



OverFlight

A New Graphical Acoustics Community Impact Tool

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Analytical Services & Materials

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Analytical Mechanics Associates



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1 Introduction & Overview

2 UI Overview

3 Modes of Operation

4 Next Steps

5 Conclusions

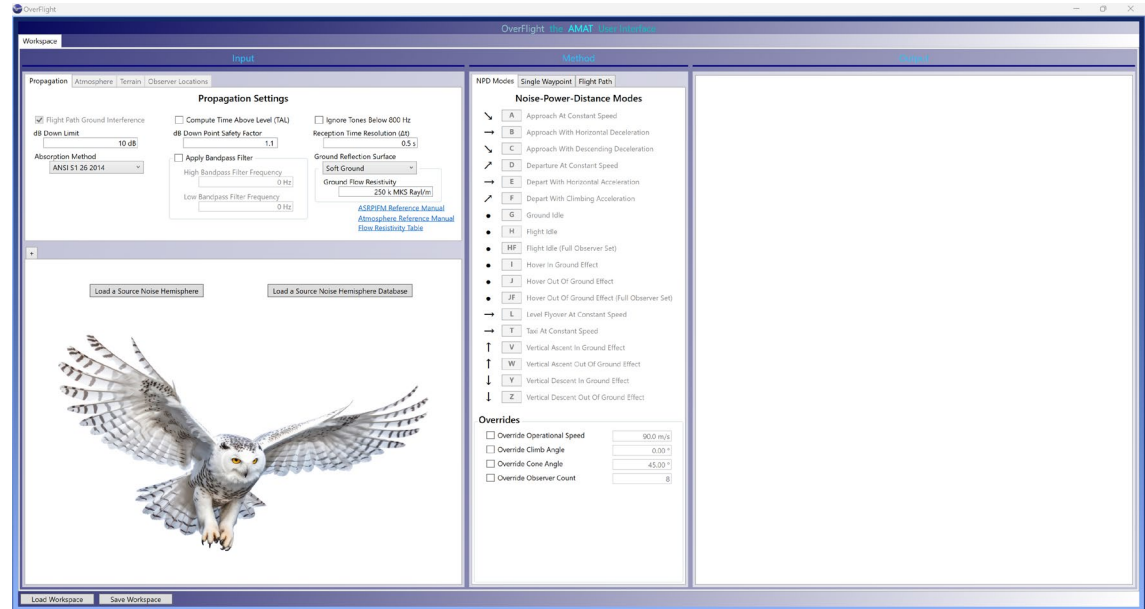


Introduction & Overview



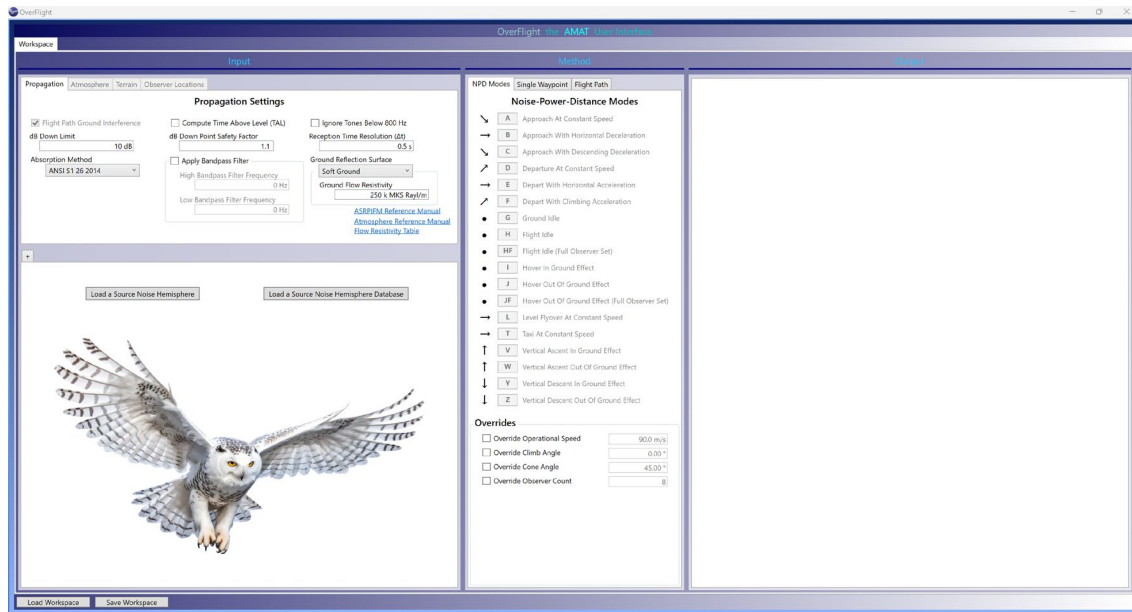
Introduction & Overview

- Aircraft operations in urban areas often produce noise complaints
- Aircraft operations planning can help reduce noise in areas of interest
- Need for an easy-to-use tool to aid in designing aircraft operations from an acoustic perspective without requiring advanced acoustic expertise

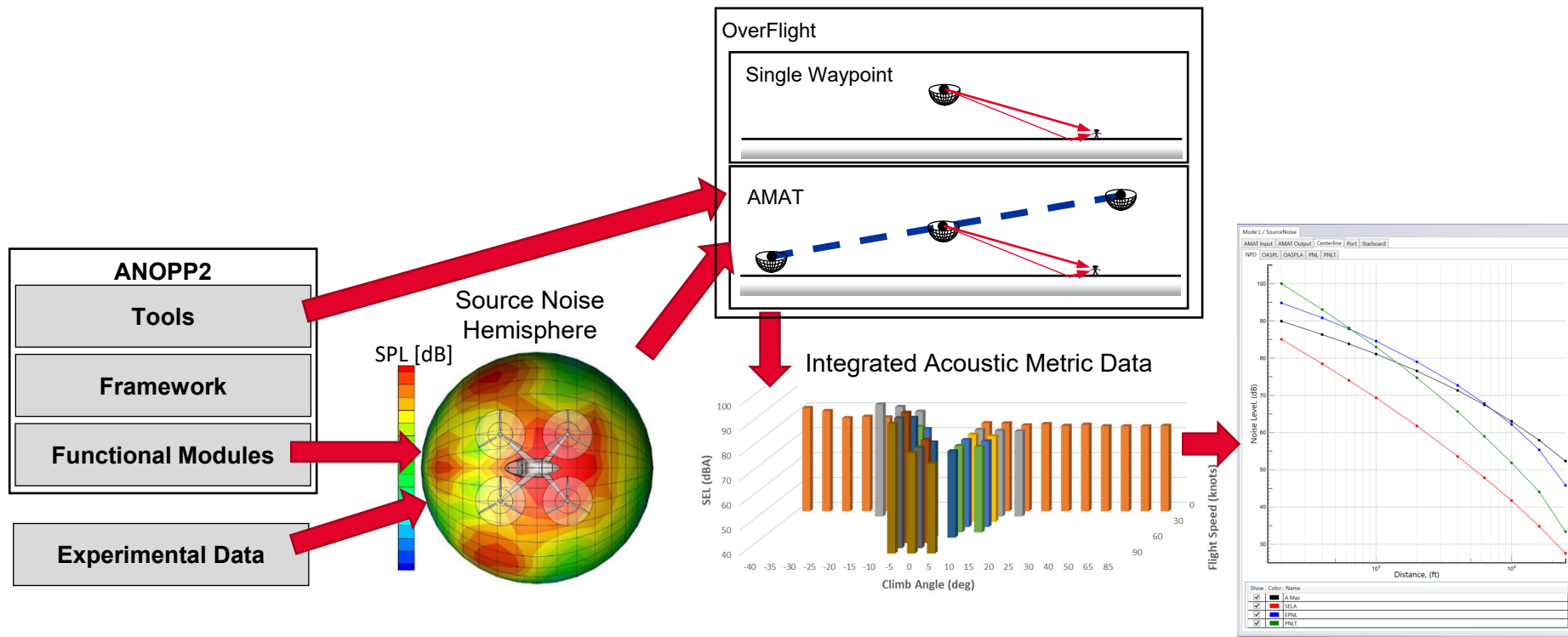


Introduction & Overview

- New user interface for land use planning and community noise impact
- Based on the Aircraft Noise Prediction Program 2 (ANOPP2) and the ANOPP2 Mission Analysis Tool (AMAT)
- Designed to be easy to use and extensible
- Supports Digital Terrain Elevation Data (DTED) for real time terrain visualization
- Easily maintain session persistence and transfer simulation settings to different computers and colleagues



