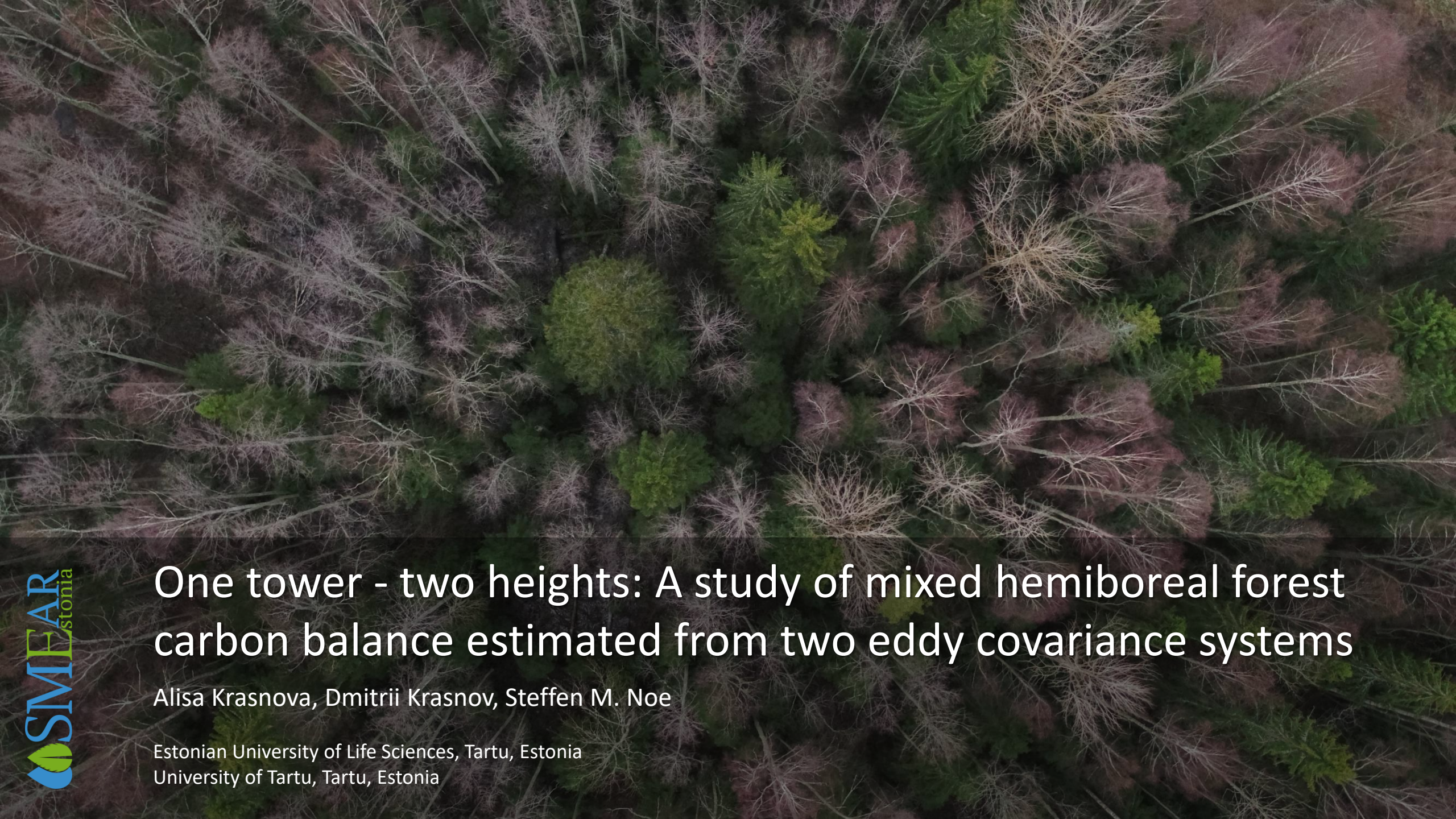


One tower - two heights: A study of mixed hemiboreal forest carbon balance estimated from two eddy covariance systems

Alisa Krasnova, Dmitrii Krasnov, Steffen M. Noe

Estonian University of Life Sciences, Tartu, Estonia
University of Tartu, Tartu, Estonia

Station for Measuring Ecosystem-Atmosphere Relations (SMEAR)

Website: http://smear.emu.ee/

Station winter video:
https://vimeo.com/315111396

CO2 eddy-covariance systems at 30m (EC30) and 70m (EC70) 2015-2018 (in this study)

