

# Stellarium

## *Astronomical Simulation for Research and Outreach*



**Georg Zotti**



LUDWIG  
BOLTZMANN  
INSTITUTE

Archaeological Prospection and Virtual Archaeology



China-VO Lecture: Feb. 1, 2021.



# OUTLINE

## Stellarium

The perfect learning/teaching/outreach tool?

Notes about development

## Virtual Archaeoastronomy

Landscapes

Architecture and skylscapes

OUTREACH: 100m<sup>2</sup> of skyscape in an archaeological exhibition

Some further highlights

Skycultures



# Stellarium Desktop Planetarium

- Multiplatform
- Pretty sky simulation
- diverse projections (stereographic, cylindrical, etc.)
- Exchangeable constellation patterns (star myths)
- photo horizons
- **Plugin-extendable**
- **Open-source community project**  
→ ADD YOUR CORRECTIONS



# Stellarium Facts

- ❑ Started in Summer of 2000 by Fabien Chéreau
- ❑ First team active until ~2012: Look&Feel
- ❑ About 10 major contributors
- ❑ Currently 2-4 active developers
  - Alexander Wolf (Maintainer; Barnaul, Russia)
  - Georg Zotti (Vienna, Austria)
  - [Fabien Chéreau](#)
  - [Guillaume Chéreau](#)
- ❑ 18.500 commits by 186 contributors
- ❑ >900.000 lines of code
- ❑ >80 languages – 429 translators on [transifex](#)
- ❑ 658 financial supporters: **THANK YOU!**
- ❑ Quarterly releases, about 300.000 to 700.000 downloads each

 Stellarium-Web



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 open collective

Make your community sustainable.



# Community Effort: Translation

transifex Dashboard Teams Reports Search Strings Stellarium

stellarium English (en) → German (de) QA Check Overview Concordance

4613 All 54 Untranslated 38 Unreviewed

Filters reviewed:no

Text Status Tag Users Date Label More

| ID   | Source Text                                    | Target Text   | Status     |
|------|--|---|------------|
| 1628 | &New Folder                                    | &Neuer Ordner   | Unreviewed |
| 1629 | Show &hidden files                             | Zeige &verborgene Dateien   | Unreviewed |
| 1630 | Show FOV center marker when position is search | Zeige die mittlere Markierung des Gesichtfeldes, wenn die Position gesucht wird | Unreviewed |
| 1955 | Recent Searches                                | Letzte Suchen   | Unreviewed |
| 1959 | Max items to display:                          | Max. Anzahl zum Anzeigen  | Unreviewed |
| 1960 | Trails thickness in pixels                     | Strichstärke für Spuren, Pixels   | Unreviewed |
| 1995 | Orbits thickness in pixels                     | Strichstärke für Orbits, Pixels   | Unreviewed |
| 2015 |  |   |            |

Context Suggestions History Glossary Comments

4 suggestions available Concordance

100% match &Neuer Ordner &New Folder

Added by gzotti in Stellarium / stellarium, 4 months ago

Review Save Changes

Docs API Integrations Blog Community Releases Status Contact Privacy Terms English Transifex © 2020

transifex

- >36.000 strings
- 429 translators
- 80 languages
- +15 without translators

Join the team!



**Landscape + Sky + Observer = Skyscape**



The Night Sky is alive!





# Astronomical Cultural Heritage







# Astronomical Cultural Heritage



TWANight.org

*Anthony Ayiomamitis*



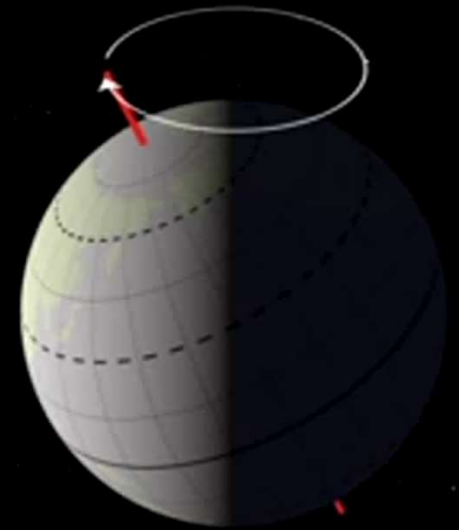
# Astronomical Cultural Heritage





## Why do we have to Simulate the Sky?

- Site accessibility
  - not required to disturb the site
- The past sky cannot be observed!
  - Earth's precession





## Why do we have to Simulate the Sky?

- Site accessibility
  - not required to disturb the site
- The past sky cannot be observed!
  - Earth's precession
  - Stellar proper motion
  - Light pollution
- Speed-up research
  - allows observations during a full year within minutes



## Requirements of Astronomical Accuracy for Historical Application



### Planet positions:

- VSOP87 (recommended: -4000 ... +8000)
- JPL DE430/DE431 Accurate planet positions -13.000...+17.000



Precession/Obliquity: IAU 2006, Vondrák et al. 2011/12  
Nutation: IAU 2000B



$\Delta T$  (earth rotation): over 30 models



Accurate Lunar Physical Ephemeris  
(Lunar Rotation) and planet axes

Coming 0.21.0

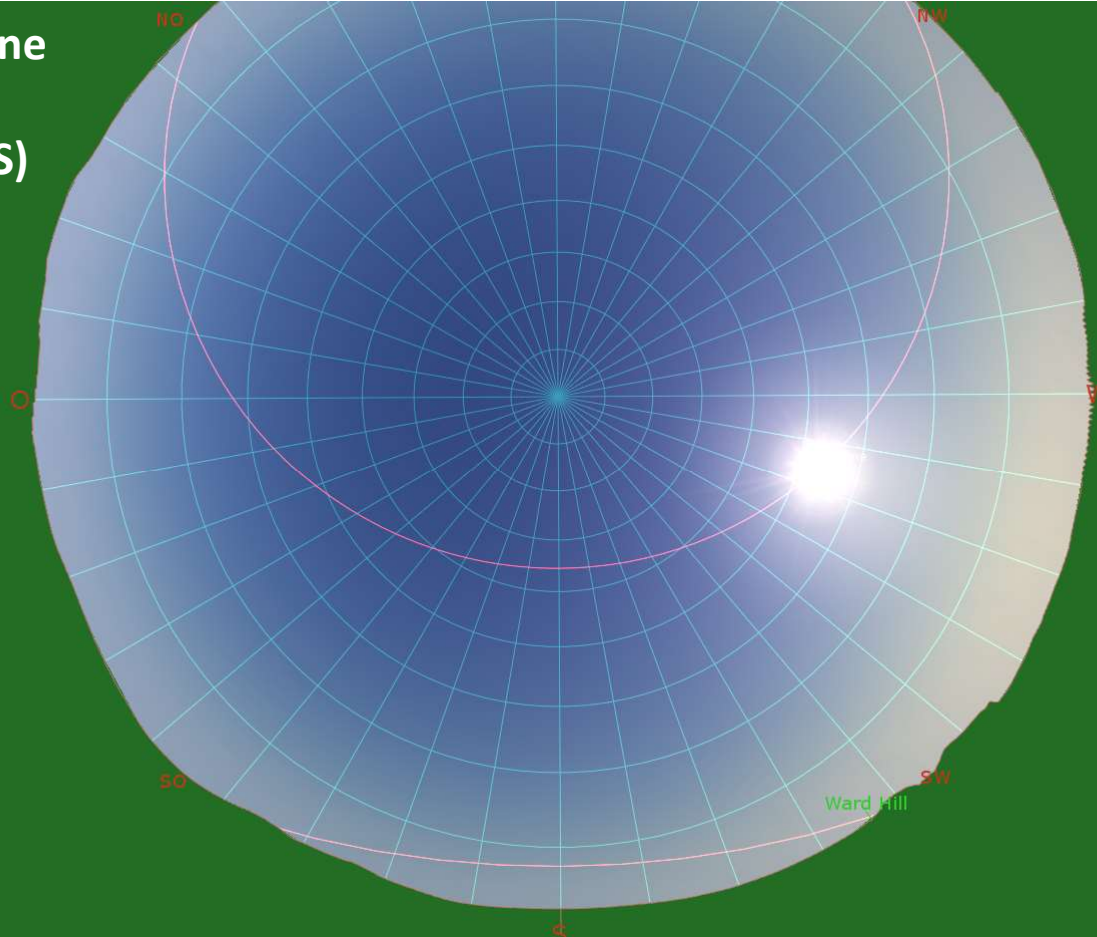
**TODO** Fix mismatch with Lunar occultations (aberration)



## Landscapes and Horizons in Stellarium 0.20

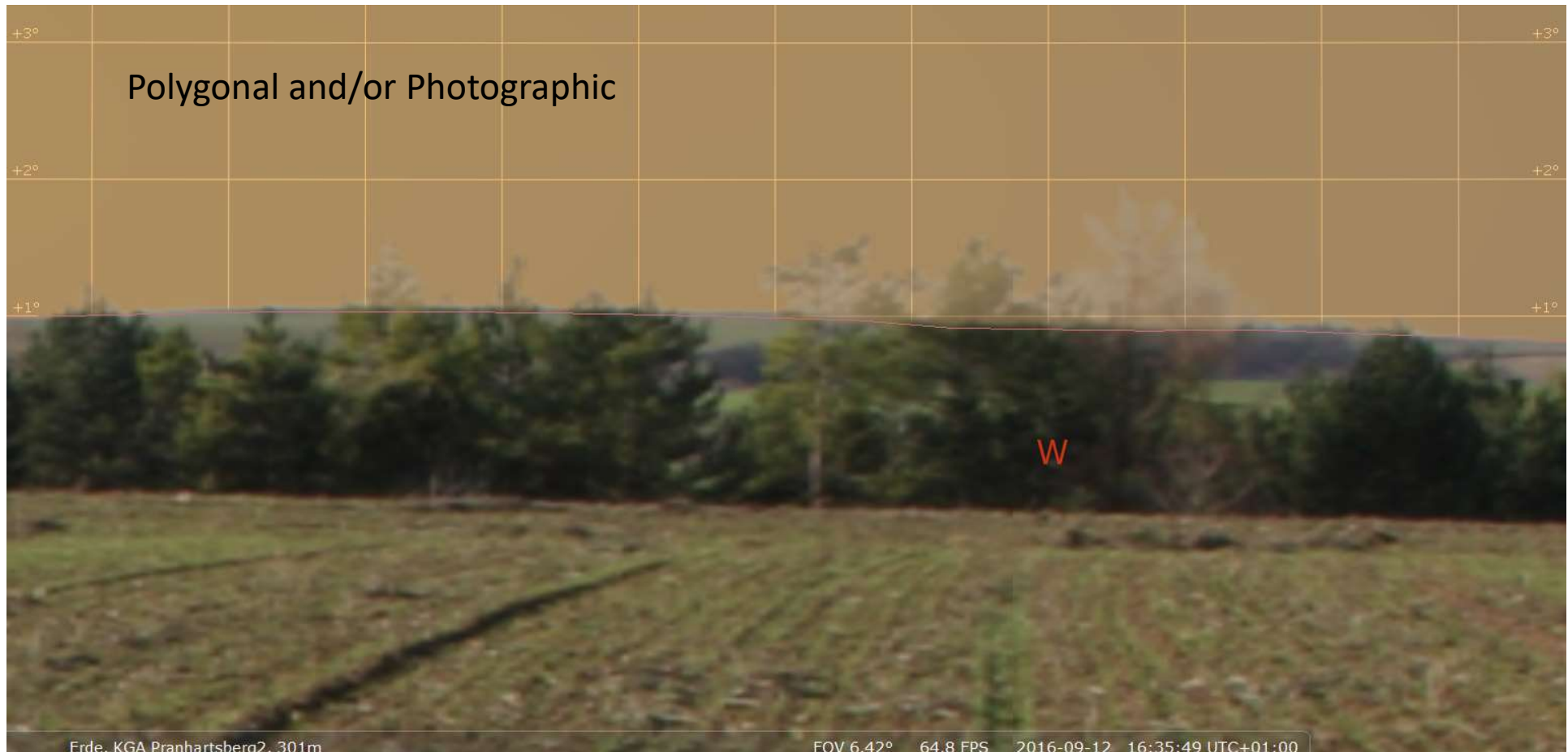
From Polygonal line

- Measured
- Computed (GIS)





## Landscapes and Horizons in Stellarium 0.20

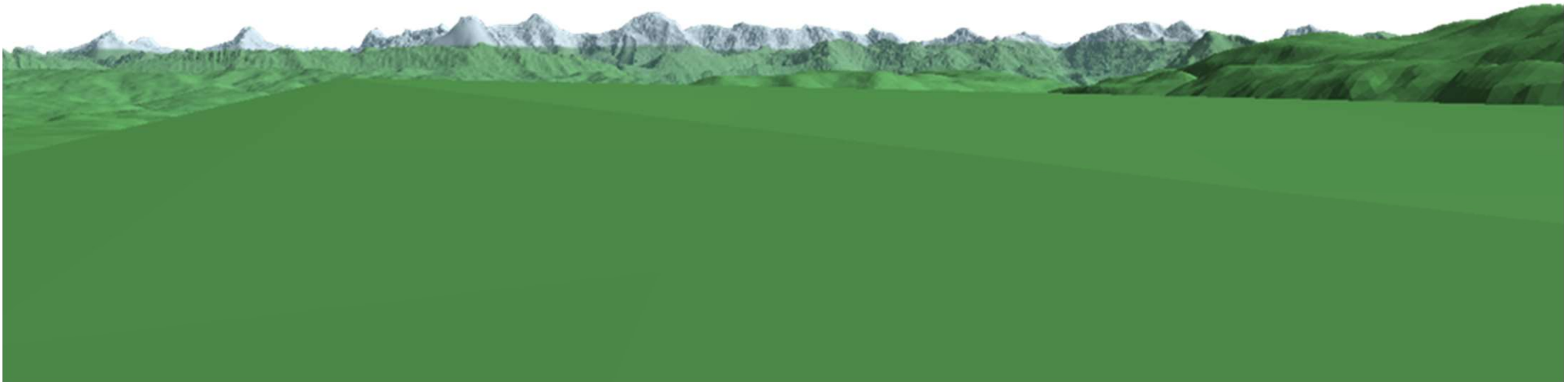




## Landscapes and Horizons in Stellarium 0.20

Andrew Smith: Horizon - <http://agksmith.net/horizon/default.html>

can export Stellarium Landscapes (SRTM 90m and 30m based; others: TBD).







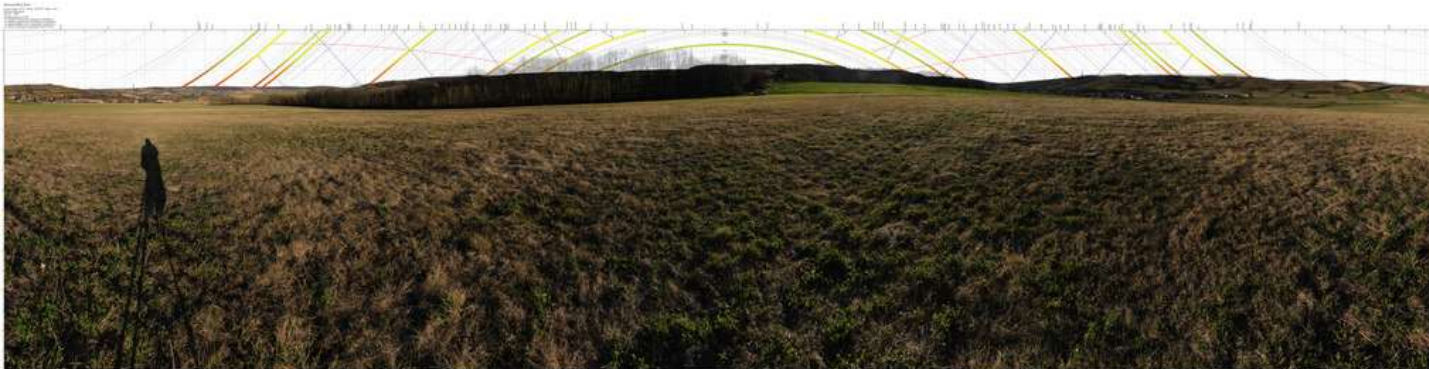
# Landscapes and Horizons in Stellarium 0.20





# Calibrated Horizon Panorama for Stellarium

- Diagram of surveyed horizon line, may be augmented with
  - azimuth/altitude
  - solar and lunar key tracks
- star tracks



