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THE IRIS STORMLOG APPLICATION

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1. INTRODUCTION

The National Weather Service (NWS) Inter-Regional Integrated Services (IRIS) Database Project seeks to create a single foundation upon which numerous independent yet compatible software applications can be built (Schmidt et al. 2008). These applications will help consolidate the collection and management of critical information at NWS offices during active weather. One of the first such programs being developed for the IRIS platform is StormLog, a map-based web application for managing contact information, for logging interactions between the NWS and these contacts, and for tracking outreach activities.

Two key components of the IRIS project are a geospatially enabled relational database and a set of programming libraries that can be utilized for collaborative development of applications. Initial IRIS applications like StormLog will support better coordination and communication within a forecast office, between offices, and with external partners.

The IRIS project also seeks to demonstrate how an agency-wide Enterprise Geographic Information System (GIS) would support this and many other NWS projects. The map-based StormLog interface is designed to help generate more timely and accurate storm reports for improved decision support, greater scientific integrity, and enhanced performance measures.

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A great deal of time has been spent assembling the geographic foundation required to support the StormLog map interface. If these mapping components and geographic data were already available in an Enterprise GIS, IRIS and countless other map-based applications in the NWS could leverage those resources instead of duplicating the effort of building them from scratch.

Members of the IRIS project team continually reinforce the need for Regional and National support, assistance, and cooperation. This priority is reflected in the "Inter-Regional" name of the project itself. IRIS has never been a project confined to one forecast office or one NWS region. From the very beginning its goal has been to identify related projects across the agency and get those people working together toward a common goal.

2. STORMLOG AND THE IRIS PROJECT

IRIS applications like StormLog do not duplicate tools such as the NWS Advanced Weather Interactive Processing System (AWIPS) for interrogating hydro-meteorological data (Friday, 1994). Rather, IRIS applications track NWS partner and customer information, customer needs, and all interactions between the NWS and those affected by its services (Figure 1).

During active weather, many NWS customers become important partners in the agency mission, feeding critical reports to forecast offices while simultaneously disseminating NWS products to a wider audience. The NWS long ago established the importance of having up-to-date information about these vital contacts readily available to the

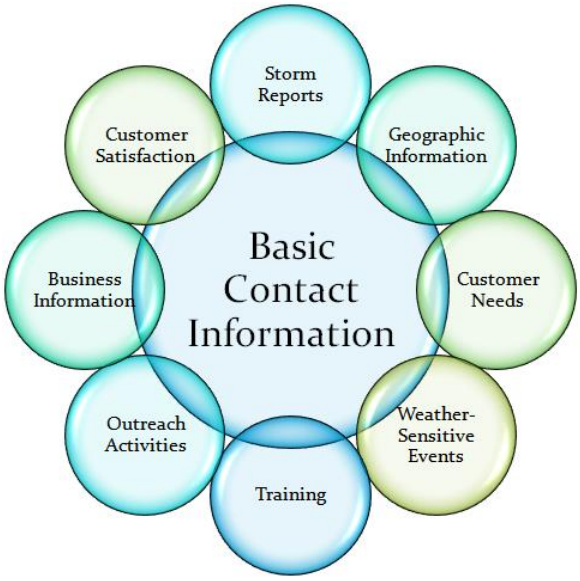

Figure 1. Potential IRIS database content.

operational forecaster (e.g. U.S. Department of Commerce, 1991). Even so, the NWS has never initiated a national effort to create a platform for managing this information across the agency. StormLog for the first time would provide a standardized method for storing and sharing contact information as well as storm reports during severe weather.

During periods of quiet weather, many of the interactions between NWS employees and external contacts could be considered Customer Relationship Management (CRM) activities. These might include spotter training classes, media interviews, meetings, seminars, and any other outreach work. It is through these interactions that the agency gains a better understanding of what its customers need and how those services can be provided. However, since much of this work is performed by personnel at local forecast offices, information about customer needs may be well understood but confined within these local offices. IRIS therefore offers a common agency-wide platform for tracking CRM activities as well as the information they generate. In this way IRIS supports better coordination with customers and sets the stage for a greater focus on service requirements for the agency as a whole.

The IRIS project recognizes that it would make little sense for the NWS to track CRM information in one database while keeping storm reports and partner information somewhere else. By putting all of this information in a single database, IRIS avoids the duplication of effort that would be required to maintain two independent copies of basic contact information. In this way IRIS also serves the needs of internal and external NWS users at all levels, from local forecast offices to national headquarters.

