13th International Peat Congress.
“After Wise Use - The Future of Peatlands”
International Peat Society
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ASSESSING THE WATER BALANCE OF TROPICAL PEATLANDS BY INVERSE GROUNDWATER MODELLING

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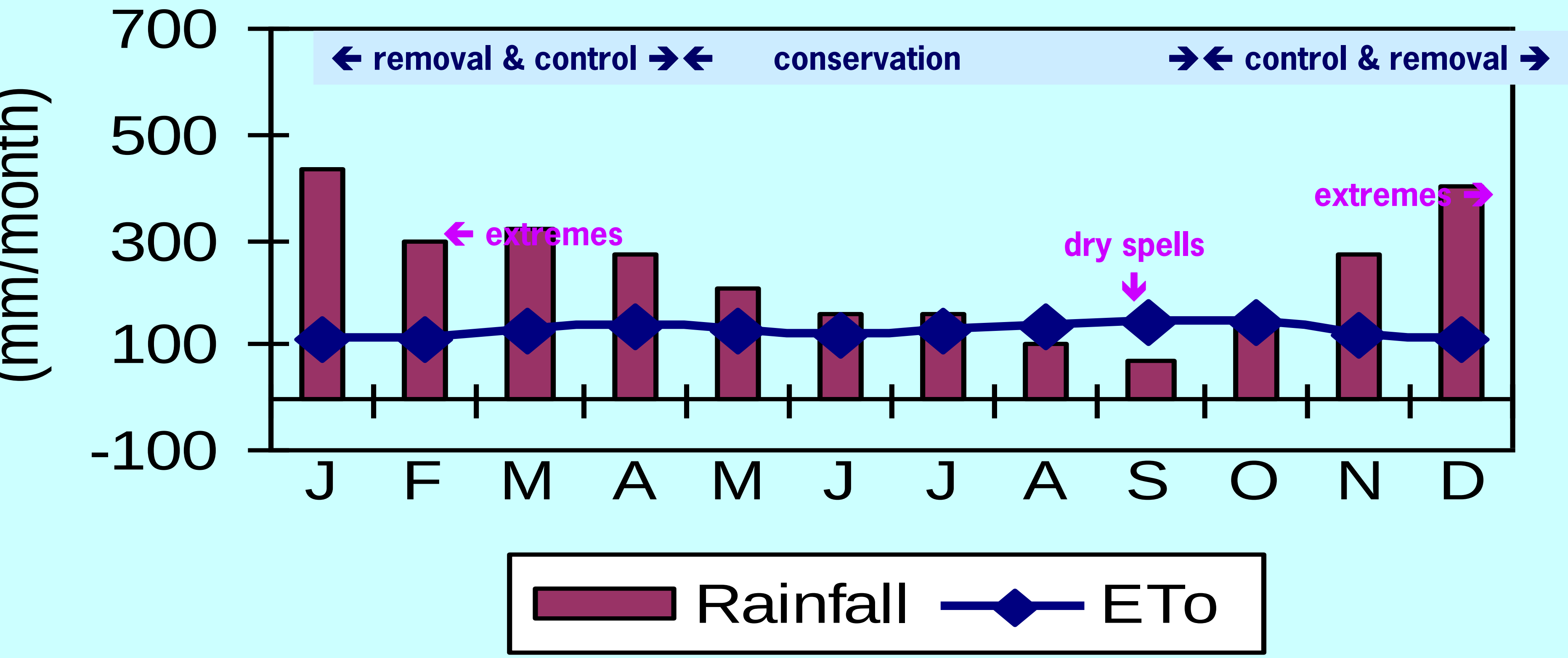
Why do we want to know the water balance ?

Water management is needed:

- To reduce subsidence
- To reduce the risk of fire

What do we know?

Rainfall is the only source of water



Ritzema and Wösten, 2002

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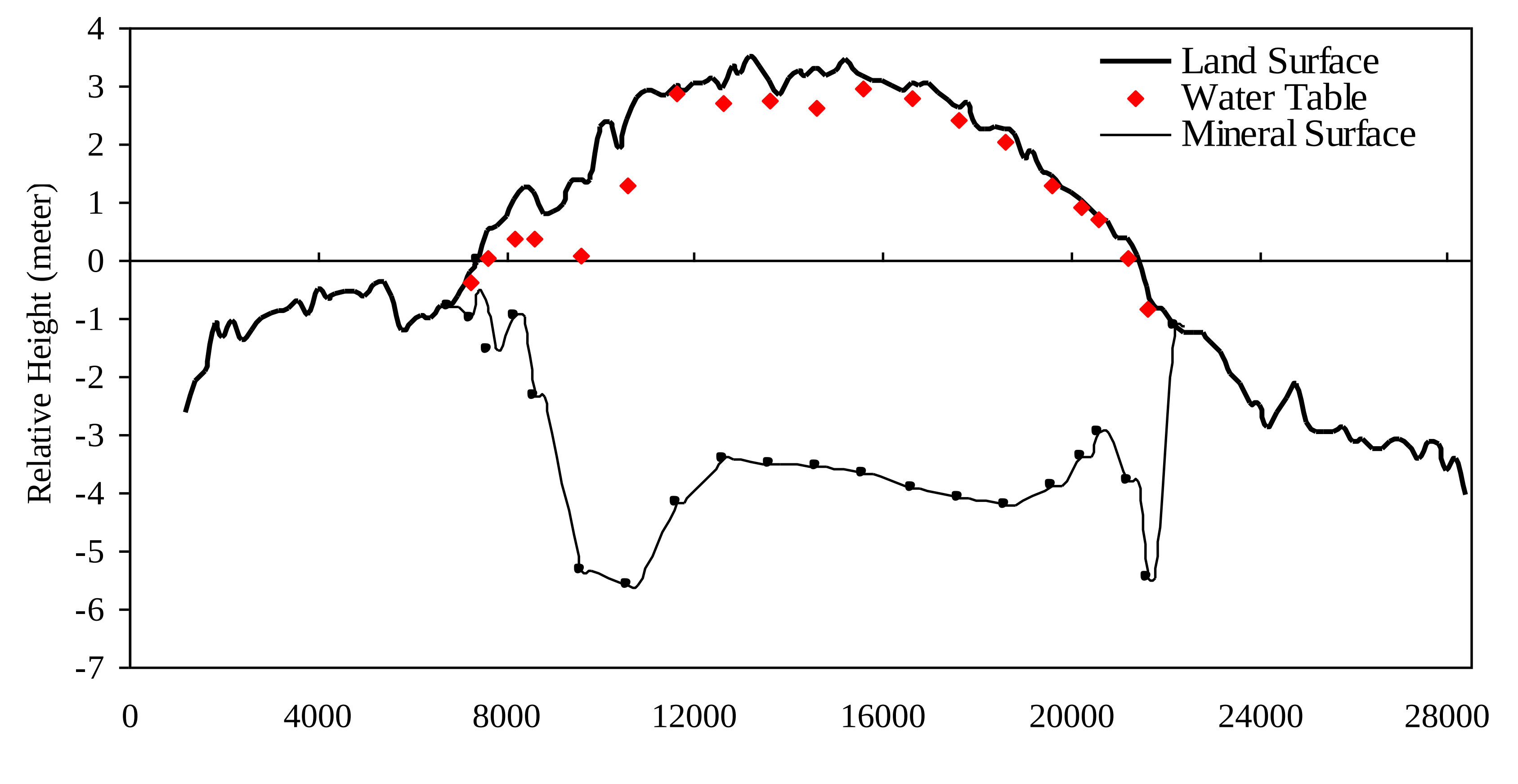
What do we know?

