

## DX ToolBox

DX Toolbox searches the world for you, gathering information on solar and geomagnetic conditions that affect radio propagation. DX Toolbox also has several built in propagation forecasting tools. An active internet connection is required to use DX ToolBox.

It displays in real-time the following important readings:

- Solar Flux
- A-Index
- K-Index
- X-Ray Flux levels
- X-Ray flares
- Solar Wind
- Earth's Magnetic Field
- Radio Blackout conditions
- Geomagnetic Storm conditions
- Solar Radiation Storm conditions

In addition, the last month's worth of Solar Flux, A-Index, K-Index, Sun Spot Number, and background X-Ray Flux are plotted.

Maps showing auroral levels, as well as the maximum F layer frequency (related to MUF) over various parts of the world are also displayed. In addition, images of the Sun from the SOHO satellite are also shown.

A grayline map of the world is also available, showing the daylit, dark, and most importantly the grayline region, where propagation is often greatly enhanced.

Propagation conditions can be estimated between two points on the Earth.

DX ToolBox features several windows, each described on the following pages:

## Preferences

The first time you use DX ToolBox, you should set your preferences:

**Latitude:** The latitude of your location as a decimal number. Use a positive number if you are north of the equator, negative if south. For example, 39.5 for 39 degrees, 30 minutes.

**Longitude:** The longitude of your location as a decimal number. Use a positive number if you are east of the prime meridian, negative if west. For example, -77.25 for 77 degrees, 15 minutes west.

**UTC Offset:** The number of hours you are ahead of UTC. Enter a negative number if behind UTC. For example, -5 for EST, -4 for EDT.

**Alarm Settings:** You can set thresholds for the K index, X-Ray flux, and Bz (z component of the Earth's magnetic field). If the current readings exceed these levels, and "Play Alert Sound" is checked in the Current Conditions window, an alert sound will be played if these values are exceeded. This can be used to alert you that a solar flare is occurring, or auroral conditions or poor propagation is expected. Here is how it works:

For the K index, enter a number from 1 to 9. If the K index reaches or exceeds this value, an alarm will sound.

For the X-Ray flux, enter either C, M, or X to specify the minimum flare intensity that will cause an alarm.

For Bz, enter the \*maximum\* Bz value. Usually, you will enter a negative number, since negative Bz values usually produce aurora conditions. For example, if you enter a value of -20, then any Bz value equal to -20, or more negative, will produce an alarm.

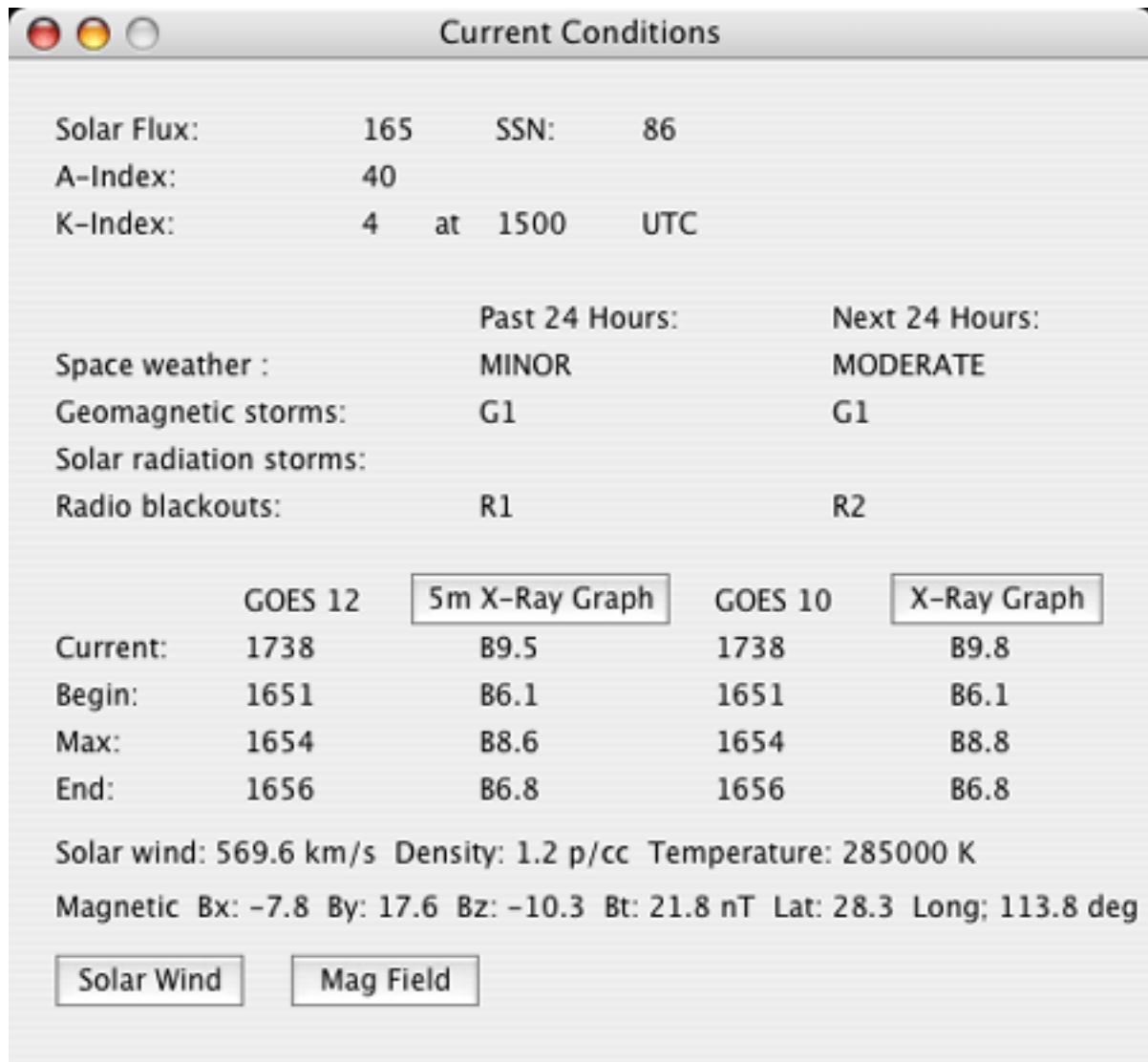
**Add callsign prefixes instead of countries to location menus:** When checked, callsign prefixes will be used instead of country names, in the location menus. Note that DX ToolBox requires the cty.dat file for the country list. This file comes with the download, and must be kept in the same folder as the application itself.

**Proxy Support:** if you are behind a firewall and need to use a proxy for web

access, you can check the Use Proxy box, and enter in the server address and port number. You must then quit and re-start DX ToolBox for the change to take effect. Only proxies that do not require authentication can be used.

**Gain Offset:** This value (in dB) will be added to all estimated signal levels. It can be used to adjust the values computed by DX ToolBox, if you believe they are too low or high for your uses.

## Current Conditions



The Current Conditions window displays real-time readings for the following:

**Solar Flux:** A measurement of the energy output of the Sun at certain radio frequencies. This is an indication of how strong the ionosphere is. The higher the solar flux, the better able the ionosphere is able to reflect shortwave radio waves, and the higher the frequency of waves which may be reflected.

