

Night Sky Explorer VR

Immersive Visualization of Territories Under Artificial Light

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Maxim Spur, 09/10/2025

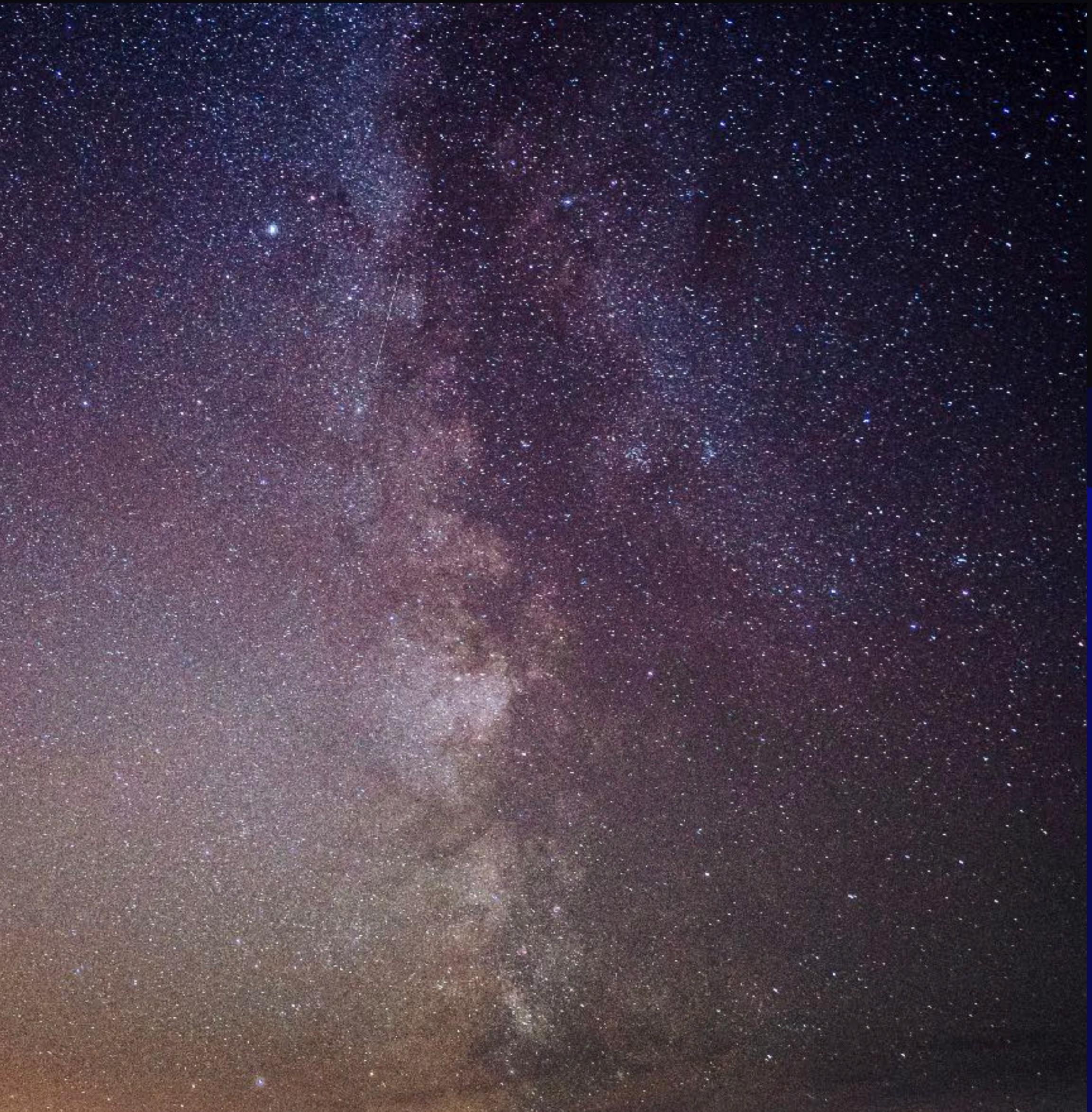
Journée Territoires et Immersion(s) – Pessac