Elevation of the peatdome, peat thickness and depth of watertable



Adi Jaya, 2005

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What do we know?

	Hydraulic conductivity (m/d)
Johre	0.7 – 51.8
Sarawak	0.01 - 160

DID, 2001

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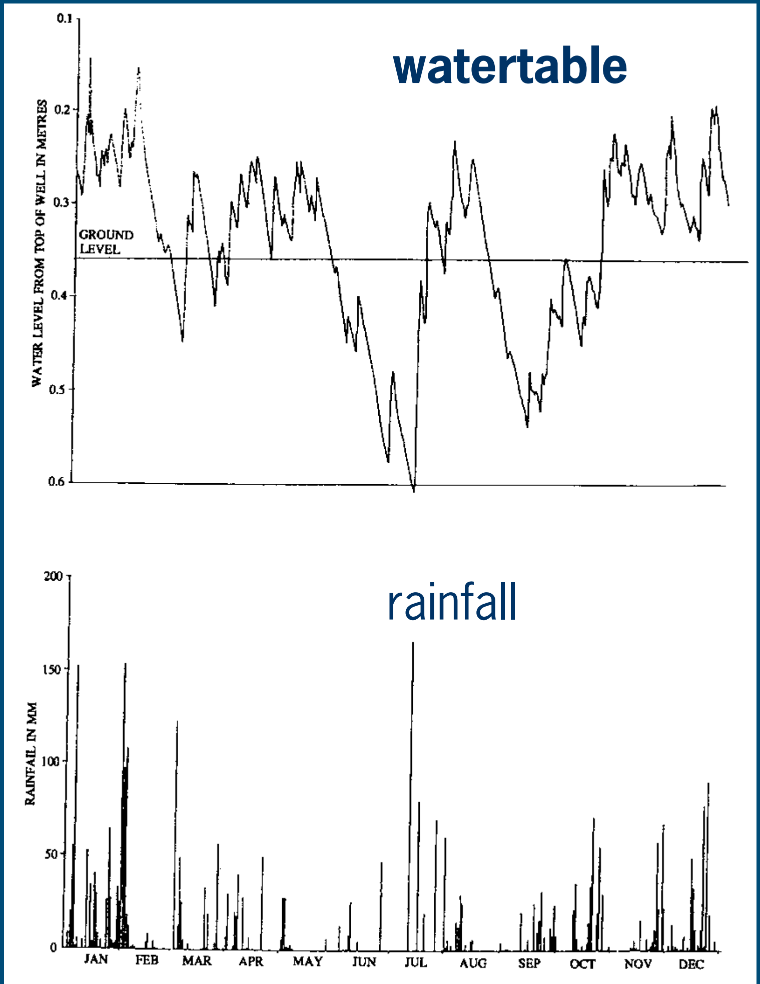
What do we know?