**A-Index:** A measurement of the disturbance of the Earth's geo-magnetic field. Lower numbers are better. Higher numbers indicate poor conditions. The range of values is from 0 to 400. Only one A-Index value is computed for

each day, after the end of the day.

K-Index: Another measurement of the disturbance of the Earth's geomagnetic field. Lower numbers are better. Higher numbers indicate poor conditions. The range of values is from 1 to 9. A new K-Index value is computed every three hours.

The current space weather conditions, geomagnetic storms, solar radiation storms, and radio blackout conditions are reported, as well as the forecast for the next 24 hours. None means that there is no adverse weather for that condition.

Next are x-ray readings from two Earth orbiting satellites. These show the current readings, as well as the time, duration, and intensity of the last detected solar flare.

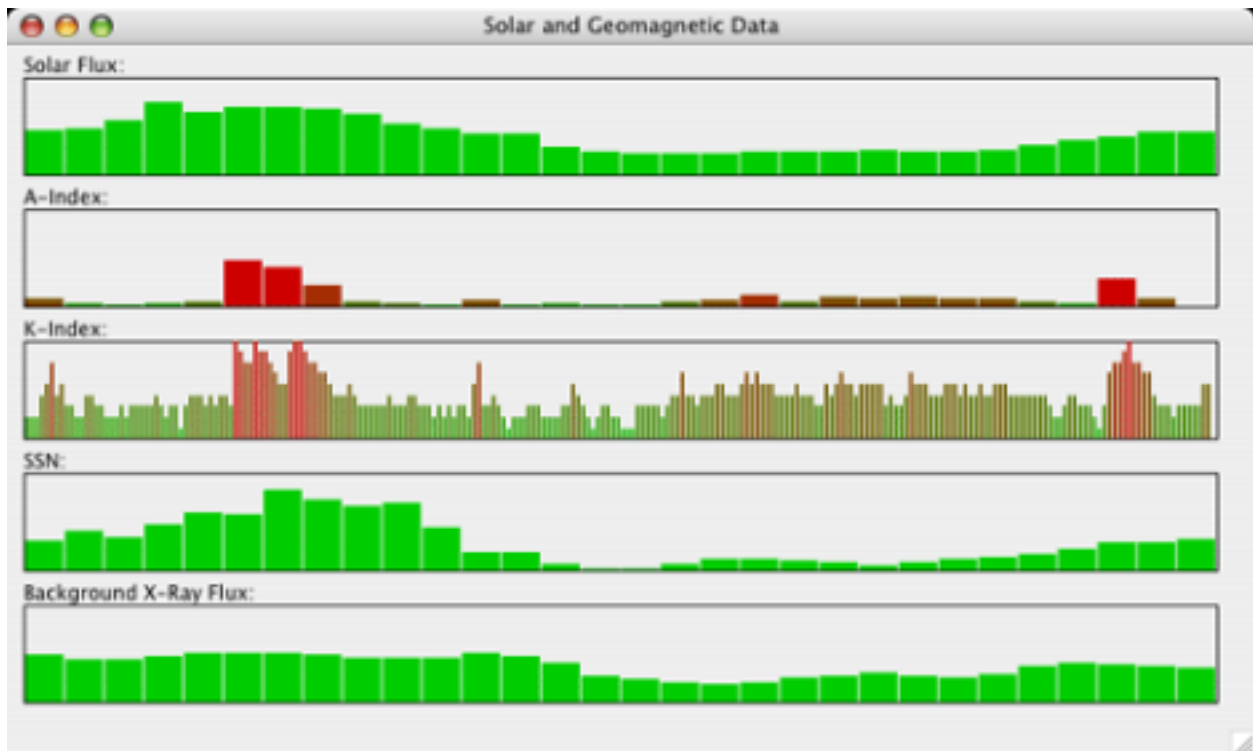
Clicking the "X-Ray Graph" or "5m X-Ray" Graph button will bring up a window showing x-ray flux from the GOES satellites, at either a 1 or 5 minute update rate. High levels of x-ray flux generally lead to noisy conditions, and flares (large peaks) can cause blackouts over much or even all of the HF spectrum.

Clicking the "Solar Wind" or "Mag Field" buttons will bring up a window with a graph of values for the solar wind or the Earth's magnetic field. Likewise there are buttons to display graphs of proton and electron flux readings.

Finally, solar wind and geomagnetic readings are shown. A Coronal Mass Ejection (CME) from the Sun, impacting the Earth, will cause an increase in solar wind speeds. If the geomagnetic field Z component is pointing South (negative) at this time, it is possible for auroral conditions to be produced.

