



Editorial

When difficult times knock on our doors, we realize how important it is to have a solid community that can assist and walk with us side-by-side through hard times. It is no different with the Central Florida GIS community. With a good sense of companionship we get together and talk among ourselves, discussing how to overcome the challenges rising before us.

Spring just started and there are several opportunities for you to help the CFGIS community continue to be solid and well structured:

- ✓ Make the best use of your data and avoid data duplication by [sharing](#) it with CFGIS.
- ✓ Get involved in the planning procedures of the two [CFGIS users group](#) meetings scheduled for July 23 and November 12.
- ✓ Plan to attend these meetings and learn about the best technologies across the region.
- ✓ Contribute articles or "[tips and tricks](#)" for the next CFGIS newsletter.
- ✓ Participate in the CFGIS surveys - they are created to help us serve you better.
- ✓ Help the CFGIS team organize the next regional GIS trainings.
- ✓ Collaborate in professional organizations like Florida Surveyors, Florida URISA, URISA, or ASPRS.
- ✓ Share your ideas with us about how to improve [CFGIS!](#)

By being active in our field we are supporting each other, especially our peers that are going through difficult times. We hope you enjoy this issue of the CFGIS newsletter. We created it focusing on how we could keep you well informed about what is going on in our industry throughout our region and state.

Contribute! Make a difference! Together we can accomplish more!

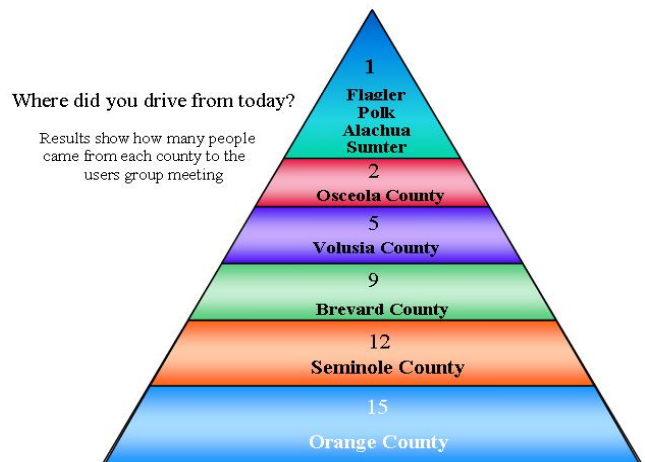
By Claudia Paskauskas - East Central Florida Regional Planning Council GIS Manager.

First CFGIS Users Group meeting for 2009!

By the ECFRPC GIS Team

On February 27th CFGIS held the first Users Group Meeting of 2009 at the FDOT D5 Orlando urban office. And it was great!!! We had nine counties out of ten being represented! It is great to know that we are really coming together to share information, ideas and a common vision for the future of Central Florida's GIS. There were some great presentations, demonstrations and did I mention the refreshments and raffle prizes?

Tammi Rhodes and Neil Garlock from Seminole County shared their Map Book creations.



*"The will to win, the desire to succeed, the urge to reach your full potential...these are the keys that will unlock the door to personal excellence."
-Eddie Robinson*

Save the date:

*CFGIS Users Group
July 23, 2009
Orlando, FL*

*CFGIS GIS DAY
November 12, 2009
Join us for a fun day
of GIS and much
more!*

What type of training would you like to see come to our area? Share your thoughts with us at <http://www.cfgis.org/Education.aspx>

Not only did they show us how to create a map book more intelligently but it was also a prompt to always remember who you are making a map for. Not everyone is proficient in GIS, and sometimes all they need is a paper map(s) for immediate reference, like the firefighters.

Dave Jordan and Al Hill updated us on Brevard County and Volusia County's GIS program. Both counties have a good base of GIS data developed and knowledge available that can be drawn upon for references and projects. Douglas Lynch from TranSystems told us how he used Network Analyst and made a Travel Time simulation for Volusia County Scenic Byways. This was a great demonstration of how useful and powerful the Network Analyst extension is. To wrap up we had the always informational Tips and Tricks presentation. Keith Smith gave us a brief demonstration of how to create your own symbol style sets in ArcMap. A good time saving trick to improve the quality and creativity of our maps.

There were some new interactive maps at the Users Group and we appreciate your participation with them. The results of the "Where did you drive from today?" map were tallied and are shown in the graphic, the numbers represent the people that traveled to the Users Group from that county.

We also asked for input regarding training: What kind of training you would like to see come to our area. We will continue to collect results for this through our website www.cfgis.org/Education.aspx

Don't forget to mark your calendars for the next meeting, July 23rd. There will be a special presentation on Emergency Management and much more. See you there!

Save the date for the CFGIS GIS Day celebration. GIS Day will be celebrated on November 18th, but CFGIS will hold a special Users Group on November 12th! More information will come out soon.



What's New?

