THE MICROMETEOROLOGICAL TOWER AT RESOLUTE, N.W.T.*

Introduction

The purpose of this note is to bring to the attention of physical scientists the existence of a 100-ft. micrometeorological tower at Resolute in the Canadian Arctic.

The tower was erected during the IGY to provide information on vertical profiles of temperature and wind. Measurements of this kind are useful in indirect estimations of the surface energy balance through a study of vertical fluxes of heat and momentum in the air near the ground.

Because of various instrumental difficulties, no meaningful wind data have been obtained. However, the vertical temperature difference system has been operating more or less continuously since August 22, 1957.

Instrumentation

The tower, Fig. 1, has a relatively open exposure. Shielded ventilated and matched resistance thermometers are mounted on booms at the 2.6-, 6.4-, 16-, 40-, and 100-ft. levels. A self-balancing potentiometer determines the temperature differences between the 6.4-ft. level and each of the others. The results are printed on a Brown multipoint recorder.

An *in situ* calibration on June 9, 1960, using stirred ice baths showed that the system had an accuracy of 0.1, 0.1, 0.2, and 0.1°C. for the temperature differences between the 6.4-ft. and the 2.6-, 16-, 40-, and 100-ft. sensors, respectively.

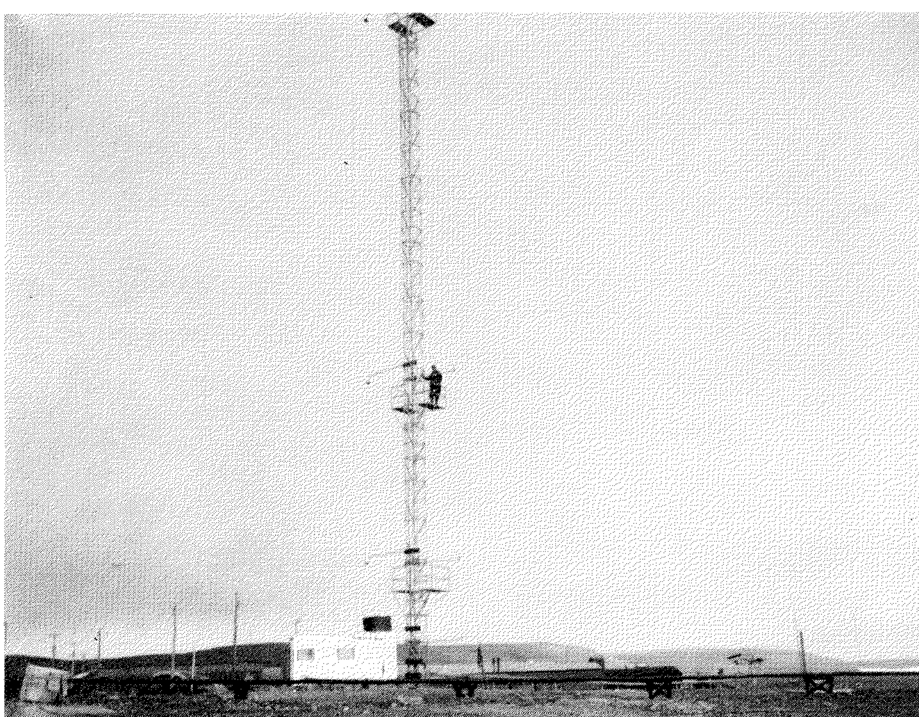
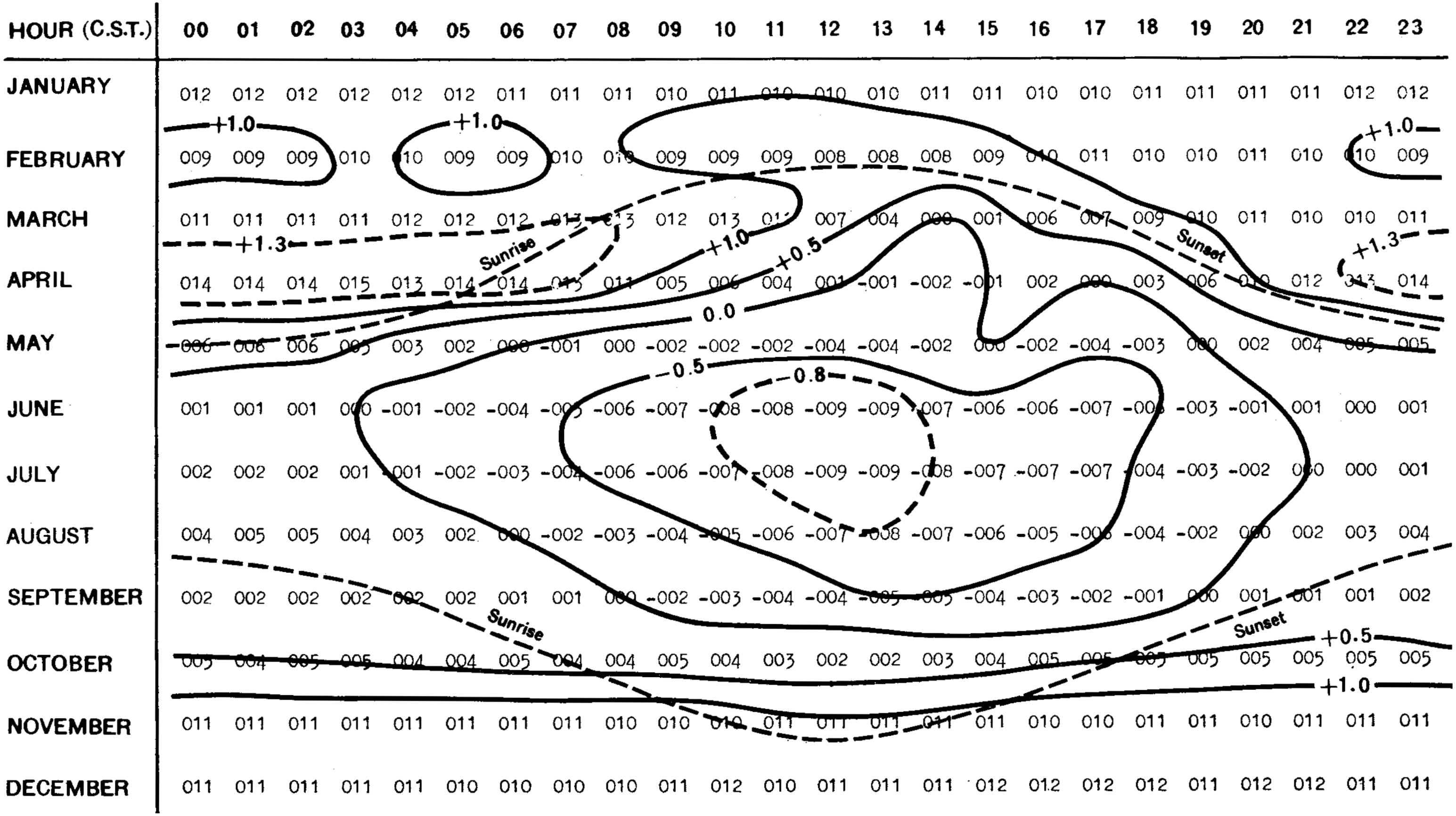


Fig. 1. The 100-ft. tower at Resolute, N.W.T.

Hourly temperature differences, ($T_{16} - T_{6.4}$) and ($T_{100} - T_{6.4}$), have been

*Published with the approval of the Director, Meteorological Branch, Canada Department of Transport.



