EXPANDED AGRICULTURAL WEATHER SERVICE FOR ALABAMA, FLORIDA AND GEORGIA

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The National Weather Service Agricultural Weather Program began in 1959 as a pilot project authorized and funded by Congress with the mandate of making more specific crop-weather information available to Mississippi Delta farmers. Success was immediate. Surveys following the 1959 crop season estimated 40 dollars were returned to Delta farmers for every Federal dollar spent. Later, an enthusiastic Congress voted to expand the Agricultural Weather Program into several other weather sensitive agricultural areas in the United States. One of these areas, later named the Tri-State area, was comprised of the south half of Georgia, the southeast corner of Alabama, and northwest Florida.

It was from the resources of the Tri-State Agricultural Weather Program that the Environmental Studies Service Center (ESSC) was formed in July of 1973 to serve the states of Alabama, Florida and Georgia. The immediate effect of reorganization was at least four fold. First, it concentrated at one location Tri-State agricultural meteorology skills. Second, it achieved efficiencies by consolidating into one center separate but similar functions and services previously provided. Third, it allowed central focusing of objectives and services to benefit the agricultural industry. And fourth, the service program area was expanded to include all of Alabama, Florida, and Georgia.

The expanded agricultural weather service for the three states has been accomplished in three phases. First, an Environmental Studies Service Center was established at Auburn University on July 1, 1973 which concentrated at one location the highly specialized agricultural meteorology skills necessary to formulate real-time interpretative statements which relate weather forecasts and climatological data to the needs of diversified agriculture of Alabama, Florida, and Georgia. Second, in March, 1974 the agricultural weather forecasts provided by National Weather Service Forecast offices at Birmingham and Atlanta, and the advisory services performed by ESSC Auburn, were expanded to include all of Alabama and Georgia. And third, on November 1, 1974 the agricultural weather service was expanded to include all of Florida. The expanded service in peninsular Florida features year-around agricultural weather forecasts by the Weather Service Office at Lakeland and agricultural weather interpretations from ESSC Auburn.

The Basic ESSC Concept: Interpretation

The ESSC has as its basic mission the real time formulation of interpretative statements relating meteorological events and climatological data to the diversified agriculture of the southeast. The interpreter role emphasized in the mission is much broader than real time formulation of advisories. It also permeates deeply into the research programs. Injection of interpretation into the research program was the result of an early conclusion in ESSC program formulation that one of the greatest contributions that could be made was the simultaneous transfer of agricultural and meteorological technology for use in the operational decisions confronting the man-on-the-farm.

The decision to emphasize the interpreter role in ESSC programs was recently reinforced by Dr. H. B. Cheney in his Presidential address to the American Society of Agronomy. Dr. Cheney said, "About 40 years ago Glenn Frank, while President of the University of Wisconsin, made a convincing statement extolling the primary need for more able interpreters. He suggested that we always will have people who will add new facts through research, but there will be a scarcity of people with interest and capacity to interpret or translate the applicable facts and knowledge on a subject. This need for capable interpreters is even greater today than it was four decades ago" (1).

ESSC Objectives and Program Areas

The interpretive statements, called advisories, are issued at least once daily during weekdays and as needed on weekends. They are created and fashioned so that relevant agricultural weather information is available for the use of the agricultural community in decision making which will result in:

1. Increased food and fiber production.
2. Reduced agricultural production costs.

3. Reduced weather related agricultural losses.
4. Diminished land, water and air pollution from agricultural operations.
5. Minimized energy usage for agricultural production.
6. Improved assessment and management of agricultural resources.

The basic mission of formulating real time operational agricultural weather advice for the agricultural industry to achieve the above objectives is supported by concentrating efforts in five program areas. They are:

1. Conducting field and in-house research and exhaustive literature reviews which address the most important weather related agricultural problems in the three states served by the Center. The objective of each study and review is to obtain information that is directly applicable to the advisory function.
2. Maintaining an agricultural weather station network in the three states which provides daily meteorological and special phenomena data important in agricultural production.
3. Establishing and maintaining a climatological data set for the three states to support advisory and research efforts.
4. Fostering avenues of cooperation with the land grant universities, especially the Cooperative Extension Service and the Agricultural Experiment Station, other government and state agricultural agencies, and grower organizations in the three states, for the purpose of maximizing usefulness of agricultural weather information.
5. Developing new and/or alternate methods of transmitting agricultural weather information and advice as directly as possible to the ultimate user.

