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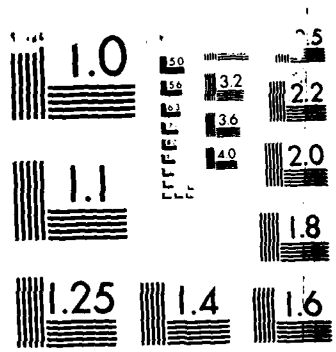

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Woods Hole Oceanographic Institution

Data Tabulations and Analysis of Diurnal Sea Surface Temperature Variability Observed at LOTUS

by

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Technical Report

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Approved for Distribution:

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Robert C. Beardsley, Chairman
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Abstract

Air/sea measurements from the Long-Term Upper Ocean Study (LOTUS) buoy in the Sargasso Sea are analyzed to learn how the diurnal response of sea surface temperature, ΔT_s, is related to the surface heating, H, and the wind stress, S. Data are taken from the LOTUS-3 and LOTUS-5 records which span the summers of 1982 and 1983. The basic data are shown in monthly plots, and the analyzed daily values of ΔT_s, H, and S are given in tables and in figures.

Analyzed data show a clear trend of ΔT_s increasing with H and decreasing with S. A best-fit, three-parameter, empirical function can account for 90 percent of the variance in a screened subset of the LOTUS data (172 days) and 81 percent of the variance of the full data set (361 days).

The analyzed data are also compared with a theoretical model function now used for ocean predictions in the Diurnal Ocean Surface Layer model (DOSL) of Fleet Numerical Oceanography Center. The DOSL model function was derived from the assumption that wind-mixing occurs by a mechanism of shear flow instability. It is fully predictive and shows a parameter dependence consistent with the LOTUS data over a wide range of H and S. The DOSL model function can account for almost as much variance as the best-fit empirical function.

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I. INTRODUCTION

In this study we use oceanographic and meteorological field observations to examine the response of sea surface temperature to diurnal heating and wind stress. The data were acquired by the Long-Term Upper Ocean Study (LOTUS) buoy which was deployed in the northwestern Sargasso Sea (34°N, 70°W) from 1982 to 1984 (Briscoe and Weller, 1984; Deser, Weller and Briscoe, 1983; Tarbell, Montgomery and Briscoe, 1985). The LOTUS data are well suited for this study because the signal of local heat storage is generally large compared to the effects of horizontal advection, and because the LOTUS data provide high accuracy and temporal resolution.

The aim of the analysis is, first, to reduce the time series data to daily values of the heating, H, wind stress, S, and surface temperature response, ΔT_s, and second, to determine the dependence of ΔT_s upon H and S. There is a practical value to this result -- the function $\Delta T_s(H,S)$ defined or verified by these data can be used to forecast or hindcast the diurnal cycle, and a scientific value -- these data show how a rotating fluid responds to a stabilizing heat flux and an imposed stress.

The primary purpose of this technical report is to provide time series plots of the original LOTUS data, a tabulation of the analyzed data, and a listing of the FORTRAN program which evaluates a theoretical model function.

II. LOTUS DATA AND ANALYSIS METHODS

The LOTUS data used for this analysis are time series measurements of wind speed, insolation and ocean temperatures at 0.6, 5, 10, 15, 25, 50 and 75 m at 15 min intervals (Deser et al., 1983; Tarbell, Pennington and Briscoe, 1984). Estimates of the wind stress, τ, and surface heat flux, $Q = I + L$, where I is insolation and L is the heat loss, were made as described by Stramma et al. (1986). The data sets analyzed are from the deployments LOTUS-3 (May 14, 1982 through October 20, 1982) and LOTUS-5 (April 15, 1983 through October 30, 1983). Monthly plots of the full data set are in Appendix A. In Appendix B we list the analyzed daily values of the wind stress, wind speed, insolation, etc., so that other investigators will have ready access to our intermediate results.

A. Sea Surface Temperature Response

The ocean's response to the forcing of the winds and solar heating is characterized here by the amplitude of the sea surface temperature response, ΔT_s, where T_s is the LOTUS temperature at 0.6 m depth, and Δ indicates the change (increase) over a day. If the diurnal cycle is the dominant signal in T_s, then the lowest T_s of the day will occur between 0500 and 0900 hours (all times quoted in the text are local solar; local noon is 1730 Z), and the highest T_s will occur between 1100 and 1800. We have estimated the diurnal response of sea surface by subtracting the lowest temperature observed between 0500 and 0900 from the highest temperature observed between 1100 and 1800. The result is listed in Appendix B as "DEL T".

This process of subtracting the lowest from the highest temperature will alias high frequency noise (compared to diurnal) into larger ΔT_s. In Section IV.B we will evaluate the resulting bias in the analyzed ΔT_s by inspection of the estimates available at very low values of surface heating.

B. Daily Averages

In the following analysis we compute a "daily" value as an average over the period during each day when $Q > 0$. Let t_1 be the time when Q first becomes positive, and let t_2 be the time when Q becomes negative at sunset. Daily average is defined here as

$$\overline{(\quad)} = \frac{1}{2P_Q} \int_{t_1}^{t_2} (\quad)\, dt ,$$

where $P_Q = 1/2\,(t_2 - t_1)$. (On some days Q may become negative within the time interval $t_1 < t < t_2$ when increased cloud cover causes the insolation to drop below the value of the heat loss. A second, alternate, time scale, PQ_2, (not used here) was defined to be literally the half time that Q was positive for each day.)

Daily average values are tabulated in Appendix B as:

"U", daily average wind speed ($m\ s^{-1}$),

"TAU", daily average wind stress (Pa),

"L", average heat loss ($W\ m^{-2}$).

Standard deviations are also listed as "SD U", "SD TAU', and "SD L". In computing SD TAU we sum the standard deviations of the east and north components to take account of varying wind direction. In some of the later comparisons with models we will screen out those days having highly variable or irregular forcing and retain the days which have comparatively steady forcing.

C. Insolation

The amplitude of insolation has been estimated in three ways.

1) Maximum Observed Insolation

The maximum insolation observed on each day was extracted from the records, and is listed as I_1. If there were no clouds, then I_1 together with the duration of the insolation, D, would completely characterize the insolation for any day. However, cloud-free days are the exception rather than the rule, and we have therefore defined two other more useful measures of insolation.

2) Integrated Insolation

The integral of the insolation has been used to define I_2 as

$$I_2 = \frac{\int_{t_3}^{t_4} I \, dt}{D \Gamma},$$

where

I = observed insolation,

t_3 = the start of insolation,

t_4 = the end of insolation,

D = duration of the insolation, $t_4 - t_3$,

$\Gamma = \frac{1}{DF_m} \int_{t_3}^{t_4} F(t, \phi, \alpha) dt = 0.57$, a constant,

$F(t, \phi, \alpha)$ = theoretical clear sky insolation; function of year day, t, latitude $\phi = 34°$N, and clear sky transmittance, $\alpha = 0.8$. F_m is the daily maximum (List, 1958).

Because the insolation records have some slight noise, t_3 was estimated to occur a half hour before $I \geq 30\ W\ m^{-2}$, and similarly t_4 was taken to be a half hour beyond $I \leq 30\ W\ m^{-2}$ in late afternoon. The error in defining the period of insolation in this manner is ± 15 minutes for most days, which gives about 4 percent error in the computed amplitude (I_2) of the insolation.

3) Least Squares Fit to Insolation

As an alternative measure of insolation, we have also carried out a least squares fit of the normalized theoretical insolation function F onto observed insolation to compute the amplitude "I_3" (Appendix B). The standard deviation of the fit, listed as "SD I_3", provides a convenient, objective measure of the variability of insolation due to cloud cover. In a later analysis we screen out days with highly variable insolation by setting an upper limit on the ratio, SD I_3/I_2.

D. Horizontal Advection

The analysis thus far has been concerned only with the vertical fluxes of heat and momentum. Our implicit assumption of a local balance is valid as long as there is no horizontal advection occurring in the water column. However, the effects of horizontal advection are evident in the LOTUS data as occasions when the water column (above 75 m) underwent depth-independent temperature changes. Since we were unable to account for the effects of horizontal advection explicitly, we sought to identify at least the most obvious occurrences of horizontal advection so that we could eliminate the corresponding days from the analysis.

A local heat balance analysis was performed by comparing the net surface heat flux with the observed heat storage in the water column,

$$EPS = \frac{\int_{t_1}^{t_2} Q\,dt - \Delta B}{\int_{t_1}^{t_2} Q\,dt},$$

where B is the observed heat storage to 25 m depth, and $\Delta B = B(t_2) - B(t_1)$. The values of EPS are listed in Appendix B. This alone does not effectively identify horizontal advection since vertical advection can also cause significant changes in heat storage without changing T_s (note especially the period 10 to 30 September 1983, Figure A.12, when there were very large changes in temperature at 25 m and deeper, but no corresponding changes in the near surface). We have therefore used the tabulated EPS values as a guide, and proceeded to subjectively identify periods where horizontal advection seemed to be important. These were noted by setting the flag $A = 1$ (Appendix B), and included only 44 days (two periods in 1982 and three in 1983), or about 12 percent of the complete data set.

III. RESULTS

Our analysis of the full data set is presented graphically in Figure 1 where the diurnal response of sea surface temperature is plotted against independent variables proportional to the heating and wind stress. The "heating" variable was computed as:

$$H = \frac{Q\ P_Q}{\rho_o\ C_p}\ (C\ m)$$

where

$$Q = I_2 + \bar{L}\ (W\ m^{-2}),$$
$$\rho_o = 1023\ (kg\ m^{-3}),\ \text{and}$$
$$C_p = 4183\ (J\ kg^{-1}\ C^{-1}).$$

The product $Q\ P_Q$ is proportional to the (warming) heat flux supplied to the ocean; division by $\rho_o\ C_p$ gives kinematic units, C m, which are more readily interpreted. In a similar way the "stress" variable was computed as:

$$S = \frac{\bar{\tau}\ P_\tau}{\rho_o}\ (m^2\ s^{-1}),$$

where

τ = daily average wind stress (Pa),
P_τ = acceleration time scale = $1/f[2 - 2\cos(fP_Q)]^{1/2}$ (s), and
f = Coriolis parameter (s^{-1}).

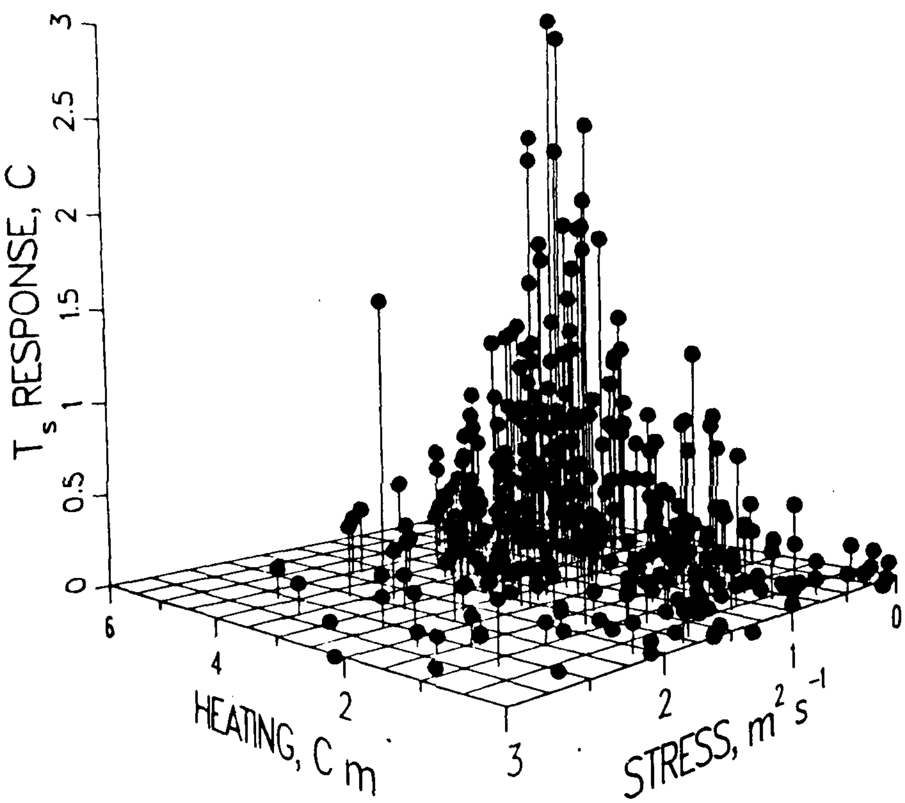


Figure 1: The complete LOTUS-3 and LOTUS-5 data sets, one data point per day (361 days). (Note that what we term "stress" has the units of volume transport per unit length.)

In this final regard the scaling begins to follow the theory developed by Price, Weller and Pinkel (1986; hereafter, PWP) where the vertical mixing due to wind stress was presumed to occur through shear flow instability caused by wind-driven currents. [The amplitude of the wind-driven current (or diurnal jet) was estimated to be W/D where D is the trapping depth, and $\Delta T_s \sim H/D$.] The f-dependence of P_τ takes account of rotation which in this case is small enough that $P_\tau \approx P_Q$. In effect, the heating rate Q and the wind stress τ are multiplied by nearly the same time scale (which does vary from day to day).

While there is a good deal of scatter in the data of Figure 1, it is also apparent that there is a significant functional dependence of ΔT_s upon H and S. Within the variable range sampled here, ΔT_s increases with increasing H and with decreasing S -- the qualitative result expected.

Before we attempt to define or test a model function, we first screen the data to omit the days which one would expect, <u>a priori</u>, to be unsuitable for defining a function $\Delta T_s(H,S)$. That is, we assume that if the wind was steady during the day and H was regular (not intermittent due to cloud cover), then some function $\Delta T_s(H,S)$ should obtain. On the other hand, if the wind, say, were highly variable during a day, then there are additional degrees of freedom present, and a function dependent upon S alone might not be appropriate. The LOTUS data set is large enough that we can omit days with irregular or variable forcing and still retain a large sample spanning a wide parameter range.

In Figure 2 we have omitted the days identified as showing some effects of horizontal advection (discussed in Section II.D), and in Figure 3 we have also omitted days having either highly variable insolation, SD $I_3/I_2 \geq 1/2$, or highly variable wind stress, SD TAU/TAU $\geq 1/2$. The result of this screening is to eliminate some of the points which lie furthest from the mean trend of the data. The last version, Figure 3, will be used for model definition and testing, but we also make comparisons with the full data set.

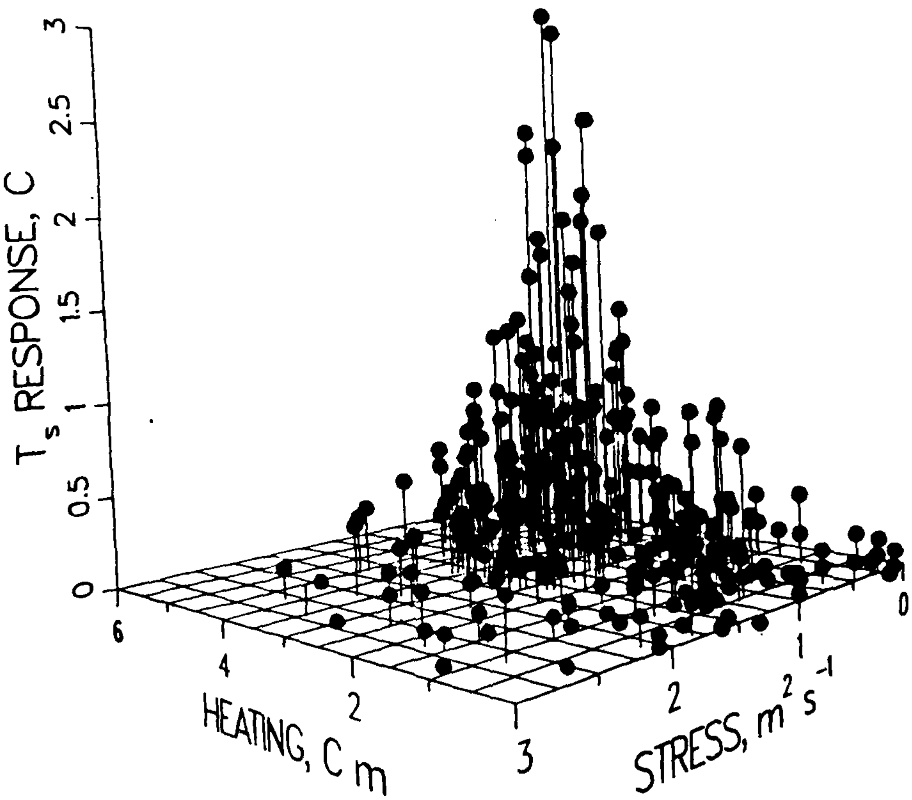


Figure 2: Same as Figure 1 but omitting time periods identified as showing effects of horizontal advection (316 days remaining).

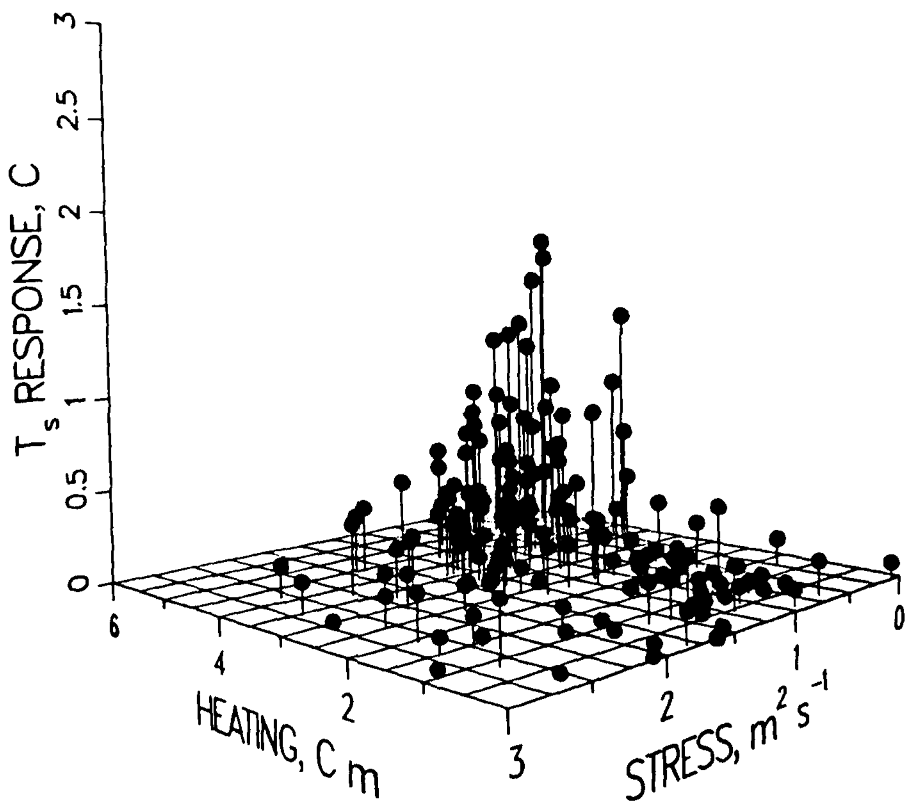


Figure 3: Same as Figure 2, but also omitting individual days having highly variable wind stress or irregular insolation (172 days remaining). This is referred to as the screened data set.

