MISSISSIPPI SOYBEAN PROMOTION BOARD
PROJECT NO. 47-2016 (YEAR 2)
2016 FINAL REPORT

TITLE: Web-based Interface for Atmospheric Stability and Spray Timing Recommendations

PI: Yanbo Huang, Ph.D. yanbo.huang@ars.usda.gov

BACKGROUND AND OBJECTIVES

It is essential that the aerial applicator avoid pesticide application under 'stable' atmospheric conditions when a temperature inversion is likely to occur. Under those conditions, a parcel of air cannot rise and disperse, and the spray layer is "ready to move" off-target, sometimes for miles, when the wind speed increases. These conditions are frequently associated with calm wind, and it is during these periods when the danger of stable atmosphere is the greatest.

Progress on previously funded MSPB grants (currently for 2014-2015, Optimal Timing of Aerial Spray Application to Avoid Inversion-Induced Far-Field Movement of Spray), have yielded several outcomes based on our measurements and use of atmospheric stability relationships. Details (including graphs and tables) will be indicated in the final report. We are at the point where information developed needs to be promulgated via the web; we feel that it will be the most effective medium for dissemination of guidelines based on real-time data. Also, through development of the web-based interface, data acquisition, processing, analysis and communication, a solid foundation will be laid for developing a mobile interface next to providing timely information for applicators.

Objectives.

1. To build formal flow logic into a prototype web-based system, which is easily used by pilots and farm managers to use data transmitted directly by our temperature and wind sensing systems with indications of whether or not conditions are suitable to spray.

2. To expand the web-based system to include recommendations based on temperature rise and fall, similar to a rule illustrated by the Arkansas Plant Board (http://170.94.200.136/weather/Inversion.aspx). This objective will use data obtained from the Mississippi State University weather network as systems become reliable.