Introduction & Overview



Introduction & Overview





UI Overview

UI Overview

OverFlight

Workspace

User Input

Propagation

Atmosphere

Terrain

Observer Locations

Propagation Settings

☒ Flight Path Ground Interference

dB Down Limit

10 dB

Absorption Method

ANSI S1 26 2014

☐ Compute Time Above Level (TAL)

dB Down Point Safety Factor

1.1

☐ Apply Bandpass Filter

High Bandpass Filter Frequency

0 Hz

Low Bandpass Filter Frequency

0 Hz

☐ Ignore Tones Below 800 Hz

Reception Time Resolution (dt)

0.5 s

Ground Reflection Surface

Soft Ground

Ground Flow Resistivity

250 k MKS Ray/m

[ASDIPEM Reference Manual](#)
[Atmosphere Reference Manual](#)
[Flow Resistivity Table](#)

Bell430Hemis Database

Speed

0.0 knots

Flight Path Angle

0.00 °

Clear Lookup

Speed	Climb Angle
52.3 knots	0.56 °
60.9 knots	0.18 °
61.3 knots	0.00 °
68.2 knots	0.00 °
82.7 knots	0.00 °
85.0 knots	0.02 °
85.2 knots	0.09 °
98.7 knots	0.00 °
107.5 knots	0.02 °
107.7 knots	0.00 °
120.1 knots	0.16 °
133.3 knots	0.12 °
137.1 knots	0.20 °

Export Database

Source Noise Hemispheres

Source File

Be430721.nc

Operational Speed

52.3 knots

Climb Angle

0.56 °

Includes Doppler

False

Lossless

True

Radius

30.48 m

Source Noise

☐ OASPL
 ☒ OASPLA

☐ 10 Hz
 ☐ 12.5 Hz
 ☐ 16 Hz
 ☐ 20 Hz
 ☐ 25 Hz
 ☐ 31.5 Hz

☐ 40 Hz
 ☐ 50 Hz
 ☐ 63 Hz
 ☐ 80 Hz
 ☐ 100 Hz
 ☐ 125 Hz

☐ 160 Hz
 ☐ 200 Hz
 ☐ 250 Hz
 ☐ 315 Hz
 ☐ 400 Hz
 ☐ 500 Hz

☐ 630 Hz
 ☐ 800 Hz
 ☐ 1000 Hz
 ☐ 1250 Hz
 ☐ 1600 Hz
 ☐ 2000 Hz

☐ 2500 Hz
 ☐ 3150 Hz
 ☐ 4000 Hz
 ☐ 5000 Hz
 ☐ 6300 Hz
 ☐ 8000 Hz

☐ 10000 Hz

Method

Output

NPD Modes

Single Waypoint

Flight Path

Noise-Power-Distance Modes

A

Approach At Constant Speed

B

Approach With Horizontal Deceleration

C

Approach With Descending Deceleration

D

Departure At Constant Speed

E

Depart With Horizontal Acceleration

F

Depart With Climbing Acceleration

G

Ground Idle

H

Flight Idle

HF

Flight Idle (Full Observer Set)

I

Hover In Ground Effect

J

Hover Out Of Ground Effect

JF

Hover Out Of Ground Effect (Full Observer Set)

L

Level Flyover At Constant Speed

T

Taxi At Constant Speed

V

Vertical Ascent In Ground Effect

W

Vertical Ascent Out Of Ground Effect

Y

Vertical Descent In Ground Effect

Z

Vertical Descent Out Of Ground Effect

Overrides

☐ Override Operational Speed

90.0 m/s

☐ Override Climb Angle

0.00 °

☐ Override Cone Angle

45.00 °

☐ Override Observer Count

8

Load Workspace

Save Workspace

UI Overview

User Input

Mode Configuration

Workspace
Input
Method
Output

Propagation Settings

☒ Flight Path Ground Interference

dB Down Limit

Absorption Method
ANSI S1.26.2014

☐ Compute Time Above Level (TAL)

dB Down Point Safety Factor

☐ Apply Bandpass Filter

High Bandpass Filter Frequency

Low Bandpass Filter Frequency

☐ Ignore Tones Below 800 Hz

Reception Time Resolution (Δt)

Ground Reflection Surface
Soft Ground

Ground Flow Resistivity
250 k MKS Ray/m

[ASDIPEM Reference Manual](#)
[Atmosphere Reference Manual](#)
[Flow Resistivity Table](#)

Source Noise Hemispheres

Source File: Be430721.nc

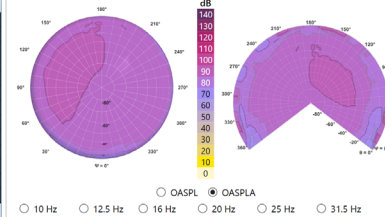
Operational Speed: 52.3 knots

Climb Angle: 0.56 °

Includes Doppler: False

Lossless: True

Radius: 30.48 m



☐ OASPL ☒ OASPLA

☐ 10 Hz ☐ 12.5 Hz ☐ 16 Hz ☐ 20 Hz ☐ 25 Hz ☐ 31.5 Hz
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☐ 10000 Hz

[Export Database](#) [SourceNoise](#)

Noise-Power-Distance Modes

NPD Modes: ☒ Single Waypoint ☐ Flight Path

- ☒ **A** Approach At Constant Speed
- ☐ **B** Approach With Horizontal Deceleration
- ☐ **C** Approach With Descending Deceleration
- ☒ **D** Departure At Constant Speed
- ☐ **E** Depart With Horizontal Acceleration
- ☐ **F** Depart With Climbing Acceleration
- ☐ **G** Ground Idle
- ☐ **H** Flight Idle
- ☒ **HF** Flight Idle (Full Observer Set)
- ☐ **I** Hover In Ground Effect
- ☐ **J** Hover Out Of Ground Effect
- ☐ **JF** Hover Out Of Ground Effect (Full Observer Set)
- ☐ **L** Level Flyover At Constant Speed
- ☐ **T** Taxi At Constant Speed
- ☐ **V** Vertical Ascent In Ground Effect
- ☐ **W** Vertical Ascent Out Of Ground Effect
- ☐ **Y** Vertical Descent In Ground Effect
- ☐ **Z** Vertical Descent Out Of Ground Effect