IV. FIT TO AND COMPARISON WITH MODELS

These data may be used to define purely empirical model functions and to test theoretical model functions. To quantify data/model comparisons, we have calculated statistics of the deviations,

$$T' = \Delta T_s - \Delta T_m ,$$

where ΔT_m is ΔT evaluated by the best fit or theoretical model at the H, S of the corresponding, observed ΔT_s. The ensemble Average Deviation is

$$AD = \langle T' \rangle = \frac{1}{N} \sum T' ,$$

where N is the number of days;
the Percentage of Variance accounted for by the model is

$$PV = 100 \left[1 - \frac{\langle T'^2 \rangle}{\langle \Delta T_s^2 \rangle} \right] ;$$

and the Correlation Coefficient is

$$CC = \frac{\langle \Delta\tilde{T}_m \, \Delta\tilde{T}_s \rangle}{\langle \Delta\tilde{T}_m^2 \rangle^{1/2} \, \langle \Delta\tilde{T}_s^2 \rangle^{1/2}} ,$$

where ($\tilde{}$) indicates departure from the ensemble mean. (PV and CC differ in that CC is independent of bias error. Here the bias error is small compared to random errors, and we emphasize PV in our discussion.)

A. Empirical Model

A purely empirical model function is defined from the data by maximizing PV for the three parameter function,

$$\Delta T(H,S) = \alpha H^{\beta} \exp(-S/\gamma).$$

This functional form was chosen by inspection of the data, and under the assumption that ΔT should vanish as $H \to 0$, and should be finite as $S \to 0$. Values of α, β, γ which maximize PV were found by a searching method to be:

$$\alpha = 0.20 \pm 0.03 \quad (C) ,$$
$$\beta = 1.40 \pm 0.1 \quad \text{and}$$
$$\gamma = 0.80 \pm 0.05 \quad (Pa).$$

These give PV = 90 (see also Table I), showing that there is indeed a strong dependence of ΔT_s upon the presumed independent variables, H and S. This best fit function is plotted as a surface along with the screened data in Figure 4.

B. Positive Bias of ΔT_s

A consistent result of the data/model comparisons is that AD tends to be positive, i.e., on average the observed ΔT_s lie slightly above the model prediction (as can be seen in Figure 4). This is at least partially a result of a bias error inherent in the day-night differencing procedure used to estimate the diurnal response of surface temperature (Section II.A). To check this we have plotted the ΔT_s available at small values of H, Figure 5. Note that ΔT_s tends to remain slightly positive as H goes to zero; $\langle \Delta T_s \rangle = 0.07$ C for $H < 0.05$ C m, which is unphysical, and presumed to be a bias error of the analysis.

C. Theoretical Model

A theoretical model function derived by PWP and now in use at Fleet Numerical Oceanography Center as part of the Diurnal Ocean Surface Layer (DOSL) model may be tested using these data. The only additional parameters needed to evaluate the model (see Appendix C for model listing) are those that define the optical properties of the water. For the LOTUS site we use Type I parameters appropriate for very clear ocean waters (Stramma et al., 1986; Paulson and Simpson, 1977: long wave extinction scale, $\beta_1 = 0.35$ m; short wave extinction scale, $\beta_2 = 23$ m, and the fraction of long wave insolation, $R = 0.58$).

The statistics of this model/data comparison are in Table I, and the result is plotted in Figure 6. Note that AD is again slightly positive and

Table I

Statistics of Data / Model Comparisons

	Best Fit, Empirical Model		DOSL Model	
	Full Data Set	Screened Data Set	Full Data Set	Screened Data Set
Number of Days	361	172	361	172
Average Deviation, C	0.06	0.04	0.08	0.07
Percent Variance	81	90	74	87
Cross-Correlation	0.82	0.91	0.80	0.89

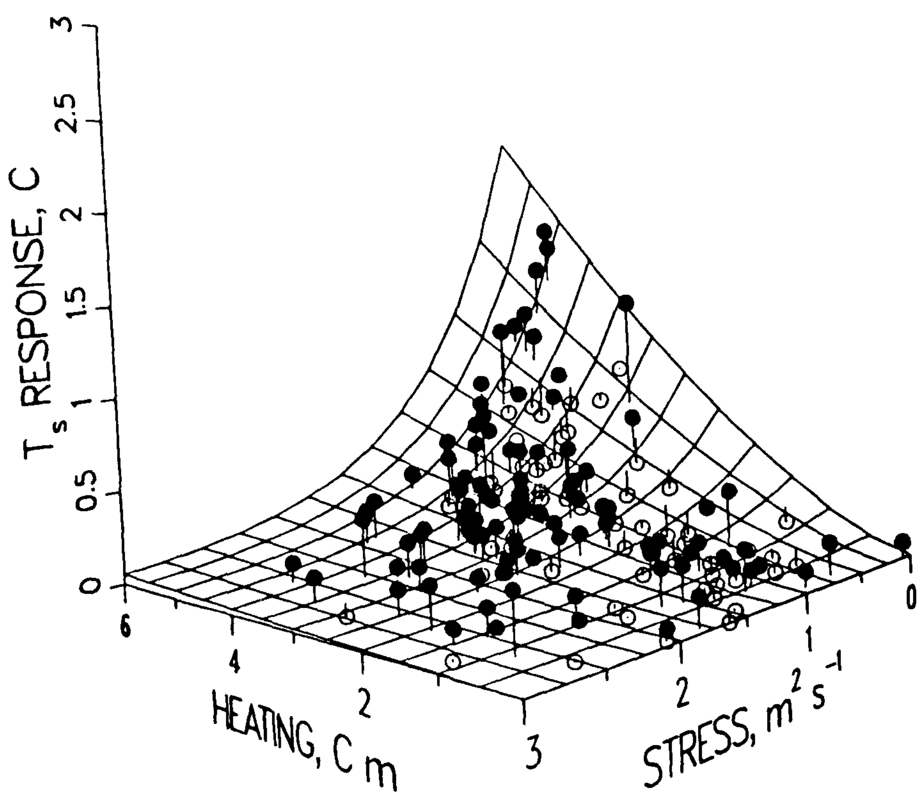


Figure 4: Screened data set and the best-fit empirical model function shown as a surface. Data points which lie above the surface are solid, those below are open. Vertical lines connect the points to the model surface.

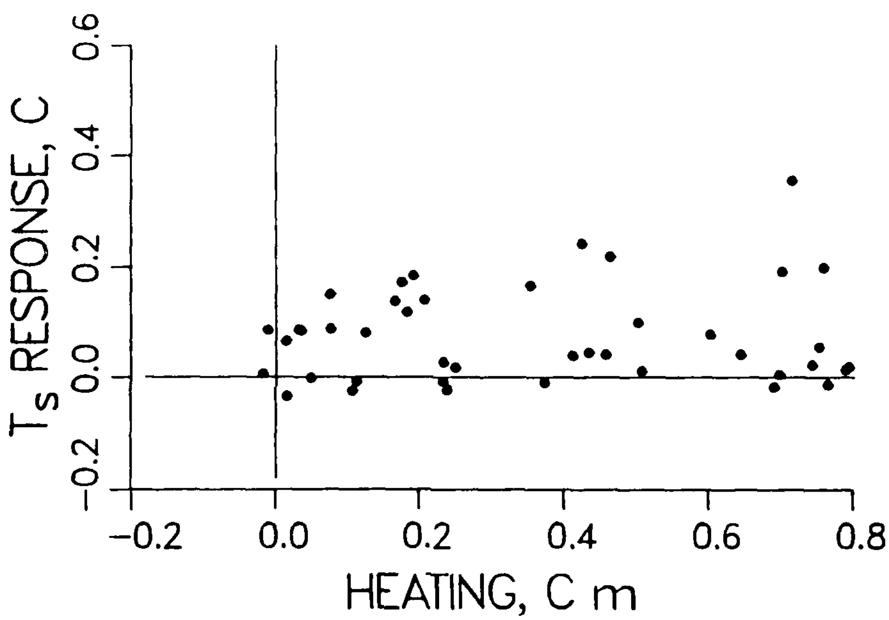


Figure 5: Sea surface temperature response at very low values of heating. Note that the estimates have a small mean value, ~ 0.07 C, as heating vanishes, probably because of a bias error inherent in the day/night differencing method used to define the diurnal response.

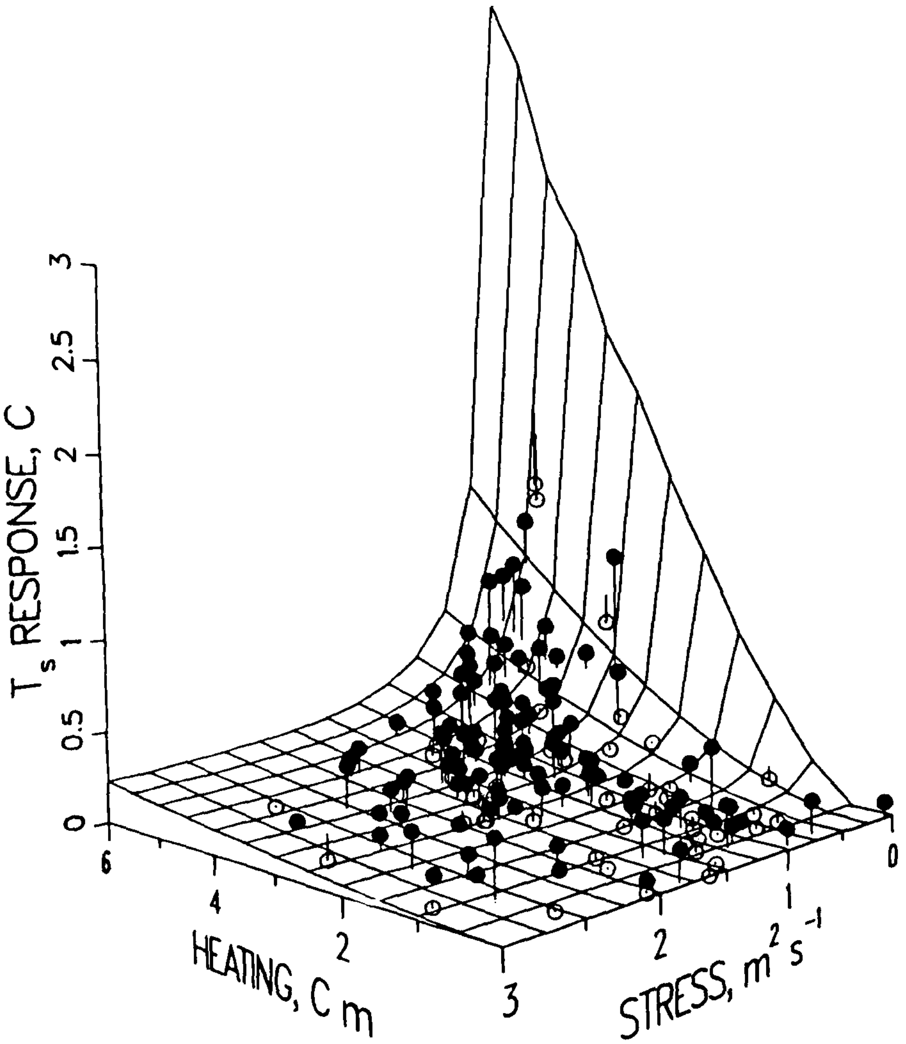


Figure 6: Screened data set and the DOSL model function.

that $PV = 87$, or nearly as successful as the best-fit empirical function. The empirical model function and the DOSL model function differ significantly only in the limit of very large H and vanishing S where there are not enough data to tell which is better.

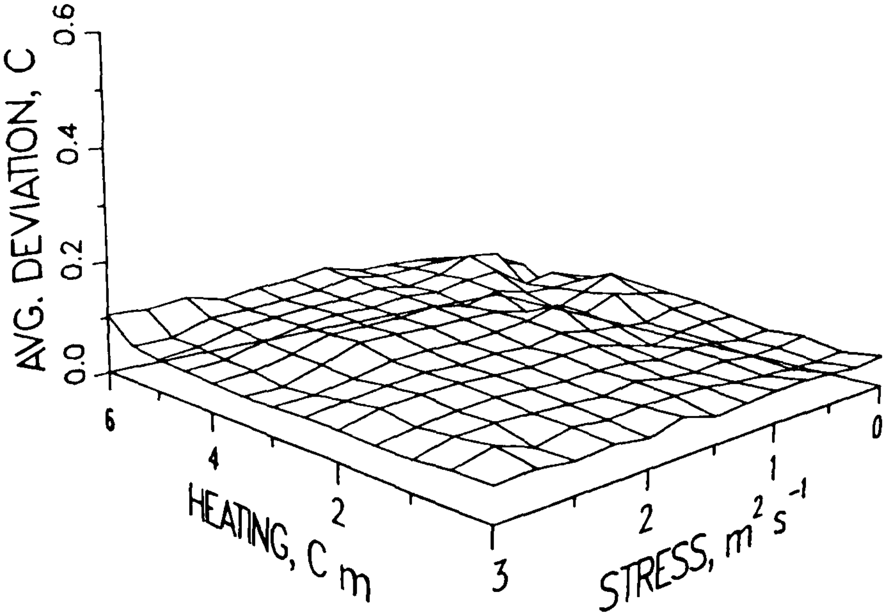
The DOSL model function appears to follow the trend of the data reasonably well (suggested also by large PV). To check explicitly whether there may be coherent structure in the deviations, we have smoothed and interpolated T' to a regular grid, and plotted the resulting local average T' (local in H,S) as a surface in Figure 7 left. This surface lies slightly above 0 almost everywhere (by about 0.05 to 0.1 C), consistent with the bias noted before. There is no obvious low mode structure to the surface, which suggests that the model function dependence upon H and S is reasonably consistent with the H, S dependence of the LOTUS data. Said differently, the deviations do indeed appear to be random (aside from the bias of the analysis).

In a similar way the local average root mean square deviation was computed and plotted in Figure 7 right. This surface does have a significant low mode structure with the rms T' increasing as does ΔT_s. In the range where $\Delta T_s \approx 2$ C, the rms $T' \approx 0.4$ C. (In the limit of small H, large S, the rms $T' \approx 0.1$ C, which is essentially the statistics of the data itself.) A random error which increases with the signal might result from variable wind stress or insolation (recall that SD TAU/TAU is allowed to be as large as 1/2 here).

A statistical comparison of the DOSL model with the full data set shows that there is still a significant dependence of ΔT_s upon H and S (PV = 74, Table I), though on some specific days the deviation may be quite large.

V. CONCLUSIONS

The LOTUS-3 and LOTUS-5 data sets have been used to define and test model functions that relate the diurnal response of sea surface temperature to the imposed surface heat flux and wind stress. Either a best fit empirical function or the DOSL model function developed by PWP can account for roughly 80% of the ΔT_s variance observed in the LOTUS data set. The DOSL



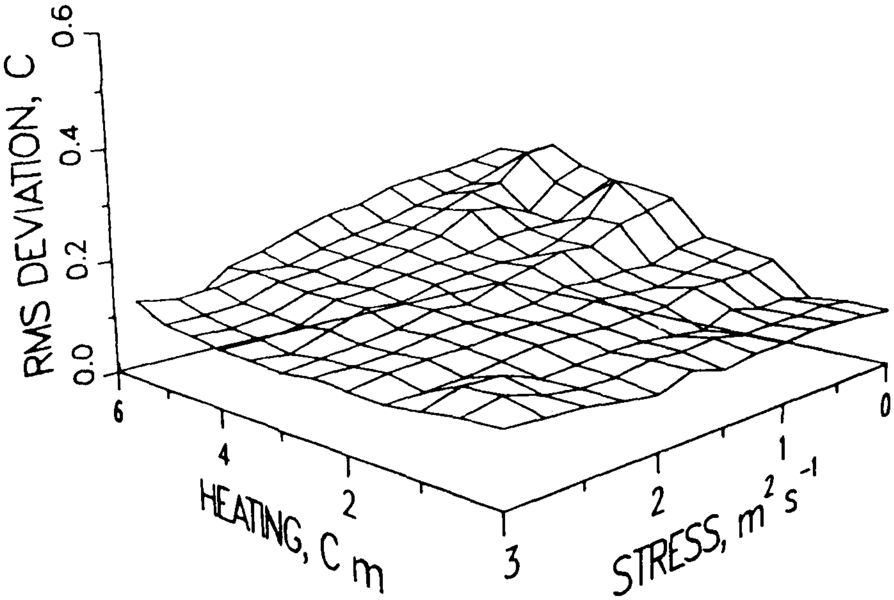


Figure 7: The average (top) and root mean square (bottom) field of the deviations, T', from Figure 6. The surfaces were constructed by smoothing over neighboring values. The heavy border shows where deviation = 0.

Note that the average value tends to be about 0.1 C throughout the full range of H and S, with little evidence of low mode structure. On the other hand, the rms value is largest where ΔT_S is also largest. This suggests that there may be a "hidden variable" not accounted for by the present scaling and model assumptions (e.g., using only the daily mean value to represent the wind stress).

function has the advantage of showing explicit dependence upon sea water optical properties and latitude, while in the empirical function this dependence is implicit in the parameter values.

The DOSL model function was based upon the idea that the currents generated by wind stress cause vertical mixing by a mechanism of shear flow instability. The resulting function $\Delta T_s(H,S)$ which follows from this idea has a parameter dependence consistent with the LOTUS field data. This is indirect evidence that the mixing assumption was a good one (but to make a strong test requires sensitivity testing and alternate model testing not attempted here).

The tests of the DOSL model function made here do suggest that that function is appropriate physically. That is, if given accurate forecasts of heating and wind stress, the DOSL model should return an accurate upper ocean forecast. Of course, on any specific site or day, the ocean's response could be dominated more by advection, or by sub-mesoscale variability of the winds, than by the forecast diurnal response (recall the larger scatter in the full data set compared to the screened data set.) It may be that the large scale (atmospheric mesoscale) patterns of diurnal warming will be forecast more successfully than will the point-wise response studied here.

The most readily observable quantities are the cloud cover (needed to calculate H) and the sea surface temperature itself. This suggests that an inversion of $\Delta T_s(H,S)$ to estimate S (or wind speed) might be useful at least in the low S regime where there is some sensitivity. As a qualitative example, Stramma et al. (1986) have shown that regions of large ΔT_s are coincident with regions of weak sea surface pressure gradient, e.g., ridges of the marine high pressure systems. Thus, given a map of H and ΔT_s a forecaster, or an analysis program, could easily sketch in the locations and perhaps some measure of the width of low wind speed regions over the world ocean.

Acknowledgments

We are grateful to the Office of Naval Research for their support of the LOTUS project through contracts N00014-76-C-0197, NR 083-400 and N00014-84-C-0134, NR 083-400 with the Woods Hole Oceanographic Institution. CMB was supported as a 1985 Lucretia Johnson Summer Fellow; JFP and RAW were supported by the ONR contracts mentioned above. Our thanks go also to Ms. Nancy Pennington who carried out much of the data reduction and plotting, and to Ms. Mary Ann Lucas and Ms. Barbara Gaffron who helped prepare the manuscript.

