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International Workshop on Peatland Management
*“Future Aspect of Management in Tropical and Cool Temperate Peatlands;
Harmonious and Sustainable Relationship with Nature”*

Peat Subsidence in Tropical and Cool Temperate Peatland

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Peatland development requires drainage (and proper water management)



Near Sapporo, Japan, ca. 1910

(Northern Studies Collection, Hokkaido University Library)



Central Kalimantan, 2011



Sarobetsu Peatland, Hokkaido, Japan, 2011

Drainage of peatland induce subsidence



Bibai, Hokkaido



Canal Bridge, Kalampangan, Central Kalimantan



Kalampangan, Central Kalimantan

Amount of subsidence (cm)

Apr/02 Apr/03 Apr/04 Apr/05 Apr/06 Apr/07 Apr/08 Apr/09

Date of survey

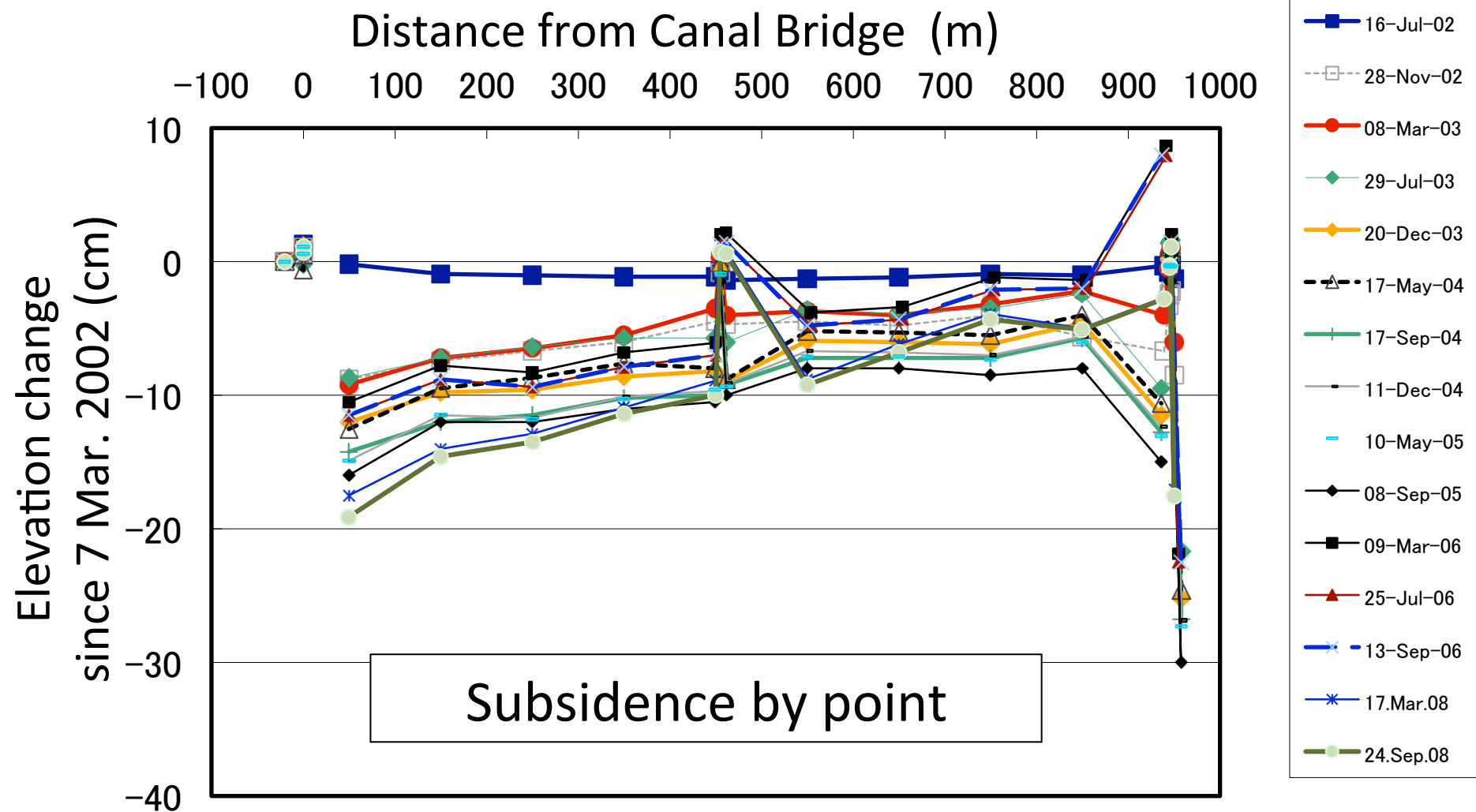
Cumulative subsidence at each point

Legend:

- Canal
- Bridge 1-3
- Bridge 1-1
- Bridge 1-2
- No.1
- No.2
- No.3
- No.4
- No.5
- No.6
- No.6-1
- No.6-2
- No.7

