Atlas of Radiation Budget Measurements from Satellites (1962-1970)

By

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Preface

Radiation budget measurements taken at the top of an atmospheric column will continue to grow in importance for monitoring and predicting changes within the column. As atmosphere and ocean circulation models grow in sophistication such measurements may certainly be incorporated as initial or update conditions. Already the measurements have contributed to a global radiation budget climatology which verified or corrected previous estimates, pointed out significant changes within a year and year-to-year in the radiation budget, and/or specified net energy transports by both the atmosphere and oceans.

The existing data have contributed to the design of new radiation budget measurements systems. In the mid-seventies, data from the Earth Radiation Budget experiment on the Nimbus F and G satellites will augment these earlier data. A conceptual study, including engineering design and scientific requirements, is now underway to define the radiation budget measurement system of the 1980's and beyond.

Abstract

Radiation budget data measured at the top of the atmosphere by earth-orbiting satellites are presented for various time periods in the years 1962 through 1970. They appear in the form of contoured maps which were derived from 5 seasonal and 25 monthly and semi-monthly data sets. Data published by other authors within this time period are not duplicated but are referenced for the reader's benefit. Part I contains documentation and contoured maps. Part II contains data tabulation at each 10 degrees latitude and longitude: it appears on microfiche inside the cover.

CONTENTS

TABLE 1: AVAILABLE RADIATION BUDGET DATA FROM U.S. SATELLITES: TIROS 4 (T4), TIROS 7 (T7), EXPERIMENTAL (EX), NIMBUS 2 (N2), NIMBUS 3 (N3), ESSA 3 (E3), ESSA 5 (E5), ESSA 7 (E7), ESSA 9 (E9), ITOS 1 (II), AND NOAA 1 (NO1)
DATA NOT INCLUDED IN THIS ATLAS DENOTED BY BRACKETS [ ].

Months	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	No.
JAN				EX(1030)		[E3]		[E7]	[E9],N3(1130)		2
FEB				EX				[E7]	[E9]	[NO1]	1
MAR				EX				[E7]	[E9], [I1]	[NO1]	1
APR				EX(0840)				[E7],N3(1130)	[I1]		2
MAY				EX(0855)	[N2]	[E5]		*N3	[I1]	[NO1]	2
JUN				EX(0910)	[N2]	[E5]		[E9],N3(1130)	[I1]		2
JUL			EX(0830)	EX(0925)	N2(1130)	[E5]		[E9],N3(1130)			4
AUG			*EX	EX(0940)		[E5]		[E9],N3(1130)			3
SEP			EX	*EX(1000)		[E5]		[E9]			2
OCT			EX	EX(1020)			[E7]	[E9],N3(1130)			3
NOV			EX	[EX]			[E7]	[E9]			1
DEC			EX(1030)		E3(1340)		[E7]	[E9]			2
Seasons											
DJF			T7	EX		E3			N3		4
MAM	T4		T7	EX				N3			4
JJA		T7	EX	EX	N2			N3			5
SON		T7	EX	EX				N3			4

NOTE: The DJF Season id assigned the year of the respective January * not included in season average.

A certain amount of information about the satellite experiments is necessary to give the data scientific utility. All users are strongly encouraged to refer to the following for background information: Vonder Haar and Suomi (1971); Vonder Haar (1972); and Raschke et al., (1973). In addition, the following remarks concern spatial and temporal sampling biases in the 30 basic sets which were not accounted for in data reduction.

2.1 Spatial Sampling Bias

There are areas on some maps where data do not appear because of various sampling problems. Satellite measurements poleward of 62.5° latitude do not exist with the TIROS series of satellites due to a low inclination angle of the orbit (Bandeen et al., 1965). The January 21 to February 3, 1970 Nimbus 3 daytime samples (shown in Table 1 as January, 1970) are missing from eastern Asia to south of Australia. Night time infrared exitance samples are also missing over a large area of western Europe, western Africa and the South Atlantic. For a more detailed account and analysis of the Nimbus 3 data see Raschke et al. (1973).

2.2 Temporal Sampling Bias

A major temporal sampling defiency is the local time bias in the data acquired from sun-synchronous satellites. These satellites sample at the same local sun time (or nearly so) each day. Thus, albedo and radiant exitance measurements are representative at that time but do not account for diurnal changes in cloudiness and radiating temperatures.

The TIROS series of measurements do not contain this bias since their orbital precession allowed sampling at all local times over a period of less than 3 months (76 days for TIROS 7). The numbers in parentheses in Table 1 indicate the nominal local sun time of the equatorial crossing during the daylight passes only. Vonder Haar and Hanson (see Vonder Haar, 1968 or Vonder Haar, 1972) did a preliminary study of the diurnal bias in the satellite radiation budget data.

3.0 DISCUSSION OF THE ATLAS DATA

Each radiation budget data set is composed of the fundamental radiation budget components, i.e., planetary albedo, absorbed shortwave radiation, longwave exitance and net radiation. The relationships between the components are represented as:

$$RN = (1.0-A)I - RL$$

or

$$RN = RA - RL$$

with the notation defined as:

RN, net radiation ($cal \cdot cm^{-2} \cdot min^{-1}$)

A, Albedo

I, solar insolation at P=0 (Solar constant taken as 1.95 $cal \cdot cm^{-2} \cdot min^{-1}$)

RL, longwave radiant exitance ($cal \cdot cm^{-2} \cdot min^{-1}$)

RA, absorbed shortwave radiation

All components present the values at the top of an atmospheric column (pressure=0) and each is a function of latitude, longitude and time.

In addition to the four component maps of the mean season and 17 season average data there are four maps representing the deviation from

the zonal average (Vonder Haar, 1972). The values on these maps were derived mathematically as:

$$Z' = Z - \bar{Z}$$

where $\bar{Z}$ is the average around a latitude circle; Z is the radiation budget component at each grid point; Z' is the deviation from zonal average at each grid point.

All data are gridded on a 10 degree latitude by 10 degree longitude grid and are objectively contoured on an equidistant map projection. Contour intervals of isoline values for each data set analysis are shown in Table 2. Monthly and seasonal data were combined to arrive at seasonal, annual and mean annual averages (17 season average). Missing data areas are without contours on the maps. The contoured maps appear in the order shown in the List of Contoured Maps.

TABLE 2 CONTOUR INTERVALS

Albedo	$\frac{5}{100\%} = 0.05$
Deviation From Zonal Average	$\frac{4}{100\%} = 0.04$
Longwave Radiation	0.03 Cal cm^{-2} min^{-1}
Deviation From Zonal Average	0.02 Cal cm^{-2} min^{-1}
Net Radiation	0.04 Cal cm^{-2} min^{-1}
Deviation From Zonal Average	0.02 Cal cm^{-2} min^{-1}
Absorbed Radiation	0.05 Cal cm^{-2} min^{-1}
Deviation From Zonal Average	0.03 Cal cm^{-2} min^{-1}

4.0 References

1. Bandeen, W.R., M. Halev, and I. Strange, 1965: A Radiation Climatology in the Visible and Infrared from the Tiros Meteorological Satellites. NASA TN D-2534.

2. Boldyrev, V.G., and Vetlov, I.P., 1970: Spatial and Temporal Variability of the Escaping Radiation. Meteorol. I. Gidrolog, 23-32, A 71-14637.

3. Raschke, E., 1968: The Radiation Balance of the Earth-Atmosphere System From Radiation Measurements of the Nimbus II Metiorological Satellite. NASA TN D-4589.

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5. Vonder Haar, T.H. and V.E. Suomi, 1971: Measurements of the Earth's Radiation Budget from Satellites During a Five-year Period, Part I: Extended Time and Space Means: Journ. Atmos. Sci., 28, 3, pp. 305314.

6. Vonder Haar, T.H., 1972: Natural Variations of the Radiation Budget of the Earth-Atmosphere System as Measured from Satellites, Conference on Atmospheric Radiation, American Mereorological Society, Fort Collins, Colo. pp. 211-220.

7. Winston, J.S. and V.R. Taylor, 1967: Atlas of World Maps of Long-wave Radiation and Albedo for Seasons and Months Based on Measurements from TIROS IV and TIROS VII, ESSA Tech. Report NESC 43.

8. Winston, J.S., 1972: Comments on "Measurements of the Earth's Radiation Budget from Satellites Furing a Five-year Period: Part I. Extended Time and Space Means." Journal Atmospheric Sci., Vol 29, No. 3, pp. 598-601.

5.0 LIST OF CONTOURED MAPS

* Seasons are defined as: Spring M-A-M, Summer J-J-A, Fall S-O-N, Winter D-J-F.

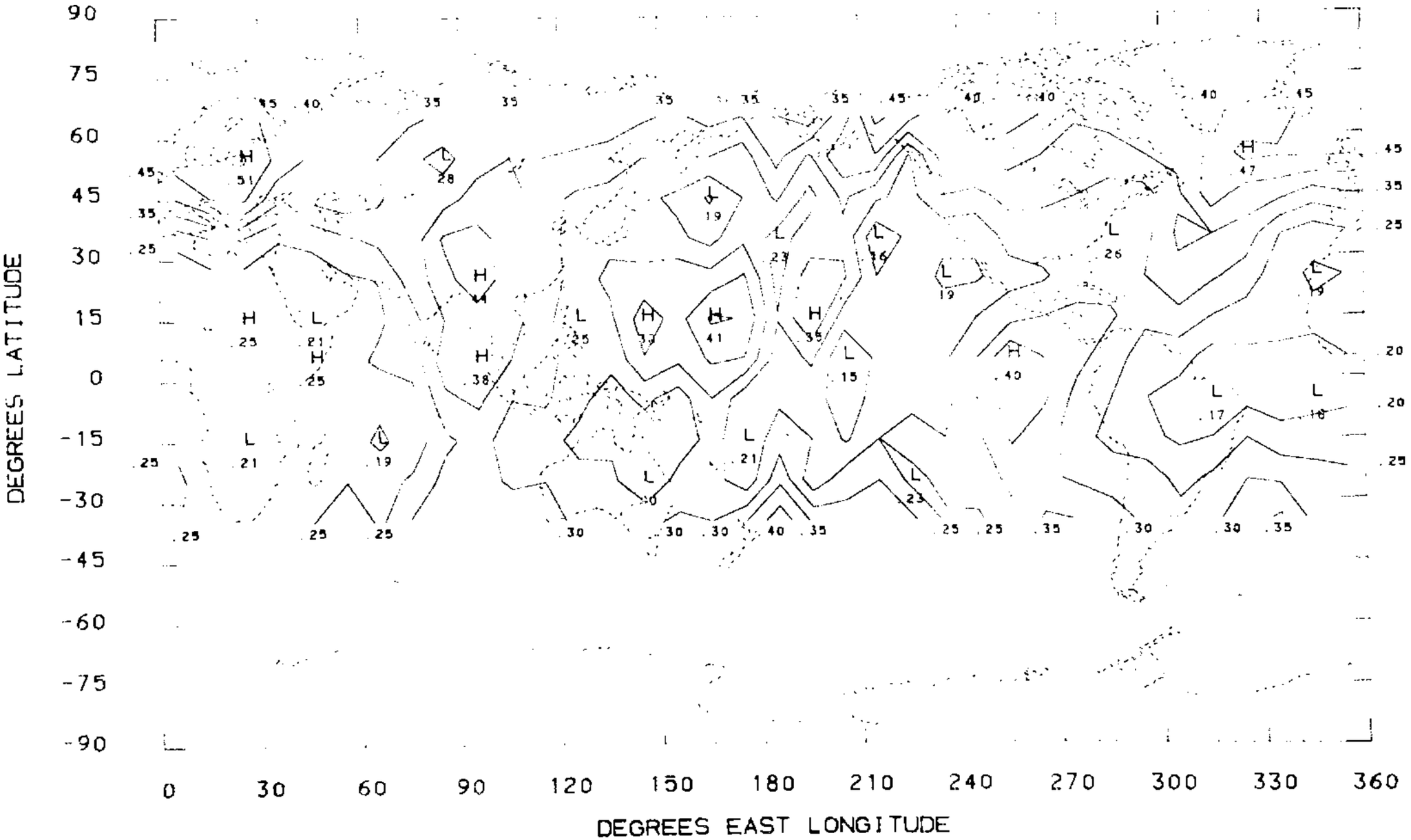
Acknowledgements

We thank the many scientists and engineers who contributed to the success of the satellite experiments. Professor Verner Suomi's personal research and dedication to the goal of measuring the earth's radiation budget inspired all of us. Mr. Jeffrey Gailiun assisted with the map layout and Ms. Lyn Koch typed the manuscript.

We also acknowledge the Atmospheric and Hydrospheric Applications Division of NASA Goddard Space Flight Center for sponsoring, under Grant NGR 06-002-102, the collection and preparation of this report. Additionally, the Atlas includes information from previous publications referenced in section 2.0 which were under various government sponsorships.

PLANETARY ALBEDO

JULY 1964



LONGWAVE RADIATION (LY/MIN)

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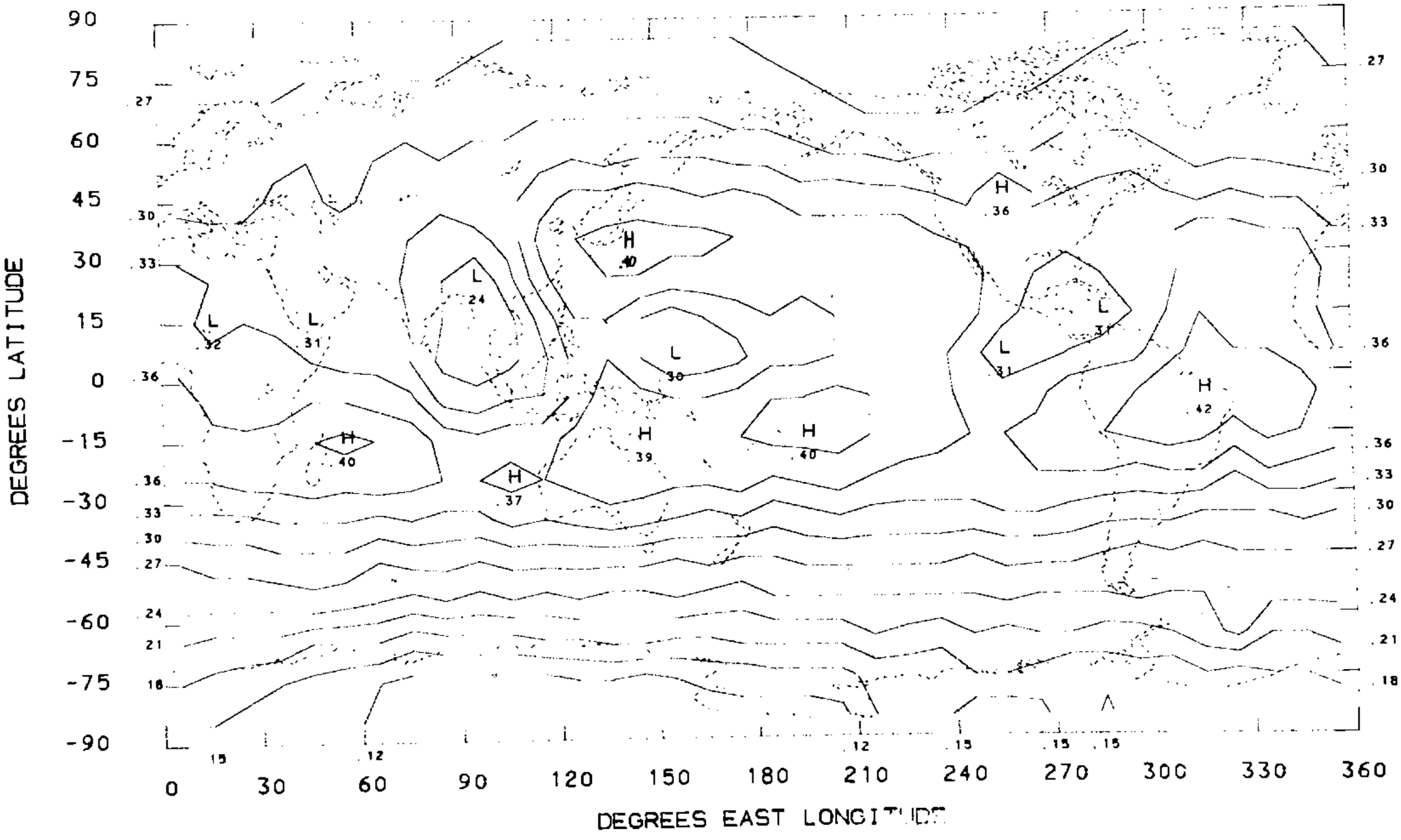

NET RADIATION (LY/MIN)

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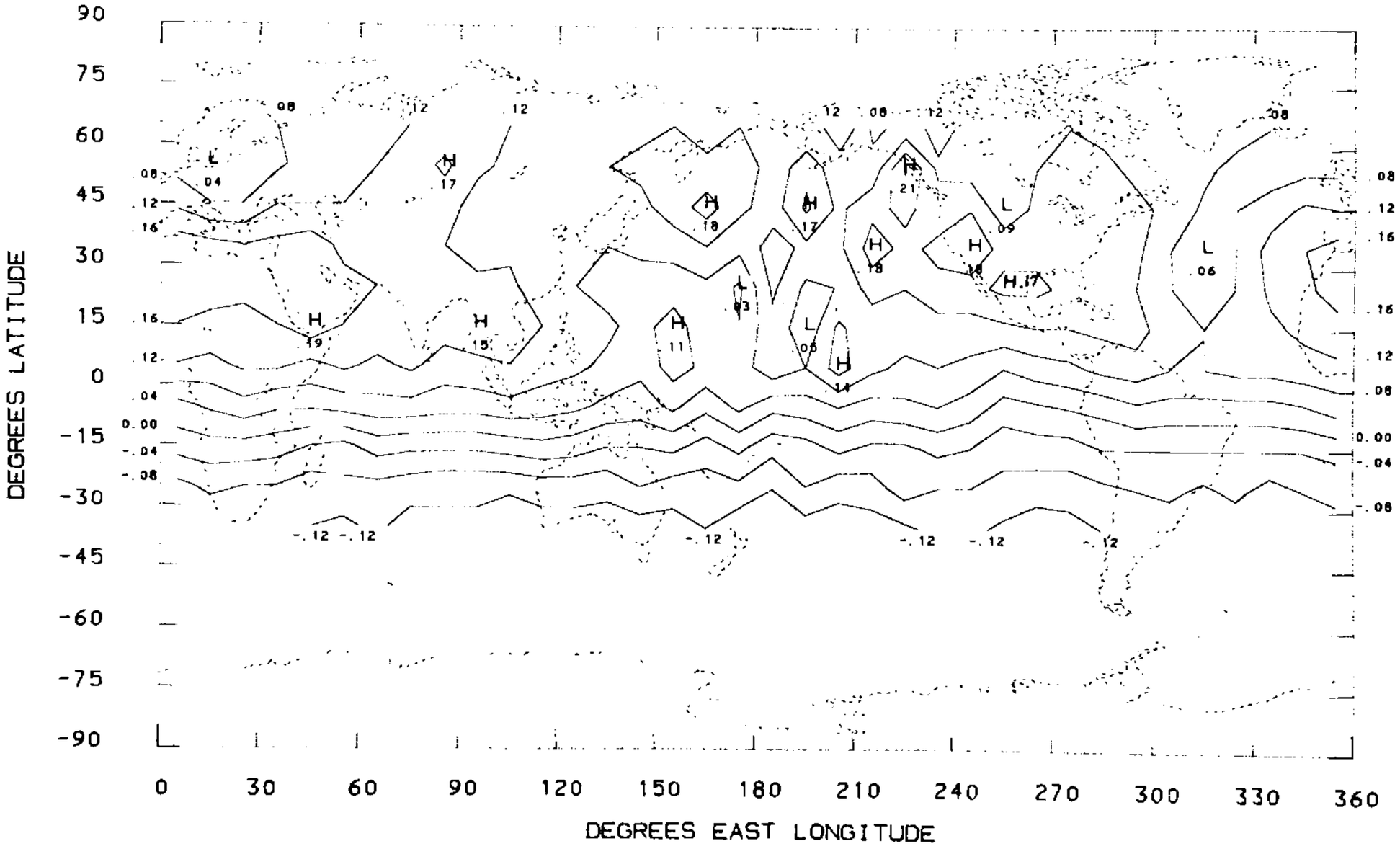

ABSORBED RADIATION (LY/MIN)