Night Sky

Skyglow

Light Pollution

Artificial Light at Night

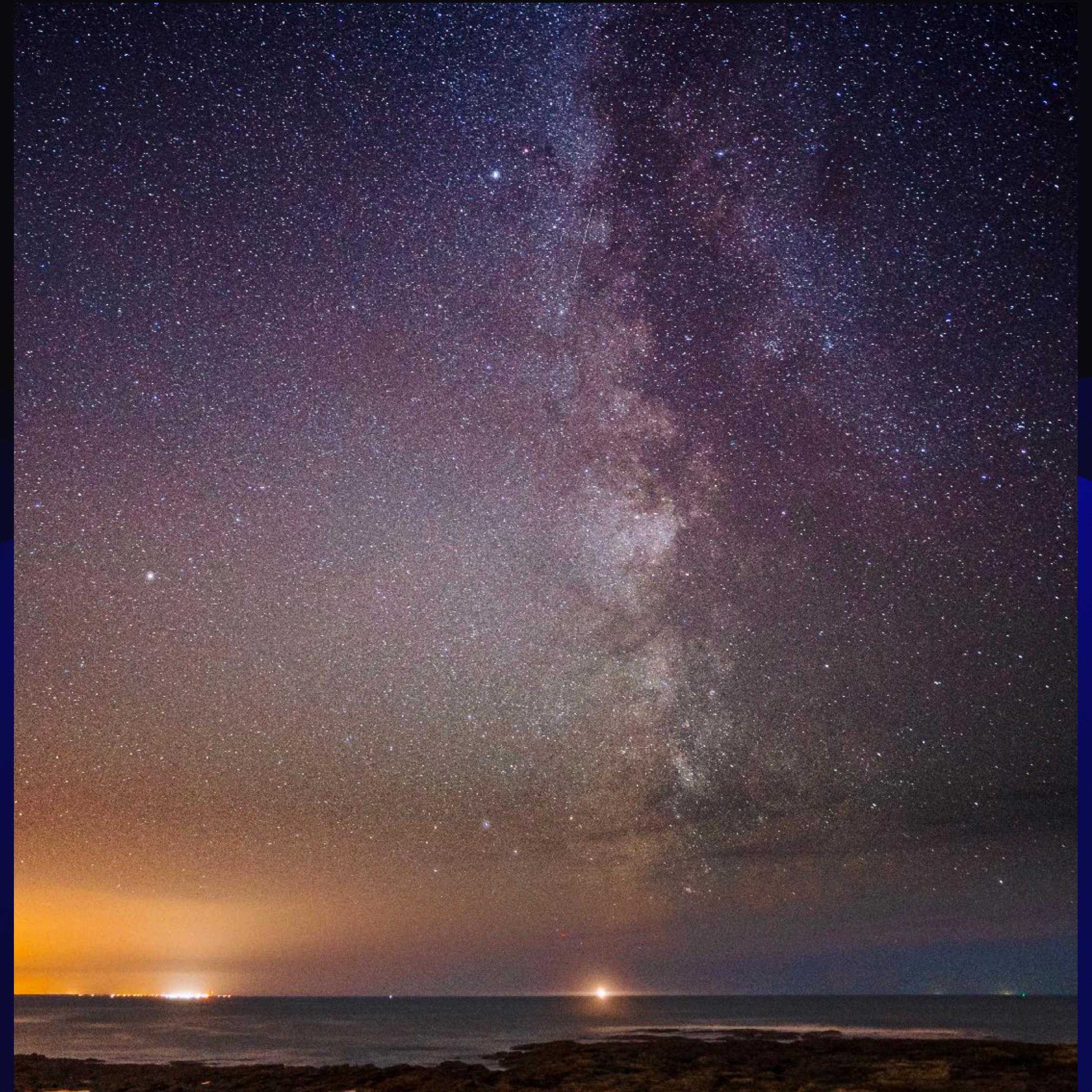


Night Sky

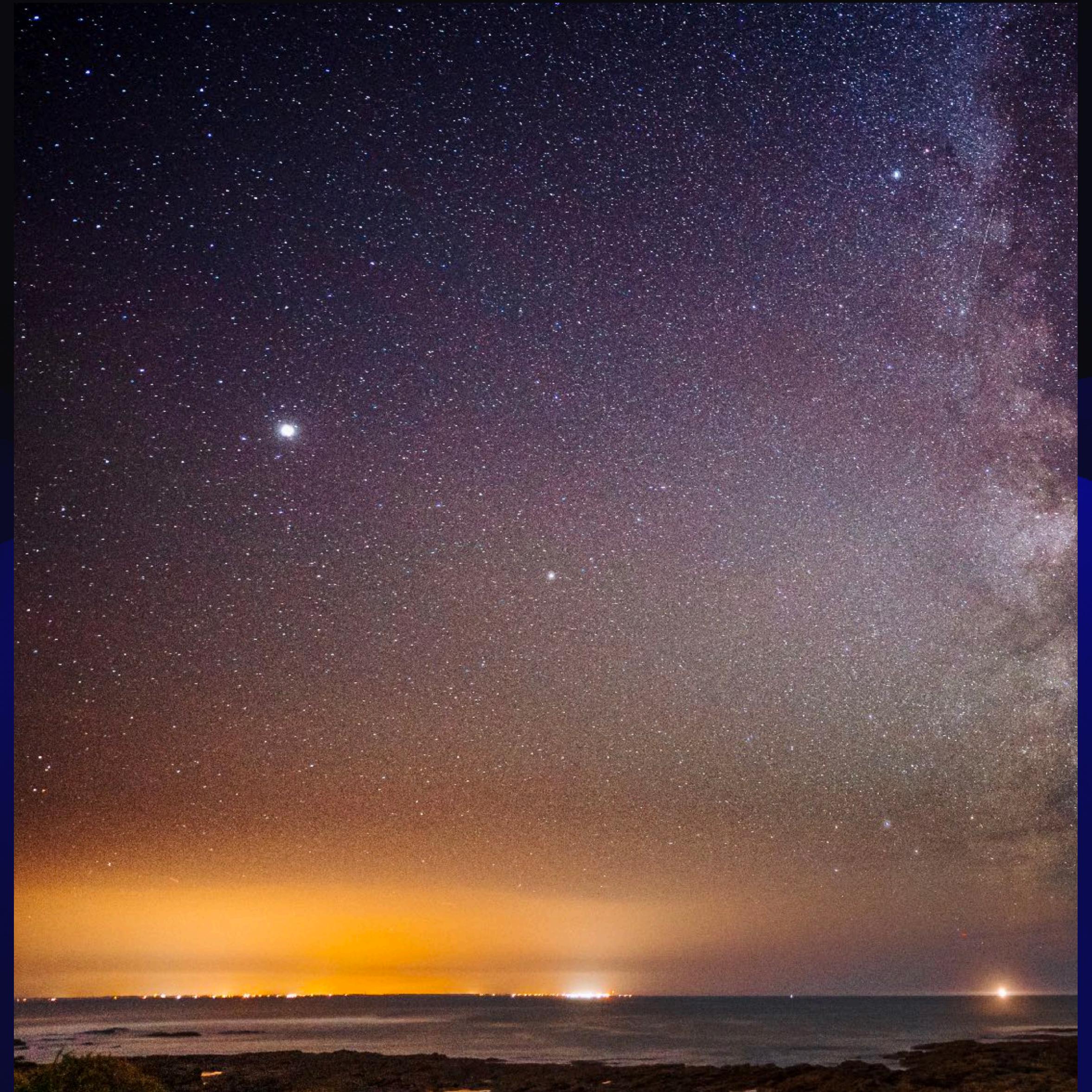
Skyglow

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Night Sky Skyglow Light Pollution Artificial Light at Night



