Global peatlands and climate change: emissions and mitigation options

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International Mire Conservation Group

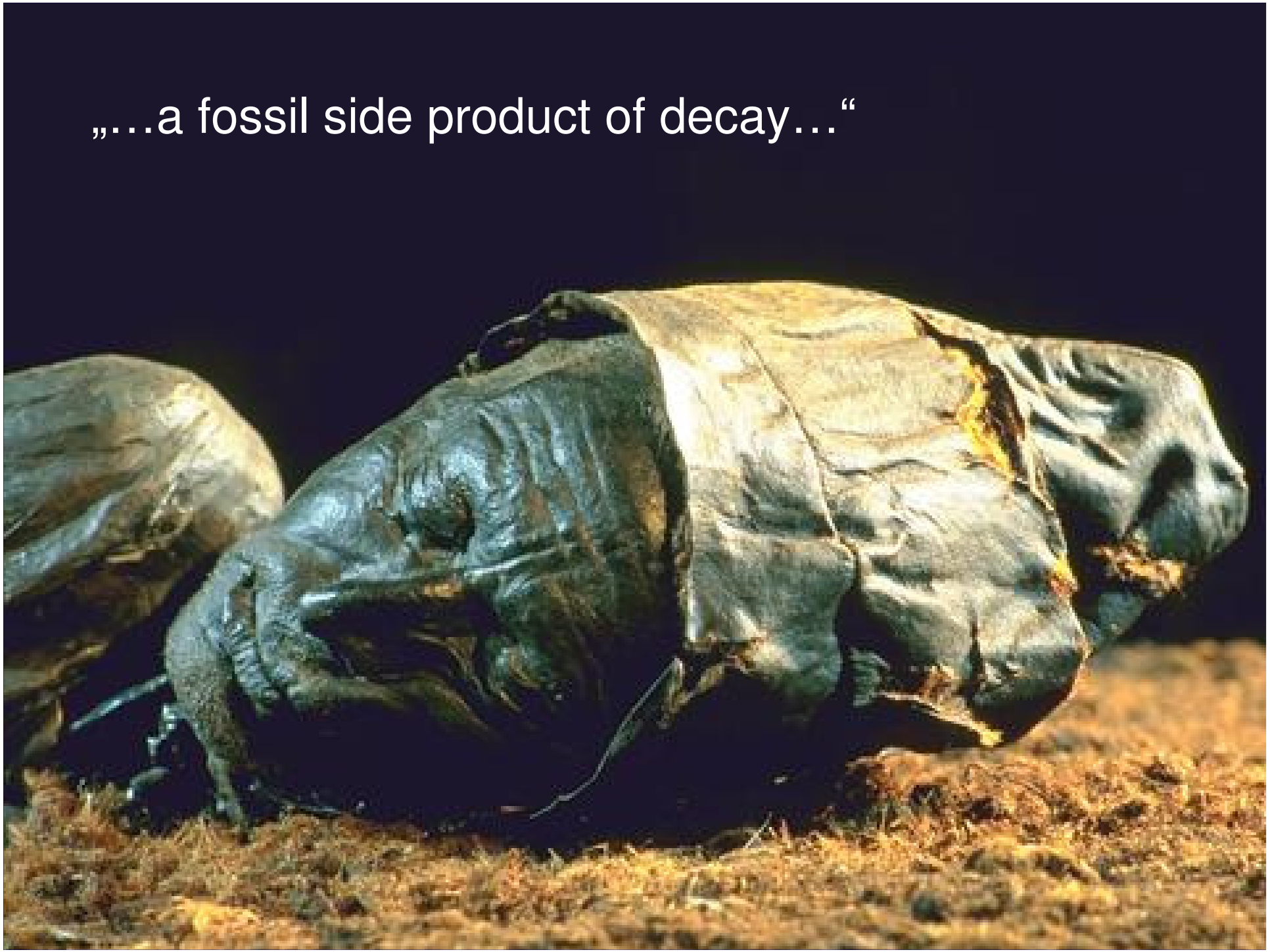
Peat…

„The differentiation of biomass versus fossil fuels starts with peat, which constitutes a fossil side product of decay.“

„Using the latter resource, CO_2 is released that has been stored since several thousands of years.“

Rode et al. 2005 BfN-Skripten 136

„…a fossil side product of decay…“



Peatlands store organic material

Tollund man, Danmark

In living peatlands:

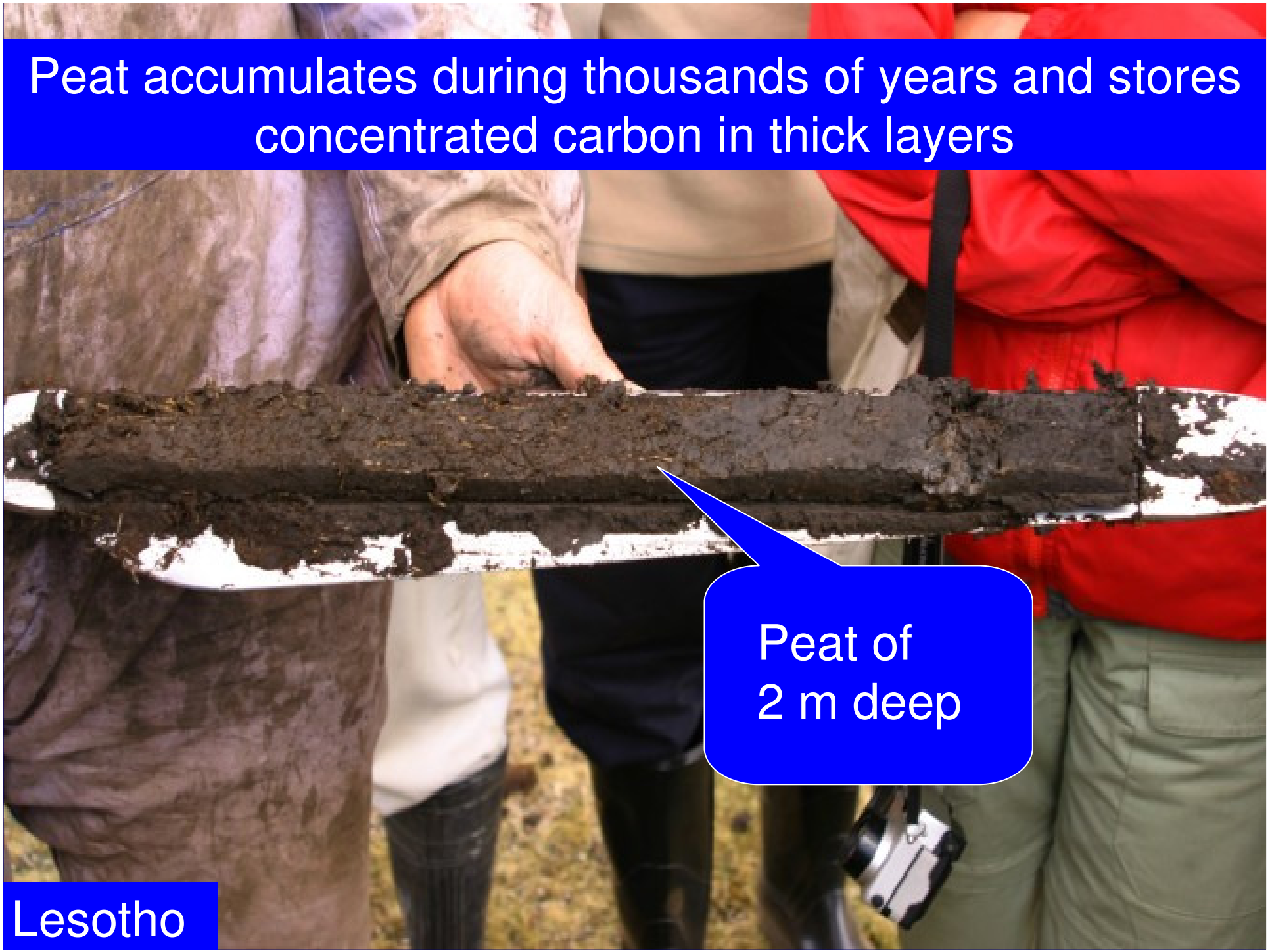
- Production > decay
- Peat accumulates
- positive C-balanse

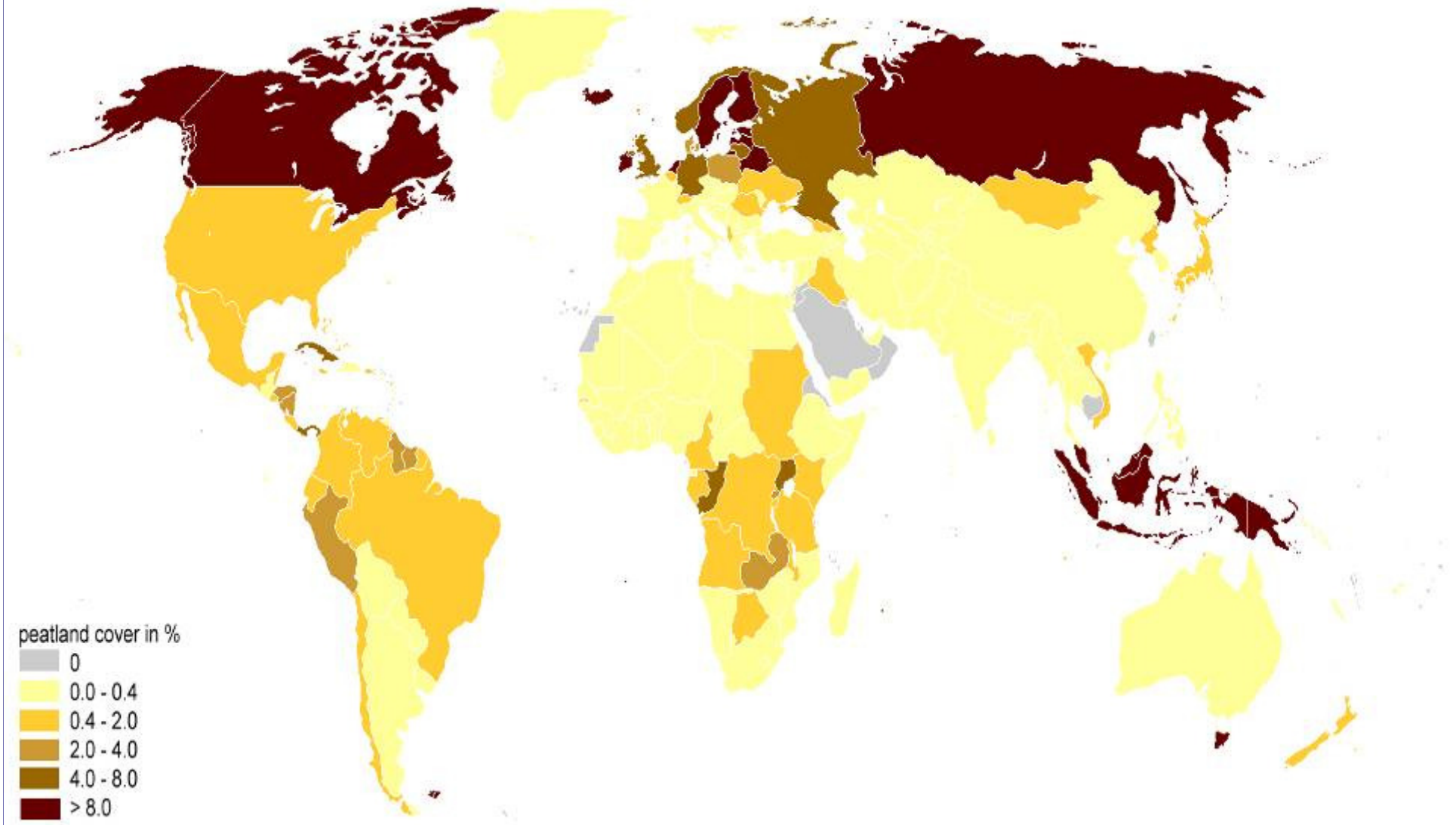
Colchis,Georgia

Peat accumulates as a result of water saturation: Natural peatlands are wetlands

Flow Country, Scotland

Peat accumulates during thousands of years and stores concentrated carbon in thick layers



