TVSTUDY

INSTRUCTION MANUAL

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USING TVSTUDY

Launching TVStudy

To launch TVStudy, navigate your terminal to the directory where TVStudy was installed and then type and run:

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

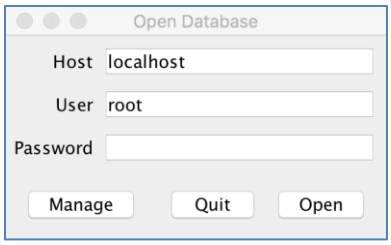
If you are running on the Mac platform, you could instead launch tvstudy.jar from Finder.

If you are running on the Linux platform and receive an error message that looks like this:

```
Exception in thread "main" java.lang.UnsupportedClassVersionError:
gov/fcc/tvstudy/AppManager : Unsupported major.minor version 51.0
```

You may have two versions of Java installed and TVStudy is attempting to launch using the older one. To resolve this issue, remove the older version of Java from your system using the normal method of removing such software. TVStudy 2.x requires Java 8.

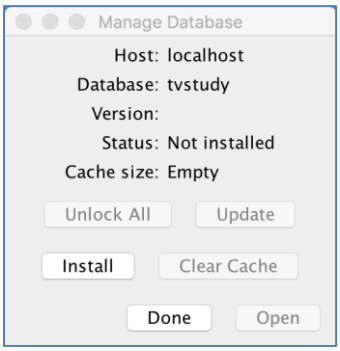
Upon opening TVStudy, you will see the Open Database window.

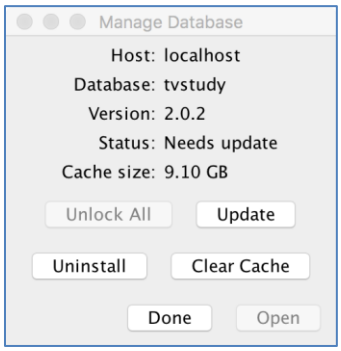


If you're running your MySQL database server on your machine, you may need to enter "localhost" or "127.0.0.1" as your host name. You will need the user name and password to access your database. When finished, click "Open."

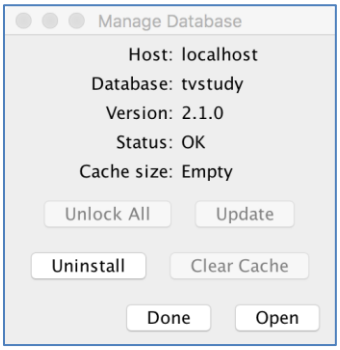
Managing the TVStudy Database

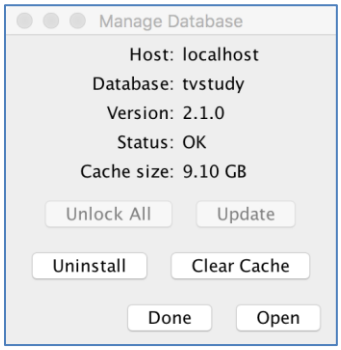
If this is your first time running a new or updated version of TVStudy, the software will open the "Manage Database" window. If not, you can open the Manage Database window by clicking "Manage" after putting your password into the "Open Database" window.





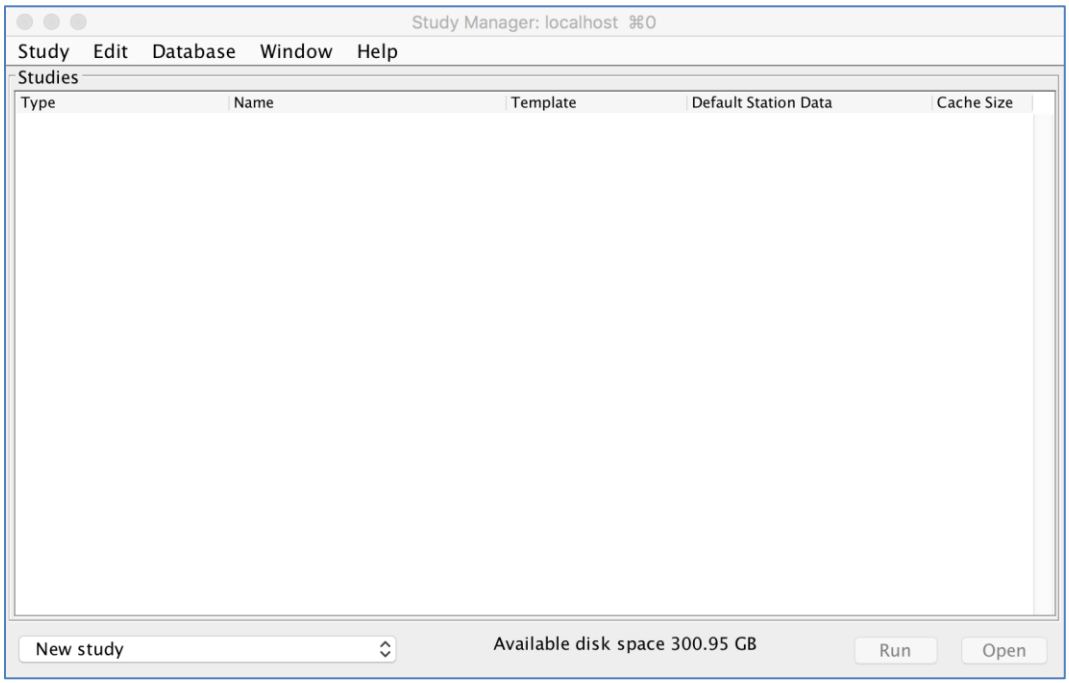
This window allows you to update your database to the latest version if you are upgrading, or install the root database for a new installation. Click "Install" or "Update," as appropriate, and it will do so automatically, taking up to or more than about 20 minutes, depending on the speed of your computer.





This window also allows you to resolve some common database issues, such as locked databases preventing you from gaining access to the Study Manager window, corrupt database, or cache problems by clicking the appropriate buttons.

Study Manager Window



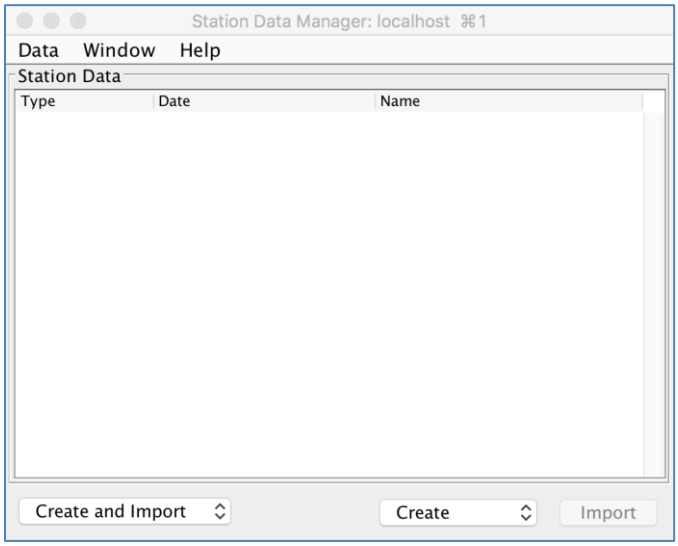
The first time opening the software you will see an empty Study Manager window, as shown above. This window will allow you to see your studies and configure TVStudy for use. In TVStudy, datasets and templates are managed from the Database drop-down menu, rather than through the Create New Study window as was the case in older versions of TVStudy.

The study names in this window are color coded according to their status. A full list of the possible colors in the Study Manager window is provided below.

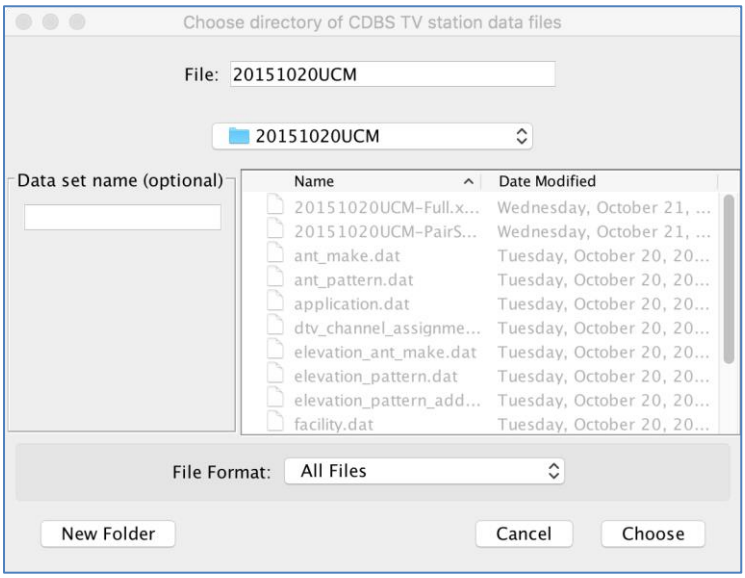
Blue indicates a study that has a description, which can be viewed by hovering over the blue text.
Green indicates a study that is open for editing.
Red indicates a study that is locked and presently being run.
Gray indicates a study that is locked for some reason other than running.

Managing Datasets

TVStudy has the capability of performing various types of analyses pertaining to broadcasting. In order to use TVStudy to run analyses, you should import at least one CDBS or LMS dataset. If you are looking to conduct an OET Bulletin No. 74 analysis, a dataset of wireless sites and antenna patterns is also required (see Appendix B). To import a dataset, begin by opening the Database menu and choosing Station Data Manager.



At the bottom left corner, click the "Create and Import" drop-down and choose the type of dataset you would like to import. (Note that to use the same CDBS dataset for both TV and FM, it must be imported twice, once for each option in this menu.) Navigate to the location containing your CDBS[1], LMS[2], or wireless data files for import.



[1] To download today's CDBS dataset, see: https://www.fcc.gov/media/radio/cdbs-database-public-files
[2] To download today's LMS dataset, see: https://enterpriseefiling.fcc.gov/dataentry/public/tv/lmsDatabase.html

In the image above, a copy of the November 2015 CDBS Extract dataset associated with the incentive auction has been selected, as an example. In the pane at the side of the window, you can give the dataset an optional name, otherwise a default name comprised of the data type and data date will be created. If you are creating a number of studies using different datasets, naming each dataset may prove useful in keeping them organized. Either click "Choose" to use the default name, or after entering a name, click "Choose." Clicking "Cancel" will prevent the dataset from being imported. If you are importing a wireless dataset, a second window will appear asking you to choose the associated wireless antenna pattern dataset.

For an import of CDBS or LMS data to be successful, TVStudy needs, at a minimum, the files listed in Appendix B. A complete dataset file set should always import successfully so long as the set is not corrupt.

After a brief wait while the dataset files are imported, you should now see your dataset in the list.

To rename or delete a dataset, simply click the Data menu and choose Rename or Delete, respectively.

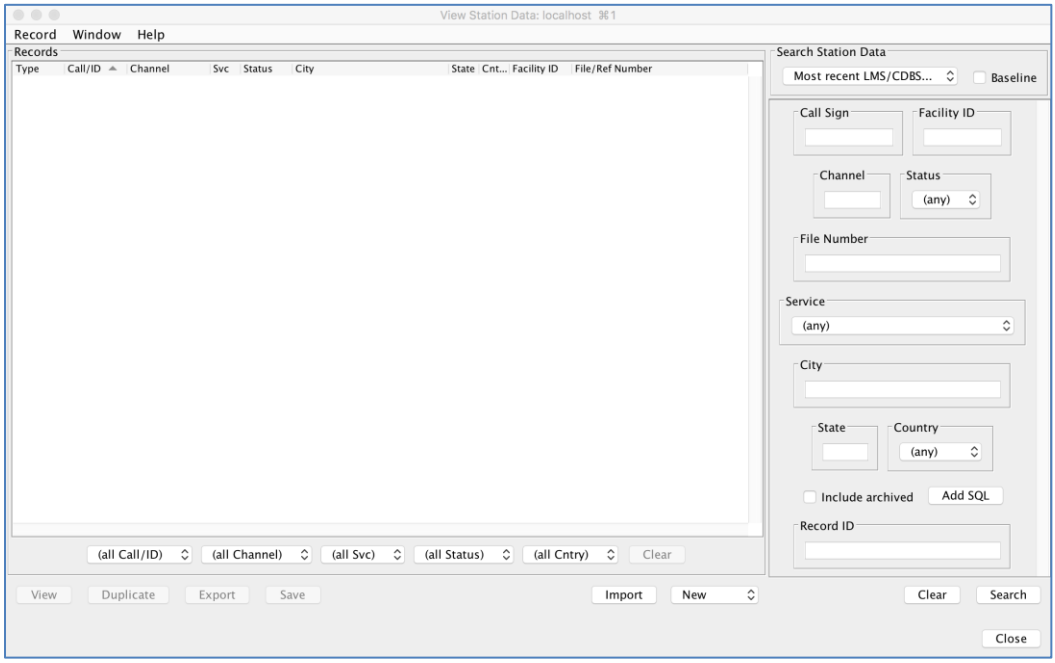
Please note that if you receive an error message when importing an older CDBS dataset, it may be the result of an incompatibility between TVStudy and the CDBS data. On December 2, 2014, the application.dat file was modified, and TVStudy 1.3.2 was the first version which properly handled the new format. However, TVStudy no longer handles the previous format by default. In the /lib directory, a command line utility called fix_application is provided to adjust the format of an older application.dat to be compatible with the current version. Additionally, but not recommended, you could modify the layout TVStudy is expecting of CDBS datasets by modifying the lib/cdbs_table_defs.dat file and restarting TVStudy.

The Create menu allows the creation of custom datasets within TVStudy. This can be accomplished by importing files containing stations specified in XML. A future version of TVStudy is intended to support imports from spreadsheets, among other options, in this menu, and no support is provided for the feature in its current state.

View and Manage Dataset Records

TVStudy has the ability to view the data contained in a dataset without first creating a study. You can also use this mode to create user records for later use, or import or export individual station records.

To access this feature, go to the Database menu and choose "View Station Data."



User Records

In the dataset drop-down list there are three additional datasets available other than those previously imported; "TV user records", "FM user records" and "Wireless user records". User records are records imported or entered by the TVStudy user. User records exist to allow users to check the results of alternate station parameters on interference studies. ***Once saved, user records cannot be deleted***.

Viewing Records

To view a record, choose which dataset you would like to use from the "Search Station Data" section. Choose your search parameters, if any, and then click "Search". Matching results will appear in the pane at the left. When you select one and click "View" you will see the data associated with the record. Any set of results can be filtered using the filter options below the Records pane.

Note the button to "Add SQL". This allows you to enter custom search parameters based on any field in CDBS or LMS. For example, when using a CDBS dataset, you could enter the following query and your search would only return results that are within Zone I, excluding any that fail to meet other criteria selected in the other part of the window:

```
tv_eng_data.fac_zone = 1
```

For a full set of query examples, please see Appendix H on page 114.

Importing and Exporting Records

From this window it is possible to import XML records into the User records database or export XML records from any dataset.

To import a record, simply click the "Import" button and locate the XML file containing the record you wish to import. Select the record, click "Import", and your record will be imported. Once you are satisfied, click "Save" and the record will be added to the User records database. Regardless of the type of station(s) you are importing from XML, TVStudy will ask you to select an existing CDBS/LMS dataset to resolve any references that may be contained in the imported XML file.

To export a record, select the record you wish to export by searching in this window, then click "Export". Navigate to the directory in which you would like to save your exported record, enter a name for your export file, and then click "Export".

Creating Records

You can also manually create records to add to the TV, FM, or wireless User records databases from this window, either by entering the parameters by hand or by duplicating an existing record and modifying it prior to saving.

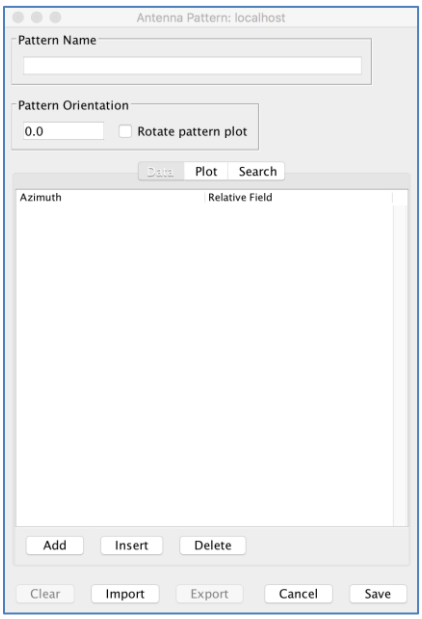
Creating a new record and duplicating an existing record are nearly identical processes. The difference, as you might expect, is that when duplicating an existing record, the new record's values are pre-populated with the data from the record being duplicated. This is useful for creating new records at existing locations, whether these are intended to represent new stations to be located on an existing tower or modifications to existing stations.

If you wish to duplicate a record, use the search function to search for the record you wish to duplicate. When you've found it, click it, and then click "Duplicate". Otherwise, click the "New" drop-down and choose the type of record you wish to create. For this example, we will look at a new TV user record.

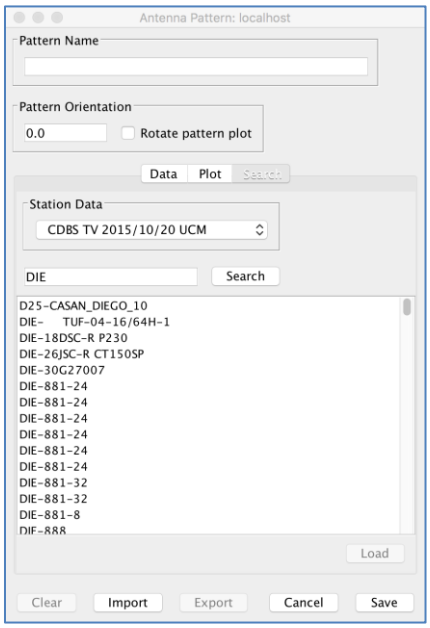
When you are satisfied with the station parameters you have entered, click "Save". When you're back in the "Browse Station Data" window, click "Save" again to save the record to the User records database. (More information on the settings in the "Service Area" section can be found on page 19.)

Note that if you wish to create a DTS, you can pre-populate the reference point and the reference facility by duplicating an existing TV digital record and then setting the service to "TV digital DTS".

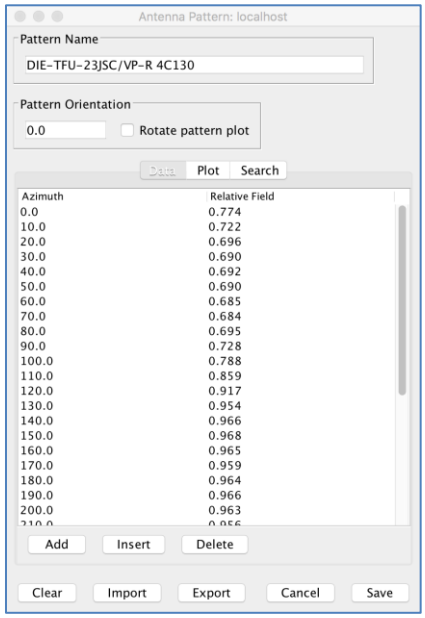
Antenna Pattern Editor – Azimuth Patterns



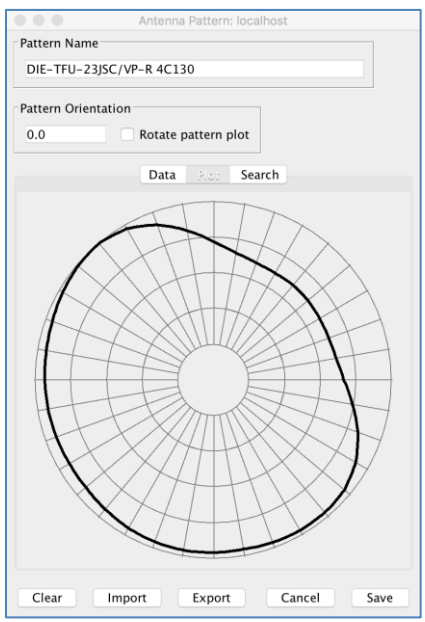
When editing or creating a record, by clicking "Edit" for the azimuth pattern, you can either retrieve an existing pattern from a CDBS/LMS dataset, a wireless dataset, or manually specify your own pattern. You can also use this window to view, create, or modify patterns in CDBS/LMS/wireless records. Please note that transmit antenna patterns in TVStudy are defined with linear relative field values, not in dB, with 1.0 indicating the direction of maximum radiation.



Click on the "Search" tab to search for an existing antenna pattern to use. For TV or FM antennas, you can search by make, model, or antenna ID number. For wireless antennas, you can search by antenna ID or antenna name. Note that manufacturer names and model numbering conventions may not be strictly followed in CDBS/LMS records. When you locate the desired pattern, click "Load."

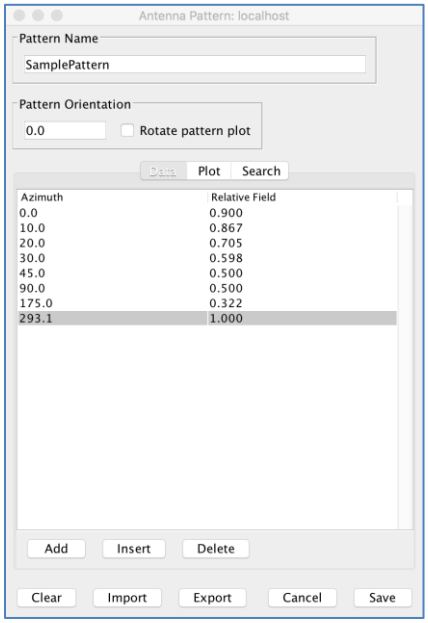


Here you can see that the field values now appear in the Pattern Data area. You can click and edit the values if you wish. To see the antenna pattern graphically as a polar plot, click on the "Plot" tab.

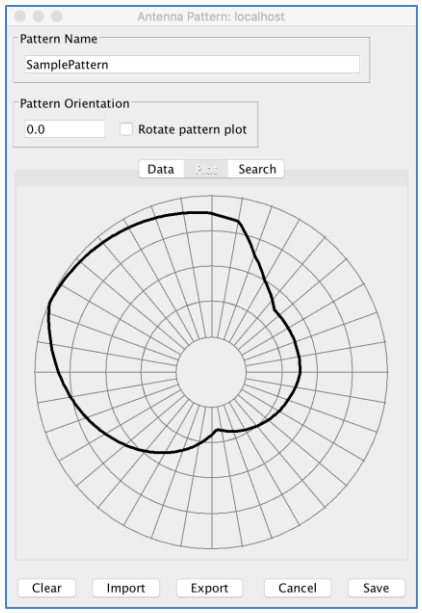


You can Import and Export antenna patterns using the "Import" and "Export" buttons. A CSV file is produced on Export and is required on Import. TVStudy will interpolate between the azimuth angles provided, so you can provide as many or as few azimuth values as you wish. It is advised that your pattern include all maxima and minima.

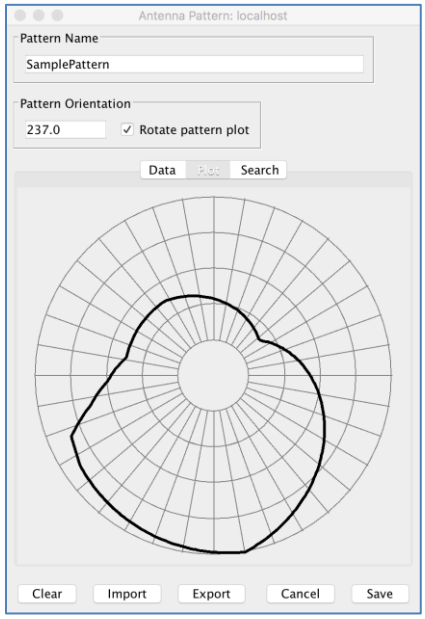
If you want to specify an omni-directional pattern, click on "Clear" and all field values will be deleted, thus producing an omni.



Custom antenna patterns can also be created by using the "Add" button to add azimuths and field values. TVStudy will interpolate between the angles provided, so you can provide data for as many or as few azimuth values as you wish. It is advised that your pattern include all maxima and minima.



The antenna pattern can be displayed graphically by clicking the "Plot" tab, just as with antenna patterns contained in CDBS/LMS/wireless datasets.



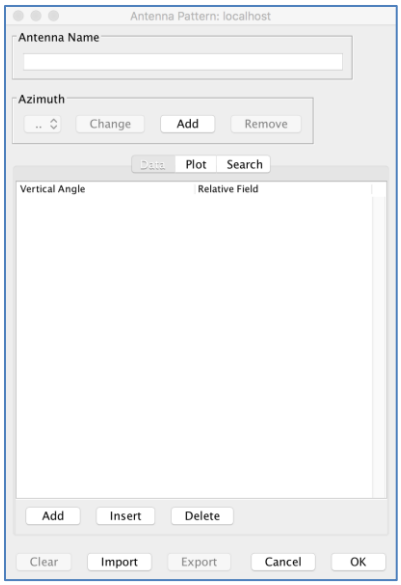
Additionally, by checking the "Rotate pattern plot" checkbox and setting a value, you can rotate your antenna pattern. The rotated pattern value represents the pattern rotation with respect to true north, N degrees ET.

When finished, click "Save." The antenna name and any rotation will now appear in the Azimuth Pattern section of the Station Data window.

Antenna Pattern Editor – Elevation and Matrix Patterns

An elevation pattern is used in conjunction with an azimuth pattern to produce a 3-dimensional representation of the antenna. A matrix pattern, by contrast, is used when the antenna is not symmetrical; it allows for an antenna with a different azimuth pattern at varying vertical angles. When filing with the FCC, it is recommended that you file an azimuth and elevation pattern with or without mechanical beam tilt, unless it is entirely impossible to accurately characterize the antenna that way.

If you wish to view, create, or edit an elevation or matrix pattern, click Edit in the Elevation Pattern section.



This feature functions like the antenna pattern editor for azimuth patterns, but provides a selection option to allow the viewing, creation, or editing of a matrix pattern, if desired. To create or edit a matrix pattern, rather than an elevation pattern, simply click the Add button and create elevation patterns for each azimuth of the matrix pattern. Please note that while this may not seem to be the most intuitive way to manage matrix patterns, it is the manner in which they are stored and managed in CDBS and LMS.

The vertical angle values found in elevation patterns and beam tilts are defined in TVStudy as a positive number being a downward tilt. As such, 90 degrees represents an angle pointing straight down, while -90 degrees represents an angle pointing straight up.

Also note that if you edit an elevation pattern and do not provide a field value at 90 degrees below the horizon (straight down), TVStudy will hold the last value. So if the last value provided is a 0.2 field value at 20 degrees, TVStudy will assume that the 0.2 field value is a uniform value used all the way to 90 degrees. To have it diminish to 0.001 by linear interpolation, the minimum value allowed by TVStudy, set a 0.001 field value at 90 degrees.

Service Area Settings

TVStudy allows for the evaluation of stations based on alternate areas besides the standard FCC contour. Some of these options can be selected study-wide in the Contours section of the Parameters tab, but those settings can be overridden by adjusting the setting for an individual station record.

The options are as follows:

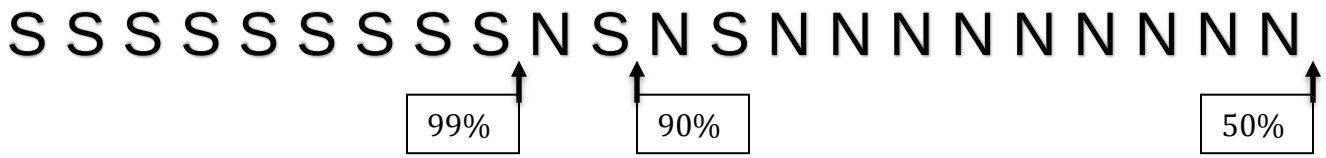
- **Default contour –** Uses the default settings provided for in the study.
- **FCC curves contour –** Uses the FCC F(50,90) curves contour at the level in Cont. Level.
- **FCC contour plus distance –** Uses the FCC F(50,90) curves contour at the level in Cont. Level, then adds the distance in km provided in Mode Arg.
- **FCC contour plus percent –** Uses the FCC F(50,90) curves contour at the level in Cont. Level, then adds the percentage distance provided in Mode Arg.
- **L-R contour percent above –** See below.
- **L-R contour length above –** See below.
- **L-R contour length below –** See below.
- **Constant distance –** Uses a circle of radius in km given in Mode Arg.
- **Geography fixed –** Uses a fixed-location geography; select from the Geography drop-down.
- **Geography relocated –** Uses a geography whose center point is relocated to that of the station coordinates; select from the Geography drop-down. (See page 25 for more on geographies.)
- **Unrestricted –** Uses a circle of fixed radius defined in the "Maximum desired signal distance" study parameter.

Each of the Longley-Rice contour methods uses a selection of parameter settings found in the L-R Contours tab in combination with the settings found in the Contours tab.

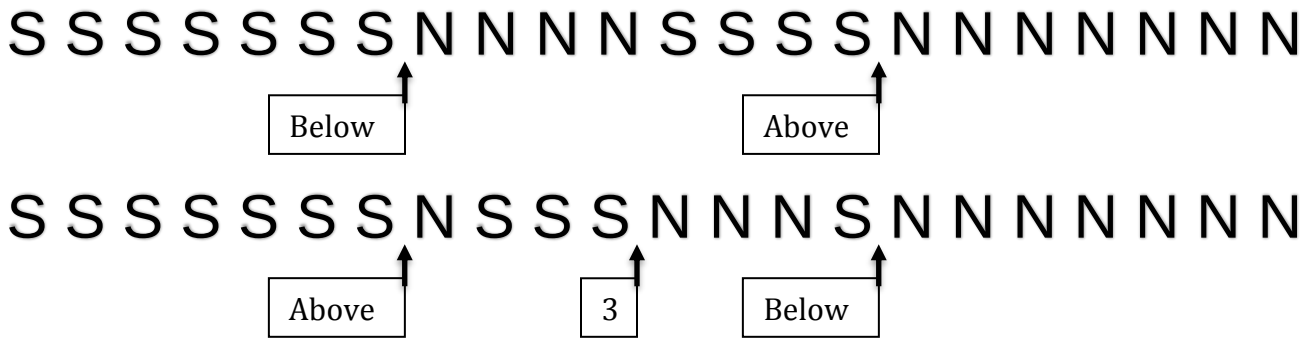
Details of how each of the Longley-Rice contour methods functions can be found on the next page.

To understand the Longley-Rice contour options, see below. In each case, a selection of points is used to calculate path-loss along each radial surrounding the transmitter. Note that in the example graphics, S represent a Service point, while N represents a No service point.

Longley-Rice Contour Percent Above draws the contour line at a distance where the percentage of service points is met. In the example seen below, the transmitter is assumed to be at the left edge.



Longley-Rice Contour Length Above/Below each draw the contour line based on consecutive service or no service points. For the Above case, it moves from the transmitter toward the edge, and is the last time the Mode Arg. number of consecutive points are above service. For the Below case, it moves from the edge toward the transmitter, and is the last time the Mode Arg. Number of consecutive points are below service. See the two examples below, where Mode Arg. is assumed to be set to 4 and the transmitter is assumed to be at the left edge.

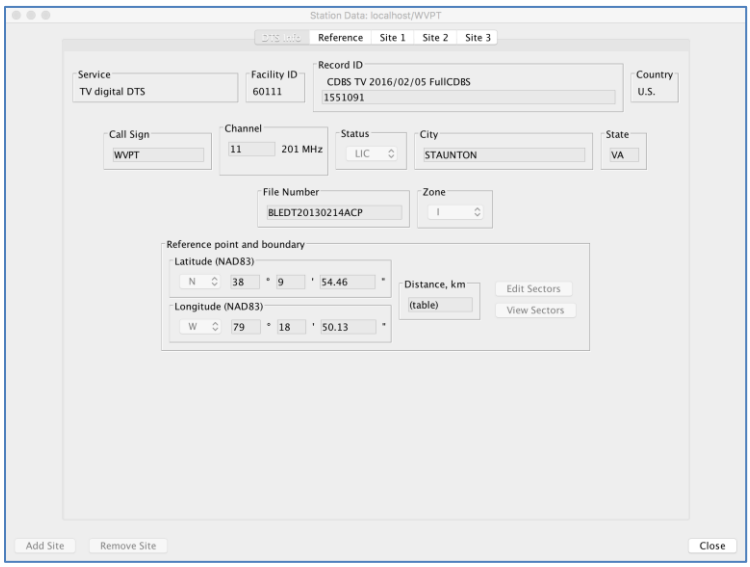


In the first example, if Mode Arg. had been set to 5 instead of 4, the locations of the Above and Below contours would be flipped.

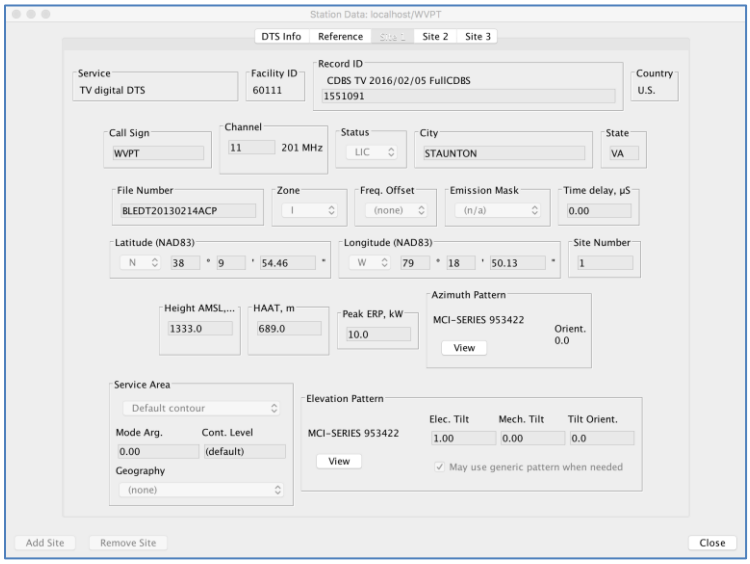
In the second example, had Mode Arg. been set to 3 instead of 4, both the Above and Below cases would have drawn the contour at the point labeled “3”, while a setting of 1 would have flipped the locations of the Above and Below contours in that example. This shows how the setting can impact where the contour is drawn even for the same terrain path.

