

A Variable Resolution Approach for Zonal Glare Assessment

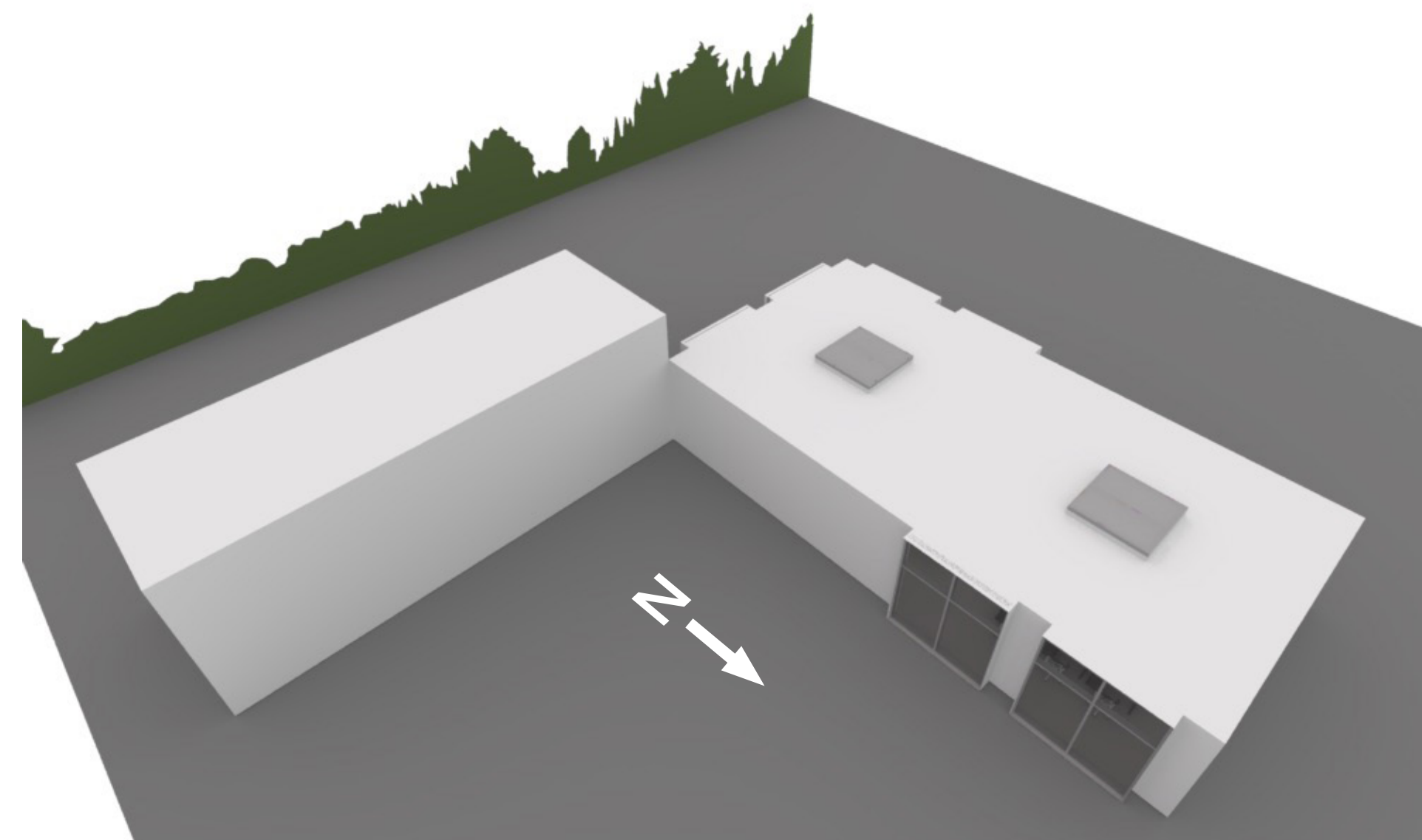
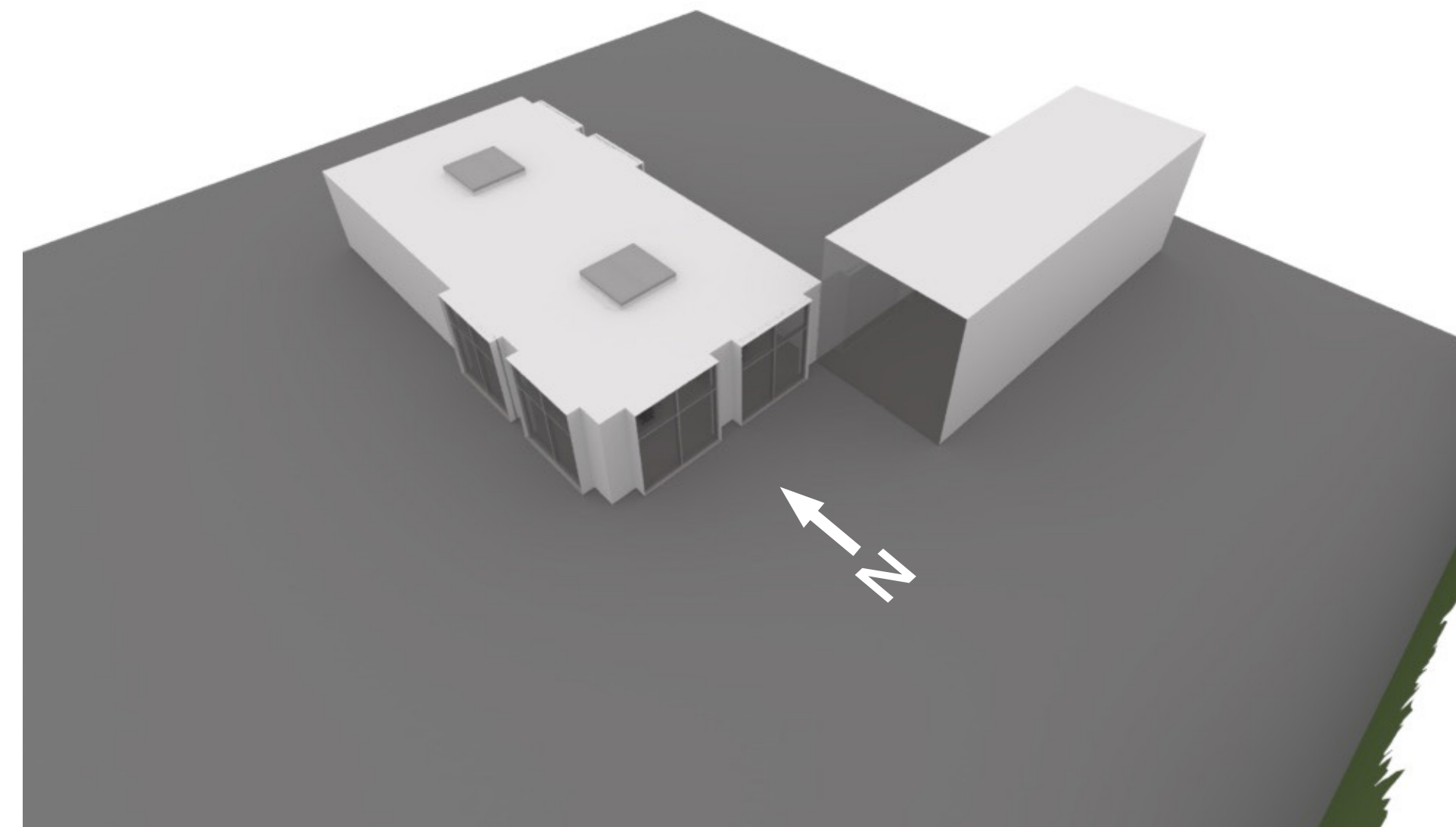
1

Outline

Measuring glare with simulation

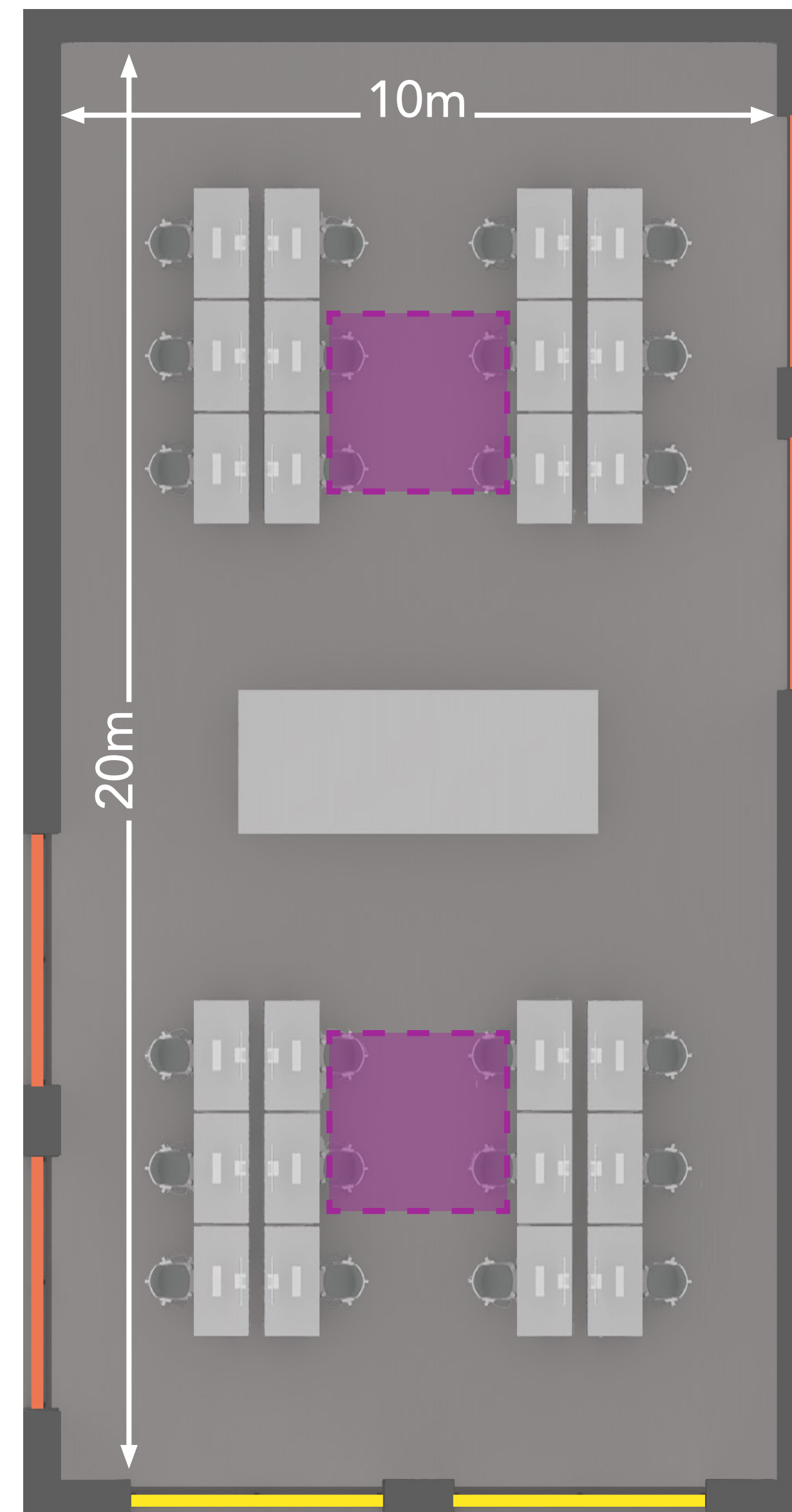
Finding glare with simulation

Adaptive sampling



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Two Levels of Detail

- Detailed (furniture and mullions)
- Simple

Materials

- specular reflections from mullions and glass and monitors
- semi-specular reflections from floor and desks

East/West Vertical Glazing

- Clear Glass (Simple and Detailed)
- Fabric Shades (Detailed)
- Louvers (Detailed)
- Stripes (Simple)

South Glazing

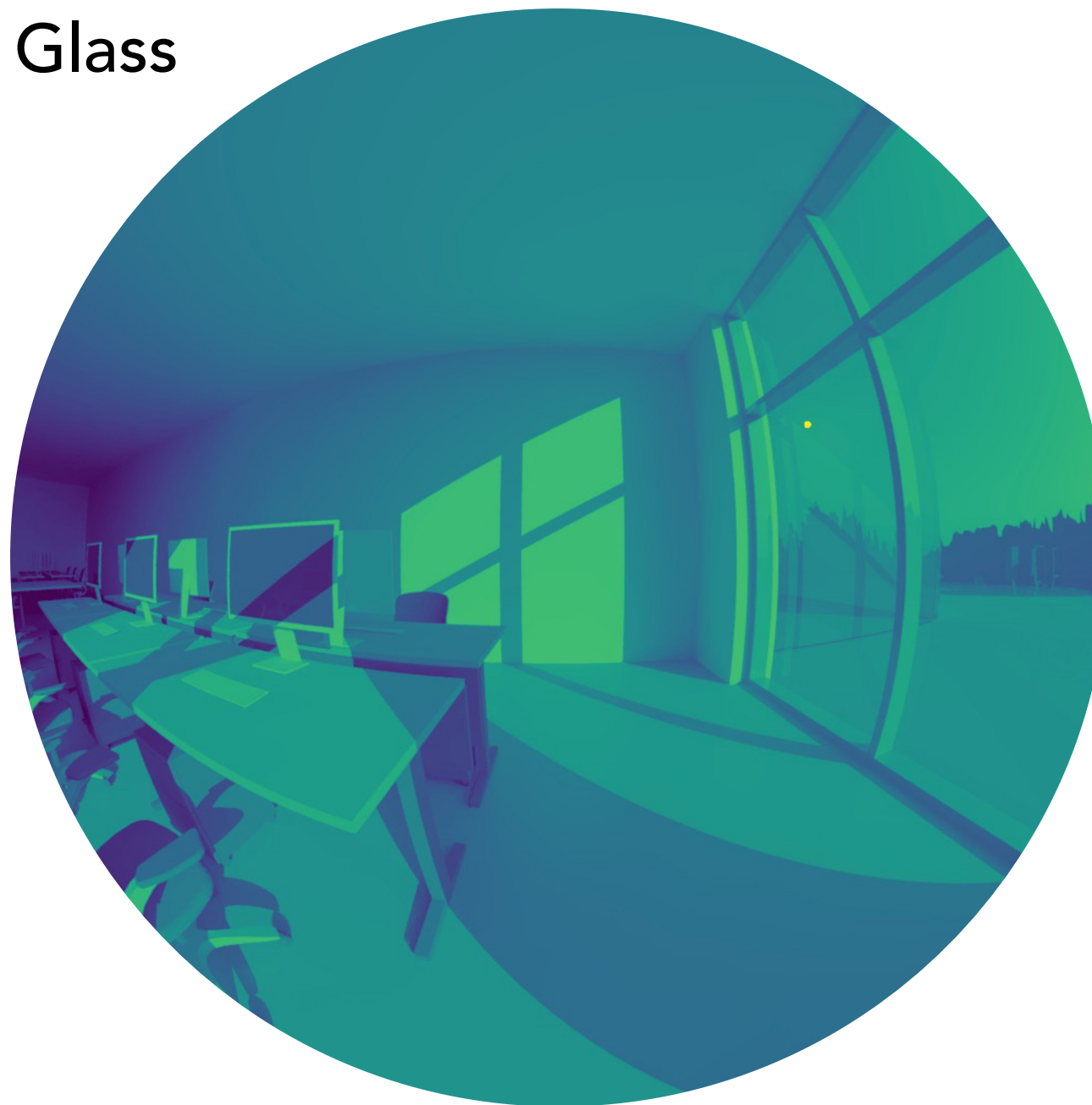
- Clear Glass (Simple and Detailed)
- Fabric Shades (Detailed)
- Louvers (Detailed)
- Stripes (Simple)
- Dots (Simple)

Skylights

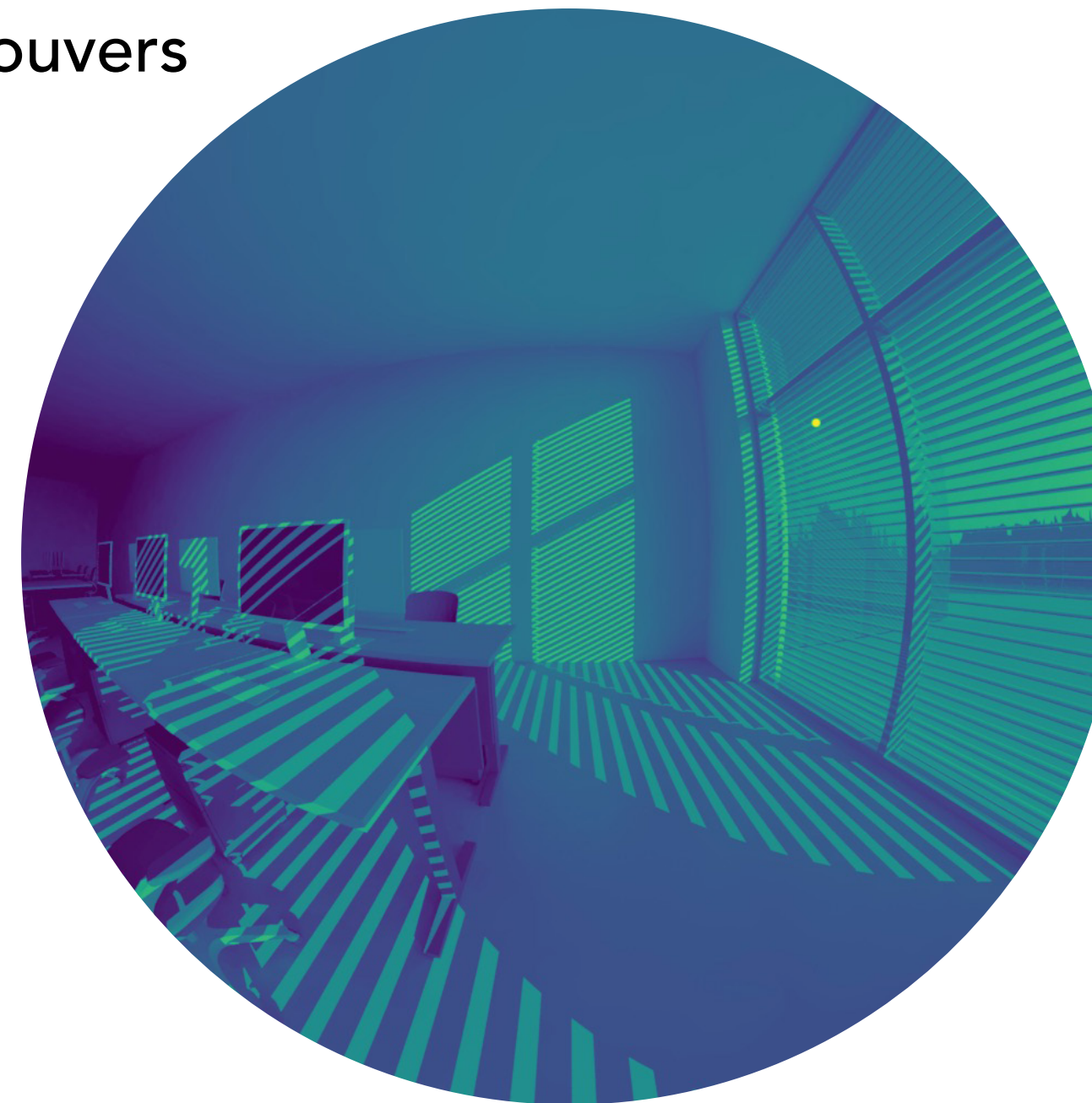
- Translucent Glass (Simple and Detailed)
- Stripes (Simple)

