



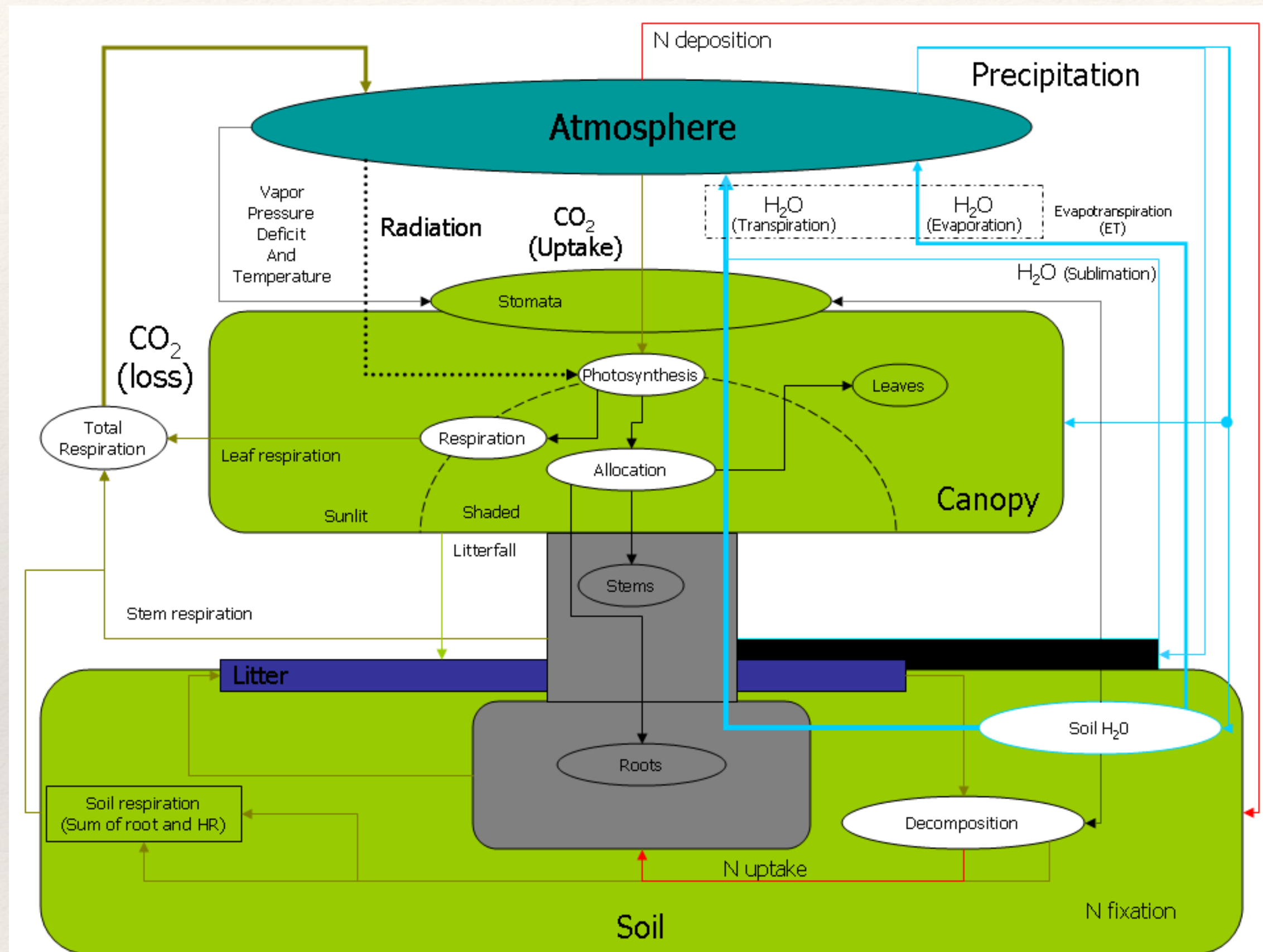
CIRES暨研究資料管理推進室團隊交流

微氣象觀測資料格式及倉儲介紹

以地景尺度生態系統服務評估建構地面型光電發展之社會生態系統整合治理-地景尺度碳水收支模擬平台的建立與應用(子計畫四)

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東華大學陸域生態實驗室

2023.01.12



來源:University of Montana, URL:<https://www.ntsg.umt.edu/images/biome-bgc>



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# 微氣象參數

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- ❖ 依據不同的研究目的，我們需要測量（以直接或間接的）參數來指引環境狀態或是通量，像是：
  - ❖ 環境狀態：氣溫、大氣相對濕度、大氣壓力、降雨量、風速、風向...
  - ❖ 能量通量：長短波輻射量、光合作用有效輻射量
  - ❖ 物質通量：二氧化碳、水、甲烷氣體濃度

# 低頻度資料

- ❖ 測量參數：氣溫、氣壓、RH、土溫、土壤濕度...
- ❖ 取樣頻度通常是 1s 以上，再計算成 1/10/30 min 統計值
- ❖ 資料記錄器整合為具規格化的文字檔(.csv / .txt)
- ❖ 在生豐電廠的觀測項目中，我們可以提供一般使用的資料，包含日期時間及衍生參數，大約有20欄的參數，每日48筆。
- ❖ real-time monitoring 是有機會的



