The scenario of carbon management by water management, fire fighting and forest recovery in tropical peatland

Micro → Small → Meso → Large → Global – Scales

1 cm　10 m　10 km　1000 km

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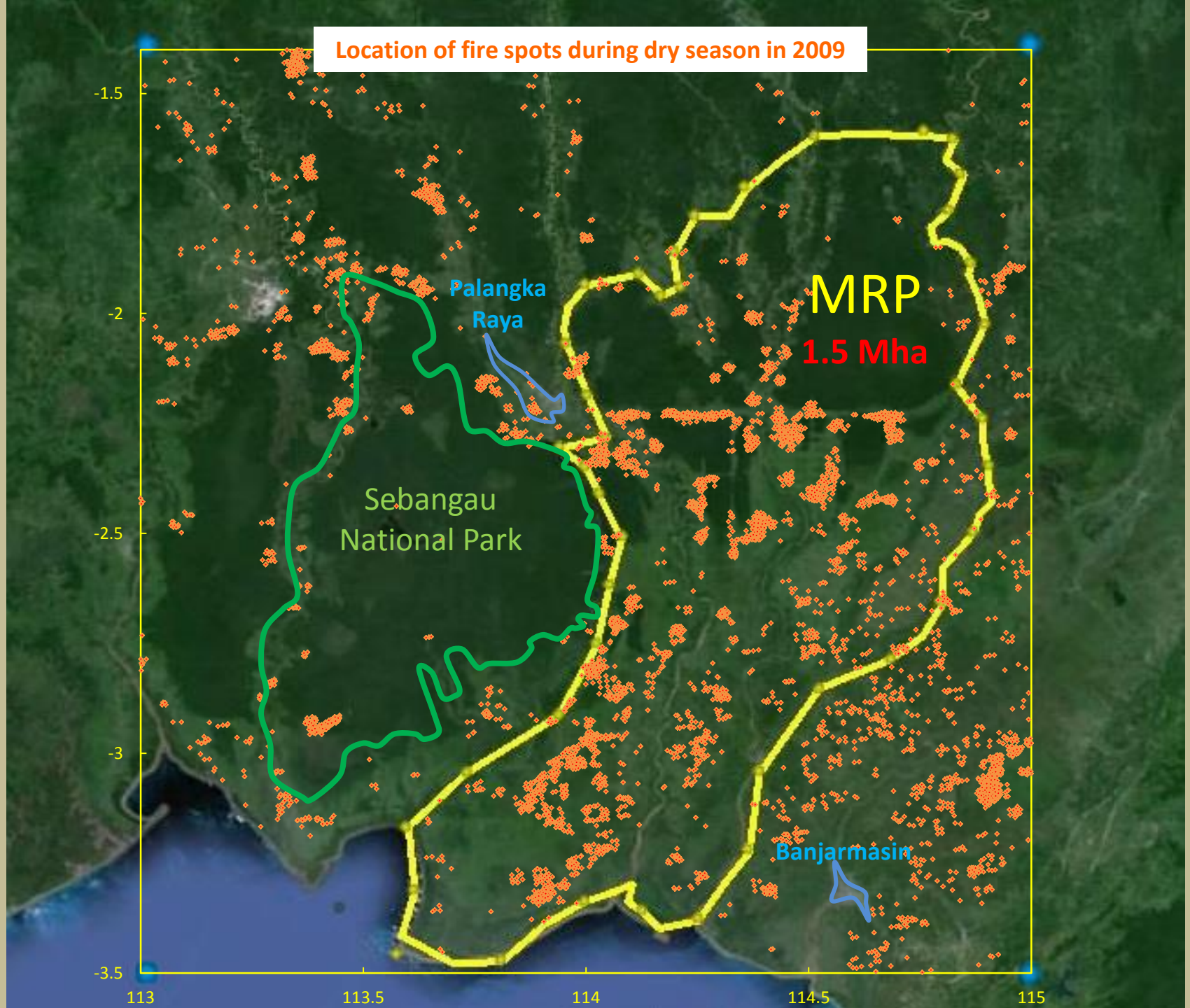
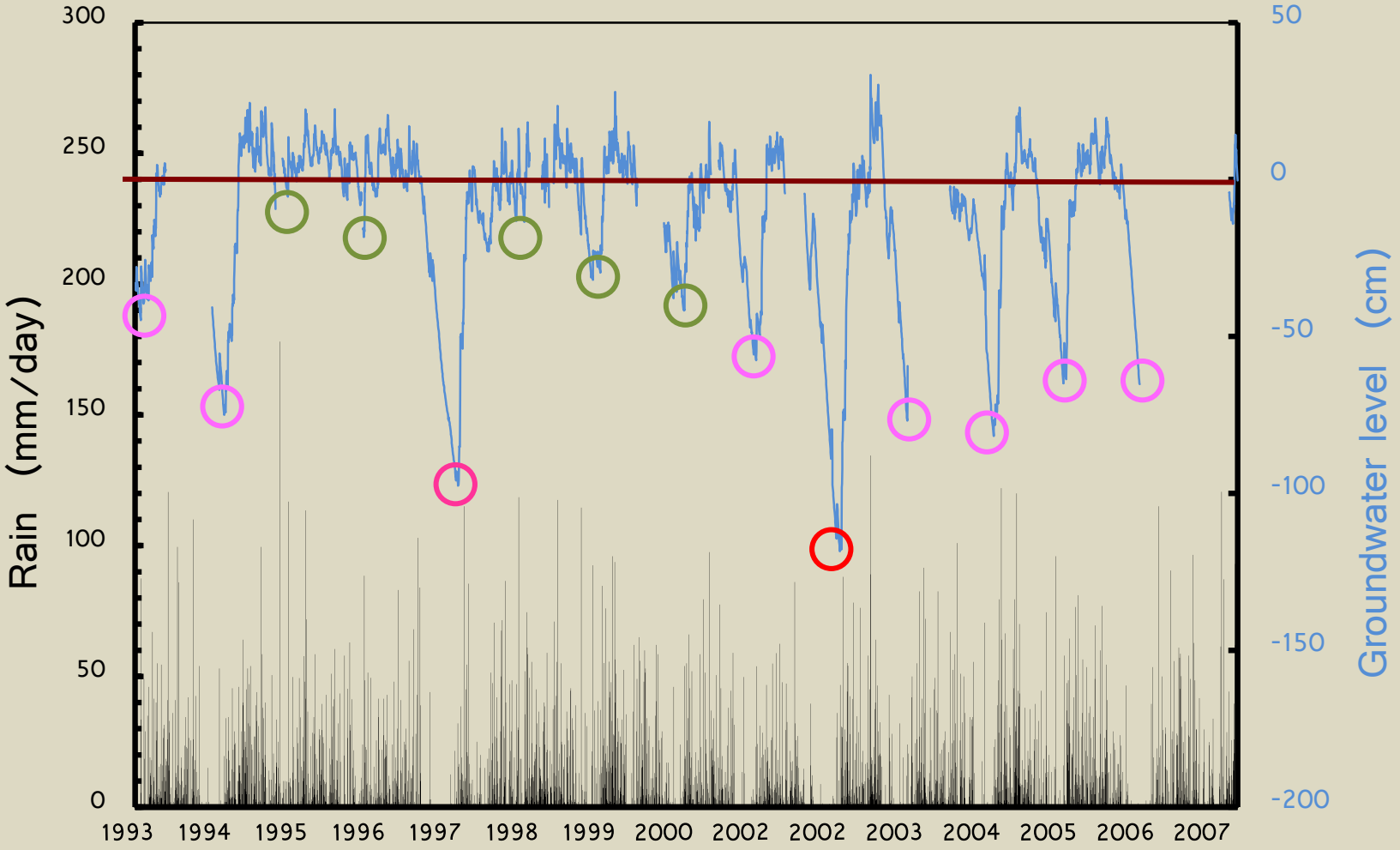
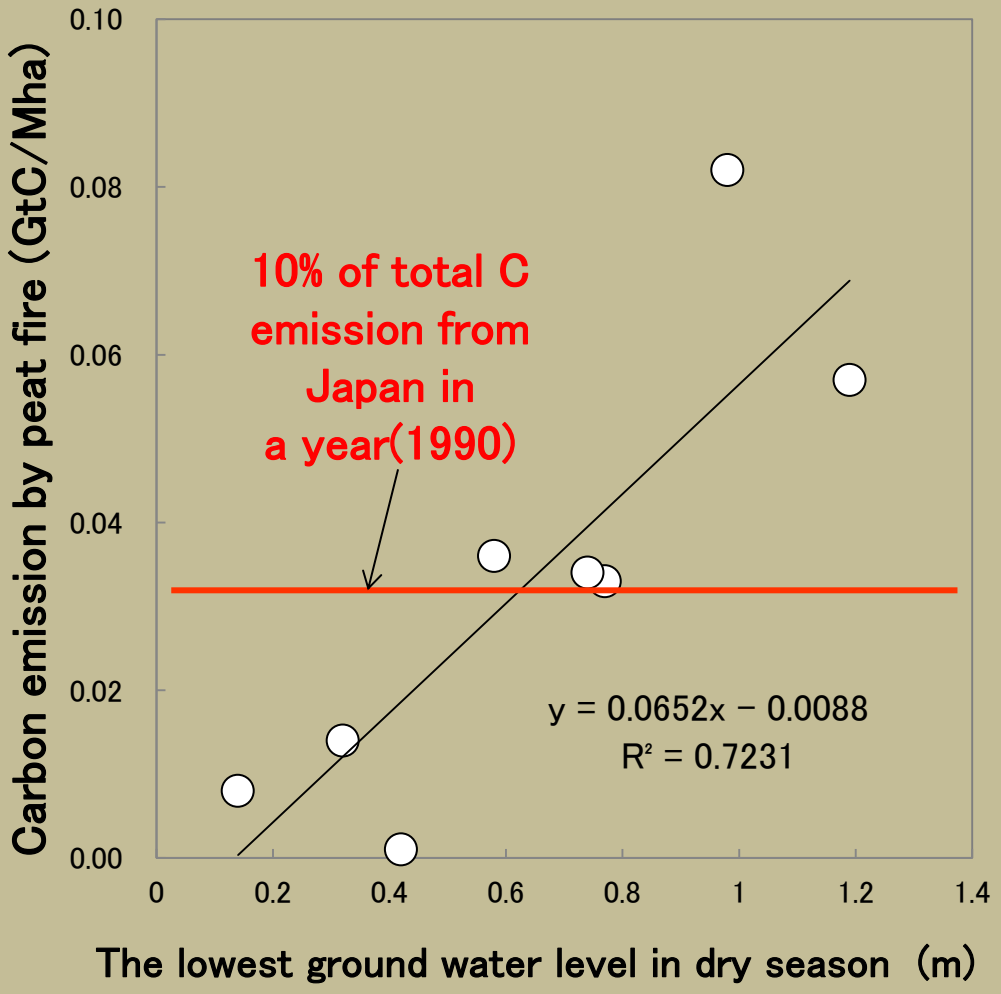
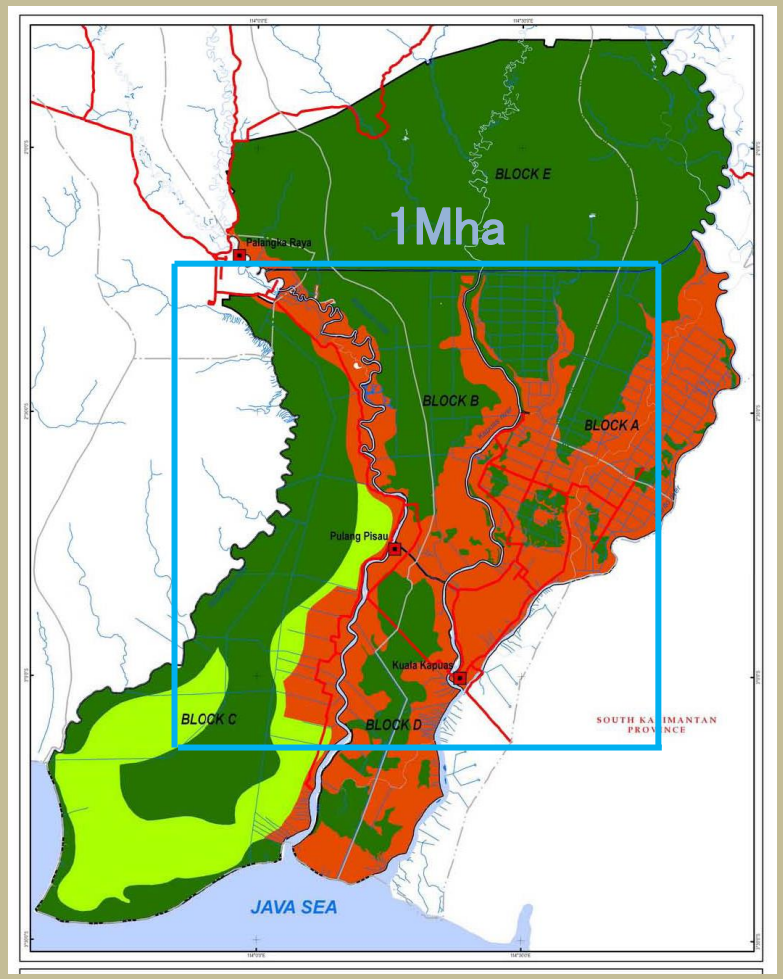

