Media

Project Information Kit

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1. Introduction to the Glenda Project

Between 1950 and 1999, there have been a total of 40,522 documented tornadoes in the United States. This astonishing number of tornadoes has killed 4,460 people, injured scores more, and has caused property damage totaling in the billions of dollars. On the average, 810 tornadoes strike the heartland of our country each year, killing 89 people.[1]

Within recent years, there has been a concentrated, ongoing effort to increase the level of effectiveness of the country's severe weather early warning system, with emphasis on tornadoes and thunderstorms. Currently, early warning systems are able to issue alarms that provide the public with an advance notice ranging from 4 to 11 minutes. [2] However, there are still gaps in the system, and tornadoes can often time strike without warning. In order to understand the conditions necessary to create these weather anomalies, one must first obtain data from the "heart of the beast" – from directly inside a tornado or thunderstorm. Each year, brave men and women who are dedicated to the study of weather put their lives on the line chasing these storms. They launch weather balloons into them. The routinely throw themselves into the path of danger to obtain photo and video documentation. The government even flies airplanes through them. However, there has been no means by which to obtain readings directly from the heart of a tornado. The arrival of the Glenda Project has changed this.

The movie "Twister" [3] detailed the adventures of a rag-tag band of storm chasers in Middle America, and their efforts to obtain scientific data from the heart of a tornado. Interpersonal relationships aside, the central focus of the story was the scientific package named "Dorothy" after the main character in the movie classic, "The Wizard of Oz". [4] This package resembled a covered wash tub filled with hundreds of round electronic sensors the size of a golf ball. The story line finds Dorothy sucked up by a tornado, releasing its payload of tiny sensors, which in turn transmitted data directly to a laptop computer in real time.

As is typical with many tales from Hollywood, the concept was sound, but the theory was flawed. The concept of introducing a scientific payload into a tornado to take direct readings is not new. The problem that confronts this endeavor is the dampening effect of the electromagnetic field created by the tornado. This field creates a barrier that effectively inhibits any radio or telemetric data transmissions from inside the heart of a tornado.

This is where Glenda Project comes in. The Glenda Project was loosely named in honor of the good witch "Glinda" in the "Wizard of Oz." Simply put, Glenda is an amateur weather research project that involves the introduction of scientific payloads into the heart of tornadoes and thunderstorms, where various data is obtained. The payloads are introduced into these weather anomalies by trained pursuit and recovery teams through the use of portable, reusable rocket systems. The pursuit and recovery teams via onboard tracking systems later recover the rockets and their payloads, and the data is downloaded for tabulation and analysis. The goal of this project is two-fold; to obtain relevant data that will give scientists a better understanding of the makeup of tornadoes and severe thunderstorms, thereby aiding in the creation of better early warning systems that will ultimately provide more time for people to take shelter, thereby saving lives.

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[1] *Source: National Climate Data Center, Ashville, NC "tornadoes and Deaths by Year and Month – 1950 to 1999"*

[2] *Source: Testimony of Meteorologist Dennis McCarthy, NOAA, before U.S. House of Representatives, June 16, 1999*

[3] *Warner Brothers films; 1996*

[4] *MGM Studios; 1939*

2. Project Concept

The Glenda Project is seen as a supportive tool of discovery to further advance the level of knowledge about the understanding of atmospheric processes and their relationships to geological structure. The Glenda Project is dedicated to the research and development of flight delivery systems in support of instrument packages used in arenas such as micro-climatology, micro-prospecting, severe storm data collection, and remote sensing. The Glenda Project utilizes a comprehensive network of supercomputing cluster facilities for operations and research activities and to perform tasks with rapid response problem resolution. The crew of the Glenda Project believes that our avant-garde approach to exploring weather phenomena will provide new knowledge with understanding, and with time and analysis we truly believe that some influence or control of dynamic weather phenomena will take place providing long term improved safety for people and property.

The primary mission of the Glenda Project is to provide the capability to rapidly gather previously inaccessible localized microclimate data from altitudes ranging from ground level to over 100,000 feet and to return this data for immediate use. The core of the Glenda Project is a reusable sounding rocket, and weather balloon delivery system research and development program designed to place instrument packages into areas previously considered to be too hazardous or inaccessible using traditional platforms such as aircraft, helicopters, kites, etc.

