

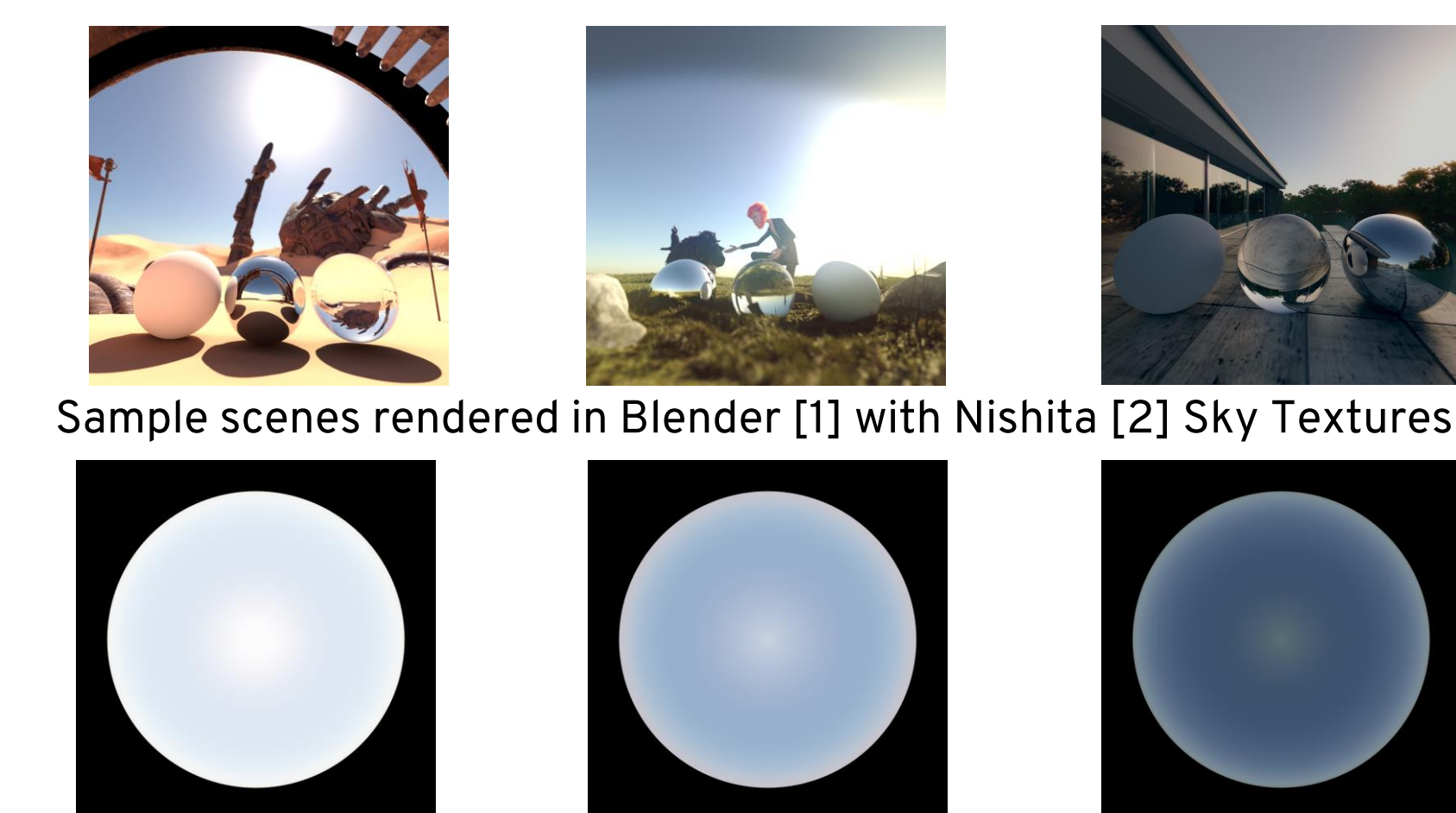
Motivation.

To generate visually appealing and physically accurate skies:

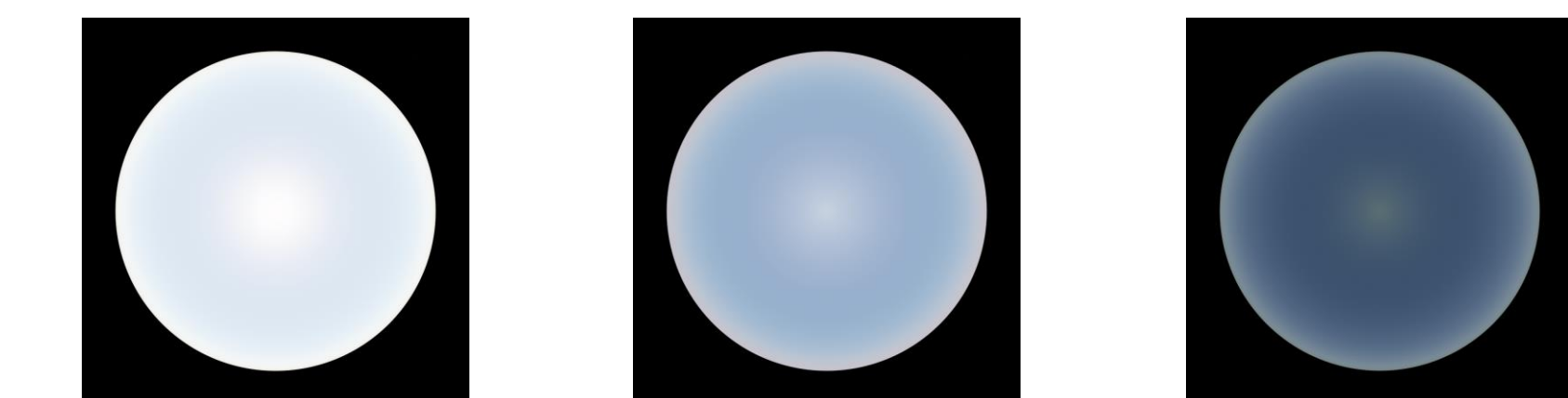
- Per user-controlled solar positioning.
- Per user-defined atmospheric components.
- Per user-defined locations, dates, times and weather conditions.

