Sound Mapping Tools Details

Version: SMT 4.4

Last updated: 12 April 2017

This document is designed to list known issues/bugs, potential avenues for future development (wish list), and the development history of different versions. Some of the issues listed here are relatively minor and are not expected to influence the average user. Additional documentation will be available in the Sound Mapping Tools User’s Manual and an overview is presented in the ReadMe.txt document.

**Contents**

1. Issues
2. Wish list
3. Development History

# Issues

SOUND MAPPING TOOLS:

\* When run from Python, the soundprophlpr function changes the global extent, and does not restore it to the original extent settings upon completion.

\* French language setting uses a comma instead of a period, and this caused problems in the pre-update version of SPreAD-GIS.

* Need to find a way for the computer to check for this, and flag it up with an intuitive error message if it occurs.

\* Running tools directly from the base directory may cause the code to crash (e.g., D:/)

\* There is an error related to output path, toolbox path, current workspace, scratch workspace, but we have been unable to isolate exactly what is causing it. See Appendix C: Troubleshooting for more details

\*Drag & Drop of layers into the toolbox does not work

* + Toolbox inputs are not correctly specified to allow the drag and drop. Changing the toolbox layer type might enable this feature to work properly

\*Memory errors occur when running large numbers of points

* + Can break jobs into fewer points and summarize results
  + Probably could be fixed by using subprocess at some point to make the call.

\* Sound Mapping Tools works for 1/3 octave frequency bands, not for individual frequencies.

\* Frequency bands must be at least 1 Hz apart as decimals are truncated and frequencies with the same integer part will be overwritten. This should be a non-issue for the frequency range for most acoustic studies

\* Sound frequencies above 999999 Hz will crash the code because ESRI limits the number of characters in a GRID file's name to 13 and the frequency is appended to an existing file base. This should be a non-issue, as the highest known frequency an organism can hear is 300,000 Hz (Moir et al. 2013 <http://dx.doi.org/10.1098/rsbl.2013.0241>)

\* The propagation time raster occasionally has no values in it

* I have not been able to replicate this bug

\* Results may be missing from multipoint analysis

* This was reported by a user, but I have been unable to replicate this

\* Check for a bug in C-weighting (c\_weight raster).

* I do not recall the context for why I thought there might be a bug in this section

\* Non-standard NLCD codes may crash the automated reclassification of NLCD land cover data

* Different sources apparently have used different NoData codes, and these may cause problems

\* There is a cap on the maximum file path length, due to limits associated with ESRI GRD files (which are used as intermediates)

* This may already have been fixed in the code, and the cap may just need to be changed

\* One user had a problem where the toolbox would return a blank selection despite the chosen point existing within the chosen extent

* I have not been able to replicate this error

\* One user using a custom land cover had an empty final result

* I was not provided sufficient details to diagnose this error

\* Intermediate files are not reliably deleted due to a persistent schema lock

* There are still some search cursors used with syntax known to cause this sort of problem
* A second source of this problem may be associated with arcpy.Raster. I think this may leave a schema lock on the raster as long as the layer is in Python’s memory.

\* IDLE IDE does not output the arcpy.AddMessage outputs. This leads to no information about progress as the tool runs.

SPREAD-GIS ONLY:

\* SPreAD-GIS does not consider the 3-dimensional distance when computing spherical spreading loss or atmospheric absorption, making it unsuitable for aerial sources.

\* The older version (corresponding to use\_old\_barrier = 1, which is the default to maintain backwards compatibility) is not compatible with ArcGIS 10.5 due to a bug in the Spatial Analyst Path Distance tool.

\* Source elevation is determined from the dem using bilinear interpolation (alternative would be to use the source cell value). This can lead to odd behavior where the source cell is not visible.

\* Barrier loss is based on a regression based on data in Harrison et al. 1980. The sensitivity

of the barrier loss estimates to uncertainty in these estimates is unknown

\* Harrison et al. 1980 applies a barrier cap of 23 dB. No such cap is applied in old implementation of SPreAD-GIS.