3. Standard Mission Profile

Simply put, the standard mission of the Glenda Project is the insertion of highly specialized instrument payloads into severe weather anomalies such as thunder storms and tornadoes, where relative data from within can be obtained, recorded and either transmitted or later recovered for download and analysis.

This primary mission is achieved through the use of robust, reusable amateur research rockets. Rocket vehicles were selected as the primary delivery system for the Glenda Project payloads because they do not suffer from the limitations inherent with other current, standard delivery systems such as aircraft, helicopters, kites, etc.

The Project Glenda research rocket vehicles have several advantages over standard delivery systems currently used by other weather research projects. The rockets are portable, and have the inherent ability for rapid deployment with "launch and run" capability. The research rocket propulsion system is extremely easy to use, which aids in the speed of vehicle/payload preparation. Each payload is adaptable for external sensors to match user-specific applications. Each research rocket is composed of composite components designed for extreme environments. On-board locator transmitters allow for rapid recovery by project chase teams. And finally, off-the-shelf components are used where ever possible to reduce operating costs and facilitate ease of repair when needed.

There are currently two rocket vehicles that have been developed for use by the Glenda Project. Each vehicle has been painstakingly developed and aggressively field tested through conducting test launchings at various locations throughout the Pacific Northwest under a wide range of field and weather conditions.

Propulsion for the project's research rockets is provided by the "Pro-38" rocket motor propulsion system. This is the first commercial thermoplastic propellant-based solid rocket motor ever created, and is produced by Cesaroni Technology, Inc. (CTI) of Toronto, Canada. The Pro-38 is a modular, reloadable solid propellant rocket motor system designed primarily for use in launching small experimental payloads by universities, colleges, research institutes and sport rocketry enthusiasts. This system was chosen over several other systems due to its relative ease of use in the field, as well as its quick preparation time.

The primary, most common payload utilized by the Glenda Project in our research rockets is the data logger. A data logger is an electronic instrument that records measurements over time. Typically, data loggers are small, battery-powered devices that are equipped with a microprocessor, data storage and sensors. Most data loggers utilize software on a personal computer to initialize the logger and view the collected data. Prior to a Glenda launch, the data logger is connected to a laptop computer. Then, Windows-based software is used to select logging parameters such as sampling intervals, start times, etc., after which the logger is initialized. The logger is then disconnected from the laptop and installed inside the Glenda payload capsule. Upon launch, the logger records each measurement and stores it in memory along with the time and date. After recovery by members of the Glenda Project chase teams, the logger is then reconnected to the laptop computer and the software is again used to access the recorded data as a series of graphs for better analysis of the data points over time. The tabular data can be viewed as well, or exported to a spreadsheet for further analysis.

A typical data logger payload is programmed to obtain a combination of temperature, relative humidity, and barometric pressure. Also accompanying the payload is a tracking locator/transmitter to assist the chase crews in recovery. Total payload weight including the capsule is less than one pound.

During the Glenda Project's infancy, a digital chart recording system was connected to a laptop computer at a Glenda Project base camp in an effort to collect data from a forecasted dynamic weather system that

moved through our launch area. This was a ground test of the systems that would one day be launched as a payload within the project's weather research rockets. The systems performed flawlessly throughout the day and detected the passage of local storm cells and weather fronts as they passed through the area. The concept was proven feasible, and encouraged our research and development team to continue.

The Glenda Project utilizes sensors combined with ground-based laptops to provide a digital based chart record of ground conditions mapped over time. During September 2004, the Glenda Project performed a thermal mapping mission using the chart recording ground station, as well as both active and passive payloads in research rocket test flights. The purpose of the two flights was to confirm, or refute the existence of a region of thermal activity over the site of what was once an air strip used for agricultural purposes.

The first research rocket sounding employed the Glenda 98mm booster lofting an active transmitting payload broadcasting temperature, relative humidity and barometric pressure data to the ground station. The second sounding flight was made using the Glenda 54mm booster carrying aloft a passive payload recording temperature and relative humidity.

