

Monitoring Weather Conditions Near Wildfires

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Statement of the problem/topic of the research or creative work

Due to the dangerous and highly susceptible nature of wildland fires to change and threaten lives and property, it is critical to monitor and be aware of conditions surrounding these wildfires. The vulnerability of fire-fighting personnel and the public to changing weather conditions near wildfires necessitates improved monitoring of those meteorological conditions around the nation.

As part of the National Mesonet Program of the National Weather Service, SynopticLabs/MesoWest provides access to weather observations from over 30,000 locations that are made available by hundreds of data providers (<https://synopticlabs.org>). Federal and state agencies most responsible for fighting wildfires support the Remote Automated Weather Station (RAWS) network to monitor conditions in fire prone areas nationwide while the National Weather Service often deploys portable RAWS stations as part of fire suppression operations.

Improving access to RAWS and other observations in intuitive web displays is critical for improved situational awareness. To acquire the necessary data, basic fire metadata from GeoMAC is downloaded and archived. Using that metadata, the Synoptic Labs Mesonet API (synopticlabs.org/api) is queried to obtain the IDs, coordinates, and distance from fires for all nearby weather stations. Of particular interest is to provide web-based displays that help alert fire personnel and the public to weather conditions that are defined by them to be critical to monitor, e.g., user-selectable changes in winds, temperature, moisture, or weather conditions.

Relevant background

Critical to this work is an understanding of what weather conditions need to be monitored and what impact they can have both in the behavior of the wild fire and in the actions taken by the firefighters. Understanding what impact changes in wind speed/direction, relative humidity, temperature, and precipitation can have on the wildland fire is vital to be able to know how best to respond in order to contain and react to the fires.

Most important in this project is learning and developing programming skills. This project will require code to be written in multiple languages (namely Python, JavaScript, and HTML) and working in different manners. Starting with a beginner's understanding of Python and JavaScript, steps will need to be taken to specifically develop skills in writing scripts to download, parse, and archive daily updates on the wildfires in the United States. Additionally, learning how to make that information available to the web browser for display and additional querying and sorting of weather observations.

Specific activities to be undertaken and a timetable allotted for each activity

The first steps include web research and noting what fire weather products are already available. Creating a web display directed at a particular audience (firefighters, etc.) requires knowing what information and how much information they would want to have displayed. Besides investigating what similar products already exist, speaking with those who work in the field of wildland firefighting will be helpful to know what web application they would get the most use from. (Approximately 1-2 weeks to complete).

After the initial research, developing code to parse the available data from GeoMAC and archiving it is the next step. This code will be written in Python and made to run a few times a

day to ensure the most up-to-date information regarding each fire (perimeter, size, etc.) is being presented on the web application. Building on an introductory level of Python programming experience, this step will require studying and applying various new methods of programming techniques. (Approximately 2-3 weeks to complete).

Once the wildfire metadata are being collected, we'll use another Python script to make a query for each fire and gather a list of the nearest weather stations and their distance from the fire's perimeter (using Python to query the SynopticLabs Mesonet API for the weather station's metadata). (Approximately 1-2 weeks to complete).

With that data available, it will be served up to the web browser via a Python Tornado service. The next step is to build the web application to properly display the information. We'll use JavaScript to load in the data and generate maps, graphs, and tables to display the data in a clean, meaningful manner. We'll use D3.js and jQuery to build our webpage and generate the needed graphics in as little time as possible. (Approximately 2-3 weeks to complete).

Once the webpage is ready, the final step will be implementing the web application with a live data feed and ensure proper functionality. Debugging and cleaning up the code to ensure it runs as smooth and swiftly as possible will be very important as well. (Approximately 1-2 weeks to complete).

Relationship of the proposed work to the expertise of the faculty mentor

John Horel, Professor in the Department of Atmospheric Science, has been directing MesoWest Research Group (http://meso1.chpc.utah.edu/mesowest_overview/#) since it began prior to 1997. In that time, he has overseen and directed the creation of MesoWest, which collects and makes available weather observations from over 50,000 weather stations across the United States.

MesoWest, using the abundant weather observations it receives, has created fire monitoring web applications in the past (for example, http://mesowest.utah.edu/cgi-bin/droman/wx_monitor.cgi). Additionally, MesoWest has partnered with both Alaska Fire and Fuels (<http://fire.synopticlabs.org/alaska/>) and Great Lakes Forest Fire Compact (<http://glffc.utah.edu/>) to create fire weather monitoring web applications. These applications provide information to firefighters in those areas on various weather and fire conditions to enable them to better monitor their situations. Dr. Horel is very involved in the creation and design of these products and assuring they fit the needs of the firefighters and fire managers in those areas to best help them get the information they require.

Dr. Horel has taught and continues to teach several courses in the Atmospheric Science department that relate to this project, such as Environmental Programming, Environmental Instrumentation, and Professional Development in the Atmospheric Sciences. Additionally, Dr. Horel has authored or co-authored dozens of scientific papers on weather observation, fire monitoring, and other similar topics. John Horel has been heavily involved in the field of Atmospheric Science for many years and has a vast wealth of knowledge and skills that will be invaluable in completing this project.

Relationship of the proposed work to the student's future goals

I have several interests for my future goals, including fire weather, severe weather, and incorporating programming and web development in a meteorological field. I have only recently begun teaching myself programming skills (building on the brief introduction to Matlab programming I received in classes) and this project affords me the opportunity to learn and develop more skills and techniques in several programming languages. These skills will be invaluable on any job application and useful in numerous research or career settings.