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 #2

Received and published: 1 October 2016

The manuscript describes the concept of an image inpainting (IIP) method and its application to data gap filling for carbon dioxide fluxes (i.e., net ecosystem exchange; NEE). Since, as far as I know, flux researchers are not familiar with the IIP method and/or similar image analyses. It can provide important information and insight for the study area. While the manuscript is worth to be published, I have a critical question and some comments/questions on it.

A range of NEE should be different at site by site. In fact, the range of the site DEGri 2012 is from -30 to + 20 (Figure 3), and its of the site UKAMo 2010 is from -10 to +5 (Figure 6). Even the ranges are different, color scales at the both site are the same; the lowest is blue, around zero is green, and the highest is yellow. When those ranges

and scales are used for converting to gray scales, an representative NEE value of each gray scale is changeable at site by site, and it may lead to complex interpretations of "noise" because it is obtained from the difference between the gap filling values (i.e., scale of gray) and the real values. For an uniform analysis over the sites, why the fixed range for color/gray scales (for example, -30 to +20 for all site) is not applied? If there is some reason to use the specific range for color/gray scale for each site, please mention about it.

Other minor comments are listed below.

Title: It is hard to infer the contents of the manuscript by reading the term "Cahn-Hilliard inpainting". Please try to express this in different words.

Page 3, line 26-27: Can colored fingerprint figures (e.g., Figure 3 (b), (e), (h) and (k)) be applied to the IIP? Why are the figures converted to gray scale images? (Is the IIP limited only to the gray scale images?)

Page 4, line 18: What does the "T" mean in equation 1? There is no explanation.

Page 5, line 28: "patitioned" -> "partitioned" ?

Page 6, line 14-16 and Page 14, Figure 5(d): Richardson et al. (2006) showed that random errors of fluxes follow a double exponential distribution. Though the noise in the manuscript and the random errors in Richardson et al. (2006) are different concepts, how about also trying to fit the noise to the double exponential distribution?

Page 8, line 9-10: The authors noticed that the IIP performed less well for long gaps which gives rise to a question. Are the "long gaps" mentioned in the context a gap percentage of total data, or an absolute gap length? If a site has a one month data gap in a one year data set, the gap percentage is ca. 8% and, in my understanding, it may lead to a less accurate result. However, in the case of a one month data gap in a ten years data set using one fingerprint figure, the absolute gap length is the same but the gap percentage changes to small (ca. 0.8%), and will it produce a different result or the

same? It should be made clear whether the "long gaps" referred to are the percentage or the absolute length.

Page 18, Table 2: What does the "sample size" mean? Are the data points used for the IIP?

Reference: Richardson et al. (2006) A multi-site analysis of random error in tower-based measurements of carbon and energy fluxes, Agricultural and Forest Meteorology, 136, pp. 1–18.

———————————————