22nd Nov 18

Documentation on the Terrestrial Observatory of Lonzée (OTL)

1. Owners/Authors

Principal Investigator (PI): Bernard Heinesch
Manager of eddy covariance fluxes and continuous meteorological measurements: Anne De Ligne
Manager of biomass measurements: Tanguy Manise

This report was written by Anne De Ligne and Tanguy Manise.

2. Site description

The Lonzée site is a cropland (the land has been cultivated for more than 75 years) with a 4-year rotation : sugar beet (*Beta vulgaris* L.), winter wheat (*Triticum aestivum* L.), potato (*Solanum tuberosum* L.), winter wheat (*Triticum aestivum* L.) (Beginning in 2000).

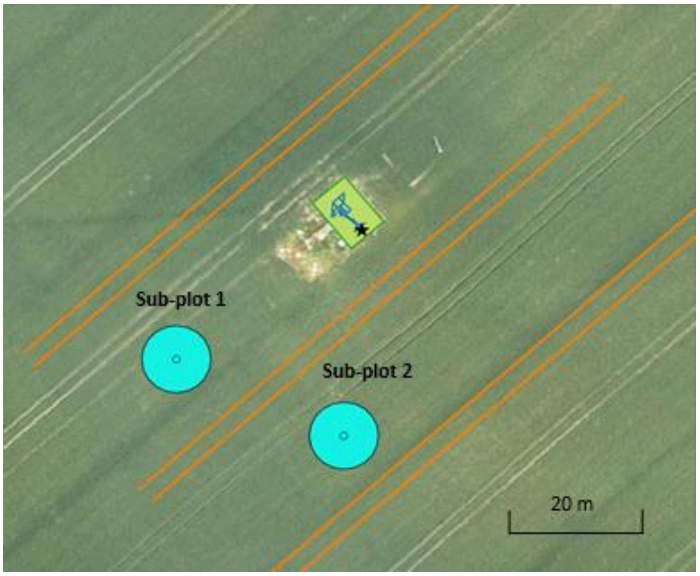
Here is the schedule of crops since 2004 with sowing/planting and harvest dates :

Years	Crop	Sowing/planting - harvest
2004	Sugar beet	30.03.04 / 29.09.04
2004-2005	Winter wheat	14.10.04 / 03.08.05
2006	Patato	01.05.06 / 15.09.06
2006-2007	Winter wheat	13.10.06 / 05.08.07
2008	Sugar beet	22.04.08 / 04.11.08
2008-2009	Winter wheat	13.11.08 / 07.08.09
2009	Mustard	01.09.09 / 01.12.09
2010	Patato	25.04.10 / 05.09.10
2010-2011	Winter wheat	14.10.10 / 16.08.11
2012	Maize	14.05.12 / 13.10.12
2012-2013	Winter wheat	25.10.12 / 12.08.13
2013	Mustard	05.09.13 / 15.11.13
2014	Patato	07.04.14 / 22.08.14
2014-2015	Winter wheat	15.10.14 / 02.08.15
2015	Mustard	26.08.15 / 09.12.15
2016	Sugar beet	12.04.16 / 27.10.16
2016-2017	Winter wheat	29.10.16 / 30.07.17
2017	Mustard	07.09.17 / 08.12.17
2018	Patato	23.04.18 / 11.09.18
2019	Winter wheat	10.10.18 / ???

3. Site localisation

Site geographical coordinates are 50°33'5.8"N - 4°44'46.5"E

The plan view below shows the sub-plots of the site where samplings are conducted. There are two sub-plots (in blue on the plan) of 5 meters radius. The orange lines indicate where the tractor was moving in 2018.



Main wind : 225°
Mean peak footprint : 60 m
Location of sub-plot 1 : 234,4° - 32,89 m
Location of sub-plot 2 : 184,8° - 30,61 m

4. Flux measurements

4.1 List of sensors variables

Variables Code List :

TABLE 1: Base names for data variable labels[1]

Variable	Units	Description
TIMEKEEPING		
TIMESTAMP	YYYYMMDDHHMMSS	ISO timestamp - short format
GASES		
CO2	umolCO2 mol-1	Carbon Dioxide (CO2) mole fraction
H2O	mmolH2O mol-1	Water (H2O) vapor mole fraction

[1] Please see Appendix A for timekeeping base names used for transitional and compatibility purposes.

