Homeland Security
Science and Technology

Workshop on Analytical Capability Development

Sponsored By:
DHS Science & Technology Directorate

Hosted By:
NSF Center of Research Excellence
in Science and Technology at FIU

Waterview Conference Center,
1919 North Lynn Street,
Arlington, VA

February 8-9, 2011

Post-conference Report 1:

GEOSPATIAL DATA ANALYTICS

By: **Dr. Nabil Adam**
Science & Technology Directorate

http://TerraFly.fiu.edu/DHS/

Unclassified

Table of Contents

The Directorate gratefully acknowledges the contribution to this report of the following researchers at the National Science Foundation Research Centers:

Principal Co-contributor: **Naphtali Rishe**
NSF Industry-University Cooperative Research Center at FIU and FAU http://CAKE.fiu.edu
NSF Center of Research Excellence in Science and Technology at FIU http://CREST.fiu.edu
FIU High Performance Database Research Center
Florida International University, University Park, ECS-243, Miami, FL 33199 http://TerraFly.FIU.edu

Co-contributors:
FIU: **Debra Davis**, **Martha Gutierrez**, **Scott Graham**, **Malek Adjouadi**, **Armando Barreto**
FAU: **Borko Furht**
UIC: **Ouri Wolfson**
UMBC: **Yelena Yesha** and **Yaacov Yesha**

GEOSPATIAL DATA ANALYTICS:

TerraFly Case Study

1. Introduction

> *March 11th, 2011, 2:46pm – A magnitude 9.0 earthquake strikes just off the northeast coast of Japan. Within an hour, a tsunami estimated at over 30 feet high hits the coast of Japan, sweeping away entire villages and killing tens of thousands of people* [1] .
>
> *April 20th, 2010 – A massive explosion on the BP Deepwater Horizon drilling platform in the Gulf of Mexico caused the largest oil spill in US history, killing 11 workers and spilling an estimated 4.9 billion barrels of oil* [2].

Disasters, whether environmental or manmade, have catastrophic impacts that require both quick action and long-term interventions. Mitigating the effects of those disasters requires knowledge about similar events and advanced disaster planning. Major challenges in disaster planning and intervention include a lack of up-to-date information on situational and environmental conditions, major communication gaps, and a lack of effective coordination in planning and recovery operations. With a worldwide average of 387 natural disasters a year alone [3], it is imperative that solutions are found to combat and eliminate these problems. The implementation of cutting-edge technology, in particular, is key for advancement of the science and solutions for disaster mitigation [4] [5].

1.1. The Challenge

Implementing the types of cutting-edge technology needed for the diverse needs of disaster-related solutions is complex and challenging. Massive amounts of data are required, and this data is often heterogeneous, from divergent sources, and consists of both structured and unstructured data. Geospatial and remotely-sensed data, such as geo-referenced satellite imagery and aerial photography, provides particularly critical information that either is not available in other forms, or is not otherwise easily conveyed. This type of data, however, is inherently very large, thus significantly increasing the complexity of possible technological solutions [6; 7; 8; 9; 10].

There are also numerous challenges with the use of existing GIS tools for processing and analyzing geospatial data [8]. The primary challenges involved include:

1. The use of multiple, disparate tools are often necessary, some of which are expensive, and require specialized skills and training to use;
2. The data must often be imported into these separate tools, each of which may require the data to be in different formats; and
3. The ability to combine heterogeneous types of data is not always possible using the GIS tools currently available.

Another difficulty is that the typical end-users' technological backgrounds are very diverse, ranging from scientists to disaster mitigation and recovery planners to on-the-ground disaster responders. This requires the availability of robust systems and tools that are very flexible and easy to use, so that end-users can focus on the work that they need to get done without having to worry about the technology behind the system they are using [11] [12]. Because of the nature of disasters, new and updated information needs to be made available in a timely manner, and in a form that can quickly and efficiently be consolidated and conveyed to multiple, diverse users at the same time.

Interestingly, the challenges faced by those in the disaster mitigation field are not unique. There are numerous fields that rely on the use of geospatial and remotely sensed data. The same types of technological solutions designed for disaster mitigation can also be implemented in and have major impacts on other fields. The most apparent are fields in scientific discovery such as ecological and environmental research, archeology, oceanography, and meteorology, among many others. Other fields that have more ordinary, day-to-day impact on people's lives would also greatly benefit from similar solutions. This includes areas ranging from government operations such as public works and urban planning to business fields such as real estate and tourism.

For example, in real estate, there are many variables that affect the value and desirability of a particular property: neighborhood, local businesses, crime rates, roads and transportation, school quality, level of urbanization, etc. As with disaster preparedness and recovery, the data necessary to provide needed information often comes from diverse, heterogeneous data sources that may be structured or unstructured. Geospatial data, once again, can provide information that is otherwise not available or in a format that is difficult to interpret. All this data must be collected, consolidated, analyzed and visualized in an easy to understand format to be effectively utilized. This challenge is further compounded in that the technical backgrounds of potential users are very diverse, ranging from engineers and surveyors, to developers, real estate agents and potential buyers.

1.2. A Solution - TerraFly

Identifying a solution to these intense and complex issues may seem overwhelming. Through the use of innovative research and cutting-edge technology, TerraFly has been created to provide a flexible, robust and forward-thinking solution to these multifaceted challenges. Specifically, TerraFly is designed to efficiently and effectively deal with the challenges involved in handling and analysis of massive amounts of heterogeneous geospatial and related data, as well as with the challenges that users encounter when attempting to use traditional GIS tools.

This article discusses geospatial data analytics using TerraFly as a case study. An overview of TerraFly will first be presented, followed by discussions of TerraFly's capabilities in data handling, information visualization, flexibility and customization, and specific domains in which TerraFly is currently used, such as disaster planning and recovery, science and research, real estate and travel.

TerraFly is a technology and tools for visualization and querying of geospatial data. The visualization component of the system provides users with the experience of virtual "flight" over maps comprised of aerial and satellite imagery overlaid with geo-referenced data. The data drilling and querying component of the system allows the users to easily explore geospatial data, to create geospatial queries, and get instant answers supported by high-performance multidimensional search mechanisms. TerraFly's server farm ingests, geo-locates, cleanses, mosaics, and cross-references 40TB of basemap data and user-specific data streams. TerraFly's Application Programming Interface allows rapid deployment of interactive Web applications and has been used to produce systems for disaster mitigation, ecology, real estate, tourism, and municipalities. TerraFly's Web-based client interface is accessible from anywhere via any standard Web browser, with no client software to install.

2. TerraFly's Advanced Geospatial Data Processing

2.1. Overview

The cornerstones of TerraFly is in its portability, fly-over technology, ability to integrate multiple sets of geospatial and related data into customizable, multi-layered products, and inclusion of powerful but easy to use visualization, querying and analysis tools. As can be seen on TerraFly's landing page (see Figure 1) [13], users are able to easily select the geographic area they are interested in exploring. By streaming incremental imagery tiles, TerraFly enables users to engage in virtual flights (see Figure 2) where they maintain full control over flight speed, direction and altitude (spatial resolutions) via an intuitive, flash-based navigation system.

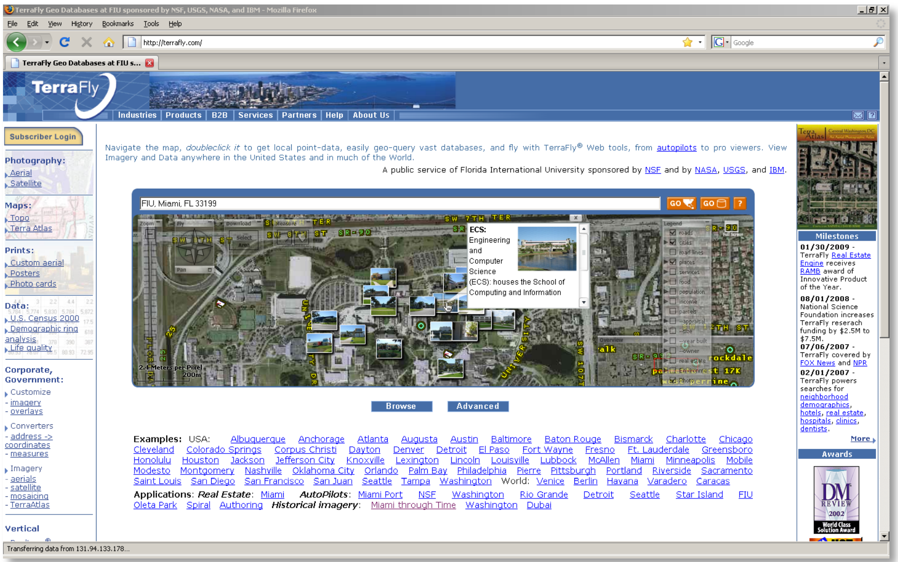


Figure 1. TerraFly Landing Page

TerraFly's data-mining tools are capable of delivering an extensive amount of data related to user-specified geographical locations [14; 15; 16; 17]. Unlike most GIS applications [18], TerraFly eliminates the need for the end-user to deal with any technical aspects of the system. Users are able to easily query for data of interest, and have that data automatically visualized in the form of non-obstructing geo-referenced overlays, or data layers, combined with spatial imagery [19; 20; 21; 22]. The most popular types of overlaid data include NAVTEQ NAVSTREETS street vectors, World OpenStreetMaps, property parcels, Yellow pages, White pages, demographics, Geographic places (Worldwide from NGA and other sources, USGS Geographic Names Information System), services, hotels, and real estate listings. This is just a sampling of datasets..

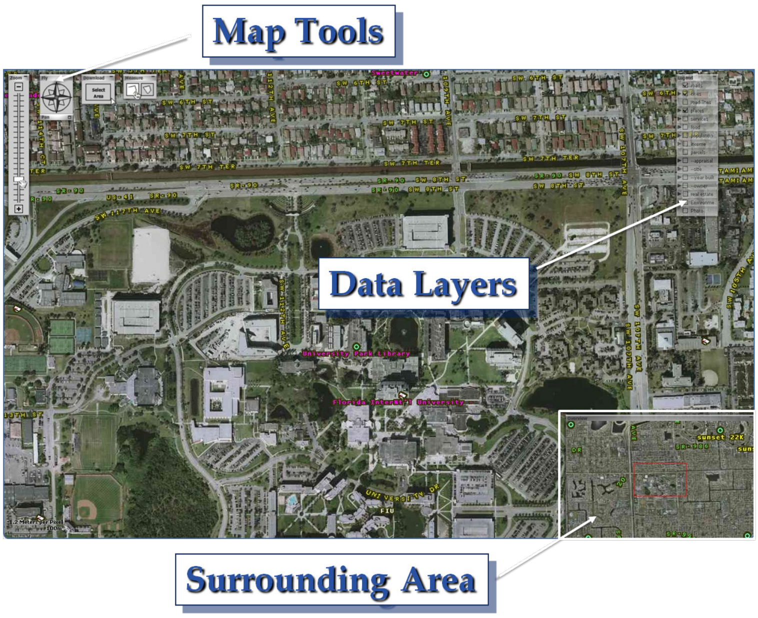


Figure 2. TerraFly Flight and Data Layers Control Layout

In addition to data overlays, TerraFly provide users with a drill-down detailed information page on a point or area (see Figure 3). For example, users can use TerraFly's address locator capability to "fly" to a specified address, and then request more specific information about that particular location. To do this, the user clicks on the particular point of interest on the spatial image. A preview page will pop up in the flight window that contains a summary of information about that particular location, along with links to more detailed location information. To view the more detailed information, the user clicks on the associated link in the preview page, and the user will be taken to a new page where more detailed local information, such as demographic data, local restaurants and businesses, etc. is displayed below the flight window (see Figure 4).

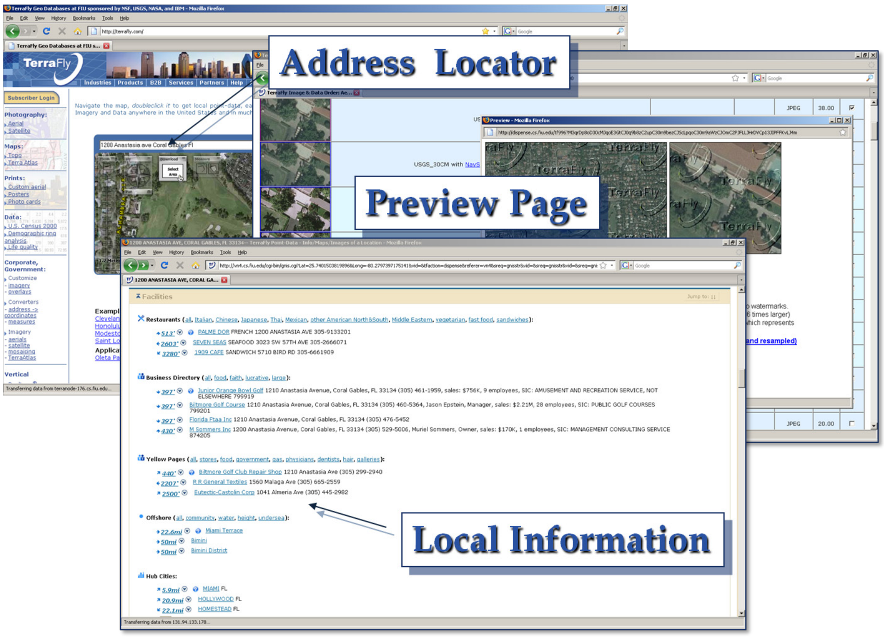


Figure 3. Sample of TerraFly's Data Drill Down

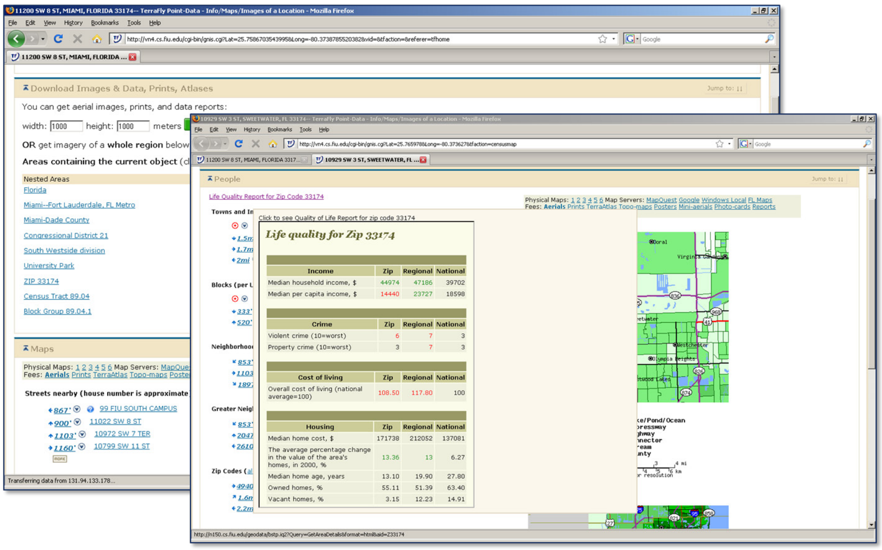


Figure 4. Demographics and Quality of Life overview page

The TerraFly system has querying and analysis capabilities that are the result of intensive, cutting-edge and innovative computing research. The tools available in TerraFly include user-friendly geospatial querying, data drill-down, interfaces with real-time data suppliers, demographic analysis, annotation, route dissemination via autopilots, customizable applications, production of aerial atlases, and an application programming interface (API) for web sites. Many of TerraFly's capabilities and the technology behind them, such as TerraFly's underlying data storage mechanism, client-server interaction, user interface, ability to overlay additional information layers, and ergonomics of use and maintenance, have been described in numerous professional publications [23; 24; 25; 26; 27; 28; 29; 30]. More recent advancements in TerraFly's data handling capabilities, namely improved user-centric data integration and mapping tools, data repository, and advanced data indexing and preprocessing, are described in the remainder of this section. Advances in TerraFly's data visualization capabilities, such as times series visualization, a customizable autopilot, and the TerraFly data dispenser, are described in Section 3.

2.2. Data Repository

A critical component of TerraFly is its data repository, and a major strength lies in its integration of heterogeneous data sources including relational and semantic databases and web sources with spatial data. TerraFly's data repository was one of the first GIS databases that were able to store heterogeneous data in one database [23; 24; 25; 26; 31; 32]. As with other GIS tools, there are two main types of geo-referenced spatial data that TerraFly must handle: raster (satellite and aerial photography) and vector data (points, lines and polygons) [6] [33]. TerraFly's data repository currently stores the following:

Raster Data. The entire collection of Digital Orthophoto Quarter Quadrangle (DOQQs) produced by the USGS (1m-resolution orthorectified aerial photography of the entire USA, including once-over 13TB coverage and 5TB of multi-temporal updates); the entire collection of USGS Urban Area High Resolution Orthoimagery (15-30cm imagery covering 135 metropolitan areas–15TB), and Landsat imagery [34] covering USA and parts of the world, imagery from local sources (7cm/pixel and up), and a vast collection of satellite imagery, particularly from GeoEye and Ikonos satellites.

Vector Data. The TerraFly vector collection includes 1.5 billion geolocated objects, 50 billion data fields, 1 billion polylines, 120 million polygons, including: all World roads, Worldwide geographic places and features, 24 billion demographic data items (3,000 fields x 8 million objects), 1 billion economic data items including the US Census demographic and socioeconomic datasets [35], 110 million USA cadastre polygons and detailed data on each parcel, DEM Elevation data, 15 million records of businesses (with company stats, management roles, contacts and radius demographics for each business), 2 million physicians with expertise detail, various public place databases (including the USGS GNIS [36] and NGA GNS), Wikipedia, extensive global environmental data (including daily feeds from NASA and NOAA satellites and the USGS water gauges), and hundreds of other datasets.

New Data is constantly being updated and added to TerraFly's data repository. For a current listing of available data, please see [37].

2.3. TerraFly's Advanced Data Geocoding Capabilities

A commonly used feature of GIS and mapping systems is the ability to geocode street addresses. As with most GIS and mapping applications, precise and accurate geocoding of available data in TerraFly is critical. If implemented with sufficient precision, this ability can satisfy the needs of many businesses' day-to-day functions (e.g., realtors, attorneys, engineers, etc.), as well as the more complex needs of government and research (e.g., information retrieval from spatial databases) [38]. For many years, most mapping systems have used standard interpolation geocoding that estimates where on a street a particular address is located. There are a number of assumptions associated with these standard methodologies, such as consistent standardization of street numbers in all areas and substantial accuracy of the underlying data. Because it is an estimate, and not a coordinate point associated with a specific building, this type of geocoding has a certain level of inaccuracy and often results in near misses. For example, when using one of these standard methods, the resulting point often lies outside of the parcel property lines of the building of interest and sometimes a few buildings away.

To address this issue and to provide the significantly higher level of precision required for many TerraFly applications, ***roof-top geocoding*** has been implemented in TerraFly via the inclusion of First American Parcel Point Nationwide Cadastre data [39] along with efficient data management algorithms. This data set contains attributes that are intended to support data integration related to land parcels across jurisdictional boundaries, and includes parcel boundaries, parcel centroid, addresses, Assessor's Parcel Numbers (APN) and ownership information [40] [39] (ownership information is not available in all counties).

After initial data cleanup to remove data with missing components and incorrectly formatted records, the data was cross-referenced with other datasets and a precise geocoding component was created for TerraFly. Specifically, TerraFly's rooftop geocoder was created using spatial indexes and data structures already used in

TerraFly, with street address interpolation and string matching algorithms. In short, the process is as follows:

1. When a query for a particular address is made, TerraFly uses a standard interpolation methodology to generate approximate coordinates for the requested location.
2. These coordinates are then used to perform a nearest neighbor query to retrieve any nearby parcels from the data set.
3. A local search for the best matching parcel is performed on the results.
4. If a match is found for that parcel in the database, the coordinates for that record are returned to the user.

TerraFly also has ***location-sensitive geocoding***. If the user is focused in a particular location and provides a partial address or a partial description of a geographic or social place, the system will look for the best match, weighing the factors of place importance and its proximity to the user's current location.

2.4. Image Mosaics, Raster Data Analysis and Amelioration

As is seen in section 2.2, TerraFly has nearly 40TB of aerial and satellite imagery in its data repository. As with vector data, TerraFly requires high quality raster data to perform many of its applications. However, not all of the imagery is of a high enough quality for appropriate visualization, and sometimes multiple images for the same locations, are shot at different times or by different instruments. Nevertheless, some users desire to see original unaltered imagery. Most users, however, desire to see a pixel-by-pixel mosaic of the best imagery available. "Best'' is a user group specific criterion, and TerraFly accepts various definitions of what "best" means for a particular user group. The default "best" is the freshest, the sharpest, and the most natural-color imagery. Thus, in preparation for mosaicing, TerraFly performs image analysis on its raster data.

Two different types of imagery analysis are conducted to improve TerraFly's image quality: (1) detection of black regions in individual tiles and (2) histogram analysis on an entire data set. When imagery data is acquired or post-processed, individual data tiles may contain areas of black interspersed or surrounded by good quality imagery. As a result, detection of black regions is performed tile by tile, and results of the analysis are stored as meta-data inside each tile. When tiles are retrieved, this meta-data is accessed and algorithms are used to determine how to best mosaic that particular tile with better quality imagery for the best quality output to the user.

Entire data sets are sometimes affected by color distortion that is not easily detected when imagery is analyzed on a tile by tile basis. Therefore, histogram analysis is conducted on the entire data set. To provide end users with the most accurate and flexible data product, results of the histogram analysis are stored separately from the original data set. This provides the user with the option of seeing either the original or corrected imagery.

Both of these types of image analysis involve data-intensive computing, particularly on the large data sets inherent to spatial data. TerraFly's raster analysis applications have been ported to MapReduce [41] [42], a highly efficient framework that automates the use of parallel processing through the use of mappers and reducers (see [43] for more details on MapReduce). For detection of black regions, each mapper is assigned a certain number of tiles to analyze, depending on the size of the data set and the number of mappers. No reducer is needed for further processing. For histogram analysis, each mapper is responsible for analyzing a portion of the data set, and the partial result is sent to the reducer. The reducer then combines all of the results and computes the final output. TerraFly's use of MapReduce has resulted in a dramatic improvement in computing time, and has shown close to linear scalability [41].

2.5. Spatial Keyword Indexing (SKI)

Spatial data is inherently very large, complex and often heterogeneous in nature. This makes meticulous and efficient data management a major challenge, particularly when dealing with extremely large databases such as TerraFly's data repository. However, appropriate data indexing can be used to make querying of data more efficient. To address this and improve performance, TerraFly includes an innovative, hybrid method to efficiently process top-k spatial queries with conjunctive Boolean constraints on textual content [16].

Specifically, this method combines an R-tree structure and text indexing into a location-aware inverted index by using spatial references in posting lists. R-Trees are often used as an indexing mechanism for spatial search query processing [44; 45; 18]. In the TerraFly-SKI hybrid method, an R-tree index is modified in the upper level nodes with the addition of a list of leaf nodes that have the same parent. An inverted file is altered to contain a list of pointers to some of the R-tree's nodes, creating a spatial inverted file. To process a query, the R-tree is traversed in a top-down method using a best-first traversal algorithm. If at least one object exists that satisfies the Boolean condition in the subtree, then a node entry is made into the priority queue. Otherwise, the unnecessary subtree traversal is eliminated. The result is a disk-resident, dual-index data structure that is used to effectively and proactively prune the search space [16].

Although this method produces improved performance, the indexing process can take a substantial amount of time. How much time is needed depends on the size of the database, as well as the size of the lexicon found in the spatial inverted file. For a database that contains N objects, where those objects are used to construct the SKI's modified R-tree, the number of insert operations is $O(N)$. When constructing the spatial inverted file, the most expensive operation involves sorting the lexicon, with a construction time of $O(N + V \log(V))$, where V is the size of the lexicon.

MapReduce has been used to improve image processing computing time for data in TerraFly's data repository [41]. The use of parallel computing to improve the efficient construction of inverted indices has been studied by other researchers [43]. TerraFly's work with MapReduce has been leveraged to improve processing time in SKI construction. In this process, the R-tree structure is built with two MapReduce pairs as in [2]. The output includes references to R-tree nodes as intermediate data for use in the following job. Considering each object as a document, a MapReduce job also builds the spatial inverted file on the database lexicon. The MapReduce compound uses the intermediate data generated in the first iteration.

The resulting SKI's data structures are stored remotely in the Cloud, and are downloaded to a local host to serve interactive queries. In this process, the SKI data structures are partitioned because the number of "smaller" SKI structures is equal to the number of Reducers used in the MapReduce job. As a result, queries are processed with a modified version of the search algorithm proposed in [16] [27].

3. Advanced Data Visualization Capabilities

New and innovative technologies and functionality are continually being developed and added to TerraFly's already extensive capabilities. Section 2 presented key advances in TerraFly's backend and data handling capabilities. Those technological advances are functions that end-users may not be entirely aware of, but that affect them and the quality of their work substantially. In this section, some of TerraFly's most recent advancements in data visualization and user-centric capabilities are discussed. Although equally as important as the advances made on the back end, end users ability to interact with the system is more directly affected by advances to TerraFly's visualization engine. Specifically, this section discusses TerraFly's time series visualization capabilities, auto pilot, and data dispenser.

3.1. Time Series Visualization

A powerful capability is the TerraFly TimeSeries application. This application has a unique ability to provide efficient and ergonomic dissemination of imagery with spatio-temporal data overlays. In other words, the TerraFly TimeSeries application can retrieve geospatial and remotely sensed imagery of the same geographic location that was acquired during different time periods. The system is then able to create an animated sequence over time to clearly show historical changes.

