

Identifying local PV shading in urban areas based on AC power and regional irradiance measurement

Citation for published version (APA):

Bognár, Á., Loonen, R. C. G. M., Valckenborg, R. M. E., & Hensen, J. L. M. (2017). *Identifying local PV shading in urban areas based on AC power and regional irradiance measurement*. Poster session presented at 9e Editie Sunday / Onderzoek Ontmoet Praktijk, 8 November 2017, Bussum, Nederland, Bussum, Netherlands.

Document status and date:

Published: 08/11/2017

Document Version:

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

Take down policy

If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

Identifying Local PV Shading in Urban Areas based on AC Power and Regional Irradiance Measurement

Ádám Bognár^{a*}, Roel Loonen^a, Roland Valckenborg^b, Jan Hensen^a

^aBuilding Physics and Services, Eindhoven University of Technology, Postbus 513 5600 MB, Eindhoven, The Netherlands

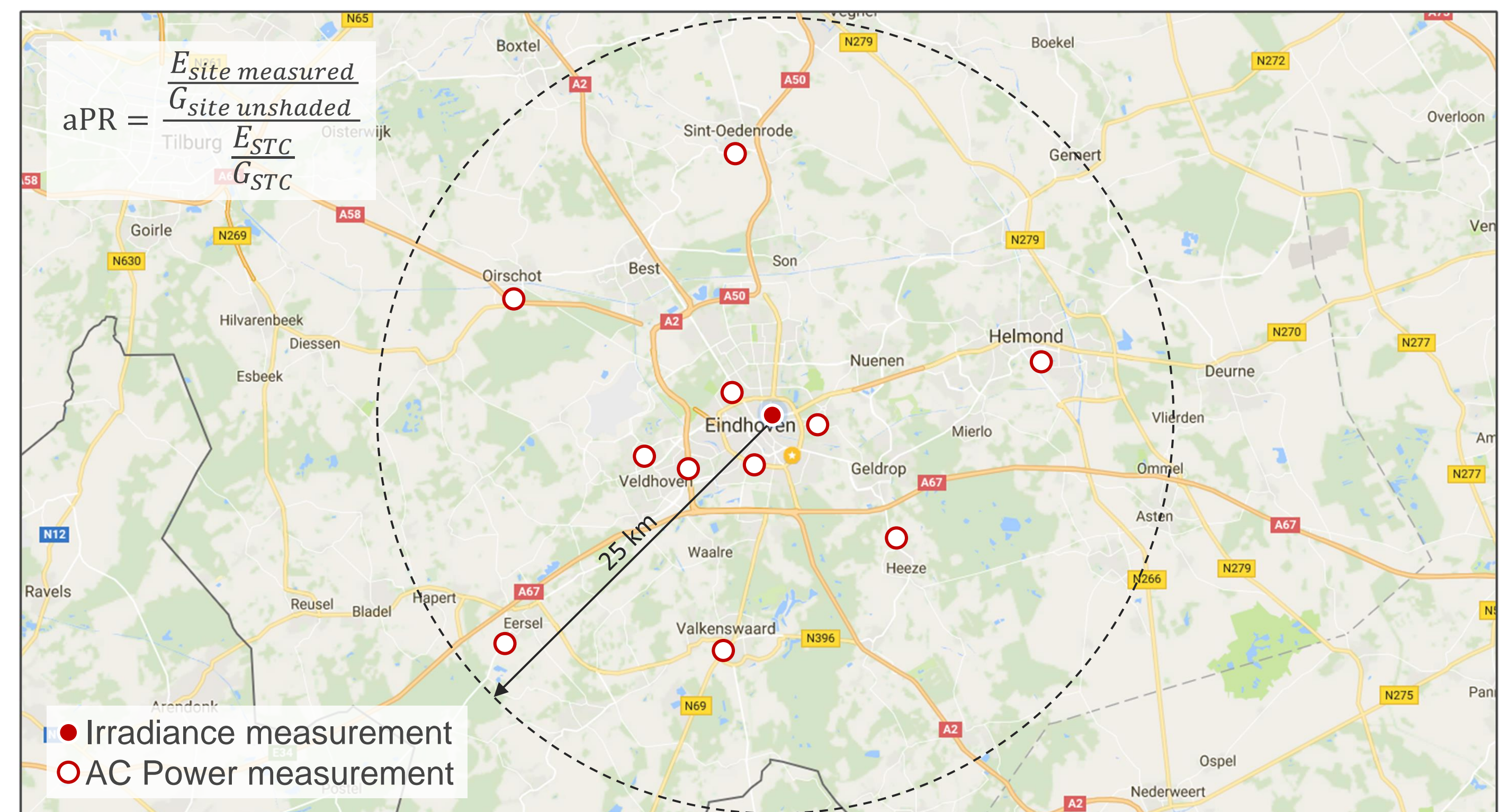
^bSolar Energy Application Centre (SEAC), High Tech Campus 21, Eindhoven, The Netherlands