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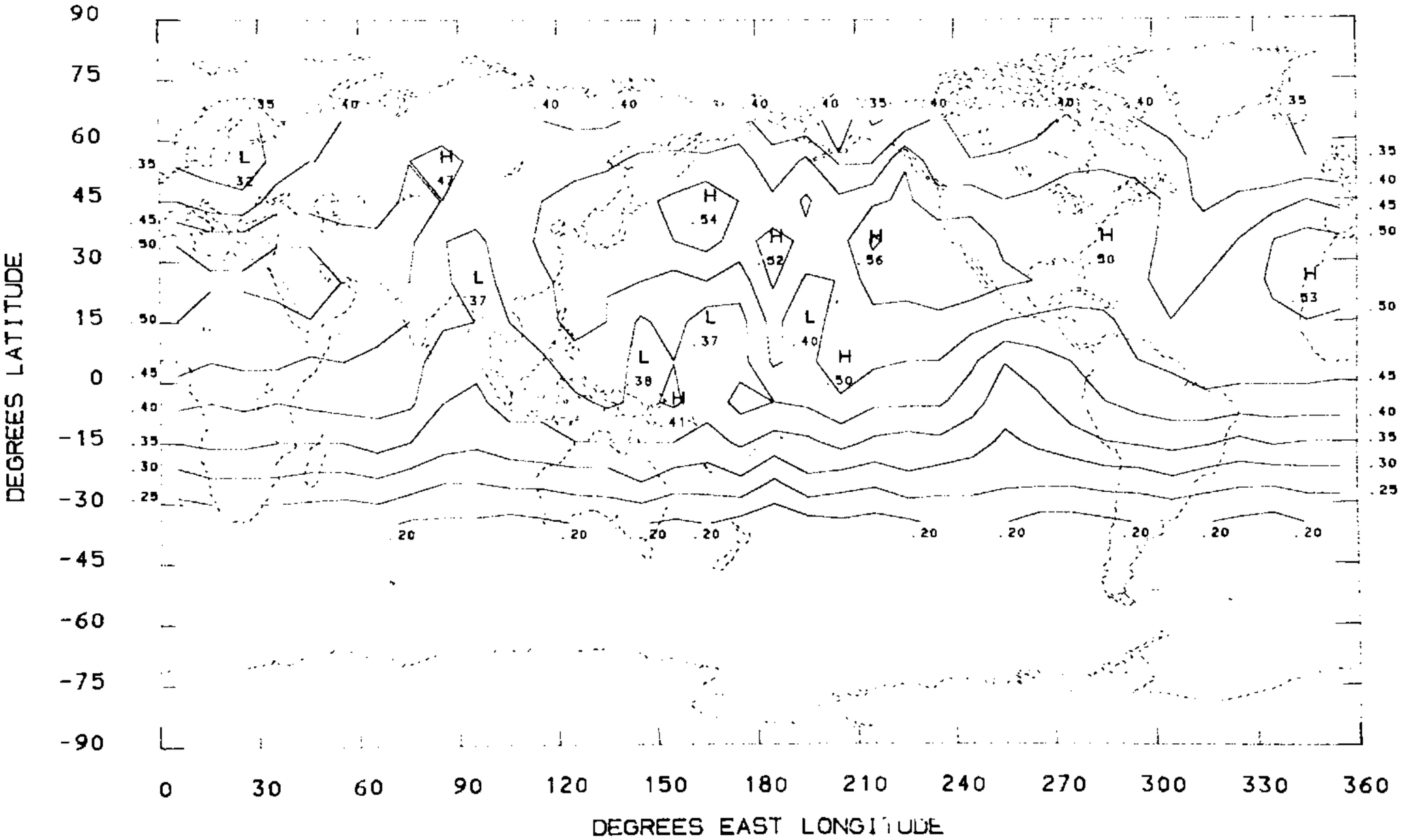

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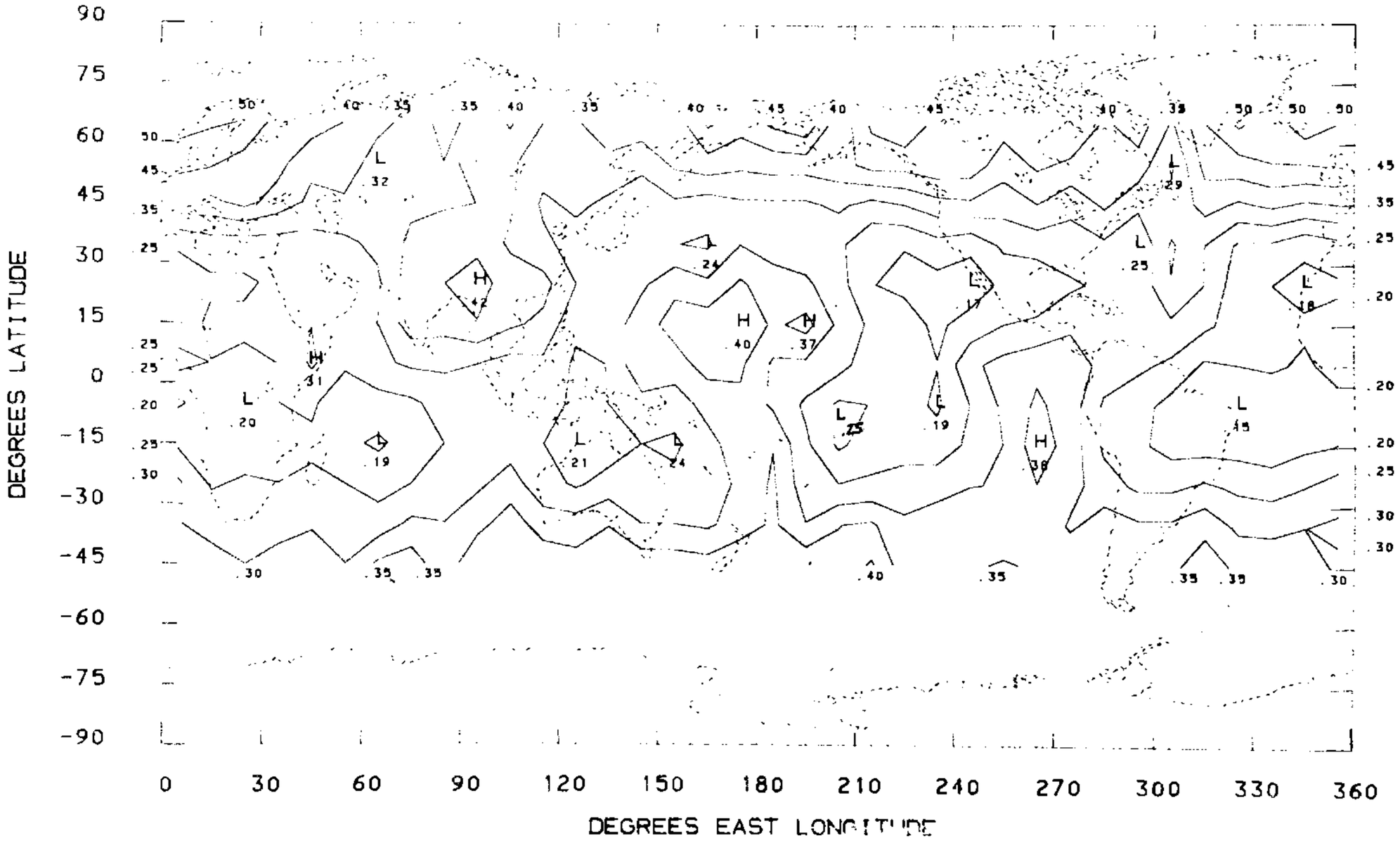

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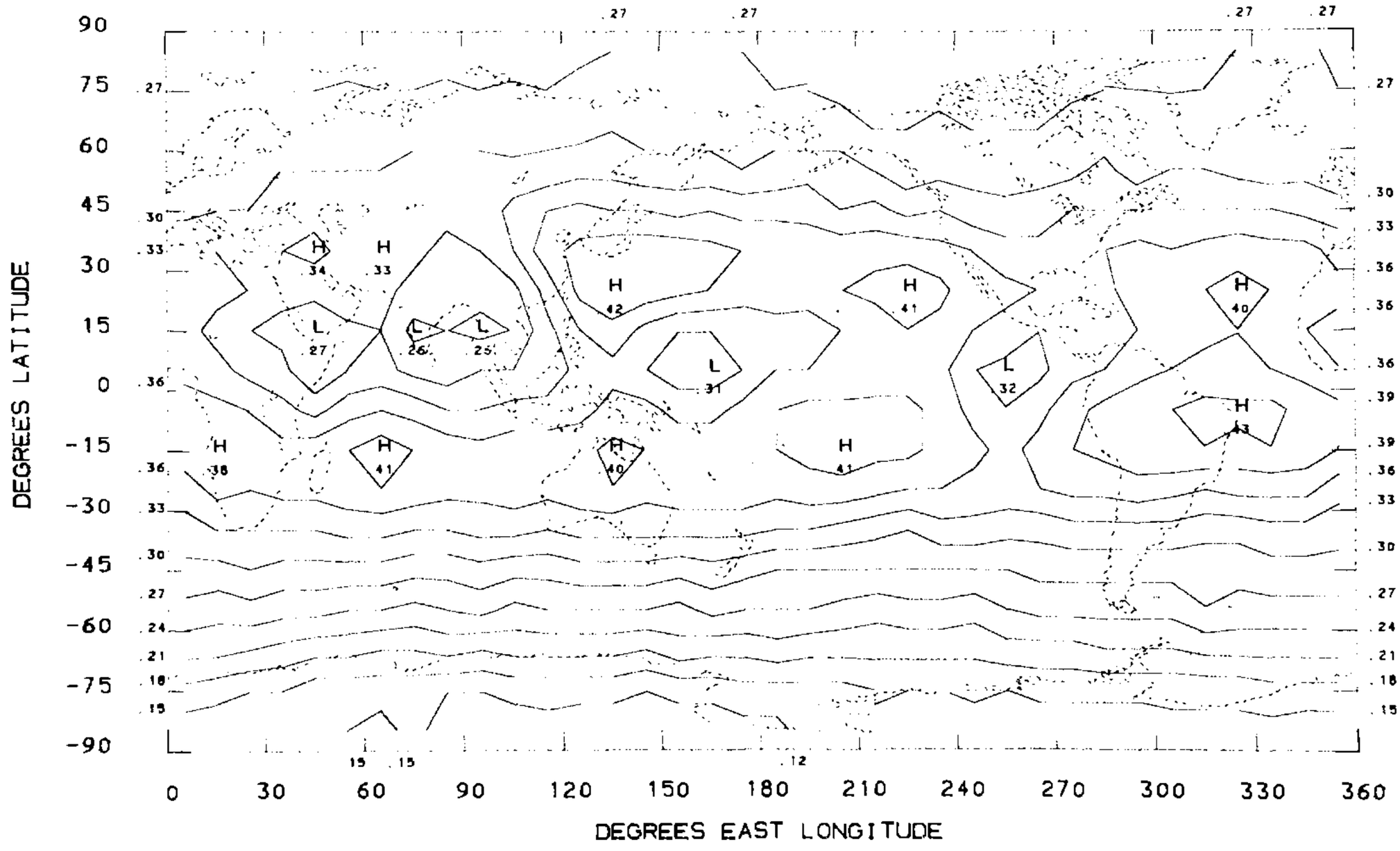

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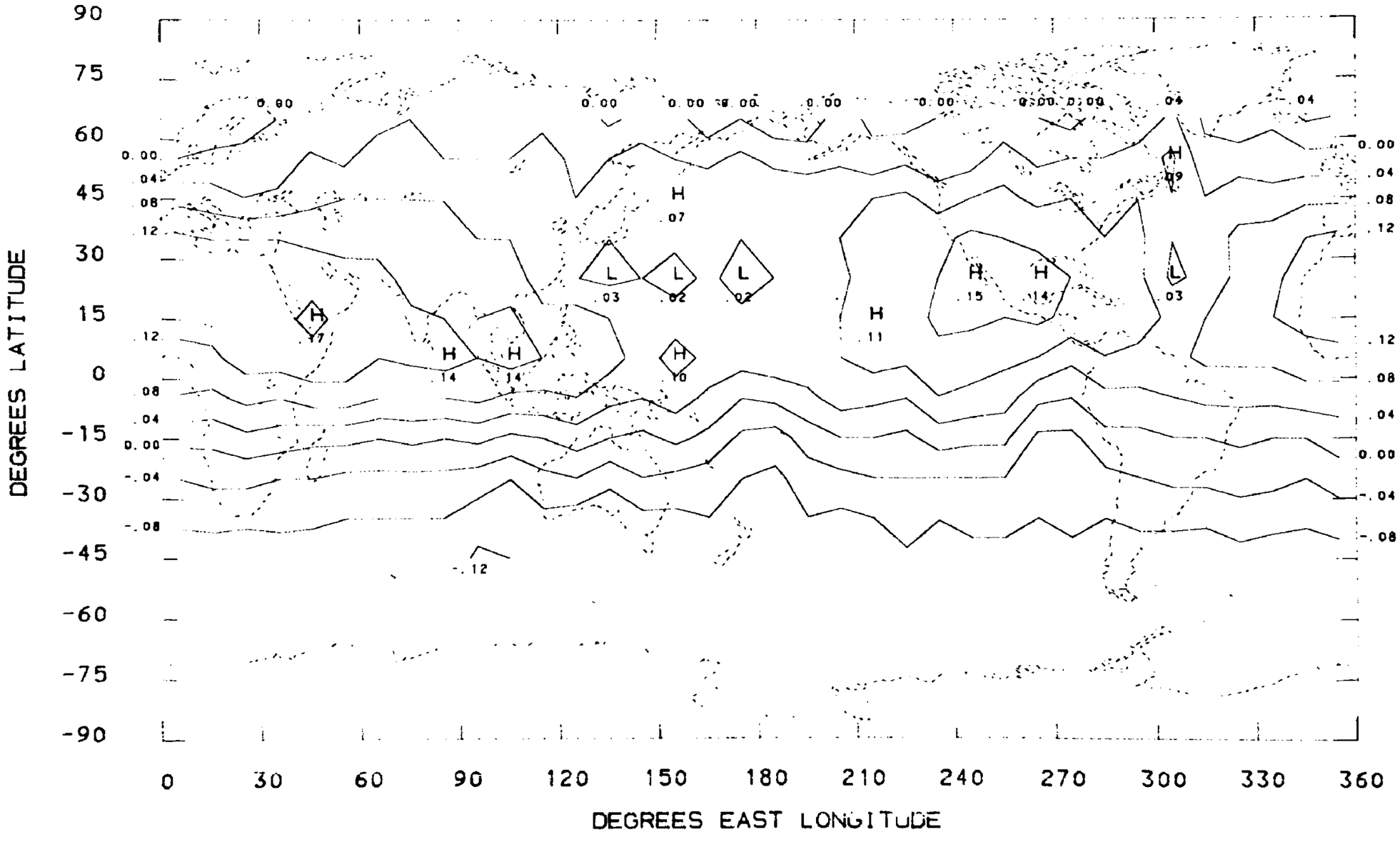

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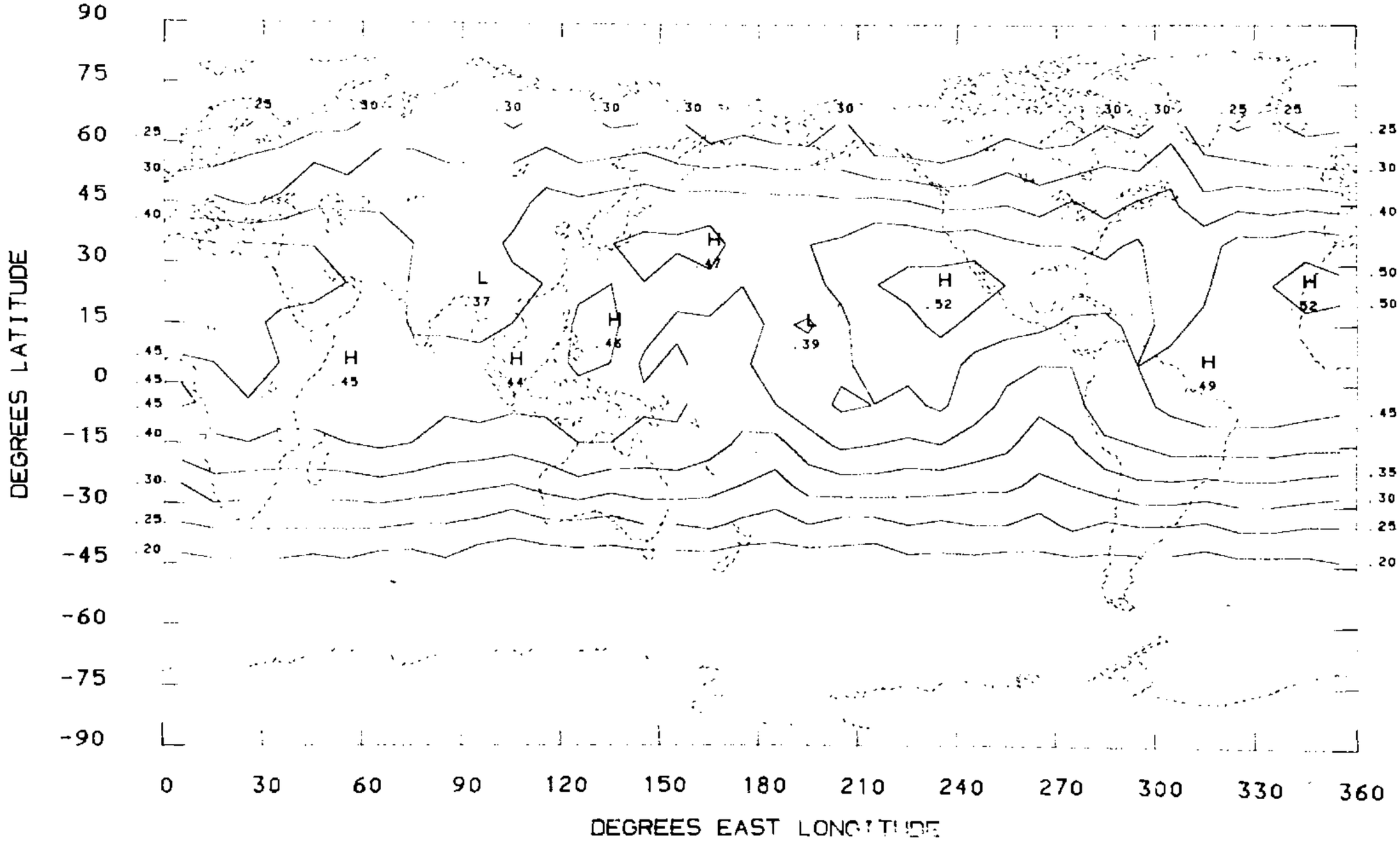