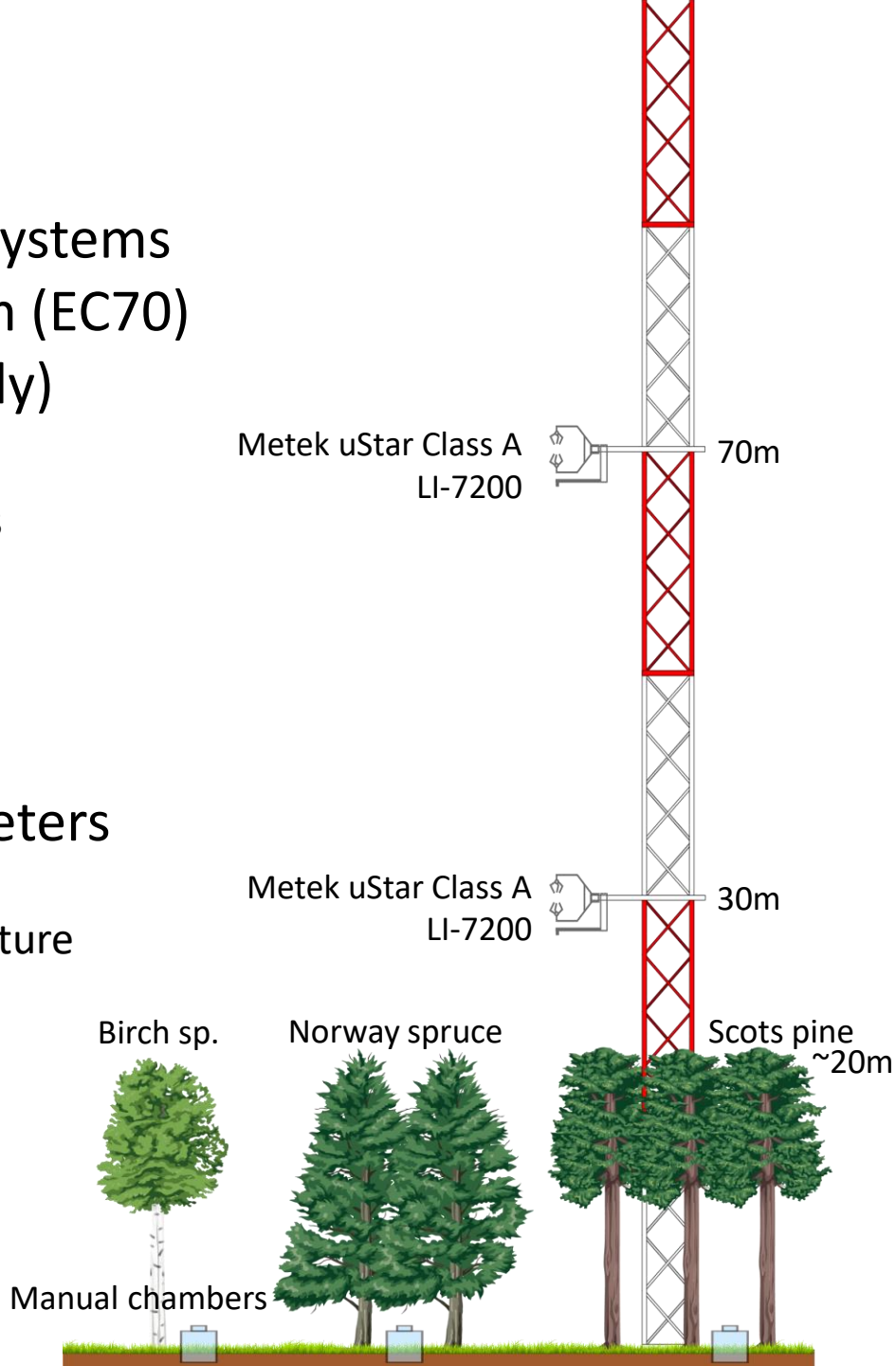
- EddyUH
- U* threshold 0.3m/s
- ReddyProc (MDS)
- MATLAB