To accomplish this, the TimeSeries application uses the coordinates of the current map center that it has received from the TerraFly API to send a request for information on available images to the TerraFly SO service (imagery source service). The SO service provides the TimeSeries application with an XML formatted string that contains information about available imagery sources, resolutions and acquisition dates. Upon receipt of this information, the TimeSeries application parses the XML [46] and orders the sources by acquisition date, starting with earliest date to the latest date. It then creates a time-line panel that accurately reflects the proportion of the number of days between acquisition dates, and then searches for the closest resolution images of the requested location. The TimeSeries application then generates URLs needed to request the corresponding imagery. Once the imagery servers provide the requested images, the TerraFly API loads the imagery and creates an overlay in the viewing area. The TimeSeries application creates the animated time sequence by fading-in and –out the corresponding images in the timeline. Specifically, this fading-in and -out effect is achieved by changing the transparency parameter of these images from low to high (fade-in) or high to low (fade-out) every 40 milliseconds at a rate of 25 frames per second.

The resulting time series can be quite dramatic and useful, particularly in disaster mitigation applications. When an extreme event occurs, certain features or characteristics of a particular area might be radically changed. With this unique use and visualization of historic data, the TerraFly TimeSeries application enables taking the important information and creating a new synthetic view of an emergent reality. This can not only aid in response to the disaster, but it also provides researchers with a rich source of data that can be studied to find better ways to plan and respond to similar types of disasters.

The recent earthquakes and tsunami that hit Japan in March of 2011 provides a cognizant example of the power of this technology. As can be seen in Figure 5, Figure 6 and Figure 7, the before, during and after geospatial images, respectively, of the tsunami are quite dramatic. In the image from April 4th, 2010, entire neighborhoods can clearly been seen as having been established and intact. The image from March 12th, 2011, the day after the tsunami hit, shows that water has rushed well inland, inundating those neighborhoods. The final image, from March 19th, 2011, shows the aftermath once the waters have finally receded. Those neighborhoods were completely decimated. Although images from the ground would show the devastation, the remotely sensed images allow researchers to better study the overall impact and patterns of this catastrophic event.

Figure 5. Ishinomaki, Japan, before the earthquakes and tsunami of March 11th, 2011

Figure 6. Ishinomaki, Japan, the day after the earthquakes and tsunami of March 11th, 2011

Figure 7. Ishinomaki, Japan, 8 days after the earthquakes and tsunami of March 11th, 2011

3.2. Auto Pilot

TerraFly includes the autopilot technology that allows users to preplan and map out a customized flight path of interest. With this tool, end users can quickly and easily select specific destinations over spatial and remotely-sensed images, and the system will automatically create that flight path as a series of point destinations at the speed and altitude (resolution) desired by the user. The speed and altitude need not remain static during the automated flight. At any point in the predefined flight sequence, users may include changes in speed, and zoom in (i.e., view higher resolution data) or zoom out (i.e., view lower resolution data) at will. The user is also able to determine which additional features will be displayed while traveling in the flight path. In essence, any feature or information that is possible to view when the user is in manual mode can be added as a component of the requested flight path. The Autopilot flight sequence creation tool can be seen in Figure 8.

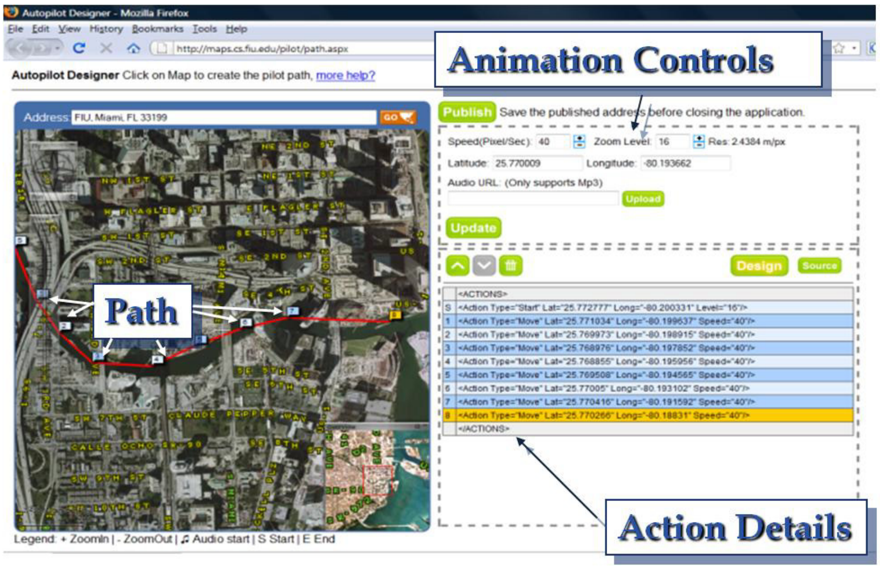


Figure 8. TerraFly's Autopilot Flight Sequence Creation Tool

Once a flight sequence is defined, the flight path is overlaid the geospatial images in the flight path window. As can be seen in Figure 9, users are able to fly along the requested flight path in the main TerraFly flight window without any intervention by the user. Users will also be able to see a zoomed out overview of the overall flight sequence in a smaller window found in the lower right-hand corner of the flight area.

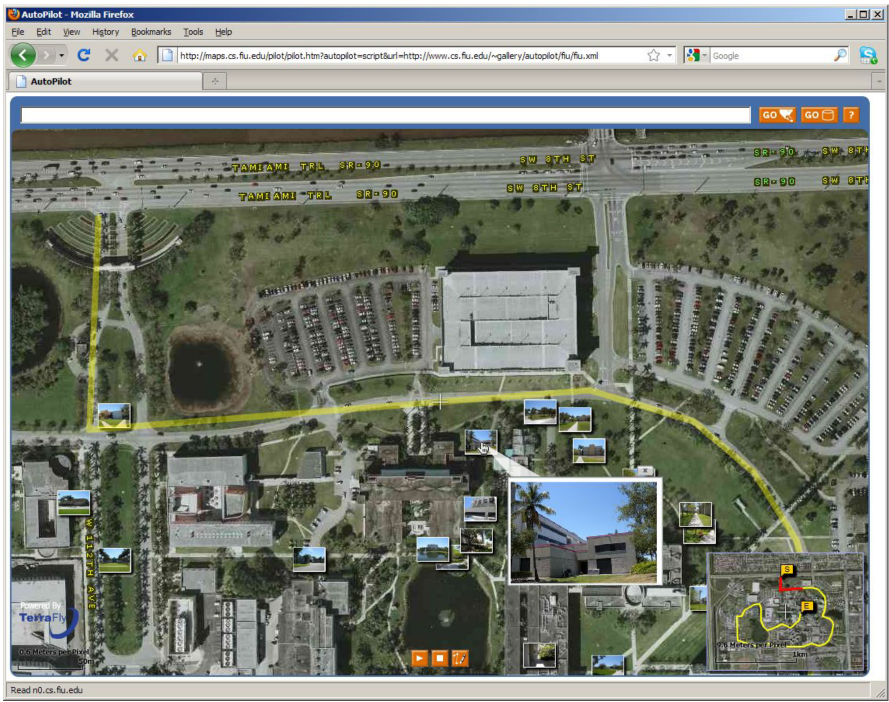


Figure 9. TerraFly's Autopilot Flight Path Window

TerraFly’s autopilot technology is not merely for entertainment value. There are numerous applications for this technology, including education, emergency preparedness in urban areas, and the study of crops in rural areas. To best illustrate this, imagine this scenario. A local office of emergency preparation and response is notified of the imminent approach of a hurricane to their region. Officials and employees must make preparations to both mitigate effects of the hurricane, as well as be prepared to respond in the aftermath. With TerraFly’s autopilot technology, coordinated autopilot flight paths could be created prior to the storm event and assigned to specific responders. Once the storm as passed and new data is available regarding storm impacts in the area, each responder could quickly and easily engage their assigned flight sequence to view and interpret impact results. The responders would not have to manually control movement over the area of interest and could, instead, just focus on gaining the information that they need. Further, this same flight path could easily be used over and over as updates and new information come in. The auto-piloted path can be annotated with voice clips, images, and data.

3.3. Data Dispenser

There are times when end users are in need of being able to work with spatial data outside of TerraFly. For example, an environmentalist may need to run complex, domain specific analyses that cannot be accomplished in TerraFly itself. Alternately, a business may need a large, high quality poster print of a particular area but lack to equipment to produce the poster. To address these needs, TerraFly provides a flexible and user friendly data dispenser that end users can use to acquire any spatial and related data for a location of their choice [47].

TerraFly's data dispenser provides users with fast and convenient access to a map or a remotely sensed image. The data dispenser has been designed with an easy to use, intuitive interface that allows users to acquire data without any specialized training or tools. Users are able to easily choose, mark and dispense satellite images or aerial photos of any size, and in varied formats. TerraFly's dispenser can also provide the user with textual geo-referenced data associated with a dispensed image. When combined with the requested imagery, this data gives the user a unique information package associated with the geographical area of interest. Numerous products, both digital and printed, are available to the user. End users can order large poster prints, aerial photos and topomaps, atlases as auto-formatted pdf files, photo prints, GeoEye satellite products, reports, and more [48].

To the user, requesting data via TerraFly is very simple. The download button is clicked, the user selects the area of interest using the mouse to manipulate a bounding box, and then selects "download" from the menu. Once this request is sent to the system, TerraFly's data dispenser module searches TerraFly's imagery database for all image tiles that can be used to generate the imagery for the user-defined area. TerraFly's information databases are searched for all the possible data reports related to the selected area. TerraFly also has the capability to search data sources on other sites. Currently, TerraFly also searches the GeoEye Archives for the availability of GeoEye and Ikonos imagery. As can be seen in Figure 10, once the searches are complete, the system generates a customized web page that presents users with all of the unique product options available for the area of interest.

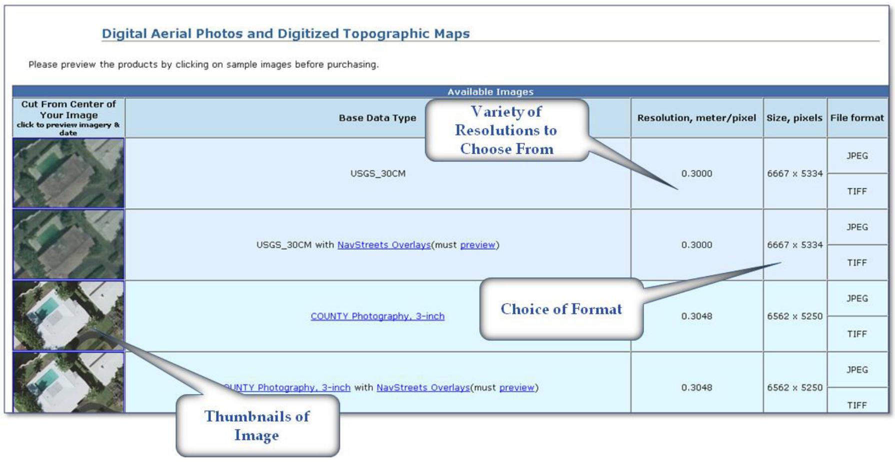


Figure 10. Customized Web Page Created by TerraFly's Data Dispenser

4. Application Domains

TerraFly's use of innovative research and cutting-edge technology has created a flexible, robust and forward-thinking solution that has multiple domain applications. The wide range and types of data available in TerraFly makes the system useful to a much broader user base than conventional geographic information systems. In this section, an overview of the primary domains that currently use TerraFly are presented, namely, disaster mitigation and response, research and scientific inquiry, real estate, travel and tourism, and government operations and public interest.

4.1. Disaster Mitigation and Response

When a disaster occurs, fundamental aspects of life dramatically change. Major impacts often include changes to the physical environment that are far reaching and easy to discern. The importance of the positive impact that information technology can have on disaster mitigation and response has been discussed in several US government and international reports. They all agree that greater resources in information technology will improve the ability to plan for and respond to disasters, ultimately saving lives and property [4] [5].

Discussions throughout this paper have touched upon TerraFly's prominence as a tool for disaster mitigation and response. As has been noted, TerraFly has multiple capabilities that researchers, planners and responders can use to vastly improve disaster planning and response. For example, as was seen in Section 3.1 TerraFly's TimeSeries visualization capabilities can quickly and easily show users physical changes to the environment as a result of a disaster. However, other types of impacts, such as economic impacts, can also be visualized in TerraFly.

As can be seen in Figure 11, TerraFly has the ability to provide visualization of economic changes, such as changes in property values, as the result of a disaster. The example presents patterns of changes in property values affected by the BP Deep Water Oil Spill. Unlike major impacts on the physical environment, this type of impact is one that is not clearly seen with the naked eye. Instead, combining, overlaying, and analyzing different types of pertinent data are required to gain this understanding.

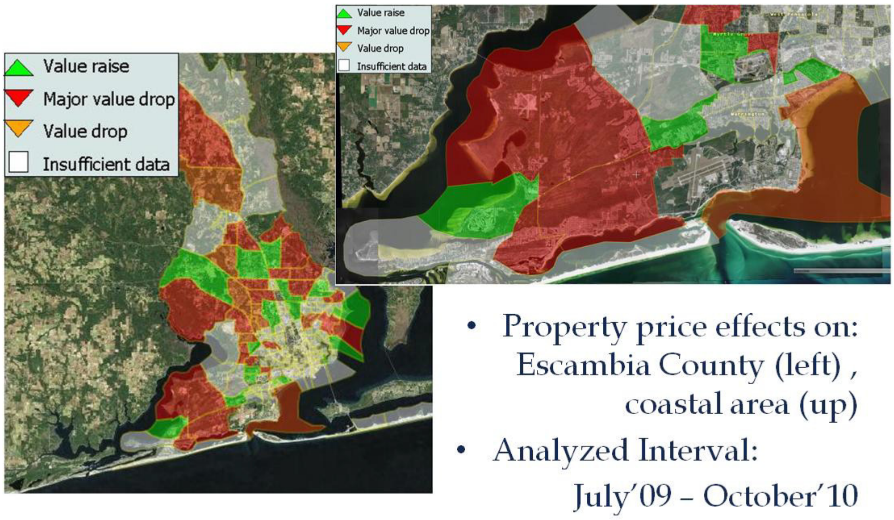


Figure 11. The Effect of the BP Deepwater Oil Spill on Property Values

4.2. Research and Scientific Inquiry

TerraFly is also extensively used as a tool for research and scientific inquiry. TerraFly is used to support and engage in many domains of computing research such as data processing, query optimization, parallel processing, storage of massive amounts of data, etc. TerraFly also provides numerous data analysis and visualization tools for scientists in various domains. Figure 12 shows Hydrology data analysis tools in TerraFly. With this tool's intuitive interface, users are able to view and analyze data, and have results of their analyses displayed as imagery, charts and tables.

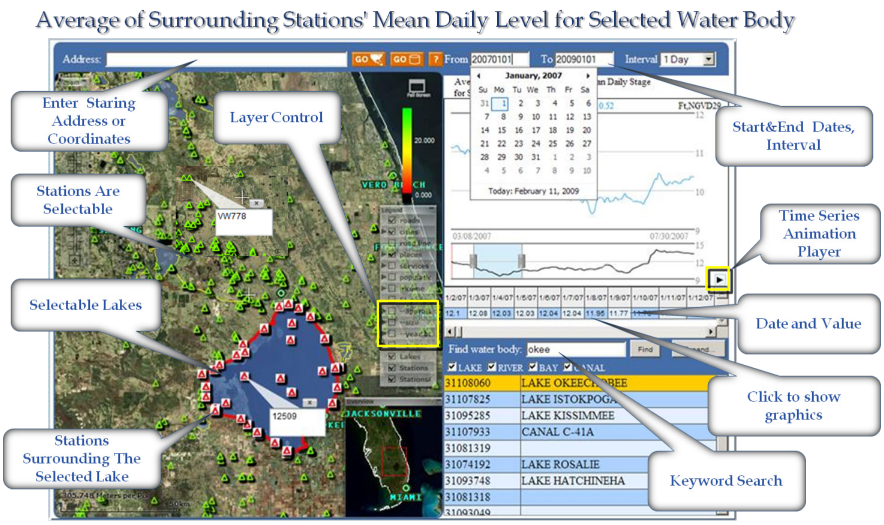


Figure 12. In situ data and graphs in TerraFly for Use in Hydrological Analysis

Additional functionality found in TerraFly, such as time series data, key word searches, and layer control, is also available on this screen. For example, users are able to select a date range and view time series animation of changes, as well as graphs that plot these changes over time. As can be seen in Figure 12, very detailed geospatial temporal plots are available to users of this application. As with all TerraFly flight windows, locations are searchable by address, and more detailed data for specific points is available at the click of the mouse. For example, clicking on one of the stations provides information about that particular site.

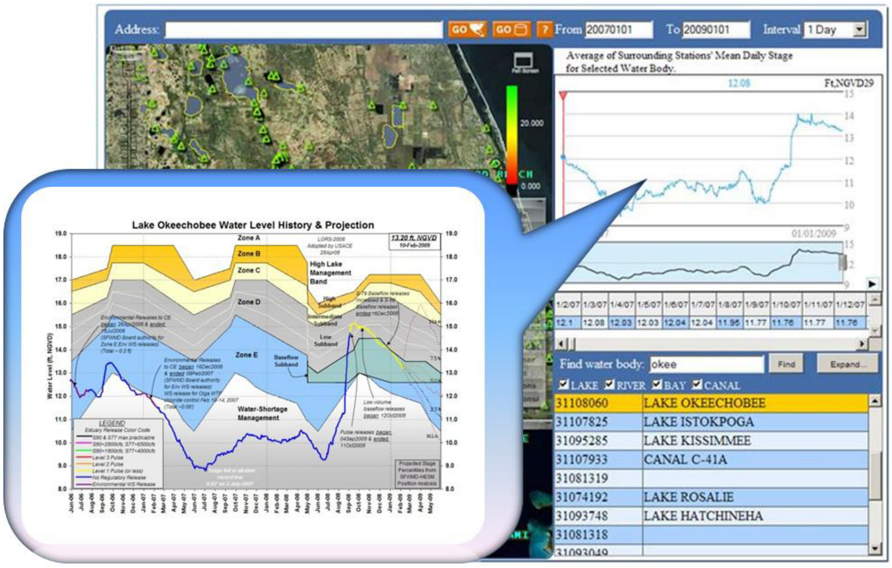


Figure 13. Geospatial-temporal Plots

4.3. Real Estate

TerraFly also provides tools for various business domains, such as Real Estate. Real estate related services are provided to real estate agents, buyers and sellers. TerraFly downloads real estate sale listings from the Multiple Listing Service (MLS) and overlays this data onto spatial imagery. As can be seen in Figure 14, variables such as property types, prices and square footage are overlaid, with more detailed information and additional variables available at the click of the mouse. Users are able to quickly and easily see the number and location of homes for sale in a neighborhood, as well as nearby features that may affect the desirability of a property such as proximity to a park or school. Realtors can take potential buyers on virtual tours of a neighborhood, and map out driving and transportation routes of interest.

TerraFly's Real Estate component also provides powerful data mining capabilities. Again, as can be seen in Figure 14, end users are able to search for properties based on attributes such as asking price, number of bedrooms, square footage and various other keywords. A common search in South Florida, for example, is for ocean front condominiums or single family homes with a pool.

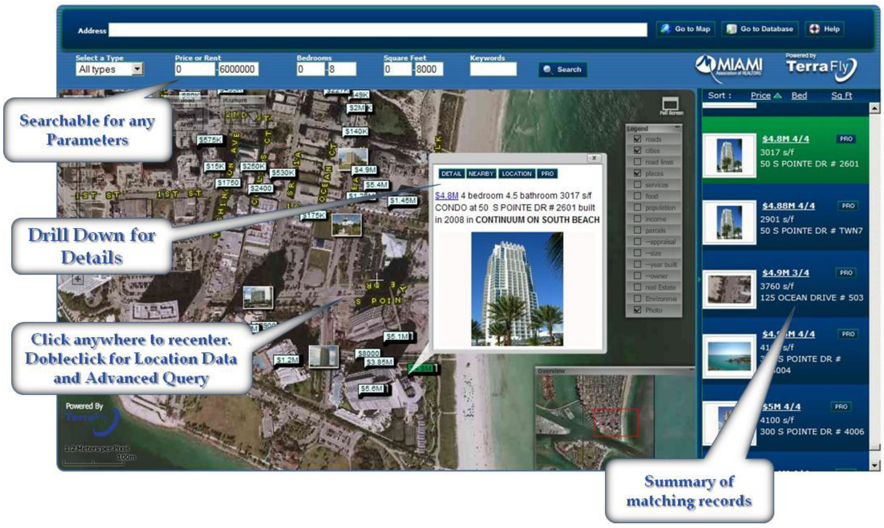


Figure 14. TerraFly's Real Estate Consumer Application Interface

The power of this type of capability is not fully appreciated until one attempts to glean the same information without the ability to visualize it in a tool such as TerraFly. For example, imagine you are a buyer looking to purchase a home in a specific neighborhood. What you would typically be given is a list of properties for sale with their addresses and other relevant data such as square footage. Trying to visualize the locations of these properties in one's mind is rather difficult, particularly in relation to desirable and undesirable features in the neighborhood. Further, visualization in TerraFly provides significantly more information about a particular property than a standard MLS listing. For instance, a home's address may indicate that it is on a small quiet street, but there is no information on what surrounds that property. It may be that the property backs up to a noisy highway or busy street. This would easily be seen in TerraFly, but would not be apparent to anyone using the typical MLS listing until the home is visited in person.

Another real estate application available in TerraFly can used to study real estate value trends over time. As can be seen in Figure 15, users can view and analyze valuation trends of specific census block groups by selecting the census block of interest and entering start and end dates. Data such as average price per square foot is overlaid onto aerial imagery, and can be animated over time. The application also includes a trending graph so that users can see average changes in prices over their specified dates, as well as a list of sales prices by date.

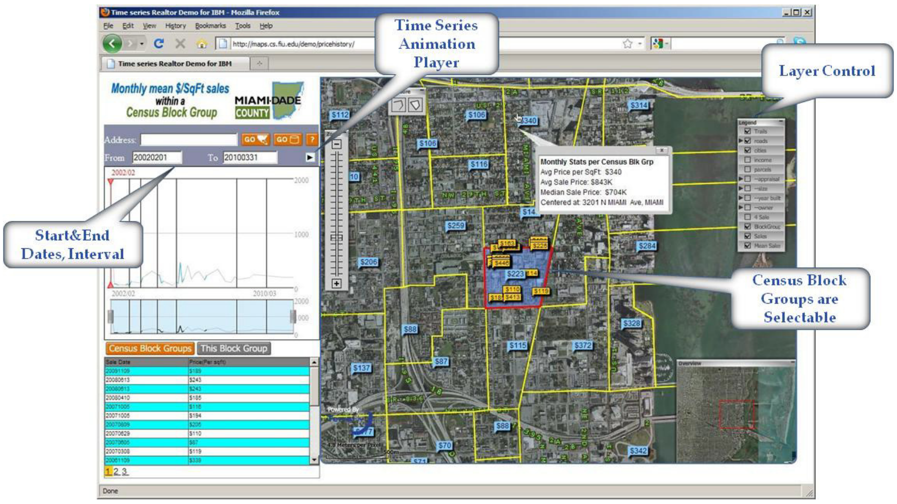


Figure 15. Historical Property Value Trends

4.4. Travel and Tourism

TerraFly's capabilities are also useful to the travel and tourism industry. As can be seen in Figure 16, TerraFly's auto pilot mapping tool can be used to create virtual tours of vacation destinations of interest. Tour operators can provide potential clients with a bird's eye view of tour packages that highlight points of interest with pertinent information and high resolution geo-referenced images of particular locations. Tour operators could even use TerraFly to customize tour packages for individuals, creating the tour route with the direct input of their clients.

For example, tour operators can create a tour through Washington, DC, to show to potential clients. As they take their clients on a virtual tour, the clients can see various points of interest and let the tour operator know which destinations and points of interest they are interested in including in their tour package and which are of not interest to them. The tour operator could immediately make changes in the auto pilot to reflect the client's wishes and immediately show them the resulting new planned tour.

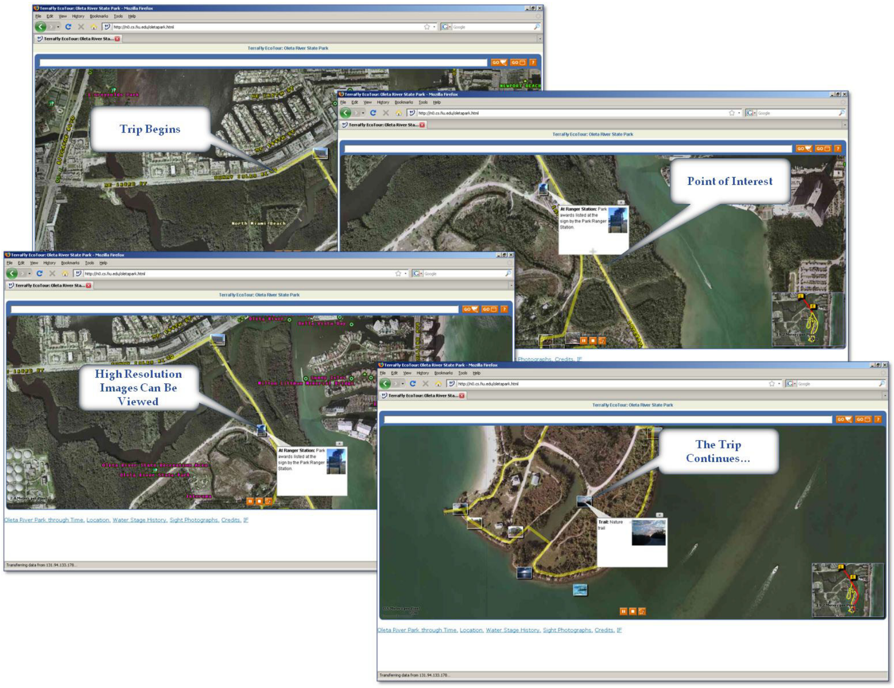


Figure 16. Sample Tour Using TerraFly's Auto Plot Tool

4.5. Government and Public Interest

The wide range and types of data available in TerraFly, along with TerraFly's robust, flexible and easy to use functionality is especially useful for government agencies and public interest. TerraFly's value as a tool for disaster planning and recovery has been illustrated throughout this paper. There are, however, numerous day-to-day functions that government agencies are responsible for that TerraFly is well suited to support. In fact, as can be seen in Figure 17, several local municipalities in Florida (The City of Coral Gables, The City of North Miami Beach, and The City of Miami Gardens, among others) have adopted TerraFly on their websites to provide citizens with up to date information in their area, as well as tools to help make it easier for residents to work with their local government agencies and offices.