Viewing DTS Facilities

Distributed Transmission System (DTS) facilities have multiple transmitter sites for a single facility ID and record. The method for viewing these is slightly different from the method for conventional stations. To begin, select a DTS station and click "View."



Instead of going straight to the transmitter information screen, you are given information about the facility, the reference point coordinates and reference distance. Across the top are tabs showing the various station data records associated with the record. Click one.



Now you see the normal screen for viewing or editing a record in TVStudy. You may view the record in the same way that you would for any non-DTS facility. When you create or duplicate a DTS, you will use a similar interface; make note of the "Add Site" and "Remove Site" buttons at the bottom left.

Managing Study Templates

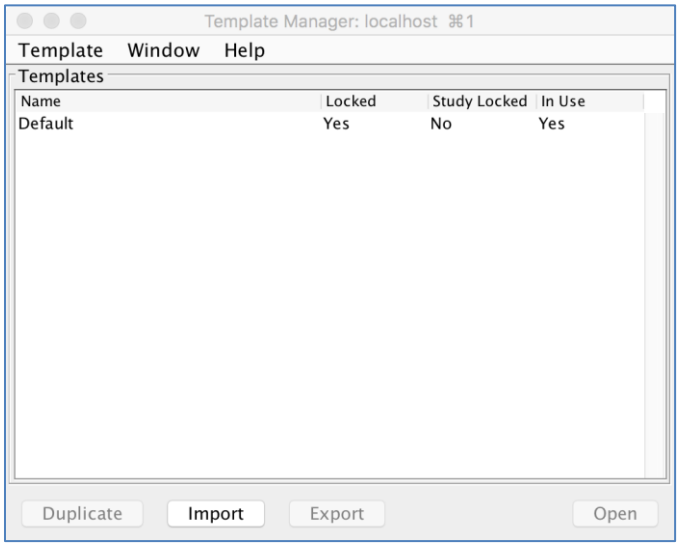
TVStudy comes with a default template with typical study parameter settings; however, if you have a set of parameters that you would like to use regularly, you may want to consider creating a customized template for your study. Once you've created or imported a custom template, you will have the option of selecting it when you create a study, so you do not have to manually adjust the various study parameters.

Creating a Study Template

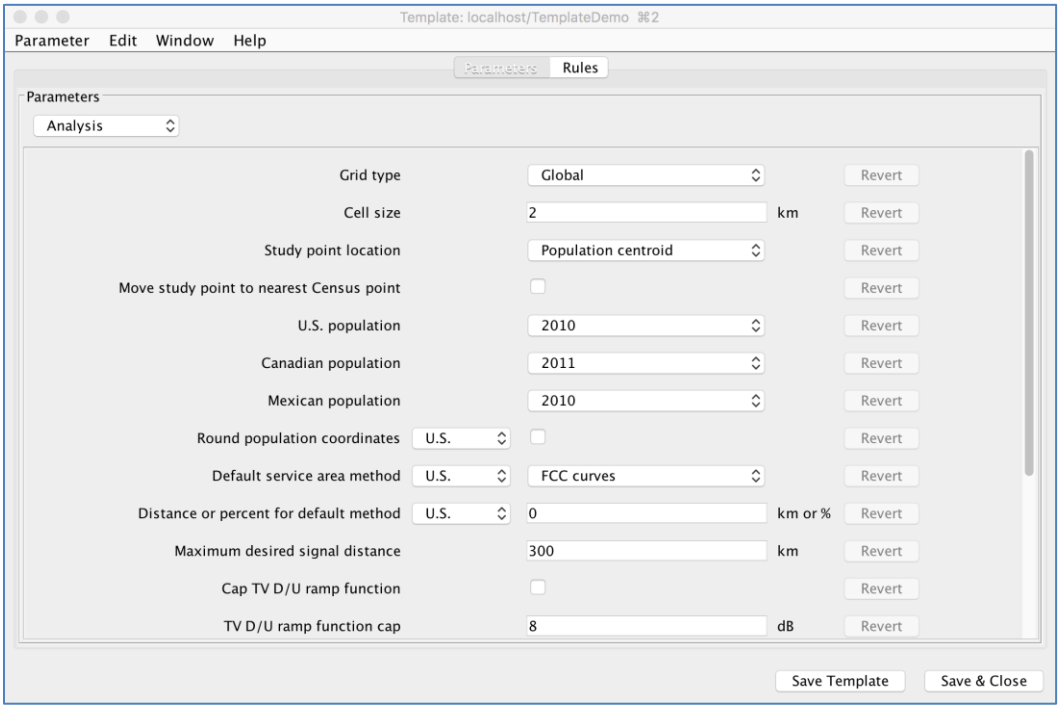
There are two ways to create a study template.

One way is to use the parameters of an existing study as your template. Enter the Study window with the study whose parameters you wish to use as your template and select "Save Study Template" from the Study dropdown menu. Give your template a name, and then click "OK."

The other way is to use the Template Manager. From the Study Manager window, open the Database menu and click "Template Manager".



Click the line named "Default" and click the "Duplicate" button.

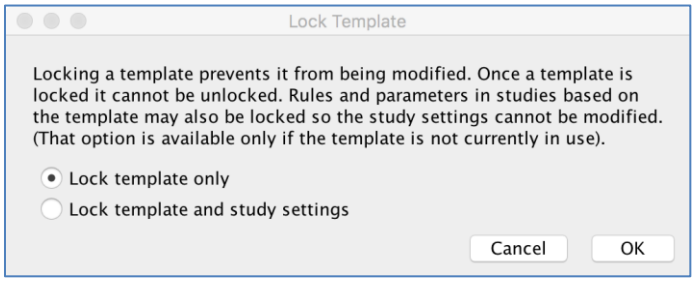


After providing your new template with a name, you are presented with an interface like the one found in the Study window, where you can set the rules and parameters as desired. (See pages 57 and 58.) When finished, simply click "Save Template" at the bottom right.

Locking a Study Template

The purpose of locking a template is to ensure that the study parameters and interference rules defined by the template cannot change in the future, so study results will remain consistent and comparable over time. There are two lock levels, and the second is more restrictive than the first. Once a template is locked it cannot be unlocked, nor can the lock level be changed.

To lock a study template, open the template in the Template Manager. Then click the Template menu and click on "Save and Lock".



TVStudy will then ask how you want the template locked.

> **Lock template only –** The first lock level prevents the template from being edited. Any new study using a locked template will have the same initial/default parameters and rules as any past study using that template. However, with this first lock level the parameters

and rules may still be edited within studies using the template, so individual studies can still be customized. A template may be locked at the first level even if existing studies are using the template.

Lock template and study settings – This lock level also prevents the template from being edited as above, but in addition it prevents the parameters and rules from being edited within any study using the template. Using a template locked at the second level means the parameters and rules are always exactly the same in every study using the template; the settings cannot be changed. This provides the highest level of assurance that study results will not vary due to parameter or rule changes. A template cannot be locked at the second level if any existing studies are using the template.

Note: A template must be locked with "Lock template only" in order to be used in an interference check study. Neither a study locked with "Lock template and study settings" nor an unlocked template can be used. This restriction is necessary to support multi-user installations of TVStudy where an administrator determines the study configuration for all users. This also allows results for studies run through the web interface to be cached, since the results remain valid as long as the template is not changed. Additionally, since the wireless frequency and bandwidth are template settings, wireless templates should be either unlocked or locked with the "Lock template only" setting unless users are sure the same frequency and bandwidth are required for every study.

Exporting or Importing a Study Template

You can also share a study templates with others. To do so, click the template you wish to export, and then click "Export." You are now prompted to give the study template file a name. Do so, and then click "Export." You can now share your study template with others.

To import a study template that has been shared with you, click "Import," then navigate to the location where the template is saved. Select the desired template file, then click "Import." The study template will now be shown in the Template Manager window and be available for you to choose when creating studies.

Deleting a Study Template

If a template is not in use for any studies, it is possible to delete the template. To do so, simply click the template within the Template Manager, then from the Template menu, click on "Delete".

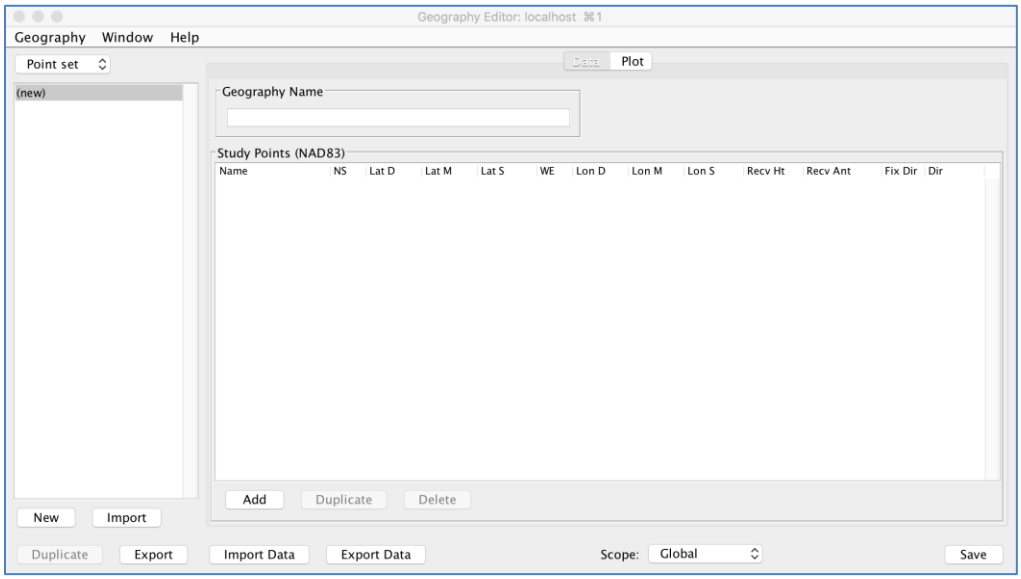
Using the Geography Editor

The Geography Editor is used to define or modify study points or study areas other than station-specific TV service contour areas. The Geography Editor is found in the Database drop-down menu and can be accessed from various other locations in the user interface.

The Geography Editor has two panes. The pane at the left contains a list of geographies, selectable by type, while the pane at the right provides a way to view, create, or edit the details of those geographies.

Creating a New Geography

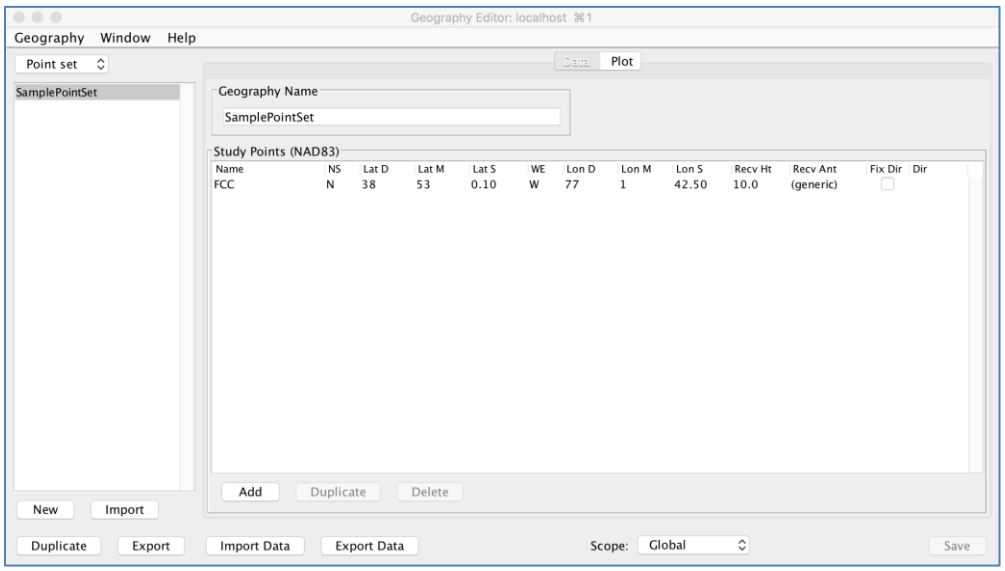
To create a geography, choose the type of geography you wish to create from the drop-down at the top of the left pane, then click on the "New" button at the bottom of the pane.



In the pane at the left, a new geography has been added without a name. To the right, at the top of the pane, enter a name for the new geography in the "Geography Name" field. By default, this name is populated as "New", but TVStudy will not allow you to save the study with that name. Once you have done so, you can set the appropriate attributes for the new geography. There is also a Plot tab which will show a plot of the selected geography.

Please note that the box, circle, and sector geographies are projected into latitude and longitude using the spherical bearing and distance method. For the box, that means the east-west distance between any two opposite points at the same latitude will be the width distance. For the circle or sectors circular arcs, the spherical distance between the center and any point on the circumference will be the radius. If those geographies are shown on a map, they may look slightly distorted depending on the forward map projection being used, since that projection may not be the exact inverse of the spherical method. Using the "azimuthal equidistant" projection method with the geography center as the projection point would produce an exact box or circle.

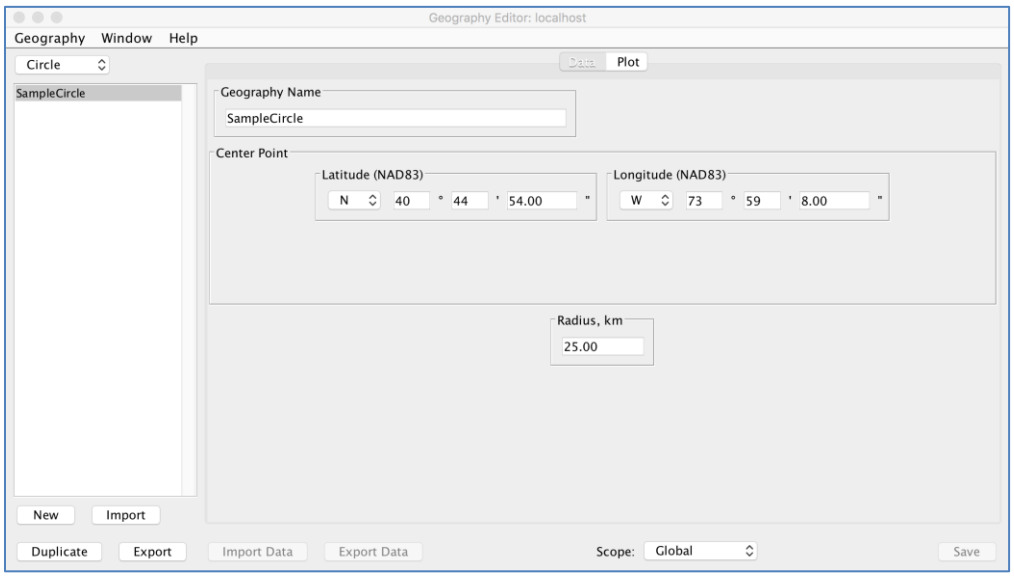
Creating a Point Set Geography

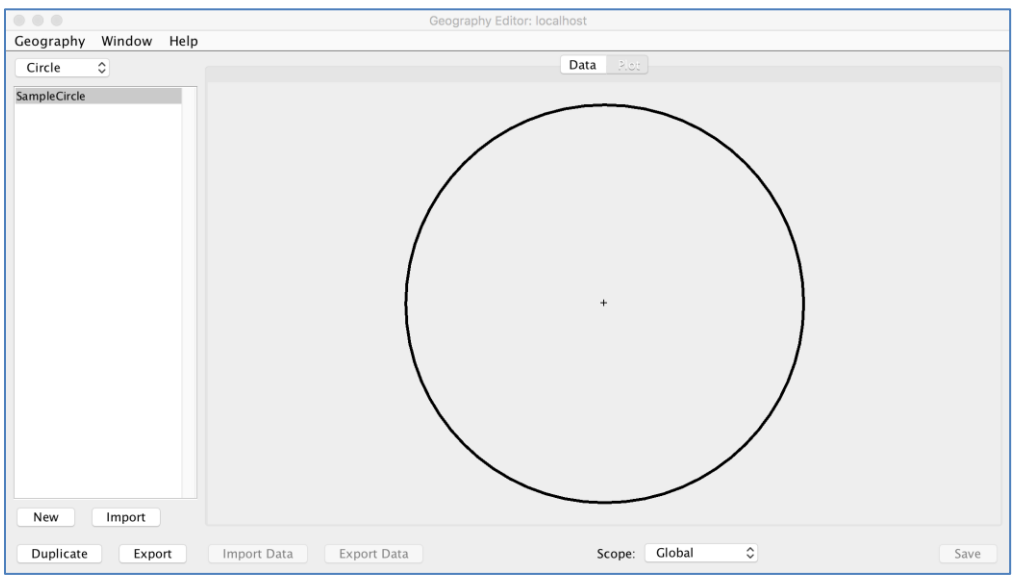


Each point has a name (which is optional), a set of NAD83 coordinates, a receive antenna height in meters, an ability to choose a receive antenna pattern (see Page 33), and an ability to fix the direction of the receive antenna pattern.

From here you can add as many points as you would like, delete points, or duplicate points. Duplicating points can be helpful if you wish to test a given location for different heights, patterns, and/or fixed orientations. In addition, you can import or export points in CSV format.

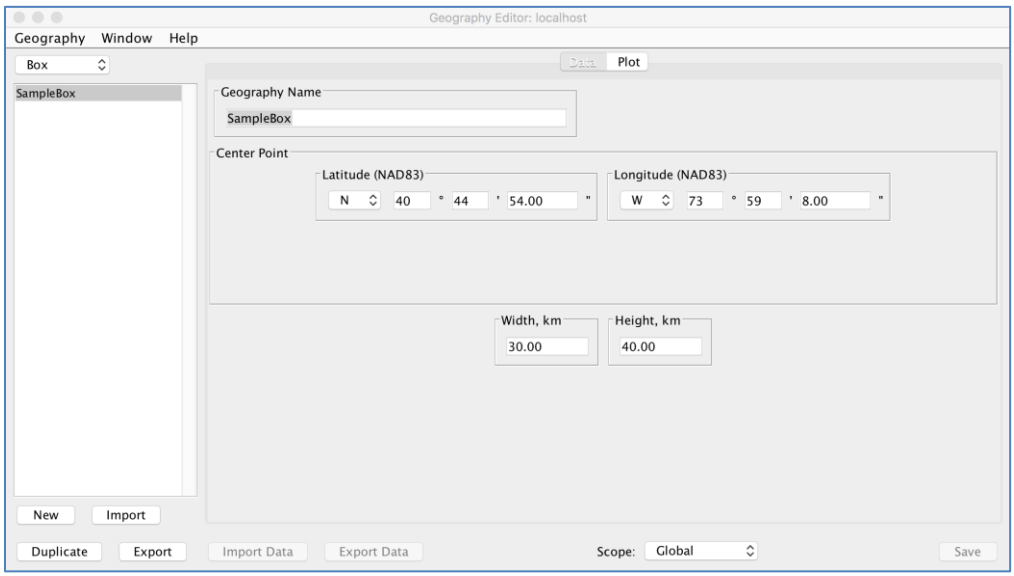
Creating and Viewing a Circle Geography

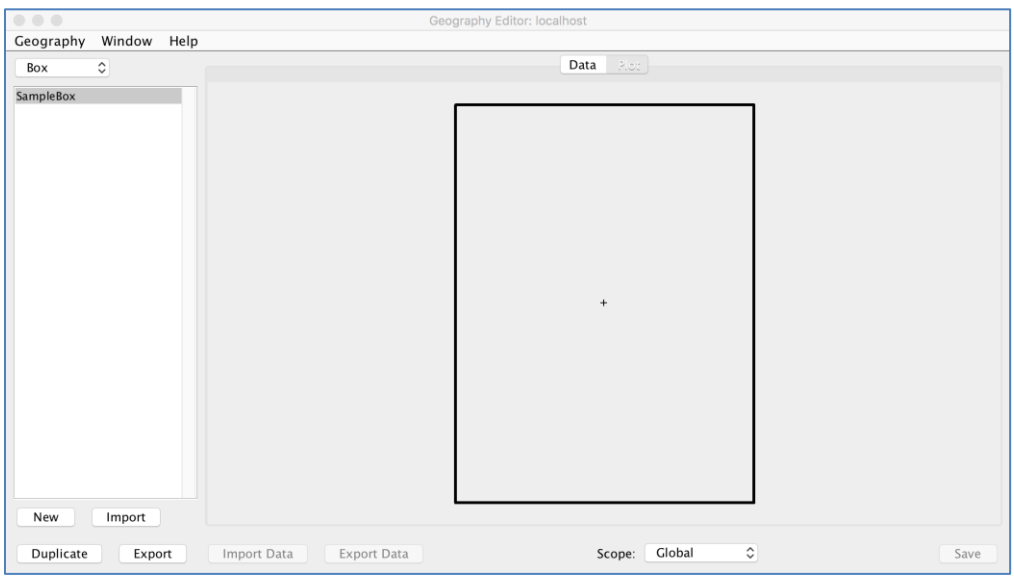




A circle geography has a name, a set of NAD83 coordinates at its center, and a radius in km, as seen above.

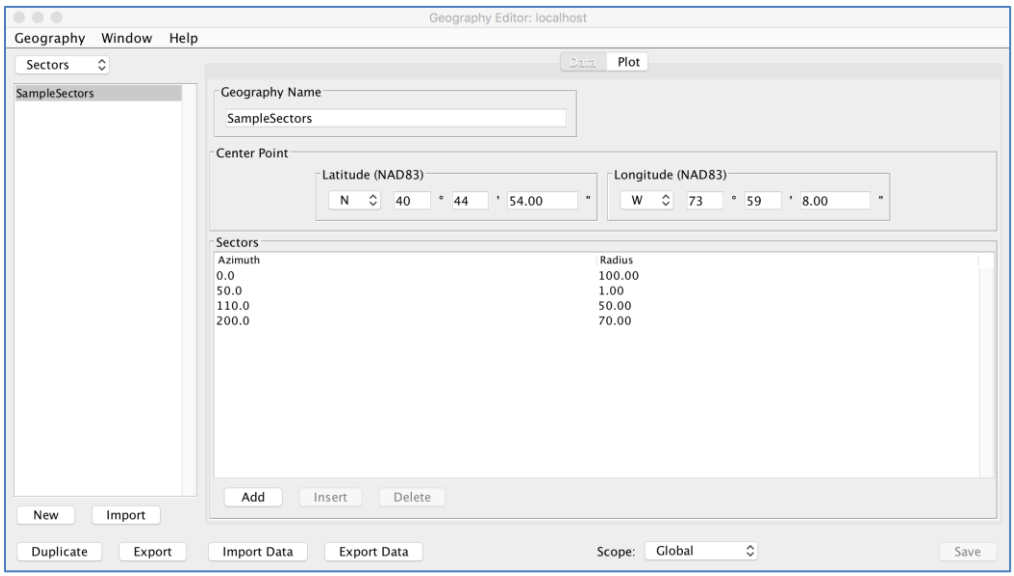
Creating and Viewing a Box Geography

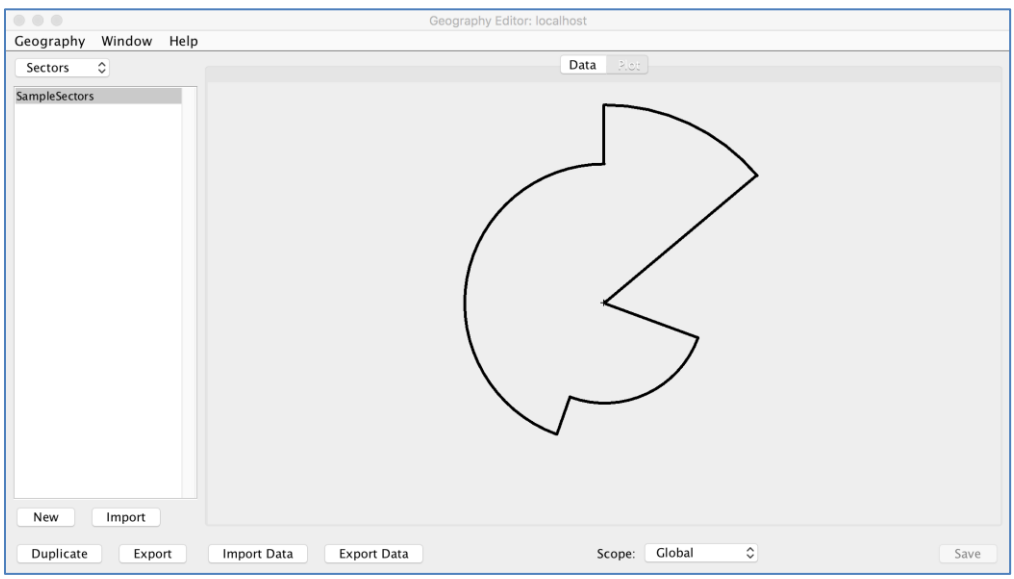




A box geography has a name, a set of NAD83 coordinates at its center, and height and width values in km, as seen above.

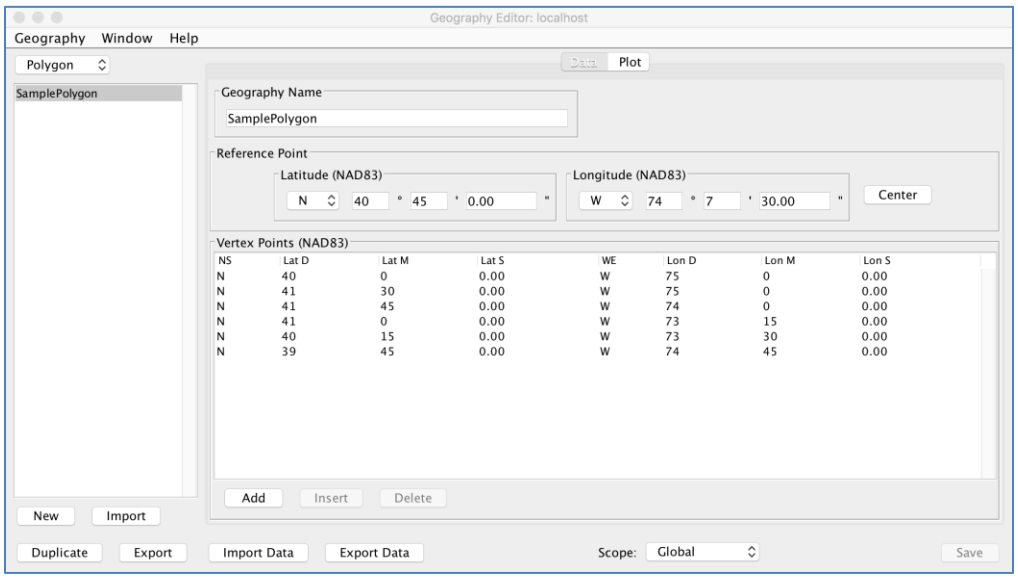
Creating and Viewing a Sectors Geography

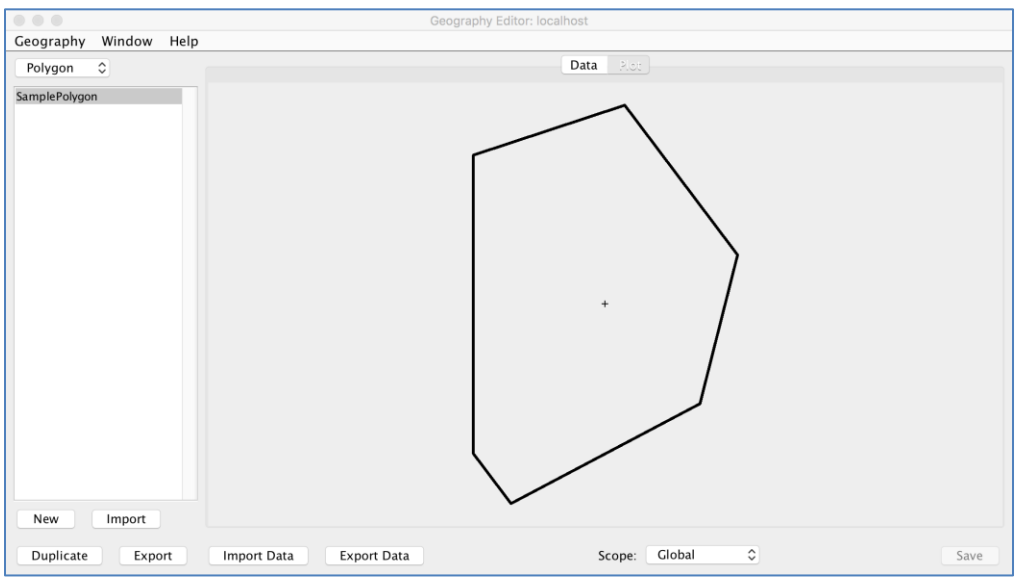




A sectors geography has a name, a set of NAD83 coordinates at its center, and a collection of degree and radius (km) measurements making up a collection of sectors, as seen above. Please note that the sectors must be input in order by azimuth, starting at 0 degrees.

Creating and Viewing a Polygon Geography





A polygon geography has a name, a set of NAD83 reference coordinates which may or may not be at the center, and a collection of vertex points, as seen above. Clicking the "Center" button will set the reference coordinates to the center of the polygon.

Managing Geographies

At the bottom of the window, you can manage geographies by duplicating an entire geography or by importing/exporting geographies.

Geographies can be imported and exported as text files without a header row (using the Import Data and Export Data buttons) or as XML files (using the Import and Export buttons). Before importing your text file using Import Data, the type of geography to match your file data must be selected in the drop-down window. For point sets, four comma separated fields are used in this format with a row for each point in the set:

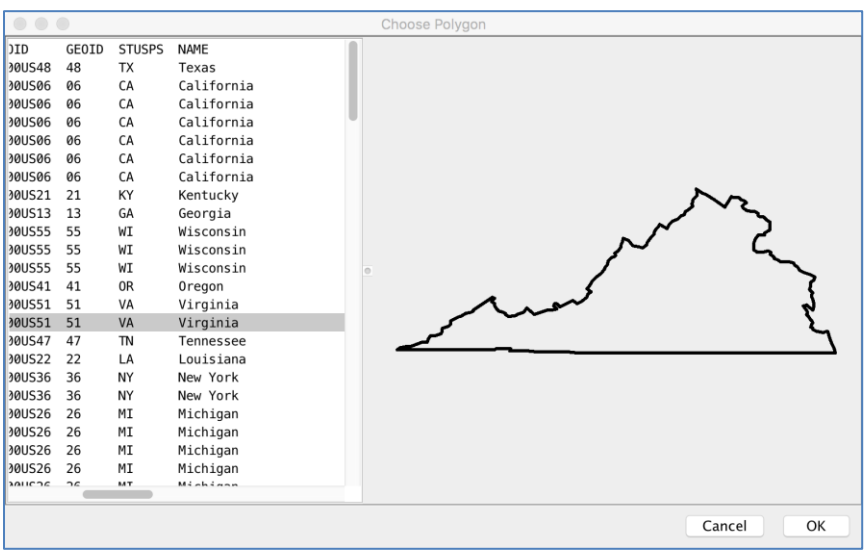
<pointname>,<latitude>,<longitude>,<receiveheight>

For a sectors geography, the format is a single row of data specifying each sector start and end angle as well as radius with semi-colons separating each sector area:

<0>,<radius1>,<sector1endangle>;<sector1endangle>,<radius2><sector2endangle>;<sector2endangle>,<radius3>,<360>

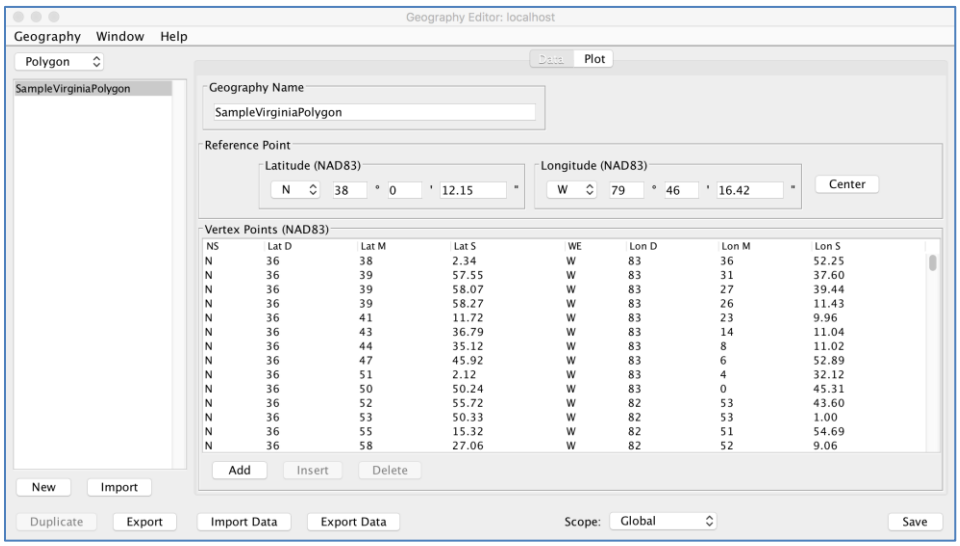
For polygons, two comma separated fields of latitude and longitude with a row for each vertex point. Circle and box geographies cannot be imported or exported via text files.

