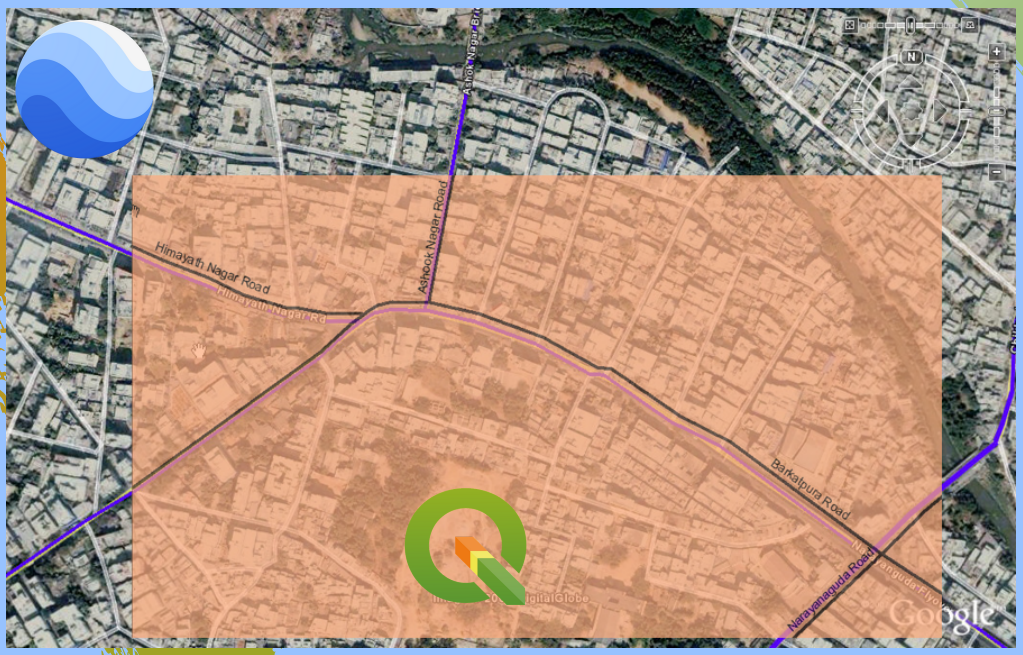
Creating Road Lines for Urban Centers Using Open Tools



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SIM-air working paper series # 01-2008

URBAN emissions .info

(UEinfo) was founded in 2007 with the vision to be a repository of information, research, and analysis related to air pollution. There is a need to scale-up research applications to the secondary and the tertiary cities which are following in the footsteps of the expanding mega-cities. Advances in information technology, open-data resources, and networking, offers a tremendous opportunity to establish such tools, to help city managers, regulators, academia, and citizen groups to develop a coordinated approach for integrated air quality management for a city.

UEinfo has four objectives: (1) sharing knowledge on air pollution (2) science-based air quality analysis (3) advocacy and awareness raising on air quality management and (4) building partnerships among local, national, and international airheads.

This report was conceptualized, drafted, and designed by the members of UEinfo.

All the working papers and more are accessible @ www.urbanemissions.info/publications

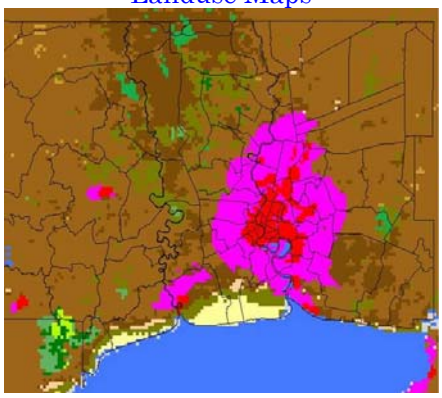
Send your questions and comments to simair@urbanemissions.info