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APPENDIX A

Monthly Time-Series Plots of LOTUS Data

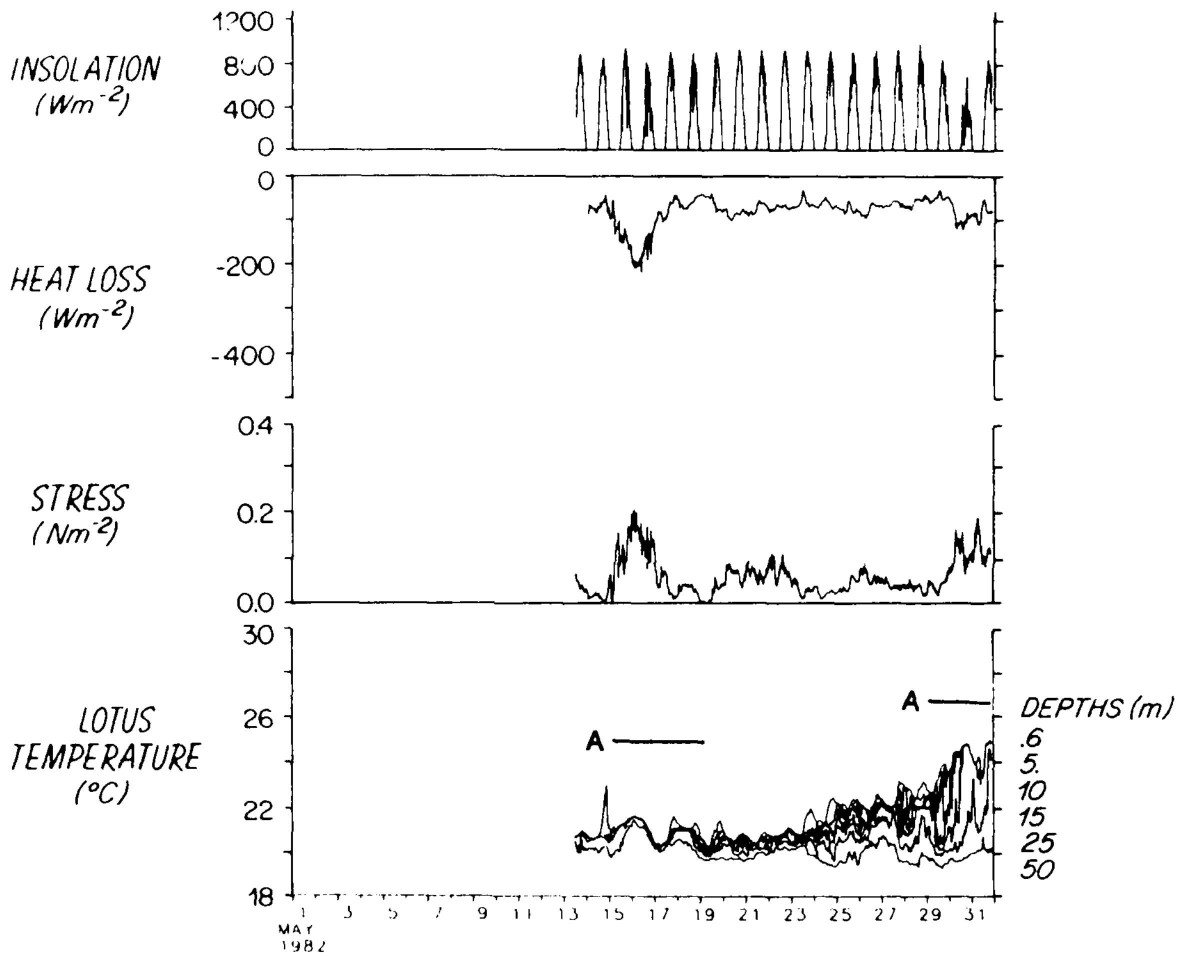

Figure A.1: Monthly time series from May, 1982. The periods during which advection appears to be important (discussed in Section II.D) are denoted by the bar labelled A.

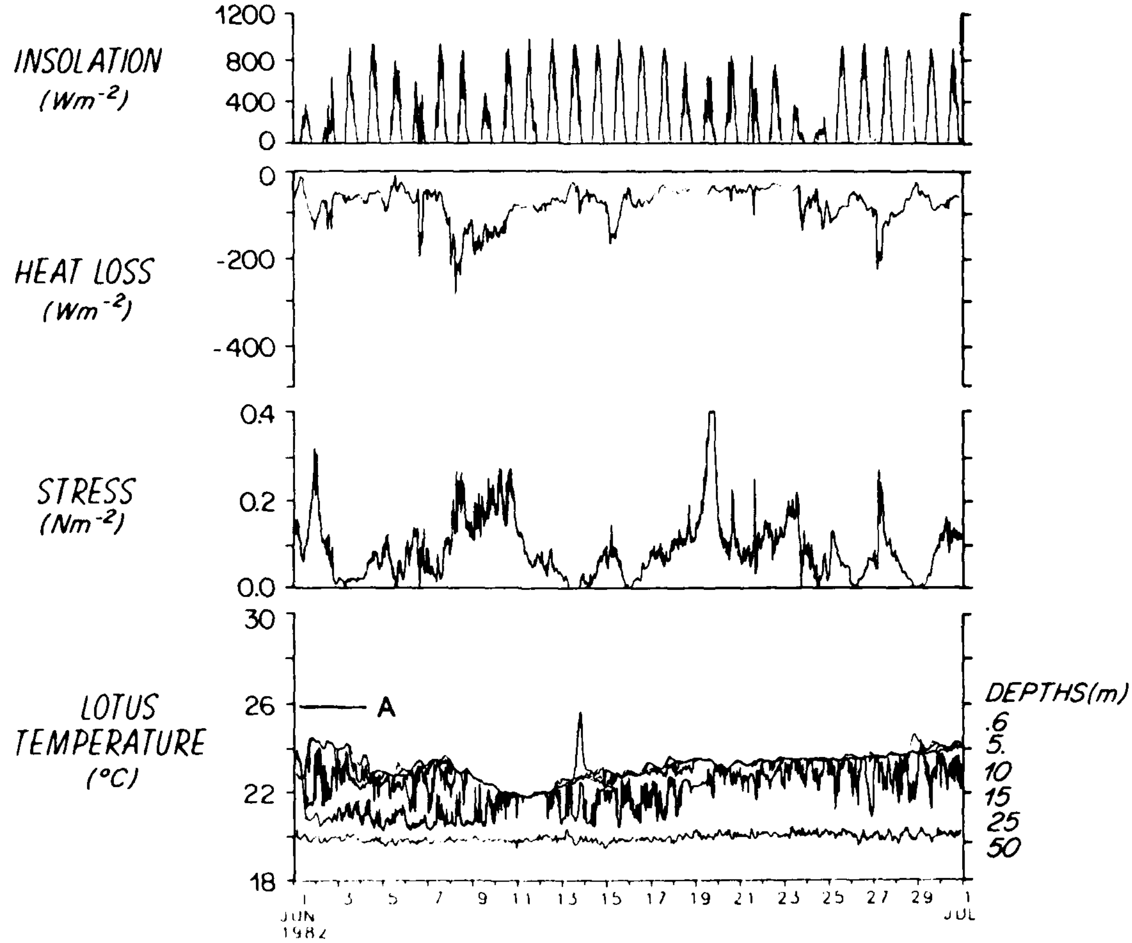

Figure A.2: Monthly time series from June, 1982.

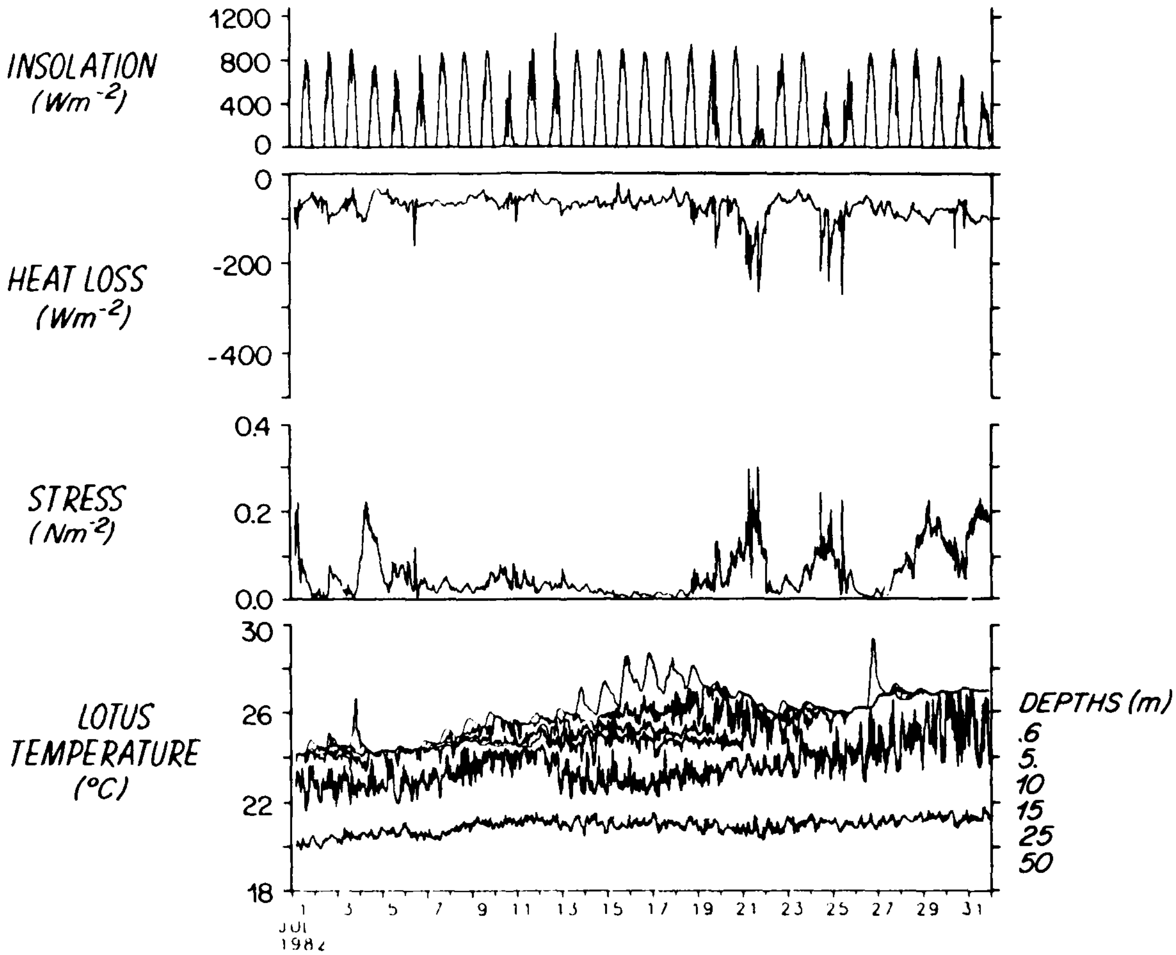

Figure A.3: Monthly time series from July, 1982.

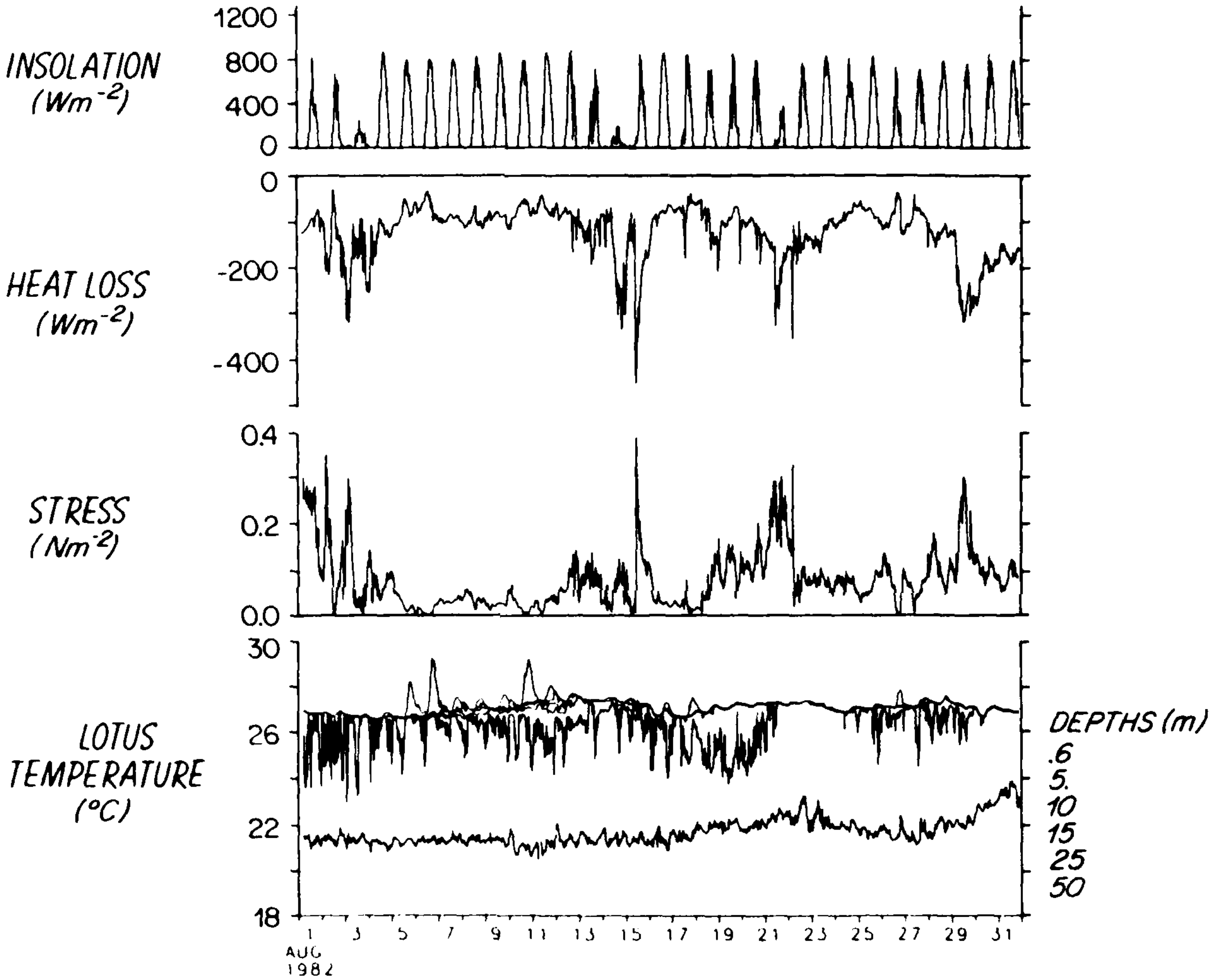

Figure A.4: Monthly time series from August, 1982.

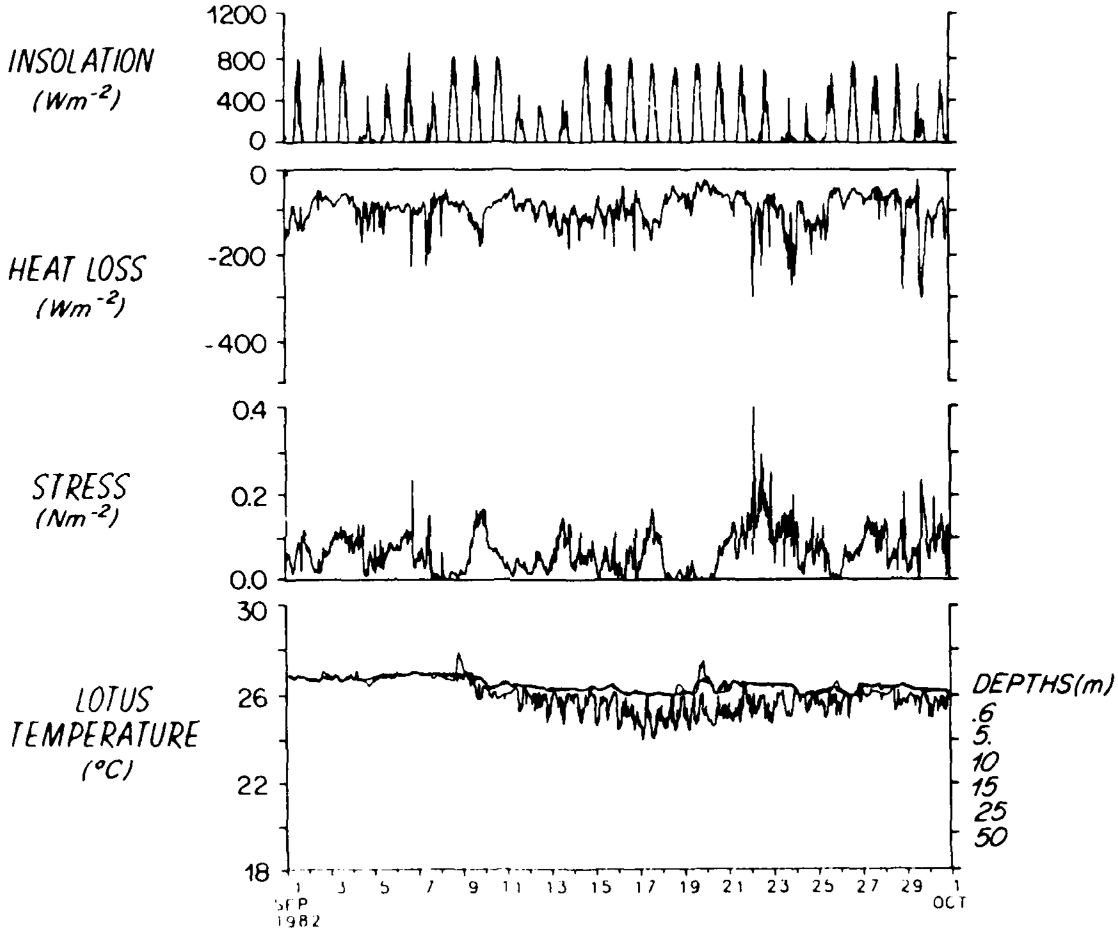

Figure A.5: Monthly time series from September, 1982.

