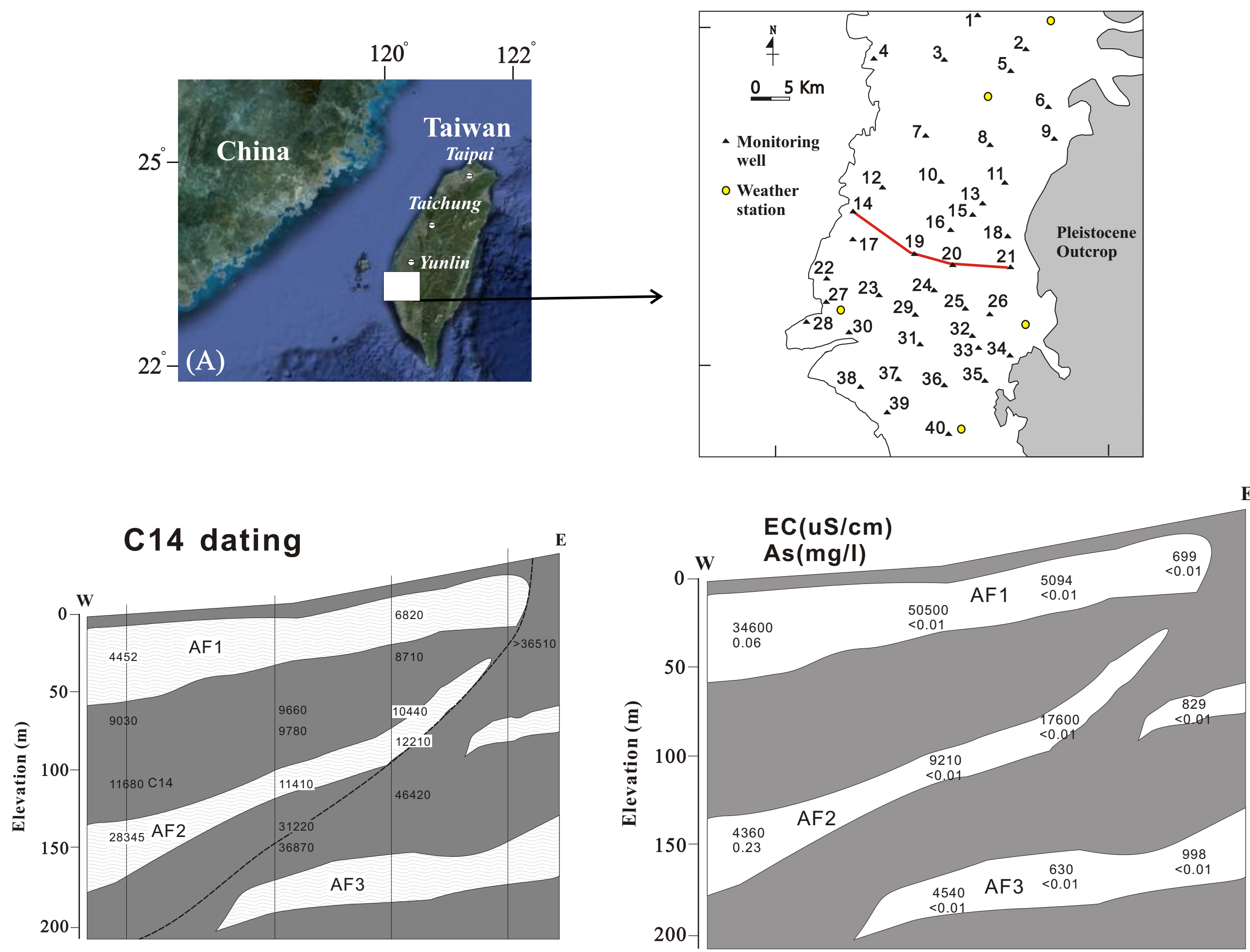HS8.2.3/ERE5.3 - Thermal and mechanical processes and energy storage in porous and fractured aquifers

