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Decoupling investigations

in floodplain forest

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ICOS INTEGRATED CARBON OBSERVATION SYSTEM

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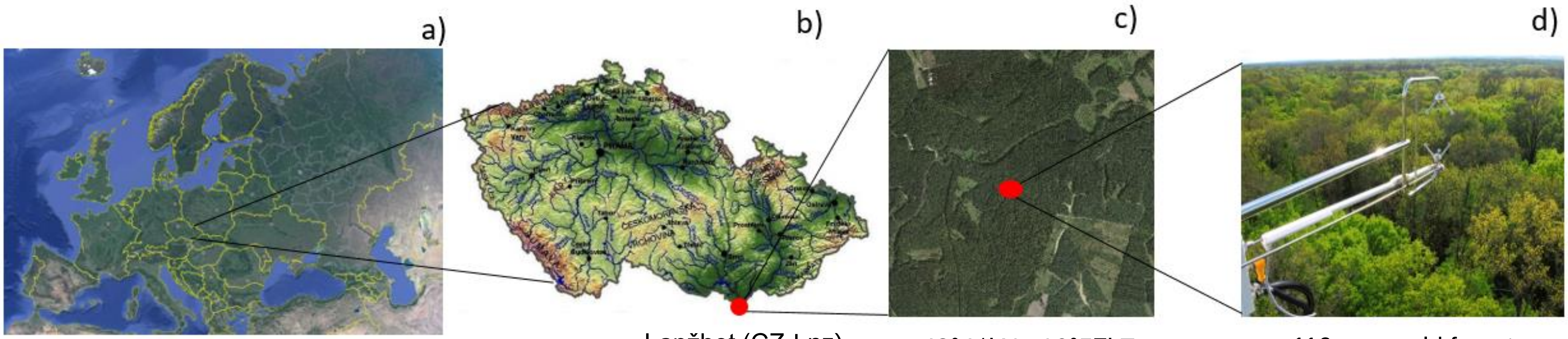
Lanžhot, Czech Republic

Lanžhot is proposed as ICOS Class 1 station (CZ-Lnz)



Lanžhot (CZ-Lnz)

48°41’ N, 16°57’ E

~110 years old forest

- T_{air} = 9.3°C
- Precip = 540mm
- avg GWL = -2.7m
- soil types: Eutric Humic Fluvisol, Haplic Fluvisol, and Eutric Fluvisol (FAO 2014 Classification)
- min. soil depth of 60 cm

Table 1. Stand structural characteristics.

Tree species	No. tree ha^{-1}	Mean DBH (SD) [cm]	Mean H (SD) [m]	BA species [m^2 ha^{-1}]	Share in BA_{stand} [%]
Quercus robur	32	51.8 (12.3)	31.0 (3.6)	7.13	23.5
Fraxinus excelsior	48	56.4 (9.2)	35.9 (3.4)	12.30	40.6
Ulmus laevis	6	38.9 (2.2)	28.8 (1.8)	0.35	1.2
Carpinus betulus	148	27.7 (11.2)	23.4 (6.9)	10.41	34.4
Acer campestre	4	19.8 (7.0)	20.0 (0.6)	0.07	0.2
Tilia cordata	2	18.3 (-)	11.8 (-)	0.03	0.1

- site managed hydrologically
- represents relatively dry conditions
- rarely flooded

Decoupling investigations...

- why decoupling investigations are so important in the forests?
  - high probability overestimating of carbon sink strength
  - relevant net CO_2 flux can be calculated
  - systematic errors in the flux estimation due to decoupling can be avoided by excluding from the analysis particular flux measurement data, based on a threshold criterion for the friction velocity u* or the vertical velocity variance σw above the canopy
  - literature examples: Tota et al.,2008; Acevedo et al.,2009; Thomas et al., 2013; Limoges et al. 2017; Jocher et al., 2017; Freundorfer et al. 2019;
- decoupling in broadleaf forests

Research is still ongoing

Main goal: to derive detailed understanding of the carbon exchange in Lanzhot floodplain forest (using below- and above-canopy EC measurements) the first study of this kind within Czech Republic.

To reach this goal we evaluate different single- and two-level filtering strategies of the above canopy derived carbon exchange values and the impact of these filterings on the annual ecosystem carbon exchange rates.

Hypothesis: Our hypothesis is that conventional single-level EC flux filtering strategies like the u* filtering might not be sufficient to fully capture the carbon exchange of the studied ecosystem.

