

Author Response to the RC1: Anonymous Referee #1

General comments:

The subject of the paper is relevant to the subject of this journal. The paper contains some new data relevant for publication. The presentation is clearly described, also the length of the paper is adequate. The title and the abstract are pertinent and understandable.

The authors give proper credit to related work and clearly indicate the own contribution.

>> We thank the reviewer for providing encouraging comments and valuable suggestions that improved the paper's readability. Our responses to specific comments are below.

Specific Comments:

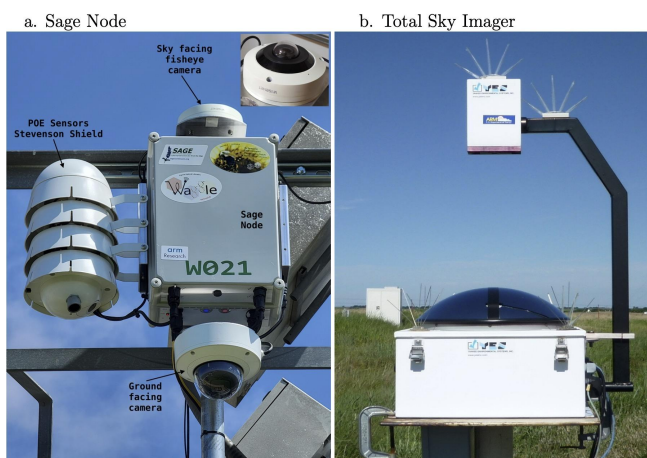
- Section 2: the tools applied are not explained (e.g. which programming language, libraries for image processing, etc.)

>> We provided the Python source code of the Sage plugin in the code availability section. For readers' convenience, we have added the following statement in section 2.2:

The above implementation of the PC algorithm is available in several programming languages, notably C++, Python, and R in packages `openCV` (`mulSpectrums`), `SkImage` (`phase_cross_correlation`), and `imagefx` (`pcorr3d`) respectively. For this study, we used the Python implementation of Picel et al. (2018) using `NumPy` and `SciPy` packages. (See code availability section).

- Section 2.1: an image of the used instrumentation (TSI, Sage camera) would be instructive.

>> We have added Figure 1 showing a TSI camera system and a Sage node with sky facing camera and other sensors.



Also, explain "CEIL".

>> Thank you for pointing this out. We have now changed to using the full name for the ceilometer. The description of the working of the Ceilometer is also rearranged for clarity (See section 2.1.3). We hope this change makes the text easier to follow.

- Section 2.2: Explain in more detail the phase correlation and FFT methodology, not just refer to the paper of Leese et al.

$C(\mu, \nu)$ is not explained.

>> The PC method is now described in more detail with added reference in section 2.2. The following paragraph is added after the PC method description for more clarity.

Suppose image I2 is a spatially translated version of image I1. In that case, the phase covariance matrix $Cov(p,q)$ is zero everywhere except for a sharp peak at the location corresponding to the displacement between the two images. The peak intensity is a good measure of the quality of the motion vector. Due to the reasons mentioned in Section 1, the actual peak in the covariance matrix can be fuzzy, and it corresponds to the best-fitting translational motion in the images. Sharp single-pixel peaks can sometimes occur in the covariance matrix, due to the high-frequency noise and artifacts in the images, which are flattened using Gaussian smoothing on $Cov(p,q)$ with $\sigma = 3$.

$C(\mu, \nu)$ is now explained in point 2 in section 2.2.

Section 3: The U and V components are used widely in the manuscript but nowhere explained in detail.

>> We thank the reviewer for suggesting this. The meaning of U and V components and their association with the X and Y image axis is now described at the end of section 2.2.

For each image block, the peak covariance location is assigned as the local motion vector in image I2 with respect to image I1. As per the meteorological convention for winds, the U component is positive for an eastward flow, and the V component is positive for a northward flow. The location of the peak covariance from the center of the matrix gives the shift in the image features in the time period along the X and Y dimensions of the image. We saved X and Y shifts and computed the motion vectors per minute. The image top is oriented towards the north and therefore in the subsequent sections, the motion in the X and Y directions are referred to as U and V components, respectively.