Mapping location, extent and drainage status of organic soils in East Africa

GREIFSWALD MIRE CENTRE

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INTRODUCTION

When considering peatlands and organic soils in the tropics, the huge areas in SE Asia prevail in public and scientific perception, whereas Africa has largely been out of focus. The extent and status of peatlands and organic soils in East Africa was largely speculative, although their presence is known since decades. They basically occur in the high altitudes of the uplifted flanks of the East African Rift System, isolated volcanoes and the Ethiopian highlands, in the Zambezian floodplains (e.g. Zambia), and in coastal environments (e.g. Mozambique and Madagascar). Their coverage in recent soil maps or GIS databases is very poor and their drainage status widely unknown, although they play a crucial role for water supply and regulation, water and nutrient retention, food security, and for overall livelihoods. In spite of rapid developing remote sensing methods, peatland and organic soil mapping from space still has to struggle with the complexity of peatlands and their use. Furthermore, drained and used organic soils loose many of their key features like the even vegetation and high soil moisture. Accordingly, our mapping approach concentrates on the merging of already existing, often national geospatial soil and proxy information and the use of recent satellite and aerial imagery.
We conducted a nationwide GIS and remote sensing based organic soil mapping for Burundi, Kenya, Rwanda, Tanzania, Uganda and Zambia at scale 1:25,000.

METHODS

Our mapping approach links various science networks, methodologies and databases, including those of peatland/landscape ecology for understanding where peatlands may occur (cf. Figure 1) and follows a broad definition of organic soils as having a minimum soil organic carbon threshold of 12% and it considers any depth of the organic layer larger than 10 cm.
Spatially explicit information on soil and proxy data has been assessed from open access online archives. In order to avoid high costs our approach for wall-to-wall organic soil mapping across vast areas basically uses freely available GIS, satellite and aerial imagery. For example, we applied the Topographical Wetness Index from the African Soil Information Service. The mapping has been carried out manually in high resolution (1:25,000). The resulting GIS database includes for every organic soil polygon information on key references, the reliability of the integrated information (3 classes: confirmed, probable and possible occurrence of organic soil following a detailed decision key) and information on drainage and degradation intensity (3 classes: no, slight and heavy degradation; cf. Figure 2).