Creating GIS Road Maps for Urban Centers

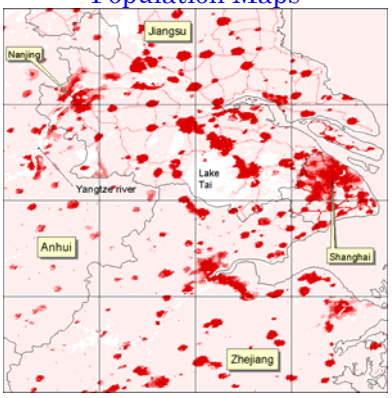
Geographical Information Systems (GIS) for Air Pollution Modeling

Air pollution modeling is a data intensive task, requiring information on sources of pollution (emission strengths and location) followed by their distribution to geo-referenced grid or to particular locations, commonly noted in latitudes and longitudes. This information is required for analyzing the impact of emissions on ambient concentrations, through a series of dispersion calculations at local, regional, and global levels. The air pollution modeling activities, beginning with the distribution of emissions to dispersion, concentrations to impacts, and resource allocations, require some level of geographic understanding of the city. For example, population and landuse maps, residential areas for domestic emissions, location of industries and road maps for vehicular emissions. Some examples are provided in the Figure below.

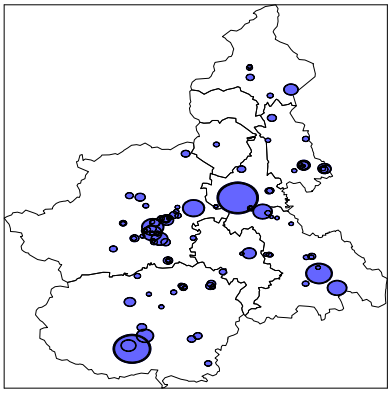
Landuse Maps



Population Maps



Industrial Locations

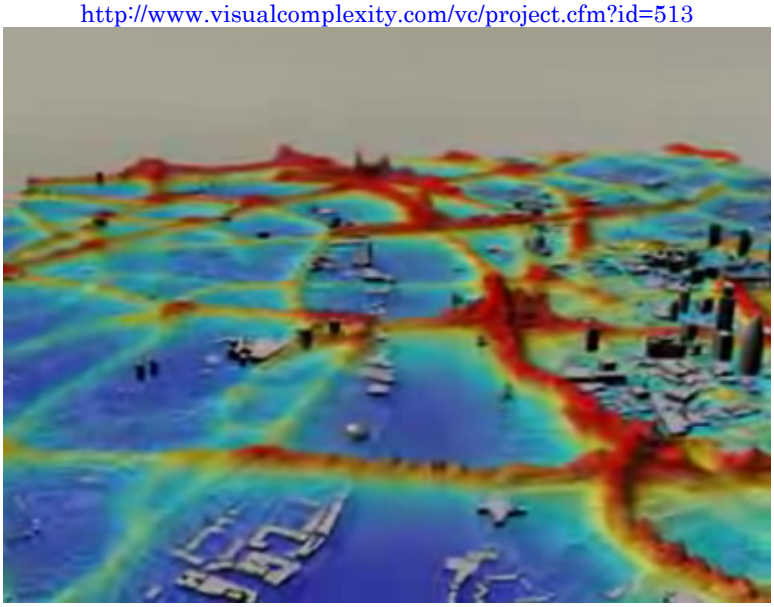


Road Maps

A GIS database enables capturing of information, layering, analysis and presentation of geographically referenced data, as shown in the figures above (information is presented from a variety of sources for four different cities). The organization of data by location allows data from a variety of sources to be easily combined in a uniform framework.

Besides representation and presentation of geo-referenced data, a variety of models now utilize GIS technology of air pollution analysis. The integration of GIS and air pollution modeling is of advantage for progress in environmental research, since both methods are synergistic. More generally, no computer system is perfect for all purposes of modeling. Since there is no such thing as a "perfect modeling system" and all the existing systems have their particular strengths and weaknesses, it might often be required to use more than one system to cover all aspects of an application area.

