# 3D Terrain Databases

*VRSG real-time scene of an MQ-9 Reaper entity loitering over 3D terrain of the Grand Canyon built with National Agriculture Imagery Program (NAIP) imagery.*

MVRsimulation's virtual terrain of:

- Continental USA plus Alaska and Hawaii
- Africa, Asia and the Middle East, Australia and Oceania, Europe, North America, and South America



MVRsimulation

# Overview


*VRSG real-time scene of Hajin, Syria, featuring destroyed culture, a convoy, and an explosion.*

MVRsimulation has built 3D terrain covering most regions of the world in its round-earth geocentric VRSG terrain format for rendering in Virtual Reality Scene Generator (VRSG®). These 3D terrain datasets were built with MVRsimulation's Terrain Tools, with culture placement completed with MVRsimulation's Scenario Editor.

*All images in this document are screenshots of VRSG real-time scenes of MVRsimulation's available 3D terrain.*

**Regions**

- Continental USA with AK and HI (CONUS++) with 29 geospecific modeled airfields and several urban training sites. Continental USA terrain was recompiled and released in 2023 with National Agriculture Imagery Program (NAIP) imagery.
- Africa, with a geospecific virtual replica of Kismayo, Somalia, and Tripoli, Libya.
- Asia and the Middle East, with geospecific virtual replicas of Khairabad, Afghanistan; Baghdad; Hajin, Syria; Aden, Yemen; Okinawa, Mount Fuji, and Tokyo, Japan; and Mischief Reef, Spratly Islands.
- Australia and Oceania
- Europe, with 0.25 mpp natural color inset of Latvia with five replica areas of interest (AOIs) Keguma, Riga, Segulda, Senite, and Zilupe; 0.50 mpp natural color insets of Portugal and Spain, geospecific replicas of the Monte Real Air Base (LPMR), Leiria, Portugal; Albacete Airport, Leon, and Lugo, Spain; 0.50 to 15.0 mpp resolution source imagery of Ukraine with cultural inset of Luhansk in eastern Ukraine built from 0.30 mpp imagery; and a virtual replica of Kaliningrad, Russia.
- North America (excluding CONUS++)
- South America

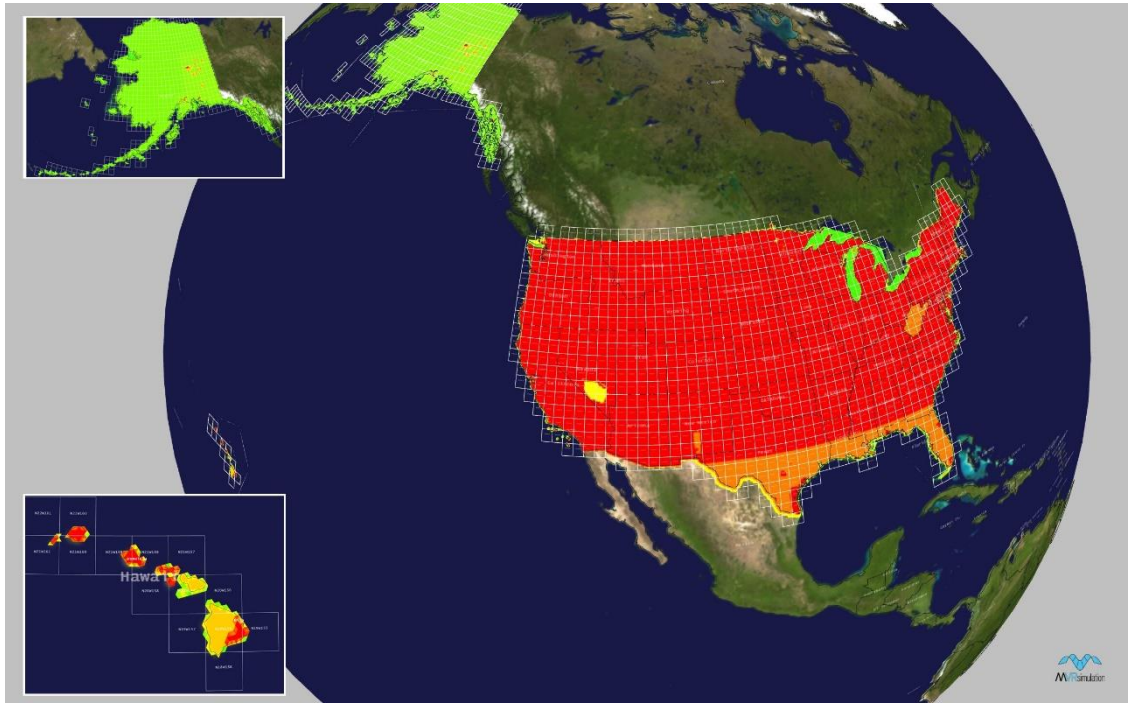
All terrain datasets contain high-resolution insets of many areas of interest (AOI). You can add culture assets from MVRsimulation's extensive model libraries, your own models, or models extruded and textured with Esri CityEngine® using MVRsimulation's VRSG Scenario Editor.

**Availability**

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

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

# MVRsimulation CONUS ++ Terrain Coverage



*Coverage map of CONUS++ 3D VRSG terrain in MVRsimulation's Model Viewer.*

**CONUS 3D VRSG Dataset size:** 1,900 geocells (19,000,000 sq km)
**Terrain post spacing:** 10 meters-per-post
**Elevation source**: NED 10 m
**Terrain imagery:** 1 meter-per-pixel (mpp) National Agriculture Imagery Program (NAIP) imagery, with high-resolution inset imagery ranging from 0.24 to 0.50 mpp for several urban areas and most US military installations. Includes sub-inch imagery collected by MVRsimulation's SUAS.

### Alaska 3D Terrain

**Dataset size:** 430 geocells (1,717,854 sq km)
**Terrain post spacing:** 50 meters-per-post
**Elevation source:** DTED0, DTED1, DTED2, SRTM, and GTOPO30
**Terrain imagery:** 15 mpp NaturalVue Landsat, 5 mpp Fairbanks and Anchorage, 1 mpp imagery Fairbanks and Wainwright, 60 cm imagery Anchorage, Eielson AFB, Allen Army Airfield.

### Hawaii 3D Terrain

**Dataset size:** 14 geocells (28,311 sq km)
**Elevation:** NED 10m
**Terrain post spacing** : 10 meters-per-post
**Terrain imagery**: 0.25 mpp, 0.30 mpp and 2 mpp of Island of Hawaii, 0.30 mpp of Maui, Kahoolawe, Lanai, Molokai, Kauai, and Niihau, 0.50 mpp of Oahu Hickman AFB.

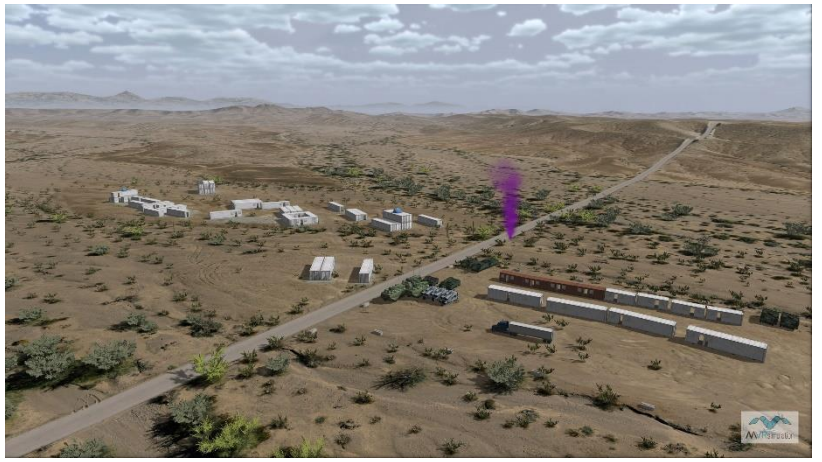

*VRSG real-time scene of an F-16 entity in flight over a rugged section of virtual terrain of the Tonto National Forest, AZ, built with NAIP imagery.*

# CONUS ++ 3D Terrain – Virtual Replicas of Training Sites

*VRSG real-time scenes of geospecific 3D terrain of CONUS++ training sites.*

*Aberdeen Test Center, Mulberry Point, MD*

*Ft. Benning McKenna MOUT Site*



*SOTACC Village MOUT Site, Yuma Proving Ground, AZ*

*National Training Center (NTC): Ft. Irwin, Tiefort City, Bicycle Lake, CA*

*Ft. Wainwright Martinez Collective Training Facility (CACTF), Fairbanks, AK*

*White Sands Missile Range (WSMR), NM*

# Leschi Town MOUT Site at Joint Base Lewis-McChord (JBLM), Washington

**Imagery coverage:** 3.3 geocell (147 km x 224 km) database built from 1 mpp NAIP imagery covering greater Seattle/Tacoma Area.

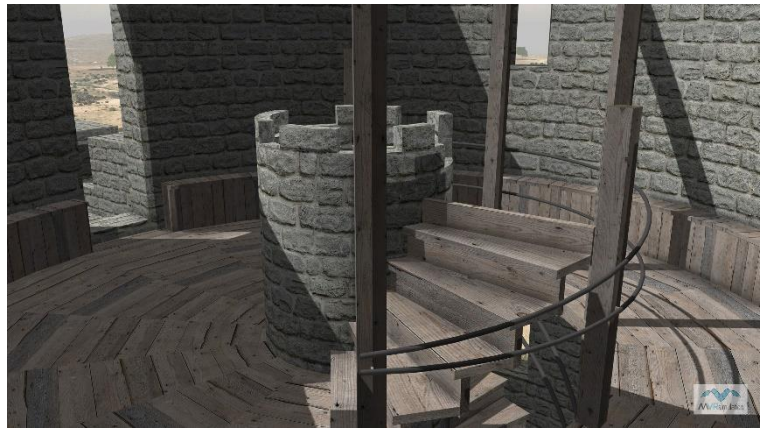
**Elevation coverage:** 100 meters per post elevation data. A 3D model of the terrain was stitched into the MOUT site using information derived from site photographs provided to MVRsimulation.

