

EddyPro and SmartFlux Outputs

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EddyPro 7 Outputs

Express Mode

-  eddypro_stats
-  eddypro_user_stats
-  eddypro_Exp_biomet_2019-03-29T094307_exp.csv
-  eddypro_Exp_fluxnet_2019-03-29T094307_exp.csv
-  eddypro_Exp_full_output_2019-03-29T094307_exp.csv
-  eddypro_Exp_metadata_2019-03-29T094307_exp.csv
-  processing_2019-03-29T094307_exp.eddypro

Advanced Mode

1. More output files

-  eddypro_binned_cospectra
-  eddypro_binned_ogives
-  eddypro_full_cospectra
-  eddypro_spectral_analysis
-  eddypro_stats
-  eddypro_user_stats
-  eddypro_Adv_biomet_2019-03-29T095752_adv.csv
-  eddypro_Adv_fluxnet_2019-03-29T100126_adv.csv
-  eddypro_Adv_full_output_2019-03-29T100126_adv.csv
-  eddypro_Adv_metadata_2019-03-29T100126_adv.csv
-  eddypro_Adv_qc_details_2019-03-29T095752_adv.csv
-  processing_2019-03-29T100126_adv.eddypro

2. Able to choose output files

EddyPro Outputs – Express Mode

-  eddypro_stats
-  eddypro_user_stats
-  eddypro_Exp_biomet_2019-03-29T094307_exp.csv
-  eddypro_Exp_fluxnet_2019-03-29T094307_exp.csv
-  eddypro_Exp_full_output_2019-03-29T094307_exp.csv
-  eddypro_Exp_metadata_2019-03-29T094307_exp.csv
-  processing_2019-03-29T094307_exp.eddypro

Similarity I: Eddypro_stats and Eddypro_user_stats



eddypro_GHG_st1.csv



eddypro_GHG_st2.csv



eddypro_GHG_st3.csv



eddypro_GHG_st4.csv



eddypro_GHG_st5.csv



eddypro_GHG_st6.csv



eddypro_GHG_st7.csv

1. Unprocessed (data set as imported from the raw file)
2. After de-spiking
3. After cross-wind correction
4. After angle-of attack correction
5. After double rotation for tilt correction
6. After time lag compensation
7. After de-trending

Similarity II: Eddypro_stats and Eddypro_user_stats

Label	Description
filename	name of the raw file (or first file of a set) from which the data in the current averaging interval was extracted
date	date of the end of the averaging period
time	time of the end of the averaging period
n_samples	number of valid records found in the raw file (or set of raw files)
mean (<i>var</i>)	mean value of variable (<i>var</i>)
var (<i>var</i>)	variance of variable (<i>var</i>)
cov (<i>u/var</i>)	covariance between the <i>u</i> wind component and <i>var</i>
cov(<i>v/var</i>)	covariance between the <i>v</i> wind component and <i>var</i>
cov (<i>w/var</i>)	covariance between the <i>w</i> wind component and <i>var</i>
st_dev(<i>var</i>)	standard deviation of variable <i>var</i>
skw(<i>var</i>)	skewness of variable <i>var</i>
kur(<i>var</i>)	kurtosis of variable <i>var</i>

Difference: Eddypro_stats and Eddypro_user_stats



Sensitive variables

- used for flux calculation

- Wind components (u, v, w)
- Sonic temperature (Ts) or speed-of-sound (sos)
- Gas concentrations/densities for CO₂, H₂O, CH₄ or N₂O
- Temperatures (Tcell, Tin and Tout) and cell pressure (Pcell)



Non-sensitive variables

- not used for flux calculation

- Despiking
- Tilt correction
- Detrending
- Time lag compensation
- Calculation of main statistics

EddyPro Output File Formats

- Eddypro_output ID_biomet_yyyy_mm_ddTHHMMSS.csv
(Mean biomet values of flux averaging period)
- Eddypro_output ID_Fluxet_yyyy_mm_ddTHHMMSS.csv
(Output file in Fluxnet format)
- **Eddypro_output ID_full_yyyy_mm_ddTHHMMSS.csv**
(Final results file from raw data processing)
- Eddypro_output ID_metadata_yyyy_mm_ddTHHMMSS.csv
(All the metadata used for flux calculations)
- Processing_yyyy_mm_ddTHHMMSS.eddypro
(EddyPro project settings)

