

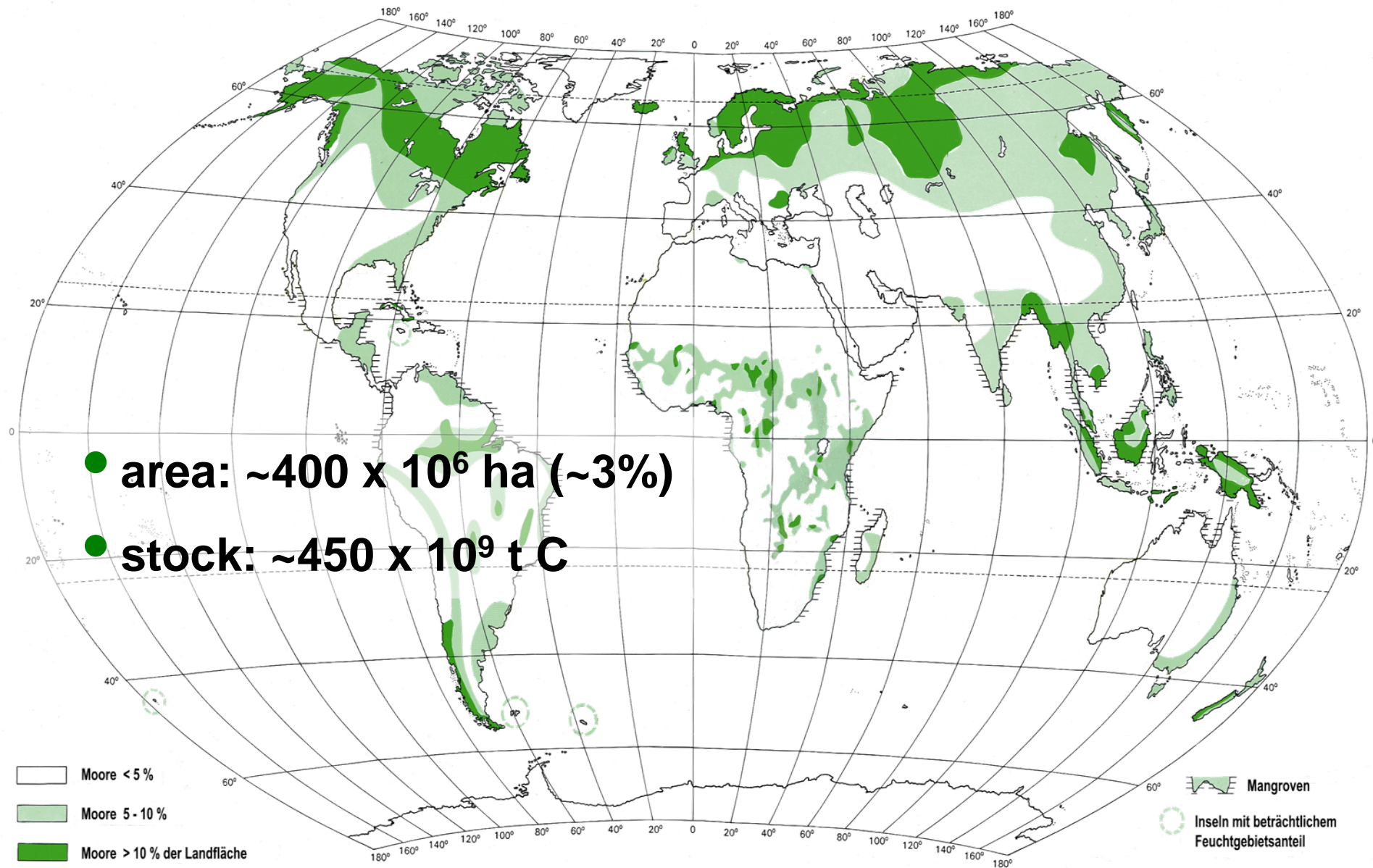
Emissions from peat soils (organic soils, histosols)