**Cultural features:** Fourteen photorealistic MOUT building models with interiors, multiple levels, and articulated doors. The terrain also contains bridges, signs, sewer pipes, power transformers, streetlights, curbs, barriers, tombstones, metal gates, concrete and wire fences, ventilation shafts, drain spouts, picnic tables, flag poles, manhole covers, electric utility panels, a culvert, a parking lot, a storage tank, and geotypical volumetric trees of varying types.

# Marine Corps Base Camp Pendleton MOUT Sites
# Combat Town 25 and Kilo 2





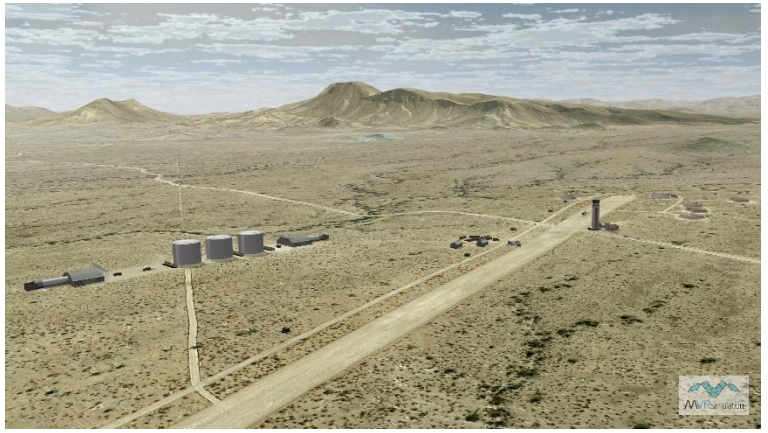
**Imagery coverage:** 30 cm per-pixel resolution USGS satellite imagery.
**Elevation coverage:** 60 cm LIDAR elevation data blended to 10-meter NED.
Also features a geometric water shoreline.

**Cultural features:** Substantial 3D content created from publicly available photos and videos. Geospecific buildings are comprised of mobile containers and concrete buildings with interiors. Other culture includes fences, stones, dumpsters, grass, vegetation, powerlines, street signs, climbing structures, bleachers, trees, graveyard, mosque, observation tower, gas station, market area, and a castle.

# CONUS ++ 3D Terrain – Virtual Replicas of Ranges

*VRSG real-time scenes of geospecific 3D terrain of CONUS training ranges.*

*Fallon Range Training Complex, NV*



*Goldwater Range, AZ*

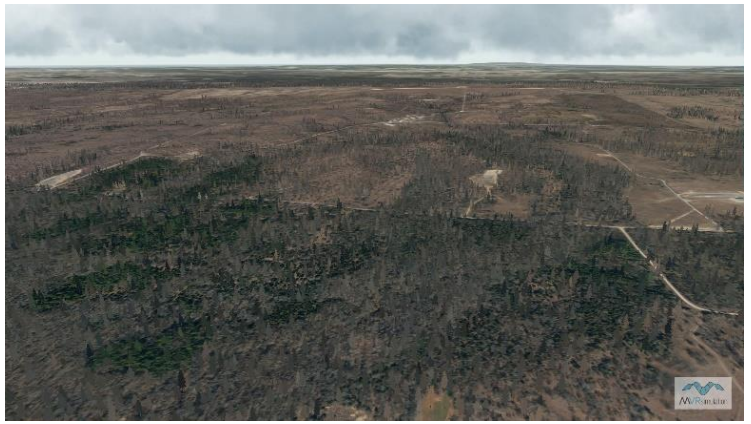
*Yuma Proving Ground, AZ*

# Fallon Range Training Complex (FRTC), Nevada


**Imagery coverage:** 2 cm per pixel imagery of the B-17 and B-19 ranges; imagery collected by MVRsimulation's small data collection UAV.

**Elevation coverage:** NED 10 meter elevation data.

# Razorback Range at Fort Chaffee Joint Maneuver Training Center (FCJMTC), AR



**Imagery coverage:** 30 cm per-pixel resolution imagery.
**Elevation coverage:** 10 meter NED elevation data.
**Cultural features:** Dense forests with a total of 842,643 trees.

# Yuma Proving Ground, Arizona

**Prospect Square area of Yuma Proving Ground**
**Imagery coverage:** 2 cm per-pixel resolution imagery; imagery collected by MVRsimulation's small data collection UAV.
**Elevation coverage:** 2 to 10 meter elevation data.
**Cultural features:** SOTACC Village MOUT site, helipads, connex containers, desert vegetation, roads, vehicles.

**Laguna Army Airfield at Yuma Proving Ground**
**Imagery coverage**: .30 mpp
**Elevation coverage**: Interpolated NED 1/3 (10m)
**Cultural features**: Runway, runway lights, two geotypical hangars

*Details such as craters left from the impact of various munition types are evident in both the 2 cm resolution imagery and elevation data.*

# CONUS ++ 3D Terrain – Virtual Replicas of Airports

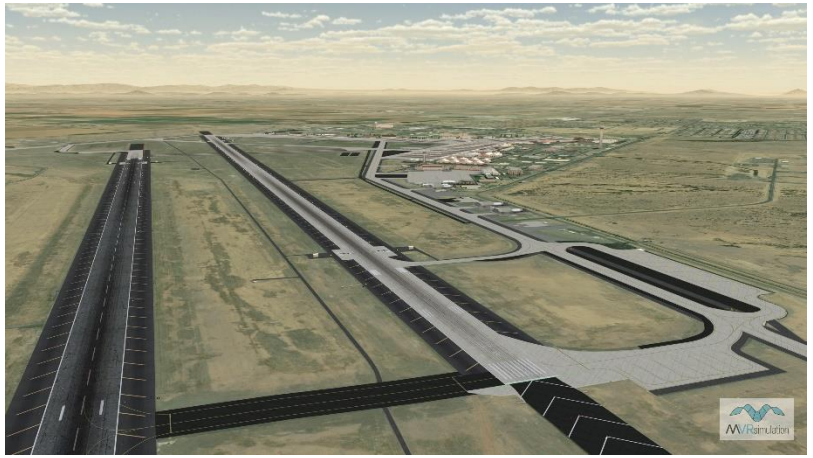
*VRSG real-time scenes of a selection of 29 CONUS geospecific airfields and airports.*

*Amarillo International Airport, Amarillo, TX*

*Baltimore Washington International Airport*

*Fort Worth Naval Air Station/Carswell Field, TX*

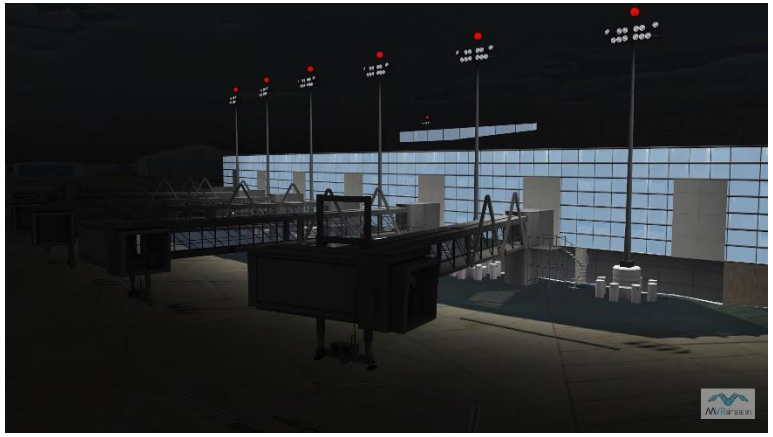
*Lackland Air Force Base, Albuquerque, NM*



