Time of Day

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Contents

Chapter 1

Main Page

1.1 About

Time of Day is a package to render realistic dynamic sky domes with day and night cycle, clouds, cloud shadows, weather types and physically based atmospheric scattering.

Sky:

- Physically based sky shading
- Rayleigh & Mie scattering
- Highly customizable
- Sun and moon god rays (Unity Pro)
- Aerial perspective (Unity Pro)

Lighting:

- Full PBR & HDR support
- Realtime Unity 5 ambient light
- Realtime Unity 5 reflections

Clouds:

- Normal mapped cloud layers
- Dynamically batched horizon clouds
- Adjustable wind speed & direction
- Configurable coverage and shading
- Correctly projected cloud shadows

Time & Location:

- Dynamic day & night cycle
- Adjustable time progression curve
- Full longitude, latitude & time zone support
- Full Gregorian calendar support
- Realistic sun position
- Realistic moon position and phase
- Realistic star rotation

Performance & Requirements:

- Extremely optimized shaders & scripts
- Zero dynamic memory allocations
- Supports shader model 2.0
- Supports all platforms
- Supports linear & gamma color space
- Supports forward & deferred rendering
- Supports HDR & LDR rendering

- Supports virtual reality hardware

[Forum Thread | Web Player | Documentation]

You can expect a thoroughly documented, well-written and highly optimized code base.
Includes references to the scientific papers the atmospheric scattering calculations are based on.

1.2 Getting Started

1. Add the sky dome to your scene:
   - Drag the prefab "Time of Day/Prefabs/Sky Dome" into your scene
   - Tweak the parameters until you are satisfied with the result
2. Move the sky dome to the camera position in every frame:
   - Select your camera and add the Time of Day camera script (Component -> Time of Day -> Camera Main Script)
   - Make sure the sky reference is set to the sky dome
3. Render god rays on the camera:

- Select your camera and add the Time of Day god ray script (Component -> Time of Day -> Camera God Rays)
- Make sure the sky reference is set to the sky dome

REMARK: The camera script moves the sky dome directly before clipping the scene, guaranteeing that all other position updates have been processed. You should not move the sky dome in "LateUpdate" because this can cause minor differences in the sky dome position between frames when moving the camera.

1.3 Day & Night Cycle

The script TOD_Time manages the dynamic day & night cycle. Enabling and disabling this script enables and disables the automatic time progression.

The following parameters are being set by TOD_Time:

- TOD_Sky.Cycle.Hour
- TOD_Sky.Cycle.Day
- TOD_Sky.Cycle.Month
- TOD_Sky.Cycle.Year

It also offers a time curve that can be modified via the Unity inspector to speed up or slow down certain parts of the day-night cycle. The X axis of the graph denotes the current internal time, which always progresses linearly. The Y axis of the graph denotes the time that is being set in the sky dome and is therefore visible to the player. That means the higher the inclination of the curve the faster this certain part of the day passes by.

The following events are fired by TOD_Time:

- TOD_Time.OnMinute
- TOD_Time.OnHour
- TOD_Time.OnDay
- TOD_Time.OnMonth
- TOD_Time.OnYear

1.4 Weather Manager

The script TOD_Weather can be used to automatically set various parameters of TOD_Sky according to certain weather presets.

The following parameters are being set by TOD_Weather:

- TOD_Sky.Atmosphere.Fogginess
- TOD_Sky.Clouds.Density
- TOD_Sky.Clouds.Sharpness
- TOD_Sky.Clouds.Brightness

1.5 Time Zone & Location Coordinates

The TOD_Sky.World and TOD_Sky.Cycle parameter sections allow for configuration of the sky dome to simulate the exact earth, sun and moon movement for any location on the planet depending on Gregorian date, UTC/GMT time zone and geographic coordinates. This allows to recreate eclipses just as they would occur in real life.

It is important to manually set the correct time zone offset (TOD_Sky.World.UTC) that fits the longitude and latitude parameters in order to use local time instead of UTC.

All of those parameters are completely optional - if the sky dome should be used in a generic fantasy world they can simply be ignored and left at their default values.

1.6 Ambient Light & Reflections

Unity 5 introduced new ways to approximate ambient light and reflections. For a primer on the new features, watch the Unite 2014 talk.

Time of Day offers full support for Unity 5 image-based ambient light and reflections. It can update both the per-scene ambient light and a realtime reflection probe at runtime. Ambient light can be disabled (i.e. not managed by Time of Day), a solid color, a gradient or spherical harmonics. Reflections can be disabled (i.e. not managed by Time of Day) or a cubemap. Both ambient light and reflections contain approximations of the atmosphere in the top half and lerp to the configured ambient light color towards the bottom half. This means the ambient light color set on the Time of Day prefab can be looked at as the ground color of the scene in those cases.

Time of Day also allows you to include some or all layers of your scene in the reflection probe bake process. This should be used with care since updating a reflection probe with various reflected objects is an expensive operation. For most scenes it should be fine to only render the sky dome to the realtime reflection probe by using "Skybox" clear flags and a "Nothing" culling mask.

1.7 Rendering Quality

There are various different quality levels for the sky dome. Those quality settings can be configured via script or directly in the Unity inspector.

TOD_SkyQuality:

- Per-vertex calculates the sky dome color for every vertex and interpolates between them
- Per-pixel calculates the sky dome color for every pixel

TOD_CloudQuality:

- Bumped offers complex cloud shading with dynamic density and cloud normal mapping
- Density offers simplified cloud shading with dynamic density but without normal mapping
- Fastest offers extremely simplified cloud shading with simplified cloud shape calculations

TOD_MeshQuality:

- High tessellation sky dome (2562 verts) and moon (574 verts)
- Medium tessellation sky dome (642 verts) and moon (294 verts)
- Low tessellation sky dome (162 verts) and moon (148 verts)

For the best visual quality it is recommended to use Time of Day with the following Unity Pro setup:

- Linear color space in player settings
- HDR enabled on the main camera
- The following image effects (in that order)
    1. "Image Effects -> Bloom and Glow -> Bloom" or "SE Natural Bloom & Dirty Lens" from the Asset Store
    2. "Image Effects -> Color Adjustments -> Tonemapping"
    3. "Image Effects -> Color Adjustments -> Color Correction" or "Amplify Color" from the Asset Store

1.8 Performance Remarks

- The size of a web player with just the sky dome is only around 200KB as most equations are evaluated dynamically
- All scripts and shaders are highly optimized and will not have a significant FPS impact on desktop computers
- Older mobile devices should choose quality settings that offer suitable performance
- Cloud shadows utilize a Unity projector and require another draw call for all objects they are projected on
- Realtime reflections that include objects other than the sky dome can be expensive and should be used with care

1.9 Rendering Order

All components of the sky dome are being rendered after the opaque but before the transparent meshes of your scene. That means only areas of the sky dome that are not being occluded by any other geometry have to be rendered.

The rendering order of the sky dome components is the following:

- Space Dome (if not manually disabled)
- Sun Plane (if on screen)
- Moon Mesh (if on screen)
- Atmosphere (if not manually disabled)
- Clear Alpha (if god rays are enabled)
- Cloud Layer (if not manually disabled)
- Billboards (if billboard clouds are enabled)

This leads to 3-6 draw calls (all billboards can be batched dynamically on Unity Pro) to render the complete sky dome, depending on the scene setup.

1.10 Custom Shaders

The TOD_Sky script sets some global shader parameters that can be used in your custom shaders. For a complete list see the TOD_Base.cginc file. Any of those variables can be used in any shader by simply defining uniform variables with the same name, which will then automatically be set to the most recent values every frame. It is also possible to simply include TOD_Base.cginc to get access to all variables.

In addition to those base variables there is also TOD_Scattering.cginc, which offers functions to easily evaluate the scattering equations in custom shaders.

1.11 Networking

- To network date and time, synchronize the property TOD_Sky.Cycle.Ticks of type long
- To network cloud movement, synchronize the property TOD_Sky.Components.Animation.CloudUV of type Vector4

1.12 Parameter Import & Export

It is possible to export custom presets via the "Export" button in the TOD_Sky inspector panel and import them on a different prefab or even in a different project via the "Import" button. Exported parameters can also be loaded at runtime by using the appropriate API calls.

1.13 Example Scripts

The package comes with various example scripts to demonstrate sky dome integration.

