SATELLITE FROST FORECAST SYSTEM

The color-coded thermal map of the Florida peninsula on the cover is a satellite view of the January 13, 1981 freeze, one of the two most disastrous freezes of this century. The map is a product of the Satellite Frost Forecast System (SFFS) developed by the Institute of Food and Agricultural Sciences of the University of Florida with support from the National Aeronautics and Space Administration. SFFS acquires temperatures sensed by the GOES-EAST satellite from the National Oceanic and Atmospheric Administration (NOAA) facilities in Suitland, Md., through an automated telephone link (see insert). Instructions within the mini-computer, the heart of SFFS, partition the temperature data into color bands and cause the resulting map to be displayed on a color TV screen within minutes of the reception of the satellite data. Currently, NOAA sectorizes the infrared satellite data, i.e., partitions the Florida peninsula data from that for the hemisphere, and moves it to a separate queue from which SFFS acquires it by a telephone call that requires about 3 minutes per map.

The application of satellite infrared sensing to the horticultural frost warning situation is fortunate since the mechanism that produces the frost damage is the same mechanism that is used to sense the surface temperature, i.e., infrared radiation loss from the exposed surface to outer space. Radiation loss is maximum on nights in which the sky is clear and dry, which is precisely when the satellite's view of the surface is the most complete (no clouds) and its temperature calibration (through the Stefan-Boltzmann Law) is the most convincing. Colors just east of Florida and over the Gulf Stream indicate the clouds that develop as the cool continental air flows over the warm Gulf Stream waters and wedges the warmer, moist air upward to form clouds, the tops of which show up cold relative to the warm ocean surface.

SFFS not only acquires the infrared satellite data and displays thermal maps of the data in color but also schedules programs which predict future satellite views during the frost night. SFFS automatically interrogates microprocessors at 15 remote weather stations in Florida via telephone and receives coded indications of air temperature, soil temperature, wind speed, and net radiation from the site as a basis for these predictions.

Less than a minute is required to interrogate an individual station, leaving time to repeat the process in those cases when transmission is incomplete. Information from the remote weather stations forms the input of a model that solves the surface energy budget equation and predicts the temperature fall at each of the ten sites for the remainder of the night. A second model takes predicted temperatures from the first model and fabricates thermal maps for each night by recalling the temperature patterns from past frosts and freezes. This is an application of the horticultural principle of site selection. Textbooks describe the patterns as results of cold air drainage and thermal conductivity of exposed surface. Prediction maps have the same configuration as the observed maps, and the system can display 2 maps on the TV screen side by side at the same time. It can subtract one map from another and display temperature differences as a color-coded map. This latter process provides an excellent test of the predictability of the models as the forecasts are verified.

After development is completed, SFFS will be operated by the National Weather Service of NOAA from the Forecast Office in Ruskin, Fla. One of the mini-computers is there now and National Weather Service forecasters have been aided by SFFS products in the development of their frost warnings for the past several seasons. Dissemination of color thermal maps from the system to five Florida County Extension Offices and one in Southern Georgia through links to APPLE II micro-computers is planned for this winter.

SFFS has been developed within the Climatology Program of the Fruit Crops Department and has provided other useful in the program. One is a black-and-white copy of a printout of satellite map data using symbols which can be equated back to temperature through a translation table incorporated in the printout. These records of the freeze have been found very useful in assessment of frost damage and in modifying harvesting decisions since the products are easily and rapidly copied for distribution. Dissemination of color maps of the system is being developed through a network of micro-computers at County Extension Offices that are programmed to call SFFS computers to acquire both observed and predicted maps and display them on TV screens locally. GOES data acquired through SFFS is being used in research studies toward the development of real-time estimated evapotranspirational losses that are required for management of water resources.

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