IX. Visual and Audio Effects

VR-Forces has many visual effects that add to your understanding of the interactions between simulation objects. These include fire and detonation lines, sensor contact lines, communications lines, and emitter volumes. You can test for line-of-sight with the intervisibility feature. You can also display many different lighting effects.

2. Displaying Tactical Information and Effects

This chapter describes how to manage special visual effects that can be applied to simulation objects.

> ⓘ Many of the effects described in this chapter apply to individual entities in Stealth mode. By default, simulation objects in aggregate-level scenarios do not use 3D models. Therefore, effects such as trailing effects, smoke clouds, and fire and detonation effects are not supported.

2.1. Displaying Trailing and Decal Effects (3D Only)

VR-Forces supports trailing effects such as contrails for missiles and aircraft and dust clouds for vehicles. It also supports decal effects, such as tire tracks, footprints, and wakes. In essence, trailing effects are effects that are dispersed through the air, while decal effects are effects that are printed on the ground.

Trailing effects and decal effects are properties of an observer mode. You can enable and disable them on a per-observer basis.

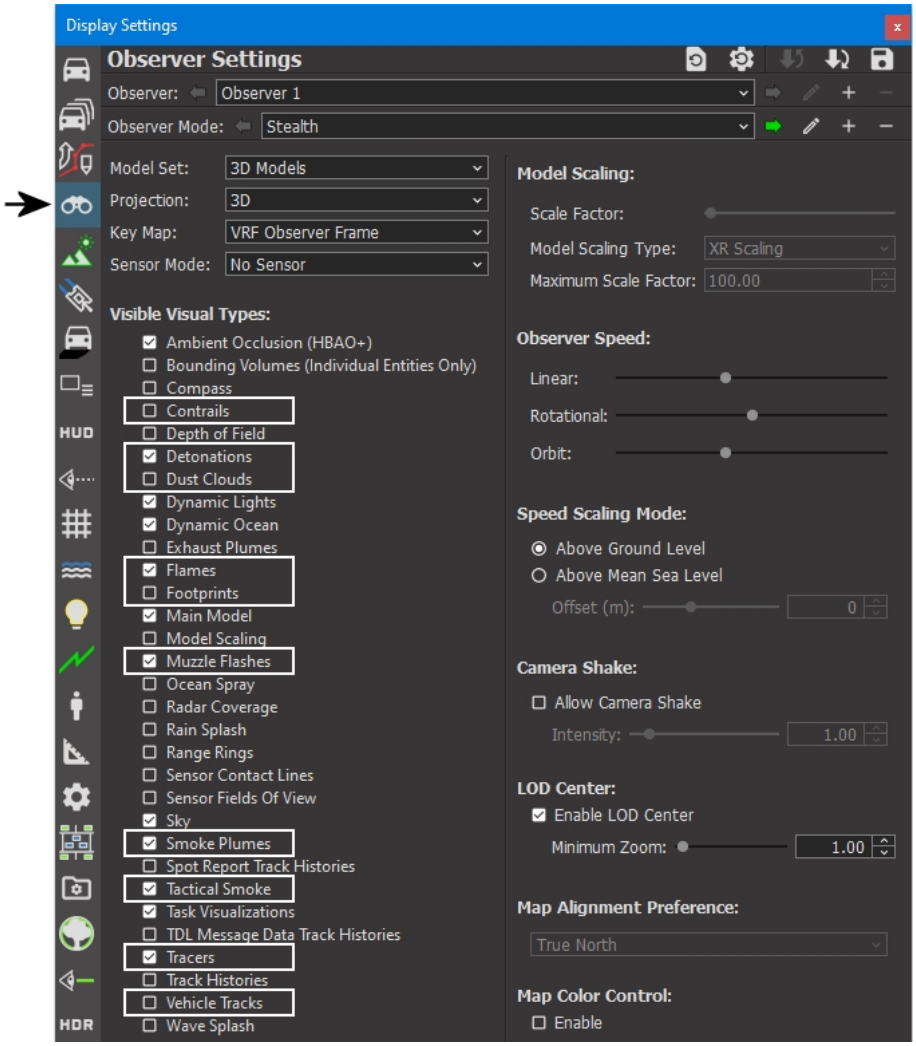
Figure 1 illustrates some trailing effects.

Figure 1. Vehicle tracks, dust cloud

➤ **To enable or disable trailing effects or decal effects:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 2).

Figure 2. Display Settings dialog box, Observer Settings



3. Select or clear the check box for each effect that you want to change.

> ⓘ You can also enable and disable trailing and decal effects by choosing **Observer > *effect***.

2.1.1 Specifying Models for Trailing Effects and Decal Effects

Trailing effects and decal effects are configured through model definitions. (For the purposes of configuration, trailing effects are categorized as decals.) Each effect must have a model definition that uses a decal schema. Then, in an entity's entity definition, you configure a visualizer for the effect. For details about creating model definitions, please see "Creating and Editing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.

2.1.2 Displaying Persistent Tracks

When displaying tracks, the default for decal effects of vehicle's tracks is to fade after about 20 seconds. You can specify that those tracks should persist on the terrain rather than fading out. This is primarily intended for use with aerial surveillance scenarios. Tracks must be enabled for the persistent tracks to display. See "2.1. Displaying Trailing and Decal Effects (3D Only)" on page 5.

For persistent tracks to display on the terrain, you must draw a Persistent Tracks Area and then create tracks in that area. There are two ways to create persistent tracks: set vehicles to move through the area, or draw tracks in that area.

➤ **To permanently display vehicles' tracks in an area:**

1. Open the Create Object Palette.
2. Click the Terrain filter ().
3. Select Persistent Tracks Area.
4. Click to place the vertices of the persistent tracks area. Double-click when you place the final vertex. The area is created.

   While the scenario is running, any ground vehicles that move through the area will leave permanent, persistent decal effects.

➤ **To draw persistent tracks:**

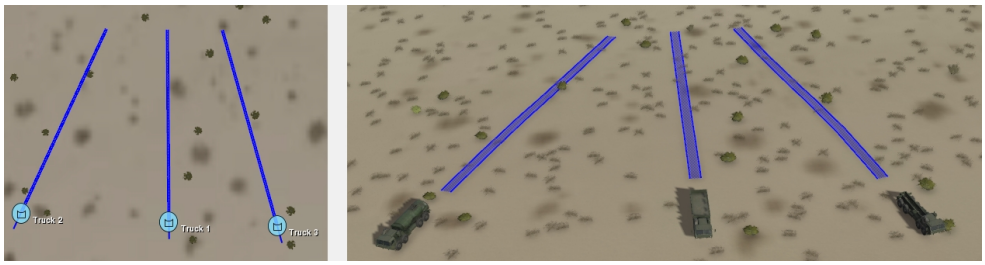
1. Choose **Simulation > Dynamic Terrain > Add Persistent Tracks**. The Add Persistent Tracks dialog box opens.
2. Click the Draw Track button. The Create Route dialog box opens.
3. On the terrain, draw a route where you want the tracks to display. Double-click to place the final point or click Create. You return to the Add Persistent Tracks dialog box.
4. From the Track Type list, choose the type of tracks you want to create:
   - Inline Wheeled. Motorcycles, bicycles, and other vehicles where one wheel is behind the other.
   - Wheeled. Vehicles with two wheels per axle.
   - Dual Wheeled. Vehicles with four wheels on one or more axles.
   - Tracked. Tanks and other vehicles that move using continuous track, caterpillar track, or treads.
5. From the Track Depth list, choose Light, Medium, or Heavy. Light tracks are less visible than Medium tracks, and likewise Medium tracks are less visible than Heavy tracks.
6. Click OK.

2.2. Displaying Track Histories

Track histories allow you to track the paths of simulation objects during an exercise, including the path of munitions as they travel from the shooter to the target. When track histories are enabled, each simulation object leaves a track ribbon. The ribbon's default

color is based on the simulation object's force. Figure 3 illustrates track histories.

Figure 3. Track history - 2D and 3D



Track histories are a property of an observer mode. You can enable and disable them on a per-observer basis.

- Track histories have a significant performance and memory cost. For simulations with large simulation object counts, turning track histories off can improve performance and memory usage.
- If a ground entity is traveling over uneven terrain, the track history may appear broken. If you want to see it as a complete, solid line, you must edit the entity's definition and change the Track History's **allowocclusion** setting to false. You must apply this setting before connecting to the simulation. See the chapter on *Element Definitions* in the *Adding Content to MAK ONE Applications Reference Manual*.
- If you reposition a simulation object, any existing track history is removed and a new one starts to draw.

➤ **To enable or disable display of all track histories:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 2 on page 6).
3. Select the observer mode for which you want to change the Track Histories setting.
4. Select or clear the Track Histories check box.

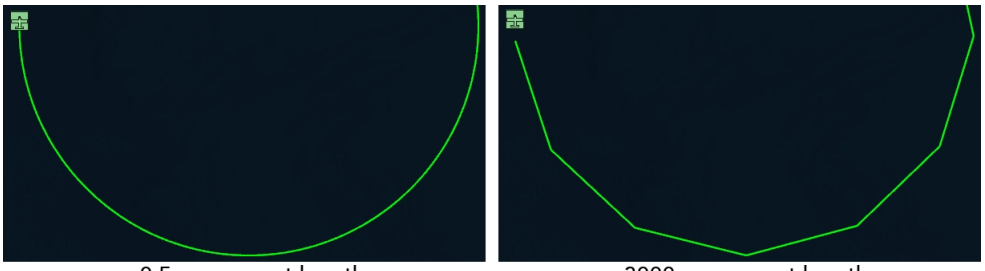
You can also enable or disable track histories by choosing **Observer > Track Histories** or clicking the Track Histories button ( ) on the Observer Settings Toolbar.

2.2.1 Configuring Track History Segments and Timeout

You can configure how long track history ribbons are drawn. A track history is composed of a series of segments joined together to form a line. You can configure how long each segment is and how many segments at a time can be displayed. Drawing shorter segments improves the accuracy of the track history, but can degrade performance. Increasing the maximum number of segments provides a longer history, but can clutter up the screen if there are many simulation objects and can also affect performance. Figure 4 illustrates the

visual result of drastically changing the segment length. The left track history uses the default segment length of 0.5 meters. The right track history has a segment length of 3000 meters.

Figure 4. Track history segment length



When a track history reaches the maximum number of segments configured, it starts dropping segments from the beginning of the history (the oldest segments).

You can specify that track histories have an infinite length. In this case they never drop segments.

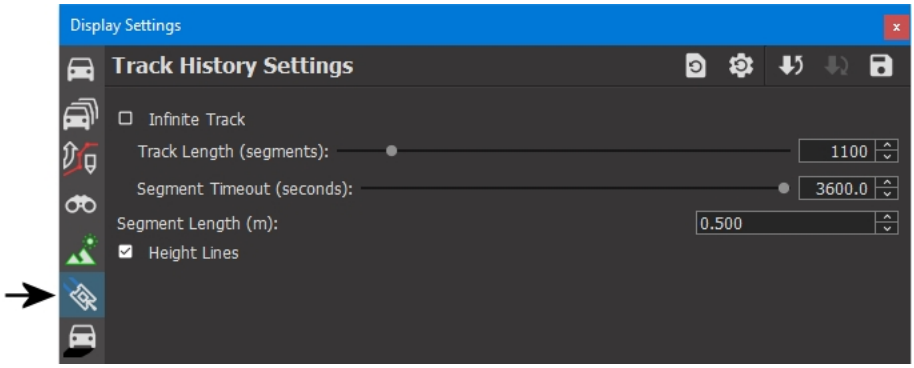
> ⚠ If you specify infinite length for track histories, it is possible that you could eventually use up all the memory in your computer and the program would crash.

You can also specify a timeout value for track histories. The total length of a track history is determined by a combination of the oldest segment creation time, the segment length, and the number of segments.

➤ **To configure track histories:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Track History Settings page (Figure 5).

Figure 5. Track History Settings page



3. If you want track histories to have an indefinite length, select the Infinite Track check box.
4. To change the number of segments that can be displayed for a track history, adjust the Track Length slider, or enter a value in the box.

5. To change the segment timeout, adjust the Segment Timeout slider. The default is 3600 seconds (60 minutes).
6. To specify the length of each track history segment, enter a value in the Segment Length box.

2.2.2 Displaying HAT Lines for Track Histories (3D Only)

You can choose whether to display height-above-terrain (HAT) lines for track histories in the scenario. These thin, light-colored lines display in regular intervals, pointing towards the terrain to help you visualize the height. There is no terrain intersection; if the route is above water, the HAT lines can go below sea level.

> ⓘ To configure the appearance of the HAT lines, edit the Track History visual definition for the entity's element definition and specify the values for **enableheightlines**, **heightlinescolor**, and **heightlinesspacing**. See the *Element Definitions* chapter in the *Adding Content to MAK ONE Applications Reference Manual* to learn more.

➤ **To enable or disable HAT lines for track histories:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Track History Settings page (Figure 5 on the previous page).
3. Select or clear the Height Lines check box.

2.2.3 Coloring an Entity's Track History

You can change the color of an entity's track history. (By default, the track uses the color assigned to the entity's force.) The color you assign is visible only to you in your local GUI and does not persist in later sessions.

➤ **To change an entity's track history color:**

1. Right-click the entity and select **Color Track History**.
2. In the submenu, select a color or **Custom Color**.
3. If you selected **Custom Color**, choose a swatch from the basic colors, click a spot on the palette, specify a shade using its HTML color code, or click **Pick Screen Color** to use a color you see on the screen.
4. To return the entity to its default color, select **Color Track History > Clear Override**.

2.2.4 Displaying a Terrain Profile for a Track History

You can display a terrain profile for a track history. (For complete information about terrain profiles, see "Using Terrain Profiles".)

> ⓘ The track history terrain profile does not display the track history that is drawn in the window when you enable track histories. It creates an independent track that starts when you open the terrain profile window.

➤ **To display a terrain profile for a track history:**

1. Select the simulation object whose track history terrain profile you want to see.
2. Choose **Objects > Terrain Profile > Track History Profile**. The Terrain Profile dialog box opens. It updates as the simulation object moves.

2.3. Viewing Fire and Detonation Effects

VR-Forces can display graphic effects when munitions are fired and detonated. They are not supported in 2D observer modes.

- Flaming effects.
- Smoke plumes.
- Detonations.
- Muzzle flashes.
- Tracers. Tracers are displayed if the munition in a fire interaction is a tracer munition and the munition is mapped to a tracer model, and the munition must be direct fire. You can configure munitions in the Simulation Object Editor. For details, see "Creating and Editing Munitions". (Entities with weapons that support tracer munitions must enable tracer use for tracers to display. For details about enabling tracer use, see "Tracer Use".)

➤ **To enable fire and detonation effects:**

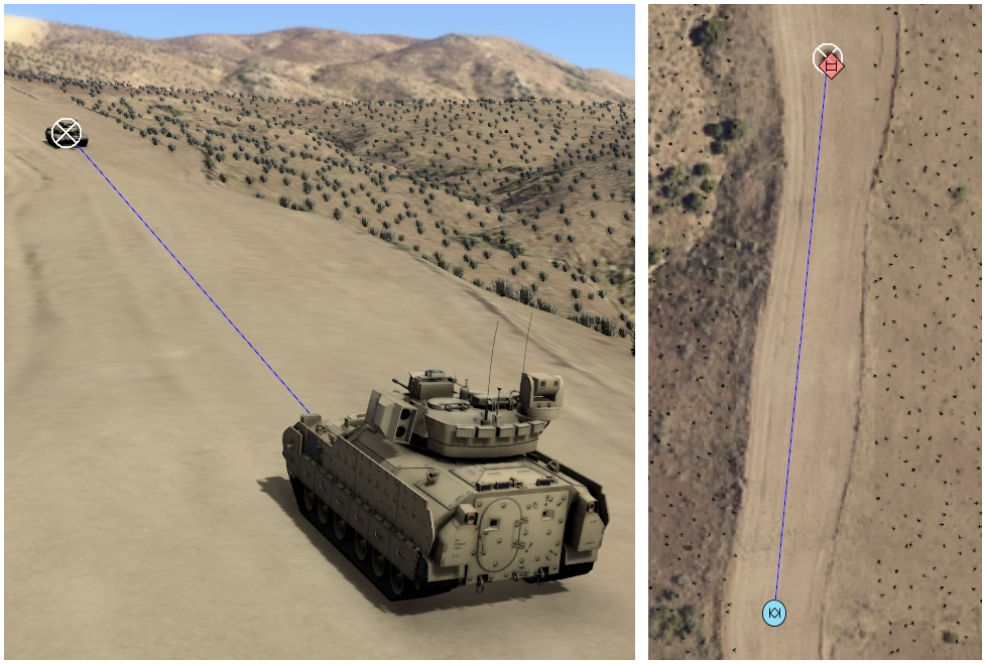
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 2 on page 6).
3. Select or clear the appropriate check boxes.

> ⓘ You can also enable or disable display of a fire or detonation effect by choosing **Observer >** *effect*, where *effect* is Flames, Smoke Plumes, Detonations, Muzzle Flashes, or Tracers.

2.4. Viewing Fire and Detonation Lines

If fire and detonation lines are enabled, when an entity fires a munition, a line is drawn between the entity and the location of the detonation. The line is colored for the force of the shooter (Figure 6).

Figure 6. Fire line and detonation - 3D and 2D



A detonation is identified by a circle with an X through it. The detonation color indicates the result of the detonation:

- Entity impact – white.
- Ground impact – gray.
- Airburst – black.
- Other – white.

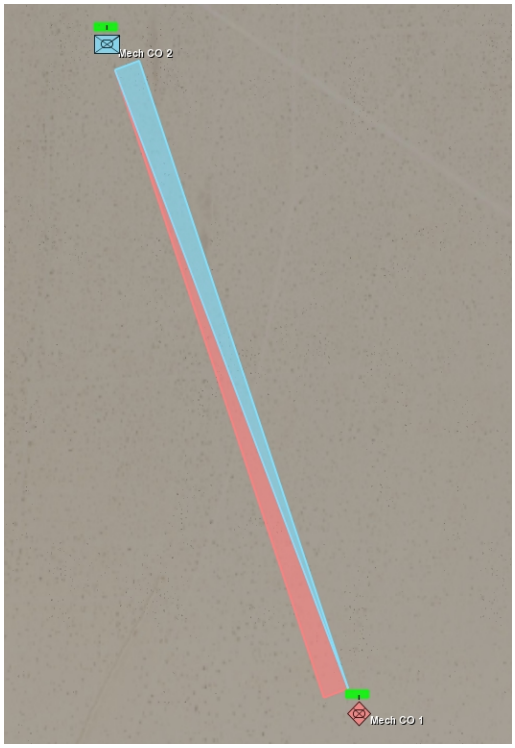
➤ To enable or disable display of fire and detonation lines, choose **Settings > Fire / Detonate Lines** or click the Fire/Detonate Lines button (⊗) on the Display Settings Toolbar.

2.5. Viewing Unit Combat Graphics

When simulation objects in aggregate-level scenarios engage in combat, they display two types of graphics, attack indicators, and attack animations. Attack indicators are triangular areas that show the direction a unit is attacking. They are colored with the force of the attacker. Attack animations show where a simulation object is being attacked. The footprint sector where the attack is taking place blinks from green to white.

The graphics persist until the attack is over.

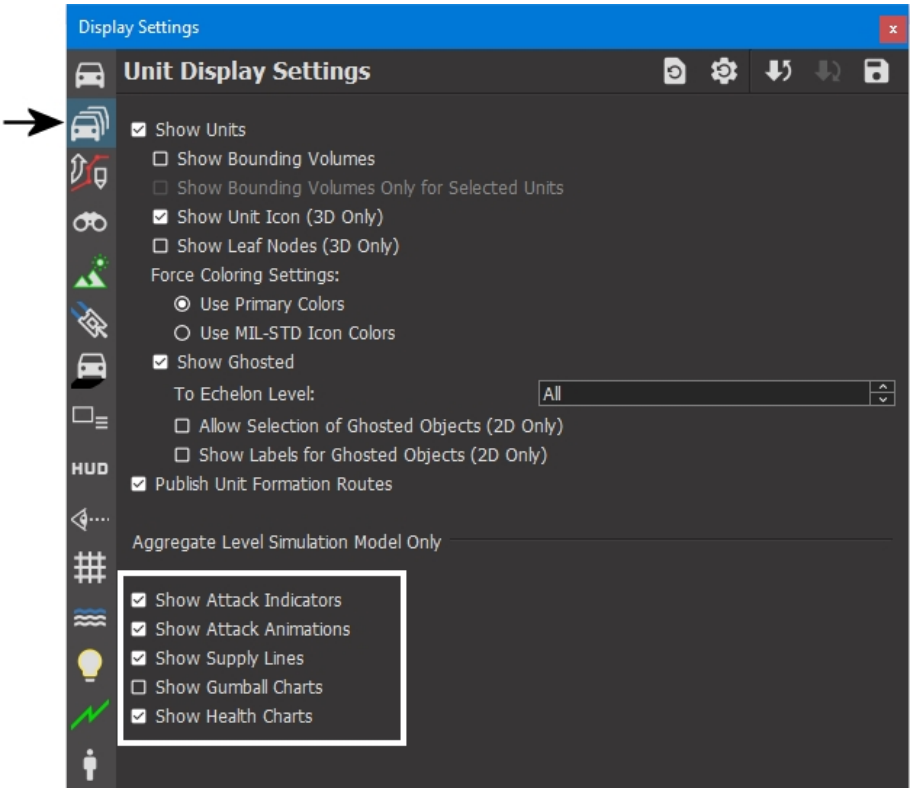
Figure 7. Attack indicators



➤ **To enable or disable unit combat graphics:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Unit Display Settings page (Figure 8).

Figure 8. Unit Display Settings page



3. To enable or disable attack indicators, select or clear the Show Attack Indicators check box.
4. To enable or disable attack animations, select or clear the Show Attack Animations check box.

2.6. Visualizing Tasks

VR-Forces can display graphics that help to show the task a simulation object is executing. Figure 9 and Figure 10 illustrate task visualization lines in Plan View mode and Stealth mode that show an entity moving to a location, and also an aircraft entity moving to a waypoint with its estimated time of arrival according to the simulation clock.

Task visualizations are not available for some tasks.

Task visualizations are supported only for individual entities, not for units.

To maintain adequate GUI performance, task visualizations have limits:

- No more than 10 simulation objects can show task visualizations at the same time.
- The maximum number of segments in a task visualization line is 80. If a simulation object is following a route or series of points that requires more than 80 segments to visualize, VR-Forces samples the points in the line. The resulting visualization line will not be as precise as the actual path the object is following, but still provides a general sense of its intent.

If either of these conditions is met, VR-Forces prints messages if the notification level is set to verbose.

You can specify that tasks be visualized for the selected simulation object. You can also specify that tasks be visualized on a per simulation object basis. The per-simulation object setting is saved as part of the scenario.

Figure 9. Task visualization of human entity moving to location

Figure 10. Task visualization of a fixed wing entity moving to a waypoint

➤ To enable or disable task visualization lines, choose **Observer > Task Visualizations** or click the Task Visualizations button () on the Observer Toolbar.

2.6.1 Displaying Task Visualizations for an Entity

If task visualization is enabled, by default they are displayed for the selected entity. You can disable automatic display of task visualizations for the selected entity. If this setting is disabled, you can still show a task visualization by pinning it to an entity, as described in "2.6.2 Pinning Task Visualizations for an Entity" below.

➤ **To specify that the selected simulation object show task visualization lines:**

1. Enable task visualizations.
2. Select an entity.
3. Choose **Settings > Display**. The Display Settings dialog box opens.
4. Select the Entity Display Settings page.
5. Select the Show Task Visualizations for Selected Entity check box. Clear the check box to disable them.

2.6.2 Pinning Task Visualizations for an Entity

By default, when task visualizations are enabled, they are only displayed for the selected entity. You can pin task visualization to an entity so that they are displayed even if it is not selected. This is the only way to have multiple entities visualize their tasks at the same time. You can pin a task visualization and display it even if the Show Task Visualization for Selected Entity check box on the Entity Display Settings page is cleared.

➤ **To pin task visualizations for a simulation object:**

1. Select the simulation object for which you want to visualize tasks.
2. Choose **Objects > Decorations > Pin Task Visualizations**.

2.7. Displaying Sensor Contact Lines

You can display lines between a simulation object and the objects it detects with its sensors (Figure 11 on the facing page). Display of sensor contact lines requires two levels of control. Display of sensor contact lines is an observer-specific setting. They must be enabled in the observer mode to be displayed.