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	V
1	date	time	DOY	Ta_1_1_1	PA_1_1_1	RH_1_1_1	Rn_1_1_1	LWin_1_1_1	LWout_1_1_1	Swin_1_1_1	Sout_1_1_1	PPFD_1_1_1	MWS_1_1_1	WD_1_1_1	N
2	2018/8/2	17:30	214.729	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
3	2018/8/2	18:00	214.749	303.0633333	67673.33333	70.67	NaN	NaN	NaN	NaN	NaN	22.43666667	1.388333333	64.67053663	N
4	2018/8/2	18:30	214.77	302.44	67680	73.95	-17.8833333	-27.4566667	-5.71966667	3.688333333	-0.16533333	6.250666667	0.751333333	88.53254334	N
5	2018/8/2	19:00	214.791	302.07	67686.66667	76.04333333	-27.0133333	-29.3933333	-3.69466667	-1.18566667	0.133333333	0.957333333	2.025333333	151.5980587	N
6	2018/8/2	19:30	214.812	301.7233333	67693.33333	77.96	-24.37	-26.3833333	-3.94666667	-1.801	0.128333333	0.249333333	1.192333333	63.49641067	N
7	2018/8/2	20:00	214.833	301.1866667	67700	80.76666667	-24.5833333	-26.6066667	-3.78666667	-1.72833333	3.43E-02	0.27	0.375666667	158.8999909	N
8	2018/8/2	20:30	214.854	300.6	67713.33333	84.63333333	-17.16	-18.6766667	-2.71566667	-1.13833333	6.43E-02	0.313	0.767666667	275.5222753	N
9	2018/8/2	21:00	214.874	300.1933333	67720	87.43333333	-16.9333333	-18.23	-2.32766667	-1.14633333	-0.117	0.345	1.110666667	226.3280678	N
10	2018/8/2	21:30	214.895	299.74	67720	89.36666667	-32.9133333	-32.91	-2.26966667	-2.12233333	0.15	0.379666667	1.061666667	243.4962123	N
11	2018/8/2	22:00	214.916	299.7	67720	88.5	-34.27	-33.8666667	-1.77666667	-1.57233333	0.605	0.344	0.963666667	195.8634026	N
12	2018/8/2	22:30	214.937	299.2366667	67730	90.43333333	-25.9333333	-26.0666667	-1.807	-1.40566667	0.268	0.372333333	1.764	229.1025304	N
13	2018/8/2	23:00	214.958	298.97	67730	91	-25.04	-24.84	-1.362	-1.29866667	0.264	0.376666667	1.519	209.4002706	N
14	2018/8/2	23:30	214.979	298.9133333	67723.33333	91.03333333	-25.8433333	-25.01	-0.743	-0.96766667	0.607	0.369666667	2.058	248.0278993	N
15	2018/8/3	0:00	215	299.0266667	67720	90.06666667	-29.0633333	-28.8866667	-1.67866667	-1.46633333	0.392	0.372	1.927333333	209.3082589	N
16	2018/8/3	0:30	215.02	298.4966667	67720	92.6	-15.8533333	-15.4766667	-0.597	-0.78033333	0.19466667	0.381666667	2.482666667	237.599563	N
17	2018/8/3	1:00	215.041	298.7966667	67713.33333	91.53333333	-24.9033333	-24.0333333	-0.642	-0.99033333	0.522	0.378666667	2.695	244.7993571	N
18	2018/8/3	1:30	215.062	298.8066667	67706.66667	91.36666667	-36.49	-35.3166667	-1.123	-1.74133333	0.556333333	0.375666667	2.94	245.2664421	N

