Appendix 1 List of some international large-scale land-surface experiments over past 15 years

Programs		Period	Locations	Surfaces	Resources
BOREAS	the Boreal Ecosystem Atmosphere Study	1993-1997	Saskatchewan, Canada	boreal forest	Sellers et al., 1995; 1997
EFEDA	the ECHIVAL Field Experiment in a Desertification-Threatened Area, the European field experiment in desertification-threatened areas	1991-1995	Southeast, Spain	dryland and crop field	Bastiaanssen et al., 1997; Bolle, 1995; Boulet et al., 1997; Michels and Jochum, 1995
FIFE	the First International Satellite Land Surface Climatology Project (ISLSCP) Field Experiment	1987-1989	Kansas, USA	praire	Hall and Sellers, 1995; Sellers and Hall, 1992; Sellers et al., 1992
GAME	the GEWEX (Global Energy and Water Cycle Experiment) Asian Monsoon Experiment				Higuchi, 1999
GAME-HUBEX	the HUaihe River Basin EXperiment	1996-1998	Huaihe River Basin, China	crop field and paddy field	
GAME-Thailand		1996-1998	Thailand	tropical forest and paddy field	
GAME-Siberia		1996-2000	Siberia, Russia	coniferous and tundra	
GAME-Tibet		1996-1998	Tibet, China	grassland and wetland	
HAPEX-MOBILHY	the Hydrological-Atmospheric Pilot EXperiment-Modelidsation du BILan Hydrique	1986-1988	Southwest, France	farmland and forest	Andre et al, 1986
HAPEX-SAHEL	the Hydrological-Atmospheric Pilot EXperiment-Sahel	1992	Sahel, Niger	savannah and cropfield	Goutorbe et al., 1994, 1997
HEIFE	the HEIhe River Basin Field Experiment on Land Surface Processes	1990-1993	Northwest, China	desert, Gobi, oasis	Niu et al., 1997; Tamagawa, 1996; Wang et al., 1998
NOPEX	the Northern Hemisphere Climate-Processes Land-Surface Experiment	1994-1996	Uppsala, Sweden	boreal forest	Cienciala et al., 1998; Halldin et al., 1998, 2000; Lundin and Halldin, 1994a, 1994b
TABLE92	the Tsukuba Atmospheric Boundary Layer Experiment 92	1992	Tsukuba, Japan	heterogeneous surfaces	Hiyama et al., 1995; Sugita et al., 1993

Appendix 2 Characteristics of C3 and C4 functional types (After Jones, 1992; Larcher, 1995; Box, 1995, 1996)

Items	C3	C4
1. ANATOMY		
Kranz anatomy(distinct bundle sheath)	No	Yes
Frequency of leaf bundles	Low	High
Leaf air space volume(%): monocots	10-35%	<10%
dicots	20-55%	<30%
2. BIOCHEMISTRY		
Early products of ^{14}C fixation	C3 acids (PGA)	C4 acids (oxaloacetate, malate, aspartate)
Primary carboxylase (CO_2-acceptor)	RuBP	PEP
Carbon isotope fractionation during photosynthesis ($\delta\ ^{13}C$, ‰)	-22 to -40	-9 to -19
Absolute sodium requirement	No	Yes
3. PHYSIOLOGY		
CO_2 compensation point (ppmv)	30-80	<10
Apparent photorespiration (CO_2 release in light)	Yes	No
Enhancement of P_n in low O_2	Yes	No
Quantum requirement (mol mol^{-1} CO_2)	15-22	19
Mesophyll resistance	Larger	Small
($m^2 s\ mol^{-1}$)	7-15	1. 2-5
($s\ cm^{-1}$)	3-6	0.5-2.0
Relative stomatal sensitivity to environment	Insensitive	Sensitive
Intercellular space CO_2 partial pressure (pascal)	~0.7	~0.4
Maximum photosynthetic rate		
(μ mol m^{-2} s^{-1})	14-40	18-55
(mg CO_2 m^{-2} s^{-1})	0.6-1.7	0.8-2.4
Optimum day temperature (°C)	c.15-30	25-40
Net photosynthetic capacity	Slight to high	High to very high
Light saturation of photosynthesis	Usually	Rarely
Redistribution of assimilation products	Slow	Rapid
4. ECOLOGY		
Initial growth (spring)	Early	Late
Commonly-distributed regions	Temperate, and at high altitudes	Tropical, arid, and at low altitudes
Transpiration ratio (water requirement)	High	Low
(g H_2O lost per g CO_2 fixed)	450-950	250-350
Water use efficiency	Low	High
Maximum growth rate (g m^{-2} day^{-1})	34-39	51-54
Average productivity	Medium	High
(tonne ha^{-1} yr^{-1})	c. 40	60-80