Location of fire spots during dry season in 2009
-1.5
-2
-2.5
-3
-3.5
113
113.5
114
114.5
115
Palangka Raya
MRP
1.5 Mha
Sebangau National Park
Banjarmasin

Groundwater level in a peat swamp forest and rainfall in Central Kalimantan, Indonesia

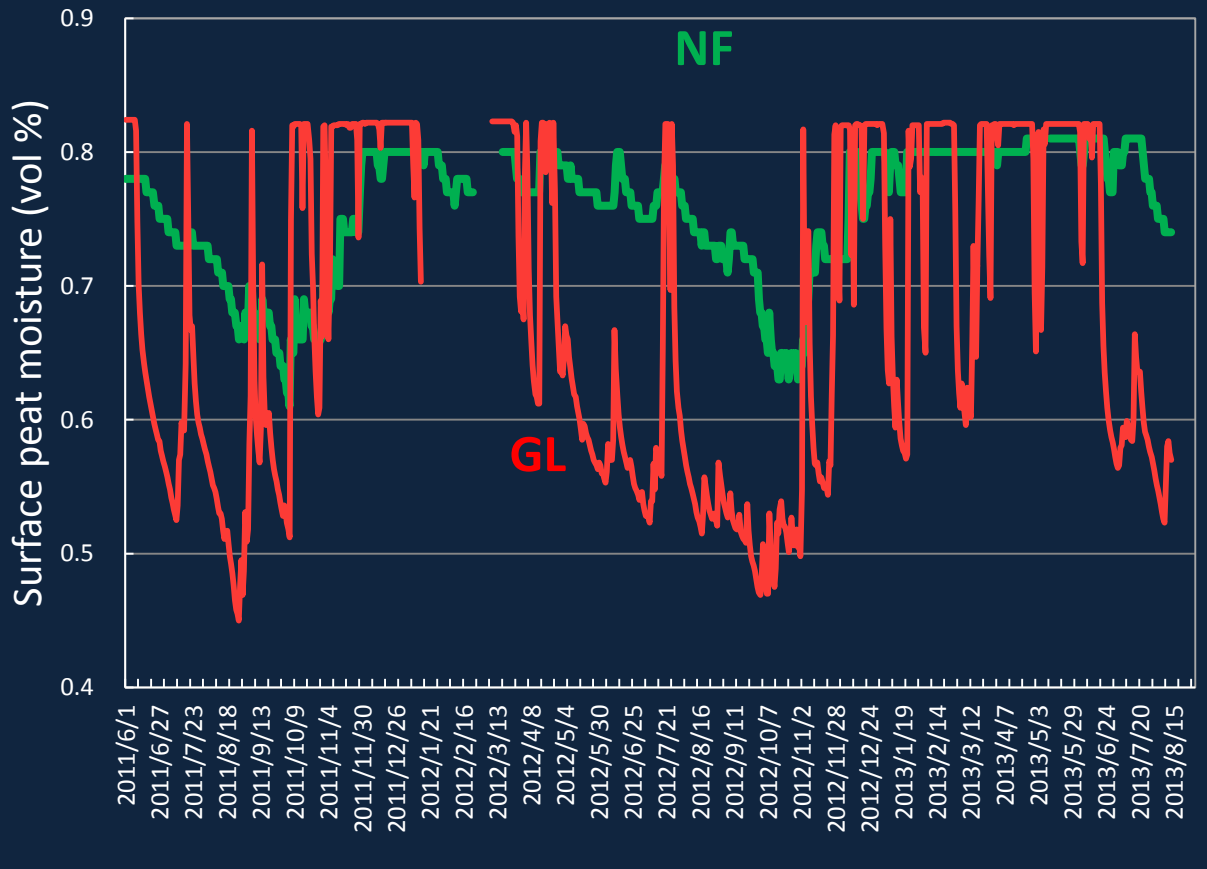


The lowest groundwater level in a year and carbon emission by peat fire in tropical peatland





Seasnal change of moisture contents of surface peat layer in different types of vegetation

