

Heat Content of Lake Ontario and
Estimates of Average Surface
Heat Fluxes during IFYGL

F.M. Boyce, W.J. Moody and B.L. Killins

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(Résumé en français)

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ABSTRACT

This report is a contribution to the Energy Balance Program of The International Field Year on The Great Lakes. The net heat flux across the surface of Lake Ontario from April 1972 until June 1973 is estimated using data from 46 ship cruises and measurements of river temperatures and discharges. An effort has been made to compute the degree of uncertainty attached to the heat flux values. Results are given in graphical and tabular form; the latter are interpolated to standard weekly intervals.

RÉSUMÉ

Ce rapport s'insère dans le programme du bilan énergétique intégré à l'Année internationale d'étude des Grands lacs. Le flux thermique net de part en part du lac Ontario, d'avril 1972 à juin 1973, y est calculé d'après les renseignements fournis par 46 croisières et la mesure des débits et températures des cours d'eau. On s'est employé à calculer le degré d'incertitude inhérent aux valeurs des flux thermiques. Les résultats se présentent sous la forme de graphiques et de tableaux. Dans le dernier cas, ils sont interpolés à des intervalles hebdomadaires types.

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INTRODUCTION

From April 1972 until July 1973, during the International Field Year on the Great Lakes (IFYGL), a large effort was made to evaluate the fluxes of thermal energy across the surface of Lake Ontario (Elder et al. 1974). Knowledge of these fluxes is essential to an understanding of how Lake Ontario influences the climate of the adjacent region. Furthermore, it may be possible to refine the empirical formulae used to estimate evaporation and transfer of sensible heat and to obtain parameterizations of these fluxes in terms of easily measured mean variables which are applicable to the other Great Lakes.

Unlike the land's surface, a deep body of water stores a substantial portion of incoming thermal energy during the spring and summer (both surface and subsurface waters are warmed) and releases this energy back to the atmosphere during the fall and winter. The periods of maximum and minimum heat content occur later than the periods of maximum and minimum heat flux. It is this lag effect that helps to moderate the climate on the shores of a large lake.

If the distribution of temperature within a lake is known at various points in time, the quantity of heat stored in the lake, and its changes can be computed. The change in heat content between two such points in time, less the quantity of heat added by tributary streams, and thermal effluents is equal to the quantity of heat which has crossed the lake's upper free surface. The computation of these fluxes is the purpose of this work.

MEASUREMENTS

The main body of data consists of temperature profiles taken from ships at a network of stations (Figure 1) during 46 IFYGL Heat content surveys. Whenever possible, two ships were used in order to reduce the survey time. Most cruises were completed within 60 hours. The task was divided between U.S. and Canadian vessels (Table 1). Guildline electronic bathythermographs (EBT's) were installed aboard all vessels, and with rare exceptions these instruments were used to obtain all the temperature profiles. The Guildline probe is lowered from a stationary vessel and, coupled with an X-Y recorder, produces a continuous analogue plot of temperature versus depth (pressure). The plots constitute the primary data used in this report. The design of the survey and the sampling methods are discussed in Appendix 1.

Additional measurements of lake temperatures were obtained from moored self-recording instruments (current meters, fixed temperature profilers) (Figure 2). These measurements consist of repeated temperature samples (up to 10 samples per hour) at fixed depths and locations. In the present work, these measurements have not been used in the heat content calculations but rather they have served to describe the nature of the time variability of the lake's thermal structure at time scales shorter than those of the ship surveys. The surface temperature of the lake was measured at regular intervals with an airborne infrared thermometer (ART) (Irbe and Mills, 1976).

An effort has been made to estimate the quantity of heat carried to and from the lake by rivers, streams and discharges of waste heat. The overall effect of these fluxes is small, but some, notably the Niagara River inflow and the St. Lawrence River outflow, have marked local effects. Data on stream flow and temperatures has been obtained from Water Survey of

Canada, U.S. Geological Survey, St. Lawrence Seaway Authority, and Ontario Hydro. Local observers were recruited to measure water temperatures at the mouths of the Credit, the Ganaraska, the Trent and the Moira Rivers on the Canadian shores from April until November 1972.

Data collected by the consulting engineers, H. G. Acres [H. G. Acres Ltd., 1970] was used to estimate the waste heat rejected to the lake from power generating stations, sewers, and heavy industry. The computation of the heat advected to and from the lake is described in Appendix 2.

Additional heat flux terms arise from precipitation into the lake and from phase changes (melting of snow and formation and melting of ice cover). Available data permit an order of magnitude estimate only of these terms (See Appendix 5.)

COMPUTATIONS AND ERROR ANALYSIS

Analogue to Digital Conversion of Temperature Depth Plots

After much experimentation [Boyce, 1971] a simple manual method was devised which represents a continuous temperature depth profile by a sequence of up to 9 temperature depth pairs. These pairs define 8 continuous linear segments which best fit the analogue trace. This information together with the sampling time, station number and position, and depth to the bottom can be stored on a single 80 column IBM card (Appendix 3). The mean square error of this representation, expressed as heat content (squared) contributes about 10% of the total variance which also includes internal waves, instrument accuracy, and digitization errors [Boyce, 1971].

All of the temperature profiles obtained during the IFYGL cruises were reduced in this fashion to IBM card images, key punched, and edited in card form and then committed to magnetic tape. The coded profiles are simply manipulated in either card or magnetic tape form. The chief disadvantage of this method is the ease with which errors can be introduced in the manual coding stage. Verifying the data took much longer than we had anticipated.

Computation of Stored Heat

For computational purposes, the lake was divided horizontally into 2 km square elements (4 km^2). The bathymetry was represented by the average depth of each of the elements (adjusted for lake level). The lake was further subdivided horizontally into 10 zones (Figure 3) based on known regional differences in the lake's thermal structure and on the distribution of moored current meters in the IFYGL network. These zones are arbitrary and do not affect heat content calculations. Finally, the lake was vertically divided into 8 layers defined by the depths 0, 10, 20, 40, 60, 90, 120, and 150 m.

The algorithm employed to compute stored heat has similarities with the Thiessen polygon approach [Thiessen, 1912]. Starting with the first layer (0 - 10m), each element of the lake within the layer is assigned to the sampling point nearest to it. Thus data from station 1, over the vertical interval 0 to 10 metres is applied to all the elements closer to station 1 than to any other station. This is equivalent to a horizontal linear interpolation of the temperature data between sampling points. By various simple strategies, the computations are reduced to reasonable limits. The procedure is repeated for each layer, with intermediate results being stored by zone and by layer. The choice of layer depth represents a balance between accuracy and computational economy. The Algorithm, known as program Z00P, is the latest of a family of similar routines

[Boyce, 1973] and is described in Appendix 4 together with tests on its accuracy. The latter indicate that less than 25% of the total variance of the final heat content value is due to the computational method.

Accuracy of the Final Result

In outlining the methods used to measure the temperature distribution within the lake and to compute the stored heat, we have mentioned several sources of error. We shall summarize them here.

The errors can be classified into two groups, those whose effects we can estimate a priori, and those over which we have no such control. In the first group are uncertainties arising from internal wave activity (motions of the thermocline occurring at time scales much shorter than the duration of a cruise), instrument errors, digitization errors, and computational errors. In estimating the combined effect of these errors we assume that the 105 stations, if properly sampled, would adequately define the thermal structure of the lake. In this context, a single EBT profile represents one sample of population whose range is established by the level of internal wave activity and random temperature fluctuations. These are known to be ubiquitous phenomena; by assuming them to be random, and by using rough estimates of their amplitudes, we can arrive at an estimate of their contribution to the total error [Boyce, 1971]. The Guildline EBT and the associated electronics and recording apparatus have an accuracy of the order $\pm .05^{\circ}\text{C}$ in temperatures and about $\pm 0.5\%$ of the depth range used under good conditions. In actual practice, these limits are probably closer to $\pm 0.1^{\circ}\text{C}$ and $\pm 1 \text{ m}$. To complete this list we must add the errors due to the digitization and computation stages briefly discussed above. Since the heat content may be viewed as a weighted mean of the vertical integrals of the individual

profiles, we assume that the error of the mean is approximately $N^{-1/2}$ times the error of an individual profile where N is the number of stations (nominally 100). The error estimates are summarized in Table 2; the total variance (error) is the square root of the sum of the individual variances.

The second type of error arises from the finite duration of the surveys. Rather than an instantaneous picture of the temperature structure, we have a potentially blurred image due to the changes in structure occurring while the cruise is in progress. The changes can be due to heating and cooling or due to the internal readjustment of the water masses to changes in meteorological forcing. The latter source of error could be properly termed aliasing error and its effect is impossible to estimate. We suspect that it could be large.

Excluding the aliasing term, we propose a formula for estimating error of the form

$$E = \frac{E_0(t)}{\sqrt{N}} + f(q, \tau)$$

E_0 is the error due to the sources listed in Table 3, expressed on a per-station basis; N is the number of stations. The function f, indicating the contribution due to finite survey duration, must increase monotonically with τ (zero for $\tau = 0$) and must also depend to some extent on the average rate of heat flux q. We propose that the form of f is

$$f(q, t) = \alpha qt$$

where α is a constant. Clearly if q is constant during the survey period and if the heat content is evaluated at the mid-point of the survey, as we do in fact, then α would be identically zero. α represents then a measure of the non-uniformity of the heat flux primarily at diurnal time scales.

This formula assumes, in effect, that variability of the heat flux as expected by $f(q, \tau)$ increases with the absolute value of the mean flux itself.

The choice of α is for the moment subjective. Letting $\alpha = 1$ is an extreme situation, for it implies that there is no cancellation of errors in the averaging process. From various simple models of the heating and cooling processes, we conclude that $\alpha = 0.2$ provides a conservative estimate of error.

As can be seen from Table 2, $E_o(t)$ is strongly correlated with the stratification of the lake. We have used the data of Figure 4 and made $E_o(t)$ to be linearly related to the difference between mean lake temperature and the temperature of the upper 10 m. E_o assumes the value of 3000 cal/cm² when this difference is maximum and 1500 cal/cm² when the lake is homogeneous. In this fashion we have estimated the confidence limits of the heat content calculation for each cruise (Table 1).

Letting $q_1 \pm \Delta q_1$ be the heat content \pm confidence limits for cruise 1 at central time t_1 , and $q_2 \pm \Delta q_2$ be the heat content \pm confidence limit for cruise 2 at central time t_2 , the mean rate of heat transfer between t_2 and t_1 is

$$\frac{q_2 - q_1}{t_2 - t_1} \pm \sqrt{\frac{\Delta q_1^2 + \Delta q_2^2}{t_2 - t_1}},$$

assuming the two measurements to be statistically independent. This formula has been employed to construct Figure 5. The reader will be well aware of the subjective nature of this error estimate.

RESULTS

Heat content computations have been made at regular weekly intervals via linear interpolation of the cruise data in time. These computations are presented in tabular form in Appendix 6. The main body of these results can be summarized in a few diagrams (Figs. 4, 5, 6).

The heat storage cycle in the lake can be represented by a plot of the average temperature of the lake versus time (Figure 4). During IFYGL, the maximum heat content occurred near Sept. 20, 1972 (7.5°C) and the following minimum occurred around March 1, 1973 (1.5°C). The change of 6°C is equivalent to a heat transfer of 10.02×10^{18} calories. A curve showing average temperature of the upper 10 m of the lake is plotted on the same diagram. The divergence of the lake mean temperature and the temperature of the upper 10 m can be construed as a measure of the stratification of the lake. Maximum summer stratification appears to precede maximum heat content by a week or so, whereas maximum winter stratification appears to precede minimum heat content by a small amount.

The relevant curves, insofar as energy budgets are concerned, are those of Figures 5 and 6. Figure 5 shows the average rate of heat content change between the IFYGL cruises. An estimate of the 95% confidence limits of these fluxes is shown on the diagram. The types of errors included in this estimate are instrument errors, digitization errors, computational errors, losses of accuracy due to missing stations and extended survey periods. Errors due to large scale water motions occurring during the surveys (aliasing) cannot be directly estimated, but the possibility of this additional error can be inferred from the wind record and from the changes in the large scale thermal structure. The likelihood of such contamination is expressed on the curve of Figure 5.

Finally, Figure 6 shows the average surface heat flux and the flux due to advective heat transfer (rivers, power plants, etc.) at weekly intervals. The choice of weekly intervals is a computational convenience intended to allow a more simple dove-tailing of the different data sets in the energy balance computation. As one can see from Figure 5, the error estimates depend on the time interval between successive cruises; they are less for longer intervals, since the errors for each heat content evaluation become smaller in relation to the change in heat content. In view of the large week-to-week variations in rate of heat content changes we should be wary of applying a mean rate of change taken over two or three weeks, say, to a situation where the other components of the energy balance are evaluated at weekly intervals or less.

It is noteworthy that the period where heat is lost from the lake (September to March) exhibits the greatest variability in heat transfer rates. Presumably this is due to the greater input of mechanical energy to the lake during the episodic but vigorous fall storms and the decreasing stability of the water column as heat is removed.

The curve of weekly averaged heat flux from rivers, power plants, and sewers (Fig. 6) shows that this flux is less than 10% of the surface flux except at brief periods when the surface flux changes sign. It is, moreover, dominated by the Niagara-St. Lawrence through-flow (Appendices 2 and 6). The mean absolute value of the surface heat flux is about 300 cal/cm²/day, whereas that of the "advective" component is about 5 cal/cm²/day.

For the sake of completeness, we have tabulated monthly mean values of surface heat fluxes, advected heat flux including precipitation, and effective heat fluxes due to ice formation and melting (estimate only) (Table 4, Appendices 2 and 5). This table emphasizes the importance of the

ice-melt term in the heat budget in March.

CONCLUSIONS

It is not the aim of this work to optimize the manner in which the surface heat flux data are presented. This can only be done when all the terms in the Energy Budget have been gathered together. The purpose of this report is to present the facts in such a way as to make their interpretation as simple and as honest as possible.

It is clear, nevertheless, that the uncertainties in the individual heat content computations are too large to permit useful energy budget computations at a weekly time interval. The choice of an averaging interval (biweekly or longer) must await scrutiny of the other input terms.

ACKNOWLEDGEMENTS

The successful completion of some 46 IFYGL cruises is a tribute to the stamina of both the research vessels involved and their crews. Winter cruises on Lake Ontario are uncomfortable, lonely, and often dangerous activities, and we acknowledge the high quality of seamanship and cheerful devotion to duty which has produced one of the most valuable sets of data ever collected on the Great Lakes.

Mr. Robert Gottinger assisted with the programming of the Z00P algorithm and Janet Macavella and Karen Miles helped with data reduction and verification.

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APPENDIX 1

Survey Design and Sampling Methods

The approach to the unattainable ideal is the determination of the temperature of the lake at every point at a single instant in time. With the available resources of two major ships equipped with Guildline EBT probes we must attempt to approach the ideal goal as closely as possible. Using the expression developed in the main body of the test for the confidence limits applying to a heat content determination, we get

$$E = \frac{E_0(t)}{\sqrt{N}} + kT,$$

where $E_0(t)$ is the confidence limit for a single EBT profile, N is the number of stations, T is the duration of the cruise and k is taken to be 20% of the mean heat flux. T is related to N by the expression (for a single ship)

$$T = \sqrt{N} \times \frac{\sqrt{A}}{V} + N \tau_s$$

where A is the surface area of the lake, V is the speed of the ship, τ_s is the time taken to occupy the station. This last expression is based on the assumptions that the plan of lake has a small aspect ratio and that the stations are uniformly distributed over the lake's surface.

E is minimized when

$$\frac{E_0 V}{k\sqrt{A}} = \left(1 + \frac{2\tau_s V \sqrt{N}}{\sqrt{A}}\right)^N.$$

When two ships are operated simultaneously, the effective V and τ_s are doubled and halved respectively from the single ship values.

Taking $V = 10$ knots, $\tau_s = 0.3$ hr for a single ship, $E_o = 3000 \text{ cal/cm}^2$, and $k = 5 \text{ cal/cm}^2/\text{hour}$ ($0.2 \times \text{max surface heat flux}$), ($A = 1.85 \times 10^4 \text{ km}^2$), the optimum number of stations using two ships works out to be 92. The time taken to run the pattern is about 50 hours and E is 550 cal/cm^2 . These figures constitute a worst case situation and it is interesting that the 93 station IFYGL pattern run with two ships comes close to the optimum.

In winter time (no stratification) E_o becomes 1500 cal/cm^2 and the optimum number of stations using a single ship is 40 over a time of 35 hours. E is 412 cal/cm^2 . The enforced single-ship cruises thus did not cost a heavy error penalty.

Sampling Procedure

The configuration of the Guildline EBT probe used in the Field Year requires that the ship be almost fully stopped before lowering the probe to the bottom. During the station manoeuvres the ship tends to drift downwind and the flow pattern around the ship can range from a downwind vertical displacement of water particles to an upwind internal hydraulic jump [Boyce, 1971].

In order to minimize the effects of the disturbance on the temperature profile it is necessary to sample on the downwind side of the ship and outboard a distance which depends on the draft of the ship. This is usually awkward. However, through judicious manoeuvering of the ship and by good coordination between bridge and deck, a procedure can be developed to eliminate the worst of the ship disturbance problem. Suppose that the EBT davit is located on the port side of the ship. The ship approaches the

station with the wind on the starboard bow. Forward way is reduced until there is just sufficient way to carry the ship past the zone of propeller wash disturbance with a slight upwind component.

The EBT cast is made as soon as the ship has slowed sufficiently to avoid a large trailing wire angle but before the ship has started to drift downwind (Figure 7). Only the down trace is recorded. In heavy weather, such manoeuvres may be impractical, but on the other hand, the more homogeneous upper layers which result from increased vertical mixing reduce the severity of the disturbance.

APPENDIX 2

Heat flow to Lake Ontario from Rivers and Streams, Power Generating Stations, and Industrial and Municipal Wastes

In addition to thermal energy transferred across the surface of the lake, energy is admitted to or lost from the basin by virtue of flows of water through the lateral boundaries (inflow and outflows) and by electrical generating stations, and by industries and municipalities which draw water from the lake and return it at higher temperatures

Let Q_{ai} be the quantity of heat with respect to a reference temperature, θ_0 , which flows into the lake from a river or stream (i^{th} tributary) during a time interval $t_0 \leq t \leq t_1$. Q_{ai} will be of the form

$$Q_{ai} = \int_{t_0}^{t_1} \rho C_p q_i(t) (\theta_i(t) - \theta_0) dt$$

where C_p is the specific heat of water (assumed constant), $q_i(t)$ is the volumetric flow rate of the tributary, and $\theta_i(t)$ is the temperature of the tributary as it enters or leaves the lake. We can calculate the quantity of heat with respect to θ_0 advected into the basin by summing over all the N tributaries and outflows

$$Q_A = \sum_{i=1}^N Q_{ai}$$

Since, in practice, flow and temperature data are available at a limited number of tributaries $N' < N$, an estimate of Q_A may be formed as a weighted sum of the measured tributaries

$$Q_A \approx \sum_{j=1}^{N'} W_j Q_{aj}$$

where the W_j 's are all greater than 1 and represent the contributions of adjoining watersheds of presumably similar characteristics. The choice of W_j 's must meet the requirement for a water balance in the lake, that is to say

$$\sum_{j=1}^{N'} W_j \int_{t_0}^{t_1} q_j(t) dt = \text{change of mass of water in basin}$$

due to evaporation precipitation and shifts of mean lake level. This is a necessary but not sufficient criterion for the correct choice of the W_j 's.

The heat rejected to the lake from power generating stations, sewers, and industrial effluents could be computed in the same fashion provided mean flows through the system and both intake and outfall temperatures were known. In practice, these contributions may be estimated from simple rules of thumb based on knowledge of the industrial processes (thermal efficiencies) involved.

Stream and Rivers

Daily temperature records are available for a limited number of rivers flowing into Lake Ontario (Table 5) (Figures 8 and 9). On the Canadian shore, The Canada Centre for Inland Waters recruited local observers to measure water temperatures at the mouths of the Credit, the Humber, the Ganaraska, the Moira and the Trent Rivers. Ryan Thermographs (clockwork analogue recorder using pressure-sensitive paper and a Bourdon tube for temperature element) were used to give a time-continuous record which was

augmented by a daily bucket thermometer reading. These records extend from April 1972 through November 1972.

On the U.S. side of the lake, temperature data is available from the Niagara, the Genessee, the Black, and the St. Lawrence Rivers. This data was obtained from U.S. Geological Survey - Water Resources Data for New York.

The temperature of water flowing from the Bay of Quinte into Lake Ontario is estimated from data provided by the Ontario Ministry of the Environment [D.A. Hurley, 1974, personal communication] and from the temperatures of the Moira and Trent Rivers.

Daily flow rates and drainage basin areas on the Canadian side were obtained for all significant tributaries from the Water Survey of Canada. Similar data was obtained for the U.S. side from U.S. Geological Survey.

Using a map of the drainage basin of Lake Ontario, the drainage areas flowing into each of the shore zones of the lake were planimetered. For each zone, the sum of the gauged drainage areas was computed and the ratio of gauged to ungauged portion of the zone calculated. Each gauged stream was assigned temperature data from the stream nearest to it where temperature measurements were obtained. For each day and each zone the sums of the temperature discharge products were formed for the gauged areas and then the ratio of gauged to ungauged areas was used to extend the estimate to the rest of the drainage area in that zone (Table 6).

The heat advected to the lake by streams is summed over weekly intervals coincident with the weekly water balance measured by the Water Balance Board.

Heat from Power Generating Stations, Sewage, and Industry

Data sources for these computations are H.G. Acres and Co. Reports (H. G. Acres 1970) and monthly estimates of heat rejected during 1972 to Lake Ontario for 3 stations in the Toronto area supplied by the Generation Projects Division of Ontario Hydro. The power plants considered are listed in Table 7. It will be noted that the plants are grouped in the Toronto area and in the Rochester-Oswego area.

Using averaged monthly values of heat rejected furnished by Ontario Hydro and extrapolating the shape of the demand curve, expressed as a fraction of total capacity, to the stations on the U.S. side (output - capacity x monthly fraction), smooth curves were constructed for the outputs of these plants over the field year.

The conversion from megawatt hours of power produced to calories of heat rejected to the lake was accomplished using formulae based on the overall efficiencies of fossil fueled and nuclear power stations.

Fossil fueled station 1.03×10^9 calories rejected/MW hour

Nuclear station 1.77×10^9 calories rejected/MW hour

The next stage was to compute the heat rejected to each of the shore zones of the lake over successive weekly intervals. Finally, one must consider additional inputs of heat from municipal sewage and manufacturing activities (see table 1, H.G. Acres Ltd. 1970). These are considered to be constant throughout the year. These sources are listed in Table 8.

Heat Adverted by Zones

It is a simple matter to compute the net heat transported to the whole lake (referred to some arbitrary temperature), but it is generally impossible to compute the net heat advected to each zone, since we have no direct information on the advection of heat through the open lake boundaries

of the zone. We have assumed that this heat is transported at the temperature of the outflowing St. Lawrence river water. Thus the net heat advected to the zone by rivers is taken to be the product of the river discharge to the zone and the temperature difference between the inflowing water and the outflowing St. Lawrence water. This measure produces at best a qualitative estimate which is included in the tables of Appendix 6.

APPENDIX 3

Nine Point Digitization of Continuous Analogue Traces of Temperature Versus Depth

The rationale behind the choice of this format has been discussed by Boyce, 1971.¹³ Briefly resumed

1. A digital representation of the analogue plot of temperature versus depth (original format of field data) is required for machine computations.
2. The reconstructed profile drawn from the numerical data must conserve the main features of the original profile and also the vertical integrals of the original and reconstructed profiles (heat content per unit surface area) must be equal within acceptable limits. The limits in this case are defined primarily by the accuracy of the original trace.
3. The method must be economical with only the minimum number of data points consistent with (2) above being retained. Moreover, the digitization procedure must be workable by technical and clerical staff whose basic training is not necessarily in the field of physical limnology.

The procedure employed was to represent the original trace by a maximum of 8 continuous straight line segments, the end points of which constitute 9 temperature depth pairs (surface temperature, the temperature-depth pair at maximum penetration of the instrument, and seven interior points to be chosen by the person performing the digitization). The interior points selected are those where the slope of the temperature depth profile changes most rapidly, the so-called "break points" of the curve. The resolution of this scheme is sufficient to document the main features of the profile plus

some of the more important secondary features such as transient thermoclines, sheets and layers, etc. (Figure 10). In Lake Ontario, temperatures are recorded to the nearest 0.1°C and depths to the nearest metre.

The 9 temperatures and 8 depths (surface temperature implies zero depth) plus time, geographical location, and other identifiers are recorded on a simple 80 column IBM card in the format given in Table 9.

APPENDIX 4

The ZØØP ALGORITHM

Description

The computer program ZØØP is designed to compute an approximation to the volume integral

$$(1) \quad Q(t) = \iiint_V C(x, y, z, t) dx dy dz$$

where $C(x, y, z, t)$ is the concentration of heat or dissolved substance (quantity/unit volume) defined in a lake basin. The volume of integration is defined by the bottom topography of the basin and the mean elevation of the free surface. $Q(t)$ is the total quantity of the measured parameter in the basin. In practice, an approximation to the continuous concentration field $C(x, y, z, t)$ must be constituted from a series of vertical profiles of concentration made at time t , and at different points on the surface of the basin*,

$$c_k(x_k, y_k, z, t) \quad k = 1, 2, \dots K$$

The approximation to the integral (1) can be expressed as a weighted sum of the vertical integrals of K concentration profiles

$$(2) \quad Q(t) \approx \int_0^z B \sum_{k=1}^K A_k(z) c_k(z, t) dz$$

The weighting function $A_k(z)$ may be interpreted as the horizontal "areas of influence" ascribed to each sampling point on the horizontal plane. The in-

* In practice the profiles are made at different times as in the case of a ship survey, but they are treated as if they were made at same central time, t . The accuracy of the volume integral $Q(t)$ is affected by this spread in sampling time (see appendix 1 of this report).

dividual profiles extend vertically to a depth z_k limited by the water depth at that point so that

(3)

$$A_k(z) \equiv 0; z > z_k$$

The simplest manner by which the function $A_k(z)$ can be defined is via the Thiessen polygon approach (Thiessen, 1911). If we divide the horizontal plane into a number, L , of small elements or cells, whose vertical projections extend to $z = z_{Bl}$, $\ell = 1, 2, \dots, L$, then at any given level z , the value of the function $A_k(z)$ is equal to the sum of the areas of all the cells within the lake whose centre points lie closer to the point (x_k, y_k) than to any other of the K sampling points, and whose vertical span encompasses the level z ($z_{Bl} > z$).

An equivalent stratagem is to assign to each of the cells data from the sampling point nearest to it provided that the cell and the vertical profile both extend through the level z in question. This is the procedure adopted in the ZOP algorithm. Practical considerations necessitate the division of the lake into a finite number of horizontal layers defined by the planes $z = z_m$, $m = 0, 1, 2, \dots, M$, where $z_0 = 0$ and z_M is equal to the depth of the deepest sample profile. Within each layer, each cell which extends into the layer is assigned data from the sampling point nearest to it provided that the sample profile extends through the layer (Fig. 11). Since z_M is generally less than z_B , the deepest point in the lake, it is assumed that the concentration value measured at z_M applies to the volume of the lake between the horizontal planes $z = z_M$ and $z = z_B$. The validity of this assumption depends on how closely z_M approaches z_B and the vertical

structure of the concentration profiles near $z = z_M$.

The heart of the matter is the effective horizontal interpolation imposed by this approach. The vertical resolution is at the discretion of the operator. The Thiessen polygon approach is approximately equivalent to a linear interpolation between adjoining stations; it is rough but honest and lends itself well to the computation of lake volume total. Given the time variability of vertical distribution within a lake, each profile must be viewed as a single sample of a random variable, and in this context the simple area weighting is the most appropriate way to form what is essentially a lake-wide average. The principles of the algorithm are more fully discussed in an earlier report (Boyce, 1973).

Inputs to the program are a digital representation of the bathymetry of the lake with reference to a fixed datum, the height of the water level above the datum at the time of the survey, the depths of the horizontal planes defining the layers of vertical integration, a zone directory which determines to which horizontal zone an individual cell belongs, and the vertical profiles at the sampling position together with their locations.

Outputs from the program are the estimates of stored heat and average temperature by zone within each layer plus layer totals, zone totals, and lake totals.

Major advantages of the algorithm are that it adjusts automatically to changes in the number and horizontal distribution of the station profiles, and all computations are referred to a single representation of the lake bathymetry.

Included at the end of this appendix is an annotated listing of ZOOP in FORTRAN IV language as programmed for a C.D.C. 3300 computer.

Sensitivity of Computed Lake Heat Content to Choice of Vertical Layers
of Integration and to Changes in Horizontal Station Distribution

(a) Vertical Layers

Two sets of temperature data were used. Set A comprised the profiles from the June 12-16, 1972 cruise on Lake Ontario. Set B comprised the profiles from the September 5-7, 1972 cruise. The set A data is representative of the late thermal bar period when horizontal and vertical temperature gradients are pronounced, and represents a worst-case situation from the point of view of complexity of the temperature distribution pattern. Set B data is representative of complete vertical stratification.

Four different layering schemes were tested. The depths of the planes separating each layer are given in Table 10a.

Scheme 1, with the largest number of layers was considered to be the most accurate and served as a control. Scheme 3 was chosen as the compromise between accuracy and computation effort and was used for the routine computations of heat content. Scheme 3 was further tested by a series of computations made with each of the horizontal planes shifted upwards one metre for each computation (Table 10b).

The computations using the original scheme 3, plus the 9 additional variants, 3a to 3j, were averaged and the standard deviation calculated. This standard deviation is representative of the error introduced by the interaction of a fixed set of layers of integration with a presumably random collection of maximum sampling depths. The results of these tests are summarized in Table 11.

It is seen that the accuracy of the integration decreases with the number of horizontal layers as expected. The significant figure, however, is the standard deviation of the average of computations using schemes 3, 3a,

....3i. This deviation, about 0.03×10^{18} cal or 160 cal/cm^2 , is much larger than the deviation of the mean from the standard value. Thus the expected error of a single computation using layering scheme 3 is $\pm 160 \text{ cal/cm}^2$ during stratified conditions.

The above calculations were performed using the full set of stations (105). A test of the sensitivity of the scheme to changes in sample patterns was made by running the program with half the stations only. The division of the data into two parts was done in 3 ways (Table 12). Layering scheme 3 was employed and the differences are expressed with respect to the value obtained for the full complement of stations.

This test reveals one of the problems inherent with the interpolation scheme. On the basis of past data and theories of lake motions, the variations of thermal structure are more rapid offshore than along shore. Hence one would expect that sampling ought to be more dense in directions perpendicular to the shoreline in order to produce the best accuracy for the least number of stations. This notion suggests that of the three methods of splitting the data in two, the first, alternate north-south line, would best preserve the main features of the thermal structure. The horizontal interpolation scheme, however, makes no distinction between the distances in offshore and alongshore directions and thus operates most successfully with a uniform spacing of stations.

The above results indicate that the error incurred by loss of stations up to 50% of the original pattern is of the order of 10 cal/cm^2 per station.

To summarize, the horizontal layering scheme introduces an uncertainty of $\pm .03 \times 10^{18}$ cal ($\pm 160 \text{ cal/cm}^2$) into the computed heat content figure, while the sensitivity of this figure to lost stations in the

original pattern is about ± 10 cal/cm² per station dropped. In view of the additional sources of error (see main text) the present scheme of integration was judged to be adequate.

P R O G R A M Z O O P

A COMPUTER ROUTINE FOR CALCULATING PARTIAL AND TOTAL LAKE VOLUME CONTENTS OF A DISSOLVED SUBSTANCE FROM ARBITRARY DISTRIBUTION OF CONCENTRATION PROFILES.