Surface Soil Temperatures of Various Land Cover Types within the Chianan Plain, Southern Taiwan
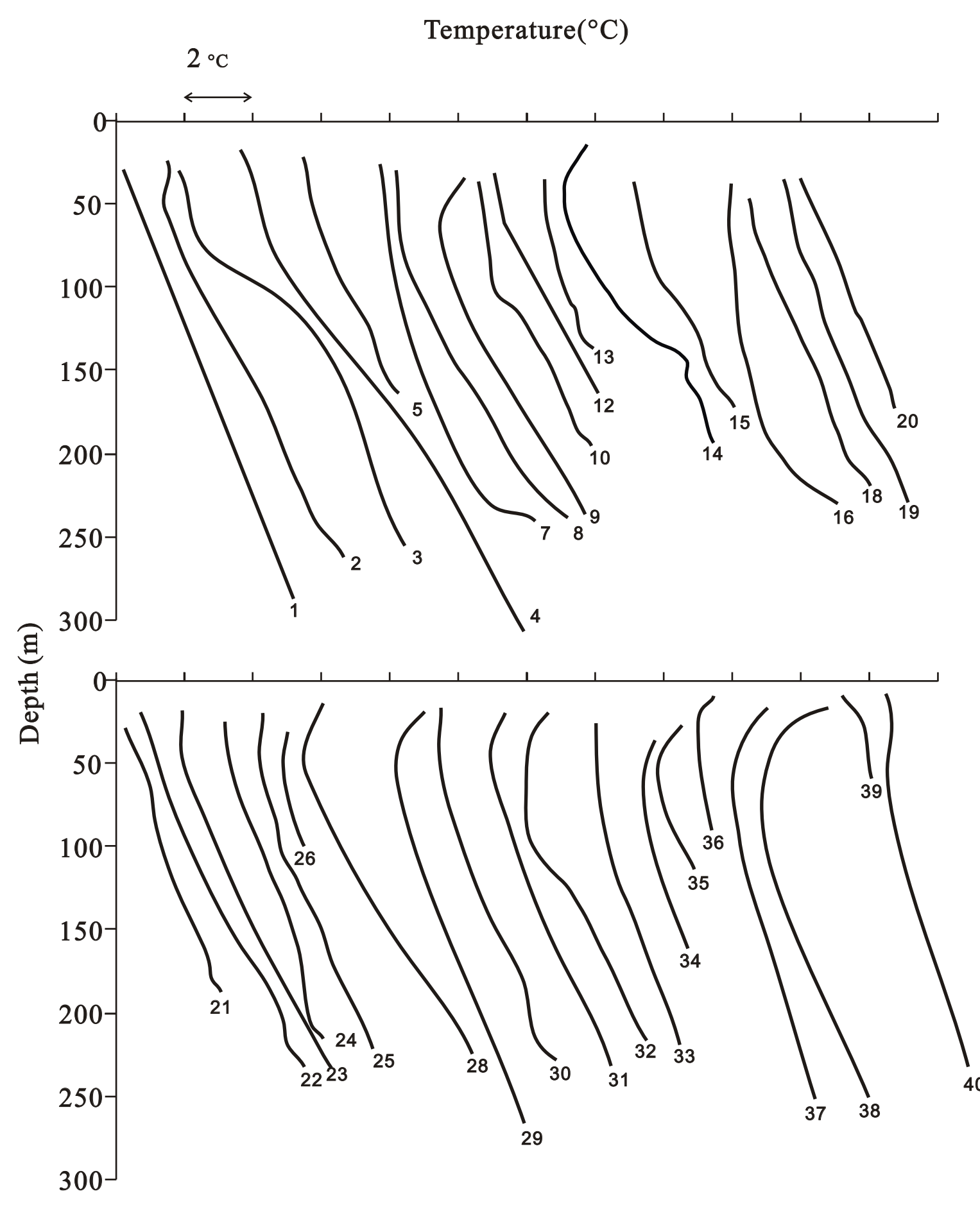
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The study area and hydrogeology