Soil respiration

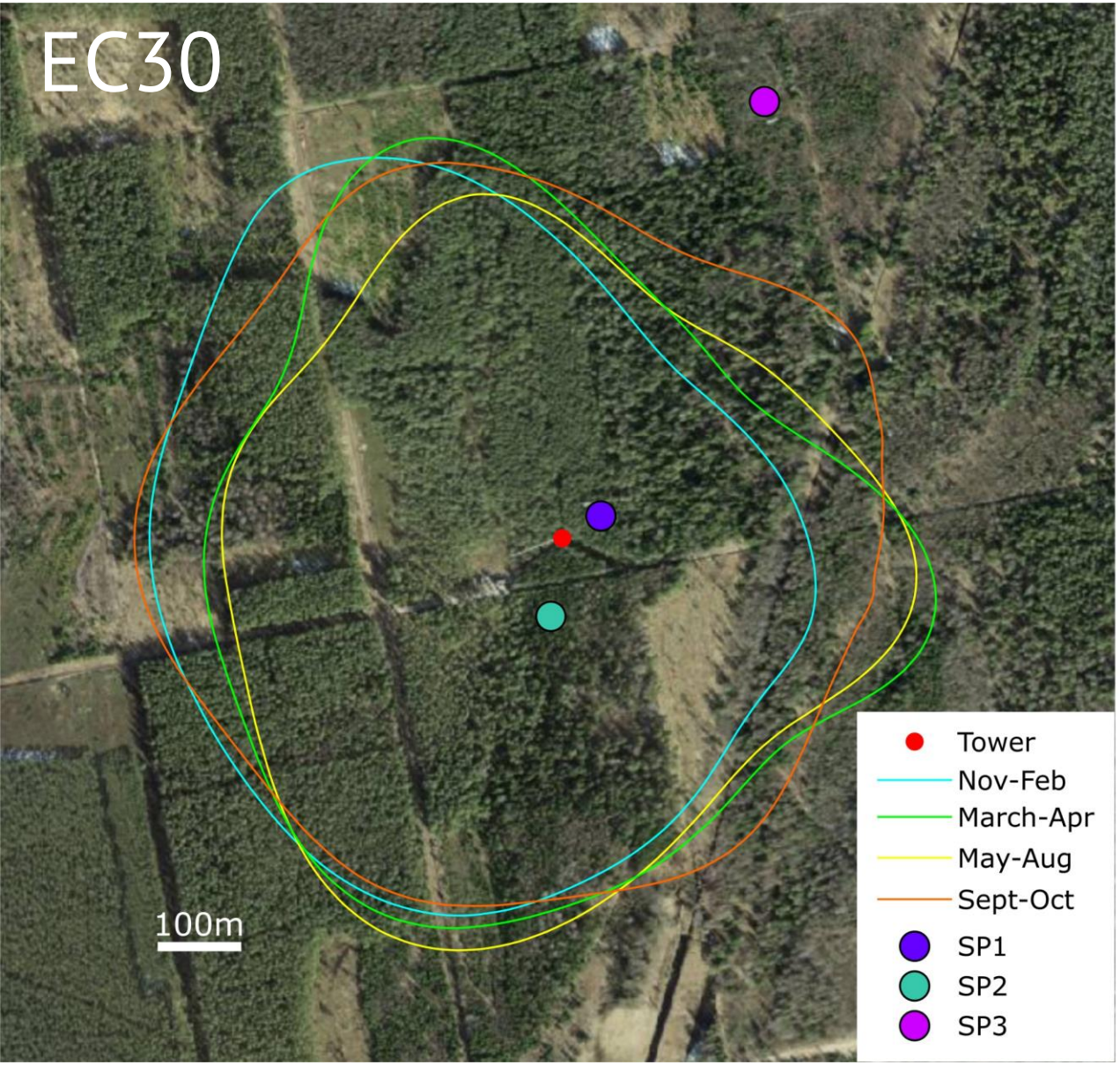
- Manual chambers

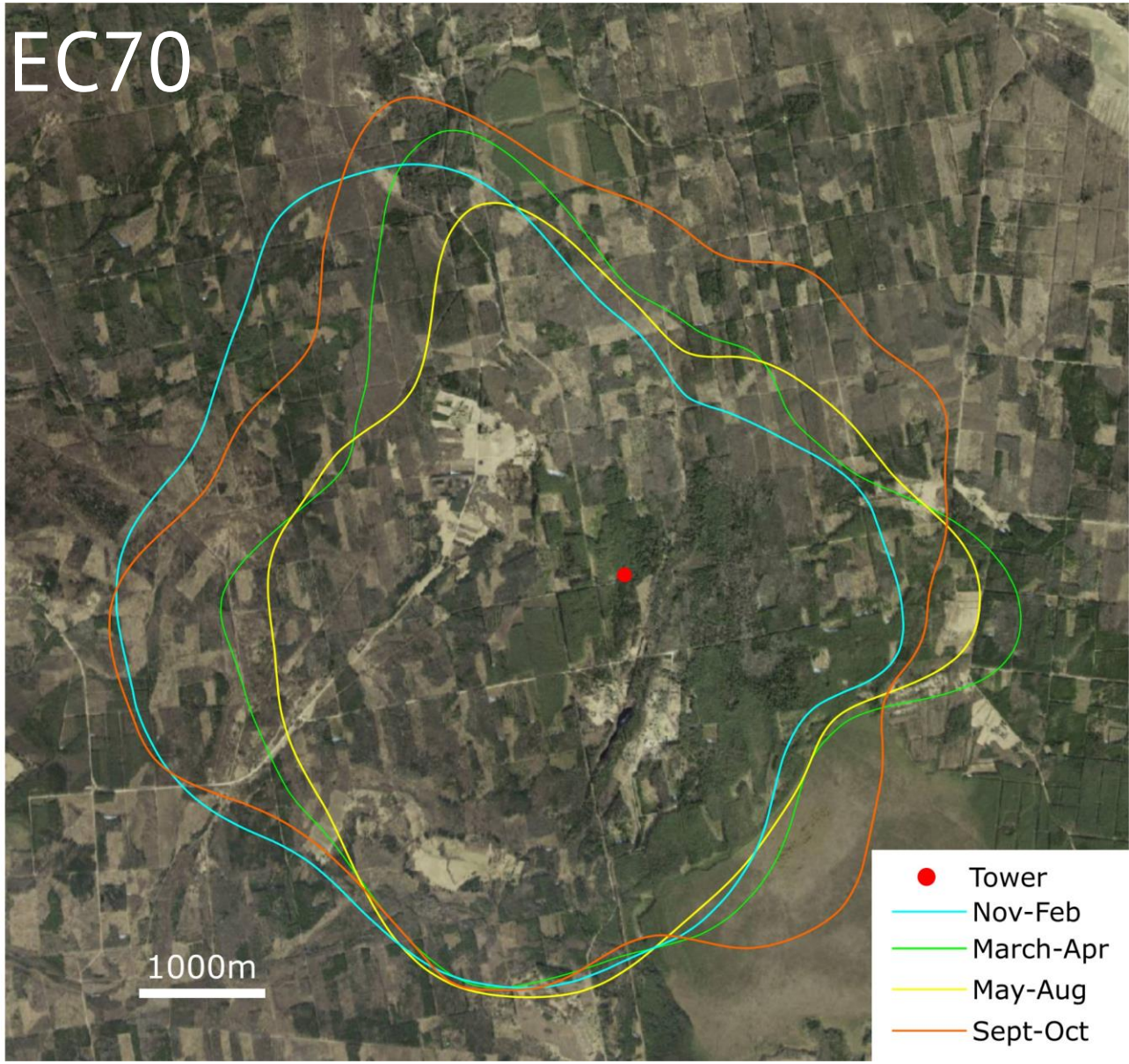
Meteorological parameters

- Solar radiation