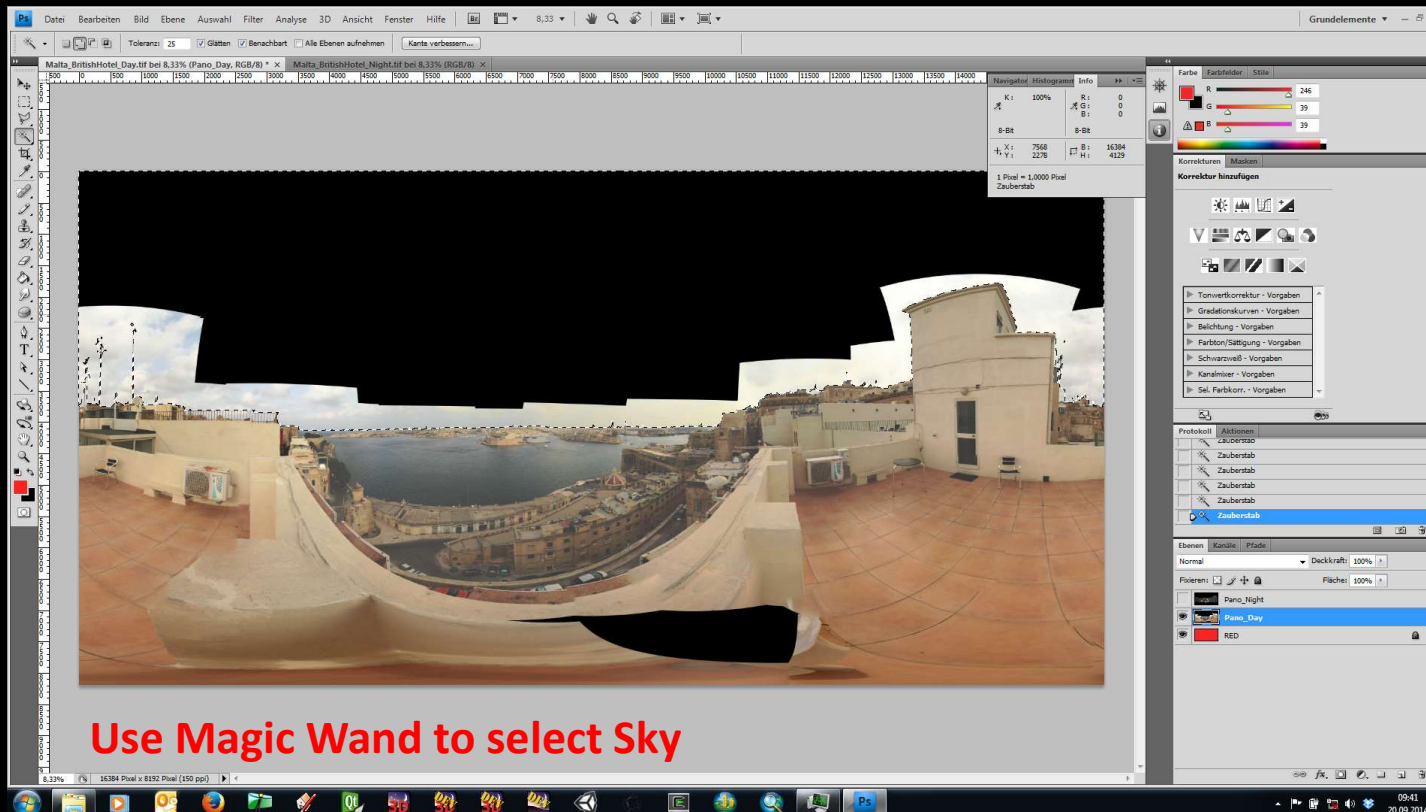
- Photo series from location of total station
- Panoramisation (*Hugin* open-source panorama software)
- Combine pano with diagram of surveyed horizon line
- Adjustment of anchor image orientation
- Iterate into perfection





