Contribution of Russian terrestrial ecosystems to global soil respiration flux

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INTRODUCTION

The global CO_2 flux from soils is an important regulator of climate change as well as determinant of net ecosystem C balance (Baggs, 2006).

The territory of Russia occupies more than 1/9 of the land surface. The role of Russian soils in the global carbon cycle is very considerable;

Therefore, more accurate estimates of the carbon fluxes from the terrestrial ecosystems of Russia should be obtained.

Previous estimates of total and microbial respiration for Russian territory:

- **Total respiration flux:**

  3.12 Pg C yr^{-1} - *only for growing period (Kudeyarov et al., 1995);*

  4.50 Pg C yr^{-1} - *for whole year (Kudeyarov, Kurganova, 1998);*

- **Microbial respiration flux:**

  2.60-3.05 Pg C yr^{-1} *(Kudeyarov, 2000; Nilsson et al., 2000).*

This study was aimed to:

(1) gather and analyze the database on soil respiration in Russia;

(2) develop a model for the assessment of the annual CO_2 fluxes from soils on the basis of summer CO_2 fluxes observations;

(3) calculate the total respiration flux from Russian soils for the whole territory of Russia with the use of geo-information technologies.

Analysis of soil respiration database

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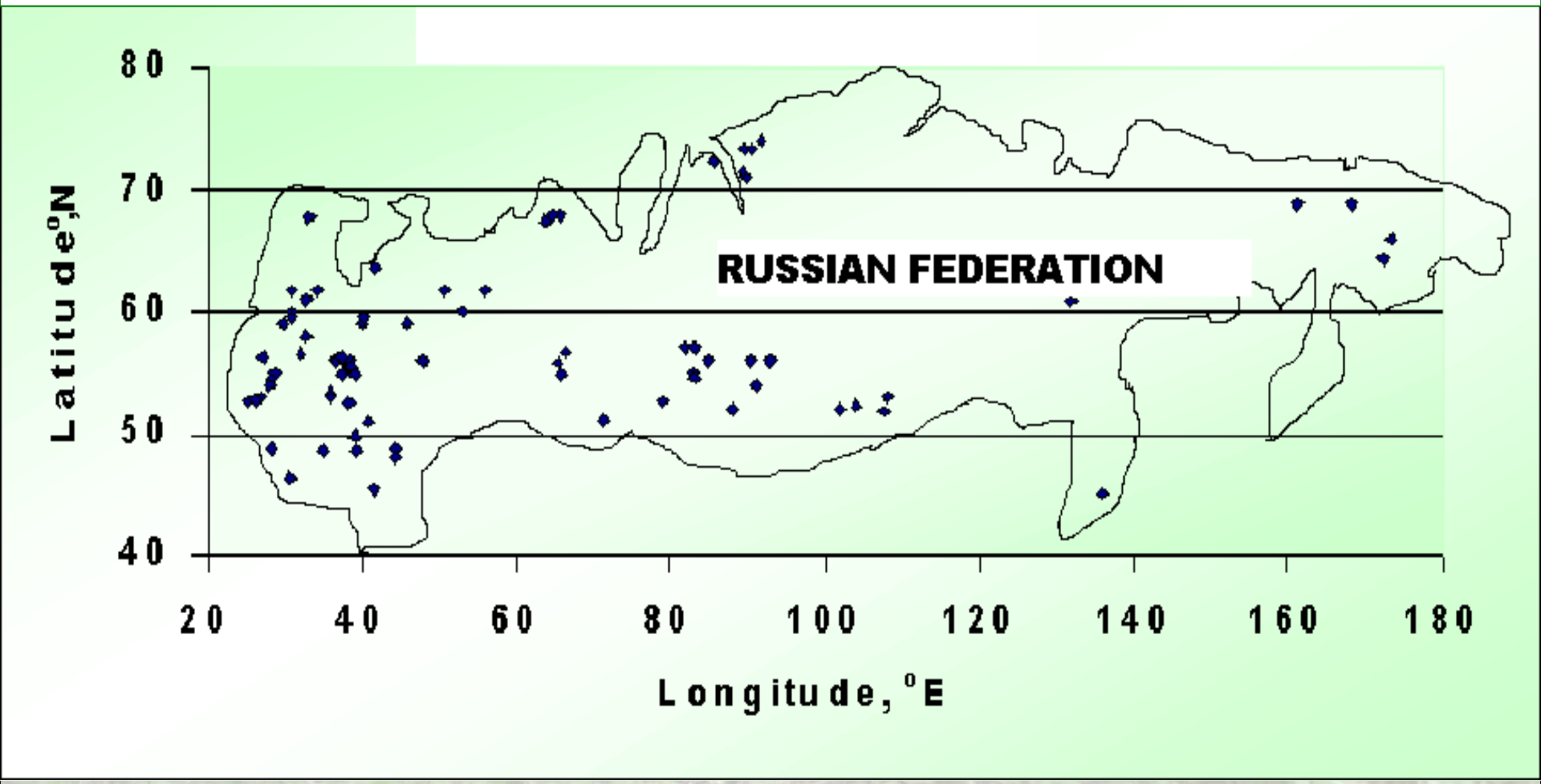
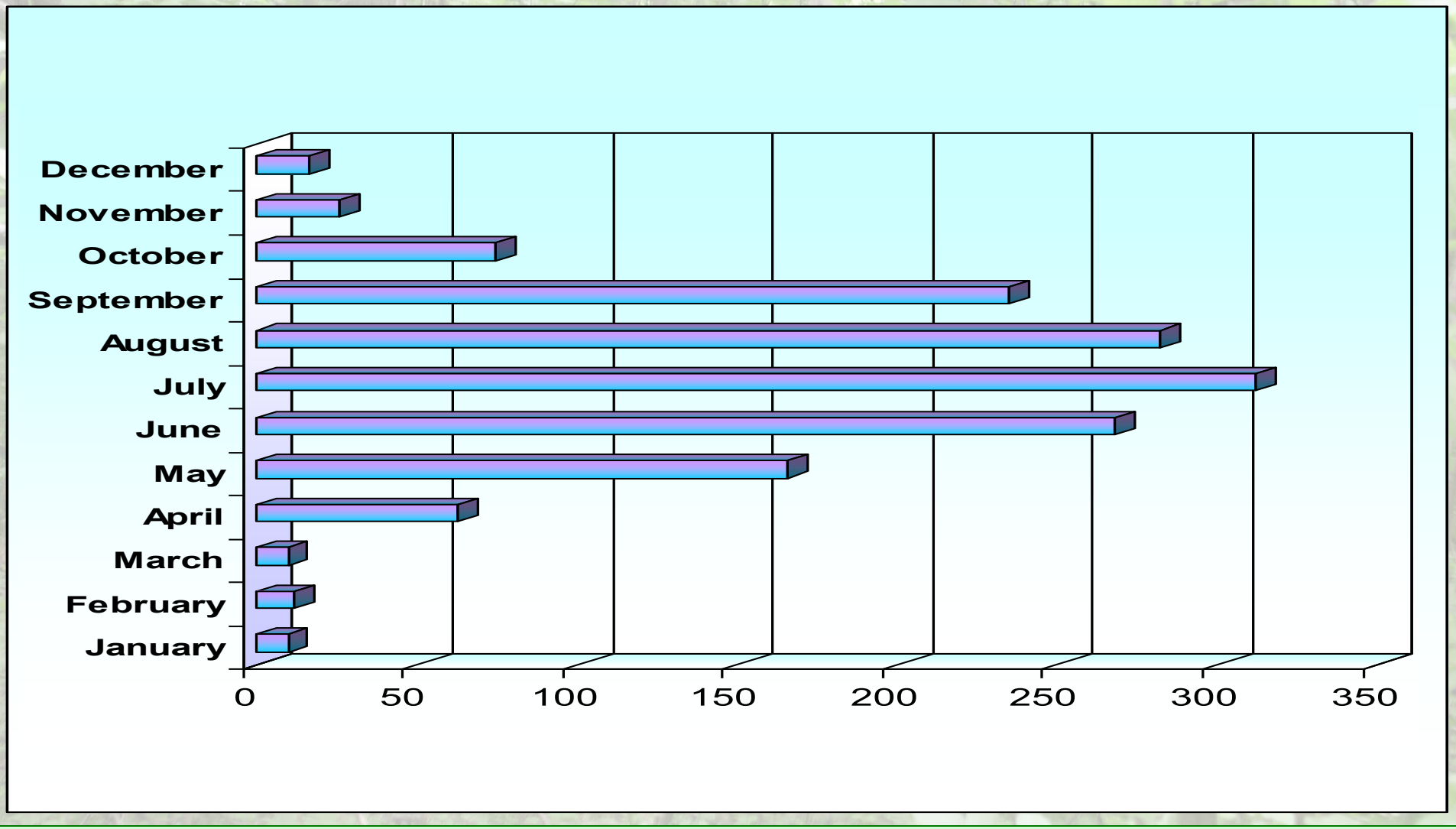
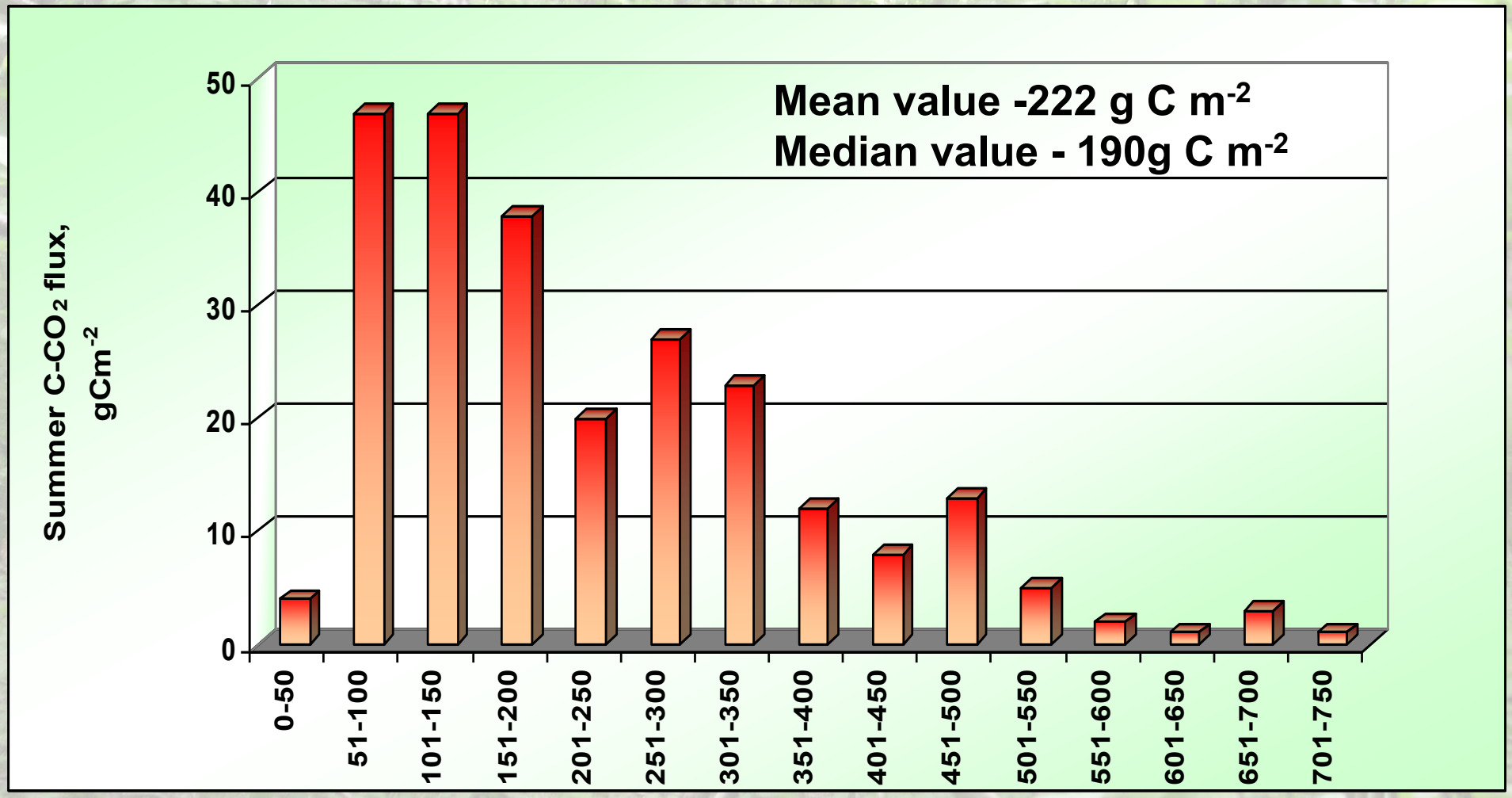
Location of sites on soil respiration (SR) measurements