*Luke Air Force Base, NV*

*Tucson International Airport, AZ*

# Amarillo International Airport (KAMA) and Amarillo, Texas

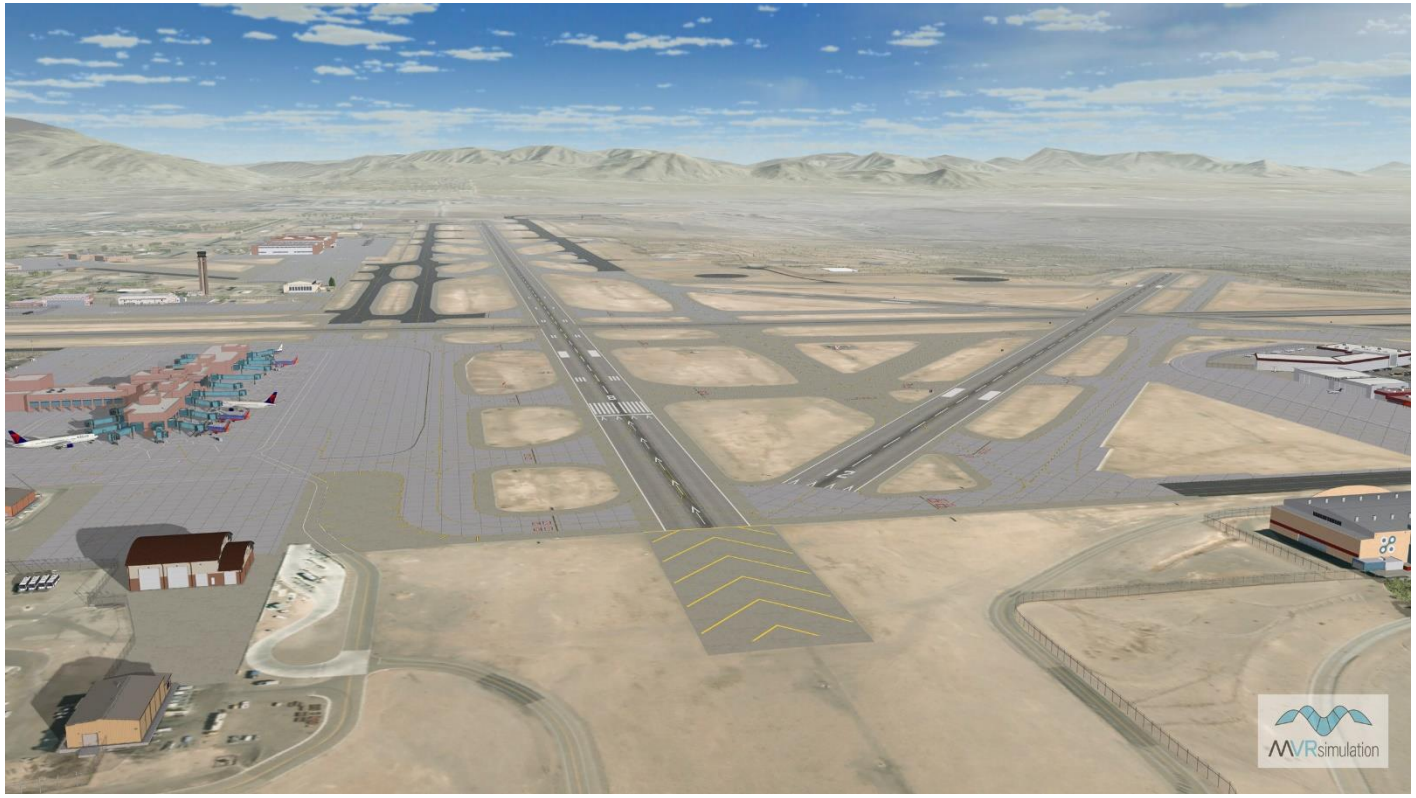
**Imagery coverage:** 5 mm per-pixel and 2 cm imagery of the airport (14 sq km) collected by MVRsimulation's small data collection UAV, 30 cm Maxar imagery of the airport, and 30 cm Texas Open Data (TRNIS) imagery of the Amarillo metro area blended to 1m NAIP base imagery.

**Elevation coverage:** Overall elevation was built with interpolated NED 1/3 (10 m) and underlying CONUS++ DTED1.

**Cultural features:** 85 airport buildings and other structures, 113 airport signs, and 18 runway lights. Many were structures built with textures derived from 5 mm and 2 cm imagery. Other 3D cultural elements include:

- 69,708 Esri® CityEngine® building models with emissive light textures, populating Amarillo.
- CityEngine roads of Amarillo: major roads and residential streets.
- 229,906 tree points (including height data) within Amarillo, derived from Lidar data.
- 2D extruded fences with a wire fence texture surrounding the airport, and geolocated pole placement of powerlines models near the airport.

# Kirtland AFB and Albuquerque International Sunport (KABQ), NM






**Imagery coverage:** 15 cm per pixel of the Kirtland Air Force Base / Albuquerque International Sunport area blended into 1 mpp NAIP imagery surrounding the area.

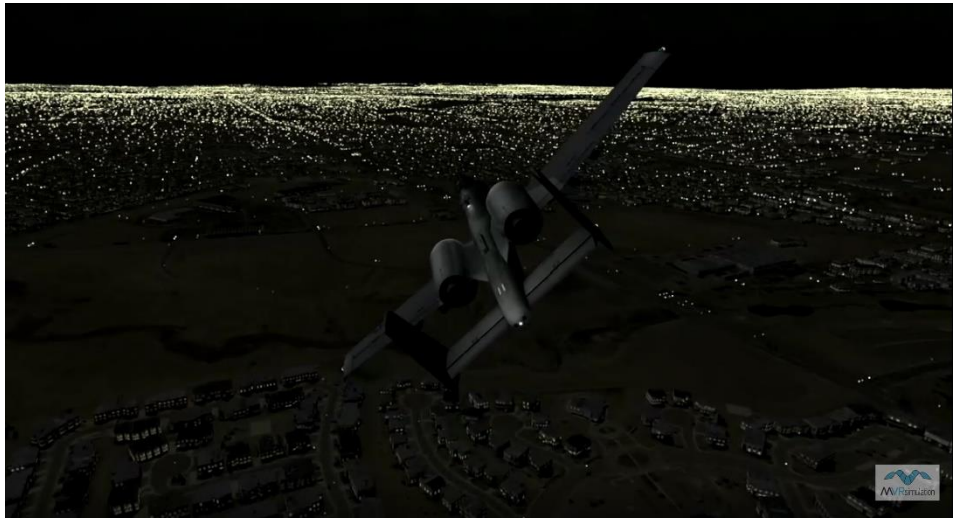
**Elevation coverage:** Interpolated NED 1/9 (3m), Interpolated NED 1/3 (10m) – Helipad.

**Cultural features:** Runway model, buildings, control tower, bridge, runway lights, hangers, storage containers, water tanks / towers, light poles.

# Lackland Air Force Base / Kelly Field (KSKF), Texas


**Imagery coverage**: 15 cm per pixel San Antonio area and 1 meter NAIP imagery surrounding the area.
**Elevation coverage**: 10 mpp NED and DTED 1
**Cultural features**: Runway, runway lights, hangars, geotypical buildings/hangars, light poles, trees, storage tanks. Surrounding the modeled Lackland AFB is terrain of Greater San Antonio, comprised of 182,166 buildings that were generated with Esri CityEngine®. The models were extruded and textured from OpenStreetMap (OSM) data, exported from CityEngine in FBX format, and then converted to MVRsimulation's model format.

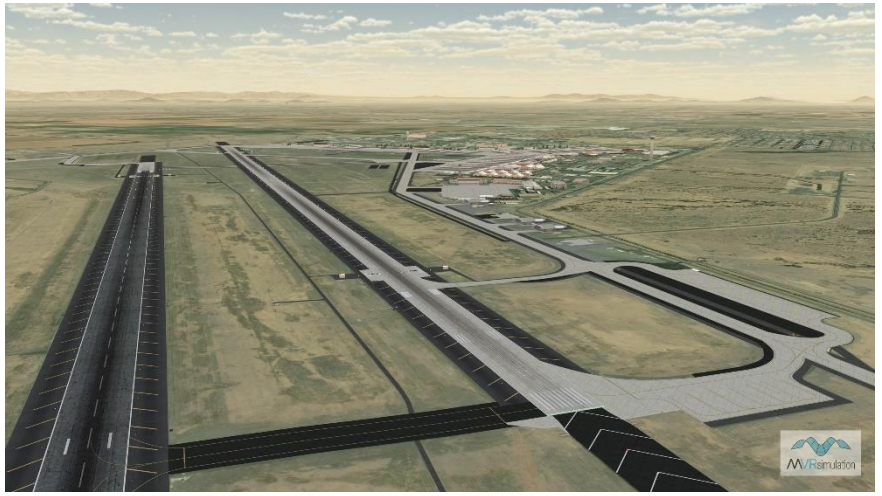
# Buckley Air Force Base (KBKF) and Denver, Colorado



**Imagery coverage:** 15 cm per pixel imagery of the airfield area and blended into 1 mpp underlying NAIP imagery.
**Elevation coverage:** Overall elevation was built with interpolated NED 1/3 (10 m) and underlying CONUS++ DTED1.

**Cultural features:** Runways, runway lights and signage, a geospecific control tower and 24 other geospecific buildings, fuel storage tanks, water towers, radars, geotypical volumetric trees, and light points. Surrounding Buckley AFB is terrain of Greater Denver, comprised of 439,379 buildings which were generated with Esri CityEngine®. The terrain of the area, including the nearby Rocky Mountains, has over 4.5 million trees. For simulating night scenes, the terrain contains thousands of cultural light points of Buckley AFB, Aurora, and Denver.

# Luke Air Force Base (KLUF ), Arizona



**Imagery coverage:** 1 mpp resolution NAIP imagery of Arizona, 0.24-0.50 mpp of the Luke airfield and Barry M. Goldwater Range (BMGR), 0.30 mpp of Luke AFB facilities, and Phoenix metro area.

**Elevation coverage:** 1 arc second (30 meters per post) National Elevation Data (NED). Custom elevation model of Luke airfield that matches with at least 95% accuracy official airfield elevations.

**Cultural features:** Geolocated models of hangars, offices, storage facilities, and other structures: 104 at Luke AFB and 107 at the East Tactical Range (ETAC) at the BMGR (97 unique geospecific models built from photos taken onsite), a unique high-resolution F-16C aircraft model; runway models at Luke AFB and the main ETAC airfield; 673 static vehicle and sign models; 831,581 cultural lights of the greater Phoenix area as well as runway lights and runway signage at Luke AFB; and 103 geotypical volumetric trees.

# Nellis Air Force Base (KLSV) - Nevada

**Imagery coverage:** 0.30 meters per pixel (mpp) commercial imagery of the Nellis airfield blended into 1 mpp NAIP overall imagery.