# Edit Panorama in Layer-aware Image Editor

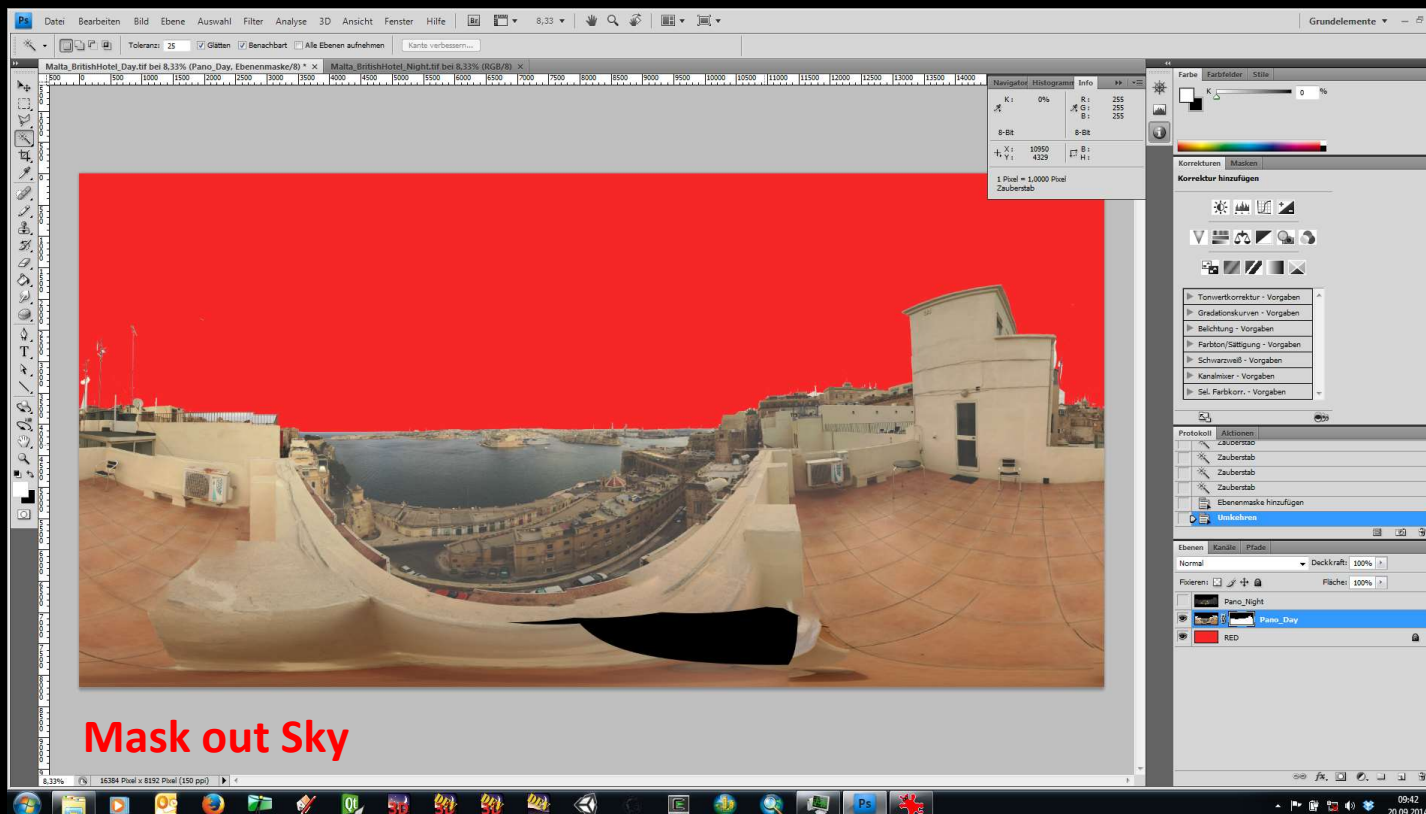
- e.g., the GIMP, Photoshop





# Edit Panorama in Layer-aware Image Editor

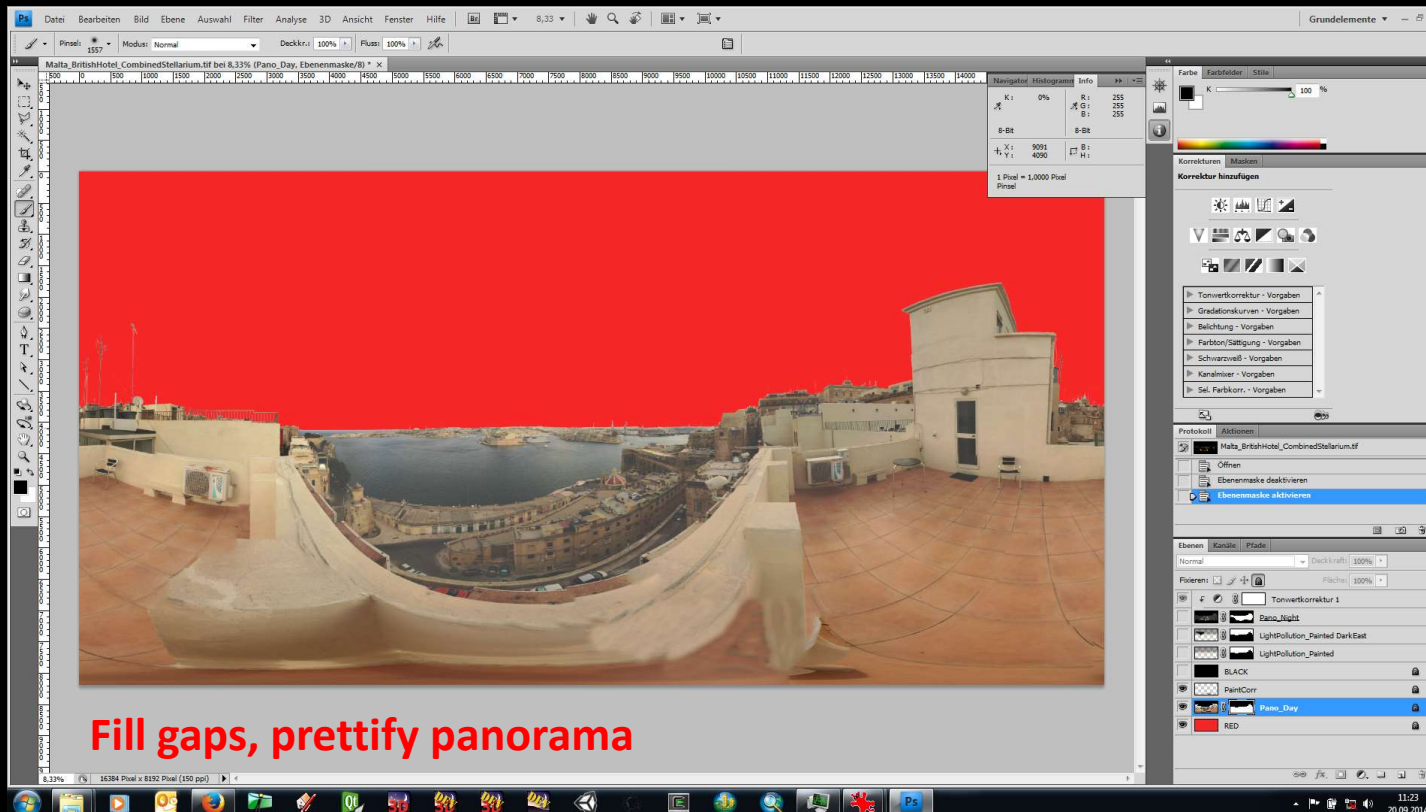
- e.g., the GIMP, Photoshop





# Edit Panorama in Layer-aware Image Editor

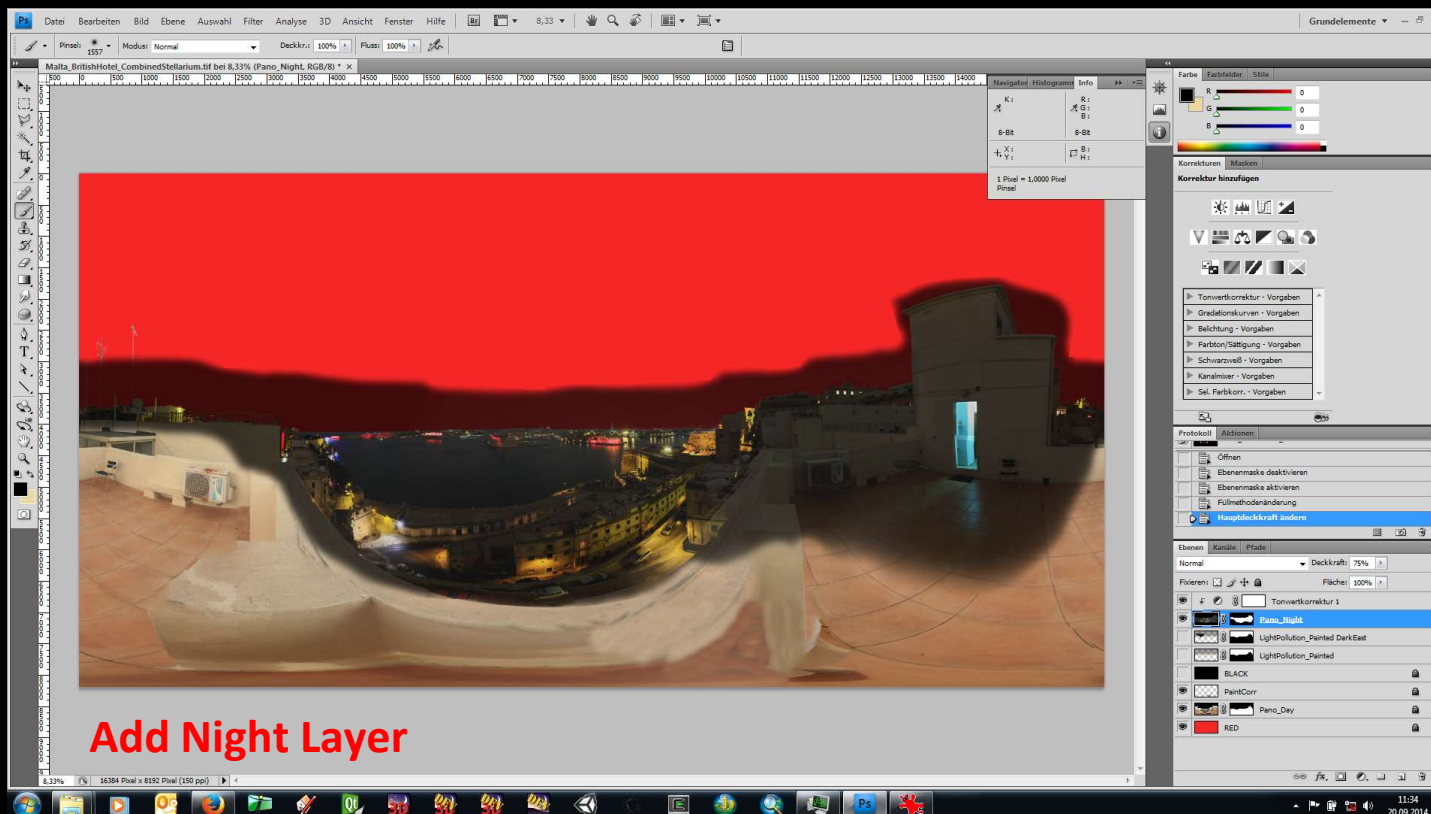
- e.g., the GIMP, Photoshop





# Edit Panorama in Layer-aware Image Editor

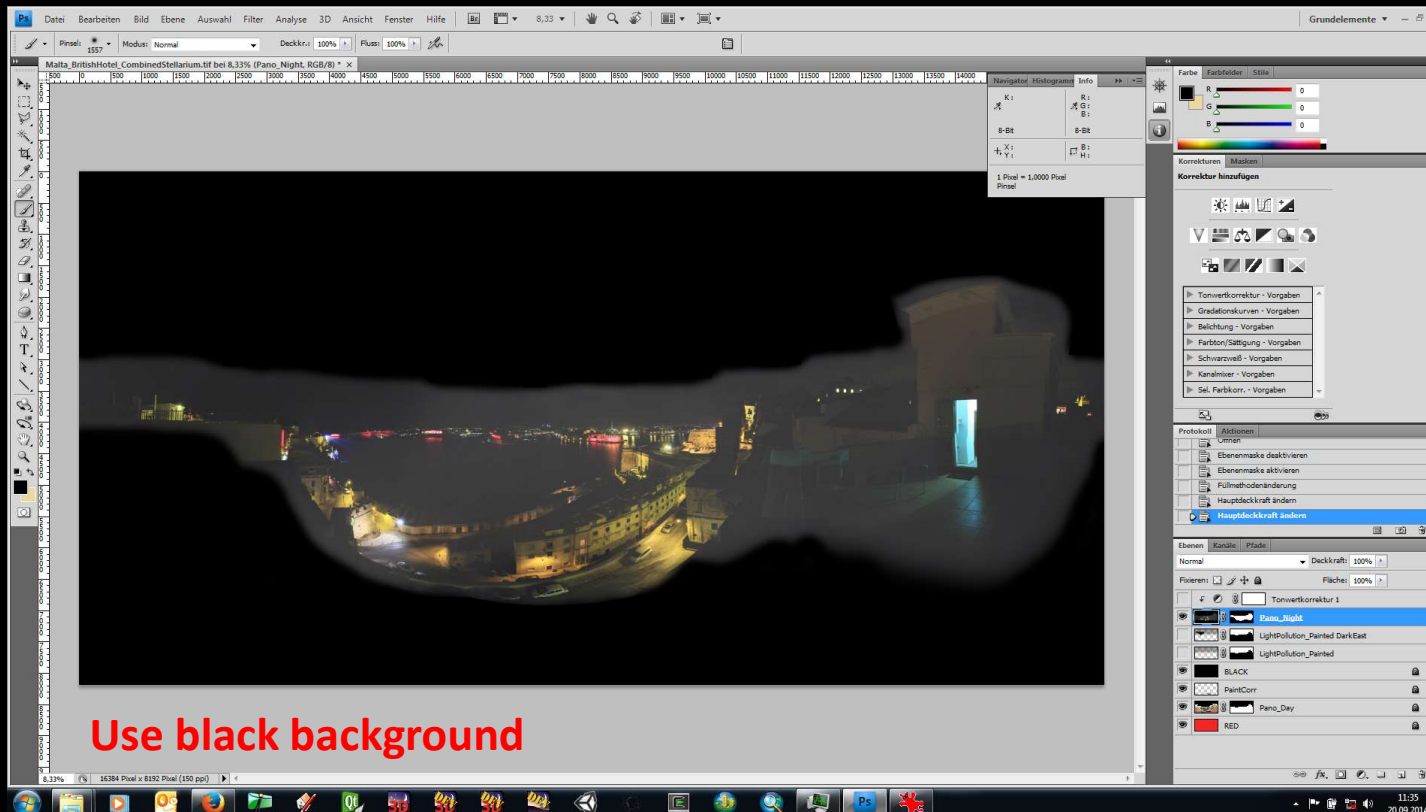
- e.g., the GIMP, Photoshop





# Edit Panorama in Layer-aware Image Editor

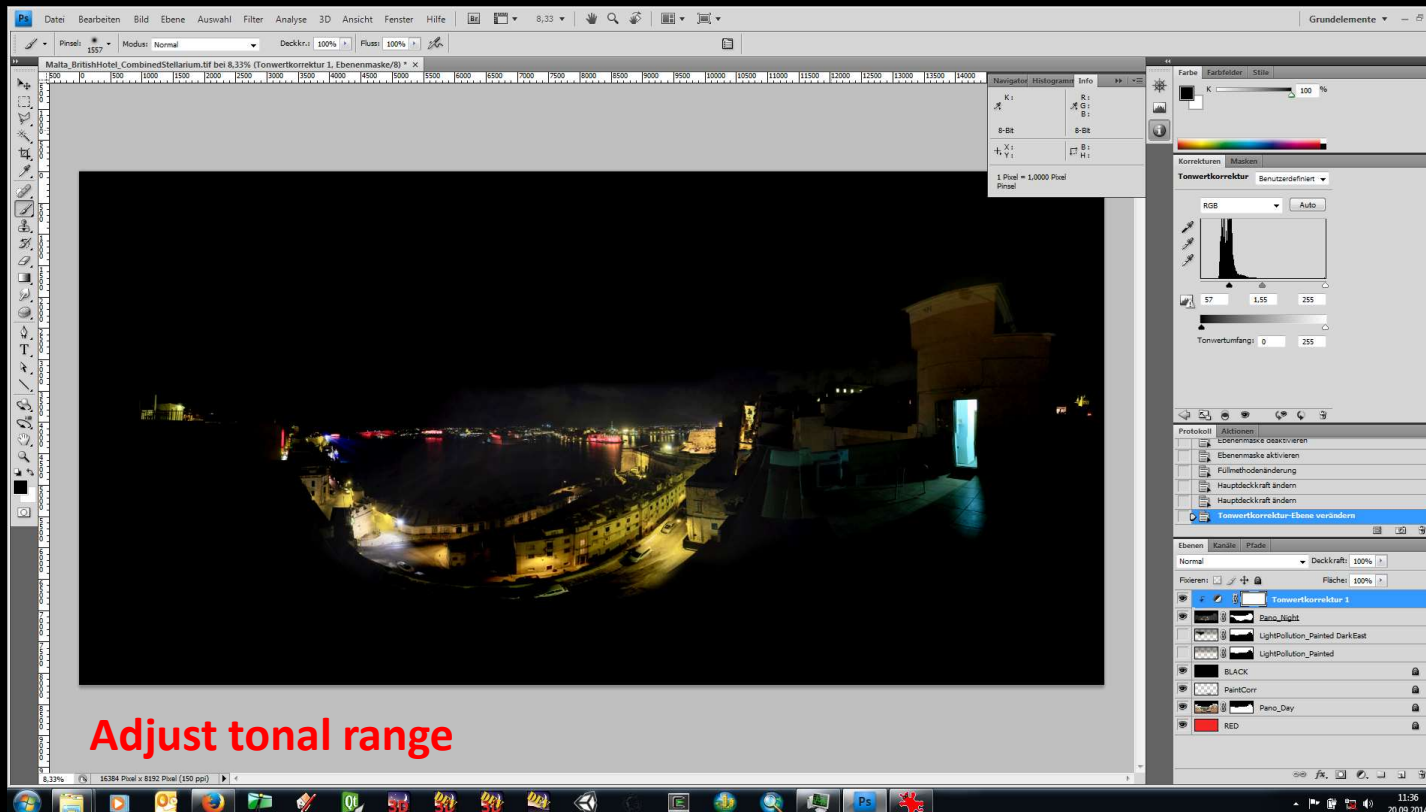
- e.g., the GIMP, Photoshop





# Edit Panorama in Layer-aware Image Editor

- e.g., the GIMP, Photoshop

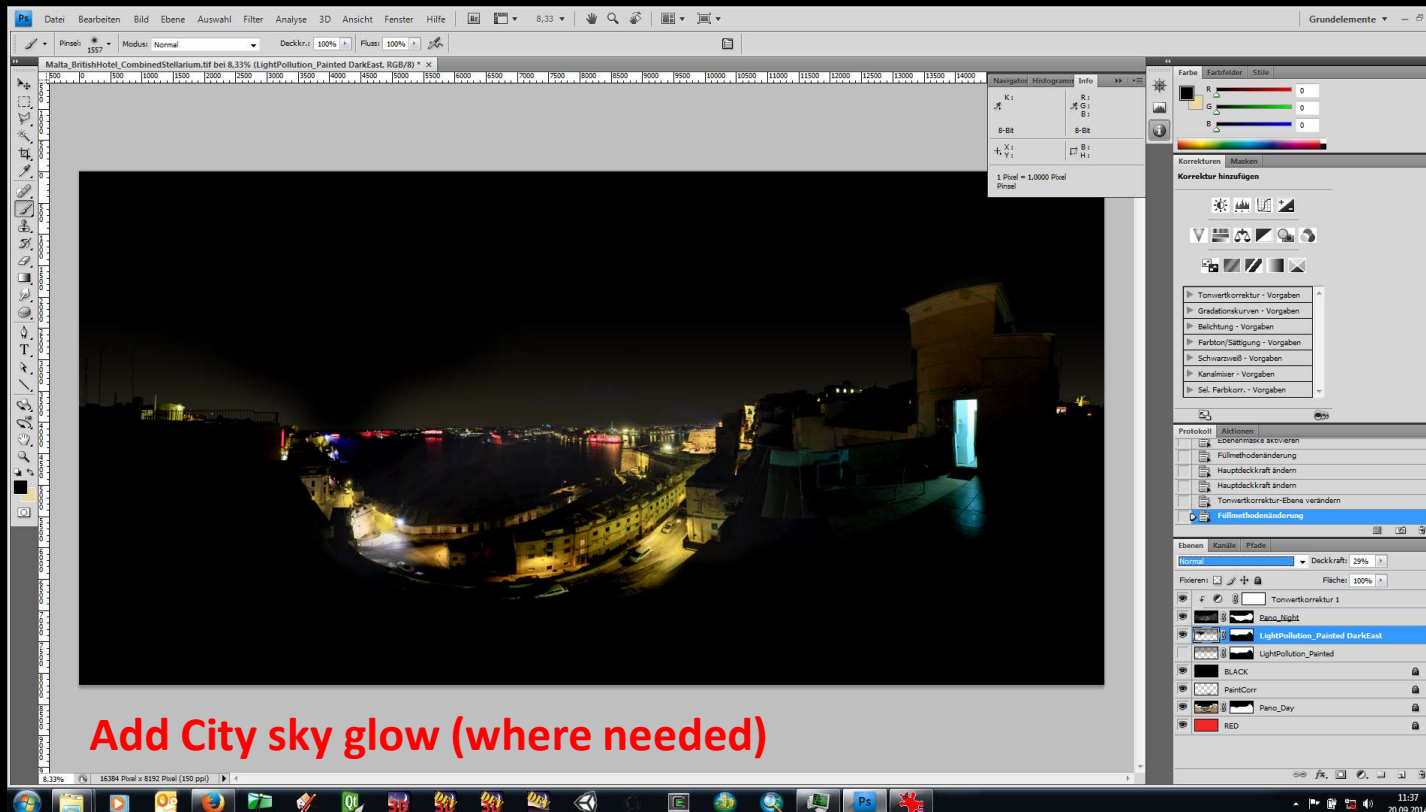






# Edit Panorama in Layer-aware Image Editor

- e.g., the GIMP, Photoshop



# Example: Valletta (Malta), Great Harbour



# Example: Valletta (Malta), Great Harbour

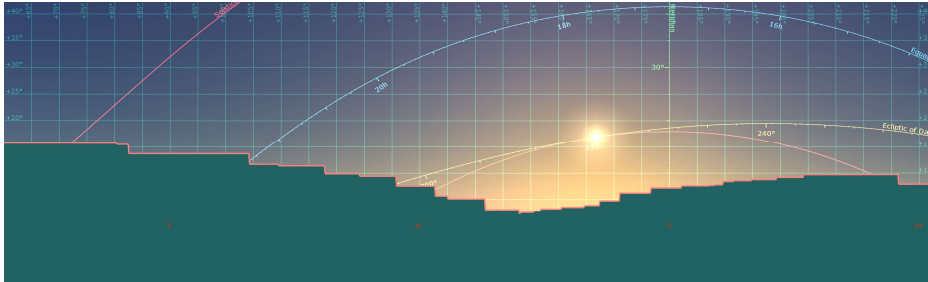


Erde, GZ Valletta, Malta, 60m

FOV 50.7° 15.1 FPS 2014-09-20 20:30:14



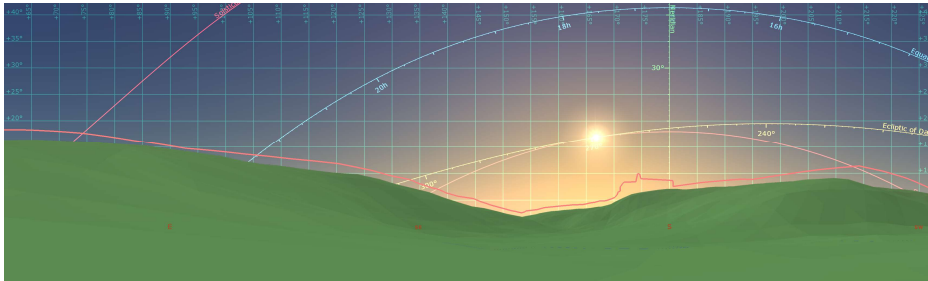
## Landscapes and Horizons in Stellarium 0.20



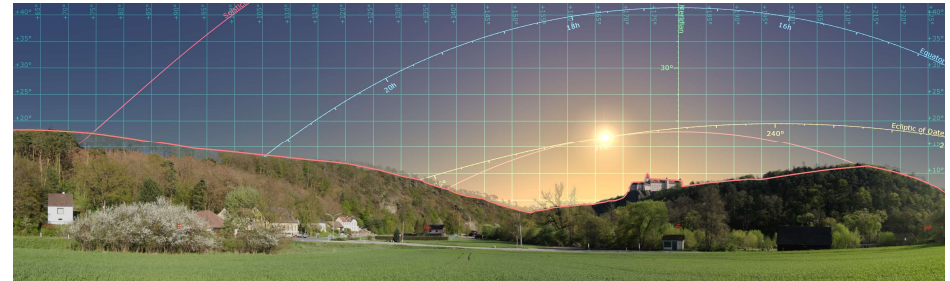
HeyWhatsThat/HoriZONE



Google Earth/Hugin + Survey Line

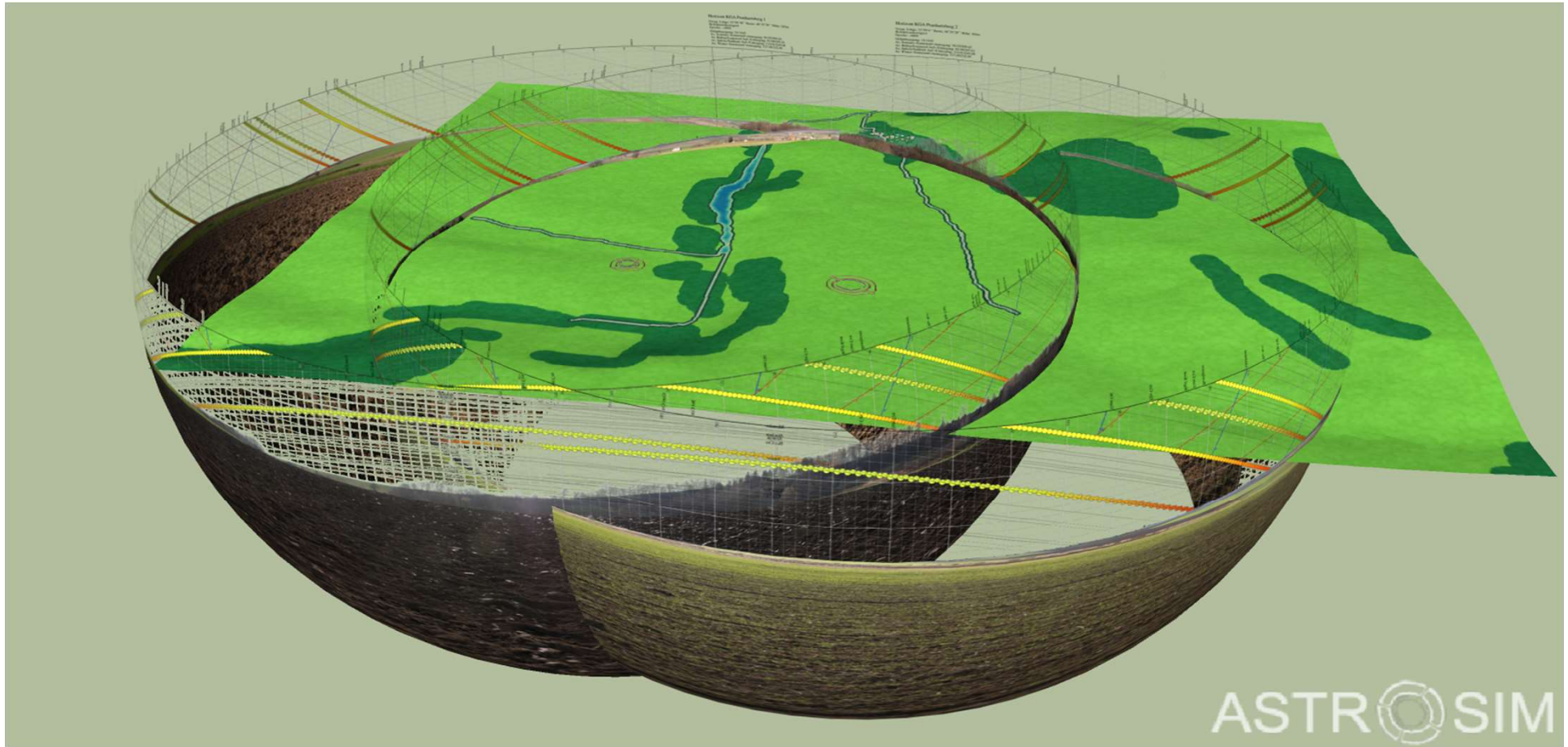


Andrew Smith's Horizon + Survey Line



Photos/Hugin + Survey Line

# One Horizon for Each Viewpoint



# Therefore... 3D Models in Stellarium!

Using Virtual Reconstructions in Stellarium's Scenery3D Plugin:

## – Landscape model from

- GIS (ArcGIS, QGIS, ...)
  - Sketchup Pro (Trimble)
- } → TIN export/convert

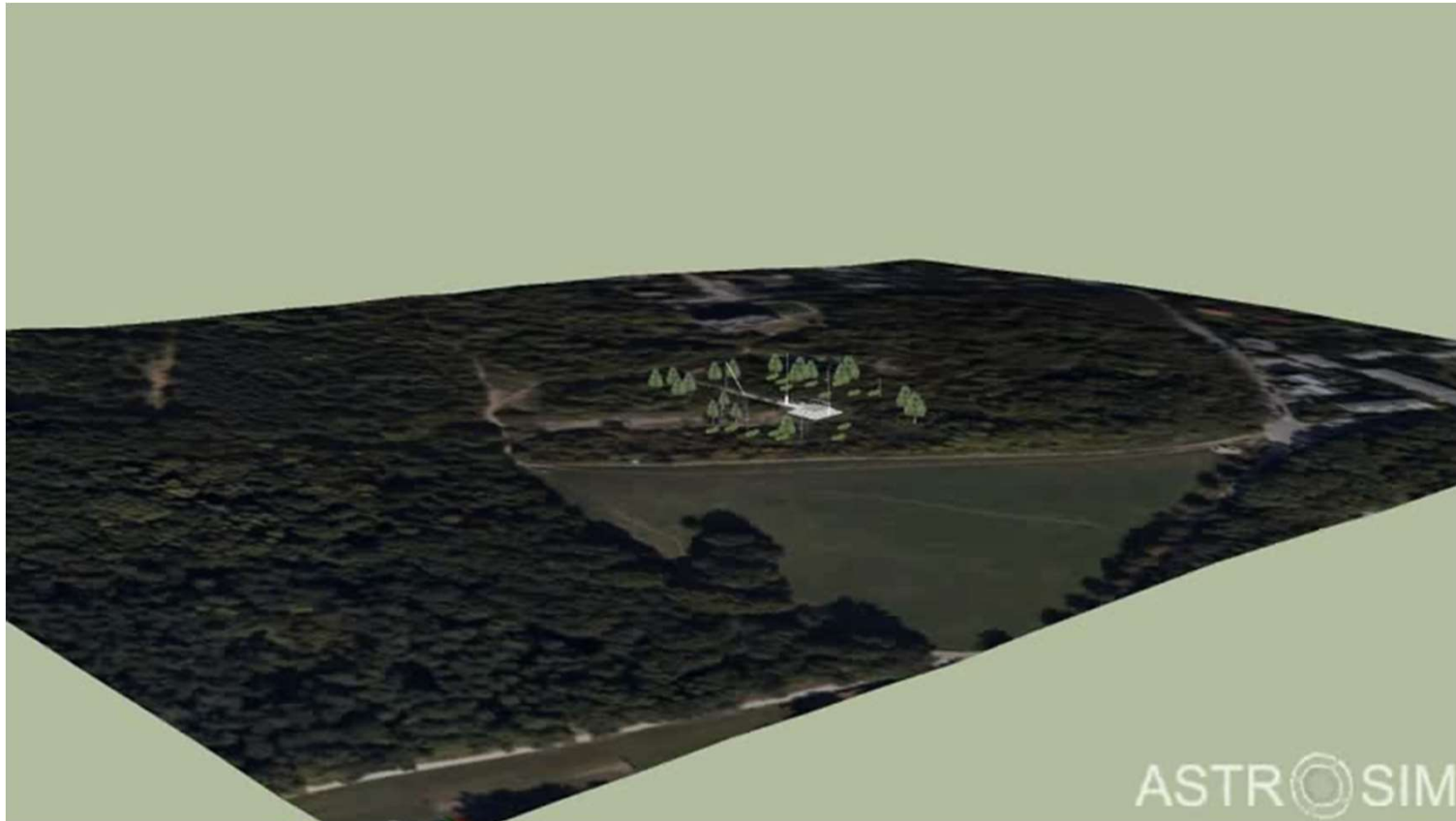
## – Building/feature model from

- Modellers (CAD, 3D Studio, Maya, Blender, ...)
- Laserscan models
- Image-Based Models (Photoscan, SfM-MVS, ...)
- etc.

