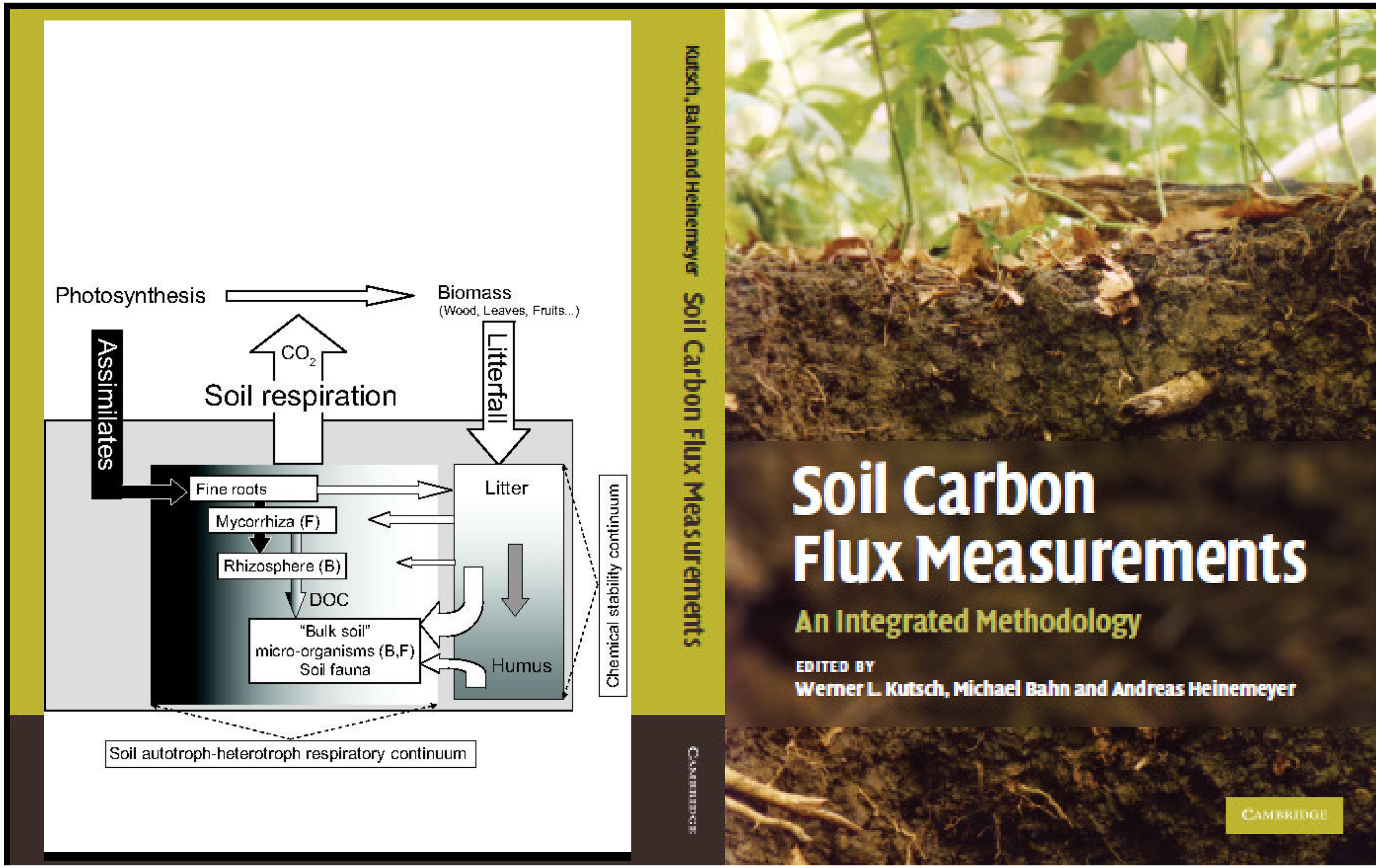
“Kutsch, Bahn, Heinemeyer, CUP 2009”



CTCD Centre *for* Terrestrial Carbon Dynamics

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

Modelling upland peat carbon:

past present and future

“Thinking big, working small and modelling in between”

Dr Andreas Heinemeyer andreas.heinemeyer@york.ac.uk
University of York, Environment Department

CTCD
Centre *for* Terrestrial Carbon Dynamics

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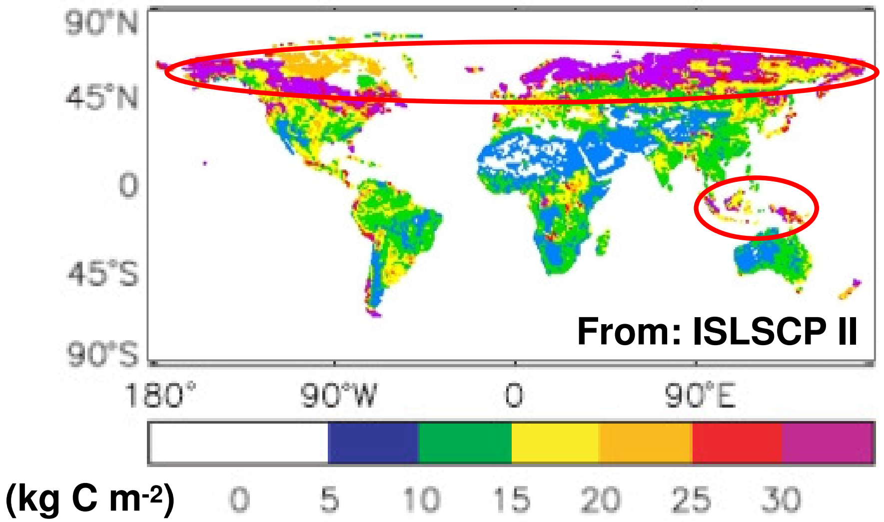
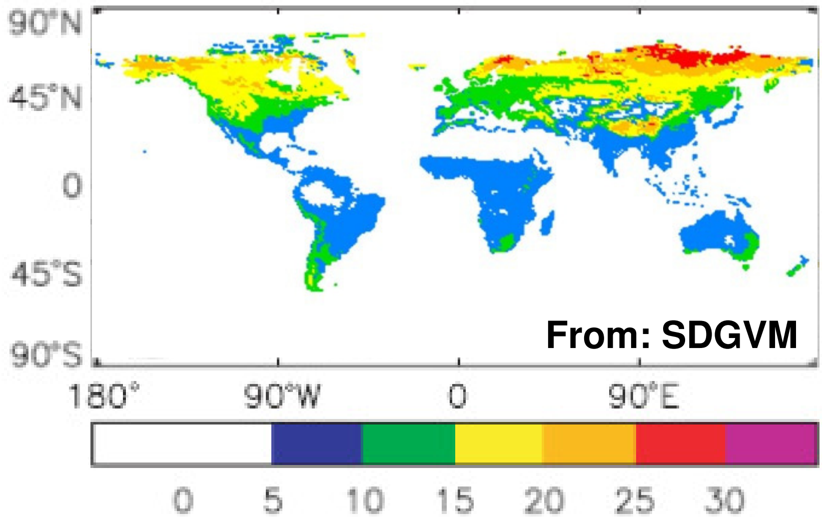
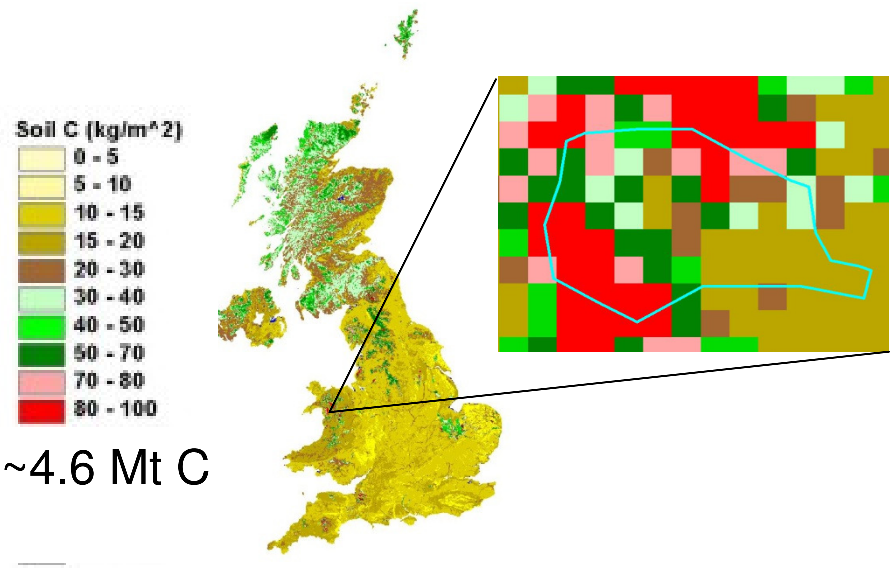
Current models & peat