At the time of the two Glenda flights, the ground temperature was approximately 80 degrees, with a relative humidity of around 37% to 38%. Under the standard atmospheric model, temperature and humidity decrease as altitude increases. At the launch site, this was not the case. Both temperature and humidity remained relatively constant until 1,300 to 1,400 feet. Then things got interesting. The temperature rose rapidly, and the humidity level dropped. The sensors detected a 500 foot layer of hot, dry air which topped over 124 degrees at 11:00 in the morning. That translated into a 40+ degree difference from ground conditions. As the rocket penetrated the layer, the sensors recorded more "normal" readings. The data between the two test flights supported one another and have provided a body of evidence proving the existence of a thermal layer above the air strip that has been suspected for years by local and regional pilots.

Over the past eight years, the primary goal of the Glenda Project has been to develop payloads capable of collecting data from within thunderstorms, tornadoes and other hazardous environments. During 2004 and 2005, Glenda completed its first successful mapping missions and is well under way to further extend its flight envelope to even more hazardous environments. With the success of the recent flights, the development phase of the project is now complete. The next series of launches will allow the project to continue to mature, and return even more valuable data.

On April 22nd, 2016, the Glenda Project launched its latest iteration weather balloon system deploying a Vaisala RS-92 SGP radiosonde payload, combined with our updated antenna and receiver ground station.

The April 22nd flight featured a 400 gram balloon filled with 50 cubic feet of helium. Projected flight altitude was approximately 90,000 feet. The RS-92 payload contained a GPS positioning system plus a weather sensor suite telemetry package. Ground wind speed was around 10 mph with temperatures in the 70's.

The radiosonde ground station featured our existing Sirio WY400-10N Yagi antenna combined with our new Uniden BC-125AT Narrow Band FM (NFM) receiver.

Shortly after 3:15pm, a thunderstorm passed through the area and the weather balloon and its associated payload were ingested into the storm system for a successful storm intercept.
Flight performance was impressive and we achieved a viable data set from launch to balloon burst at just over 50,000 feet, continuing on under parachute until loss of signal at 41,000 feet due to the level of turbulence from the storm cell combined with earth curvature and local terrain.

In September of 2014, the Glenda Project took the first of a series of steps by deploying the GlendaNet, a set of Weatherpak weather stations monitoring “conventional” weather variables. Two of the Weatherpaks were wireless, with the third, hard wired to an intercept vehicle.

In 2015, the Glenda Project added additional wireless Weatherpak systems.
A wireless ground station network allows for a highly flexible system that can easily adapt to rapidly changing field conditions, and provides a high level of confidence of data capture in the event a remote station is disabled during a severe weather intercept.

As the Glenda Project continues to mature and evolve, more advanced sensors will be deployed to higher altitudes and within even more extreme environments. Glenda is proving itself to be more than capable of collecting data, and returning safely.

The Glenda Project currently has additional sensor packages and ground stations under development, which will soon be operational. These payload packages include radiological detection systems, magnetometer mapping and electromagnetic detection, lightening detection and early warning systems, and GPS integration to generate payload wind speed and directional data.

For 2016, the Glenda Project successfully integrated multiple software applications from a common data source.

Integration was achieved between the ALOHA Hazmat and Coastal Environmental’s Intercept software using common data from a Weatherpak weather station.

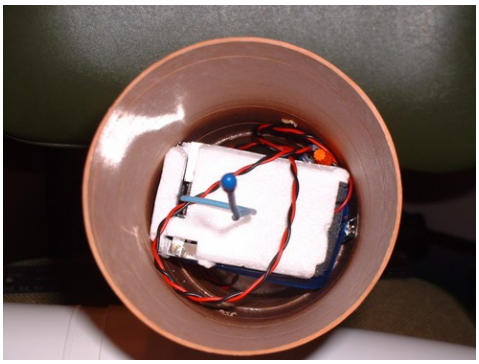
This capability now allows more efficient and effective data processing requiring fewer deployed ground stations

4. Equipment Overview

Launch Vehicles –

There are currently two research rockets that have been developed by the Glenda Project for use as delivery vehicles for our payloads. One is 54mm in diameter, the other 98mm. Each research rocket vehicle has been designed for a specific task based upon support of the chosen mission profile. Each research rocket vehicle is constructed of robust yet lightweight composite materials selected to withstand the rigors of the hazardous environments they will be subjected to. All of the research rocket vehicles of the Glenda Project were designed to be reusable, with a very short turn-around time.