What is New in EddyPro 7

➤ New Fluxnet output

 eddypro_stats

 eddypro_user_stats

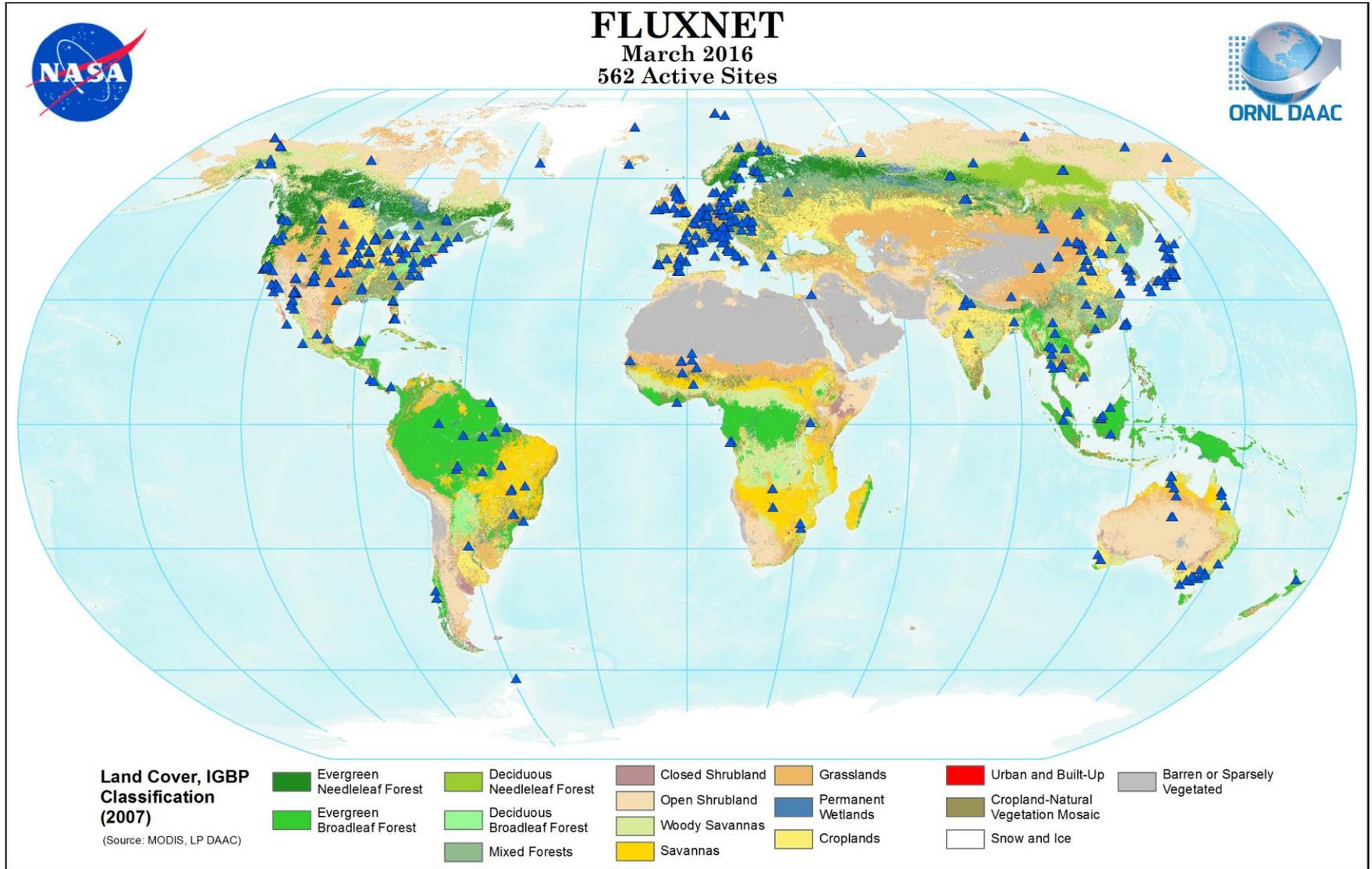
 eddypro_Exp_biomet_2019-03-29T094307_exp.csv

 eddypro_Exp_fluxnet_2019-03-29T094307_exp.csv

 eddypro_Exp_full_output_2019-03-29T094307_exp.csv

3	4	5	496	497
DOY_START	DOY_END	FILENAME_HF	TS	
126.021	126.042	2012-05-05T003000_AIU-0288.ghg	22.9422	
126.042	126.062	2012-05-05T010000_AIU-0288.ghg	22.8257	
126.062	126.083	2012-05-05T013000_AIU-0288.ghg	22.7016	
126.083	126.104	2012-05-05T020000_AIU-0288.ghg	22.561	
126.104	126.125	2012-05-05T023000_AIU-0288.ghg	22.38	

FLUXNET Network



https://daac.ornl.gov/FLUXNET/guides/Fluxnet_site_DB_Fig1.png

Full Output File – File Information

filename	-	name of the raw file (or the first of a set) from which the data set for the current averaging interval was extracted
date	yyyy-mm-dd	date of the end of the averaging period
time	HH:MM	time of the end of the averaging period
file_records	#	number of valid records found in the raw file (or set of raw files)
used_records	#	number of valid records used for current the averaging period

Raw data file: Start of the logging period

Output file: End of the averaging period

filename	date	time
	[yyyy-mm]	[HH:MM]
2011-04-05T050000_AIU-0205.ghg	4/5/2011	5:30
2011-04-05T053000_AIU-0205.ghg	4/5/2011	6:00
2011-04-05T060000_AIU-0205.ghg	4/5/2011	6:30

Corrected Fluxes and Quality Flags

Tau	$\text{kg m}^{-1} \text{s}^{-2}$	corrected momentum flux
qc_Tau	#	quality flag for momentum flux
H	W m^{-2}	corrected sensible heat flux
qc_H	#	quality flag for sensible heat flux
LE	W m^{-2}	corrected latent heat flux
qc_LE	#	quality flag latent heat flux
gas_flux	$\mu\text{mol m}^{-2} \text{s}^{-1}(\dagger)$	corrected gas flux
qc_gas_flux	#	quality flag for gas flux

- Gases: CO_2 , H_2O , CH_4 , and N_2O
- For gases, equal to Net Ecosystem Exchange (NEE)
- Final flux results.

Storage Fluxes

H_strg	W m ⁻²	estimate of storage sensible heat flux
LE_strg	W m ⁻²	estimate of storage latent heat flux
gas_strg	μmol m ⁻² s ⁻¹ (†)	estimate of storage gas flux

$$S = \int_0^z \frac{\partial CO_2}{\partial t} dz$$

- Storage terms are estimated from concentrations based on a 1-point profile
- Corrected fluxes do not include storage fluxes

Gas and Air Properties

gas_molar_density	mmol m ⁻³	measured or estimated molar density of gas
gas_mole_fraction	μmol m ⁻³ (†)	measured or estimated mole fraction of gas
gas_mixing_ratio	μmol m ⁻³ (†)	measured or estimated mixing ratio of gas
air_temperature	K	mean temperature of ambient air, either calculated from high frequency air temperature readings, or estimated from sonic temperature
air_pressure	Pa	mean pressure of ambient air, either calculated from high frequency air pressure readings, or estimated based on site altitude (barometric pressure)
air_density	kg m ⁻³	density of ambient air

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If no air temperature and pressure data available

- Air temperature is estimated from sonic temperature and water vapor density
- Air pressure is estimated based on site altitude (barometric pressure).