Currently, we cannot adequately predict peatland soil C stocks and C dynamics







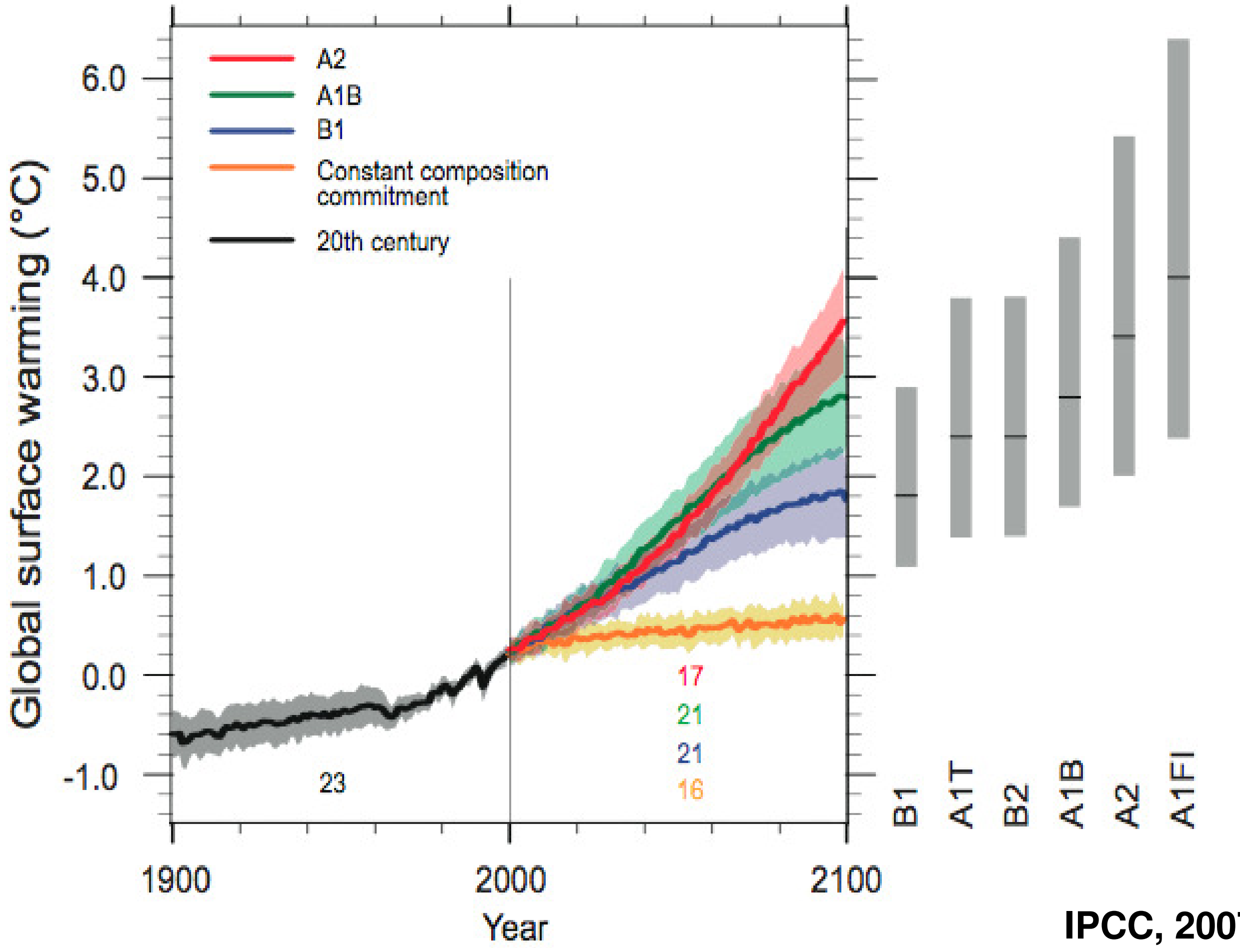
Most current models lack:

- Holocene peat accumulation
- total peat column decomposition
- peat depth dynamics
- dynamic water table
- vegetation feedbacks
- topography effects

→ lacking a pedogenesis concept

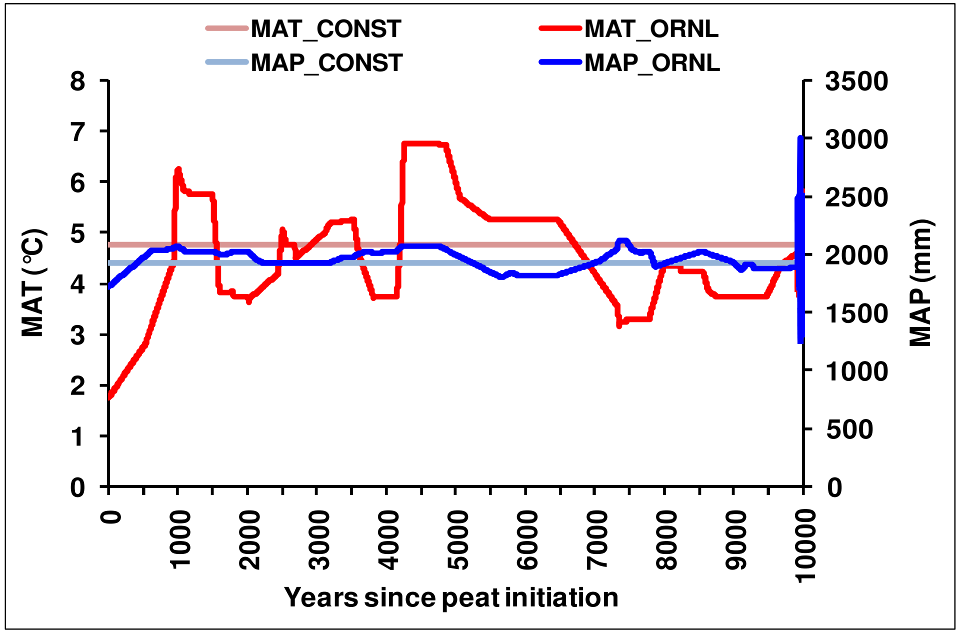
Feedback implications

So, how much can we trust current model SOC - climate feedbacks (CO_2 & CH_4)?