\* Regressions based on Harrison et al. 1980 used an unknown method (max value? min value?) from

the tables reported in the paper. Using the median value would likely be more appropriate.

\* Sample patch section rounds data due to a problem with floating point rasters.

(had to specify "LONG").

\* The old version of SPreAD-GIS produces unexpected outputs where the maximum sound value does not appear to be at the source point (e.g., due to smoothing of wind loss raster, due to non-inclusion of wind effects where there is line-of-sight to distant locations).

\* Elevation values > 100,000 m may produce buggy results (not concerning, as the elevation difference between the Marianas trench and Mt. Everest is only ~20,000 m

\* The 1/3 octave bands at 125, 160, 200, 250, 315 were not in the original Harrison et al. 1980 model. Values for atmospheric absorption were updated based on a national standard, but other modules relied on extrapolation based on the equations in Harrison et al. 1980.

\* The cumulative effects of multiple barriers is not been taken into account.

\* SPreAD-GIS's classification of upwind or downwind is very sharp and could be improved

\* No option to suppress ArcGIS messages

\* ArcGIS 10.3 appears not to be using bilinear interpolation in elevation calculations even though this option is specifically supported & specified.

\* There is a slight difference in elevation calculations between ArcGIS 10.3 and 10.4 in the old version of SPreAD-GIS. This lead to a difference of 0.01 dB for one of five test points in the final projection in the unit test data. Consequently, model outputs may vary depending on software version, but are not expected to vary too substantially. See validationhlpr.py for unit tests where ArcGIS 10.3 and 10.4 produce different results.

NMSIMGIS ONLY

\* The landscape is divided into two or more pieces, as running the model for everything as a single piece is resulting in an error (a single run may be more efficient for small landscapes).

* + Crashes when n\_chunks == 0, the code has been patched to make this situation never occur.

\* Measurement distance for source is resampled to 304.8 m (1000 ft), accounting only for spherical spreading loss

\* Running NMSIMGIS through the Toolbox GUI may encounter memory errors for large landscapes. Python does not encounter the same error (related to a patch to Mosaic Raster, see code in the merge\_rasters function in nmsimhlpr for details).

\* An unidentified error crashed a NMSIMGIS analysis of 1000 random points after ~513 points. The cause has not yet been pinpointed.

ISO 9613-2 ONLY

\* Model assumes single diffraction for all barriers

\* Model does not currently apply the meteorological correction, although the correction was partially coded in the nmsimhlpr.py script

\* Model appears to be rounding barrier effects to nearest dB. This could be indicative of a larger problem.

\* Model does not include Foliage effects

\* Model does not include reflections

\* Model does not include structures (residential or industrial)

