Peatlands, peat fires and peatland restoration

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In living peatlands:
• Production is larger than decay
• Dead plants accumulate as peat

Georgia
Peat accumulates through water saturation:
Natural peatlands are wetlands!
Peatlands are found in almost every country. Worldwide: 4 million km$^2$
Peat accumulates during thousands of years and stores concentrated carbon in thick layers in Lesotho.
While covering only 3% of the World’s land area, peatlands contain 500 Gigaton of carbon.

Germany
i.e. twice the carbon stock of the world’s total forest biomass
When drained, peatlands become strong sources of greenhouse gases (GHG) and very susceptible to fire.
Peatland emissions per country (in Megaton CO$_2$e/yr): highest global urgency for peatland rewetting
Peat fires cause worldwide almost half of the emissions from drained peatlands

Indonesia
Peat fires are not a local but a global issue, And not completely new...

Global vulnerability of peatlands to fire and carbon loss

Merritt R. Turetsky¹*, Brian Benscoter², Susan Page³, Guillermo Rein⁴, Guido R. van der Werf⁵ and Adam Watts⁶

Globally, the amount of carbon stored in peats exceeds that stored in vegetation and is similar in size to the current atmospheric carbon pool. Fire is a threat to many peat-rich biomes and has the potential to disturb these carbon stocks. Peat fires are dominated by smouldering combustion, which is ignited more readily than flaming combustion and can persist in wet conditions. In undisturbed peatlands, most of the peat carbon stock typically is protected from smouldering, and resistance to fire has led to a build-up of peat carbon storage in boreal and tropical regions over long timescales. But drying as a result of climate change and human activity lowers the water table in peatlands and increases the frequency and extent of peat fires. The combustion of deep peat affects older soil carbon that has not been part of the active carbon cycle for centuries to millennia, and thus will dictate the importance of peat fire emissions to the carbon cycle and feedbacks to the climate.
Aristotle (4th century BC) on peat fires in Italy

- “near the Eridanus (Po) delta a marsh seems to exist ... in which the water is warm and its smell is deep and heavy.

- No living being drinks those waters and no bird flies over them because it could fall down and die. The local people say that Phaeton fell into that marsh when he was killed by a flash of lightning from Zeus”
This peatland still burns regularly: Po valley, Italy, 2006
Meanwhile, a state in alliance with us, that of the Ubii, suffered grievously from an unexpected calamity. Fires suddenly bursting from the earth seized everywhere on country houses, crops, and villages, and were rushing on to the very walls of the newly founded colony. Nor could they be extinguished by the fall of rain, or by river-water, or by any other moisture.
Однако, еще задолго до начала книгопечатания в оставшихся нам памятниках старины то здесь, то там можно встретить различные записи, относящиеся к болотам. Представления о первых таких записях в России дают нам наши летописи. Летописец, собирая различные факты из жизни страны, отмечал также и произошедшие на него сильное впечатление своей стихийной силой пожары болот.

В Лавреньевской летописи (Рис. 1) за 1092 год записано:
«В се же лето мноси борове взгарахуся сами и болота.»
За 1223 год там же:
«Бе ведро вельми и мноси борове и болота загорахуся и дымове сильны бяху, яко недалече бе видети человеком; бе бо яко мгла к земли прилегла, яко и птицам по аэру не бе льзе летати, но падаху на землю и умираху.»
В Новгородской летописи за 1430 год тоже говорится о пожарах болот:
«Той же осени вода бысть мала вельма и земля и леса горяху и дым мног вельми.»
Scheuchzer (1746) on burning peatland in Switzerland

Brennender Morast.

Peatland burning in Germany 19th century
Haze (peat smoke) from peatland burning in Germany spreading over Europe in 1848, 1857 and 1867
Peat smoke over equatorial Asia 22 October 1997
The 1997 peat fires in Indonesia caused the largest increase in worldwide CO$_2$ concentration ever measured.
Peat fires burning throughout winter (2010-2011) in Russia

Nizhegorodskaja Oblast, Foto: Frank Edom
Peat fire smouldering >10 years in South Africa
Peat fires in Kazakhstan
Peat fires in Vietnam
Peat fires in Malaysia
Peat fires burning every year in Indonesia
...creating enormous damage...
...to economy and health, locally and worldwide...
Coal monoxide over equatorial Asia October 2015
Peatlands burn if *drained, abandoned, and accessible*. 
Drained peatlands burn more when water levels are lower

- No fires
- Moderate fires
- Big fires
Drained peatlands burn exponentially more in drier years
Peatlands burn more if already burned before

Kettridge et al. 2015
To prevent fires, peatlands must be wet

<table>
<thead>
<tr>
<th>Fire risk</th>
<th>wet</th>
<th>drained</th>
</tr>
</thead>
<tbody>
<tr>
<td>unused</td>
<td>conservation</td>
<td>abandoned</td>
</tr>
<tr>
<td>used</td>
<td>paludiculture</td>
<td>managed land</td>
</tr>
</tbody>
</table>
To prevent fires and emissions, peatlands have to be rewetted.
Rewetting is done for various purposes (‘ecosystem services’)

New book 2016
Rewetting to reduce haze and emissions

Kalimantan
Indonesia plans to rewet 2.7 million ha (!!) until 2020
Rewetting to restore biodiversity

Germany
Rewetting for carbon credits

Belarus
Rewetting for water purification

33.2%  
30.0%  
21.5%  
15.4%

NO₃-N  TN  PO₄-P  TP

Schmalstede  Flintbek  Reesdorf

Trepel 2010
Rewetting to reduce drainage costs

Germany
Rewetting for water retention

- Revitalized peatland close to dam
  Supplying ground water layer 1 km upstream

Rewetting

- Revitalisiertes Moor in der Nähe des Staus
- Speisender Grundwasserleiter ca. 1 km oberstrom
Rewetting to produce renewable biomass resources (paludiculture)
Rewetting recently got attention from all major conventions

"Wetland drainage and rewetting" is a system of practices for draining and rewetting on land with organic soil that covers a minimum area of 1 hectare. The activity applies to all lands that have been drained since 1990 and to all lands that have been rewetted since 1990 and that are not accounted for under any other activity as defined in this annex, where drainage is the direct human-induced lowering of the soil water table and rewetting is the direct human-induced partial or total reversal of drainage.

2012 Durban
UNFCCC - KP

IPCC 2014

Ramsar 2015
...from global players...
Peatland conservation & rewetting

Since March 2011, a global standard for peatland conservation and rewetting has been developed. MRV Methodologies have been developed and experiences have been summarized. And new markets have emerged.
Peatland rewetting: Russia taking the lead!...
Peatland must be wet:
For climate, for people, for ever!