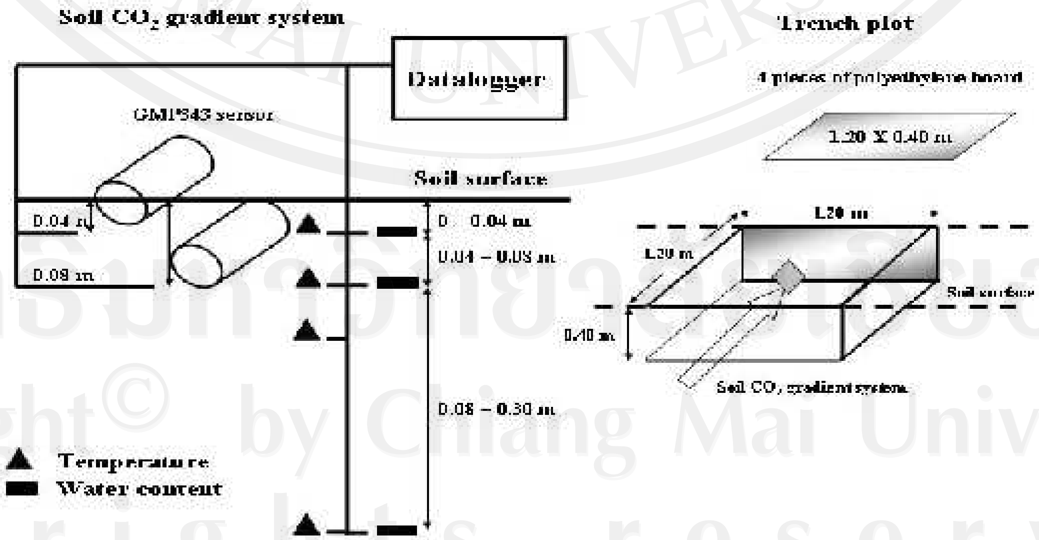
APPENDIX

Appendix A The experiment set up for soil gradient method using the solid-state infrared gas analyzers (GMP343, Vaisala Inc., Finland) and trenching method



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Appendix B CO_2 gradient data analysis

CO_2 concentration measurements by the solid-state infrared gas analyzer was corrected and used to calculate the surface CO_2 efflux. The data from the CO_2 sensors constitute the volume fraction C_v (μmol mol^{-1}). Volume fraction can be changed to mole concentration by:

$$C = \frac{C_v P}{RT}$$

where C is the mole concentration (μmol mol^{-3}), C_v the volume fraction (μmol mol^{-1}), P the air pressure(1.013 x 10^5 Pa), T the soil absolute temperature (K), and R the universal gas constant(8.3144 J mol^{-1} K^{-1}).

The flux of CO_2 at depth z will be calculated using Fick's first law of diffusion:

$$F = -D_s \frac{dC}{dz},$$

where F = the CO_2 efflux (μmol m^{-2}s^{-1}) , D_s is the soil CO_2 diffusion coefficient in the soil (m^{2}s^{-1}), C is the CO_2 concentration (μmol m^{-3}) and dC/dz is the vertical soil CO_2 gradient. The negative sign indicates that the efflux is in the direction of decreasing concentration.

Ds can be estimated as

$$D_s = \xi D_a ,$$

where ξ is the gas tortuosity factor, and D_a is the CO_2 diffusion coefficient in the free air.

The effect of temperature and pressure on D_a will be given by:

$$D_a = D_{a0}\left(\frac{T}{T_0}\right)^{1.75}\left(\frac{P_0}{P}\right)$$

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where T is the temperature (K), P the air pressure (1.013 x 10^5 Pa), D_{a0} a reference value of D_a at T_0 (20 °C or 293.15 K) and P_0 (1.013 x 10^5 Pa), and is given as 1.47 x 10^{-5} m^2 s^{-1}.

There are several empirical models in the literature for computing ξ. The Moldrup model (Moldrup *et al.,* 2000), was applied to various undisturbed soil.

$$\xi = \frac{\varepsilon^{2.5}}{\phi}$$

where ε is the volumetric air content (air-filled porosity), ϕ the porosity or sum of the volumetric air content ε and the volumetric water content θ. Note,

$$\phi = 1 - \frac{\rho_b}{\rho_m} = \varepsilon + \theta$$

where ρ_b is the bulk density (g cm^{-3}), and ρ_m the particle density for mineral soil, with a typical value of 2.65 g cm^{-3}.