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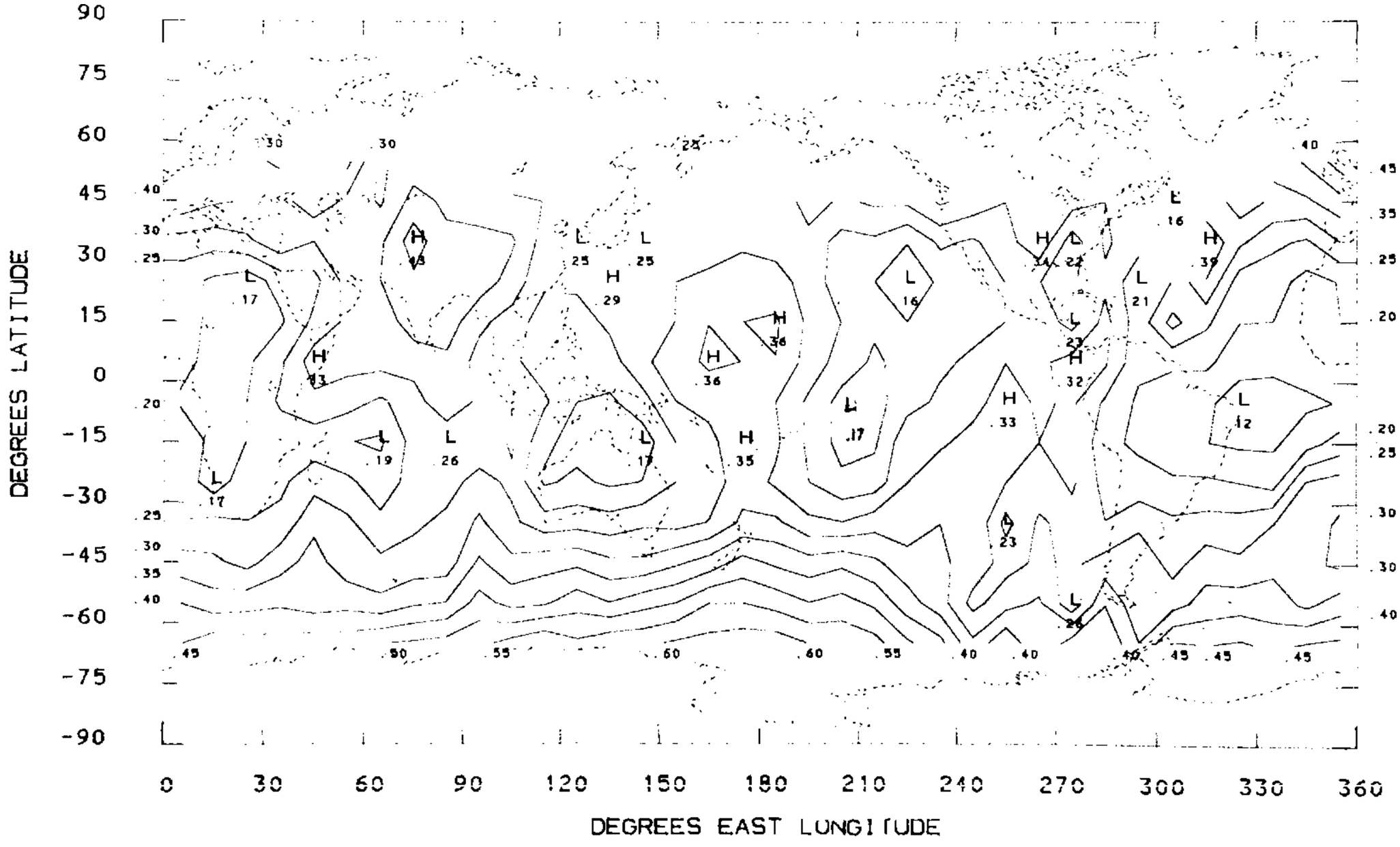

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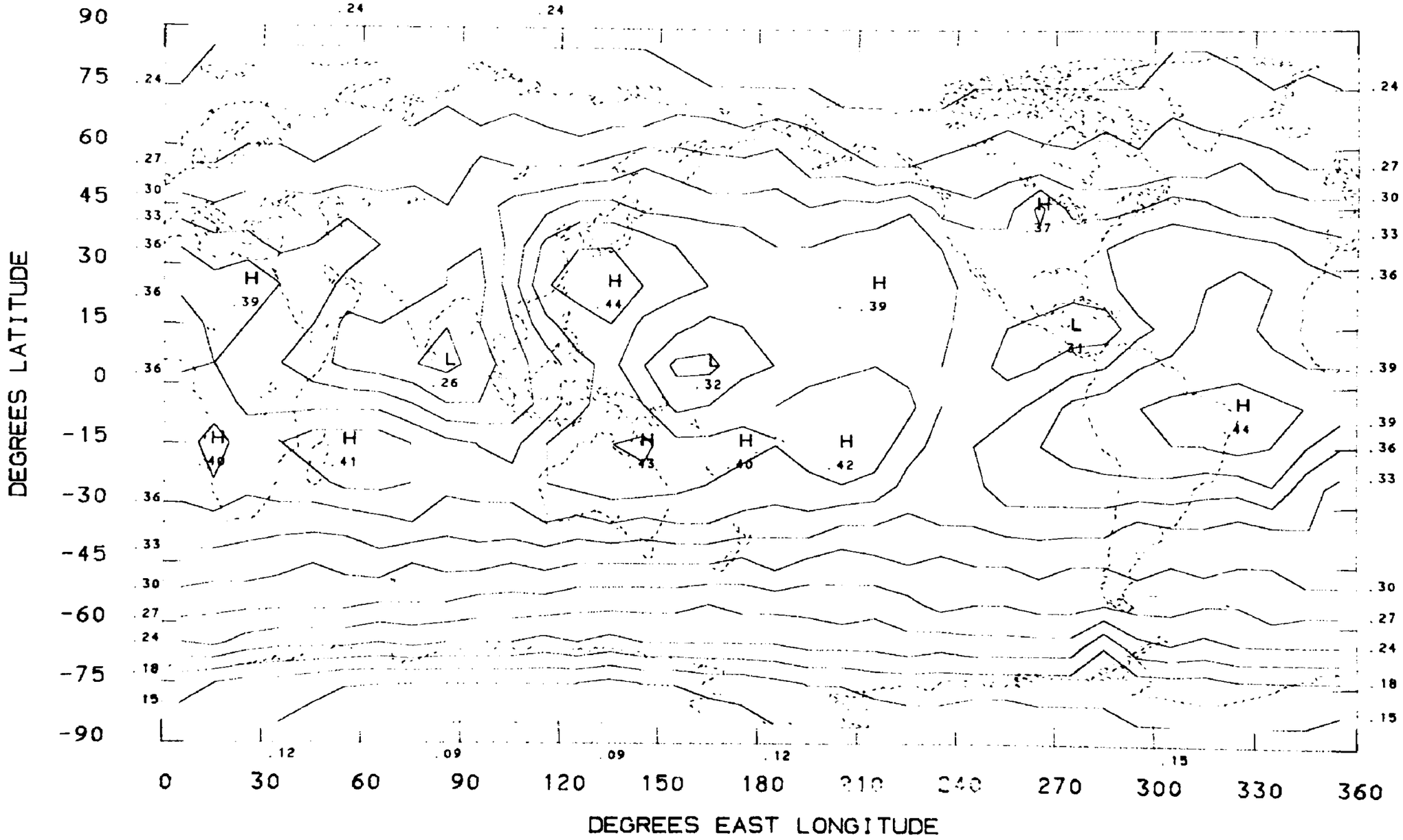

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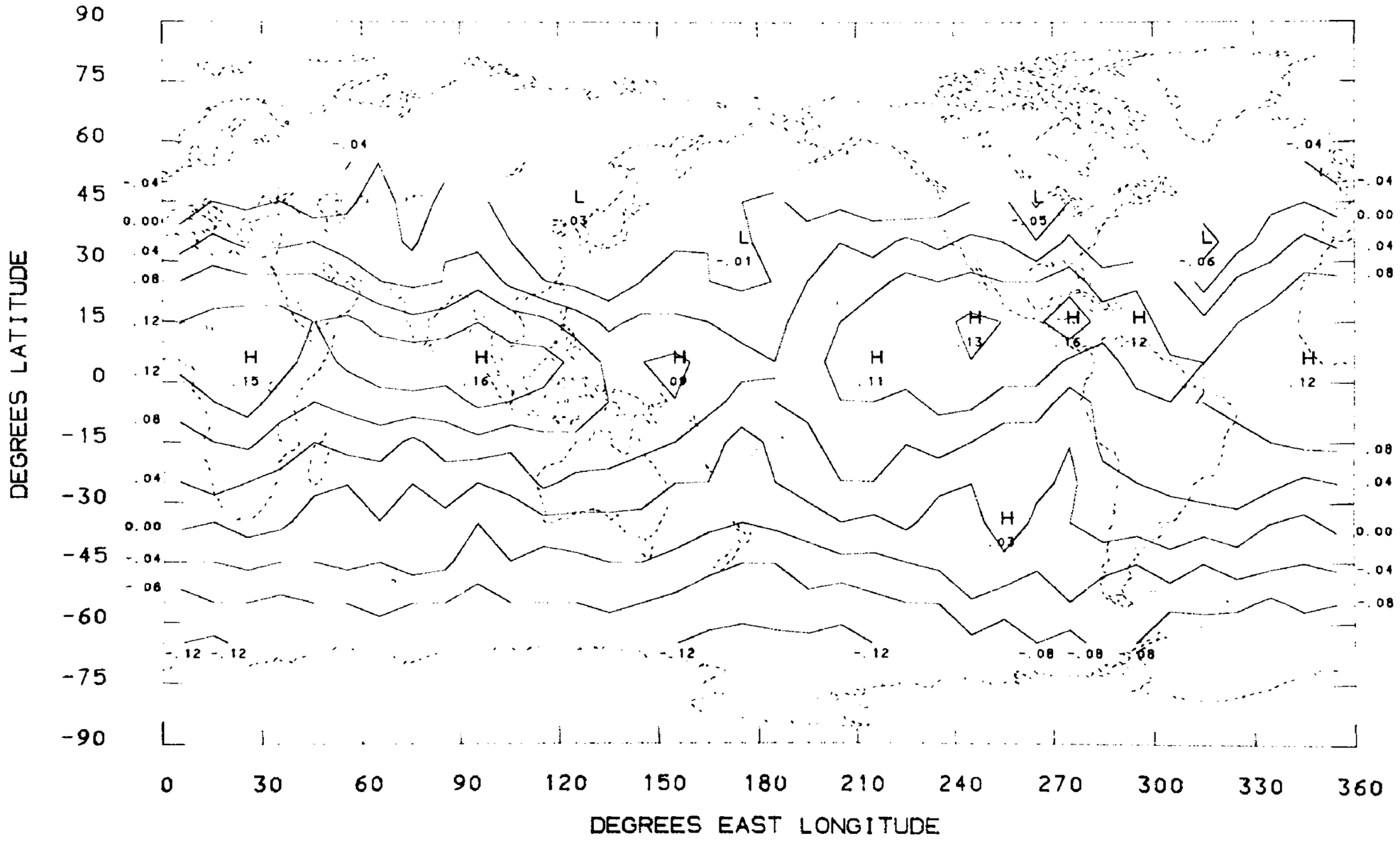

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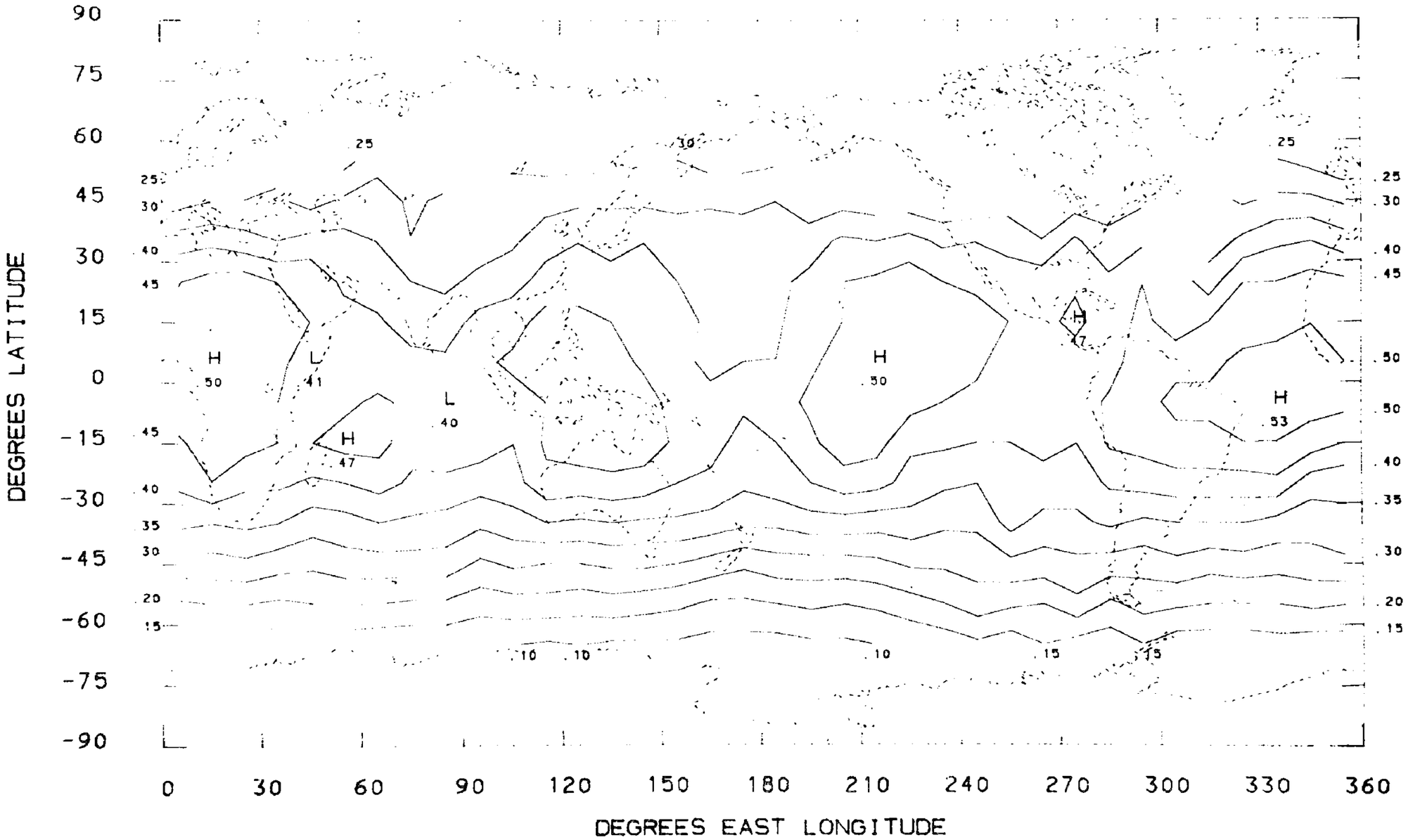

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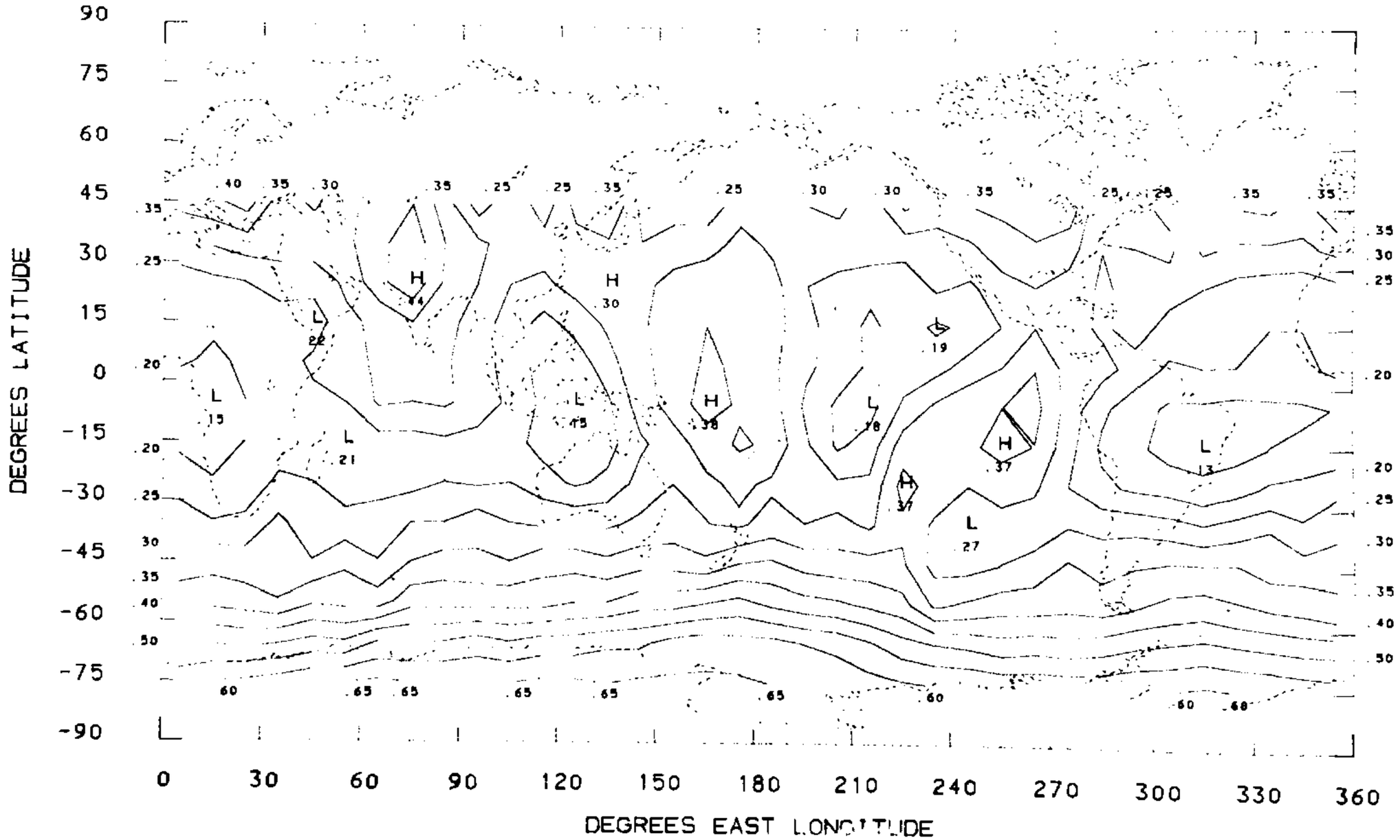

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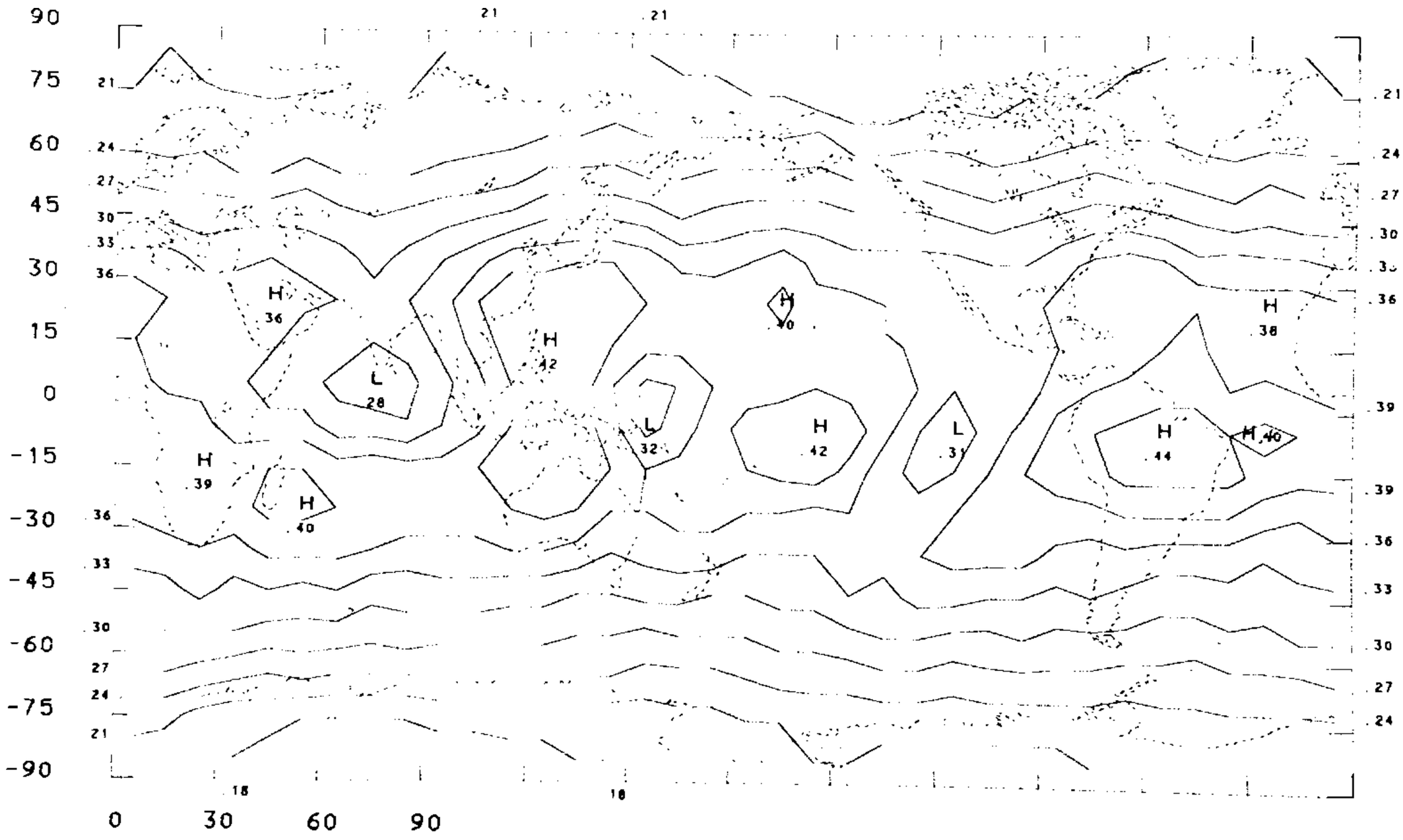