The ESSC goals, programs and mission, all focused on the advisory function, are highlighted in the ESSC motto.

"Get the *right* weather information in the *right* form to the *right* farm at the *right* time."

Research

Much effort has been expended in defining current major agricultural meteorology problem areas in the three states, which if ameliorated by research, would result in achieving one or more goals as well as significant economic returns to agricultural interests. Four particularly conspicuous problem areas have been identified. They include the accurate prediction of spring soil temperatures; the accurate accounting of areal soil moisture throughout the year, but especially during the major growing season; the freeze hazard to crop and fruit production; and, in general, the best understanding possible of the interactions between weather and climate and the major commodities produced in the three states.

Three sub-program areas have been established to facilitate investigations of the four major problem areas. They are modeling, environmental satellite applications, and commodity weather reviews.

Modeling. Early in the process of delineating the direction of Center research, it was apparent that an appreciable effort would be expended in readying models for use in the advisory program. At that time two important management philosophy guidelines were adopted. First, model development would not in general be attempted, but rather ESSC efforts would be directed toward adaptation, calibration, and verification of existing "point" models for use on a wide area basis in a real time operational program. Second, statistically based (stochastic) models were to be avoided, if possible, and only physically or physiologically based (deterministic) models would be chosen for modification. It was reasoned that only by using physical or physiological models there would be some assurance that the models could be used in other agricultural weather program areas with only minor adjustments.

Three deterministic models have been selected for immediate adaptation. They include a soil temperature prediction model, a soil water balance model, and a cotton model. All three require daily meteorological inputs to drive the models. A concerted research effort has been mounted in modeling with the goal of operationally testing the models during the 1975 crop season.

It is anticipated that the soil temperature prediction model and the soil water balance model will provide acceptable estimates of present and predicted distributions of soil temperature and soil moisture in the three states. These estimates are critically needed in the interpretation of crop weather relationships. The cotton model has been tested on field data from several locations in the southeast. The performance of the model has been excellent. It has provided realistic outputs of cotton growth and development and reasonable estimates of yield for the test plots.

A major problem confronted in readying models for real time operational use is the adaptation of a model which was developed for a "point" (e.g., field plot, small watershed) to one that will represent a "wide area" (e.g., county, crop reporting

district, basin) with no or only a minimal loss of sensitivity. This is called areal adaptation in the Center. The problem is further compounded when it is desired to operate several models on a real time basis and to test and validate additional models to be used later in the advisory service. It is also clearly desirable that for both testing and operational purposes that all models accept the same inputs (if needed) for an arbitrarily defined base area. This would facilitate the replacement of current models with an improved version or introducing additional models into the advisory program.

Satellite Applications. Much has been written about the potential uses of satellite data in agriculture, but a literature review revealed that to date promised potentiality far outweighed actual application. In addition no evidence was uncovered which indicated satellite data is being used on a real time operational basis in agriculture.

The review disclosed, however, that technology exists to effectively use environmental satellite data in a real time agricultural meteorology program. A research program has been implemented to transfer the satellite technology for application in the advisory program. It centers on development of techniques and methods providing the absolute radiation temperature at the earth's surface and then incorporating the thermal data as "wide area" inputs into the areally adapted models. In addition, the thermal data will have great utility in improving service in areas where freeze hazards exist. The thermal data will pictorially portray with time the real time development of a freeze allowing growers to sharpen decisions in management of cold protection practices. In addition, a "cold night" climatology can be produced which will be valuable in land use planning and in improving "spot" temperature forecasts.

An example of a map of apparent surface temperature distribution as seen by weather satellites for a large portion of peninsular Florida is shown in Figure 1. For orientation of the reader, Cape Kennedy is shown at the right center, Tampa Bay in left center and Lake Okeechobee near the bottom of the picture.

The gray tones represent temperature regimes that differ by about 1°C (1.8°F). The lightest gray tone indicates the coldest area and the darkest tone the warmest. Note that some areas in the southern portion of peninsular Florida (lower portion of the picture) appear to have the same surface temperatures (same gray tone) as those much further north (top of picture).