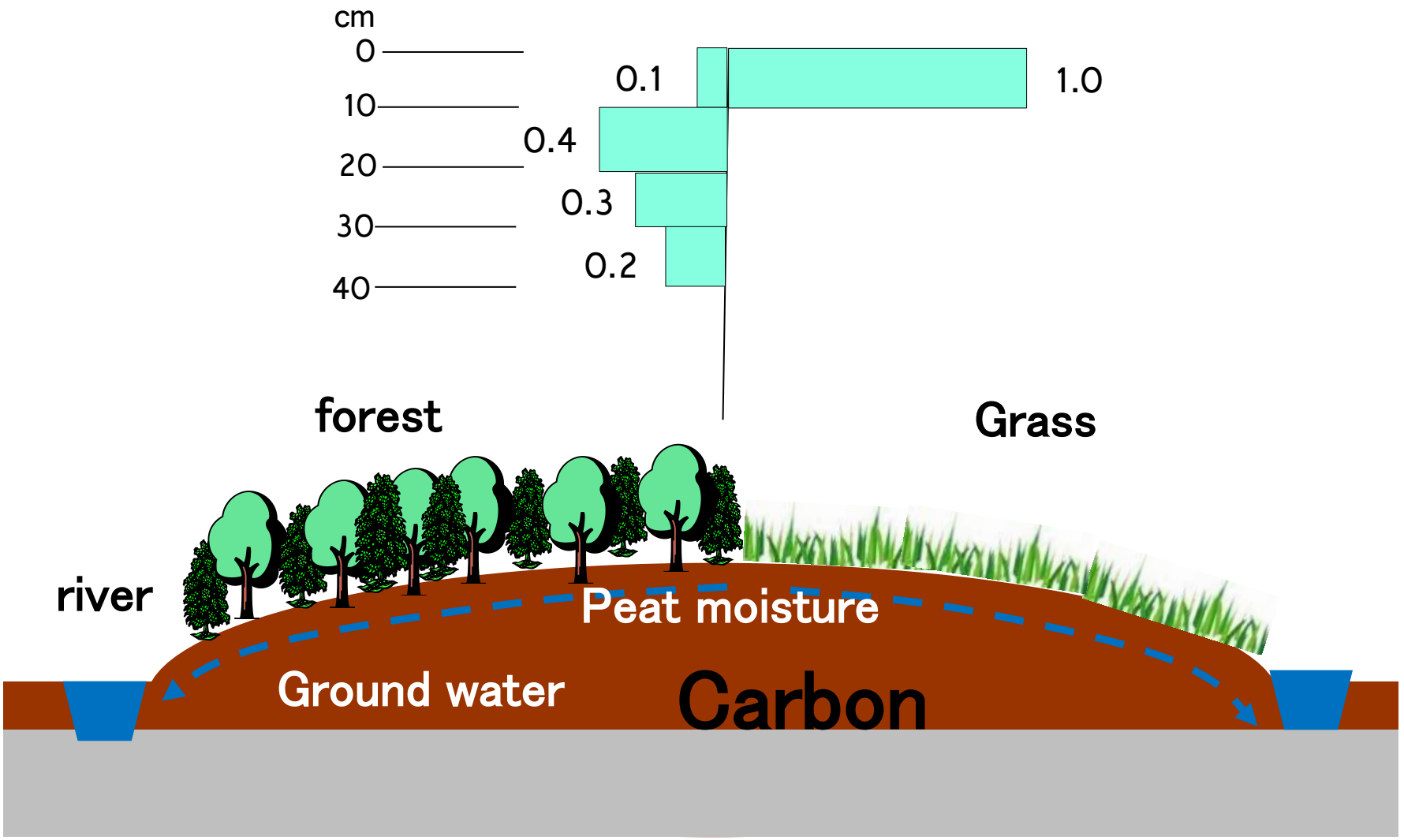


Data was contributed by Dr. Adi Jaya

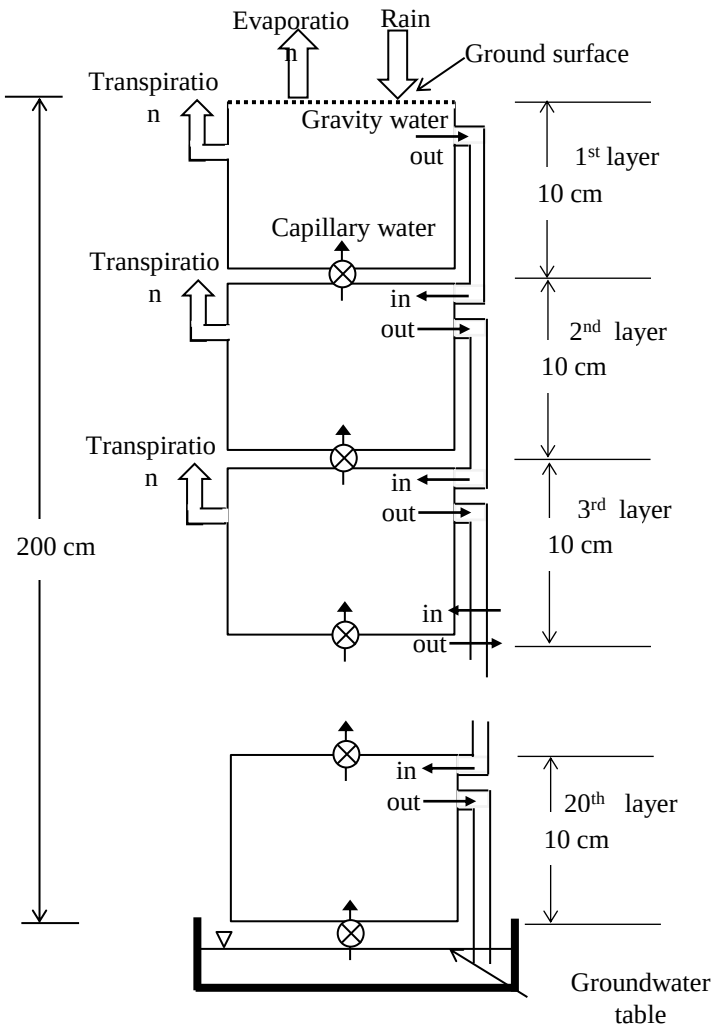
NF: Natural forest

GL: Grass land

Water use patterns by root system



Tank model for estimation of peat moisture



The water budget in the first layer in the unit time

$$\Delta W_1 = P + E + T_1 + F_{o1} + C_{i1} \qquad \text{Eq. 1}$$

where, ΔW_1: the change of water in the layer and subscript means number of layer, P: Rain, E: evaporation from the ground surface, T_1: transpiration through plant, F_{o1}: flow out to lower layer by infiltration, C_{i1}: flow in from lower layer by capillary.