**Elevation coverage:** Custom DEM overlaid on the source DEM to provide greater than 95% accuracy for runway elevations compared to FAA charts.

**Cultural features:** 163 high-resolution, geolocated models of hangars, offices, storage facilities, and other buildings at the airfield, (48 unique geospecific models built from photos taken onsite), a high-resolution F-16C aircraft model, and the runway; a neighborhood of 644 residential houses (2 unique models); cultural lights (336,264 total light points), and runway signage; 363 geotypical volumetric trees.

# Muir AAF (KMUI) – Fort Indiantown Gap, Pennsylvania



**Imagery coverage:**
0.30 mpp imagery of the Muir AAF area, coupled with overall 1 mpp NAIP imagery.
**Elevation coverage:**
3 meters per post elevation data and DTED-1 surrounding the area.
**Cultural features:**
Contains a detailed geospecific model of the control tower, includes geotypical models of hangars, storage facilities, and other buildings at the airfield, model of the runway; 3 helipads, runway lighting, cultural lights and geotypical volumetric trees.

# Homestead Air Reserve Base (KHST), Florida

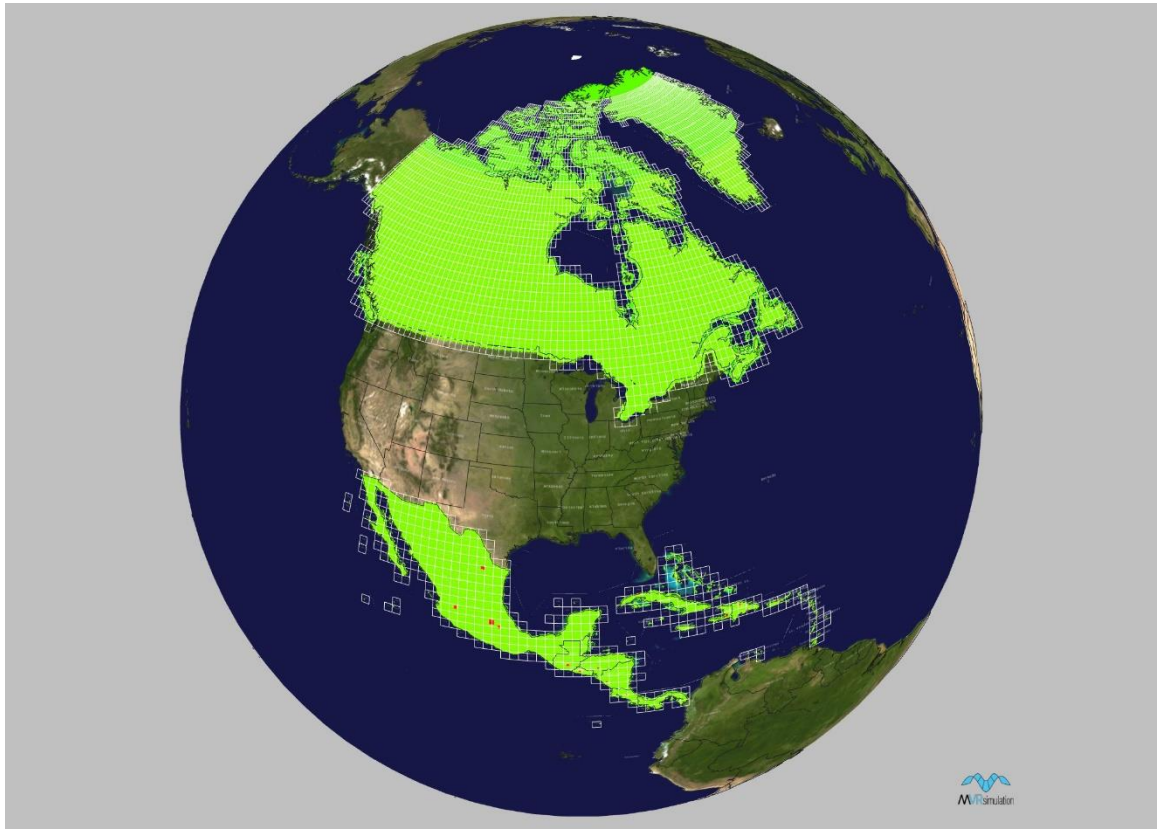
**Imagery coverage**:  30 cm per pixel Homestead area and 1 meter NAIP imagery surrounding the area.
**Elevation coverage**: 30 mpp elevation posting.
**Cultural features**: Runway, runway lights, hangars, control tower.

# Ft. Worth Naval Air Station/ Carswell Field (KNFW), Texas


**Imagery coverage:** 30 cm per pixel of Dallas/Fort Worth and 1mpp NAIP imagery surrounding the area.
**Elevation coverage:** DTED 1 + custom elevation to align with FAA charts.
**Cultural features:** Runway model, buildings, control tower, bridge, runway lights, hangers, storage containers, water tanks/towers, light poles.

# MVRsimulation North America 3D Terrain Coverage

**(Excluding CONUS)**



*Coverage map of North 3D VRSG terrain America (excluding CONUS) in MVRsimulation's Model Viewer.*

**Elevation source:** 3-arcseconds (90 meter)
**Terrain imagery:** 60 cm high-resolution natural color insets of:
- Havana, Cuba
- Santa Domingo and Santiago De Los Caballeros, Dominican Republic
- Port-au-Prince, Haiti
- San Juan, Puerto Rico
- San Jose, Costa Rica
- San Salvador, El Salvador
- Guatemala City, Guatemala
- Tegucigalpa, Honduras
- Aguascalientes, Guadalajara, Mexico City, Monterrey, and Puebla, Mexico
- Managua, Nicaragua
- Underlying 15 meter NaturalVue imagery.

*Real-time VRSG screen capture of San Juan, Puerto Rico, 3D terrain.*

# North America 3D Terrain

*VRSG real-time scenes of high resolution areas of Mexico City, San Salvador, San Juan, Havana, Port au Prince, Guatemala City, on MVRsimulation's virtual North America 3D terrain.*

*Mexico City, Mexico*

*San Salvador, El Salvador*

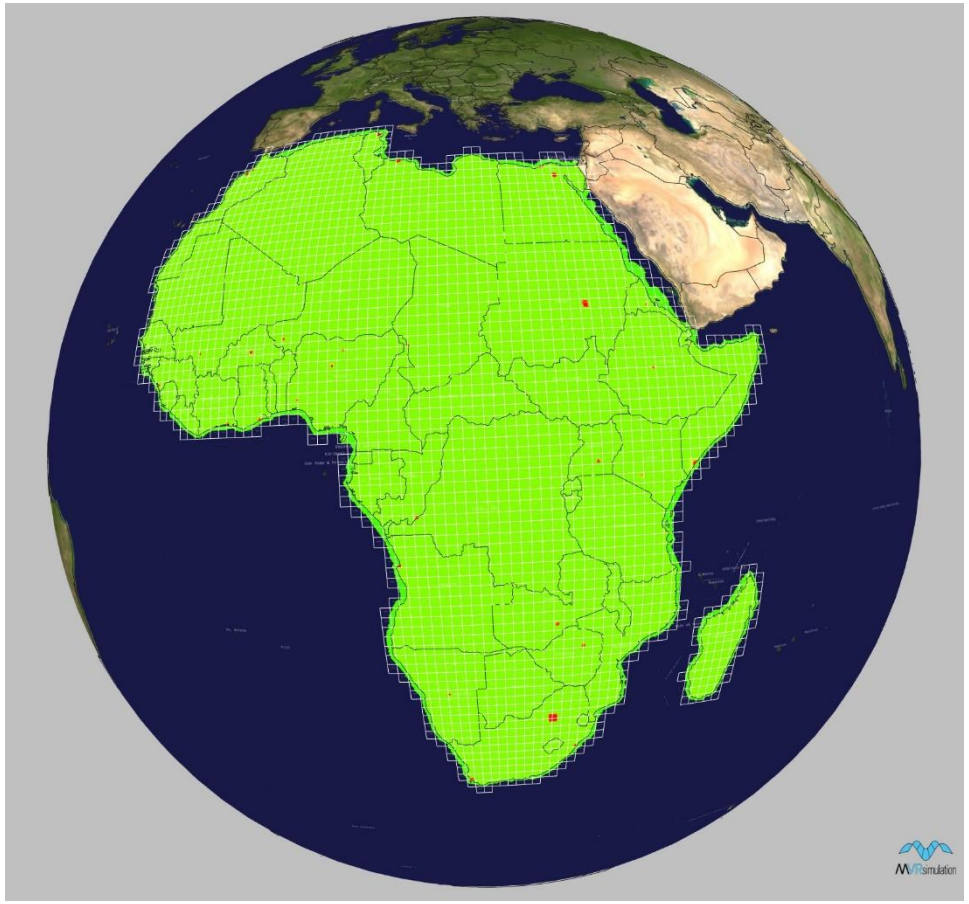
*San Juan, Puerto Rico*

*Havana, Cuba*

*Port au Prince, Haiti*

*Guatemala City, Guatemala*

# MVRsimulation Africa 3D Terrain Coverage



*Coverage map of Africa 3D VRSG round-earth terrain in MVRsimulation's Model Viewer.*

**Database size:** 2,750 geocells
**Terrain post spacing:** 60 meters-per-post (mpp), 30 mpp of Kismayo, Somalia
**Elevation source data:** 3 arcsecond (90 mpp) SRTM, 3 arcsecond DTED1
**Imagery source data:** 60 cm natural color insets of Algiers, Algeria; Luanda, Angola; Ouagadougou, Burkino Faso; Ndjamena, Chad; Abidjan, Cote d'Ivoire; Kinshasa, Democratic Rep. of Congo; Djibouti City, Djibouti; Alexandria, Egypt; Cairo, Egypt; Asmara, Eritrea; Addis Ababa, Ethiopia; Accra, Ghana; Conakry, Guinea; Nairobi, Kenya; Tripoli, Libya; Bamako, Mali; Nouakchott, Mauritania; Casablanca, Morocco; Rabat, Morocco; Windhoek, Namibia; Niamey, Niger; Ibadan, Nigeria; Kano, Nigeria; Kaduna, Nigeria; Dakar, Senegal; Freetown, Sierra Leone; Mogadishu, Somalia; Johannesburg, South Africa; Cape Town, South Africa; Durban, South Africa; Khartoum, Sudan; Dar es Salaam, Tanzania; Tunis, Tunisia; Kampala, Uganda; Lusaka, Zambia; Harare, Zimbabwe; and 0.50 mpp natural color inset of Kismayo, Somalia. 15 meters-per-pixel (mpp) Natural Vue imagery of the African continent.