Overrides

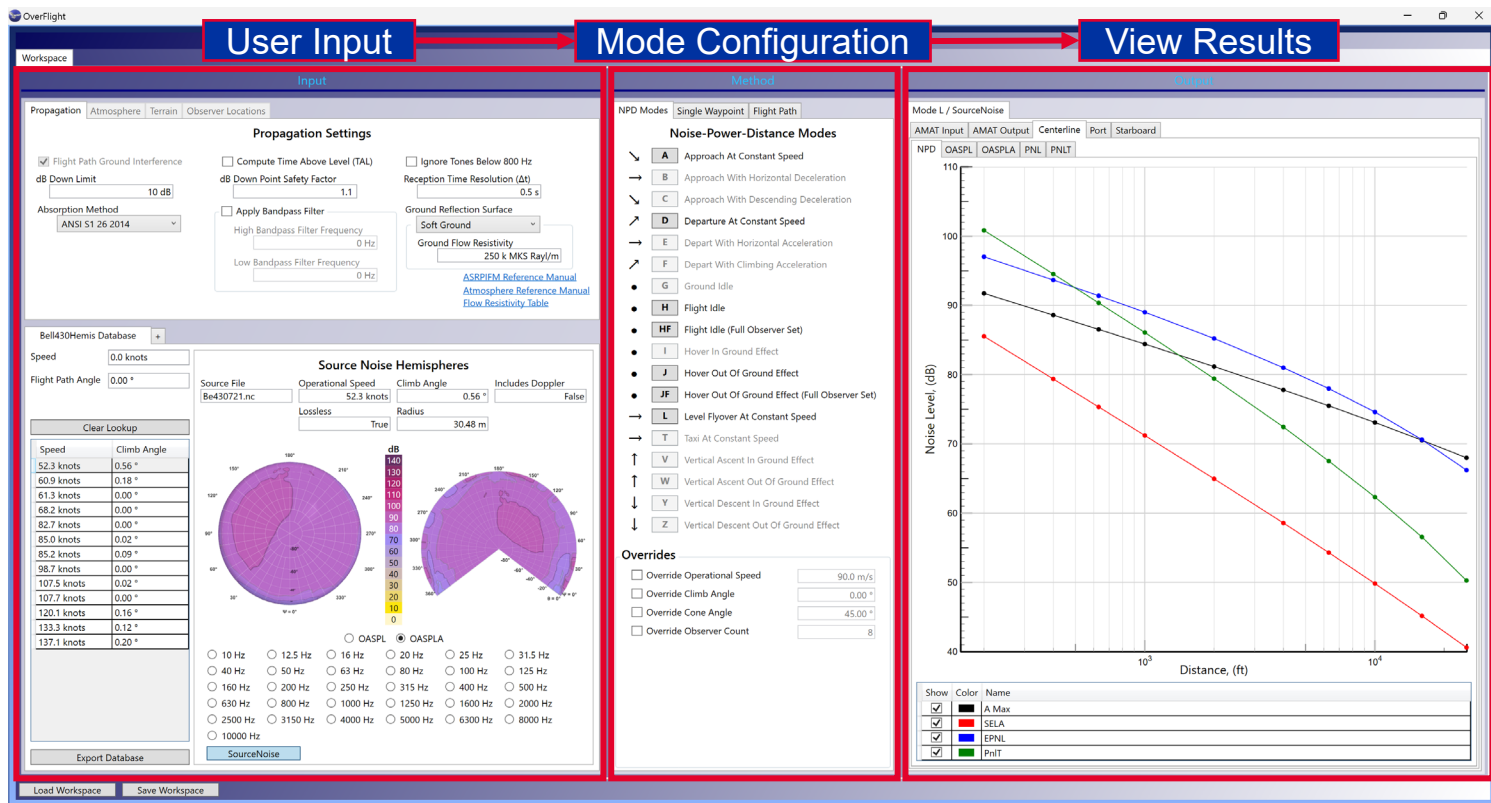
☐ Override Operational Speed

☐ Override Climb Angle

☐ Override Cone Angle

☐ Override Observer Count

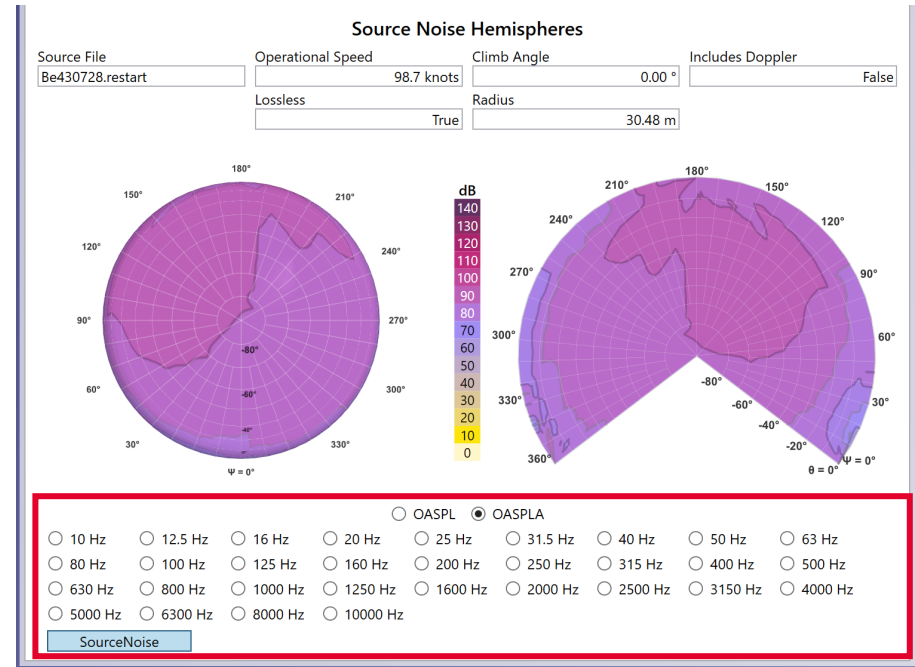
UI Overview





UI Overview: Hemispheres

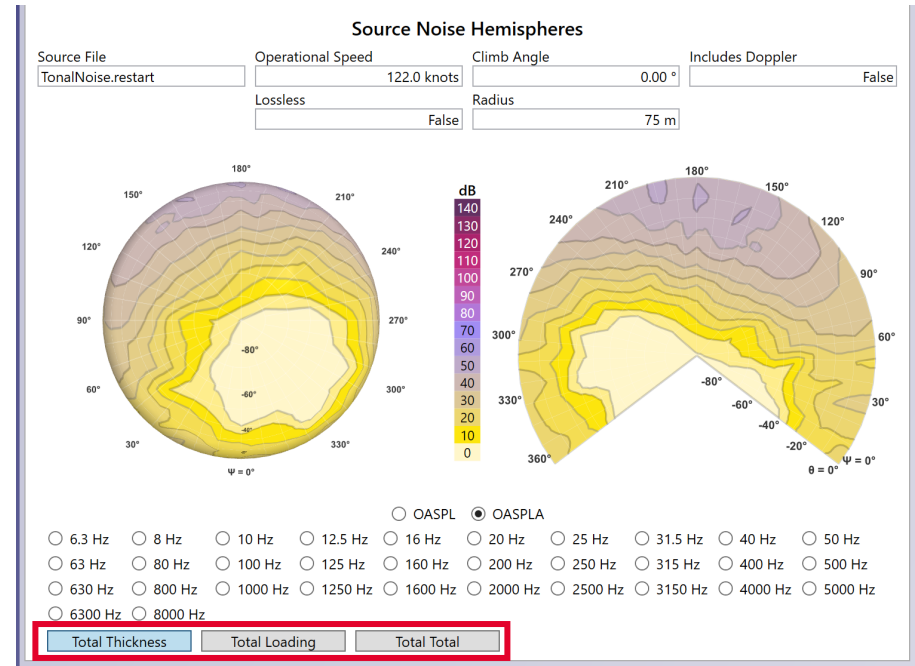
- Supports ANOPP2 Restart files and traditional netCDF (RNM/AAM) hemispheres
- View different one-third octave bands, or OASPL/OASPLA





UI Overview: Hemispheres

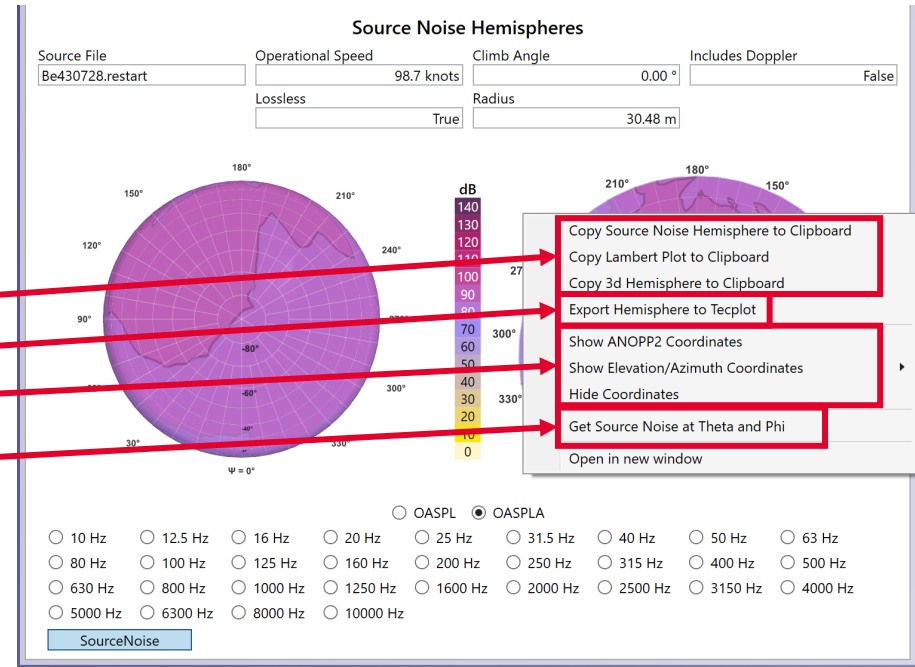
- Supports ANOPP2 Restart files and traditional netCDF (RNM/AAM) hemispheres
- View different one-third octave bands, or OASPL/OASPLA as well as different noise components





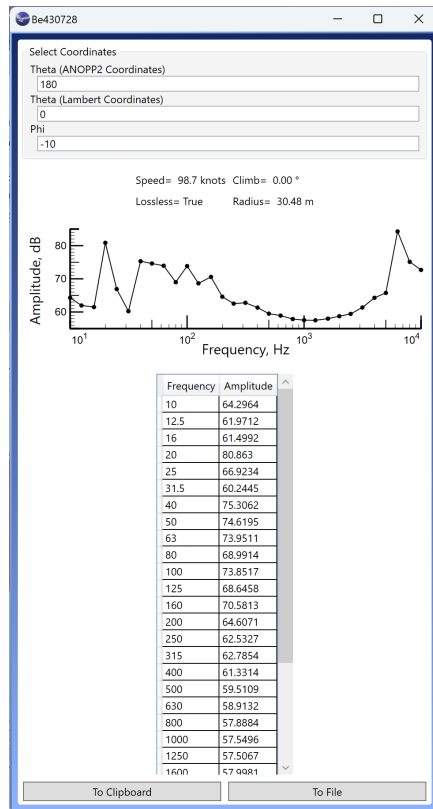
UI Overview: Hemispheres

- Supports ANOPP2 Restart files and traditional netCDF (RNM/AAM) hemispheres
- View different one-third octave bands, or OASPL/OASPLA as well as different noise components
- Right click provides more options
 - Copy images to clipboard
 - Export hemispheres to Tecplot
 - Change display coordinates
 - View source noise spectrum at specified point