By the ECFRPC GIS Team

"What's New" will connect you with the latest and greatest in GIS happenings all around the region. This quarterly publication announces very exciting news from all over the region.

- **ETDM data now available at CFGIS Clearinghouse:** FDOT District made more than 400 layers available to the CFGIS clearinghouse through the Environmental Transportation Decision Making (ETDM) program. The data is shared via metadata XML files and is directly linked with the host that keeps and maintains all the information, Florida Geographic Data Library (FGDL).
- **New and Updated Generalized Future Land Use:** The ECFRPC completed another round of updates for the Regional Future Land Use dataset. The data corresponds with updates approved by DCA for 2008's 3rd and 4th quarters (July to December). The new Regional FLU files and updated maps are available for download at the CFGIS Clearinghouse and Map Gallery.
- **Next Round of the URISA Leadership Academy:** The next URISA Leadership Academy (ULA) will be held in Seattle December 7th to 11th, 2009. Plan ahead to attend this specialized leadership training designed for GIS practitioners. Professionals from twenty five states and four countries already took advantage of this training opportunity. Go to www.urisa.org/ula to get more information about the URISA Leadership Academy.

Don't forget:

*ESRI Southeast Regional Users Group Conference
4/27 - 4/29 in
Jacksonville, FL.*

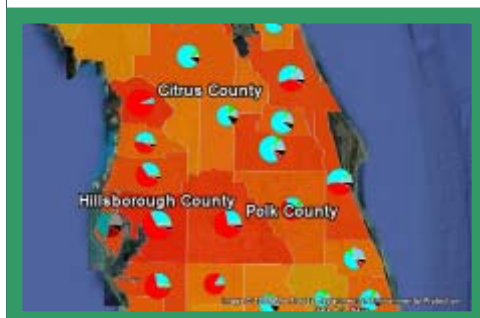
"Join the CFGIS team congratulating the new GISPs..."

- **New Tornado and Hurricane Data and Maps published on CFGIS:** The CFGIS clearinghouse and Map Gallery were updated with tornado and hurricane data from the 2008 hurricane season. One of the maps loaded to the map gallery represents tropical storm Fay's path and major areas of impact. Tropical storm Fay was the sixth named storm of the 2008 Atlantic hurricane season.
- **CFGIS February Users Group Presentations Published:** [Click here](#) and navigate to "General CFGIS Documents" to download the PowerPoint presentations from the February 2009 CFGIS Users Group meeting.
- **New FLURISA Secretary on board:** Join the FLURISA board in welcoming the new secretary - Sam Palmer. Sam works with the GeoPlan Center and has been collaborating with the Florida chapter of URISA as the GatorLand Regional Director.
- **Census PSAP Updating:** the ECFRPC worked in collaboration with Brevard County Planning department to update the Census tracts, blocks, CDPs, and CCDs for the 2010 Census. The project was completed early March and the proposed changes will be validated by Census by April 16th, 2009.
- **Stay Tuned - URISA Certified Workshops Coming Soon:** Florida URISA Chapter, FLURISA, will soon start a round of URISA Certified Workshops. FLURISA is working diligently to make the workshops available at no cost or at a very low fee. The training opportunities will be offered to FLURISA membership only. To receive notifications about these training opportunities and other FLURISA activities go to www.flurisa.org and sign up to become a member of the organization; FLURISA has waived the membership fees for 2009.
- **CFGIS Spring Puzzle:** Heather Halverstadt from Brevard County 911 was the lucky winner of the 2008 CFGIS winter game. Heather won a \$25 BP gas card that was graciously donated by Whitney Laurien. A new CFGIS puzzle is already available for download at the www.cfgis.org website. Play the game! Have Fun!
- **821 New GISPs:** The GIS Certification Institute announced on February 25, 2009 that additional 821 professionals were awarded with the GISP certification. That brings the GISP database to a total of 4,386 worthy and certified professionals. [Click here](#) to see a full list of all GISPs. Here is a brief list of some of our regional peers that were certified during the past three months:
Robert Arehart, Donna Bailey, Melvin Barnes, Jay Besch, Frank Broome, Ken Brown, William Burkholder, Mark Churchik, Joseph Duncan, Christie Flickinger, Catherine Galgano, Benjamin Garcia, Carmen Garcia, Kay Gargis, Miguel Garriga, Michael Gilbrook, Mustapha Girei, Kevin Gray, Devin Hannon, John Harrington, Rikki Hartung, Mariana Hristova, Steven Johnson, Michael Jones, Ajay Krishnadillari, Samuel Lopes, Luis Martinez, Christie McElroy, Carlos Mona, Kevin Mouyard, Lisa O'Neil, Kathy O'Sullivan, Judith Pizzo, John Polean, Bindu Ravi, Tammi Rhodes, Martin Roche, Frank Salmon, Joel Salmons, Paul Schlondelmayer, Louis Schoolkate, Raymond Stolinis, Kary Tareen, Fred Walters, and Elaine Whitehead.