- AudioAtDay / AudioAtNight / AudioAtWeather: Fade audio sources in and out according to a time of day or a specific weather type
- ParticleAtDay / ParticleAtNight / ParticleAtWeather: Fade particle systems in and out according to a time of day or a specific weather type
- RenderAtDay / RenderAtNight / RenderAtWeather: Enable or disable renderer components according to a time of day or a specific weather type
- LightAtDay / LightAtNight / LightAtWeather: Fade light intensities in and out according to a time of day or a specific weather type
- LoadSkyFromFile: Load exported sky dome parameters at runtime from a TextAsset that can be assigned via drag & drop

1.14 Frequently Asked Questions

Q: How can I get a TOD_Sky reference in my custom scripts?

- TOD_Sky.Instance keeps a static reference to the most recent sky dome that has been instantiated
- TOD_Sky.Instances keeps a static list of referenes to all sky domes that have been instantiated

Q: How can I use the sky dome with virtual reality devices like the Oculus Rift?

- Add the TOD_Camera script to one of the cameras (preferably the one that's being rendered first)
- The sky will render correctly without artifacts

Q: How can I render a cubemap or custom skybox at night?

- Select the shader "Time of Day/Space (Cube)" on the space material
- Assign your cubemap to the material

Q: How can I align the sky dome geographic directions with those of my scene?

- Rotate the sky dome around the y-axis such that the sun rises in the east of your scene

Q: How can I fix Z-fighting and sorting issues with the cloud shadows?

- Adjust the values for "Offset" directly in the shader code of the cloud shadow shaders

REMARK: Offset values have to be constants and can therefore only be adjusted directly in the shader code. Suitable values depend on the depth buffer resolution of the targeted platform and hardware. While the default values work in most scenarios, some scenes might require some further tweaking.

Q: How can I disable some part of the sky dome?

- Disable any child game object to keep that specific part of the sky dome from rendering
- You can also disable any script on the parent game object individually to disable that specific functionality

REMARK: Always disable entire child objects instead of their individual components like mesh renderers. The enabled states of components are being be modified by the sky dome scripts, which will otherwise override your changes.

1.15 Contact Information

If you have any questions that cannot be answered using the FAQ or documentation feel free to contact me:

- In the official forum thread of the package
- Via personal message on the Unity community forums
- Via Twitter
- Via my website

REMARK: I should always be able to reply within two work days. If I have not replied after several days, please try using a different method to contact me as there might be an issue with the one you chose. If I am not available for multiple days I will always try to announce this beforehand in the offical forum thread.

1.16 Literature

The following literature has been used to implement physically based atmospheric scattering and aerial perspective:

1. Bruneton, Neyret
2. Preetham, Shirley, Smits

3. Hoffman, Preetham
4. Nishita, Sirai, Tadamura, Nakamae

1.17 Changelog

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VERSION 3.0.0
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- Added new atmospheric scattering model (supports planet shadowing)
- Added ColorRange parameter to specify whether or not to output colors in high dynamic range
- Added SkyQuality parameter variable (can be per-vertex and per-pixel)
- Added dynamically batched normal mapped billboard horizon clouds (see Clouds.Billboards)
- Added inspector variable tooltips
- Added events that are fired when a year, month, day, hour or minute have passed to TOD_Time
- Added an image effect that renders atmospheric scattering and aerial perspective in a single pass
- Added profiler samples to TOD_Sky
- Improved inspector variable interface by using property drawers
- Improved inspector variable verification by using property attributes
- Improved cloud layer shading
- Improved shader property update performance
- Improved space rotation by using local sidereal time
- Fixed errors in Unity 5 Beta 21 (this means Beta 20 is no longer supported)
- Changed all textures from PNG to TGA
- Changed all color inspector variables to gradients
- Changed sun shader to a procedural shape instead of a texture
- Removed a number of now unused parameters

VERSION 2.3.5
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- Fixed inaccuracy issues with the time curve approximation
- Fixed possible gimbal lock in the space dome rotation
- Tweaked the default space texture to be more resistant to tiling
- Made all example scripts initialize in Start() instead of OnEnable()
- Made the Space (Cube) shader fade to black in the bottom half of the sky dome
- Made Clouds.Density clamp between 0 and 1

VERSION 2.3.4
-------------
- Fixed moon position being vastly off
- Fixed space texture tiling to infinity towards the horizon (could cause issues when rotating)
- Tweaked horizon line for low haziness values
- Tweaked the default prefab parameters
- Disabled headless mode detection in-editor
- Simplified and optimized TOD_Time calculations
- Changed rendering order of sun and moon to support eclipses
- Made inspector adjustments to the cycle properties correctly progress day, month and year
- Made moon phase get calculated directly from the sun position
- Removed Moon.Phase inspector variable (no longer required)
- Removed Progress* fields from TOD_Time (no longer required)
- Removed Moon (Flat) shader (adjusting Moon.Contrast now has the same effect)

VERSION 2.3.3
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- Added TOD_Sky.LoadParameters(...) to load exported parameters at runtime
- Added LoadSkyFromFile example script
- Added skybox material that is assigned to the render settings skybox for dynamic GI
- Added TOD_Sky.Moon.HaloSize to increase or decrease the size of the moon halo
- Added TOD_Sky.Reflection.ClearFlags to specify which clear flags to use for the reflection cubemap
- Added TOD_Sky.Reflection.CullingMask to specify which layers to include in the reflection cubemap
- Added warning to TOD_Camera if skybox clear flags are used (redundant with a sky dome)
- Made parameter export and import remember the most recently specified path
- Made the reflection cubemap less bright in the bottom hemisphere
- Made light source color fall off to black before switching positions
- Changed reflection baking to use a native Unity 5 realtime reflection probe (better quality)
- Changed TOD_Sky.RenderToSphericalHarmonics(...) and TOD_Sky.RenderToCubemap(...) APIs
- Renamed TOD_Components.*Shader to TOD_Components.*Material
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- Removed TOD_Sky.Fog.UpdateInterval (it's fast enough to update every frame anyhow)
- Removed TOD_Sky.Fog/Ambient/Reflection.Directional (now part of fog mode, unused for the others)
- Removed some parameters that are unused on Unity 3 and Unity 4 if running those versions

VERSION 2.3.2

- Fixed that the sky dome would go into headless mode (i.e. black) on mobile
- Fixed an error in Unity 5 Beta 14 (this means Beta 13 is no longer supported)
- Made sky fogginess correctly affect the light intensity
- Optimized coloring calculations
- Renamed TOD_AmbientType.Flat to TOD_AmbientType.Color
- Renamed TOD_AmbientType.Trilight to TOD_AmbientType.Gradient
- Renamed TOD_Sky.RenderToSH3(...) to TOD_Sky.RenderToSphericalHarmonics(...)

VERSION 2.3.1

- Fixed errors if sky dome renderers or mesh filters were deleted (i.e. when running on a server)
- Fixed that ScatteringColor(...) in TOD_Scattering.cginc would add some stuff to its alpha value
- Fixed issues if the main camera of a scene changes after scene load
- Added TOD_Sky.World.Horizon to specify whether or not to adjust the horizon to zero level
- Added TOD_Sky.UpdateFog(), TOD_Sky.UpdateAmbient() and TOD_Sky.UpdateReflection() to API
- Added headless mode detection to skip some rendering calculations when running on a server
- Made TOD_Sky.SampleAtmosphere(...) only include the moon halo if directLight is true
- Made the moon halo always fade out when the moon is below the horizon
- Made TOD_Sky.Cycle.DateTime have DateTimeKind.Utc instead of DateTimeKind.Unspecified
- Made the fog color values clamp between 0 and 1 to avoid super bright glowing directional fog
- Changed TOD_AdditiveColor and TOD_MoonHaloColor in TOD_Base.cginc to float3 (alpha is unused)
- Removed TOD_Components.CameraTransform as it is no longer required