Road subsidence, Kalampangan, Central Kalimantan

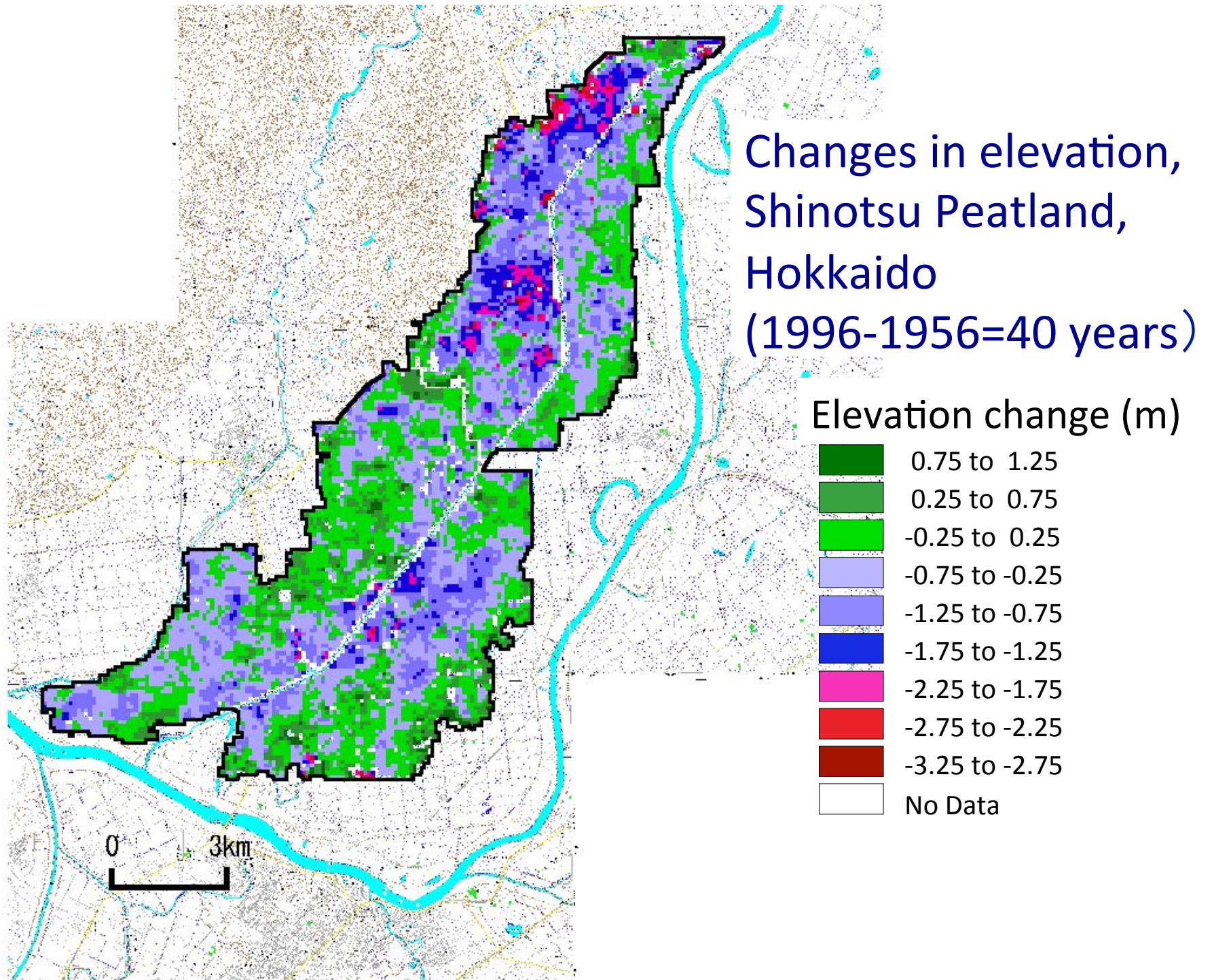
Mar. 2002 – Sept. 2008



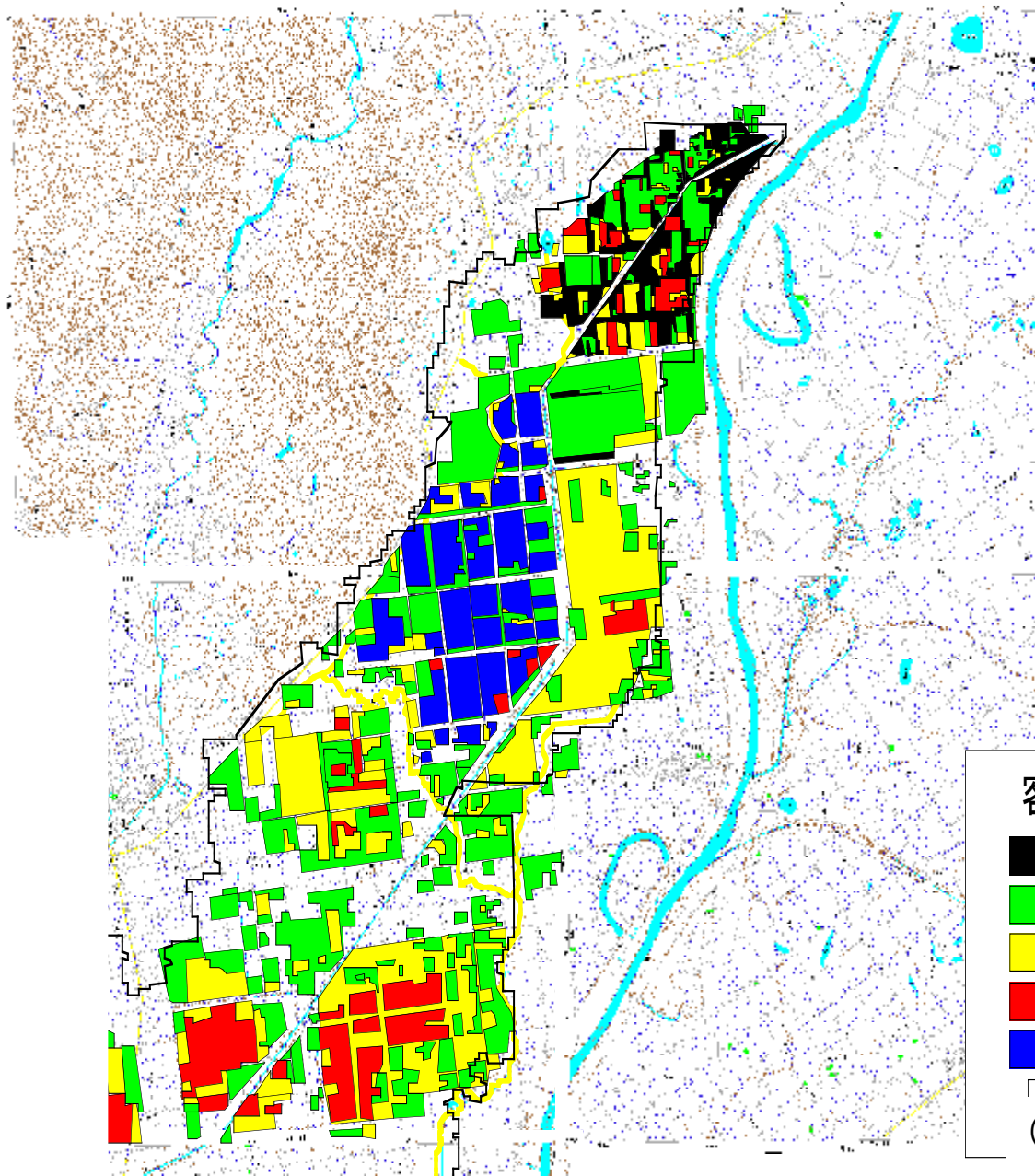




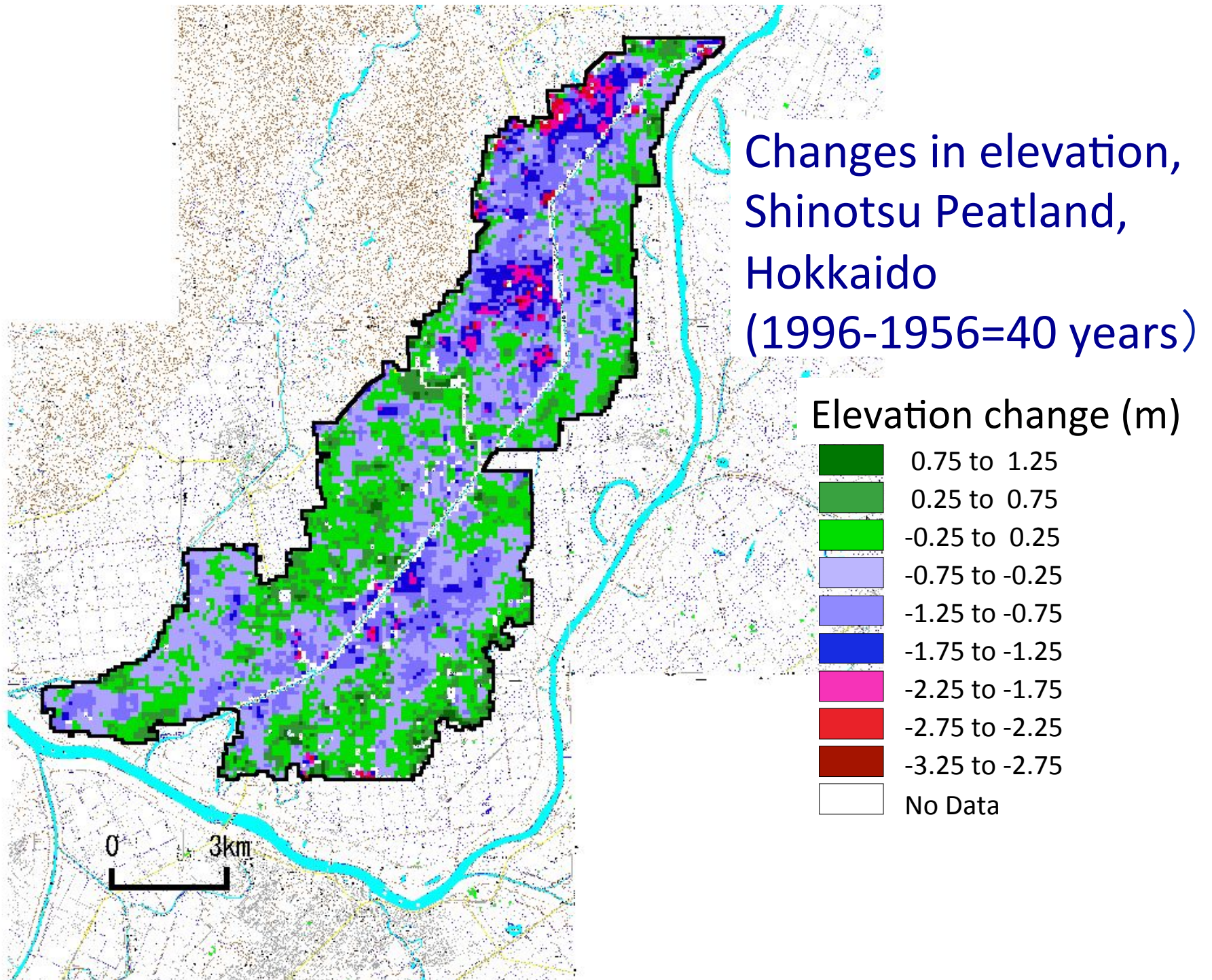
Peatland used as rice paddy in Shinotsu Peatland, Hokkaido