Geometry Options

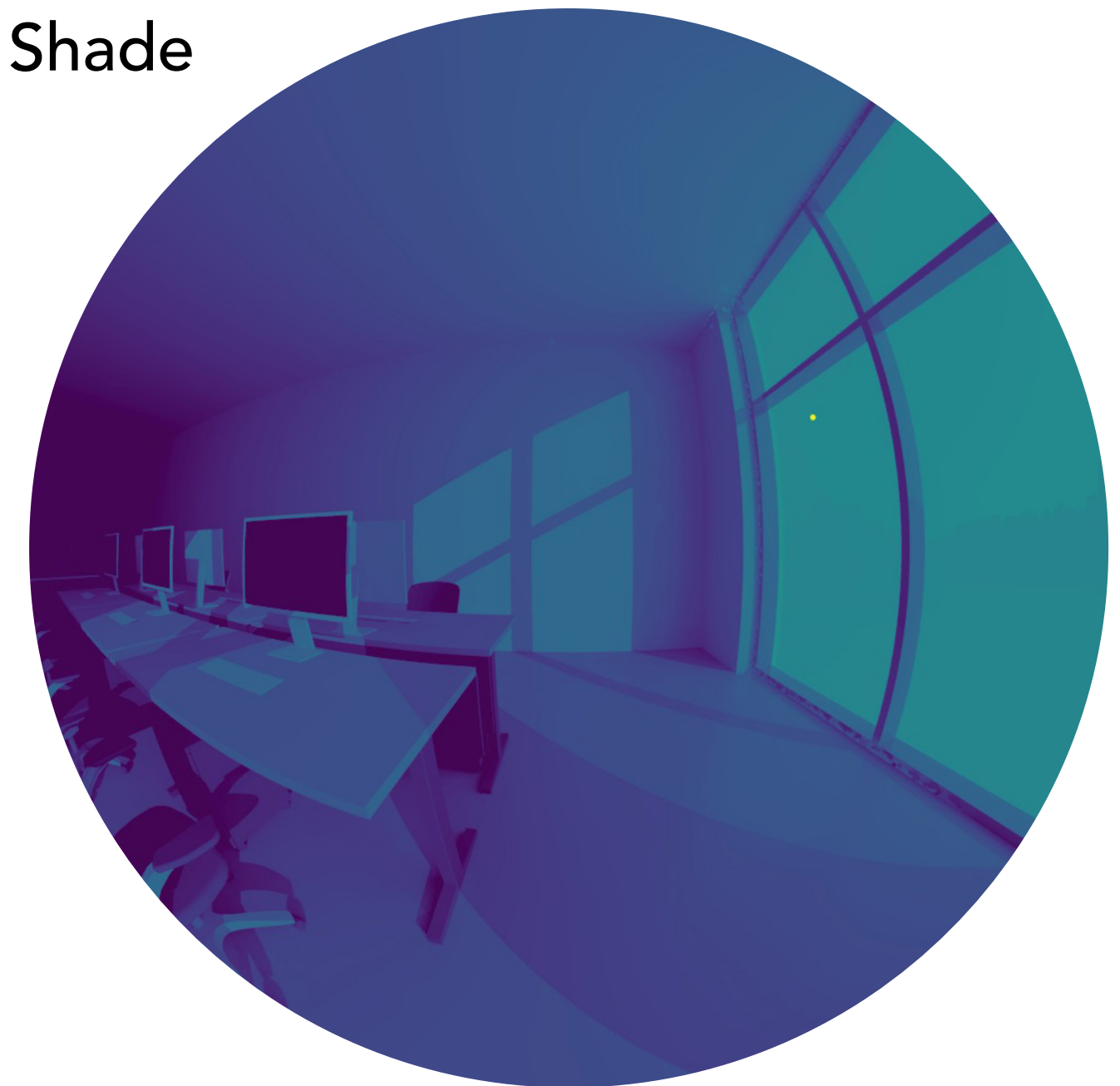
Detailed: Glass



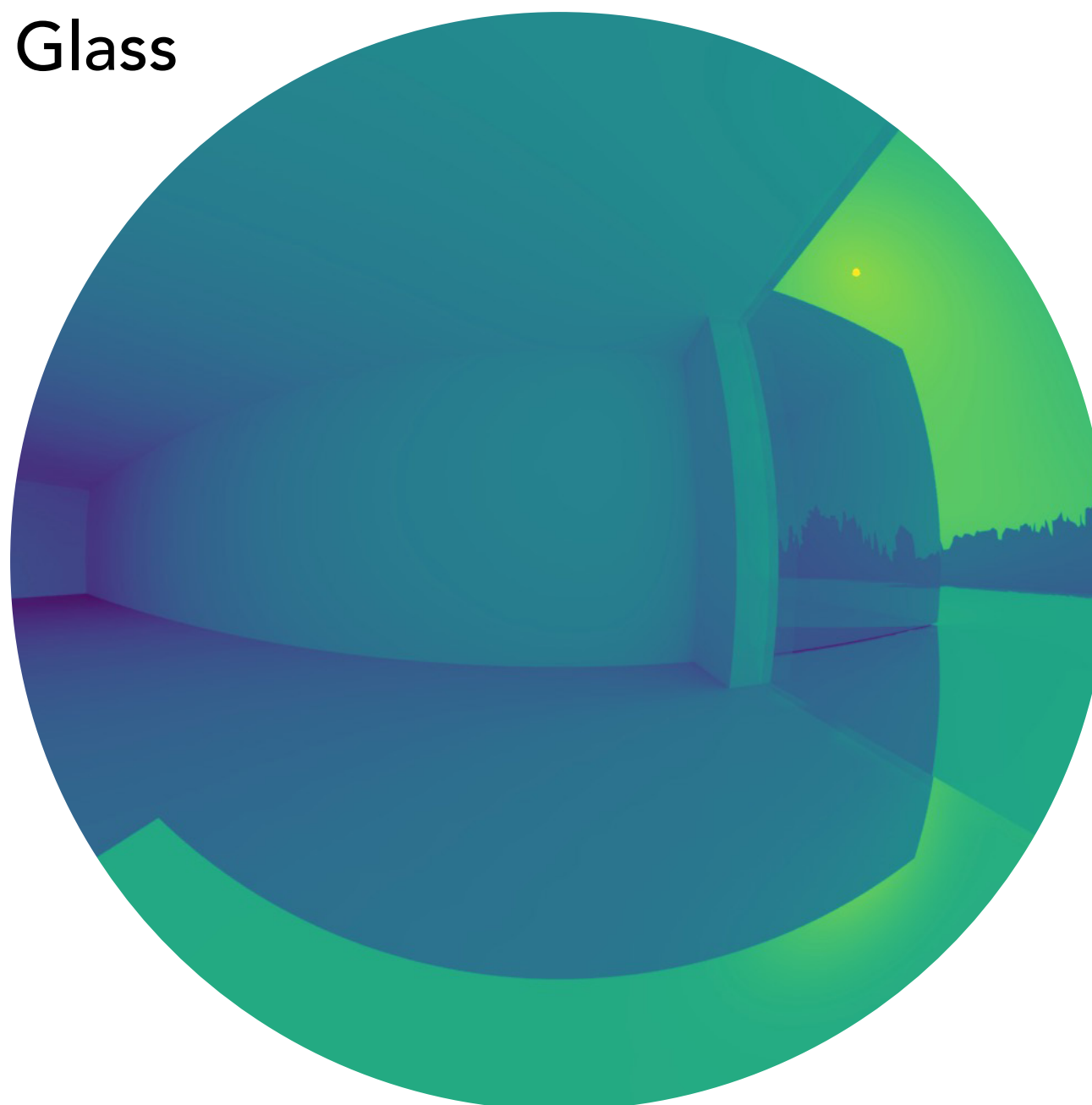
Louvers



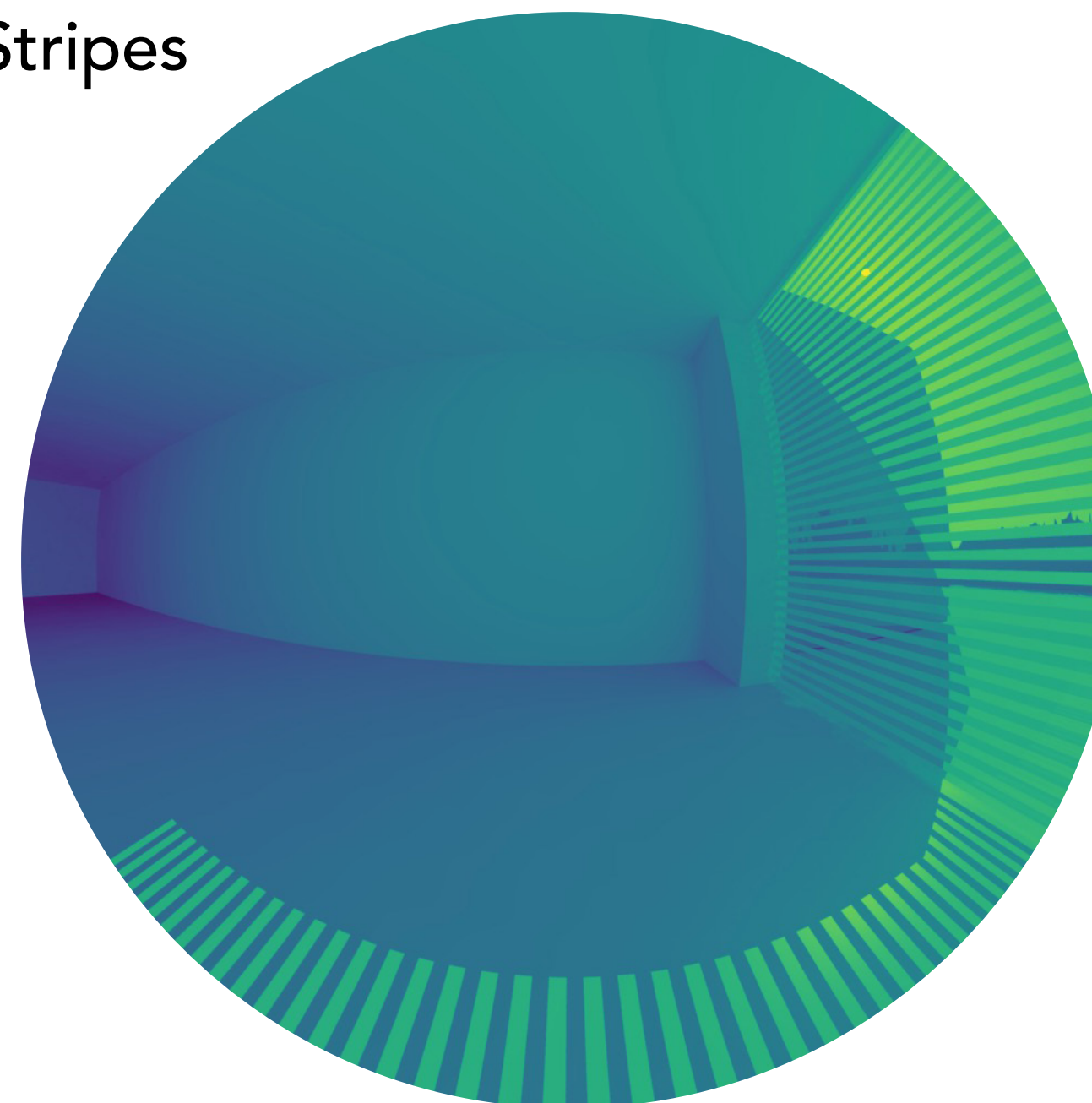
Shade



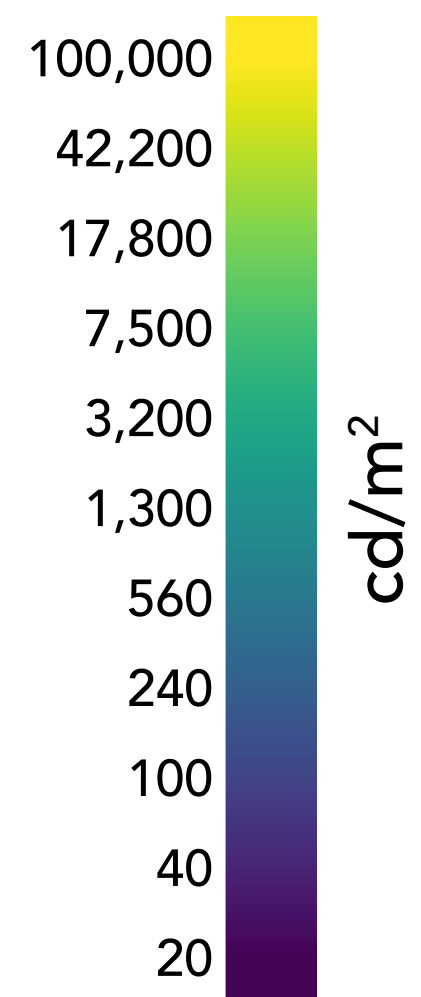
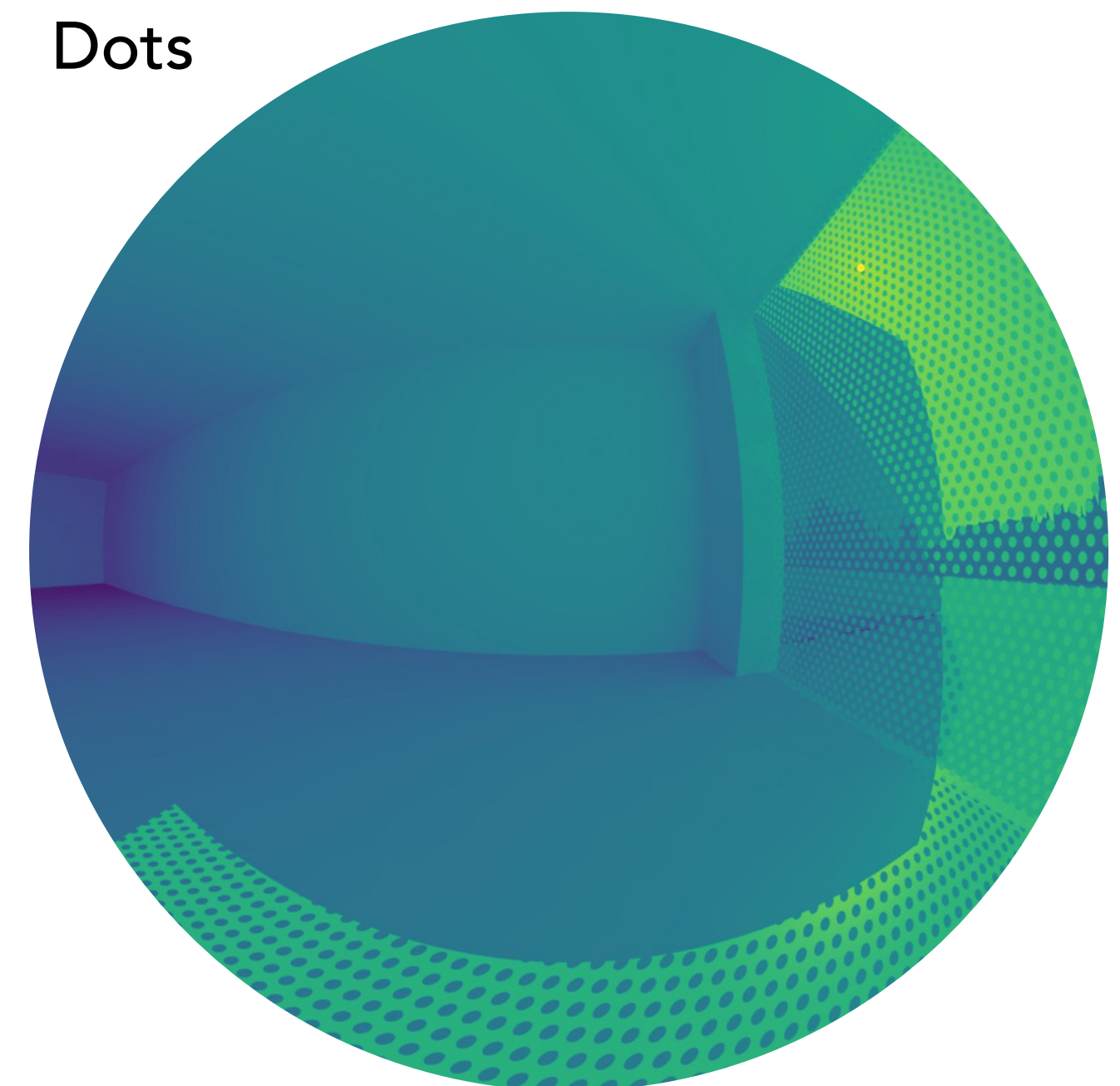
Simple: Glass



Stripes



Dots



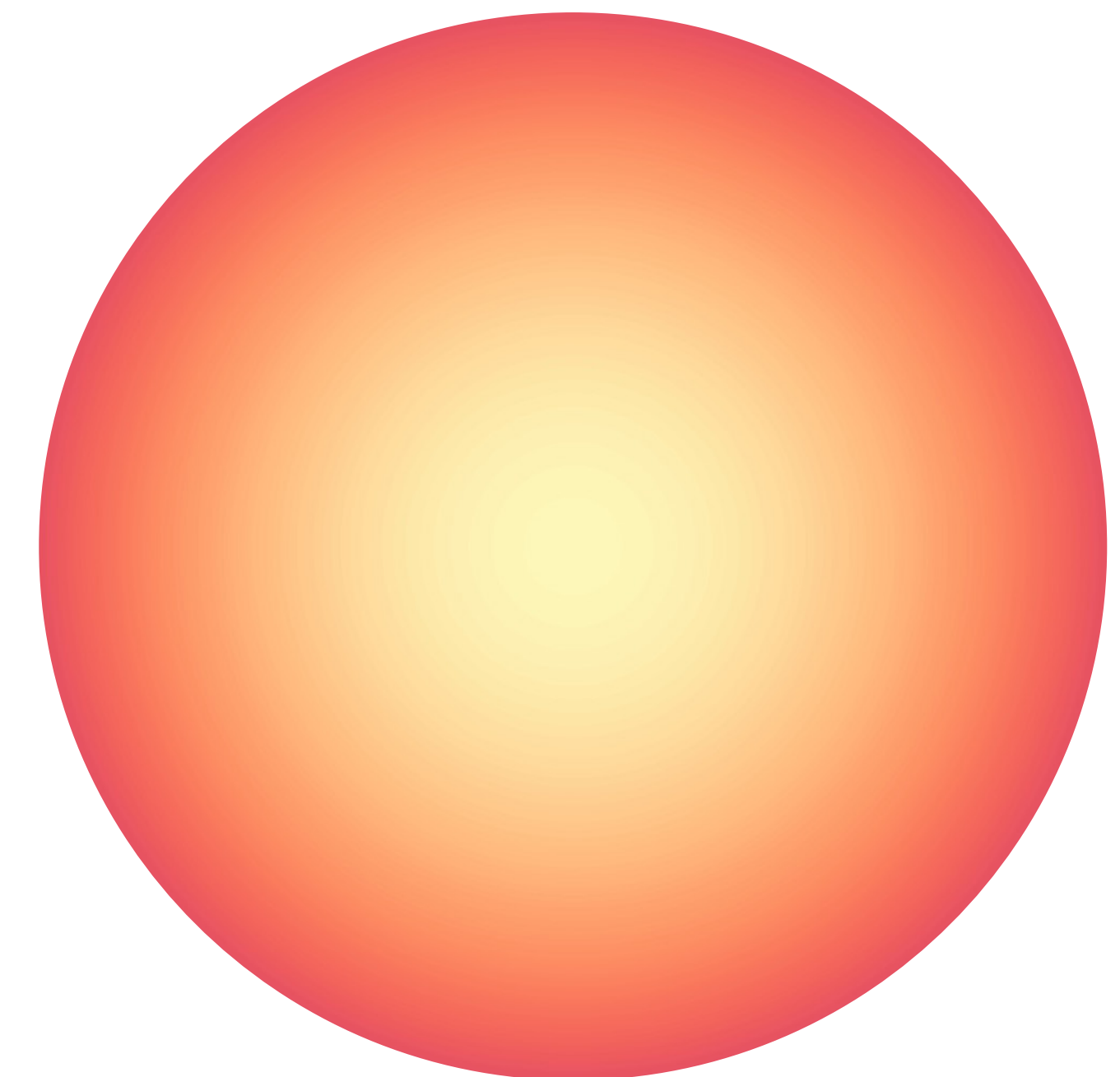
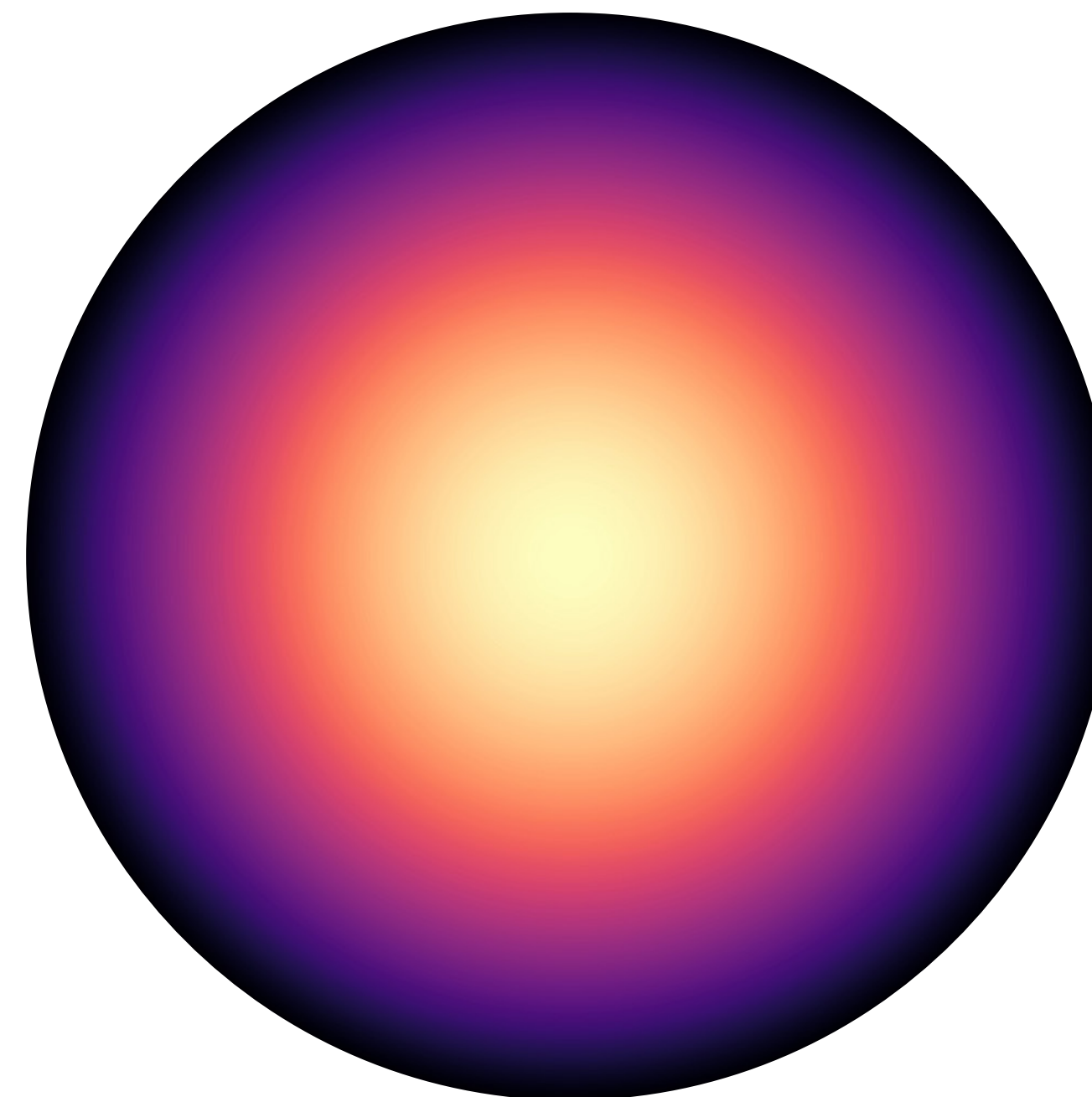
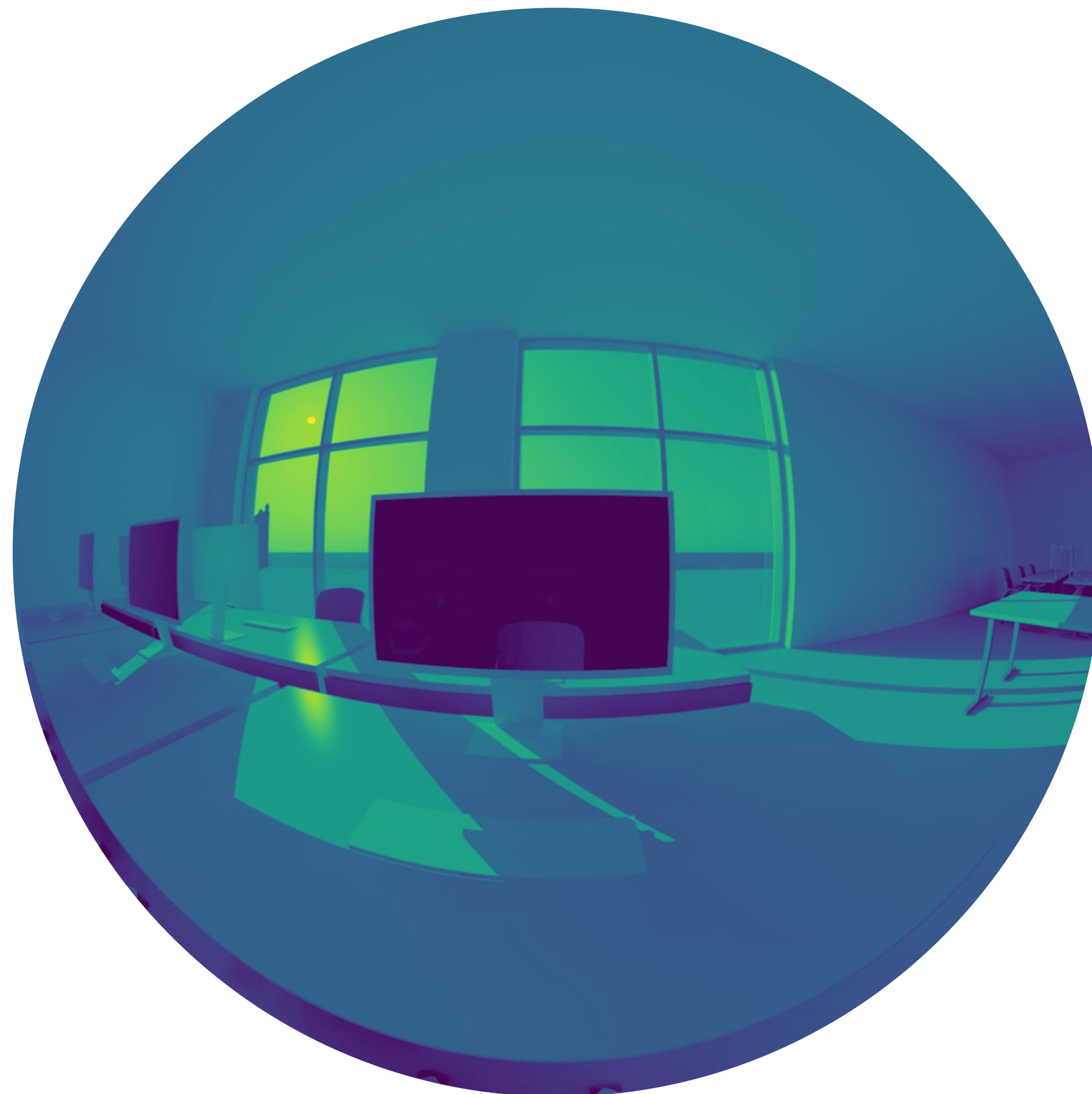
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Luminance: L_x