} → **georeferenced  
.OBJ**



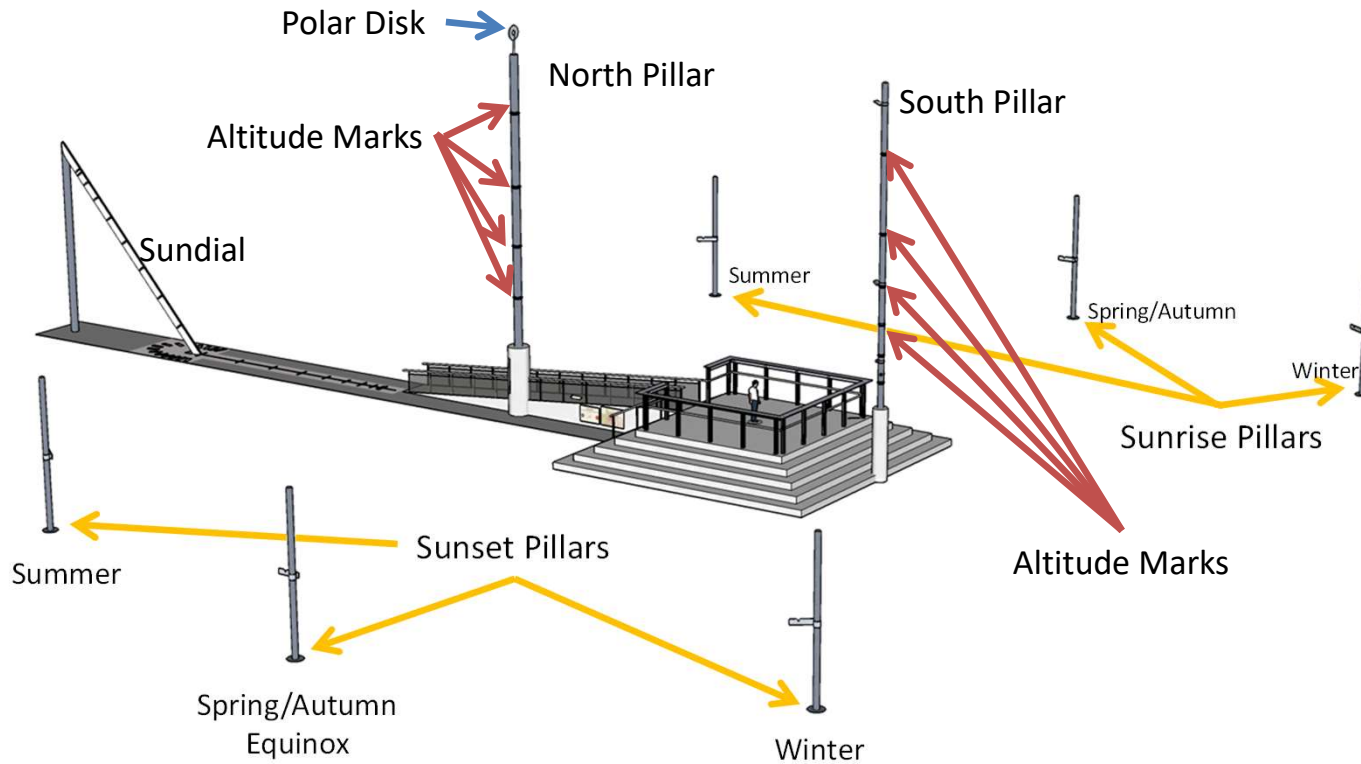
## A Test Model: Vienna Sterngarten



Modelled 2011/12 in Google SketchUp 8



# Sterngarten Model: Testing Geometry

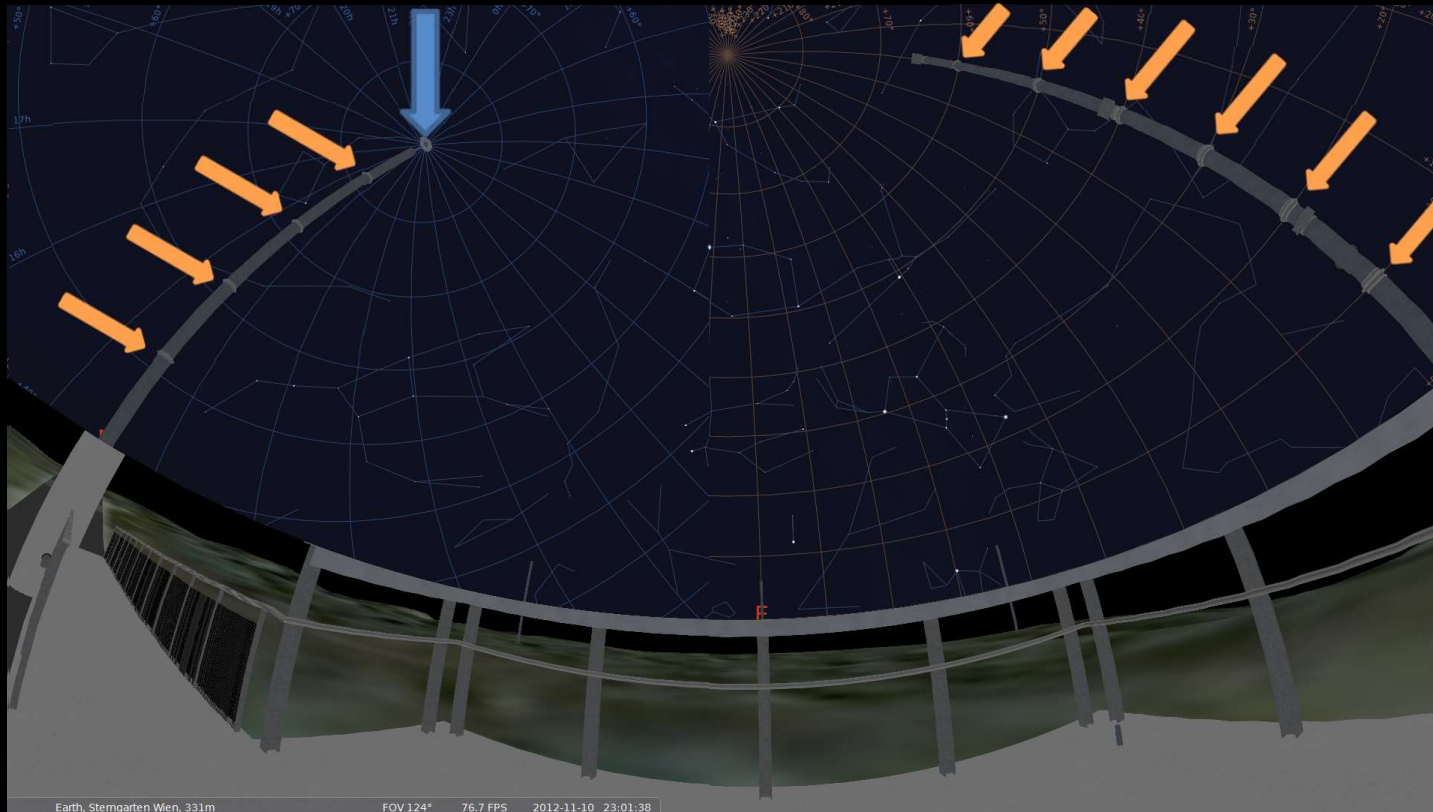


**A place to demonstrate basic astronomical concepts to the public.**





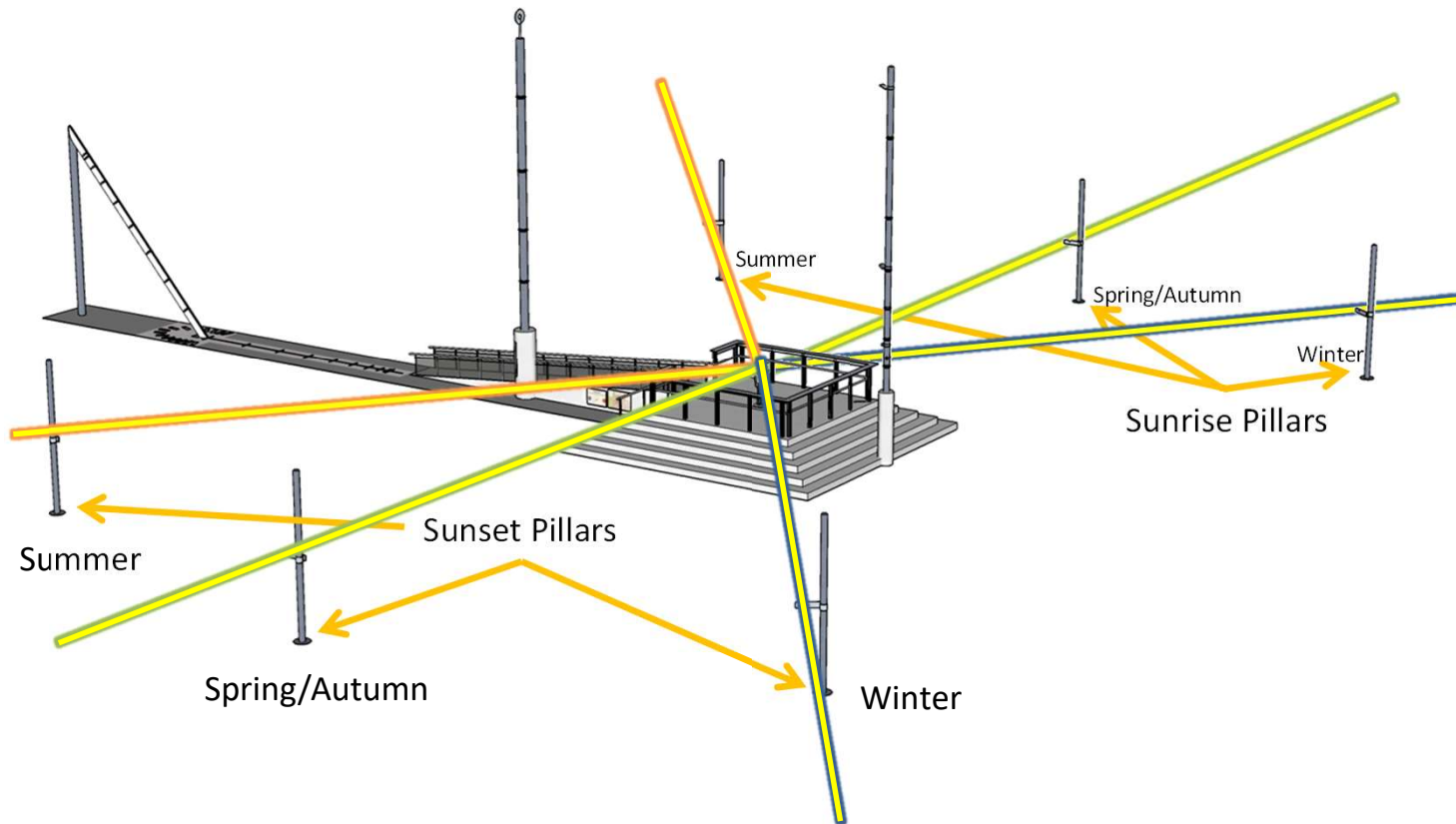
# Sterngarten Model: Testing Geometry



Altitude marks coincide with altitudes in the sky, Pole disk indicates celestial pole.