# Desired Features

* Delete intermediate files for Create\_Summary tool
  + currently being prevented by a schema lock on a raster
* Improve error handling for errors that occur within subprocess.call commands
  + currently those error messages are lost, and this makes for an unhelpful error message and a challenging time for troubleshooting.
* Add a check to confirm that the decimal setting uses a period, and not a comma (useful information here, but I don’t understand it well enough to implement it: https://stackoverflow.com/questions/953416/find-out-the-language-windows-was-installed-as
* Improve handling of point\_fill for 4 digit points
  + Alternative: Explicitly cap the number of points the model can take at 999.
* Add option for audibility to use rasters in non-ESRI GRID format
* Look into situation where ISO 9613-2 model has barrier effects that are lower than the ground effects without the barrier
* Add meteorological correction option to ISO 9613-2.
  + It has been scripted, but needs to be called at the correct place in the code
* Add a tool to calculate time audible
* Allow tool outputs to write to a file geodatabase
* Allow creation of directional .src files
* Add plotting & visualization tools for examining source data prior to the creation of a .src file
* Add a default to convert landcover data in float type to a signed integer to avoid a crash due to an inability to add a raster table. (add to auto-reclassification tool)
* Add a sensitivity analysis to look at variation in temperature, humidity, and wind
  + Mostly coded – need to find the bug that is allowing the minimum value raster to exceed the maximum value raster!
  + Re-integrate into toolbox (perhaps as a separate tool)
* Add a tool to produce nice contour outputs (currently this is accomplished manually in ArcGIS)
* Add check that a specified directory exists, only give overwrite warning if a directory has been removed (suggested by Matt Haffner)
* Improve model efficiency for NMSIMGIS
* Fix the schema locks
* Add check for cell size and give message if input cell sizes don’t match
* Add a warning to SPreAD-GIS if a high source offset is specified
  + SPreAD-GIS does not include elevation when calculating spherical spreading loss
  + check for a S\_OFFSET greater than 30 m? 10 m?
* Ambient conditions are tied to SPREADTYPE field
  + Add support for the NMSIMTYPE field or custom classifications.
* Status indicator for overall progress is desired
  + Or print statements about how much is left to run
  + This may be IDE specific – see Issue pertaining to IDLE
  + Maybe useful information here: http://pro.arcgis.com/en/pro-app/arcpy/geoprocessing\_and\_python/controlling-the-progress-dialog-box.htm
* Add tool to display locations where a sound source would be audible given a receiver location (inverse of main output – instead of saying here is a source, where can a receiver hear it, it says here is a receiver, where would sources of a specified level have to be to be audible?

**IMPROVEMENTS TO DOCUMENTATION:**

* Better documentation of how to convert a .csv source file to a NMSim .src file
* Better documentation of the use\_nmsimgis\_source function
* Check whether ANSI S1.42-2001 R2016 is different from ANSI S1.4-1983 Appendix C for A-weighting
* Include detailed instructions for how to analyze noise from a road

# Development history

**V4.4** (Released 4/12/2017)

ADDITIONS

\* Added a model for calculating sound loss according to ISO 9613-2 (spherical spreading, atmospheric absorption, ground effects, and barrier effects only)

\* Added a tool for calculating (human) audibility of sound given 1/3 octave levels and 1/3 octave background levels

\* Added a tool for calculating how loud a signal must be to be audible given background noise levels and species-specific critical ratio/band information

CHANGES

\*\*\*\* Changed the calculation of area for the AssessImpacts tool

\* Changed SPreAD-GIS to keep intermediate files for every frequency (formerly they were overwritten)

\* Patched bug where a 3D distance of 0 crashes NMSIMGIS by converting a 0 distance to be 1 m.

\* \*\*\*\* Changed spherical spreading loss equation in SPreAD-GIS to correspond to ISO 9613-2

\* \*\*\*\* Changed spherical spreading loss calculation for cell of origin for SPreAD-GIS to correspond to a 1 m distance (this may give different results than NMSIMGIS, which uses the difference between the origin cell coordinates and the source point coordinates)

\* \*\* Changed wind speed of 0 to give 0 wind loss. Previously, 0 wind speed gave erroneously high levels of sound loss

\* \*\*\*\* Added a new option for calculation of barrier loss. The new calculations are expected to be more computationally intensive but patch the following issues:

ISSUE: Path Distance calculations lead to differences of ~0.5 dB in the

vegetation loss module between the ArcGIS 9.3 and 10.x versions

PATCH: Path Distance is no longer used. Values are expected to deviate more

substantially from ArcGIS 9.3, but to better conform to the original

SPreAD model

ISSUES:

\* Some areas below the source point that are visually obstructed are not treated as being acoustically obstructed

\* Barrier elevation is based on an average elevation of all barriers in that direction, rather than based on the elevation of the most important barrier

\* Barrier calculations may include barriers beyond the receiver point, and are therefore extent dependent.