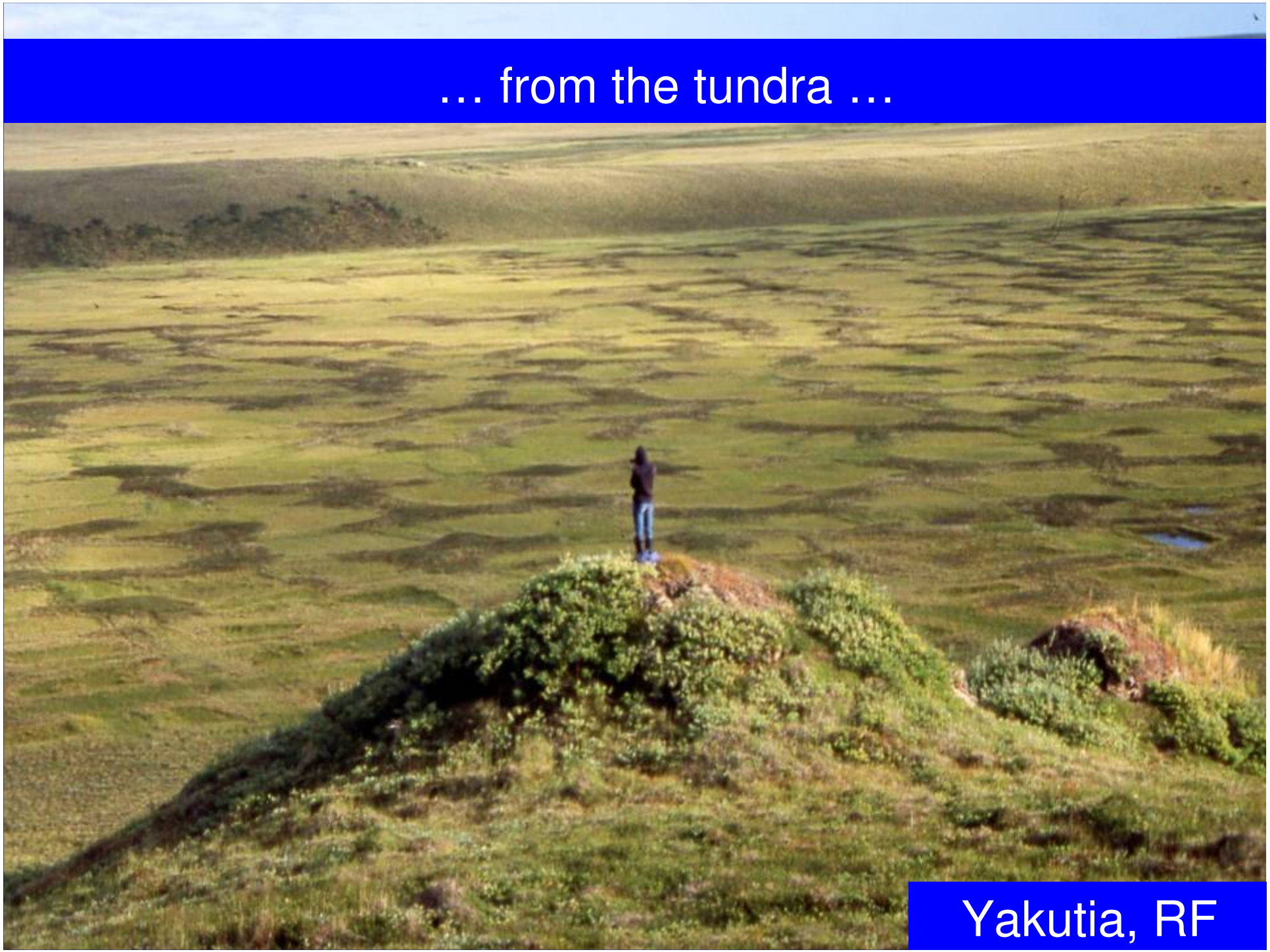


Peatlands are found in almost every country.
Worldwide: 4 million km^2

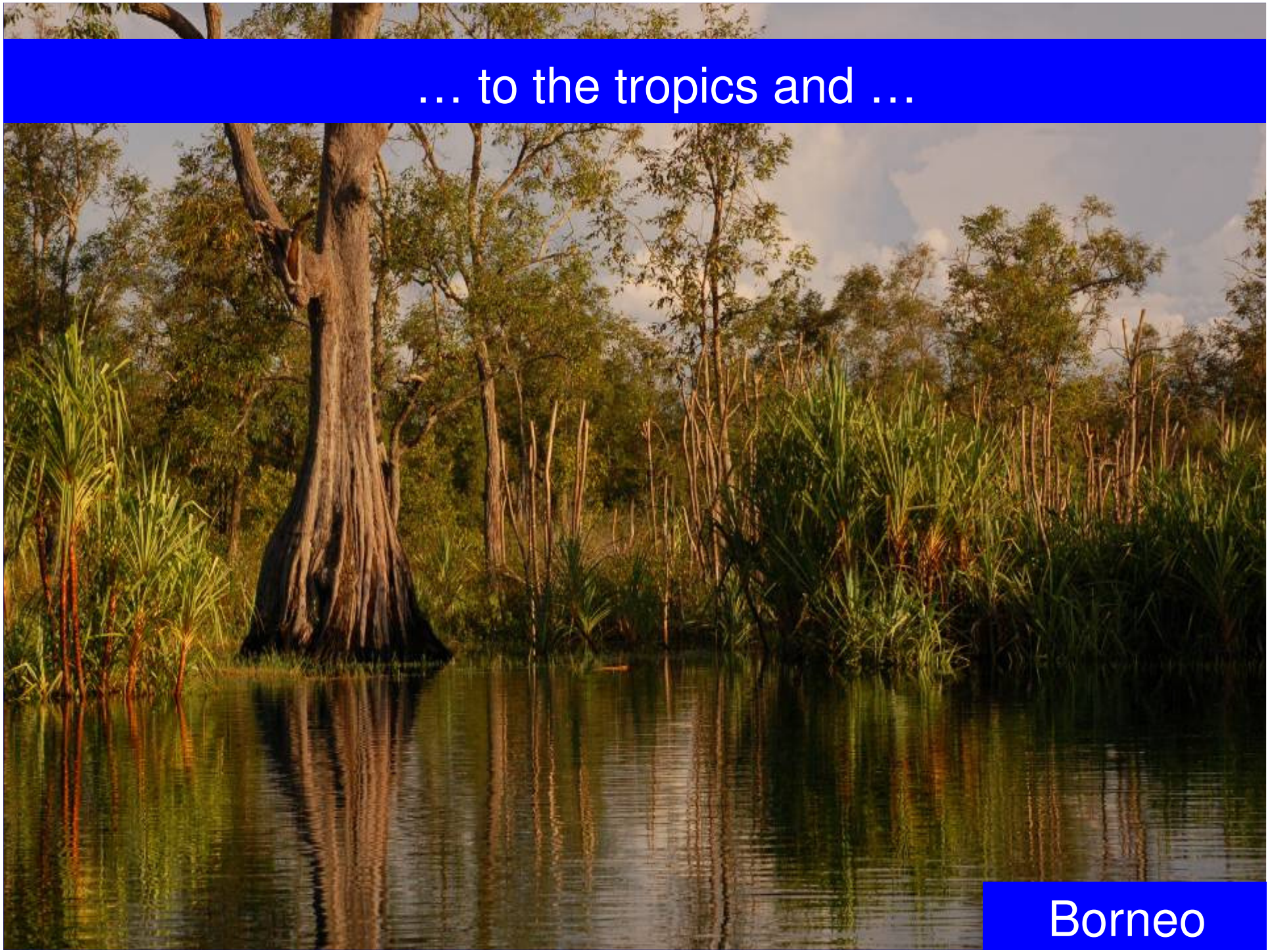
Peatlands are everywhere

Sichuan, China

… from the tundra …



Yakutia, RF


… to the tropics and …
Borneo

…to the uttermost part of the World…

Tierra del Fuego
Argentina

…from the mountains …

Kyrgystan

… to the sea …

Archangelsk, RF

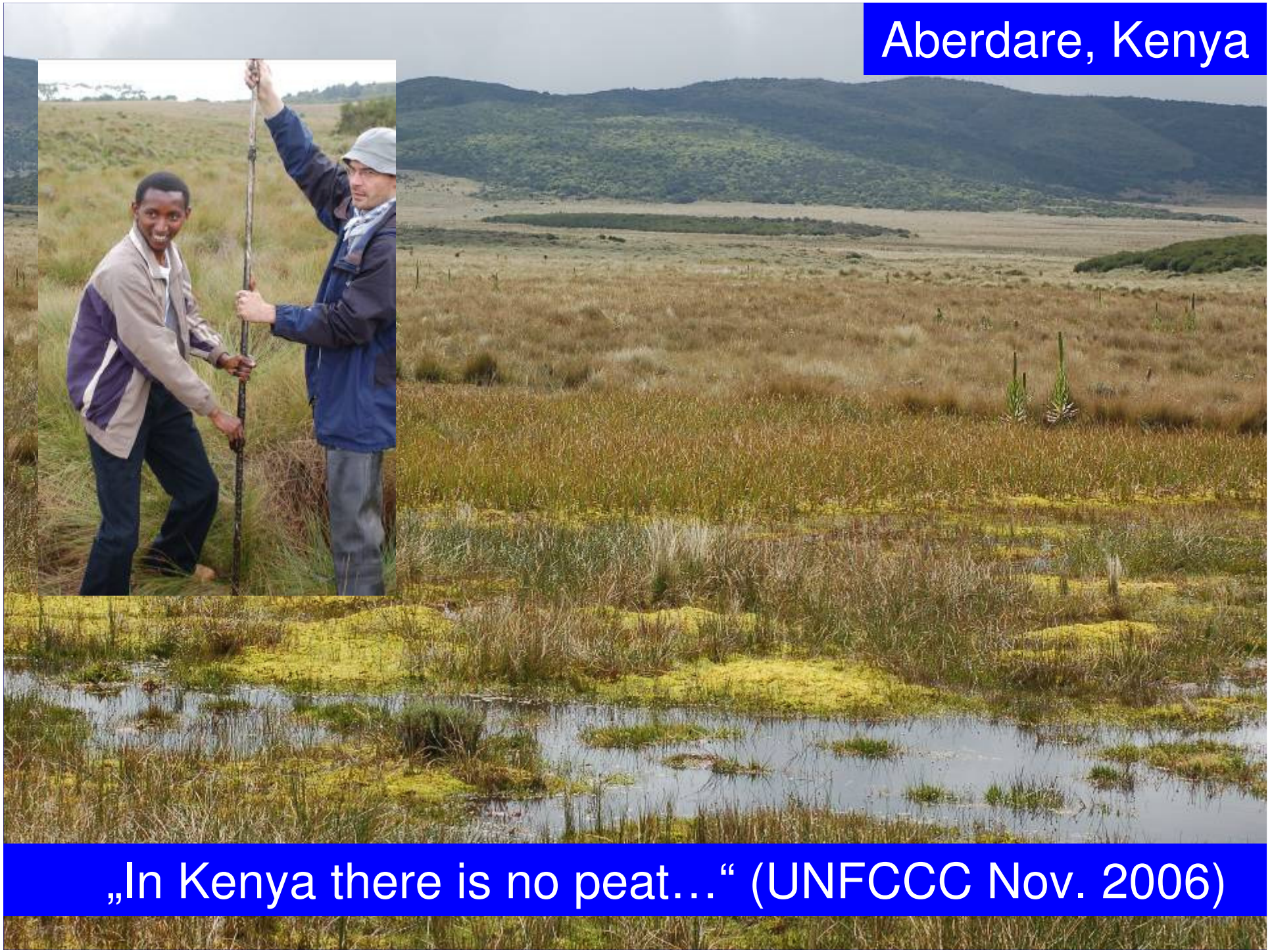
… and even in the city of Ramsar (Iran) !…