Join the CFGIS team congratulating our regional peers that successfully accomplished the certification.

Fun News - U.S. Carbon Dioxide Map funded by NASA is now available on Google Earth

By Whitney Laurien | East Central Florida Regional Planning Council



Google Earth is now hosting some very exciting and informative interactive maps that detail carbon dioxide emissions from fossil fuel combustion. The maps can display fossil fuel emissions by the hour, geographic region and fuel type. They can also show the estimates of the hourly carbon dioxide outputs of factories, power plants, vehicle traffic and residential/commercial areas. These maps were funded by NASA as well as the U.S. Department of Energy through the joint North American Carbon Program. A team of researchers integrated seven data

sets including Earth's surface imagery, fossil fuel emissions data, and Census population data. The team created an incredible carbon dioxide inventory that included results from the burning of 48 different types of fossil fuels.

"The two highest sources in the US for total CO₂ emissions are Los Angeles County, CA with 22,302,428 metric tons followed by Harris County, TX with a total of 20,029,057 metric tons annually."

*Play the spring
CFGIS puzzle at
www.cfgis.org*

This data has been available to the scientific community since April of 2007 but not until now was it integrated into an image based format that could be viewed online by the public. This is a good opportunity to see your local city or county emissions in relation to the state or even the country. This information is critical to understanding our society today in terms of greenhouse gases, climate change, air quality and so many more aspects of our environment. To give you a taste of the data, a few local figures were pulled: Seminole County for the year had a total of 1,029,533 metric tons of CO₂ emissions, 693,238 tons came from Onroad travel. Orange County had 2,524,784 metric tons of CO₂ emissions, 344,612 came from aircraft and 1,577,604 came from Onroad travel. The two highest sources in the US for total CO₂ emissions are Los Angeles County, CA with 22,302,428 metric tons followed by Harris County, TX with a total of 20,029,057 metric tons annually.

Future plans for this project, known as the Vulcan Project, include intertwining data from more space based instruments to precisely make global measurements of atmospheric carbon dioxide paired with accurate geographic coverage to find the sources and sinks of the greenhouse gas. Phase two of this project will hopefully be creating similar inventories for Canada and Mexico's emissions. □

This is a Google Earth Plug-in, [click here](#) to check out this cool GIS creation.

Lake County Creates a Customer Service-Oriented Application

*By Lake County in conjunction with the Growth Management Department |
Submitted by Sue Carroll, GIS Project Manager, Lake County Information Technology*



Background

Lake County is located at the center of peninsular Florida northwest of Orlando. Its 1,156 square miles are home to approximately 290,500 residents. For most of its history it was a sleepy, rural county of clean lakes and acres and acres of orange groves. Agriculture was the mainstay of the economy. Even into the 1980's it was still considered a rural getaway from the fast-growing Orlando and Orange County just next door. And county administration was still in the pre-computer age when maps were paper, and zoning clearances were filled out by hand.

The Problem

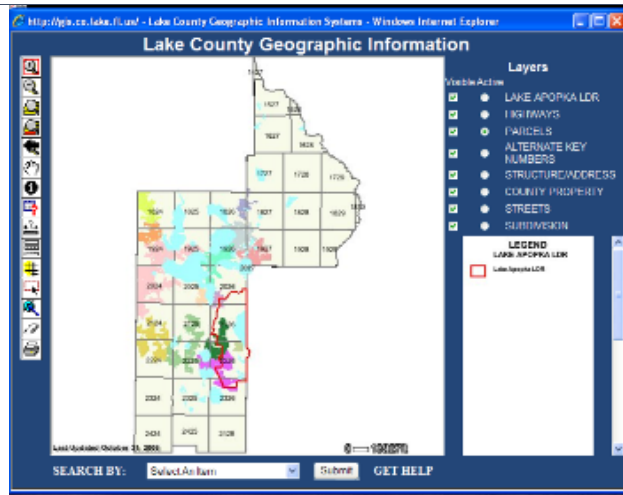
Then came the citrus freezes of the 1980's and the development boom of the 1990's and the early 2000's. Development soared as the workforce in Orlando realized they could have the best of both worlds - working in the city and living in a quiet, rural county just down the highway - and former grove owners turned their unprofitable agricultural acres into highly profitable housing developments. But it came so quickly that the county administration was nearly overwhelmed with development requests, zoning clearances, building permits and every other request to build, develop and sell the former citrus groves and turn them into homes.

Processing times of days became weeks, and then months as the volume of requests climbed annually. Decisions to permit or not to permit on any given property were based on paper maps that were aging and literally falling apart - attrition of jobs had meant the maps were not being properly maintained, and files that had to be researched had first to be retrieved from any of several off-site storage facilities. The citizens we are employed to serve were losing patience. Something had to be done to modernize the way Lake County did business.