\* Barrier delineation can fail or produce strange results in perfectly flat landscapes due to issues with calculation of flow direction & delineation of basins

\* Wind effects are excluded for areas where there is direct line of sight

\* Harrison et al. 1980 include a 25 dB loss cap for wind + barrier in the SPreAD paper model

However, no such cap exists in the SPreAD-GIS model

\* Estimates of barrier distance use interpolation, and some of the interpolation results are very poor (e.g. distance of > 6000 m to barrier reported for locations within 2000 m of a barrier.

PATCH: Barrier calculation is now based on a terrain transect (similar to NMSIMGIS) and the code revisions eliminate all of the above issues.

\* \*\*\*\* Changed calculation of vegetation loss in the new option to be more in line with Harrison et al. 1980. Specifically, the 14 dB maximum loss is now included, and the vegetation loss is based on equations that better fit Table 8 from Harrison et al. 1980.

\* \*\*\*\* New option removes step where wind and vegetation are excluded when there is line of sight

\* \*\*\*\*Moved calculate\_mean\_elevation and euclidean\_dist\_dir functions outside the frequency loop to try to avoid a schema lock and increase model efficiency.

#\*\*# CHECK IF STILL TRUE: This appears to have slightly changed the model extent, and has led to very slight changes in model results (a change of 0.21 dB for one test point).

\* Changed SPreAD-GIS to create intermediates that represent the intermediate module's contribution to the final raster. A Pick step is used to exclude some loss from some intermediates, and that is unclear when examining the original intermediates.

\* Corrected Search Cursor syntax in calculate\_mean\_elevation and delineate\_barrier functions in spreadgishlpr.py to reduce likelihood of a persistent schema lock

\* The above did not solve a specific schema lock problem (unable to delete dem\_ft) and the same raster is used by multiple steps, so I moved that processing step to make its deletion unnecessary (SPreAD-GIS).

\* Removed unused functions from spreadgishlpr.py to reduce total amount of code and improve readability.

\* Patched syntax errors in Add\_SPREADTYPE and ADD\_NMSIMTYPE functions for landfire

\* Changed name of intermediates directory to temp (main folder) to avoid confusion with the intermediate directory (spreadgis point subfolder)

\* Patched a bug in the code that checks that all inputs are in the same projection

\* Patched NLCD conversion of SPREADTYPE to convert 90 to water not coniferous forest.

\* Fixed the default path for the toolbox directory in the "Test model compatibility" GUI tool.

\*Wind speed of 0 does not apply the shadow zone correction and overestimates upwind loss

**V4.3** (patch of public release, 10/31/2016)

\* \*\*\*\* Patched Spherical Spreading Loss and Vegetation modules to eliminate NoData point at source. This may fix the the issue identified above where the maximum sound value does not appear at the sound source.

\* \*\*\*\* Patched final smoothing step to exclude the cell of origin, as the smoothing changes greatly reduces the values relative to their true sound levels

\* Patched code to allow validation to complete for 10.4.1 It now skips checking intermediate files, on the assumption that checking the final outputs is sufficient, as the intermediate files would be challenging and computationally intensive to patch.

\* Corrected bugs in ConvertToSRC.py and the associated ArcGIS tool to enable it to run properly.

\* Added very limited support for landfire landcover to Add\_SPREADTYPE and Add\_NMSIMTYPE functions (contains syntax bugs that need to be fixed before it is functional, only a subset of the included landcover types are included).

**V4.2** ("soft" public release, 10/10/2016)

\* \*\*\*\* Changed atmospheric absorption in nmsimgis to use three-dimensional distance instead of two-dimensional distance

\* Changed toolbox directory input to select the "toolbox" folder instead of the folder that contains it.

\* Changes to toolbox input parameters to improve clarity and ease of use

\* Tutorial description updated to be clearer

\* User's manual updated

\* Re-organized the Toolbox and added an Extra Tools toolset to introduce additional useful tools without distracting users from the main model tools.