The evaporation E in Equation 1 is replaced with the water flew into the first layer by capillary C_{i1} from the second layer. The rain P is replaced with the water F_{o1} flew out from the first layer. Transpiration T_2 becomes active when the second layer is unsaturated by water.

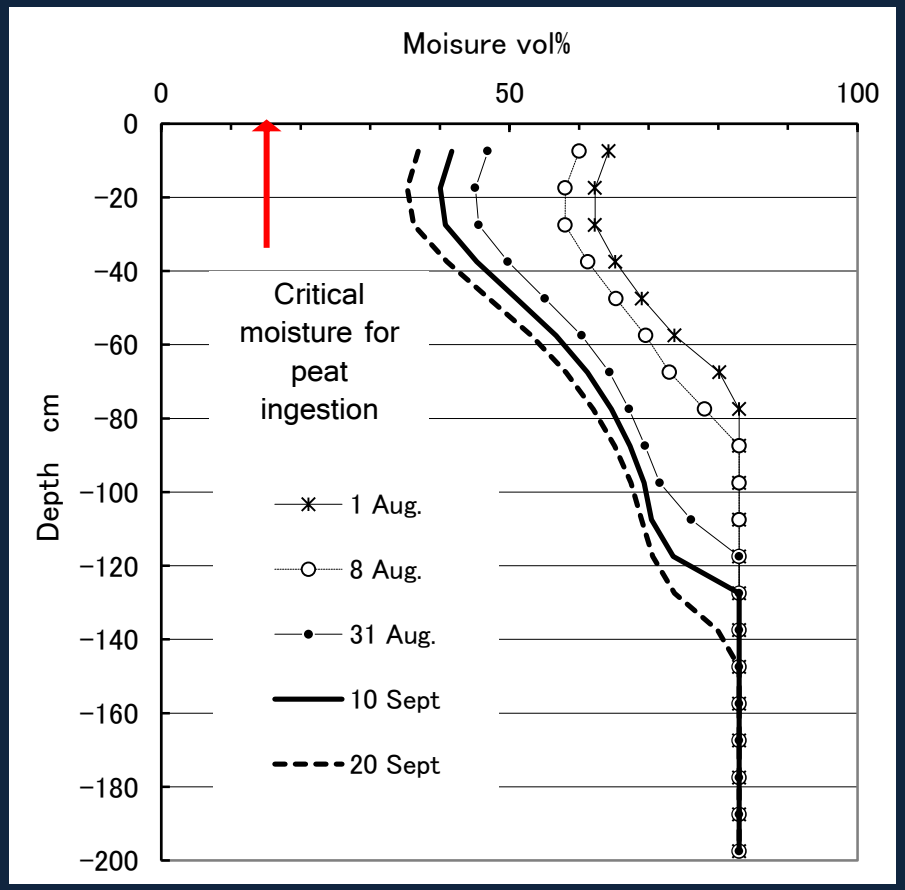
$$\Delta W_2 = F_{o1} + F_{o2} + C_{i1} + C_{i2} + T_2 \qquad \text{Eq. 2}$$

Water budgets in the layers without effect of transpiration are follows to next equation.