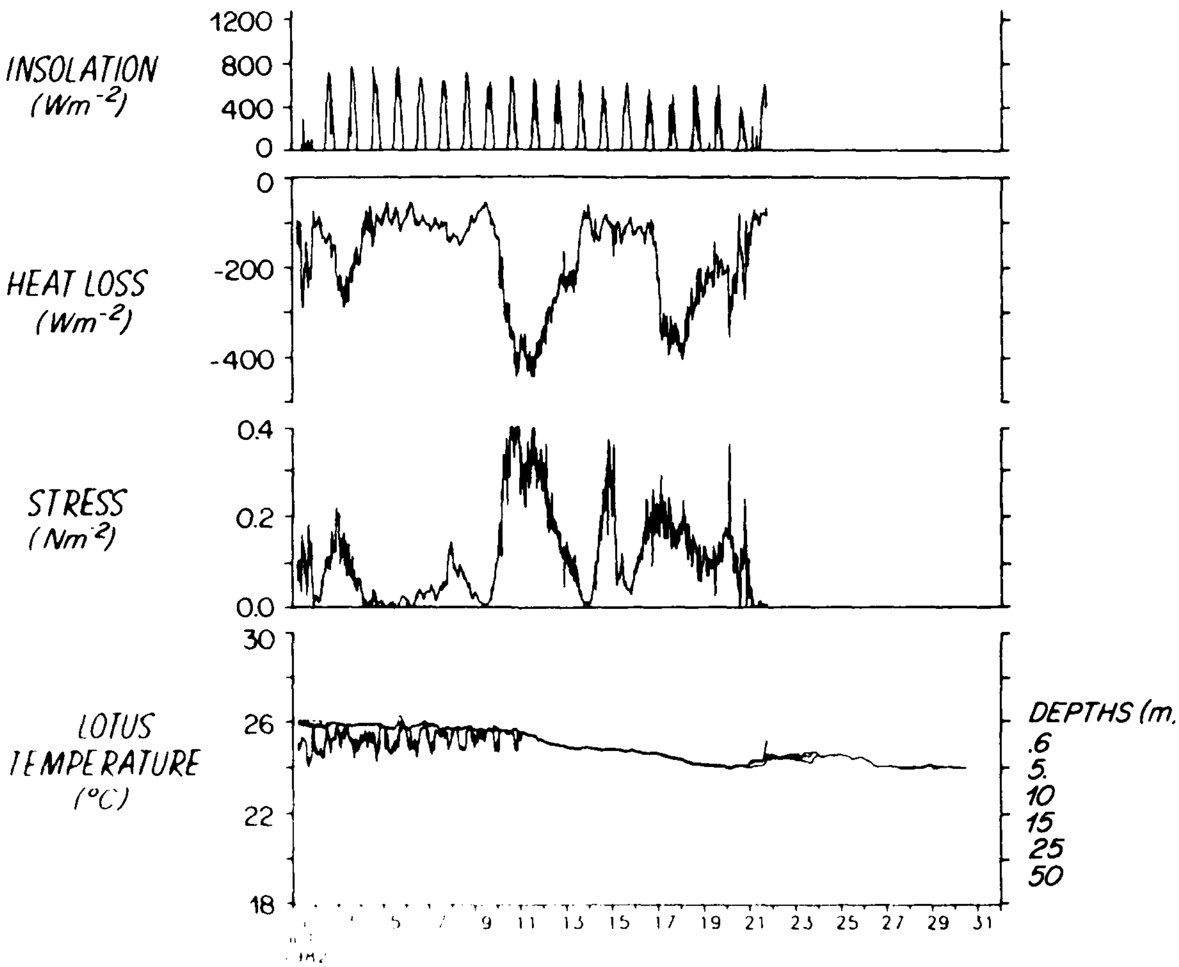

Figure A.6: Monthly time series from October, 1982.

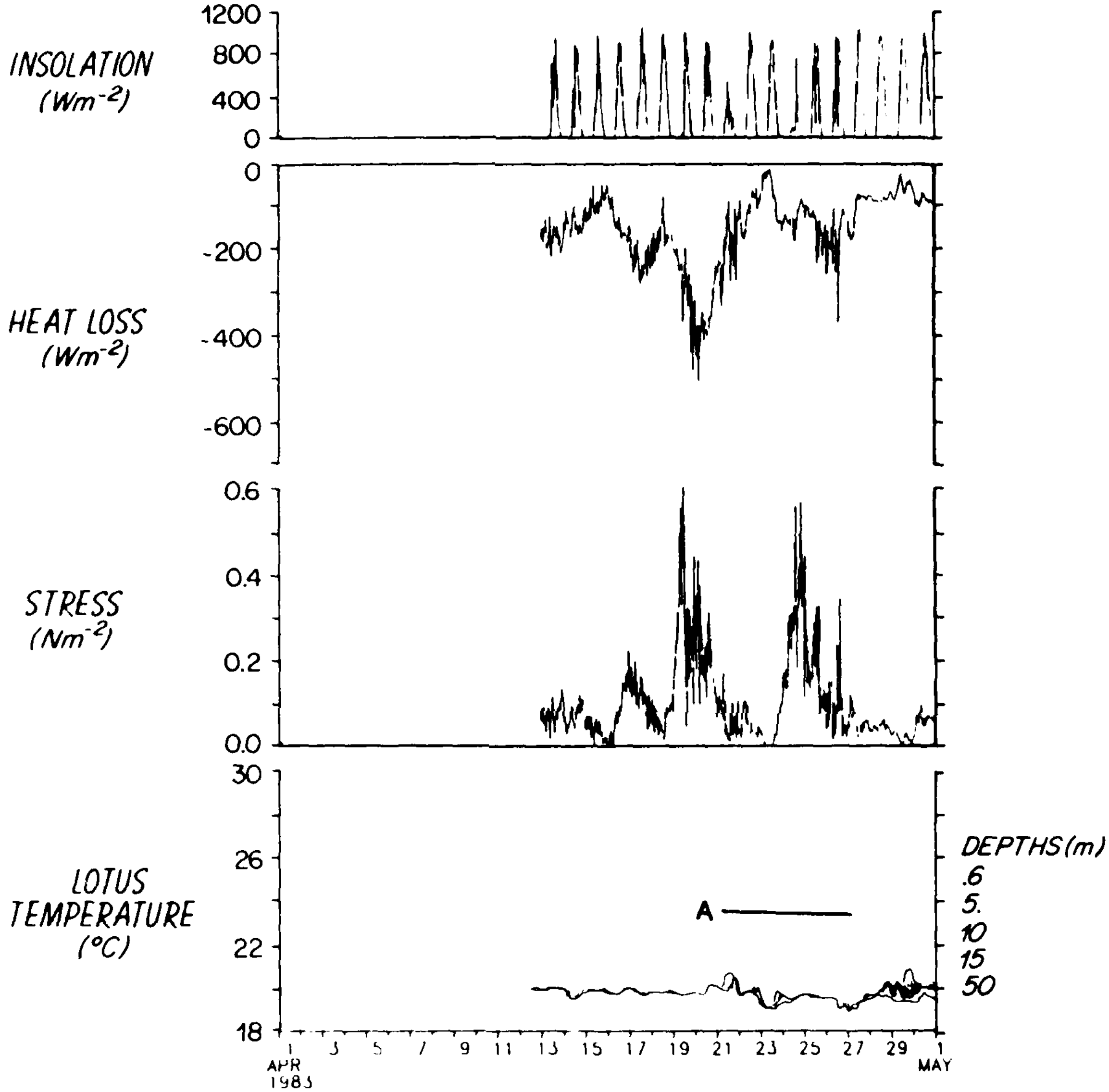

Figure A.7: Monthly time series from April, 1983.

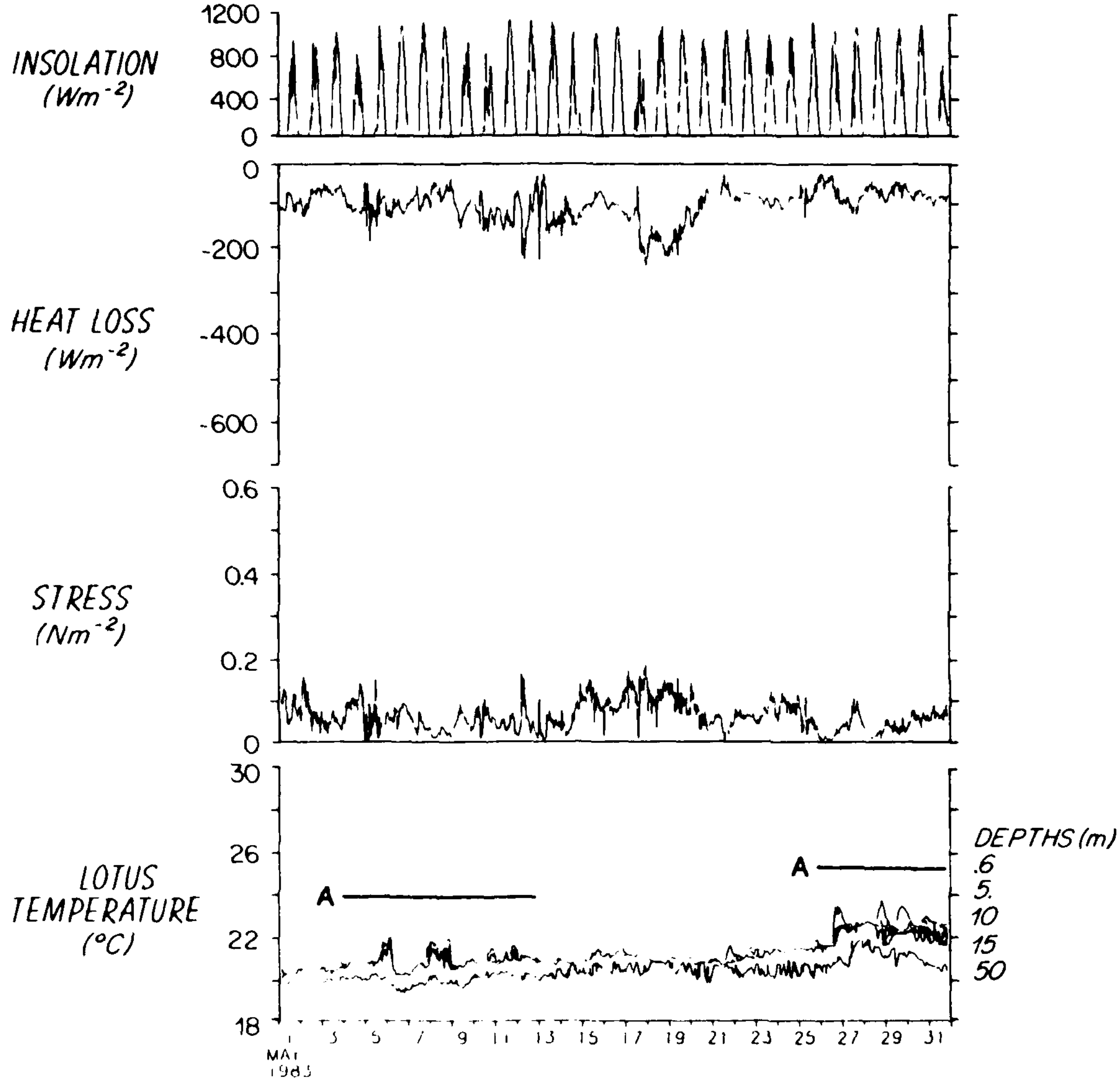

Figure A.8: Monthly time-series from May, 1983.

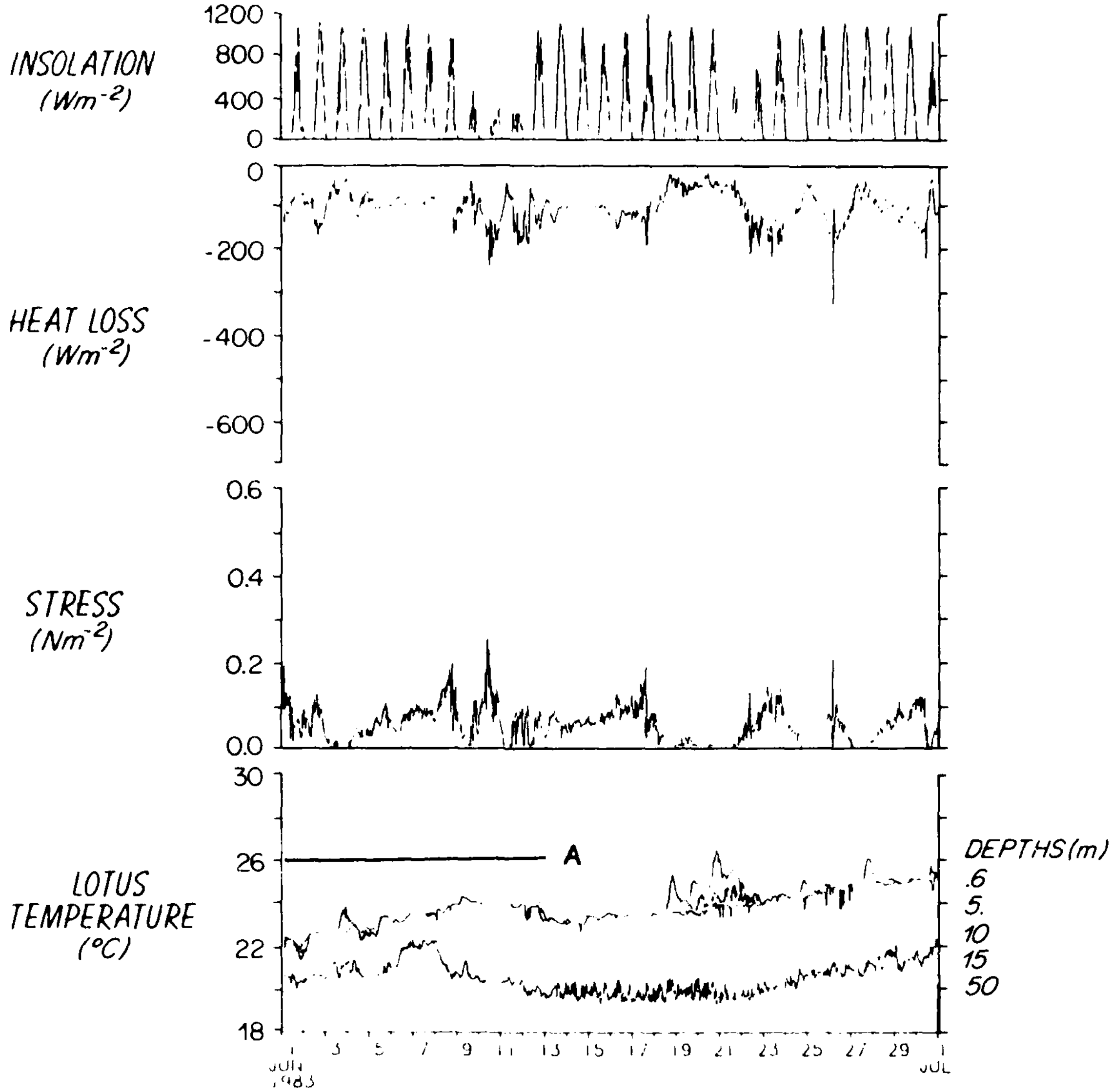

Figure A.9: Monthly time-series from June, 1983.

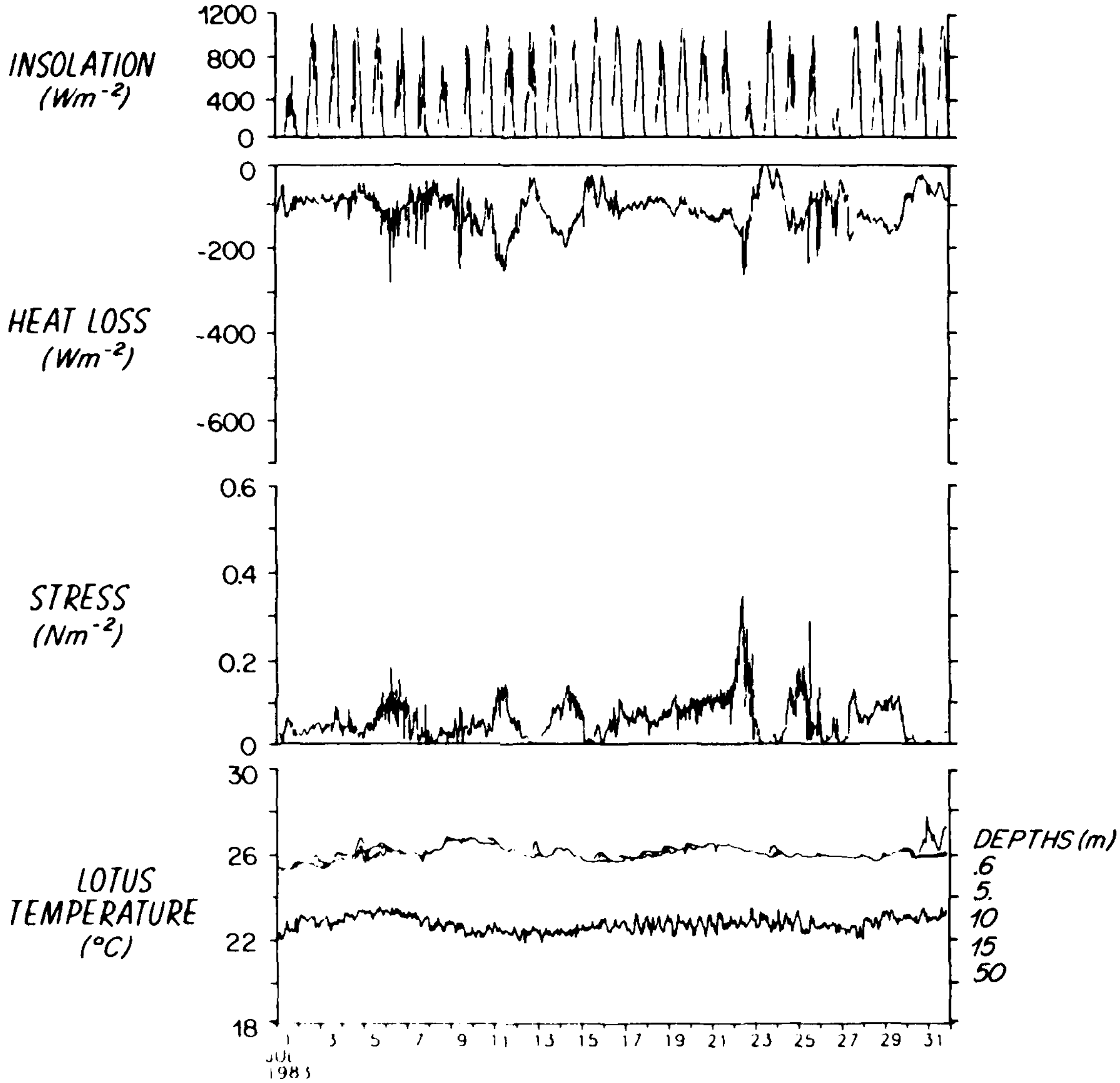

Figure A.10: Monthly time-series from July, 1983.

