

GSG 5-6 Series



The GSG-5/6 Series are end-of-life products of Safran's Trusted 4D GNSS simulator product line. GNSS Constellation Simulators are mainly used for in-line production and development testing, including navigational fix and position testing.

GSG-5 Series simulators reproduce the GNSS signal of a GPS receiver input. Depending on the configuration, these units simulate up to sixteen GNSS satellites, up to 3 SBAS satellites, together with optional multipath and interference signals. The GSG-5 Series applies models to simulate satellite motions, atmospheric effects, and different antenna types. The movement of the GPS receiver under test is defined using NMEA data or pre-defined trajectory models.

GSG-6 Series simulators add advanced features and can simulate up to 64 independent satellite channels on different frequency bands.

In addition, the GSG5/6 series are designed with a front panel display along with an intuitive software user interface - GSG StudioView.

GSG-7/8 Series



GSG-7 & 8 deliver the highest standard of GNSS signal testing in a cost-effective, easy-to-use, turnkey form factor supporting the growing need for location-aware applications and systems that require navigation or timing.

GSG-Converter

This tool made in Python allows the user to automatically convert GSG-5/6 scenarios in Skydel for GSG-7 or 8 simulators. The list of functionalities that can be converted is defined in Appendix A - Table 1.

1. Installation:

1.1. Executable

Download the toolkit containing the converter.

1.2. Python:

1. Install python:

Make sure python is install (from version 3.8) or download the latest python version from <https://www.python.org/downloads/>.

2. Open a terminal and check the installation:

```
$ python --version (or python3 --version for Linux platform)
```

3. Install the python packages:

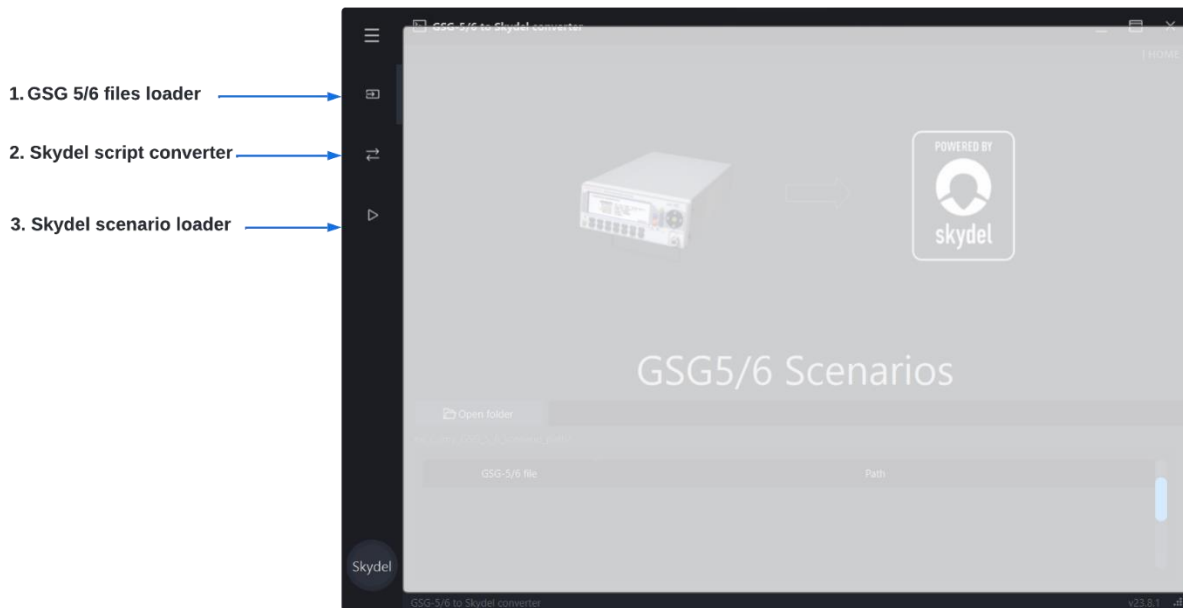
```
$ pip install -r requirements.txt.
```

4. Run the GSG-Converter script:

```
$ python main.py
```

2. GSG Converter

The GSG converter has 3 main menus:



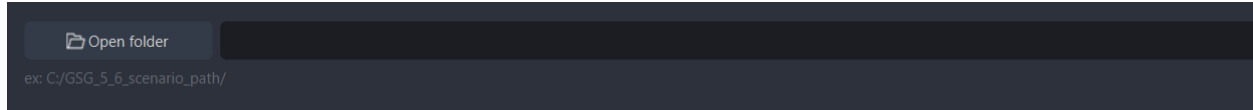
2.1. GSG-5/6 file loader menu

This menu appears by default when starting the application.