Wind and Turbulence

Unrotated and rotated three wind components: u, v, and w

u_rot	m s^{-1}	rotated u wind component (mean wind speed)
v_rot	m s^{-1}	rotated v wind component (should be zero)
w_rot	m s^{-1}	rotated w wind component (should be zero)

Wind speed and direction

wind_speed	m s^{-1}	mean wind speed
max_wind_speed	m s^{-1}	maximum instantaneous wind speed
wind_dir	$^{\circ}$ (degrees)	direction from which the wind blows, with respect to Geographic or Magnetic north

Turbulence parameters

u^*	m s^{-1}	friction velocity
TKE	$\text{m}^2 \text{s}^{-2}$	turbulent kinetic energy
L	M	Monin-Obukov length
$(z-d)/L$	#	Monin-Obukhov stability parameter

Footprint

x_peak

m

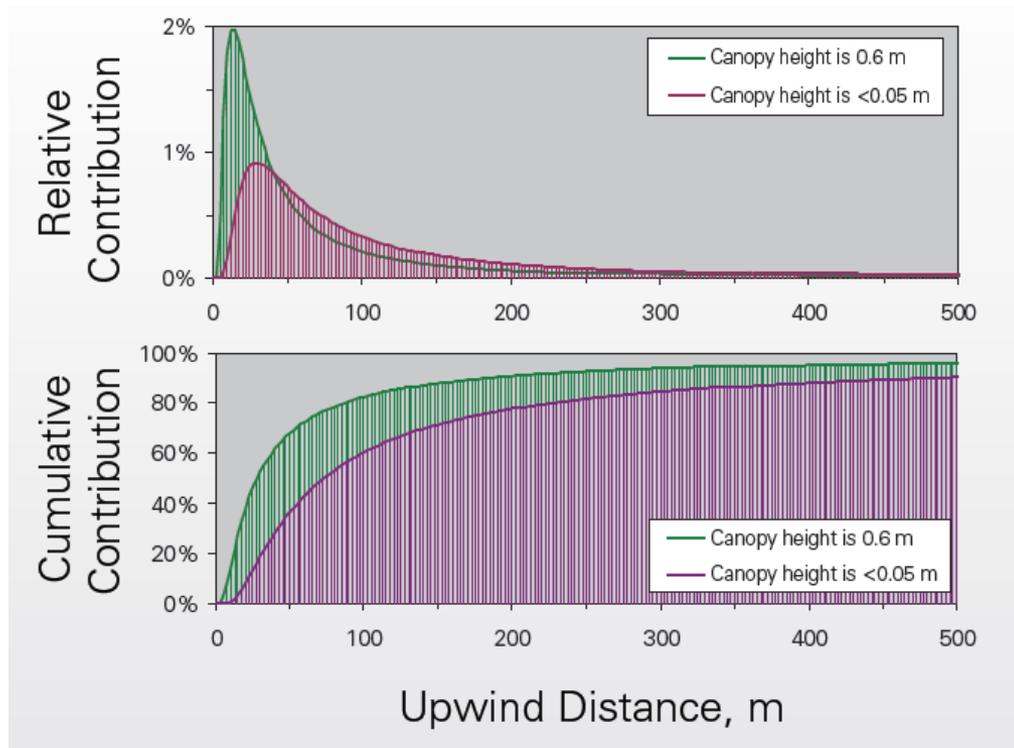
along-wind distance providing the highest (peak) contribution to turbulent fluxes

x_10%

m

along-wind distance providing 10% (cumulative) contribution to turbulent fluxes

x_30%, x_50%, x_70%, x_90%



Spectral Correction Factors

un_Tau	$\text{kg m}^{-1} \text{s}^{-2}$	uncorrected momentum flux
Tau_scf	#	spectral correction factor for momentum flux
un_H	W m^{-2}	uncorrected sensible heat flux
H_scf	#	spectral correction factor for sensible heat flux
un_LE	W m^{-2}	uncorrected latent heat flux
LE_scf	#	spectral correction factor for latent heat flux
un_gas_flux	$\mu\text{mol m}^{-2} \text{s}^{-1}(\dagger)$	uncorrected gas flux
gas_scf	#	spectral correction factor for gas flux

➤ $\text{scf} = F_{\text{true}} / F_{\text{measured}}$

➤ $\text{scf} > 1$

Hard Flags and Diagnostics

spikes	8u/v/w/ts/co2 /h2o/ch4/none	Hard flags for individual variables for spike test
amp_res	8u/v/w/ts/co2 /h2o/ch4/none	Hard flags for individual variables for amplitude resolution
drop_out	8u/v/w/ts/co2 /h2o/ch4/none	Hard flags for individual variables for drop-out test

- Flagged for quality issues based on various criteria
- Flags 0 for good quality, 1 for bad quality, and 9 for values not calculated

8u/v/w/ts/co2/h2o/ch4/none

800000009

DP	DQ	DR	DS	DT	DU
diagnostic_flags_LI-7500A			diagnostic_flags_LI-7700		
chopper_LI-7500	detector_LI-7500	pH_LI-7500	sync_LI-7500	not_ready_LI-7700	no_signal_LI-7700
[#_flagged_recs]	[#_flagged_recs]	[#_flagged_recs]	[#_flagged_recs]	[#_flagged_recs]	[#_flagged_recs]
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

Custom Variables

EV	EW	EX	EY
custom_variables			
air_t_mean	air_p_mean	co2_mean	h2o_mean
--	--	--	--
287.6563945	97529.49232	378.9224766	13.67288579
287.5615905	97536.26254	378.8656877	13.40743966
286.6554498	97529.12577	379.7712094	13.64764479
286.3570617	97535.46518	380.8968833	13.9376531
285.7731864	97559.73668	382.3884786	13.95274986
285.5737962	97570.94328	380.9291808	13.63473591
285.3251548	97582.13416	381.6878291	13.15995196
284.7614498	97593.73383	384.0084412	12.6089211