**NOTE:** The SSN (Sun Spot Number) is only updated if the Solar and Geomagnetic Data window is also open.

## Solar and Geomagnetic Data

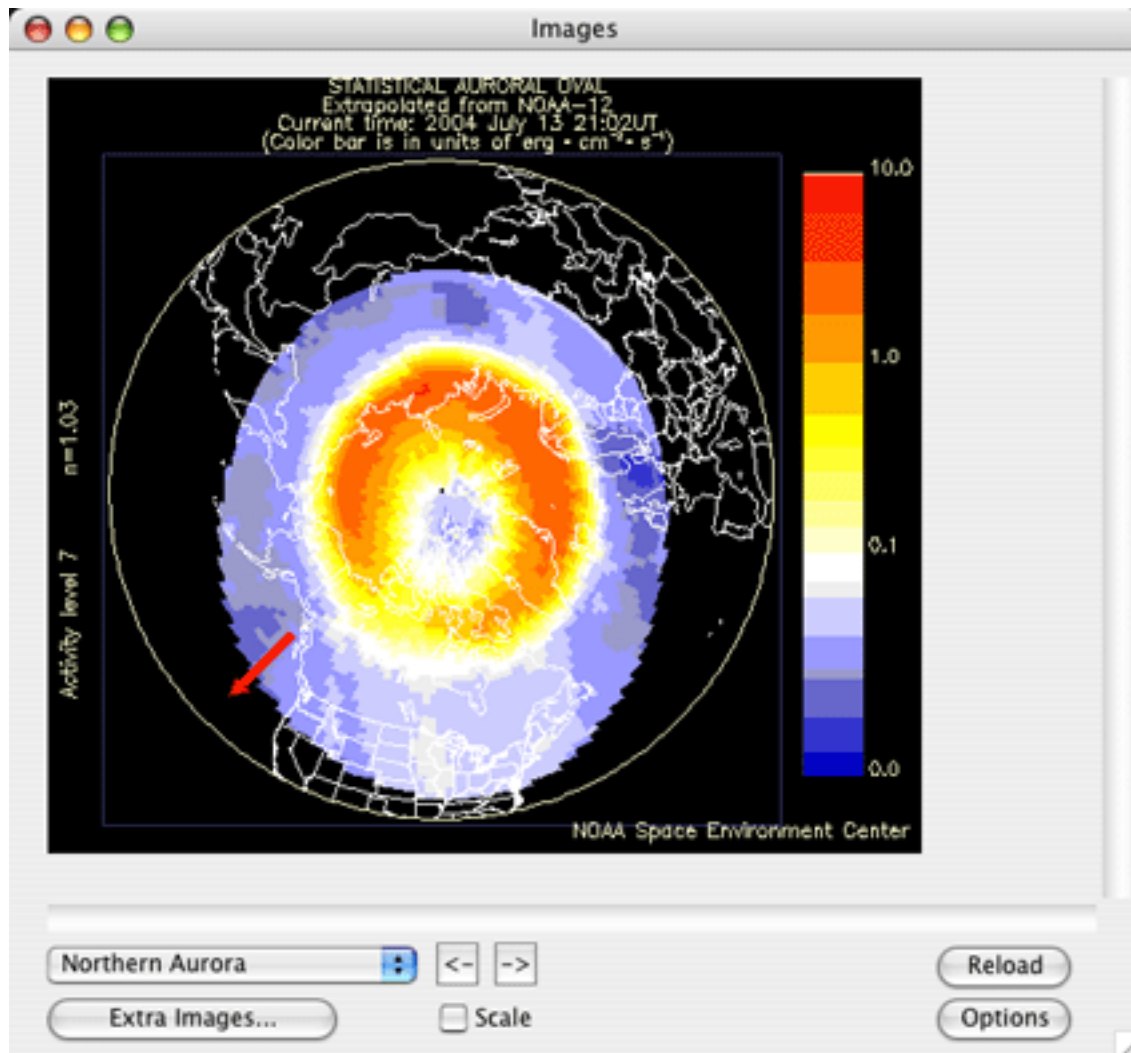


This window graphs five important values - the daily Solar Flux, A-Index, Sun Spot Number, and Background X-Ray Flux readings, as well as the K-Index readings produced every three hours.

The higher the solar flux and SSN, the higher the frequencies that will be reflected by the ionosphere. The lower the A and K Index values and Background X-Ray Flux, the better the overall shortwave radio conditions.

Hi K-Index values, especially in the 7-9 range, can indicate that auroral conditions are possible.

## Images



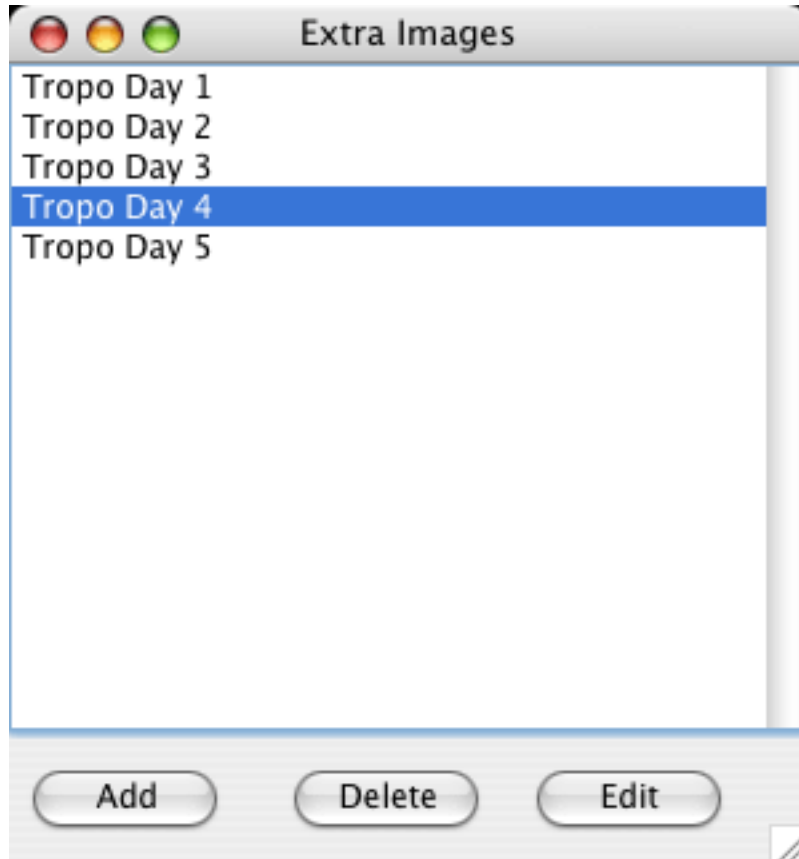
The Images window allows you to display several different images and graphs from the web, such as the extent of the auroral oval shown here. Other auroral and propagation related images are available by selecting them from the popup menu in the lower left corner of the window.

It takes several moments to load these images when DX ToolBox is started, especially on a slow (dialup) internet connection. Clicking the Reload button will reload all of the images.

The right and left arrow buttons let you shift through the loaded pictures. If

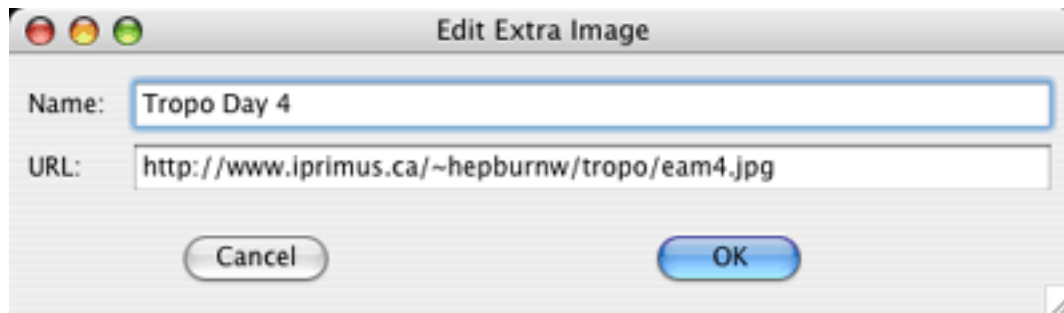
the Scale checkbox is clicked, the images will be scaled to the size of the window,

Clicking on the Options button will bring up a list of all of the images, you can select which are loaded by checking the box next to that image name. You can also specify additional images to load. Click on the Extra Images button, and you will see a window like the following:



Click on the Add button, and you will get another window, allowing you to enter in a name for the image, and the URL to load:

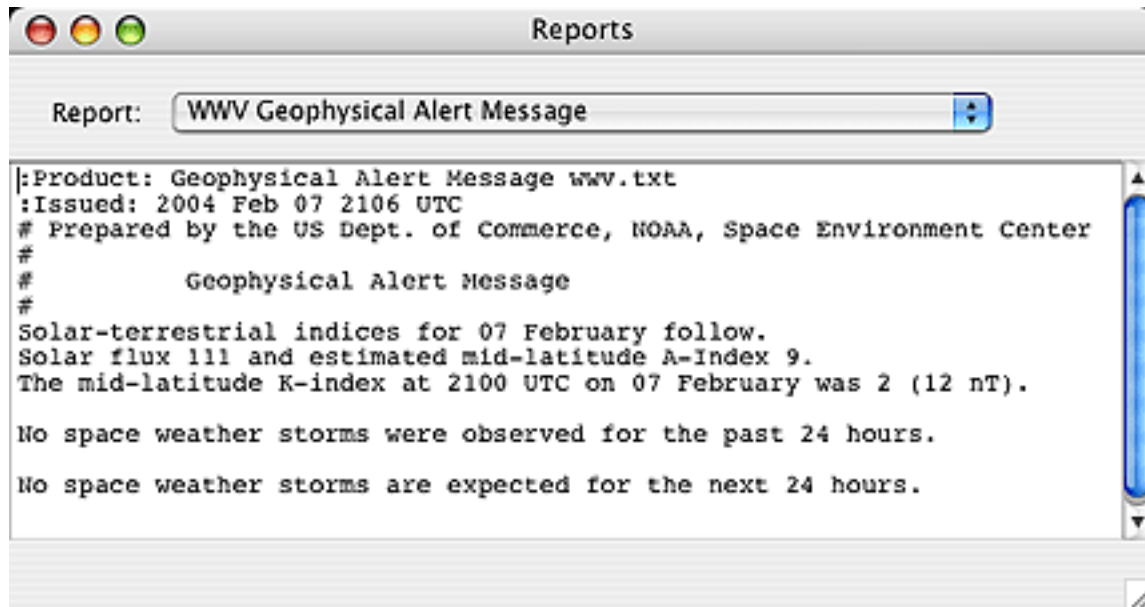




You can usually copy the URL from your web browser, and paste it into the URL line. After adding additional images, be sure to close and re-open the Images window for the changes to take effect.

## Reports

The reports windows lets you look at many different text reports that continue useful information related to propagation conditions:



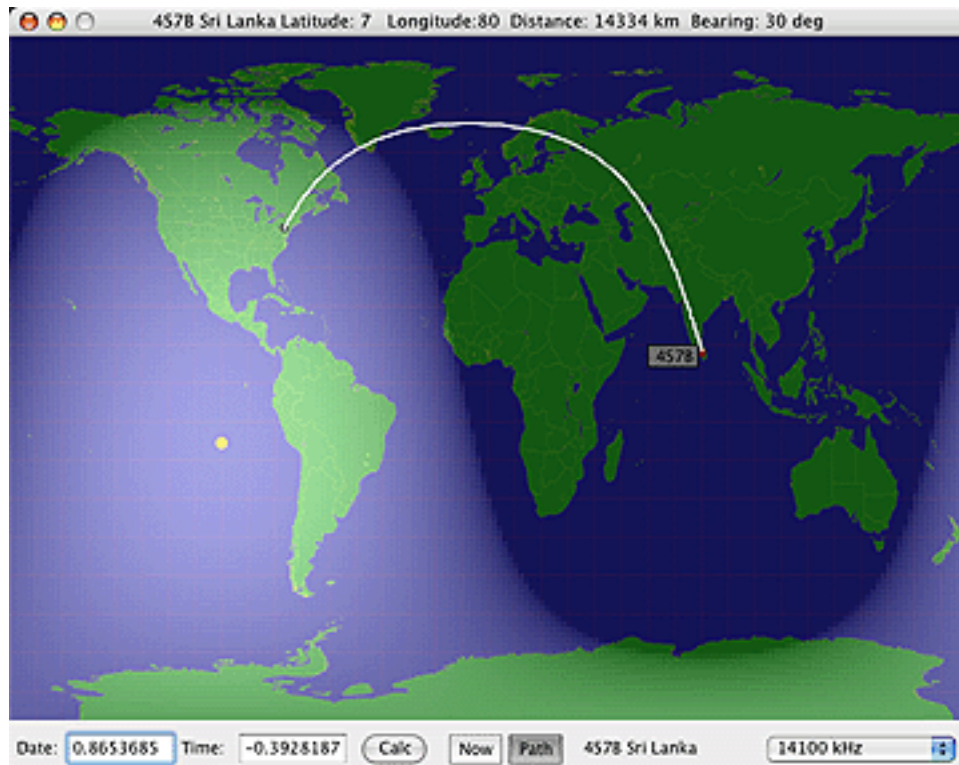
Just select the report from the popup menu. It will take a few moments for all of the reports to be loaded, you can watch the download status at the bottom of the window.

The following reports are available:

- WWV Geophysical Alert
- 27 Day Space Outlook
- 45 Day AP Forecast
- Geomagnetic Data
- Daily Geomagnetic Data
- Daily Particle Data
- Daily Solar Data
- GEOALERT
- Daily Magnetometer Analysis Reports
- Hourly Magnetometer Analysis Reports
- Predicted Sunspot Numbers and Radio Flux
- Report of Solar-Geophysical Activity
- Solar and Geophysical Activity Summary
- Solar Region Summary

Weekly Highlights and Forecasts  
Current Space Weather Indices  
Space Weather Event Reports  
Daily Space Weather Indices  
Summary of Space Weather Observations  
3-day Space Weather Predictions

## Grayline Map



This window displays a map of the world, showing the day and night regions, and the important grayline region between the two.

Propagation is generally enhanced between regions in the grayline. That is, if you are in the grayline, then often you will find excellent propagation conditions to/from other locations also in the grayline.

Due to the tilt of the Earth's axis, the shape of the grayline changes throughout the year, so that certain stations may only be in the grayline along with your location at specific times of the year, if at all.

When the Now checkbox is checked, the map will update in real-time.

Otherwise, you can enter a date and time in the appropriate boxes, and click the Calc button, to be shown the grayline conditions for that date and time.

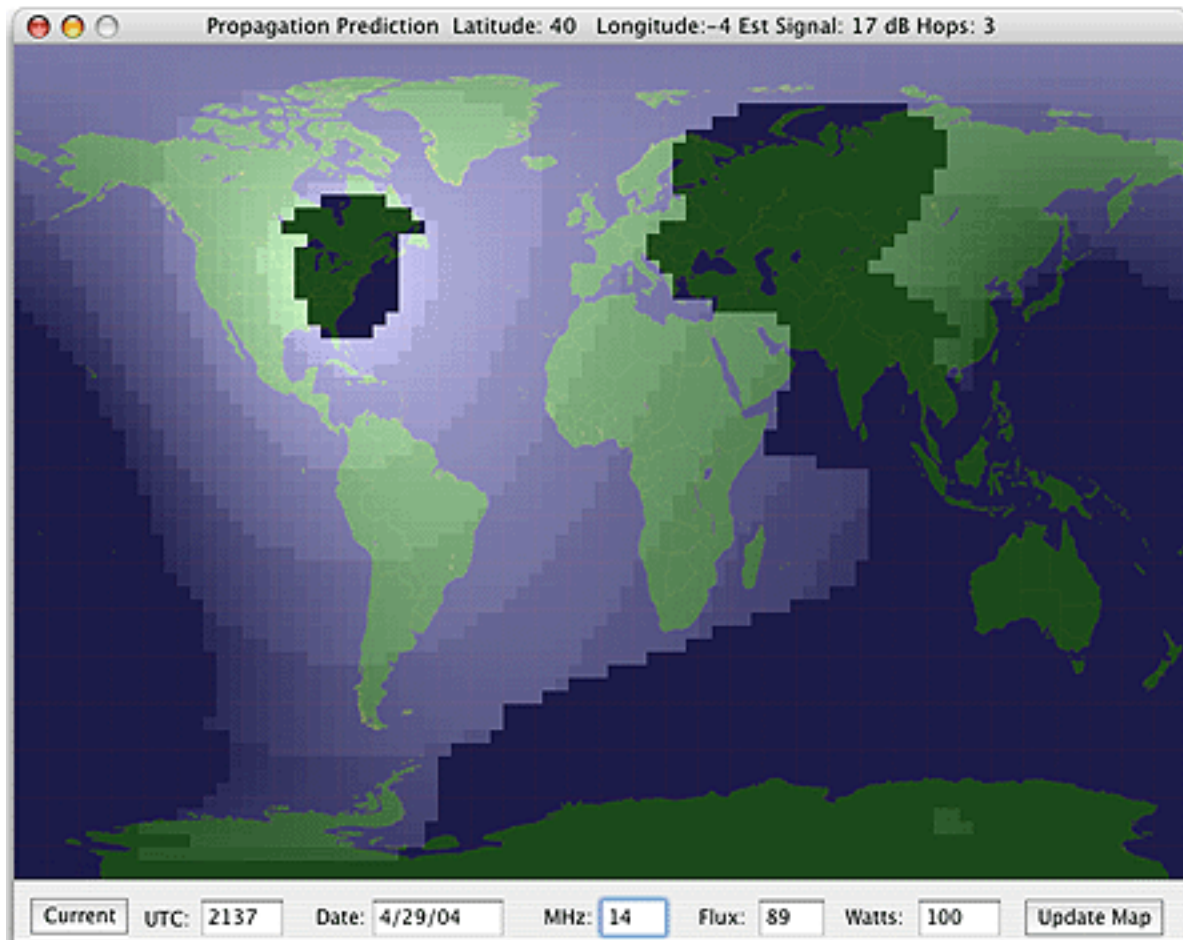
If you select a frequency from the pop-up menu in the lower right corner of the window, the map will update every 10 seconds, showing the location of the currently active NCDXF/IARU beacon for that frequency. The call of the