Commodity Weather Reviews. Earlier, the importance of the role of the interpreter in scientific endeavor was discussed. To emphasize that role, several reviews have been written by Center personnel to assess and interpret specific commodity-weather interactions. These reviews, which currently are working papers in draft form, are highlighted by numerous examples where advisories can be issued by ESSC personnel which can be used advantageously by those in agricultural production.

Seven reviews have been written. They cover tobacco, small grains, peanuts, soil temperatures, cotton, deciduous fruit crops with emphasis on peaches, and poultry. Other reviews are planned for the future.

Effect of Climatic Change on Non-Domestic Wheat Yields. A reimbursable research project funded by the Department of Transportation Climatic Impact Assessment Program is addressing the implications of climatic change on wheat production outside of the continental United States. Special attention is given to analysis of areas of the world where wheat production now is in delicate balance with existing climatic conditions, such as parts of Canada, Russia, Argentina and Australia.

Four reports have been submitted to the Department of Transportation. One report reviews the climate in six major wheat growing areas of the world; another report discusses historical aspects of climatic change on rice and wheat production; a third report contains an analysis of the effect of certain parametric climatic changes on Russian wheat production; a fourth paper discusses effects of climatic and other factors on wheat yields in Argentina.

Agricultural Weather Station Network

An agricultural weather station network is necessary not only to supplement temperature and precipitation observations from existing synoptic and aviation network stations, but also to provide observations of climatic elements not usually observed such as solar radiation, pan evaporation, soil temperature and duration of vegetative wetting. The observations not only provide requisite information for preparation of the state advisories and verification of forecasts, but also supply critically needed inputs for the models being adapted for the advisory program.

The basic agricultural weather station network of approximately 40 stations is nearly complete. Most stations are located at state Agricultural Ex-