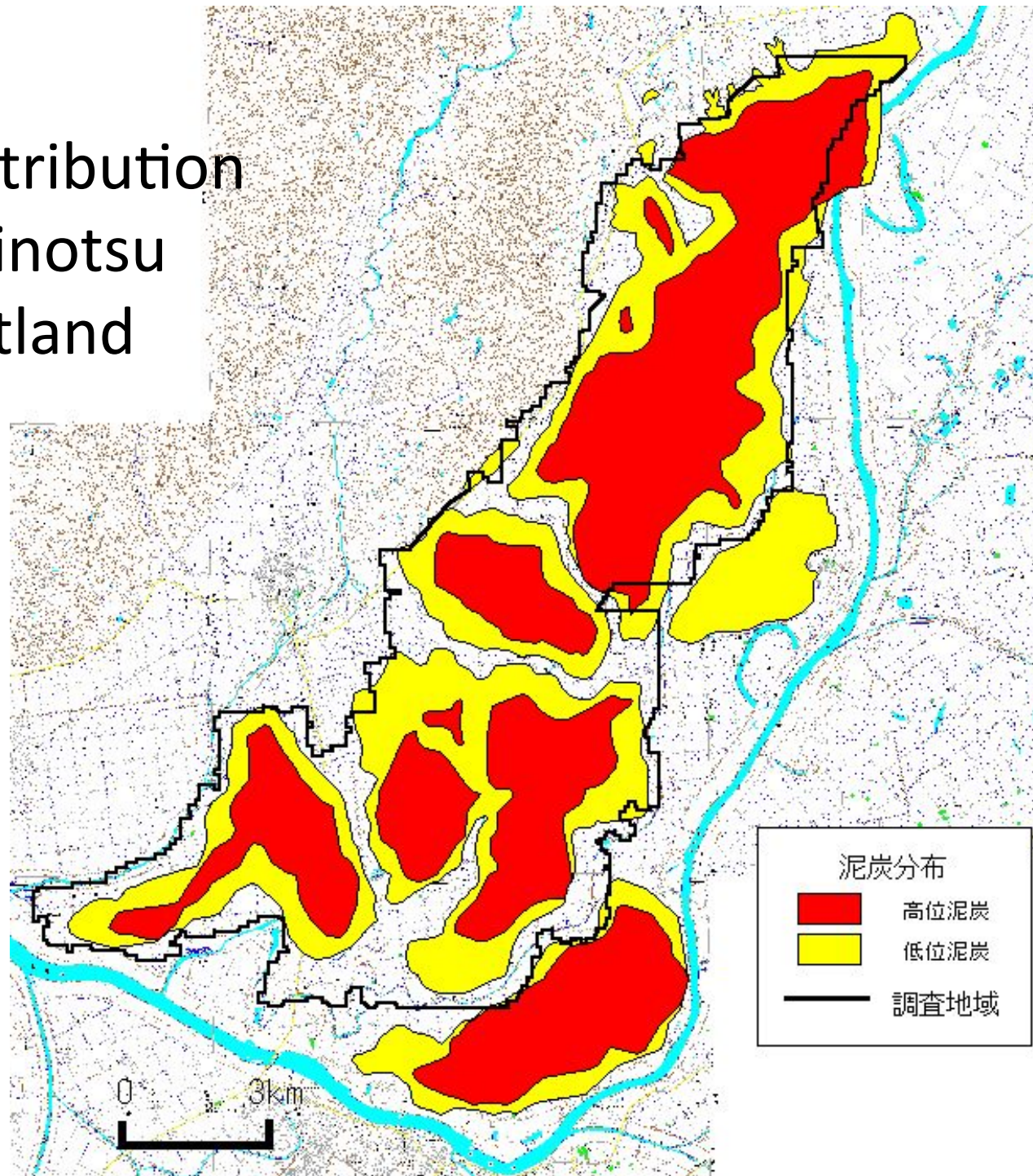
Thickness of dressed soil (1960~1992)



(after Koyama et al., 1995)