Relation between rainfall and watertable over time

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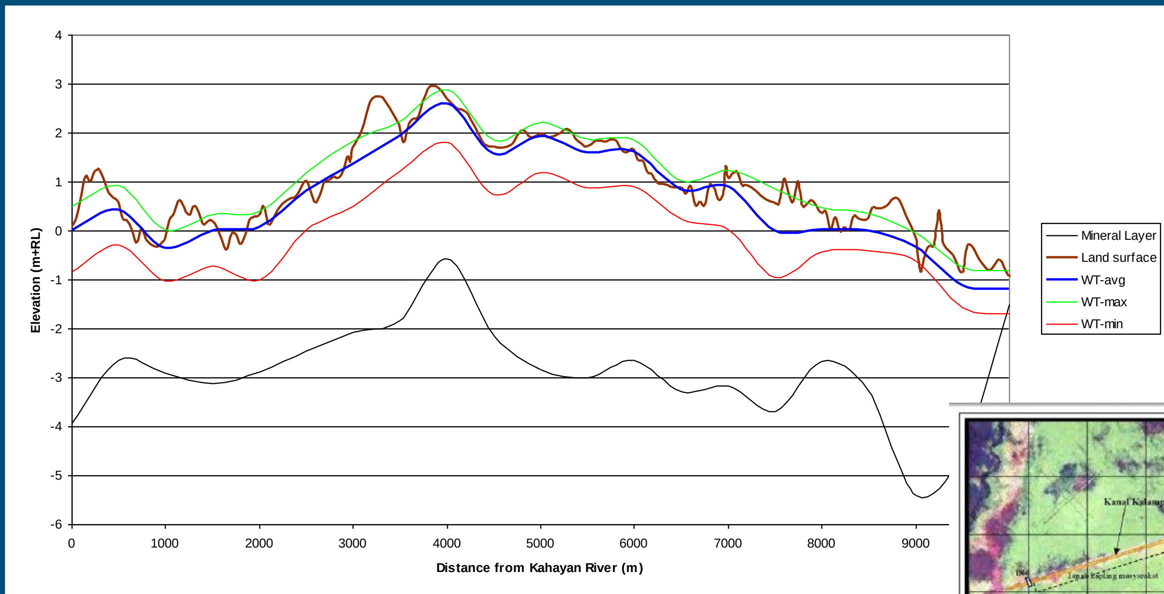
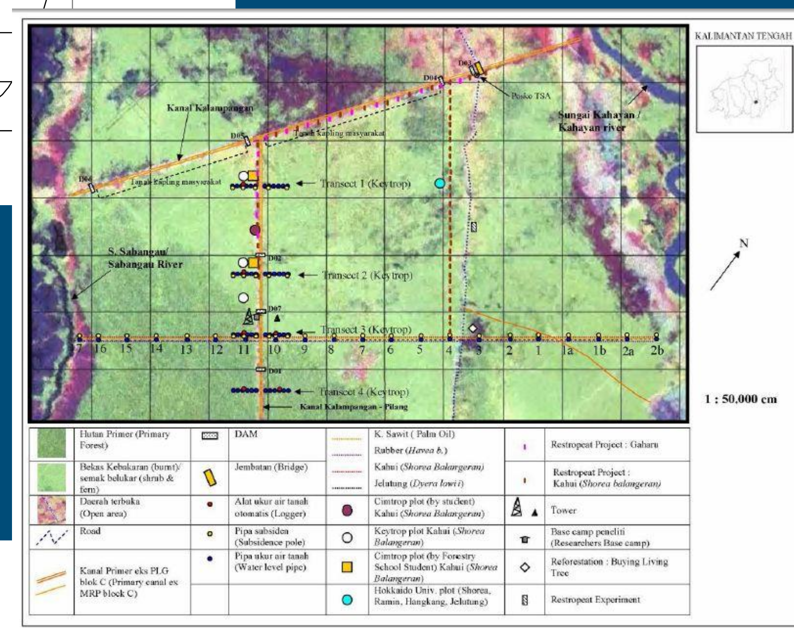
What do we know?