THIS IS A MODIFIED VERSION OF PROGRAM SPLITCH. ALL SUBROUTINES USED IN THIS DECK ARE THE SAME AS THOSE OF SPLITCH, EXCEPT FOR SUBROUTINE SPLIT, WHICH WAS OMITTED. THE MAXIMUM NUMBER OF STATIONS HAS BEEN INCREASED TO 125

DESCRIPTION OF INPUTS, OUTPUTS, AND CONTROL PARAMETERS

IMAX,JMAX	MAXIMUM DIMENSIONS OF SPATIAL ARRAYS (154,57)
KMM	MAXIMUM NUMBER OF STATIONS (125)
Z(KP),KP=1,KDM	LEVELS DEFINING LAYER DEPTHS (METRES) KDM.LE.10
KDMM	MAXIMUM NUMBER OF LAYERS EXTENDING FROM SURFACE TO DEEPEST POINT LAYER KDMM EXTENDS FROM Z(KDM-2) TO DEEPEST POINT
DLAT	GRID LENGTH (KM)
DA	CELL AREA (M**2)
AA(L),BB(L),L=1,5	COEFFICIENTS DEFINING TRANSFORMATION BETWEEN GEOGRAPHICAL COORDINATES (LAT,LONG) AND GRID COORDINATES (I,J)
PHIM,GM	LAT AND LONG OF GRID ORIGIN (DEGREES)
IM,JM	DIMENSION OF GRID (SPATIAL ARRAYS)
ZB0(I,J)	IM.LE.IMAX, JM.LE.JMAX I=1,IM, J=1,JM CONTAINS ZONE NUMBER AND DEPTH OF EACH GRID CELL INT(ZB0(I,J)/1000.)=ZONE NUMBER AMOD(ZB0(I,J),1000.)=DEPTH (M)
BRANCH	INPUT CONTROL FOR DIGITAL BATHYMETRY BRANCH=0, ZB0 INPUT FROM CARDS BRANCH=1, ZB0 INPUT FROM DISK
IZ	STARTING ZONE FOR PARTIAL VOLUME CONTENT INCREASING IN STEPS OF 1 TO IZMAX
HD	HEIGHT OF WATER LEVEL ABOVE CHART DATUM (METRES)
IDIR	ZONE DIRECTORY CONTROL IDIR.NE.0 CAUSES OUTPUT OF ZONE MAP
NSTAT(K),K=1,KM	STATION NUMBER (1 TO 999)

C STATIONS ARE NUMBERED WITHIN THE PROGRAM
 C VIA THE INDEX K, K=1,KM
 C LATITUDE OF KTH STATION,
 C DEGREES AND MINUTES
 C
 C PSTAT(K,1,1) LONGITUDE OF KTH STATION,
 C PSTAT(K,1,2) DEGREES AND MINUTES
 C
 C C(K,KL),ZM(K,KL) CONCENTRATION-DEPTH PAIRS
 C (DEPTHS IN METRES) MAX KL=9
 C
 C SCAFC COEFFICIENT USED TO CONVERT OUTPUT TO
 C DESIRED UNITS , OUTPUT UNITS FOR VOLUME
 C CONTENTS ARE (CONCENTRATION UNIT)*(VOLUME
 C UNIT=M**3)*SCAFC
 C
 C ZSTAT(K) MAXIMUM SAMPLING DEPTH AT KTH STATION
 C
 C
 C ZSFC(NC,KD) OUTPUTS
 C AREA OF LOWER SURFACE OF KD-TH LAYER
 C CONTAINED IN NC-TH ZONE (M**2)
 C ZVOL(NC,KD) VOLUME OF KD-TH LAYER CONTAINED IN
 C NC-TH ZONE (M**3)
 C ZTOT(NC,KD) VOLUME CONTENT OF KD-TH LAYER CONTAINED
 C IN NC-TH ZONE
 C ZCON(NC,KD) AVERAGE CONCENTRATION OF KD-TH LAYER
 C CONTAINED IN NC-TH ZONE
 C STOL(KD) AREA OF LOWER SURFACE OF KD-TH LAYER
 C (WHOLE LAKE) (M**2)
 C VOLTL(KD) VOLUME OF KD-TH LAYER (WHOLE LAKE) (M**3)
 C CONTOL(KD) VOLUME CONTENT OF KD-TH LAYER
 C (WHOLE LAKE)
 C AVLAY(KD) AVERAGE CONCENTRATION IN KD-TH LAYER
 C (WHOLE LAKE)
 C TVOL(NC) VOLUME OF NC-TH ZONE (M**3)
 C CONTO(NC) VOLUME CONTENT OF NC-TH ZONE
 C AZON(NC) AVERAGE CONCENTRATION OF NC-TH ZONE
 C VTOL TOTAL VOLUME OF LAKE (M**3)
 C HTOL TOTAL VOLUME CONTENT OF LAKE
 C ALAK AVERAGE CONCENTRATION OF LAKE

INPUT DECK

CARD NO.	VARIABLES	FORMAT
1	TI(L),L=1,20 TITLE CARD FOR DIGITAL MAP	20A4
2	BRANCH	I1
3	IDIR	I5
4	IZ,IZMAX,HD	2I5,F10.2

```

C      5          KDM,Z(KP),KP=1,KDM      I3,10F7.2
C      6          DLAT,PHIM,GM,IM,JM      F4.0,2F10.5,2I3
C      7          AA(I)   I=1,5           5E14.6
C      8          BB(I)   I=1,5           5E14.6
C      9          SCAFC, TI(L) L=1,15      E12.5,8X,15A4
C          SCALE FACTOR AND OUTPUT UNITS

C      10+        ZBO(I,J) I=1,IM, J=1,JM  19F5.0

C          CONCENTRATION DEPTH DATA

C      1          TI(L) L=1,20          20A4
C          TITLE CARD FOR CONCENTRATION DATA

C      2+        NSTAT(K),((PSTAT(K,L,M),L=1,2),M=1,2),
C                  C(K,1),(C(K,N),ZM(K,N),N=2,9)
C          FORMAT 224

C          BLANK CARD AT END OF STATION DATA

```

```

INTEGER RAN
INTEGER TI(20),BRANCH
LOGICAL STOR,PLOT
DIMENSION ZSFC(20,10),STOL(10),MHYP(125)
DIMENSION ZVOL(15,10),ZCON(15,10),ZTOT(15,10),AZON(15)
DIMENSION CONTOL(10),VOLTL(10),AVLAY(10)
DIMENSION ISEL(125)
DIMENSION CONTO(15),TVOL(15)
DIMENSION Z(10),PLOT(10)
DIMENSION NHYP(125),CONST(125),VOL(125)
DIMENSION PSTAT(125,2,2)
COMMON/RAND/RAN
COMMON/ZEST/ZSTAT(125)
COMMON/GOEFF/AA(5),BB(5)
COMMON/VARS/ISTAT(125),JSTAT(125),STOR(125)
COMMON/VNAM/NSTAT(125)
COMMON/VCON/IM,JM,KM,SCAFC
COMMON/FACT/GM,PHIM,SLAT,SLONG
COMMON/    NO(154,57),ZBO(154,2),LB
COMMON/DTA/C(125,9),ZM(125,9)
EQUIVALENCE (NO(1),PSTAT(1))
DATA IMAX,JMAX,KMM/154,57,125/
CALL FORMS(1)
RAN=1

```

READ IN CONTROL DATA

READ(5,200) TI

READ(5,203) BRANCH
READ(5,204) IDIR

```

READ(5,210) IZ,IZMAX,HD
READ(5,600) KDM,(Z(KP),KP=1,KDM)
READ(5,201) DLAT,PHIM,GM,IM,JM
DA=(DLAT*1000.)**2
READ(5,601) AA,BB

C
WRITE(6,199)
WRITE(6,607) TI
WRITE(6,606) PHIM,GM
WRITE(6,610) HD
WRITE(6,605) AA,BB
READ(5,611) SCAFG,(TI(L),L=1,15)
WRITE(6,612)(TI(L),L=1,15)

C
C      TEST FOR ADEQUATE PROGRAM DIMENSION
C
IF((IM.LE.IMAX).AND.(JM.LE.JMAX))GO TO 1
WRITE(6,202) IM,JM,IMAX,JMAX
STOP 00001
1 CONTINUE

C
C      READ IN MEAN DEPTHS OF GRID CELLS
C
C      CALL READ(HD,BRANCH)

C
C      READ IN STATION DATA.

READ(5,200) TI
WRITE(6,607) TI
DO 100 K=1,KMM
READ(5,224) NSTAT(K),((PSTAT(K,I,J),I=1,2),J=1,2),C(K,1),C(K,KL)
C),ZM(K,KL),KL=2,9
IF(NSTAT(K).LE.0)GOTO 2
ZM(K,1)=0.0
DO 191 II=1,9
IJ=10-II
IF(ZM(K,IJ).NE.0.)GO TO 192
191 CONTINUE
192 ZSTAT(K)=ZM(K,IJ)
100 CONTINUE

C
C      FLAG.  PROGRAM SPACE FILLED BY STATION DATA
C
WRITE(6,205)NSTAT(KMM)
K=KMM+1

C
2 KM=K-1

C
C      CHECK ON SAMPLING AND INTEGRATION DEPTHS. IF Z(KDM) IS GREATER
C      THAN MAX ZSTAT(K),Z(KDM) IS CHANGED TO MAX ZSTAT(K)
C

```

```

ZSM=1.0
DO 500 K=1,KM
IF(ZSTAT(K).LE.ZSM)GO TO 500
ZSM=ZSTAT(K)
KSM=K
500 CONTINUE
DO802L=1,9
LL=10-L
IF(ZM(KSM,LL).GT.0.)GOT0803
802 CONTINUE
803 TB=C(KSM,LL)
DO 501 KD=1,KDM
IF(Z(KD).GT.ZSM) GO TO 502
501 CONTINUE
GO TO 503
502 KDM=KD
Z(KD)=ZSM
503 CONTINUE
WRITE(6,77) KDM,(Z(M),M=1,KDM)

C
C      CALCULATION OF INDICES ISTAT(K),JSTAT(K) , OF CELL ENCLOSING
C      STATION NSTAT(K)
C
DO 104 K=1,KM
CALL SEED(K,IO,JO,DLAT)
IF(((IO.GE.1).AND.(IO.LE.IM)).AND.((JO.GE.1).AND.(JO.LE.JM)))
1GO TO 105
C
C      FLAG AND STOP. ERRONEOUS STATION DATA
C
WRITE(6,206)NSTAT(K)
STOP 00002
C
105 ISTAT(K)=IO
JSTAT(K)=JO
104 CONTINUE
C
C      MAIN BODY OF PROGRAM STARTS HERE
C
C
C
C
C      KDMM=KDM-1
C
C
C      STORE CONCENTRATION-DEPTH DATA
C
REWIND 25
WRITE(25) ((C(I,J),ZM(I,J),J=1,9),I=1,KM)
ENDFILE 25
C
C      ZONE MAP IS PRINTED OUT IN THIS LOOP

```

```

C
      IF (IDIR.EQ.0) GO TO 308
C
      WRITE(6,340)
      CALLIFLWR(1)
      DO 303 J=1,JM
      CALLIFLWR(2)
      DO 302 I=1,IM
      JBO = ZBO(I,LB)/1000.
      XBO=AMOD(ZBO(I,LB),1000.)
      IF (XBO.GT.0.0) GO TO 305
      NO(I,J)= -10
      GO TO 302
 305 NO(I,J)=JBO
 302 CONTINUE
 303 CONTINUE
      CALLIFLWR(3)
      DO 301 L=1,154
      WRITE (61,300) (NO(L,N),N=1,57)
 301 CONTINUE
 308 WRITE(6,198)
      WRITE(6,199)

C
C          INITIALIZE ZONE AND LAYER TOTALS
C
      DO 123 NC=1,15
      CONTO(NC)=0.
      TVOL(NC)=0.
      DO 1123 KD=1,10
      ZVOL(NC,KD)=0.
      ZCON(NC,KD)=-1.0
      ZTOT(NC,KD)=0.
 1123 CONTINUE
 123 CONTINUE

C
C          VOLUME CONTENT OF EACH LAYER IS COMPUTED IN THIS LOOP
C          (ENDS ON STATEMENT 101)
C
      DO 101 KD=1,KDMM
      ZU=Z(KD)
      ZL=Z(KD+1)
      VOLTL(KD)=0.
      CONTOL(KD)=0.
      STOL(KD)=0.

C
C          INITIALIZE ARRAY NO(I,J)
C
      CALLIFLWR(1)
      DO 103 J=1,JM
      CALLIFLWR(2)
      DO 102 I=1,IM

```

```

XBO=AMOD(ZBO(I,LB),1000.)
IF(XBO.GT.Z(KD)) GO TO 50
NO(I,J)=-100
GO TO 102
50 NO(I,J)=0
102 CONTINUE
103 CONTINUE
CALLLIFLOWR(3)

C
C      CHOOSE STATIONS WHOSE PROFILES PASS THROUGH KD-TH LAYER
C      AND ASSIGN CENTRE CELLS IN ARRAY NO(I,J)
C

DO 120 K=1,KM
KKK=K
IF(ZSTAT(K).LT.Z(KD+1)) GO TO 53
STOR(KKK)=.TRUE.
I=ISTAT(KKK)
J=JSTAT(KKK)
IF(NO(I,J).GE.0) GO TO 54

C
C
C
C      FLAG AND STOP. ERRONEOUS STATION DATA
C
C

GO TO 53
54 NO(I,J)=K
GO TO 120
53 STOR(K)=.FALSE.
120 CONTINUE

C
C      ASSIGN NO(I,J) CELLS TO INDIVIDUAL STATIONS
C

CALL FILL

C
C      THIS SEGMENT (TO STATEMENT 116) DISTRIBUTES VOLUME CONTENT BY
C      ZONE WITHIN EACH LAYER AND SUMS TOTALS FOR EACH LAYER
C

ZLL=0.0
DO 116 NCC=IZ,IZMAX
NC=NCC
DO 109 K=1,KM
NHYP(K)=0
CONSTA(K)=0.
MHYP(K)=0
109 VOL(K)=0.
CALLLIFLOWR(1)
DO 111 J=1,JM
CALLLIFLOWR(2)
DO 110 I=1,IM
K=NO(I,J)

```

```

JBO=INT(ZBO(I,LB)/1000.)
ZW=AMOD(ZBO(I,LB),1000.)
IF(K.GT.0.AND.JBO.EQ.NC) GO TO 115
GO TO 110
115 IF(ZW.GE.ZL)GOTO126
MHYP(K)=MHYP(K)+1
VOL(K)=VOL(K)+(ZW-ZU)
CALL LAYIN(K,ZU,ZW,CONC)
CONSTA(K)=CONSTA(K)+CONC
GO TO 110
126 NHYP(K)=NHYP(K)+1
110 CONTINUE
111 CONTINUE
CALLLIFLOWR(3)
CONLAY=0.
VOLAY=0.
SRZ=0.
CONC=1.
DO 15 KDUM=1,KM
K=KDUM
HYK=FLOAT(NHYP(K))
SRZ=SRZ+HYK+FLOAT(MHYP(K))
IF(HYK.LE.0.) GO TO 415
CALL LAYIN(K,ZU,ZL,CONC)
415 VOLAY=VOLAY+VOL(K)+HYK*(ZL-ZU)
CONLAY=CONLAY+CONSTA(K)+HYK*CONC
15 CONTINUE
IF(VOLAY.EQ.0.) GO TO 116
AVCON=CONLAY/(VOLAY*SCAFC)
CONLAY=CONLAY*DA
CONT0(NC)=CONT0(NC)+CONLAY
TVOL(NC)=TVOL(NC)+VOLAY*DA
CONTOL(KD)=CONTOL(KD)+CONLAY
VOLTL(KD)=VOLTL(KD)+VOLAY*DA
STOL(KD)=STOL(KD)+SRZ*DA
ZVOL(NC,KD)=VOLAY*DA
ZCON(NC,KD)=AVCON
ZTOT(NC,KD)=CONLAY
ZSFC(NC,KD)=SRZ*DA
116 CONTINUE
AVLAY(KD)=CONTOL(KD)/(VOLTL(KD)*SCAFC)
101 CONTINUE
C
C           STATION LOOP ENDS HERE
C
C           ESTIMATE OF VOLUME CONTENT OF LAKE BELOW DEEPEST SAMPLING
C           POINT(ZZM)
C           (DEEPEST CONCENTRATION(TB)*VOLUME BELOW LEVEL ZZM)
C           THIS COMPLEMENT IS ADDED TO THE TOTALS FOR THE LAYER KDMM
C
C           CALLLIFLOWR(1)

```

```

DO 800 J=1,JM
CALLIFLWR(2)
DO 800 I=1,IM
JBO=ZBO(I,LB)/1000.
ZZM=AMOD(ZBO(I,LB),1000.)
IF (ZZM.LE.ZSM) GOT0800
ZAM=(ZZM-ZSM)*DA
TAM=TB*ZAM*SCAFC
CONTO(JBO)=CONTO(JBO)+TAM
TVOL(JBO)=TVOL(JBO)+ZAM
ZVOL(JBO,KDMM)=ZVOL(JBO,KDMM)+ZAM
ZTOT(JBO,KDMM)=ZTOT(JBO,KDMM)+TAM
800 CONTINUE
CALLIFLWR(3)

C          COMPUTATION OF LAKEWIDE TOTALS AND AVERAGE CONCENTRATIONS
C          FOR EACH ZONE
C

HTOL=0.
VTOL=0.
DO 933 NC=IZ,IZMAX
HTOL=HTOL+CONTO(NC)
VTOL=VTOL+TVOL(NC)
AZON(NC)=CONTO(NC)/(TVOL(NC)*SCAFC)
933 CONTINUE
C          TOTAL LAKE CONTENTS
WRITE(6,935)
ALAK=HTOL/(VTOL*SCAFC)
WRITE(6,931) VTOL,HTOL,ALAK
DO 950 NC=IZ,IZMAX
IF (ZVOL(NC,KDMM).EQ.0.) GO TO 950
ZCON(NC,KDMM)=ZTOT(NC,KDMM)/(ZVOL(NC,KDMM)*SCAFC)
950 CONTINUE

C          PRINTED OUTPUTS
C

WRITE(6,951)
WRITE(6,607) TI
WRITE(6,988)
WRITE(6,1001)
WRITE(6,989)(Z(J),J=2,KDMM)
WRITE(6,1001)
WRITE(6,1002)
DO 953 NC=IZ,IZMAX
WRITE(6,954) NC,(ZVOL(NC,J),J=1,KDMM),TVOL(NC)
WRITE(6,1001)
953 CONTINUE
VU=0
KDMMX1=KDMM-1
DO 955 J=1,KDMMX1
VU=VU+VOLTL(J)
955 CONTINUE

```

```

VUU=VU+VOLTL(KDMM)
VKM=VTOL-VUU
VKDMM=VTOL-VU
WRITE(6,1002)
WRITE(6,1001)
WRITE(6,956)(VOLTL(J),J=1,KDMMX1),VKDMM,VTOL
WRITE(6,951)
WRITE(6,607)TI
WRITE(6,1088)
WRITE(6,1001)
WRITE(6,989)(Z(J),J=2,KDMM)
WRITE(6,1001)
WRITE(6,1002)
DO 1953 NC=IZ,IZMAX
WRITE(6,1954)NC,(ZSFC(NC,J),J=1,KDMM),STOL(NC)
WRITE(6,1001)
1953 CONTINUE
WRITE(6,1956)(STOL(J),J=1,KDMM)
WRITE(6,951)
WRITE(6,607)TI
WRITE(6,957)
WRITE(6,1001)
WRITE(6,989)(Z(J),J=2,KDMM)
WRITE(6,1001)
WRITE(6,1002)
DO 958 NC=IZ,IZMAX
WRITE(6,990)NC,(ZTOT(NC,J),J=1,KDMM),CONTOL(NC)
WRITE(6,1001)
958 CONTINUE
WRITE(6,1002)
WRITE(6,1001)
CKM=TB*VKM*SCAFC
CONTOL(KDMM)=CONTOL(KDMM)+CKM
WRITE(6,991)(CONTOL(J),J=1,KDMM),HTOL
WRITE(6,951)
WRITE(6,607)TI
WRITE(6,959)
WRITE(6,1001)
WRITE(6,989)(Z(J),J=2,KDMM)
WRITE(6,1001)
WRITE(6,1002)
DO 960 NC=IZ,IZMAX
WRITE(6,961)NC,(ZCON(NC,J),J=1,KDMM),AZON(NC)
WRITE(6,1001)
960 CONTINUE
WRITE(6,1002)
WRITE(6,1001)
TBB=CONTOL(KDMM)/(VKDMM*SCAFC)
WRITE(6,962)(AVLAY(J),J=1,KDMMX1),TBB,ALAK

```

C
C
C

NO PUNCHED OUTPUT IF ISENSWCH(1).GE.1

```

IF(ISENSWCH(1)) 821,821,822
821 WRITE(62,200) TI
      WRITE(62,980)
      DO 981 L=IZ,IZMAX
      NC=L
      WRITE(62,982) NC,(ZVOL(NC,KD),KD=1,KDMM),TVOL(NC)
981 CONTINUE
      WRITE(62,983)(VOLTL(KD),KD=1,KDMM),VTOL
      WRITE(62,200) TI
      WRITE(62,984)
      DO 985 L=IZ,IZMAX
      NC=L
      WRITE(62,982) NC,(ZTOT(NC,KD),KD=1,KDMM),CONT0(NC)
985 CONTINUE
      WRITE(62,983)(CONTOL(KD),KD=1,KDMM),HTOL
      WRITE(62,200) TI
      WRITE(62,986)
      DO 987 L=IZ,IZMAX
      NC=L
      WRITE(62,982) NC,(ZCON(NC,KD),KD=1,KDMM),AZON(NC)
987 CONTINUE
      WRITE(62,983)(AVLAY(KD),KD=1,KDMM),ALAK
822 STOP 7777

```

C
C
C
C

FORMATS

```

77 FORMAT(10X,I10,9F10.1)
198 FORMAT(1HR)
199 FORMAT(1H1)
200 FORMAT(20A4)
201 FORMAT(F4.0,2F10.5,2I3)
202 FORMAT(5X,56HPROGRAM-DIMENSION-INSUFFICIENT-TO-RECEIVE DIGITAL
     1MAP,/,5X,3HIM=,I4,5X,3HJM=,I4,5X,5HIMAX=,I4,5X,5HJMAX=,I4)
203 FORMAT(I1)
204 FORMAT(I5)
205 FORMAT(5X,37HPROGRAM SPACE FILLED BY STATION DATA.,/,
     120HLAST STATION NUMBER=,I4)
206 FORMAT(5X,7HSTATION,I4,2X,23HLIES OUTSIDE THE REGION)
207 FORMAT(1H0,21X,32HVOLUME CONTENT FOR LAYER BETWEEN,F6.1,1X,
     110HMETRES AND,F6.1,1X,14HMETRES IN ZONE,I3)
208 FORMAT(/,6X,28HNO SOLUTION FOR Y AT STATION,I4)
210 FORMAT(2I5,F10.2)
224 FORMAT(I3,9X,2(F2.0,F3.1),F3.1,8(F3.1,,F3.0))
300 FORMAT(5X,57I2)
320 FORMAT(50X,32HAVERAGE CONCENTRATION OF LAKE IS,1PE15.6/)
330 FORMAT(//50X,32H TOTAL VOLUME CONTENT OF LAKE IS,4X,1PE15.6/)
335 FORMAT(//60X,10H*****//)
340 FORMAT(///20X,19HDEFINITION OF ZONES//)
600 FORMAT(I3,10F7.2)
601 FORMAT(5E14.6)
605 FORMAT(1H0,32H TRANSFORMATION COEFFICIENTS-X- ,5(1PE15.4)/1X,

```

1 32H -Y-, 5E15.4)
 606 FORMAT(1H0,29H MAP ORIGIN (IN DEGREES) IS (,F5.2,1H,,F5.2,1H),)
 607 FORMAT(1HQ,//10X,20A4)
 610 FORMAT(/5X,15HWATER LEVEL IS ,F8.2,2X,24HMETRES ABOVE CHART DATUM
 1)
 611 FORMAT(E12.5,8X,15A4)
 612 FORMAT(/,5X,15A4/)
 761 FORMAT(1H0//50X,33H TOTAL VOLUME CONTENT OF LAKE IS ,4X,1PE15.6/)
 762 FORMAT(50X,33H AVERAGE CONCENTRATION OF LAYER IS ,4X,1PE15.6/)
 763 FORMAT(/,5X,45H VOLUME OF LAKE BELOW DEEPEST SAMPLING DEPTH = ,
 1PE12.5,6H M**3//5X,22H DEEPEST OBSERVATION AT,1X,0PF5.1,
 2 21HM. OCCURS AT STATION, I4,11H VALUE = ,F5.1,5H DEG.C.,//5X,
 3 34H CONTRIBUTION TO VOLUME CONTENTS = ,1PE12.5,29H ADJUSTED TOTAL
 4 CONTENTS = ,E12.5)
 931 FORMAT(10X,3E20.11)
 935 FORMAT(////,5X,25H VALUES FOR THE WHOLE LAKE,//)
 951 FORMAT(1H1)
 954 FORMAT(5X,I2,2X,1H*,10(-10P1F12.5))
 956 FORMAT(3X,7HTOTAL *,10(-10P1F12.5))
 957 FORMAT(///,11X,36HTOTAL CONTENTS (10**15 KILOCALORIES),/)
 959 FORMAT(///,11X,33H AVERAGE TEMPERATURES (DEGREES C.),/)
 961 FORMAT(5X,I2,2X,1H*,10(3X,F6.2,3X))
 962 FORMAT(3X,7HTOTAL *,10(3X,F6.2,3X))
 980 FORMAT(5X,25H VOLUMES BY ZONE AND LAYER)
 982 FORMAT(I3,7E11.4,/,3X,7E11.4)
 983 FORMAT(3X,7E11.4,/,3X,7E11.4)
 984 FORMAT(5X,31H HEAT CONTENTS BY ZONE AND LAYER)
 986 FORMAT(5X,20H AVERAGE TEMPERATURES)
 988 FORMAT(///,11X,21H VOLUMES (10**10 M**3),/)
 989 FORMAT(3X,64H ZONE * LAYER DEPTHS (BOTTOM) (M) LAST COLUMN IS TOT
 1 AL FOR ZONE ,/,9X,1H*,/,9X,2H*,10(3X,F6.1,3X))
 990 FORMAT(5X,I2,2X,1H*,10(-15P1F12.5))
 991 FORMAT(3X,7HTOTAL *,10(-15P1F12.5))
 1001 FORMAT(9X,1H*)
 1002 FORMAT(3X,130(1H*))
 1088 FORMAT(///,11X,37H SURFACE AREAS AT TOP OF LAYER (KM**2),/)
 1954 FORMAT(5X,I2,2X,1H*,10(-6P1F10.1,2X))
 1956 FORMAT(3X,7HTOTAL *,10(-6P1F10.1,2X))

C

END

SUBROUTINE READ (HD,BRANCH)

THIS SUBROUTINE READS AND ORGANIZES DEPTH INFORMATION WHICH IS STORED IN THE ARRAY ZBO(I,J). THE CORRECTION TO DEPTHS FOR MEAN WATER LEVEL IS MADE HERE. THE ARRAY ZBO IS STORED ON DISC FILE ACCESSED THROUGH UNIT 20

INTEGER BRANCH
COMMON /VCON/ IM,JM,KM
COMMON // NO(154,57),ZBO(154,2)
IMM2 = IM-2
DO 10 L=1,2
 DO 10 I=1,154
10 ZBO(I,L) = 0.
REWIND 20
IF (BRANCH.EQ.1) REWIND 30
BRANCH = BRANCH+1
L = 1
DO 100 J=1,JM
 GO TO (20,30), BRANCH
20 READ (5,130) (ZBO(I,L),I=1,IMM2)
 GO TO 40
30 READ (30) (ZBO(I,L),I=1,IMM2)
40 IF (HD) 50,80,50
50 DO 70 I=1,IM
 ZIL = ZBO(I,L)
 IF (ZIL) 60,70,60
60 ZBO(I,L) = ZIL+HD
70 CONTINUE
80 IF (J.EQ.1) GO TO 90
 IF (IFUNIT(20)) 120,90,120
90 BUFFER OUT (20,1) (ZBO(1,L),ZBO(154,L))
 L = 3-L
100 CONTINUE
 IF (IFUNIT(20)) 120,110,120
110 END FILE 20
 RETURN
120 WRITE (6,140)
 STOP 10001
130 FORMAT (19F4.0)
140 FORMAT (1H0,35\$ERROR ENCOUNTERED DURING BUFFER OUT)
END

SUBROUTINE SEED (K,I0,J0,DLAT)

THIS SUBROUTINE CONVERTS FROM GEOGRAPHICAL COORDINATES TO GRID COORDINATES. INPUTS ARE LATITUDE AND LONGITUDE (PSTAT(K,2,2)) AND OUTPUTS ARE INDICES IO,JO, OF THE GRID CELL INTO WHICH THE POINT FALLS. THE TRANSFORMATION IS EXPRESSED AS TWO SECOND ORDER POLYNOMIALS IN LAT. AND LONG.

```

REAL LAT,LONG
COMMON /COEFF/ A(5),B(5)
COMMON /FACT/ GM,PHIM,LAT,LONG
COMMON /VNAM/ NSTAT(125)
COMMON // PSTAT(125,2,2)
LAT = PSTAT(K,1,1)+PSTAT(K,2,1)/60.0
LONG = PSTAT(K,1,2)+PSTAT(K,2,2)/60.0
G = GM-LONG
P = LAT-PHIM
X = G*A(1)+P*A(2)+P*G*A(3)+(G**2)*A(4)+(P**2)*A(5)
Y = G*B(1)+P*B(2)+P*G*B(3)+(G**2)*B(4)+(P**2)*B(5)
IO = (X/DLAT)+1.
JO = (Y/DLAT)+1.
RETURN
END

```

SUBROUTINE IFLWR (N)

THIS SUBROUTINE TRANSFERS DEPTH AND ZONE INFORMATION ON AND OFF INTERMEDIATE DISC STORAGE (UNIT 20).

```
COMMON // NO(154,57),ZB0(154,2),L
GO TO (10,20,40), N
10 REWIND 20
BUFFER IN (20,1) (ZB0(1,1),ZB0(154,1))
L = 2
RETURN
20 IF (IFUNIT(20)) 60,30,70
30 BUFFER IN (20,1) (ZB0(1,L),ZB0(154,L))
L = 3-L
RETURN
40 IF (IFUNIT(20)) 60,50,50
50 RETURN
60 WRITE (6,80)
STOP 20001
70 WRITE (6,90)
STOP 20002
80 FORMAT (1H0,41HPARITY ERROR ENCOUNTERED DURING BUFFER IN)
90 FORMAT (1H0,43HUNEXPECTED EOF ENCOUNTERED DURING BUFFER IN)
ENO
```

SUBROUTINE SLUFF (I,J,MOVE)

DUE TO FINITE GRID RESOLUTION, A STATION MAY BE ASSIGNED
TO A CELL OF DEPTH LESS THAN THE MAXIMUM SAMPLING DEPTH.
SLUFF CHECKS ADJOINING CELLS TO SEE IF ONE OF THEM IS
DEEP ENOUGH TO CONTAIN THE STATION. IF NOT, THE PROGRAM
PRINTS A FLAG AND STOPS.

LOGICAL MOVE

```
DIMENSION II(8), JJ(8)
COMMON // NO(154,57) ,ZB0(154)
DATA II/0,1,1,1,0,-1,-1,-1/
DATA JJ/1,1,0,-1,-1,-1,0,1/
MOVE = .TRUE.
DO 10 K=1,8
  IO = I+II(K)
  JO = J+JJ(K)
  IF (NO(I,J).EQ.0) RETURN
```

10 CONTINUE

```
MOVE = .FALSE.
```

```
RETURN
```

```
END
```

SUBROUTINE FILL

ALGORITHM ASSIGNING CELLS IN LAYER TO NEAREST STATION
WITH PROFILE EXTENDING THROUGH THE LAYER.

```
INTEGER RAN
LOGICAL STOR
COMMON /RAND/ RAN
COMMON /VARS/ ISTAT(125),JSTAT(125),STOR(125)
COMMON/VCON/IM,JM,KM,SCAFC
COMMON // NO(154,57)
DO 40 I=1,IM
  DO 40 J=1,JM
    IF (NO(I,J).NE.0) GO TO 40
    MINDSQ = 1000000
    DO 30 K=1,KM
      RAN = -RAN
      IF (.NOT.STOR(K)) GO TO 30
      IMIS = I-ISTAT(K)
      JMJS = J-JSTAT(K)
      KOISSQ = IMIS*IMIS+JMJS*JMJS
      IF (KOISSQ-MINDSQ) 20,10,30
10    IF (RAN) 20,20,30
20    MINDSQ = KOISSQ
    KNEAR = K
30    CONTINUE
    IF (NO(I,J) = KNEAR) GO TO 40
40 CONTINUE
RETURN
END
```

SUBROUTINE LAYIN (K,ZU,ZL,CONLAP)

PERFORMS VERTICAL INTEGRATION OF K-TH PROFILE BETWEEN DEPTHS ZU AND ZL. CONLAP = OUTPUT. IF PROFILE DOES NOT EXTEND TO ZU OR ZL, FLAG IS PRINTED AND PROGRAM STOPS.

```
DIMENSION CW(10), ZW(10)
COMMON /VNAM/ NSTAT(125)
COMMON/VCON/IX,JX,KM,SCAFC
COMMON/DTA/C(125,9),ZM(125,9)
SIG(A,A1,B,B1,Z) = A+((A1-A)/(B1-B))*(Z-B)
JM = 9
DO 10 J=1,JM
  IF (ZM(K,J).GT.ZU) GO TO 20
10 CONTINUE
  WRITE (6,80) NSTAT(K)
  WRITE (6,90) (C(K,J),ZM(K,J),J=1,JM)
  CONLAP = 0.0
  STOP 30001
20 IF ((J-1).GT.0) GO TO 30
  JJ = J+1
  CW(1) = SIG(C(K,J),C(K,JJ),ZM(K,J),ZM(K,JJ),ZU)
  GO TO 40
30 JJ = J-1
  CW(1) = SIG(C(K,JJ),C(K,J),ZM(K,JJ),ZM(K,J),ZU)
40 ZW(1) = ZU
  IW = 1
  DO 50 JW=J,JM
    IW = IW+1
    IF (ZM(K,JW).GE.ZL) GO TO 60
    CW(IW) = C(K,JW)
    ZW(IW) = ZM(K,JW)
50 CONTINUE
  WRITE (6,100) NSTAT(K)
  WRITE (6,90) (C(K,J),ZM(K,J),J=1,JM)
  STOP 30002
60 JJ = JW-1
  CW(IW) = SIG(C(K,JJ),C(K,JW),ZM(K,JJ),ZM(K,JW),ZL)
  ZW(IW) = ZL
  IWM = IW
  CONLAP = 0.0
  DO 102 IW = 2,IWM
    ZWL = ZW(IW)
    ZWU = ZW(IW-1)
    IF(ZWU.EQ.ZWL) GO TO 102
    AI = (CW(IW)-CW(IW-1))/(ZWL-ZWU)
    AO = CW(IW-1) - AI*ZWU
    CONLAP = CONLAP + AO*(ZWL-ZWU)+0.5*AI*(ZWL*ZWL-ZWU*ZWU)
102 CONTINUE
```

CONLAP = CONLAP*SCAFC
80 FORMAT (1H0,36H PROFILE DOES NOT EXTEND TO TOP LAYER/8HSTATION ,I4)
90 FORMAT (1X,5(3X,2HC=,F5.2,3X,3HZM=,F5.2,1H/))
100 FORMAT (1H0,42H PROFILE DOES NOT EXTEND TO BOTTOM OF LAYER/
\$7HSTATION,I4)
RETURN
END

APPENDIX 5

Estimates of Heat Fluxes to and from Lake Ontario Due to Rain, Snow, and the Formation and Melting of Ice

A heat flux across the surface of the lake is produced by rain falling onto the lake, snow falling onto the lake, and by snow and ice cover. We assume that these fluxes are small in comparison with the major surface fluxes, at least in the average, but an order of magnitude estimate seems appropriate if only to decide whether a more exact analysis is warranted.