John Couwenberg

ERNST MORITZ ARNDT
UNIVERSITÄT GREIFSWALD



Wissen
lockt.
Seit 1456

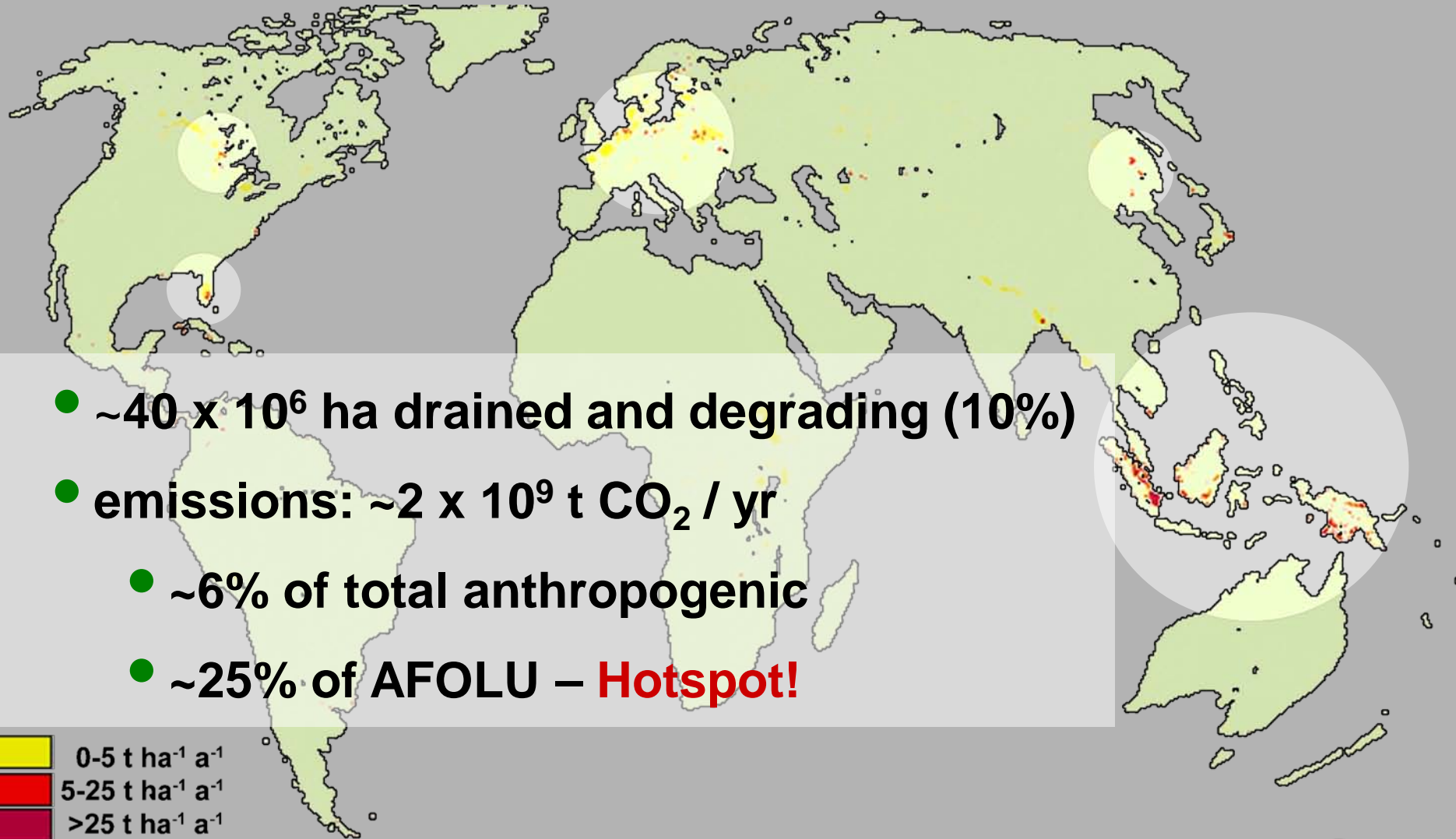


**conventional use = drainage
(forest land, cropland, grazing land,
peat extraction)
stored C \rightarrow CO₂**

NE Germany (1978)