Histogram of SR measurements according to different months



Histogram of summer CO_2 fluxes from soils in Russian terrestrial ecosystems



Development of model for the assessment of the annual CO_2 fluxes

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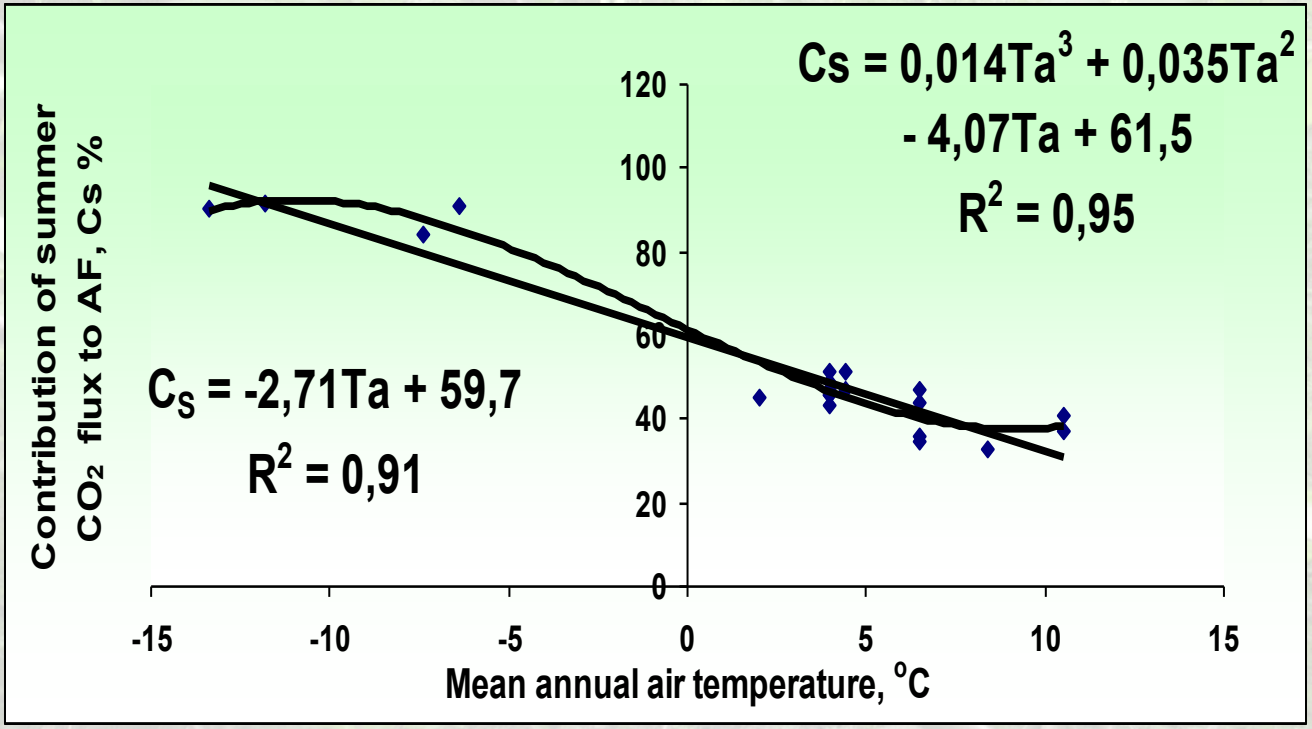
Mean annual air temperature and share of summer CO_2 flux (C_s) to the annual CO_2 flux