Peat distribution in Shinotsu Peatland

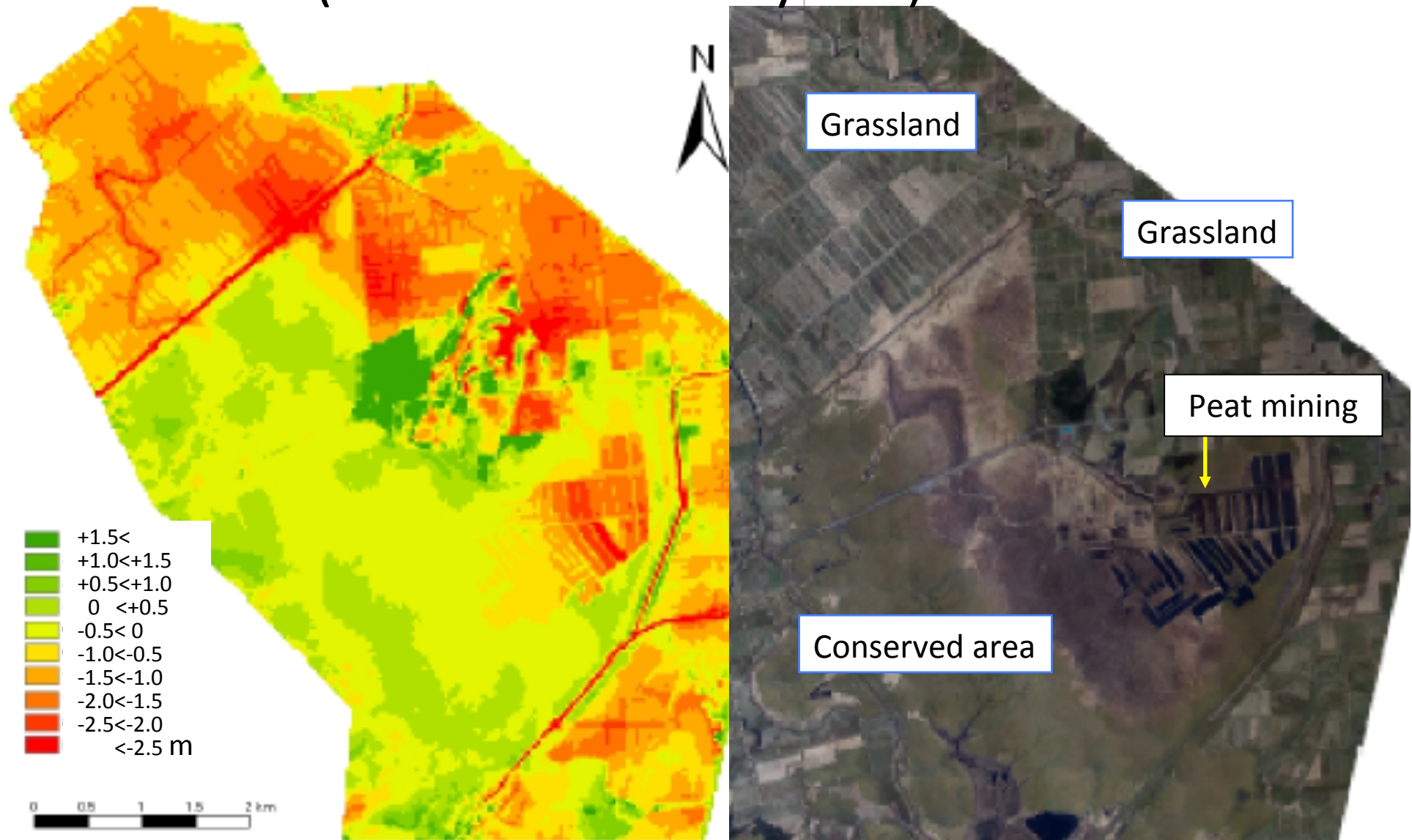


Sarobetsu Mire, Northern Hokkaido





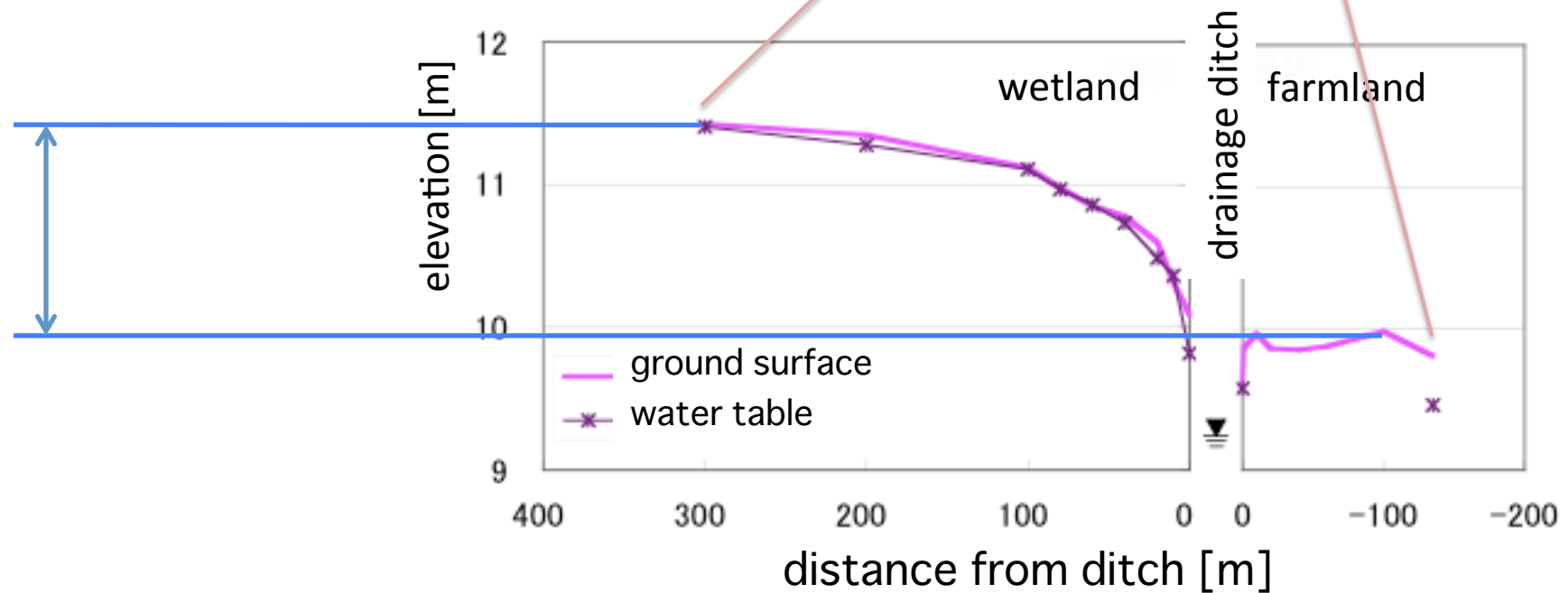
Subsidence of Sarobetsu Mire, Northern Hokkaido (2002 - 1956 = 46 years)

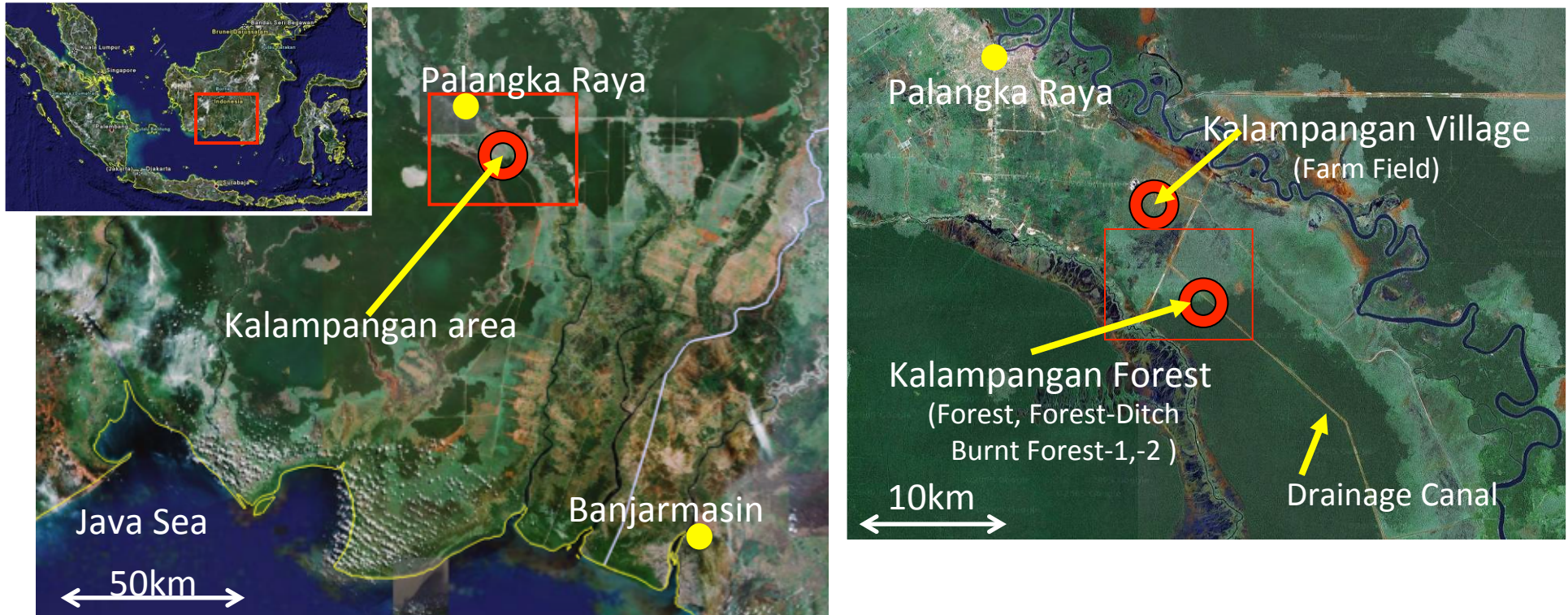






Cross section along wetland and farmland





Study Site

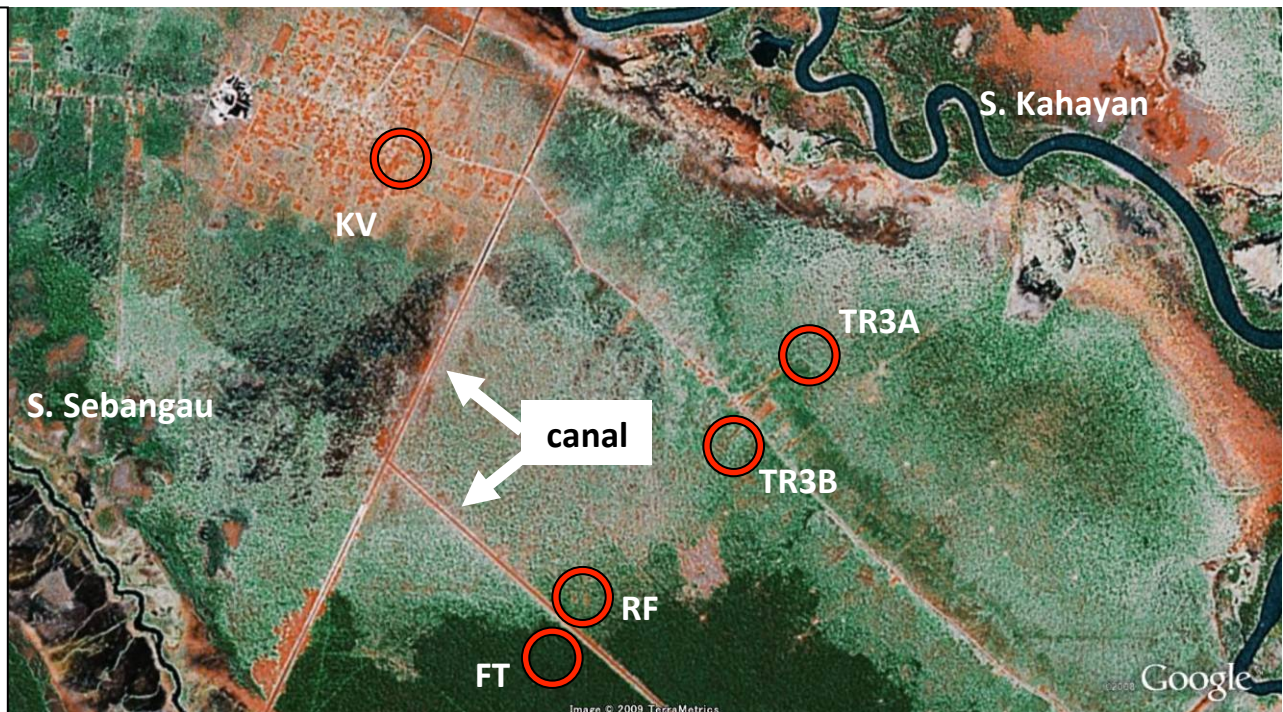
- Kalampangan area of the Central Kalimantan, Indonesia.
- Gradually reclaimed into agricultural area since late 1970's – early 1980's.
- Mega Rice Project affected part of the area by canal construction during 1996 and 1997.
- Forest fires (peat fires) occurred in 1997, 2002 and 2009.



