
# TVSTUDY

## INSTALLATION AND UPGRADE GUIDE

Office of Engineering and Technology
Federal Communications Commission
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version 2.3.0

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# UPGRADING FROM TVSTUDY 2.2.5

The following text will guide you through the process of upgrading TVStudy 2.2.5 to the latest version, 2.3.0.[1] It is strongly recommended that you upgrade only from version 2.2.5, since upgrading from older versions of the software could require you to drop and recreate the database. Otherwise, you should Uninstall and then Install the database again using the Manage Database window, instructions for which can be found at the beginning of the TVStudy manual.

## Downloading the TVStudy Files

From the FCC TVStudy website, you will need to obtain two of the three files listed below.

> **2024May_tvstudy_data_updates.tar.xz –** Contains updates to the required data files.
> **2024May_tvstudy_mac_files.tar.xz** – Contains all of the necessary code and executables to run TVStudy 2.3.0 on the Mac platform.
> **2024May_tvstudy_linux64_files.tar.xz** – Contains all of the necessary code and executables to run TVStudy 2.3.0 on the Linux platform.

These files have been posted to https://www.fcc.gov/oet/tvstudy and can be downloaded by the end user. The .tar.xz file should then be unzipped to the directory that TVStudy is contained in, overwriting some older files. The .tar.xz file has the file structure found on the next page. (On Linux, the extract command is: `tar -xJvf <name of xz file>`.) The complete TVStudy directory structure can be found on page 10. Please note that the xml/ directory should only contain the two files shown on the next page.

The Terrain Database Test and Verification Utility has been updated with TVStudy 2.3.0. Download the new version and place its files in the dbase/ directory.

Beginning with Mac OSX 10.15 ("Catalina"), TVStudy should no longer be installed in the /Applications directory. Due to changes to Mac OSX security policy, TVStudy may no longer run properly from that location. If TVStudy is currently installed there, moving the entire TVStudy/ directory to the home directory should resolve the issue.

**Please see the notes on page 6 before attempting to launch TVStudy 2.3.0.**

You should now be done except for configuring Ghostscript if you have not already (see page 9 for Mac or page 12 for Linux), unless you need to recompile TVStudy. (See page 14 for more information on recompiling TVStudy.)

[1] Please note that version 1.3.2 (Patched) was the software version of TVStudy used the incentive auction. This previous version still remains available for download at: http://data.fcc.gov/download/incentive-auctions/OET-69/.

### *TVStudy Files Download Data Structure*

```
dev/
      build/                  (empty)
      lib/                    (contains necessary libraries for compilation)
      Makefile
      Manifest.txt
      Manifest_dbutil.txt
      src/                    (this is the source code for compilation)
help/
      manual.pdf
lib/
      cdbs_table_defs.dat
      check_install
      config.props
      convert_ned13
      country_poly.csv
      dbutil.jar
      dbutil.props
      fix_application
      land_mobile.csv
      land_mobile_exclude.csv
      land_mobile_waiver.csv
      [libcrypto]
      [libmysqlclient]
      [libmysqlharness]
      [libssl]
      monitor_station.csv
      mysql-jdbc.jar
      pair_study_post
      pgsql-jdbc.jar
      ptelev
      ptelev.conf
      sharing_guests.dat
      top_markets.csv
      tvstudy
      tvstudy-api.jar
      tvstudy-core.jar
      tvstudy-gui.jar
      versions.dat
xml/
      TVIXCheck.xml
      TVIXCheckTemplate.xml
tvstudy.jar
```

## Notes About TVStudy Upgrades

On the Mac, if after attempting to open the tvstudy.jar file you receive a message that the software cannot be opened, right-click on tvstudy.jar and click "Open." This will bypass a Mac security feature that prevents TVStudy from running, and you should then by able to open TVStudy without this work-around in the future.

On the Mac, if after launching TVStudy you receive a prompt related to security regarding either an unverified publisher or a "dylib" file, dismiss the window, then close TVStudy and reopen. Before upgrading the database, repeat this process until the prompts stop appearing when you launch TVStudy. It may take up to 10 attempts. This is a Mac security issue related to adding support for MySQL 8 to TVStudy. Do not move the files to the trash. You may also wish to accept warnings found in the security settings window.

After upgrading, you may receive the error message: "The study engine executable file is not properly installed. Editing may occur however no study runs will be performed." On newer versions of Mac OS, this may be caused by new security features and require you to manually approve the TVStudy code to run. To do so, open the Finder and navigate to your TVStudy/ directory. Command-click or right-click on the tvstudy executable and click "Open." You may then receive a pop-up message asking if it is okay to run. Once you approve it, you should be able to run it accordingly from within TVStudy. If you plan to run any Pair Studies, repeat the process but with the pair_study_post file. Additional security-related issues with running TVStudy on newer versions of MacOS may be discussed in the FAQ. On Linux, this may happen because you may now need to install the libmysqlclient21 package in order for TVStudy to run successfully.

If you have trouble connecting to the database, try changing the Host from localhost to 127.0.0.1.

Please note that even if you are upgrading an existing installation of TVStudy, the database upgrade process may take a long time because TVStudy 2.3.0 will add indexes to the various datasets in order to improve search performance. Please do not terminate your database upgrade early if it is taking a long time, as this may corrupt the database.