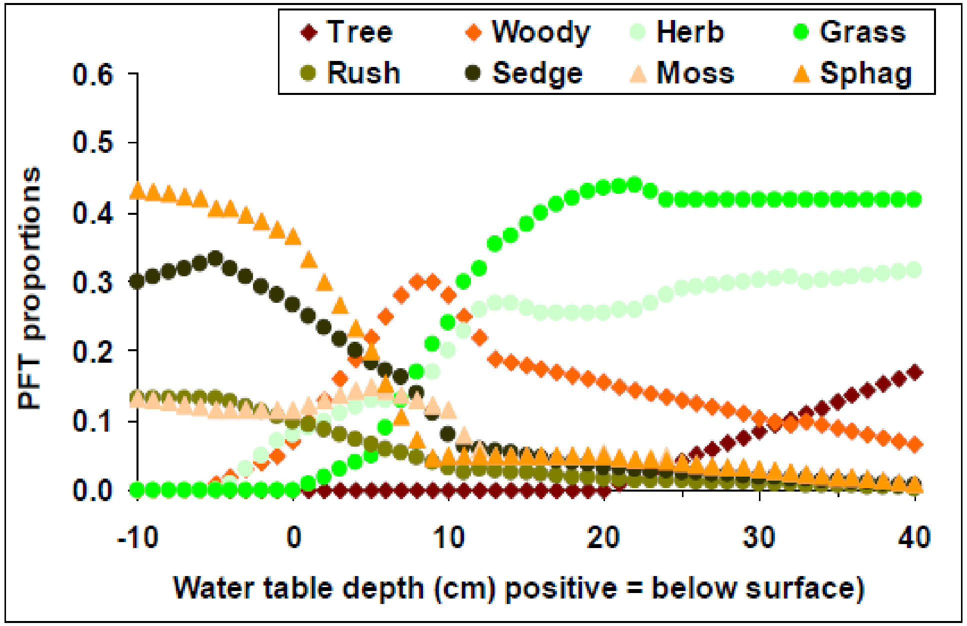


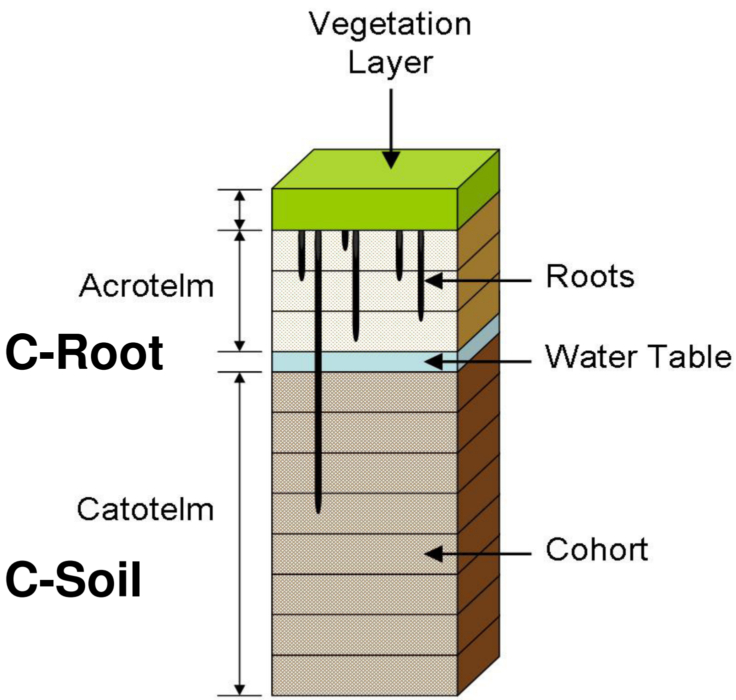
IPCC, 2007

MILLENNIA peat model

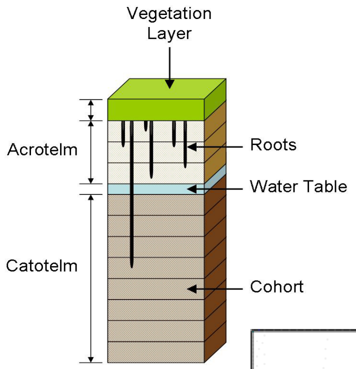


Cohort model
Basic climate
Long-term spin-up
Dynamic water table
Dynamic vegetation
Litter quality