VERSION 2.3.0

- Fixed atmosphere banding towards nighttime by adding dithering from a lookup texture
- Fixed that SetupQualitySettings() would allocate 0.6kb of memory every frame
- Added TOD_Animation.RandomInitialCloudUV to randomize the clouds at startup
- Added optional shader "Moon (Flat)" for a flatter moon shading
- Added TOD_Sky.World.ZeroLevel to set the zero / water level of a scene
- Added TOD_Camera.DomePosOffset to specify a sky dome position offset relative to the camera
- Added TOD_Sky.Initialized to check whether or not the sky dome has been initialized
- Made RenderSettings.ambientLight get set in every ambient mode (for legacy shaders)
- Made fog, ambient and reflection really get updated every single frame if their update interval is 0
- Made sun and moon meshes fade out exactly at the horizon line
- Made the color of the sky dome beneath the horizon line fade to a darker tone towards the bottom
- Made the atmosphere shader additive (greatly improves moon / atmosphere blend)
- Made the night texture fade to black at daytime (due to the new additive atmosphere)
- Made the moon phase always be rotated towards the direction of the orbital path of the moon
- Made the sun texture converge towards a circle for very high sun mesh brightnesses
- Moved more enums to the global namespace and added the TOD_ prefix
- Moved Cycle.Longitude, Cycle.Latitude and Cycle.UTC to the World parameter category
- Changed the returned alpha value of TOD_Sky.SampleAtmosphere(...) to one
- Changed the returned alpha value of ScatteringColor(...) in TOD_Scattering.cginc to one
- Renamed TOD_Sky+Variables to TOD_Sky+API (now contains all API methods and properties)
- Renamed TOD_Sky+Quality to TOD_Sky+Settings (now sets all project and scene settings)
- Renamed TOD_SunShafts to TOD_Rays (now handles god rays of both sun and moon)
- Renamed TOD_Sky.SunShaftColor to TOD_Sky.RayColor
- Renamed TOD_Sky.Light.ShaftColoring to TOD_Sky.Light.RayColoring
- Renamed TOD_Sky.Sun.ShaftColor to TOD_Sky.Sun.RayColor and added TOD_Sky.Moon.RayColor
- Removed TOD_Sky.World.HorizonOffset and TOD_Sky.World.ViewerHeight (now covered by ZeroLevel)
- Removed TOD_AmbientType.Hemisphere since it was removed from Unity 5 (use trilight instead)
- Removed clampAlpha parameter from TOD_Sky.SampleAtmosphere(...)
- Replaced TOD_Sky.Ambient.Exposure with Day.AmbientMultiplier and Night.AmbientMultiplier
- Replaced TOD_Sky.Reflection.Exposure with Day.ReflectionMultiplier and Night.ReflectionMultiplier

VERSION 2.2.0

- Fixed a moon shader compilation error in Unity 5 on Windows
- Added support for Unity 5 ambient light modes (tricolor, hemisphere, spherical harmonics)
- Added support for Unity 5 realtime reflections (sky cubemap)
- Added TOD_Sky.Stars.Position to specify whether or not to move the stars with the earth rotation
- Added TOD_Sky.SampleAtmosphere(...) overload that ignores direct light

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- Added TOD_Sky.RenderToCubemap(...) with various overloads
- Added TOD_Sky.RenderToSH3(...) with various overloads
- Added TOD_Sky.SampleFogColor(), TOD_Sky.SampleSkyColor() and TOD_Sky.SampleEquatorColor()
- Added optional shader to project cubemaps onto the space object
- Removed TOD_Sky.FogColor (access RenderSettings.fogColor instead)
- Removed TOD_Sky.Stars.Density (directly adjust the texture instead)
- Moved all fog parameters to TOD_Sky.Fog
- Moved all ambient light parameters to TOD_Sky.Ambient
- Moved all reflection parameters to TOD_Sky.Reflection
- Made audio example scripts set the volume in OnEnable()

VERSION 2.1.1
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- Fixed various issues in gamma color space
- Fixed time not properly incrementing in some cases if TOD_Time.ProgressDate was checked
- Fixed some inconsistencies with the light and cloud color calculations, leading to better results overall
- Fixed cloud shadow shape calculation being off for the lowest quality setting
- Fixed cloud UV world space adjustments being off for rotated sky domes
- Rescaled TOD_Sky.Light.CloudColoring (custom prefabs have to be readjusted accordingly)
- Rescaled TOD_Sky.Night.CloudMultiplier (custom prefabs have to be readjusted accordingly)
- Added TOD_Sky.Day.CloudColor and TOD_Sky.Night.CloudColor
- Added TOD_Sky.Instance and TOD_Sky.Instances to easily get the most recent sky or all skies in the scene
- Added TOD_Animation.WorldSpaceCloudUV
- Added overloads of T() and ScatteringColor() that take distance into account to TOD_Scattering.cginc
- Removed TOD_Base.cginc include from TOD_Scattering.cginc (now has to be included in the shader file)
- Brought the sun shaft image effect up to date
- Changed the code indentation policy (indent with tabs, align with spaces)
- Prepared more parts of the codebase for Unity 5

VERSION 2.1.0
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- Added XML export and import of the prefab parameters
- Added TOD_Scattering.cginc that contains functions to sample the scattering color
- Added TOD_Base.cginc that contains shader parameters and common transformations
- Added TOD_World2Sky and TOD_Sky2World shader matrices
- Added TOD_Sky.Stars.Brightness parameter to make stars get affected by bloom image effects
- Added TOD_Sky.LocalMoonDirection, TOD_Sky.LocalSunDirection and TOD_Sky.LocalLightDirection
- Added TOD_Sky.Sun.MeshBrightness and TOD_Sky.Moon.MeshBrightness
- Added TOD_Sky.Sun.MeshContrast and TOD_Sky.Moon.MeshContrast
- Added TOD_Sky.Clouds.Glow to adjust the light source glow applied to the clouds
- Added TOD_Sky.Atmosphere.FakeHDR to adjust the fake HDR mapping that is applied at dusk and dawn
- Added TOD_Time.TimeCurve to specify a time progression curve for the day night cycle
- Added two new cloud textures (the old ones can be deleted if unused)
- Removed two unnecessary calls to InverseTransformDirection from TOD_Sky.SampleAtmosphere
- Improved space texture to better work with the new brightness parameter
- Improved visual quality of the atmosphere when using HDR
- Improved cloud layer rendering
- Made TOD_Sky.Cycle.DateTime accurate to one millisecond rather than one second
- Made camera scripts automatically search for the sky dome if no reference is set in the inspector
- Moved all moon parameters to TOD_Sky.Moon.X (was TOD_Sky.Night.MoonX and TOD_Sky.Cycle.MoonX)
- Moved all sun parameters to TOD_Sky.Sun.X (was TOD_Sky.Day.SunX)

VERSION 2.0.9
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- Fixed time not getting incremented properly
- Fixed inaccuracies when progressing time and moon phase with extremely high frame rates
- Fixed inaccuracies when progressing time and moon phase with extremely fast time scales

VERSION 2.0.8
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- Fixed that sun and moon could visibly pop in and out if scaled extremely huge
- Fixed that the date would not get fully incremented for extremely fast time scales
- Fixed that the sun shafts could go through clouds
- Tweaked the TOD_Sky.IsDay and TOD_Sky.IsNight thresholds
- Replaced TOD_Time.UpdateInterval with TOD_Sky.Light.UpdateInterval (now only affects the light source)
- Prepared parts of the codebase for Unity 5 (specifically the new transform behaviour)

VERSION 2.0.7
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- Fixed an issue where the ambient light color would never fully lerp to the night value

VERSION 2.0.6
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- Replaced Day/Night.AmbientIntensity with Day/Night.AmbientColor to offer more customization options
- Added Light.AmbientColoring to adjust ambient light coloring at dusk and dawn
- Added example scripts to enable / disable lights in the scene at day / night / weather
- Added inspector variable to adjust the time update interval in TOD_Time
- Added option to use the real-life moon position rather than the fake "opposite to sun" moon position
- Made all components of TOD_Sky initialize before Start() so that they are accessible from other scripts
- Disabled the automatic light source shadow type adjustment so that the user can manually set it

VERSION 2.0.5
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- Changed cloud scale parameters from float to 2D vectors to define different scales in x and y direction
- Fixed TOD_Camera always causing the scene to be edited if enabled
- Fixed cloud inconsistencies between linear and gamma color space
- Fixed moon halo disappearing in gamma color space and made the color alpha affect its visibility
- Fixed an issue where the demo mouse look script could overwrite previously imported Standard Assets
- Fixed possible sun and moon gimbal lock that could cause them to spin towards zenith
- Fixed sun shafts being too faint in some setups
- Improved overall lighting calculations
- Improved moon visuals
- Made the sky dome play nice with "depth only" clear flags
- Made the cloud coloring still darken the clouds even for very low values
- Made Components.Animation.CloudUV modulo with the cloud scale to avoid unnecessarily large values
- Added inspector variables to adjust sun shaft base color and sun shaft coloring
- Added the property Cycle.Ticks to get the time information as a long for easy network synchronization
- Added the property Cycle.DateTime to get the time information as a System.DateTime
- Added an inspector variable to set a minimum value for the light source height

