08 Glare and Atomospheric Effects

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Thatgamecompany—*Journey* (2012)

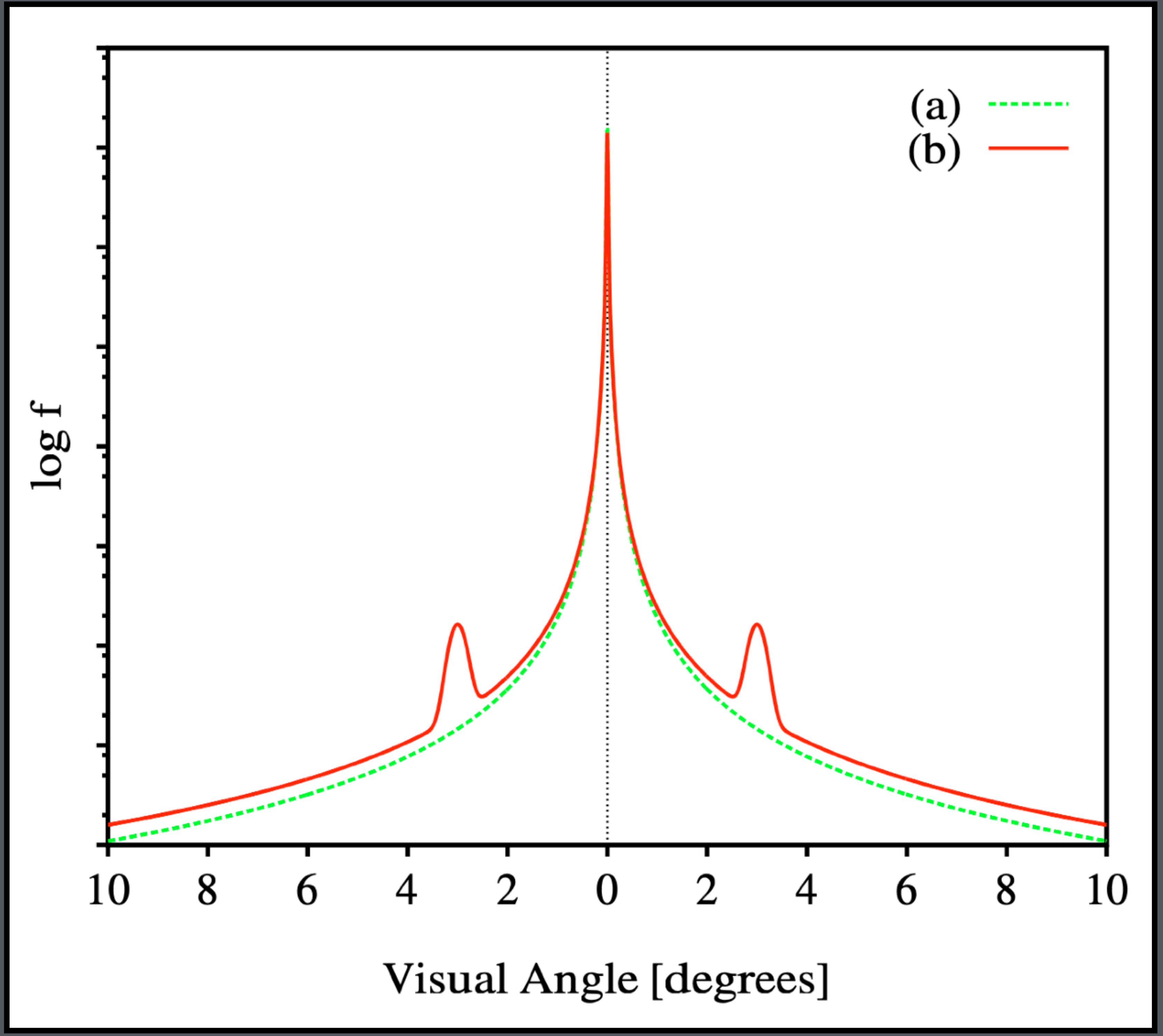
Scattering in the eye

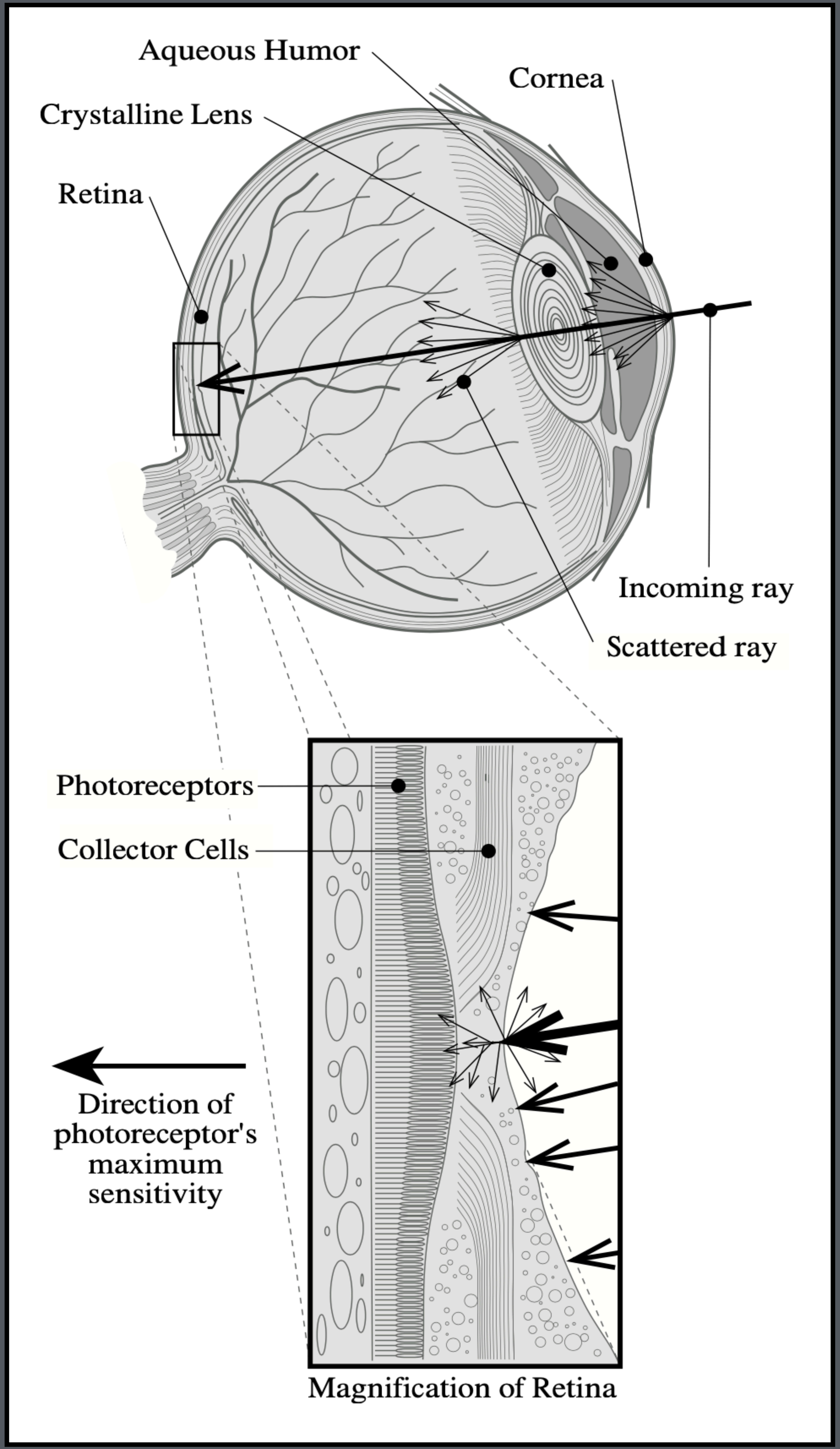
Scattering also happens inside the eye

Causes “flare” from bright sources to add with other parts of the image

Amount of flare

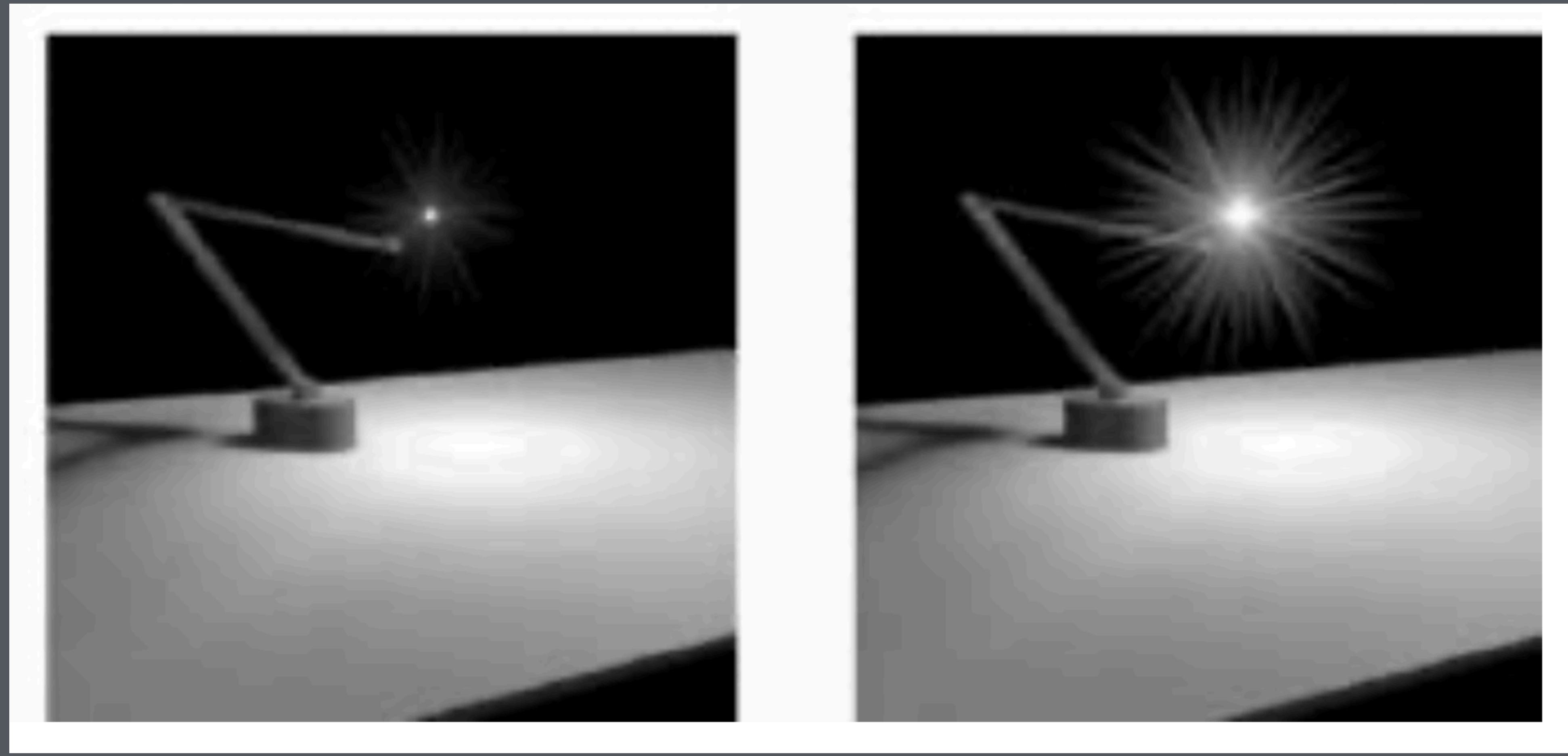
- depends on angle between the source and the pixel receiving flare
- angle ~= image-space distance, so model as a convolution





Spencer, Shirley, Zimmerman, Greenberg SIGGRAPH 1995

Bloom and lenticular flare



Spencer, Shirley, Zimmerman, Greenberg SIGGRAPH 1995

Plan

Physics of the Air

- scattering due to gases
- scattering due to aerosols/particles
- distribution of atmosphere