CH4	nmolCH4 mol-1	Methane (CH4) mole fraction
NO	nmolNO mol-1	Nitric oxide (NO) mole fraction
NO2	nmolNO2 mol-1	Nitrogen dioxide (NO2) mole fraction
N2O	nmolN2O mol-1	Nitrous Oxide (N2O) mole fraction
O3	nmolO3 mol-1	Ozone (O3) mole fraction
FC	umolCO2 m-2 s-1	Carbon Dioxide (CO2) flux
FCH4	nmolCH4 m-2 s-1	Methane (CH4) flux
FNO	nmolFNO m-2 s-1	Nitric oxide (NO) flux
FNO2	nmolFNO2 m-2 s-1	Nitrogen dioxide (NO2) flux
FN2O	nmolN2O m-2 s-1	Nitrous oxide (N2O) flux
FO3	nmolFO3 m-2 s-1	Ozone (O3) flux
SC	umolCO2 m-2 s-1	CO2 storage flux
SCH4	nmolCH4 mol-1	Methane (CH4) storage flux
SNO	nmolNO mol-1	Nitric oxide (NO) storage flux
SNO2	nmolNO2 mol-1	Nitrogen dioxide (NO2) storage flux
SN2O	nmolN2O mol-1	Nitrous oxide (N2O) storage flux
SO3	nmolO3 mol-1	Ozone (O3) storage flux
FOOTPRINT		
FETCH_MAX	m	Distance at which footprint contribution is maximum
FETCH_90	m	Distance at which footprint cumulative probability is 90%
FETCH_80	m	Distance at which footprint cumulative probability is 80%
FETCH_70	m	Distance at which footprint cumulative probability is 70%
FETCH_FILTER	adimensional	Footprint quality flag: 0 identifies data measured when wind coming from direction that should be discarded
FC_SSITC_TEST	adimensional	Quality check - Mauder and Foken 2004
FCH4_SSITC_TEST	adimensional	Quality check - Mauder and Foken 2004
FNO_SSITC_TEST	adimensional	Quality check - Mauder and Foken 2004
FNO2_SSITC_TEST	adimensional	Quality check - Mauder and Foken 2004
FN2O_SSITC_TEST	adimensional	Quality check - Mauder and Foken 2004
FO3_SSITC_TEST	adimensional	Quality check - Mauder and Foken 2004
HEAT		
G	W m-2	Soil heat flux
H	W m-2	Sensible heat flux
LE	W m-2	Latent heat flux
SG	W m-2	Heat storage in the soil above the soil heat fluxes measurement
SH	W m-2	Heat storage in the air
SLE	W m-2	Latent heat storage flux
SB	W m-2	Heat storage in biomass
H_SSITC_TEST	adimensional	Quality check - Mauder and Foken 2004
LE_SSITC_TEST	adimensional	Quality check - Mauder and Foken 2004
MET_WIND		

WD	Decimal degrees	Wind direction
WS	m s-1	Wind speed
WS_MAX	m s-1	maximum WS in the averaging period
USTAR	m s-1	Friction velocity
ZL	adimensional	Stability parameter
TAU	Kg m-2 s-1	Momentum flux
MO_LENGTH	m	Monin-Obukhov length
U_SIGMA	m s-1	Standard deviation of velocity fluctuations (towards main-wind direction after coordinates rotation)
V_SIGMA	m s-1	Standard deviation of lateral velocity fluctuations (cross main-wind direction after coordinates rotation)
W_SIGMA	m s-1	Standard deviation of vertical velocity fluctuations
TAU_SSITC_TEST	adimensional	Quality check - Mauder and Foken 2004
MET_ATM		
PA	kPa	Atmospheric pressure
RH	%	Relative humidity, range 0-100
TA	deg C	Air temperature
VPD	hPa	Vapor Pressure Deficit
T_SONIC	deg C	Sonic temperature
T_SONIC_SIGMA	deg C	Standard deviation of sonic temperature
PBLH	m	Planetary boundary layer height
MET_SOIL		
SWC	%	Soil water content (volumetric), range 0-100
TS	deg C	Soil temperature
WATER_TABLE_DEPTH	cm	Water table depth
MET_RAD		
ALB	%	Albedo, range 0-100
APAR	umol m-2 s-1	Absorbed PAR
FAPAR	%	Fraction of absorbed PAR, range 0-100
FIPAR	%	Fraction of intercepted PAR, range 0-100
NETRAD	W m-2	Net radiation
PPFD_IN	umolPhoton m-2 s-1	Photosynthetic photon flux density, incoming
PPFD_OUT	umolPhoton m-2 s-1	Photosynthetic photon flux density, outgoing
PPFD_BC_IN	umolPhoton m-2 s-1	Photosynthetic photon flux density, below canopy incoming
PPFD_BC_OUT	umolPhoton m-2 s-1	Photosynthetic photon flux density, below canopy outgoing
PPFD_DIF	umolPhoton m-2 s-1	Photosynthetic photon flux density, diffuse incoming
PPFD_DIR	umolPhoton m-2 s-1	Photosynthetic photon flux density, direct incoming
SW_IN	W m-2	Shortwave radiation, incoming
SW_OUT	W m-2	Shortwave radiation, outgoing
SW_BC_IN	W m-2	shortwave radiation, below canopy incoming
SW_BC_OUT	W m-2	shortwave radiation, below canopy outgoing
SW_DIF	W m-2	Shortwave radiation, diffuse incoming