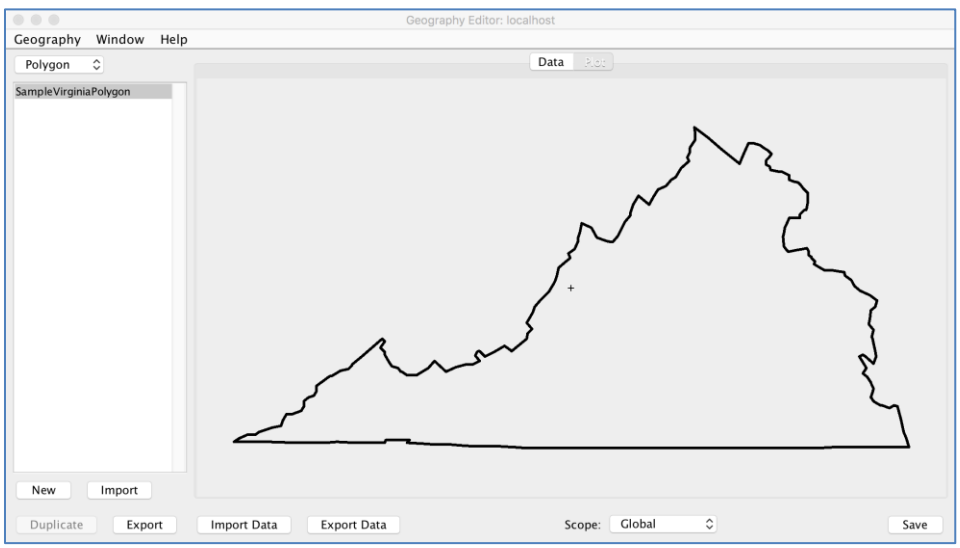
A particularly useful function of TVStudy's geography editor is the ability to import polygons from ShapeFiles. To do this, be sure "Polygon" is the selected geography type, then click "Import". Navigate to the ShapeFile you wish to import the polygon from and click "Import".



If the Shapefile contains multiple polygons, TVStudy gives you the ability to choose which polygon to import. The pane at the left shows the attributes for each polygon. Clicking one will show its shape on the right, to help ensure you've selected the correct one. When you've selected the correct one, click "OK".

Please note that TVStudy's geography editor only allows the import of individual polygons and not shapes made up of multiple polygons. Thus, as seen in the example image above, the bulk of the state of Virginia is being imported without the Eastern Shore because they are two separate polygons which make up a single shape in the ShapeFile. Only one polygon or the other can be imported or used at a time.



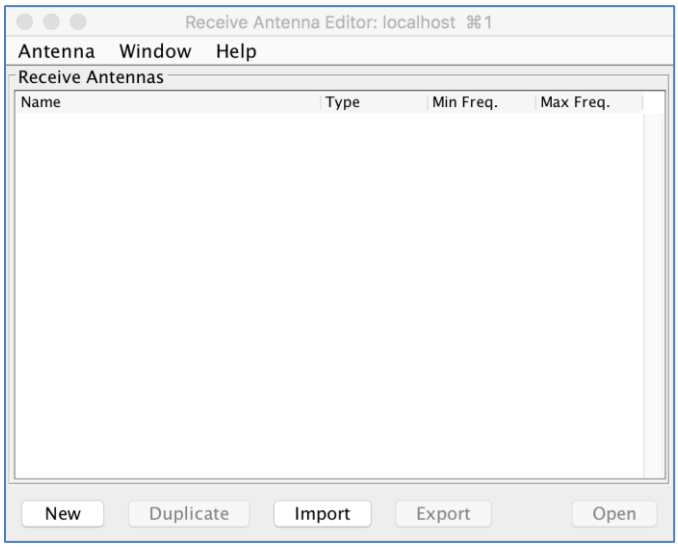


The reference point is automatically set to the center at import, and the name can be set as with any other polygon.

One additional feature of Geographies is their scope. A geography created from a Geography Editor window opened elsewhere in the software will limit the availability of that geography to the location it is found in. For example, if the Geography Editor is opened from within a study, then the geography will only be available within that study. If you wish to make it available to other studies, its scope would need to be changed to "Global" and this can be done with the Scope drop-down at the bottom of the window opened from within the study in which it was created. Scope can only ever be made broader, not narrower.

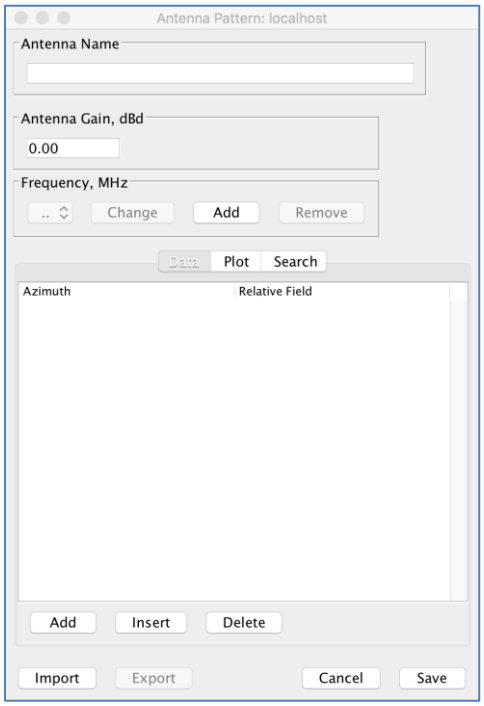
Using the Receive Antenna Editor

The receive antenna editor allows for the creation, editing, importing, and exporting of receive antenna patterns for use in Points mode studies. To access the editor, select it from the Database menu.



Creating a Receive Antenna Pattern

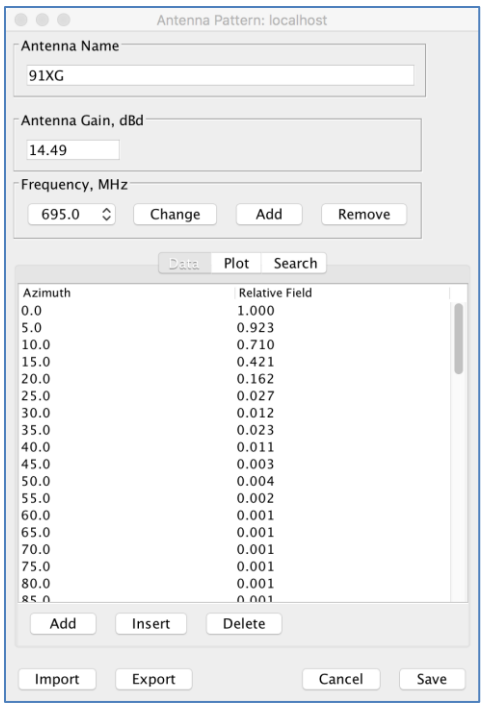
To create a receive antenna pattern, click "New".



Though similar to the Antenna Pattern Editor (see Page 14), there are two key differences. First, a receive antenna pattern can have different patterns at different frequencies, though this is not

required. Values are interpolated between frequencies when a specific frequency is unavailable. Second, the maximum gain in dBd for the antenna at any frequency must be provided in the field at the top.

In addition, it is possible to import an antenna pattern specified in absolute dB and TVStudy will automatically convert it into the appropriate format. The only thing that needs to be done manually is entering the gain value; as noted above, this value must be in dBd, so if the values in the file are in dBi, simply subtract 2.15 from the maximum value in the file and put the result in that field. Please note that in a receive antenna covering multiple frequencies, the gain is the maximum gain at any frequency; all other values should be relative to that maximum value. Additionally, be sure that the 1 value is at the 0 degree azimuth so that TVStudy correctly orients the antenna when it is used. (See page 26 for information on orienting the pattern in a point set geography.)



If you use the Import or Export functions from within this window, a pattern can be imported or exported for a single frequency. Using Import or Export from the Receive Antenna Editor window allows for the import or export of antenna patterns covering multiple frequencies at once. If an antenna is used for a frequency it does not support, the last value is held, much like with elevation patterns.

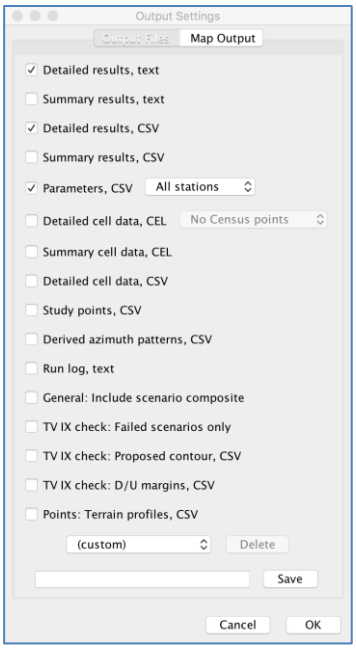
Managing Output Settings

TVStudy allows the user to save and use preset collections of output files that can be selected from a drop-down list.

Types of Output Files

TVStudy has a wide array of output files to choose from. Please note that all outputs featuring geographic coordinates are in the NAD83 datum.

Not listed below are the **tvstudy_settings.txt** file, which contains all of the rules and study parameters used in the study and is always output, and **tvixstudy.txt** which is always output when a TV Interference Check study is run and imitates the output of the *tv_process* software previously used by the Media Bureau for application processing. Also not listed are the pair study output files, which are always output when a pair study is run (see Appendix F).



Detailed results, text (tvstudy.txt) – Provides textual files listing all the stations and their coverage areas for each scenario.

Summary results, text (tvstudy.txt) – Same as above, but in a condensed form. If several scenarios are run at once, the summary output file will lump them all together into one output file.

Detailed results, CSV (tvstudy.csv) – Provides detailed CSV output files showing service and interference, as well as which station(s) are causing interference.

Summary results, CSV (tvstudy.csv) – Same as above, but in a condensed form. If several scenarios are run at once, the summary output file will lump them all together into one output file.

Parameters, CSV (parameters.csv) – Provides a CSV output file listing all the stations parameters used in the study. You may choose to output the parameters of all stations or just desired stations, but the output is otherwise identical. The Antenna Information section gives the field value for each 10-degree increment of azimuth. If any other important field values exist at other azimuths, they are given as Extra Field Values, which show the Azimuth followed by the Field Value, repeating until all have been provided.

Detailed cell data, CEL (tvstudy.cel) – Creates a text file showing cell-by-cell results for your scenario(s). This is a highly detailed list of output for every cell evaluated for every station in the scenario, including the D/U ratios, exact study point coordinates, and other values that may be useful for post-processing. This file may be very large. You may choose whether or not to output rows containing all of the Census points used in determining the population contained in a cell for non-points mode studies. (See Appendix D.)

Summary cell data, CEL (tvstudy.cel) – Similar to the above, but this output leaves out many of the details of the study except for the population of the cell and whether the cell has service or not. If several scenarios are run at once, the summary output file will lump them all together into one output file. (See Appendix D.)

Detailed cell data, CSV (various) - This is a set of three to five comma separated text files with very detailed information on the calculated field strengths and D/U ratios in every grid cell in the study. The number of files created depends on the type of study being performed. (See Appendix D.)

Study points, CSV (points.csv) - Creates a CSV output listing all the cells used in the study along with their populations.

Derived azimuth patterns, CSV (hpat-<app info>.csv) – Creates a CSV output of each radial plus the field value determined for it. This is particularly useful for stations with mechanical tilt or a matrix pattern when the "Derive azimuth pattern checkbox" study parameter is checked.

Run log, text (log.txt) – Saves the run log for any given study. This is particularly useful if you have a number of studies queued to run in a sequence.

General: Include scenario composite (various) – Creates additional output files and adds lines to existing ones to include the composite coverage for all desired stations within a scenario. This can be useful when studying a station along with its translators to determine total coverage.

TV IX check: Failed scenarios only (tvixstudy.txt) – This is a setting which modifies the output of tvixstudy.txt to include detailed information only about scenarios which fail to clear the interference threshold. This setting also provides requested detailed outputs, such as Map data, only for failure cases.

TV IX check: Proposed contour, CSV (tvixcontour.csv and tvixcontour_base.csv) – This output provides CSV output files showing the contours produced when testing the proposal against the 1% expansion test. If that test is not conducted, the files are not produced.

TV IX check: D/U margins, CSV (margins.csv) – This output provides a very simple CSV output file for each failure case in a TV IX check study which shows, for each azimuth, the amount of adjustment (in dB) necessary to eliminate the interference in that azimuth, plus the count of population impacted.

Points: Terrain profiles, CSV (profile-<callsign>_<channel>_<service type>_<status>-<pointname>.csv) This setting is only applicable for studies run in the points mode and willgenerate a terrain path profile file between each station and each point in a point set. The resultant files have two fields; distance in kilometers from transmit point to evaluation point and terrain elevation in meters above mean sea level.

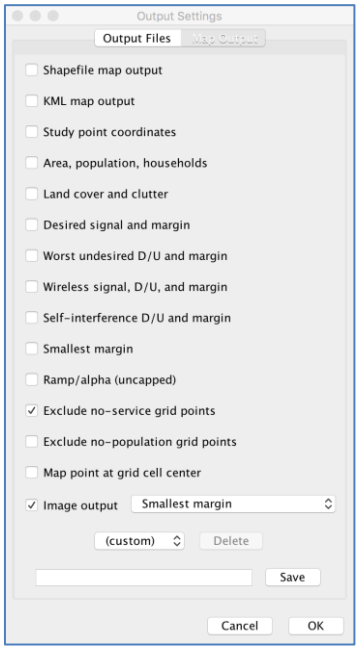
The Map Output tab lists various options controlling the map and map metadata outputs. These outputs have their own separate presets.

ShapeFile map output (various) - Creates a set of ESRI ShapeFiles for the results of the scenario(s). (See Appendix E.)

KML Map output (various) - Creates a set of Google KML files for the results of the scenario(s). (See Appendix E.)

Study point coordinates – Includes as attributes the coordinates of each study point.

Area, population, households – Includes as attributes the area, population, and household count for each cell.



Land cover and clutter – Includes as attributes the land cover and clutter category for each cell.

Desired signal and margin – Includes as attributes the desired signal level and margin above threshold for each cell.

Worst undesired D/U and margin – Includes as attributes the worst case undesired D/U and margin above threshold for each cell.

Wireless signal, D/U, and margin – Includes as attributes the wireless signal level, D/U, and margin above threshold for each cell.

Self-interference D/U and margin – Includes as attributes the DTS Self-Interference D/U and margin above threshold for each cell.

Smallest margin – Includes as attributes the smallest margin from the four options above and which of the four is responsible for the number provided.

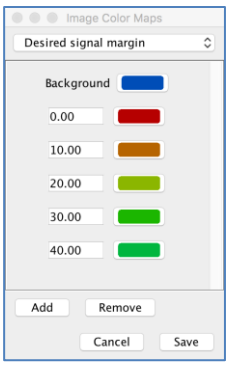
Ramp/alpha (uncapped) – Includes as an attribute the D/U Ramp function (or OET74 Alpha factor) adjustment for each cell.

Exclude no service points – Excludes any points without service from the map outputs.

Exclude no population points – Excludes any points without population from the map outputs.

Map point at cell center – Places the map point at the cell center for display purposes regardless of the centroid type used in the study.

Image output – For scenarios with a single desired station, TVStudy can produce an image output file with an associated KML for overlay on Google Maps. This option will only be available if GhostScript is installed on your system and a symbolic link to the "gs" executable is



placed in your lib/ directory. (See the Installation and Upgrade Guide for discussion of how to configure this feature.) Additionally, the colors for the image output can be set in the Image Color Maps menu option in the Database drop-down in the Study Manager window.

Saving and Deleting Settings Presets

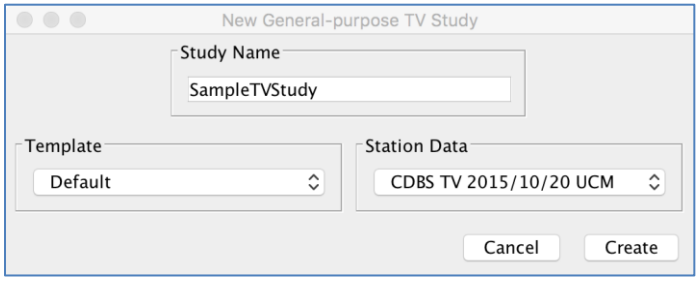
Managing presets for output file settings is very simple. To save a new collection of settings, set accordingly, enter the name at the bottom, and click Save. If the name matches an existing name, TVStudy will overwrite the existing saved settings without a confirmation prompt.

To delete a collection of settings, choose it from the drop-down at the top and click “Delete”.

Creating a New General Purpose Study

General purpose studies can be used to study coverage and interference between either groups of TV stations or groups of FM stations. The example provided here will cover TV stations; however, a short section explaining the differences that an FM station presents can be found on page 59.

To begin, choose "General-purpose TV" or "General-purpose FM" from the "New study" drop-down menu at the bottom left corner.



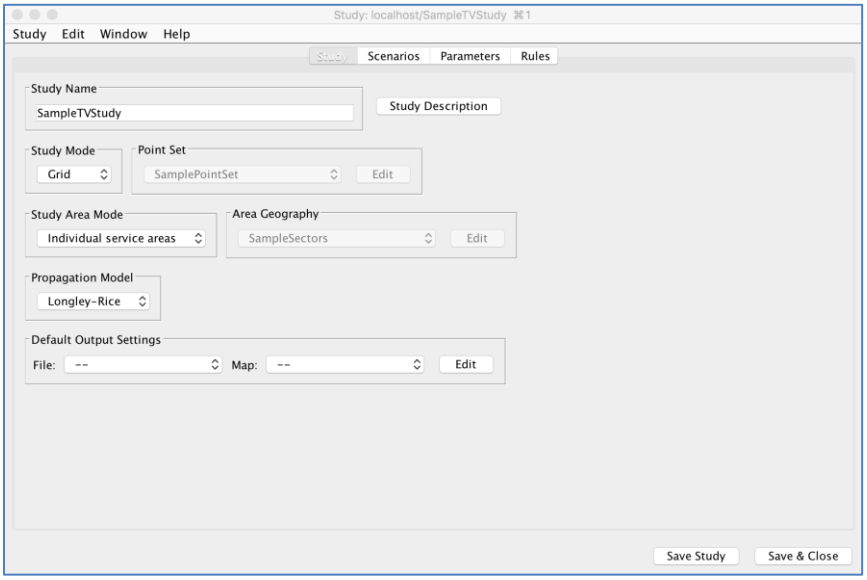
This is the interface for creating a general purpose study. In "Study Name," choose a name for your study. You will want to avoid special characters and limit the length to a reasonable number of characters, since this name is used to create the path for your output files.

At the left, you must choose a template to use. The Default template will always be present. Additional templates may be added to allow you to pre-select parameters for your study. The FCC may distribute templates for specific types of studies to help ensure that TVStudy users obtain consistent results. Learn how to create and manage study templates on page 22.

At the right, you may choose a CDBS/LMS dataset to use as the default for the study. Learn how to import and manage datasets on page 9.

When you're satisfied with your name, template, and dataset, click "Create."

Once a study has been created, you are shown the Study window. There are four tabs in this window: Study, Parameters, Rules, and Scenarios. When creating a new study, the window automatically opens to the "Study" tab so you can set the various study options. (When opening an existing study, the window automatically opens to the "Scenario" tab.)



This tab allows you to set various study options.

Study Name – Sets the name of the study.

Study Description –The description field is a place to store notes and details about this study for future reference. The description is not only shown here, but also in the Study Manager window when hovering over their names, and in the Run window.

Study Mode/Point Set – Sets the study mode and, when Points is selected, the point set to use for the study. Grid mode is the standard behavior used to model stations. Points mode grants the ability to evaluate coverage and interference at specific points rather than within an automatically generated grid. The point set can be selected from the drop-down menu, and point sets are created in the Geography Editor as described on page 26.

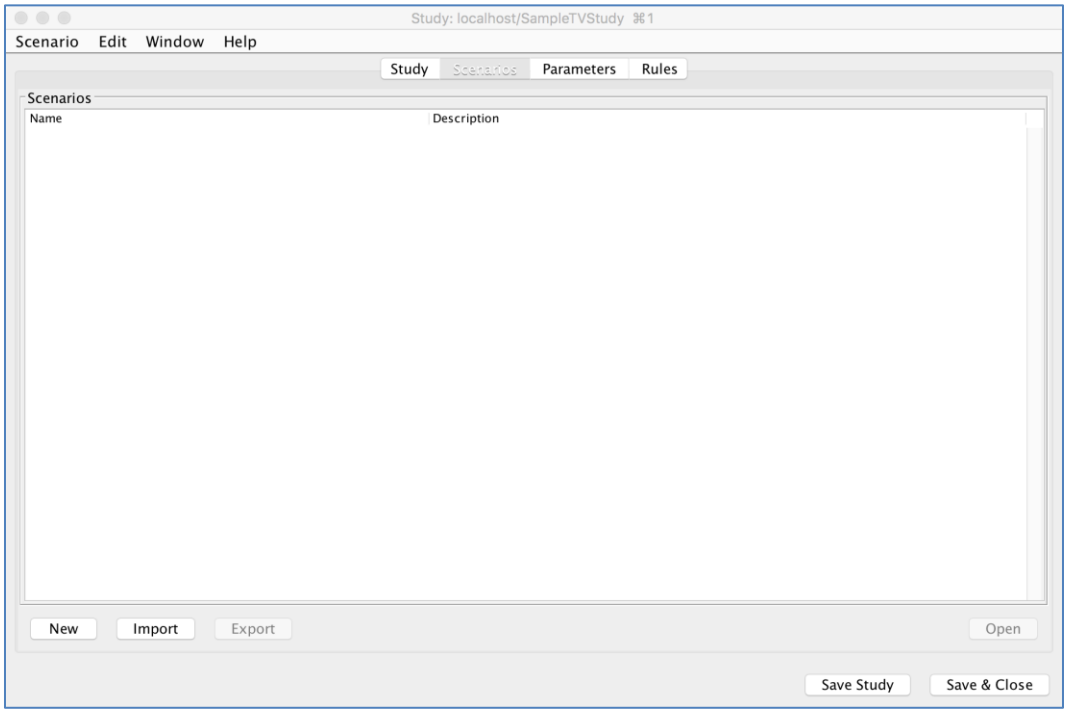
Study Area Mode/Area Geography – Sets the study area mode and, when Fixed Geography is selected, the geography to use in the study. This option allows for stations to be evaluated using a contour method, as is typical, or by one of two alternative means. Fixed Geography is useful for evaluating the coverage of stations within a geography. For example, a station could evaluate its coverage within its DMA, regardless of contour boundary. Alternatively, Unrestricted replaces the contour with a fixed distance defined in the "Maximum desired signal distance" study parameter. Settings other than Individual service areas overrides those service area settings for individual stations in most cases.

Propagation Model – Sets the propagation model to use for the study. By default, TVStudy uses of Longley-Rice, but also has examples permitting the use of the FCC curves as if it were a propagation model, as well as Free Space. TVStudy provides an API for writing code to support custom models as well; see the Installation and Upgrade Guide for details.

Default Output Settings – If left unset, these default to the "last used" output settings. Otherwise, if set, any time the study is run, the options defined here will be set by default.

Creating a New Scenario

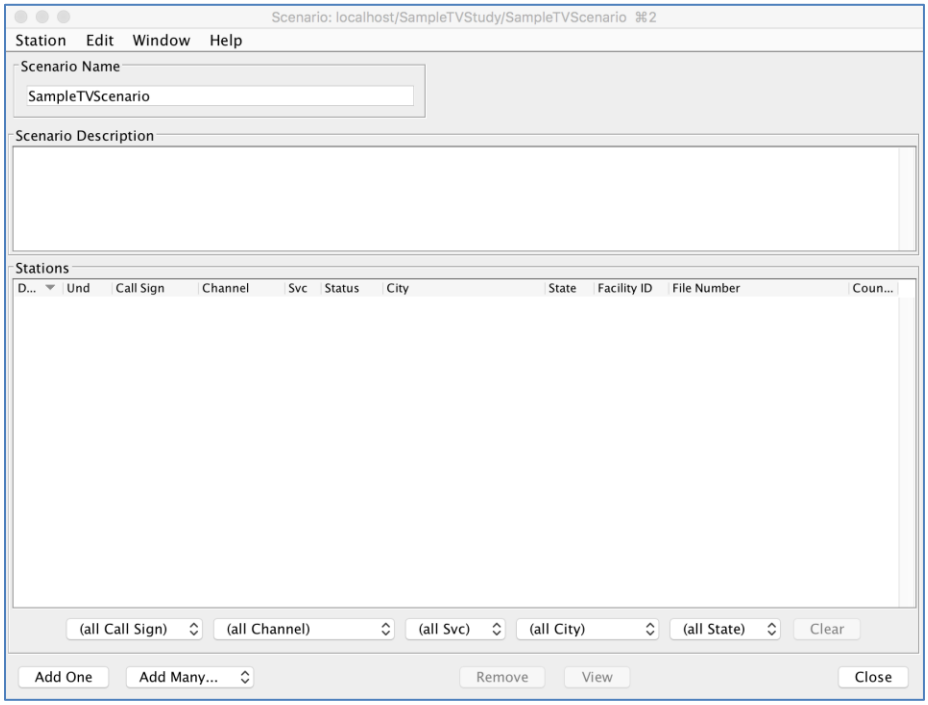
The next step is to create a new Scenario. To do this, switch to the Scenario tab.



Key concepts: A "study" is a set of parameters that are used to analyze stations. A "scenario" is a specific set of stations to be considered. Each scenario is independent of the other scenarios, but utilizes all of the parameters as specified in the study.

The first step is to create a new scenario, which is done using the Scenarios tab. Begin by clicking "New" at the bottom left corner.

You will be prompted to give the scenario a name. As with the study name, you will want to avoid special characters and limit the length to a reasonable number of characters, since this name is used to create the path for your output files. Then click "OK."



You are given a blank "Scenario" window. The description field is a place to store notes and details about this scenario for your own future reference. The description is not only shown here, but also in the Study window when looking at your scenarios.

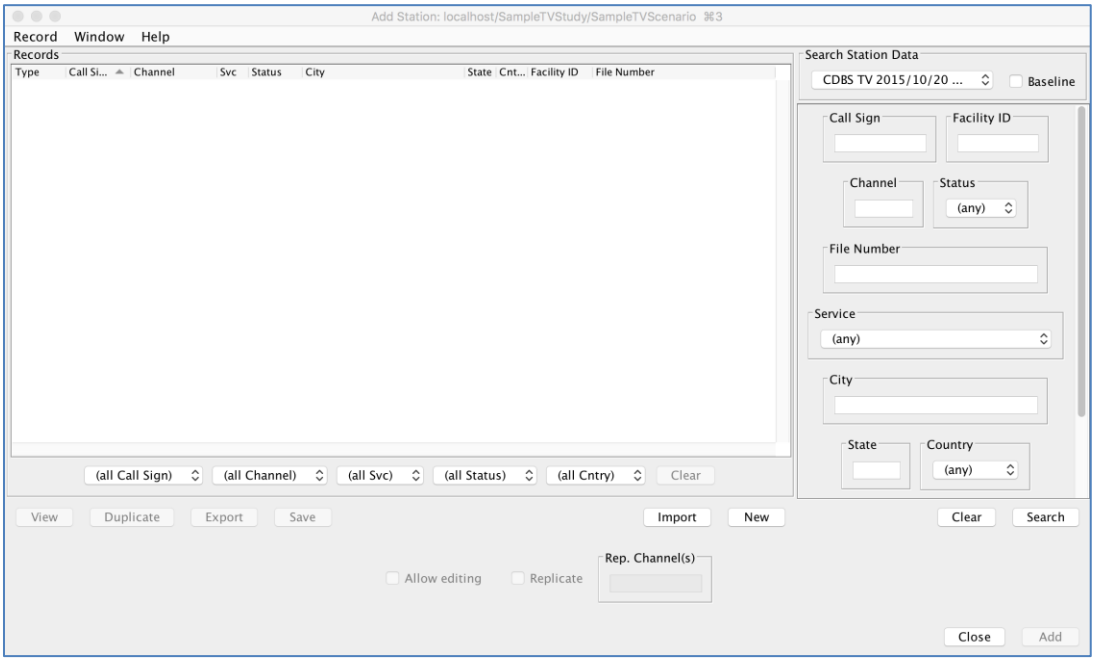
Key concepts: There are two types of stations you can add to a scenario. A "desired" station is one that will be evaluated for coverage and interference to the coverage area. An "undesired" station is one that will only be a potential interference source for desired stations. You can (and normally should) evaluate a station as both desired and undesired at the same time, such that a station evaluated for coverage and incoming interference can also cause interference to other stations, though there may be cases in which a station should be only one or the other. Each scenario requires at least one desired station.

Adding Station(s) to a Scenario

There are two ways to add stations to a scenario.

Adding Individual Stations or New Stations

To add one station at a time, click "Add One" at the bottom left corner.

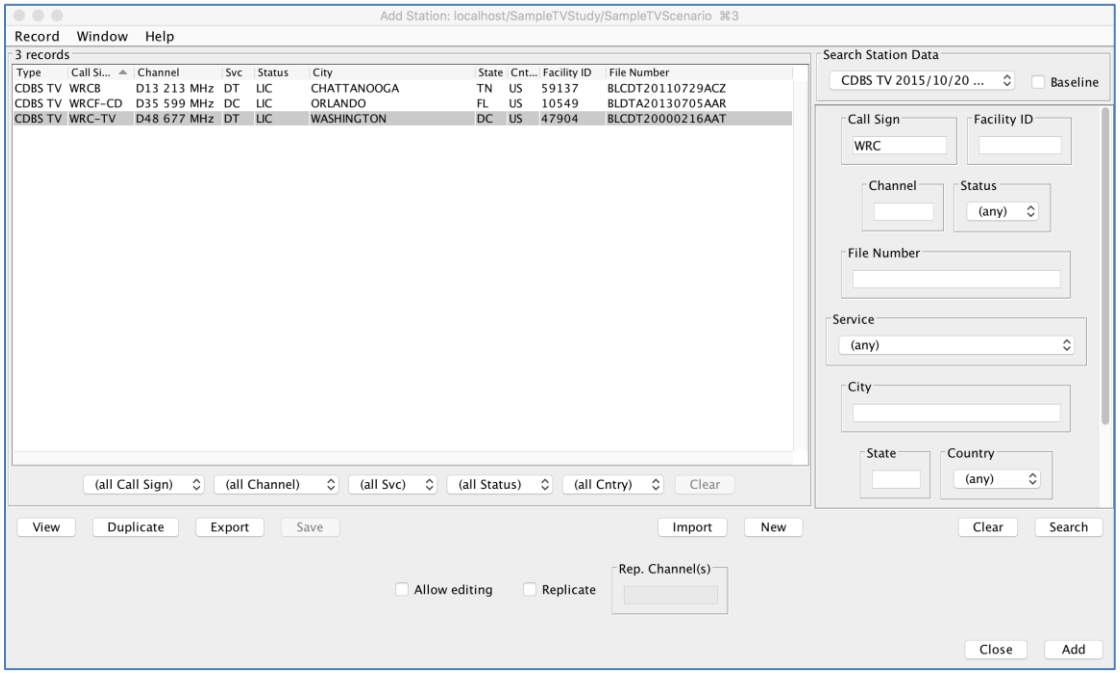


The Add Station window shown strongly resembles the View Station Data window detailed on page 10 and can be operated in the same way. They key difference here is the added functionality at the bottom which allows records to be editable or replicated, and of course the "Add" button which places the record into the scenario. For more information on editing and replicating records, see page 50.

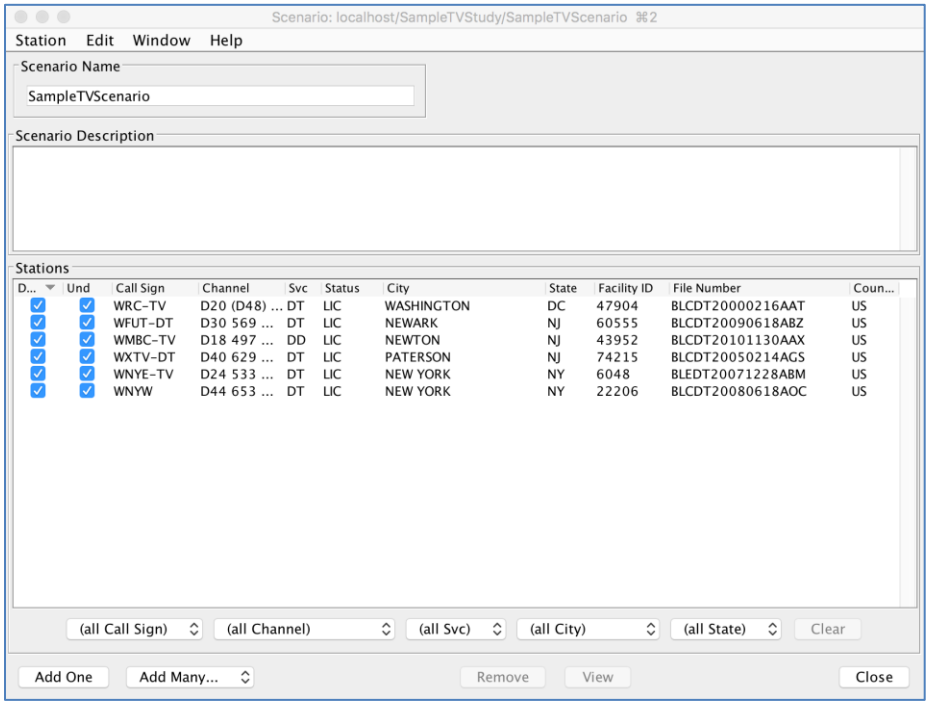
One minor difference from the behavior of the View Station Data window is that you may still use the "New" button to create a new record or the "Import" button to import a record, but you are not required to then save the record to the User records database. If you do wish to save your record to the User records database, simply click "Save" before clicking "Add". If not, simply create the record and click "Add" without first clicking "Save".