Atmospheric Phenomena

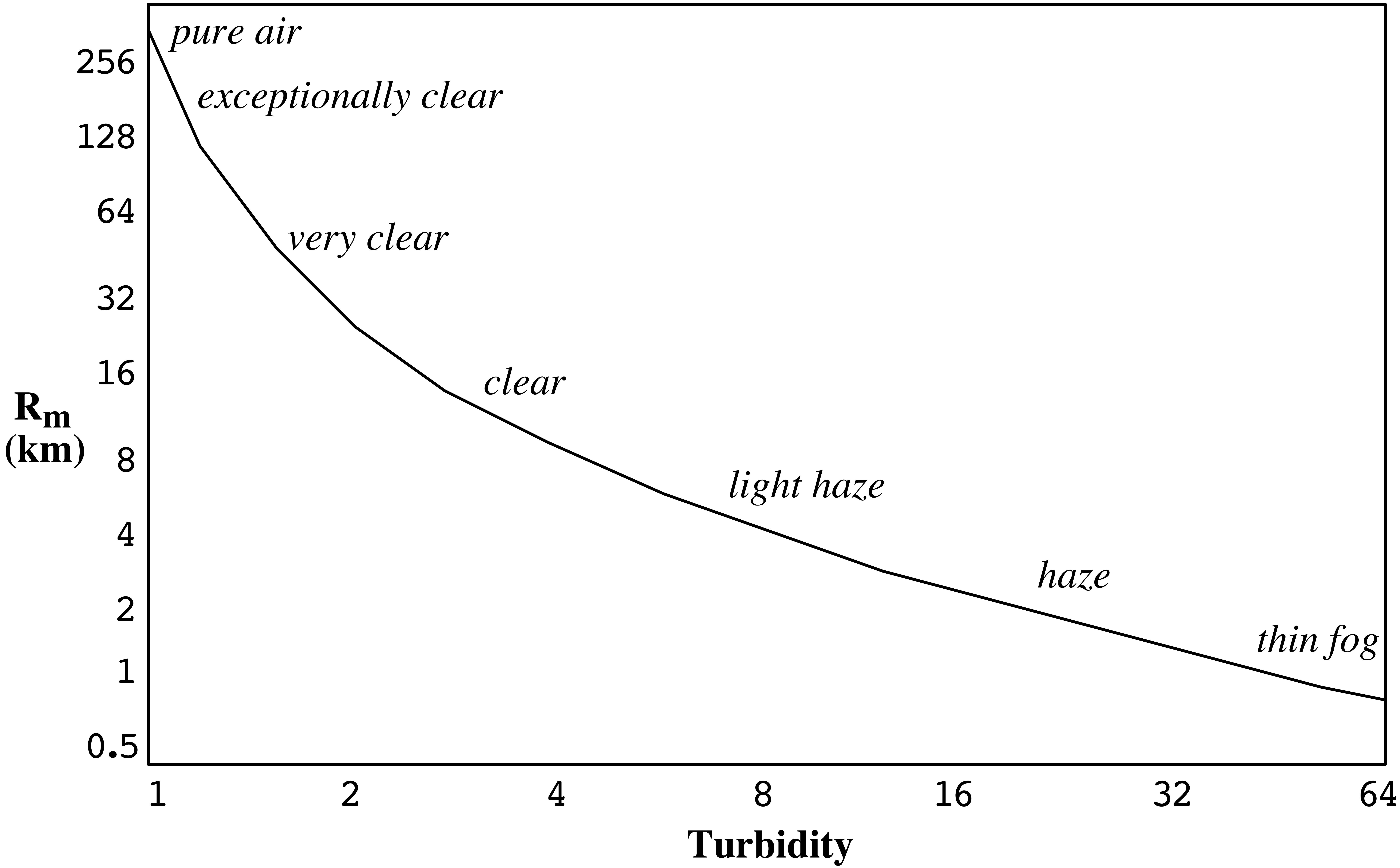
- sunlight
- skylight
- aerial perspective
- clouds

Computational Models

- ray and path tracing
- analytic approximations

Bibliography

- Nishita et al., “Display of The Earth Taking into Account Atmospheric Scattering,” SIGGRAPH 1993.
- Preetham, Shirley, Smits, “A Practical Analytic Model for Daylight,” SIGGRAPH 1999.
- Hosek & Wilkie, “An Analytic Model for Full Spectral Sky-dome Radiance,” SIGGRAPH 2012.