London Air Pollution in 3D
http://www.visualcomplexity.com/vc/project.cfm?id=513



Road Maps

One of the common databases used for air pollution modeling is the road maps. This is most useful for analysis of the traffic data, location of the highways, main and arterial roads, identifying the residential vs. commercial areas, congested vs. non-congested areas, and modeling of vehicular emissions (directly from the vehicular exhaust and indirect fugitive dust on the paved and unpaved roads) as line sources.

In most of the cities (especially, the secondary cities in the developing world), accessible and reliable information is hard to find - time intensive to process, and expensive to purchase, for example software such as ArcGIS is not free (although, some of the GIS data readers are). This makes the generation of data, representation, and use of the road maps, an integral part of the air pollution analysis, very difficult.

Also, given the importance of the transport sector, their contribution to the air pollution and global climate change greenhouse gas emissions, it is important that cities (and local agencies) prepare and maintain their road maps in GIS, for better understanding of the vehicular movement, exposure to air pollution, and effective urban planning.

This document aims at illustrating the use of freely available resources, such as Google earth and ArcReader for generating road maps for a given urban center.

It is important to note that, generating GIS maps, where not available, is a time intensive process. With patience and some minimum resources, one can build a GIS based road network for use is a variety of applications.

Resources Required

1. **Google Earth**: This tool can be downloaded, free of cost @ http://earth.google.com/.

2. **ArcExplorer**, a GIS data reading tool can be downloaded, free of cost @ http://www.esri.com/software/arcexplorer/explorer.html. ArcExplorer is a lightweight GIS data viewer written in Java that is used to perform basic GIS functions (e.g., view, navigate, and query). If user is already familiar with using of GIS data (at least reading and viewing of the GIS data) and has other GIS based tools installed on their computers, this is not necessary. The shape files generated at the end of this exercise can be viewed in any of the GIS software that the user finds convenient to operate.

3. **kml2shp converter**, this is an open source code and can be downloaded, free of cost @ http://www.zonums.com/kml2shp.html. This allows the user to convert the road maps generated in Google earth to GIS based shape files.

Follow the instructions and install the software.

Steps to creating GIS road maps

For this exercise, *example of Hyderabad*, India will be used.

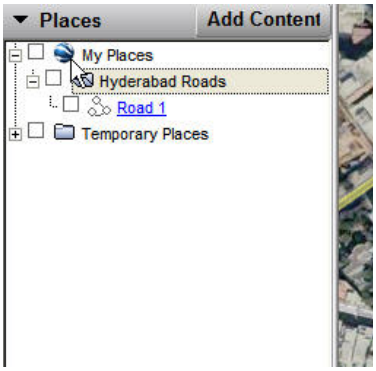
Step 01: Open Google Earth and zoom to city of interest.

After zooming, wait for a few minutes, depending on your internet speed, for the map to fully load. For most of the cities, detailed road maps for at least the main roads, with road names are available on Google earth. Zoom to a section of the roads.

Under "My Spaces", make a folder with desired name. Here named "Hyderabad Roads". All the roads lines generated should be saved in this folder for easy use and conversion to GIS.

City of Interest

Roads of interest

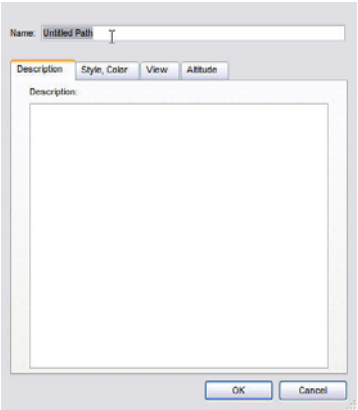


Directory in "My places"