3. MOTIVATIONS

The IRIS StormLog program is a complete redesign of the StormLog application that has been in use at the St. Louis NWS office for several years. There were two primary motivations for the creation of the original StormLog. The first was to improve the management of contact information. The second was to improve the management of report information. These same motivations are the foundation for the new application.

3.1 Better Management of Contact Information: From the Desktop to the Server

Staff members at NWS forecast offices interact with a large number and wide variety of contacts during active weather. These contacts include trained spotters, law enforcement agencies, emergency managers, and the media. StormLog was designed to administer all of this information in one central location that could be accessed from anywhere in the office and by any staff member. While the Intranet at St. Louis already did this fairly well for most types of contacts, managing local spotter records required a lot more work.

Prior to the development of StormLog at St. Louis, local spotter records were stored in a Paradox desktop database on the PC of the Warning Coordination Meteorologist (WCM). When the WCM would conduct a spotter training session, attendees could elect to fill out an information sheet so they could be contacted in the future, especially during active weather. The WCM would assign each spotter a unique number and then enter their information, including name, address, training date, and phone numbers, into the database. Over the years roughly 2000 records accumulated. To make these somewhat manageable, spotter records for each of the counties in the St. Louis County Warning Area were given a separate database table, for 47 tables overall. Periodically each table was exported to a static webpage on the office Intranet and to the AWIPS D2D Spotters Readout.

This approach had both merits and disadvantages. The most important merit was that

spotter records were even maintained at all. Especially in rural areas, trained spotters who can be contacted during an event often are the best source of ground-truth information for decision assistance and warning verification. The Paradox solution provided a central location where all spotter information could be contained, which greatly aided in the outreach and severe weather verification programs.

The biggest disadvantage of this approach was storing all of the records in a desktop database on the WCM's computer. This made it difficult for anyone besides the WCM to view the latest information until it was exported. Likewise, it was inconvenient for anyone besides the WCM to update records or add new ones. Corrections to static information on the Intranet were jotted on a sheet of paper and left for the WCM to address as time permitted. Perhaps weeks later the actual webpages and other dependent interfaces, like the AWIPS Spotters Readout, would be updated. These update issues made the accuracy of the database contents questionable at times, and provided a single point of failure if a hardware issue occurred on the WCM computer without a recent database backup.

Instead of using a desktop database, the IRIS StormLog application consolidates critical contact information in a server database. This way the most current information is available at all times and can be displayed dynamically by any forecaster from any PC. Any staff member can edit the data, and all updates are available everywhere instantly, including at backup offices. Up-to-date information can be organized in tables or overlaid with maps, radar images, satellite photos, and other imagery (Figure 2). Although StormLog is designed for the administrative PC network in NWS offices, AWIPS applications that display contact information, such as the Spotters Readout, also can be updated automatically on a nightly basis from the IRIS database.

The Stormlog application would allow any member of the local forecast office to access outreach information which would become extremely important if the Warning Coordination Meteorologist (WCM) is not available to provide the needed information.

3.2 Better Management of Report Information

An important feature of the D2D program in AWIPS is that it can display hydro-meteorological