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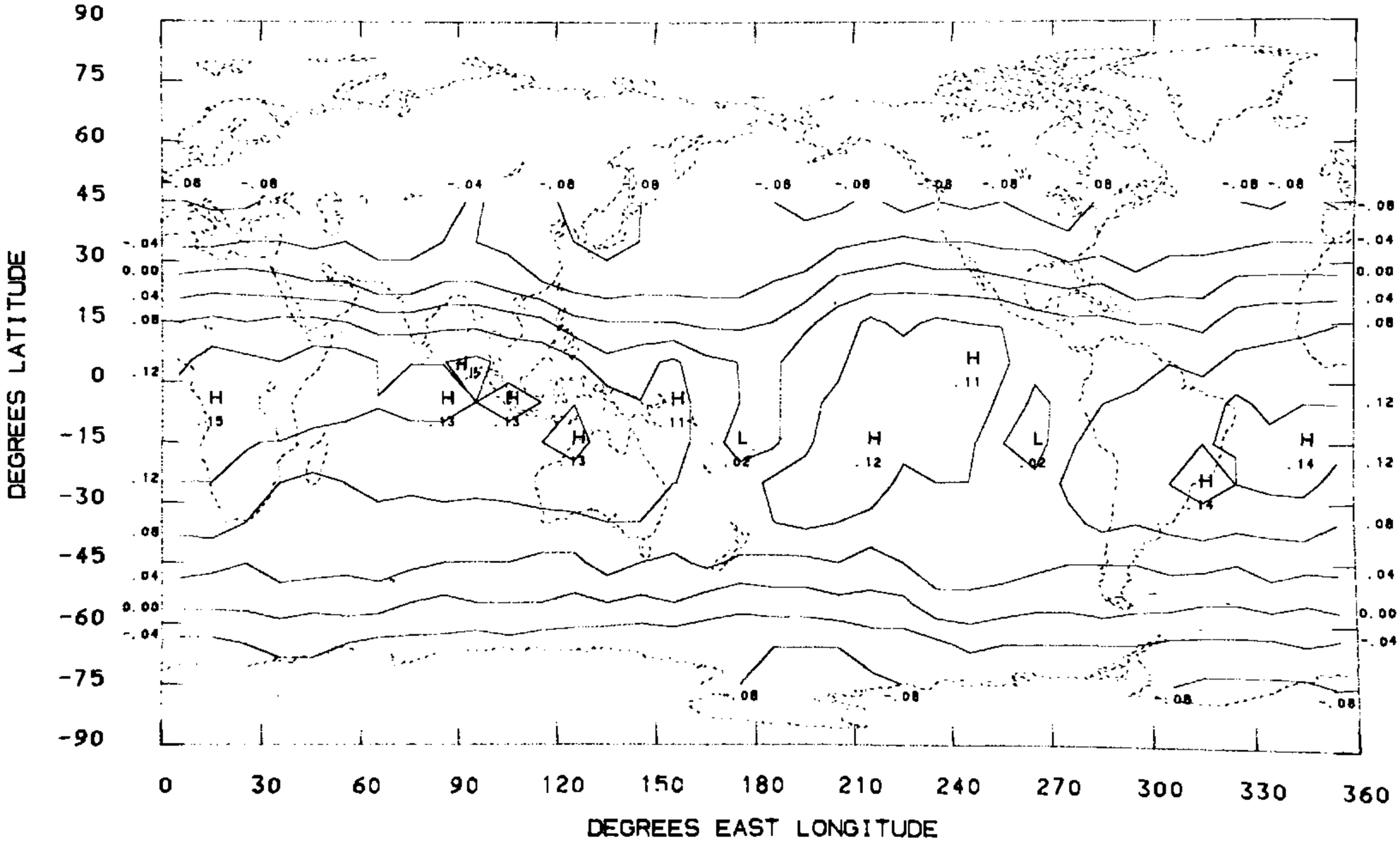

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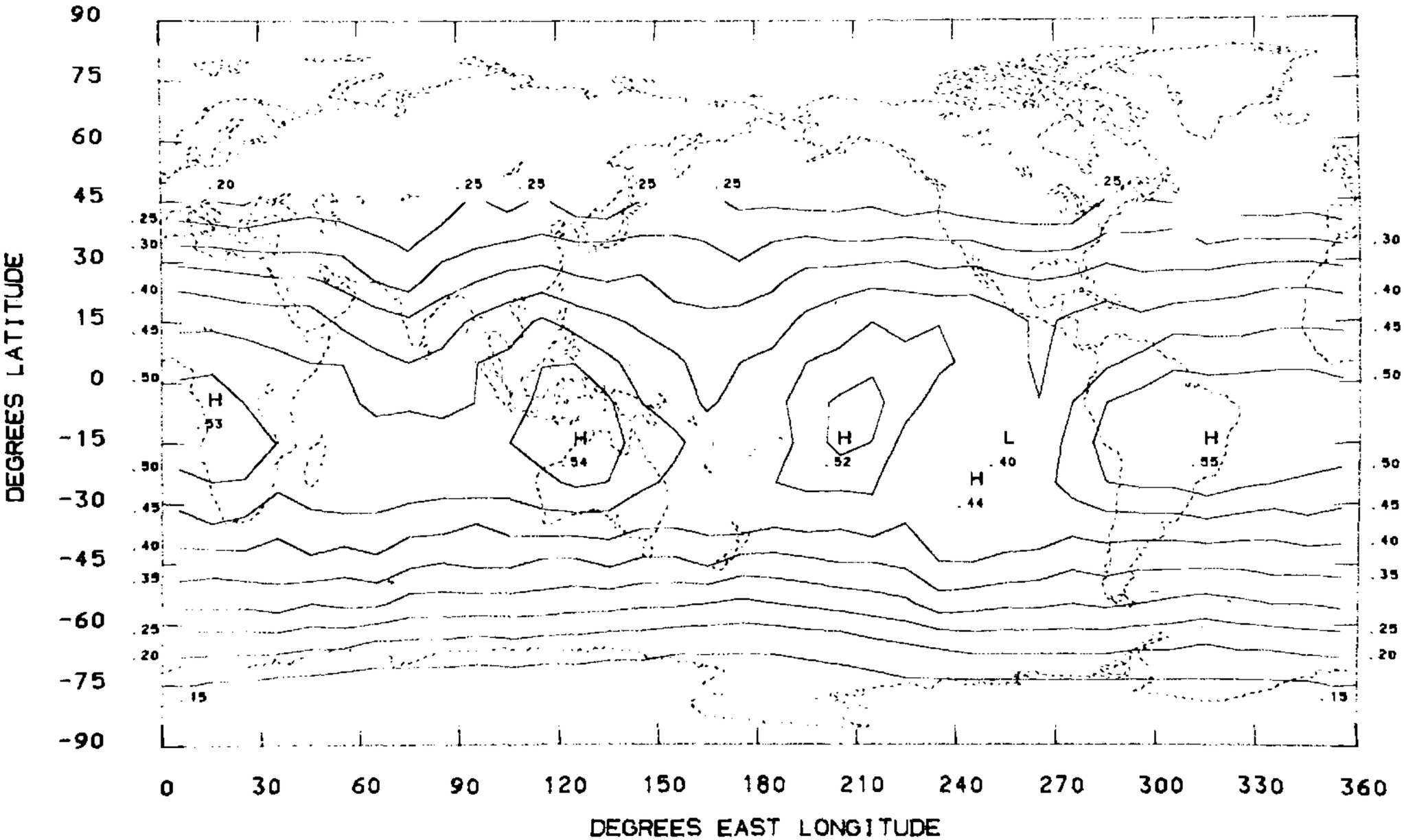

PLANETARY ALBEDO

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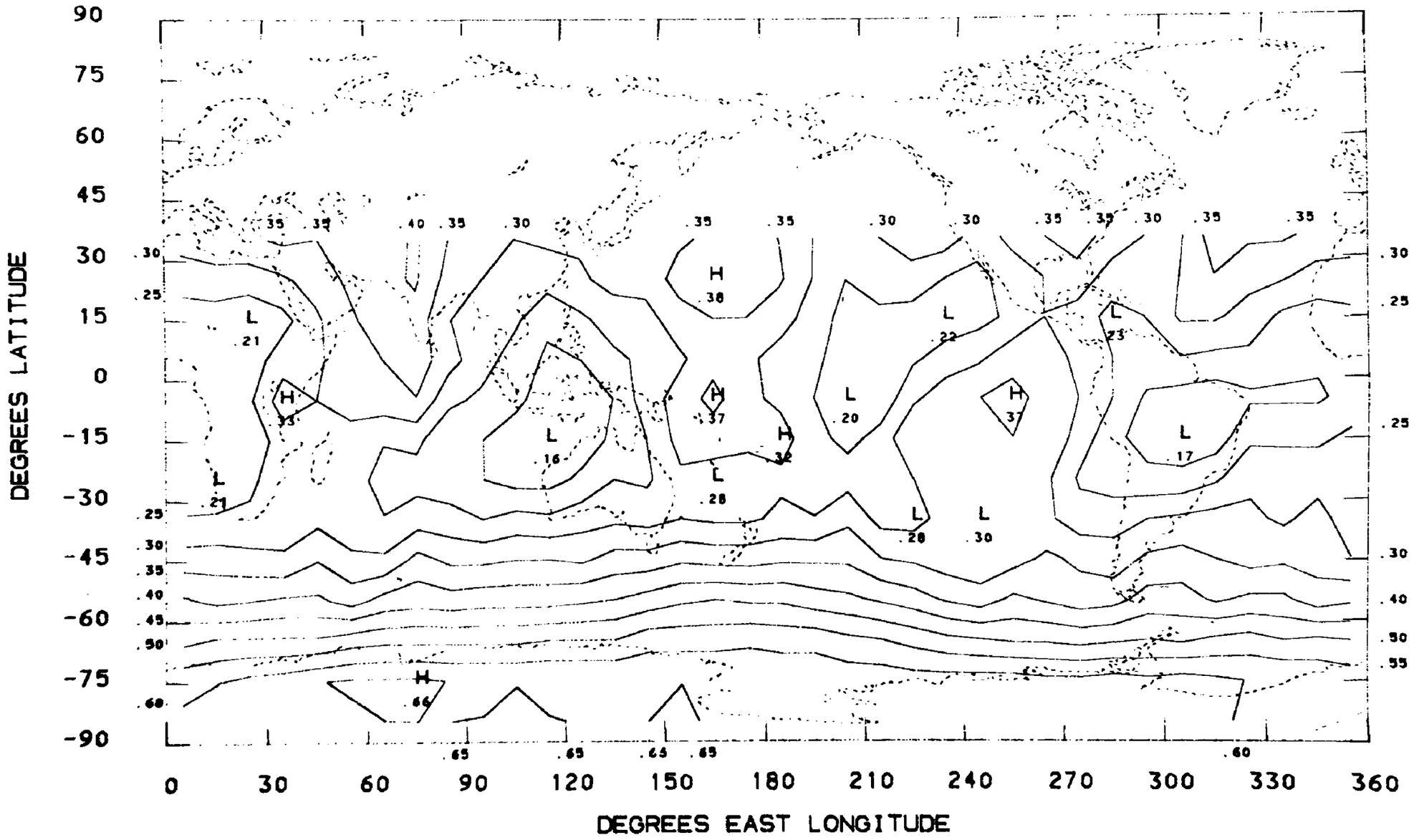

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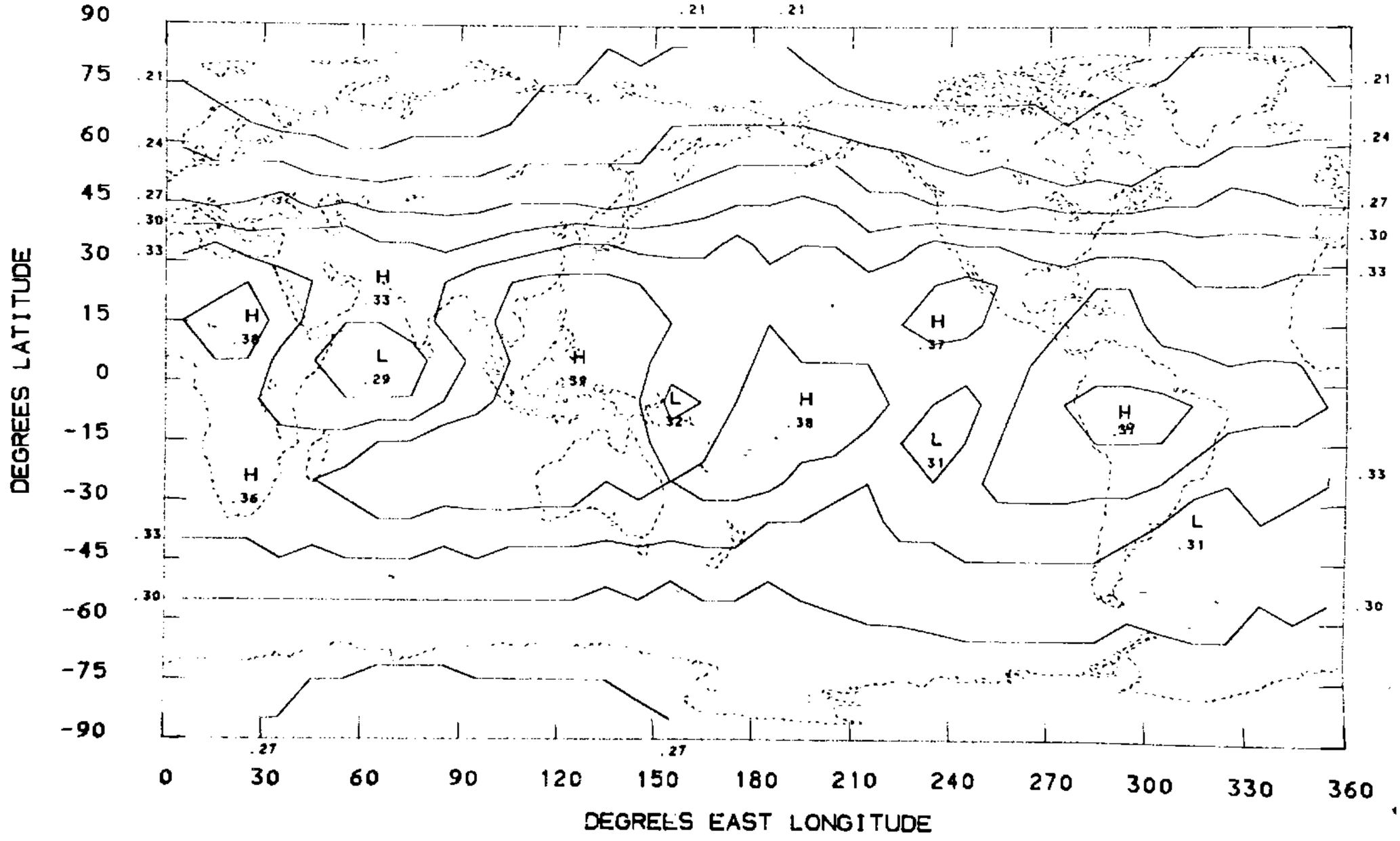

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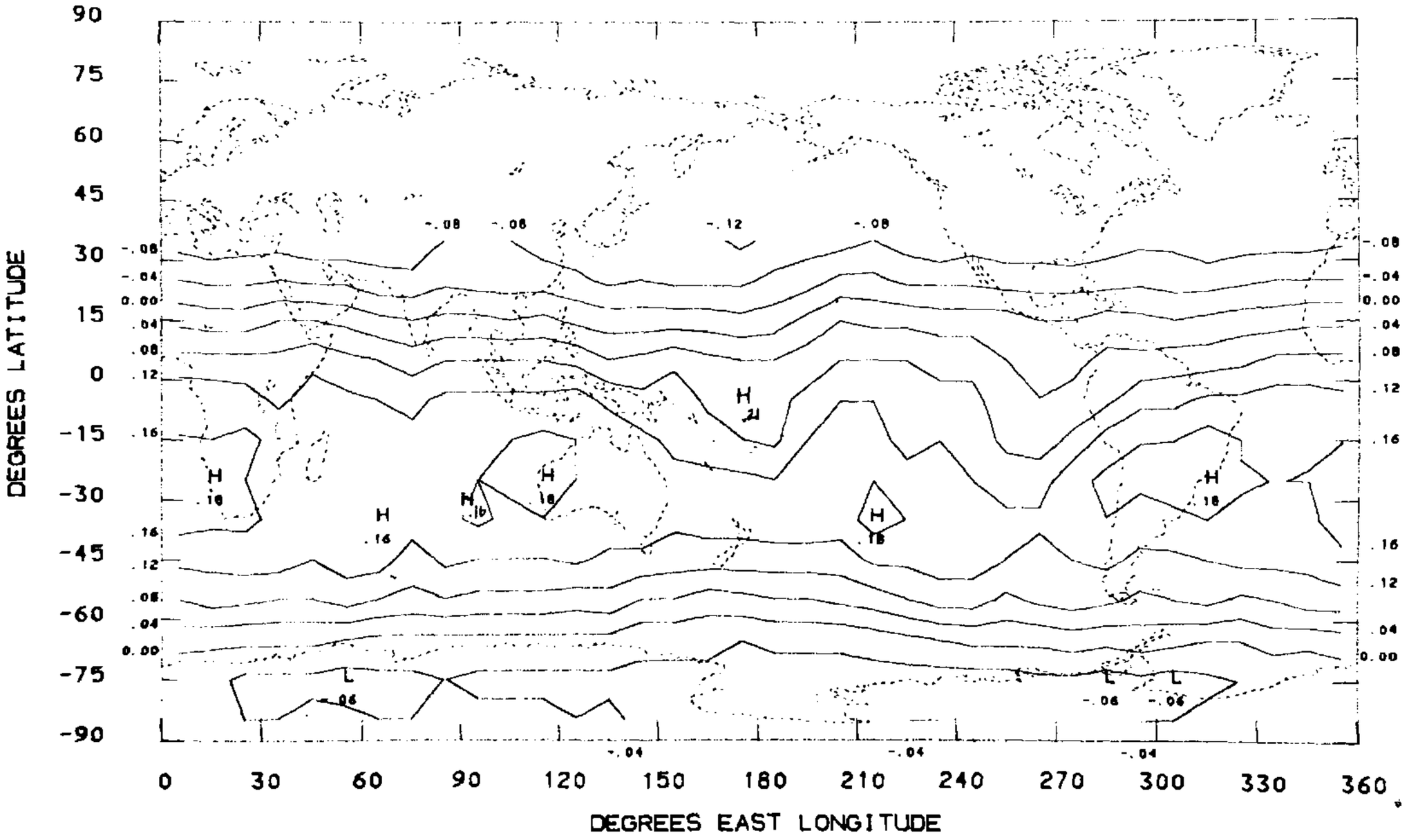