# Sterngarten Model: Testing Refraction





# Sterngarten Model: Testing Refraction

No refraction



Sunrise behind pillar

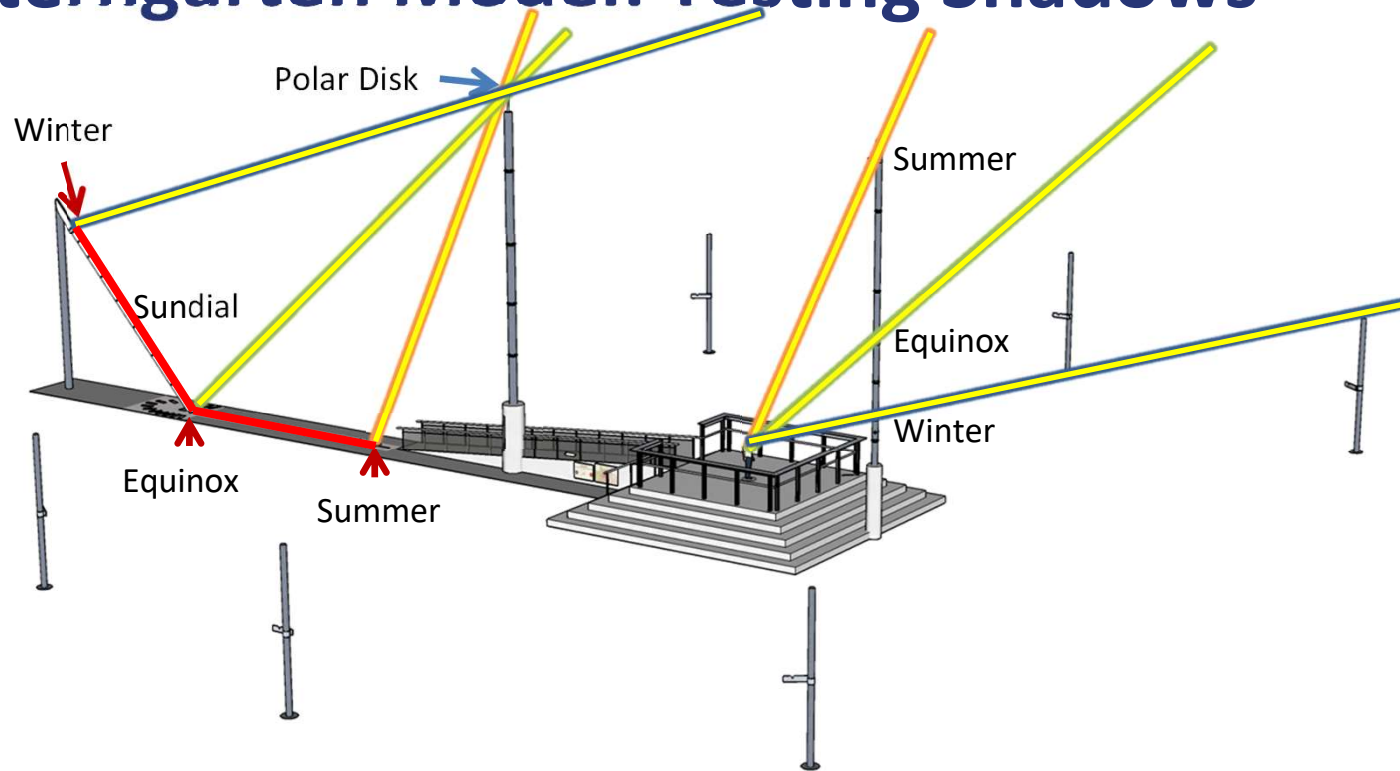
Refraction



Sunrise behind notch  
Sun squashed

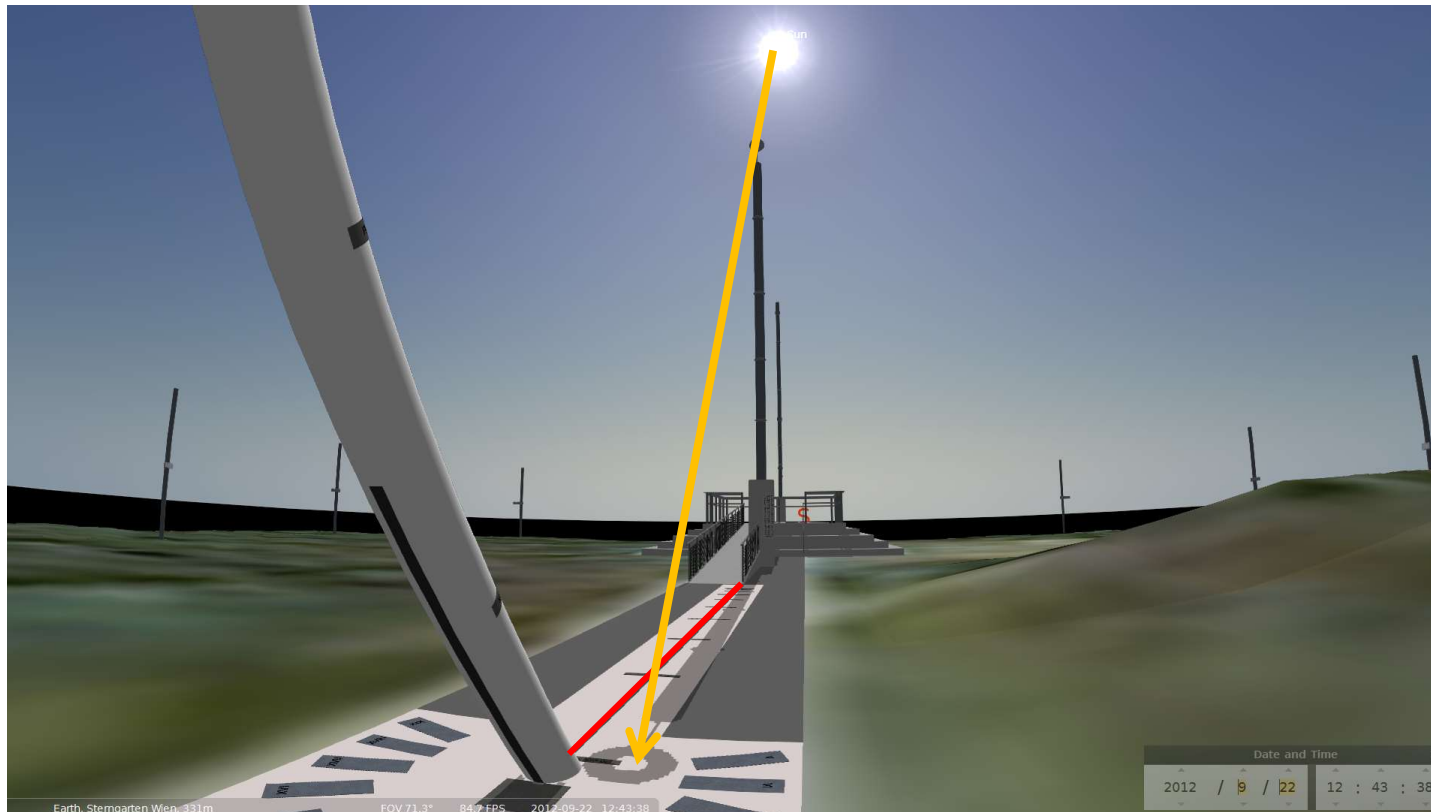


# Sterngarten Model: Testing Shadows





# Sterngarten Model: Testing Shadows





## Sterngarten Model: Testing Shadows



Dengfeng observatory (Gaocheng; AD1276)

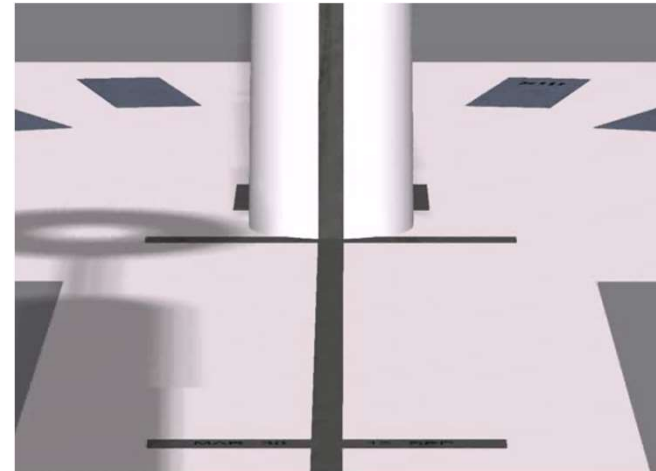


# Sterngarten Model: Testing Shadows

Noon Shadow Transit on 2010-03-20



Image sequence 2010-03-20 (~Spring equinox)  
Disk shadow must touch pillar foot



Simulation in Stellarium/Scenery3d  
+ Same behaviour  
- optional soft shadows only blurred (fake)



## Chichen Itza: El Castillo equinox “snake” phenomenon



“Snake Shadow” (Wikimedia)

Model from Google 3D Gallery

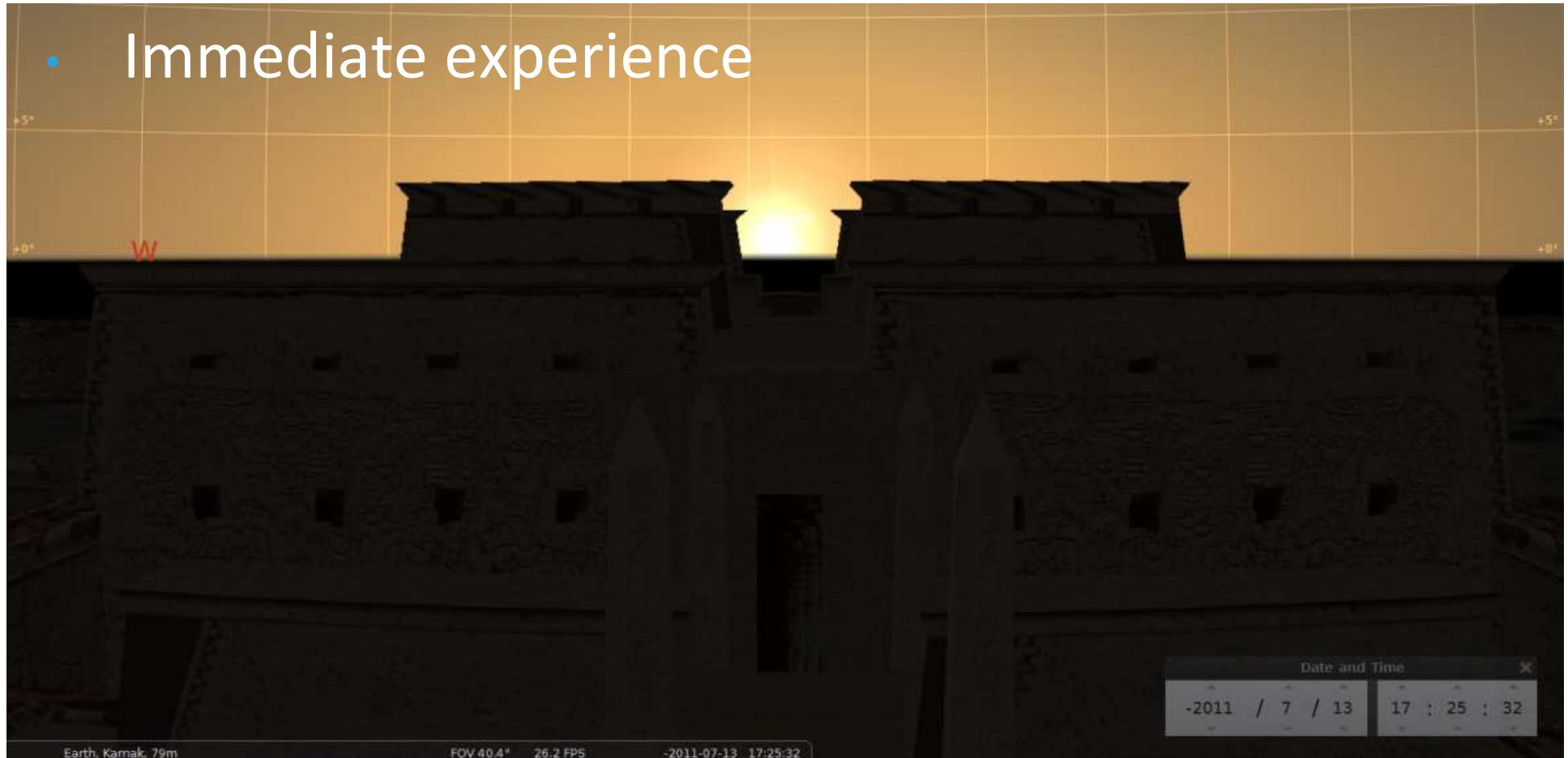
Stellarium simulation for same day,  
2009-03-21





# 3D Models in Stellarium

- Immediate experience



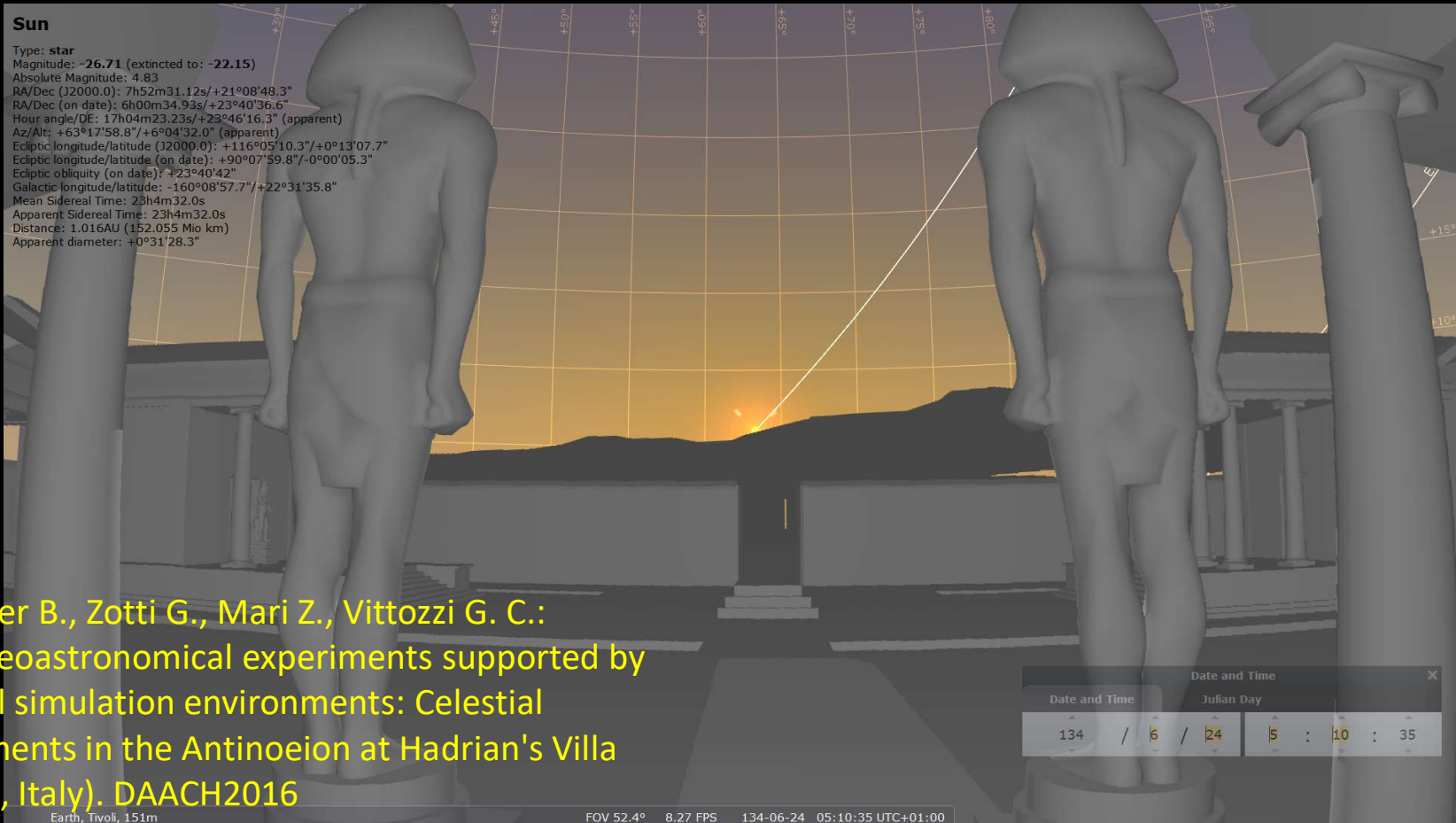
## 3D Models in Stellarium

- Immediate experience
- Interactive exploration





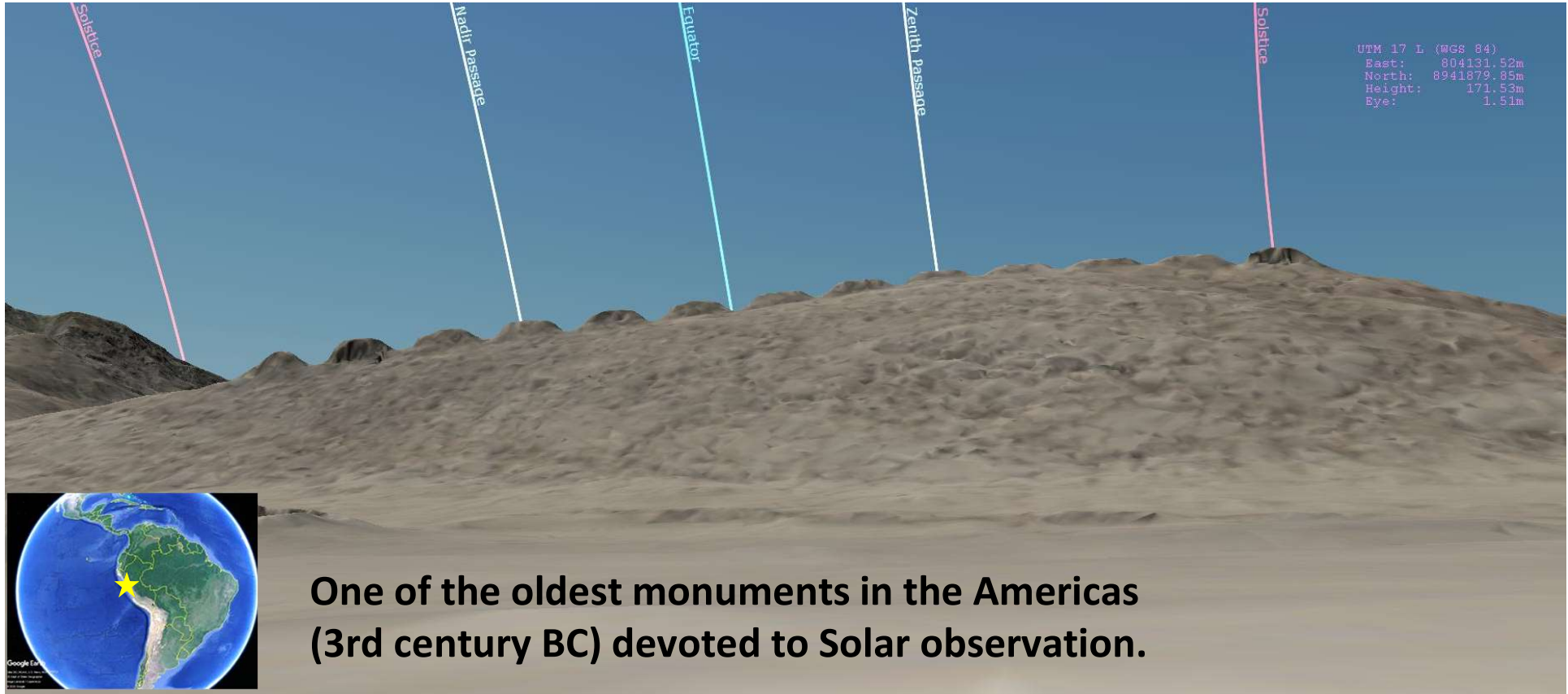
# Hadrian's Villa, Tivoli: „Antinoeion“



Frischer B., Zotti G., Mari Z., Vittozzi G. C.:  
Archaeoastronomical experiments supported by  
virtual simulation environments: Celestial  
alignments in the Antinoeion at Hadrian's Villa  
(Tivoli, Italy). DAACH2016



## Astronomical Cultural Heritage: Chankillo, Peru



Made from LiDAR data courtesy Clive Ruggles & Ivan Ghezzi



## Astronomical Cultural Heritage: Chankillo, Peru





# Stellarium 0.17 & Scenery3D: Laser Scan



# Combine with Unity Game Engine



G. Zotti et al.  
Serious Gaming for Virtual Archaeoastronomy  
Studies in Digital Heritage, 4(1):51-74, 2020  
DOI:10.14434/sdh.v4i1.31041

2020-12-21T16:44:26.000

# Combine with Unity Game Engine

G. Zotti et al.  
Serious Gaming for Virtual Archaeoastronomy  
Studies in Digital Heritage, 4(1):51–74, 2020  
DOI:10.14434/sdh.v4i1.31041