SW_DIR	W m-2	Shortwave radiation, direct incoming
LW_IN	W m-2	Longwave radiation, incoming
LW_OUT	W m-2	Longwave radiation, outgoing
LW_BC_IN	W m-2	Longwave radiation, below canopy incoming
LW_BC_OUT	W m-2	Longwave radiation, below canopy outgoing
SPEC_RED_IN	umolPhoton m-2 s-1	Radiation (red band), incoming
SPEC_RED_OUT	umolPhoton m-2 s-1	Radiation (red band), outgoing
SPEC_RED_REFL	adimensional	Reflectance (red band)
SPEC_NIR_IN	umolPhoton m-2 s-1	Radiation (near infra-red band), incoming
SPEC_NIR_OUT	umolPhoton m-2 s-1	Radiation (near infra-red band), outgoing
SPEC_NIR_REFL	adimensional	Reflectance (near infra-red band)
SPEC_PRI_TGT_IN	umolPhoton m-2 s-1	Radiation for PRI target band (e.g., 531 nm), incoming
SPEC_PRI_TGT_OUT	umolPhoton m-2 s-1	Radiation for PRI target band (e.g., 531 nm), outgoing
SPEC_PRI_TGT_REFL	adimensional	Reflectance for PRI target band (e.g., 531 nm)
SPEC_PRI_REF_IN	umolPhoton m-2 s-1	Radiation for PRI reference band (e.g., 570 nm), incoming
SPEC_PRI_REF_OUT	umolPhoton m-2 s-1	Radiation for PRI reference band (e.g., 570 nm), outgoing
SPEC_PRI_REF_REFL	adimensional	Reflectance for PRI reference band (e.g., 570 nm)
NDVI	adimensional	Normalized Difference Vegetation Index
PRI	adimensional	Photochemical Reflectance Index
R_UVA	W m-2	UVA radiation, incoming
R_UVB	W m-2	UVB radiation, incoming
MET_PRECIP		
P	mm	Precipitation
P_RAIN	mm	Rainfall
P_SNOW	mm	Snowfall
D_SNOW	cm	Snow depth
RUNOFF	mm	Run off
BIOLOGICAL		
DBH	cm	Diameter of tree measured at breast height (1.3m) with continuous dendrometers
LEAF_WET	%	Leaf wetness, range 0-100
SAP_DT	deg C	Difference of probes temperature for sapflow measurements
SAP_FLOW	mmolH2O m-2 s-1	Sap flow measurement
STEMFLOW	mm	Stemflow
THROUGHFALL	mm	Excess water from wet leaves reaching the ground
T_BOLE	deg C	Bole temperature
T_CANOPY	deg C	Temperature of the canopy
PRODUCTS		
NEE	umolCO2 m-2 s-1	Net Ecosystem Exchange
RECO	umolCO2 m-2 s-1	Ecosystem Respiration
GPP	umolCO2 m-2 s-1	Gross Primary Productivity

Source : http://www.europe-fluxdata.eu/home/guidelines/obtaining-data/variables-and-formats

In addition of the variable name it is requested to use a 3 figures code which identifies univocally the location within the site where measurements are taken. The importance of this code is related to the possibility to associate to each variable a set of metadata like the method or instrument used, the measurement depth/height, the last calibration of the sensor etc.
Generally, the name of the variable has to be indicated as:

$$\mathbf{VAR\_x_1\_x_2\_x_3}$$

VAR= variable name (refer to the list of input variables)
The first figure stands for the position of the sensors on a 2D space. For instance, if soil temperature is measured at 3 different locations, these can be numbered as 1, 2, 3.

TS_1_x_x	**TS_2_x_x**	**TS_3_x_x**
location 1	*location 2*	*location 3*

The second figure represents the vertical level (height above the ground/depth of the soil) of the sensors. Supposing to measure soil temperature at 3 different depths along a vertical profile at each location, then each variable can be identified as follows:

TS_1_1_x	**TS_2_1_x**	**TS_3_1_x**	*depth 1*
TS_1_2_x	**TS_2_2_x**	**TS_3_2_x**	*depth 2*
TS_1_3_x	**TS_2_3_x**	**TS_3_3_x**	*depth 3*
location 1	*location 2*	*location 3*	

Numeration increases moving downwards along a vertical profile but same number at two different locations can indicate different height/depth, that is specified in the metadata. So for example the deeper soil temperature measurement point in two different profiles of 4 sensors each will be indicated as TS_1_4_1 and TS_2_4_1 even if the first is at 80cm and the second 120cm below ground.
The third figure identifies the presence of replicated measurements in the same location. For instance, given 2 replicates of soil temperature measurements at position 1 and depth 1 (i.e. for sensors comparison), these would be indicated as:

TS_1_1_1 TS_1_1_2

Another example where the third figure should be used is for measurements at tree level like sap flow sensors. In this case the first figure indicate the tree (again specified in the metadata), the second the measurement height if you have for example sap flow measurements on the same tree at different heights and the third can be used to identify different sensors at the same height, commonly used in sap flow measurements.

4.2 Timestamp

The timestamp of data is 30 minutes.
Since February 2017, meteorological data are acquired every 20 seconds except for soil and rainfall sensors which are recorded every 60 seconds. They are then averaged by 30 minutes.