Site of Subsidence Observation

- 3 sites measuring peatland subsidence since 2001.
- 2 new sites starting from 2008.
- Peat sampling by hand boring. Measurement of bulk density, C content, loss on ignition, etc.
- Hydrological measurement

- Farm plot in the village (KV)
- Regrowing forest (suffer fire in 1998, 2002 and 2009) (RF)
- Forest effected by the canal (FT)
- Disturbed shrub with high freq. of fire (TR3A)
- Disturbed shrub with less freq. of fire (TR3B)





Farm field (KV)



Regrowing forest (RF)



Forest effected
by canal (FT)



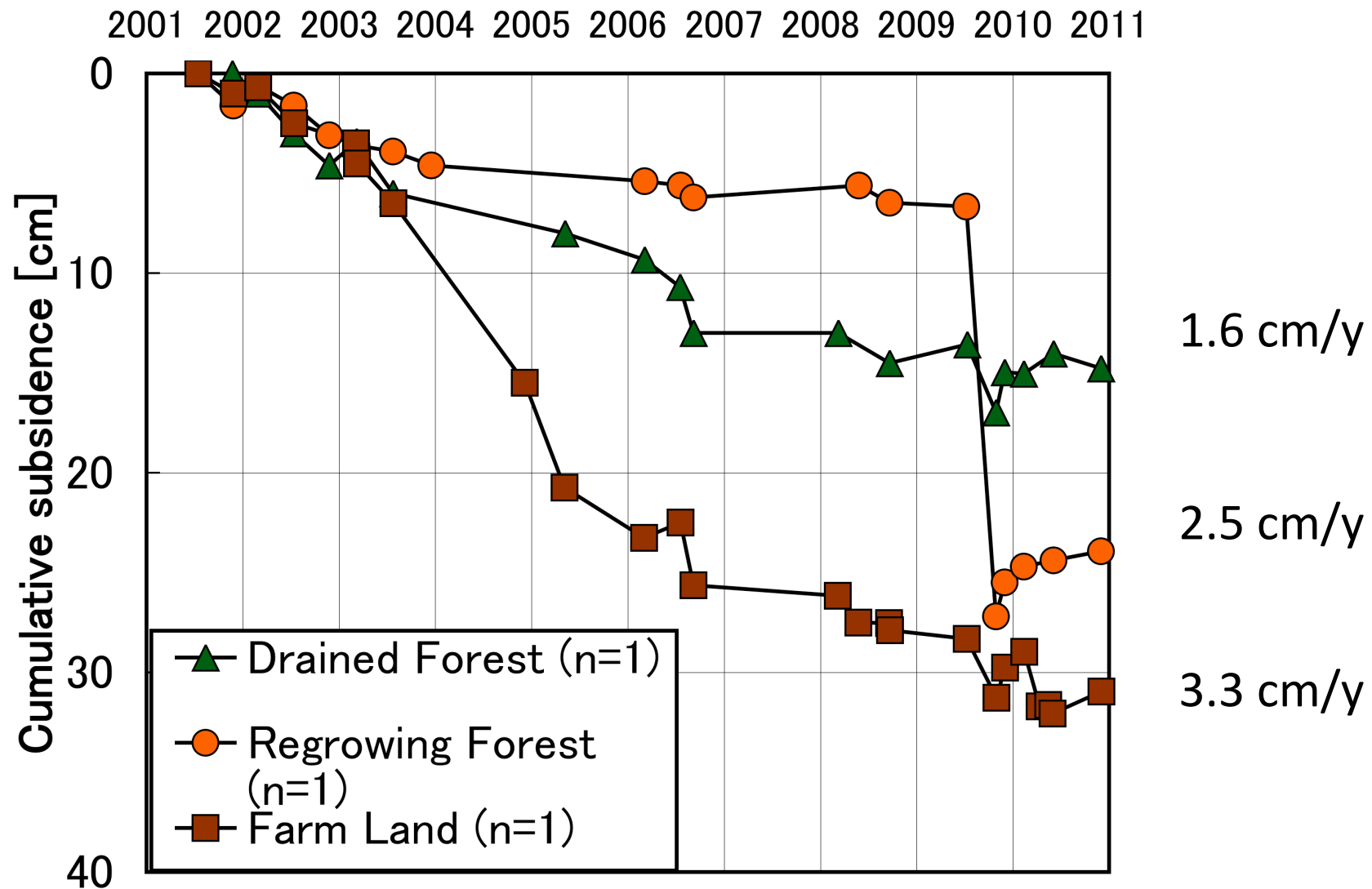
Disturbed shrub (TR3A)



Measurement iron and PVC pipes for subsidence in KV (Farm plot in Kalampangan village, KALTENG)

Amount of subsidence since 2001.

Subsidence in Kalampangan, Central Kalimantan



3 causes of subsidence

Subsidence = compression + decomposition

||

[consolidation
+
shrinkage]