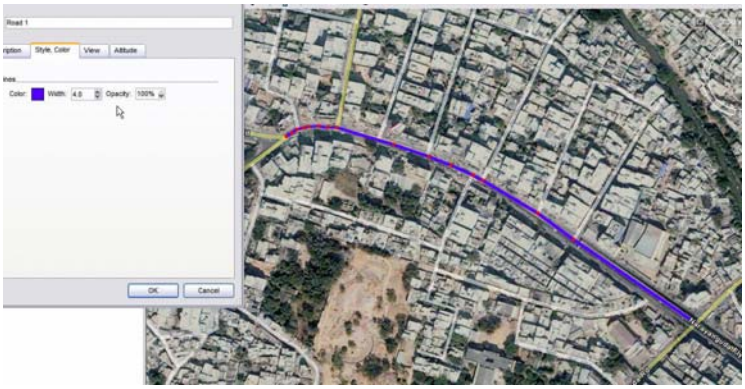
Step 02: Make the path in Google Earth.

After zooming as shown in Step 01, start making the paths along the roads of interest, by following the instructions below.

1. Click on  , available at the top menu. This will allow making the desired path by clicking points along the road displayed. Once clicked, a window will pop, requiring the user to insert a road name. Insert road name, but DO NOT close the window. Start clicking along the path – click more closer points for curvy paths.
2. You can change the look (color and thickness) of the path by checking the "Style, Color" tab. Width of 4.0 is more visible. Default color is white.
3. Click in one direction only. Once the road length is finished, click OK. This road will be saved under the name provided. Repeat this process multiple times for multiple roads.
4. Closer the Google map zoom to the road, easier and closer to the reality the road map will be.



Insert path name here, but do not close this window



Start clicking to create the path

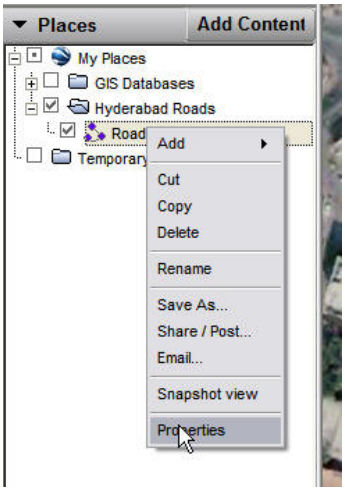
Step 03: Corrections to existing roads.

After making the roads, if some corrections are required, follow these instructions.

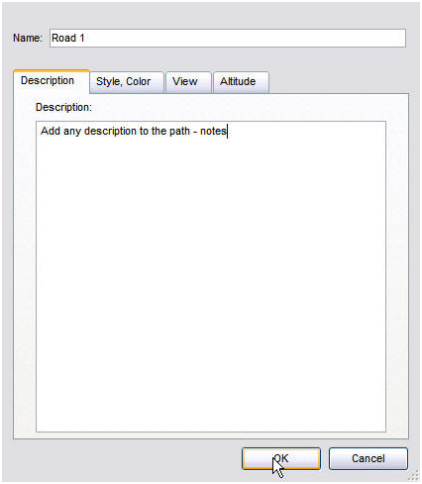
1. At any given time, any path can be corrected. Use the highlighted points (in red) to adjust the position of the connecting points (also read the instructions in Google earth for further details)
2. Once the path is corrected click on the last point on the path to continue. This is important to avoid loops and other complications.
3. A path can be edit only when the edit window is open. To open a path in edit mode (if already closed), right click on the path name and click on properties (as shown below).
4. A description can be added to each of the paths, under tab "description".

