IUCN UK Committee

Peatland Programme

Peatland Hydrology Review – 28 September 2010

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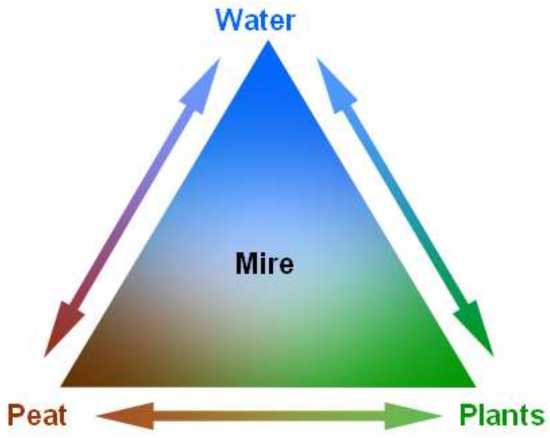
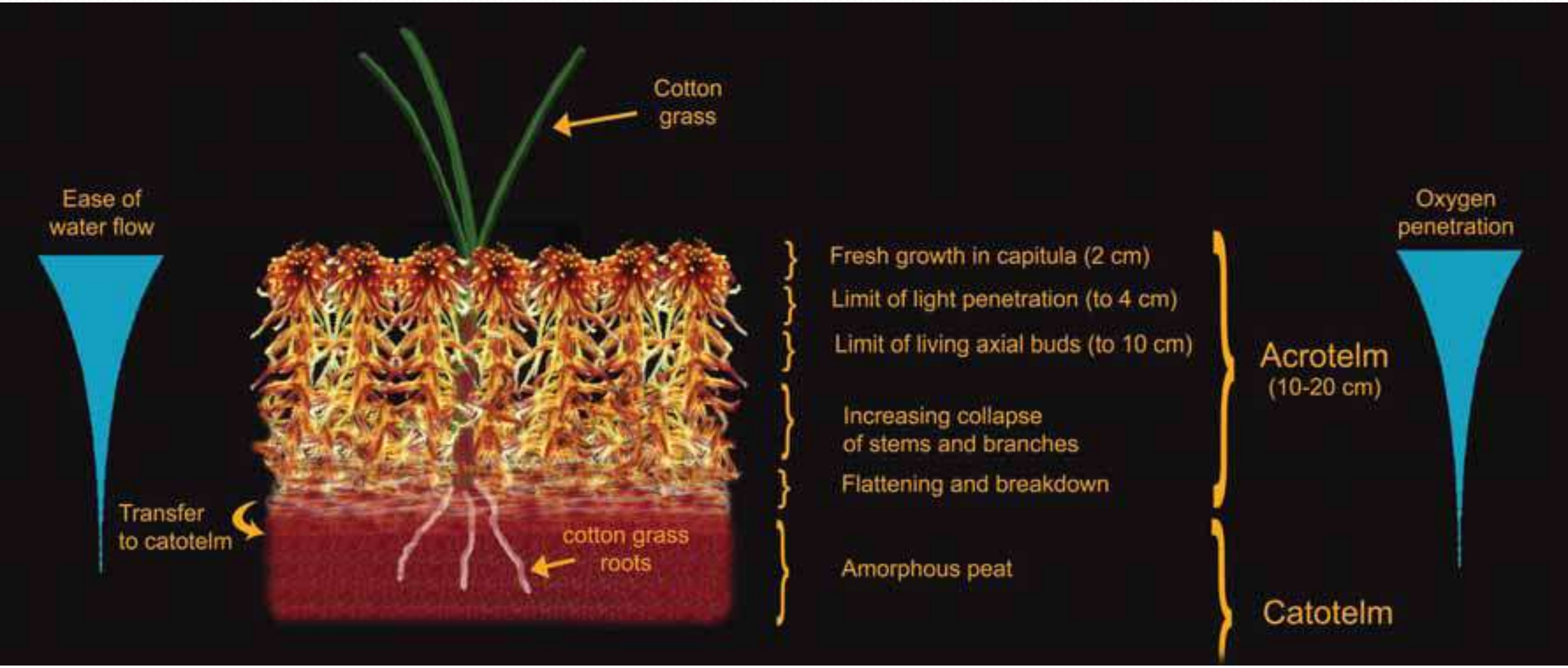
Scope of IUCN UK Peatland Hydrology review:

- Water levels and issues related to soil moisture and desiccation
- Water flows including flood risk
- Water quality including dissolved organic carbon (DOC), water colour and sediment transport

Water quantity and quality combine to affect the flora and fauna of a particular peatland
….but predicition is complex



(diagram from Schumman and Joosten, 2008)



Acrotelm structure and properties
From Lindsay (2010), based on Clymo (1983, 1992)

Water tables in “good condition” peat

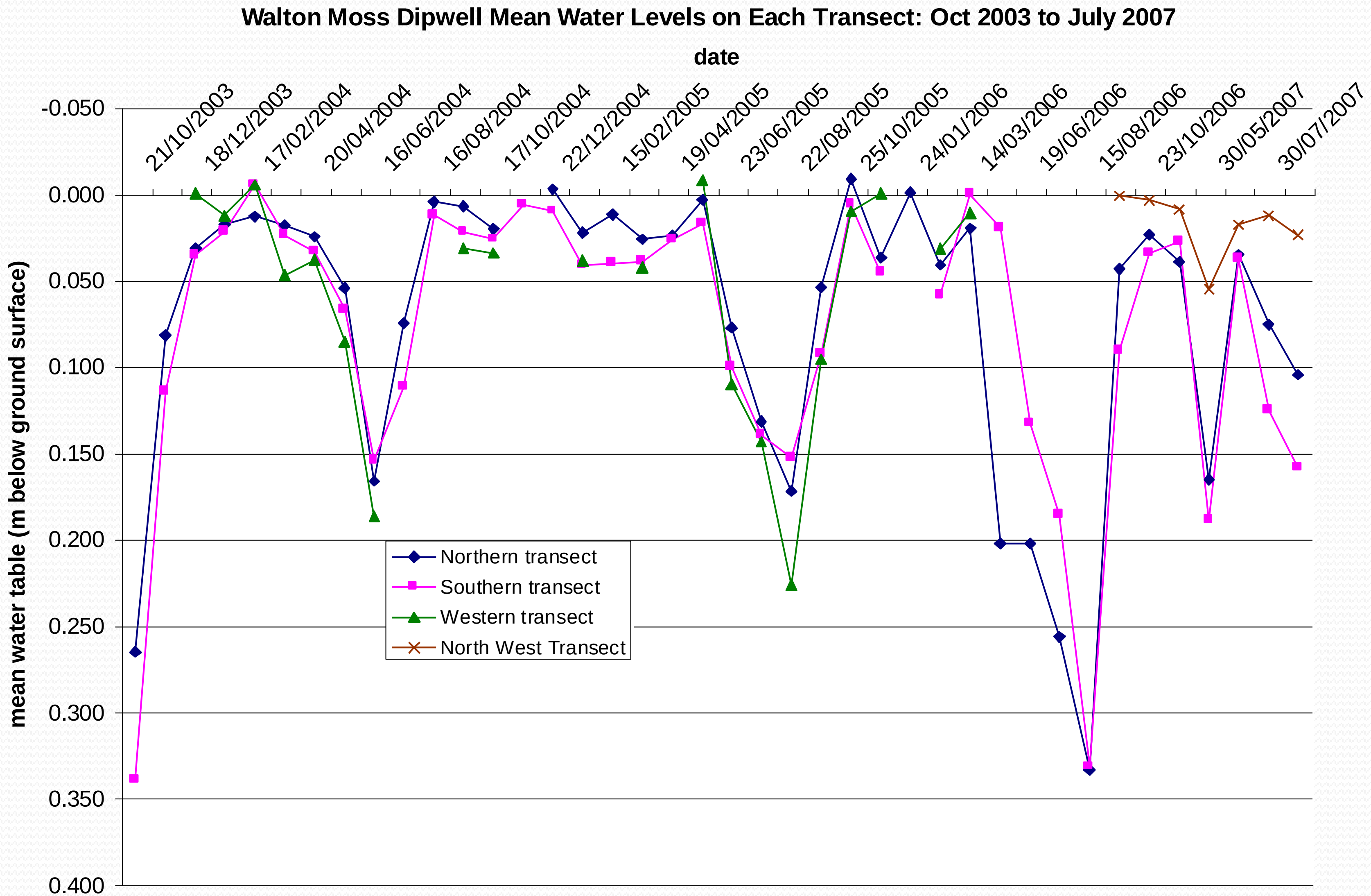
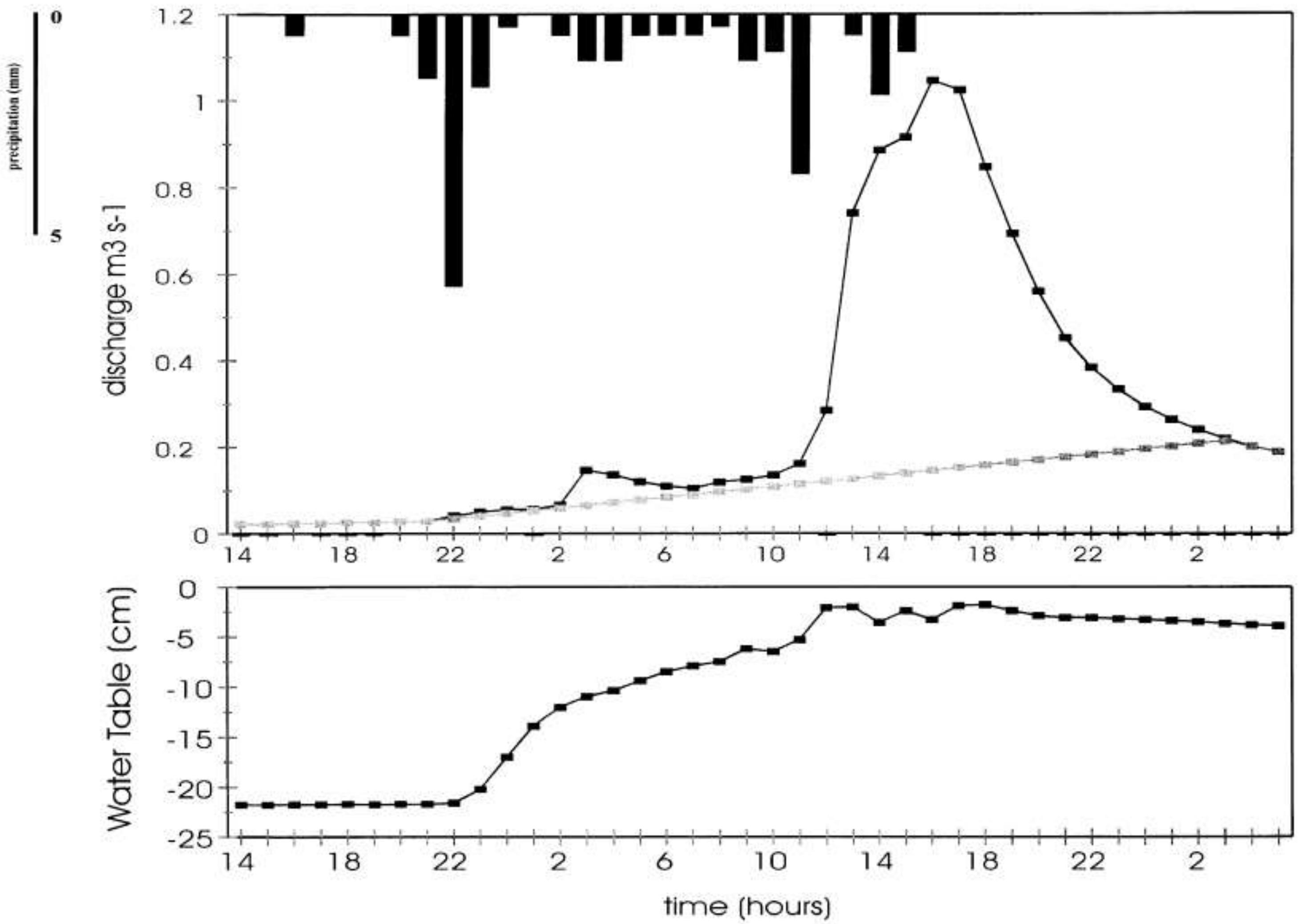