Of many areas we know almost nothing

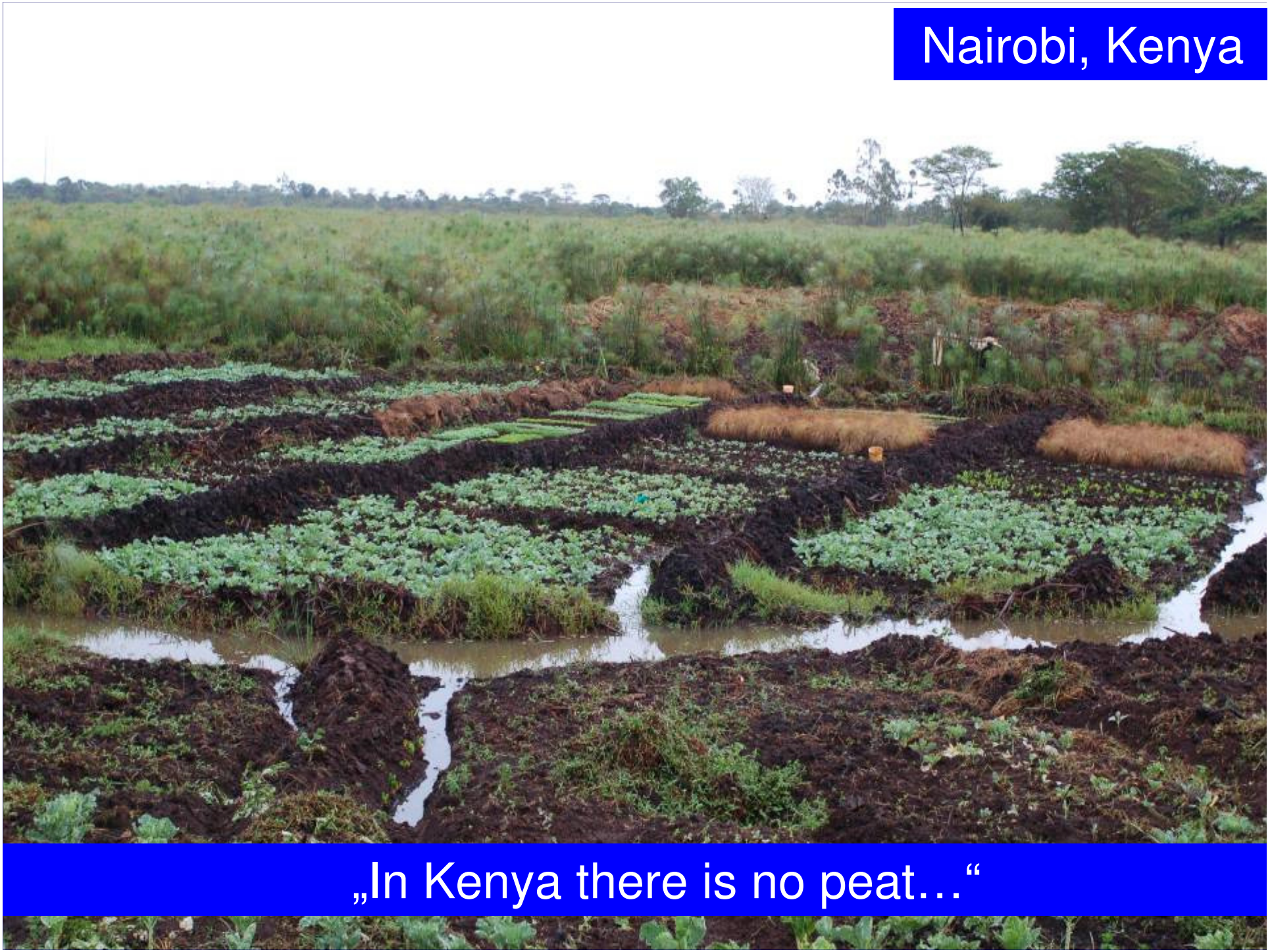
Peatlands have long been overlooked…

The Cinderella Syndrom

Ruoergai, Tibet

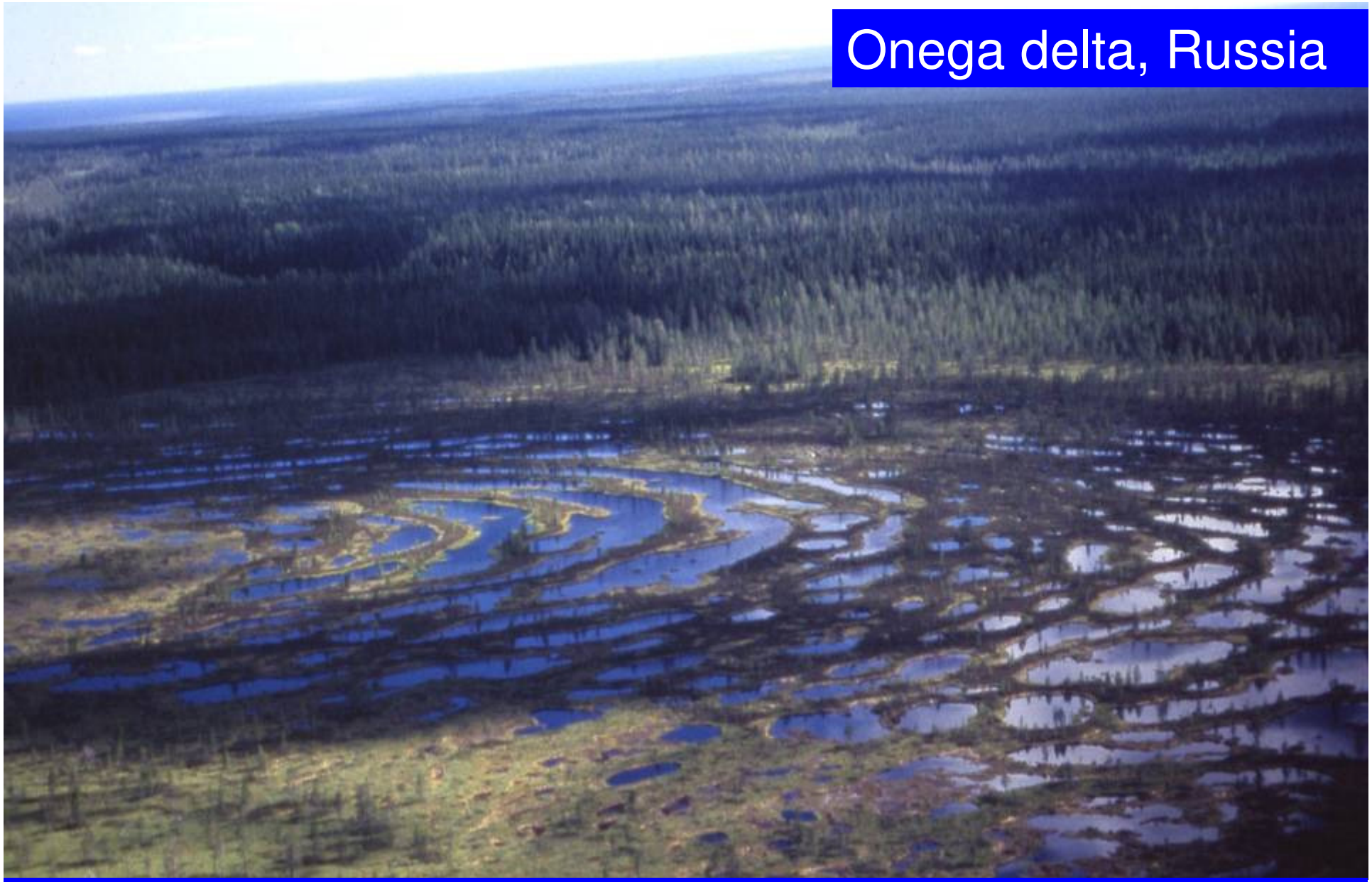

Aberdare, Kenya
„In Kenya there is no peat…“ (UNFCCC Nov. 2006)

Nairobi, Kenya



„In Kenya there is no peat…“

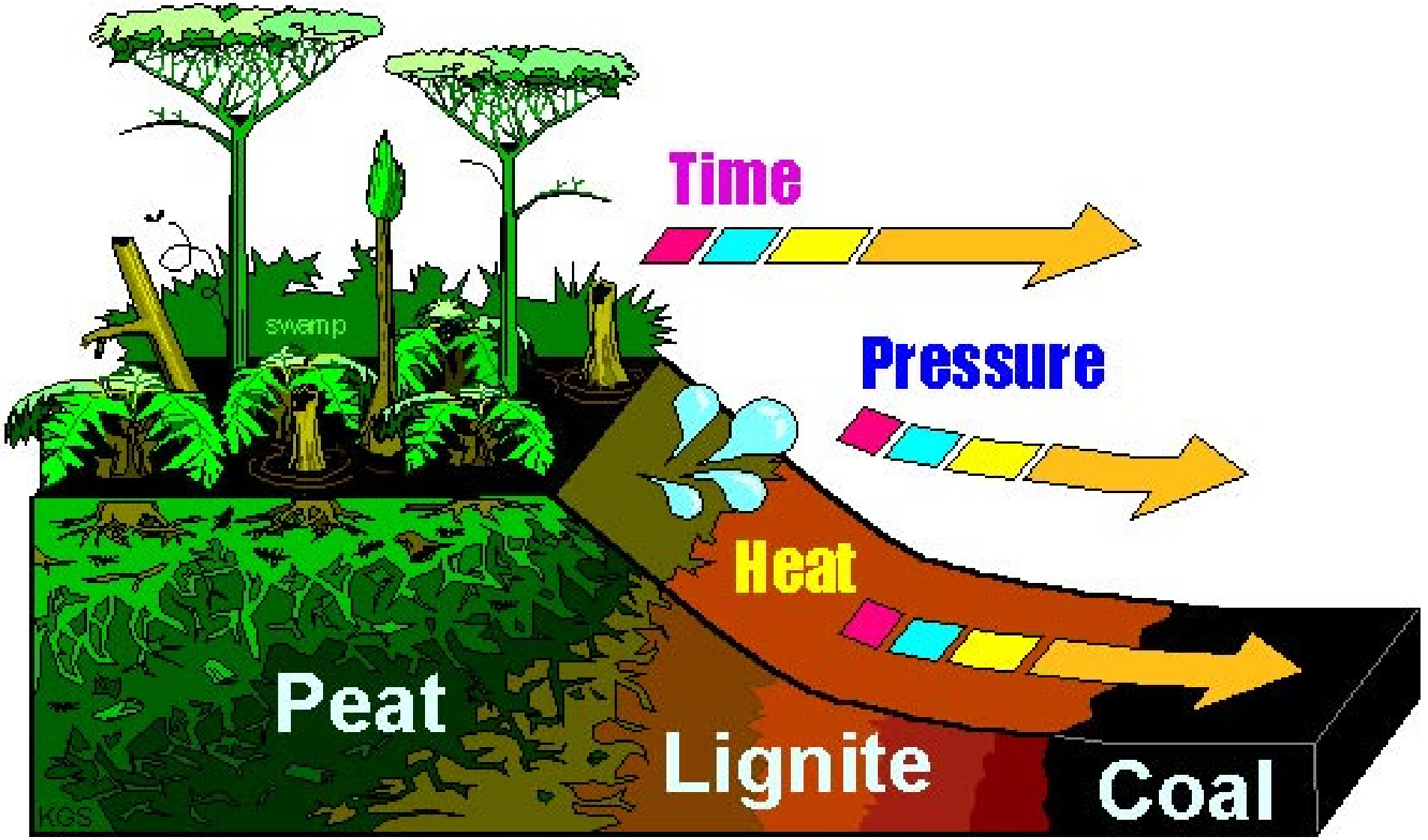
Peatlands are the most space-effective carbon (C) stocks of all terrestrial ecosystems.



In the boreal zone peatlands contain 7 x more carbon per ha than other ecosystems, in the tropics 10 x.

While covering only 3% of the World's land area, peatlands contain 500 Gt of carbon in their peat.

This is equivalent to 75% of all C in the air, equal to all terrestrial biomass, and 2 times the carbon stock in the total forest biomass of the world.



Coal and lignite and part of the “mineral” oil and gas originated from peat of previous geological periods.

Sequestration and long-term storage of carbon require permanent waterlogging

Kalimantan, Indonesia

When drained, peatlands become vigorous sources of carbon dioxide (and nitrous oxide)


Globally, degraded peatlands emit 2 Gtons CO_2 yr^{-1}

Annual peat-CO_2-losses

Mton CO_2	Cause	Mio Ha
400	Peatland fires SE Asia	
750	Agriculture outside SE Asia	30
600	Drained peatlands in SE Asia	12
120	Drained peatland forestry	15
150	Urbanisation, infrastructure	5
60	Peat extraction	

Importance of fires!...

Mton CO_2	Cause	Mio Ha
400	Peatland fires SE Asia	
750	Agriculture outside SE Asia	30
600	Drained peatlands in SE Asia	12
120	Drained peatland forestry	15
150	Urbanisation, infrastructure	5
60	Peat extraction	

… but problem not simply solved by fire fighting…

…land use is similarly important…

Mton CO_2	Cause	Mio Ha
400	Peatland fires SE Asia	
750	Agriculture outside SE Asia	30
600	Drained peatlands in SE Asia	12
120	Drained peatland forestry	15
150	Urbanisation, infrastructure	5
60	Peat extraction	

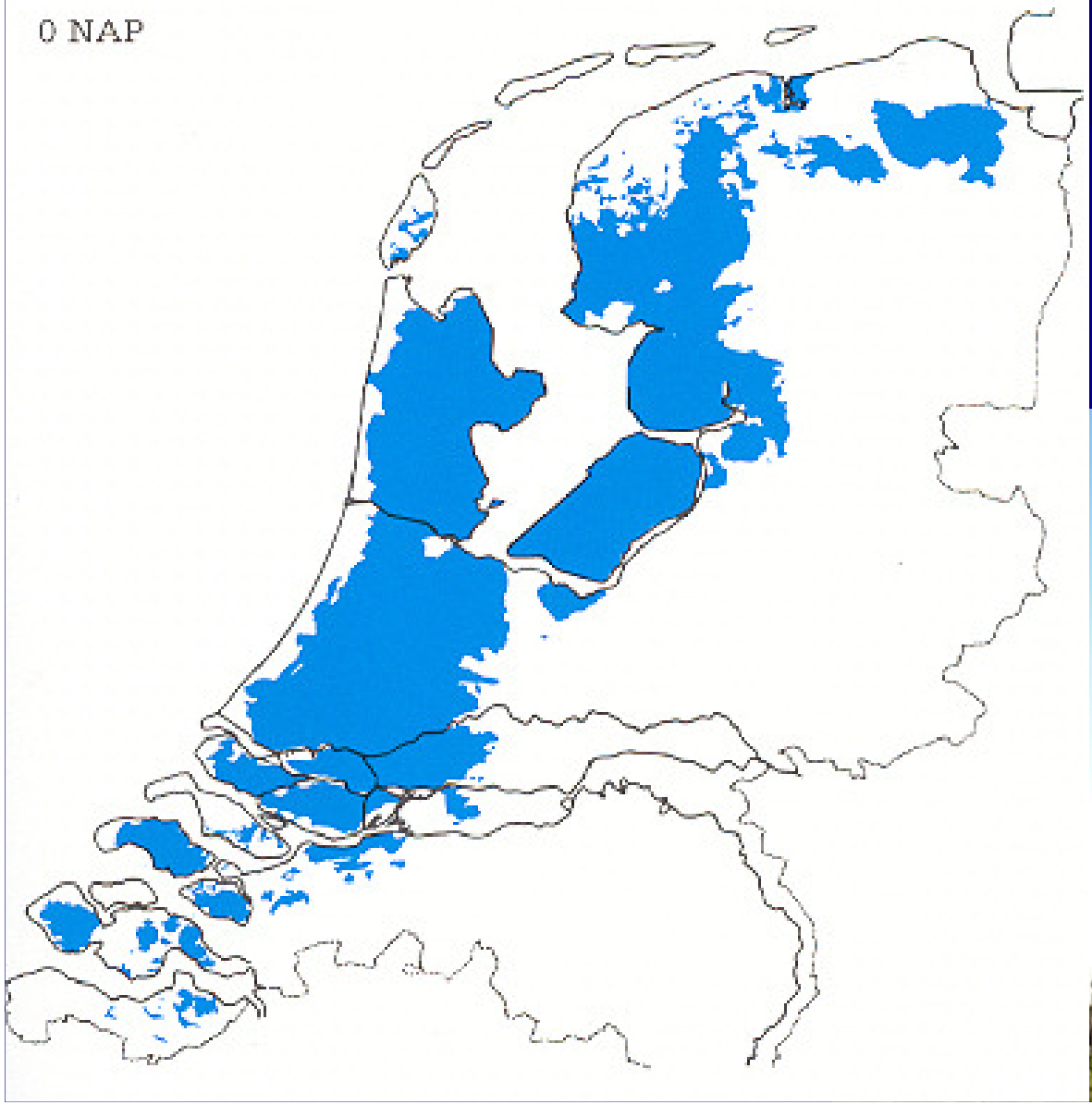
Peatland agriculture imitates dryland agriculture…

Kalimantan

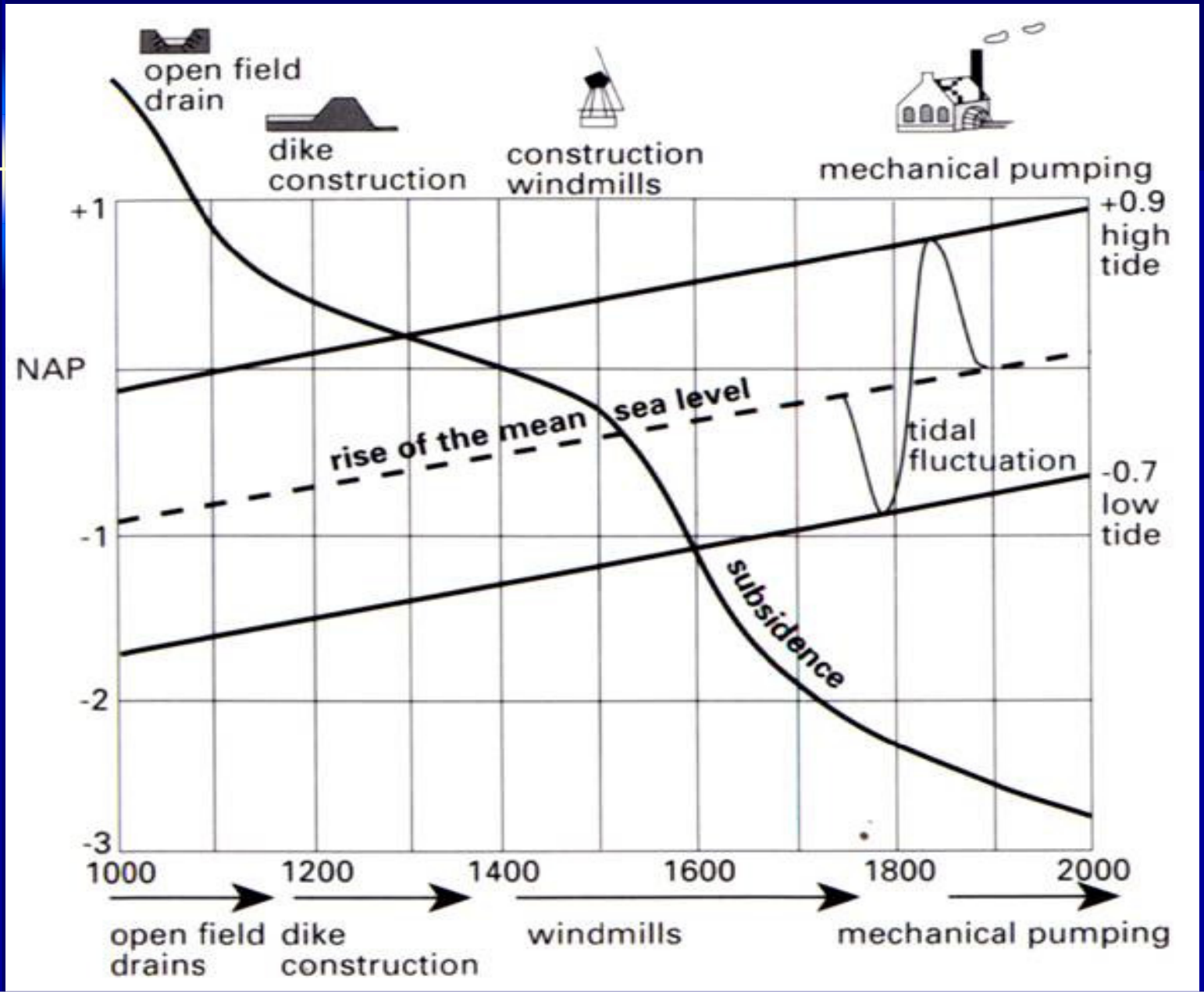
…although draining, tilling and fertilizing are most effective to enhance peat oxidation and degradation…