We can compute CO_2 flux (F_z) at the depth of Z in the soil:

$$F_z = -\left(\frac{D_{a0}P_0}{RT_0^{1.75}}\right)\frac{(\phi-\theta)^{2.5}}{\phi}T_z^{1.75}\frac{d(C_{vz}/T_z)}{dz},$$

where T_z and C_{vz} are the temperature and CO_2 volume fraction, respectively, at the depth of z. At a certain small layer of soil if we measure CO_2 concentration at the depth of z_i and z_{i+1} with concentration C_i and C_{i+1}, a constant flux rate with in this layer can be summarized in the following equation.

$$F_i = -\left(\frac{D_{a0}P_0}{RT_0^{1.75}}\right)\frac{(\phi-\theta)^{2.5}}{\phi}\left(\frac{T_i+T_{i+1}}{2}\right)^{1.75}\left(\frac{C_{i+1}/T_{i+1}-C_i/T_i}{z_{i+1}-z_i}\right)$$

where F_i is the CO_2 flux (µmol m^{-2} s^{-1}) between depth z_i and z_{i+1} (m), T_i and T_{i+1} are the temperature (K) at the depths of z_i and z_{i+1}, C_i and C_{i+1} the CO_2 concentration (µmol mol^{-1}) at the depth z_i and z_{i+1}, ϕ is the soil porosity, θ the volumetric water content between the depth z_i and z_{i+1}, and constants D_{a0} = 1.47 x 10^{-5} m^2 s^{-1}, R = 8.314 J mol^{-1} K^{-1}, T_0 = 293.15 K, and P_0 = 1.1013 x 10^5 Pa. The depth z is in the negative sigh when it is an input for an equation.

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Appendix C Eddy covariance system

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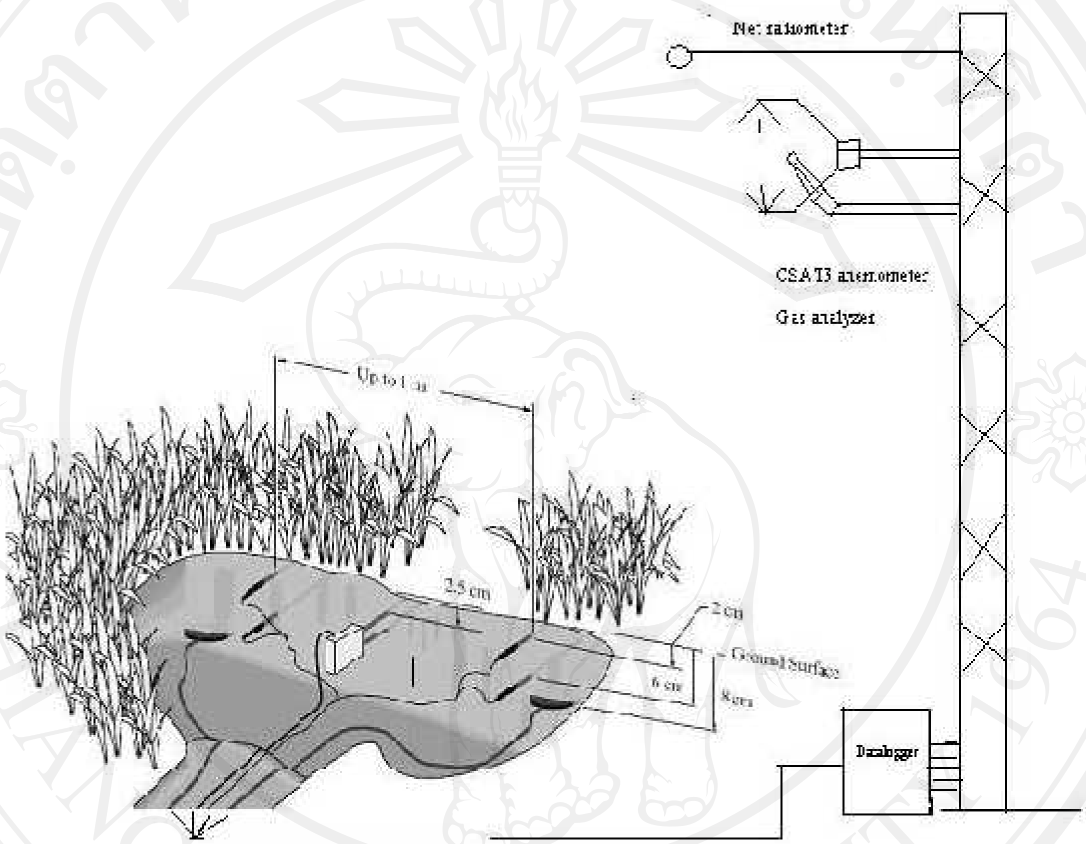
Appendix D Experiment setup of eddy covariance system and energy balance system