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Instrumentation

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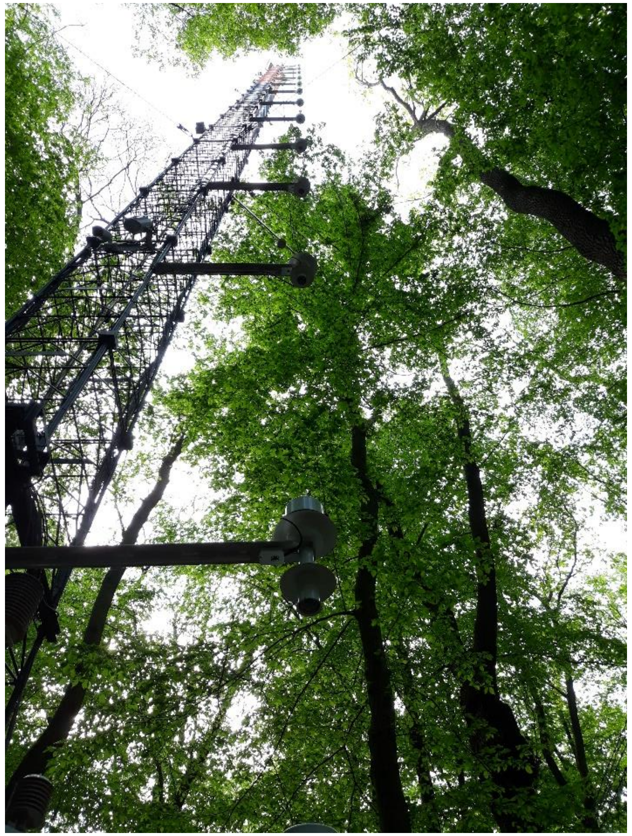
EC above the canopy
(at a height of 48 m above ground)



EC below the canopy
(at a height of 3.5 m above ground)

Both systems consisted of a Gill HS-50 sonic anemometer (Gill Instruments Limited, Hampshire, UK) and a LI-7200 (LI-COR Environmental, Lincoln, USA) gas analyser for detecting H_2O and CO_2 mixing ratios (dry mole fraction).
The sampling frequency of both systems was 20 Hz.