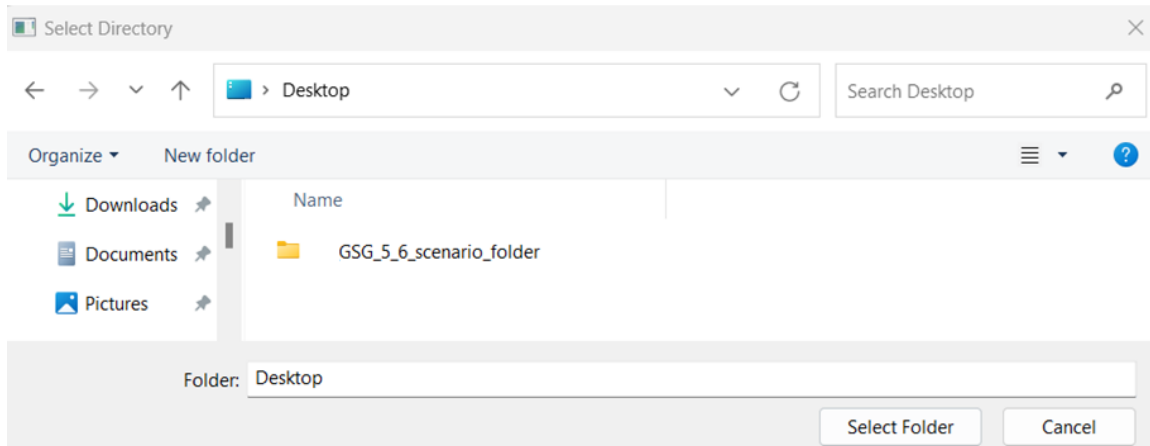
2.1.1. Files loader button

The *Open folder* button allows you to import the GSG 5/6 scenario files.



NB: It's possible to load and convert files from a single GSG-5/6 scenario at a time. Also, the current release of the GSG converter only considers the scenario file (.scen) and the NMEA trajectory file (.nmea).

Make sure that all scenario files are in the same folder, then click *Open folder*:



Once the folder is selected, the list of GSG 5/6 files will appear as shown below:



Let's check the characteristics of the *Daytona500.scen* scenario used as an example with GSG-Studio View:

a. In the General tab, we can get the start time and duration of the simulation:

- **Start time:** 9/26/2011 at 00:00
- **Duration:** 1 minute

The screenshot shows the 'General' tab of the GSG-Studio interface. It contains two main sections: 'Start time' and 'Duration'. The 'Start time' section has a 'Date' field set to '9/26/2011' and a 'Time' field set to '00 : 00'. There is a checkbox for 'Synchronize from NTP server' which is currently unchecked. The 'Duration' section has three input fields: 'Days' (0), 'Hours' (0), and 'Minutes' (1). To the right of these fields are three radio buttons: 'One-go' (unchecked), 'Looping' (checked), and 'Forever' (unchecked).

The scenario is in Looping mode (it will restart again right after).

The initial position of the vehicle is defined as follows:

The screenshot shows the 'Start position' tab of the GSG-Studio interface. It contains two main sections: 'Geographic coordinates' and 'ECEF coordinates'. The 'Geographic coordinates' section has four input fields for Latitude and Longitude in different formats: Degrees°, Deg° Min', and Deg° Min' Sec''. The 'ECEF coordinates' section has three input fields for X (m), Y (m), and Z (m). There is also a 'Leap Seconds' field at the bottom.

Geographic coordinates			
	Degrees°	Deg° Min'	Deg° Min' Sec''
Latitude	N29°11'13.8"	N29.187167°	N29°11.2300'
Longitude	W81°4'23.28"	W081.073133°	W081°04.3880'

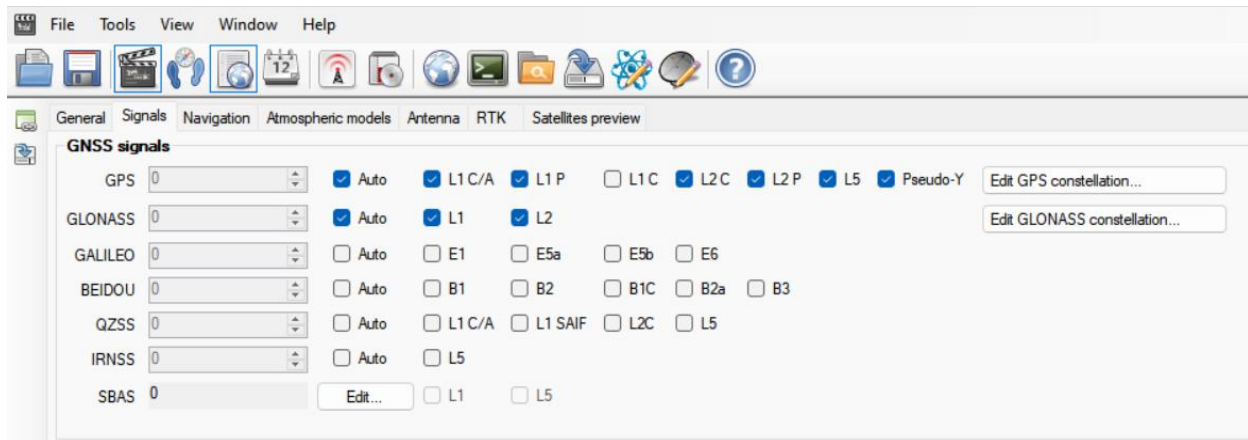
Altitude above ellipsoid (m) 0.00

ECEF coordinates		
X (m)	Y (m)	Z (m)
864744.060	-5505249.628	3092028.771

Leap Seconds 0

b. The constellations selected in the GSG scenario can be viewed in the *Signals* tab:

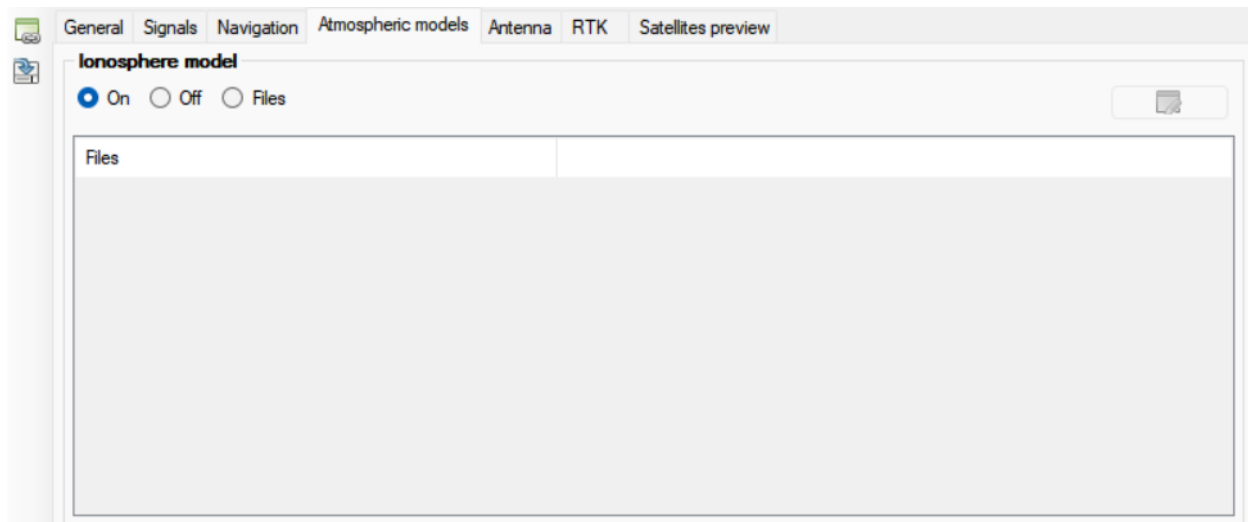
- **Upper L-Band:** GPS L1 C/A, L1 P-code, GLONASS G1
- **Lower L-Band:** GPS L2C, GPS L2 P-code, GPS L5, GLONASS G2



- c. This GSG5/6 scenario is provided with an NMEA file (Daytona500.nmea) which contains the trajectory of the simulated vehicle:



- d. The ionospheric model is set to **On**:



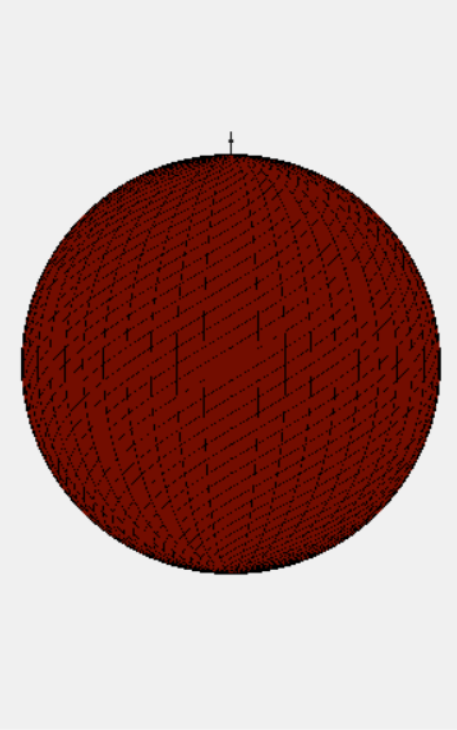
On mode used a reverse model of the model described in IS-GPS-200D, section 20.3.3.5.2.5. When set on **Off**, no effect caused by the ionosphere will be used in the simulation. The **Files** option allows users to simulate ionospheric delays using IONEX files.

The Saastamonian tropospheric model is enabled:

Tropospheric model	
Type	Parameters
<input checked="" type="radio"/> Saastamoinen	Temperature (°C) 20
<input type="radio"/> Black model	Pressure (mBar) 1000
<input type="radio"/> Goad & Goodman	Humidity (%) 50
<input type="radio"/> STANAG	
<input type="radio"/> DO-229	
<input type="radio"/> Off	

Atmospheric parameters (temperature, pressure, and humidity) are not applicable to Skydel currently.

e. The selected antenna model is Zero model:

General	Signals	Navigation	Atmospheric models	Antenna	RTK	Satellites preview
Antenna model						
<input type="radio"/> Helix						
<input type="radio"/> Patch						
<input type="radio"/> Cardioid						
<input checked="" type="radio"/> Zero model						
<input type="radio"/> GPS-703-GGG						
<input type="radio"/> File <input type="text"/>						
Lever arm						
dX, m 0.000 dY, m 0.000 dZ, m 0.000						
						