It is assumed that rain enters the lake at the local wet-bulb temperature, T_w , so that the amount of heat entering the lake during a rainfall of P cm is $\rho C_p P T_w$ calories/cm² with respect to the reference temperature of 0°C. If the precipitation enters the lake as snow, the largest portion of the attendant heat flux will be due to the latent heat of the melting. Thus after a snowfall of S cm, the amount of heat which has entered the lake is

$$- \rho_s S L_m \text{ calories/cm}^2$$

where ρ_s is the density of snow (taken as 1/12 that of water at 0°C) and L_m is the latent heat of melting (taken as 80 calories/gram). The minus sign indicates that heat is lost from the lake in the melting process. It is assumed that the snow enters the lake at temperatures close to 0°C and hence that the sensible heat transfer from the snow is negligible compared with the latent heat effect.

Since the distribution of precipitation in time is episodic, a precise estimate of the heat flux would require knowledge of the wet-bulb temperature during the major precipitation events. This information is available in the meteorological records, but the labour of compiling it is out of

proportion to the present goal of providing an order of magnitude estimate.

For this purpose, the mean monthly values of air temperature T , accumulated snow and rain totals $P_T = P_R + S$, mean vapour pressure e , and mean atmospheric pressure p provided by the Canadian Atmospheric Environment Service [Phillips and McCullough, 1974] have been considered adequate. A brief examination of the data over the entire basin shows that a rapid perusal of this data shows that the amounts of rain and snow vary considerably from one end of the basin to the other. To reflect this variation we have expressed lake totals as the weighted mean of values at four locations, namely, two locations on the shore of Lake Ontario and two locations on the shore of the lake, namely Toronto and Trenton on the Canadian side, and Rochester and Watertown on the U.S. side (Figure 12).

The equation [Haltiner, G.J., and Martin, F.L., 1957]

$$\frac{T - T_w}{e_w - e} \approx \frac{0.662 L_e}{C_{pd} p}$$

where T is the mean monthly air temperature, T_w is the mean monthly wet-bulb temperature, e_w is the mean monthly saturation vapour pressure, L_e is the latent heat of evaporation, C_{pd} is the specific heat at constant pressure of dry air, and p is the mean atmospheric pressure, expresses the relationship among the meteorological variables. e_w is the

saturation vapour pressure on water and is a function of T_w , the wet-bulb

temperature. L_e is the latent heat of evaporation, C_{pd} is the specific heat at constant pressure of dry air (.240 cal/gm°C) and p is the mean atmospheric pressure. Solving the above expression for T_w , and then using

Reynolds averaging under the assumption that L_e is constant, indicate that the expression should apply to a good approximation to mean values. The monthly mean value of T_w so obtained will at times differ substantially

from the value obtained during periods of rainfall, and this analysis would

be invalid for any purpose other than an order of magnitude estimate. In

order not to significantly complicate each computation, with the added problem, the computations a simple iterative procedure is used to determine T with

values of $e_w(T_w)$ being taken from the Smithsonian Meteorological Tables

[List, 1949].

The results of these computations are given in tabular form (Table 3, column 3) for the whole Lake.

In the western half of Lake Ontario, significant ice cover is a rare and ephemeral event and its influence on a weekly heat budget can be safely neglected. A seasonal ice cover does develop at the eastern end of the lake in the Kingston basin and pack ice accumulates in the Eastern Basin. Based on data from ship cruises, the seasonal ice cover in the Kingston Basin was in place by January 15, 1973, and had melted by March 26, 1973. The area of the Kingston Basin is approximately 1500 km^2 and a typical ice thickness in mid-season is 50 cm. Assuming that the ice cover formed at a uniform rate during the first 35 days (January 15 to February 19) and melted at a uniform rate during the next 35 days (Feb. 19 to March 26) and without accounting for what must be a sizeable transport of ice down the St. Lawrence river (of the order of $10\text{km}^2/\text{day}$), the local surface fluxes of heat during the formation and melting of this ice are $\pm 114 \text{ cal/cm}^2/\text{day}$ or $\pm 9 \text{ cal/cm}^2/\text{day}$ on a whole lake basis. These are the effective fluxes to a lake full of water only (specific heat of $1 \text{ cal/gm/}^\circ\text{C}$). Significant quantities of pack ice were observed on the 12-14 February cruise (3000 km^2) and on the February 26-28 cruise (4500 km^2). This ice had melted by 12-15 March 1973. This ice was present for about 35 days. Assuming as before constant rates of growth and an average thickness of 10 cm, and assuming that the maximum area of the ice pack was 5000 km^2 , the heat flux on a whole lake basis is $+ 13 \text{ cal/cm}^2/\text{day}$ between February 5 and February 22 and $- 13 \text{ cal/cm}^2/\text{day}$ between Feb. 23 and March 13. Thus the estimate of effective heat fluxes due to ice formation on a whole lake basis are:

+ 9 cal/cm²/day January 15 to February 5
+ 22 cal/cm²/day February 6 to February 20
- 22 cal/cm²/day February 21 to March 13
+ 9 cal/cm²/day March 14 to March 26

Once again these are to be construed as order of magnitude estimates. When applied to the whole lake, the effective heat flux due to ice formation and melting is of minor importance, but since the ice is confined to the Eastern regions of the lake, the local effects are significant and suggest that more work should be done on this aspect of the energy budget.

APPENDIX 6

Results in Tabular Form

Julian Day	Date	Julian Day	Date	Julian Day	Date
103	12 April 1972	271	27 September	432	7 March
110	19 April	278	4 October	439	14 March
117	26 April	285	11 October	446	21 March
124	3 May	292	18 October	453	28 March
131	10 May	299	25 October	460	4 April
138	17 May	306	1 November	467	11 April
145	24 May	303	8 November	474	18 April
152	31 May	320	15 November	481	25 April
159	7 June	327	22 November	488	2 May
166	14 June	334	29 November	495	9 May
173	21 June	341	6 December	502	16 May
180	28 June	348	13 December	509	23 May
187	5 July	355	20 December	516	30 May
194	12 July	362	27 December	523	6 June
201	19 July	369	3 January 1973	530	13 June
208	26 July	376	10 January	537	20 June
215	2 August	383	17 Janauary	544	27 June
222	9 August	390	24 Janauary		
229	16 August	397	31 January		
236	23 August	404	7 February		
243	30 August	411	14 February		
250	6 Sept.	418	21 February		
257	13 Sept.	425	28 Februáry		
264	20 Sept.				

Note: The dates indicated on the tables are Julian Days counted from Day 1 on January 1, 1972. The correspondances with regular calendar dates are given above.

AVERAGE TEMPERATURES AT 00H ON DAY103.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	1.77	1.77	1.65	1.31	1.60	1.33	1.60	1.20	1.52	1.69	1.48
20M	1.81	1.71	1.70	1.66	1.45	1.33	1.59	1.20	1.52	1.69	1.49
40M	1.85	1.70	1.70	1.77	1.38	1.34	1.54	1.21	1.53	1.71	1.50
60M	1.93	1.71	1.70	1.77	1.39	1.35	1.57	1.37	1.54	1.72	1.54
90M	1.84	1.76	1.72	1.76	1.28	1.37	1.61	1.52	1.62	1.76	1.57
BOT	1.80	1.77	2.00	1.82	1.43	1.97	1.82	1.77	2.04	2.03	2.00
TOT	1.84	1.73	1.79	1.67	1.42	1.59	1.59	1.25	1.76	1.79	1.66

KEY TO SYMBOLS AND UNITS

HSD = TOTAL HEAT CONTENT CHANGE OF ZONE (KCAL)

QR = HEAT INPUT FROM RIVERS RELATIVE TO OUTFLOW TEMPERATURE (KCAL)

HO = HEAT INPUT FROM POWERPLANTS AND SEWERS (KCAL)

HSN = NET HEAT CONTENT CHANGE (TOTAL - ADVECTIVE) (KCAL)

A/S = RATIO ADVECTIVE TO SURFACE FLUX COMPONENTS

FS = AVERAGE SURFACE FLUX DURING INTERVAL (CAL/CM²/DAY)

AVERAGE TEMPERATURES AT 00H ON DAY110.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	2.20	2.07	1.96	1.86	1.93	1.57	2.17	1.93	1.79	2.28	1.91
20M	2.18	1.87	1.89	2.07	1.93	1.56	2.20	1.91	1.79	2.06	1.87
40M	2.06	1.79	1.90	2.02	1.58	1.58	1.73	1.68	1.79	1.90	1.75
60M	2.05	1.85	1.91	2.01	1.61	1.60	1.77	1.67	1.79	1.90	1.77
90M	1.97	1.80	1.92	2.71	1.47	1.61	1.81	1.80	1.85	1.90	1.78
BOT	2.08	1.93	1.96	1.93	1.90	1.88	1.85	1.98	2.09	2.04	2.00
TOT	2.08	1.87	1.92	1.99	1.70	1.70	1.91	1.81	1.92	2.00	1.86

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 103. TO 00H ON DAY 110.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.225E+14	0.790E+13	0.204E+14	0.637E+13	0.252E+14	0.545E+14	0.181E+14	0.722E+14	0.856E+14	0.298E+14	0.334E+15
QR	0.118E+13	0.272E+12	0.000E+00	-0.162E+12	0.569E+12	0.000E+00	0.441E+12	0.134E+13	0.000E+00	0.442E+13	0.899E+13
HO	0.456E+11	0.636E+11	0.000E+00	0.859E+10	0.850E+13	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.254E+11	0.170E+12
HSN	0.213E+14	0.756E+13	0.204E+14	0.652E+13	0.246E+14	0.545E+14	0.956E+13	0.709E+14	0.656E+14	0.254E+14	0.325E+15
A/S	0.057	0.044	0.000	-0.024	0.623	0.000	0.048	0.019	0.000	0.175	0.020
FS	193.9	130.5	245.3	230.7	203.1	248.0	241.0	270.4	355.9	193.5	251.1

AVERAGE TEMPERATURES AT 00H ON DAY117.

	1	2	3	4	ZONE NUMBER (11=TOTAL)	5	6	7	8	9	10	11
10M	2.59	2.33	1.96	1.95	2.34	1.80	2.60	2.29	1.96	2.56	2.18	
20M	2.44	2.29	2.00	2.45	2.17	1.79	2.64	2.30	1.96	2.38	2.13	
40M	2.30	1.98	2.01	2.21	1.76	1.78	1.93	2.07	1.97	2.04	1.96	
60M	2.30	2.04	2.02	2.21	1.71	1.80	1.95	1.91	1.96	2.05	1.94	
90M	2.17	1.95	2.03	2.22	1.68	1.82	1.97	1.97	1.99	2.06	1.95	
BOT	2.09	1.89	2.01	2.12	2.02	2.03	2.04	2.17	2.17	2.17	2.11	
TOT	2.33	2.06	2.01	2.19	1.92	1.89	2.18	2.16	2.06	2.19	2.04	

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 110, TO 00H ON DAY 117.

	1	2	3	4	ZONE NUMBER (11=TOTAL)	5	6	7	8	9	10	11
HSD	0.235E+14	0.114E+14	0.143E+14	0.413E+13	0.201E+14	0.866E+14	0.848E+13	0.450E+14	0.691E+14	0.250E+16	0.308E+15	
QR	0.430E+12	0.104E+12	0.000E+00	-0.656E+13	0.339E+12	0.000E+00	0.349E+12	0.223E+13	0.000E+00	0.603E+13	0.422E+13	
HO	0.211E+12	0.475E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.498E+12	0.123E+13	
HSN	0.229E+14	0.108E+14	0.143E+14	0.107E+14	0.198E+14	0.866E+14	0.811E+13	0.428E+14	0.691E+14	0.205E+14	0.303E+15	
A/S	0.028	0.053	0.000	-0.613	0.017	0.000	0.046	0.052	0.000	0.221	0.018	
FS	208.3	186.7	172.0	377.6	163.0	394.0	202.6	163.2	207.3	156.2	233.8	

AVERAGE TEMPERATURES AT 00H ON DAY124.

	1	2	3	4	ZONE NUMBER (11=TOTAL)	5	6	7	8	9	10	11
10M	3.29	2.85	2.21	2.32	2.81	2.12	2.93	3.31	2.26	3.32	2.73	
20M	2.87	2.32	2.24	2.47	2.64	2.11	2.83	3.24	2.25	2.94	2.57	
40M	2.69	2.33	2.26	2.41	2.13	2.07	2.17	2.94	2.24	2.40	2.34	
60M	2.61	2.36	2.27	2.42	2.10	2.08	2.18	2.90	2.23	2.37	2.28	
90M	2.45	2.31	2.28	2.44	1.98	2.08	2.20	3.13	2.25	2.33	2.23	
BOT	2.31	2.26	2.35	2.33	1.96	2.23	2.34	2.59	2.32	2.34	2.29	
TOT	2.72	2.39	2.29	2.41	2.32	2.14	2.62	3.11	2.27	2.56	2.36	

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 117, TO 00H ON DAY 124.

	1	2	3	4	ZONE NUMBER (11=TOTAL)	5	6	7	8	9	10	11
HSD	0.374E+14	0.193E+14	0.412E+14	0.419E+13	0.358E+14	0.116E+15	0.780E+13	0.122E+15	0.113E+15	0.499E+14	0.547E+15	
QR	0.209E+12	0.551E+11	0.000E+00	-0.136E+14	0.163E+12	0.000E+00	0.181E+12	0.187E+13	0.000E+00	0.248E+13	0.562E+13	
HO	0.180E+12	0.498E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.552E+12	0.127E+13	
HSN	0.370E+14	0.187E+14	0.412E+14	0.178E+14	0.356E+14	0.116E+15	0.768E+13	0.120E+15	0.113E+15	0.469E+14	0.551E+15	
A/S	0.010	0.029	0.000	-0.764	0.005	0.000	0.016	0.016	0.000	0.065	-0.008	
FS	337.2	323.5	495.4	628.4	293.9	526.6	191.8	459.5	469.8	357.7	426.1	

AVERAGE TEMPERATURES AT 00H ON DAY131.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	3.64	3.19	2.51	3.40	3.51	2.33	3.20	4.12	2.46	3.64	3.16
20H	3.36	2.60	2.46	2.61	3.33	2.32	3.12	3.65	2.45	2.98	2.91
40H	2.86	2.58	2.46	2.56	2.51	2.29	2.42	3.09	2.45	2.48	2.54
60H	2.83	2.60	2.46	2.54	2.46	2.29	2.43	2.71	2.44	2.50	2.46
90H	2.70	2.53	2.47	2.50	2.36	2.28	2.42	2.80	2.42	2.47	2.42
80T	2.54	2.66	2.40	2.26	2.15	2.30	2.33	2.58	2.43	2.46	2.39
TOT	3.00	2.65	2.45	2.70	2.81	2.30	2.67	3.47	2.46	2.69	2.57

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL...FROM 00H ON DAY 124, TO 00H ON DAY 131.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.262E+14	0.150E+14	0.249E+14	0.595E+13	0.446E+14	0.716E+14	0.705E+13	0.479E+14	0.860E+14	0.105E+14	0.347E+15
QR	0.255E+12	0.578E+11	0.000E+00	-0.125E+14	0.188E+12	0.000E+00	0.191E+12	0.289E+13	0.000E+00	0.355E+13	0.860E+12
HO	0.158E+12	0.522E+12	0.000E+00	0.850E+10	0.850E+13	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.579E+12	0.130E+13
HSN	0.258E+14	0.144E+14	0.249E+14	0.184E+14	0.444E+14	0.716E+14	0.764E+13	0.446E+14	0.860E+14	0.144E+14	0.345E+15
A/S	0.016	0.040	0.000	-0.676	0.004	0.000	0.028	0.065	0.000	0.288	0.006
FS	235.0	248.0	299.4	650.3	366.3	325.0	190.8	170.2	357.6	109.6	266.5

AVERAGE TEMPERATURES AT 00H ON DAY130.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	4.29	4.03	2.88	5.35	3.63	2.74	5.29	4.38	2.56	3.92	3.56
20H	3.54	3.55	2.71	3.49	3.25	2.64	3.88	3.71	2.55	3.07	3.08
40H	3.36	2.90	2.72	3.13	3.05	2.54	2.92	3.10	2.54	2.77	2.79
60H	3.33	2.92	2.76	3.02	2.90	2.55	2.96	3.07	2.54	2.71	2.73
90H	3.13	2.77	2.71	2.84	2.72	2.61	2.86	2.91	2.53	2.62	2.66
80T	2.47	2.47	2.47	2.45	2.28	2.48	2.46	2.64	2.50	2.50	2.49
TOT	3.62	3.07	2.66	3.51	3.12	2.55	3.47	3.57	2.52	2.66	2.78

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL...FROM 00H ON DAY 131, TO 00H ON DAY 138.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.433E+14	0.246E+14	0.316E+14	0.159E+14	0.275E+14	0.118E+15	0.252E+14	0.124E+14	0.460E+14	0.235E+14	0.365E+15
QR	0.974E+11	0.467E+11	0.000E+00	-0.101E+14	0.140E+12	0.000E+00	0.142E+12	0.148E+13	0.000E+00	0.241E+13	-0.910E+12
HO	0.167E+12	0.540E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.606E+12	0.133E+13
HSN	0.491E+14	0.240E+14	0.316E+14	0.260E+14	0.274E+14	0.110E+15	0.250E+14	0.109E+14	0.460E+14	0.205E+14	0.365E+15
A/S	0.006	0.024	0.000	-0.387	0.005	0.000	0.007	0.136	0.000	0.147	0.001
FS	364.9	414.4	380.8	919.4	225.6	536.9	625.5	41.6	191.3	156.3	281.8

AVERAGE TEMPERATURES AT 00H ON DAY145.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	7.91	5.42	3.36	7.81	6.29	3.52	6.69	7.56	3.13	5.79	5.35
20M	4.38	3.88	3.15	4.47	3.88	3.06	4.15	5.19	3.05	3.54	3.76
40M	3.59	3.55	3.15	3.24	3.54	2.85	2.90	3.97	3.03	3.15	3.24
60M	3.54	3.51	3.18	3.31	3.27	2.87	2.96	3.42	3.04	3.15	3.12
90M	3.30	3.32	3.19	3.36	3.04	2.86	3.08	3.17	3.04	3.11	3.04
BOT	2.85	2.78	2.83	2.85	2.39	2.83	2.88	3.03	2.93	2.90	2.88
TOT	4.27	3.71	3.09	4.33	3.99	2.91	3.80	5.10	3.00	3.49	3.36

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 138. TO 00H ON DAY 145.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.805E+14	0.377E+14	0.649E+14	0.163E+14	0.794E+14	0.164E+14	0.108E+14	0.198E+15	-0.247E+15	0.845E+14	0.984E+15
QR	0.714E+11	0.437E+11	0.000E+00	-0.125E+14	0.158E+12	0.000E+00	0.147E+12	0.205E+13	0.000E+00	0.367E+13	-0.235E+13
HO	0.141E+12	0.540E+12	0.000E+00	0.850E+10	0.850E+10	0.800E+00	0.212E+11	0.420E+10	0.000E+00	0.622E+12	0.134E+13
HSN	0.803E+14	0.371E+14	0.649E+14	0.288E+14	0.792E+14	0.164E+15	0.106E+14	0.196E+15	0.247E+15	0.802E+14	0.985E+15
A/S	0.003	-0.016	0.000	-0.435	-0.002	0.000	-0.016	0.010	0.000	-0.054	-0.001
FS	731.5	660.4	780.4	1017.4	653.5	766.1	265.5	748.1	1027.0	612.1	761.3

AVERAGE TEMPERATURES AT 00H ON DAY152.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	8.80	7.59	5.52	8.87	7.93	3.86	6.57	7.75	3.89	5.55	6.06
20M	5.49	3.92	4.19	5.35	4.53	3.43	4.53	6.26	3.56	3.59	4.38
40M	3.79	3.75	3.58	3.78	3.92	3.20	3.42	4.07	3.39	3.50	3.56
60M	3.72	3.68	3.47	3.60	3.66	3.20	3.41	3.61	3.36	3.48	3.43
90M	3.56	3.40	3.44	3.50	3.41	3.20	3.42	3.43	3.23	3.38	3.30
BOT	3.15	3.02	3.13	3.16	2.78	3.09	3.32	3.23	3.10	3.22	3.11
TOT	4.72	4.14	3.60	4.90	4.66	3.22	4.14	5.48	3.26	3.70	3.71

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 145. TO 00H ON DAY 152.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.423E+14	0.247E+14	0.768E+14	0.110E+14	0.594E+14	0.142E+15	0.105E+14	0.469E+14	0.167E+15	0.285E+14	0.588E+15
QR	0.307E+11	0.393E+11	0.000E+00	-0.152E+14	0.696E+11	0.000E+00	0.799E+11	0.686E+12	0.000E+00	0.283E+13	-0.128E+14
HO	0.144E+12	0.529E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.634E+12	0.135E+13
HSN	0.421E+14	0.241E+14	0.768E+14	0.262E+14	0.593E+14	0.142E+15	0.104E+14	0.462E+14	0.147E+15	0.250E+14	0.599E+15
A/S	0.004	-0.024	0.000	-0.579	-0.002	0.000	0.010	0.015	0.000	0.138	-0.019
FS	383.7	416.4	923.5	925.8	489.1	646.1	259.7	176.3	611.2	191.0	463.3

AVERAGE TEMPERATURES AT 00H ON DAY159.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10N	9.85	7.74	5.27	11.71	8.16	4.53	11.44	10.91	4.41	6.97	7.35
20N	5.20	4.63	4.02	6.35	4.98	3.93	8.21	6.49	3.71	4.51	4.79
40N	3.97	3.99	3.78	3.99	4.33	3.56	3.68	4.46	3.56	3.65	3.83
60N	3.85	3.87	3.72	3.82	3.95	3.53	3.62	3.91	3.50	3.55	3.64
90N	3.79	3.81	3.69	3.73	3.76	3.51	3.60	3.79	3.45	3.53	3.57
80T	3.62	3.48	3.51	3.68	3.48	3.37	3.50	3.66	3.36	3.42	3.39
TOT	6.99	4.45	3.80	5.76	5.01	3.56	5.73	6.57	3.51	4.11	4.10

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 152, TO 00H ON DAY 159.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.262E+14	0.184E+14	0.319E+14	0.171E+14	0.329E+14	0.160E+15	0.502E+14	0.143E+15	0.121E+15	0.558E+14	0.657E+15
QR	0.789E+10	0.271E+11	0.800E+00	-0.769E+13	0.773E+11	0.000E+00	0.105E+12	0.616E+12	0.300E+00	0.143E+13	-0.719E+13
HO	0.150E+12	0.387E+12	0.000E+00	0.050E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.300E+00	0.634E+12	0.121E+13
HSN	0.260E+14	0.180E+14	0.319E+14	0.248E+14	0.319E+14	0.160E+15	0.501E+14	0.142E+15	0.121E+15	0.537E+14	0.663E+15
A/S	0.006	0.023	0.000	-8.310	0.003	0.000	0.003	0.004	0.000	0.038	-0.009
FS	237.3	310.3	383.6	876.4	263.2	727.9	1250.6	543.3	503.1	410.1	512.4

AVERAGE TEMPERATURES AT 00H ON DAY166.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10N	8.69	6.66	6.07	11.02	6.73	5.11	11.12	9.68	5.88	7.72	7.27
20N	5.83	5.51	5.08	8.10	5.81	4.33	7.20	8.23	5.00	5.26	5.76
40N	4.23	4.36	4.22	4.62	4.62	3.81	4.23	5.45	4.04	4.40	4.31
60N	3.80	3.90	3.90	3.77	3.92	3.69	3.73	4.14	3.74	3.73	3.79
90N	3.82	3.85	3.80	3.61	3.79	3.66	3.65	4.03	3.59	3.60	3.68
80T	3.78	3.75	3.68	3.80	3.67	3.54	3.73	3.33	3.39	3.39	3.48
TOT	6.96	4.53	4.13	6.13	4.96	3.78	5.69	6.91	3.83	4.48	4.36

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 159, TO 00H ON DAY 166.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.230E+13	0.460E+13	0.483E+14	0.740E+13	-0.300E+13	0.101E+15	-0.100E+13	0.432E+14	0.164E+15	0.504E+14	0.411E+15
QR	-0.382E+11	0.241E+10	0.000E+00	-0.476E+13	0.424E+11	0.000E+00	0.320E+11	-0.200E+12	0.000E+00	0.111E+13	-0.732E+13
HO	0.152E+12	0.349E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.634E+12	0.118E+13
HSN	-0.241E+13	0.429E+13	0.483E+14	0.122E+14	-0.305E+13	0.101E+15	-0.105E+13	0.434E+14	0.164E+15	0.487E+14	0.417E+15
A/S	-0.047	0.083	0.000	-0.391	-0.013	0.000	-0.051	-0.005	0.000	0.036	-0.015
FS	-22.0	73.3	580.8	429.9	-31.8	459.5	-26.3	165.6	681.9	371.3	322.4

AVERAGE TEMPERATURES AT 00H ON DAY173.

	1	2	3	4	ZONE NUMBER (11=TOTAL)						10	11	
	10M	20M	40M	60M	80M	TOT		10M	20M	40M	60M	80M	TOT
	10.00	9.44	10.30	10.05	9.77	7.82		9.14	12.25	8.18	10.25	9.69	
	5.68	6.15	5.20	5.09	6.63	5.19		5.19	8.39	5.44	5.79	6.08	
	4.16	4.52	4.29	4.10	4.53	4.14		4.11	5.15	4.20	4.19	4.35	
	3.93	4.03	4.02	3.92	3.97	3.88		3.91	4.04	3.91	3.95	3.94	
	3.88	3.83	3.86	3.87	3.89	3.79		3.85	3.93	3.83	3.84	3.83	
	3.86	3.86	3.79	3.87	4.12	3.67		3.78	3.73	3.69	3.73	3.70	
	5.18	5.09	4.54	5.32	5.68	4.18		5.07	7.61	4.22	4.99	4.75	

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 166, TO 00H ON DAY 173.

	1	2	3	4	ZONE NUMBER (11=TOTAL)						10	11	
	HSD	QR	HO	HSN	A/S	FS		HSD	QR	HO	HSN	A/S	FS
	0.199E+14	-0.192E+11	0.158E+12	0.198E+14	0.007	180.0		0.327E+14	0.863E+10	0.000E+00	0.323E+14	0.007	558.0
	0.634E+14	0.523E+13	0.450E+10	0.634E+14	0.000	568.0		-0.159E+14	0.700E+11	0.000E+00	-0.211E+14	0.181E+15	762.4
	0.645E+14	0.000E+00	0.850E+10	0.644E+14	0.001	562.4		0.645E+14	0.000E+00	0.850E+10	0.644E+14	0.181E+15	-747.7
	0.181E+15	0.339E+11	0.212E+11	0.181E+15	0.000	531.4		-0.197E+14	0.297E+12	0.000E+00	-0.198E+14	0.205E+15	823.5
	0.902E+14	0.000E+00	0.420E+10	0.899E+14	0.003	531.4		0.205E+15	0.135E+13	0.000E+00	0.899E+14	0.674E+14	843.0
	0.694E+14	0.487E+13	0.622E+12	0.674E+14	0.000	514.6		0.694E+14	0.117E+13	0.000E+00	0.674E+14	0.685E+15	852.3
	0.691E+15	0.487E+13	0.117E+13	0.685E+15	0.029	529.4		0.691E+15	0.000E+00	0.117E+13	0.685E+15	0.029	852.3

AVERAGE TEMPERATURES AT 00H ON DAY180.

	1	2	3	4	ZONE NUMBER (11=TOTAL)						10	11	
	10M	20M	40M	60M	80M	TOT		10M	20M	40M	60M	80M	TOT
	9.79	9.64	10.96	14.09	10.10	9.82		12.47	12.13	9.05	10.09	10.41	
	6.42	7.59	6.51	8.64	8.15	5.71		7.97	9.58	6.33	6.73	7.16	
	5.65	5.17	4.86	5.04	5.24	4.54		4.99	5.71	4.88	4.88	5.02	
	4.64	4.66	4.33	4.45	3.96	4.09		4.32	4.30	4.16	4.31	4.23	
	4.06	3.96	4.14	4.23	3.94	3.97		4.05	3.97	3.98	4.04	4.00	
	3.90	3.89	3.86	3.90	3.51	3.82		3.86	4.08	3.79	3.80	3.81	
	5.78	5.59	4.92	7.04	6.22	4.52		6.44	8.05	4.53	5.33	5.16	

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 173, TO 00H ON DAY 180.