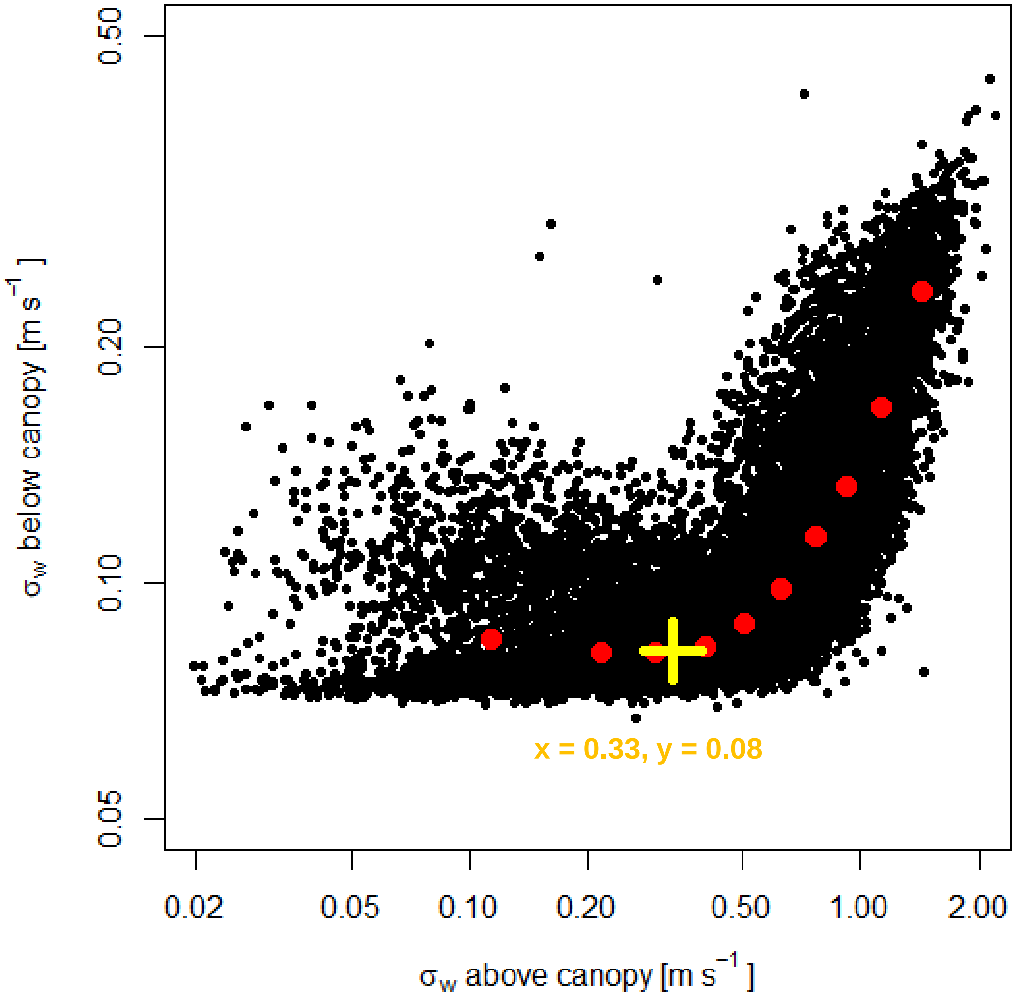
Filtering approaches

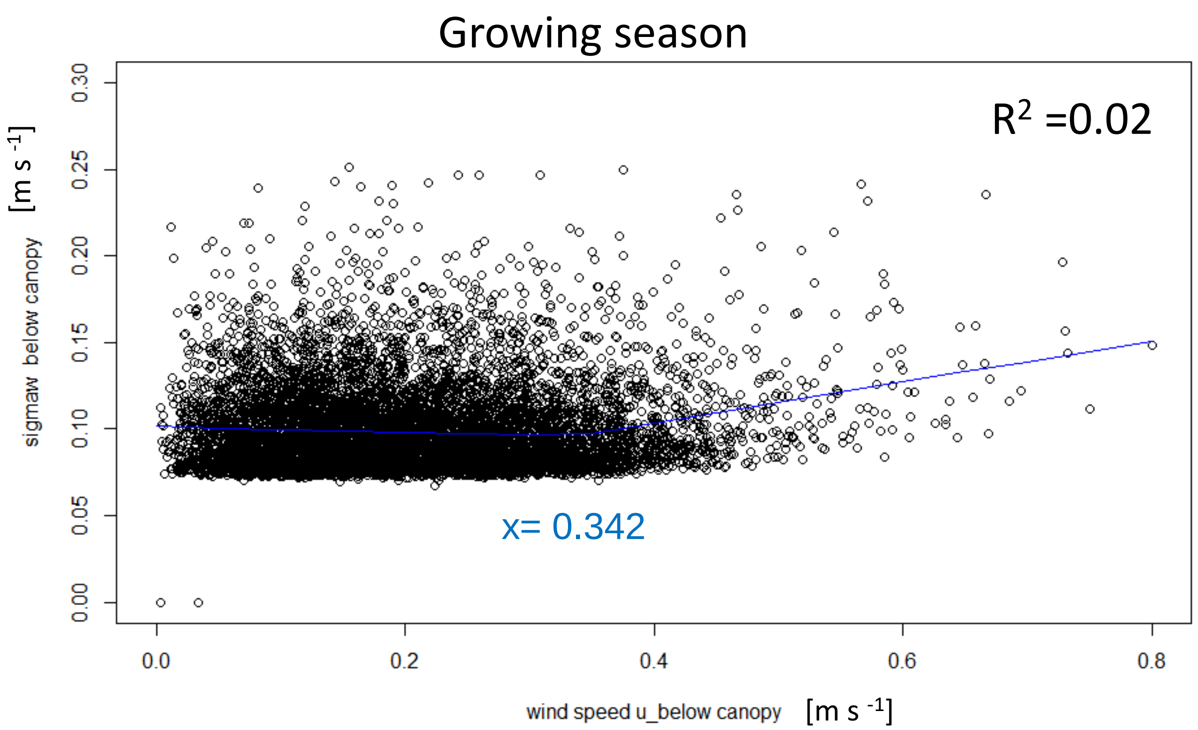
- filtering based on quality flags
- u* filtering
- σw two-level filtering
- filtering regarding „weak wind-strong wind” regimes