Frequency GPS L1						

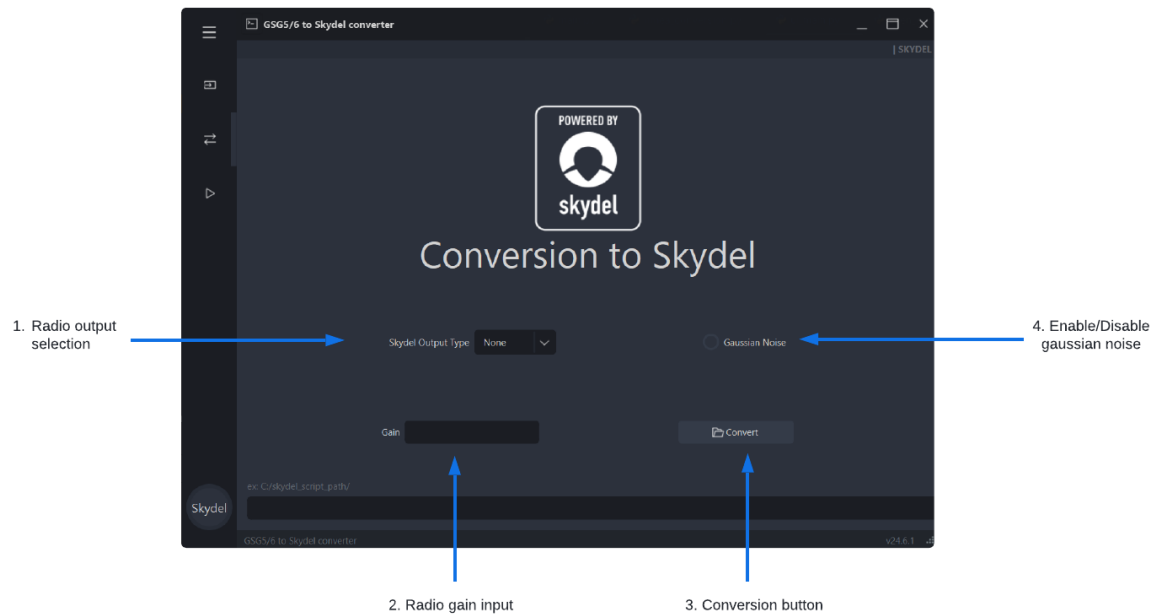
The lever arm location is set to zero in all axes.

2.2. Skydel script converter

This page allows users to convert data files from GSG-StudioView, GSG-5/6 into Skydel script files.

Two types of files will be generated:

- a Skydel SDX script file
- a python script file



2.2.1. Skydel output selection

Use the Skydel Output selection drop-down list to select the radio type.

Note :

- **None**: RF is not generated, and IQ is not saved, raw logging data is saved.
- **NoneRT**: Like None but runs in Real Time. Useful when developing [automation](#) scripts.
- **DTA-2115B**: Software-defined radio from DekTec.
- **DTA-2116**: Software-defined radio from DekTec.

2.2.2. Radio gain

Enter the selected SDR gain in the *radio gain input* field. By default, the gain is 50 dB for DTA-2115B and DTA-2116.

2.2.3. Gaussian noise selection

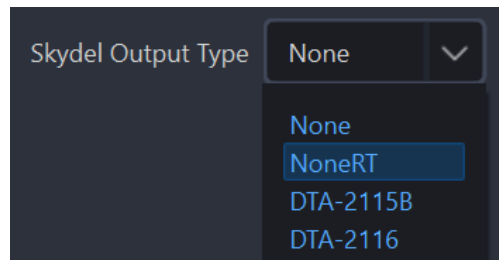
Add Gaussian Noise in Skydel scripts to reproduce realistic C/No.