	1	2	3	4	ZONE NUMBER (11=TOTAL)						10	11		
	HSD	QR	HO	HSN	A/S	FS		HSD	QR	HO	HSN	A/S	FS	
	0.567E+14	0.214E+11	0.166E+12	0.565E+14	0.003	514.9		0.295E+14	0.234E+11	0.000E+00	-0.398E+12	0.486E+14	0.561E+14	0.161E+15
	0.574E+14	0.000E+00	0.360E+12	0.574E+14	0.013	502.4		0.338E+14	0.157E+12	0.000E+00	0.180E+12	0.486E+14	0.561E+14	0.161E+15
	0.486E+14	0.000E+00	0.850E+10	0.484E+14	0.000	690.2		0.486E+14	0.000E+00	0.850E+10	0.484E+14	0.432E+14	0.561E+14	0.453E+14
	0.160E+15	0.000E+00	0.212E+11	0.166E+15	0.003	1209.0		0.160E+15	0.000E+00	0.212E+11	0.420E+10	0.308E+14	0.552E+14	0.692E+15
	0.453E+14	0.234E+13	0.615E+12	0.453E+14	0.017	526.0		0.453E+14	0.102E+14	0.000E+00	0.234E+13	0.453E+14	0.615E+12	0.118E+13
	0.692E+15	0.102E+14	0.423E+12	0.692E+15	0.017			0.692E+15	0.000E+00	0.423E+12	0.423E+14	0.423E+14	0.681E+15	0.681E+15

AVERAGE TEMPERATURES AT 00H ON DAY187.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	12.67	12.16	12.67	16.00	12.75	12.09	15.24	13.84	11.75	14.30	12.92
20M	7.69	7.62	7.33	9.32	8.36	6.67	9.71	9.41	7.26	8.13	7.88
40M	5.64	5.47	5.13	5.51	5.63	4.80	5.11	5.61	4.91	4.93	5.15
60M	4.65	4.38	4.29	4.21	4.22	4.25	4.26	4.10	4.20	4.33	4.27
90M	3.93	3.95	4.00	3.96	4.05	4.05	4.02	4.02	4.02	4.07	4.02
BOT	3.97	3.97	3.94	3.95	3.49	3.92	3.94	4.08	3.91	3.91	3.92
TOT	6.39	5.96	5.15	7.53	6.93	4.85	7.22	8.42	4.84	6.10	5.56

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 180. TO 00H ON DAY 187.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.580E+14	0.219E+14	0.343E+14	0.101E+14	0.653E+14	0.153E+15	0.250E+14	0.520E+14	0.161E+15	0.106E+15	0.685E+15
QR	0.362E+11	0.285E+11	0.000E+00	0.182E+13	0.586E+11	0.000E+00	0.379E+11	-0.389E+11	0.000E+00	0.101E+13	0.104E+14
HO	0.175E+12	0.376E+12	0.000E+00	0.850E+10	0.850E+19	0.000E+00	3.212E+11	0.420E+10	0.000E+00	0.560E+12	0.115E+13
HSN	0.586E+14	0.215E+14	0.343E+14	0.827E+13	0.652E+14	0.153E+15	0.249E+14	0.520E+14	0.161E+15	0.114E+15	0.673E+15
A/S	0.004	0.019	0.000	0.221	0.001	0.000	0.002	-0.001	0.000	0.015	0.017
FS	533.8	370.9	412.5	292.6	538.1	696.1	622.9	198.5	669.4	793.9	520.5

AVERAGE TEMPERATURES AT 00H ON DAY194.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	13.01	12.80	15.37	17.82	15.19	14.98	17.76	16.34	14.56	17.04	15.30
20M	7.43	7.19	7.88	10.07	8.52	6.96	9.87	11.08	7.68	9.03	8.43
40M	5.58	5.23	5.20	5.61	5.32	4.79	5.28	5.96	4.89	4.98	5.18
60M	4.50	4.19	4.24	4.18	4.14	4.18	4.26	4.20	4.18	4.28	4.22
90M	3.92	3.91	3.96	3.92	3.97	3.99	4.00	4.02	4.02	4.06	3.99
BOT	3.94	3.95	3.93	3.95	3.81	3.90	3.93	4.04	3.90	3.91	3.91
TOT	6.36	5.90	5.39	8.01	7.36	5.04	7.72	9.60	5.04	6.57	5.85

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 187. TO 00H ON DAY 194.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.270E+13	-0.370E+13	0.370E+14	0.940E+13	0.388E+14	0.870E+14	0.161E+14	0.153E+15	0.105E+15	0.643E+14	0.507E+15
QR	0.137E+11	0.114E+11	0.000E+00	0.642E+13	0.434E+11	0.000E+00	0.129E+11	0.228E+12	0.030E+00	0.436E+12	0.784E+13
HO	0.186E+12	0.392E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.517E+12	0.114E+13
HSN	-0.290E+13	-0.410E+13	0.370E+14	0.297E+13	0.387E+14	0.870E+14	0.161E+14	0.153E+15	0.105E+15	0.633E+14	0.498E+15
A/S	-0.069	-0.098	0.000	2.168	0.001	0.000	0.002	0.002	0.000	0.015	0.010
FS	-26.4	-70.8	444.9	104.9	319.6	395.8	481.3	582.9	436.6	483.4	386.9

AVERAGE TEMPERATURES AT 00H ON DAY201.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	13.10	13.20	18.01	19.58	17.43	17.77	20.15	18.83	17.27	19.51	17.56
20H	7.03	6.76	8.41	10.84	8.72	7.20	9.94	13.01	8.15	10.05	9.04
40H	5.52	4.94	5.24	5.68	5.37	4.76	5.45	6.43	4.88	5.08	5.22
60H	4.33	4.01	4.21	4.19	4.03	4.09	4.27	4.33	4.17	4.24	4.16
90H	3.93	3.88	3.93	3.92	3.87	3.93	3.98	4.02	4.01	4.03	3.96
BOT	3.90	3.91	3.90	3.94	4.13	3.88	3.90	4.00	3.87	3.89	3.88
TOT	6.27	5.79	5.63	8.49	7.74	5.21	8.19	10.88	5.23	7.03	6.14

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 194. TO 00H ON DAY 201.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.870E+13	-0.620E+13	0.357E+14	0.950E+13	0.339E+14	0.770E+14	0.149E+14	0.165E+15	0.103E+15	0.618E+14	0.488E+15
QR	-0.464E+11	0.313E+11	0.000E+00	0.808E+13	0.568E+11	0.000E+00	0.531E+10	0.352E+12	0.000E+00	0.397E+12	0.808E+13
HO	0.203E+12	0.394E+12	0.000E+00	0.850E+10	0.850E+10	0.006E+00	0.212E+11	0.420E+10	0.000E+00	0.505E+12	0.114E+13
HSN	-0.886E+13	-0.662E+13	0.357E+14	0.141E+13	0.338E+14	0.770E+14	0.149E+14	0.165E+15	0.103E+15	0.609E+14	0.479E+15
A/S	-0.018	-0.064	0.000	5.721	0.002	0.000	0.002	0.002	0.000	0.015	0.019
FS	-80.7	-114.3	429.3	50.0	279.1	350.3	371.5	628.2	428.2	464.7	370.0

AVERAGE TEMPERATURES AT 00H ON DAY208.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	13.72	13.10	18.07	20.38	16.71	17.59	20.72	19.79	18.40	20.41	18.04
20H	7.05	7.01	9.13	11.75	9.68	7.92	11.25	15.93	10.41	13.79	10.72
40H	5.45	4.76	5.31	6.02	5.41	4.74	5.53	7.79	5.26	5.84	5.55
60H	4.33	4.01	4.27	4.30	4.02	4.10	4.21	4.33	4.23	4.30	4.20
90H	3.91	3.90	3.94	3.97	3.91	3.95	3.98	4.05	4.04	4.04	3.98
BOT	3.86	3.87	3.87	3.91	3.89	3.86	3.89	4.00	3.89	3.89	3.88
TOT	6.34	5.77	5.70	8.89	7.78	5.24	8.51	12.21	5.53	7.76	6.42

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 201. TO 00H ON DAY 208.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.760E+13	-0.140E+13	0.114E+14	0.800E+13	0.420E+13	0.160E+14	0.100E+14	0.171E+15	0.153E+15	0.994E+14	0.480E+15
QR	-0.940E+11	-0.316E+10	0.000E+00	0.899E+13	0.451E+11	0.000E+00	-0.259E+10	0.832E+11	0.000E+00	-0.265E+12	0.321E+13
HO	0.214E+12	0.410E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.505E+12	0.117E+13
HSN	0.748E+13	-0.181E+13	0.114E+14	-0.100E+13	0.415E+13	0.160E+14	0.998E+13	0.171E+15	0.153E+15	0.932E+14	0.476E+15
A/S	0.016	-0.225	0.000	-8.972	0.013	0.006	0.002	0.001	0.000	0.002	0.009
FS	68.2	-31.2	137.1	-35.5	34.2	72.8	249.3	652.2	636.1	756.7	367.6

AVERAGE TEMPERATURES AT 00H ON DAY215.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	14.35	13.00	18.14	21.19	15.99	17.42	21.29	20.75	19.52	21.31	18.52
20H	7.07	7.25	9.85	12.67	10.64	8.64	12.56	18.04	12.66	17.54	12.40
40H	5.39	4.58	5.38	6.35	5.45	4.72	5.61	9.15	5.64	6.60	5.88
60H	4.32	4.01	4.33	4.41	4.01	4.11	4.17	4.33	4.30	4.35	4.23
80H	3.90	3.91	3.95	4.02	3.95	3.96	3.99	4.09	4.07	4.05	4.00
BOT	3.83	3.82	3.84	3.89	3.64	3.85	3.88	4.01	3.91	3.89	3.87
TOT	6.42	5.74	5.78	9.29	7.83	5.28	8.83	13.54	5.82	8.50	6.71

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 208. TO 03H ON DAY 215.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.750E+13	-0.150E+13	0.114E+14	0.790E+13	0.420E+13	0.160E+14	0.101E+14	0.172E+15	0.153E+15	0.990E+14	0.470E+15
QR	-0.867E+11	-0.132E+11	0.000E+00	0.636E+13	-0.481E+10	0.000E+00	0.137E+10	-0.452E+12	0.000E+00	0.142E+12	-0.596E+13
HO	0.228E+12	0.415E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.545E+12	0.123E+13
HSN	0.736E+13	-0.190E+13	0.114E+14	0.153E+13	0.420E+13	0.160E+14	0.101E+14	0.172E+15	0.153E+15	0.983E+14	0.475E+15
A/S	0.019	-0.211	0.000	4.158	0.001	0.000	0.002	-6.003	0.000	0.007	-0.010
FS	67.0	-32.8	137.1	54.2	34.6	72.8	251.7	658.0	636.1	750.3	366.3

AVERAGE TEMPERATURES AT 00H ON DAY222.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	14.26	13.58	16.44	18.26	15.92	16.18	19.86	19.89	18.40	19.88	17.58
20H	9.07	8.87	10.07	11.94	11.99	9.88	13.76	18.43	13.79	16.50	13.89
40H	5.79	5.11	5.64	6.00	5.86	5.32	6.04	9.93	6.73	7.37	6.55
60H	4.38	4.14	4.32	4.34	4.13	4.27	4.33	4.53	4.58	4.63	4.40
80H	3.97	3.95	3.96	4.01	3.95	3.99	3.98	4.16	4.19	4.21	4.07
BOT	3.86	3.88	3.86	3.90	3.76	3.89	3.89	4.18	3.98	4.02	3.93
TOT	6.82	6.19	5.71	8.51	8.20	5.40	8.91	13.47	6.06	8.43	6.84

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 215. TO 03H ON DAY 222.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.366E+14	0.256E+14	-0.107E+14	-0.155E+14	0.329E+14	0.560E+14	0.230E+13	-0.120E+14	0.121E+15	-0.960E+13	0.230E+15
QR	-0.113E+12	-0.208E+11	0.000E+00	0.396E+13	-0.595E+11	0.000E+00	0.177E+10	-0.381E+12	0.300E+00	0.117E+12	-0.119E+14
HO	0.244E+12	0.416E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.579E+12	0.128E+13
HSN	0.365E+14	0.252E+14	-0.107E+14	-0.195E+14	0.330E+14	0.560E+14	0.220E+13	-0.116E+14	0.121E+15	-0.970E+13	0.241E+15
A/S	0.004	0.016	0.000	-8.204	-8.002	0.000	0.010	0.032	0.000	-0.072	-0.044
FS	332.3	434.9	-128.7	-688.5	271.8	254.8	56.9	-44.3	503.1	-74.0	186.0

AVERAGE TEMPERATURES AT 00H ON DAY229.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	14.14	14.21	14.68	15.18	15.89	14.92	16.35	18.94	17.18	18.35	16.58
20M	11.14	10.55	10.27	11.16	13.34	11.15	14.96	17.81	14.86	15.22	13.71
40M	6.22	5.68	5.91	5.63	6.29	5.95	6.49	10.64	7.84	9.14	7.23
60M	4.43	4.28	4.31	4.26	4.26	4.42	4.51	4.73	4.86	4.91	4.57
90M	4.06	4.00	3.97	3.99	3.95	4.12	3.96	4.23	4.32	4.37	4.14
BOT	3.90	3.93	3.88	3.91	3.92	3.93	3.90	4.36	4.05	4.15	3.99
TOT	7.22	6.65	5.64	7.69	8.59	5.53	8.99	13.31	6.29	8.33	6.97

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 222. TO 00H ON DAY 229.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.378E+14	0.269E+14	-0.111E+14	-0.165E+14	0.340E+14	0.600E+14	0.210E+13	-0.230E+14	0.119E+15	-0.150E+14	0.210E+15
QR	-0.119E+12	-0.125E+11	0.000E+00	0.280E+13	-0.528E+11	0.000E+00	-0.174E+10	-0.329E+12	0.000E+00	-0.941E+11	-0.118E+14
HO	0.261E+12	0.412E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.606E+12	0.132E+13
HSN	0.377E+14	0.265E+14	-0.111E+14	-0.193E+14	0.340E+14	0.600E+14	0.208E+13	-0.227E+14	0.119E+15	-0.155E+14	0.221E+15
A/S	0.004	0.015	0.000	-0.145	-0.001	0.000	0.009	0.014	0.000	-0.033	-0.048
FS	343.1	457.2	-133.5	-682.6	280.8	273.0	52.0	-86.5	49.8	-118.4	170.4

AVERAGE TEMPERATURES AT 00H ON DAY236.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	15.57	15.11	16.75	17.96	16.33	17.01	19.66	19.34	18.54	19.53	17.03
20M	10.48	10.25	11.83	13.53	12.61	12.42	17.01	17.21	16.23	17.42	16.41
40M	5.89	5.67	6.22	6.63	5.89	6.05	7.25	8.87	7.97	9.34	7.17
60M	4.28	4.22	4.33	4.60	4.16	4.34	4.56	4.54	4.80	4.89	4.51
90M	4.80	3.98	3.97	4.03	3.92	4.01	3.98	4.17	4.24	4.28	4.10
BOT	3.84	3.89	3.86	3.90	4.07	3.91	3.90	4.24	3.99	4.04	3.95
TOT	7.23	6.71	5.97	8.90	8.40	5.75	9.75	12.74	6.64	8.95	7.14

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 229. TO 00H ON DAY 236.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.500E+12	0.350E+13	0.496E+14	0.238E+14	-0.173E+14	0.181E+15	0.240E+14	-0.750E+14	0.760E+14	0.830E+14	0.270E+15
QR	-0.156E+11	0.169E+10	0.000E+00	0.658E+13	0.403E+10	0.000E+00	0.669E+10	-0.111E+12	0.000E+00	0.277E+12	-0.986E+13
HO	0.275E+12	0.413E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.634E+12	0.136E+13
HSN	0.241E+12	0.309E+13	0.496E+14	0.172E+14	-0.173E+14	0.101E+15	0.240E+14	-0.749E+14	0.760E+14	0.821E+14	0.270E+15
A/S	1.074	0.134	0.800	0.383	-0.001	0.006	0.001	0.001	0.000	0.011	-0.038
FS	2.2	53.2	596.5	608.4	-142.8	459.5	598.7	-285.8	316.0	626.4	215.2

AVERAGE TEMPERATURES AT 00H ON DAY243.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	16.98	16.01	18.72	20.56	16.81	18.99	20.85	19.72	19.82	20.61	19.02
20M	10.01	10.02	13.27	15.71	11.99	13.64	18.85	16.66	17.51	19.48	15.10
40M	5.59	5.65	6.49	7.51	5.52	6.15	7.93	7.22	8.10	10.43	7.11
60M	4.14	4.18	4.34	4.88	4.07	4.27	4.60	4.37	4.73	4.88	4.45
90M	3.94	3.96	3.96	4.07	3.91	4.00	4.01	4.12	4.17	4.18	4.06
BOT	3.79	3.85	3.84	3.89	4.23	3.89	3.90	4.12	3.93	3.93	3.91
TOT	7.28	6.79	6.28	10.01	8.26	5.97	10.44	12.23	6.57	9.52	7.30

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 236. TO 00H ON DAY 243.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.380E+13	0.410E+13	0.461E+14	0.216E+14	-0.138E+14	0.970E+14	0.214E+14	-0.690E+14	0.710E+14	0.760E+14	0.270E+15
QR	-0.192E+10	0.104E+11	0.000E+00	0.795E+13	0.137E+11	0.000E+00	0.109E+11	-0.606E+11	0.000E+00	0.333E+12	-0.944E+13
HO	0.283E+12	0.415E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.649E+12	0.139E+13
HSN	0.392E+13	0.368E+13	0.461E+14	0.136E+14	-0.138E+14	0.970E+14	0.214E+14	-0.689E+14	0.710E+14	0.750E+14	0.278E+15
A/S	0.080	0.116	0.000	0.584	-0.002	0.000	0.002	0.001	0.000	0.013	-0.029
FS	32.1	63.4	554.4	482.2	-114.0	441.3	533.7	-263.1	295.2	572.5	214.9

AVERAGE TEMPERATURES AT 00H ON DAY250.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	18.16	17.06	18.97	20.04	17.84	19.63	20.02	19.62	19.66	20.21	19.16
20M	12.68	10.83	12.94	14.72	13.19	14.16	17.09	17.12	17.31	19.21	15.47
40M	5.85	5.55	6.10	6.26	5.79	6.29	7.22	7.82	8.14	9.77	7.13
60M	4.15	4.25	4.32	4.33	4.11	4.35	4.53	4.55	4.81	4.94	4.50
90M	4.00	3.94	3.96	3.97	3.95	4.02	3.99	4.22	4.16	4.12	4.06
BOT	3.86	3.86	3.86	3.91	4.21	3.91	3.98	4.01	3.90	3.90	3.91
TOT	7.92	7.03	6.21	9.34	8.76	6.05	9.83	12.51	6.55	9.29	7.36

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 243. TO 00H ON DAY 250.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.595E+14	0.134E+14	-0.102E+14	-0.135E+14	0.437E+14	0.360E+14	-0.199E+14	0.320E+14	-0.120E+14	-0.310E+14	0.900E+14
QR	-0.203E+11	-0.681E+10	0.000E+00	0.427E+13	-0.473E+11	0.000E+00	0.649E+10	-0.163E+12	0.000E+00	0.219E+12	-0.166E+14
HO	0.286E+12	0.417E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.669E+12	0.141E+13
HSN	0.592E+14	0.130E+14	-0.102E+14	-0.178E+14	0.437E+14	0.360E+14	-0.199E+14	0.322E+14	-0.120E+14	-0.319E+14	0.105E+15
A/S	0.004	0.032	0.000	-0.260	-0.001	0.000	-0.001	-0.005	0.000	-0.026	-0.144
FS	539.7	224.1	-122.7	-628.5	360.8	163.8	-497.7	122.7	-49.9	-243.4	81.3

AVERAGE TEMPERATURES AT 00H ON DAY257.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	18.29	16.68	18.55	19.94	17.70	18.77	19.57	19.43	19.40	19.71	18.92
20M	12.38	11.68	12.99	15.39	12.46	13.79	14.26	18.62	17.99	18.43	15.60
40M	5.61	5.46	5.93	6.52	5.68	6.16	6.56	10.04	8.44	9.29	7.35
60M	4.12	4.09	4.27	4.51	4.23	4.37	4.45	5.01	4.89	4.83	4.54
90M	3.93	3.89	3.97	4.18	3.93	4.06	4.09	4.17	4.20	4.18	4.06
BOT	3.87	3.88	3.92	4.01	3.91	3.93	4.03	4.33	3.94	3.96	3.94
TOT	7.82	7.02	6.17	9.56	8.60	6.01	9.13	13.51	6.65	3.04	7.41

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 250. TO 00H ON DAY 257.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.910E+13	-0.500E+12	-0.700E+13	0.420E+13	-0.144E+14	-0.190E+14	-0.220E+14	0.127E+15	0.520E+14	-0.350E+14	0.800E+14
QR	-0.322E+11	-0.138E+11	0.000E+00	0.194E+13	-0.570E+11	0.000E+00	0.372E+10	-0.134E+12	0.000E+00	0.975E+11	-0.206E+14
HO	0.291E+12	0.427E+12	0.000E+00	0.850E+10	0.650E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.686E+12	0.144E+13
HSN	-0.935E+13	-0.913E+12	-0.700E+13	0.225E+13	-0.144E+14	-0.190E+14	-0.220E+14	0.127E+15	0.520E+14	-0.358E+14	0.992E+14
A/S	-0.027	-0.452	0.000	0.867	0.003	0.000	-0.001	-0.001	0.000	-0.022	-0.193
FS	-85.2	-15.7	-84.2	79.5	-118.4	-86.4	-550.1	485.1	216.2	-273.1	76.6

AVERAGE TEMPERATURES AT 00H ON DAY264.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	15.63	13.02	16.90	18.60	15.23	17.35	19.24	18.70	18.64	18.96	17.55
20M	9.69	8.74	13.16	14.90	12.62	15.93	17.98	18.47	18.48	18.43	15.87
40M	5.28	4.99	5.81	6.64	5.86	7.52	7.74	13.14	10.34	10.56	8.59
60M	4.11	4.01	4.33	4.69	4.20	4.44	4.58	4.91	5.01	4.97	4.60
90M	3.90	3.91	3.94	3.95	3.95	4.02	4.03	4.15	4.19	4.16	4.06
BOT	3.83	3.88	3.86	3.88	3.97	3.89	3.96	3.91	3.93	3.95	3.90
TOT	6.94	6.03	6.02	9.24	8.22	6.23	9.98	14.15	6.90	9.21	7.50

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 257. TO 00H ON DAY 264.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.848E+14	-0.581E+14	-0.230E+14	-0.660E+13	-0.359E+14	0.100E+15	0.263E+14	0.780E+14	0.125E+15	0.220E+14	0.140E+15
QR	-0.329E+10	-0.568E+10	0.000E+00	0.429E+13	-0.140E+11	0.000E+00	0.257E+10	-0.132E+12	0.000E+00	0.685E+11	-0.155E+14
HO	0.295E+12	0.433E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.764E+12	0.147E+13
HSN	-0.851E+14	-0.585E+14	-0.230E+14	-0.109E+14	-0.359E+14	0.100E+15	0.263E+14	0.781E+14	0.125E+15	0.212E+14	0.154E+15
A/S	-0.003	-0.007	0.000	-0.394	0.000	0.000	-0.001	-0.002	0.000	0.036	-0.091
FS	-775.3	-1009.8	-276.6	-385.3	-296.1	455.0	656.3	298.1	519.7	162.0	119.1

AVERAGE TEMPERATURES AT 00H ON DAY271.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	14.80	14.75	15.72	15.68	16.55	16.27	14.91	17.78	17.68	17.90	16.75
20H	12.76	13.23	13.02	13.99	15.31	14.74	13.71	17.59	17.09	16.77	15.59
40H	6.30	7.02	6.53	7.63	8.16	7.54	7.46	11.62	9.32	9.06	8.46
60H	4.42	4.37	4.34	4.53	4.60	4.54	4.89	4.66	5.01	5.46	4.71
90H	3.97	3.94	3.96	4.04	3.99	4.07	4.12	4.12	4.26	4.36	4.13
BOT	3.86	3.90	3.87	3.90	4.11	3.92	3.96	4.24	3.99	3.98	3.96
TOT	7.56	7.36	6.04	8.76	9.66	8.11	8.55	13.22	6.65	8.69	7.41

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 264. TO 00H ON DAY 271.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.582E+14	0.770E+14	0.250E+13	-0.350E+13	0.129E+15	-0.550E+14	-0.449E+14	-0.119E+15	-0.132E+15	-0.710E+14	-0.160E+15
QR	0.123E+11	-0.926E+10	0.000E+00	0.419E+13	-0.303E+11	0.000E+00	0.661E+09	-0.182E+12	0.000E+00	0.859E+10	-0.164E+14
HO	0.286E+12	0.437E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	-0.000E+00	0.738E+12	0.150E+13
HSN	0.579E+14	0.766E+14	0.250E+13	-0.337E+14	0.129E+15	-0.550E+14	-0.449E+14	-0.119E+15	-0.132E+15	-0.717E+14	-0.165E+15
A/S	0.005	0.006	0.000	-0.306	0.000	0.000	0.000	0.001	0.000	-0.010	0.103
FS	527.5	1321.2	30.1	-484.3	1065.0	-250.2	-1121.9	-453.4	-548.8	-547.5	-112.2

AVERAGE TEMPERATURES AT 00H ON DAY278.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	14.71	14.78	14.95	15.70	15.89	15.30	14.81	16.57	16.39	15.84	15.77
20H	13.83	13.78	13.44	14.67	14.87	14.48	13.81	16.40	16.06	15.49	15.39
40H	7.66	7.91	6.44	7.57	7.71	7.25	7.18	11.46	8.35	9.20	8.26
60H	4.46	4.38	4.26	4.36	4.58	4.40	4.54	4.94	4.68	4.85	4.56
90H	4.00	3.91	3.92	3.98	3.97	4.03	3.98	4.22	4.17	4.12	4.06
BOT	3.83	3.83	3.82	3.87	3.82	3.88	3.91	4.07	3.92	3.91	3.88
TOT	8.03	7.62	5.96	8.81	9.37	5.94	8.38	12.62	6.28	8.15	7.16

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 271. TO 00H ON DAY 278.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.431E+14	0.146E+14	-0.120E+14	0.700E+12	-0.274E+14	-0.798E+14	-0.590E+13	-0.810E+14	-0.193E+15	-0.740E+14	-0.420E+15
QR	-0.374E+11	-0.177E+11	0.000E+00	0.541E+13	-0.507E+11	0.000E+00	0.114E+10	-0.103E+12	0.000E+00	0.168E+11	-0.112E+14
HO	0.255E+12	0.511E+12	0.000E+00	0.650E+10	0.650E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.793E+12	0.160E+13
HSN	0.429E+14	0.141E+14	-0.120E+14	-0.472E+13	-0.274E+14	-0.790E+14	-0.592E+13	-0.809E+14	-0.193E+15	-0.748E+14	-0.410E+15
A/S	0.005	0.035	0.000	-1.168	-0.002	0.000	-0.004	0.001	0.000	-0.311	0.024
FS	390.7	243.4	-164.3	-166.8	-225.7	-359.4	-147.9	-308.7	-802.4	-570.9	-317.2

AVERAGE TEMPERATURES AT 00H ON DAY285.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	13.14	11.54	12.56	14.04	9.62	12.58	13.97	13.53	12.92	13.47	12.70
20M	12.70	10.55	12.09	13.06	10.00	12.28	13.66	13.02	12.66	13.35	12.38
40M	9.16	6.55	9.02	11.20	6.90	9.81	11.25	11.58	9.92	12.19	9.82
60M	4.57	4.24	4.73	6.27	4.34	5.33	7.51	6.75	5.50	6.84	5.60
90M	3.96	3.93	3.95	4.10	4.04	4.14	4.57	4.13	4.21	4.75	4.17
BOT	3.85	3.81	3.85	3.91	3.87	3.88	3.96	3.96	3.88	3.92	3.87
TOT	7.99	6.44	6.16	9.51	7.05	6.11	9.95	11.26	6.13	6.90	7.01

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 278. TO 00H ON DAY 285.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.420E+13	-0.600E+14	0.299E+14	0.133E+14	-0.209E+15	0.740E+14	0.406E+14	-0.177E+15	-0.790E+14	0.990E+14	-0.270E+15
QR	-0.562E+11	-0.140E+11	0.000E+00	0.501E+13	-0.846E+11	0.000E+00	-0.111E+11	-0.397E+12	0.000E+00	-0.165E+12	-0.950E+13
HO	0.255E+12	0.588E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.846E+12	0.173E+13
HSN	-0.440E+13	-0.694E+14	0.299E+14	0.828E+13	-0.209E+15	0.740E+14	0.406E+14	-0.177E+15	-0.790E+14	0.903E+14	-0.262E+15
A/S	-0.045	-0.008	0.000	0.606	0.000	0.000	0.000	0.002	0.000	0.007	0.030
FS	-40.1	-1196.9	359.6	292.9	-1720.0	336.7	1213.6	-673.9	-328.5	750.3	-202.6

AVERAGE TEMPERATURES AT 00H ON DAY292.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	7.47	5.45	9.24	11.24	5.61	8.04	12.34	11.30	10.89	11.91	9.49
20M	7.03	5.38	8.96	10.71	5.38	7.88	11.85	11.62	10.66	11.76	9.32
40M	6.57	4.68	8.29	10.47	5.16	7.33	9.98	11.62	10.14	11.57	8.72
60M	5.04	4.20	6.34	8.71	4.40	5.97	9.43	8.54	7.29	10.81	6.80
90M	4.08	3.92	4.71	6.45	4.11	4.68	7.72	4.32	4.75	7.25	4.86
BOT	4.72	4.69	4.37	6.78	4.89	4.88	4.36	3.72	3.86	3.91	3.99
TOT	5.85	4.61	6.13	9.35	4.99	5.41	9.94	10.46	6.23	9.18	6.51

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 285. TO 00H ON DAY 292.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.201E+15	-0.106E+15	-0.500E+13	-0.310E+13	-0.184E+15	-0.323E+15	-0.200E+12	-0.102E+15	0.540E+14	0.270E+14	-0.840E+15
QR	-0.707E+11	-0.229E+11	0.000E+00	0.470E+13	-0.684E+11	0.000E+00	-0.113E+11	-0.533E+12	0.000E+00	-0.247E+12	-0.555E+13
HO	0.286E+12	0.590E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.893E+12	0.181E+13
HSN	-0.201E+15	-0.107E+15	-0.500E+13	-0.789E+13	-0.184E+15	-0.323E+15	-0.210E+12	-0.101E+15	0.540E+14	0.264E+14	-0.836E+15
A/S	-0.001	-0.065	0.000	-0.607	0.000	0.000	-0.047	0.005	0.000	0.025	0.005
FS	-1835.1	-1838.7	-69.7	-278.8	-1517.2	-1469.5	-5.2	-387.2	224.5	201.1	-646.3

AVERAGE TEMPERATURES AT 00H ON DAY299.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	6.60	5.66	6.21	10.07	9.20	8.54	10.55	11.12	10.62	10.85	9.52
20H	5.98	5.53	7.93	9.38	8.89	8.23	10.45	11.18	10.47	10.76	9.29
40H	5.44	5.17	7.09	8.41	7.60	7.33	9.19	11.26	9.73	10.59	8.52
60H	4.66	4.85	5.51	6.21	6.01	6.16	7.48	9.88	7.16	9.68	6.76
90H	4.02	4.57	4.33	4.62	4.57	4.92	5.46	5.75	4.83	6.31	4.87
BOT	4.10	4.03	3.98	4.07	3.84	3.92	3.97	4.10	4.02	4.24	3.98
TOT	5.17	4.97	5.44	7.58	7.40	5.51	8.44	10.58	6.20	8.36	6.47

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 292. TO 00H ON DAY 299.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.637E+14	-0.209E+14	-0.103E+15	-0.346E+14	0.215E+15	0.470E+14	-0.471E+14	0.150E+14	-0.180E+14	-0.990E+14	-0.700E+14
QR	-0.180E+12	-0.692E+11	0.000E+00	0.775E+13	-0.115E+12	0.000E+00	-0.413E+10	-0.421E+12	0.000E+00	-0.676E+11	-0.144E+13
HO	0.267E+12	0.589E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.929E+12	0.183E+13
HSN	-0.638E+14	0.204E+14	-0.103E+15	-0.424E+14	0.216E+15	0.470E+14	-0.471E+14	0.154E+14	-0.180E+14	-0.999E+14	-0.704E+14
A/S	-0.001	0.025	0.000	-0.183	0.000	0.000	0.000	-0.027	0.000	-0.009	-0.005
FS	-581.2	351.6	-1233.8	-1498.0	1778.4	213.8	-1176.8	58.8	-74.8	-762.1	-54.4

AVERAGE TEMPERATURES AT 00H ON DAY306.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	5.92	8.22	7.26	6.70	9.67	8.46	7.75	10.71	10.00	10.82	9.11
20H	5.12	8.04	7.13	6.40	9.48	8.36	7.04	10.71	9.96	9.96	8.93
40H	4.97	6.07	6.10	5.99	7.98	7.93	8.35	10.60	9.50	3.58	8.31
60H	4.73	5.18	5.14	4.99	6.72	6.44	6.64	9.59	7.43	8.14	6.76
90H	4.19	4.50	4.38	4.38	5.19	4.93	4.93	5.81	4.80	5.53	4.83
BOT	4.00	3.98	3.97	3.93	3.96	4.06	4.11	4.04	3.92	4.03	3.98
TOT	4.88	5.88	5.10	5.62	7.93	5.69	6.94	10.14	6.08	7.55	6.34

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 299. TO 00H ON DAY 306.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.279E+14	0.526E+14	-0.523E+14	-0.382E+14	0.474E+14	0.630E+14	-0.468E+14	-0.570E+14	-0.600E+14	-0.109E+15	-0.210E+15
QR	-0.233E+12	-0.441E+11	0.000E+00	0.541E+13	-0.102E+12	0.000E+00	-0.387E+10	-0.697E+12	0.000E+00	-0.674E+11	-0.110E+13
HO	0.278E+12	0.591E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.955E+12	0.187E+13
HSN	-0.279E+14	0.521E+14	-0.523E+14	-0.436E+14	0.475E+14	0.630E+14	-0.468E+14	-0.563E+14	-0.600E+14	-0.110E+15	-0.211E+15
A/S	-0.002	0.010	0.000	-0.124	-0.002	0.000	0.000	0.012	0.000	-0.008	-0.004
FS	-254.6	898.1	-628.9	-1542.4	391.7	377.6	-1169.3	-214.9	-269.5	-838.6	-162.9

AVERAGE TEMPERATURES AT 00H ON DAY313.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	7.19	8.46	6.94	7.86	9.28	7.94	7.13	9.82	9.38	9.21	8.71
20M	6.96	8.20	6.74	5.68	9.03	7.90	7.10	9.85	9.36	9.18	8.56
40M	6.43	7.52	6.24	5.22	8.37	7.41	6.38	9.92	9.06	8.87	8.10
60M	5.65	6.42	5.15	4.94	6.72	5.95	5.37	8.62	7.13	7.49	6.53
90M	4.64	4.58	4.40	4.46	5.07	4.68	4.59	5.88	5.12	5.11	4.65
BOT	4.10	4.13	4.11	4.26	4.47	4.01	4.21	4.25	3.95	3.99	3.98
TOT	5.96	6.53	5.11	5.57	7.88	5.41	6.04	9.38	9.98	7.03	6.20

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 306. TO 00H ON DAY 313.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.101E+15	0.376E+14	0.140E+13	-0.100E+13	-0.460E+13	0.127E+15	-0.284E+14	-0.960E+14	-0.550E+14	-0.706E+14	-0.250E+15
QR	-0.256E+12	-0.480E+11	0.000E+00	0.575E+13	-0.176E+12	0.000E+00	-0.547E+10	-0.954E+12	0.000E+00	-0.163E+12	0.155E+13
HO	0.291E+12	0.556E+12	0.000E+00	0.850E+10	0.050E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.993E+12	0.188E+13
HSN	0.101E+15	0.371E+14	0.140E+13	-0.676E+13	-0.443E+13	0.127E+15	-0.284E+14	-0.950E+14	-0.550E+14	-0.714E+14	-0.253E+15
A/S	0.000	0.014	0.000	-0.852	0.038	0.000	-0.001	0.010	0.000	-0.012	-0.014
FS	924.4	640.0	16.8	-238.9	-36.6	-577.8	-709.7	-362.7	-228.7	-545.1	-195.9