Preetham, Shirley, & Smits SIGGRAPH 1999

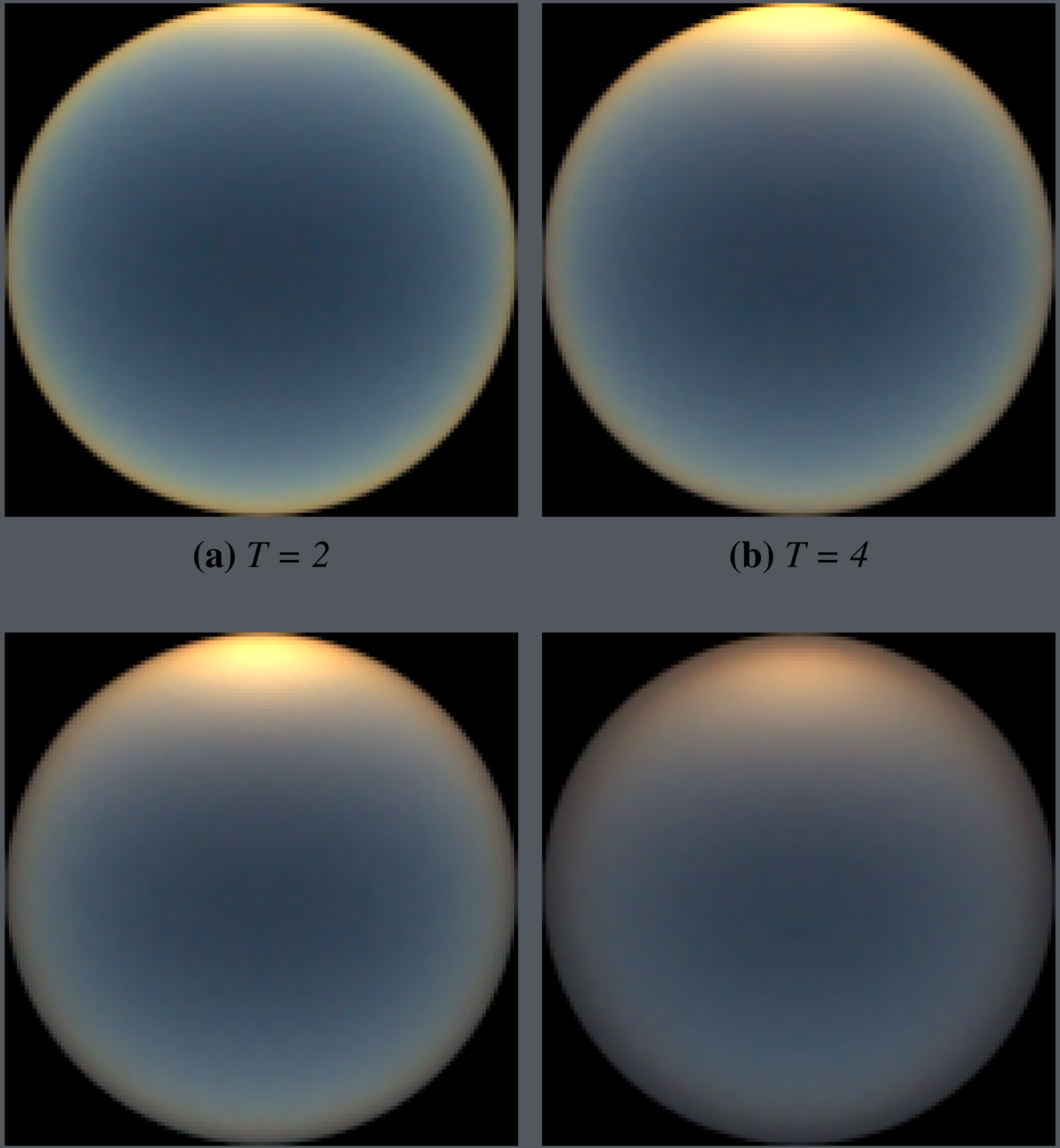
42°, T=1

.5°, T=1

.5°, T=6

.25°, T=7

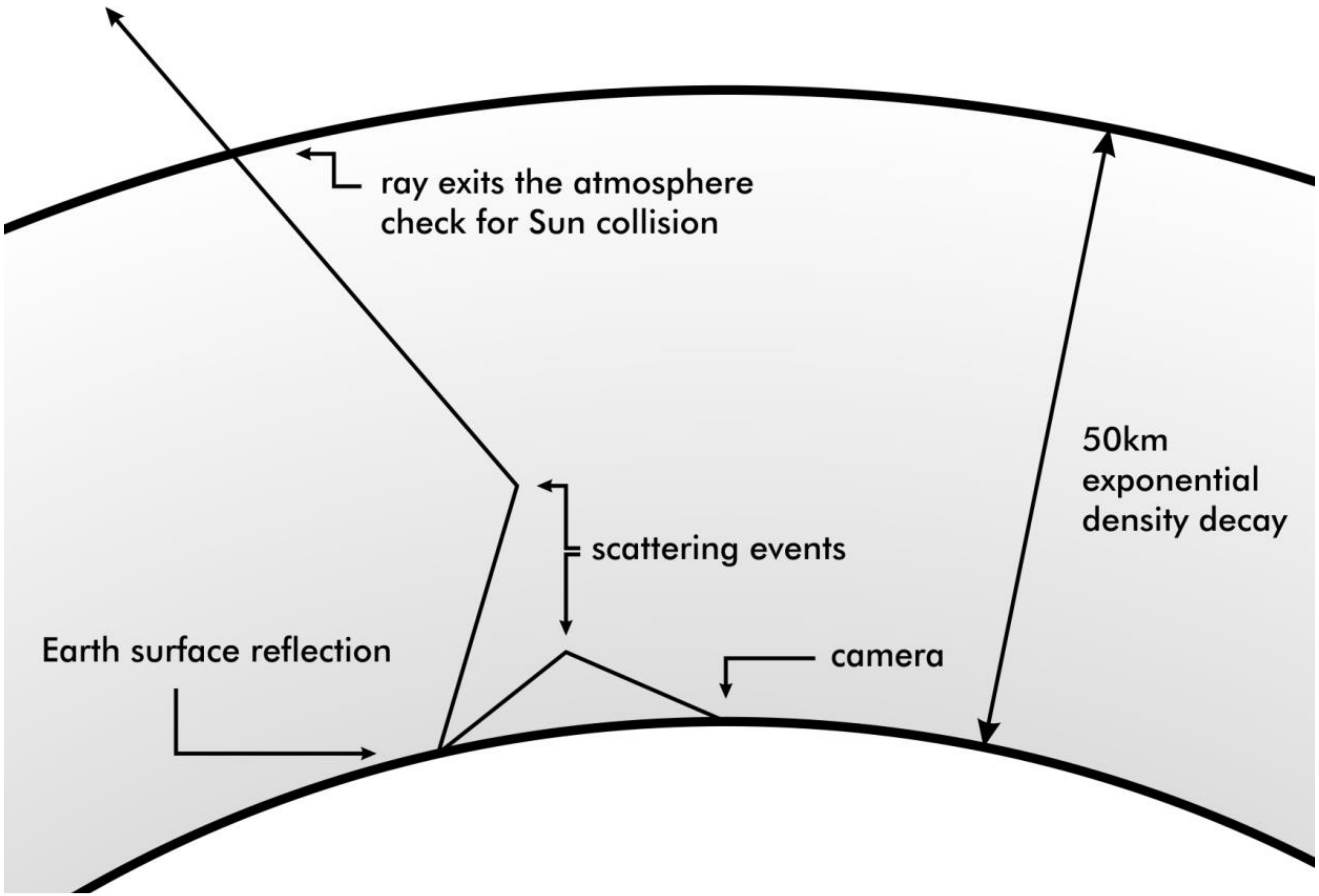
Hosek & Wilkie CG&A 2013



(a) $T = 2$ (b) $T = 4$ (c) $T = 6$ (d) $T = 8$

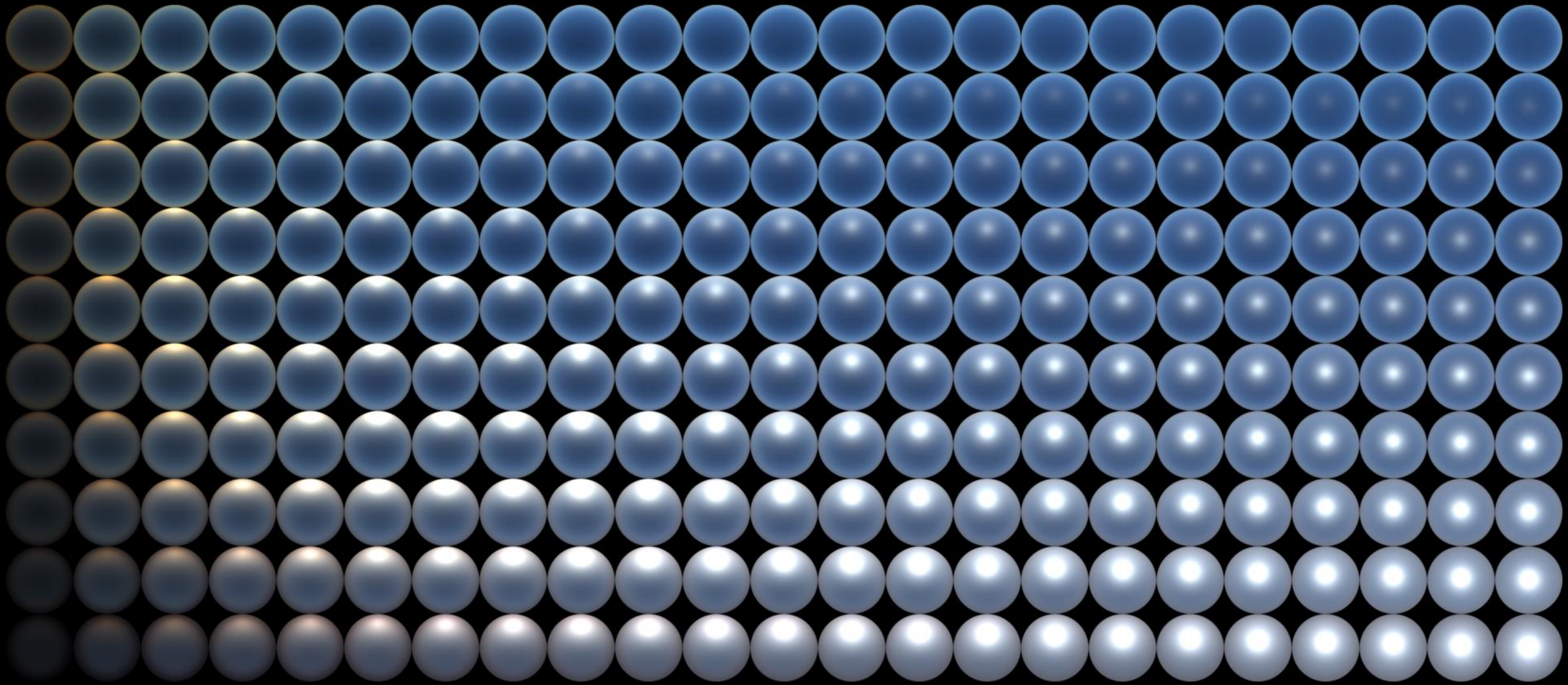
Hosek & Wilkie SIGGRAPH 2012

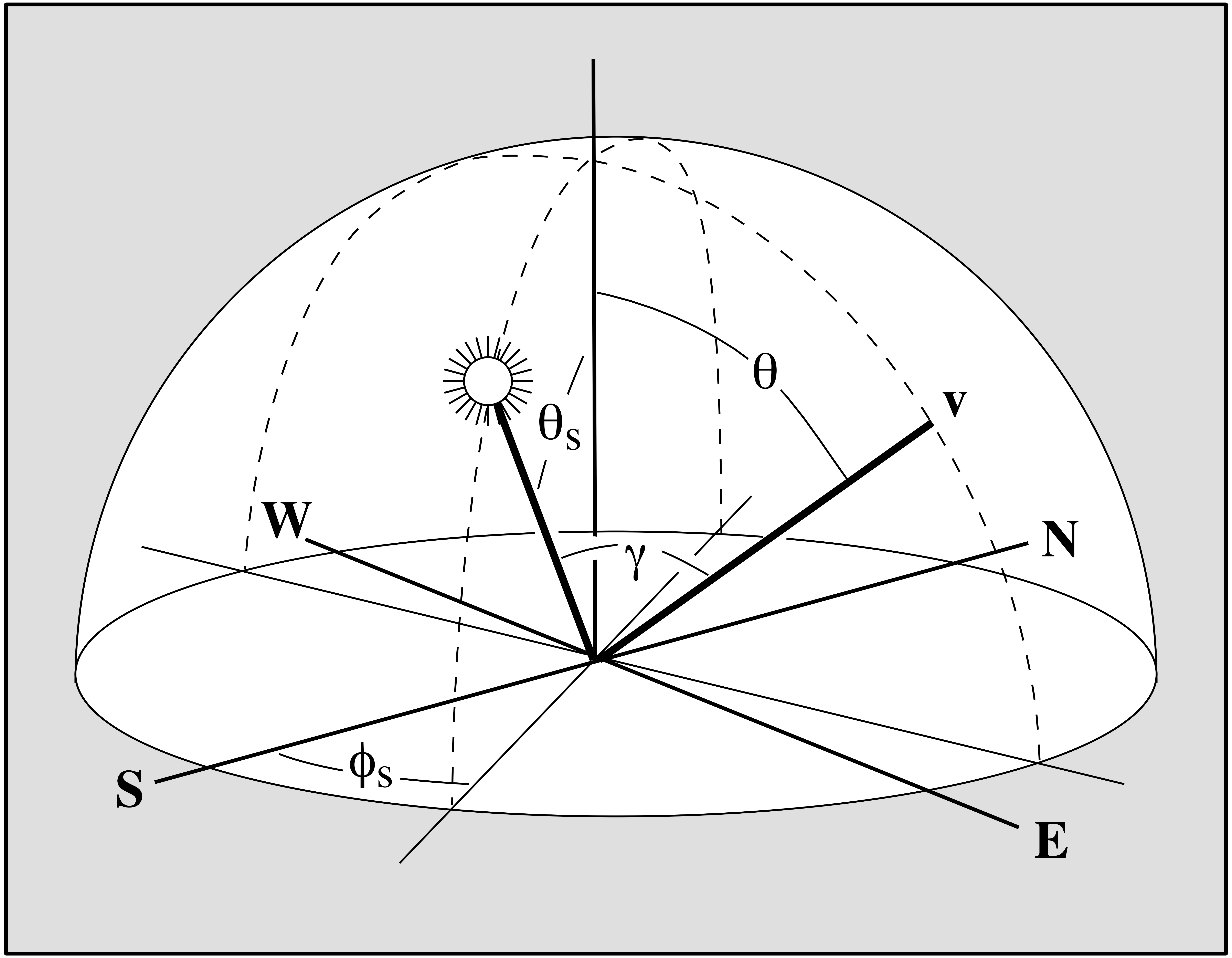
Obtaining Reference Data



Computer
Graphics
Charles
University

Result: Raw Data





Preetham, Shirley, & Smits SIGGRAPH 1999

Empirical analytic sky models

CIE Standardized sky model

- parameters A…E are tabulated for various conditions and solar elevations

$$\mathbb{F}_{CIE2003}(\theta,\gamma) = (1+Ae^{B/\cos\theta})(1+C(e^{D\gamma}-e^{D\frac{\pi}{2}})+E\cos^2\gamma)$$

- Preetham provides empirical analytic functions for these coefficients in x, y, Y