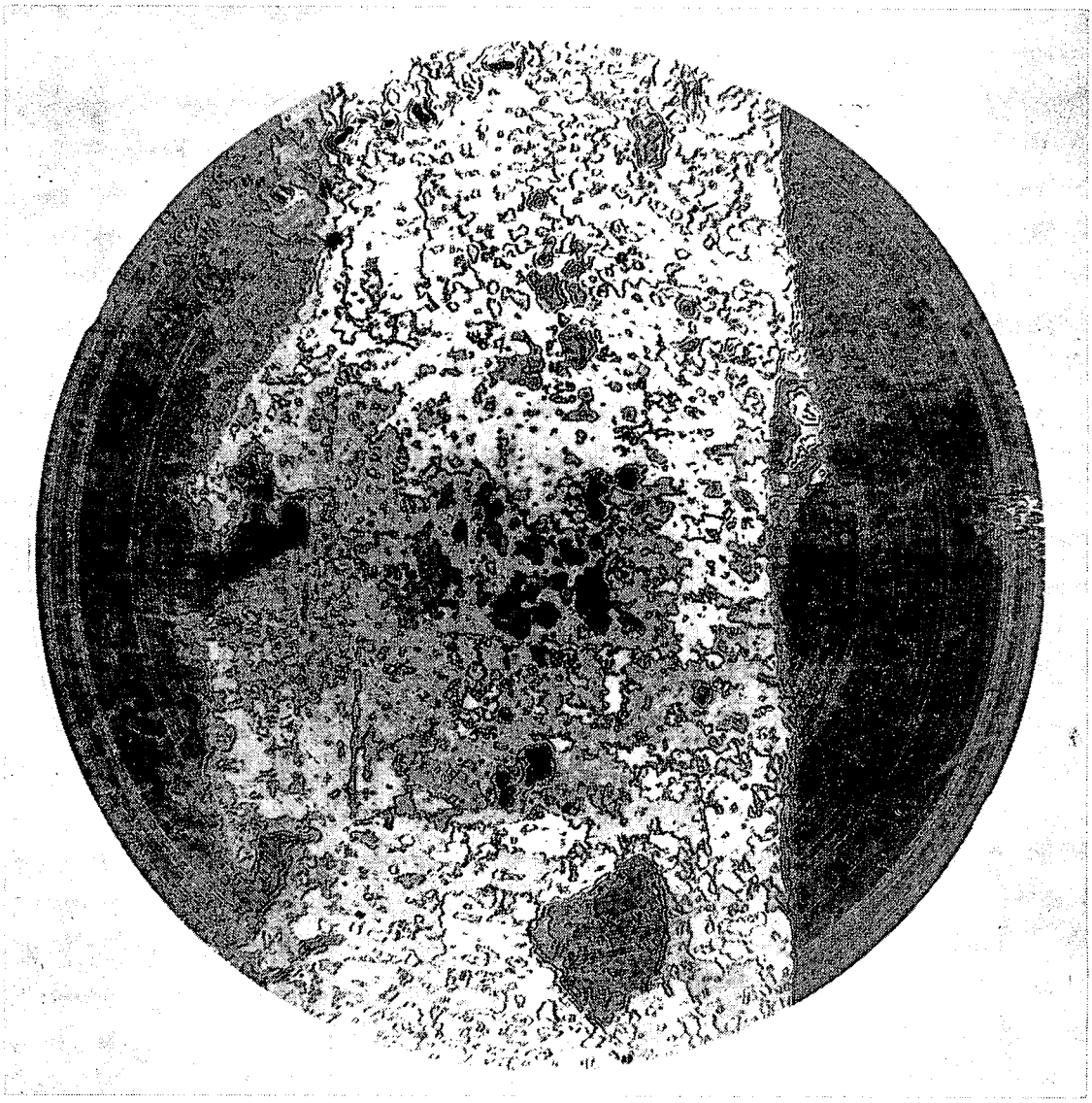

Fig. 1. Map of apparent surface temperature in peninsular Florida as seen by a National Oceanic and Atmospheric Administration meteorological satellite on a cold night during the 1973-74 winter. The lightest gray tone indicates the coldest area and the darkest gray tone the warmest. Gray tones indicate a thermal difference of about 1°C.

periment Stations. Stations in the basic network are equipped with maximum and minimum thermometers, an eight inch rain gage, and a soil thermometer. In addition some stations are also equipped with a hygrothermograph, a Davis-Hughes vegetative wetting system, an evaporation pan, ozone monitors, and devices for measuring solar radiation.

Two well instrumented micrometeorological stations are also maintained, one at Auburn and the other at Quincy, Florida. A third station is planned for development at a state agricultural experiment station in Georgia.

The observations from the agricultural weather stations are collected daily at approximately 8:00 a.m. The observations are used as needed by the

Environmental Studies Service Center and the Weather Service Forecast Offices in weather forecasts and advisories.

Agricultural Climatology

A thorough knowledge of the climatology of the three states as well as tabluations of probability distributions of selected climatic elements are absolutely essential for the conduct of a highly successful agricultural weather program. Unfortunately, the synoptic climatology of the three states is known only in an elementary way, and except for limited rainfall and temperature data, probability data are virtually nonexistent.

To overcome this deficiency, raw climatological data for all climatological stations in the three states has been obtained on magnetic tape from the National Climatic Center. Most of the data covers the period 1948 through 1973. This data is now being subjected to quality control procedures.

A grid of long term, representative climatological stations is being selected for each state which will comprise the basic climatological network for analysis of climatic elements. Data not stored on magnetic tape, but available for the pre-1948 period, will be punched and added to the magnetic tape record.

One climatological study has been completed and is currently undergoing peer review. The study presents an atlas with tables of thunderstorm and hail day probabilities in the southeastern United States.

Liaison

Fifteen years of experience in the operation of an agricultural weather program has demonstrated on numerous occasions the absolute necessity for constant liaison with cooperators, users, and other National Weather Service offices. Liaison provides and maintains a forum for exchange of ideas and information, and probably most important, a vital feedback mechanism to the ESSC whereby cooperators and users can discuss freely and openly the type and quality of services being rendered and the need for additional services.

The ESSC shares with all components of the land grant universities in the three states a common responsibility of providing within the limit of their resources the best research and the best service possible to the agricultural industry. Weather is a common and significant factor that must be considered continuously throughout the complex chain of events that finally leads to agricultural production. It is not surprising then that most of the ESSC liaison involves communication with components of the land grant universities exploring new and better methods of putting weather to work in agriculture.