The Solution

Leadership (the first thing that must be had) came from the top, when the Director of Growth Management decided that since this was primarily a spatial data problem then it should require a GIS solution. The main players - the Zoning Director and Chief Planner, and the GIS Director and GIS Project Manager - came together and proposed an interactive mapping application that would bring all the necessary data for Planning and Development decision-making together into one digital map. It would contain a base map of parcels, streets, lakes, etc. plus Zoning, wetlands, flood zones, and aerial photography. And most importantly it would contain a layer that identifies properties that have had some type of development approval. This layer of "Buildable Lots" was the main layer that needed to be created in order for this application to function.

*"Models are great
for automated
work flows,
specifically the
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parameters and
variables like
buffers, merges,
queries etc."*



Lake County Development Regulations have a number of ways to meet development requirements including Lot Splits, Lot of Record, Average Setback Determinations, Deeds prior to 1981, Permits, Ordinances, Site Plans, Unity of Titles, and Variances. Plus they are required to track things like Accessory Dwelling Units, Lot Line Deviations, and Fire Arms Sales Affidavits. It was this type of documentation that needed to become digital and visible on a map, so it was decided to identify each of the properties defined by these documents and map them into a feature class that could then be displayed on the interactive base map.

The first step was to gather all the documents together. This was an organizational challenge of heroic proportions. Files had to be tracked down and the storage boxes delivered to the Zoning Office where they were logged in as "received", then sent to the GIS office to be mapped. Fortunately, the Zoning Division had had the foresight to catalog all of the documents originally sent to storage by document type, year, and box number. It was just a matter of systematically requesting each box from the off-site storage area. But there were hundreds of boxes that had to be processed, and they were each logged at every step of the way - received by Zoning, sent to GIS, returned to Zoning, returned to storage - with a date and initials. We didn't want to lose any of this historic original data. But locating these documents was only half the battle. Many of them were decades old. Most were hand written or carbon copied and the ink was fading. They were stapled, folded or otherwise attached to other documents that had to be organized and sorted out. And many of the documents had changed styles over the years and the identifying information or legal description was not always located in the same place on the page. The mapping team had to carefully examine each document that was to be mapped in order to input all the data accurately.

Once the data sources and types were identified, a personal geodatabase was designed to hold a separate feature class for each of 12 general document types. Domains were assigned as needed since several of the document types also had various "flavors" (i.e. Lot Splits could be Family Lot Splits, Minor Lot Splits, etc.). We didn't have access to a multi-editor environment like ArcSDE at the time, so it was decided to use personal geodatabases to at least have the domain functionality. Two part-time and two full-time mappers were assigned to this project and each was given a copy of the personal gdb.

Then the GIS team began the mapping process. They spent the next 18 months poring over each document of the 12 different types, reading and mapping the legal description for the property that was being permitted, split, combined, or otherwise approved for development. They employed several different methods in locating the properties including searching the parcel layer for the tax account number or PIN number, reading and plotting the legal description, doing an address search, etc. Whatever information was available to locate the property. Then they would either copy and paste the parcel into the document feature class, sketch around the existing parcels to create a new polygon, or, sometimes, even use the COGO Traverse tool. As each mapper finished with a document type, their features were copied into a Master Geodatabase that collected all the data into one place.

Each record was attributed with data taken from the paper document - file number, approval date, etc., and documents that had been recorded by the County Clerk's Office were searched for on the clerk's webpage and the URL of their scanned image was pasted into a hyperlink field in the feature class.

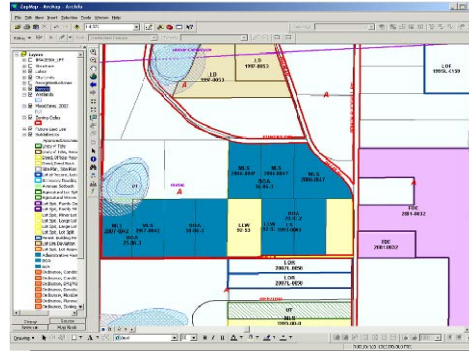
This would give instant access to the image of the document without having to retrieve it from storage or try to find it in a filing cabinet. Over 30,000 documents were input into the various

"Knowing where things are, and why, is essential to rational decision making"
-Jack Dangermond, ESRI

“Satellite data provide quick and useful baseline information on the parameters controlling the occurrence and movement of groundwater.”

feature classes in this way.

This, then, was the birth of ZapMap - Lake County's Zoning and Permits Mapping Application. The necessary base map, development, and document layers were added to an ArcGIS map document, and symbolized and labeled to the liking of the Zoning Staff. They now had the ability to search for a property and see all the previous activity associated with that property - had it been split from a larger parent parcel? Was it recognized as a legal Lot of Record? Had it undergone a Unity of Title to increase the total acreage thus meeting the size requirements? What is the Zoning? Are there any wetlands or flood plains on the property? All these questions and more could now be answered right from the desktop.