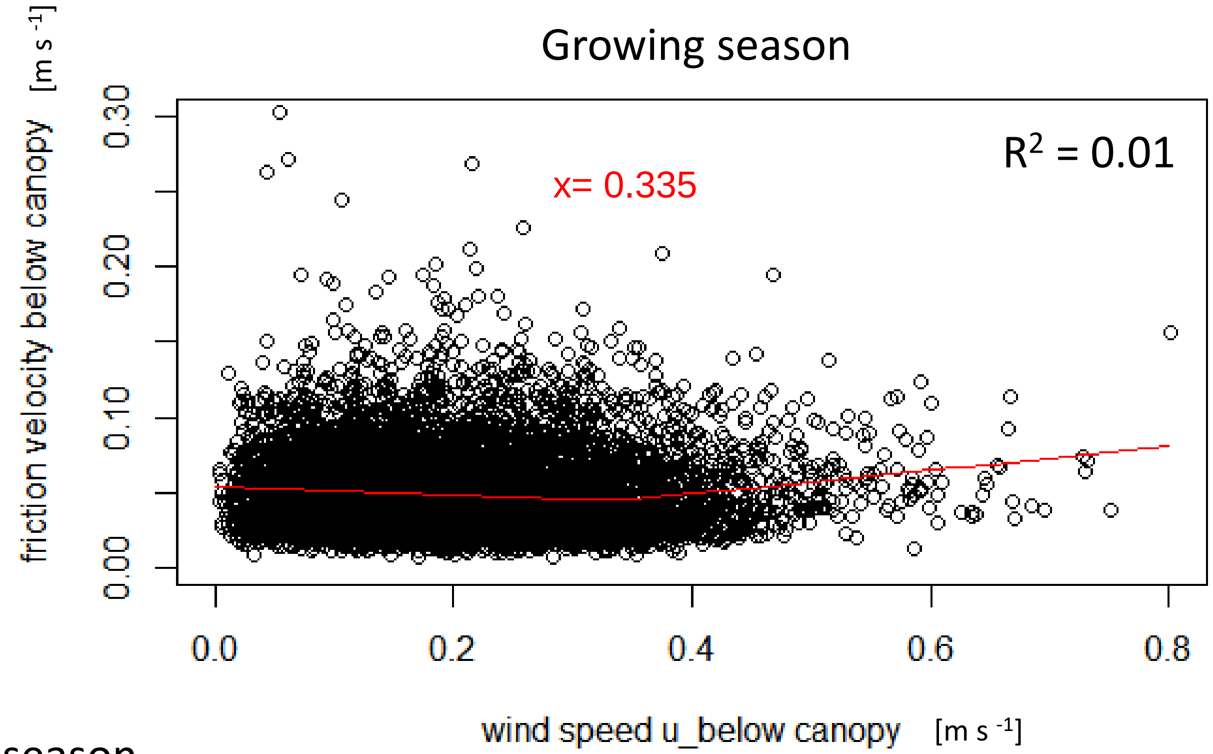
Measurement period: 2015-2018 (EddyPro® software)
with focal period 18.04.2018 – 18.04.2019 (TK3 EC software)

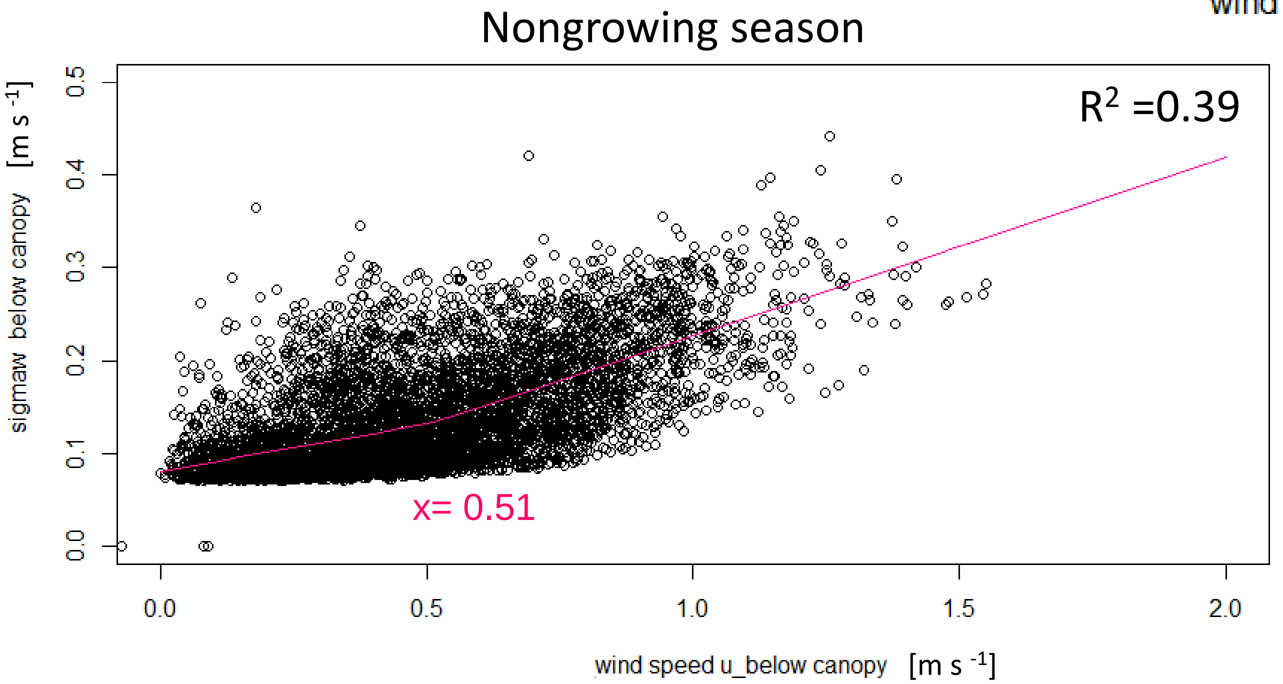
Flux footprint calculations were conducted for the focal period with the Flux Footprint Prediction (FFP) online tool (http://footprint.kljun.net/) which follows the procedure in Kljun et al. (2015).