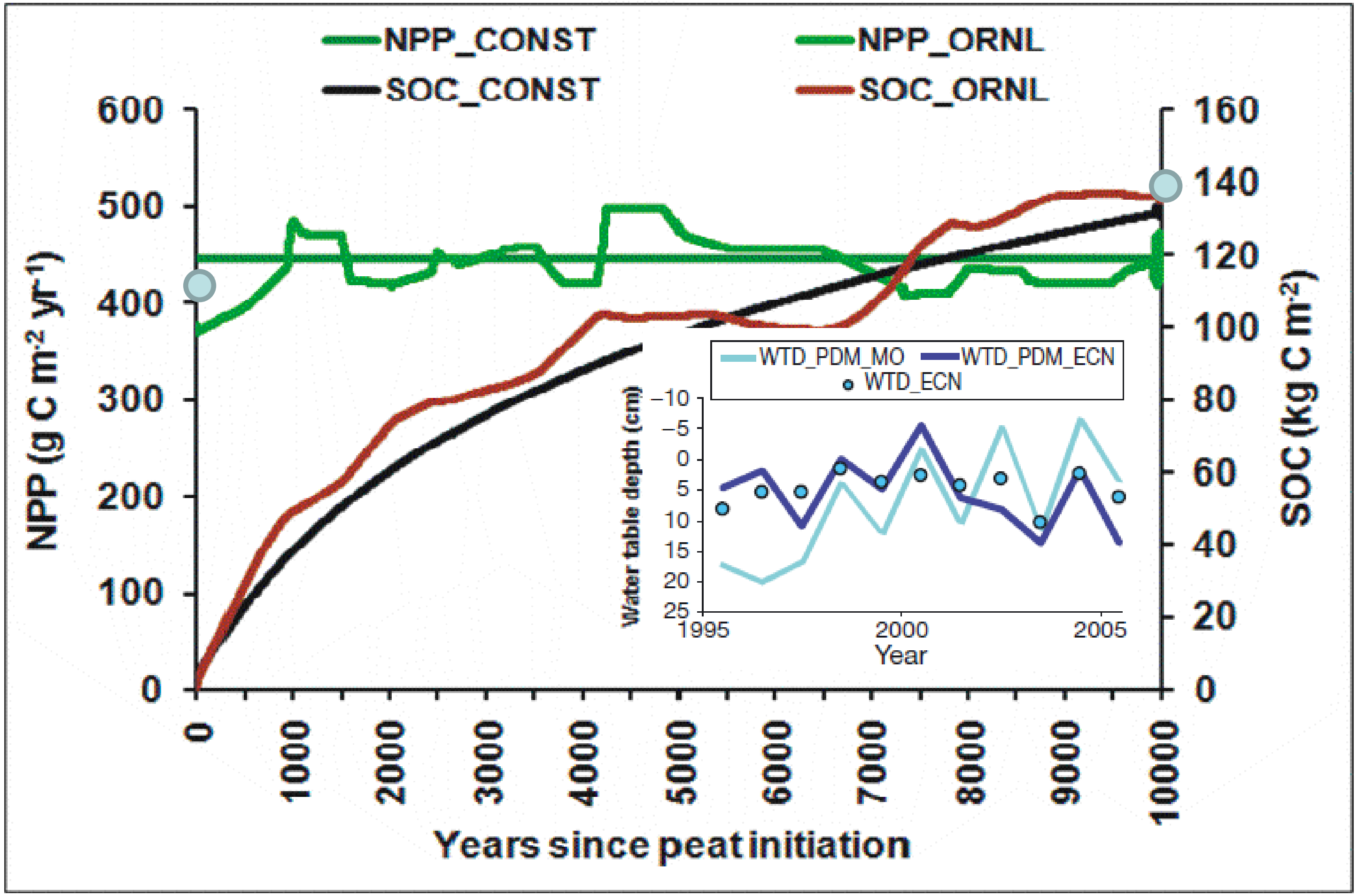
MILLENNIA: current C stocks



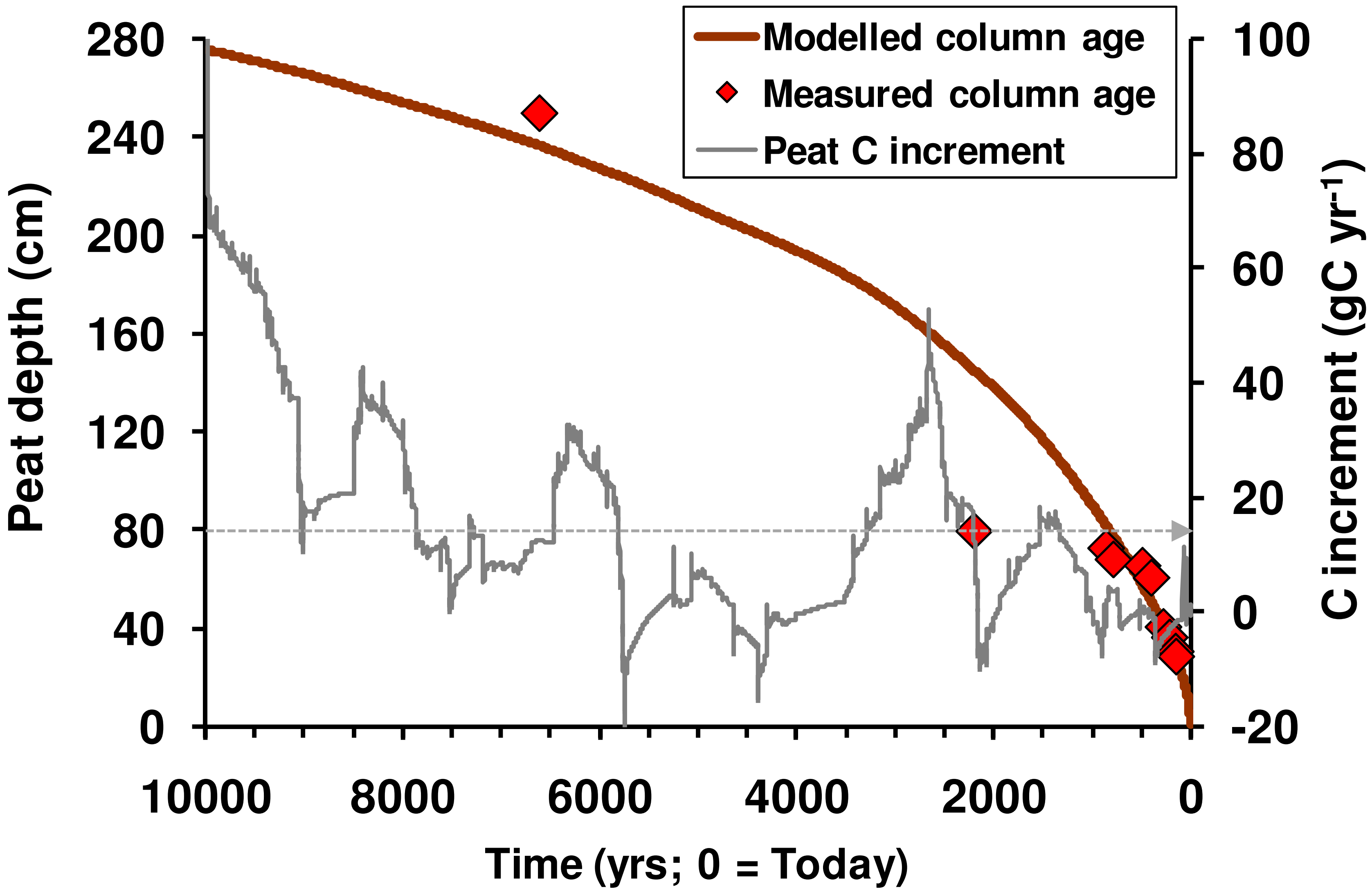
Climate Research, 2010

The MILLENNIA peat cohort model: predicting past, present and future soil carbon budgets and fluxes under changing climates in peatlands