Current Limitations To State-Of-The-Art:

- Physically based models are computationally expensive.
- Parametric models emulate only clear and overcast skies.
- ANN/DNN models offer limited resolution, realism and weather/locality variation.



Sample scenes rendered in Blender [1] with Nishita [2] Sky Textures



Pretham [3], Nishita [2], and Hosek/Wilkie [4]
Parametric sky textures rendered using Blender [1]

Dataset.

Laval HDRDB: HDR Sky Database [5]

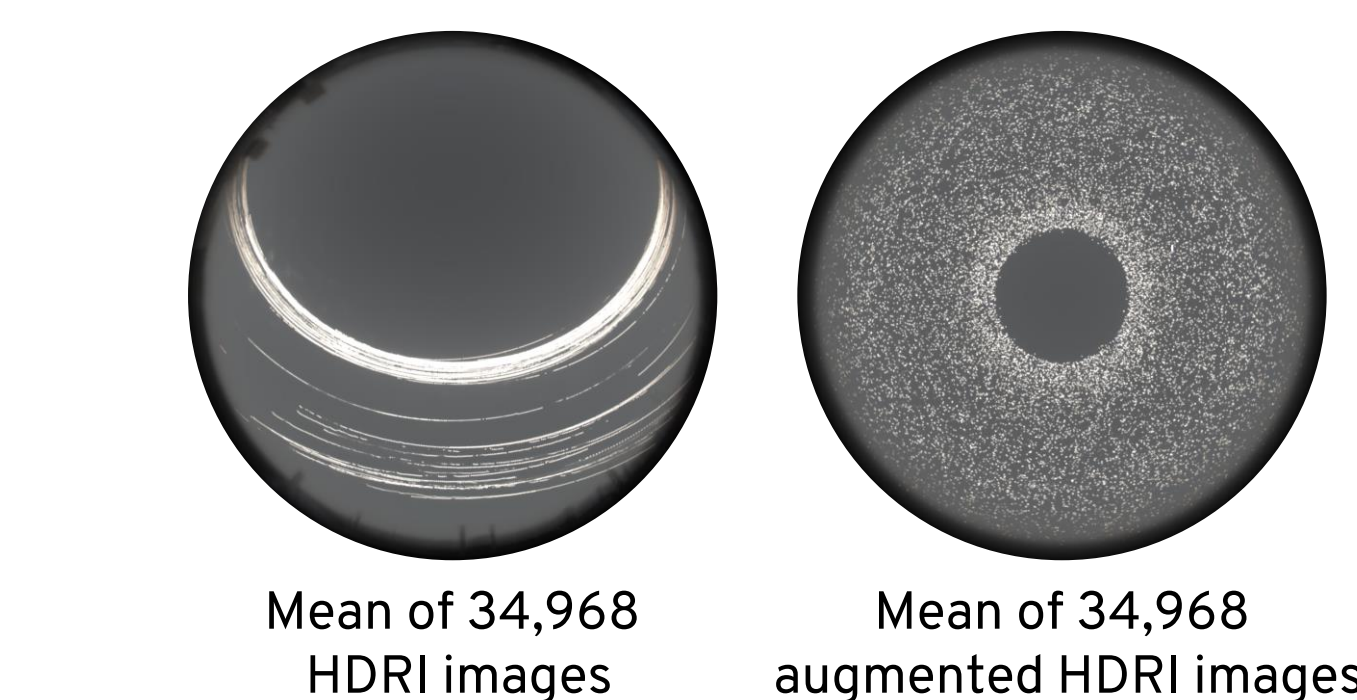
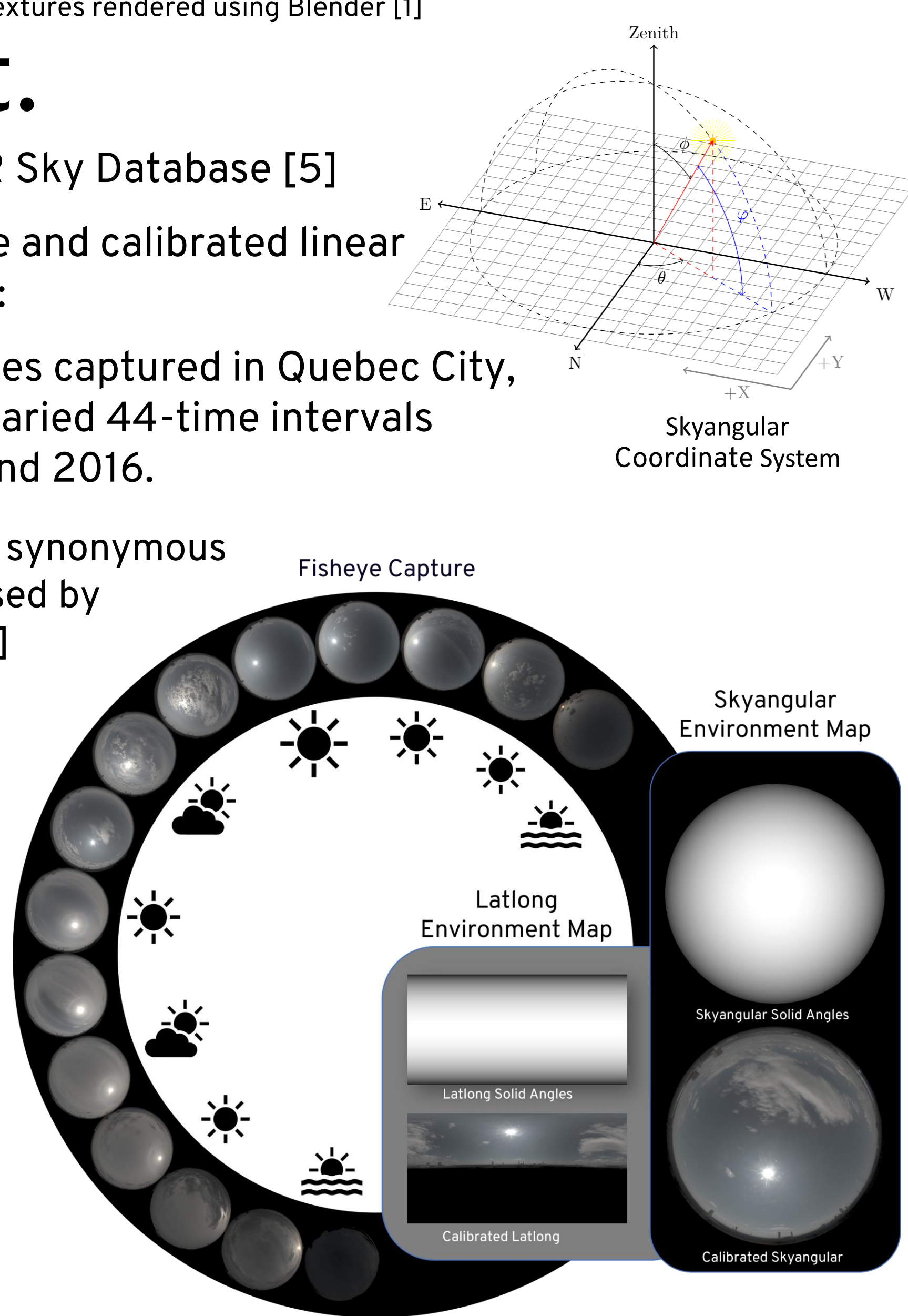
Physically accurate and calibrated linear environment maps:

- 34K+ HDR images captured in Quebec City, Canada across varied 44-time intervals between 2015 and 2016.

- Full HDR capture synonymous to method proposed by Stumpfel et al. [6]

- Rich and varied atmospheric conditions.

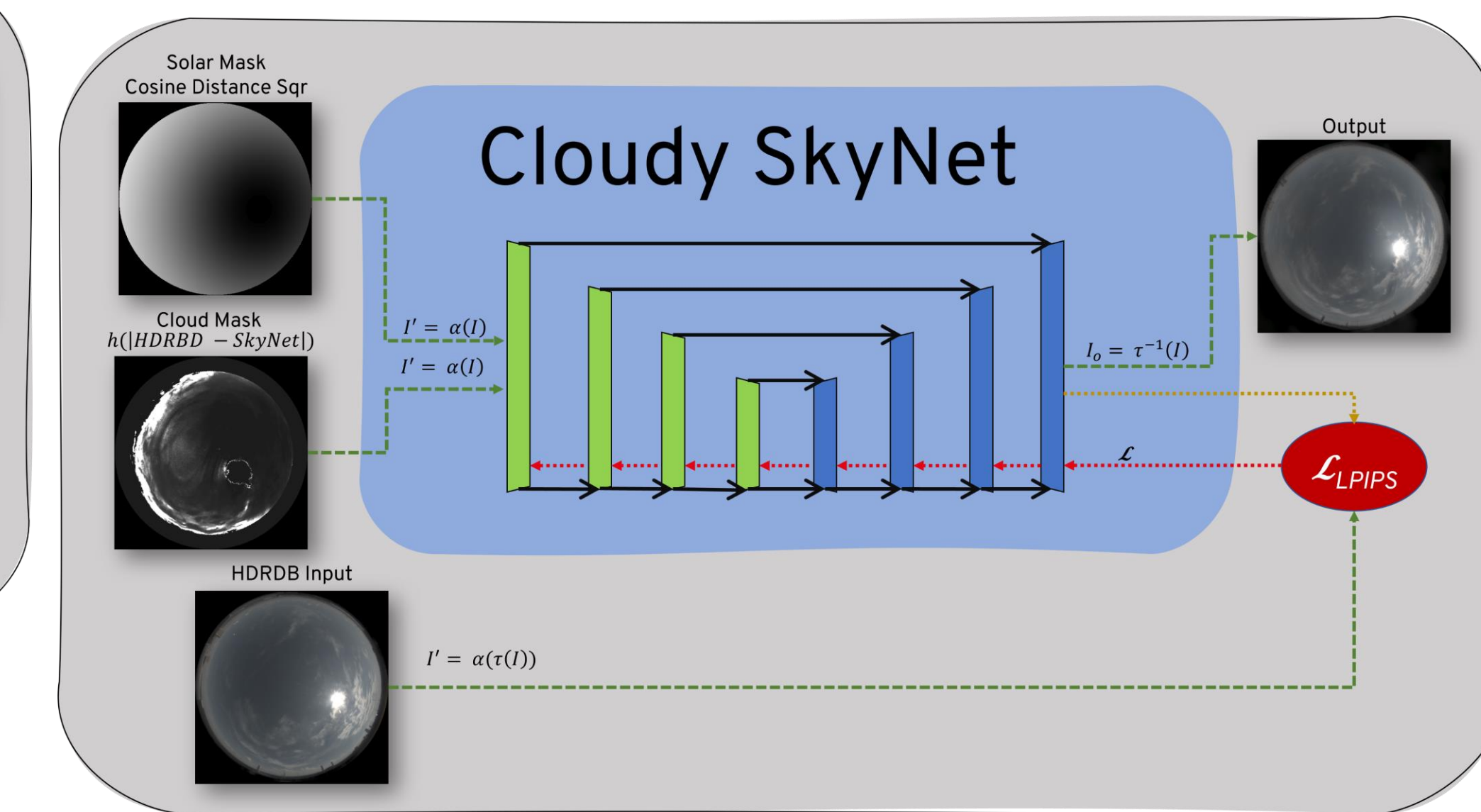
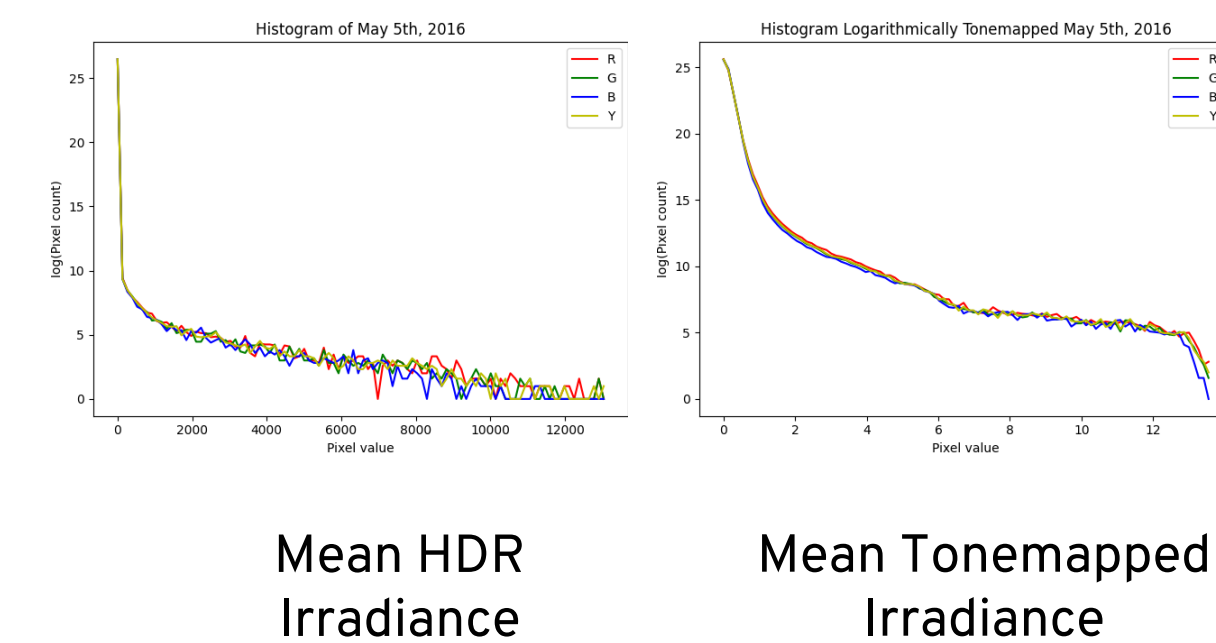
