A New Method for Radiance Skies

Mark J. Stock

8th International Radiance Workshop
Harvard University
Graduate School of Design
Oct 23, 2009

Outline

- Motivation
- Goals
- Sky models
- Implementation
- Results

Serge Brunier

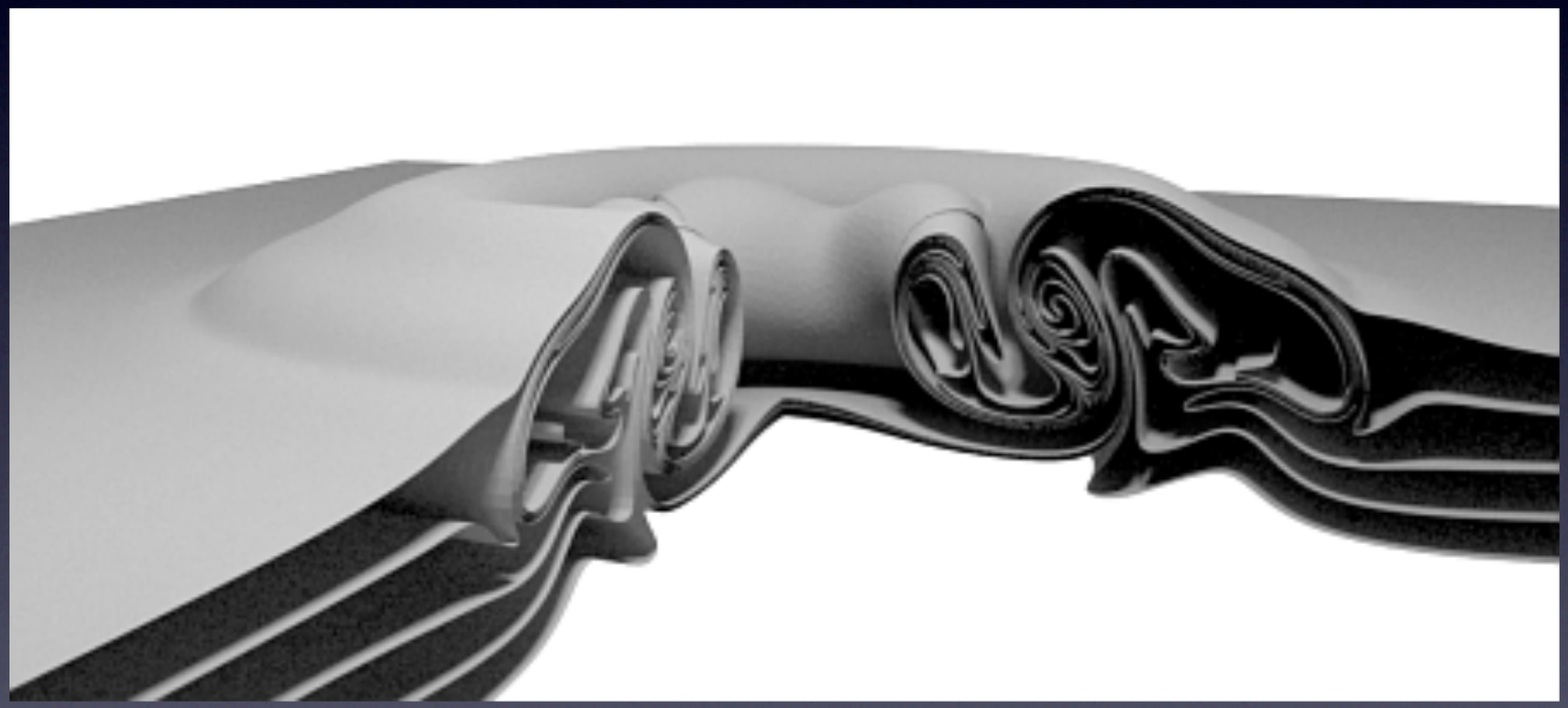
Serge Brunier

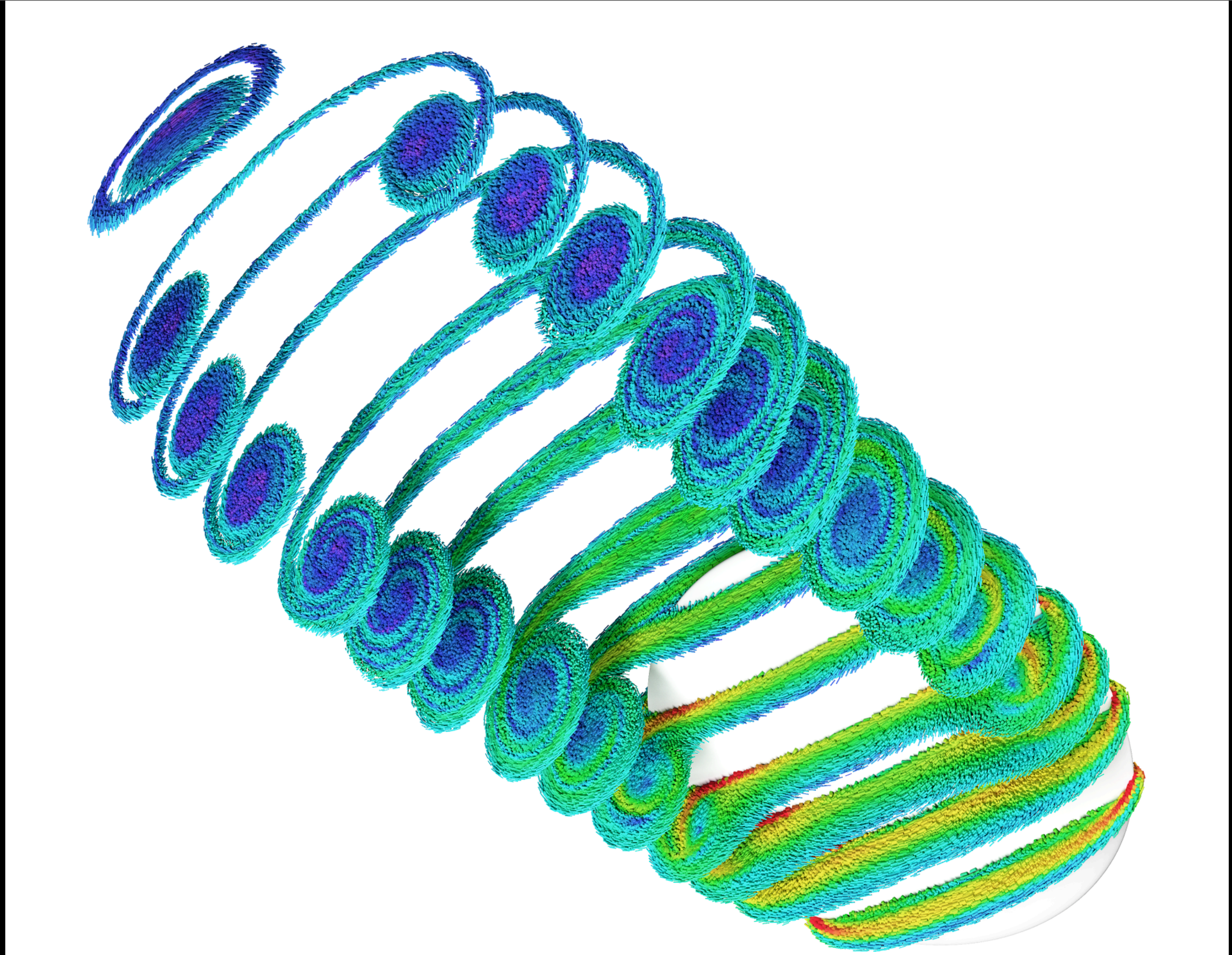
My background

- Aerospace engineer

My background

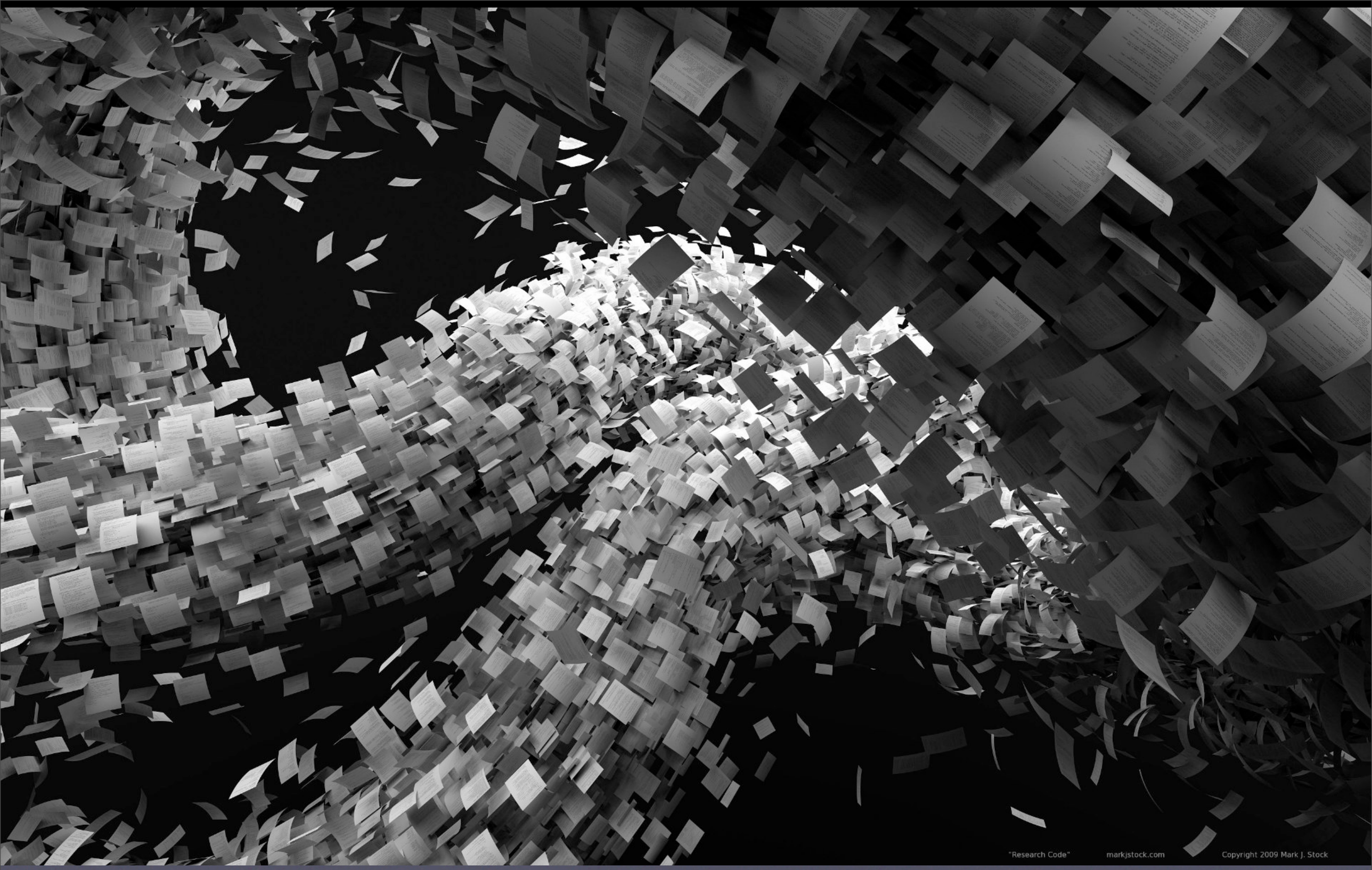
- Aerospace engineer





My background

- Aerospace engineer
- Artist



Research Code, 2009

Untitled, 2009

Goals

- Colorful sky for artistic renderings
- Accurate enough for wider applicability
- Plug-in replacement for *gensky*

Challenges

- Wide irradiance variation!