When display of sensor contact lines is enabled, you can specify that sensor contact lines be shown for specific simulation objects, for the selected simulation object, or for both. If you enable display of sensor contact lines for a specific simulation object, the setting is saved with the scenario.

You can also configure the width and color of sensor contact lines.

Figure 11. Sensor contact lines

2.7.1 Enabling the Display of Sensor Contact Lines

Regardless of other settings, you must enable the display of sensor contact lines in the observer to see them.

➤ **To enable the display of sensor contact lines:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 2 on page 6).
3. In the settings list, select Sensor Contact Lines.

> ⓘ You can also enable or disable sensor contact lines by choosing **Observer > Sensor Contact Lines** or clicking the Sensor Contact Lines button () on the Observer Settings Toolbar.

2.7.2 Specifying Which Simulation Objects Display Sensor Contact Lines

Assuming that the display of sensor contact lines is enabled, you can specify that particular simulation objects always display them and you can specify that simulation objects display sensor contact lines if they are selected.

➤ **To display sensor contact lines for a simulation object whether it is selected or not:**

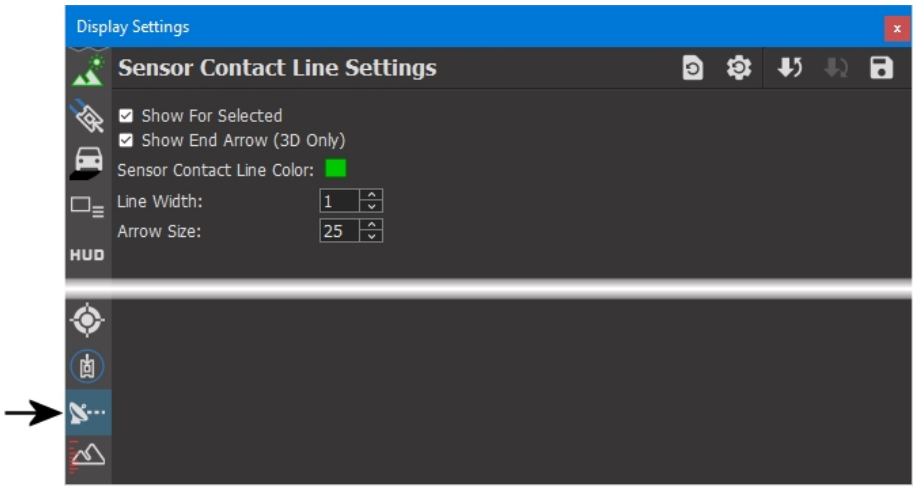
1. Select the simulation objects for which you want to enable sensor contact lines.
2. Choose **Objects > Decorations > Pin Sensor Contacts**.

> ⓘ This setting is saved with the scenario.

➤ **To enable display of sensor contact lines by the selected simulation objects:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Sensor Contact Line Settings page (Figure 12).

Figure 12. Sensor Contact Settings page



3. Select or clear Show For Selected.

ⓘ This setting is saved with the GUI settings.

Removing Sensor Contact Line Pins

➤ **To remove the sensor contact line pin:**

1. Select a simulation object that has sensor contact lines pinned.
2. Choose **Objects > Decorations > Pin Sensor Contacts**. The track history pin is removed.

➤ To remove track history pins for all entities, choose **Objects > Decorations > Remove All Pin Sensor Contacts**.

2.7.3 Configuring Sensor Contact Lines

You can set the color, line width, and arrow size of sensor contact lines.

➤ **To configure sensor contact lines:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Sensor Contact Settings page (Figure 12 above).
3. Change the values as desired.

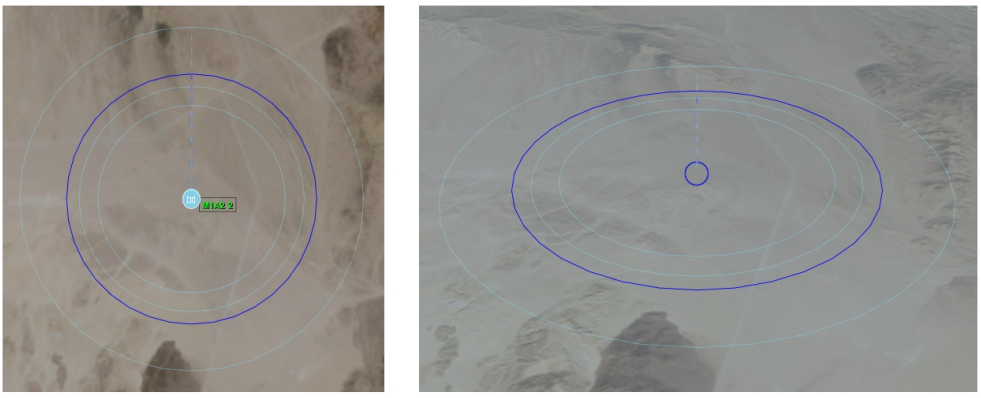
2.8. Displaying Threat and Sensor Range Rings

You can display a simulation object's threat range – the area within which its armaments are effective. The threat range is displayed as a circle, with a line indicating the entity's heading (Figure 13). A ring displays for each weapon system that the entity has. For

example, in Figure 13, the M1A2 entity has an inner ring for its 62 mm machine gun and an outer ring for its 120 mm main gun.

You can also display range rings for a simulation object's sensors.

Figure 13. Range rings (entity-level scenario)

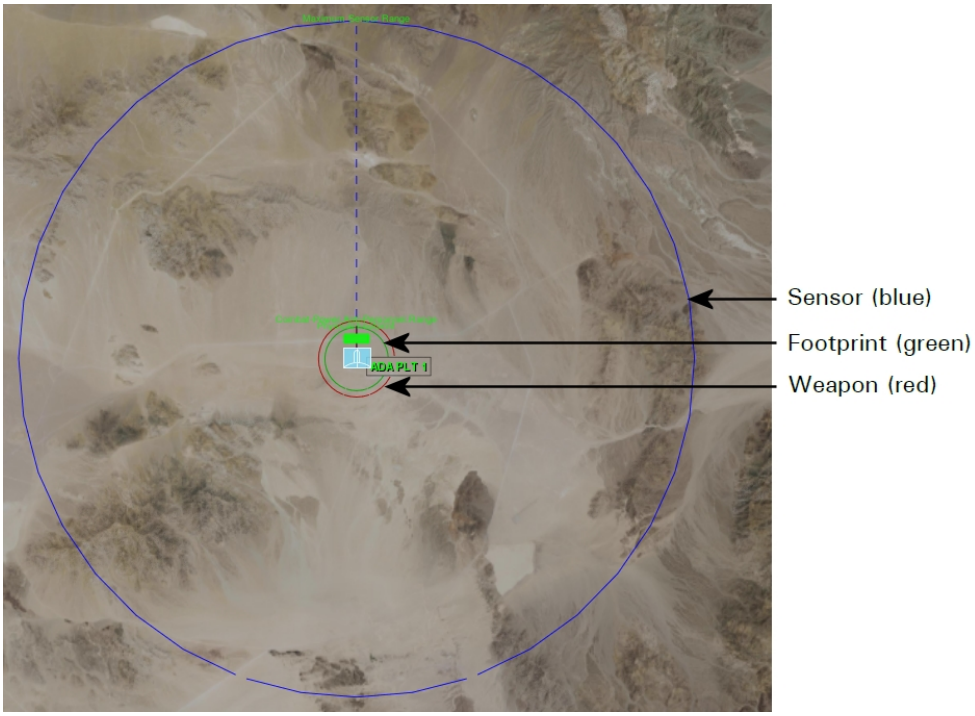


2D 3D

Simulation objects in aggregate-level scenarios display range rings that show their combat effectiveness and a footprint that represents the physical area that the unit occupies (Figure 14). Unit range rings have breaks to show the front, rear, left flank, and right flank sectors.

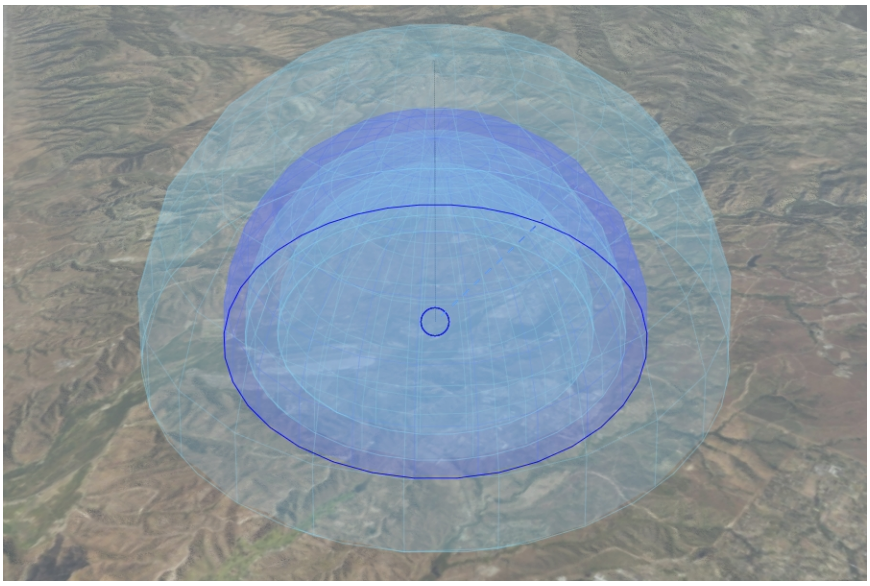
> On small databases, a simulation object's range ring may extend beyond the edge of the terrain display.

Figure 14. Range rings (aggregate-level scenario)



You enable range rings globally. They are an observer-specific option. You display range rings on a per-entity basis. You can globally configure the color of rings, their transparency, and the display of labels. In 3D views, you can specify whether to display a range sphere (Figure 15).

Figure 15. Range ring sphere

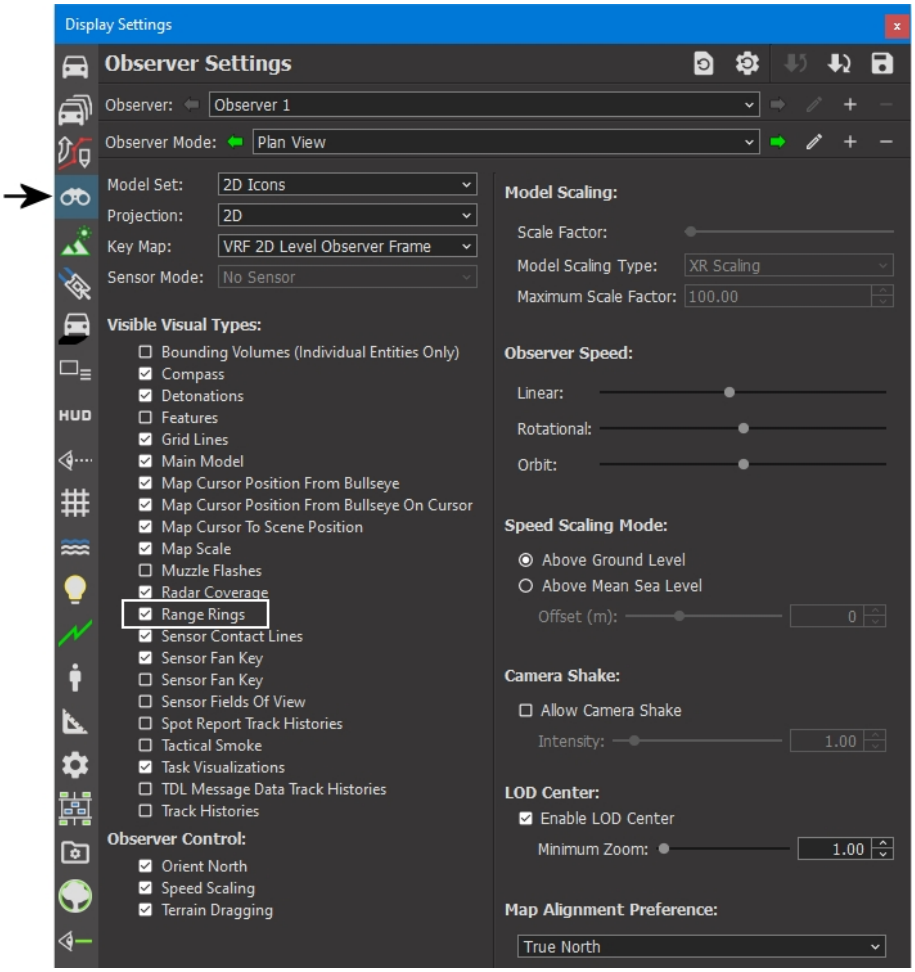


2.8.1 Enabling and Disabling the Display of Range Rings

➤ **To enable or disable the display of range rings:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 16).

Figure 16. Observer Settings page



3. In the list of options, select or clear the Range Rings check box.

> You can also enable and disable range rings by choosing **Observer > Range Rings** or by clicking the Range Rings button ( ) on the Observer Settings Toolbar.

2.8.2 Pinning Range Rings for a Simulation Object

You display range rings on a per-entity basis. By default, if range rings are enabled, when you select an object, its range rings are displayed as long as the object is selected. You can pin range rings to an object so that they are displayed even if the object is not selected.

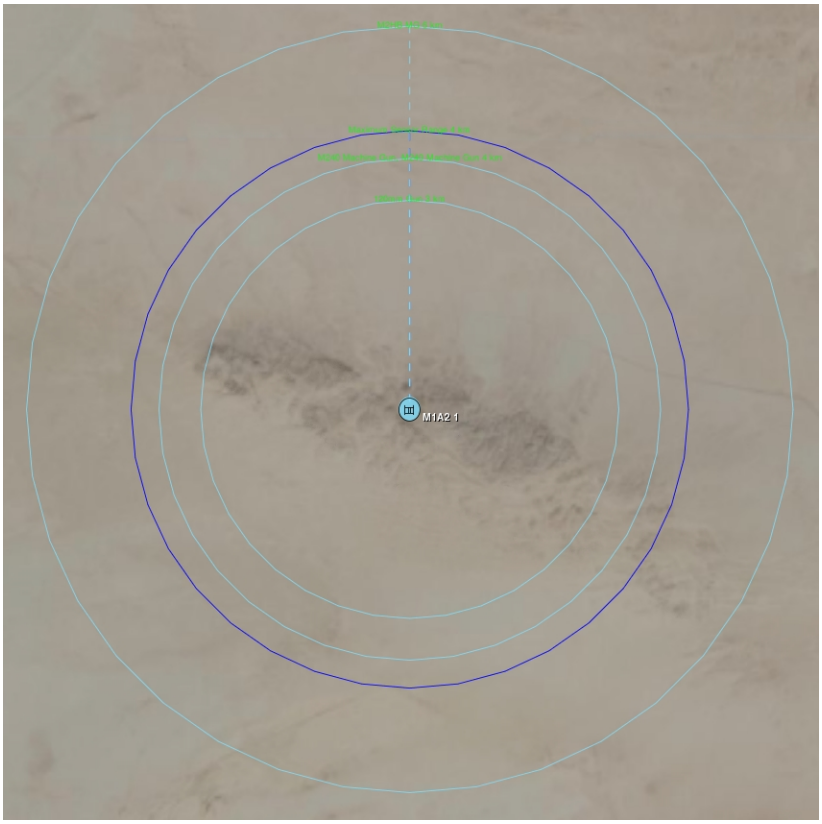
➤ **To pin range rings for a simulation object:**

1. Enable range rings, as described in "2.8.1 Enabling and Disabling the Display of Range Rings" on the previous page.
2. Select a simulation object.
3. Choose **Objects > Decorations > Pin Range Rings**.

2.8.3 Configuring the Display of Range Rings

You can configure the color of range rings and their transparency by weapon type and sensor type. You can also configure the display of range ring labels (Figure 17). A label can display the entity name, weapon type, and range of the weapon.

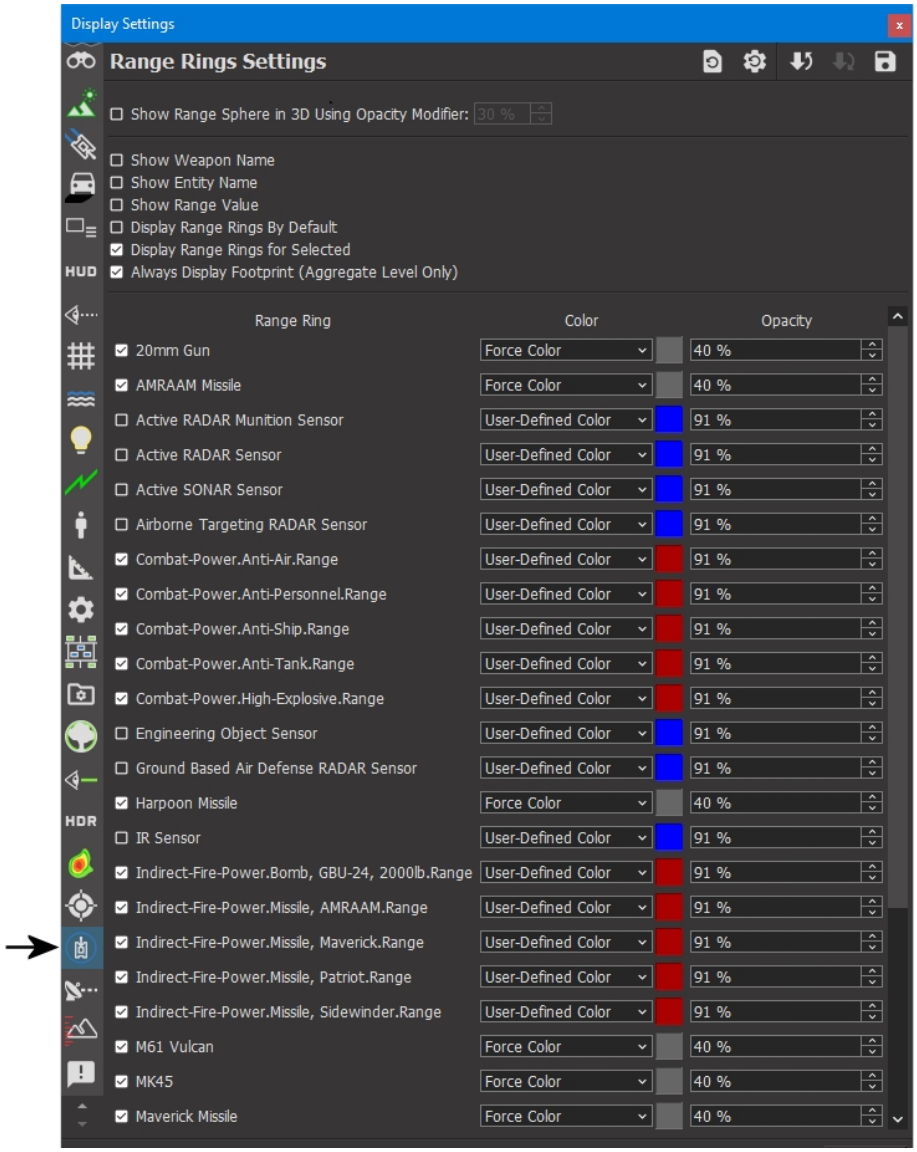
Figure 17. Range ring labels



➤ **To configure the display of range rings:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Range Rings Settings tab (Figure 18).

Figure 18. Range Rings Settings page (*AggregateLevelBase.sms*)



3. To display a sphere in 3D views, select the Show Range Sphere in 3D Using Opacity Modifier check box. Optionally, change the opacity modifier value.
4. To display the type of sensor or weapon system, select the Show Weapon Name check box.
5. To display the name of the simulation object, select the Show Entity Name check box.
6. To show the range of the sensor or weapon system, select the Show Range Value check box.
7. To automatically display range rings when a simulation object is created or discovered on the network, select Display Range Rings by Default.

> ⓘ If you select this option, when you load a scenario, range rings are displayed for all simulation objects. When you select the option after loading a scenario, they display only for simulation objects that are created or discovered on the network after you selected the option.

8. To display range rings for a selected simulation object that has not enabled range rings, select Display Range Rings for Selected.
9. To always show the footprint of a simulation object, select Always Display Footprint.
10. To enable or disable display of range rings for a particular weapon system, select or clear the check box for that system.
11. To change the color used to display a range ring:
    a. For the type of weapon system or sensor whose color you want to change, select User-Defined Color in the Color column list. The color swatch next to the list changes.
    b. Click the color swatch. A color picker dialog box opens.
    c. Select the color you want to use.
    d. Click OK.
12. To change the opacity for a range ring, for the weapon system whose range ring opacity you want to change, change the value in the Opacity column.

2.8.4 Configuring Display of Weapon System Ranges

You can use range rings to display the range for weapon systems and publish them to the network as enumerations. If you create a new weapon system, you must add it to the list.

Range ring enumerations are stored in: *./appData/settings/enumerations/VRF-enums.xml*.

The range ring name and enumeration are defined in the weapon's sysdef file. For example:

```
(DtRwString
  (default-range-name "120mm Gun")
)
(DwRwInt
  (range-id 7)
)
```

2.9.  Displaying Laser Designators

You can display laser designation information if it is available. VR-Forces displays a green circle and the laser code (on top of the entity icon or model) (Figure 19).

Figure 19. Laser designators - 3D and 2D

➤ To display laser designators, choose **Settings > Laser Designators**.

> In the Visual Model Editors, you can configure the 2D and 3D Laser Designators visualizer definitions for entities to display a line, and you configure the appearance of the line. In the Entity Definition Editor, specify the desired values for the islaserlinevisualized, lasercodelodoutaltitude, laserlinestipplepattern, or laserlinecolor visual definition attributes.

2.10. Displaying Supply Lines

Simulation objects in aggregate-level scenarios can provide supplies to and receive supplies from other simulation objects. When a simulation object is supplying another entity you can display supply lines that show resupply is taking place.

➤ **To display supply lines:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Unit Display Settings page (Figure 8 on page 14).
3. Select or clear Show Supply Lines.

2.11. Displaying Tactical Smoke

VR-Forces can display tactical smoke munitions fired by VR-Forces entities. You may want to disable tactical smoke if it obscures the observer's view. Also, if many entities are generating smoke, it could affect performance.

- Do not confuse tactical smoke and smoke plumes. Smoke plumes are a visual effect displayed when an entity is on fire. Tactical smoke visualizes a smoke munition that affects line-of-sight.
- If you disable display of tactical smoke, VR-Forces continues to simulate its existence in the sim. engine and it continues to affect line-of-sight.

➤ **To enable tactical smoke:**

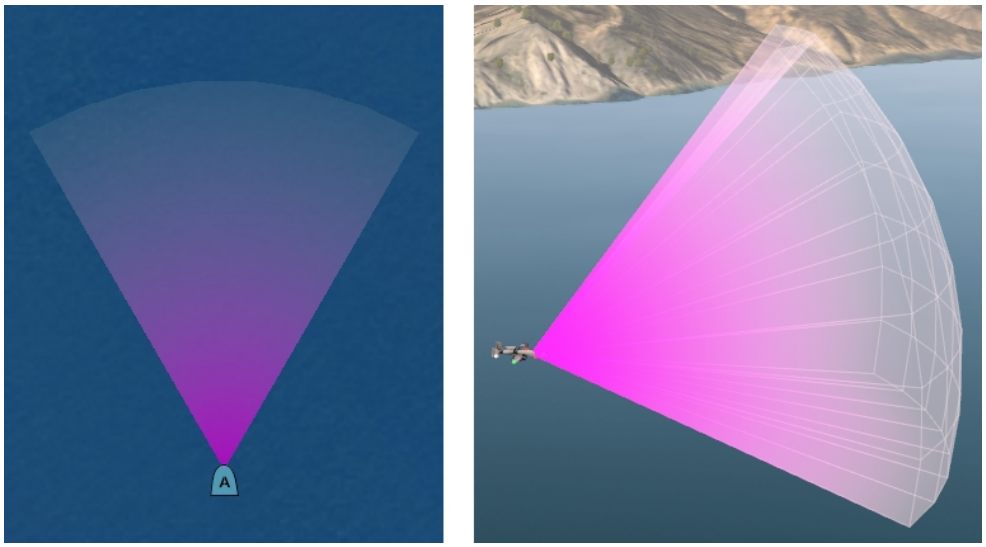
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 2 on page 6).
3. Select or clear the Tactical Smoke check box.

You can also enable or disable display of a fire or detonation effect by choosing **Observer > Tactical Smoke**.