VERSION 2.0.4
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- Added a property for the atmosphere renderer component to TOD_Components
- Added properties for all child mesh filter components to TOD_Components
- Changed the quality settings to be adjustable at runtime via public enum inspector variables
- Merged the three prefabs into a single prefab as separate quality prefabs are no longer required
- Fixed the materials always showing up in version control
- Fixed the sky dome always causing the scene to be modified and the editor always asking to save on close
- Fixed the customized sky dome inspector not always looking like the default inspector
- Improved the performance of all cloud shaders by reducing interpolations from frag to vert
- Improved the visuals of all cloud shaders and streamlined their style
- Increased the default cloud texture import resolution to 1024x1024
- Added a white noise texture for future use

VERSION 2.0.3
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- Fixed all issues with DX11 rendering in order to fully support DX11 from this point on

VERSION 2.0.2
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- Fixed an issue where the image effect shaders could overwrite previously imported Standard Assets

VERSION 2.0.1
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- Changed date and time organization to represent the valid Gregorian calendar
- Addressed issues with the Unity sun shaft image effect by providing a modified image effect
- Fixed clouds not correctly handling the planetary atmosphere curvature
- Fixed clouds not offsetting according to the world position of the sky dome
- Fixed cloud glow passing through even the thickest of clouds
- Fixed cloud shadow projection
- Fixed Light.Falloff not affecting the toggle point of the light position between sun and moon
- Automatically disable the corresponding shadows if Day/Night/Clouds.ShadowStrength is set to 0
- Removed Clouds.ShadowProjector toggle as it is no longer required
- Tweaked the old moon halo to not require an additional draw call and added it back in
- Made the sky dome position in world space add an offset to the cloud UV coordinates
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- Added Light.Coloring to adjust the light coloring separate from the sky coloring
- Rescaled some parameters for easier use and tweaked their default values

VERSION 2.0.0
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- Moved all documentation to Doxygen
- Renamed the folder "Sky Assets" to "Assets"
- Made the color space be detected automatically by default
- Reworked the sun texture and shader
- Allow light source intensities greater than one
- Reworked the way ambient light is being calculated
- Reworked the way light affects the atmosphere and clouds
- Improved all scattering calculations, especially the integral approximation
- Automatically disable space the game object at night
- Added a public method to sample the sky dome color in any viewing direction
- Added a fog bias parameter to lerp between zenith and horizon color
- Adjusted the atmosphere alpha calculation
- Added a parameter to easily adjust the scattering color
- Added shader parameters for the moon texture color and contrast
- Adjusted the render queue positions
- Removed the moon halo material as it is no longer required
- Added the physical scattering model to the night sky
- Greatly improved the weather system
- Added fog and contrast parameters to the atmosphere
- Restructured the parameter classes to be more intuitive to use
- Moved all component references into a separate class
- Made the sky presets be applied via editor script rather than separate prefabs
- Improved cloud shading and performance across the board
- Removed the cloud shading parameter
- Added cloud glow from the sun and moon
- Added sky and cloud tone multipliers to sun and moon
- Added viewer height and horizon offset parameters
- Slightly improved overall performance
- Replaced ambient intensity with two parameters for sun and moon
- Replaced the two directional lights with a single one that automatically follows either sun or moon

VERSION 1.7.3
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- Added two parameters "StarTiling" and "StarDensity" to the "Night" section
- Added "Offset -1, -1" to the cloud shadow shaders to avoid Z-fighting on some platforms
- Tweaked the cloud shader for more consistent results in linear and gamma color space
- Tweaked the moon texture to be a lot brighter by default, especially on mobile
- Tweaked the automatically calculated fog color to be similar to the horizon color
- Removed the property "Brightness" from the moon shader as it is no longer needed

VERSION 1.7.2
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- Fixed the ambient light calculation being too dark, even with high ambient light parameter values
- Added the properties "SunZenith" and "MoonZenith" to access sun and moon zenith angles in degrees
- Added a paramter "Halo" to adjust the moon halo intensity and made its color be derived from the light
- Changed several parameters to be clamped between 0 and 1
- Changed the name of the property "OrbitRadius" to "Radius"
- Tweaked the moon phase calculation of both moon mesh and moon halo
- Tweaked several default parameter values of the prefabs

VERSION 1.7.1
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- Changed the default cardinal direction axes of the sky dome (x axis is now west/east, z axis south/north)
- Removed the property "ZenithFactor" as it is no longer being used
- Moved all child object references into a separate toggleable section called "Children"
- Tweaked the default parameters of the prefabs (brightness, haziness, cloud color, moon light intensity)
- Tweaked the calculations of the moon light color, ambient light at night and cloud tone at night
- Tweaked the default sun and moon base color based on good real life approximations
- Tweaked the moon halo
- Renamed the parameter "ShadowAlpha" in "Clouds" to "ShadowStrength"
- Added the parameter "ShadowStrength" for the sun and moon lights

VERSION 1.7.0
-------------
```

```
- Fixed an issue where the sun could incorrectly travel around the north,
  even though the location is in the northern hemisphere (Thanks Gregg!)
- Fixed an issue that led to the brightest parts of the sky dome being slightly too dark
- Fixed the automatically calculated fog color not being exactly the same as the horizon
- Added a name prefix to all components to prevent name collisions with other packages
- Added cloud shadows (can be disabled)
- Added UTC time zone support
- Added a parameter to configure the color of the light reflected by the moon
- Added parameters for wind direction in degrees and wind speed in knots
- Added an option to automatically adjust the ambient light color (disabled by default)
- Added a parameter to adjust the sun's light color
- Added a plane with an additive shader at the sun's position to always render a circular sun
- Added dynamic cloud shape adjustments to the "Low" prefab (cloud weather types will now also work)
- Added shading calculations to the "Low" and "Medium" prefabs
- Improved the performance of "Low" prefab by reducing the vertex count
- Improved the performance of "Low" prefab by removing the moon halo for that prefab by default
- Improved the cloud shading of the "High" prefab
- Improved the visual quality of the weather presets
- Improved the calculation of the sun's position
- Changed the automatic fog color adjustment to be disabled by default
- Changed the moon halo to adjust according to the moon phase
- Changed the name of the parameter from "Color" to "AdditiveColor" for both day and night
- Changed the cloud animation to support network synchronization
- Changed the default tiling of the stars texture to 1 (was 3)
- Changed the moon vertex count in all presets to scale with the device performance
- Removed the parameter "CloudColor" from "NightParameters" as it is now derived from the moon light color

VERSION 1.6.1
-------------
- Fixed an issue related to HDR rendering

VERSION 1.6.0
-------------

- Improved the visuals and functionality of the weather system
  (most METAR codes should now be possible to achieve visually)
- Improved performance of the moon halo shader
- Added official support for HDR rendering
- Replaced the sun mesh with implicit sun scattering in the atmosphere layer
  to reduce dome vertex count, draw calls and pixel overdraw
- Added an additional quality level (now Low/Medium/High instead of Desktop/Mobile)
- Added sky dome presets from various locations around the globe for easier use
- Tweaked the wavelength constants a little to allow for a wider range of sun coloring adjustments

VERSION 1.5.1
-------------

- Fixed an issue causing a missing sun material in the mobile prefab

VERSION 1.5.0
-------------

- Enabled mip mapping of the stars texture by default to avoid flickering
- Added support for using custom skyboxes at night (see readme for details)
- Greatly improved the parametrization of the sun color influence at sunrise and sunset
- Added internal pointers to commonly used components for faster access
- Split the sun and moon parameters into their own property classes
- Adjusted the cloud shading calculation to keep it from darkening some clouds too much
- Adjusted the color wavelengths to produce a more realistic blue color of the sky by default
- Made the moon phase influence the intensity of the sunlight reflected by the moon
- Replaced the lens flares with custom halo shaders that are correctly being occluded by clouds
- Enabled the new halo effects on mobile
- Moved all shaders into a "Time of Day" category
- Added a basic weather manager with three weather types

VERSION 1.4.0
-------------

- Added "Fog { Mode Off }" to the shaders to properly ignore fog
- Added the parameter "Night Cloud Color" to render clouds at night
- Added the parameter "Night Haze Color" to render some haze at night
- Added the parameter "Night Color" to add some color to the night sky
- Renamed the parameter "Haze" to "Haziness"
```

```
- Renamed the parameter "Sky Tone" to "Brightness"
- Renamed the properties "Day" and "Night" to "IsDay" and "IsNight"
- Restructured all sky parameters into groups
- Improved the sun lens flare texture
- Improved the stars texture
- Fixed a rendering artifact at the horizon for low haziness values
- Made the scattering calculation in gamma space look identical to linear space