Testing

Once the MXD was created we started with a small test group. Three Associate Planners in the Zoning Division were tasked with test driving the application. They were looking to see if all the needed layers were included in the Table of Contents? Were the labels legible? Was it easy to use? They also created the workflow for how the application would be used in their overall business process, and conducted visual testing for completeness of data.

As usual, as more and more staff saw the ZapMap in action, they all wanted access to it and we realized that the single personal geodatabase was not up to the task of accommodating all the users who showed interest. So we decided to re-model it into a single ArcSDE feature class. We combined all the document type layers into one feature class called "BuildableLots" (this was the informal name we had given the project prior to this and it just seemed to stick). Each document type became a subtype within the feature class, and the individual domains were associated with a specific subtype.

Once the data was loaded into ArcSDE, the MXD could more easily accommodate multiple users over the network. So we expanded the test group to the entire Zoning Division - about 11 Planners and Associates, and then out to the Planning & Community Design staff - another 12 or 13 Planners and Staffers. The GIS Project Manager conducted basic ArcMap training to teach all the novice users the fine art of panning and zooming, selecting by attribute, and identifying layers. The main purpose of the ZapMap is to query and identify. And it does that extremely well.

Currently, ZapMap is in beta/test mode. The staff uses it for initial research, but still double checks on the data the old fashioned way with paper maps. With so much data, and from such poor original sources, it would be impossible to QA/QC it in a single pass. So we decided to allow for an extended, parallel process with the old, paper maps still as a resource until everyone is comfortable with its use, and to give enough time to validate the new digital data.

The Future

Future hopes for the ZapMap Application include scanning the remaining unrecorded documents and linking them to the geographic data. We are working closely with our Information Technology/Records Management Department for that solution.

We are also actively moving toward installing and using ArcGIS Server which will allow us to publish ZapMap as a map service and serve it out to the Web - internally at first, but eventually out to the public where they will be able to do a lot of their own research before they even come in to the county office thereby cutting down on wait time and application processing time.

Everyone who has seen or used the Lake County ZapMap Application has been extremely pleased and each one of them comments on how much easier their job is getting just by having access to it. ■

“We must remember that one determined person can make a significant difference, and that a small group of determined people can change the course of history.”

-Sonia Johnson

Tips and Tricks - Creating a model to save you time

By Whitney Laurien | East Central Florida Regional Planning Council

Have you ever worked on a project with multiple steps, a few pre-existing conditions and some particular requests by the contractor? By this I mean, someone gave you conditions and allowances in regards to particular features and told you to find the best location for their needs. So you put together the project as requested, find your locations and then go to the meeting to present your findings. Have you ever arrived at this meeting only to hear that they would now like to change the buffer size, exclude areas that were previously included and basically change the plans for what you'll be doing the rest of the day? It happens all the time, but how quickly can you respond? Did you know that instead of going back to the office and redoing all of your previous work, you can actually redo the entire scenario right before their very eyes?

Creating a model of a multiple step process is a very simple and effective solution for situations where you may need to change the numbers around to fit a new scenario. A model will group your entire process in one swoop, and once it is made it can be edited and rerun much quicker than you could ever redo everything by hand. Models are great for automated work flows, specifically the ones with parameters and variables like buffers, merges, queries etc.


To create a model you will need to make a new Toolbox in ArcMap: right click on ArcToolbox and select 'New Toolbox.' Name your toolbox then right click on your new toolbox and select New >Model. This will bring up a blank pop up screen where you can add queries, tool functions, map algebra, and more.

Here comes the fun part, drag and drop. You can drag quite a few, if not all of the functions in ArcToolbox over to the Model box to create your model processing steps: buffers, merges, intersect, map algebra, clip, convert to raster etc. So let's say you want to do two buffers: 1mile around schools, 3 miles around parks, and you'll need to intersect these buffers because wherever they overlap is where they will possibly build a new donut shop (fictitious but I'm sure not to far from the truth these days!).

Find your 'Buffer tool' under Analysis > Proximity, drag Buffer into the Model box. Double click on the Buffer box in the model which will bring up a familiar dialog box to fill out. Once you set an input and specify what the output will be, the white boxes will change to their respectable colors and a blue circle will appear to show what the input file is.



Next drag the Intersect tool into the model. This time instead of double clicking however, you can connect the two datasets with what can be referred to as the 'Magic Wand,' this tool will

automatically add the data that is already in your model to the input. Click this button  then use the wand to draw an arrow from each buffer to the Intersect tool. Once again the tool will change from white to a color.