While TVStudy 2.3 can now use MySQL 8, **users of the Mac are strongly encouraged not to upgrade MySQL** unless there is a need to do so. In the FCC's experience, such an attempt can cause loss of the existing study database at best, and a broken MySQL installation at worst.

For Ubuntu users, please note that the FCC has now upgraded its Ubuntu installations to Ubuntu 22.04. This may cause unforeseen issues or inconsistencies for users of older version versus the information contained in this installation guide.

The FCC has not tested TVStudy on newer ARM-based Mac computers, and thus can make no guarantees as to the functionality and performance of TVStudy on those systems. However, other than the Mac OS security items noted above, the FCC is unaware of any reason it should not work.

Beginning with TVStudy 2.3.0, the files for download are now compressed in .tar.xz format. This is to provide for smaller file sizes and faster downloads. The FCC observed a decrease in file size of more than 30% in most cases by switching from .tar.gz format to .tar.xz format.

# INSTALLING TVSTUDY FOR THE FIRST TIME

In most cases, installing TVStudy is straightforward; both the Mac and 64-bit Linux versions come with pre-compiled executables. Compilation instructions are included in this document in case the user is attempting to install on a 32-bit Linux or would like to recompile after making modifications. (Modifications are not recommended if the intent is to produce results matching those produced by the FCC.) On the Mac platform, Mac OS 10.13 ("High Sierra") or newer is required.

Please note that the Terrain Database Test and Verification Utility may be useful if you experience problems with terrain or other underlying data files in TVStudy. You should download the utility and place its files in the dbase/ directory.

Disclaimer: The TVStudy software has been tested with MySQL Community Server versions 5.7 and 8; it may or may not work with older versions. The MySQL server typically runs on the same computer as TVStudy itself, and these instructions assume that this is the case. Please note that you must have administrator privileges on your computer to complete this process; you will be prompted to enter your password several times.

## Installing TVStudy on a Mac

### *Installing and Configuring Prerequisites*

Download a copy of MySQL Community Server from: http://www.mysql.com/downloads/mysql/

Open the MySQL DMG file and install the package. Use the default install location. Be careful to note the root password that MySQL requires you to set; you will need it to set up MySQL for TVStudy. When it is finished installing, you can check the status by opening System Preferences and selecting the "MySQL" icon. By default, the box "Automatically Start MySQL Server on Startup" is checked so the server is always running. This should not affect normal computer operations. If the box is not checked, you will have to open System Preferences and make sure the server is running before each use of TVStudy.

If you wish to test or reset the password, launch the Terminal application. At the prompt, open the MySQL monitor by entering:

```
/usr/local/mysql/bin/mysql -u root -p
```

Enter the password you noted earlier. (If this password does not work, you may need to restart MySQL in safe mode in order to reset the password. The steps for doing so are beyond the scope of this document, but look online for steps that involve running MySQL in safe mode.)

If you wish to change the password, at the MySQL command prompt, enter the following commands, exactly as shown except for replacing the quoted text string `'pass_here'` with your desired root password.

```
ALTER USER 'root'@'localhost' IDENTIFIED WITH mysql_native_password BY
'password_here';
```

Close the MySQL monitor by entering the `exit` command. You may now close the terminal window.

You may need to install Java 8 if it is not already installed. Specifically, you should install the Java 8 JRE, which can be found here: https://www.java.com/en/download/

### *Installing and Configuring TVStudy*

From the FCC TVStudy website, you will need to obtain the three files listed below.

**2013Jan_tvstudy_data_files.tar.xz** – Contains all of the necessary data files.
**2024May_tvstudy_data_updates.tar.xz** – Contains updates to the necessary data files.
**2024May_tvstudy_mac_files.tar.xz** – Contains all of the necessary code and executables.

You should extract the files into a directory called tvstudy/ in your home directory. Once extracted, you should have a directory structure which looks like the one shown at the end of this section.

Several optional data files labeled CDED and NLCD are also available at the URL above. These contain high-resolution terrain data for Canada (Canadian Digital Elevation Data) and the 2006, 2011, 2016, and 2021 U.S. National Land Cover Data. The CDED dataset is about 34 GB in size and the NLCD datasets are each about 2 GB. There is some overlap of the USGS National Elevation Dataset (DEM, included with the 2013Jan_tvstudy_data_files) in Canada, so the CDED dataset should not be needed except for certain studies in Canada outside the U.S.-Canada border areas. Note, however, that the FCC uses the CDED dataset for all 1-second terrain calculations involving Canada and the NED and CDED elevation data are not identical, so to match FCC analysis results, the CDED data may be required. The 2006 NLCD is used as a reference for clutter adjustments in studies using the method of OET Bulletin No. 73 and is not used in the method of OET Bulletin No. 69 or OET Bulletin No. 74.

### *Installing and Configuring Ghostscript*

In order to create image output maps in TVStudy, a key function of the Google Maps output format, the Ghostscript software needs to be installed. The best way to install it is to download and run the installer for the software which can be found here: http://pages.uoregon.edu/koch/

In order to use the image output functionality in TVStudy, a symbolic link needs to be created, pointing to the Ghostscript executable, and placed within the lib/ directory of your TVStudy directory. To do this, run the `which gs` command, which will give the location of the executable. For this example, the result of the command will be /usr/local/bin/gs. Then, navigate to the lib/ directory and run this command, modified to match your result:

```
ln –s /usr/local/bin/gs
```

You may now proceed to the Launching TVStudy section of this document on page 18.