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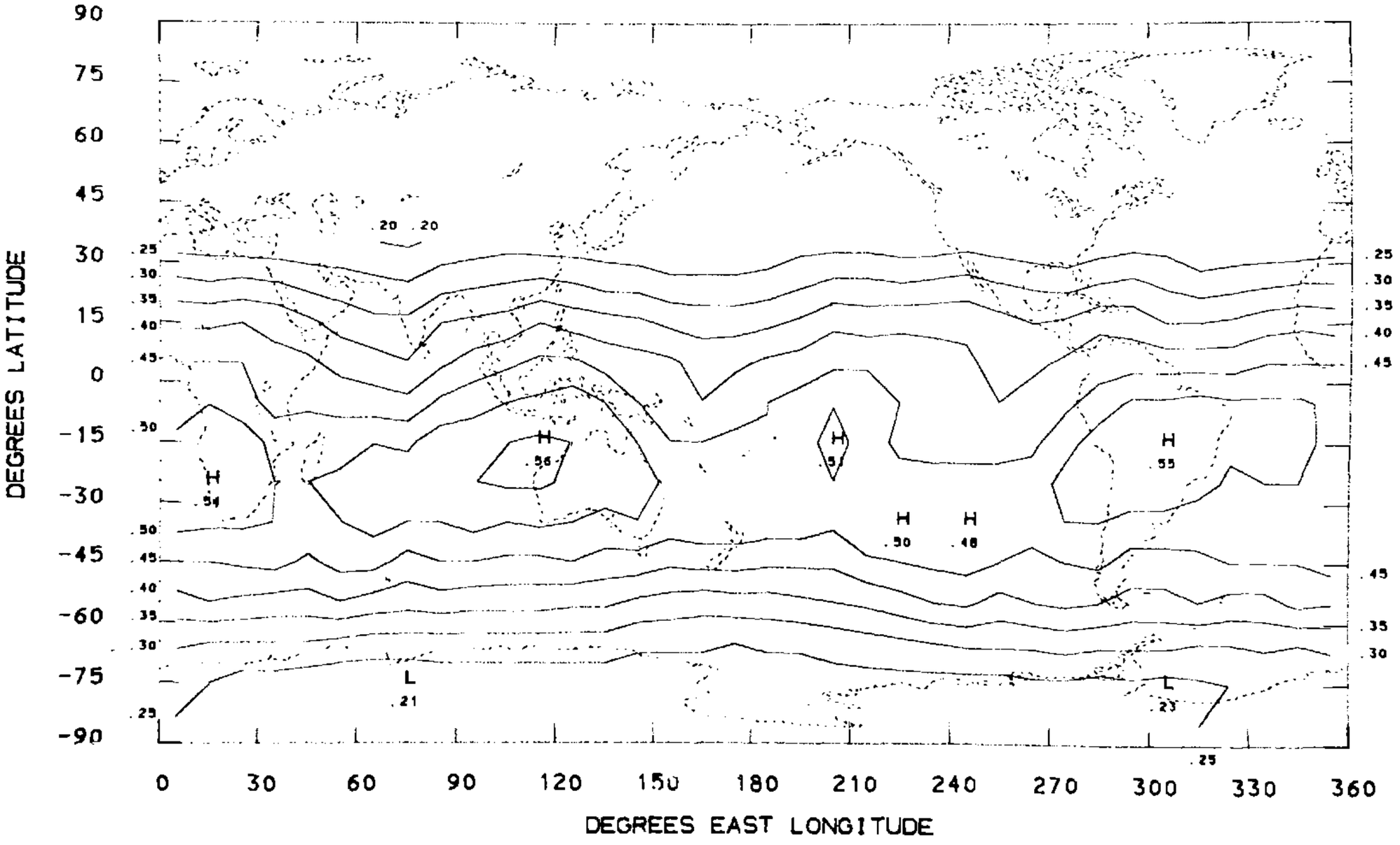

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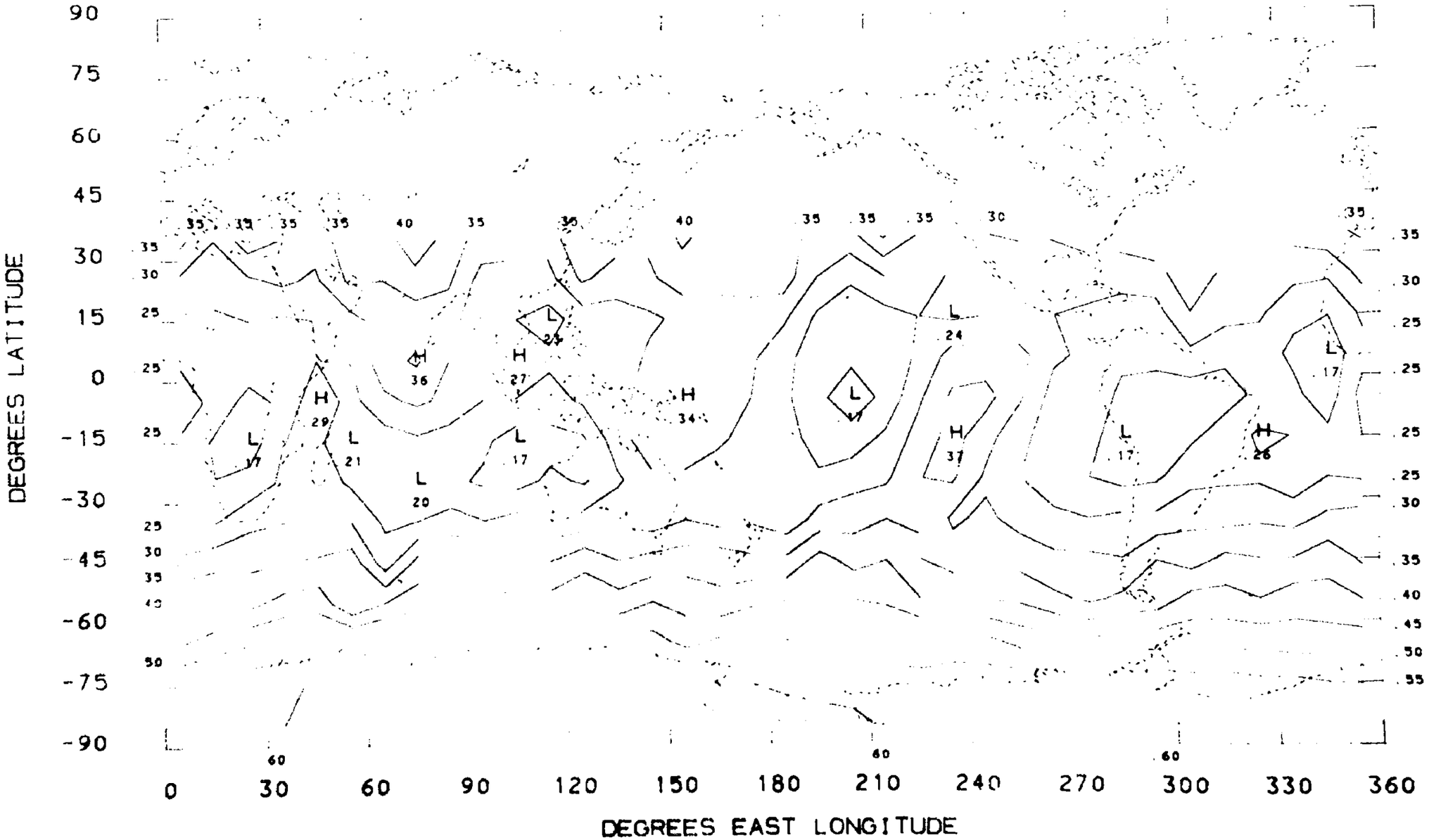

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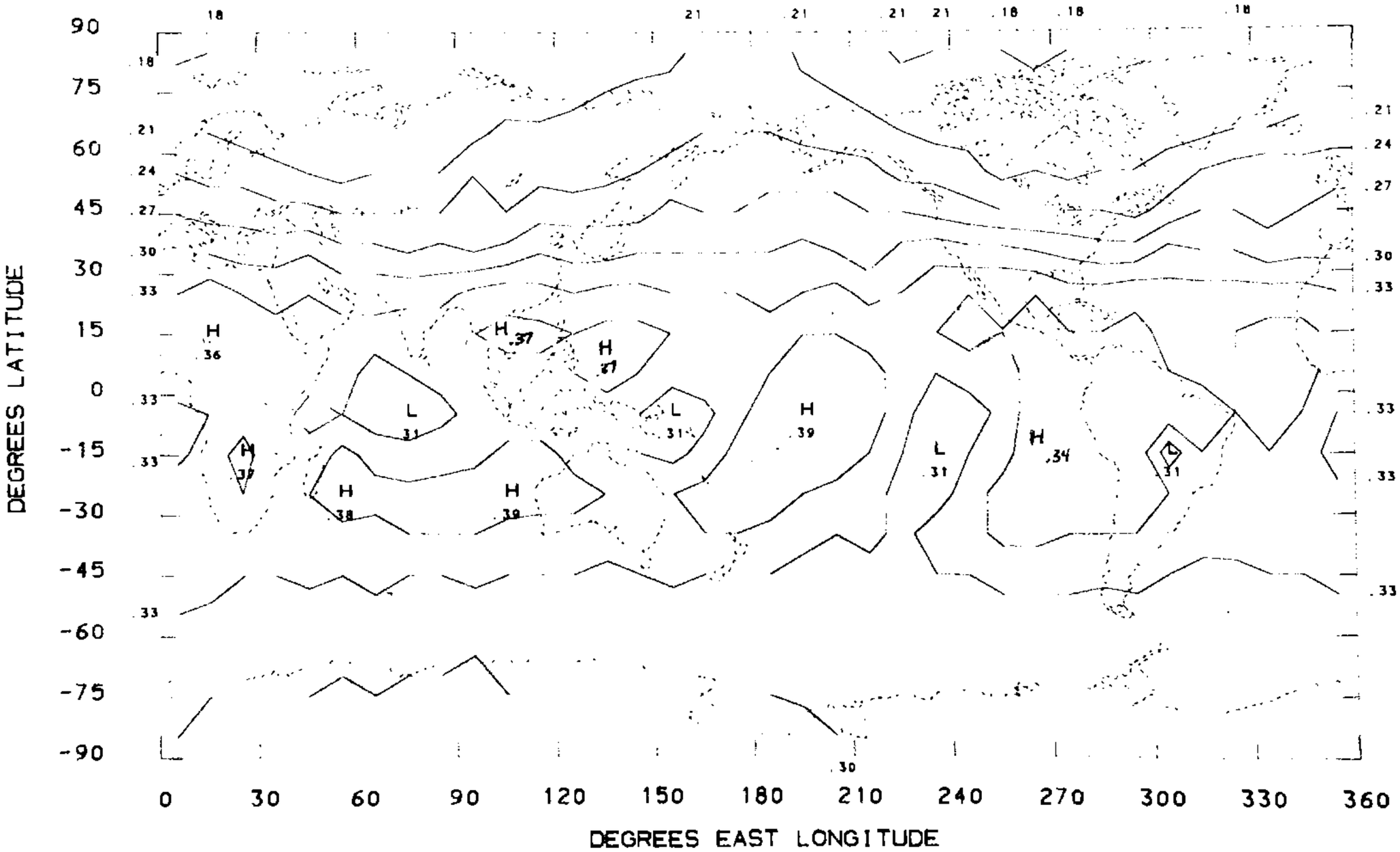

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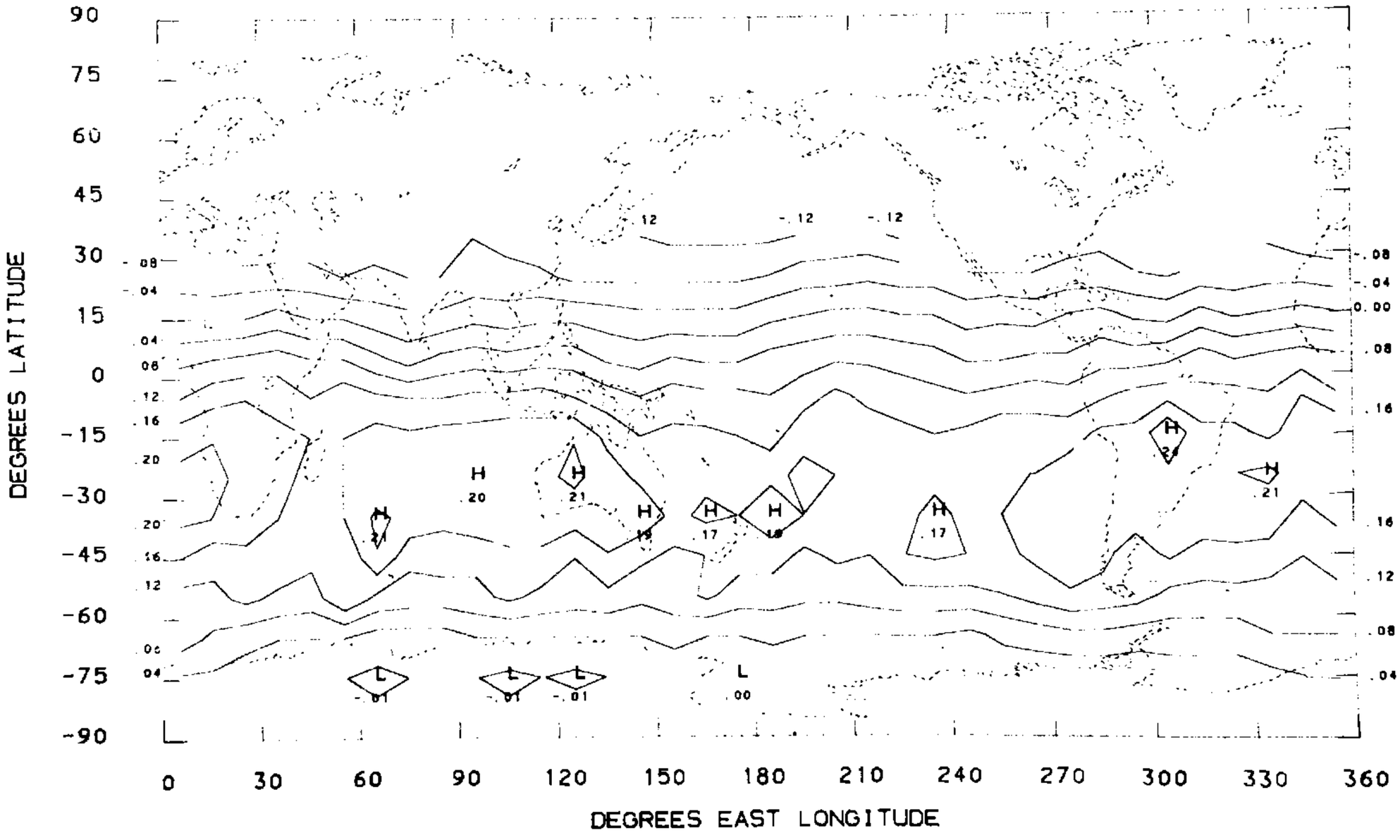

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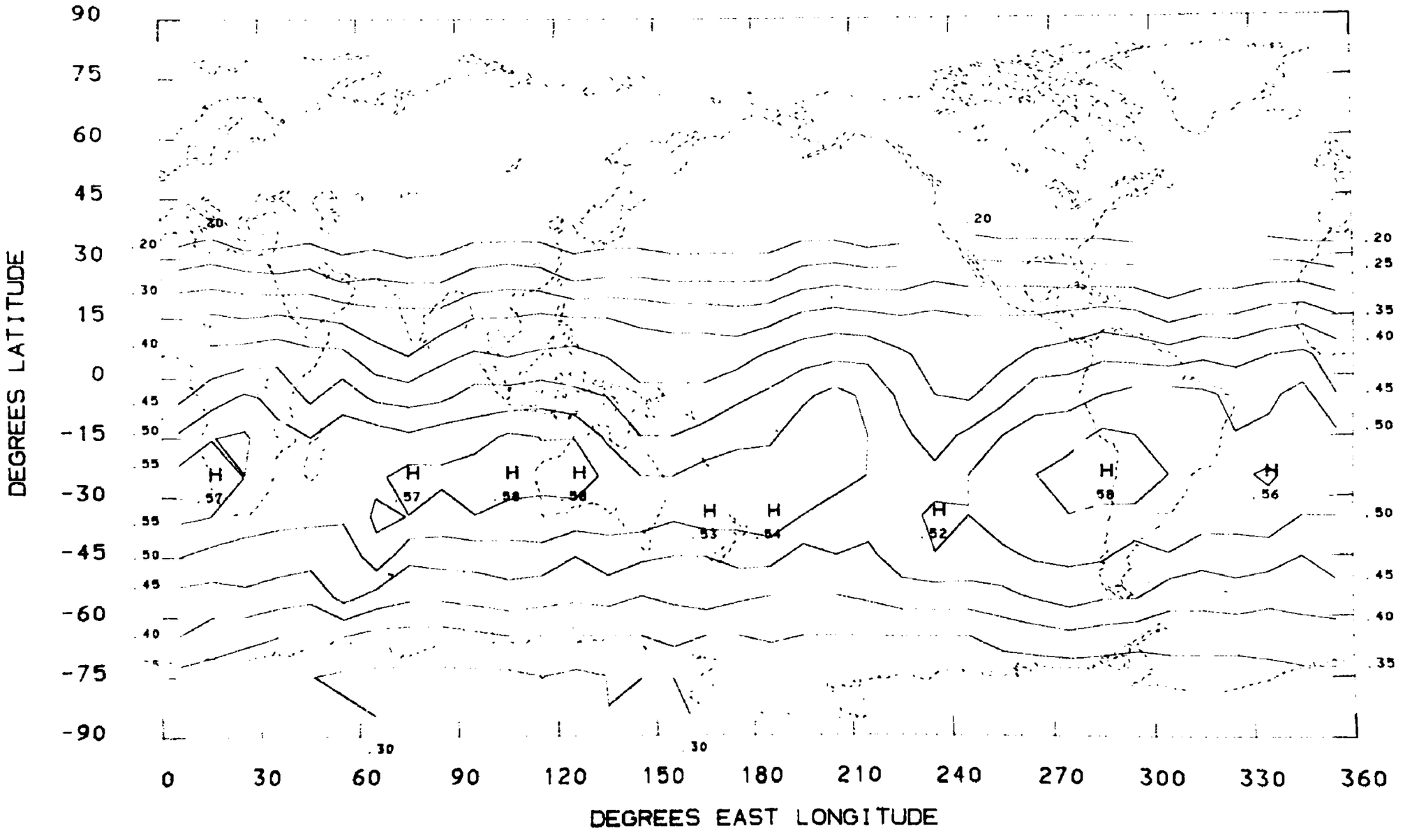

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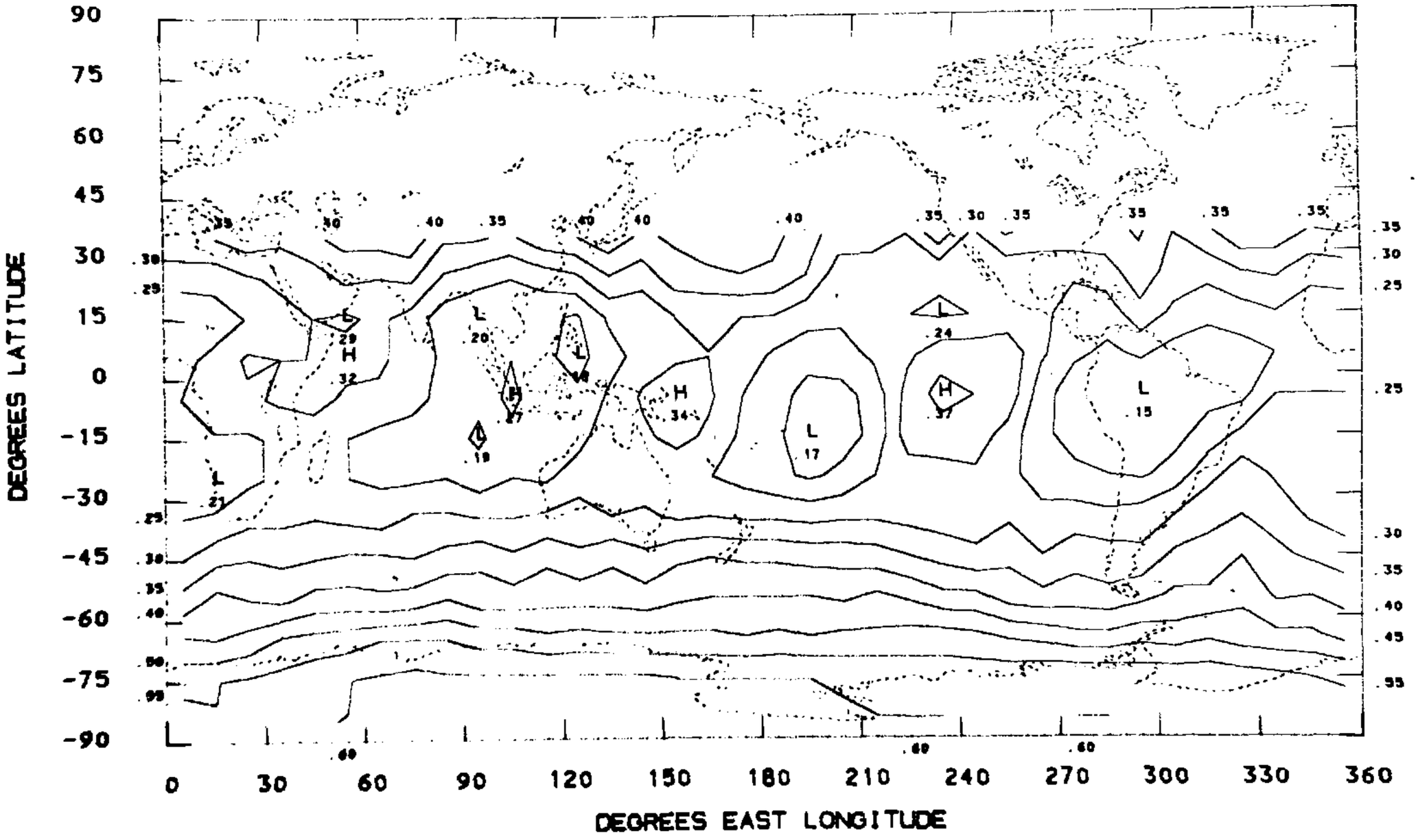