Data found on the European Fluxes Database Cluster are in Local Time without daylight saving time (UTC+1).
The timestamp of variables found in internal files (MET, FLX, BRUT, UNCOR) are in the UTC time until April 2015. On the 1st May 2015, those internal files are in UTC+1.
L2 files are always in UTC+1.

4.3 Sensors

The sensors used are listed below for different periods.

- 2018 : installation for the labelling of the station in the ICOS network
- 2014 to 2017: installation of sensor with ICOS project.
- 2004 to 2013: first installation

The list is complete for 2014 and further. Additional and more precise information is available in the station logbooks available by contacting Anne De Ligne (Anne.DeLigne@ulg.ac.be).

Before 2014, an investigation has been conducted to gather a maximum of previous information in this document; it’s possible that some information is missing before 2014. If you have any question or comment, please contact us (Anne.DeLigne@ulg.ac.be).

Since 2018: Labelling of the station in the ICOS network

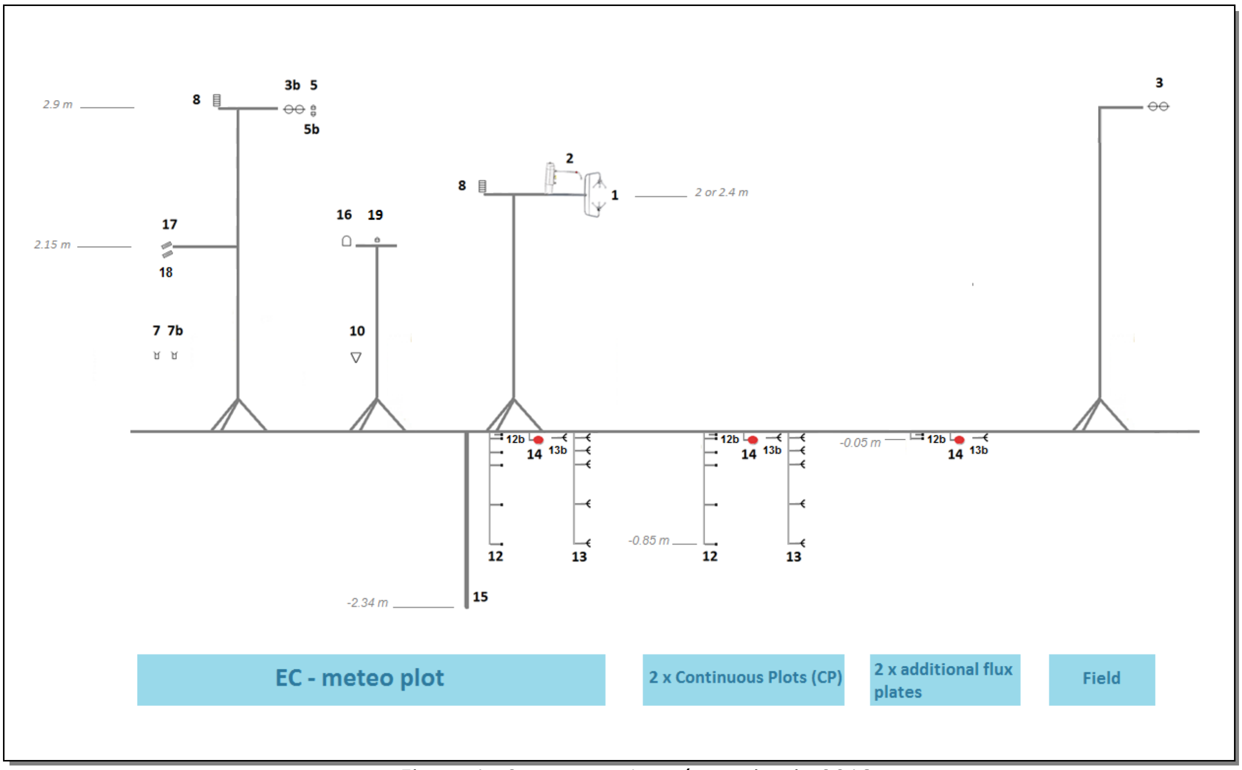


Figure 1 : Sensors on Lonzée station in 2018

Figure 2 : Picture of the “EC-meteo” plot of Lonzée station in 2018

	Date of installation	Device	Reference	Variable	Code	Height (m)	nbr.
1	1.01.2014	Sonic anemometer	Solent Research HS-50, Gill Instruments Lymington, UK	Wind velocity	WS_1_1_1, WD_1_1_1	2 or 2.4	1
2	1.01.2014	Infrared gas analyzer	LI-7200, LI-COR, Lincoln, NE, US	Concentration of CO_2 and of H_2O	CO2_1_1_1, H2O_1_1_1	1.96 or 2.06	1
3	28.08.2014	Pyrradiometer	CNR 4, Kipp and Zonen, Delft, NL	Solar radiation	SW_IN_1_1_1, SW_OUT_1_1_1, LW_IN_1_1_1, LW_OUT_1_1_1, LW_T_BODY_1_1_1	2.9	1
3b	4.10.2005	Pyrradiometer	CNR1, Kipp and Zonen, Delft, NL	Solar radiation (Back up)	SW_IN_1_1_2, SW_OUT_1_1_2, LW_IN_1_1_2, LW_OUT_1_1_2, LW_T_BODY_1_1_2	2.9	1
5	1.07.2014	Photo-receptor Cells	PAR Quantum sensor SKP 215, Skye Instruments Limited, Llandrindod Wells, UK	Photosynthetic Photon Flux Density	PPFD_IN_1_1_1	2.9	1
5b	1.07.2014	Photo-receptor Cells	PAR Quantum sensor SKP 215, Skye Instruments Limited, Llandrindod Wells, UK	Reflected Photosynthetic Photon Flux Density	PPFD_OUT_1_1_1	2.7	1