*a.bognar@tue.nl

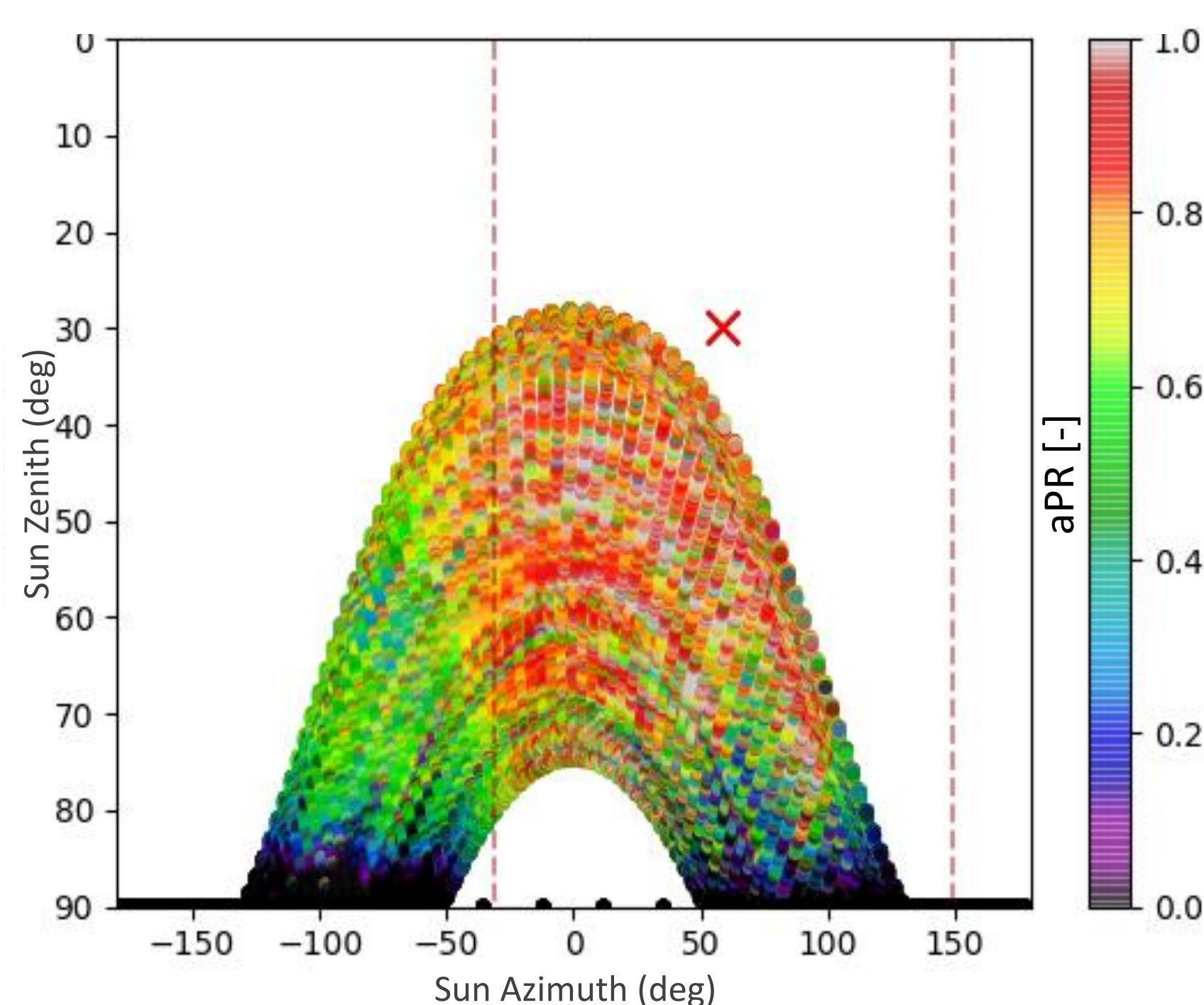
- Photovoltaics in the built environment
- Automated on-site shade detection
- Machine learning – Support Vector Machine
- Fault detection, performance monitoring

In the new era of BIPV applications, it is natural, that PV is installed on a surface that is regularly shaded. Furthermore, dependency of future buildings on on-site electricity generation will increase. This drives the need for accurate performance monitoring, of which shade detection is an essential element.