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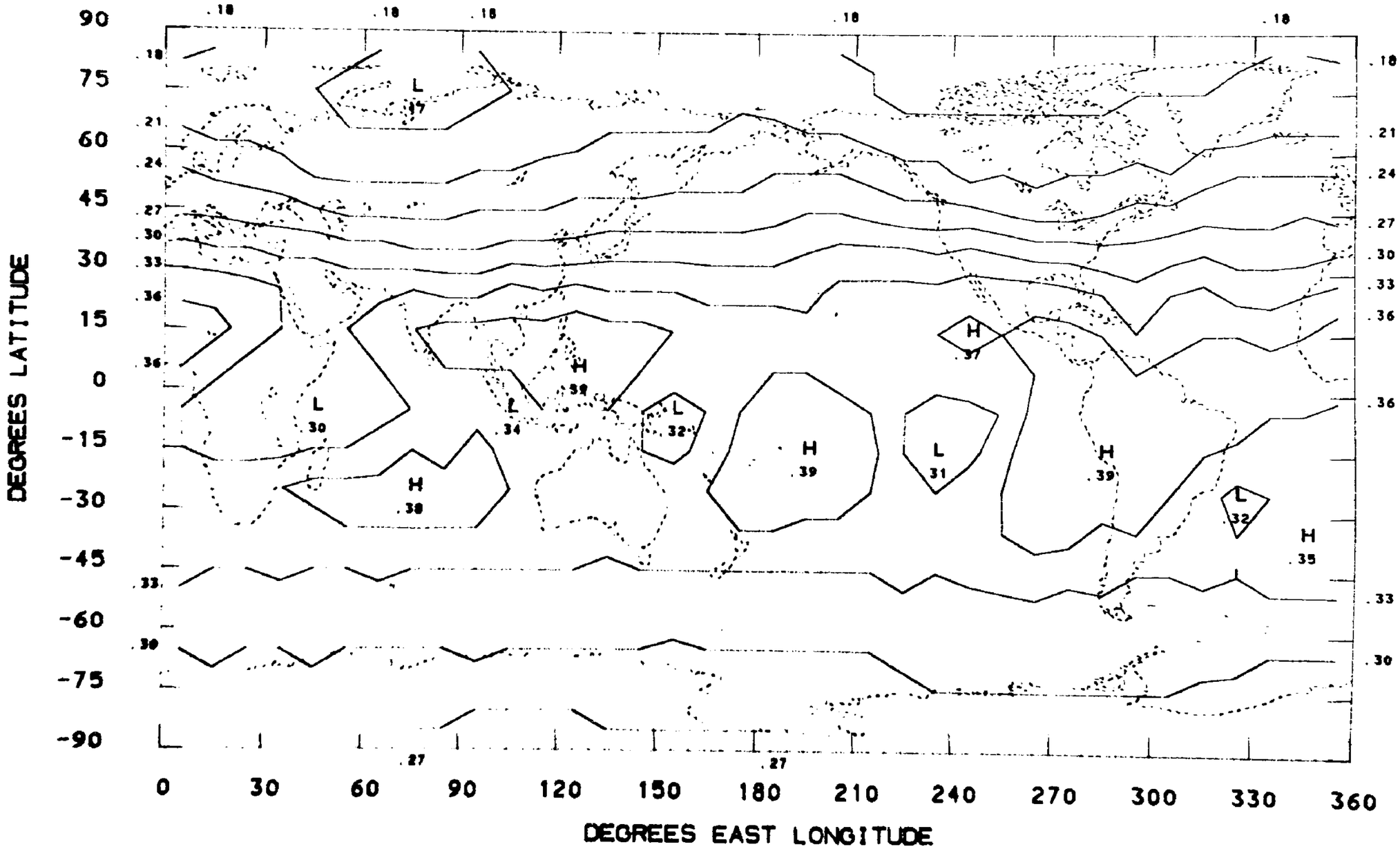

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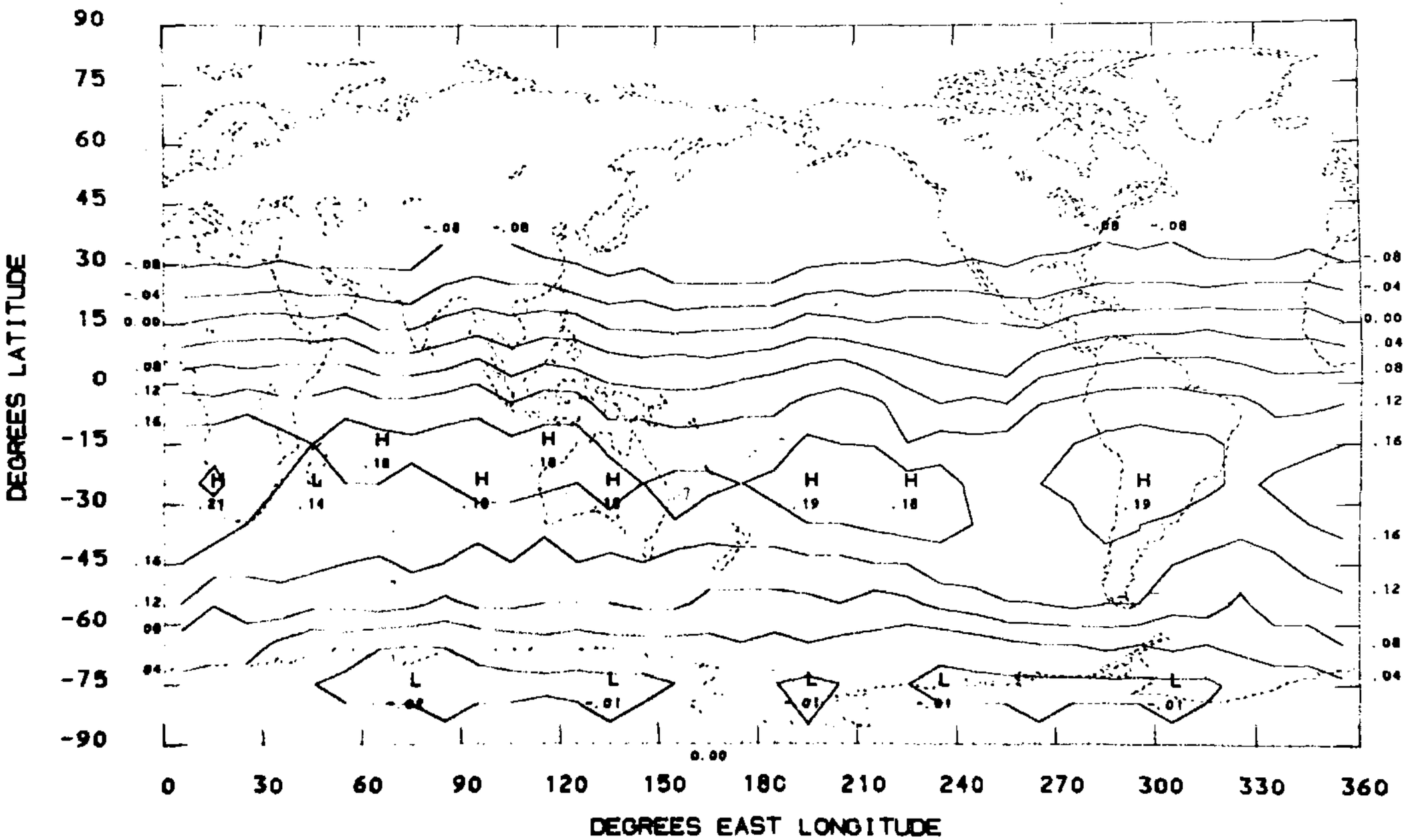

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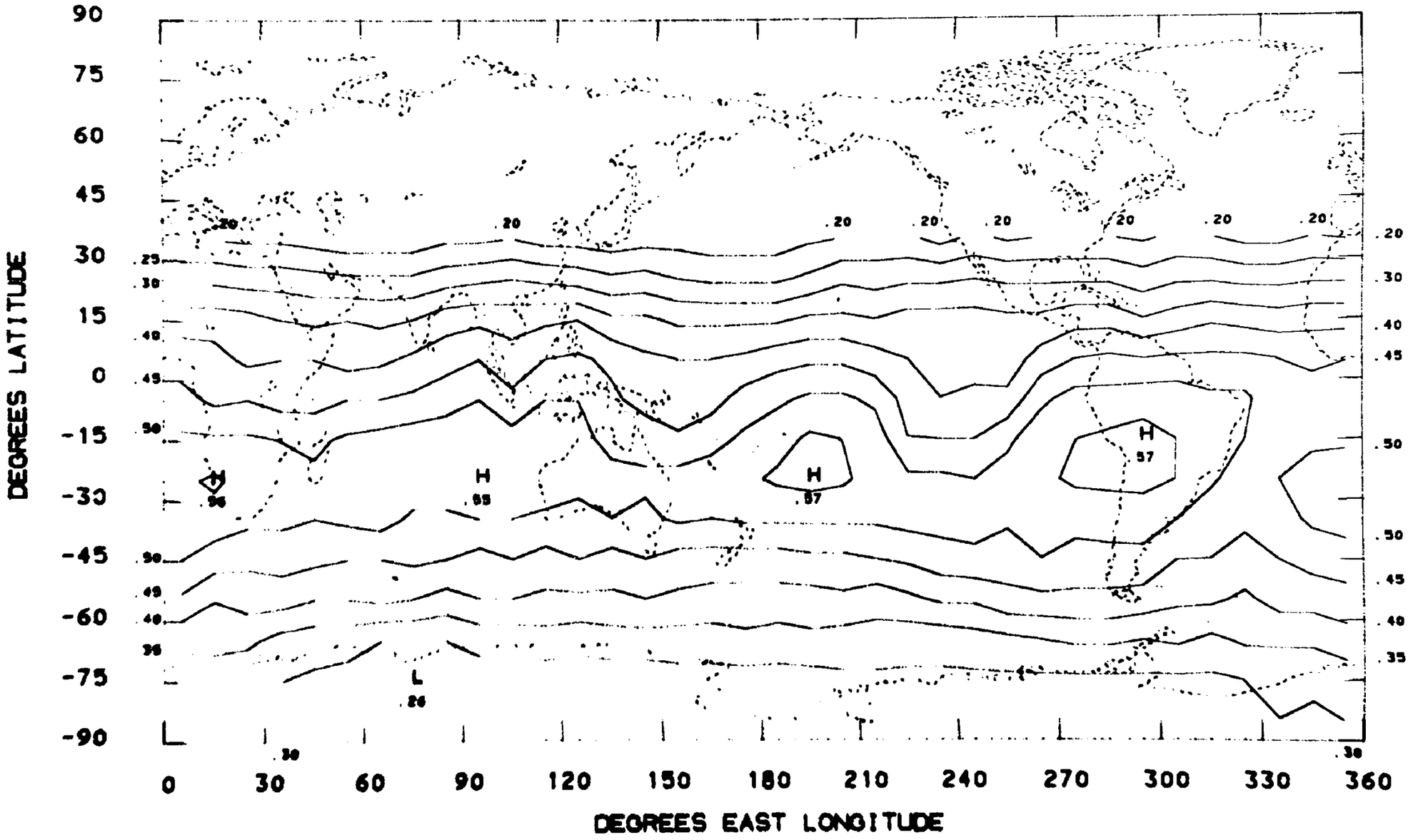

PLANETARY ALBEDO

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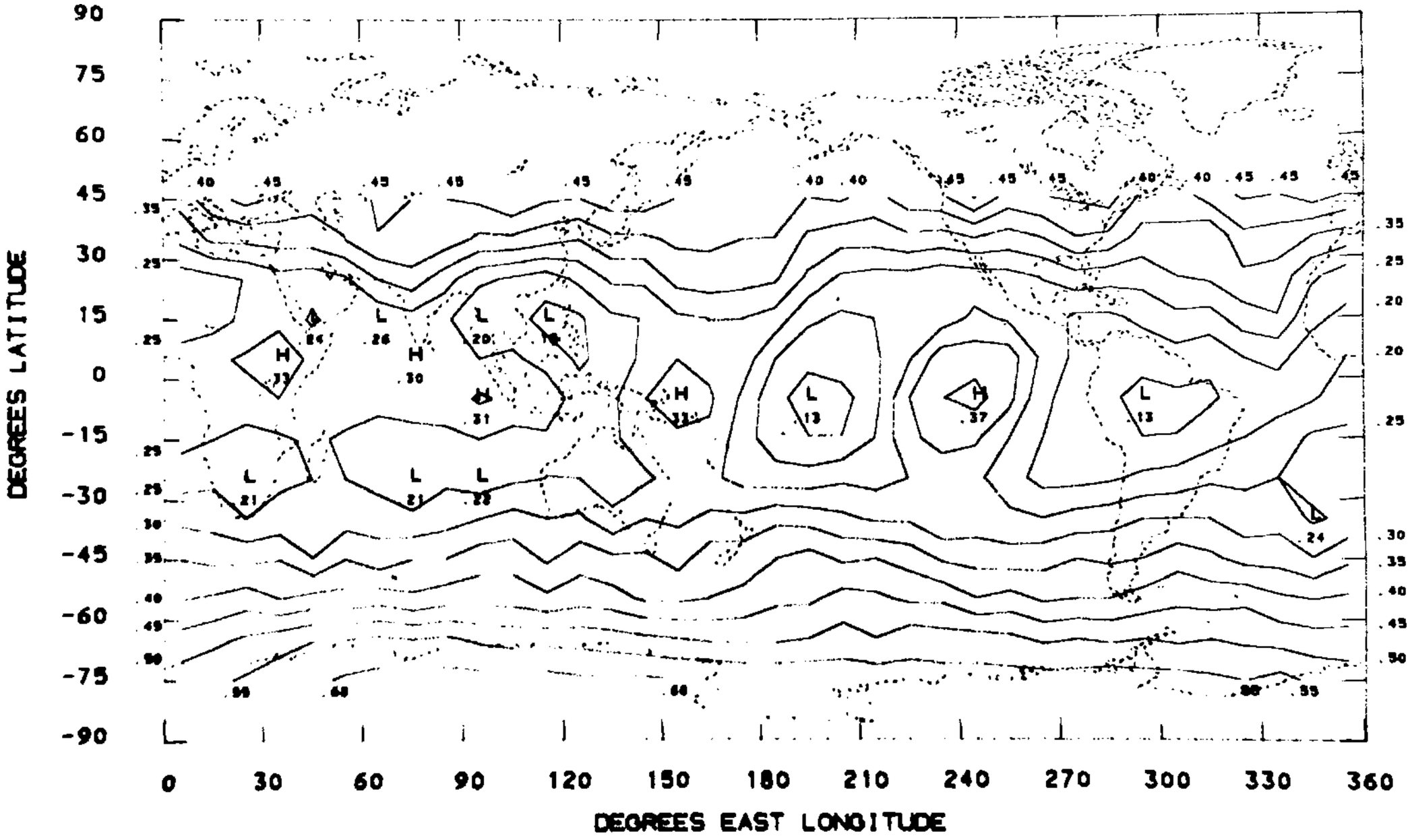

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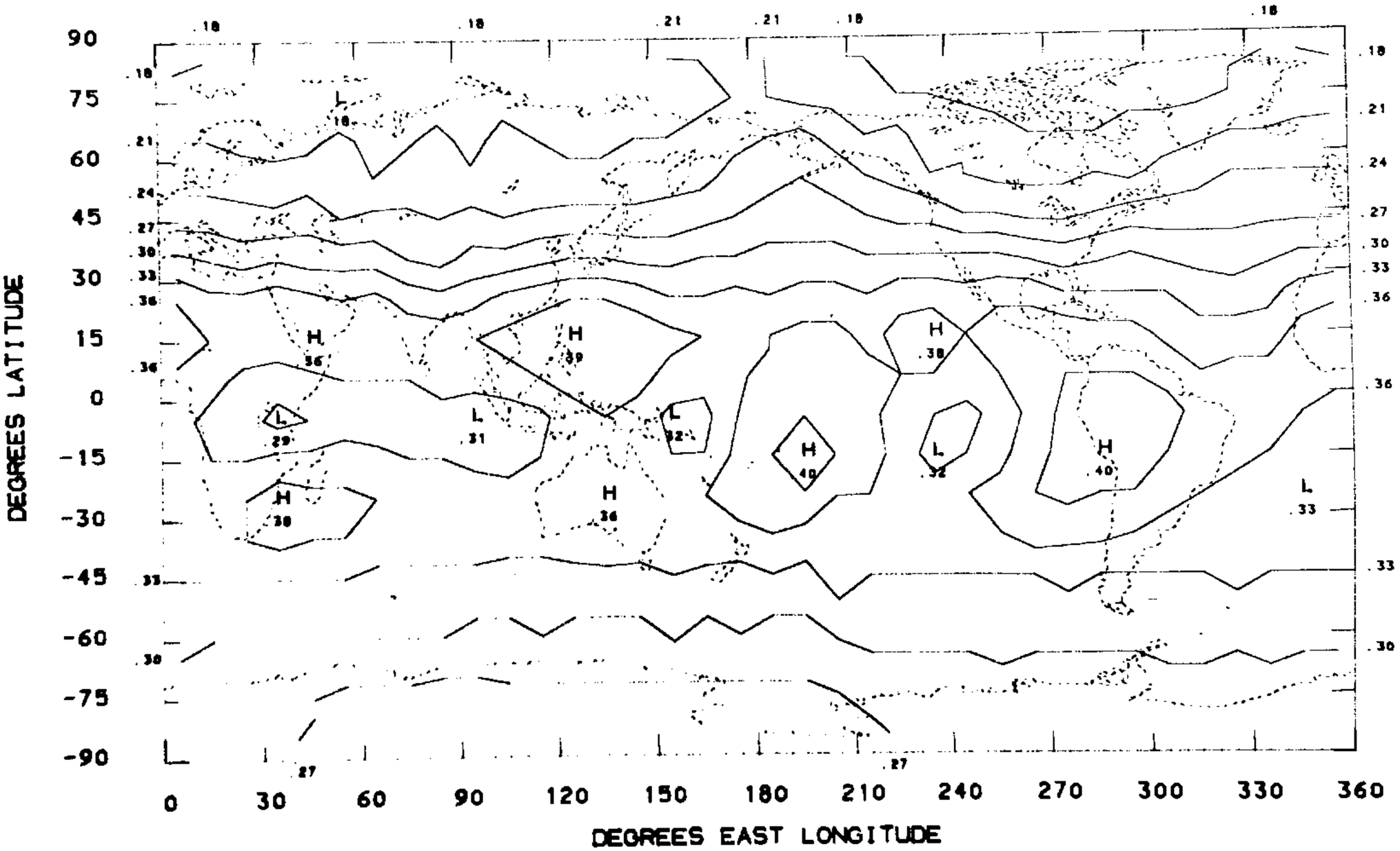