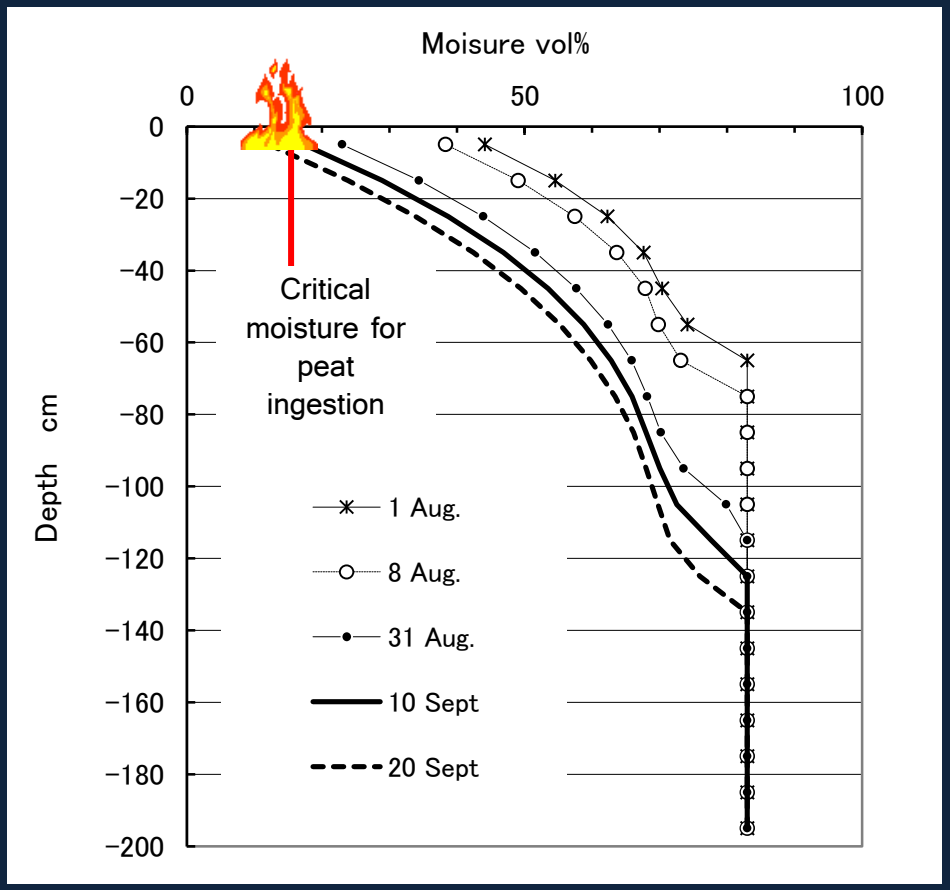
$$\Delta W_n = F_{on-1} + F_{on} + C_{in-1} + C_{in} \qquad \text{Eq. 3}$$

Peat moisture profiles

Evapotranspiration: 4 mm/day Balk density:0.17 g/cm^{33} Field capacity: 35 vol%



with dense canopy



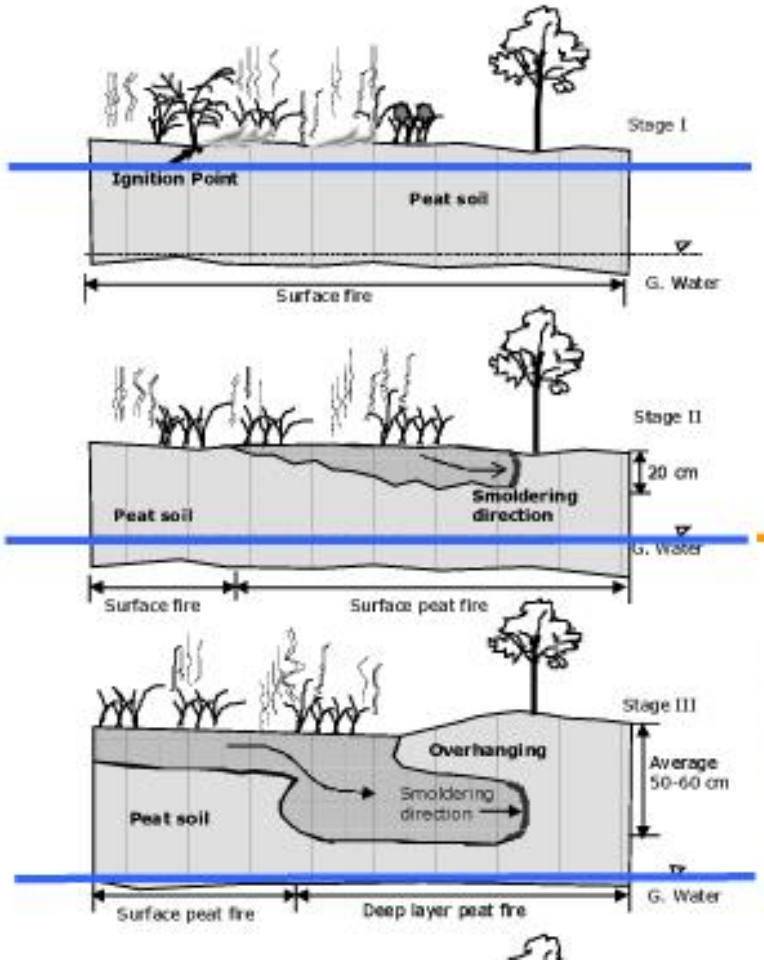
without canopy

Combustion process of peat fire

(A. Dj. Usup et al., 2003)