## *TVStudy Directory Structure*

```
cache/                          (directory is initially empty)
cdbs/                           (this contains one or two older datasets)
data/
   pop_ca_2006.dat   pop_ca_2006_names.dat   (2006 Canadian Census data)
   pop_ca_2011.dat   pop_ca_2011_names.dat   (2011 Canadian Census data)
   pop_ca_2016.dat   pop_ca_2016_names.dat   (2016 Canadian Census data)
   pop_ca_2021.dat   pop_ca_2021_names.dat   (2021 Canadian Census data)
   pop_mx_2010.dat   pop_mx_2010_names.dat   (2010 Mexican Census data)
   pop_mx_2020.dat   pop_mx_2020_names.dat   (2020 Mexican Census data)
   pop_us_2000.dat   pop_us_2000_[names/zcta].dat  (2000 US Census data)
   pop_us_2010.dat   pop_us_2010_[names/zcta].dat  (2010 US Census data)
   pop_us_2020.dat   pop_us_2020_[names/zcta].dat  (2020 US Census data)
dbase/
   cded/       (empty)           (placeholder for Canadian terrain data)
   cem/        (223 files)       (these are Mexican terrain data)
   gtopo/      (25,537 files)    (these are 30-second terrain data)
   nadcon/     (28 files)        (these are data for converting between datums)
   ned/        (1,964 files)     (these are 1-second terrain data)
   ned13/      (empty)           (placeholder for 1/3-second terrain data)
   nlcd/       (empty)           (placeholder for 2006 clutter data)
   nlcd2011/   (empty)           (placeholder for 2011 clutter data)
   nlcd2016/   (empty)           (placeholder for 2016 clutter data)
   nlcd2021/   (empty)           (placeholder for 2021 clutter data)
   srtm/       (719 files)       (these are SRTM terrain data)
   usgs/       (1,362 files)     (these are U.S. 3-second terrain data)
dev/
   build/                        (empty)
   lib/                          (contains necessary libraries for compilation)
   Makefile
   Manifest.txt
   Manifest_dbutil.txt
   src/                          (this is the source code for compilation)
help/
   manual.pdf                    (instruction manual for TVStudy)
lib/
   cdbs_table_defs.dat                libssl.1.0.0.dylib
   check_install                      monitor_station.csv
   config.props                       mysql-jdbc.jar
   convert_ned13                      pair_study_post
   country_poly.csv                   pgsql-jdbc.jar
   dbutil.jar                         ptelev
   dbutil.props                       ptelev.conf
   fix_application                    sharing_guests.dat
   land_mobile.csv                    top_markets.csv
   land_mobile_exclude.csv            tvstudy.jar
   land_mobile_waiver.csv             tvstudy-api.jar
   libcrypto.1.0.0.dylib              tvstudy-core.jar
   libmysqlclient.21.dylib            tvstudy-gui.jar
   libmysqlharness.1.dylib            versions.jar
out/                            (directory is initially empty)
xml/
   TVIXCheck.xml                      TVIXCheckTemplate.xml
tvstudy.jar
```

## Installing TVStudy on Linux

These instructions assume the use of a Debian-based Linux distribution, such as the popular Ubuntu operating system. If you are using a different distribution, you will need to adjust these instructions accordingly. Additionally, the TVStudy executable provided is compiled for a 64-bit Linux system, and these instructions assume that you have sudo permissions.

Please note that the Terrain Database Test and Verification Utility may be useful if you experience problems with terrain or other underlying data files in TVStudy. You should download the utility and place its files in the dbase/ directory.

### *Installing and Configuring Prerequisites*

To begin, you will need to install some prerequisites (MySQL server, Java, and Ghostscript). In a terminal window, enter the command:

```
sudo apt-get install mysql-server openjdk-8-jre ghostscript libmysqlclient21
```

The system should install the prerequisite software, and should then ask you to set a root password for MySQL. Please make sure to note the root password for MySQL, as you will need it to configure and run TVStudy. If you are not prompted to create a root password, you will need to open a terminal and open the MySQL monitor by entering:

```
sudo mysql -u root
```

Enter the password for your user account. If you do not have administrative privileges on your account, you'll need to consult with your system administrator. At the MySQL command prompt, enter the following commands, exactly as shown except for replacing the quoted text string `'pass_here'` with your desired root password.

```
ALTER USER 'root'@'localhost' IDENTIFIED WITH mysql_native_password BY
'password_here';
```

Close the MySQL monitor by entering the `exit` command.

### *Installing and Configuring TVStudy*

From the FCC TVStudy website, you will need to obtain the three files listed below.

**2013Jan_tvstudy_data_files.tar.xz** – Contains all of the necessary data.
**2024May_tvstudy_data_updates.tar.xz** – Contains updates to the necessary data files.
**2024May_tvstudy_linux64_files.tar.xz** – Contains all of the necessary code and executables.

To extract the files, you can use a GUI archive tool, or run this command for each .tar.xz file:

```
tar -xJvf <name of file with .tar.xz at the end>
```

Once these files are extracted, you should have a directory structure which looks like the one shown at the end of this section.