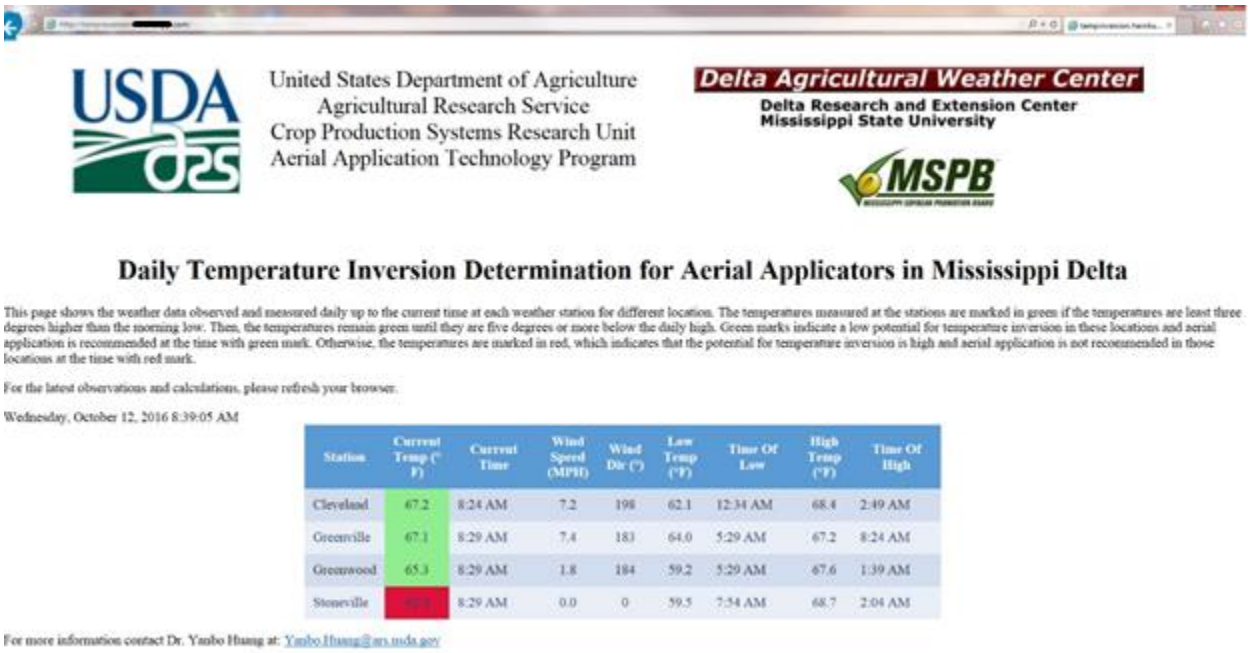
REPORT OF PROGRESS

Objective 1 – The formal flow logic was developed and finalized for data acquisition and recommendations on how to use weather instruments for stability determinations (Fig. 1). The algorithm of the flow logic was coded using Python programming language and environment, and the program was built into a web-based system to use the data from location temperature and wind sensing systems with indications of whether conditions are suitable to spray.

<table>
<tr><td rowspan="3">Before Noon</td><td rowspan="3">$T-T_{low}>3^\circ$ F
where T is the current temperature and T_{low} is the lowest temperature observed in the morning so far.</td><td>Yes</td><td colspan="3">No Inversion and spray OK</td></tr>
<tr><td rowspan="2">No</td><td rowspan="2">$T-T_{low}<T_{th}$
T_{th} is the temperature increase threshold, for example 2° F</td><td>Yes</td><td colspan="2">Strong inversion and no spray suggested</td></tr>
<tr><td>No but WS>4 mph? where WS is the wind speed</td><td>Yes</td><td>Spray OK</td></tr>
<tr><td rowspan="3">After Noon</td><td rowspan="3">$T_{high}-T\leq5^\circ$ F
where T is also the current temperature and T_{high} is the highest temperature observed in the afternoon so far.</td><td>Yes</td><td colspan="3">No Inversion and spray OK</td></tr>
<tr><td rowspan="2">No</td><td rowspan="2">$T_{high}-T\geq T_{th}$
T_{th} is also the temperature increase threshold, for example 7° F</td><td>Yes</td><td colspan="2">Strong inversion and no spray suggested</td></tr>
<tr><td>No but WS>4 mph? where WS is also the wind speed</td><td>Yes</td><td>Spray OK</td></tr>
<tr><td></td><td></td><td></td><td></td><td>No</td><td>Not spray</td></tr>
</table>

Figure 1. Flow logic for data acquisition and recommendations on timing of atmospheric stability.

Objective 2 - The web-based system was expanded with the built-in flow logic to include recommendations based on temperature rise and fall, similar to a rule illustrated by the Arkansas Plant Board (http://170.94.200.136/weather/Inversion.aspx). The web site was designed as Fig. 2 and actually implemented pending agency authorization as Fig. 3.



United States Department of Agriculture
Agricultural Research Service
Crop Production Systems Research Unit
Aerial Application Technology Program

Delta Agricultural Weather Center
Delta Research and Extension Center
Mississippi State University

Daily Temperature Inversion Determination for Aerial Applicators in Mississippi Delta

This page shows the weather data observed and measured daily up to the current time at each weather station for different location. The temperatures measured at the stations are marked in green if the temperatures are least three degrees higher than the morning low. Then, the temperatures remain green until they are five degrees or more below the daily high. Green marks indicate a low potential for temperature inversion in these locations and aerial application is recommended at the time with green mark. Otherwise, the temperatures are marked in red, which indicates that the potential for temperature inversion is high and aerial application is not recommended in those locations at the time with red mark.

For the latest observations and calculations, please refresh your browser.

Wednesday, October 12, 2016 8:39:05 AM

Station	Current Temp (° F)	Current Time	Wind Speed (MPH)	Wind Dir (°)	Low Temp (°F)	Time Of Low	High Temp (°F)	Time Of High
Cleveland	67.2	8:24 AM	7.2	198	62.1	12:34 AM	68.4	2:49 AM
Greenville	67.1	8:29 AM	7.4	183	64.0	5:29 AM	67.2	8:24 AM
Greenwood	65.3	8:29 AM	1.8	184	59.2	5:29 AM	67.6	1:39 AM
Stoneville	62.3	8:29 AM	0.0	0	59.5	7:54 AM	68.7	2:04 AM

