

Interactive comment on “A robust gap-filling method for Net Ecosystem Exchange based on Cahn–Hilliard inpainting” by Yufeng He and Mark Rayment

Anonymous Referee #1

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The paper presents the application of an image reconstruction technique (IIP - Image Inpainting) to fill gaps in eddy covariance timeseries of Net Ecosystem Exchange. The authors compare the method proposed with another generally used technique (MDS – Marginal Distribution Sampling) using artificial gaps and de-noised timeseries from 6 eddy covariance sites and 12 years of data, concluding that the IIP method has similar performances respect to the MDS and it is outweighing MDS in case of de-noised timeseries.

The paper is well written but the analysis is weak, not very innovative and not convincing mainly because:

1) The comparison of the two method is based on artificial gaps of up to 7 days; this

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is definitely a period too short to challenge the IIP method. In fact, as also the authors say, the drivers used by the MDS method add noise in the performances and for this reason on short gaps it is expected that methods based only on NEE interpolation will work better (the Mean Diurnal Variation (Falge et al 2001) is also based only on NEE data and will probably perform well in these conditions). The effect of changed environmental conditions will be probably visible on a longer time interval and for this reason the IIP should be evaluated on gaps of 2-3 weeks.

2) The discussion on the noise on the NEE data is interesting and largely correct. However the conclusions related to the study are somehow expected and not proving the goodness of the IIP method. In fact as the authors assert the IIP is an “highly smoothness estimator” and for this reason it is expected that its performances in the image re-construction will dramatically improve if the image is “smoothed” and simplified. It is also expected that with an “oversimplified” NEE time-series the effect of the short term variability of the meteorological drivers for the MDS can only add noise to the result (the potential short term relation driver-output is broken by a filtering applied to the output; for example the fast pulse effect on respiration due to precipitation or the fast reaction of photosynthesis due to cloudy periods).

3) Some of the results interpretation are subjective and not justified. For example the fact that the reconstruction of the larger gap in summer in the DE-Gri site (figure 3) by the IIP is something to be positively evaluated because smoother and less noisy respect to MDS (page 5) needs to be proved. It is possible that the correct reconstruction is the one from the MDS method. . . only artificial (long) gaps can say which method is more close to the original measured data

Reference: Falge et al. (2001) Gap filling strategies for defensible annual sums of net ecosystem exchange, *Agricultural and Forest Meteorology* 107, pp. 43–69

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