7	20.06.2014	Weighing Rain Gauge	TRwS415, MPS system sro, Bratislava, SK	Precipitation	P_1_1_1	1.05	1
7b	19.04.2004	Tipping Bucket Rain Gauge	52202, R.M. Young Company, Traverse city, MI, US	Precipitation (Back up)	P_1_1_2	1.35	1
8	1.07.2014	Resistive platinium thermometer and electrical capacitive hygrometer	HMP155, Vaisala Oyj, Helsinki, FI	Air temperature, Air humidity	TA_1_1_1, RH_1_1_1, TA_1_1_2, RH_1_1_2	2, 2.9	2
10	9.08.2013	Barometer	PTB110/CS106, Campbell Scientific, Logan, UT, US	Atmospheric pressure	PA_1_1_1	0.9	1

12	05.2018	Platinum resistance thermometer	Temperature Profile Probe MTPP, MicroStep spol. s r.o., Bratislava, SK	Soil temperature	TS_1_2_1 to TS_1_6_1, TS_2_2_1 to TS_2_6_1, TS_3_2_1 to TS_3_6_1,	-0.05, -0.15, -0.25, -0.55, -0.85	3
12b	05.2018	Platinum resistance thermometer	PT100D Digital Thermometer, MicroStep spol. s r.o., Bratislava, SK	Soil temperature	TS_1_1_1, TS_1_1_1, TS_3_1_1, TS_4_1_1 to TS_4_2_1, TS_5_1_1 to TS_5_2_1,	-0.01, -0.05	7
13	15.04.2015	Silicon bandgap temperature sensor (transistor) and capacitance sensors (FDR)	EnviroSCAN Probe, Sentek Sensor Technologies, Stepney, SA, AU	Soil water content	SWC_1_1_1 to SWC_1_5_1, SWC_2_1_1 to SWC_2_5_1, SWC_3_1_1 to SWC_3_5_1	-0.05, -0.15, -0.25, -0.55, -0.85	3
13b	05.2018	Time domain reflectometer	ML3 ThetaProbe Soil Moisture Sensor, Delta-T Devices Ltd, Cambridge, UK	Soil water content	SWC_1_1_2, SWC_2_1_2, SWC_3_1_2, SWC_4_1_1, SWC_5_1_1	-0.05	5
14	1.09.2014 1.04.2015 2016	Self-Calibrating Soil Heat Flux Plate	HFP01SC, Hukseflux Thermal Sensors B.V., Delft, NL	Soil Heat Flux	G_1_1_1 to G_5_1_1	-0.05	3
15	11.04.2018	Pressure Transducer	CS451, Campbell Scientific, Logan, UT, US	Water table depth	WCP_1_1_1, WTD_1_1_1	-2.34	1
16	1.07.2014	Sonic Ranging Sensor	SR50A-L, Campbell Scientific, Logan, UT, US	Snow depth	D_SNOW_1_1_1	2.13	1
17	1.07.2014	Infra-red Remote Temperature Sensor	IR 120, Campbell Scientific, Logan, UT, US	Canopy temperature	T_CANOPY_1_1_1	2.15	1
18	07.11.2006	NDVI sensor	Labo ESE Unif Paris	NDVI	NDVI_1_1_1	2.15	1
19	6.08.2004	Photo-receptor Cells	Sunshine sensor type BF3, Delta-T Devices Ltd, Cambridge, UK	diffuse PPFD	PPFD_DIF_1_1_1	2.5	1