Night Sky Skyglow Light Pollution Artificial Light at Night



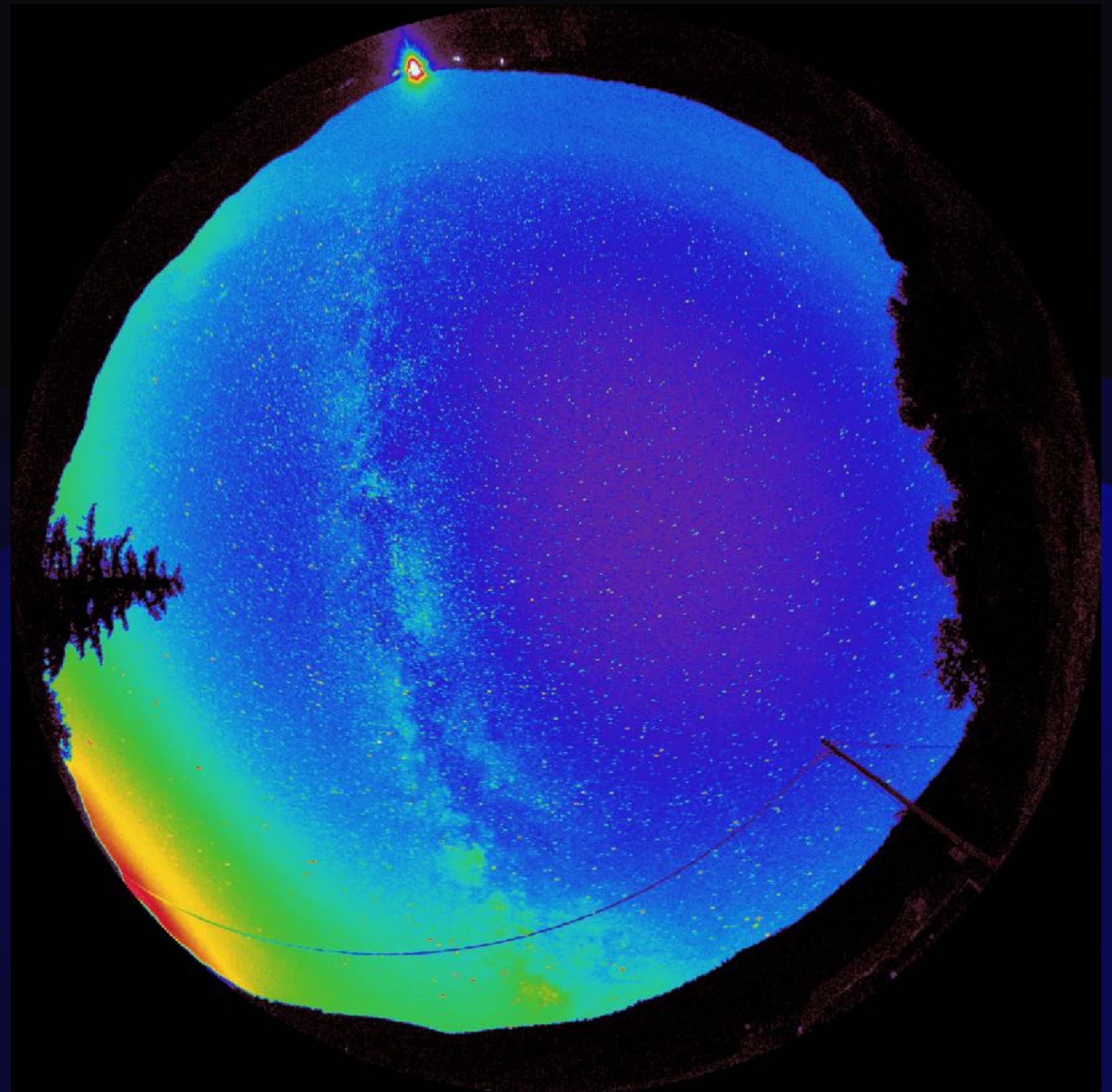
All-Sky Images

From DarkSkyLab

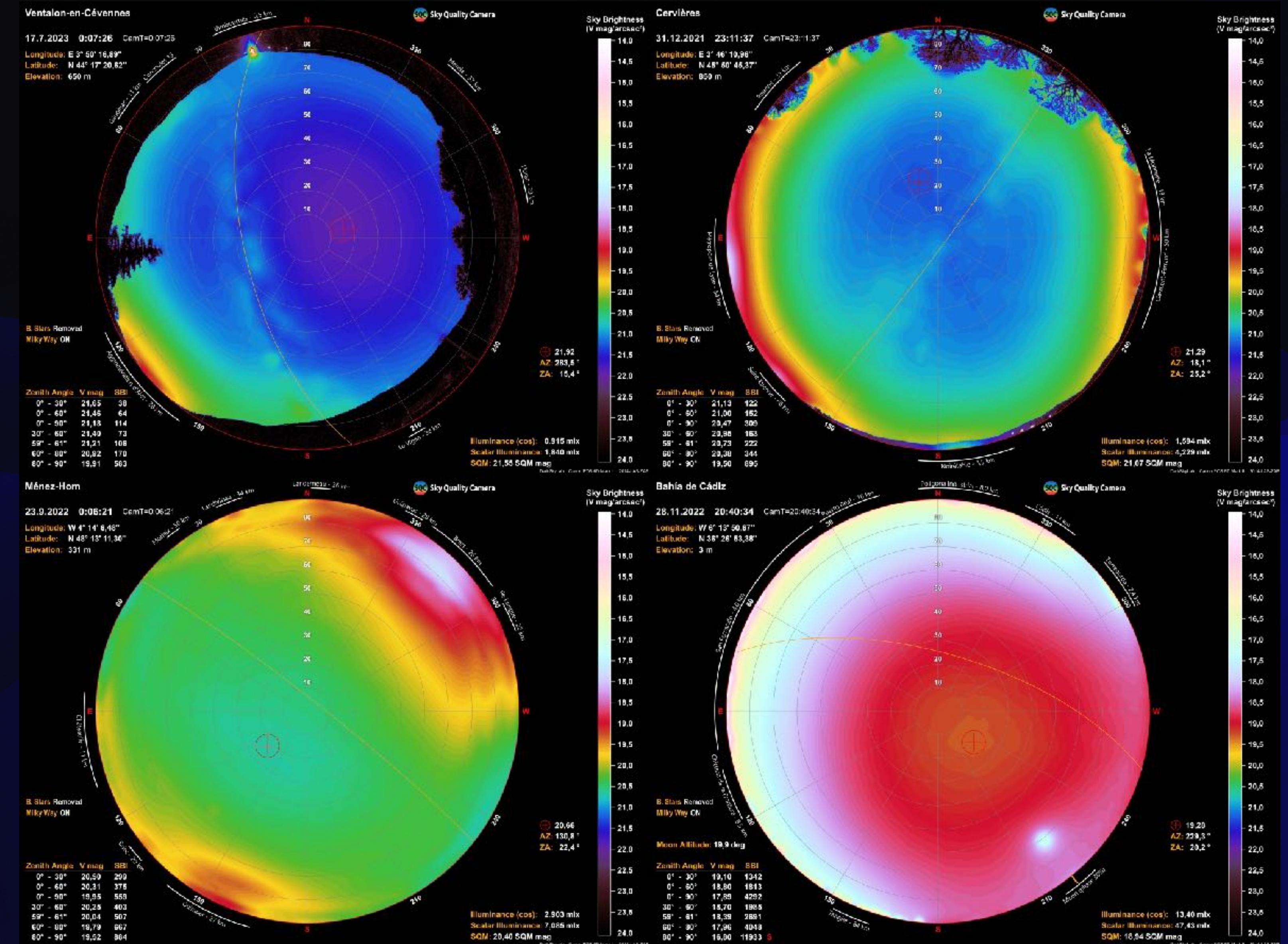
Visual



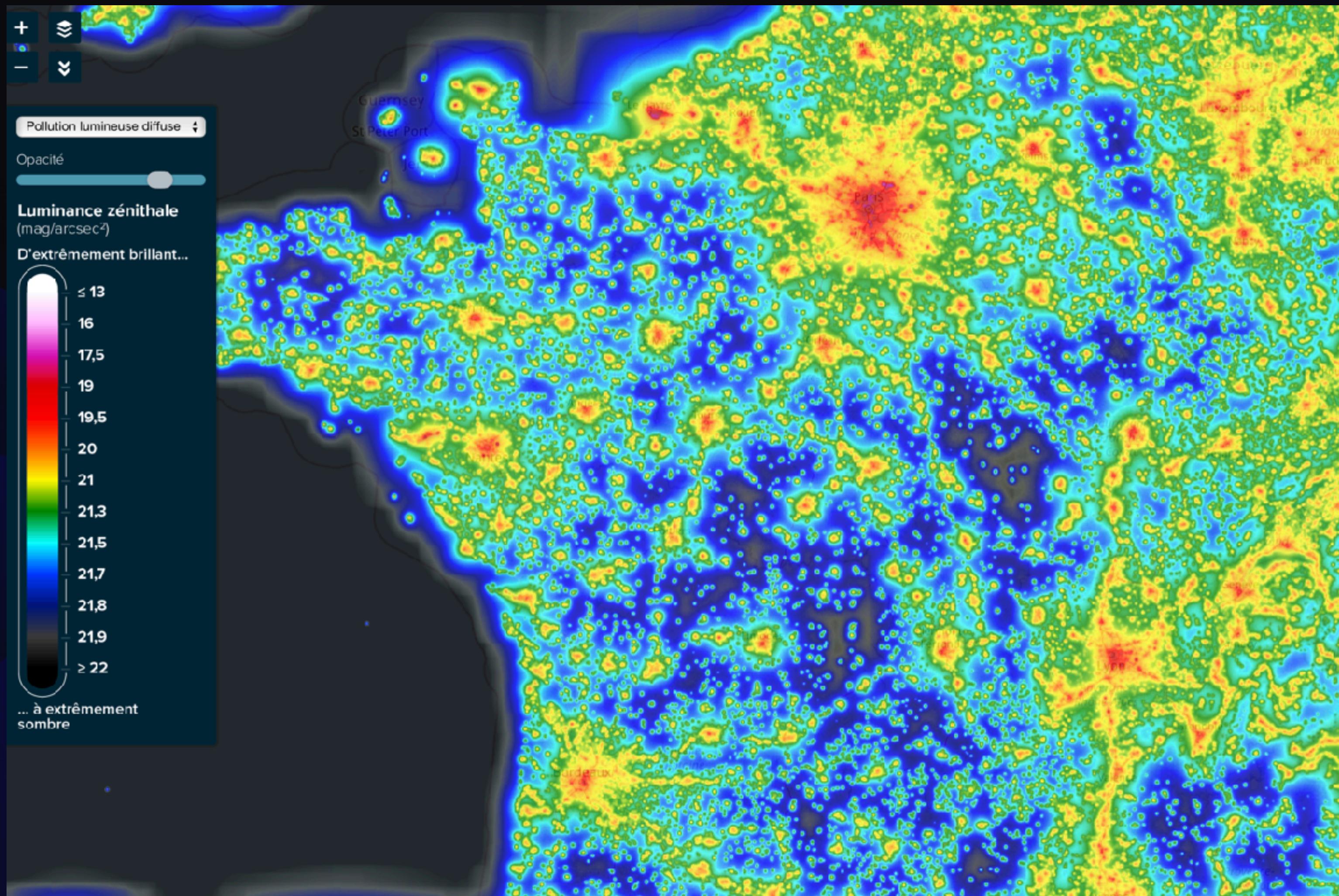
All-Sky Images From DarkSkyLab Luminance



All-Sky Images Processed and Analyzed (SkyQualityCamera)