Sun	1.3 e+3 W/m^2
Sky	6.4 e+1
Moon	2.1 e-3
Venus	1.3 e-6
Starlight	3.0 e-8

Challenges

- Wide apparent magnitude variation!

Sun	-26.73
Moon	-12.6
Venus	-4.6
Sirius	-1.47
Human limit	+6.5

Existing Sky Models

- Image-based (next talk w/ Prof. Inanici)
- Computational: Klassen, Kaneda, Nishita
- Analytic: CIE sunny, overcast, Perez
- Preetham, Shirley, Smits, *A Practical Analytic Model for Daylight*, ICCGIT1999
- Wann Jensen *et al.*, *A Physically-Based Night Sky Model*, SIGGRAPH 2001

Perez

- Perez, Seals, Ineichen, *An all-weather model for sky luminance distribution*, Solar Energy 1993

$$F(\theta,\gamma) = (1 + Ae^{B/cos\theta})(1 + Ce^{D\gamma} + E\cos^2\gamma)$$

$$Y_{Perez} = Y_z \frac{F(\theta,\gamma)}{F(0,\theta_{sun})}$$

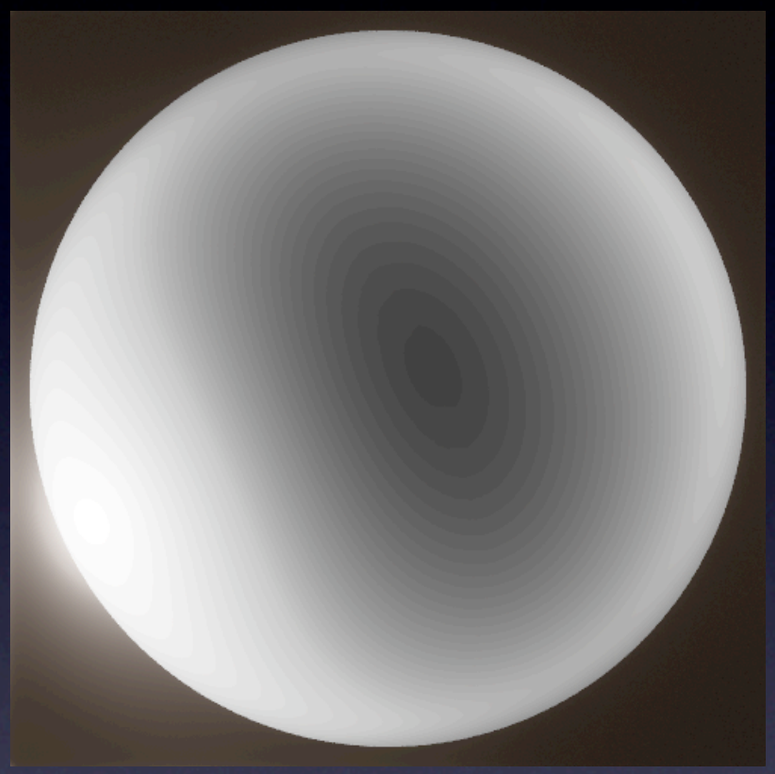
Adjustment

- Errors at horizon and low sun angles

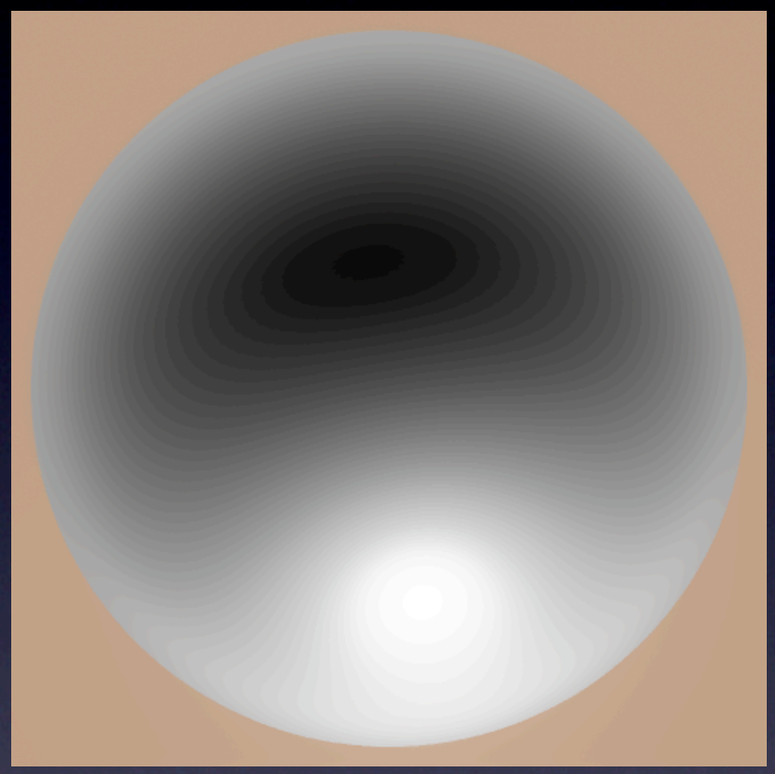
$$F(\theta,\gamma) = (1 + Ae^{B/(0.004+|cos\theta|)})(1 + Ce^{D\gamma} + E\cos^2\gamma)$$