CO₂ emission hotspots



Wide variety of site parameters influence emissions

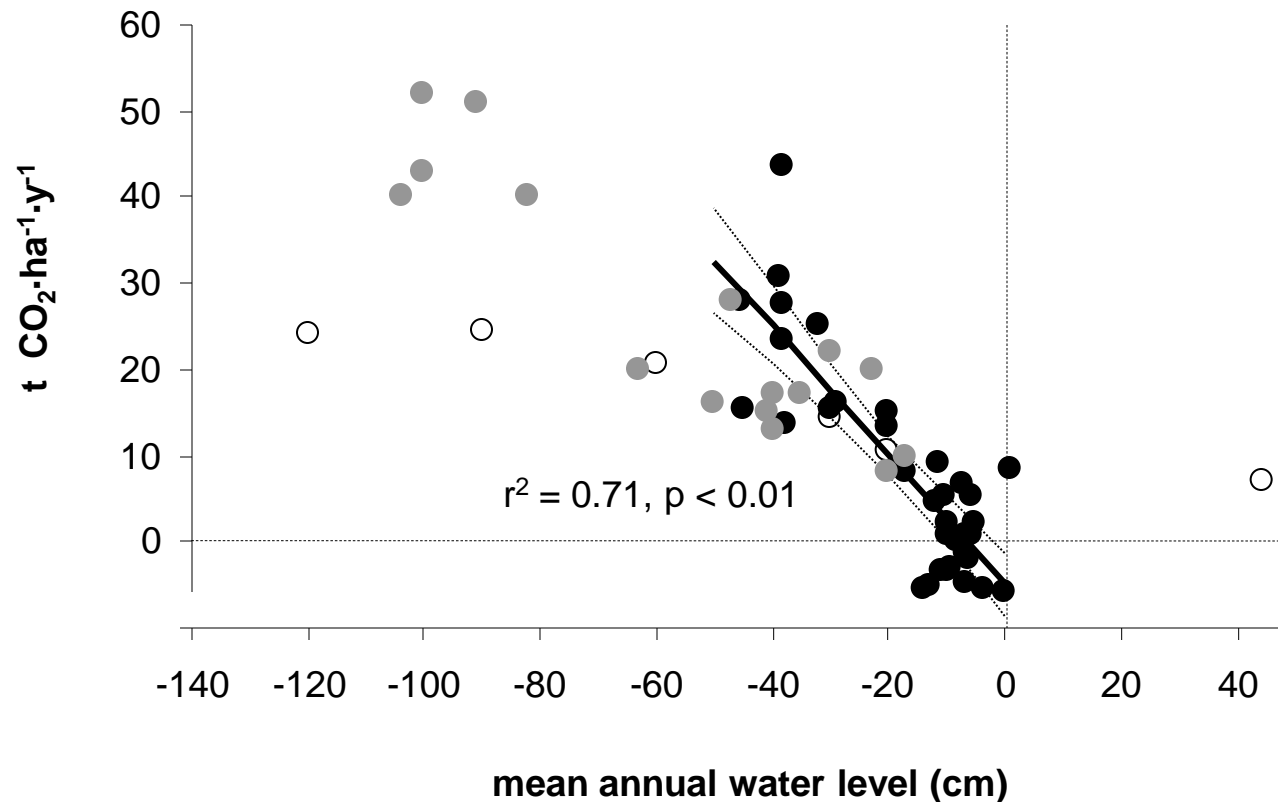
**... peatland type, peat type, peat thickness,
spatial heterogeneity, land use, former land use,
vegetation, abiotic conditions (temperature, water level,
water level fluctuations, nutrient status, pH...), ...**

Meta-analysis showed:

annual GHG emissions mainly depend on water level

CO₂ emissions from temperate European peatlands

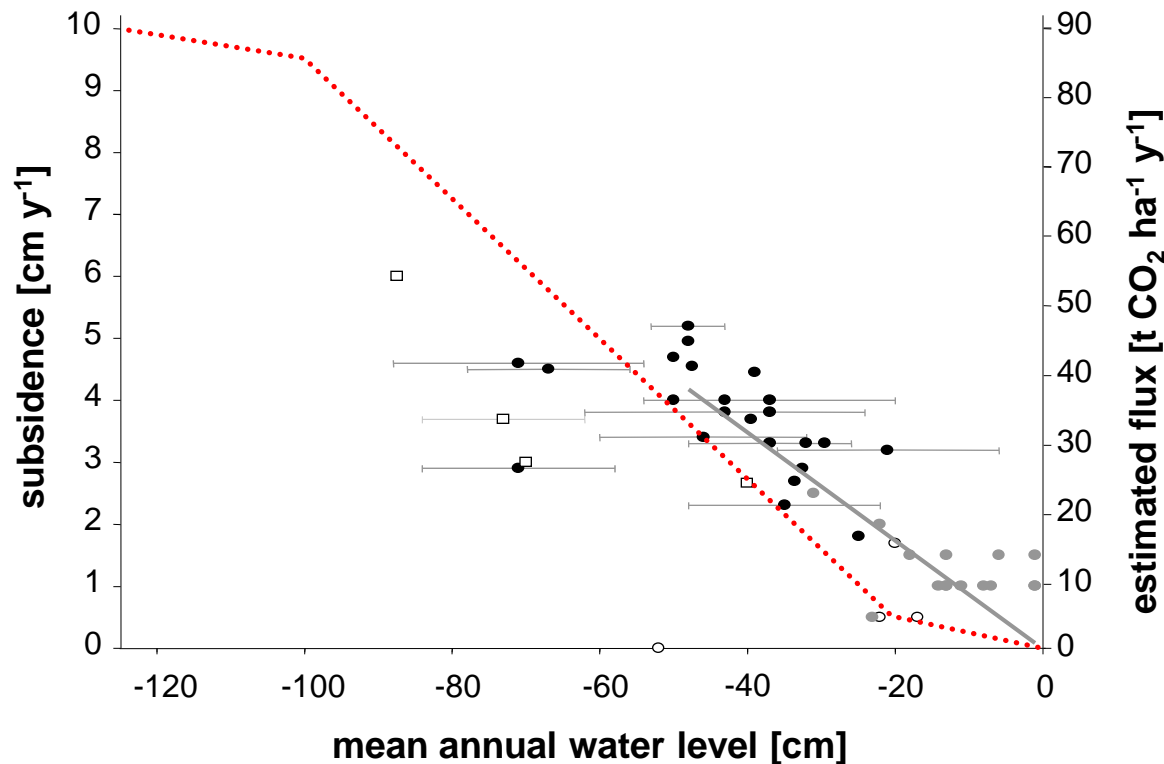
Direct flux measurements, site specific subsidence



Couwenberg et al. (in rev.), ● field flux, ● site specific subsidence, ○ laboratory; data collated from Augustin (unpubl.), Bortoluzzi et al. (2006), Drösler (2005), Flessa et al. (1997), Jacobs et al. (2003), Meyer (1999), Müller et al. (1997), Mundel (1976), Nieveen et al. (1998), Veenendaal et al. (2007), van den Akker et al., 2008; Verhagen et al., 2009.

