High resolution image-based inventory of the wetland area in western Siberia

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Introduction

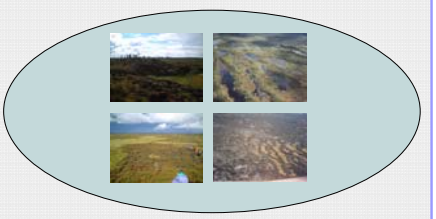
Northern wetlands directly affect the climate change by controlling of the carbon balance: they represent the CO_2 sink and CH_4 source. There is no unified classification of Siberian wetlands elaborated at middle and high spatial resolution, therefore only crude representation of wetland typology is used as a base for global modeling (*Matthews and Fung,* 1987; *Aselmann and Crutzen,* 1989). The information on spatial distribution of the major wetland types and their patterns are critical for quantifying the trace gas fluxes and sink of the atmospheric carbon. We applied a multi-scale approach to make a general and realistic estimation of spatial patterns in West Siberian peat-accumulating wetlands.

Step 1: Regional Wetland typology map (1:2,500,000 scale), manually digitized in GIS software (MapInfo 6.5)

The entire area of WS is divided into 20 wetland types and complexes.

In-situ measurements of the plant biomass, net primary production, GHG emission, and other components of the C-cycle usually comprise a range of wetland micro-landscapes (or habitats), i.e. ridges, hollows, hummocks, etc.

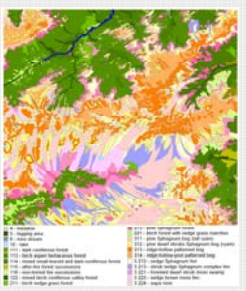
(!) We should estimate the areal fractions of these micro-landscapes composing the vegetation mosaic of 20 classes at the Wetland typology map.



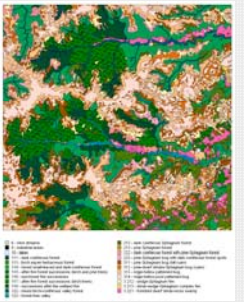
The regional scale map was further refined by manual classifications based on satellite imagery to provide more details on spatial structure of the patterned wetlands, which are widely distributed in the boreal region of WS.

Step 2: Satellite image classification (LANDSAT TM, ETM+)

Climatic gradient of WS and location of test areas (in the boreal region, WS).

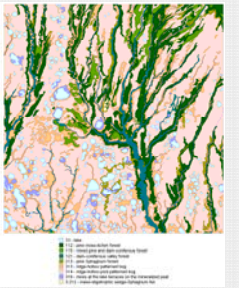


Kedrovy: 57°N, 79°E
90×82 km^2



Tomsk Obl.: 58°N, 76°E
70×70 km^2

Langepas: 61°N, 75°E
45×48 km^2



Polesye: 62°N, 76°E
72×75 km^2

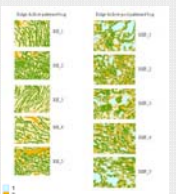
LANDSAT TM, ETM+ imagery (free downloaded from Global Land Cover Facility, glcf.umiacs.umd.edu/…) were processed in appr. 1:200,000 scale based on classification system developed by *Lapshina and Vasiliev* (2001), which was slightly modified. About 30 classes of forest, paludified forest and wetland ecosystems were derived for the boreal region.

At this scale, the images were classified into 10 wetland classes, compared with a large-scale Wetland typology map, which used only 3 classes within the boreal region. But the complex landcover types (e.g. open patterned wetlands) are also presented in this classification.

Step 3: QuickBird image classification

Finally, we evaluated the fractional area coverage of microlandscape elements (ridges, hollows, and lakes) for each type of patterned wetland by interpreting the high resolution satellite imagery (QuickBird, 0.6 m/pixel). Then, this information was applied to elucidate the structure of patterned wetlands on satellite image-based maps for the same climatic region.

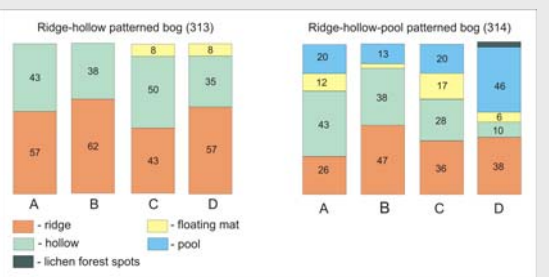
We produced a set of 10-12 small key sites (0.25-0.35 km^2) per a quarter of the LANDSAT scene, where the total area of each micro-landscape, average fraction and their standard deviations were calculated automatically in GIS system.



id	Legend	Main mire type, %	Including other community type, %
223	Pine-Sphagnum bog with dark coniferous forest spots (n=9)	96.16± 0.75	3.84±0.75 (forest spots)
313	Ridge-hollow patterned bog (n=10)	93.77±2.05	6.23± 2.05 (ryam)
314	Ridge-hollow-pool patterned bog (n=10)	95.50±1.87	4.50± 1.87 (ryam)

Wetland type	Ridge	Hollow	Floating mat	Lake
Ridge-hollow(n=5)	42.48±4.31	49.8±5.42	7.72±3.28	-
Ridge-hollow-pool (n=5)	36.0±1.64	27.5±2.13	16.56±2.7	19.94±4.8

Average fractions of wetland micro-landscapes per test area, %



A, B, C, and D: test areas are mentioned from south to north in the boreal region, WS.

Test areas: A – Kedrovy, B – Tomsk Obl., C – Langepas, D – Polesye.

- Total area of West Siberia is 2 602×10^9 m^2.
- The peatland area is 685×10^9 m^2 (about 27 % of the total).

References

Aselmann, I., and P.J. Crutzen (1989), Global distribution of natural freshwater wetlands and rice paddies, their net primary productivity, seasonality and possible methane emissions, *J. Atmos. Chem., 8,* 307-358.

Matthews, E., and I. Fung (1987), Methane emissions from natural wetlands: Global distribution, area, and environmental characteristics of sources, *Global Biogeochem. Cycles, 1,* 61-86.

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