$$Y_{mod} = Y_{Perez}\min(1, \exp^{20(z_{sun}-0.05)})$$

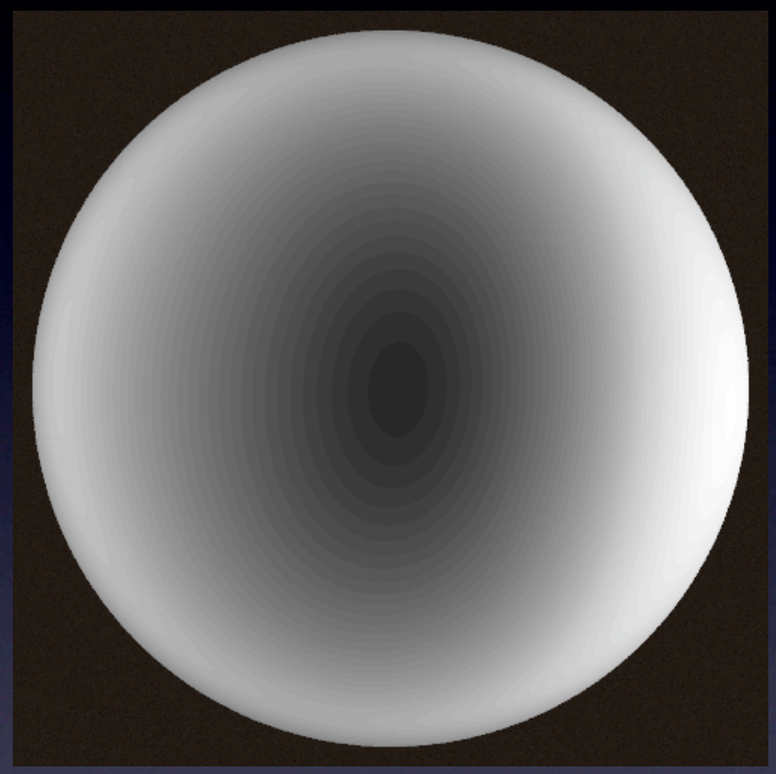
gensky -t 2



7am



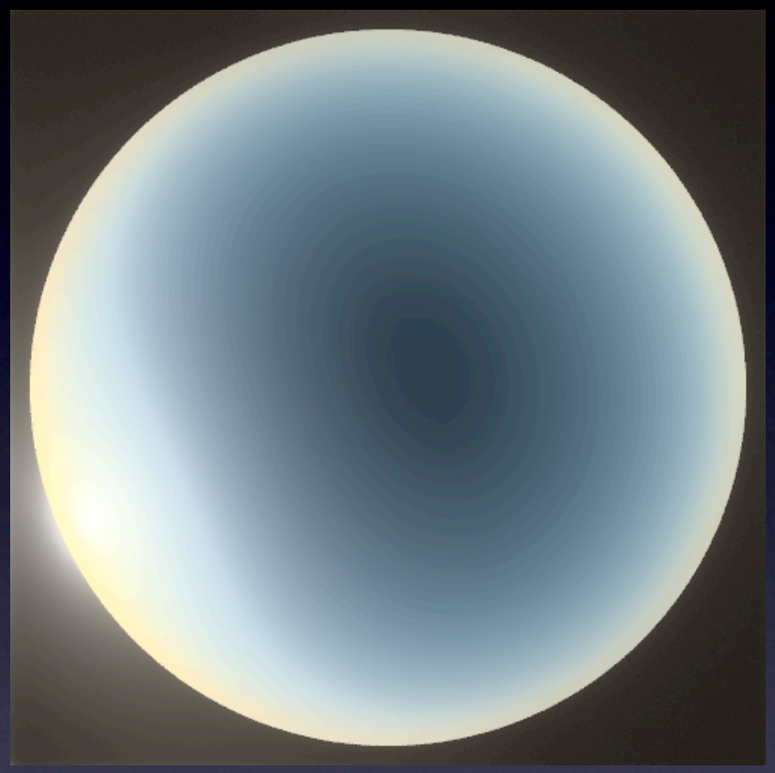
12pm



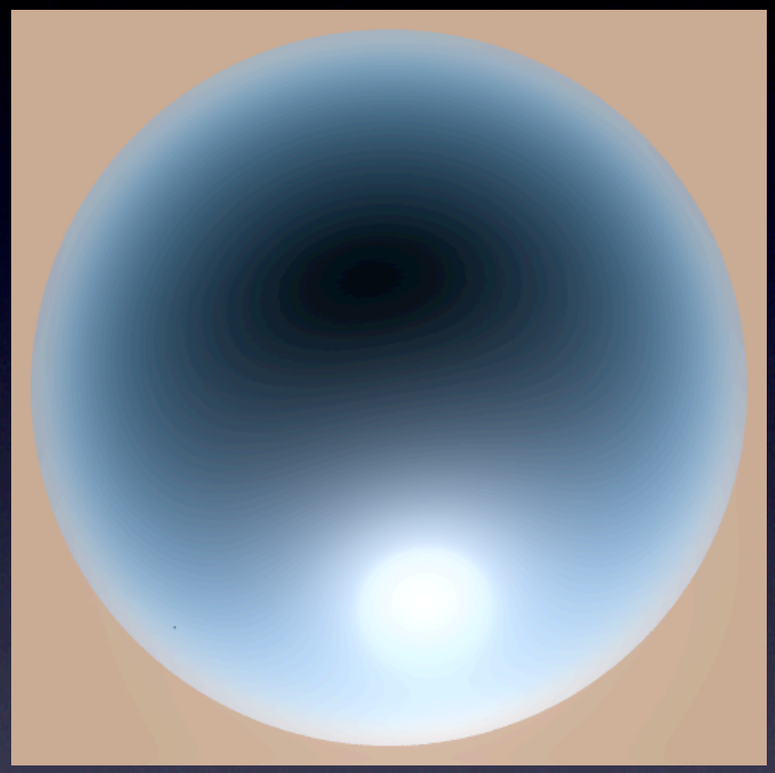
6pm

Boston, Oct. 23, 2009, facing south, turbidity 2.0, pcond -v -s

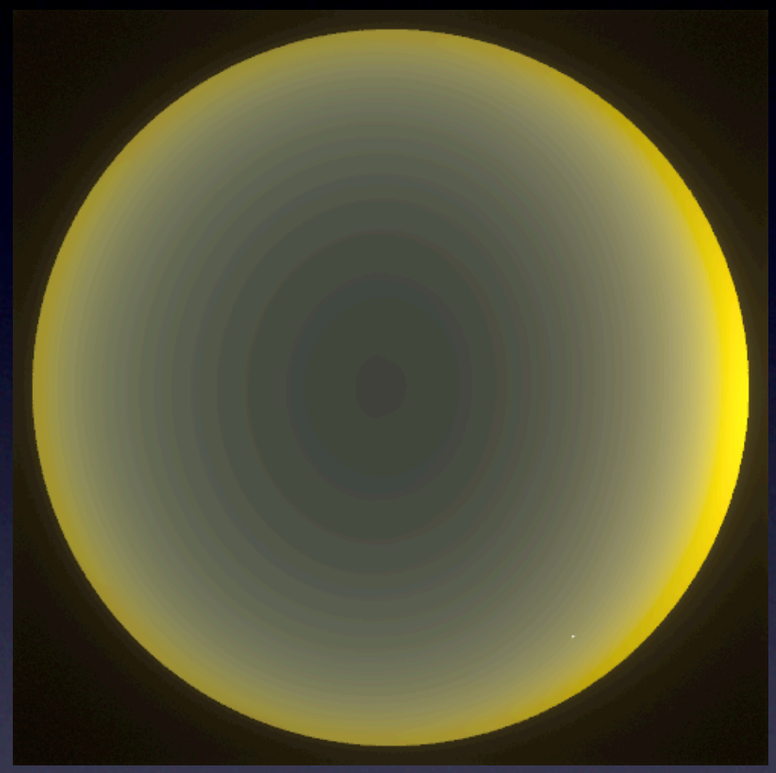
genutahsky -t 2



7am



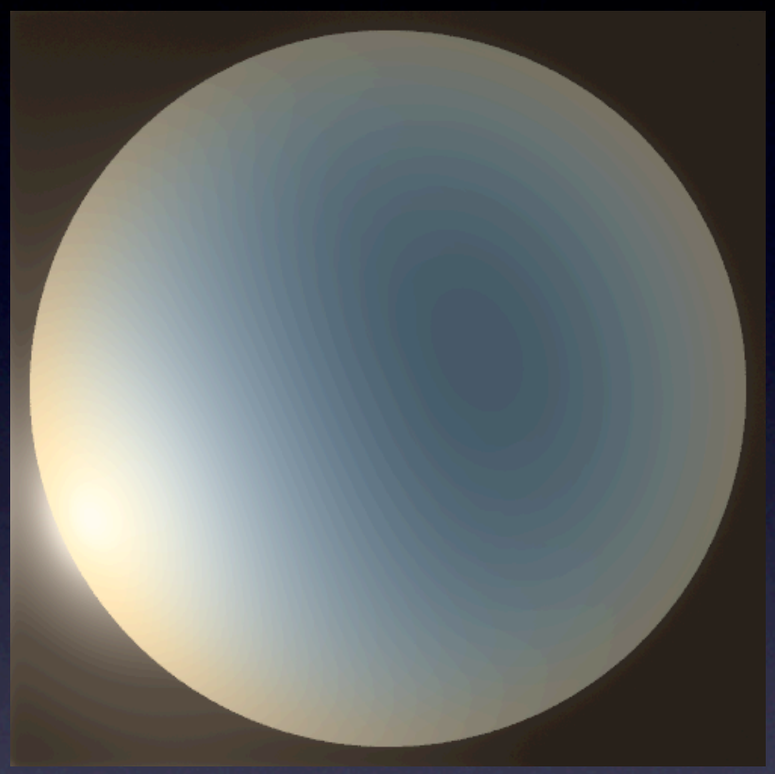
12pm



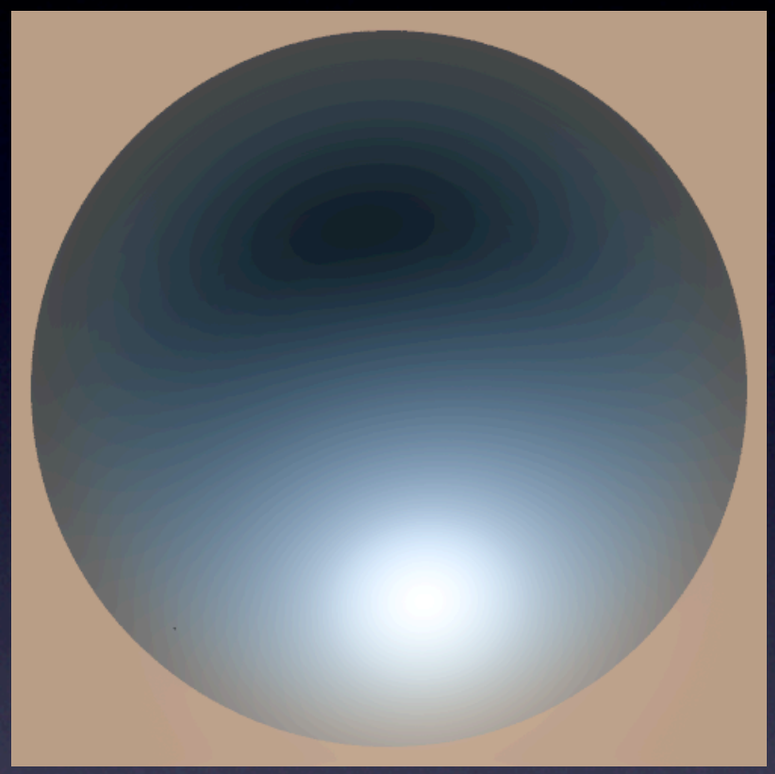
6pm

Boston, Oct. 23, 2009, facing south, turbidity 2.0, pcond -v -s

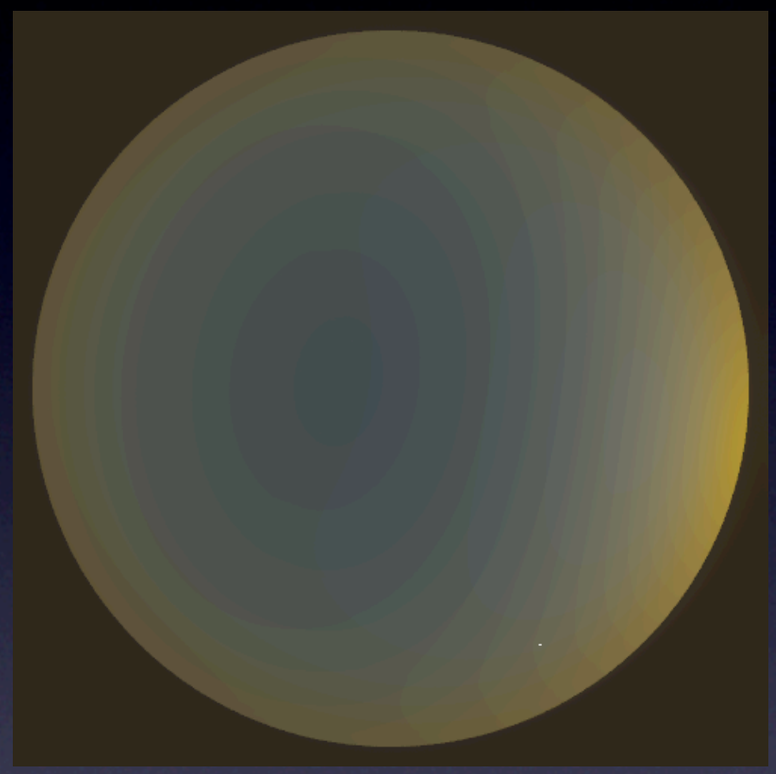
genutahsky -t 4



