

SPLAT RF Signal Propagation, Loss And Terrain analysis tool

Ian Marsh, M0UAT

October 2010

I have been interested in propagation but have found very little in the way of tools for the higher bands from 50Mhz upward. I discovered SPLAT after reading an article on VHF/UHF propagation in the QRP quarterly magazine. The author suggested this propagation application is useful for generating accurate plots since the earth is not smooth. I operate QRP and in my QTH in Farningham I have poor for line of sight for radio operating on the higher bands. The SPLAT application promised to provide some useful information and has proved helpful in locating good mobile operating locations.

SPLAT stands for **S**ignal **P**ropagation, **L**oss **A**nd **T**errain and is an analysis tool written by John A. Magliacane KD2BD. This software is used for frequencies between 20 MHz and 20 GHz. This software is based on the Longley-Rice Irregular Terrain Model. SPLAT is supplied as a compiled program for Unix, Linux and Windows but can also be compiled from source code. The source is GNU General Public License version 2 and is published by the Free Software Foundation.

I am not going to explain in detail how to install this software on a PC or workstation, this is not too complex but this would take up a lot of space. This article explains some of the setup files required how I have put this software to use with a couple of example plots. You can download SPLAT from KD2DB's web page, at www.gsl.net/kd2bd/splat.html. SPLAT produces reports, graphs and high resolution maps that show the line of sight and Longley-Rice coverage analyses for single and multiple transmitters. Longley-Rice plots take into account the terrain of the area and the fact that the earth is not flat.

SPLAT is a command-line program, and to run it you type "splat" followed by a number of command-line options. Before running this application you will require digital elevation model (DEM) data, this is freely available from the website http://dds.cr.usgs.gov/srtm/version2_1/SRTM3/. The DEM data has been produced from the Space Shuttle STS-99 Radar Topography Mission and covers most of the populated parts of Earth. The DEM files are given a file name based upon the location of that square on the earth, e.g. N051E001.htg. This example DEM file contains elevation data between 51 degrees north and 52 degrees north and 1 degree east to 2 degrees east.

The DEM files need to be converted to SDF format using the srtm2sdf utility which comes with the SPLAT application download. SPLAT runs from prepared configuration files used to store various settings that are used by the application. The "QTH" files are used to store station location data and Longley-Rice parameters are stored in an ".LRP" (Longley-Rice parameters) file.

An example of a QTH file is below and contains a station name, latitude, longitude (East of 0, are negative) and height above sea level in meters, m indicates meters otherwise if no units are specified the application assumes the unit are in feet.

```
M0UAT
51.222
-0.22
30m
```

Longley-Rice parameter data files are required for SPLAT to determine RF path loss, field strength, or received signal power level in either point-to-point or area prediction mode. Longley-Rice model parameter data is read from files having the same base name as the transmitter site QTH file, but with a LRP extension.

SPLAT Longley-Rice (LRP) file example:

```
15.000 ; Earth Dielectric Constant for Average ground (Relative
permittivity)
0.005 ; Earth Conductivity (Siemens per meter)
301.000 ; Atmospheric Bending Constant (N-units)
144.000 ; Frequency in MHz (20 MHz to 20 GHz)
6 ;Radio Climate (6 = Maritime Temperate)
0 ;Polarization (0 = Horizontal, 1 = Vertical)
0.50 ; Fraction of situations (50% of locations)
0.50 ; Fraction of time (50% of the time)
30.0 ; ERP in Watts (optional)
```

It is also useful to setup a cities file that will be used to place towns or points of interest on the final map image. The exact location for towns can be found using Google maps, but make sure that any locations east of the Greenwich meridian line are stored as negative values. I found this out when I had Maidstone located at Reigate and Gravesend in West London. Example data in cities.dat file contains City/Town name, latitude and longitude. Example : Tonbridge, 51.919, -0.3 and Dartford, 51.3, -0.4

So here is an example command line as used to generate the plot below:

```
splat -t m0uat.qth -L 20 -s cities.dat -o map.ppm -metric
```

The above command will generate a Longley-Rice plot (Figure 1) for my QTH in Farningham using my cities.dat and assuming the receiving antenna height of 20 meters, and outputting to a map.ppm file. The above example LRP will be used and the area prediction map is shown below.