# 低頻度資料

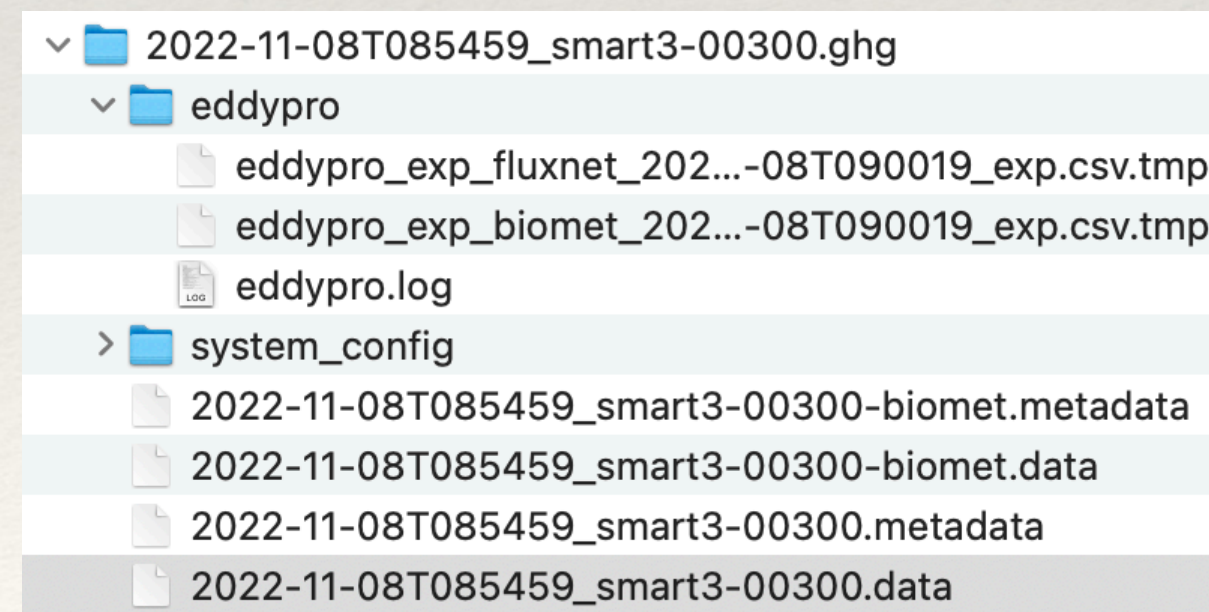
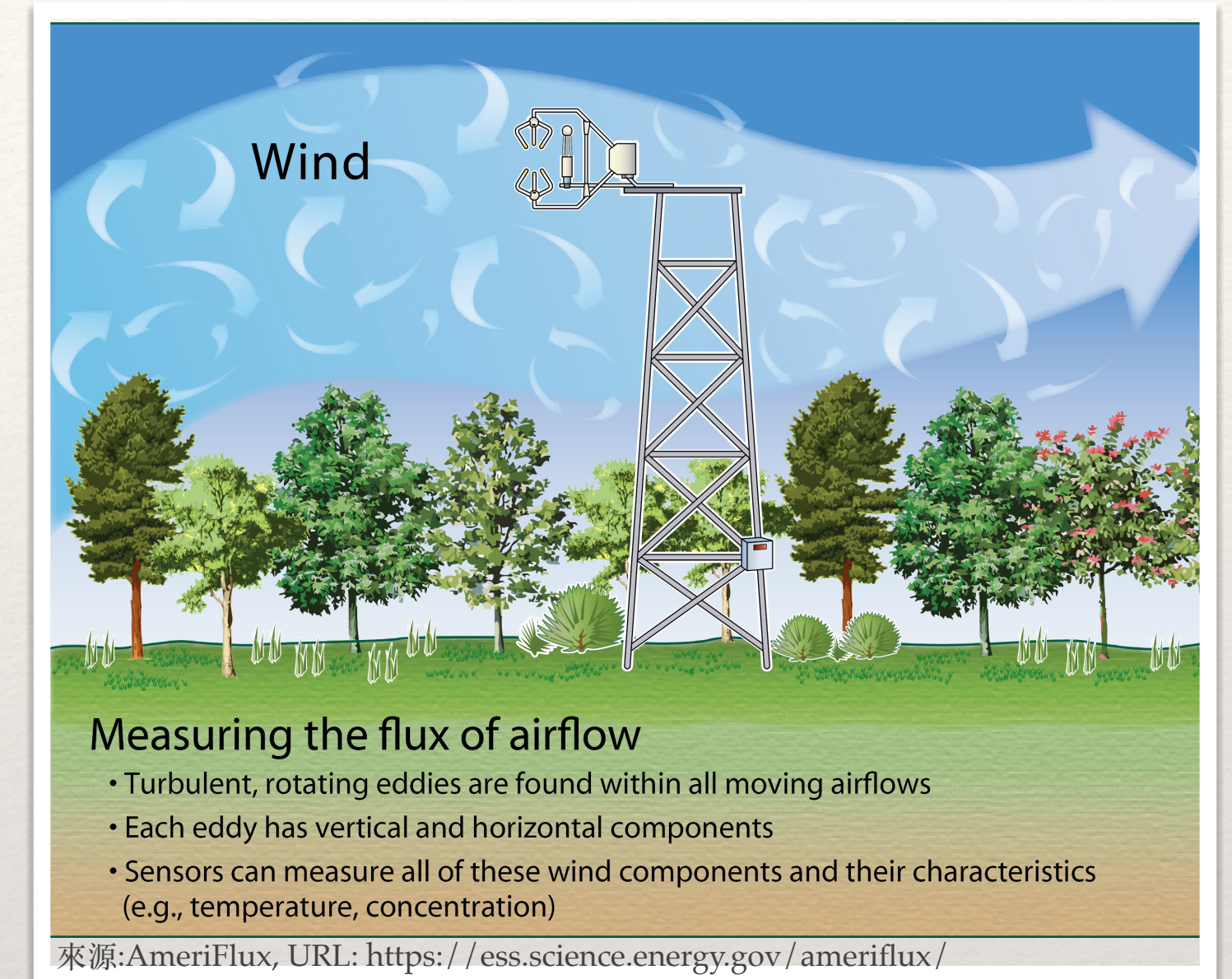
- ❖ 不同土地利用類型的土壤呼吸觀測
- ❖ 觀測方式：土壤氣室法觀測二氧化碳、水分、甲烷通量
- ❖ 每月一次固定點測量、每點三重複
- ❖ 取樣頻度：1 Hz
- ❖ 原始檔為具規格化的文字檔(.json)
- ❖ 一般使用時匯出統計值為文字檔.txt，包含日期時間及衍生參數，大約有15欄的參數。



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	LI-8200	LI-8200	LI-8200	LI-7810	LI-7810	LI-7810	LI-7810	LI-7810	LI-7810	LI-7810	LI-7810	CHAMBER	CHAMBER	CHAMBER
2	DATE_TIME initial_value	LABEL	REP	FCO2_DRY LI	FCO2_DRY LI	FCO2_DRY	FCO2_DRY R	FCH4_DRY LI	FCH4_DRY LI	FCH4_DRY	FCH4_DRY R	TA mean	TS_2 mean	SWC_2 me
3	[YYYY-MM-DD HH:MM:SS]	[#]	[#]	[umol+1m-2	[#]	[umol+1m-2	[#]	[nmol+1m-2	[#]	[nmol+1m-2	[#]	[C]	[C]	[m+3m-3]
4	2022/3/10 9:49	PL-1	REP_1	0.82799	0.95408	0.71028	0.83319	0.02969	0.30628	0.02969	0.30628	25.79919	27.6425	
5	2022/3/10 9:52	PL-1	REP_2	0.81874	0.95458	0.89719	0.95564	0.03246	0.42137	0.03246	0.42137	25.64246	27.6525	0.1672
6	2022/3/10 9:55	PL-1	REP_3	0.77675	0.9391	0.77808	0.91418	0.02295	0.25991	0.02295	0.25991	25.4853	27.35	0.21
7	2022/3/10 10:05	CR-1	REP_1	0.75751	0.95284	0.76571	0.95285	-0.00169	0.00163	-7.80878	0.01576	25.75978	26.825	0.133
8	2022/3/10 10:08	CR-1	REP_2	0.77428	0.9519	0.81735	0.95211	-0.00083	0.00035	-0.00083	0.00035	26.31215	26.32083	0.1329
9	2022/3/10 10:11	CR-1	REP_3	0.72461	0.95831	0.72461	0.95831	-0.00122	0.00083	-0.00122	0.00083	26.23981	25.9075	0.1310
10	2022/3/10 10:22	PL-2	REP_1	3.04773	0.99587	3.10053	0.99588	460.02057	0.99921	468.8121	0.99922	26.45863	26.7	0.1406
11	2022/3/10 10:25	PL-2	REP_2	3.01498	0.99678	3.01498	0.99678	460.60726	0.99928	460.60726	0.99928	26.46989	26.7	0.139
12	2022/3/10 10:28	PL-2	REP_3	2.84583	0.99579	2.95647	0.99585	450.70679	0.99937	450.70679	0.99937	26.00253	26.82167	0.1367
13	2022/3/10 10:37	CR-2	REP_1	3.81372	0.99776	3.81372	0.99776	111.97703	0.99964	111.97703	0.99964	27.64274	28.37	0.21
14	2022/3/10 10:40	CR-2	REP_2	3.69613	0.99712	3.69613	0.99712	110.27782	0.99962	110.27782	0.99962	27.50763	28.6	0.2112
15	2022/3/10 10:43	CR-2	REP_3	3.62485	0.99754	3.63483	0.99754	109.78661	0.99967	109.78661	0.99967	27.19385	28.6	0.2112
16	2022/3/10 10:55	PL-3	REP_1	1.82829	0.99016	1.82829	0.99016	0.48492	0.99411	0.49175	0.99412	26.5184	28.88	0.1062
17	2022/3/10 10:58	PL-3	REP_2	2.0679	0.99183	2.0679	0.99183	0.52637	0.99115	0.52637	0.99115	26.73547	28.36	0.103
18	2022/3/10 11:01	PL-3	REP_3	1.79996	0.99276	1.79996	0.99276	0.5073	0.9894	0.52109	0.98944	26.09315	27.83833	0.1008