AVERAGE TEMPERATURES AT 00H ON DAY320.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	7.28	7.53	6.57	7.42	8.38	6.71	6.96	8.88	8.47	8.01	7.85
20M	7.04	7.11	6.54	7.48	8.32	6.65	6.69	8.83	8.46	7.93	7.74
40M	6.66	7.00	6.36	7.34	8.09	6.53	6.20	8.97	8.34	7.92	7.55
60M	6.59	6.80	5.98	6.76	7.28	6.26	6.02	8.60	7.04	6.67	6.76
90M	5.56	6.40	5.17	4.99	5.62	4.90	5.21	5.40	5.09	5.26	5.17
BOT	5.12	4.99	4.40	4.28	3.95	3.89	4.05	4.17	3.90	3.94	3.97
TOT	6.47	6.72	5.48	6.71	7.69	5.17	6.11	8.57	5.72	6.41	6.02

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 313. TO 00H ON DAY 320.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.484E+16	0.107E+14	0.563E+14	0.222E+14	-0.169E+14	-0.113E+15	0.240E+13	-0.102E+15	-0.132E+15	-0.829E+14	-0.300E+15
QR	-0.415E+12	-0.873E+11	0.000E+00	0.600E+13	-0.254E+12	0.000E+00	-0.396E+11	-0.164E+13	0.000E+00	-0.547E+12	0.498E+13
HO	0.308E+12	0.527E+12	0.000E+00	0.850E+10	0.050E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.102E+13	0.190E+13
HSN	0.465E+14	0.103E+14	0.563E+14	0.161E+14	-0.167E+14	-0.113E+15	0.242E+13	-0.100E+15	-0.132E+15	-0.834E+14	-0.307E+15
A/S	-0.002	0.043	0.000	0.378	0.015	0.000	-0.008	0.016	0.000	-0.006	-0.022
FS	442.0	177.0	677.0	569.8	-137.4	-514.1	60.4	-383.0	-540.8	-636.3	-237.2

AVERAGE TEMPERATURES AT 00H ON DAY327.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	6.93	6.79	6.29	7.16	7.38	6.14	6.37	7.58	7.19	6.33	6.89
20M	6.89	6.72	6.23	7.13	7.29	6.12	6.33	7.63	7.15	6.59	6.87
40M	6.66	6.38	6.13	7.05	7.18	6.06	6.04	7.83	7.05	6.37	6.73
60M	6.54	6.14	6.03	6.89	6.75	5.96	5.86	7.69	6.69	5.91	6.39
90M	6.25	5.54	5.62	6.09	5.02	5.03	5.36	5.50	5.09	5.29	5.26
BOT	4.64	4.88	4.31	4.31	4.18	4.20	4.34	4.54	4.12	4.28	4.19
TOT	6.50	6.09	5.48	6.76	6.87	5.13	5.91	7.53	5.43	5.68	5.71

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 320. TO 00H ON DAY 327.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.240E+13	-0.364E+14	0.700E+12	0.100E+13	-0.739E+14	-0.160E+14	-0.620E+13	-0.133E+15	-0.153E+15	-0.988E+14	-0.512E+15
QR	-0.245E+12	-0.379E+11	0.000E+00	0.739E+13	-0.105E+12	0.000E+00	-0.131E+12	-0.136E+13	-0.000E+00	-0.202E+13	0.454E+13
HO	0.319E+12	0.523E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.166E+13	0.194E+13
HSN	0.233E+13	-0.369E+14	0.700E+12	-0.640E+13	-0.738E+14	-0.160E+14	-0.609E+13	-0.132E+15	-0.153E+15	-0.378E+14	-0.518E+15
A/S	0.032	-0.013	0.000	-1.156	0.001	0.000	0.018	0.010	0.000	0.010	-0.012
FS	21.2	-636.4	8.4	-226.4	-608.7	-72.8	-152.1	-502.7	-636.1	-746.6	-600.7

AVERAGE TEMPERATURES AT 00H ON DAY334.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	5.81	5.68	5.46	5.97	5.77	5.50	6.06	6.16	6.54	5.98	5.96
20M	5.69	5.68	5.46	6.20	5.70	5.48	5.74	6.18	6.53	6.10	5.95
40M	5.66	5.73	5.43	6.15	5.65	5.45	5.61	6.38	6.54	6.16	5.95
60M	5.62	5.51	5.38	6.07	5.52	5.43	5.46	6.16	6.52	6.01	5.85
90M	5.33	5.18	5.25	5.77	5.39	5.29	5.31	7.38	6.31	6.02	5.72
BOT	4.98	5.04	4.71	5.04	5.14	4.56	4.92	5.17	4.62	4.91	4.63
TOT	5.57	5.48	5.18	5.99	5.62	5.08	5.60	6.30	5.69	5.81	5.52

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 327. TO 00H ON DAY 334.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.872E+14	-0.351E+14	-0.467E+14	-0.150E+14	-0.111E+15	-0.240E+14	-0.990E+13	-0.156E+15	0.136E+15	0.178E+14	-0.332E+15
QR	-0.257E+12	-0.335E+11	0.000E+00	0.830E+13	-0.977E+11	0.000E+00	-0.140E+12	-0.121E+13	0.000E+00	-0.168E+13	0.777E+13
HO	0.331E+12	0.531E+12	0.000E+00	0.850E+10	0.650E+10	0.000E+00	0.212E+11	0.429E+10	0.000E+00	0.138E+13	0.198E+13
HSN	-0.873E+14	-0.356E+14	-0.467E+14	-0.233E+14	-0.111E+15	-0.240E+14	-0.978E+13	-0.155E+15	0.136E+15	0.184E+14	-0.342E+15
A/S	-0.001	-0.014	0.000	-0.356	-0.001	0.000	-0.012	0.008	0.000	-0.033	-0.029
FS	-7.95.1	-614.2	-561.6	-824.2	-916.5	-109.2	-246.3	-590.3	565.5	140.5	-264.1

AVERAGE TEMPERATURES AT 00H ON DAY341.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	5.09	4.81	5.06	5.01	4.68	5.08	4.97	5.00	5.81	5.06	5.14
20M	5.16	4.98	5.09	5.30	4.75	5.08	4.92	5.09	5.81	5.39	5.24
40M	5.16	5.15	5.09	5.32	4.79	5.08	5.13	5.40	5.81	5.43	5.31
60M	5.12	5.11	5.06	5.29	4.82	5.07	5.09	5.67	5.79	5.45	5.33
90M	5.05	5.10	5.06	5.22	5.00	5.05	5.04	6.03	5.68	5.39	5.30
BOT	4.94	4.83	4.81	5.03	4.54	4.71	4.85	5.47	4.64	4.91	4.71
TOT	5.10	5.03	5.00	5.22	4.78	4.93	5.03	5.29	5.30	5.26	5.11

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 336. TO 00H ON DAY 341.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.436E+14	-0.262E+14	-0.267E+14	-0.151E+14	-0.748E+14	-0.660E+14	-0.177E+14	-0.127E+15	-0.206E+15	-0.741E+14	-0.677E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.248E+13	0.000E+00	0.000E+00	-0.117E+12	-0.588E+12	0.000E+00	-0.140E+13	0.376E+12
HO	0.342E+12	0.552E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.111E+13	0.204E+13
HSN	-0.439E+14	-0.268E+14	-0.267E+14	-0.176E+14	-0.748E+14	-0.660E+14	-0.176E+14	-0.127E+15	-0.206E+15	-0.738E+14	-0.673E+15
A/S	-0.008	-0.021	0.000	-0.161	0.000	0.000	0.005	0.004	0.000	0.004	-0.002
FS	-400.4	-461.6	-321.1	-621.9	-617.0	-300.3	-439.7	-483.4	-856.5	-563.3	-524.5

AVERAGE TEMPERATURES AT 00H ON DAY348.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	4.59	4.15	4.72	4.52	3.88	4.72	4.32	4.07	5.37	4.66	4.58
20M	4.77	4.81	4.74	4.62	4.30	4.70	4.27	4.25	5.37	4.89	4.74
40M	4.81	4.83	4.74	4.72	4.39	4.80	4.88	4.78	5.37	5.14	4.93
60M	4.86	4.85	4.74	4.73	4.42	4.88	4.88	5.14	5.38	5.14	4.98
90M	4.91	4.90	4.75	4.71	4.78	4.90	4.86	5.53	5.33	5.13	5.04
BOT	4.67	4.76	4.76	4.76	4.39	4.86	4.81	5.24	4.88	4.88	4.86
TOT	4.79	4.75	4.75	4.67	4.33	4.83	4.68	4.56	5.16	4.99	4.88

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 341. TO 00H ON DAY 348.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.294E+14	-0.165E+14	-0.377E+14	-0.164E+14	-0.400E+14	-0.470E+14	-0.111E+14	-0.932E+14	-0.700E+14	-0.361E+14	-0.391E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.376E+13	0.000E+00	0.000E+00	-0.117E+12	-0.684E+12	0.000E+00	-0.106E+13	0.231E+13
HO	0.353E+12	0.573E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.113E+13	0.209E+13
HSN	-0.290E+14	-0.171E+14	-0.377E+14	-0.146E+14	-0.400E+14	-0.470E+14	-0.110E+14	-0.925E+14	-0.700E+14	-0.362E+14	-0.395E+15
A/S	-0.012	-0.034	0.000	-0.259	0.000	0.000	0.009	0.007	0.000	-0.002	-0.011
FS	-271.1	-294.6	-453.4	-514.8	-330.8	-213.8	-274.8	-353.0	-291.0	-276.0	-305.6

AVERAGE TEMPERATURES AT 00H ON DAY355.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	3.67	3.68	4.18	2.82	3.81	4.35	2.86	2.52	4.52	3.81	3.69
20M	3.94	4.17	4.40	3.10	3.23	4.36	3.30	2.77	4.53	4.24	3.91
40M	4.02	4.21	4.42	4.41	3.75	4.44	4.47	3.34	4.53	4.54	4.23
60M	4.36	4.21	4.42	4.41	4.15	4.47	4.47	4.22	4.59	4.63	4.45
90M	4.42	4.34	4.44	4.44	4.30	4.51	4.45	4.60	4.76	4.68	4.57
BOT	4.47	4.47	4.50	4.61	4.27	4.65	4.43	4.61	4.82	4.73	4.71
TOT	4.16	4.19	4.43	3.91	3.68	4.53	3.99	3.19	4.70	4.48	4.37

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 348, TO 03H ON DAY 355.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.591E+14	-0.323E+14	-0.480E+14	-0.148E+14	-0.585E+14	-0.139E+15	-0.214E+14	-0.173E+15	-0.239E+15	-0.675E+14	-0.853E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.602E+13	0.000E+00	0.000E+00	-0.649E+10	-0.201E+12	0.000E+00	-0.154E+12	0.677E+13
HO	0.369E+12	0.578E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.115E+13	0.213E+13
HSN	-0.595E+14	-0.329E+14	-0.480E+14	-0.209E+14	-0.585E+14	-0.139E+15	-0.214E+14	-0.173E+15	-0.239E+15	-0.685E+14	-0.862E+15
A/S	-0.006	-0.018	0.000	-0.289	0.000	0.000	-0.001	0.001	0.000	-0.014	-0.010
FS	-541.8	-567.3	-577.2	-737.6	-482.6	-632.4	-534.8	-660.9	-993.7	-522.7	-666.1

AVERAGE TEMPERATURES AT 00H ON DAY362.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	3.51	3.39	3.88	2.53	2.97	4.16	2.90	2.38	4.29	3.70	3.50
20M	3.66	3.70	4.19	3.09	3.11	4.17	3.16	2.59	4.29	4.01	3.70
40M	3.83	3.90	4.22	4.12	3.56	4.24	4.34	3.19	4.30	4.34	4.02
60M	4.06	3.93	4.23	4.12	3.84	4.27	4.33	3.90	4.34	4.44	4.21
90M	4.19	4.11	4.26	4.16	4.18	4.39	4.29	4.28	4.56	4.48	4.40
BOT	4.31	4.35	4.35	4.09	4.26	4.54	4.23	4.30	4.67	4.56	4.57
TOT	3.91	3.90	4.24	3.66	3.51	4.38	3.88	3.00	4.51	4.30	4.19

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 355, TO 00H ON DAY 362.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.235E+14	-0.161E+14	-0.280E+14	-0.466E+13	-0.146E+14	-0.670E+14	-0.320E+13	-0.229E+14	-0.990E+14	-0.238E+14	-0.303E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.874E+13	0.000E+00	0.000E+00	0.556E+11	0.505E+11	0.000E+00	0.574E+12	0.100E+14
HO	0.381E+12	0.578E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.113E+13	0.213E+13
HSN	-0.239E+14	-0.167E+14	-0.280E+14	-0.134E+14	-0.146E+14	-0.670E+14	-0.320E+13	-0.230E+14	-0.990E+14	-0.255E+14	-0.315E+15
A/S	-0.016	-0.035	0.000	-0.652	-0.001	0.000	-0.023	-0.002	0.000	-0.067	-0.039
FS	-217.6	-287.7	-336.7	-474.0	-120.5	-304.8	-81.8	-87.6	-411.6	-194.6	-243.6

AVERAGE TEMPERATURES AT 00H ON DAY369.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	3.15	3.10	3.57	2.24	2.92	3.97	2.94	2.24	4.05	3.59	3.31
20M	3.37	3.22	3.98	3.09	2.99	3.97	3.02	2.41	4.06	3.78	3.48
40M	3.65	3.60	4.02	3.84	3.37	4.04	4.21	3.03	4.07	4.14	3.82
60M	3.77	3.64	4.04	3.84	3.52	4.07	4.20	3.59	4.09	4.25	3.98
90M	3.96	3.89	4.07	3.88	4.06	4.26	4.13	3.96	4.36	4.27	4.22
BOT	4.15	4.23	4.20	3.77	4.24	4.43	4.03	4.01	4.52	4.40	4.44
TOT	3.65	3.62	4.05	3.42	3.34	4.23	3.77	2.82	4.31	4.12	4.01

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 362. TO 00H ON DAY 369.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.236E+14	-0.162E+14	-0.280E+14	-0.467E+13	-0.146E+14	-0.670E+14	-0.330E+13	-0.229E+14	-0.390E+14	-0.237E+14	-0.303E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.745E+13	0.000E+00	0.000E+00	0.816E+11	0.384E+11	0.000E+00	0.931E+12	0.894E+13
HO	0.392E+12	0.567E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.103E+13	0.203E+13
HSN	-0.240E+14	-0.168E+14	-0.280E+14	-0.121E+14	-0.146E+14	-0.670E+14	-0.340E+13	-0.229E+14	-0.990E+14	-0.257E+14	-0.314E+15
A/S	-0.016	-0.034	0.000	-0.615	-0.001	0.000	-0.030	-0.002	0.000	-0.076	-0.035
FS	-218.6	-289.3	-336.7	-428.8	-120.5	-304.8	-85.0	-87.5	-411.6	-195.8	-242.7

AVERAGE TEMPERATURES AT 00H ON DAY376.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	2.73	2.61	3.62	1.23	2.63	3.73	1.83	0.63	1.33	1.35	2.07
20M	3.25	3.57	3.79	3.24	3.01	3.78	2.22	0.70	1.34	1.40	2.33
40M	3.43	3.63	3.80	3.74	3.50	4.15	4.22	3.69	4.26	4.35	3.97
60M	3.53	3.70	3.82	3.76	4.01	4.18	4.22	4.17	4.27	4.35	4.10
90M	3.64	3.73	3.85	3.79	4.03	4.18	4.18	4.25	4.29	4.36	4.13
BOT	3.74	3.97	3.99	3.88	4.38	4.27	4.12	4.20	4.31	4.34	4.26
TOT	3.38	3.55	3.85	3.19	3.43	4.15	3.47	2.26	3.90	3.59	3.73

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 369. TO 00H ON DAY 376.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.255E+14	-0.370E+13	-0.292E+14	-0.439E+13	0.810E+13	-0.360E+14	-0.950E+13	-0.707E+14	-0.213E+15	-0.712E+14	-0.457E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.193E+13	0.000E+00	0.000E+00	0.642E+11	-0.912E+10	0.000E+00	0.105E+13	0.344E+13
HO	0.402E+12	0.553E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.927E+12	0.192E+13
HSN	-0.259E+14	-0.425E+13	-0.292E+14	-0.633E+13	0.809E+13	-0.360E+14	-0.959E+13	-0.707E+14	-0.213E+15	-0.732E+14	-0.462E+15
A/S	-0.016	-0.130	0.000	-0.306	0.001	0.000	-0.009	0.000	0.000	-0.027	-0.012
FS	-236.0	-73.4	-351.1	-223.8	66.7	-163.8	-239.4	-269.8	-885.6	-558.4	-357.4

AVERAGE TEMPERATURES AT 00H ON DAY383.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	3.13	3.10	3.57	1.79	2.44	3.20	1.39	0.84	2.66	2.13	2.39
20H	3.39	3.35	3.69	2.57	2.55	3.21	1.51	0.98	2.68	2.70	2.59
40H	3.47	3.58	3.70	3.66	3.22	3.44	3.76	1.76	2.94	3.62	3.15
60H	3.56	3.70	3.71	3.65	3.33	3.43	3.76	2.69	3.04	3.66	3.35
80H	3.63	3.75	3.72	3.71	3.41	3.46	3.78	3.47	3.27	3.81	3.48
BOT	3.79	3.80	3.75	3.97	3.91	3.48	3.84	3.66	3.42	3.61	3.50
TOT	3.48	3.57	3.71	3.10	3.00	3.42	2.99	1.58	3.18	3.35	3.20

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 376. TO 00H ON DAY 383.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.990E+13	0.110E+13	-0.217E+14	-0.166E+13	-0.375E+14	-0.333E+15	-0.148E+14	-0.866E+14	-0.374E+15	-0.322E+14	-0.889E+15
QR	0.000E+00	0.000E+00	0.000E+00	-0.204E+13	0.000E+00	0.000E+00	0.508E+10	-0.218E+11	0.000E+00	0.200E+12	-0.158E+13
HO	0.412E+12	0.546E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.900E+12	0.190E+13
HSN	0.949E+13	0.556E+12	-0.217E+14	0.370E+12	-0.375E+14	-0.333E+15	-0.148E+14	-0.866E+14	-0.374E+15	-0.333E+14	-0.889E+15
A/S	0.043	0.984	0.000	-5.480	0.000	0.000	-0.002	0.000	0.000	-0.933	0.000
FS	86.4	9.6	-260.9	13.1	-309.4	-1515.0	-370.3	-330.4	-1555.0	-254.1	-687.3

AVERAGE TEMPERATURES AT 00H ON DAY390.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	2.97	2.99	3.40	2.12	2.04	2.77	1.89	0.78	2.66	2.08	2.25
20H	3.12	3.14	3.47	2.21	2.14	2.79	1.98	0.91	2.69	2.65	2.42
40H	3.40	3.38	3.55	3.38	2.72	2.92	3.32	1.67	2.77	3.20	2.86
60H	3.49	3.45	3.56	3.48	2.84	2.95	3.35	2.45	2.87	3.25	3.05
80H	3.57	3.57	3.58	3.51	2.96	3.02	3.43	3.37	3.10	3.46	3.22
BOT	3.62	3.64	3.56	3.64	3.63	3.30	3.57	3.63	3.39	3.43	3.38
TOT	3.36	3.38	3.54	3.01	2.55	3.07	2.89	1.48	3.09	3.89	3.00

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 383. TO 00H ON DAY 390.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.112E+14	-0.111E+14	-0.253E+14	-0.180E+13	-0.407E+14	-0.163E+15	-0.316E+13	-0.121E+14	-0.460E+14	-0.351E+14	-0.349E+15
QR	0.000E+00	0.000E+00	0.000E+00	-0.114E+13	0.000E+00	0.000E+00	0.708E+10	0.000E+00	0.000E+00	0.148E+12	-0.841E+12
HO	0.412E+12	0.543E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.893E+12	0.189E+13
HSN	-0.116E+14	-0.116E+14	-0.253E+14	-0.670E+12	-0.407E+14	-0.163E+15	-0.319E+13	-0.121E+14	-0.460E+14	-0.361E+14	-0.350E+15
A/S	-0.035	-0.047	0.000	1.685	0.000	0.000	-0.009	0.000	0.000	-0.029	-0.003
FS	-105.6	-200.9	-304.2	-23.7	-335.8	-741.6	-79.6	-46.2	-191.3	-275.8	-270.5

AVERAGE TEMPERATURES AT 00H ON DAY397.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	2.79	2.84	3.21	2.43	1.64	2.34	2.41	0.71	2.61	1.98	2.09
20M	2.83	2.93	3.25	1.87	1.74	2.37	2.50	0.84	2.63	2.54	2.23
40M	3.30	3.17	3.39	3.30	2.20	2.42	2.90	1.66	2.66	2.79	2.60
60M	3.41	3.18	3.40	3.31	2.38	2.48	2.94	2.26	2.74	2.86	2.77
90M	3.50	3.38	3.43	3.30	2.52	2.60	3.09	3.29	2.98	3.12	2.97
BOT	3.44	3.48	3.37	3.29	3.35	3.15	3.29	3.62	3.60	3.27	3.30
TOT	3.22	3.17	3.37	2.92	2.10	2.73	2.81	1.42	3.03	2.63	2.80

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 390. TO 00H ON DAY 397.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.125E+14	-0.118E+14	-0.257E+14	-0.186E+13	-0.408E+14	-0.154E+15	-0.266E+13	-0.870E+13	-0.310E+14	-0.353E+14	-0.325E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.263E+12	0.000E+00	0.000E+00	0.167E+11	-0.891E+13	0.000E+00	0.390E+12	0.630E+12
HO	0.389E+12	0.539E+12	0.000E+00	0.850E+10	0.650E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.893E+12	0.186E+13
HSN	-0.129E+14	-0.123E+14	-0.257E+14	-0.213E+13	-0.408E+14	-0.154E+15	-0.272E+13	-0.870E+13	-0.310E+14	-0.366E+14	-0.328E+15
A/S	-0.030	-0.044	0.000	-0.127	0.000	0.000	-0.014	0.001	0.008	-0.035	-0.008
FS	-117.4	-212.9	-389.0	-75.4	-336.6	-700.7	-67.9	-33.2	-126.9	-279.2	-253.3

AVERAGE TEMPERATURES AT 00H ON DAY404.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	2.29	2.32	2.78	1.87	1.22	2.17	1.83	0.82	2.36	1.50	1.83
20M	2.48	2.57	2.98	1.97	1.45	2.31	2.23	0.95	2.44	2.06	2.06
40M	2.80	2.72	3.12	2.92	1.77	2.38	2.64	1.53	2.52	2.47	2.39
60M	3.08	2.75	3.15	3.05	2.09	2.47	2.93	2.21	2.62	2.65	2.62
90M	3.24	3.16	3.21	3.14	2.62	2.62	3.02	3.02	2.83	2.91	2.85
BOT	3.25	3.23	3.21	3.15	3.14	3.06	3.16	3.40	3.25	3.17	3.17
TOT	2.85	2.80	3.13	2.65	1.76	2.68	2.63	1.41	2.88	2.55	2.64

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 397. TO 00H ON DAY 404.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.355E+14	-0.216E+14	-0.357E+14	-0.526E+13	-0.298E+14	-0.230E+14	-0.557E+13	-0.800E+12	-0.790E+14	-0.372E+14	-0.273E+15
QR	0.000E+00	0.000E+00	0.000E+00	-0.115E+13	0.000E+00	0.000E+00	0.360E+11	-0.653E+11	0.000E+00	0.383E+12	-0.452E+12
HO	0.362E+12	0.546E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.890E+12	0.184E+13
HSN	-0.359E+14	-0.221E+14	-0.357E+14	-0.412E+13	-0.290E+14	-0.230E+14	-0.563E+13	-0.739E+12	-0.790E+14	-0.385E+14	-0.274E+15
A/S	-0.010	-0.025	0.000	0.277	0.000	0.000	-0.010	0.083	0.000	-0.033	-0.005
FS	-326.7	-382.1	-429.3	-145.7	-265.9	-104.6	-140.5	-2.8	-328.5	-293.6	-212.1

AVERAGE TEMPERATURES AT 00H ON DAY 411.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	1.80	1.82	2.35	1.32	0.81	2.00	1.26	0.91	2.10	1.03	1.56
20H	2.13	2.21	2.71	2.05	1.16	2.23	1.95	1.03	2.23	1.60	1.87
40H	2.31	2.26	2.84	2.54	1.34	2.31	2.77	1.39	2.36	2.15	2.16
60H	2.75	2.33	2.90	2.80	1.80	2.44	2.89	2.13	2.68	2.44	2.46
90H	2.98	2.96	3.00	2.97	2.31	2.63	2.95	2.73	2.69	2.71	2.73
BOT	3.06	2.98	3.04	3.03	2.93	2.98	3.03	3.17	3.10	3.06	3.05
TOT	2.48	2.44	2.98	2.38	1.44	2.63	2.44	1.38	2.72	2.28	2.47

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 404, TO 00H ON DAY 411.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.347E+14	-0.212E+14	-0.354E+14	-0.527E+13	-0.291E+14	-0.270E+14	-0.593E+13	-0.330E+13	-0.810E+14	-0.368E+14	-0.280E+15
QR	0.000E+00	0.000E+00	0.000E+00	-0.142E+13	0.000E+00	0.000E+00	0.110E+11	-0.787E+11	0.000E+00	0.251E+12	-0.135E+13
HO	0.344E+12	0.542E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.890E+12	0.182E+13
HSN	-0.350E+14	-0.217E+14	-0.354E+14	-0.386E+13	-0.291E+14	-0.270E+14	-0.596E+13	-0.323E+13	-0.810E+14	-0.379E+14	-0.280E+15
A/S	-0.010	-0.025	0.000	0.366	0.000	0.000	-0.005	0.023	0.000	-0.030	-0.002
FS	-319.3	-375.1	-425.7	-136.4	-240.1	-122.8	-148.9	-12.3	-336.8	-289.5	-216.8

AVERAGE TEMPERATURES AT 00H ON DAY 418.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	1.59	1.59	2.08	0.91	0.82	1.54	1.00	0.54	1.57	0.84	1.22
20H	1.83	1.81	2.47	1.65	1.01	1.66	1.40	0.64	1.67	1.25	1.45
40H	2.25	1.94	2.56	2.28	1.20	1.73	2.07	0.89	1.79	1.81	1.73
60H	2.56	2.19	2.68	2.48	1.52	2.05	2.42	1.55	2.04	2.16	2.10
90H	2.81	2.84	2.83	2.81	2.17	2.45	2.72	2.26	2.49	2.53	2.54
BOT	2.96	2.87	2.97	3.04	2.74	2.92	3.02	2.88	3.03	2.95	2.97
TOT	2.31	2.22	2.72	2.09	1.29	2.36	2.00	0.93	2.45	2.04	2.21

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 411, TO 00H ON DAY 418.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.159E+14	-0.126E+14	-0.272E+14	-0.566E+13	-0.128E+14	-0.121E+15	-0.138E+14	-0.571E+14	-0.142E+15	-0.31E+14	-0.439E+15
QR	0.000E+00	0.000E+00	0.000E+00	-0.201E+13	0.000E+00	0.000E+00	0.255E+10	-0.655E+10	0.000E+00	0.746E+11	-0.219E+13
HO	0.339E+12	0.542E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.873E+12	0.186E+13
HSN	-0.162E+14	-0.131E+14	-0.272E+14	-0.366E+13	-0.128E+14	-0.121E+15	-0.139E+14	-0.571E+14	-0.142E+15	-0.323E+14	-0.439E+15
A/S	-0.021	-0.041	0.000	0.547	-0.001	0.000	-0.002	0.000	0.000	-0.029	0.001
FS	-147.9	-226.7	-327.1	-129.4	-105.6	-550.5	-346.0	-217.9	-590.4	-246.9	-339.0

AVERAGE TEMPERATURES AT 00H ON DAY425.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	1.40	1.39	1.83	0.58	0.83	1.12	0.79	0.22	1.10	0.70	0.93
20M	1.56	1.44	2.24	1.30	0.87	1.14	0.93	0.29	1.16	0.96	1.07
40M	2.19	1.63	2.30	2.05	1.08	1.20	1.43	0.44	1.27	1.50	1.34
60M	2.36	2.05	2.47	2.18	1.27	1.69	1.98	1.02	1.63	1.89	1.77
90M	2.62	2.72	2.66	2.64	2.04	2.28	2.50	1.82	2.30	2.36	2.36
BOT	2.81	2.76	2.89	3.02	2.57	2.86	2.99	2.47	2.96	2.84	2.90
TOT	2.14	2.01	2.54	1.82	1.16	2.12	1.60	0.53	2.20	1.83	1.97

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 418, TO 00H ON DAY 425.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.159E+14	-0.119E+14	-0.264E+14	-0.515E+13	-0.116E+14	-0.111E+15	-0.126E+14	-0.514E+14	-0.129E+15	-0.281E+14	-0.402E+15
QR	0.000E+00	0.000E+00	0.000E+00	-0.190E+13	0.000E+00	0.006E+00	0.270E+10	0.000E+00	0.000E+00	0.656E+11	-0.222E+13
HO	0.341E+12	0.543E+12	0.000E+00	0.850E+10	0.650E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.862E+12	0.179E+13
HSN	-0.162E+14	-0.124E+14	-0.264E+14	-0.318E+13	-0.115E+14	-0.111E+15	-0.126E+14	-0.514E+14	-0.129E+15	-0.290E+14	-0.402E+15
A/S	-0.021	-0.044	0.000	0.619	-0.001	0.000	-0.002	0.000	0.000	-0.032	0.001
FS	-168.0	-214.7	-317.5	-112.5	-95.8	-503.2	-314.0	-196.0	-936.3	-221.5	-310.4

AVERAGE TEMPERATURES AT 00H ON DAY432.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	1.55	1.50	1.98	1.42	0.98	1.46	1.47	0.59	1.54	1.39	1.29
20M	1.63	1.48	2.19	1.69	1.00	1.49	1.64	0.65	1.57	1.47	1.38
40M	1.93	1.62	2.24	2.09	1.15	1.54	1.74	0.84	1.64	1.67	1.55
60M	2.06	1.97	2.36	2.16	1.36	1.81	2.02	1.31	1.86	1.89	1.85
90M	2.29	2.55	2.53	2.40	2.04	2.28	2.30	2.06	2.37	2.31	2.34
BOT	2.68	2.78	2.77	2.62	2.63	2.88	2.67	2.64	3.02	2.87	2.92
TOT	1.98	1.97	2.46	1.99	1.25	2.23	1.87	0.89	2.37	2.02	2.09

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 425, TO 00H ON DAY 432.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.153E+14	-0.250E+13	-0.127E+14	0.335E+13	0.820E+13	0.526E+14	0.855E+13	0.459E+14	0.880E+14	0.249E+14	0.201E+15
QR	0.000E+00	0.000E+00	0.000E+00	-0.270E+12	0.000E+00	0.000E+00	0.449E+11	0.000E+00	0.000E+00	0.297E+12	-0.166E+12
HO	0.350E+12	0.538E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.855E+12	0.178E+13
HSN	-0.156E+14	-0.304E+13	-0.127E+14	0.361E+13	0.819E+13	0.526E+14	0.840E+13	0.459E+14	0.880E+14	0.237E+14	0.199E+15
A/S	-0.022	-0.177	0.000	-0.073	0.001	0.000	0.000	0.000	0.000	0.049	0.008
FS	-162.6	-52.4	-152.7	127.7	67.6	239.3	211.9	175.0	365.9	181.2	154.1

AVERAGE TEMPERATURES AT 00H ON DAY 439.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	1.71	1.60	2.13	2.25	1.13	1.80	2.14	0.96	1.97	2.06	1.66
20H	1.69	1.51	2.13	2.07	1.14	1.84	2.35	1.02	1.98	1.98	1.69
40H	1.68	1.61	2.19	2.14	1.22	1.87	2.04	1.23	2.00	1.85	1.77
60H	1.76	1.90	2.25	2.14	1.45	1.93	2.05	1.60	2.08	1.88	1.93
90H	1.96	2.39	2.40	2.17	2.04	2.26	2.11	2.30	2.44	2.26	2.31
BOT	2.55	2.63	2.66	2.22	2.68	2.89	2.35	2.80	3.07	2.90	2.96
TOT	1.82	1.93	2.38	2.16	.35	2.35	2.14	1.25	2.54	2.20	2.21

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL... FROM 00H ON DAY 432, TO 00H ON DAY 439.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.150E+14	-0.240E+13	-0.124E+14	0.332E+13	0.620E+13	0.520E+14	0.845E+13	0.458E+14	-0.870E+14	0.247E+14	0.199E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.230E+13	0.000E+00	0.000E+00	0.146E+12	0.362E+12	0.000E+00	0.156E+13	0.447E+13
HO	0.395E+12	0.533E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.847E+12	0.178E+13
HSN	-0.154E+14	-0.293E+13	-0.124E+14	0.101E+13	0.819E+13	0.520E+14	0.828E+13	0.455E+14	0.870E+14	0.223E+14	0.193E+15
A/S	-0.023	-0.182	0.000	2.273	0.001	0.000	0.020	0.008	0.300	0.168	0.032
FS	-139.9	-50.6	-169.1	35.9	67.6	236.6	206.9	173.4	361.7	170.1	149.0

AVERAGE TEMPERATURES AT 00H ON DAY 446.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	1.82	1.67	2.20	2.28	1.33	1.91	2.23	1.34	2.11	2.19	1.83
20H	1.79	1.66	2.20	2.13	1.35	1.92	2.26	1.39	2.12	2.16	1.85
40H	1.78	1.73	2.24	2.22	1.37	1.94	2.12	1.68	2.14	2.10	1.92
60H	1.85	1.89	2.27	2.23	1.53	1.98	2.13	1.88	2.19	2.12	2.03
90H	2.11	2.20	2.37	2.25	1.93	2.17	2.16	2.30	2.40	2.34	2.27
BOT	2.50	2.58	2.57	2.31	2.30	2.70	2.34	2.61	2.88	2.77	2.77
TOT	1.91	1.94	2.36	2.23	1.47	2.28	2.18	1.57	2.50	2.31	2.23

