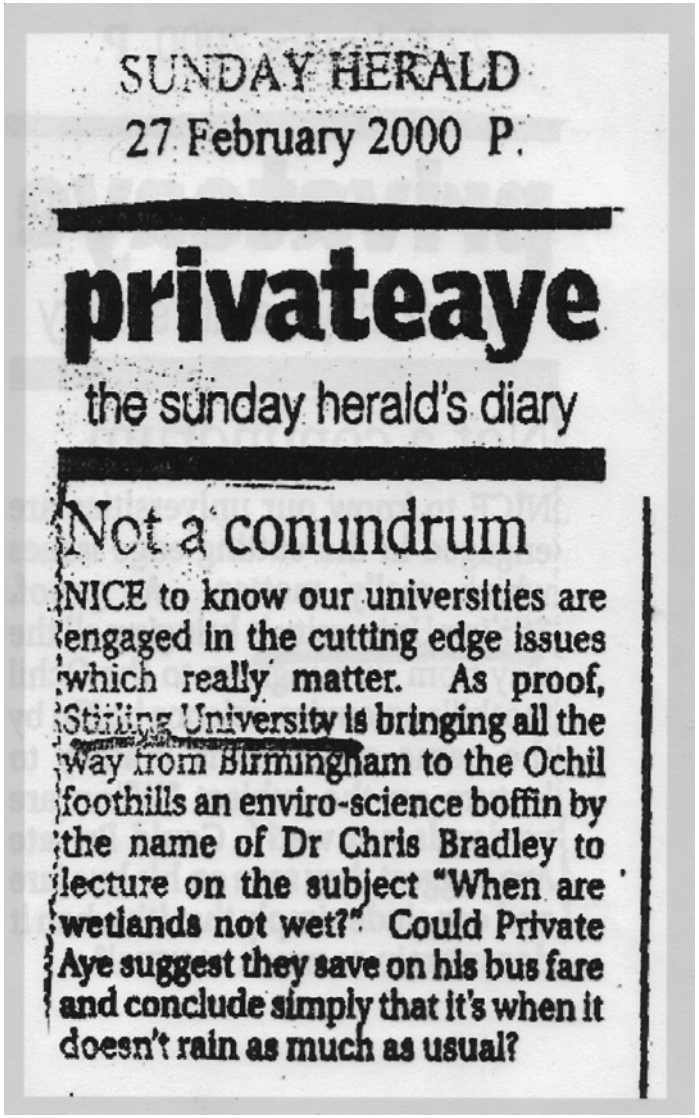
The water:

surface water hydrology

Chris Bradley

University of Birmingham

when wetlands are not wet…..



SUNDAY HERALD
27 February 2000 P.

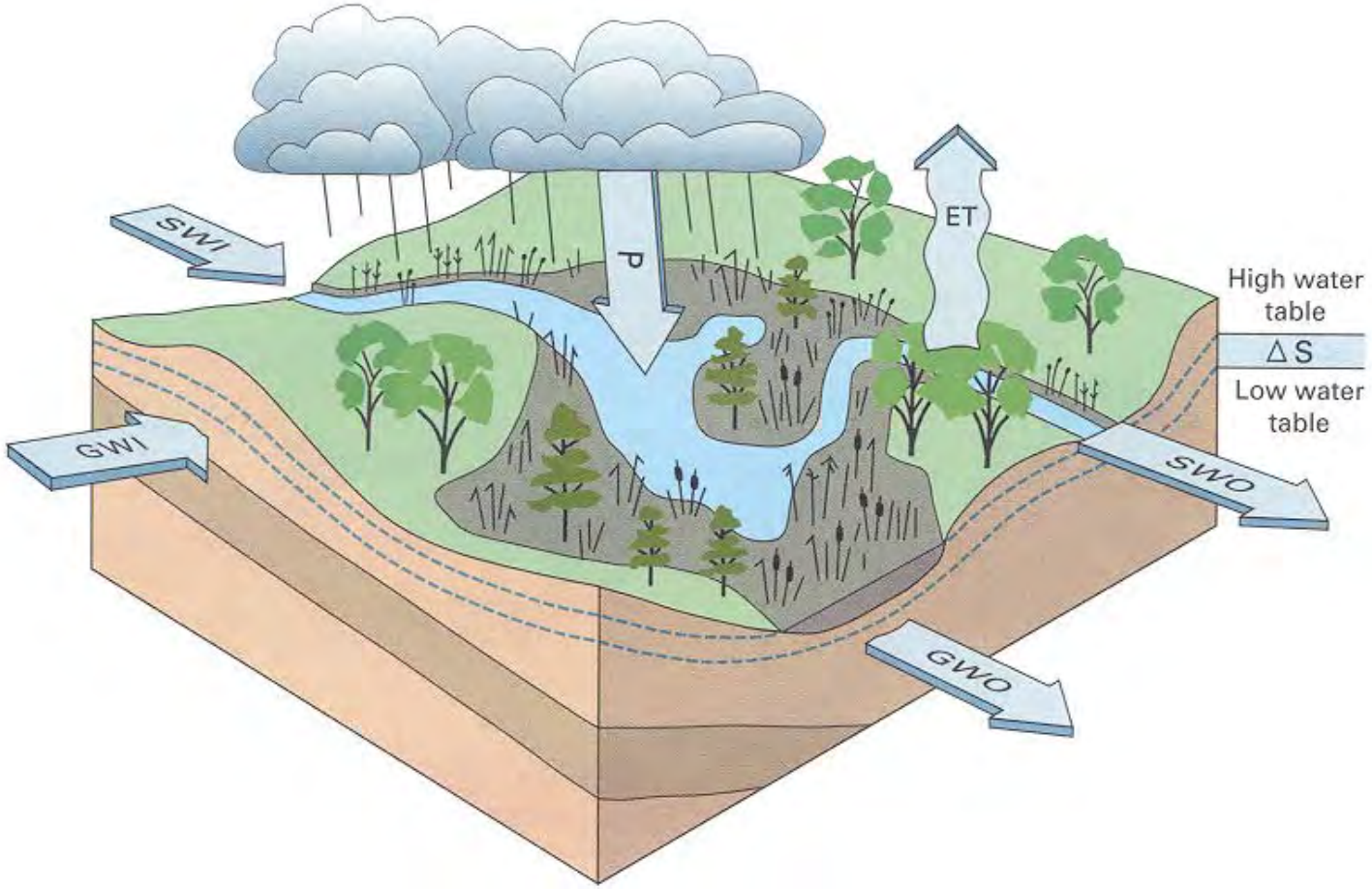
privateaye

the sunday herald's diary

Not a conundrum

NICE to know our universities are engaged in the cutting edge issues which really matter. As proof, Stirling University is bringing all the way from Birmingham to the Ochil foothills an enviro-science boffin by the name of Dr Chris Bradley to lecture on the subject "When are wetlands not wet?" Could Private Aye suggest they save on his bus fare and conclude simply that it's when it doesn't rain as much as usual?