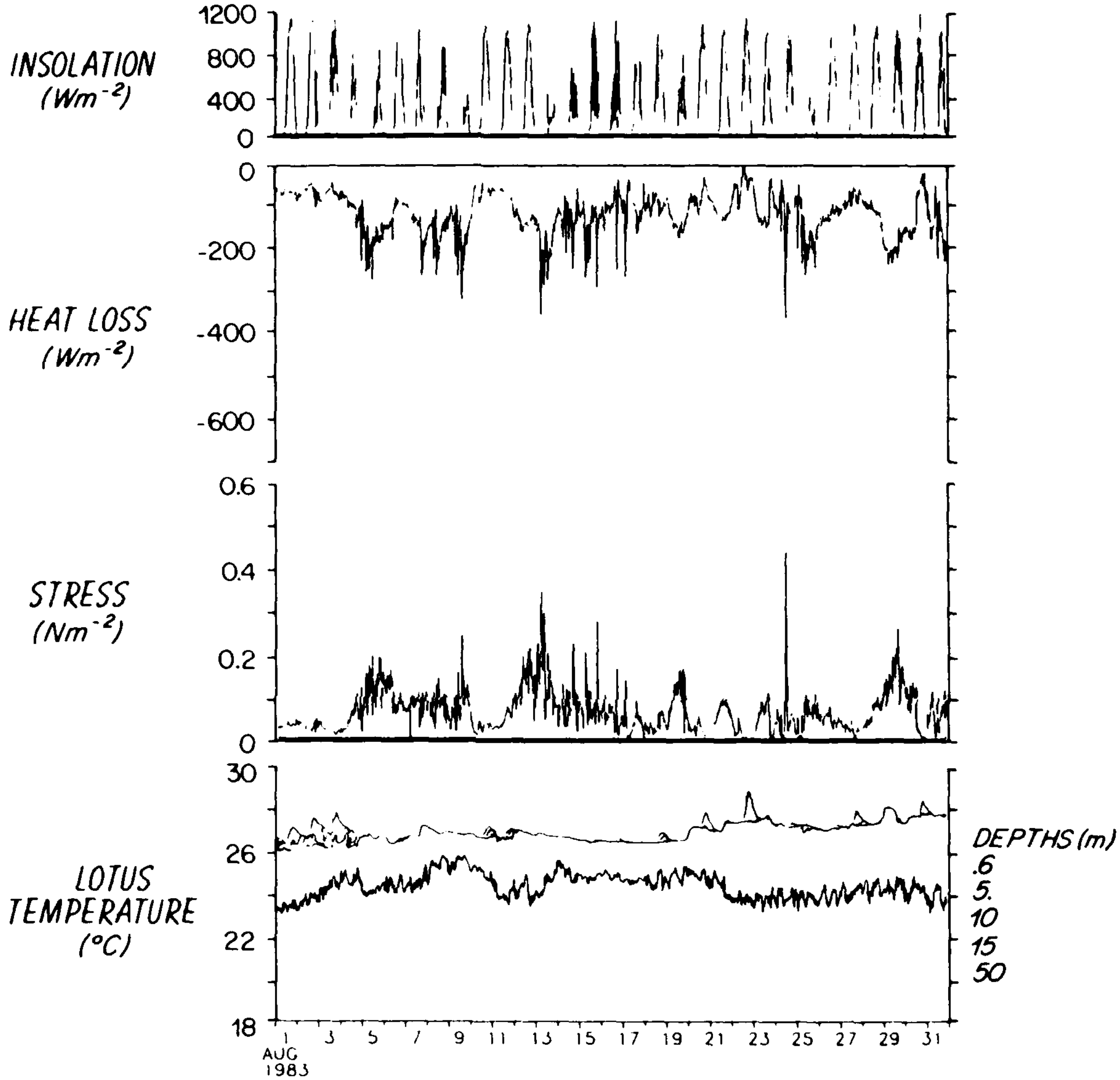

Figure A.11: Monthly time-series from August, 1983.

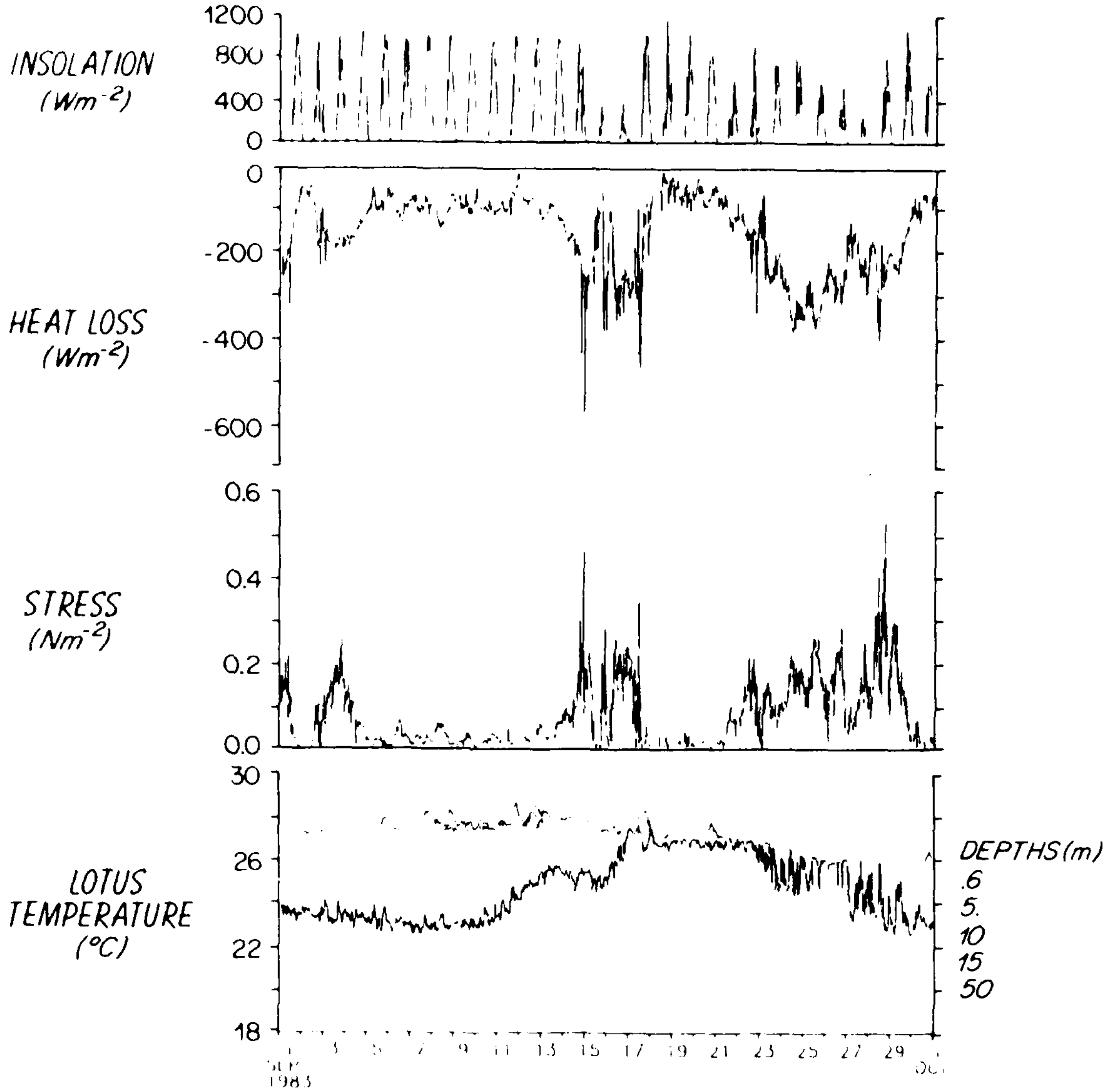

Figure A.12: Monthly time-series from September, 1983.

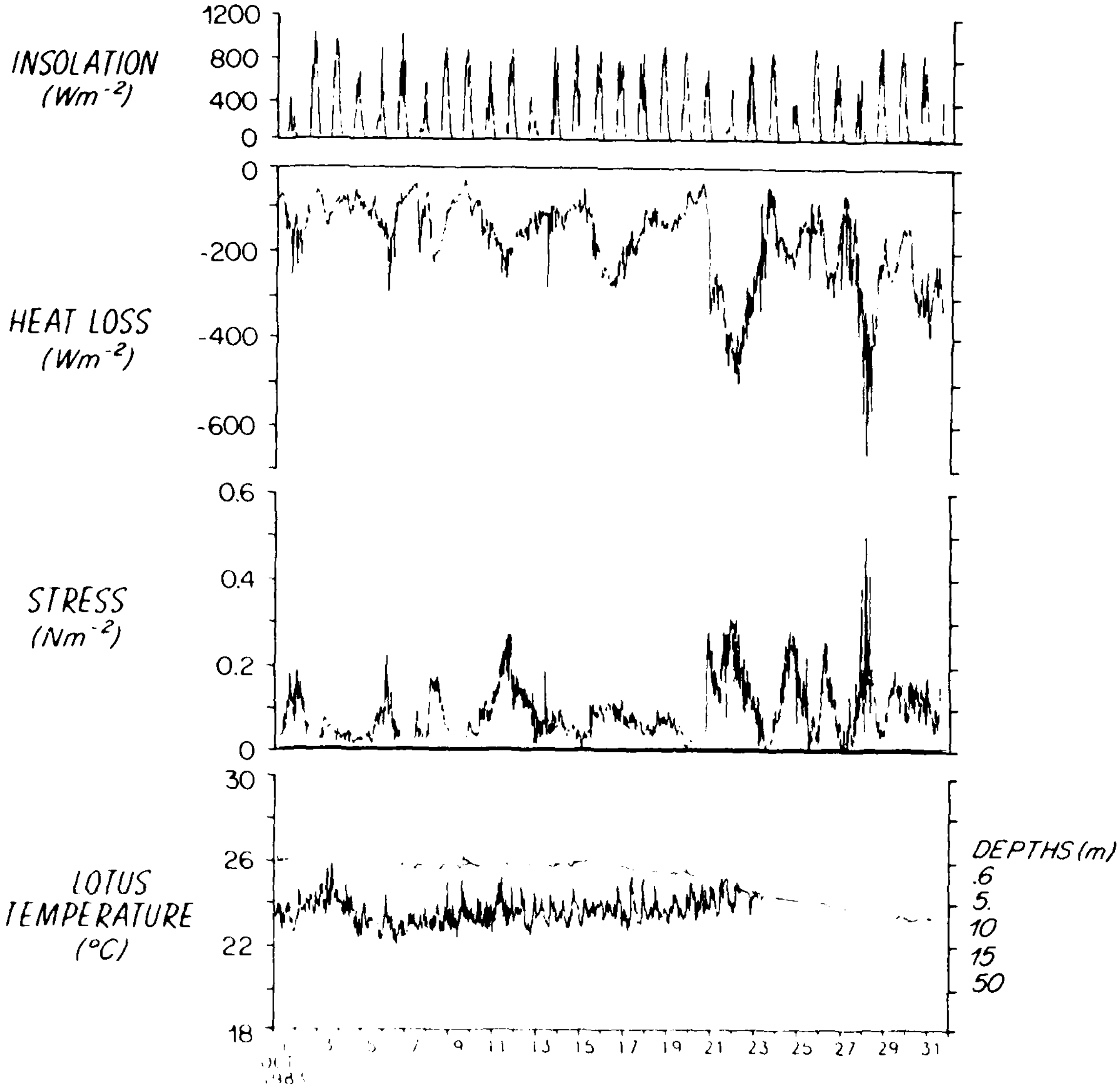

Figure A.13: Monthly time series from October, 1983.

APPENDIX B

Listing of Analyzed Data

YR	MO	DAY	DEL T	TAU	SD TAU	U	SD U	I1	I2	I3	SD I3	L	SD L	I2-L	PQ	PQ2	EPS	A	HEATING	STRES
82-	V	-14	2.377	0.012	0.013	2.2	0.8	1012	992	965	55	67	10	924	5.88	5.88	0.848	0	4.57	0.22
82-	V	-15	0.330	0.116	0.048	7.8	1.1	1118	952	958	140	146	12	805	5.25	5.25	-0.635	1	3.56	1.96
82-	V	-16	-0.098	0.126	0.030	8.1	0.6	970	653	635	173	148	16	505	5.13	5.00	8.731	1	2.18	2.08
82-	V	-17	1.251	0.030	0.023	3.6	1.4	1076	1002	982	75	67	16	935	6.00	6.00	-1.903	1	4.72	0.57
82-	V	-18	0.381	0.031	0.010	3.9	0.6	1067	860	835	141	58	8	802	6.00	6.00	3.304	1	4.05	0.59
82-	V	-19	1.201	0.030	0.016	3.7	1.1	1076	953	938	123	69	13	883	5.88	5.88	-2.104	1	4.37	0.55
82-	V	-20	0.459	0.059	0.015	5.5	0.7	1102	1035	1034	55	86	4	949	6.13	6.13	0.294	0	4.89	1.13
82-	V	-21	0.566	0.058	0.012	5.4	0.5	1106	929	923	105	66	5	863	6.13	6.13	-0.226	0	4.45	1.10
82-	V	-22	0.401	0.075	0.015	6.3	0.5	1098	1049	1045	54	72	3	976	6.00	6.00	0.471	0	4.93	1.41
82-	V	-23	1.216	0.023	0.009	3.3	0.7	1099	1039	1028	68	59	11	979	6.13	6.13	-0.071	0	5.05	0.45
82-	V	-24	1.153	0.023	0.006	3.3	0.4	1099	961	966	126	65	8	895	6.25	6.25	0.354	0	4.71	0.44
82-	V	-25	0.696	0.046	0.016	4.8	0.8	1081	978	946	104	75	9	903	6.25	6.25	0.558	0	4.75	0.89
82-	V	-26	0.911	0.051	0.009	5.1	0.4	1099	959	931	99	67	3	891	6.13	6.13	-1.621	0	4.59	0.97
82-	V	-27	1.202	0.036	0.006	4.2	0.3	1113	973	963	114	63	5	909	6.25	6.25	3.174	0	4.78	0.69
82-	V	-28	0.805	0.032	0.013	4.0	0.7	1166	941	936	139	53	4	888	6.25	6.25	-0.634	0	4.67	0.62
82-	V	-29	0.787	0.041	0.015	4.5	0.9	1008	852	838	118	48	7	804	6.25	6.25	-2.506	1	4.23	0.80
82-	V	-30	0.345	0.104	0.027	7.4	0.8	820	560	525	147	101	10	458	5.50	5.25	-3.232	1	2.12	1.83
82-	V	-31	1.522	0.107	0.014	7.5	0.5	1005	898	890	87	75	12	823	5.75	5.75	-7.496	1	3.98	1.94
82-	VI	-01	1.792	0.116	0.044	7.7	1.3	443	338	323	50	62	27	275	5.00	5.00	-3.001	1	1.16	1.87
82-	VI	-02	0.057	0.072	0.036	5.9	1.7	745	341	267	177	93	22	248	5.88	4.88	7.258	1	1.23	1.33
82-	VI	-03	0.128	0.026	0.011	3.5	0.3	1065	770	755	140	71	4	699	6.00	6.00	7.669	1	3.53	0.49
82-	VI	-04	0.238	0.072	0.014	6.1	0.6	1095	907	913	102	60	3	847	6.13	6.13	1.448	0	4.37	1.37
82-	VI	-05	0.722	0.040	0.040	4.3	1.3	912	759	733	129	43	10	715	6.13	6.13	0.342	0	3.69	0.76
82-	VI	-06	0.095	0.088	0.079	6.7	1.4	684	393	330	191	105	48	287	6.00	4.38	-7.127	0	1.45	1.65
82-	VI	-07	0.281	0.064	0.036	5.5	1.6	1095	834	831	149	76	18	758	5.88	5.75	2.674	0	3.75	1.17
82-	VI	-08	0.226	0.191	0.041	9.8	0.8	1027	735	745	181	179	33	555	4.13	3.88	-0.208	0	1.93	2.62
82-	VI	-09	-0.002	0.187	0.033	9.8	0.6	569	451	412	98	148	12	303	4.63	4.50	0.250	0	1.18	2.83
82-	VI	-10	0.042	0.211	0.043	10.3	0.7	1038	834	828	129	107	14	726	5.25	5.25	0.850	0	3.21	3.57
82-	VI	-11	0.251	0.067	0.013	5.9	0.5	1149	798	768	215	87	5	710	5.75	5.75	-0.089	0	3.44	1.21
82-	VI	-12	0.680	0.058	0.022	5.4	0.8	1148	938	939	114	77	5	860	6.13	6.13	0.973	0	4.44	1.10
82-	VI	-13	3.095	0.008	0.012	1.7	1.0	1091	998	973	124	54	21	943	5.88	5.88	-1.245	0	4.66	0.15
82-	VI	-14	0.324	0.061	0.026	5.5	1.0	1080	957	964	100	75	7	881	5.88	5.88	0.784	0	4.36	1.12
82-	VI	-15	0.406	0.044	0.025	4.5	1.5	1144	1024	1015	74	101	29	922	5.75	5.75	0.635	0	4.46	0.80
82-	VI	-16	0.600	0.046	0.015	4.7	0.8	1082	1016	1010	59	80	5	935	6.00	6.00	-0.876	0	4.72	0.86
82-	VI	-17	0.621	0.075	0.021	6.2	0.6	1044	898	906	107	49	4	849	6.00	6.00	-0.960	0	4.29	1.40
82-	VI	-18	0.172	0.123	0.021	8.1	0.6	898	635	618	120	53	2	582	5.88	5.88	0.263	0	2.88	2.27
82-	VI	-19	-0.003	0.373	0.105	12.7	1.0	730	534	506	125	56	9	478	5.75	5.75	1.975	0	2.31	6.77
82-	VI	-20	0.366	0.117	0.047	7.8	1.1	967	737	704	186	53	10	684	6.38	6.38	-0.651	0	3.67	2.30
82-	VI	-21	0.231	0.092	0.044	6.8	1.4	969	641	568	243	53	14	587	6.13	5.63	-1.074	0	3.03	1.74
82-	VI	-22	0.248	0.114	0.019	7.8	0.7	861	676	679	106	43	3	632	6.13	6.00	-0.177	0	3.26	2.16