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL... FROM 00H ON DAY 439, TO 00H ON DAY 446.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	-0.930E+13	0.500E+12	-0.180E+13	0.241E+13	0.112E+14	-0.290E+14	0.153E+13	0.425E+14	-0.180E+14	0.151E+14	0.338E+14
QR	0.000E+00	0.000E+00	0.000E+00	0.497E+13	0.000E+00	0.000E+00	0.292E+12	0.844E+12	0.000E+00	0.165E+13	0.671E+13
HO	0.359E+12	0.521E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.830E+12	0.175E+13
HSN	0.894E+13	-0.206E+11	-0.180E+13	-0.357E+13	0.112E+14	-0.290E+14	0.122E+13	0.417E+14	-0.180E+14	0.126E+14	0.225E+14
A/S	0.040	*****	0.000	-1.395	0.001	0.000	0.258	0.020	0.000	0.196	0.464
FS	81.5	-0.4	-21.6	-126.4	92.3	-131.9	30.4	158.9	-74.8	96.3	-17.4

AVERAGE TEMPERATURES AT 00H ON DAY453.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	1.93	1.75	2.27	2.32	1.53	2.02	2.33	1.72	2.26	2.33	2.01
20M	1.89	1.80	2.27	2.21	1.56	2.01	2.18	1.75	2.27	2.34	2.02
40M	1.88	1.86	2.28	2.30	1.53	2.02	2.21	1.96	2.28	2.35	2.07
60M	1.93	1.89	2.30	2.32	1.63	2.03	2.22	2.16	2.30	2.35	2.13
90M	2.25	2.02	2.34	2.34	1.83	2.08	2.21	2.31	2.38	2.41	2.24
BOT	2.45	2.52	2.47	2.40	1.98	2.52	2.35	2.43	2.69	2.64	2.60
TOT	2.01	1.95	2.35	2.30	1.60	2.23	2.23	1.90	2.47	2.42	2.25

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 446. TO 00H ON DAY 453.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.960E+13	0.800E+12	-0.140E+13	0.151E+13	0.117E+14	-0.260E+14	0.171E+13	0.426E+14	-0.150E+14	0.153E+14	0.410E+14
QR	0.000E+00	0.000E+00	0.000E+00	0.688E+12	0.000E+00	0.000E+00	0.928E+11	0.220E+12	0.000E+00	0.112E+13	0.227E+13
HO	0.353E+12	0.513E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.785E+12	0.169E+13
HSN	0.925E+13	0.287E+12	-0.140E+13	0.813E+12	0.117E+14	-0.260E+14	0.160E+13	0.424E+14	-0.150E+14	0.134E+14	0.370E+14
A/S	0.038	1.784	0.000	0.857	0.001	0.000	0.071	0.005	0.000	0.142	0.107
FS	84.3	5.0	-16.8	28.7	96.4	-118.3	39.9	161.7	-62.4	102.2	-28.6

AVERAGE TEMPERATURES AT 00H ON DAY460.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	2.21	2.00	2.38	2.91	1.94	2.27	2.55	2.24	2.47	2.71	2.33
20M	2.16	2.03	2.37	2.54	1.85	2.28	2.60	2.22	2.48	2.58	2.30
40M	2.11	2.05	2.34	2.44	1.82	2.29	2.61	2.22	2.49	2.67	2.29
60M	2.11	2.09	2.37	2.44	1.91	2.31	2.61	2.36	2.52	2.66	2.34
90M	2.21	2.18	2.41	2.49	2.11	2.35	2.62	2.52	2.58	2.50	2.42
BOT	2.50	2.43	2.50	2.51	2.38	2.62	2.65	2.65	2.78	2.73	2.60
TOT	2.18	2.12	2.41	2.56	1.90	2.43	2.67	2.27	2.63	2.58	2.44

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 453. TO 00H ON DAY 460.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.165E+14	0.102E+14	0.950E+13	0.519E+13	0.204E+14	0.960E+14	0.770E+13	0.494E+14	0.840E+14	0.222E+16	0.329E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.480E+13	0.000E+00	0.006E+00	0.142E+12	0.770E+12	0.000E+00	0.134E+13	0.668E+13
HO	0.319E+12	0.526E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.614E+12	0.150E+13
HSN	0.162E+14	0.960E+13	0.950E+13	0.365E+12	0.284E+14	0.960E+14	0.754E+13	0.486E+14	0.840E+14	0.202E+14	0.321E+15
A/S	0.020	0.054	0.000	12.498	0.000	0.000	0.022	0.016	0.000	0.097	0.026
FS	167.4	167.0	114.2	13.6	234.2	436.6	168.2	185.5	349.3	154.5	268.0

AVERAGE TEMPERATURES AT 00H ON DAY467.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	2.70	2.63	2.70	3.75	2.35	2.68	3.13	2.66	2.64	3.10	2.72
20H	2.69	2.64	2.59	3.33	2.27	2.49	3.15	2.80	2.65	2.93	2.65
40H	2.51	2.33	2.55	2.74	2.14	2.47	2.59	2.57	2.66	2.60	2.53
60H	2.49	2.37	2.57	2.73	2.16	2.49	2.60	2.63	2.68	2.63	2.55
90H	2.53	2.39	2.59	2.73	2.33	2.52	2.61	2.72	2.72	2.66	2.60
BOT	2.61	2.54	2.60	2.68	2.57	2.72	2.63	2.78	2.86	2.83	2.78
TOT	2.57	2.60	2.59	3.02	2.24	2.58	2.78	2.72	2.76	2.80	2.65

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 460. TO 00H ON DAY 467.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.372E+14	0.166E+14	0.277E+14	0.922E+13	0.303E+14	0.700E+14	0.987E+13	0.590E+14	0.670E+14	0.303E+14	0.357E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.241E+12	0.000E+00	0.000E+00	0.260E+12	0.722E+12	0.000E+00	0.215E+13	0.483E+13
HO	0.275E+12	0.475E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.482E+12	0.127E+13
HSN	0.369E+14	0.161E+14	0.277E+14	0.997E+13	0.303E+14	0.700E+14	0.959E+13	0.583E+14	0.670E+14	0.277E+14	0.351E+15
A/S	0.007	0.029	0.000	0.028	0.000	0.000	0.029	0.012	0.000	0.095	0.017
FS	336.4	278.2	333.1	317.2	269.9	318.5	239.5	222.4	278.6	211.2	271.2

AVERAGE TEMPERATURES AT 00H ON DAY474.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	3.20	2.86	3.03	4.60	2.78	2.69	3.72	3.48	2.81	3.65	3.12
20H	3.22	2.85	2.82	4.14	2.70	2.76	3.69	3.37	2.82	3.28	3.01
40H	2.90	2.61	2.76	3.04	2.45	2.65	2.77	2.93	2.82	2.89	2.77
60H	2.87	2.66	2.77	3.02	2.46	2.67	2.78	2.90	2.84	2.80	2.76
90H	2.86	2.59	2.78	2.98	2.56	2.69	2.79	2.92	2.87	2.82	2.78
BOT	2.72	2.66	2.71	2.86	2.75	2.82	2.82	2.90	2.95	2.93	2.87
TOT	2.97	2.69	2.78	3.49	2.57	2.73	3.09	3.18	2.88	3.02	2.86

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 467. TO 00H ON DAY 474.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.378E+14	0.169E+14	0.281E+14	0.934E+13	0.304E+14	0.690E+14	0.994E+13	0.593E+14	0.660E+14	0.307E+14	0.357E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.356E+12	0.000E+00	0.000E+00	0.529E+11	0.308E+12	0.000E+00	0.132E+13	0.145E+13
HO	0.245E+12	0.474E+12	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.460E+12	0.124E+13
HSN	0.376E+14	0.164E+14	0.281E+14	0.898E+13	0.304E+14	0.690E+14	0.987E+13	0.590E+14	0.660E+14	0.289E+14	0.354E+15
A/S	0.007	0.029	0.000	0.041	0.000	0.000	0.008	0.005	0.000	0.062	0.008
FS	342.2	283.4	307.9	317.4	250.7	313.5	246.4	225.1	274.4	220.6	273.8

AVERAGE TEMPERATURES AT 03H ON DAY 481.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	3.71	3.30	3.36	5.65	3.19	2.90	4.31	4.10	2.99	4.12	3.52
20H	3.75	3.26	3.04	4.95	3.12	2.91	4.23	3.95	2.99	3.64	3.37
40H	3.29	2.88	2.97	3.35	2.77	2.84	2.95	3.28	2.99	3.10	3.01
60H	3.25	2.95	2.97	3.31	2.73	2.84	2.96	3.16	3.00	2.98	2.97
90H	3.19	2.80	2.97	3.23	2.78	2.85	2.98	3.12	3.01	2.99	2.95
BOT	2.83	2.78	2.83	3.04	2.93	2.92	3.00	3.02	3.03	3.03	2.97
TOT	3.36	2.97	2.96	3.96	2.90	2.88	3.40	3.63	3.01	3.25	3.07

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 474, TO 00H ON DAY 481.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.378E+14	0.168E+14	0.282E+14	0.934E+13	0.304E+14	0.690E+14	0.997E+13	0.592E+14	0.670E+14	0.306E+14	0.358E+15
QR	0.000E+00	0.000E+00	0.000E+00	-0.237E+13	0.600E+00	0.000E+00	0.772E+11	0.761E+12	0.089E+00	0.168E+13	-0.302E+13
HO	0.466E+11	0.636E+11	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.254E+11	0.178E+12
HSN	0.378E+14	0.167E+14	0.282E+14	0.117E+14	0.304E+14	0.690E+14	0.987E+13	0.584E+14	0.670E+14	0.289E+14	0.361E+15
A/S	0.001	0.004	0.000	-0.202	0.000	0.000	0.010	0.013	0.000	0.059	-0.008
FS	344.0	268.8	339.1	413.7	250.7	313.9	246.5	223.0	276.6	220.5	278.9

AVERAGE TEMPERATURES AT 00H ON DAY 480.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	4.22	3.74	3.70	6.31	3.64	3.13	4.92	4.74	3.18	4.61	3.93
20H	4.28	3.68	3.27	5.74	3.56	3.12	4.77	4.53	3.17	3.99	3.73
40H	3.69	3.16	3.19	3.65	3.09	3.02	3.14	3.63	3.16	3.31	3.25
60H	3.62	3.24	3.17	3.59	3.01	3.02	3.14	3.43	3.16	3.15	3.17
90H	3.52	3.00	3.16	3.47	3.00	3.02	3.16	3.31	3.15	3.15	3.13
BOT	2.94	2.90	2.94	3.22	3.10	3.02	3.18	3.14	3.12	3.13	3.06
TOT	3.76	3.26	3.15	4.42	3.24	3.03	3.72	4.09	3.14	3.47	3.28

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 481, TO 00H ON DAY 488.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.376E+14	0.169E+14	0.284E+14	0.926E+13	0.309E+14	0.700E+14	0.100E+14	0.600E+14	0.680E+14	0.368E+14	0.362E+15
QR	0.000E+00	0.020E+00	0.000E+00	-0.281E+13	0.000E+00	0.000E+00	0.115E+12	0.399E+12	0.000E+00	0.125E+13	-0.562E+13
HO	0.466E+11	0.636E+11	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.254E+11	0.178E+12
HSN	0.376E+14	0.168E+14	0.284E+14	0.121E+14	0.309E+14	0.700E+14	0.986E+13	0.596E+14	0.680E+14	0.295E+14	0.367E+15
A/S	0.001	0.004	0.000	-0.232	0.000	0.000	0.014	0.007	0.000	0.043	-0.015
FS	342.1	290.5	341.5	426.5	254.8	318.5	246.3	227.4	282.7	225.3	284.0

AVERAGE TEMPERATURES AT 00H ON DAY495.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	5.21	4.53	4.47	7.33	4.30	3.87	5.96	6.04	4.00	5.63	4.91
20H	4.76	4.10	3.68	6.04	4.25	3.58	5.22	5.20	3.57	4.30	4.22
40H	3.99	3.49	3.43	3.86	3.42	3.30	3.46	4.01	3.39	3.47	3.52
60H	3.72	3.47	3.34	3.71	3.23	3.23	3.35	3.63	3.34	3.30	3.36
90H	3.60	3.19	3.30	3.56	3.20	3.20	3.32	3.45	3.30	3.29	3.29
BOT	3.11	3.08	3.11	3.34	3.22	3.17	3.32	3.26	3.24	3.25	3.20
TOT	4.10	3.59	3.39	4.76	3.77	3.28	4.12	4.74	3.36	3.76	3.58

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS.

TIME INTERVAL....FROM 00H ON DAY 488, TO 00H ON DAY 495.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.327E+14	0.197E+14	0.366E+14	0.675E+13	0.480E+14	0.113E+15	0.130E+14	0.854E+14	0.112E+15	0.392E+14	0.507E+15
QR	0.000E+00	0.000E+00	0.000E+00	-0.126E+13	0.000E+00	0.000E+00	0.737E+11	0.321E+12	0.000E+00	0.151E+13	-0.247E+13
HO	0.466E+11	0.636E+11	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.254E+11	0.170E+12
HSN	0.327E+14	0.196E+14	0.366E+14	0.800E+13	0.480E+14	0.113E+15	0.129E+14	0.851E+14	0.112E+15	0.377E+14	0.509E+15
A/S	0.001	0.003	0.000	-0.157	0.000	0.000	0.007	0.004	0.000	0.041	-0.004
FS	297.5	338.8	440.1	283.0	395.8	514.1	322.3	324.6	465.7	287.5	393.6

AVERAGE TEMPERATURES AT 00H ON DAY502.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10H	6.19	5.31	5.24	8.36	6.15	4.60	7.01	7.35	4.82	6.66	5.90
20H	5.24	4.52	4.09	6.34	4.95	4.03	5.66	5.87	3.97	4.77	4.71
40H	4.29	3.82	3.67	4.08	3.75	3.59	3.78	4.39	3.63	3.62	3.80
60H	3.82	3.69	3.51	3.82	3.46	3.45	3.56	3.82	3.52	3.46	3.54
90H	3.69	3.37	3.45	3.65	3.40	3.38	3.48	3.58	3.45	3.43	3.44
BOT	3.28	3.25	3.28	3.46	3.35	3.32	3.46	3.39	3.36	3.37	3.34
TOT	4.44	3.93	3.63	5.10	4.30	3.52	4.53	5.40	3.57	4.05	3.88

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS.

TIME INTERVAL....FROM 00H ON DAY 495, TO 00H ON DAY 502.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.326E+14	0.198E+14	0.366E+14	0.671E+13	0.479E+14	0.114E+15	0.130E+14	0.854E+14	0.112E+15	0.393E+14	0.507E+15
QR	0.000E+00	0.000E+00	0.000E+00	-0.125E+13	0.003E+00	0.000E+00	0.705E+11	0.269E+12	0.000E+00	0.114E+13	-0.497E+13
HO	0.466E+11	0.636E+11	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.254E+11	0.170E+12
HSN	0.326E+14	0.197E+14	0.366E+14	0.796E+13	0.479E+14	0.114E+15	0.129E+14	0.851E+14	0.112E+15	0.381E+14	0.512E+15
A/S	0.001	0.003	0.000	-0.157	0.000	0.000	0.007	0.003	0.000	0.331	-0.009
FS	296.6	340.5	440.1	281.3	395.0	518.7	322.4	324.8	465.7	291.0	395.6

AVERAGE TEMPERATURES AT 00H ON DAY509.

	1	2	3	4	5	6	7	8	9	10	11
ZONE NUMBER (11=TOTAL)											
10H	7.18	6.10	6.01	9.38	7.41	5.34	8.06	8.65	5.64	7.68	6.88
20H	5.72	4.94	4.51	6.65	5.65	4.69	6.11	6.54	4.38	5.16	5.21
40H	4.58	4.16	3.91	4.29	4.08	3.87	4.09	4.77	3.86	3.78	4.08
60H	3.93	3.92	3.68	3.94	3.69	3.66	3.77	4.02	3.70	3.61	3.73
90H	3.78	3.56	3.60	3.73	3.60	3.57	3.64	3.72	3.68	3.57	3.60
BOT	3.45	3.42	3.45	3.58	3.47	3.48	3.60	3.51	3.49	3.49	3.48
TOT	4.78	4.27	3.87	5.44	4.83	3.77	4.94	6.05	3.78	4.34	4.18

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 502. TO 00H ON DAY 509.

	1	2	3	4	5	6	7	8	9	10	11
ZONE NUMBER (11=TOTAL)											
HSD	0.326E+14	0.197E+14	0.365E+14	0.680E+13	0.480E+14	0.113E+15	0.130E+14	0.854E+14	0.112E+15	0.392E+14	0.507E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.342E+12	0.000E+00	0.000E+00	0.466E+11	0.458E+11	0.000E+00	0.793E+12	-0.469E+13
HO	0.466E+11	0.636E+11	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.254E+11	0.176E+12
HSN	0.326E+14	0.196E+14	0.365E+14	0.645E+13	0.480E+14	0.113E+15	0.129E+14	0.854E+14	0.112E+15	0.384E+14	0.512E+15
A/S	0.001	0.083	0.000	0.054	0.000	0.000	0.005	0.031	0.000	0.021	-0.003
FS	296.6	338.8	438.3	228.1	395.8	514.1	323.0	325.7	465.7	292.9	395.3

AVERAGE TEMPERATURES AT 00H ON DAY516.

	1	2	3	4	5	6	7	8	9	10	11
ZONE NUMBER (11=TOTAL)											
10H	6.16	6.89	6.78	10.41	8.67	6.08	9.10	9.96	6.46	8.70	7.86
20H	6.20	5.36	4.92	6.95	6.34	4.95	6.55	7.21	4.78	5.55	5.70
40H	4.88	4.49	4.15	4.51	4.42	4.16	4.41	5.15	4.09	3.94	4.35
60H	4.03	4.15	3.84	4.05	3.91	3.67	3.98	4.21	3.68	3.76	3.91
90H	3.86	3.74	3.74	3.82	3.80	3.75	3.79	3.85	3.75	3.70	3.76
BOT	3.62	3.60	3.62	3.70	3.59	3.63	3.74	3.63	3.61	3.62	3.63
TOT	5.13	4.60	4.11	5.78	5.36	4.01	5.35	6.71	4.00	4.63	4.48

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 509. TO 00H ON DAY 516.

	1	2	3	4	5	6	7	8	9	10	11
ZONE NUMBER (11=TOTAL)											
HSD	0.326E+14	0.197E+14	0.366E+14	0.670E+13	0.480E+14	0.114E+15	0.130E+14	0.854E+14	0.112E+15	0.392E+14	0.506E+15
QR	0.000E+00	0.000E+00	0.000E+00	0.337E+13	0.000E+00	0.000E+00	0.713E+11	0.553E+12	0.000E+00	0.115E+13	-0.233E+13
HO	0.466E+11	0.636E+11	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.254E+11	0.176E+12
HSN	0.326E+14	0.196E+14	0.366E+14	0.332E+13	0.480E+14	0.114E+15	0.129E+14	0.848E+14	0.112E+15	0.380E+14	0.508E+15
A/S	0.001	0.083	0.000	1.015	0.000	0.000	0.007	0.007	0.000	0.031	-0.004
FS	296.6	338.8	440.1	117.6	395.8	518.7	322.4	323.7	465.7	290.2	392.7

AVERAGE TEMPERATURES AT 00H ON DAY523.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	9.16	7.69	7.58	11.45	9.93	6.64	10.16	11.27	7.31	9.74	8.86
20M	6.68	5.79	5.33	7.26	7.04	5.41	7.00	7.89	5.19	5.94	6.20
40M	5.18	4.82	4.38	4.71	4.74	4.44	4.72	5.53	4.32	4.09	4.63
60M	4.13	4.37	4.01	4.16	4.14	4.08	4.19	4.40	4.05	3.91	4.10
90M	3.95	3.93	3.89	3.91	4.00	3.93	3.95	3.99	3.90	3.64	3.91
BOT	3.79	3.77	3.79	3.92	3.72	3.78	3.88	3.75	3.73	3.74	3.76
TOT	5.67	4.94	4.36	6.12	5.89	4.26	5.76	7.36	4.21	4.92	4.77

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 516. TO 00H ON DAY 523.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.327E+14	0.199E+14	0.366E+14	0.680E+13	0.479E+14	0.113E+15	0.131E+14	0.857E+14	0.112E+15	0.334E+14	0.508E+15
QR	-0.000E+00	0.000E+00	0.000E+00	0.177E+13	0.000E+00	0.000E+00	0.115E+12	0.445E+12	0.300E+00	0.157E+13	-0.611E+13
HO	0.466E+11	0.636E+11	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.300E+00	0.254E+11	0.178E+12
HSN	0.327E+14	0.198E+14	0.366E+14	0.502E+13	0.479E+14	0.113E+15	0.130E+14	0.853E+14	0.112E+15	0.378E+14	0.514E+15
A/S	0.001	0.003	0.000	0.354	0.000	0.000	0.011	0.035	0.300	0.342	-0.012
FS	297.5	342.2	440.1	177.5	395.0	514.1	23.8	325.3	465.7	258.5	397.2

AVERAGE TEMPERATURES AT 00H ON DAY530.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
10M	11.14	10.12	10.15	13.51	11.78	9.64	11.96	13.05	9.92	11.61	11.10
20M	7.21	6.78	6.08	8.09	7.60	6.02	7.92	9.10	5.98	5.83	7.01
40M	5.09	4.87	4.42	4.57	4.83	4.43	4.67	5.71	4.36	4.15	4.67
60M	4.12	4.30	4.00	4.10	4.17	4.17	4.14	4.40	4.05	3.93	4.09
90M	3.93	3.93	3.68	3.91	3.99	3.62	3.95	3.98	3.30	3.86	3.91
BOT	3.79	3.78	3.80	3.94	3.70	3.79	3.87	3.67	3.74	3.75	3.77
TOT	5.83	5.40	4.62	6.60	6.36	4.45	6.20	8.18	4.44	5.29	5.10

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL....FROM 00H ON DAY 523. TO 00H ON DAY 530.

	ZONE NUMBER (11=TOTAL)										
	1	2	3	4	5	6	7	8	9	10	11
HSD	0.345E+14	0.269E+14	0.406E+14	0.960E+13	0.431E+14	0.107E+15	0.130E+14	0.106E+15	0.121E+15	0.514E+14	0.554E+15
QR	-0.000E+00	0.000E+00	0.000E+00	0.137E+12	0.000E+00	0.000E+00	0.108E+12	0.633E+12	0.000E+00	0.186E+13	-0.103E+14
HO	0.466E+11	0.636E+11	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.300E+00	0.254E+11	0.178E+12
HSN	0.345E+14	0.268E+14	0.406E+14	0.945E+13	0.431E+14	0.107E+15	0.137E+14	0.106E+15	0.121E+15	0.435E+14	0.564E+15
A/S	0.001	0.002	0.000	0.015	0.000	0.000	0.009	0.006	0.060	0.036	-0.015
FS	313.9	463.0	488.2	334.3	355.4	486.6	361.4	403.2	503.1	377.9	436.0

AVERAGE TEMPERATURES AT 00H ON DAY 537.

	1	2	3	4	ZONE NUMBER (11=TOTAL)			7	8	9	10	11
					5	6						
10M	13.12	12.56	12.72	15.56	13.53	12.43	13.76	14.83	12.54	13.49	13.34	
20M	7.75	7.77	6.63	8.92	8.16	6.64	8.83	10.31	6.78	7.72	7.62	
40M	5.01	4.92	4.46	4.43	4.91	4.43	4.62	5.90	4.39	4.22	4.70	
60M	4.11	4.23	4.00	4.03	4.21	4.05	4.10	4.41	4.05	3.96	4.09	
90M	3.91	3.93	3.88	3.91	3.98	3.92	3.94	3.98	3.91	3.87	3.91	
BOT	3.79	3.80	3.81	3.87	3.69	3.79	3.86	3.60	3.74	3.75	3.77	
TOT	6.19	5.86	4.89	7.08	6.83	4.72	6.63	9.00	4.68	5.67	5.43	

HEAT CONTENT CHANGES DUE TO SURFACE FLUXES AND ADVECTIVE COMPONENTS

TIME INTERVAL,...,FROM 00H ON DAY 530, TO 00H ON DAY 537.

	1	2	3	4	ZONE NUMBER (11=TOTAL)			7	8	9	10	11
					5	6						
HSD	0.345E+14	0.276E+14	0.406E+14	0.950E+13	0.430E+14	0.106E+15	0.139E+14	0.106E+15	0.121E+15	0.514E+14	0.553E+15	
OR	0.000E+00	0.000E+00	0.000E+00	0.398E+13	0.009E+00	0.000E+00	0.439E+11	0.225E+12	0.000E+00	0.111E+13	-0.128E+14	
HO	0.466E+11	0.636E+11	0.000E+00	0.850E+10	0.850E+10	0.000E+00	0.212E+11	0.420E+10	0.000E+00	0.254E+11	0.178E+12	
HSN	0.345E+14	0.269E+14	0.406E+14	0.551E+13	0.430E+14	0.106E+15	0.138E+14	0.106E+15	0.121E+15	0.503E+14	0.566E+15	
A/S	0.001	0.002	0.000	0.723	0.000	0.000	0.005	0.002	0.000	0.023	-0.022	
FS	313.9	464.8	488.2	195.0	354.6	482.3	345.5	403.6	503.1	383.6	437.2	

TABLES 1 to 12

Table 1. Summary of parameters relevant to the accuracy of estimates of heat content based on ship cruises.

1 Cruise No.	2 Central Time Duration	3 Ships	4 Stations Sampled	5 Peak Wind Stress	6 Heat Content 10^{18} calories w.r.t. 0°C	7 Errors	8 Remarks
1	6/4/72, 97 (82)	L,PD	90	E,2, 5/4/72	2.696	1 (244)	
2	11/4/72, 103 (48)	L,PD	91	E,2, 5/4/72	2.785	1 (196)	
3	18/4/72, 110 (66)	L,PD	84	SW,1, 16/4/72	3.121	1 (321)	
4	25/4/72, 117 (50)	L,PD	83	W,3, 22/4/72	3.421	1 (285)	
5	2/5/72, 124 (50)	L,PD	93	SW,1,2/5/72	3.975	1 (363)	
6	9/5/72, 131 (50)	L,PD	93	SE,1, 10/5/72	4.322	1 (305)	
7	16/5/72, 138 (64)	R,A	74	SE,1, 10/5/72	4.683	1, 2 (374)	
8	25/5/72, 146 (69)	A	65	W,1, 25/5/72	5.836	1, 2 (686)	
9	1/6/72, 153 (56)	R, A	58	W,1, 25/5/72	6.357	1, 2 (463)	
10	7/6/72, 159 (47)	L,PD	93	light winds	6.935	1 (428)	
11	14/6/72, 166 (91)	R,A	81	SE, 1.5, 14/6/72	7.360	1,2,3,4 (497)	

Table 1. (Cont.)

1 Cruise No	2 Central Time Duration	3 Ships	4 Stations Sampled	5 Peak Wind Stress	6 Heat Content 10^{18} calories w.r.t. 0°C	7 Errors	8 Remarks
88	12	21/6/72, 173 (80)	R	59	S,2, 22/6/72	8.068	1,2,3,4 (666)
	13	28/6/72, 180 (91)	R,A	51	S,2, 22/6/72	8.740	1,2,3,4 (728)
	14	6/7/72, 188 (50)	R,A	93	W, 1.3, 30/6/72	9.473	1 (463)
	15	18/7/72, 201 (53)	R,A	91	Light Winds	10.368	1 (438)
	16	2/8/72, 215 (80)	R,A	87	light winds	11.382	1, 3 (557)
	17	15/8/72, 229 (47)	R,A	90		11.790	1, 4 (368)
	18	29/8/72, 243 (44)	R,A	92	light winds	12.318	1, 4 (394)
	19	6/9/72, 251 (44)	R,A	88	light winds	12.431	1,2 (334)
	20	13/9/72, 257 (74)	R,A	90	light winds	12.499	1, 3 (331)
	21	19/9/72, 264 (50)	R,A	93	NE,1, 15/9/72	12.643	1, 4 (324)
	22	26/9/72, 271 (43)	R,A	89	high winds	12.505	1, 4 (310)

Table 1. (Cont.)

1 Cruise No	2 Central Time Duration	3 Ships	4 Stations Sampled	5 Peak Winds Stress	6 Heat Content 10^{18} calories w.r.t. 0°C	7 Errors	8 Remarks
23	5/10/72, 279 (58)	MK, PD	92	light winds	12.004	1 (419)	
24	12/10/72, 286 (64)	R, A	87	SE, 2, 8/10/75	11.753	1, 4 (354)	First fall storm
25	18/10/72, 292 (62)	R, A	93	NE, 2, 16/10/72	10.945	1, 4 (609)	Big upwelling
26	26/10/72, 300 (43)	R, A	93	light winds	10.864	1, 4 (243)	Relaxation of upwelling
27	1/11/72, 307 (87)	R	57	W, 1.25, 30/10/72	10.649	1, 2, 3, 4 (388)	major adjustments large scale features
28	7/11/72, 313 (43)	R, A	87	W, 1.5, 7/11/72 S, 2, 8/11/72	10.444	1, 2, 3, 4 (273)	very unsteady
29	14/11/72, 320 (61)	R.A.	82	SW, 3, 14/11/72	10.129	1, 2, 3, 4 (324)	
30	21/11/72, 326 (62)	R, A	90	SW, 3, 14/11/72	9.630	1, 2, 3, 4 (414)	Considerable evolution large scale features
31	28/11/72, 334 (62)	R, A	91	NE, 4.2, 27/11/72	9.305	1, 2, 3, 4 (282)	
32	7/12/72, 342 (75)	L, PD	93	SW, 2.5, 4/12/72 E, 2, 6/12/72	8.493	1, 3 (498)	overtur
33	13/12/72, 348 (73)	L, PD	89	NE, 2.5, 12/12/72	8.203	1 (319)	

Table 1. (Cont.)

1 Cruise No	2 Central Time Duration	3 Ships	4 Stations Sampled	5 Peak Winds Stress	6 Heat Content 10^{18} calories w.r.t. 0°C	7 Errors	8 Remarks
34	19/12/72, 353 (40)	L, PD	56	NE, 3, 18/12/72	7.419	1, 2 (486)	partial survey
35	4/1/73, 370 (51)	L, PD	51	W, 3, 30/12/72 NE, 3, 1/1/73 NE, 3, 4/1/73 W, 3, 5/1/73	6.687	1, 2 (316)	
36	9/1/73, 377 (51)	L, PD	27	W, 3, 5/1/73	(6.343)		incomplete
37	17/1/73, 383 (70)	L, PD	81	NE, 2.5, 15/1/73	5.364	1 (496)	Winter Thermal Bar
38	30/1/73, 397 (59)	L, PD	40	3, 2, 29/1/73 NE, 2, 30/1/73 W, 2.5, 31/1/73	4.733	1, 2 (372)	Partial coverage due to ice, breakdowns
39	13/2/73, 411 (48)	L	47		4.195	1, 2 (320)	ice cover east end
40	27/2/73, 425 (46)	L	46	SW, 1.5, 27/2/73	3.323	1, 2 (372)	winter thermocline minimum heat content
41	13/3/73, 439 (55)	L, PD	91	SW, 1.5, 14/3/73	3.734	1, 2 (240)	
42	27/3/73, 453 (50)	L, PD	93		3.799	1 (171)	
43	4/4/73, 460 (73)	PD	93	SW, 3.5, 1/4/73	4.147	1, 2 (321)	

Table 1. (Cont.)

1 Cruise No	2 Central Time Duration	3 Ships	4 Stations Sampled	5 Peak Winds Stress	6 Heat Content 10^{18} calories w.r.t. 0°C	7 Errors	8 Remarks
44	1/5/73, 489 (51)	PD	60	SW, 2, 2/5/73	5.557	1, 2 (333)	Thermal bar
45	5/6/73, 523 (57)	L	61		8.099	1, 2 (454)	
46	27/6/73, 545 (54)	L	62		9.839	1, 2 (479)	full stratification

Column 1: Sequential cruise number.

Column 2: Central date of cruise: day/month/year,
Julian Day commencing January 1, 1972.
Duration of cruise in hours (bracketed figure).

Column 3: Ships taking part in the cruise

L C.S.S. Limnos
PD C.C.G.S. Porte Dauphine
MK M.V. Martin Karlsen
R N.O.A.A. Ship Researcher
A Cape Fear Technical Institute ship
Advance II

Column 4: Number of stations sampled.

Column 5: Peak Wind Stress (Dynes/cm² computed with constant drag coefficient of 0.003) in ten day interval prior to the cruise. Letters refer to octant to which the stress is directed. Central figure of group is peak stress (daily average) in dynes/cm², date refers to day on which peak wind stress occurred (day, month, year).

Column 6: Heat content of lake in 10^{18} calories with respect to 0°C .

Column 7: Code denoting quality of synoptic picture of lake thermal structure and associate computations.