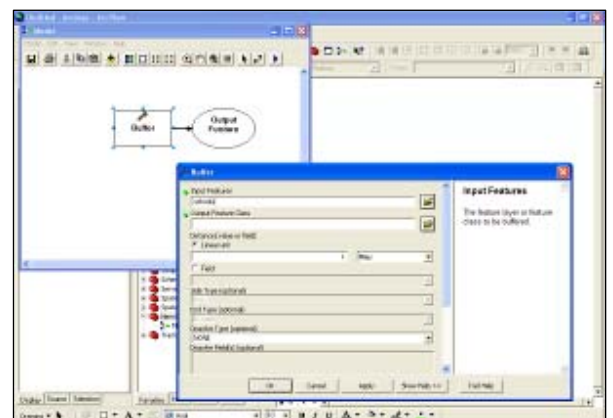
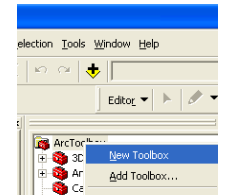
Lastly, let's say you want to run a query to narrow down the choices for a Donut Shop location, the tool called 'Make Feature Layer' will allow you to build a query and the selected layers will then become a temporary output layer. To build the query, double click on Make Feature Layer

"Integrated remote sensing/GIS can be a powerful tool for planning artificial recharge structures."

Save the date:

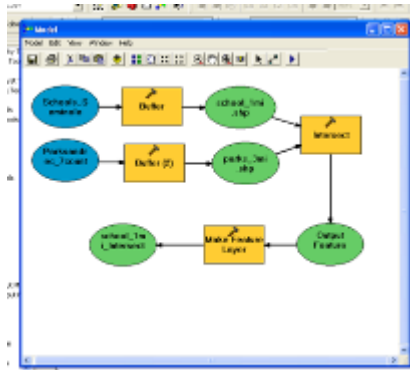
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in the model, within the dialog box there will be a line called Expression. Hit the button and the familiar query dialog pop up can be seen and filled out. This can be useful if there are additional parameters in regards to the donut shop that can be translated into a query equation.



So far this is roughly what my very simplistic donut shop Siting Model would look like. Save the model (Model> Save). Also right click on the very last output on the map, in this case school_1mi_Intersect, and click 'Add to Display' so that your results will display on your actual map, that's the point after all, to see some results! Once you are ready, cross your fingers and choose Model>Run Entire Model, it may take a few minutes and you will see the colors of boxes changing to red in the background as they are running, this means that step is being processed.

Once you have made this model you can change and calibrate the numbers set for the functions, you can add or remove steps and then you can rerun the model for a

different set of outcomes. Get the results you need, save time and be more efficient, just another reason to say GI-Yes! □

"Please help the ECFRPC in welcoming the new CFGIS Workshop Organization that was created for the benefit of the Central Florida GIS community."

New CFGIS Workshop Organization

By Claudia Paskauskas | East Central Florida Regional Planning Council

The ECFRPC, in conjunction with volunteers from the Central Florida GIS (CFGIS) community, developed a multi-day educational workshop held in September 2007 and 2008. The Central Florida GIS community responded positively to the workshop, which had over 250 attendees on both occasions, and then aimed for the workshop to be held annually.



The workshop committee identified several areas of potential expansion and growth for future events that go beyond what the ECFRPC and CFGIS program can commit in regards to staff time and resources. To continue facilitating the annual CFGIS Workshop, the CFGIS action plan study recommended that an independent organization be established. The creation of this organization would enable its ability to freely partner with several other entities such as FLURISA, FACM, FSMS, and ASPRS, and to develop themed events that offer education while facilitating networking for practitioners of GIS.

The ECFRPC assisted legally and financially in facilitating the establishment and incorporation of the new CFGIS Workshop Organization. The new organization was established as a free standing 501 C3. As a free standing organization the group established by-laws to govern its activities as well as elect or appoint a board to direct the organization efforts. The new board members are Al Hill, Mira Bourova, Nancy Church, Kathy O'Sullivan and Lakshmi Sankaran. The ECFRPC through the CFGIS program may, on occasion, and at the discretion of the RPC Board and Executive Director, act as a sponsor for the CFGIS workshop, however, all primary workshop functions, responsibilities, liabilities, and decisions now rest with the CFGIS Workshop Organization.

Please help the ECFRPC in welcoming this new organization that was created for the benefit of the Central Florida GIS community. □

Save the date:

Next CFGIS Workshop:

September 21-22, 2009- Alt. Springs, FL

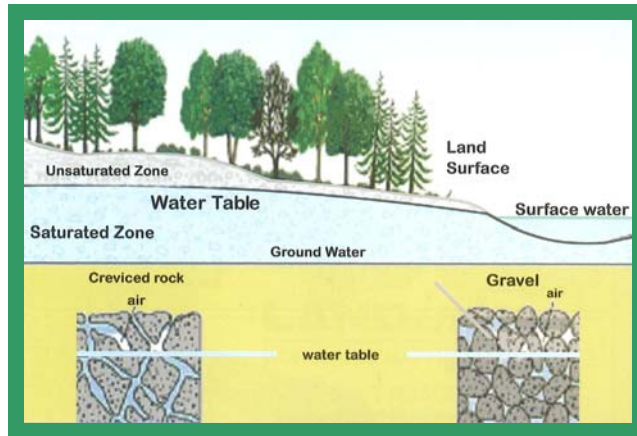
Remote Sensing Steers Sustainable Groundwater Management

