Aviation Event Statistics

Manual

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Chapter 1

General Documentation

This section contains the core documentation for setting up and starting with IO-AVSTATS. It covers everything from installation to basic and advanced configurations.

1.1 Introduction

The Aviation Event Statistics (**IO-AVSTATS**) includes the following applications:

- **ae1982** - Aviation Event Analysis
- **pd1982** - IO-AVSTATS-DB Database Profiling
- **slara** - Association Rule Analysis

1.2 Requirements

The required software is listed below. Regarding the corresponding software versions, you will find the detailed information in the Release Notes.

1.2.1 Operating System

Continuous delivery / integration (CD/CI) runs on Ubuntu and development is also done with macOS and Windows 10/11.

The installation of Homebrew is required for macOS. If necessary, Homebrew can be installed with the following command:

```
/bin/bash -c "$(curl -fsSL
https://raw.githubusercontent.com/Homebrew/install/HEAD/install.sh)"
```

For the Windows operating systems, only additional the functionality of the `make` tool must be made available, e.g. via Make for Windows

The command-line shells supported are:

Operating system	Command-line shell(s)
macOS	zsh
Ubuntu	bash
Windows 10/11	cmd and PowerShell

For macOS and Ubuntu, the end-of-line character and the execution authorization may need to be adjusted for the shell scripts. If the `dos2Unix` program is installed, the necessary adjustments can be made using the scripts `./scripts/run_prep_zsh_scripts.zsh` (macOS) or `./scripts/run_prep_bash_scripts.sh` (Ubuntu).

1.2.2 Python

This project utilizes Python from version 3.10, which introduced significant enhancements in type hinting and type annotations. These improvements provide a more robust and clear definition of function parameters, return types, and variable types, contributing to improved code readability and maintainability. The use of Python 3.11 ensures compatibility with these advanced typing features, offering a more structured and error-resistant development environment.

1.2.3 Docker Desktop

The project employs PostgreSQL for data storage and leverages Docker images provided by PostgreSQL to simplify the installation process. Docker Desktop is used for its ease of managing and running containerized applications, allowing for a consistent and isolated environment for PostgreSQL. This approach streamlines the setup, ensuring that the database environment is quickly replicable and maintainable across different development setups.

1.2.4 Miniconda

Some of the Python libraries required by the project are exclusively available through Conda. To maintain a minimal installation footprint, it is recommended to install Miniconda, a smaller, more lightweight version of Anaconda that includes only Conda, its dependencies, and Python.

By using Miniconda, users can access the extensive repositories of Conda packages while keeping their environment lean and manageable. To install Miniconda, follow the instructions provided in the `scripts` directory of the project, where operating system-specific installation scripts named `run_install_miniconda` are available for Windows (CMD shell), Ubuntu (Bash shell), and macOS (Zsh shell).

Utilizing Miniconda ensures that you have the necessary Conda environment with the minimal set of dependencies required to run and develop the project efficiently.

1.2.5 MS Access Database Engine- only for Windows

This Software consists of a set of components that facilitate the transfer of data between existing Microsoft Office files such as Microsoft Office Access (*.mdb and *.accdb) files and Microsoft Office Excel (*.xls, *.xlsx, and *.xlsb) files to other data sources. Connectivity to existing text files is also supported.

1.2.6 DBeaver Community - optional

DBeaver is recommended as the user interface for interacting with the PostgreSQL database due to its comprehensive and user-friendly features. It provides a flexible and intuitive platform for database management, supporting a wide range of database functionalities including SQL scripting, data visualization, and import/export capabilities. Additionally, the project includes predefined connection configurations for DBeaver, facilitating a hassle-free and streamlined setup process for users.

1.3 Installation

1.3.1 Python

The project repository contains a `scripts` directory that includes operating system-specific installation scripts for Python, ensuring a smooth setup across various environments.

- **macOS**: The `run_install_python.zsh` script is available for macOS users. This script is adapted for the Zsh shell, which is the standard shell on recent versions of macOS, and it streamlines the Python installation.
- **Ubuntu**: For users on Ubuntu, the `run_install_python.sh` script is provided. This Bash

script is created to operate within the default shell environment of Ubuntu, facilitating the Python installation process.

- **Windows**: The `run_install_python.bat` script is tailored for users on Windows systems. It is designed to be run in the Command Prompt and automates the Python installation process on Windows.

These scripts are named according to the convention `run_install_python.<ext>`, where `<ext>` corresponds to the script extension appropriate for the target operating system and shell environment (e.g., *.bat* for Windows, *.sh* for Ubuntu Bash, *.zsh* for macOS). Users are recommended to execute the script matching their OS to ensure an efficient Python setup.

1.3.2 Miniconda

The `scripts` directory includes a collection of operating system-specific scripts named `run_install_miniconda` to streamline the installation of Miniconda. These scripts are designed to cater to the needs of different environments, making the setup process efficient and user-friendly.

- **Windows CMD Shell**: The `run_install_miniconda.bat` script is tailored for the Windows CMD shell. It automates the Miniconda installation process on Windows, providing a hassle-free setup with a simple double-click or command line execution.
- **Ubuntu Bash Shell**: Ubuntu users can take advantage of the `run_install_miniconda.sh` script. This Bash script is intended for use within the Ubuntu terminal, encapsulating the necessary commands to install Miniconda seamlessly on Ubuntu systems.
- **macOS Zsh Shell**: For macOS, the `run_install_miniconda.zsh` script is available. It is optimized for the Zsh shell, which is the default on recent versions of macOS. This script simplifies the installation and configuration of Miniconda, ensuring a smooth integration with macOS.

Each script in the `scripts` directory is named to reflect its compatibility with the corresponding operating system and shell environment. Users are encouraged to execute the script that matches their OS for a smooth and error-free Miniconda installation experience.

1.3.3 Docker Desktop

The `scripts` directory contains scripts that assist with installing Docker Desktop on macOS and Ubuntu, facilitating an automated and streamlined setup.

- **macOS**: The `run_install_docker.zsh` script is designed for macOS users. By utilizing this Zsh script, the installation of Docker Desktop on macOS is executed through a series of automated steps, which are managed by the script to ensure a smooth installation process.
- **Ubuntu**: The `run_install_docker.sh` script is available for Ubuntu users. This Bash script sets up Docker Desktop on Ubuntu systems by configuring the necessary repositories and managing the installation steps through the system's package manager.
- **Windows**: For Windows users, it is recommended to download and install Docker Desktop using the traditional installer available at Docker Desktop for Windows. This approach guarantees the most stable version and is tailored to integrate seamlessly with Windows-specific features and configurations.

Please select and execute the appropriate script for your operating system from the `scripts` directory. Windows users should follow the provided link to obtain the official installer for a guided installation experience.

1.3.4 MS Access Database Engine

- **Windows**: The software can be downloaded from here and then installed according to the instructions provided.
- **Ubuntu Bash Shell**: The necessary software can be downloaded with the package manager `apt`

as follows:

```
sudo apt-get update -y
sudo apt-get install -y unixodbc-dev
```

- **macOS Zsh Shell**: The necessary software can be downloaded with the package manager `Homebrew` as follows:

```
brew update
brew install unixodbc
```

1.3.5 DBeaver - optional

DBeaver is an optional but highly recommended tool for this software as it offers a user-friendly interface to gain insights into the database internals. The project provides convenient scripts for installing DBeaver on macOS and Ubuntu.

- **macOS**: The `run_install_dbeaver.zsh` script is crafted for macOS systems. By running this Zsh script, users can easily install DBeaver and quickly connect to the database for management and querying tasks.
- **Ubuntu**: For Ubuntu users, the `run_install_dbeaver.sh` script facilitates the installation of DBeaver. This Bash script automates the setup process, adding necessary repositories and handling the installation seamlessly.
- **Windows**: Windows users are advised to download and install DBeaver using the official installer from the DBeaver website at DBeaver Download. The installer ensures that DBeaver is properly configured and optimized for Windows environments.

To install DBeaver, locate the appropriate script in the `scripts` directory for macOS or Ubuntu. If you're a Windows user, please use the provided link to access the official installer for an intuitive installation experience.

1.3.6 Python Libraries

The project's Python dependencies are managed partly through Conda and partly through pip. To facilitate a straightforward installation process, a Makefile is provided at the root of the project.

- **Development Environment**: Run the command `make conda-dev` from the terminal to set up a development environment. This will install the necessary Python libraries using Conda and pip as specified for development purposes.
- **Production Environment**: Execute the command `make conda-prod` for preparing a production environment. It ensures that all the required dependencies are installed following the configurations optimized for production deployment.

The Makefile targets abstract away the complexity of managing multiple package managers and streamline the environment setup. It is crucial to have both Conda and the appropriate pip tool available in your system's PATH to utilize the Makefile commands successfully.

1.4 Configuration IO-AVSTATS

For the administration of the configuration parameters of **IO-AVSTATS** the tool dynaconf is used. The file `settings.io_aero.toml` is available as the configuration file. The names of **IO-AVSTATS** related environment variables must include the prefix `IO_AERO`. Layered environments are supported. The `test` layer is used for the automated tests.

1.4.1 Available Parameters

Parameter	Description
correction_work_dir	file directory containing the files with the manual corrections
database_commit_size	number of rows processed before a progress message is created
download_chunk_size	chunk size for download from the **NTSB** website
download_file_aviation_occurrence_categories	name of the file containing data of aviation occurrence categories
download_file_countries_states_json	name of the file containing data of countries and states
download_file_faa_airports_xlsx	name of the file containing data of airports
download_file_faa_npias	name of the file containing National Plan of Integrated Airport Systems
download_file_faa_runways_xlsx	name of the file containing data of runways
download_file_main_phases_of_flight	name of the file containing data of main phases of a flight
download_file_sequence_of_events	name of the file containing data of sequence of events
download_file_simplemaps_us_cities_xlsx	simplemaps: name of the zipped US city file
download_file_simplemaps_us_zips_xlsx	simplemaps: name of the zipped US zip code file
download_file_zip_codes_org_xls	ZIP Code Database: name of the unzipped US zip code file
download_timeout	seconds to wait for the server to send data
download_url_ntsb_prefix	prefix of the download link for the **NTSB** data sets
download_work_dir	working directory for the processing of **NTSB** data sets
is_runtime_environment_local	local execution environment - unlike Docker
is_verbose	display progress messages for processing
max_deviation_latitude	maximum decimal deviation of the latitude in the database table even
max_deviation_longitude	maximum decimal deviation of the longitude in the database table even
odbc_connection_string	connection string for the MS Access ODBC driver
postgres_connection_port	database port number
postgres_container_name	container name
postgres_database_schema	database schema name
postgres_dbname	database name
postgres_dbname_admin	administration database name
postgres_host	database server hostname
postgres_password	database password
postgres_password_admin	administration database password
postgres_password_guest	guest database password

postgres_pgdata	file directory on the host for the database files
postgres_user	database username
postgres_user_admin	administration database username
postgres_user_guest	guest database username
postgres_version	requested PostgreSQL version from DockerHub
razorsql_jar_file_windows	name of the jar file (Windows version)
razorsql_java_path_windows	name of the Java file (Windows version)
razorsql_profile	name of the RazorSQL connection profile
razorsql_reference_dir	file directory of the database schema reference file
razorsql_reference_file	file name of the database schema reference file

1.4.2 Example

```
[default]
check_value = "default"
correction_work_dir = "data/correction"
database_commit_size = 10000
download_chunk_size = 524288
...

[test]
check_value = "test"
correction_work_dir = "data/correction_test"
download_work_dir = "data/download_test"
postgres_connection_port = 5433
postgres_container_name = "io_avstats_db_test"
postgres_password = "postgres_password"
postgres_password_admin = "postgres_password_admin"
postgres_pgdata ="data/postgres_test"
```

1.4.3 Notes

The configuration parameters in the configuration files can be overridden with corresponding environment variables, e.g. the environment variable `IO_AERO_IS_VERBOSE` overrides the configuration parameter `is_verbose`.

1.5 Configuration Logging

In **IO-AVSTATS** the Python standard module for logging is used - details can be found here.

The file `logging_cfg.yaml` controls the logging behaviour of the application.

Default content:

```
version: 1

disable_existing_loggers: False

formatters:
  simple:
    format: "%(asctime)s [%(name)s] [%(module)s.py  ] %(levelname)-5s
%(funcName)s:%(lineno)d %(message)s"
  extended:
    format: "%(asctime)s [%(name)s] [%(module)s.py  ] %(levelname)-5s
```

```
%(funcName)s:%(lineno)d \n%(message)s"

handlers:
  console:
    class: logging.StreamHandler
    level: INFO
    formatter: simple
  file_handler:
    class: logging.FileHandler
    level: INFO
    filename: logging_io_aero.log
    formatter: extended

root:
  level: DEBUG
  handlers: [ console, file_handler ]
```

1.6 First Steps

To get started, you'll first need to clone the repository, which contains essential scripts for various operating systems. After cloning, you will use these scripts to install the necessary foundational software. Finally, you will complete the repository-specific installation to set up your environment correctly. Detailed instructions for each of these steps are provided below.

1.6.1 Cloning the Repository

Start by cloning the *io-avstats* repository. This repository contains essential scripts and configurations needed for the project.

```
git clone https://github.com/io-aero/io-avstats
```

1.6.2 Install Foundational Software

Once you have successfully cloned the repository, navigate to the cloned directory. Within the *scripts* folder, you will find scripts tailored for various operating systems. Proceed with the subsection that corresponds to your operating system for further instructions.

macOS

To set up the project on a macOS system, the following steps should be performed in a terminal window within the repository directory:

a. Grant Execute Permission to Installation Scripts

Provide execute permissions to the installation scripts:

```
chmod +x scripts/*.zsh
```

b. Install Python and pip

Run the script to install Python and pip:

```
./scripts/run_install_python.zsh
```

c. Install Miniconda and the Correct Python Version

Use the following script to install Miniconda and set the right Python version:

```
./scripts/run_install_miniconda.zsh
```

d. Install Docker Desktop

To install Docker Desktop, run:

```
./scripts/run_install_docker.zsh
```

e. Optionally Install DBeaver

If needed, install DBeaver using the following script:

```
./scripts/run_install_dbeaver.zsh
```

f. Close the Terminal Window

Once all installations are complete, close the terminal window.

Ubuntu

To set up the project on an Ubuntu system, the following steps should be performed in a terminal window within the repository directory:

a. Grant Execute Permission to Installation Scripts

Provide execute permissions to the installation scripts:

```
chmod +x scripts/*.sh
```

b. Install Python and pip

Run the script to install Python and pip:

```
./scripts/run_install_python.sh
```

c. Install Miniconda and the Correct Python Version

Use the following script to install Miniconda and set the right Python version:

```
./scripts/run_install_miniconda.sh
```

d. Install Docker Desktop

This step is not required for WSL (Windows Subsystem for Linux) if Decker Desktop is installed in Windows and this is configured for WSL 2 based engine.

To install Docker Desktop, run:

```
./scripts/run_install_docker.sh
```

e. Optionally Install DBeaver

If needed, install DBeaver using the following script:

```
./scripts/run_install_dbeaver.sh
```

f. Close the Terminal Window

Once all installations are complete, close the terminal window.