YR	MO	DAY	DEL T	TAU	SD TAU	U	SD U	I1	I2	I3	SD I3	L	SD L	I2-L	PQ	PQ2	EPS	A	HEATING	STRES
82-	VI	-23	0.038	0.132	0.066	8.1	2.2	421	294	277	102	62	24	231	5.00	4.25	2.721	0	0.98	2.14
82-	VI	-24	0.045	0.040	0.031	4.2	1.5	304	194	150	72	98	28	95	5.38	3.88	-10.595	0	0.43	0.69
82-	VI	-25	0.347	0.058	0.012	5.4	0.4	1056	913	911	75	94	5	821	6.13	6.13	-0.274	0	4.24	1.10
82-	VI	-26	0.443	0.048	0.018	4.8	0.9	1091	888	896	111	83	12	805	5.63	5.63	3.010	0	3.81	0.86
82-	VI	-27	0.291	0.101	0.024	7.2	0.6	1052	725	715	298	122	13	602	5.50	5.50	0.152	0	2.79	1.76
82-	VI	-28	1.024	0.019	0.012	2.8	1.0	1021	1008	996	17	69	13	939	6.25	6.25	0.955	0	4.94	0.36
82-	VI	-29	0.442	0.063	0.032	5.6	1.2	1046	933	927	70	84	13	849	6.13	6.13	-0.768	0	4.38	1.21
82-	VI	-30	0.298	0.122	0.016	8.0	0.3	1037	811	781	122	71	3	740	5.25	5.25	0.451	0	3.27	2.05
82-	VII	-01	0.715	0.043	0.026	4.4	1.5	951	896	881	69	62	9	833	5.75	5.75	1.028	0	4.03	0.78
82-	VII	-02	0.763	0.043	0.031	4.3	1.7	1036	896	899	93	88	15	807	5.63	5.63	2.413	0	3.82	0.76
82-	VII	-03	2.325	0.017	0.021	2.7	1.0	1067	1006	992	66	64	13	941	6.13	6.13	0.782	0	4.85	0.33
82-	VII	-04	0.160	0.135	0.029	8.4	0.9	891	855	830	56	49	13	806	6.13	6.13	0.610	0	4.15	2.56
82-	VII	-05	0.311	0.068	0.016	5.9	0.6	848	629	606	107	66	6	562	5.13	5.13	1.775	0	2.43	1.12
82-	VII	-06	0.456	0.035	0.020	4.0	0.9	1001	662	643	146	74	10	587	5.38	5.38	0.787	0	2.66	0.59
82-	VII	-07	0.696	0.036	0.016	4.2	0.7	1024	963	952	53	70	4	893	6.25	6.25	0.321	0	4.70	0.70
82-	VII	-08	0.836	0.026	0.008	3.5	0.5	1036	1019	1001	20	64	7	955	6.38	6.38	-0.139	0	5.13	0.51
82-	VII	-09	0.753	0.041	0.016	4.5	0.9	1043	1003	988	70	54	8	949	6.25	6.25	0.528	0	4.99	0.79
82-	VII	-10	0.141	0.046	0.021	4.7	1.0	822	346	333	175	63	10	282	4.75	4.75	-0.758	0	1.13	0.72
82-	VII	-11	0.576	0.028	0.012	3.6	0.8	1052	831	822	133	52	6	779	6.13	6.13	-0.663	0	4.02	0.54
82-	VII	-12	0.693	0.027	0.007	3.6	0.4	1227	710	688	204	64	3	645	5.63	5.63	1.622	0	3.06	0.49
82-	VII	-13	1.291	0.023	0.006	3.2	0.4	1051	1014	993	62	71	5	942	6.13	6.13	0.754	0	4.86	0.43
82-	VII	-14	1.560	0.015	0.006	2.6	0.5	1054	1003	1003	72	68	8	934	6.25	6.25	-1.061	0	4.91	0.30
82-	VII	-15	2.481	0.007	0.004	1.6	0.4	1059	1006	998	53	55	14	950	6.50	6.50	-0.112	0	5.20	0.14
82-	VII	-16	1.803	0.008	0.004	1.8	0.3	1024	996	983	41	65	6	931	6.38	6.38	-0.476	0	4.99	0.16
82-	VII	-17	1.698	0.009	0.003	1.9	0.3	1029	974	973	67	56	9	917	6.38	6.38	0.031	0	4.92	0.18
82-	VII	-18	1.076	0.022	0.018	3.0	1.2	1107	986	982	63	68	20	917	6.00	6.00	0.288	0	4.63	0.41
82-	VII	-19	0.430	0.054	0.039	5.0	1.7	1034	780	770	166	87	32	692	5.88	5.75	0.616	0	3.42	1.00
82-	VII	-20	0.350	0.098	0.023	7.1	0.7	1082	928	936	115	82	21	845	6.25	6.25	1.285	0	4.45	1.88
82-	VII	-21	0.140	0.149	0.059	8.7	1.2	881	232	212	139	174	47	58	4.25	2.00	42.192	0	0.21	2.10
82-	VII	-22	0.756	0.026	0.017	3.4	1.1	1007	901	871	106	59	6	842	6.25	6.25	0.329	0	4.43	0.50
82-	VII	-23	0.482	0.046	0.024	4.6	1.4	1024	973	957	51	55	9	917	6.38	6.38	-0.575	0	4.92	0.91
82-	VII	-24	-0.018	0.113	0.019	7.7	0.5	624	353	365	95	110	24	243	3.38	3.25	-0.251	0	0.69	1.29
82-	VII	-25	0.306	0.044	0.034	4.6	1.1	844	459	424	199	89	15	370	5.38	5.25	-3.277	0	1.68	0.75
82-	VII	-26	3.216	0.007	0.008	1.6	0.6	1020	1010	988	41	70	14	939	6.13	6.13	-0.861	0	4.84	0.14
82-	VII	-27	0.554	0.044	0.022	4.5	1.2	1062	945	947	94	86	12	859	6.00	6.00	2.001	0	4.34	0.82
82-	VII	-28	0.310	0.105	0.039	7.3	1.4	1071	959	946	78	85	8	874	6.00	6.00	0.272	0	4.41	1.97
82-	VII	-29	0.161	0.160	0.019	9.2	0.4	986	867	885	104	83	3	784	5.25	5.25	0.743	0	3.46	2.70
82-	VII	-30	0.219	0.080	0.027	6.4	1.0	789	568	563	103	75	15	492	5.50	5.38	-2.401	0	2.28	1.40
82-	VII	-31	0.049	0.195	0.021	10.0	0.3	636	522	484	93	99	4	422	5.25	5.25	-0.114	0	1.87	3.29
82-	VIII	-01	0.039	0.218	0.056	10.3	1.1	967	597	588	115	97	11	500	4.88	4.88	4.755	0	2.05	3.45

YR MO DAY	DEL T	TAU	SD TAU	U	SD U	I1	I2	I3	SD I3	L	SD L	I2-L	PQ	PQ2	EPS	A	HEATING	STRES
82-VIII-02	0.292	0.048	0.042	4.4	2.3	800	450	449	164	95	38	355	3.75	3.63	-2.621	0	1.12	0.61
82-VIII-03	0.086	0.030	0.023	3.6	1.1	323	163	155	50	154	32	8	4.75	2.13	309.765	0	0.03	0.46
82-VIII-04	0.313	0.063	0.028	5.6	1.0	1029	965	956	57	112	11	852	5.00	5.00	0.195	0	3.59	1.03
82-VIII-05	1.651	0.017	0.009	2.7	0.8	947	908	889	44	74	13	833	5.88	5.88	-2.123	0	4.12	0.31
82-VIII-06	2.527	0.009	0.009	1.7	0.9	947	904	899	63	63	20	841	5.88	5.88	-1.098	0	4.16	0.16
82-VIII-07	0.798	0.031	0.006	3.9	0.3	954	934	920	29	91	3	842	5.88	5.88	-0.164	0	4.16	0.58
82-VIII-08	0.612	0.029	0.017	3.6	0.7	978	915	898	59	95	14	820	5.50	5.50	0.093	0	3.80	0.50
82-VIII-09	0.738	0.024	0.006	3.4	0.3	1011	942	936	68	87	4	854	5.75	5.75	1.330	0	4.13	0.44
82-VIII-10	2.067	0.010	0.007	2.0	0.6	937	905	886	57	62	5	842	5.88	5.88	1.345	0	4.17	0.19
82-VIII-11	0.792	0.029	0.016	3.6	1.0	1012	981	971	74	70	14	911	6.00	6.00	1.961	0	4.60	0.54
82-VIII-12	0.451	0.093	0.036	6.9	1.1	1035	849	838	176	88	17	760	5.63	5.38	-1.531	0	3.60	1.67
82-VIII-13	0.044	0.084	0.025	6.5	0.7	852	507	472	186	132	33	375	4.88	3.88	2.676	0	1.54	1.33
82-VIII-14	-0.035	0.049	0.033	4.8	1.1	251	154	130	50	128	21	26	0.75	0.25	-54.163	0	0.02	0.13
82-VIII-15	0.355	0.135	0.033	8.3	0.8	998	475	442	247	224	44	251	3.38	3.38	1.768	0	0.71	1.54
82-VIII-16	0.658	0.027	0.009	3.6	0.3	1008	1016	997	35	79	6	936	5.75	5.75	1.043	0	4.53	0.49
82-VIII-17	1.108	0.024	0.025	3.2	1.1	995	734	757	204	79	32	654	5.88	5.38	-0.542	0	3.24	0.44
82-VIII-18	0.334	0.074	0.035	6.0	1.5	840	613	605	155	109	28	504	5.13	4.88	-1.751	0	2.17	1.23
82-VIII-19	0.225	0.103	0.041	7.2	1.3	1005	665	668	179	83	11	581	5.25	5.25	-0.599	0	2.57	1.74
82-VIII-20	0.122	0.132	0.039	8.3	1.0	933	701	690	154	115	23	585	4.88	4.63	-0.948	0	2.40	2.09
82-VIII-21	-0.025	0.226	0.042	10.5	0.7	452	267	241	120	203	19	63	2.00	2.00	5.208	0	0.11	1.57
82-VIII-22	0.163	0.076	0.029	6.1	1.1	899	546	538	230	141	16	405	4.88	4.88	0.373	0	1.66	1.20
82-VIII-23	0.062	0.068	0.019	5.8	0.6	977	971	951	39	115	13	856	5.25	5.25	2.009	0	3.78	1.14
82-VIII-24	0.252	0.073	0.021	6.1	0.5	952	772	750	96	81	9	690	5.38	5.38	-0.145	0	3.12	1.26
82-VIII-25	0.308	0.072	0.021	6.0	0.9	972	910	897	52	86	8	824	5.63	5.63	0.713	0	3.90	1.29
82-VIII-26	0.833	0.027	0.031	3.1	1.9	861	552	555	136	64	16	488	4.50	4.38	-0.512	0	1.85	0.39
82-VIII-27	0.436	0.053	0.023	5.0	1.1	838	777	744	101	79	9	698	5.25	5.25	-0.766	0	3.08	0.89
82-VIII-28	0.399	0.076	0.029	6.2	0.9	926	893	876	65	123	10	769	4.50	4.50	-0.429	0	2.91	1.12
82-VIII-29	0.120	0.201	0.065	9.9	1.3	904	733	746	110	275	31	457	3.00	3.00	-1.364	0	1.15	2.07
82-VIII-30	0.312	0.100	0.020	7.2	0.5	1001	884	848	113	195	11	689	4.88	4.88	-1.232	0	2.83	1.59
82-VIII-31	0.003	0.100	0.018	7.2	0.5	937	896	872	76	176	10	719	5.00	5.00	1.468	0	3.03	1.62
82- IX -01	0.030	0.071	0.022	6.0	0.9	920	648	644	156	131	14	516	4.00	3.88	1.542	0	1.74	0.95
82- IX -02	0.532	0.048	0.036	4.8	1.1	1046	860	851	88	74	10	785	4.88	4.88	0.243	0	3.22	0.75
82- IX -03	0.284	0.104	0.015	7.4	0.4	908	849	823	92	71	4	777	5.00	5.00	-0.429	0	3.27	1.69
82- IX -04	0.065	0.052	0.021	5.0	1.0	519	140	134	80	130	17	9	1.75	1.75	-6.119	0	0.01	0.32
82- IX -05	0.096	0.077	0.021	6.3	0.5	652	430	435	111	98	7	332	3.75	3.75	1.459	0	1.05	0.97
82- IX -06	0.158	0.097	0.054	7.0	1.4	987	670	670	162	111	33	558	4.88	4.63	0.295	0	2.29	[illegible]
82- IX -07	0.163	0.022	0.031	2.9	1.6	563	327	289	131	108	34	219	4.63	3.50	0.892	0	0.86	0.34
82- IX -08	1.360	0.018	0.006	2.8	0.4	936	860	845	72	91	4	769	5.25	5.25	0.437	0	3.40	0.31
82- IX -09	0.157	0.139	0.021	8.6	0.6	957	871	840	97	142	15	728	5.13	5.13	1.655	0	3.14	2.31
82- IX -10	0.267	0.059	0.016	5.4	0.6	934	895	878	51	85	4	809	5.38	5.38	0.271	0	3.66	1.01

YR	MO	DAY	DEL T	TAU	SD TAU	U	SD U	I1	I2	I3	SD I3	L	SD L	I2-L	PQ	PQ2	EPS	A	HEATING	STRES
82-	IX	-11	0.034	0.041	0.009	4.5	0.4	536	335	308	84	97	7	238	4.63	4.63	1.762	0	0.93	0.63
82-	IX	-12	-0.014	0.044	0.016	4.6	0.7	409	352	340	56	93	10	259	3.50	3.50	4.078	0	0.76	0.52
82-	IX	-13	0.099	0.101	0.032	7.2	0.6	476	309	288	83	125	9	183	3.25	3.25	-1.377	0	0.50	1.11
82-	IX	-14	0.191	0.057	0.018	5.3	0.5	959	820	814	100	123	6	697	4.75	4.75	0.463	0	2.79	0.88
82-	IX	-15	0.221	0.046	0.032	4.7	1.0	844	721	701	166	117	17	603	4.50	4.25	1.531	0	2.29	0.69
82-	IX	-16	0.248	0.056	0.036	5.1	1.6	929	822	820	116	112	29	710	5.13	4.75	0.828	0	3.06	0.92
82-	IX	-17	0.088	0.119	0.028	7.9	0.8	898	775	778	85	143	17	631	4.75	4.75	0.457	0	2.52	1.85
82-	IX	-18	0.554	0.013	0.011	2.3	0.9	817	777	766	60	66	10	710	5.13	5.13	-0.098	0	3.06	0.22
82-	IX	-19	1.151	0.008	0.008	1.8	0.6	853	865	843	51	59	13	806	5.38	5.38	-0.899	0	3.65	0.14
82-	IX	-20	0.410	0.063	0.029	5.6	0.9	882	762	739	110	68	6	694	5.13	5.13	-1.268	0	2.99	1.04
82-	IX	-21	0.143	0.110	0.029	7.5	1.0	863	659	643	122	71	9	588	5.13	5.13	0.347	0	2.54	1.81
82-	IX	-22	0.070	0.172	0.048	9.4	1.0	800	492	478	145	109	43	383	4.75	3.88	0.463	0	1.53	2.66
82-	IX	-23	0.006	0.139	0.011	8.6	0.3	486	110	104	94	194	8	-83	0.25	0.25	0.198	0	-0.02	0.12
82-	IX	-24	0.084	0.076	0.015	6.2	0.3	440	187	129	131	139	7	48	0.88	0.88	-0.051	0	0.04	0.23
82-	IX	-25	0.597	0.018	0.015	2.7	1.0	757	511	492	154	76	25	435	4.63	4.63	0.879	0	1.69	0.27
82-	IX	-26	0.579	0.063	0.022	5.7	0.4	890	805	800	81	63	6	741	5.00	5.00	-2.003	0	3.12	1.01
82-	IX	-27	0.122	0.103	0.027	7.3	0.8	726	679	661	91	64	16	615	4.88	4.63	1.319	0	2.52	1.64
82-	IX	-28	0.185	0.086	0.032	6.6	1.2	851	528	561	167	76	14	451	4.13	4.13	0.027	0	1.57	1.18
82-	IX	-29	0.027	0.117	0.110	7.4	2.4	644	245	195	133	185	97	60	4.63	1.63	-5.967	0	0.23	1.77
82-	IX	-30	0.022	0.105	0.030	7.4	1.1	689	380	353	177	86	6	294	3.00	3.00	1.532	0	0.74	1.08
82-	X	-01	0.024	0.103	0.077	7.2	1.5	382	132	108	68	201	27	-69	4.50	0.38	-0.852	0	-0.26	1.52
82-	X	-02	0.200	0.118	0.023	7.9	0.6	870	771	747	118	143	14	627	4.63	4.63	-0.043	0	2.44	1.80
82-	X	-03	0.078	0.072	0.024	6.0	0.9	932	814	802	138	194	24	619	4.38	4.00	0.516	0	2.28	1.04
82-	X	-04	0.123	0.020	0.012	2.9	0.8	934	715	728	105	105	20	610	4.13	4.13	1.354	0	2.12	0.28
82-	X	-05	0.597	0.016	0.012	2.5	1.0	917	856	831	64	93	16	762	5.00	5.00	0.825	0	3.21	0.25
82-	X	-06	0.299	0.032	0.015	3.9	0.5	813	771	769	53	97	7	674	4.50	4.50	1.138	0	2.55	0.48
82-	X	-07	0.178	0.063	0.030	5.6	1.1	783	765	753	60	108	11	657	4.63	4.50	0.802	0	2.56	0.96
82-	X	-08	0.105	0.050	0.017	4.9	0.9	861	705	718	126	115	13	590	4.00	4.00	1.949	0	1.99	0.67
82-	X	-09	0.370	0.027	0.020	3.3	1.3	763	739	708	79	80	17	658	4.63	4.63	-0.086	0	2.56	0.40
82-	X	-10	0.149	0.388	0.039	12.9	0.3	821	726	711	105	351	25	375	3.25	2.50	-1.020	0	1.03	4.28
82-	X	-11	-0.010	0.321	0.033	12.0	0.4	798	593	601	104	396	19	196	2.25	1.88	6.929	0	0.37	2.50
82-	X	-12	0.005	0.151	0.027	8.9	0.7	783	635	606	111	245	20	389	3.50	3.50	1.465	0	1.15	1.78
82-	X	-13	0.175	0.022	0.015	3.1	0.9	780	618	634	111	108	27	509	3.75	3.75	0.455	0	1.61	0.28
82-	X	-14	0.048	0.243	0.062	10.8	0.9	722	573	574	75	97	11	476	4.00	4.00	0.588	0	1.60	3.25
82-	X	-15	0.081	0.047	0.021	4.8	0.5	760	698	679	49	106	11	591	4.50	4.50	0.646	0	2.24	0.69
82-	X	-16	0.044	0.190	0.047	10.0	0.6	695	537	514	94	111	12	426	3.88	3.75	0.865	0	1.39	2.47
82-	X	-17	-0.008	0.159	0.029	9.1	0.5	628	448	421	118	342	17	105	2.63	1.63	6.434	0	0.23	1.43
82-	X	-18	0.019	0.113	0.030	7.6	1.0	738	557	541	142	255	28	301	3.13	2.88	1.327	0	0.79	1.21
82-	X	-19	0.015	0.121	0.024	8.0	0.5	730	498	501	147	190	16	307	3.13	2.50	0.931	0	0.81	1.29
82-	X	-20	0.041	0.111	0.069	7.1	2.6	512	381	375	68	183	53	198	3.88	3.13	2.995	0	0.65	1.44