Figure 17. Local Municipalities that Use TerraFly on Their Websites

In addition, much of the data collected and used by government is well suited for integration into TerraFly. For example, as can be seen in Figure 18, crime incident report data is associated with specific locations. TerraFly can easily process and overlay that data on geospatial imagery, providing both professional users and lay people with data visualization that is much more intuitive and easy to understand. Further, this data can be combined with other vector data available for that same area. The data could then be analyzed to determine if there are any trends or associations affecting the occurrence of particular types of incidences.

Importing property tax assessment data into TerraFly also aids in government operations. As can be seen in Figure 19, by being able to view text records alongside with visual property imagery, tax assessor employees can more easily compare and analyze assessments between similar and dissimilar properties. This provides more consistency and accuracy in assessment procedures and valuation. Further, with the use of TerraFly's time series application, tax assessor employees can compare recent imagery with historical imagery to determine whether any changes have been make to a property that would necessitate a change in assessment value.

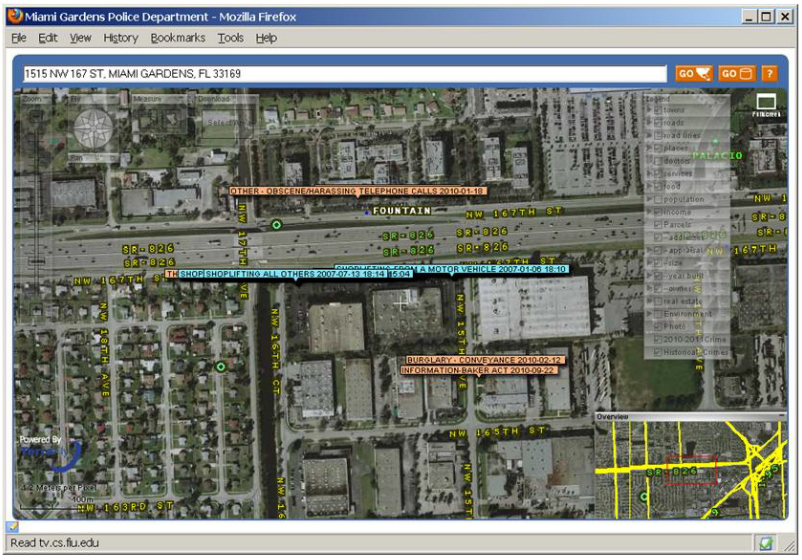


Figure 18. Crime Incidence Report Data Overlaid on Geospatial Imagery

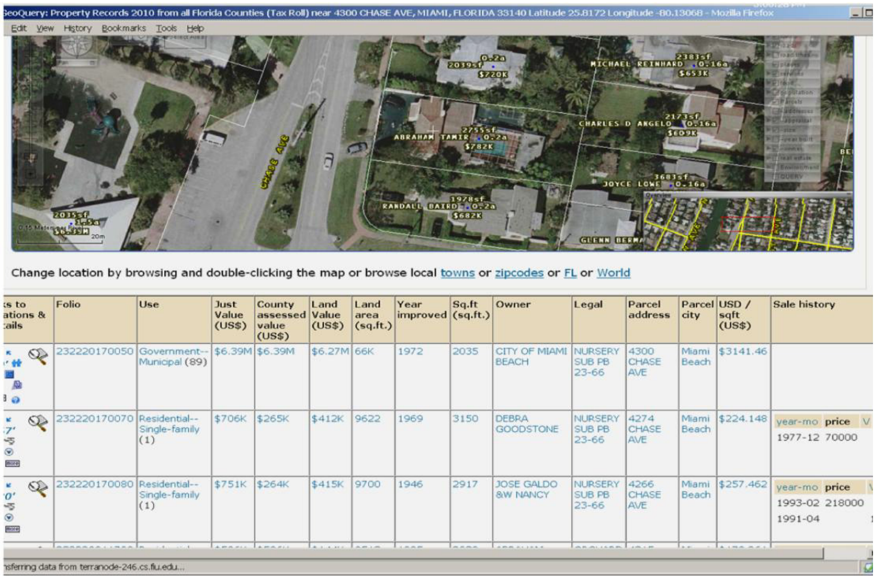


Figure 19. Property Tax Assessment for Individual Properties

Finally, there are also numerous capabilities in TerraFly that individuals find useful in their day-to-day lives. Overlaying data from the White Pages, for example, improves its usability for many individuals (see Figure 20). Users are able to search for needed information in the White Pages not just by a person's full name, but also by attributes such as address, phone number, or the names of other individuals in the home. Alternately, users can search the geospatial imagery visually to find a particular location, and related information.

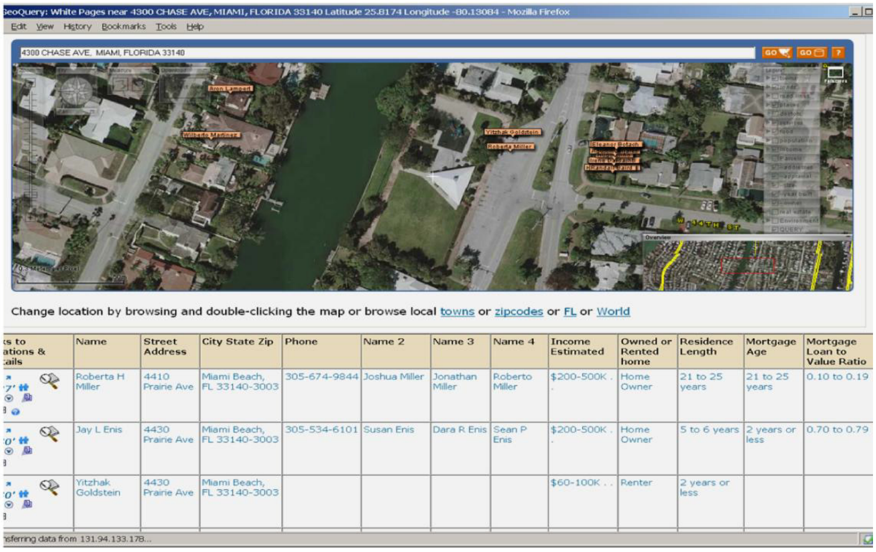


Figure 20. White Pages

5. Conclusions and Future Directions

Through the implementation of innovative techniques and technologies, TerraFly provides users with GIS capabilities without the need to learn complex interfaces or deal with the technology behind the system. It is a robust, user-friendly system that has wide appeal to many different types of users, and application to many different domains. TerraFly has been covered by both popular and specialized media, including TV (e.g. *Fox* and *Discovery*), radio (*NPR*), newspapers (e.g. *New York Times*, *USA Today*), magazines (e.g. *Science*) and journals (e.g. *Nature*). The project's primary sponsor is the National Science Foundation (NSF). Of the 53,000 NSF-funded projects in 2009, it chose 120, including TerraFly, for the NSF annual report to congress [49].

Several new projects and new directions are currently being pursued that will improve the technical capabilities and expand TerraFly's functions. One of them is the incorporation of social media, including using information gathered from social media as a viable data source. As the popularity of social media has increased, so has its potential for providing up-to-the-minute information on pertinent happenings in the world. If implemented appropriately, this could have a substantial impact on disaster response. It is no longer unusual for news of a particular event to be posted on a social networking site before any other media or type of communication. The challenge, however, is trying to determine how to most efficiently and effectively filter pertinent and accurate data from massive streams of messy, irrelevant, and inaccurate data.

Efforts are being made to expand data sharing capabilities and communication, particularly for disaster planners and responders. Areas being examined to aid in this include: (1) creation of a "citizens sensor network" that can potentially provide near instantaneous geolocation and visual coverage of extreme events; (2) development of techniques to better manage a solid communication infrastructure for disaster responders by providing services via the cloud and (3) generate models and simulations to better predict outcomes, that can subsequently be used to disseminate mission critical information and provide guidance for emergency response.

As the usefulness of spatial and related data increases and expands to new domains, efforts will also increase to determine how the needs of these new domains can be met while still providing a robust, innovative and intuitive system.

Acknowledgement

This work was supported in part by NSF grants CNS-0821345, HRD-0833093, IIP-0829576, IIP-0931517, CNS-1057661, IIS-1052625, CNS-0959985, CNS-0837556, CNS-0426125, DGE-0549489, IIS-0957394, IIP-0934339, OISE-0730065, and IIS-0847680, DHS contract HSHQDC_11_C_00019, and support of USGS, IBM, CoreLogic, and ADCi. We greatly appreciate the support and guidance of our NSF Program Directors Rita Virginia Rodriguez, Richard Smith, Demetrios Kazakos, Victor Santiago, Maria Zemankova, and Juan Figueroa. We would like to thank Patrick Hogan of NASA World Wind [50] for his continued guidance and support in research and development of TerraFly's open-source APIs, 3D visual environment for visualizing spatio-temporal data with moving objects, and keyword-spatio-temporal queries on moving objects. We have greatly benefited from collaborating with current and former researchers at NASA Goddard Space Flight Center, particularly Milton Halem, Bill Teng, Patrick Coronado, and Bill Campbell. IBM has provided invaluable support and guidance, particularly Oded Cohn, Juan Caraballo, Adalio Sanchez, and Howard Ho.

6. References

1. International Tsunami Information Center. "11 March 2011, MW 9.0, Near the East Coast of Honshu Japan Tsunami". [Online] 2011. http://itic.ioc-unes-co.org/index.php?option=com_content&view=article&id=1713&Itemid=2365&lang=en.
2. Gulf Oil Spill. NOAA.gov. [Online] http://www.education.noaa.gov/Ocean_and_Coasts/Oil_Spill.html.
3. D. Guha-Sapir. "Disasters in Numbers 2010". Center for the Epimediology of Disasters. [Online] 2011. http://www.cred.be/publications?order=field_year_value&sort=desc.
4. Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina. "A FAILURE OF INITIATIVE: Final Report of the Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina". U.S. House of Representatives, Feb. 15th, 2006.
5. National Commssion of the BP Deepwater Horizon OIl Spill and Offshore Drilling. "Deep Water: The gulf oil disaster and the future of offshore drilling". Report to the President. 2011.
6. H. Samet. “The design and analysis of spatial data structures”. Addison-Wesley, Reading, MA,1990.
7. T. Keating, W. Phillips, and K. Ingram. "An Integrated Topologic Database Design for Geographic Information Systems". Photogrammetric Engineering and Remote Sensing, vol. 53, no. 10, 1987, pp. 1399-1402.
8. R.A. Lorie and A. Meier. "Using a Relational DBMS for Geographical Databases". Geo-Processing, vol. 2, 1984, pp. 243- 257.
9. M. Egenhofer. “Why not SQL!”. In International Journal on Geographical Information Systems, 6(2), p. 71-85, 1992.
10. H. Samet. “Applications of spatial data structures”. Addison-Wesley, Reading, MA, 1990.
11. H.V. Jagadish, A. Chapman, A. Elkiss, M. Jayapandian, Y. Li, A. Nandi, and C. Yu. "Making Database Systems Usable,". In ACM's Special Interest Group on Management of Data (SIGMOD), June 11–14, 2007, Beijing, China.
12. A. E. Wade. “Hitting the Relational Wall”. Objectivity Inc. White Paper. [Online] 2005. http://www.objectivity.com/pages/object-oriented-database-vs-relational-database/default.html.
13. TerraFly Landing Page. TerraFly. [Online] http://terrafly.fiu.edu.
14. N. Rishe, W. Teng, H. Rui, S. Graham, M. Gutierrez. "Web-based Dissemination of TRMM Data via TerraFly.". EOS Transactions, American Geophysical Union, 85(47), Fall Meeting Supplement, December 2004.
15. N. Rishe, J. Yuan, R. Athauda, S.C. Chen, X. Lu, X. Ma, A. Vaschillo, A. Shaposhnikov, D. Vasilevsky. “Semantic Access: Semantic Interface for Querying Databases”. ACM SIGMOD Digital Symposium Collection DiSC01. June 2003. pp. 591-594.
16. A. Cary, O. Wolfson, and N. Rishe. "Efficient and Scalable Method for Processing Top-k Spatial Boolean Queries". Proceedings of the 22nd

International Conference on Scientific and Statistical Database Management. Published as Lecture Notes in Computer Science. Vols. 6187/2010: Scientific and Statistical Database Management, Springer Berlin / Heidelberg, 2010, pp. 87-95.

17. A. Prasad Sistla, Ouri Wolfson, Bo Xu, Naphtali Rishe. "Answer-Pairs and Processing of Continuous Nearest-Neighbor Queries". Proceedings of the 2011 The Seventh ACM SIGACT/SIGMOBILE International Workshop on Foundations of Mobile Computing (FOMC 2011). San Jose, California, June 9th, 2011.
18. N. Roussopoulos, C. Faloutsos, and T. Sellis. "Nearest Neighbor Queries". In Proc. ACM SIGMOD International Conference on Management of Data, pp. 71-79, 1995.
19. N. Rishe and O. Wolfson. "Thin Client Technologies for Spatial Data Visualization.". Proceedings of the National Science Foundation Computing Research Infrastructure 2007 PI Meeting: Computer Science Department Boston University (NSF CRI 2007 PI Meeting). June 3-5, 2007, Boston, Massachusetts. pp 84-88.
20. P. Szczurek, B. Xu, O. Wolfson, J. Lin, N. Rishe. "Prioritizing Travel Time Reports in Peer-to-Peer Traffic Dissemination". Proceedings of the IEEE International Symposium on Communication Systems, Networks and Digital Signal Processing (7th CSNDSP). Newcastle, U.K. July 21-23, 2010. pp 454-458.
21. Bo Xu, O. Wolfson, C. Naiman, N. Rishe, R. M. Tanner. "A Feasibility Study on Disseminating Spatio-temporal Information via Vehicular Ad-hoc Networks.". Proceedings of the Third International Workshop on Vehicle-to-Vehicle Communications 2007 (V2VCOM 2007). Istanbul, Turkey. pp 146-151.
22. O. Wolfson, B. Xu, H. Yin, N. Rishe. "Discovery Using Spatio-temporal Information in Mobile Ad-Hoc Networks. In: Web and Wireless Geographical Information Systems, 5th International Workshop, W2GIS 2005, Lausanne, Switzerland, December 15-16, 2005. SpringerVerlag Lecture Notes in Computer Science 3833. pp. 129-142.
23. N. Rishe. "TerraFly: NASA Regional Applications Center". The AMPATH Workshop: Identifying Areas of Scientific Collaboration Between the US and the AMPATH Service Area, Florida International University, Miami. Conference Report. August 15-17, 2001 p. 7-8. pp. 7-8.
24. D. Davis-Chu, N. Prabakar, N. Rishe, A. Selivonenko. "A System for Continuous, Real-Time Search and Retrieval of Georeferenced Objects". Proceedings of the ISCA 2nd International Conference on Information Reuse and Integration (IRI-2000). Nov. 1-3, 2000. pp. 82-85.
25. N. Prabhakaran, V. Maddineni, and N. Rishe. "Spatial Overlay of Vector Data on Raster Data in a Semantic Object- Oriented Database Environment." International Conference on Imaging Science, Systems, and Technology (CISST '99), June 28 - July 1, 1999, Las Vegas, Nevada, pp. 100-104. . pp. 100-104.

26. N. Rishe, S. Chen, N. Prabakar, M.A. Weiss, W. Sun, A. Selivonenko, D. Davis-Chu. “Terrafly: A High-Performance Web-Based Digital Library System for Spatial Data Access”. ICDE 2001: International Conference on Data Engineering, April 2-6, 2001, Heidelberg, Germany. pp. 17-19 . pp. 17-19.
27. A. Cary, Y. Yesha, M. Adjouadi, N. Rishe. “Leveraging Cloud Computing in Geodatabase Management”. Proceedings of the 2010 IEEE Conference on Granular Computing GrC-2010. Silicon Valley, August 14-16, 2010. pp. 73-78.
28. P. Szczurek, B. Xu, O.i Wolfson, J. Lin, N. Rishe. “Learning the relevance of parking information in VANETs”. Proceedings of the seventh ACM international workshop on VehiculAr InterNETworking. Chicago, Illinois. September 24, 2010. ISBN:978-1-4503-0145-9. pp 81-82, September 2010.
29. D. Ayala, J. Lin, O. Wolfson, N. Rishe, M. Tanizaki. “Communication Reduction for Floating Car Data-based Traffic Information Systems”. Second International Conference on Advanced Geographic Information Systems, Applications, and Services, pp 44-51, February 10-16, 2010.
30. W. Teng, N. Rishe, H. Rui. "Enhancing access and use of NASA satellite data via TerraFly.". In Proc. ASPRS 2006 Annual Conference, May 1-5, 2006, Reno, NV. pp. 5-6.
31. N. Rishe. "Database Design: The Semantic Modeling Approach". McGraw-Hill, 1992.
32. N. Rishe, and Q. Li. “Storage of Spatial Data in Semantic Databases.”. In Proceedings of the 1994 ASME International Computer in Engineering Conference, Minneapolis, MN, pp. 793-800, Sept 11-14, 1994.
33. G. Muffin. “Raster versus Vector Data Encoding and Handling: A Commentary”. Photogrammetric Engineering and Remote Sensing, Vol. 53, No. 10, pp.1397-1398, 1987.
34. Landsat Project Policy and History: Landsat 7 Mission Specifications, NASA Goddard Space Flight Center,. [Online] http://ltpwww.gsfc.nasa.gov/LANDSAT/CAMPAIGN_DOCS/PROJECT/L7_Specifications.html.
35. Tiger Overview, United States Census Bureau, Tiger/Line data. [Online] http://www.census.gov/geo/www/tiger/overview.html.
36. USGS mapping Information: Geographic Names Information System (GNIS). [Online] http://mapping.usgs.gov/www/gnis/.
37. TerraFly data coverage. TerraFly. [Online] http://n0.cs.fiu.edu/terrafly.coverage.htm.
38. Federal Geographic Data Committee (FGDC) Subcommittee for Cadastral Data. "Today’s Cadastral Information Customers and Requirements". FGDC Cadastral Subcommittee. [Online] 2008. http://www.nationalcad.org/data/documents/cadastral%20data%20customers.pdf.
39. CoreLogic. "CoreLogic ParcelPoint". [Online] 2011. http://www.faspatial.com/databases/parcelpoint?format=pdf.
40. N. von Meyer, B. Ader, Z. Nagy, D. Stage, B. Ferguson, K. Benson, B. Johnson, S. Kirkpatrick, R. Stevens, and D. Mates. "Parcel Identifiers for

Cadastral Core Data: Concepts and Issues". FGDC Cadastral Subcommittee. [Online] July 2002. http://www.nationalcad.org/data/documents/parcelID.pdf.
41. A. Cary, Z. Sun, V. Hristidis, and N. Rishe. "Experiences on Processing Spatial Data With MapReduce". in Springer Lecture Notes in Computer Science. Vols. 5566/2009: Scientific and Statistical Database Management. (Proceedings of the 21st International Conference on Scientific and Statistical Database Management. New Orleans, Louisiana, USA. June 1-5, 2009.), pp. 302-319.
42. Z. Sun, T. Li, N. Rishe. "Large-Scale Matrix Factorization using MapReduce.". Proceedings of the 2010 IEEE International Conference on Data Mining Workshops. Sydney, Australia. December 13, 2010. ISBN: 978-0-7695-4257-7. pp 1242-1248.
43. J. Dean and S. Ghemawat. "MapReduce: Simplified Data Processing on Large Clusters". Commun. ACM 51, 1 (January 2008), 107-113.
44. A. Guttman. "R-trees: A dynamic index structure for spatial searching". In Proceedings ACM SIGACT-SIGMOD Conference on the Principles of Database Systems, p. 569-592, 1984.
45. R. Finkey, J. Bentley. "Quadtrees: A data structure for retrieval on Composite Keys". 1974. pp. 57-97.
46. Extensible Markup Language (SML) 1.0 (Fifth Edition). W3C Recommendation. [Online] Novermber 26, 2008. http://www.w3.org/TR/REC-xml/.
47. N. Rishe, M. Gutierrez, A. Selivonenko, S. Graham. "TerraFly: A Tool for Visualizing and Dispensing Geospatial Data.". Imaging Notes, Summer 2005. Vol. 20, 2, pp. 22-23.
48. GeoEye Imagery Collection. GeoEye. [Online] 2011. http://www.geoeye.com/CorpSite/products-and-services/imagery-collection/Default.aspx.
49. National Science Foundation. FY 2010 Budget Request to Congress. National Scienc Foundation. [Online] May 7th, 2009. http://www.nsf.gov/about/budget/fy2010/pdf/entire_fy2010.pdf.
50. NASA World Wind. http://worldwind.arc.nasa.gov/.