VERSION 1.3.0
-------------

- Greatly improved performance on mobile devices
- Greatly improved sunset and sunrise visual quality
- Added a parameter to control how strongly the sun color affects the sky color
- Added realistic sun and moon lens flare effects
- Added two additional cloud noise textures
- Improved handling of latitude and longitude
- Made the sky dome render correctly independent of its rotation

VERSION 1.2.0
-------------

- Fixed some bugs regarding linear vs. gamma space rendering
- Fixed some issues with the horizon fadeout
- Adjusted sun and moon size
- Optimized sun and fog color calculation
- Greatly improved visual quality of the cloud system
- Added parameter to control cloud tone, allowing for dark clouds
- Added improved stars texture at night
- Added parameter to control the sun color falloff speed

VERSION 1.1.0
-------------

- First public release on the Asset Store

VERSION 1.0.0
-------------

- First private release for internal use
```

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 3

Class Index

3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 4

Class Documentation

4.1 TOD_AmbientParameters Class Reference

Parameters of the ambient mode.

Public Attributes

- TOD_AmbientType Mode = TOD_AmbientType.Color

  Ambient light mode.
- float UpdateInterval = 1.0f

  Refresh interval of the ambient light probe in seconds.

4.1.1 Detailed Description

Parameters of the ambient mode.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.2 TOD_Animation Class Reference

Cloud animation class.

Public Attributes

- float WindDegrees = 0.0f

  Wind direction in degrees. 0 for wind blowing in northern direction. 90 for wind blowing in eastern direction. 180 for wind blowing in southern direction. 270 for wind blowing in western direction.
- float WindSpeed = 1.0f

  Speed of the wind that is acting on the clouds.
- bool WorldSpaceCloudUV = true

  Adjust the cloud coordinates when the sky dome moves.
- bool RandomInitialCloudUV = true

  Randomize the cloud coordiantes at startup.

Properties

- Vector4 CloudUV `[get, set]`

  Current cloud UV coordinates. Can be synchronized between multiple game clients to guarantee identical cloud positions.
- Vector4 OffsetUV `[get]`

  Current offset UV coordinates. Is being calculated from the sky dome world position.

4.2.1 Detailed Description

Cloud animation class.

Component of the sky dome parent game object.

The documentation for this class was generated from the following file:

- TOD_Animation.cs

4.3 TOD_AtmosphereParameters Class Reference

Parameters of the atmosphere.

Public Attributes

- float RayleighMultiplier = 1.0f

  [0, ∞] Intensity of the atmospheric Rayleigh scattering.
- float MieMultiplier = 1.0f

  [0, ∞] Intensity of the atmospheric Mie scattering.
- float Brightness = 1.5f

  [0, ∞] Overall brightness of the atmosphere.
- float Contrast = 1.5f

  [0, ∞] Overall contrast of the atmosphere.
- float Directionality = 0.7f

  [0, 1] Directionality factor that determines the size and sharpness of the glow around the sun.
- float Fogginess = 0.0f

  [0, 1] Density of the fog covering the sky.

4.3.1 Detailed Description

Parameters of the atmosphere.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.4 TOD_Camera Class Reference

Sky dome management camera component.

Public Member Functions

- void **DoDomeScaleToFarClip** ()
- void **DoDomePosToCamera** ()

Public Attributes

- TOD_Sky sky

  Sky dome reference inspector variable. Will automatically be searched in the scene if not set in the inspector.
- bool DomePosToCamera = true

  Automatically move the sky dome to the camera position in OnPreCull().
- Vector3 DomePosOffset = Vector3.zero

  The sky dome position offset relative to the camera.
- bool DomeScaleToFarClip = true

  Automatically scale the sky dome to the camera far clip plane in OnPreCull().
- float DomeScaleFactor = 0.95f

  The sky dome scale factor relative to the camera far clip plane.

Properties

- bool **HDR** `[get]`

4.4.1 Detailed Description

Sky dome management camera component.

Move and scale the sky dome every frame after the rest of the scene has fully updated.

The documentation for this class was generated from the following file:

- TOD_Camera.cs

4.5 TOD_CloudParameters Class Reference

Parameters of the clouds.

Public Attributes

- float Density = 1.0f

  [0, 1] Density of the clouds.
- float Sharpness = 3.0f

  [0, ∞] Sharpness of the clouds.
- float Brightness = 1.0f

  [0, ∞] Brightness of the clouds.
- int Billboards = 0

  [0, ∞] Number of billboard clouds to instantiate at start. Billboard clouds are not visible in edit mode.
- float ShadowStrength = 0.0f

  [0, 1] Opacity of the cloud shadows.
- Vector2 Scale1 = new Vector2(3, 3)

  Scale of the first cloud layer.
- Vector2 Scale2 = new Vector2(7, 7)

  Scale of the second cloud layer.

4.5.1 Detailed Description

Parameters of the clouds.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.6 TOD_Components Class Reference

Component manager class.

Public Member Functions

- void Initialize ()

  Initializes all component references.

Public Attributes

- GameObject Sun = null

  Sun game object reference.
- GameObject Moon = null

  Moon game object reference.
- GameObject Atmosphere = null

  Atmosphere game object reference.
- GameObject Clear = null

  Clear game object reference.
- GameObject Clouds = null

  Clouds game object reference.
- GameObject Space = null

  Space game object reference.
- GameObject Light = null

  Light game object reference.
- GameObject Projector = null

  Projector game object reference.
- GameObject Billboards = null

  Billboards game object reference.
- Transform DomeTransform

  Transform component of the sky dome game object.
- Transform SunTransform

  Transform component of the sun game object.
- Transform MoonTransform

  Transform component of the moon game object.
- Transform LightTransform

  Transform component of the light source game object.
- Transform SpaceTransform

  Transform component of the space game object.
- Renderer SpaceRenderer

  Renderer component of the space game object.
- Renderer AtmosphereRenderer

Renderer component of the atmosphere game object.

- Renderer ClearRenderer

  Renderer component of the clear game object.
- Renderer CloudRenderer

  Renderer component of the cloud game object.
- Renderer SunRenderer

  Renderer component of the sun game object.
- Renderer MoonRenderer

  Renderer component of the moon game object.
- MeshFilter SpaceMeshFilter

  MeshFilter component of the space game object.
- MeshFilter AtmosphereMeshFilter

  MeshFilter component of the atmosphere game object.
- MeshFilter ClearMeshFilter

  MeshFilter component of the clear game object.
- MeshFilter CloudMeshFilter

  MeshFilter component of the cloud game object.
- MeshFilter SunMeshFilter

  MeshFilter component of the sun game object.
- MeshFilter MoonMeshFilter

  MeshFilter component of the moon game object.
- Material SpaceMaterial

  Main material of the space game object.
- Material AtmosphereMaterial

  Main material of the atmosphere game object.
- Material ClearMaterial

  Main material of the clear game object.
- Material CloudMaterial

  Main material of the cloud game object.
- Material SunMaterial

  Main material of the sun game object.
- Material MoonMaterial

  Main material of the moon game object.
- Material ShadowMaterial

  Main material of the projector game object.
- Light LightSource

  Light component of the light source game object.
- Projector ShadowProjector

  Projector component of the shadow projector game object.
- TOD_Sky Sky

  Sky component of the sky dome game object.
- TOD_Animation Animation

  Animation component of the sky dome game object.
- TOD_Time Time

  Time component of the sky dome game object.
- TOD_Weather Weather

  Weather component of the sky dome game object.
- TOD_Camera Camera

  Main component of the camera game object.
- TOD_Rays Rays

  God ray component of the camera game object.
- TOD_Scattering Scattering

  Scattering component of the camera game object.

4.6.1 Detailed Description

Component manager class.

Component of the main camera of the scene.

The documentation for this class was generated from the following file:

- TOD_Components.cs

4.7 TOD_CycleParameters Class Reference

Parameters of the day and night cycle.

Public Attributes

- float Hour = 12

  [0, 24] Current hour of the day.
- int Day = 15

  [1, 31] Current day of the month.
- int Month = 6

  [1, 12] Current month of the year.
- int Year = 2000

  [1, 9999] Current year.

Properties

- System.DateTime DateTime `[get, set]`

  All time information as a System.DateTime instance.
- long Ticks `[get, set]`

  All time information as a single long. Value corresponds to the System.DateTime.Ticks property.

4.7.1 Detailed Description

Parameters of the day and night cycle.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.8 TOD_DayParameters Class Reference

Parameters that are unique to the day.

Public Attributes

- Gradient SkyColor

  Color of the light that hits the atmosphere.
- Gradient LightColor

  Color of the light that hits the ground.

- Gradient RayColor

  Color of the god rays.
- Gradient CloudColor

  Color of the clouds.
- Gradient AmbientColor

  Color of the ambient light.
- float LightIntensity = 1.0f

  [0, ∞] Intensity of the light source.
- float ShadowStrength = 1.0f

  [0, 1] Opacity of the shadows dropped by the light source.
- float ColorMultiplier = 1.0f

  [0, 1] Brightness of colors.
- float AmbientMultiplier = 1.0f

  [0, 1] Brightness of ambient light.
- float ReflectionMultiplier = 1.0f

  [0, 1] Brightness of reflected light.

4.8.1 Detailed Description

Parameters that are unique to the day.

4.8.2 Member Data Documentation

4.8.2.1 Gradient TOD_DayParameters.AmbientColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(094, 089, 087, 255), 0.0f),
            new GradientColorKey(new Color32(094, 089, 087, 255), 1.0f)
        }
    }
```

Color of the ambient light.