N	Soil	Vegetation	Mean annual, air T,°C	C_S, %	Reference
1	Podbur tundra	Moss-lichen	-13,4	90,2	Zamolodchikov, Karelin, 2001
2	Podbur tundra	Moss-lichen	-11,8	91,3	Zamolodchikov, Karelin, 2001
3	Podbur tundra	Moss-lichen	-7,4	84,2	Zamolodchikov, Karelin, 2001
4	Podbur tundra	Moss-lichen	-6,4	91,0	Zamolodchikov, Karelin, 2001
5	Sandy soil	Spruse forest	2	45,0	Havas&Maenpaa, 1972
6	Sod-podzolic	Forest mixed	4,0	45,6	Lopes de Gerenyu et al., 2001
7	Sod podzolic	Grassland	4,0	45,6	Lopes de Gerenyu et al., 2001
8	Grey forest soil	Forest Mixed	4,0	48,8	Lopes de Gerenyu et al., 2001
9	Grey forest soil	Grassland	4,0	43,1	Lopes de Gerenyu et al., 2001
10	Grey forest soil	Arable	4,0	51,6	Lopes de Gerenyu et al., 2001
11	Podzol (iron)	Pine (scots) forest	4,4	47,3	Pajary, 1995
12	Podzol (iron)	Pine (scots) forest	4,4	51,4	Pajary, 1995
13	Loamy sandy	Beech-spruce forest	6,5	35,9	Dorr&Munich.,1987
14	Peat-bog	Low bog	6,5	44,0	Adam, Star, 1997
15	Brownerde	Spruce Forest	6,5	46,9	Adam, Star, 1997
16	Kolluvisol	Grassland	6,5	34,8	Adam, Star, 1997
17	Soil	Crops	8,4	32,9	Monteith et al., 1964
18	Soil	Sweet Chestnut	10,5	37,4	Anderson, 1973
19	Soil	Beech	10,5	40,9	Anderson, 1973

Models for calculation of total annual CO_2 flux (AF):



Cs - contribution of summer CO_2 flux (Fs) to AF, %;

Ta- mean annual air temperature, °C;

We know (from data base):