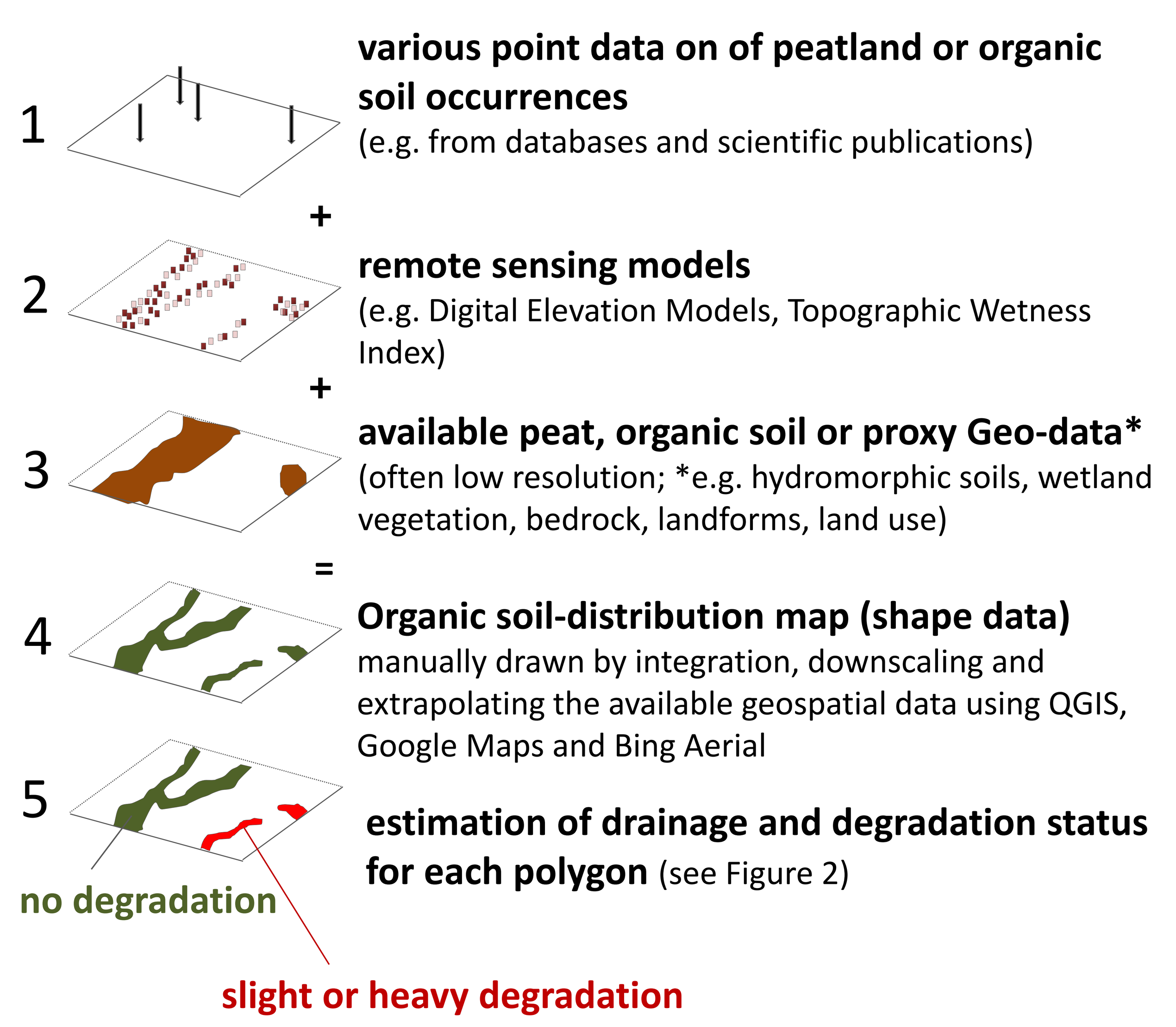

Figure 1: Schematic illustration of the peatland and organic soil mapping process.