If you are using an existing record from a dataset, once you select the record that you wish to add to your scenario and choose any editing or replication options, click "Add" in order to add the station to your scenario. The Add Station window will remain open to allow you to add additional individual stations, or you may click "Close" to return to the Scenario window.

Note that you can add records from datasets other than the one associated with the study. These records are added to the study itself and not to the User records database.

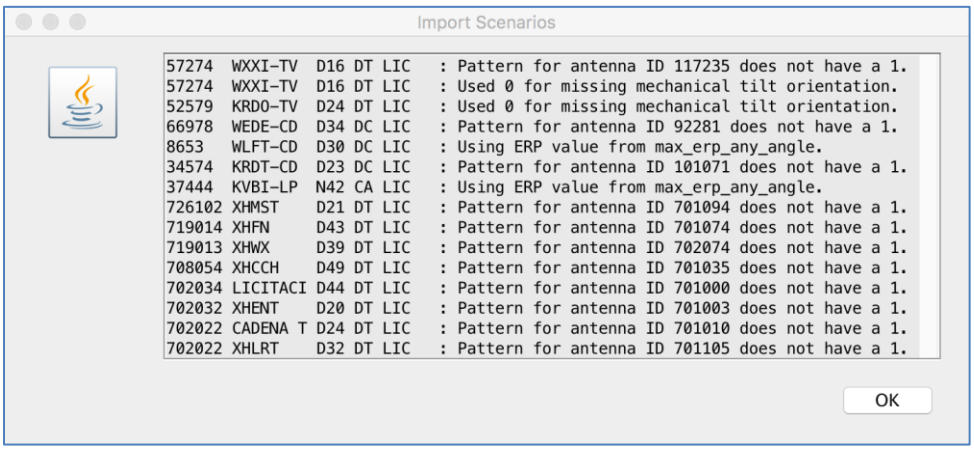


TVStudy will warn you of any unusual conditions it encounters (see page 46) and then add the station to your scenario. By default, stations added in this method are assumed to be both desired and undesired, which is shown in the above Scenario window. To make it undesired only, uncheck the box in the "Des" (Desired) column. To make it desired only, uncheck the box in the "Und" (Undesired) column. Unchecking both boxes will omit the station from being evaluated.



By clicking and dragging, or by using the usual method for your operating system to select multiple items, you can remove the selected stations from the scenario by clicking the “Remove” button at the bottom right, or modify their desired or undesired status all at once using the options in the Edit drop-down menu.

CDBS/LMS Data Warnings



CDBS/LMS data warnings will not prevent execution of a study; they are provided to alert you to potentially anomalous conditions that may affect the results of the study. Each warning message includes the facility ID, call sign, channel, and status of the record that triggered the warning.

Used default for missing ERP/HAAT – If the search returns one or more Mexican allotments missing values for ERP and/or HAAT, TVStudy warns you that it is defaulting to the values you assigned when the study was created.

Derived missing AMSL from HAAT – If a station or allotment is missing its antenna radiation center height above mean sea level (RCAMSL), TVStudy will calculate it from the height above average terrain (HAAT) value using the selected terrain database. This should only appear on non-US records.

Converted ERP from dBk to kilowatts – If a station has an ERP less than or equal to 0, it is assumed the ERP was entered in dBk instead of kW, and the value is converted to kilowatts.

Using ERP value from max_erp_any_angle – When using CDBS data, if a station has a value in the max_erp_any_angle field greater than that of the effective_erp field, TVStudy will use the max_erp_any_angle value.

Transposed mechanical tilt parameters – Some stations with mechanical beam tilt have reversed values for the mechanical tilt (depression) angle and the tilt orientation (azimuth). If a record has a tilt value greater than 11.1 degrees, TVStudy will swap the values.

Ignored out-of-range electrical/mechanical tilt – The value in the noted field is less than -10 or greater than 11.1 degrees. TVStudy substitutes a value of 0.

Used 0 for missing mechanical tilt orientation – The mechanical tilt is non-zero but the tilt orientation is 0, which may mean that the tilt orientation (azimuth N degrees ET) was not entered in CDBS/LMS. This may not be an error if the tilt orientation is actually toward N 0 degrees ET. The user should independently verify the correct parameters and edit the record if necessary.

Antenna ID <#> not found – No pattern data exists for the station's antenna ID number. TVStudy assumes the station is omni-directional.

Pattern does not have a 1 – Some antenna horizontal plane (azimuth) patterns in CDBS/LMS are missing a 1.0 maximum relative field point, usually because a station has its maximum at a value between the azimuth values supported by CDBS/LMS (*i.e.*, every 10 degrees). TVStudy warns you about this condition, but takes no corrective action.

Pattern for antenna ID <#> is bad, <msg> – Some antenna horizontal plane (azimuth) patterns in CDBS/LMS contain errors (listed below) and TVStudy assumes the antenna is omni-directional:

Azimuth out of range – Pattern had azimuth(s) less than 0 or greater than 359.999.
Duplicate azimuths – Pattern had two or more field values given for the same azimuth.
Relative field out of range – Pattern had field value(s) less than or equal to 0 or field value(s) greater than 1.
Not enough points – Pattern had fewer than two points.

Elevation antenna ID <#> not found – No data exists for the station's elevation antenna ID number. TVStudy applies a generic pattern, if allowed. If the pattern is supposed to be a matrix pattern, TVStudy also assumes the station is omni-directional.

Elevation pattern does not have a 1 – Some antenna elevation patterns in CDBS/LMS are missing a 1.0 maximum relative field point, usually because the antenna is at an odd rotation but the data is entered only every 10 degrees. TVStudy warns you about this condition, but takes no corrective action.

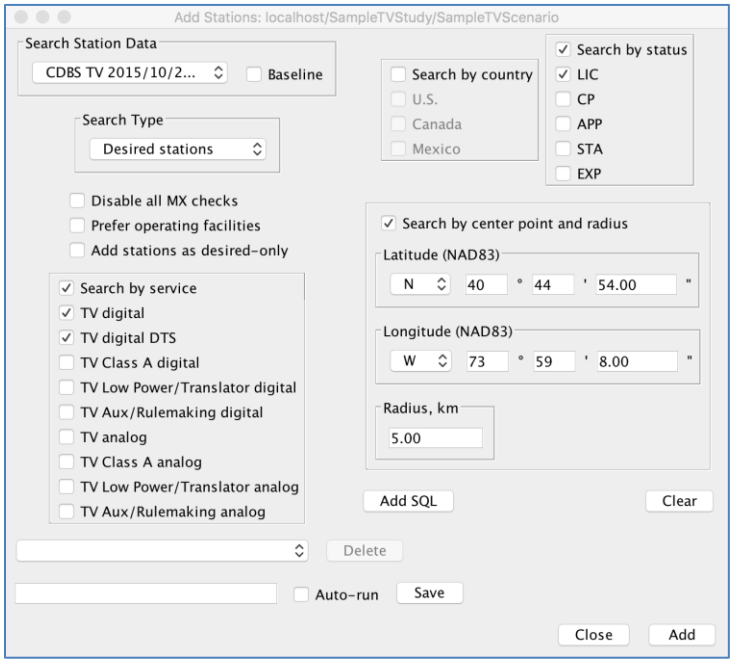
Elevation pattern for antenna ID <#> is bad, <msg> – Some antenna elevation patterns in CDBS contain errors, and TVStudy instead applies a generic pattern, if allowed. (By default, the generic pattern is not allowed for wireless records.) If the pattern is supposed to be a matrix pattern, TVStudy also assumes the station is omni-directional and appends "**at azimuth <#>**" to the end of the message.

Depression out of range – Pattern had elevation angle(s) outside the range $-90 \leq \theta \leq 90°$.
Duplicate depression angles – Pattern had two or more field values given for the same elevation angle.
Relative field out of range – Pattern had field value(s) less than or equal to 0 or field value(s) greater than 1.
Pattern data not found – Pattern data was not successfully loaded.
Not enough points – Pattern had fewer than two points.

Important: Warning messages will only appear once for a given CDBS/LMS record in a given study; if the same record is used again in a different scenario, the warnings do not appear.

Adding Multiple Stations with a Search

It is not necessary to add stations one at a time. You can add multiple stations at once using a search function. To access this, click "Add Many" at the bottom left corner of the scenario window and choose whether you wish to add Desired or Undesired stations.



There are four common search methods shown on this screen, along with the button to Add SQL.

At the top left, you can choose from which dataset you wish to add stations to the scenario. Users may now add stations from any imported dataset into a given study.

Immediately below that, you can choose whether the stations you seek to add here are desired or undesired stations. If you choose to add undesired stations, only stations that meet the rules to be considered for your desired stations will be added, regardless of the other parameters. For example, if you only have desired stations in Texas and you set TVStudy to only search for undesired stations in Canada, TVStudy will return no results. <u>This also means that you must have at least one desired station in your scenario in order to add undesired stations.</u>

Also note the three checkboxes at the left side of the window.

> **Disable all MX checks –** This option disables all mutual exclusivity (MX) checks in the software. Checking this box is not recommended unless you are specifically checking two stations at the same location and channel. Any stations added with this checkbox selected are added as desired, but not undesired, to prevent any stations from receiving excessive interference.
>
> **Prefer operating facilities –** By default, this search window prefers the "newest" record in CDBS (*i.e.*, applications outrank construction permits outrank licenses). Checking "Prefer

operating facilities" flips the order. A pending license will outrank a license will outrank a construction permit will outrank an application.

Add stations as desired-only – By default, stations added with the "Desired stations" search type are automatically added as both desired and undesired. If you check this box, the records will be added as desired only.

If you are running multiple Add Many queries across multiple scenarios, the bottom of the window allows you to save or retrieve those queries. A saved search selection menu, name field, and "Save" and "Delete" buttons now appear at the bottom of the search dialog. At the bottom of a scenario editor window, in place of the button to open the search dialog, is a menu listing available searches. That menu will always have two default choices, "Desired" and "Undesired", which open the search dialog with nothing set other than the desired/undesired selection. Other saved search selections appearing in the scenario editor menu may open the search dialog configured for the saved search; however, a saved search may also run immediately when selected without opening the dialog. In the search dialog next to the "Save" button is an "Auto-run" check-box. If that is checked when the search is saved, it will run automatically when selected from the scenario editor menu. Saved searches with the auto-run setting have "(auto)" following the name in the menu. However, auto-run is not triggered when selecting a saved search from the menu in the search dialog itself. If you need to edit an auto-run search, first open the search dialog using some other selection (e.g. "Desired" or "Undesired"), then select the auto-run saved search from the menu in the dialog. A saved search preserves all search settings in the search dialog, including any SQL code entered with the "Add SQL" button, but it does not preserve the station data selection. When choosing an auto-run saved search from the scenario editor, the study's default station data will be used for the search. If the study does not have a default station data set, selecting an auto-run search will open the search dialog configured for the saved search so the desired station data can be selected.

When finished, click "Add".

After reviewing CDBS/LMS data warning messages (see page 46), if any, click "OK."

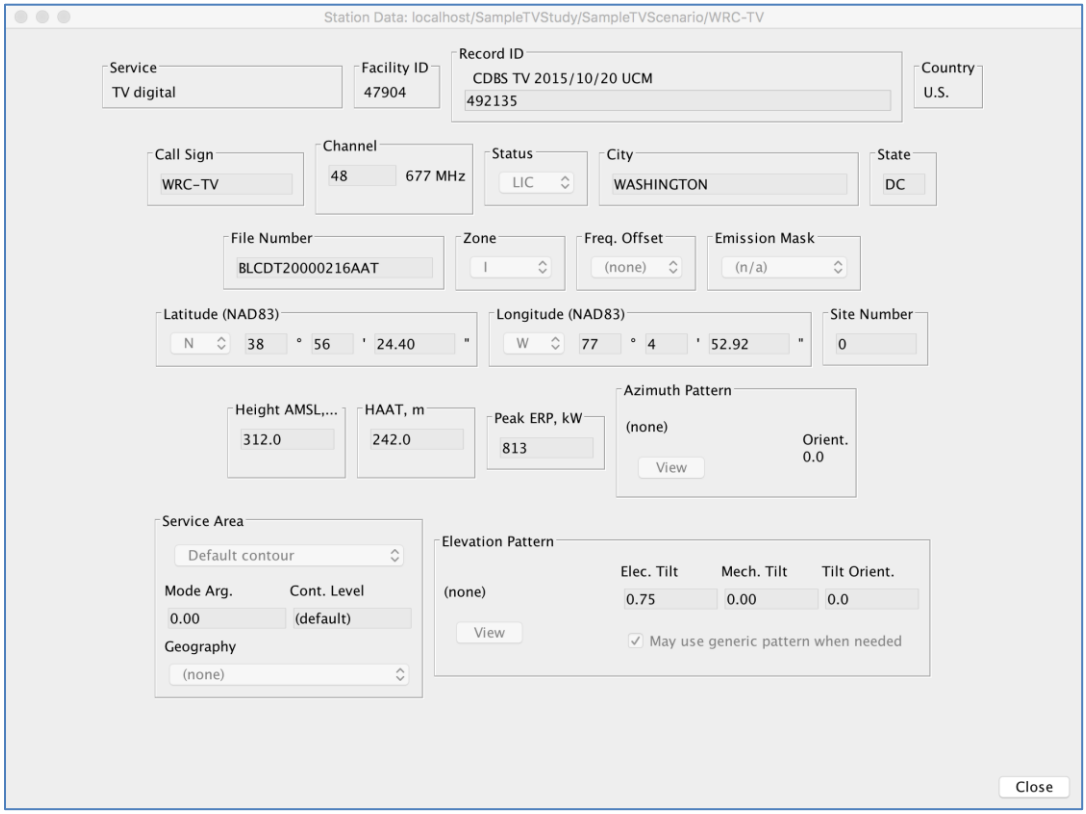
TVStudy then tells you how many stations it found. Click "OK," and now you will see the stations you selected appear in your scenario.

Modifying and Replicating Station(s) in a Scenario

One way of providing additional flexibility when studying stations in TVStudy is to allow modification of a station's engineering parameters.

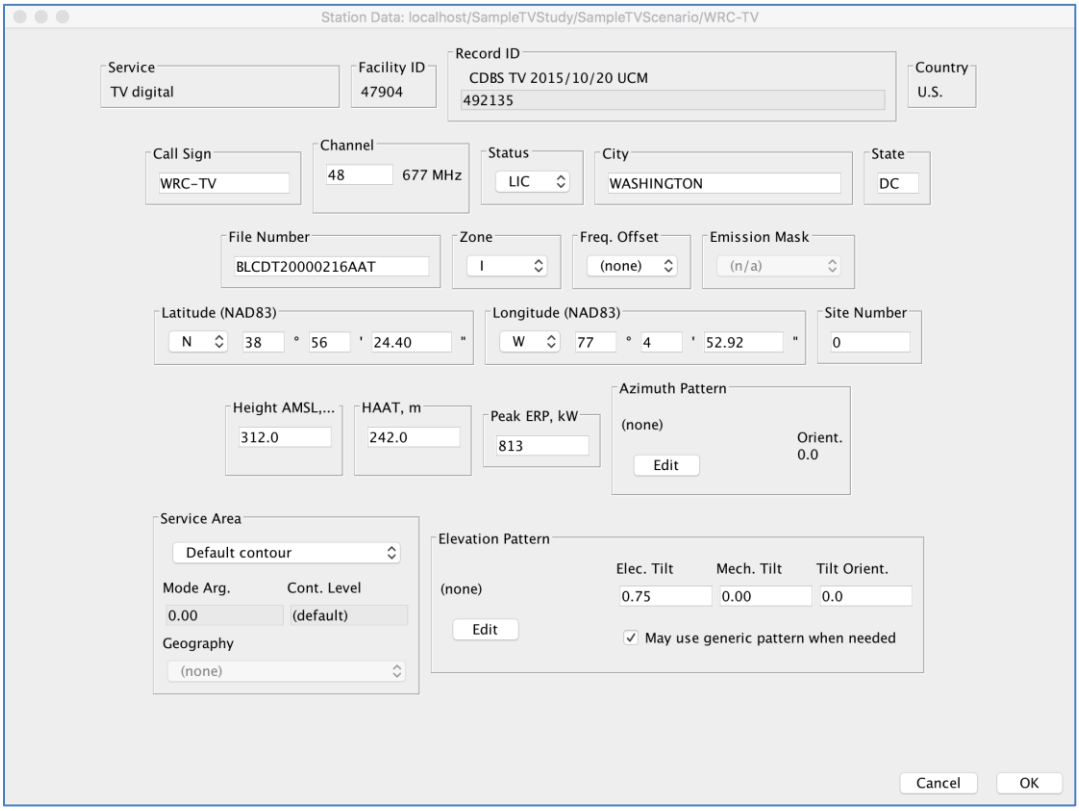
Modifying and Reverting Stations

To view details about a record, click "View" at the bottom right corner of the Scenario window.



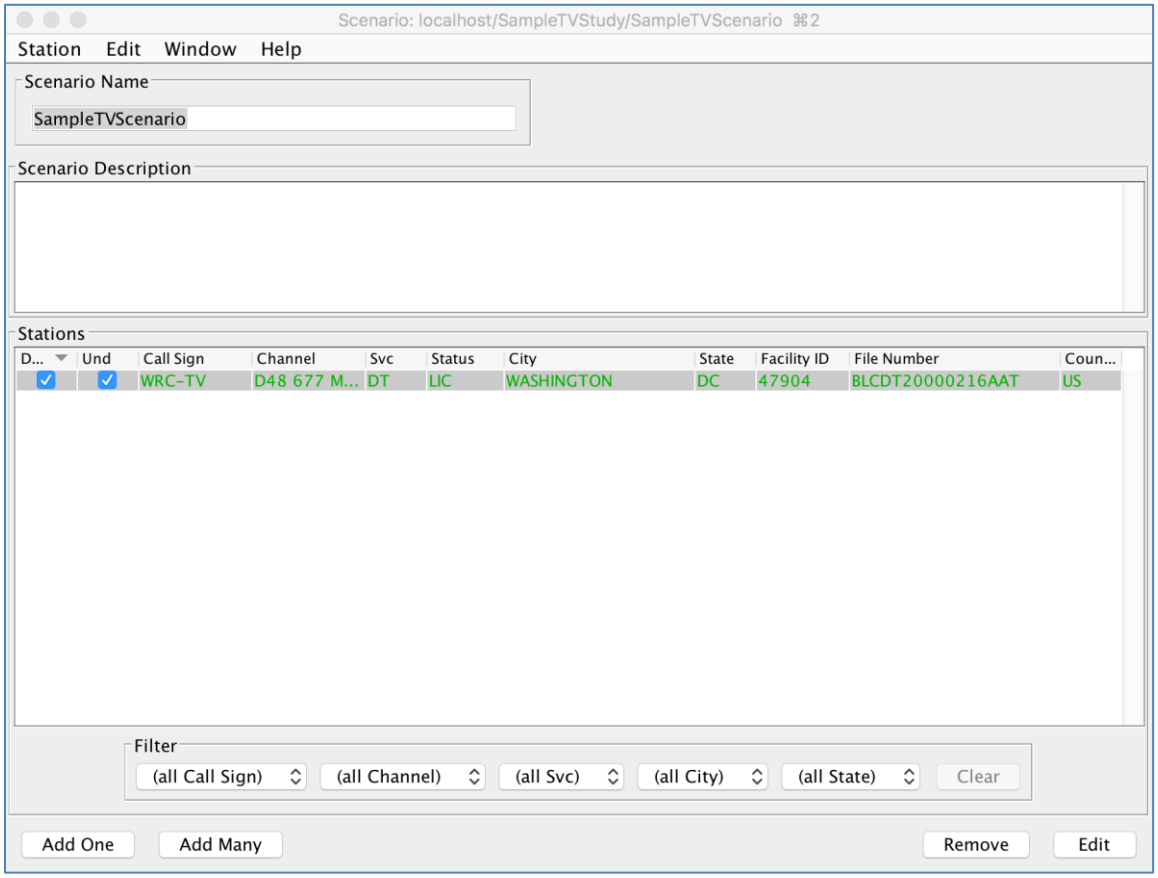
Note that the parameters in this window are grayed out and cannot be edited; this is a feature of TVStudy. An entry that cannot be edited is known to be consistent across multiple scenarios. As such, any calculations made about its coverage and/or interference can be cached and reused in other scenarios in the study. However, it is also possible that the values in CDBS/LMS may not be what you wish to use in a given scenario. By clicking "OK" and going back to the Scenario window, you can choose "Allow Editing" from the Station drop-down menu and edit the record.

The appropriate window opens and you can make the edits you wish to the relevant parameters in the record.



Some values cannot be changed, such as the country or service, but the other values can be adjusted as desired. Note that if you set the "Height AMSL" field to "-999", TVStudy will compute the height AMSL from the HAAT value. Similarly, setting the "HAAT" field to "-999" will cause TVStudy to compute the HAAT from the height AMSL value. If both values are set to "-999", TVStudy will assume the transmitter is above the ground by the value given in the Minimum transmitter height AGL parameter in the Propagation menu. It will add that height to the ground elevation to derive the height AMSL and then compute the HAAT accordingly.

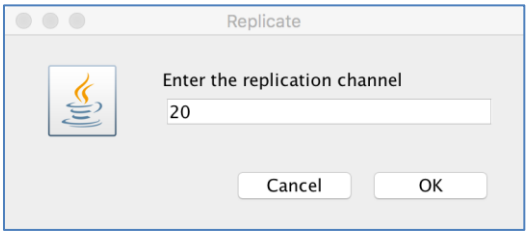
When you're finished, click "OK".



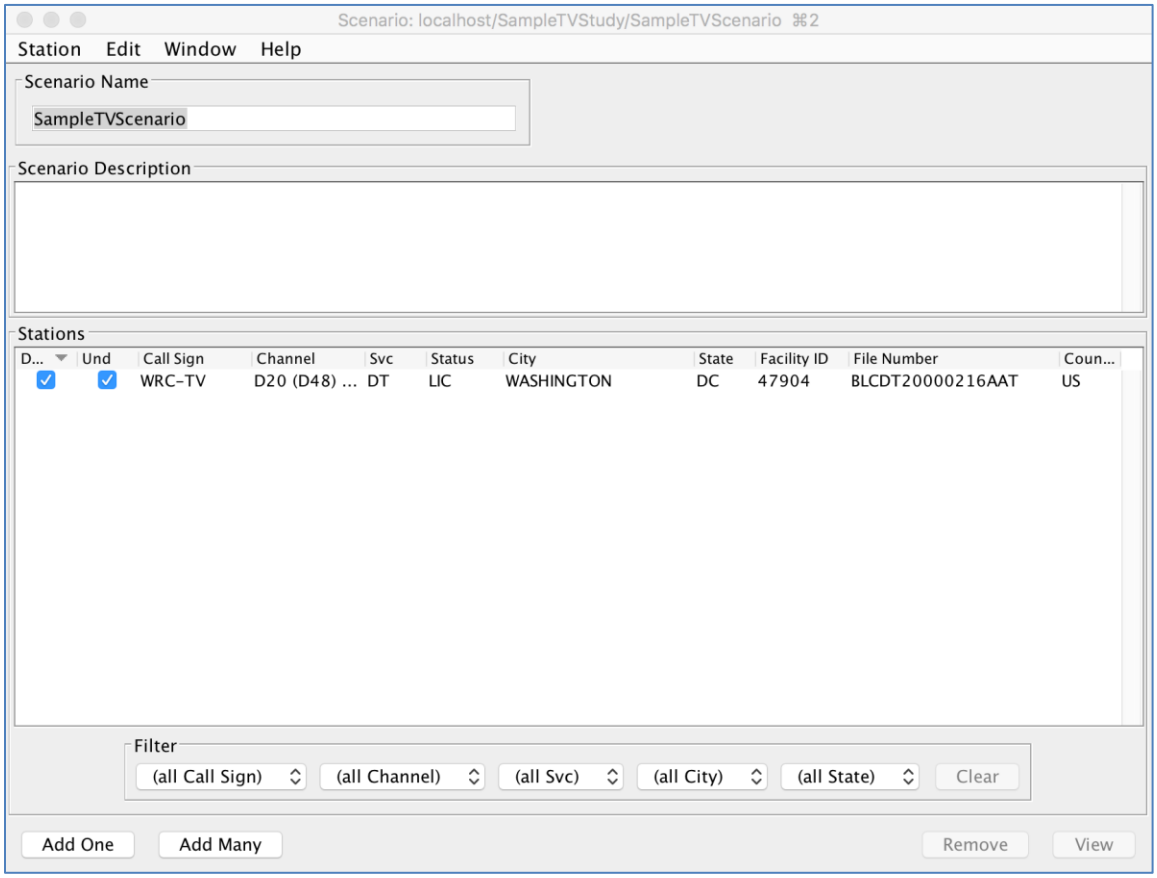
Editable records appear in green in the Scenario window. If you want to revert back to the original unedited record values, choose "Revert" from the Station dropdown menu.

Replicating Stations

A feature of TVStudy is that you can choose to replicate a station's coverage on a different channel. To do so, select "Replicate…" from the Station dropdown menu.

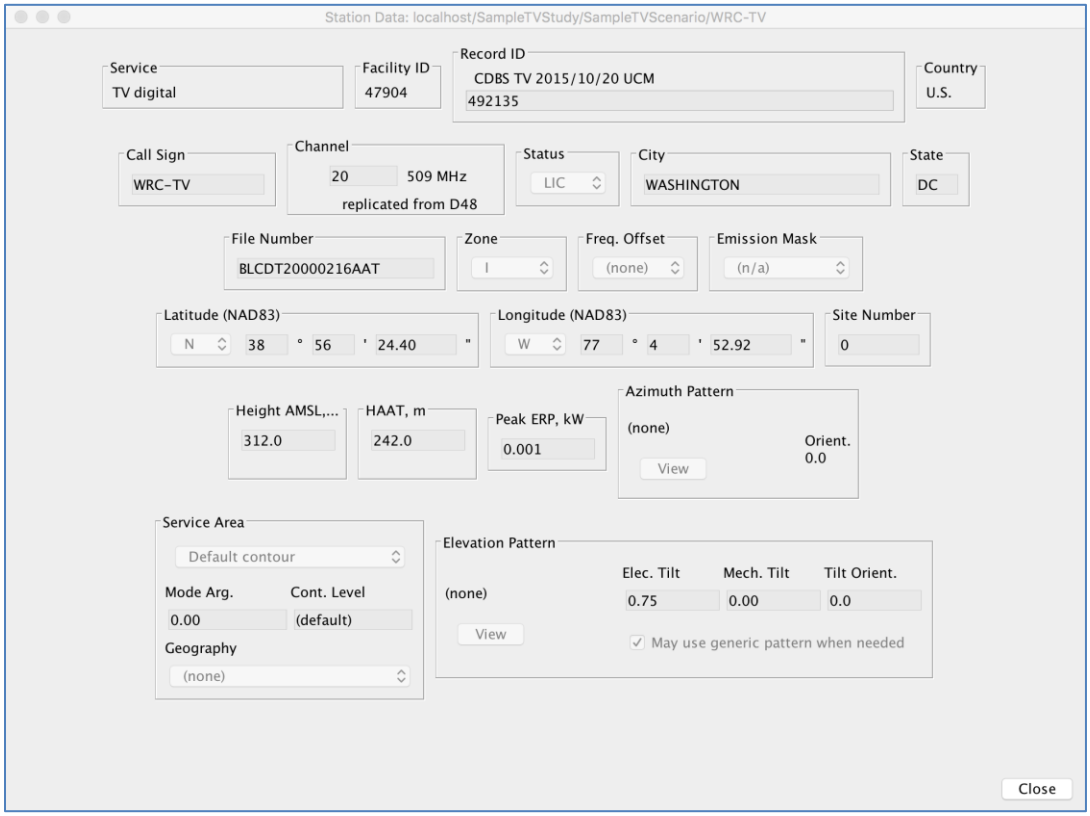


Enter the channel you wish to replicate to and click "OK."



In the above example, you can see that the "Channel" column now shows D20 as the replication channel, while (D48) appears in parentheses to show the station's original channel number.

Replication of either an analog or digital record will produce a digital replication. TVStudy will not replicate stations to new analog channels under any circumstance.



If you view the replicated record prior to running a study, you will note that the ERP is now listed as 0.001 kW. The replication power level is not determined until runtime. TVStudy, upon running the study, will increase the ERP as needed until the station is replicated on the new channel, after which viewing this record will show the resulting ERP.

As with Editable records, choosing "Revert" from the Station menu will return the replicated station to its original channel.

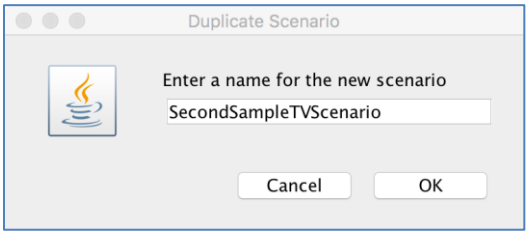
When you are satisfied with your scenario, close the Scenario window and return to the Study window.

Managing Scenarios

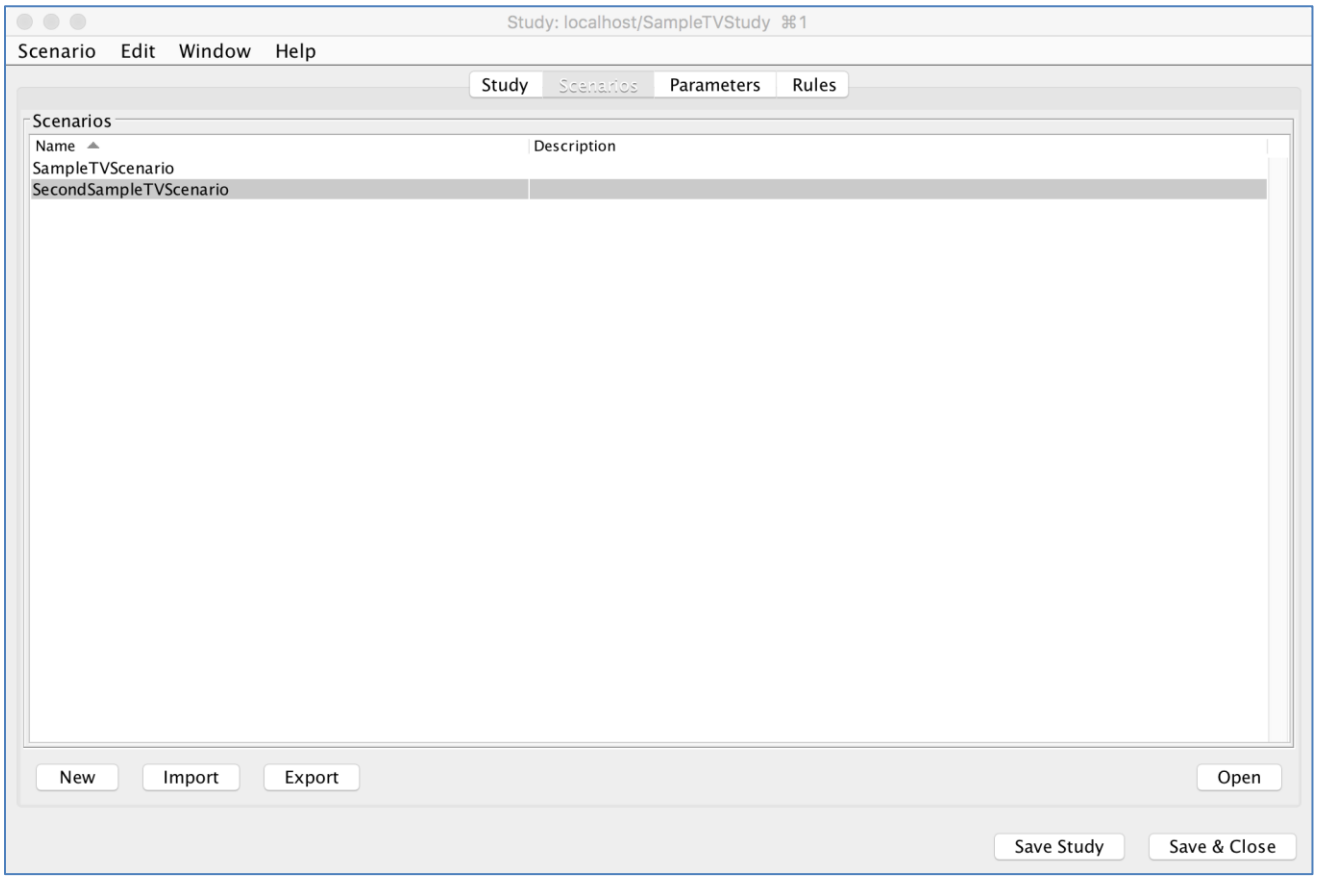
Duplicating a Scenario

One useful feature in TVStudy is the ability to duplicate a scenario.

Choose the "Duplicate…" option from the Scenario dropdown menu.