Use the intermediate points to adjust the curves or paths

After corrections, click on the last point to continue making path



Right click on pathname and click properties



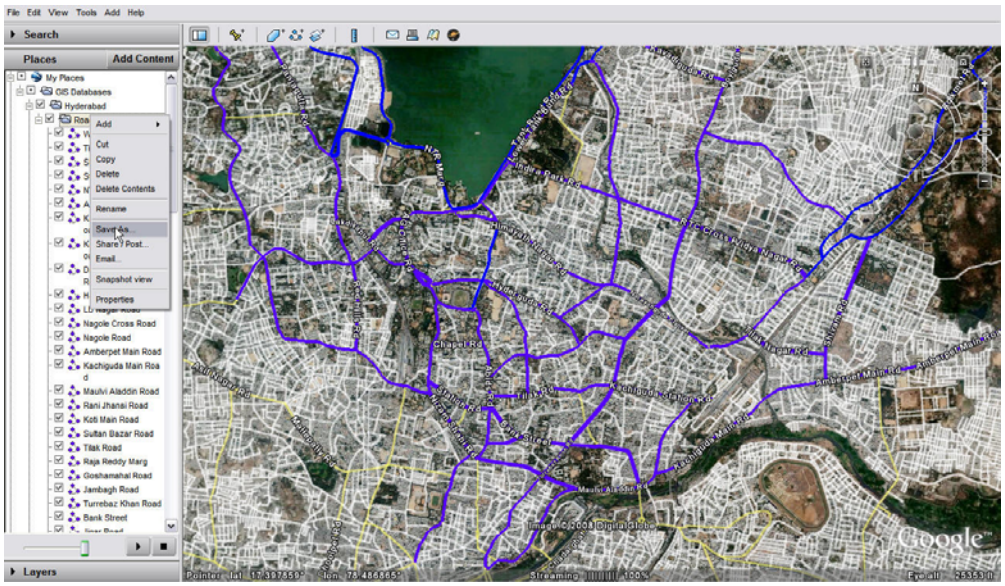
Make necessary changes to the path and click OK to close path

Step 04: Saving the road maps.

While the road maps are being generated and compiled, it is advised to *save the paths every 5 mins* (if not sooner). This is to avoid any loss of work due to technical or computational errors. Google Earth, due to high definition mapping, in zoom mode, is known to consume a large amount of computer cache and it is possible that the computer may freeze while the paths are being generated. So, it is advised to save the files as and when possible to avoid losing of any work.

*File should be saved as *.kml files.*

In this example, the paths file is saved as "Raods.kml", for use in next steps.



After creating the paths, preferred saving format is *.kml

Step 05: Multiple Layers.

In this example, only the main roads are highlighted and converted to paths. User can make multiple folders with variety of road maps – highways, main roads, arterial roads, feeder roads, etc. Follow the instructions from Step 1 to 4, to make such paths and folders.

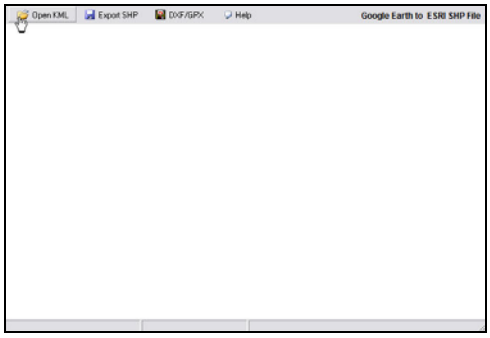
Step 06: Converting to Shape Files.

Open the kml2shp program. The kml to shp conversion consists of the four steps illustrated below.

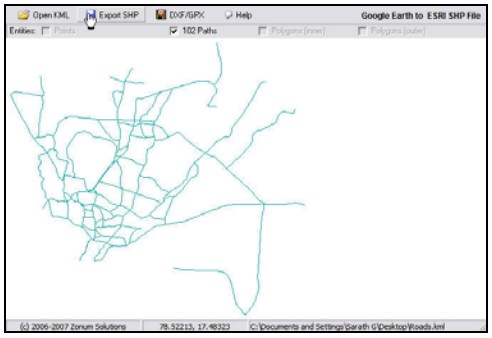
While choosing the shape file type, if the kml file contains all point, path, and polygons, user has option to export each of them individually, by selecting which to export (on top menu under the export button).

Final shape file name (click on  to choose location and filename) should not include any spaces, preferably. This is mainly to avoid any processing errors in the GIS tools.