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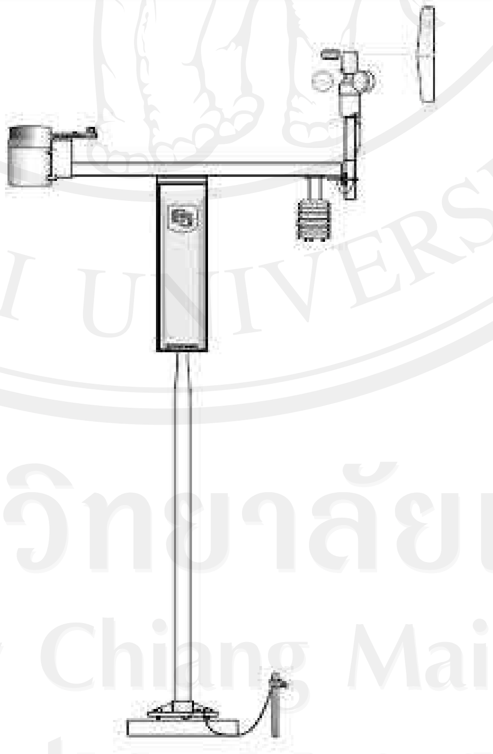
Appendix E ET106 weather station



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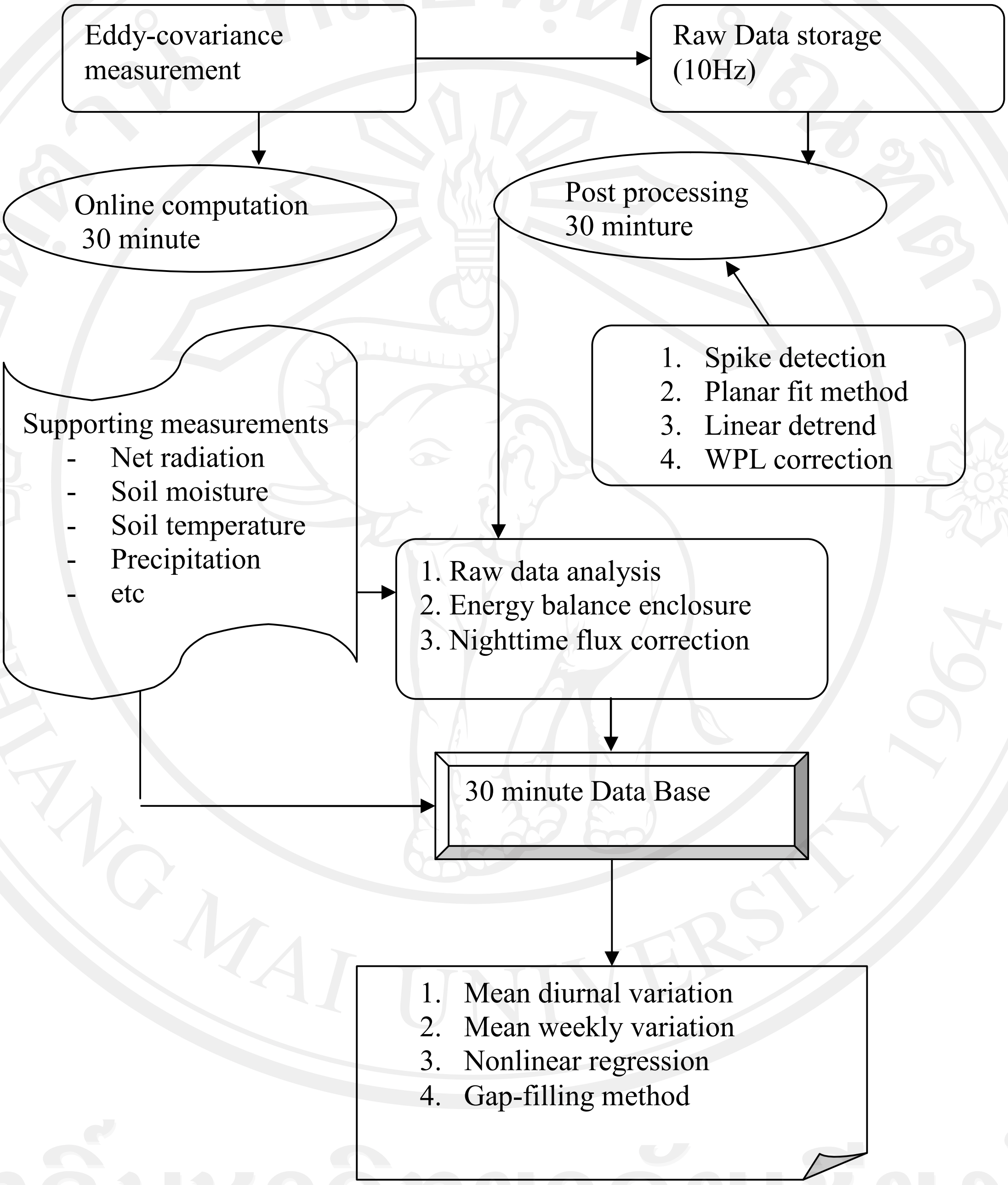
Appendix F Flow chart of data acquisition, processing and archiving.