A method is developed, that relies on locally measured AC power and regional irradiance data. By calculating the apparent Performance Ratio (aPR) and applying machine-learning algorithms on the measured AC power data, locally shaded periods are identified, without local irradiance measurement. The method consists of 5 steps.

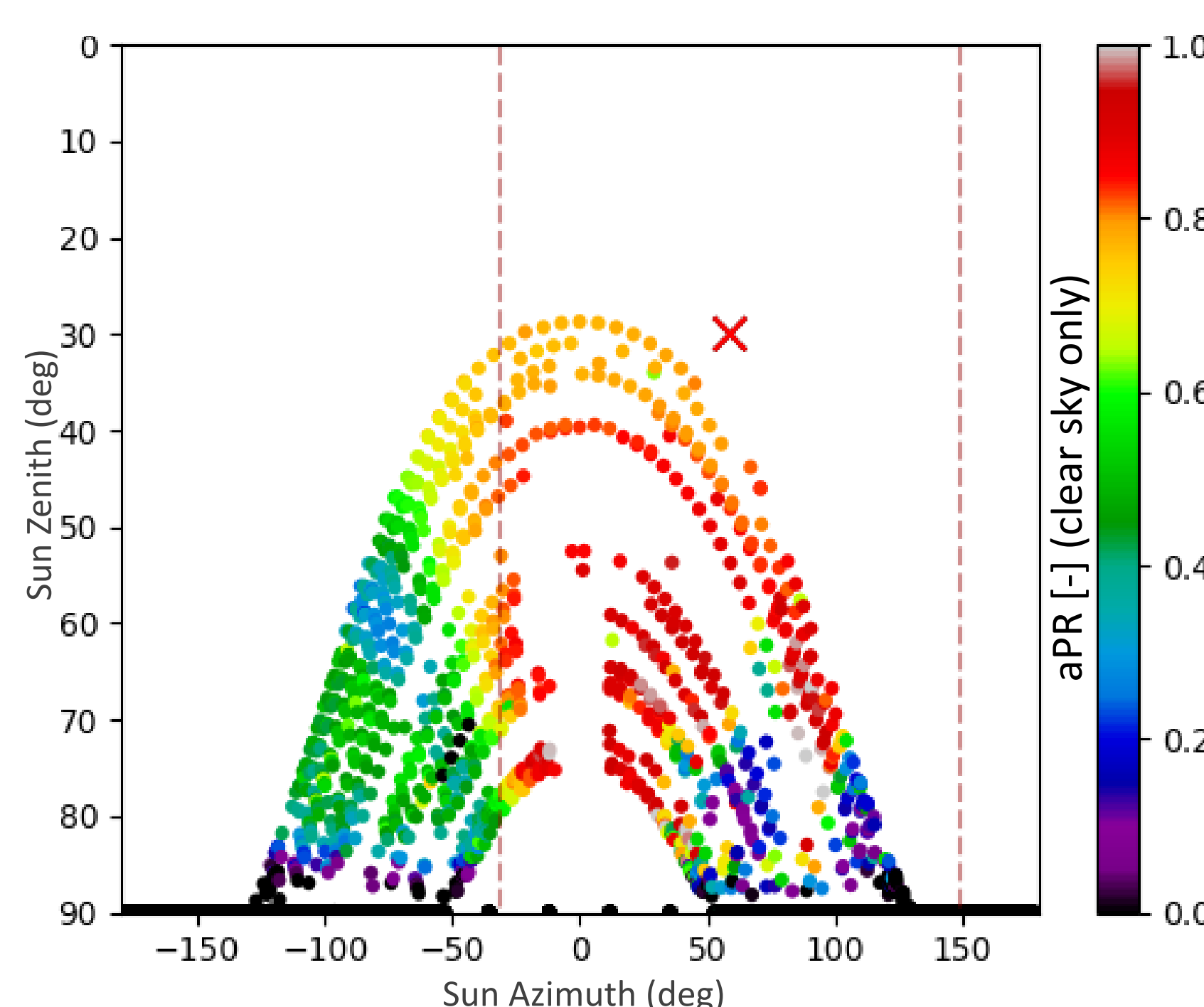


Step 1. Analemma graph



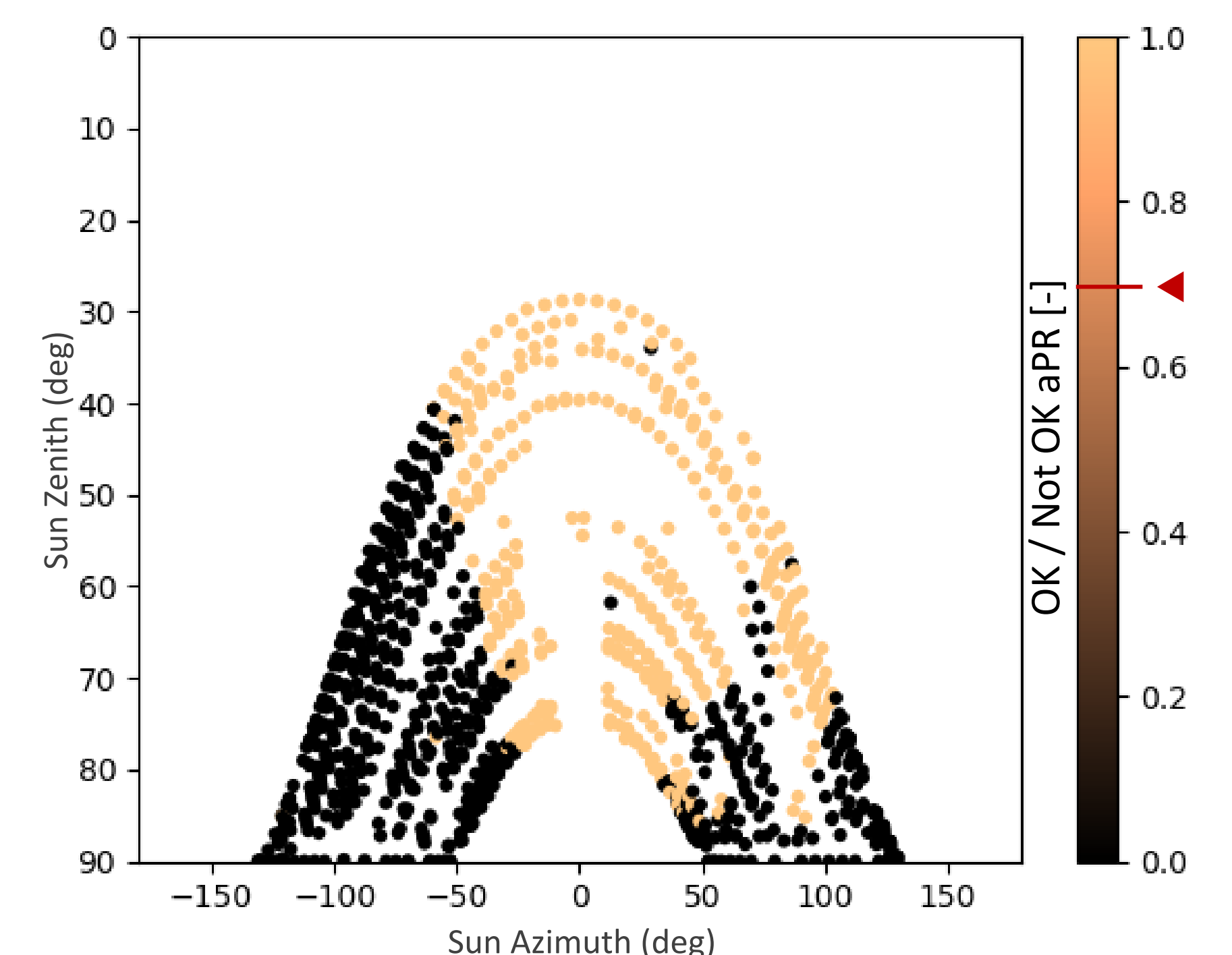
Create an analemma graph of aPR. Each point on the graph represents a solar position. aPR is marked with colors.