-summer CO_2 flux **Fs;**

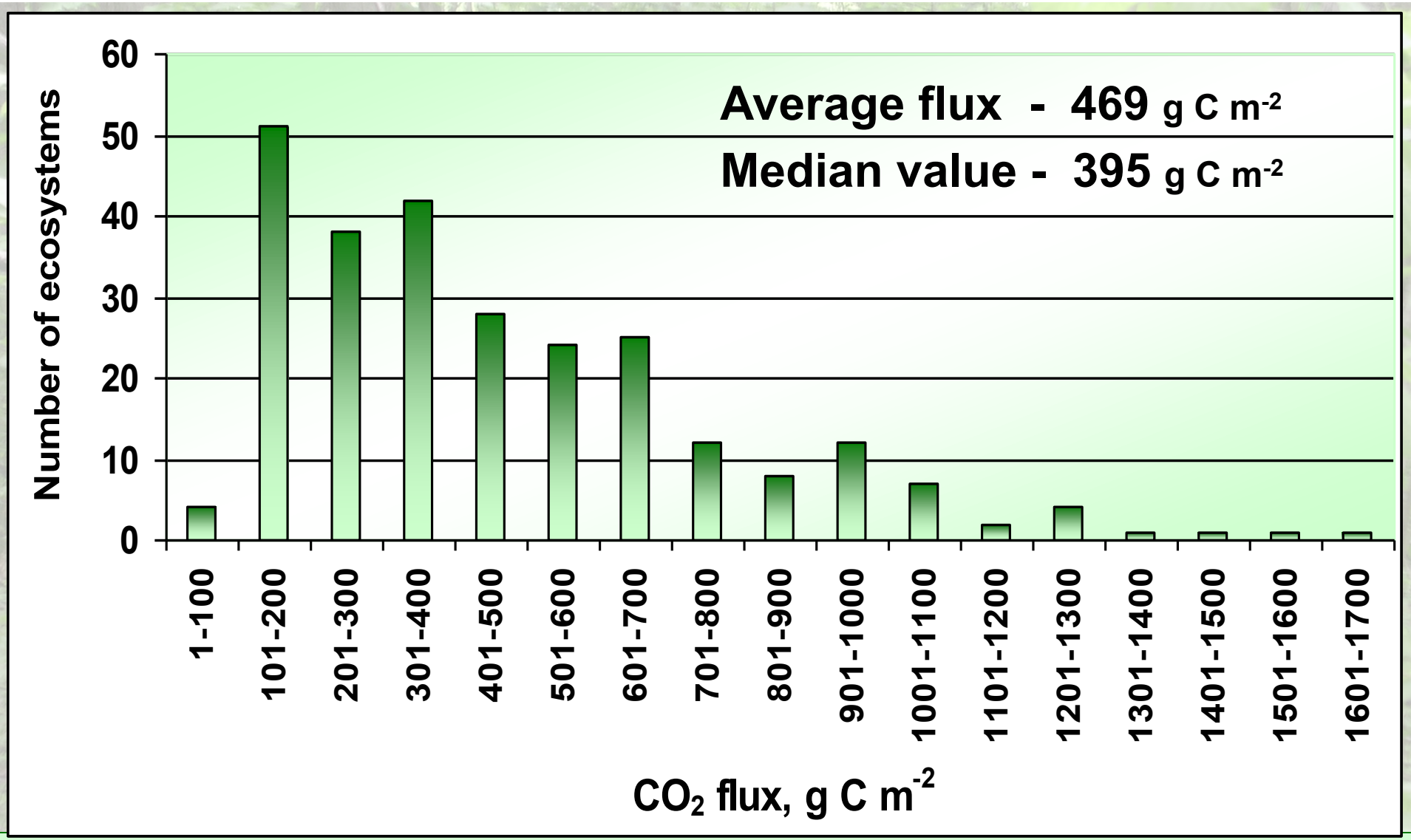
-mean annual air temperature, **Ta;**

We can calculate:

Cs (according to model),

AF = Fs * 100 / Cs

Histogram of annual CO_2 fluxes from soils in Russian forest zone



Estimate of total respiration flux from Russian soils

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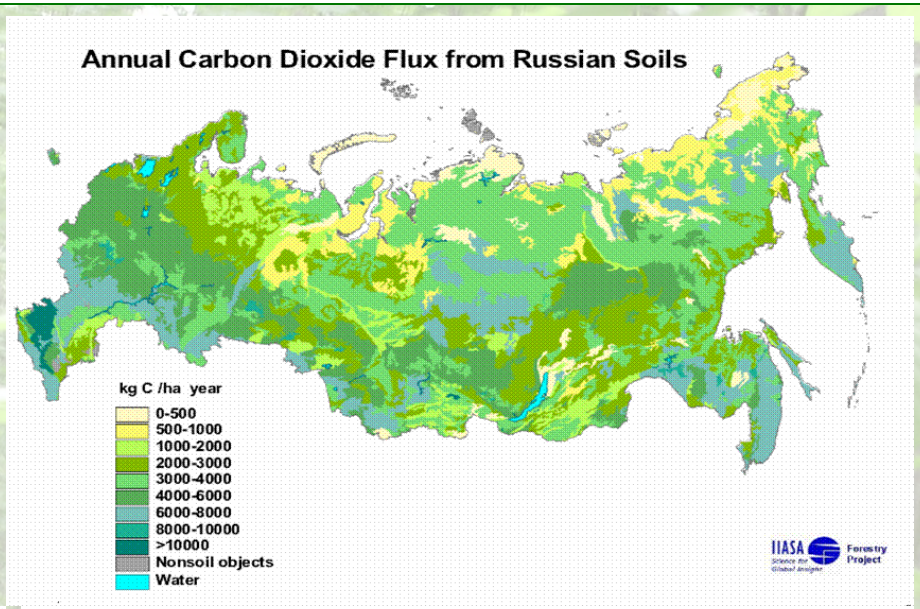
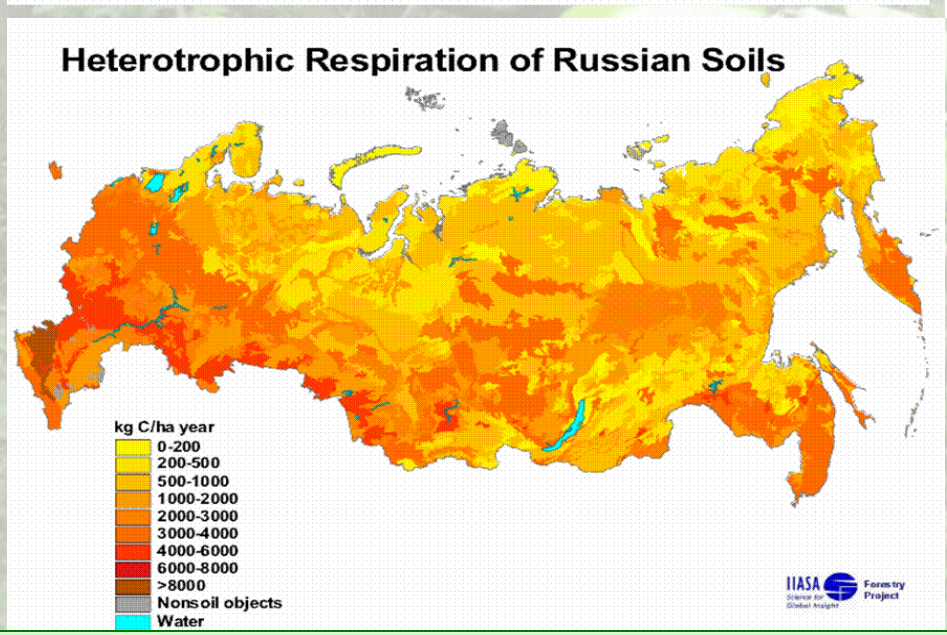
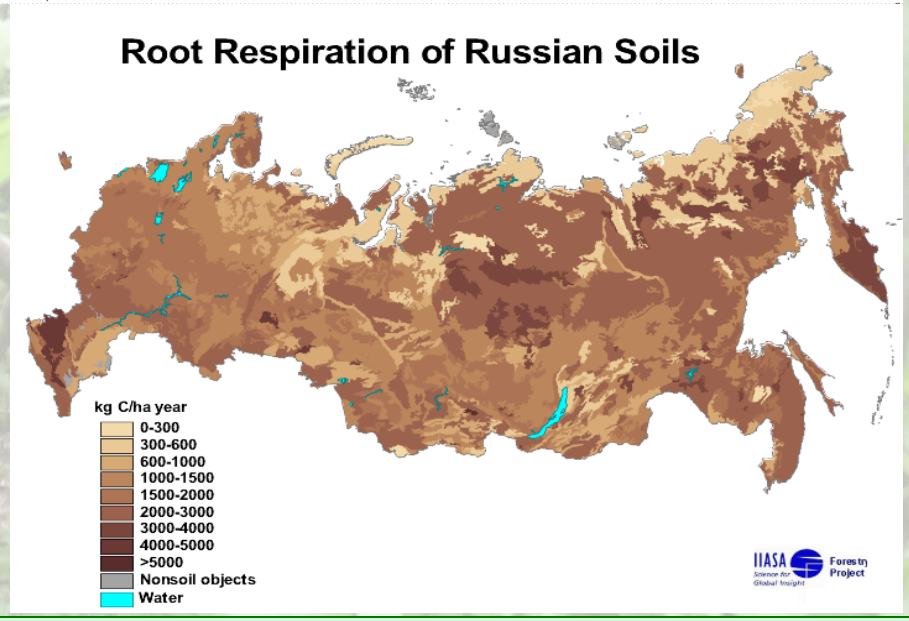
Soil division and soil respiration maps







Contribution of Russian terrestrial ecosystems to global C-fluxes

Parameter	World	Russia	
		abs.units	%
Area, million km^2	148.65	17.08	11.5
NPP, Gt C/yr	60	4.41	7.4
TSR, Gt C/yr	64-72	5.67	7.9-9.3
Industrial CO_2 emission, Gt C/yr	7.7	0.41	2.5
Soil organic C pool (0-100cm), Gt C	1500	296	20
C-balance, Gt C/yr	2.7	0.91	33.7

Conclusions:

- **The presented estimation of total CO_2 flux from Russian terrestrial ecosystems (5.67 Gt/yr) could be approximately addressed to the 1990s – the initial period of Kyoto Protocol.**
- **Uncertainties of this estimation depend upon amount and quality of available experimental data, accuracy and resolution of the soil map at scale 1:5 million, spatial aggregation techniques and regression models used.**
- **To update this estimate, it needs to increase the numbers and the geographical representatives of long-term measurements, and to use up-to-date areas of croplands, grasslands and forests on Russian territory.**

Thank you for attention!