Windows 10/11

To set up the project on a Windows 10/11 system, the following steps should be performed in a command prompt (cmd) within the repository directory:

a. Install Python and pip

Run the script to install Python and pip:

```
scripts/run_install_python.bat
```

b. Install Miniconda and the Correct Python Version

Use the following script to install Miniconda and set the right Python version:

```
scripts/run_install_miniconda.bat
```

c. Close the Command Prompt

Once all installations are complete, close the command prompt.

d. Install Docker Desktop

To install Docker Desktop, download the software from here:

https://www.docker.com/products/docker-desktop/

and follow the installation instructions.

e. Optionally Install DBeaver

If needed, install DBeaver, download the software from here:

https://dbeaver.io/

and follow the installation instructions.

1.6.3 Repository-Specific Installation

After installing the basic software, you need to perform installation steps specific to the *io-avstats* repository. This involves setting up project-specific dependencies and environment configurations. To perform the repository-specific installation, the following steps should be performed in a command prompt or a terminal window (depending on the operating system) the repository directory.

Setting Up the Python Environment

To begin, you'll need to set up the Python environment using Miniconda, which is already pre-installed. You can use the provided Makefile for managing the environment.

*a. For **production** use, run the following command:*

```
make conda-prod
```

*b. For **software development**, use the following command:*

```
make conda-dev
```

These commands will create and configure a virtual environment for your Python project, ensuring a clean and reproducible development or production environment. The virtual environment is automatically activated by the Makefile, so you don't need to activate it manually.

System Testing with Unit Tests

If you have previously executed *make conda-dev*, you can now perform a system test to verify the installation using *make test*. Follow these steps:

a. Run the System Test:

Execute the system test using the following command:

```
make tests
```

This command will initiate the system tests using the previously installed components to verify the correctness of your installation.

b. Review the Test Results:

After the tests are completed, review the test results in the terminal. Ensure that all tests pass without errors.

If any tests fail, review the error messages to identify and resolve any issues with your installation.

Running system tests using *make tests* is a valuable step to ensure that your installation is working correctly, and your environment is properly configured for your project. It helps identify and address any potential problems early in the development process.

Downloading Database Files (Optional)

Database files can be downloaded from the IO-Aero Google Drive directory *io_aero_data/io-avstats/-*

*database/io_avstats_db*to your local repository directory *data*. Before extracting, if a *postgres* directory exists within the *data* directory, it should be deleted.

Follow these steps to manage the database files:
a. Access the IO-Aero Google Drive Directory:

Navigate to the IO-Aero Google Drive and locate the directory *io_aero_data/TO DO/database/TO DO*.
b. Download Database Files:

Download the necessary database files from the specified directory to your local repository directory *data*.
c. Delete Existing postgres Directory (if present):

If a directory named *postgres* already exists within the *data* directory, you should delete it to avoid conflicts.
d. Extract Database Files:

The downloaded database files are in an archive format (ZIP) and should be extracted in the *data* directory. After completing these steps, the database files should reside in the *data* directory of your local repository and will be ready for use.

Creating the Docker Container with PostgreSQL DB

To create the Docker container with PostgreSQL database software, you can use the provided *run_io_avstats* script. Depending on your operating system, follow the relevant instructions below:
a. macOS (zsh):

```
./scripts/run_io_avstats.zsh s_d_c
```

b. Ubuntu (sh):

```
./scripts/run_io_avstats.sh s_d_c
```

c. Windows 10/11 (cmd):

```
scripts\run_io_avstats.cmd s_d_c
```

These commands will initiate the process of creating the Docker container with PostgreSQL database software.

1.7 Advanced Usage

The main tool for operating **IO-AVSTATS** is the ``**run_io_avstats**`` script. The script is fully available in the Windows version and in a greatly reduced version for macOS and Ubuntu.

1.7.1 Overview

The following tasks can be executed with this script:

Code	Task	Additional parameter(s)
a_o_c	Load aviation occurrence categories into PostgreSQL	
c_d_c	Run Docker Compose tasks - Cloud	`clean`, `down`, `logs` or `up`
c_d_i	Create or update an application Docker image	`all` or single Streamlit app
c_d_s	Create the IO-AVSTATS-DB PostgreSQL database schema	
c_f_z	Zip the files for the cloud	
c_l_l	Correct decimal US latitudes and longitudes	
c_p_d	Cleansing PostgreSQL data	
f_n_a	Find the nearest airports	
l_a_p	Load airport data into PostgreSQL	
l_c_d	Load data from a correction file into PostgreSQL	-e / -excel

l_c_s	Load country and state data into PostgreSQL	
l_n_a	Load NTSB MS Access database data into PostgreSQL	-m / -msaccess
l_s_d	Load simplemaps data into PostgreSQL	
l_s_e	Load sequence of events data into PostgreSQL	
l_z_d	Load ZIP Code Database data into PostgreSQL	
r_d_s	Refresh the PostgreSQL database schema	
r_s_a	Run a Streamlit application	
s_d_c	Set up the IO-AVSTATS-DB PostgreSQL database container	
u_d_s	Update the IO-AVSTATS-DB PostgreSQL database schema	
u_p_d	Complete processing of a modifying MS Access file	-m / -msaccess
v_n_d	Verify selected NTSB data	
version	Show the **IO-AVSTATS** version	

1.7.2 Detailed task list

`a_o_c` - Load aviation occurrence categories into PostgreSQL

Purpose

Load the definition of the valid CICTT codes.

Data Source

The data source can be found on the NTSB website here:

- AVIATION OCCURRENCE CATEGORIES - DEFINITIONS AND USAGE NOTES

The NTSB provides the data in a `pdf` file which must then be converted to MS Excel format `xlsx` before processing.

Implementation

```
CREATE TABLE public.io_aviation_occurrence_categories (
    cictt_code varchar(10) NOT NULL,
    identifier varchar(100) NOT NULL,
    definition text NOT NULL,
    first_processed timestamp NOT NULL,
    last_processed timestamp NULL,
    last_seen timestamp NULL,
    CONSTRAINT io_aviation_occurrence_categories_pkey PRIMARY KEY (cictt_code)
);
```

...

`c_d_c` - Run Docker Compose tasks - Cloud

Purpose

Manage the Docker containers needed in the cloud:

- **portainer**: container management
- **IO-AVSTATS-DB**: PostgreSQL database
- Application **ae1982**: Aircraft Events since 1982
- Application **pd1982**: Profiling Data since 1982
- Application **slara**: Association Rule Analysis
- **load_balancer**: load balancer NGINX

Processing Options

```
- clean - Remove all containers and images
- down  - Stop  Docker Compose
- logs  - Fetch the logs of a container
- up    - Start Docker Compose
```

`c_d_i` - Create or update an application Docker image

Purpose

Create the application-specific Docker images and store them on DockerHub.

Processing Options

```
- all     - All Streamlit applications
- ae1982  - Aircraft Accidents in the US since 1982
- pd1982  - Profiling Data for the US since 1982
- slara   - Association Rule Analysis
```

`c_d_s` - Create the IO-AVSTATS-DB PostgreSQL database schema

Purpose

Create the database schema including the following steps, among others:

1. creation of a new database user, and
2. creation of a new database, and
3. creation of database objects such as database tables and so on.

The following parameters are used when creating the database schema:

- *postgres_dbname_admin* - administration database name
- *postgres_password_admin* - administration database password
- *postgres_user_admin* - administration database username

Subsequently, the task `u_d_s` (Update the PostgreSQL database schema) is also executed.

`c_f_z` - Zip the files for the cloud

Purpose

Collect and zip the elements needed for the cloud to run the **IO-AVSTATS** application there. The result is contained in the file **cloud.zip**.

`c_l_l` - Correct decimal US latitudes and longitude

Purpose

An attempt is made to calculate missing decimal longitudes and latitudes using the database tables **`io_lat_lng`** and **`io_states`**.

Implementation

1. In the database table **`events`** the values in the columns **`io_dec_lat_lng_actions`**, **`io_dec_latitude`**, **`io_dec_longitude`** and **`io_latlong_acq`** are deleted.
2. **All rows in the database table `events` are processed where at least one of the columns `dec_latitude` or `dec_longitude` is empty or 0 and the column `ev_country` has the content `USA`.**
    - 2.1 An erroneous swapping of latitude and longitude is corrected.
    - 2.2 An attempt is made to calculate a missing column **`dec_latitude`** from the column **`latitude`** and a missing column **`dec_longitude`** from the column **`longitude`**.

- 2.3 An attempt is made to calculate a missing column **`dec_latitude`** or **`dec_longitude`** from the column **`ev_site_zipcode`**.
- 2.4 It tries to calculate a missing column **`dec_latitude`** or **`dec_longitude`** from the column **`ev_city`**.
- 2.5 An attempt is made to calculate a missing column **`dec_latitude`** or **`dec_longitude`** from the column **`ev_state`**.
- 2.6 For a missing column **`dec_latitude`** resp. **`dec_longitude`** the center of the USA is assumed.

`c_p_d` - Cleansing PostgreSQL data

Purpose

Clean up data the abnormalities in the database. This includes the following activities:

- remove trailing whitespace in string data types (trimming),
- converting string data types that contain only whitespace to NULL (nullifying).

As a result, a much simplified processing of the data is possible, e.g. for comparisons.

On the one hand, the task can be executed explicitly with the **``run_io_avstats_db``** script (task **``c_p_d``**) and, on the other hand, it always runs after loading NTSB MS Access data into the PostgreSQL database (task **``l_n_a``** and **``u_p_d``**).

`f_n_a` - Find the nearest airports

- TODO

Purpose

`l_a_p` - Load airport data into PostgreSQL

- TODO

Purpose

Data Source

Implementation

`l_c_d` - Load data from a correction file into PostgreSQL

- TODO

Purpose

Data Source

Implementation

This task allows files containing aviation accident data to be downloaded from the NTSB download site. These files are there as MS Access databases in a compressed format. The following subtasks are executed:

1. A connection to the NTSB download page is established.
2. The selected file is downloaded to the local system in chunks.
3. The downloaded file is then unpacked.
4. A script with the database schema definition is created with RazorSQL from the downloaded database.
5. The newly created script is then compared with a reference script for matching.

`l_c_s` - Load country and state data into PostgreSQL

- TODO

Purpose

Data Source

Implementation

`l_n_a` - Load NTSB MS Access database data into PostgreSQL

Purpose

This task allows files containing aviation event data to be downloaded from the **NTSB** download site. These files are there as MS Access databases in a compressed format. The following subtasks are executed:

1. A connection to the **NTSB** download page is established.
2. The selected file is downloaded to the local system in chunks.
3. The downloaded file is then unpacked.
4. A script with the database schema definition is created with RazorSQL from the downloaded database.
5. The newly created script is then compared with a reference script for matching.

Subsequently, the downloaded data can be loaded into the PostgreSQL database with the task `l_n_a` (Load NTSB MS Access database data into PostgreSQL).

Data Sources

- **Pre2008.zip**: data set for 1982 through 2007
- **avall.zip**: data set from 2008 to the present
- **upDDMON.zip**: monthly supplements on the 1st, 8th, 15th and 22nd

Implementation

The PostgreSQL database **IO-AVSTATS-DB** completely maps the database schema of the **NTSB** MS Access database.

`l_s_d` - Load simplemaps data into PostgreSQL

- TODO

Purpose

Data Source

Implementation

This task transfers the data from an NTSB MS Access database previously downloaded from the NTSB website to the PostgreSQL database. The same MS Access database can be processed several times with this task without any problems, since only the changes are newly transferred to the PostgreSQL database. The initial loading is done with both MS Access databases Pre2008 ubd avall. After that only the monthly updates are then transferred.

`l_s_e` - Load sequence of events data into PostgreSQL

- TODO

Purpose

Data Source

Implementation

`l_z_d` - Load ZIP Code Database data into PostgreSQL

- TODO

Purpose

Data Source

Implementation

This task transfers the data from an NTSB MS Access database previously downloaded from the NTSB website to the PostgreSQL database. The same MS Access database can be processed several times with this task without any problems, since only the changes are newly transferred to the PostgreSQL database. The initial loading is done with both MS Access databases Pre2008 ubd avall. After that only the monthly updates are then transferred.

`r_d_s` - Refresh the PostgreSQL database schema

- TODO

Hereby changes can be made to the database schema. The task can be executed several times without problems, since before a change is always first checked whether this has already been done.

1. Materialized database view

- ``**io_app_ae1982**`` - provides the data for processing the task ``**c_l_l**`` (Correct decimal US latitudes and longitudes).

Example protocol:

> Progress update 2022-…:09.337180 : INFO.00.004 Start Launcher. Progress update 2022-…:09.342679 : INFO.00.001 The logger is configured and ready. Progress update 2022-…:09.352180 : INFO.00.005 Argument task='r_d_s'. Progress update 2022-…:09.352180 : ——-. Progress update 2022-…:09.352180 : INFO.00.071 Refreshing the database schema. Progress update 2022-…:09.352180 : ———————————————————————————————————— Progress update 2022-…:19.366370 : INFO.00.069 Materialized database view is refreshed: io_app_ae1982. Progress update 2022-…:19.366370 : ——-. Progress update 2022-…:19.366370 : 10,187,690,800 ns - Total time launcher. Progress update 2022-…:19.366370 : INFO.00.006 End Launcher. Progress update 2022-…:19.366370 : ==.

`r_s_a` - Run the IO-AVSTATS application

- TODO

`s_d_c` - Set up the PostgreSQL database container

- TODO

`u_d_s` - Update the PostgreSQL database schema

- TODO

Hereby changes can be made to the database schema. The task can be executed several times without problems, since before a change is always first checked whether this has already been done.

1. New database tables:

- ``**io_countries**``: contains latitude and longitude of selected countries.

- ``**io_lat_lng**``: used to store the **simplemaps** and **United States Zip Codes.org** data.
- ``**io_states**``: contains the identification, name, latitude and longitude of all US states.

2. Extensions for database tables:

2.1 Database table ``**events**``.

- The columns ``**io_city**``, ``**io_country**``, ``**io_latitude**``, ``**io_longitude**``, ``**io_site_zipcode**`` and ``**io_state**`` to store manual corrections.
- The columns ``**io_deviating_dec_latitude**``, ``**io_deviating_dec_longitude**``, ``**io_invalid_latitude**``, ``**io_invalid_longitude**``, ``**io_invalid_us_city**``, ``**io_invalid_us_state**`` and , ``**io_invalid_us_zipcode**`` for documenting data plausibility (task ``**v_n_d**``).
- the columns ``**io_dec_lat_lng_actions**``, ``**io_dec_latitude**`` and ``**io_dec_longitude**`` to store corrected decimal latitude and longitude values.

3. New database views:

- ``**io_lat_lng_issues**`` - provides the data for processing the task ``**c_l_l**`` (Correct decimal US latitudes and longitudes).
- ``**io_accidents_us_1982**`` - provides event data for aviation accidents in the U.S. since 1982.