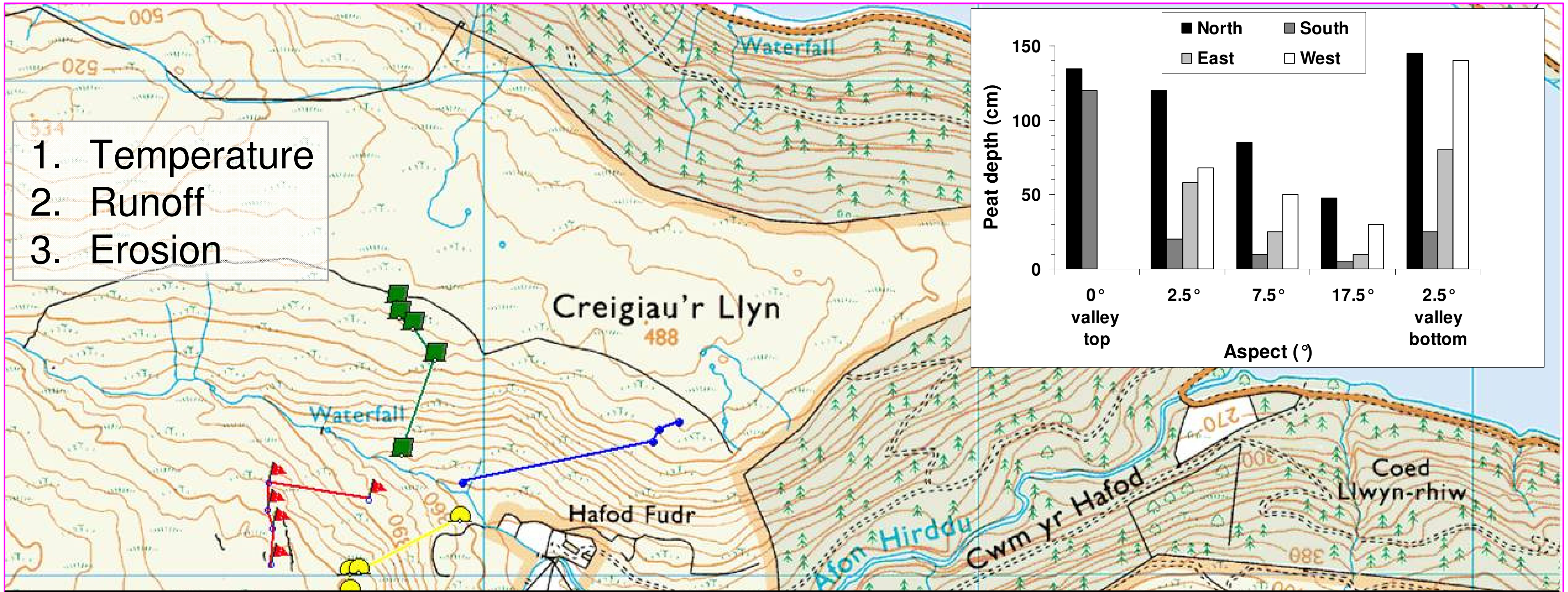
Andreas Heinemeyer[1,*], Simon Croft[2,6], Mark H. Garnett[3], Emanuel Gloor[4], Joseph Holden[4], Mark R. Lomas[5], Phil Ineson[1]



MILLENNIA: SOC age



MILLENNIA: topography

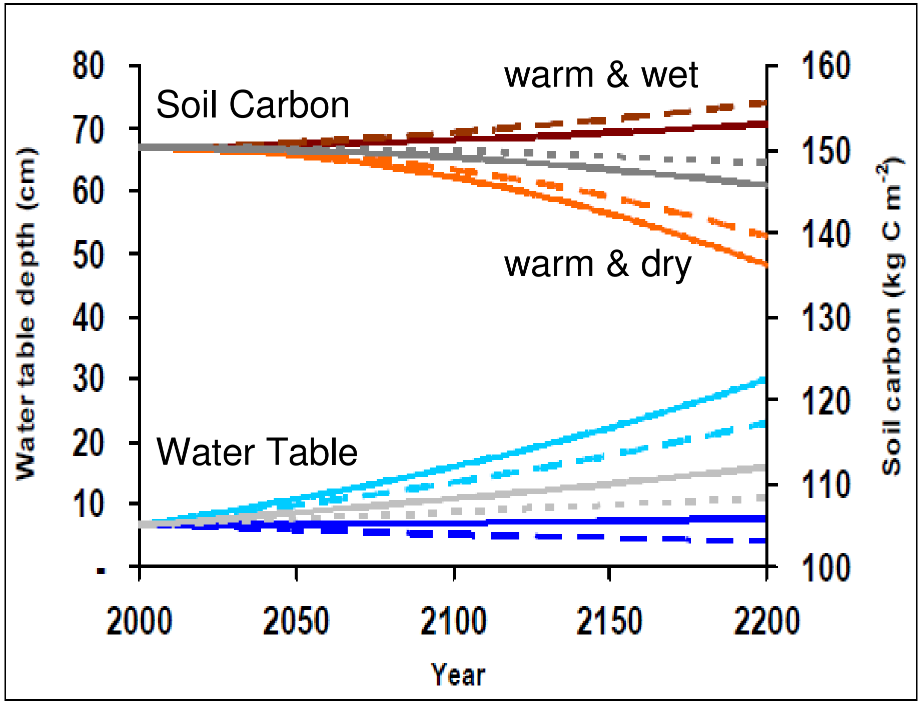


Terrain information			Model *vs*. Site data		Model *vs*. Site data	
Elevation (m)	**Slope (°)**	**Aspect (°)**	**SOC (kgC m^{-2})**	**SOC (kgC m^{-2})**	**Peat Depth (cm)**	**Peat Depth (cm)**
500-700	**0-5**	**N**	**131.86**	**121.37**	**240.02**	**233.50**
500-700	**0-5**	**S**	**124.66**	**66.77**	**227.28**	**151.00**
500-700	**5-10**	**N**	**129.18**	**76.46**	**235.34**	**145.33**
500-700	**5-10**	**S**	**103.78**	**42.43**	**190.48**	**87.00**
500-700	**10-25**	**N**	**91.21**	**51.97**	**168.54**	**105.00**
500-700	**10-25**	**S**	**22.25**	**29.40**	**37.01**	**65.50**

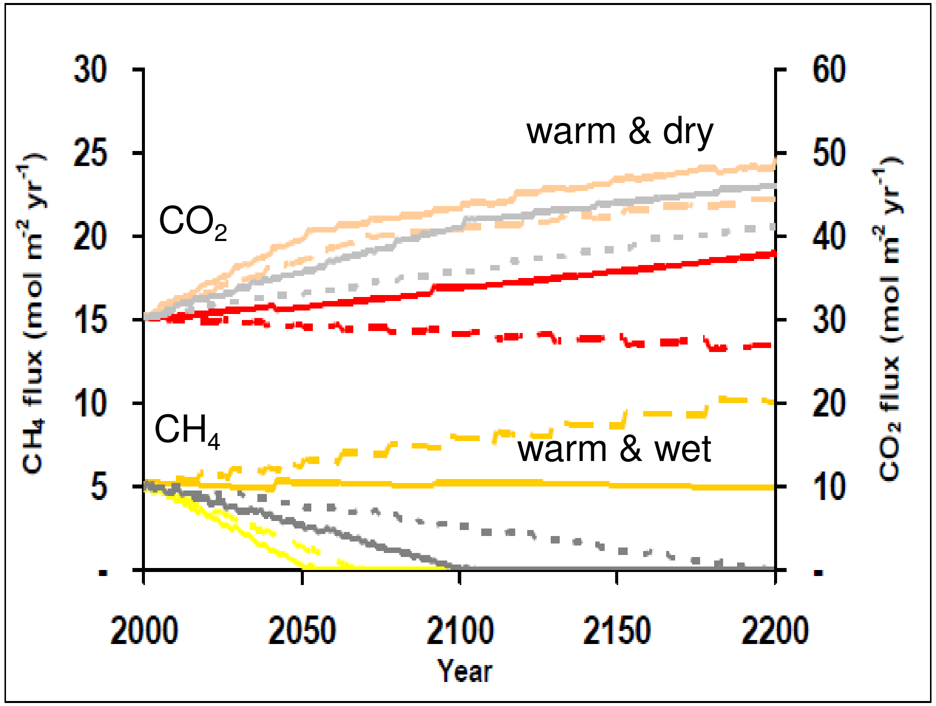
MILLENNIA: future C dynamics

Temperature rise (+2 or +4℃)
Precipitation change (±25 % mm)