Several optional data files labeled CDED and NLCD are also available at the URL above. These contain high-resolution terrain data for Canada (Canadian Digital Elevation Data) and the 2006, 2011, 2016, and 2021 U.S. National Land Cover Data. The CDED dataset is about 34 GB in size and the NLCD datasets are each about 2 GB. There is some overlap of the USGS National Elevation Dataset (DEM, included with the 2013Jan_tvstudy_data_files) in Canada, so the CDED dataset should not be needed except for certain studies in Canada outside the U.S.-Canada border areas. Note, however, that the FCC uses the CDED dataset for all 1-second terrain calculations involving Canada and the NED and CDED elevation data are not identical, so to match FCC analysis results, the CDED data may be required. The 2006 NLCD is used as a reference for clutter adjustments in studies using the method of OET Bulletin No. 73 and is not used in the method of OET Bulletin No. 69 or OET Bulletin No. 74.

### *Installing and Configuring Ghostscript*

In order to create image output maps in TVStudy, a key function of the Google Maps output format, a symbolic link needs to be created, pointing to the Ghostscript executable, and placed within the lib/ directory within your TVStudy directory. To do this, run the `which gs` command, which will give the location of the executable. For this example, the result of the command will be /usr/bin/gs. Then, navigate to the lib/ directory and run this command:

```
ln –s /usr/bin/gs
```

Be sure to alter the command to match your result.

If you are using a Linux installation that is not 64-bit, or otherwise determine that you need to compile TVStudy from source, please continue to page 14. Otherwise, you may advance to the Launching TVStudy section of this document on page 18.

## *TVStudy Directory Structure*

```
cache/                              (directory is initially empty)
cdbs/                               (this contains one or two older datasets)
data/

      pop_ca_2006.dat   pop_ca_2006_names.dat   (2006 Canadian Census data)
      pop_ca_2011.dat   pop_ca_2011_names.dat   (2011 Canadian Census data)
      pop_ca_2016.dat   pop_ca_2016_names.dat   (2016 Canadian Census data)
      pop_ca_2021.dat   pop_ca_2021_names.dat   (2021 Canadian Census data)
      pop_mx_2010.dat   pop_mx_2010_names.dat   (2010 Mexican Census data)
      pop_mx_2020.dat   pop_mx_2020_names.dat   (2020 Mexican Census data)
      pop_us_2000.dat   pop_us_2000_[names/zcta].dat  (2000 US Census data)
      pop_us_2010.dat   pop_us_2010_[names/zcta].dat  (2010 US Census data)
      pop_us_2020.dat   pop_us_2020_[names/zcta].dat  (2020 US Census data)
dbase/
      cded/       (empty)           (placeholder for Canadian terrain data)
      cem/        (223 files)       (these are Mexican terrain data)
      gtopo/      (25,537 files)    (these are 30-second terrain data)
      nadcon/     (28 files)        (these are data for converting between datums)
      ned/        (1,964 files)     (these are 1-second terrain data)
      ned13/      (empty)           (placeholder for 1/3-second terrain data)
      nlcd/       (empty)           (placeholder for 2006 clutter data)
      nlcd2011/   (empty)           (placeholder for 2011 clutter data)
      nlcd2016/   (empty)           (placeholder for 2016 clutter data)
      nlcd2021/   (empty)           (placeholder for 2021 clutter data)
      srtm/       (719 files)       (these are SRTM terrain data)
      usgs/       (1,362 files)     (these are U.S. 3-second terrain data)
dev/
      build/                        (empty)
      lib/                          (contains necessary libraries for compilation)
      Makefile
      Manifest.txt
      Manifest_dbutil.txt
      src/                          (this is the source code for compilation)
help/
      manual.pdf                    (instruction manual for TVStudy)
lib/
      cdbs_table_defs.dat                libssl.1.0.0.so
      check_install                      monitor_station.csv
      config.props                       mysql-jdbc.jar
      convert_ned13                      pair_study_post
      country_poly.csv                   pgsql-jdbc.jar
      dbutil.jar                         ptelev
      dbutil.props                       ptelev.conf
      fix_application                    sharing_guests.dat
      land_mobile.csv                    top_markets.csv
      land_mobile_exclude.csv            tvstudy
      land_mobile_waiver.csv             tvstudy-api.jar
      libcrypto.1.0.0.so                 tvstudy-core.jar
      libmysqlclient.21.so               tvstudy-gui.jar
      libmysqlharness.1.so               versions.dat
out/                          (directory is initially empty)
xml/
      TVIXCheck.xml                      TVIXCheckTemplate.xml
tvstudy.jar
```

# USING THE PROPAGATION MODEL API

TVStudy 2.1 and newer supports multiple propagation models. By default, TVStudy comes with three models:

1) Longley-Rice
2) FCC curves
3) Free space

While the latter two are not strictly "propagation models" in the traditional sense, the idea is that they can be used as if they are propagation models on a cell-by-cell basis.

Additionally, and more importantly, TVStudy now provides an API in C such that developers outside the FCC can implement their own propagations models in TVStudy if desired. To learn more about this API, open the dev/src/model directory and read the instructions contained in the comments weaved throughout the model.c and model.h files. The inclusion of FCC curves and free space as models were designed to provide additional examples of how propagation model code could be written with the new API beyond the single Longley-Rice model that was included previously.