2.12. Displaying Electromagnetic Emissions

VR-Forces can display electromagnetic emissions (emitter volumes) for entities that have emitter systems (Figure 20). You can configure the colors used to represent emitter frequencies and you can configure the size of the emitter volumes. (For details about configuring emitter volumes, see "8.1. Emitter Volumes Overview" on page 88.)

Figure 20. Emitter volumes - 2D and 3D

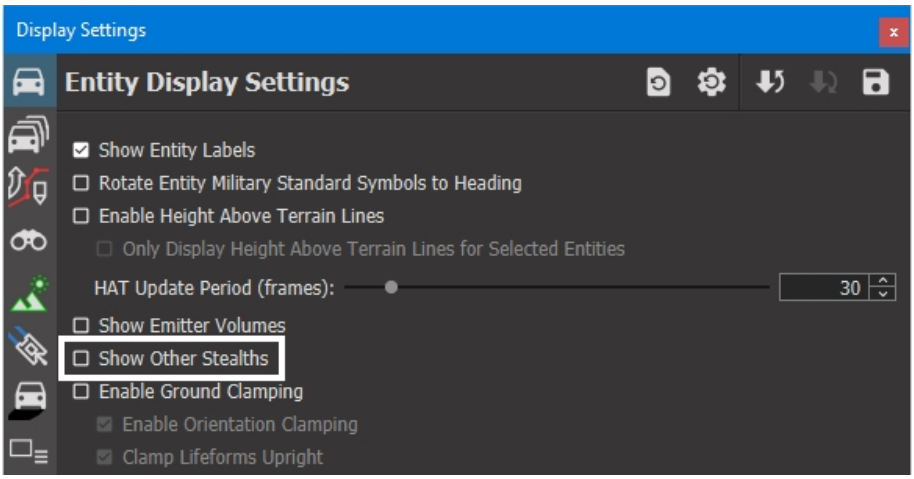


Display of emitter volumes only affects entities that have emitter systems.

➤ **To enable or disable display of electromagnetic emissions:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 21).

Figure 21. Entity Display Settings page



3. Select or clear the Show Emitter Volumes check box.

> You can also enable or disable emitter volumes by choosing **Settings > Emitter Volumes**, or clicking the Emitter Volumes button ( ) on the Display Settings Toolbar.

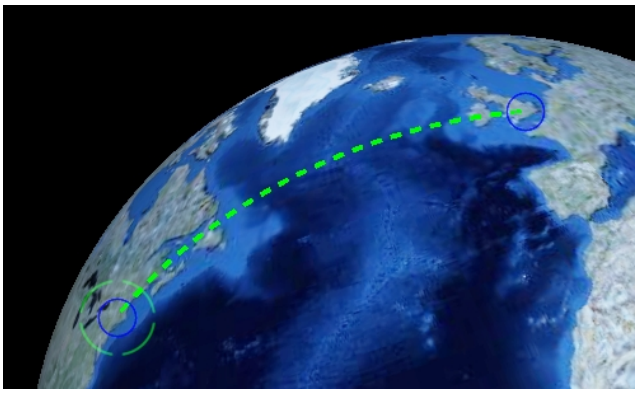
2.13. Displaying Radio Communication Lines

VR-Forces can display squawk indicators when a simulation object sends a signal interaction. It can also display communication lines between simulation objects when a VR-Forces simulation object (or a simulation object in an application built with the appropriate MAK libraries) sends a radio message to another simulation object. You can configure a communication line's color and lifetime. Figure 22 displays squawk indicators and a line-of-sight communication line.

Figure 22. Radio communication line and squawk indicators

For communications over large distances, a line-of-sight communication line would travel through the earth. Therefore, you can also display communication lines drawn with the curvature of the earth (Figure 23).

Figure 23. Curvature of the earth communication line



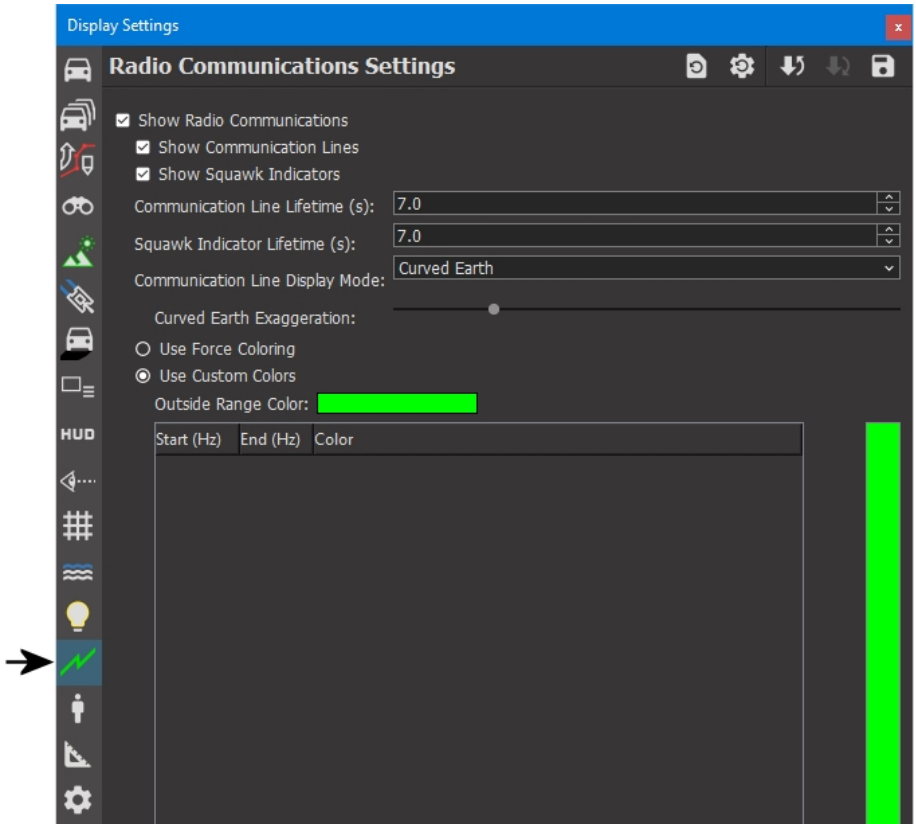
2.13.1 Enabling Radio Communications Graphics

You can globally enable or disable the ability to display radio communication lines. When they are enabled, you can enable and disable communication lines and squawk indicators separately.

➤ **To enable or disable radio communications graphics:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Radio Communications Settings page (Figure 24).

Figure 24. Radio Communications Settings page



3. Select or clear the Show Radio Communications check box.

> You can also enable and disable communication lines by choosing **Settings > Radio Communication Display** or by clicking the Radio Communications button ( ) on the Display Settings Toolbar.

➤ **To enable or disable communication lines:**

1. Enable radio communication lines.
2. Select or clear the Show Communication Lines check box.

➤ **To enable or disable squawk indicators:**

1. Enable radio communication lines.
2. Select or clear the Show Squawk Indicators check box.

2.13.2 Configuring the Lifetime and Display Mode

You can configure how long a radio communication line is displayed. You can also configure whether it is displayed using line-of-sight or curvature of the earth.

➤ **To configure the lifetime and display mode for radio communication lines:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Radio Communications Settings page (Figure 24 on the previous page).
3. To specify how long a communication line or squawk indicator should be displayed, enter a value, in seconds, in the Communication Line Lifetime and Squawk Indicator Lifetime fields.
4. To specify the display mode, select an option in the Communication Line Display Mode list.
5. If you select Curvature of the Earth, adjust the Curved Earth Exaggeration slider to change the degree to which the curvature is exaggerated.

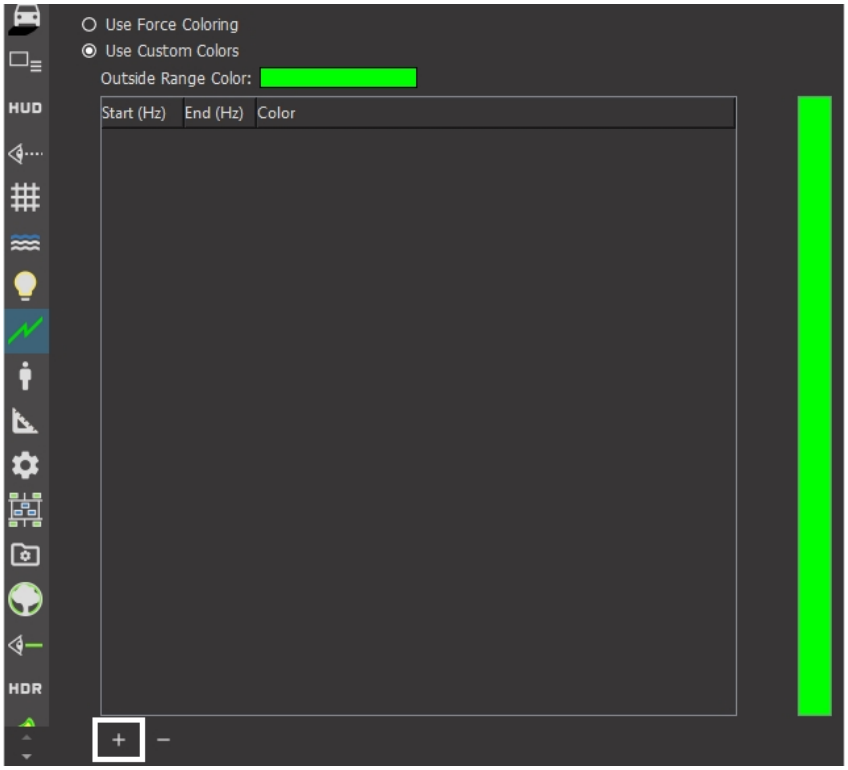
2.13.3 Configuring the Color of Radio Communication Lines

By default, radio communication lines are green. You can configure communication lines to use force coloring or to be colored based on the frequency of the message. When you color by frequency, you specify colors for the frequency ranges you are interested in and a color to use for all messages outside the specified frequencies.

➤ **To configure the color of radio communication lines:**

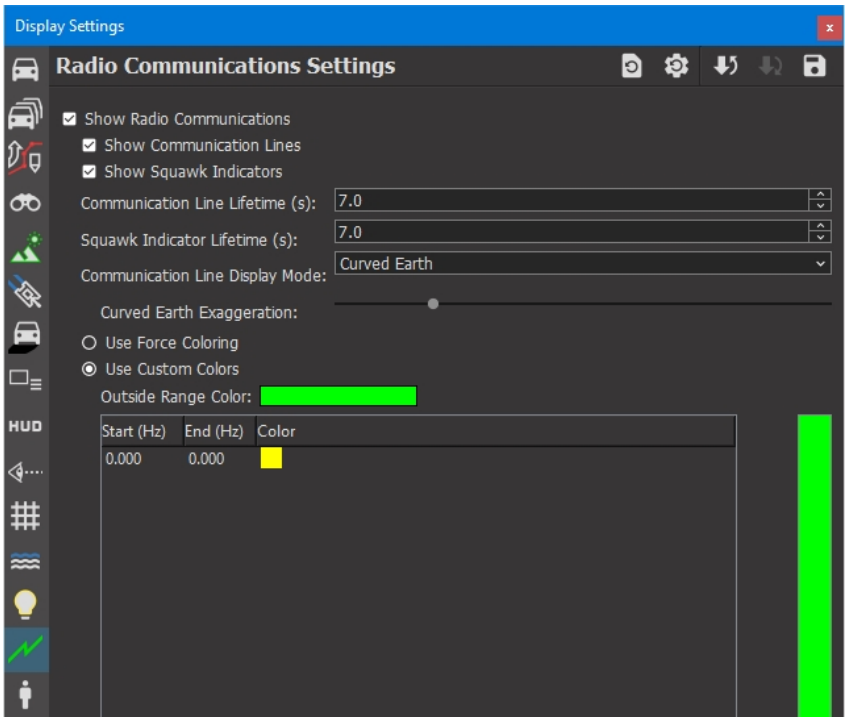
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Radio Communications Settings page (Figure 24 on the previous page).
3. To color radio communication lines using the force color, select the Use Force Coloring option.
4. To color radio communication lines by frequency:
    a. Select the Use Custom Colors option.
    b. Click the Add button (+). A range is added to the frequency list with a default color (Figure 25).

Figure 25. New frequency point



c. Double-click the starting value of the range to make it editable (Figure 26).

Figure 26. Editable frequency point



d. Type the starting frequency you want to use.

e. Edit the end frequency.

f. Double-click the color swatch and select a color for this range.

g. Optionally, add points for different frequency ranges.

h. Optionally, click the Outside Range Color color swatch and specify a color for all frequencies not specified in the frequency list.

ⓘ If you configure multiple frequency ranges, you cannot add a range whose values are within those of an existing range.

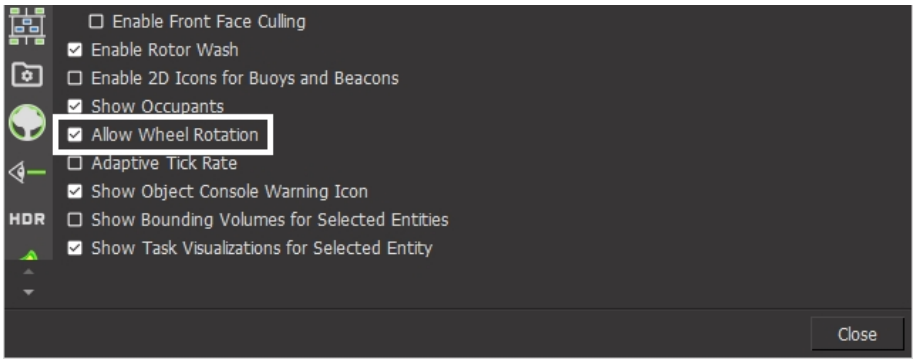
2.14. Enabling and Disabling Wheel Rotation

For vehicles that have articulated parts specified for the wheels, you can enable and disable rotation of the wheels. The rate of rotation is determined by the size of the wheel, the speed of the vehicle, and whether the vehicle is turning.

➤ **To enable or disable the rotation of vehicle wheels:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 27).

Figure 27. Wheel Rotation Settings



3. Select or clear the Allow Wheel Rotation check box.

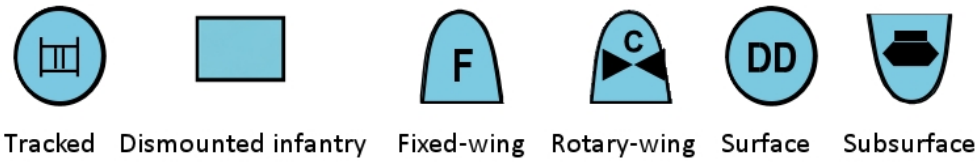
3. Visualizing 2D Icons and 3D Models

This chapter describes how to change how 2D icons and 3D models look.

3.1. Simulation Object Icons

The 2D Icons model set uses MIL-STD 2525B icons. Figure 28 illustrates basic icon shapes for friendly forces.

Figure 28. MILSTD-2525B icons



The color and shape code for 2D simulation object icons is:

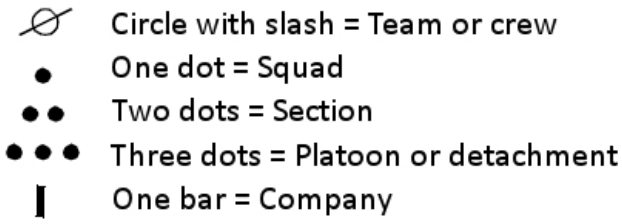
- Light blue – friendly.
- Pink (light red) – hostile.
- Light green – neutral.

Symbols have a black border except:

- If there is no border on the top, the entity domain is subsurface, for example, submarines.
- While selected, simulation objects have a white border.

Symbols that represent units have unit identifiers above the symbol, as illustrated in Figure 29.

Figure 29. Unit echelon indicators



3.1.1 Changing the Size of 2D Icons

The Plan View observer mode uses the 2D Icons model set for simulation objects.

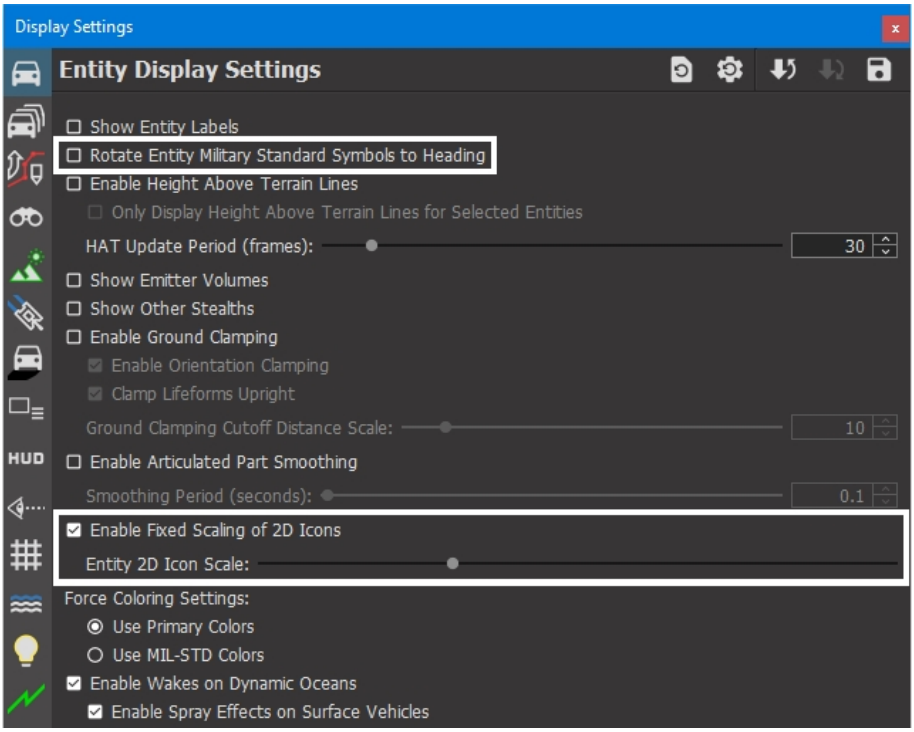
Manually Changing Icon Scale

You can change the size of 2D icons. When many simulation objects are close together, reducing the size of the icons can reduce overlap.

➤ **To change the size of simulation object icons:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 30).

Figure 30. Entity Display Settings page



3. Select the Enable Fixed Scaling of 2D Icons check box.
4. Adjust the Entity 2D Icon Scale slider.

Scaling 2D Icons by Altitude

Additionally, the 2D icons scale based on the observer's altitude, appearing smaller from greater heights. As with symbol decorations, the 2D icons display at full size when you hover over or select a simulation object.

➤ **To enable the resizing of icons based on altitude:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page.
3. Clear the Enable Fixed Scaling of 2D icons check box.

You can also enable or disable the resizing of icons based on altitude using the Display Settings Toolbar.

➤ To enable or disable the resizing of icons, click the Dynamically Scale Icons button .

ⓘ Additionally, symbol decorations can be hidden based on the observer's altitude. See "Hiding Symbol Decorations by Altitude".

3.1.2 Rotating 2D Icons to a Simulation Object's Heading

By default, when a simulation object's heading changes, the heading indicator points to the new heading, but the icon remains oriented towards zero degrees (North). You can specify that icons rotate to the heading of the simulation object. This is enabled for airborne

entities such as aircraft and munitions, but you can also enable it for other entities as needed.

> By default, this setting applies only to aircraft entities. If you want to override the Rotate Entity Military Standard Symbols to Heading setting for specific entities, such as ground entities, edit the Entity Definition and set the rotateicontoheading attribute for the Military Symbology Icon definition. See the chapter on *Element Definitions* in the *Adding Content to MAK ONE Applications Reference Manual*.

Figure 31. 2D icon rotated to heading

➤ **To rotate icons to a simulation object's heading:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 30 on the previous page).
3. Select the Rotate Entity Military Standard Symbols to Heading check box.

> You can also click the Rotate 2D MIL STD Symbols button ( ) in the Display Settings Toolbar.

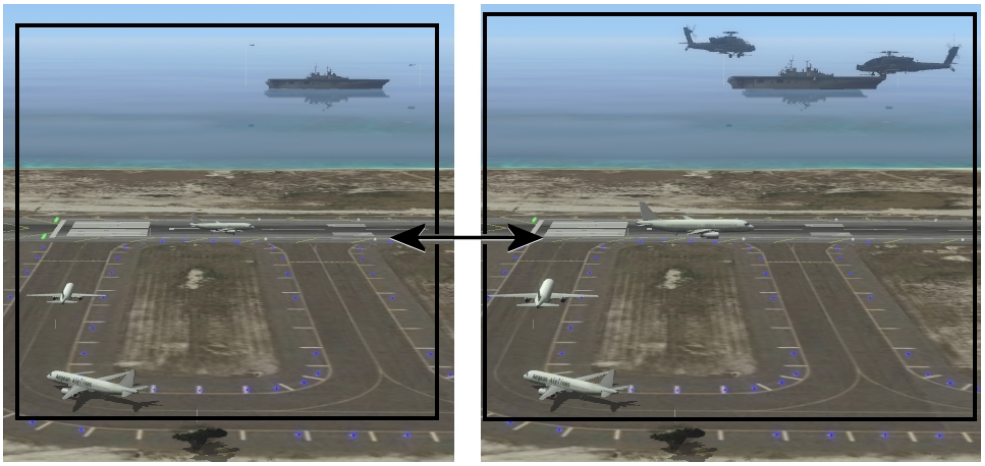
3.2. Exaggerating the Scale of 3D Entity Models

If you view the terrain in Stealth observer mode, beyond a certain distance most 3D entity models are too small to see. Model scaling lets you exaggerate the scale of entity models to see them at a great distance. Figure 32 shows the same scene with model scaling off and on. When model scaling is off, only the largest entities are visible. When models are scaled, they are all visible.

VR-Forces supports two methods of model scaling:

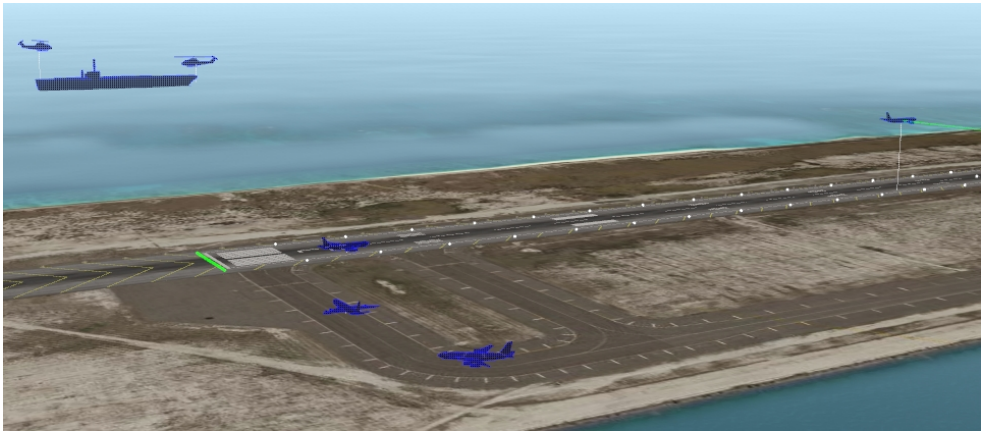
- XR scaling. XR scaling tries to give all entities approximately equal visibility. It does not preserve size relationships between entities. The visual effect of model scaling depends on an entity's size and the observer's distance from the entity. When the observer is close to an entity, scaling models may not make any noticeable difference in its size.
- Linear scaling. Linear scaling scales all entities by the current model scale factor. The distance from the observer is not taken into account. A model scale factor of 10 scales all entities to be 10 times normal size.

Figure 32. Model scaling off and on (Stealth observer mode)



Another way to quickly change the visibility of entities is to switch to XR observer mode. In XR mode, entities are immediately scaled and are represented by colorized 3D models to enhance their visibility.