# OUTREACH: The Skyscape Planetarium

- Exhibition in the MAMUZ Museum for Prehistory, Mistelbach (Austria) 2016-17.
- Stonehenge Horseshoe in 1:1 replica stones
- 25x4m curved screen, 5 projectors
- Scripted show (~20 minutes)
- Archaeoastronomical details explained with simulated sky



G. Zotti, F. Schaukowitz, M. Wimmer: The Skyscape Planetarium.  
In Culture and Cosmos, vol.21 269–281, 2017.  
[https://www.cultureandcosmos.org/pdfs/21/CCv21\\_17Zotti.pdf](https://www.cultureandcosmos.org/pdfs/21/CCv21_17Zotti.pdf)



# The Skyscape Planetarium



G. Zotti, F. Schaukowitsch, M. Wimmer: The Skyscape Planetarium.  
In Culture and Cosmos, vol.21 269–281, 2017.  
[https://www.cultureandcosmos.org/pdfs/21/CCv21\\_17Zotti.pdf](https://www.cultureandcosmos.org/pdfs/21/CCv21_17Zotti.pdf)



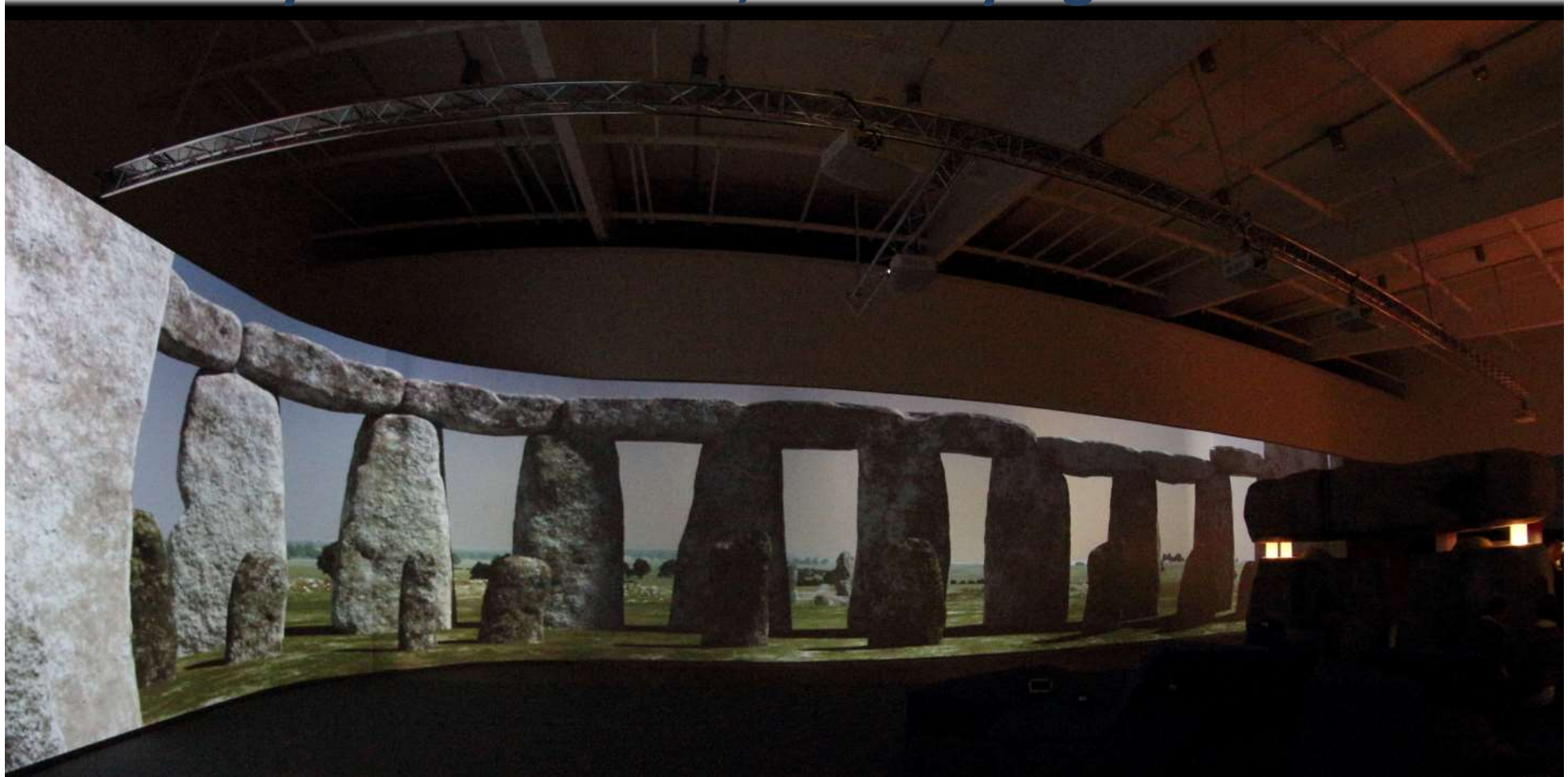
# The Skyscape Planetarium



G. Zotti, F. Schaukowitz, M. Wimmer: The Skyscape Planetarium.  
In *Culture and Cosmos*, vol.21 269–281, 2017.  
[https://www.cultureandcosmos.org/pdfs/21/CCv21\\_17Zotti.pdf](https://www.cultureandcosmos.org/pdfs/21/CCv21_17Zotti.pdf)



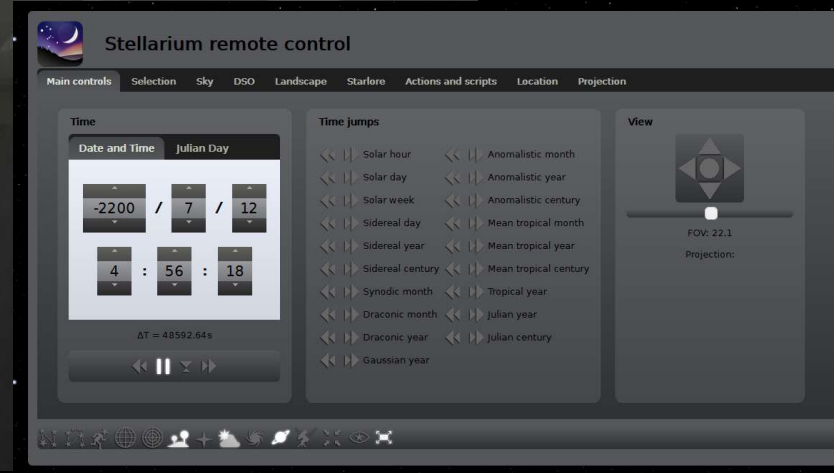
## Only 2D Panoramas, but varying illumination





# Remote Control Web Interface

- Stellarium as web server
- Replicates most GUI settings
- Avoids user interface on big screen
- Allows
  - external communication
  - starting shows at preprogrammed times
- Optional Operator uses web browser
  - on PC
  - simple 7" Tablet





# Here comes the Sun...

**Sun**

Type: **star**  
Magnitude: **-26.71** (after extinction: **-20.84**)  
Absolute Magnitude: 4.83  
RA/Dec (J2000.0): 6h00m24.71s/+23°26'13.4"  
RA/Dec (on date): 6h00m27.56s/+23°26'08.8"  
Hour angle/DE: 15h55m9.63s/+23°46'58.1" (apparent)  
Az/Alt: +51°30'49.8"/+0°58'13.6" (apparent)  
Ecliptic longitude/latitude (J2000.0): +90°05'40.0"/-0°00'07.9"  
Ecliptic longitude/latitude (on date): +90°05'19.2"/-0°00'12.3"  
Ecliptic obliquity (on date): +23°26'21"  
Galactic longitude/latitude: -173°34'43.3"/+0°03'38.5"  
Mean Sidereal Time: 21h54m40.5s  
Apparent Solar Time: 21h54m39.5s  
Distance: 1.016AU (152,030 Mio km)  
Apparent diameter: 30'31.96"

Sun

Solstice

Date and Time

Date and Time

Julian Day

2000 / 6 / 21 | 6 : 3 : 18

Earth, 7r\_STH\_10C\_pano, 104m

FOV 22.1° 103 FPS 2000-06-21 06:03:18 UTC+02:00



## MAMUZ: Nightly Tours



MAMUZ



# MAMUZ: Nightly Tours







# MAMUZ: Nightly Tours





## Remote Sync Plugin

- **Synchronize time and settings on several screens**
  - Useful when projection not possible
- **Exclude particular settings from synchronisation**

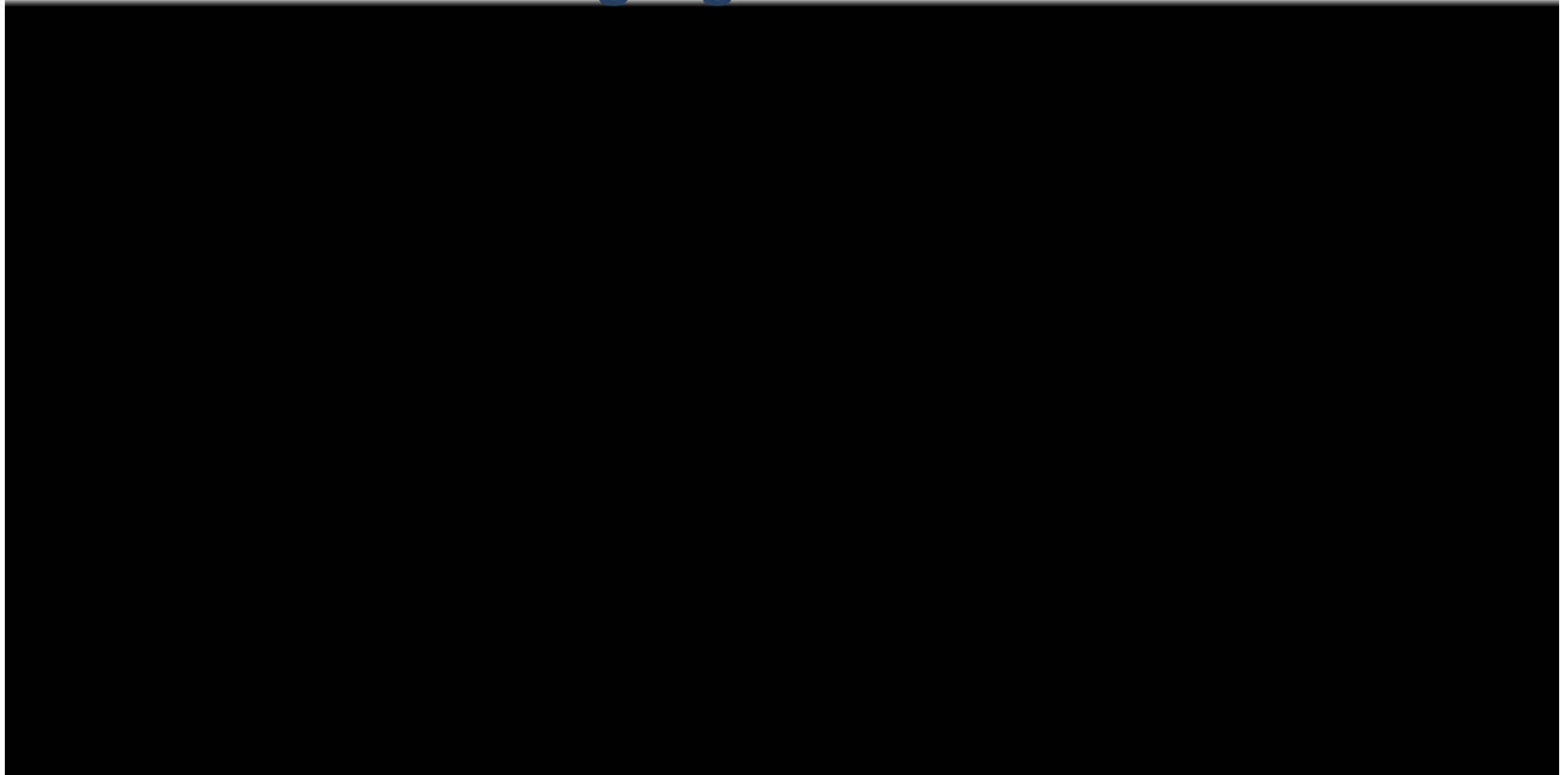
→ highlight different settings per screen

- skyculture
- unaided vs. telescope view
- ...





## A Few More Highlights



# Lunar Eclipse Comparison

## Moon

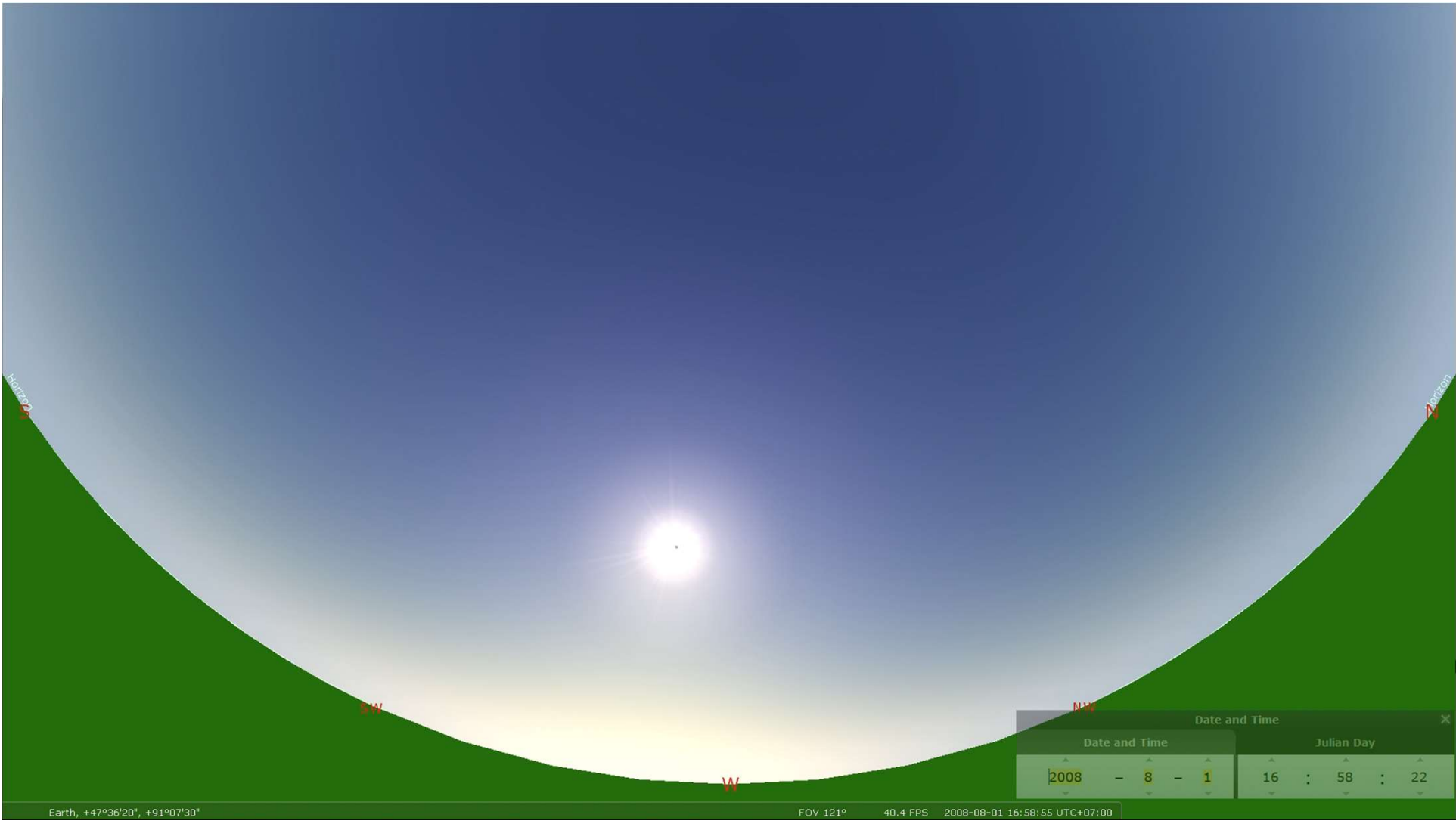
Type: moon  
Magnitude: -8.38 (reduced to -7.82 by 3.17 Airmasses)  
Absolute Magnitude: 0.21  
Mean Opposition Magnitude: -12.74  
q/δ (J2000.0): 20h30m20.04s / -19°46'16.1"  
q/δ (on date): 20h31m23.21s / -19°46'27.1"  
h/δ: 22h12m33.75s / -19°39'35.6" (apparent)  
A/a: +15°22'10.6" / +18°20'20.1" (apparent)  
l/b: +24°50'12.5" / -30°18'01.8"  
SQL/SCB: -11°18'51.1" / +47°29'03.2"  
A/B (J2000.0): +208°01'50.8" / -0947'07.8"  
A/B (on date): +208°17'11.9" / -0947'14.5"  
Ecliptic obliquity (on date): 123°26'07.1"  
Mean Sidereal Time: 18h43m53.6s  
Apparent Sidereal Time: 18h43m52.8s  
Rise: 20h39m  
Transit: 1h05m  
Set: 5h32m  
Parallactic Angle: -18°38'06.1"  
IAU Constellation: Cap  
Hourly motion: +0°21'41" towards 83.2°  
Hourly motion: da=+0°22'52" db=+0°02'43"  
Elongation: +179°04'04.8"  
Phase angle: +0°55'46.3"  
Illuminated: 100.0%  
Moon age: 14.8 days old (Full Moon)  
Position angle of bright limb: +133.4950°  
Distance from Sun: 1.018 AU (152,317 M km)  
Distance: 0.002701 AU (404021.405 km)  
Light time: 0h00m01.3s  
Orbital velocity: 0.972 km/s  
Heliocentric velocity: 30.283 km/s  
Sidereal period: 27.32 days (0.075 a)  
Synodic period: 29.53 days (0.081 a)  
Apparent diameter: +0°29'33.98"  
Diameter: 3474.8 km  
Sidereal day: 05h43m11.7s  
Mean solar day: 706h4m03.0s  
Albedo: 0.120  
Penumbral eclipse magnitude: 2.00360  
Umbral eclipse magnitude: 0.93309



| Date and Time |              |
|---------------|--------------|
| Date and Time | Julian Day   |
| 2018 - 7 - 27 | 23 : 17 : 41 |