CO₂ emissions from tropical SE Asian peatlands

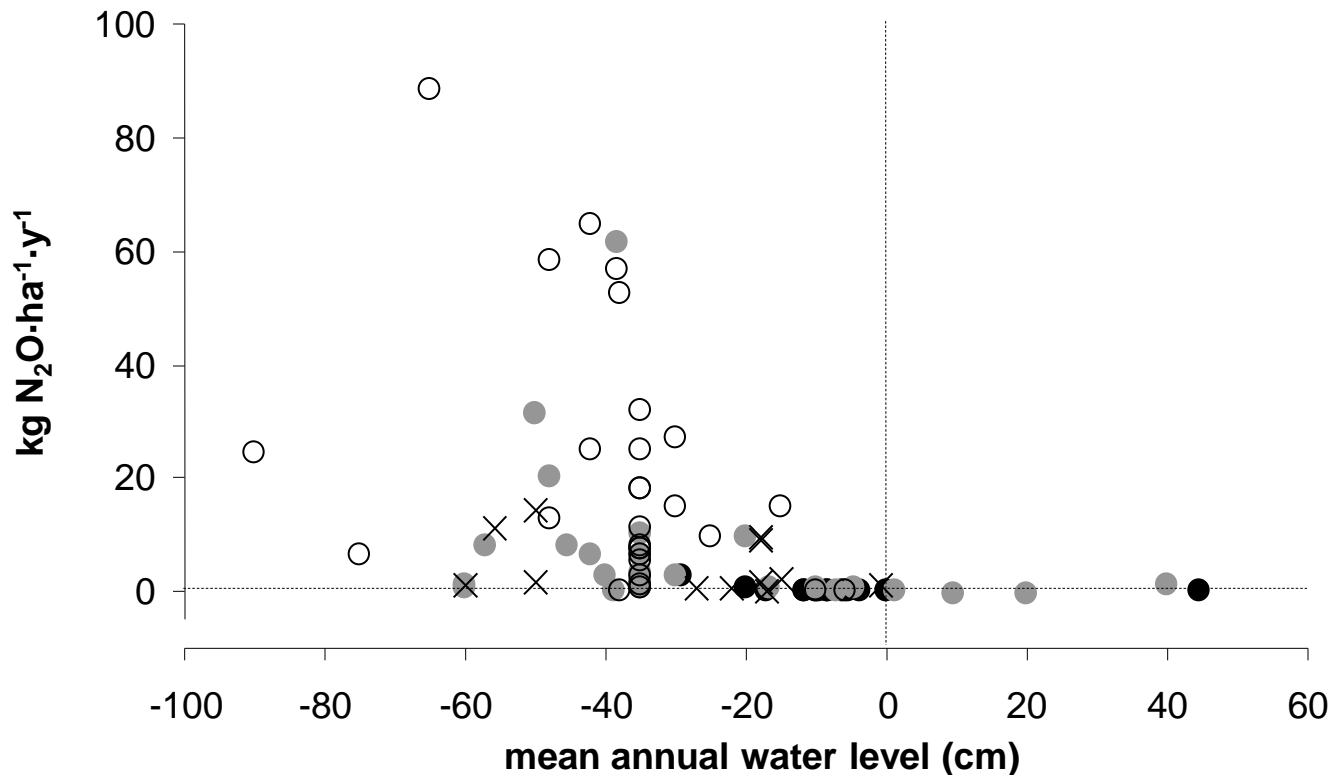
Subsidence as a proxy (cf. Armentano & Menges 1986, IPCC 2006)



Couwenberg et al. (2010), red line: Hooijer (2008, unpubl.)