Fluctuation of the watertable over the peat dome

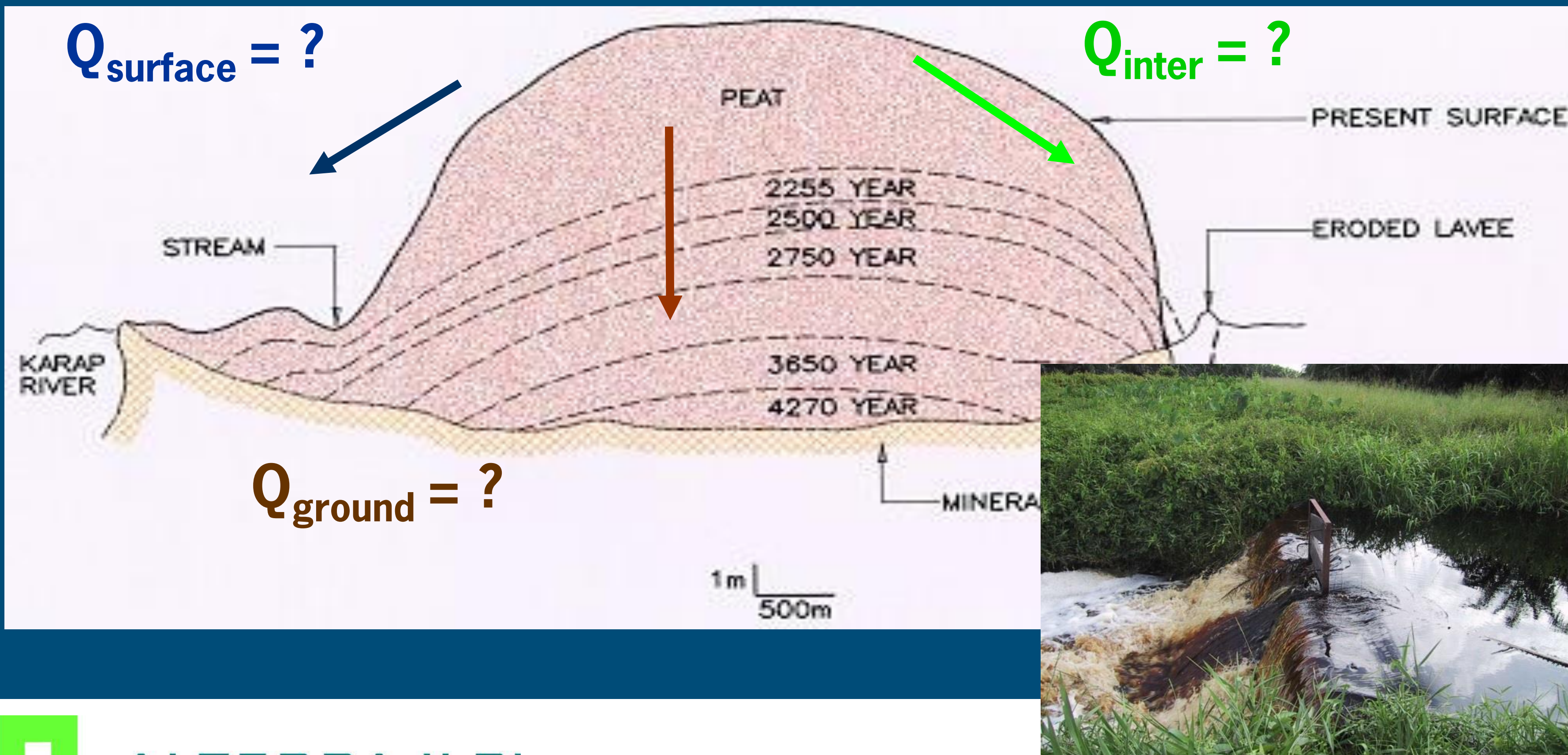




Limin and Ritzema, 2008

What we don't know: discharges !

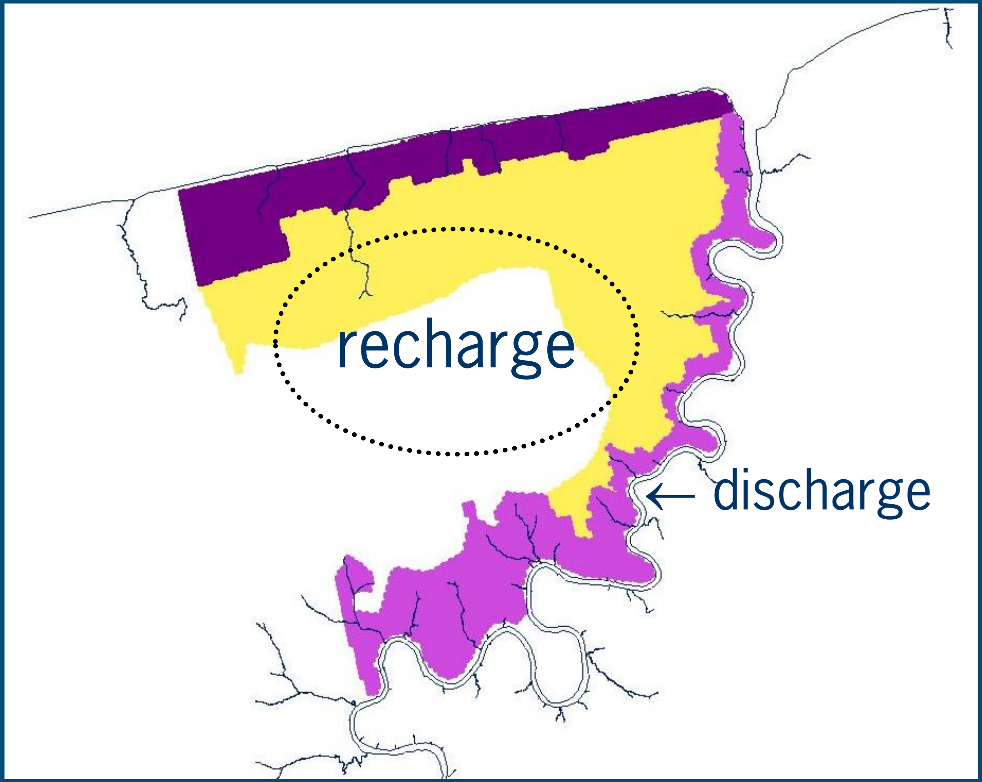
$$P = E + Q + \Delta S = E + Q_{surface} + Q_{inter} + Q_{ground} + \Delta S$$



GROUNDWATER MODEL - Modflow

- Model: Processing Modflow for Windows (PMWIN) 5.0.79
- Steady state calculations
- Input data: level of peat dome and mineral subsoil from grid survey, k-values from literature, …
- Recharge determined through inverse modelling

Modflow – Balingian, Mukah, Sarawak, Malaysia



- Area: approx. 10,000 ha
- Predominantly Anderson 3 soils (7,970 ha)
- Identified as a Rural Growth Centre (RGC) by the Government of Sarawak in 1994
- Main development oil palm plantations
- Total population: about 3,000 (1992)