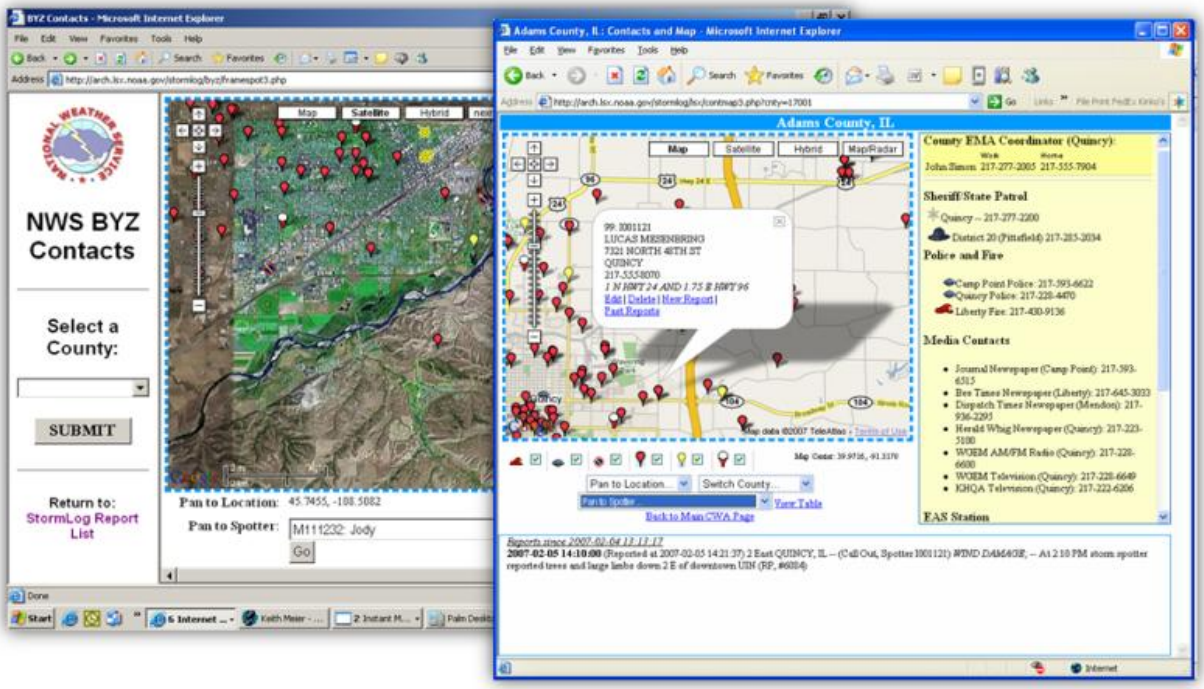

Figure 2. Prototypes of the StormLog interface for displaying contact information at NWS offices in Billings, MT, (left) and St. Louis, MO.

data from myriad sources together on one screen. For example, radar and satellite imagery can be overlaid with surface and upper-air observations, lighting data, and numerical model output. Prior to the deployment of AWIPS, NWS meteorologists consulted multiple independent data platforms while trying to assemble a coherent picture of the atmosphere. In most NWS offices today, this same approach is used to manage the wide variety of reports that are collected during active weather.

3.2.1 Getting Away From Paper Logs

When the original StormLog was developed at St. Louis around 2001, severe weather reports came mainly from phone calls into or out of the forecast office. Each staff member kept their own paper log and shouted reports across the room. No one person had a complete picture of the entire event as it unfolded. This made it difficult to incorporate details of reports in warnings and follow-up statements and to send real-time Local Storm Reports (LSRs). After an event, the individual logs were collected and the reports were compiled. Even then it could be fairly difficult and time-consuming to assemble a comprehensive summary of all the information.

After StormLog was implemented, staff could log phone calls electronically on any PC. Once a call was logged, it was visible on any of the office PCs. StormLog soon replaced paper phone logs completely. This cut down on noise, improved communication, and reduced duplication of effort by helping avoid repeat calls to one source. Online logs also helped warning forecasters incorporate real-time reports into statements. After an event, or even weeks or months later, it was easy to print a nicely formatted log of all the reports sorted by time of occurrence.

In order for the StormLog application to be fully functional, it must also allow a Local Storm Report (LSR) or similar product to be sent at the same moment a credible severe report is logged, without re-entering information in a separate application. Of course, non-severe reports also have value and could be disseminated in a similar manner.

3.2.2 Integrating Every Type of Report

While StormLog originally was designed to replace paper phone logs, reports today in the NWS might come not only from phone calls but from various external sources such as E-Spotter, a chat message, an email, an amateur radio operator, a mesonet, or the Automated Surface Observing System. Each of these constitutes an independent data portal. As with the AWIPS platform, there needs to be a way of integrating all of this information into one display (Figure 3).

The NWS also must position itself to take advantage of other data sources or new communication technologies that become available in the future. One underutilized technology that exists today is the Automated Position Reporting System (APRS). APRS uses amateur radio to transmit position reports, weather data, and messages between users. This would be an ideal source of data for sending directly to a system like IRIS.

Another tool that would be extremely useful for decision assistance or warning verification is a camera phone with a global positioning system (GPS). Although even a simple text message might be valuable, spotters or the public with a GPS camera phone could snap a storm or damage photo and send it directly to the NWS. The exact time and location of the photo would be included automatically. This concept actually was tested for several months with great success at the St. Louis forecast office.