- Variables not used for flux computation
- No unit output

Outputs from Advanced Mode

Express Mode

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-  eddypro_Exp_full_output_2019-03-29T094307_exp.csv
-  eddypro_Exp_metadata_2019-03-29T094307_exp.csv
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Advanced Mode

More output files

-  eddypro_binned_cospectra
-  eddypro_binned_ogives
-  eddypro_full_cospectra
-  eddypro_spectral_analysis
-  eddypro_Adv_qc_details_2019-03-29T095752_adv.csv

Full and Binned Spectra or Co-spectra

➤ Full spectra or co-spectra

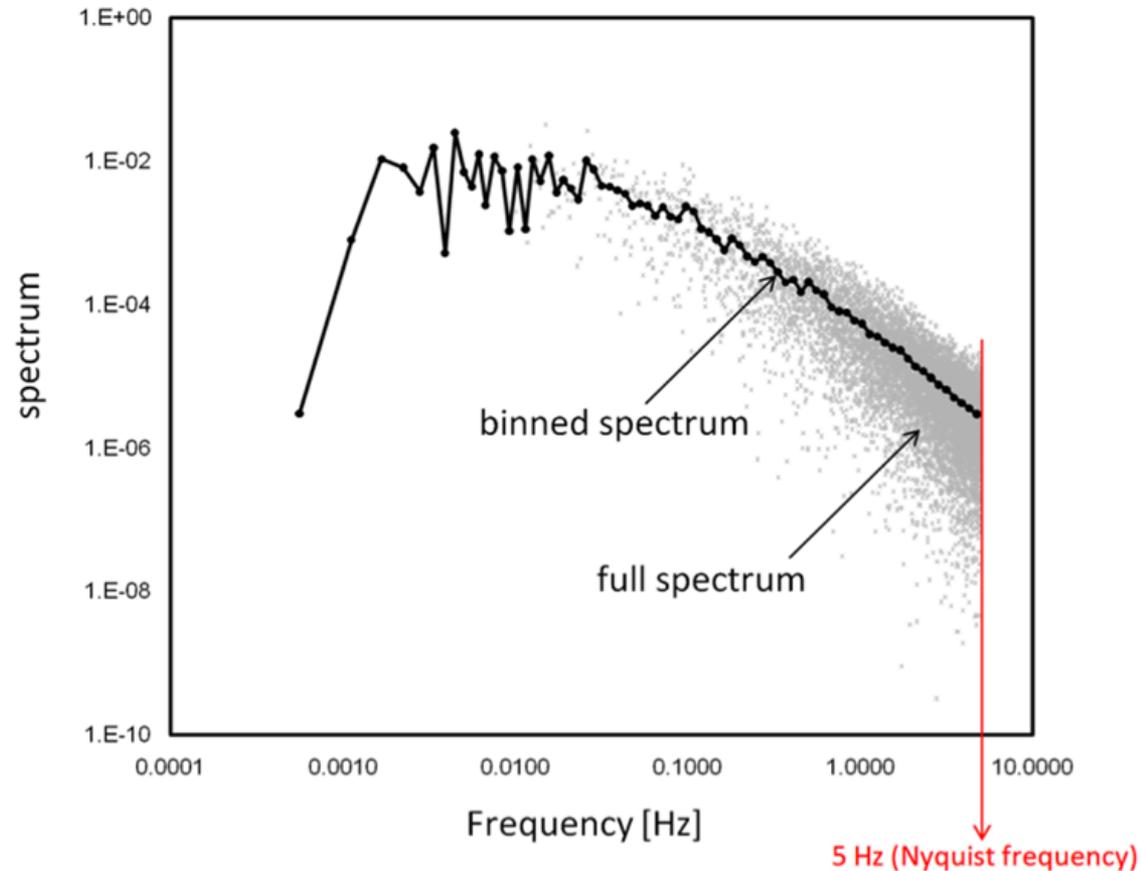
0.00056 ($=1/(30*60)$) – 5 ($=10/2$) s

9000 frequencies

➤ Binned spectra or co-spectra

0.00056 ($=1/(30*60)$) – 5 ($=10/2$) s

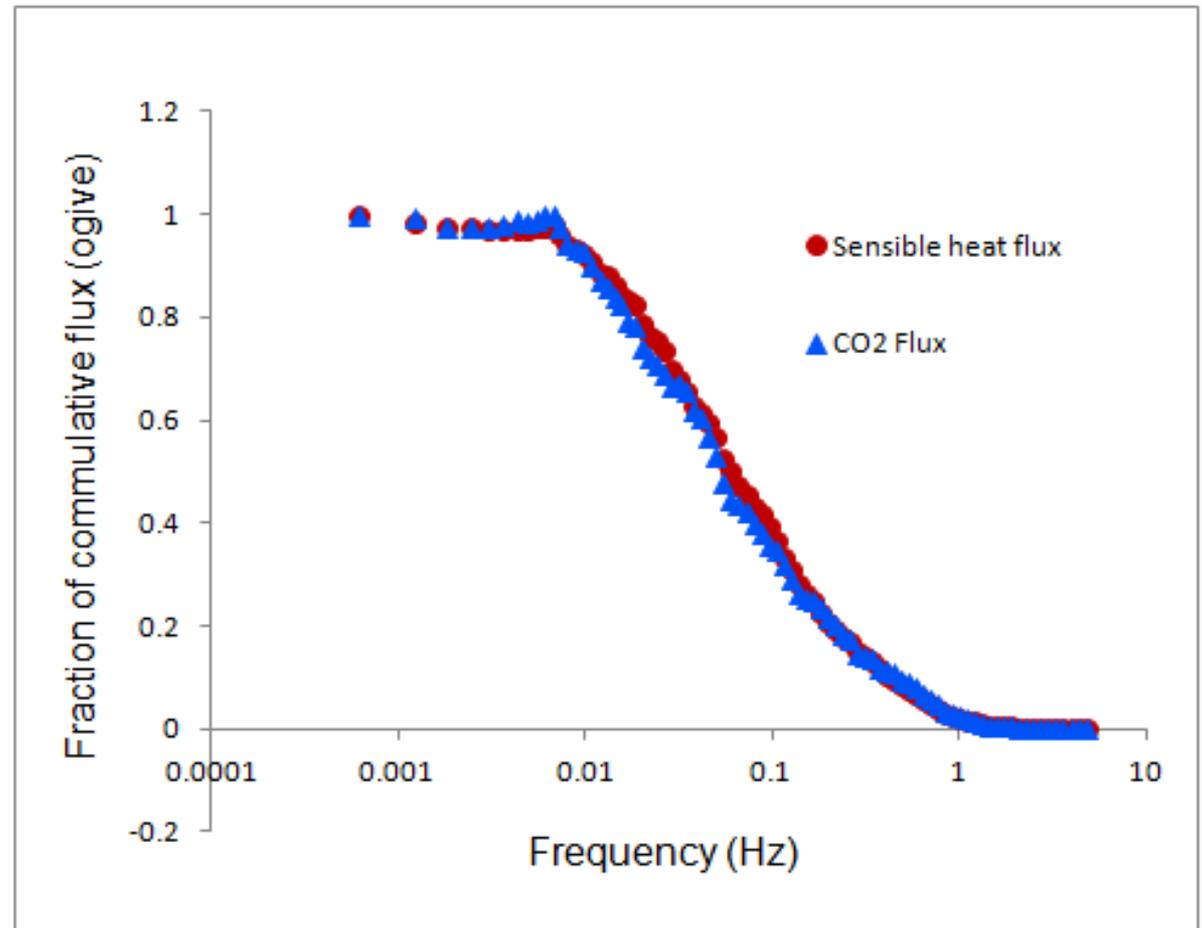
