Contribution of wavelets to decrease gap filling in turbulent surface fluxes measurements

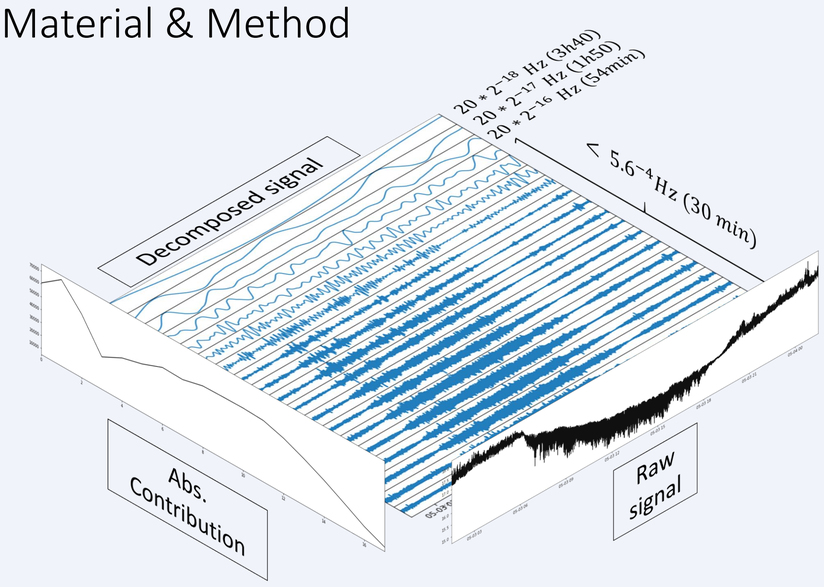
Pedro Coimbra[1] (pedro-henrique.herig-coimbra@inrae.fr), Benjamin Loubet[1], Olivier Laurent[2], Pauline Buysse[1], Jérémie Depuydt[1], Daniel Berveiller[3], Nicolas Delpierre[3], Matthias Mauder[4]

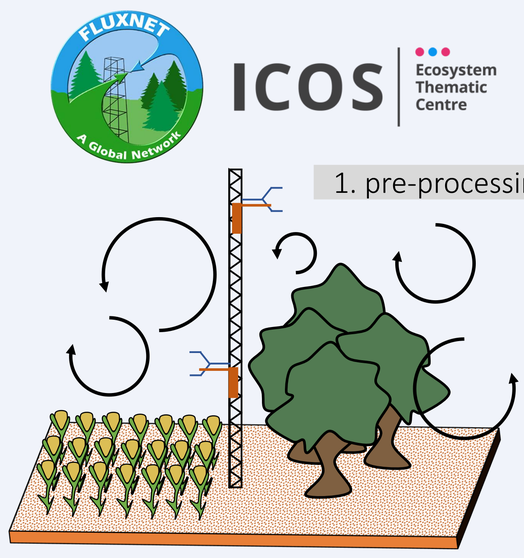
[1]EcoSys, **INRAE-AgroParisTech, Université Paris Saclay**, France; [2]LSCE, **Université Paris Saclay**, France; [3]**ESE,** Université Paris-Saclay, France; [4]TU Dresden, Dresden, Germany.