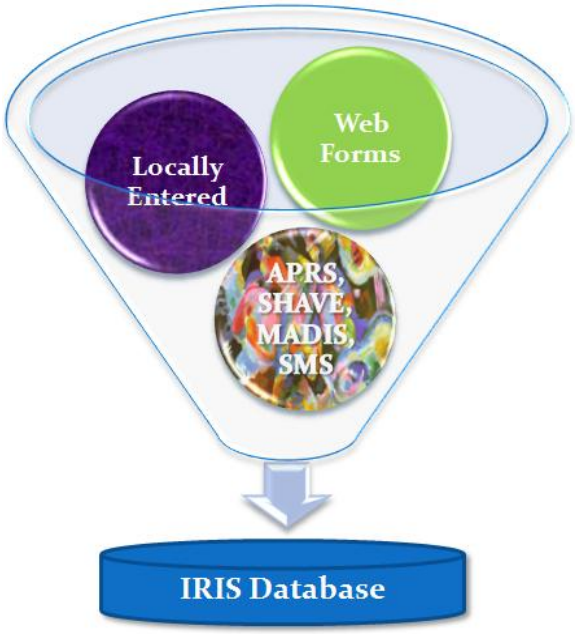

Figure 3. Reports from any portal should be funneled to a single database.

Finally, in 2006 the National Severe Storms Laboratory conducted the Severe Hail Verification Experiment, or SHAVE (Smith, 2006). The primary objective of this experiment was to describe the distribution of hail sizes in hail swaths produced by severe thunderstorms. Collection of high temporal and spatial resolution data was enhanced via verification telephone calls to select data points along a storm's path immediately following storm passage. As valuable as these reports might have been to warning forecasters, the NWS unfortunately did not have a standard platform like IRIS in place to ingest the data from this experiment in real-time.

There also is value in being able to associate a report with a particular spotter or other contact and to store that information along with the report (Figure 4). This should be possible no matter which portal the contact chooses to use for reporting. Over time this would allow a WCM or other staff member to review all the reports from a particular person and to understand who has been the most (or least) helpful at providing information to the NWS. The most valuable spotters even could be recognized or rewarded in some way.

3.2.3 Sharing Data Between Offices

Those NWS offices that have managed to consolidate multiple data sources into one platform likely have done so on their own initiative. This makes it difficult to share such data with neighboring offices, including those assigned to provide service backup. It therefore is essential that the NWS develop a standard data platform which all offices can share.

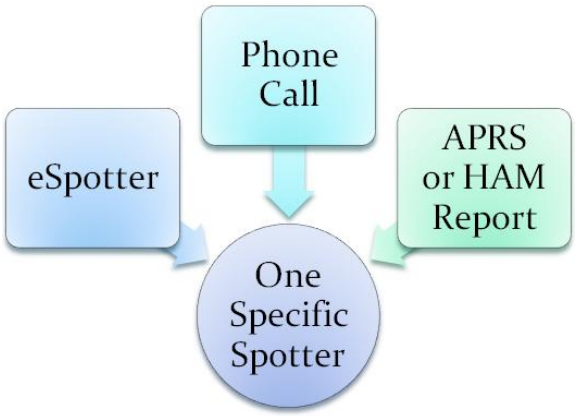

Figure 4. An individual spotter should be credited with a report submitted through any data portal.

Reports, both severe and non-severe, must be easily and instantly accessible from neighboring offices. In the event that a forecast office would need to invoke service backup in the heat of battle, like during a large severe weather outbreak, the backup office could pick up exactly where the original office left off. All the information the backup office would need to assume warning responsibilities, including up-to-date contact information and a running report log, would be readily available in IRIS. Neighboring offices that do not have backup responsibility also would benefit by being able to monitor reports from weather moving into their area. This could be done without tying up phone lines and causing an additional workload for already-busy staff.

3.2.4 Improving LSR Accuracy

More critically, however, StormLog seeks to improve both the temporal and the spatial accuracy of LSRs. Events can be correlated in time and space to specific radar echoes and map locations, instead of being assigned an estimated time and direction/range from a town (Figure 5). Finally, polygon warnings could be integrated with all of these high-quality reports to produce real-time verification statistics.