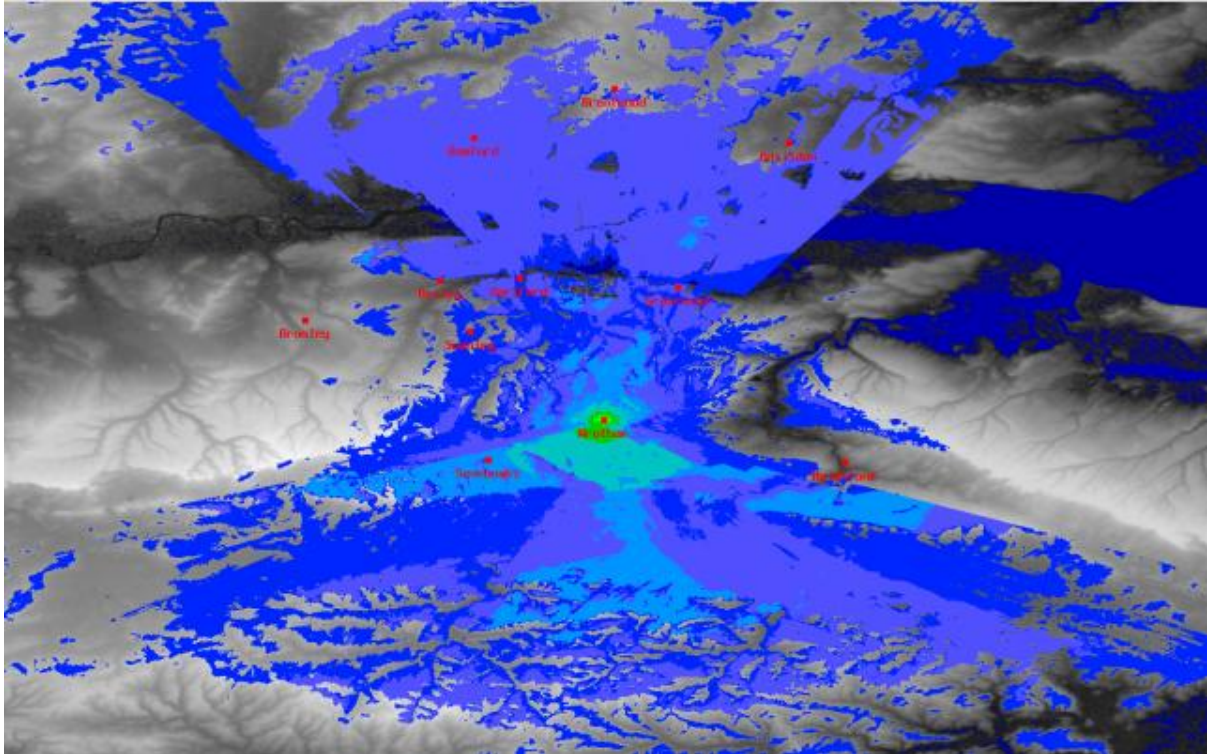


Figure 2. Wrotham Hill, Kent. Running 30W ERP.

SPLAT may also be used to perform line-of-sight terrain analysis between two specified site locations. For example:

splat -t m0uat.qth -r wrotham.qth -l path_loss_profile.png -metric

This command generates a line-of-sight terrain analysis between the transmitter specified in tx_site.qth and receiver specified in rx_site.qth using a True Earth radius model, and writes a SPLAT Path Analysis Report in text format and a graph showing distance (km) against path loss (dB). The Analysis report contains a lot of information including:

```
Summary for the link between M0UAT and Wrotham:

Free space path loss: 94.16 dB
Longley-Rice path loss: 117.11 dB
Attenuation due to terrain shielding: 22.95 dB
Field strength at Wrotham: 33.32 dBuV/meter
Signal power level at Wrotham: -87.11 dBm
Signal power density at Wrotham: -112.47 dBW per square meter
Voltage across 50 ohm dipole at Wrotham: 12.62 uV (22.02 dBuV)
Voltage across 75 ohm dipole at Wrotham: 15.45 uV (23.78 dBuV)
```

SPLAT can also generate graphs. The filename extension specified to SPLAT determines the format of the graph produced, .png will produce a 640x480 colour PNG graphic file, while .ps or .postscript will produce postscript output. Output in formats such as GIF, Adobe Illustrator, AutoCAD dxf and LaTeX are also supported.