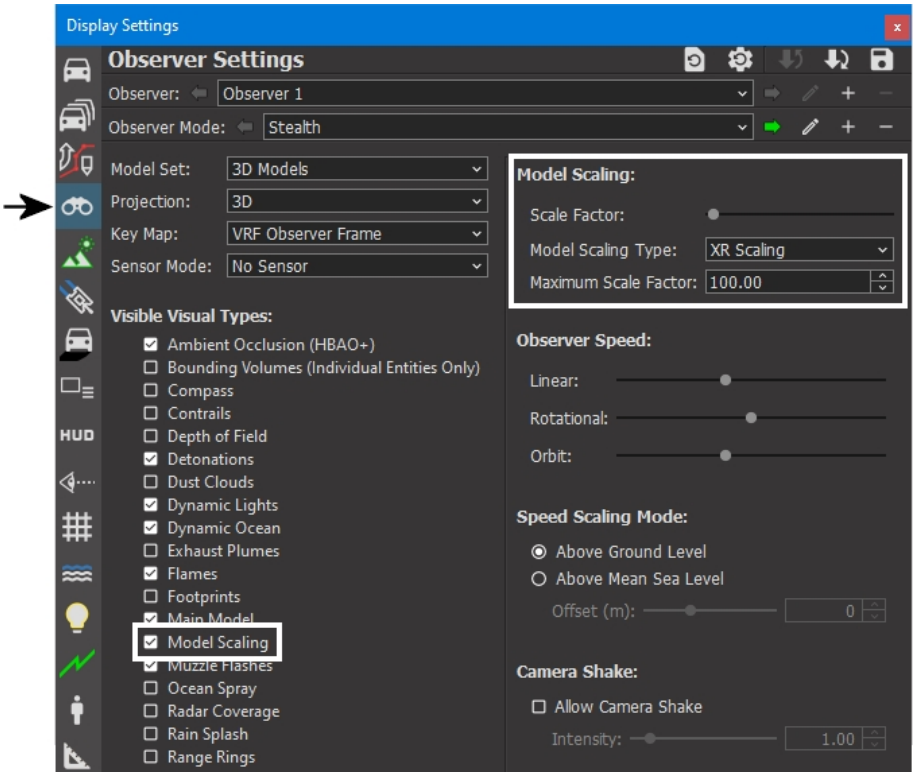
Figure 33. XR mode



➤ **To scale entity models:**

1. Choose **Observer > Advanced Settings**. The Display Settings dialog box opens to the Observer Settings page (Figure 34).

Figure 34. Observer Settings page



2. In the list of observer attributes, select Model Scaling.
3. In the Model Scaling Type list, select the type of scaling you want to use: XR or linear.
4. Optionally, change the Maximum Scale Factor.
5. Adjust the Scale Factor slider to the amount of scaling that you want.

3.3. Hiding 3D Models

You can hide 3D models and 3D colorized models.

➤ **To hide 3D models:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 34 above).
3. In the list of observer settings, clear the Main Model check box.

3.4. Displaying DI-Guys in Vehicles

If a vehicle has interior geometry, you can configure it to display DI-Guy characters inside the vehicle. If a vehicle is configured to display a DI-Guy, the model is added automatically. You can enable and disable display of DI-Guys. This is a global setting.

The characters displayed in vehicles are for display purposes only. They do not exist as entities in the simulation.

You can show and hide occupants on a per-entity basis with the Hide Occupants set data request. For details, see "Hide Occupants".

➤ **To enable or disable display of DI-Guys in vehicles:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page.
3. Select or clear the Show Occupants check box.

4. Lighting Effects

This chapter describes the lighting effects supported by VR-Forces.

4.1. Displaying Lighting Effects

VR-Forces can simulate a variety of lighting effects, including:

- Dynamic lighting
- Ocean planar reflection
- Lens flare
- Crepuscular (sun) rays
- Shadows

Use of lighting effects affects performance. VR-Forces lets you enable and disable some effects so you can adjust the mixture of performance and effects that best meets your needs.

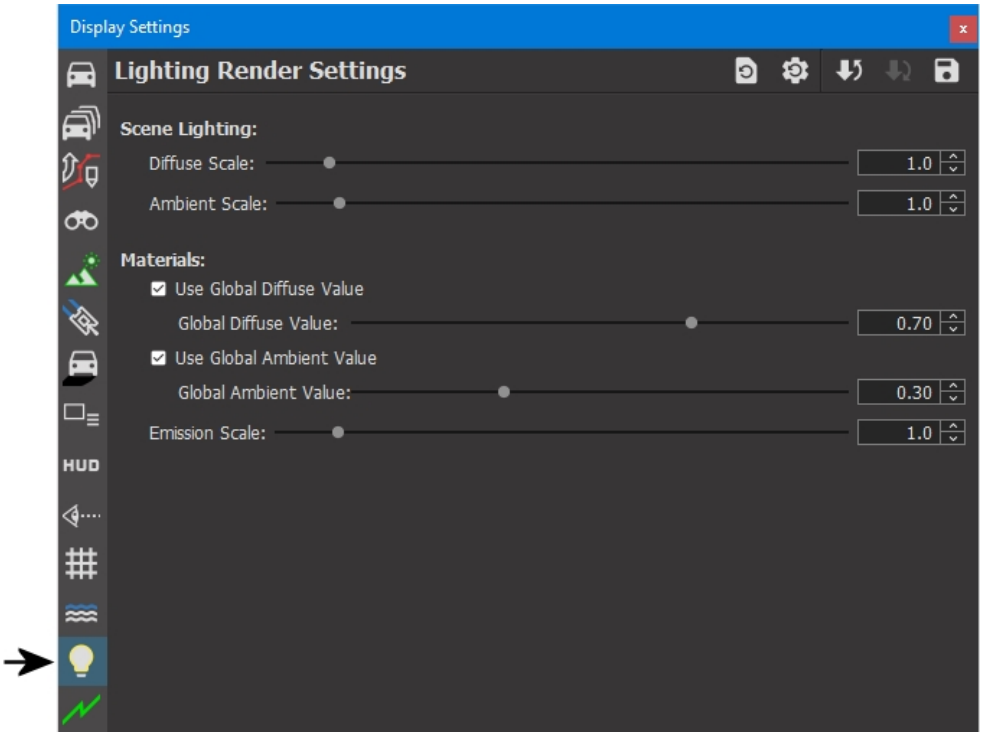
4.2. Advanced Lighting Settings

VR-Forces allows you to adjust the lighting for the scene and materials.

➤ **To access the lighting render settings:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 35).

Figure 35. Lighting Render Settings



4.2.1 Configuring Ambient and Diffuse Lighting

Ambient lighting is the lighting available to objects that are not in a direct form of light, such as sunlight. Diffuse lighting is light that is reflected off an object. You can adjust the overall amount of ambient and diffuse lighting in the scene and you can configure whether objects use the material ambient and diffuse values specified in their models or use values provided by VR-Forces.

Configuring the Ambient and Diffuse Scale Values for Scene Lighting

You can set a scale factor for ambient and diffuse light that is present in the scene. Lower values make objects darker. Higher values make them lighter. The ambient or diffuse scale factor is independent of how material ambient and diffuse values are set.

➤ **To specify the ambient and diffuse lighting scale values:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 35 on the previous page).
3. Adjust the Diffuse Scale slider or change the value in the box.
4. Adjust the Ambient Scale slider or change the value in the box.

Configuring the Material Ambient and Diffuse Values for Materials

Polygons in a 3D scene have a material and a texture. Polygon materials may specify specular, diffuse, and ambient colors that define the way they respond to incoming light.

The ambient color specifies the color used when it is in indirect light. Sometimes the ambient values for different objects do not work well together. You can specify that objects use the ambient material value, or let VR-Forces globally specify ambient material values.

In addition to specifying which material ambient and diffuse values to use, you can set a scale factor. Lower values make objects darker. Higher values make them lighter. The material ambient or diffuse scale factor is independent of how ambient and diffuse values are set for scene lighting.

➤ **To configure the material ambient value:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 35 on the previous page).
3. To use the ambient values specified by objects, clear the Use Global Ambient Value check box. To have VR-Forces use a global value, select the Use Global Ambient Value check box.
4. If you selected the Use Global Ambient Value check box, optionally, adjust the Global Ambient Value slider or change the value in the box.

➤ **To configure the material diffuse value:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 35 on page 42).
3. To use the diffuse values specified by objects, clear the Use Global Diffuse Value check box. To have VR-Forces use a global value, select the Use Global Diffuse Value check box.
4. If you selected the Use Global Diffuse Value check box, optionally, adjust the Global Diffuse Value slider or change the value in the box.

4.2.2 Specifying the Emissive Lighting Scale

You can change a scale value that controls the brightness of emissive textures. This allows you to make windows, street lights, and other emissive light sources darker or brighter. Increasing the scale value increases the brightness.

➤ **To specify the emissive lighting scale value:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 35 on page 42).
3. Adjust the Emission Scale slider or change the value in the box.

4.3. Displaying Dynamic Lighting

VR-Forces can display light cast by light sources such as headlights, street lamps, and spotlights. Display of dynamic lighting is an observer-specific feature. It is enabled by default.

Dynamic lights are either part of the terrain or part of an entity model. If they are part of an entity model, they can be set permanently on or they can be turned on and off by the appearance bit. VR-Forces entities that have lights can enable them using the Appearance set data request.

Figure 36 shows a night-time scene with dynamic lighting enabled. The truck's taillights cast light to the rear. The headlights cast light forward. Street lamps and windows are also casting light.

Figure 36. Dynamic Lighting enabled

- Light points can be configured to automatically turn on at dusk and turn off at dawn. For details, see "4.3.1 Daylight Control of Lights" on the next page.
- Emissive lights are always on, day or night. The headlights on vehicles shipped with MAK products are configured with Dynamic Lights and Emissive Textures which are controlled by the Appearance State "Head Lights On". When the headlights are on and dynamic lights are enabled, the emissive textures are visible.

You cannot change these lighting settings.

➤ **To enable dynamic lighting:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page.
3. In the list of settings, select Dynamic Lights.

You can also enable or disable dynamic lighting by choosing **Observer > Dynamic Lights**.

4.3.1 Daylight Control of Lights

Lights that have a light point type specified can be placed under daylight control.

- Light points that do not have a light point type defined are not automatically placed under daylight control.
- Light points in an OpenFlight file that are loaded as an articulated model use the **daylightControlledLights** model definition parameter.
- Light points with a type defined use the Daylight Controlled parameter for their type in *./appData/importConfig/Lights_DefaultValues_3_2.csv*.

For more information about configuring light points, see "Configuring Light Points" in the *Adding Content to MAK ONE Applications Reference Manual*.

Light sources (lights that cast light onto other objects) are discovered on the cull pass of the scene graph. Sources found under the terrain root or props root of the scene graph are automatically put under daylight control.

4.4. Displaying Ocean Planar Reflections

VR-Forces can show the reflection of terrain and objects on water (Figure 37). To see planar reflections, dynamic ocean must be enabled. (For details about enabling dynamic ocean, see "Enabling Marine Effects".)

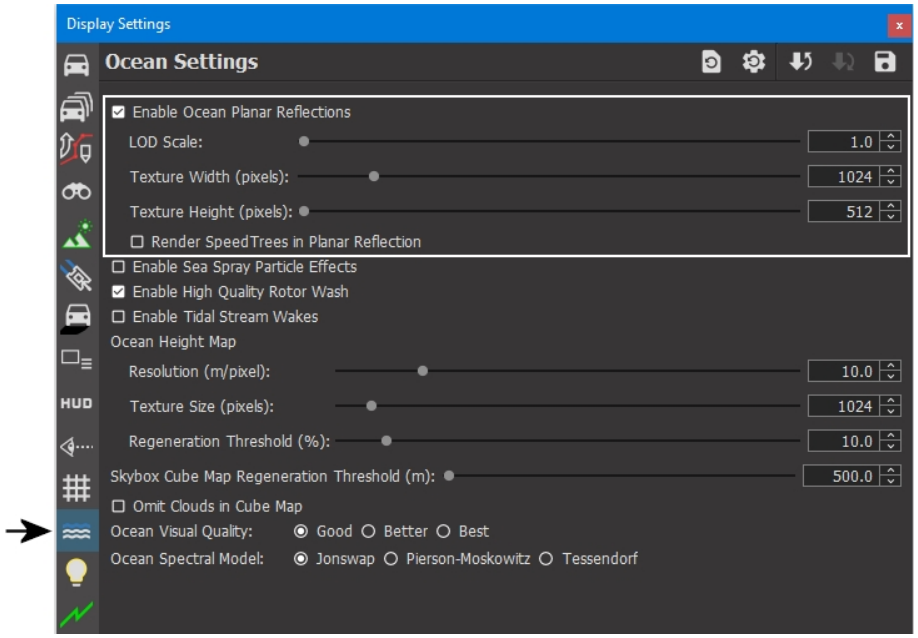
Displaying ocean planar reflections degrades performance. See "4.4.1 Configuring Ocean Planar Reflections" on the facing page for details.

Figure 37. Ocean planar reflection

➤ **To enable or disable planar reflections:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 38).

Figure 38. Ocean Settings



3. Select or clear the Enable Ocean Planar Reflections check box.

4.4.1 Configuring Ocean Planar Reflections

As with other visuals, ocean planar reflections are controlled by the observer's LOD Distance Scale setting. To reduce the performance impact of ocean planar reflections, you can configure the LOD scale specifically for ocean planar reflections. The LOD scale affects the distance from the observer at which VR-Forces switches LODs. The higher the value, the more quickly LODs are switched.

> ⓘ You can adjust the LOD Distance Scale for terrain in the Observer Control Panel (Figure 2).

The Texture Height and Texture Width parameters affect the resolution of the ocean planar reflection texture, in pixels. Higher resolution decreases performance.

You can also enable and disable display of SpeedTrees as planar reflections.

➤ **To configure ocean planar reflections:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 38 above).
3. To change the ocean planar reflection LOD scale, adjust the LOD Scale slider under Enable Ocean Planar Reflections, or change the value in the box.
4. To change the width or height of the ocean planar reflection texture, adjust the Texture Width or Texture Height slider under Enable Ocean Planar Reflections, or change the values in the boxes.
5. To include SpeedTrees in ocean planar reflections, select the Render SpeedTrees in Planar Reflections check box.

4.5. Lens Flare

Lens flare is a visual artifact often seen when looking at light sources such as the sun through a camera lens (Figure 39). VR-Forces can simulate lens flare when the observer looks towards the sun.

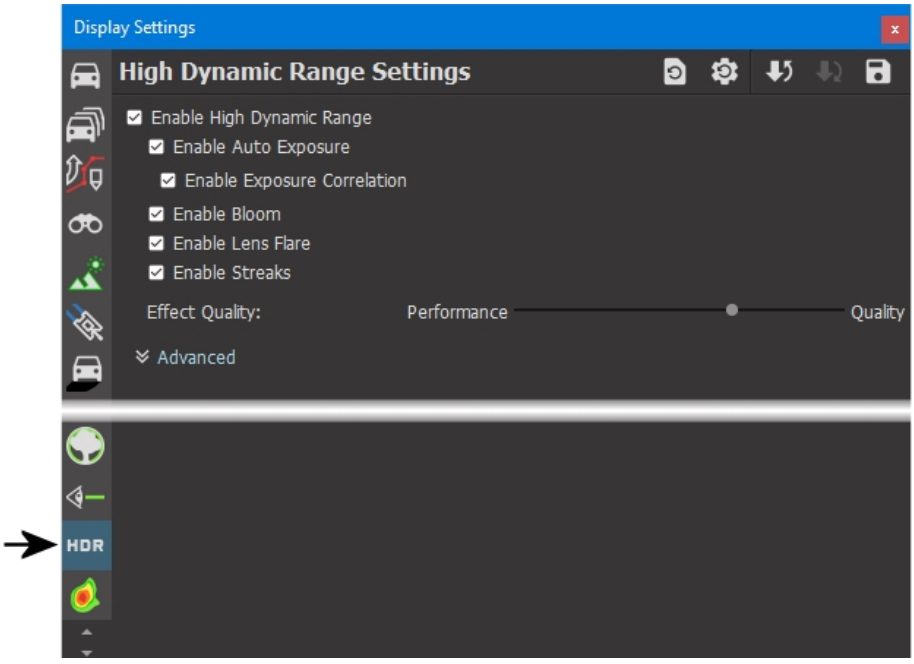
Figure 39. Lens flare

ⓘ Lens flare is supported only when high dynamic range lighting is enabled. You can also enable this in the High Dynamic Range Settings page.

➤ **To enable or disable lens flare:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the High Dynamic Range Settings page (Figure 40).

Figure 40. High Dynamic Range Settings page

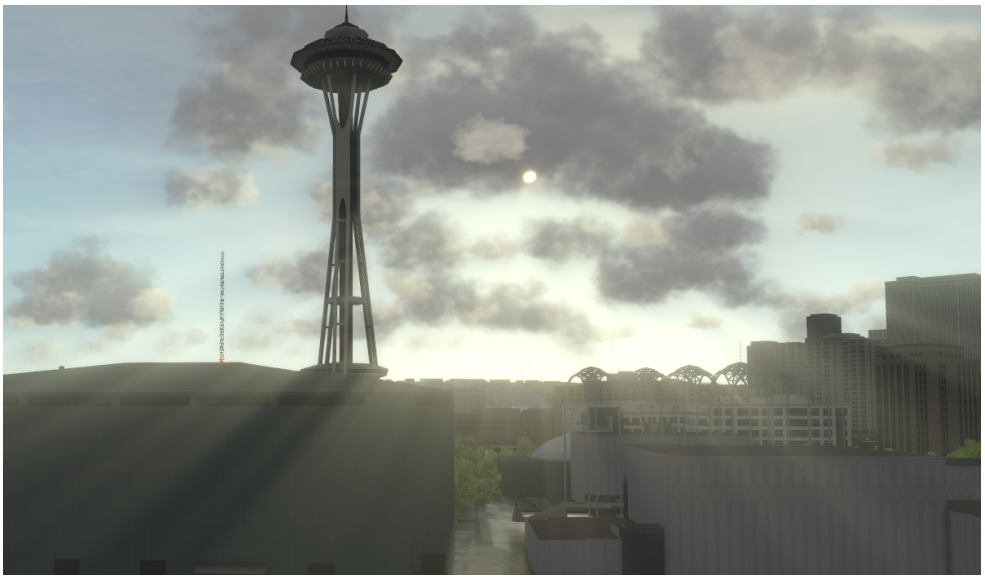


3. Select or clear the Enable Lens Flare check box.

4.6. Displaying Crepuscular (Sun) Rays

VR-Forces can simulate the effect of crepuscular rays (sunbeams) beaming through clouds (Figure 41).

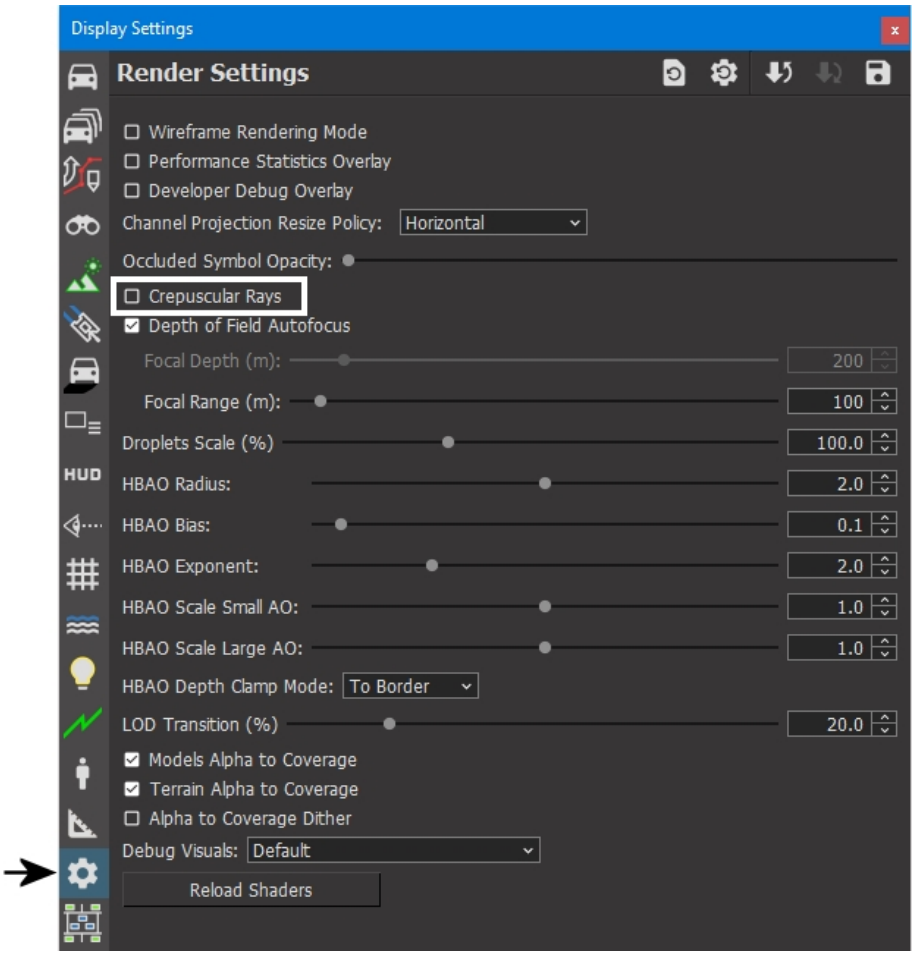
Figure 41. Crepuscular rays



➤ **To enable or disable crepuscular (sun) rays:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 42).

Figure 42. Render Settings page



3. Select or clear the Crepuscular Rays check box.

4.7. Configuring the Skybox Cube Map

A skybox cube map is a graphics technique used to render reflections and sky effects. The skybox cube map is rendered from the location of the observer. As the observer moves, the cube map needs to be recalculated, which is computationally expensive.

VR-Forces lets you configure the distance that the observer has to move (the skybox cube map regeneration threshold) before it recalculates the cube map. Increasing the threshold can improve performance, at the cost of visual quality.

You can also choose to omit clouds in the skybox cube map. Omitting clouds can increase performance.

➤ **To configure the skybox cube map:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 38 on page 47).
3. Adjust the Skybox Cube Map Regeneration Threshold slider or enter a value in the box.
4. Optionally, select the Omit Clouds in Cube Map check box.

4.8. Flashlight Mode

VR-Forces can light a circular area as if the observer is using a aflashlight. You can move the flashlight beam and increase or decrease the diameter of the flashlight beam.

Figure 43. Flashlight mode

➤ To turn flashlight mode on or off, press **F**.

➤ To move the flashlight beam, hold down **Alt** and the right mouse button, then move the mouse.

➤ To change the size of the flashlight beam, hold down **Alt** and move the mouse scroll wheel forward or back.

4.9. Using High Dynamic Range Lighting

High dynamic range (HDR) lighting makes scenes look more realistic. They look particularly good on HDR monitors. HDR is enabled by default.

➤ **To configure HDR lighting:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the High Dynamic Range Settings page (Figure 40 on page 49).
3. To enable or disable HDR lighting, select or clear the Enable High Dynamic Range check box.
4. Enable other settings as desired.
5. For those settings that are enabled, adjust their parameters. Table 1 describes the HDR settings.

Table 1. HDR settings

Setting	Description
Enable High Dynamic Range	Turns High Dynamic Range (HDR) on and off. When HDR is turned on, the scene is rendered in 16 bits per color floating point and then tone mapped to 8 bits per color before being sent to the display. Additionally, there are post-process effects applied to objects that are greater than the display range.
Enable Auto Exposure	Turns auto exposure on and off, which is a post process that scales the intensity of the rendered image based on the intensity of the screen. When auto exposure is turned off, the global lighting values are used to scale the intensity to a reasonable value.
Enable Exposure Correlation	When auto exposure is enabled, this controls whether all the channels share the same auto exposure adjustment. When enabled, all channels use the exposure for the main luminance. If if it disabled, each channel across master or slave computes its own luminance.
Enable Bloom	Turns the bloom post process effect on and off. This effect is a blurring of high intensity objects in the scene which gives a glow around bright objects like light points.
Enable Lens Flare	Turns the lens flare post process effect on and off. This effect creates a lens flare effect for high intensity objects.
Enable Streaks	Turns the streak post process effect on and off. This effect creates a star effect by streaking the high intensity objects in all directions.
Advanced Settings	
Dynamic Light Scale	When HDR is turned on, the intensity of dynamic lights are scaled by this setting.
Emissive Texture Scale	When HDR is turned on, the intensity of the emissive textures is scaled by this setting.
Light Point Scale	When HDR is turned on, light point intensity is scaled by this setting.