To compile the modified code, follow the compilation instructions on the following page.

In order to use your alternate propagation models in TVStudy, you must recompile your code and then restart TVStudy. At start-up, the TVStudy Java UI queries the C utility to determine which propagation models are available and will then display them accordingly. If the Java UI is not restarted, it will have no way of knowing that new models are available.

# COMPILING TVSTUDY FROM SOURCE

These instructions assume the use of a Debian-based Linux distribution, such as the popular Ubuntu operating system. If you are using a different distribution or the Mac, you may need to adjust these instructions accordingly.

In your terminal, enter the following command:

```
sudo apt-get install openjdk-8-jdk gfortran libmysqlclient-dev
```

This will install the additional prerequisites necessary to compile TVStudy.

You are now ready to build TVStudy. Enter:

```
cd dev
make
```

Waiting a few seconds should result in newly-compiled tvstudy executable and JAR files. If it does not, you may need additional prerequisites or you may need to make additional modifications to dev/src/tvstudy.h or dev/Makefile in order to compile TVStudy successfully. Those instructions are beyond the scope of this document. Then enter:

```
make install
cd ..
```

These commands should place you back in the folder in which you placed the TVStudy files and allow you to continue to the "Launching TVStudy" section of this document on page 18.

**Note:** If you are using a Red Hat-based operating system, you may need to adjust your Makefile. In Red Hat, libmysqlclient.so has historically been located in /usr/lib64/mysql, as opposed to /usr/lib/x86_64-linux-gnu as it is on Debian-based operating systems like Ubuntu.

# COMMENTS REGARDING TVSTUDY ON WINDOWS

The FCC does not provide an executable version of TVStudy for the Windows platform, but there is no reason to believe that it should not be possible to compile and run TVStudy on Windows with some modification to the code. As such, this section is designed to obtain the appropriate files necessary, short of actual modification and compilation of the code. As an alternative to compiling the TVStudy source code for direct execution under Windows, the user may wish to consider installing a virtual OS environment (such as Ubuntu under Oracle's VirtualBox) and running one of the supplied executables in a virtual machine.

From the FCC TVStudy website, you will need to obtain the data files and one of the two platform-specific files listed below.

**2013Jan_tvstudy_data_files.tar.xz** – Contains all of the necessary data files required to run TVStudy successfully. All users need to download this file.
**2024May_tvstudy_data_updates.tar.xz** – Contains updates to the necessary data files.
**2024May_tvstudy_mac_files.tar.xz** – Contains all of the necessary code and executables to run TVStudy on Mac OS or to compile TVStudy for Mac OS.
**2024May_tvstudy_linux64_files.tar.xz** – Contains all of the necessary code and executables to run TVStudy on 64-bit Linux or to compile TVStudy for Linux.

Please note that you will need to install Java 8, MySQL, and GhostScript in order to use TVStudy. You are strongly advised to read either the Mac or Linux installation section in full in order to ensure you have the installation fully configured.

# USING THE TVSTUDY DATABASE UTILITY

TVStudy has the ability to manage its internal database, as well as the datasets within it, from the command line. This gives users the ability to set TVStudy to automatically download the daily dump of LMS by adding a job to crontab (on Linux) or by otherwise using the normal method of automating tasks (on Mac).

To access this utility directly, navigate to your TVStudy directory, and then run:

```
java -jar lib/dbutil.jar
```

This utility allows database installation, update, un-installation, and station data download and import to be performed from a command-line environment. Running without any further commands will provide usage details.

Database host and user can be provided by command option, and the password is entered interactively. Alternately, login information can be placed in a new properties file, lib/dbutil.props, using property keys "host", "user", "name", and "password". The "name" is optional, and is for supplying an alternate root database name for multiple installations on the same server. If "name" is not specified it defaults to "tvstudy", which is the default name used in a typical TVStudy installation. The password is stored in cleartext, so if you are concerned about password security, the file should have limited permissions, i.e. only owner read and write.

For automating the download and import process, here is an example of how to automate the download and import of LMS data every day at 5AM on Linux. Run "`crontab -e`" and then add this line to the bottom of the file, adjusted for the location of your TVStudy directory:

```
0 5 * * * cd /home/username/tvstudy && java -jar lib/dbutil.jar
download lmstv
```

Save and quit. Every day, when 5AM strikes, the LMS download and import process should occur automatically.

# USING THE TVSTUDY COMMAND LINE TOOL

TVStudy comes with a command line tool which exposes several of the useful internal functions of the software such that they can be run separately or scripted for other purposes. This tool is called ptelev (from its original function, to look up ground elevation at a point) and is found in the lib/ directory. To run correctly, it must be called from the root of the TVStudy installation.

The tool is configured using the lib/ptelev.conf file. This file contains various settings for the command line tool. Be sure these are set the way you want them to get the answers you expect.

The command operates in the following manner:

```
lib/ptelev <switch> <mode number> <inputs>
```

To see all of the details, run `lib/ptelev help` and you will get a full set of switches, numbers, and required inputs. The number sets which function the software performs, and these are as follows.