# 高頻度資料

- ❖ 通量觀測：水、二氧化碳、甲烷通量
- ❖ 觀測方式：渦度相關法
- ❖ 取樣頻度：10 Hz (20 Hz)，通常以 30 min 為一筆原始檔
- ❖ 原始檔為檔案群(.ghg / .zip)

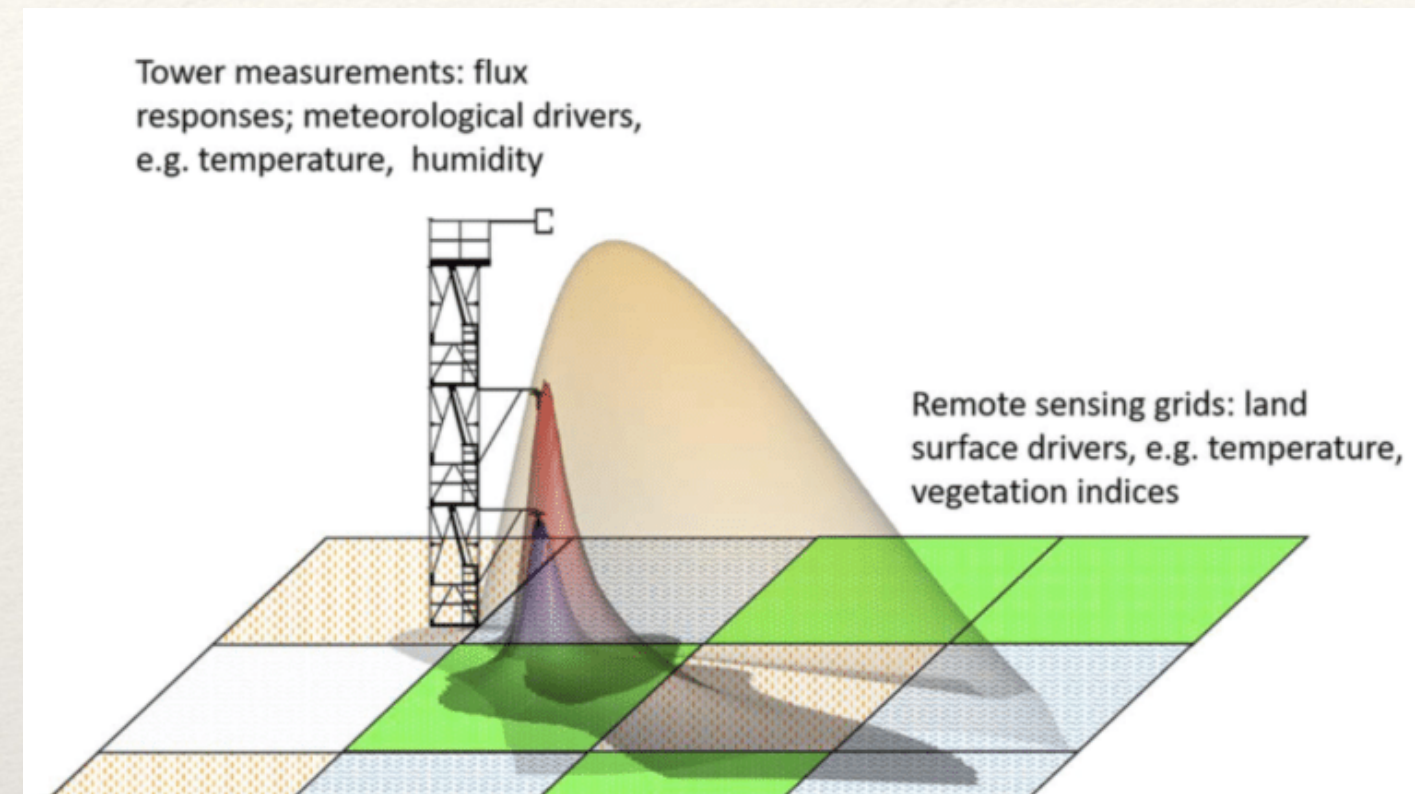


```
Model: LI-7500DS Open Path CO2/H2O Analyzer
SN: 75D-4201
Instrument: smart3-00300
File Type: 2
Software Version: 8.9.0
Timestamp: 08:54:59
Timezone: Asia/Taipei
```

