Climatic factors of bogging in the north Eurasia

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All forms of bogging processes are excellent examples of landscape self-development. Having began approx. 6000 years ago bogs demonstrate phenomenally stable growth. Steadily they cover slightly sloping surfaces. Climatic conditionality of distribution of peatlands and boggy forest does not cause doubt. At the same time reliable estimations of their climatic ecological niche to us are not known. Peatlands cadastre data (European part of Russia, Archangelsk and Komi region, Western Siberia), high-resolution grids of monthly climate for the global land surface (New, 2002) and digital elevation models create necessary conditions for the decision of this task.

Total peatlands area, mean and maximum depth, carbon stock and peat ash value have been calculated for grid unit 1x1º. Analysis showed that each peatlands variable have non-linear relation with month temperatures, precipitations, hydrothermal index. Only ash-content grows with the temperature increase and precipitation decrease. Comparing R-squared for partial parabolic functions we can see that leading role in bogging belongs to hydrothermal mode in May, August and September. Joint influence of temperature and precipitation influences bogging in July.

As a whole, general properties of peatlands determined by non-linear dependency of temperature and precipitation in spring and winter months. Summer climate plays little but independent role. To build general statistical model, we can calculate two-dimensional dependences between peat density and temperature and precipitation. Than we add to this model independent variables – elevation and slope of surface. Apparently, peatlands are not typical for high altitude as well as low altitude. Next independent variable added to model is slope. Finally, statistical model describes 62% of peatlands carbon stock variation with standard error of estimate 3.8 g/m^2. Spatial variation of peatlands area and peatlands depth described by the same dependency type but with another parameters. We should note that statistical model do not account the beginning of bogging process and it is assumed that all peatlands have equal age. On the one hand this degrades model quality but on the other hand it shows that age of peatlands of vast territory is rather equal.

Thus, carbon accumulation rate is function of climate and relief. Bogging optimum is May temperature +2.5ºC and 36 mm of precipitation, June – +11ºC and 40 mm, July – +15ºC and does not depend on precipitation amount, August – +12ºC and 54 mm, September – +5ºC and 44 mm. But the leading role belongs to hydrothermal mode of spring and autumn. Thus, active period of bog, its growth and borders strongly depends from spring climate. Autumn determine growth rate but not borders, summer climate plays small role in peat accumulation.

We believe that peatlands forming began during warming in Holocene, which determined increasing of precipitation and vegetative period. The peatlands of boreal forest zone are sustainable for modern climate changes as sphagnum has low sensitivity to summer and winter climate.

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References

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