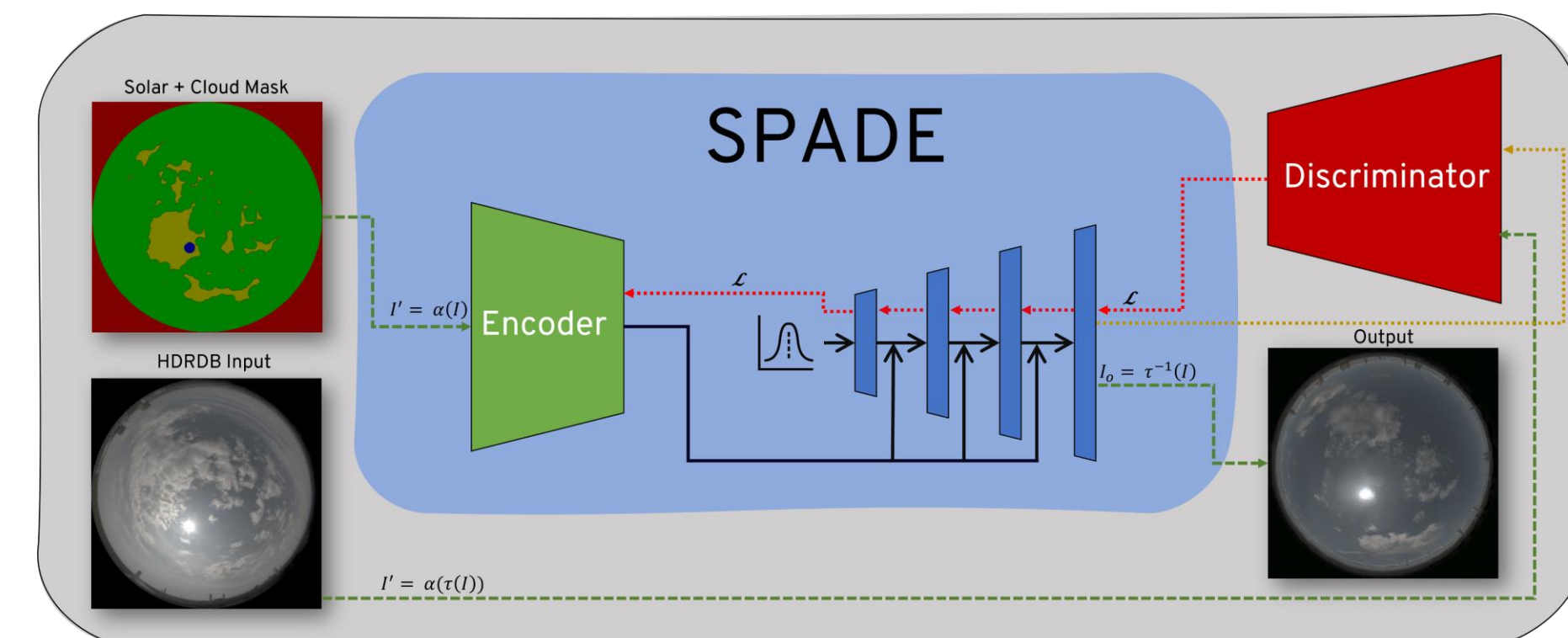
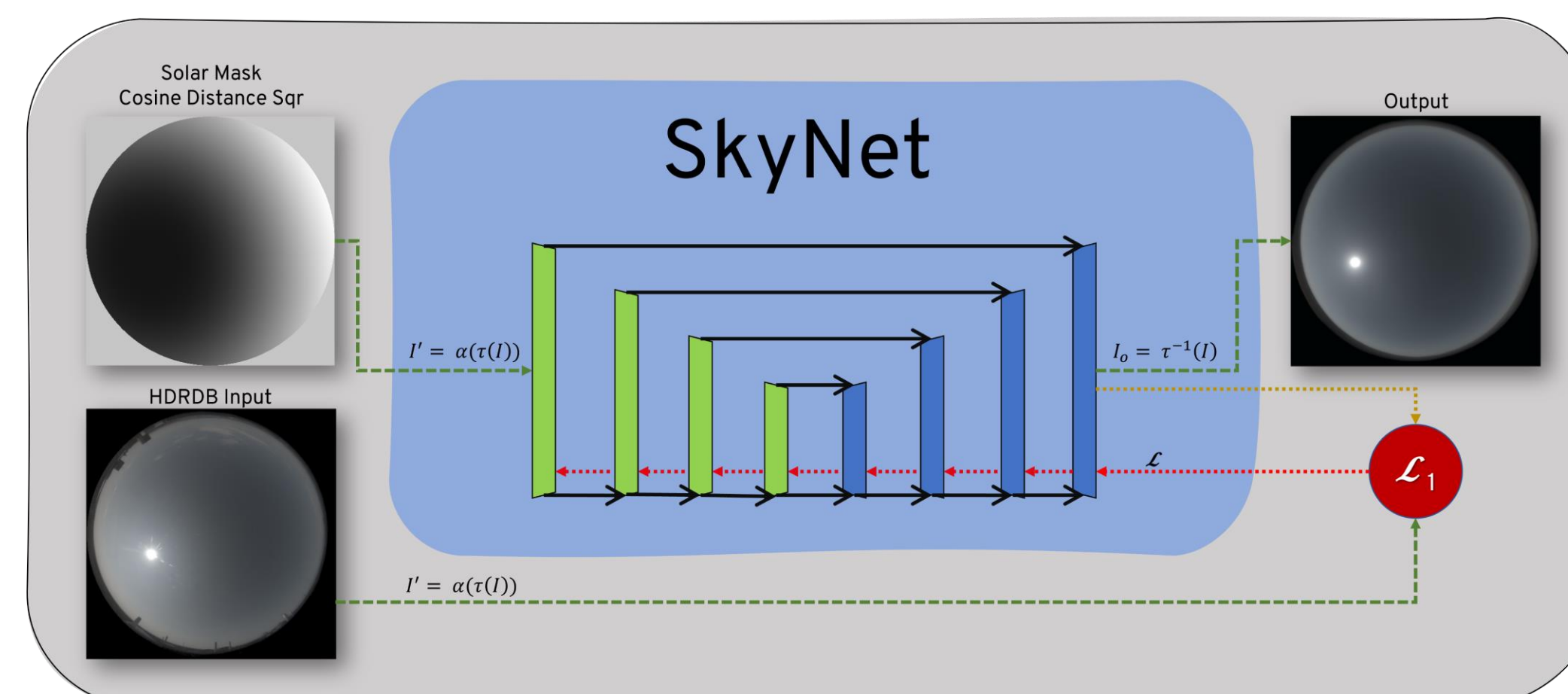
- Visual artifacts are few. Subject to lens flair, vignetting, and ghosting.