- Air and soil temperature
- Soil water content



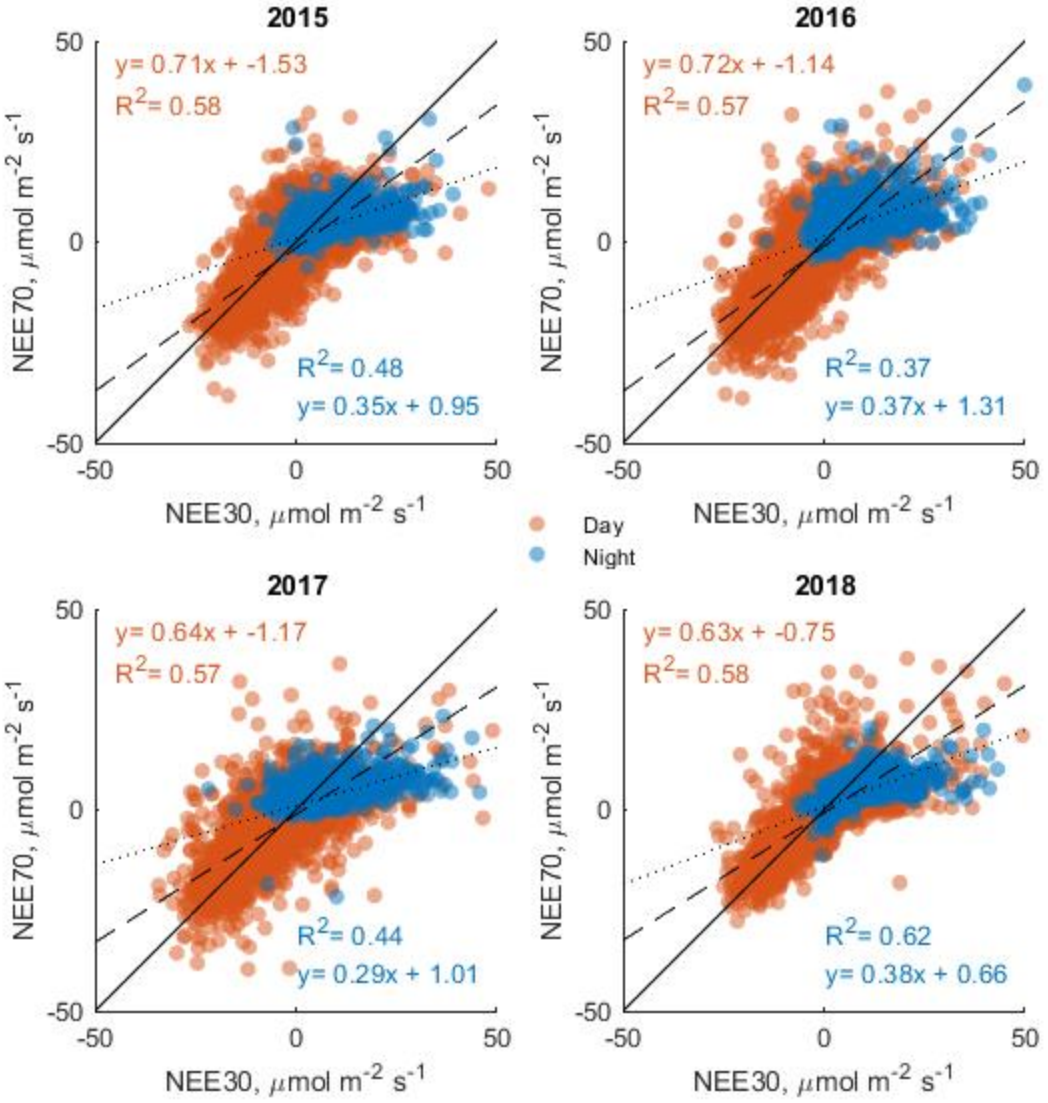
Footprint areas (years are pooled together). Model by Kljun et al 2015