Appendix 3 Plant species appeared at the grassland of the Environmental Research Center of the University of Tsukuba, Japan (After Liu and Oikawa, 1993; and Tanaka, 1999). Dominant species are marked with asterisks.

Family name	Scientific name	Functional type	Life form	Flowering period
Compositae	*Achillea sibirica*	C_3	Perennial	Jul. to Sep.
	Ambrosia artemisiaeforia	C_3	Annual	Jul. to Oct.
	* *Artemisia princeps*	C_3	Perennial	Sep. to Oct.
	Erigeron annuus	C_3	Annual/B	Jun. to Aug.
	Gnapharium affine	C_3	iennial	Apr. to Jun.
	Gnapharium japanicum	C_3	Biennial	May to Oct.
	Hypochoeris radicata	C_3	Perennial	Jun. to Oct.
	Ixeris dentata	C_3	Perennial	May to Oct.
	* *Solidago altissima*	C_3	Perennial	Sep. to Nov.
			Perennial	
Cyperales	*Cyperus microiria*	C_3	Perennial	Aug. to Oct.
Equisetaceae	*Equisetum arvense*	C_3	Perennial	Mar. to Apr.
Graminneae	* *Andropogon virginicus*	C_4	Perennial	Aug. to Oct.
	Anthoxanthum odoratum	C_3	Perennial	May to Jul.
	Dactylis gromerata	C_3	Perennial	Jul. to Aug.
	Digitaria cillaris	C_4	Annual	Aug. to Oct.
	Echinochloa crusgalli	C_4	Annual	Aug. to Oct.
	Eragrostis curvula	C_4	Perennial	Aug. to Oct.
	Eragrostis ferruginea	C_4	Perennial	Aug. to Oct.
	* *Festuca arundinacea*	C_3	Perennial	Jun. to Aug.
	* *Imperata cylindrica*	C_4	Perennial	Apr. to Jun.
	* *Miscanthus sinensis*	C_4	Perennial	Jul. to Oct.
	Phragmites communis	C_3	Perennial	Aug. to Oct.
	Pleloblastus chino	C_4	Perennial	
	Zoysia japonica		Perennial	May to Jun.
Haloragaceae	*Haroragis micrantha*	C_3	Perennial	Jul. to Sep.
Hypericaceae	*Hypericum erectum*	C_3	Perennial	Jul. to Sep.
Juncaceae	*Luzula capitata*	C_3	Perennial	Apr. to May
Leguminosae	*Albizia julibrissin*	C_3	Perennial	Jun. to Jul.
	Cassia nomame	C_3	Perennial	Aug. to Oct.
	Dunbaria villosa	C_3	Perennial	Aug. to Sep.
	Kummerovia striata	C_3	Annual	Aug. to Sep.
	Lespedeza bicolor	C_3	Perennial	Sep. to Oct.
	* *Lespedeza cuneata*	C_3	Perennial	Aug. to Oct.
	Lespedeza pilosa	C_3	Perennial	Aug. to Oct.
	Pueraria lobata	C_3	Perennial	Jun. to Sep.
	Trifolium pratense	C_3	Perennial	May to Oct.
	Trifolium repense	C_3	Perennial	May to Oct.
	Vicia sativa	C_3	Biennial	Apr. to May
	Wisteria floribunda	C_3	Perennial	Apr. to Jul.