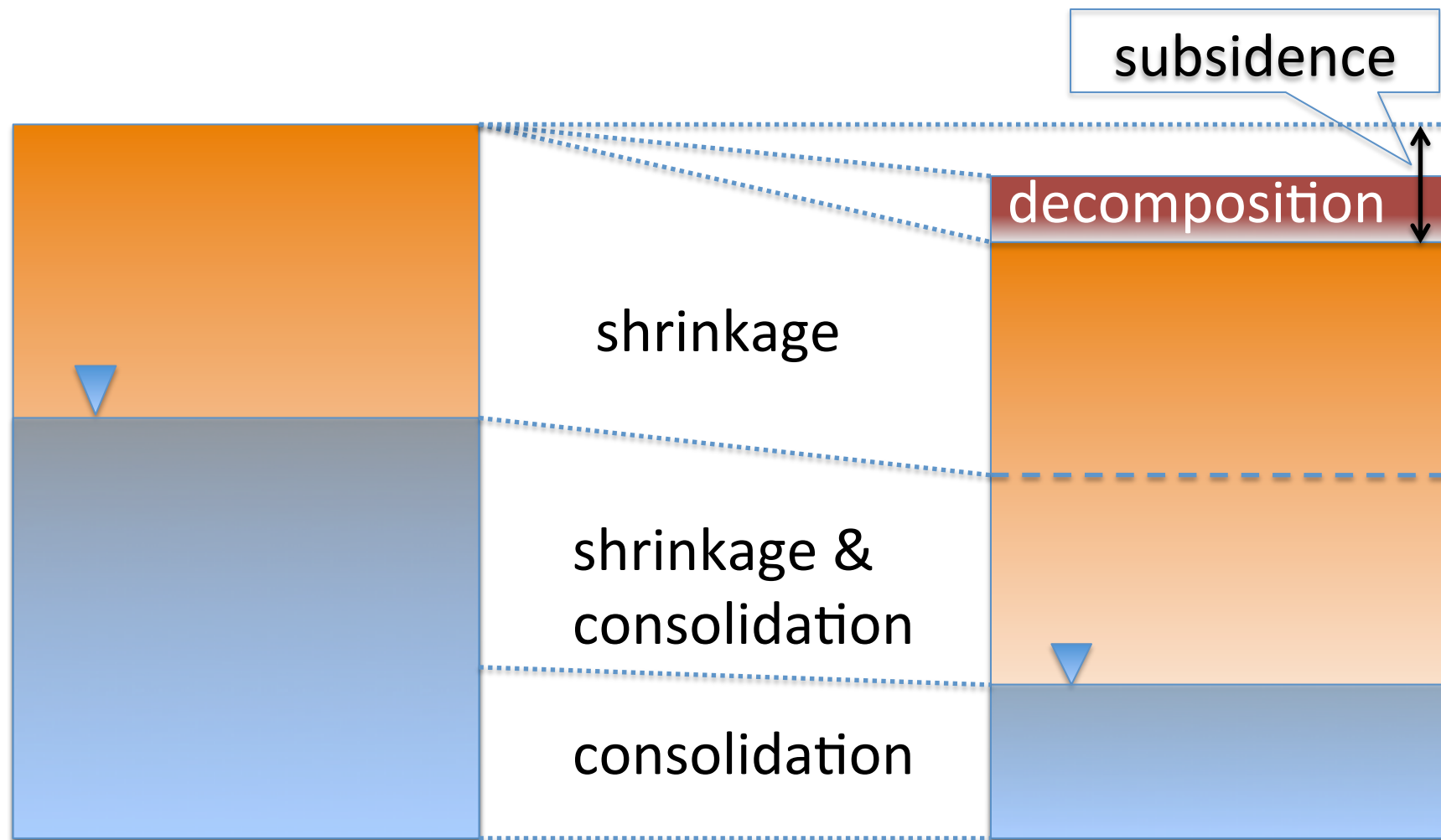
||

activity of
microorganism

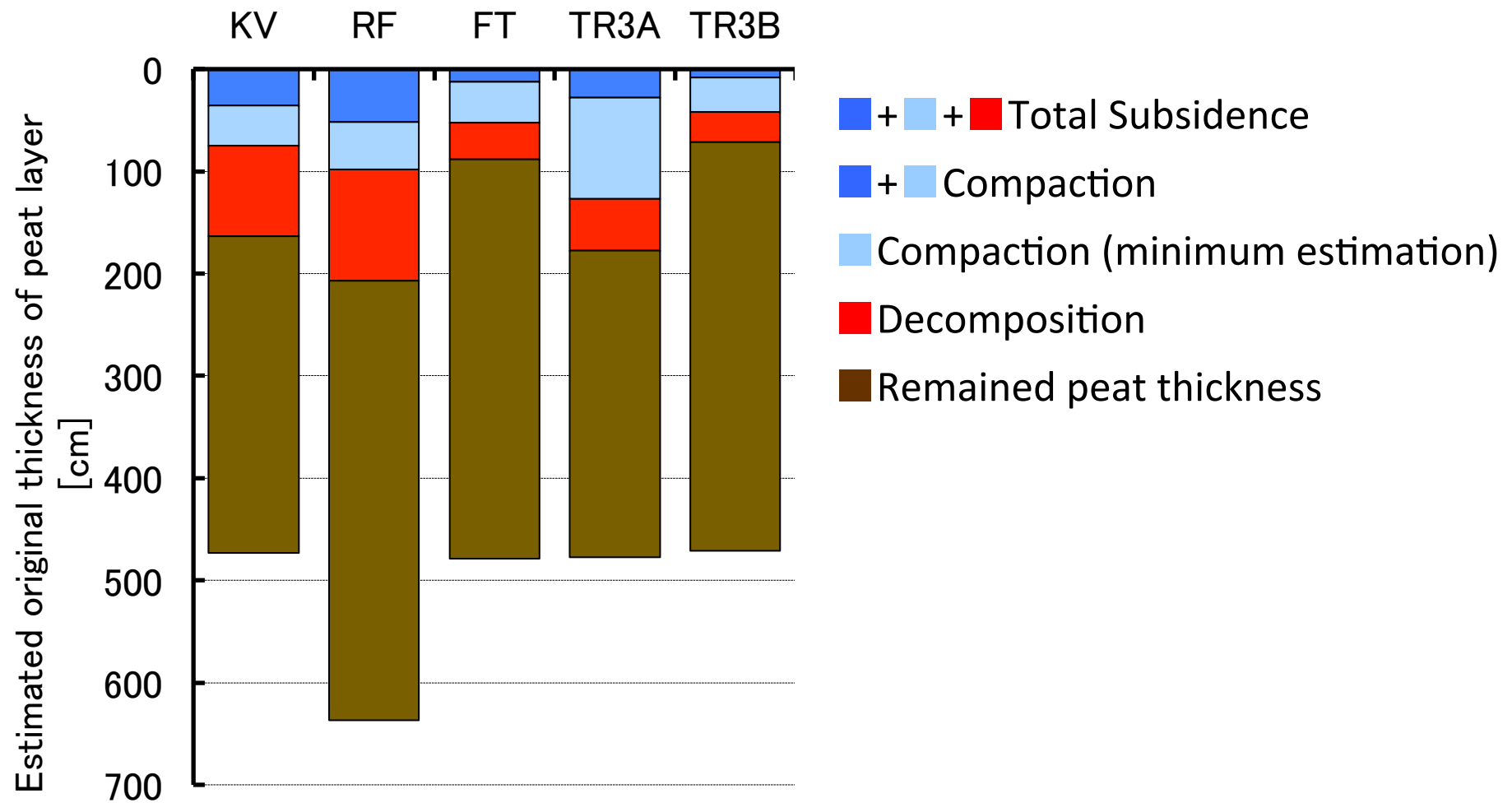
Definitions;

- ✘ compression = physical volume change.
- ✘ consolidation = physical volume change accompanied by dehydration.
- ✘ shrinkage = physical volume change not accompanying dehydration.