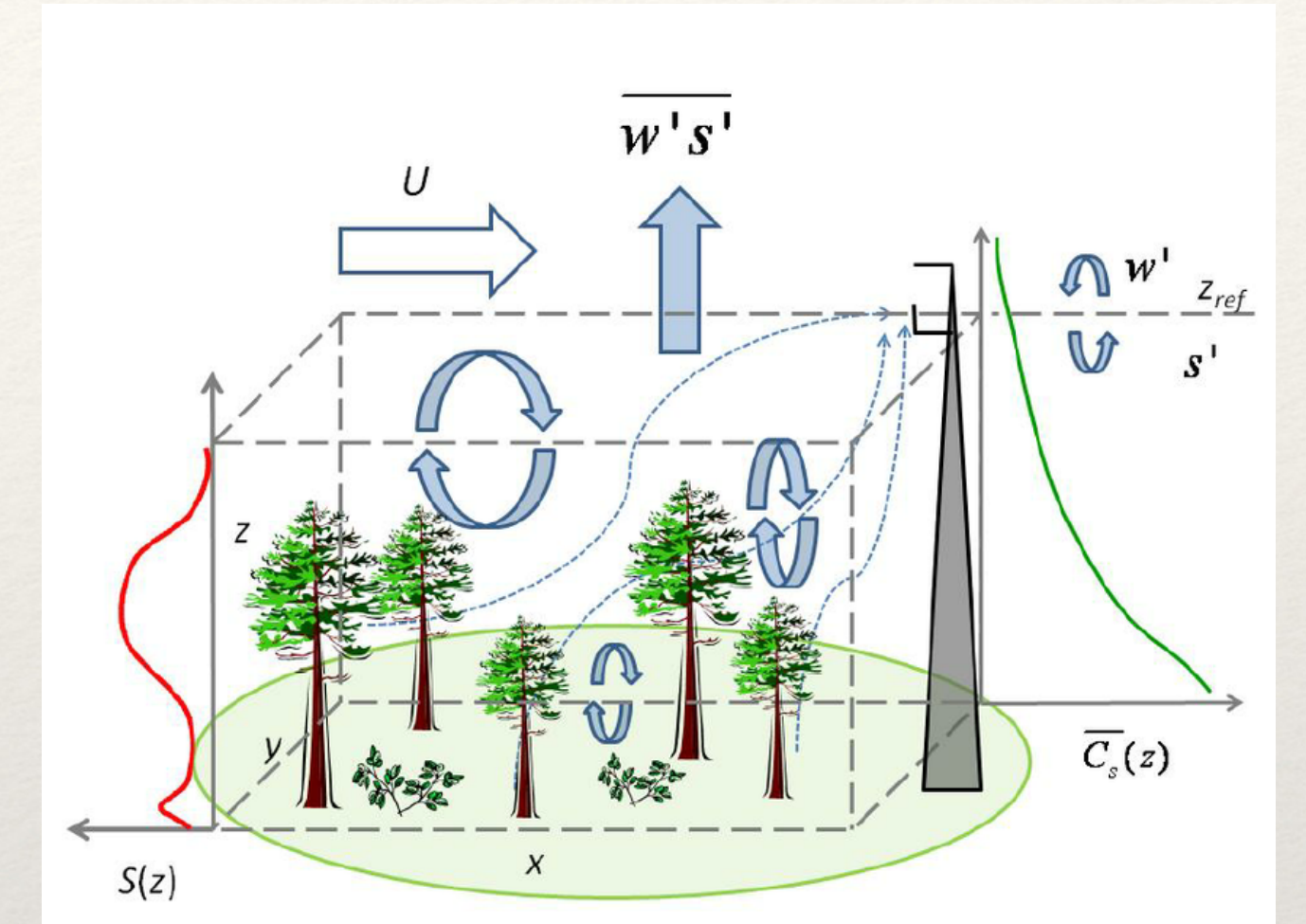
DATAH	Seconds	Nanoseconds	Diagnostic	Value	Diagnostic Value 2	Date	Time	CO2 (mmol/m <sup>3</sup> )	H2O (mmol/m <sup>3</sup> )	Temperature (C)	Pressure (kPa)	CO2 Si	
DATA	1667868899	700000000	255	0	2022-11-08 08:54:59:700	16.7095	959.465	24.6016	100.267	97.4659	-9999	-9999	048
DATA	1667868899	800000000	255	1	2022-11-08 08:54:59:800	16.7208	959.474	24.6016	100.263	97.4604	-9999	-9999	033
DATA	1667868899	900000000	255	1	2022-11-08 08:54:59:900	16.7349	959.14	24.6018	100.259	97.4506	-9999	-9999	247
DATA	1667868900	0	255	1	2022-11-08 08:55:00:000	16.7307	959.573	24.6017	100.253	97.4534	-9999	-9999	117
DATA	1667868900	1000000000	255	1	2022-11-08 08:55:00:100	16.7267	959.705	24.6014	100.253	97.4616	-9999	-9999	247
DATA	1667868900	2000000000	255	1	2022-11-08 08:55:00:200	16.7364	959.47	24.6013	100.248	97.4642	-9999	-9999	200
DATA	1667868900	3000000000	255	1	2022-11-08 08:55:00:300	16.7298	959.708	24.601	100.248	97.4634	-9999	-9999	210
DATA	1667868900	4000000000	255	1	2022-11-08 08:55:00:400	16.7308	959.482	24.6006	100.251	97.4632	-9999	-9999	248
DATA	1667868900	5000000000	255	1	2022-11-08 08:55:00:500	16.7123	957.799	24.6005	100.256	97.4572	-9999	-9999	005
DATA	1667868900	6000000000	255	1	2022-11-08 08:55:00:600	16.7223	957.936	24.6006	100.257	97.4556	-9999	-9999	005
DATA	1667868900	7000000000	255	1	2022-11-08 08:55:00:700	16.7317	958.507	24.6007	100.251	97.4556	-9999	-9999	001
DATA	1667868900	8000000000	255	1	2022-11-08 08:55:00:800	16.7343	958.813	24.6007	100.244	97.4635	-9999	-9999	002
DATA	1667868900	9000000000	255	1	2022-11-08 08:55:00:900	16.7294	959.172	24.6007	100.249	97.4662	-9999	-9999	013

