3D Terrain

www.mvrsimulation.com | sales@mvrsimulation.com | US 617-739-2667

MVRsimulation® has built geospecific 3D terrain covering Continental USA plus AK and HI (CONUS++), and the continents of Africa, Asia, Australia and Oceania, Europe, North America, and South America in its round-earth geocentric terrain format. These 3D terrain datasets were built with MVRsimulation's Terrain Tools for real-time visualization in MVRsimulation's Virtual Reality Scene Generator® (VRSG®).

The terrain datasets are suitable for rendering virtual worlds in applications such as glass-cockpit displays, intelligence, surveillance, and reconnaissance (ISR) applications, joint fires close-air-support (CAS) exercises, and fixed-wing cockpit simulation. MVRsimulation updates these terrain datasets on an ongoing basis as new higher-resolution source data becomes available.

For a given area of interest (AOI), you can add culture assets from MVRsimulation's extensive model libraries, your own models, or models extruded and textured with Esri CityEngine®. You can also construct pattern-of-life scenarios using MVRsimulation's Scenario Editor. Terrain Tools users can also choose to enhance or augment existing MVRsimulation 3D terrain by building custom terrain with their own source data such as higher-resolution data or by simply adding built-in road features to refine the existing terrain for a given AOI. New terrain tiles are blended seamlessly with previously compiled terrain tiles.

MVRsimulation can also work with you to build a custom 3D terrain of an AOI, such as an airfield, or training range for your simulation needs.

Note: MVRsimulation's 3D terrain is "Additional Materials" and is provided "as is" as described in our license agreement. Although MVRsimulation might modify or enhance source imagery, some visual artifacts from that source imagery might remain in the terrain.

CONUS++

The CONUS++ terrain was built with high-resolution geospecific orthoimagery and varying levels of digital elevation models. The baseline terrain consists of 1-meter per-pixel (mpp) National Agriculture Imagery Program (NAIP) imagery (except for Alaska and Hawaii) combined with 10-meter per-post National Elevation Database (NED) elevation data. The entire terrain covers 1,900 geocells, and the terrain tiles amount to approximately 37.3 TB on disk.

Several high-resolution 3D culture areas are included throughout the CONUS++ terrain including military training sites, airports, and urban centers. Many of these areas are modeled from photographs taken at the actual sites.

The CONUS++ terrain also contains three AOIs that were built with sub-inch resolution imagery collected by MVRsimulation's small UAS: Prospect Square area of the Yuma Proving Ground, AZ; two target ranges at the Fallon Range Training Complex, Naval Aviation Warfighting Development Center (NAWDC) at Naval Air Station (NAS) Fallon, NV; and Amarillo International Airport, TX.

Virtual terrain created with sub-inch resolution imagery is critical for real-time simulation; high-fidelity visual cues such as helicopter landing areas, vehicle targets, and small craters left from exploded ordnance are visible on the terrain and bullet holes are visible on targets.

Among the CONUS++ culture AOIs MVRsimulation has modeled are nearly 30 virtual airports. All have the CONUS++ base

Image on the cover: *VRSG real-time scene of virtual terrain of Mischief Reef, in the eastern region of the Spratly Islands, South China Sea.*

VRSG real-time scene of the modeled Kilo MOUT site on the geospecific virtual terrain of USMC Camp Pendleton, CA, built with NAIP imagery.

imagery of 1 mpp or better resolution. All include higher-resolution insets, with imagery ranging from 0.15 mpp to 0.60 mpp, blended with the underlying 1 mpp NAIP imagery. Elevation sources for most airports are 10 meters-per-post and are blended for a seamless transition to the underlying terrain and to a custom elevation that matches FAA airport elevations with at least 95% accuracy.

VRSG real-time scene of an F-16 entity in flight over a rugged section of virtual terrain of theTonto National Forest, AZ, built with NAIP imagery.

Many virtual airports were built at the request of customers. In most cases, a site-specific control tower was built (based on publicly available photos) and used with a combination of geotypical airfield models from MVRsimulation's extensive culture model libraries. Cultural features for some airports are geospecific, based on photos of the buildings and other structures.

VRSG real-time scene of a section of runway 4/22 on the virtual Amarillo International Airport, built with 5mm per-pixel drone imagery.