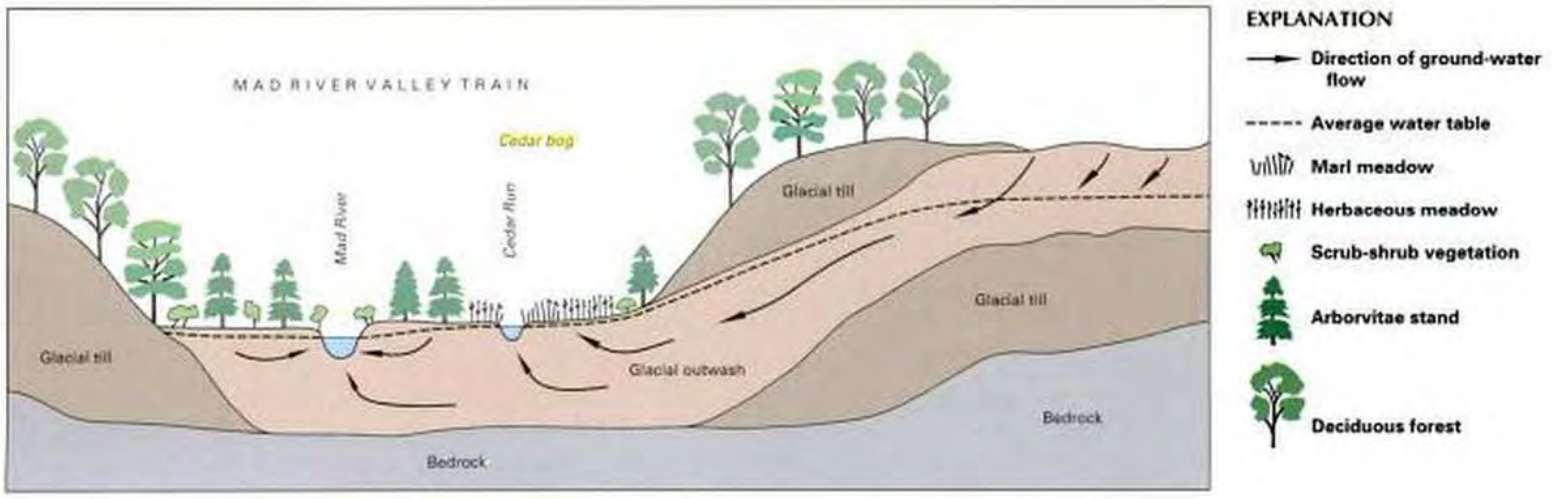
- Unsaturated Processes historically neglected in wetlands;
- Are time-invariant parameters appropriate for annual hydrological models?
- Significance of prolonged water shortage uncertain:
  - hydrophobicity; macro-pore development; mineralisation of organic deposits
  - Ecological and Biogeochemical implications?



Components of the Wetland Water Budget:

$$P + SWI + GWI = ET + SWO + GWO + \Delta S$$

Cedar Bog (Ohio)



Wetland: a 'green fuzz that grows on top of, and as a result of, hydrogeologic setting'

Catfield Fen

Hydrology and Earth System Sciences, 1, *115–135* (1997) © EGS

Hydrology & Earth System Sciences

Surface Water Processes and Groundwater Flow Within a Hydrologically Complex Floodplain Wetland, Norfolk Broads, U.K.

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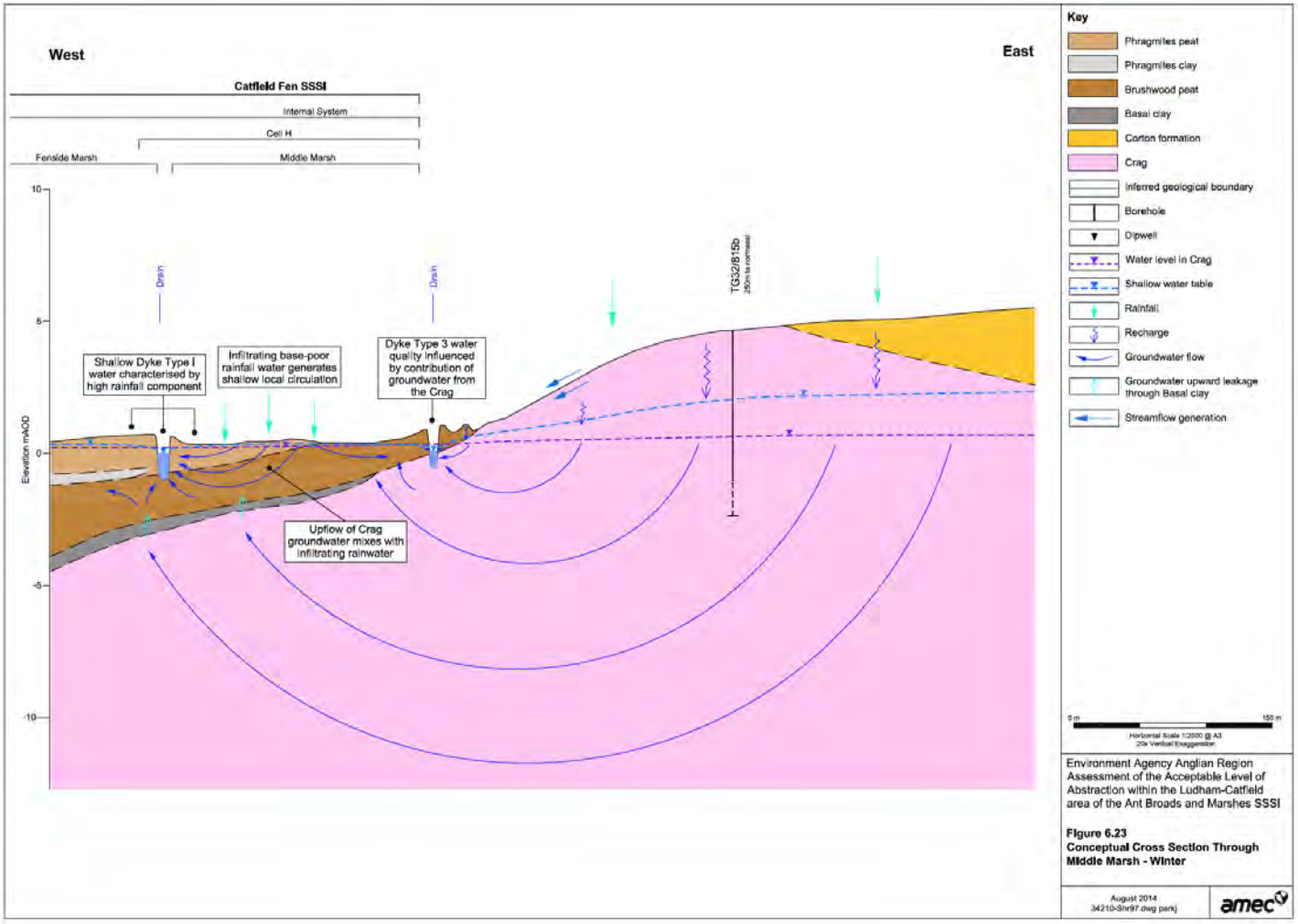
Abstract

