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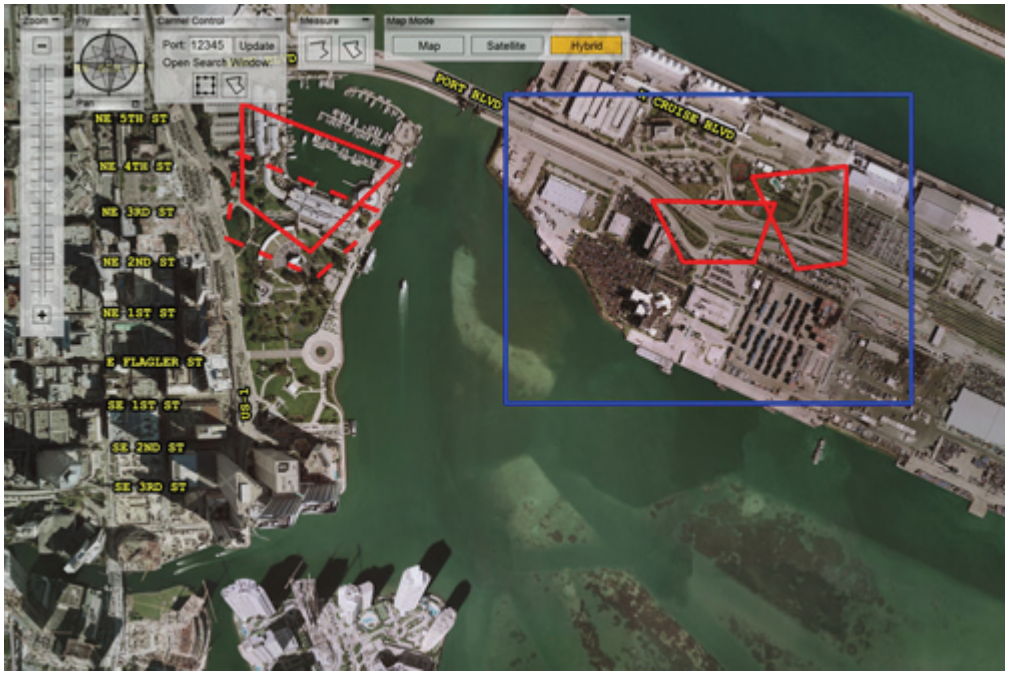
TerraFly Maps Enable Monitoring of Airborne Cameras

Although video surveillance recording is the state-of-the-practice, the video collected is normally used only after the fact – it cannot easily be accessed in real time, does not have accurate geolocation capabilities, and cannot be easily integrated with other forms of critical information. This state-of-the-practice lack of situational awareness will be overcome by the CARMEL-TerraFly system.



CARMEL-TerraFly user interface. The map shows the Port of Miami with moving traces of areas videotaped by airborne cameras. Solid trapezoids are ground projections synchronized with playback, dotted trapezoids are real-time projections of cameras' views. The blue rectangle allows selection of video fragments at times and locations of interest.

The project integrates cutting-edge Context Aware Rich Media Extensible Middleware technology (known as CARMEL) from IBM Research – Haifa (http://www.haifa.ibm.com) with the TerraFly Geospatial System at the Center for Advanced Knowledge Enablement (CAKE). This integrated system offers innovative situational awareness technology, while helping expand the Center's international influence and connections. By combining IBM Haifa's Geographic Information Systems (GIS) and streaming technology research, CARMEL is a geographically anchored, video-on-demand streaming infrastructure that provides: 1) scalable, end-to-end low-delay and resilient streaming technologies; 2) on-demand bandwidth adaptation (transcoding); 3) highly accurate geographical searches, 4) real-time, geo-located notification, and; 5) high performance, service oriented architecture-enabled technologies.

TerraFly is a technology and tools for the visualization and querying of geospatial data. It 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, 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. The interface allows rapid deployment of interactive Web applications. It is accessible from anywhere via any standard Web browser, with no client software to install.

This novel technology would transform public safety assurance and the ability to quickly respond to situations. The CARMEL-TerraFly project marries these two technologies, providing geographically anchored streaming services that can be combined with and accessed via the intuitive TerraFly user interface. Users will be able to select a geographic area of interest, retrieve multimedia data from sensors in the area and view streaming video of moving objects in real time (e.g., vehicles, people, animals, etc.). Users will also be able to set temporal and geographic constraints to view the path traversed by a specific moving object or group of objects. There are numerous potential applications for this advanced technology, particularly for command and control operations such as homeland security, law enforcement and disaster response. For example, using the CARMEL-TerraFly system, law enforcement could be alerted to a situation such as a hit-and-run accident. Officers would be able to quickly pin-point the geographic location, view streaming media of the current location to quickly assess the situation, and, through the use of additional sensors, track the offender's vehicle.