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CURRICULUM VITAE

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Birth 1 October 1978, Sukhothai, Thailand

Academic record

Qualification	Area of concentration	Year	Institution
Ph.D. candidate	Crop Production†	2004- present‡	Chiang Mai University
M.S. (Agric.)	Agronomy	2004	Chiang Mai University
B.S. (Agric.)	Agronomy	2000	Chiang Mai University
High school		1996	Sukhothai Wittayakom School, Sukhothai

† Thesis title "Effect of rainfall variation on soil carbon dioxide efflux in wheat and peanut fields"

‡ Examination expected August 2009

Other training

2006-2008 Conducted the research work at the Department of Crop and Soil Sciences, The University of Georgia, Griffin Campus, USA. (March 2006- November 2008).

2006 Attended the Stable Isotope Ecology Course at the University of Utah, Salt Lake City, Utah, USA. (11^{st} -23^{nd} May 2006)

Scholarship and awards

Royal Golden Jubilee Ph. D. Scholarship (RGJ) of The Thailand Research Fund, Thailand (2004-present).

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Received the 4th place (honorable awards) from ASA Southern Branch Annual Meeting, February 3-5, 2008, Dallas Adams Mark-Convention Center, Grand Hall, Dallas, Texas.

Received the supporting fund from Prof. Dr. Monique Y. Leclerc, The University of Georgia, Griffin Campus, USA (March 2006-November 2008).

Received the Annual Bronze Medals for Academic Achievement, from Chiang Mai University in 2000.

Work experience

Teaching Assistant, Department of Agronomy, Faculty of Agriculture, Chiang Mai University (2004-2006).

Student Assistant, 27th Conference on Agricultural and Forest Meteorology, 17th Conference on Biometeorology and Aerobiology. 22-25 May 2006, Catamaran Resort Hotel, San Diego, California, USA.

Student Assistant, Terrestrial Carbon Project 2007. During August 12 through 26, at Oklahoma, USA.

Student Assistant, 28th Conference on Agricultural and Forest Meteorology, 18th Conference on Biometeorology and aerobiology, 28 April- 2 May 2008, Wyndham Orlando Resort, Orlando, Florida , USA.

Publications and paper

Chayawat, C., Thanapornpoonpong, S. and C. Senthong. Effect of Long- term Storage on Mineral content and Seed Quality of soybean. 2003. Journal of Agriculture, Chiang Mai University 2: 391- 396, 2546.

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Pingintha, N., Chayawat, C., Hong, J and M. Y. Leclerc. 2007. Book review Y. Luo and X. Zhou, Soil Respiration and the Environment, Academic Press, An Imprint of Elsevier Science, London (2006) ISBN 0-12-088782-7. Agricultural and Forest Meteorology, V 144, Issues 3-4, P. 159-244.

Xiaofeng, G., Chayawat, C., Pingintha, N., Zhang, G. and M.Y. Leclerc. 2007. Flux-variance method to estimate the heat, water and carbon exchange under convective conditions. A poster presented at Ameriflux Annual Meeting, October 17-19, 2007, Boulderado Hotel, Boulder, Colorado, USA.

Chayawat, C., Leclerc, M.Y., Hong, J., Beasley, J.P., Zhangand, G. and C. Senthong. 2008. Response of soil CO_2 efflux to rainfall variability in wheat and peanut fields. A poster presented at ASA Southern Branch Annual Meeting, February 3-5, 2008, Dallas Adams Mark-Convention Center, Grand Hall, Dallas, Texas.

Chayawat, C., Leclerc, M.Y., Beasley, J.P., Zhang, G. and C. Senthong. 2008. Influence of rainfall events on soil respiration. A poster presented at Ameriflux Annual Meeting, October 17-19, 2008, Boulderado Hotel, Boulder, Colorado, USA.

Chayawat, C., Leclerc, M.Y., Beasley, J.P., Zhang, G. and C. Senthong. 2008. Mechanism and environmental control of soil respiration during and after rainfall events in Agricultural Ecosystem. A poster presented at AGU meeting, December 15-19, 2008, San Francisco, USA

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