Catfield Fen lies on the floodplain of the River Ant,—adjacent to Barton Broad, a flooded 13th century peat cutting in East Anglia, England. There are few studies of the hydrology of floodplain mires so this paper presents the results of a study of the surface and groundwater components of a fen system within the Norfolk Broads region. The study was undertaken as part of a larger study (Gilvear *et al.*, 1993; Gilvear *et al.*, 1994) to ascertain the sensitivity of East Anglian fen systems to groundwater abstraction and pollution.

Catfield Fen is a surface-water-dominated system maintained primarily by precipitation and flows to and from the river system. Upward groundwater flows from the Pleistocene Crag aquifer through a discontinuous clay layer to the fen and hillslope inputs also contribute nutrient rich waters to the wetland. Different areas of the marsh receive varying contributions of flow from these various sources so that spatial variations occur in surface water chemistry. The fen is hydrologically complex because a number of open drainage ditches, cut across its surface, act as preferential pathways for water movement. Part of the fen is effectively isolated from direct inundation from riverine flooding by a small embankment; thus defines an 'internal compartment' for which a tentative overall water balance is calculated. Both the drainage ditches and the embankment have modified surface and groundwater flows locally but have not altered the overall hydrological functioning or the water balance of the natural wetland system. The groundwater flow modelling demonstrates the sensitivity of the fen to groundwater abstraction. The results of the overall study suggest firstly that the site is complex and vulnerable to both surface and groundwater abstraction and pollution and secondly demonstrate the complexity and difficulty of investigations of the hydrology of floodplain mires.

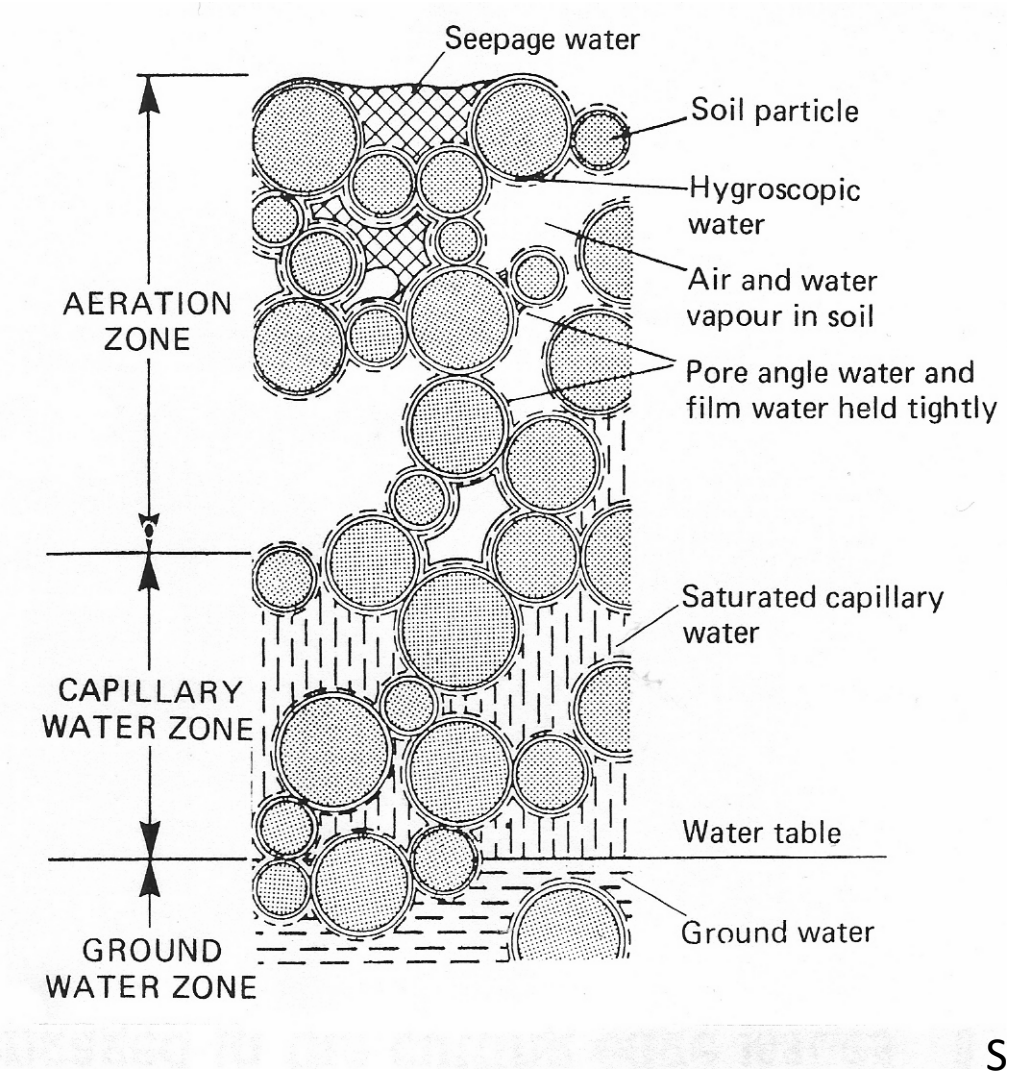
'surface-water dominated system maintained primarily by precipitation and flows to and from the river system' ?