Mean of 34,968 HDR images

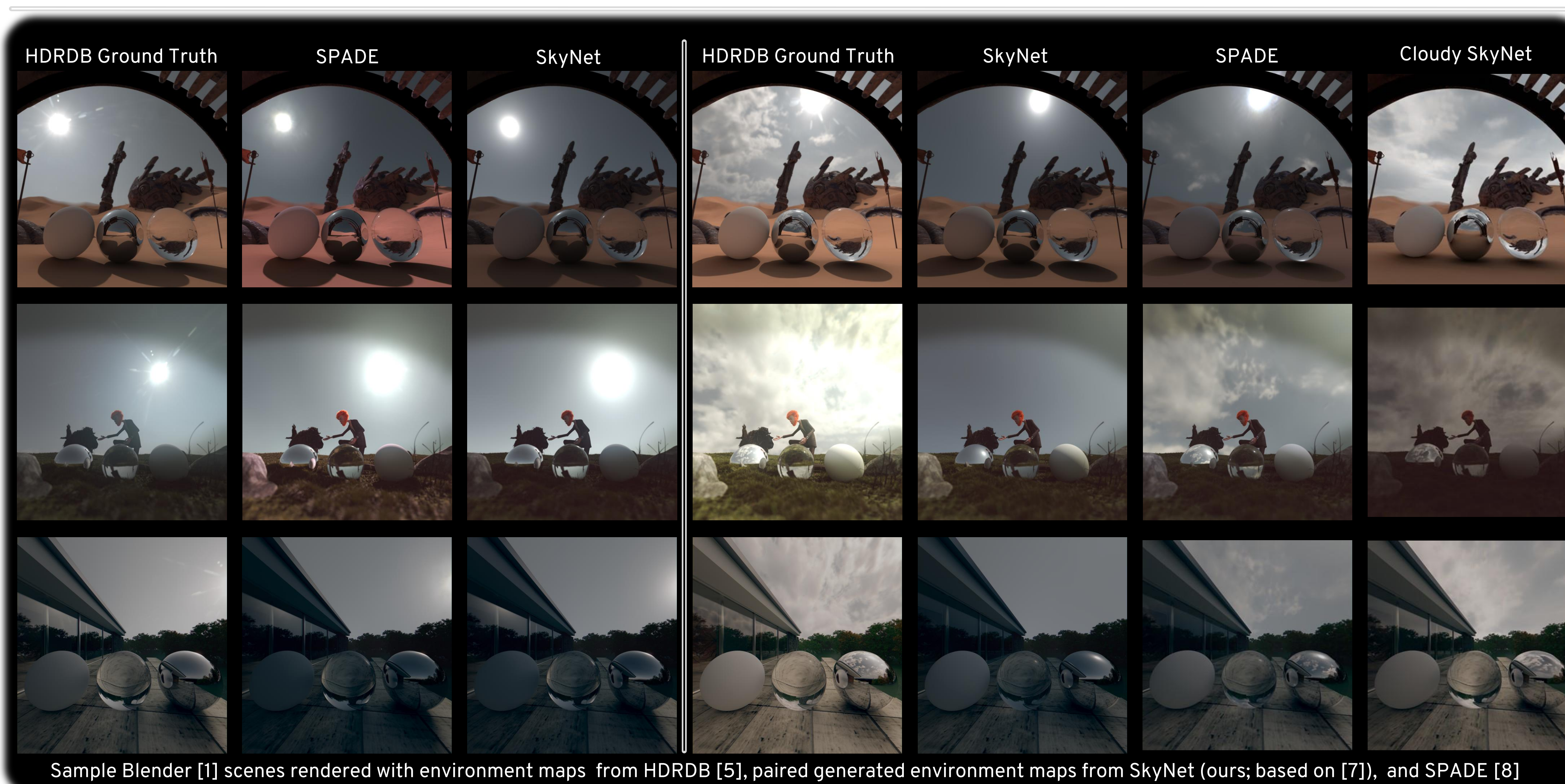
Mean of 34,968 augmented HDR images

Method.



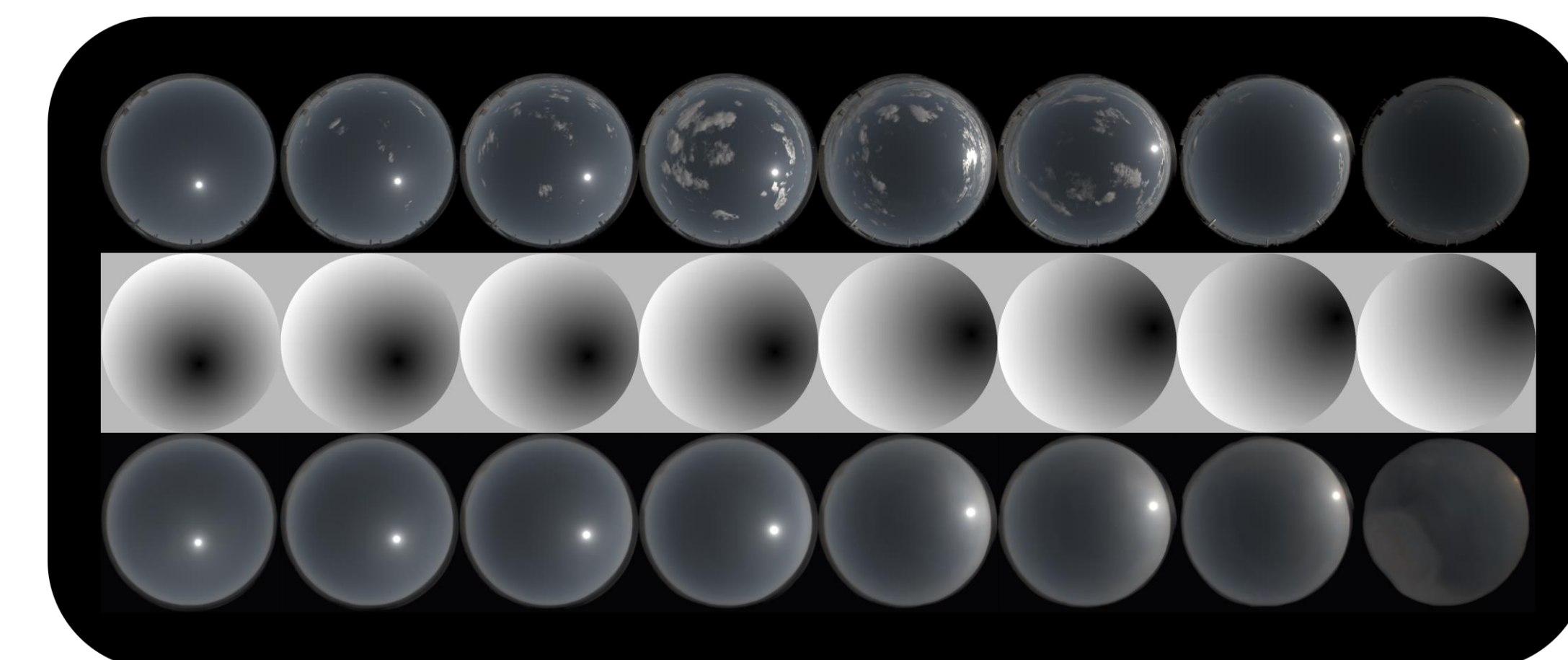
Where:

- α defines uniform random affine rotation around zenith.
- $h(I)$ defines HSV cloud segmentation.
- τ defines logarithmic tonemapping by $\tau(I) = \log_2(I + 1)$ and inversely $\tau^{-1}(I) = 2^I - 1$

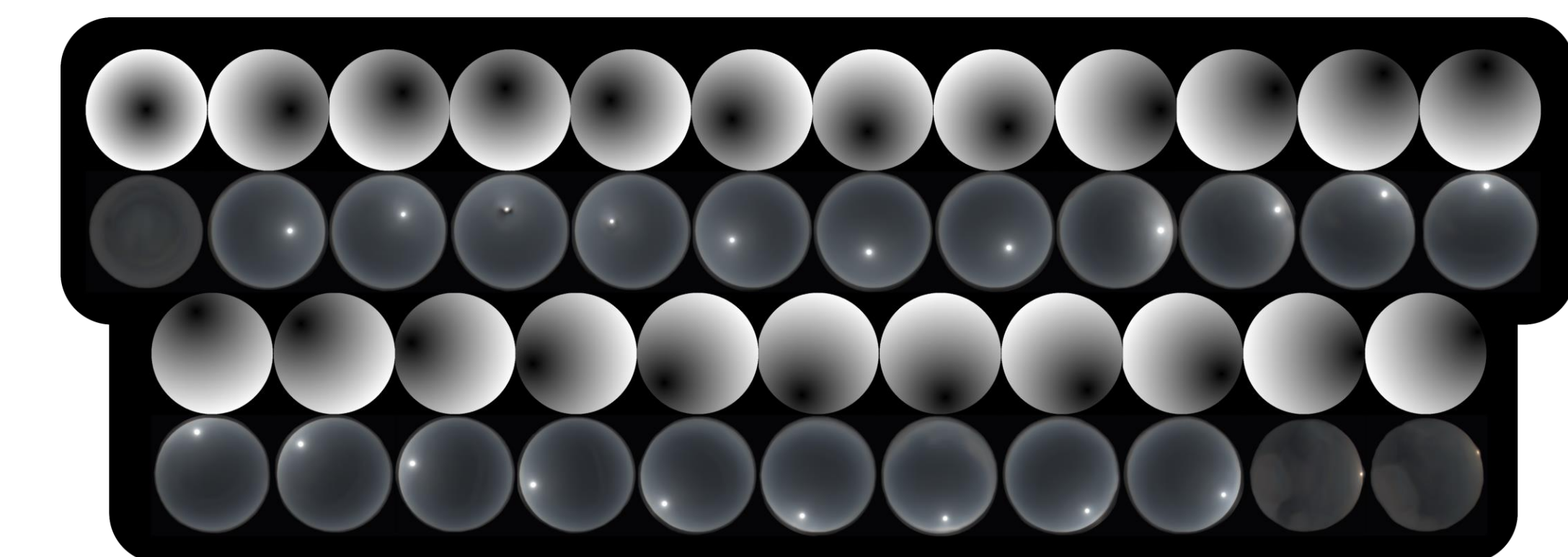


Sample Blender [1] scenes rendered with environment maps from HDRDB [5], paired generated environment maps from SkyNet (ours; based on [7]), and SPADE [8]

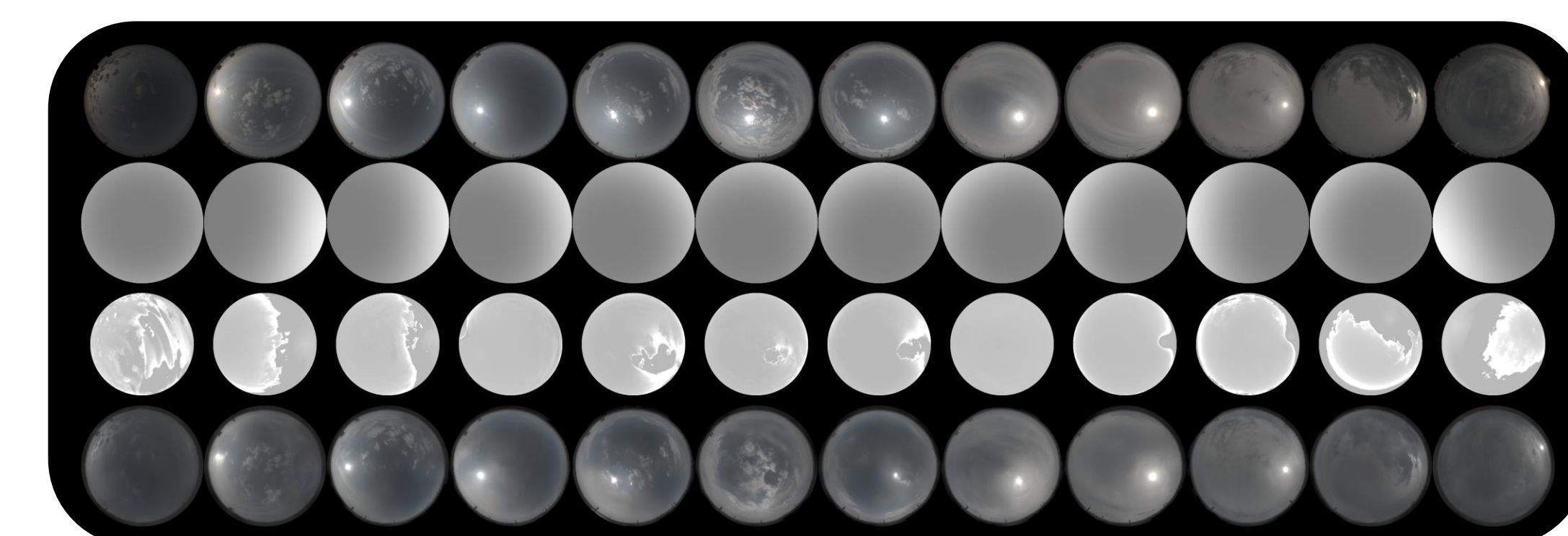
Results.