7am



12pm



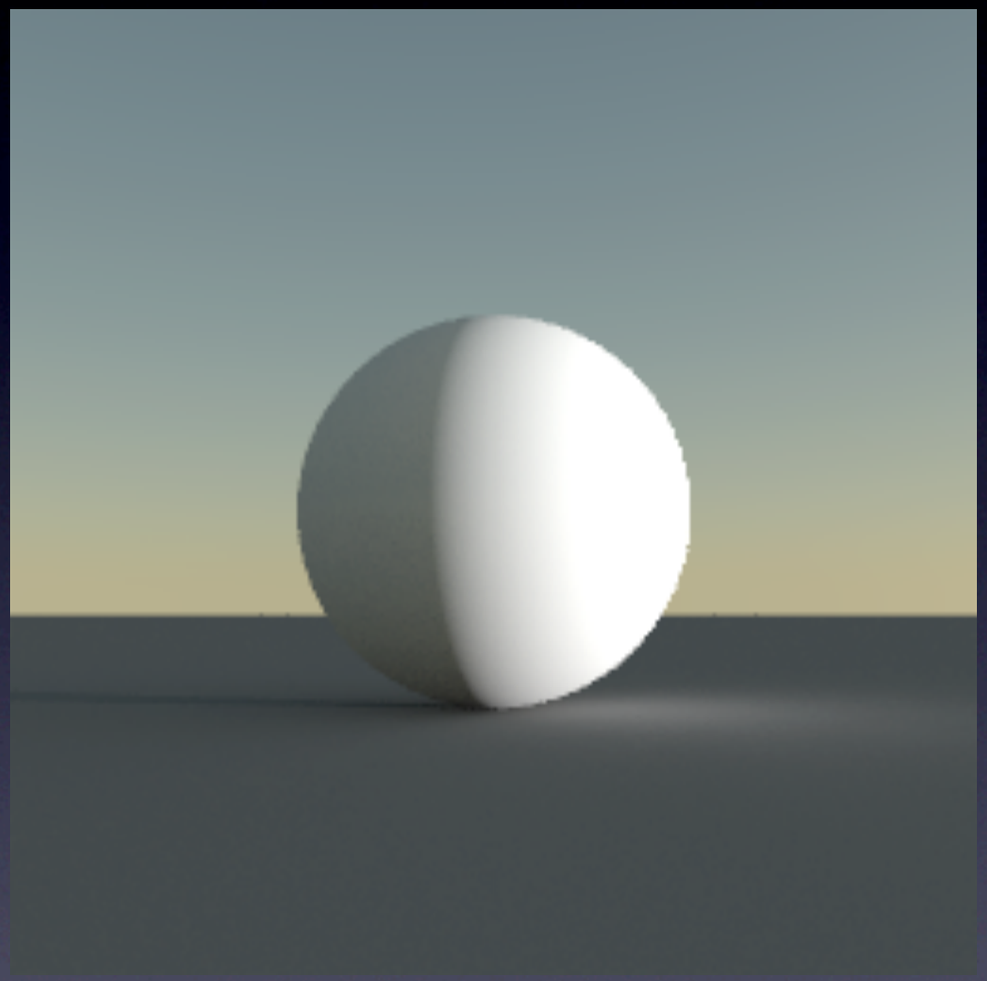
5:30pm

Boston, Oct. 23, 2009, facing south, turbidity 4.0, pcond -v -s

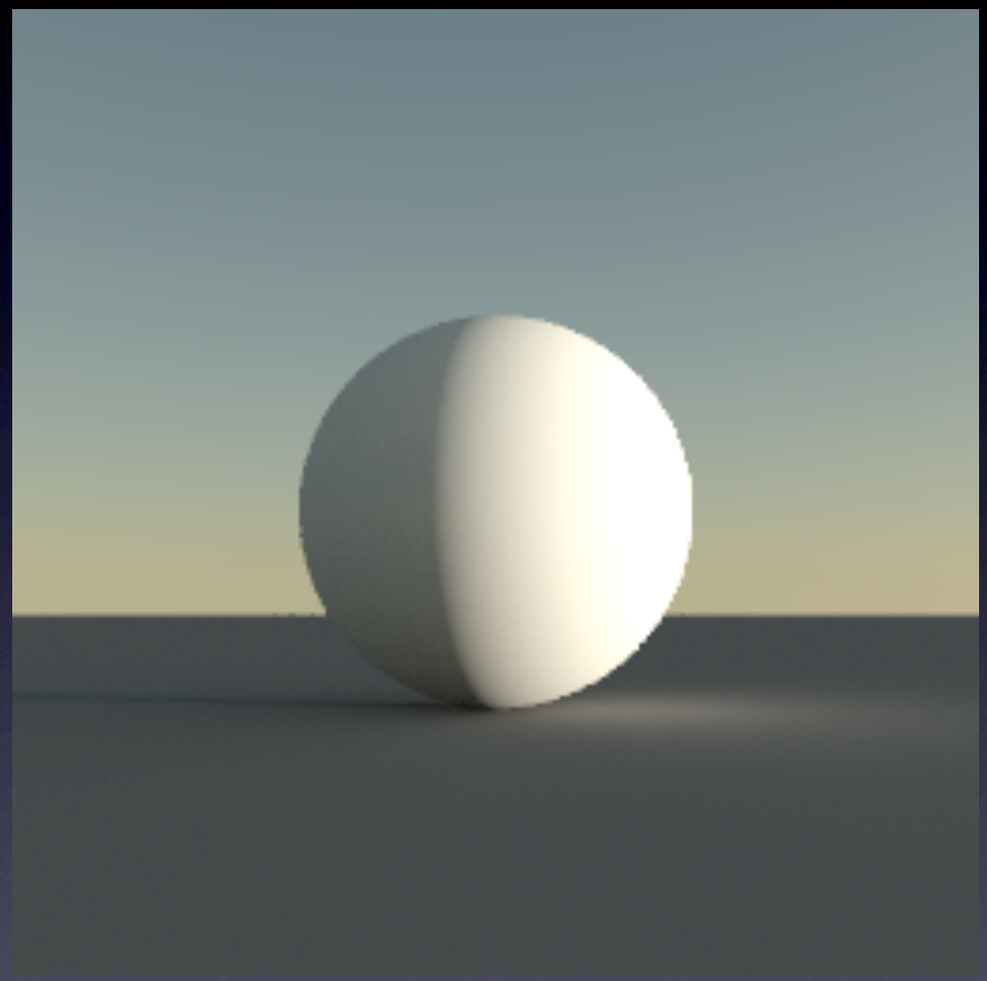
Sun

- As gensky, but uses libnova for placement
- Accurate solar disc size
- Sun color varies from D65 to lower temp
- Multiple suns for smoother penumbras?

Non-D65 sun



6500K



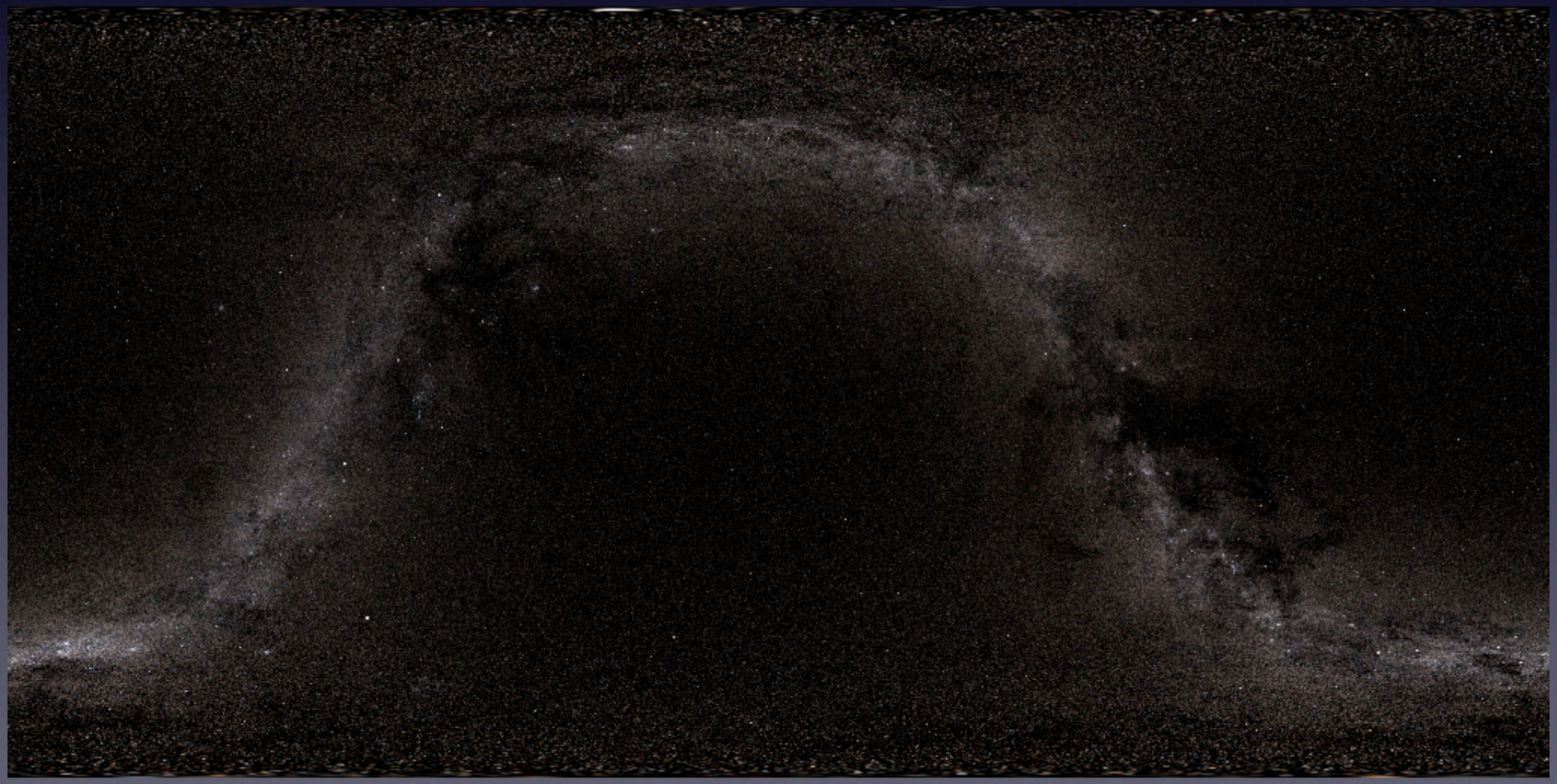
5216K

Moon, Planets

- Moon brightness, position, disc size
- Venus, Jupiter, Mars - if above horizon
- Magnitude-to-luminosity conversion
- Solid disk--No Lunar crescent (yet)