TerraFly Analytics Presentation

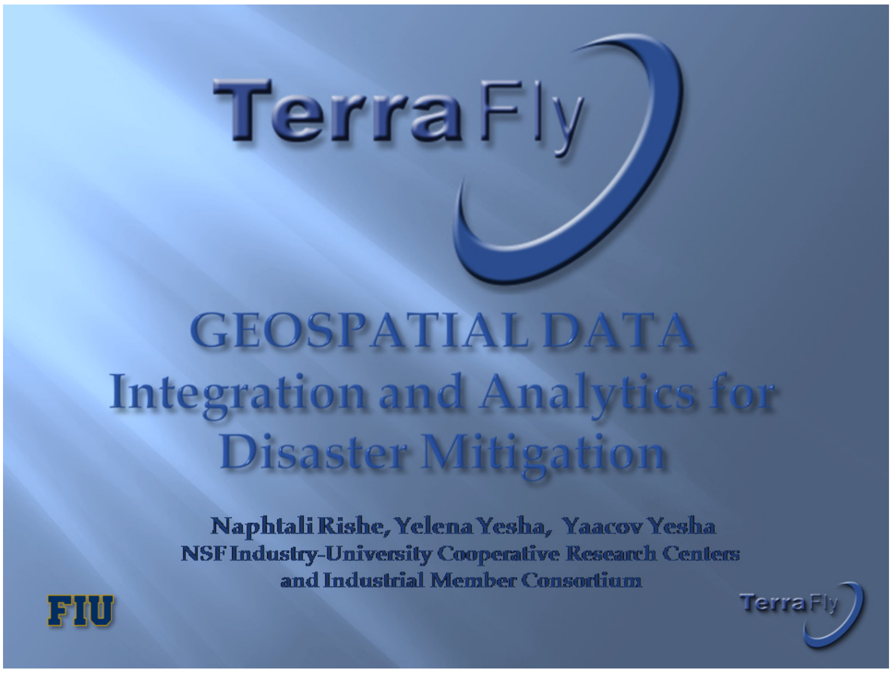
Dr. Naphtali Rishe

NSF Industry-University Cooperative Research Center for Advanced Knowledge Enablement (CAKE.fiu.edu) at Florida International and Florida Atlantic Universities

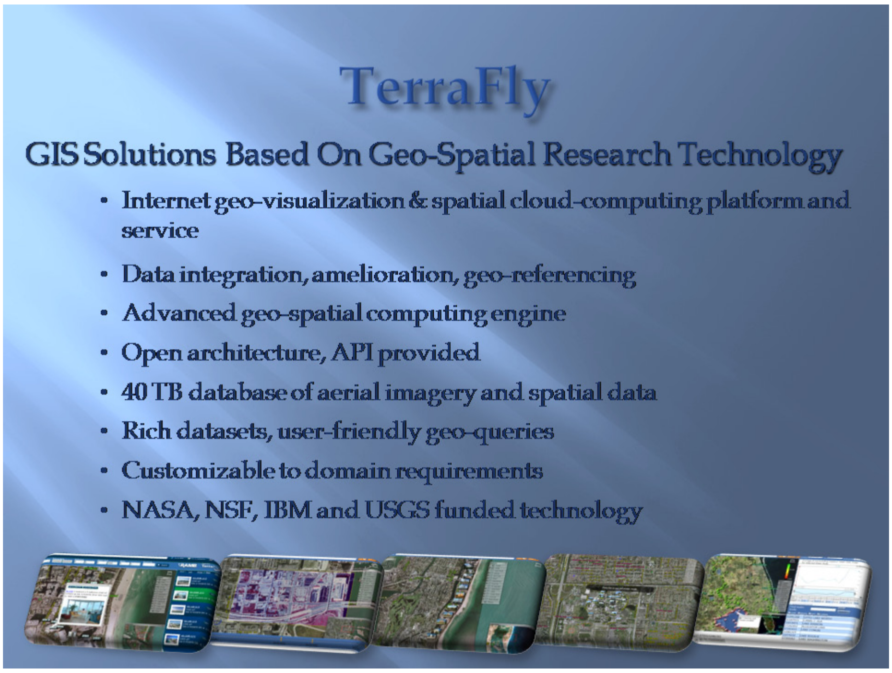
NSF Center of Research Excellence in Science and Technology at Florida International University (CREST.FIU.edu)

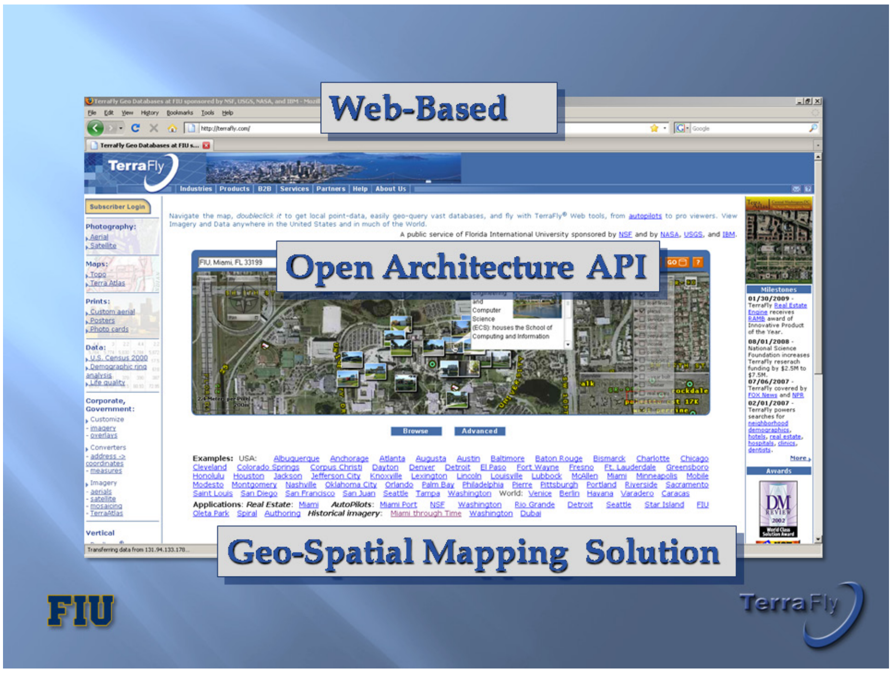
Dr. Yelena Yesha and Dr. Yaacov Yesha

NSF Industry-University Cooperative Research Center for Multicore Productivity Research (CHMPR.umbc.edu) at University of Maryland Baltimore County


TerraFly
GEOSPATIAL DATA
Integration and Analytics for
Disaster Mitigation
Naphtali Rishe, Yelena Yesha, Yaacov Yesha
NSF Industry-University Cooperative Research Centers
and Industrial Member Consortium
FIU
TerraFly

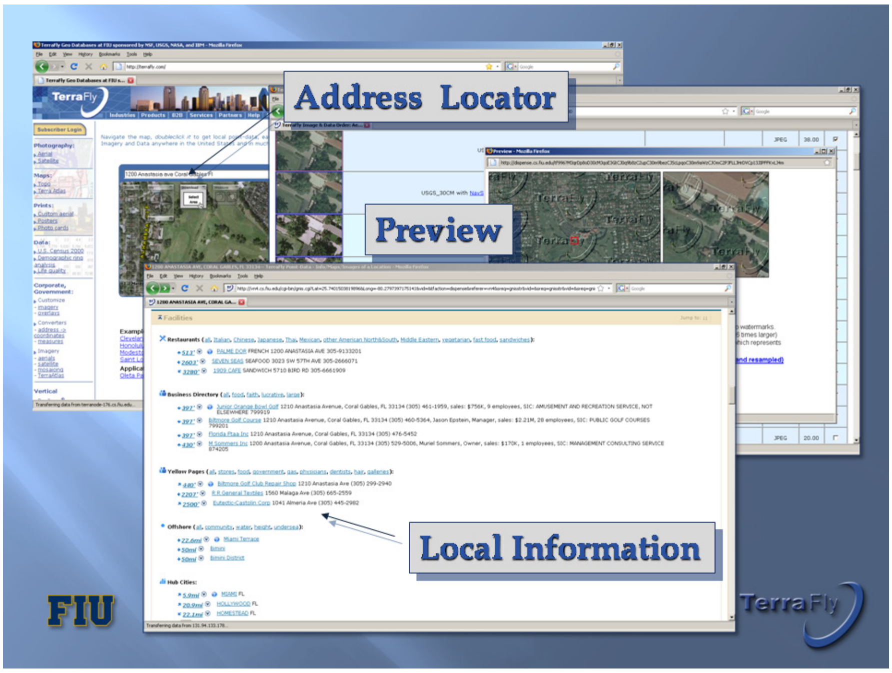

High Performance Database Research Center
Expertise:
Data visualization
Spatial databases
Aggregation of heterogeneous databases
Database design methodologies
Information analysis
GIS
Location Data
DATABASE
Director: Dr. Naphtali David Rishe
The Inaugural Outstanding University Professor of FIU
Awards: $40M, Patents: 4, Books: 4, Papers: 250
FIU
TerraFly

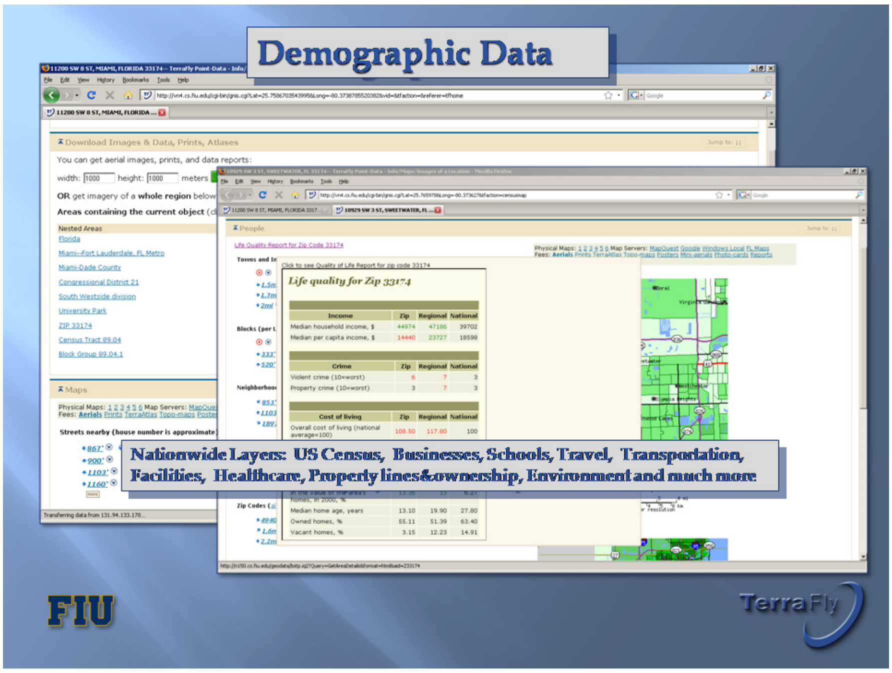

TerraFly
GIS Solutions Based On Geo-Spatial Research Technology
• Internet geo-visualization & spatial cloud-computing platform and service
• Data integration, amelioration, geo-referencing
• Advanced geo-spatial computing engine
• Open architecture, API provided
• 40 TB database of aerial imagery and spatial data
• Rich datasets, user-friendly geo-queries
• Customizable to domain requirements
• NASA, NSF, IBM and USGS funded technology


Web-Based
Open Architecture API
Geo-Spatial Mapping Solution
FIU
TerraFly


Map Tools
Data Layers
Surrounding Area
FIU
TerraFly

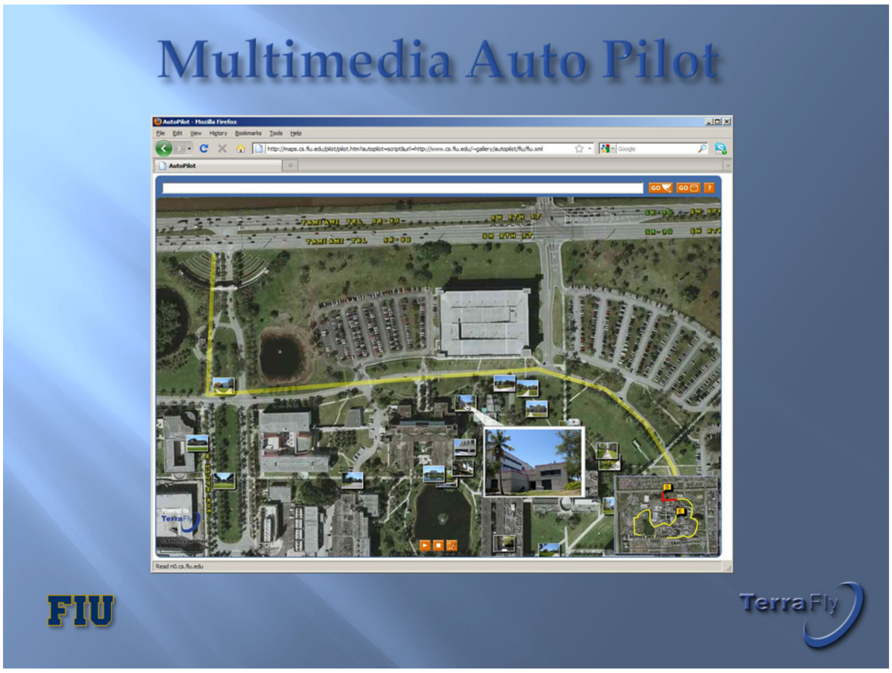

Image Quality; Location Data
• Drill down to local information
• Query datasets
• Annotate location
• User-Defined Applications
• Download imagery and TerraFly Products
(Digital files, Prints, TerraAtlas, Census Data)
FIU
TerraFly


Address Locator
Preview
Local Information
FIU
TerraFly

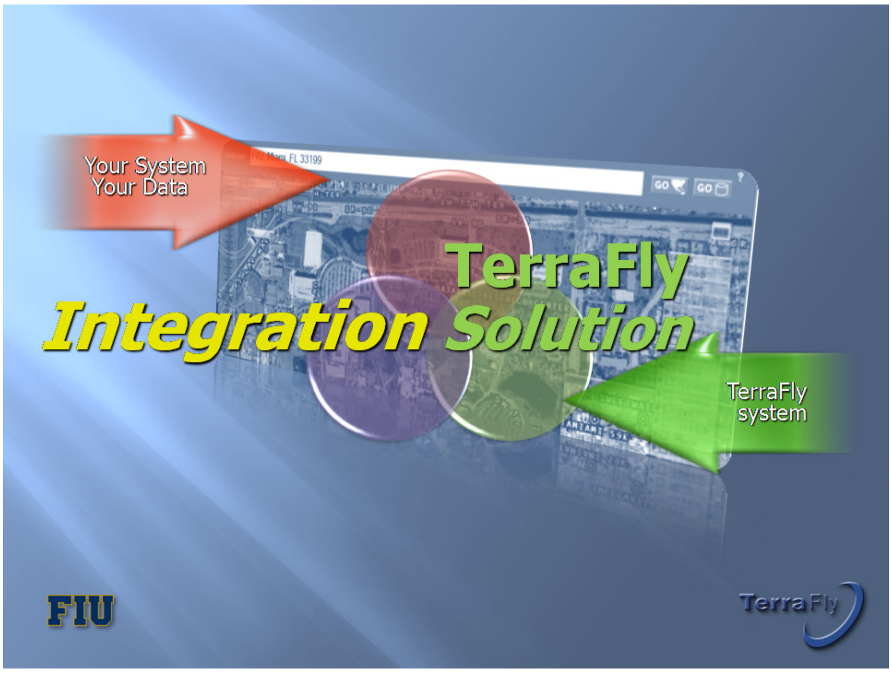

Demographic Data
Nationwide Layers: US Census, Businesses, Schools, Travel, Transportation, Facilities, Healthcare, Property lines&ownership, Environment and much more
FIU
TerraFly


Time Series: Miami Construction
GO
GO
?
NE 15TH ST
NE 13TH
1ST AVE
2003
Legend
roads
cities
road lines
places
services
food
population
income
parcels
--appraisal
--size
--year built
--owner
Environme
Overview
Powered By
1.2 Meters per Pixel
100m
02/21/1999
06/01/2003
01/01/2005
09/01/2007
FIU
TerraFly


Time Series: The 2011 Tsunami
Ishinomaki, Miyagi-ken, Japan
04/04/2010
03/12/2011
03/19/2011
FIU
TerraFly


Multimedia Auto Pilot
FIU
TerraFly

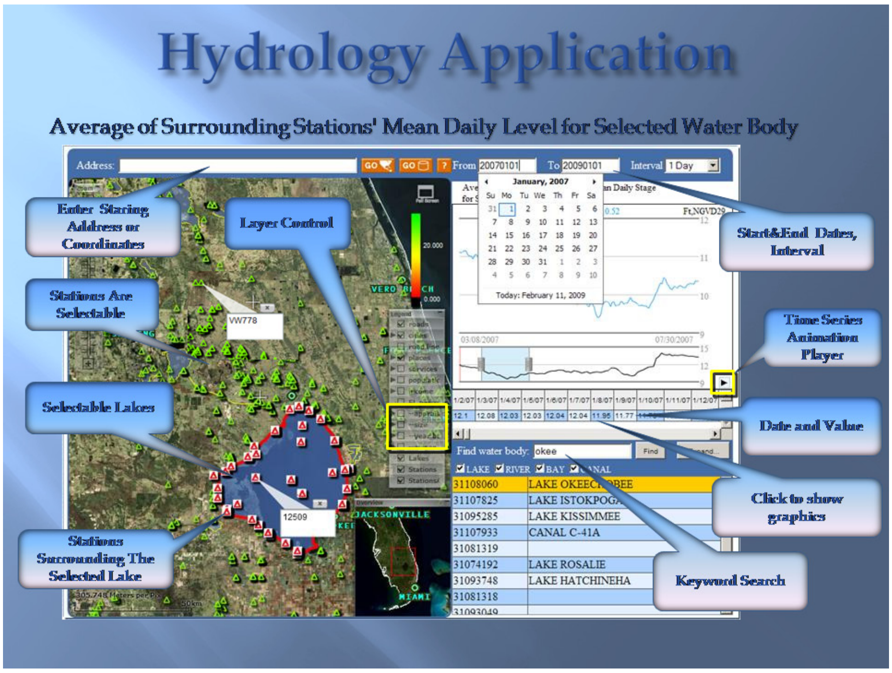

Auto Pilot Designer
Animation Controls
Path
Action Details
Autopilot Designer Click on Map to create the pilot path, more help?
Publish
Update
Design
Source
Legend: + ZoomIn | - ZoomOut | ♫ Audio start | S Start | E End
FIU
TerraFly


Your System
Your Data
TerraFly
Integration Solution
TerraFly
system
FIU
TerraFly


Solutions
Water Management
Real Estate
Geo-Photos
Tourism
TerraFly
Travel
Education
Change Detection
Insurance

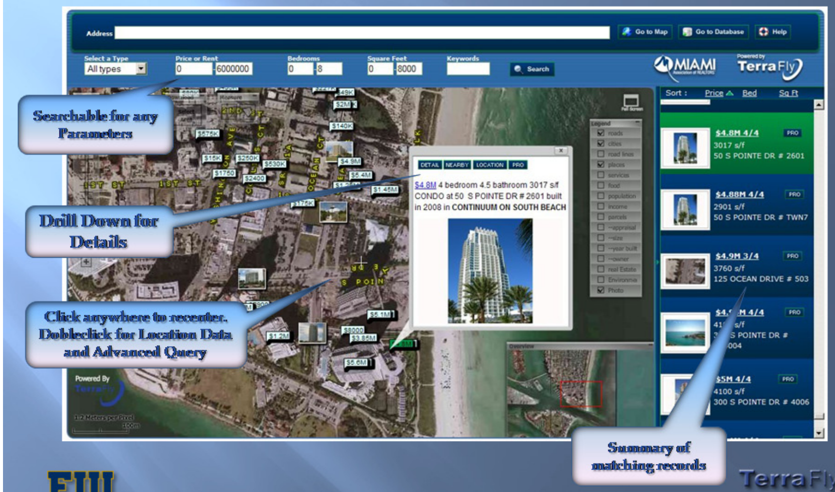

Customers & Partnerships
MIAMI Association of REALTORS
The Miami Herald
FLORIDA State Parks
USGS science for changing world
CORAL GABLES
NASA
Google
National Science Foundation - CISE
IBM
American Digital Cartography inc.
sfwmd.gov
FIU FLORIDA INTERNATIONAL UNIVERSITY
CoreLogic
village of PINECREST FLORIDA
City of Florida City
VILLAGE OF EL PORTAL
City of North Miami Beach, Florida
NMB
Now More Beautiful!
OPA-LOCKA Florida
INFOWeather
HI-TECH REAL ESTATE
MAKING CLIENTS FOR LIFE
ONLINE REAL ESTATE
TerraFly


TerraFly Maps
FIU
TerraFly


Hydrology Application
Average of Surrounding Stations' Mean Daily Level for Selected Water Body
Address:
From 20070101
To 20090101
Interval 1 Day
Enter Staring Address or Coordinates
Layer Control
Start&End Dates, Interval
Stations Are Selectable
Time Series Animation Player
Selectable Lakes
Date and Value
Click to show graphics
Stations Surrounding The Selected Lake
Keyword Search
Find water body: okee
LAKE RIVER BAY CANAL
31108060 LAKE OKEECHOBEE
31107825 LAKE ISTOKPOGA
31095285 LAKE KISSIMMEE
31107933 CANAL C-41A
31081319
31074192 LAKE ROSALIE
31093748 LAKE HATCHINEHA
31081318


Geo-spatio-temporal Plots
Address:
From 20070101
To 20090101
Interval 1 Day
Average of Surrounding Stations' Mean Daily Stage for Selected Water Body.
Lake Okeechobee Water Level History & Projection
Find water body: okee
LAKE RIVER BAY CANAL
31108060 LAKE OKEECHOBEE
31107825 LAKE ISTOKPOGA
31095285 LAKE KISSIMMEE
31107933 CANAL C-41A
31081319
31074192 LAKE ROSALIE
31093748 LAKE HATCHINEHA
31081318

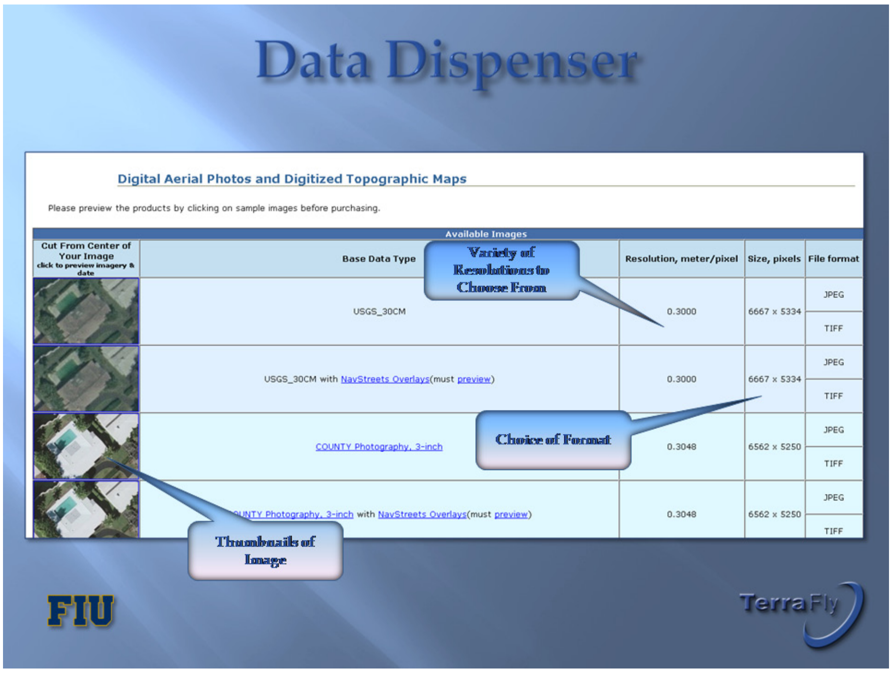
Real Estate Application

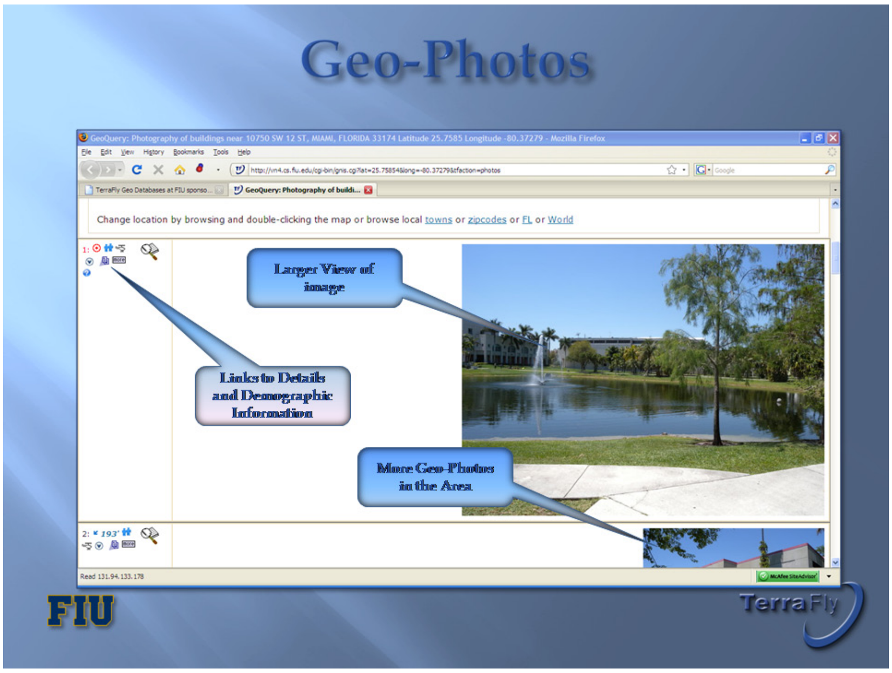


Real Estate Application

- Clients
  - MIAMI Realtor Assoication
  - Brokers
  - Consumers
- Challenge
  - Easy Query
  - Embeddable, rebrandable, customizable
- Awards
  - **TerraFly: Innovative Product of the Year 2008** – awarded by RAM


Historical Property Values
Time Series Animation Player
Layer Control
Start&End Dates, Interval
Census Block Groups are Selectable
Monthly mean $/SqFt sales within a Census Block Group
MIAMI-DADE COUNTY
Monthly Stats per Census Blk Grp
Avg Price per SqFt: $340
Avg Sale Price: $843K
Median Sale Price: $704K
Centered at: 3201 N MIAMI Ave, MIAMI
Census Block Groups
This Block Group
FIU
TerraFly

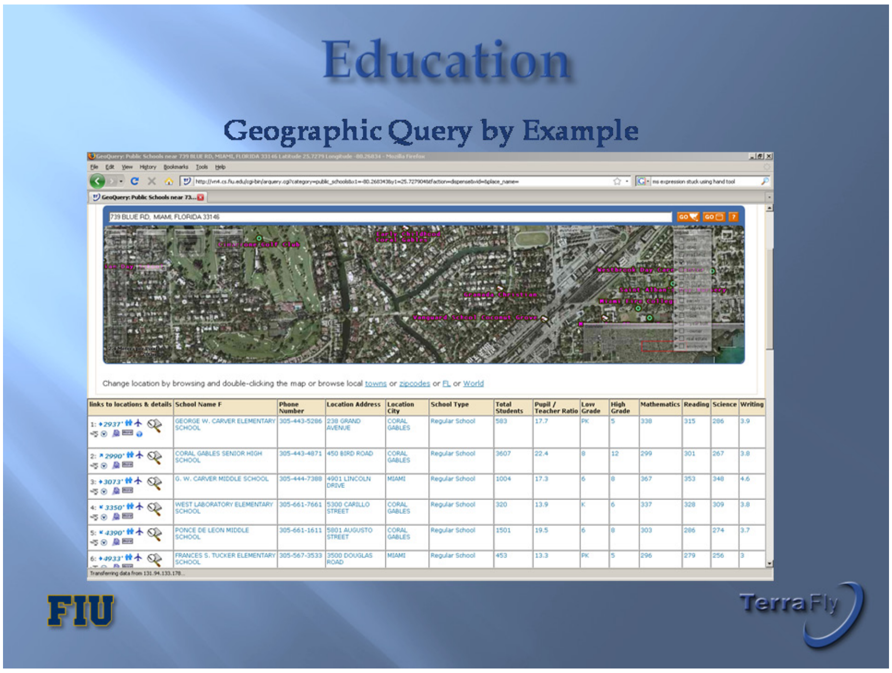

Data Dispenser
Digital Aerial Photos and Digitized Topographic Maps
Please preview the products by clicking on sample images before purchasing.
Available Images
Cut From Center of Your Image
Base Data Type
Resolution, meter/pixel
Size, pixels
File format
USGS_30CM
0.3000
6667 x 5334
JPEG
TIFF
USGS_30CM with NavStreets Overlays(must preview)
COUNTY Photography, 3-inch
0.3048
6562 x 5250
Variety of Resolutions to Choose From
Choice of Format
Thumbnails of Image
FIU
TerraFly