More and better agricultural weather advisories are the quickest way of integrating weather and agriculture. Liaison since the organization of the ESSC in July of 1973, therefore, has centered on the theme of making advisories more effective as soon as possible. To accomplish this numerous meetings have been arranged with officials of the three state Cooperative Extension Services. The meetings have resulted in arrangements for coordination of crop and weather information and the subsequent interpretations contained in the advisories. The active participation by the Cooperative Extension Services is a decided plus factor for the advisory program.

Frequent telephone and personal contacts have also been made with the Directors of the Land Grant University Experiment Stations serving the three states. They have been kept informed of activities at the Center. Discussions have also ranged over future ESSC plans and activities as well as areas for mutual cooperation in attacking common weather related agricultural problems.

Communications with grower and other user organizations have been limited; however, plans have been laid to accelerate this activity during the next year. Most user contacts to date have been with officials of the poultry organizations serving the three states.

The formation of an independent advisory board to the Director of the ESSC is being actively pursued. The committee would be composed of approximately ten agricultural experts representing various areas of the agricultural economy in the southeast. The advisory board would overview the total ESSC program for relevancy, scope, balance and focus.

Frequent liaison contacts are made with the forecast office, usually daily. Most contacts are by necessity made on the telephone although personal visits are exchanged between the ESSC and the forecast offices from time to time.

Communication of Products

The right agricultural weather information in the right form is worthless if it is not intercepted at the right farm at the right time. The dissemination of the agricultural weather forecasts and advisory information to the agricultural community is dependent on the mass media such as radio, television, and newspapers. The mass media receives the information on a teletype network which

directly links Weather Service Forecast Offices, the ESSC, and the mass media. A handful of agriculturally oriented corporations also subscribe to the teletype network, but overwhelmingly the agricultural community receives its information directly from the mass media.

Alternate methods of dissemination of weather information have been investigated. Especially promising is the possibility of emanating an agricultural weather program from the Auburn University Production Center of the Alabama Education TV Commission. Use of the Alabama TV Commission facilities would permit television transmission of agricultural weather information to 96 percent of the farmers of Alabama.

Summary

Manpower and equipment resources formerly allocated to four locations in the United States National Weather Service Tri-State Agricultural Weather Program area were centralized at one location on July 1, 1973. The mission of the new office, named Environmental Studies Service Center, is to formulate interpretative statements translating meteorological and climatological information to meet the diversified needs of agriculture in the states of Alabama, Florida, and Georgia. The mission is supported by concentrating efforts in five program areas which include research and review, an agricultural weather station network, an agricultural climatology data bank, liaison with cooperators and users, and communication of information to users. These programs provide the necessary support to enable farmers and agribusiness managers in the three states to make decisions which will result in increased food and fiber production, reduced production costs, reduced weather related agricultural losses, diminished pollution from agricultural operations, minimized energy usage for agricultural production, and improved assessment and management of agricultural resources.

The prototype Environmental Studies Service Center appears to be after one year of operation an attractive innovation for improved agricultural weather services in the program area being served. Major advantages of centralization include central focusing on objectives and programs, higher quality research, improved daily operational weather advisories, and a better service for every agriculturist in the three-state area.

Literature Cited

1. Cheney, H. B. 1974. Presidential address. *Agronomy Journal*, 66(1):1-2.

WEATHER FORECAST AND ADVISORY SERVICE FOR AGRICULTURE IN THE SOUTHEAST

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Abstract. **With the beginning of real-time weather advice to agribusiness in peninsular Florida on November 1, 1974, the National Weather Service's Agricultural Weather Program has now been extended to include all farming areas of Florida, Alabama and Georgia. The service program includes, in addition to year-round agricultural weather forecasts tailored to the needs of agribusiness, a year-round real-time agriweather interpretation and advisory service. Also, a special weather reporting network has been established to monitor weather elements important to agriculture in support of the forecast and advisory services.**

Real-time weather advice, based upon known crop-weather interactions and a meteorologist's interpretation of how past, present and forecast weather will affect agribusiness, is provided by a staff of agricultural meteorologists located at the Environmental Studies Service Center, Auburn, Alabama. The advisories are issued to enable agribusiness to take advantage of favorable weather to maximize production and to reduce agricultural losses resulting from unfavorable weather.

All agriculture weather forecasts and weather advisories reach the ultimate user by way of a state teletype weather circuit and local radio and TV disseminators.