Summer cross-section through Middle Marsh



Amec, 2014: Figure 6.23

Water in the Soil:

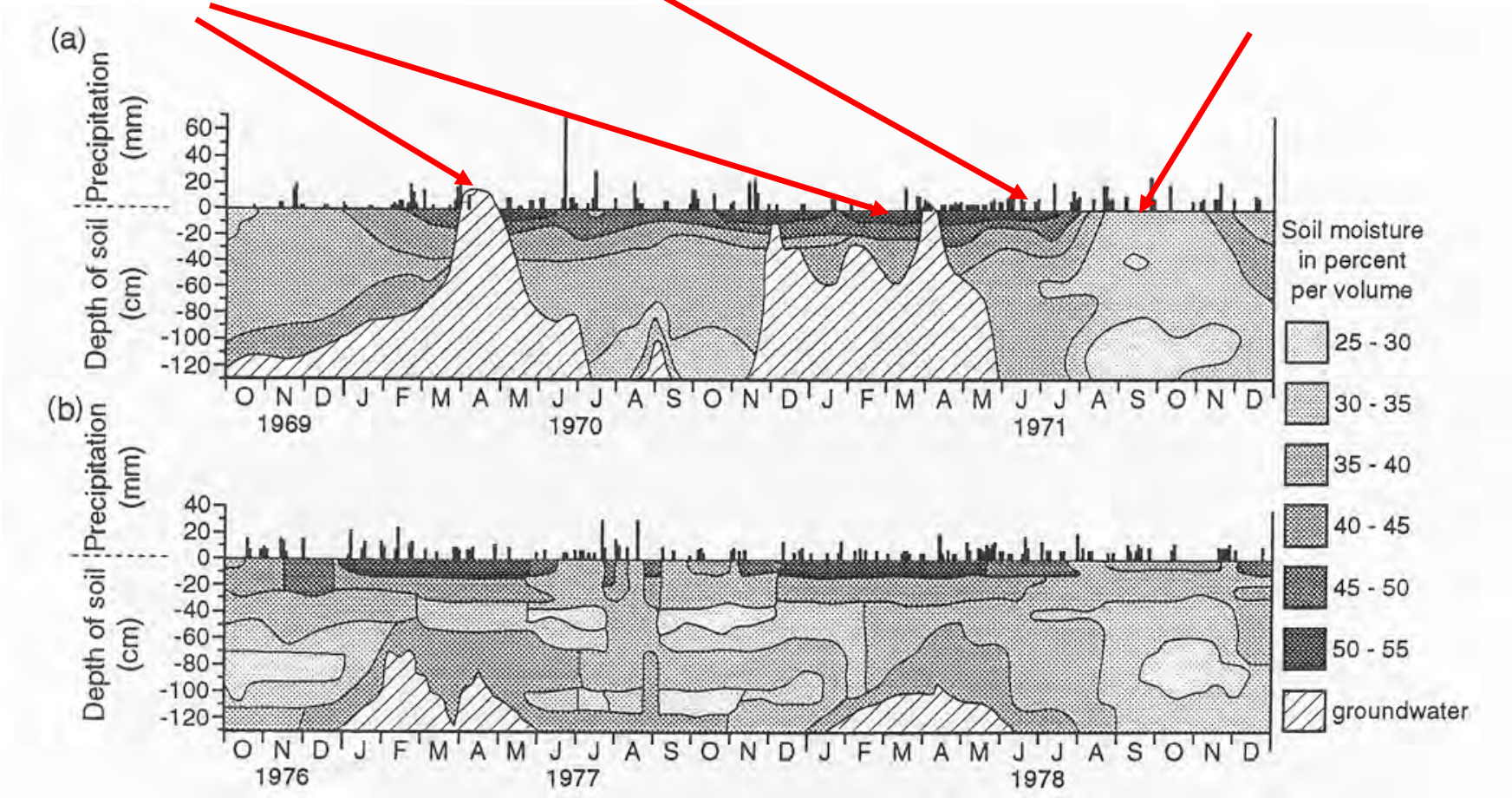


Shaw, 1988: Fig. 5.4

1. Groundwater saturation

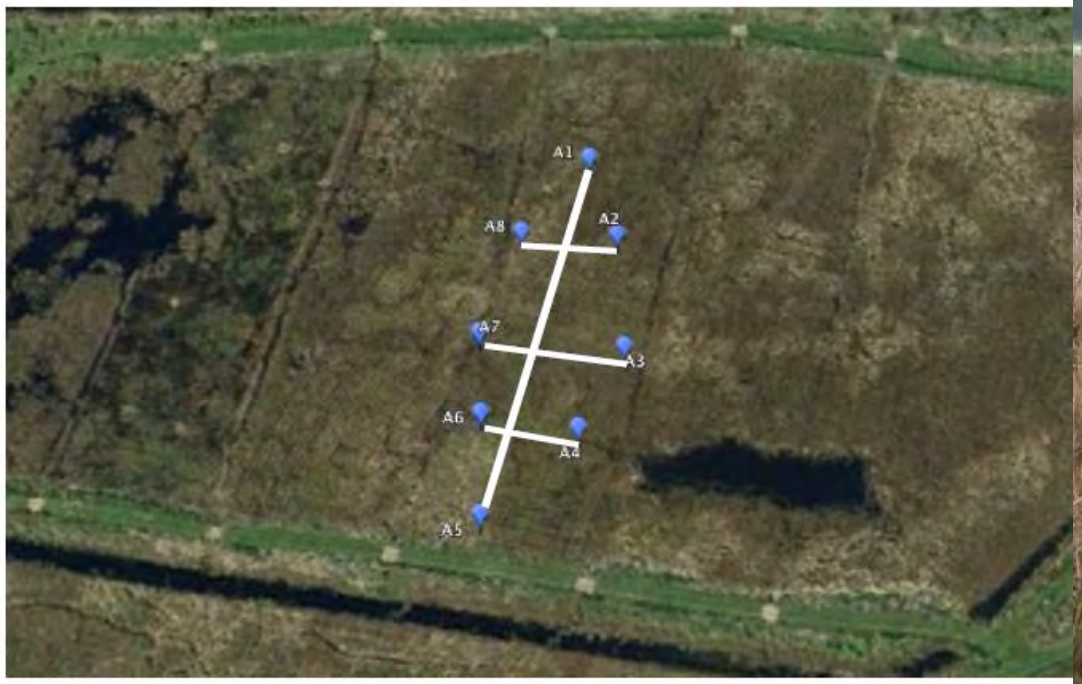
2. Precipitation-driven moisture content