> **Economic Impact:** The potential economic impact of CARMEL-TerraFly is substantial because it can be a cost effective public safety tool that reduces law enforcement costs, increases effectiveness of situational evaluation and response and contribute to economic improvement of areas. Litigation costs could also be decreased as more timely and accurate evidence becomes available for use in and out of the courtroom. In addition, the system could improve the effectiveness of situational evaluations and subsequent responses by providing tools for better resource allocation, thus improving the safety of responders and the public, and ultimately saving lives and property. Finally, use of this system could ultimately reduce crime, which, in turn, would lower the cost of doing business and contribute to local and national economic improvement.

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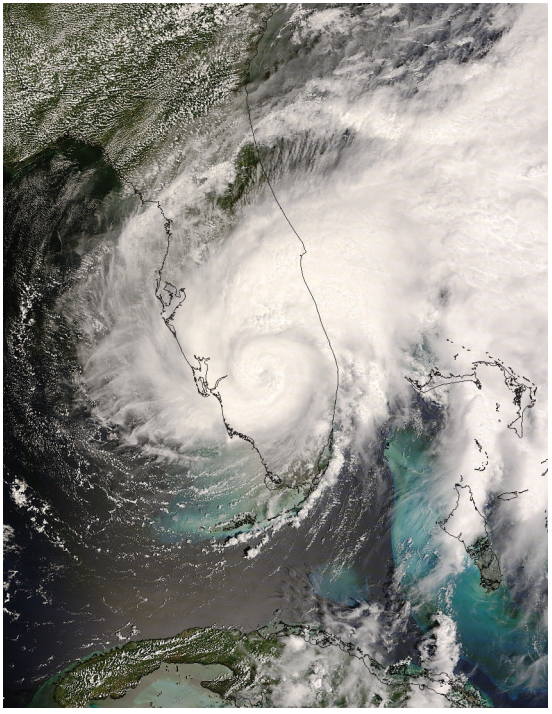
Business Continuity Information Network: Faster Community Driven Disaster Recovery



Technology used during the storm Fay, which impacted Florida.

In coastal areas throughout the US information sharing is critical for community resilience and protection of economic interests. Studies indicate that following hurricanes approximately 40% of companies fail within 36 months when they were closed for 3 or more days. Years of meteorological data have demonstrated that South Florida is particularly prone to extensive damage from hurricanes. There are a myriad of toolkits, checklists, and other business continuity tools available that address how to prepare businesses for disaster. None of these stand-alone tools provide a means for business users to connect with local governments to monitor ongoing situations before, during and after natural disasters.

The Business Community Information Network (BCIN), at the Center for Advanced Knowledge Enablement (CAKE), provides a platform for public and private sector communities to work in a coordinated fashion, providing the right information, to the right person, at the right time, in the right format. Florida International University, its public and private sector partners, including Office Depot, Wal-Mart, IBM, the Greater Miami Chamber of Commerce, and county and city government agencies, have developed BCIN; a unique information sharing web-based software that provides a means for at-risk local businesses to receive and share timely and vital preparedness, response, and recovery information. This information helps protect critical infrastructure and provide high demand recovery resources.

CAKE researchers have captured processes, workflow, and continuity "best practices" in an intuitive user interface that displays, queries and reports on over 26 different situational categories such as ports, roads, utilities, fuel, and other critical infrastructure and recovery resources. The BCIN is available year-round as a service. This business-to-business community network provides participating companies with a new powerful tool to track their key employees and supply chain status, and locate needed recovery goods and services. The system helps government agencies assess damage and prioritize recovery needs.

Economic Impact: Based on training exercises, surveys and other feedback our participants feel they will significantly benefit by utilizing the system and its capabilities. Information sharing is critical for community resilience and overall economic well being in coastal areas throughout the US. Since May 2009, the system has been operational in four South Florida counties: Miami-Dade,

Broward, Palm Beach, and Monroe. The system was tested in response to storms Fay (see photo), Gustav, and Ike and used in numerous state and local hurricane and terrorist disaster training situations. Hundreds of individuals from government agencies, NGOs, and businesses have been acquainted with and trained on the system. Based on data from the Insurance Information Institute, if 5% of the companies in South Florida could gain the capability to speed up their hurricane recovery by one week, then $220M of non-property economic losses could be avoided.