C Stocks



C fluxes

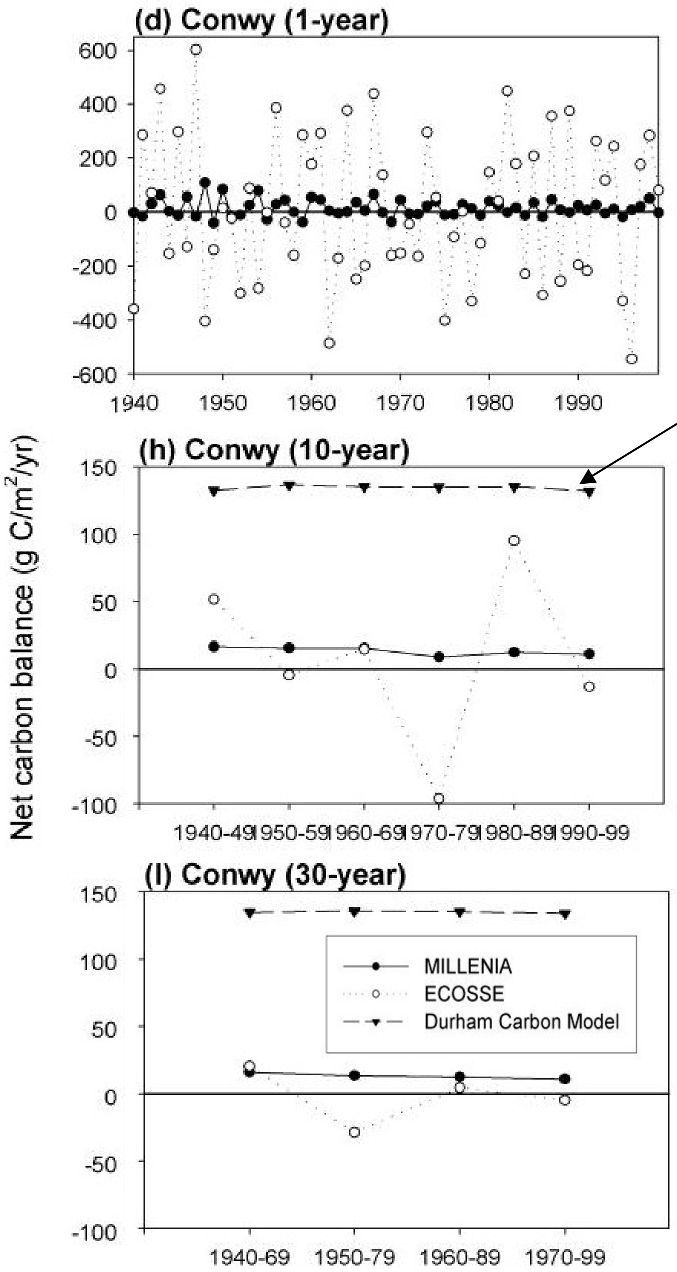


Model inter-comparison: Migneint

Climate Research, 2010

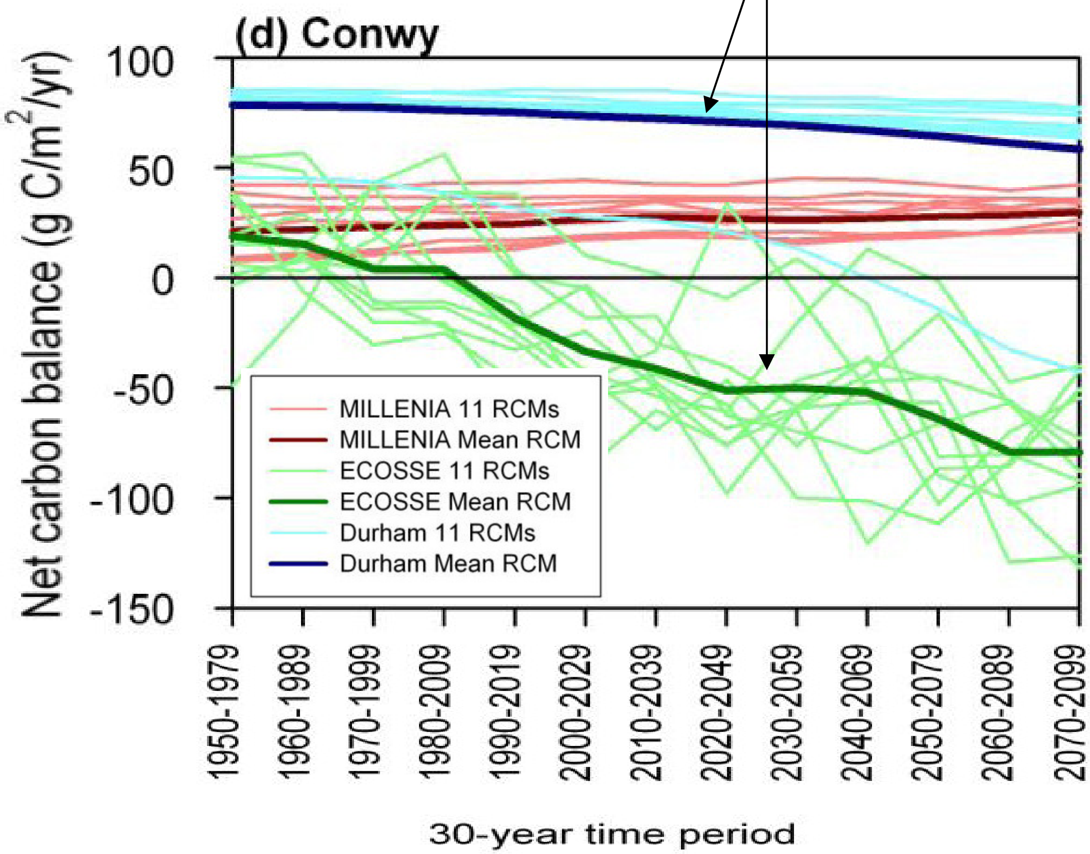
Model inter-comparison between statistical and dynamic model assessments of the long-term stability of blanket peat in Great Britain (1940–2099)

J. M. Clark[1,*], M. F. Billett, M. Coyle, S. Croft, S. Daniels, C. D. Evans, M. Evans, C. Freeman, A. V. Gallego-Sala, A. Heinemeyer, J. I. House, D. T. Monteith, D. Nayak, H. G. Orr, I. C. Prentice, R. Rose, J. Rowson, J. U. Smith, P. Smith, Y. M. Tun, E. Vanguelova, F. Wetterhall, F. Worrall



= to 20 cm peat/ year!

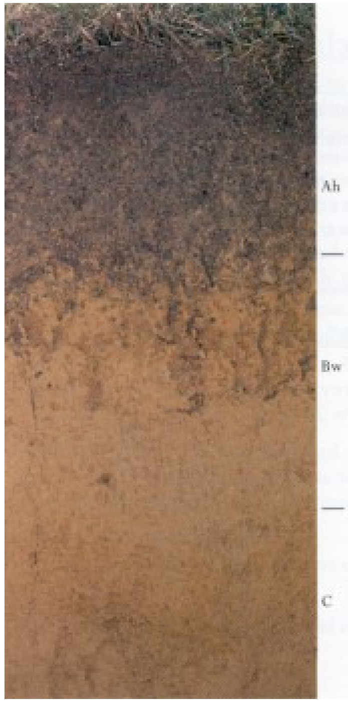
Temperature!