4.8.2.2 Gradient TOD_DayParameters.CloudColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(255, 255, 255, 255), 0.0f),
            new GradientColorKey(new Color32(255, 200, 100, 255), 1.0f)
        }
    }
```

Color of the clouds.

4.8.2.3 Gradient TOD_DayParameters.LightColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(255, 243, 234, 255), 0.0f),
            new GradientColorKey(new Color32(255, 107, 000, 255), 1.0f)
        }
    }
```

Color of the light that hits the ground.

4.8.2.4 Gradient TOD_DayParameters.RayColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(255, 243, 234, 255), 0.0f),
            new GradientColorKey(new Color32(255, 107, 000, 255), 1.0f)
        }
    }
```

Color of the god rays.

4.8.2.5 Gradient TOD_DayParameters.SkyColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(255, 243, 234, 255), 0.0f),
            new GradientColorKey(new Color32(255, 243, 234, 255), 1.0f)
        }
    }
```

Color of the light that hits the atmosphere.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.9 TOD_FogParameters Class Reference

Parameters of the fog mode.

Public Attributes

- TOD_FogType Mode = TOD_FogType.Color

  Fog color mode.
- float HeightBias = 0.0f

  [0, 1] Fog color sampling height.
  = 0 fog is atmosphere color at horizon.
  = 1 fog is atmosphere color at zenith.

4.9.1 Detailed Description

Parameters of the fog mode.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.10 TOD_ImageEffect Class Reference

Image effect base class.

Public Attributes

- TOD_Sky sky = null

  Sky dome reference inspector variable. Will automatically be searched in the scene if not set in the inspector.

4.10.1 Detailed Description

Image effect base class.

Based on PostEffectsBase from the Unity Standard Assets. Extended for image effects that depend on a TOD_Sky reference.

The documentation for this class was generated from the following file:

- TOD_ImageEffect.cs

4.11 TOD_LightParameters Class Reference

Parameters of the light source.

Public Attributes

- float UpdateInterval = 0.0f

  [0, ∞] Refresh interval of the light source position in seconds.
- float MinimumHeight = 0.0f

  [-1, 1] Controls how low the light source is allowed to go.
  = -1 light source can go as low as it wants.
  = 0 light source will never go below the horizon.
  = +1 light source will never leave zenith.

4.11.1 Detailed Description

Parameters of the light source.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.12 TOD_MaxAttribute Class Reference

Public Member Functions

- **TOD_MaxAttribute** (float max)

Public Attributes

- float **max**

The documentation for this class was generated from the following file:

- TOD_Attributes.cs

4.13 TOD_MinAttribute Class Reference

Public Member Functions

- **TOD_MinAttribute** (float min)

Public Attributes

- float **min**

The documentation for this class was generated from the following file:

- TOD_Attributes.cs

4.14 TOD_MoonParameters Class Reference

Parameters that are unique to the moon.

Public Attributes

- Gradient MeshColor

  Color of the moon mesh.
- float MeshSize = 1.0f

  [0, ∞] Size of the moon mesh in degrees.
- float MeshBrightness = 1.0f

  [0, ∞] Brightness of the moon mesh.
- float MeshContrast = 1.0f

[0, ∞] Contrast of the moon mesh.

- Gradient HaloColor

  Color of the moon halo.

- float HaloSize = 0.1f

  [0, ∞] Size of the moon halo.

- TOD_MoonPositionType Position = TOD_MoonPositionType.Realistic

  Type of the moon position calculation.

4.14.1 Detailed Description

Parameters that are unique to the moon.

4.14.2 Member Data Documentation

4.14.2.1 Gradient TOD_MoonParameters.HaloColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(025, 040, 065, 255), 0.0f),
            new GradientColorKey(new Color32(025, 040, 065, 255), 1.0f)
        }
    }
```

Color of the moon halo.

4.14.2.2 Gradient TOD_MoonParameters.MeshColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(255, 233, 200, 255), 0.0f),
            new GradientColorKey(new Color32(255, 233, 200, 255), 1.0f)
        }
    }
```

Color of the moon mesh.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.15 TOD_NightParameters Class Reference

Parameters that are unique to the night.

Public Attributes

- Gradient SkyColor

  Color of the light that hits the atmosphere.
- Gradient LightColor

  Color of the light that hits the ground.
- Gradient RayColor

  Color of the god rays.
- Gradient CloudColor

  Color of the clouds.
- Gradient AmbientColor

  Color of the ambient light.
- float LightIntensity = 0.1f

  [0, ∞] Intensity of the light source.
- float ShadowStrength = 1.0f

  [0, 1] Opacity of the shadows dropped by the light source.
- float ColorMultiplier = 1.0f

  [0, 1] Brightness of colors.
- float AmbientMultiplier = 1.0f

  [0, 1] Brightness of ambient light.
- float ReflectionMultiplier = 1.0f

  [0, 1] Brightness of reflected light.

4.15.1 Detailed Description

Parameters that are unique to the night.

4.15.2 Member Data Documentation

4.15.2.1 Gradient TOD_NightParameters.AmbientColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(025, 040, 065, 255), 0.0f),
            new GradientColorKey(new Color32(025, 040, 065, 255), 1.0f)
        }
    }
```

Color of the ambient light.

4.15.2.2 Gradient TOD_NightParameters.CloudColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
            },
        colorKeys = new GradientColorKey[] {
```

```
            new GradientColorKey(new Color32(025, 040, 065, 255), 0.0f),
            new GradientColorKey(new Color32(025, 040, 065, 255), 1.0f)
        }
    }
```

Color of the clouds.

4.15.2.3 Gradient TOD_NightParameters.LightColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(025, 040, 065, 255), 0.0f),
            new GradientColorKey(new Color32(025, 040, 065, 255), 1.0f)
        }
    }
```

Color of the light that hits the ground.

4.15.2.4 Gradient TOD_NightParameters.RayColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(025, 040, 065, 255), 0.0f),
            new GradientColorKey(new Color32(025, 040, 065, 255), 1.0f)
        }
    }
```

Color of the god rays.