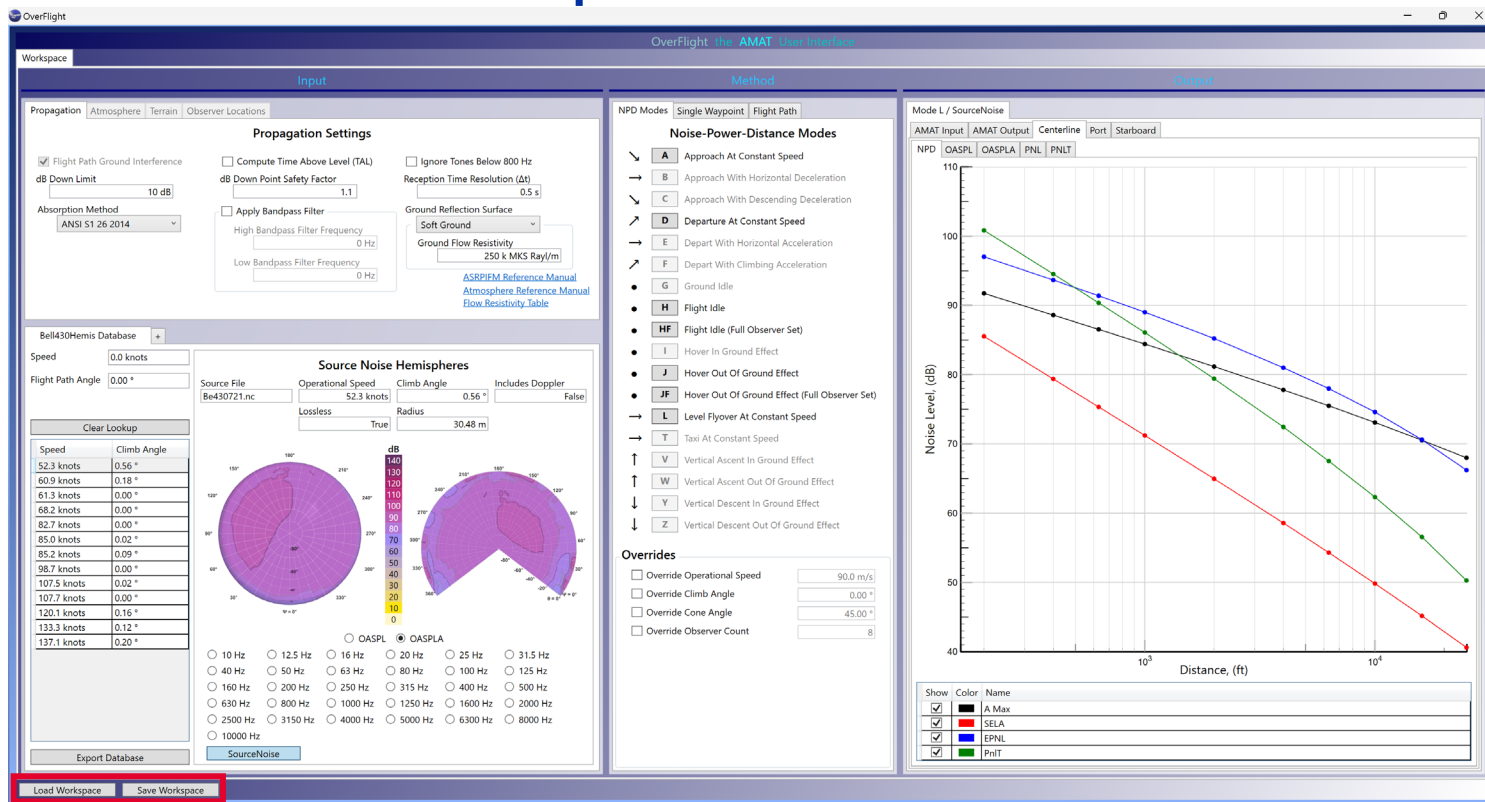


UI Overview: Hemispheres

- Supports ANOPP2 Restart files and traditional netCDF (RNM/AAM) hemispheres
- View different one-third octave bands, or OASPL/OASPLA as well as different noise components
- Right click provides more options
 - Copy images to clipboard
 - Export hemispheres to Tecplot
 - Change display coordinates
 - View source noise spectrum at specified point
- Save source spectrum to file or clipboard



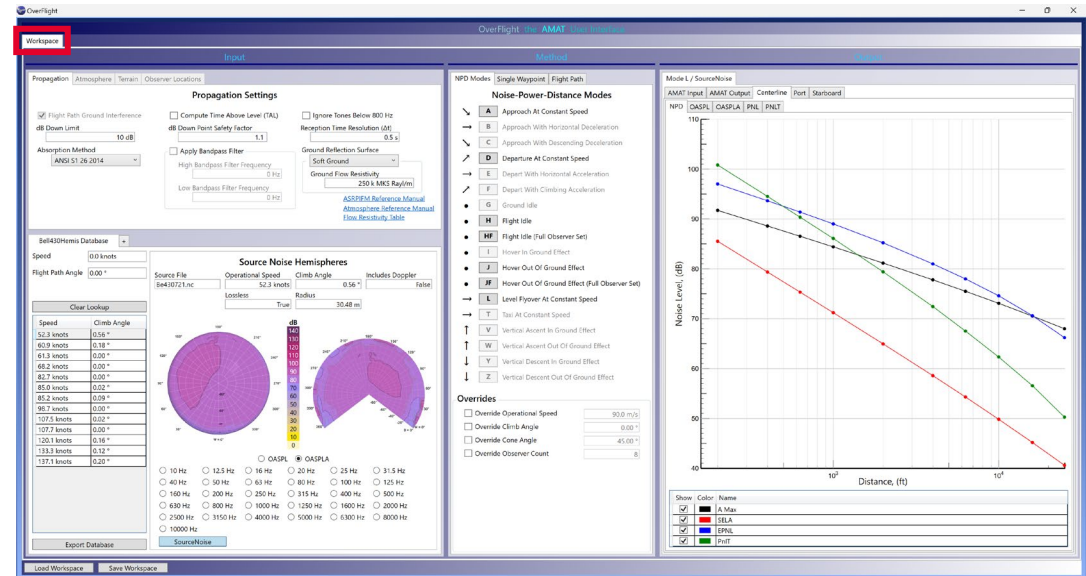
UI Overview: Workspaces





UI Overview: Workspaces

- Save Workspace
 - Saves all user input: Loaded hemispheres and databases, propagation settings, atmosphere settings, etc.
 - Saves method settings
- Load Workspace loads back all information saved in workspace file. Results are recomputed
- Different workspaces for different tasks. Different tabs for different workspaces





Acoustic Propagation

Acoustic Propagation

- Powered by ANOPP2 Straight Ray Propagation Internal Functional Module (ASRPIMF)
 - Straight ray propagation: no curvature due to wind, atmospheric variations, etc.
 - Accounts for spherical spreading

Propagation
Atmosphere
Terrain
Observer Locations

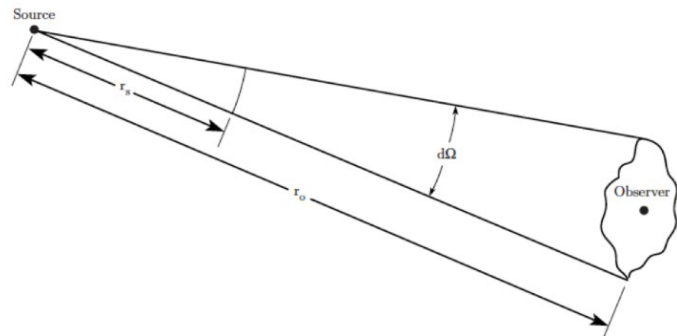
Propagation Settings

Absorption Method
ANSI S1 26 2014

Ground Reflection Surface
Soft Ground

Ground Flow Resistivity
250 k MKS Rayl/m

[ASRPIMF Reference Manual](#)
[Atmosphere Reference Manual](#)
[Flow Resistivity Table](#)