Lanžhot


x = 0.33, y = 0.08
0.50
0.20
0.10
0.05
σw below canopy [m s-1]
0.02
0.05
0.10
0.20
0.50
1.00
2.00
σw above canopy [m s-1]

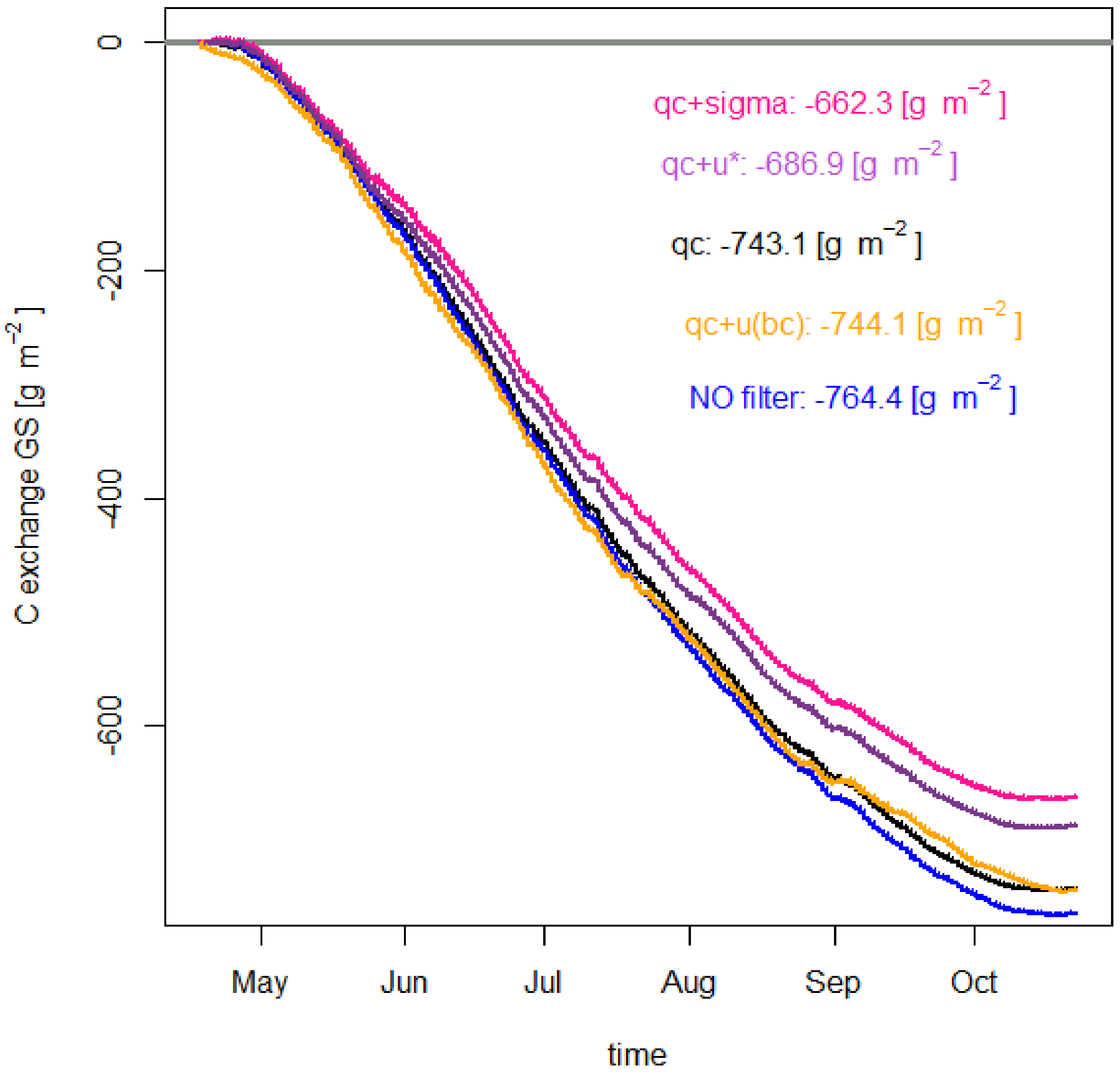

Growing season
R2 =0.02
x= 0.342
sigmaw below canopy [m s -1]
wind speed u_below canopy [m s -1]
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.0
0.2
0.4
0.6
0.8


