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Impact of CO_2 emissions on the geoecological state of landscapes of the British Isles: carbon footprint versus the assimilation potential

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The geoecological state of landscapes is determined by the type and intensity of anthropogenic impacts, the ability of geosystems to sustain them and the number of population living within a particular landscape unit. The main sources of CO_2 emissions are thermal power plants, industrial facilities, transport and waste utilization. In Great Britain 163 enterprises produce 254.7 MMT CO_2Eq. and 20 enterprises in Ireland – 17.8 MMT CO_2Eq. Total transport emissions are 122 MMT CO_2Eq. Utilization of solid wastes collected on the British Isles produces about 4.2 MMT CO_2Eq. The spatial pattern of CO_2 sources within the landscapes is particularly mosaic. Among the indicators which characterize the capacity of landscapes to neutralize wastes the assimilation potential (AP) is particularly important. The neutralization is based on the process of sequestration of gaseous substances, i.e. their accumulation in leaves, branches and stocks during respiration and growth of trees and in water bodies by aquatic organisms. Thus the AP is calculated basing on the area of forests and wetlands which perform the regulating services in landscapes. Total absorbing capacity of forests of the British Isles is 6.805 MMT CO_2Eq. Inland waters cover 0.01% of the territory and their assimilating role is minor.
The evaluation procedure includes several analytical steps: 1) inventory of the volumes of CO_2 emissions by all anthropogenic sources within the borders of natural geosystems; 2) calculation of the area of CO_2 assimilation in landscapes and the maximum possible volumes of CO_2 sequestration; 3) comparison of the volumes of emissions and the assimilation potential of each landscape, classification of landscapes into debtors (with the deficit of AP) and creditors (with surplus AP); 4) calculation of population in each landscape; 5) risk assessment for the inhabitants living within landscapes-debtors; 6) classification and mapping of landscapes according to their geoecological state.
The assimilation potential of landscapes-creditors is higher, than it is necessary for the neutralization of CO_2 emissions; they are capable of the positive biotic regulation of carbon cycle. But the most landscapes in England are debtors – their AP is sometimes well below the amount of CO_2 emissions, so they cannot neutralize wastes completely any more. Such geosystems reach critical thresholds of environmental services exploitation, their biota turns from a carbon pool into a source of its drain, thus endangering the regulatory abilities of landscapes. The geoecological situation in these geocomplexes creates the risk of serious diseases for inhabitants, and such landscapes are considered as unfavorable for living. According to the calculations to neutralize all CO_2 emissions produced within the British Isles they need an area 16 times larger than the available one. Hence the transition to a low-carbon energy regime to mitigate CO_2 emission within landscapes-debtors is a most actual challenge.