beacon is also displayed to the left of the pop-up menu.

If you have the Path checkbox checked, then the great circle (shortest) path between your location and the other station will be drawn, with the beam heading in the title bar of the window, along with the distance in kilometers. The other station is either the currently active beacon, or determined by the position of the mouse cursor over the map of the world. A more faint line will also be drawn showing the long path.

Clicking on a location will bring up the Propagation Path calculator, to help estimate the propagation conditions between your location and that location.

## Propagation Prediction Window

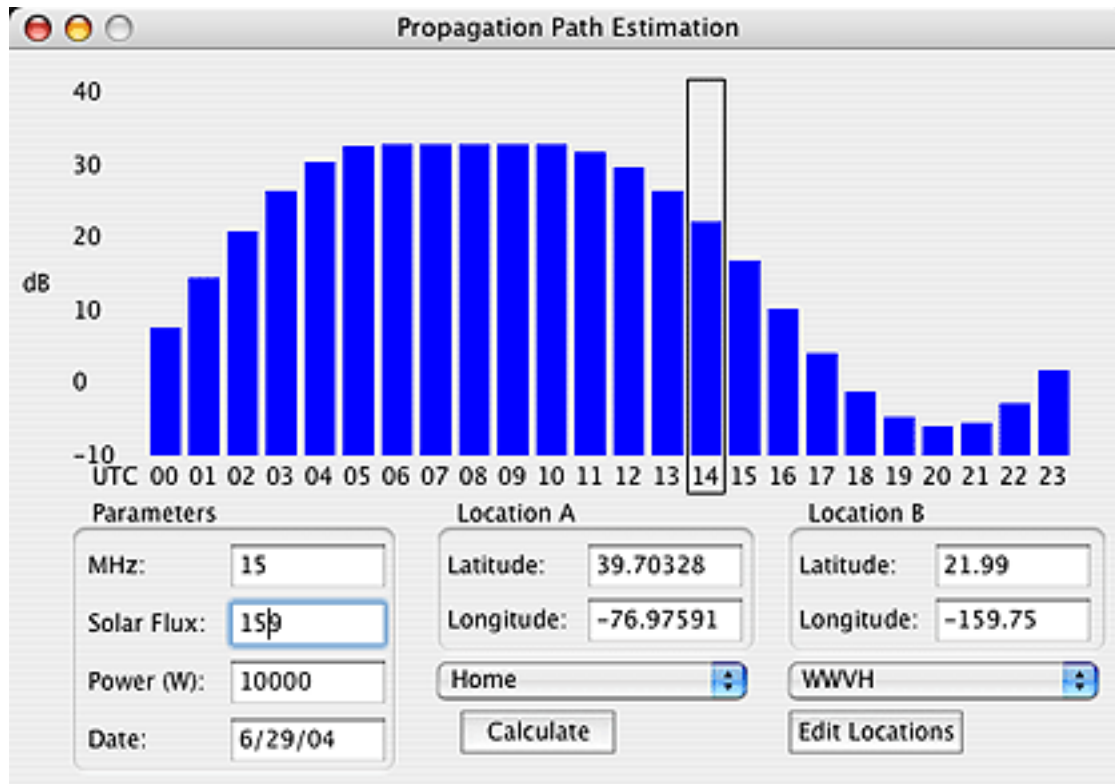


This window allows you to estimate the propagation conditions between two points on the Earth. The required information is the current solar flux, the desired frequency in MHz, the transmitter power level, and the current date and time. Enter this information, and press the Update Map button. The displayed map shows the estimated signal. Your location is taken from the Preferences, and the solar flux is automatically grabbed from the Current Conditions Window. You can of course change these values, as well as the time and date. Clicking on the Current button will place the current date and time in those fields.

As you move the cursor around the map, it will display the estimated signal level in dB. The assumptions are that the receive bandwidth is about 2.5 kHz, and the minimum sensitivity of the receiver is -123 dBm, typical for most modern receivers.

Please note that propagation is a lot like weather forecasting, except it is rarely even that accurate! But it will give you a good guide as to what propagation conditions can be expected.

## Propagation Path Estimation



This window allows the propagation for a particular path to be estimated. Enter the frequency in MHz, solar flux, transmitter power, date, and the two locations (location A is pre-set to your location as set in the Preferences) and click Calculate. A plot for the entire day will be generated showing estimated signal levels.

You can also bring this window up by clicking on a location on either the Grayline Map window or the Propagation Map window. Location A will be filled in with your location (as entered into the Preferences) and Location B will be filled in with the latitude and longitude of the location you clicked.