Igniting and expansion of peat fire

Lowering of groundwater level and drying of surface peat



Surface fire

Surface peat fire

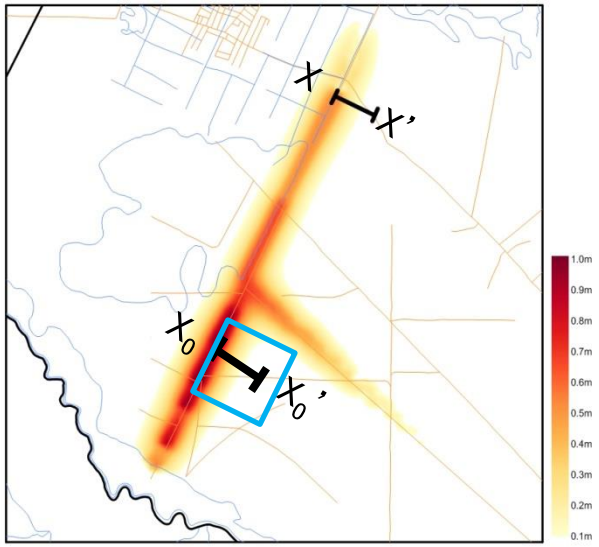
Deep peat fire

What is rewetting of tropical peatlands

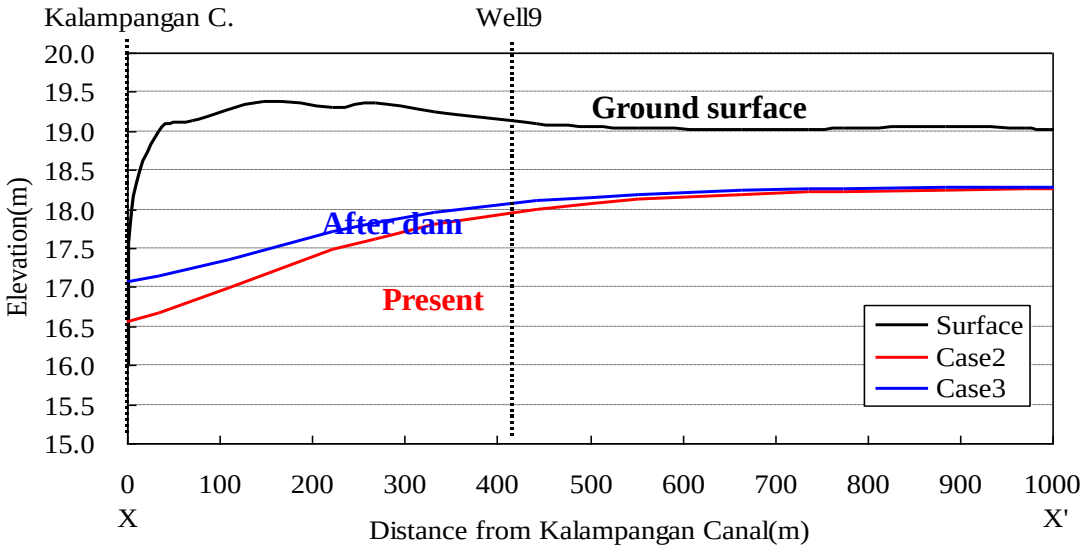
1. Increasing of groundwater level

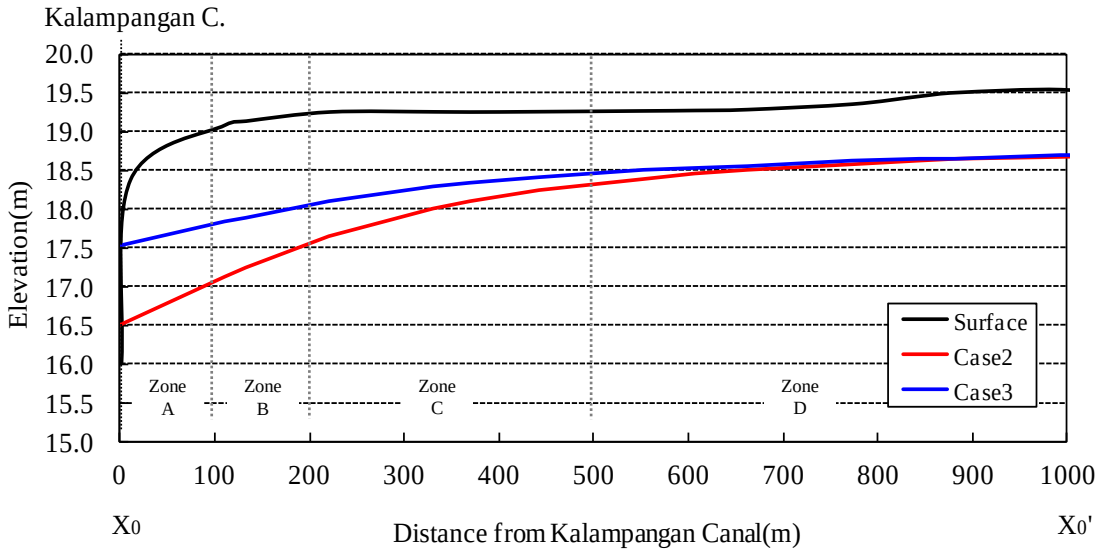
2. Recover the dense forest

Made clear the effects of canal and dam constructions on groundwater regime in peat dome (2)