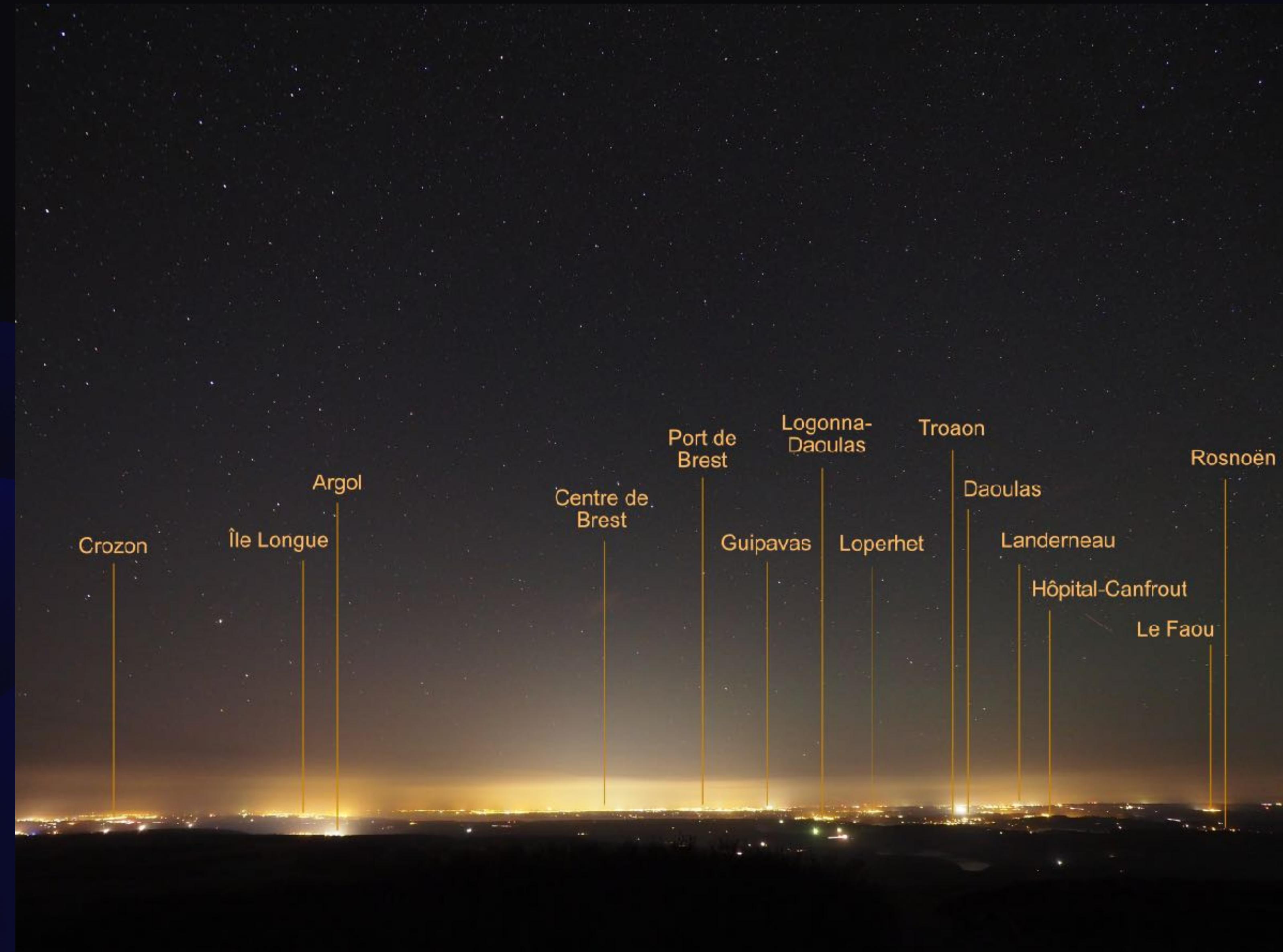


Light Sources Manually Annotated for Identification and Communication



Light emission maps used for reference, © DarkSkyLab

Light Sources Manually Annotated for Identification and Communication

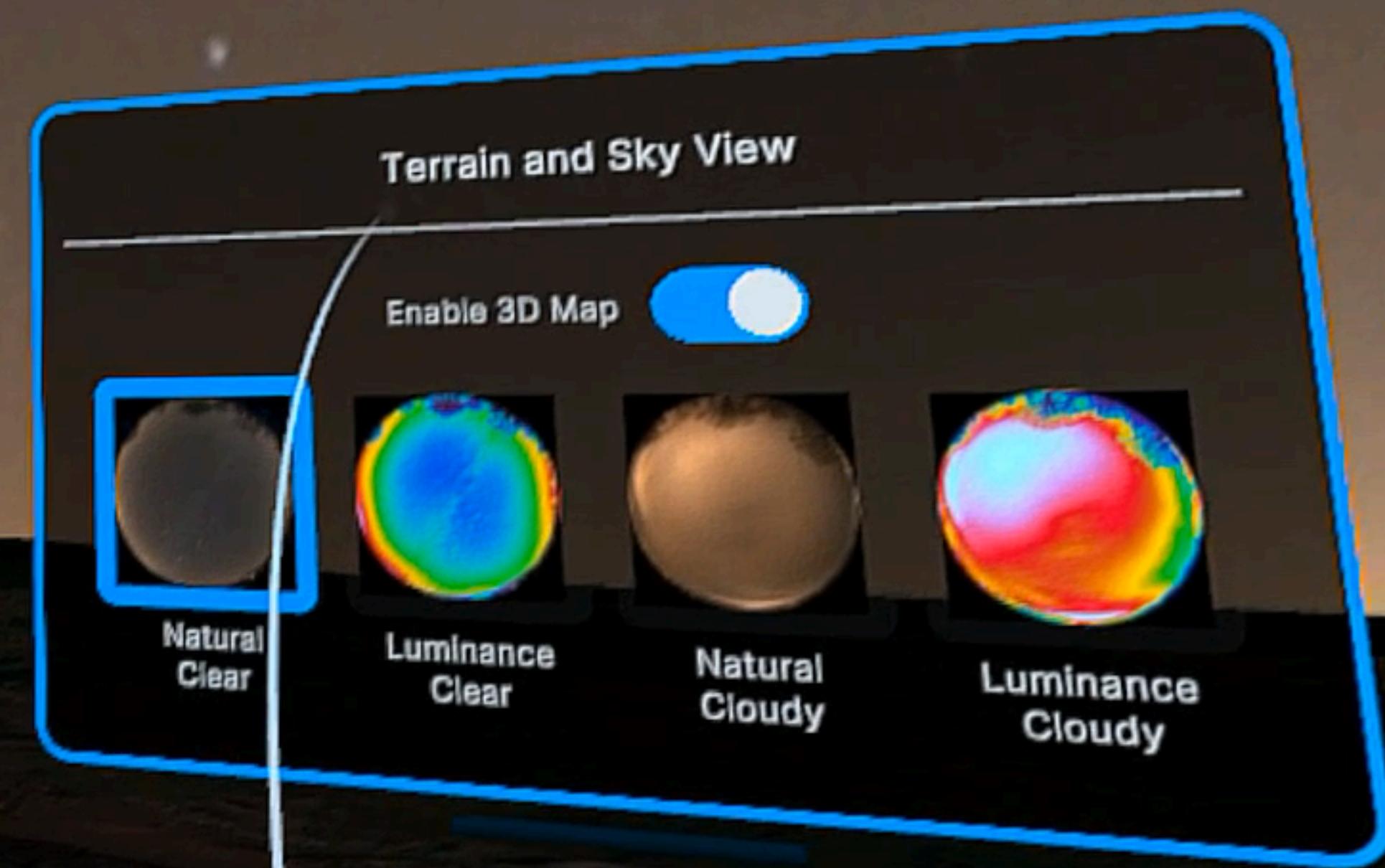