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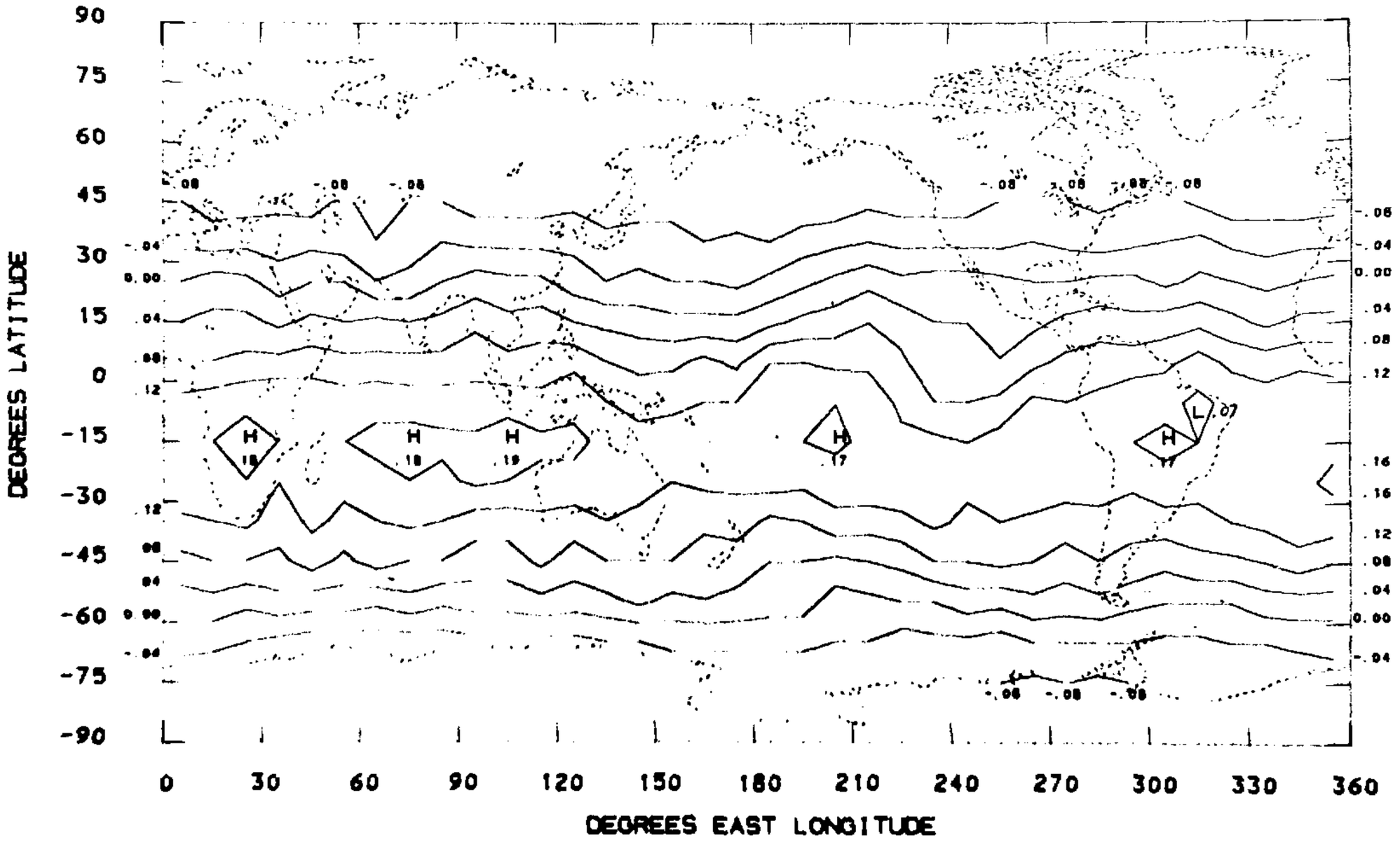

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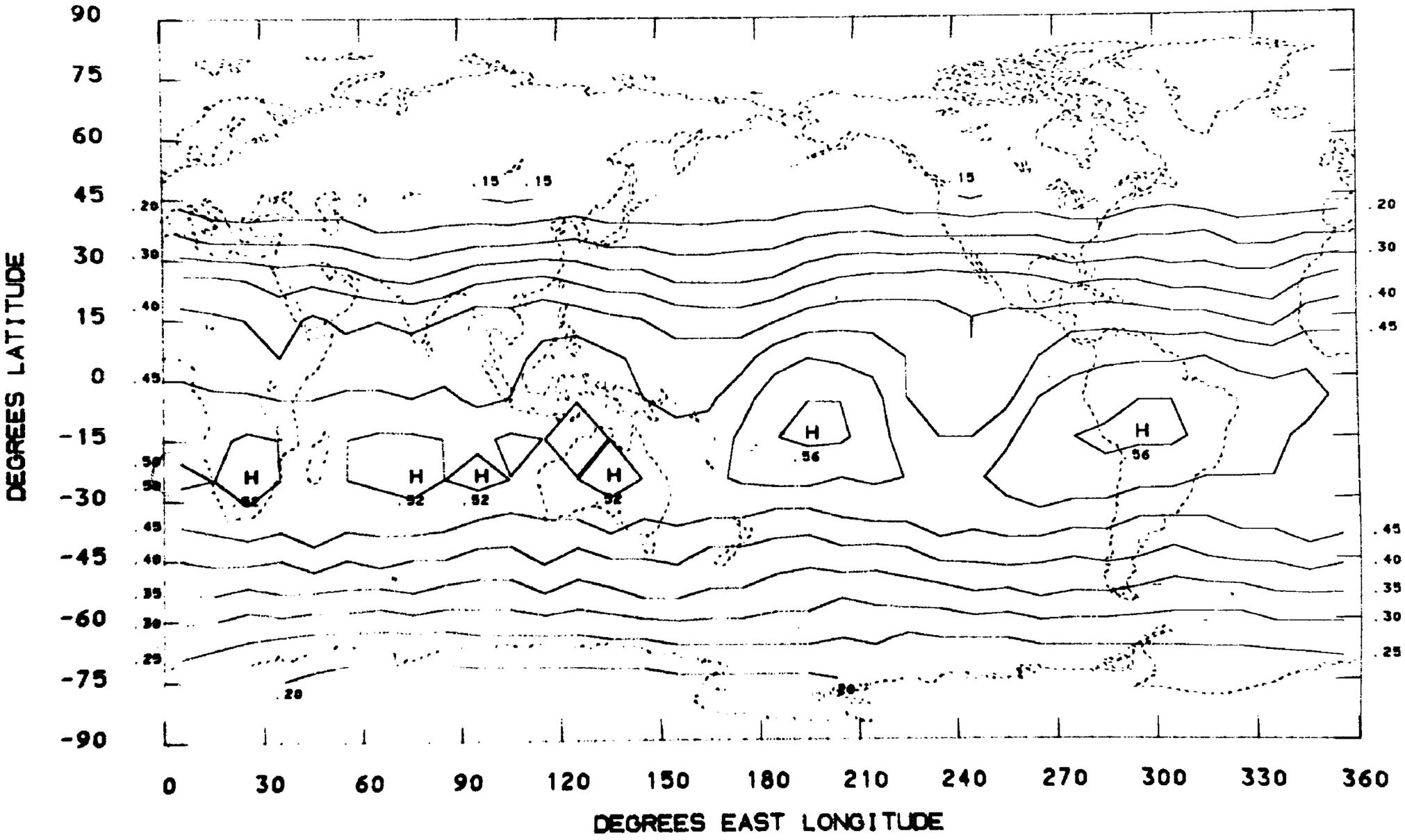
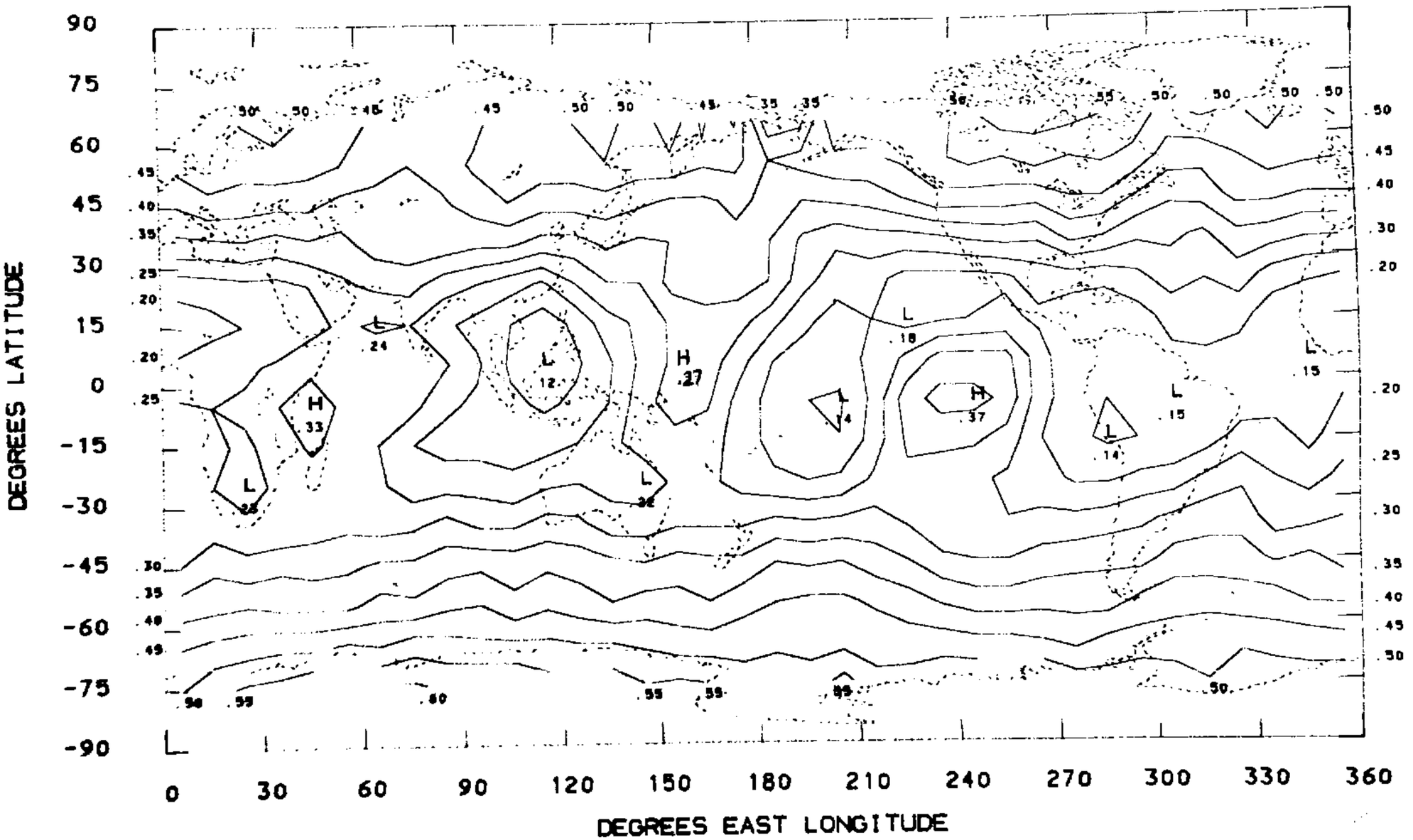


PLANETARY ALBEDO

MARCH 1965



LONGWAVE RADIATION (LY/MIN)

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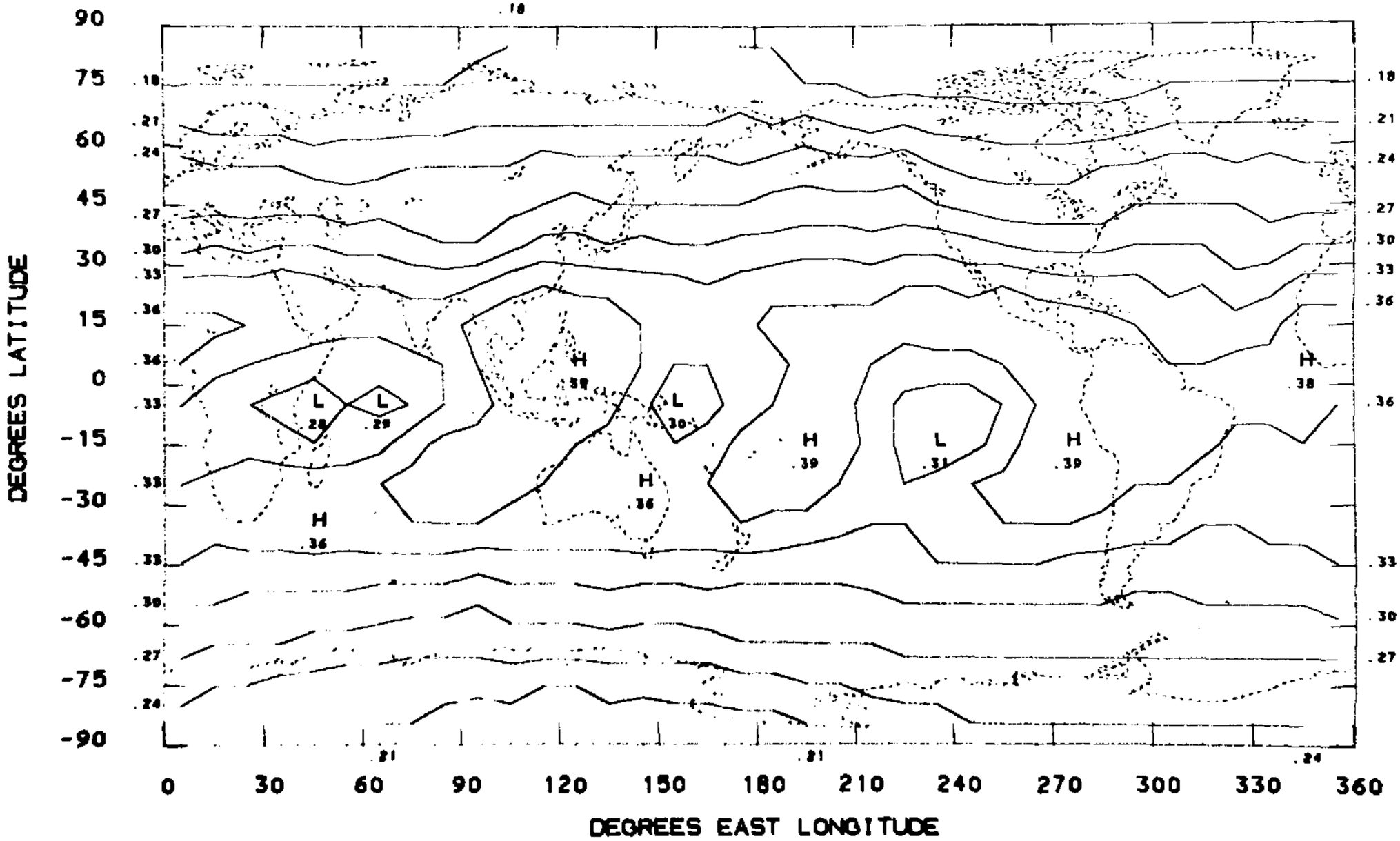

NET RADIATION (LY/MIN)

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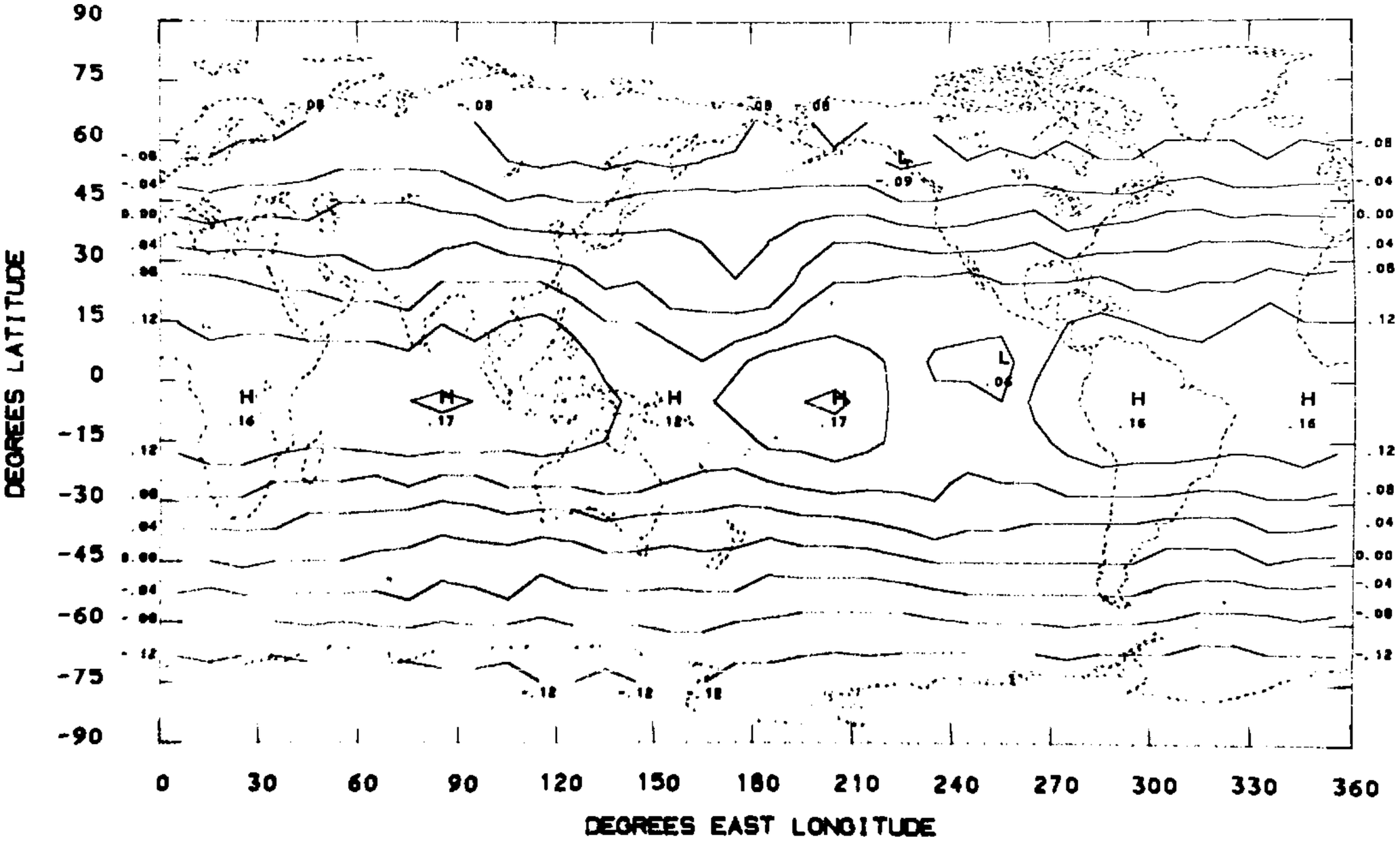