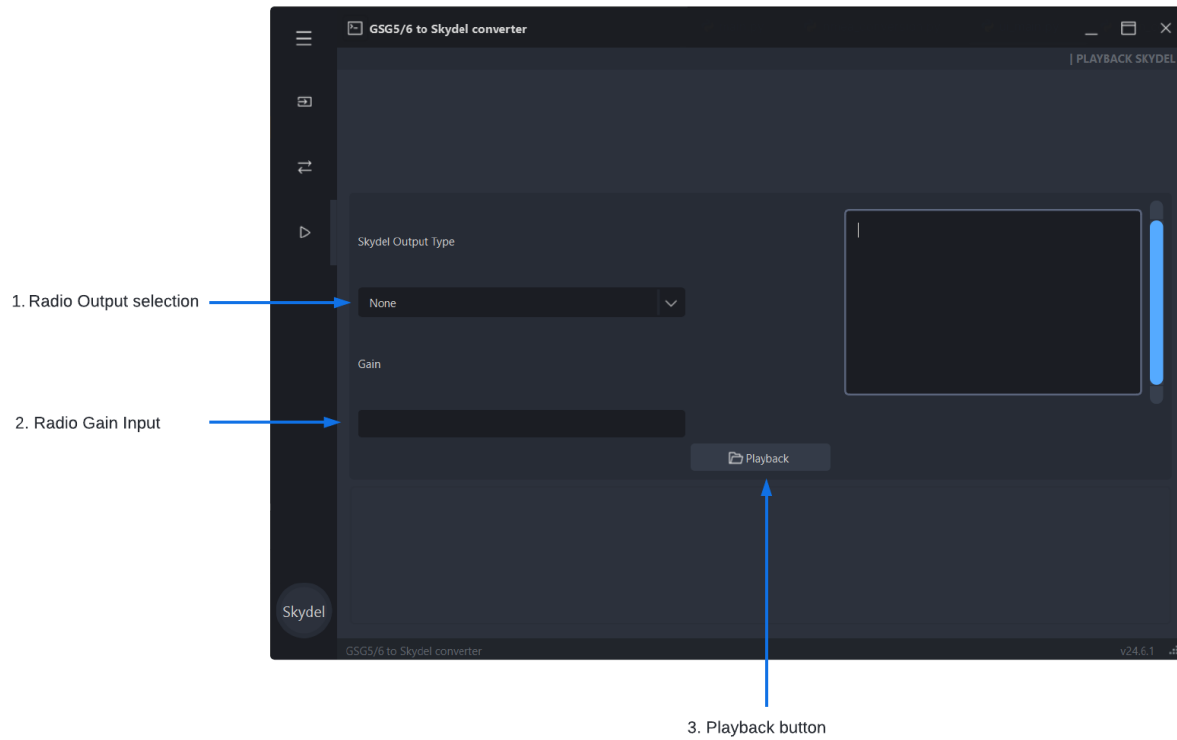
2.2.4. Conversion button

Convert the loaded GSG5/6 scripts into python and skydel script.

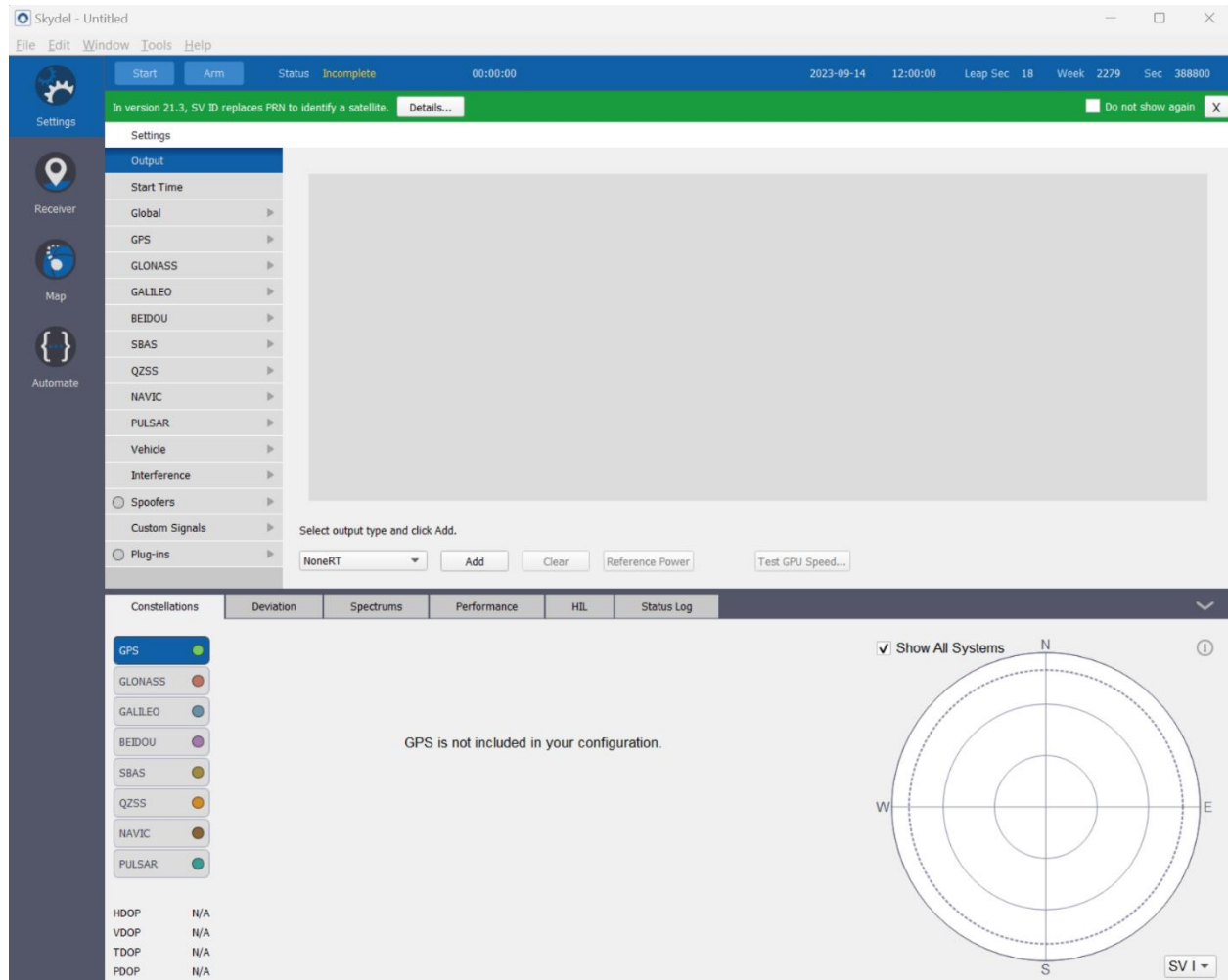
2.3. Playback in Skydel

This page will allow you to directly replay GSG5/6 scenarios in the Skydel interface.