*Real-time VRSG screen capture of virtual Kismayo, Somalia.*

# Africa 3D Terrain

*Djibouti City, Djibouti*

*Tripoli, Libya*

*Kismayo, Somalia*

*Kismayo, Somalia*

*Cairo, Egypt*

*Capetown, South Africa*

# Kismayo, Somalia

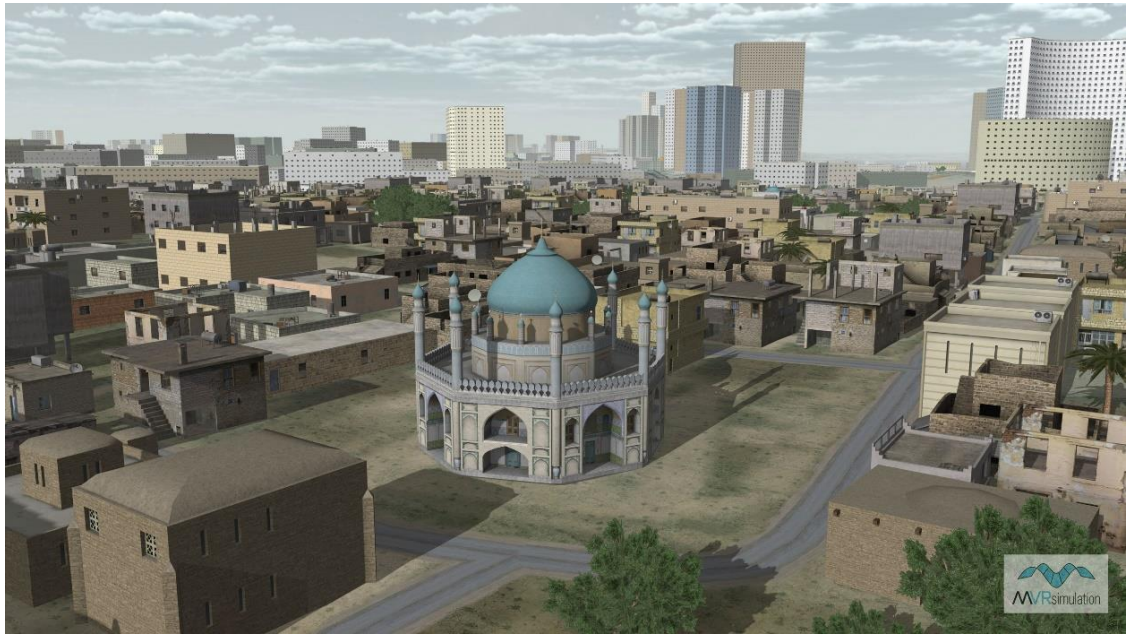
**Imagery coverage:** 50 cm per-pixel Digital Globe (GeoEye-1) satellite imagery covering 1,017 sq km of the southern Somalia port city and are blended into 15 meters-per-pixel (mpp) natural view imagery.

**Elevation coverage:** SRTM void filled elevation source data.

*VRSG real-time scene of a virtual building complex compared with the actual photo of the building on which the model was based.*

**Cultural features:** 2,987 geospecific models of buildings and other structures built for the neighborhoods, commercial district, airport, and the port with textures derived from ground-level photographs taken on the streets of Kismayo. The urban density is augmented with 18,575 building models generated in Esri CityEngine from building footprint data. Building models contain emissive light-map textures, and powerlines and streetlights with light lobes are located along major roads. A total of 21,562 building models plus nearly 90,620 trees sit on the virtual terrain.

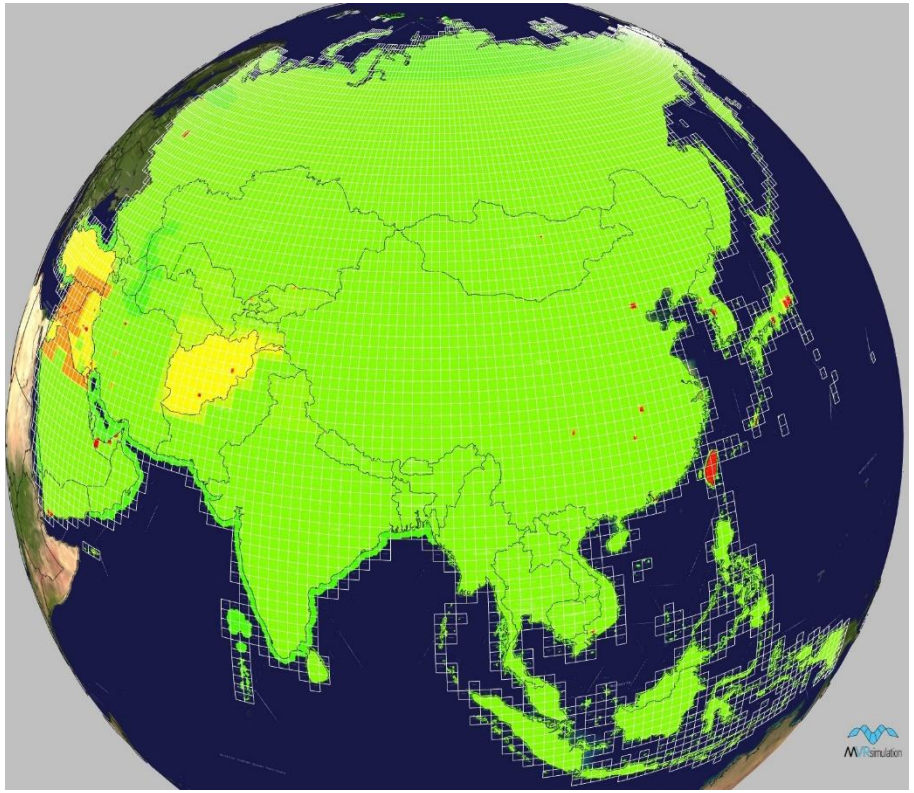
# Tripoli, Libya



**Imagery coverage:** 0.60 meters per-pixel (mpp) resolution imagery compiled into surrounding 15m Landsat imagery.

**Elevation coverage:** 90 mpp SRTM elevation data.
**Cultural features:** 12,456 building models generated in Esri CityEngine, a road network compiled with OSM data; vegetation, water towers, and vehicles from MVRsimulation's robust 3D model libraries. For nighttime viewing, some building models contain emissive light-map textures; a few contain light lobes.

# MVRsimulation Asia 3D Terrain Coverage



*Coverage map of Asia 3D VRSG terrain in MVRsimulation's Model Viewer.*

**Modeled areas of interest**

Hajin, Syria
Mischief Reef, South China Sea
Aden, Yemen
Afghan village in Kabul province, based on the village of Khairabad
Abu Dhabi and Dubai, UAE
Bagdad, Iraq
Okinawa, Mount Fuji, and Tokyo, Japan
Seoul, South Korea
Taiwan (Republic of China)

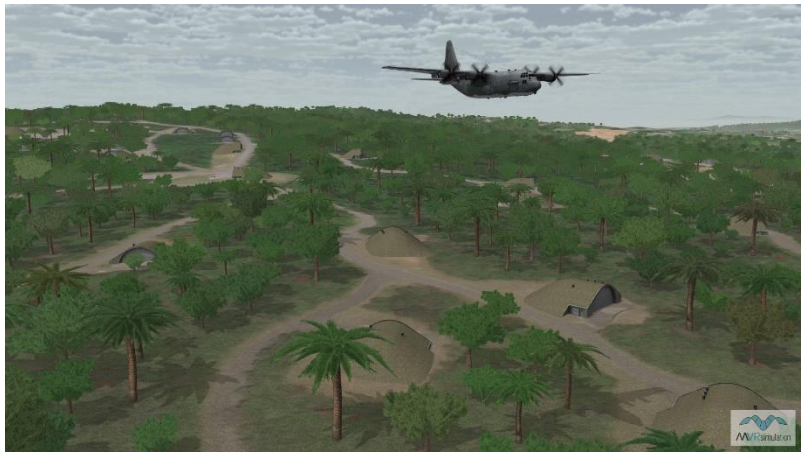
**Database size:** 6,411 geocells.
**Elevation source data:** 3 arcsecond (60 mpp) DTED level 1 & 2 and void-filled SRTM.
**Imagery source data:** 2.5 mpp SPOT satellite imagery of Afghanistan;
1 mpp black-and-white imagery color fused with 15 mpp color imagery of Iraq (approximately 70-geocell area), Kuwait, Yemen, Syria, and portions of Jordan, Lebanon, and Saudi Arabia; and 60 cm natural color insets of:
- Basrah, Kabul province, and Kandahar, Afghanistan
- Yerevan, Armenia
- Baku, Azerbaijan
- Beijing, Changsha, Chongqing, Hong Kong, and Wuhan, China
- Tbilisi, Georgia
- Isfahan, Mashhad, Shiraz, Tabriz, and Tehran, Iran
- Baghdad, and Kirkuk, Iraq
- Osaka and Tokyo, Japan
- Bishkek, Kyrgyzstan
- Ulaanbaatar, Mongolia
- Pyongyang, North Korea
- Seoul, South Korea
- Ashgabat, Turkmenistan
- Ankara and Istanbul, Turkey
- Dubai, UAE
- Tashkent, Uzbekistan
- Ho Chi Minh City, Vietnam