By Raghuvveer Jalli and Abhishek Mista | Earth Imaging Journal | September/October 2008

Groundwater is the world's primary regulator of fresh water resources. Aquifers and other groundwater reservoirs form the invisible, subsurface part of the natural water cycle. In fact, groundwater underpins sustainable development. Drinking water is drawn mainly from groundwater because it is naturally protected and reliable.

Water resources can be used sustainably only if their spatial characteristics and their variation through time are properly understood. Because of the global scale of this topic, only remote sensing and related geospatial technologies are up to the task of monitoring and modeling groundwater.

Remote sensing can be used to identify features that directly or indirectly indicate groundwater quantity and quality, including land use patterns. Geographic Information System (GIS) technology can be used to integrate and analyze spatial and nonspatial data obtained from diverse sources. Remote sensing, coupled with GIS, is the most effective way to analyze water resources at local, regional and global scales.



Remote Sensing/GIS in Groundwater Hydrology

Groundwater isn't a matter of chance, but a predictable consequence of the interactions of climatic, geomorphic and geological factors. A systematic study of these factors leads scientists to better delineate prospective zones in any region. A remote sensing/GIS approach to groundwater potential mapping and condition assessment is possible in a variety of locations, even in hard rock crystalline formations where the occurrence and movement of groundwater is complex.

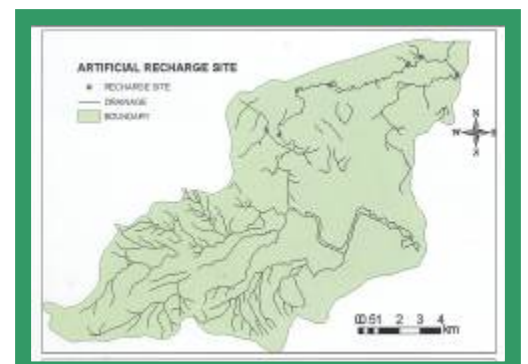
The art of remote sensing has unique potential to vividly display the size, shape, pattern and spatial distribution of various aquifer systems, as well as their deformation signatures and morphogenetic landforms. Remote sensing has obvious advantages of spatial, spectral and temporal availability of data covering large and inaccessible areas within a short time. Thus, it has become a highly effective tool in assessing, monitoring and conserving groundwater resources. Satellite data provide quick and useful baseline information on the parameters controlling the occurrence and movement of groundwater. Factors such as geology/lithology, structure/lineament, geomorphology, soil, landuse/landcover, hydrological parameters, etc., can be integrated with slopes, drainage density and other collateral data in a GIS framework. Such data can be analyzed with GIS using logical conditions to derive groundwater zones and artificial recharge sites.

Seeking Improved Groundwater Management Tools

Officials in India recently launched a study to better identify, monitor and manage groundwater. They partnered with RMSI to develop and test an integrated remote sensing/GIS technique to investigate groundwater recharge in hard rock terrains, delineate the area's groundwater potential zones, and suggest suitable sites and methods for artificial recharge to augment the area's groundwater recharge. The study's results will give various government/semi-government, nongovernmental organizations and the private sector the opportunity to manage water resources more effectively in the study area and elsewhere where the particular conditions exist.

The Study Area

The study area, Jhagrabaria, lies in the Allahabad district of India's Uttar Pradesh state. Geologically the area is composed of Upper Vindhyan formations that mainly consist of sandstone and shale. Allahabad's Yamuna River area is generally known as a hard rock area. The area has exposed Vindhyan, with a maximum alluvial thickness of 50 meters. The area's elevation varies from 90-150



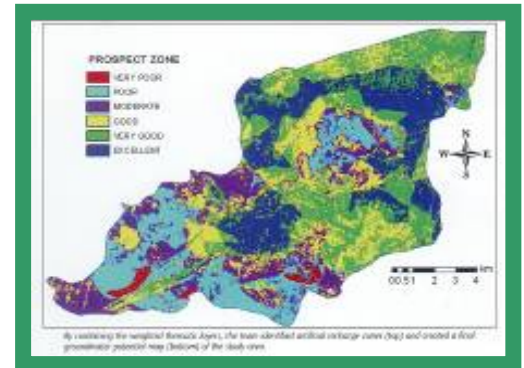
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-Eddie Robinson

“..as more and more staff saw the ZapMap in action, they all wanted access to it..”

meters above the mean sea level. High monsoon run-off is a conspicuous feature, and the underlying friable sandstone has fairly high potential for run-off water to percolate down into groundwater reserves.