Acoustic Propagation

- Powered by ANOPP2 Straight Ray Propagation Internal Functional Module (ASRPIMF)
 - Straight ray propagation: no curvature due to wind, atmospheric variations, etc.
 - Accounts for spherical spreading
- Atmospheric absorption
 - Several models
 - SAE ARP 866A
 - 1978 ICAO
 - ANSI S1.26-1978
 - ANSI S1.26-2014
 - Atmospheric attenuation averaged across atmosphere layers using selected absorption method
 - Uniform per layer, no spatial variance

Propagation
Atmosphere
Terrain
Observer Locations

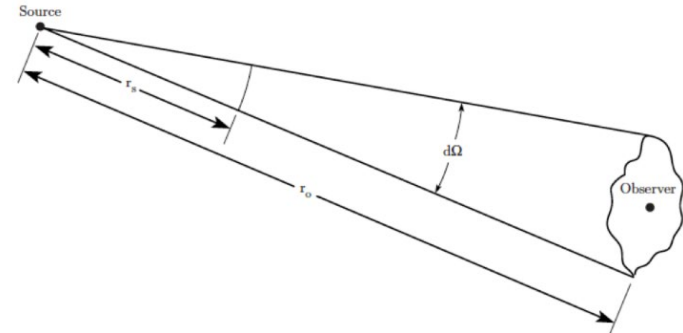
Propagation Settings

Absorption Method
ANSI S1 26 2014

Ground Reflection Surface
Soft Ground

Ground Flow Resistivity
250 k MKS Rayl/m

[ASRPIMF Reference Manual](#)
[Atmosphere Reference Manual](#)
[Flow Resistivity Table](#)





Acoustic Propagation

- Powered by ANOPP2 Straight Ray Propagation Internal Functional Module (ASRPIMF)
 - Straight ray propagation: no curvature due to wind, atmospheric variations, etc.
 - Accounts for spherical spreading
- Atmospheric absorption
 - Several models
 - SAE ARP 866A
 - 1978 ICAO
 - ANSI S1.26-1978
 - ANSI S1.26-2014
 - Atmospheric attenuation averaged across atmosphere layers using selected absorption method
 - Uniform per layer, no spatial variance
- Ground reflection model based off Chien and Soroka[†]
- Ground impedance model base off K. Attenborough[‡]
 - Options are: no reflection, hard reflection, soft reflection
 - Uniform, no spatial variance

Propagation | Atmosphere | Terrain | Observer Locations

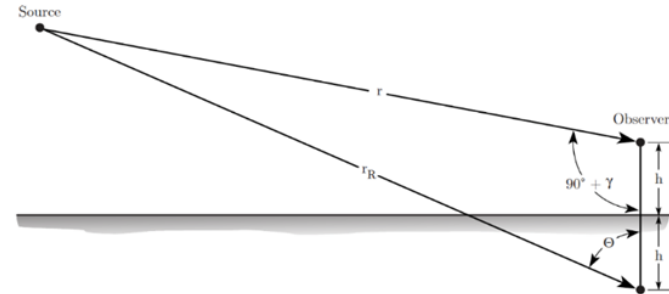
Propagation Settings

Absorption Method:

Ground Reflection Surface:

Ground Flow Resistivity:

[ASRPIMF Reference Manual](#)
[Atmosphere Reference Manual](#)
[Flow Resistivity Table](#)



[†]C.F.Chien and W.W.Soroka, "Sound Propagation along an Impedance Plane," *Journal of Sound and Vibration*, Vol. 43, 1975, pp. 9–20.

[‡] K. Attenborough, "Acoustical impedance models for outdoor ground surfaces," *Journal of Sound and Vibration*, Vol. 99, 1985, pp. 521–544.



Modes of Operation: Noise-Power-Distance

Modes of Operation: Noise-Power-Distance



- User Inputs
 - Propagation settings

Propagation | Atmosphere | Terrain | Observer Locations

Propagation Settings

☒ Flight Path Ground Interference
dB Down Limit: 10 dB
Absorption Method: ANSI S1.26.2014

☐ Compute Time Above Level (TAL)
dB Down Point Safety Factor: 1.1
☐ Apply Bandpass Filter
High Bandpass Filter Frequency: 0 Hz
Low Bandpass Filter Frequency: 0 Hz

☐ Ignore Tones Below 800 Hz
Reception Time Resolution (Δt): 0.5 s
Ground Reflection Surface: Soft Ground
Ground Flow Resistivity: 250 k MKS Rayl/m

[ASRP/EM Reference Manual](#)
[Atmosphere Reference Manual](#)
[Flow Resistivity Table](#)

Be430728 | Bell430Hemis Database | +

Source Noise Hemispheres

Source File: Be430728.restart | Operational Speed: 98.7 knots | Climb Angle: 0.00 ° | Includes Doppler: False
Lossless: True | Radius: 30.48 m

☐ OASPL ☒ OASPLA

SourceNoise

Modes of Operation: Noise-Power-Distance



- User Inputs
 - Propagation settings
 - Source noise hemisphere

Propagation
Atmosphere
Terrain
Observer Locations

Propagation Settings

☒ Flight Path Ground Interference
dB Down Limit: 10 dB
Absorption Method: ANSI S1.26.2014

☐ Compute Time Above Level (TAL)
dB Down Point Safety Factor: 1.1
☐ Apply Bandpass Filter
High Bandpass Filter Frequency: 0 Hz
Low Bandpass Filter Frequency: 0 Hz

☐ Ignore Tones Below 800 Hz
Reception Time Resolution (Δt): 0.5 s
Ground Reflection Surface: Soft Ground
Ground Flow Resistivity: 250 k MKS Ray/m
[ASRP/EM Reference Manual](#)
[Atmosphere Reference Manual](#)
[Flow Resistivity Table](#)

Be430728
Bell430Hemis Database
+

Source Noise Hemispheres

Source File: Be430728.restart
Operational Speed: 98.7 knots
Climb Angle: 0.00 °
Includes Doppler: False

Lossless: True
Radius: 30.48 m

☐ OASPL
☒ OASPLA

☐ 10 Hz
☐ 12.5 Hz
☐ 16 Hz
☐ 20 Hz
☐ 25 Hz
☐ 31.5 Hz
☐ 40 Hz
☐ 50 Hz
☐ 63 Hz

☐ 80 Hz
☐ 100 Hz
☐ 125 Hz
☐ 160 Hz
☐ 200 Hz
☐ 250 Hz
☐ 315 Hz
☐ 400 Hz
☐ 500 Hz

☐ 630 Hz
☐ 800 Hz
☐ 1000 Hz
☐ 1250 Hz
☐ 1600 Hz
☐ 2000 Hz
☐ 2500 Hz
☐ 3150 Hz
☐ 4000 Hz

☐ 5000 Hz
☐ 6300 Hz
☐ 8000 Hz
☐ 10000 Hz

SourceNoise

Modes of Operation: Noise-Power-Distance



- User Inputs
 - Propagation settings
 - Source noise hemisphere or selection from database

Propagation | Atmosphere | Terrain | Observer Locations

Propagation Settings

☒ Flight Path Ground Interference

dB Down Limit: 10 dB

Absorption Method: ANSI S1.26.2014

☐ Compute Time Above Level (TAL)

dB Down Point Safety Factor: 1.1

☐ Ignore Tones Below 800 Hz

Reception Time Resolution (Δt): 0.5 s

☐ Apply Bandpass Filter

High Bandpass Filter Frequency: 0 Hz

Low Bandpass Filter Frequency: 0 Hz

Ground Reflection Surface: Soft Ground

Ground Flow Resistivity: 250 k MKS Ray/m

[ASBPiEM Reference Manual](#)
[Atmosphere Reference Manual](#)
[Flow Resistivity Table](#)

Be430728 | Be430Hemis Database

Speed: 0.0 knots

Flight Path Angle: 0.00 °

Clear Lookup

Speed	Climb Angle
52.3 knots	0.56 °
60.9 knots	0.18 °
61.3 knots	0.00 °
68.2 knots	0.00 °
82.7 knots	0.00 °
85.0 knots	0.02 °
85.2 knots	0.09 °
98.7 knots	0.00 °
107.5 knots	0.02 °
107.7 knots	0.00 °
120.1 knots	0.16 °
133.3 knots	0.12 °
137.1 knots	0.20 °