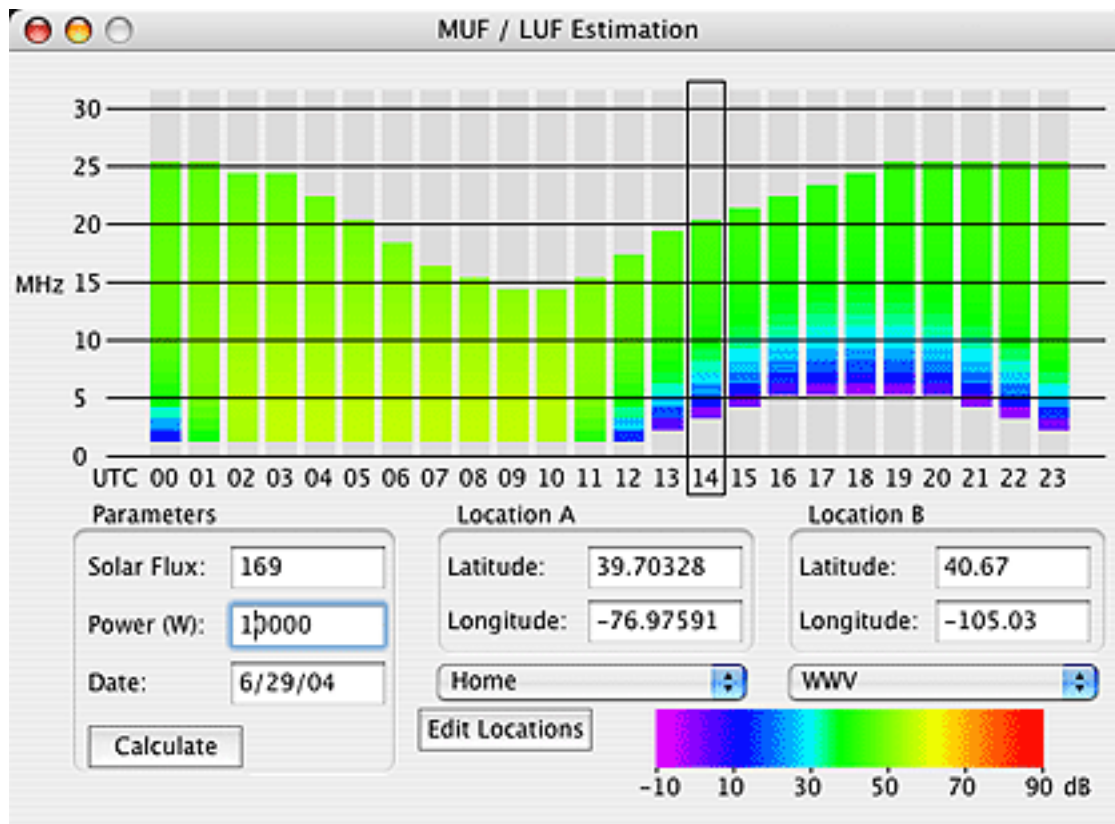
The popup menus can be used to select a location. Click on the Edit Locations button to add, change, or delete a location. You'll need to close and re-open this window for the changes to take effect.



## MUF / LUF Estimation Window

This window allows the signal strength for a particular path to be estimated for the range of frequencies over which propagation is expected.

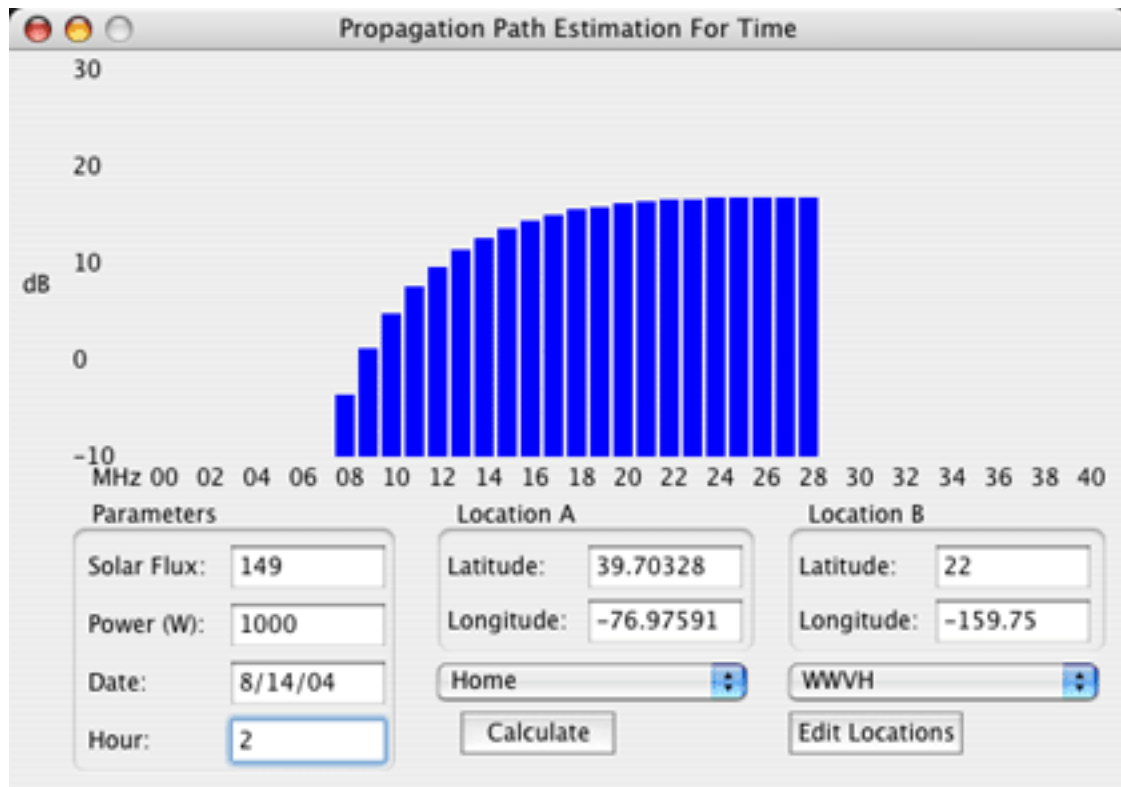
Enter the solar flux, transmitter power, date, and the two locations (location A is pre-set to your location as set in the Preferences) and click Calculate. A plot for the entire day will be generated showing estimated signal levels for the range of frequencies. The color mapping ranges from violet for a weak signal, to red for a strong signal, using the same color order as in a visible light rainbow (violet, blue, green, yellow, orange, red).



The popup menus can be used to select a location.

You can also bring this window up by holding down the shift key while clicking on a location on either the Grayline Map window or the Propagation Map window. Location A will be filled in with your location (as entered into the Preferences) and Location B will be filled in with the latitude and longitude of the location you clicked.

## Propagation Path Estimation For Time Window



This window allows the propagation for a particular path to be estimated. Enter the solar flux, transmitter power, date, the current UTC hour, and the two locations (location A is pre-set to your location as set in the Preferences) and click Calculate. A plot for that hour of the specified day will be generated showing estimated signal levels between 0 and 40 MHz.

You can also bring this window up by control-clicking on a location on either the Grayline Map window or the Propagation Map window. Location A will be filled in with your location (as entered into the Preferences) and Location B will be filled in with the latitude and longitude of the location you clicked.

The popup menus can be used to select a location. Click on the Edit Locations button to add, change, or delete a location. You'll need to close and re-open this window for the changes to take effect.