Database Generation

Spatial database creation is the first step for carrying out groundwater delineation studies in a GIS environment. The spatial data consist of various thematic maps – soil, geology, slope, landuse/landcover, etc. To make the thematic data easy to manipulate, all the thematic maps were based on a common coordinate system. Next the study team added the attributes –nonspatial data– for each map. To generate the nonspatial database, the team used ArcGis 8.3 software from ESRI. The attribute data represent characteristics, qualities, and relationships of the map features and geographic locations. After adding the attributes, the team developed a final thematic map.



Creating Thematic Layers

To generate a groundwater potential zone map of the study area, various thematic maps were prepared from India's IRS-1D LISS III satellite data and a referenced base map. The satellite data and information collected during field checks were incorporated into the prepared maps. Standard image interpretation keys such as tone, color, texture, pattern, shape, size, vegetation trend and association were used to recognize and delineate various lithological and geomorphic units. The units were digitized on the screen by keeping the base map as a backdrop. The study generated several maps, including a boundary of the study area, soils, geomorphology, geology, slope, lineaments, overburden thickness, contour and spot height, and drainage.

Model Development

The study team used a multicriterion evaluation model (MCE)/weight index model, which entails assigning weights to different layers to consider their relative importance and significance to each other. The simplest MCE algorithm is the “weighted linear summation technique.” Using this method, the team multiplied standardized scores by the weight for each of the layers and allocated a score to each pixel on the output map. The map shows final weights - higher weights are given to layers or classes that have a greater effect on groundwater evaluation. The higher the weight, the higher the effect of that particular layer/class on the groundwater delineation. After assigning weights to all the map classes, the team made a final groundwater potential map that combined all the weighted thematic layers. The expression for the overlay operations is below:

$$\text{Output map} = \{(\text{Geology}) + (\text{Geomorphology}) + (\text{Overburden thickness}) + (\text{Slope}) + (\text{Landuse}) + (\text{Soil}) + (\text{Lineament buffer map})\}$$
$$\text{Output} = \text{Groundwater Potential Map}$$

Artificial Recharge Estimation Analysis

Artificial recharge is the process of artificially augmenting the natural movement of surface water into underground formations. This is accomplished by constructing infiltration facilities or by inducing recharge from surface water bodies. Integrated remote sensing/GIS can be a powerful tool for planning artificial recharge structures.

Underscoring the Value of Geospatial Techniques

The study successfully produced an integrated remote sensing/GIS-based methodology for evaluating groundwater resources. Moreover, the GIS-based analysis for selecting artificial recharge can be calculated by integrating four thematic layers: drainage, slope, lineament, and lithology. Based on this analysis, artificial recharge zones can be identified as potential groundwater sites. Remote sensing techniques also were found to be suitable for generating a landuse/landcover map by digitally processing the IRS-1D LISS-III satellite data. In turn, the data can be effectively integrated into a GIS environment for additional groundwater studies, thereby augmenting available water supplies. Such efforts are key to raising living standards in villages throughout the Indian subcontinent and beyond.

FRESH WATER: Earth's Most Precious Resource

Oceans cover about three-fourths of Earth's surface. According to the United nations, that total amount of water on Earth is about 1,400 million cubic kilometers, which is enough to cover the planet with a layer of water about 3,000 meters deep. However, only 2.7 percent of



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the total water available on Earth is fresh water, of which about 75.2 percent lies frozen in polar regions and another 22.6 percent is present as groundwater. The rest resides in lakes, rivers, soil, vegetation and the atmosphere.

What is effectively available for consumption and other uses is a small proportion of the quantity available in rivers, lakes and groundwater. Thus, a crisis in water resources development and management arises because most of the water isn't available for use. Moreover, the fresh water that is available is characterized by its highly uneven spatial distribution. Not surprisingly, when water as a commodity begins making headlines worldwide, better water resources management through remote sensing and other geospatial science also begins to take center stage. ▣

Upcoming Events

- GITA Geospatial Infrastructure Solutions Conference - Jacksonville, FL - April 19 - 22, 2009
- ESRI Southeast Regional Users Group Conference - Jacksonville, FL - April 27 - 29, 2009
- SERUG Conference - Jacksonville, FL April 29 - May 1, 2009
- CFTPG Users Group Brown Bag - FDOT D5 Office, Orlando, FL - May 21, 2009
- CFTPG Users Group Brown Bag - FDOT D5 Office, Orlando, FL - August 20, 2009
- 2009 CFGIS Workshop - Hilton Altamonte Springs -Orlando, FL - September 21 - 22, 2009
- URISA Annual Conference - Anaheim, CA - September 29 - October 2, 2009
- URISA Leadership Academy - Seattle, WA - December 7 - 11, 2009

Check the CFGIS website (www.cfgis.org) for more events!