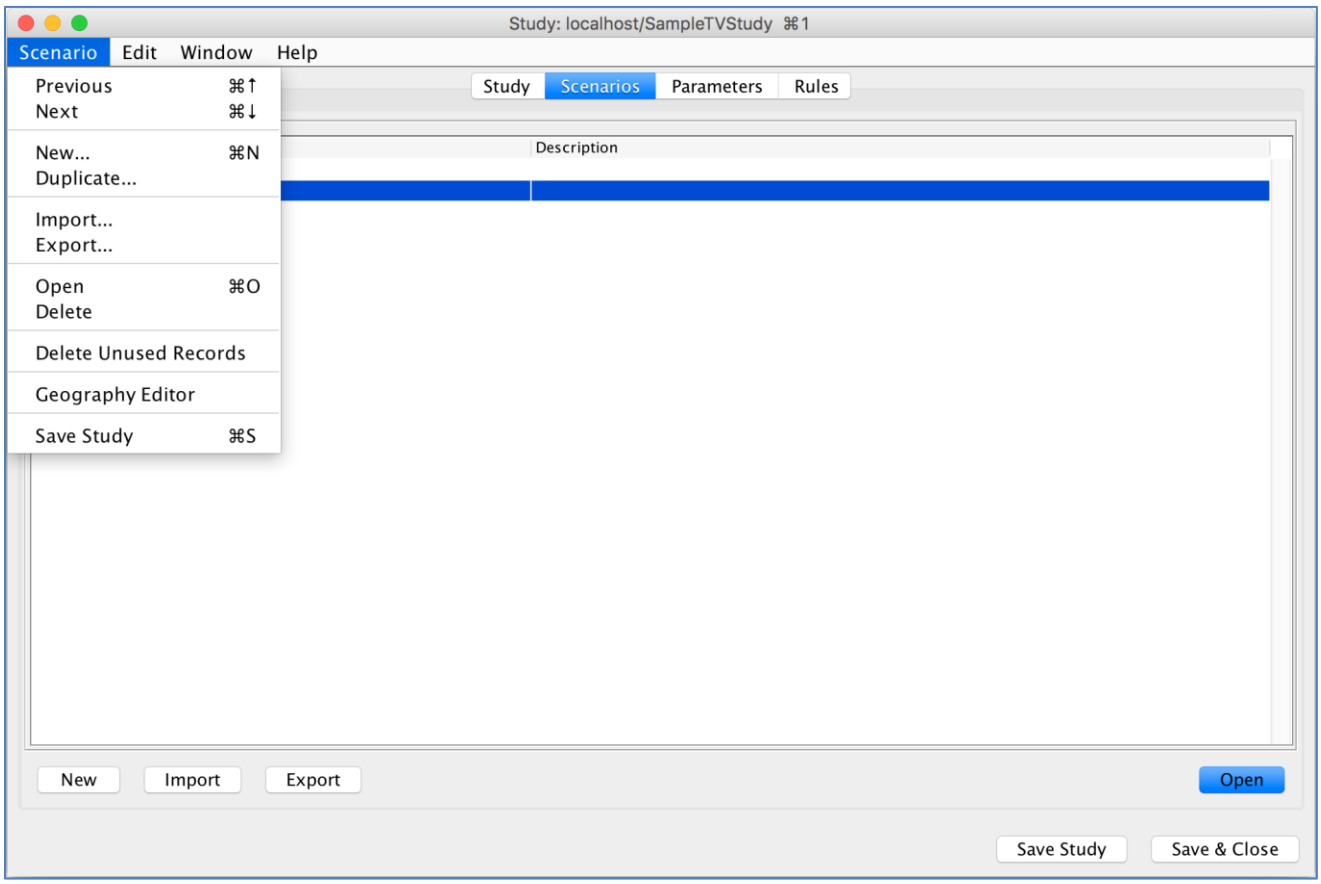
You are prompted to give the new scenario a name. You will want to avoid special characters and limit the length to a reasonable number of characters, since this name is used as part of the path for your output files. TVStudy immediately opens the new duplicate scenario for you, on the assumption that you will immediately wish to make some modifications.



When finished, close the scenario and both scenarios will be visible in the Study window.

Importing, Exporting, and Deleting Scenarios

Other useful features are the ability to import, export, and delete scenarios. Importing and exporting scenarios can be useful for comparing the results of a scenario across multiple studies. You can also delete scenarios that are no longer required.



To export a scenario, click "Export" at the bottom left. The file is exported as an XML file, so navigate to where you would like to save it, give it a name, and click "Save." See Appendix G for details on the XML file format.

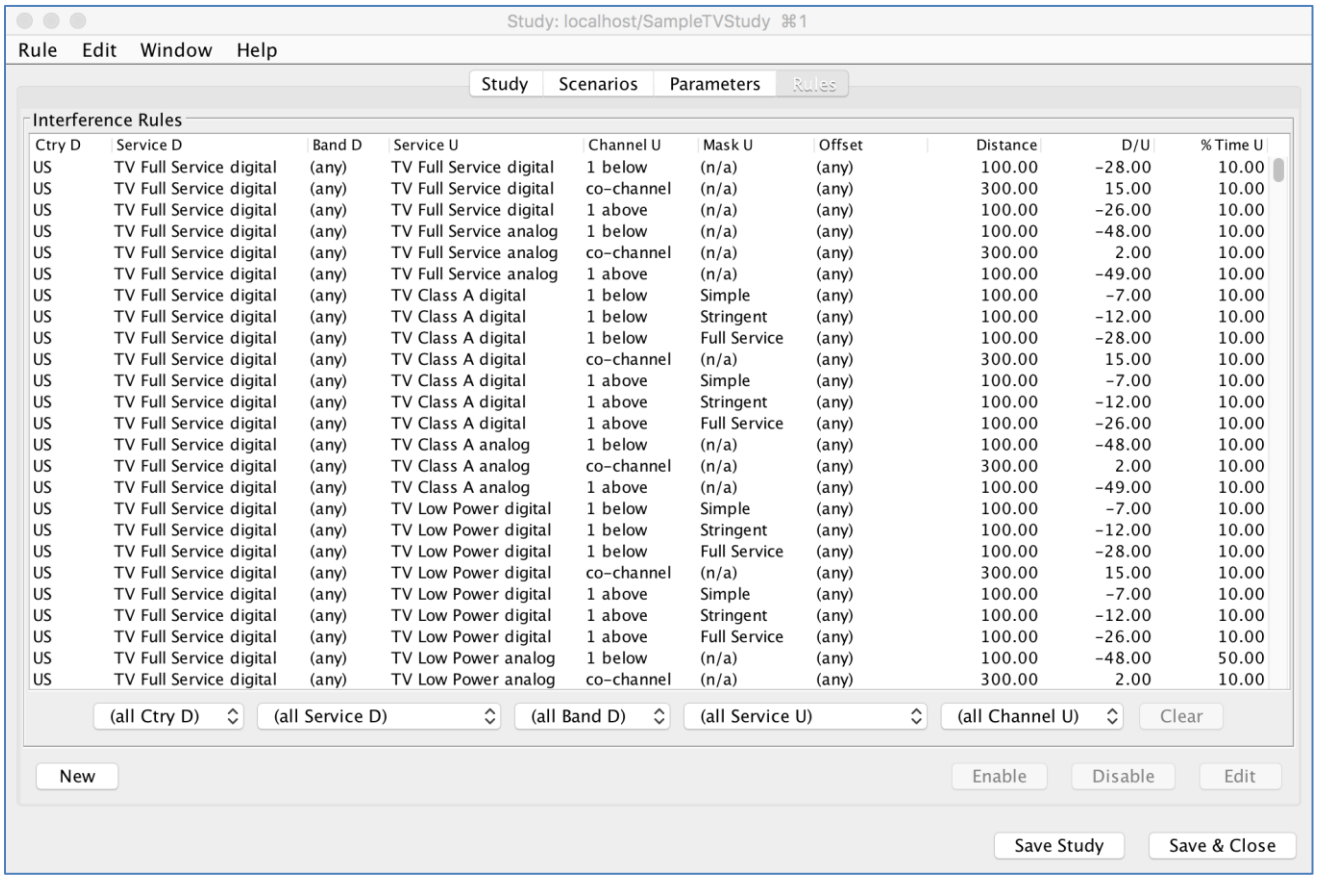
To import a scenario, click "Import" at the bottom left. Navigate to where the file you wish to import is located, click on it, and click "Open."

To delete a scenario, click on the scenario you would like to delete, then select "Delete" from the Scenario dropdown menu.

If you receive a message that TVStudy is out of keys and you have previously deleted stations or scenarios from a study, try using the "Delete Unused Records" option. This will remove records which are kept in a study even after they are deleted in case they are needed again. This will free keys for use in the study.

Examining the Study Rules

Clicking on the Rules tab will show you all of the rules that are used in this study. These are the values specified in OET Bulletin No. 69 or suggested by the FCC, and are typically not changed. You can filter them, edit them, disable or enable them, and you can change multiple parameters at once using "Enable/Disable by Type" in the Rule menu.



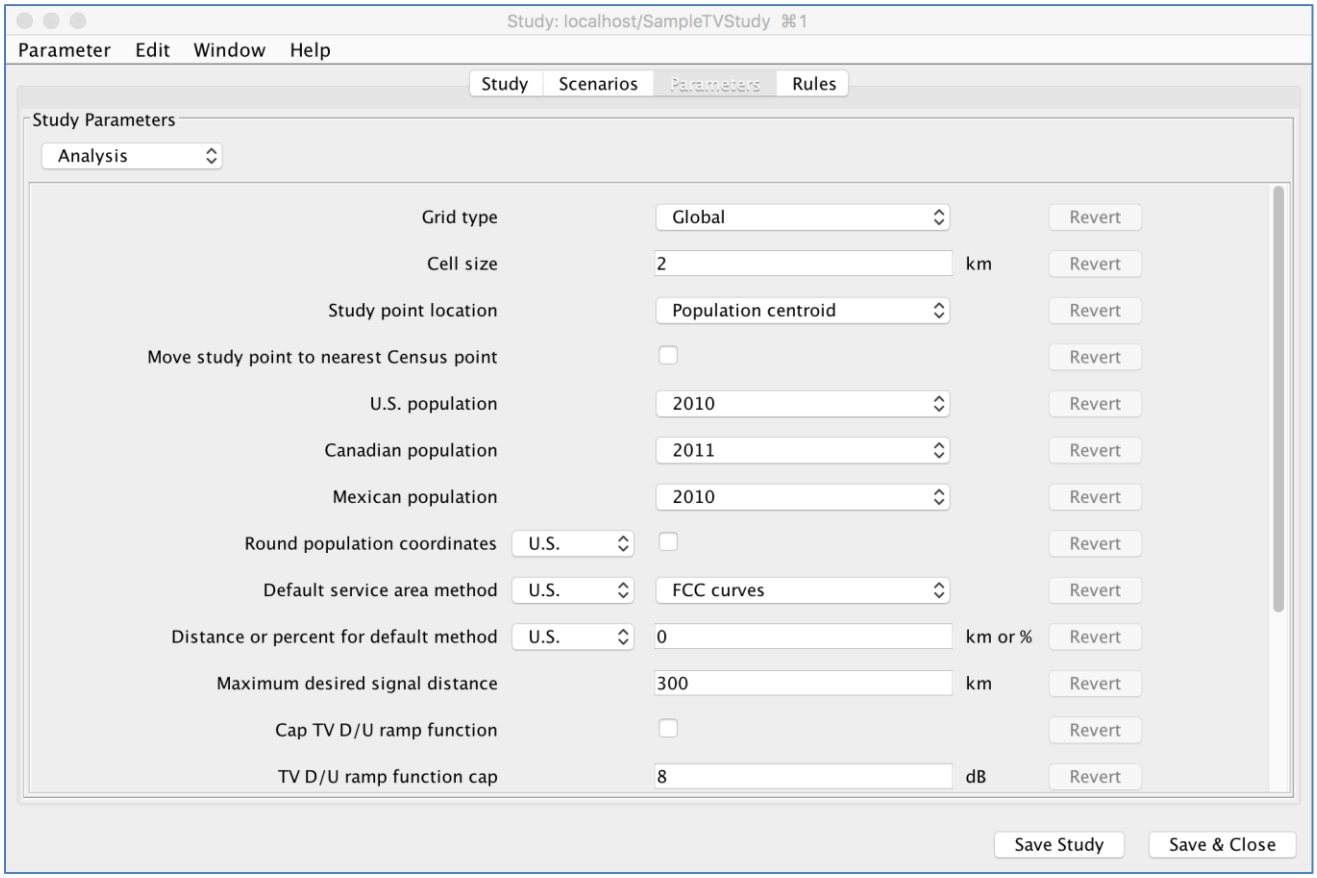
Ctry D	Service D	Band D	Service U	Channel U	Mask U	Offset	Distance	D/U	% Time U
US	TV Full Service digital	(any)	TV Full Service digital	1 below	(n/a)	(any)	100.00	-28.00	10.00
US	TV Full Service digital	(any)	TV Full Service digital	co-channel	(n/a)	(any)	300.00	15.00	10.00
US	TV Full Service digital	(any)	TV Full Service digital	1 above	(n/a)	(any)	100.00	-26.00	10.00
US	TV Full Service digital	(any)	TV Full Service analog	1 below	(n/a)	(any)	100.00	-48.00	10.00
US	TV Full Service digital	(any)	TV Full Service analog	co-channel	(n/a)	(any)	300.00	2.00	10.00
US	TV Full Service digital	(any)	TV Full Service analog	1 above	(n/a)	(any)	100.00	-49.00	10.00
US	TV Full Service digital	(any)	TV Class A digital	1 below	Simple	(any)	100.00	-7.00	10.00
US	TV Full Service digital	(any)	TV Class A digital	1 below	Stringent	(any)	100.00	-12.00	10.00
US	TV Full Service digital	(any)	TV Class A digital	1 below	Full Service	(any)	100.00	-28.00	10.00
US	TV Full Service digital	(any)	TV Class A digital	co-channel	(n/a)	(any)	300.00	15.00	10.00
US	TV Full Service digital	(any)	TV Class A digital	1 above	Simple	(any)	100.00	-7.00	10.00
US	TV Full Service digital	(any)	TV Class A digital	1 above	Stringent	(any)	100.00	-12.00	10.00
US	TV Full Service digital	(any)	TV Class A digital	1 above	Full Service	(any)	100.00	-26.00	10.00
US	TV Full Service digital	(any)	TV Class A analog	1 below	(n/a)	(any)	100.00	-48.00	10.00
US	TV Full Service digital	(any)	TV Class A analog	co-channel	(n/a)	(any)	300.00	2.00	10.00
US	TV Full Service digital	(any)	TV Class A analog	1 above	(n/a)	(any)	100.00	-49.00	10.00
US	TV Full Service digital	(any)	TV Low Power digital	1 below	Simple	(any)	100.00	-7.00	10.00
US	TV Full Service digital	(any)	TV Low Power digital	1 below	Stringent	(any)	100.00	-12.00	10.00
US	TV Full Service digital	(any)	TV Low Power digital	1 below	Full Service	(any)	100.00	-28.00	10.00
US	TV Full Service digital	(any)	TV Low Power digital	co-channel	(n/a)	(any)	300.00	15.00	10.00
US	TV Full Service digital	(any)	TV Low Power digital	1 above	Simple	(any)	100.00	-7.00	10.00
US	TV Full Service digital	(any)	TV Low Power digital	1 above	Stringent	(any)	100.00	-12.00	10.00
US	TV Full Service digital	(any)	TV Low Power digital	1 above	Full Service	(any)	100.00	-26.00	10.00
US	TV Full Service digital	(any)	TV Low Power analog	1 below	(n/a)	(any)	100.00	-48.00	50.00
US	TV Full Service digital	(any)	TV Low Power analog	co-channel	(n/a)	(any)	300.00	2.00	10.00

You can filter rules by type in order to more easily locate rules you wish to view or modify. Simply use the dropdowns in the "Filter" area. To remove the filtering, click the "Reset" button at the right.

Study templates also include values for the rules, meaning that if you devise a set of custom rules and then save or export a study template, the rules specified will be included.

Setting the Study Parameters

To set study parameters, click the "Study" tab.



The Study Parameters section is broken up into groups accessed by a dropdown, which contain parameters that are generally related to each other. There are many parameters that can be adjusted as desired. The parameter settings are memorialized in the TVStudy Settings output file which can be used by others to duplicate your study settings. To see a complete list of these parameters, please see Appendix A.

When finished with your study, click "Save Study" and close the Study window, or click "Save & Close".

Differences with an FM General Purpose Study

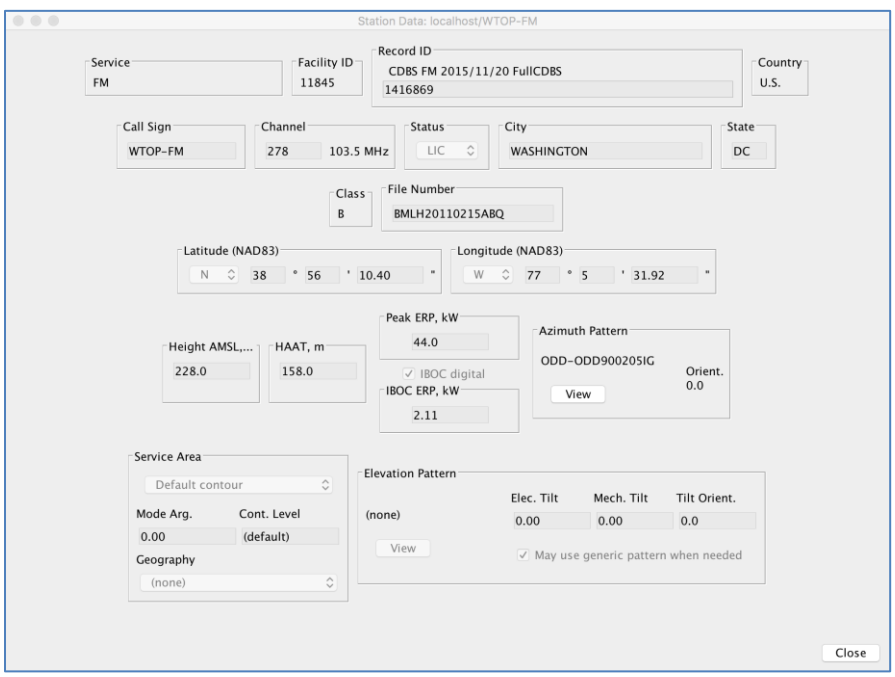
FM general-purpose studies are nearly identical to TV general-purpose studies, with two major exceptions.

53rd and 54th Adjacent Rules

TVStudy has support for 53rd and 54th adjacent interference calculations. While this is contained in the Rules tab like any other rule, it behaves slightly differently from other rules. While the D/U ratio is given as 0 dB for these cases, that D/U ratio is only triggered if the field strength in the cell for both stations is at least 91 dBu. This value and behavior was determined by the FCC in NPRM FCC 88-87 and R&O FCC 89-64, in docket 86-144.

IBOC Interference

TVStudy has support for computing interference caused by IBOC transmissions of adjacent channel FM stations, which can be turned on or off with a parameter setting in the Analysis tab. As such, when viewing or modifying a station, you will see an extra field, as shown in the picture here:

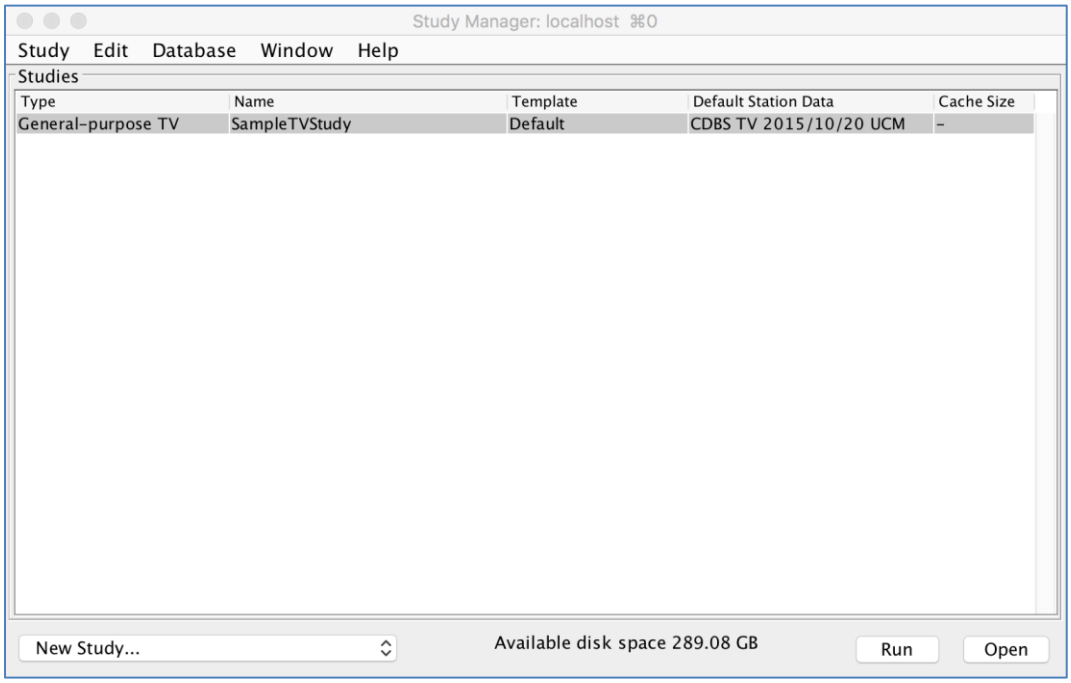


TVStudy uses CDBS to determine whether or not a station is operating with IBOC in order to prepopulate the IBOC digital checkbox for each station added to a scenario. It further attempts to determine the power of the IBOC signal from CDBS records, but if it cannot for any reason, it assumes the default -20 dBc power value.

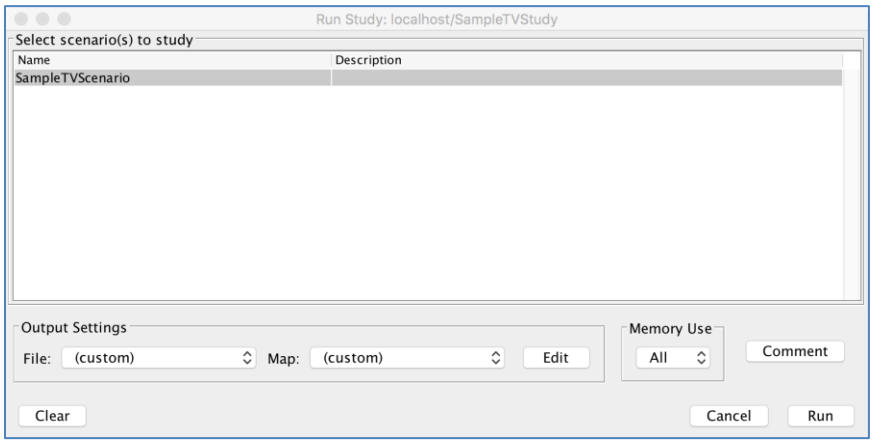
The presence of interference is calculated based on the formula that was used to determine the F(50,10) contour overlap prohibition as proposed by iBiquity and NPR and adopted by the FCC in DA 10-208 (page 6). Using the standard FCC adjacent channel interference rules, this interference is masked up to -14 dBc and only alters results at power levels higher than that value.

Running Your Study

Running a General Purpose Study



To run a study, click on the study you wish to execute, then click "Run" at the bottom right corner.



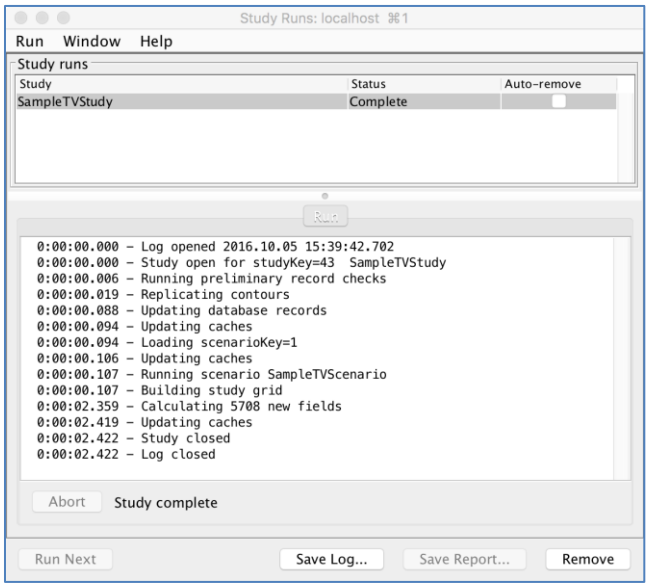
By default, all of the scenarios are selected to be run, but you may click on the scenario(s) you wish to run if you wish to only run some or one of the scenarios included. If you select no scenario(s), TVStudy will do some initial calculations, such as contour projection, and cache the resulting data for future scenario runs. However, this will produce no output data.

Next, you can select the output files you wish to output from this run. Details on the output file configuration can be found on page 35.

You are then able to select the amount of free memory to be used in your study. If you plan to run more than one study at a time, it may be useful to allocate only a fraction of the available memory to a particular run.

You can also add a comment to be included in your report, CSV, and/or cell file(s).

When you are satisfied, click “Run.”



The run window is relatively simple. At the top, a queue of all the study runs that are running, queued to run, or have finished without being removed are listed. The current one is highlighted, and can be viewed at the bottom. While running, the bottom pane indicates what TVStudy is doing, gives an estimate of how much time may be remaining, and has an Abort button.

Important: If you choose to abort a study while it is running, <u>avoid doing so when the last line in the output window reads “Updating Caches”</u> as this can lead to data corruption issues. If you do this, you should clear the cache on the study before rerunning.

At the bottom left is a "Run Next" button which allows you to move a highlighted queued study run to the top of the queue beneath the currently running study.

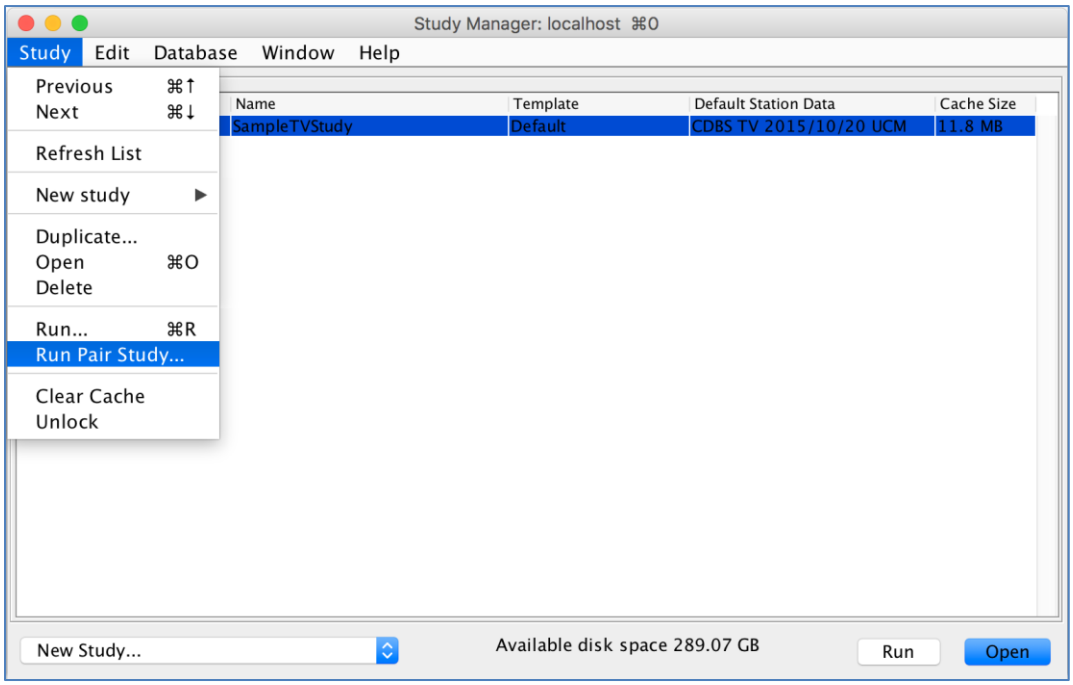
When the run is finished, you can save the contents of the run window to a file by selecting the "Save Log" option. Click “Remove” to remove a completed study from the pane at the top. If no studies are remaining, the “Remove” button becomes a “Close” button which will return you to the Study Manager window.

Your output files have been placed in a directory structure within the “out” directory. The folder structure follows the format of `../out/<servername>/<studyname>/<scenarioname>`.

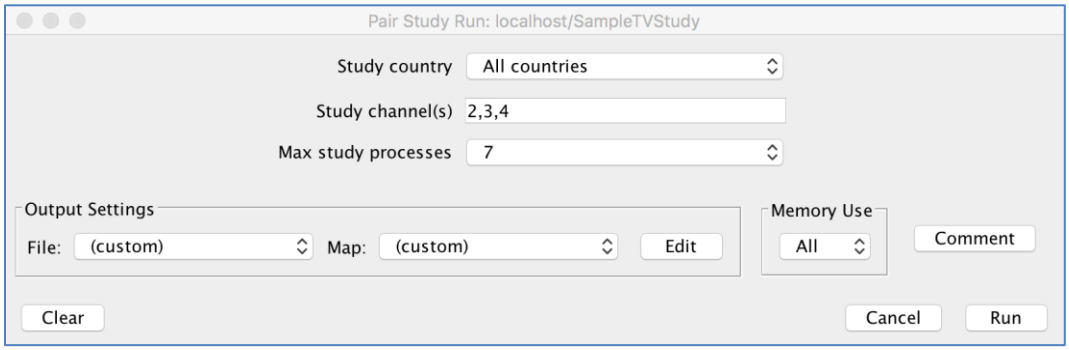
Running a Pair Study

One of the key features of TVStudy is the ability study arbitrary pairs of stations on one or more specified channels to see whether they can coexist based on some interference criteria. This is called a "pair study." A pair study takes every pair of stations and studies them on the same channel (co-channel) as well as with each station placed lower-adjacent and upper-adjacent to the other, in order to determine interference levels in each channel relationship. The pair study produces a set of CSV files with cell-by-cell determinations of service and interference designed to be input into post-processing software. These instructions will show you how to run a pair study. Post-processing these data is not part of TVStudy and is not covered in this manual.

First, in order to successfully run a pair study, your Study must have a single Scenario. In addition, no stations from Guam, American Samoa, or any other location in the southern or eastern hemispheres can be included, and TVStudy cannot run a pair study if any stations north of 73 degrees latitude are included.



In the Study Manager window, choose "Run Pair Study…" from the Study dropdown menu.

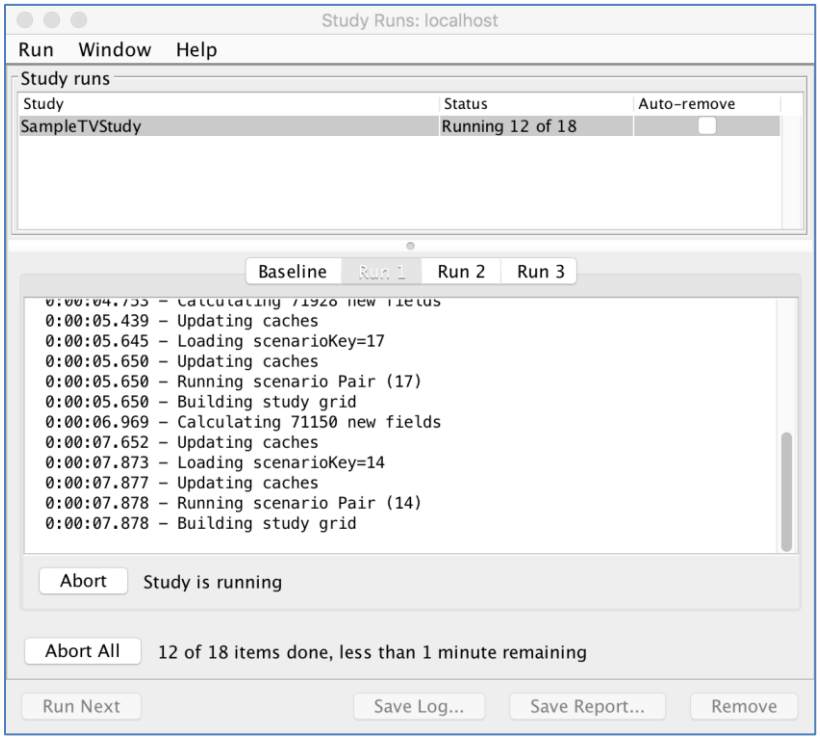


In the Run Pair Study window, enter the country you wish to study (or all countries), the channel(s) on which you wish to run your pair study (these channels are the co-channel study, the associated adjacent channels are determined automatically), and then choose the number of processes you would like to use. TVStudy will offer you as many processes as you have processors or cores as reported by your operating system, and it is recommended that you run at least one less than the maximum number provided, to allow for database access overhead without causing the system to slow down. Attempting to run more than 10 channels at a time is not recommended due to various memory constraints. If your computer has a small amount of RAM, more restrictive limits (*i.e.*, fewer than 10 channels) may apply.

The software can also produce many of the standard output files for the baseline. (See page 35.) The Cell file output is unavailable in a pair study, but the normal pair study output files provide cell-level data. (See Appendix F.)

The pair study may consume as much RAM as is determined to be free by TVStudy. If you try to run other studies while TVStudy is executing a pair study, the software will queue those studies to run after the pair study is complete, or you can limit the amount of memory used as in a normal study run. You can also set a comment to be included with your output files.