…and to destroy the peatland subsistence base…

…*Nether*-lands: 1000 yr of peatland drainage, now half the country under sea level…



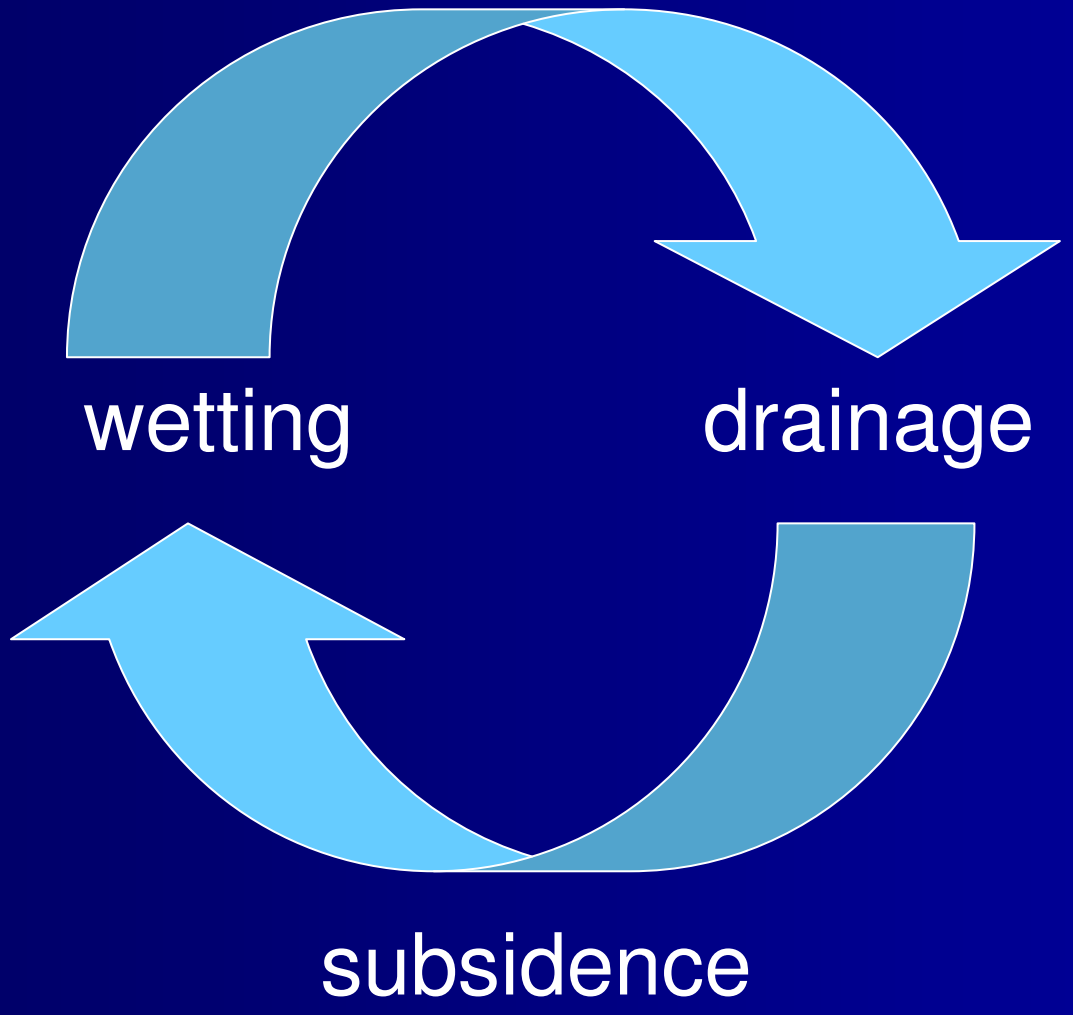
Low Countries: bogged down by peatland drainage…



Holme Post UK: 4 m subsidence in 150 years…

Regular agriculture on peatland requires drainage…

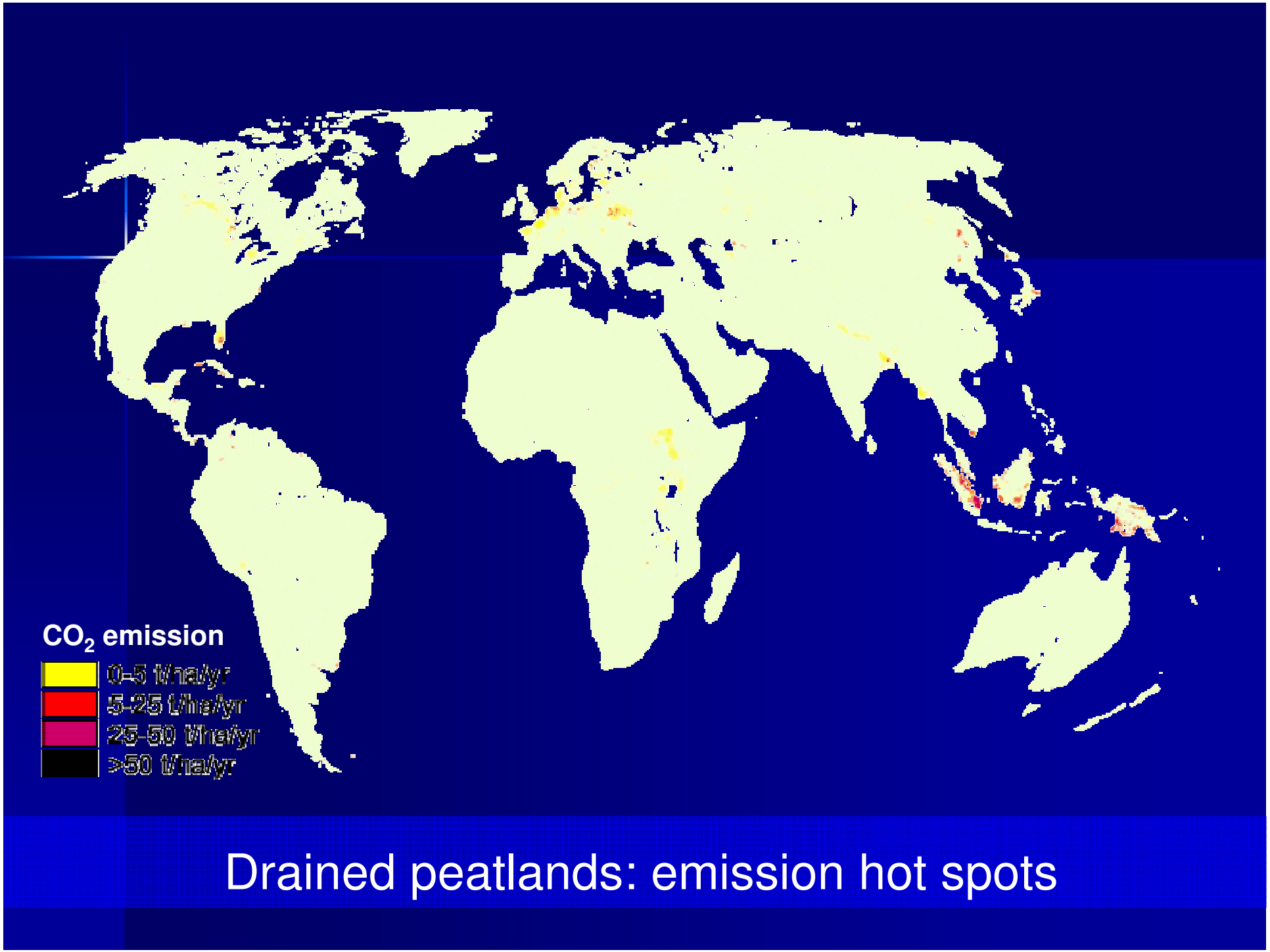
…causing the "*devil's cycle*" of peatland utilisation…



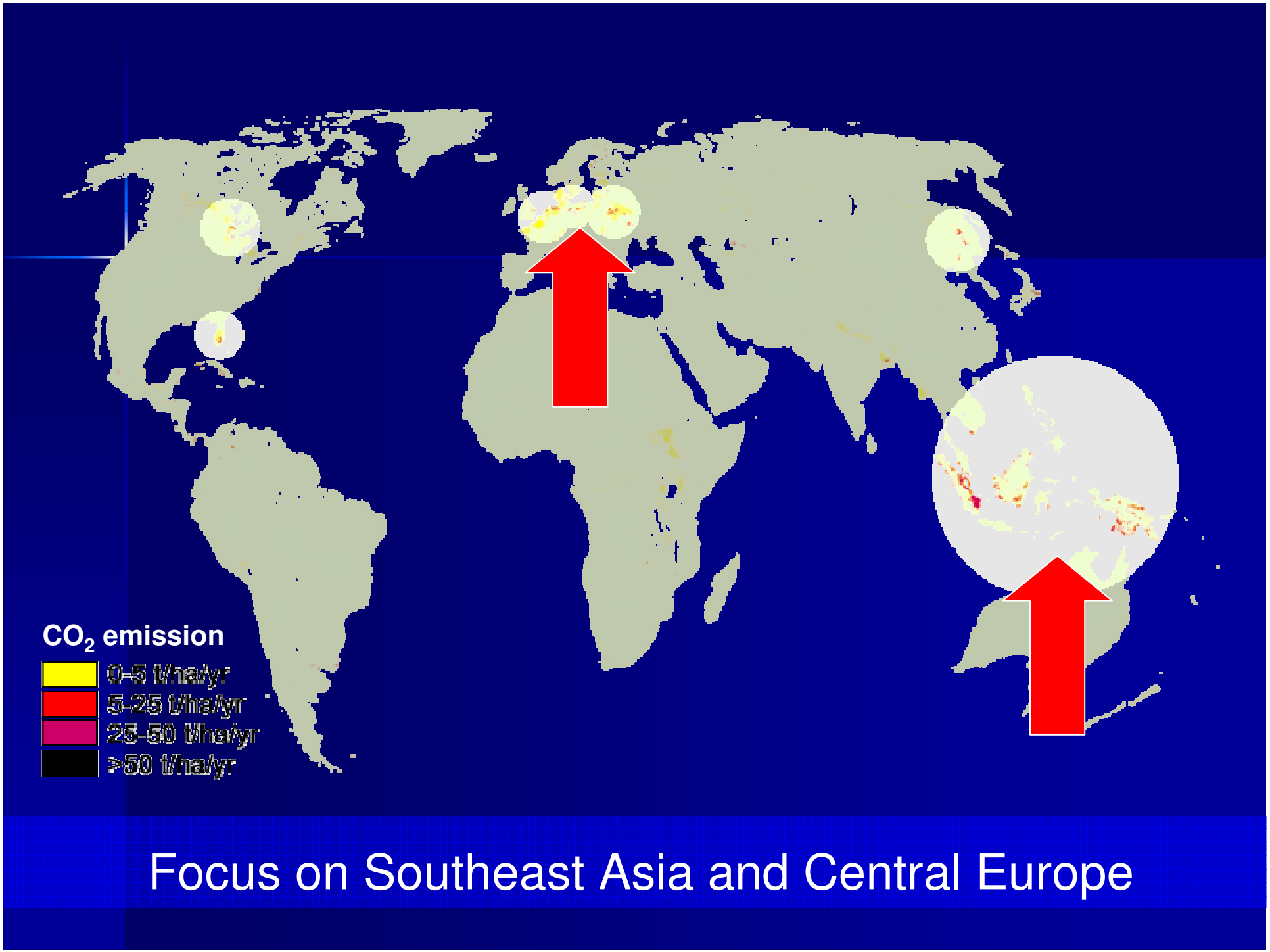
…certainly when cultivating desert plants on peat…

…or dryland species like mayze…

0.3 % of the land surface is responsible for 6 % of the total global anthropogenic CO_2 emissions…