C14 dating

The Chianan plain is a coastal plain which is composed of unconsolidated fine-grain fluvial-deltaic deposit from Pleistocene to now. There are 40 groundwater monitoring wells.
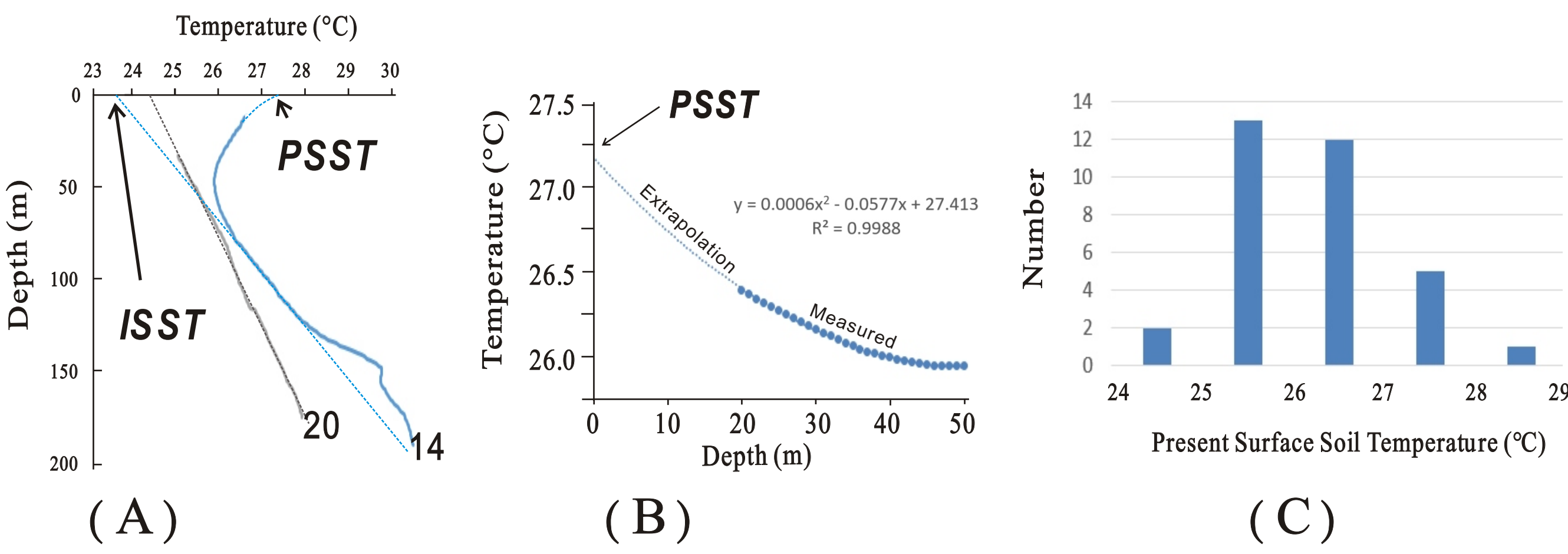
## Temperature-depth Profiles in 2015

Plots of the temperature-depth profiles obtained for 36 monitoring wells located within the Chianan Plain in 2015. Temperature-depth profiles are shifted for avoiding overlapping.

ISST   PSST

Initial and Present Surface Soil Temperature


(A)   (B)   (C)