Source File: Be430725.nc

Operational Speed: 85.2 knots

Climb Angle: 0.09 °

Includes Doppler: False

Lossless: True

Radius: 30.48 m

Source Noise Hemispheres

dB

☐ OASPL ☒ OASPLA

☐ 10 Hz ☐ 12.5 Hz ☐ 16 Hz ☐ 20 Hz ☐ 25 Hz ☐ 31.5 Hz
☐ 40 Hz ☐ 50 Hz ☐ 63 Hz ☐ 80 Hz ☐ 100 Hz ☐ 125 Hz
☐ 160 Hz ☐ 200 Hz ☐ 250 Hz ☐ 315 Hz ☐ 400 Hz ☐ 500 Hz
☐ 630 Hz ☐ 800 Hz ☐ 1000 Hz ☐ 1250 Hz ☐ 1600 Hz ☐ 2000 Hz
☐ 2500 Hz ☐ 3150 Hz ☐ 4000 Hz ☐ 5000 Hz ☐ 6300 Hz ☐ 8000 Hz
☐ 10000 Hz

Export Database

SourceNoise

Modes of Operation: Noise-Power-Distance

- User Inputs
 - Propagation settings
 - Source noise hemisphere or selection from database
- Standard Noise-Power-Distance Modes (NPD)
 - Currently Available Modes: A, D, H, HF, J, JF, and L

NPD Modes
Single Waypoint
Flight Path

Noise-Power-Distance Modes

- ↘ **A** Approach At Constant Speed
- **B** Approach With Horizontal Deceleration
- ↘ **C** Approach With Descending Deceleration
- ↗ **D** Departure At Constant Speed
- **E** Depart With Horizontal Acceleration
- ↗ **F** Depart With Climbing Acceleration
- **G** Ground Idle
- **H** Flight Idle
- **HF** Flight Idle (Full Observer Set)
- **I** Hover In Ground Effect
- **J** Hover Out Of Ground Effect
- **JF** Hover Out Of Ground Effect (Full Observer Set)
- **L** Level Flyover At Constant Speed
- **T** Taxi At Constant Speed
- ↑ **V** Vertical Ascent In Ground Effect
- ↑ **W** Vertical Ascent Out Of Ground Effect
- ↓ **Y** Vertical Descent In Ground Effect
- ↓ **Z** Vertical Descent Out Of Ground Effect

Overrides

- ☐ Override Operational Speed
- ☐ Override Climb Angle
- ☐ Override Cone Angle
- ☐ Override Observer Count

Modes of Operation: Noise-Power-Distance

- User Inputs
 - Propagation settings
 - Source noise hemisphere or selection from database
- Standard Noise-Power-Distance Modes (NPD)
 - Currently Available Modes: A, D, H, HF, J, JF, and L
 - Can override prediction parameters

NPD Modes
Single Waypoint
Flight Path

Noise-Power-Distance Modes

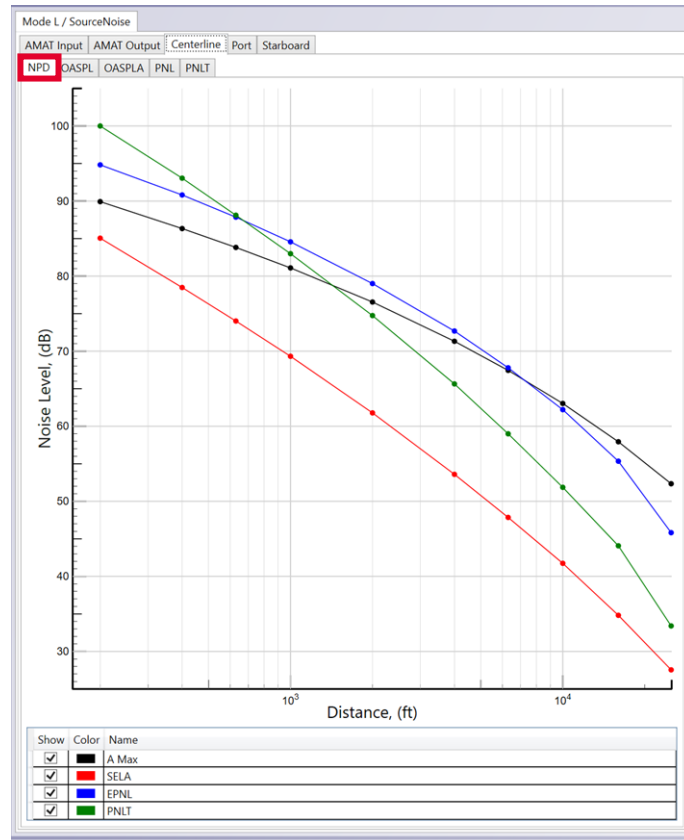
- ↘ **A** Approach At Constant Speed
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- **L** Level Flyover At Constant Speed
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- ↑ **V** Vertical Ascent In Ground Effect
- ↑ **W** Vertical Ascent Out Of Ground Effect
- ↓ **Y** Vertical Descent In Ground Effect
- ↓ **Z** Vertical Descent Out Of Ground Effect

Overrides

<input type="checkbox"/> Override Operational Speed	90 m/s
<input type="checkbox"/> Override Climb Angle	0 °
<input type="checkbox"/> Override Cone Angle	45 °
<input type="checkbox"/> Override Observer Count	8

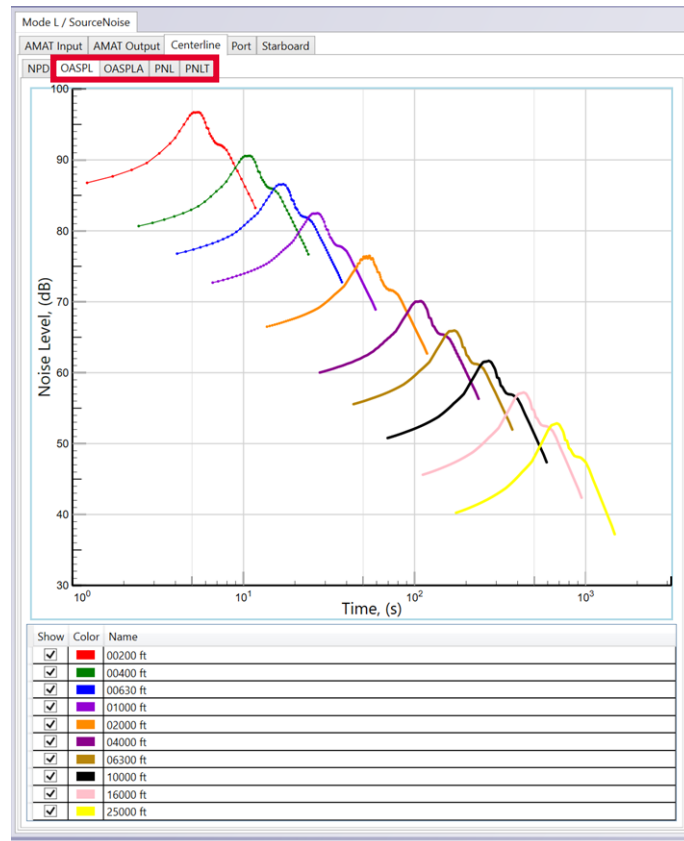
Modes of Operation: Noise-Power-Distance

- User Inputs
 - Propagation settings
 - Source noise hemisphere or selection from database
- Standard Noise-Power-Distance Modes (NPD)
 - Currently Available Modes: A, D, H, HF, J, JF, and L
 - Can override prediction parameters
- Results:
 - NPD Curves



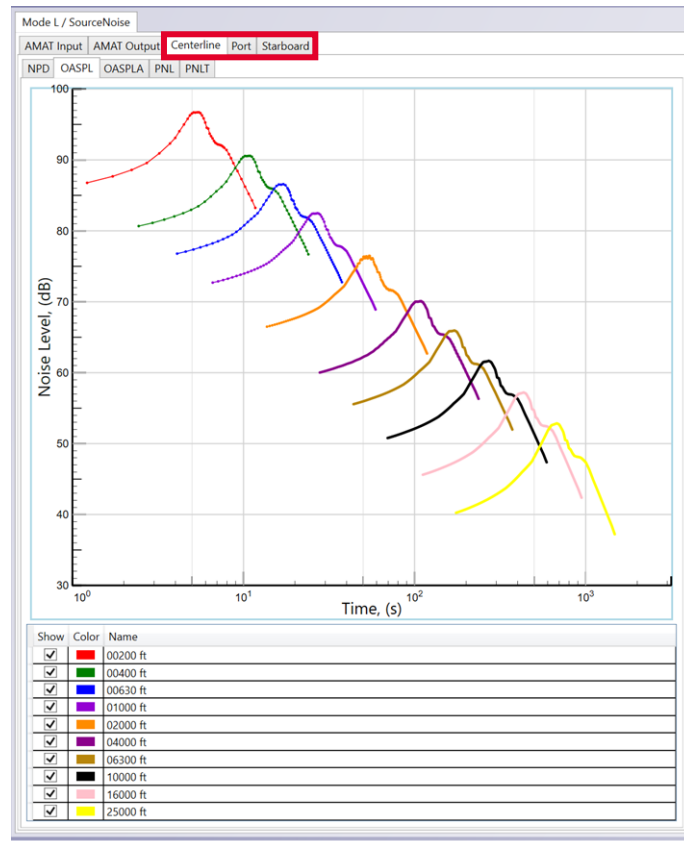
Modes of Operation: Noise-Power-Distance