`u_p_d` - Complete processing of a modifying MS Access file

- TODO

`v_n_d` - Verify selected NTSB data

Purpose

This task can be used to perform a plausibility check for the following columns in the database table `**events**`:

- `**dec_latitude**`,
- `**dec_longitude**`,
- `**ev_state**`,
- `**ev_site_zipcode**`,
- `**latitude**`,
- `**longitude**`,

and the combination of:

- `**ev_state**` and `**ev_city**`,
- `**ev_state**`, `**ev_city**` and `**ev_site_zipcode**`.

The results of the check are stored in the following columns:

- `**io_deviating_dec_latitude**` (absolute difference),
- `**io_deviating_dec_longitude**` (absolute difference),
- `**io_invalid_latitude**` (true),
- `**io_invalid_longitude**` (true),
- `**io_invalid_us_city**` (true),
- `**io_invalid_us_city_zipcode**` (true),
- `**io_invalid_us_state**` (true),

- **`io_invalid_us_zipcode`** (true).

The tests are performed according to the following logic:

- **`io_deviating_dec_latitude`**: Absolute difference between **`dec_latitude`** and **`latitude`** exceeding a given limit in **`max_deviation_latitude`**.
- **`io_deviating_dec_longitude`**: Absolute difference between **`dec_longitude`** and **`longitude`** exceeding a given limit **`max_deviation_longitude`**.
- **`io_invalid_latitude`**: Can the latitude in the **`latitude`** column be converted to its decimal equivalent?
- **`io_invalid_longitude`**: Can the longitude in the **`longitude`** column be converted to its decimal equivalent?
- **`io_invalid_us_city`**: For country *USA* and the given state, is the specified value in the **`ev_city`** column an existing city?
- **`io_invalid_us_city_zipcode`**: For country *USA* and the given state, are the specified values in the **`ev_city`** column and in the **`ev_site_zipcode`** column an existing city?
- **`io_invalid_us_state`**: For country *USA*, is the specified value in the **`ev_state`** column a valid state identifier?
- **`io_invalid_us_zipcode`**: For country *USA*, is the specified value in the **`ev_site_zipcode`** column an existing zip code?

`version` - Show the ``IO-AVSTATS`` version

- TODO

1.7.3 First installation

The initial load in a fresh Windows environment requires the execution of the following tasks in the given order:

- **``c_d_s``** - Create the IO-AVSTATS-DB PostgreSQL database schema
- **``l_c_s``** - Load country and state data into PostgreSQL
- **``l_a_p``** - Load airport data into PostgreSQL
- **``a_o_c``** - Load aviation occurrence categories into PostgreSQL
- **``l_s_e``** - Load sequence of events data into PostgreSQL
- **``l_s_d``** - Load simplemaps data into PostgreSQL
- **``l_z_d``** - Load ZIP Code Database data into PostgreSQL
- **``u_p_d``** - Complete processing of a modifying MS Access file: **``Pre2008``**

1.7.4 Regular updates

Every 1st of the month

1. Stop the Docker container **``IO-AVSTATS-DB``**
2. Restore the current state of Pre2008
3. Start the Docker container **``IO-AVSTATS-DB``**
4. Process the current **``avall``** file with code **``l_n_a``**

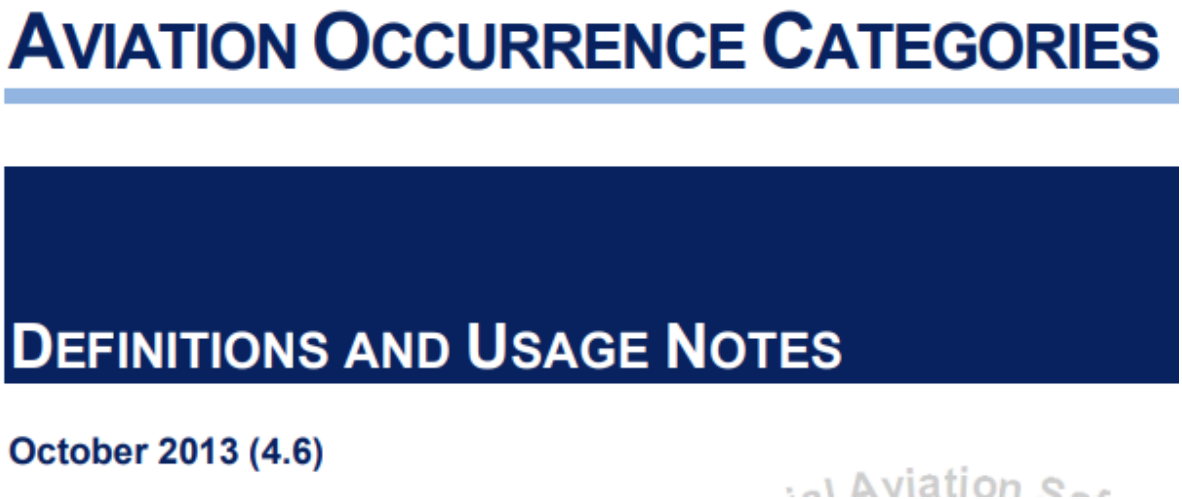
Every 1st, 8th, 15th and 22nd

- Process the current **``upDDMON``** file with code **``u_p_d``**

1.8 Data Sources

1.8.1 AVIATION OCCURRENCE CATEGORIES

The CICTT codes used in the `**Aviation_Occurrence_Categories/aviation_occurrence_categories.xlsx**` file is taken from this document.



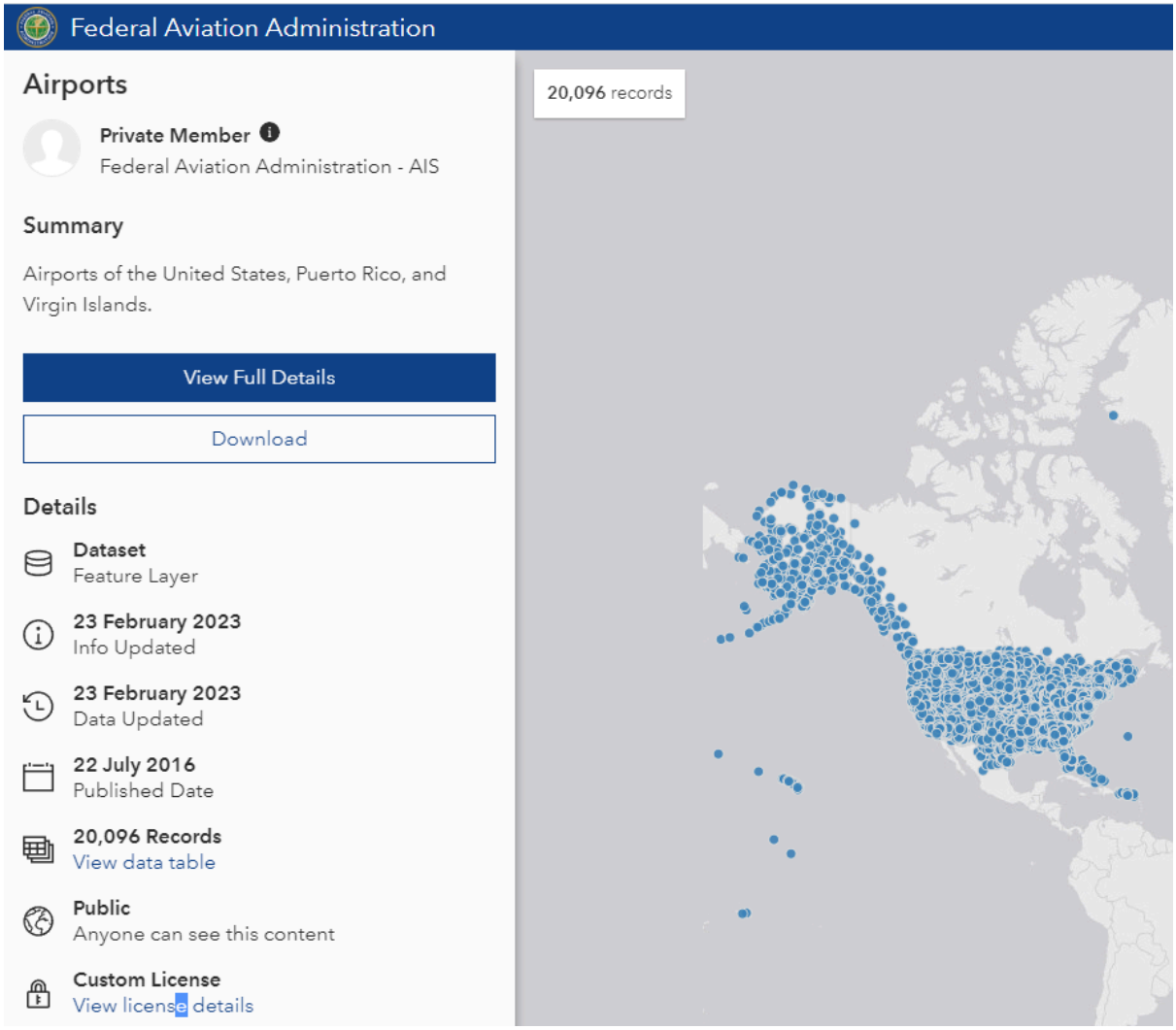
1.8.2 CICTT_SOE_MAP.csv

The content of the database table *io_sequence_of_events* is created based on this csv file.

eventsoe_no	meaning	CICTT_Code	CICTT_Description
0	Unknown or undetermined	UNK	Unknown
10	Aircraft loading event	RAMP	Ground Handling
20	Aircraft servicing event	RAMP	Ground Handling
30	Preflight or dispatch event		
40	Aircraft maintenance event		
50	Aircraft inspection event		
60	Attempted remediation/recovery		
70	Airport occurrence	ADRM	Aerodrome
80	Ground handling event	RAMP	Ground Handling
81	AC/prop/rotor contact w person	RAMP	Ground Handling
82	Prop/jet/rotor blast/suction	RAMP	Ground Handling
90	Abnormal runway contact	ARC	Abnormal Runway Contact
91	Tailstrike	ARC	Abnormal Runway Contact
92	Hard landing	ARC	Abnormal Runway Contact
93	Dragged wing/rotor/float/other	ARC	Abnormal Runway Contact
94	Landing gear collapse	ARC	Abnormal Runway Contact

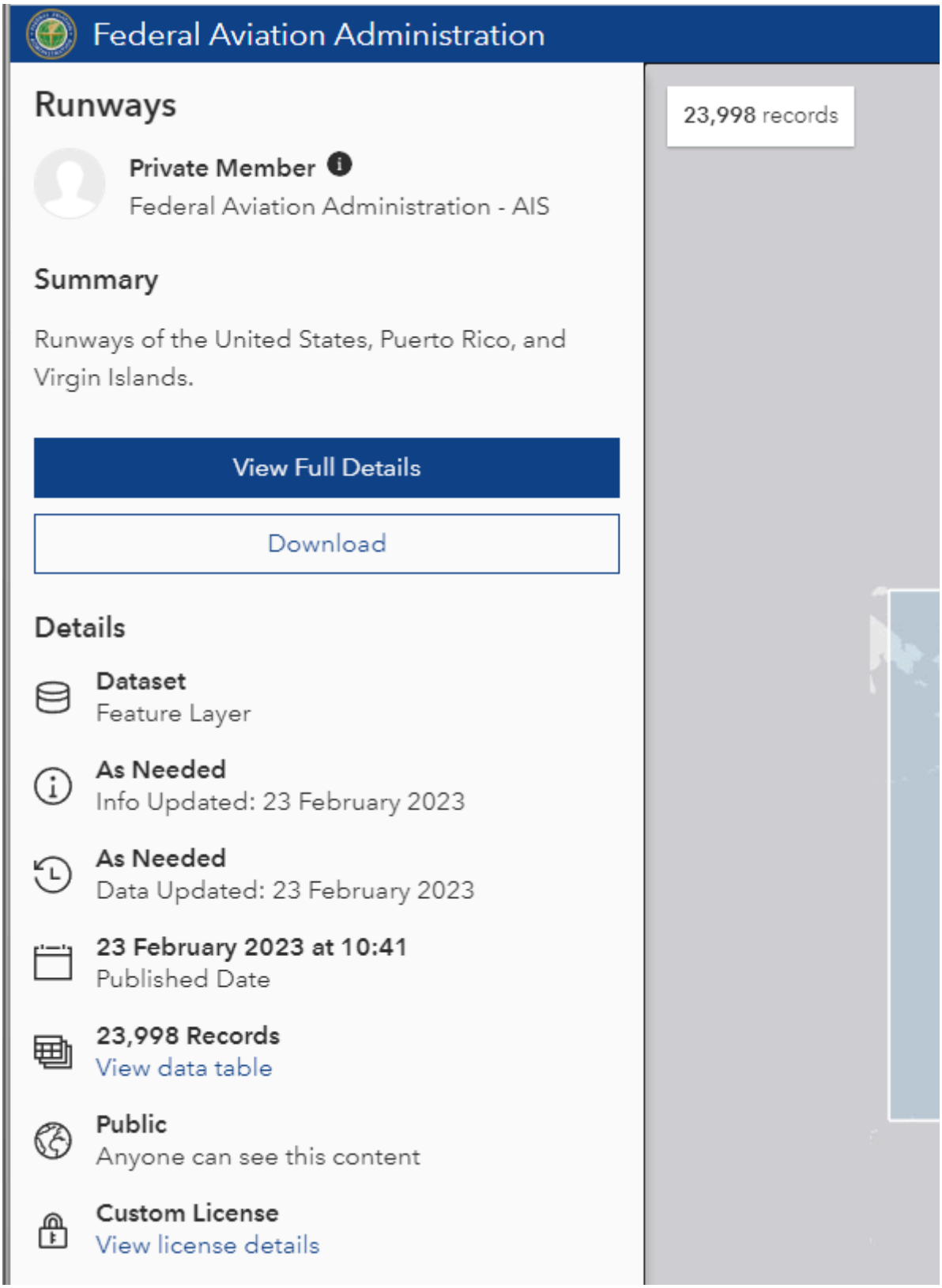
1.8.3 FAA Airports

The FAA provides data on airports in the United States in the form of a csv file. This data is updated by the FAA at irregular intervals.