(A) The PSST and ISST, extrapolated from the temperature-depth profile obtained from No. 14. The straight dashed lines are assumed to be original temperature-depth profiles that were not affected by surface warming or groundwater flow.
(B) The PSST, 27.39°C, extrapolated from the 20-50 m portion of the temperature-depth profile of No. 14 by using a second-degree polynomial fitting with an R^2 of 0.9987.
(C) A histogram of PSST obtained from 36 monitoring wells in 2015.
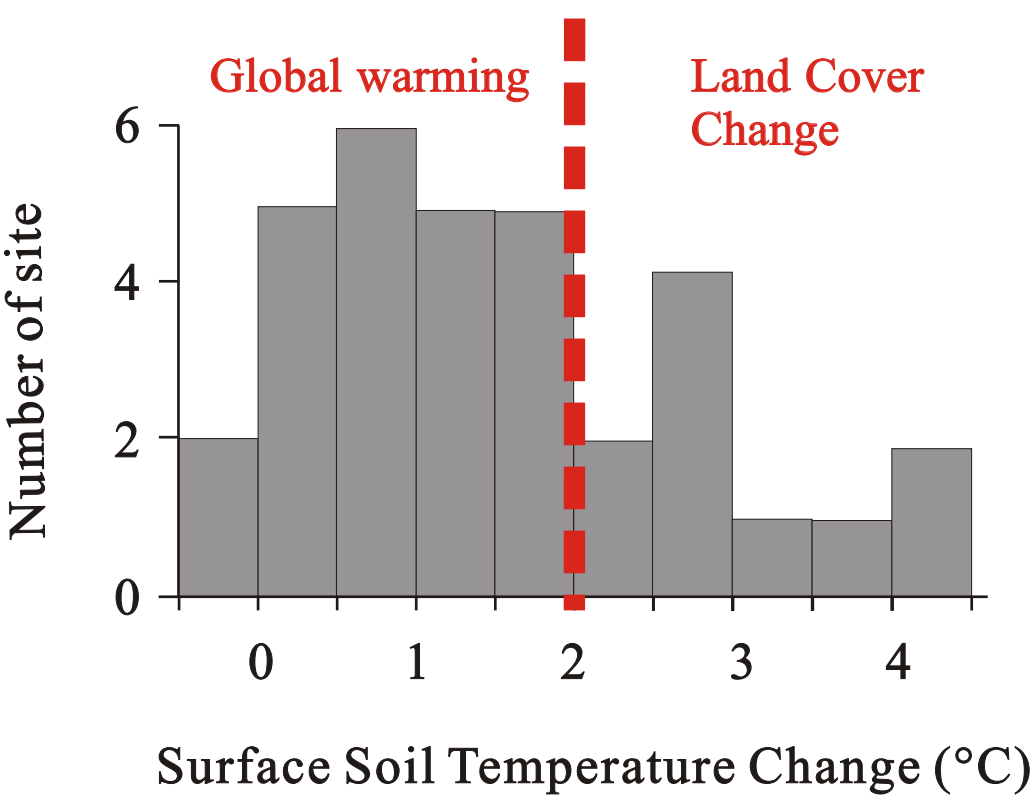
SST change (PSST minus ISST) are -0.5 to 4.11 °C with only two values are negative. The most of values are positive (warming) with 82% sites 0 to 3°C. The change of air temperature worldwide due to global warming is 1.0-2.0 °C during 1901-2015. The cause for SST change larger than 2 °C should attribute to other mechanism in addition to global warming.

Percentages of Land Cover Types   Radius of 100m
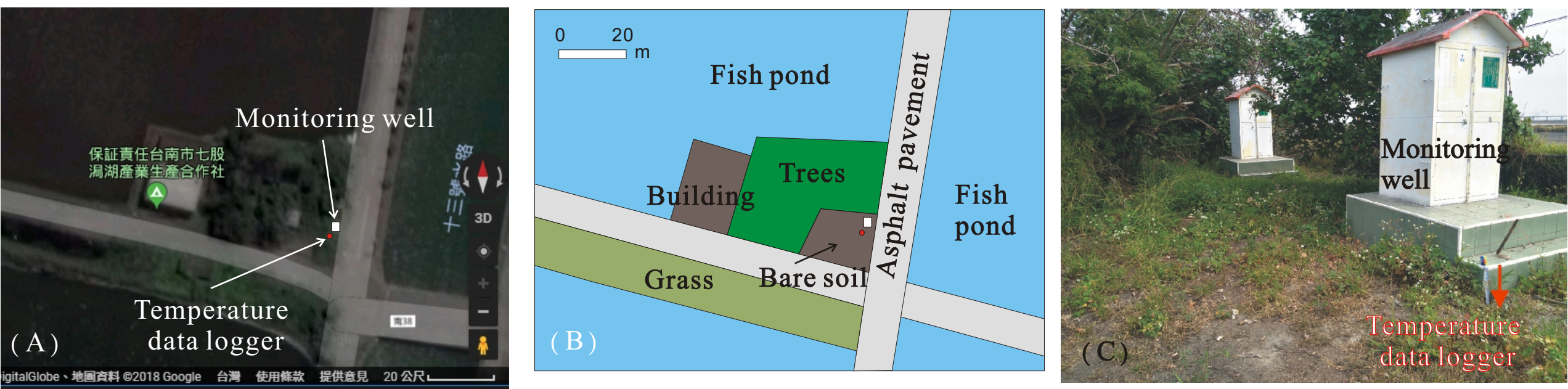
(A) The location of monitoring well No. 28 within a Google image.
(B) Land cover types were manually identified based on a Google image.
(C) bare soil, trees and the temperature data logger.