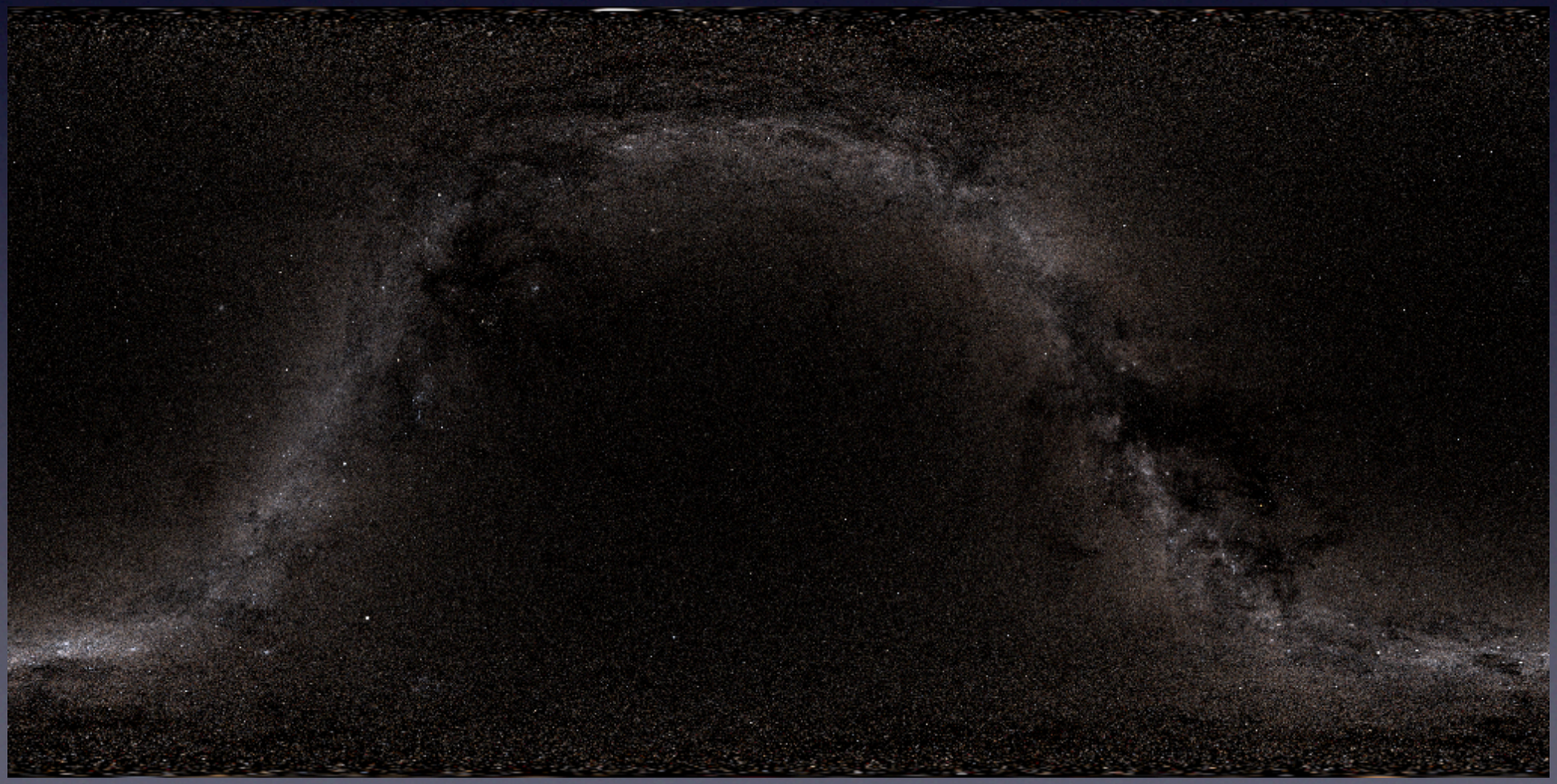
Stars

- Data from Tycho-2 survey (2.5M stars)
- 8192x4096 RGB “MDR” colorpict



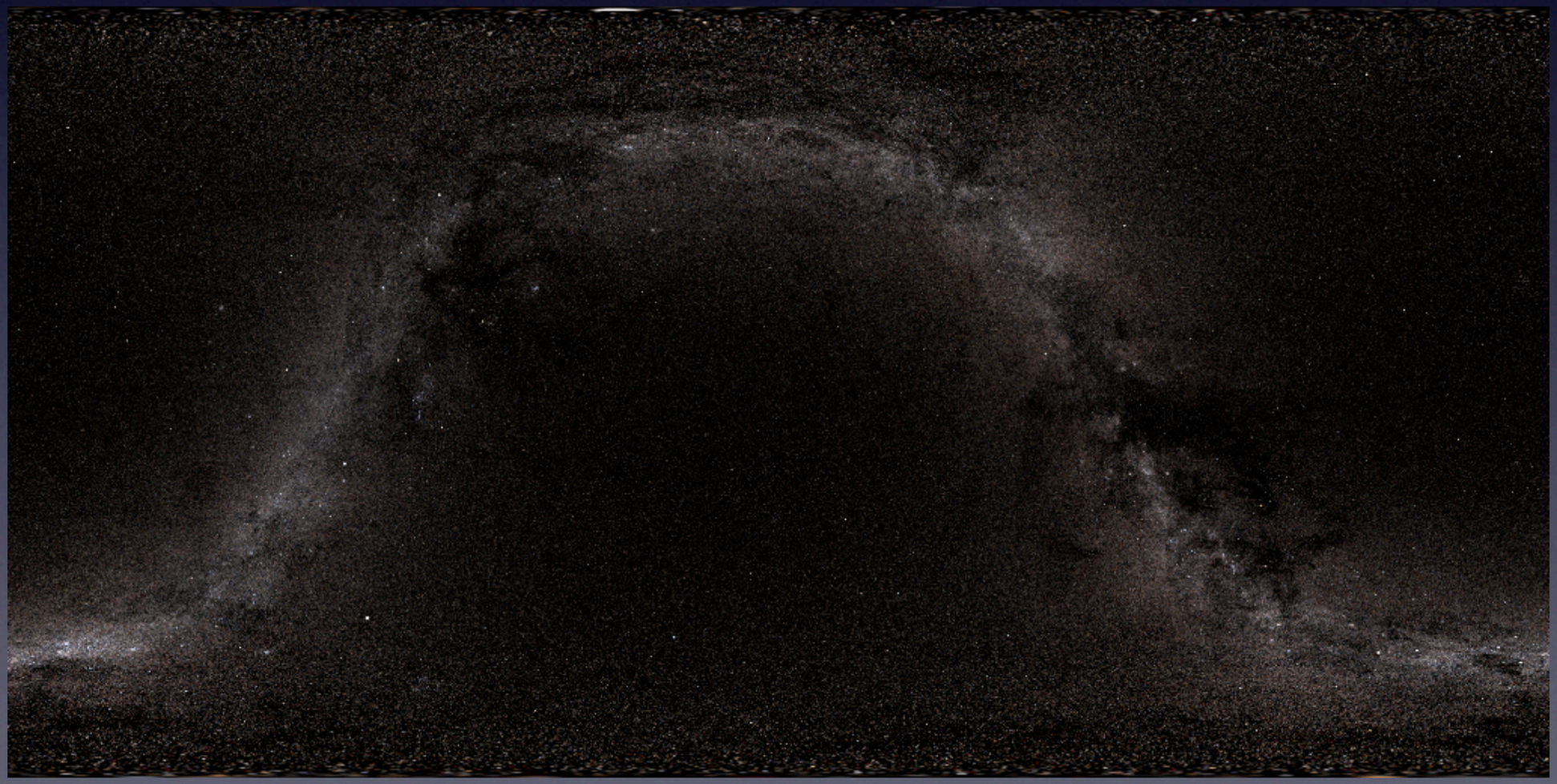
Stars

- 384MB 16384x8192 RGB TIFF from
  http://svs.gsfc.nasa.gov/goto?3572



Stars

- Reduced 2:1 in cinepaint (10-bit range)



Merging sky and stars

```
void colorfunc skyfunc
4 skyr skyg skyb utah.cal
0
4 2.5 0.0965795 0.365116 -0.925939
```

Merging sky and stars

```
void colorfunc skyfunc
void colorpict starmapcolor
7 noneg noneg noneg
  TychoSkymapII.t5_08192x04096.hdr
  sphere.cal inf_u inf_v
0
1 0.5
```

Merging sky and stars

```
void colorfunc skyfunc
void colorpict starmapcolor
void mixfunc mixedcolor
4 skyfunc starmapcolor half half.cal
0
0
```

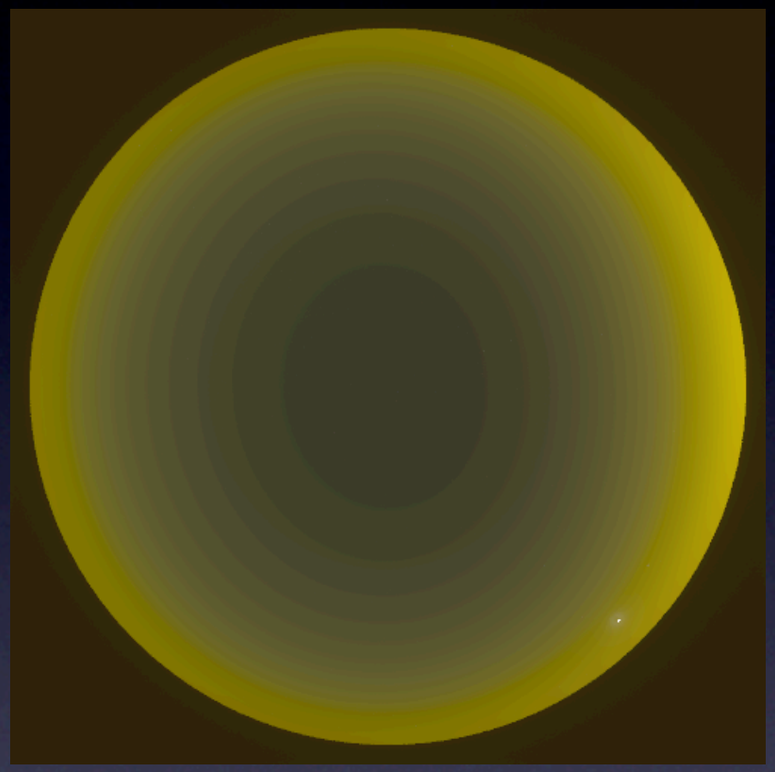
Merging sky and stars

```
void colorfunc skyfunc
void colorpict starmapcolor
void mixfunc mixedcolor
mixedcolor glow mixedglow
0
0
4 2. 2. 2. 0
```