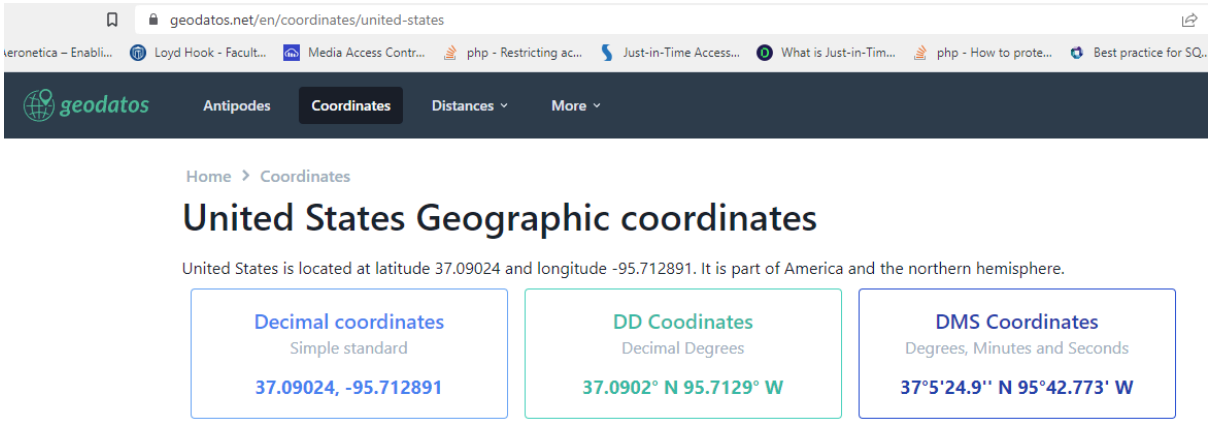
1.8.4 FAA Runways

The FAA provides data on runways in the United States in the form of a csv file. This data is updated by the FAA at irregular intervals.



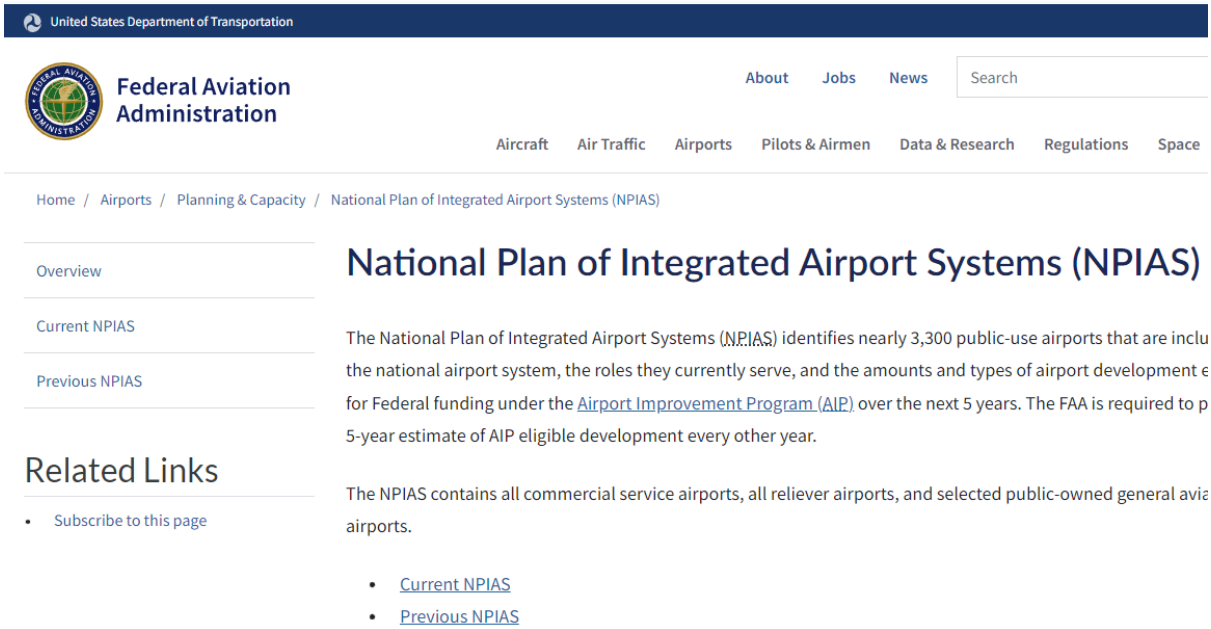
1.8.5 geodatos

The decimal latitude and longitude for the USA used in the `**Countries_States/countries_states.json**` file is taken from the geodatos website.



1.8.6 National Plan of Integrated Airport Systems (NPIAS)

The FAA provides data on preferred airports in the United States in the form of an MS Excel file. This data is updated by the FAA at irregular intervals.



1.8.7 NTSB

The main data used in **IO-AVSTATS** is provided by the National Transportation Safety Board. On the accident data page is the link Downloadable data sets, which contains the aviation accident data in MS Access format for free download.

File	Created (mm/dd/yyyy)	Description
avall.zip	current	Data from January 1, 2008 to today
PRE1982.zip	10/27/2020	unknown
Pre2008.zip	09/30/2020	Data from January 1, 1982 to December 31, 2007
upDDMON.zip	current	New additions and updates until DD day in the month MON

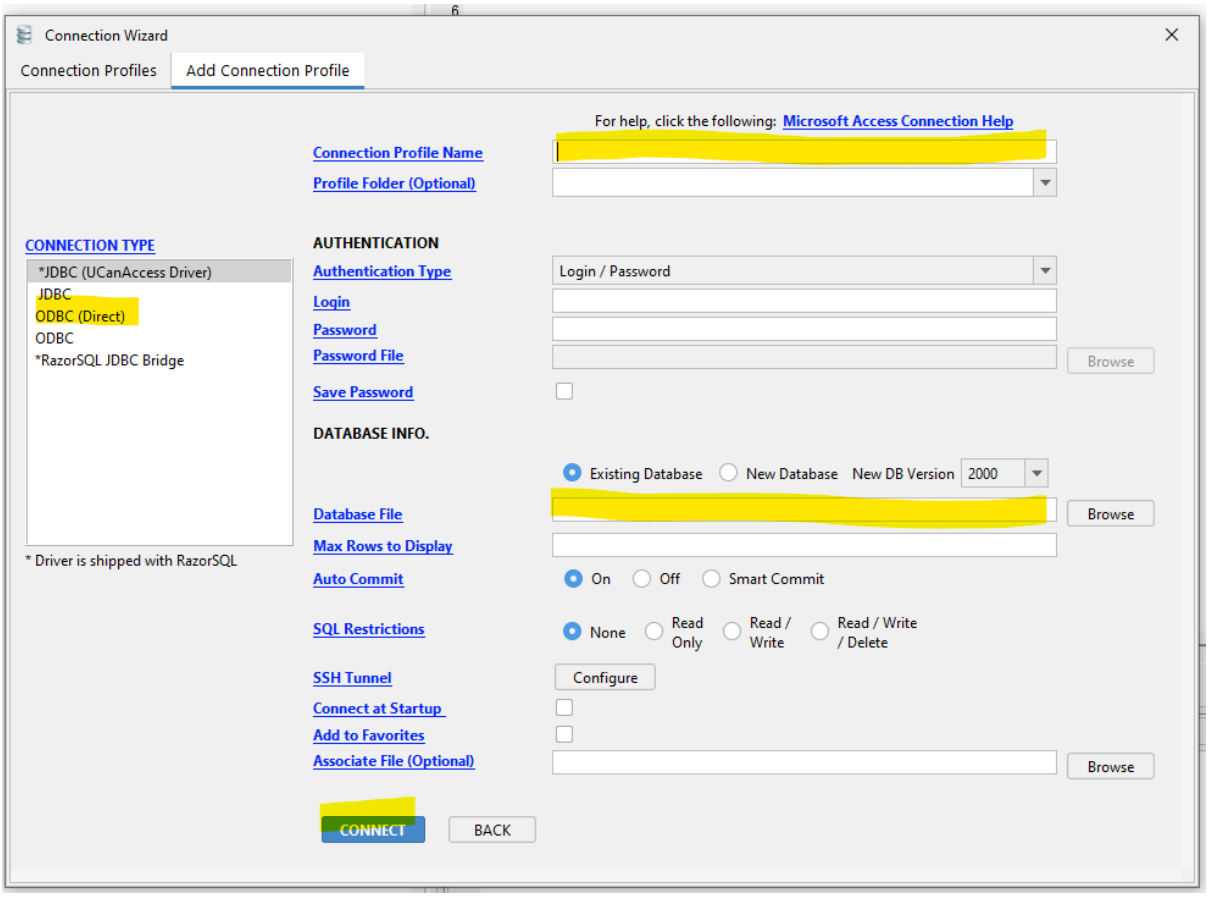
The schemas of the two databases *avall* and *Pre2008* are identical except for the two new optional columns *dec_latitude* and *dec_longitude* in the database table *events* of the database *avall*.

Database Schema Comparison

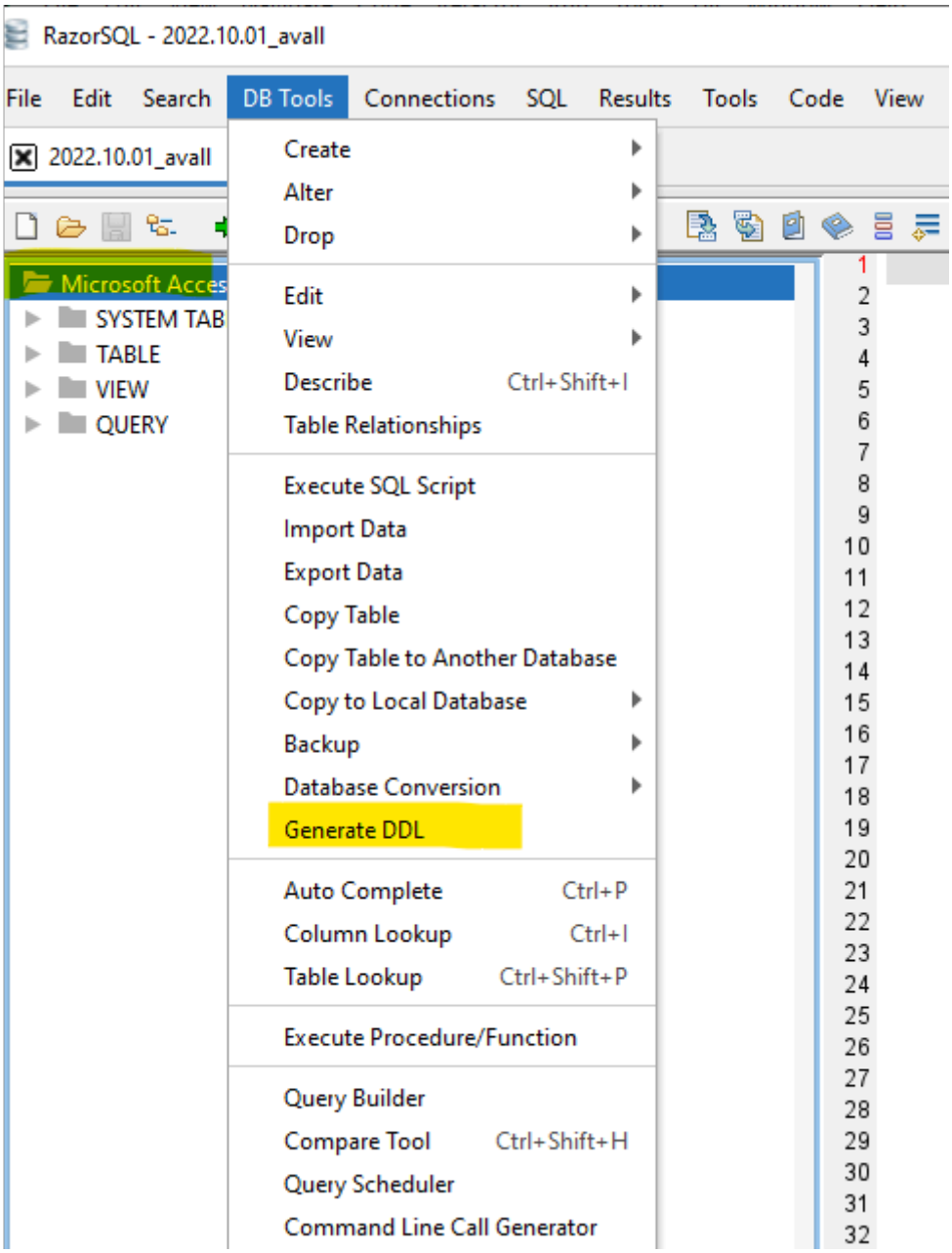
Before any new **NTSB** data set can be processed, the database schema of the new data set must first be compared with the database schema of the previous version of the **NTSB** data set *avall.mdb*.

Procedure:

- The RazorSQL program is started.
- Under 'Connections' select 'Add Connection Profile'.
- Select *MS Access* under *Add Connection Profile*.
- *Connection Type* is ODBC (Direct).
- In addition, an entry must be made at *Connection Profile Name* and *Database File*: - Connection Profile Name: IO-AVSTATS - Database File: IO-AVSTATS.mdb
- After pressing the *CONNECT* button you will be connected to the selected MS Access database.



- After opening the database, a SQL script with the DDL statements can be generated in the menu under *DB Tools* and *Generate DDL*.



- This SQL script can be saved as a file for further processing in the menu under *File* and *Save As*.

In case of any discrepancy, these must be implemented into the existing PostgreSQL database.

Table Processing Order

Based on the foreign keys (FK) present in the database schema, the following processing sequence results when creating the database schema and loading or updating the database tables:

Level 1 - without FK - events

Level 2 - FK: *ev_id* - aircraft - dt_events - NTSB_Admin

Level 3 - FK: *ev_id* & *Aircraft_Key* - dt_aircraft - engines - Events_Sequence - Findings - Flight_Crew - injury - narratives - Occurrences

Level 4 - FK: *ev_id* & *Aircraft_Key* & *crew_no* - dt_Flight_Crew - flight_time

Level 4 - FK: *ev_id* & *Aircraft_Key* & *Occurrence_No* - seq_of_events

Issues

The problem database tables listed below are not included in the PostgreSQL database schema.
Empty database tables

The following database tables are included in the Entity Relationship Diagram (ERD), but they do not contain any data in the database: - Occurrences - seq_of_events
Legacy database tables

The following database tables are included in the database but are missing from the ERD: - Country - ct_iaids - ct_seqevt - eADMSPUB_DataDictionary - states
Inconsistent database data - foreign key

- database table *ntsb_admin*: database table *event* has no row with *ev_id = 20210527103155* (data source: *avall.zip*) - as a consequence, the foreign key to the events table had to be removed