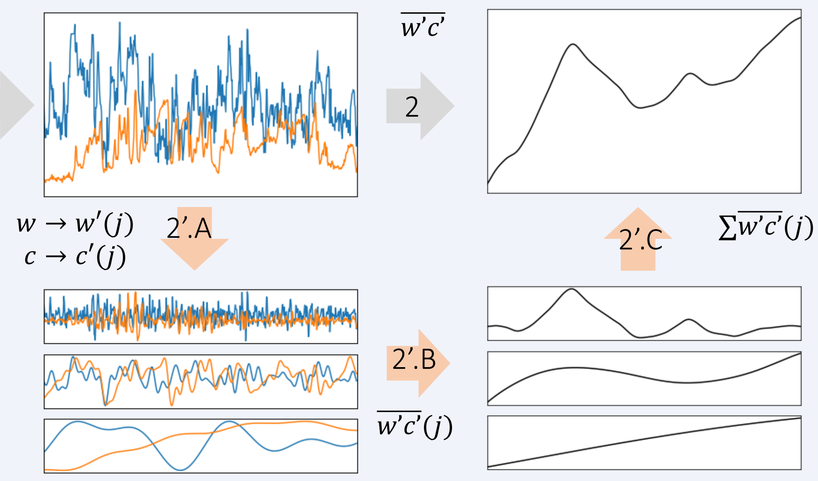
INTRO

- Since the 90's flux tower measurements have established as the breakthrough monitoring tool for bioclimatology and climate change.
- Tower location is chosen so that the flux footprint falls down on an accepted-to-be-homogeneous target area resulting on reliable on-site measurements.
- Measurements receive quality flags and medium and low-quality data are replaced using gap-filling methods.
- Around 20% of data is unreliable due to non-stationarity, which the eddy-covariance method (standard) requires, but wavelets do not.

Material & Method







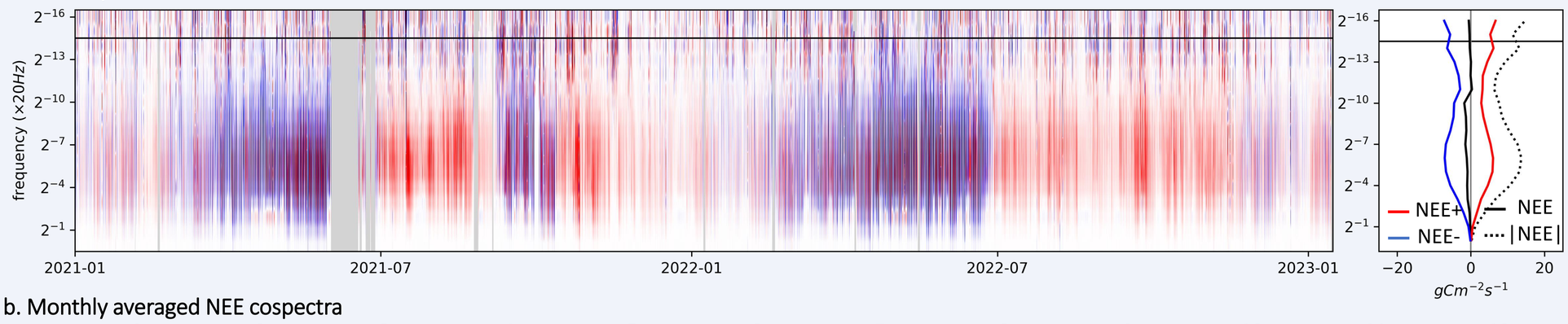
Results for FR-Gri (Crop site)

2021: Rapeseed;

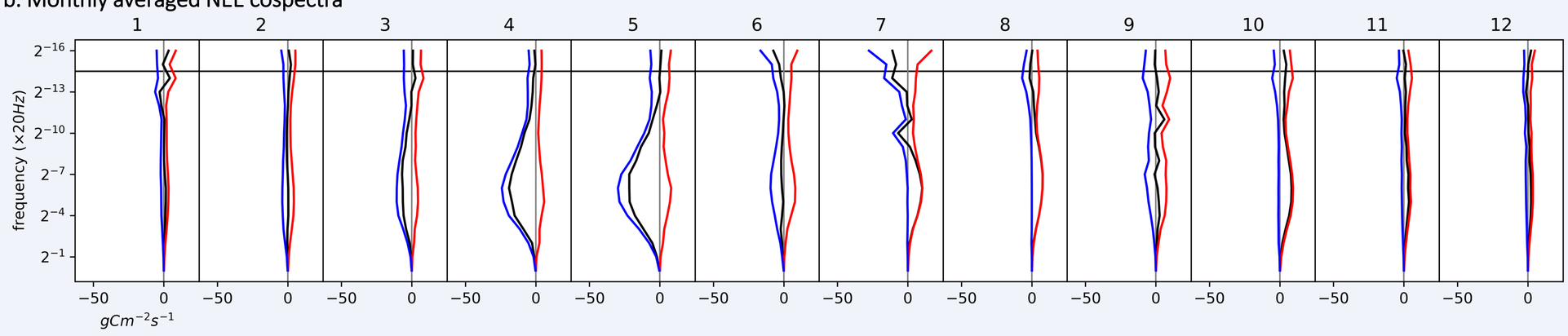
2022: Winter wheat;