Calibrated by matching recharge and discharge areas

Grobbe, 2003

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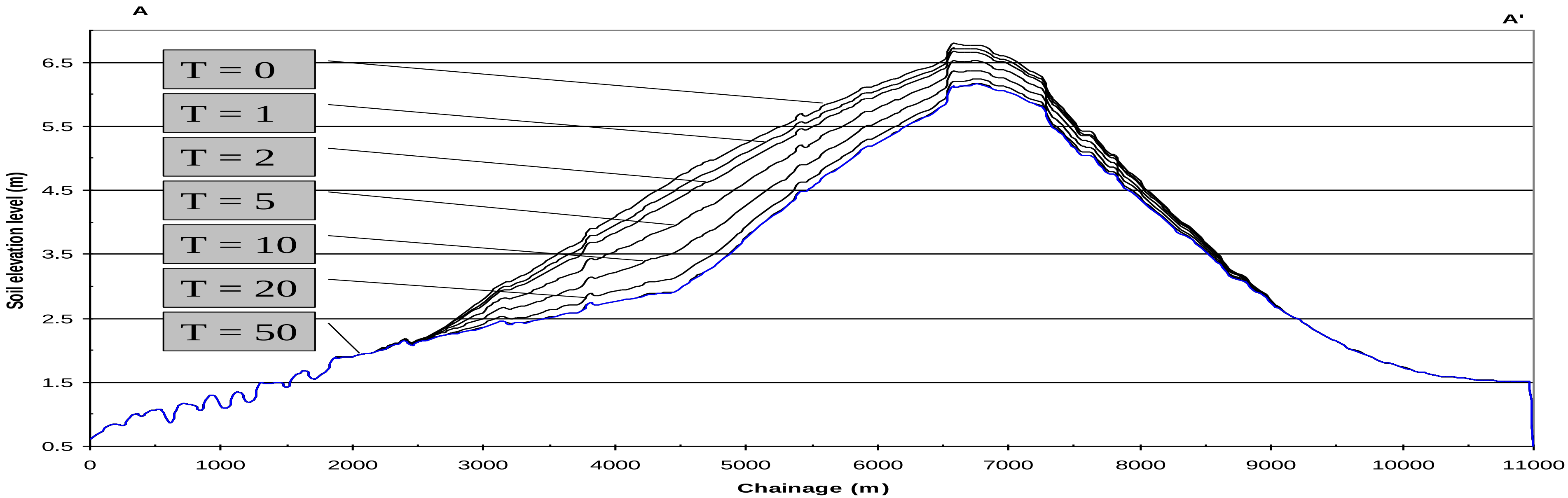
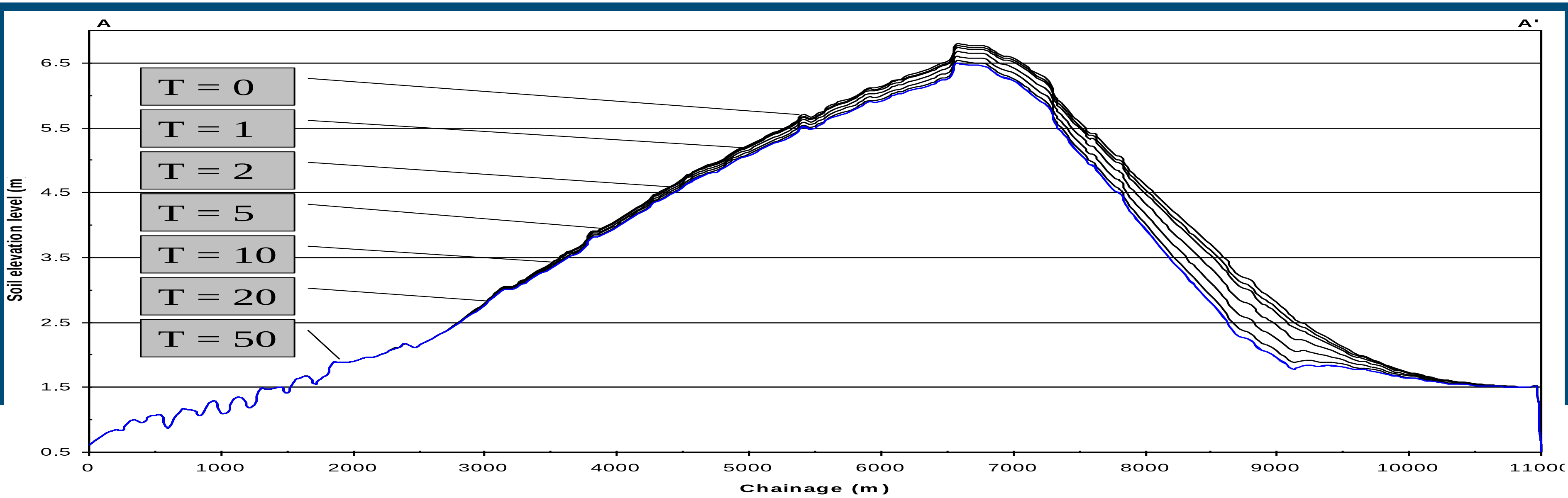
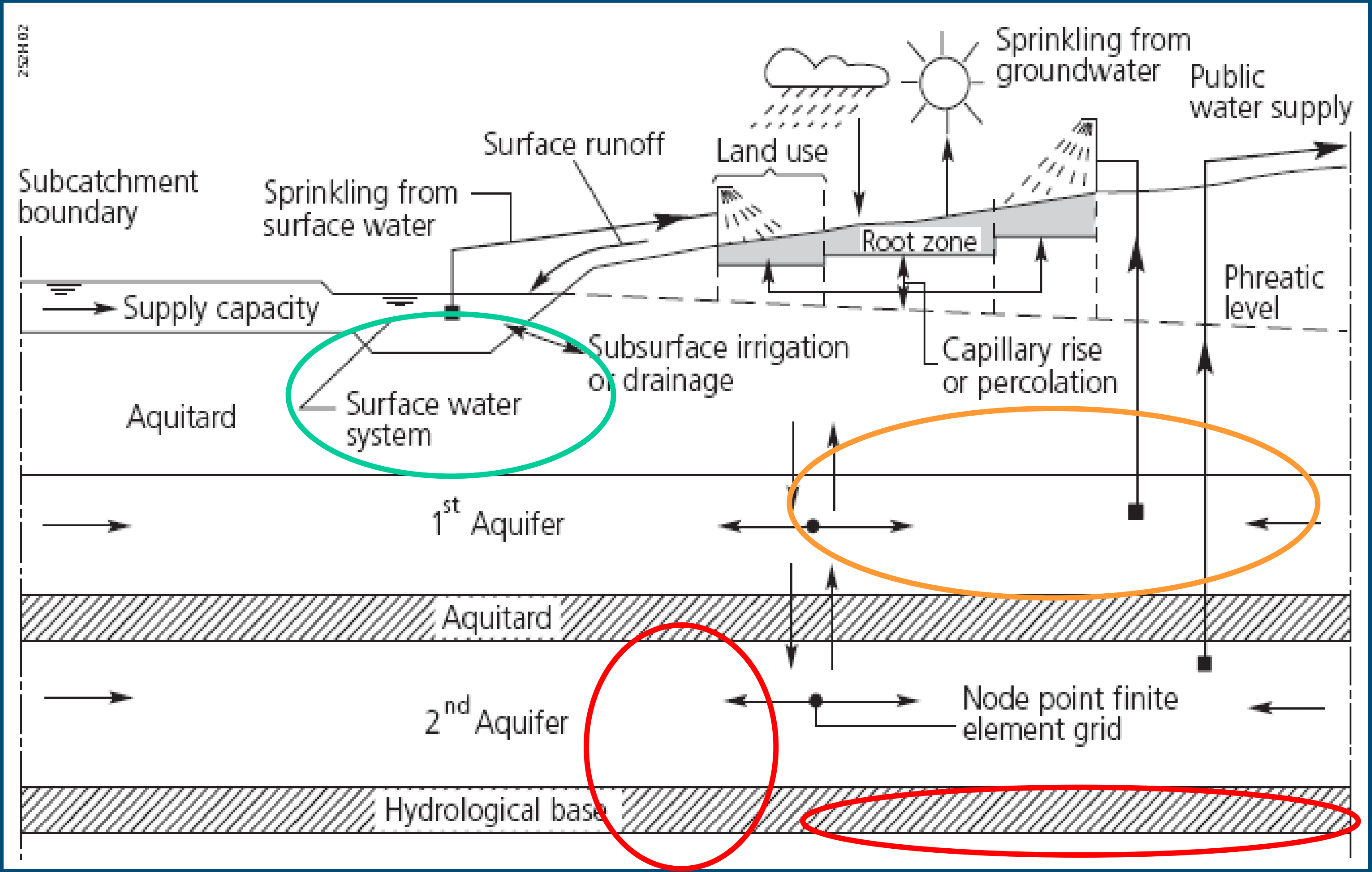
RESULTS – scenarios: subsidence over time