Hosek extended sky model

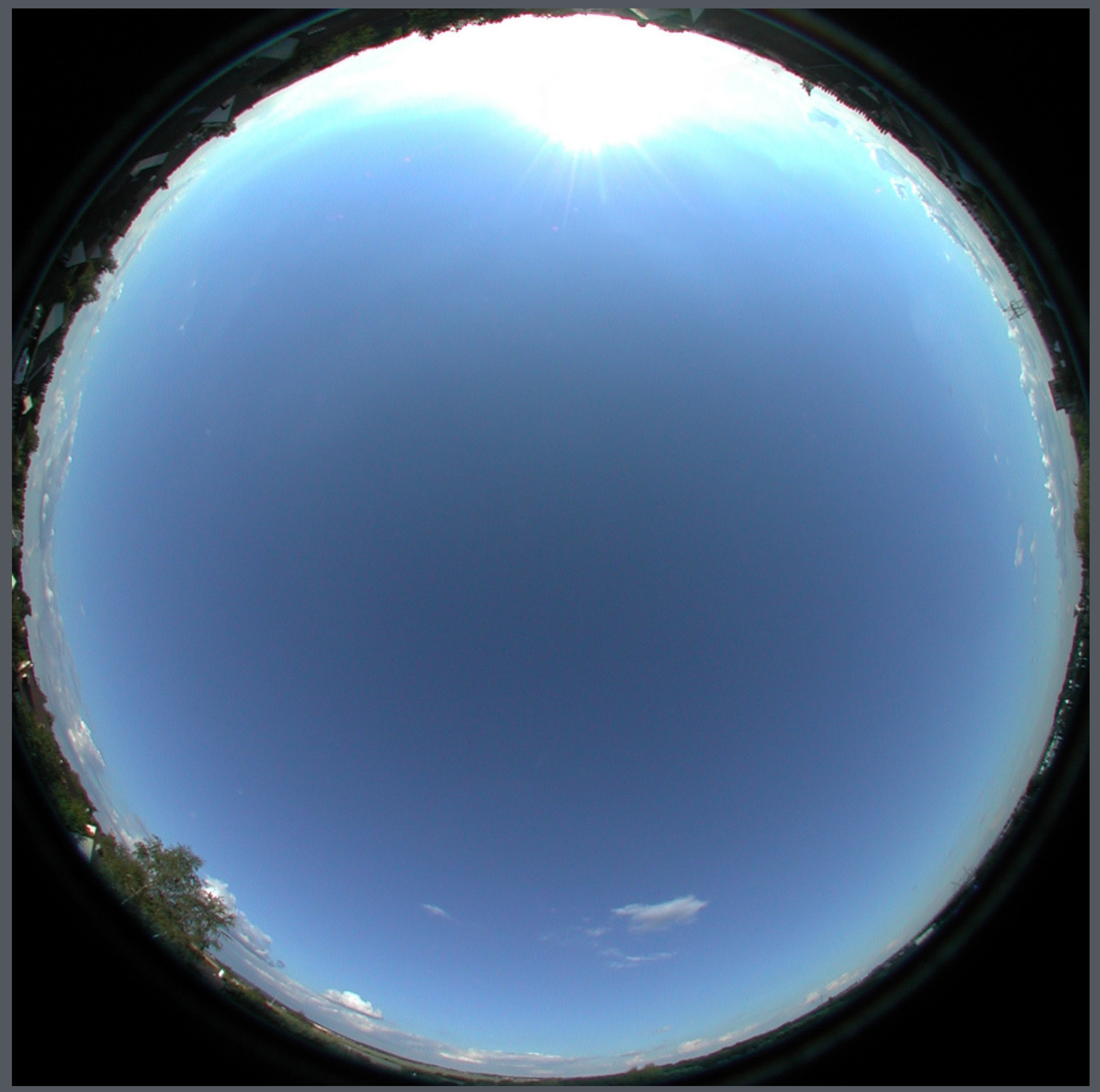
$$\mathbb{F}(\theta,\gamma) = (1 + Ae^{\frac{B}{\cos\theta+0.01}}) \cdot (C + De^{E\gamma} + F\cos^2\gamma + G\cdot\chi(H,\gamma) + I\cdot\cos^{\frac{1}{2}}\theta)$$

$$\chi(g,\alpha) = \frac{1+\cos^2\alpha}{(1+g^2-2g\cdot\cos\alpha)^{\frac{3}{2}}}$$

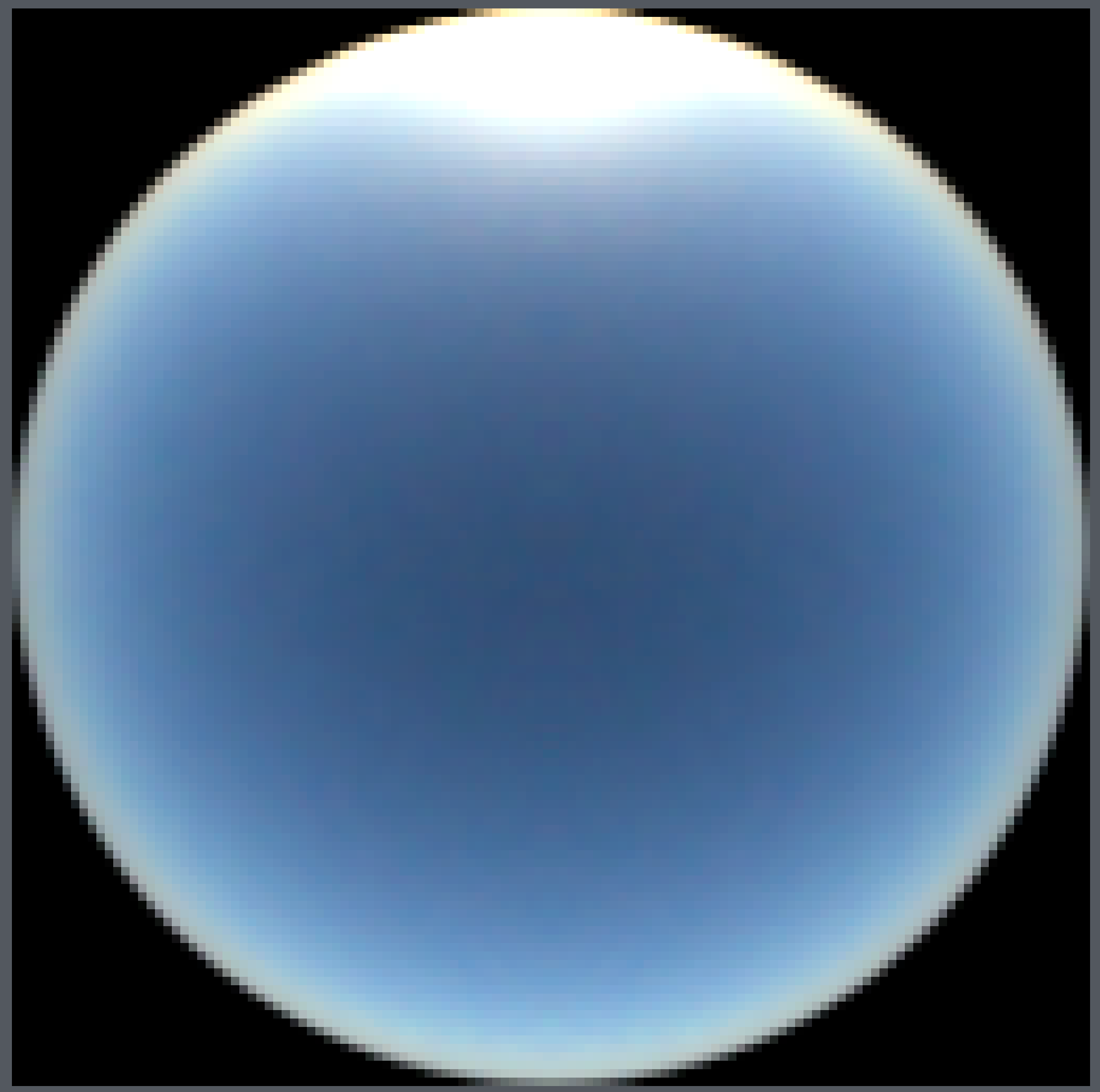
- They provide tabulated values for A…I, fitted to simulation; models turbidity quite a bit better.