Position: θ, ϕ

Size: Ω



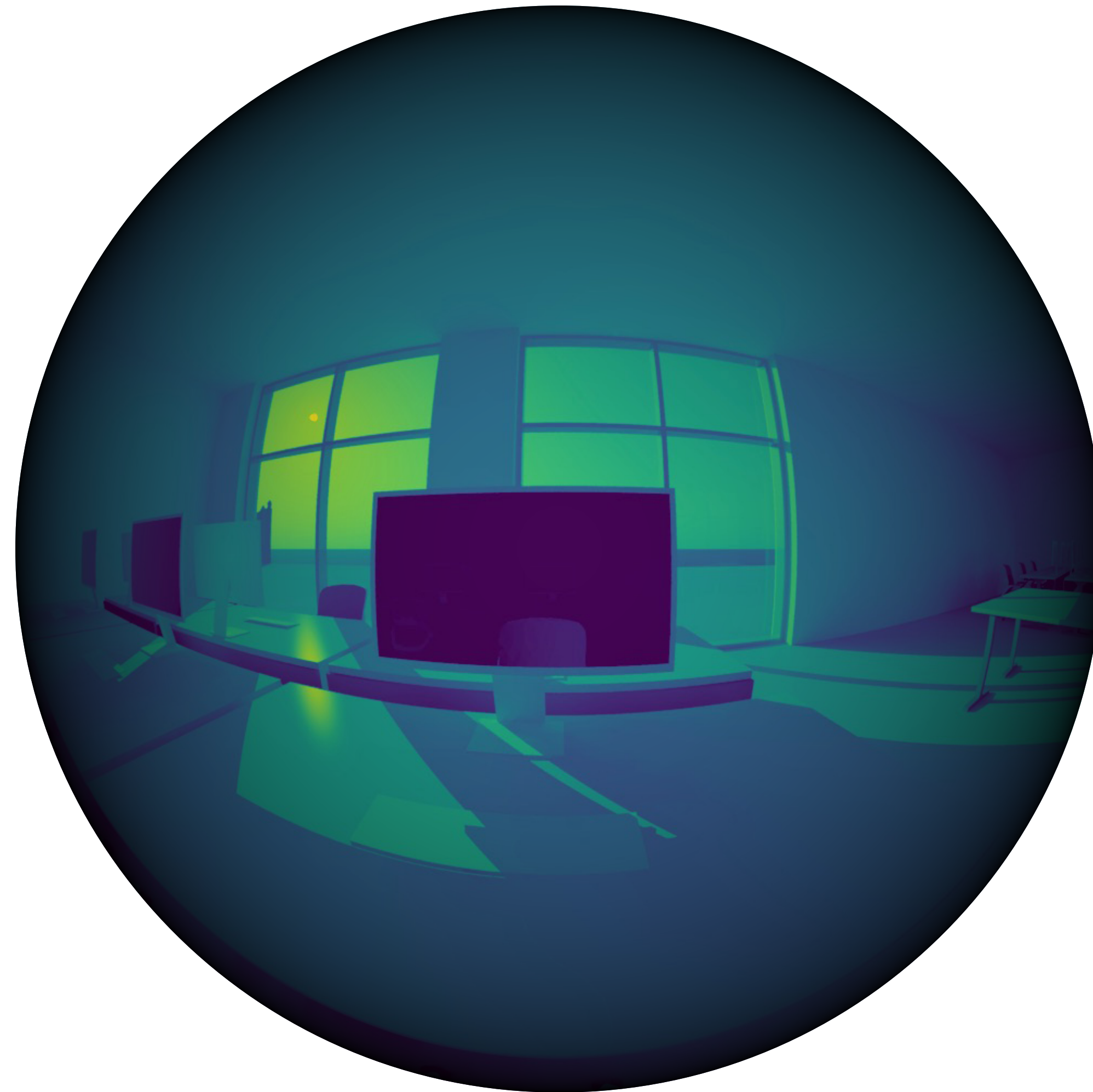
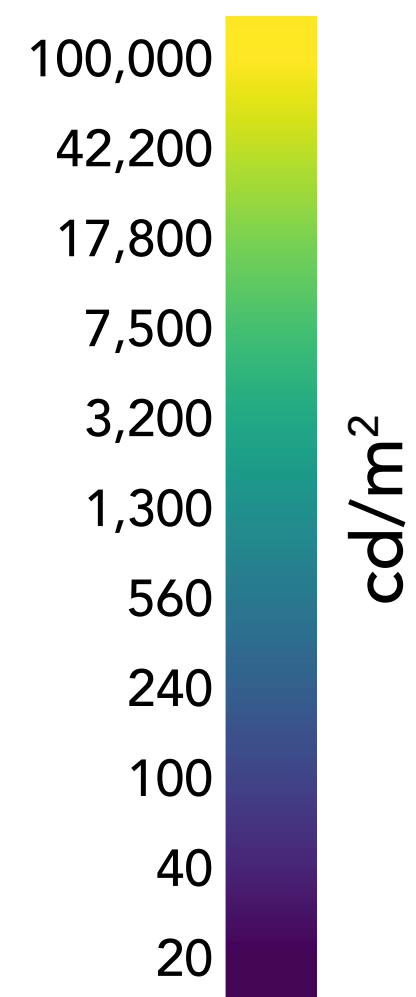
Luminance / Brightness

Location / Importance
(example: \cos / E_v)

Size / Solid Angle
(solid angle / pixel)

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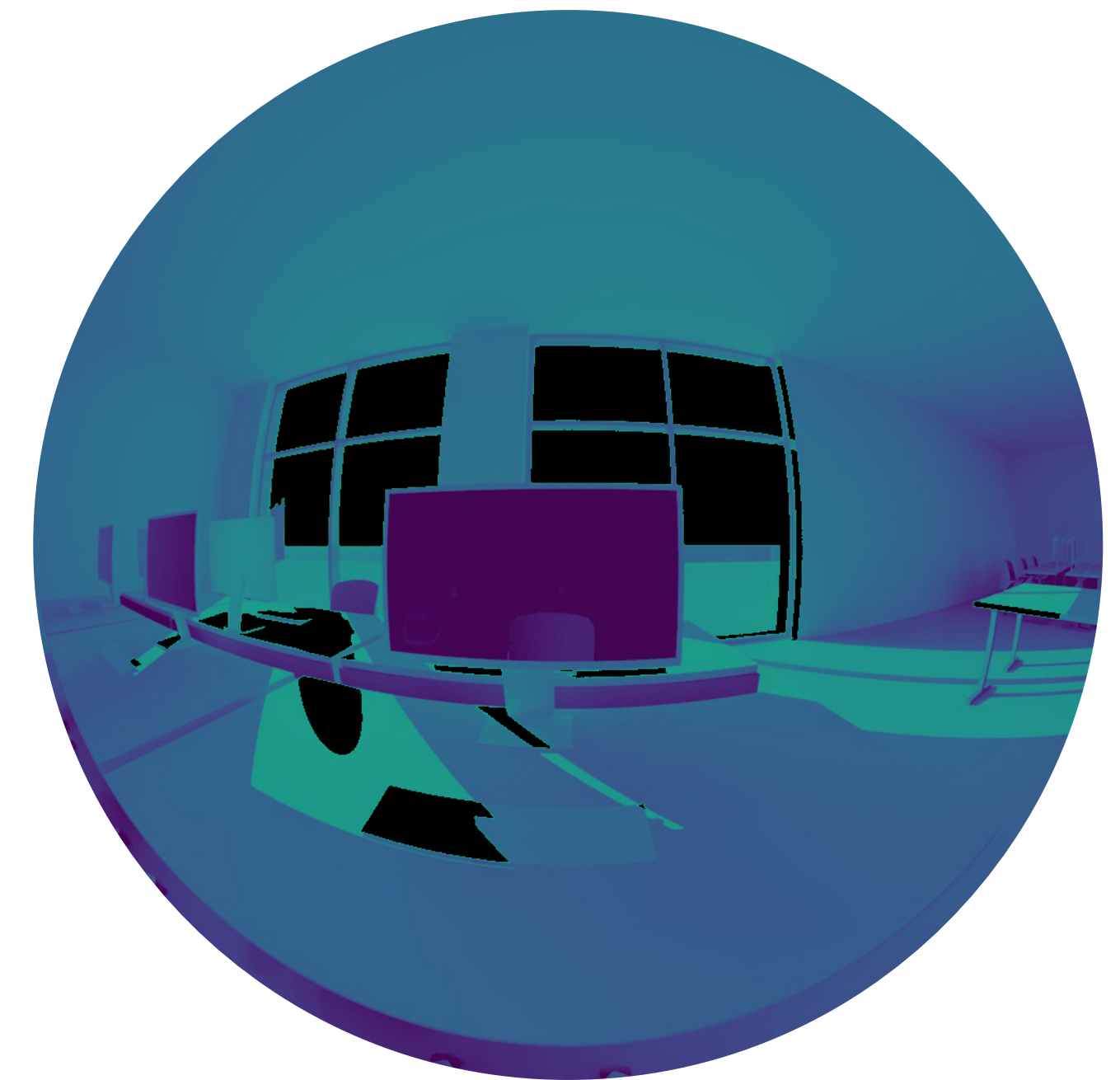
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Vertical Illuminance
Saturation / Adaptation

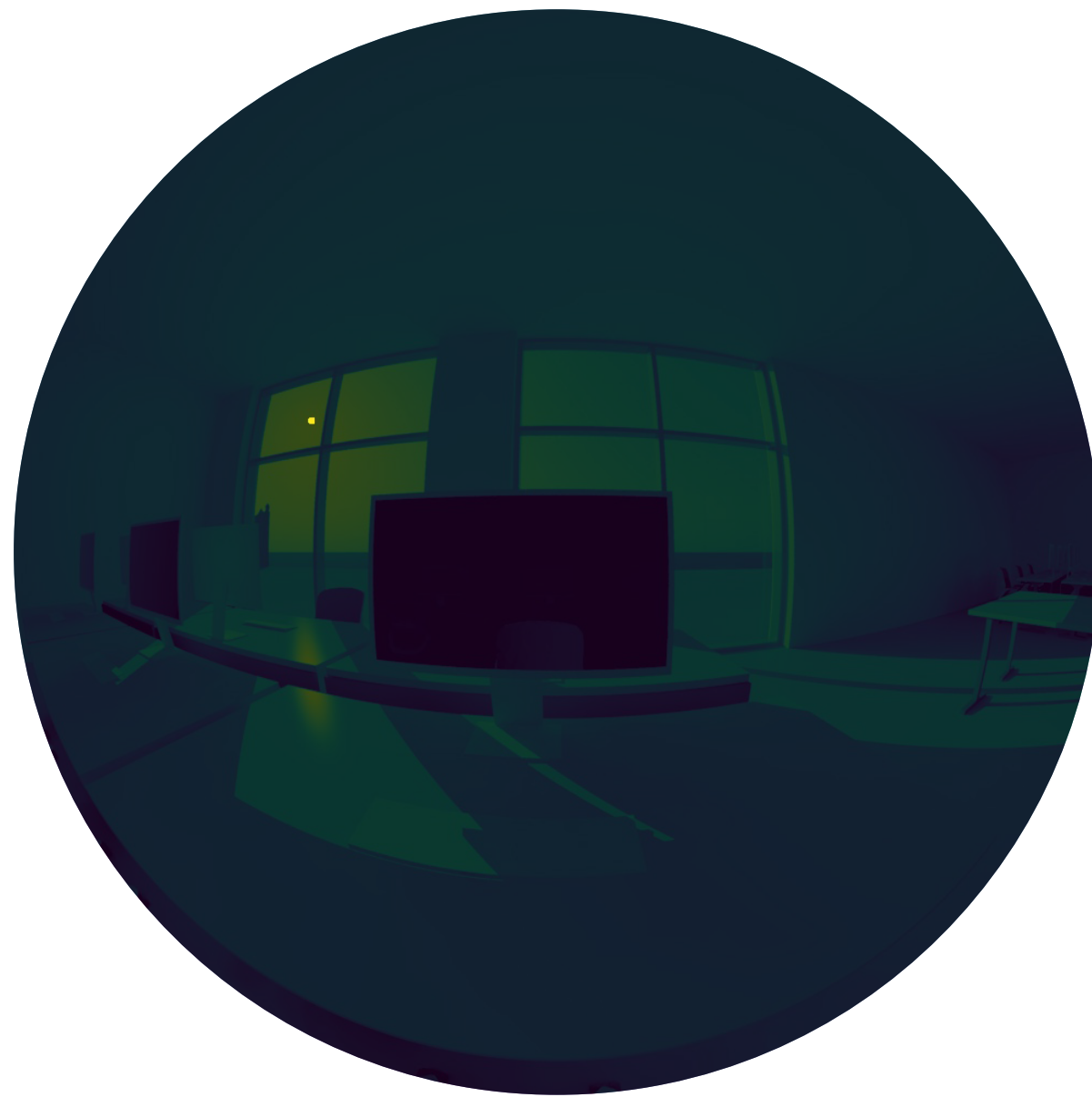


Source Lum., Direction, Size
Saturation / Contrast

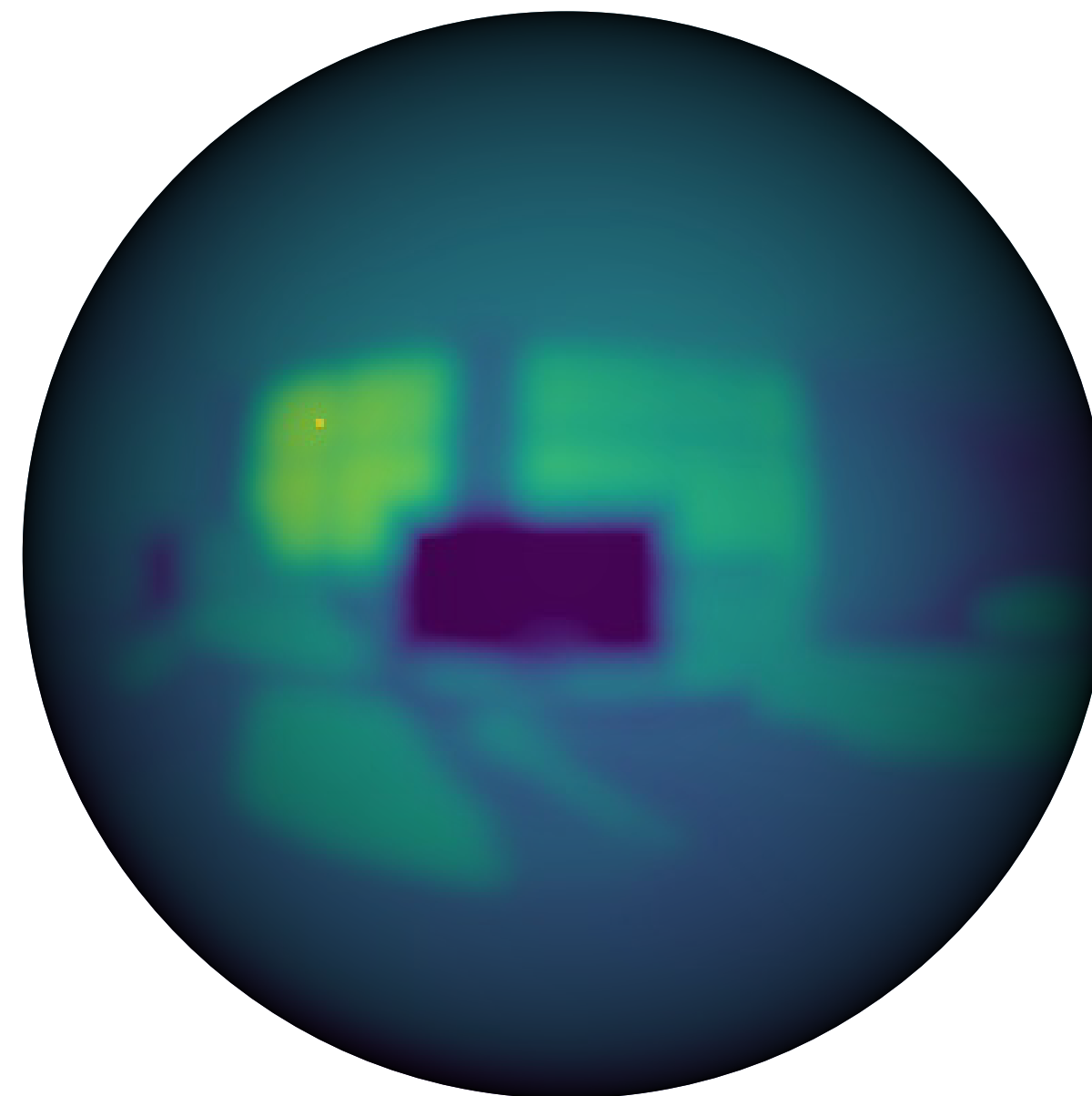


Background Luminance
Adaptation / Contrast

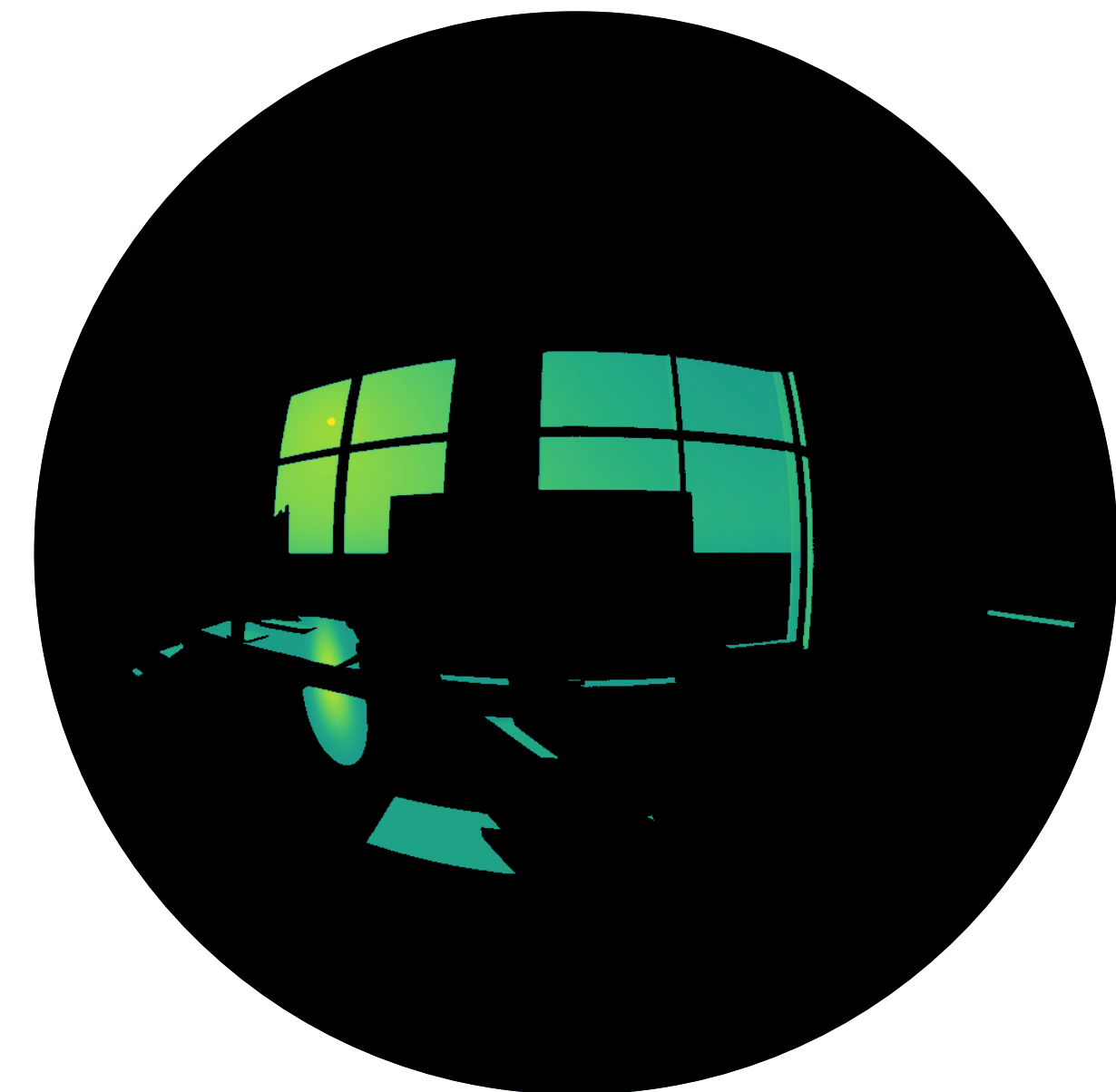
Direct Sun Detection



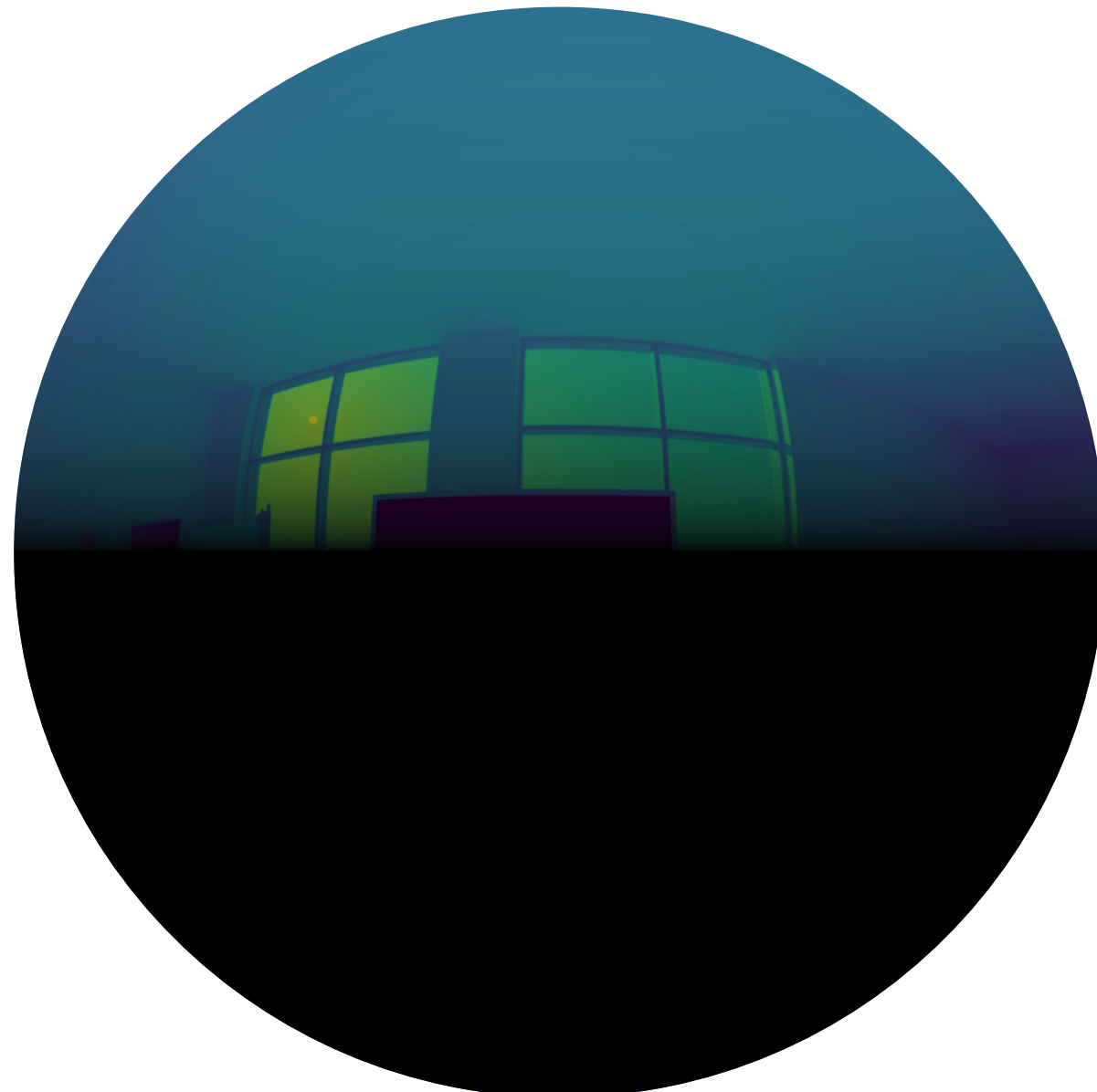
Vertical Illuminance (point)