The task of obtaining a proper verification database to support scientific research and performance evaluation is best accomplished by special field projects. However, such projects usually are not feasible for individual NWS offices. Instead, the NWS builds its verification database using information gathered through standard warning verification efforts. Preliminary event information is distributed initially in Local Storm Reports (LSRs). These LSRs serve as the basis for the official reports that are published monthly in *Storm Data.* Unfortunately, the imprecise and incomplete nature of LSRs is reflected in many of the final *Storm Data* reports, making it difficult to use this publication with confidence (Lenning, 1998; Witt et al. 1998; Hales 1993).

Even for events documented as preliminary Local Storm Reports, there are numerous important reasons for seeking the highest possible spatial and temporal accuracy. Most fundamental of these reasons is the desire for scientific integrity. Events with an incorrect time or location would not be correlated with the storm feature that produced the event. This hinders users who wish

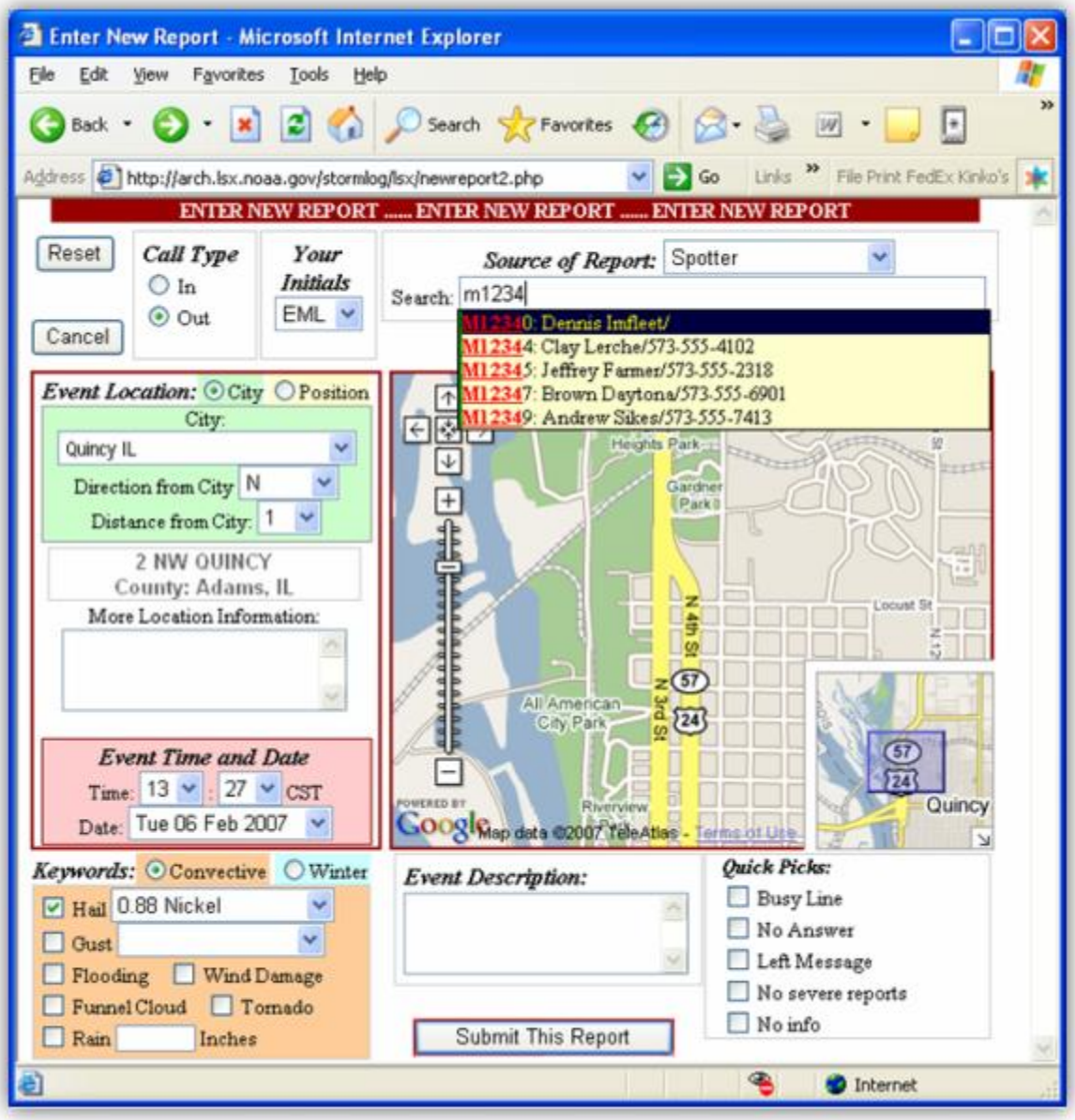

Figure 5. StormLog prototype interface for logging storm reports.

to track these reports in real-time. Problems would be especially evident when reports are plotted on a map together with radar data.