GROUNDWATER MODEL - Modflow



Surface Water

Unsaturated Zone

Saturated Zone

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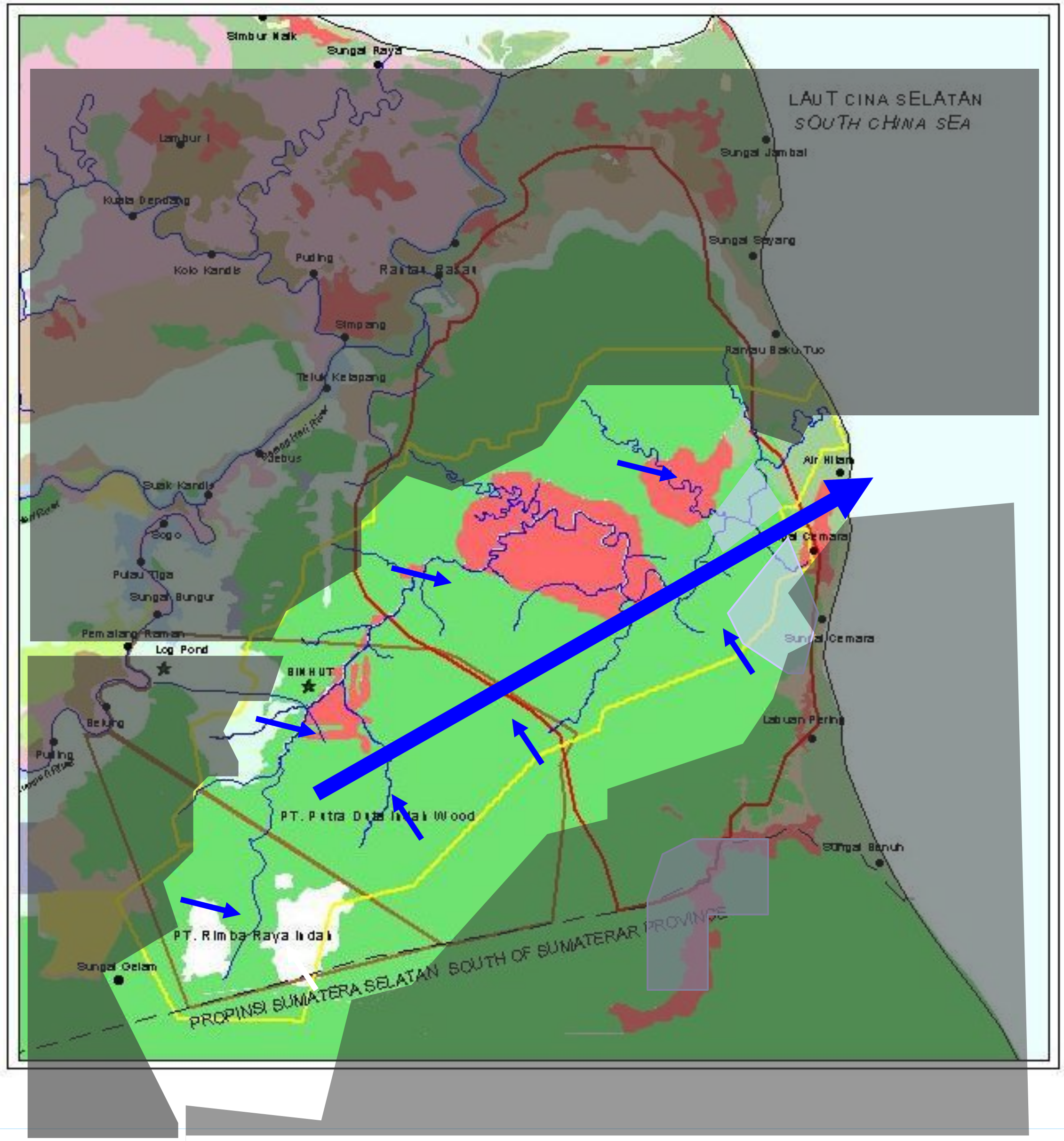
Querner, 1997