Brought to VR

All-Sky Images as Skybox

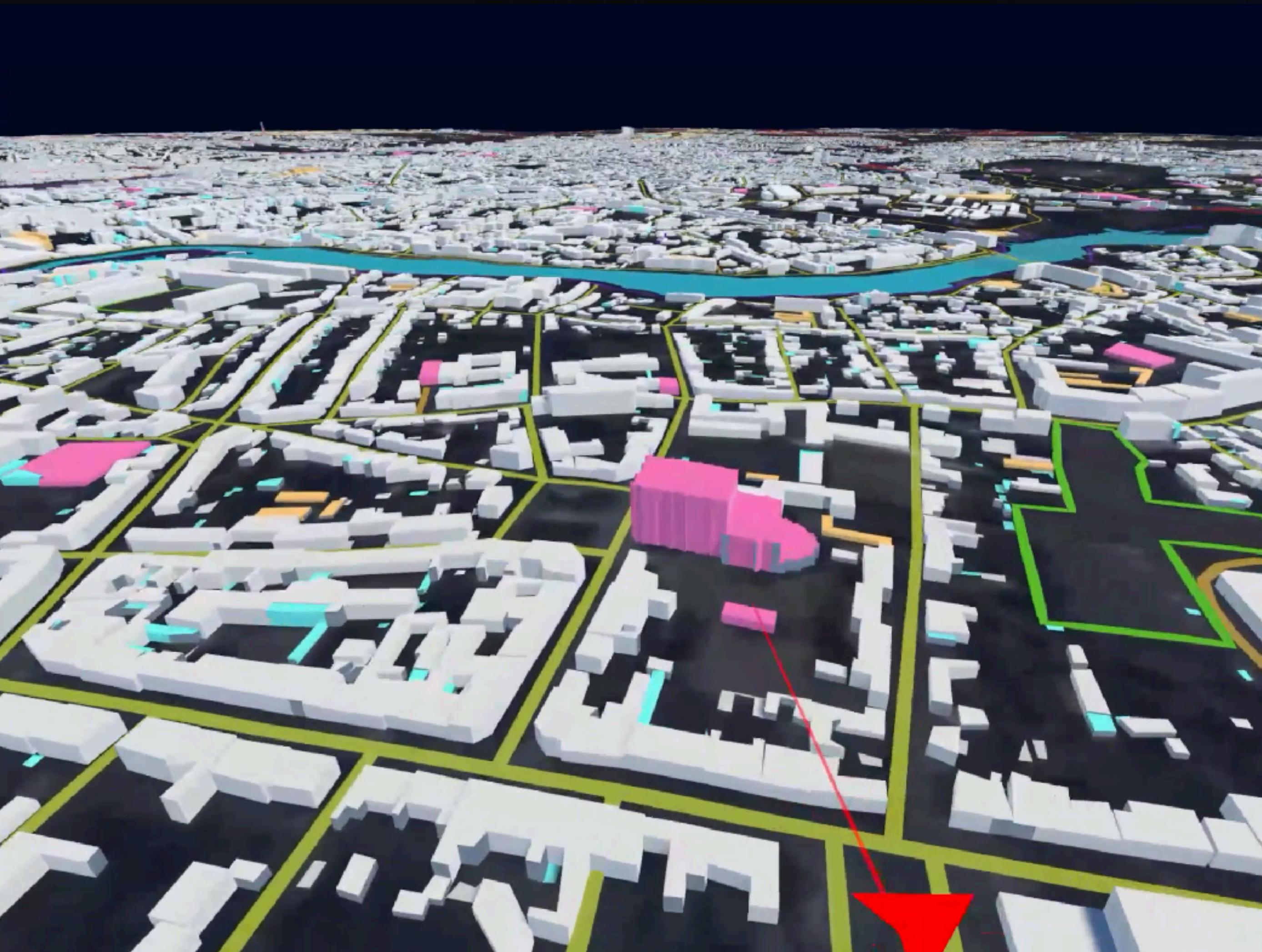
Google Earth Geometry

through Cesium in Unity



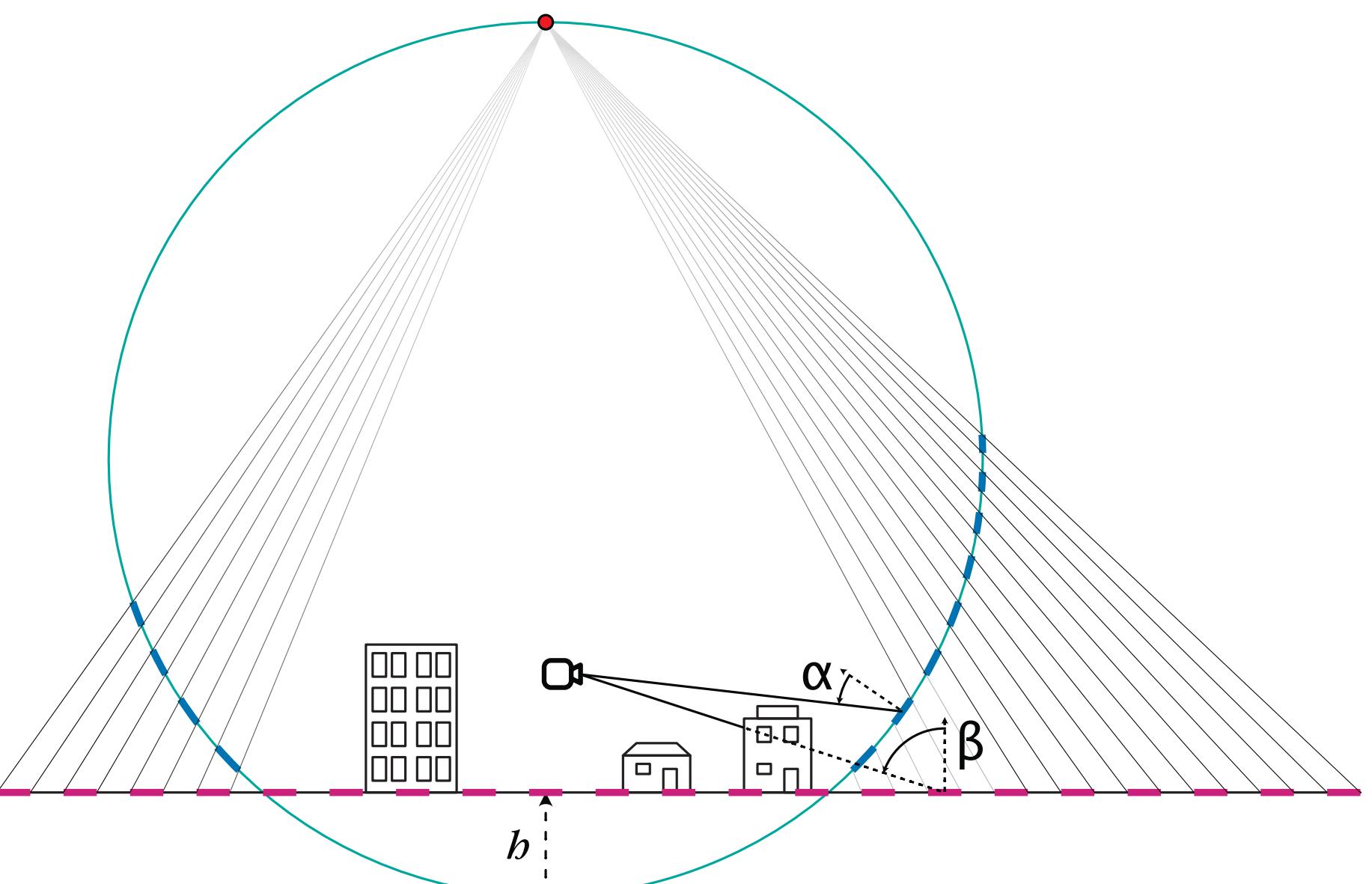
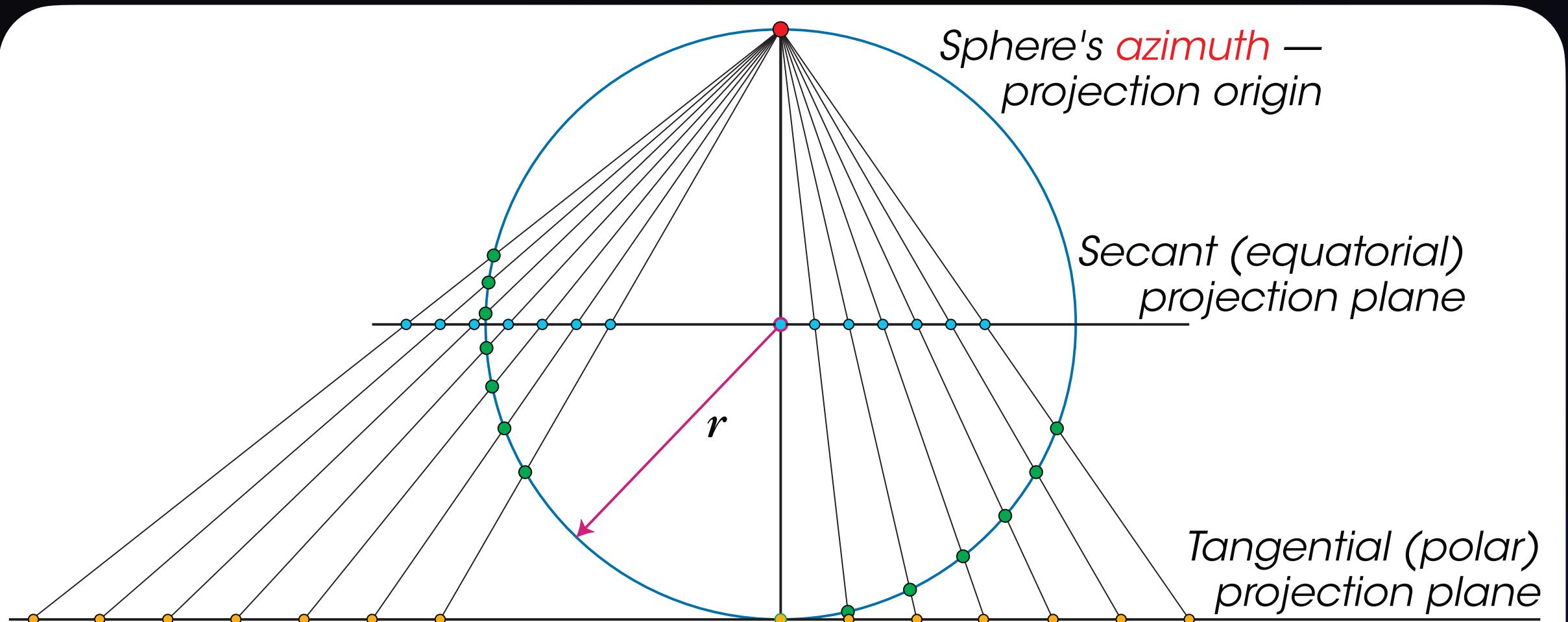
Inverse Stereographic Projection