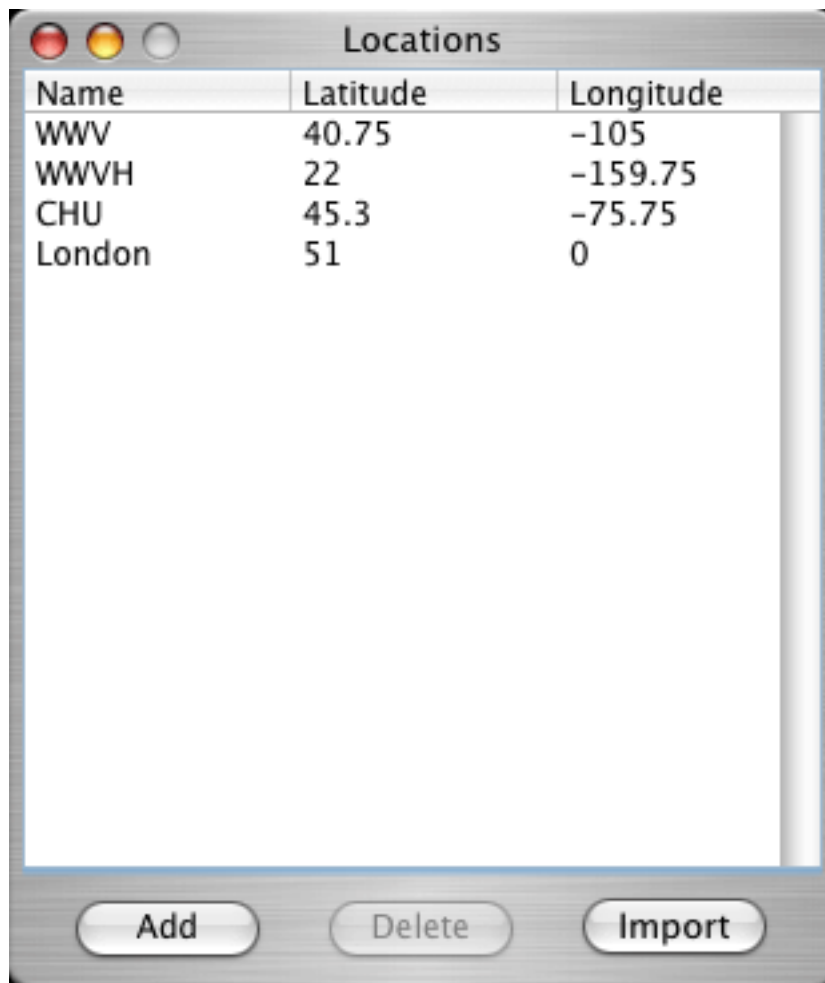
## Locations Window

This window allows you to add, edit, and delete locations that appear in popup menus. To add a new location, click the add button, and then type in the location name, latitude (N is positive, S is negative), and longitude (E is positive, W is negative).

To edit a location, double click on that location in this window. To delete a location, click on the location in this window, and then click the Delete button.

You can import a large number of entries at once, using the Import button, by putting them into a comma delimited text file, one on a line, like this:  
location,latitude,longitude

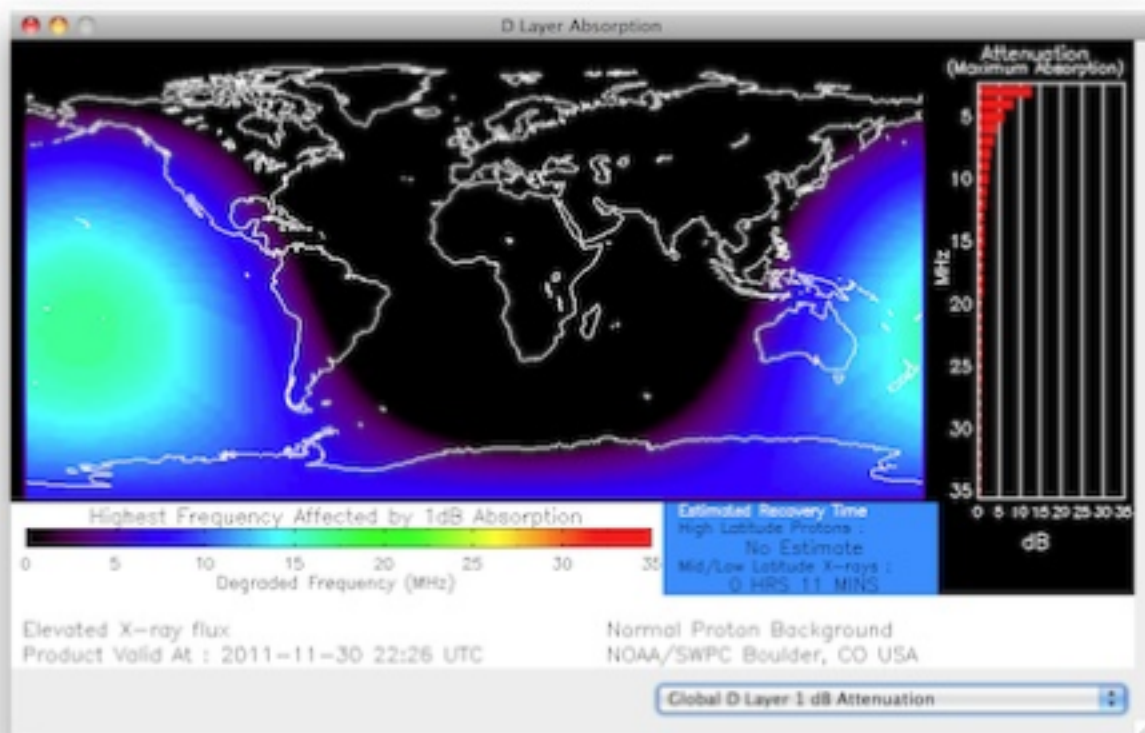
You can have a maximum of 100 locations.



## D Layer Absorption Window

This window displays various maps of the Earth, showing the level of D layer absorption at various frequencies. Excessive D layer absorption is caused by elevated x-ray flux levels, often due to a solar flare. It first affects lower frequencies, and then moves up to higher frequencies as the D layer starts to more strongly attenuate radio waves.

One of 21 different maps can be displayed, or “Cycle through images” can be selected to automatically cycle through the maps.



## MUF Calc Window

This window allows you to calculate the estimated MUF based on the current foF2 (maximum vertical incidence reflected frequency for the F2 layer), hmF2 (height of the F2 layer) and the distance between the two locations. In addition, the takeoff angle will be computed.