\* Reorganized output path directories

\* Fixed a bug where summarize = 3 or summarize = 4 would delete existing model results needed for the analysis

\* Changed keep\_intermediates == 0 to also delete temporary folders and intermediate weighting rasters

**V4.1** (limited release 9/15/2016 at Technical Workshop)

\* Changed handling of landcover in nmsimgis and SPreAD-GIS

\* \*\* Changed the Add\_SPREADTYPE function to classify woody wetlands (and wetlands in general)

as water, based on their treatment in NMSim.

\* Improved tool documentation and tool interface

\* Updated and fixed tutorial

\* Patched bug in model that prevented an overall background raster from being used when

keep\_intermediates was set to "YES"

\* Patched bug in nmsimgis where the code crashed when no source information was provided

instead of using the default values.

\* nmsimgis results found to match main NMSim model (without Nord2000) and cleared for general use!

**V4.0** (9/8/2016)

\* Corrected a bug in basin extraction (changed to "NEAREST" from "BILINEAR")

\* Added ambient comparison to nmsimgis, SMT now supports comparison with overall

background layers such as the Geospatial Sound Model outputs

\* Changed file naming system and output locations

\* Changed nmsimgis inputs (head, roll, pitch, velocity, engine power, source offset)

to come from the input shapefile.

\* nmsimgis model now functional (but currently giving incorrect results)

\* Added background ambient comparison to nmsimgis

\* Added code to truncate overall results to 0 dB (toolbox, other options in Python)

\* Changed SPreAD-GIS to no longer truncate individual 1/3 octave bands at 0 dB

**V3.7** (8/13/2016, given to one person, not a stable release)

\* Fix bug where 10,000 Hz crashed summarization code

\* Changed transect calculation to use bilinear interpolation instead of nearest neighbor in nmsimgis

\* Major improvements to nmsimgis (but still not functional)

**V3.6** (invitation only beta version, 6/3/2016)

\* Changed file naming system to allow the code to run for 10,000+ Hz

\* Added a tool (AssessImpact) to assess sound impacts on a focal area (python only)

\* Moved the step clipping the DEM to the desired extent into soundprophlpr.py to

facilitate its reuse in nmsimgis

\* Added options to control summarization of model outputs

\* Added an option to allow automated deletion of intermediate files (to prevent the

creation of millions of unnecessary intermediate files, Python & SPreAD-GIS only).

\* Progress made on implementing nmsimgis (still non-functional - produces incorrect outputs)

\* changed the base directory to be the same as the output\_dir variable, changed

the results directory to be modelname\_results. Intermediates now go into modelname\_intermediates.

Goal is to reduce the number of unnecessary directories.

\* Reduced the number of messages displayed by ArcMap when looping through files

(for improved readability and progress updates)

\* Began adding code to allow analyses over time (not yet functional, Python only)

**V3.5** (invitation only beta version, 5/13/2016)

\* Added a python function to facilitate extracting values for specific sampling points

(not callable from the main toolbox)

\* removed write\_intermediates option from NoisePropagationOnePoint function

\* Changed to allow creation of a timing file (Python only)

\* Disabled features currently in development (annotated with #DD# to avoid confusion

in the public release.

- code to sum acoustic energy across frequencies

- code to sum over multiple points (note: change from previous version)

- code to sum over multiple frequencies

- nmsimgis

**V3.4** (Internal release 4/15/2016)

\* Toolbox name changed from SPreAD-GIS to Sound Mapping Tools to reflect addition of NMSimGIS

\* Tool interface changed to have separate tools for validation, spread-gis, and nmsim-gis

due to a bug when trying to run a combined tool (only present when running script via

toolbox directly in ArcGIS).

\* Patched bug in 10.4 where an existing field would crash the code.

\* \*\*\*\* Patched bug (patch in all versions, bug only in 10.4). In 10.4, arcpy.sa.Sample

produced erroneous -9999 values. The patch appears to have let to some slight changes

in calculated intermediates but does not appear to have affected the overall results.