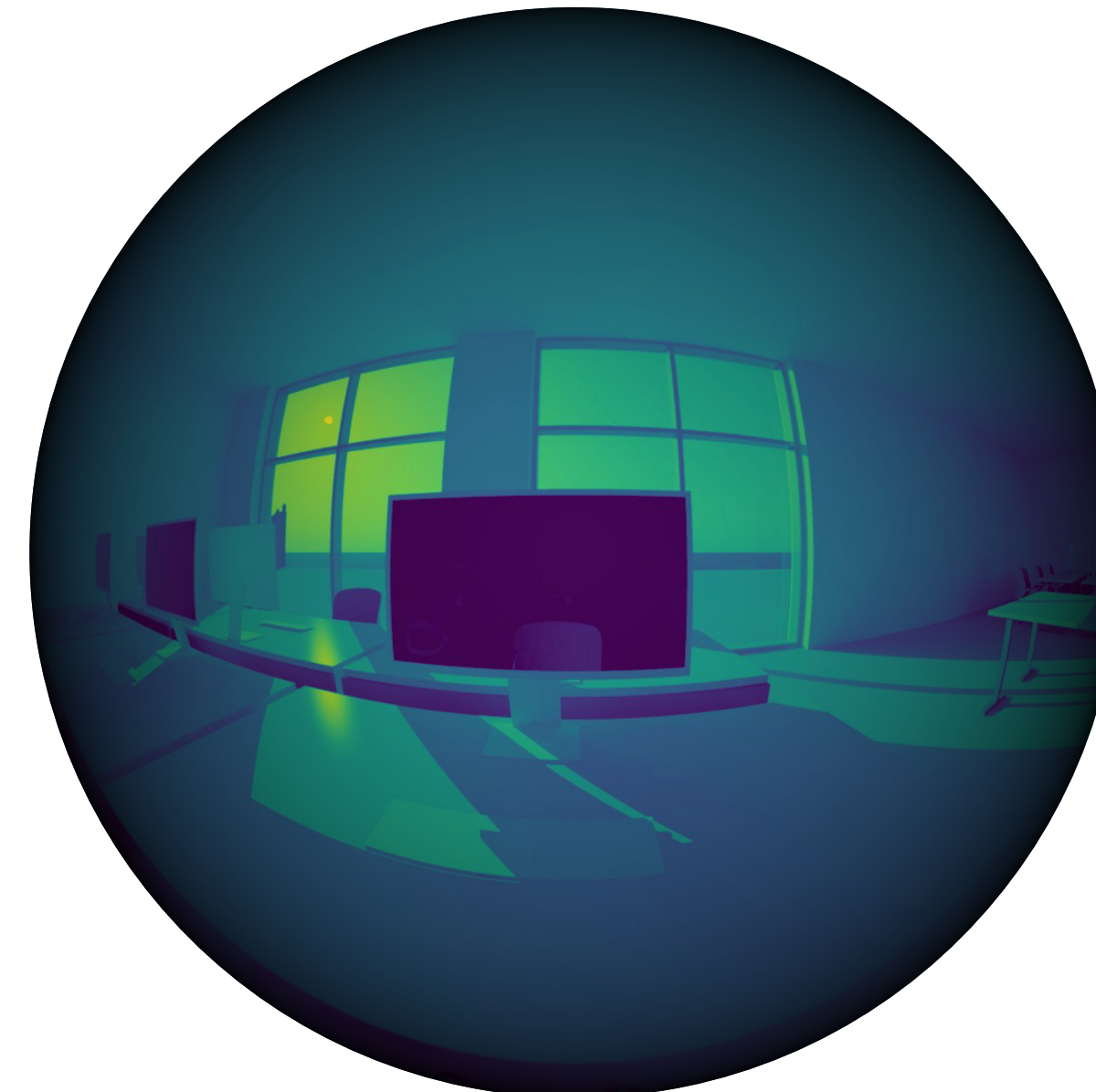
Direct View



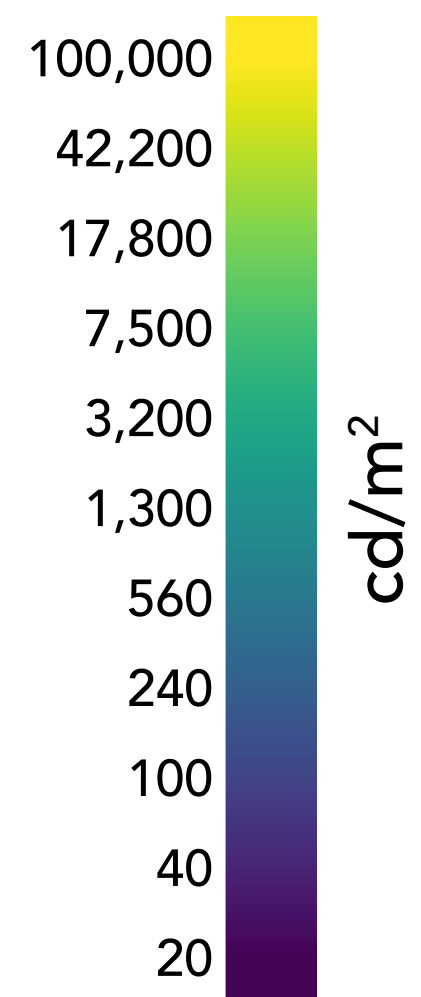
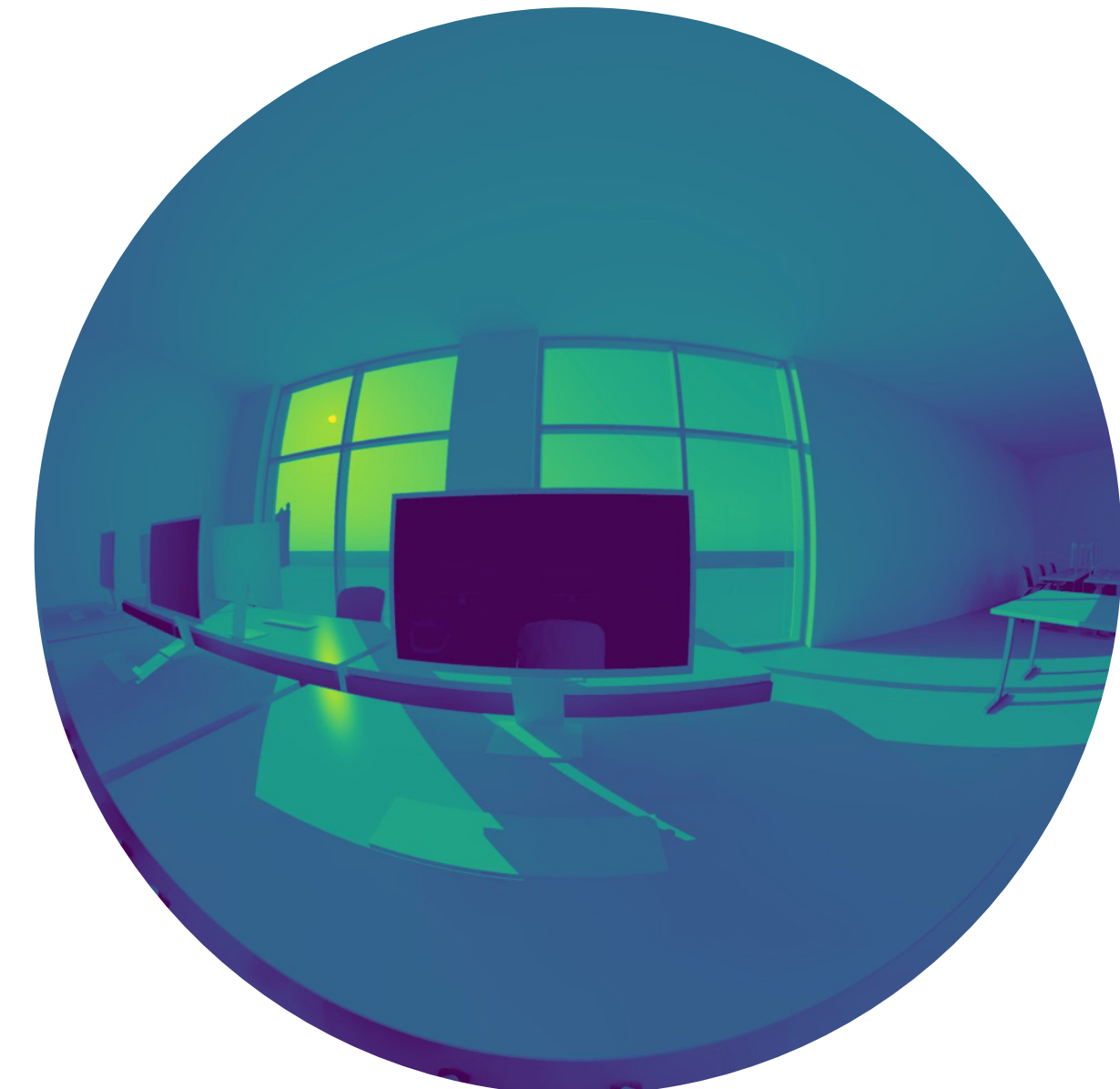
Horizontal Illuminance



Vertical Illuminance (image)



Full Luminance Map



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Finding Glare - Shades Down

Direct Sun Detection



Vertical Illuminance (point)



Direct View



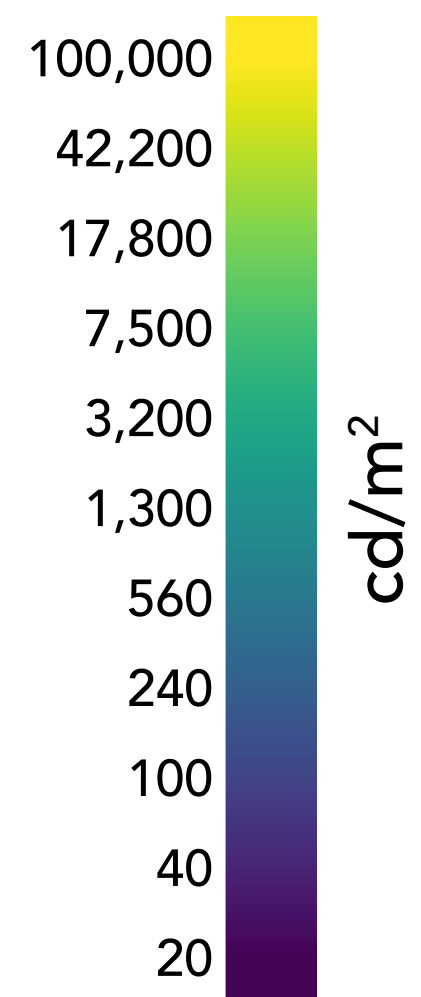
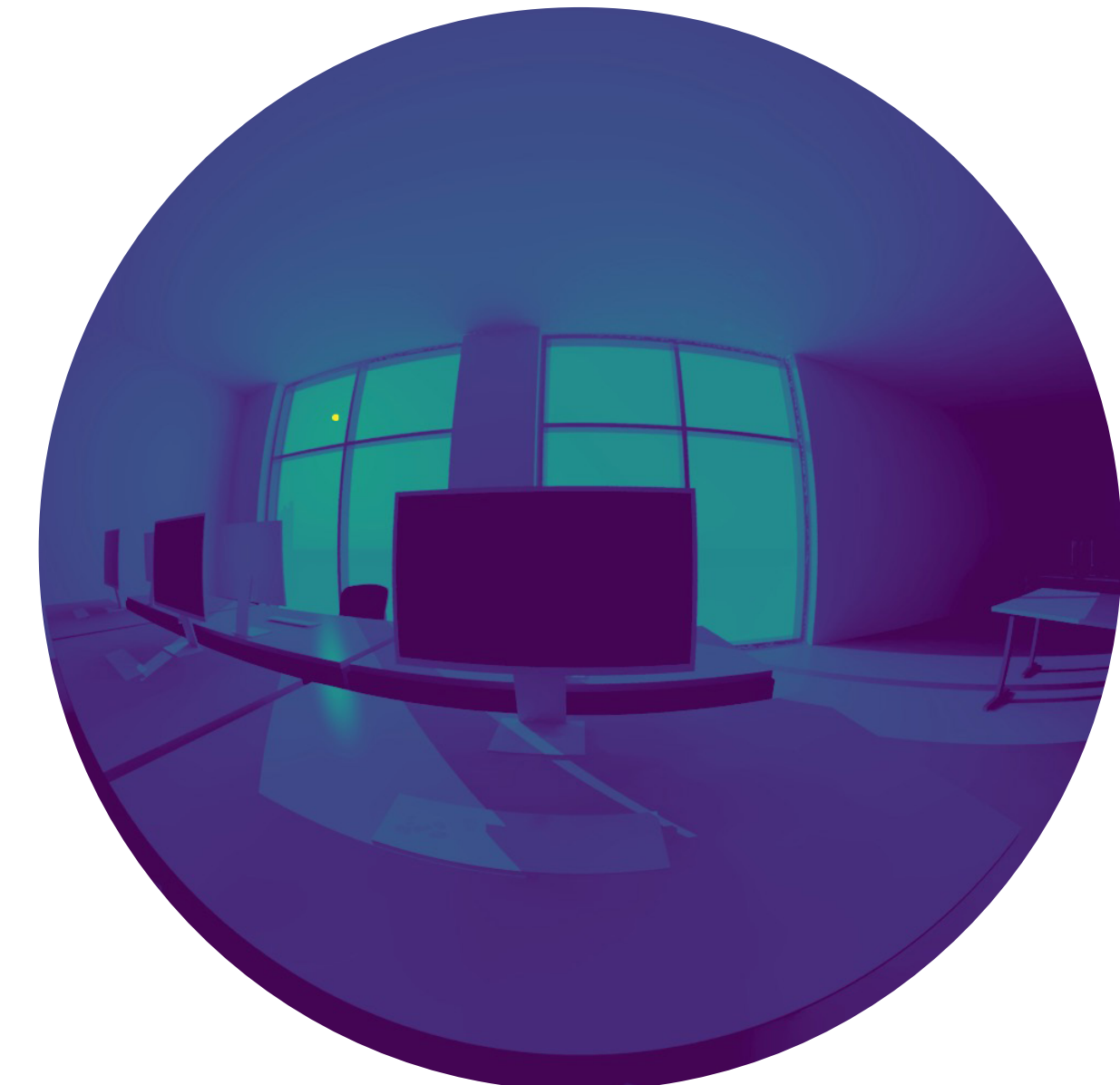
Horizontal Illuminance



Vertical Illuminance (image)



Full Luminance Map



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Finding Glare - Contrast Dominated

Direct Sun Detection



Vertical Illuminance (point)



Direct View



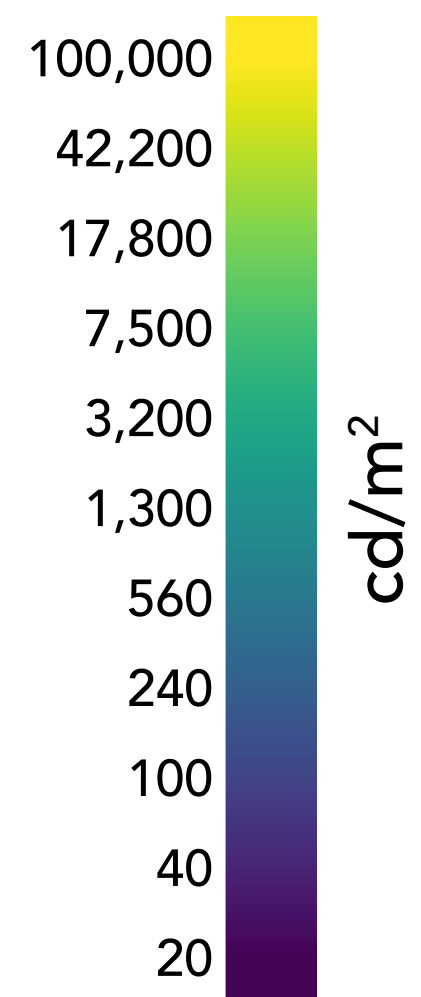
Horizontal Illuminance



Vertical Illuminance (image)



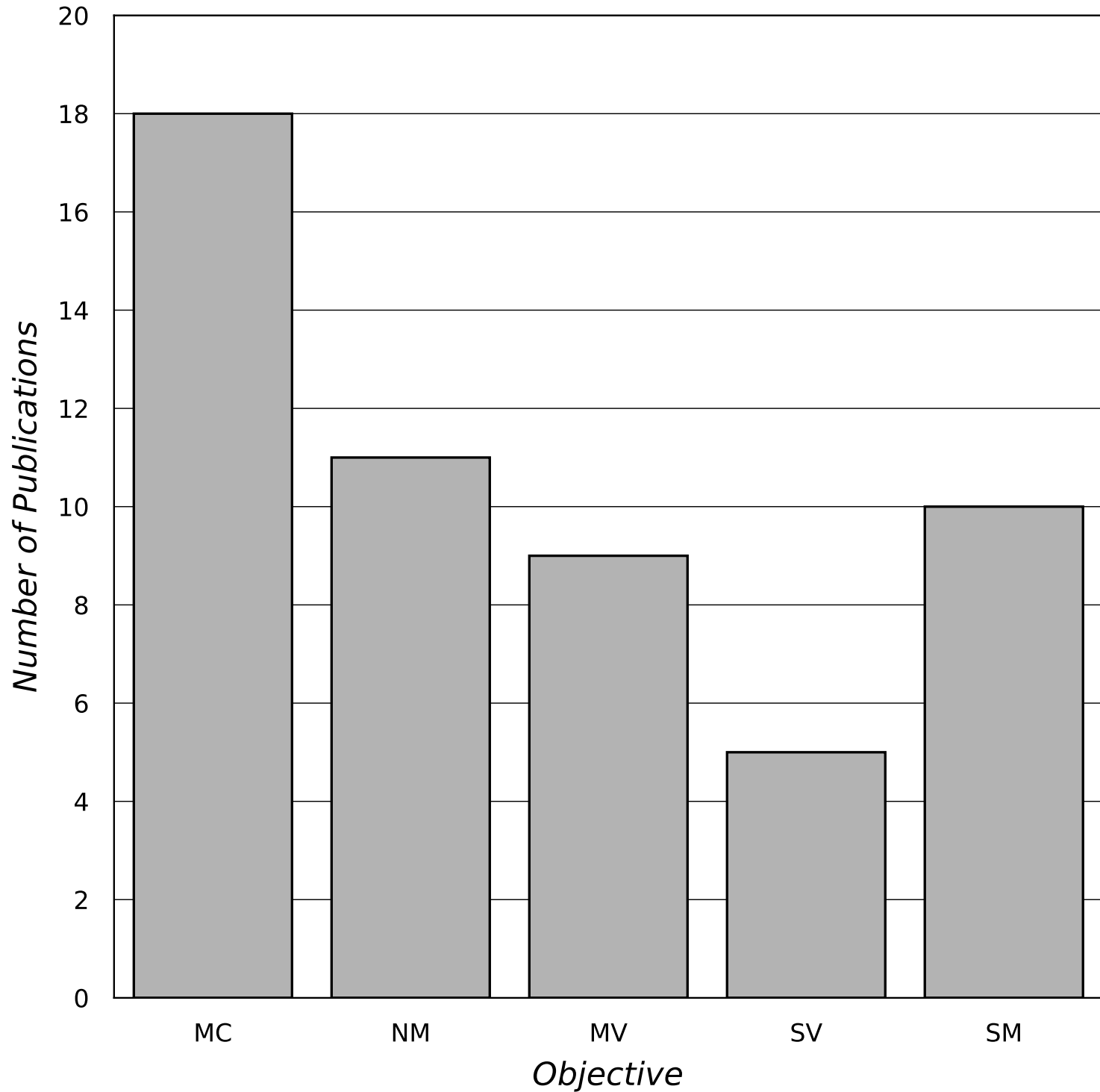
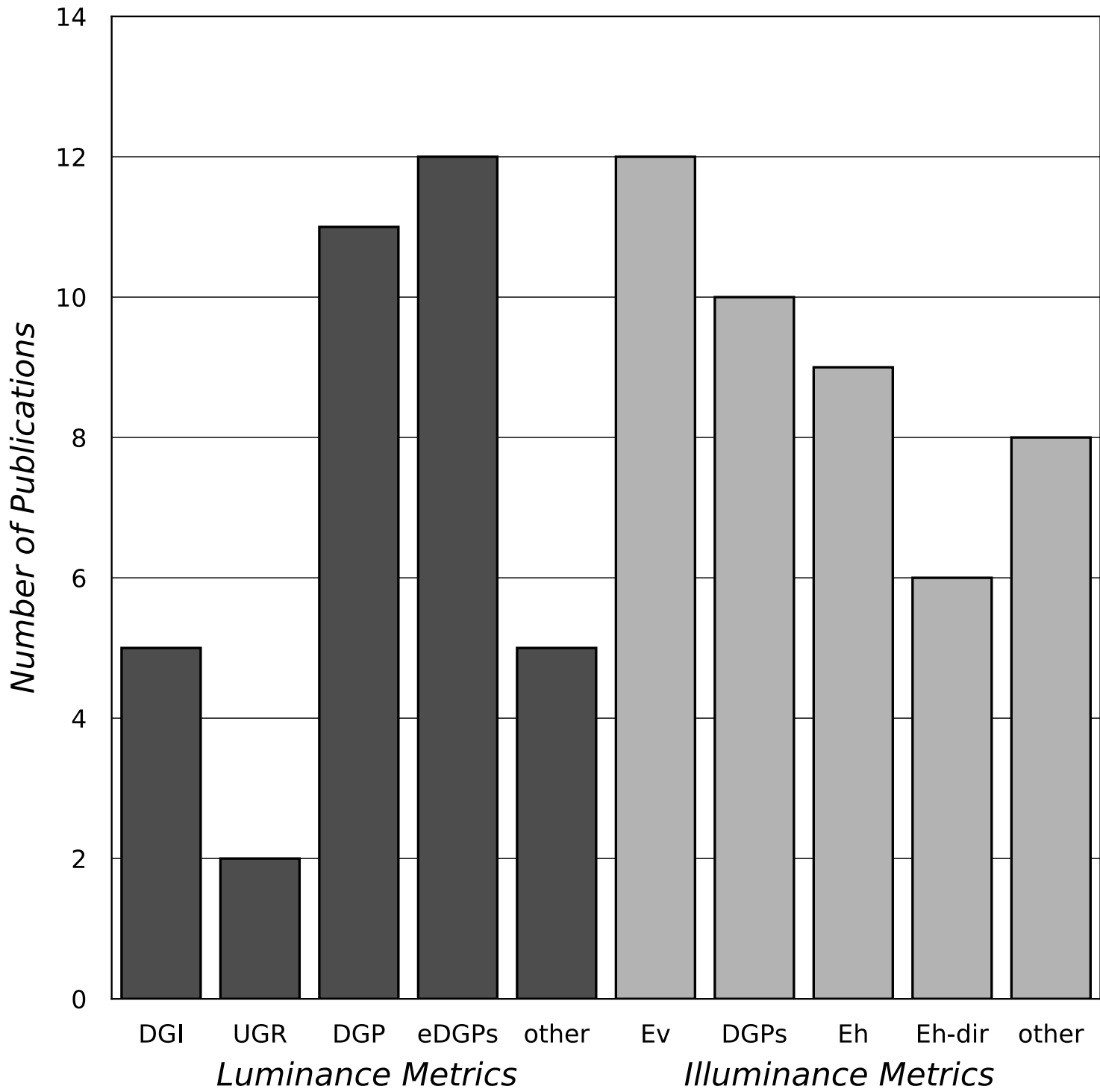
Full Luminance Map



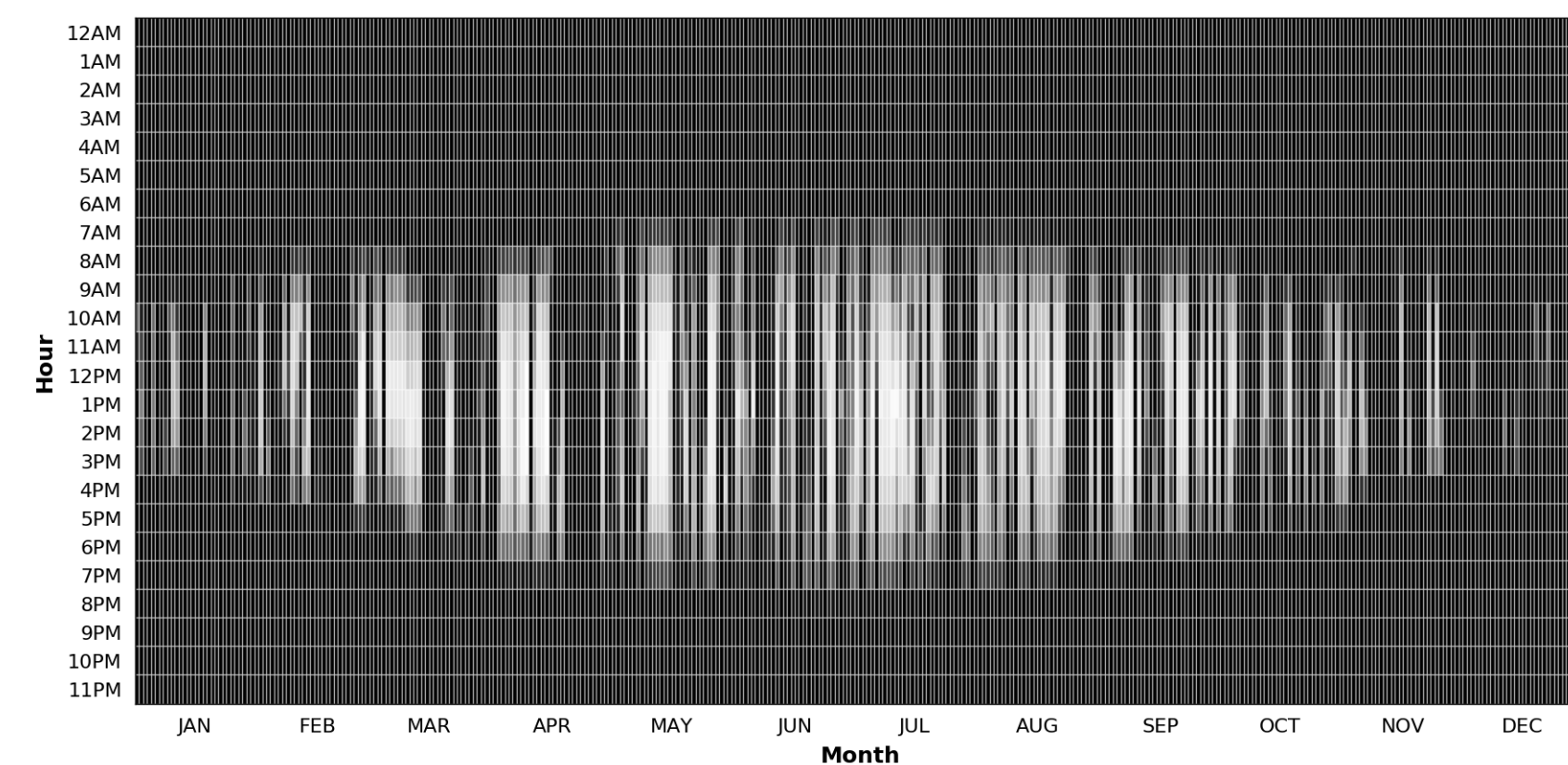
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study	author (year)
1	Wienold (2007)
2	Wienold (2009)
3a	Jakubiec and Reinhart (2011)
3b	Jakubiec and Reinhart (2011)
4	Mardaljevic et al. (2012)
5	Chan and Tzempelikos (2013)
6	Konstantzos et al. (2015)
7a	Torres and Verso (2015)
7b	Torres and Verso (2015)
8	Mcneil and Burrell (2016)
9	Atzeri et al. (2016)
10	Jakubiec and Reinhart (2016)
11	Konstantzos and Tzempelikos (2017)
12	Jones and Reinhart (2017)
13	Atzeri et al. (2017)
14	Dutra de Vasconcellos (2017)
15	Garcia-Hansen et al. (2017)
16	Nezamdoost and Wymelenberg (2017)
17	Tsianaka (2018)
18	Jakubiec et al. (2018)
19	Jakubiec (2018)
20	Kong et al. (2018)
21	Bian (2018)
22	Bian et al. (2018)
23a	Santos and Caldas (2018)
23b	Santos and Caldas (2018)
24	Giovannini et al. (2018)
25	Abravesh et al. (2019)
26	Zomorodian and Tahsildoost (2019)