Consolidation, shrinkage and decomposition

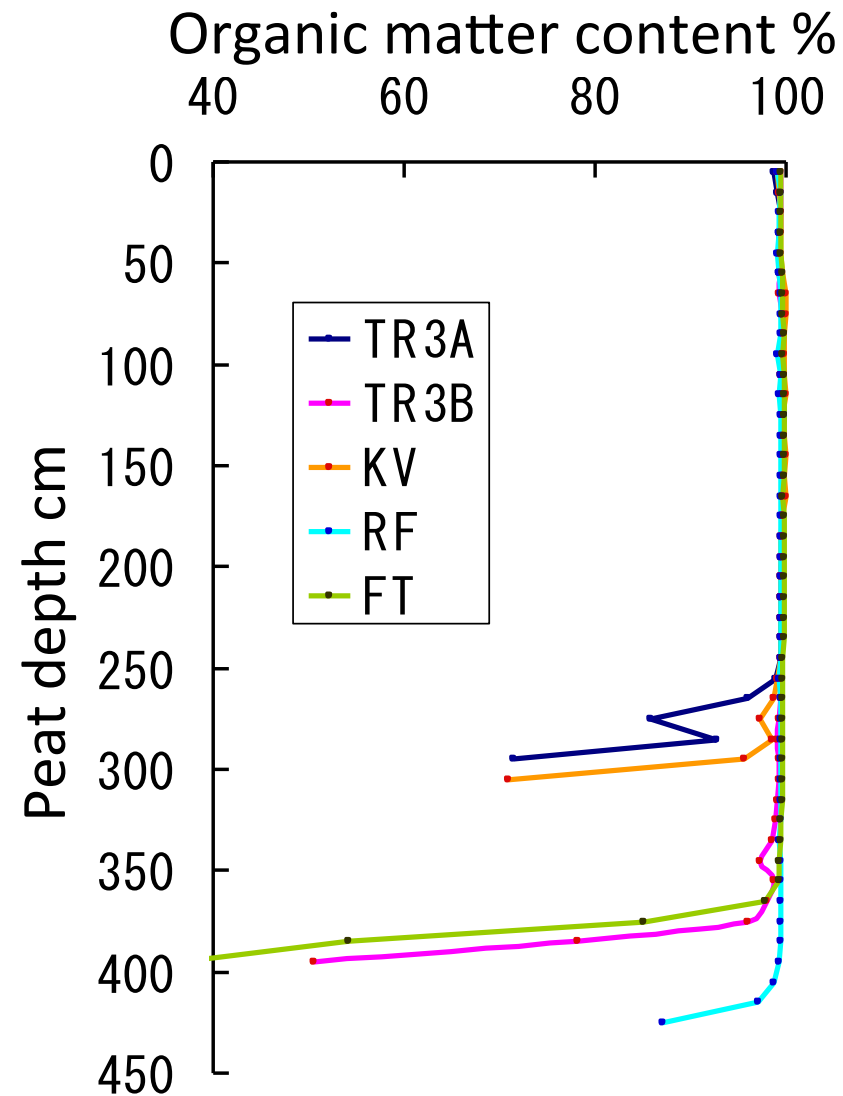


Example of result of factor estimation for subsidence

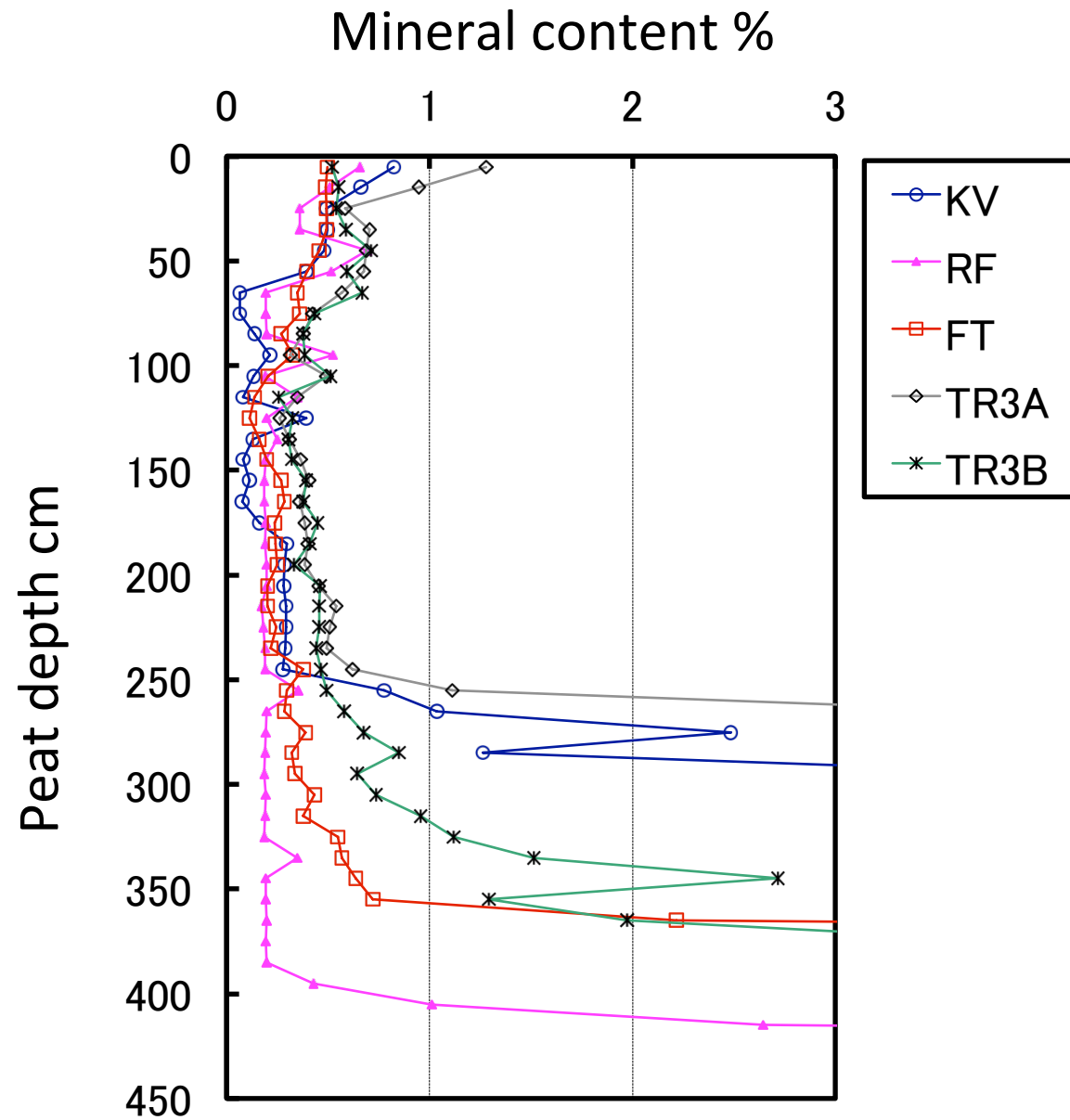


Organic matter content of peat

More than 99% in
Kalampangan area,
Central Kalimantan.