50 cm natural color insets of:
- Abu Dhabi, UAE
- Aden, Yemen
- Hajin, Syria
- Okinawa and Mt. Fuji, Japan
- Taiwan (Republic of China)

*Real-time VRSG screen capture of Aden, Yemen, 3D terrain.*

# MVRsimulation's Asia 3D Terrain

*Hajin, Syria*



*Kadena Air Base, Okinawa, Japan*

*Dubai, UAE*

*Aden, Yemen*

*Mischief Reef, Spratly Islands, South China Sea*

*Taiwan*

# Hajin, Syria

**Imagery coverage:** 50 cm high-resolution imagery licensed from Digital Globe blended to underlying 1-to-2-meter imagery of all of Syria.
**Elevation coverage:** SRTM elevation data compiled with a 30-meter elevation post spacing.
**Cultural features:** 112 geospecific building models, 13,326 CityEngine building models, 25,478 vegetation models, plus power lines and 1,376 streetlights with light lobes. For nighttime viewing, all building models contain emissive light-map textures and 22 of the geospecific buildings have light lobes (some have multiple light lobes).

# Aden, Yemen

**Imagery coverage:** Aden was built with 50 cm over base Yemen terrain, which was built with 15-meter Landsat-8 imagery.
**Elevation coverage:** STRM compiled at 30 meters-per-post.
**Cultural features:** Several thousand geotypical CityEngine building models populated throughout Aden and Little Aden, and several roads were compiled into the terrain throughout the Aden area. Also includes a 2D model of the runway at Aden International Airport, bridges connecting mainland Aden to Little Aden, and geotypical oil tank models are placed throughout the area. Geotypical fences and tree models were also populated throughout the terrain.

# Okinawa, Mt. Fuji, and Tokyo, Japan

**Okinawa imagery coverage:** 30-50 cm covering much of the Okinawa Prefecture including the Main Island of Okinawa, Kerama, Iheya, Izena, Aguni, le, Yoron, and Lotorishima islands.
**Okinawa elevation coverage:** 30m SRTM data.
**Okinawa cultural features:** Includes models of Kadena Air Base (RODN), Futenma Air Base (ROTM), and Naha Airport (ROAH). The main island is also populated with several thousand geo-typical tree models, CityEngine buildings, and geotypical models from MVRsimulation's robust culture model libraries.

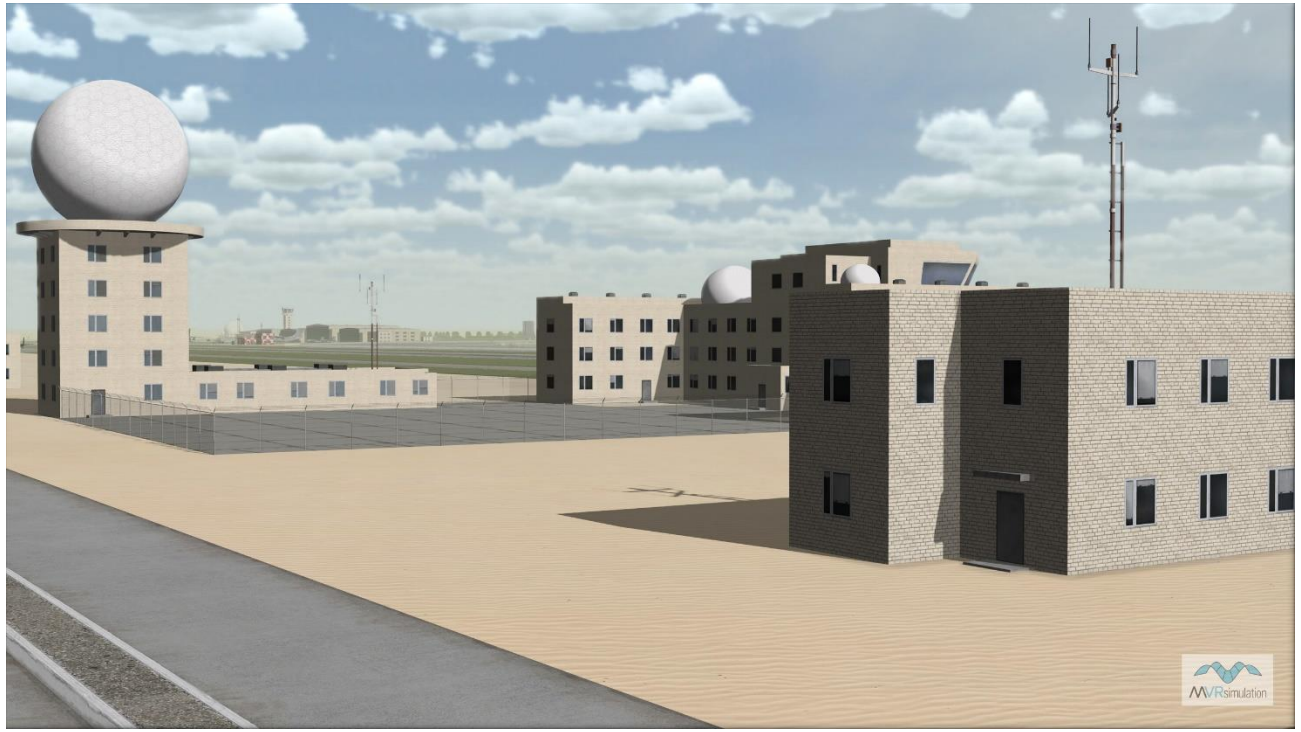
**Mount Fuji imagery coverage:** 50 cm blended seamlessly with underlying 60 cm Japan imagery
**Okinawa elevation coverage:** 30 m SRTM
**Okinawa cultural features:** Several thousand tree models.

**Tokyo imagery coverage:** 60 cm
**Tokyo elevation coverage:** 30 m SRTM
**Tokyo cultural features:** Several thousand geotypical buildings were compiled using OSM building footprints and were procedurally extruded using an RPK in Terrain Tools which was created in ESRI's CityEngine.

# Taiwan

**Imagery coverage:** 50 cm.
**Elevation coverage**: 30 m SRTM.
**Cultural features:** Tree models from MVRsimulation's culture model libraries are populated throughout the terrain and are color sampled from the terrain imagery.

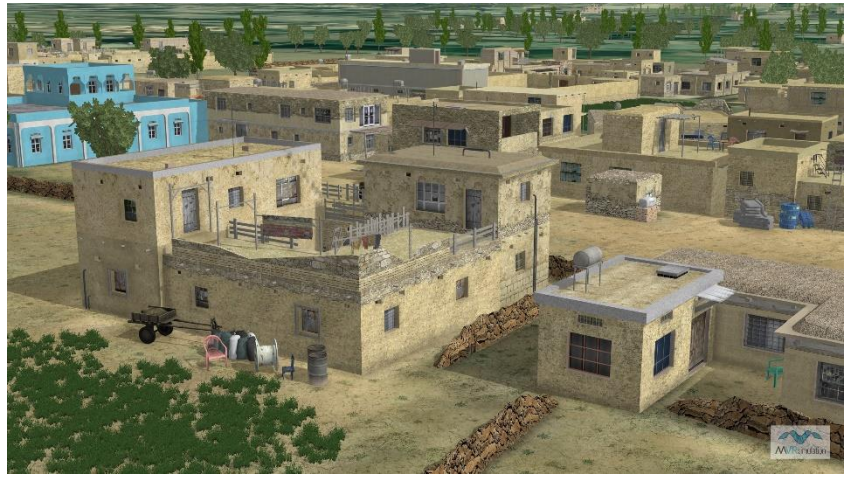
# Mischief Reef, Spratly Islands, South China Sea



High-resolution hand-modeled terrain includes shoreline and bathymetry, ideal for sea-based and littoral training scenarios. Due to the sensitivity and availability of high-resolution overhead imagery of the occupied reefs in the South China Sea, terrain was built without geographically specific imagery.

**Cultural features:** 249 buildings, a runway, 20,377 vegetation elements, 2,632 miscellaneous shipping containers, turrets, airport instruments, fences, and stones.

# Afghanistan Village



**Imagery coverage:** Overall imagery resolution of the virtual terrain of the whole country is 2.5 meters per pixel; includes an area of 1,120 sq. km of 60 cm Digital Globe commercial satellite source imagery and. Within this area is the highly detailed 2 sq. km terrain of a 3D geospecific Afghan village.

**Elevation coverage:** 90 meter elevation posts; the effective terrain elevation resolution is much higher in the village areas as the construction of inferred cultural features from the geospecific imagery such as courtyards, tree line, and crops further define the elevation relief. This terrain is built entirely from commercial, non-export controlled source data.