All airports contain accurate runways and runway lights, markings, and signage. Cultural features on some are geo-specific, based on photos of the buildings and other structures.

MVRsimulation and many of its customers use Esri's CityEngine 3D modeling software to generate geotypical procedural building models compiled in Terrain Tools. CityEngine is used for creating huge procedural cities using CGA code and building footprint data. The buildings can be compiled directly into the terrain from a rule package containing compiled CGA rule files. MVRsimulation provides customers its CGA rule packages for specific terrain to use in Terrain Tools.

AFRICA

The Africa terrain dataset includes the high-resolution replica of the port city of Kismayo, Somalia, which is populated with hundreds of geospecific culture models built from ground-level photos taken on the streets of Kismayo. In addition, several hundred other buildings were modeled by matching their footprints visible in the imagery with geotypical models with culturally and architecturally accurate details. Coverage of the entire continent includes several capital cities compiled into the terrain with a high-resolution orthoimagery mosaic. The virtual replica of the capital city of Tripoli, Libya, features 12,456 building models generated in CityEngine, and geotypical Middle Eastern buildings from MVRsimulation's robust culture model libraries. The terrain's other cultural features include a road network, vegetation, water towers, and vehicles from MVRsimulation's 3D model libraries. For nighttime viewing, some building models contain emissive light-map textures; a few contain light lobes.

VRSG real-time scene of a neighborhood on virtual Kismayo, Somalia.

ASIA

The Asia terrain dataset contains several high-resolution geospecific replicas:

- Hajin, Syria, includes 112 geospecific buildings, 13,326 CityEngine building models, 25,478 vegetation models, plus streetlights and powerlines.
- Aden, Yemen, includes thousands of CityEngine building models, a road network, a 2D model of the runway at Aden International Airport, bridges connecting mainland Aden to Little Aden, geotypical oil tank models, and geotypical 2D fences and tree models.
- Mischief Reef, Spratly Islands, South China Sea, features high-resolution hand-modeled terrain, shoreline, and bathymetry; geospecific source data was used for visual reference. Culture includes 249 geospecific building models, a geospecific runway model, 20,377 vegetation models, and 2,632 models of shipping containers, turrets, and airport instruments.
- Taiwan, Republic of China, including portions of the Penghu Islands, and Green Island. The terrain is populated with tree models from MVRsimulation's culture model libraries throughout, which are color sampled from the 50cm terrain imagery.
- Okinawa, Mt. Fuji, and Tokyo, Japan. The Okinawa terrain includes a model of Kadena Air Base (RODN), Futenma Air Base (ROTM), and Naha Airport (ROAH). The main island is populated with CityEngine buildings and geotypical models from MVRsimulation's robust culture model libraries. It and the Mt. Fuji terrain are also populated with several thousand geotypical tree models. The high-resolution geospecific terrain inset of Tokyo is comprised of thousands of CityEngine models.
- Al Hamra, Abu Dhabi, and Dubai, United Arab Emirates (UAE). The terrain area of the Abu Dhabi District includes 16,960 CityEngine buildings, road networks, powerline segments, and geotypical trees from MVRsimulation's culture model libraries. The virtual replica of Dubai includes over 6,000 CityEngine buildings.
- Seoul, South Korea, includes 757,989 City Engine building models and 38 bridges. Building models were generated from South Korean government building footprint data, with emissive light-map textures for nighttime lighting. Light points follow the road network.
- Khairabad, Afghanistan, includes over 650 photo-realistic building models in neighborhoods along the Kabul-Gardez highway in southern Kabul province.
- Baghdad, Iraq, includes a modeled neighborhood next to the Green Zone with several city blocks of photo-realistic buildings and other cultural elements.

Coverage of the entire continent includes several capital cities compiled into the terrain with a high-resolution orthoimagery mosaic.

VRSG real-time scene of virtual Taiwan terrain.

AUSTRALIA AND OCEANIA

The Australia terrain includes 0.60 mpp high-resolution natural color insets of several areas of interest: Sydney, Perth, Canberra, Melbourne, and Brisbane.

The Oceania terrain includes 0.60 mpp high-resolution natural color insets of Pohnpei and Weno Islands, Federated States of Micronesia; Auckland and Christchurch, New Zealand; Rota Island and Tinian & Saipan Islands of the Northern Mariana Islands. The terrain also includes a 0.30 mpp inset of Guam.