When you are satisfied, click “Start.”



Pair studies are contained in the same Study Runs window as other studies. As the pair study runs, you can monitor its progress by clicking the various tabs as they appear in the bottom pane. It will first calculate the numbers of stations and pairs to be studied, and then it will run a baseline study of the stations on their original channels to determine existing interference conditions. Next, the software will take a sufficiently large run and break it into as many pieces as the number of assigned processes, and will run pair studies for every combination. Finally, the resulting data is post-processed and then output to the appropriate "out" directory, leaving six files which are documented in Appendix F.

When you click "Remove," the software will restore the database to its normal state.

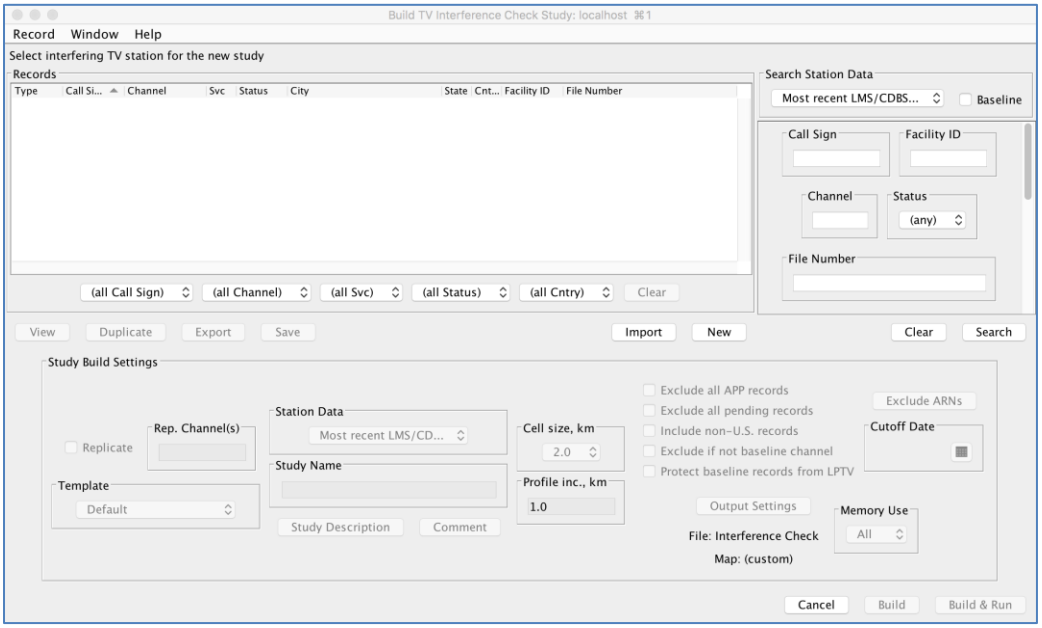
Configuring and Creating TV Interference Check Studies

TVStudy has the ability to run TV interference check studies. This is the kind of study that the FCC Media Bureau's *tv_process* software was previously used to produce for TV application processing, in which new applications can be evaluated to determine whether or not they meet the FCC's interference standards.

Creating and Running an Interference Check Study

Before creating a TV Interference Check study, you first need to be sure to import at least one dataset, preferably an LMS dataset for post-Incentive Auction studies, so that the TV Interference Check mode has a source from which to build studies.

Much of the process of creating and running an interference check study is automated, but you must start the process. To begin, from the Study Manager window, click "New study" and choose "TV interference check".



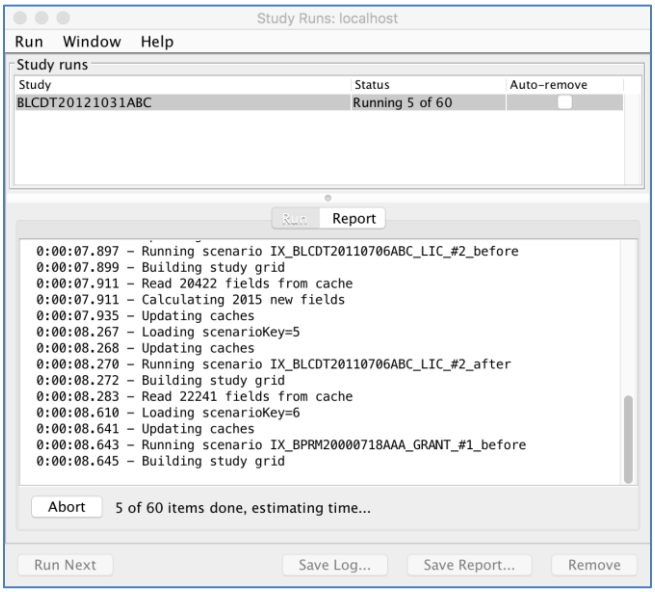
The Interference Check Study window strongly resembles the View Station Data window detailed on page 10 and can be operated in the same way. They key difference here is the added functionality at the bottom. This allows you to set the study description, cell size, profile resolution, and include or exclude specific records from the analysis. You may also exclude specific records; to do so, click the Exclude ARNs button, then put the ARN for each file number to be excluded on a separate line in the "Records to exclude (ARNs)" window. (As an example, if you wish to exclude BLCDT-20090714AAW, you would input only 20090714AAW, leaving off the BLCDT prefix. For LMS-filed records, input the entire file number, for example, 0000003746)

You will also find a collection of checkboxes to modify the construction of the study. The first checkbox allows you to exclude all application records, while the next will exclude pending records, and the third will allow you to include records from outside the US. The fourth is available if the selected template has the Baseline exclusion date set. This was designed to assist in post-

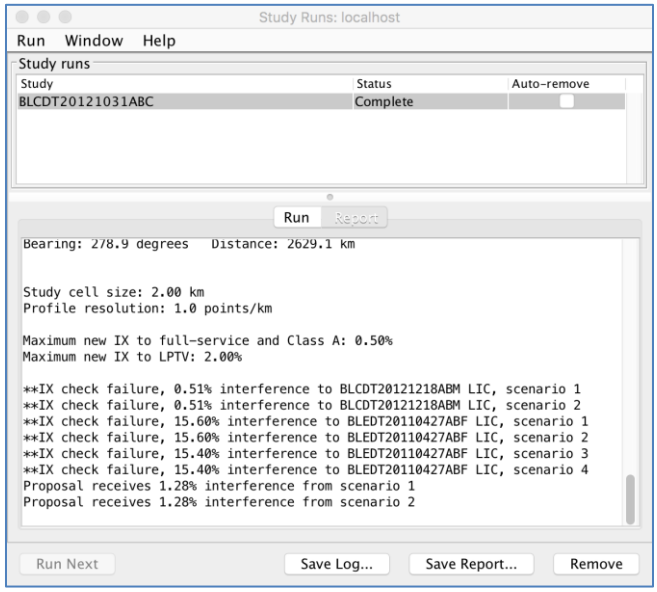
Incentive Auction application processing; applications dated before the date set in the template are only included in the study if the channel matches the channel in the baseline, preventing pre-auction records from being considered. The fifth checkbox is for LPTVs for planning immediately post-Incentive Auction; in the initial 90-day filing period, it may be difficult for an LPTV station to determine what full-power and Class A facilities to protect until those stations file their applications. This checkbox allows an LPTV station to be tested against those baseline facilities before such applications are filed.

(**Note:** A template must be locked with "Lock template only" in order to be used in an Interference Check study. Neither a study locked with "Lock template and study settings" nor an unlocked template can be used. See page 23.)

When you are satisfied that you have selected or created the proper record with the proper study settings, click "Build and Run." (If you want to modify the study before it runs, you can instead choose "Build".) TVStudy will then warn you about any data issues it encounters (see page 46) and automatically generate the necessary scenarios and begin to run.



The run window is similar to that used for General Purpose study runs, with a pane of studies at the top and the selected study at the bottom. The bottom pane has a single Abort button, like the General Purpose study, but now the pane has two tabs.



In addition to the Run tab that is present in General Purpose studies, Interference Check mode also has a Report tab, which contains a summary of the results of the coverage study when it is finished. This output mimics the output that *tv_process* would have provided, including a mention of whether or not an interference check has passed or failed. To save this output, click "Save Report..." at the bottom right. You can also save the log file and remove the study from the run window at the bottom right.

Your output files, including the tvixstudy.txt file which mimics the output of *tv_process* are placed in a directory structure within the "out" directory. The folder structure follows the format of `../out/<servername>/<studyname >`.

Please note that all outputs featuring geographic coordinates are in the NAD83 datum.

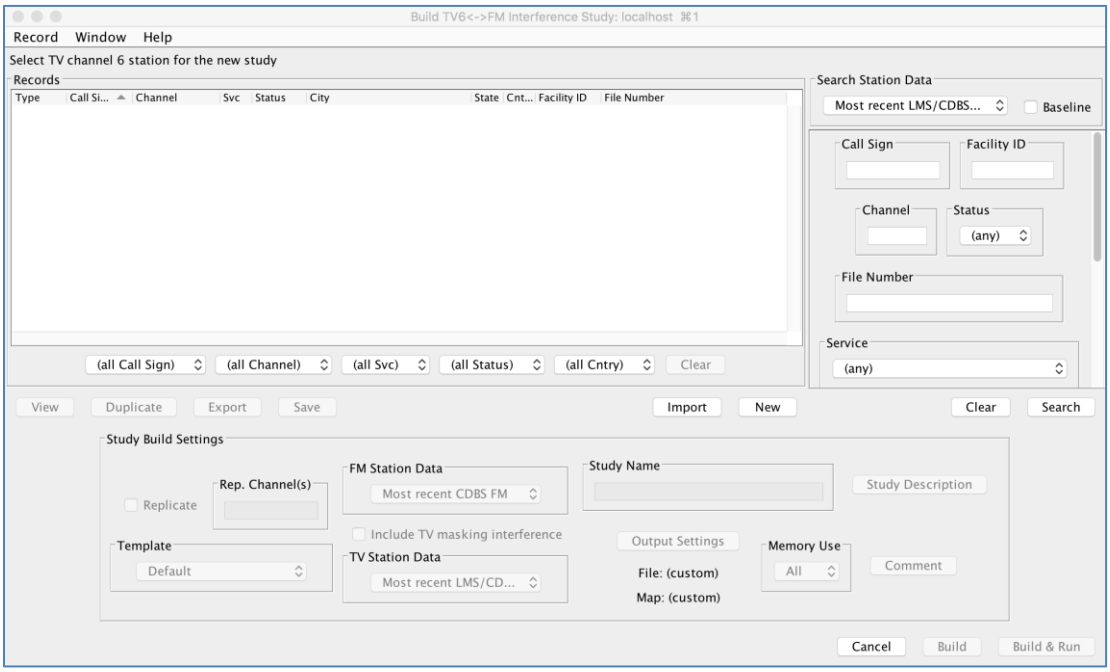
Creating a New TV6<->FM Study

TVStudy has the ability to run interference studies to determine interference between TV Channel 6 and FM. The study evaluates interference in both directions at once, and can evaluate a single desired TV channel 6 station along with an assortment of undesired TV Channels 5 and 6 stations as well as both desired and undesired FM stations in the 88-92 MHz range.

In the TV into FM direction, the rule is simply that a showing must be made, with no explicit requirement of what the showing must contain. OET used some of the studies provided during the DTV transition as a basis for a method of computing this interference potential in TVStudy. In addition, an NPR study from 2009 was used as the basis for an alternative model for predicting FM interference into digital TV Channel 6. TVStudy allows the use of either this new method or the existing method via a study parameter (see Page 89), and OET would appreciate informal user feedback on these alternative models. However, users are on notice that suitable procedures have not been established to define interference to digital television from FM stations through a notice and comment rulemaking, and that the results obtained from the use of this feature are therefore not binding on licensees or the Commission.

Using the TV6<->FM Study Wizard

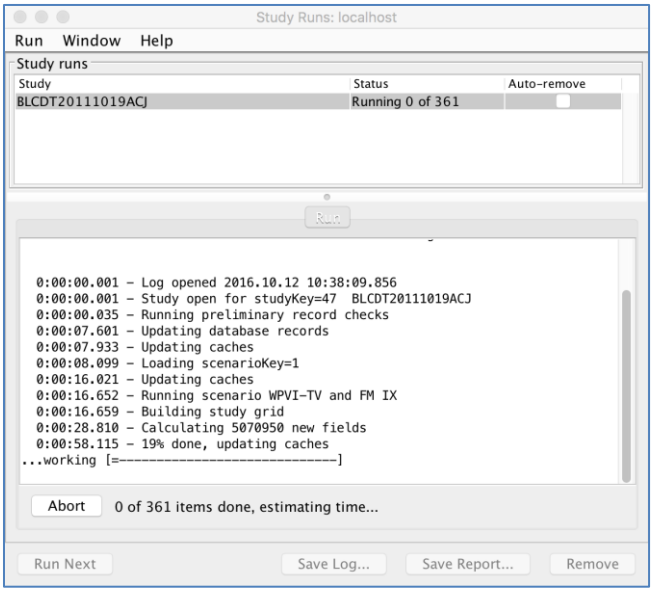
To create a TV6<->FM study using the study wizard, choose "TV6<->FM Interference" from the "New study" drop-down menu at the bottom left corner.



TVStudy now asks for the selection of a TV station, using the normal screens for selecting stations from a dataset. At the bottom are different options that apply only to TV6<->FM studies.

First, at the left, you can replicate a station not on channel 6 to channel 6 in order to evaluate it. You can also edit a record without saving for use in your study without using the replication function.

Next, select the FM station data you wish to you. You can also choose to include or exclude TV masking interference and choose the dataset from which to gather it. The name, description, output files settings, and memory usage can also be set here. Then you can either Build the study or Build & Run. Building the study allows you to modify it before running, while Building and Running starts the run as soon as the build is complete.



When finished, the result files, which are otherwise identical to the general purpose output files, will show coverage and interference for both TV channel 6 and FM.

Using the Advanced Mode

The Advanced mode works exactly the same way as a general purpose study, except that you will be immediately prompted to add a channel 6 TV station as soon as you create a scenario within the study. Then simply add FM and other channel 5 and 6 TV stations as desired. For more information, see the instructions for working with general purpose studies on page 39.

Creating and Running Wireless to TV Interference Studies

Wireless to TV interference studies in TVStudy apply the procedures described in OET Bulletin No. 74[3] to determine interference between wireless and a single victim DTV station.

Culling distances are based on the distance between the closest point on the TV station contour and the location of the wireless site and distances are calculated in TVStudy using the cosine method of calculating distances. If you wish to edit the culling distances, you can do so on the wireless tab of the study parameters so long as the study settings of the study template are not locked.

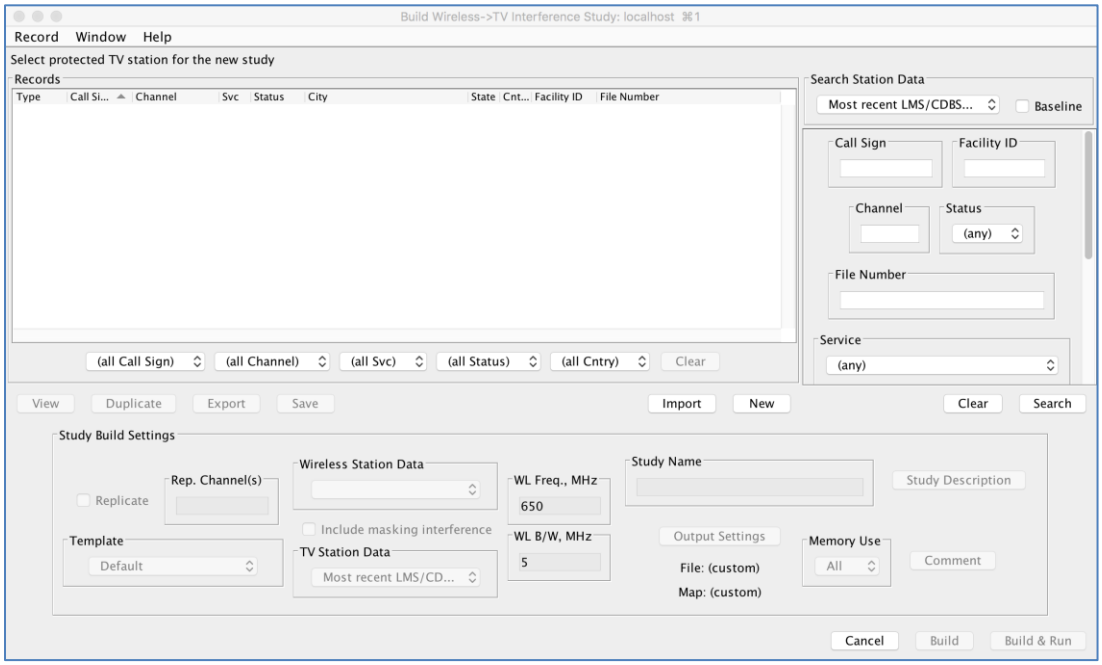
There are two ways to set up and run a Wireless to TV interference study; via the study wizard or using the advanced wireless to TV study windows.

Using the Wireless to TV Study Wizard

To create a wireless to TV interference study using the study wizard, you will first need to import a wireless site dataset and corresponding wireless antenna dataset. See the "Managing Datasets" on page 9 and Appendix B on page 91 of this manual for information on how to do this.

Once you have imported your wireless/antenna datasets, you are ready to create a new Wireless to TV interference study using the study wizard. To begin, choose "Wireless to TV Interference" from the "New study" drop-down menu at the bottom left corner.

[3] https://www.fcc.gov/bureaus/oet/info/documents/bulletins/oet74/OET74.pdf



At the top of the window, you can search for and choose the victim TV station from any of the existing CDBS/LMS datasets or you can import or create a new a TV station record to serve as the victim TV station. To search an existing dataset, select the dataset from the top drop-down menu and enter any other search criteria. To list all TV stations in a dataset, simply click the "Search" button without entering any other criteria. You can also filter search results using the filter criteria below the search results window.

To import a TV station via XML you can click on the "Import" button and select your XML file with the TV station data. You will be asked to choose an existing CDBS/LMS dataset to resolve any XML references to record IDs. You can also create a new TV user record from this window by clicking on the "New" button and filling in the TV user record form and then clicking "Save".

Near the bottom of the window, in "Study Name," type a name for your study. You will want to avoid special characters and limit the length to a reasonable number of characters, since this name is used to create the path for your output files.

Below that, you must choose a study template to use. The Default template will always be present. Additional templates may be added to allow you to pre-select parameters for your study. The FCC may distribute templates for specific types of studies to help ensure that TVStudy users obtain consistent results. Learn how to create and manage study templates on page 22.

Immediately beneath that is a button which will allow you to add a description of your study.

To the right, you must choose a wireless dataset to use to find interferers for the study. Additionally, you can choose whether or not masking TV interference is to be considered and, if so, from which database those interfering stations should be retrieved.

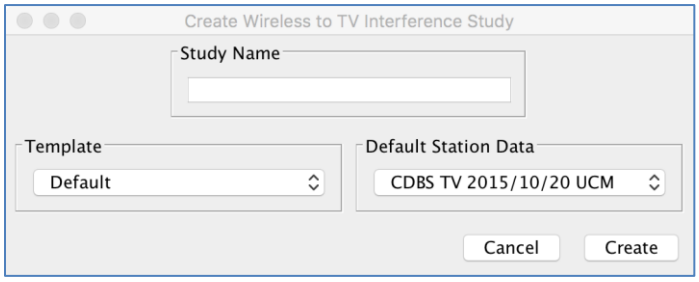
Finally, enter the appropriate wireless frequency and bandwidth to evaluate against the victim TV station in question. The study settings of the template selected must be unlocked in order to set the appropriate wireless center frequency and bandwidth.

Once you have completed all of the above, click "Build" to build the study or "Build & Run" to both build the study and run the analysis. If you have selected a database from which to pull masking TV interferers, your study will include any undesired co-channel or adjacent channel TV stations within the distance specified by the rules in the template.

Using the Advanced Mode

If you wish to create a wireless to TV interference study via XML import or create multiple scenarios within the same study, you can use the advanced mode to create an empty study and then add one or more scenarios.

To build a new scenario in the advanced mode, click "New" at the bottom of the Study window and select "Wireless to TV Interference (advanced)".

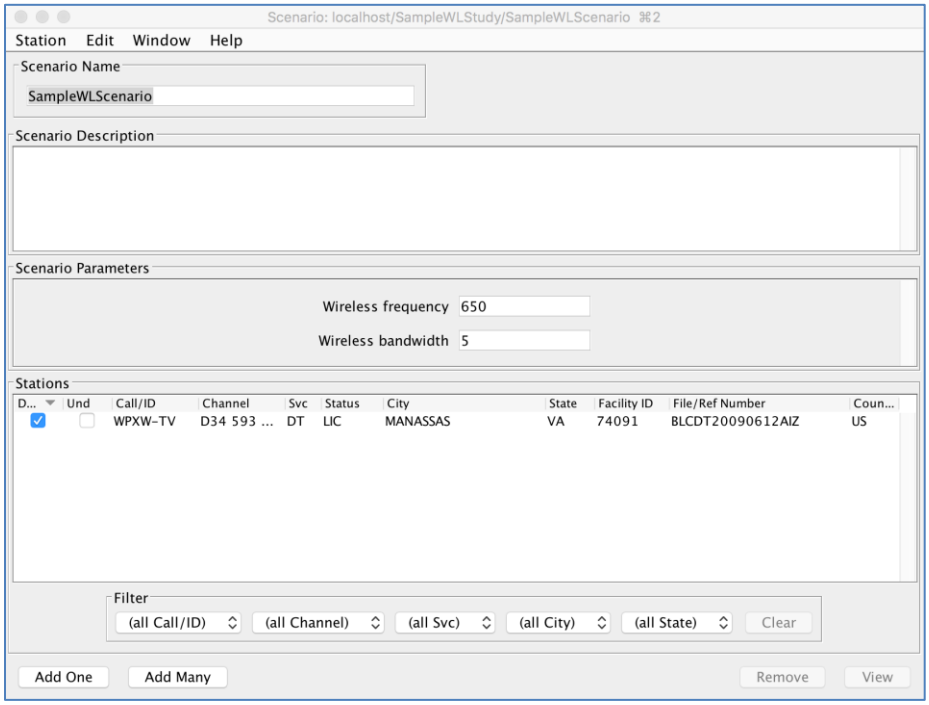


Provide a Study name, select the study template to use, and select the CDBS/LMS TV station dataset for the study to use. Once you have done this, click "Create".

An empty study window will appear, similar to that of the General-purpose study modes. From this window you can import one or many XML scenarios or you can manually build the scenario from existing databases. To import an entire scenario, click on the "Import" button at the bottom of the window and select your XML scenario file.

To manually add a scenario, click on the "New" button at the bottom of the study window. A New Scenario window will appear which allows you to select your victim TV station from any of the existing TV databases. If desired, you can import a single TV station record from an XML file or create a new TV user record. At the bottom of the window, provide a name for your new scenario. Finally, click "Create" at the bottom right corner of the screen to create your new scenario.

Note that once you have selected your victim TV station, you will be unable to remove it from the scenario. The only way to change your victim TV station is to create a new scenario.



To add interferers to your new scenario, click on the "Add One" or "Add Many" button. Select the wireless database from which you want to import new interfering sites. If you are only adding one new site, enter the search criteria, import a new interfering site from XML, or create a new one from scratch.

When adding many, all relevant sites in the database which you select are added. If you are adding sites from a TV database, all TV stations within distances as specified by the rules will be added to the scenario. When adding sites from a wireless database, all sites in the selected database will be added to the scenario.

Be sure to set your wireless frequency and wireless bandwidth as appropriate.

To run the study, Save and Close the study, and then click the Run button in the Study Manager window. A run window similar to that of the General-purpose mode will appear. For more information on how to use it, see page 60.

Managing Studies

Duplicating a Study

Much like duplicating a scenario, you can also duplicate an entire study.

To do so, select "Duplicate" from the Study dropdown menu. You are prompted to give the duplicated study a name, and then TVStudy immediately opens up the new duplicate study for you, on the assumption that you will immediately wish to make modifications.

When finished, simply close the Study window as usual and you will now be able to see both studies.

Refreshing the Study Manager

Because TVStudy is designed for use in a multi-user environment, it is possible for studies to be created by several users working simultaneously. However, these may not immediately automatically display in each user's study manager. The list is refreshed automatically once per minute; to refresh the study manager immediately, select "Refresh List" from the Study dropdown menu.

Unlocking Studies and Editors

If a study appears in gray, this means that it is locked. In a multi-user environment, this may mean another user is currently editing the study, and the study is locked to prevent conflicting edits. However, in a single-user environment this often comes about when the software is closed incorrectly or crashes. In these cases, TVStudy provides an option to unlock a study.

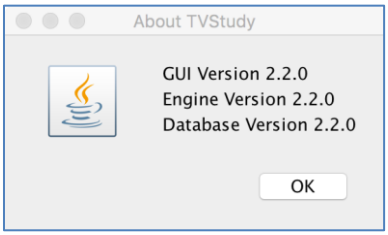
To unlock a study, click the study, then choose "Unlock" from the "Study" drop-down menu.

Similarly, geographies and receive antenna patterns can suffer from conflicting edits, and have a similar locking function. Should you find that one or both are locked, choose "Clear Edit Lock" from the "Database" drop-down menu.

Using the TVStudy Help Menu

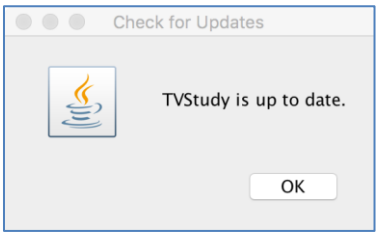
The TVStudy Help menu has four options, designed to help you use and maintain TVStudy.

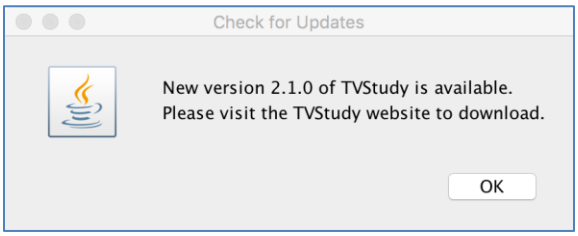
About TVStudy



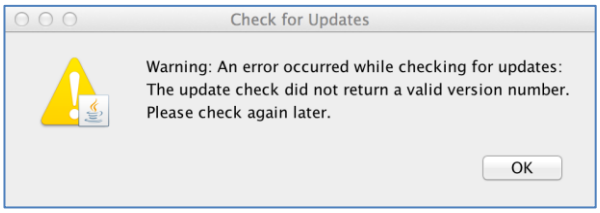
The About TVStudy menu option shows you the version number of the graphical user interface (GUI), the TVStudy engine, and the database. This may be helpful for troubleshooting issues if an upgrade from one version to another does not complete successfully.

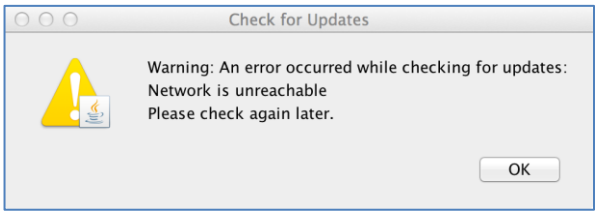
Check for Updates





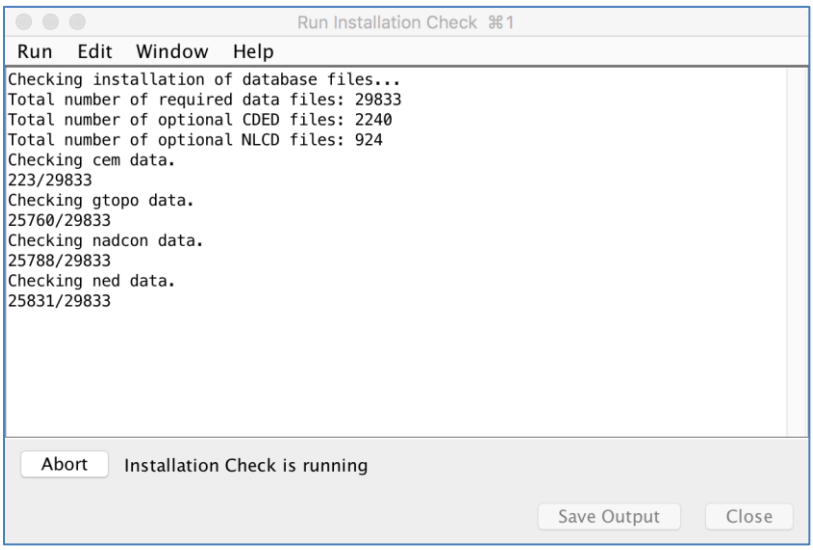
The Check for Updates menu option queries the TVStudy host server to determine if a newer version of TVStudy is available. Depending on the results of that query, one of the above messages will display.





If TVStudy is unable to reach the server for any reason while querying for a newer version, an error message like the ones above may display.

Check Installation



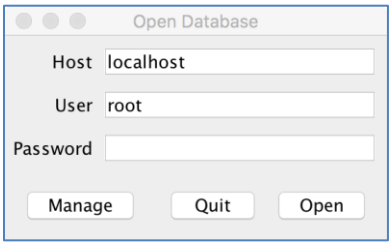
This option verifies all of the files in the dbase directory to ensure that none of the files are corrupt, missing, or inaccessible. It requires the Terrain Database Test and Verification Utility in order to function, which is available as a separate download on the TVStudy website. The utility must be placed in the directory /dbase.

Documentation

The Documentation menu option will display this manual. Note that a copy of this manual must be located in the /help directory of TVStudy and be named “manual.pdf”.

Closing TVStudy

When closing TVStudy on the Mac, never use the quit (⌘Q) command. This can leave the database in an unclean state, and any unsaved changes will be lost. Instead, you should always quit by using the red dot (•) in the top-left corner of each window, until you are back at the "Open Database" window.



In the "Open Database" window, click "Quit." The quit button will become active only when all of the other TVStudy windows are closed and it is safe to quit.

Troubleshooting TVStudy

If you find you are unable to open a study, the study may be locked. A study is locked when it is being edited, either by you or another user, or when it is being used to run a study. If a study fails part way through, it may leave the database in an unclean state, including a state in which a lock may remain on the study in question even though that study is not in use. To resolve this, click on the study in question in the Study Manager window, and select "Unlock" from the Study dropdown menu. (See page 74.)

It is uncommon, but not impossible, to experience data corruption issues or similar unexplained events, and you may want to try remedying them by clearing the cache. TVStudy creates a large number of cache files in order to make multiple scenario runs in a study run faster, but if this cache becomes corrupt, unexpected behavior could occur. To clear the cache, click on the study in question in the Study Manager window, and select "Clear Cache" from the Study dropdown menu. Cache data files can also consume a large amount of disk space that can be recovered by clearing the cache on studies that are not actively being used. Once the cache is cleared, the calculations used to create the cached results will have to be repeated.

Should you encounter any lingering issues after conducting a study, you may consider clearing out unused records. The "Run Pair Study…" function creates multiple scenarios that are hidden from the user, but remain stored in cache after the run is finished, and other study types which have replicated records in them can also leave hidden records behind. To clear such records, open the study in question, then select "Delete Unused Records" from the Scenario dropdown menu.

Contact Information

If you encounter any problems 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

APPENDIX A

Study Parameters

This appendix lists all of the study parameters available. It also notes which parameters can be set differently for **Each country** versus which apply to **All countries**, as well as which kinds of studies each is available for. ("**T**" means TV and wireless to TV, **"X"** means TV IX Check only, "**W**" means wireless to TV only, "**F**" means FM, **"6"** means TV6<->FM.)

Analysis

Grid type	All countries	**T**			
Type of cell grid used to measure coverage area and population in the study. • **Global** – Generates a uniform, global grid that all stations share. • **Local** – Generates grids unique to each station location. (Not permitted for OET-74.)					
Cell size	All countries	**T**	**6**	**F**	
Nominal length of each side of a square grid cell, in kilometers.					
Study point location	All countries	**T**	**6**	**F**	
In conjunction with the next parameter, controls where the study point is located in each cell. • **Population centroid –** The study point is at the population-weighted centroid of the cell. • **Cell center –** The study point is at the center of the cell. • **Largest population –** The study point is at the Census point with the largest amount of population contained in the cell. • **All population –** Use all of the population points individually. In this mode, each cell could have multiple study points.					
Move study point to nearest Census point	All countries	**T**	**6**	**F**	
Determines whether the study point is moved to the nearest Census point, if applicable.					
U.S. population[4]		**T**	**6**	**F**	
Source of U.S. population data. Data is available from the U.S. Census for 2000 and 2010.					
Canadian population[4]		**T**	**6**	**F**	
Source of Canadian population data. Data is available from the Canadian Census for 2006, 2011, and 2016.					
Mexican population[4]		**T**	**6**	**F**	
Source of Mexican population data. Data is available from the 2010 Mexican Census.					
Round population coordinates	Each country	**T**			
The FCC's Media Bureau tv_process application processing software rounds Census Block coordinates to the nearest integer second. If checked, TVStudy will round population coordinates in the same way.					
Default service area method	Each country	**T**	**6**	**F**	
Method used for defining the study area for each station. These are described in full on page 19. • **FCC curves** • **FCC plus distance** • **FCC plus percent** • **Longley-Rice percent above** • **Longley-Rice length above** • **Longley-Rice length below**					

[4] Selecting "None" will disable population counting for that country and TVStudy will not report land area separately for that country; total land area will instead be reported.