Growing season
R2 = 0.01
x= 0.335
friction velocity below canopy [m s -1]
wind speed u_below canopy [m s -1]
0.00
0.10
0.20
0.30
0.0
0.2
0.4
0.6
0.8


Nongrowing season
R2 =0.39
x= 0.51
sigmaw below canopy [m s -1]
wind speed u_below canopy [m s -1]
0.0
0.1
0.2
0.3
0.4
0.5
0.0
0.5
1.0
1.5
2.0

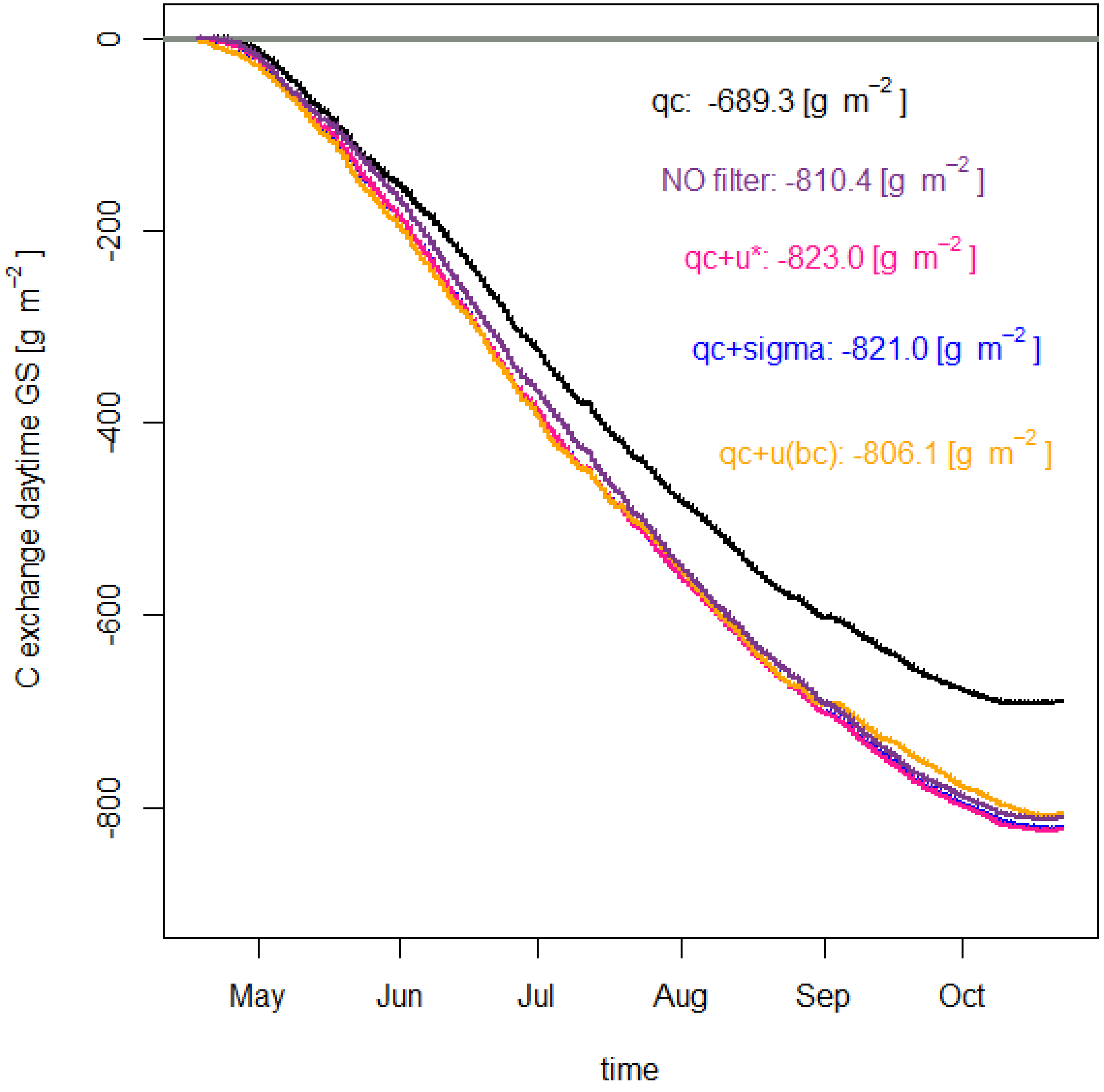
Results of different filtering approaches.