YR	MO	DAY	DEL T	TAU	SD TAU	U	SD U	I1	I2	I3	SD I3	L	SD L	I2-L	PQ	PQ2	EPS	A	HEATING	STRES
83-	IV	-13	0.058	0.070	0.036	6.1	0.5	921	627	635	138	168	11	458	3.63	3.63	0.593	0	1.40	0.86
83-	IV	-14	0.367	0.083	0.043	6.6	1.0	861	663	655	168	149	18	514	4.88	4.50	-1.497	0	2.11	1.31
83-	IV	-15	0.164	0.036	0.023	4.2	1.0	946	586	603	135	104	15	482	4.88	4.88	0.882	0	1.98	0.56
83-	IV	-16	0.249	0.106	0.054	7.5	1.0	895	705	722	117	160	14	545	4.25	4.13	-1.033	0	1.95	1.49
83-	IV	-17	0.138	0.113	0.062	7.8	0.7	1019	769	760	109	252	18	517	4.50	4.50	-0.124	0	1.96	1.67
83-	IV	-18	0.153	0.057	0.039	5.3	1.4	966	854	852	64	160	26	693	5.00	5.00	0.370	0	2.92	0.93
83-	IV	-19	0.111	0.222	0.138	10.8	0.9	976	649	697	181	275	25	374	3.00	3.00	0.147	0	0.94	2.27
83-	IV	-20	0.296	0.223	0.108	10.6	0.8	886	659	658	128	381	21	278	3.50	2.88	-0.228	0	0.82	2.64
83-	IV	-21	0.039	0.041	0.032	4.4	1.4	532	289	249	91	183	43	105	4.63	2.13	293.492	1	0.41	0.63
83-	IV	-22	0.312	0.034	0.018	4.2	0.6	1003	890	880	67	96	17	793	5.25	5.25	1.001	1	3.51	0.58
83-	IV	-23	0.727	0.023	0.025	2.9	1.9	902	820	814	92	72	39	747	5.38	5.38	-1.926	1	3.38	0.40
83-	IV	-24	0.184	0.412	0.208	13.2	0.8	739	228	198	126	122	16	106	2.13	1.75	-1.332	1	0.19	3.04
83-	IV	-25	-0.036	0.186	0.131	10.0	1.6	882	707	674	178	155	29	551	4.88	4.38	1.781	1	2.26	2.95
83-	IV	-26	0.017	0.100	0.090	7.4	1.8	942	727	688	226	180	60	546	5.38	4.38	2.425	1	2.47	1.72
83-	IV	-27	0.414	0.043	0.030	4.8	0.8	1005	881	887	91	88	8	792	5.50	5.50	-0.612	0	3.67	0.75
83-	IV	-28	0.392	0.048	0.018	5.1	0.3	943	955	937	35	95	4	860	5.50	5.50	-0.401	0	3.98	0.85
83-	IV	-29	0.742	0.015	0.011	2.6	0.9	954	901	892	55	58	12	843	5.88	5.88	0.485	0	4.17	0.27
83-	IV	-30	0.277	0.061	0.019	5.7	0.4	976	890	873	96	90	6	800	5.25	5.25	0.654	0	3.54	1.03
83-	V	-01	0.236	0.067	0.027	5.9	0.9	894	603	597	119	102	14	500	5.50	5.50	-0.530	0	2.31	1.17
83-	V	-02	0.215	0.050	0.028	5.3	0.5	875	675	681	142	79	5	596	5.38	5.38	0.370	0	2.70	0.87
83-	V	-03	0.457	0.044	0.023	4.9	0.8	973	866	834	112	77	7	789	5.50	5.50	-0.828	0	3.65	0.78
83-	V	-04	0.074	0.102	0.043	7.6	0.5	771	622	587	104	122	5	499	5.13	5.13	1.342	1	2.16	1.69
83-	V	-05	1.182	0.031	0.027	4.1	0.9	1025	700	703	211	100	13	599	4.13	4.13	-3.601	1	2.08	0.42
83-	V	-06	0.095	0.072	0.033	6.3	0.6	1031	1001	987	55	119	10	881	5.63	5.63	0.752	1	4.17	1.28
83-	V	-07	0.811	0.037	0.017	4.3	0.7	1069	997	976	82	101	13	896	5.13	5.13	-0.243	1	3.86	0.61
83-	V	-08	0.699	0.022	0.012	3.2	0.6	1022	897	893	136	82	14	815	6.00	6.00	2.068	1	4.12	0.41
83-	V	-09	0.475	0.047	0.020	5.0	0.6	868	705	680	109	117	12	588	5.38	5.38	-2.572	1	2.66	0.81
83-	V	-10	0.850	0.058	0.024	5.6	0.7	766	537	484	185	141	14	395	4.63	4.63	-3.318	1	1.54	0.88
83-	V	-11	0.347	0.038	0.018	4.3	0.9	1082	1013	1001	90	140	21	872	5.75	5.75	0.271	1	4.22	0.69
83-	V	-12	0.185	0.029	0.017	3.7	1.0	1074	962	931	109	109	30	852	5.25	5.25	1.841	1	3.76	0.49
83-	V	-13	0.220	0.043	0.020	4.7	0.5	1059	966	938	98	153	11	813	5.38	5.38	0.608	0	3.68	0.75
83-	V	-14	0.108	0.065	0.031	5.8	1.1	976	519	490	229	146	11	373	5.50	3.75	0.285	0	1.73	1.14
83-	V	-15	0.264	0.089	0.044	7.2	0.6	960	833	837	102	90	10	742	5.75	5.75	0.421	0	3.59	1.62
83-	V	-16	0.438	0.081	0.040	6.7	0.6	1020	978	970	34	115	7	862	5.50	5.50	0.135	0	3.99	1.41
83-	V	-17	0.207	0.104	0.090	7.4	1.8	804	399	375	147	170	47	228	5.00	3.75	-2.111	0	0.96	1.68
83-	V	-18	0.051	0.112	0.041	7.7	0.5	1026	861	850	101	199	16	662	5.13	5.13	0.767	0	2.86	1.85
83-	V	-19	0.078	0.083	0.033	6.7	0.6	1049	905	905	92	153	25	751	5.25	5.25	0.963	0	3.32	1.39
83-	V	-20	0.204	0.040	0.023	4.7	0.8	947	752	764	91	94	12	658	5.50	5.38	1.003	0	3.05	0.70
83-	V	-21	0.893	0.024	0.014	3.5	0.8	984	887	868	135	72	11	814	5.88	5.88	0.103	0	4.03	0.45
83-	V	-22	0.536	0.055	0.018	5.5	0.2	994	907	893	69	85	2	821	5.88	5.88	0.347	0	4.06	1.02

YR	MO	DAY	DEL T	TAU	SD TAU	U	SD U	I1	I2	I3	SD I3	L	SD L	I2-L	PQ	PQ2	EPS	A	HEATING	STRES
83-	V	-23	0.184	0.084	0.038	6.8	0.8	944	850	830	86	107	8	742	5.88	5.88	0.048	0	3.67	1.56
83-	V	-24	0.233	0.080	0.037	6.7	0.4	933	744	727	109	97	5	647	5.13	5.13	-0.432	0	2.79	1.32
83-	V	-25	0.470	0.033	0.031	4.1	1.2	1058	833	840	124	81	18	752	5.75	5.75	0.365	0	3.64	0.60
83-	V	-26	1.892	0.016	0.011	2.7	1.0	986	857	851	110	73	21	784	6.13	6.13	-3.953	1	4.04	0.30
83-	V	-27	0.296	0.067	0.030	6.1	0.7	1011	829	830	142	111	13	717	5.63	5.63	-0.083	1	3.40	1.20
83-	V	-28	1.121	0.017	0.010	3.0	0.6	1022	926	927	99	78	9	848	6.00	6.00	2.900	1	4.28	0.33
83-	V	-29	0.812	0.027	0.018	3.8	0.5	1011	910	893	98	68	8	842	6.25	6.25	0.732	1	4.43	0.52
83-	V	-30	0.517	0.053	0.020	5.4	0.3	1045	977	970	74	84	6	893	5.63	5.63	-0.519	1	4.23	0.95
83-	V	-31	0.057	0.059	0.021	5.7	0.4	670	433	422	107	93	4	340	4.63	4.50	-3.960	1	1.32	0.89
83-	VI	-01	0.221	0.053	0.027	5.5	0.7	1039	621	642	193	85	6	536	5.88	4.88	5.317	1	2.65	0.98
83-	VI	-02	0.056	0.091	0.044	7.0	0.7	1094	956	964	80	150	11	806	5.50	5.50	1.106	1	3.73	1.60
83-	VI	-03	1.310	0.011	0.008	2.2	0.7	1043	950	944	118	60	11	890	6.25	6.25	-0.118	1	4.68	0.21
83-	VI	-04	0.387	0.033	0.016	4.1	0.7	1030	950	949	79	92	17	857	5.88	5.88	1.999	1	4.24	0.61
83-	VI	-05	0.199	0.076	0.033	6.5	0.7	1011	739	751	143	116	8	622	5.50	5.38	-2.276	1	2.88	1.34
83-	VI	-06	0.481	0.073	0.033	6.4	0.6	1075	903	902	92	101	6	802	5.75	5.75	-1.138	1	3.88	1.33
83-	VI	-07	0.041	0.083	0.031	6.7	0.3	1023	779	781	137	89	5	690	5.75	5.75	1.854	1	3.34	1.50
83-	VI	-08	0.336	0.139	0.074	8.8	0.9	946	642	667	165	122	16	520	5.00	3.88	-0.040	1	2.19	2.26
83-	VI	-09	0.030	0.051	0.041	4.9	1.9	471	292	273	74	92	27	199	5.13	4.63	5.221	1	0.86	0.84
83-	VI	-10	0.118	0.113	0.063	7.9	0.7	309	221	184	72	174	19	47	4.63	1.50	10.376	1	0.18	1.71
83-	VI	-11	0.241	0.057	0.040	5.4	1.4	259	263	223	71	153	30	109	4.63	3.38	22.776	1	0.42	0.87
83-	VI	-12	0.274	0.054	0.028	5.3	0.9	1024	888	875	116	126	18	762	5.88	5.88	3.151	1	3.77	1.00
83-	VI	-13	0.236	0.062	0.025	5.8	0.5	1097	1078	1061	32	107	9	970	5.88	5.88	1.705	0	4.80	1.15
83-	VI	-14	0.336	0.063	0.017	5.8	0.3	1055	832	832	92	102	4	730	5.88	5.88	-0.167	0	3.61	1.16
83-	VI	-15	0.301	0.077	0.028	6.5	0.3	908	761	733	87	109	7	652	5.88	5.88	-0.740	0	3.22	1.43
83-	VI	-16	0.122	0.094	0.036	7.2	0.3	1031	823	833	152	119	4	704	5.38	5.38	-1.103	0	3.18	1.61
83-	VI	-17	0.202	0.092	0.063	7.1	1.7	1252	744	720	186	127	25	616	6.00	5.88	-0.040	0	3.11	1.73
83-	VI	-18	1.917	0.008	0.010	1.8	1.1	1027	913	923	98	47	14	866	6.25	6.25	0.846	0	4.55	0.16
83-	VI	-19	1.160	0.020	0.012	3.2	0.6	1057	836	850	151	58	8	777	6.13	6.13	0.517	0	4.01	0.39
83-	VI	-20	1.906	0.007	0.005	1.8	0.5	1077	879	886	119	48	9	831	6.13	6.13	-0.263	0	4.28	0.14
83-	VI	-21	0.314	0.010	0.008	2.0	0.8	522	397	381	65	66	14	330	5.88	5.50	3.281	0	1.63	0.18
83-	VI	-22	0.398	0.058	0.026	5.5	0.7	676	528	522	101	155	18	372	4.00	3.88	1.571	0	1.25	0.77
83-	VI	-23	0.247	0.108	0.046	7.7	0.6	1052	856	834	146	154	17	702	5.88	5.88	1.788	0	3.47	1.98
83-	VI	-24	0.942	0.022	0.019	3.1	1.5	1051	1001	992	59	88	23	913	6.13	6.13	0.817	0	4.71	0.42
83-	VI	-25	0.550	0.032	0.021	3.9	1.1	1094	921	928	109	112	20	808	5.75	5.75	0.666	0	3.91	0.57
83-	VI	-26	0.258	0.052	0.024	5.2	0.7	1108	1044	1041	54	142	18	902	5.88	5.88	-0.007	0	4.46	0.96
83-	VI	-27	1.250	0.008	0.006	1.9	0.5	1065	951	958	81	66	11	885	6.00	6.00	0.112	0	4.47	0.15
83-	VI	-28	0.290	0.051	0.020	5.2	0.8	1077	1040	1031	60	101	10	939	5.88	5.88	0.323	0	4.64	0.95
83-	VI	-29	0.242	0.082	0.036	6.7	0.8	1077	889	878	119	117	13	772	5.88	5.88	-0.448	0	3.82	1.51
83-	VI	-30	0.787	0.022	0.027	3.0	1.7	946	598	567	131	82	30	515	5.25	5.25	-0.130	0	2.28	0.37
83-	VII	-01	0.339	0.037	0.024	4.3	1.0	568	371	342	85	115	16	256	5.88	5.38	-2.426	0	1.27	0.68

YR MO DAY	DEL T	TAU	SD TAU	U	SD U	I1	I2	I3	SD I3	L	SD L	I2-L	PQ	PQ2	EPS	A	HEATING	STRES
83- VII-02	0.424	0.036	0.017	4.4	0.4	1084	930	931	101	97	4	832	5.75	5.75	0.793	0	4.03	0.66
83- VII-03	0.523	0.054	0.024	5.4	0.8	1079	911	929	116	101	10	810	5.50	5.25	-0.626	0	3.75	0.95
83- VII-04	0.866	0.027	0.014	3.7	0.6	1102	959	956	153	81	12	878	6.00	5.88	-0.383	0	4.43	0.51
83- VII-05	0.246	0.062	0.030	5.7	0.9	1006	883	862	109	114	19	768	5.63	5.63	0.612	0	3.64	1.11
83- VII-06	0.083	0.081	0.047	6.8	0.8	1015	706	647	189	127	21	579	5.25	5.25	1.843	0	2.56	1.37
83- VII-07	0.368	0.021	0.025	3.1	1.4	949	376	390	191	101	34	275	4.00	3.63	0.031	0	0.93	0.28
83- VII-08	0.656	0.025	0.016	3.6	0.5	702	499	486	85	99	11	399	5.25	5.25	-3.725	0	1.76	0.42
83- VII-09	0.325	0.028	0.015	3.7	0.7	855	558	548	201	126	21	432	4.63	4.13	-2.717	0	1.68	0.42
83- VII-10	0.313	0.034	0.021	4.1	0.8	1043	981	958	53	128	23	853	5.50	5.50	1.113	0	3.95	0.59
83- VII-[illegible]	0.139	0.074	0.038	6.1	1.1	982	830	805	148	202	26	627	4.75	4.75	0.988	0	2.51	1.14
83- VII-12	0.753	0.006	0.007	1.4	0.8	980	745	719	145	70	21	675	5.75	5.75	0.038	0	3.27	0.10
83- VII-13	0.394	0.064	0.029	5.8	0.9	1101	956	968	105	156	14	800	5.50	5.50	-1.008	0	3.70	1.12
83- VII-14	0.039	0.095	0.042	7.3	0.4	904	733	735	89	151	13	581	5.00	5.00	2.343	0	2.45	1.54
83- VII-15	0.493	0.019	0.018	2.9	1.3	1118	1006	994	83	76	25	930	6.25	6.25	0.324	0	4.89	0.37
83- VII-16	0.314	0.064	0.034	5.8	1.3	1050	1001	986	55	114	17	886	5.75	5.75	0.950	0	4.29	1.16
83- VII-17	0.330	0.070	0.031	6.2	0.5	931	870	871	50	109	6	761	5.50	5.50	0.254	0	3.52	1.22
83- VII-18	0.306	0.059	0.022	5.7	0.5	903	737	721	96	97	5	640	5.50	5.50	-0.237	0	2.96	1.03
83- VII-19	0.342	0.075	0.032	6.5	0.3	1019	974	962	55	104	6	869	5.75	5.75	0.102	0	4.21	1.35
83- VII-20	0.208	0.097	0.045	7.4	0.3	944	804	785	135	128	6	676	5.63	5.50	-0.039	0	3.20	1.74
83- VII-21	0.110	0.105	0.055	7.8	0.5	999	715	719	100	125	6	590	5.00	5.00	0.991	0	2.48	1.71
83- VII-22	0.077	0.117	0.085	8.2	1.8	519	348	339	79	136	30	212	3.38	3.25	1.634	0	0.60	1.34
83- VII-23	0.529	0.006	[illegible]	1.5	1.1	1145	907	918	180	40	19	866	6.38	6.38	1.012	0	4.65	0.13
83- VII-24	0.239	0.102	0.048	7.5	0.6	946	702	691	137	142	15	559	4.75	4.75	-0.399	0	2.24	1.58
83- VII-25	0.246	0.048	0.059	5.0	1.6	961	645	666	150	105	36	539	4.25	3.88	-0.024	0	1.93	0.67
83- VII-26	0.011	0.022	0.022	3.2	1.6	365	213	155	96	108	34	105	5.75	2.75	-5.405	0	0.51	0.41
83- VII-27	0.193	0.077	0.042	6.5	1.0	1069	980	978	83	144	19	836	5.25	5.25	0.559	0	3.69	1.30
83- VII-28	0.419	0.083	0.029	6.7	0.3	1081	936	936	112	142	4	794	5.50	5.50	-0.406	0	3.68	1.45
83- VII-29	0.268	0.069	0.038	6.0	1.6	1081	942	940	100	142	23	799	5.88	5.88	0.462	0	3.95	1.28
83- VII-30	1.831	0.002	0.002	0.8	0.4	1100	905	887	107	45	5	860	5.75	5.75	-0.081	0	4.16	0.03
83- VII-31	1.064	0.015	0.012	2.6	1.0	1045	1001	1004	54	75	15	926	5.88	5.88	0.442	0	4.58	0.28
83-VIII-01	0.716	0.030	0.010	4.0	0.3	1079	1006	1011	56	83	5	922	5.88	5.88	0.779	0	4.56	0.56
83-VIII-02	0.917	0.025	0.012	3.5	0.6	1060	984	993	125	76	14	908	5.63	5.38	0.751	0	4.30	0.44
83-VIII-03	0.945	0.012	0.006	2.4	0.4	1076	859	840	152	80	9	779	5.63	5.63	0.128	0	3.69	0.21
83-VIII-04	-0.007	0.067	0.029	6.0	0.6	746	454	424	123	126	16	327	4.38	4.38	0.454	0	1.21	0.96
83-VIII-05	0.191	0.134	0.057	8.5	1.0	778	435	424	122	188	13	247	3.38	2.50	-4.885	0	0.70	1.53
83-VIII-06	0.273	0.080	0.034	6.7	0.5	996	971	957	65	112	6	858	5.50	5.50	0.101	0	3.97	1.40
83-VIII-07	0.515	0.076	0.044	6.4	1.0	1044	553	507	274	180	45	373	4.38	2.75	-3.893	0	1.37	1.10
83-VIII-08	0.150	0.085	0.041	6.9	0.6	828	573	566	139	185	27	387	4.63	3.50	0.539	0	1.51	1.29
83-VIII-09	0.087	0.099	0.065	7.4	0.6	369	231	195	98	198	22	32	2.75	2.00	-7.756	0	0.08	0.94
83-VIII-10	0.556	0.033	0.015	4.2	0.5	1004	930	933	63	83	8	847	5.63	5.63	0.056	0	4.01	0.58