Table 1. HDR settings (continued)

Setting	Description
Shininess Scale	When HDR is turned on the lighting shininess component is scaled by this setting. Exposure adjustments are all related to how the intensity of the scene is scaled before being tone mapped. These values are in order based on when they are applied to the scalar.
Specular Scale	When HDR is turned on the lighting specular component is scaled by this setting.
Rate Scale	When Auto Exposure is enabled, this scales the time it takes for the auto exposure to adjust to changes in the scene. Increase this value to reduce the time it takes for the auto exposure to adjust.
Pre Scale	When Auto Exposure is enabled, this scales the calculated intensity for the scene. Increase this value to reduce the overall intensity of the final image.
Min Difference	When Auto Exposure is enabled, this clamps the minimum value of the calculated intensity to a portion of the global lighting value. This is used to prevent the auto exposure from going too low compared to the global lighting value.
Max Difference	When Auto Exposure is enabled, this clamps the maximum value of the calculated intensity to a portion of the global lighting value. This is used to prevent the auto exposure from going too high compared to the global lighting value.
Post Scale	Scales the scalar after all Auto Exposure calculations have been done. This also affects the global lighting value when Auto Exposure is turned off. Increase this value to reduce the overall intensity of the final image.
Final Clamp Min	The minimum value for the final value that will be used to scale the intensity prior to tone mapping.
Final Clamp Max	The maximum value for the final value that will be used to scale the intensity prior to tone mapping.
Bloom Scale	Scales the bloom before it is applied to the scene. Increase this value to increase the intensity of the bloom effect on high intensity objects.
Lens Flare Scale	Scales the lens flare effect before it is applied to the scene. Increase this value to increase the intensity of the lens flare effect.
Streak Intensity Scale	Scales the streaks before they are applied to the scene. Increase this value to increase the intensity of the streak effect on high intensity objects.
Number of Streaks	Number of streaks that the streak effect will create for each high intensity object. Maximum of 8 streaks.
Streak Length Scale	Scales the length of the streak effect. Increase this value to increase the length of the streak effect.

Table 1. HDR settings (continued)

Setting	Description
Streak Rotation Offset	Rotates the streak effect so that it changes the direction that the streaks point.
Gamma	Final color correction used to adjust the image based on the display. Change this value based on the characteristics of the display being used.

4.10. Disabling Lighting and Clouds

When you are using XR observer mode and you move the observer out from the terrain, the lighting and cloud effects can interfere with your ability to view simulation objects. Therefore, VR-Forces lets you quickly disable lighting effects and clouds. By default, they are enabled in Stealth observer mode and disabled in XR observer mode.

➤ To enable or disable lighting and clouds, choose **Observer > Sky**.

4.11. Displaying Shadows (3D Only)

VR-Forces can display shadows for props, entities, and terrain features (Figure 44). It can also display shadows on the ocean.

Figure 44. Shadows

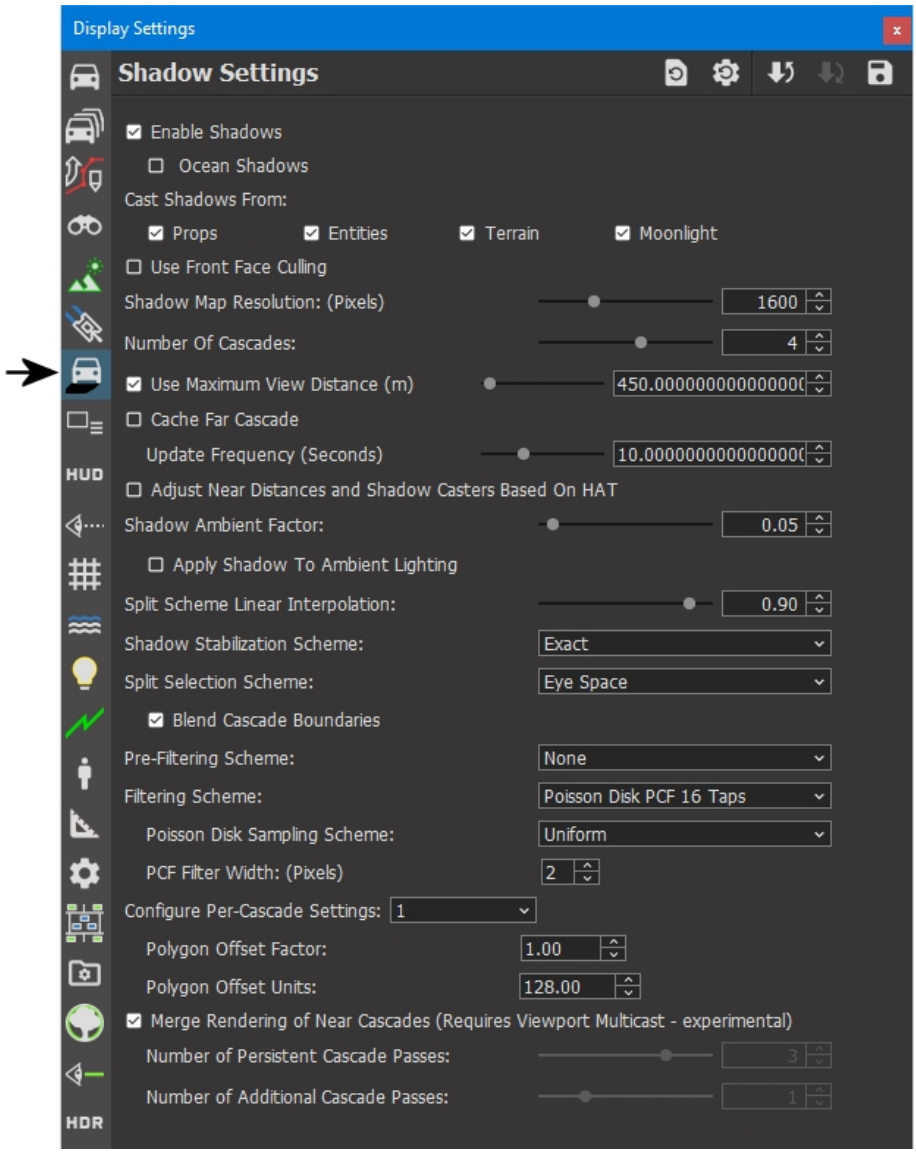
You can enable and disable shadows, and you can also configure shadow quality.

ⓘ Enabling shadows can affect performance.

➤ **To enable and disable shadows globally:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Shadow Settings page (Figure 45).

Figure 45. Display Settings, Shadow Settings page



3. Select or clear the Enable Shadows check box to controls shadows on the terrain.
4. Select or clear the Ocean Shadows check box to control shadows on only the dynamic ocean.
5. To enable or disable shadows for specific object types, select or clear the check boxes under Cast Shadows From.

ⓘ You can also enable and disable shadows by choosing **Settings > Shadows**.

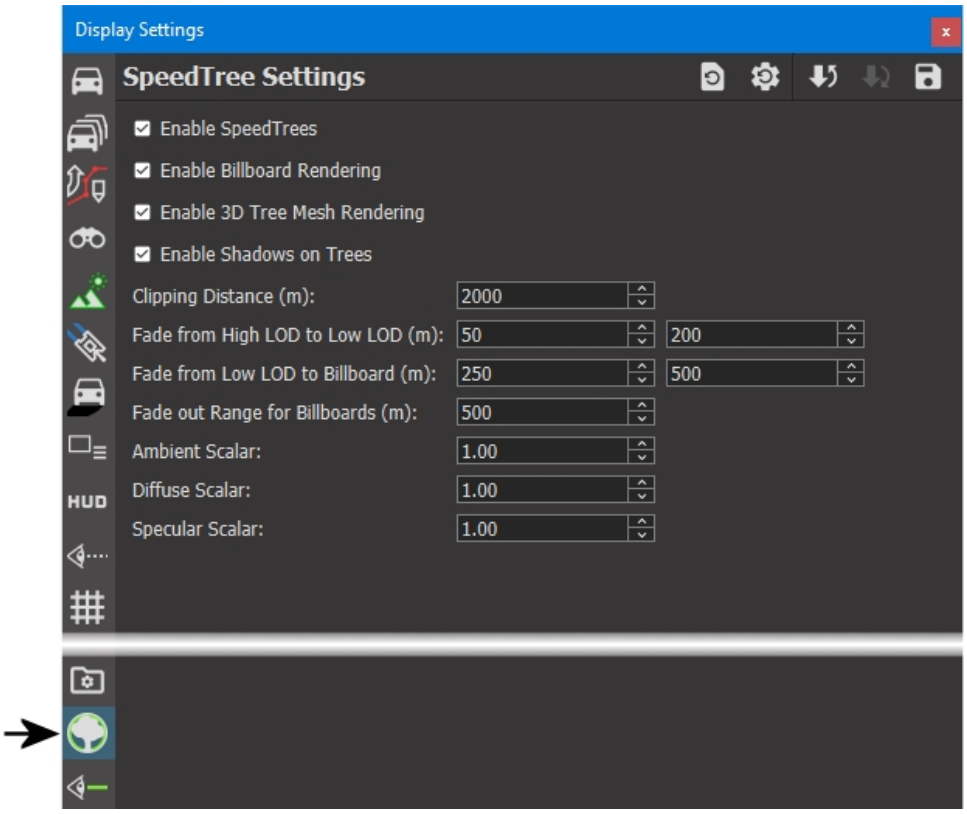
4.11.1 Enabling Shadows on Trees

You can enable and disable casting of shadows on SpeedTree trees.

➤ **To enable or disable casting shadows on SpeedTree trees:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the SpeedTree Settings page (Figure 46).

Figure 46. SpeedTree Settings page



3. Select or clear the Enable Shadows on Trees check box.

4.11.2 Configuring Shadows

You can configure which objects cast shadows and parameters that affect performance and the quality of shadows.

Shadows are drawn based on a shadow map. A shadow map determines what parts of a scene are in shadow relative to a light source. Then the scene is drawn showing the shadows that would be visible from the viewpoint of the observer.

Scenes are split into sections, called cascades. The cascades that are closest to the camera show the highest resolution shadows. Many of the settings control the size of cascades and how they merge together.

For an in-depth understanding of how shadows are rendered in 3D scenes, please see the many articles available on the world wide web.

➤ **To configure how shadows are rendered:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Shadow Settings page (Figure 45 on page 55).
3. Change the parameters as desired. Table 2 briefly describes them.

Table 2. Shadow settings

Setting	Description
Use Front Face Culling	Use of face front culling is a choice between more shadow acne (an effect similar to Z-fighting) and more light bleeding artifacts.
Shadow Map Resolution	Increasing shadow map resolution provides more detail at the cost of performance and increased memory use.
Number of Cascades	The more cascades there are, the more detail is rendered, at the expense of memory usage and performance.
Use Maximum View Distance	If enabled, specifies how far away shadows are displayed. The smaller the area in which shadows are displayed, the more quickly they are displayed and the higher the quality. If disabled, uses the scene values.
Cache Far Cascade	Caches the farthest cascade and updates it less frequently than the near cascade, which increases performance.
Adjust Near Distances and Shadow Casters Based On HAT	As the observer moves higher above the terrain, the near cascade shrinks and only entities are rendered to them. The far cascade becomes responsible for the terrain shadows.
Shadow Ambient Factor	Fades out shadows. It determines how much light gets through.
Apply Shadow to Ambient Lighting	By default, shadows only affect the diffuse and specular lighting. Enable this option to also apply shadows to ambient lighting. This can make shadows darker.
Split Scheme Linear Interpolation	Adjusts how cascades are distributed between a logarithmic approach and a linear approach.
Shadow Stabilization Scheme	A list of different ways to reduce the shimmer that is common in shadow maps.
Split Selection Scheme	A list of different ways to choose which cascade a piece of geometry is in.
Pre-Filtering Scheme	A list of different shadow casing techniques to try to smooth shadows.
Filtering Scheme	Affects how blurred the shadow map is.

Table 2. Shadow settings (continued)

Setting	Description
Configure Per-Cascade Settings	Lets you configure the polygon offset for cascades.
Merge Rendering of Near Cascades	Lets you draw cascades all at once instead of individually. This improves performance. It is available on supported video cards (NVIDIA 980 or newer). If disabled, you can configure the number of cascades passes to draw shadows.

5. Marine Effects

This chapter describes different marine effects and water droplets.

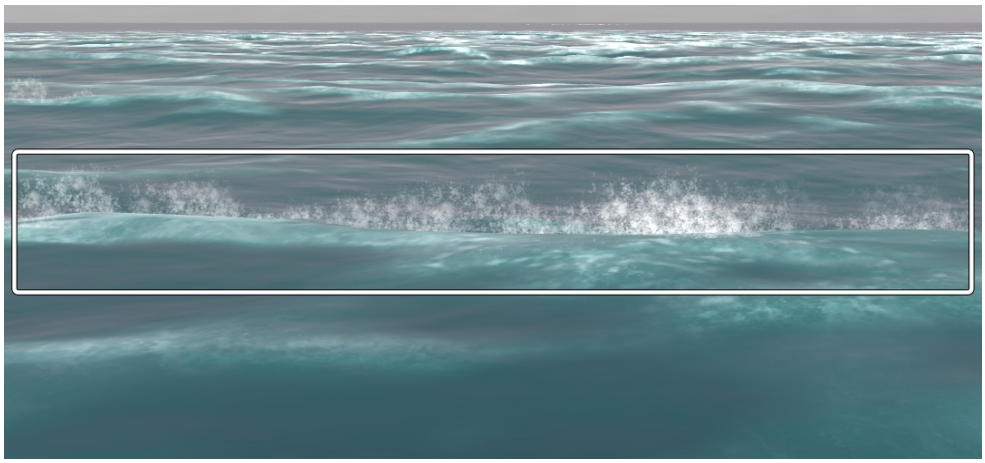
5.1. Displaying Water Droplets and Splash Effects

When it is raining, VR-Forces can simulate raindrops hitting the observer's camera lens (Figure 47). If the observer is close to the surface of the ocean (as if a periscope were being raised or lowered), VR-Forces can simulate the effect of waves and water droplets splashing on the observer's camera.

Figure 47. Rain effect

When dynamic ocean is enabled, VR-Forces can simulate sea spray (most visible in high seas) (Figure 48). It can also display rotor wash for hovering helicopters. You can display rotor wash at two levels of quality.

Figure 48. Sea spray effects

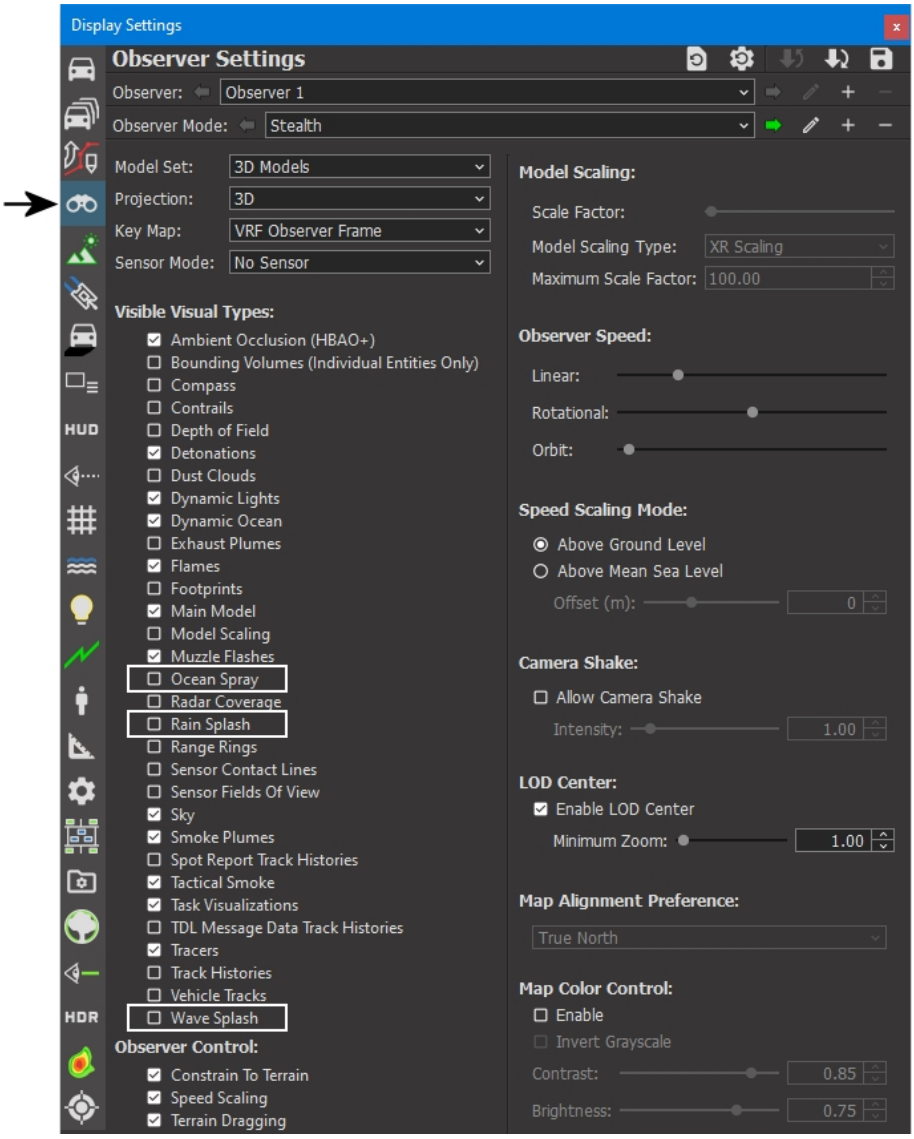


You can change the size of the water droplets for splash effects and sea spray. For details, see "5.1.2 Setting the Size of Water Droplets" on page 62.

➤ **To enable or disable splash effects on the camera:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 49).

Figure 49. Observer Settings page



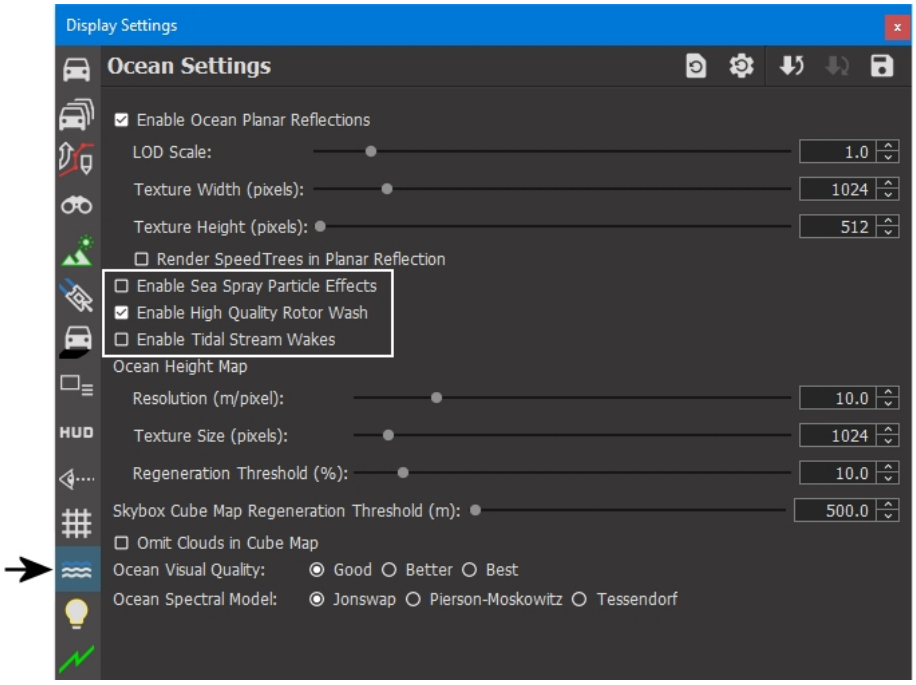
3. Select or clear the Ocean Spray, Rain Splash, or Wave Splash visible visual type check boxes.

5.1.1 Enabling Sea Spray

➤ **To enable sea spray effects:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 50).

Figure 50. Ocean Settings page



3. Select Enable Sea Spray Particle Effects.

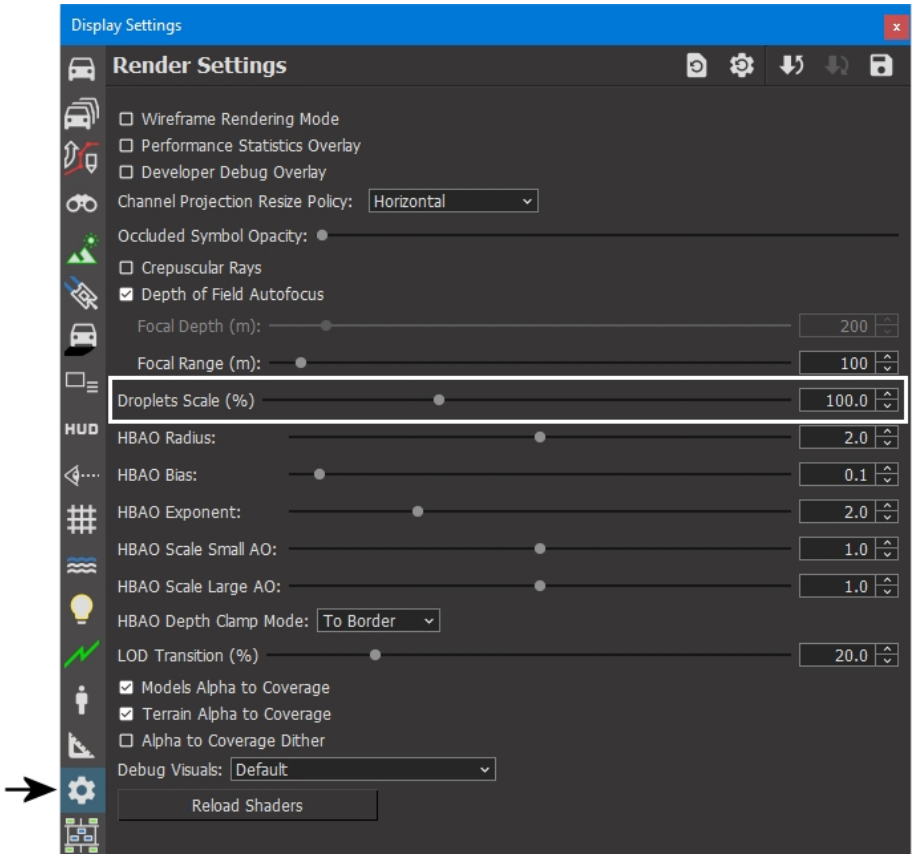
5.1.2 Setting the Size of Water Droplets

You can change the size of water droplets for splash effects and sea spray.

➤ **To change the size of water droplets:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 51).

Figure 51. Render Settings page



3. Adjust the Droplets Scale slider or enter a value in the box.

5.1.3 Enabling and Disabling Rotor Wash

If dynamic ocean is enabled, VR-Forces can display rotor wash over the water for rotary-wing entities. VR-Forces can also display rotor wash over land for some soil types. You can enable or disable rotor wash globally.

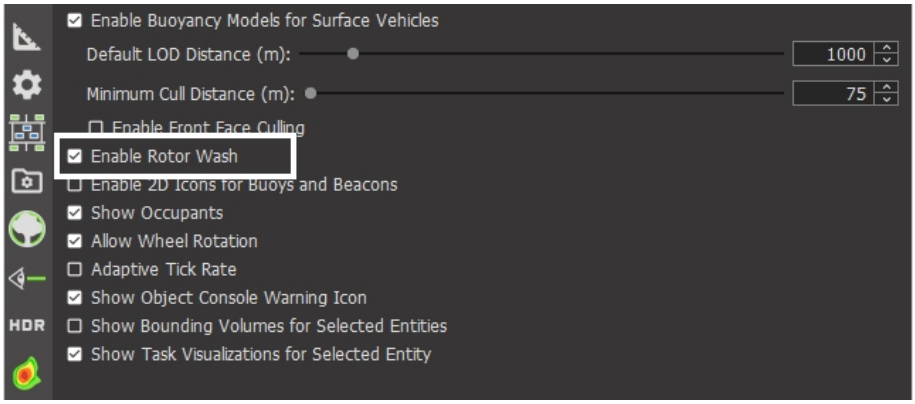
Rotor wash is a particle system. You can edit rotor wash particle systems in the Particle System Editor. For details, see *Special Effects (Particle Systems)* in the *Adding Content to MAK ONE Applications Reference Manual*.

> ⓘ VR-Forces displays rotor wash only for helicopters that are simulated by VR-Forces. There is no DIS or HLA standard for rotor wash. VR-Forces sends special messages to enable its display.

➤ **To enable or disable rotor wash:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 52).

Figure 52. Rotor wash option



3. Select or clear the Enable Rotor Wash check box.

5.1.4 Enabling High Quality Rotor Wash

➤ **To enable or disable high quality rotor wash:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 50 on page 62).
3. Select or clear the Enable High Quality Rotor Wash check box.