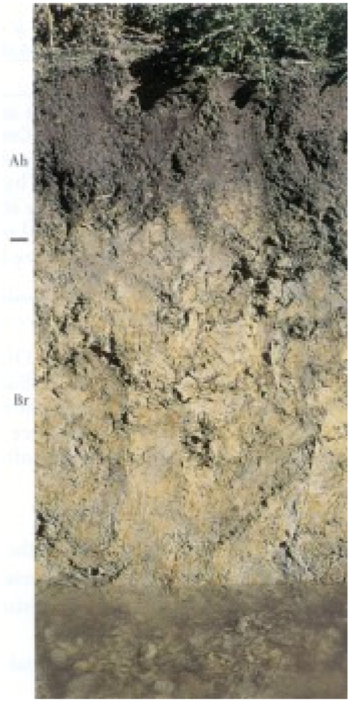
Major UK Soil Types

Rendzinas

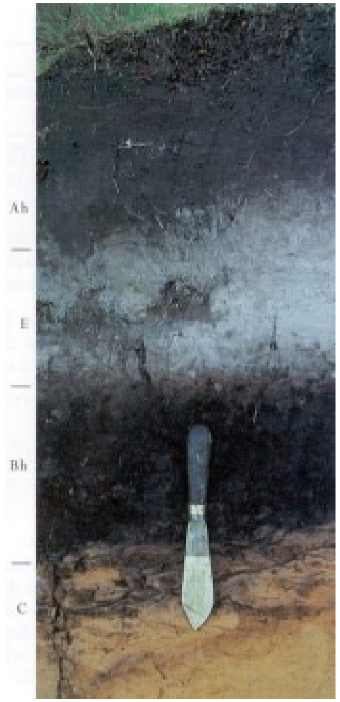
Brown Earths



Gleys



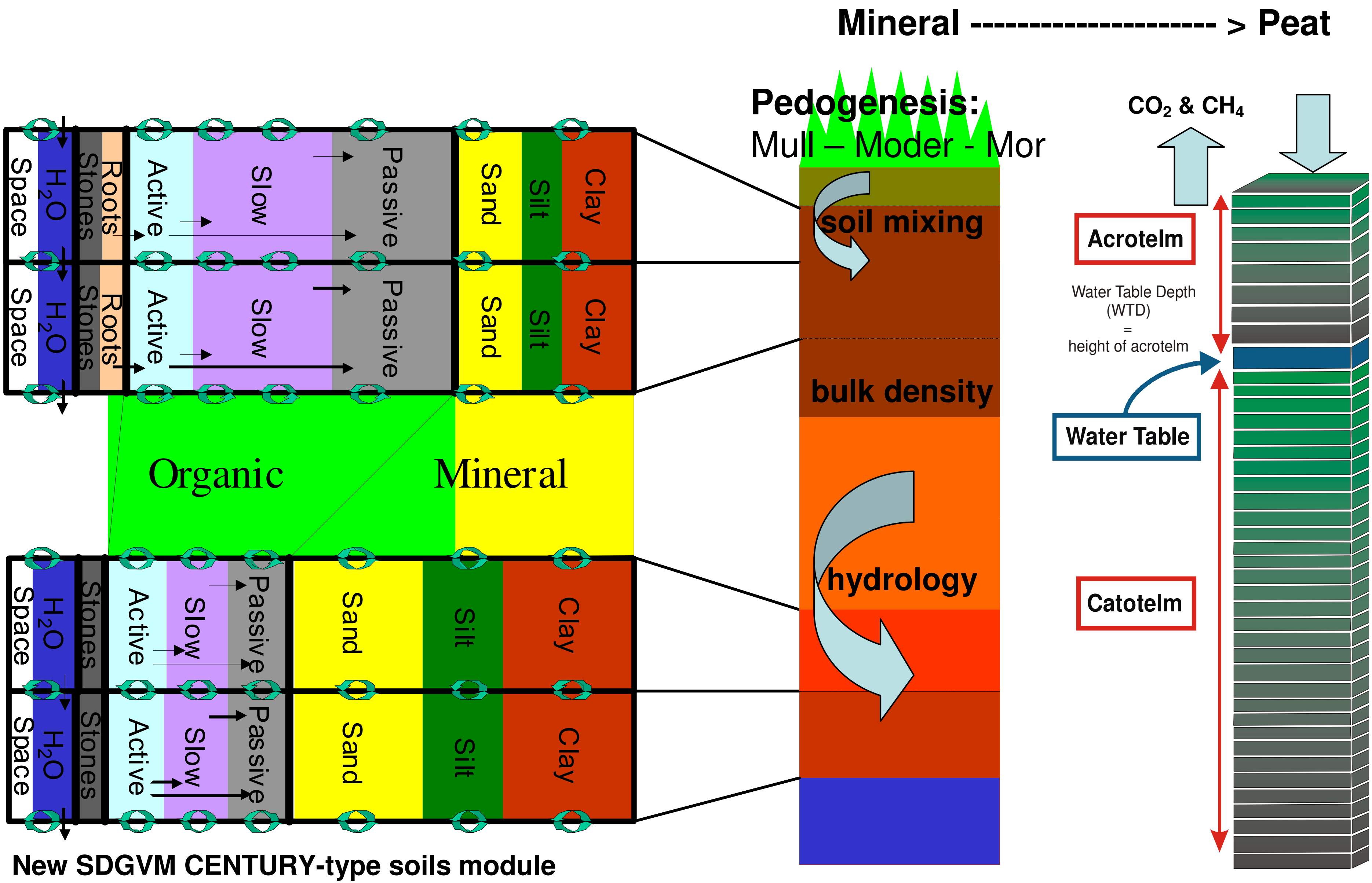
Podsols



Peats

Requires dynamic changes in both, percentage and amount of texture

Future modelling: pedogenesis



Thank you !

