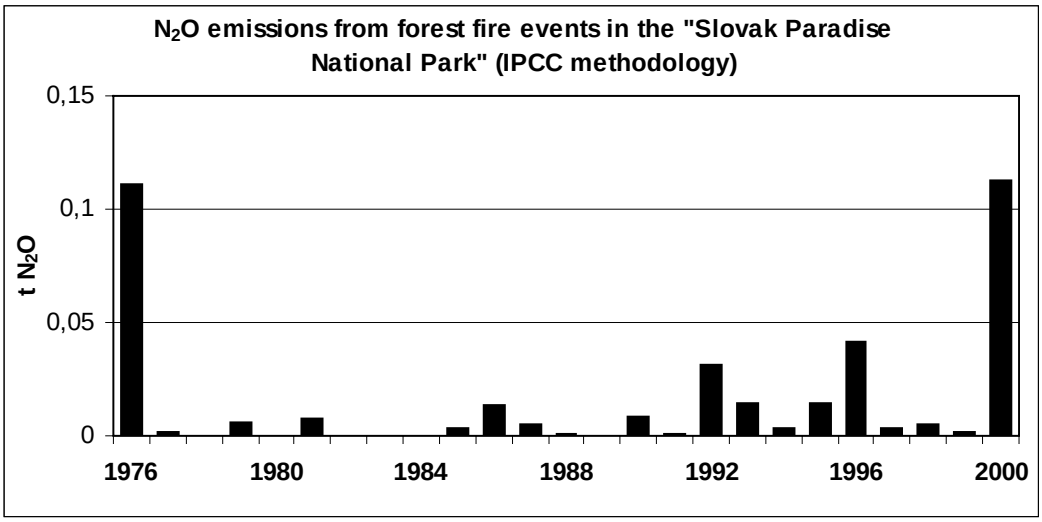

Figure 4 *Annual nitrous oxide emissions from forest fire events in the „Slovak Paradise National Park“*

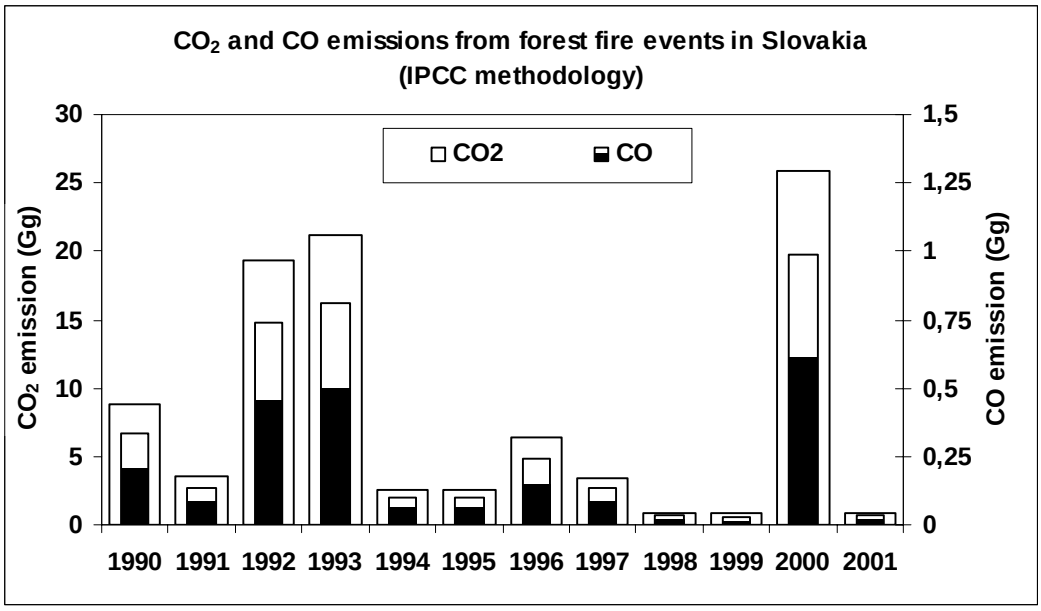

Figure 5 *Annual carbon mono and dioxide emissions form forest fire events in Slovakia*

For better understanding Fig.5 documents the results of carbon mono and dioxide emission inventory in Slovakia within the period 1990-2001. The highest value in 2000 is also connected with the large forest fire event in Slovak Paradise National Park.

Conclusions

The forest fire events have several important consequences related to the forest management activities, ecological and environmental planning of urban infrastructure as well as for socio-economic devlopment of the regions. Open burning of biomass represents one of the important sources of greenhouse gas emissions into the atmosphere. Although the GHG emissions from forest fires do not play a crucial role in GHG inventory budget in Slovakia, the increase of forest fire occurrence can be expected in the near future due to the more frequent occurrence of drought periods within the vegetation period in Slovakia (Lapin et al. 1996).

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