\* \*\*\*\* Changed validation to only check aal raster to 4 decimal places to mask minor differences between 10.3 & 10.4

\* Frequency dropped as an input to nmsimgis (as this information is given in the required .src file)

\* Extent must be rectangular (cannot be a custom shape) was dropped from the list of issues.

Now it is just an aspect of the model documented in the user's guide.

\* Source code documentation improved & flags (#\*\*#) checked for inclusion in known issues

**V 3.3** (Never released)

\* Wind direction is now the direction the wind is blowing FROM not the direction the wind is blowing TO.

\* Simplified tool interface & updated ArcGIS tool documentation (in progress)

\* Changed Frequency, Sound Level of Source & Measurement distance to be input as "String" instead of "Double" to accommodate possibility of inputting tables.

\* Changed tool to allow selection of output directory

\* Model inputs are now metric instead of Old English (but some calculations still convert to Old English)

\* Changed to allow flexible choice of cell size (conversion for nmsimgis in progress)

**V 3.2**

\* \*\*\*\* Changed viewshed tool to ObserverPoints tool to allow user to specify observer offset & starting elevation.

This now includes a default 1 unit elevation offset & will produce different results than the 9.3 SPreAD-GIS model

This also patches a critical bug in Arc9.3 where unrealistic results were occuring in a simulated landscape.

\* Multifrequency code was modified to allow calculation of remaining frequencies

when a frequency cannot be processed successfully

\* Search cursor processes were wrapped in try/excepts to try to prevent files

from remaining locked after the script exits with an error

\* Added option to get timing of code sections for benchmarking purposes (in progress)

\* moved eucdist\_z from intermediates to intermediates/veg

\* expanded test code

\* In process of adding NMSim compatibility. Added dlls directory which contains the dll

produced by Bruce Ikelheimer and added Sources folder that contains sources originally

used in NMSim

\* Major changes to G\_NMSim.py and nmsimhlpr.py scripts

\* A\_AmbientSoundConditions.py can now be called as a function

\* (python only) Multipoint function changed to allow outputting results to a

custom directory.

\* Changed handling of environmental settings to be less redundant

\* \*\*\*\* Added snapRaster to environmental settings to better control extent of output.

\* \*\*\*\* Fixed environmental settings so that output is snapped to inputs

\* \*\* Updated handling of model extent

\* \*\* Changed model extent to only use a minimum bounding rectangle and not custom shapes.

\* Patched a bug present in 10.3.1 (but not in 10.3 - removed MakeTableView step - turns out it was also unnecessary)

\* Changed script to auto-detect whether it is being run from Python or ArcGIS toolbox

**V 3.1**

\* Corrects bugs in Wind Loss, Topography and Barrier Loss, and overall summation

sections

\* Corrected a bug in Wind Loss section where negative downwind values were being generated

\* Reorganized the script to subtract each form of loss separately at the end instead of

sequentially in process.

\* Changed code to accept user-specified input paths

- But only when running as script in debug mode in Python

\* Removed old ArcGIS 9.3 code

\* Removed string from imports statement (and os and shutil from A\_Ambient...)

\* Restricted allowed frequencies to those given in the drop-down menu in the ArcGIS toolbox

\* Added F\_CodeValidation.py and validationhlpr.py to provide a worked example with

the code and to provide test code to ensure consistent outputs.

\* Converted each Loss Section to a function and moved them to the helper script

spreadhlpr

\* B\_NoisePropagationforSinglePoint is now a function, with a small piece of code at the bottom

of the script that only executes if it is the main function

\* NoisePropagationforSinglePoint.py (no prefix) was removed from the toolbox.

\* Scripts now start with letters instead of numbers to improve Python syntax

\* Multipoint and Multi-frequency scripts no longer delete the results folder

\* This README was added.

**V 3.0** (Never released)

\*\*\*\* Atmospheric absorption differs between ArcGIS 9.3 and 10.x

(but at 5 decimal places - very minor!)

\* Code updated to be compatible with ArcGIS 10.x.

\* Runs, but does not produce correct outputs.