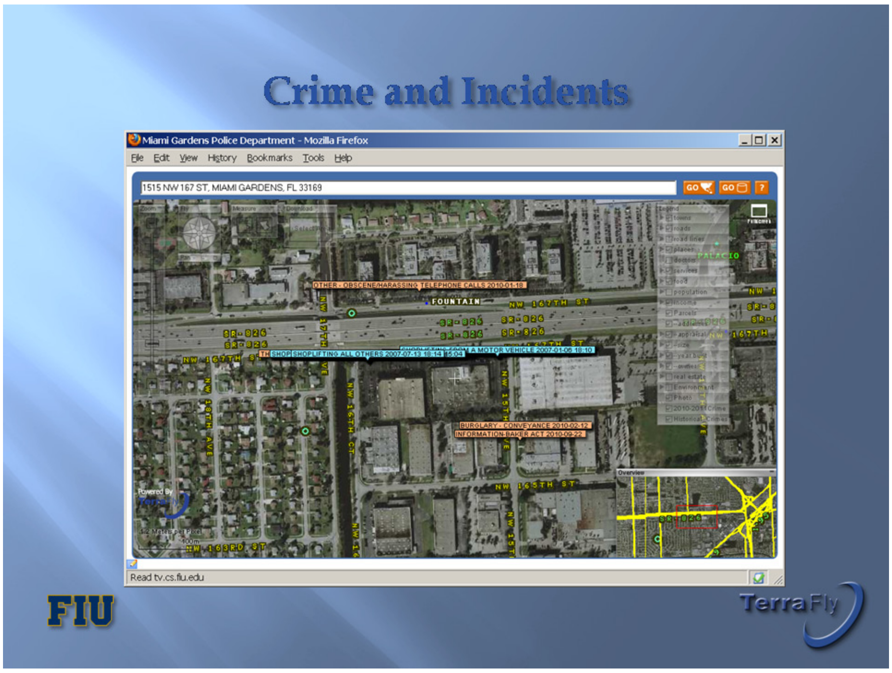

Geo-Photos
Change location by browsing and double-clicking the map or browse local towns or zipcodes or FL or World
Larger View of image
Links to Details and Demographic Information
More Geo-Photos in the Area
FIU
TerraFly

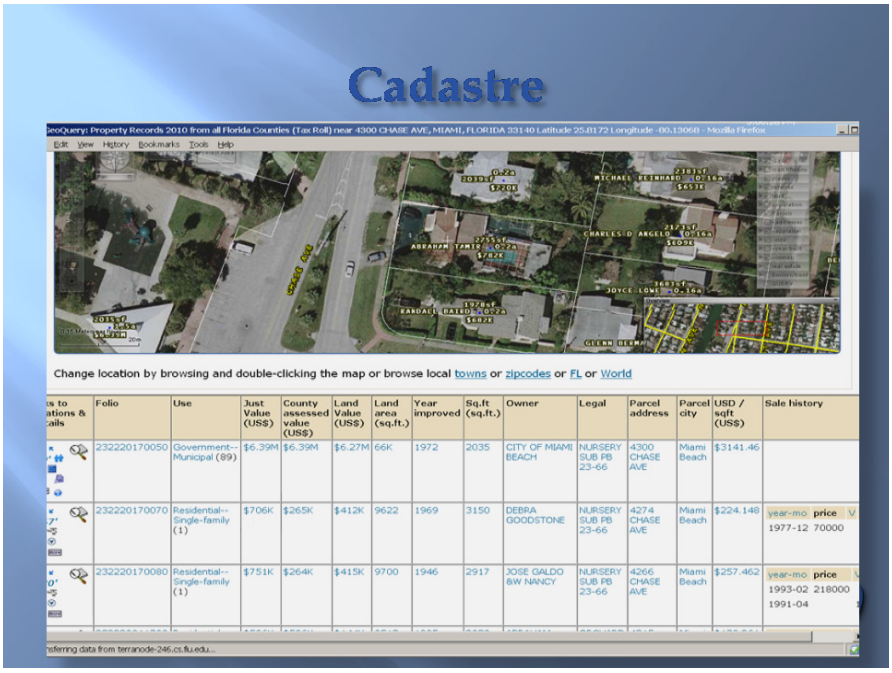

Geo-Photos
High-resolution Geo-located Photos
BERLIN, Germany
FIU
TerraFly

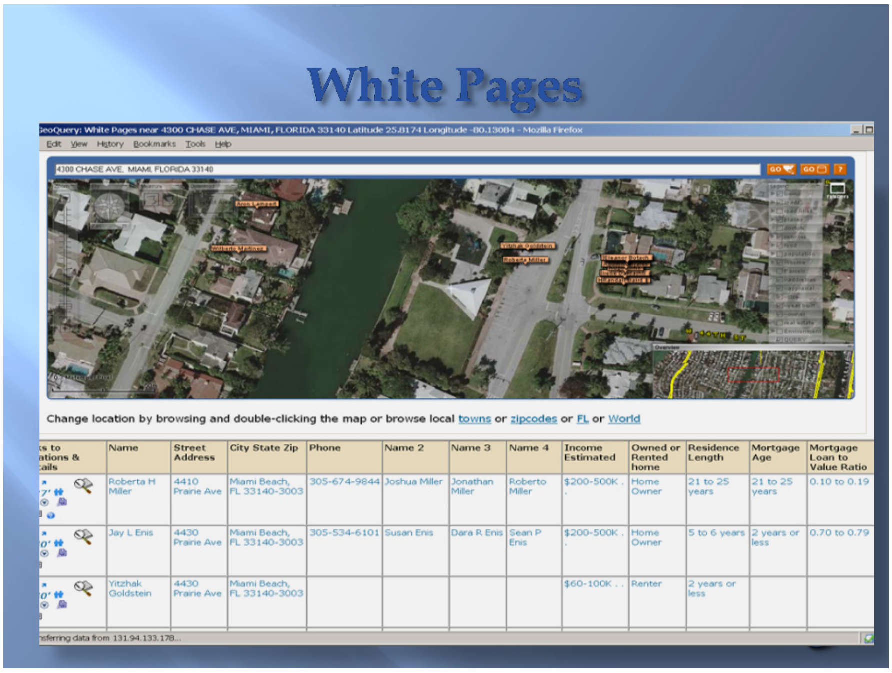

Ecology
The Trip Continues....
Trail: Nature trail
Oleta River Park through Time, Location, Water Stage History, Sight Photographs, Credits, IP
FIU
TerraFly

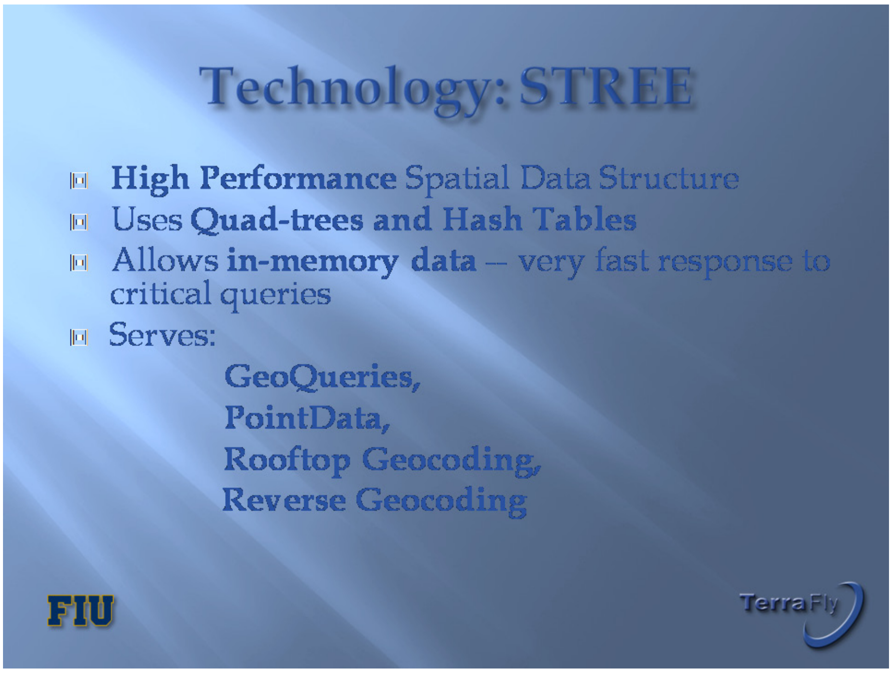

Tourism
Tour of Vancouver Olympic Venues
GEORGIA VIAD
EXPO
PACIFIC BLVD
EXPO BLVD
MARINASIDE CRES
CAMBIE BRG
QUEBEC ST
FIU
TerraFly

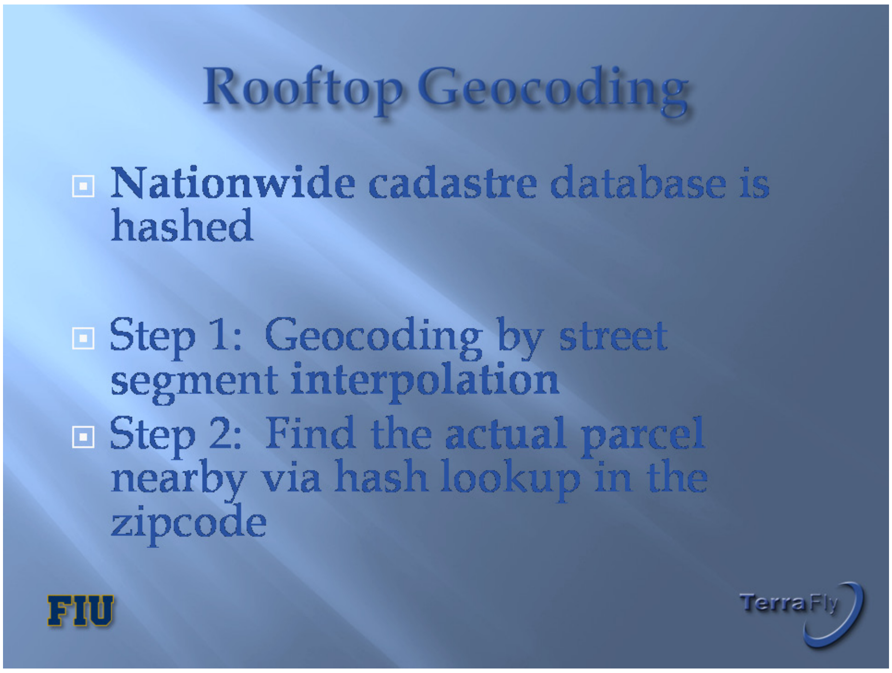

Education
Geographic Query by Example
739 BLUE RD, MIAMI, FLORIDA 33146
Change location by browsing and double-clicking the map or browse local towns or zipcodes or FL or World
FIU
TerraFly


Crime and Incidents
Miami Gardens Police Department - Mozilla Firefox
File Edit View History Bookmarks Tools Help
1515 NW 167 ST, MIAMI GARDENS, FL 33169
Read tv.cs.fiu.edu
FIU
TerraFly


Cadastre
Change location by browsing and double-clicking the map or browse local towns or zipcodes or FL or World
Folio
Use
Just Value (US$)
County assessed value (US$)
Land Value (US$)
Land area (sq.ft.)
Year improved
Sq.ft (sq.ft.)
Owner
Legal
Parcel address
Parcel city
USD / sqft (US$)
Sale history
232220170050 Government--Municipal (89) $6.39M $6.39M $6.27M 66K 1972 2035 CITY OF MIAMI BEACH NURSERY SUB PB 23-66 4300 CHASE AVE Miami Beach $3141.46
232220170070 Residential--Single-family (1) $706K $265K $412K 9622 1969 3150 DEBRA GOODSTONE NURSERY SUB PB 23-66 4274 CHASE AVE Miami Beach $224.148 year-mo price 1977-12 70000
232220170080 Residential--Single-family (1) $751K $264K $415K 9700 1946 2917 JOSE GALDO &W NANCY NURSERY SUB PB 23-66 4266 CHASE AVE Miami Beach $257.462 year-mo price 1993-02 218000 1991-04


White Pages
4300 CHASE AVE, MIAMI, FLORIDA 33140
Change location by browsing and double-clicking the map or browse local towns or zipcodes or FL or World
Name
Street Address
City State Zip
Phone
Name 2
Name 3
Name 4
Income Estimated
Owned or Rented home
Residence Length
Mortgage Age
Mortgage Loan to Value Ratio
Roberta H Miller 4410 Prairie Ave Miami Beach, FL 33140-3003 305-674-9844 Joshua Miller Jonathan Miller Roberto Miller $200-500K Home Owner 21 to 25 years 21 to 25 years 0.10 to 0.19
Jay L Enis 4430 Prairie Ave Miami Beach, FL 33140-3003 305-534-6101 Susan Enis Dara R Enis Sean P Enis $200-500K Home Owner 5 to 6 years 2 years or less 0.70 to 0.79
Yitzhak Goldstein 4430 Prairie Ave Miami Beach, FL 33140-3003 $60-100K Renter 2 years or less


Technology: STREE
High Performance Spatial Data Structure
Uses Quad-trees and Hash Tables
Allows in-memory data – very fast response to critical queries
Serves:
GeoQueries,
PointData,
Rooftop Geocoding,
Reverse Geocoding
FIU
TerraFly


Rooftop Geocoding
Nationwide cadastre database is hashed
Step 1: Geocoding by street segment interpolation
Step 2: Find the actual parcel nearby via hash lookup in the zipcode
FIU
TerraFly

Parallel Spatial-Similarity Joins

- Combination of **Spatial and Non-spatial**
- **Applications**: data cleansing, record linkage, duplication detection, geocoding enhancement

MapReduce:

Step 1: Spatial partitioning

Step 2: Ranked pairs weighting spatial and non-spatial attributes

Step 3: Incrementally improve ranking, searching adjacent clusters of the partition

FIU

TerraFly

Spatial Keyword Search

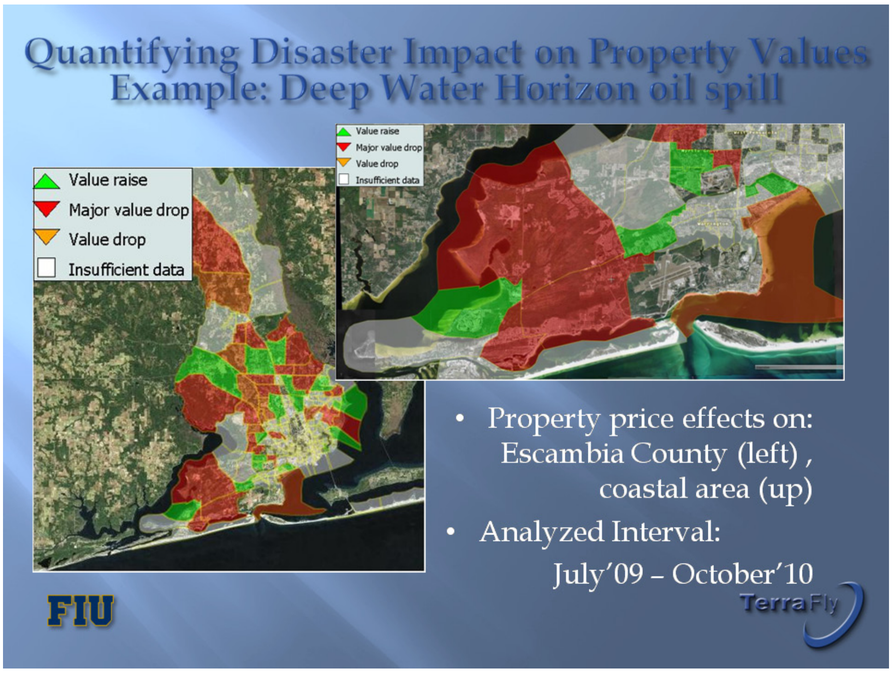
- Textual, Structured, and Spatial attributes

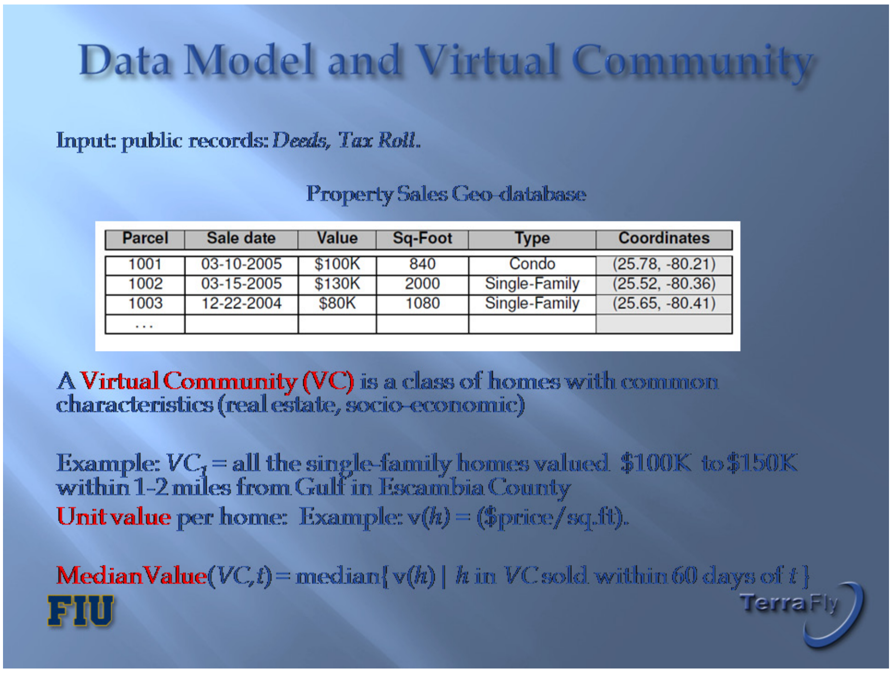
id	type	description	loc.
1	house	pool, building	(1,2)
2	condo	beach, view, collins	(3,4)
3	house	water, fountain	(5,6)
		. . .	

- Optimization of ***spatial queries*** with constraints on *text* and ***numeric*** attributes
- Example: "*find the closest houses to my **current location** with **pool** or **beach** access*".
- Leveraging R-trees and Inverted Files. SSDBM 2010: Ariel Cary et al. "*Efficient and Scalable Method for Processing Top-k Spatial Boolean Queries*".

FIU

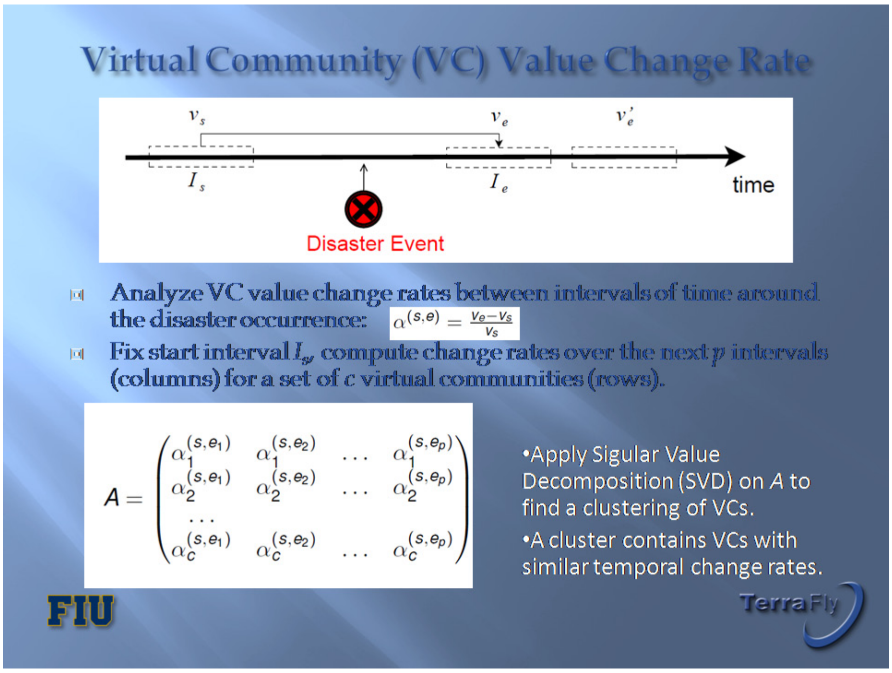
TerraFly

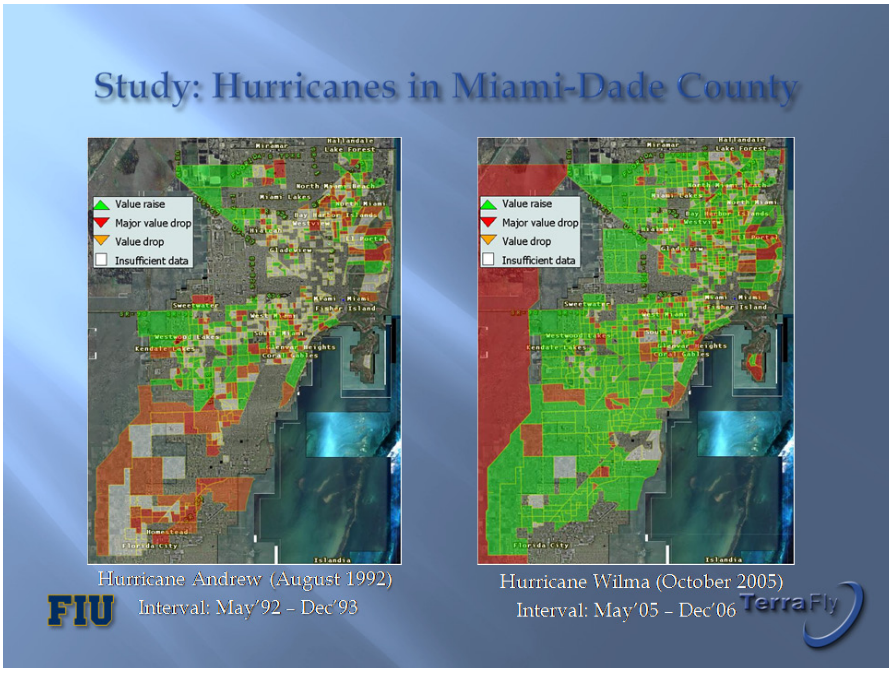

Quantifying Disaster Impact on Property Values
Example: Deep Water Horizon oil spill
Value raise
Major value drop
Value drop
Insufficient data
Value raise
Major value drop
Value drop
Insufficient data
• Property price effects on: Escambia County (left), coastal area (up)
• Analyzed Interval:
July'09 – October'10
FIU
TerraFly

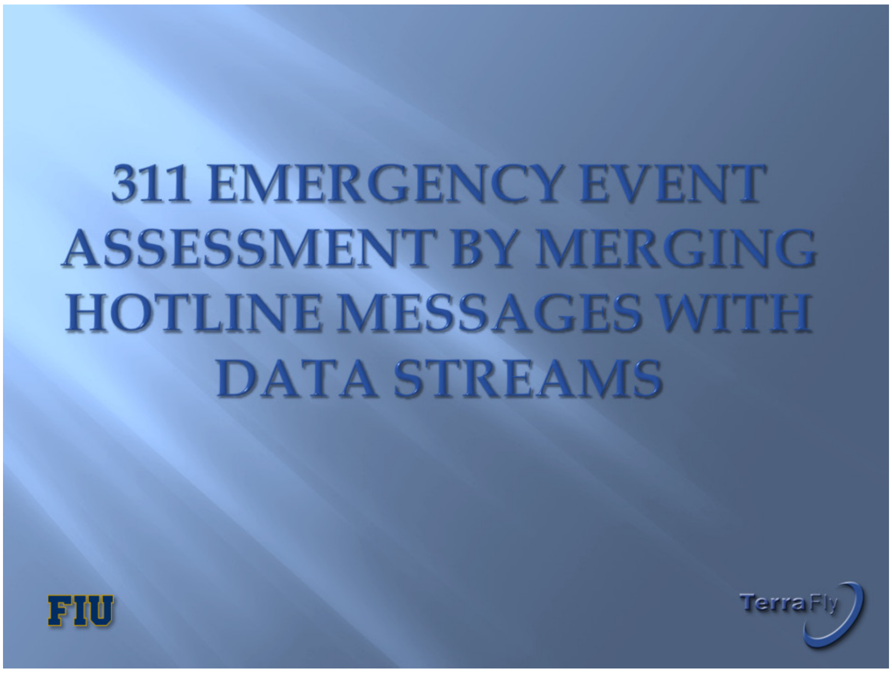

Data Model and Virtual Community
Input: public records: Deeds, Tax Roll.
Property Sales Geo-database

Parcel	Sale date	Value	Sq-Foot	Type	Coordinates
1001	03-10-2005	$100K	840	Condo	(25.78, -80.21)
1002	03-15-2005	$130K	2000	Single-Family	(25.52, -80.36)
1003	12-22-2004	$80K	1080	Single-Family	(25.65, -80.41)
...					