User-specified number of exponential spaced frequency bins (100 as default)



Spectral or Co-spectral Ogives

$$Og_{wc}(f) = \int_{f_{high}}^f Co_{wc}(f) df$$

Integration of co-spectra from the current frequency to the Nyquist frequency



Spectral Analysis

1. Ensemble and modeled cospectra
 - average, Massman fitted, and Kaimal model
 - 1) Stable ($-650 < L < 0$)
 - 2) Unstable ($0 < L < 1000$)
2. Binned average cospectra every three hours sorted by time of day
3. Binned average and predicted H₂O spectra sorted by RH-class
4. Binned average and predicted spectra for CO₂ and CH₄



eddypro_Landfill_ensemble_and_model_cospectra_2012-05-13T165334



eddypro_Landfill_ensemble_cospectra_by_time_2012-05-13T165334



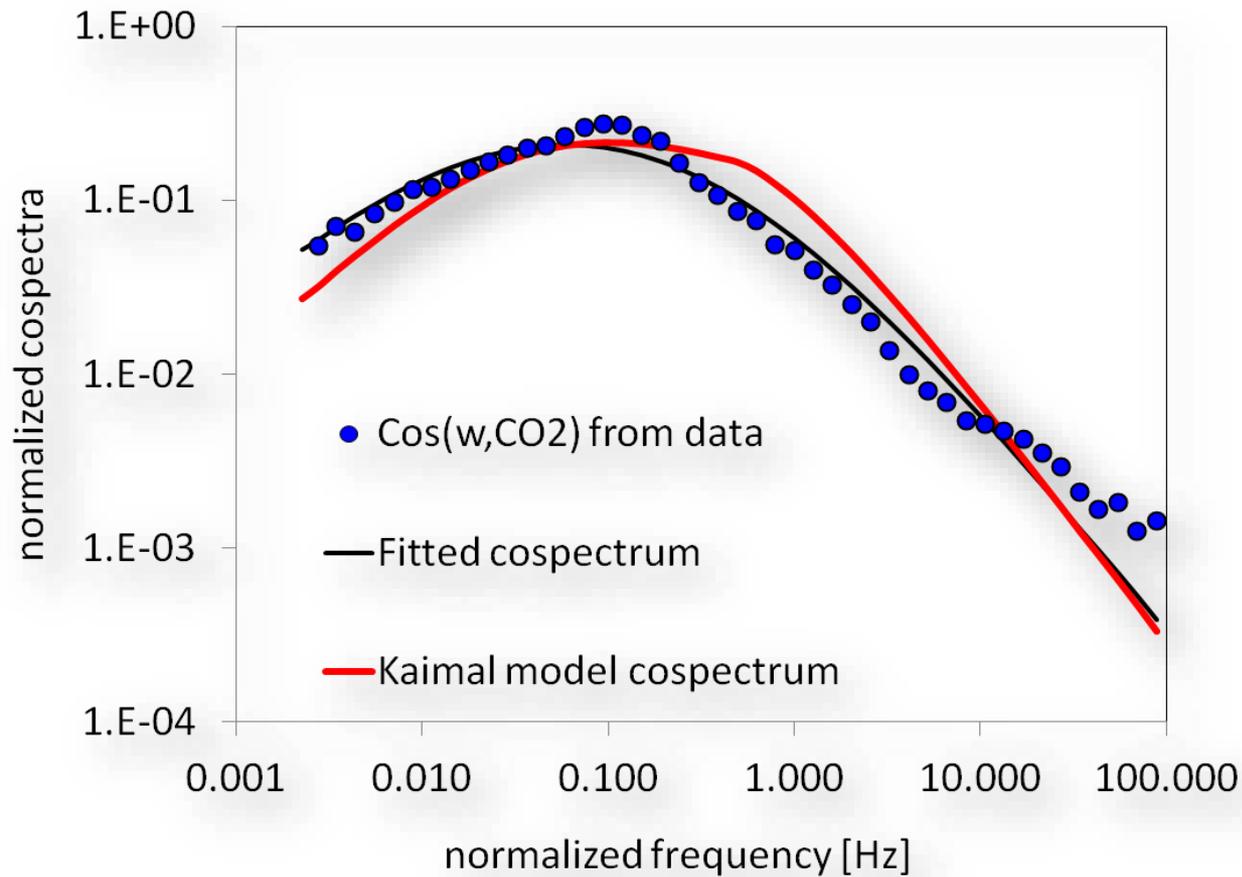
eddypro_Landfill_h2o_ensemble_spectra_2012-05-13T165334