Drained peatlands: emission hot spots

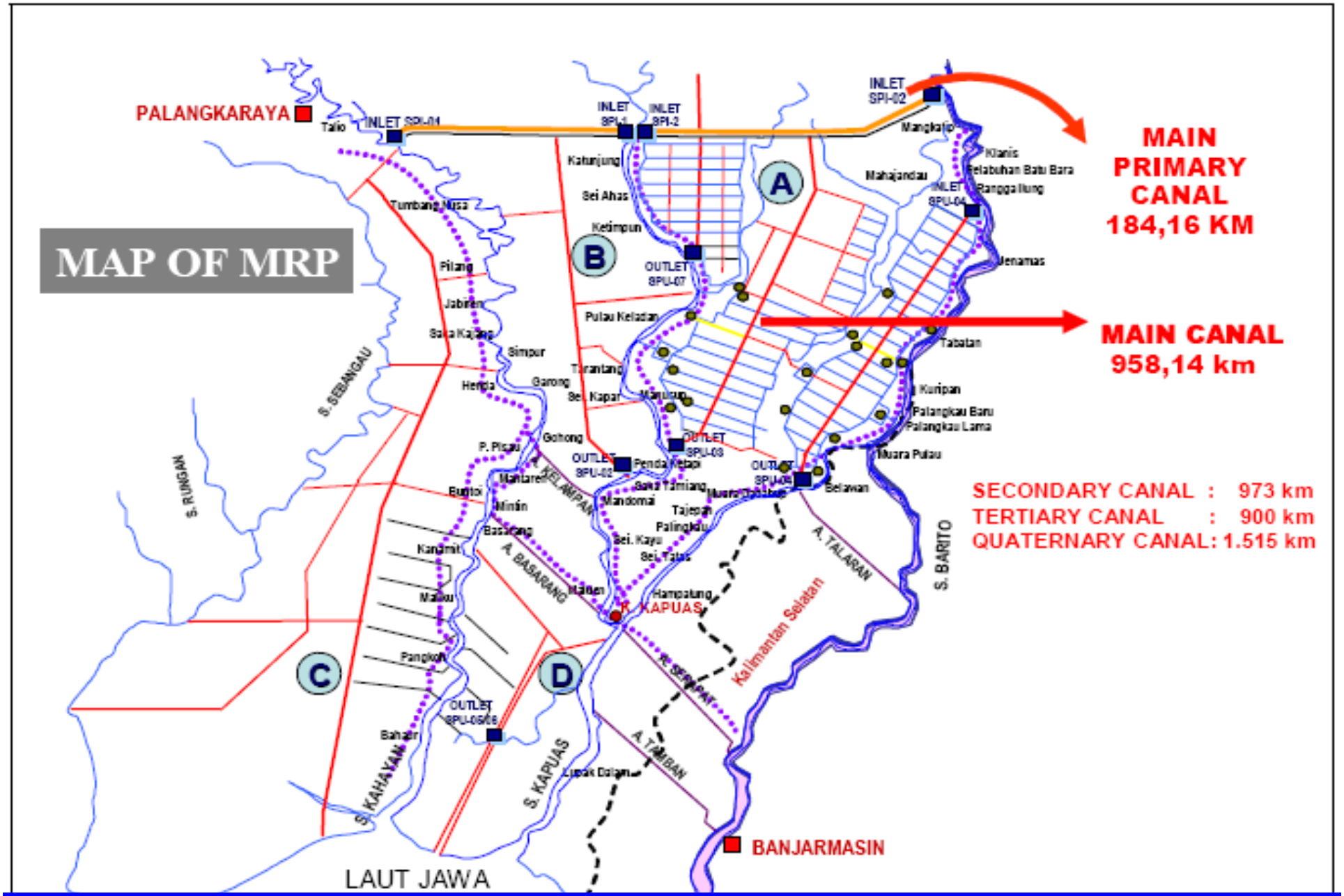


Focus on Southeast Asia and Central Europe


Kalimantan, Indonesia
Hotspot SE Asia

Kalimantan, Indonesia

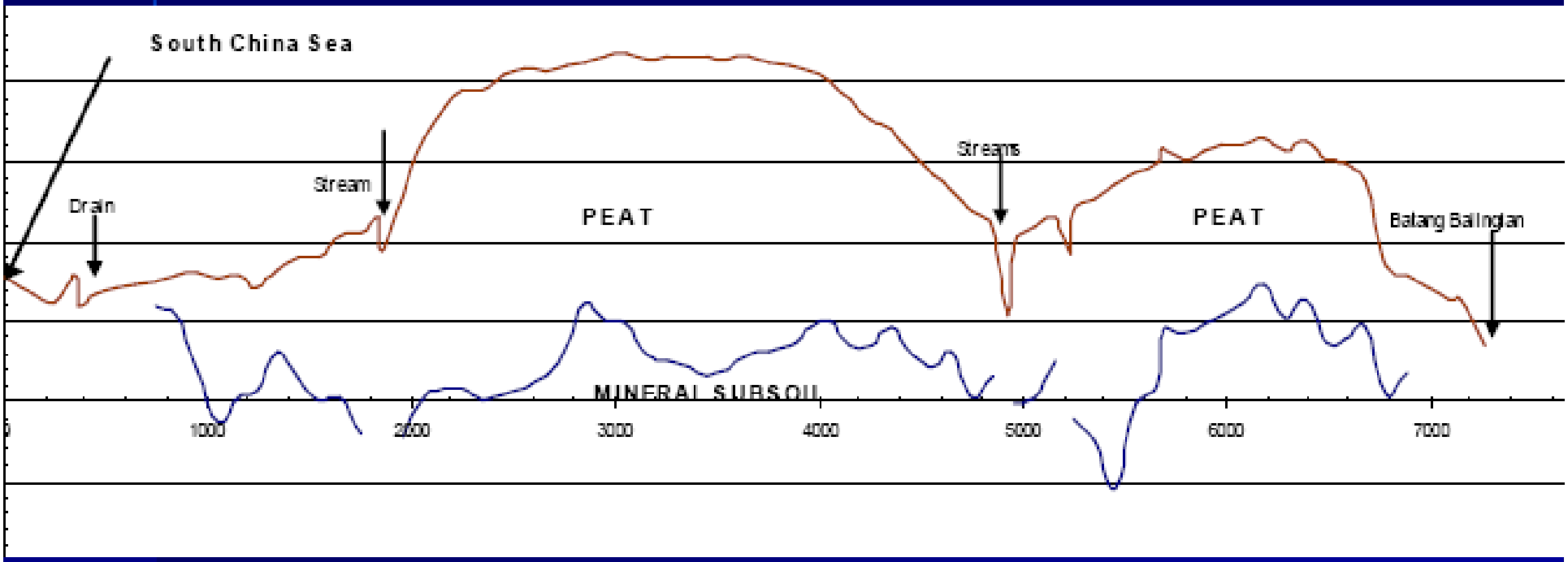
1996: 1.2 Mio ha peat swamp drained in Kalimantan



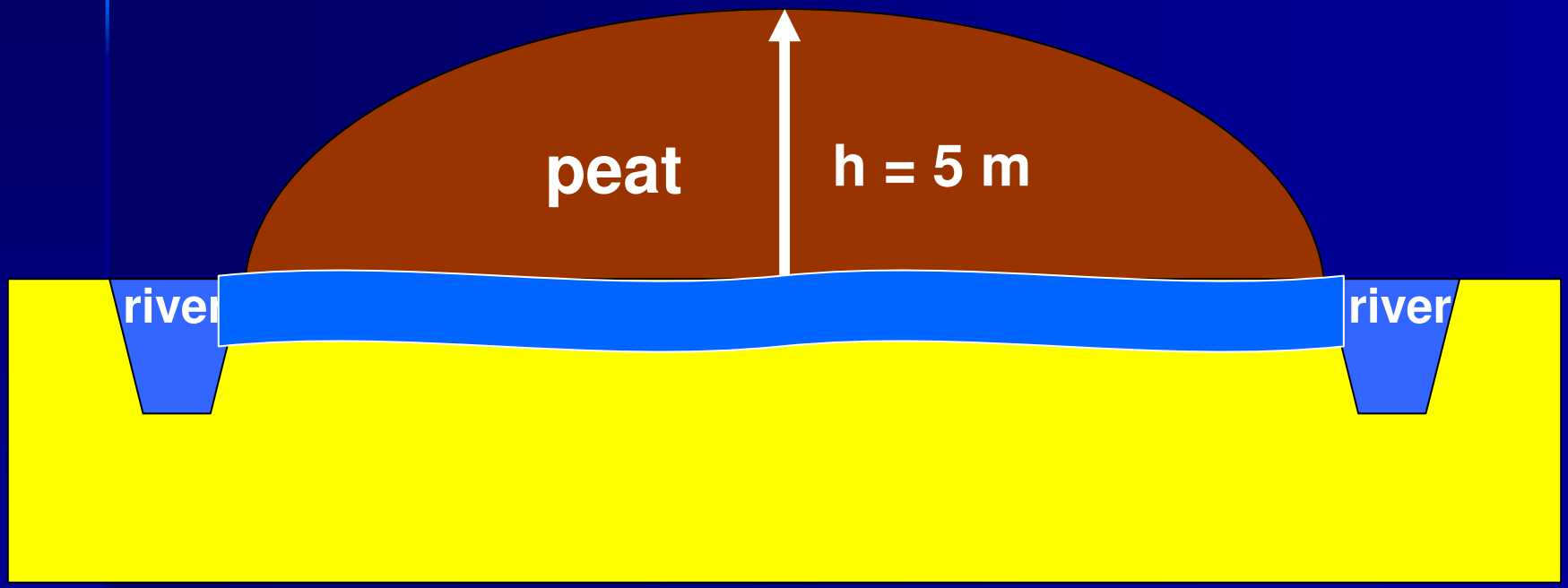
Mega Rice Project: 3,389 km large drainage canals

Aim: rice fields for transmigrants from Java

..by using water from rivers for irrigation…



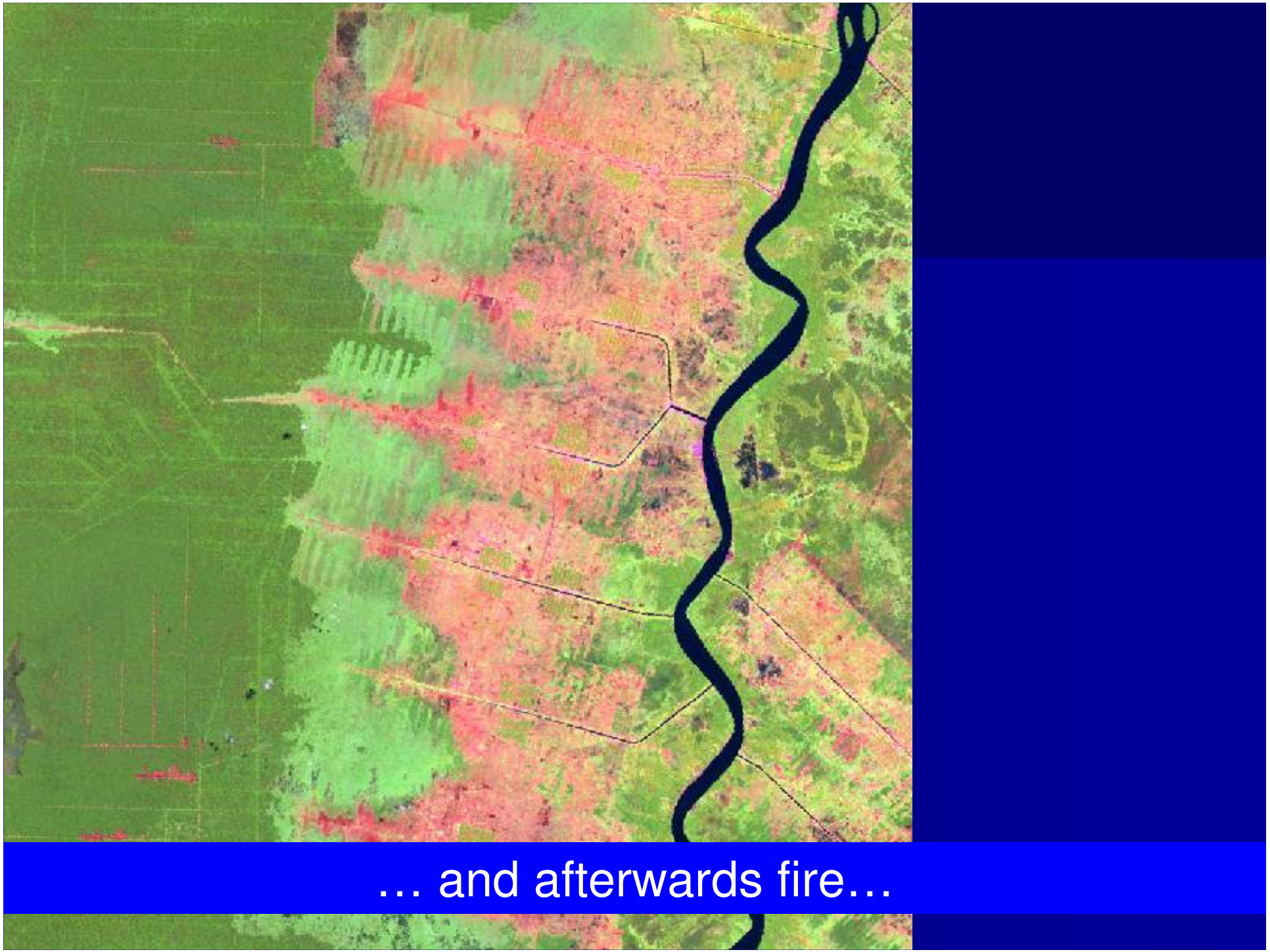
But the peatlands between the rivers are domed…



Connecting the rivers by canals lead to massive drainage of the peatlands

Some areas were colonized for dry agriculture…

But canals enabled access for illegal logging…



… and afterwards fire…


Most is not utilized….


…and burns every year….

…so that half of the year the area is covered by smoke...