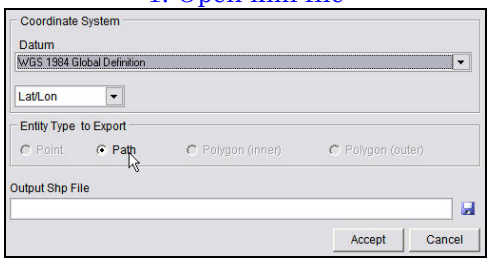
Click "Accept" and shape files will be generated and saved in the location specified. Three files will be generated - "Roads.shp", "Roads.dbf", and "Roads.shx". All three are required when loading the shape file into GIS program and all three should always remain in the same directory.



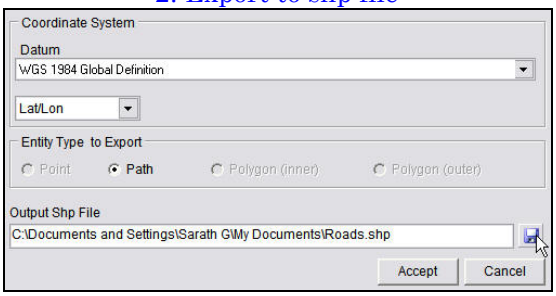
1. Open kml file



2. Export to shp file



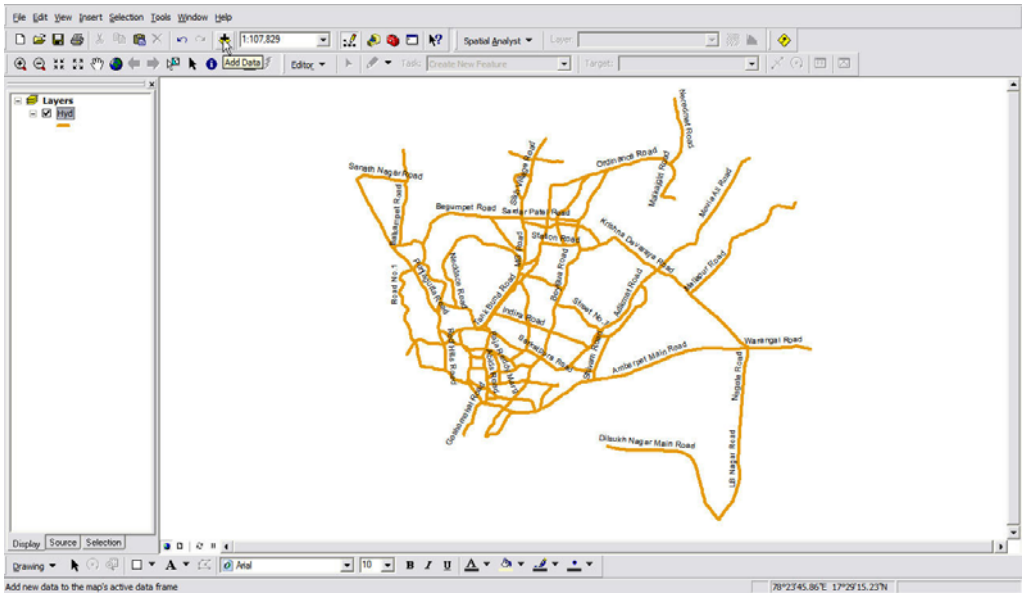
3. Choose shape file type – "path" for road maps



4. Choose shape file location and name, click accept

Step 07: Use the Shapefile in user convenient GIS program.

Shapefile is ready for use. User can manipulate and analyze the data in multiple forms, by following the GIS and pollution modeling instructions. For the outputs presented under Step-04 and Step-06 from Google earth and kml2shp programs, the final product in GIS looks like below.



Final ouput in ArcGIS – road names can be displayed, as saved in Step-04

In Conclusion

This exercise is time consuming, but results in a great product with multiple uses.

For use of GIS, manuals, and free databases, visit www.esri.com

The SIM series is accessible @ www.urbanemissions.info

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