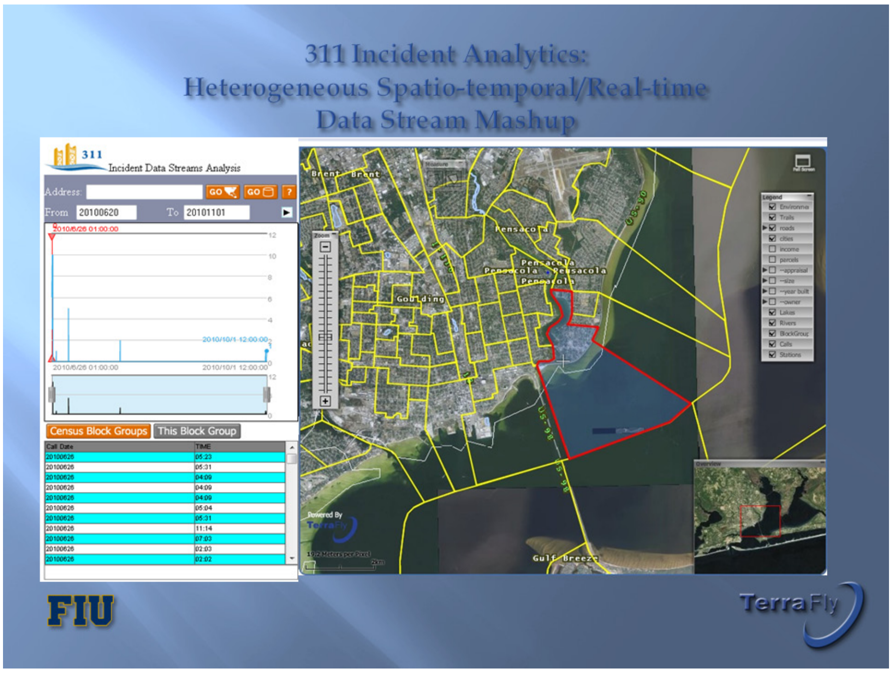
A Virtual Community (VC) is a class of homes with common characteristics (real estate, socio-economic)
Example: VC_1 = all the single-family homes valued $100K to $150K within 1-2 miles from Gulf in Escambia County
Unit value per home: Example: v(h) = ($price/sq.ft).
MedianValue(VC,t) = median{ v(h) | h in VC sold within 60 days of t }
FIU
TerraFly

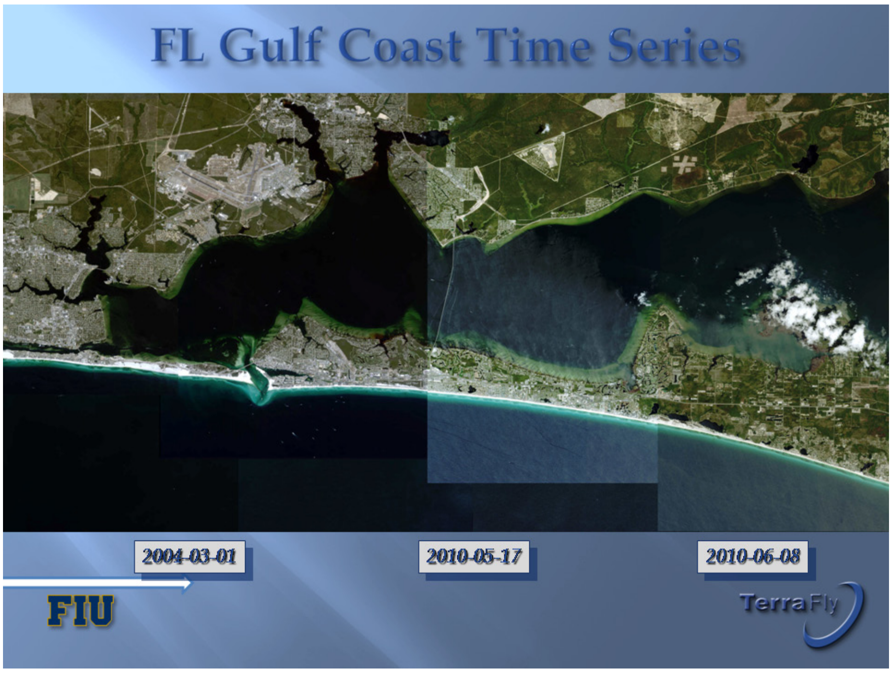

Virtual Community (VC) Value Change Rate
v_s
v_e
v'_e
I_s
I_e
time
Disaster Event
Analyze VC value change rates between intervals of time around the disaster occurrence: $\alpha^{(s,e)} = \frac{v_e - v_s}{v_s}$
Fix start interval I_s, compute change rates over the next p intervals (columns) for a set of c virtual communities (rows).
$A = \begin{pmatrix} \alpha_1^{(s,e_1)} & \alpha_1^{(s,e_2)} & \dots & \alpha_1^{(s,e_p)} \\ \alpha_2^{(s,e_1)} & \alpha_2^{(s,e_2)} & \dots & \alpha_2^{(s,e_p)} \\ \dots & & & \\ \alpha_c^{(s,e_1)} & \alpha_c^{(s,e_2)} & \dots & \alpha_c^{(s,e_p)} \end{pmatrix}$
•Apply Sigular Value Decomposition (SVD) on A to find a clustering of VCs.
•A cluster contains VCs with similar temporal change rates.
FIU
TerraFly


Study: Hurricanes in Miami-Dade County
Value raise
Major value drop
Value drop
Insufficient data
Hurricane Andrew (August 1992)
Interval: May'92 – Dec'93
Value raise
Major value drop
Value drop
Insufficient data
Hurricane Wilma (October 2005)
Interval: May'05 – Dec'06
FIU
TerraFly


311 EMERGENCY EVENT ASSESSMENT BY MERGING HOTLINE MESSAGES WITH DATA STREAMS
FIU
TerraFly


Objective
Towards a Nation-wide 311 System
Citizens
Incident Related Information
• Voice Calls
• Text Messages
• Multimedia Messages
Emergency Managers
• Disseminate advisories to targets population
• Request updates from specific individuals
Info enriched and shared with existing systems
FIU
TerraFly


311 Incident Analytics:
Heterogeneous Spatio-temporal/Real-time
Data Stream Mashup
311
Incident Data Streams Analysis
Address:
From 20100620
To 20101101
Census Block Groups
This Block Group
Pensacola
Goulding
Gulf Breeze
FIU
TerraFly


FL Gulf Coast Time Series
2004-03-01
2010-05-17
2010-06-08
FIU
TerraFly


FL Gulf Coast Time Series
Ishinomaki, Miyagi-ken, Japan
2010-04-04
2011-03-12
2011-03-19
FIU
TerraFly


Profiled
Discovery CHANNEL
nature
scienceupdate
The Miami Herald
YAHOO! Picks
AERO-NEWS NETWORK
FOX NEWS .com
geo COMMUNITY
DM REVIEW 2002 World Class Solution Award
Science magazine
Québec PME
n p r
techtv
USA TODAY Tech
ktla5 WB
USA TODAY HOT SITE
The New York Times ON THE WEB
FIU
TerraFly


Solutions
Water Management
Real Estate
Geo-Photos
TerraFly
Tourism
Travel
More about TerraFly Solutions:
Solution Center
http://maps.cs.fiu.edu/Solution/
Developer Center
http://maps.cs.fiu.edu/solution/ForDevelopers/
Change Detection
Insurance
Home
http://TerraFly.com

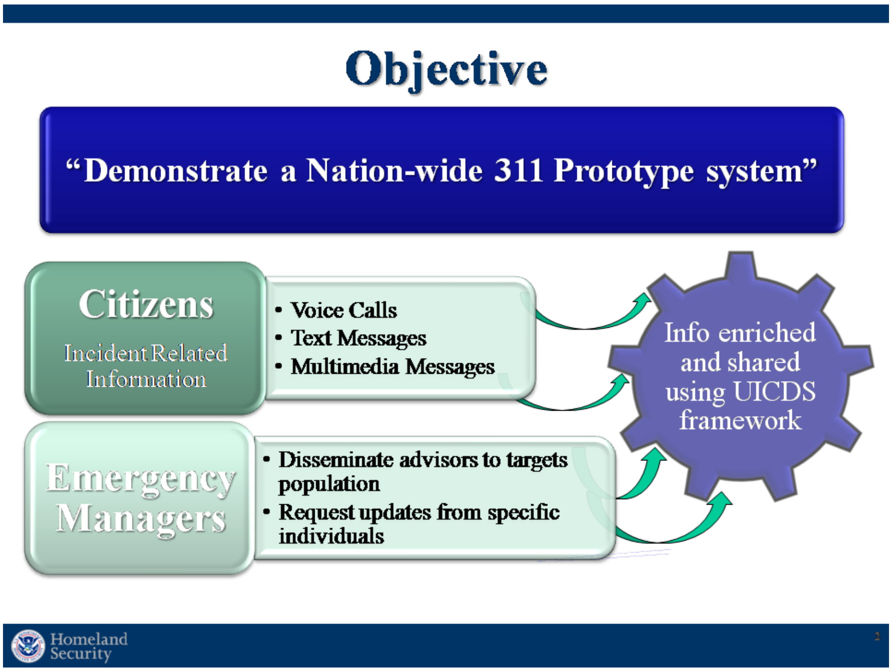

Thank You !
TerraFly

Towards a Nationwide 311 System for Incident Control and Analysis

Dr. Nabil Adam

Science and Technology Directorate
Department of Homeland Security


WALL ST
AMBULANCE
Nation-wide "311" Demo
Rutgers University – CIMIC
Florida International University (FIU)
University of California Irvine (UCI)
October 1, 2010
Dr. Nabil Adam, Fellow/Senior Program Manager
Infrastructure & Geophysical Division
Science and Technology Directorate, U.S. Department of Homeland Security
Homeland Security


Objective
"Demonstrate a Nation-wide 311 Prototype system"
Citizens
Incident Related Information
• Voice Calls
• Text Messages
• Multimedia Messages
Info enriched and shared using UICDS framework
Emergency Managers
• Disseminate advisors to targets population
• Request updates from specific individuals
Homeland Security

The Demo Team

Florida International University (FIU):

1. Naphtali Rishe, Professor & Director, High Performance Database Research Center and NSF Industry-University Cooperative Research Center
2. Martha Gutierrez, Manager of the above Centers
3. Jaime Ballesteros, PhD student and Software Engineer
4. Fan Ping, Software Engineer

University of California-Irvine (UC-Irvine):

1. Sharad Mehrotra, Professor & Director CERT
2. Nalini Venkatasubramanian, Professor, CERT
3. Dmitri Kalashnikov, Research Professor, CERT
4. Reza Rahimi, Kerim Oktay, Kartik Udupa, and Rabia Nuray, PhD students

Rutgers University CIMIC:

1. Vijay Atluri, Professor & Research Director, CIMIC
2. Basit Shafiq, Research Professor, CIMIC
3. Ghulam Nabi, Software Engineer, CIMIC
4. Jaideep Vaidya, Professor, CIMIC
5. Soon Chun, Professor, CUNY

Homeland Security 3

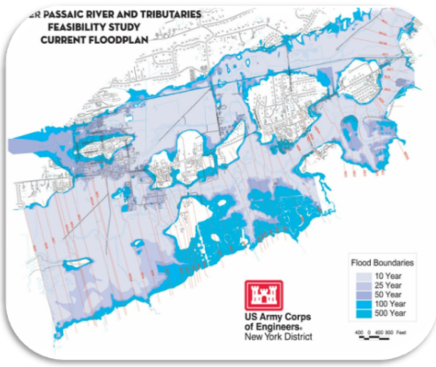
Scenario

A. River Flooding in Central New Jersey

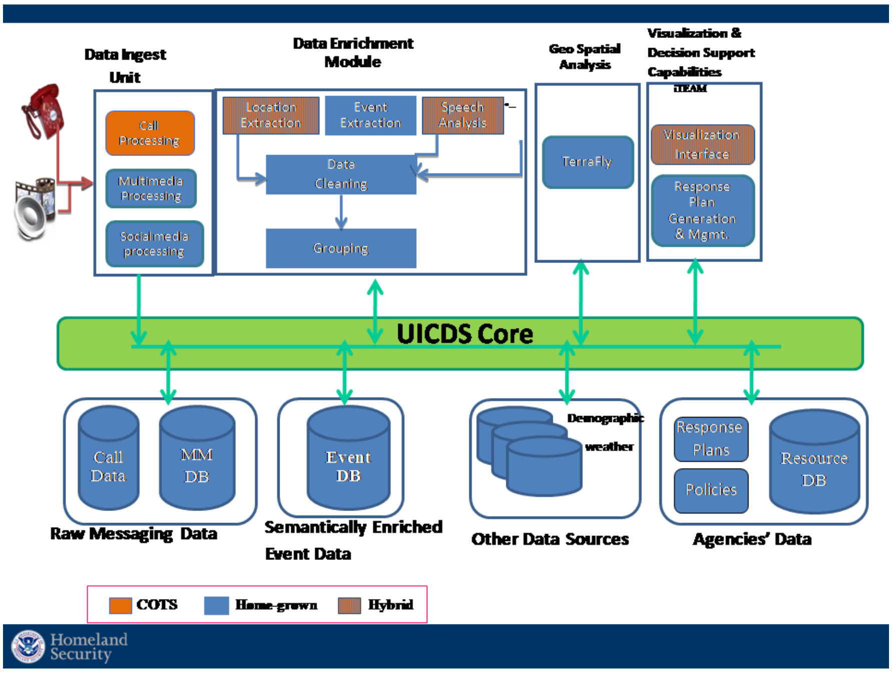
- Water level in Passaic River and Raritan River is crested more than 5 feet above the flood level
- There are many reports about downed electricity lines, fallen trees, road closures, people stranded in cars/houses, etc.

B. Nation-wide "311" System Setup

- Citizens use SMS, MMS, Voice
- Citizens request assistance
- Citizens provide updates



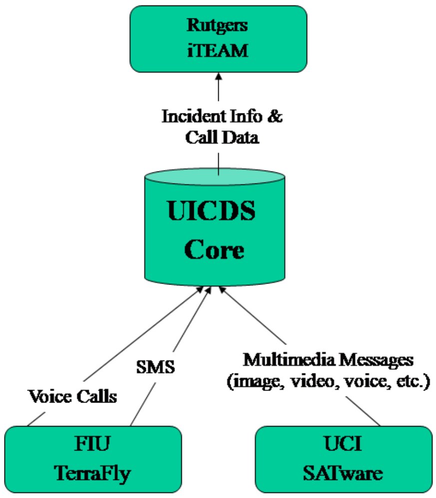
Homeland Security 4



Architecture

For this demo

- Voice calls & SMS messages are captured and processed by the FIU TerraFly system
  - Users make calls to FIU number "786-693-2911"
- Multimedia messages are captured and processed by UCI
  - Users send multimedia messages from cell phones to uci.311@gmail.com
- This data is shared with Rutgers iTEAM system via UICDS core running at Rutgers CIMIC
- Any UICDS compatible IM system can retrieve this data from the core
- Demo Link



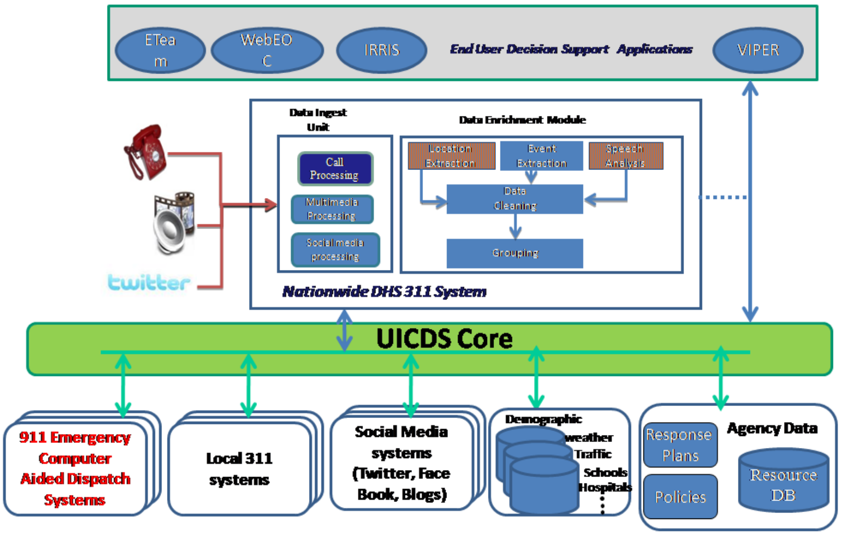
Homeland Security

COTS and Home-grown Modules

- Data Ingest Unit
  - **COTS:** Google Voice; White pages; USGS Gage Feeds; NASA TRMM feed; Java Mail API; twitter4J; MySQL
  - **Home-grown:** TerraFly (funded by NSF); FIU Data Extractor (funded by NSF) speech capture component for Android phones (funded through NSF & DHS); data ingest server
- Data Enrichment
  - **COTS:** Google Voice, White pages, Stanford Named Entity Recognizer, GATE Extractor, Google Maps Java API, MySQL
  - **Home-grown:** Location & event extraction (funded by NSF), location cleaning component (funded by NSF), event grouping component
- Visualization & Decision Support
  - **COTS:** Google Maps, JESS, Protégé, MySQL, Oracle
  - **Home-grown:** iTEAM (funded by NSF, Rutgers Academic Excellence award, and SAP Research), Ontology and reasoning components (funded by NSF, Rutgers Academic Excellence Award), EDXL messaging component (funded by DHS-S&T and ARDEC)

Homeland Security

Architecture



Homeland Security

Extensions/Enhancements (Short Term)

Interactive communication with the sensor

- querying/pinging the individual cell phone users for providing updates with voice messages, latest images, or live video

Correlation between calls and other sensors

- e.g., FIU is collecting and presenting USGS water level and flow gages data nationwide
- integration of human oriented sensors (e.g., phone calls, images, etc.) with other sensor information (e.g., traffic loop sensors, instrumented buildings, etc).

Complex queries involving joins of calls data with demographic, socioeconomics, and municipal data

Collating multiple calls/messages about the "same" incident

Making information extraction from messages more robust including location, event type, caller's intent, urgency, etc.

Homeland Security 9

Extensions/Enhancements (Long Term)

Making analysis/retrieval/triggers tolerate errors/uncertainty in location, type, and also speech recognition in case of audio data

Closed loop sensing wherein alerts (either automatically or through human intervention) could result in request for additional sensing information

Enhancing the existing situational awareness product to serve needs of diverse community of users

- Evacuation planning, hospital planning, community information portal, operation planning

Homeland Security 10

Homeland Security

Homeland Security 11

Preliminary ideas as to how would this system integrate with 911 (assuming “right” policies are in place)

- Upon completion of a 911 call the operator may release the recording of the call to the 311 system by clicking a button in their screen; or, if appropriate, the commanding level may setup the system so that all call records from particular geography and time frame be copied to 311 after being automatically screened via keywords for relevance to the situation.

Homeland Security

Analytical Query Examples

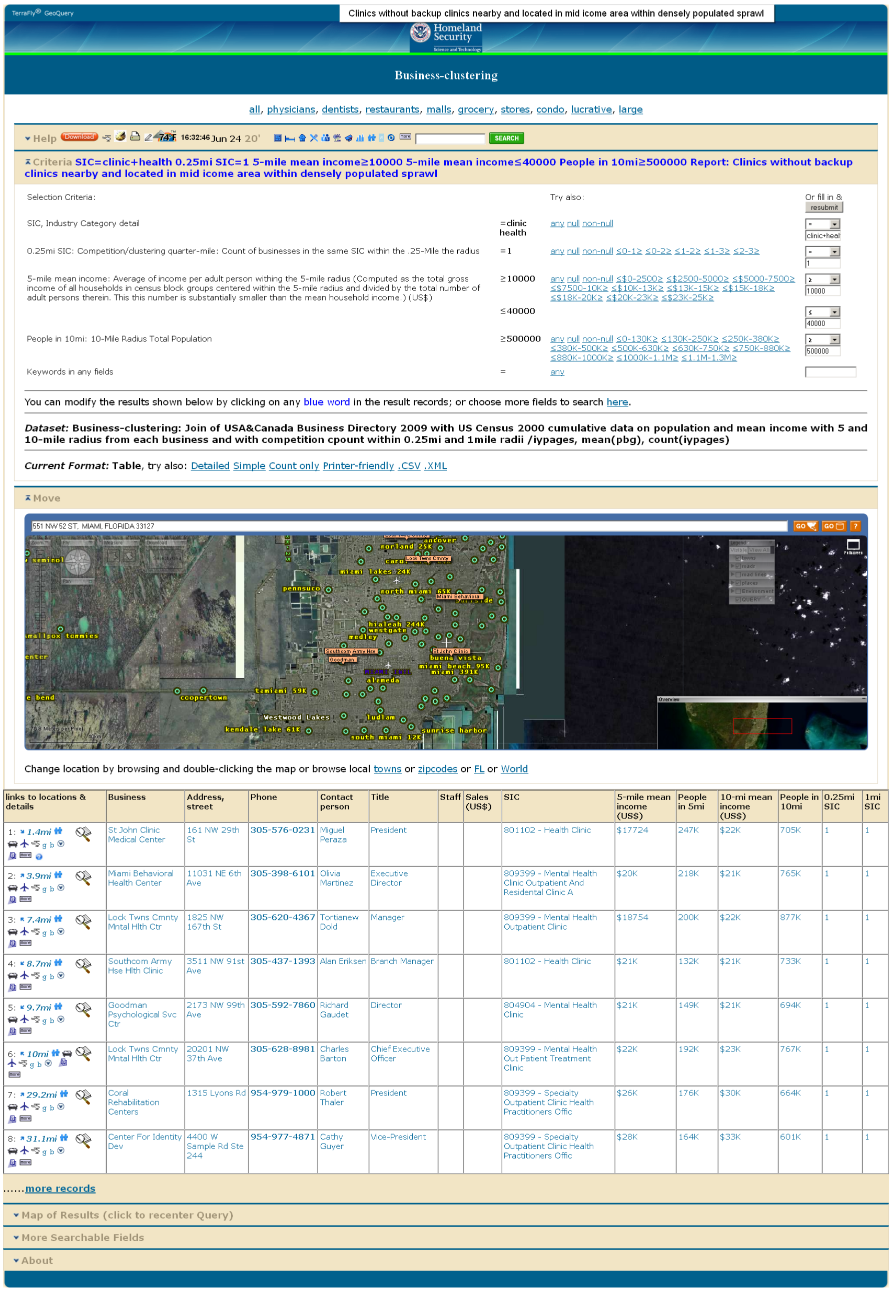
TerraFly is a technology and tools for visualization, querying and analysis of geospatial data. The visualization component of the system provides users with the experience of virtual "flight" over maps comprised of aerial and satellite imagery overlaid with geo-referenced data. The data drilling and querying component of the system allows the users to easily explore geospatial data, to create geospatial queries, and get instant answers supported by high-performance multidimensional search mechanisms. TerraFly's server farm ingests, geo-locates, cleanses, mosaics, and cross-references 40TB of basemap data and user-specific data streams. TerraFly's Application Programming Interface allows rapid deployment of interactive Web applications and has been used to produce systems for disaster mitigation, ecology, real estate, tourism, and municipalities. TerraFly's Web-based client interface is accessible from anywhere via any standard Web browser, with no client software to install.

TerraFly tools include user-friendly geospatial querying, data drill-down, interfaces with real-time data suppliers, demographic analysis, annotation, route dissemination via autopilots, customizable applications, production of aerial atlases, and an application programming interface (API) for production of Web-based map applications.

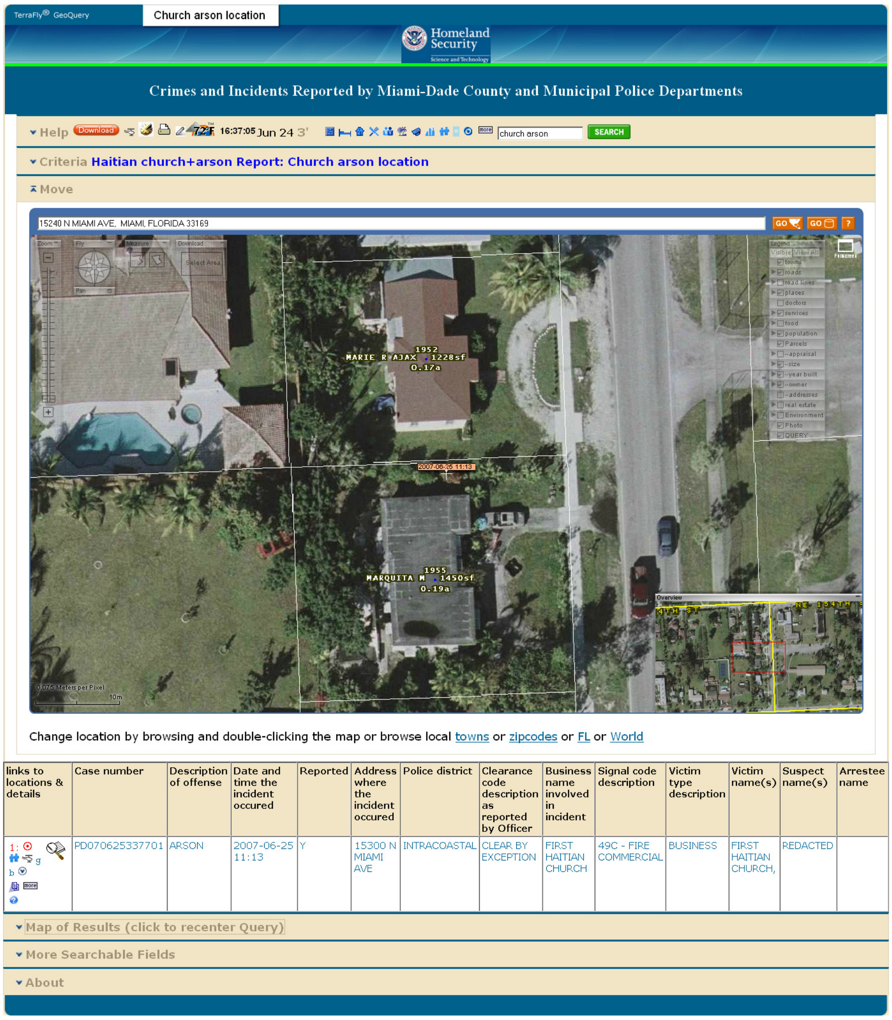
The TerraFly project has been featured on TV news programs (including FOX TV News), worldwide press, covered by the New York Times, USA Today, NPR, and Science and Nature journals. The project's primary sponsor is the National Science Foundation (NSF). Of the 53,000 NSF-funded projects in 2009, it chose 120, including TerraFly, for the NSF annual report to Congress.