From previous (PhD) work

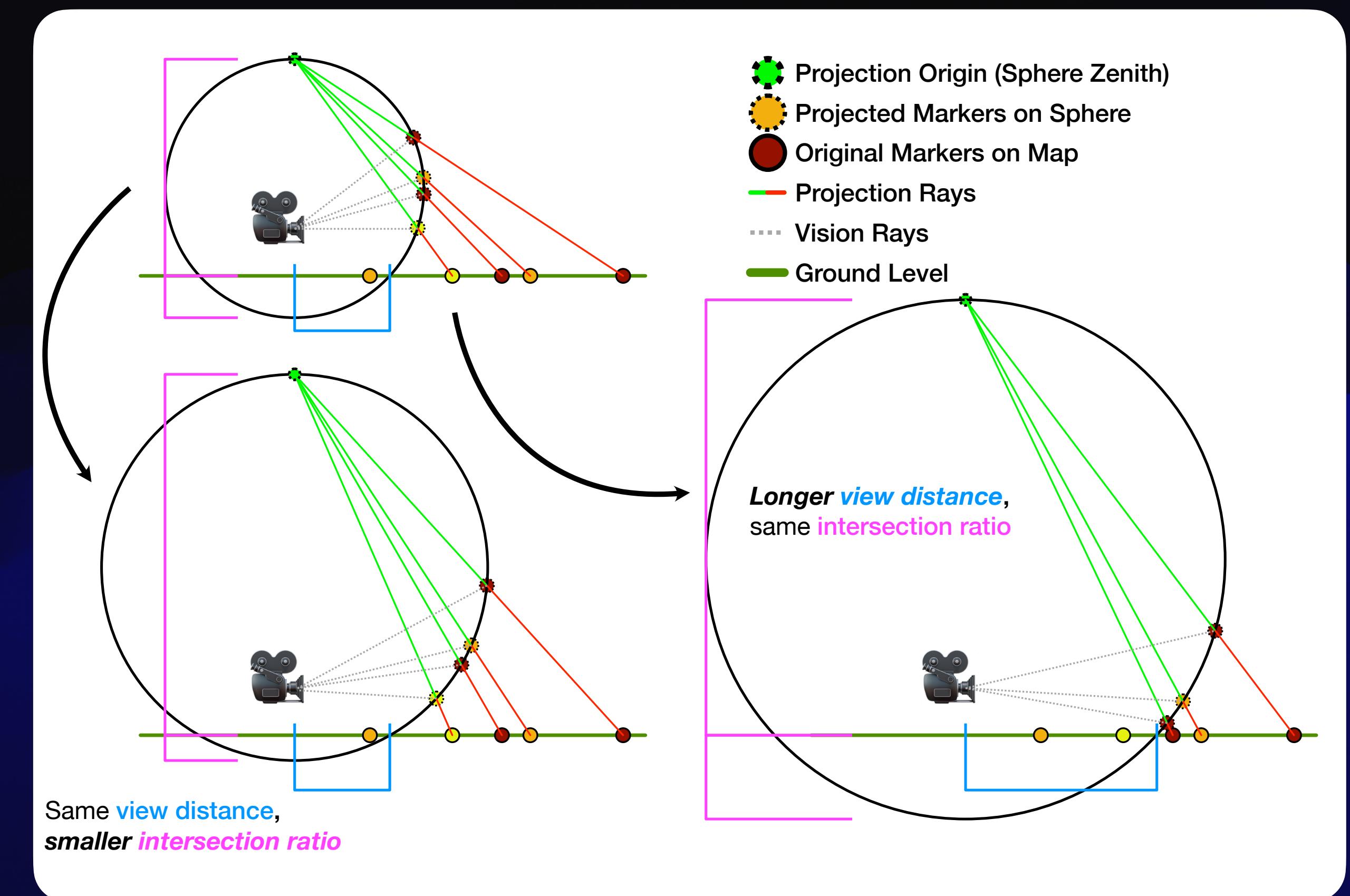


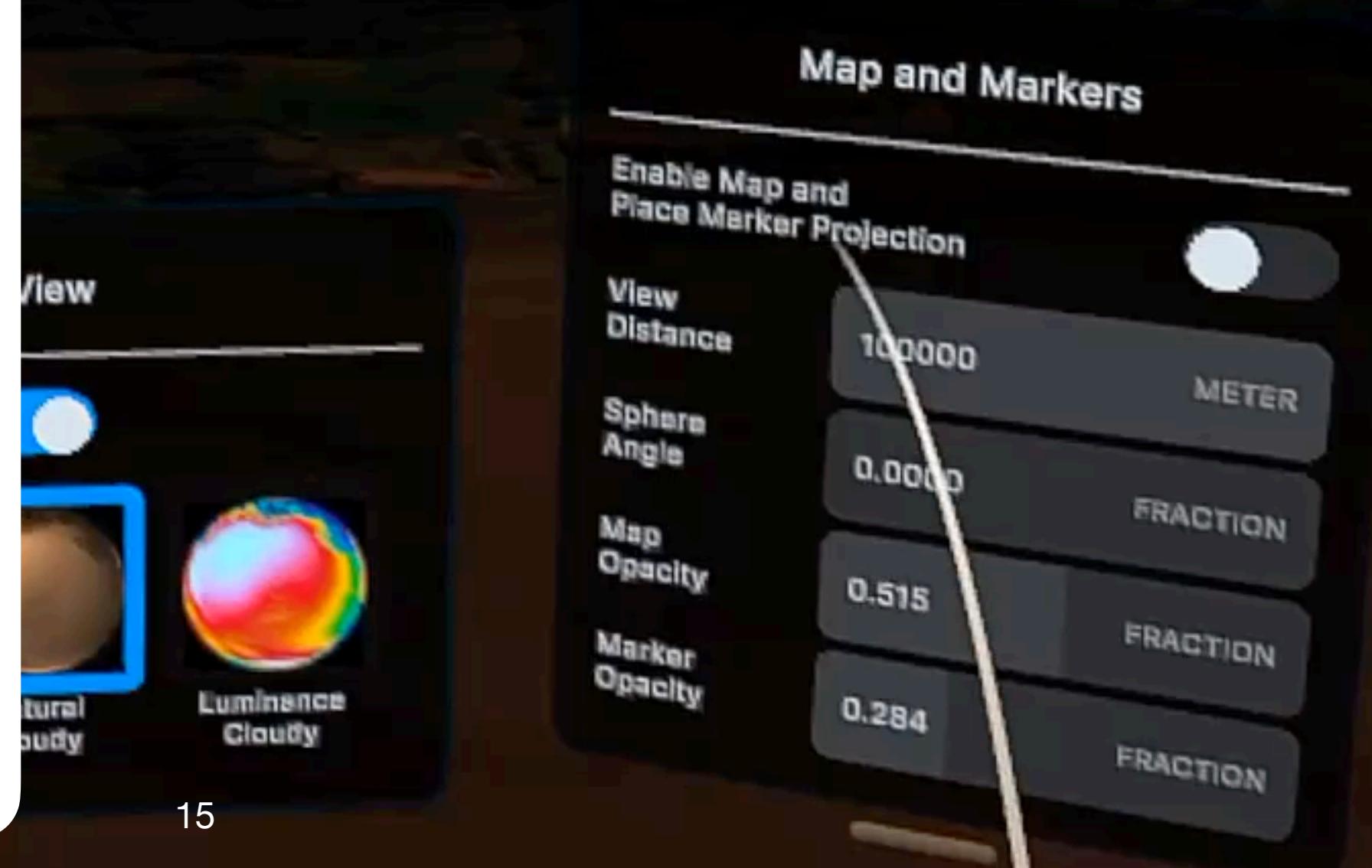
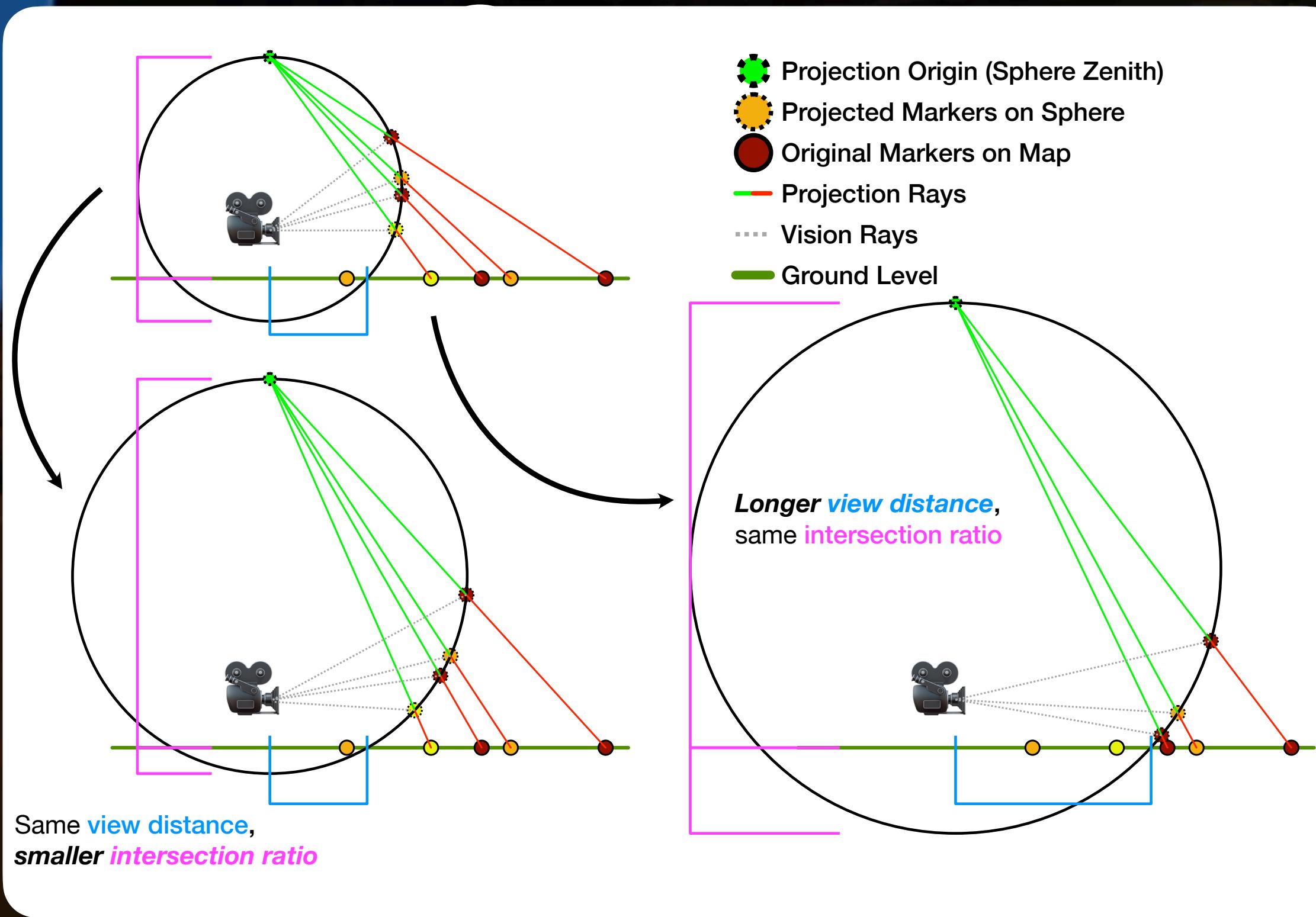
Inverse Stereographic Projection