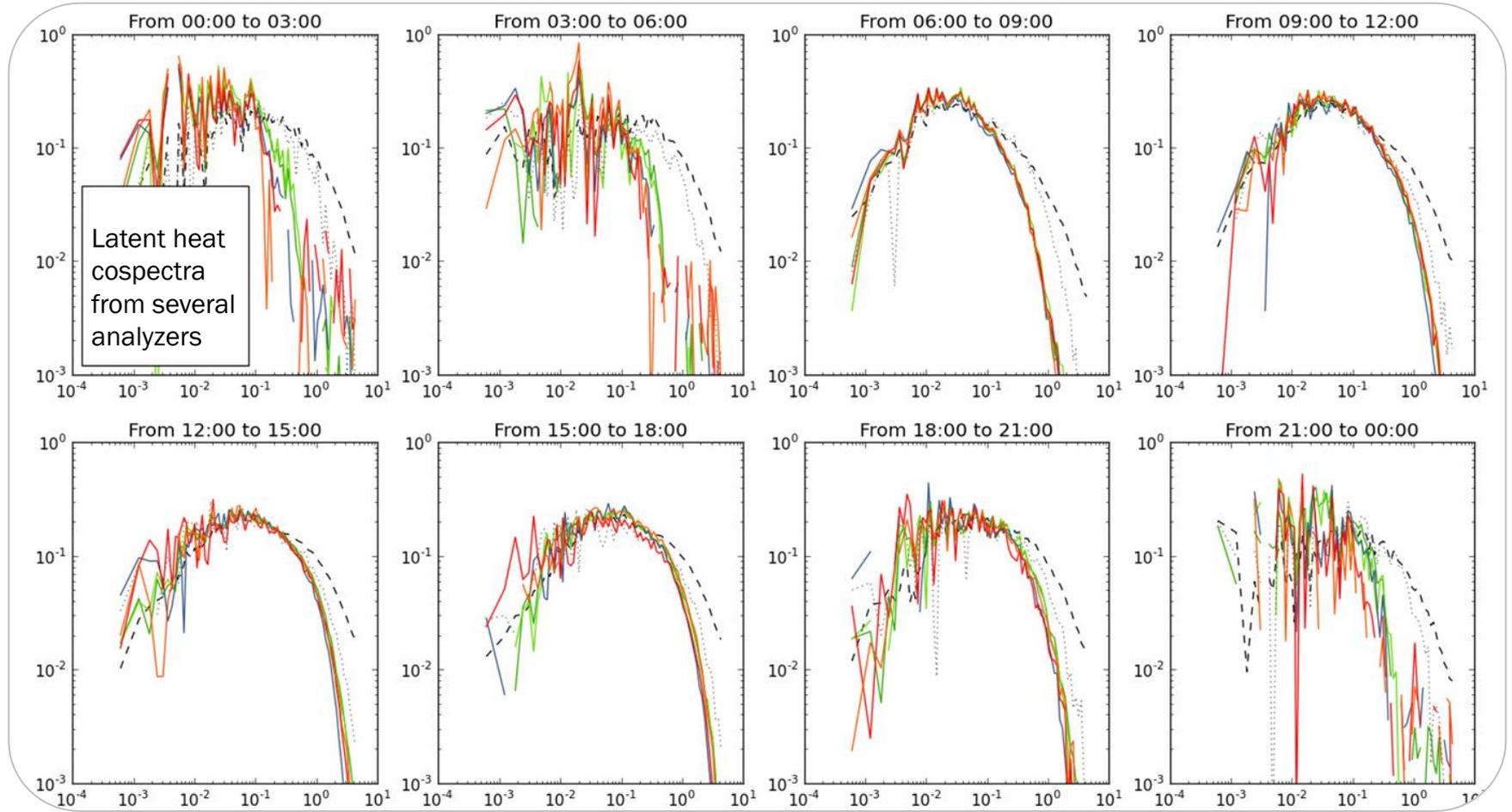
eddypro_Landfill_passive_gases_ensemble_spectra_2012-05-13T165334

Ensemble Cospectra Sorted by Stability Regimes

Months ensemble cospectra for all unstable periods



Ensemble Cospectra Sorted by Time-of-day



Biomet Data Output File

Mean Biomet values of flux averaging period

Eddypro_output ID_biomet_yyyy_mm_ddTHHMMSS.csv

File Type:	2				
Software Version:	5.9.7				
Timestamp:	0:01:15				
Timezone:	US/Central				
DATE	TIME	AIRTEMP(C)	BATTERY(V)	BATTERYTEMP(C)	GLOBRAD(W/m^2)
5/7/2012	00:02:00:000	14.8513	11.8387	16.6	-0.576236
5/7/2012	00:03:00:000	14.8266	12.1226	16.6	-0.615977
5/7/2012	00:04:00:000	14.7846	12.1157	16.6	-0.576236
5/7/2012	00:05:00:000	14.7611	12.2766	16.4	-0.655717
5/7/2012	00:06:00:000	14.7299	12.3153	16.4	-0.357664
5/7/2012	00:07:00:000	14.7439	12.3158	16.4	-0.87429
5/7/2012	00:08:00:000	14.7229	12.3185	16.4	-0.834549
5/7/2012	00:09:00:000	14.6905	12.3215	16.4	-0.476885
5/7/2012	00:10:00:000	14.7102	12.3197	16.4	-0.834549

EddyPro Output – More Information

- EddyPro help: 1) EddyPro Help → Online help
 2) Instruction Manual (PDF)