Payloads –



A variety of mission-specific payloads have been developed for the Glenda Project. The standard payload consists of on-board data loggers that record such data points as temperature, humidity and barometric pressure. Other payloads transmit directly to nearby mobile project ground stations. Other payloads currently under development include radiological detection systems, magnetometer mapping and electromagnetic detection, lightening detection and early warning systems, and GPS integration to generate payload wind speed and directional data.

Portable Weather Station –

Ground crews of the Glenda Project utilize the TMQ-34 portable weather measuring system that is powered by a Ni-Cad battery. The TMQ-34 alphanumerically displays wind speed and direction, peak wind, temperature, dew point, barometric pressure, three-hour pressure change, and the minimum and maximum temperature. The entire TMQ-34, including the system case, weighs about 20 pounds. The set contains a computer module with a pressure sensor, and the main sensor module with a red sensor for temperature, a white sensor for humidity, a wind direction compass, and an anemometer to measure wind speed. The TMQ-34 can operate in temperatures ranging from a low of –59.5 degrees to 132 degrees. The Glenda Project chose this

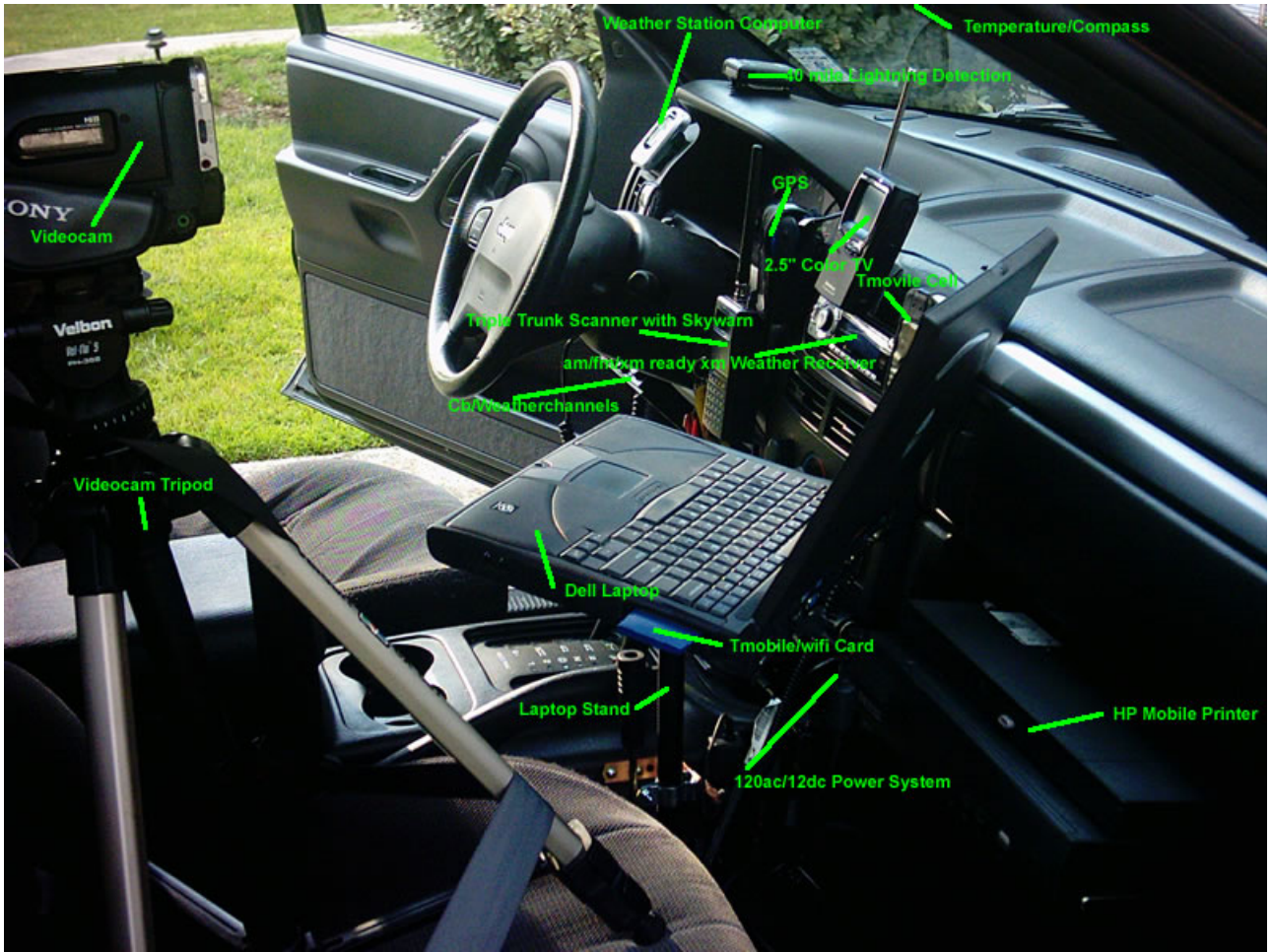
system over others due to its development by the military for use in tactical environments, with an operating range of 100 feet below sea level to 10,000 feet above sea level. It is a very robust, portable, easily assembled system.