- Originally for mapping spheres to planes
- Conformal projection: preservation of local angles and small shapes
- Inverted and adapted for focus + context views of urban environments



Inverse Stereographic Projection Interaction Parameters



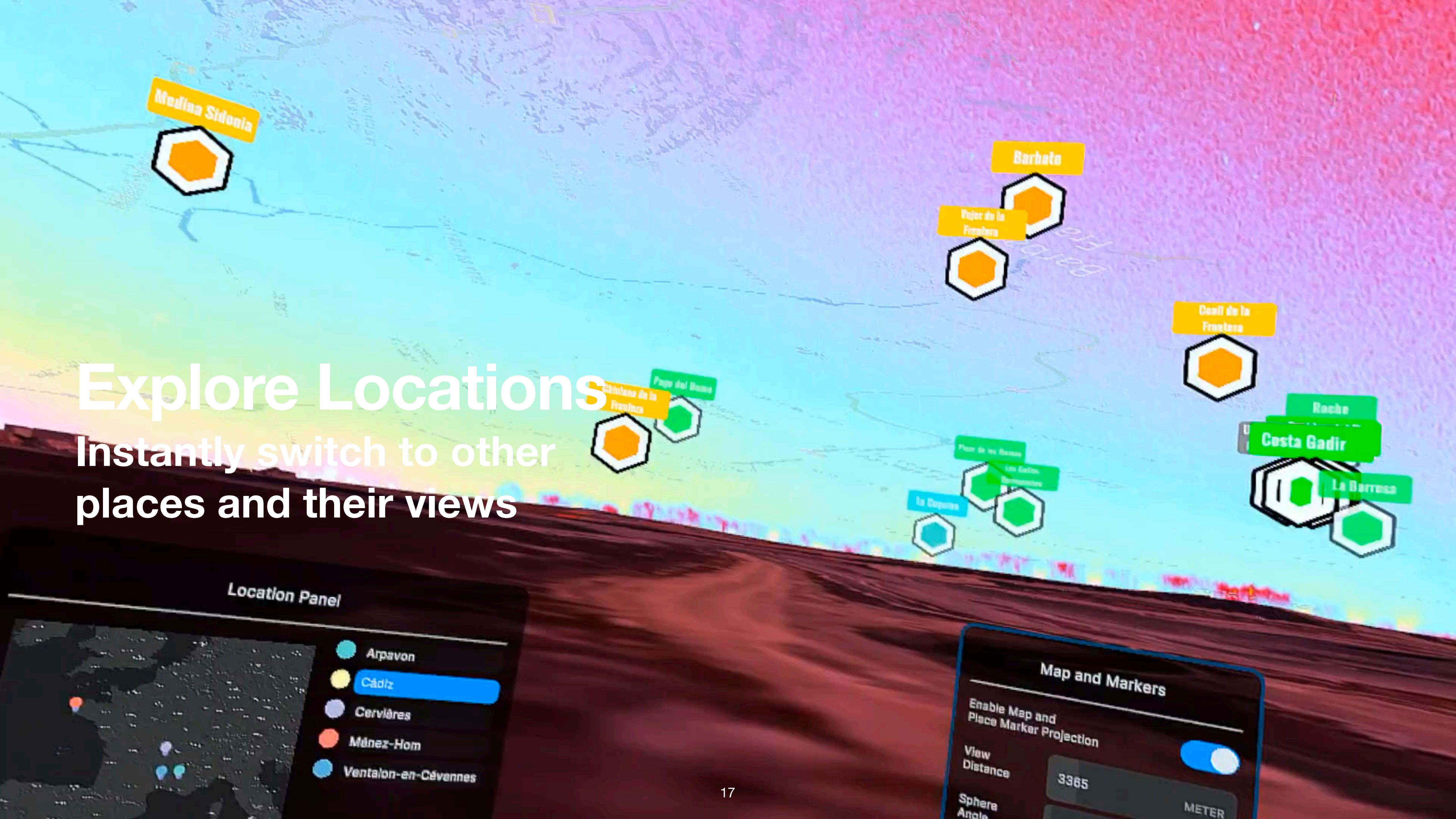


Explore Locations

Instantly switch to other
places and their views

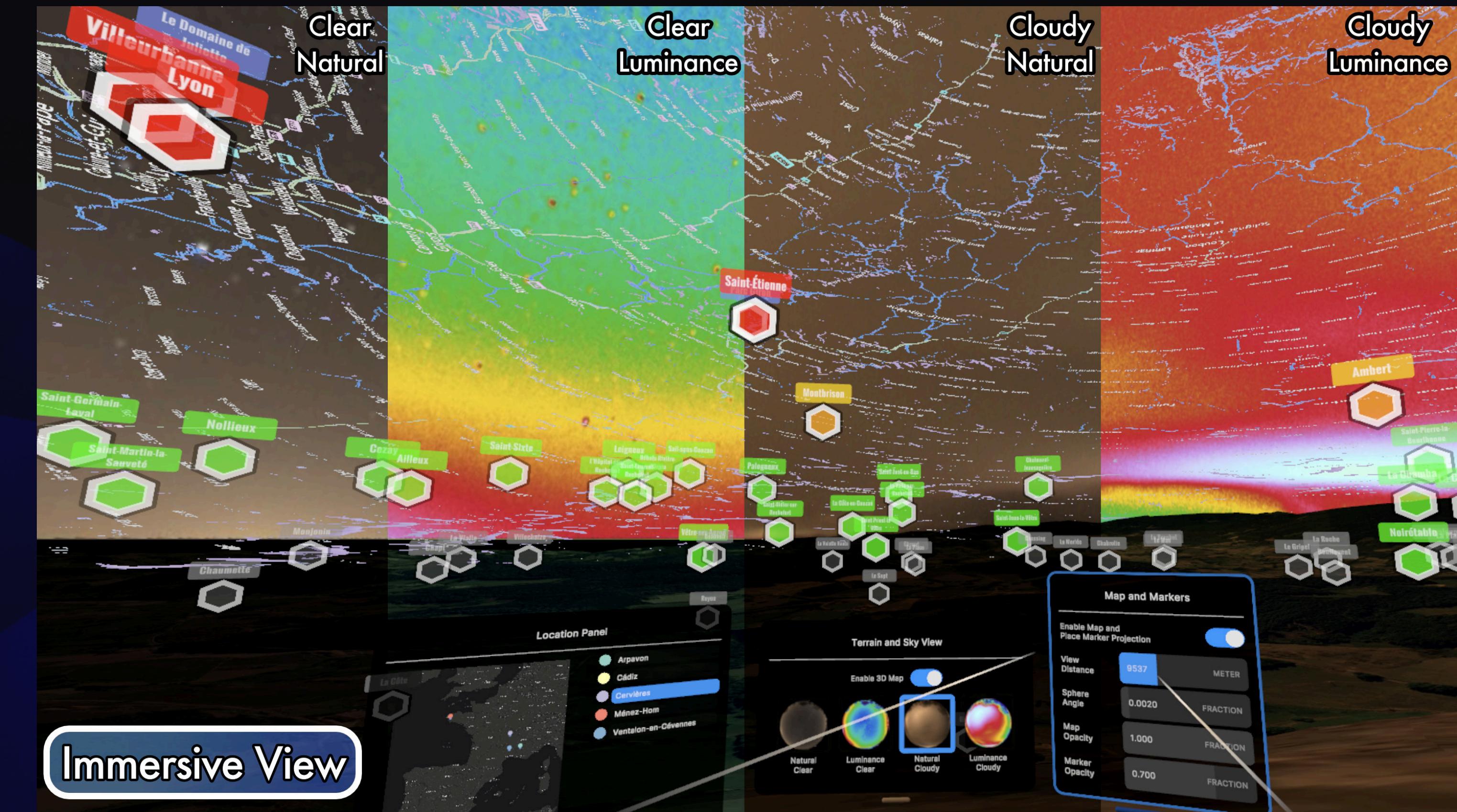
Explore Locations

Instantly switch to other places and their views



Value Added Analysis

- Fast Identification
- Education
- Exploration
- Outreach
- Communication



Next Steps

Add Simulation

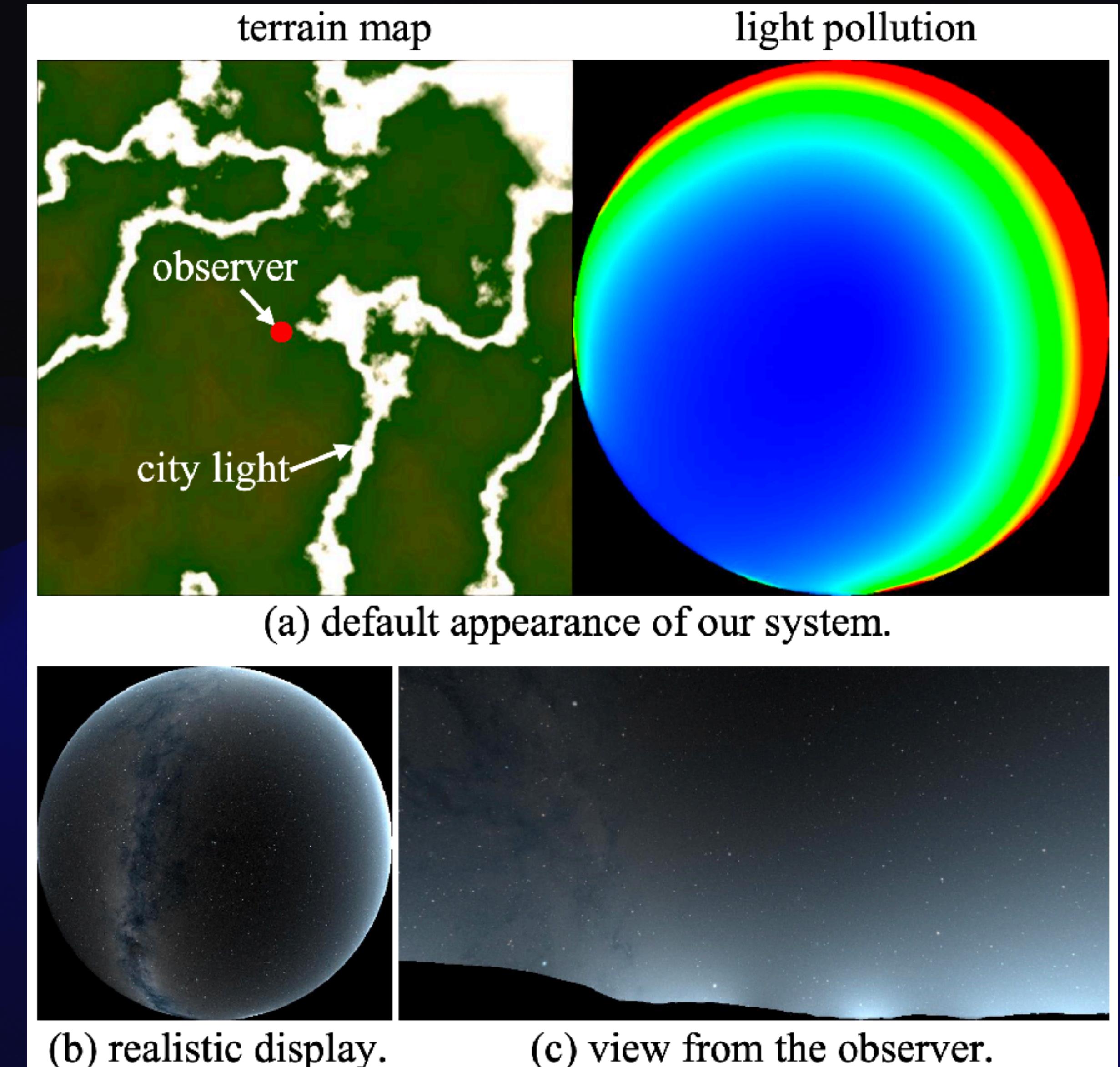
- VIIRS-DNB Satellite data as input, all-sky image as output
- Would allow for exploration of any location!



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References

Further Reading

- J. C. Barentine. **Night sky brightness measurement, quality assessment and monitoring.** Nature Astronomy, 6(10):1120–1132, 2022.
doi: 10.1038/s41550-022-01756-2 1
- P. Deverchère, S. Vauclair, G. Bosch, S. Moulherat, and J. H. Cornuau. **Towards an absolute light pollution indicator.** Scientific Reports, 12(1):17050, Oct 2022.
doi: 10.1038/s41598-022-21460-5 1
- Y. Dobashi, N. Ishikawa, and K. Iwasaki. **Efficient Visualization of Light Pollution for the Night Sky.** ACM Transactions on Graphics, 42(6), 2023. doi: 10.1145/3618337 2
- A. Jechow, F. Höller, and C. C. Kyba. **Using all-sky differential photometry to investigate how nocturnal clouds darken the night sky in rural areas.** Scientific Reports, 9(1):1–14, 2019. doi: 10.1038/s41598-018-37817-8 1