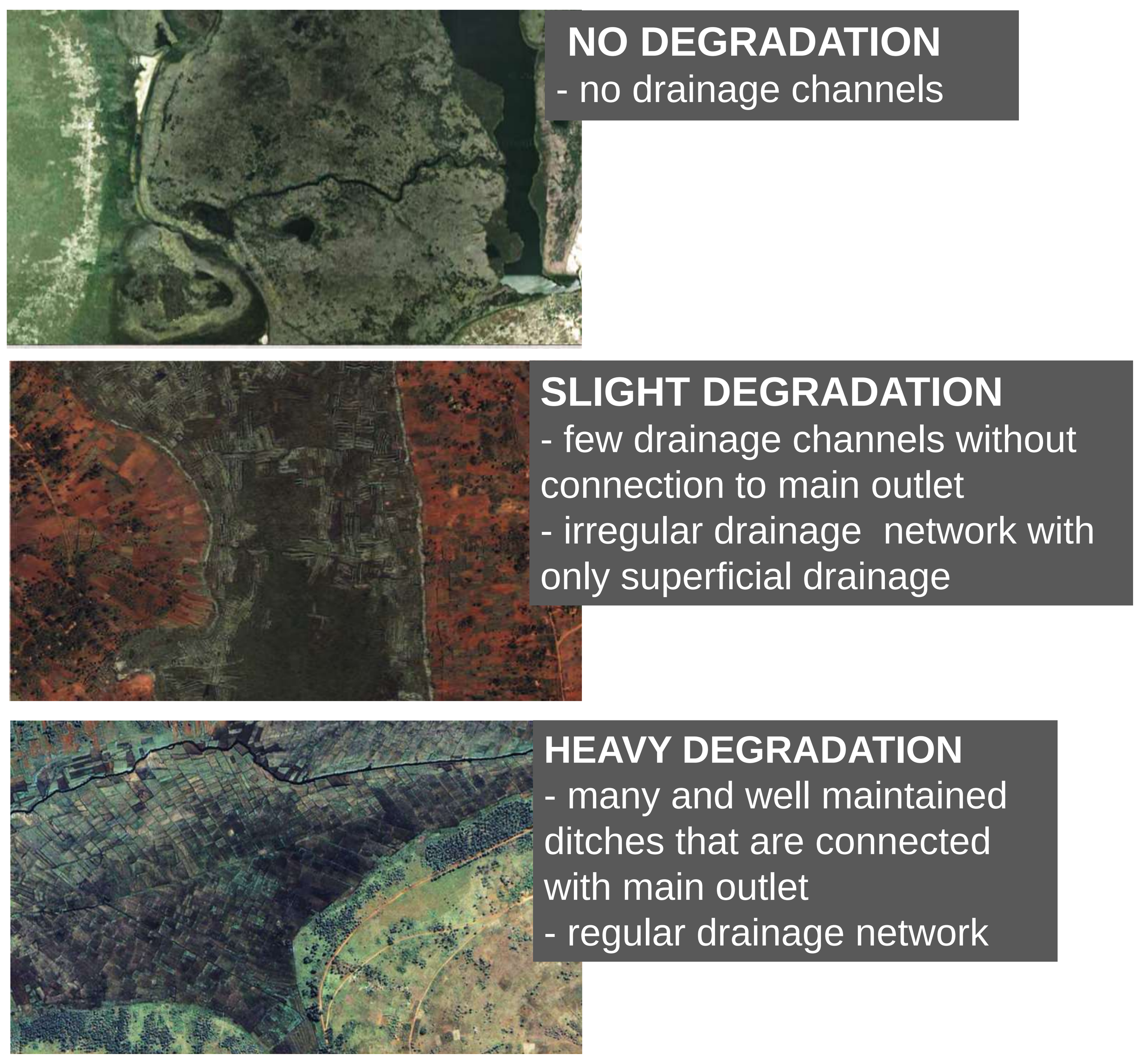

Figure 2: Estimation of the drainage and degradation status based on visually analysis of the drainage schemes via satellite and aerial images.