Inconsistent database data - country USA and state

```
SELECT ev_state,
       count(*)
FROM events
WHERE ev_country = 'USA'
  AND NOT ev_state IN (SELECT state
                       FROM io_states ius)
GROUP BY ev_state
ORDER BY ev_state
```

ev_state	count
AO	17
CB	1
GM	45
GU	8
OF	14
PO	15
PR	112
UN	3
VI	6

Inconsistent database data - invalid USA latitude

```
SELECT count(*)
  FROM io_lat_lng_issues
 WHERE io_dec_lat_lng_actions LIKE '%ERROR.00.920%'
```

count
430

Inconsistent database data - invalid USA longitude

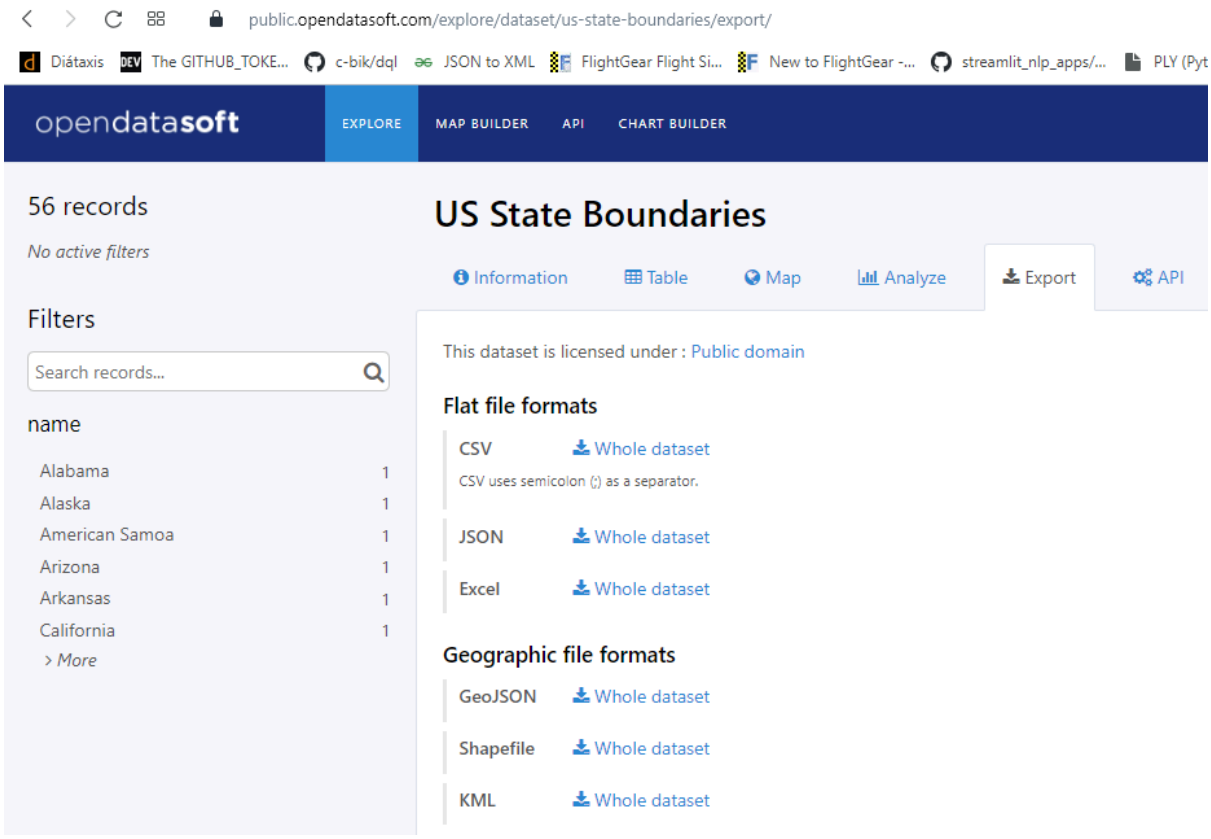
```
SELECT count(*)
  FROM io_lat_lng_issues
 WHERE io_dec_lat_lng_actions LIKE '%ERROR.00.921%'
```

count
462

1.8.8 opendatasoft

The decimal latitudes and longitudes for the US states used in

the `**Countries_States/countries_states.json**` file are taken from the opendatasoft website.



1.8.9 simplemaps

In order to fill in the missing decimal latitudes and longitudes, free available data from **simplemaps** is used. simplemaps offers postal codes and cities with their latitude and longitude.

The US Zip Codes Database link provides latitude and longitude for selected US zip codes:

zip	lat	lng
00601	18.18027	-66.75266
00602	18.36075	-67.17541
00603	18.45744	-67.12225
00606	18.16585	-66.93716
00610	18.2911	-67.12243
00611	18.27698	-66.80688
00612	18.41283	-66.7051
00616	18.41878	-66.6679
00617	18.44598	-66.56006
00622	17.98892	-67.1566
00623	18.08429	-67.15336
00624	18.05905	-66.71932

The United States Cities Database link provides latitude and longitude for selected US cities:

city_ascii	state_id	state_name	county_fips	county_name	lat	lng
New York	NY	New York	36081	Queens	40.6943	-73.9249
Los Angeles	CA	California	06037	Los Angeles	34.1141	-118.4068
Chicago	IL	Illinois	17031	Cook	41.8375	-87.6866
Miami	FL	Florida	12086	Miami-Dade	25.784	-80.2101
Dallas	TX	Texas	48113	Dallas	32.7935	-96.7667
Houston	TX	Texas	48201	Harris	29.786	-95.3885
Philadelphia	PA	Pennsylvania	42101	Philadelphia	40.0077	-75.1339
Atlanta	GA	Georgia	13121	Fulton	33.7628	-84.422
Washington	DC	District of Columbia	11001	District of Columbia	38.9047	-77.0163
Boston	MA	Massachusetts	25025	Suffolk	42.3188	-71.0852
Phoenix	AZ	Arizona	04013	Maricopa	33.5722	-112.0892
Detroit	MI	Michigan	26163	Wayne	42.3834	-83.1024
San Francisco	CA	California	06075	San Francisco	37.7558	-122.4449
Seattle	WA	Washington	53033	King	47.6211	-122.3244
San Diego	CA	California	06073	San Diego	32.8313	-117.1222
Minneapolis	MN	Minnesota	27053	Hennepin	44.9635	-93.2678

1.8.10 United States Zip Codes.org

In order to fill in the missing decimal latitudes and longitudes, free available data from **United States Zip Codes.org** is used. **United States Zip Codes.org** offers more complete postal codes but only with estimated latitudes and longitudes.

zip	type	decommissioned	primary_city	acceptable_cities	state	country	latitude	longitude
00501	UNIQUE	0	Holtsville		NY	US	40.81	-73.04
00544	UNIQUE	0	Holtsville		NY	US	40.81	-73.04
00601	STANDARD	0	Adjuntas		PR	US	18.16	-66.72
00602	STANDARD	0	Aguada		PR	US	18.38	-67.18
00603	STANDARD	0	Aguadilla	Ramey	PR	US	18.43	-67.15
00604	PO BOX	0	Aguadilla	Ramey	PR	US	18.43	-67.15
00605	PO BOX	0	Aguadilla		PR	US	18.43	-67.15
00606	STANDARD	0	Maricao		PR	US	18.18	-66.98
00610	STANDARD	0	Anasco		PR	US	18.28	-67.14
00611	PO BOX	0	Angeles		PR	US	18.28	-66.79
00612	STANDARD	0	Arecibo		PR	US	18.45	-66.73
00613	PO BOX	0	Arecibo		PR	US	18.45	-66.73
00614	PO BOX	0	Arecibo		PR	US	18.45	-66.73
00616	STANDARD	0	Bajadero		PR	US	18.42	-66.67
00617	STANDARD	0	Barceloneta		PR	US	18.45	-66.56
00622	STANDARD	0	Boqueron		PR	US	17.99	-67.15
00623	STANDARD	0	Cabo Rojo		PR	US	18.08	-67.14

1.9 PostgreSQL Administration

IO-AVSTATS uses the PostgreSQL DBMS for data management. PostgreSQL is a very powerful relational database system where the SQL language can be extended by procedural add-ons like PL/pgSQL or PL/Python.

IO-AVSTATS provides all the tools to import the data from the MS Access databases available on the **NTSB** website and the data from the basic flat files available on **simplemaps** United States Cities Database and US Zip Codes Database websites.

1.9.1 Docker

The PostgreSQL Docker community provides PostgreSQL images suitable for **IO-AVSTATS** on DockerHub. The official image can be found here. The *c_d_l* task available in the *run_io_avstats_db* script downloads a selected PostgreSQL DBMS image from DockerHub and creates, configures and starts a Docker container.

1.9.2 Parameterization

The parameters can be defined either via environment variables or in the *settings.io_aero.toml* file. Details can be found under *Configuration* and *IO-AVSTATS*.

The following parameters are used when downloading the Docker image and creating the Docker container:

- `postgres_connection_port` - the database IP address
- `postgres_container_name` - the container name
- `postgres_dbname_admin` - the administration database name
- `postgres_password_admin` - the administration database password
- `postgres_pgdata` - the file directory on the host for the database files
- `postgres_user_admin` - the administration database username
- `postgres_version` - the requested PostgreSQL version from DockerHub

When using environment variables, they must contain the prefix `IO_AERO_`, e.g., `IO_AERO_POSTGRES_USER`.

1.9.3 Backup & Restore

Since the **IO-AVSTATS** database contains only statistical data, it is subject to a relatively low frequency of change. The following three events can lead to a change in the **IO-AVSTATS** database:

1. a new change file on the **NTSB** download site, or
2. an evolution of the database software or schema, or
3. a new PostgreSQL version that requires database migration.

This does not require sophisticated methods for backing up and restoring the **IO-AVSTATS** database, especially since the database contents reside in a dedicated local file directory. For data backup it is therefore sufficient to create a copy of the file directory with the **IO-AVSTATS** database before a change event. This copy can then replace the corrupted **IO-AVSTATS** database in the event of an error.

Very important: before any backup or restore, the PostgreSQL Docker container must be stopped first!

Master Data Logs

Chapter 2

Transaction Data Logs

Chapter 3

Chapter 4

API Documentation

Here, you will find detailed API documentation, which includes information about all modules within the IO-AVSTATS, allowing developers to understand the functionalities available.

4.1 ioavstats

4.1.1 ioavstats package

Subpackages

ioavstats.pages package
Submodules
ioavstats.pages.Association_Rule_Analysis module
ioavstats.pages.Aviation_Event_Analysis module
ioavstats.pages.Database_Profiling module
Module contents

IO-AVSTATS Applications.

Submodules

ioavstats.Menu module

IO-Aero Menu.

ioavstats.avstats module

IO-AVSTATS interface.

`ioavstats.avstats.`**`check_arg_msaccess`** (*args: Namespace*) → None
Check the command line argument: -m / –msaccess.

Parameters **`args`** (*`argparse.Namespace`*) – Command line arguments.

`ioavstats.avstats.`**`check_arg_msexcel`** (*args: Namespace*) → None
Check the command line argument: -e / –msexcel.

Parameters **`args`** (*`argparse.Namespace`*) – Command line arguments.

`ioavstats.avstats.`**`check_arg_task`** (*args: Namespace*) → None
Check the command line argument: -t / –task.

Parameters **`args`** (*`argparse.Namespace`*) – Command line arguments.

`ioavstats.avstats.`**`cleansing_postgres_data`** ( ) → None
c_p_d: Cleansing PostgreSQL data.

ioavstats.avstats.**correct_dec_lat_lng** ( ) → None
c_l_l: Correct US decimal latitudes and longitudes.

ioavstats.avstats.**create_db_schema** ( ) → None
c_d_s: Create the PostgreSQL database schema.

ioavstats.avstats.**download_ntsb_msaccess_file** (*msaccess: str*) → None
d_n_a: Download a NTSB MS Access database file.

Parameters **msaccess** (*str*) – The NTSB MS Access database file without file extension.

ioavstats.avstats.**find_nearest_airports** ( ) → None
f_n_a: Find the nearest airports.

ioavstats.avstats.**generate_sql** ( ) → None
Generate SQL statements: INSERT & UPDATE.

ioavstats.avstats.**get_args** ( ) → None
Load the command line arguments into the memory.

ioavstats.avstats.**load_aviation_occurrence_categories** ( ) → None
a_o_c: Load aviation occurrence categories into PostgreSQL.

ioavstats.avstats.**load_airport_data** ( ) → None
l_a_p: Load airport data into PostgreSQL.

ioavstats.avstats.**load_correction_data** (*filename: str*) → None
l_c_d: Load data from a correction file into PostgreSQL.

Parameters **filename** (*str*) – The filename of the correction file.

ioavstats.avstats.**load_country_state_data** ( ) → None
l_c_s: Load country and state data into PostgreSQL.

ioavstats.avstats.**load_ntsb_msaccess_data** (*msaccess: str*) → None
l_n_a: Load NTSB MS Access database data into PostgreSQL.

Parameters **msaccess** (*str*) – The NTSB MS Access database file without file extension.

ioavstats.avstats.**load_sequence_of_events** ( ) → None
l_s_e: Load sequence of events data into PostgreSQL.

ioavstats.avstats.**load_simplemaps_data** ( ) → None
l_s_d: Load simplemaps data into PostgreSQL.

ioavstats.avstats.**load_zip_code_db_data** ( ) → None
l_z_d: Load ZIP Code Database data into PostgreSQL.

ioavstats.avstats.**progress_msg** (*msg: str*) → None
Create a progress message.

Parameters **msg** (*str*) – Progress message

ioavstats.avstats.**progress_msg_time_elapsed** (*duration: int*, *event: str*) → None
Create a time elapsed message.

Parameters
- **duration** (*int*) – Time elapsed in ns.
- **event** (*str*) – Event description.

ioavstats.avstats.**refresh_db_schema** ( ) → None
r_d_s: Refresh the PostgreSQL database schema.

ioavstats.avstats.**terminate_fatal** (*error_msg: str*) → None
Terminate the application immediately.

Parameters **error_msg** (*str*) – Error message

ioavstats.avstats.**update_db_schema** ( ) → None
u_d_s: Update the PostgreSQL database schema.

ioavstats.avstats.**verify_ntsb_data** ( ) → None
v_n_d: Verify selected NTSB data.

ioavstats.avstats.**version** ( ) → str
Return the version number of the IO-AVSTATS application.

Returns The version number of the IO-AVSTATS application

Return type str

ioavstats.code_generator module

IO-AVSTATS interface.

ioavstats.code_generator.**generate_sql** ( ) → None
Generate SQL statements: INSERT & UPDATE.
The underlying database structures originate from a DDL export of RazorSQL.

ioavstats.db_ddl_base module

Managing the database schema of the PostgreSQL database.

ioavstats.db_ddl_base.**create_db_schema** ( ) → None
Create the database schema.

ioavstats.db_ddl_base.**refresh_db_schema** ( ) → None
Refresh the database schema.

ioavstats.db_ddl_base.**update_db_schema** ( ) → None
Update the database schema.

ioavstats.db_dml_base module

Managing the database schema of the PostgreSQL database.

ioavstats.db_dml_base.**download_us_cities_file** ( ) → None
Download a US zip code file.

ioavstats.db_dml_base.**download_zip_code_db_file** ( ) → None
Download the ZIP Code Database file.

ioavstats.db_dml_base.**load_airport_data** ( ) → None
Load airports.

ioavstats.db_dml_base.**load_aviation_occurrence_categories** ( ) → None
Load aviation occurrence categories.

ioavstats.db_dml_base.**load_country_state_data** ( ) → None
Load country and state data.

ioavstats.db_dml_base.**load_sequence_of_events** ( ) → None
Load sequence of events sequence data.

ioavstats.db_dml_base.**load_simplemaps_data** ( ) → None
Load simplemaps data.

ioavstats.db_dml_base.**load_zip_codes_org_data** ( ) → None
Load ZIP Code Database data.

ioavstats.db_dml_corr module

Managing the database schema of the PostgreSQL database.

ioavstats.db_dml_corr.**ROW: list[OrderedDict]**

ioavstats.db_dml_corr.**cleansing_postgres_data** ( ) → None
Cleansing PostgreSQL data.

ioavstats.db_dml_corr.**correct_dec_lat_lng** ( ) → None
Correct decimal latitude and longitude.

ioavstats.db_dml_corr.**find_nearest_airports** ( ) → None
Find the nearest airports.

ioavstats.db_dml_corr.**load_correction_data** (*filename: str*) → None
Load data from a correction file into the PostgreSQL database.