2014 to 2017

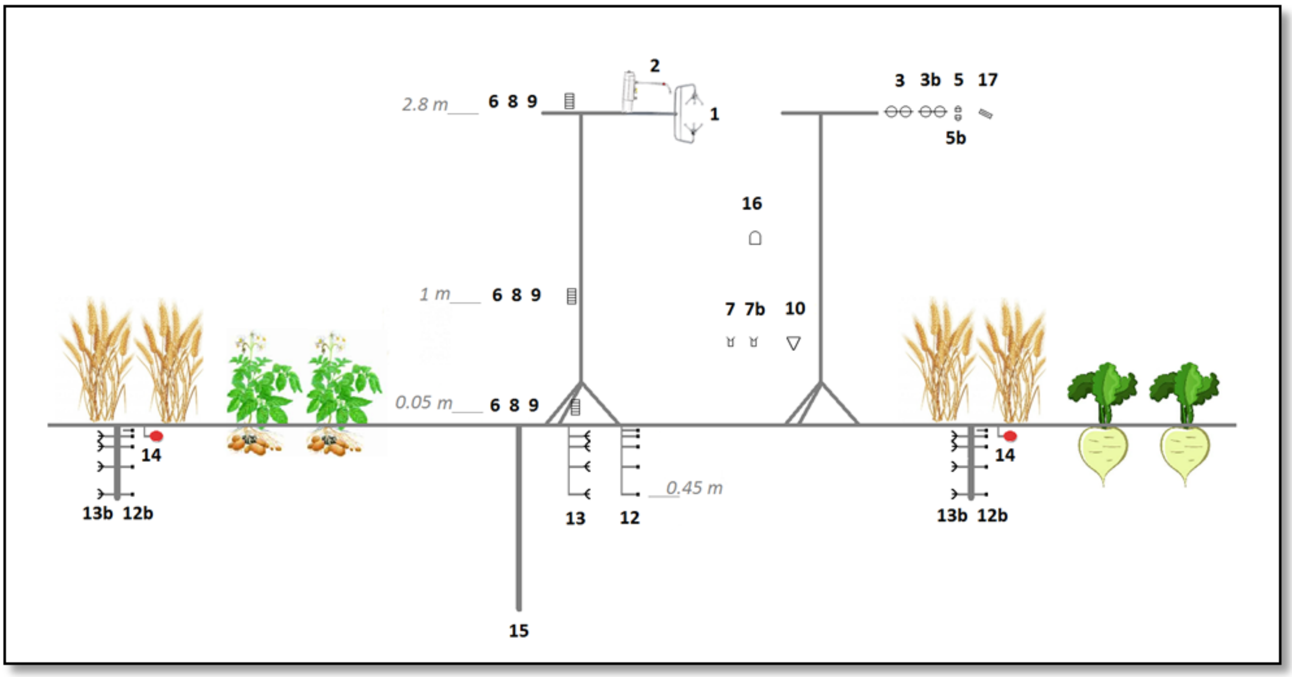


Figure 3 : Sensors on Lonzée station in 2014

	Date of installation	Device	Reference	Variable	Code	Height (m)	nbr.
1	1.01.2014	Sonic anemometer	Solent Research HS-50, Gill Instruments Lymington, UK	Wind velocity	WS_1_1_1, WD_1_1_1	2.8	1
2	1.01.2014	Infrared gas analyzer	LI-7200, LI-COR, Lincoln, NE, US	Concentration of CO2 and of H2O	CO2_1_1_1, H2O_1_1_1	2.8	1
3	28.08.2014	Pyrradiometer	CNR 4, Kipp and Zonen, Delft, NL	Solar radiation	SW_IN_1_1_1, SW_OUT_1_1_1, LW_IN_1_1_1, LW_OUT_1_1_1, NETRAD_1_1_1	2.8	1
3b	4.10.2005	Pyrradiometer	CNR1, Kipp and Zonen, Delft, NL	Solar radiation (bis)	SW_IN_1_1_2, SW_OUT_1_1_2, LW_IN_1_1_2, LW_OUT_1_1_2, NETRAD_1_1_2	2.8	1
5	1.07.2014	Photo-receptor Cells	PAR Quantum sensor SKP 215 Skye Instruments Limited, Llandrindod Wells, UK	Photosynthetic Photon Flux Density	PPFD_IN_1_1_1	2.88	1

5b	1.07.2014	Photo-receptor Cells	PAR Quantum sensor SKP 215 Skye Instruments Limited, Llandrindod Wells, UK	Reflected Photosynthetic Photon Flux Density	PPFD_OUT_1_1_1	2.65	1
6		Waiting for protocol		CO_2 concentration	CO2_1_1_2, CO2_1_2_1, CO2_1_3_1	2.8, 1, 0.3	3
7	20.06.2014	Weighing Rain Gauge	TRwS415, MPS system sro, Bratislava, Slovakia	Precipitation	P_1_1_1	1.1	1
7b	19.04.2004	Tipping Bucket Rain Gauge	52202, R.M. Young Company, Traverse city, MI, US	Precipitation (bis)	P_1_1_2	1.4	1
8	1.07.2014	Thermistor and electrical capacitive hygrometer	RHT2nl, Delta-T Devices Ltd, Cambridge, UK	Air temperature, Air humidity	TA_1_1_1 to TA_1_3_1, RH_1_1_1 to RH_1_3_1, TA_1_1_2, RH_1_1_2	2.8, 1, 0.3	4
10	9.08.2013	Barometer	PTB110/CS106, Campbell Scientific, Logan, UT, US	Atmospheric pressure	PA_1_1_1	0.9	1
12	1.09.2014 1.04.2015 2016	Electrical resistance thermometer	PT 107, Campbell Scientific, Logan, UT, US	Soil temperature	TS_1_1_1 to TS_1_5_1, TS_2_1_1, TS_3_1_1, TS_1_1_2	-0.01, -0.05, -0.15, -0.25, -0.45	8
13	1.09.2014	Time domain reflectometer	CS616, Campbell Scientific, Logan, UT, US	Soil moisture	SWC_1_1_1 to SWC_1_4_1,	-0.05, -0.15, -0.25 -0.45	4
12b - 13b	1.04.2015, 1.04.2015, 15.04.2015	Silicon bandgap temperature sensor (transistor) and capacitance sensors (FDR)	EnviroSCAN Probe, Sentek Sensor Technologies, Stepney, SA, AU	Soil temperature and moisture	TS_1_2_2 to TS_1_5_2, TS_2_2_1 to TS_2_5_1, TS_3_2_1 to TS_3_5_1, SWC_1_1_2 to SWC_1_4_2, SWC_2_1_1 to SWC_2_4_1, SWC_3_1_1 to SWC_3_4_1,	-0.05, -0.15, -0.25 -0.45	3