The 40TB TerraFly data collection includes, among others, 1-meter aerial photography of almost the entire United States and 3-inch to 1-foot full-color recent imagery of major urban areas. TerraFly vector collection includes 1.4 billion geolocated objects, 50 billion data fields, 1 billion polylines, 120 million polygons, including: all World roads, the U.S. Census demographic and socioeconomic datasets, 110 million U.S. parcels with property lines and ownership data, 15 million records of businesses with company stats and management roles and contacts, 2 million physicians with expertise detail, various public place databases (including the USGS GNIS and NGA GNS), Wikipedia, extensive global environmental data (including daily feeds from NASA and NOAA satellites and the USGS water gauges), and hundreds of other datasets.

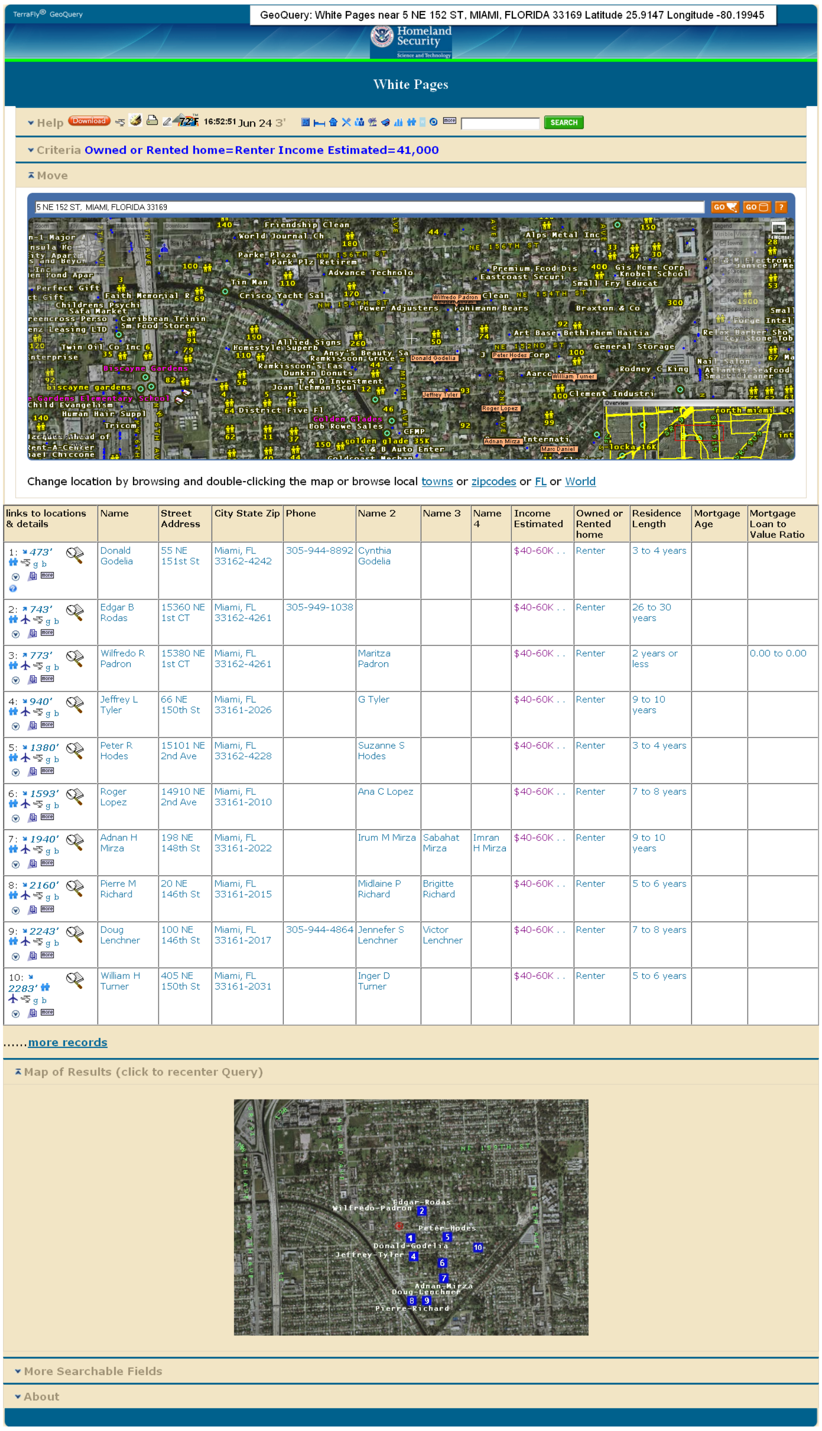
Query examples follow.



Query: Clinics without backup clinics nearby and located in middle income areas within densely populated sprawl. This query involves a geospatial join and aggregation of business data and demographics.



Query: Church Arson Locations. The query is against a Crimes database while the map shows also the relevant Cadastre data. TerraFly contains 110 million polygons of almost all parcels in the USA.



TerraFly® GeoQuery

GeoQuery: White Pages near 5 NE 152 ST, MIAMI, FLORIDA 33169 Latitude 25.9147 Longitude -80.19945

Homeland Security

White Pages

Help Download 16:52:51 Jun 24 SEARCH

Criteria Owned or Rented home=Renter Income Estimated=41,000

Move

5 NE 152 ST, MIAMI, FLORIDA 33169

Change location by browsing and double-clicking the map or browse local towns or zipcodes or FL or World

links to locations & details	Name	Street Address	City State Zip	Phone	Name 2	Name 3	Name 4	Income Estimated	Owned or Rented home	Residence Length	Mortgage Age	Mortgage Loan to Value Ratio
1: 473' g b more	Donald Godelia	55 NE 151st St	Miami, FL 33162-4242	305-944-8892	Cynthia Godelia			$40-60K . .	Renter	3 to 4 years		
2: 743' g b more	Edgar B Rodas	15360 NE 1st CT	Miami, FL 33162-4261	305-949-1038				$40-60K . .	Renter	26 to 30 years		
3: 773' g b more	Wilfredo R Padron	15380 NE 1st CT	Miami, FL 33162-4261		Maritza Padron			$40-60K . .	Renter	2 years or less		0.00 to 0.00
4: 940' g b more	Jeffrey L Tyler	66 NE 150th St	Miami, FL 33161-2026		G Tyler			$40-60K . .	Renter	9 to 10 years		
5: 1380' g b more	Peter R Hodes	15101 NE 2nd Ave	Miami, FL 33162-4228		Suzanne S Hodes			$40-60K . .	Renter	3 to 4 years		
6: 1593' g b more	Roger Lopez	14910 NE 2nd Ave	Miami, FL 33161-2010		Ana C Lopez			$40-60K . .	Renter	7 to 8 years		
7: 1940' g b more	Adnan H Mirza	198 NE 148th St	Miami, FL 33161-2022		Irum M Mirza	Sabahat Mirza	Imran H Mirza	$40-60K . .	Renter	9 to 10 years		
8: 2160' g b more	Pierre M Richard	20 NE 146th St	Miami, FL 33161-2015		Midlaine P Richard	Brigitte Richard		$40-60K . .	Renter	5 to 6 years		
9: 2243' g b more	Doug Lenchner	100 NE 146th St	Miami, FL 33161-2017	305-944-4864	Jennefer S Lenchner	Victor Lenchner		$40-60K . .	Renter	7 to 8 years		
10: 2283' g b more	William H Turner	405 NE 150th St	Miami, FL 33161-2031		Inger D Turner			$40-60K . .	Renter	5 to 6 years		

......more records

Map of Results (click to recenter Query)

More Searchable Fields

About

Query: Search White Pages for renters in a given income range.

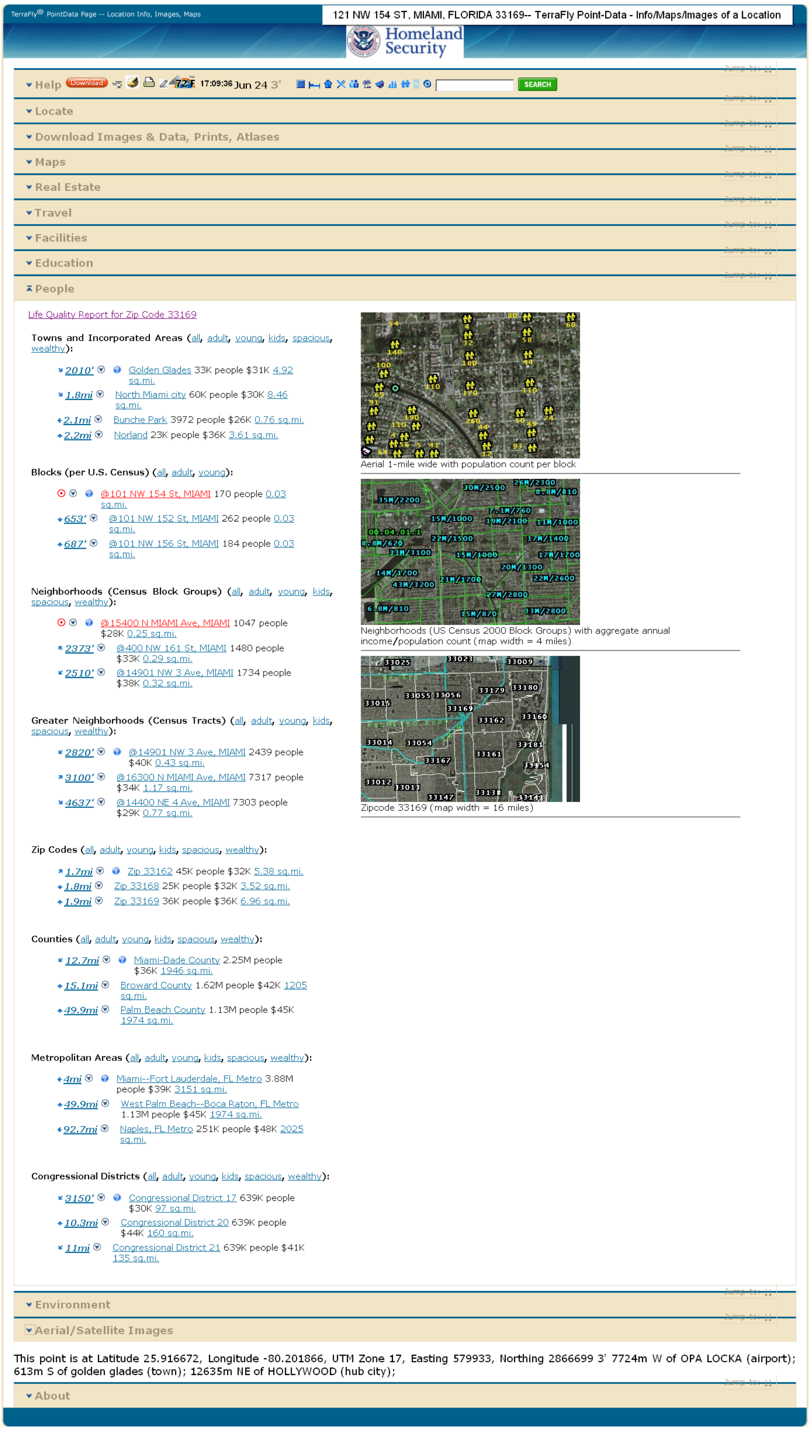
Demographic data for Block Group 3.01.3 and Comparison Zones

FAMILY TYPE BY PRESENCE AND AGE OF OWN CHILDREN [20]

Universe: Families

	United States		South Region		South Atlantic Division		Florida		Miami-Dade County		Census Tract 3.01 1.2 sq.mi. around 16300 N MIAMI Ave, MIAMI		Block Group 3.01.3 0.3 sq.mi. around 15400 N MIAMI Ave, MIAMI		
Total:	71,787,347	100.0%	26,257,626	100.0%	13,584,023	100.0%	4,210,760	100.0%	548,493	100.0%	1,579	100.0%	**243**	**100.0%**	Total:
Married-couple family:	54,493,232	75.9%	19,740,328	75.2%	10,197,413	75.1%	3,192,266	75.8%	370,898	67.6%	959	60.7%	**137**	**56.4%**	Married-couple family:
With own children under 18 years:	24,835,505	34.6%	8,764,414	33.4%	4,339,541	31.9%	1,215,197	28.9%	175,547	32.0%	582	36.9%	**76**	**31.3%**	With own children under 18 years:
Under 6 years only	5,892,433	8.2%	2,108,125	8.0%	1,058,044	7.8%	286,514	6.8%	41,551	7.6%	112	7.1%	**20**	**8.2%**	Under 6 years only
Under 6 years and 6 to 17 years	5,316,384	7.4%	1,809,154	6.9%	871,605	6.4%	249,439	5.9%	37,168	6.8%	157	9.9%	**14**	**5.8%**	Under 6 years and 6 to 17 years
6 to 17 years only	13,626,688	19.0%	4,847,135	18.5%	2,409,892	17.7%	679,244	16.1%	96,828	17.7%	313	19.8%	**42**	**17.3%**	6 to 17 years only
No own children under 18 years	29,657,727	41.3%	10,975,914	41.8%	5,857,872	43.1%	1,977,069	47.0%	195,351	35.6%	377	23.9%	**61**	**25.1%**	No own children under 18 years
Other family:	17,294,115	24.1%	6,517,298	24.8%	3,386,610	24.9%	1,018,494	24.2%	177,595	32.4%	620	39.3%	**106**	**43.6%**	Other family:
Male householder, no wife present:	4,394,012	6.1%	1,545,802	5.9%	809,941	6.0%	259,494	6.2%	43,924	8.0%	161	10.2%	**37**	**15.2%**	Male householder, no wife present:
With own children under 18 years:	2,190,989	3.1%	761,619	2.9%	393,867	2.9%	126,709	3.0%	16,889	3.1%	82	5.2%	**18**	**7.4%**	With own children under 18 years:
Under 6 years only	594,889	0.8%	203,632	0.8%	106,447	0.8%	34,223	0.8%	4,508	0.8%	21	1.3%	**7**	**2.9%**	Under 6 years only
Under 6 years and 6 to 17 years	284,895	0.4%	94,421	0.4%	48,070	0.4%	16,274	0.4%	2,578	0.5%	13	0.8%	**2**	**0.8%**	Under 6 years and 6 to 17 years
6 to 17 years only	1,311,205	1.8%	463,566	1.8%	239,350	1.8%	76,212	1.8%	9,803	1.8%	48	3.0%	**9**	**3.7%**	6 to 17 years only
No own children under 18 years	2,203,023	3.1%	784,183	3.0%	416,074	3.1%	132,785	3.2%	27,035	4.9%	79	5.0%	**19**	**7.8%**	No own children under 18 years
Female householder, no husband present:	12,900,103	18.0%	4,971,496	18.9%	2,576,669	19.0%	759,000	18.0%	133,671	24.4%	459	29.1%	**69**	**28.4%**	Female householder, no husband present:
With own children under 18 years:	7,561,874	10.5%	2,910,498	11.1%	1,489,820	11.0%	437,680	10.4%	70,316	12.8%	303	19.2%	**50**	**20.6%**	With own children under 18 years:
Under 6 years only	1,532,745	2.1%	599,802	2.3%	302,866	2.2%	83,805	2.0%	11,967	2.2%	57	3.6%	**14**	**5.8%**	Under 6 years only
Under 6 years and 6 to 17 years	1,274,233	1.8%	481,241	1.8%	240,766	1.8%	71,183	1.7%	12,050	2.2%	52	3.3%	**11**	**4.5%**	Under 6 years and 6 to 17 years
6 to 17 years only	4,754,896	6.6%	1,829,455	7.0%	946,188	7.0%	282,692	6.7%	46,299	8.4%	194	12.3%	**25**	**10.3%**	6 to 17 years only
No own children under 18 years	5,338,229	7.4%	2,060,998	7.8%	1,086,849	8.0%	321,320	7.6%	63,355	11.6%	156	9.9%	**19**	**7.8%**	No own children under 18 years

Query: Demographic data drilldown to explore 20,000 fields per block census group. Shown here is the family profile field for a given block group and its comparison to larger geographic zones.



TerraFly Point-Data: Data summarization page: teaser subrecords form various datasets around a given location, allowing the user to further drill-down and query

Workshop on
Analytic Capability Development

Workshop Overview

The Department of Homeland Security (DHS) Science and Technology Directorate (S&T) will host the Analytic Capability Development Working Group (ACDWG) two day workshop to discuss challenges related to: developing, enhancing, and integrating analytic capabilities into a common framework spanning the Homeland Security Enterprise.

Workshop Details

Date: February 8-9, 2011
Time: 8:00AM-5:30PM
Location: Waterview Conference Center—1919 N. Lynn Street—Arlington, VA 22209
Committee:
-Dr. Nabil R. Adam, Host, DHS S&T
-Mr. Dean Checknita, DHS NPPD
-Mr. V. Pierce Ostrander, DHS Office of Policy

DHS established the ACDWG to increase awareness around existing analytical capabilities, spur collaborations that reduce stove-piping and duplication of analytic effort, create consistent, transparent, defensible, and shared knowledge, and streamline development efforts at all levels. The ACDWG aims to reduce the lifecycle and capital investment costs of analytic efforts while continually enhancing the ability to inform decision-makers within mandated timeframes, fulfilling a key mandate of the Bottom-Up Review.

Workshop Goals and Objectives

The objective of the workshop is to provide a forum to discuss common challenges and address the analytic and decision-support needs for the Homeland Security (HS) Missions and Strategic Goals, affirmed by the *Quadrennial Homeland Security Review*. This includes enhancing our abilities to use analysis to inform decisions for:

- ☐**Mission 1**: Preventing terrorism and enhancing security
- ☐**Mission 2**: Securing and managing our borders
- ☐**Mission 3**: Enforcing and administering our immigration laws
- ☐**Mission 4:** Safeguarding and securing cyberspace
- ☐**Mission 5:** Ensuring resilience to disasters

Additionally, the work shop will focus on the following enabling functions:

- ☐*Developing an Analytic Workforce*: How can we better recruit, train, credential, and retain Program, Mission, and Risk Analysts?
- ☐*The Use of Tools: Models, Simulations, and Data*: How can we better share models and tools? How should we team to develop new models and simulations? How can we develop conditioned data suitable for program analysis and evaluation or modeling and simulation?
- ☐*Analytical Frameworks*: How can we develop an Analytic Agenda to facilitate cross-function/cross mission area coordination and collaboration for program as well as mission and risk analysts?

Workshop Structure

The workshop will include keynote speeches, panel discussions, and breakout working groups addressing specific analytical issues. Please see the agenda for more details. On Day 1, Breakout Groups will address QHSR Missions, grouped according to compatible analysis requirements. On Day 2, Breakout Groups will examine important enabling functions for the DHS analytical capability, including the recruitment, training and certification of analysts; models, data and simulations; and the development and integration of an analytical framework. On both days, summaries of the Groups' preliminary findings will be reported back to the Workshop participants.

Registration

Workshop attendance is open only to DHS federal employees.
For registration details and an up-to-date copy of this workshop announcement and agenda, please visit:
https://www.enstg.com/signup/passthru.cfm?ConferenceCode=WOR38958 Location Data.

Hosted by the NSF Center of Research Excellence in Science and Technology at FIU (Dr. N. Rishe, Director)

Workshop on Analytic Capability Development

FEBRUARY 8, 2011 AGENDA		
Time	**Topic**	**Speaker**
0800 - 0900	***Registration*** *24th Floor Lobby* ***Note:*** *Upon arrival to the Waterview Conference Center all participants will check out an access card that will allow each participant to "badge" themselves thru the security turnstiles for arrival and departures during the duration of the workshop. The access cards must be checked back into the workshop's registration desk prior to departing the meeting on Day 2.*	---
0900 - 0915	***Workshop Introduction and Administrative Remarks*** *Room: Riverview*	**Dr. Nabil Adam,** S&T **Mr. Dean Checknita,** NPPD **Mr. Pierce Ostrander,** PLCY
0915 - 0930	***Workshop Kickoff*** *Room: Riverview*	**Mr. Christopher Doyle,** Director, HSARPA, S&T
0930 - 1000	***Science and Technology Directorate: R&D Partnerships*** *Room: Riverview*	**Dr. Tom Cellucci,** Director, R&D Partnerships, S&T
1000 - 1030	***Keynote Address:*** *"Creating the Homeland Security Analytic Enterprise: Enhancing Our Analytic Capabilities and Systems, and Engaging Decision-Makers of the Benefits of Informed Decision Making"* *Room: Riverview*	**Mr. Rand Beers,** Under-Secretary, NPPD
1030 - 1045	***Break*** *24th Floor Lobby*	---
1045 - 1215	***Panel Discussion:*** *"Views from Outside"* *Room: Riverview*	**Dr. Scott Weidman,** The National Academies **Dr. Dan Chiu,** Office of the Under Secretary of Defense for Policy **Mr. Chris Hart,** National Transportation and Safety Board

Workshop on
Analytic Capability Development

1215 - 1330	***Lunch and Discussion with DHSACDWG Chairs*** ***The Analytic Capability Development Working Group:*** *Why Now?* *Room: Riverview*	**Mr. Dean Checknita,** Interim Co-Chair DHSACDWG NPPD
1330 - 1345	***Movement to Breakout Rooms***	—
1345 - 1530	***Breakout Groups:*** *Homeland Security Missions and Strategic Goals* ***Group A: Missions 1&4*** *Room: Tera* ○ *Preventing Terrorism and Enhancing security* ○ *Safeguarding and Securing Cyberspace* ***Group B: Missions 2&3*** *Room: Archimedes* ○ *Securing and Managing our Borders* ○ *Enforcing and Administering our Immigration Laws* ***Group C: Mission 5*** *Room: Brennan* ○ *Ensuring Resilience to Disasters*	**Mr. Tom Finan,** NPPD **Mr. David Throckmorton ,** CPB **Mr. Cory Gruber,** FEMA
1530 - 1600	***Break/Slide Construction*** *24th Floor Lobby*	—
1600 - 1700	***HS Mission Breakout Group Discussion Presentations*** *Room: Riverview*	**Groups A, B, C Chairs/Co-chairs**

Homeland Security
Science and Technology

Workshop on Analytic Capability Development

FEBRUARY 9, 2011 AGENDA		
Time	**Topic**	**Speaker**
0800 - 0815	***Workshop Welcome Remarks*** *Room: Riverview*	**Dr. Nabil Adam,** S&T **Dr. Naphtali Rishe,** FIU NSF Center **Mr. Dean Checknita,** NPPD IP **Mr. Pierce Ostrander,** PLCY
0815 - 0900	***Panel Discussion:*** *"Views from Inside"* *Room: Riverview*	**DHS CHCO/CLO, CFO, and CIO,**
0900 - 0915	***Break*** *24th Floor Lobby*	---
0915 - 1045	***Breakout Groups:*** *Analytical Capability Enabling Functions* ***Group D:*** *Room: Tera* — *Recruitment, Training, and Certification of Analysts* ***Group E:*** *Room: Archimedes* — *Models, Simulations, and Data* ***Group F:*** *Room: Brennan* — *Analytic Framework and Integration*	**Mr. George Tanner,** MGMT **Mr. Brandon Wales,** NPPD **Mr. Mitch Crosswait,** PLCY
1045 - 1115	***Break/Slide Construction*** *24th Floor Lobby*	—
1115 - 1230	***Analytical Capability Enabling Functions Mission Breakout Group Discussion Presentations*** *Room: Riverview*	**Groups D, E, F Chairs/Co-chairs**
1230 - 1345	***Keynote Closing Speaker*** *'One DHS':* *Using the ACDWG to Align Missions and Provide Decision Makers With Transparent and Defensible Recommendations* *Room: Riverview*	**Mr. Alan Cohn,** Deputy Assistant Secretary for Policy (Strategic Plans)
1345 - 1400	***The ACDWG: Next Steps*** *Room: Riverview*	**Mr. Pierce Ostrander,** Interim Co-Chair DHSACDWG PLCY

Analytic Capability Development Working Group Workshop

February 8 - 9, 2011

Speaker Biographies

Biography: Dr. Nabil R. Adam

I. Research: Dr. Adam serves as a Fellow and Sr. Program Manager at the US Department of Homeland Security - Infrastructure & Geophysical Division, Science & Technology Directorate where he manages the Complex Event Modeling, Simulation, and Analysis program initiated in 2008. He also serves as the technical lead for the Unified Incident Command & Decision Support System program and has initiated the Cyber-physical Systems Security initiative. Dr. Adam is a Professor of Computers and Information Systems at Rutgers University; the Founding Director of the Rutgers University Center for Information Management, Integration and Connectivity; and the Director of the information Technology for Emergency management (i-TEAM) Research Laboratory. Dr. Adam is one of the Co-founders and past Director of the Meadowlands Environmental Research Institute. Additional research positions held include serving as past Chair of the MSIS Department at RBS.

II. Publication and Invention: Dr. Adam has published numerous technical papers covering such topics as information management, information security and privacy, data mining, Web services and modeling & simulation. His papers appeared in refereed journals and conference proceedings including, IEEE Transactions on Software Engineering, IEEE Transactions on Knowledge and Data Engineering, ACM Computing Surveys, Communications of the ACM, Journal of Management Information Systems, and International Journal of Intelligent and Cooperative Information Systems. He has co-authored/co-edited ten books. Dr. Adam is the co-founder and the Executive-Editor-in-Chief of the International Journal on Digital Libraries and serves on the editorial board of a number of journals including Journal of Management Information Systems, and the Journal of Electronic Commerce. He is also the co-founder and past chair of the IEEE Technical Committee on Digital Libraries. Dr. Adam holds a European issued Patent and has two pending patent applications submitted to the U.S. Patent and Trademark Office, all related to Web services.