N₂O emissions from temperate European peatlands

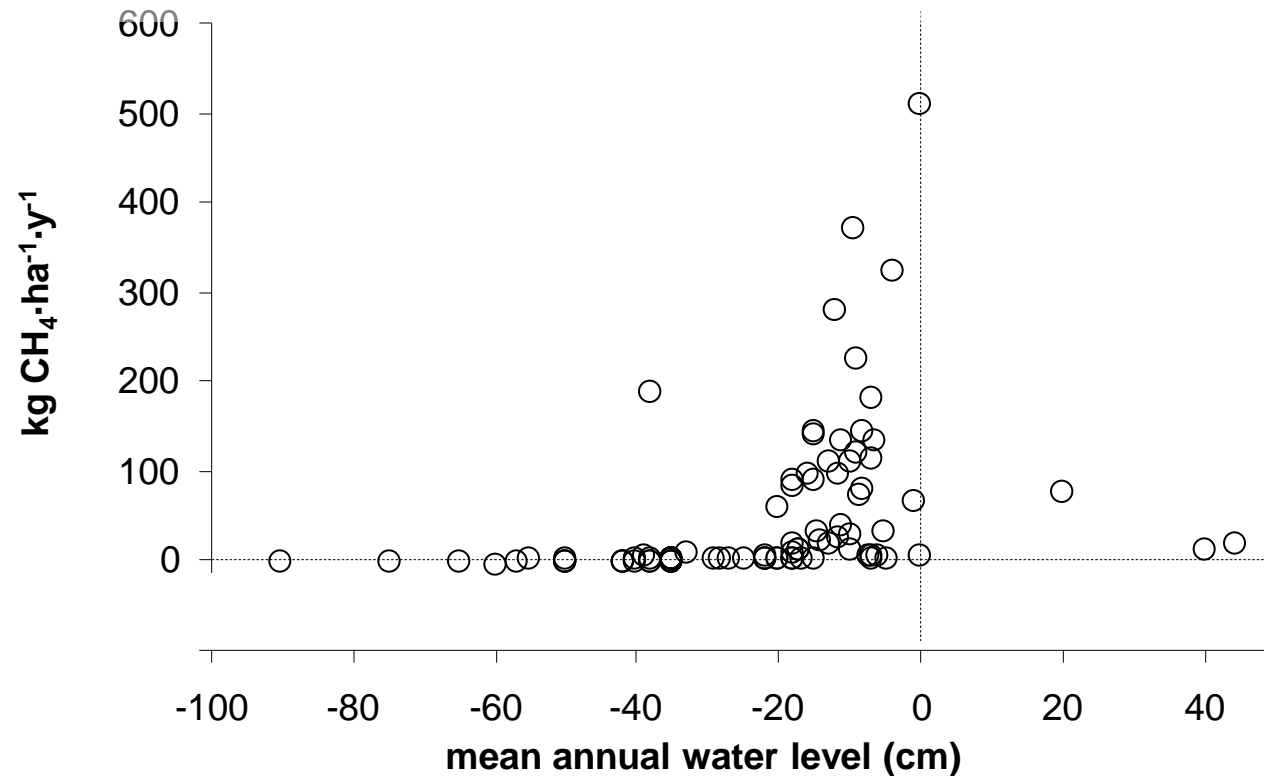
Direct flux measurements



Couwenberg et al. (in rev.), ● bog sites, ● fen sites without fertilizer application, ○ fen sites with fertilizer application; x treed sites. Data collated from Augustin (unpubl), Augustin & Merbach (1998), Augustin et al. (1998), Brummer et al. (1999), Drösler (2005), Flessa et al. (1998), Hendriks et al. (2007), Jacobs et al. (2003), Meyer (1999), Müller (1999), Tauchnitz et al. (2008), Velthof et al. (1996), Von Arnold (2004), Wild et al. (2001).