…and the fires eat into the remaining peat forests…

30% of children under 5 years have lung diseases

Rewetting by building dams

…by hand…

…under difficult conditions…

Large dams and many are necessary…

Reforestation…

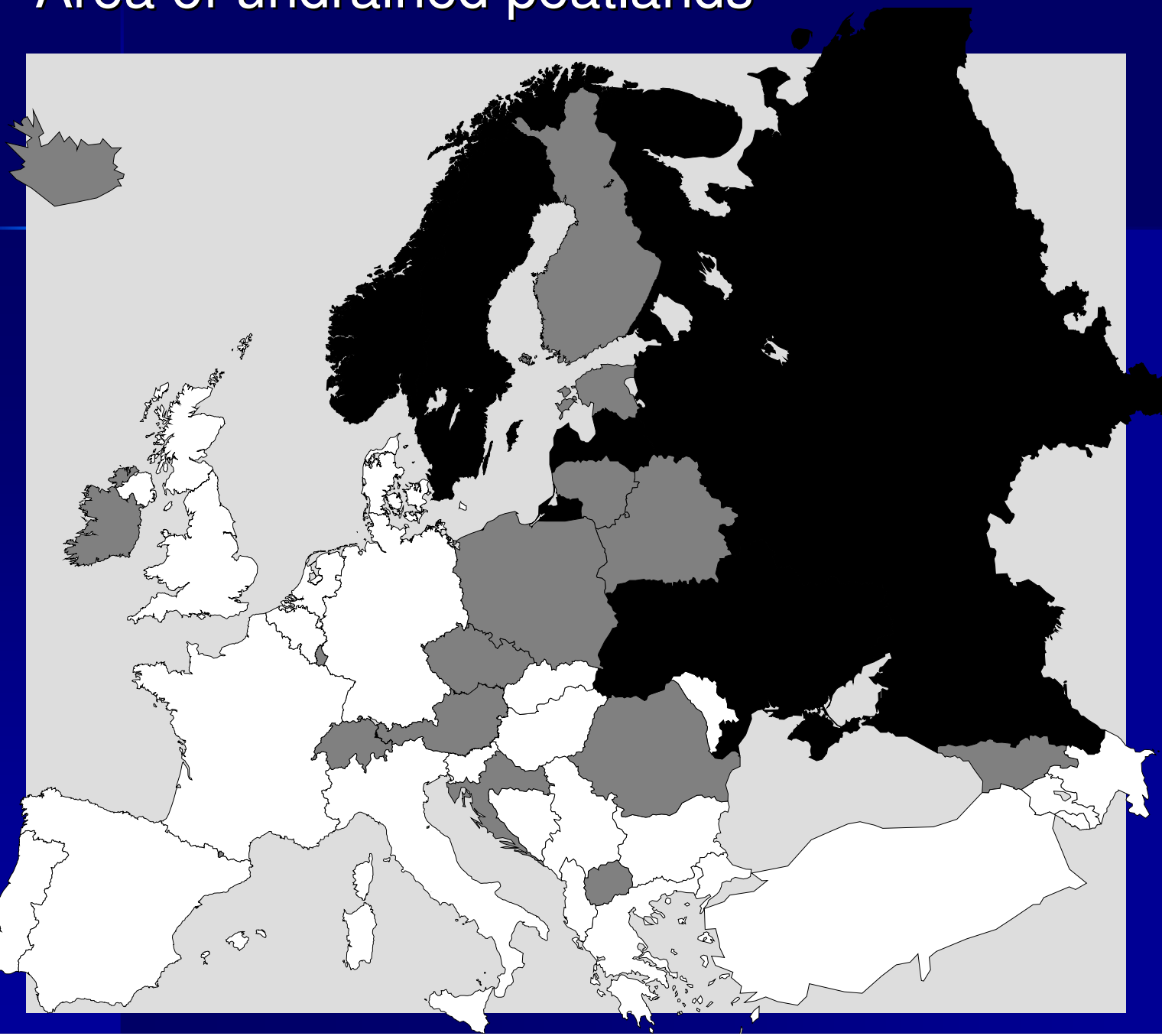
Tree nurseries…


Young and old…

Planting of commercial species…


Rospuda, Poland
Hotspot Central Europe

Area of undrained peatlands



< 10%

10-50%

> 50%

Total left : 48 %

(33 % excl. Russia)

Wohlgemuth, J., 1962, Egon und das achte Weltwunder. Neues Leben, Berlin.

> 90 % of peatlands in W+C-Europe are „dead“:
drained for agriculture, forestry, and peat extraction

Large areas of peatland have disappeared without leaving a trace of peat.

Since 1990s: socio-economic changes and increasing soil degradation lead to abandonment

→Rewetting projects,
→also to reduce emissions of greenhouse gases

How much less gas emissions after rewetting?

Can these reductions be accounted under KP or VCS?

No simple question because different gases (CO_2, CH_4, N_2O) react differentially on rewetting…

In the first years after rewetting net emissions may even increase, because of methane …

Our modelling results indicate:

- Rewetting of drained peatlands always leads to ***huge benefits*** compared to the continuation of the present situation.
- Even in the most pessimistic scenario, rewetting leads – within a few years - to decreased emissions.

Initial CH_4-peak:

- seems to last short (5 – 10 years?)
- can be decreased and avoided by
  - Selection of peatland types and status
  - Careful water management
  - Removal of biomass of ‘negative’ species
  - Establishment of ‘positive’ species

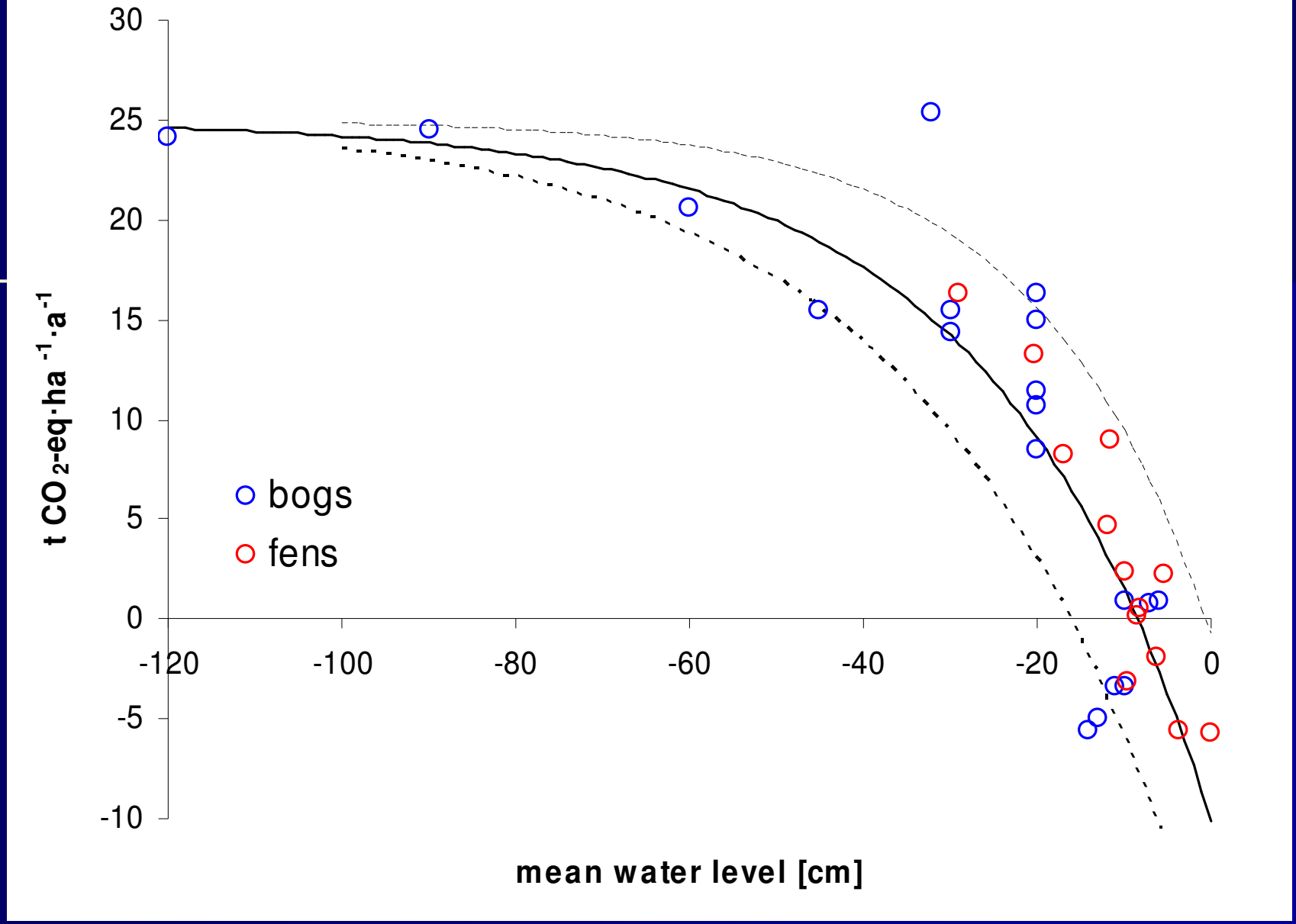
Peatlands and climate

- Rewetting is promising
- Belarus and Ukraine want to rewet
- And sell the carbon credits on the voluntary market (Kyoto not yet possible)

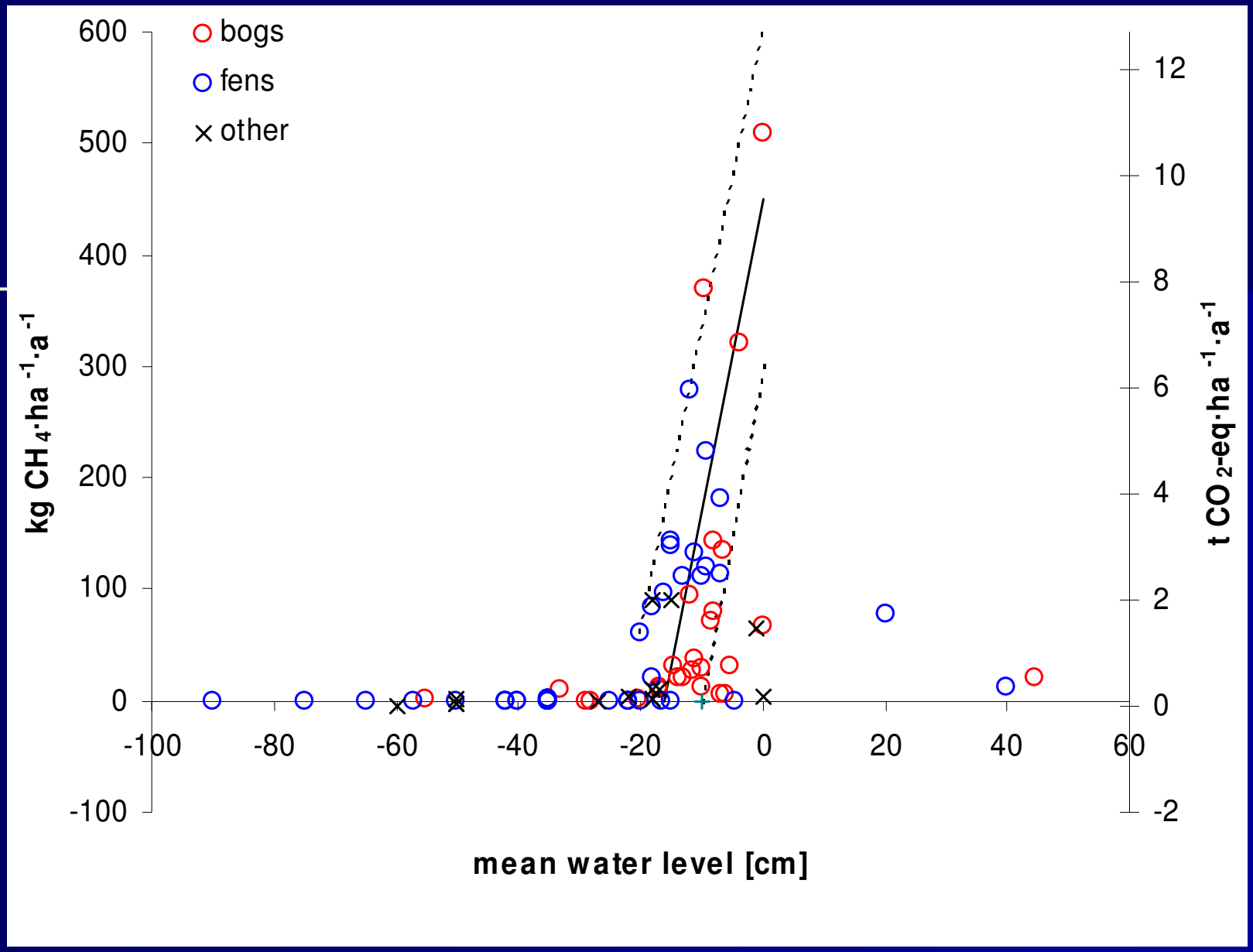
→ Requirements for carbon reduction sales:
„***real, measurable, verifiable & additional***“

Measuring directly is complicated and expensive

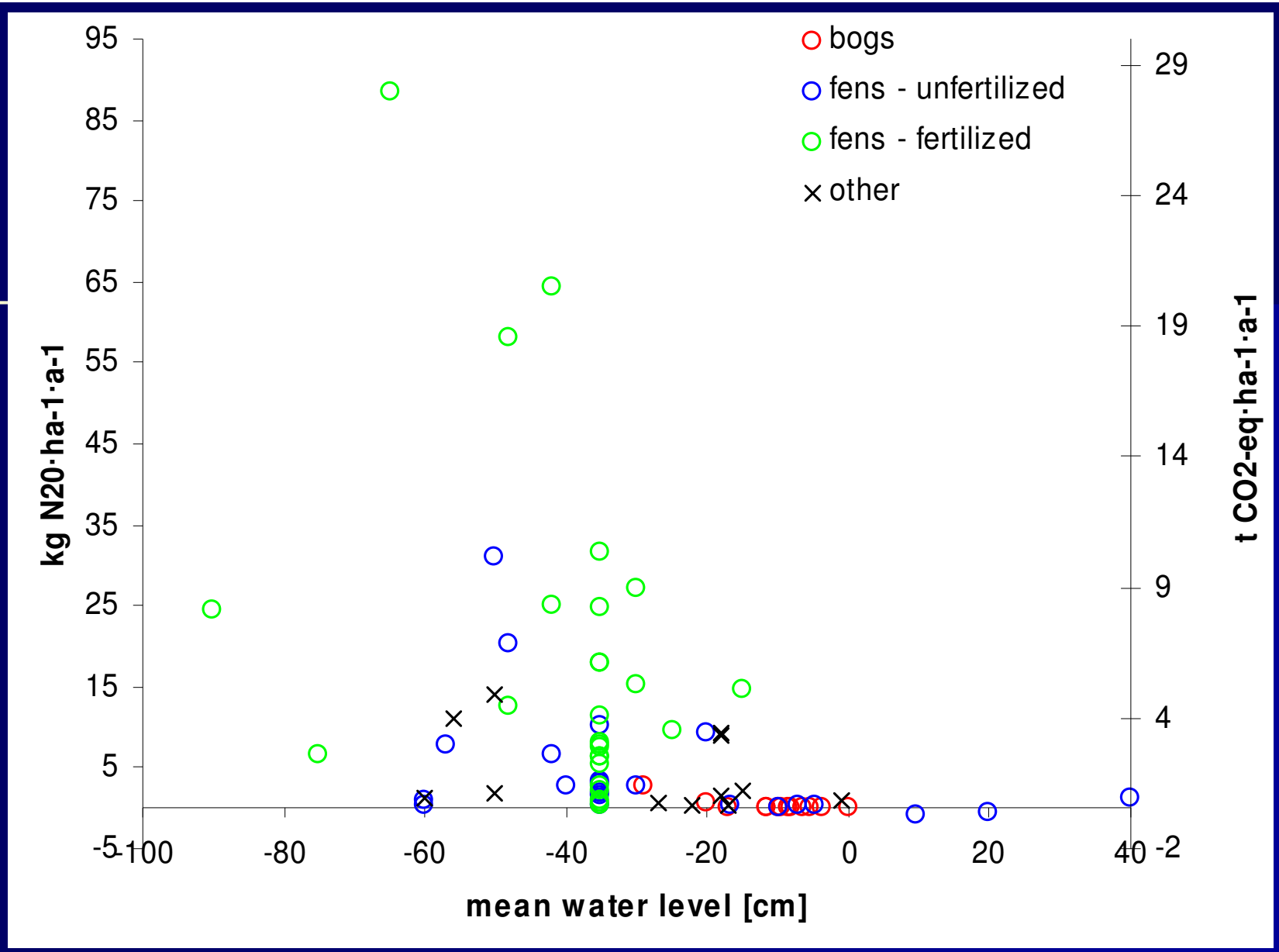
Therefore we developed a method to assess emissions by using vegetation as indicator