Figure 3 Average water levels at Walton Moss 2003 – 2007 (Labadz *et al* 2007)



Hydrograph and water table response for the event of 6 July 1995, showing the importance of near surface water tables in generating stream runoff (discharge). After Evans *et al* (1999)

Stream flow generation in peatlands

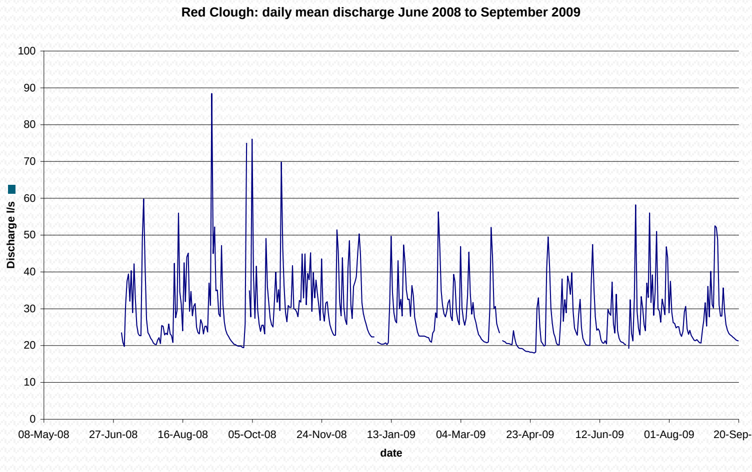
Peat is NOT a “sponge” slowly releasing much water.

Even intact peat is highly productive of storm runoff.

It generates little baseflow in out-flowing streams during times of low rainfall.

Rainfall input is rapidly followed by a response of rising flow (discharge) in the stream, then an almost equally rapid fall back to a very low base flow level.

Pipe flow important.