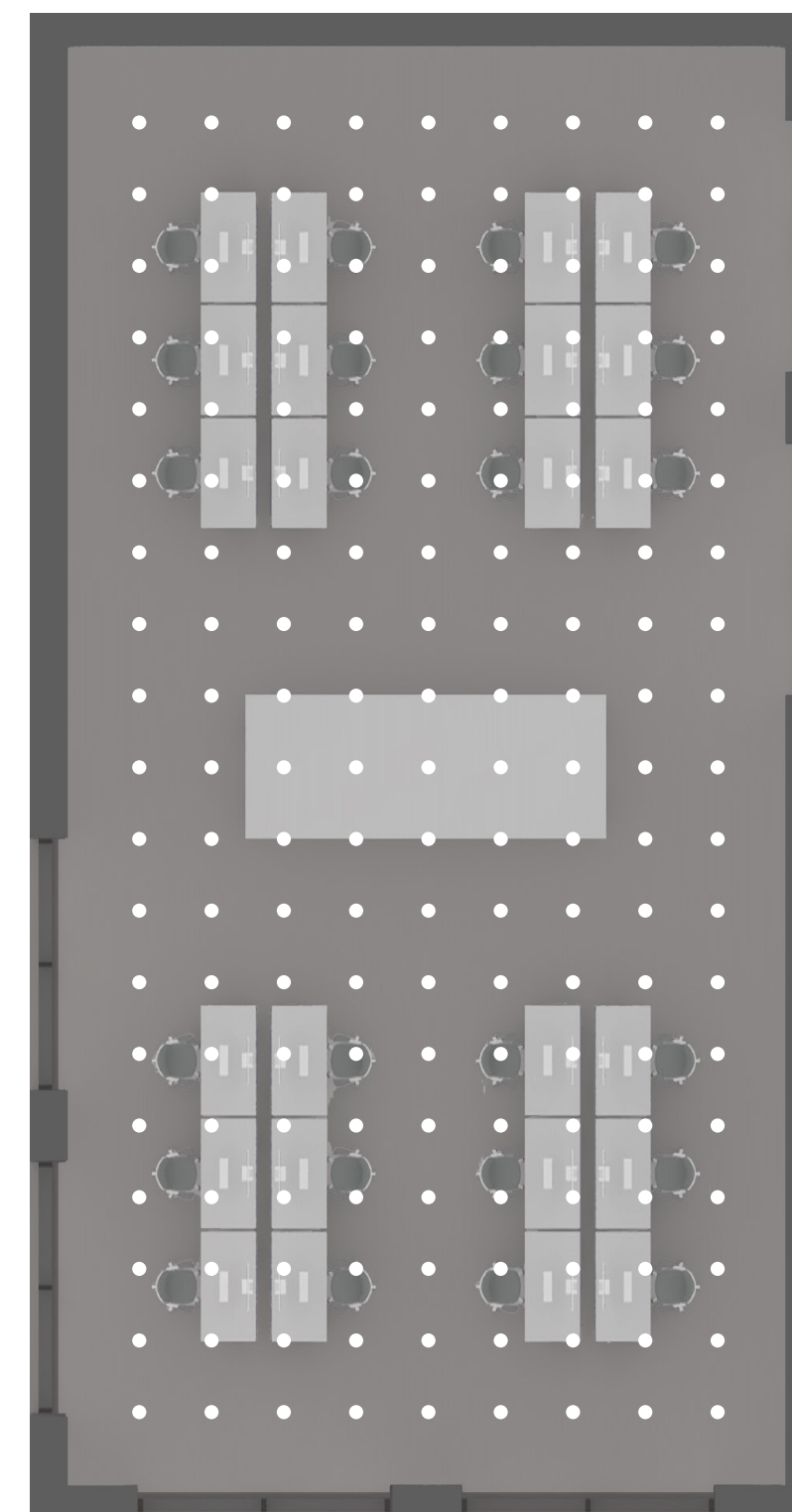
Time / Sun Position



Size: ~4000 hours

Resolution: 5 min to 1 hour (22/29)

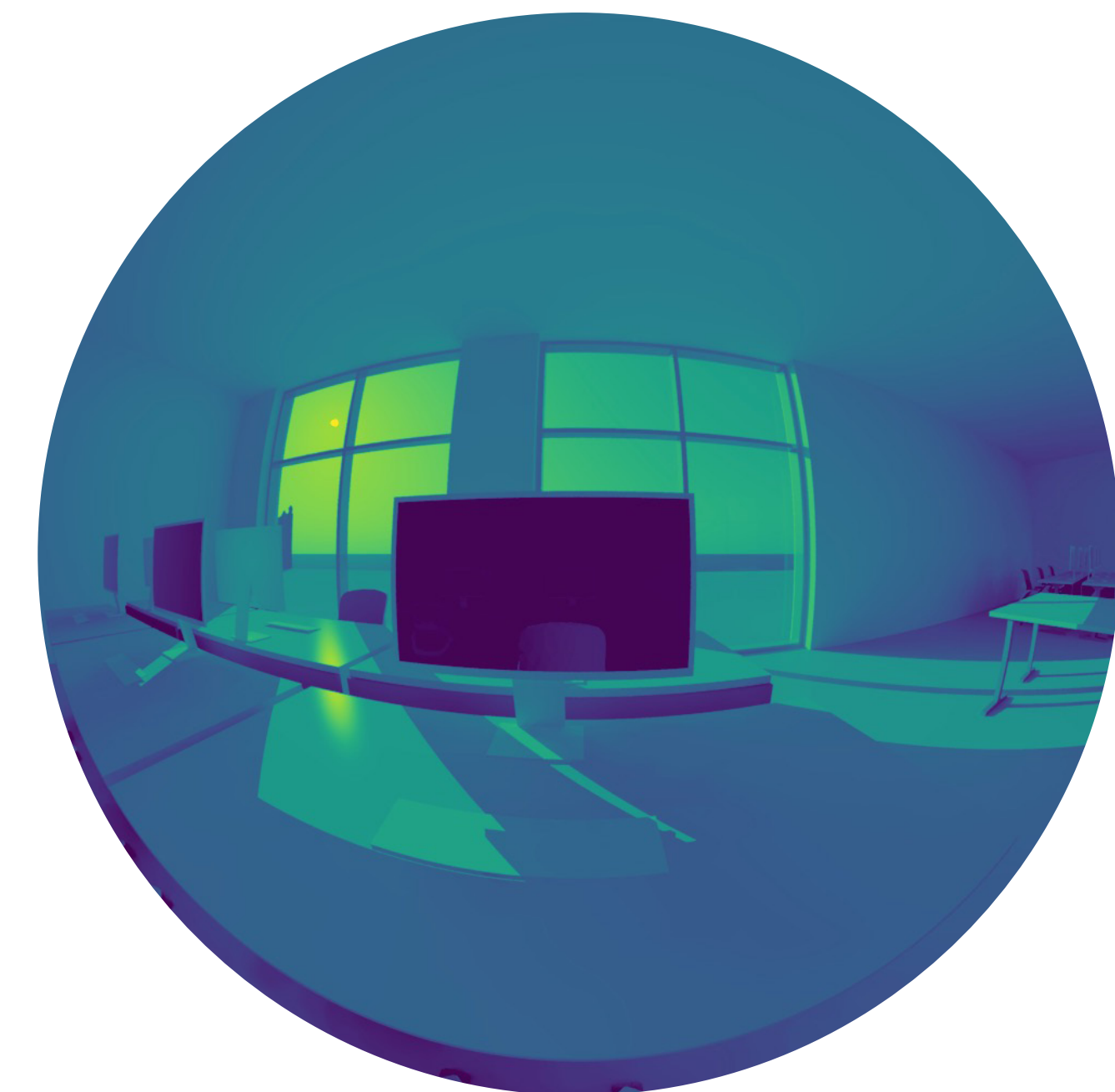
Position: x, y, (z)



Size at 0.5 meters: 684 points

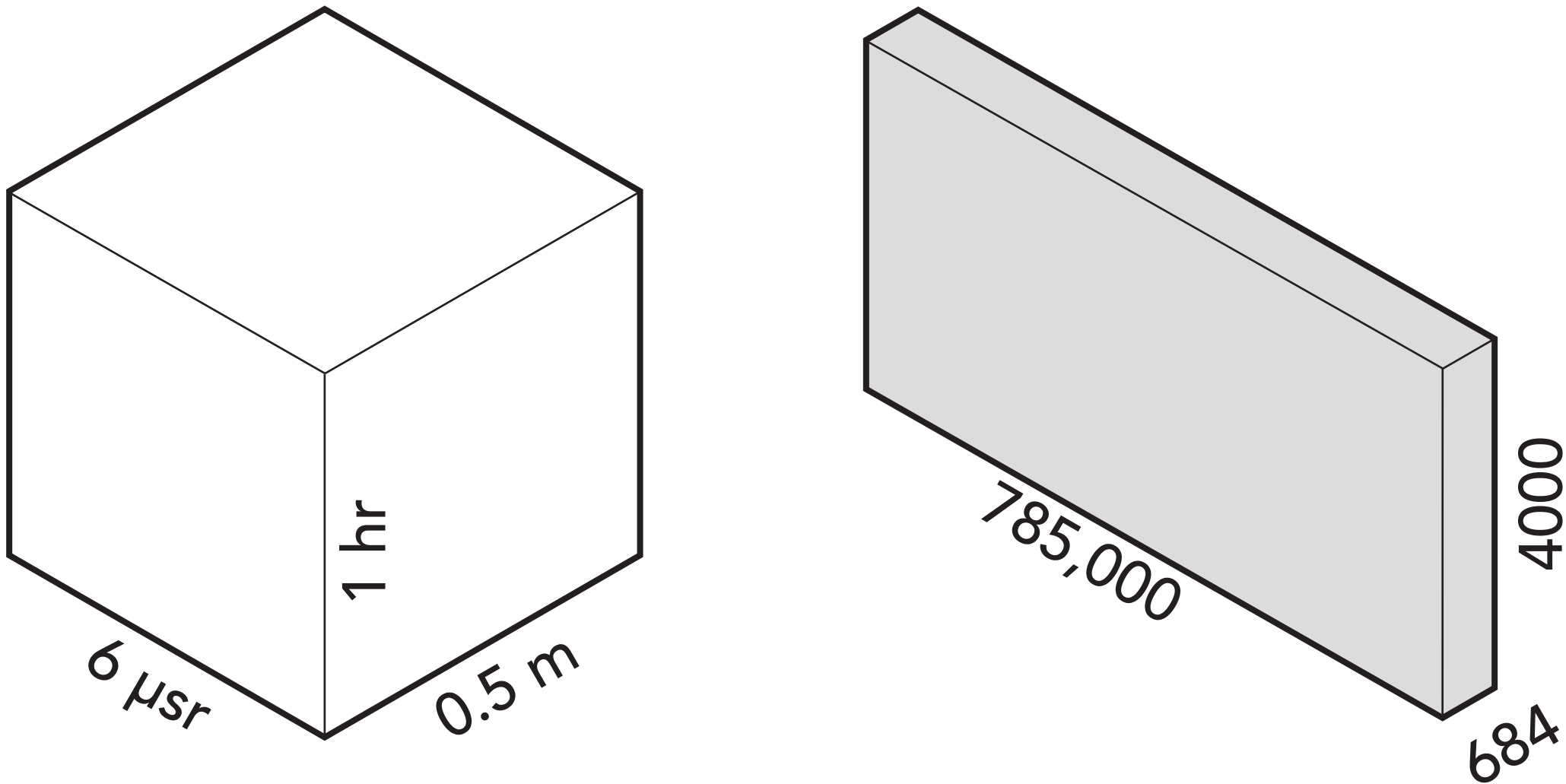
Among Studies including a regular grid, 0.25-1 meter

Direction: θ , ϕ

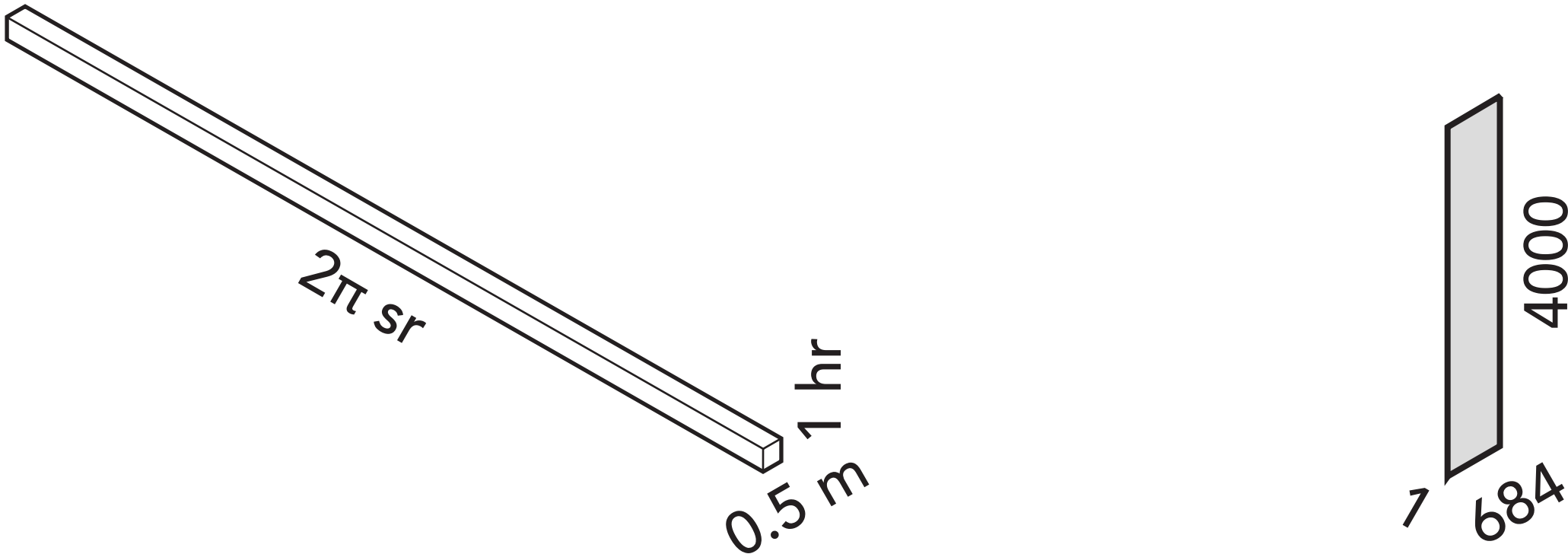


Recommended size for evalglare: 1000x1000 pixels (785,000)

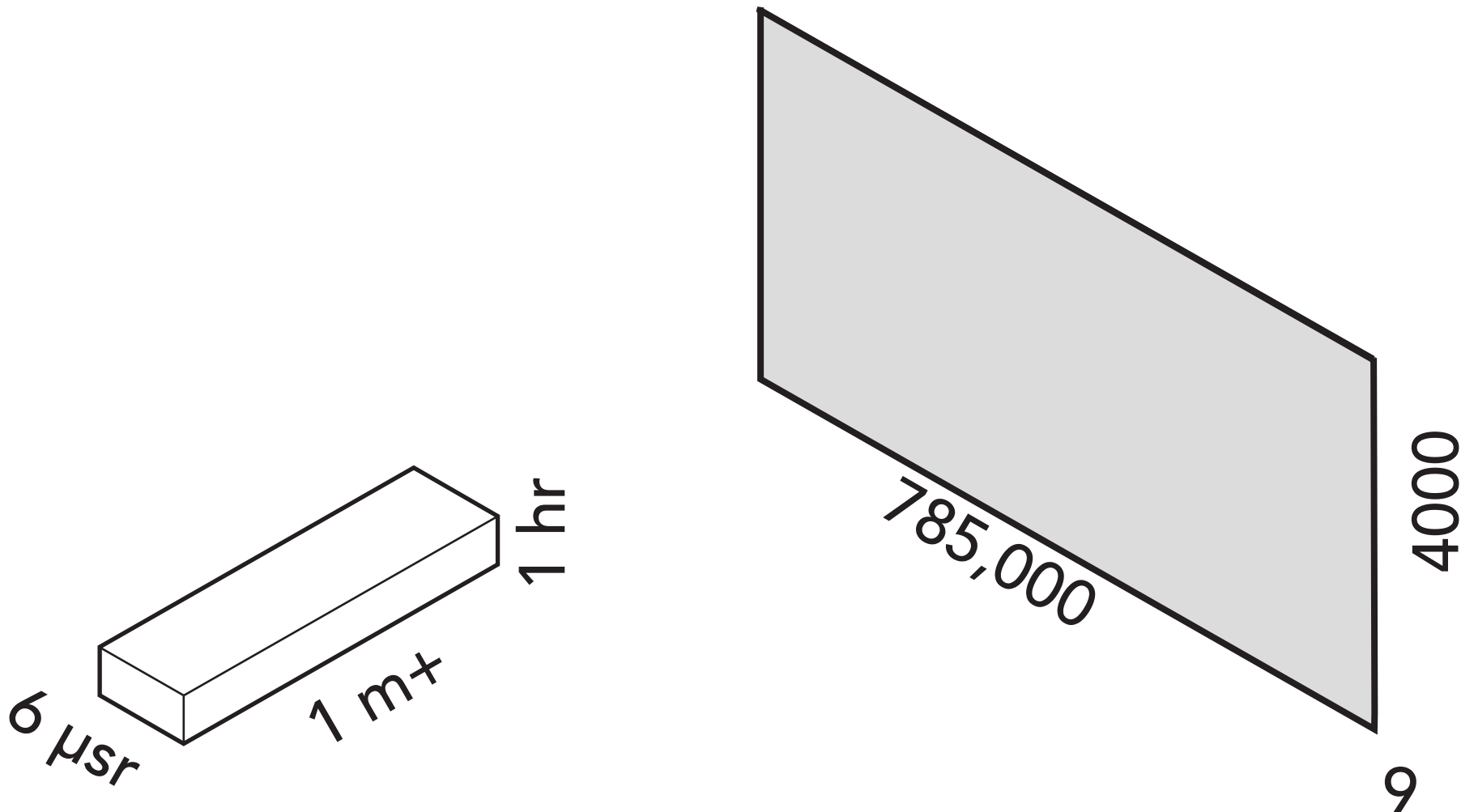
~6 microsteradians for -vta



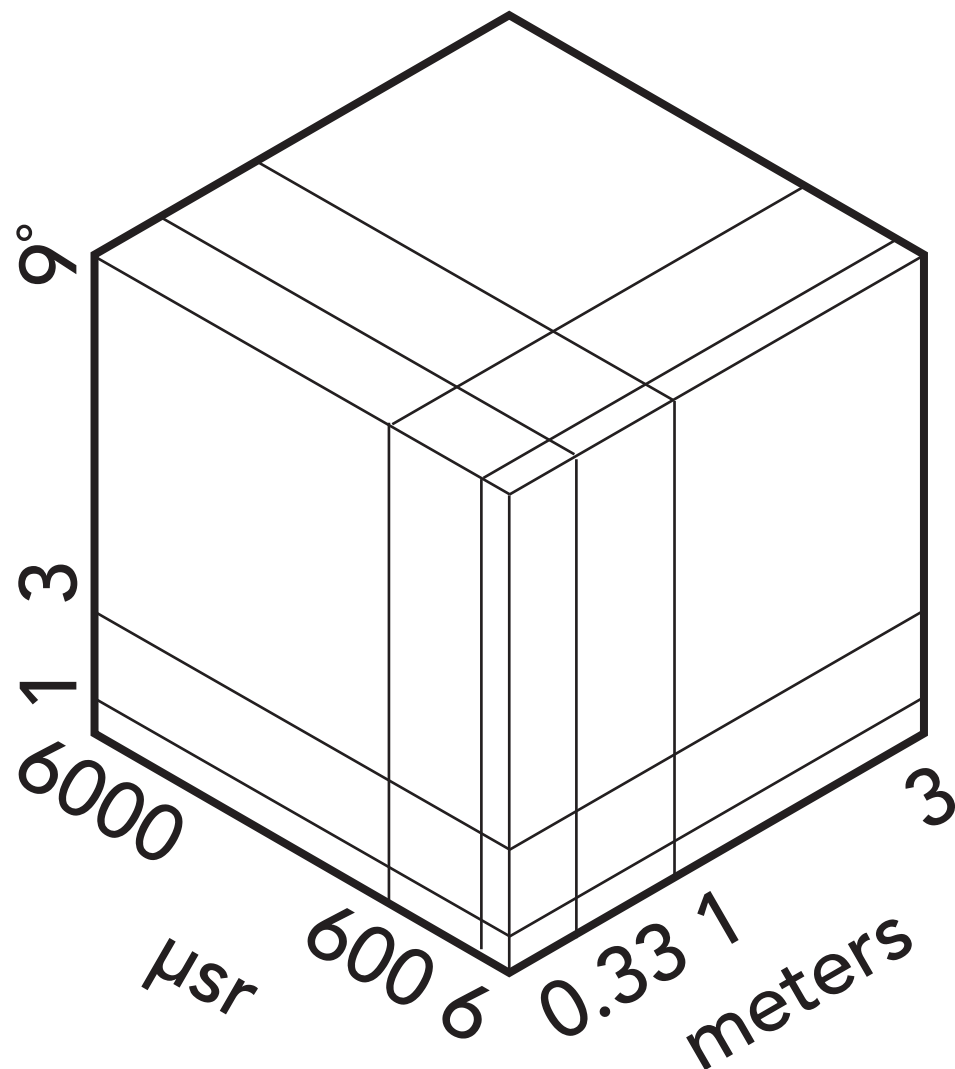
Unit Consensus Magnitude



Unit Illuminance Magnitude



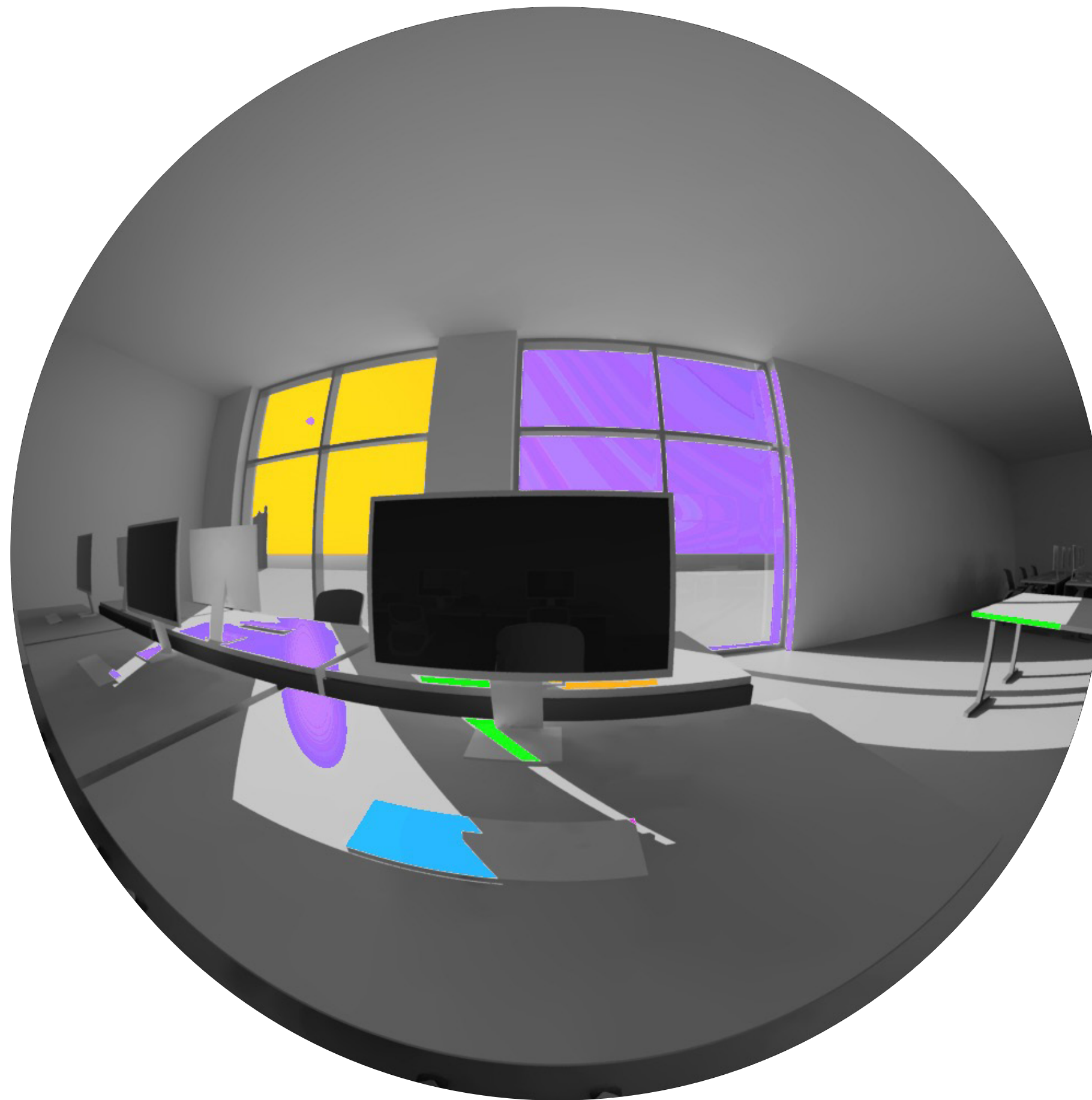
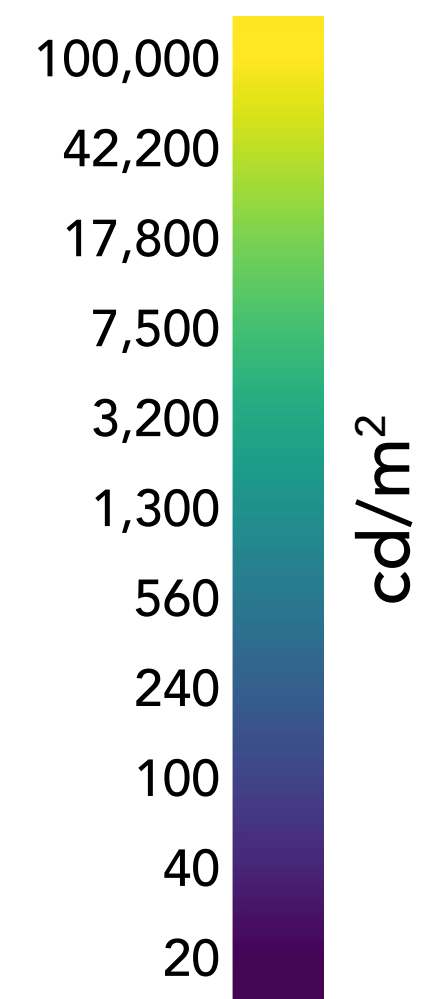
Unit Luminance Magnitude