SIMGRO: Land Management

RESTORPEAT

Air Hitam, Jambi, Sumatra, Indonesia:

Oil palm plantations in the upper part of a peatland catchment



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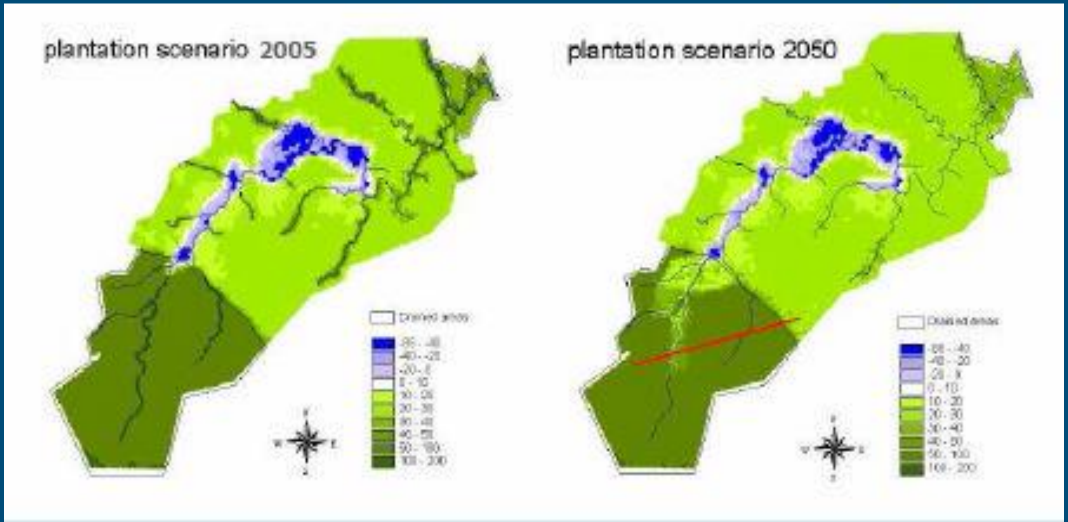
SIMGRO: Jambi, Sumatra, Indonesia

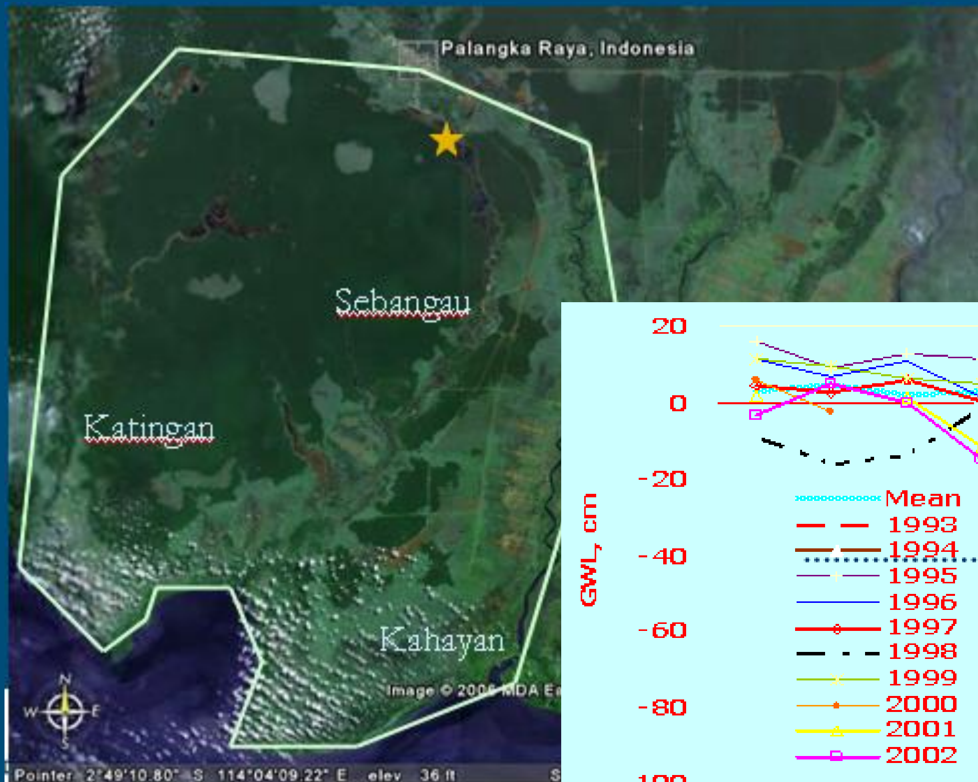
Plantations in the upstream part of the catchment will reduce flow rates and change directions of flow → changes in river flows