| No	Trees (%)	Buildings (%)	Crops (%)	Bare soils (%)	Fish ponds (%)	PSST °C	CSST °C	ISST °C
1	4	12	78	6	0	24.3	25.4	23.7
2	11	9	62	18	0	25.6	25.7	24.3
4	15	30	0	26	29	27.0	26.6	24.5
5	0	0	85	15	0	25.3	25.6	24.5
8	5	13	65	8	9	25.6	25.6	23.7
9	24	59	0	18	0	27.1	26.4	24.1
12	0	10	69	21	0	25.3	25.8	24.5
13	6	60	0	34	0	26.6	26.5	25.3

$$T_1LC_1 + T_2LC_2 + T_3LC_3 + T_4LC_4 + T_5LC_5 = CSST$$

Calculated SSTs (CSSTs) were estimated where T1, T2…T5 are the temperatures for each land cover type; and LC1, LC2…LC5 are the percentages of each land cover type within a radius of 100m.

Temperatures of Land Cover Types

$$MAE = \Sigma \left| PSST_n - CSST_n \right| /n$$

MAE (mean absolute error) was determined, n is the number of temperature-depth profiles. Using trial and error to determine the minimum MAE.
temperatures were
24.9°C for crops,
25.6°C, trees
25.6°C, buildings
26.5°C, fish ponds
28.8°C, bare soil
a minimum MAE of 0.6°C.
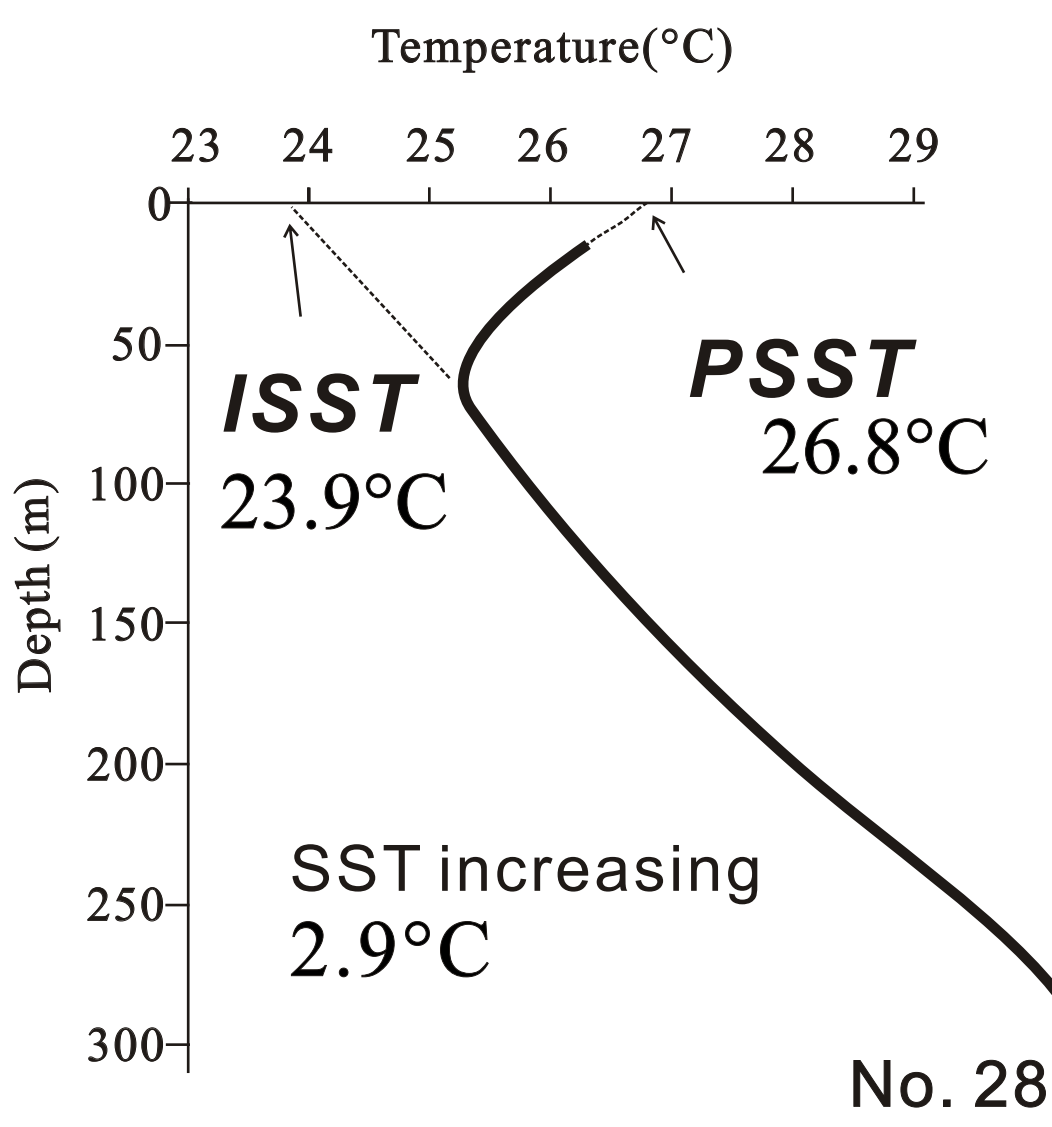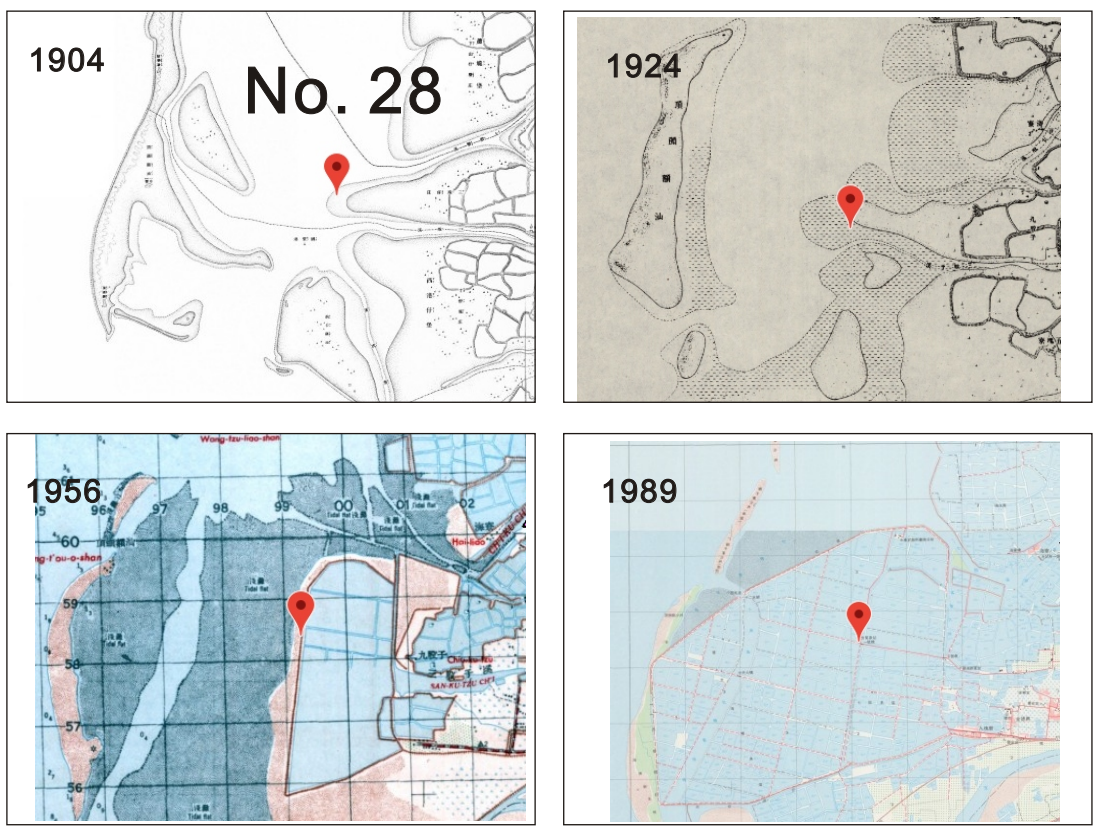
The left curve displays a warming trend from a depth of 60 m, with the SST increasing by 2.9 °C, larger than the global warming of 2.0°C. The SST should be increased due to the land cover change from tidal flat to fish ponds in addition to increasing temperature of global climate change.
Tidal flat temperatures here were 23.2-25.4°C (Belkin and Lee 2014), consistent with the ISST of 23.9°C from the study.
Calculated temperatures of this study for fish ponds and bare lands were 26.8-28.8°C.