**Cultural features:** Approximately 520 custom-built 3D structures that match the building footprints visible on the source imagery. Many buildings are multi-level and contain modeled interiors. Open doorways, translucent windows, and stairways, and damage states contribute to making the structures within the virtual village suitable for tactical scenarios. The textures of many cultural features are derived from publicly available. Geospecific agricultural fields are also modeled and can be tailored to represent various crop types over different seasons. The modeled village is based on the village of Khairabad in the southern part of the Kabul province.

# Baghdad, Iraq

**Imagery coverage:** 60 cm per pixel of Baghdad, Iraq, and CIB 1 mpp imagery surrounding the area.
**Elevation coverage:** DTED 2.
**Cultural features:** Photo-realistic buildings (residential, office, and commercial buildings, and mosques) signs, sewer pipes, power lines, streetlights, curbs, concrete and wire fences, culverts, a control tower, water towers and trees of varying types.

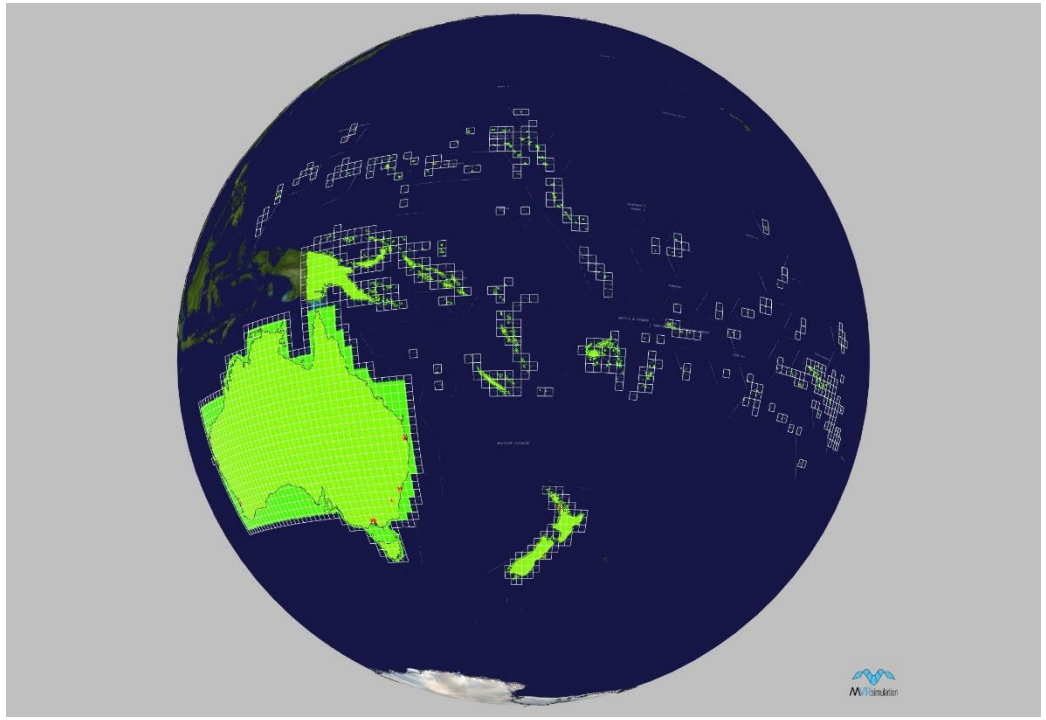
# United Arab Emirates

Two areas of interest (AOI): Abu Dhabi and Dubai.

Abu Dhabi District includes Dalma Island, Sir Baniyas Island, Higher Yasat, Lower Yasat, Al Ruways Industrial City, Al Dhannah City, Al Hamra, Shuweihat Island, and Barakah.
**Imagery coverage:** 50 cm imagery
**Elevation coverage:** 30 mpp SRTM
**Cultural features:** Includes over 9,370 road segments from OSM , 3080 powerline segments from UAE open data, and 377 OSM wall segments. Over 16,960 3D building models, which were created with Esri CityEngine. The models were extruded and textured from Open Street Map (OSM) data. Geotypical trees from VRSG's culture model libraries.

Dubai
**Imagery coverage:** 60 cm per-pixel resolution imagery.
**Elevation coverage:** DTED 1 elevation data.
**Cultural features:** Over 6,000 3D building models, which were created with Esri CityEngine. The models were extruded and textured from Open Street Map (OSM) data.

# MVRsimulation Australia & Oceania 3D Terrain Coverage



*Coverage map of Australia and Oceania 3D VRSG terrain in MVRsimulation's Model Viewer.*

**Database size:** 1412 geocells.
**Imagery source data:** 60 cm natural color insets of: Sydney, Canberra, Brisbane, Perth, and Melbourne, Australia; Pohnpei and Weno Islands, Federated States of Micronesia; Auckland and Christchurch, New Zealand; Rota Island and Tinian & Saipan Islands of the Northern Mariana Islands. Also 0.30 mpp inset of Guam. Underlying 15 meter NaturalVue imagery.
**Elevation source data:** Guam elevation is 3 meters (NED 1/9), Overall 3-arcsecond STRM sub-sampled to achieve a nominal 60 m post spacing.

*Real-time VRSG screen capture of virtual Won Pat International Airport, Guam.*

# MVRsimulation's Australia & Oceania 3D Terrain

*Sydney, Australia*

*Won Pat International Airport, Guam*

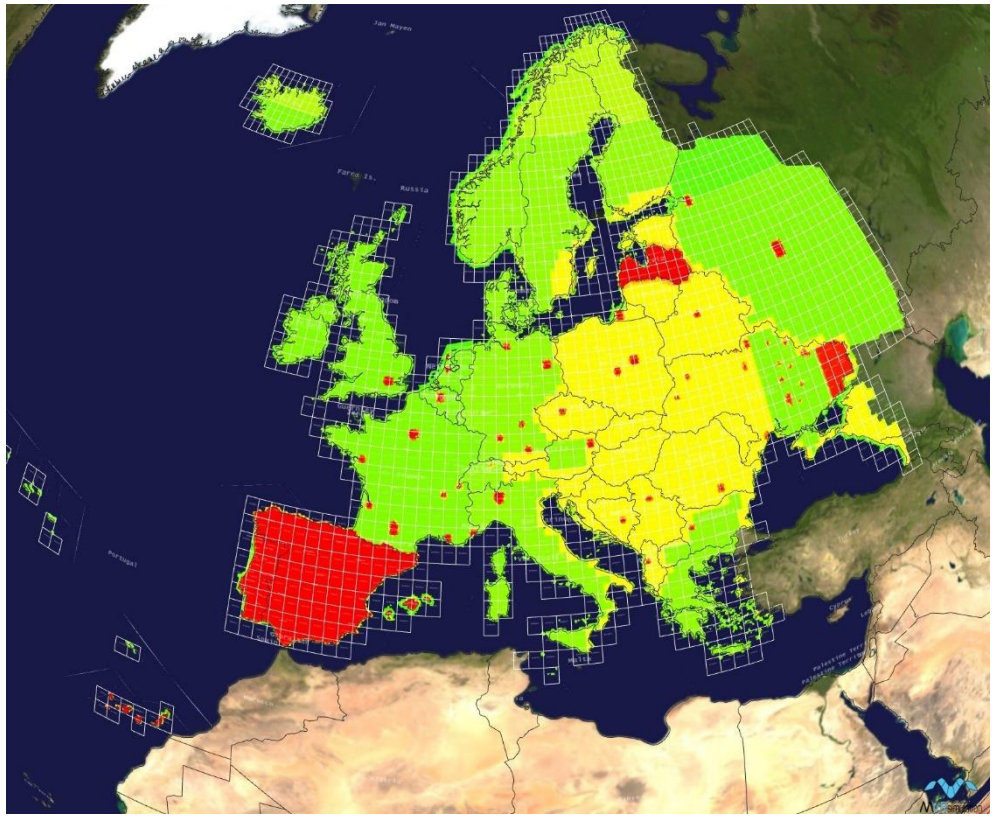
*Guam Naval Air Base*

*Pohnpei International Airport, Micronesia*

*Saipan Island, Northern Mariana Islands*

*Christchurch, New Zealand*

# MVRsimulation Europe 3D Terrain Coverage



*Coverage map of Europe 3D VRSG terrain in MVRsimulation's Model Viewer.*

**Cultural features:** Geospecific replicas of Monte Real Air Base, Portugal, and Los Llanos Albacete Air Base, Spain; Keguma, Riga, Segulda, Senite, and Zilupe, Latvia; Luhansk, Ukraine; and geotypical urban culture of Kaliningrad extruded and textured in Esri CityEngine.

The Europe terrain also contains bathymetric shorelines for supporting VRSG's 3D ocean simulation.

**Database size:** 1509 geocells.
**Elevation source data:** 3-arcsecond DTED level 1 & 2 and void-filled SRTM data.
**Imagery source data:** 0.25 mpp natural color inset of Latvia, 0.30 mpp natural color inset of Luhansk, Ukraine; 0.50 mpp natural color insets of Portugal, Spain and eastern Ukraine. 0.60 mpp natural color insets of Tirana, Albania; Vienna, Austria; Minsk, Belarus; Brussels, Belgium; Sarajevo, Bosnia and Herzegovina; Sofia, Bulgaria; Prague, Czech Republic; Paris, Lille, Nantes, Bordeaux, Lyon, Toulouse, Marseilles, Nice, and Cannes France; Berlin, Hamburg, Munich, Stuttgart, and Nuremberg, Germany; Reykjavik, Iceland, Milan, Italy; Amsterdam, Netherlands; Warsaw and Lodz, Poland; Bucharest, Romania; Kaliningrad), Moscow, and St. Petersburg, Russia; Belgrade, Serbia; Geneva and Zurich, Switzerland; Kiev, Kharkiv, and Odessa, Ukraine; and London, United Kingdom. 2.5 mpp natural color insets of Albania, Austria, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Finland, Germany, Greece, Hungary, Italy, Kosovo, Lithuania, Macedonia, Montenegro, Poland, Russia, Serbia, Slovakia, Sweden, Switzerland, Turkey, and Ukraine. Underlying 15 meter NaturalVue imagery.

