



EGUsphere, referee comment RC3
<https://doi.org/10.5194/egusphere-2022-331-RC3>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on egusphere-2022-331

Anonymous Referee #3

Referee comment on "Auroral alert version 1.0: two-step automatic detection of sudden aurora intensification from all-sky JPEG images" by Masatoshi Yamauchi and Urban Brändström, EGU Sphere, <https://doi.org/10.5194/egusphere-2022-331-RC3>, 2022

The paper presents a fast approach for real-time Aurora detection by using RGB images acquired by an All-Sky-Camera (ASC) (i.e., full frame camera with a fish-eye lens, pointing towards the sky), located in an a heated-dome at the Kiruna Observatory. The aim of the authors is to identify intensification of auroral arc with expanding motion, named Local-Arc-Breaking (LAB), and send email alerts when the "Level 6" criterion for LAB aurora detection is satisfied.

The proposed approach is composed of two steps: 1) perform a pixel-wise classification of all the image pixels into different categories (including three aurora categories), based on the color information of the pixel itself; 2) compute a series of indexes based on the percentage of pixels detected for each category and the average luminosity of the most intense aurora pixels. Based on the computed indexes, the alert system can detect most relevant aurora events and trigger an alert.

The topic is interesting and the proposed solution for a real time alert is relevant, especially because it is a fast and not computationally expansive approach (which is crucial for real-time applications). However, there are some critical aspects that should be solved (or at least discussed):

- Computation of the thresholds and transferability of the method.

The pixel-wise classification is basically based on thresholding on RGB data, and it relies on a large number of thresholds. This makes the classification fast and computationally easy. However, it requires a proper fine tuning of the threshold levels, that is crucial for an accurate classification. I believe that threshold calibration is mostly based on the authors' experience, as very little information about this is provided in the paper. The

clear consequence of this, is that the procedure may not be transferable to another site, with different environmental conditions and different instruments (as the authors stated in the paper). With this idea in mind, it would be useful if the authors can discuss deeper their choices and provide some more considerations that have led to the derived threshold values, rather than just providing the values themselves.

- Camera geometry

Is the camera geometry considered in your study? I understand that you are not trying to reconstruct the location of the aurora (which may be an interesting extension of your study for the future), but the "occupancy" of the pixel classified as aurora (within the different classes), among the total amount of pixels. However, you are using a fish-eye lens (Nikon Nikkor 8 mm), with strong geometrical distortions, that require a proper camera model for correcting them (please, see e.g., https://docs.opencv.org/4.x/db/d58/group__calib3d__fisheye.html). I think that this aspect should be taken into account (e.g., by undistorting the images before any image processing) or at least discussed to see if geometrical distortions have a relevant impact on the accuracy of the classification.

- Comparison with different methods

It would be useful to have some comparison with different state-of-the-art approaches (or also widely established methods, if any) to fully grasp the potential of the proposed solution.

- Deep Learning

In the paper, the authors state that Neural Networks (NN) are black boxes, difficult to debug, and strongly dependent on the training data. I partially agree with the authors on these statements. However, I believe that Deep Learning (DL) is a powerful tool for identifying the presence of aural events and to classify them, according to a-priori defined classes (as it is done in this paper) and ground truth data (manually classified images, or images classified with the algorithm proposed in this paper). Moreover, if the NN layers are trained with datasets from different locations and cameras, and with proper data augmentation, this may result in a more transferable and generalized approach, that can be applied in different observatories. Additionally, NN is basically based on sequences of filter convolutions. Therefore, it may overcome the limitation of considering each pixel independently from its neighborhood for the classification (of course DL is not the only possible solution for this: spatial filters, Markov Random Fields are few other examples). Eventually, DL may be combined with the step 2 of the proposed solution to build a real time alert framework.

All this thing considered, I understand that the use of DL is out of the scope of this paper (I suggest considering it for future works, though), but I believe that some more references and discussions on recent works that involve DL for aurora image classification may improve the quality and completeness of this work.

- **Figure and Tables**

I believe that figures and tables can be improved. In my opinion, Figure 1 is not clear, and it should be revised (please, see comments in the pdf supplement). Additionally, figures with ASC images are often placed far from the text in which they are cited (even 3 or 4 pages afterwards), and this prevent a smooth read of the paper. I suggest revising figure placement in the text, reducing the number of ASC images to the really informative ones and making them bigger.

Moreover, I believe that the tables containing the thresholding conditions are too verbose and don't add relevant information in the text. Moreover, they are splitted in different pages, making even harder to read the tables. I suggest summarizing the main concepts of the tables (e.g., the different classes and the main classification criteria) in just one or two tables to be included in the main text of the paper. On the other hand, all the thresholds can be condensed in one table in the appendix.

- **Background knowledge**

As commented by other reviewers, I also believe that some background knowledge should be included in the text to allow a wider community to understand your work.

Please, refer to the comments included in the pdf supplement for other minor comments.

Please also note the supplement to this comment:

<https://egusphere.copernicus.org/preprints/2022/egusphere-2022-331/egusphere-2022-331-RC3-supplement.pdf>