0.537±0.038 km^2

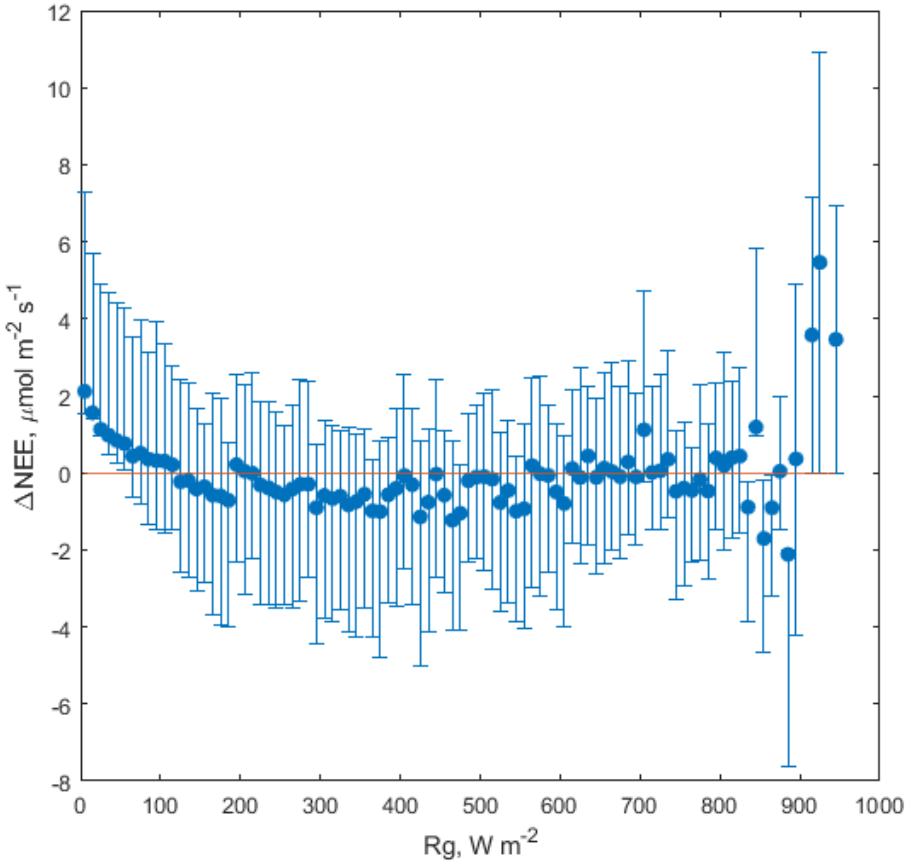
25.966±3.569 km^2



Markers are 30-min averaged measured NEE
"Night": Rg<5 W/m^2

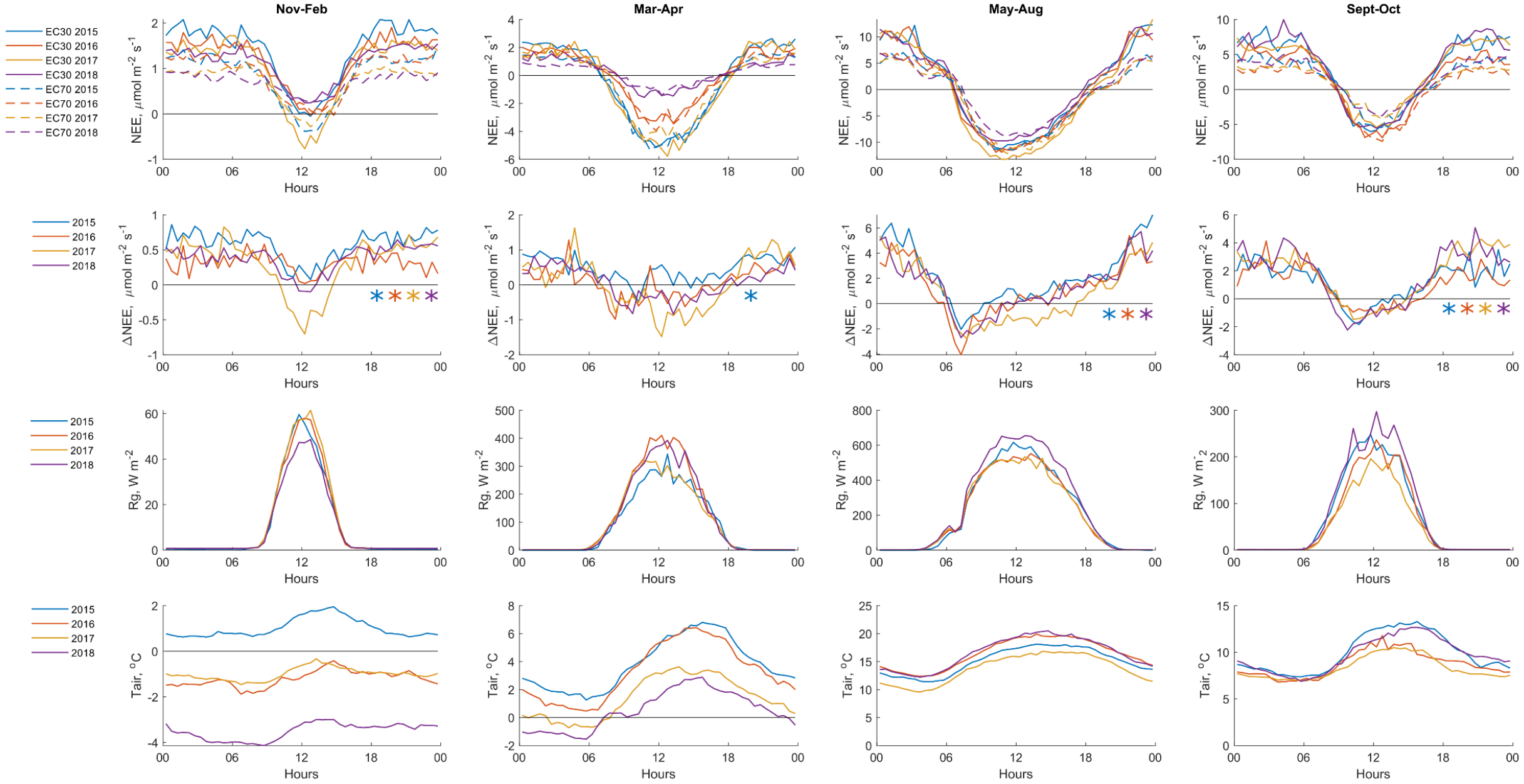
At half-hourly scale all the 4 studied years have similar pattern:
negative daytime fluxes are closer to the 1:1 line and positive nighttime

:70.



This difference decreased with the increase of total radiation until Rg~200 W/m^2 with no further effect. ΔNEE was mostly positive until the total radiation reached around 130 W/m^2

Median diurnal cycles of NEE, ΔNEE, total radiation, air temperature



* The difference is statistically significant (Kruskal-Wallis test + Bonferroni adjustment)

$NEE30_{night} > NEE70_{night}$

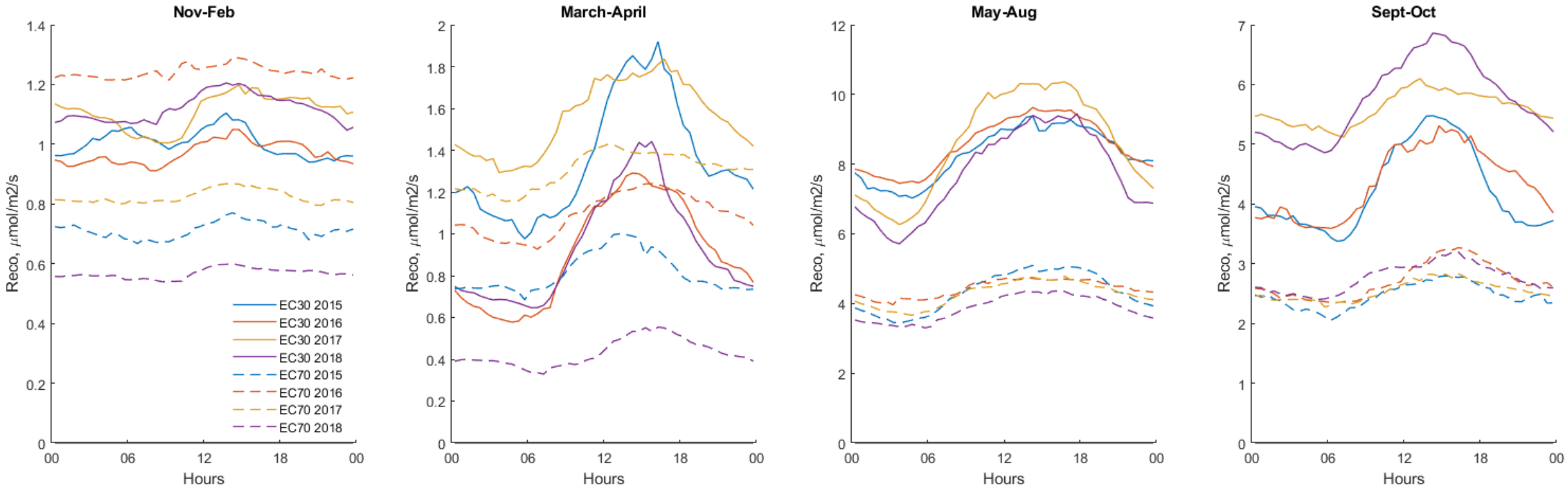
↓

$ER30_{night} > ER70_{night}$

↓

$ER30_{day} > ER70_{day}$

Flux partitioning:
More “traditional” nighttime data based method (Reichstein et al., 2005)
will by definition make daytime respiration values higher if the nighttime values are higher.
Daytime data based method (Lasslop et al., 2010)
calculates ER_{day} independently from ER_{night}



CO2 „hot spots“?