14	1.09.2014 1.04.2015 2016	Self-Calibrating Soil Heat Flux Plate	HFP01SC, Hukseflux Thermal Sensors B.V., Delft, NL	Soil Heat Flux	G_1_1_1, G_2_1_1, G_3_1_1	-0.05	3
15	1.12.2014	Pressure Transducer	ED752, Baumer, Frauenfeld, CH	Water table depth	WATER_TABLE_DEPTH_1_1_1	-3	1
16	1.07.2014	Sonic Ranging Sensor	SR50A-L, Campbell Scientific, Logan, UT, US	Snow depth	D_SNOW_1_1_1	2	1
17	1.07.2014	Infra-red Remote Temperature Sensor	IR 120, Campbell Scientific, Logan, UT, US	Canopy temperature	T_CANOPY_1_1_1	2	1
-	07.11.2006	NDVI sensor	Labo ESE Unif Paris	NDVI	NDVI_1_1_1	1.7	1
-	6.08.2004	Photo-receptor Cells	Sunshine sensor type BF3, Delta-T Devices Ltd, Cambridge, UK	diffuse PPFD	PPFD_DIF_1_1_1	2.7	1

2004 to 2013

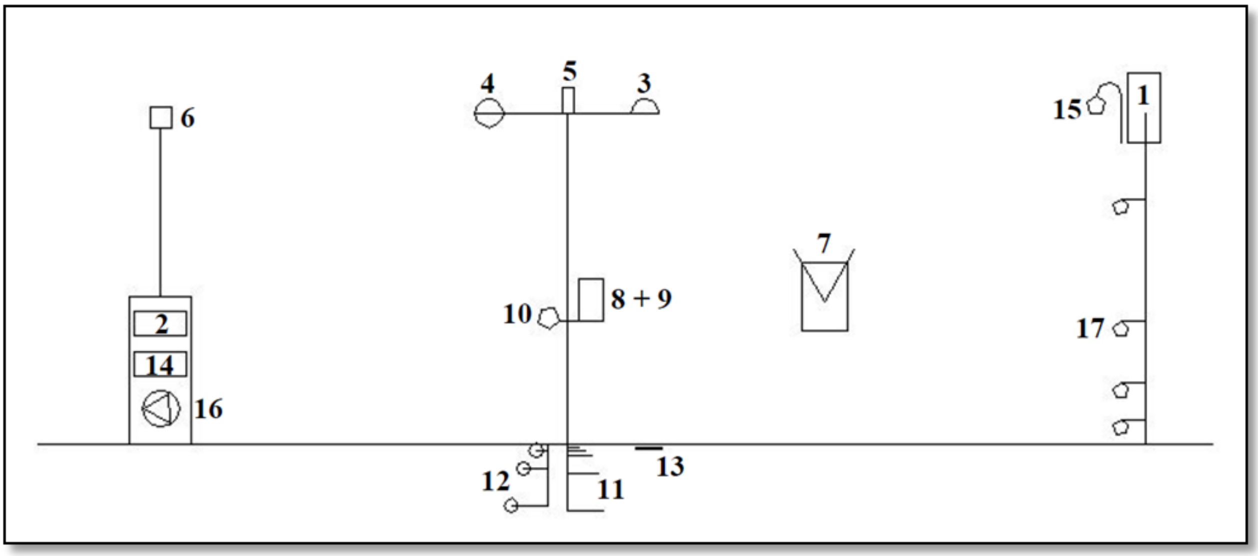


Figure 4 : Sensors on Lonzée station in 2006

List of sensors, made in 2004:

	Date of installation	Device	Reference	Variable	Code	Height (m)	nb r.
1	1.04.2004	Sonic anemometer	Solent Research R3, Gill Instruments Lymington, UK	Wind velocity	WS_1_1_1, WD_1_1_1	2.7	1
2, 15	1.04.2004	Infrared gas analyzer	LI-7000, LI-COR, Lincoln, NE, USA	Concentration of CO2 and of H2O	CO2_1_1_1, H2O_1_1_1	2.7	1
3	1.04.2004	Pyranometer	CM21, Kipp and Zonen, Delft, NL	Global solar radiation	SW_IN_1_1_1*	2.7	1
4	1.04.2004	Pyrradiometer	Q*7.1, REBS, Seattle, WA, USA	Net solar radiation	NETRAD_1_1_1	2.7	1
5	1.04.2004	Photo-receptor Cells	PAR Quantum sensor SKP 215 Skye Instruments Limited, UK	Photosynthetic Photon Flux Density	PPFD_IN_1_1_1	2.7	1
6	6.08.2004	Photo-receptor Cells	Sunshine sensor type BF3, Delta-T Devices Ltd, Cambridge, UK	diffuse PPFD	PPFD_DIF_1_1_1	2.7	1
7	19.04.2004	Collector + Tipping Bucket	Unit of physics, FUSAGx, Gembloux (B)	Precipitation	P_1_1_1	1	1

8 - 9	1.04.2004	Thermistor and electrical capacitive hygrometer	RHT2nl, Delta-T Devices Ltd, Cambridge, UK	Air temperature Air humidity	TA_1_1_1, RH_1_1_1	1.3	1
10	1.04.2004	Barometer	MPX4115A, Motorola, Phoenix, AR, USA	Atmospheric pressure	PA_1_1_1	1	1
11	1.04.2004	Thermometer with platinium resistance	PT 100, Jumo	Soil temperature	TS_1_1_1, TS_1_2_1, TS_1_3_1, TS_1_4_1, TS_1_5_1	-0.03, -0.055, -0.09, -0.26, -0.56	5
12	1.04.2004	Time domain reflectometer	ML2 ThetaProbe, Delta-T Devices Ltd, Cambridge, UK	Soil moisture	SWC_1_1_1, SWC_1_2_1, SWC_1_3_1	-0.05, -0.2, -0.4	3
13	1.04.2004	Soil Heat Flux Plate	HFP01, Hukseflux Thermal Sensors B.V., Delft, NL	Soil Heat Flux	G_1_1_1	-0.06	1
14, 17	30.08.200 4	Infrared gaz analyser	Gascard II, Edinburgh Sensors Ltd, UK	CO_2 concentration	CO2_1_2_1 - CO2_1_5_1	1.8, 1, 0.5, 0.2	1

* SW_IN_1_1_1 is the CM21 until CNR1 installation

Additional *sensors*

	4.10.2005	Pyrradiomete r	CNR 1, Kipp and Zonen, Delft, NL	Solar radiation	SW_IN_1_1_1, SW_OUT_1_1_1, LW_IN_1_1_1, LW_OUT_1_1_1, NETRAD_1_1_1	2.7	1
	7.11.2006	NDVI sensor	labo ESE Unif Paris, F	NDVI	NDVI_1_1_1	2	1
	7.11.2006	PRI sensor	SKR1800, Skye Instruments Limited, UK	PRI	PRI_1_1_1 *	2	1

* PRI_1_1_1 is not included in L2 files, see UNCOR files

4.4 Process

Soft

The soft used to process data has been from the beginning up to now : Eddysoft . (using : Block average, 2D coordinate rotation).

Canopy Height

The canopy height varies from year to year and depending on the species.
Since 2004, vegetation reaches maximum 0.62 meters height for sugar beet, 0.85 meters height for potato and 0.97 meters height for winter wheat.

High frequency correction

The procedure of high frequency correction is described in the available internal report, *Method for high frequency correction for CO_2 and water vapour fluxes*, written by A. De Ligne.

5. Biomass measurements

Sub-plots for ICOS (Integrated Carbon Observation System) biomass measurements were installed in early 2014. Before this, above and belowground biomass, leaf area index and nutrient content of foliage and root (N, P, K and C) were measured each year since 2004.

The table below lists variables that are and will be measured from 2014.

Variables	Unit	Technique	Spatial scale	Temporal scale	2014	2015	2016	2017	2018
Above and belowground biomass	G dry matter / m²	Destructive sampling	Sub-plots	6 times per growing season	x	x	x	x	x
Leaf area index	m²/m²	Destructive sampling	Sub-plots	6 times per growing season	x	x	x	x	x
Number of plants per hectare	N / ha	-	Sub-plots	Once at the beginning of the growing season	x	x	x	x	x
Leaf area to mass ratio	G dry matter / cm²	Destructive sampling	Sub-plots	Once a year	x	x	x	x	x
C and N mass fraction	G element / kg dry matter	Destructive sampling	Sub-plots	Once a year	x	x	-	x	x
Canopy height	m	-	Sub-plots	6 times per growing season	-	x	x	x	x
Remaining biomass after harvest	G dry matter / m²	Destructive sampling	Sub-plots	Once just after harvest	x	x	x	x	x
Soil carbon content	Kg/m²	Motor corer	Whole field	Once every 10 years	-	-	-	x	-
Phenology	Days of the beginning and the end of growing season	-	Sub-plots	Every year	x	x	x	x	x
Information (Management and disturbance)	-	-	Whole field	Continuously	x	x	x	x	x