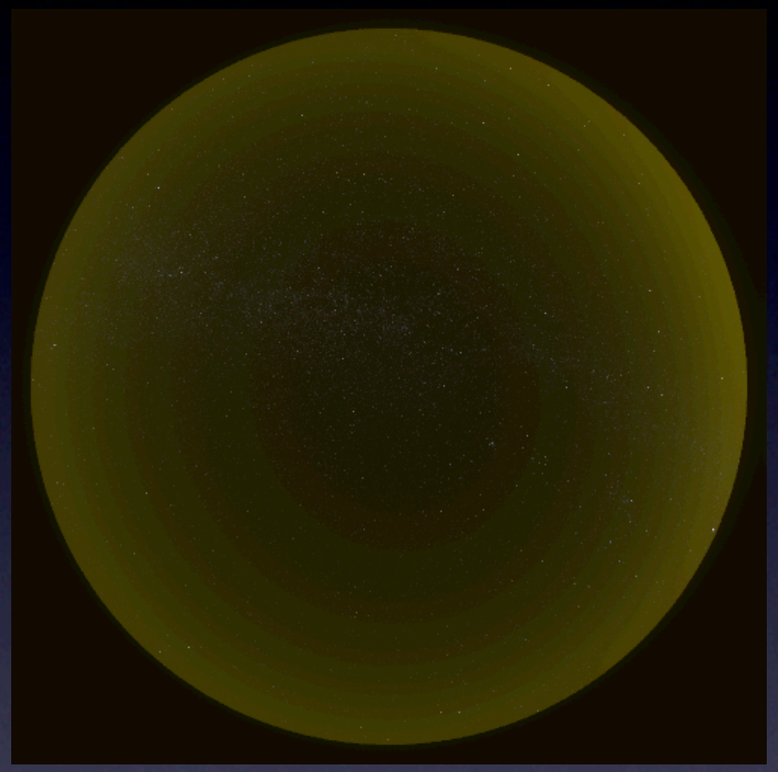
Merging sky and stars

```
void colorfunc skyfunc
void colorpict starmapcolor
void mixfunc mixedcolor
mixedcolor glow mixedglow
mixedglow source skydome
0
0
4 0 0 1 190
mixedglow source grounddome
0
0
4 0 0 -1 170
```