Step 2. Filtering for clear sky



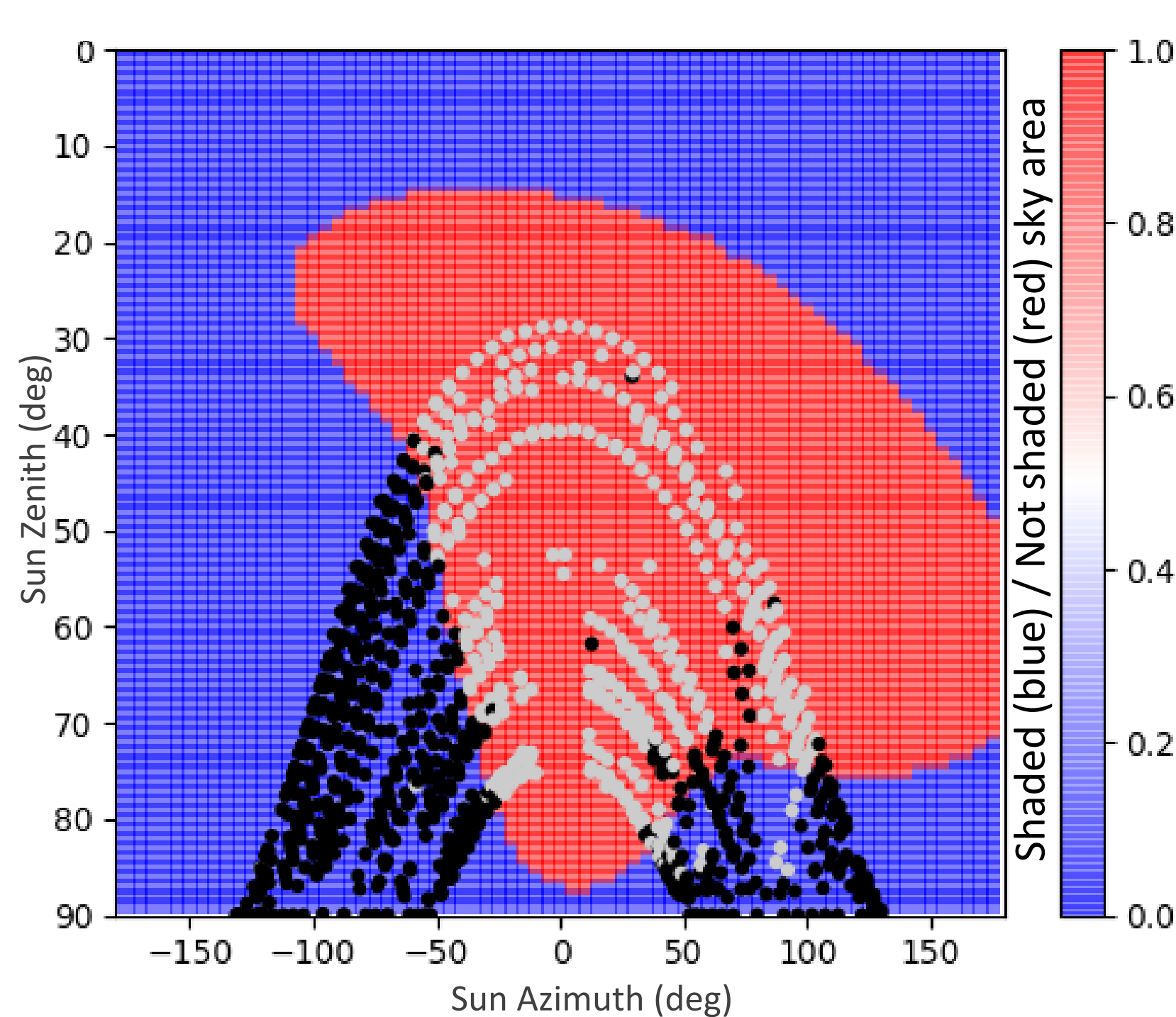
Eliminate data points with possibility of cloud-shading, using clear sky detection by Matthew J. Reno and Clifford W. Hansen.