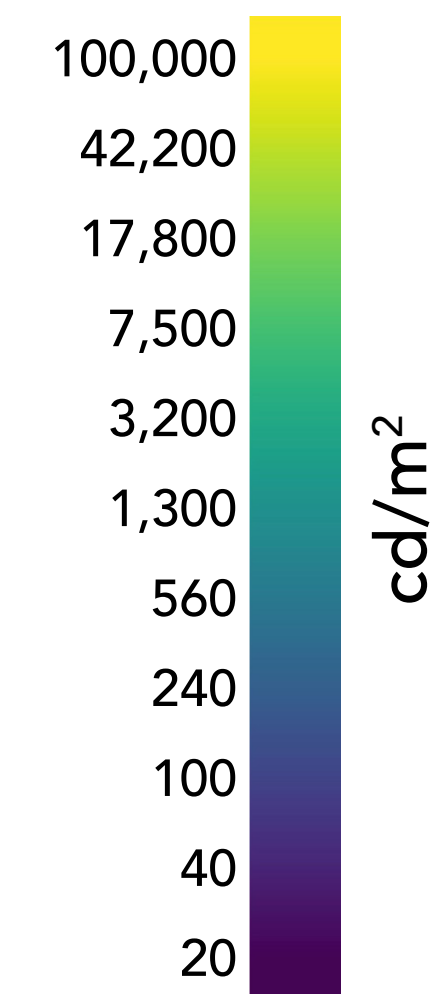
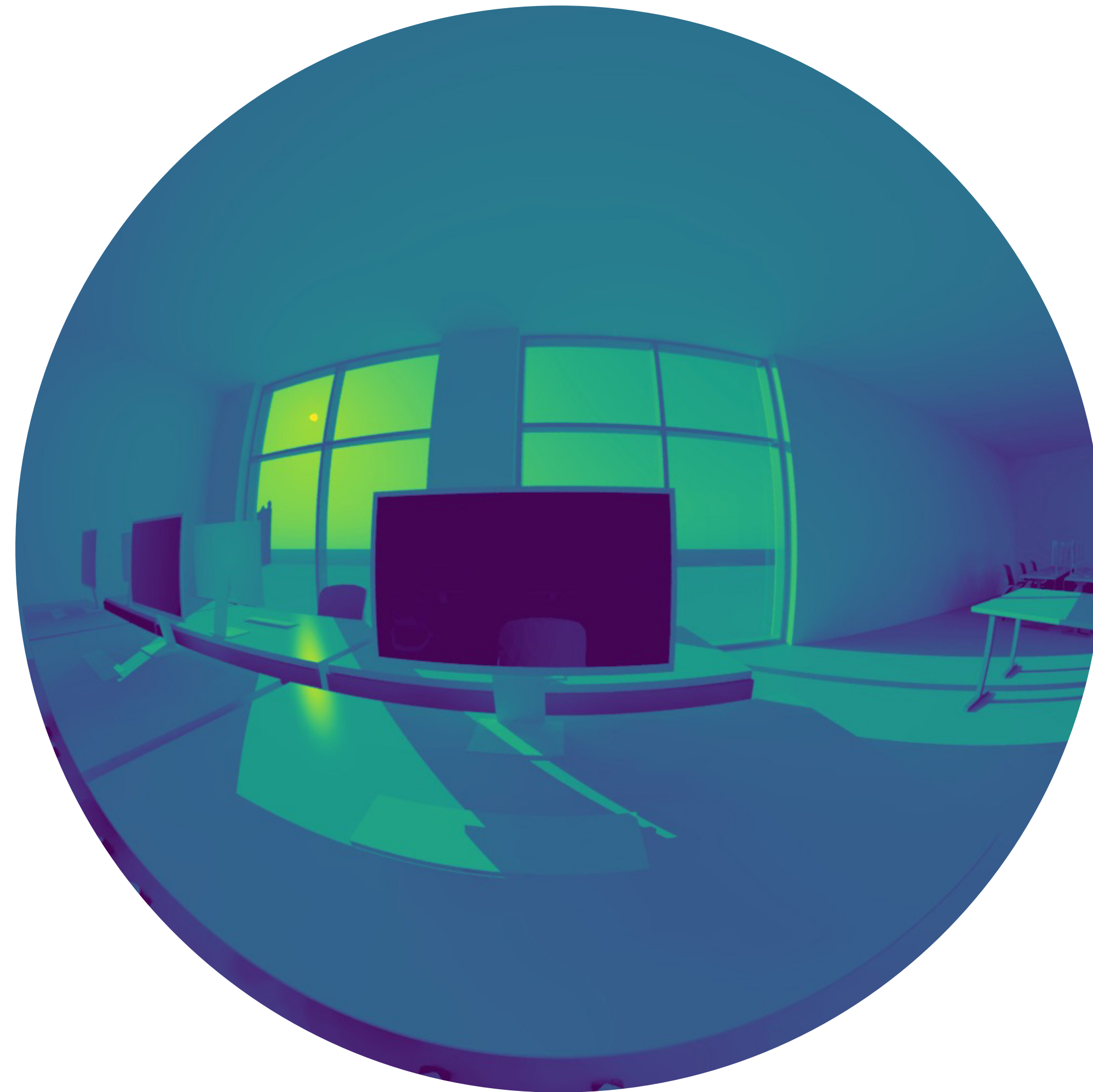


Unit

Adaptive

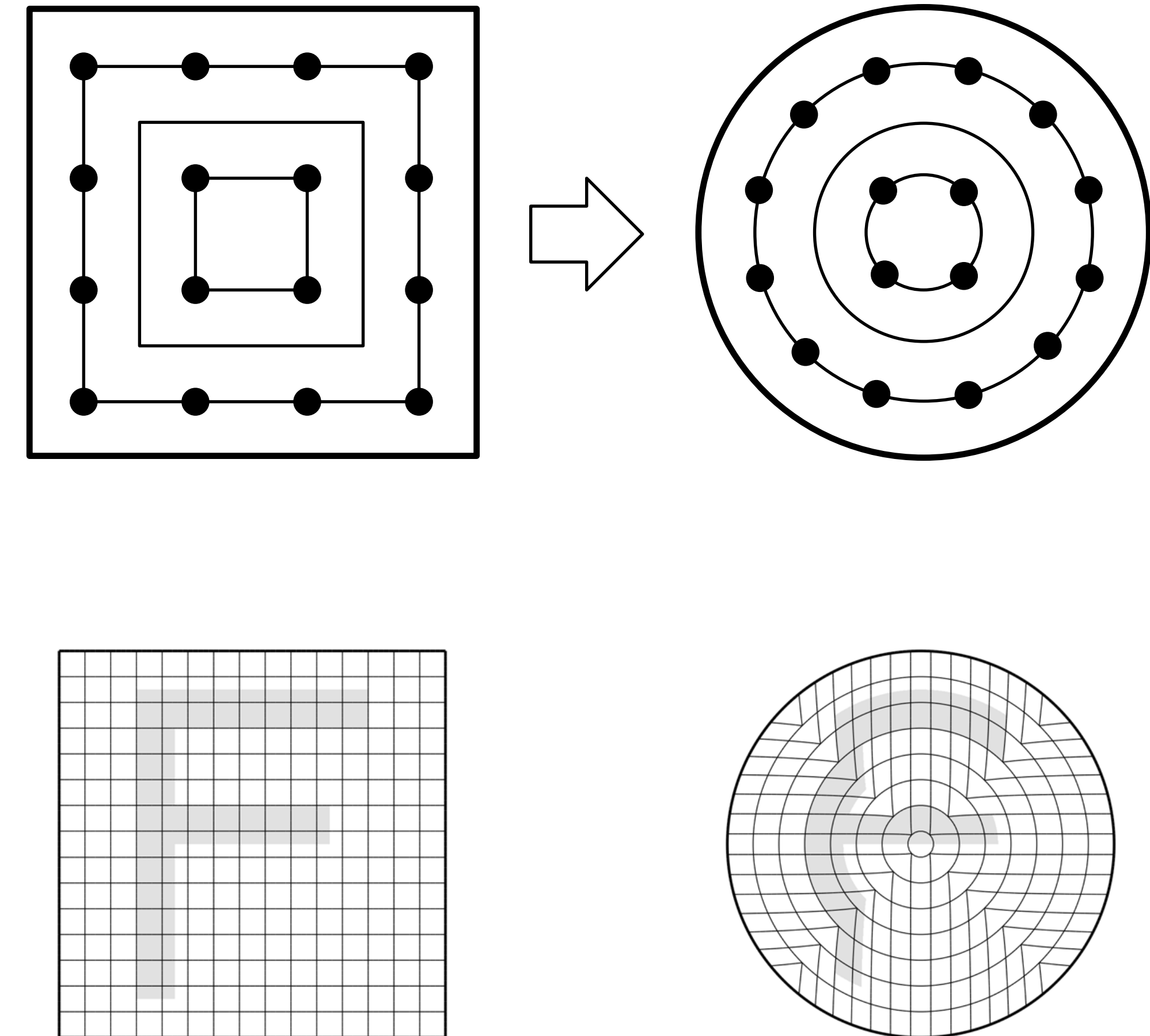
Magnitude



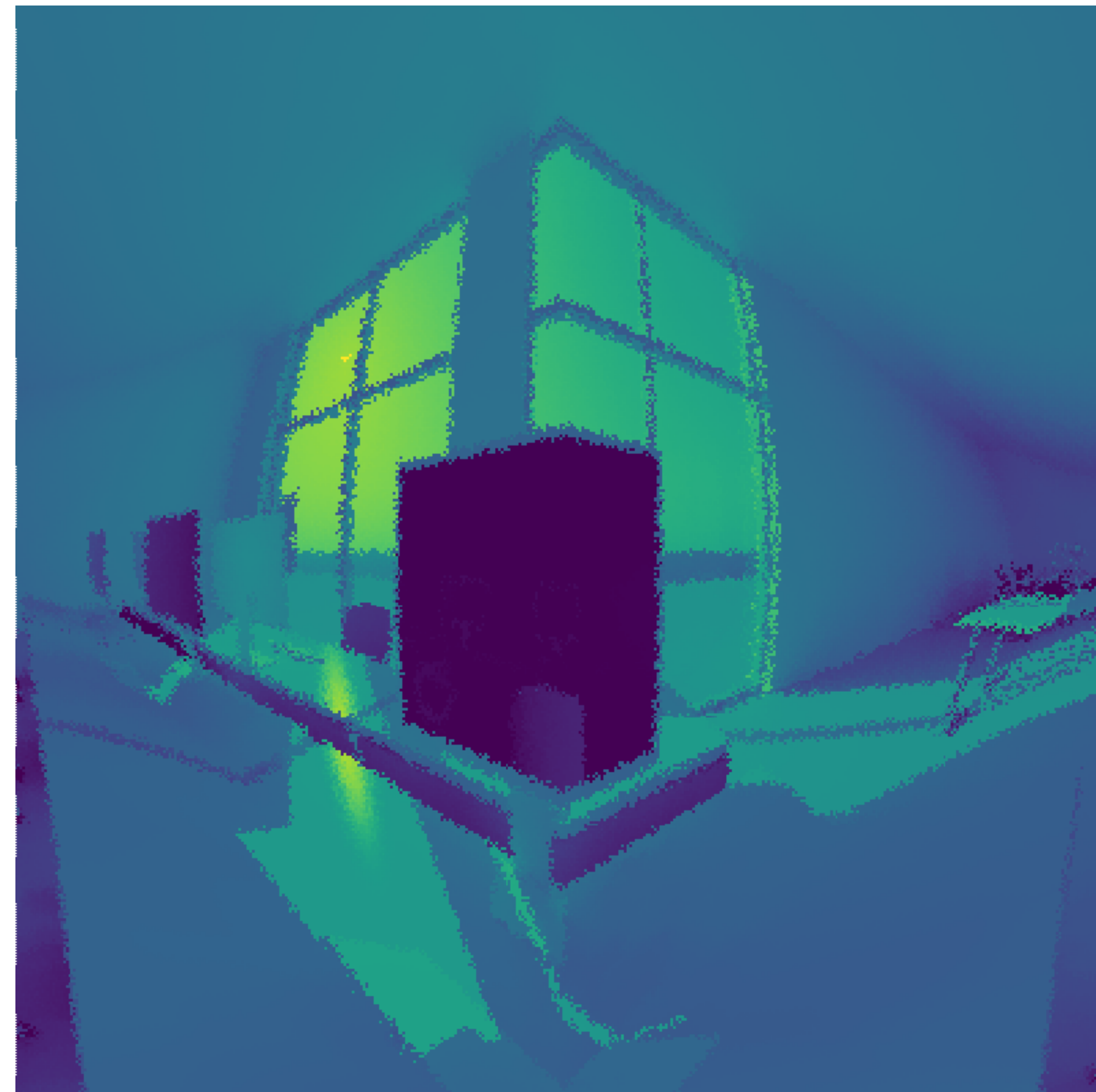


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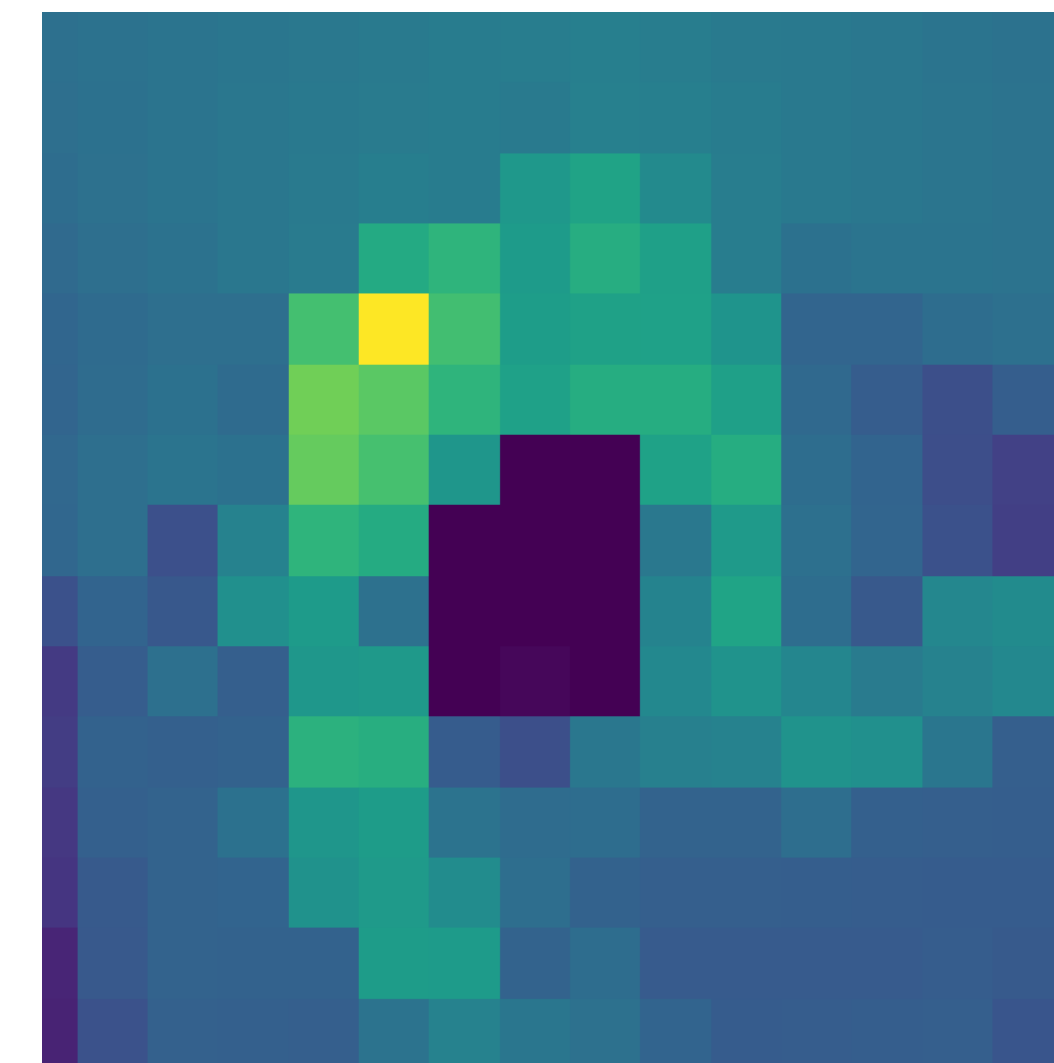
Shirley, Peter, and Kenneth Chiu. A Low Distortion Map Between Disk and Square. Journal of Graphics Tools, vol. 2, no. 3, Jan. 1997, pp. 45-52. Taylor and Francis+NEJM, doi:10.1080/10867651.1997.10487479.



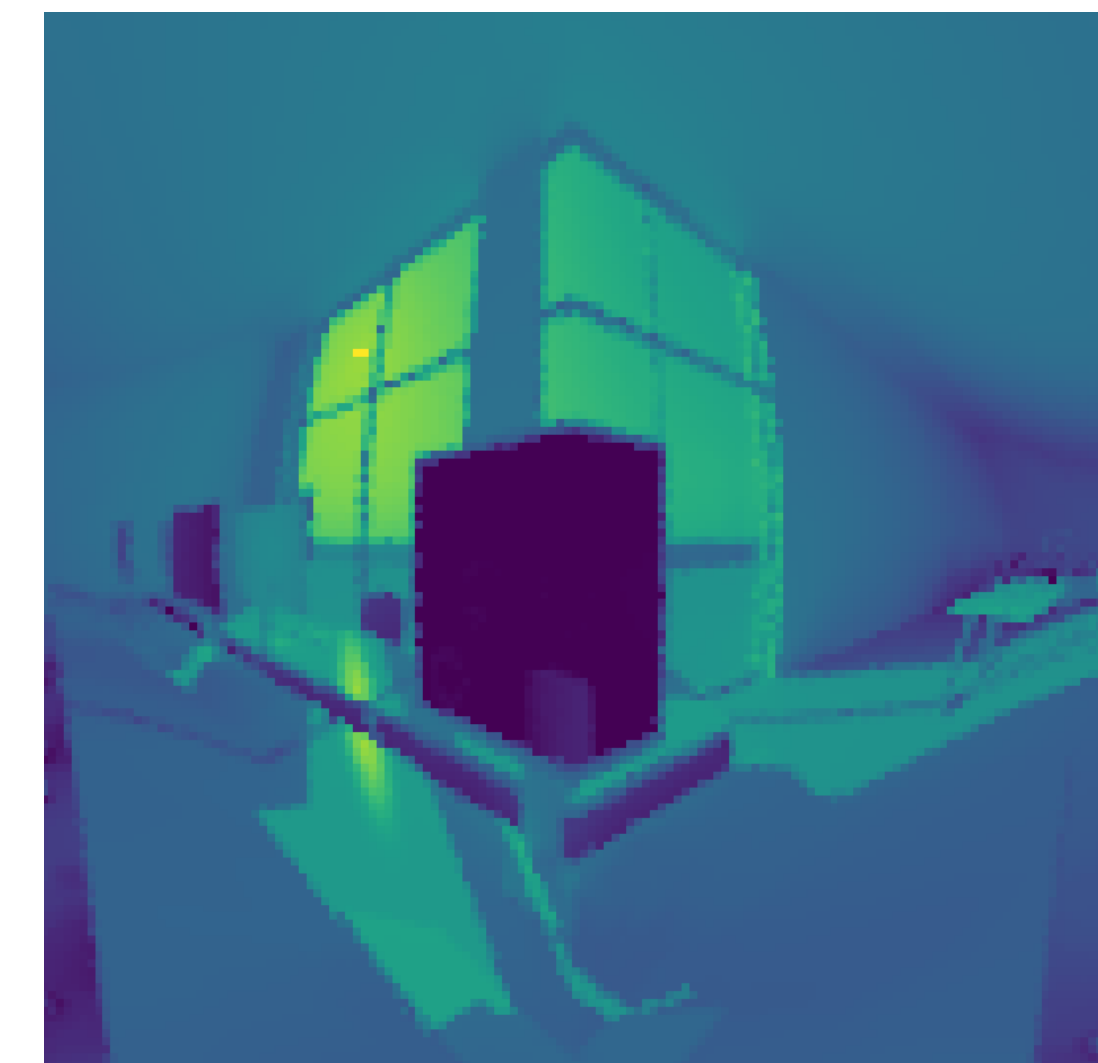
Level 3 (405 x 405)