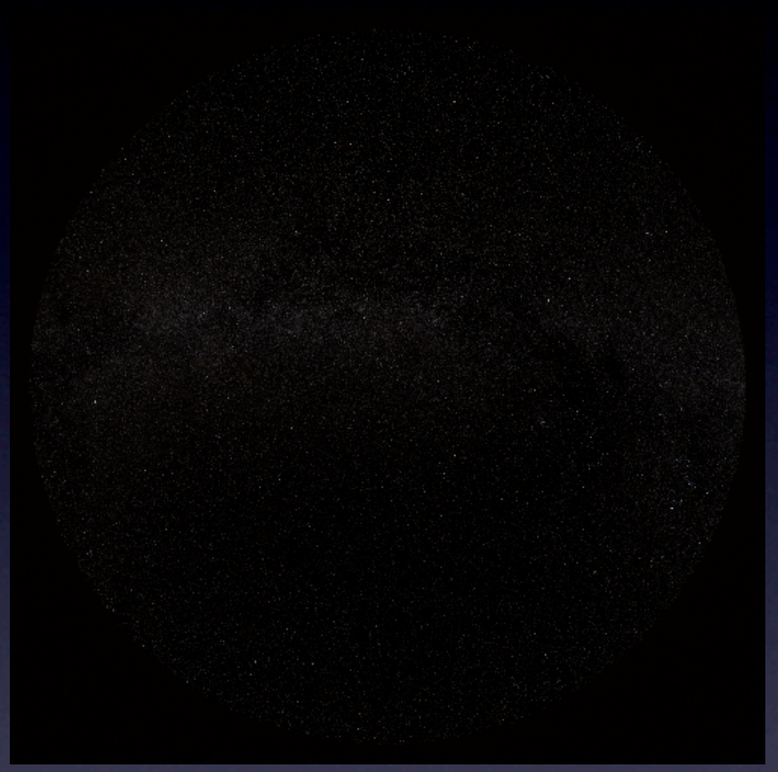
Merging sky and stars



7pm



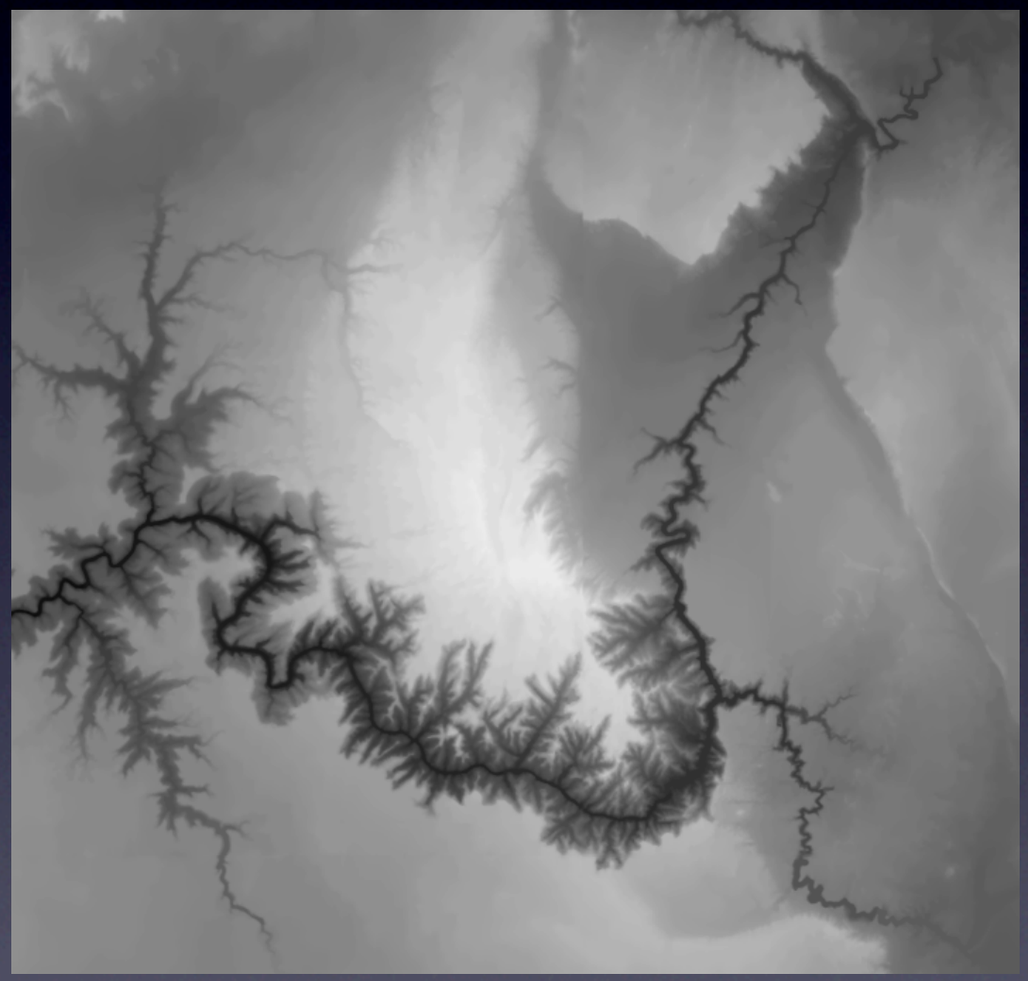
8pm



9pm

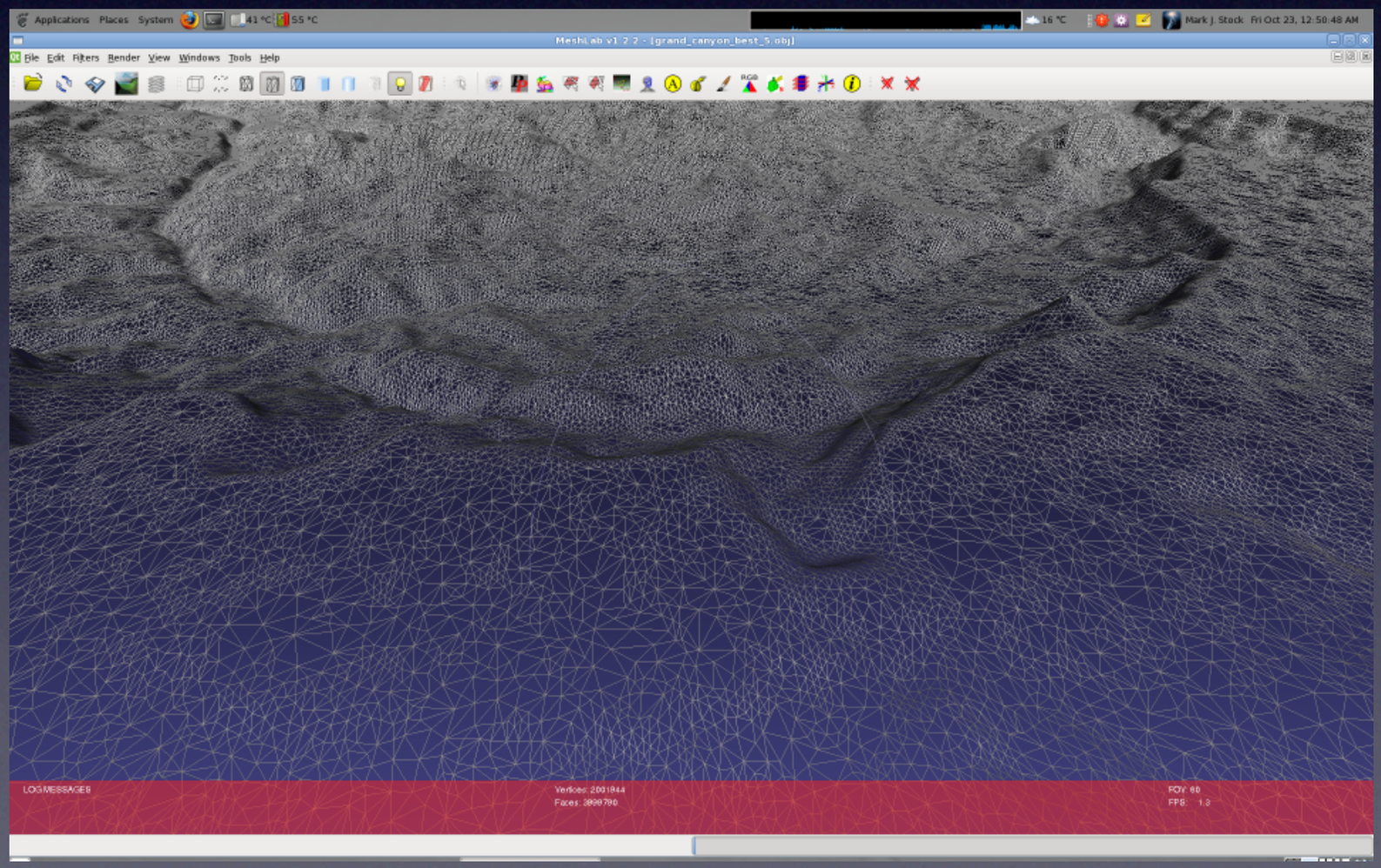
Land model

- USGS 30m DEMs

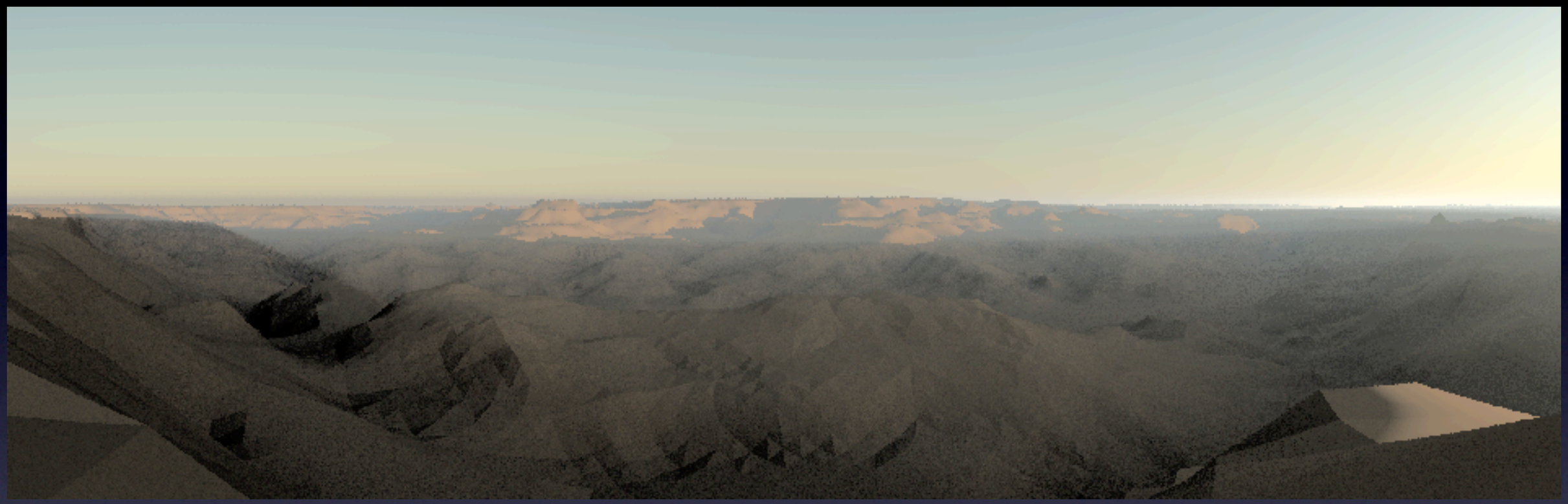


Land model

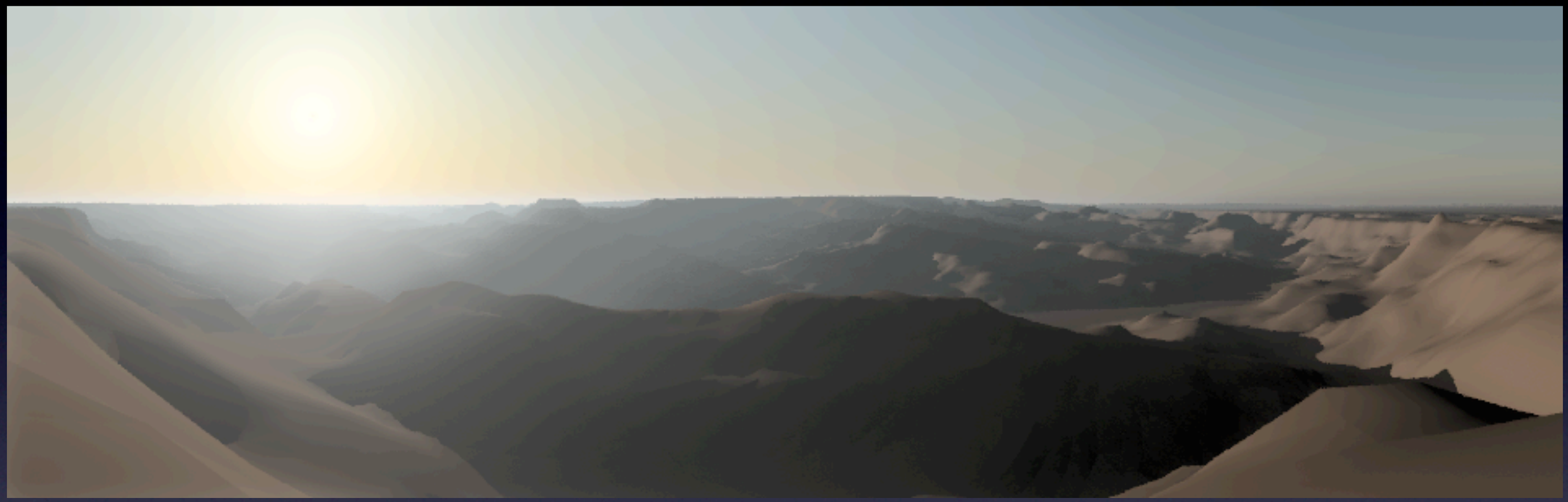
- USGS 30m DEMs
- Long tool chain to get Radiance mesh