5.2. Displaying Wakes and Spray Effects

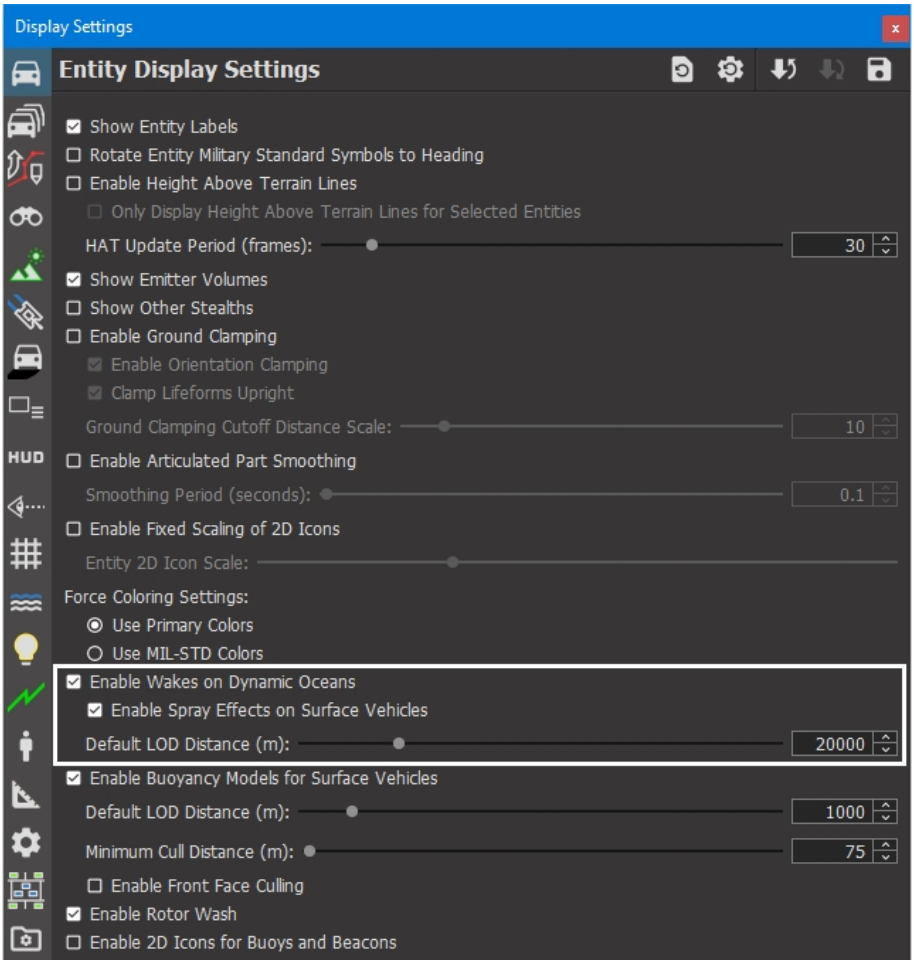
When dynamic ocean is enabled, surface entities display wakes and spray effects. However, these effects affect performance. You can disable them if you need to emphasize performance over visual effects.

Wakes have their own schema, with many attributes, including length, offset, the amount of time over which they fade out, and LOD distance. You can edit these attributes for individual entities in the Visual Model Editors dialog box.

➤ **To enable or disable wakes and spray effects:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 53).

Figure 53. Entity Display Settings page



3. To enable or disable wakes, select or clear the Enable Wakes on Dynamic Oceans check box.
4. If wakes are enabled, select Enable Spray Effects on Surface Vehicles to enable spray effects. Clear the check box to disable them. Disabling wakes also disables spray effects.

5.3. Enabling Buoyancy for Surface Entities

When dynamic ocean is enabled, surface entities can bob up and down with wave action. Be aware that the buoyancy models affect performance. You can disable buoyancy if you need to emphasize performance over visual effects. You can also control the area where buoyancy models are calculated.

If buoyancy is enabled, VR-Forces calculates buoyancy only for models within certain distances of the observer:

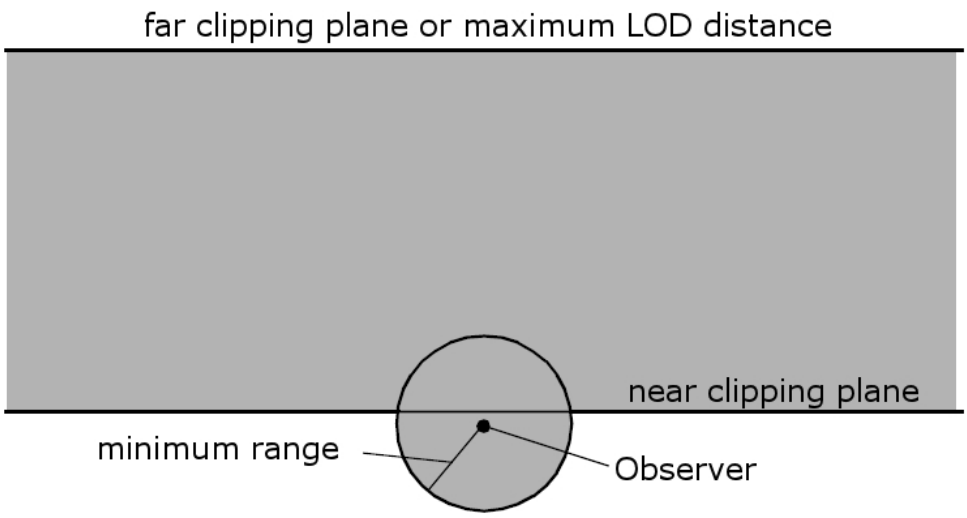
- Buoyancy models are always calculated for entities within the minimum cull distance. This ensures that if the observer turns, entities that are relatively near show buoyancy immediately.

- Buoyancy models are not calculated for entities that are beyond the maximum buoyancy LOD range. You can set this value on a per-entity basis in its entity model definition. If it is not set in the model definition, VR-Forces uses the default LOD distance specified on the Entity Display Settings page. If the default distance is set to 0.0, then entities that do not have an LOD range set in their model definitions have an infinite buoyancy range (although buoyancy is still not calculated past the far clipping plane).
- Buoyancy models are not calculated for entities beyond the far clipping plane or nearer than the near clipping plane.

ⓘ VR-Forces uses the nearer of the far clipping plane or the maximum buoyancy LOD range to determine the distance at which it stops calculating buoyancy models.

When buoyancy is enabled, you can specify that VR-Forces use face front culling. VR-Forces calculates buoyancy models for all entities within the minimum range and all entities between the near clipping plane and the far clipping plane or maximum buoyancy LOD range, whichever is closest. In Figure 54, the shaded area is the area in which buoyancy models are calculated.

Figure 54. Face front culling



By default, face front culling is disabled and only distance culling is used.

➤ **To enable or disable the buoyancy models:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 53 on the previous page).
3. Select or clear the Enable Buoyancy Models for Surface Vehicles check box.
4. To specify the distance beyond which buoyancy models are not calculated, adjust the adjacent Default LOD Distance slider or change the value in the box. (If the default distance is set to 0, then entities that do not have an LOD range set in their model definitions have an infinite buoyancy range. However, buoyancy is not

calculated past the far clipping plane.)

5. To specify the radius within which all entities have their buoyancy models calculated, adjust the Minimum Cull Distance slider or change the value in the box.
6. Optionally, specify use of face front culling.

6. Using CameraFX Sensor Views

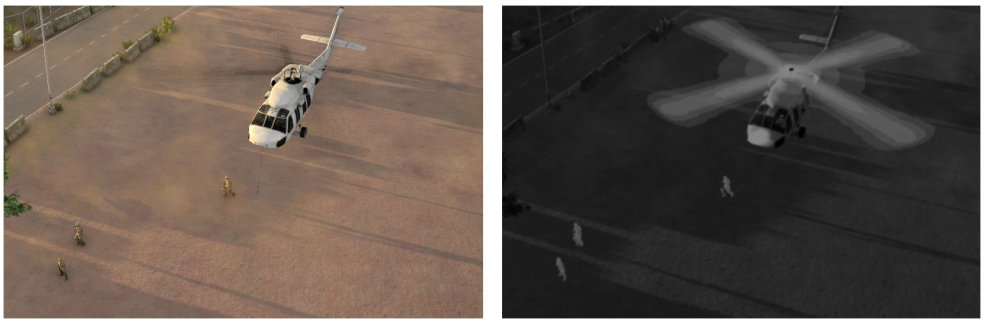
This chapter explains how to enable and configure simulated night-vision goggle (NVG) and infrared views of the scene.

6.1. Using Sensors

VR-Forces can simulate the way that the 3D scene would look if an observer were using visual sensor devices such as night vision goggles or viewing the infrared spectrum (Figure 55). This is an observer-specific setting. You can adjust the contrast, blur, and noise of the view.

VR-Forces includes one sensor module: CameraFX, which uses the SenSim libraries from JRM Technologies. The sensors do not take into account the materials of the objects that you are viewing. They simply filter the view to produce the desired effect. CameraFX supports only one "ActiveRegion" per entity based on the power plant status. If you want physics-based sensor effects, you can purchase the SensorFX Plug-in for VR-Forces, developed by JRM. For details, please contact your MAK salesperson.

Figure 55. CameraFX - dawn, no sensor and IR sensor



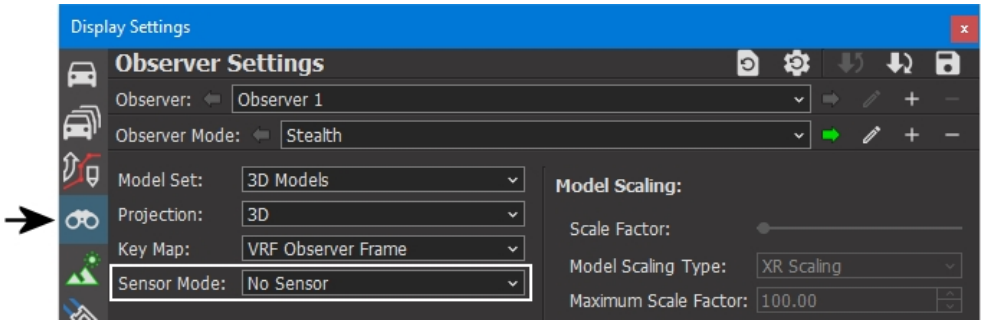
ⓘ The sensors described in this chapter are strictly visual effects. They have no relationship to the sensor systems used by simulation objects.

6.2. Enabling Sensors

Sensors are observer-specific (Figure 56). VR-Forces includes observer modes that have sensors enabled. The names of the observer modes match the sensor modes that they enable.

- NVG (CameraFX) (night vision goggles).
- IR (CameraFX) (infrared).
- IR BlackHot (CameraFX).
- Camera (CameraFX). This mode uses the Visual Camera sensor mode.

Figure 56. Sensor setting for observer mode



The default settings for the Camera observer mode make it look very similar to Stealth observer mode. The difference is that when you use the Camera observer mode, you can change the view by changing the sensor settings, such as blur, noise, and gain.

You can also specify use of a sensor configuration as a channel attribute.

➤ **To enable sensors, do one of the following:**

- Select an observer mode that has a sensor configured.
- Edit an observer mode to use a sensor.
- Create a new observer mode and configure it with a sensor.
- Change the Sensor attribute for a channel.

For details about creating and editing observer modes, see "Creating and Editing Observer Modes". For details about editing channel attributes, see "Changing a Channel's Attributes".

6.3. Configuring Sensors

You can configure the following aspects of sensors:

- Blur. The sharpness of the image.
- Noise. The graininess of the image.
- Gain. The contrast and brightness of the image. (IR only)
- Lighting overrides. You can adjust the amount of ambient and diffuse light and the intensity of light emitted by DI-Guys and other entities.
- Sensor texture. VR-Vantage supports a shader-based effects map called a Sensor Texture map. This is a three-channel texture that adds the red, green, or blue channels as appropriate when the observer is in an NVG CameraFX or IR mode. You can enable and disable use of these textures and specify their intensity. For more information about shader-based effects maps, see "Using Shader-based Effect Maps" in the *Adding Content to MAK ONE Applications Reference Manual*.

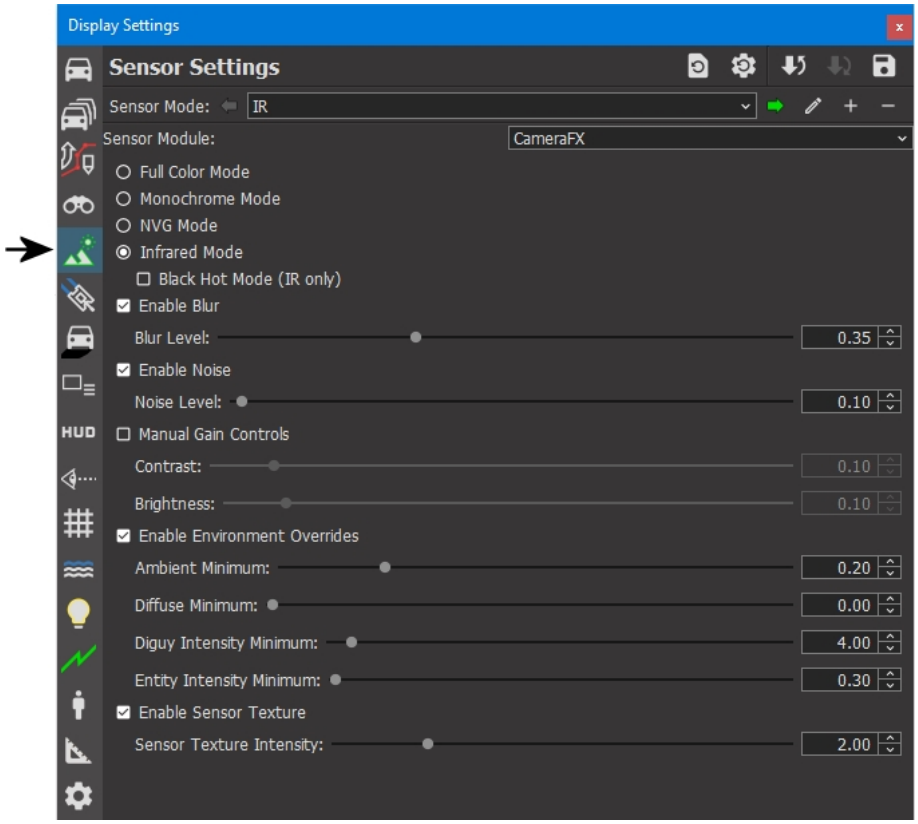
You can configure a separate set of settings for each sensor type. VR-Forces remembers the settings. When you change the settings for a sensor type, they affect the display only if that sensor type is in use. For example, if you select NVG in the sensor list on the Observer

Settings page, and select IR in the Sensors list on the Sensor Settings page, the changes you make to the IR configuration do not affect the NVG display you are looking at. If you then switch to IR in the VR-Forces window, the new IR settings take effect.

➤ **To configure sensors:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Sensor Settings page (Figure 57).

Figure 57. Sensor Settings page



3. In the Sensor Mode list, select the sensor that you want to configure.
4. Select the Sensor module from the list.
5. Select the sensor mode (Monochrome, NVG, and so on). If you select Infrared Mode, select or clear the Black Hot Mode check box.

- It may seem obvious that if, for example, you select NVG from the Sensor Mode list, you would select it for the sensor type. However, VR-Forces lets you add additional sensor configurations to the list and, in that case, you would need to specify the correct sensor type for the new sensor. For example, you might create a sensor called NVG-High Contrast. Then you would select NVG as the sensor type and adjust the contrast accordingly.
- Full Color Mode provides natural coloring, as you would see with no sensor modes applied. The benefit of creating a sensor mode using this option is that you can apply noise or blur to the scene.

6. For each setting you want to change, select the controlling check box and adjust the sliders.

6.4. Adding New Sensors

You can add, rename, and delete sensors.

➤ **To add a sensor:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Sensor Settings page (Figure 57 on the previous page).
3. On the Sensor Mode line, click the Add button (+). A new sensor called sensor_*number* is added. There are no configuration options on the page. (To rename the sensor, click the Rename button (✎) and enter a new name.)
4. In the Sensor Module list, select CameraFX. The available configuration options are added to the page.
5. Select the type of sensor that you want this to be (Full Color, Monochrome, Infrared, or NVG).
6. Set the Blur, Noise, and Gain levels.

7. Intervisibility and Range

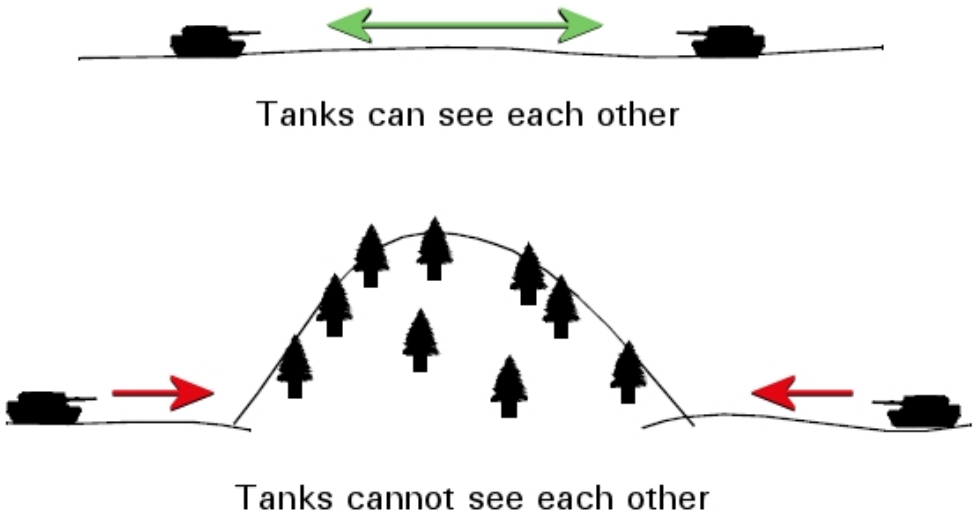
This chapter explains how to use the intervisibility and range line features.

7.1. Intervisibility (Line-of-Sight)

You can display intervisibility (line-of-sight or LOS) between points, within areas, and between a point and all simulation objects in a defined area. Intervisibility displays can be transient or permanent. Permanent intervisibility displays are objects. You can resize them and move them around the terrain. Intervisibility objects can be tied to a particular simulation object.

You can display a terrain profile for point-to-point intervisibility lines.

Figure 58. Intervisibility



You can configure parameters for intervisibility objects, such as the height above the terrain from which intervisibility is calculated. You can also change the colors used to display intervisibility.

- By default, intervisibility between simulation objects is calculated from the center of their bounding volumes. It is possible that this may not match the line-of-sight calculations used by the simulation application whose output you are viewing. If so, simulation objects may shoot at targets for which they do not appear to have line-of-sight. The VR-Forces target detection sensor uses an offset, which is often above the center of the entity. Unless you change the Origin LOS Elevation value in the Intervisibility Options dialog box to use the same offset as the target detection sensor, simulation objects may shoot at targets for which they do not appear to have line-of-sight.
- Linear and areal features do not block line-of-sight. Only point features block LOS.

7.2. Types of Intervisibility

VR-Forces supports these types of intervisibility:

- Point-to-point (intervisibility line).
- Intervisibility fan.
- Entity intervisibility.

The intervisibility fan and entity intervisibility are displayed as a circular area. However, intervisibility calculations are made within a cylindrical area extending above and below the terrain, so that intervisibility calculations can be made for air platform entities and subsurface entities.

In the 2D view, intervisibility lines are fully visible on the terrain. In the 3D view, they may pass through the terrain.

7.2.1 Point-to-Point Intervisibility

Point-to-point intervisibility (Figure 59) shows the line-of-sight between any two points. The portion of the line that is visible from the starting point is green. The portion that is not visible is red. You can change the colors used.

Figure 59. Point-to-point intervisibility - 2D and 3D

7.2.2 Intervisibility Fan

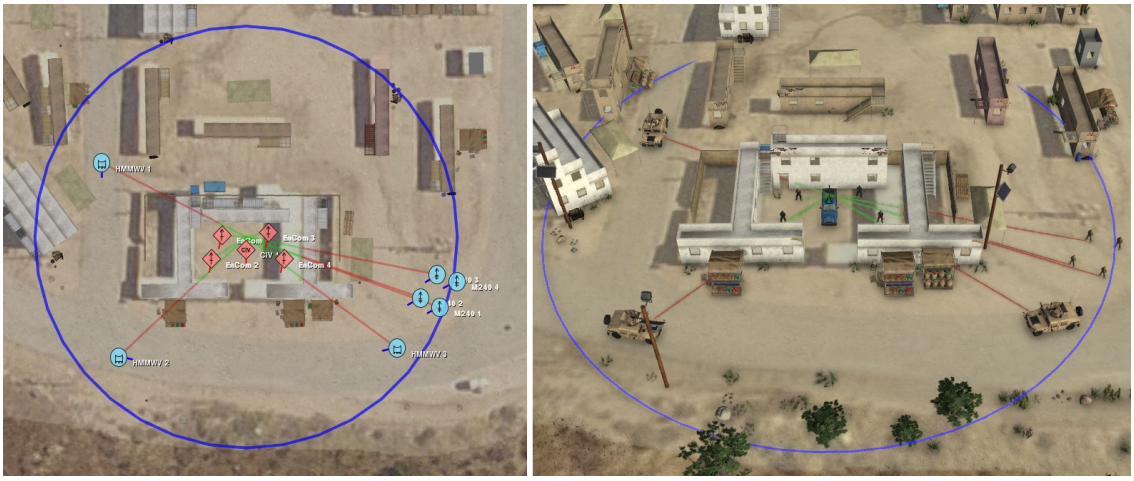
An intervisibility fan (Figure 60) shows a series of lines radiating from the center of a circle to its outer edge. Each ray shows intervisibility along its path from the origin to the border. You can configure the distance between rays. (For details, see "7.5. Configuring Intervisibility Lines and Fans" on page 81.)

Figure 60. Intervisibility fan - 2D and 3D

7.2.3 Simulation Object Intervisibility

Simulation object intervisibility (Figure 61) shows which simulation objects are visible from the center of a defined area and whether the simulation objects can see the center point. If you center the intervisibility circle on a point on the terrain, you can see which simulation objects can see that point. If you lock the circle to a simulation object, you can see which simulation objects can see that object and which it can see. (For details, see "7.5. Configuring Intervisibility Lines and Fans" on page 81.)

Figure 61. Simulation object intervisibility - 2D and 3D



7.3. Intervisibility Objects Can Be Transient or Permanent

You can configure intervisibility objects to be transient or permanent. (For details, see "7.5. Configuring Intervisibility Lines and Fans" on page 81.) A transient intervisibility object displays intervisibility from the origin point (defined by a mouse click) to wherever you move the cursor. If you click the mouse again, you reset the origin. You cannot use the mouse for other actions until you exit intervisibility mode (by right-clicking). This mode is convenient when you want to quickly check intervisibility, but do not want to keep intervisibility objects in the display.

A permanent intervisibility object stays in the display after you create it. You can resize the object, edit drawing options, and move it around the display. Intervisibility objects are not saved as part of the scenario.

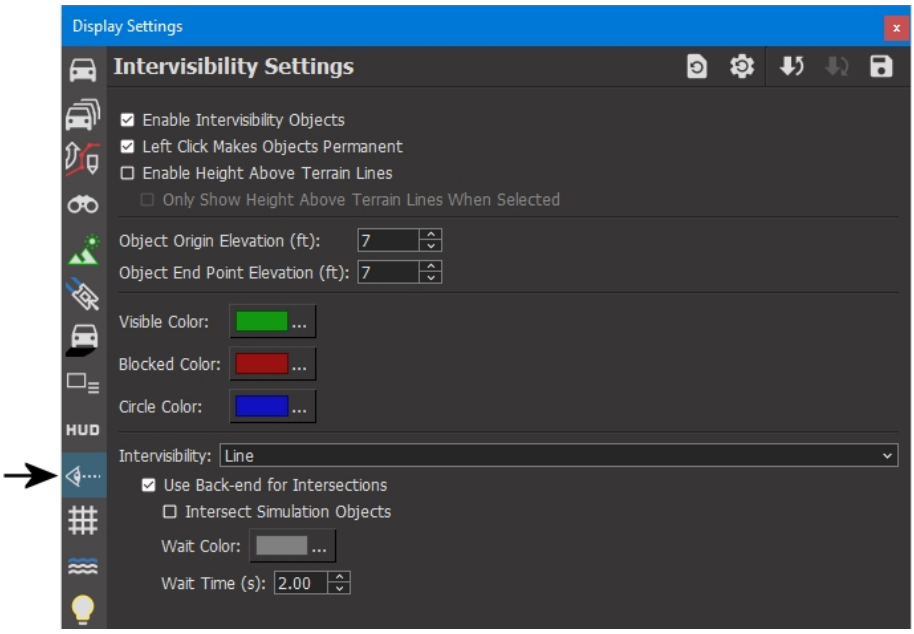
7.3.1 Creating a Transient Intervisibility Object

Transient intervisibility objects do not stay in the display after you quit intervisibility mode.