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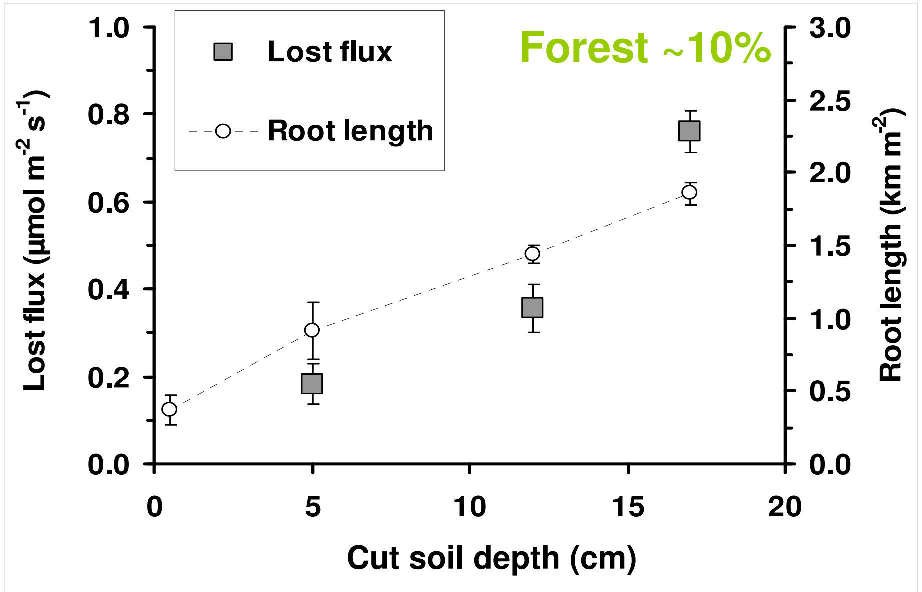
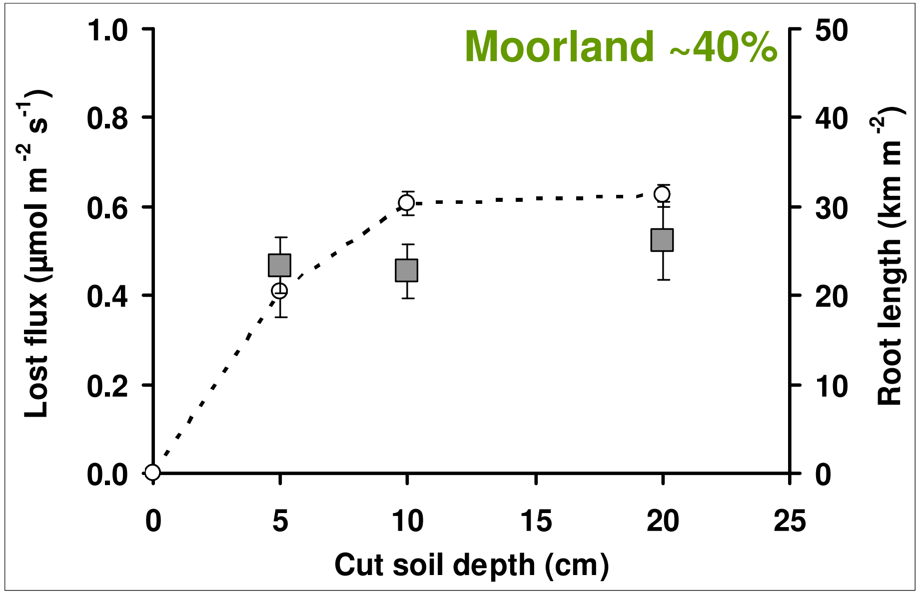
Edinburgh aircraft team,
Bob Baxter, Brian Huntley, Fred Worrall,
Mark Garnett, UKPopNet staff,
Simon Croft, Pippa Gillingham,
Project students and many others...!

Collar insertion and 'lost' root flux

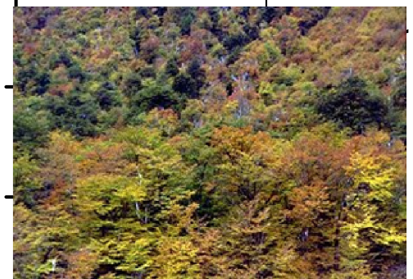




European Journal of Soil Science, 2010

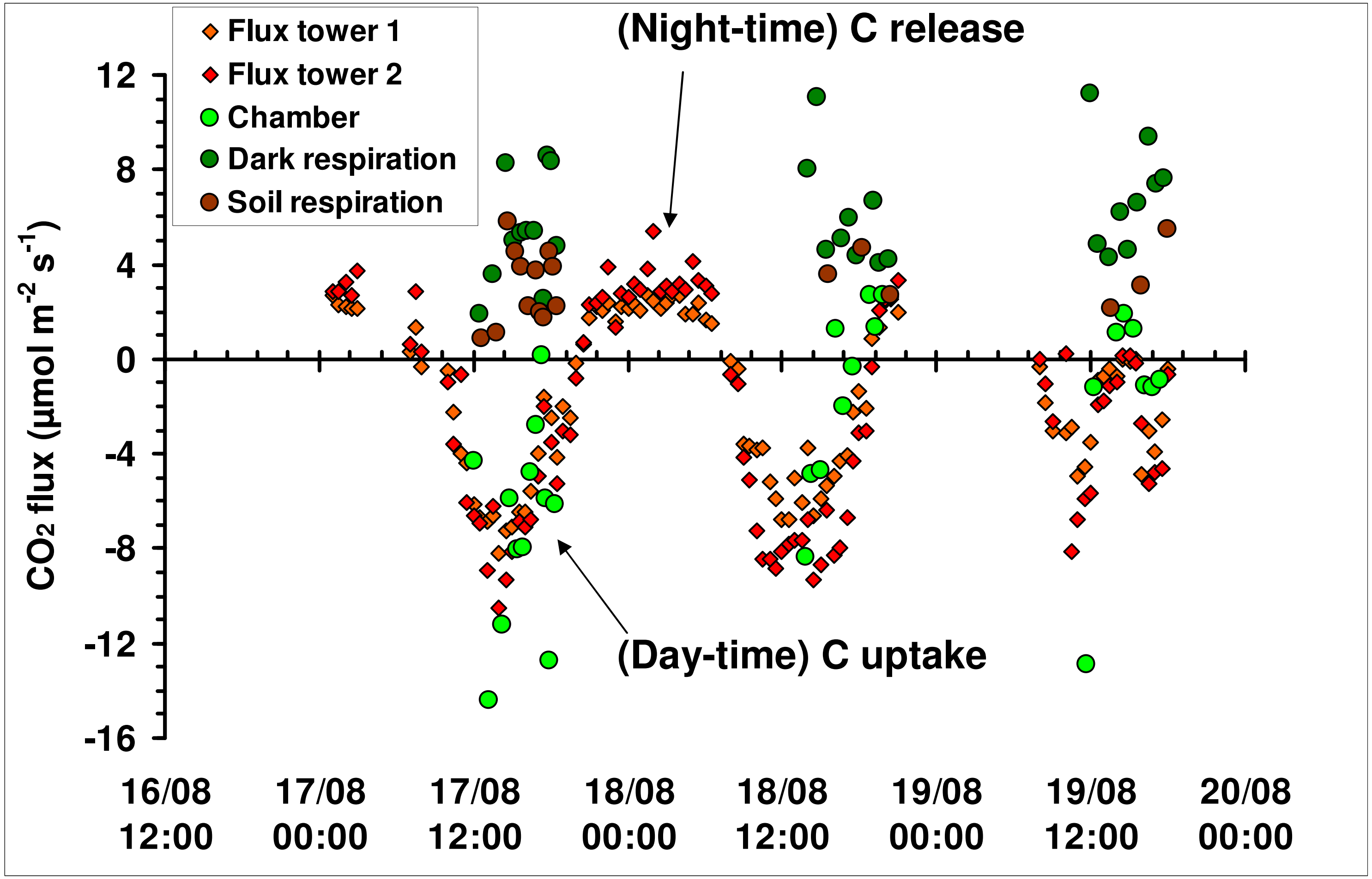
Soil respiration: implications of the plant-soil continuum and respiration chamber collar-insertion depth on measurement and modelling of soil CO_2 efflux




Tundra	trop. Forest	con. Forest	dec. Forest	Moorland
6 cm	7 cm	7 cm	4 cm	17 cm

‘Breaking down’ flux components



Scaling up from plot to landscape