CH₄ emissions from temperate European peatlands

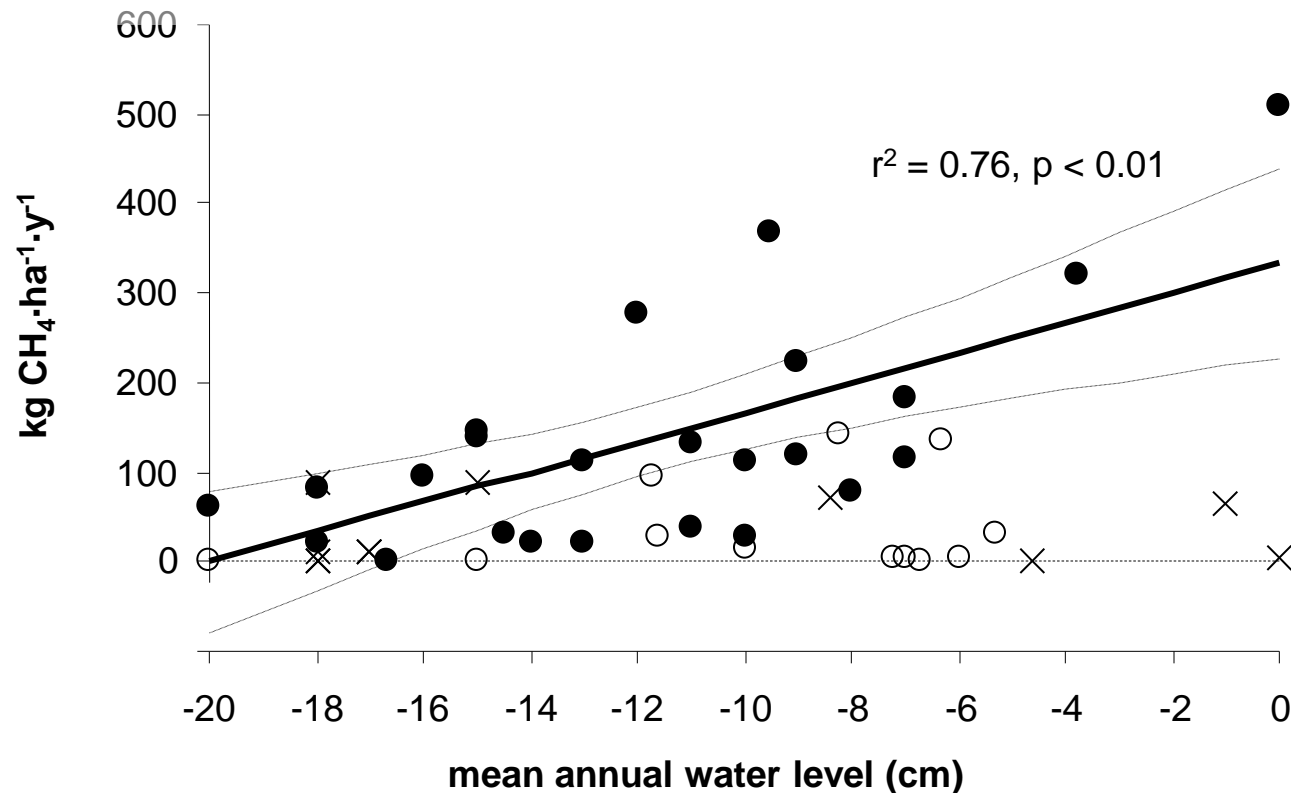
Direct flux measurements (annual flux)



Couwenberg et al. (in rev.), Data collated from Augustin (2003, unpubl.), Augustin & Merbach (1998), Augustin et al. (1996), Bortoluzzi et al. (2006), Drösler (2005), Hendriks et al. (2007), Jacobs et al. (2003), Meyer (1999), Müller (1999), Sommer et al. (2003), Tauchnitz et al. (2008), Van den Bos (2003), Van den Pol-Van Dasselaar et al. (1999), Van Huissteden et al. (2006), Von Arnold (2004), Wild et al. (2001). Data from ditches and flooded harvests are not included.

CH₄ emissions from temperate European peatlands

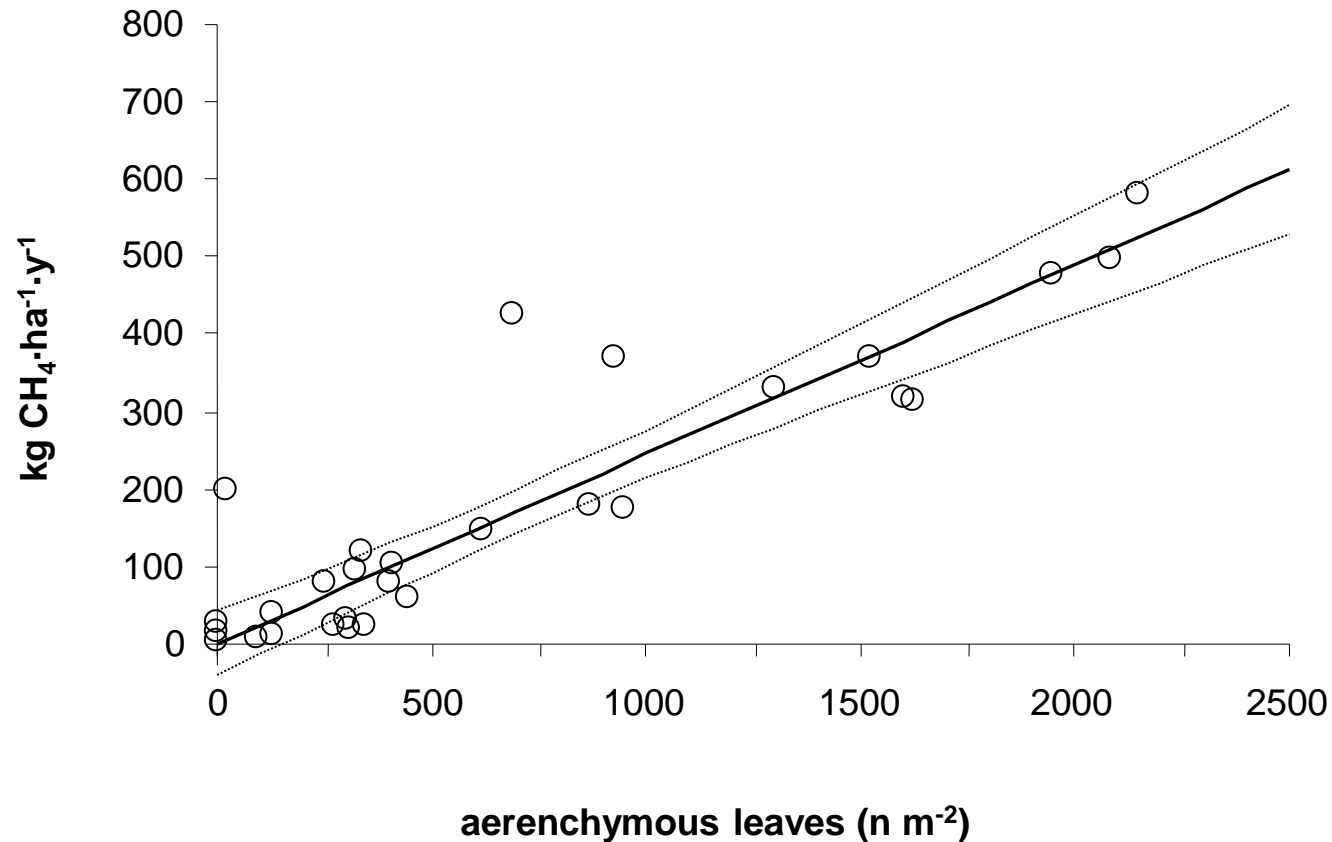
Direct flux measurements (annual flux)