1. Residual errors (instrument, random interval waves) only.
2. Possibility of error due to faulty distribution of samples (omitted stations).
3. Possibility of errors due to prolonged cruise duration.
4. Possibilities of errors due to ongoing large-scale readjustment of lake thermal structure.

Figure in brackets: Standard deviation (error) in cal/cm² based on number of stations sampled, duration of cruise and rate of heat transfer.

Column 8: Remarks

Table 2. Data defining 10 zones of Lake Ontario. Each zone is defined by shoreline and straight lines drawn on a polyconic projection between the points labelled in Figure 3.

(a) Areas of zones (km^2) and list of points defining zone boundaries

Zone	Area km^2	Boundary Points
1	1568	A D
2	828	A BEF
3	1188	BCFG
4	404	CDGH
5	1732	EFJNM
6	3140	FJNOKG
7	572	GKOPH
8	3744	MNOTU
9	3436	NOTSRO
10	1872	ORSTUP

(b) Positions of boundary points (see Figure 3)

Boundary Point	Latitude (Degrees North)	Longitude (Degrees West)
A	43° 37.4'	79° 21.8'
B	43° 31'	79° 19'
C	43° 19'	79° 14'
D	43° 13.9'	79° 11.9'
E	43° 51.3'	78° 51.2'
F	43° 44'	78° 49'
G	43° 26'	78° 44'
H	43° 20.4'	78° 42.5'
J	43° 49.5'	78° 02.5'
K	43° 27'	78° 00'
M	44° 01.3'	77° 39.5'
N	43° 50'	77° 41'
O	43° 27'	77° 44'
P	43° 20.1'	77° 44.9'
Q	43° 47'	76° 49.5'
R	43° 25'	76° 57'
S	43° 32'	76° 38'
T	43° 41'	76° 26'
U	43° 41'	76° 12'

Table 3. Sources of random error appearing in heat content computations.
 Figures quoted are errors of the mean value of 100 samples
 (stations) drawn from the same population.

Source of error	Standard Deviation (cal/cm ²)	
	Summer Full Stratification	Winter Negligible Stratification
Internal Waves	± 132	± 50
Instrument errors	± 200	± 100
Digitization	± 50	± 25
Computation (ZØØP)	± 160	± 100
Total (root sum of squares)	±290 cal/cm ²	±150 cal/cm ²

Table 4. Monthly mean values of surface heat flux, advected flux, heat flux due to precipitation , and effective heat flux due to ice formation and melt for the period April 1972 to June 1973.

Month	Surface Heat Flux cal/cm ² /day	Rivers Power Plants cal/cm ² /day	Rain & Snow cal/cm ² /day	Ice cal/cm ² /day	(2)+(3)+(4) as% of (1) (absolute values)
Apr 72	280	4	-2		<1
May	440	0	3		<1
June	480	0	6		1.2
July	430	6	5		2.6
Aug	220	-6	6		<1
Sept	100	-11	5		6.0
Oct	-200	-6	1		2.5
Nov	-260	4	-5		<1
Dec	-400	6	-14		2.0
Jan 73	-340	4	-6	6	<1
Feb	-260	0	-8	14	2.3
Mar	+40	4	-1	-20	<u>42.5</u>
Apr	+280	3	1		1.4
May	+380	-2	3		<1
June	+420	-4	4		<1

Table 5. List of tributaries to Lake Ontario for which temperature data was obtained.

River	Source of Data	Index (see Table 6)
Moira	CCIW	1
Trent	CCIW	7
Ganaraska	CCIW	3
Humber	CCIW - GLI	4
Credit	CCIW	5
Niagara	Ontario Hydro	6
St. Lawrence	U.S. Geological Survey	7
Genessee	U.S. Geological Survey	8
Black	U.S. Geological Survey	9
Bay of Quinte outflow	Ontario M.O.E. (D. A. Hurley)	10

Table 6. List of tributaries to Lake Ontario for which flow data was obtained. The list is organized by zone (see Figure 3). The table gives the drainage area of each zone, the drainage area of each of the tributaries, and the source of temperature data applied to each tributary.

Zone No	Total Drainage Area of Zone km ²	Tributaries	Drainage Area Gauged Flow km ²	Temperature Data (see Table 5)
1	5589	Spencer Creek Grindstone Twenty mile Credit Oakville East Oakville Etobicoke Mimico Humber Black	166 78 293 829 98 199 197 62 800 <u>57</u> 2717	5 5 5 5 5 5 4 4 4 5
2	1453	Don Duffin Highland Rouge Little Rouge Lynde	287 285 88 202 78 <u>106</u> 1046	4 4 3 3 3 3
5	1052	Oshawa Wilmot Bowmanville Ganaraska Soper Shelter V.	111 83 83 264 78 <u>65</u> 762	3 3 3 3 3 3
4	665 km ²	Niagara	see note 1	5
7	2157		see note 2	8
10	24154	Genessee Allen Sterling Oswego	6364 80 114 <u>13203</u> 19761	8 8 8 8

Table 6. (Cont.)

Zone	Total Drainage Area of zone Km ²	Tributaries	Drainage Area Gauged Flow Km ²	Temperature Data (See Table 5)
8 U.S. side	6962	Sandy Black	331 <u>4859</u> 5190	9 9
8 Can. Side	20161	Trent Moira Salmon Napanee Weton	12043 2616 891 777 111 16438	10 10 10 10 1
8 St. Lawrence outflow	7189	Oswegatchie	2520 see note 3	9

Note 1

The runoff from 665 km² of land in zone 4 is added to the discharge from the Niagara River and the Welland Canal system. Runoff data and temperature data from zone 1 are applied to this area.

Note 2

Runoff figures for zone 1 and temperatures from the Genesee river are applied to this zone.

Note 3

The gauging station for the St. Lawrence outflow is located at Cornwall, Ontario, downstream from Wolfe Island, the assumed outlet. Drainage from 7189 km² flows to the St. Lawrence between Wolfe Island and Cornwall. The Oswegatchie River flow data and temperatures from the Black River are employed to calculate the heat flow from this region (718.9 km²) which is then subtracted from the St. Lawrence Figures based on Cornwall data to yield the effective outflow of heat at Wolfe Island.

Table 7. List of major electrical power plants rejecting heat to Lake Ontario during 1972-73.

Name	Utility	Location	Zone	Type	Capacity MW
Beebee	Rochester Gas and Electric	Rochester	10	Fossil	222
Russel	"	"	10	"	282
Ginna	"	"	10	Nuclear	470
J.A. Fitzpatrick	Power Authority State of N.Y.	Oswego	10	Nuclear	850
Oswego	Niagara Mohawk Power Co.	Oswego	10	Fossil	407
Nine Mile Point	"	Oswego	10	Nuclear	650
Pickering	Ontario Hydro	Pickering	2	Nuclear	2000
Manby	Ontario Hydro	Toronto	2	Fossil	65
Hearn	Ontario Hydro	Toronto	2	Fossil	1200
Lakeview	Ontario Hydro	Port Credit	1	Fossil	2400

Table 8. Estimates of heat rejected to Lake Ontario from sewer outfalls and industrial processes.

Zone	Heat Rejected from Sewers and manufacturing activities calories/week
1	.466 x 10^{14}
2	.636
5	.085
8	.042
10	.254
7	.212
4	.085
Total	1.78×10^{14} cal/week
On a lake-wide basis this amounts to about 1 cal/cm ² /week which is completely negligible.	

Table 9. Format of 9 point digitization of continuous temperature profile on an 80 column IBM card.

Zone	Data	Format
1 - 3 inclusive	Station Number	13
4 - 5 inclusive	year	12
6 - 7 inclusive	month	12
8 - 9 inclusive	day	12
10 - 12 inclusive	hour	F 3.1 (no sign or decimal)
13 - 14 inclusive	lat. (degrees)	12
15 - 17 inclusive	lat. (minutes)	F 3.1 (no sign or decimal)
18 - 19 inclusive	Long. (degrees)	12
20 - 22 inclusive	Long. (minutes)	F 3.1 (no sign or decimal)
23 - 25 inclusive	Surface Temp. °C to nearest 0.1°C	
26 - 73 inclusive	up to 8 temperatures - *depth pairs left-filled	8 (F3.1, 13)
74 - 76 inclusive	depth to bottom (m)**	13
77 inclusive	index of point marking top of thermocline	11
78 inclusive	index of point marking bottom of thermocline	11
79 - 80 inclusive	descriptive codes	

* If only 4 pairs are needed, then columns 26-49 are used and columns 50-73 remain blank.

** Temperatures are recorded to the nearest 0.1°C, depths to the nearest metre.

Table 10. Test sequences of layer depths for the program Z00P.

(a) Schemes of Decreasing Vertical Resolution

Schemes	No. of Layers	Depths of planes of separation (m)
1	31	0,5,10...,95,100,110,...180,190,196, 196 to deepest point in lake (196+)
2	21	0,10,20,... 180,190,196, 196+
3	max of 10	0, 10, 20, 40, 60, 90, 120, 150 150 to bottom from scheme one
4	max of 6	0, 50, 100, 150, 150 to bottom from scheme 1

(b) Variants of Scheme 3

3a	max of 10	0,9,19,39,...,149,149+
3B	max of 10	0,8,18,38,...,148,148+
3C	max of 10	0,7,17,37,...,147,147+
.		
.		
3i	max of 10	0,1,11,21,...,141,141+

Table 11. Results of tests on Z00P using different layering schemes. Data set A consists of profiles from the cruise of June 12-16, 1972 (Thermal bar conditions), while data set B consists of profiles from the cruise of Sept. 5-7, 1972 (fully stratified conditions).

Data Set	Layering Scheme	Heat Content (10^{18} cal)	Absolute Difference with regard to Scheme 1 (10^{18} cal)	cal/cm^2
A	1	7.275	0	0
A	2	7.256	.019	103
A	3	7.268	.007	38
A	4	7.058	.217	1180
A	Average 3,3a,... 3i	$7.266 \pm .03$.01	49
B	1	12.335	0	0
B	2	12.339	.004	22
B	3	12.340	.005	27
B	4	12.390	.055	296
B	Average, 3,3a... 3i	$12.324 \pm .02$.011	60

Table 12. Results of Z00P computations using half-data sets. Results are expressed as absolute heat content differences with respect to computations using full data sets. Layering scheme 3 is employed.

Data Set	Method of Division	Difference cal/cm ²
A	Alternate N.S. Lines	560
A	Alternate stations in sequence	410
A	random	350
B	alternate N.S. Lines	490
B	Alternate stations in sequence	110
B	random	750
R.M.S. value		480

FIGURES 1 to 12

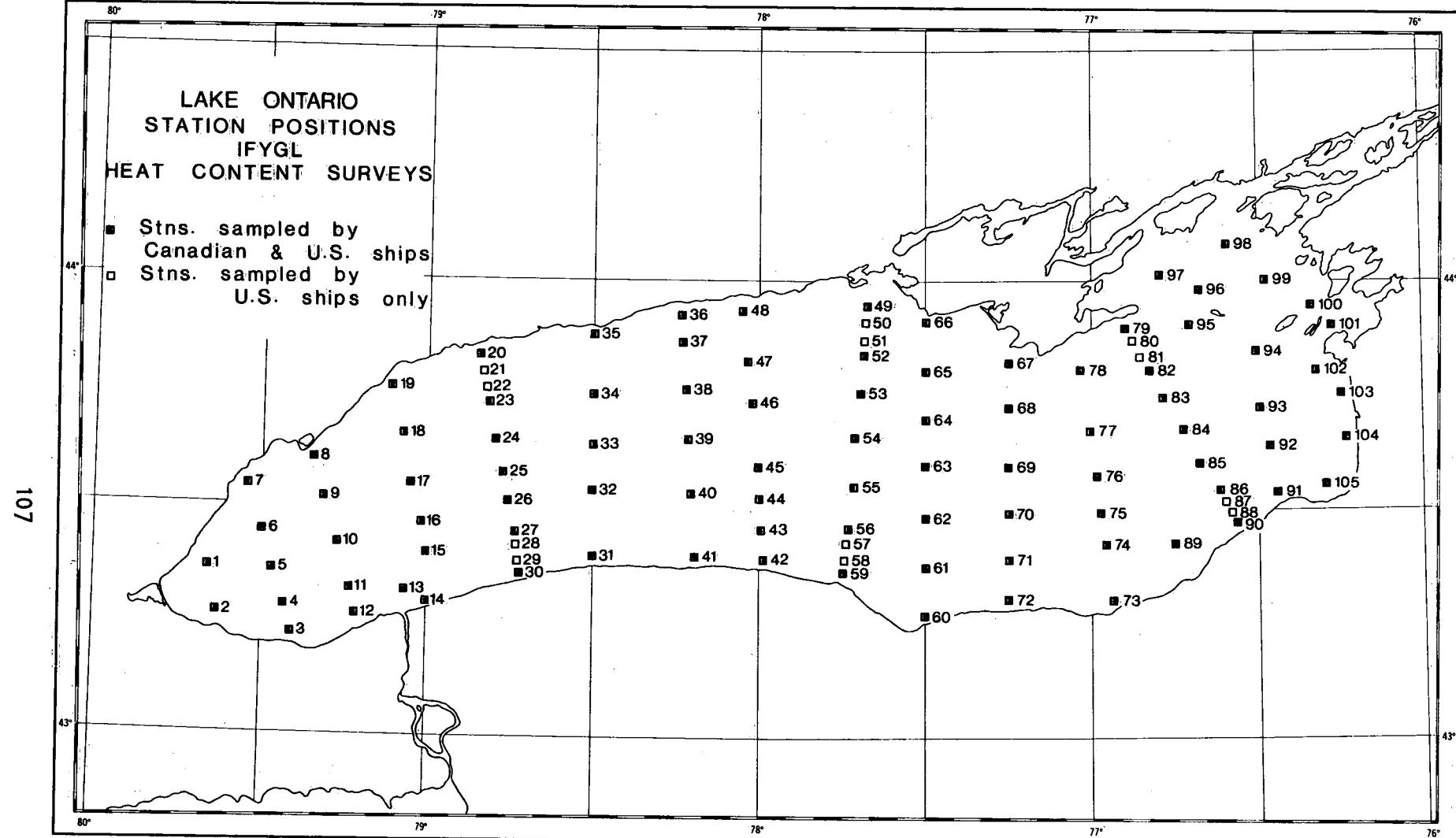


Figure 1. Map of Lake Ontario showing the locations of stations at which temperature profiles were routinely obtained.

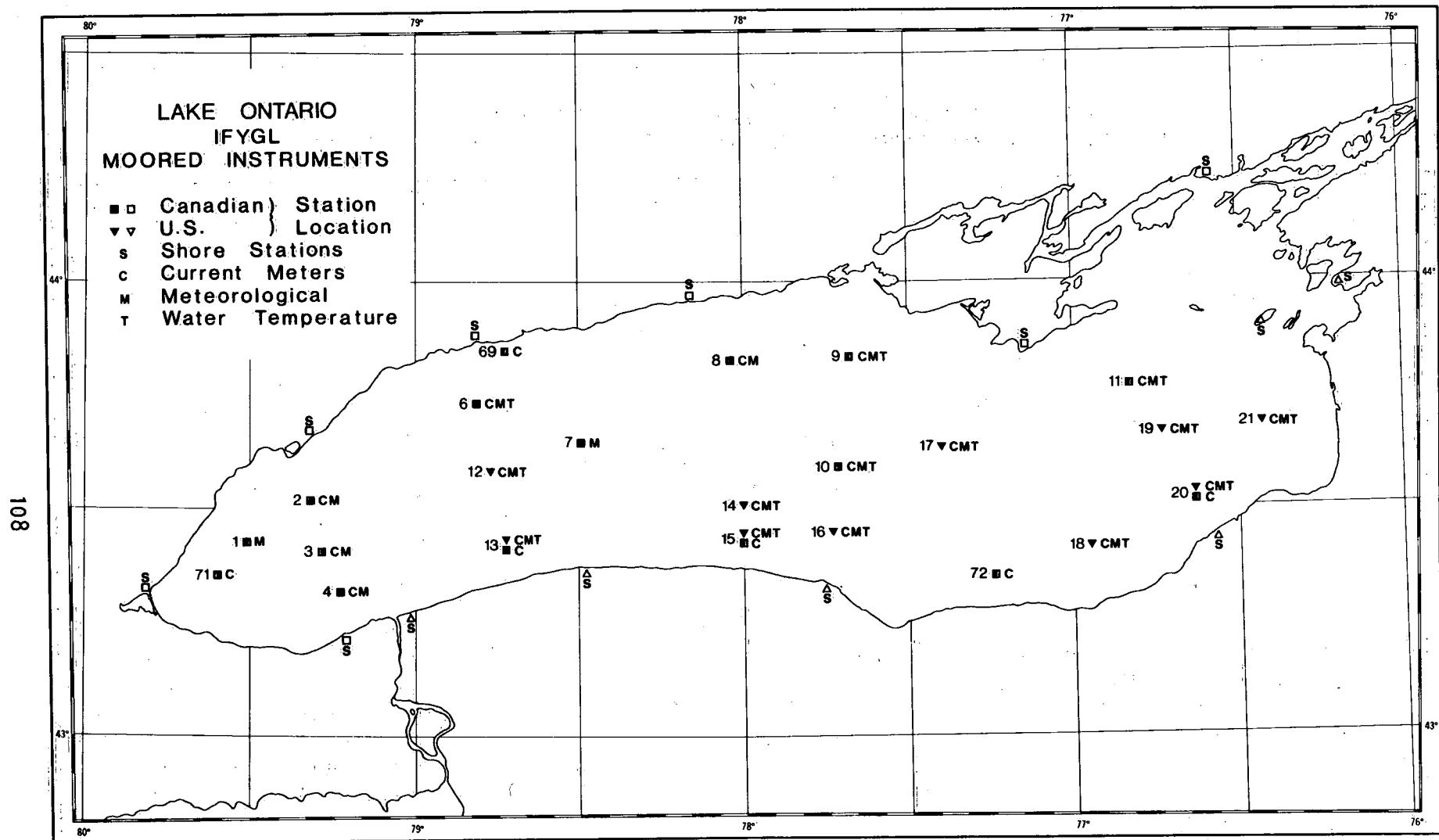


Figure 2. Map of Lake Ontario showing the distribution of moored self-recording instruments during IFYGL.

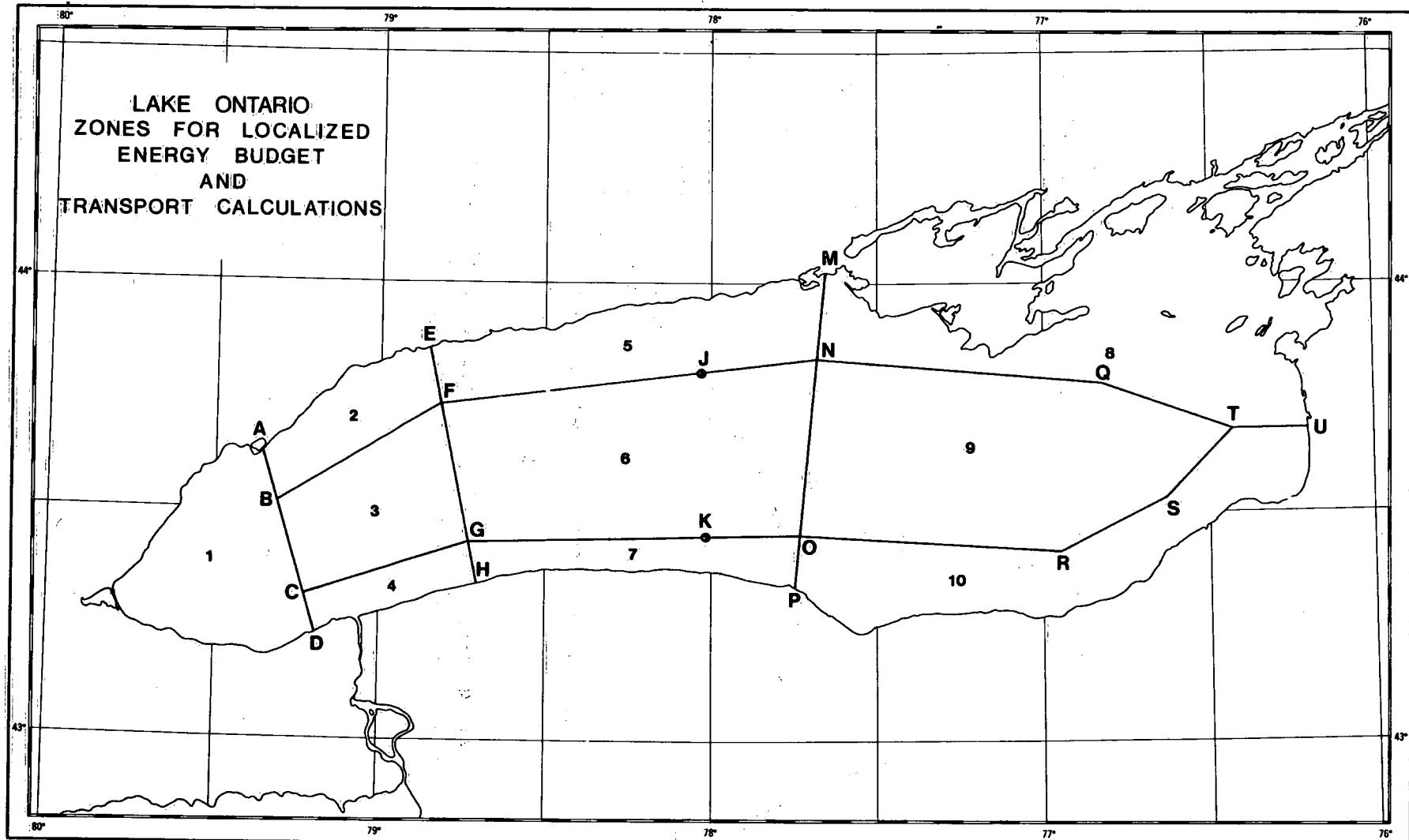


Figure 3. Map of Lake Ontario showing its subdivision into 10 zones.
Table 2 has defined these zones.

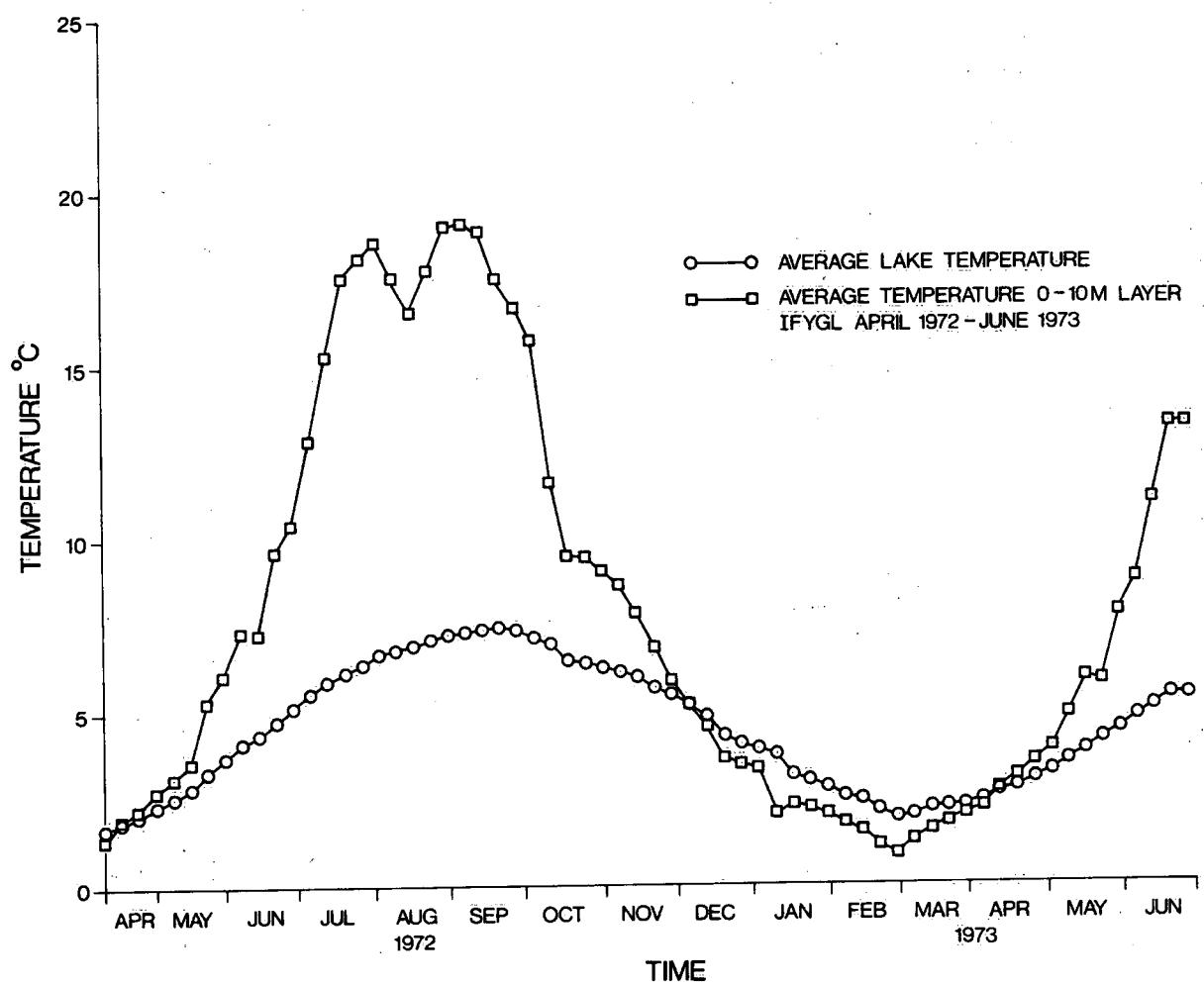


Figure 4. Average temperature of Lake Ontario (whole lake) and temperature of the upper 10 m during IFYGL.

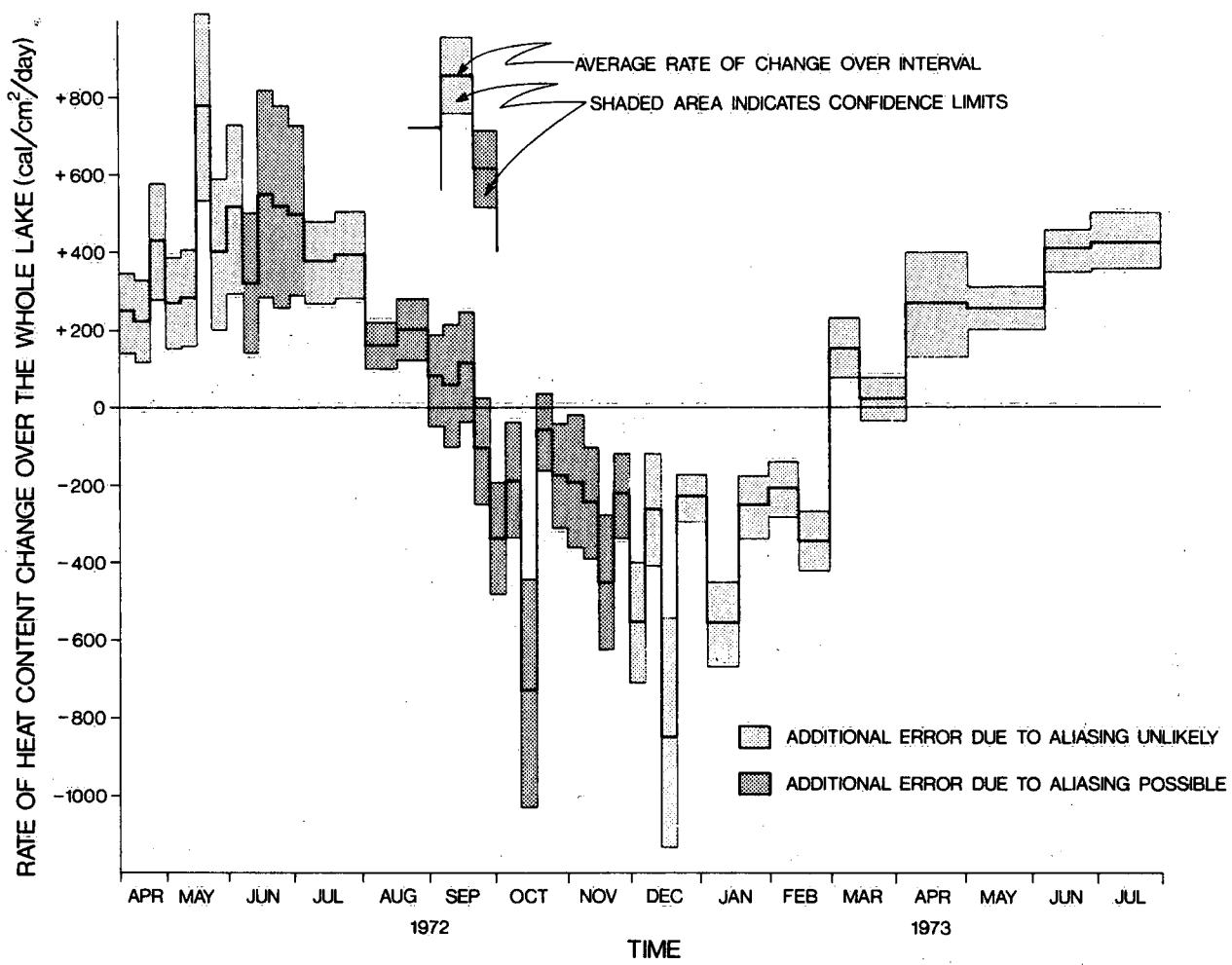


Figure 5. Rate of heat content change over Lake Ontario during IFYGL. Shaded zones show 95% confidence limits of heat fluxes exclusive of possible error due to imperfection of surveys with large scale internal flows in the lake (aliasing). The probability of such addition error is indicated on the diagram.

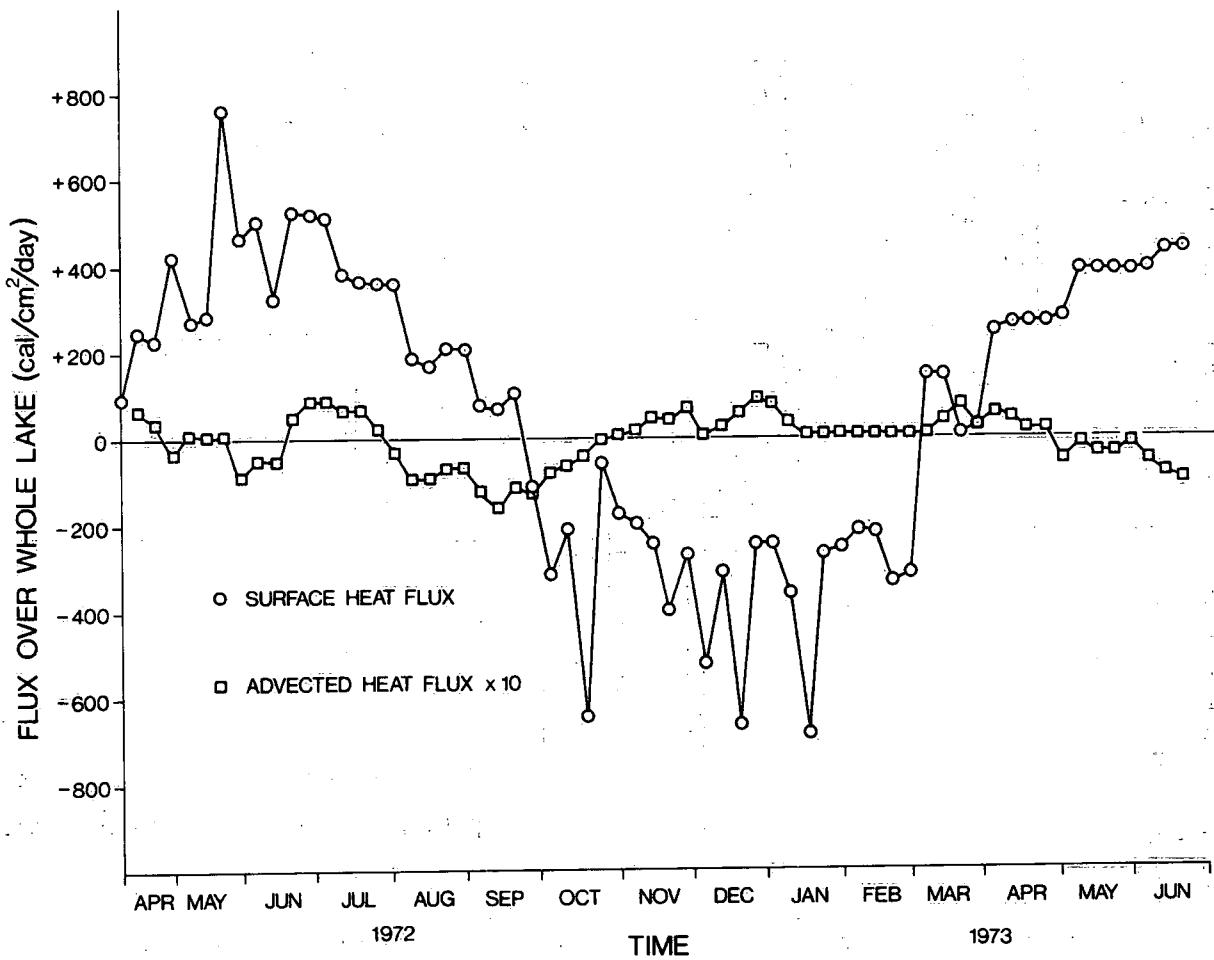


Figure 6. Net surface heat flux and heat flux from tributaries and power plants at weekly intervals over Lake Ontario. The advected heat flux term is multiplied by 10 as it is shown on the diagram.