- User Inputs
 - Propagation settings
 - Source noise hemisphere or selection from database
- Standard Noise-Power-Distance Modes (NPD)
 - Currently Available Modes: A, D, H, HF, J, JF, and L
 - Can override prediction parameters
- Results:
 - NPD Curves
 - OASPL, OASPLA, PNL, and PNLT at different altitudes



Modes of Operation: Noise-Power-Distance

- User Inputs
 - Propagation settings
 - Source noise hemisphere or selection from database
- Standard Noise-Power-Distance Modes (NPD)
 - Currently Available Modes: A, D, H, HF, J, JF, and L
 - Can override prediction parameters
- Results:
 - NPD Curves
 - OASPL, OASPLA, PNL, and PNLT at different altitudes
 - Available at different observer angles where applicable: Centerline, Port, Starboard





Modes of Operation: Single Waypoint

Modes of Operation: Single Waypoint

- User Input
 - Propagation
 - Atmosphere
 - Terrain from DTED
 - Source noise hemisphere or database

Propagation | Atmosphere | Terrain | Observer Locations

Propagation Settings

Absorption Method:

Ground Reflection Surface:

Ground Flow Resistivity:

[ASRP/EM Reference Manual](#)
[Atmosphere Reference Manual](#)
[Flow Resistivity Table](#)

Propagation | Atmosphere | Terrain | Observer Locations

Atmospheric Conditions

Altitude	Temperature	Pressure	Relative Humidity
0 m	15 °C	101.325 kPa	0.7

[Atmosphere Reference Manual](#)

Propagation | Atmosphere | Terrain | Observer Locations

Terrain

Map Coordinates | Available Locations | DTED Resources

Geodetic Map Coordinates
 Enter coordinates for South-West corner.
 Then enter either the North-East corner or the Extent.

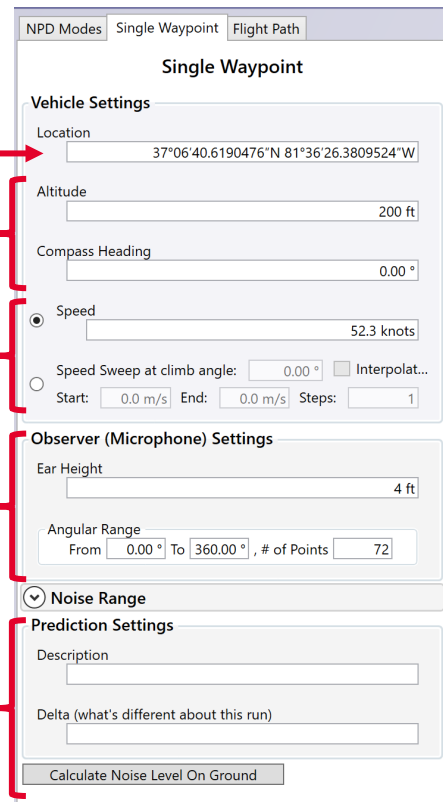
North-East Corner:

(Extent):

South-West Corner (Anchor Point):

Modes of Operation: Single Waypoint

- User Input
 - Propagation
 - Atmosphere
 - Terrain from DTED
 - Source noise hemisphere or database
- Method configuration
 - Location for terrain line-of-sight calculation
 - Vehicle position and orientation
 - Vehicle speed or a range of speeds
 - Observer settings
 - User notes



The screenshot shows the 'Single Waypoint' configuration window. Red arrows connect the list items to specific fields: 'Location for terrain line-of-sight calculation' points to the 'Location' field; 'Vehicle position and orientation' points to the 'Altitude' field; 'Vehicle speed or a range of speeds' points to the 'Speed' field; 'Observer settings' points to the 'Observer (Microphone) Settings' section; and 'User notes' points to the 'Description' field in the 'Prediction Settings' section.

NPD Modes | Single Waypoint | Flight Path

Single Waypoint

Vehicle Settings

Location:

Altitude:

Compass Heading:

☒ Speed:

☐ Speed Sweep at climb angle: ☐ Interpolat...

Start: End: Steps:

Observer (Microphone) Settings

Ear Height:

Angular Range: From To , # of Points

☒ Noise Range

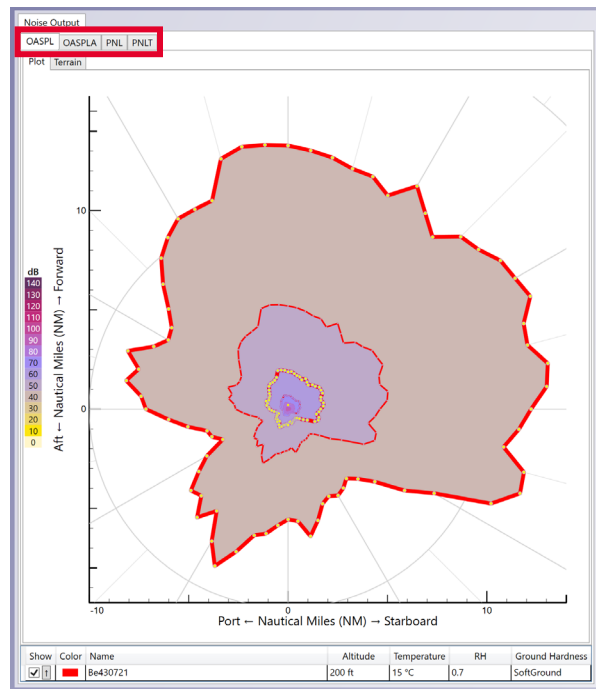
Prediction Settings

Description:

Delta (what's different about this run):

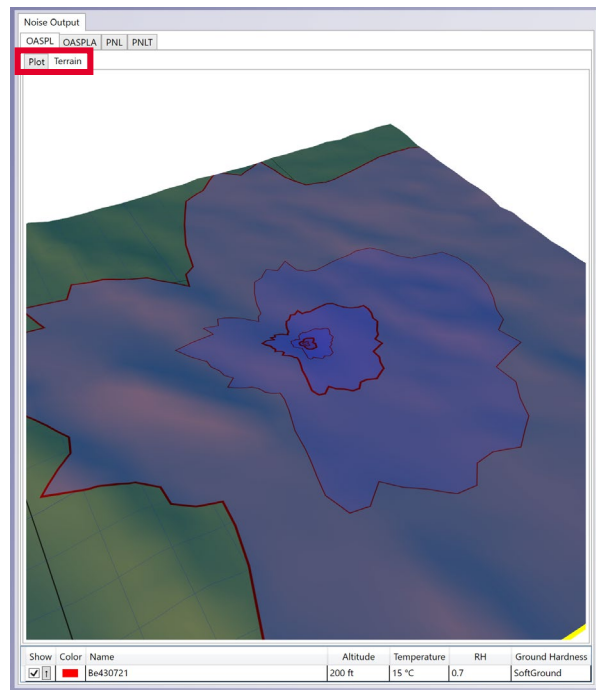
Modes of Operation: Single Waypoint

- User Input
 - Propagation
 - Atmosphere
 - Terrain from DTED
 - Source noise hemisphere or database
- Method configuration
 - Location for terrain line-of-sight calculation
 - Vehicle position and orientation
 - Vehicle speed or a range of speeds
 - Observer settings
 - User notes
- Results
 - Contours of OASPL, OASPLA, PNL, and PNLT