YR MO DAY	DEL T	TAU	SD TAU	U	SD U	I1	I2	I3	SD I3	L	SD L	I2-L	PQ	PQ2	EPS	A	HEATING	STRES
83-VIII-11	0.424	0.052	0.020	5.3	0.7	965	920	912	60	91	8	829	5.75	5.75	0.075	0	4.01	0.95
83-VIII-12	-0.027	0.158	0.079	9.4	0.6	1017	893	899	121	152	9	741	5.13	5.13	1.724	0	3.20	2.61
83-VIII-13	-0.002	0.117	0.063	8.0	0.8	377	226	190	80	212	30	13	4.13	1.00	-1.154	0	0.05	1.60
83-VIII-14	0.006	0.101	0.066	7.3	1.5	612	391	365	118	161	40	229	4.38	3.38	3.242	0	0.84	1.46
83-VIII-15	0.193	0.073	0.056	6.2	1.3	1052	726	696	232	149	41	577	4.75	4.63	0.180	0	2.31	1.14
83-VIII-16	0.231	0.049	0.035	5.0	1.5	1050	504	462	200	104	36	400	5.50	5.00	0.060	0	1.85	0.87
83-VIII-17	0.070	0.048	0.022	5.0	0.7	675	460	415	171	135	22	324	4.25	3.75	0.014	0	1.16	0.67
83-VIII-18	0.490	0.039	0.025	4.4	1.1	1068	979	964	97	108	15	871	5.50	5.50	0.086	0	4.03	0.68
83-VIII-19	0.108	0.123	0.065	8.5	0.8	756	481	462	113	170	10	310	4.00	3.88	-0.165	0	1.04	1.65
83-VIII-20	0.710	0.022	0.017	3.2	1.1	1025	939	931	51	90	26	849	5.50	5.50	1.191	0	3.93	0.39
83-VIII-21	0.601	0.081	0.026	6.6	0.3	981	929	920	38	141	5	788	5.00	5.00	-1.524	0	3.32	1.32
83-VIII-22	1.455	0.007	0.007	1.6	0.7	1078	989	965	109	51	18	938	5.75	5.75	0.500	0	4.54	0.12
83-VIII-23	0.173	0.058	0.041	5.1	2.4	971	753	765	135	125	39	627	5.13	5.00	2.358	0	2.71	0.95
83-VIII-24	0.214	0.051	0.036	5.0	1.3	941	724	751	134	138	33	586	3.88	3.75	0.895	0	1.91	0.66
83-VIII-25	0.172	0.069	0.028	6.0	0.6	360	266	254	58	190	18	75	2.75	1.88	3.365	0	0.18	0.65
83-VIII-26	0.323	0.045	0.025	4.9	0.7	997	898	897	75	128	11	770	5.38	5.38	0.462	0	3.48	0.77
83-VIII-27	0.694	0.020	0.014	3.1	0.9	1032	1002	984	28	89	15	912	5.63	5.63	0.460	0	4.32	0.35
83-VIII-28	0.293	0.075	0.030	6.4	0.5	1020	970	956	60	125	9	845	5.38	5.38	-0.245	0	3.82	1.29
83-VIII-29	0.150	0.162	0.078	9.2	1.0	980	813	799	136	204	18	609	4.88	4.50	4.424	0	2.50	2.56
83-VIII-30	0.741	0.027	0.036	3.3	2.0	1142	865	843	144	81	36	783	4.75	4.75	-0.084	0	3.13	0.42
83-VIII-31	0.099	0.056	0.035	5.4	1.4	1012	637	685	201	165	34	471	3.75	3.00	1.079	0	1.49	0.71
83- IX -01	0.615	0.031	0.029	3.8	1.6	992	897	904	79	108	27	788	5.00	5.00	-0.342	0	3.32	0.50
83- IX -02	0.142	0.046	0.039	4.7	1.6	965	461	430	217	149	37	311	4.88	3.38	0.729	0	1.28	0.73
83- IX -03	0.074	0.186	0.098	9.9	0.5	996	659	648	134	186	8	472	4.38	4.38	0.670	0	1.74	2.68
83- IX -04	0.311	0.055	0.026	5.5	0.4	1029	910	896	120	137	9	772	5.13	5.13	-0.103	0	3.33	0.91
83- IX -05	0.845	0.016	0.009	2.8	0.6	1017	947	916	111	91	15	856	5.38	5.38	0.147	0	3.87	0.27
83- IX -06	0.633	0.037	0.019	4.3	0.9	994	925	908	92	107	17	817	5.25	5.25	0.604	0	3.61	0.62
83- IX -07	0.765	0.022	0.011	3.3	0.6	1007	946	942	78	96	11	849	5.25	5.25	0.265	0	3.75	0.37
83- IX -08	0.724	0.026	0.018	3.5	1.1	998	868	869	100	100	20	767	5.13	5.13	0.763	0	3.31	0.43
83- IX -09	0.682	0.024	0.014	3.5	0.6	877	852	843	26	106	10	745	5.25	5.25	0.319	0	3.29	0.40
83- IX -10	0.417	0.027	0.012	3.7	0.7	926	841	850	72	105	9	736	5.00	5.00	0.808	0	3.10	0.43
83- IX -11	1.111	0.012	0.011	2.2	1.0	980	847	842	130	62	23	784	5.50	5.13	0.154	0	3.63	0.21
83- IX -12	0.396	0.028	0.016	3.7	0.7	970	926	919	62	90	14	835	5.13	5.13	1.268	0	3.60	0.46
83- IX -13	0.190	0.048	0.022	5.0	0.7	976	921	924	62	117	14	804	5.00	5.00	1.349	0	3.38	0.77
83- IX -14	0.082	0.151	0.081	8.9	1.4	913	602	572	189	234	58	368	4.00	3.13	1.403	0	1.24	2.02
83- IX -15	0.138	0.014	0.010	2.7	0.6	343	213	201	64	114	22	99	2.00	1.38	27.933	0	0.17	0.10
83- IX -16	0.085	0.201	0.008	10.1	0.1	370	165	159	70	264	4	-99	0.13	0.13	-115.810	0	-0.01	0.09
83- IX -17	0.433	0.032	0.033	4.1	1.3	991	854	864	114	145	49	709	4.50	4.50	2.285	0	2.69	0.47
83- IX -18	0.571	0.008	0.011	1.8	0.9	1126	593	592	194	44	17	549	5.63	5.63	0.080	0	2.60	0.15
83- IX -19	0.291	0.018	0.015	3.1	0.7	999	752	732	120	73	16	678	5.13	5.13	0.775	0	2.93	0.30

YR	MO	DAY	DEL T	TAU	SD TAU	U	SD U	I1	I2	I3	SD I3	L	SD L	I2-L	PQ	PQ2	EPS	A	HEATING	STRES
83-	IX	-20	0.832	0.013	0.011	2.4	0.9	907	880	872	42	74	16	806	5.13	5.13	0.082	0	3.48	0.22
83-	IX	-21	0.056	0.065	0.030	5.9	0.7	573	366	338	119	131	11	234	4.63	3.75	1.679	0	0.91	0.99
83-	IX	-22	0.041	0.152	0.084	9.0	1.1	893	380	388	215	173	27	206	2.63	1.88	0.715	0	0.46	1.38
83-	IX	-23	0.004	0.081	0.037	6.6	0.4	729	527	538	91	225	12	301	2.75	2.75	1.239	0	0.70	0.77
83-	IX	-24	0.013	0.168	0.075	9.4	0.5	785	610	596	120	332	15	277	3.38	3.00	1.951	0	0.79	1.90
83-	IX	-25	0.017	0.206	0.098	10.3	0.5	552	439	432	67	331	21	107	2.75	1.88	9.648	0	0.25	1.94
83-	IX	-26	0.150	0.233	0.086	10.8	0.4	525	328	303	84	288	20	39	2.25	1.13	19.301	0	0.08	1.81
83-	IX	-27	0.115	0.000	0.000	0.0	0.0	257	179	138	78	2	0	176	-10.25	0.00	-300.160	0	-1.52	0.00
83-	IX	-28	-0.037	0.302	0.218	11.9	0.9	794	554	527	146	239	21	315	4.00	3.38	8.459	0	1.06	4.04
83-	IX	-29	0.128	0.105	0.057	7.6	1.3	1050	744	741	135	152	21	591	4.63	4.25	0.543	0	2.30	1.60
83-	IX	-30	0.745	0.015	0.012	2.9	0.6	852	622	619	146	73	10	549	4.63	4.50	0.168	0	2.14	0.22
83-	X	-01	0.080	0.118	0.045	8.0	0.8	384	243	196	108	177	36	66	2.25	0.75	29.724	0	0.13	0.92
83-	X	-02	0.330	0.031	0.020	4.0	1.0	991	847	822	91	92	15	754	5.13	5.00	0.250	0	3.25	0.51
83-	X	-03	0.261	0.040	0.019	4.6	0.6	923	818	819	73	107	13	711	4.88	4.75	-0.015	0	2.92	0.63
83-	X	-04	0.137	0.016	0.007	2.7	0.5	622	460	452	59	89	11	371	4.13	4.13	0.741	0	1.29	0.22
83-	X	-05	0.054	0.069	0.024	6.0	0.7	845	391	368	164	152	11	239	3.75	3.13	1.652	0	0.76	0.87
83-	X	-06	0.234	0.035	0.019	4.4	0.4	980	705	674	142	93	8	611	4.75	4.75	-0.348	0	2.44	0.55
83-	X	-07	0.166	0.020	0.013	3.0	1.0	535	271	259	129	103	20	167	2.50	2.00	-1.957	0	0.35	0.17
83-	X	-08	0.359	0.083	0.049	6.7	1.2	851	759	759	62	146	25	612	4.38	4.38	1.158	0	2.26	1.20
83-	X	-09	0.632	0.021	0.017	3.1	1.1	834	775	759	78	75	21	700	4.75	4.75	-0.628	0	2.80	0.33
83-	X	-10	0.202	0.081	0.030	6.6	0.6	720	472	439	128	163	19	309	4.25	3.63	-1.596	0	1.11	1.15
83-	X	-11	0.146	0.213	0.102	10.5	0.4	843	680	698	104	205	10	474	3.50	3.50	1.466	0	1.40	2.52
83-	X	-12	0.218	0.097	0.046	7.4	0.7	411	292	253	107	139	9	152	3.63	2.75	-5.210	0	0.46	1.18
83-	X	-13	0.196	0.053	0.028	5.4	0.7	852	542	533	176	122	14	420	4.13	3.38	0.023	0	1.46	0.73
83-	X	-14	0.247	0.041	0.017	4.6	0.6	876	602	605	179	107	7	494	4.38	4.25	0.703	0	1.82	0.59
83-	X	-15	0.111	0.084	0.028	6.7	0.3	834	665	647	126	211	13	454	3.63	3.50	0.150	0	1.39	1.02
83-	X	-16	0.045	0.083	0.037	6.7	0.5	746	682	650	132	241	22	440	3.38	3.25	0.918	0	1.25	0.95
83-	X	-17	0.074	0.053	0.024	5.3	0.6	812	667	614	126	157	21	510	4.38	4.38	0.421	0	1.88	0.76
83-	X	-18	0.168	0.068	0.021	6.0	0.5	877	815	805	61	148	7	667	4.00	4.00	0.250	0	2.25	0.91
83-	X	-19	0.295	0.028	0.020	3.6	1.4	820	696	697	86	108	23	588	4.63	4.63	0.285	0	2.29	0.43
83-	X	-20	0.193	0.025	0.024	3.2	1.7	672	531	528	66	96	36	435	3.88	3.88	-1.330	0	1.42	0.33
83-	X	-21	-0.009	0.000	0.000	0.0	0.0	482	207	172	85	3	0	203	-12.25	0.00	731.030	0	-2.10	0.00
83-	X	-22	0.198	0.132	0.052	8.5	0.7	793	567	565	134	326	23	241	3.75	2.50	-3.605	0	0.76	1.67
83-	X	-23	-0.001	0.019	0.020	2.9	1.1	845	731	724	90	104	31	626	4.50	4.38	2.568	0	2.37	0.28
83-	X	-24	-0.008	0.247	0.079	11.0	0.2	353	282	270	61	225	13	56	2.38	1.50	7.460	0	0.11	2.03
83-	X	-25	0.127	0.044	0.033	4.9	1.3	861	787	800	70	138	19	648	3.88	3.75	0.511	0	2.11	0.57
83-	X	-26	0.003	0.091	0.060	6.9	1.8	753	546	530	110	224	43	321	4.00	3.13	2.129	0	1.08	1.21
83-	X	-27	-0.024	0.072	0.058	6.0	1.6	588	355	293	158	271	71	84	3.38	1.50	-4.394	0	0.24	0.82
83-	X	-28	0.089	0.053	0.040	5.4	0.8	864	746	742	77	248	27	497	3.50	3.50	0.438	0	1.46	0.63
83-	X	-29	0.198	0.135	0.074	8.8	0.2	873	780	776	53	174	17	606	4.00	4.00	-0.530	0	2.04	1.81

APPENDIX C

FORTRAN Listing of the DOSL (PWP) Model Function

```
      SUBROUTINE DAYSCL(QI,QL,PQ,TAU,DSC,TSC,USC,ICON)
C
C THIS SUBROUTINE COMPUTES THE AMPLITUDE OF THE DIURNAL
C CYCLE FROM THE FOLLOWING INPUT DATA:
C  QI, SOLAR INSOLATION MAXIMUM, WATTS PER METER SQUARED
C  QL, HEAT LOSS, WATTS PER METER SQUARED (USUALLY NEGATIVE)
C  PQ, HALF THE TIME INTERVAL DURING WHICH QI + QL > 0, SECONDS
C  TAU, WIND STRESS, PASCALS
C
C OUTPUT VARIABLES ARE:
C  DSC, MINIMUM TRAPPING DEPTH, METERS
C  TSC, DIURNAL RANGE OF SEA SURFACE TEMPERATURE, CENTIGRADE
C  USC, AMPLITUDE OF THE DIURNAL JET, METERS PER SECOND
C  ICON, FLAG = 1 IF CONVECTION LIMIT WAS REACHED (VANISHING TAU)
C
C REFERENCE TO THEORY IS IN PRICE, WELLER AND PINKEL, JGR, 1986
C
C DOCUMENTED BY J. F. PRICE, JULY 2, 1985, W.H.O.I.
C
      COMMON/APLANE/BETA1,BETA2,R,F,ALPHA,G,CPW,RO
C
C THE COMMON APLANE DELIVERS PARAMETERS WHICH ARE SITE SPECIFIC:

C  BETA1, EXTINCTION COEFFICIENT FOR LONGWAVE INSOLATION, METERS
C  BEAT2, AS ABOVE FOR SHORTWAVE
C  R, THE FRACTION OF INSOLATION ASCRIBED TO BETA 1, NON-D
C  F, CORIOLIS PARAMETER, INVERSE SECONDS
C  ALPHA, THERMAL EXPANSION COEFFICIENT, KILOGRAMS PER METER CUBED
C   PER DEGREE CENTIGRADE (IN A LINEAR STATE EQUATION)
C  G, ACCELERATION DUE TO GRAVITY, METERS PER SECOND SQUARED
C  CPW, HEAT CAPACITY OF SEA WATER, JOULES PER KILOGRAMS SECOND
C  RO, DENSITY OF SEA WATER, KILOGRAMS PER METER CUBED (CONSTANT)
C
C
      ICON = 0
C
C COMPUTE PS, THE ACCELERATION TIME SCALE
C
      PS = (SQRT(2.)/F)*SQRT(1. - COS(F*PQ))
C
      QNET = QI + QL
C
C CHECK THAT QNET AND PQ ARE > 0.  IF NOT, RETURN
C
       IF(QNET.LT.0..OR.PQ.LT.0.1) THEN
       TSC = 0.
       USC = 0.
       DSC = 999.
       ICON = 9
       RETURN
       END IF
C
```

```
      CONST = (1./RO)*SQRT(-ALPHA*G/CPW)
C
C  EVALUATE THE SCALES IN THE STRESS-DOMINATED REGIME
C
      USC = 1.5*SQRT(QNET*PQ)*CONST
      DSC = 0.45*(1./RO)*TAU*PS/(SQRT(QNET*PQ)*CONST)

      TSC =1.5*(QNET*PQ)**1.5*CONST/(TAU*PS*CPW)
C
C  TAKE ACCOUNT OF THE EFFECT OF PENETRATING INSOLATION
C
      RS1 = (1. - R)*(QI - QL)/QI
      HLAM = (1. - RS1*EXP(-DSC/BETA2))
C
      TSC = TSC*HLAM**1.5
      USC = USC*HLAM**0.5
      DSC = DSC/HLAM**1.5
C
C  NOW, CHECK TO SEE IF CONVECTION LIMIT IS REACHED
C
      CALL CDEP(QI,QL,R,BETA1,BETA2,CDZ,QDC,RIC)
C
      TCON = PQ*QDC/(RO*CPW)
C
      IF(TCON.LT.TSC) THEN
C
C  IF CONVECTION LIMIT WAS REACHED, THEN USE CONVECTION SCALES
C
      ICON = 1
      TSC = TCON
      USC = TAU*PS/(RO*CDZ)
      DSC = CDZ + (PQ/(RO*CPW))*RIC/TSC
C
C
      END IF
C
      RETURN
      END
C
C
C
```

```
      SUBROUTINE CDEP(QI,QL,R,B1,B2,CD,QDC,RIC)
C
C  THIS SUBROUTINE COMPUTES THE CONVECTION DEPTH FOR THE
C  DIURNAL CYCLE.
C
C  INPUT DATA ARE:
C   QI, THE MAXIMUM SOLAR INSOLATION, WATTS PER METER SQUARED
C   QL, HEAT LOSS, WATTS PER METER SQUARED
C   R, FRACTION OF INSOLATION IN LONG WAVE COMPONENT, NON-D
C   B1, EXTINCTION SCALE FOR LONG WAVE INSOLATION, METERS
C   B2, EXTINCTION SCALE FOR SHORT WAVE INSOLATION, METERS
C
C  THE OUTPUT DATA ARE:
C   CD, THE DAILY MINIMUM CONVECTION DEPTH, METERS
C   QDC, HEAT FLUX ABSORBED ABOVE CD, WATTS PER METER CUBED
C   RIC, THE SOALAR INSOLATION AT DEPTH CD, WATTS PER METER SQUARED
C
C
C
C  JIM PRICE, 1 JULY 1985, W.H.O.I.
C
C
      DZ = 0.05
C
C  SET DEFAULT VALUES
      CD = 26.
      QDC = 0.1
C
C


      DO 4 J=1,500
      Z = FLOAT(J)*DZ
      RIZ = QI*(1. - (R*EXP(-Z/B1) + (1.-R)*EXP(-Z/B2)))
      DIDZ = QI*(R*EXP(-Z/B1)/B1 + (1.-R)*EXP(-Z/B2)/B2)
      ELS = (RIZ + QL)/Z
C
      IF(ELS.GE.DIDZ) GO TO 5
C
    4 CONTINUE
      GO TO 9
    5 CONTINUE
C
      CD = Z
      QDC = (ELS + DIDZ)/2.
      RIC = RIZ
C
    9 CONTINUE
      RETURN
      END
C
```

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50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. WHOI-86-5	2.	3. Recipient's Accession No.
4. Title and Subtitle **Data Tabulations and Analysis of Diurnal Sea Surface Temperature Variability Observed at LOTUS**			5. Report Date Feburary 1986
			6.
7. Author(s) Clarke M. Bowers, James F. Price, Robert A. Weller and Melbourne G. Briscoe			8. Performing Organization Rept. No. WHOI-86-5
9. Performing Organization Name and Address Woods Hole Oceanographic Institution Woods Hole, Massachsuetts 02543			10. Project/Task/Work Unit No.
			11. Contract(C) or Grant(G) No. (C) N00014-76-C-0197, NR 083-400 and N00014-84- (G) C-0134, NR 083-400
12. Sponsoring Organization Name and Address Office of Naval Research Environmental Sciences Directorate Arlington, Virginia 22217			13. Type of Report & Period Covered Technical
			14.

15. Supplementary Notes

This report should be cited as: Woods Hole Oceanog. Inst. Tech. Rept. WHOI-86-5.

16. Abstract (Limit: 200 words)

Air/sea measurements from the Long-Term Upper Ocean Study (LOTUS) buoy in the Sargasso Sea are analyzed to learn how the diurnal response of sea surface temperature, ΔT_S, is related to the surface heating, H, and the wind stress, S. Data are taken from the LOTUS-3 and LOTUS-5 records which span the summers of 1982 and 1983. The basic data are shown in monthly plots, and the analyzed daily values of ΔT_S, H, and S are given in tables and in figures.

Analyzed data show a clear trend of ΔT_S increasing with H and decreasing with S. A best-fit, three-parameter, empirical function can account for 90 percent of the variance in a screened subset of the LOTUS data (172 days) and 81 percent of the variance of the full data set (361 days).

The analyzed data are also compared with a theoretical model function now used for ocean predictions in the Diurnal Ocean Surface Layer model (DOSL) of Fleet Numerical Oceanography Center. The DOSL model function was derived from the assumption that wind-mixing occurs by a mechanism of shear flow instability. It is fully predictive and shows a parameter dependence consistent with the LOTUS data over a wide range of H and S. The DOSL model function can account for almost as much variance as the best-fit empirical function.

17. Document Analysis a. Descriptors

1. diurnal cycle
2. sea surface temperature
3. upper ocean

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement:	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 51
Approved for publication; distribution unlimited.	20. Security Class (This Page)	22. Price

(See ANSI-Z39.18) See Instructions on Reverse OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

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