Growing season (GS) (18.04-22.10.2018), day and night



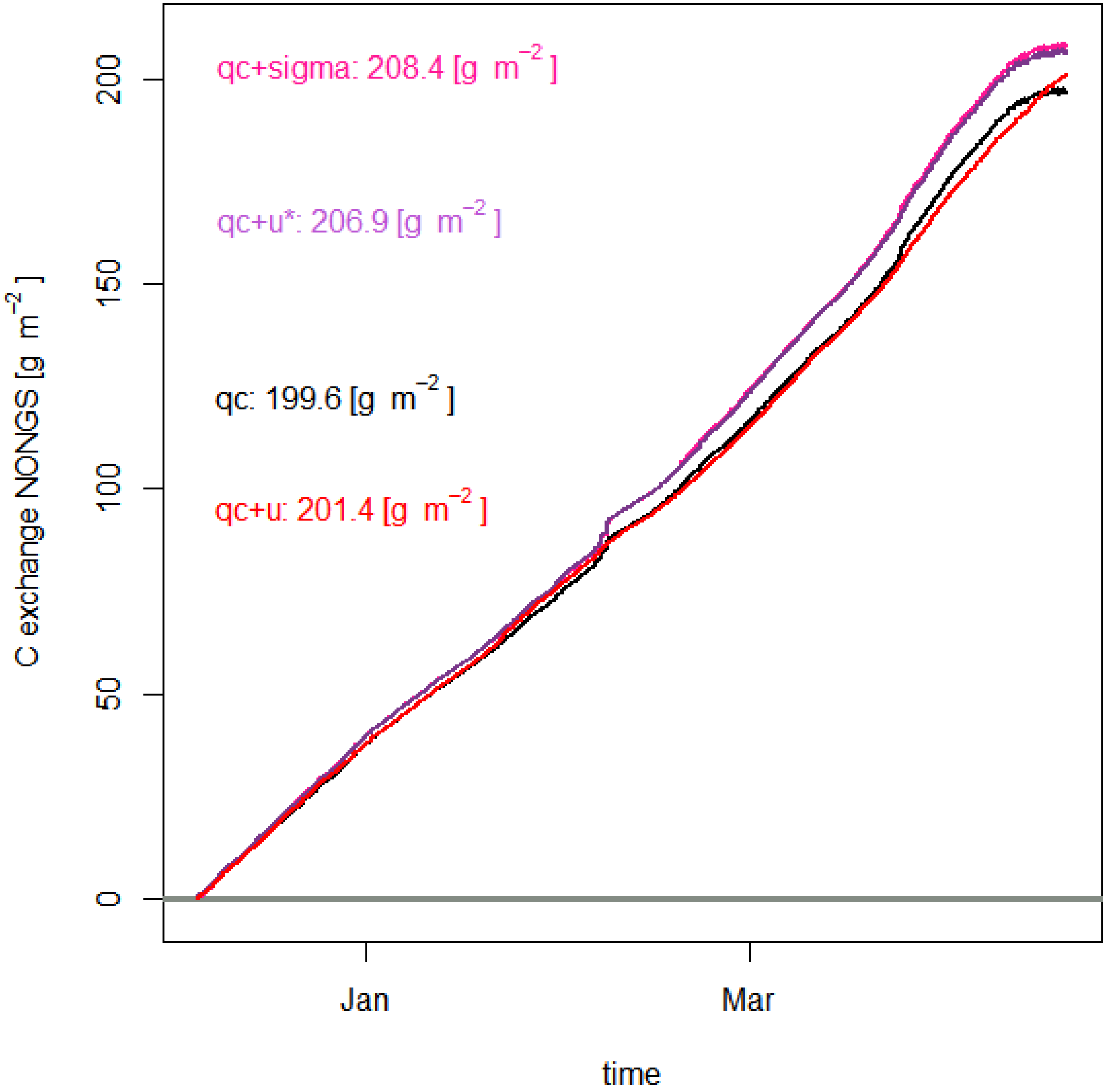
Results of different filtering approaches.