Environment maps of clear skies visually match paired images from the Laval HDR Sky Database.



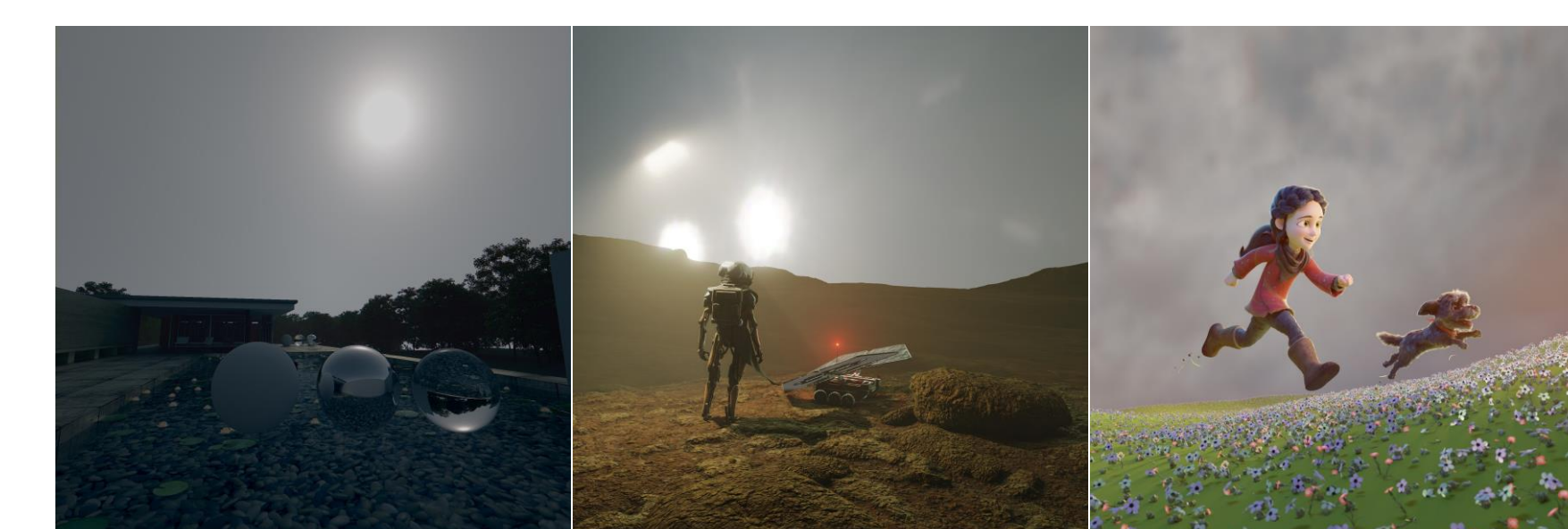
Environment maps of clear skies can be generated per artist specification for any desired time-of-day



Environment maps of cloudy skies can be generated per artist specification from a multimodal family of atmospheric components to creating a wide range of weather pattern.

Applications.

Sky models are an integral part of daylight environment simulation with various applications, including civil engineering, urban planning and visual arts.



Sample Blender creations with artistic use of environment maps [1]

References:

- [1] Blender Foundation. Blender 3.1. [Online]. Available: <https://www.blender.org/>
- [2] T. Nishita, T. Srai, K. Tadamura, and E. Nakamae, "Display of the earth taking into account atmospheric scattering," in Proceedings of the 20th annual conference on Computer graphics and interactive techniques, 1993, pp. 175–182.
- [3] A. J. Pretham, P. Shirley, and B. Smits, "A practical analytic model for daylight," in Proceedings of the 26th Annual Conference on Computer Graphics and Interactive Techniques, ser. SIGGRAPH '99. USA: ACM Press/Addison-Wesley Publishing Co., 1999, p. 91–100. [Online]. Available: <https://doi.org/10.1145/311535.311545>
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- [6] J. Stumpfel, A. Jones, A. Wenger, C. Tchou, T. Hawkins, and P. Debevec, "Direct hdr capture of the sun and sky," in ACM SIGGRAPH 2006 Courses, ser. SIGGRAPH '06. New York, NY, USA: Association for Computing Machinery, 2006, p. 5–es. [Online]. Available: <https://doi.org/10.1145/1185657.1185687>
- [7] D. Griffiths, T. Ritschel, and J. Philip, "Outcast: Outdoor single-image relighting with cast shadows," Computer Graphics Forum, vol. 41, no. 2, pp. 179–193, 2022. [Online]. Available: <https://onlinelibrary.wiley.com/doi/abs/10.1111/cgf.14467>
- [8] T. Park, M. Liu, T. Wang, and J. Zhu, "Semantic image synthesis with 130 spatially-adaptive normalization," CoRR, vol. abs/1903.07291, 2019. [Online]. Available: 131 <http://arxiv.org/abs/1903.07291>



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