- (a) Using (discrete) wavelet transform we retrieve NEE decomposed in time and frequency;
- (a, right) Lower frequencies averaged out;
- (b) negative NEE (NEE-) spreads more into middle frequencies than NEE+;
- (b) Some negative NEE appears on the band of 1 $\mathbf{min}^{-1}$ in July (bare soil);
- (c) Gap-filled showed no bias ($< 1 gCm^{-2}s^{-1}$);
- (d) New simple wavelet-based direct partitioning method shows promising results compared with standard NT method;

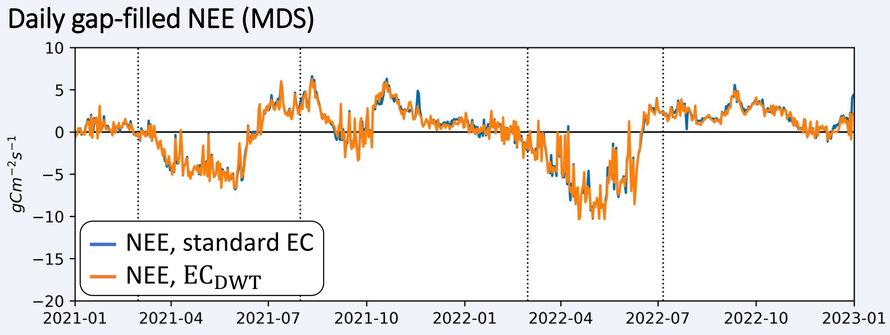
a. NEE cospectra



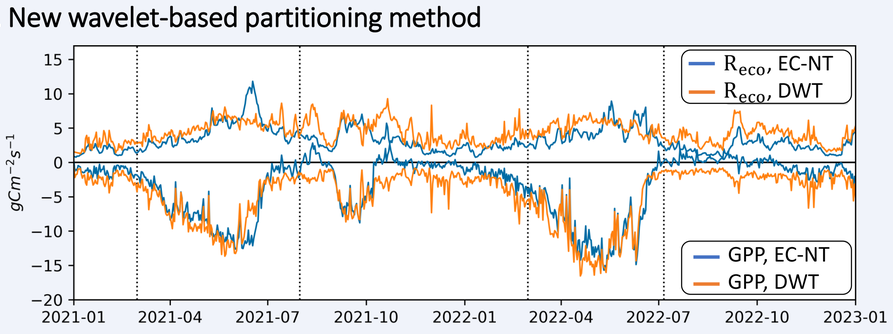
b. Monthly averaged NEE cospectra



c. Daily gap-filled NEE (MDS)



d. New wavelet-based partitioning method



Discussion

- Above results were compared with four-years in a forest site (FR-Fon) in the same region;
- Discrete Wavelet Transform allowed to keep around 20 % more data as high-quality in comparison with standard Eddy Covariance;
- No significant bias found in gap-filled NEE, nor for partitioning;
- FR-Gri (here) and FR-Fon (not showed) presented characteristic NEE cospectra profiles: lower frequencies contributions averaged out (NEE=0); peak contribution for FR-Fon at a lower frequency than for FR-Gri, attributed to the difference in height; negative NEE peaked on lower frequencies than positive NEE, suggesting processes such as GPP and Reco could be split in different frequencies;
- New direct partitioning method shows great promise in having a fully-observation-based partitioning;
- These findings contribute to expanding the methodological options for EC measurements available to researchers.