Base Camp –

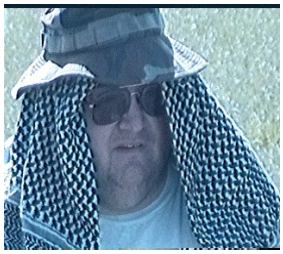
Pursuit and Recovery Vehicles –

Chase teams of the Glenda Project utilize the Jeep Grand Cherokee as the vehicle of choice for field operations, based upon its proven field record of performance and ease of maintenance. In addition to its primary mission of payload deployment, each vehicle is intended to act as a base camp, as well as for pursuit and recovery post-payload deployment.

As the picture below illustrates, every bit of the interior of the vehicle has been utilized for the incorporation of scientific equipment necessary to support the primary mission of the Glenda Project.



5. Team Member Biographies



DAVE DAVIS – Launch Operations Director – Mr. Davis holds a Bachelor of Science degree in Industrial Engineering from Eastern Kentucky University. Davis brings decades of experience to the Glenda Project from his work in commercial industry rocket research and with the United States Government as a Senior Industrial Engineer on the Space Shuttle Program (external fuel tank). He has also operated as a Statistical Consultant for the aerospace industry. A past Prefect of the Tripoli Rocketry Association as well as a current member of the National Association of Rocketry, Mr. Davis has long been considered to be one of the leading experts in the field of amateur rocketry in the Pacific Northwest region.

ROBERT PULLMAN – Long Range Sensor Development – Mr. Pullman holds a Bachelor of Arts degree from the University of New Brunswick, Fredericton, N.B., Canada. Pullman has four decades of experience in the field of communications and the computer industry, and his expertise is known world-wide. His work has enabled governments around the world to formulate policies and legislation in local, national and international forums. Pullman has developed products that are used by universities for seminars, by corporations for internal operations to meet government regulations, by scientists for research work in field and laboratory conditions, by government departments for device operations and maintenance, and by the military for use in battlefield applications. Pullman's current field of endeavor is weather research through the Glenda Project.

JANICE PULLMAN – Scientist – Mrs. Pullman, wife of project member Robert Pullman, helped to establish the concept of the Glenda Project. She held a Bachelor of Science degree from Northern Kentucky University where she graduated Cum Laude. She was working on her PhD in Molecular Biology at the University of Southern Mississippi when she passed away on March 4, 2004 after a brief battle with Leukemia. Mrs. Pullman was known for her work in cancer research, and was the co-author of 18 published scientific papers. Her expertise in the field of Science and Medical Technology allowed for the development of new laboratory techniques and procedures which are used by a variety of major research institutions. Her continuous drive to learn and progress has left an indelible mark on the Glenda Project, and we continue forward to ensure her lust for knowledge always continues.

TIMOTHY QUIGG – Media Communications and Public Relations – Brings a unique mix of personal background and professional experience to the Glenda Project.
Quigg has over two decades of experience in customer service and media relations. He is the former Assistant Editor of Extreme Rocketry Magazine (2000 to 2007), as well as a freelance writer of numerous articles for Sport Rocketry Magazine. He is a current member of the National Association of Rocketry, and is the 2001 recipient of the National Association of Rocketry's President's Award, in recognition of his work with youth in model rocketry on a national level. He has also written a book on the topic of high power rocketry; "A Guide to Level One Certification" currently published by ARA Press. With over 33 years in law enforcement, he's currently the Civil Deputy for the Columbia County Sheriff's Office.

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