➤ **To display transient intervisibility:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 62).

Figure 62. Intervisibility Settings page



3. Clear the Left Click Makes Objects Permanent check box.
4. Choose **Intervisibility > Create** *intervisibility_type*, where *intervisibility_type* is a type of intervisibility object, or click one of the buttons on the Intervisibility Toolbar.
5. Click on the terrain to place the origin of the intervisibility object.
6. Move the cursor around the terrain to expand and contract the object. For point-to-point intervisibility, moving the cursor also changes the direction of the line.
7. To change the origin of the intervisibility display, click another location on the terrain.
8. Right-click to cancel intervisibility mode.

7.3.2 Creating a Permanent Intervisibility Object

Permanent intervisibility objects remain in the display after you create them. (However, they are not saved as part of the scenario.)

➤ **To create a permanent intervisibility object:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 62 on the previous page).
3. Select Enable Intervisibility Objects.
4. Select Left Click Makes Objects Permanent.
5. Choose **Intervisibility > Create** *intervisibility_type*, where *intervisibility_type* is a type of intervisibility object, or click one of the buttons on the Intervisibility Toolbar.
6. Click on a simulation object or on a location on the terrain where you want the origin of the intervisibility object to be located. An intervisibility object is displayed. As you move the cursor closer to the origin, or farther away from it, the circle or line contracts and expands. If you are displaying point-to-point, you can rotate the line around the origin before you specify the end point.
7. Click on the terrain where you want to fix the end point of a line or border of a circle.

7.4. Editing an Intervisibility Object

You can change these aspects of an intervisibility object:

- The location of either end point of an intervisibility line, to change its length and direction.
- The origin of an intervisibility fan, thereby moving the entire fan.
- The diameter of an intervisibility fan.

ⓘ If an intervisibility object is anchored to a simulation object, you cannot change the origin.

➤ **To change the length or diameter of an intervisibility object:**

1. To edit a line, double-click its end point.

   To edit a fan, select the object, then double-click the outer ring of the fan.

   The cursor changes to ✣ (a four-way arrow).
2. Drag the end point or circle towards or away from the origin. If you are editing an intervisibility line, you can move the end point to any location.
3. Click to exit edit mode.

ⓘ To revert to the original size of the intervisibility object, right-click while you are still in edit mode.

➤ **To move an intervisibility fan or line:**

1. Double-click a fan's center point or any place on a line. The cursor changes.
2. Drag the object to a new location.

3. Click to set the location.

> To revert to the original location of the intervisibility object, right-click while you are still in edit mode.

7.5. Configuring Intervisibility Lines and Fans

You can configure attributes of intervisibility objects:

- The elevation of the origin and end point.
- The sampling rate for intervisibility fans.
- The update rate for entity intervisibility fans.
- Display of height above terrain lines (3D) and height labels (3D and 2D).
- The colors used to display intervisibility objects.

When you change colors or the sampling rate, changes affect all existing intervisibility objects. Changes to the origin and end point elevation only affect newly created objects.

VR-Forces can calculate intersections in the GUI or sim. engine.

➤ **To configure intervisibility objects:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 62 on page 79).
3. For Intersection configuration, select the intervisibility object to configure in the Intervisibility list.
4. Change the settings as desired. Table 3 describes the settings.

Table 3. Intervisibility settings

Option	Description
Enable Intervisibility Objects	Enables the creation of intervisibility objects.
Left Click Makes Objects Permanent	Enables permanent intervisibility objects. See "7.3.1 Creating a Transient Intervisibility Object" on page 79 and "7.3.2 Creating a Permanent Intervisibility Object" on page 79.
Enable Height Above Terrain Lines	Enables or disables display of height above terrain lines (3D) and height labels (3D and 2D).
Only Show Height Above Terrain Lines Only for Selected	If selected, HAT lines are displayed only for the selected intervisibility objects.

Table 3. Intervisibility settings (continued)

Option	Description
Object Origin Elevation	The height, in meters, above the terrain at the origin point from which to calculate intervisibility.
Object End Point Elevation	The height, in meters, above the terrain at the end point to use to calculate intervisibility.
Visible Color Blocked Color	The colors to use for the portion of an intervisibility line that a simulation object can see and the portion where visibility is blocked.
Circle Color	The color to use for the outer circle of an intervisibility fan.
Intersections	
Intervisibility	You can select Line, Fan, or Object Fan.
Use Sim. Engine for Intersections	Select this check box to calculate intersections based on the sim. engine. Clear this check box to use the GUI.
Intersect Simulation Objects	Select this check box to include simulation objects when calculating intervisibility in the sim. engine.
Wait Color	Specify the color to display on simulation objects while VR-Forces calculates intervisibility.
Wait Time	Specify the delay after an entity stops moving to query the sim. engine for intersection information. If the entity begins moving again before the information is received from the sim. engine, VR-Forces ignores the sim. engine result. If you set the time to 0, you could flood the network with requests and impact performance.
Fan Line Sample Interval	The distance, in degrees, between each ray in a intervisibility fan. After changing this value, press **Enter** or click away from the field. (This field is only available when you select Fan from the Intervisibility list.)

7.6. Pinning an Intervisibility Object to a Simulation Object

When you pin an intervisibility object to a simulation object, the intervisibility object moves with the simulation object and you know that its origin is centered on the simulation object.

➤ **To pin an intervisibility object to a simulation object:**

1. Select the simulation object to which you want to pin the intervisibility object.
2. Choose **Intervisibility > Create** *intervisibility_type*, where *intervisibility_type* is a type of intervisibility object, or click one of the buttons on the Intervisibility Toolbar. The origin is placed on the simulation object icon or model.
3. Specify the end point for the intervisibility object.

7.7. Showing and Hiding Intervisibility Lines

You can toggle the display of intervisibility lines on and off.

➤ **To enable or disable the display of intervisibility lines:**

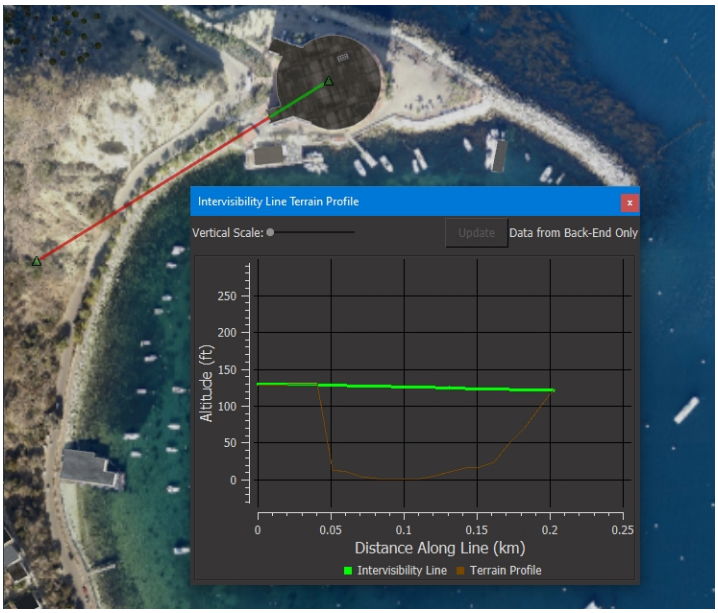
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 62 on page 79).
3. Select or clear the Enable Intervisibility Objects check box.

> You can also enable and disable display of intervisibility objects by choosing **Intervisibility > Enable/Disable Intervisibility**, or by clicking the Enable/Disable Intervisibility button () on the Intervisibility Toolbar.

7.8. Displaying an Intervisibility Line's Terrain Profile

By default, a terrain profile window is displayed automatically when you create an intervisibility line. The terrain profile can be very helpful when you try to understand how terrain changes are affecting intervisibility. Figure 63 shows an obstructed intervisibility line and its terrain profile, whose graph illustrates the line intersecting the terrain.

Figure 63. Terrain profile for an intervisibility line



You can disable this setting on the Display Settings dialog box, Terrain Profile Settings page. For details, see "Configuring Terrain Profiles".

7.9. Deleting Intervisibility Objects

Before you delete an intervisibility object, note that:

- If you delete a simulation object that has an intervisibility object pinned to it, the intervisibility object is also deleted.
- If an intervisibility object is pinned to a simulation object, you can delete the intervisibility object without affecting the simulation object by selecting the outer circle or end point and then deleting it.

➤ To delete an intervisibility object, select the object and choose **Intervisibility > Delete** (or press **Delete**).

7.10. Range Lines

During a session, range lines allow you to see the great circle distance and bearing between a start and end point in the Plan View (2D). The distance between the two points and the bearing from the start point to the end point display at the midpoint of the line. If the end points move, for example, the simulation object it is attached to is moving, then this information changes to reflect the change in distance and heading.

See "7.10.1 Creating a Range Line" below and "7.10.3 Configuring Range Lines" on page 86 for details about using this feature.

7.10.1 Creating a Range Line

You can create a range line in the Plan View to see the great circle distance between two points and also the bearing from the start point to the end point.

When you create a line from the context menu or Create menu, you can place each end of the line on a point in the terrain or attach it to a simulation object. If either end of a range line is attached to a simulation object, the distance and bearing information updates as the simulation object moves.

You can also quickly draw a range line using the middle mouse button to measure a distance without connecting it to any objects. This is useful when you want to quickly check the distance and bearing between two points.

Figure 64. Placing a range line on the terrain

Figure 65. Attaching a range line to a simulation object

➤ **To draw a quick range line:**

1. Position the cursor at the position you want to measure from and then press and hold the middle mouse button.
2. Move the cursor to the position you want to measure to. Observe the information displayed beside the line.
3. When you are finished, release the middle mouse button. The line disappears.

➤ **To create a range line from the context menu:**

1. Right-click on a point in the terrain or on a simulation object. If you click on a simulation object, that is the start point for the range line.
2. From the context menu, choose **Create > Create Range Line**. If you clicked on a simulation object, continue to step 4.
3. Click to place the start point on a place in the terrain or on a simulation object (if one is not already selected).
4. Click to place the end point. You can also place it on the terrain or a simulation object.

➤ **To create a range line from the Create menu:**

1. Choose **Create > Create Range Line**. If a simulation object is selected, that is the start point for the range line. Continue to step 3.
2. If you did not have a simulation object selected, position the cursor where you want the range line to begin. If you want to attach it to a simulation object, place the cursor over that object until its outline turns white and then click. To place the start point on the terrain, simply click on the location.
3. Position the cursor where you want the range line to end and then click. You can attach the end point to a simulation object or a point on the terrain. The range line persists until you delete it or you rewind the scenario.

7.10.2 Deleting a Range Line

➤ **To delete a range line:**

1. Select the line.
2. Choose **Intervisibility > Delete**.

> ⓘ You can also use the context menu to choose **Intervisibility > Delete**.

7.10.3 Configuring Range Lines

You can configure the attributes of range lines using the Model Definition Editor. For details about editing model definitions, see "Creating and Editing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.)

- The font and offset for the measurement text.
- The colors used to display range lines and text.
- The thickness and style of the range lines.
- The font size of the distance and bearing data.
- Whether the measurements round up to a higher unit (for example, meters to kilometers).

➤ **To configure range lines:**

1. Choose **Settings > Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page.
3. Select OverlayRangeLine.
4. Change the settings as desired.

> ⓘ
> - Range lines and bearing use the distance measurement for the application, as specified in Display Units Settings. See "Specifying Display Units".
> - If you enable AreSmartDistancesForMeasurementTextEnabled, VR-Forces rounds the measurement up. For example, if the range measurement is set to meters and the line is longer than a kilometer, the display unit changes to kilometers.

8. Configuring Emitter Volumes

This chapter explains how to configure display of emitter volumes. For information about how to configure simulation of emitters, see "Configuring Emitters and Radios".

8.1. Emitter Volumes Overview

You can configure how VR-Forces colors emitter volumes, how they are drawn, and how they are scaled for visibility. You can configure emitter volumes by editing the DefaultEllipsoidArc model definition or by creating customized ellipsoid arc model definitions and applying them to different entity models.

> For an entity to display emitter volumes in 2D observer modes and 3D observer modes, it must have a 2D Emitter Volume visualizer in its 2D model set and 3D Emitter Volume visualizer in its 3D model sets. The DefaultEllipsoidArc model definition is an attribute of the visualizer.

8.1.1 Configuring Emitter Volume Color

By default, emitter volumes are displayed using fixed colors for high frequency and low frequency. You can configure emitter volumes to be colored based on the emission frequency or pulse rate. When emitter volume color represents frequency, color is determined by the frequency field of the EM Emission update message. In both cases, you specify a low frequency or pulse rate value and a high value.

If the emitter frequency or pulse rate is lower than your specified low value, the emitter volume is red. As frequency rises above the specified low value, emitter volume color changes, progressing through the colors of the visible spectrum until the specified high value is reached. At the high value and above, the emitter volume is violet.

To change coloring from the default, you must add the appropriate attributes to the emitter volume visualizer for the entities whose model definitions you want to change. Table 4 describes the emitter volume visualizer attributes that affect emitter volume color.

Table 4. Emitter volume visualizer attributes

Attribute	Description
colorByFrequency	If True, color by frequency instead of using static colors.
lowFrequency	The low frequency threshold for coloring by frequency. Default: 800 MHz.
highFrequency	The high frequency threshold for coloring by frequency. Default: 1 GHz.
usePulseFrequency	If **colorByFrequency** is True and **usePulseFrequency** is True, color emitter volumes by pulse frequency.
lowPulseFrequency	The low pulse rate threshold for coloring by frequency. Default: 100 Hz.
highPulseFrequency	The high pulse rate threshold for coloring by frequency. Default: 3 KHz.

8.1.2 Controlling Emitter Volume Radius

An emitter volume's radius (that is, the distance it extends from the emitter) is based in part on emitter power and in part on elevation and azimuth sweep data obtained from EM-Emission state messages. A higher emitter power value results in a longer radius,

while a wider field of view results in a shorter radius (because the radiated power is distributed over a wider area).

If VR-Forces relied exclusively on these values, the range of sizes among different emitter types could become too wide to be practical, with some emissions being barely visible, and other emissions covering the entire virtual world. Therefore, a configurable exponent weight and scale factor have been added to help fine tune the emitter beam radii. The radius exponent weight (a value between 0 and 1) slows the growth of the radius when power or area is greater than 1 and increases the growth of the radius when power or area is less than 0. The scale factor increases the radii of all beams by the given value.

To change the scale factor and exponent from the default, you must add one or both of these attributes to the emitter volume visualizer for the entities whose model definitions you want to change:

- linearScale. The amount of linear scaling applied to all emitter volumes. Default: 100.
- exponentialScale. The amount of exponential scaling applied to emitter volumes. Default: 0.1.

How VR-Forces Calculates the Radius

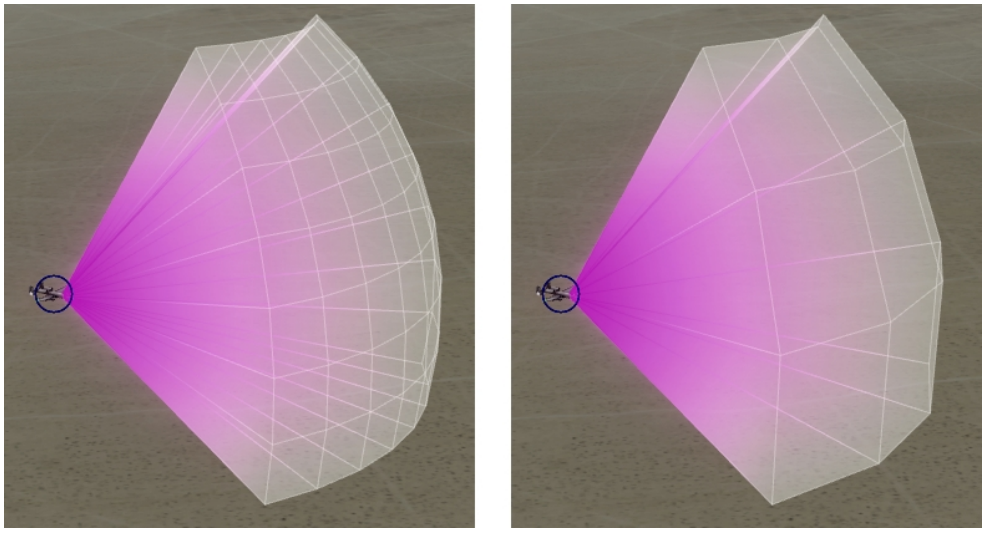
VR-Forces calculates emitter volume radius by approximating the spread of the emissions based on the elevation and azimuth sweeps. If the approximate coverage is zero, it sets the value to 1. Then it applies the linear and exponential scaling values. The code for implementing this is:

```
double tempVar = 8*elevationSweep*sin(2*azimuthSweep);
if (tempVar <=0) tempVar=1.0;
scale = linearScale * pow(sqrt(power/tempVar), exponentialScale );
```

8.1.3 Configuring Emitter Volume Segments

VR-Forces displays an emitter volume as a group of spherical sections projecting from the sensing device. By default, for each 10 degrees (or portion thereof) in the emitter's field of view, VR-Forces draws one segment. Figure 66 shows segments set to 10º (the default) and 30º.

Figure 66. Emitter volume segments - 10° and 30°



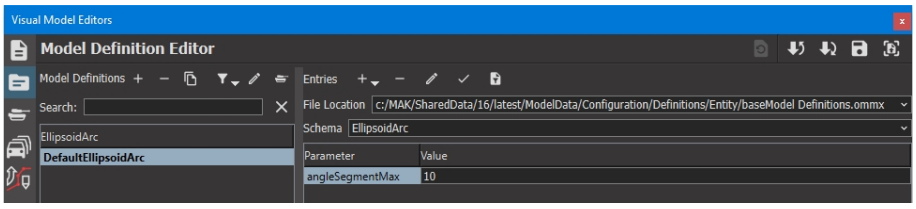
Emitter volume segments are managed by the EllipsoidArc schema and model definitions based on it. VR-Forces ships with one ellipsoid arc model definition – DefaultEllipsoidArc. You can edit this model definition or create copies of it and customize them. If you want to have different emitter volumes for different entities, assign a different ellipsoid arc model definition to each one.

Specifying the Segment Angle

➤ **To specify the segment angle:**

1. Decide whether you want to export the edited model definition to its own file or to an existing file. (For details about the model definition work flow, see "Model Definition Files" in the *Adding Content to MAK ONE Applications Reference Manual*.)
2. Choose **Settings > Visual Model Editors**. The Visual Model Editors dialog box opens.
3. Select the Model Definition Editor page (Figure 67).
4. If you want to export the edited model definition to an existing file, use the Load and Replace procedure to load the file. (For details, see "Importing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.)
5. Click the Filter button ( ) and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
6. Select DefaultEllipsoidArc (Figure 67).

Figure 67. EllipsoidArc model definition

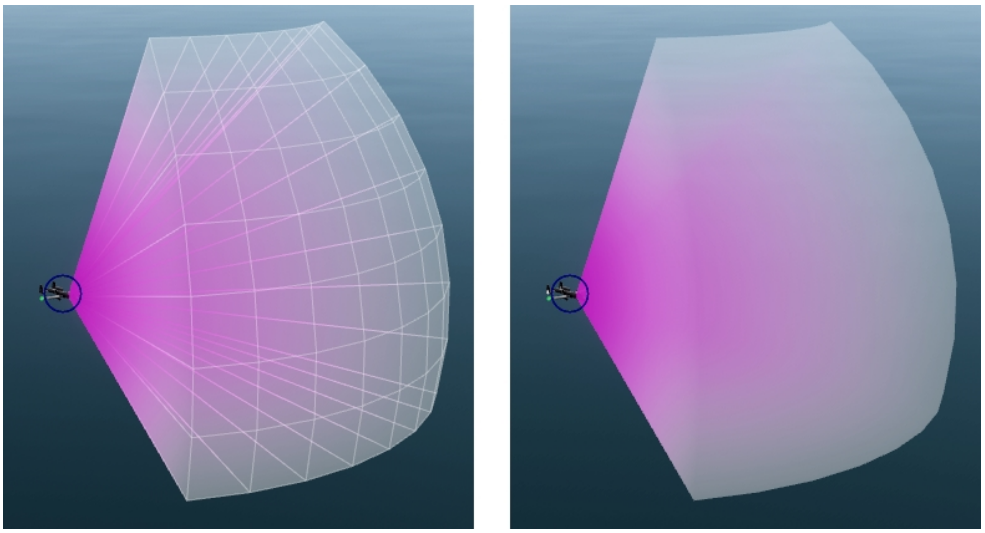


7. Click the Add a new parameter button (+▾) and select **angleSegmentMax**.
8. Change the value of the **angleSegmentMax** parameter. The minimum value is 10 (degrees); the maximum is 45.
9. Export the updated setting to the loaded definition file or to a separate file.

Displaying Segment Outlines

By default, VR-Forces displays opaque outlines showing the segment edges along the surface of the emitter volume.

Figure 68. Segment outlines - on and off



➤ **To display or hide segment outlines:**

1. Decide if you want to export the edited model definition to its own file or to an existing file. (For details about the model definition work flow, see "Model Definition Files" in the *Adding Content to MAK ONE Applications Reference Manual*.)
2. Choose **Settings > Visual Model Editors**. The Visual Model Editors dialog box opens.
3. Select the Model Definition Editor page.
4. If you want to export the edited model definition to an existing file, use the Load and Replace procedure to load the file. (For details, see "Importing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.)
5. Click the Filter button (▼) and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
6. Select DefaultEllipsoidArc.
7. Change the value of the **showLines** parameter.
8. Export the updated setting to the loaded definition file or to an individual file.

Adding a Custom EllipsoidArc Model Definition

If you want to customize the segment angle and segment outlines for a particular entity without changing the values for other entities, you must create a separate ellipsoid arc model definition and add it to the entity's model definition.

➤ **To create a custom ellipsoid arc model definition:**

1. Decide if you want to export the edited model definition to its own file or to an existing file. (For details about the model definition work flow, see "Model Definition Files" in the *Adding Content to MAK ONE Applications Reference Manual*.)
2. Choose **Settings > Visual Model Editors**. The Visual Model Editors dialog box opens.
3. Select the Model Definition Editor page (Figure 67 on page 90).
4. If you want to export the edited model definition to an existing file, use the Load and Replace procedure to load the file. (For details, please see "Importing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.)
5. Click the Filter button () and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
6. Select DefaultEllipsoidArc.
7. Click the Duplicate Model Definition button (). The Duplicate Model Definition dialog box opens with a default definition name.
8. Accept the generated name or type a new name for the model definition.
9. Click OK. The model definition is added to the list.
10. Change the parameter values for the new model definition as desired.
11. Select the Entity Definition Editor page.
12. Select the entity whose emitter volume you want to change.
13. Select the 3D Sensor Volume visualizer for the entity.
14. Click the Value column for the **modeldefinition** attribute. The Choose Model Definition dialog box opens. It has a list of model definitions.
15. Select the model definition that you just created.
16. Click OK.
17. Export the updated setting to the loaded definition file or to an individual definition file.
18. If you are connected to an exercise, disconnect and then reconnect to enable the new model definition.

9. Sound Effects

VR-Forces can play sound effects for entities, fire events, and detonation events.

9.1. Introduction to Sound Effects

VR-Forces can associate sound effects with entities, fire events, and detonation events. You can enable and disable use of sound effects and you can specify settings that determine how sounds are perceived.

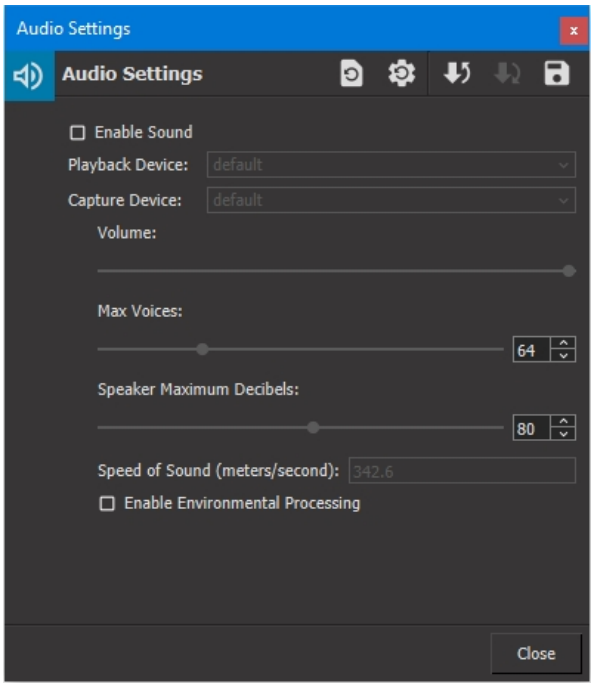
> ⓘ Using sound effects can degrade performance.