RESULTS

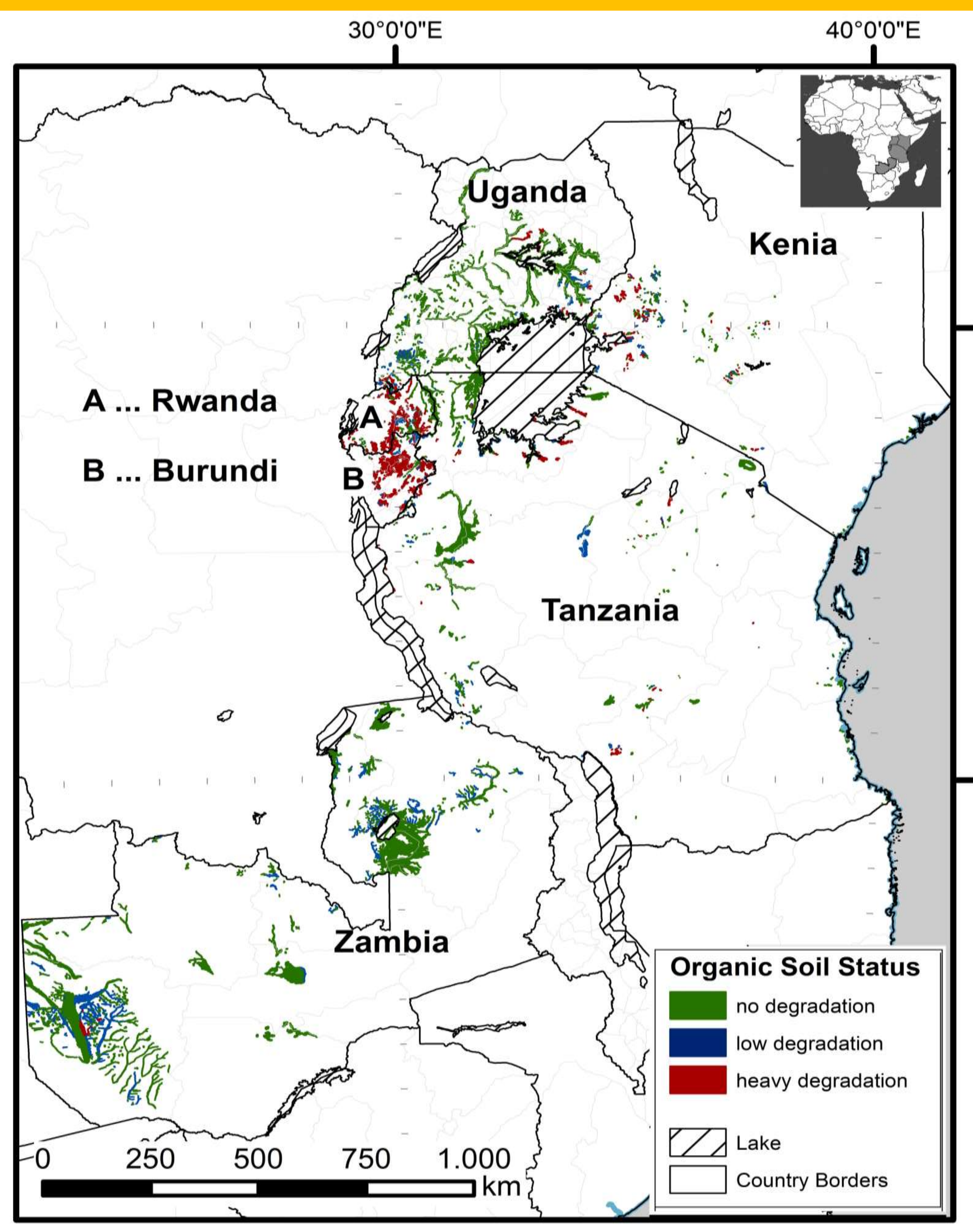

Figure 3: Organic Soil map for the Lake Victoria region and Zambia. Shown is the coverage of 'confirmed organic soils', 'probable organic soils' and 'possible organic soils'. Also aggregated soil units are displayed that include different proportions of organic soil.

Our mapping resulted in the identification of 27,308 km² of organic soils in the Lake Victoria neighbouring countries and Zambia. Burundi contains 657 km² of organic soils (= 2.4% of the country area), Kenya 455km²(0.1 %), Rwanda 1,202 km² (4.6%), Tanzania 4,221km² (0.4 %), Uganda 4,111km² (1.7 %) and Zambia 16,664 km² (3,6%; Table 1).

Many organic soils are still unaffected by human activity (24,024 km² = 88.0 % of the total mapped organic soils). Zambia hold most of these undisturbed organic soils with 15,165 km², followed by Tanzania and Uganda with 3,999 km² and 3,907 km² , respectively. The largest areas of pristine organic soils are located in at Lake Bangweulu and the Zambezi Floodplains (Zambia), in the extensive valleys that end in Lake Kyoga and around Lake Victoria in Uganda and northeast Tanzania (Figure 3).

The degradation hotspots are situated in the highest areas of the African rift system in Burundi, where slight and heavily drained and degrading organic soils cover 600 km² (91% of the total mapped organic soil area), and only 57 km² (9%) have remained untouched (Table 1, Figure 3). In contrast Zambia sustain 15,165 km² (91%) of organic soils pristine an only 1499 km² (9%) are degrading). In Rwanda and Kenya approximately half of the organic soils are drained and degrading, including 552 km² (46% of the total mapped organic soils) in Rwanda, and 207 km² (45%) in Kenya. Only 5% of the organic soils in Uganda and 6% in Tanzania are slightly or heavily degraded (Table 1).

Table 1: Extent of organic soils according to their degradation status. Included are only polygons with the the reliability classes 'confirmed organic soil' and 'probable organic soil'.

Degradation Status	Burundi km²	%	Rwanda km²	%	Uganda km²	%	Tanzania km²	%	Kenya km²	%	Zambia km²	%
1- no	57	9	649	54	3,907	95	3,999	95	247	55	15,165	91
2- slight	78	11	115	10	126	3	149	3	96	21	1,382	8
3- heavy	522	80	437	36	78	2	73	2	111	24	117	1
total	657	100	1,201	100	4,111	100	4,221	100	454	100	16,664	100

CONCLUSIONS

The integration of old field data, legacy soil and proxy maps, specialized knowledge and modern RS and GIS technologies of our mapping approach enables acquiring a comprehensive, detailed, rather reliable and anytime updatable GIS database at low cost. This approach has been developed in the framework of the Global Peatland Database at Greifswald Mire Centre (Germany) and can be applied to other countries.

Feeding the Nile River, sustaining a fast growing and widely poor population and already facing climatic changes, the organic soils of the Lake Victoria catchment are partially under heavy threat. Considering the key role of organic soils (incl. peatlands) for water provision and regulation and their rapid deterioration after drainage, our inventory open perspectives for specific organic soil protection and rewetting actions.

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