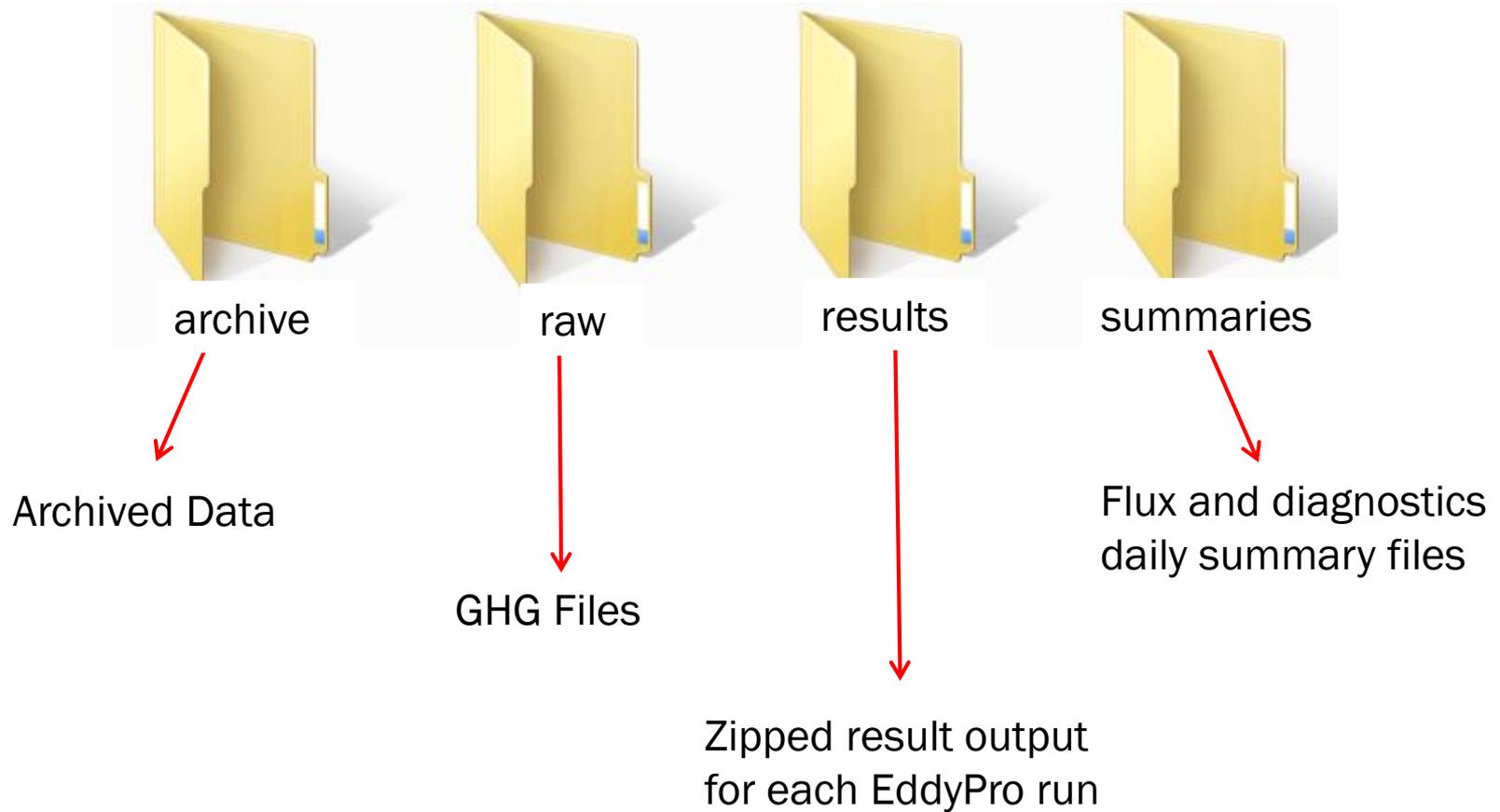
Shorthand for variables in output files from EddyPro.

Label	Units, Format, or Range	Description
filename	-	Name of the raw file (or the first of a set) from which the dataset for the current averaging interval was extracted
date	yyyy-mm-dd	Date of the end of the averaging period
time	HH:MM	Time of the end of the averaging period
file_records	#	Number of valid records found in the raw file (or set of raw files)

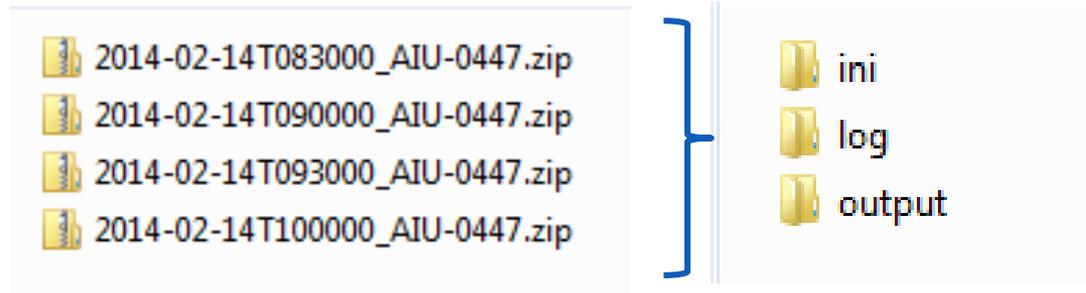
Biomet variables supported by EddyPro.