Mode 1 – Ground elevation at a point.
Mode 2 – Convert NAD83 coordinates to NAD27.
Mode 3 – Convert NAD27 coordinates to NAD83.
Mode 4 – Calculate HAAT from RCAMSL.
Mode 5 – Calculate HAAT from RCAGL.
Mode 6 – Determine the distance provided by the FCC Curves for given parameters.
Mode 7 – Determine the ERP required to reach a distance with FCC Curves.
Mode 8 – Calculate RCAGL from RCAMSL.
Mode 9 – Calculate RCAMSL from RCAGL.
Mode 10 – Calculate RCAGL from HAAT.
Mode 11 – Calculate RCAMSL from HAAT.
Mode 12 – Distance and bearing from point to point.
Mode 13 – Coordinates from point to a distance and bearing.
Mode 14 – UHF dipole factor adjustment.
Mode 15 – Land clutter at a point.
Mode 16 – Terrain profile from point to point.
Mode 17 – Terrain profile from a point to a distance and bearing.
Mode 18 – Field strength from point to point.
Mode 19 – Field strength from a point to a distance and bearing.
Mode 20 – Distance from a point to the US border with Canada or Mexico.

Additionally, TVStudy provides a stand-alone nadcon utility, which can be built by running `make nadcon` in the dev/ directory. This utility will run with nothing more than dbase/nadcon available, making it possible to perform NADCON conversions one by one or with a script while using relatively little disk space.

# LAUNCHING TVSTUDY

Use a terminal window to launch:

```
java -jar tvstudy.jar
```

Also note that on the Mac, prior to launching TVStudy, you will need to install the Java 8 JRE if you have not already done so. This can be downloaded from the Oracle Java website. You may also need to deal with some Apple security measures. For example, it may be necessary to right-click on the tvstudy.jar file and click Open in order to launch it the first time. If that does not resolve any issues, you may need to open the lib/ directory, right-click on some of the files like the tvstudy file, the files ending in .dylib, and the ones that end in .jar and click "Open," then close the resulting windows. This will be the case if it refuses to run citing security issues, or if when opening TVStudy, it tells you that the engine is not installed properly. The FCC cannot provide an exhaustive set of potential fixes that may be necessary to work around these Apple security issues, but did not .

Upon first login, TVStudy will open the "Manage Database" window and prompt you to update your database to the latest version if you are upgrading, or install the root database for a new installation. Click "Update" or "Install," as appropriate, and it will do so automatically, taking up to 20 minutes, though it could be more depending on the speed of your computer.

For instructions on using TVStudy, please refer to the TVStudy manual.

# CHANGE LOG

## Differences Between 2.2.5 and Older Versions

The change logs for older versions of TVStudy have been removed from this document. The Installation and Upgrade Guide for 1.3.2 (Patched) is still available at the link below and contains the changelog for all versions of TVStudy before 1.3.2 (Patched).

http://data.fcc.gov/download/incentive-auctions/OET-69/2015Oct_TVStudyInstallationGuide.pdf

Similarly, the Installation and Upgrade Guide for 2.2.5 is still available at the link below and contains the changelog for previous versions of TVStudy from 1.3.2 (Patched) through 2.2.5.

https://transition.fcc.gov/bureaus/oet/info/software/tvstudy/2018Mar_TVStudyInstallationGuide.pdf

# Differences Between 2.3.0 and 2.2.5

TVStudy 2.3 is the result of several years of work. During this process, many changes were made to implement many different features and functions. As such, this changelog lists all major changes/updates but does not name every individual issue which has been addressed since the 2.2.5 release.

## Installation Note

On the Mac, TVStudy should no longer be installed in /Applications; rather, it should be in the user home folder. The new MacOS security is far more restrictive about software installed in root folders like /Applications. If the entire TVStudy installation folder is moved into the user home folder, such issues should be resolved.

## Changes

2020 US Census data has been added to TVStudy. It is now the default population data. When using the Interference Check template, 2010 data will remain the default until August 1, 2024, when the Video Division of the Media Bureau will begin using 2020 Census data in its analyses. (See the Media Bureau Public Notice scheduled to be released simultaneously with this update to TVStudy.)

2020 Mexican Census and 2021 Canadian Census data has been added to TVStudy, and is now the default population data for those countries.

A number of changes to DTS support have been made. Added support for Class A and LPTV DTS, both in TVStudy itself and in LMS records. New output file option to save DTS self-interference analysis results to a CSV file. TVStudy Interference Check mode now reports individual DTS site border distances and checks individual DTS site distances for AM transmitters. Several issues relating to DTS facilities have been resolved, including cases that could cause TVStudy to crash. Made changes to improve the selection of the “authorized facility.” Changed descriptions of DTS bounding contour facility from “reference facility” to “authorized facility” consistent with Part 73 rule update order. Fixed a bug in CSV export, was not exporting DTS boundary sectors definition.

When running General-purpose TV and FM studies, the Run dialog now has an option to save the run result in database tables that can subsequently be used to perform further analysis with SQL queries. A menu item "Analyze Run Result..." appears in the "Study" menu of the "Study Manager" window and is enabled when a selected study has result tables.

KML map file output has been redesigned. Map features are written to a set of KML files linked together by a top-level file "map.kml", presenting a hierarchical layer structure in a map viewer. When a map has any coverage image layer, a color legend overlay is also shown. Information in image layers and layers that may have a large number of symbols is structured into tiled regions that will only appear at higher zoom levels, so the map information does not overload the viewer on large complex maps. The complete set of related KML and image files may optionally be packaged into a KMZ file placing the entire map in a single file.