Equations: Hosek & Wilkie SIGGRAPH 2012

Sky Colour Patterns (sunset)

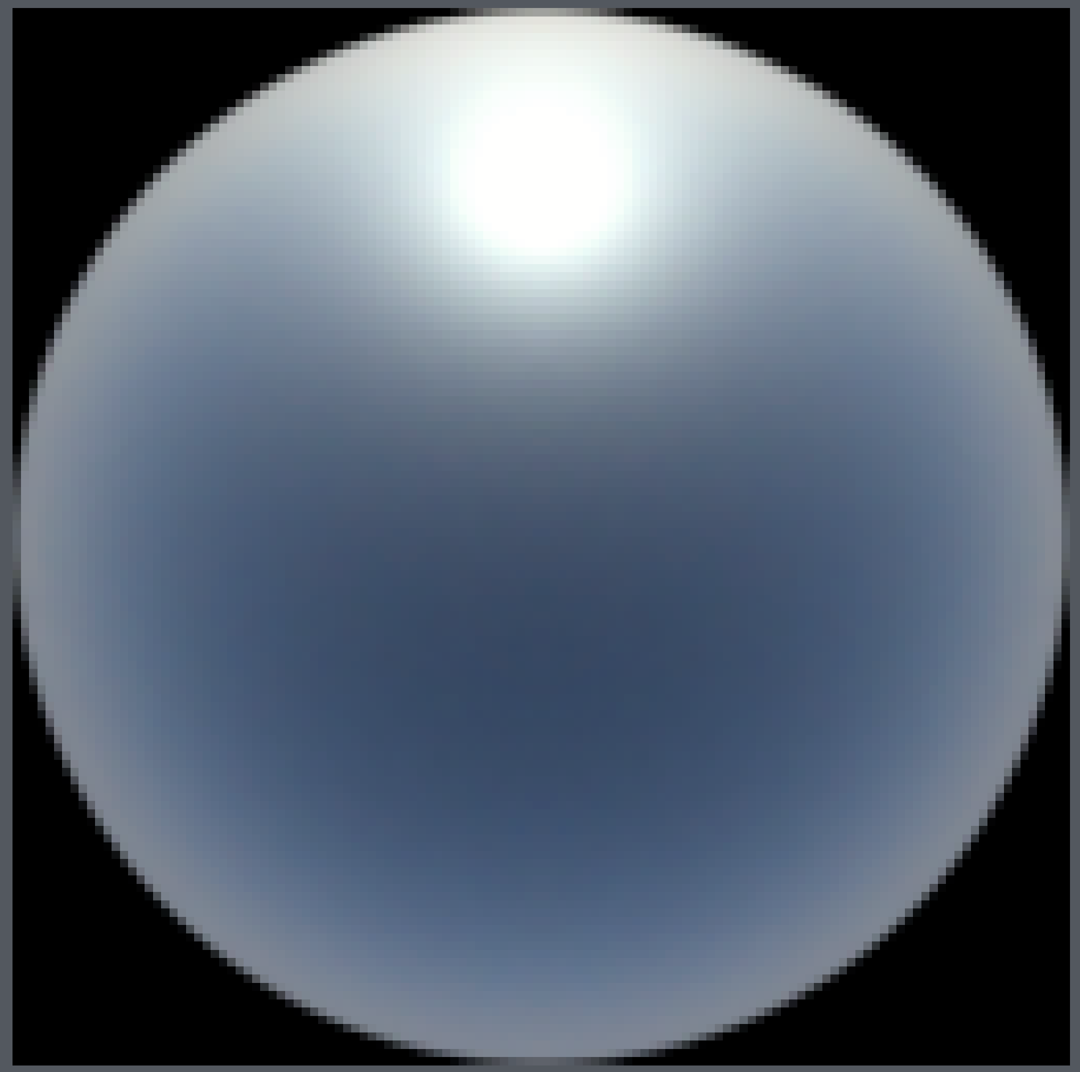


(a) *Sunrise*



(b) $\alpha = 0.1$ *T=3*

(e) *Daytime sky*



(f) $\alpha = 0.9$ *T=7*

Hosek & Wilkie SIGGRAPH 2012

Aerial perspective

Attenuation removes light from the viewing ray

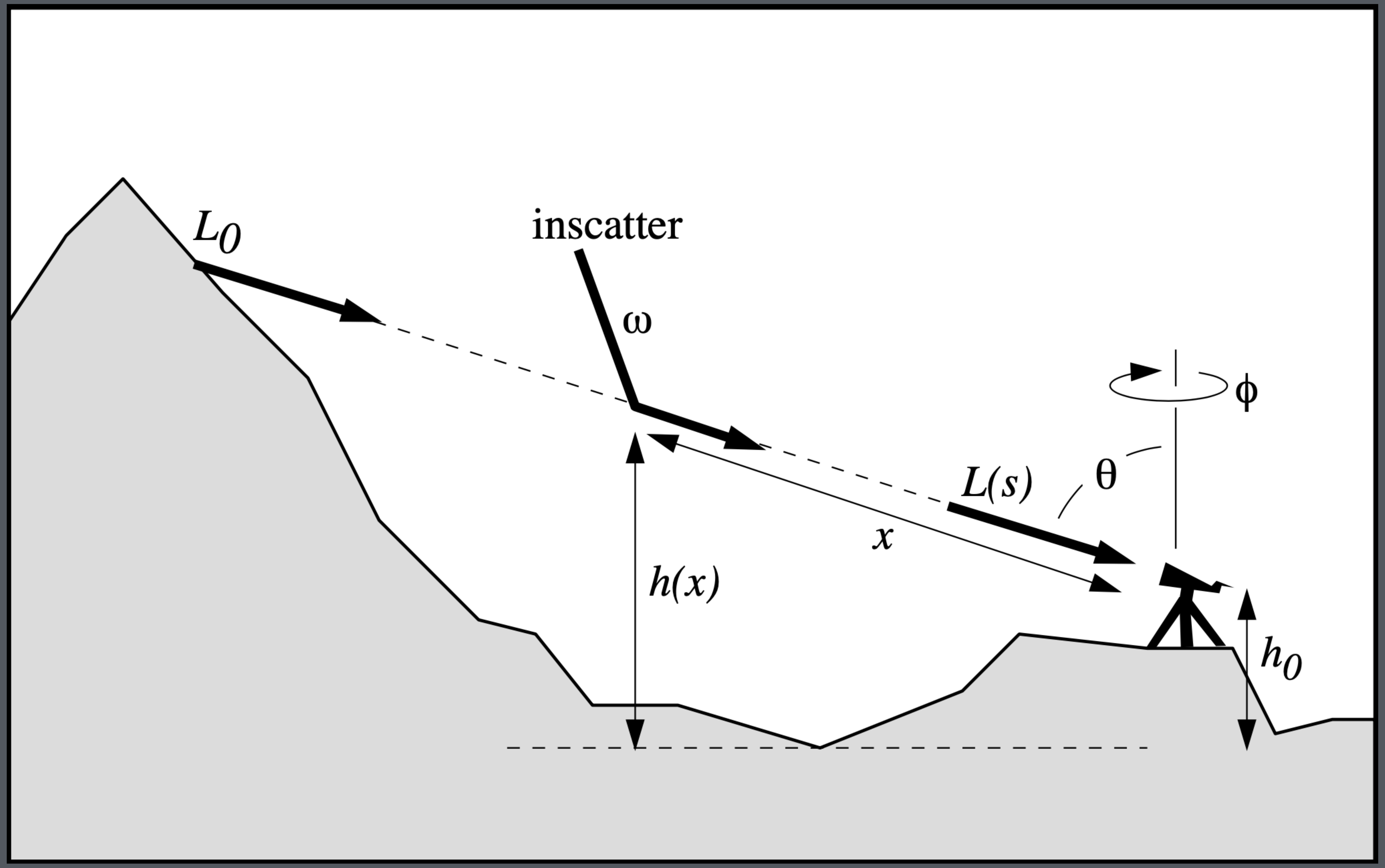
- more blue removed, resulting in warmer colors

Inscattering adds light to the viewing ray