Rising DOC and water colour

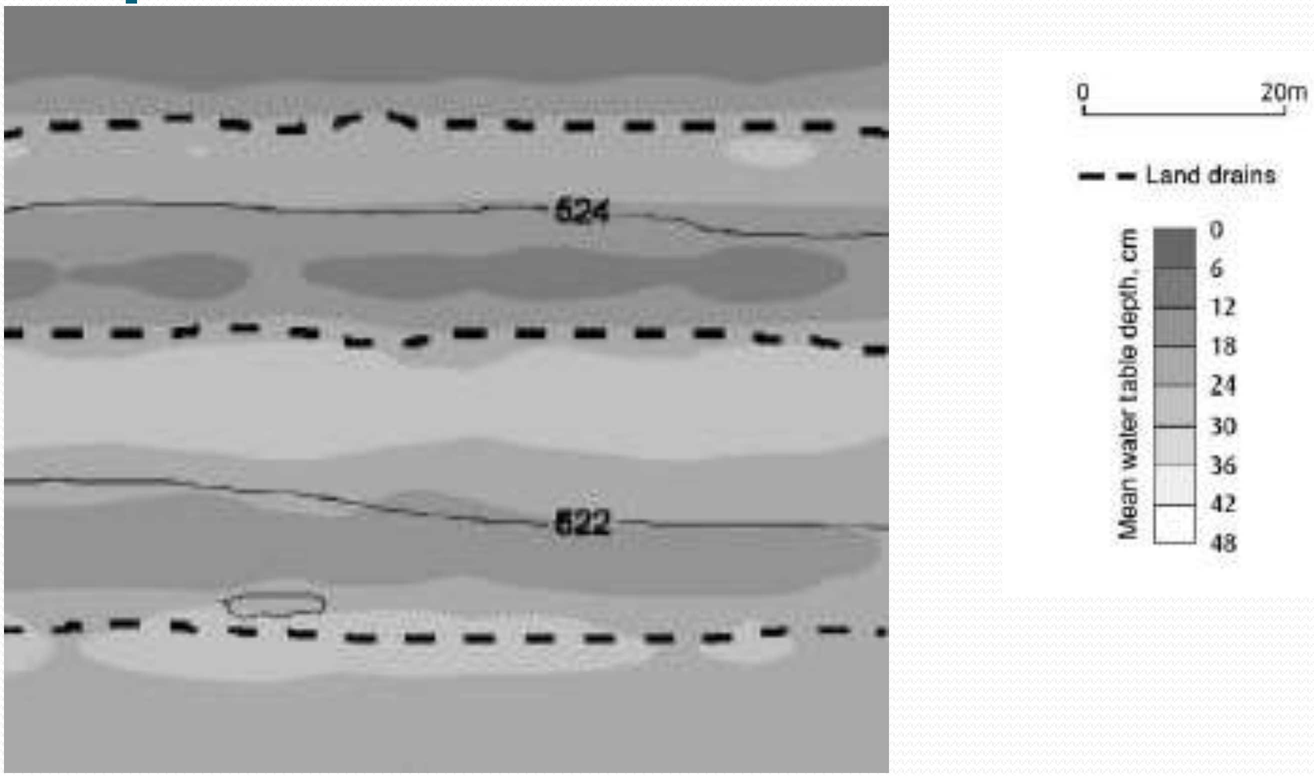
- Major issue for many water companies in recent years has been the rising trend in dissolved organic carbon (DOC) from peatland catchments

- Evans and Monteith (2004) *"Regardless of mechanism, it is clear that DOC levels in UK upland waters have almost doubled since the late 1980s, representing perhaps the largest change in upland water quality over this period. The full consequences of this change have yet to be determined, but impacts are likely to be significant, including changes in aquatic flora and fauna in response to changing light, nutrient, energy and acidity levels; increased water treatment costs in peaty areas; and increased carbon (and associated metal) export from terrestrial stores to freshwater and marine systems."*