The Image Color Map editor has been redesigned with new features added.

FM records are now available in new LMS station data downloads imported into TVStudy. Existing LMS data sets will still only provide TV records. An older LMS download may be able to provide FM records if it is re-imported to TVStudy, but only if it was originally downloaded after FM support was added to LMS. CDBS downloads no longer contain current FM station information, however CDBS FM can still be manually downloaded imported to TVStudy if needed.

Station data set management has been overhauled and the "Station Data Manager" window has been reorganized. The "Wireless" data set type now has expanded import options, adding XML format to the existing user-created CSV format, and can also now be expanded by multiple imports to the same set. The old "Generic W/L" type has been eliminated; existing sets of that type will be automatically converted to "Wireless". The "Generic TV" and "Generic FM" types are renamed "TVStudy TV" and "TVStudy FM" and have expanded import options. In addition to importing XML, both types can now import from user-created CSV files and from Canadian DBF files. The "CDBS TV" and "CDBS FM" types are now legacy formats since CDBS is no longer a current database for TV or FM station data, consequently there are no longer download options for those types. Additionally, a new menu item "Unlock" appears in the "Data" menu of the "Station Data Manager" window. This may be needed if an error or a program crash occurred during import to a "Wireless", "TVStudy TV", or "TVStudy FM" data set. During import the data set is locked to prevent concurrent imports when a database server is shared by multiple users. "Unlock" can be used if the "Import" button remains disabled when selecting a set that should allow imports.

Windows or dialogs listing multiple station records now have a menu item "Compare" to open a separate window in which parameters from several station records can be compared side-by-side.

Record search dialogs now have an option to include TV channel-sharing guest records from an LMS station data set. Guest records are usually ignored because the host station's real facility record should always be preferred; guest records will normally have facility parameters identical to the host. If guest records are added to a study they will not be flagged as either desireds or undesireds so by default they will have no effect on the study results. Care must be exercised if guest records will be used as undesireds in a study; despite the identical facility parameters, guest records are not considered MX to host station records or to records for other guest stations for the same host.

Comments for station records (appearing as a tool-tip on the call sign in record list views) from an LMS data set that are involved in TV channel-sharing now indicate the host or guest status of the record and list the call sign(s) of other station(s) involved in the sharing agreement.

In a study scenario editor window, the "Station" menu now has a "Copy to Scenario..." item available to copy selected record(s) to another scenario in the same study, optionally with or without applying MX rules against records already in the destination scenario.

A running study process can now be canceled by user request. The "Activity Queue" window now shows buttons labeled "Cancel" instead of "Abort", and these buttons can safely be used at any time during a study run with no risk of database or cache file corruption.
TVStudy can now run on MySQL 8 database servers. MySQL 5 server is also still supported.

Option for a channel change on a station record selected in a search dialog in some contexts e.g. an interference-check study build. This will change the channel on the selected record without

triggering contour replication so the ERP will not change, and the record added to the study will be editable.

Single-record search dialogs now have an option for a center-and-radius distance search. These search dialogs have been re-organized to show only more commonly-used search options in the main dialog. Less-used options, including the center-and-radius option, are now found in a sub-dialog accessed by a "More" button in the main dialog.

When deleting a study, an option appears in the confirmation dialog to also to delete study output files. This just attempts to delete the output file directory using the current study name; if the study name has been changed since a previous run, or if the output file directory has been renamed, the output files will not be deleted.

When exporting a point set geography to an XML file, a new option is available to include receive antenna data in the export for points that do not use the generic antenna. When a point set with antenna data is imported, new receive antennas may be added to the database as needed; however if an existing antenna is an exact match to the XML data, including the name as well as the entire pattern tabulation, that existing antenna will be assigned to imported points. When importing a point set without antenna data, as before existing antennas will be assigned based just on a name match, if no match the point will revert to the generic antenna.

Matrix antenna patterns can now be exported in LMS XML format. However, it is still possible for a TVStudy matrix pattern to be in a format that is not compatible with LMS. The LMS format assumes all elevation pattern slices in the matrix will have exactly the same set of depression angles tabulated; TVStudy allows the tabulations to vary between azimuths. TVStudy will check for this condition and warn if the pattern appears incompatible with LMS, however the data can still be exported regardless.

Analog TV records will now be protected from wireless station records in a wireless study build; previously only digital TV records would be considered when identifying undesired wireless records. However, the spectral overlap and D/U parameters for analog are the same as for digital which may or may not be appropriate, so this behavior is considered experimental.

There is a new mode for service contour projection using Longley-Rice using a best-fit straight line to the projected fields at incremental distances along a radial.

New option for the study point location parameter, "Highest elevation". This will use the propagation terrain database to find the coordinates of the single terrain database point with the highest elevation within each study cell.

Some output files are now sorted into folders by type in order to make them more organized.

New output file option to exclude not-calculated desired stations from the report for a points-mode study run.

The output settings dialog has been reorganized into multiple tabs making it easier to use.

Pending and archived status flags are now saved on records added to a study so the "*P" and "*A" suffixes will appear in study scenario windows as well as in search results windows.

Buttons are available to copy and paste the latitude and longitude in various dialogs and editor windows. The clipboard text format is the latitude and longitude in decimal degrees separated by a comma.