- more blue added (usually), resulting in blue contribution (away from sunrise/sunset)

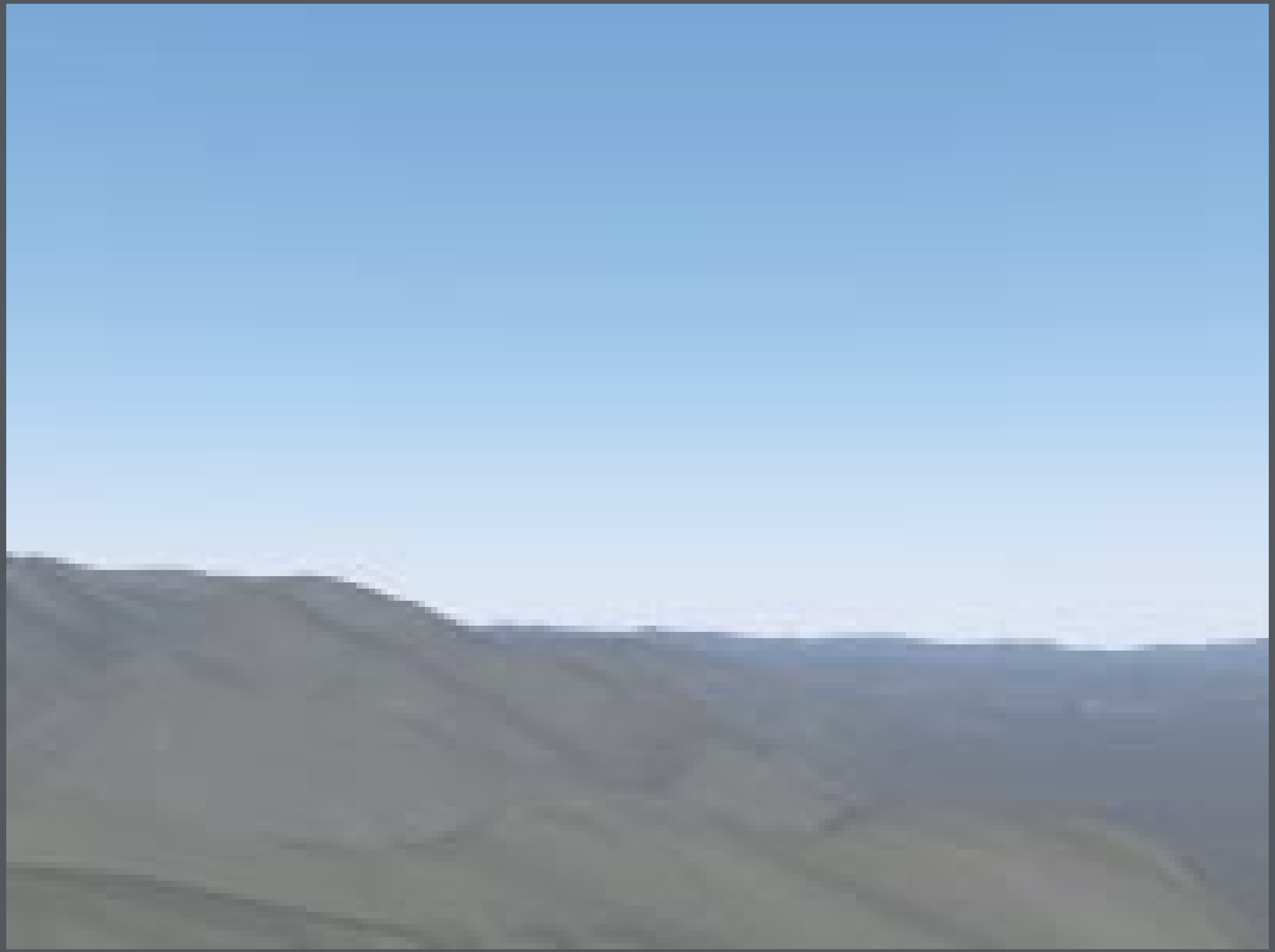
Computing both requires integration along ray

- density, sun radiance change with *h*
- analytic approximations used for fast performance



Preetham, Shirley, & Smits SIGGRAPH 1999

T=2
morning



T=6
evening

T=2
evening

T=10
overcast

Preetham, Shirley, & Smits SIGGRAPH 1999