EUROPE

The Europe terrain dataset includes several high-resolution geospecific insets with modeled culture AOIs. Most include realistic 3D building models, which were generated with Esri CityEngine. The models were extruded and textured from OSM data, exported from CityEngine in FBX format, and then converted to MVRsimulation's model format. Most are also populated with trees and other vegetation that were color-blended into the underlying terrain imagery.

- Terrain of Spain, built from 0.50 mpp resolution source imagery covering the entire country and bathymetry data of the northern/western Spain coastline, includes high-resolution 3D modeled insets of Lugo province, Leon province, geospecific replica of Los Llanos Albacete Air Base (LEAB), and the town of La Union, in Murcia province.

- Replica of Monte Real Air Base, Leira, Portugal, with a runway, taxiways, tarmacs, runway lights, signage, antennas, instruments, vegetation and several geospecific models, such as the control tower and other buildings along the flight line. Surrounding culture was generated with CityEngine. Light points follow the road network; building models contain emissive light-map textures for nighttime lighting.

- Terrain of Ukraine, built from 0.50 to 15.0 mpp resolution source imagery and SRTM1 elevation source data, includes a high-resolution 3D modeled inset of the city of Luhansk in eastern Ukraine. This AOI, built from 0.30 mpp imagery, features 57,842 CityEngine buildings, trenches, road networks, 1,687 streetlights with light lobes and powerlines, and thousands of tree and grass models.

- Terrain of Latvia, built from 0.25 mpp resolution source imagery and 10m elevation source data covering the entire country and bathymetry data of the western coastline, includes five high-resolution modeled insets of: Riga, Keguma, Segulda, Senite, and Zilupe. All AOIs are populated with CityEngine building models; each also contains roads and powerlines. Keguma includes a model of the Kegums hydroelectric power plant geo-located on the Daugava River.

- Replica of Kaliningrad, Russia, with over 17,000 realistic 3D building models, which were generated with CityEngine.

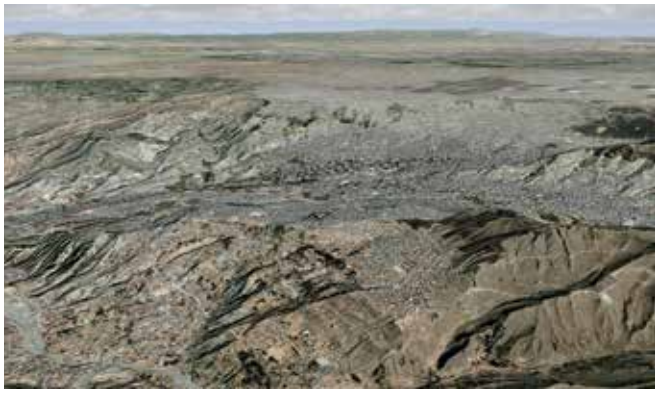
VRSG real-time scene of virtual Luhansk, Ukraine, with a trench compiled into the terrain.

NORTH AMERICA (Excluding CONUS++)

The North America terrain dataset (excluding CONUS++) is comprised of Canada, Greenland, Mexico, the Caribbean, and Central America, and includes 0.60 mpp high-resolution natural color insets of many capital cities and other cities of interest.

SOUTH AMERICA

The South America terrain dataset includes 0.60 mpp high-resolution natural color insets of many South American capital cities and other cities of interest.



VRSG real-time scene of virtual La Paz, Bolivia.

DELIVERY

MVRsimulation's 3D terrain datasets in round-earth VRSG format are available for purchase to customers who are on active VRSG software maintenance and are US Government or NATO agencies or contractors (for official use only). The terrain datasets are provided in MVRsimulation's round-earth terrain format and will only run with a valid VRSG version 7 software license with active software maintenance.

MVRsimulation's 3D terrain is distributed on portable, external drives by region. A full set of terrain is distributed on a direct attached large volume (DALV) device. Customers on active software maintenance can obtain cultural terrain updates from MVRsimulation's Download Server.

(A nominal fee covers the processing of large quantities of data in the VRSG terrain format and the hard drive distribution media.)

As additional source data becomes available, MVRsimulation will continue to build higher-resolution terrain tiles of its 3D terrain datasets of the world.

For more information, visit www.mvrsimulation.com or contact sales@mvrsimulation.com.