When the geography editor is opened from a study or record editor window and a new geography is saved, that geography is now automatically selected in the appropriate menu in the original editor window.

The "ptelev" command-line tool now has a mode to report distance from a given point to the Canadian or Mexican border.

Numerous changes and additions to report output during an interference-check study run. For the land-mobile station search, a message is always shown even if the check passes, and the relevant rules section is cited for failures, including on channel 21. For an LPTV proposal, check and report short distances to top-market cities per the rural LPTV filing window order. Updated the land-mobile waiver list. Report if a Class A in Mexican border zone does not specify a full-service mask. In the nearby AM station search results, show the actual distance to the AM station. AM station search is now done with LMS records rather than CDBS records. Added a test to cases where significant masked interference is caused by the proposal, which can be an indication of a MX case in which three (or more) records cause mutual interference so a study of one does not report a MX failure to another because a third masks the interference caused. The threshold percentage for the masked interference warning is set by study parameter, default is 10%.

2016 and 2021 NLCD data has been made available as optional downloads.

CSV/text files containing TV, wireless, and FM records in the new format can now be imported and exported in the scenario editor and the record-find UI.

When importing records from CSV/text, a new option "Separate pattern file" is shown in the file-open UI. Select that to import patterns from a separate file before processing the main record file; in-line pattern blocks in the record file are always allowed regardless of that option.

The XML record format has been removed as an import/export option in most contexts, including the scenario editor, record find, and import to TVStudy station data sets, in favor of a CSV format.

The pattern editing and import/export UIs have been extensively revised.

Error reporting during any type of XML import has been improved. The error messages will now indicate a line number in the XML file near where the error occurred; that will be the line number of the element tag at which the error was detected.

In the TVStudy preferences the default output directory location can now be changed, and the output directory for an individual study can be changed in the study editor. This changes the top level output directory; as before, individual study sub-directories are created within that top directory when a study runs. The output directory location is saved with each study; changing the

default in preferences changes the location for future new studies but does not change existing studies.

The cache directory location can now be changed in preferences. There is only one cache directory at any given time, but since the cache files are only for performance benefit they don't have to be copied to a new location and can be manually deleted from the old location after the change. A reminder message will appear about that when setting the preference.

Point set and area geography names are now shown in the study report and CSV output file headers.

Added "Save As User Record" menu option in the scenario editor. The selected record to be saved must be editable. The save dialog includes an option to replace that record in the scenario with the new user record.

Re-arranged controls in the geography editor for better clarity.

In the study manager, added folder navigation menu items and keyboard shortcuts; command-right arrow to descend, command-left arrow to go back.

Interference-check study build would produce incorrect results if a manually-selected "before" record was not actually MX to the proposal record; this is now checked and the build aborted if the "before" and proposal are not MX.

Incorrect logic for identifying sharing guests caused guest records for an LPTV channel-sharing agreement to appear as redundant host records.

Map coverage image rendering would fail when the study area included east longitudes. Map coverage image rendering would fail when the study or scenario name contained a '%' character due to a path-filtering issue in the GhostScript process.

Study run would always fail with the "All Census points" study point location option selected.

In the study engine, the azimuth pattern rotation value was not being applied to lookup in a matrix pattern.

New configuration and preference option to set the initial state of the "Protect records not on baseline channel" option in an interference-check study, option is now selected by default.

Changed LMS baseline record query to support baseline records with facility IDs that do not appear in the facility table.

Added support for a non-standard port number specified in the MySQL server host string.

Improved error reporting for SQL errors during import of LMS datasets.

Fixed issue with unsupported combinations of study run options. In "All population" study point mode, composite coverage and image output do not work correctly; the study run does not fail but output is incorrect or misleading. Prevented use of those combinations at run time, options can still

be selected but a warning will appear in the run log that composite functions are not supported in "All population" mode.

Multiple issues in the MX record logic used for scenario-building and automated study builds could cause records that should be considered MX to not be, and vice-versa. This included DRT records being considered MX to the full-service parent, and a new DTS application record not being considered MX to the existing non-DTS license record.

Fixed several UI, performance, dataset and template import, and potential crash-causing issues.

The wireless study setup wizard now provides the ability to select multiple TV records to build multiple studies using the same settings for wireless data, frequency, etc.

New option to allow manual entry of the frequency for a TV record, de-coupling that from the channel number. The frequency is used for terrain-sensitive propagation calculations, but the channel continues to be used for FCC curve lookups and interference-rule selection.

The default study template now has 2020/2021 population as default. A new interference-check template XML file is included with the same settings, however that template has a delayed activation date of August 1. Census year selections are now shown in the heading of all study report files.

"Check for Updates" feature has been removed.

# TROUBLESHOOTING

## Problems Running TVStudy

For help resolving issues with TVStudy, the FCC has prepared an FAQ page which contains a number of common issues and error messages along with information on how to resolve them. Please see the TVStudy FAQ page: https://www.fcc.gov/oet/tvstudy-faq

## Contact Information

If you encounter any problems not resolved by the FAQ page and wish to speak with someone at the FCC about TVStudy, please e-mail Mark J. Colombo at the following address: mark.colombo@fcc.gov

# LICENSING INFORMATION

## TVStudy

# MySQL Libraries

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