For more information contact Dr. Yanbo Huang at: Yanbo.Huang@ars.usda.gov

Figure 2. Graphic design of the web site

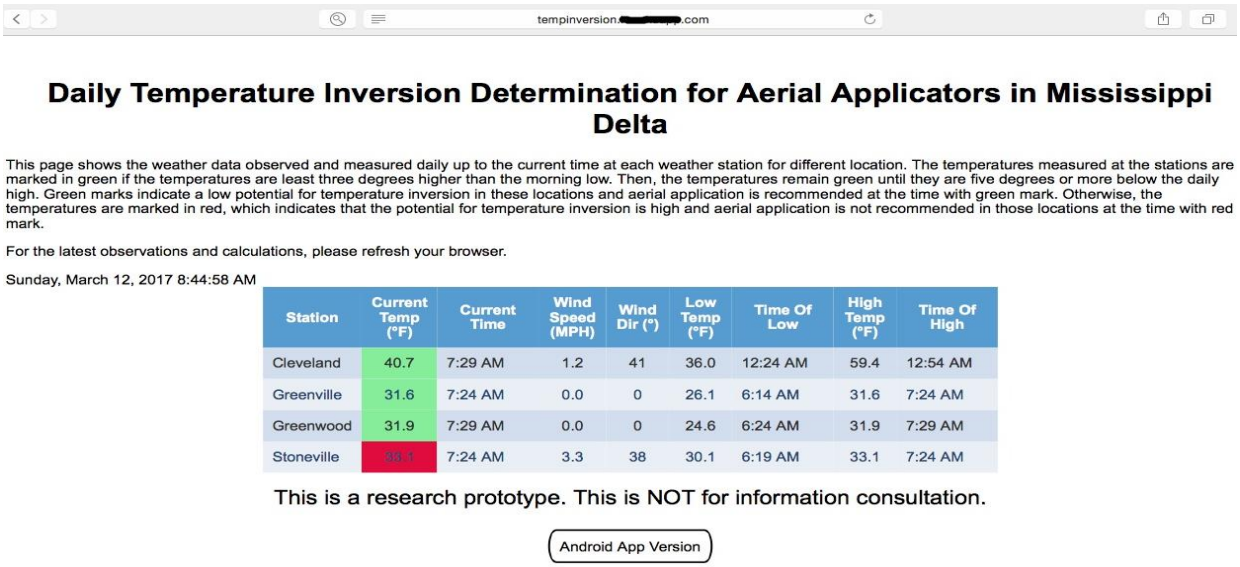


Figure 3. Executable web site

IMPACTS AND BENEFITS TO MISSISSIPPI SOYBEAN PRODUCERS

We have been able to quantify when aerial applicators should avoid spraying under certain weather conditions to mitigate the effects of far-field spray drift. Aerial applicators have expressed concern that they are sometimes pressured to spray very early in the morning. There is also a perception that optimal time for spraying is when the wind is calm. This is not the case and our data used with the simplified atmospheric stability relationships have proven this.

The web application has been successfully developed to provide real-time recommendation to aerial applicators in Mississippi Delta for the timing of the application operation to avoid off-target drift of the spray caused by temperature inversion. The system is currently designed to compute from the data measured in 10 weather stations set up by Mississippi State University and located in the Delta area, and 5 weather stations set up by USDA ARS in the Stoneville area. This system prototype can be quickly extended to upload any calculation from the weather data measured from any portable, inexpensive measuring station set up at any location in the Mississippi Delta. In Stoneville, 5 weather stations have been installed and tested to measure air temperature and wind speed. Now they are together for testing the stability and consistency of performance. As long as their stable and consistent performance is confirmed, we will separate them to install at different locations in Stoneville.

Thus far, this work has been promoted and presented to aerial applicators. It has become clear, however, that more producers need to see results from our study as they are the ones making field decisions.

END PRODUCTS

An easy-to-use web-based system that can give the applicator and producer valid recommendations on atmospheric stability to determine if it is safe to spray is in final stages of development. The development of the web-based system is essential for accessibility by both producers and aerial applicators. The target is to deliver a complete product to publish the web service starting at the beginning of the new growth season next year (2017).