- A. Jechow, C. C. Kyba, and F. Höller. **Beyond all-sky: Assessing ecological light pollution using multi-spectral full-sphere fisheye lens imaging.** Journal of Imaging, 5(4), 2019. doi: 10.3390/jimaging5040046 1
- Y. Kawai. **Development of a 3D urban modeling and disaster visualization system using open data.** In 2024 IEEE 13th Global Conference on Consumer Electronics (GCCE), pp. 268–272, 2024. doi: 10.1109/GCCE62371.2024.10760493 1
- Z. Kolláth and A. Dömény. **Night sky quality monitoring in existing and planned dark sky parks by digital cameras.** International Journal of Sustainable Lighting, 19, 05 2017. doi: 10.26607/ijsl.v19i1.70 1
- D. Sanders, E. Frago, R. Kehoe, C. Patterson, and K. J. Gaston. **A meta-analysis of biological impacts of artificial light at night.** Nature Ecology & Evolution, 5(1):74–81, Jan 2021. doi: 10.1038/s41559-020-01322-x 1
- M. Spur, V. Tourre, G. Moreau, and P. Le Callet. **Virtual data sphere: Inverse stereographic projection for immersive multi-perspective geo-visualization.** ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, V-4-2022:235–242, 2022. doi: 10.5194/isprs-annals-V-4-2022-235-2022 2
- K. Widmer, A. Beloconi, I. Marnane, and P. Vounatsou. **Review and Assessment of Available Information on Light Pollution in Europe.** Number December. 2022.
doi: 10.5281/zenodo.7314224 1

Thank you for your attention!

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