May-October data (4 years pooled together)

For each 5 degrees of wind direction:

Daytime:

Light use efficiency

Daytime respiration

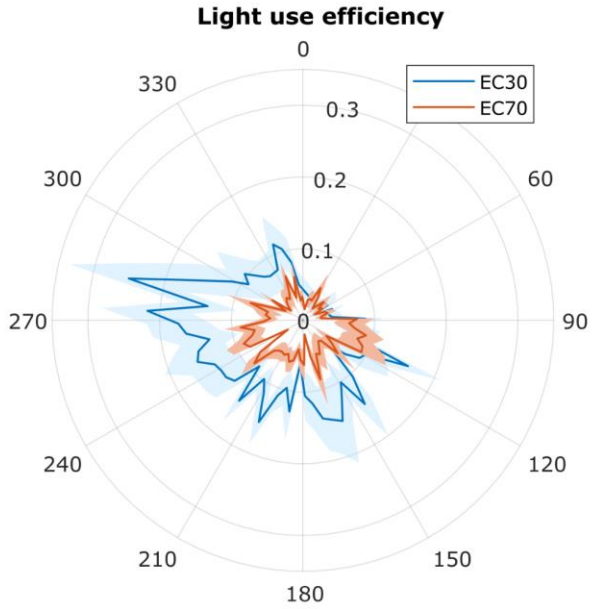
$$NEE = \frac{\alpha \cdot GPP_{max} \cdot Rg}{\alpha \cdot Rg + GPP_{max}} + RE$$

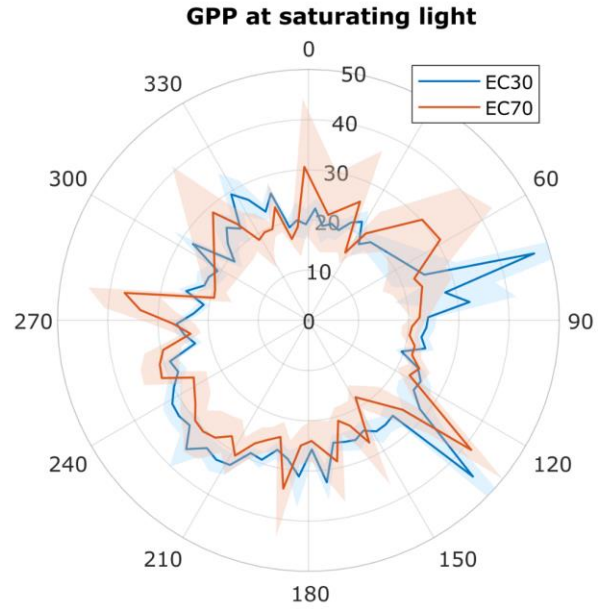
GPP at saturating light

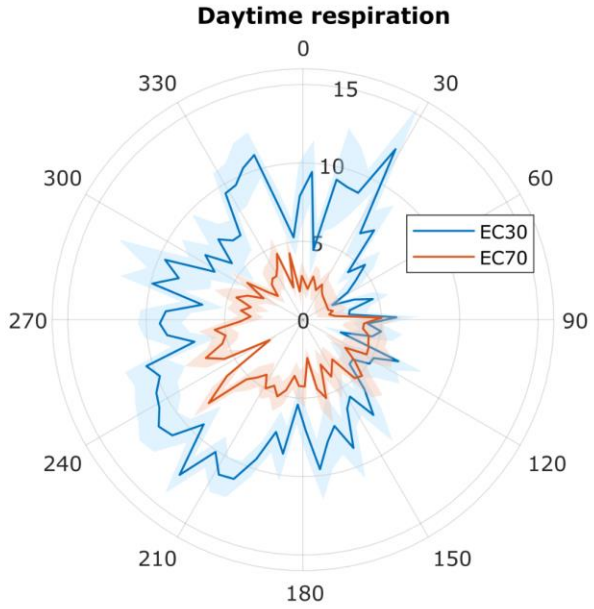
Nighttime:

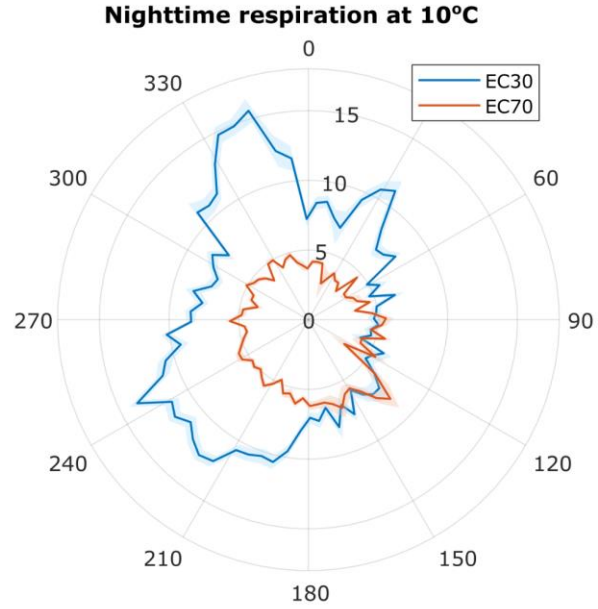
$$RE = R_{ref} \cdot e^{E_0 \cdot (\frac{1}{T_{ref} - T_0} - \frac{1}{T - T_0})}$$