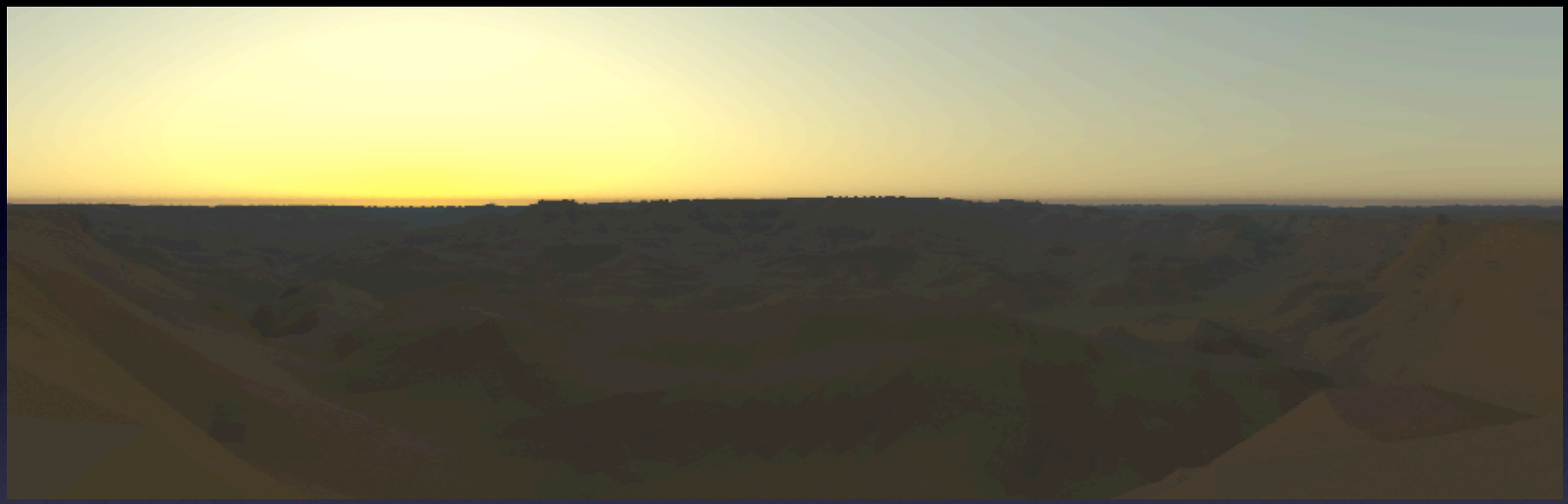
Results



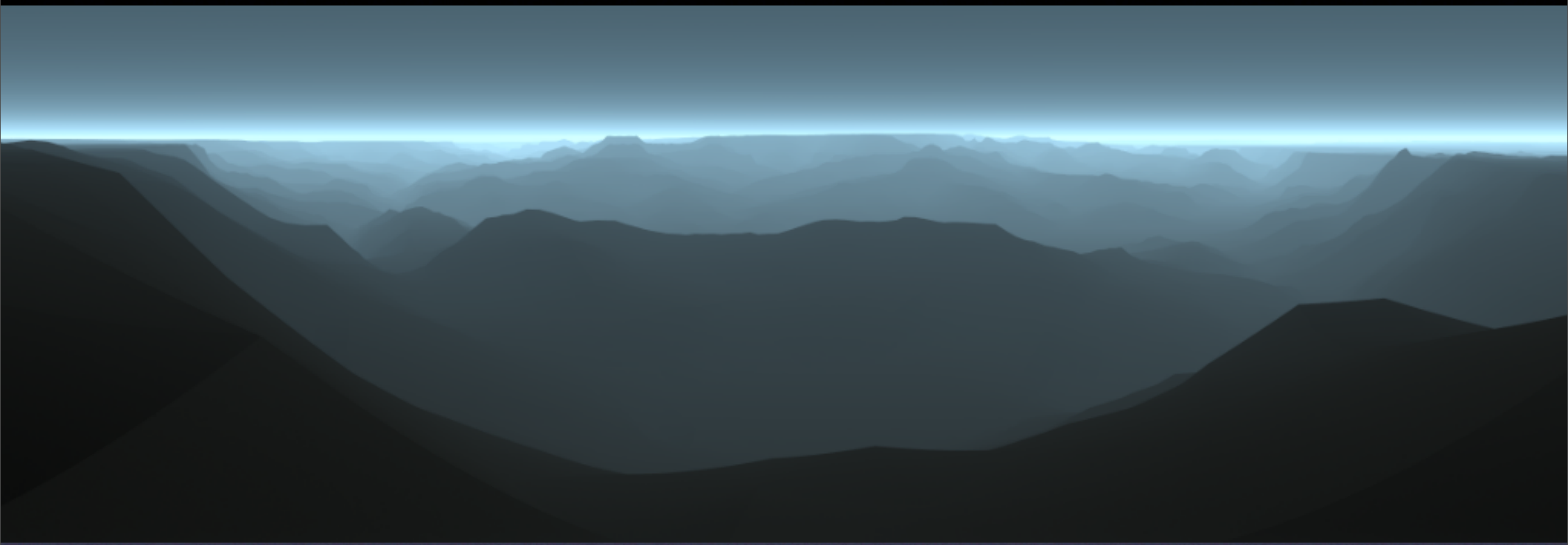
Grand Canyon at sunrise from Desert View, looking West and North



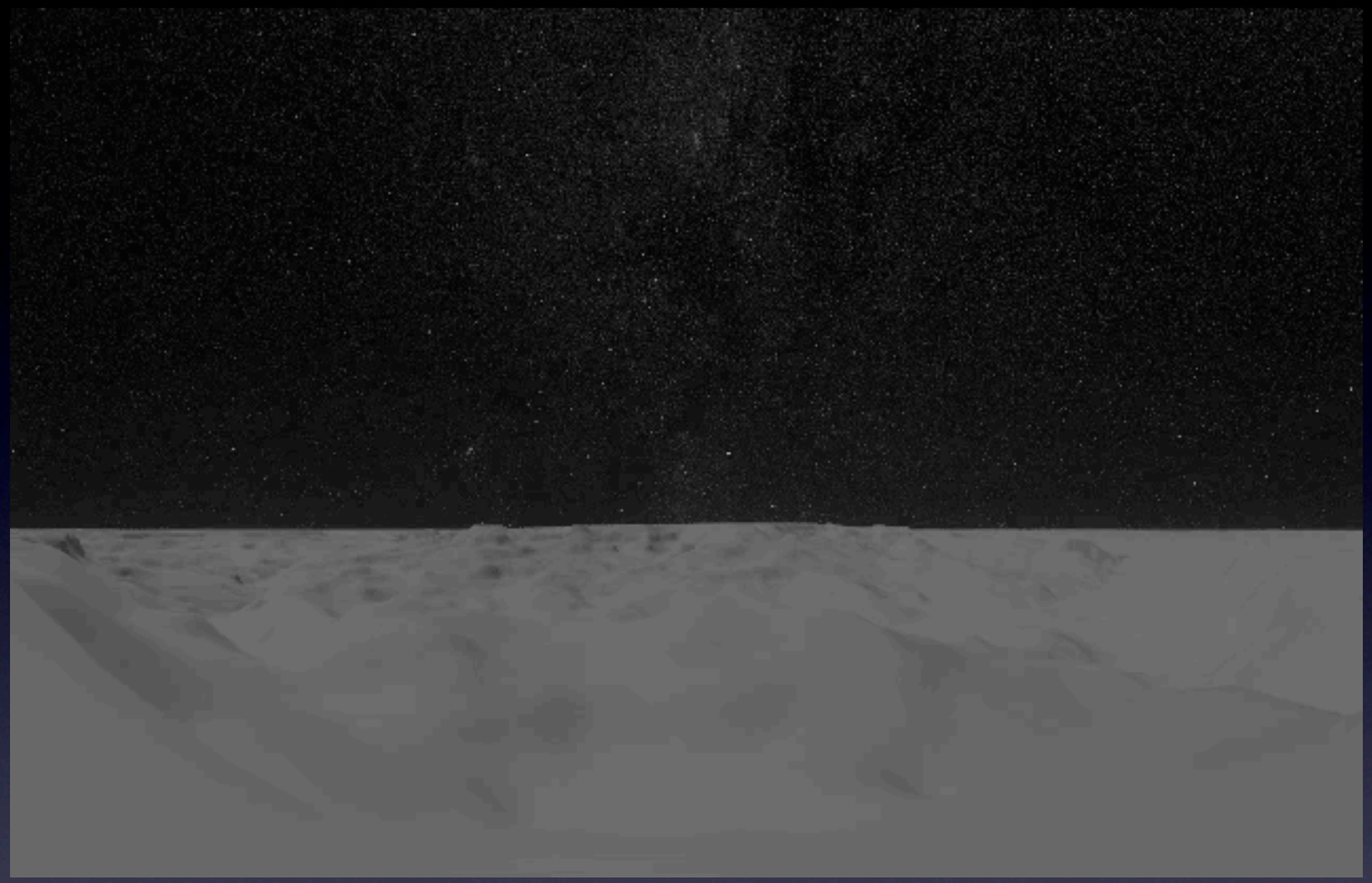
Same, before sunset



Same, after sunset



Same view, serendipitous accident



Same view, midnight-to-midnight animation

Validation

Getting genutahsky

- Package at
  `http://markjstock.org/radiance/genutahsky.zip`
- Unzip into /usr/local/lib/ray/
- Consists of
  genutahsky.c
  Makefile
  .cal files
  .hdr starmap

Building genutahsky

- Only external requirement:
  libnova package from sourceforge
- `make`
- Put files in ./ or ${RAYPATH}

Usage

- Original:
  `gensky 10 23 11EST -a 36 -o 112 -t 2.5`
- New model:
  `genutahsky 10 23 11EST -a 36 -o 112 -t 2.5`
- Forced values (-B -R -r …) unsupported

Rendering tips

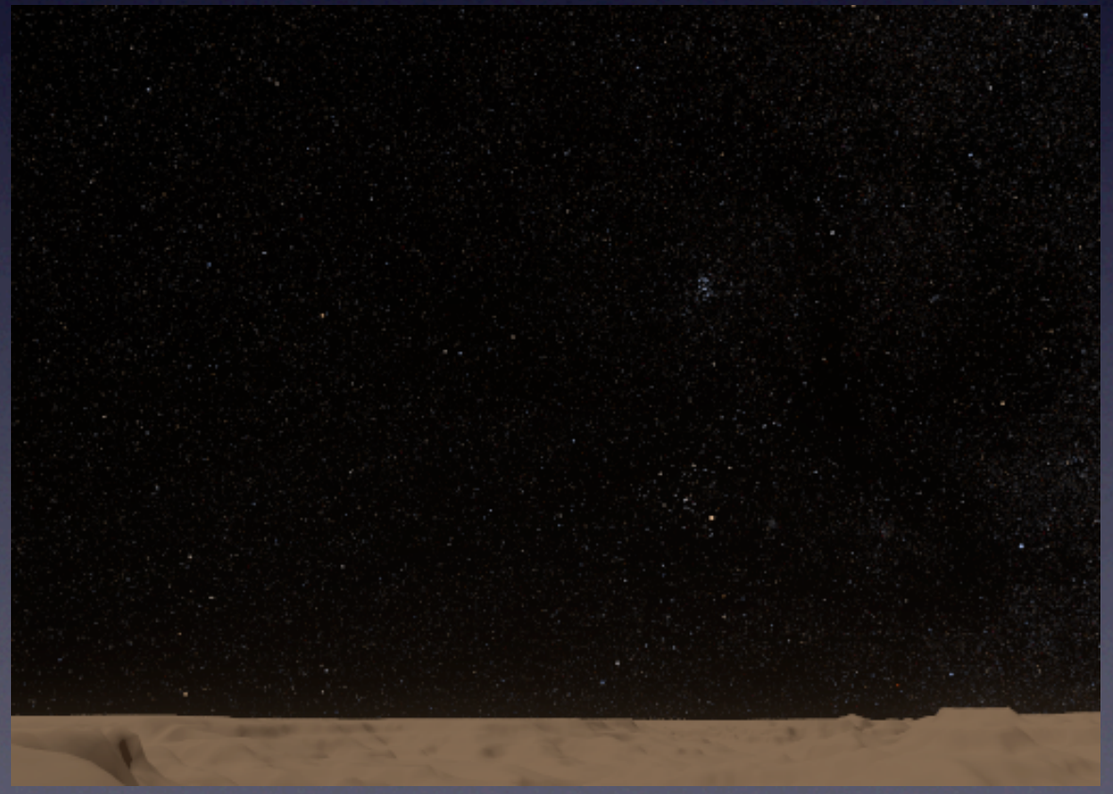
- Use generated ground haze material

Rendering tips

- Use generated ground haze material
- -lw 1.e-3 helps

Rendering tips

- Use generated ground haze material
- -lw 1.e-3 helps
- pcond -v -s (-h without -a -c)



Status

- "City" glow from distant light sources
- Wider range of turbidity (now: 1.75-5)
- Proper modifiers for aerial perspective
- Help?

Thanks!

- Greg Ward
- Christoph Reinhart and Kera Lagios
- Liam Girdwood, Petr Kubanek of libnova
- List geniuses: Rob G., Rob F., Lars G., Jack dV., Chris R., Ignacio M., Andrew McN.

A New Method for Radiance Skies

Mark J. Stock
mstock@umich.edu
http://markjstock.com/

8th International Radiance Workshop