Variable	EddyPro Label	EddyPro Units	How to Write Units	Other Supported Units
Air Temperature	Ta	K	K	C, cC, F, cF, cK
Atmospheric pressure	Pa	Pa	Pa	hPa, kPa, PSI, Torr, mmHg, Atm, Bar
Relative humidity	RH	%	%	#

SmartFlux Outputs



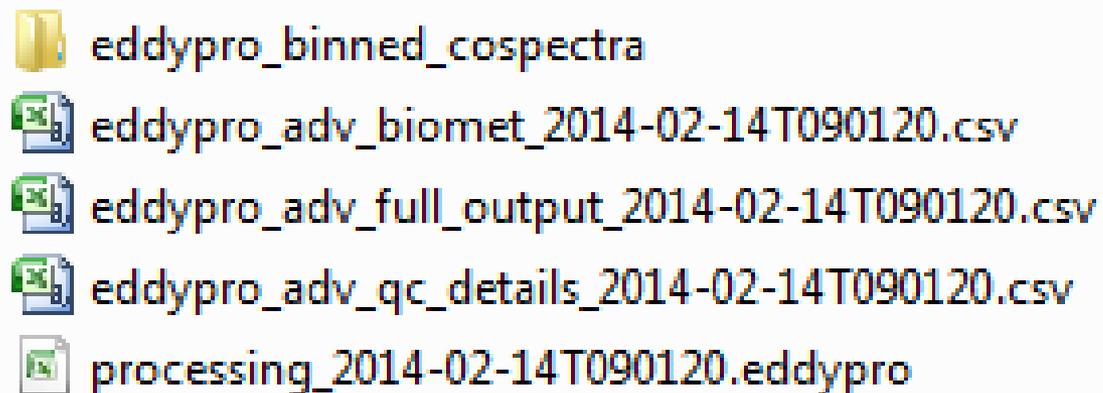
SmartFlux Results Files



ini folder: Project file used to process the data

log folder: The EddyPro[®] engine log for the run

output folder: Selected output files



SmartFlux Daily Summary Files



summaries

Flux Summary

- Final fluxes for each half hour of the day

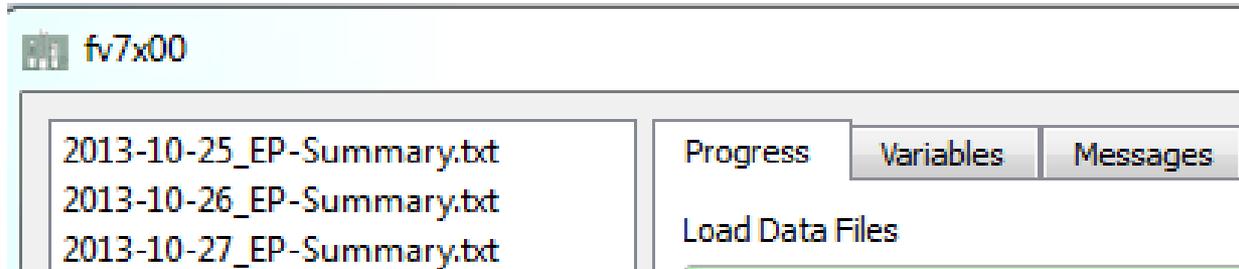
 2019-02-08_sf3-05_EP-Summary.txt

 2019-02-09_sf3-05_EP-Summary.txt

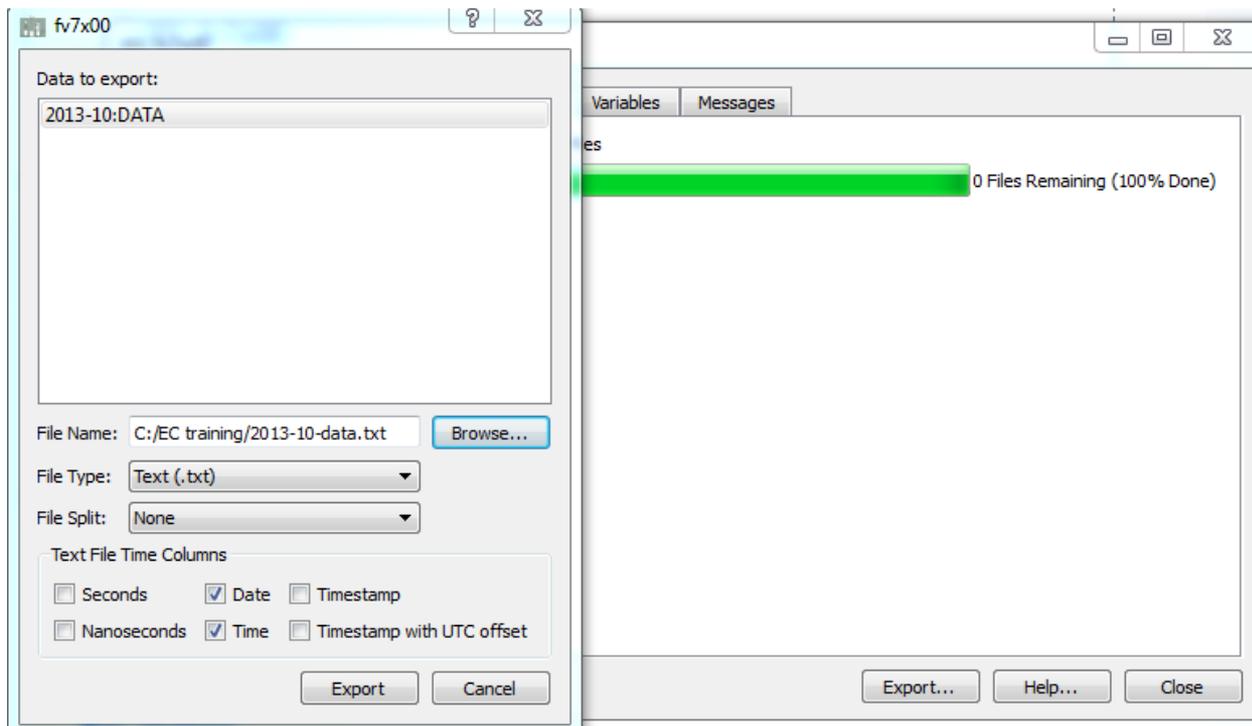
 2019-02-10_sf3-05_EP-Summary.txt

How to Combine Daily Summary Files

1. Add all the daily summary files to File Viewer



2. Export the files to a single text file



Thank You

Questions?