4. DESIGN CONSIDERATIONS

While StormLog certainly is not the only application of its kind in the NWS, its design and ties to the IRIS platform make it somewhat unique at this time. The browser-based architecture of StormLog means no special software or hardware is needed on client PCs. This minimizes the workload for system administrators at NWS offices, yet the application automatically is available to every PC in the NWS.

The primary reason why StormLog is designed for the PC network in NWS offices instead of the AWIPS network is because not everyone in the NWS has an AWIPS terminal on their desk. Since much of the information in IRIS is administrative in nature, users frequently would deal with information that has nothing to do with forecast operations. Even in forecast offices, during active

weather it can be very difficult to find an open AWIPS terminal, so not all of the phone calls will be handled by someone with access to AWIPS. Furthermore, since StormLog is used for tracking every type of interaction with external users, during severe weather one phone call might be logged as a media interview, the next as a storm report, and another as a question from an emergency manager. Having one interface for logging every type of call greatly simplifies the process of handling these calls.

Another reason for deploying IRIS and StormLog on the PC network is the ability to overlay map data from many different sources. Not everything that is displayed on the IRIS StormLog map would need to be provided by the NWS. Web mapping services from NOAA, other federal agencies, or even commercial providers could dynamically generate data or map layers for the application. This flexibility makes it very straightforward and cost-effective to incorporate new information.

It would be simple for the WCM to compile a monthly report of outreach activities from the information in this database. Information stored in IRIS would include the date, location, and number of attendees for any outreach event, including talks, tours, interviews, and customer meetings.

Most data processing occurs on the server, and both the database and the application can be hosted locally, regionally, or nationally. Database contents would be periodically exchanged between primary offices, their backup offices, as well as regional and national headquarters. These updates would facilitate the seamless service backup capability between an office and the primary and secondary service backup sites. Regional and national headquarters could also monitor activities during active weather at field sites using the Stormlog application. For purposes of data availability during service backup operations, the database and web servers could reside in a central location like a regional or national office. It also is important to balance data availability with application performance. The software must respond as if everything is running on the local PC.

The application design reflects the suggestions and feedback from staff members at NWS St. Louis. This has ultimately produced an intuitive interface which has been battle tested on several occasions. The application development feedback loop between programmers and end users will continue to produce new interface improvements which will make the ingest and display of information easier and faster for users.

5. PROJECT CHALLENGES

The development of IRIS and the StormLog application has been to this point almost entirely a grassroots effort in the NWS. Local and Regional offices understand the value and potential in what the project proposes to accomplish. The primary challenge has been to gain recognition of and support for this project at a National level. In the meantime, members of the IRIS team, many of whom have never met in person, are addressing the administrative and technical work that will sustain the team and allow the project to grow.

Resources for collaborative development of the IRIS project have been identified and implemented by the IRIS members themselves. Since there is no budget for the IRIS project, free and open-source solutions have been the most popular. These resources include the Subversion software for version control, the Trac wiki and issue tracking system for managing software development projects, the symfony PHP framework for developing web applications, the PostgreSQL database server and PostGIS extension, the GeoServer application for providing web-based geographic information, and the OpenLayers JavaScript libraries for building browser-based map interfaces. Few of the team members had any prior knowledge of these tools, so the learning curve and spin-up time have been considerable.

Developing the resources and skills for managing large technical projects in NWS field offices is not an obvious part of the NWS mission. However, the NWS would be well-served by exploring ways to improve support for programmers in the field and to get them more involved in national software development projects. This would save future project teams the enormous effort of assembling all of their resources from scratch.

6. SUMMARY

The IRIS StormLog program is a complete redesign of the StormLog application that has been in use at the St. Louis NWS office for several years. As part of the IRIS platform, StormLog data now can be shared with many other applications to support better coordination with partners, a greater

focus on customer needs and service requirements for the NWS as a whole, and more accurate storm reports for improved performance measures.

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