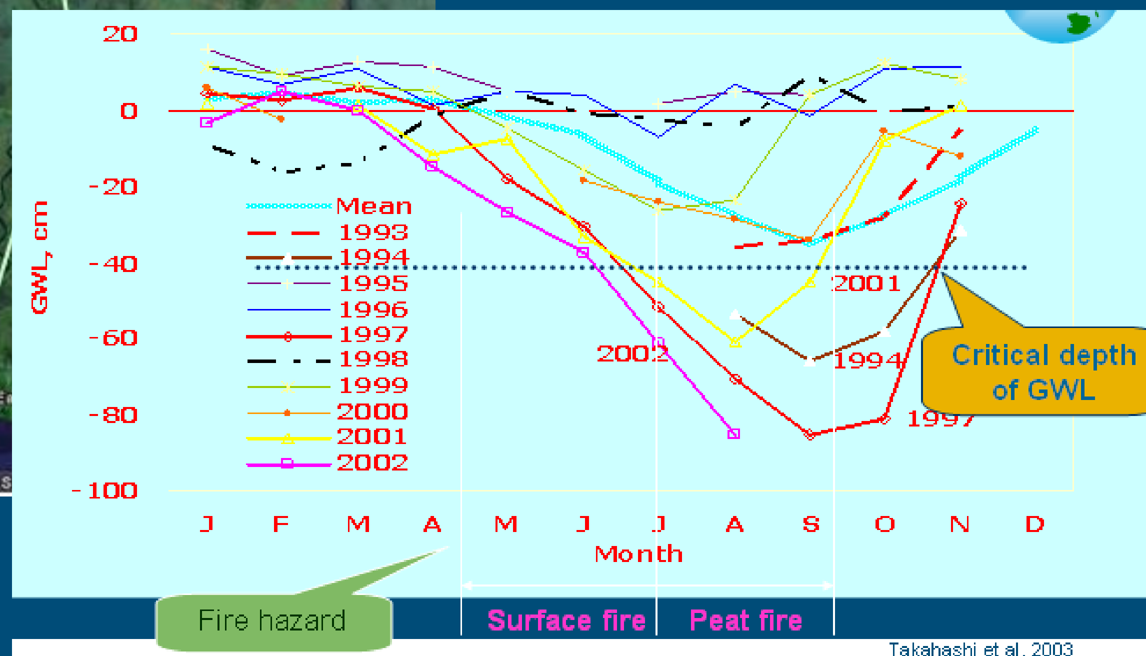
Siderius, 2004

SIMGRO: Sebangau, Central Kalimantan, Indonesia

RESTORPEAT



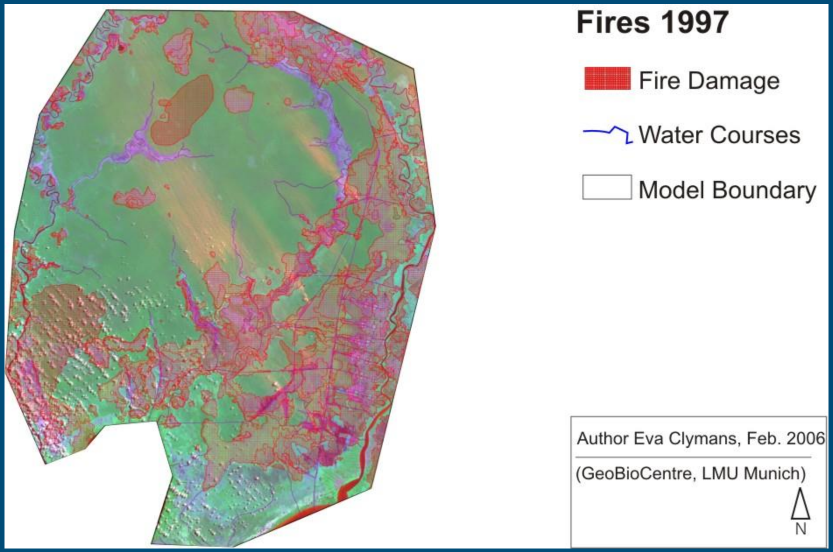
Fire risk assessment

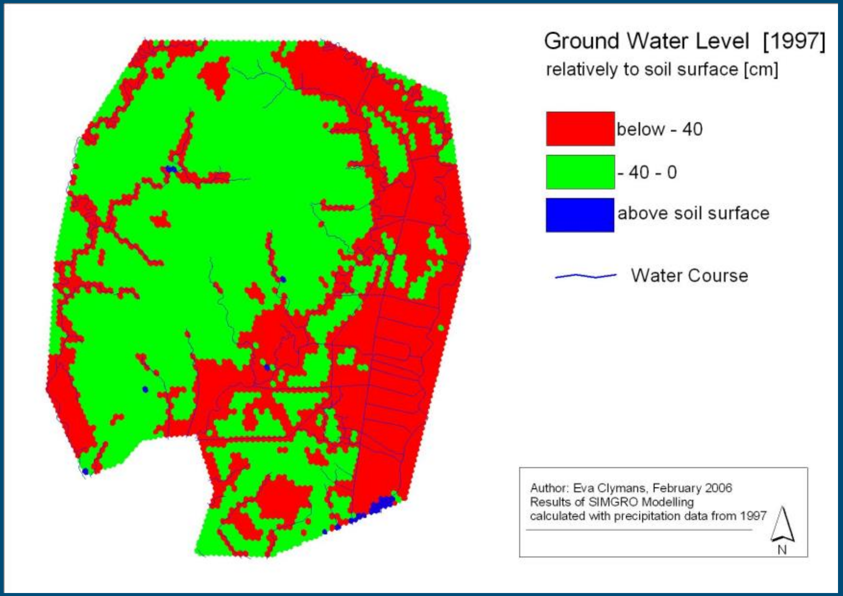


Clymans, 2006

ALTERRA-ILRI

SIMGRO: Sebangau, Central Kalimantan, Indonesia





Conclusions

- Inverse groundwater modelling can be used to assess the flow rates in tropical peatlands using data on groundwater fluctuations and rainfall

- Although hydraulic conductivity is high (K ≈ 30 m/d), groundwater flow is small (only a few percent of the rainfall) because of the low hydraulic gradients, but even with these small groundwater flow rates it is hard to maintain high watertables during dry periods

- Fluctuations of the watertable are mainly influenced by surface and interflow

- Models extrapolate groundwater levels in time and space

- Combining groundwater models with expert knowledge on e.g. agronomy, subsidence, ecology is a tool for scenario development

Thank you for your attention