Distance or percent for default method	Each country	**T**	**6**	**F**	
If applicable, the distance in km or percent number associated with the default contour method.					
Maximum desired signal distance	All countries	**T**	**6**	**F**	
A limit on any terrain-sensitive desired signal calculation in any mode, similar to the distance limits in interference rules which restrict undesired signal calculations. It does not directly limit distances to FCC contours, but it does apply to grid points within a contour. Points inside a contour but beyond the distance limit are not actually studied, the desired field strength is set to -999 and undesired signals are not calculated.					
Cap TV D/U ramp function	All countries	**T**	**6**		
Allows a cap to be placed on the value of the D/U ramp function for TV stations.					
TV D/U ramp function cap	All countries	**T**	**6**		
If enabled by the above parameter setting, the cap on the D/U ramp function in dB for TV stations.					
Adjust FM D/U for IBOC	All countries		**6**	**F**	
When checked, applies a formula derived from the formula defined in DA 10-208 to calculate IBOC interference to adjacent-channel FM stations. When unchecked, the presence of IBOC interference is ignored.					
Include DTS self-interference	All countries	**T**	**6**		
Include calculations for DTS self-interference.					
Propagation speed	All countries	**T**	**6**		
For DTS self-interference, the propagation speed used to compute the arrival times of the signals of the multiple DTS transmitters.					
Pre-arrival time limit	All countries	**T**	**6**		
Amount of time before arrival of the strongest DTS transmitter signal that a receiver is expected to be able to handle.					
Post-arrival time limit	All countries	**T**	**6**		
Amount of time after arrival of the strongest DTS transmitter signal that a receiver is expected to be able to handle.					
Required D/U	All countries	**T**	**6**		
For signals arriving before the pre-arrival time limit or after the post-arrival time limit, the D/U ratio required for interference-free reception of strongest DTS transmitter signal.					

CDBS/LMS

Respect CDBS DA flag	All countries	**T**	**6**	**F**	
In CDBS/LMS, there are a number of stations which have an antenna pattern ID specified, but are flagged as "non-directional." The default behavior of TVStudy is to ignore the flag and use the antenna pattern specified, if present. Checking this box means that the flag will always be respected (potentially ignoring directional antenna pattern data when present).					
HAAT radial count	Each country	**T**	**6**	**F**	
Defines the number of radials used to compute HAAT for TV and FM stations.					
Mexican ERP and HAAT values		**T**	**6**	**F**	
In CDBS/LMS, there are a number of Mexican allotments that lack ERP and HAAT values. These settings control what ERP and HAAT values are assigned to those allotments.					
[First/Last] TV channel	All countries	**T**	**6**		
Sets the lower/upper channel limit used for importing data from CDBS/LMS.					

Search

Check individual DTS transmitter distances	All countries	**T**	**6**		
When checked, this option uses the culling distance with regard to each DTS transmitter site to determine potential interference cells or stations, rather than only using the reference coordinates. When unchecked, only the reference coordinates are used to determine potential interference cells or stations.					
Co-channel MX distance	All countries	**T**	**6**	**F**	
This constant determines when two stations are considered to be mutually exclusive (MX) for the purposes of creating a scenario. Setting this value to zero disables this check; however, other checks for mutual exclusivity may still be applied, such as when the city, state, country, and channel are all the same between two records.					
Rule limit extra distances (and break points)	All countries	**T**	**6**	**F**	
These constants control the distance in kilometers beyond the distance specified in OET Bulletin No. 69 that a distance-based query will search for interferers for stations. Adding extra distance can help ensure that all possible interferers are considered. For stations which are not full-power UHF, the ERP will be normalized to the full-power UHF value before applying the distances here, and the break points are in kilometers and adjustable as well.					
Use maximum signal distance as rule extra	All countries	**T**	**6**	**F**	
Uses the maximum signal distance found in the Analysis tab as the rule limit extra distance, ignoring all other values.					
Spherical earth distance	All countries	**T**	**6**	**F**	
This constant specifies the spherical earth distance in kilometers per degree of arc. This constant is used for distance and bearing calculations as well as calculating depression angles in True Geometry mode.					

Contours

Contour radial count	Each country	**T**	**6**	**F**	
Number of radials used to project the contour. If using the FCC curves contour method and this value is different from Contour HAAT radial count, HAAT values are interpolated between lookup values.					
[Digital/Analog] TV full-service contour	Each country	**T**	**6**		
Controls the relevant thresholds (for each band) used to project the TV service contours.					
[Digital/Analog] Class A/LPTV contour	Each country	**T**	**6**		
Controls the relevant thresholds (for each band) used to project the LPTV and Class A TV service contours.					
Use UHF dipole adjustment	Each country	**T**			
Controls whether or not a "dipole adjustment" is applied to the service threshold at UHF.					
Dipole center frequency	Each country	**T**			
Sets the center frequency for the UHF dipole adjustment.					
FM full-service [(all)/class B/class B1] contour	Each country		**6**	**F**	
Controls the relevant thresholds used to project the service contours.					
[FM NCE/LPFM/FM translator] contour	Each country		**6**	**F**	
Controls the relevant thresholds used to project the service contours.					
Service distance limit	Each country	**T**	**6**		
These options restrict the propagation model prediction area to within these distances. A setting of 0 disables it.					

FCC Contours

Average terrain database	All countries	**T**	**6**	**F**	
Terrain database used for contour calculations.[5]					
Average terrain profile resolution	Each country	**T**	**6**	**F**	
Number of points per kilometer used to calculate the average terrain along each radial for a TV or FM station.					
Use elevation patterns	Each country	**T**	**6**	**F**	
Controls how elevation patterns are used to project contours. • **Never –** The elevation pattern is never used to project contours. • **Full-service TV only –** The elevation pattern is used to project contours for full-service TV stations only. • **All stations –** The elevation pattern is always used to project contours for every station regardless of class.					
Use real elevation patterns	Each country	**T**	**6**	**F**	
Allows the use of actual antenna elevation patterns for contour projection for all stations. If not selected, generic patterns are always used, or no elevation pattern is used if the "Use generic patterns by default" parameter is also unchecked, even if actual elevation pattern is available.					

[5] TVStudy includes 30-second, 3-second, and 1-second terrain data. The search order for terrain databases is usually CDED, CEM, NED, USGS, SRTM, then GTOPO. This search order applies if data is missing from the preferred terrain database, beginning with the preferred database for the selected terrain database. This means that if 3-second terrain is selected, it will search other 3-second terrain databases, then the 30-second GTOPO terrain database, but not the 1-second terrain databases.

Derive azimuth pattern	Each country	**T**	**6**	**F**	
For stations with mechanical beam tilt and real elevation patterns, computes an azimuth pattern for use when projecting the contour.					
FCC curve set, [digital/analog/FM]	Each country	**T**	**6**	**F**	
Controls which F-curve set is used to calculate the contour for digital TV/analog TV/FM stations.					
Lookup method below curve minimum distance	All countries	**T**	**6**	**F**	
In certain cases, station power may be so low that there is no contour distance available from which to project the contour. In these cases, you can choose TVStudy's behavior. • **Free-space –** When no curves data is available, use free-space calculations. • **Scaled free-space –** When no curves data is available, use free-space calculations but scale them to prevent discontinuities with the curves data. • **None –** When no curves data is available, use the value of the last available data point.					
Contour HAAT radial count	Each country	**T**	**6**	**F**	
Number of radials to use for HAAT lookup during contour projection. This setting is ignored if using one of the Longley-Rice contour methods.					
Minimum HAAT	Each country	**T**	**6**	**F**	
Minimum height above average terrain used to project contours.					
Average terrain [start/end] distance	Each country	**T**	**6**	**F**	
Distance where terrain samples begin/end for calculation of HAAT and projection of contours.					
Truncate DTS service area	All countries	**T**	**6**		
If checked, TVStudy limits the coverage areas of DTS stations to the DTS distance limits.					
DTS distance limit	All countries	**T**	**6**		
By default, these are the DTS coverage limits specified in the Table of Distances[6]. These values are used only if Truncate DTS service area is checked and no value is provided in the station record.					

L-R Contours

Terrain database	All countries	**T**	**6**	**F**	
Terrain database used for Longley-Rice contour calculations.[7]					
Profile resolution	All countries	**T**	**6**	**F**	
Number of points per kilometer used to retrieve the terrain path profile along each radial for a TV or FM station.					
Calculation distance increment	All countries	**T**	**6**	**F**	
Target distance between calculated signal points along each radial. Calculations occur at the profile distances.					
[Digital/Analog] desired % location	All countries	**T**	**6**	**F**	
Longley-Rice statistical parameter specifying the percentage of locations expected to get service.					
[Digital/Analog] desired % time	All countries	**T**	**6**	**F**	
Longley-Rice statistical parameter specifying the percentage of time service is expected.					

[6] See 47CFR §73.626(c).

[7] TVStudy includes 30-second, 3-second, and 1-second terrain data. The search order for terrain databases is usually CDED, CEM, NED, USGS, SRTM, then GTOPO. This search order applies if data is missing from the preferred terrain database, beginning with the preferred database for the selected terrain database. This means that if 3-second terrain is selected, it will search other 3-second terrain databases, then the 30-second GTOPO terrain database, but not the 1-second terrain databases.

[Digital/Analog] desired % confidence	All countries	**T**	**6**	**F**	
Longley-Rice statistical parameter specifying the confidence (situational variability) that service is expected.					
[Digital/Analog] undesired % location	All countries	**T**	**6**	**F**	
Longley-Rice statistical parameter specifying the percentage of locations expected to get interference.					
[Digital/Analog] undesired % confidence	All countries	**T**	**6**	**F**	
Longley-Rice statistical parameter specifying the confidence (situational variability) interference is expected.					
Receiver height AGL	All countries	**T**	**6**	**F**	
Receive antenna height above ground, in meters.					
Signal polarization	All countries	**T**	**6**	**F**	
Polarization of transmitted signal.					
Atmospheric refractivity	All countries	**T**	**6**	**F**	
Refractivity referenced to mean sea level, in N-units.					
Ground permittivity	All countries	**T**	**6**	**F**	
Relative ground permittivity.					
Ground conductivity	All countries	**T**	**6**	**F**	
Ground conductivity in Siemens per meter.					
Service mode	All countries	**T**	**6**	**F**	
Longley-Rice model parameter.					
Climate type	All countries	**T**	**6**	**F**	
Climactic zone.					

TV Replication

Replication method	Each country	**T**	**6**		
Controls how replication of stations onto different channels is performed. • **Derive Pattern –** Adjusts the ERP and antenna pattern to closely match the original contour. This usually results in a change to the azimuth pattern of the station. • **Equal Area –** Adjusts the ERP to match the geographic area enclosed by the original contour. This setting maintains the original azimuth pattern but may slightly change the contour distances.					
Digital full-service [minimum/maximum] ERP	Each country	**T**	**6**		
These values set the minimum/maximum ERP used in replication of full-service stations on each TV band.					
Digital Class A/LPTV [minimum/maximum] ERP	Each country	**T**	**6**		
These values set the minimum/maximum ERP used in replication of Class A and LPTV stations on each TV band.					

Patterns

(These parameters only apply to TVStudy's handling of TV or FM antenna patterns.)

Depression angle method	Each country	**T**	**6**	**F**	
Controls how depression angles are calculated. • **Effective height –** This method approximates the depression angle using height above ground level, mirroring the behavior of tv_process. • **True geometry –** This method calculates the actual depression angle using curved-Earth geometry and heights above mean sea level.					
Use mechanical beam tilt	Each country	**T**	**6**	**F**	
• **Never –** Never apply mechanical beam tilt values. • **Always –** The mechanical beam tilt values specified in CDBS/LMS will always be applied to the antenna elevation pattern. • **Real patterns only –** The mechanical beam tilt values specified in CDBS/LMS will only be applied to stations for which real elevation patterns are provided (either from CDBS/LMS or user-entered).					
Use generic patterns by default	Each country	**T**	**6**	**F**	
If checked, the generic OET69 elevation pattern will be applied. If unchecked, a non-directional elevation pattern will be used.					
Mirror generic patterns	Each country	**T**	**6**	**F**	
The generic OET Bulletin No. 69 elevation pattern does not specify field values for depression angles less than 0.75° and so a value of 1.0 is assumed above that depression angle. Checking this box creates a symmetric elevation pattern with a maximum field value of 1.0 at 0.75° (or some other depression angle, depending upon the other parameter settings).					
Beam tilt on generic patterns	Each country	**T**	**6**	**F**	
These options control how beam tilt is applied to the generic OET Bulletin 69 elevation pattern. • **None –** Assumes a 0.75° beam tilt for all stations. • **Full –** Adds the values in CDBS to a 0.75° beam tilt for all stations. • **Offset –** Subtracts 0.75° from the generic pattern, then adds the value in CDBS/LMS. This setting results in maximum radiation in the elevation plane being at the depression angle specified in CDBS for that station.					
Double generic pattern values	Each country	**T**	**6**		
These options control when the generic OET Bulletin No. 69 elevation pattern field values are doubled when used with LPTV and Class A TV stations. • **Never –** The values are never doubled for any station(s). • **LPTV only –** The values are doubled for LPTV stations but not for Class A stations. • **LPTV and Class A –** The values are doubled for both LPTV stations and Class A stations.					
Invert negative tilts	Each country	**T**	**6**	**F**	
Although beam tilts are conventionally angles of depression (*i.e.,* below the horizontal, so that a value of 90 means straight down and -90 means straight up), and radiation above the horizon is required to be minimized under FCC rules, some CDBS/LMS records give negative values for beam tilt. If checked, any negative electrical beam tilt values in CDBS/LMS will be assumed to be positive and thus ensures that maximum radiation is always at or below the horizontal.					
[Digital/Analog/FM] receive antenna f/b	All countries	**T**	**6**	**F**	
These fields control the front to back ratio (in decibels referenced to a dipole (dBd)) of the receive antenna used for digital TV, analog TV, and FM stations.					

Propagation

Terrain database	All countries	**T**	**6**	**F**	
Terrain database used for propagation calculations. [7]					
Profile resolution	Each country	**T**	**6**	**F**	
Number of points per kilometer used to determine the path profile for Longley-Rice path loss calculations from TV or FM stations.					
Model error handling	Each country	**T**	**6**	**F**	
Controls how TVStudy handles model warning flags. Note that warnings can be triggered either by a desired station or an undesired station, and is specific to a given signal path. • **Disregard –** Accepts the path loss result from the model. (Always applied to the desired TV signal for D/U calculations involving wireless interferers.) • **Assume service –** Assumes service for warnings on desired signal paths and no interference for warnings on undesired signal paths. • **Assume interference –** Assumes no service for warnings on desired signal paths and interference for warnings on undesired signal paths.					
Receiver height AGL	All countries	**T**	**6**	**F**	
Receive antenna height above ground, in meters.					
Minimum transmitter height AGL	All countries	**T**	**6**	**F**	
Minimum transmit antenna height above ground, in meters.					
[Digital/Analog] desired % location	All countries	**T**	**6**	**F**	
Longley-Rice statistical parameter specifying the percentage of locations expected to get service.					
[Digital/Analog] desired % time	All countries	**T**	**6**	**F**	
Longley-Rice statistical parameter specifying the percentage of time service is expected.					
[Digital/Analog] desired % confidence	All countries	**T**	**6**	**F**	
Longley-Rice statistical parameter specifying the confidence (situational variability) that service is expected.					
[Digital/Analog] undesired % location	All countries	**T**	**6**	**F**	
Longley-Rice statistical parameter specifying the percentage of locations expected to get interference.					
[Digital/Analog] undesired % confidence	All countries	**T**	**6**	**F**	
Longley-Rice statistical parameter specifying the confidence (situational variability) interference is expected.					
Signal polarization	All countries	**T**	**6**	**F**	
Polarization of transmitted signal.					
Atmospheric refractivity	All countries	**T**	**6**	**F**	
Refractivity referenced to mean sea level, in N-units.					
Ground permittivity	All countries	**T**	**6**	**F**	
Relative ground permittivity.					
Ground conductivity	All countries	**T**	**6**	**F**	
Ground conductivity in Siemens per meter.					
Service mode	All countries	**T**	**6**	**F**	
Longley-Rice model parameter.					
Climate type	All countries	**T**	**6**	**F**	
Climactic zone.					

Service

Set service thresholds	All countries	**T**	**6**	**F**	
If checked, these thresholds are used for Longley-Rice calculations in lieu of the thresholds used for contour calculations. If unchecked, the same thresholds are used for Longley-Rice calculations as are used for contour calculations.					
Digital full-service threshold	Each country	**T**	**6**	**F**	
Controls the relevant thresholds (for each band) used to project the noise-limited service contours.					
Digital Class A/LPTV threshold	Each country	**T**	**6**	**F**	
Controls the relevant thresholds (for each TV band) used to project the protected service contours.					
Analog full-service threshold	Each country	**T**	**6**	**F**	
Controls the relevant thresholds (for each TV band) used to project the service contours.					
Analog Class A/LPTV threshold	Each country	**T**	**6**	**F**	
Controls the relevant thresholds (for each TV band) used to project the protected service contours.					
Use UHF dipole adjustment	Each country	**T**	**6**		
Controls whether or not a "dipole adjustment" is applied to the service threshold at UHF.					
Dipole center frequency	Each country	**T**	**6**		
Sets the center frequency for the UHF dipole adjustment.					
FM full-service [(all)/class B/class B1] threshold	Each country		**6**	**F**	
Controls the relevant thresholds used to project the service contours.					
[FM NCE/LPFM/FM translator] threshold	Each country		**6**	**F**	
Controls the relevant thresholds used to project the service contours.					

Clutter

Apply clutter adjustments	All countries	**T**	**6**	**F**	
If checked, clutter adjustments are applied as specified in OET Bulletin No. 73.					
Land cover database	All countries	**T**	**6**	**F**	
Controls whether the 2006 or 2011 land cover database is used.					
[Category, band]	Each country	**T**	**6**	**F**	
Controls the clutter adjustment factor for each band in each of ten categories specified in OET Bulletin No. 73.					
[Category mapping]	All countries	**T**	**6**	**F**	
Allows users to modify the mapping between the sixteen land cover categories in the NLCD database and the ten clutter categories specified in OET Bulletin No. 73.					

TV IX Check

Default cell size		**X**			
Sets the default cell size for full power TV stations when setting up a TV IX Check study.					
Default propagation profile resolution		**X**			
Sets the default propagation profile resolution for full power TV stations when setting up a TV IX Check study.					
Default cell size for LPTV		**X**			
Sets the default cell size for LPTV and Class A TV stations when setting up a TV IX Check study.					
Default propagation profile resolution for LPTV		**X**			
Sets the default propagation profile resolution for LPTV and Class A TV stations when setting up a TV IX Check study.					
Maximum new interference		**X**			
Percentage of permitted new interference to full power TV stations					
Maximum new interference to LPTV		**X**			
Percentage of permitted new interference to LPTV and Class A TV station.					
Baseline exclusion date		**X**			
This date determines what cut-off date to use to determine which facilities to consider when processing applications for post-Incentive Auction stations.					
Check proposal vs. baseline		**X**			
Controls whether or not the TV IX Check mode checks for contour extension percentage and population reduction.					
Maximum contour extension from baseline		**X**			
Sets the percentage of contour extension permitted.					
Maximum population reduction from baseline		**X**			
Sets the percentage of population reduction permitted.					

Wireless

Required D/U	Each overlap	**W**			
Controls the D/U threshold applied based on wireless to TV channel spectral overlap value.					
Culling Distances	Each overlap	**W**			
Controls the culling distance from the protected TV contour based on spectral overlap, wireless site HAAT, and wireless site ERP					
Cap alpha factor	All overlaps	**W**			
Allows a cap to be placed on the value of the α factor.					
Alpha factor cap	All overlaps	**W**			
If enabled by the above parameter setting, the cap on the α factor in dB.					
Average terrain profile resolution	All overlaps	**W**			
Number of points per kilometer used to calculate the average terrain along each radial from the wireless station.					
Path-loss profile resolution	All overlaps	**W**			
Number of points per kilometer used to calculate the path profile along each radial from the wireless station.					
HAAT radial count	All overlaps	**W**			
Number of radials used to determine the HAAT of the wireless station.					
Depression angle method	All overlaps	**W**			
Controls how depression angles are calculated. • **Effective height –** This method approximates the depression angle using height above ground level, mirroring the behavior of tv_process. • **True geometry –** This method calculates the actual depression angle using curved-Earth geometry and heights above mean sea level.					
Use mechanical beam tilt	All overlaps	**W**			
If selected, TVStudy will use mechanical tilt as specified in the wireless antenna dataset.					
Mirror generic patterns	All overlaps	**W**			
If a wireless site uses the OET-69 generic elevation pattern this option allows for the mirroring of the pattern above and below the maximum relative field strength value.					
Minimum transmitter height AGL	All overlaps	**W**			
Specifies the minimum wireless transmitter height above ground level. If TVStudy finds the site is below this level based on the RCAMSL value provide it will adjust the transmitter height.					
Undesired % location	All overlaps	**W**			
Statistical parameter of location probability for wireless station path loss.					
Undesired % time	All overlaps	**W**			
Statistical parameter of time probability for wireless station path loss.					
Undesired % confidence	All overlaps	**W**			
Statistical parameter of confidence probability for wireless station path loss.					
Signal polarization	All overlaps	**W**			
Polarization of wireless transmitted signal.					
Service mode	All overlaps	**W**			
Propagation model parameter.					

TV6 <-> FM

FM undesired culling distances	All countries		**6**		
Culling distances for FM undesired stations.					
FM to TV D/U curves	All countries		**6**		
Table of values for the curves (73.525) method.					
FM to DTV D/U method	All countries		**6**		
Allows the selection of the curves (73.525) or fixed (based on NPR measurements) method of determining interference from FM into digital TV channel 6.					
FM to DTV fixed D/U table	All countries		**6**		
Table of values for the fixed method.					
FM undesired % time	All countries		**6**		
Longley-Rice statistical parameter of time probability for FM stations.					
DTV undesired culling distances	All countries		**6**		
Culling distances for DTV undesired stations.					
DTV to FM base D/U	All countries		**6**		
Base D/U ratio used to determine interference from digital TV into FM.					
TV/DTV undesired % time	All countries		**6**		
Longley-Rice statistical parameter of time probability for TV stations.					

APPENDIX B

Files Required to Import a Dataset

FCC Datasets

The following files are required for TVStudy to successfully import a CDBS TV dataset:

- am_ant_sys.dat
- ant_make.dat
- ant_pattern.dat
- application.dat
- app_tracking.dat
- dtv_channel_assignments.dat
- elevation_ant_make.dat
- elevation_pattern.dat
- elevation_pattern_addl.dat
- facility.dat
- tv_app_indicators.dat
- tv_eng_data.dat

The following files are required for TVStudy to successfully import a CDBS FM dataset:

- ant_make.dat
- ant_pattern.dat
- application.dat
- app_tracking.dat
- elevation_ant_make.dat
- elevation_pattern.dat
- elevation_pattern_addl.dat
- facility.dat
- fm_eng_data.dat
- fm_app_indicators.dat
- if_notification.dat

The structure of the CDBS data files is laid out in /lib/cdbs_table_defs.dat such that future changes to the table structure can be implemented simply by modifying or replacing that file.

The following files are required for TVStudy to successfully import an LMS TV dataset:

- application.dat
- application_facility.dat
- app_antenna.dat
- app_antenna_elevation_pattern.dat
- app_antenna_field_value.dat
- app_antenna_frequency.dat
- app_dtv_channel_assignment.dat
- app_location.dat
- facility.dat
- license_filing_version.dat
- lkp_antenna.dat
- lkp_antenna_field_value.dat
- lkp_dtv_allotment.dat
- xref_cdbs_lm_app_id_transfer.dat

TVStudy supports checks with relation to AM towers for LMS datasets, but this data (gis_am_ant_sys.dat, gis_application.dat, and gis_facility.dat) is not currently in the public LMS download. This data is expected to be made available in the near future. If AM data is unavailable from an LMS download, the AM check is not conducted.

LMS datasets are currently not supported for FM due to the absence of FM data within LMS.

Wireless Datasets

The two user created files are required to create a wireless dataset.

File 1: <basestation_data>.csv. This is a comma separated file with up to seventeen (17) fields and a new row for each wireless base station/sector. This file should not have a header row.

	Field name	Type	Description
1	Cell Site ID	Char(12)	This must not be blank and cannot contain '|', ',' or new line characters.
2	Sector ID	Integer	This field is concatenated with the Cell Site ID to form the wireless "callsign" in TVStudy GUI and reports. This field may be blank. This field cannot contain '|', ',' or new line characters.
3	Latitude (degrees)	Float	This field is NAD 83 with positive decimal degrees indicating Northern hemisphere. This field must contain a value in the range -75 to +75 degrees.
4	Longitude (degrees)	Float	This field is NAD 83 with negative decimal degrees indicating Western hemisphere. This field must contain a value in the range -180 to +180 degrees.
5	Ant Height(m)	Float	This is the base station transmit antenna radiation center height above mean sea level (AMSL) in meters.
6	HAAT (m)	Float	This is the base station transmit antenna radiation center height above average terrain (HAAT) in meters. This must be a value between -1000 and +10,000 meters. The value -999 will cause HAAT to be calculated by TVStudy.
7	ERP (kW)	Float	This is the base station effective radiated power in kilo-watts. This field must contain a value between 0.00001 and 5,000.
8	Az AntID	Integer	This is a pointer to the azimuth pattern in the associated wireless antenna database. 0 or blank means omni-directional antenna, otherwise this number must be greater than zero. If a pattern data for an ID does not exist an omni-directional pattern will be applied during the study.
9	Orientation (degrees true N)	Float	0 means true north. If blank the default is 0, otherwise the value must be in the range -360 to +360 degrees.
10	El AntID	Integer	This is a pointer to the elevation pattern in the associated wireless antenna database. 0 or blank means omni-directional antenna, otherwise this field must be greater than zero.
11	ETilt (degrees)	Float	Electrical tilt where positive degrees is downward tilt. If blank, the default is 0, otherwise the value must be in the range -10 to +11.1 degrees.
12	MTilt (degrees)	Float	Mechanical tilt where positive degrees is doward tilt. If blank, the default is 0, otherwise the value must be in the range -10 to 11.1 degrees.

13	MTilt Orientation (degrees)	Float	0 means true north. If this is blank or not present the dfault is the azimuth pattern orientation, otherwise the value must be in the range -360 to +360 degrees.
14	Reference Data	Char(22)	Optional field. This field is available for short notes about site.
15	City	Char(20)	Optional field. City associated with wireless site.
16	State	Char(2)	Optional field.
17	Country	Char(2)	"US", "CA", or "MX". When missing it is assumed to be "US".

File 2: <baseantenna_data>.csv. This is a comma separated file with a new row for each antenna pattern and five (5) or more fields as follows. This file does not have a header row.

	Field name	Type	Description
1	AntID	Integer	This must be a value greater than zero (0). This field should tie back to either the AAntID or EAntID field in the wireless base station file.
2	Pattern Type	Char(1)	"A" or "a" for azimuth pattern or "E" or "e" for elevation pattern
3	Pattern Name	Char(255)	Must not be blank and must not contain '|', ',', or new line characters.
4 until end of line	Pattern points	Float;float	Each comma-delimited field contains a degree value and a relative field value separated by a semicolon, for example "0;1.0,10;0.95,20;0.89,…". There must be at least two points in a pattern. For an azimuth pattern, the degree values must be in the range 0 to 359.999. For an elevation pattern, the degree range is -90 to 90. In either case the degree values must appear in order with no duplication. Relative field values must be greater than 0 and less than or equal to 1. If a pattern does not contain at least one point with relative field of 1 a warning message will be generated, however, import will continue.

APPENDIX C

Output File Data

To make the various output files smaller and easier for a computer to use, a number of numerical codes are used to replace words in the output. A key for translating these, as well as a list of definitions of certain other terms used within the Appendices, is provided below. In all following appendices, spaces after commas are included for legibility and are not found in the output files.

Study Key
This is a unique identifier for a given study.

Fac (Facility) ID
The Facility ID is a unique integer in CDBS/LMS used to identify a station.

File Number
This is a number denoting a specific filing in CDBS/LMS. For applications filed in CDBS, it consists of a prefix to indicate the type of filing, and an Application Reference Number (ARN) to make it unique. LMS-filed applications only have the ARN.

Country Key
1 = United States **2** = Canada **3** = Mexico

Country keys can appear in the results for two purposes. They can either refer the country from which the station being evaluated originates (Cntry), or to the country in which the evaluation point is located (InCntry).

Country Code
US = United States **CA** = Canada **MX** = Mexico

Country codes are used in XML files and in some of the summary reports.

Service Type
1 = Digital TV Full Service (CDBS: DT, DD, DS, DX, DR, DM, DN)
2 = Analog TV Full Service (CDBS: TV, TS, TA, TR, NM, NN)
3 = Digital TV Class A (CDBS: DC) **4** = Analog TV Class A (CDBS: CA)
5 = Digital LPTV or Translator (CDBS: LD) **6** = Analog LPTV or Translator (CDBS: TX, TB)
11 = Wireless sites (WL)
21 = FM Full Service (CDBS: FM, FS, FA, FR)
22 = FM Low Power (CDBS: FL) **23 =** FM Translator or Booster (CDBS: FX, FB)

Source Key
This is a unique identifier for a given station facility within a scenario. This is a temporary key assigned within each study and thus will change for the same station from study to study.

DTS Key
This is a key for DTS record sets. A DTS station has multiple records, always listed together in the file. The first is a record called the parent. The Source Key from the parent record appears in the DTS Key field for all related records. On the actual parent record, the Source Key is the same as the DTS Key. The parent always has Site value of **0**. Among the other records with the same DTS Key but other Source Key values, one of those will also have Site value of **0**; that is the reference facility record. That record may have different file number, application ID, and channel than the parent; it provides a bounding contour only. Other records with the same DTS Key and Sites other than 0 are the actual DTS transmitter sources. Those all have the same identifying information and channel shown on the parent record, so that information is not repeated.

Site
Site number. For DTS records it is used to identify the different records in a group for a DTS operation. See "DTS Key" discussion.

App (Application) ID
CDBS Application ID number, if available.

Des (Desired) Flag
0 = Station was not studied as desired; its coverage was not evaluated
1 = Station was studied as desired; its coverage was evaluated

Und (Undesired) Flag
0 = Station was not studied as undesired; it could not cause interference to desired stations
1 = Station was studied as undesired; it may contribute interference to desired stations

From Channel
When the station service is being replicated on a different channel from its original channel, this column shows the original channel.

DTS Distance
For a DTS parent record, this is the distance limit around the reference point. This may be from the distance table in FCC Rule section 73.626(c), or it may be a custom value from the database record.

DA (Directional Antenna)
Flag that specifies whether or not an antenna is directional in the azimuth direction.
DA = Directional Antenna **ND** = Non-Directional Antenna

Ant (Antenna) ID
Antenna ID number, if available.

Rotation
Degrees of clockwise azimuth rotation applied to the antenna pattern.

Offset

0 = N/A **1** = Zero
2 = Plus **3 =** Minus

Mask Filter

0 = N/A (Analog) or Full-Service (Digital) **1 =** Simple
2 = Stringent **3 =** Full-Service

Mask Type

S = Simple **T** = Stringent **F** = Full-service

Grid Type

1 = Local **2** = Global

Cell Latitude Size

This is the size of each cell in seconds with regard to latitude, since it is uniform across the grid.

Lat Index, Lon Index

Index keys for a study grid cell, given as the coordinates of the cell's southeast corner in integer arc-seconds. These are for identification and relative location only; actual coverage calculations occur at discrete points within each cell, one point for each country with population in the cell.

Clutter

Indicates what clutter correction was applied to the cell. If **0**, clutter was not enabled. Otherwise, the clutter category (**1-10**) is indicated. The clutter categories are listed in OET Bulletin No. 73, Table 3.

Result Code

1 = Interference-free service **2** = Interference **3** = No service
11 = Interference-free service, but encountered a warning flag
12 = Interference, but encountered a warning flag
13 = No service, but encountered a warning flag

Causes Ix (Interference)

0 = Does not cause interference **1** = Causes interference

Point Key

Single integer index key for a study grid cell, primarily used in pair studies. In the global mode, the Point Key is undefined for cell sizes less than 0.5 km and for grid cells outside of the northern and western hemispheres. The Point Key algorithm was designed to produce a 32-bit integer single key to help reduce storage size for SQL tables containing pair study output data. At cell sizes less than 0.5 km the number of bits required to enumerate all cells may exceed the 32-bit integer range, so the Point Key cannot be defined.

Service Flag

0 = Does not have service **1** = Has service

KWX Flag

0 = Does not have a warning flag

= Has a warning flag (1-4)

Status

APP = Application filed

CP MOD = Modification to CP granted

LIC = Licensed facility

CP = Construction Permit granted

GRANT = Allotment Granted

STA = Special Temporary Authority

Channel Description

In the tvstudy.txt file, station channel numbers are listed in a four-part coding scheme as M#CO, where:

- "M" is either "N" or "D" for Analog or Digital, respectively,
- "#" is the channel number,
- "C" is the station class and will be "A" for Class A or "L" for LPTV stations (Full-power stations will not have a value), and
- "O" is the channel offset (for analog stations only) and will be "-", "z", or "+".

Key

LatIndex-LonIndex-CountryKey = This field is comprised of hyphen separated values of integer seconds for the grid cell south east corner and the country key for the grid cell.

