# Generating ONMS Soundscape Inventory reports

## Purpose of reports

Reporting on ocean sound conditions from the ONMS long-term monitoring sites helps to ensure the information is available for sanctuaries. These updated web-based reports include the most recent results for soundscape conditions and best available ocean sound indicators. The intention of the reports is to:

* provide ONMS-sound team with updates on available data and general soundscape conditions
* provide the ONMS-sound team with a communication tool to show status and trends of soundscape conditions and ocean sound indicators
* provide an overview of ocean sound indicators available for sanctuary [condition tracking](https://sanctuarywatch.ioos.us/)

## Guiding principles

* Use publicly available data from open data repositories (e.g. NCEI-GCP)
* Transparent code development
* Leverage existing open-source data processing and visualization tools (e.g. PAMverse)
* Concise and clear explanations of graphics
* Collaborative development with ONMS sound team, regional coordinators, and Sanctuary Watch

## Important documents

* [ONMSSound\_IndicatorCategories.xlsx](https://docs.google.com/spreadsheets/d/1pl_sXZHMPfetFMQ96OYqYLhj5V3BT8vd/edit?pli=1&gid=1652443092#gid=1652443092) (edited in google sheets)
* [PAM-SI soundscape technical documentation](https://docs.google.com/document/d/1Bozh0ljFB_FDY7-KcNgiZ0VbpDklSvlz9smCTYbkiOs/edit?tab=t.0#heading=h.nw22tnaj3u92)

## Terminology

* **Soundscape Metrics** | raw audio data calibrated to 1-min power-spectral densities in hybrid millidecade frequency bands saved in NCEI netCDF file format, often referred to as sound levels dB re 1 𝜇Pa2/Hz
* **Soundscape Labels** | soundscape metrics labeled with known acoustic source(s) present. A variety of source detection methods (e.g. marine mammal calls) and non-acoustic data sources are combined with the soundscape metrics (e.g. wind speed, vessel traffic, biological survey). Soundscape labels divide the metrics into different categories to understand how sound levels vary and percent of the time soundscapes are within different categories.
* **Soundscape Scenes** | a user defined combination of the types of sources present, using the soundscape labels. For example, a *biological soundscape scene* is only when any biological sound is present.
* **Soundscape Condition** | tracking how sound levels change in different frequencies using the soundscape metrics. Soundscapes vary across years, seasons, and within a day. Differences are driven by shifts in wind and weather patterns, migration and behavior of animals, and patterns in human activities. Seasonal and annual percentiles of all the data are used to see how daily values fall within ranges for a given monitoring location.
* **Ocean Sound Indicators** | ocean resource-management relevant metrics derived from long-term monitoring of ocean sound to track status and trends conditions. These indicators track habitat, species, human-use, and management activities. There are many analytical methods used to generate ocean sound indicators. In some locations sound frequencies are dominated by a specific source and we can use this frequency (e.g. 125 Hz for vessel noise) to track conditions. Other methods detect specific sources of interest. For example, the National Marine Fisheries Service (NMFS) maintains analysis of the presence of marine mammals from ocean sound monitoring data.
* **Background Soundscape** | an estimate of sound levels when no detections are present using an unsupervised separation (e.g. RRPCA) of soundscape metrics into background and transient conditions based on decomposition of the soundscape metrics within a defined frequency band
* **Soundscape Features** | unsupervised separation of metrics into salient features and unique spectral features (e.g. clustering), dependent on settings for the automated/unsupervised learning and can be defined within sites, seasons, scenes, or management scenarios.

## Project structure

A diagram of a diagram

AI-generated content may be incorrect.

*created with Microsoft Visio*

### Audio data from long-term monitoring sites

**Explanation of current steps (video)**

1. Creating standard sound level – use available data processing software to create a standardize soundscape metrics with quality information (region-led, PAM-SI guidelines)
2. Package and archive data at NCEI (region-led); NCEI upload to GCP
3. Download data to local drive for processing- organize by site name (e.g. hi01), option to pull data from repositories hosted by partners (e.g. AWS, google drive, NMFS-cloud)
4. Run R-scripts to process data (see generating graphics section)
5. Refresh Soundscape website to see updated graphics

**Recommended updates/changes**

### Context information

**Explanation of current steps (video)**

1. The ONMS Sound team maintains and updates a google sheet with important information about the long-term monitoring sites.
2. Analysis downloads

**Recommended updates/changes**

* Update code to be able to format the text as

### Other data