9.2. Enabling Sound Effects

➤ **To enable sound effects:**

1. Choose **Settings > Audio Settings**. The Audio Settings dialog box opens (Figure 69).

Figure 69. Audio Settings page



2. Select the Enable Sound check box.
3. Optionally, specify the playback device (speaker) and capture device (microphone).

> ⓘ You can also enable and disable sound effects by clicking the Audio button () on the Display Settings toolbar.

9.2.1 Configuring Sound Effects

You can configure the sound settings.

- Playback Device. Select the speaker for the audio output.
- Capture Device. Select the microphone to use. This is typically for use with MAK Radio.
- Volume. This is the volume of the system.
- Max Voices. You can have from 1 to 256 voices, or maximum simultaneous playing sounds. Sounds that play at the same time are mixed into a single sound wave prior to being sent to the speaker. This mixing has a CPU cost. A high number of allowable voices can affect performance when there are many audio sounds trying to play.
- Speaker Maximum Decibels. Calibrates the audio system for the speakers that the system is played on. This affects how sounds at a distance fall off so that the sound loudness is realistically replicated. The default setting of 80 db represents headphones or a desktop PC's speakers. See "9.2.2 Decibels Configuration" on the next page for more information.
- Speed of Sound. This is the speed of sound in the atmosphere in meters/second. The default value is derived by using a standard day as parameters (20° C, 50% relative humidity, 1013.25 mbar/29.92 inHg). This affects the delay in playing sounds at a distance. For example, an explosion 2 km away has a several second delay from the time you can see the visual effect to when you can hear the audio effect.
- Enable Environmental Processing. Enables low pass filtering. As sound propagates through air, higher frequency sounds are more absorbed the further you move from the source of the sound. This setting replicates air absorption of a sound based on the distance the sound is from the listener.

➤ **To configure sound settings:**

1. Choose **Settings > Audio Settings**. The Audio Settings dialog box opens (Figure 69 on the previous page).
2. To select the speaker, choose a device from the Playback Device list.
3. To select the microphone, choose a device from the Capture Device list.
4. To set the volume, adjust the Volume slider.
5. To specify the maximum number of voices, adjust the Max Voices slider or change the value in the text box.
6. To set the speaker maximum decibels, adjust the Speaker Maximum Decibels slider or change the value in the text box.
7. To set the speed of sound, type a value in the Speed of Sound box.
8. To enable lowpass filtering, select the Enable Environmental Processing check box.

9.2.2 Decibels Configuration

As a feature, the VR-Forces audio system uses a sound decibel scaling system to compensate for the deployed sound systems such as headphones, computer speakers, and amplifiers. This helps provide a similar audio experience regardless of the system that you use.

You can configure each individual entity sound to match real world characteristics. For example:

- A whisper or rustling of leaves registers at 20 dB.
- A conversation at home is approximately 50 dB.
- A passenger car traveling on the freeway at 50 feet away is 70 dB.
- Inside a helicopter cabin 100 dB.

When configuring the decibels (dB) for a sound, you should select a decibel level that represents the level near the sound source. The dB setting should be the loudest level that you would ever want to hear the sound, which might differ from the real-life level. This allows the audio system to calibrate the sound levels automatically.

For each sound, based on the Speaker Maximum Decibels setting, the audio system computes a sound "reference" distance and "falloff" distance:

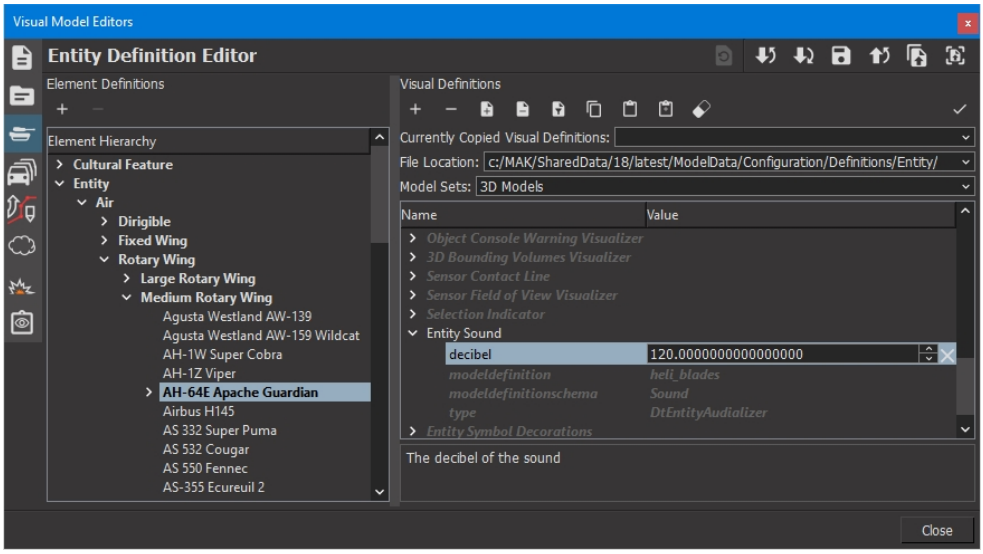
- The reference distance is the distance at which the sound is the loudest it can be heard.
- The falloff distance is the distance at which the sound can no longer be heard.

These examples show when a VR-Forces entity's sound is configured to be 80 dB and the observer is close to the entity:

- If the Speaker Maximum Decibels is set to 80 dB or lower, then the sound will be played and heard at its maximum volume.
- If the Speaker Maximum Decibels is set to 120 dB, then the sound will be played at a lower volume because the speaker system is expected to increase the heard volume to 80 dB.

Other sound effects settings are covered in "9.2.1 Configuring Sound Effects" on the previous page.

Figure 70. Example of entity decibel attribute in Entity Definition Editor



9.3. Associating Sound Files with Entities and Events

VR-Forces includes a set of sound files (WAV format) for generic entity platforms and for fire and detonation events. The files are in *./SharedData/##/latest/Audio/Sounds*. You add and edit mappings between entity types, fire events, or detonation events and sound files in the Visual Models Editor. Sound files are associated with model definitions. For example, the **filename** parameter for the heli_blades model definition specifies *$(SHARED_DATA_DIR)/Audio/Sounds/heli_blades.wav*. The Rotary Wing element definition has a parameter called **Entity Sound**. The value for the **model definition** attribute is **heli_blades**.

You can quickly see which model definitions are available for sounds by filtering the list of the Visual Model Editors, Model Definitions Editor page for the Sound schema.

10. MAK Radio

This chapter describes the MAK Radio features. There is a dialog box, which can also be run as a standalone application, and a toolbar.

10.1. MAK Radio Overview

VR-Forces supports voice communications over radios and intercoms. You can communicate with anyone using the radio application that is in the same exercise. There are 2 radios, each of which has 2 channels. (The radios are configurable. For details, see "10.4. Configuring the MAK Radio" on page 103.) Two applications can communicate only when the radios are tuned to the same frequency and that frequency is not being jammed.

There is also an intercom, which represents the internal intercom used by crew members of a single vehicle to communicate with each other. For two applications to communicate using the intercom, they must both be part of the same exercise and have the Attached Entity field set to the same entity. The ADMIN option indicates that the intercom is not connected to any entity but instead to all MAK Radio users who also specify ADMIN. For information about using the intercom and voice-activated radio, see "10.3. Using the Intercom or a VOX Radio" on page 103.

Audio data from the radio system is sent as signal interactions/PDUs on the simulation network. It can be received in other VR-Forces GUI applications, the standalone applications, or other applications that can receive standard signal interactions/PDUs (such as VR-Forces).

Radio communications are perfect. Radio signals are not affected by terrain, weather, distance, or other factors. However, you can use the standalone radio application or the radio panel in VR-Forces to jam radios. For more information about jamming, see "10.6. Jamming Radios" on page 108.

The radio uses the audio devices configured in the Audio Settings dialog box for capture and playback. See "9.2.1 Configuring Sound Effects" on page 95 for details.

10.2. Using the Radio in VR-Forces

Each configured radio has a radio head that represents its state. It displays the radio name, its frequency, and the audio levels for transmit (TX) and receive (RX).

There are different ways to use the radio: the dialog box or toolbar in VR-Forces, or the standalone application.

➤ To open the MAK Radio dialog box, choose **View > Radios**. The Radio Communications dialog box opens (Figure 71 on page 102).

➤ To open the MAK Radio toolbar, choose **View > Toolbars > Radio Control Toolbar**. The toolbar displays (Figure 72 on page 102).

➤ **To start the MAK Radio standalone application from the Windows 10 or 11 Start menu:**

1. Choose **MAK Technologies > VR-Forces 5.2 Tools**.
2. In the Tools folder, double-click the MAK Radio shortcut. The Simulation Connection Configurations dialog box opens.
3. Specify the connection information of the simulation where you want to use the radio.
4. Click Launch. The MAK Radio application opens (Figure 71 on page 102).

➤ **To start the MAK Radio standalone application from the command line:**

1. Change the directory to *./bin64* and then run `vrfLauncher --makRadio`. The Simulation Connection Configurations dialog box opens.
2. Specify the connection information of the simulation where you want to use the radio.
3. Click Launch. The MAK Radio application opens (Figure 71 on the next page).

10.2.1 Operating the Radio from the Dialog Box or Application

The controls for operating the radio are the same in the dialog box within VR-Forces and the standalone application (Figure 71).

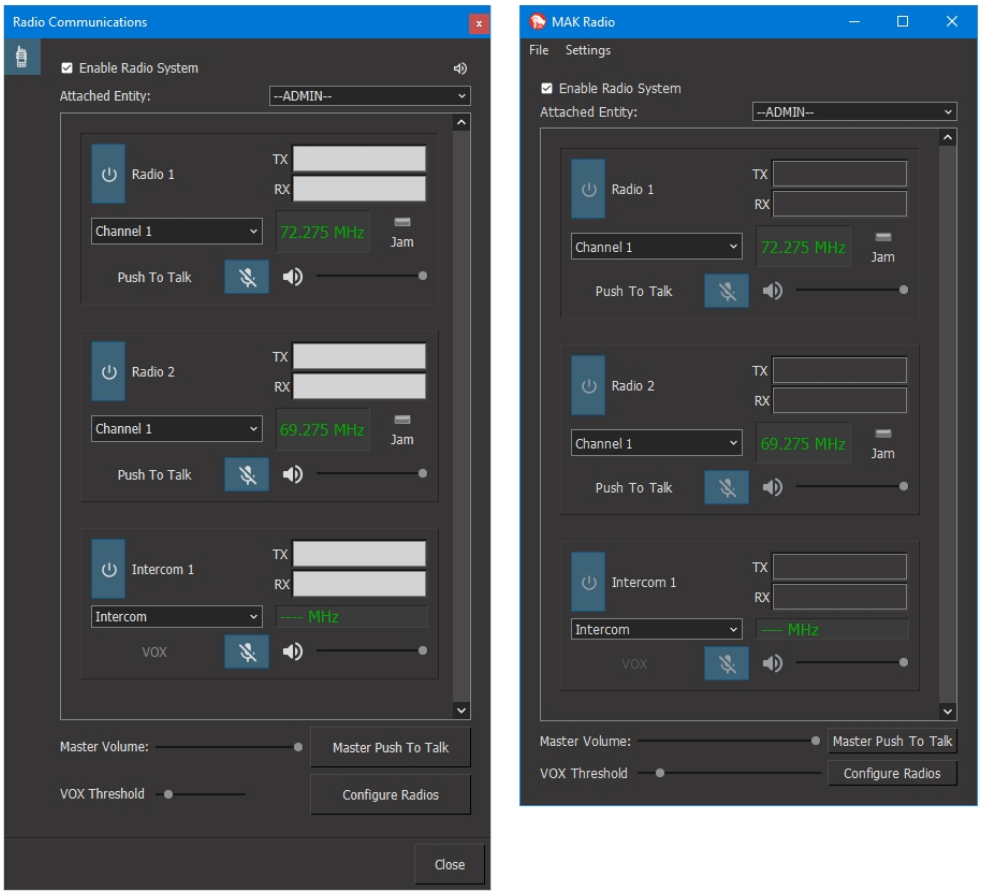
> The default key for Push to Talk is **T**, but in the standalone application you can specify other keys using the Audio Settings. See "10.5. Audio Settings" on page 107.

➤ **To use the radio:**

1. In the Radio Communications dialog box or MAK Radio standalone application, select the Enable Radio System check box.
2. In the Attached Entity list, select the entity you want to speak for, or ADMIN if you are an observer and want to talk to everyone.
3. Optionally, adjust the Master Volume slider to adjust the volume of all radios.
4. Optionally, adjust the VOX Threshold slider to adjust the level of sound needed to enable voice activated transmission. (This is usually used for intercoms, not radios.)
5. Optionally, click Master Push to Talk to transmit on all radios that are not muted.
6. To operate a radio head:
    a. Make sure the radio head power button is enabled ( ).
    b. Optionally, select a channel from the list.
    c. Click Push to Talk or press **T** to talk (if this is not a Vox radio).
    d. Click the microphone button ( ) to mute the microphone or enable it.
    e. Click the speaker button ( ) to mute the speaker or enable it.
    f. Adjust the slider to change the radio's volume.
    g. Click the Jam button ( ) to jam the radio frequency.
7. Click Configure Radios to edit the radio configuration. See "10.4. Configuring the MAK Radio" on page 103 for details.
8. In the Radio Communications dialog box only, you can click the audio settings button ( ) to access the Audio Settings for VR-Forces. See "9.2.1 Configuring Sound Effects" on page 95 for details.

    In the MAK Radio standalone application, you can choose **Settings > Audio Settings** to select the Playback Device (speaker), Recording Device (microphone), and default Push-to-Talk button using the Audio Settings. See "10.5. Audio Settings" on page 107.

Figure 71. Radio Communications dialog box and standalone application



10.2.2 Operating the Radio from the Radio Control Toolbar

You can operate the radio from the toolbar (Figure 72).

Figure 72. MAK Radio toolbar

➤ **To operate the radio using the toolbar:**

1. Choose a radio head to select it for use.
2. Optionally, select a channel from the list.
3. Click PTT to talk (if this is not a Vox radio).
4. Click the microphone button (🎤) to mute the microphone or enable it.
5. Click the speaker button (🔊) to mute the speaker or enable it.
6. To change the radio's volume, click the arrow button to open and adjust the slider.
7. Click the radio communications button (📻) to open the Radio Communications dialog box (Figure 71 above).

> If the toolbar options are disabled, you need to enable radios in VR-Forces. In the Radio Communications dialog box or the standalone application (Figure 71 on the previous page), select the Enable Radio System check box.

10.3. Using the Intercom or a VOX Radio

The intercom and VOX radios are voice activated and transmit any sound greater than the VOX threshold.

➤ **To use the intercom or a Vox radio:**

1. In the Radio Communications dialog box or MAK Radio Application, select the Attached Entity.
2. In the dialog box or application, make sure the power button is enabled ( ).

   In the toolbar, select the intercom or the VOX radio from the list. The PTT button is disabled.
3. Make sure that the microphone is not muted.
4. If you are using a Vox radio, you can select a channel.
5. Start talking.

10.4. Configuring the MAK Radio

You can configure the number of radios and channels, the channel frequencies, the sample rate, and the format. The Modulation and Crypto settings for radios are as defined for the Transmitter PDU in the IEEE DIS standard, IEEE Std 1278.1-2012.

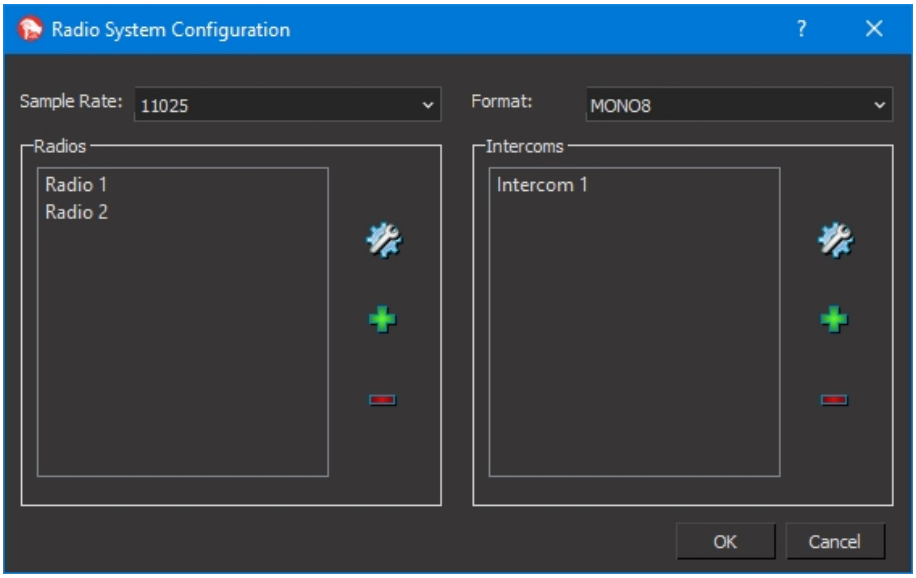
If there is a mismatch between two or more radios in the Transmission, Modulation, and Crypto settings, they cannot talk to each other. The settings must match between communicating radios for the signals to be processed and the transmissions to be heard.

Changes that you make persist from one session of VR-Forces and MAK Radio to another, and the settings are the same for both.

➤ **To configure the MAK Radios:**

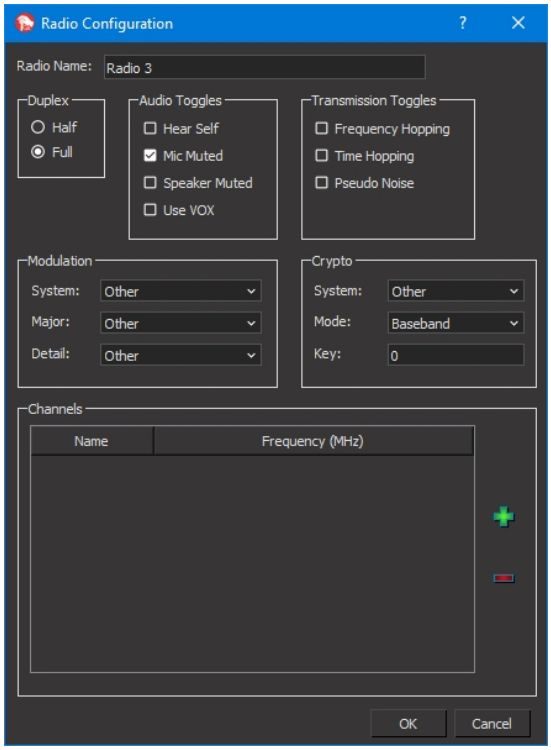
1. In the Radio Communications dialog box or MAK Radio application, click Configure Radios. The Radio System Configuration dialog box opens (Figure 73).

Figure 73. Radio System Configuration



2. To change the sample rate for all radios, select the rate from the list.
3. To change the format for all radios, select the format from the list.
4. To add or edit a radio:
    a. Click the Add Radio () or Edit button () next to the list of radios. The Radio Configuration dialog box opens.
    b. Configure the radio as needed. Table 5 on page 106 describes the settings.

Figure 74. Radio Configuration



c. Click OK.

5. To add or edit an intercom:

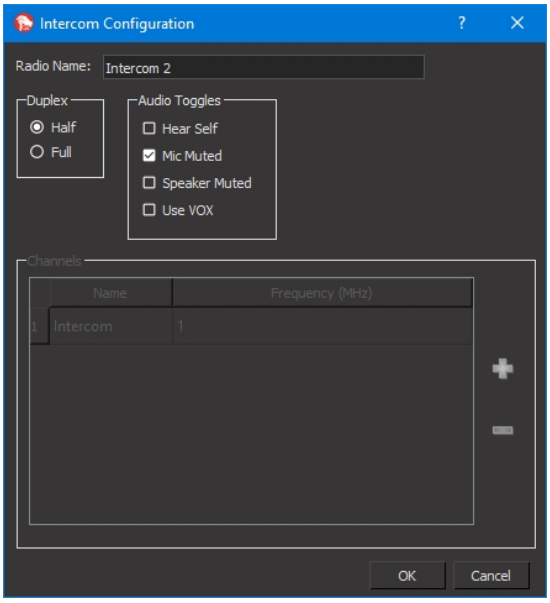
   a. To add an intercom, click the Add Intercom (). A row is added.

   b. To edit a new or existing intercom, select the row and then click the Edit button () next to the intercom list. The Intercom Configuration dialog box opens (Figure 75).

   c. If desired, edit the name of the intercom.

   d. Configure the intercom as needed. Table 5 provides information about the settings. Note that only Duplex and Audio Toggles settings are available for intercoms.

Figure 75. Intercom Configuration



e. Click OK.

6. When you are finished, click OK in the Radio System Configuration dialog box. You return to the Radio Communications dialog box. If you added or removed a radio or intercom, the list updates.

Table 5. Radio and Intercom settings

Setting	Options
Radios and Intercoms	
Duplex	— Half. Only one user can talk at a time. — Full. All users can speak simultaneously.
Audio Toggles	— Hear Self. Users can hear themselves over the speaker. — Mic Muted. Microphone defaults to muted. — Speaker Muted. Speaker defaults to muted. — Use Vox. Radio is voice-activated.
Radios only	
Transmission Toggles	— Frequency Hopping. Switches frequencies during transmission to reduce interference and avoid interception. — Time Hopping. Varies the period and duty cycle to achieve anti-jamming or low probability of intercept. — Pseudo Noise. Introduces a deterministically generated random sequence of bits.

Table 5. Radio and Intercom settings (continued)

Setting	Options
Modulation	— System. Radio system type: Generic, SINGCGARS, and so on. — Major. Modulation type: Amplitude, Pulse, and so on. — Detail. Additional information about the modulation type (options based on the Major setting).
Crypto	— System. Cryptographic system for the radio: VINSON, KY-100, and so on. — Mode. Crypto mode: Baseband, Diphase, and so on. — Key. A simulated cryptographic key. This key is a non-zero integer value for simulating secured communication. Set to 0 when simulating plain communications.
Channels	— Use the Add or Delete buttons to manage the radio's channels. — In the rows, double-click to edit each channel's name and frequency as needed.

10.5. Audio Settings

In the MAK Radio standalone application, you can access the Audio Settings. These settings allow you to specify the Playback Device (speaker), Recording Device (microphone), and one or more push-to-talk buttons.

The options are saved in *./appData/settings/makRadio/radioAudioSettings.csv*. You can copy the CSV file to other workstations that should have the same settings.

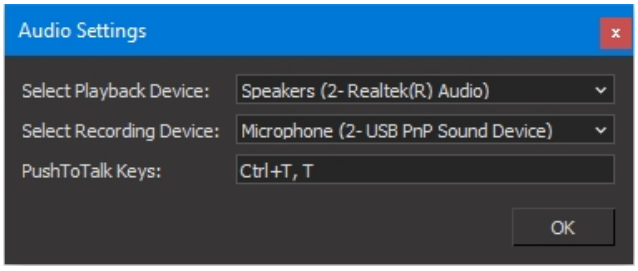
➤ **To choose a Playback Device or Recording Device:**

1. In the MAK Radio standalone application, choose **Settings > Audio Settings**. The Audio Settings dialog box opens.
2. Choose the speaker or microphone from the appropriate list.
3. Click OK.

➤ **To set the default push-to-talk key:**

1. If the Audio Settings dialog box is not open, choose **Settings > Audio Settings**.
2. Click on the Push To Talk Keys box to give it focus.
3. Press the desired key or key combination. If you want to use more than one key, continue pressing keys. Each key or key combination is separated by a comma (Figure 76).
4. Click OK.

Figure 76. Audio Settings for MAK Radio



10.6. Jamming Radios

The Radio Communications dialog box or MAK Radio application allow you to jam radio frequencies. When you click the Jam button on a radio head, it creates another radio that jams the frequency of the currently selected channel. The users will not be able to hear the radio communications, and will not see an indication that their radio is jammed.

➤ To jam a radio frequency, click the Jam button (Jam).