Drivers of change in Peatland Hydrology

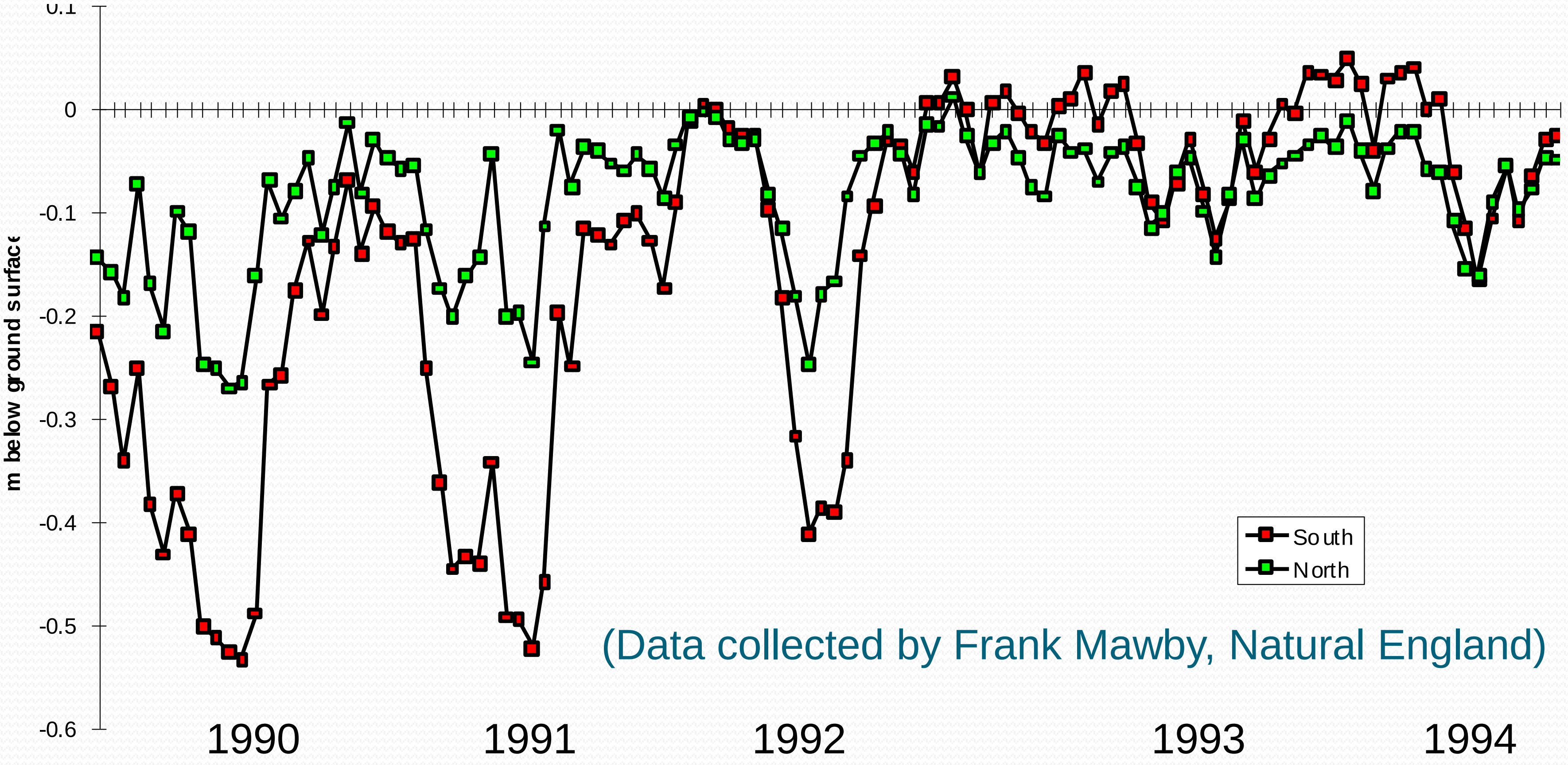
- Climate and land management are key drivers
- But effects are complex results of many interacting variables, so not easy to predict
- Effects occur on different temporal and spatial scales

Impact of artificial drainage



Mean depth to water table 2002-2004 on an artificially drained plot, showing ground contours (mAOD) and location of land drains (grips). After Holden *et al* (2006)