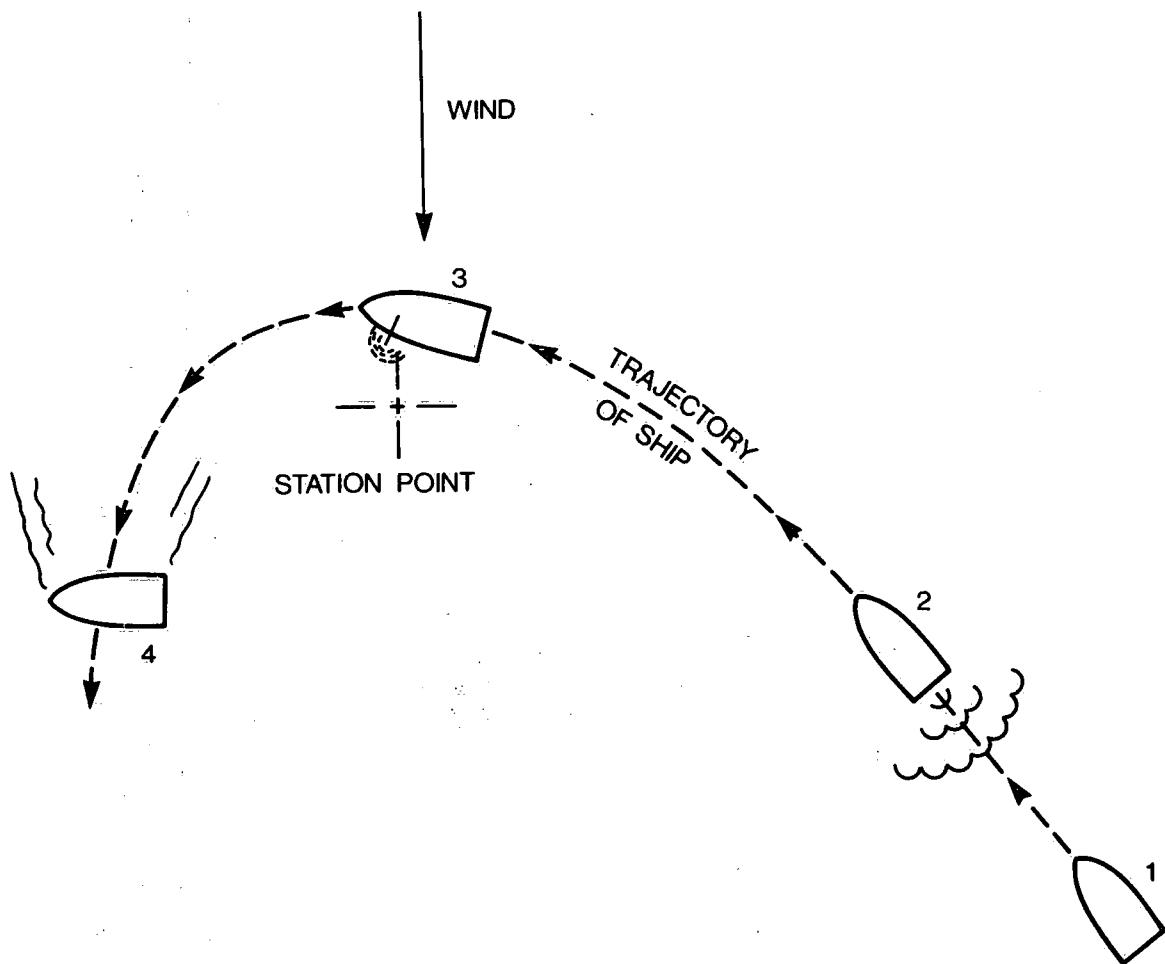


Figure 7. Recommended manoeuvres for a ship approaching an EBT station. Probe is lowered from the port side. If the probe is mounted on the starboard side, the ship should approach the station with the wind on the port bow. This procedure is designed to minimize the effect of ship disturbance on the measured temperature profile. The sequence of manoeuvres is:

1. Ship approaches station with wind on the starboard bow.
2. Engines are reversed but enough forward way is maintained to carry the vessel clear of the pool of mixed water.
3. The profile is taken as soon as possible (depends on instrument drag) after the ship is clear of the mixed water and before the vessel starts to drift downwind.
4. Recovery of probe while ship drifts downwind.

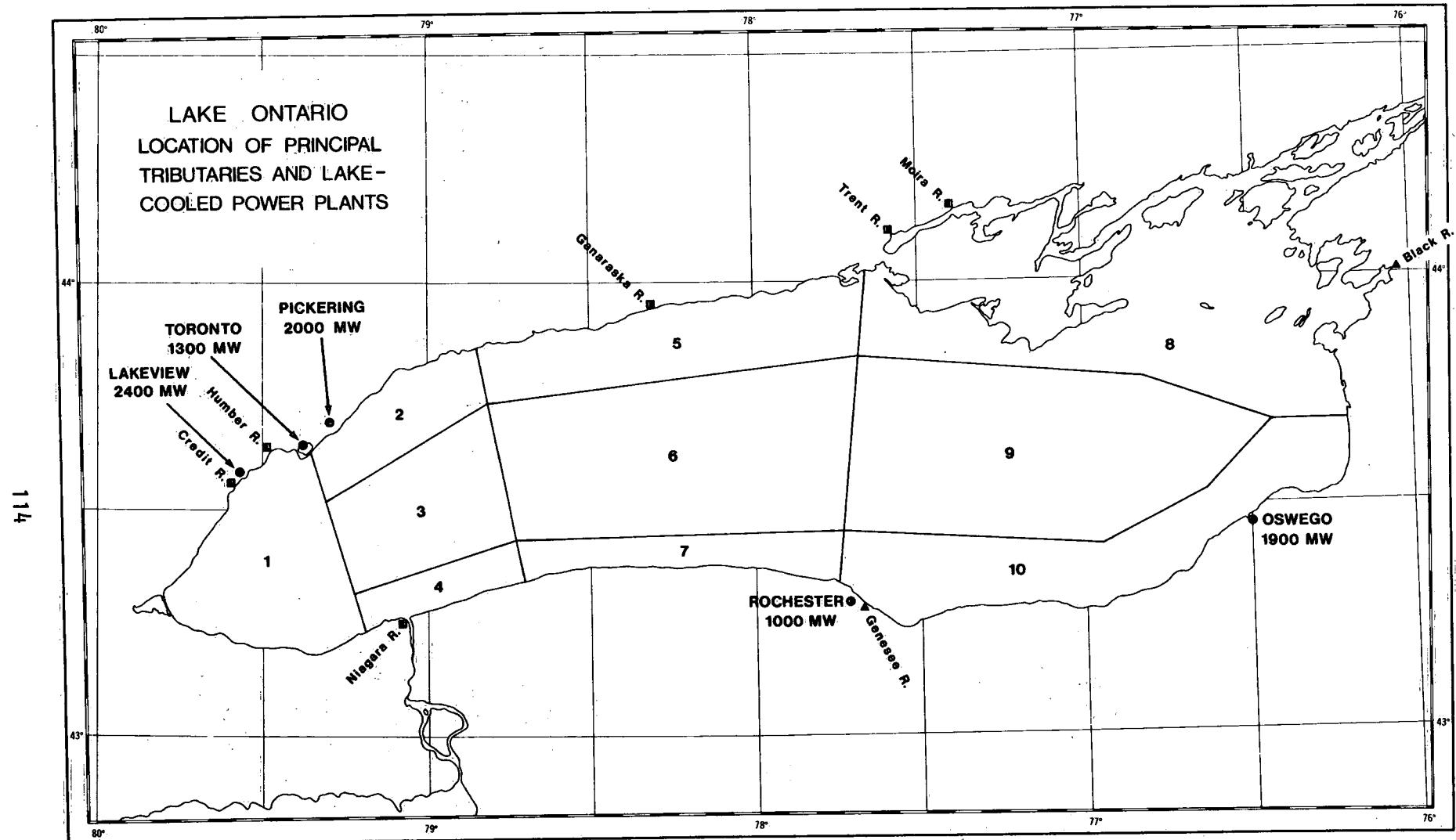
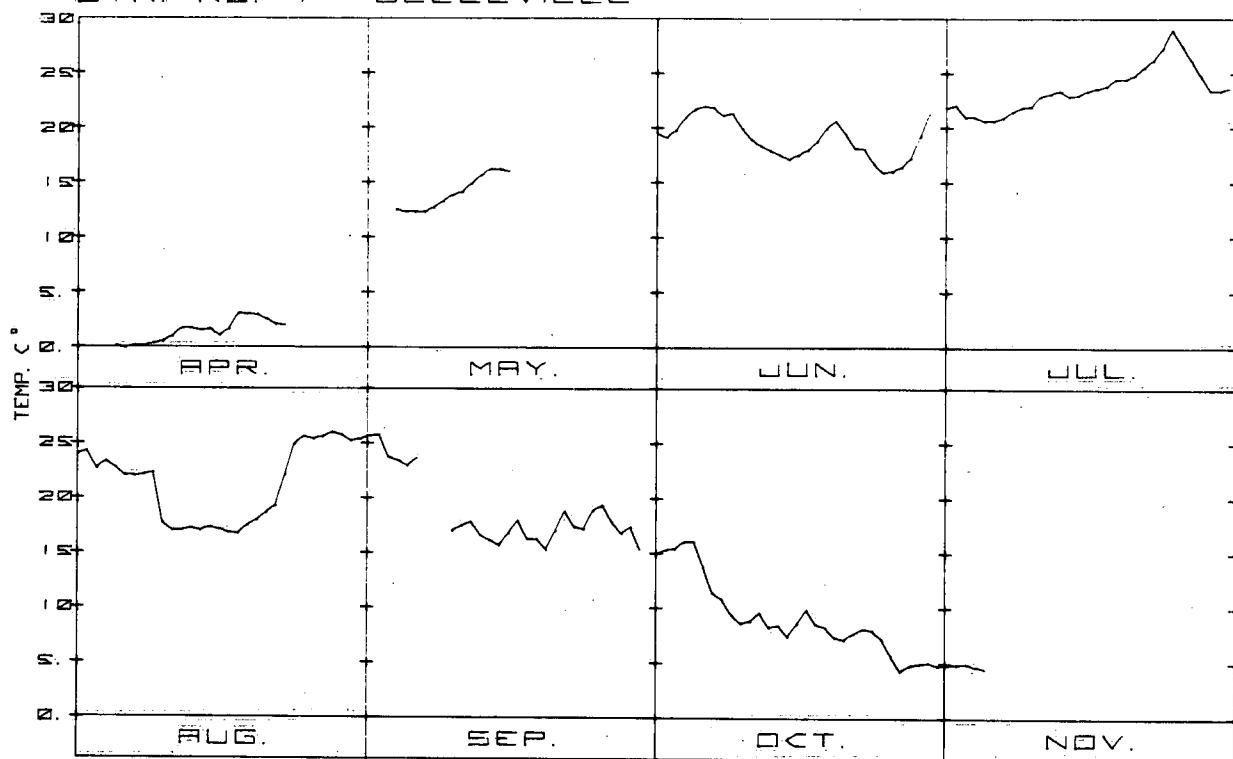


Figure 8. Map of Lake Ontario showing the location of the principal tributaries and lakewater cooled power generating stations.

THERMOGRAPH DATA 1972
STN. NO. 1 BELLEVILLE

DAILY AVG.



THERMOGRAPH DATA 1972
STN. NO. 2 TRENTON

DAILY AVG.

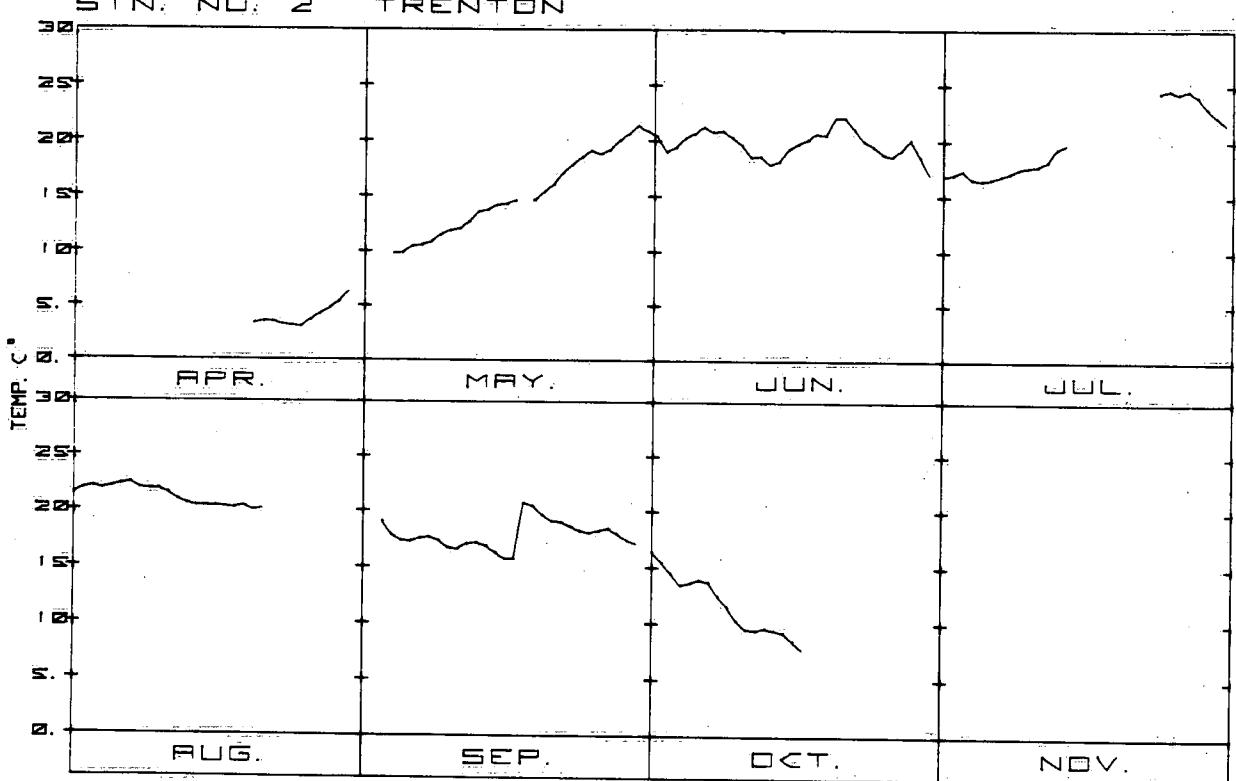
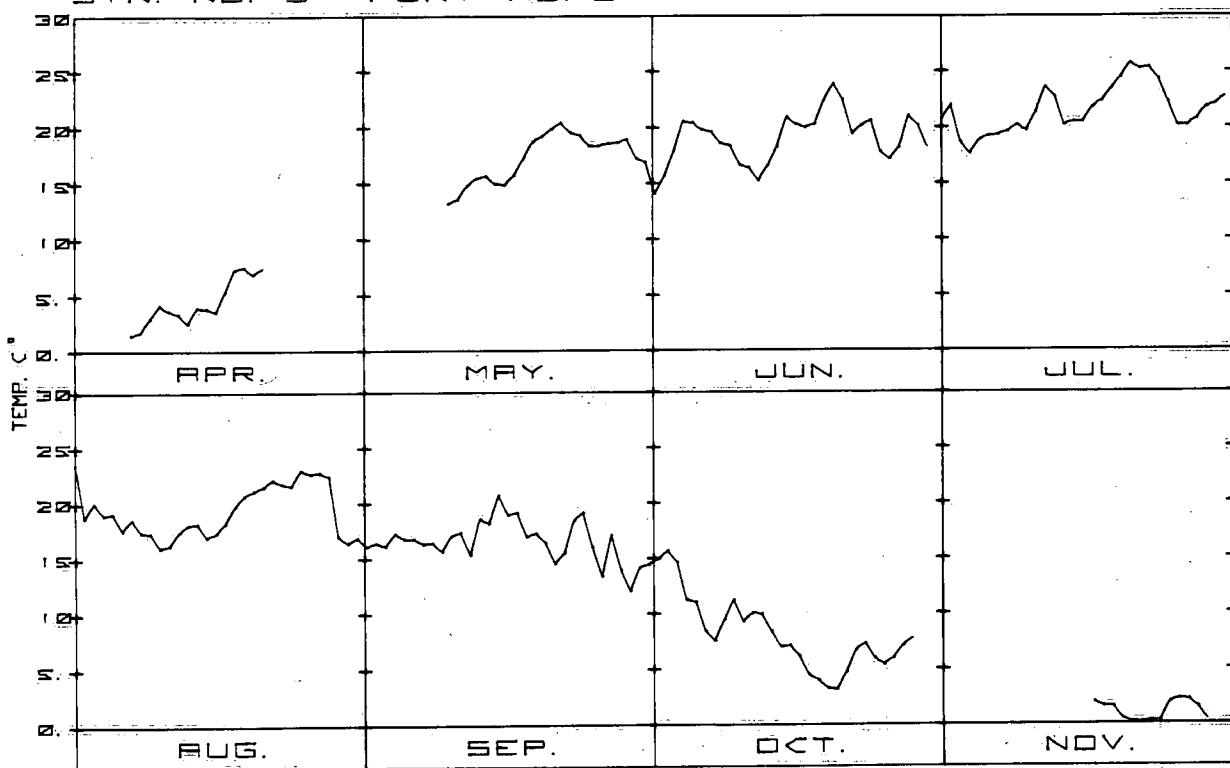


Figure 9A (for caption, see Fig. 9C)

THERMOGRAPH DATA 1972
STN. NO. 3 PORT HOPE

DAILY AVG.



THERMOGRAPH DATA 1972
STN. NO. 4A HUMBER RIVER

DAILY AVG.

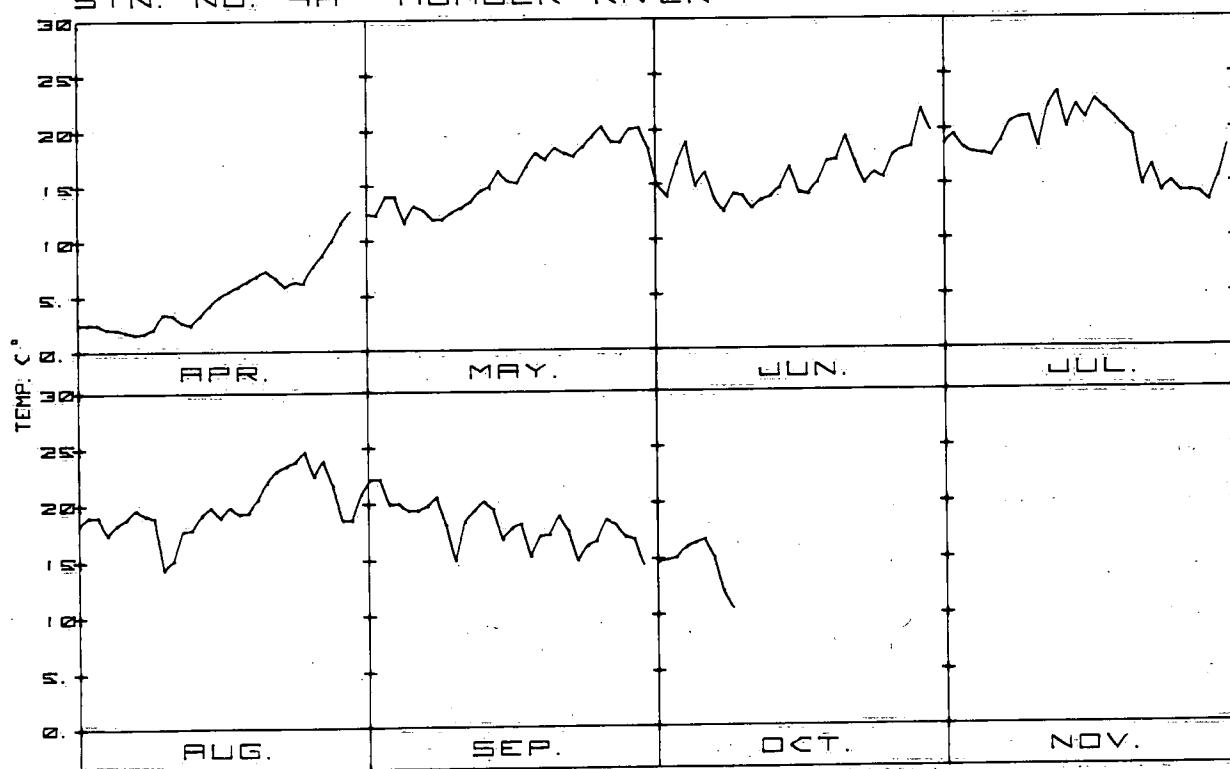


Figure 9B (for caption, see Fig. 9C)

THERMOGRAPH DATA 1972
STN. NO. 5 PORT CREDIT

DAILY AVG.

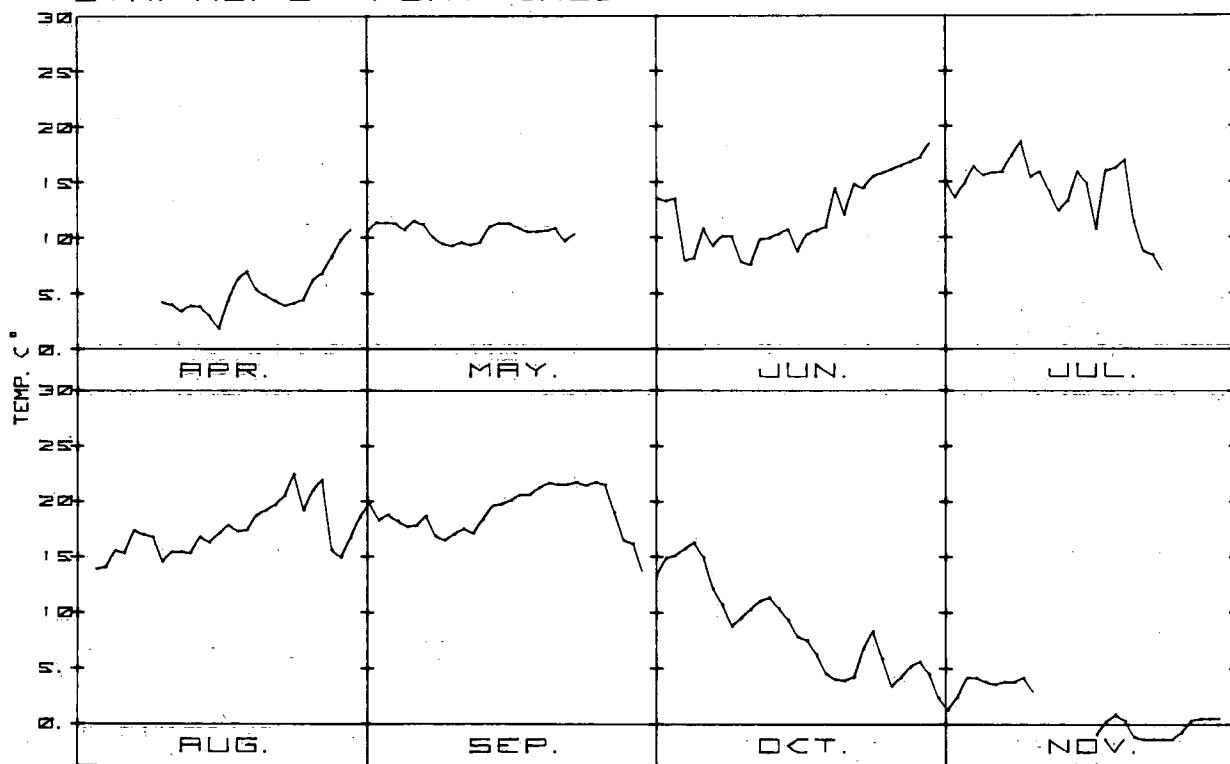
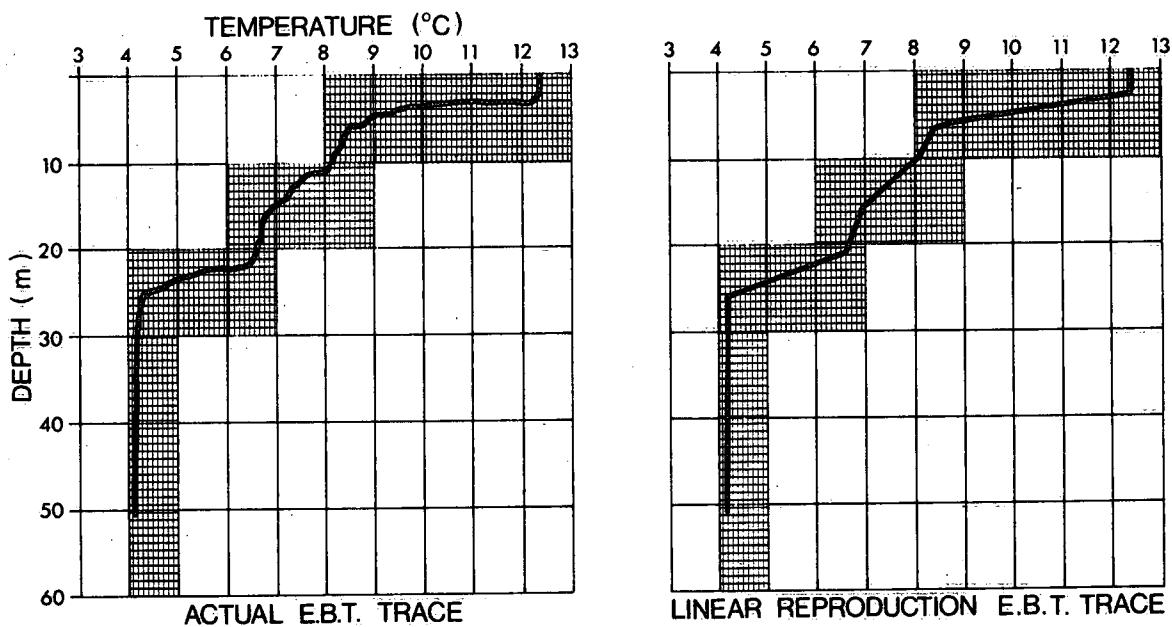


Figure 9C. Average daily temperatures of 5 streams flowing into Lake Ontario on the north side of the lake. Data from the Moira, Trent, Ganaraska and Credit Rivers were collected by local observers reporting to the Canada Centre for Inland Waters. Data for the Humber River was collected by the Great Lakes Institute of the University of Toronto.



STN#	YR	MO	DAY	HOUR	LAT ° +'	LONG ° +'	SFC.T	T ₁	D ₁	T ₂	D ₂	T ₃	D ₃	T ₄	D ₄	T ₅	D ₅	T ₆	D ₆	T ₇	D ₇	T ₈	D ₈	cons #	
203	70	10	05	191	43489	78410	124	124	003	089	006	084	007	081	010	069	016	066	021	042	026	041	051	052	71

DIGITIZED ABSTRACT FOR PUNCH CARD ENTRIES

RECORD FOR: LIMNOS 70-0-35

1908Z

70/10/05

STN. B

Figure 10. Example of a digitized temperature profile (from Boyce, 1973).

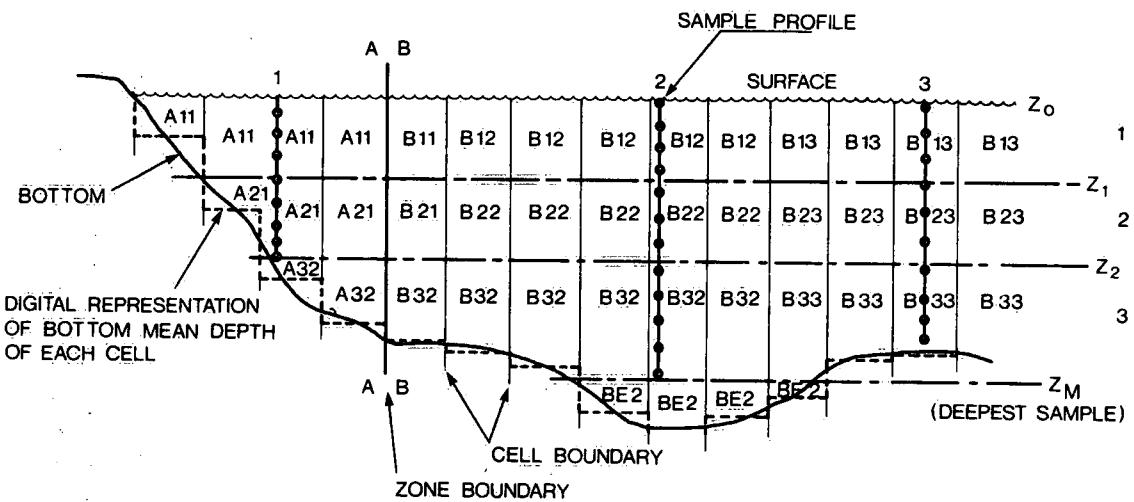


Figure 11. Example in two dimensions of the division of a basin into cells, zones, and layers. The Z00P algorithm proceeds one layer at a time. Within each element of the basin, denoted in the diagram by a three-character word, the first two characters refer to intermediate sums stored by zone and by layer. The last character indicates which sample profile applies to the element. The letter E refers to the deepest layer, the portion of the basin lying below the deepest sample depth, and the value of the deepest sample applies throughout this layer.

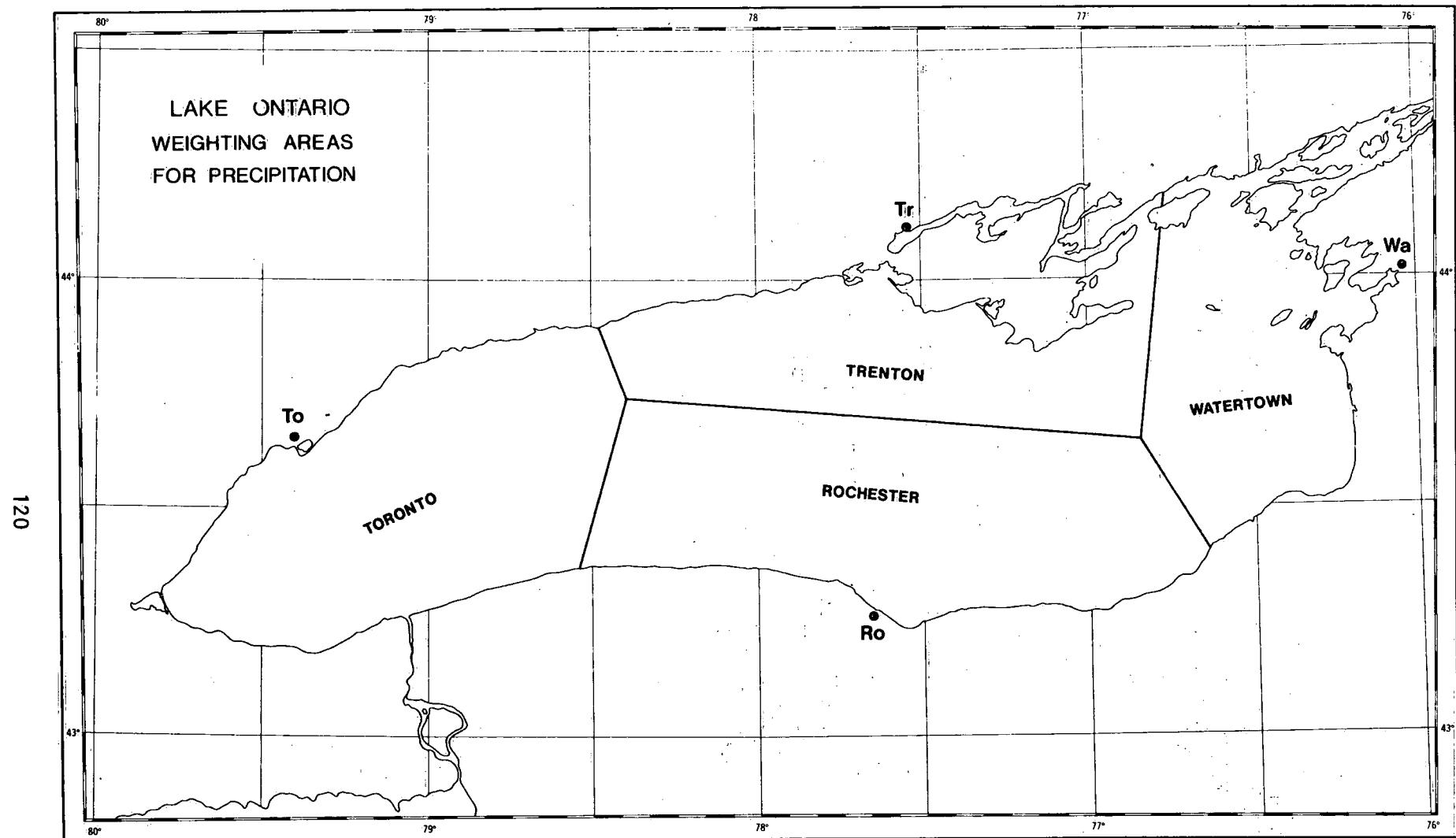


Figure 12. Map of Lake Ontario showing zones used to estimate precipitation over the lake based on measurements at four shore stations.

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3 9055 1017 3330 0