(to be continued)

Appendix 3 (continued)

Family name	Scientific name	Functional type	Life form	Flowering period
Onagraceae	*Oenothera biennis*	C_3	Biennial	Jul. to Sep.
	Paederia scandens	C_3	Perennial	Aug. to Sep.
Orchidaceae	*Spiranthes sinensis*	C_3	Perennial	May to Sep.
Pinaceae	*Pinus densiflora*	C_3	Perennial	Apr.
Plantaginaceae	*Plantago lanceolata*	C_3	Perennial	Jun. to Jul.
Polygonaceae	*Polygonum sachalinense*	C_3	Perennial	Jul. to Oct.
	Rumex acetosa	C_3	Perennial	May to Aug.
	Rumex acetosella	C_3	Perennial	May to Aug.
Portulacaceae	*Portulaca oleracea*	C_4	Annual	Jun. to Sep.
Purimuraceaea	*Lysimachia clethroides*	C_3	Perennial	Jun. to Jul.
	Lysimachia japonica	C_3		May to Jun.
Rosaceae	*Potentilla fragarioides*	C_3	Perennial	Apr. to May
	Potentilla freyniana	C_3	Perennial	Apr. to May
Scrophulariaceae	*Masus miquelli*	C_3	Perennial	Apr. to Jun.
Umbelliferae	*Hydrocotyle sibthorpioides*	C_3	Perennial	Apr. to Oct.

Appendix 4 Measured variables of the routine meteorological measurement tower at the Environmental Research Center of the University of Tsukuba, Japan (After Toritani et al., 1989).

Parameters	Instruments	Models and Makers	Height or depth (m)	Instrument accuracy
Wind direction		SA-200, Kaijo-Denki	30.5	
Wind velocities	3-D sonic anemometer-thermometers	DAT-300, Kaijo-Denki	1.6, 12.3, 29.5, 30.5	$<\pm 1\%$
Momentum fluxes	DAT-300, Kaijo-Denki	DAT-300, Kaijo-Denki	1.6, 12.3, 29.5	$<\pm 1\%$
Sensible heat fluxes	DAT-300, Kaijo-Denki	DAT-300, Kaijo-Denki	1.6, 12.3, 29.5	$<\pm 1\%$
Downward short wave radiation	Pyranometer	MS-43F, EKO	1.5	$<\pm 6\%$
Net radiation	Net radiometer	CN-11, EKO	1.5	$<\pm 5\%$ at -15 to 40 °C
Soil heat fluxes	Soil heat plates	CN-81, EKO	-0.02	$<\pm 5\%$ at -20 to 120 °C
Air temperatures	Ventilated platinum resistance thermometers	E-731, Ogasawara Keiki	1.6, 12.3, 29.5	$<\pm 1$ °C
Soil temperatures	Platinum resistance thermometers	E-751, Ogasawara Keiki	-0.02, -0.1, -0.5, -1.0	$<\pm 1$ °C
Under ground water tables	Water level gauge (float type)	W-435-1, Nakaasa	-2.2, -10.0, -22.0	$<\pm 1\%$ at full scale
Dew point temperature	Ventilated dew-point hygrometers	E-771-10, Nakaasa	1.6, 12.3, 29.5	$<\pm 0.5\%$ at full scale
Evaporation	Evaporation pan	Class A (D-211), Nakaasa	0.2	$\leq\pm 1$ mm
Precipitation	Rain gauge (tipping bucket type)	B-011-00, Nakaasa	0.3	$\leq\pm 1$ mm when rain rate < 20 mm h^{-1}; $\leq\pm 3\%$ mm when rain rate < 100 mm h^{-1}
Evapotranspiration	Weighing lysimeter (2 m id, 2 m depth	RL-15TFA, Shimazu-Seisakusho	0.0	$\leq\pm 0.032$ mm
Air pressure	Barometer	F-401, Yokogawa	5.0	
Sunshine duration	Sunshine duration meter	MS-091, EKO	8.0	± 10 min day^{-1}