4.15.2.5 Gradient TOD_NightParameters.SkyColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(025, 040, 065, 255), 0.0f),
            new GradientColorKey(new Color32(025, 040, 065, 255), 1.0f)
        }
    }
```

Color of the light that hits the atmosphere.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.16 TOD_Parameters Class Reference

All parameters of the sky dome.

Public Member Functions

- **TOD_Parameters** (TOD_Sky sky)
- void **ToSky** (TOD_Sky sky)

Public Attributes

- TOD_CycleParameters **Cycle**
- TOD_WorldParameters **World**
- TOD_AtmosphereParameters **Atmosphere**
- TOD_DayParameters **Day**
- TOD_NightParameters **Night**
- TOD_SunParameters **Sun**
- TOD_MoonParameters **Moon**
- TOD_LightParameters **Light**
- TOD_StarParameters **Stars**
- TOD_CloudParameters **Clouds**
- TOD_FogParameters **Fog**
- TOD_AmbientParameters **Ambient**
- TOD_ReflectionParameters **Reflection**

4.16.1 Detailed Description

All parameters of the sky dome.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.17 TOD_RangeAttribute Class Reference

Public Member Functions

- **TOD_RangeAttribute** (float min, float max)

Public Attributes

- float **min**
- float **max**

The documentation for this class was generated from the following file:

- TOD_Attributes.cs

4.18 TOD_Rays Class Reference

God ray camera component.

Public Types

- enum ResolutionType { **Low**, **Normal**, **High** }

  Resolutions for rendering the god rays.
- enum BlendModeType { **Screen**, **Add** }

  Methods to blend the god rays with the image.

Public Attributes

- Shader **GodRayShader** = null
- Shader **ScreenClearShader** = null
- ResolutionType Resolution = ResolutionType.Normal

  The god ray rendering resolution.
- BlendModeType BlendMode = BlendModeType.Screen

  The god ray rendering blend mode.
- int BlurIterations = 2

  The number of blur iterations to be performaed.
- float BlurRadius = 2

  The radius to blur filter applied to the god rays.
- float Intensity = 1

  The intensity of the god rays.
- float MaxRadius = 0.5f

  The maximum radius of the god rays.
- bool UseDepthTexture = true

  Whether or not to use the depth buffer. If enabled, requires the target platform to allow the camera to create a depth texture. Unity always creates this depth texture if deferred lighting is enabled. Otherwise this script will enable it for the camera it is attached to. If disabled, requires all shaders writing to the depth buffer to also write to the frame buffer alpha channel. Only the frame buffer alpha channel will then be used to check for ray blockers in the image effect.

4.18.1 Detailed Description

God ray camera component.

Based on SunShafts from the Unity Standard Assets. Extended to get the god ray color from TOD_Sky and properly handle transparent meshes like clouds.

The documentation for this class was generated from the following file:

- TOD_Rays.cs

4.19 TOD_ReflectionParameters Class Reference

Parameters of the reflection mode.

Public Attributes

- TOD_ReflectionType Mode = TOD_ReflectionType.None

  Reflection probe mode.
- ReflectionProbeClearFlags ClearFlags = ReflectionProbeClearFlags.Skybox

  Clear flags to use for the reflection.
- LayerMask CullingMask = 0

  Layers to include in the reflection.

- ReflectionProbeTimeSlicingMode TimeSlicing = ReflectionProbeTimeSlicingMode.AllFacesAtOnce

  Time slicing behaviour to spread out rendering cost over multiple frames.
- float UpdateInterval = 1.0f

  Refresh interval of the reflection cubemap in seconds.

4.19.1 Detailed Description

Parameters of the reflection mode.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.20 TOD_Resources Class Reference

Material and mesh wrapper class.

Public Member Functions

- void Initialize ()

  Initializes all resource references.

Static Public Member Functions

- static Mesh **CreateQuad** (Vector2 minUV, Vector2 maxUV)

Public Attributes

- Mesh **Quad**
- Mesh **SphereHigh**
- Mesh **SphereMedium**
- Mesh **SphereLow**
- Mesh **IcosphereHigh**
- Mesh **IcosphereMedium**
- Mesh **IcosphereLow**
- Mesh **HalfIcosphereHigh**
- Mesh **HalfIcosphereMedium**
- Mesh **HalfIcosphereLow**
- Material **CloudMaterial**
- Material **ShadowMaterial**
- Material **BillboardMaterial**
- Material **SpaceMaterial**
- Material **AtmosphereMaterial**
- Material **SunMaterial**
- Material **MoonMaterial**
- Material **ClearMaterial**
- Material **SkyboxMaterial**
- int **ID_SunSkyColor**
- int **ID_MoonSkyColor**
- int **ID_SunCloudColor**
- int **ID_MoonCloudColor**

- int **ID_SunMeshColor**
- int **ID_MoonMeshColor**
- int **ID_CloudColor**
- int **ID_AmbientColor**
- int **ID_MoonHaloColor**
- int **ID_SunDirection**
- int **ID_MoonDirection**
- int **ID_LightDirection**
- int **ID_LocalSunDirection**
- int **ID_LocalMoonDirection**
- int **ID_LocalLightDirection**
- int **ID_Contrast**
- int **ID_Brightness**
- int **ID_Fogginess**
- int **ID_Directionality**
- int **ID_MoonHaloPower**
- int **ID_CloudDensity**
- int **ID_CloudSharpness**
- int **ID_CloudShadow**
- int **ID_CloudScale**
- int **ID_CloudUV**
- int **ID_SpaceTiling**
- int **ID_SpaceBrightness**
- int **ID_SunMeshContrast**
- int **ID_SunMeshBrightness**
- int **ID_MoonMeshContrast**
- int **ID_MoonMeshBrightness**
- int **ID_kBetaMie**
- int **ID_kSun**
- int **ID_k4PI**
- int **ID_kRadius**
- int **ID_kScale**
- int **ID_World2Sky**
- int **ID_Sky2World**

4.20.1 Detailed Description

Material and mesh wrapper class.

Component of the sky dome parent game object.

The documentation for this class was generated from the following file:

- TOD_Resources.cs

4.21 TOD_Scattering Class Reference

Atmospheric scattering and aerial perspective camera component.

Public Attributes

- Shader **ScatteringShader** = null
- Texture2D **DitheringTexture** = null

4.21.1 Detailed Description

Atmospheric scattering and aerial perspective camera component.

The documentation for this class was generated from the following file:

- TOD_Scattering.cs

4.22 TOD_Sky Class Reference

Main sky dome management class.

Public Member Functions

- Vector3 OrbitalToUnity (float radius, float theta, float phi)
  Convert spherical coordinates to cartesian coordinates.
- Vector3 OrbitalToLocal (float theta, float phi)
  Convert spherical coordinates to cartesian coordinates.
- Color SampleAtmosphere (Vector3 direction, bool directLight=true)
  Sample atmosphere colors from the sky dome.
- SphericalHarmonicsL2 RenderToSphericalHarmonics ()
  Render the sky dome to 3rd order spherical harmonics.
- void RenderToCubemap (RenderTexture targetTexture=null)
  Render the sky dome to a cubemap render texture.
- Color SampleFogColor (bool directLight=true)
  Calculate the fog color.
- Color SampleSkyColor ()
  Calculate the sky color.
- Color SampleEquatorColor ()
  Calculate the equator color.
- void UpdateFog ()
  Update the RenderSettings fog color according to TOD_FogParameters.
- void UpdateAmbient ()
  Update the RenderSettings ambient light according to TOD_AmbientParameters.
- void UpdateReflection ()
  Update the RenderSettings reflection probe according to TOD_ReflectionParameters.
- void LoadParameters (string xml)
  Load parameters at runtime.

Public Attributes

- TOD_ColorSpaceType ColorSpace = TOD_ColorSpaceType.Auto
  The color space.
- TOD_ColorRangeType ColorRange = TOD_ColorRangeType.Auto
  The color range.
- TOD_SkyQualityType SkyQuality = TOD_SkyQualityType.PerVertex
  The sky quality.
- TOD_CloudQualityType CloudQuality = TOD_CloudQualityType.Bumped
  The cloud quality.
- TOD_MeshQualityType MeshQuality = TOD_MeshQualityType.High

The mesh quality.

- TOD_CycleParameters Cycle

  Parameters of the day and night cycle.
- TOD_WorldParameters World

  Parameters of the world.
- TOD_AtmosphereParameters Atmosphere

  Parameters of the atmosphere.
- TOD_DayParameters Day

  Parameters of the day.
- TOD_NightParameters Night

  Parameters of the night.
- TOD_SunParameters Sun

  Parameters of the sun.
- TOD_MoonParameters Moon

  Parameters of the moon.
- TOD_StarParameters Stars

  Parameters of the stars.
- TOD_CloudParameters Clouds

  Parameters of the cloud layers.
- TOD_LightParameters Light

  Parameters of the light source.
- TOD_FogParameters Fog

  Parameters of the fog.
- TOD_AmbientParameters Ambient

  Parameters of the ambient light.
- TOD_ReflectionParameters Reflection

  Parameters of the reflection cubemap.

Properties

- static List< TOD_Sky > Instances `[get]`

  All currently active sky dome instances.
- static TOD_Sky Instance `[get]`

  The most recently created sky dome instance.
- bool Initialized `[get]`

  Whether or not the sky dome was successfully initialized.
- bool Headless `[get]`

  Whether or not the sky dome is running in headless mode.
- TOD_Components Components `[get]`

  Containins references to all components.
- TOD_Resources Resources `[get]`

  Containins references to all resources.
- bool IsDay `[get]`

  Boolean to check if it is day.
- bool IsNight `[get]`

  Boolean to check if it is night.
- float Radius `[get]`

  Radius of the sky dome.
- float Diameter `[get]`

  Diameter of the sky dome.

- float LerpValue [get]

  Falls off the darker the sunlight gets. Can for example be used to lerp between day and night values in shaders.
  = +1 at day
  = 0 at night.
- float SunZenith [get]

  Sun zenith angle in degrees.
  = 0 if the sun is exactly at zenith.
  = 180 if the sun is exactly below the ground.
- float MoonZenith [get]

  Moon zenith angle in degrees.
  = 0 if the moon is exactly at zenith.
  = 180 if the moon is exactly below the ground.
- float LightZenith [get]

  Currently active light source zenith angle in degrees.
  = 0 if the currently active light source (sun or moon) is exactly at zenith.
  = 90 if the currently active light source (sun or moon) is exactly at the horizon.
- float LightIntensity [get]

  Current light intensity.
- Vector3 SunDirection [get]

  Sun direction vector in world space.
- Vector3 MoonDirection [get]

  Moon direction vector in world space.
- Vector3 LightDirection [get]

  Current directional light vector in world space. Lerps between TOD_Sky.SunDirection and TOD_Sky.MoonDirection at dusk and dawn.
- Vector3 LocalSunDirection [get]

  Sun direction vector in sky dome object space.
- Vector3 LocalMoonDirection [get]

  Moon direction vector in sky dome object space.
- Vector3 LocalLightDirection [get]

  Current directional light vector in sky dome object space. Lerps between TOD_Sky.LocalSunDirection and TOD_Sky.LocalMoonDirection at dusk and dawn.
- Color SunLightColor [get]

  Current sun light color.
- Color MoonLightColor [get]

  Current moon light color.
- Color LightColor [get]

  Current light color. The color of TOD_Sky.Components.LightSource. Lerps between TOD_Sky.SunLightColor and TOD_Sky.MoonLightColor at dusk and dawn.
- Color SunRayColor [get]

  Current sun ray color.
- Color MoonRayColor [get]

  Current moon ray color.
- Color RayColor [get]

  Current ray color. Lerps between TOD_Sky.SunRayColor and TOD_Sky.MoonRayColor at dusk and dawn.
- Color SunSkyColor [get]

  Current sun sky color.
- Color MoonSkyColor [get]

  Current moon sky color.
- Color SunMeshColor [get]

  Current sun mesh color.
- Color MoonMeshColor [get]

  Current moon mesh color.

- Color CloudColor [get]
  Current cloud color.
- Color AmbientColor [get]
  Current ambient light color.
- Color MoonHaloColor [get]
  Current moon halo color.
- ReflectionProbe Probe [get]
  Current reflection probe.

4.22.1 Detailed Description

Main sky dome management class.

Component of the sky dome parent game object.

4.22.2 Member Function Documentation

4.22.2.1 void TOD_Sky.LoadParameters (string *xml*) [inline]

Load parameters at runtime.

Parameters

xml	The parameters to load, serialized to XML.

4.22.2.2 Vector3 TOD_Sky.OrbitalToLocal (float *theta*, float *phi*) [inline]

Convert spherical coordinates to cartesian coordinates.

Parameters

theta	Spherical coordinates theta.
phi	Spherical coordinates phi.

Returns

Unity position in local space.

4.22.2.3 Vector3 TOD_Sky.OrbitalToUnity (float *radius*, float *theta*, float *phi*) [inline]

Convert spherical coordinates to cartesian coordinates.

Parameters

radius	Spherical coordinates radius.
theta	Spherical coordinates theta.
phi	Spherical coordinates phi.

Returns

Unity position in world space.

4.22.2.4 void TOD_Sky.RenderToCubemap (RenderTexture *targetTexture* = null) [inline]

Render the sky dome to a cubemap render texture.

Parameters

targetTexture	Target RenderTexture in which rendering should be done.

4.22.2.5 Color TOD_Sky.SampleAtmosphere (Vector3 *direction*, bool *directLight* = `true`) [inline]

Sample atmosphere colors from the sky dome.

Parameters

direction	View direction in world space.
directLight	Whether or not to include direct light.

Returns

Color of the atmosphere in the specified direction.

4.22.2.6 Color TOD_Sky.SampleFogColor (bool *directLight* = `true`) [inline]

Calculate the fog color.

Parameters

directLight	Whether or not to include direct light.

The documentation for this class was generated from the following files:

- TOD_Sky+API.cs
- TOD_Sky+Settings.cs
- TOD_Sky+Shader.cs
- TOD_Sky.cs
- TOD_Sky+Unity.cs

4.23 TOD_StarParameters Class Reference

Parameters of the stars.

Public Attributes

- float Tiling = 6.0f

  [0, ∞] Texture tiling of the stars texture.
- float Brightness = 3.0f

  [0, ∞] Brightness of the stars.
- TOD_StarsPositionType Position = TOD_StarsPositionType.Rotating

  Type of the stars position calculation.

4.23.1 Detailed Description

Parameters of the stars.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.24 TOD_SunParameters Class Reference

Parameters that are unique to the sun.

Public Attributes

- Gradient MeshColor

  Color of the sun spot.
- float MeshSize = 1.0f

  [0, ∞] Size of the sun spot in degrees.
- float MeshBrightness = 1.0f

  [0, ∞] Brightness of the sun spot.
- float MeshContrast = 1.0f

  [0, ∞] Contrast of the sun spot.

4.24.1 Detailed Description

Parameters that are unique to the sun.

4.24.2 Member Data Documentation

4.24.2.1 Gradient TOD_SunParameters.MeshColor

Initial value:

```
= new Gradient()
    {
        alphaKeys = new GradientAlphaKey[] {
            new GradientAlphaKey(1.0f, 0.0f),
            new GradientAlphaKey(1.0f, 1.0f)
        },
        colorKeys = new GradientColorKey[] {
            new GradientColorKey(new Color32(253, 171, 050, 255), 0.0f),
            new GradientColorKey(new Color32(253, 171, 050, 255), 1.0f)
        }
    }
```

Color of the sun spot.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs

4.25 TOD_Time Class Reference

Time iteration class.

Public Member Functions

- void RefreshTimeCurve ()

  Apply changes made to TimeCurve.
- float ApplyTimeCurve (float deltaTime)

  Apply the time curve to a time span.
- void AddHours (float hours, bool adjust=true)

Add hours and fractions of hours to the current time.

- void AddSeconds (float seconds, bool adjust=true)

  Add seconds and fractions of seconds to the current time.

Public Attributes

- float DayLengthInMinutes = 30

  Length of one day in minutes.
- bool UseDeviceTime = false

  Set the time to the current device time on start.
- bool UseTimeCurve = false

  Apply the time curve when progressing time.
- AnimationCurve TimeCurve = AnimationCurve.Linear(0, 0, 24, 24)

  Time progression curve.

Events

- Action OnMinute

  Fired whenever the minute value is incremented.
- Action OnHour

  Fired whenever the hour value is incremented.
- Action OnDay

  Fired whenever the day value is incremented.
- Action OnMonth

  Fired whenever the month value is incremented.
- Action OnYear

  Fired whenever the year value is incremented.

4.25.1 Detailed Description

Time iteration class.

Component of the sky dome parent game object.

4.25.2 Member Function Documentation

4.25.2.1 void TOD_Time.AddHours (float *hours*, bool *adjust* = `true`) [inline]

Add hours and fractions of hours to the current time.

Parameters

hours	The hours to add.
adjust	Whether or not to apply the time curve.

4.25.2.2 void TOD_Time.AddSeconds (float *seconds*, bool *adjust* = `true`) [inline]

Add seconds and fractions of seconds to the current time.

Parameters

seconds	The seconds to add.
adjust	Whether or not to apply the time curve.

4.25.2.3 float TOD_Time.ApplyTimeCurve (float *deltaTime*) [inline]

Apply the time curve to a time span.

Parameters

deltaTime	The time span to adjust.

Returns

The adjusted time span.

The documentation for this class was generated from the following file:

- TOD_Time.cs

4.26 TOD_Weather Class Reference

Weather management class.

Public Attributes

- float FadeTime = 10f
  Time to fade from one weather type to the other.
- TOD_CloudType Clouds = TOD_CloudType.Custom
  Currently selected cloud type.
- TOD_WeatherType Weather = TOD_WeatherType.Custom
  Currently selected weather type.

4.26.1 Detailed Description

Weather management class.

Component of the sky dome parent game object.

The documentation for this class was generated from the following file:

- TOD_Weather.cs

4.27 TOD_WorldParameters Class Reference

Parameters of the world.

Public Attributes

- float Latitude = 0
  [-90, +90] Latitude of the current location in degrees.

- float Longitude = 0

  [-180, +180] Longitude of the current location in degrees.
- float UTC = 0

  [-14, +14] UTC/GMT time zone of the current location in hours.

4.27.1 Detailed Description

Parameters of the world.

The documentation for this class was generated from the following file:

- TOD_Parameters.cs