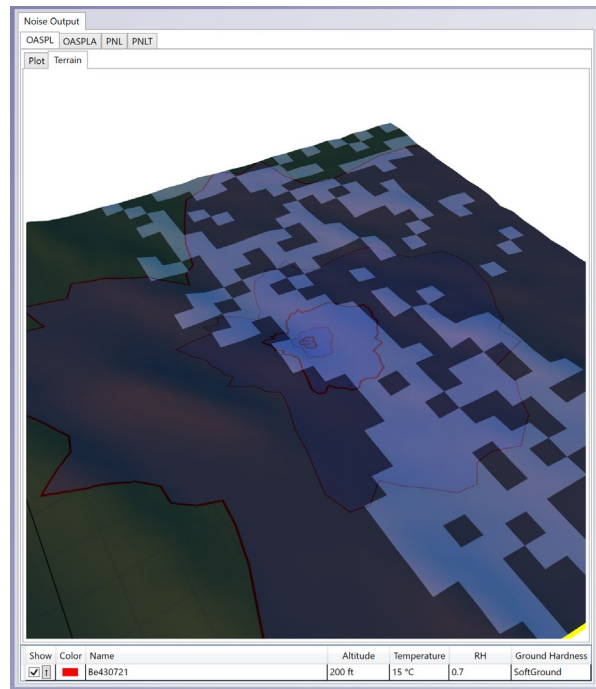
Modes of Operation: Single Waypoint

- User Input
 - Propagation
 - Atmosphere
 - Terrain from DTED
 - Source noise hemisphere or database
- Method configuration
 - Location for terrain line-of-sight calculation
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Modes of Operation: Single Waypoint

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- Results
 - Contours of OASPL, OASPLA, PNL, and PNLT
 - Viewable on terrain
 - Geometric “Line-of-Sight” can mask out acoustic results based on terrain



Modes of Operation: Single Waypoint

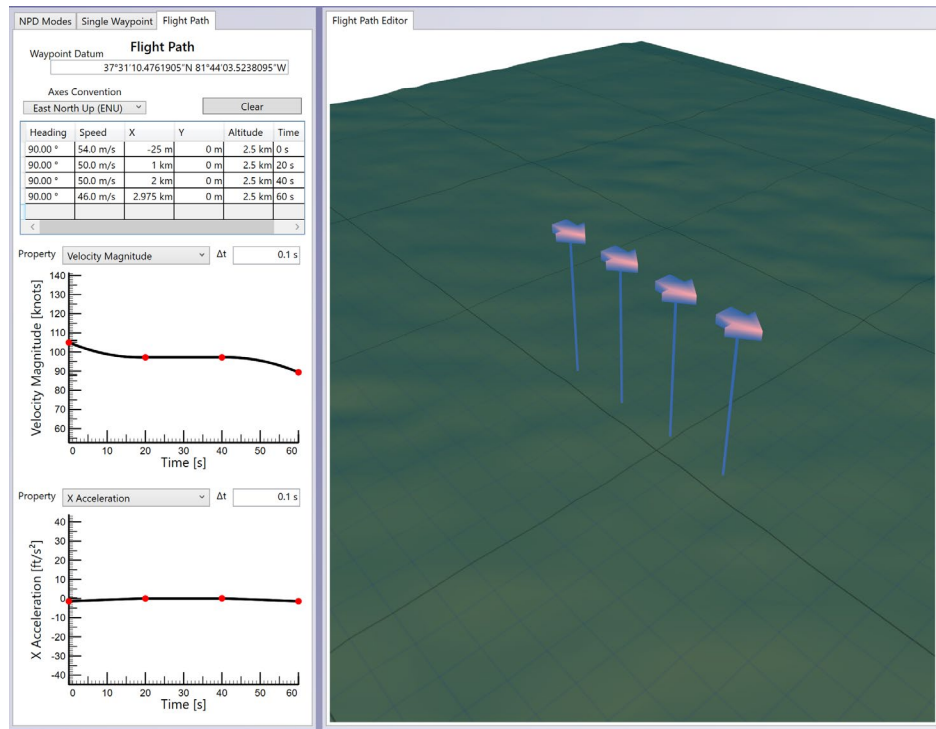




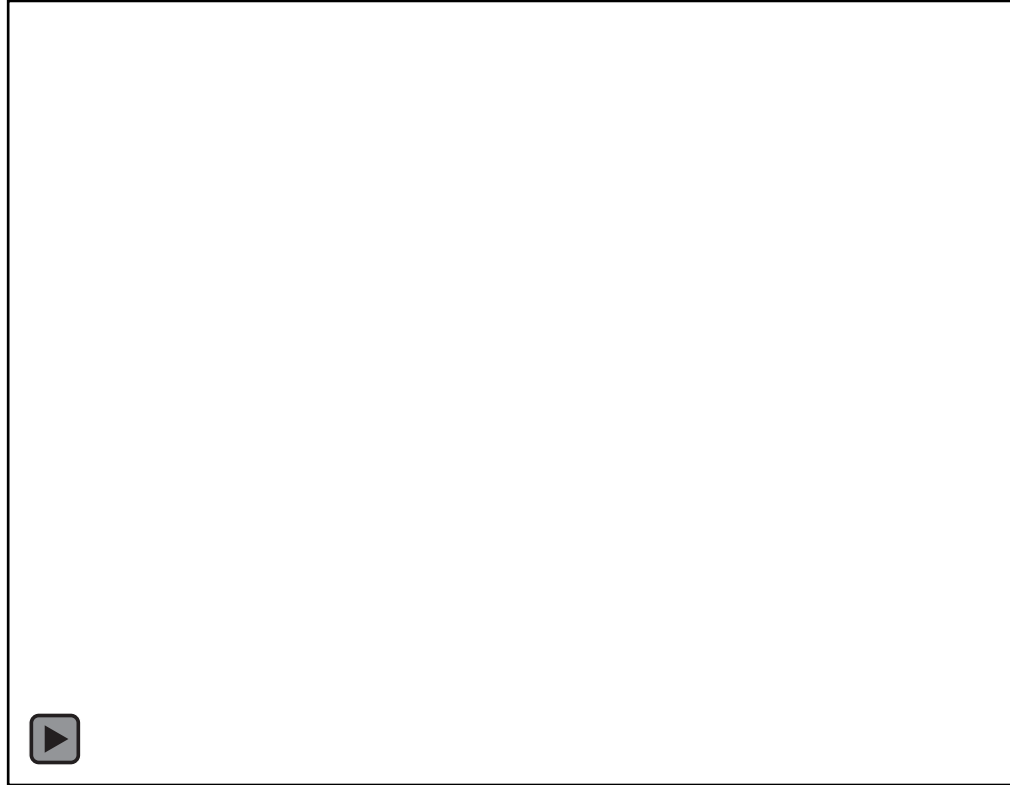
Next Steps

Next Steps: Flight Path Planning

- Integrated flight path editor
 - Edit waypoints and view path properties change in real time
 - Plan around terrain features with DTED support
- In the future:
 - Multiple pathing algorithms and vehicle dynamics models can be implemented and will be selectable
 - View acoustic contours on terrain for simulated flight path

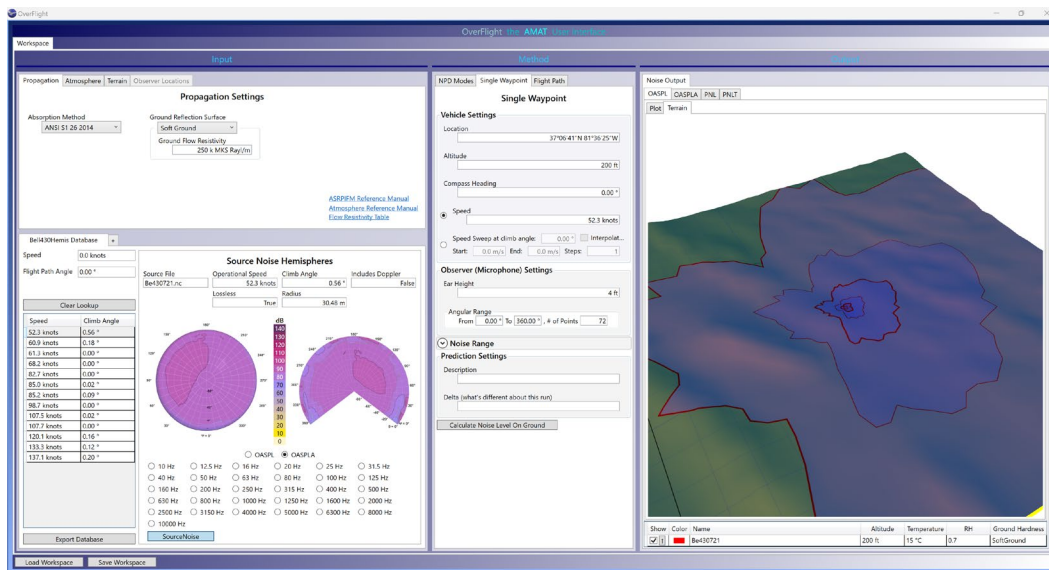


Next Steps: Flight Path Planning



Summary

- OverFlight makes acoustic predictions easy to setup and execute
- Extensible design allows for rapid implementation of new models and features
- Workspaces make for easy data sharing and program persistence
- Integrated DTED viewer to visualize acoustic impact on real terrain data
- Estimated release date: Summer 2026 with ANOPP2v1.6





Questions?

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