# 高頻度資料

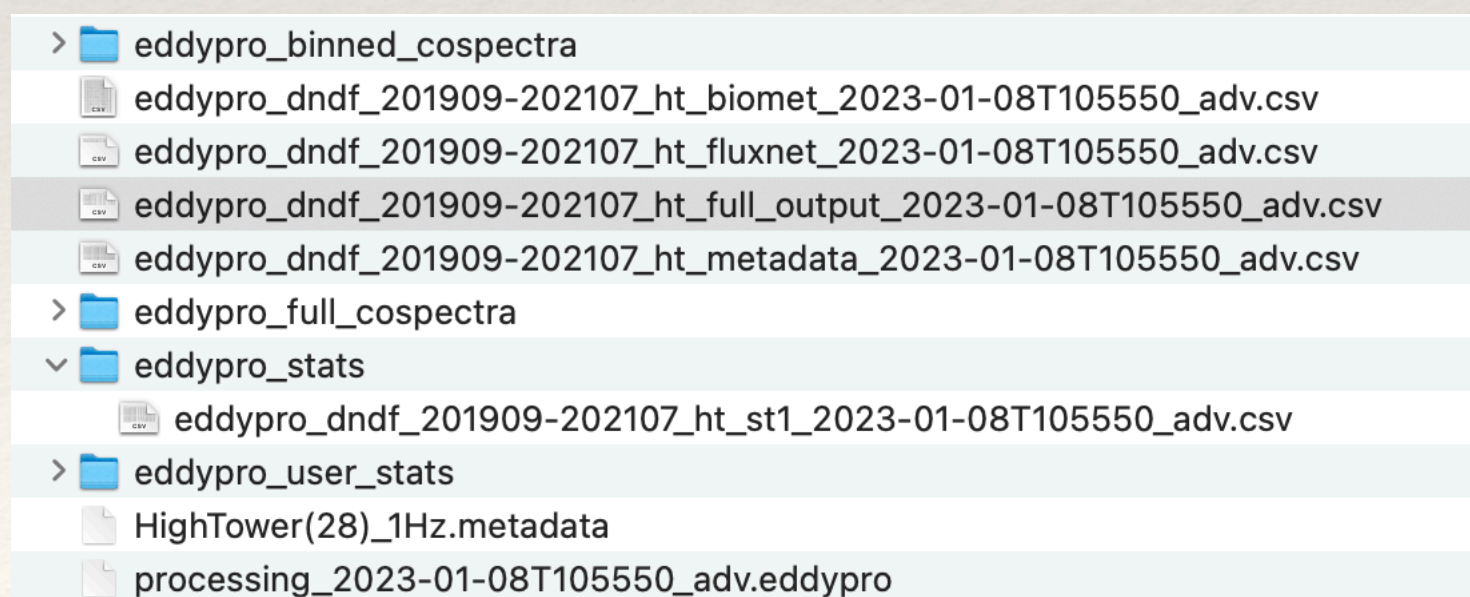
- ❖ 一般使用時會依模型、環境條件、時間區間將原始檔案再整理計算，產出第二次的檔案群
- ❖ 其中統計值為文字檔.csv，包含日期時間及衍生參數，大約有120欄的參數。



來源:Metzer (2018) Surface-Atmosphere Exchange in a Box.



來源:Launiainen (2011) Canopy processes, fluxes and microclimate in a pine forest



file info					corrected_fluxes_and_quality_flags												storage_fluxes			
filename	date	time	DOY	daytime	file_records	used_records	Tau	qc_Tau	H	qc_H	LE	qc_LE	co2_flux	qc_co2_flux	h2o_flux	qc_h2o_flux	H_strg	LE_strg	co2_strg	h2o_strg
	[yyyy-mm-dd]	[HH:MM]	[ddd.ddd]	[1=daytime]	[#]	[#]	[kg+1m-1s-2]	[#]	[W+1m-2]	[#]	[W+1m-2]	[#]	[mmol+1s-1m-1]	[#]	[mmol+1s-1m-1]	[#]	[W+1m-2]	[W+1m-2]	[mmol+1s-1m-1]	[mmol+1s-1m-1]
2019-09-19T	2019/9/19	9:30	262.3957		1	1800	-0.177928	1	81.8121	0	245.912	0	-16.3613	0	5.60407	0	-9999	-9999	-9999	-9999
2019-09-19T	2019/9/19	10:00	262.4166		1	1800	-0.11875	1	127.086	1	222.233	1	-17.328	1	5.06781	1	12.2868	8.89714	-0.28914	0.202891
2019-09-19T	2019/9/19	10:30	262.4374		1	1800	-8.04E-02	1	261.965	1	467.827	1	-27.5089	1	10.6788	1	17.9775	18.9532	-0.677166	0.432631
2019-09-19T	2019/9/19	11:00	262.4582		1	1800	-0.222209	1	238.095	1	473.45	1	-28.8917	1	10.808	1	1.43358	0.853832	-0.275748	1.95E-02
2019-09-19T	2019/9/19	11:30	262.479		1	1800	-0.514451	0	233.984	0	305.085	0	-19.0847	0	6.96189	0	-6.93893	2.24156	-1.20772	5.12E-02
2019-09-19T	2019/9/19	12:00	262.4999		1	1800	-0.389431	0	91.594	0	275.85	0	-21.0504	0	6.2916	0	-9.27595	6.63299	-1.44636	0.151286
2019-09-19T	2019/9/19	12:30	262.5207		1	1800	-0.269497	0	15.4439	0	212.172	0	-15.3999	0	4.83701	0	-8.44819	-7.48165	-2.41E-02	-0.170564
2019-09-19T	2019/9/19	13:00	262.5415		1	1800	-0.243854	0	-19.9015	1	170.059	0	-11.8975	0	3.87552	0	-6.77495	1.17075	-1.04973	2.67E-02
2019-09-19T	2019/9/19	13:30	262.5624		1	1800	-0.32381	0	-17.8836	1	146.534	0	-10.9545	0	3.33746	0	-10.8404	3.76292	-0.380947	8.57E-02
2019-09-19T	2019/9/19	14:00	262.5832		1	1800	-0.297343	0	-34.2561	0	89.2492	0	-2.68645	1	2.03143	0	-11.9499	-0.563999	1.03002	-1.28E-02