3. Summer – low moisture content

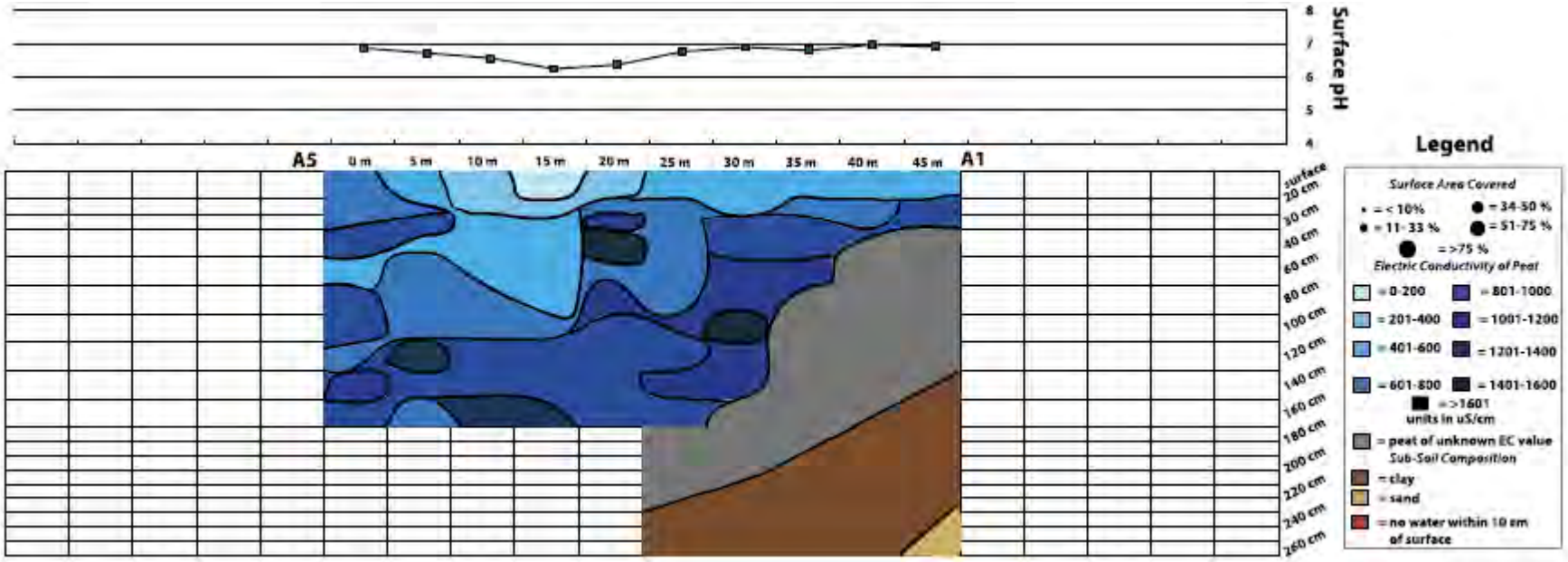


Dyje Floodplain, Former Czechoslovakia;

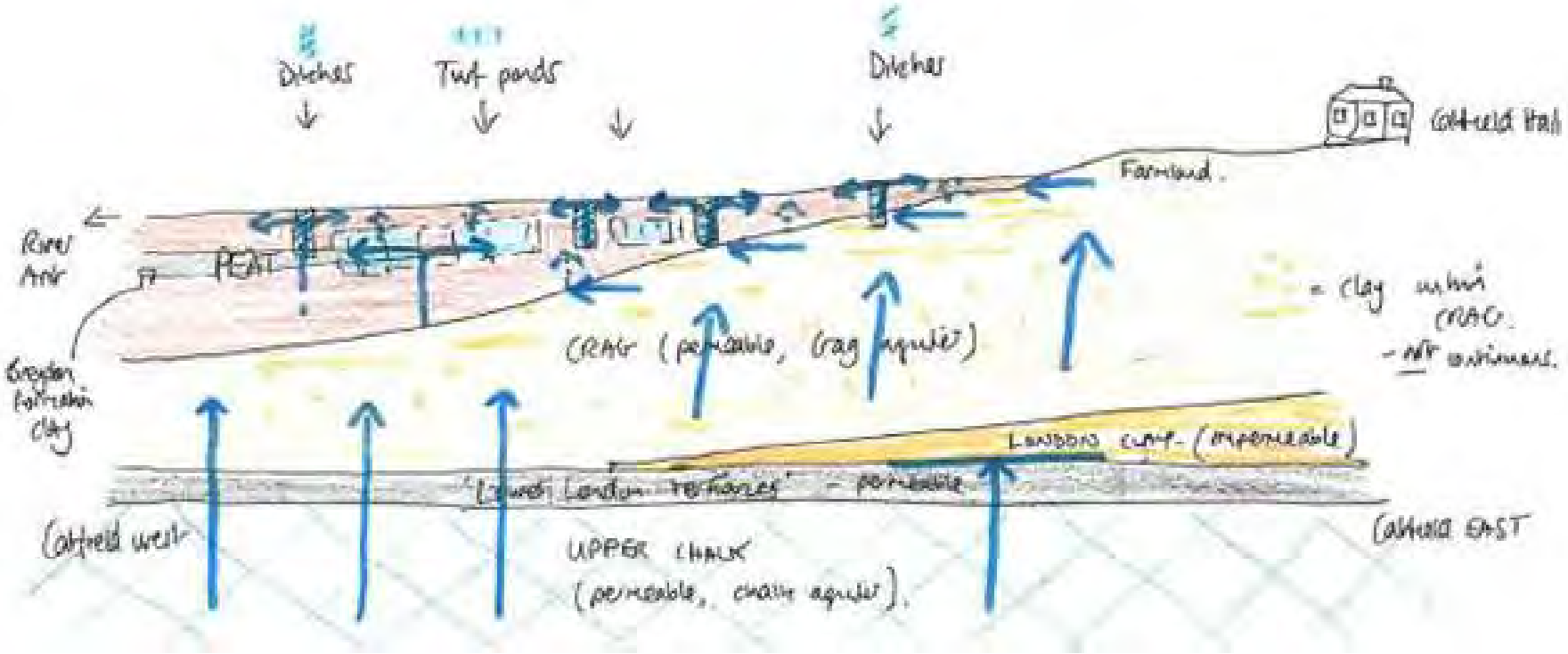
Surficial variations in fen hydrochemistry at Catfield (Pyne & Barendregt):