**Admittedly, Nature Wins!**





NW

NW

W

NW

NW

Earth, +47°36'20", +91°07'30"

FOV 121° 40.4 FPS 2008-08-01 16:58:55 UTC+07:00

| Date and Time |   |   |   | Julian Day |    |           |
|---------------|---|---|---|------------|----|-----------|
| 2008          | - | 8 | - | 1          | 16 | : 58 : 22 |

# Solar

## Solar Corona from 2008, Mongolia

### Sun

Type: star  
Magnitude: -16.98 (extincted) (-16.48)  
Absolute Magnitude: 4.83  
RA/Dec (J2000.0): 8h47m58.46s / +17°53'11.3"  
RA/Dec (on date): 8h47m58.46s / +17°53'11.3"  
HA/Dec: 4h58m47.75s / +17°53'11.3" (apparent)  
Az./Alt.: +271°20'54.7" / +23°20'15.1" (apparent)  
Gal. long./lat.: -151°23'23.5" / +33°25'39.2"  
Supergal. long./lat.: +67°04'18.0" / -46°27'08.3"  
Ecl. long./lat. (J2000.0): +129°26'16.2" / -0°00'09.5"  
Ecl. long./lat. (on date): +129°33'15.3" / -0°00'06.6"  
Ecliptic obliquity (on date): +23°26'24.2"  
Mean Sidereal Time: 13h46m52.4s  
Apparent Sidereal Time: 13h46m53.2s  
Rise: 5h31m  
Transit: 13h00m  
Set: 20h30m  
Daytime: 14h58m  
IAU Constellation: Cnc  
Distance: 1.015 AU (151.831 M km)  
Equatorial rotation velocity: 1.856 km/s  
Apparent diameter: +0°31'31.05"  
Diameter: 1392000.0 km  
Sidereal period: 1.00 days (0.003 a)  
Sidereal day: 654h36m36.1s  
Eclipse obscuration: 100.00%  
Eclipse magnitude: 1.006



Date and Time

| Date and Time |   |       | Julian Day |   |        |
|---------------|---|-------|------------|---|--------|
| 2008          | - | 8 - 1 | 18         | : | 0 : 40 |

Earth, +47°36'20", +91°07'30"

FOV 2.61° 24.7 FPS 2008-08-01 18:00:40 UTC+07:00

**(Eclipse Day, July 22<sup>nd</sup>, 2009, near Shanghai...)**







## Comet Tails in Stellarium (since 2014)

- Coma diameter and tail length formulae
  - taken from Project Pluto (Guide)
  - [https://www.projectpluto.com/update7b.htm#comet\\_tail\\_formula](https://www.projectpluto.com/update7b.htm#comet_tail_formula)
  - Original formulae by Andreas Kammerer
- Parabola-shaped tail shells
- Dust tail curvature from  $R$  and  $v$
- Details visually tweaked mostly from
  - C/1996 B1 Hyakutake and
  - C/1995 O1 Hale-Bopp
- Individual parameterisation possible

## C/1996 B2 (Hyakutake)

Type: **comet** (periodic)  
Magnitude: **0.59** (extincted to: **0.90**)  
Absolute Magnitude: 5.00  
RA/Dec (J2000.0): 4h05m03.74s/+78°46'17.2"  
RA/Dec (on date): 4h04m30.40s/+78°45'32.6"  
HA/Dec: 8h56m37.46s/+78°46'29.8" (apparent)  
Az./Alt.: +349°31'00.6"/+39°51'43.4" (apparent)  
Gal. long./lat.: +131°48'49.3"/+19°24'10.7"  
Supergal. long./lat.: +18°49'48.9"/+7°18'57.2"  
Ecl. long./lat. (J2000.0): +80°17'07.2"/+56°18'17.7"  
Ecl. long./lat. (on date): +80°13'52.9"/+56°18'15.9"  
Ecliptic obliquity (on date): +23°26'14.8"  
Mean Sidereal Time: 13h01m23.1s  
Apparent Sidereal Time: 13h01m23.4s  
Transit: 15h34m  
Circumpolar (never sets)  
I&U Constellation: Cam  
Distance from Sun: 0.985 AU (147.342 M km)  
Distance: 0.135 AU (20.190 M km)  
Orbital velocity: 42.438 km/s  
Sidereal period: 108866.911 a  
Synodic period: 1.000 a  
Phase angle: +91°45'19.1"  
Elongation: +80°28'41.3"  
Coma diameter (estimate): 586000 km (+1°39'48")  
Gas tail length (estimate): 9.22 M km (+27°10'28")  
Core diameter: 10.0 km

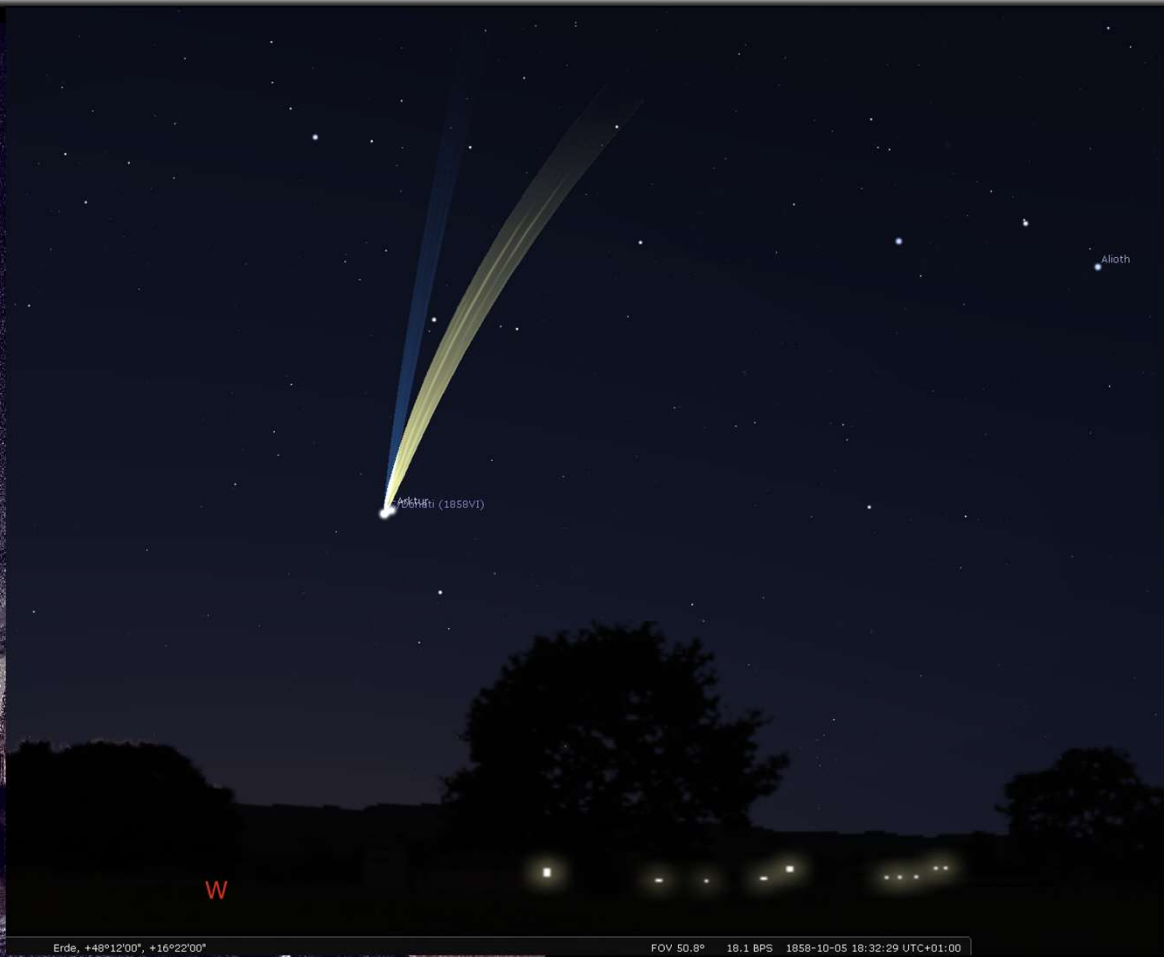


C/1996 B2 (Hyakutake)

| Date and Time |          | Julian Day |           |
|---------------|----------|------------|-----------|
| 1996          | - 3 - 28 | 0          | : 33 : 13 |



# Comet Tails in Stellarium



"C/Ikeya-Seki (1965f=1965VIII)"

Type: comet (periodic)  
Magnitude: 3.54 (extincted to 4.77)  
Absolute Magnitude: 6.20  
RA/Dec (J2000.0): 12h27m15.37s / -17°30'36.6"  
RA/Dec (on date): 12h26m01.51s / -17°30'36.6"  
HK/Dec: 19h08m38.86s / -17°28'02.7" (apparent)  
Az./Alt.: +112°39'28.5" / +9°01'03.0" (apparent)  
Gal. long./lat.: +65°01'07.3" / +44°48'33.2"  
Supergal. long./lat.: +131°56'04.8" / -11°00'40.5"  
Ecl. long./lat. (J2000.0): +193°28'37.9" / -13°28'39.4"  
Ecl. long./lat. (on date): +193°00'20.1" / -13°28'34.3"  
Ecliptic obliquity (on date): +23°26'41.3"  
Mean Sidereal Time: 7h34m18.6s  
Apparent Sidereal Time: 7h34m17.6s  
Rise: 4h15m  
Transit: 9h51m  
Set: 15h27m  
IAU Constellation: Crv  
Distance from Sun: 0.484 AU (72.392 M km)  
Distance: 1.044 AU (156.202 M km)  
Orbital velocity: 60.472 km/s  
Sidereal period: 876.701 a  
Synodic period: 1.001 a  
Phase angle: +70°24'54.6"  
Elongation: +27°20'11.4"  
Coma diameter (estimate): 394000 km (+0°08'27")  
Gas tail length (estimate): 7.63 M km (+2°47'53")  
Core diameter: 10.0 km

# C/1965S1 Ikeya-Seki

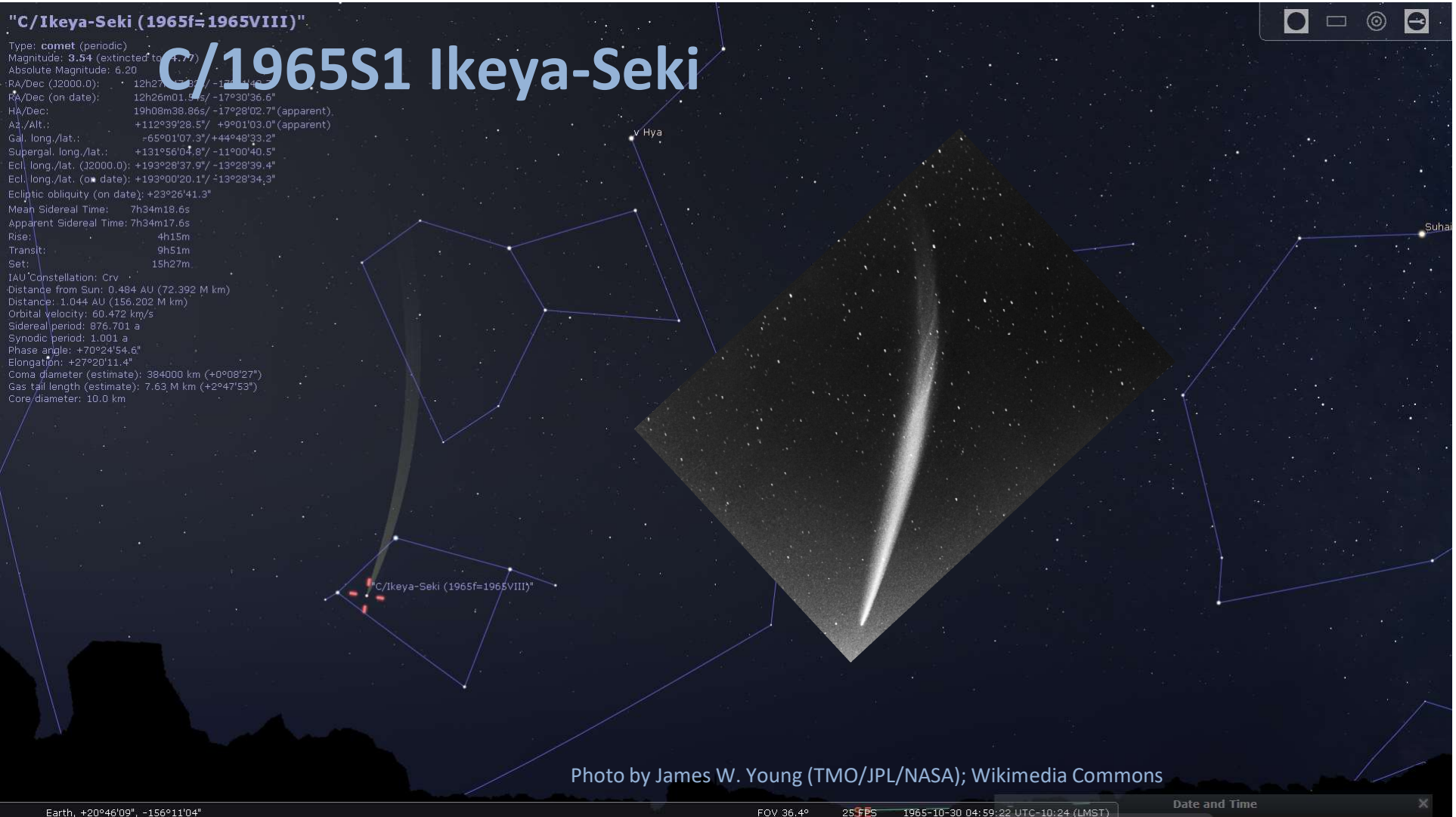


Photo by James W. Young (TMO/JPL/NASA); Wikimedia Commons

Earth, +20°46'09", -156°11'04"

FOV 36.4° 25 FPS 1965-10-30 04:59:22 UTC-10:24 (LMST)

Date and Time



# C/2006 P1 McNaught?

RA/Dec (J2000.0) of cross: 21h49m00.44s/-34°25'00.3"

-118.0°

☐ 🔍 🔄 🏠

◀ Sensor #2: Film SRL ▶

Dimensions:  
39°35.00' x 26°59.49'

X scale: 34.8027"/px  
Y scale: 23.7230"/px

Rotation: -118°  
-15° -5° -1° 0° +1° +5° +15°

◀ Telescope #3: 50mm ▶

Rayleigh criterion: 4.60"  
Dawes' limit: 3.87"  
Abbe's limit: 3.77"  
Sparrow's limit: 3.60"

◀ Lens: None ▶

MultiFrame: MFA



39°35.00' x 26°59.49'



## Comet Debris: Meteors!

- Sporadic meteors (eye candy)
- Meteor Showers plugin (by Marcos Cardinot)
  - Auto-update with IMO data
- **WANTED**
  - Fireball/meteorite fall plugin with particular events
    - Chelyabinsk
    - Europ. Fireball Network data
    - ...