Parameters **filename** (*str*) – The MS Excel file.

ioavstats.db_dml_corr.**verify_ntsb_data** ( ) → None
Verify selected NTSB data.

ioavstats.db_dml_msaccess module

Managing the database schema of the PostgreSQL database.

ioavstats.db_dml_msaccess.**load_ntsb_msaccess_data** (*msaccess: str*) → None
Load data from MS Access to the PostgreSQL database.

Parameters **msaccess** (*str*) – The MS Access database file without file extension.

ioavstats.db_dml_msaccess.**download_ntsb_msaccess_file** (*msaccess: str*) → None
Download an MS Access database file.

Parameters **msaccess** (*str*) – The MS Access database file without file extension.

ioavstats.glob_local module

Global constants and variables.

ioavstats.user_guide module

Creation of the user guide.

ioavstats.user_guide.**get_ae1982_app** ( ) → None
ae1982 - Creates the user guide for the whole application.

ioavstats.user_guide.**get_ae1982_bar_chart** (*chart_id: str, chart_title: str*) → None
ae1982 - Creates the user guide for bar charts.

ioavstats.user_guide.**get_pd1982_app** ( ) → None
pd1982 - Creates the user guide for the whole application.

ioavstats.user_guide.**get_pd1982_data_profile** ( ) → None
pd1982 - Creates the user guide for the 'Show data profile' task.

ioavstats.user_guide.**get_pd1982_details** ( ) → None
pd1982 - Creates the user guide for the 'Show details' task.

ioavstats.utils module

Application Utilities.

ioavstats.utils.**get_args** ( ) → str
Load the command line arguments into the memory.

ioavstats.utils.**get_engine** (*settings: LazySettings*) → Engine
Create a simple user PostgreSQL database engine.

ioavstats.utils.**get_postgres_connection** ( ) → <module 'psycopg.connection' from 'C:\\ProgramData\\miniconda3\\envs\\ioavstats\\Lib\\site-packages\\psycopg\\connection.py'>
Create a PostgreSQL connection.

ioavstats.utils.**prepare_latitude** (*latitude_string: str*) → str
Prepare a latitude structure.

Parameters **latitude_string** (*str*) – Latitude string.

Returns Latitude structure.

Return type str

ioavstats.utils.**prepare_longitude** (*longitude_string: str*) → str
Prepare a longitude structure.

Parameters **longitude_string** (*str*) – longitude string.

Returns longitude structure.

Return type str

ioavstats.utils.**present_about** (*pg_conn: <module 'psycopg.connection' from 'C:\\ProgramData\\miniconda3\\envs\\ioavstats\\Lib\\site-packages\\psycopg\\connection.py'>, app_id: str*) → None
Present the 'about' information.

Parameters
- **pg_conn** (*connection*) – Database connection.
- **app_id** (*str*) – Application name.

ioavstats.utils.**upd_io_processed_files** (*file_name: str, cur_pg: <module 'psycopg.cursor' from 'C:\\ProgramData\\miniconda3\\envs\\ioavstats\\Lib\\site-packages\\psycopg\\cursor.py'>*) → None
Update the database table io_processed_files.

ioavstats.utils_msaccess module

Miscellaneous helper functions.

ioavstats.utils_msaccess.**get_msaccess_cursor** (*filename: str*) → tuple[Connection, Cursor]
Create an MS Access cursor.

Parameters **filename** (*str*) – MS Access filename.

Returns ODBC database connection and cursor.

Return type tuple[pyodbc.Connection,pyodbc.Cursor]

Module contents

IO-AVSTATS.

About

This section provides additional context and legal information about IO-AVSTATS, including release notes and licensing details.

5.1 Release Notes

5.1.1 Version 24.07.08

Release Date: 08.07.2024

Applied Software

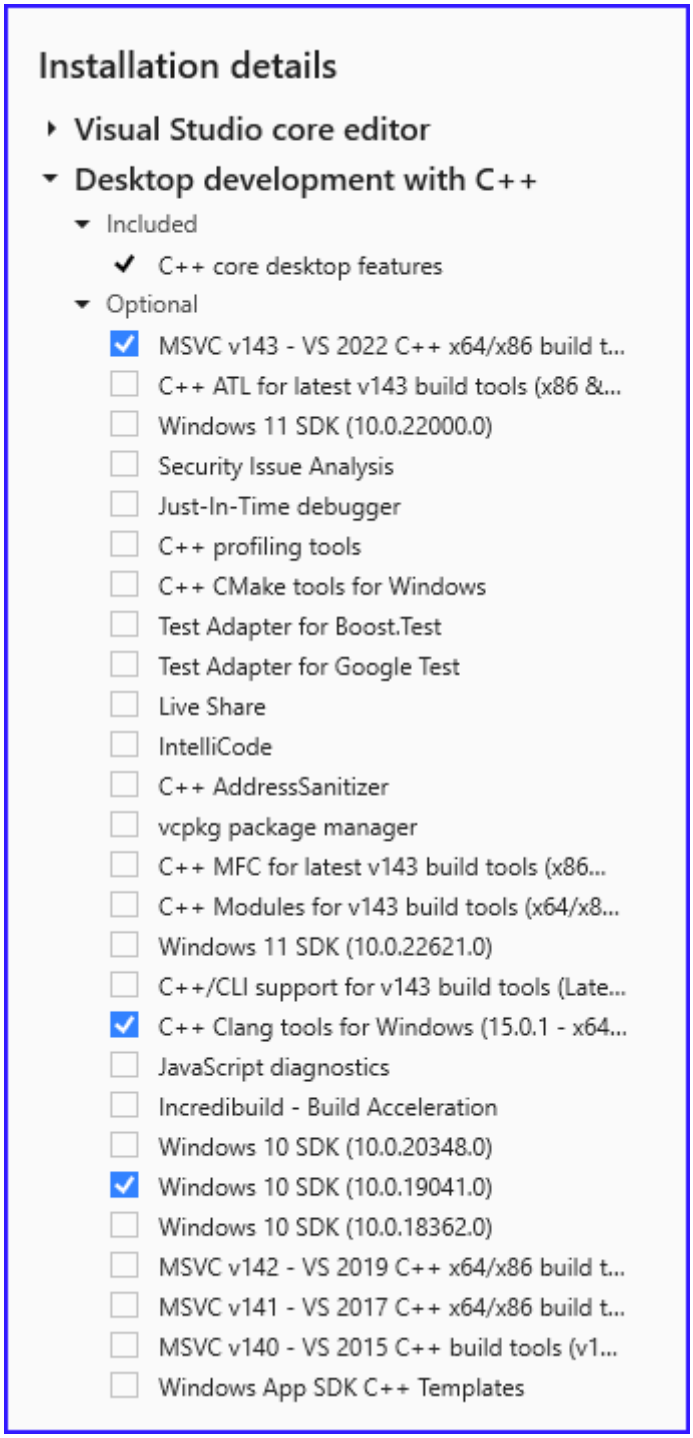
Software	Version	Remark	Status
Docker Desktop	4.32.0		upgrade
Miniconda	24.5.0		
PostgreSQL	16.3		
Python	3.11.9		
RazorSQL	10.6.0		

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	24.06		
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		
Visual Studio Community 2022	17.10.1		

Minimal Requirements Visual Studio Community 2022



Processed files

NTSB - National Transport Safety Board

Data source up08JUL.zip

- Download link: 07/08/2024 3:00:29 AM

5.1.2 Version 24.07.01

Release Date: 01.07.2024

Applied Software

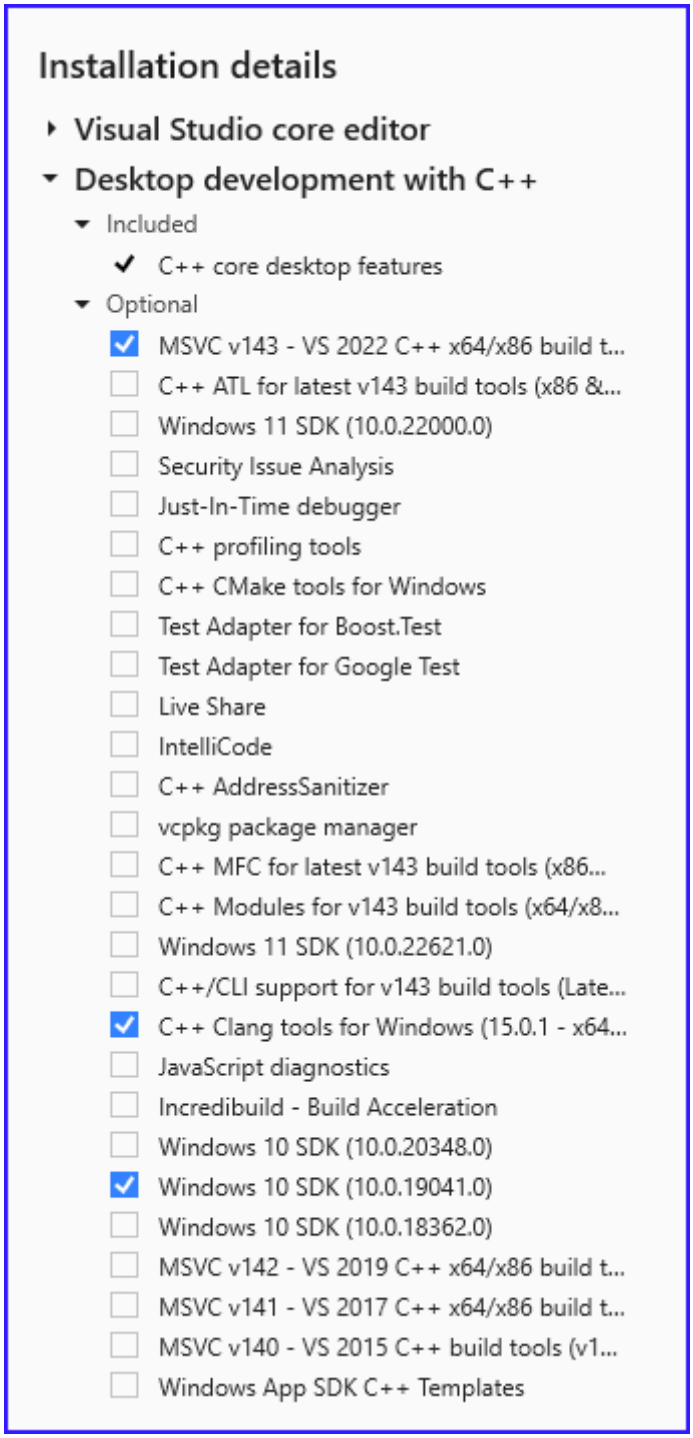
Software	Version	Remark	Status
Docker Desktop	4.31.1		upgrade
Miniconda	24.5.0		
PostgreSQL	16.3		
Python	3.11.9		
RazorSQL	10.6.0		upgrade

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	24.07		upgrade
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		
Visual Studio Community 2022	17.10.3		upgrade

Minimal Requirements Visual Studio Community 2022



Processed files

NTSB - National Transport Safety Board

Data source avall.zip

- Download link: 07/01/2024 06:01:50 AM

Data source up01JUL.zip

- Download link: 07/01/2024 3:00:27 AM

5.1.3 Version 24.06.22

Release Date: 22.06.2024

Applied Software

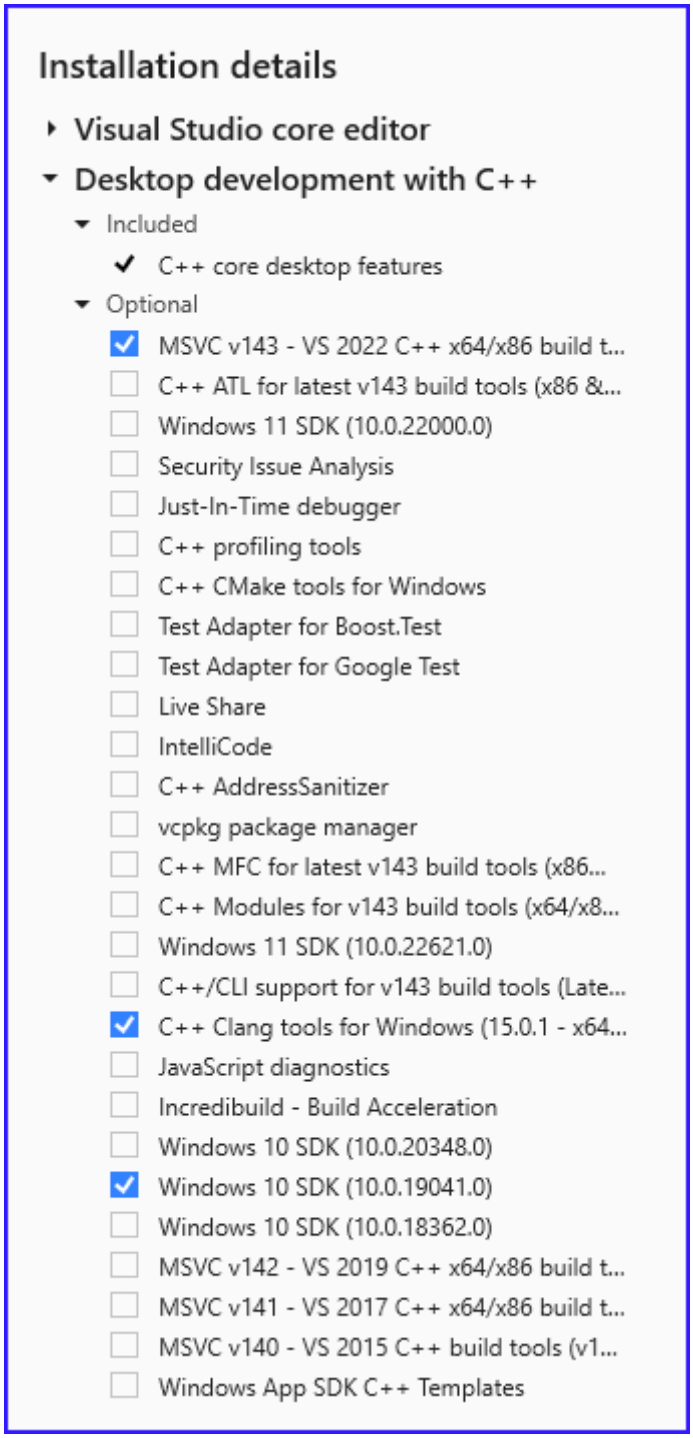
Software	Version	Remark	Status
Docker Desktop	4.31.1		upgrade
Miniconda	24.5.0		
PostgreSQL	16.3		
Python	3.11.9		
RazorSQL	10.5.5		

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	24.06		
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		
Visual Studio Community 2022	17.10.2		upgrade