Impacts of drain blockage



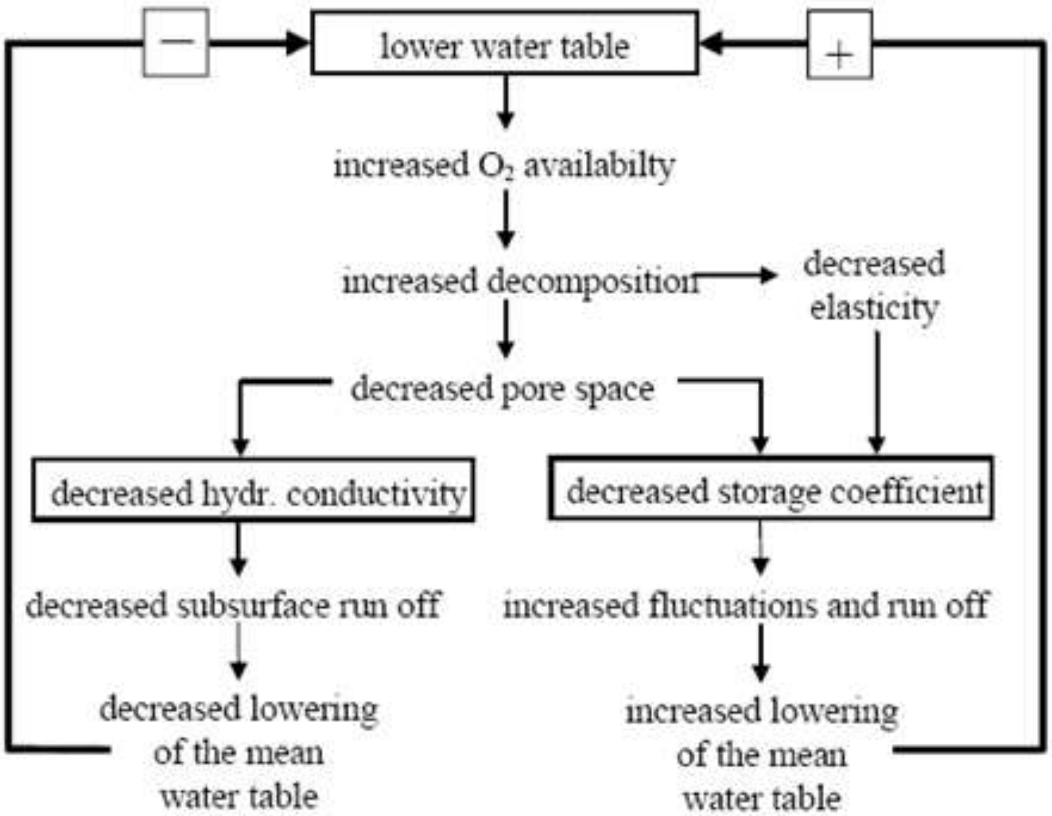
Wedholme Flow, Cumbria: mean water table relative to ground surface, transect 1 north (active raised bog) and south (abandoned cutover bog). Damming of the drains on the south transect occurred in 1992.

Impacts of drainage depend on ditch location and topography

- Ditches running up and down slope will have a different effect from those running across – potentially more likely to give rapid flow velocities and lead to erosion
- Lane (2008) noted evidence from the literature that grips could have two contradictory effects: hindering the generation of rapid runoff by enhancing soil storage, but also increasing flood risk by allowing more rapid connection of rainfall to the river network (ie increasing connectivity).
- Few published observational studies on this yet at a large catchment scale

Climate change on peat hydrology

- Changing climate is clearly expected to affect peat hydrology but prediction of impact is complex, even if the nature of the change in climate was certain.
- Change in temperature and rainfall will change evapotranspiration, water tables and flows…..but these in turn will change peat properties and vegetation communities….with several feedback mechanisms to hydrology



Feedback mechanisms between water levels and hydraulic peat properties
(after Schumann and Joosten 2008)

Monitoring peat hydrology

- Monitoring depends on the question being asked
- Monitoring PRIOR to implementation of changes is very important for understanding the scale and nature of effects
- Monitoring sites UNAFFECTED by the change is also desirable
- Modelling offers great opportunity to extend the spatial and temporal scale of results – but uncertainties must be acknowledged

- Ramchunder *et al* (2009) noted that although hundreds of millions of pounds are being invested in peatland restoration schemes in the UK uplands, including drain blocking, such investment is not being matched by appropriate monitoring programmes.
- Simply rewetting and/or revegetating degraded peat will not necessarily reverse the process response.
- They appealed for improved knowledge in order to aid practical solutions.

Conclusions on peat hydrology

- Hydrology exerts a fundamental but not simple control on peatlands – different feedback mechanisms exist
- Water quality and quantity are both important
- Surface flow dominates most intact peatlands
- Water tables, flows and quality are all VERY VARIABLE in time and space
- Drain and gully blocking has been effective at rewetting peat BUT
- Effects of drainage (and blocking) depend on the nature of the peat and the location of the channel in relation to topography and connection to the wider channel network
- Impacts on water quality can occur over long time scales (more than 5 years)

Gaps in Knowledge and Future Challenges for peat hydrology

- Our understanding of the impact on peatlands of changing water supply and climate remains a significant gap.
- Investment in changing land management has not been matched by investment in monitoring its effectiveness – some progress on drain blocking recently, more needed on wind farms and burning.
- Effects of peatland management on flood risk downstream remain largely undemonstrated.