Step 3. Binarizing



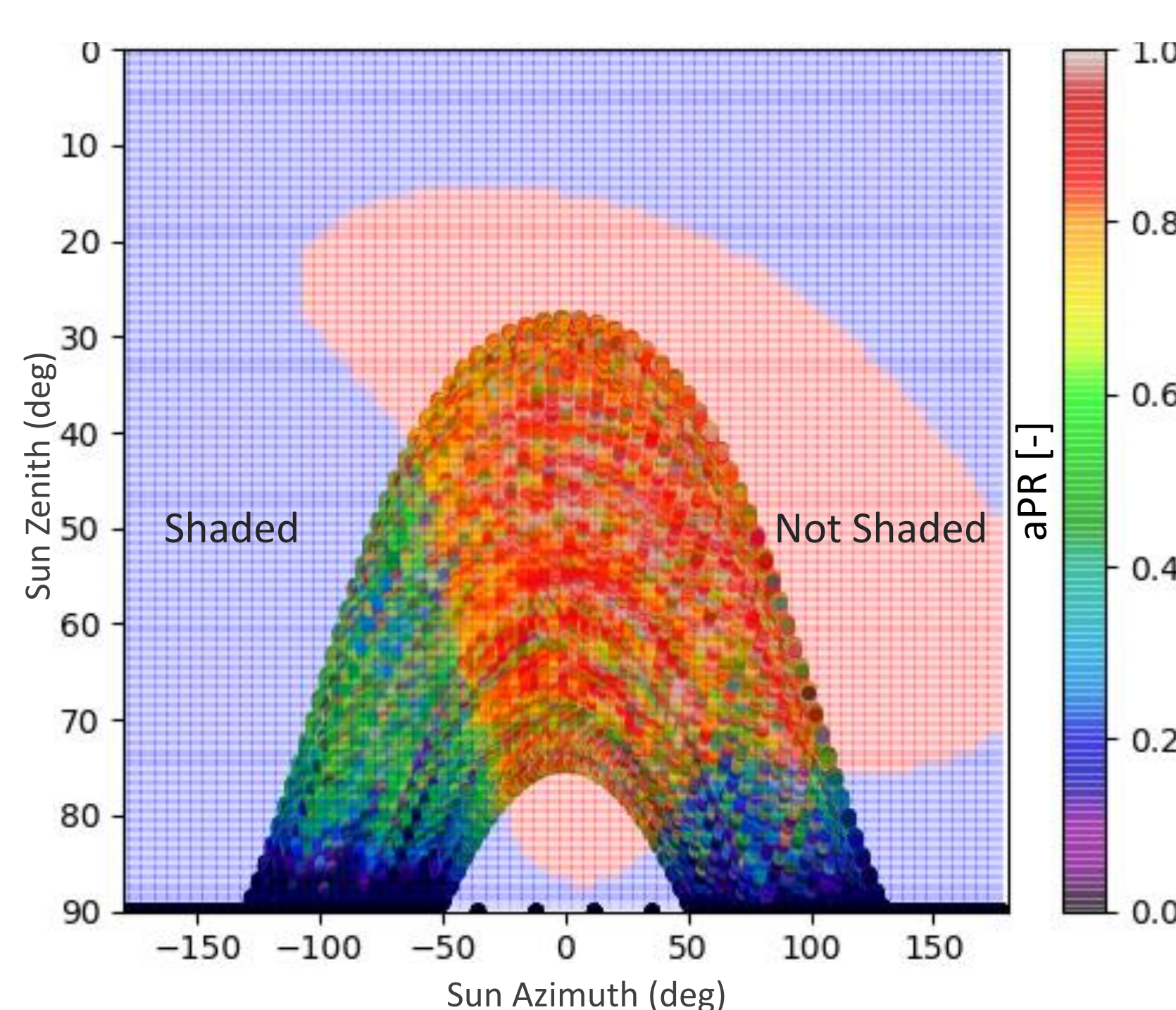
Binarizing the remaining measurement points with an aPR threshold. (<0.7) This set of points will be the training dataset for the SVM classifier.

Step 4. Train SVM



Use the previously binarized dataset to train the Support Vector Machine.

Step 5. Classification



Use trained SVM to perform a soft-margin nonlinear classification of all data points recorded in the first step to identify locally shaded sky areas.

Conclusions – future work

With this scalable method it is possible to distinguish between local and cloud-shading and - in case of a single-plane installation - to plot the shading contour of the nearby objects without local irradiance measurements. It can provide useful input for fault detection and monitoring of BIPV installations in an urban area. The next step is the validation by on-site shading measurements.