Nighttime respiration at Tref



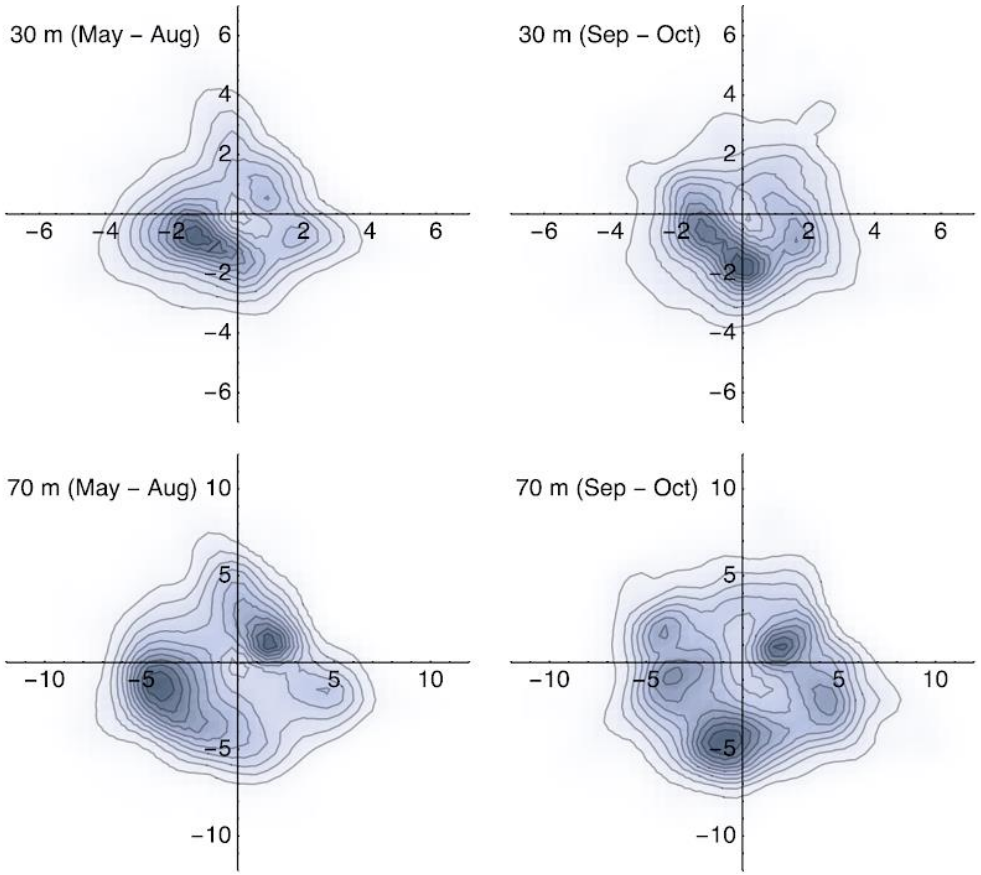




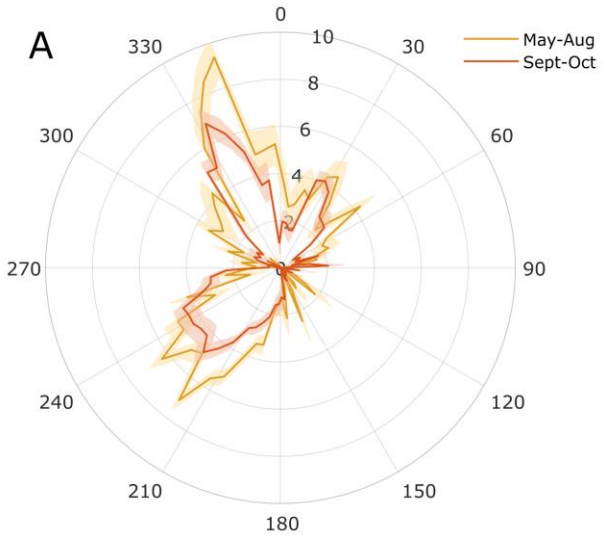


CO2 „hot spots“?