Couwenberg et al. (in rev.), ● sites with aerenchymous shunt species; ○ sites with open vegetation without shunt species; x treed sites.

CH₄ emissions from temperate European peatlands

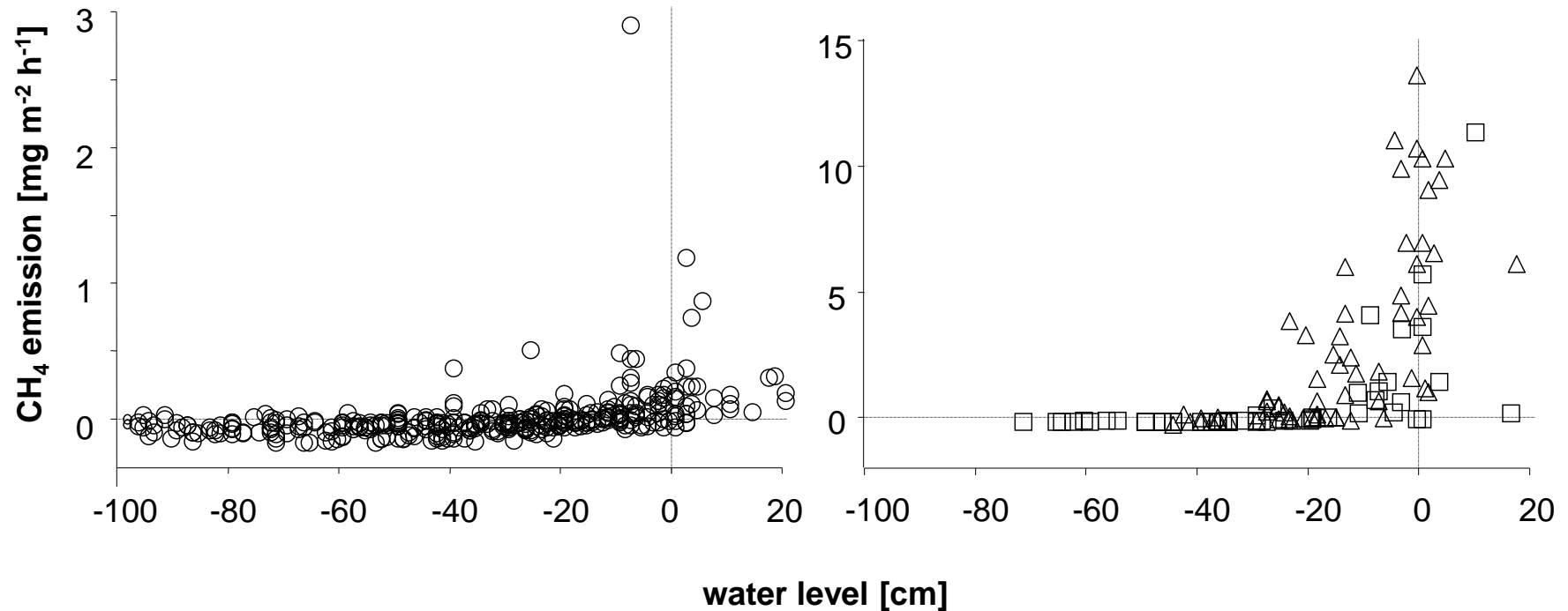
Direct flux measurements (annual flux)



After Drösler (2005)

CH₄ emissions from tropical and boreal peatlands

Direct flux measurements (hourly flux)



Couwenberg et al. (2010) - ○ Tropical; □ Temperate; △ Boreal

For all gases:

Distinction between drained and non-drained

	Drained	Not drained
CO ₂	++	-
N ₂ O	±0 to ++	~0
CH ₄	~0	+

Wetland Management

- **System of practices: drainage + rewetting**
- **Already applicable under existing activities**
- **Addresses organic soils as emission **hotspot****

Drained peatlands used for forestry (soil only)

Climate zone	EF (t CO ₂ -C ha ⁻¹ yr ⁻¹) (range)	
	IPCC (2006)	Best estimate
Tropical	1.36 (0.82-3.82)	11 (8-13.5)*
Temperate	0.68 (0.41-1.91)	
Boreal	0.16 (0.08-1.09)	4.8 (0.5-10)**

* review Couwenberg et al. (2010)

**review Maljanen et al. (2010)

Drained peatlands used for agriculture (corr. for harvest)

Climate zone	EF (t CO ₂ -C ha ⁻¹ yr ⁻¹) (range)	
	IPCC (2006)	Best estimate
(Sub-)Tropical	20 ± 90%	
Warm temperate	10 ± 90%	
Boreal/Cool temp	5 ± 90%	
Tropical cropland		11 (8-13.5)*
Temp. grassland		6.5 (2.2-14.2)**
Boreal grassland		4.9 (0.8-7.5)***
Boreal cropland		4.8 (0.8-9.1)***

*review Couwenberg et al. (2010)

**review Couwenberg et al. (in rev.)

***review Maljanen et al. (2010)

Drained peatlands under peat extraction

Climate zone	EF (t CO ₂ -C ha ⁻¹ yr ⁻¹) (range)	
	IPCC (2006)	Best estimate
Tropical	2.0 (0.06-7.0)	8*
Boreal & temperate nutrient rich	1.1 (0.03-2.9)	
Boreal & temperate nutrient poor	0.2 (0-0.6)	
Boreal, active		2 (0.8-3)**
Temperate, aband.		1.9 (0.1-4.4)***

*Couwenberg et al. (2010), shallow drained bare peat

**review Maljanen et al. (2010), excl. stockpiles

***Flessa et al. (1997), Bortoluzzi et al. (2006), Müller et al. (1997), Drösler (2005)

Methane emissions from peat soils

Climate zone	EF (kg CH ₄ ha ⁻¹ yr ⁻¹) (range) EF (t CO ₂ -C _{eq} ha ⁻¹ yr ⁻¹) (range) *	
	Drained	Wet
Boreal	8.6 (-1.1-51) 0.06 (-0.01-0.35)	56 (-1.7-525) 0.4 (-0.01-3.6)
Temperate	0.2 (-4.0-9.0) 0.001 (-0.03-0.06)	122 (-0.2-763) 0.8 (-0.001-5.2)

review Couwenberg (2009)

*GWP CH₄ = 25x GWP CO₂ (AR4)

Methane emissions from peat soils

EF (kg CH₄ ha⁻¹ yr⁻¹) (range)
 EF (t CO₂-C_{eq} ha⁻¹ yr⁻¹) (range) *

		Drained	Wet	
			Without shunts	With shunts
Boreal	Bogs	8.6 (-1.1-51) 0.06 (-0.01-0.35)	24 (-1.7-164) 0.16 (-0.01-1.1)	12 (3.1-59) 0.08 (0.02-0.4)
	Fens			123 (6.6-525) 0.8 (0.05-3.6)
Temperate		0.2 (-4.0-9.0) 0.001 (-0.03-0.06)	50 (-0.2-250) 0.34 (-0.001-1.7)	170 (0-763) 1.2 (0-5.2)

review Couwenberg (2009)

*GWP CH₄ = 25x GWP CO₂ (AR4)

Are emission reductions from peatlands MRV-able?

Emission factors for managed peat soils

An analysis of IPCC default values

Methane emissions from peat soils

(organic soils, histosols)

Facts, MRV-ability, emission factors

Peatlands in National Inventory Submissions 2009

An analysis of 10 European countries

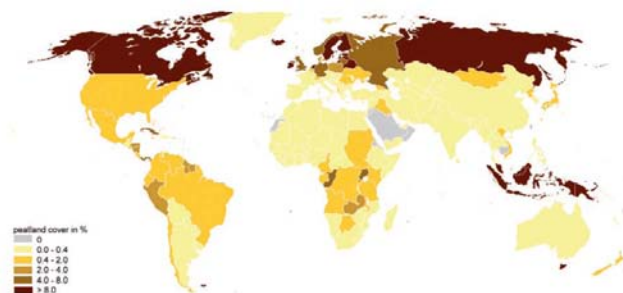
On AFOLU, 'wetland management' and the road to land-based accounting

Q&A

Questions and answers

The Global Peatland CO₂ Picture

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



WETLANDS
INTERNATIONAL

WETLANDS
INTERNATIONAL

www.imcg.net → Publications