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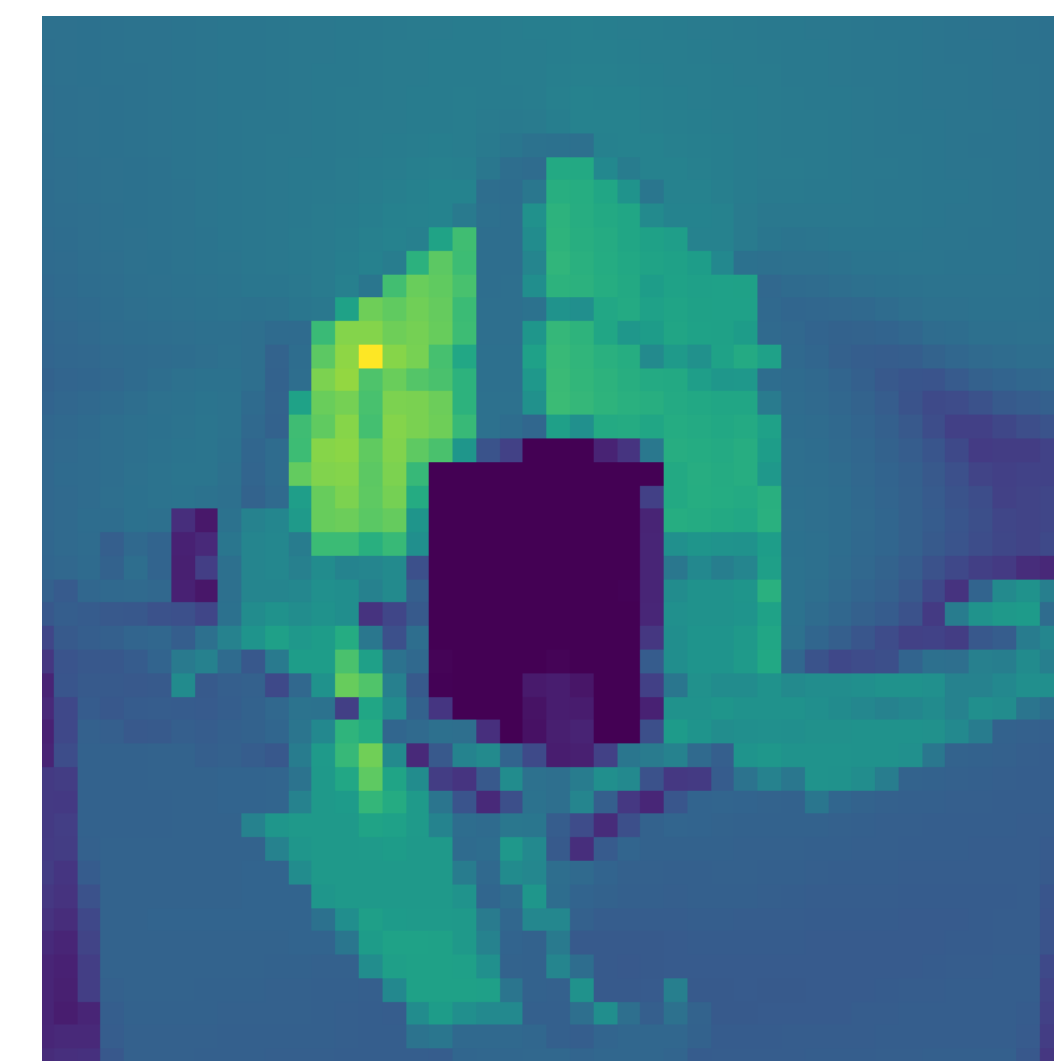
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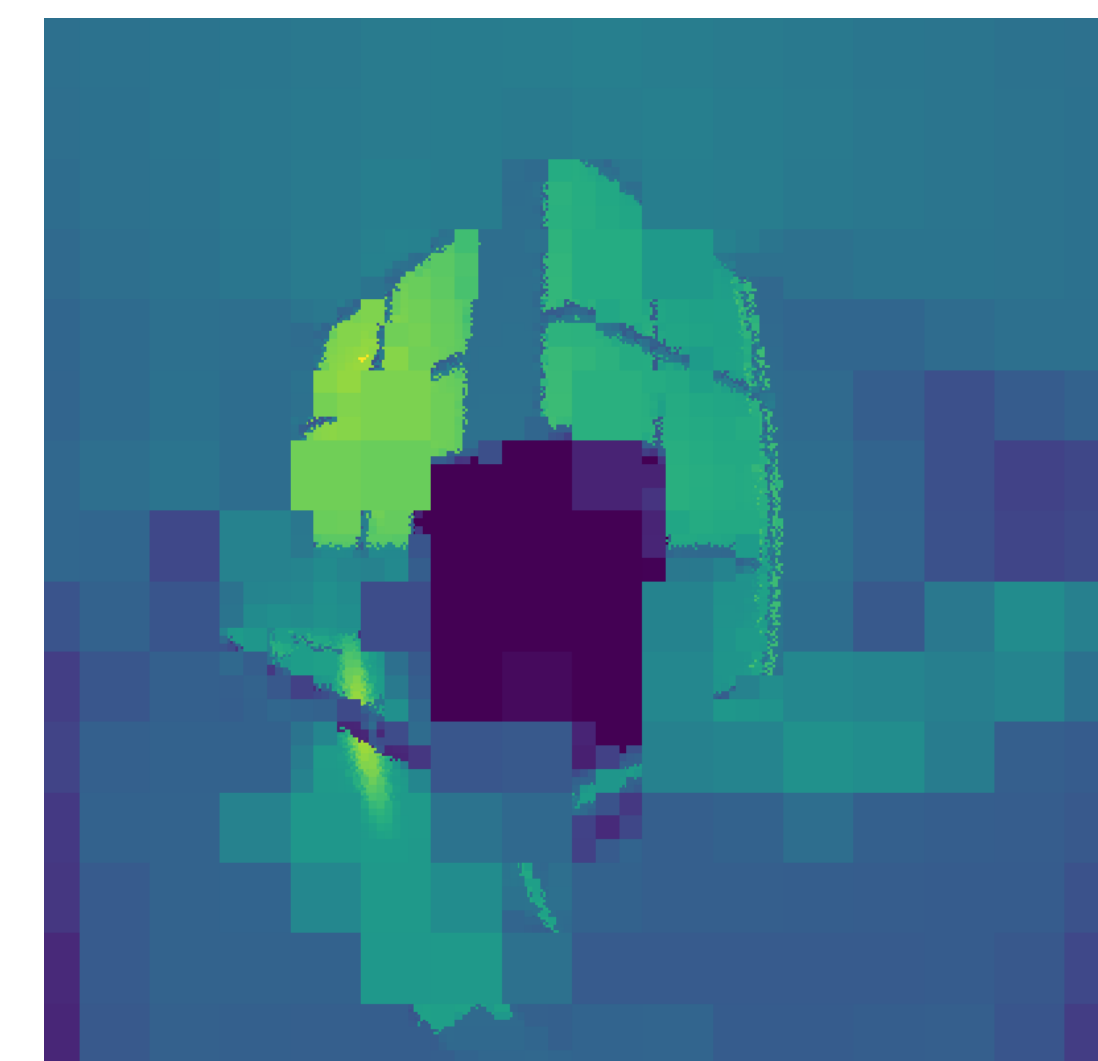
Level 0: 15x15, 0.14%



Level 2: 135x135, 11%)

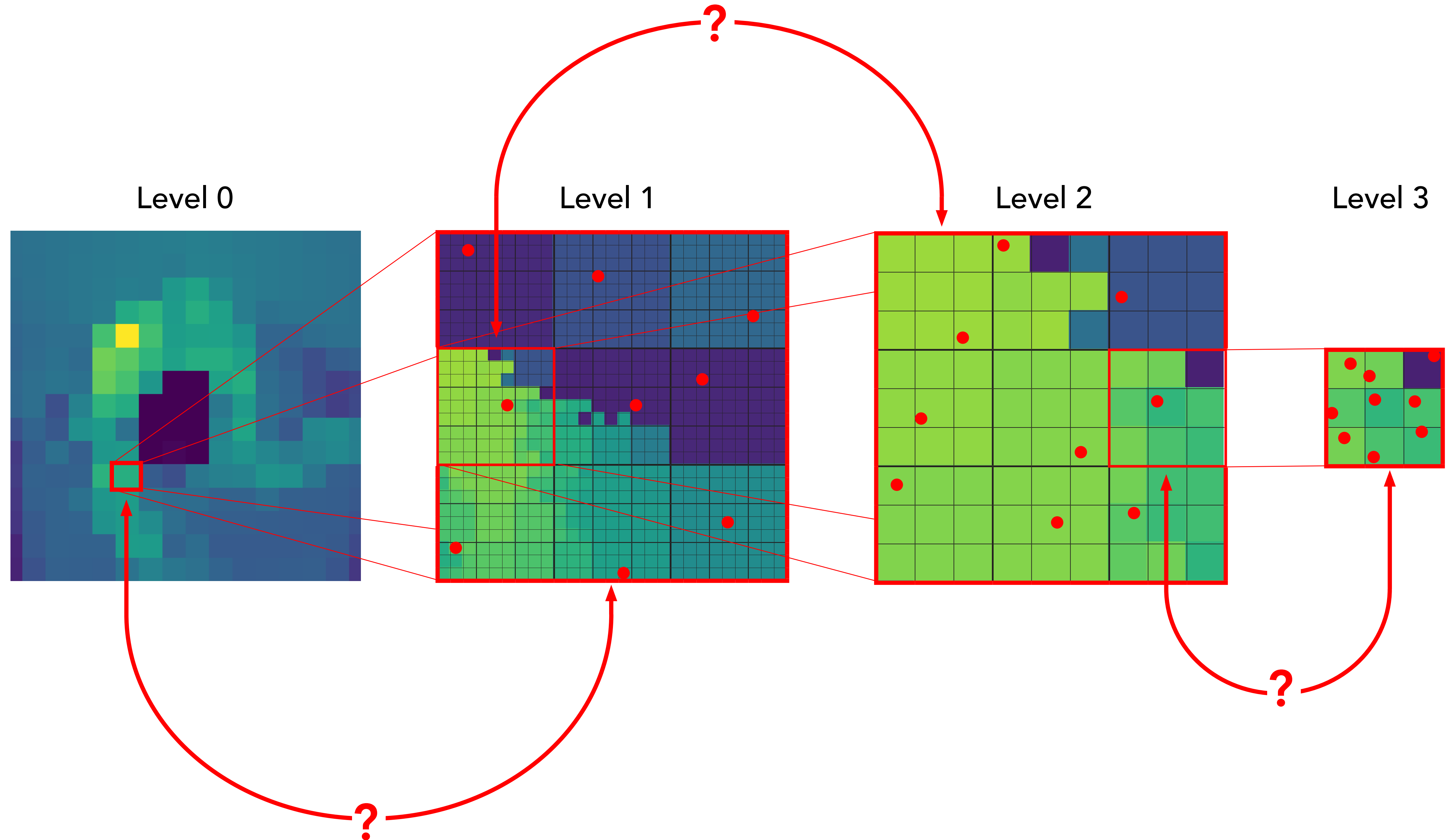


Level 1: 45x45, 1.2%



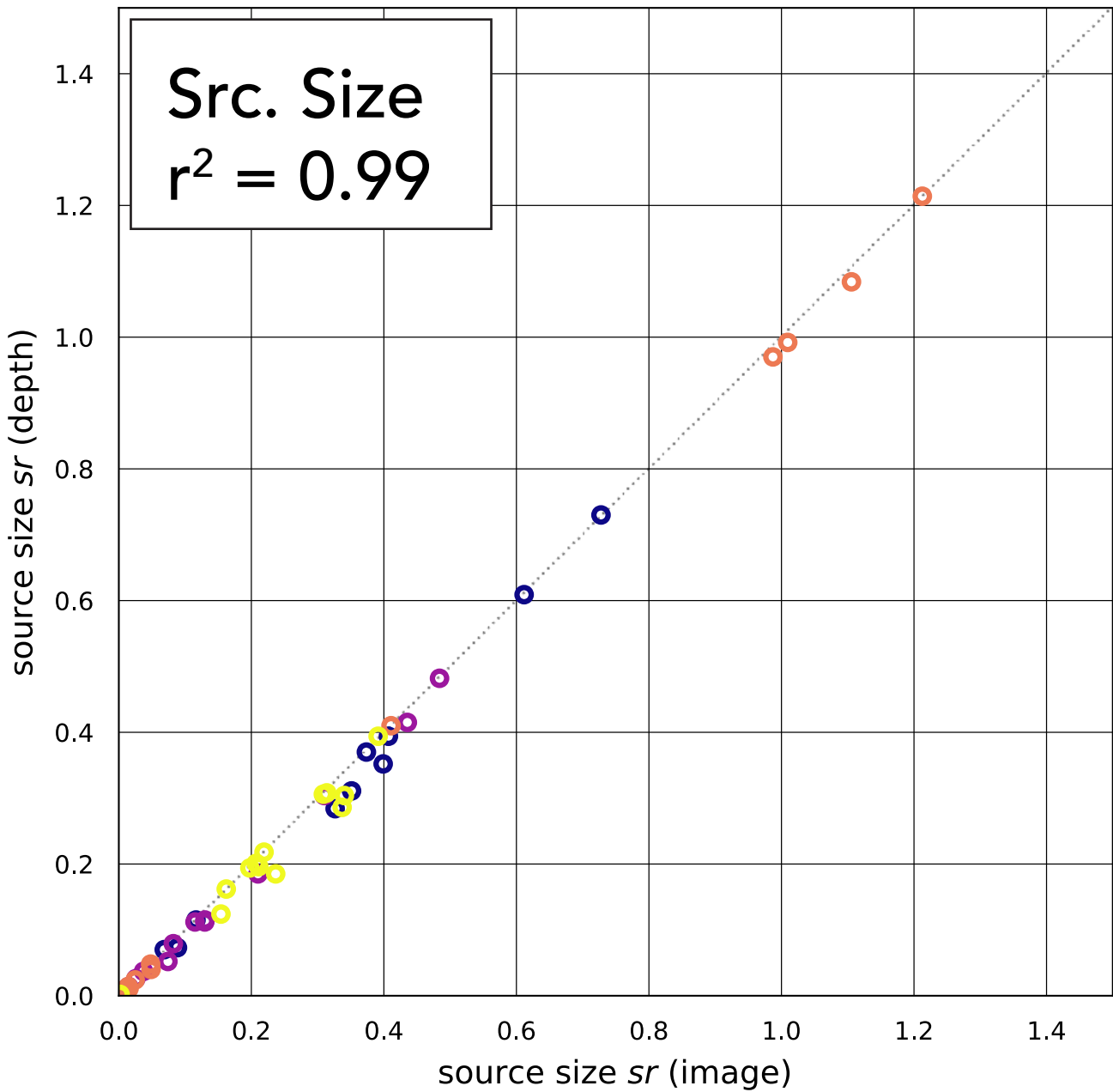
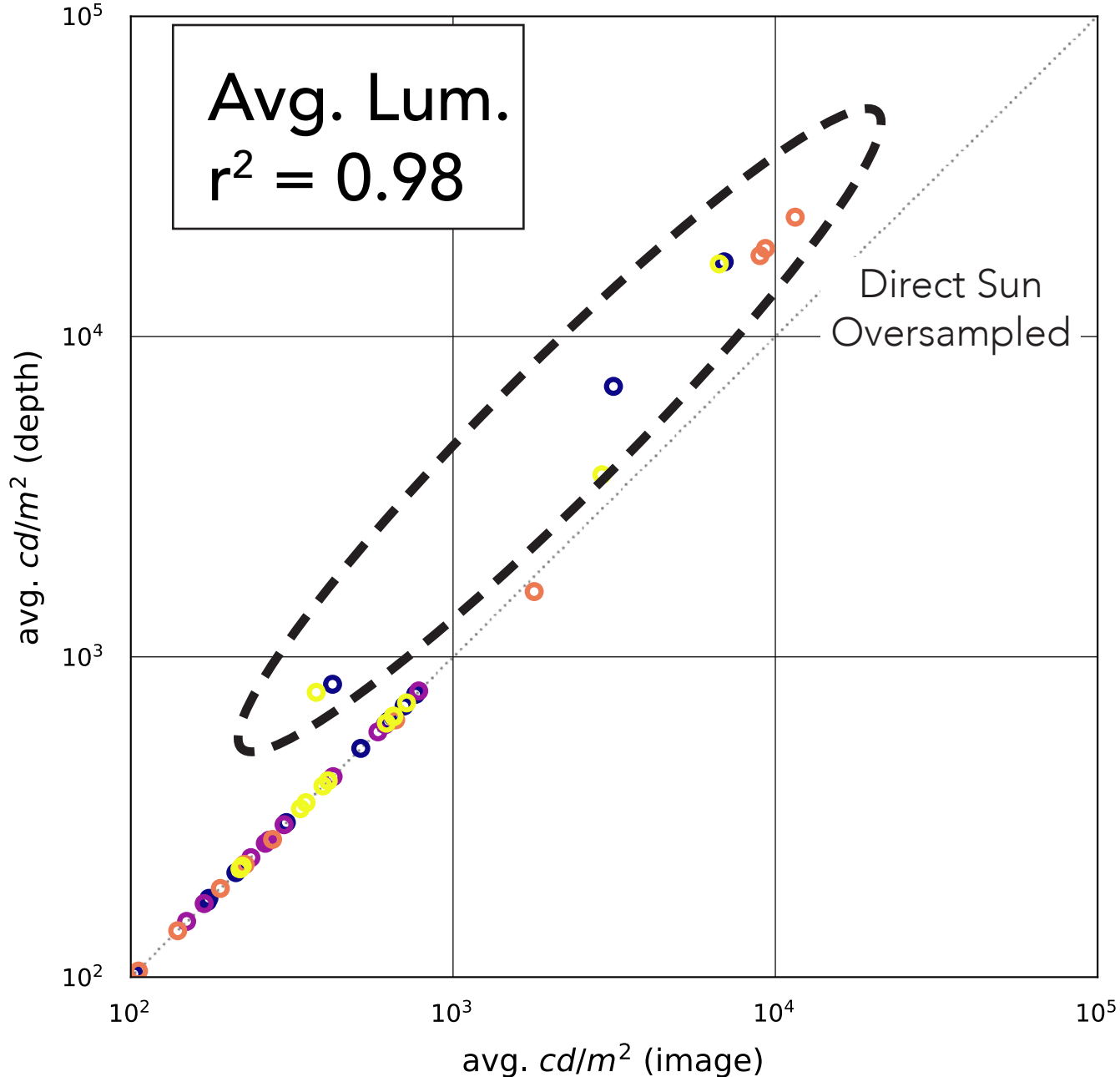
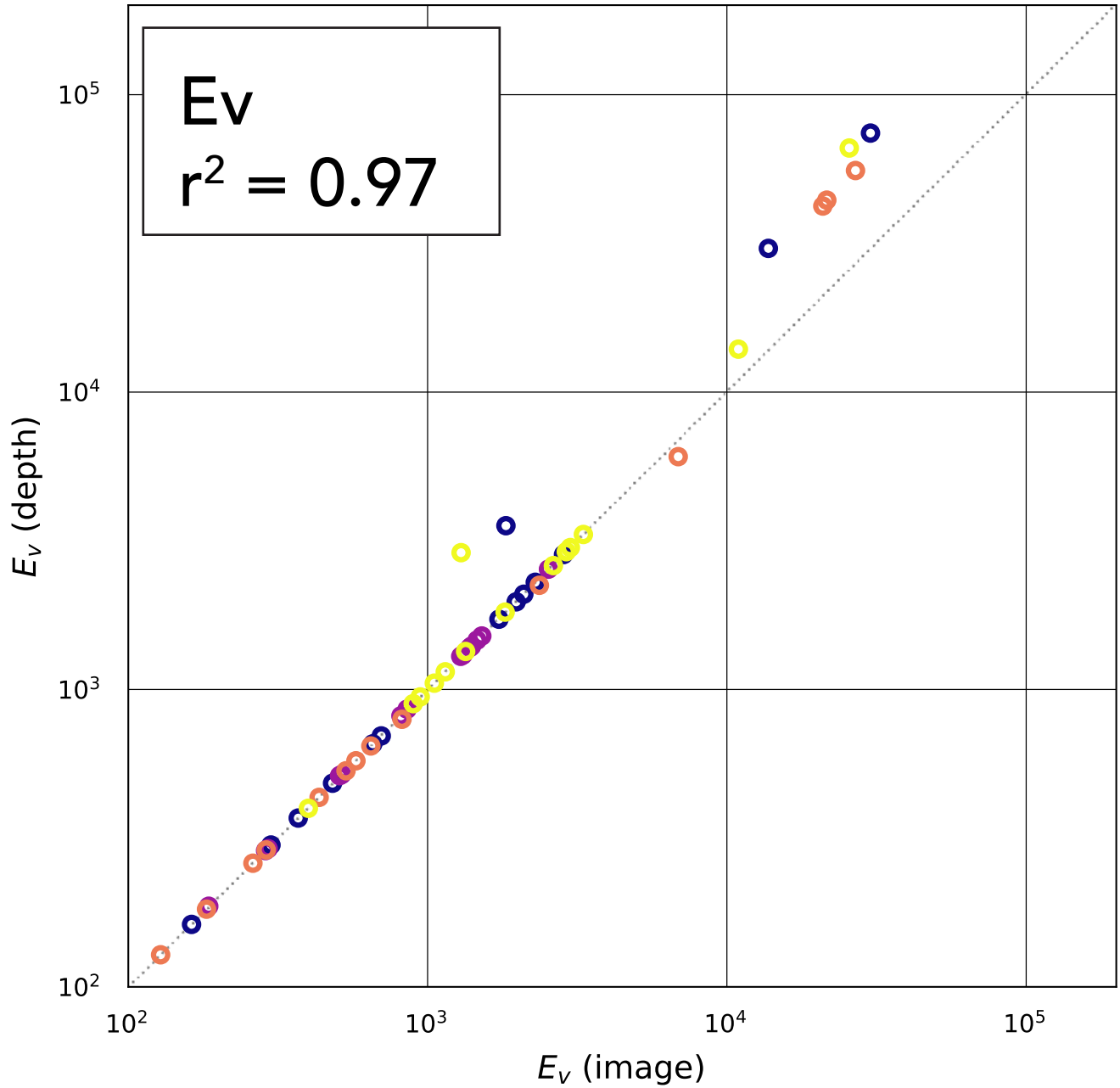
Adaptive: 2.2%