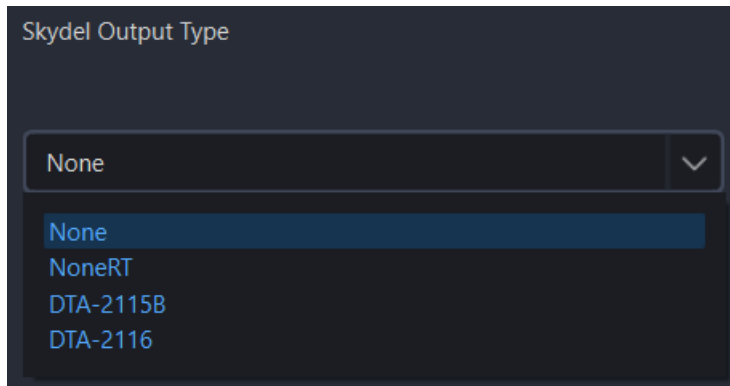


To get started, make sure an instance of Skydel is open by default:



2.3.1. Skydel output selection

The Skydel Output selection drop-down list allows you to select the type of radio that will be used in Skydel scripts.



Note :

- **None**: RF is not generated, and IQ is not saved, raw logging data is saved.
- **NoneRT**: Like None but runs in Real Time. Useful when developing [automation](#) scripts.
- **DTA-2115B**: Software-defined radio from DekTec.
- **DTA-2116**: Software-defined radio from DekTec.

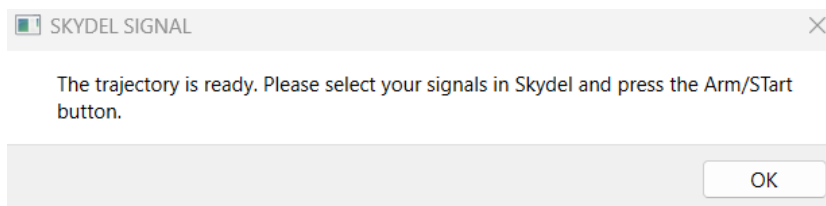
2.3.2. Radio gain

Enter the output gain of the selected SDR using the *radio gain input* field.

2.3.3. Playback button

This button sends the API commands corresponding to the data from GSG5-6 scenarios directly in a Skydel instance.

When the scenario is ready to start in Skydel, the following pop-up window will appear:



Click *Ok* to close this window and go to the Skydel instance.

Check that all the elements defined in your GSG-5/6 scenario are present such as the signals:

- a. The start date and time correspond to the settings in the GSG-Scenario (see section 2.1.1.a):

The screenshot shows the Skydel software interface. On the left is a sidebar with icons for Settings, Receiver, Map, and Automate. The main window is titled 'Settings' and has a sub-menu 'Output' selected. Under 'Output', 'Start Time' is selected, showing a date/time picker set to '2011-09-26 00:00:00'. Below this, there are options for 'Global', 'GPS', 'GLONASS', 'GALILEO', 'BEIDOU', 'SBAS', 'QZSS', 'NAVIC', and 'CUSTOM'. To the right of these options, there are settings for 'GPS Time' (set to 'Custom Time'), 'Leap Seconds Δt_{LS} ' (set to '18s'), 'Leap Seconds Future Δt_{LSF} ' (set to '18s on 2016-12-31'), and 'Duration' (set to '1 minute').

The duration was also set to 1 minute, corresponding to the GSG 5/6 scenario duration.

- b. The initial position converted from the GSG scenario has been defined in the vehicle settings:

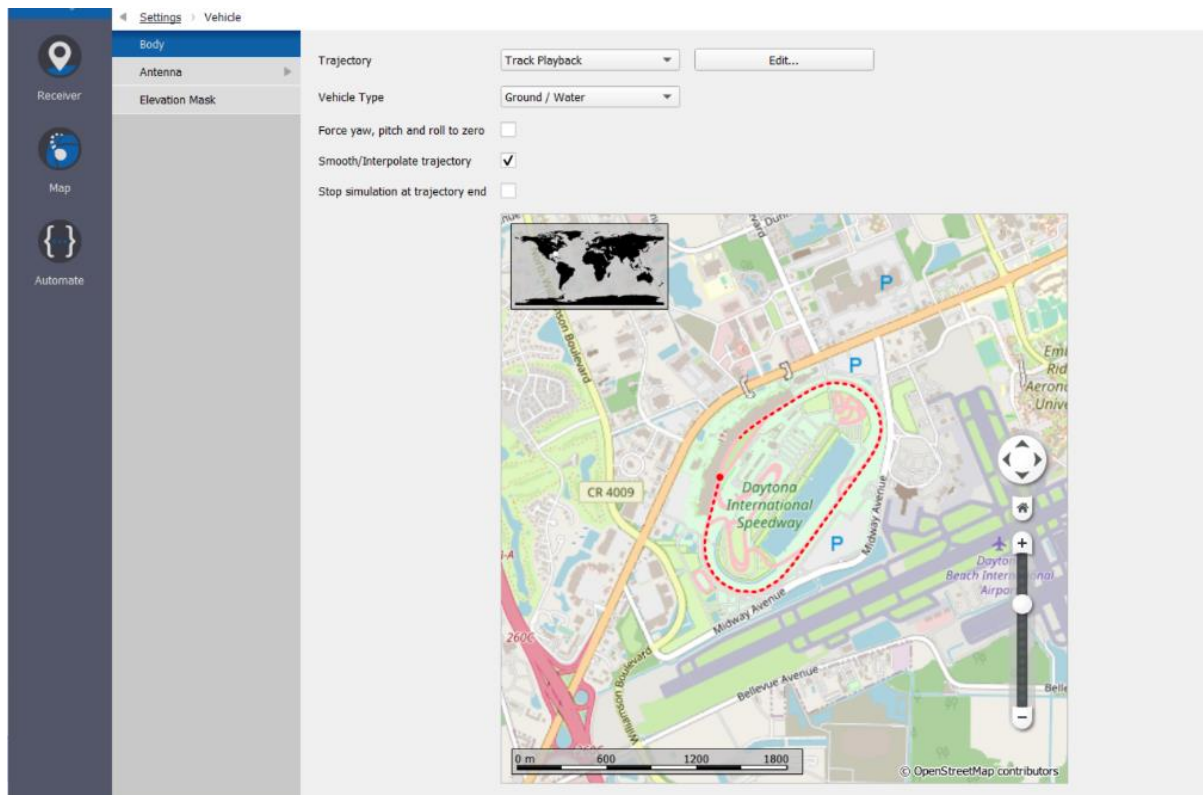
The screenshot shows the 'Vehicle' settings in Skydel. The 'Trajectory' is set to 'Fixed'. The initial position is defined as 29.18716667°, 81.07313333°, 0.000m, with Yaw=0.000°, Pitch=0.000°, and Roll=0.000°. There is a checkbox for 'Force yaw, pitch and roll to zero'. Below the text is a map showing the region around Thulagado, with labels for Amattabada, Chaupayakhan, Mulli, Parmulli, Thulagado, and Bagarkhal. A scale bar at the bottom indicates 0 m, 800 m, and 1600 m.

Given that the GSG scenario contains an NMEA file, the initial trajectory will change from **Fixed** to **Track Playback**.

- c. The constellations defined in the GSG scenario have been applied in the Skydel scenario accordingly:
 - **Upper L-Band:** GPS L1 C/A, L1 P-code, GLONASS G1
 - **Lower L-Band:** GPS L2C, GPS L2 P-code, GPS L5, GLONASS G2

Output NoneRT <div style="border: 1px dashed black; padding: 5px; text-align: center;">REAL-TIME</div>	None RT 1 Modulation ON <div>Edit Delete</div>	RF A	Signal Selection GPS L1 C/A GPS L1 P-Code GLONASS G1	Sampling Rate 50.000 MSps Central Frequency 1586.0000 MHz GPU # 0 <div>Edit</div>
	None RT 2 Modulation ON <div>Edit Delete</div>	RF A	Signal Selection GPS L2C GPS L2 P-Code GPS L5 GLONASS G2	Sampling Rate 100.000 MSps Central Frequency 1207.1400 MHz GPU # 0 <div>Edit</div>

- d. And the trajectory of the GSG5/6 scenario in the Skydel Settings -> Vehicle window:



- e. The atmospheric model was also applied as defined in the GSG scenario:

◀ Settings > Global > Atmosphere

Nominal

Errors

Tropospheric Model

Saastamoinen

Ionospheric Model

Klobuchar

Klobuchar

BDGIM

NeQuick

	Alpha	Beta	
0	4.6570000e-09	81920	s
1	1.4900000e-08	81920	s/semicircle
2	-5.9600000e-08	-65540	s/semicircle ²
3	-1.1920000e-07	-524300	s/semicircle ³

RINEX File

Import Iono Parameters...

- f. The Zero antenna model has been selected in the **settings->Vehicle->Antenna** menu.