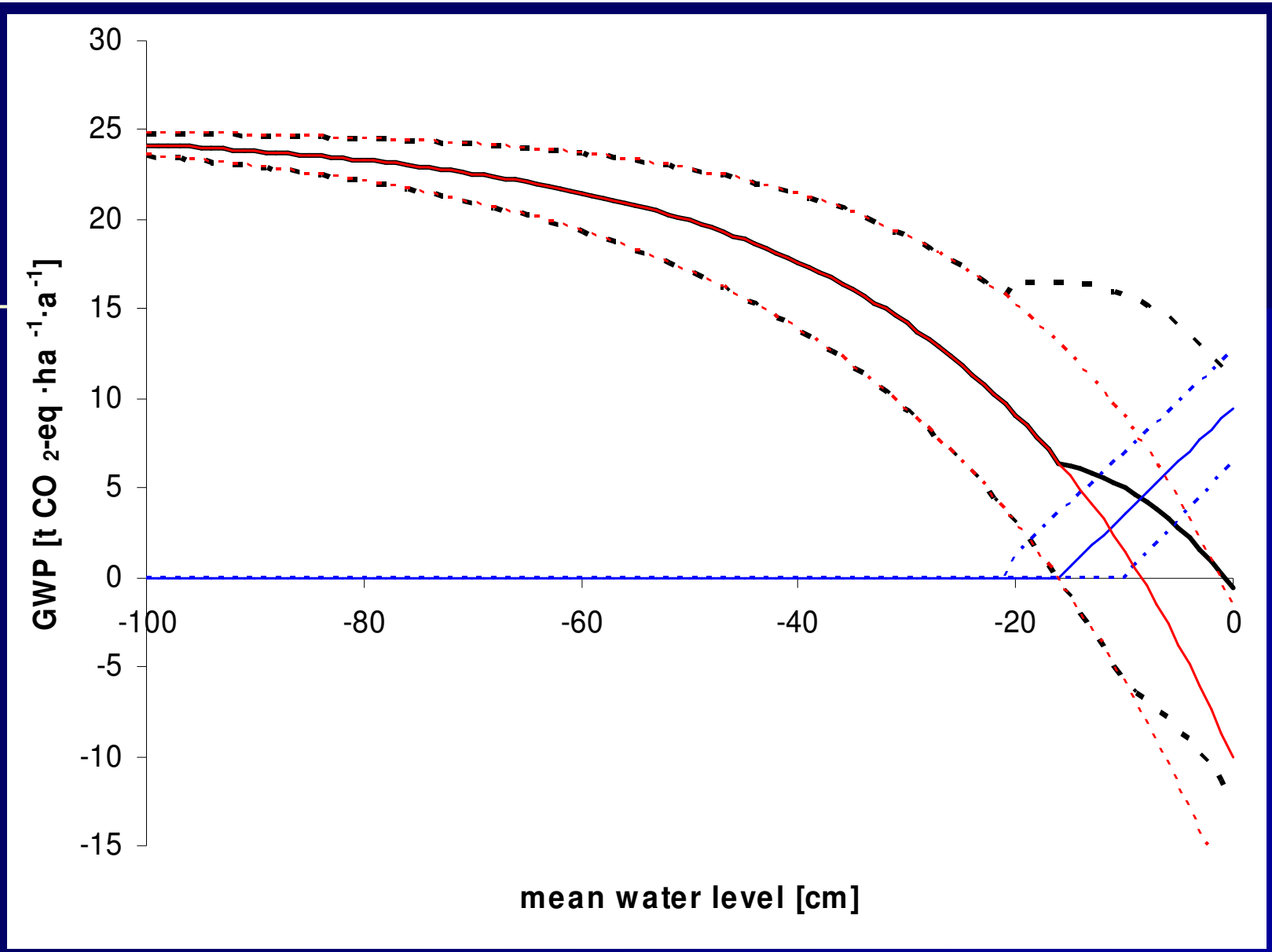
CO_2 emissions clearly correlate with water levels: they become less with higher water levels



CH_4 emissions clearly correlate with water levels: they rapidly increase when higher than 20 cm - surface



N_2O emissions clearly correlate with water levels: they do not occur when higher than 20 cm - surface



By rewetting, greenhouse gas emissions decrease, but less between – 20 cm and 0 cm

Emissions strongly related to water level
Vegetation strongly related to water level

Vegetation furthermore related to other factors that influence emissions

→ **Use vegetation as indicator for emissions!**

GESTs: Greenhouse gas Emission Site Types

	2-, 2+, 2~	(3+/2+) 3+	4+/3+	4+	5+/4+	5+	6+
	MOD. MOIST FORBS & MEADOWS	**MOIST FORBS & MEADOWS**	**VERY MOIST MEADOWS**	**VERY MOIST MEADOWS, FORBS & TALL REEDS**	**VERY MOIST TALL SEDGE MARSHES**	**WET TALL SEDGE MARSHES**	**FLOODED TALL AND SHORT REEDS**
CH_4	0	1.5 (1.3 – 2)	3.5 (2.5 – 6)	3	2.5 (2.4 – 2.6)	7 (5.0 – 9.5)	1 (0.3 – 1.7)
CO_2	24	15	13 (8.5 – 16.5)	8	2.5	0	0
GWP	24	16.5	16.5	11	5	7	1

GESTs with indicator species groups

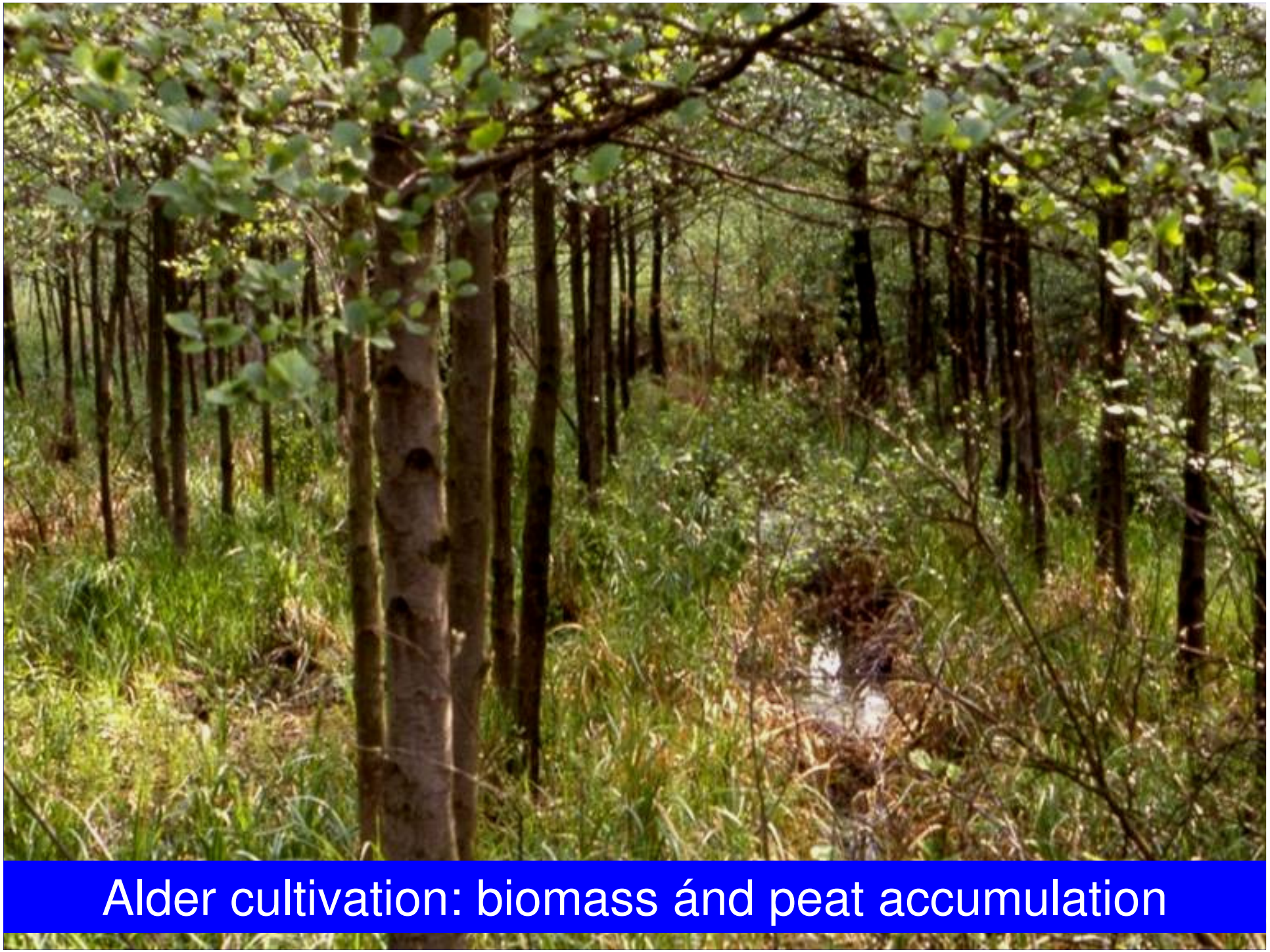
Vegetation type	Typical/differentiating species	WL class	CH_4	CO_2	GWP
Sphagnum-Carex limosa-marsh	Sphagnum recurvum agg., Carex limosa, Scheuchzeria	5+	**12.5**	<0 (±0)	12.5
Sphagnum-Carex-Eriophorum-marsh	Sph. recurvum agg., Carex nigra, C. curta, Eriophorum angustifolium				
Drepanocladus-Carex-marsh	Drepanocladus div. spec., Carex diandra, Carex rostr., Carex limosa - Carex dominated				
Scorpidium-Eleocharis-marsh	Scorpidium, Eleocharis quinqueflora - Carex (shunt) dominated				
Sphagnum-Juncus effusus-marsh	Juncus effusus, Sphagnum recurvum agg.				
Equisetum-reeds	Equisetum fluviatile				
Scorpidium-Cladium-reeds	Cladium, Scorpidium				
Sphagnum-Phragmites-reeds	Phragmites, Solanum dulcamara	5+	**10**	<0 / ±0	10
Solano-Phragmitetum	Scorpidium, Eleocharis quinqueflora - Phragmites + Solanum without Urtica-gr.				
Rorippa-Typha-Phragmites-reeds	Typha latifolia, Phragmites, Rorippa aquatica, Lemna minor				
Bidens-Glyceria-reeds	Glyceria maxima, Berula erecta, Bidens tripartita, B. cernua				
Red or green Sphagnum lawn (optimal)	Sph. magellanicum, Sph. rubellum, Sph. fuscum, Sph. recurvum agg.	5+	**5**	**-2**	3
Green Sphagnum hollow	Sph. cuspidatum, Scheuchzeria	5+	**10**	**-2**	8
Polytrichum-lawn	Polytrichum commune	5+	2	<0	2

- More climatic profit can even be made by using rewetted peatlands for biomass cultivation
- To replace fossil fuels and fossil raw materials

- PALUDICULTURE !!


Roswarowo, Poland
Paludiculture is agriculture on wet/rewetted peatlands

Alder cultivation on rewetted fens



Alder cultivation: biomass ánd peat accumulation

Reed cultivation on rewetted fens

Reed cultivation: Biomass ánd peat accumulation

Roof reed: quality product


Grasses/sedges for second generation biofuels

Nov 2004

Mai 2004

Aug 2005

Peatmoss cultivation as peat alternative in horticulture

Aug 2006

… World population will be over 9 billion until 2050…

Peatlands again under increasing pressure…

…because of demand for energy and land…

Plans for more peat for energy in Finland, Sweden, Russia, Belarus, Estonia, Ontario…

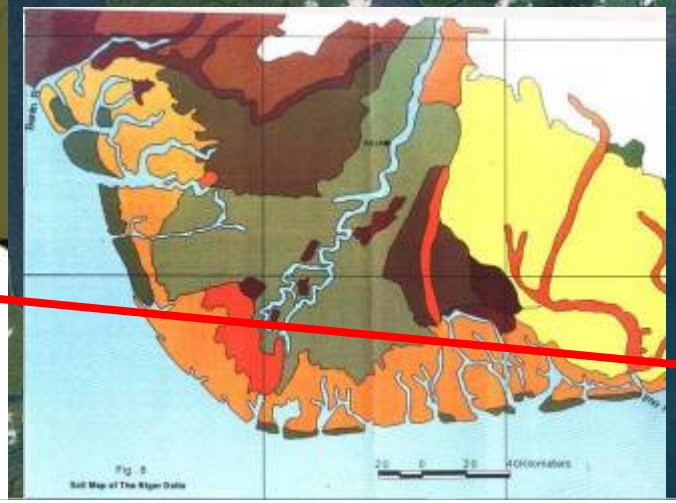
Sweden

Increasing use for oil and gas infrastructure…

Kulevi, Georgia

…everywhere in the world…

…everywhere in the world…

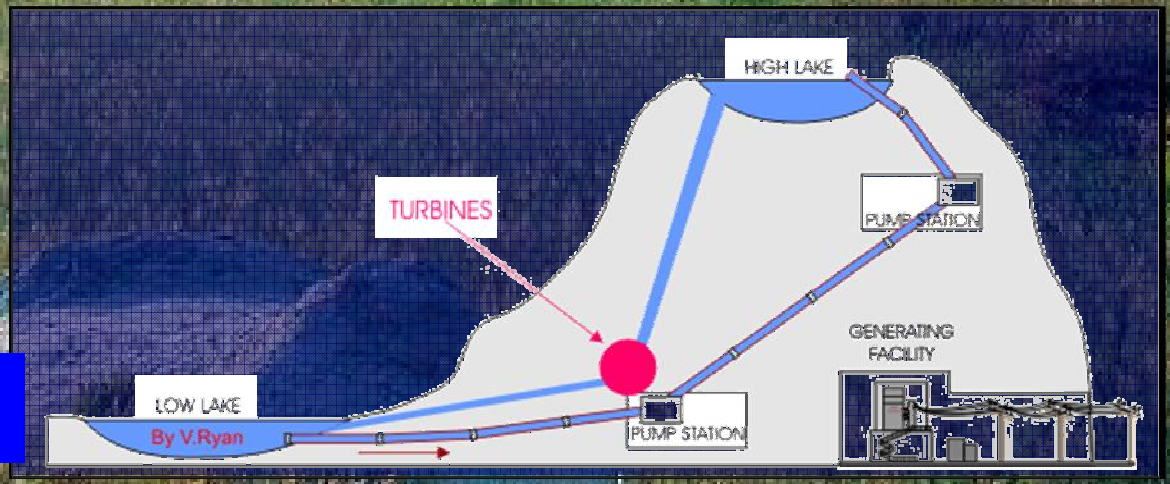


Nigeria

Land for wind energy…

Xistral, Spain

Land for hydro-electricity…



Braamhoek, S-Afrika

Land for cultivation of “bio”-fuels like palm oil…


Germany
…or mais on peatland for biogas…

…although biofuels from drained peatland produce 3 – 9 times more CO_2 than burning coal…