# 後設(詮釋)資料

- ❖ 細節很重要！  
量什麼？用什麼量？  
在哪裡量？多久量一次？
- ❖ 高頻度的資料通常已內含後設資料
- ❖ 低頻度的資料我們通常另外以描述性文字存檔紀錄 .txt/.doc
- ❖ 資料記錄器的程式於編寫時皆附說明，或是以截圖標注
- ❖ 儀器校正的數位/紙本檔案，皆另外儲存。

DNDF Instruments

latest updated:2019-09-01(DL)  
eds: 2018-07-06(DL),  
2017-07-13(DL),2017-02-24(DL)  
2016-10-09(DL),2016-10-06(DL)

Tower Location: 23.626267N(23° 37' 34.5606"), 121.415367E.(121° 24' 55.3212") (2016-11-09)  
(Tentative Location is 23.626925, 121.415775. @ 158 a.s.l. on 2016-10-06)

Tower Height: 18.0 m  
Canopy Height: ~12.0 m

Instruments Installed

Type	Manufacturer - SN	# @ Install. Height (m)	Manuals & Notes
Barometric Pressure	Met-One Inst. 092 - M1225	1x @ 13.5 (2017-07-13)	manual
Temperature Humidity	Viasala HMP155	1x @ 16.0	manual
Wind speed & direction	Young 05305/05103	1x @ 19.0	manual
Weather Transmitter	Viasala WXT520	1x @ 19.0	manual

資料記錄器

測站名稱：生豐電廠站 (FLSF)

測站啟用時間：2023/01/01

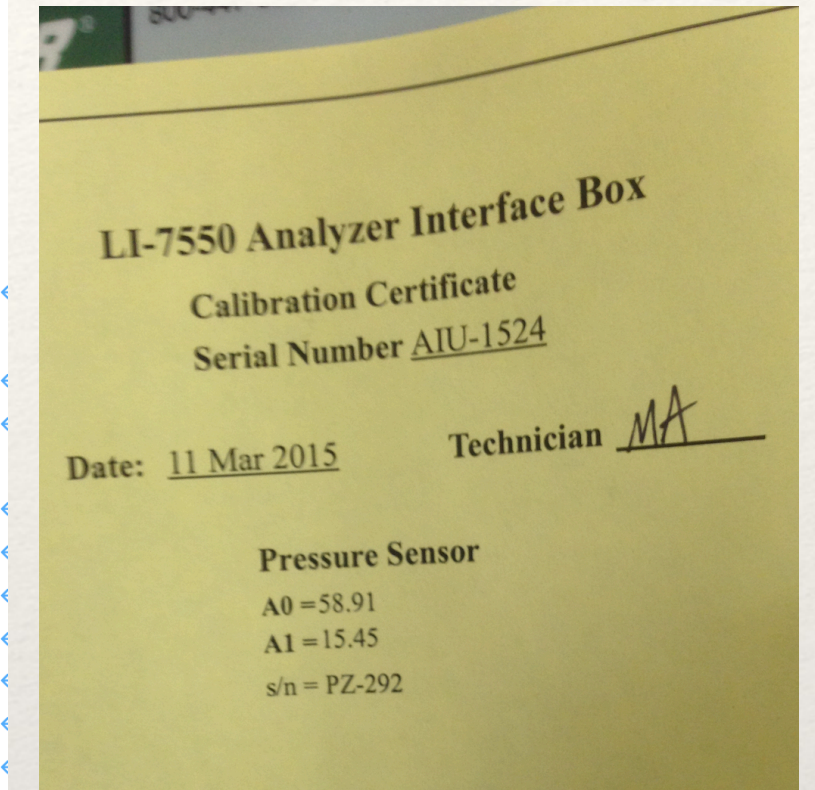
研究單位：國立東華大學陸域生態研究室

研究人員：張世杰教授、賴正偉研究助理

聯絡電話：(03) 890-3270

監測儀器、參數與記錄器類型

參數	儀器	連接線	延長線	CR1000 記錄器端口
大氣壓力	B4a-0611a	White	White	DE01-H (SE1)
		Green	Lighter Green	AG
		Red		12V(+)
		Black		G
風向 風速	Young 05103	Blue	Brown	DE01-L (SE2)
		Red	Red	VX2
		Yellow	Orange	P1
		others		AG
氣溫 相對濕度	Vaisala HMP155	Yellow	Yellow	DE02-H (SE3)
		Blue	Blue	DE02-L (SE4)
		Red	Pink	12V(+)