HOUR (C.S.T.)	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
JANUARY	012	012	012	012	012	012	011	011	011	010	011	010	010	010	011	011	010	010	011	011	011	011	012	012
FEBRUARY	009	009	009	010	010	009	009	010	010	009	009	009	008	008	008	009	010	011	010	010	011	010	010	009
MARCH	011	011	011	011	012	012	012	013	013	012	013	[illegible]	007	004	000	001	006	007	009	010	011	010	010	011
APRIL	014	014	014	015	013	014	014	013	011	005	006	004	001	-001	-002	-001	002	000	003	006	010	012	013	014
MAY	006	006	006	005	003	002	000	-001	000	-002	-002	-002	-004	-004	-002	000	-002	-004	-003	000	002	004	005	005
JUNE	001	001	001	000	-001	-002	-004	-005	-006	-007	-008	-008	-009	-009	-007	-006	-006	-007	[illegible]	-003	-001	001	000	001
JULY	002	002	002	001	-001	-002	-003	-004	-006	-006	-007	-008	-009	-009	-008	-007	-007	-007	-004	-003	-002	000	000	001
AUGUST	004	005	005	004	003	002	000	-002	-003	-004	-005	-006	-007	-008	-007	-006	-005	[illegible]	-004	-002	000	002	003	004
SEPTEMBER	002	002	002	002	002	002	001	001	000	-002	-003	-004	-004	-005	-005	-004	-003	-002	-001	000	001	001	001	002
OCTOBER	005	004	005	005	004	004	005	004	004	005	004	003	002	002	003	004	005	005	005	005	005	005	005	005
NOVEMBER	011	011	011	011	011	011	011	011	010	010	010	011	011	011	011	011	010	010	011	011	010	011	011	011
DECEMBER	011	011	011	011	011	010	010	010	010	011	012	010	011	011	011	012	012	012	012	011	012	012	011	011

Fig. 2. Average temperature differences (°C.) between 100 and 6.4 ft. at Resolute for the period of August 1957 to February 1961, inclusive.

placed on IBM punched cards and are on file in the Data Processing Section of the Meteorological Branch, Toronto. Data from other levels have been abstracted in part but are not on punched cards. In particular, the $(T_{40} - T_{6.4})$ differences are questionable despite the calibration in 1960.

The diurnal temperature difference pattern

Fig. 2 shows average hourly temperature differences between 100 ft. and 6.4 ft. for each month of the year. The period of record is from August 1957 to February 1961, inclusive. Curves for sunrise and sunset have been added for reference.

An inversion (defined as a rise of temperature with height) is usual during the hours of darkness, or when the sun is just above the horizon. At such times heat is being transferred from the 100-ft. level down to the 6.4-ft. level by the exchange processes of radiation, turbulence, and conduction.

When the sun is well above the horizon, temperature usually falls with increasing height. In June and July, for example, there were 17 hours daily of negative temperature differences, as can be seen in Fig. 2. Heat is then being propagated upward, largely by turbulent mixing.

In April, May, and June there is a distortion in mid-afternoon of the isopleths in Fig. 2. The phenomenon is believed to be real, although no satisfactory explanation has been put forward.

Conclusion

A detailed inversion climatology of Resolute is being prepared by Mr. D. Champ of the Meteorological Branch. The present note is only preliminary but it does illustrate the diurnal and seasonal character of the vertical temperature gradient near the ground.

It should be added that inversions are of importance in atmospheric pollution studies. The natural cleansing capacity of the air is reduced on such occasions and high concentrations of smoke and waste gases may develop. An inversion that persists for 2 to 3 days is a rare event in temperate latitudes. However, spells of 2 to 3 weeks are to be expected during the arctic winter. It follows that when industrial activity expands northward, careful consideration will have to be given to the control of air pollution.

R. E. Munn

A THERMOGRAPH FOR USE IN THE ARCTIC*

An instrument has been designed to obtain records of long-term temperature variation of the permafrost in the Arctic. The device is portable, battery operated, and will record temperatures at six points for approximately 4 minutes at each point. It records the data twice during a pre-selected hour every day and can be left unattended for about 8 months. It has four temperature ranges between −25°C. and +25°C. and any range can be selected according to the soil temperatures. The complete unit is shown in Fig. 1.

Description:

The general principles of the thermograph, using a thermistor in a wheatstone bridge network, have been outlined by McLean[1]. The unit consists mainly of four parts: (1) a twenty-four hour timing motor and half-hour cycling motor with cams and micro-switches; (2) bridge network with calibrated potentiometer, operation selector switch, and temperature range switch; (3) recorder; (4) battery. Power to the circuit is provided by a 6-v., 30-amp.-hr. nickel-cadmium battery. A 100 microampere galvanometric recorder is used to record the values. A power switch applies battery voltage to the 24-hour timing motor, half-hour cycling motor, recorder motor, and to the bridge circuits. A manual timer switch is provided to operate the unit on a continuous basis ('off' position) or

*Contribution No. 42, Engineering Research Service, Research Branch, Canada Department of Agriculture, Ottawa, Canada.