Reprinted from Preprint Volume: Fourth Symposium on Meteorological Observations and Instrumentation, Apr. 10-14, 1978, Denver, Colo. Published by the American Meteorological Society, Boston, Mass.

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A REMOTE WEATHER STATION FOR USE IN FOREST FIRE MANAGEMENT

James B. Harrington Jr.

Forest Fire Research Institute
Ottawa, Ontario

Good meteorological information is a vital component of modern forest fire control technology. Yet, because of the remoteness of much of Canada's vast forest, there is an inadequate coverage of weather reporting stations. Manned stations would be prohibitively expensive, and automatic stations reporting by radio are sometimes unreliable and usually beyond the means of most provincial fire control agencies. The advent of satellite communication has brought the cost of reliable remote weather stations into the economical range.

Remote weather stations communicating via satellite have been used successfully for several years. This paper describes a station, specifically designed for forest protection purposes, whose cost is within the means of fire protection agencies, and whose observations can be processed and returned to the field on a timely basis. Both the meteorological sensors and the observing site have been designed to meet Canadian Atmospheric Environment Service specifications. This is considered to be important if fire weather forecasting and map analysis over remote areas are to be improved.

The station consists of meteorological sensors, a signal conditioning unit (SCU), a transmitter, timer and antenna, a battery and the necessary masts, guys, shields, cables and containers. The meteorological sensors, their accuracy and the required range are as follows:

Temperature -

YSI linear thermistor T705

±0.05°C -10°C to +45°C

Relative Humidity -

Hygrodynamics L15-7012W hygrometer

± 3% 15% to 100%

Wind Speed -

R M Young Model 12002 Anemometer

± 1 km/hr 0 to 110 km/hr
threshold 0.5 km/hr

Wind Direction -

R M Young Model 12002 Anemovane

± 2° 0° to 352°

Rainfall -

Weathermeasure Model P501-1 gauge

0.5% at 12 mm/hr

Lightning -

Quality Technology field change counter measures cloud to ground strokes within an approximate range of 30 km.

Solar Radiation

Clairex Model CL604L P.C. photocell gives a relative indication of solar radiation intensity at the ground.

Power is supplied by high capacity caustic potash primary cells which continuously charge a set of secondary cells of high output capability (approximately 4.5 amperes) for the radio transmission cycle. The battery voltage is monitored once each hour.

The SCU receives both analog and digital signals from the meteorological sensors, performs averaging and scaling functions, converts to meteorological units suitable for direct readout, and converts to ASCII for radio transmission. Instantaneous values of the temperature and relative humidity are read. Wind speed and direction are averaged continuously using a method known as the 'exponentially mapped past' (Painting, 1975). Solar radiation is integrated over a one hour period.

Lightning strikes and tipping bucket impulses are accumulated, stored in memory and the counting circuit reset once each hour. The signal conditioning unit was designed and the entire station manufactured by Innovative Ventures Limited of Calgary, Alberta.

Once each hour, or less frequently if desired, the message stored in the signal conditioning unit is beamed via directional antenna to the GOES satellite. The transmitter, manufactured by Handar, operates on a frequency of approximately 400 MHz and is timed by a clock whose drift is less than one-half minute per year.

The message retransmitted by the GOES satellite is received and stored at the Prince Albert Satellite Station (PASS). The data is then transmitted by dedicated telephone line to the DEC10 (a large general purpose computing system) at the Canada Centre for Remote Sensing (CCRS) in Ottawa. From there it is reformatted and transmitted by automatic telephone hook-up to the PDP11/T34 (a medium scale mini-computer) at the Forest Fire Research Institute (FFRI). A program written for the PDP11 checks for errors, computes various fire weather indices and stores the data in readiness for telephone interrogation.

It is apparent that there is more data transmission in the present experimental system than would be necessary for routine operations. Once the data can be handled effectively on a research basis, all operations should be transferred to the satellite receiving station and the resulting information beamed back to the regional centres via communications satellite.

A proposed layout for the remote weather station places the instruments within a 10 m square area. The instruments are well separated to avoid interference by one instrument in the measurements of another. In particular, the lightning counter must be well separated from the anemometer mast or other high grounded objects which might interfere with the earth's electric field. The instruments are protected from lightning. The cables are in conduit to protect them from rodents. The entire station is expected to be located on cleared level ground at least five tree heights from the nearby forest. In general, this will mean that the clearing in which the station is located will be at least 200 m in diameter.

There is no doubt that the effective management of vast amounts of information, sophisticated equipment and complex methods, will require mini-computers at most regional fire management centres (Kourtz, 1977). Meteorological information obtained and analyzed automatically can be integrated into such systems, and will play a central role in their effective operation. It is anticipated that the automatic remote weather station, communicating via satellite, will become a substantial asset to fire managers. The savings due to automation of weather data acquisition and processing should greatly exceed the approximately seven thousand dollar cost of the stations.

REFERENCES

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