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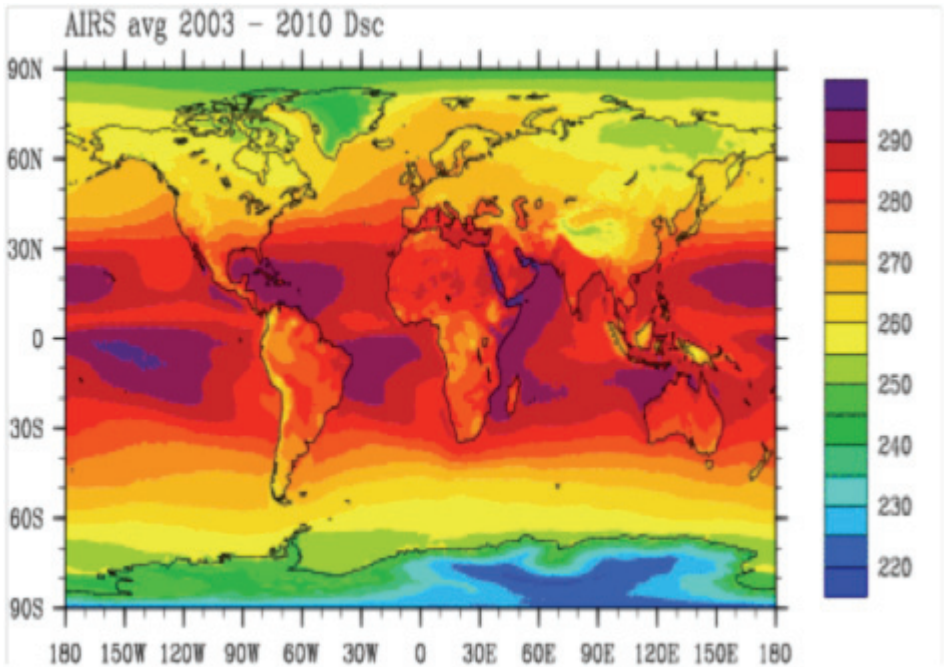
Distributed Cloud Computing: 3-D Visualization Services for Climate Data on Demand

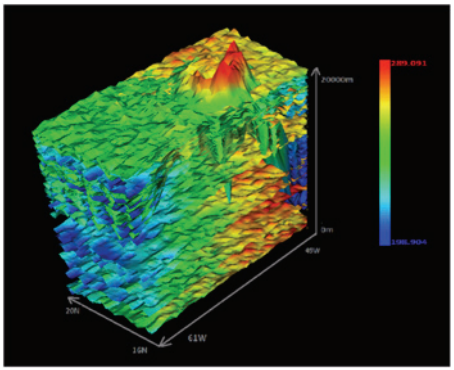
This study is a collaboration between CAKE and the Center for Hybrid Multicore Productivity Research (CHMPR) on page 79 at UMBC.



An example of the 8 year global average surface BT from 2003-2010.

Measuring the surface temperature of the entire Earth on a daily basis is a difficult challenge because 75% of the planet is covered with oceans and ice. Continuously determining, for several days to weeks, the vertical thermal field around a hurricane surrounded by dynamically rotating clouds is needed for more accurate landfall predictions. Thus, for applications ranging from climate change to hurricanes, satellites

measure the Earth's emitted infrared radiation twice daily with sufficiently high spatial and spectral resolution to provide an estimate of vertical profiles of regional or global surface brightness temperature (BT). However, in order to assess global warming, these temperatures need to be measured to within an accuracy of 0.10 °C per year since models indicate CO_2 warming of ~20-30 over 100 years. Moreover, to resolve the structure around hurricanes, infrared data at resolutions of 1-5 km are needed. Not until 2002, when the Aqua satellite was launched, has there been a single satellite with instruments that can meet both the accuracy and the spatial resolution required.



Atmospheric temperature layers up to 20,000 meters (65,619 feet).

In this multi-center collaborative project, researchers from the Center for Hybrid Multicore Productivity Research (CHMPR) at UMBC and the Center for Advanced Knowledge Enablement (CAKE) at Florida International University (FIU) and Florida Atlantic University (FAU) have developed a capability to deliver a decade of 3-D gridded arrays of animated visualizations of spectral IR satellite radiance data from instruments on AQUA. These animations render in 3-D the vertical structure of a decade of global and regional temperature trends occurring at the surface and lower troposphere. In addition, the gridding algorithm developed by CHMPR has been applied to providing CAKE with 3-D temperature profiles that specify the thermal structure around hurricanes in order to improve their landfall prediction.

CHMPR and CAKE have implemented a distributed cloud computing web-based service, called SOAR, that incorporates this visualization capability as a public service available on an advanced IBM-based server cluster. This system provides researchers and students with the ability to select regional and temporal periods and automatically transform IR orbital satellite data into spherical grid arrays of 3-D temperature profiles for viewing the continuous changing thermal structure of the atmosphere. The FIU site at CAKE augmented the satellite data visualization by providing spatiotemporal visualization and animation of the data (http://cake.fiu.edu/SOAR). The FAU site at CAKE has developed tools for 3-D visualization of the vertical temperature profiles. When coupled with gridding CHMPR software, render for the past decade the first integrated scientifically validated multi-year infrared brightness temperature record.

> **Economic Impact:** Fundamental Decadal Data Records are highly desired products recommended by the National Academy of Science/National Research Council. The SOAR distributed cloud computing web-based service enhances NASA's ACCESS program by providing fundamental brightness temperature records. This can go a long way towards improving scientific and public understanding of the nature of global and regional climate change. As a result, everyone can be better positioned to design any necessary policies and actions for mitigating negative impacts on the economy.

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