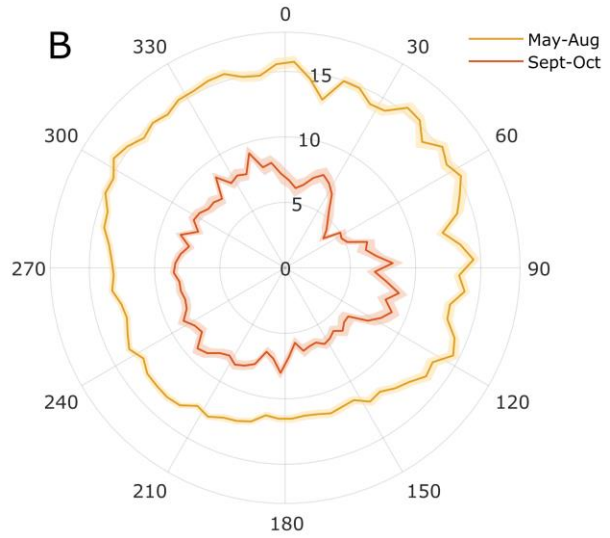
Local horizontal wind field pattern



ΔNEE = NEE30-NEE70

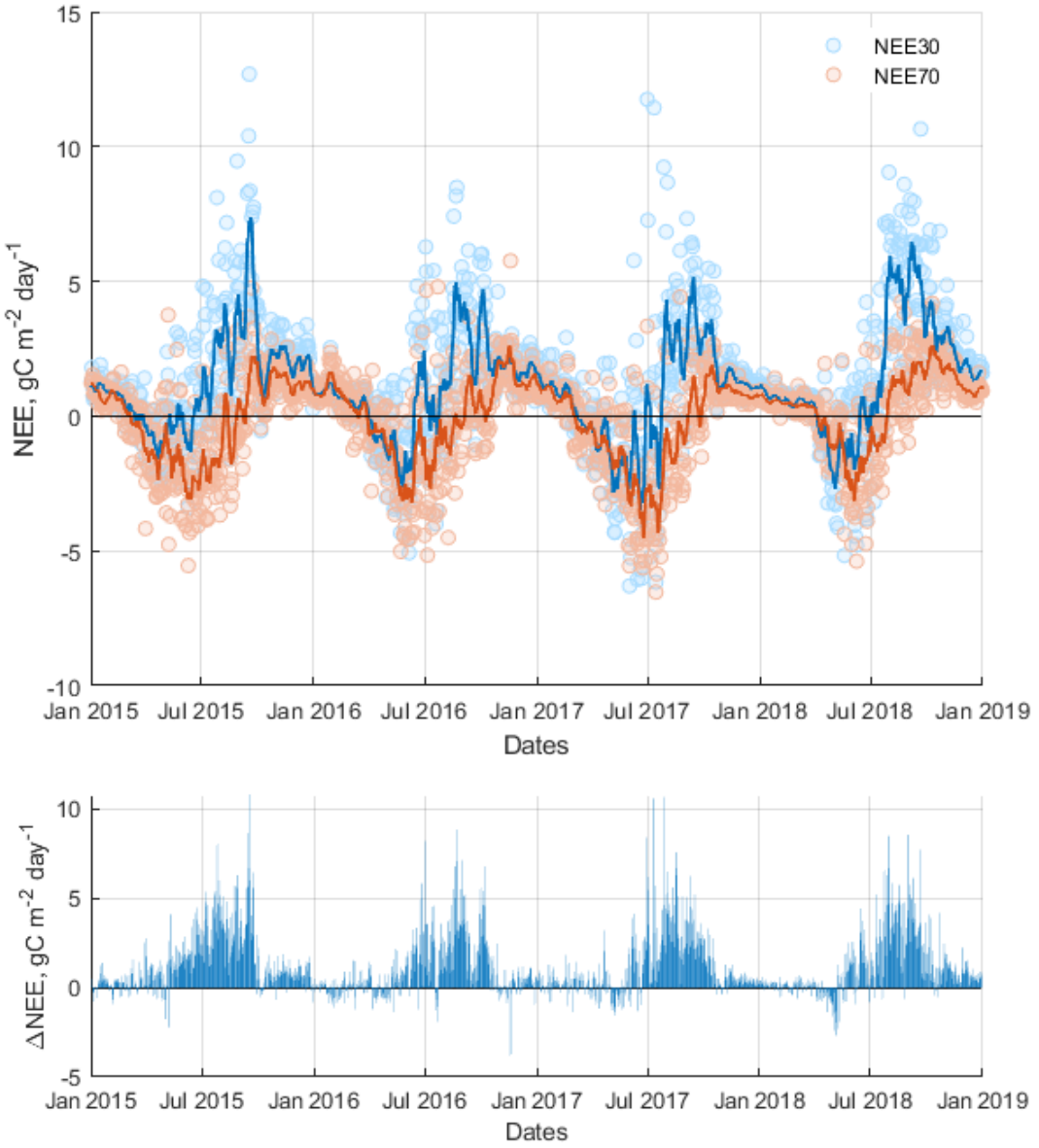


Air temperature

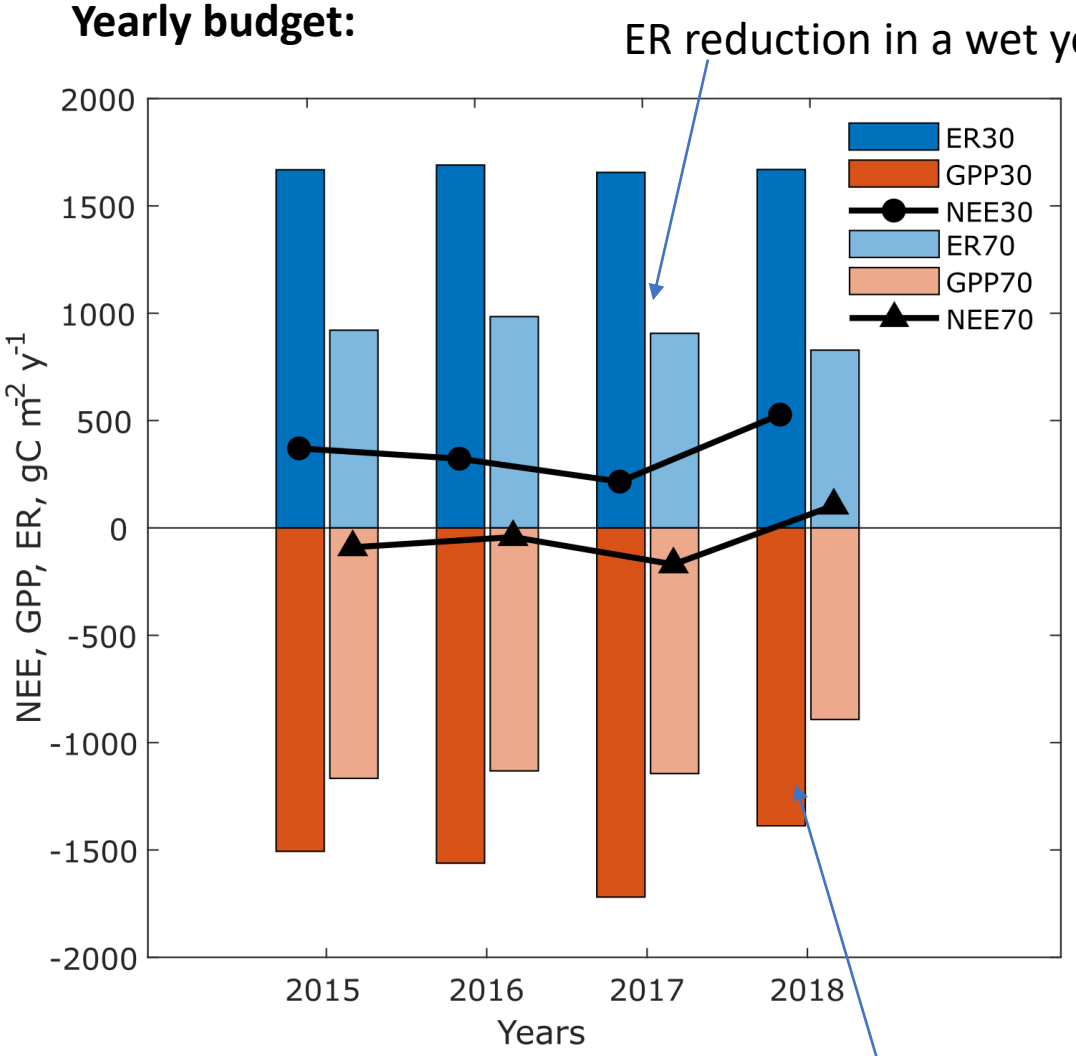


Rg<130 W/m2 (that’s when ΔNEE was the highest)

Seasonal cycle:



Yearly budget:



ER reduction in a wet year

GPP reduction, drought of 2018

Gap-filling method: MDS (in ReddyProcWeb)

Suggestions, comments, ideas are welcome! ☺