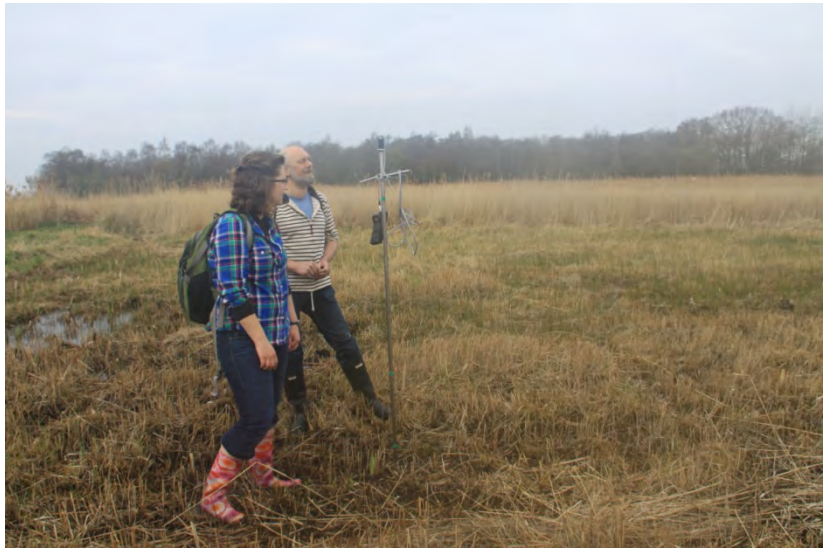
Variation in pH and Electrical Conductivity across Sphagnum Island:



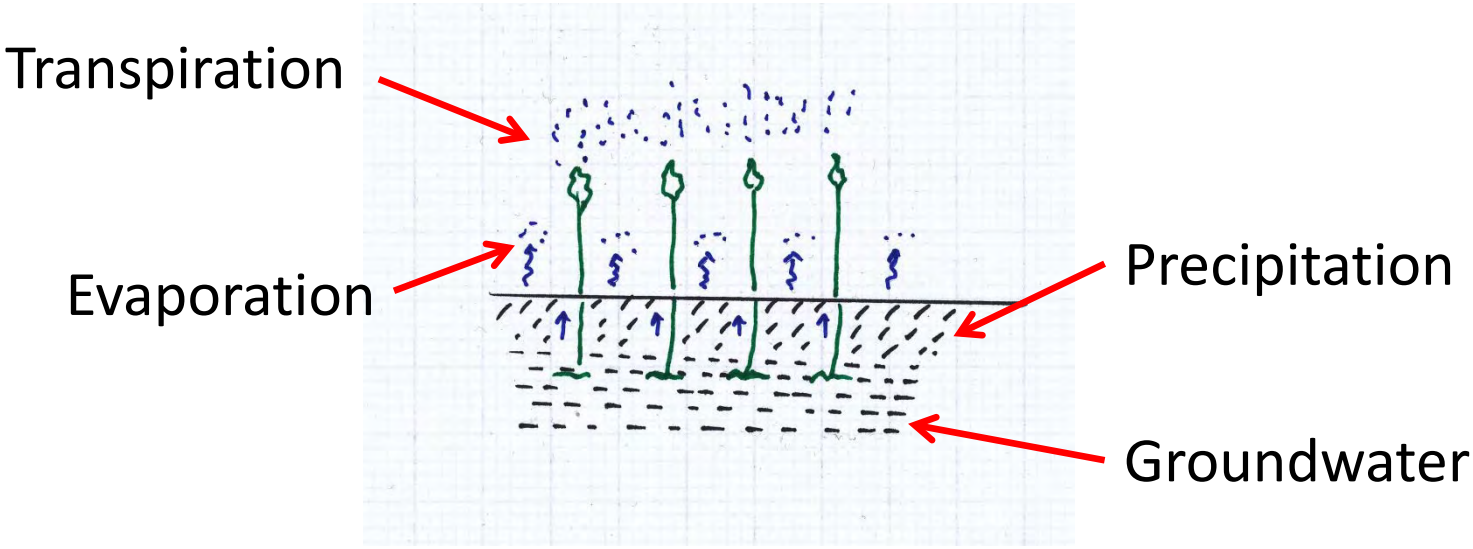
Catfield Fen Schematic:



Parmenter, 2016

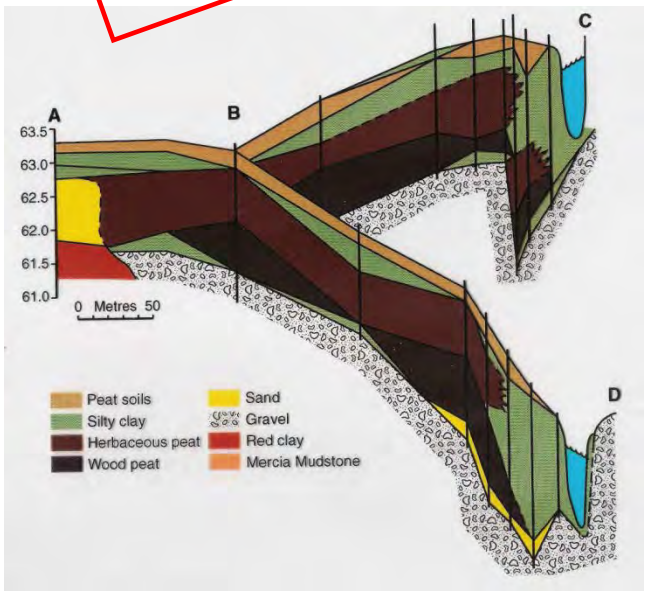


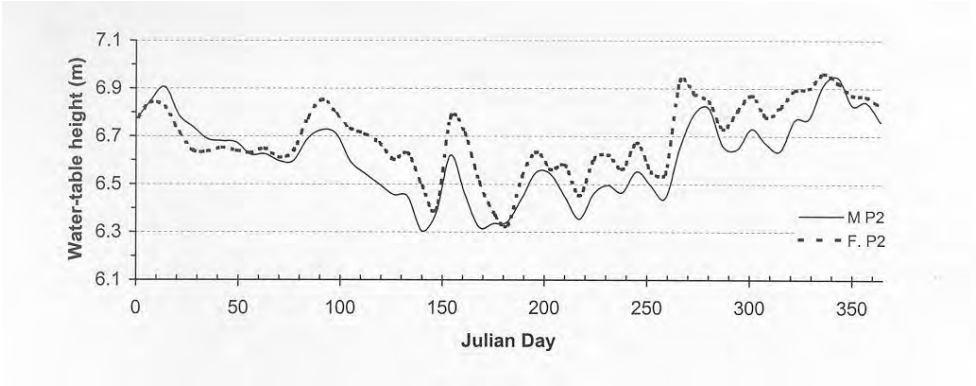
Plants as Hydrologists?
(Wheeler & Shaw, 1995)

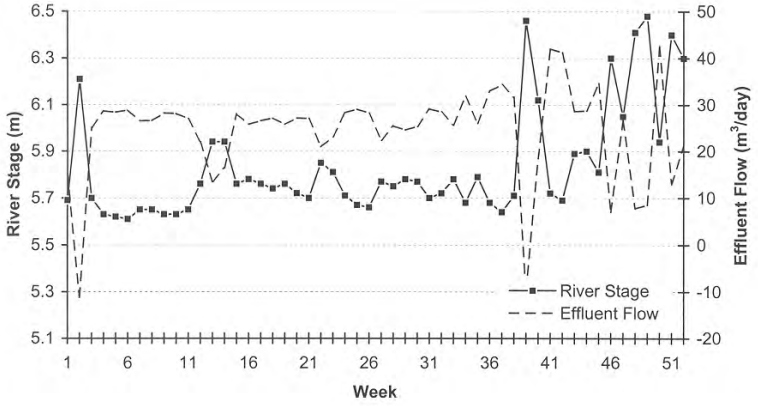


Hydroecological process interactions (e.g. leaf litter; sphagnum)

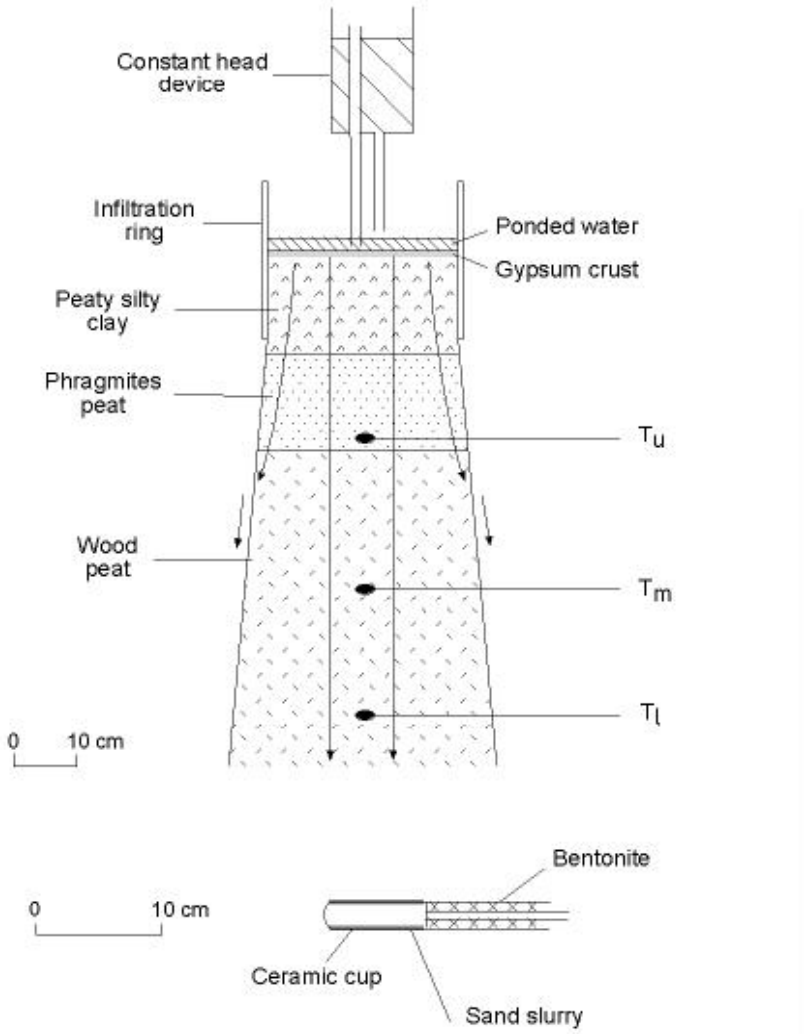
Modelling Lowland Wetlands:

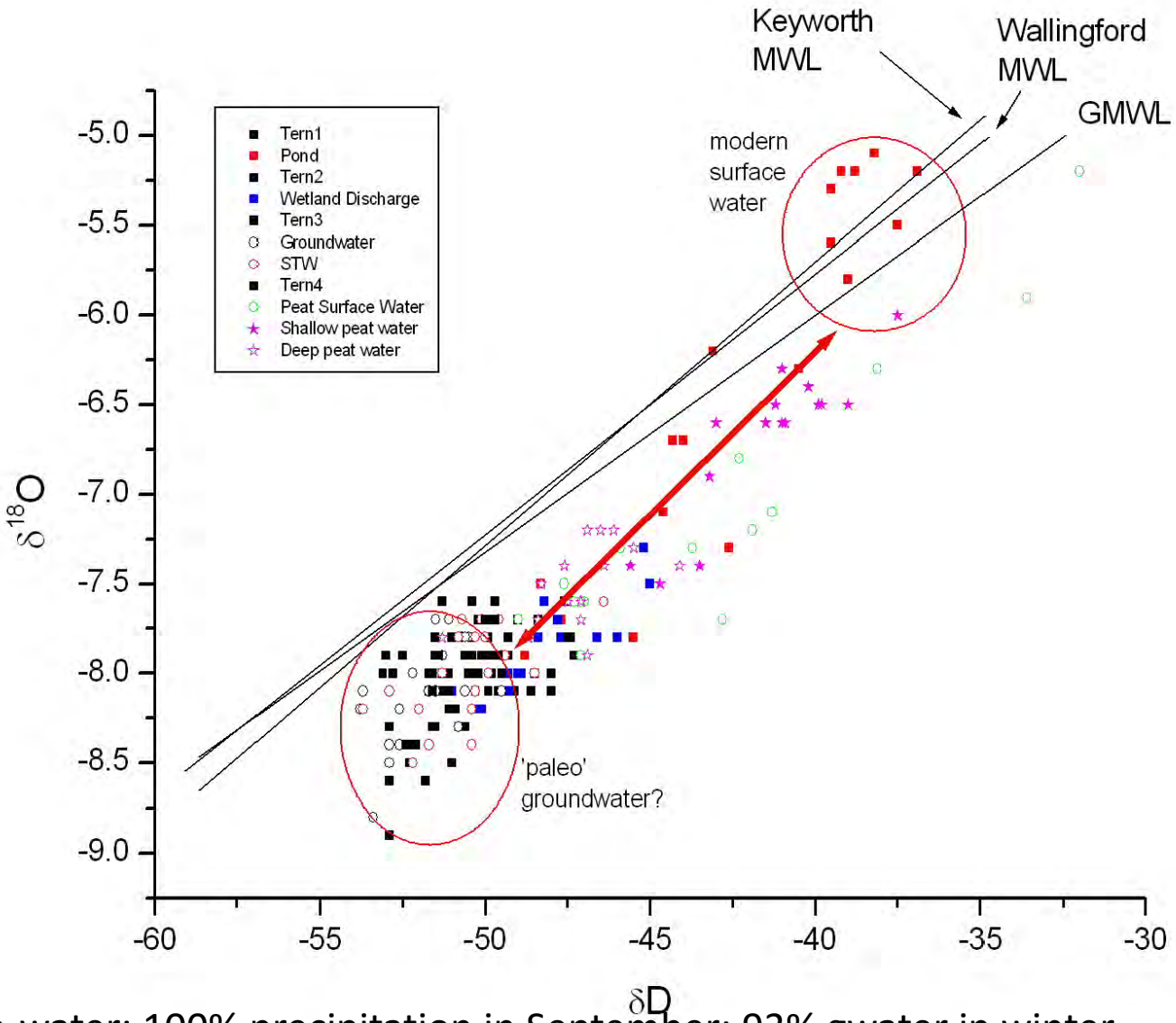






Water Flow through the Unsaturated Zone:



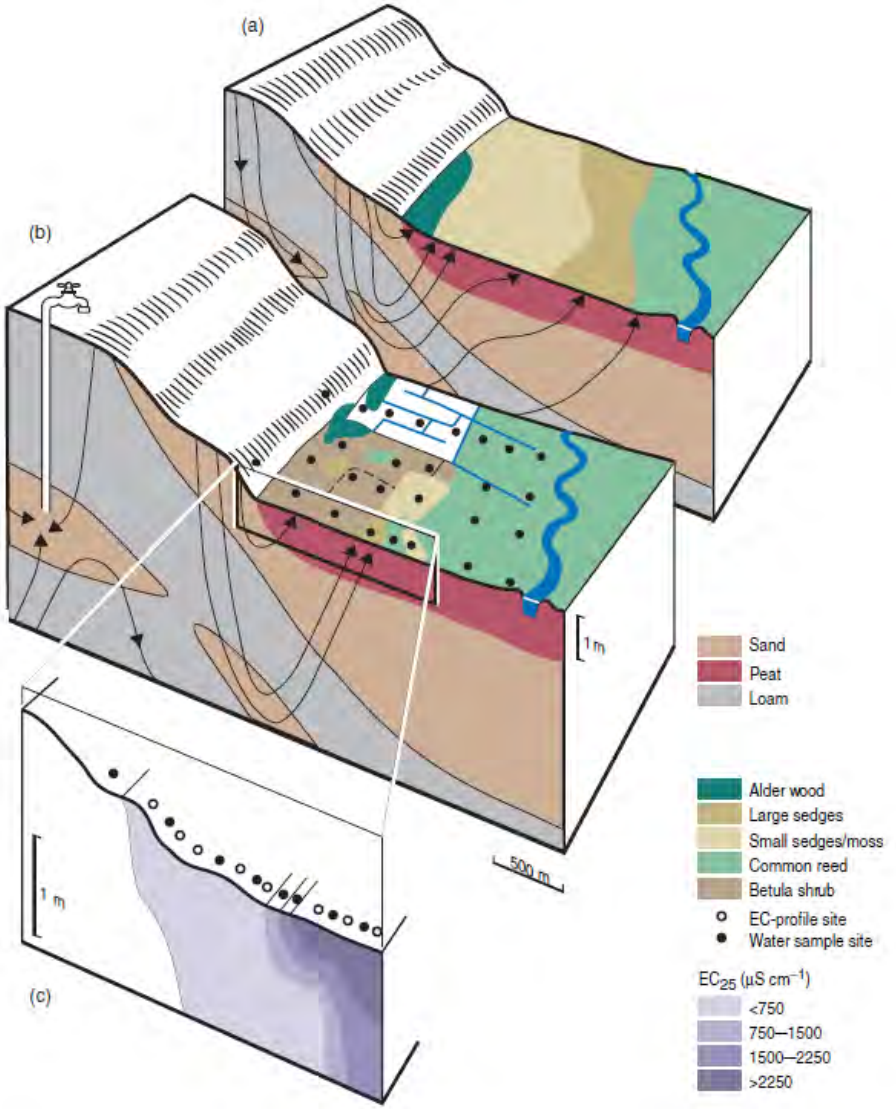


Surface-water: 100% precipitation in September; 93% gwater in winter

Shallow wetland (J): 28% gwater in summer; 81% gwater in winter

Deep wetland (K): 69% gwater in summer; 100% gwater in winter

Groundwater-fed mire, N. Germany



Grootjans & van Diggelen, 2009

Reflections on (surface-water) hydrology:

- Why try to characterize hydrology?
  - Catchment context is critical;
  - Importance of hydrological '**dynamics**':
    - Possible changes in wetland water source (and saturation) spatially and temporally

- Need for **trans-disciplinary** approaches to wetland environments:
  - Importance of hydroecological interactions at different scales?
  - Reflect on the hydrological thresholds triggering change in the wetland biota (to link output of hydrological models to wetland ecology).