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~/LTER-NDHU Dropbox/Lab's Space/研究計畫/DNDF 大農大富平地森林樣區/儀器列表_接線_程式/DNDF-202301.CR1X
1 'CR1000X Series
2 'DNDF, Taiwan
3 '2023-01-01
4 'Program author:C-W Lai
5 'Contact: david_lai@seed.net.tw
6 'Note
7 '*** Wiring ***
8 '
9 ' H (SE1) Barometric Pressure Sensor (092) - White
10 ' L (SE2) Wind Direction (05103)- ext.cable GREEN
11 '
12 'DE 02 Viasala HMP155
13 ' H (SE3) AirTC @ tower top (Viasala HMP155)
14 ' L (SE4) RH @ tower top (Viasala HMP155)
15 '
16 'DE 03 Global solar radiation at ground
17 ' H (SE5) CM3 solar radiometer -RED
18 ' L (SE6) CM3 solar radiometer -BLUE
19 ' G BLACK+BLUE(jump)
20 'DE 04 PAR(LI190SB Quantum Sensor)
21 ' H (SE7) LI190SB-RED
22 ' L (SE8) LI190SB-BLACK
23 ' G LI190SB-BLACK - jumper to AG
24 'DE 05 4WPB100 for Hukseflux NR01 4-component net radiation sensor
25 ' (4WPB100 black wire to VX1)
26 ' H (SE9)
27 ' L (SE10) 4WPB100 RED
28 ' G 4WPB100 BLUE
29 'DE 06 Hukseflux NR01 4-component net radiation sensor
30 ' H (SE11) PT100 Signal - cable 2. White - ext.cable BLACK
31 ' L (SE12) PT100 Signal Ref - cable 2. GREEN - ext.cable Lighter-GREEN
32 ' G
33 'DE 07 H (SE13) Pyranometer UP Sig - downwelling shortwave cable 1. RED - ext.cable RED
34 ' L (SE14) Pyranometer DNW Sig - upwelling shortwave cable 1. White - ext.cable WHI

```

7500DS Open Path CO2/H2O Analyzer (fe80-42bd32ffe20-7f41)

Connected to: smart13-00300

Head serial number: 750-4201  
DSI: DSI-00326  
Instrument type: LI-7500DS

CO2/H2O Analyzer: OK  
LI-7700: None  
Biomet System: smart13-00300  
Sonic Anemometer: Digital; Csi: CSAT3 (csat3 ver 4.0)

SmartFlux Status: OK

Date: 2021-08-  
Time: 12:00:  
CO2 Absorbance: 0.116  
CO2 (µmol/mol): 405.  
H2O (mmol/m³): 120.  
W (m/s): 0.0  
TS (°C): 33.699

Diagnostics

Status: Waveform SmartFlux Advanced

**Clock:**  
GPS Firmware Version: unknown  
Time Source: Primary Time Source  
Reading GPS Receiver Time? Yes  
Synced To GPS Satellite Time? Yes  
GPS Satellites Detected: 7  
Time sources consistent? Unknown  
No GHG IP Address

**FluxSuite:**  
FluxSuite URL Configured? No

**Sonic Data Collection:**  
Connection State: active  
Receiving Data? Yes  
Recorded to GHG File? No  
Sonic File Names Consistent? Yes  
Digital Sonic Files Storage Capacity: Good

**Data Repository:**  
Upload to Data Repository Enabled? Yes  
Repository URL: Yes  
URL Resolved To Address: Yes  
Upload To Data Repository Attempted? Unknown  
Upload To Data Repository Successful? Yes  
Data Repository File Storage Capacity: Good

**System Database:**  
Database Size: Good

**EddyPro:**  
Most Recent File Processed Without Errors? No  
Last File Successfully Processed:  
Last File Copied to USB Storage:  
CO2 Raw file Storage Capacity: Good

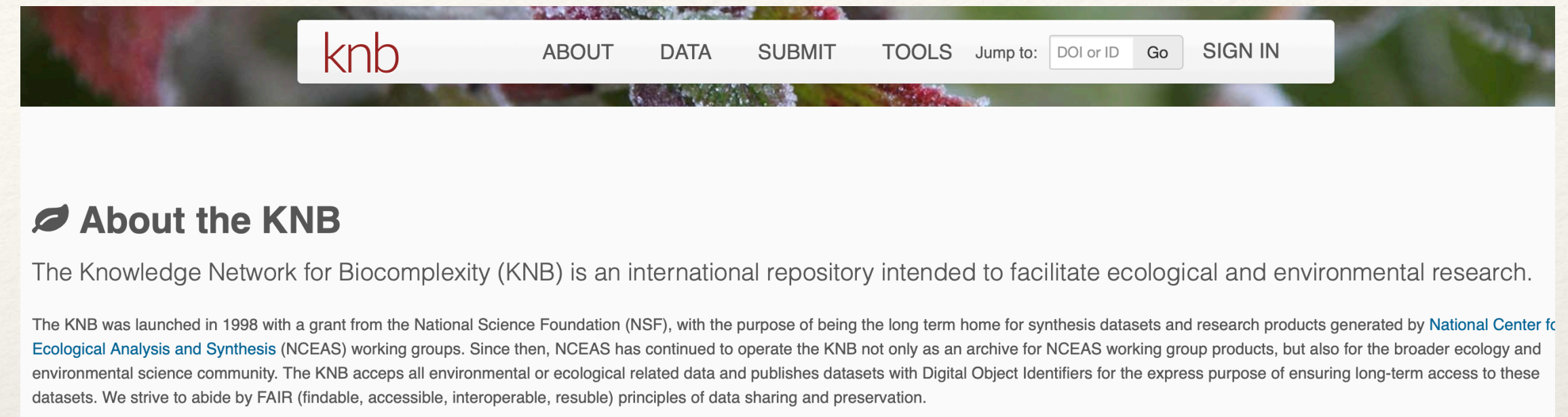
**SmartFlux USB Storage:**  
Present? Yes  
Writable? Yes

Status Refresh Rate: Once Every 15 seconds



# 倉儲

- ❖ 本地端：NAS in Lab
- ❖ 遠端：Dropbox
- ❖ Protocol: sftp/http/Rsync
- ❖ 資料 -> 資訊：  
目前的使用需求，還沒有設置規格化的資料庫，未來可視CIRES研究人員、電廠及公眾需求，挑選適合的參數、資料表另作倉儲、展示、交換。



來源:KNB, URL:<https://knb.ecoinformatics.org/>



來源:白益豪老師