# The 1833 Leonid Storm over N. America



# HiPS Sky Coverage in Multiple Wavelengths



G. Chéreau for Version 0.18.0





## Novae

- Plugin
- Automatic update feature

- Data from:

Catalog of 93 Nova Light Curves: Classification and Properties

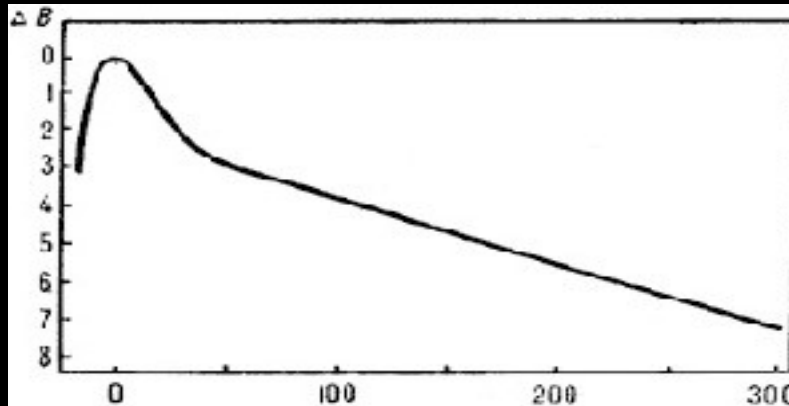
Richard J. Strobe, Bradley E. Schaefer, Arne A. Henden

<https://arxiv.org/pdf/1004.3698.pdf>

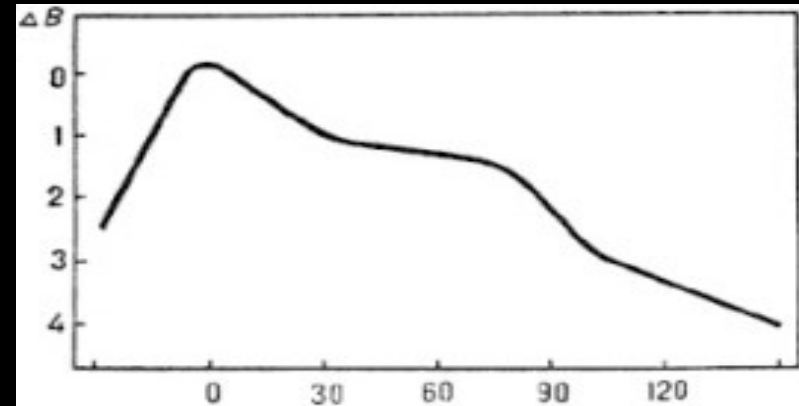


## Historical Supernovae Plugin

- Currently only simple models for Type Ia or Type II



Type Ia



Type II

- From: Fysika Kosmosa, Moscow 1986, pp 601ff, [<http://www.astronet.ru/db/msg/1188703>]
- **Better modelling desirable (SUGGESTIONS?)**

# SN 1054A

Type: **supernova**  
Magnitude: **-5.93** (reduced to **-5.23** by **3.92** Airmasses)  
 $\alpha/\delta$  (J2000.0): 5h34m30.00s/+22°01'00.0"  
 $\alpha/\delta$  (on date): 4h38m07.09s/+20°47'34.1"  
h $\delta$ : 18h08m11.83s/+20°49'52.3" (apparent)  
A/a: +74°56'18.1"/+14°42'03.9" (apparent)  
 $M/\beta$  (J2000.0): +84°05'24.4"/-1°24'30.9"  
 $M/\beta$  (on date): +70°54'37.3"/-1°24'30.9"  
Ecliptic obliquity (on date): +23°33'42.5"  
Mean Sidereal Time: 22h46m06.1s  
Apparent Sidereal Time: 22h46m06.1s  
Rise: 2h08m  
Transit: 9h26m  
Set: 16h45m  
Parallactic Angle: -52°25'28.7"  
IAU Constellation: **Tau**  
Type of supernova: **II**  
Maximum brightness: **Sun, 1054-07-03**  
Distance: **6500.00 ly**

# July 4th, 1054, China



**Note the Chinese constellations and star names!**

Earth, Beijing Ancient Observatory, 0 m FOV 42.4° 14.9 FPS Tue, 1054-07-05 03:33:19 UTC+07:45 (LMST)



# STELLARIUM SKY CULTURES

How Various Cultures See and Use the Sky



# Current Status (1)





## Current Status (1)

- Constellations
  - „official“ constellations





## Current Status (1)

- Constellations
  - „official“ constellations
  - line art („stick figures“)





## Current Status (1)

- Constellations
  - „official“ constellations
  - line art („stick figures“)
  - figure artwork (optional)

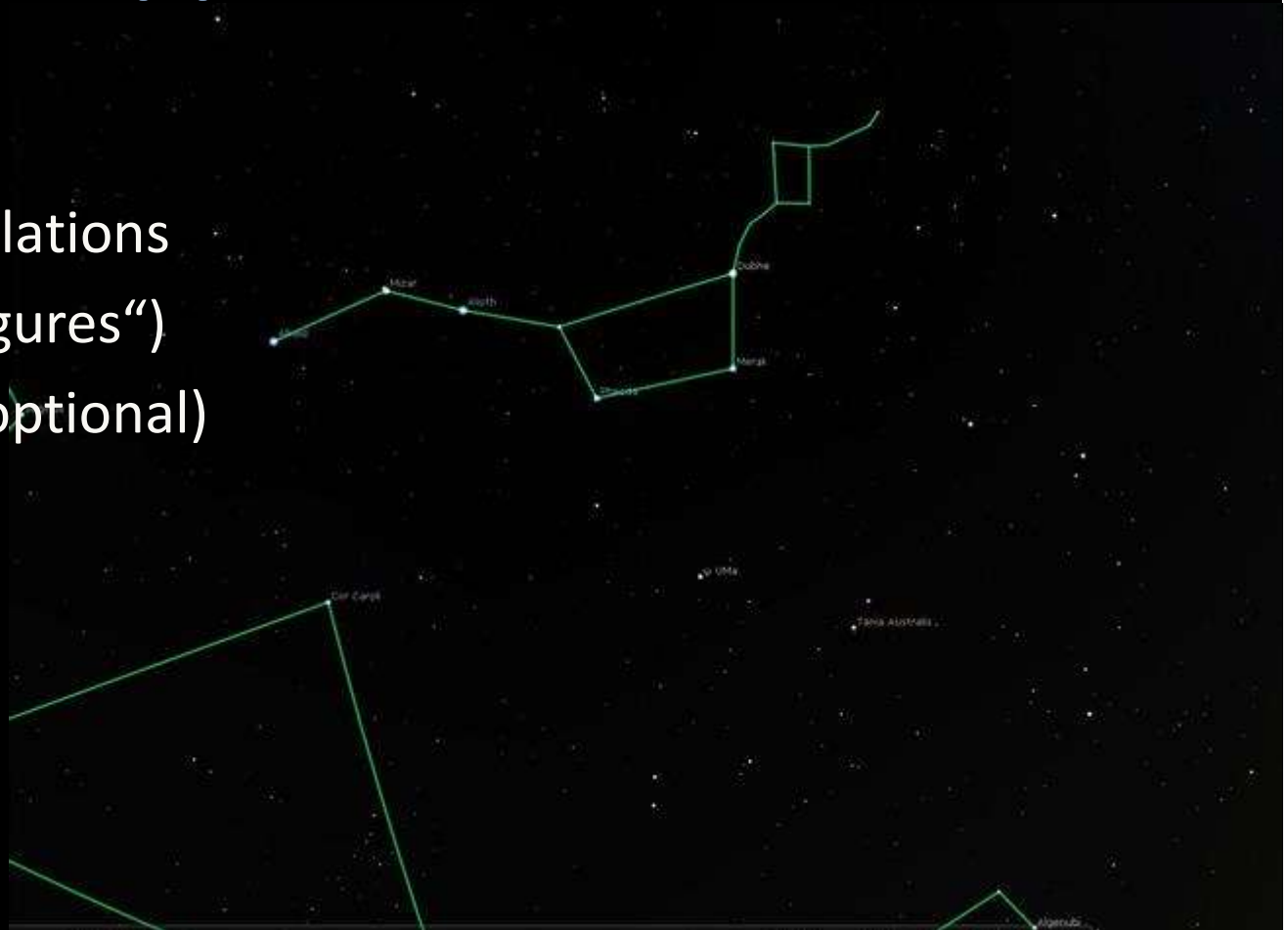






## Current Status (1)

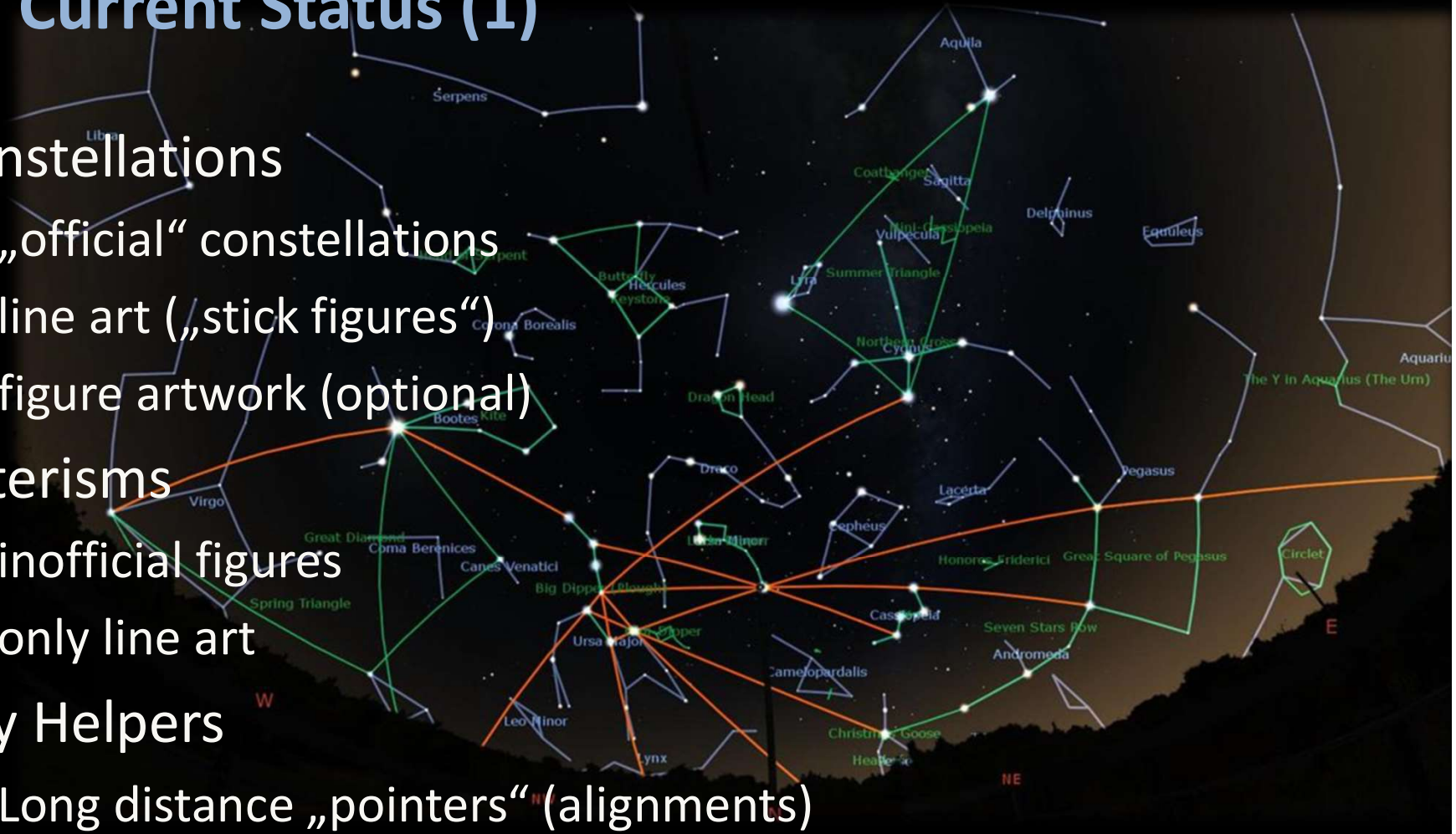
- Constellations
  - „official“ constellations
  - line art („stick figures“)
  - figure artwork (optional)
- Asterisms
  - inofficial figures
  - only line art





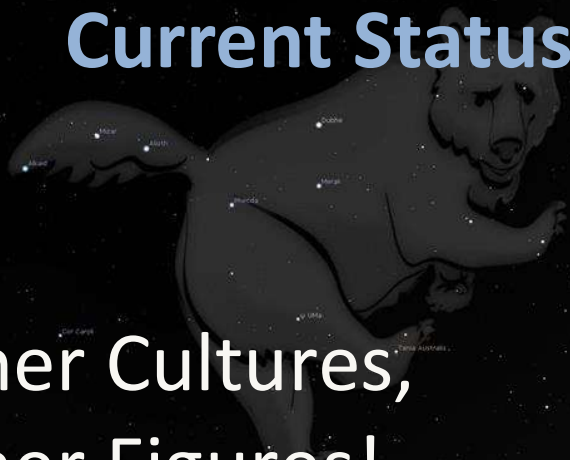
## Current Status (1)

- Constellations
  - „official“ constellations
  - line art („stick figures“)
  - figure artwork (optional)
- Asterisms
  - inofficial figures
  - only line art
- Ray Helpers
  - Long distance „pointers“ (alignments)



## Current Status (2)

Other Cultures,  
Other Figures!



Ojibwe



Chinese-Medieval



Belarus



## Missing/TBD: Lunar Stations

- Observed by many Asian cultures
- current *workarounds* by coding as asterisms
- but several schemes seem to exist:
  - asterism
  - abstract region in ecliptical coordinates
  - abstract region in equatorial coordinates
  - others?



## Missing/TBD: Dark Constellations

- Dark clouds in the Milky Way
  - Australian Aboriginals: „Emu in the Sky“
  - Inca „Yacana“ (Llama)
  - A few more  
(see Gullberg et al., 2020)
  - others?
- How to show these properly?



Gullberg et al., 2020



## We don't know everything!

- Seasonal Constellations
  - depending on Solar longitude
  - other schemes?
- Different aspect of planets
  - e.g. Mercury, Venus as Morning/Evening Stars
  - others?
- Seasonally differing star names?
- Temporally evolving Sky Cultures?
  - MUL.APIN → Greek → Ptolemy → “European/Western” → IAU
  - Old Chinese → ... → Modern Chinese?
  - ...
- Any other needs?



## Translation Issues (1)

- Proper name or just a term in original language ?
- Shall we totally switch off „Western“ names?
  - Will the „foreign“ user still know the stars&planets?
- Translation
  - Not every translatable name has been translated to English
  - Serious problem for our „Community Translators“
- Meaning
  - Missing context prevents translation
    - E.g. What is the „Blue Birth Woman“ in (D/L/N)akota Skyculture?
    - „Snake Large Anus“ → ???



## Translation Issues (2)

TODO: Show any useful combination of

- Original spelling
  - All characters from Unicode (Cuneiform, Hieroglyphs, Maya, ...)
- Transliteration
  - May depend on user language
  - **Need experts for transliteration**
- Translation to user language
  - Meaning may get lost!
  - Needs experts in the respective culture
  - **How to preserve meaning and myths?**
    - **Add meta information for translators?**
- **→ Need better description.**





# Review and Quality Assurance?

New in version 0.19: Tentative *Classification scheme*

- **Traditional**
  - „Living“ sky culture
  - Created by members of respective culture/community
- **Ethnographic**
  - „Living“ sky culture
  - From fieldwork by foreign researchers
- **Historical**
  - Past sky culture
  - Textual transmission by historians
- **Single**
  - Discrete, mostly historical work (Bayer, Schiller, Hevelius, Bode, ...)
- **Personal**
  - Not based on (peer-reviewed) culture astronomy research
  - Not supported by noteworthy community
- **Incomplete**
  - No references/further reading
  - Obviously lacking information



## Calendar Questions

- Several times in Stellarium's forum:
  - Q: “Why is the sun not at the equator at spring equinox in -8750?”
  - Reply: What date did you set for spring equinox?
  - Q: March 21
  - Reply: **WRONG.**

$$\lambda_{\odot} = 0^{\circ}$$

- Equinox is defined by sun crossing equator
- The name of the day is irrelevant



## Calendar Questions

- Stellarium has astronomical date counting

|              |     |               |               |               |        |        |        |     |
|--------------|-----|---------------|---------------|---------------|--------|--------|--------|-----|
| Historical   | ... | <b>3</b> B.C. | <b>2</b> B.C. | <b>1</b> B.C. | 1 A.D. | 2 A.D. | 3 A.D. | ... |
| Astronomical | ... | -2            | -1            | 0             | 1      | 2      | 3      | ... |

- Gregorian Calendar reform, October 1582

|                         |     |   |   |   |   |          |          |          |          |     |
|-------------------------|-----|---|---|---|---|----------|----------|----------|----------|-----|
| Julian ("old style")    | ... | 1 | 2 | 3 | 4 | <b>5</b> | <b>6</b> | <b>7</b> | <b>8</b> | ... |
| Gregorian ("new style") | ... | 1 | 2 | 3 | 4 | 15       | 16       | 17       | 18       | ... |

Protestant countries ignored the new style

→ Take care when reading ~17<sup>th</sup> century observation reports!



## NEW PLUGIN: Calendars (since V0.20.4)

- Started with 17 calendars:
  - Julian (B.C./A.D.), Gregorian, ISO Week
  - Roman, Olympiad
  - Icelandic
  - Egyptian, Armenian, Zoroastrian
  - Coptic, Ethiopic
  - Maya Long Count, Tzolkin, Haab
  - Aztec Tonalpohualli, Xihuitl
  - Balinese Pawukon
- Next version:
  - Islamic (algorithmic), Hebrew
  - Old Hindu Solar and Lunar
  - ...
- Further:
  - Chinese
  - Tibetan
  - ...





If **YOU** can and want to participate

please contact us

<https://github.com/Stellarium/stellarium>

Funded collaboration preferred!



# Thank You for Your Attention!

## Contact:

Georg Zotti

LBI ArchPro

Hohe Warte 38

1190 Vienna, Austria

Georg.Zotti@univie.ac.at

<http://archpro.lbg.ac.at>



Download Stellarium only from <https://stellarium.org>

Current release V0.20.4 (2020-12-27)

**Extensive PDF Manual**



## LBI ArchPro Partners

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### Vestfold og Telemark

FYLKESKommUNE