Pattern

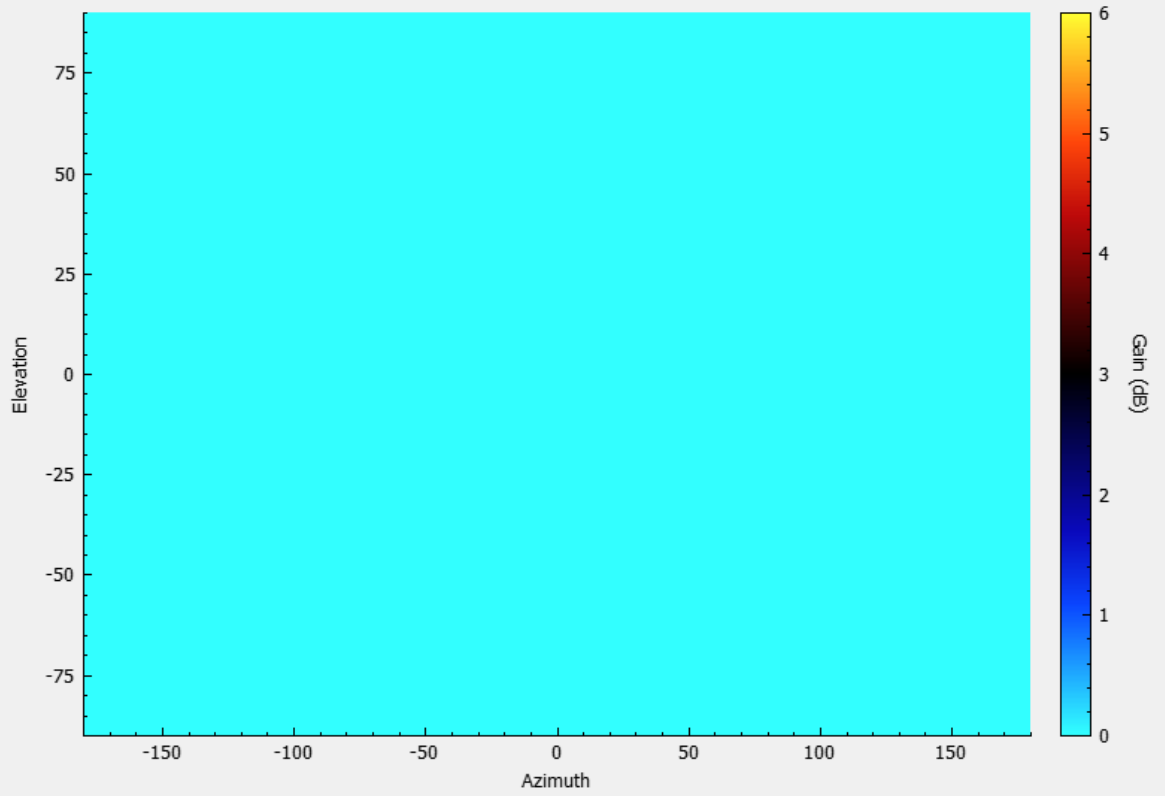
Gain Pattern and Gain Offset

L1	Custom ▾	0 dB	More...
L2	Custom ▾	0 dB	More...

Phase Pattern and Phase Offset

None ▾	0°	More...
None ▾	0°	More...

Antenna Gain



OK

Import CSV...

Export CSV...

Cancel

Annexe A :

Table 1: List of the GSG options that can be converted to Skydel features.

GSG Studio View Functionalities		Implemented in Skydel	Comments
General			
Start Time		Yes	
Duration			
	<i>Total time</i>	Yes	
	<i>Looping</i>	No	This functionality is not yet directly implemented in Skydel, but it is possible to do it using a python script.
	<i>Forever</i>	Yes	
	<i>One-go</i>	Yes	
Start position		Yes	
Signals			
GNSS Signals		Yes	In GSG scenarios, it is possible to define the maximum number of satellites to simulate. This functionality has not yet been implemented in the converter. All visible satellites will therefore be simulated by default in Skydel.
Interference Signals		No	
Multipath Signals		No	
Elevation mask		yes	
Navigation			
Trajectory			
	<i>File (NMEA)</i>	Yes	
	<i>Circle</i>	Yes	
	<i>Static</i>	Yes	
	<i>3 GPP</i>	No	
Events			
	<i>None</i>	Yes	
	<i>File</i>	No	
Environment			
	<i>None</i>	Yes	
	<i>File</i>	No	
Vehicle model			
	<i>None</i>	Yes	
	<i>File</i>	No	
Navigation Data			
	<i>Default</i>	No	
	<i>Download</i>	No	
	<i>Files</i>	No	
Atmospheric models			

Ionosphere model			
	<i>On</i>	Yes	When the ionosphere model option is ON in the GSG scenario, the Klobuchar model will be applied by default in the Skydel scenario.
	<i>Off</i>	Yes	
	<i>Files</i>	No	
Tropospheric model			
	<i>Saastamoinen</i>	Yes	
	<i>Black model</i>	No	
	<i>Goad & Goodman</i>	No	
	<i>STANAG</i>	Yes	
	<i>DO-229</i>	Yes	
	<i>Off</i>	Yes	
Parameters			
	<i>Temperature(C)</i>	No	
	<i>Pressure (mBar)</i>	No	
	<i>Humidity (%)</i>	No	
Antenna			
Antenna model			
	<i>Helix</i>	Yes	
	<i>Patch</i>	Yes	
	<i>Cardioid</i>	Yes	
	<i>Zero model</i>	Yes	
	<i>GPS-703-GGG</i>	Yes	
	<i>File</i>	No	
Lever arm			
RTK			
Base Station		No	