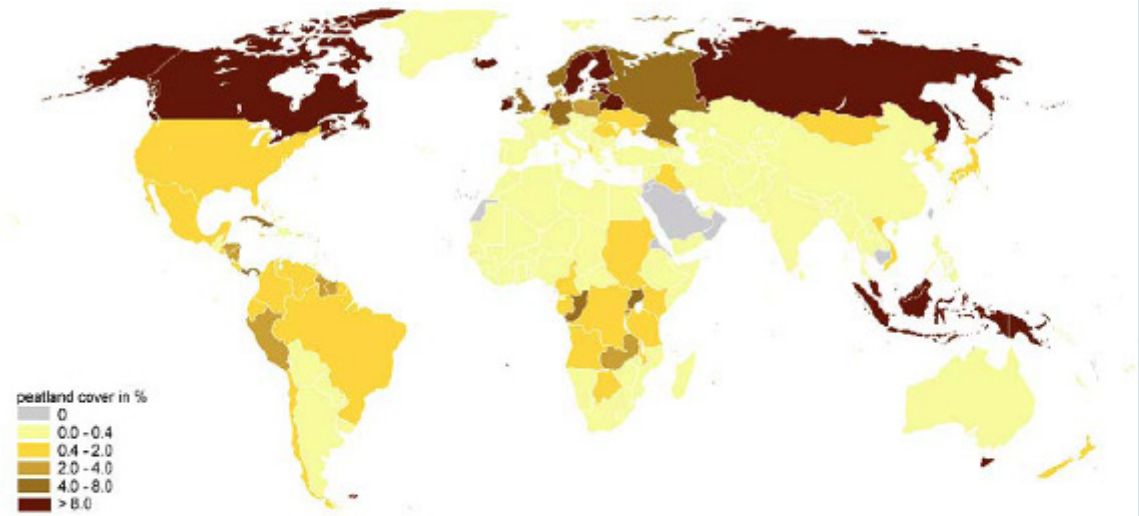
Land for growing, more demanding population…

Sichuan, China

New peatland inventory

The Global Peatland CO_2 Picture

Peatland status and drainage related emissions in all countries of the world



WETLANDS INTERNATIONAL

New peatland inventory

- All countries of the World
- Areas, C-stocks, CO_2 emissions
- 1990 and 2008
- All available data (literature, remote sensing, field observations, many people/ IMCG) → best estimates
- Default values, algorithms → comparability

World picture

- The global CO_2 emissions from drained peatland currently (2008) amount to 1.3 Gton / yr (excl. extracted peat and 0.5 Gton from fires).
- These emissions have strongly increased since 1990 (+25%).

Annex 1

- The Annex 1 countries emit 0.5 Gton CO_2 from 250,000 km^2 of drained peatland (excl. extracted peat and fires).
- These emissions have decreased since 1990.

EU

- The EU (27) is with 174 Mton/yr after Indonesia (500 Mton) and before Russia (161 Mton) the World‘s 2nd largest emittor from drained peatland (excl. extracted peat and fires) .
- These emissions have since 1990 decreased from 191 to 174 Mton (-10%).

Top emittors 2008

- The top (excl. extraction and fires) includes

Indonesia	500	Poland	24
Russia Eur. part	139	Russia Asian part	22
China	77	Uganda	20
USA (lower 48)	67	Pap. New Guinea	20
Finland	50	Iceland	18
Malaysia	48	Sweden	15
Mongolia	45	Brazil	12
Belarus	41	United Kingdom	10
Germany	32	Estonia	10

The growers

- Since 1990 peatland emissions have increased in 50 countries
- These include > 40 developing countries

- > 50% growth: **Papua New Guinea**, Burundi, **Malaysia**, **Indonesia**, Kenya, Colombia, Gabon, Togo, Dominican Republic, Trinidad and Tobago, Rwanda, **China**, Brunei, Ethiopia, Guatemala.

Peatland rewetting

Emission reduction potential:

- Gross 2 Gtons on 500,000 km^2
- Nett: much less
- Half of the CO_2 reduction annihilated by CH_4 emissions after rewetting

→ realistic several 100s Mton CO_2-eq./yr

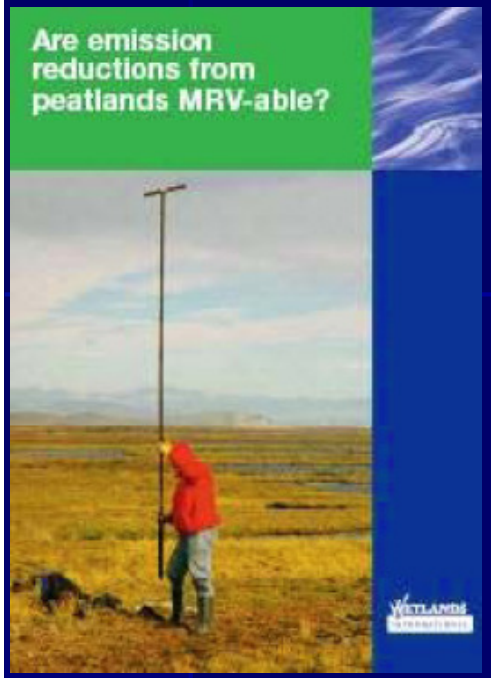
Rewet drained peatlands!

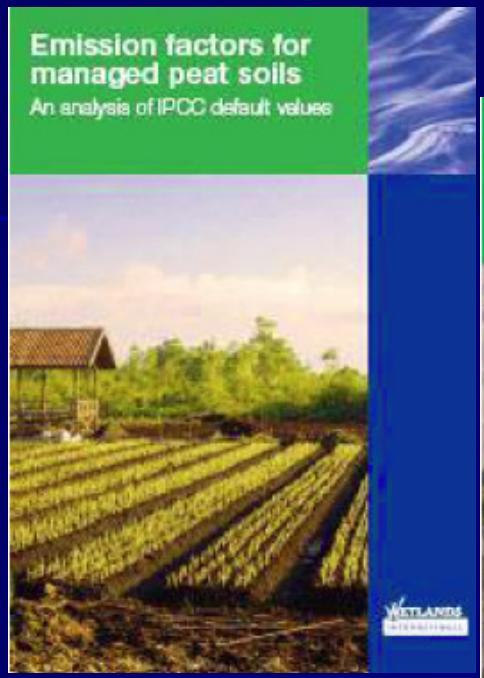
Rouergai, China

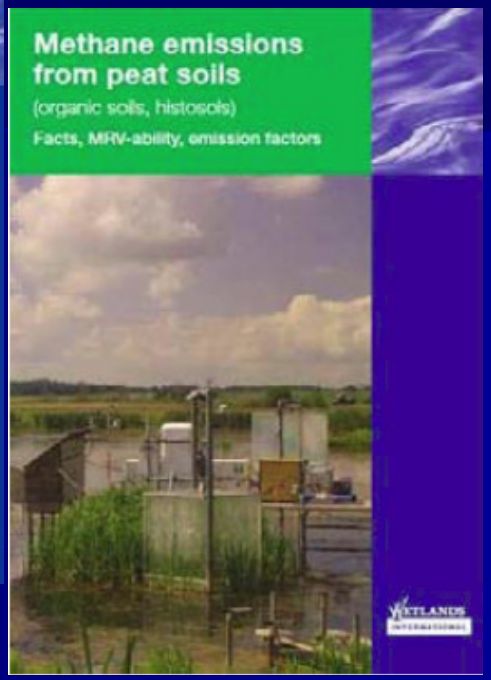
How to include peatlands in climate policies?

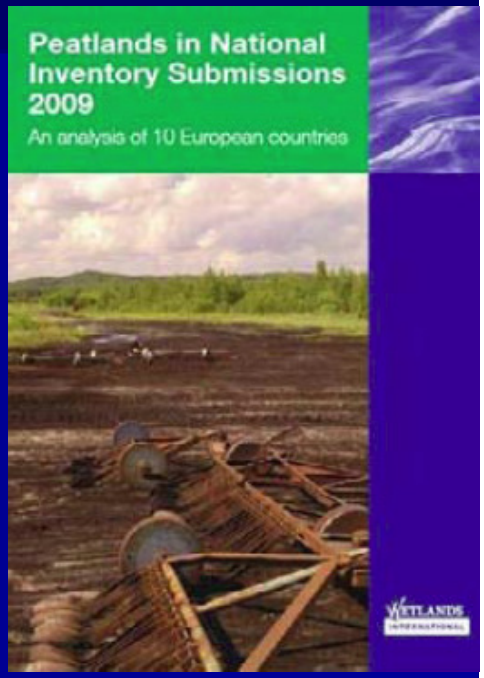
Ireland

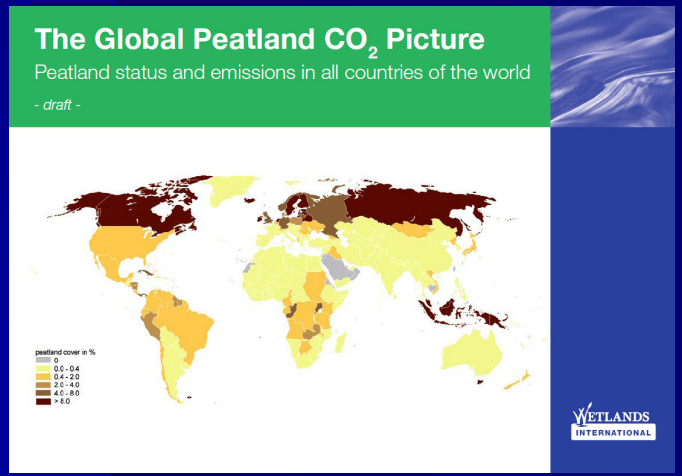
Complex under Climate Convention (Kyoto Protocol), but there is some chance…





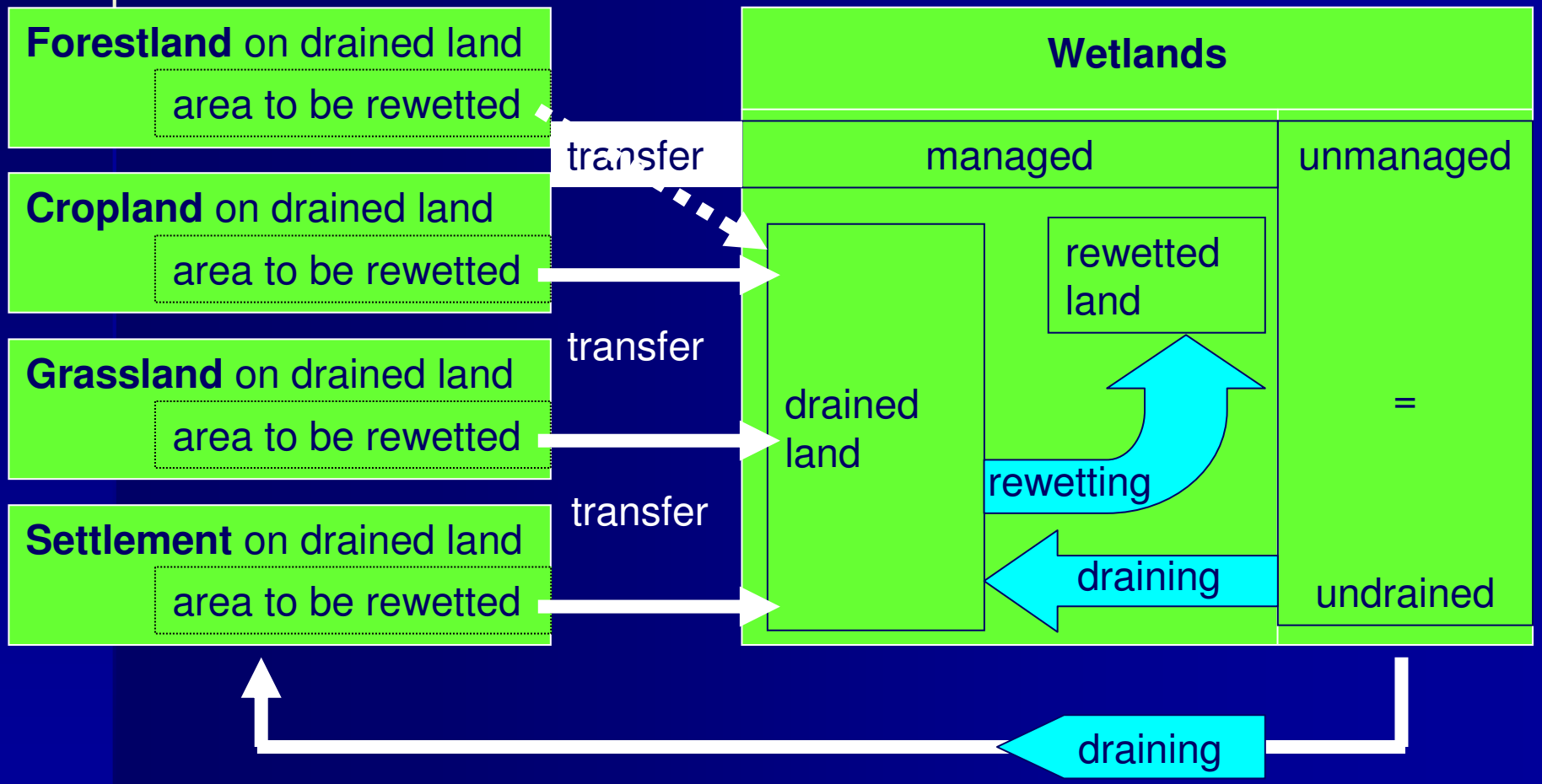






Science feeding politics

Peatland under Kyoto



More rapid is voluntary market
Voluntary Carbon Standard for peat today in public

For peat's sake:

INTERNATIONAL MIRE
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www.imcg.net

Peatlands must be wet!