The percentage is sampling relative to Level 3

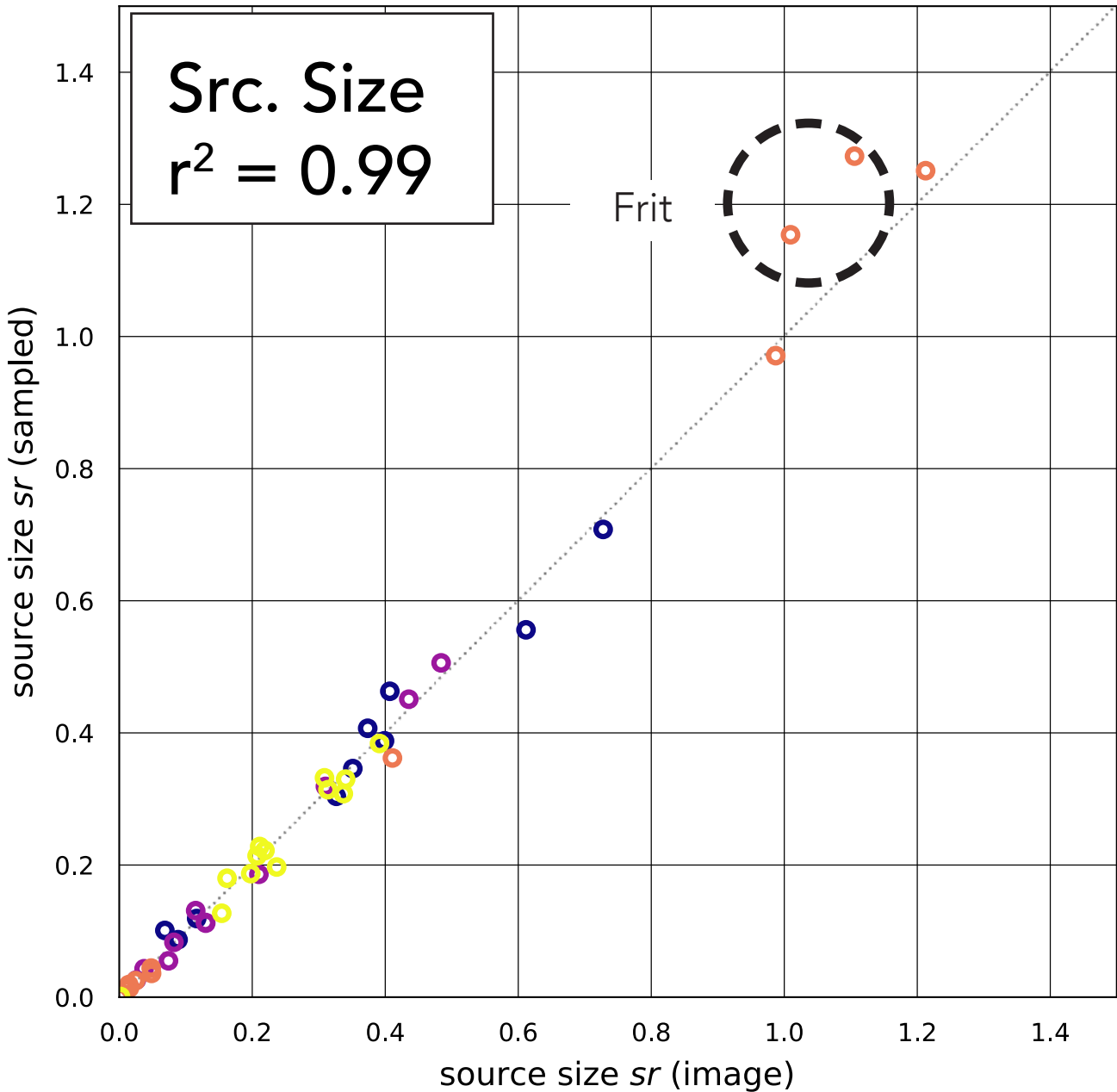
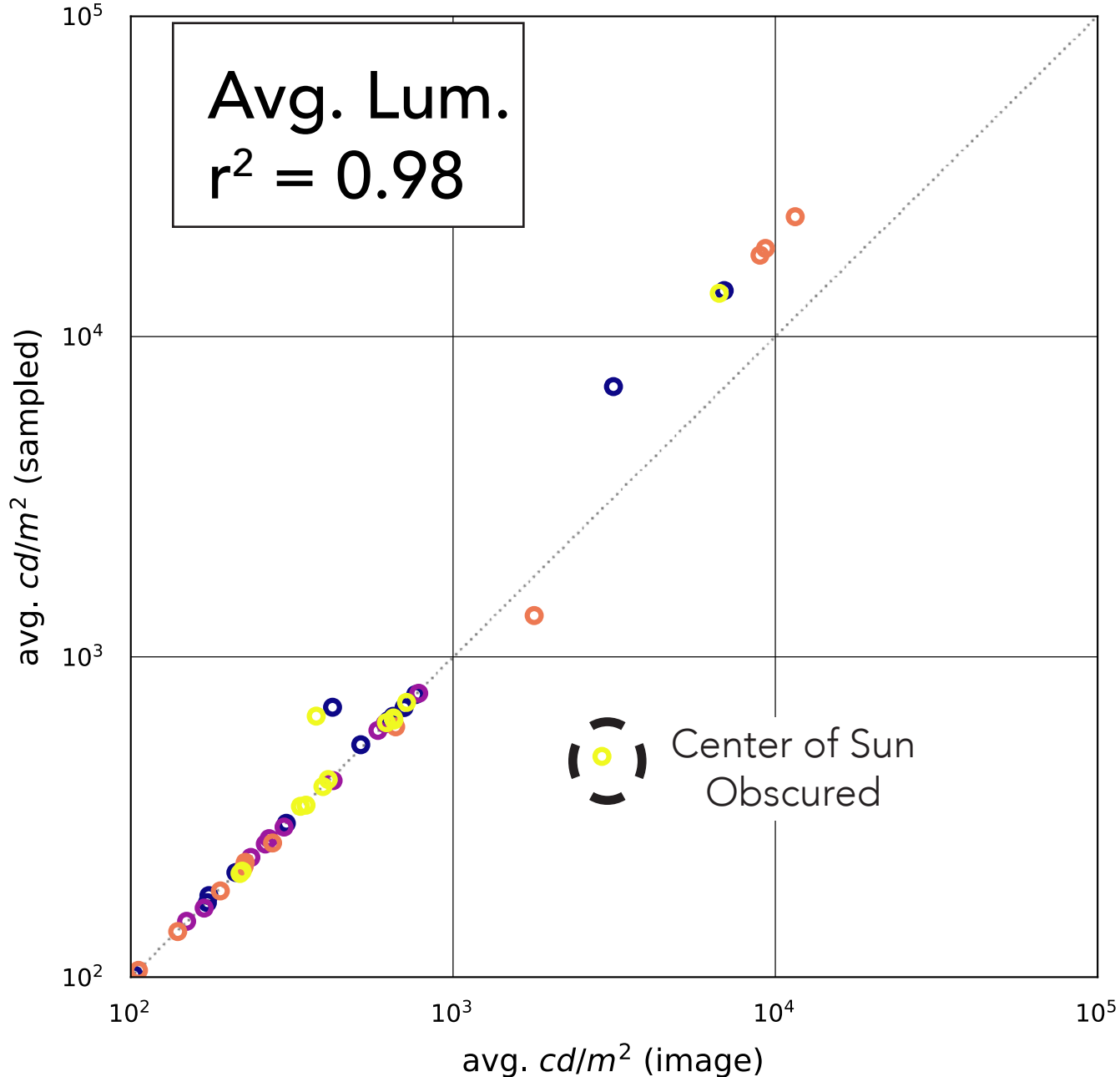
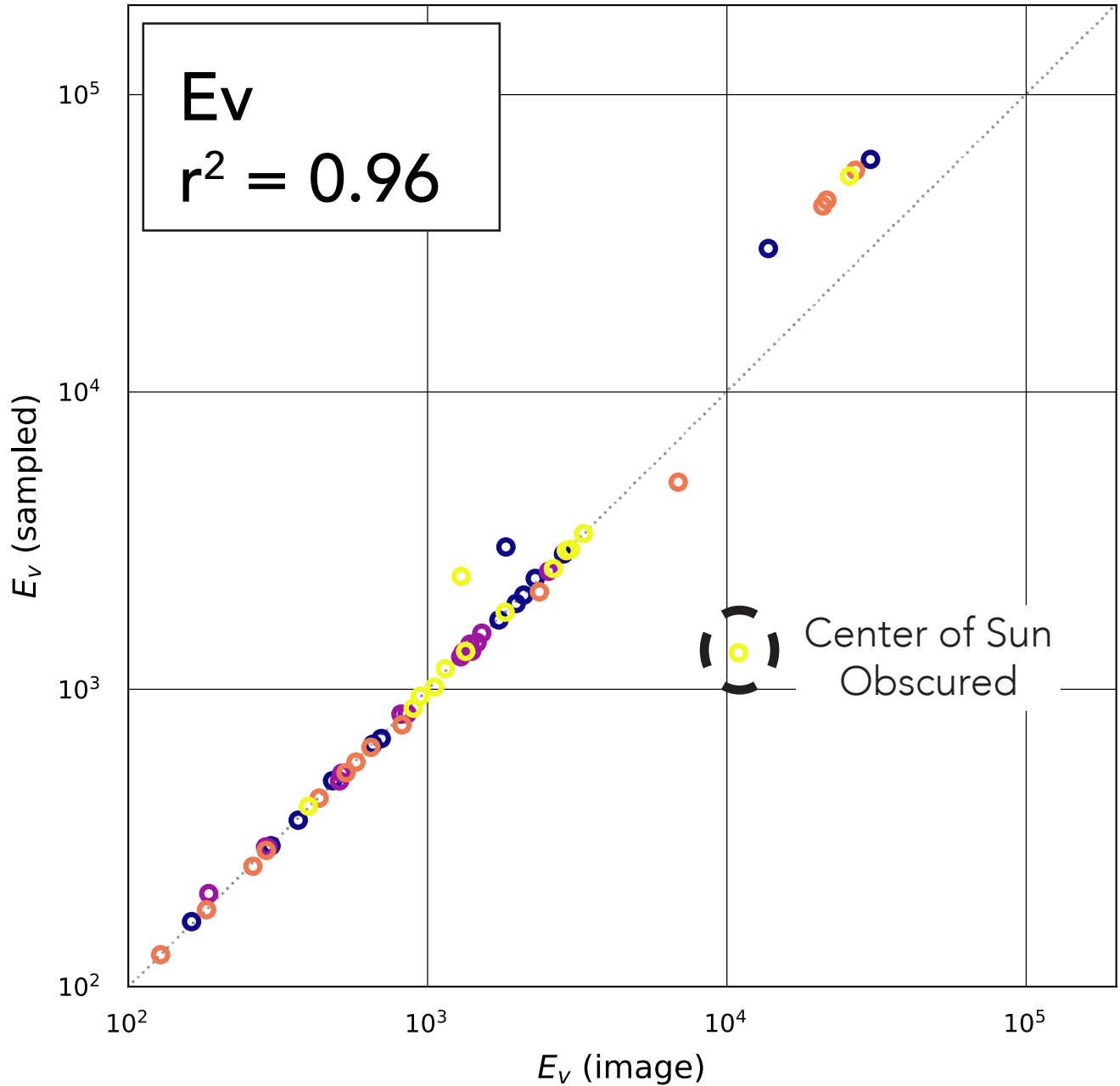


Correlation with Baseline Images (N=56)

Level 3 Resolution



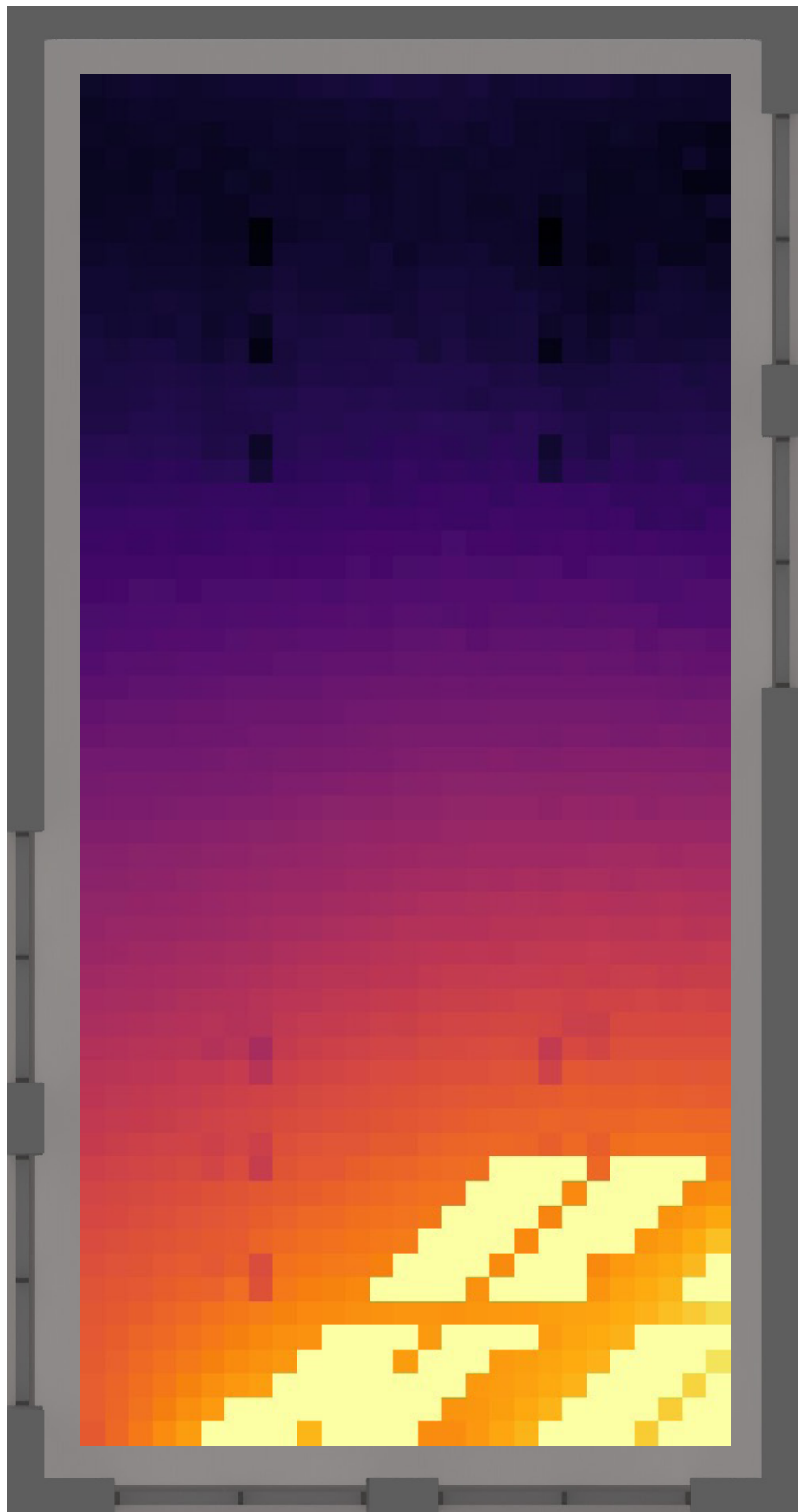
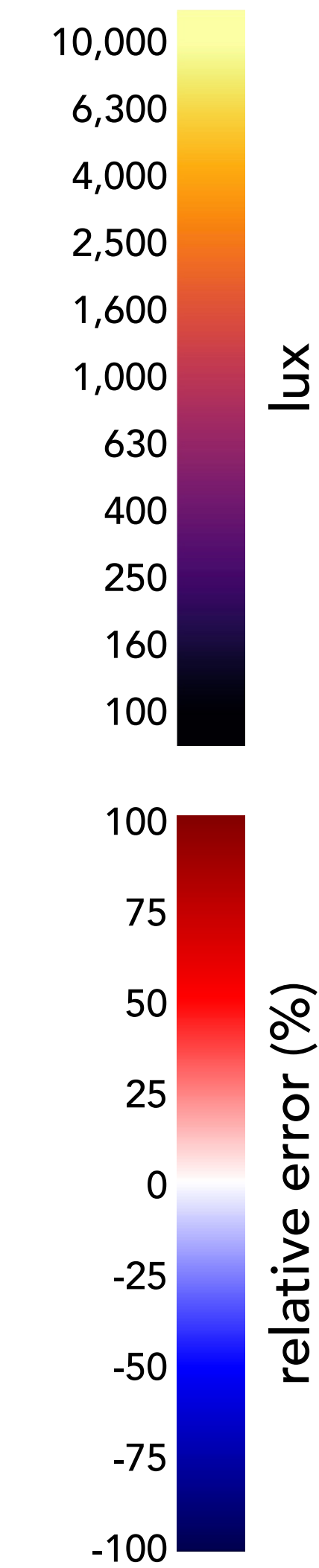
Adaptive Sampling



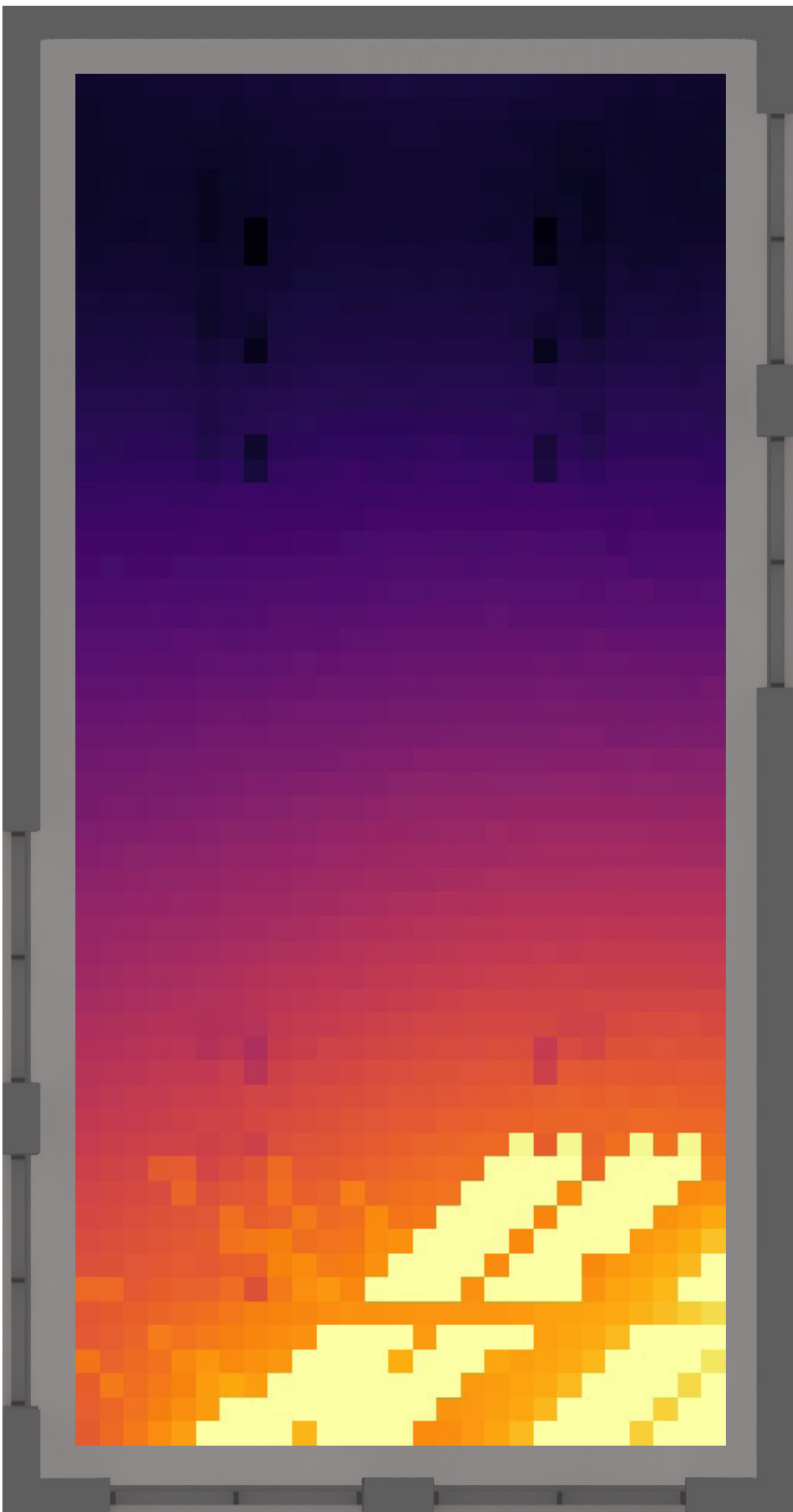
- View A
- View B
- View C
- View D

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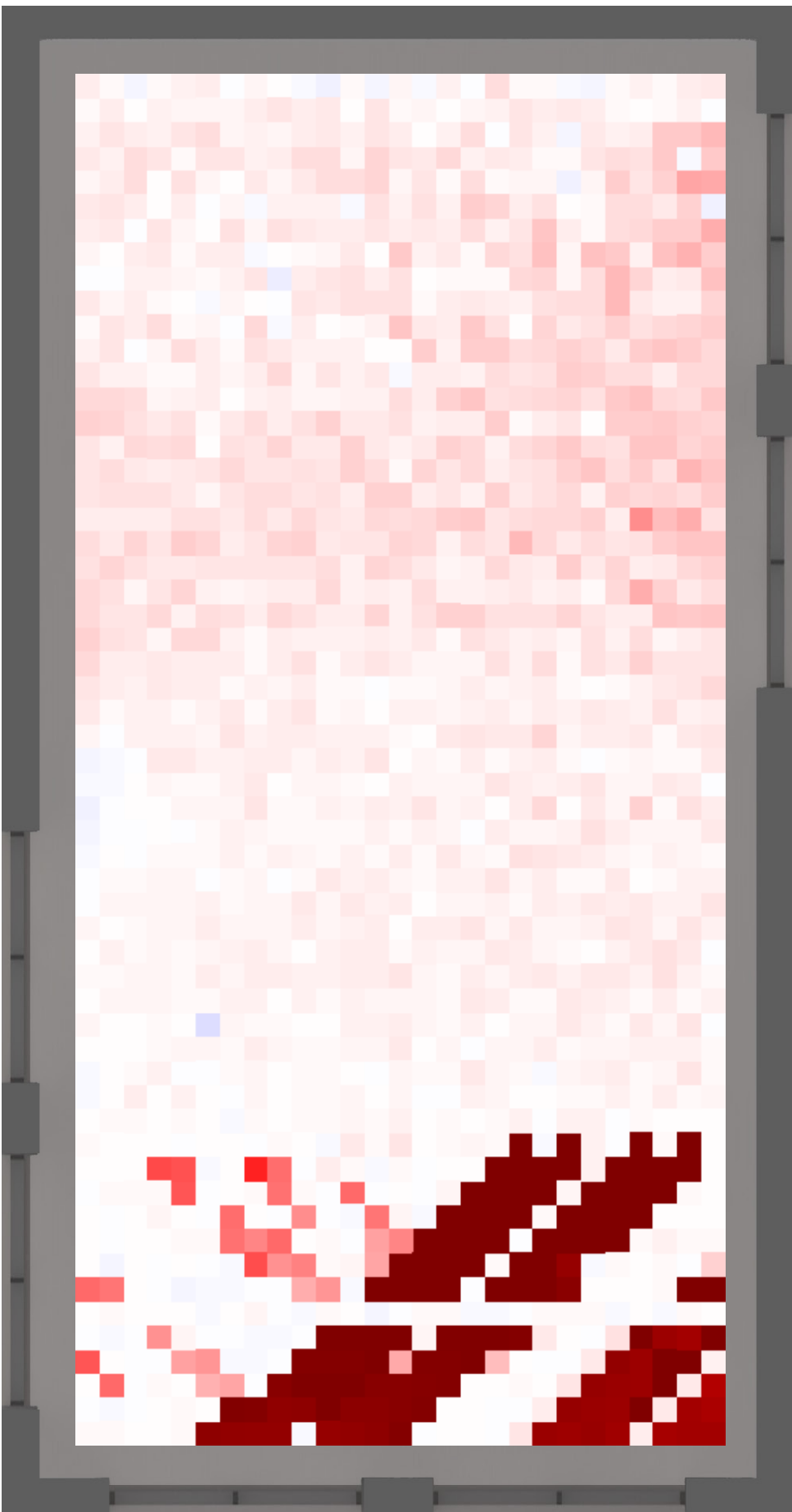
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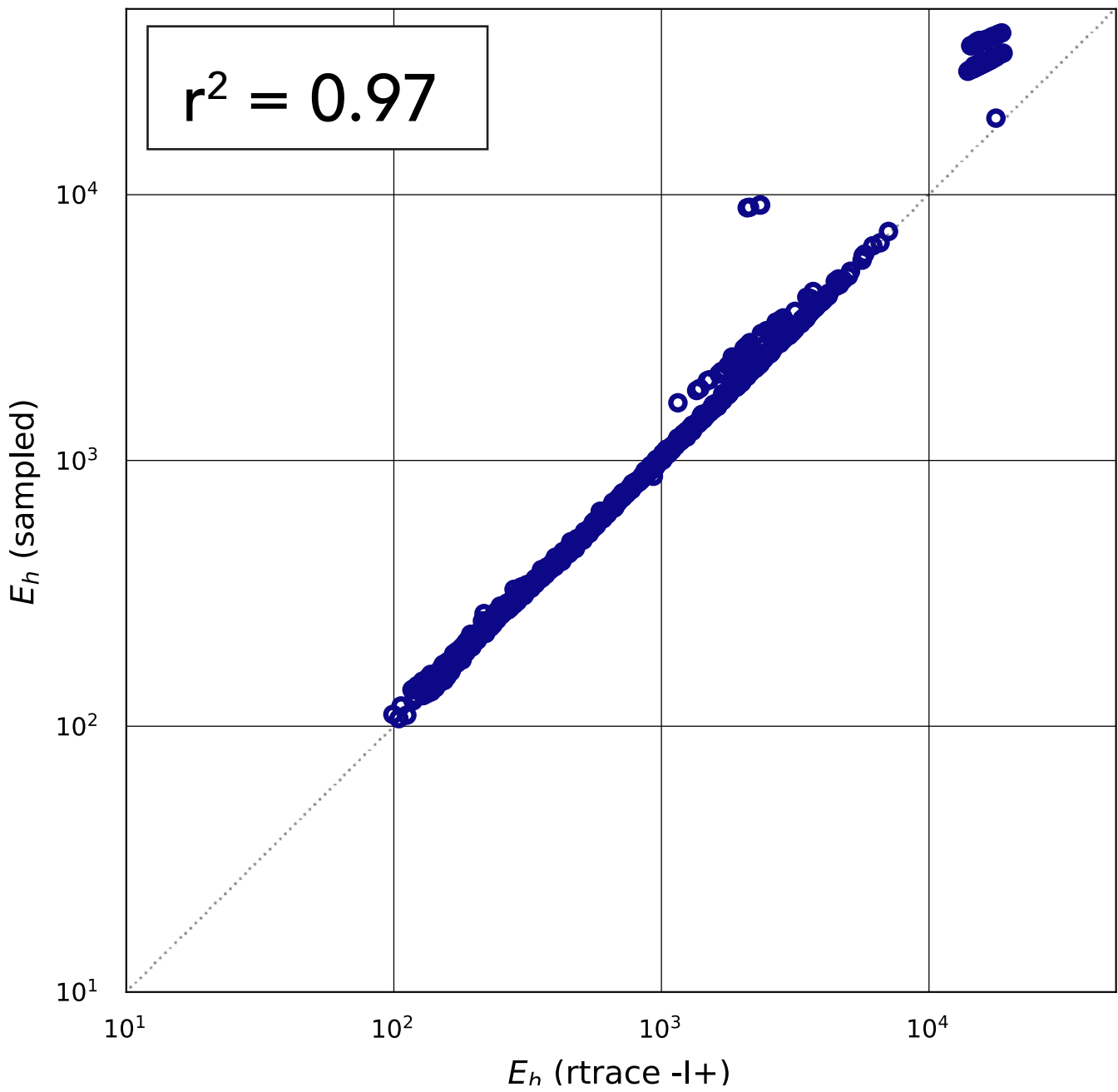
Rtrace -l+



Sampled



Sampled/Rtrace



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Lars Grobe
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project member

Jan Wienold PhD
thesis co-director

Marilyne Andersen PhD
thesis director

Stephen Wittkopf PhD
project applicant

**HOCHSCHULE
LUZERN**

EPFL

FNSNF

SWISS NATIONAL SCIENCE FOUNDATION

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Light fields in climate-based daylight modeling for spatio-temporal glare assessment
<http://p3.snf.ch/project-179067>