Growing season (GS) (18.04-22.10.2018), daytime only



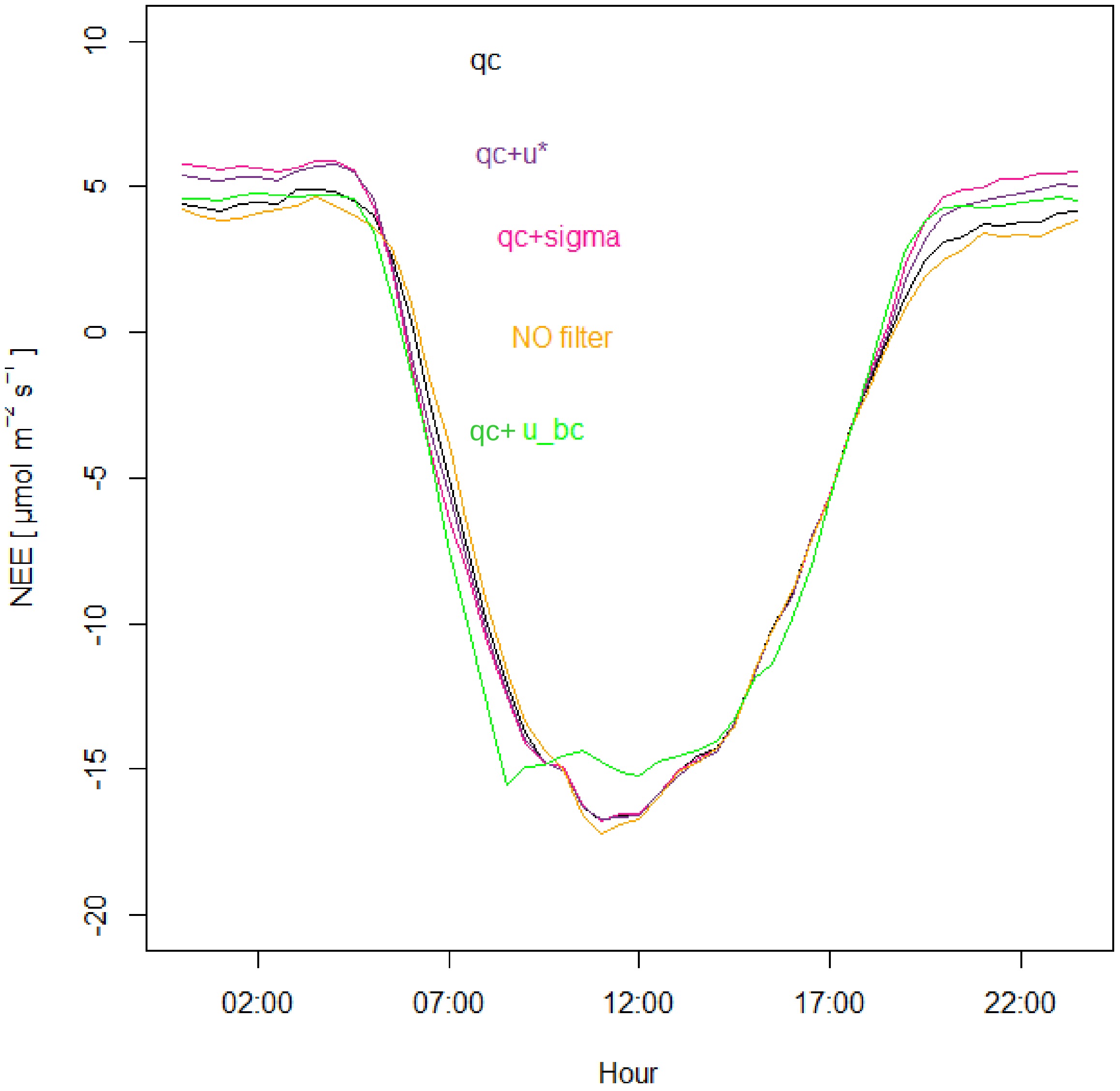
Results of different filtering approaches.

Nongrowing season (NONGS) (5.12.2018-18.04.2019), day and night



Results of different filtering approaches.

Growing season (GS) (18.04-22.10.2018), diurnal pattern of Net Ecosystem Exchange (NEE)



u* = 0.23

First observations from ongoing study

- Our hypothesis that conventional single-level EC flux filtering strategies like the u* filtering might not be sufficient to fully capture the carbon exchange of the studied ecosystem seems to be confirmed.

- Changes in amount of carbon exchanged during the GS (day and night), GS (daytime only), NONGS (day and night) like also in diurnal pattern of NEE were observed.

Acknowledgement: This work was supported by the Ministry of Education, Youth and Sports of the Czech Republic within the CzeCOS program, grant number LM2015061.


Thank you.