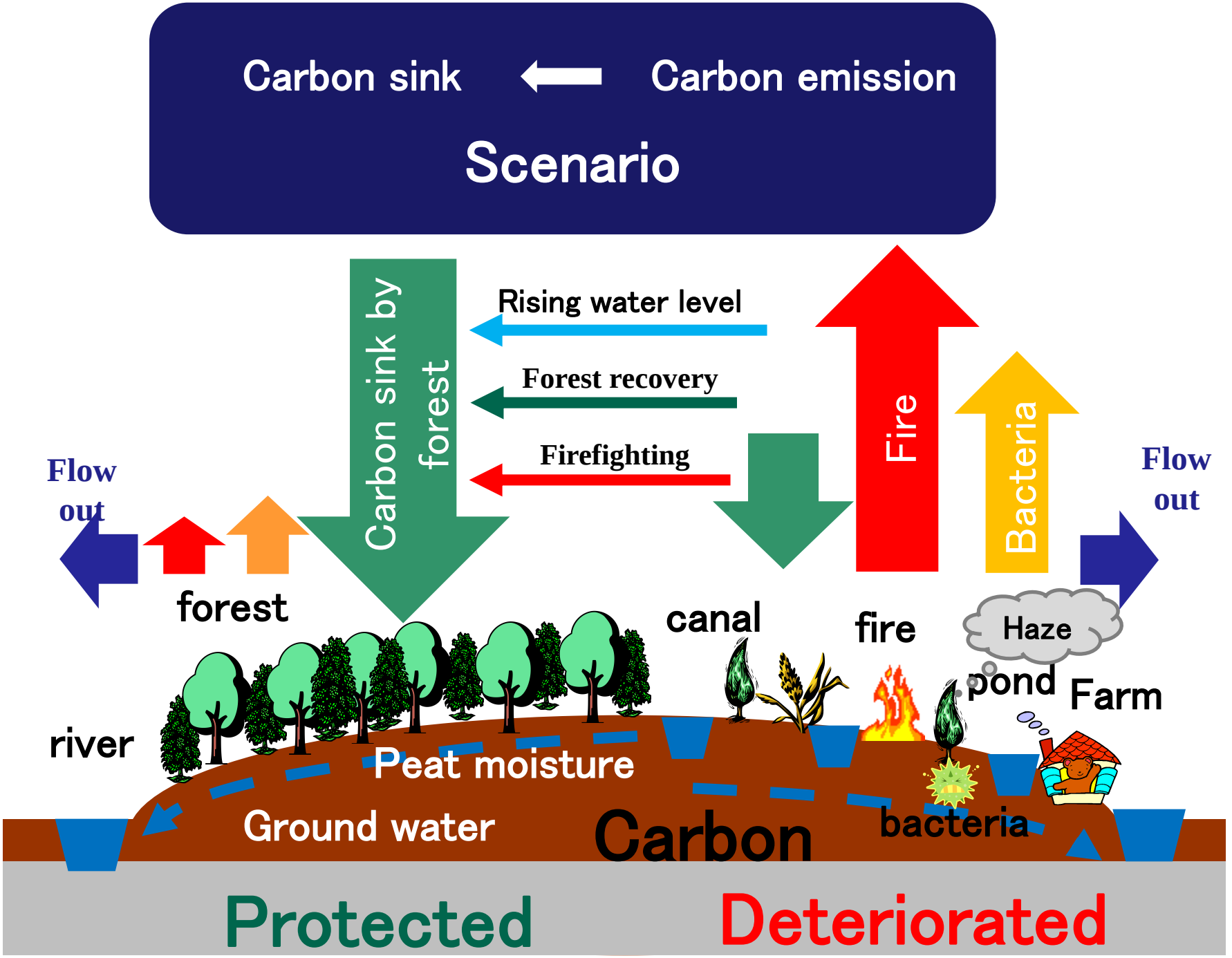
Increased groundwater level





Effect estimation of carbon management activities

	Dam construction					Fire fighting	Re-forest	Peat Moist
Zone (m)	Dam	GWL (m)	C- loss (Gt/ Mha)	C -loss (%)		Extinction rate (%)	C emit/sink	Ignite rate
A (100)	before	2.0	0.122	100		40		
	after	1.0	0.056	46.4		27.8	sink	down
B (100)	before	1.9	0.115	100		30		
	after	1.3	0.076	66.0		46.2	sink	down
C (300)	before	1.2	0.069	100		20		
	after	0.9	0.050	72.8		58.2	sink	down
D (500)	before	1.2	0.069	100		10		
	after	1.1	0.063	90.6		81.5	sink	down
Total (1000)	before		0.792	100				
	after		0.597	**75.3**		**61.8**	sink	down


Carbon sink ⟵ Carbon emission
Scenario
Carbon sink by forest
Rising water level
Forest recovery
Firefighting
Fire
Bacteria
Flow out
Flow out
forest
canal
fire
Haze
pond
Farm
river
Peat moisture
Ground water
Carbon
bacteria
Protected
Deteriorated

Conclusion

Reforestation and reformation of dense forest canopy is keys for prevention of peat fire

Terima kasih