Root Sum Square

This is the square root of the power summation of all the wireless received field strength after receiver antenna discrimination in a single grid cell.

$$RSS = 20 * Log_{10}\left(\sum\left(10^{\left(\frac{dB\mu + G_r}{20}\right)}\right)^2\right)^{\frac{1}{2}} = 10 * Log_{10}\left(\sum 10^{\left(\frac{dB\mu + G_r}{10}\right)}\right)$$

SNR Factor

This is the same value as the provided by the D/U ramp function and is defined as alpha (α) in OET Bulletin No. 74.

In SA

This is 1 if the point is inside the contour and 0 if the point is outside.

APPENDIX D

Formats of the Cell Output Files

Format of the Summary Cell Output File

The file is labeled "tvstudy.cel" and appears within the `out/<servername>/<study>` directory. It contains summary data for all scenarios that were selected to run.

Global Grid Mode

```
[scenario]
Database Server
Database Used
Study Name
Scenario Name
Timestamp
Cell Size, Grid Type, Cell Latitude Size
[comment]
Comment
[endcomment]
[sources]
Source Key, Des Flag, Und Flag, Country Key for Station, Service Type, Channel, Fac
   ID, Site, File Number, Call Sign
[endsources]
[grid]
Lat Index South Limit, Lon Index East Limit, Lat Index North Limit, Lon Index West
   Limit
[cell]
Lat Index, Lon Index
P, Country Key for Point, Point Area, Point Pop, Point Households, Clutter
R, Source Key, Site, Result Code
[endcell]
[endgrid]
[endscenario]
```

Each cell can have multiple "P" (point) entries, one for each country that has a study point in the cell. Each "P" line may be followed by multiple "R" (result) entries, one for each station that provides service at that point. **Note:** A cell file may contain study grids that overlap. Thus, there may be multiple [grid] blocks that overlap, some containing data for the same desired stations. See detailed notes below.

Local Grid Mode

The local grid mode has the same format, except the [cell]/[endcell] blocks will be replaced with:

```
[source]
Source key
R, Country Key for Point, Lat Index, Lon Index, Point Area, Point Pop, Point
   Households, Clutter, Result Code
[endsource]
```

Each source block contains "R" lines for all study points considered for one station only. Each desired station will have a separate source block.

Points Mode

```
[scenario]
Database Server
Database Used
Study Name
Scenario Name
Timestamp
Cell Size, Grid Type, Cell Latitude Size
[comment]
Comment
[endcomment]
[sources]
Source Key, Des Flag, Und Flag, Country Key for Station, Service Type, Channel, Fac
   ID, Site, File Number, Call Sign
[endsources]
[points]
P, Country Key for Point, Point Elevation, Point Receive Height, Clutter
R, Source Key, Site, Result Code
[endpoints]
[endscenario]
```

Each “P” line may be followed by multiple “R” (result) entries, one for each station that provides service at that point.

Format of the Detailed Cell Output File

The file is labeled "tvstudy.cel" and appears within the `out/<servername>/<study>/<scenario>` directory. It contains data from only one scenario.

Global Grid Mode

```
[scenario]
Database Server
Database Used
Study Name
Scenario Name
Timestamp
Cell Size, Grid Type, Cell Latitude Size
[comment]
Comment
[endcomment]
[sources]
Source Key, Des Flag, Und Flag, Country Key for Station, Service Type, Channel,
   Service Level, Number of DTS Sites, Fac ID, Site, [Lat Index South Limit, Lon
   Index East Limit, Lat Index North Limit, Lon Index West Limit,] File Number, Call
   Sign, Site
[endsources]
[grid]
Lat Index South Limit, Lon Index East Limit, Lat Index North Limit, Lon Index West
   Limit
[cell]
Lat Index, Lon Index
P, Country Key for Point, Point Lat, Point Lon, Point Area, Point Pop, Point
   Households, Clutter
C, Census Block ID, Block Pop, Block Households
D, Source Key, Site, Field Strength, Reverse Bearing, Bearing, ERP (dBk), KWX Flag,
   Service Flag
S, Site, Time Delay, Field Strength, Bearing, Receive Pattern Adjustment, Causes Ix
DS, D/U Ratio, Rule Value for Comparison, D/U Ramp Function Adjustment
U, Source Key, Field Strength, Bearing, Receive Pattern Adjustment, KWX Flag, Causes
   Ix
DU, D/U Ratio, Rule Value for Comparison, D/U Ramp Function Adjustment
[endcell]
[endgrid]
[endscenario]
```

Each cell can have multiple "P" (point) entries, one for each country with a study point in the cell. Each "P" line is followed by one or more "D" (desired) entries, one for each desired station whose contour covers the population centroid point described by the "P" line. Similarly, each "D" line can have multiple "U" (undesired) and "DU" (D/U ratio) lines, for each undesired station that is within the culling distance of the desired station as specified by the study rules. However, there is not a guarantee that "U" records always follow a "D", nor that a "DU" record will always follow a "U", since Longley-Rice warnings may abort the analysis for that grid cell if TVStudy is set to "Assume Service" or "Assume Interference" and the subsequent records will not be generated.

In the [sources] section, undesired stations do not have Lat Index Limit values.

Please note that a tvstudy.cel file may contain study grids that overlap. Thus, there may be multiple overlapping [grid] blocks, each containing data for the same desired stations. See the detailed notes on the following page.

Local Grid Mode

For a study run in local grid mode, the [cell]/[endcell] blocks are replaced by blocks in the following format:

```
[source]
Source Key
P, Lat Index, Lon Index, Country Key for Point, Point Lat, Point Lon, Point Area,
   Point Pop, Point Households, Clutter
D, Site, Field Strength, Reverse Bearing, Bearing, ERP (dBk), KWX Flag, Service Flag
U, Source Key, Field Strength, Bearing, Receive Pattern Adjustment, KWX Flag, Causes
   Ix
DU, D/U Ratio, Rule Value for Comparison, D/U Ramp Function Adjustment
[endsource]
```

Each block will have multiple "P" lines, one for each study point considered for one station only. Each "P" line is followed by just one "D" line for that station. "D" lines may be followed by multiple "U" and "DU" lines for all undesired stations checked at that point. Each desired station will have a separate source block. However, there is not a guarantee that “U” records will always follow a “D”, nor that a “DU” record will always follow a “U”, since Longley-Rice warnings may abort the analysis for that grid cell if TVStudy is set to “Assume Service” or “Assume Interference” when warnings occur and the subsequent records will not be generated.

In local grid mode, each [grid] block encloses just one [source] block, for the desired station that defined the grid. The [scenario] block will therefore typically enclose multiple [grid] blocks, one for each station studied.

A line containing [abort] may appear at any point in the data, indicating an error occurred and there is no further data for the scenario; all open data blocks are implicitly closed. When it appears, [abort] does not necessarily indicate the end of the file; another [scenario] block may begin immediately after.

Points Mode

For a study run in points mode, the [cell]/[endcell] blocks are replaced by blocks in this format:

```
[points]
Lat Index, Lon Index
P, Point Name, Country Key for Point, Point Lat, Point Lon, Point Elevation, Point
   Receive Height, Clutter
D, Source Key, Site, Field Strength, DSigAdj, DServAdj, Reverse Bearing, Bearing,
   ERP (dBk), KWX Flag, Service Flag
S, Site, Time Delay, Field Strength, Bearing, Receive Pattern Adjustment, Causes Ix
DS, D/U Ratio, Rule Value for Comparison, D/U Ramp Function Adjustment
U, Source Key, Field Strength, Bearing, Receive Pattern Adjustment, KWX Flag, Causes
   Ix
DU, D/U Ratio, Rule Value for Comparison, D/U Ramp Function Adjustment
[endpoints]
```

Each "P" line is followed by one or more "D" (desired) entries, one for each desired station whose contour covers the population centroid point described by the "P" line. Similarly, each "D" line can have multiple "U" (undesired) and "DU" (D/U ratio) lines, for each undesired station that is within the culling distance of the desired station as specified by the study rules. However, there is not a guarantee that "U" records always follow a "D", nor that a "DU" record will always follow a "U", since Longley-Rice warnings may abort the analysis for that grid cell if TVStudy is set to "Assume Service" or "Assume Interference" and the subsequent records will not be generated.

DSigAdj and DServAdj are described in the Detail CSV Cell File Points mode section of this Appendix.

Notes About the Detailed Cell Output File

If a Longley-Rice error occurs and the study was not configured to disregard errors, an error on a "D" record means that there will not be any "U" records following, regardless of whether or not any fields were actually calculated. The cell was counted as interference-free service, or ignored as no service, depending on the study configuration.

Likewise, an error on a "U" record means that there will not be any following "DU" record, since the undesired station was ignored or counted as an interferer, depending on the study configuration.

The "C" records only appear when the Census block output is chosen. This provides each Census block ID (and associated population and household count) included in each cell.

When evaluating a desired DTS, there will only be one set of values in the "D" record. Those are for the single DTS transmitter providing the strongest field strength in the cell. When evaluating an undesired DTS, the fields after "Source Key" in the "U" line repeat for each transmitter in the DTS that causes interference. Then, the following "DU" line is the result of applying the receive pattern corrections to each field strength and summing the resulting values in power.

The "U" line, thus, looks like this:

```
U, Source Key, Site Number, Field Strength, Bearing, Receive Pattern Adjustment, KWX
   Flag, Site Number, Field Strength, Bearing, Receive Pattern Adjustment, KWX Flag,
   [...] Causes Ix
```

The bearing fields in the "D" and "U" records are bearings from the cell study point back to the station, used to determine receive antenna pattern adjustments.

The D/U ratio value in the "DU" record is based on applying the receive pattern corrections to the undesired signals, and also summing the pattern-adjusted undesired signals from all DTS transmitters.

The "S" and "DS" records only appear when conducting a DTS self-interference study. Like the repeating "U" line when an undesired source is a DTS, the "S" line repeats similarly:

```
S, Site Number, Time Delay, Field Strength, Bearing, Receive Pattern Adjustment,
   Site Number, Time Delay, Field Strength, Bearing, Receive Pattern Adjustment,
   [...] Causes Ix
```

The DU Ramp Function Adjustment field in a "DU" record is non-zero for co-channel interference to a DTV desired, the required D/U ratio is adjusted by the appropriate amount before comparing to the actual D/U to determine interference.

When a cell has population in multiple countries, the cell is studied at multiple distinct study points, one based on the population from each country. In that case there will be multiple "P" records, one for each country. A portion of the area in such a cell is counted in each country, proportional to that country's population in the cells versus the total from all countries.

In global grid mode, each [grid] block will contain many [cell] blocks, one for every cell in the grid, which may span the coverage areas of multiple stations. However, even in global mode there may be multiple [grid] blocks within a [scenario] block, because the total area of a large study is automatically partitioned in to sub-grids to manage memory allocation. Typically, studies conducted on computer systems with more physical memory (RAM) will have fewer study grids than systems with less physical memory. Those separate grids may overlap, so it is possible for the same cells to appear in more than one grid, in each case with a different set of desired stations. In other words, a particular [cell] block is not guaranteed to contain all results for that cell; data for the cell may be fragmented in several [grid] blocks.

A line containing [abort] may appear at any point in the data, indicating an error occurred and there is no further data for the scenario; all open data blocks are implicitly closed. When it appears, [abort] does not necessarily indicate the end of the file; another [scenario] block may begin immediately after.

Format of Detail CSV Cell Output File

Selecting the Detail CSV output option produces three to five comma separated value (CSV) files depending on the type of analysis performed. All files are placed in the `out/<servername>/<study>/<scenario>` directory and none of the files contain a header row.

	TVStudy Analysis type	
CSV output file	Wireless -> TV Interference	All other Study Types
sources.csv	X	X
D_CelData.csv	X	X
U_CelData.csv	X	X
U_eNBCelData.csv	X	--
U_iRSSCelData.csv	X	--

sources.csv. This file lists all the sources considered in the analysis and is output for all types of analyses. It lists both desired and undesired sources as well as other pertinent information. This comma separated file contains 12 fields as follows.

Field_1. Source Key
Field_2. Desired Flag
Field_3. Undesired Flag
Field_4. Source Country Key
Field_5. Service Type
Field_6. Channel
Field_7. Service Threshold
Field_8. Number of DTS sites
Field_9. Facility ID
Field_10. Site Number
Field_11. File Number
Field_12. Call sign

D_CelData.csv. This file lists, for each grid cell or point studied, information about the desired signal.

U_CelData.csv. This file lists, for each grid cell or point studied, the desired TV signal strength versus a single undesired TV signal strength as well as the results of the D/U ratio analysis. If the undesired TV stations is a DTS station, then each DTS location is listed on a separate line with the "Site Number" field distinguishing between sites. However, the D/U ratio shown is based on the aggregate field strength of all DTS sites.

U_eNBCelData.csv. This file lists, for each grid cell or point studied, the desired TV signal strength versus a single wireless station. This file has a separate row for each wireless station versus each grid cell or study point within the desired TV station's protected contour.

U_iRSSCelData.csv. This file lists for each grid cell or point studied, the desired TV signal strength versus the root sum square value of all the wireless stations that pass the OET Bulletin No. 74 culling rules.

With the exception of the sources.csv file, the information contained in the detail CSV cell files depends on whether the study is run in Grid or Points mode.

Grid Mode outputs: Detail CSV Cell fields and field order for studies run in Grid Mode.

	CSV output file: **D = D_CelData.csv** **U = U_CelData.csv** **eNB = U_eNBCelData.csv** **iRSS = U_iRSSCelData.csv**				
Field	**D**	**U**	**eNB**	**iRSS**	**Description**
key	1	1	1	1	<Lat Index>-<Lon Index>-<country Key>
ptLat	2	2	2	2	Latitude of study point in NAD83
ptLon	3	3	3	3	Longitude of study point in NAD83
ptArea	4	4	4	4	Area of study grid in square kilometers
ptPop	5	5	5	5	Population of study grid
ptHouse	6	6	6	6	Number of households in study grid
ptClutter	7				Clutter category associated with study point
USrcKey		7	7		Source Key of the undesired transmitter
USiteNo		8			Site number of the undesired TV DTS transmitter.
DSrcKey	8	9	8	7	Source key of the desired transmitter
DSiteNo	9	10	9	8	Site number of the desired DTS transmitter
DField	10	11	10	9	Field strength of desired transmitter in dBµV/m
R2Tbear	11				Bearing from receive point to transmitter location (deg true)
T2Rbear	12				Bearing from transmitter location to receive point (deg true)
T2Rerp	13				ERP of transmitter in direction of receiver (dBk)
Srvc	14	12	11	10	Service flag. 1= Desired field strength above service threshold
iRSS				11	Aggregate receive signal strength of multiple undesired wireless transmitters in dBµV/m
UField		13	12		Field strength of undesired transmitter
RxPatAdj		14	13		Receive antenna pattern adjustment in dB
$R2T_D$bear		15	14		Bearing from receive point to desired transmitter location (deg true)
DUratio		16		12	D/U ratio in dB
DUthres		17		13	D/U threshold before any adjustment
SNRfac		18		14	S/N adjustment factor in dB
ix		19		15	Interference flag. 1 = interference is predicted
Dkwx	15	20	15	16	Propagation model kwx error flag for desired path
Ukwx		21	16		Propagation model kwx error flag for undesired path

Points Mode outputs: Detail CSV Cell fields and field order for studies run in Points Mode.

	CSV output file: **D = D_CelData.csv** **U = U_CelData.csv** **eNB = U_eNBCelData.csv** **iRSS = U_iRSSCelData.csv**				
Field	**D**	**U**	**eNB**	**iRSS**	**Description**
PointName	1	1	1	1	Point Name
CountryKey	2	2	2	2	Country Key of the point
ptLat	3	3	3	3	See grid mode table
ptLon	4	4	4	4	See grid mode table
ptElev	5	5	5	5	See grid mode table
RxHgt	6	6	6	6	Receiver height in meters AGL
ptClutter	7				See grid mode table
USrcKey		7	7		See grid mode table
USiteNo		8			See grid mode table
DSrcKey	8	9	8	7	See grid mode table
DSiteNo	9	10	9	8	See grid mode table
DField	10	11	10	9	See grid mode table
DSigAdj	11	12	11	10	Desired signal adjustment. If the point set includes a custom receive antenna pattern/orientation, this value is the relative receive antenna gain (dB) in the direction of the transmitter.
DSrvcAdj	12	13	12	11	Desired signal service level adjustment. Since the service threshold is based on OET-69 planning factors, this field is the difference between the OET-69 planning factor antenna gain and the gain of the custom antenna. If the OET-69 generic antenna pattern is used this value is zero.
R2Tbear	13				See grid mode table
T2Rbear	14				See grid mode table
T2Rerp	15				See grid mode table
Srvc	16	14	13	12	See grid mode table
iRSS				13	See grid mode table
UField		15	14		See grid mode table
RxPatAdj		16	15		See grid mode table
$R2T_D$bear		17	16		See grid mode table
DUratio		18		14	See grid mode table
DUthres		19		15	See grid mode table
SNRfac		20		16	See grid mode table
ix		21		17	See grid mode table
Dkwx	17	22	17	18	See grid mode table
Ukwx		23	18		See grid mode table

APPENDIX E

Notes About Opening the Map Output Files

TVStudy produces four or five sets of map output files in either ESRI ShapeFile and/or Google KML format:

***contours* –** This file contains the coverage contours projected by TVStudy.

***coverpts* –** This file contains the Longley-Rice study points and their result codes.

***cmpcvpts* –** This file is output only when the composite coverage option is selected. It contains the same information as the basic coverpts file, but contains the best-case result for each cell across the stations included in the composite. It also does not contain many of the additional attribute columns that coverpts supports.

***points* –** This file contains the Longley-Rice study points and their area and population counts.

***sources* –** This file contains the locations of all the transmitters studied. For wireless to TV studies, this file contains both the location of the single desired TV transmitter and the location of all the undesired wireless sites and TV stations included in the study.

For those unfamiliar with ESRI Shape Files, all four pieces are required for the files to work properly. Do not delete any of the files.

There are many software applications available for opening and manipulating the ESRI Shape Files that are output by TVStudy. One free piece of software the FCC has used for this task is Quantum GIS (QGIS), which runs on Windows, Mac, and Linux, and is available at: http://qgis.org

To produce useful maps using QGIS, you will need to obtain ShapeFiles separate from those produced by TVStudy, such as files containing political boundary data. A collection of such files can be found here: http://nationalatlas.gov/atlasftp.html?openChapters=chpbound

To add output map files to QGIS, you can simply drag the shape file into the "Layers" pane at the left.

The coverpts output file uses the same set of result codes as noted in Appendix C, and you can thus assign a different color to each result code. To get to the properties window, where such assignments can be made, double-click the appropriate shape file in the "Layers" pane at the left. Available for download is a file called TVStudyTemplate.qml, which is a template that works with the ESRI ShapeFile output format to assign the following colors to each class of points:

1 or 11 = Interference-free service = Green
2 or 12 = Cell contains interference = Red
3 or 13 = Cell receives no service = Blue

Please note that when using Points mode rather than Grid mode, the coverpts output file produced is inverted. The points are placed at the transmit locations with the appropriate service code included, allowing a map to be produced showing the locations of the stations relative to the evaluated point(s).

The sources output map file includes both desired and undesired transmitter locations as well as information on their RCAMSL, HAAT, ERP and antenna orientation. QGIS allows you to specify the symbol color and rotation based on the associated metadata in the sources ESRI Shapefile. Example QGIS templates that work with wireless to TV generated "sources" ShapeFile outputs based on ERP and HAAT are available for download ("WirelessRuleBasedERP.qml" and "WirelessRuleBasedHAAT.qml")

The map may initially appear distorted. To correct this, locate the "Project Properties" menu option, then check the "Enable 'on the fly' CRS transformation" checkbox. Finally, select one of the NAD83 coordinate systems and map projections appropriate to the area under consideration, and the map should redraw in a less distorted manner.

No support for QGIS is provided beyond the simple instructions included in this Appendix.

Finally, note that the attributes in the ShapeFiles can vary based on the map output options selected when the study is run.

- Study point coordinates – Adds two columns.
- Area, population, households – Adds three columns.
- Land cover and clutter – Adds three columns (the third indicates the clutter database used).
- Desired signal and margin – Adds three columns (the third is the DTS Site Number).
- Worst undesired D/U and margin – Adds three columns (the third is the Source Key for the station causing the D/U ratio/margin noted).
- Wireless signal, D/U, and margin – Adds three columns only, but only if a Wireless to TV interference study is being conducted.
- Self-interference D/U and margin – Adds two columns.
- Smallest margin – Adds one column.
- Ramp/alpha (uncapped) – Adds one column.

APPENDIX F

Format of the Pair Study Output Files

stations.csv **–** This file lists all of the stations in the pair study.

```
Fac ID, Channel, Des Flag, Und Flag, Service Type, Call Sign, City of License, State
   of License, Country Key for Station, Status, File Number, Latitude, Longitude
```

baseline.csv – This file provides the baseline interference and service information.

```
Fac ID, Channel, Country Key for Point, Noise Lim Area, Noise Lim Pop, Terr Lim
   Area, Terr Lim Pop, Ix Lim Area, Ix Lim Pop
```

replication.csv **–** This file lists replicated parameters for each station on each replicated channel.

```
Fac ID, Replication Channel, Country Key for Point, Noise Lim Area, Noise Lim Pop,
   Terr Lim Area, Terr Lim Pop
```

points.csv **–** This file provides information on the location of each study point.

```
Point Key, Lat Index, Lon Index, Country Key of Point, Point Lat, Point Lon, Point
   Area, Point Pop
```

service.csv **–** This file provides information on whether or not there is service at a given point.

```
Point Key, Fac ID, Channel, Service Flag
```

interference.csv **–** This file shows the points with interference along with which paired station causes the interference to that point.

```
Point Key, Fac ID, Channel, Ix Fac ID, Ix Channel
```

Please note that all outputs featuring geographic coordinates are in the NAD83 format.

APPENDIX G

Format of the Scenario XML Output

```
<TVSTUDY VERSION="105000">
<SCENARIO NAME="name">
      <DESCRIPTION>
      description text
      </DESCRIPTION>
      <PARAMETER KEY=(see below)>
            <VALUE INDEX="0" (see below)>/VALUE>
      </PARAMETER>
      <SOURCE (see attributes below)>
            <APAT>
            azimuth,relative field
            .
            .
            </APAT>
            <EPAT>
            depression,relative field
            .
            .
            </EPAT>
            <MPAT>
            azimuth,depression,relative field
            .
            .
            </MPAT>
      </SOURCE>
      .
      .
</SCENARIO>
</TVSTUDY>
```

A SOURCE may contain an APAT providing azimuth pattern data, and either an EPAT (elevation) or MPAT (matrix) providing elevation pattern data. If MPAT data is provided, APAT will also be provided. The MPAT data is normalized so each elevation pattern slice at each azimuth contains a 1.0, and the APAT data provides values at matching azimuths with the relative scaling for each slice.

A DTS operation has the reference facility (bounding contour facility) parameters in the SOURCE attributes; individual DTS transmitters in the operation are provided by DTS_SOURCE elements within the SOURCE. The attribute SITE_NUMBER is only used within the DTS_SOURCE element with SITE_NUMBER="0" referring to the reference site.

```
<SOURCE (See attributes below)>
   <DTS_SOURCE (see attributes below)>
      <APAT>
      </APAT>
      <EPAT>
      </EPAT>
   </DTS_SOURCE>
</SOURCE>
```

If the XML source is a TV station, its attributes can be read directly from an associated CDBS/LMS dataset. In this case, only the DESIRED, UNDESIRED, LOCKED, RECORD_ID, SERVICE and REPLICATE attributes are required for TVStudy version 2.x XML source files. The SERVICE attribute is not required for XML sources built in earlier versions of TVStudy. The LOCKED flag will always be "true" (the record is non-editable), and the RECORD_ID attribute provides the CDBS application ID or LMS record ID. All data for the record will be loaded directly from CDBS/LMS dataset when the scenario is imported. If the application or record ID is not found in the importing study's version of CDBS/LMS, the SOURCE entry is ignored (a warning message will be shown during import in that case).

If a record is editable (LOCKED="false"), even when the source for the record is CDBS/LMS, all record data is provided in the export in SOURCE attributes and enclosed elements. In that case it will not be necessary for the application or record ID to exist in the version of CDBS/LMS used by the importing study. The record will be in the imported scenario regardless, however if the application or record ID does not exist in CDBS/LMS of course it will not be possible to revert to the original CDBS/LMS record. When exporting a scenario, if it is expected that some records may not exist in the study dataset where the scenario will be imported, make all of those records editable prior to exporting.

If the XML source is a wireless base station, all attributes for the base station must be pulled from the XML file.

SCENARIO Attributes

When exporting a Wireless to TV Interference scenario, the wireless frequency (KEY=”355”) and bandwidth (KEY=”356”) are included as attributes of the SCENARIO. These take the following format.

```
<SCENARIO>
<PARAMETER KEY="355">
   <VALUE INDEX="0">(wireless center frequency in MHz)</VALUE>
</PARAMETER>
<PARAMETER KEY="356">
   <VALUE INDEX="0">(wireless bandwidth in MHz)</VALUE>
</PARAMETER>
</SCENARIO>
```

This allows these wireless scenario-specific parameter values to be included with the scenario XML file.

SOURCE Attributes

The following table lists the source attributes and indicates if they are required, optional or not applicable for each type of source.

R = Required
RL = Required only if source is locked
NA = Not applicable (ignored)
RU = Required only if source is unlocked
O = Optional

Attribute	Value	TV	DTS	FM	WL	Comment
LOCKED	"true|false"	R	NA	R	R	Indicates if the station record is editable, locked records are non-editable. If the source data is to be read directly from CDBS/LMS then the record must be LOCKED="true"
DESIRED	"true|false"	R	NA	R	NA	This attribute is only required when the source is part of a scenario element.
UNDESIRED	"true|false"	R	NA	R	NA	This attribute is only required when the source is part of a scenario element.
RECORD_ID	"application ID"	RL	NA	RL	NA	In versions of TVStudy prior to 2.0.0, this field is replaced by CDBS_ID. RECORD_ID is appropriate for both CDBS and LMS datasets.
SERVICE	"service code"	R	R	R	R	(e.g. "DT", "WL","FM")
REPLICATE	"replication channel"	O	NA	NA	NA	Only required when creating a replicated TV station. Can be used with LOCKED="true" or LOCKED="false"
CHANNEL	"channel"	RU	NA	RU	NA	TV or FM channel
ID	"facility id"	RU	NA	RU	NA	CDBS facility ID or equivalent user-entered value for a record that is not based on CDBS
SITE_NUMBER	"dts or drt site numb"	NA	R	NA	NA	Applicable only to the <DTS_SOURCE> element
CELL_SITE_ID	"cell site id"	NA	NA	NA	R	This field plus the SECTOR_ID attribute and is used as the call sign for TVStudy reports.
SECTOR_ID	"sector id"	NA	NA	NA	O	This field is appended to the CELL_SITE_ID attribute with a hyphen separator to form the site call sign used for TVStudy reports.
CLASS	"fm_class"	NA	NA	RU	NA	(e.g. "A","B1","C0", etc.)
COUNTRY	"country code"	RU	NA	RU	R	Station country: "US", "CA", or "MX"

Attribute	Value	TV	DTS	FM	WL	Comment
DRT	“true|false”	O	NA	NA	NA	If false or missing TVStudy assumes that the station is not a digital replacement translator
LATITUDE83	“latitude”	RU	R	RU	R	Can be decimal degrees with positive for Northern hemisphere or DMS_H.
LONGITUDE83	“longitude”	RU	R	RU	R	Can be decimal degrees *with positive for Western hemisphere* or DMS_H.
CALL_SIGN	“call”	RU	NA	RU	NA	
CITY	“city”	RU	NA	RU	O	
STATE	“state”	RU	NA	RU	O	
ZONE	“zone”	O	NA	NA	NA	TV Zone: "1", "2", or "3".
STATUS	“status”	O	NA	O	NA	Record status: "APP", "CP", "CP MOD", "LIC", "GRANT", or "STA"
MOD_TYPE	1	O	O	NA	NA	Modulation Type: Place holder for future TVStudy enhancements. This attribute is not currently used.
FILE_NUMBER	“file_number”	O	NA	O	NA	
IBOC	“true|false”	NA	NA	O	NA	Only needed if IBOC employed, if missing assumed to be false
IBOC_ERP	“iboc_erp”	NA	NA	O	NA	In kW; if missing assumed to be -20 dBc
OFFSET	“offset”	O	NA	NA	NA	Offset code: "Z", "+", or "-". In the case of no offset, the attribute does not appear.
MASK	“mask type”	O	NA	NA	NA	Emission mask code: "S", "T", or "F"; Appears only if mask setting is relevant to the record service (usually low-power television and similar records)
HAMSL	“hamsl”	RU	R	RU	R	Antenna height in meters above mean sea level. Entering -999 will cause this value to be calculated if a value is given for HAAT
HAAT	“haat”	RU	R	RU	R	Antenna height above average terrain. Entering a value of -999 will cause this value to be calculated if a value is given for HAMSL
ERP	“erp”	RU	R	RU	R	Peak horizontal effective radiated power, kW
HAS_APAT	“true|false”	O	O	O	O	If false or missing, then any APAT data included in XML record will be ignored.
USE_GENERIC	“true|false”	O	O	O	O	If false or missing, then generic elevation pattern will not be applied when elevation pattern is missing
ANTENNA_ID	“x”	O	O	O	O	Reference integer to antenna pattern.

Attribute	Value	TV	DTS	FM	WL	Comment
						This field is for informational purposes only. Imported XML stations must include the antenna pattern data in the XML file or use omni-directional by default.
APAT_NAME	"name"	O	O	O	O	
APAT_ORIENT	"azimuth"	O	O	O	O	Degrees true north. If missing, then azimuth orientation is set to 0
HAS_EPAT	"true|false"	O	O	O	O	If false or missing, then any EPAT data included in XML record will be ignored
EPAT_NAME	"name"	O	O	O	O	
EPAT_ETILT	"tilt"	O	O	O	O	Elevation pattern electrical tilt, degrees of depression.
EPAT_MTILT	"tilt"	O	O	O	O	Elevation pattern mechanical tilt, degrees of depression
EPAT_ORIENT	"azimuth"	O	O	O	O	Orientation of mechanical tilt, degrees true north
HAS_MPAT	"true|false"	O	O	O	NA	If false or missing, then any MPAT data included in an XML record will be ignored
MPAT_NAME	"name"	O	O	O	NA	Identifying name of the matrix elevation pattern.

APPENDIX H

Examples of Valid Input for "Add SQL"

CDBS and LMS

The following table contains several common examples of Additional SQL, which may be used in searches for stations. It is by no means exhaustive, but should cover some of the most common use cases for CDBS datasets.

Choose a state	`facility.comm_state = 'VA'`
Choose multiple states	`facility.comm_state IN('VA','DC','MD')`
Choose a city of license	`facility.comm_state = 'VA' AND facility.comm_city = 'Roanoke'`
Choose a channel	`tv_eng_data.station_channel = 51`
Choose a range of channels	`tv_eng_data.station_channel >= 14 AND tv_eng_data.station_channel <= 20`
Choose only Zone I	`tv_eng_data.fac_zone = 1`

Here is the same table for LMS datasets.

Choose a state	`application_facility.afac_community_state_code = 'VA'`
Choose multiple states	`application_facility.afac_community_state_code IN('VA','DC','MD')`
Choose a city of license	`application_facility.afac_community_state_code = 'VA' AND application_facility.afac_community_city = 'Roanoke'`
Choose a channel	`app_antenna_frequency.aafq_channel = 51`
Choose a range of channels	`app_antenna_frequency.aafq_channel >= 14 AND app_antenna_frequency.aafq_channel <= 20`
Choose only Zone I	`application_facility.afac_facility_zone_code = 1`

Any of these statements can be linked together in both CDBS and LMS datasets using the AND operator, the OR operator, and/or parentheses. Please consult a SQL guide for further details.

Please note that if you attempt to search by transmitter parameters such as power or height, DTS records may not be properly excluded due to the way they are stored in the database. To work around this, use a sub-select, shown in this example for searching for stations that have antennas using elevation patterns:

```
tv_eng_data.application_id IN (SELECT application_id FROM tv_eng_data WHERE
elevation_antenna_id > 0)
```

For a full list of fields in CDBS, please see the following web page:
http://www.fcc.gov/ftp/Bureaus/MB/Databases/cdbs/_readme.html

For a full list of fields in LMS, please see the following PDF:
https://enterpriseefiling.fcc.gov/dataentry/api/download/lmschema

Wireless

Wireless datasets are stored within TVStudy within a table named "base_station". The following fields are available for SQL searches from the "base_station" table:

cell_key	integer
cell_site_id	varchar(255)
sector_id	varchar(255)
cell_lat	float
cell_lon	float
rc_amsl	float
haat	float
erp	float
az_ant_id	integer
orientation	float
el_ant_id	integer
e_tilt	float
m_tilt	float
m_tilt_orientation	float
reference_number	char(22)
city	char(20)
state	char(2)
country	char(2)

The following are some examples of SQL statements that can be used to find wireless base stations within a wireless dataset:

Choose by cell site ID	`base_station.cell_site_id LIKE "PEA103%"`
Choose by sector orientation	`base_station.orientation >= 0 AND` `base_station.orientation <= 45`
Choose by city	`base_station.city = "Front Royal"`

User Records

User records are stored within TVStudy within a table named "user_record". The following fields are available for SQL searches from the user_record table.

user_record_id	integer
record_type	integer
xml_data	text
facility_id	integer
service_key	integer
call_sign	char(12)
status	char(6)
channel	integer
city	char(20)
state	char(2)
country	char(2)
file_number	char(22)
comment	text

Please note that the technical parameters for the record are contained within the xml_data field in for format of an XML SOURCE record.