Minimal Requirements Visual Studio Community 2022



Processed files

NTSB - National Transport Safety Board

Data source up22JUN.zip

- Download link: 06/22/2024 3:00:41 AM

5.1.4 Version 24.06.15

Release Date: 15.06.2024

Applied Software

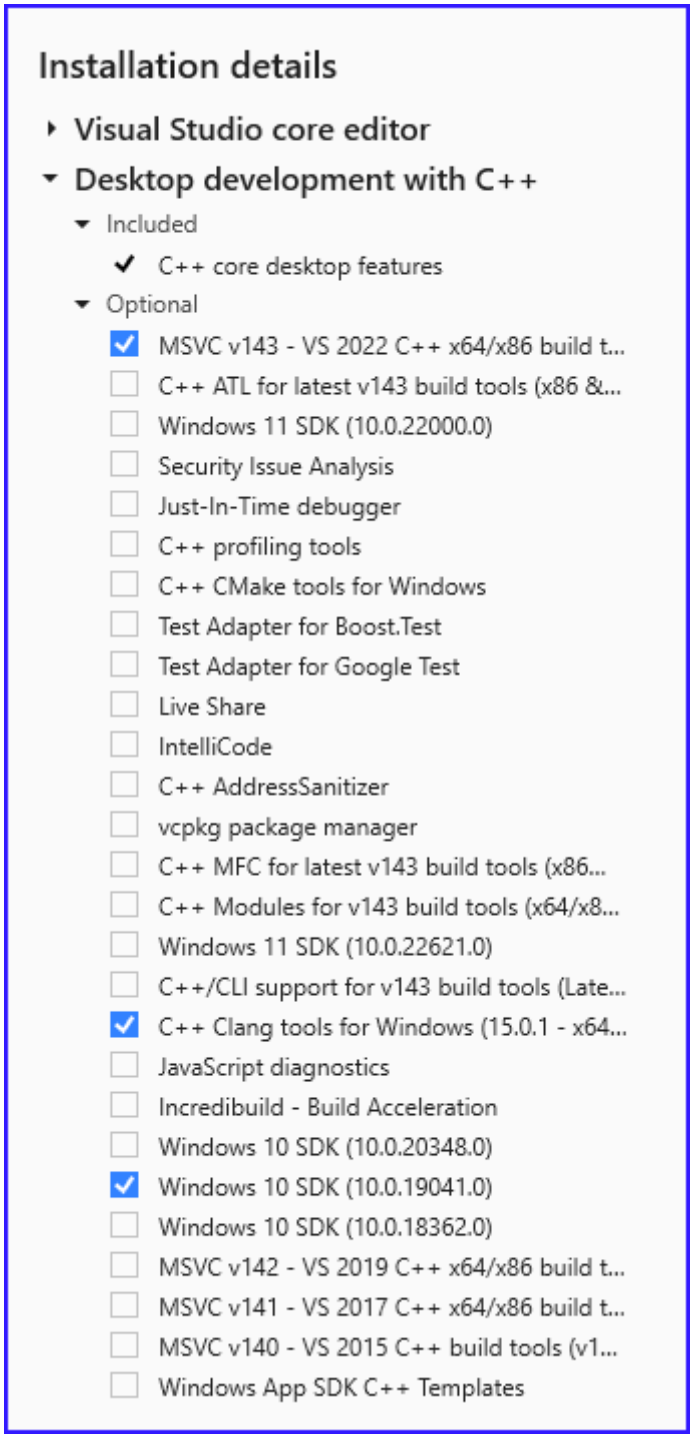
Software	Version	Remark	Status
Docker Desktop	4.30.0		
Miniconda	24.5.0		
PostgreSQL	16.3		
Python	3.11.9		
RazorSQL	10.5.5		

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	24.06		
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		
Visual Studio Community 2022	17.10.1		

Minimal Requirements Visual Studio Community 2022



Processed files

NTSB - National Transport Safety Board

Data source up15JUN.zip

- Download link: 06/15/2024 3:00:14 AM

5.1.5 Version 24.06.08

Release Date: 09.06.2024

Applied Software

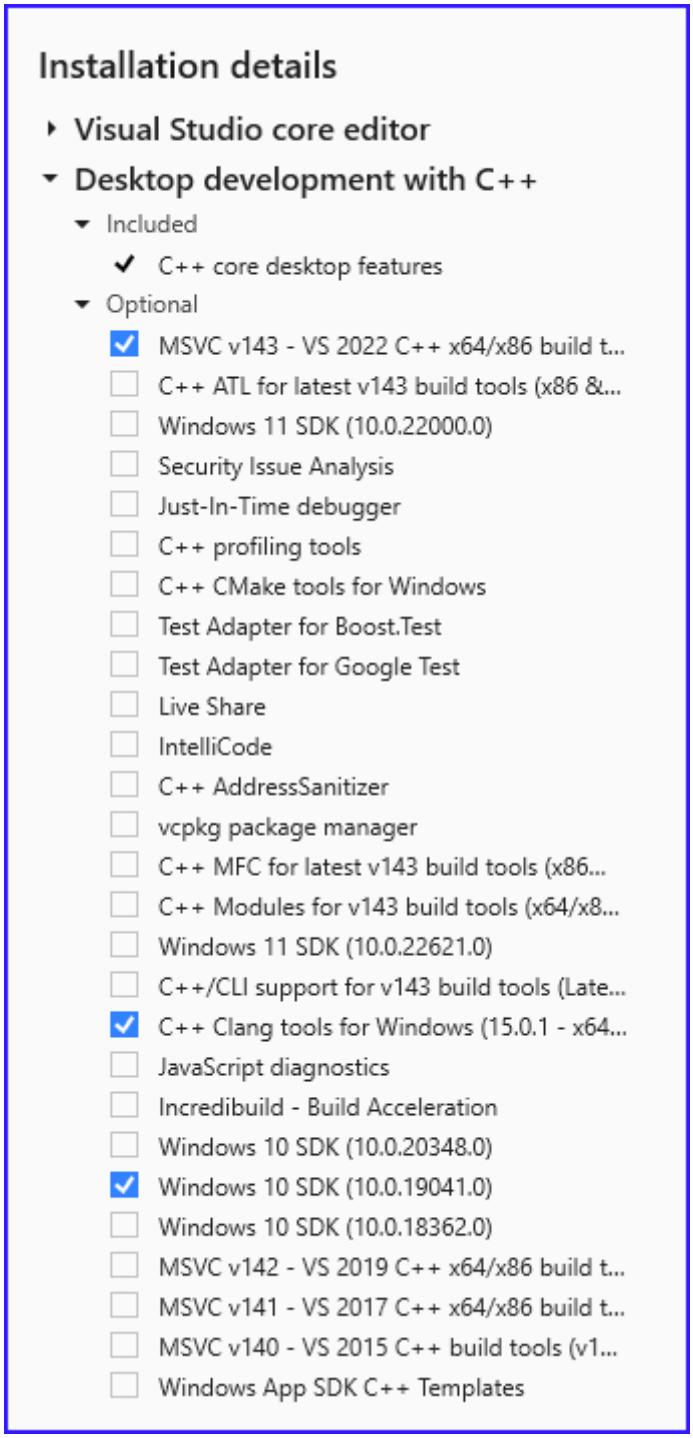
Software	Version	Remark	Status
Docker Desktop	4.30.0		
Miniconda	24.5.0		
PostgreSQL	16.3		
Python	3.11.9		
RazorSQL	10.5.5		

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	24.06		
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		
Visual Studio Community 2022	17.10.1		

Minimal Requirements Visual Studio Community 2022



Processed files

NTSB - National Transport Safety Board

Data source up08JUN.zip

- Download link: 06/08/2024 3:00:20 AM

5.1.6 Version 24.06.01

Release Date: 01.06.2024

Applied Software

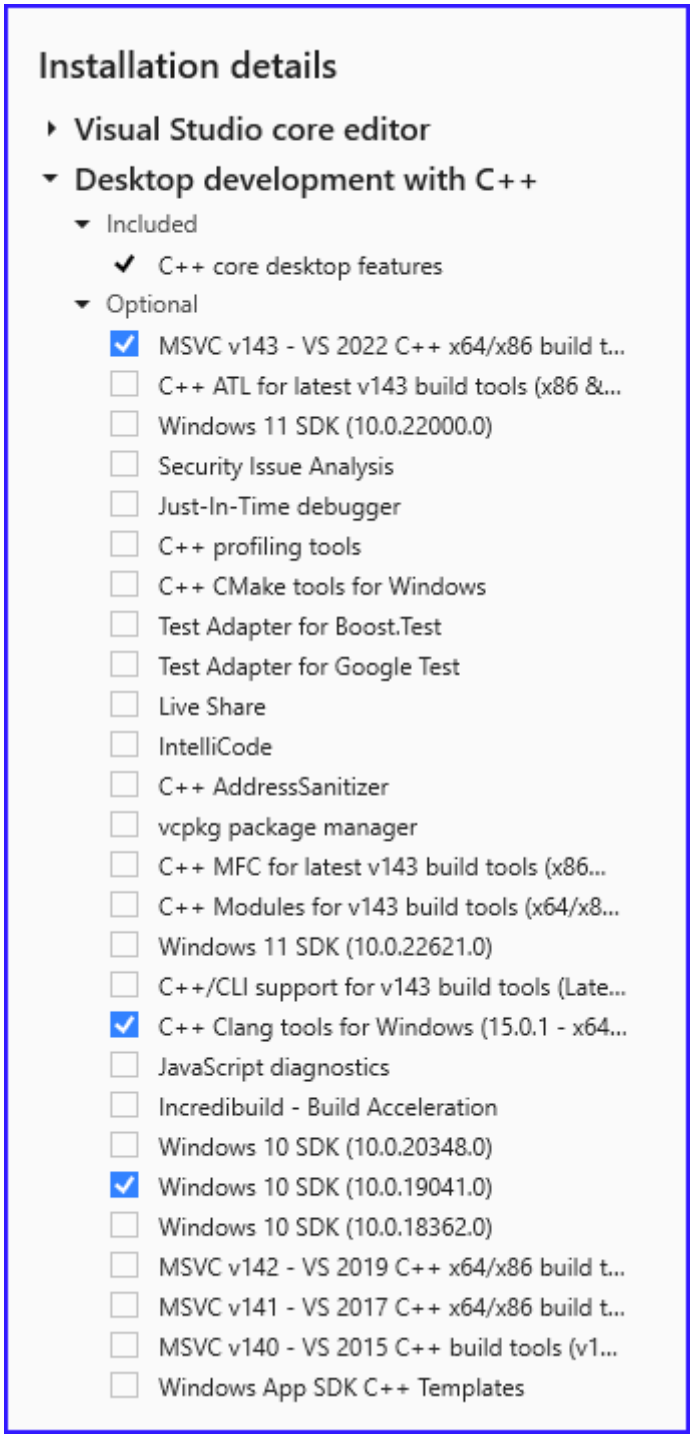
Software	Version	Remark	Status
Docker Desktop	4.30.0		
Miniconda	24.5.0		
PostgreSQL	16.3		
Python	3.11.9		
RazorSQL	10.5.5		

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	24.06		upgrade
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		
Visual Studio Community 2022	17.10.1		upgrade

Minimal Requirements Visual Studio Community 2022



Processed files

FAA - Aeronautical data Delivery Service

Data source Airports

- Download link: Version: 05/16/2024

Data source Runways

- Download link: Version: 05/16/2024

simplemaps - Interactive Maps & Data
Data source US Cities Database

- Download link: Version: 1.79

NTSB - National Transport Safety Board
Data source avall.zip

- Download link: 06/01/2024 06:11:06 AM

Data source up01JUN.zip

- Download link: 06/01/2024 3:00:21 AM

5.1.7 Version 24.05.01

Release Date: 01.05.2024

Applied Software

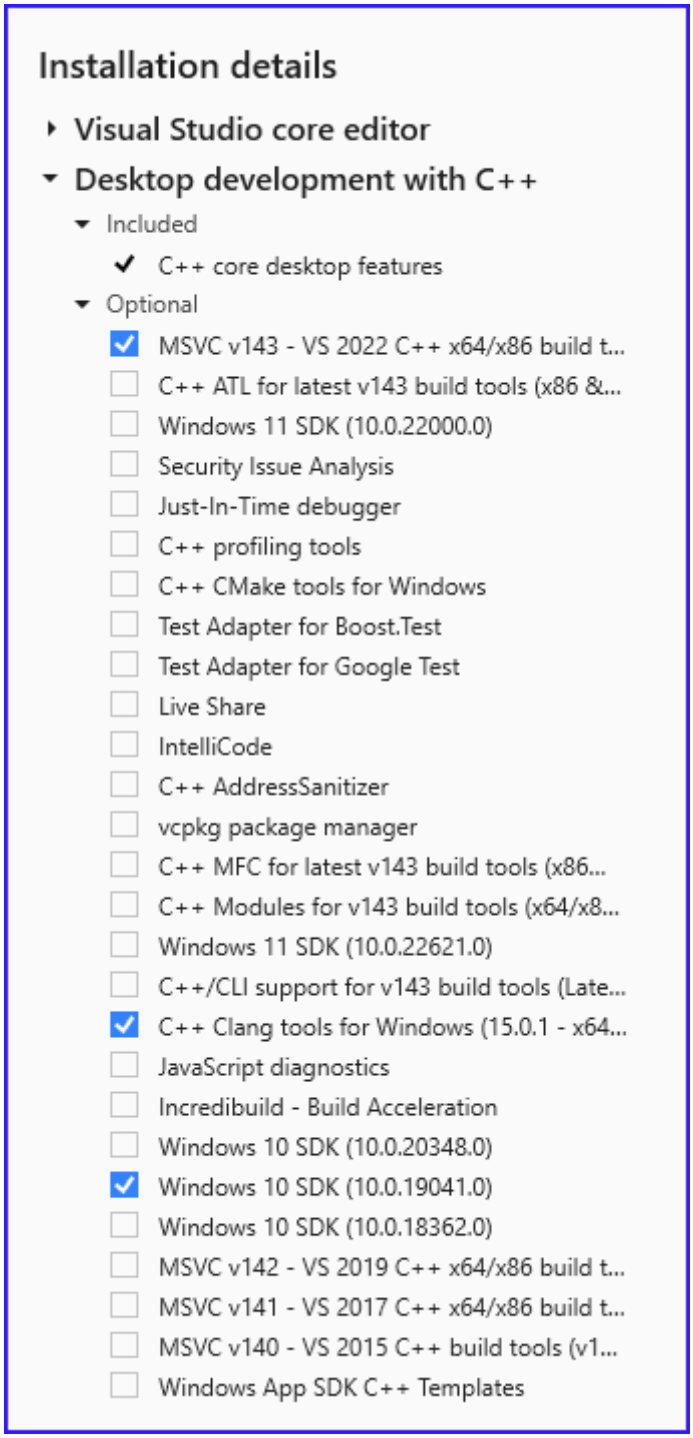
Software	Version	Remark	Status
Docker Desktop	4.29.0		
PostgreSQL	16.2		
Python	3.11.9		
RazorSQL	10.5.4		