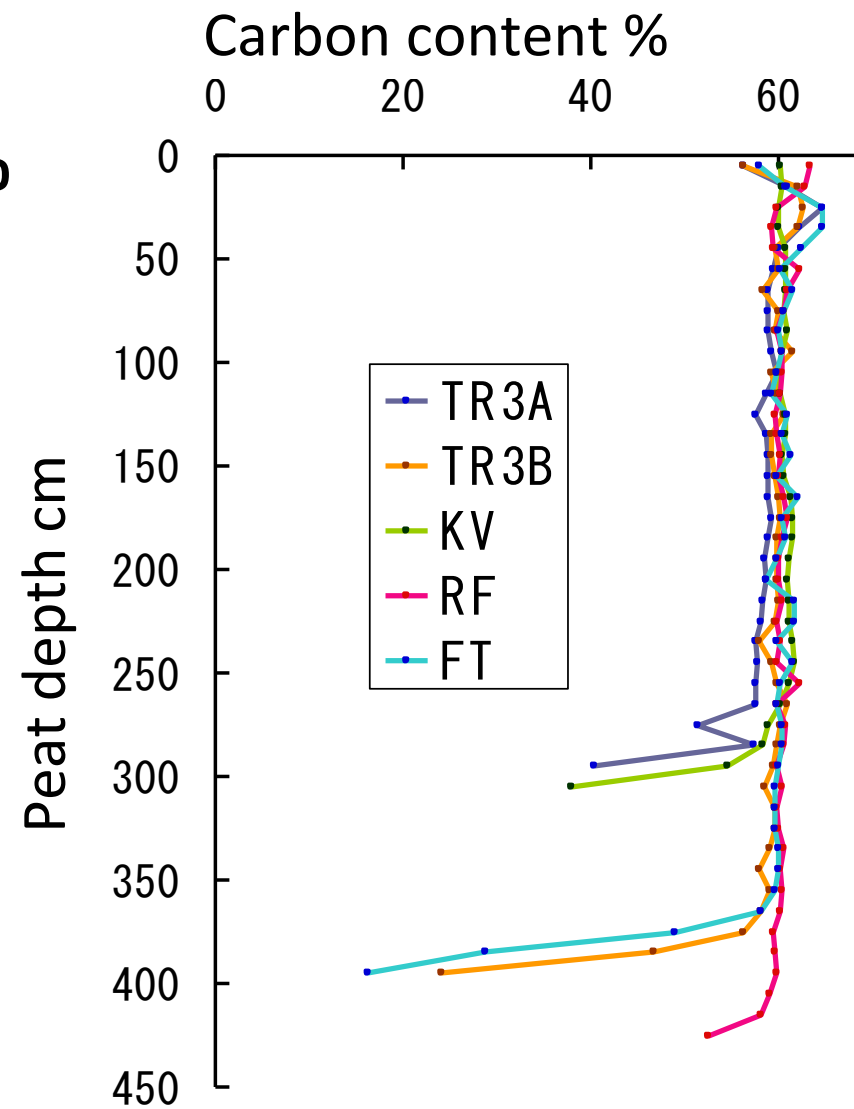


Mineral content of peat



Carbon content of peat

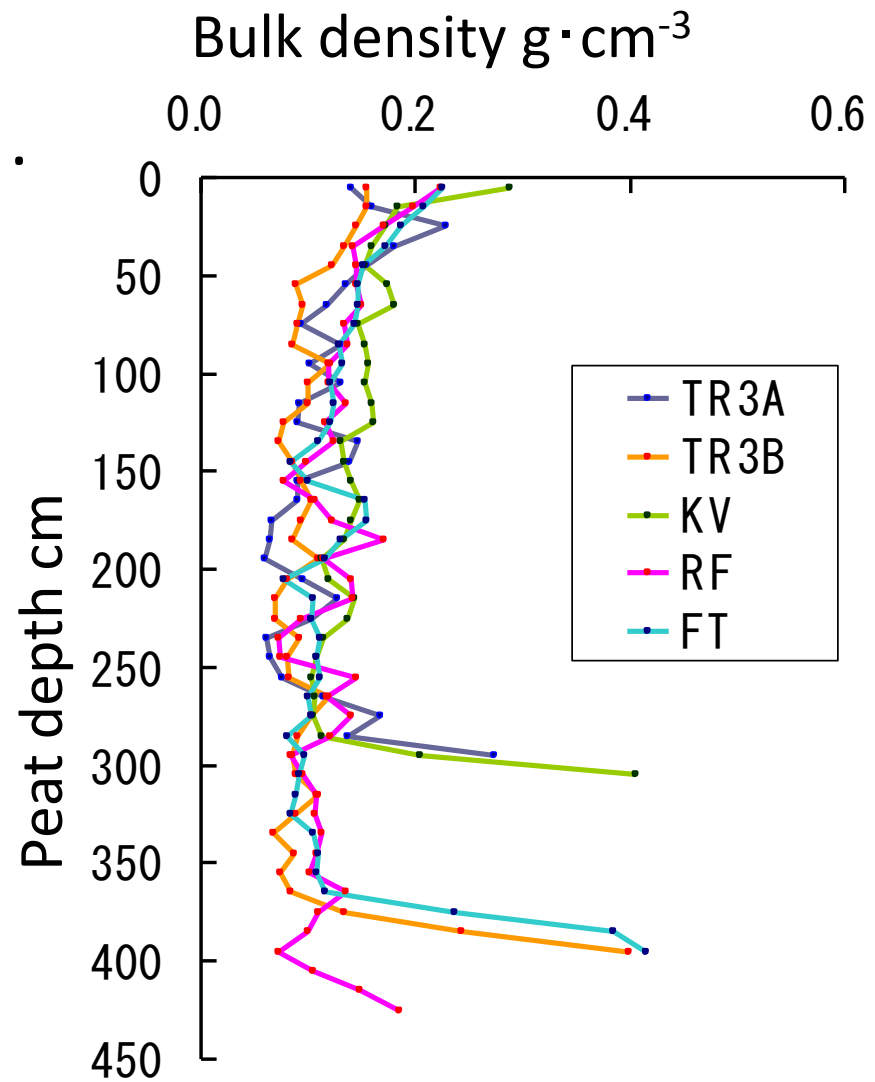
Almost constant ca. 60%



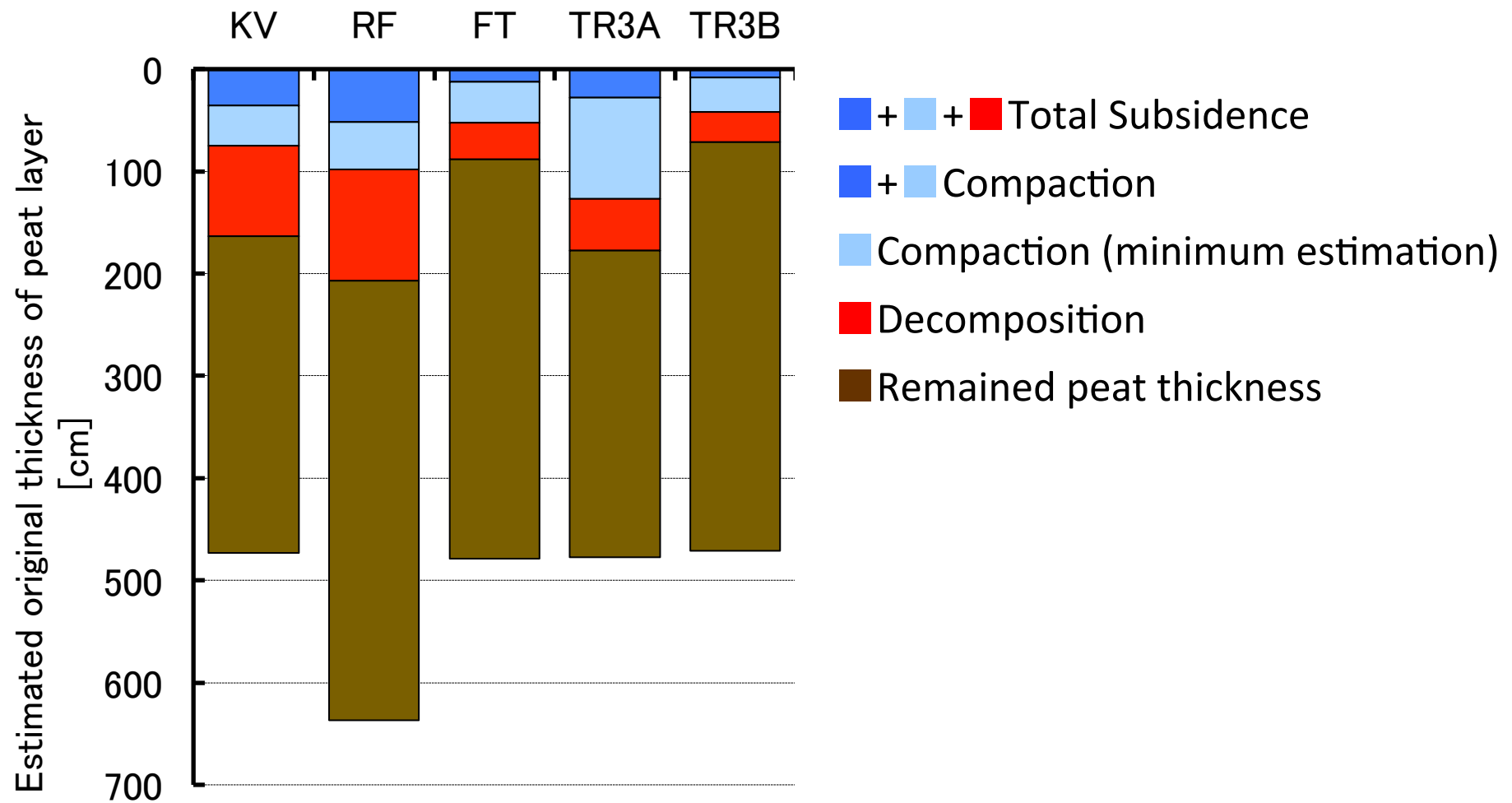
Bulk density of peat

Around $0.05 \sim 0.2 [\text{g} \cdot \text{cm}^{-3}]$.

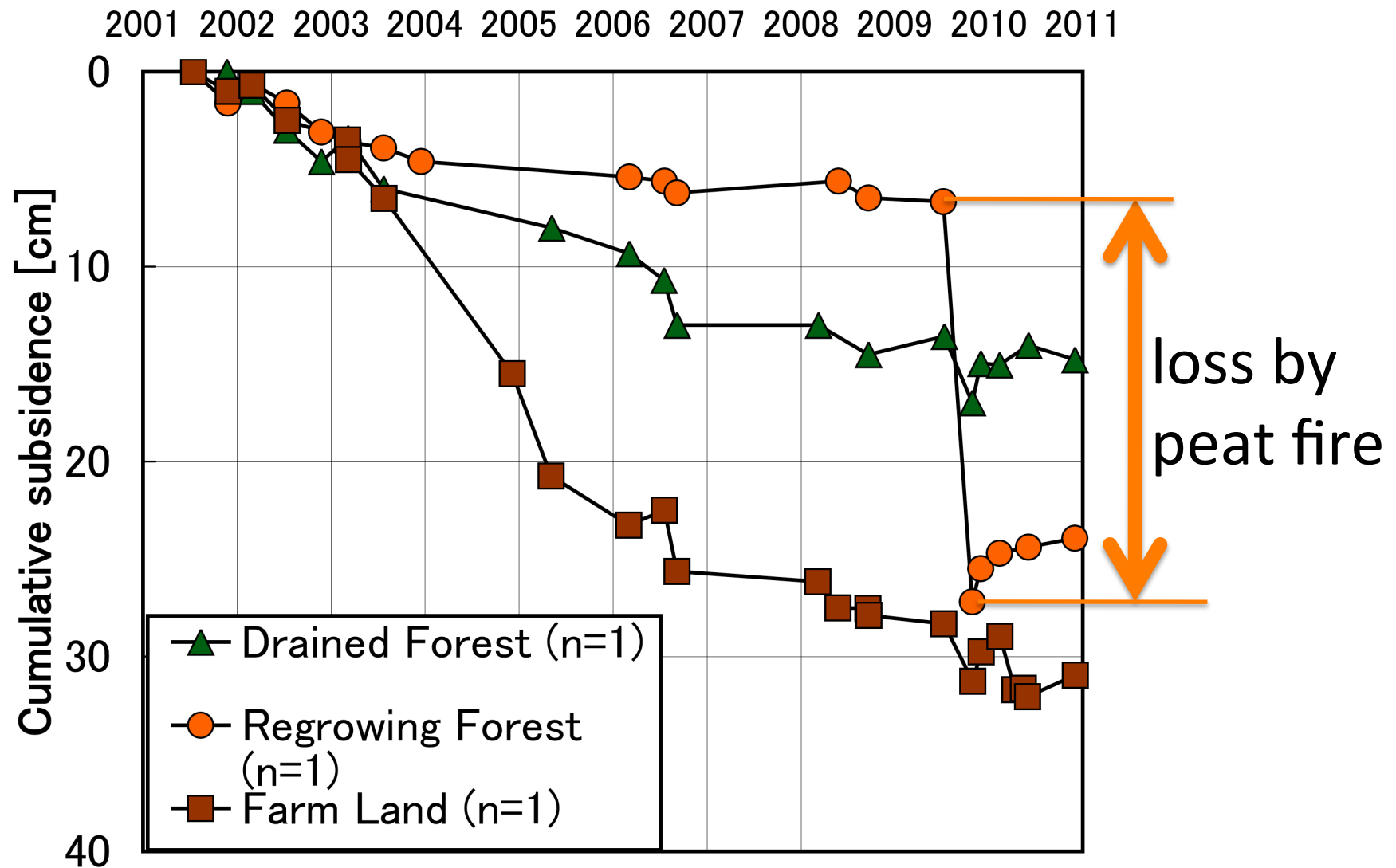
Larger in surface.



Example of result of factor estimation for subsidence



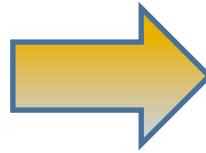
Subsidence in Kalampangan, Central Kalimantan



Peat fire of 2009



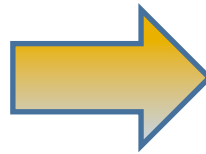
2008.7



2009.11



2009.7



2009.11

July 2009



Nov. 2009



Re-growing Forest **RF** (150m from the canal. Suffer fire in 98, 02 and¹09)

Conclusions

- Drainage induces subsidence of peat.
- Intensity of drainage affects the rate of subsidence.
- But proportion of shrinkage/consolidation/decomposition is not well known yet.
- Peat fire is another big cause for peat loss.
- Areal evaluation of subsidence is next challenge.
- Precise bulk density measurement is required.

Thank you.