III. Grants: Dr. Adam's research work has been supported by over $18 million from various federal and state agencies, including: Department of Homeland Security (DHS), the National Science Foundation (NSF), the National Security Agency (NSA), National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (DLA), the National Library of Medicine, the New Jersey Meadowlands Commission, and NASA.

IV. Entrepreneurship: In late 1998, Dr. Adam founded aTi, a software company specialized in providing state-of-the-art Web-based Knowledge Management Enabling software products and associated decision support tools targeted to the pharma/biomedical/healthcare industry. aTi's product suite was used by major content providers to deliver their contents to users around the world. Furthermore, aTi's products were licensed to some of the top 10 global pharmaceutical companies. In 2008, aTi was acquired for millions of dollars by Elsevier Health Sciences.

V. National/International Talks: Dr. Adam has been invited as a keynote speaker and a lecturer at several national/international institutions/forums/workshops, including: 36th Nuclear Information Technology Strategic Leadership Workshop, 2010; 6 Annual Cyber Security and Information Intelligence Research Workshop, Oak Ridge NL, 2010; SCADA Cyber Security Workshop, Univ. of Arizona, 2010; Health and Humanitarian Logistics, Georgia Institute of Technology, 2010; ACM/IEEE International Conference on Cyber-Physical Systems, CPS Week, Stockholm, Sweden, 2010; The Spring Simulation Multiconference (SpringSim'10), 2010; The SISO Spring Simulation Interoperability Workshop, 2010; Information, Technology, and Governance: A Grand Challenges Research Agenda, NSF, 2010; Taiwan National Science Council and National Tsing Hua Univ., Taiwan, 2009; The 5th International Conference on Collaborative Computing: Networking, Applications and Worksharing, 2009; Public Security Conference, The Hague, The Netherlands, 2009; Research & Industrial Collaboration Conference, Northeastern Univ., 2009; The Public Security Innovation Center Seminar, The Embassy of The Kingdom of The Netherlands, US, 2009; NSA Research Transformation Office, 2009; Information Assurance Research and Education Workshop, Arizona State Univ., 2009; NSF Workshop on Data Security, 2009; Power Grid Simulator Workshop, Argonne NL, 2008.

Biography: Mr. Dean Checknita

Mr. Checknita joined the Department of Homeland Security in January, 2009. He is a Senior DHS Fellow and is Chief of the Risk Developing and Modeling Branch for the Homeland Infrastructure Threat and Risk Analysis Center, Office of Infrastructure Protection, National Protection and Programs Directorate. Mr. Checknita leads the National Infrastructure Simulation and Analysis Center that in 2010 responded to over 700 requests for information or analysis and produced 17 major analytic studies. In addition to the complex modeling and simulation based analyses Mr. Checknita is responsible for developing the analytic capability to perform infrastructure risk decision support. Mr. Checknita has led the development and application of Capabilities Based Planning and Assessment and its integration with the DHS processes in the DHS Acquisition Instruction. Mr. Checknita has provided facilitation and other support to many DHS components in the areas of process reengineering, analytic framework development and implementation, and analytic capability integration.

Prior to joining DHS, Mr. Checknita led the Department of the Army Critical Infrastructure Risk Management Program. Mr, Checknita developed a holistic risk management program through the development and conduct of an Integrated Process Team involving DOD components, Army Secretariats, HQDA Staff, and Army commands. This resulted in the establishment of a Three Star led Critical Infrastructure Risk Management Steering Committee to address complex remediation. Mr, Checknita developed and implemented the Critical Infrastructure Risk Analysis Center in the Army Operations Center which produced analytic products and services for which the Center received laudatory comments from the Vice Chairman, Joint Chiefs of Staff. Mr. Checknita also served at the Headquarters, United States Army Material Command where he was a lead analyst for terrorist threats and for impact analysis for disruptions to Army Material Command logistics support to Combatant Commands.

Mr, Checknita has managed regional service operations for the nation's largest electronics retailer and received awards for process reengineering and operations research applications to transportation and distribution.

Mr. Checknita retired from career th in the Army Special Forces. Mr. Checknita had a variety of leadership assignments with the 7 Special Forces Group, 1st Special Forces Group, J-3 Special Operations Command South, and the United States John F. Kennedy Special Warfare Center and School. Mr. Checknita has extensive experience in intelligence, counterterrorism, antiterrorism, and strategic industrial target analysis.

Mr. Checknita has received numerous military awards and academic awards. He holds a M.B.A. degree from Fayetteville State University and a B.S. degree from Liberty University.

Biography: Mr. Christopher Doyle

Acting Director, Homeland Security Advanced Research Projects Agency
Science and Technology Directorate
United States Department of Homeland Security

Mr. Christopher Doyle currently leads the U.S. Department of Homeland Security (DHS), Science and Technology Directorate's (S&T) Homeland Security Advanced Research Projects Agency (HSARPA). As Acting Director, he is responsible for overseeing DHS' research and development (R&D) initiatives in the areas of borders and maritime security, chemical and biological defense, cyber security, explosives, human factors and behavioral sciences, and infrastructure protection and disaster management. Prior to this role, he led R&D for emergency response and critical infrastructure protection as the Director of the Infrastructure Protection and Disaster Management Division.

In his 18 years of public and private sector service, Mr. Doyle has developed a proven track record for identifying and anticipating trends in critical infrastructure protection and emergency management. He has successfully managed recovery efforts in several disasters, including the 1994 Northridge Earthquake, where he was responsible for the administration of over $6 billion in recovery grant funds. He was also responsible for the development of several policies related to disaster recovery to facilitate the streamlined award of grant funding to local and State governments.

After the creation of DHS and the assimilation of Federal Emergency Management Agency (FEMA) into DHS in 2003, Mr. Doyle was requested to serve as the Deputy Director of the Emergency Preparedness and Response Portfolio of Research and Development. In this role, he was essential to the formation of the DHS S&T Directorate. He has taken great strides to partner with the Federal Emergency Management Agency (FEMA) and DHS National Protection and Programs, Office of Infrastructure Protection to collaboratively develop an R&D agenda to address their highest priority R&D needs.

From 2001 until 2003, Mr. Doyle managed the day-to-day operations of both the National Earthquake Hazards Reduction Program and the National Dam Safety Program, facilitating transition of both programs into the post 9-11 environment. He was appointed by the FEMA Director to lead the Office of Corporate Affairs in 2000, where he worked numerous partnering arrangements between FEMA and the private sector to provide enhanced disaster protection at the local level.

He began his Federal career began in 1992 in the headquarters of FEMA where he learned response and recovery from the field and headquarters perspective. Prior to joining the Federal government, he spent three years in the private sector designing infrastructure development plans and managing flood plain development plans.

Since joining S&T, Mr. Doyle has received numerous awards of special distinction from the Undersecretary for Science and Technology for his outstanding public sector leadership. Most recently, one of his programs earned the annual Undersecretary's Award for Science and Technology for 2010. In 1993, he was recognized by the FEMA Director for his achievements during Hurricane Andrew response to relocate disaster victims from tents to trailers and received personal congratulations from then-President George H. W. Bush.

Mr. Doyle graduated from Virginia Tech in 1989 with a Bachelor of Science (BS) in Civil Engineering. He has been a member of the Senior Executive Service (SES) since 2007.

Biography: Dr. Thomas A. Cellucci, PhD, MBA

Chief Commercialization Officer, Director of Public-Private Partnerships and Director of Research and Development Partnerships Group (Acting)

Science and Technology Directorate

United States Department of Homeland Security

Dr. Cellucci accepted a five year appointment in 2007 from the Department of Homeland Security to serve as its first Chief Commercialization Officer. He is responsible for initiatives that identify, evaluate and commercialize technology for the specific goal of rapidly developing and deploying products and services that meet the specific operational requirements of the Department of Homeland Security's operating components, first responders and critical infrastructure/key resources owners and operators. Cellucci conducts DHS-S&T's outreach with both the private and public sectors to establish and foster mutually- beneficial working relationships that facilitate cost-effective and efficient product/service and technology development efforts. He has published eight comprehensive books dealing with the development of operational requirements and innovative public-private partnerships, developed and implemented a commercialization Process for the entire Department and established both the SECURE and FutureTECH[T] programs-- innovative public-private partnerships to cost-effectively and efficiently develop products/services and technologies for DHS' Operating Components, the First Responder community and other DHS stakeholders.

In 2010, while continuing to serve as Chief Commercialization Officer, Cellucci was appointed the Director of the Office of Public-Private Partnerships which oversees the Long Range Broad Agency Announcement (LRBAA) procurement process, Office of SAFETY Act Implementation (OSAI), Small Business Innovation Research (SBIR) Office as well as the Commercialization Office. In addition, he was named Director of Research and Development (R&D) Partnerships Group (Acting) responsible to leverage the billions of dollars in assets and the expertise of more than 1400 team members through the group's investments in national labs, universities, international partners, the private sector and government interagency partners to develop technologies and products for the Homeland Security Enterprise (HSE).

Cellucci is an accomplished entrepreneur, seasoned senior executive and Board member possessing extensive corporate and VC experience across a number of worldwide industries. Profitably growing high technology firms at the start-up, mid-range and large corporate level has been his trademark. In 1999, he founded a highly successful management consulting firm, Cellucci Associates, Inc. He has authored or co- authored over 160 articles on requirements development, commercialization, nanotechnology, laser physics, photonics, environmental disturbance control, MEMS test and measurement, and mistake- proofing processes. Cellucci co-authored ANSI Standard Z136.5 "The Safe Use of Lasers in Educational Institutions." He has also held the rank of Professor or Lecturer at institutions like Princeton University, University of Pennsylvania and Camden Community College.

As a result of his consistent achievement in the commercialization of technologies and role as DHS' first Chief Commercialization Officer, Cellucci has received numerous awards from industry, government and business. In addition, he has had the opportunity to interact with high ranking members of the United States government—including the White House, US Senate and US House of Representatives—having provided several executive briefs to three Presidents of the United States and ranking Members of Congress.

Cellucci earned a PhD in Physical Chemistry from the University of Pennsylvania, an MBA from Rutgers University and a BS in Chemistry from Fordham University. He has also attended and lectured at executive programs at the Harvard Business School, MIT Sloan School, Kellogg School and others.

Biography: Mr. Rand Beers

Under Secretary for the National Protection and Programs Directorate (NPPD) and Counter-Terrorism Coordinator
United States Department of Homeland Security

Rand Beers was appointed by President Barack Obama to serve as the Under Secretary for the National Protection and Programs Directorate (NPPD) at the U.S. Department of Homeland Security (DHS). On June 19, 2009, Beers was confirmed by the United States Senate to direct NPPD's integrated efforts to reduce risks to physical, cyber and communications infrastructures. NPPD collaborates with all levels of government, the private sector, non-government organizations, and international bodies to prevent, respond to, and mitigate threats to U.S. national security from acts of terrorism, natural disasters, and other catastrophic events. In March 2010, Secretary Janet Napolitano designated Mr. Beers as the Counter-Terrorism Coordinator to better organize and synchronize DHS' counter-terrorism related efforts and activities.

As Under Secretary for NPPD, Beers oversees the coordinated operational and policy functions of the Directorate's subcomponents - Cybersecurity and Communications (CS&C), Infrastructure Protection (IP), Risk Management and Analysis (RMA), and the United States Visitor and Immigrant Status Indicator Technology (US-VISIT) program - in support of the Department's critical mission.

Before his appointment, he was the co-lead of the DHS Transition Team for the incoming Obama Administration. Prior to the 2008 election, Beers was the President of the National Security Network, a network of experts seeking to foster discussion of progressive national security ideas around the country, and an Adjunct Lecturer at the Kennedy School of Government at Harvard, starting both in 2004.

Beers began his professional career as a Marine officer and rifle company commander in Vietnam (1964-1968). He entered the Foreign Service in 1971 and transferred to the Civil Service in 1983. He served most of his career in the Department of State, including as Deputy Assistant Secretary of State for Regional Affairs in the Bureau of Politico-Military Affairs, focusing on the Middle East and Persian Gulf (1992-1993). He was Assistant Secretary of State for International Narcotics and Law Enforcement Affairs (1998-2002).

Beers also served on the National Security Council (NSC) under the previous four Presidents: Director for Counter-terrorism and Counter-narcotics (1988-1992), Director for Peacekeeping (1993-1995), and Special Assistant to the President and Senior Director for Intelligence Programs (1995-1998), and Special Assistant to the President and Senior Director for Combating Terrorism on the NSC Staff (2002-2003). He resigned from the NSC in March 2003, retired from government service in April 2003, and served as national security advisor for the Kerry-Edwards campaign (2003-2004).

Beers earned a bachelor's degree from Dartmouth College and a master's degree from the University of Michigan.

Biography: Dr. Scott T. Weidman

Scott T. Weidman is the director of the National Research Council's Board on Mathematical Sciences and Their Applications (BMSA). He joined the NRC in 1989 with the Board on Mathematical Sciences and moved to the Board on Chemical Sciences and Technology in 1992. In 1996 he established a new board to conduct annual peer reviews of the Army Research Laboratory, which conducts a broad array of science, engineering, and human factors research and analysis, and he later directed a similar board that reviews the National Institute of Standards and Technology. He has been full-time with the BMSA since mid-2004. During his NRC career, he has staffed studies on a wide variety of topics related to mathematical, chemical, and materials sciences, laboratory assessment, risk analysis, and science and technology policy. His current focus is on building up the NRC's capabilities and portfolio related to all areas of analysis and computational science. He holds bachelor degrees in mathematics and materials science from Northwestern University and M.S. and PhD degrees in applied mathematics from the University of Virginia. Prior to joining the NRC, he had positions with General Electric, General Accident Insurance Company, Exxon Research and Engineering, and MRJ, Inc.

Biography: Mr. Christopher A. Hart

Christopher A. Hart is the Vice Chairman of the National Transportation Safety Board, having been nominated by President Obama and confirmed by the Senate in 2009. The NTSB investigates major transportation accidents in all modes of transportation, determines probable cause, and makes recommendations in an effort to prevent recurrences. He was previously a Member of the NTSB in 1990, having been nominated by (the first) President Bush.

Mr. Hart's previous positions have included:

- Deputy Director, Air Traffic Safety Oversight Service,
- Federal Aviation Administration,
- Assistant Administrator for System Safety, Federal Aviation
- Administration,
- Deputy Administrator for the National Highway Traffic Safety Administration (NHTSA),
- Deputy Assistant General Counsel to the Department of Transportation, Managing partner of Hart & Chavers, a Washington, D.C., law firm, and
- Attorney with the Air Transport Association.

Mr. Hart has a law degree from Harvard Law School and a Master's Degree (magna cum laude) in Aerospace Engineering from Princeton University. He is a member of the District of Columbia Bar and the Lawyer-Pilots Bar Association, and he is a pilot with commercial, multi-engine, and instrument ratings.

Biography: Mr. Tom Finan

Tom Finan is a Senior Counsel and Cyber Strategist with the Department of Homeland Security's National Protection and Programs Directorate (NPPD), where he is currently leading the effort to develop proposals for a resiliency-focused analysis and modeling office for NPPD that examines both cyber and physical threats to critical infrastructures, systems, and the public. Prior to his current project, Mr. Finan led discussions across DHS about how to establish a predictive analytics capability regarding cyber threats and facilitated the development of four programmatic options for consideration by senior DHS and NPPD leadership. Mr. Finan also was selected to work on an Integrated Project Team (IPT) to transform NPPD from a DHS Headquarters component into a stand-alone, operational component focused on promoting resilience and economic/homeland security.

Prior to his work as Senior Counsel and Cyber Strategist, Mr. Finan worked as a Senior Advisor for Intelligence, Analysis and Operations for the Department's then Acting Under Secretary for Intelligence and Analysis. He previously served for four years as the Director for the Subcommittee on Intelligence, Analysis and Terrorism Risk Assessment with the House Committee on Homeland Security. During his service with the Committee, Mr. Finan authored two major reports: *Beyond Connecting the Dots: A VITAL Framework for Sharing Law Enforcement Intelligence Information* and *LEAP: A Law Enforcement Assistance and Partnership Strategy*. Both reports informed many of the statutory provisions that Mr. Finan developed for Title V of the Implementing Recommendations of the 9/11 Commission Act of 2007 (P.L. 110-53).

Mr. Finan had previously worked as a litigator in private practice and, following the 9/11 attacks, worked as an Assistant General Counsel within the FBI's Office of General Counsel Civil Litigation Unit I. Mr. Finan is a cum laude graduate of the University of Minnesota Law School and received his B.A. With High Honors from the University of Virginia. He resides with his wife and three children in Silver Spring, Maryland.

Biography: Mr. David Throckmorton

David Throckmorton is currently on detail from Department of Homeland Security's Science & Technology Directorate to Customs and Border Protection Office of Technology Innovation and Acquisition. He has over 25 years of acquisition experience primarily in DoD. Mr. Throckmorton's background is in systems engineering and program management. He was responsible for several weapons integration efforts for US Navy aircraft. He also spent 9 years in the Missile Defense Agency developing system architectures and specifications. He is currently the Director of Technology Management for CBP/OTIA developing a technology roadmap, technology transition strategies, and identifying modeling requirements, capabilities, and gaps.

Mr. Throckmorton holds a B.S. in Aerospace and Ocean Engineering from Virginia Tech and a M.S. in Systems Engineering from Johns Hopkins University. He is certified DAWIA Level III in both Program Management and Systems Planning, Research, Development and Engineering.

Biography: Mr. Corey Gruber

Assistant Administrator, National Preparedness Directorate
Federal Emergency Management Agency, US Department of Homeland Security

Corey Gruber serves as the Assistant Administrator of the National Preparedness Directorate in the Federal Emergency Management Agency (FEMA), Department of Homeland Security. The Directorate has six components with over 300 personnel, including seven senior executives, and a budget of $500 million. The Directorate is charged with providing guidance, programs, activities and services to prepare the Nation to prevent, protect from, respond to and recover from all hazards. The Directorate oversees sixty-four training institutions and providers, supports nearly 150 homeland security exercises annually, including National-Level and Principal-Level (i.e., Cabinet-level) Exercises, and provides grants and cooperative agreements that target key preparedness initiatives in States and the Nation's largest urban areas. In 2006-7, he served as Acting Deputy Administrator of the newly formed Directorate and led its integration into the Agency. As Assistant Deputy Administrator he oversees establishment of the National Preparedness System required by Homeland Security Presidential Directive 8 (National Preparedness) and the Post Katrina Emergency Management Reform Act (PKEMRA), which includes eight components ranging from standards development to establishment of a comprehensive national preparedness assessment system. He is a recipient of the 2006 Secretary's Meritorious Service Award - Silver Medal. In 2010 he received the Presidential Meritorious Rank Award. He received his bachelor's degree from Pennsylvania State University, and his master's degree from Chapman University. He was certified as an Emergency Medical Technician in the State of Georgia in 1980. He is married and has two children, including a son who currently serves in the U.S. Army Special Forces.

Biography: Mr. Brandon Wales

Brandon Wales is the Director of the Homeland Infrastructure Threat and Risk Analysis Center (HITRAC) and responsible for managing the Center's $40 million budget and approximately 100 threat and risk analysts. Under his leadership, HITRAC has grown from an intelligence-centric organization to a robust all-hazards analytic resource for public and private sector partners covering the full-array of risks and challenges facing the infrastructure community.

Mr. Wales also oversees the Department's advanced modeling, simulation, and analysis program at the National Infrastructure Simulation and Analysis Center (NISAC), where researchers from the Los Alamos and Sandia National Laboratories conduct ground-breaking and forward-leaning analysis of some of the Nation's most complex infrastructure challenges.

Prior to joining the Department, Mr. Wales served as the principal national security advisor to United States Senator Jon Kyl and as a Senior Associate at a Washington-based foreign policy and national security think-tank.

Mr. Wales received his Bachelor's degree from George Washington University and his Master's degree from Johns Hopkins School of Advanced International Studies.

Biography: Dr. K. "Mitch" Crosswait

CURRENT POSITION: Deputy Director, Strategic Requirements, Capabilities and Assessments Division, Office of Policy (Strategic Plans), Department of Homeland Security. Responsibilities include development and management of the Department's Strategic Requirements Planning Process, which translates strategic goals into measurable requirements, and the integration of this process with the Department's programming, budgeting and execution processes.

EDUCATION: B.S., Applied and Engineering Physics, Cornell University, 1984
Ph.D., Nuclear Engineering, Massachusetts Institute of Technology, 1994

2004-2007: Director, Strategy, Planning and Integration, Science and Technology Directorate, Department of Homeland Security

2001-2004: Senate Armed Services Committee Staff Member

1996-2001: Senior Analyst, Strategic Defensive and Space Programs Division, OSD(PA&E)

1994-1996: Nuclear/Systems Engineer/Group Leader, TRW Environmental Safety Systems

1990-1994: Graduate Student, Massachusetts Institute of Technology

1984-1990: Technical Manager/Project Engineer, DoD/Naval Reactors Program

Biography: Mr. Alan D. Cohn

Deputy Assistant Secretary for Policy (Strategic Plans)

Alan D. Cohn is Deputy Assistant Secretary for Policy (Strategic Plans) at the U.S. Department of Homeland Security (DHS). Cohn is responsible for directing the Department's strategic planning activities, including strategy development, strategic analysis, and strategy input and direction to the Department's planning, programming, and budgeting process, its investment and acquisition process, and various capability development and Department management processes. He also represents DHS on several interagency strategy and policy committees and reviews. Cohn directed the first Quadrennial Homeland Security Review (QHSR) and oversaw the development of the QHSR Report (2010) and the follow-on DHS Bottom Up Review Report (2010). He is a member of the career Senior Executive Service and served as the Office of Policy's Senior Transition Officer for the 2008-2009 Presidential transition.

Cohn previously served as Director of Emergency Preparedness and Response Policy in the DHS Office of Policy Development from June 2006 to December 2007. During that time, he was responsible for developing and coordinating Department-wide policies regarding the Department's preparedness, response, and recovery mission. Cohn received the Secretary's Silver Medal in 2007 for his work in that position.

Prior to joining DHS in June 2006, Cohn was counsel at Akin Gump Strauss Hauer & Feld LLP in Washington, D.C. He practiced labor and employment law and counseled clients with respect to homeland security issues.

Cohn is an Adjunct Professor at Georgetown University Law Center, where he teaches a course he developed on domestic preparedness law and policy. He authored or co-authored chapters on federalism and catastrophic events, sources of public funding for preparedness, and mutual aid agreements in HOMELAND SECURITY AND EMERGENCY MANAGEMENT: A LEGAL GUIDE FOR STATE AND LOCAL GOVERNMENTS (Ernest B. Abbott & Otto J. Hetzel eds., 2d Ed., American Bar Association 2010), and has written and spoken on a variety of homeland security and emergency management issues.

Cohn has been a certified emergency medical technician (EMT) since 1990, and was associated with FEMA's National Urban Search & Rescue (US&R) Response System from 1995 until he began service with DHS in 2006. He served as a Planning Officer on the Fairfax County US&R Task Force from 1998 to 2006, as a US&R officer in the Joint Field Office in Austin, Texas during the response to Hurricane Rita in 2005, and as a US&R officer in the National Response Coordination Center during the initial FEMA US&R response to the attacks of September 11, 2001 as well as during the 1995 and 1996 hurricane seasons. Cohn responded to the 1993 World Trade Center bombing as an EMT with the New York City emergency medical services system. Cohn holds an A.B. from Columbia University and a J.D. from Georgetown University Law Center.

Biography: Naphtali David Rishe

The Inaugural Outstanding University Professor
Professor of Computer Science
Director, FIU High Performance Database Research Center
Director, NASA Regional Applications Center in Miami
Director, NSF FIU-FAU-Dubna Industry/University Cooperative Research Center for Advanced Knowledge Enablement
Director, NSF Center of Research Excellence in Science and Technology at FIU

Dr. Rishe is the Author of 3 books on database design and geography; Editor of 5 books on database management and high performance computing; Inventor of 4 U.S. patents on database querying, semantic database performance, Internet data extraction, and computer medicine; Author of 300 papers in journals and proceedings on databases, software engineering, Geographic Information Systems, Internet, and life sciences; Awardee of over $40 million in research grants by Government and Industry, including NASA, NSF, IBM, DoI, USGS; Architect of major industrial projects -- both prior to his academic career, and as a consultant since; Founder and Director of the High Performance Database Research Center at FIU (HPDRC); Director of the NSF Center for Research Excellence in Science and Technology at FIU (CREST) and of the NSF International FIU-FAU-Dubna Industry-University Cooperative Research Center for Advanced Knowledge Enablement (I/UCRC); Mentor of 70 postdocs, PhDs and MS; the inaugural FIU Outstanding University Professor. Rishe's TerraFly project has been extensively covered by worldwide press, including the *New York Times*, *USA Today*, NPR, *Science* and *Nature* journals, and *FOX TV* News.

Principal Projects:

- TerraFly -- a 40 TB database of aerial imagery and Web-based GIS
- Semantic Wrapper of Relational Databases and Application of SQL for Concise Semantic Querying
- Semantic Database Management
- Medical Informatics

High Performance Database Research Center, School of Computing and Information Sciences, University Park, FIU ECS-243, Miami, FL 33199
Telephone: (305) 348-1706; FAX: (305) 348-1707; rishe@fiu.edu

http://HPDRC.fiu.edu