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	23.01		
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		
Visual Studio Community 2022	2022		

Minimal Requirements Visual Studio Community 2022



Processed files

simplemaps - Interactive Maps & Data
Data source US Zip Codes Database

- Download link: Version: 1.85

NTSB - National Transport Safety Board
Data source avall.zip

- Download link: 05/01/2024 06:16:00 AM

Data source up01MAY.zip

- Download link: 05/01/2024 3:00:20 AM

5.1.8 Version 24.04.01

Release Date: 01.04.2024

Applied Software

Software	Version	Remark	Status
AWS CLI	2.15.34		upgrade
Docker Desktop	4.28.0		
Python	3.10.11		
RazorSQL	10.5.3		

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	23.01		
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		

Processed files

FAA - Aeronautical data Delivery Service

Data source Airports

- Download link: Version: 03/21/2024

Data source Runways

- Download link: Version: 03/21/2024

NTSB - National Transport Safety Board

Data source avall.zip

- Download link: 04/01/2024 06:09:05 AM

Data source up01APR.zip

- Download link: 04/01/2024 3:00:22 AM

5.1.9 Version 24.03.01

Release Date: 01.03.2024

Applied Software

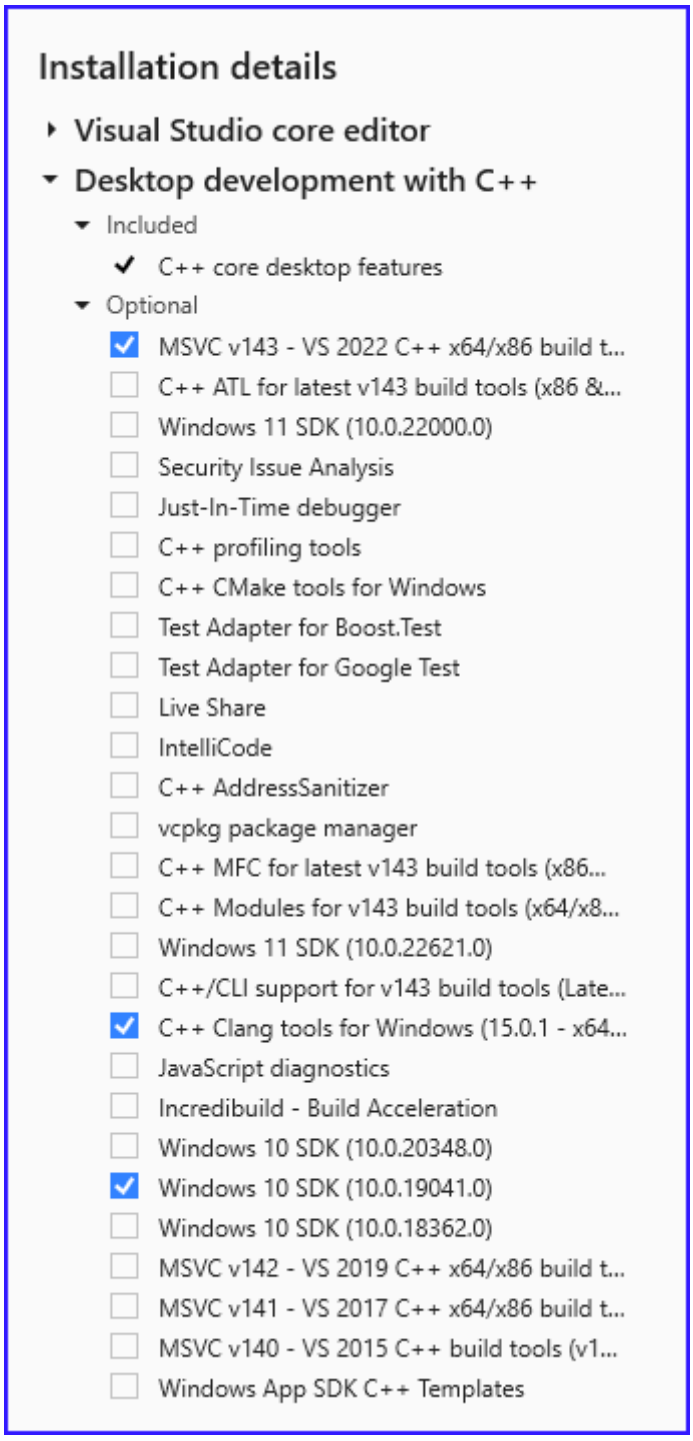
Software	Version	Remark	Status
AWS CLI	2.15.20		
Docker Desktop	4.27.2		upgrade
Python	3.10.11		
RazorSQL	10.5.3		

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	23.01		
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		

Minimal Requirements Visual Studio Community 2022



Processed files

NTSB - National Transport Safety Board

Data source avall.zip

- Download link: 03/01/2024 06:03:06 AM

Data source up01MAR.zip

- Download link: 03/01/2024 3:00:23 AM

5.1.10 Version 24.02.01

Release Date: 01.02.2024

Applied Software

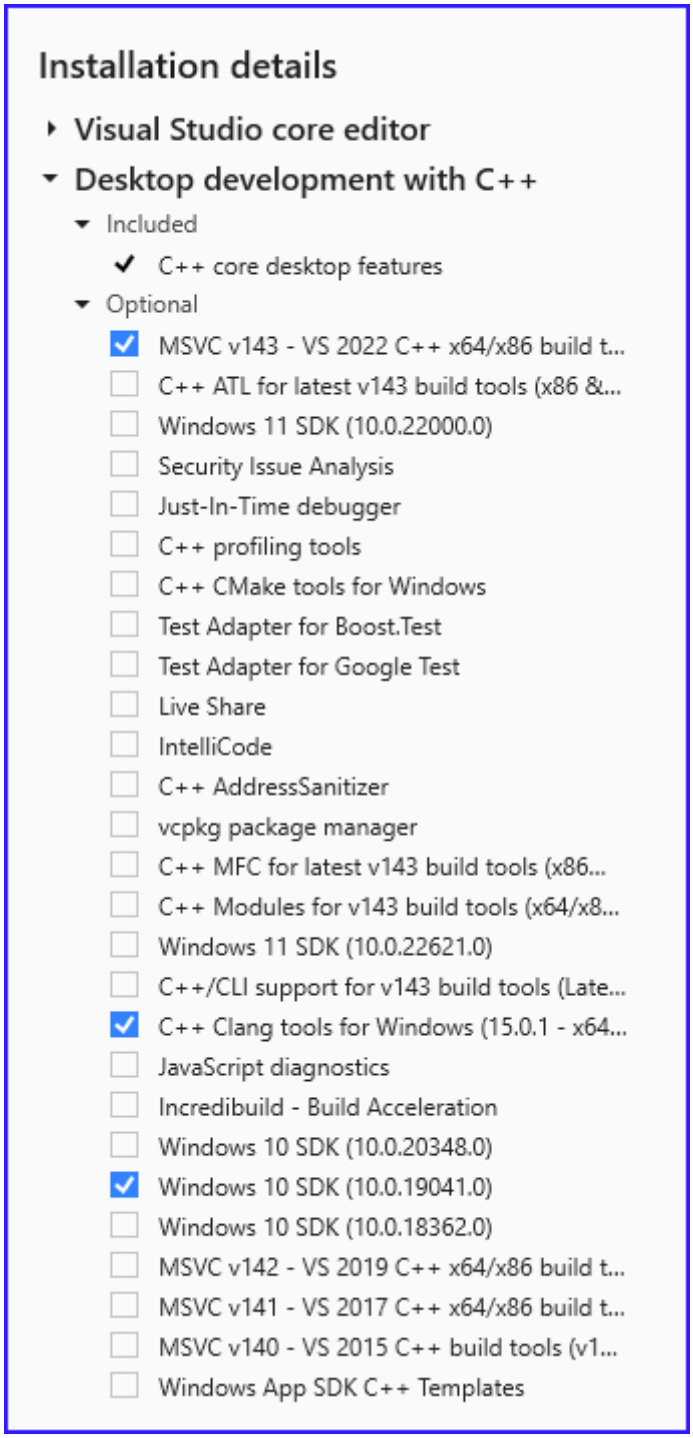
Software	Version	Remark	Status
AWS CLI	2.15.16		upgrade
Docker Desktop	4.26.1		
PostgreSQL	16.1		
Python	3.10.11		
RazorSQL	10.5.3		upgrade

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	23.01		
The LLVM Compiler Infrastructure	17.0.6		
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		
Visual Studio Community 2022	2022		

Minimal Requirements Visual Studio Community 2022



Processed files

FAA - Aeronautical data Delivery Service

Data source Airports

- Download link: Version: 01/25/2024

Data source Runways

- Download link: Version: 01/25/2024

simplemaps - Interactive Maps & Data
Data source United States Cities Database

- Download link: Version: 1.78

Data source US Zip Codes Database

- Download link: Version: 1.84

NTSB - National Transport Safety Board
Data source avall.zip

- Download link: 02/01/2024 06:15:30 AM

Data source up01FEB.zip

- Download link: 02/01/2024 3:00:41 AM

5.1.11 Version 24.01.01

Release Date: 01.01.2024

Applied Software

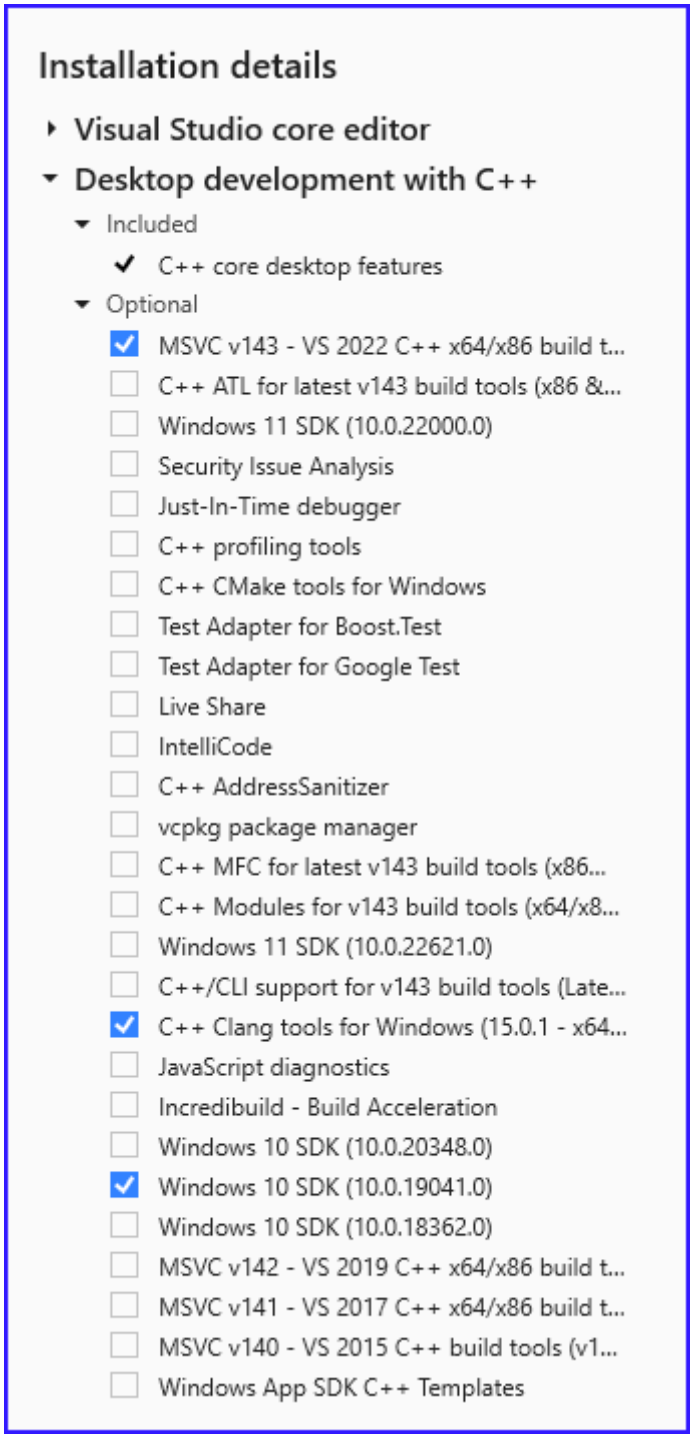
Software	Version	Remark	Status
AWS CLI	2.15.3		
Docker Desktop	4.26.1		
PostgreSQL	16.1		
Python	3.10.11		
RazorSQL	10.5.1		

Windows-specific Software

Important: All software components should be installed in the 64 bit version!

Software	Version	Remark	Status
7-Zip	23.01		
The LLVM Compiler Infrastructure	17.0.6		
Make for Windows	3.81		
MS Access Database Engine 2016 Redistributable	8/11/2020		
Visual Studio Community 2022	2022		

Minimal Requirements Visual Studio Community 2022



Processed files

NTSB - National Transport Safety Board

Data source avall.zip

- Download link: 01/01/2024 06:23:50 AM

Data source up01JAN.zip

- Download link: 01/01/2024 3:00:17 AM

5.2 End-User License Agreement

5.2.1 End-User License Agreement (EULA) of IO-Aero Software

This End=User License Agreement ("**EULA**") is a legal agreement between you and **IO-Aero**.

This **EULA** agreement governs your acquisition and use of our **IO-Aero Software** ("Software") directly from **IO-Aero** or indirectly through a **IO-Aero** authorized reseller or distributor (a "Reseller").

Please read this **EULA** agreement carefully before completing the installation process and using the **IO-Aero Software**. It provides a license to use the **IO-Aero Software** and contains warranty information and liability disclaimers.

If you register for a free trial of the **IO-Aero Software**, this **EULA** agreement will also govern that trial. By clicking "accept" or installing and/or using the **IO-Aero Software**, you are confirming your acceptance of the Software and agreeing to become bound by the terms of this **EULA** agreement.

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License Grant

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- Reproduce, copy, distribute, resell or otherwise use the Software for any commercial purpose
- Allow any third party to use the Software on behalf of or for the benefit of any third party
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- use the Software for any purpose that **IO-Aero** considers is a breach of this **EULA** agreement Intellectual Property and Ownership

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IO-Aero reserves the right to grant licences to use the Software to third parties.

Termination

This **EULA** agreement is effective from the date you first use the Software and shall continue until

terminated. You may terminate it at any time upon written notice to **IO-Aero**.

It will also terminate immediately if you fail to comply with any term of this **EULA** agreement. Upon such termination, the licenses granted by this **EULA** agreement will immediately terminate, and you agree to stop all access and use of the Software. The provisions that by their nature continue and survive will survive any termination of this **EULA** agreement.

Governing Law

This **EULA** agreement, and any dispute arising out of or in connection with this **EULA** agreement, shall be governed by and construed in accordance with the laws of the United States.

Indices and tables

- genindex
- modindex

6.1 Repository

Link to the repository for accessing the source code and contributing to the project:
IO-AVSTATS GitHub Repository

6.2 Version

This documentation is for IO-AVSTATS version 24.3.22.

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