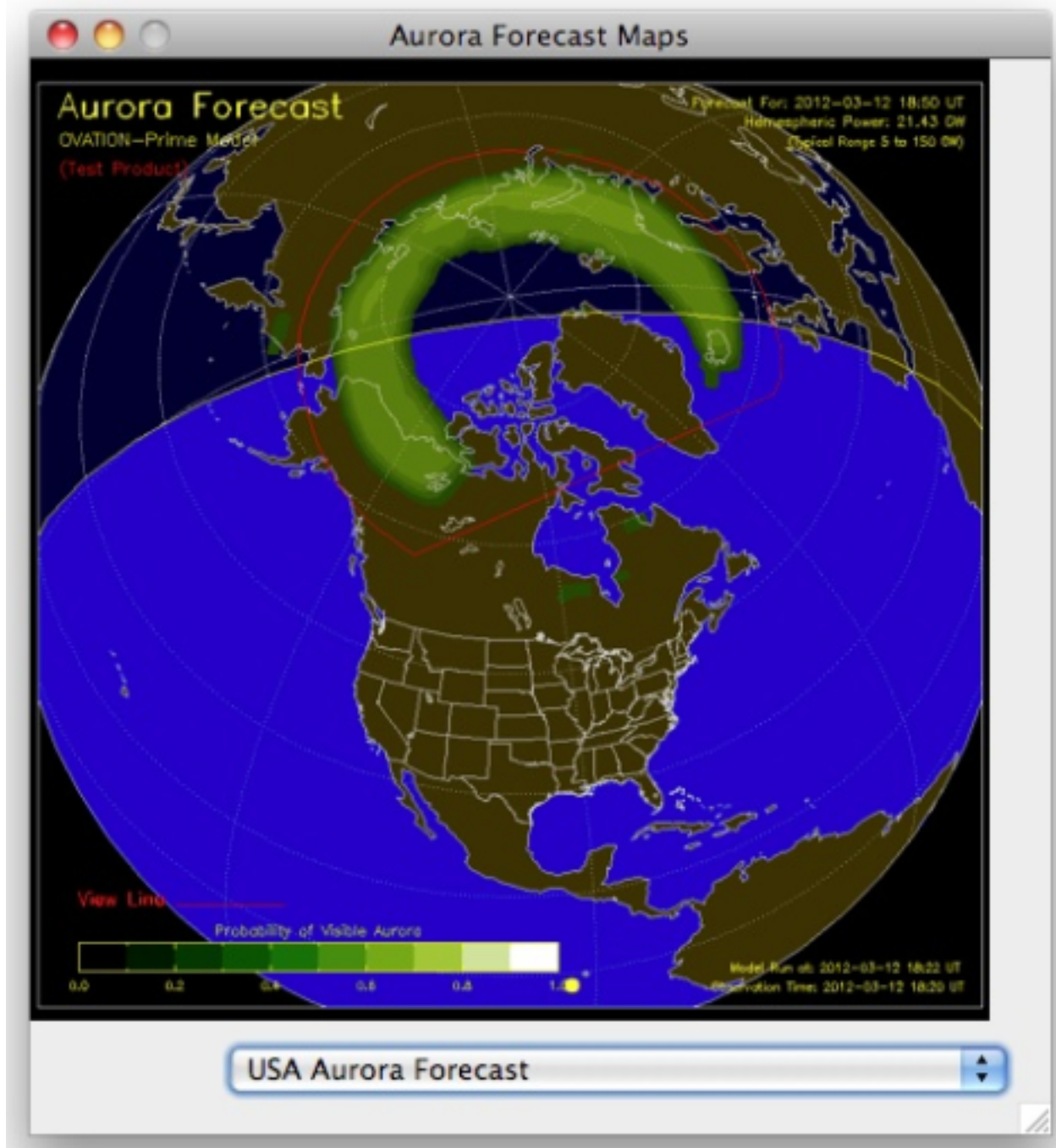
By selecting the foF2 and hmF2 tabs, maps of their current values around the world will be displayed (assuming you have a working internet connection).

The screenshot shows a macOS-style window titled "MUF Calc Window". It features three tabs: "Calc" (which is selected and highlighted in blue), "foF2", and "hmF2". Below the tabs, there are three input fields for user data: "foF2:" with a value of "9" and unit "MHz", "hmF2:" with a value of "250" and unit "km", and "Distance:" with a value of "700" and unit "km". At the bottom, two calculated values are displayed: "Calc MUF:" with a value of "15.5" and unit "MHz", and "Takeoff Angle:" with a value of "35.5" and unit "degrees". The window has standard macOS window controls (red, yellow, and green buttons) in the top-left corner.

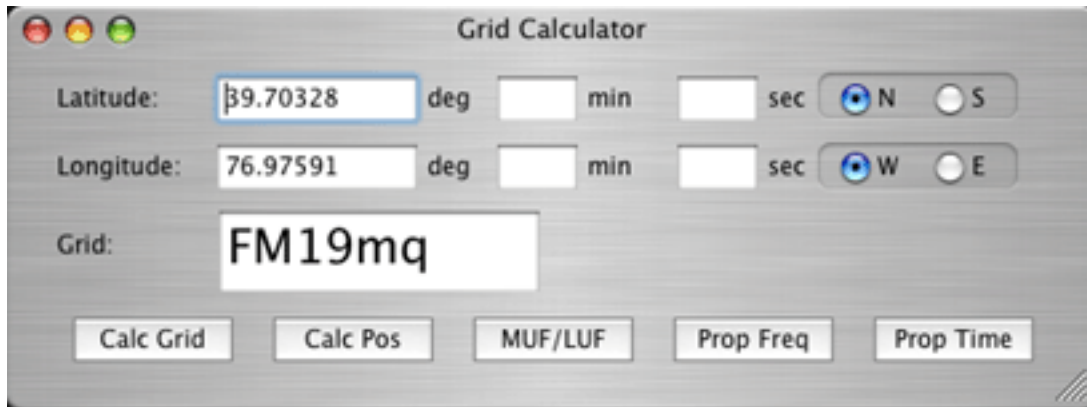
Input	Value	Unit
foF2:	9	MHz
hmF2:	250	km
Distance:	700	km
Calc MUF:	15.5	MHz
Takeoff Angle:	35.5	degrees

## Aurora Forecast Maps Window

This window allows you to view aurora forecast maps for various parts of the world. You can select one map to view, or have DX ToolBox cycle through the various maps.



## Grid Calculations

The image shows a software window titled "Grid Calculator". It has a standard macOS-style title bar with red, yellow, and green window control buttons. The interface includes three input rows. The first row is for Latitude, with a text box containing "39.70328", followed by "deg", "min", and "sec" labels, and radio buttons for "N" (selected) and "S". The second row is for Longitude, with a text box containing "76.97591", followed by "deg", "min", and "sec" labels, and radio buttons for "W" (selected) and "E". The third row is for the Grid, with a text box containing "FM19mq". At the bottom, there are five buttons: "Calc Grid", "Calc Pos", "MUF/LUF", "Prop Freq", and "Prop Time".

The Grid Calculator lets you determine the grid square from the longitude and latitude. You can enter them as decimal numbers as shown in the above example, or enter integer values for the degrees, minutes, and seconds. Then click on the Calc Grid button.

You can also enter in the grid location, and calculate the latitude and longitude for that grid by clicking on the Calc Pos button.

Each of the other three buttons will display one of the propagation tool windows, with the propagation conditions forecast for the path from your location to the one specified in the Grid Calculator.

There is also the Grid Square and Time Zone Map which shows a map of the world, with the grids marked out. The time zones are also shown.

You can type a 4 digit grid square into the text box and click the **Jump To** button, and the map will be re-centered (roughly) at that grid square location.

## **Ionosonde Plot**

This window lets you see graphs of ionosonde data from a number of sites around the world. Select the site from the first popup menu, then select the type of graph from the second. There are three types:

### **foF2:**

This is a plot of the highest frequency that will be reflected from the F2 layer of ionosphere when transmitted straight up. As the incident angle is decreased, higher frequencies will be reflected, that is, more distant stations can be heard, or alternatively, more distant locations can receive the signal. This effect explains the “skip zone” around a transmitter site.

### **f0Es:**

This is a plot of the highest frequency that will be reflected from the E layer of the ionosphere.

### **hmF2:**

This is a plot of the height of the F2 layer of the ionosphere. Along with the foF2 value, it can be used to calculate the MUF for a given path. See the MUF Calc Window above.