*VRSG real-time scene of virtual Pedrafita do Cebreiro, Lugo, Galicia, Spain.*

# Europe 3D Terrain

*Pedrafita do Cebreiro, Lugo, Spain*

*Keguma, Latvia*

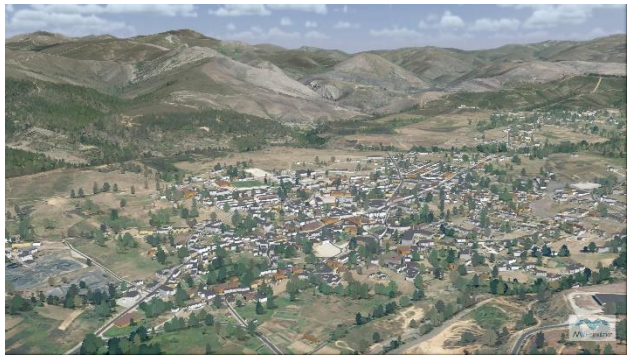
*Monte Real Air Base, Portugal*

*Kaliningrad, Russia*

*Los Llanos Albacete Air Base, Spain*

*Luhansk, Ukraine*

# Spain



**Imagery coverage:** Overall 0.50 meters per pixel (mpp) resolution.
**Elevation coverage:** SRTM1 (30m) source data covering the entire country, including procedural bathymetry of the northern/western Spain.
**Culture insets of:**

- Lugo province, built with 0.25 mpp imagery and 5 meter elevation data. Populated with over 3 million trees. (Over 23 million trees cover Lugo, Asturias, Leon, Orense, Cantabria, and Palencia.) Several roads and highways populated with OSM road data. Five sets of twin tunnels and 55 bridges modeled along highway A6 leading to the town of Pedrafita do Cebreiro, with streetlights and tunnel lights, illuminated with light lobes for tunnel and nighttime scenes. Outskirts of town populated mainly with building models generated with Esri CityEngine with emissive light-map textures.
- Leon province, built with 0.40 mpp imagery and 30 meter elevation. Compiled are 3,385 buildings generated with CityEngine for Fabero, Lilo de Bierzo, Otero de Naraguantes, Fontoria, Sesamo, Vega de Espinareda, La Espino, and Espinareda de Vega. Modeled towns also contain streetlights with light lobes and powerlines. Several roads were populated with OSM road data.
- Los Llanos Albacete Air Base (LEAB), built with 0.40 mpp imagery and 2 meter elevation of the air base. Albacete province populated with over 45,000 trees. Airfield includes 80 geospecific building models and other structures placed along the flight-line, Illuminated airport guidance signs, taxiway markings, and PAPI and runway lights. Geolocated air base models were built from publicly available photos. Surrounding the airbase, building models generated with Esri CityEngine were compiled into the terrain of the city of Albacete; buildings contain emissive light-map textures for nighttime lighting.
- La Union, Murcia, built with 0.25 mpp imagery and 30 meter elevation. Includes 95 building models; 24 geospecific with a destroyable switch, 71 generated in Esri CityEngine. Roads were also created using CityEngine. Populated with streetlight and tree models from MVRsimulation's 3D culture model libraries.

# Latvia


**Imagery coverage:** 0.25 meters per-pixel (mpp) resolution open-source imagery.

**Elevation coverage** Digital terrain model compiled at 10m.
**Cultural features:** Five areas of interest (AOIs) totalling in 38,913 geotypical building models generated in Esri CityEngine, road networks and powerlines: Keguma (3,771 buildings), Riga (22,276 buildings), Segulda (6,402 buildings), Senite (4,562 buildings), and Zilupe (1,902 buildings). Keguma also features a model of the Kegums hydroelectric power station geolocated on the Daugava River. For nighttime viewing, building models contain emissive light-map textures. The entire terrain is populated with tens of thousands of trees, color-blended to match the underlying imagery.

# Luhansk, Ukraine

**Imagery coverage:** 30cm of Luhansk AOI blended to 50cm imagery of eastern Ukraine terrain

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**Elevation coverage:** SRTM 30m blended to an underlying SRTM 90m/DTED1 Ukraine terrain

**Cultural features:** 57,842 CityEngine buildings, 1,687 streetlights with light lobes, powerlines, thousands of tree models, 5,465 road vectors throughout Luhansk AOI, trench models compiled into Luhansk AOI.

Also available is a high-resolution, geotypical urban Ukraine MOUT site situated in the city area of Kharkiv. This detailed geotypical model of five unique city blocks is comprised of over 40 buildings in different configurations conducive to urban combat training.

# Kaliningrad, Russia

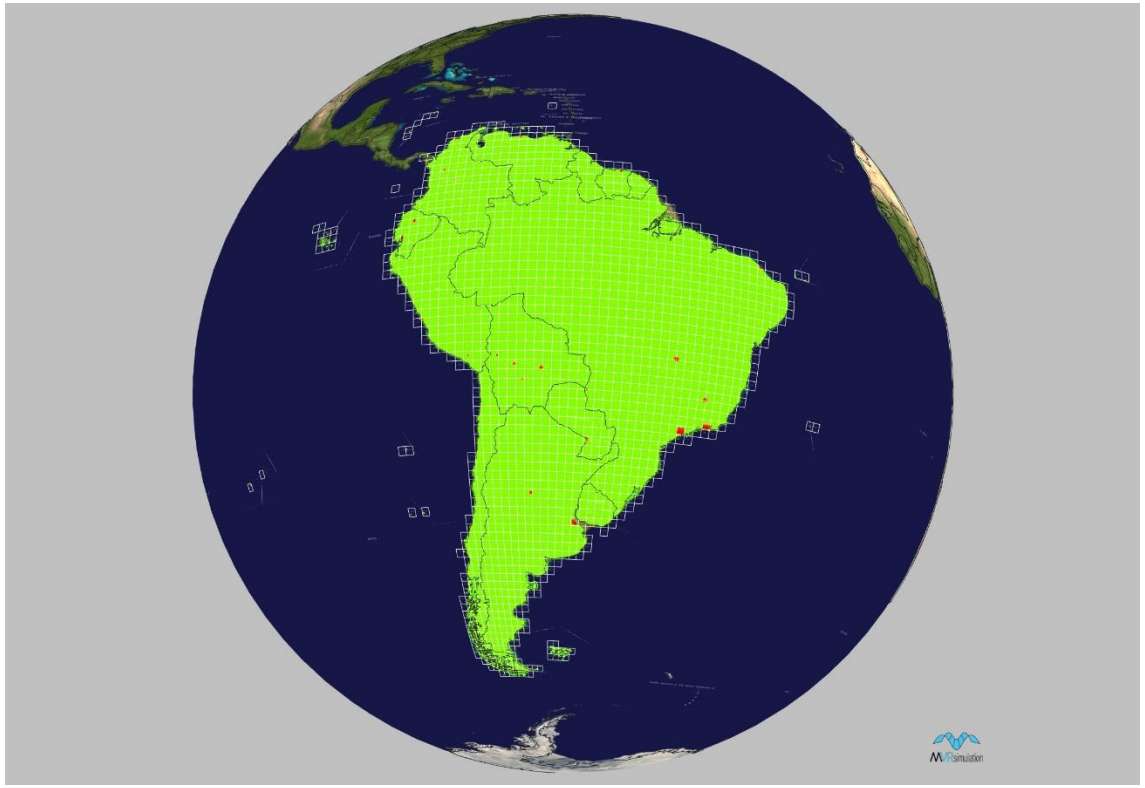
## Kaliningrad – Russia

**Imagery coverage:** 60 cm per-pixel resolution imagery.

**Elevation coverage:** DTED 2 elevation data (30m).

**Cultural features:** Over 17,000 realistic 3D building models, which were created with Esri CityEngine. The models were extruded and textured from Open Street Map (OSM) data.

# MVRsimulation South America 3D Terrain Coverage



*Coverage map of South America 3D VRSG terrain in MVRsimulation's Model Viewer.*

**Dataset size:** 1,718 geocells
**Elevation source**: 3-arcsecond STRM sub-sampled to achieve a nominal 60 m post spacing
**Terrain imagery**: 60 CM natural color insets of:
- Buenos Aires and Cordoba, Argentina
- Cochabamba, La Paz, and Santa Cruz, and Sucre, Bolivia
- Belo Horizonte, Brasilia, Fortaleza, Rio de Janeiro, and Sao Paulo, Brazil
- Barranquilla, Bogota, and Medellin, Columbia
- Guayaquil and Quito, Ecuador
- Cayenne, French Guyana
- Asuncion, Paraguay
- Arequipa and Lima, Peru
- Paramaribo, Suriname
- Montevideo, Uruguay
- Caracas and Maracaibo, Venezuela
- Underlying 15 meter NaturalVue imagery.

*Real-time VRSG screen capture of virtual La Paz, Bolivia.*

# South America 3D Terrain

*Arequipa, Peru*

*Rio de Janeiro, Brazil*

*Quito, Ecuador*

*Medellin, Columbia*

*Montevideo, Uruguay*

*Maracaibo, Venezuela*