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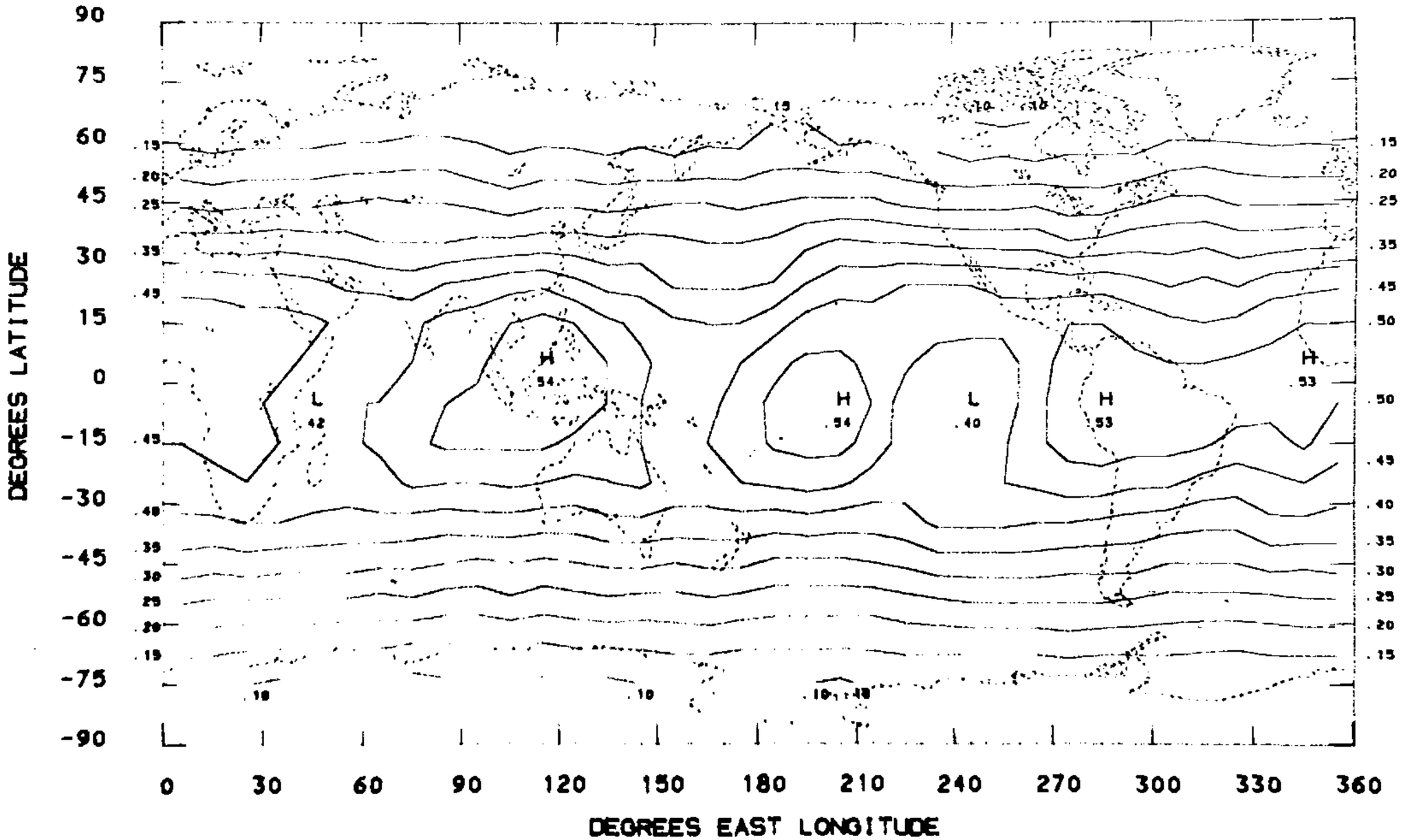
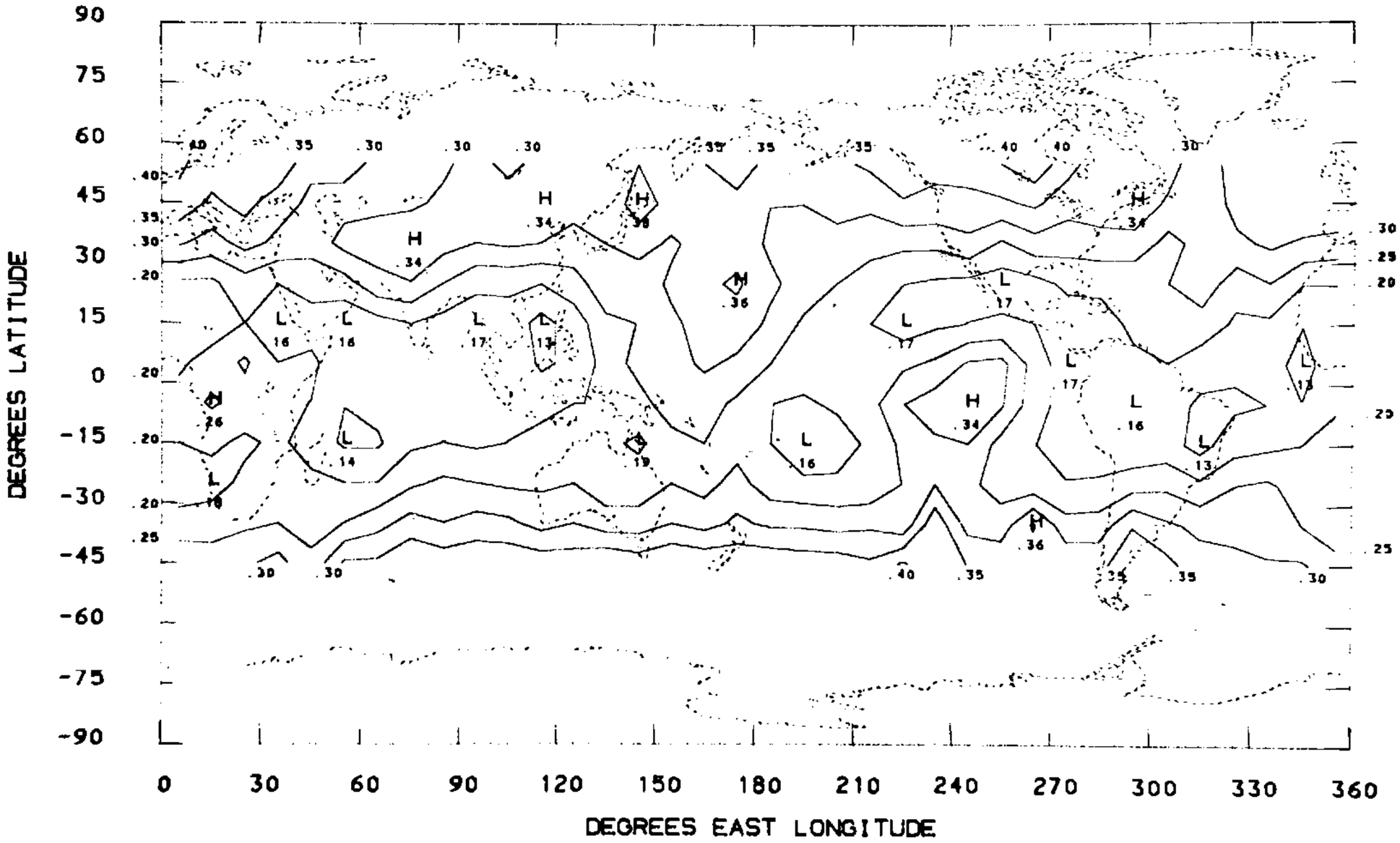


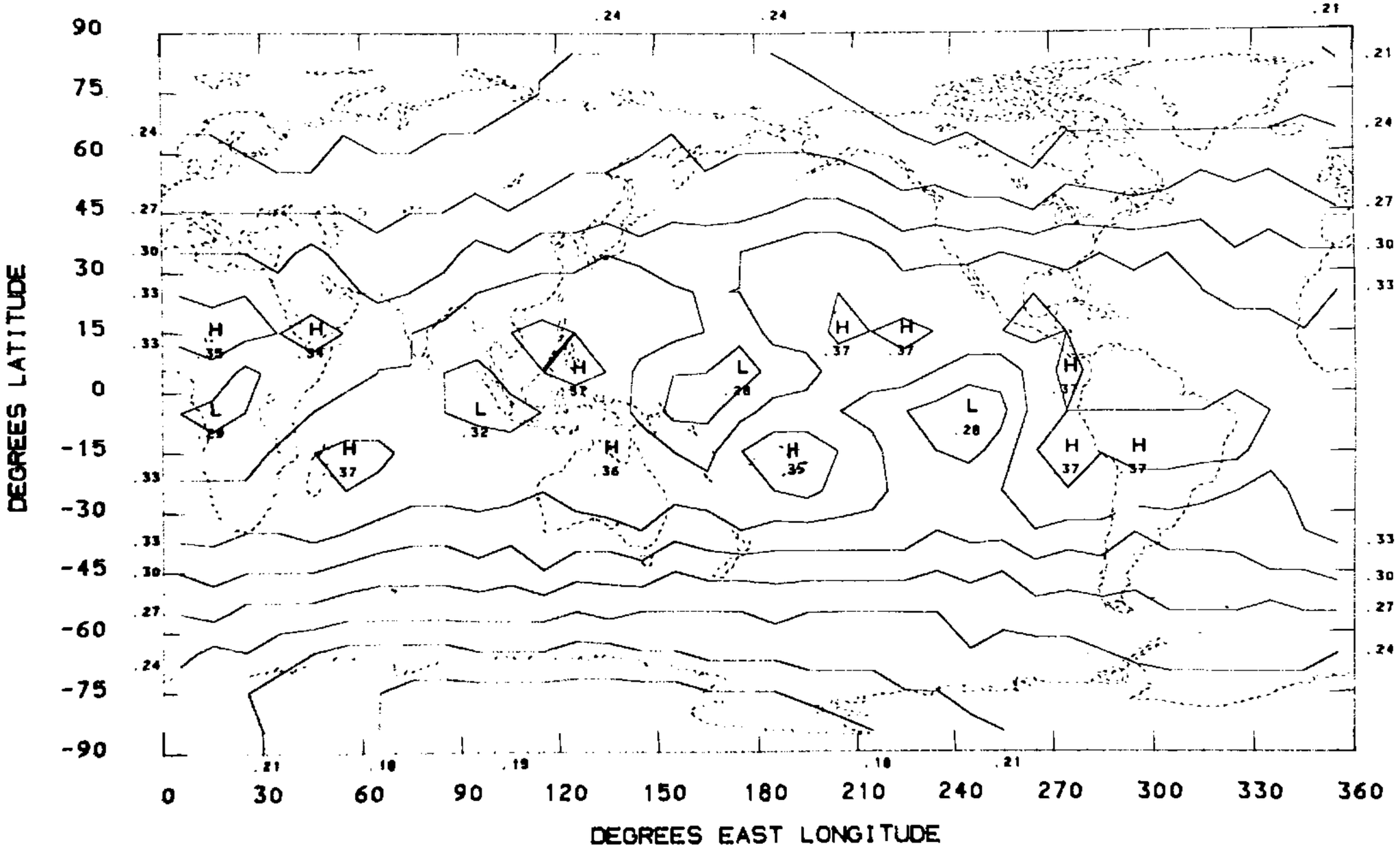
PLANETARY ALBEDO

APRIL 1965



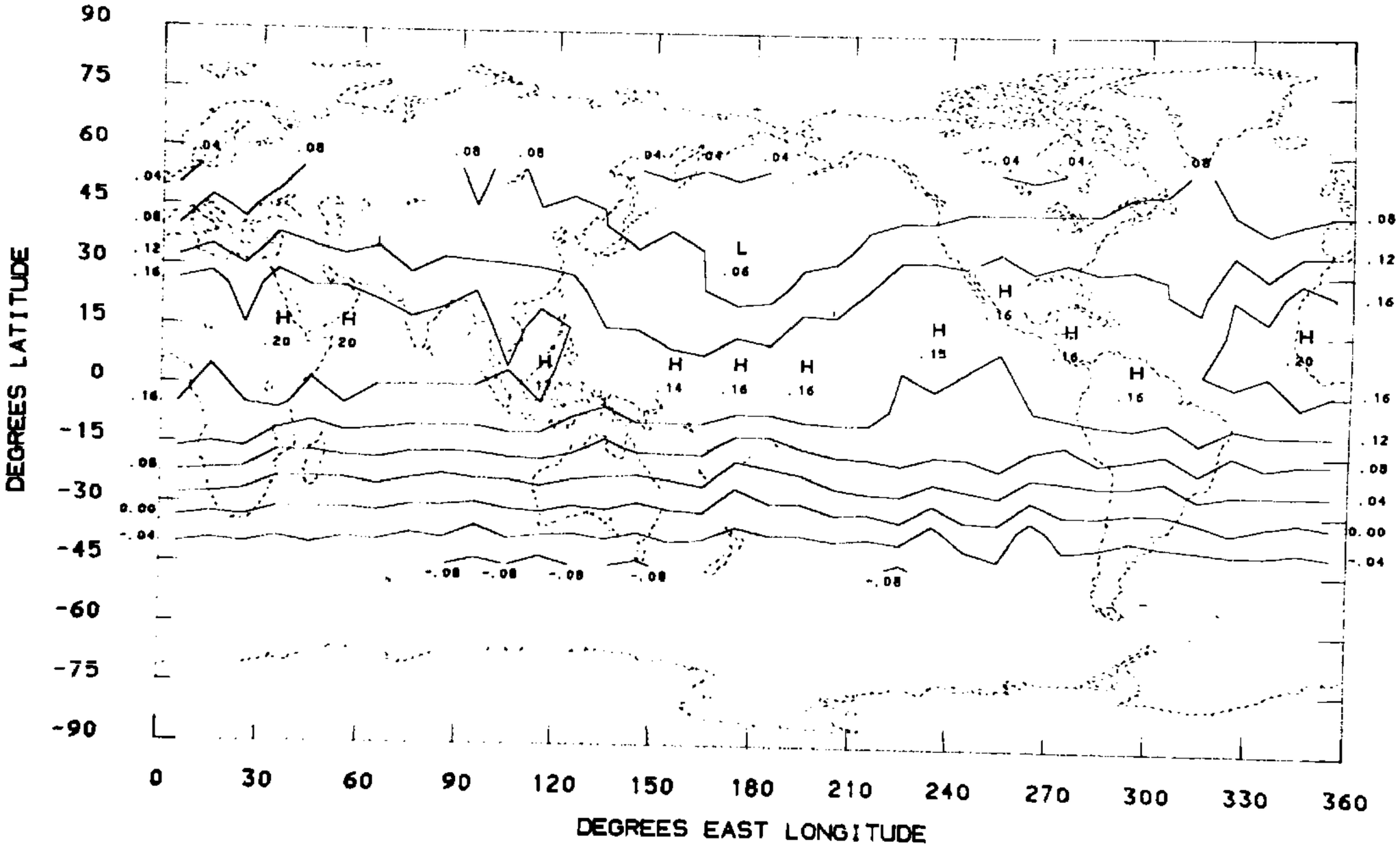
LONGWAVE RADIATION (LY/MIN)

APRIL 1965



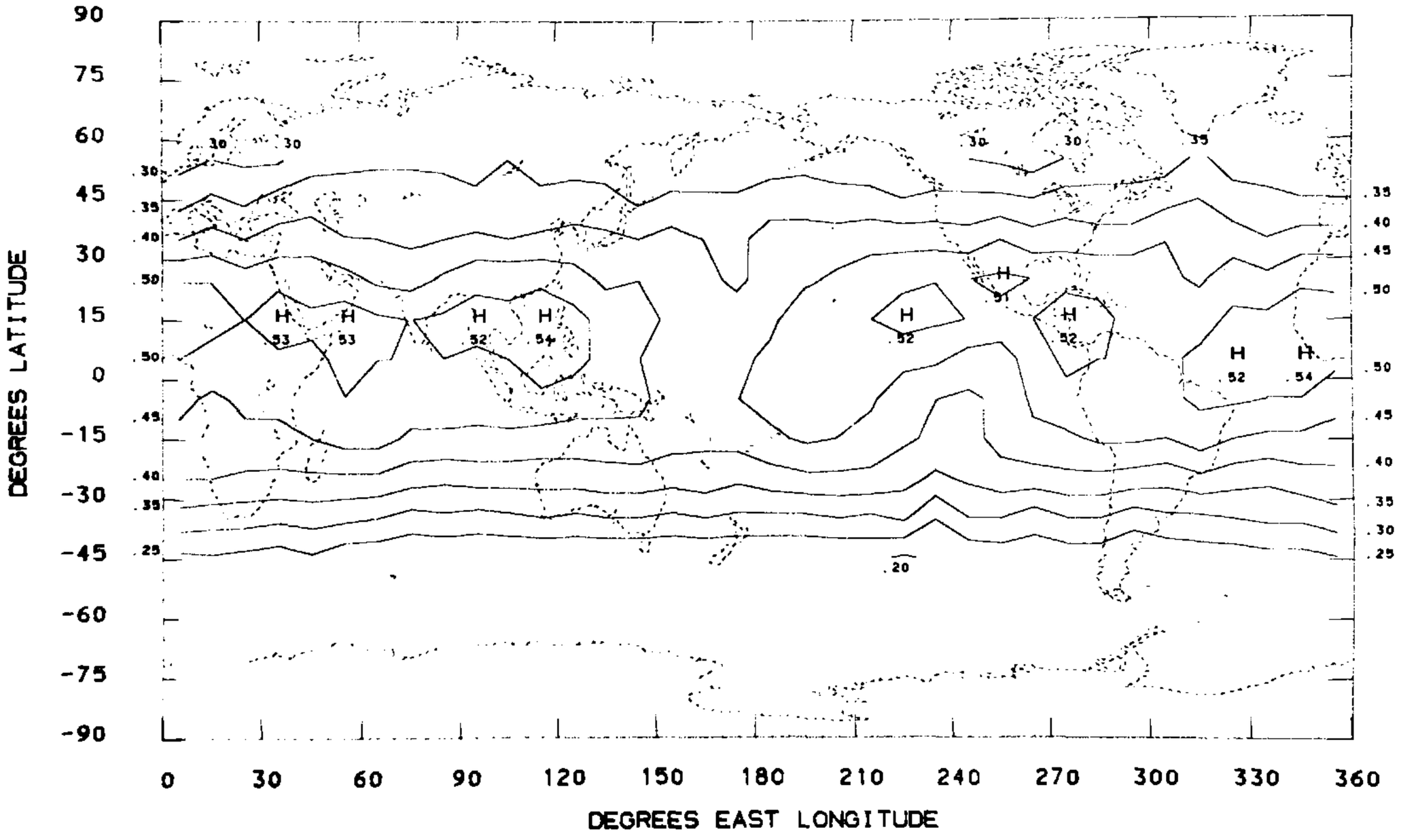
NET RADIATION (LY/MIN)

APRIL 1965



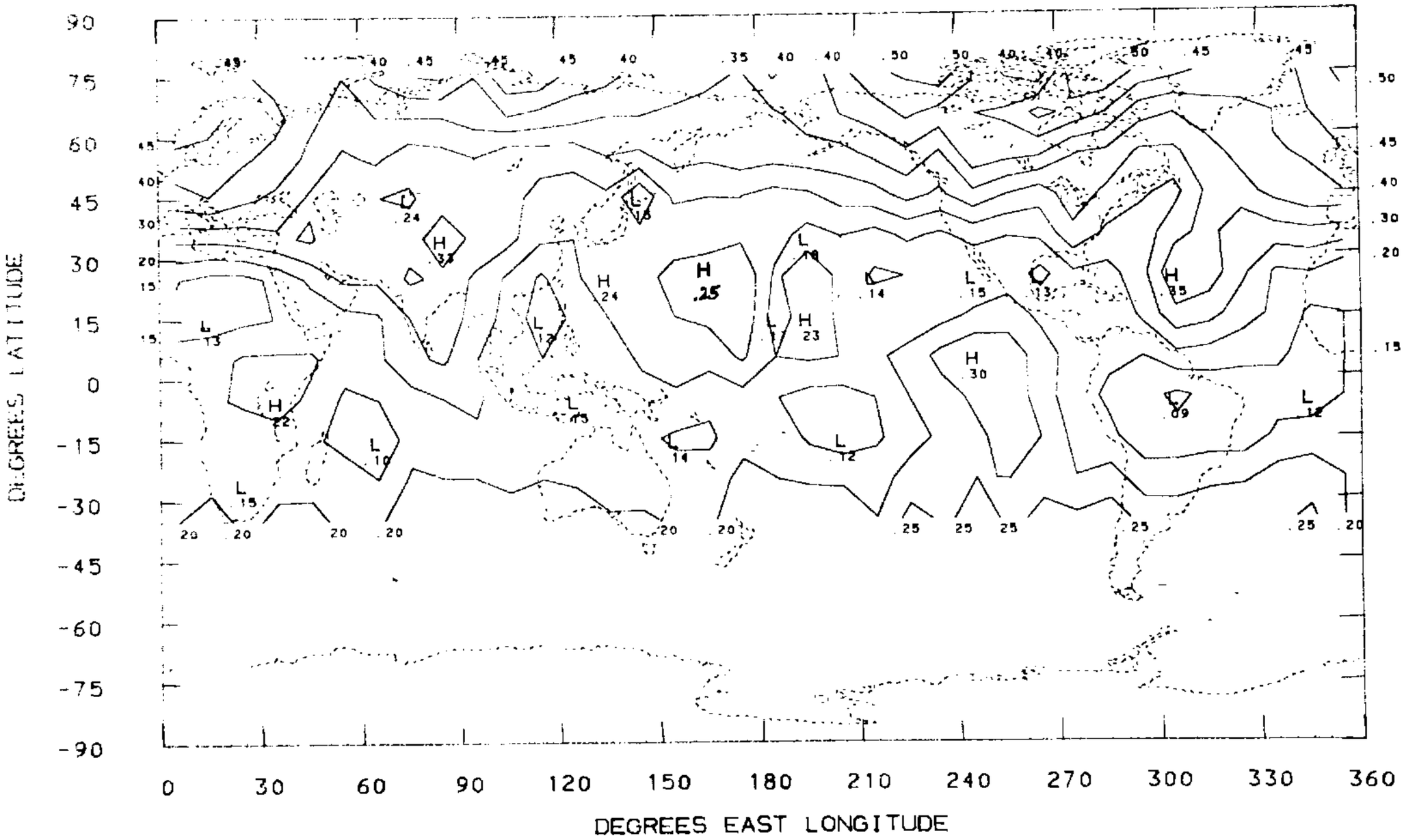
ABSORBED RADIATION (LY/MIN)

APRIL 1965



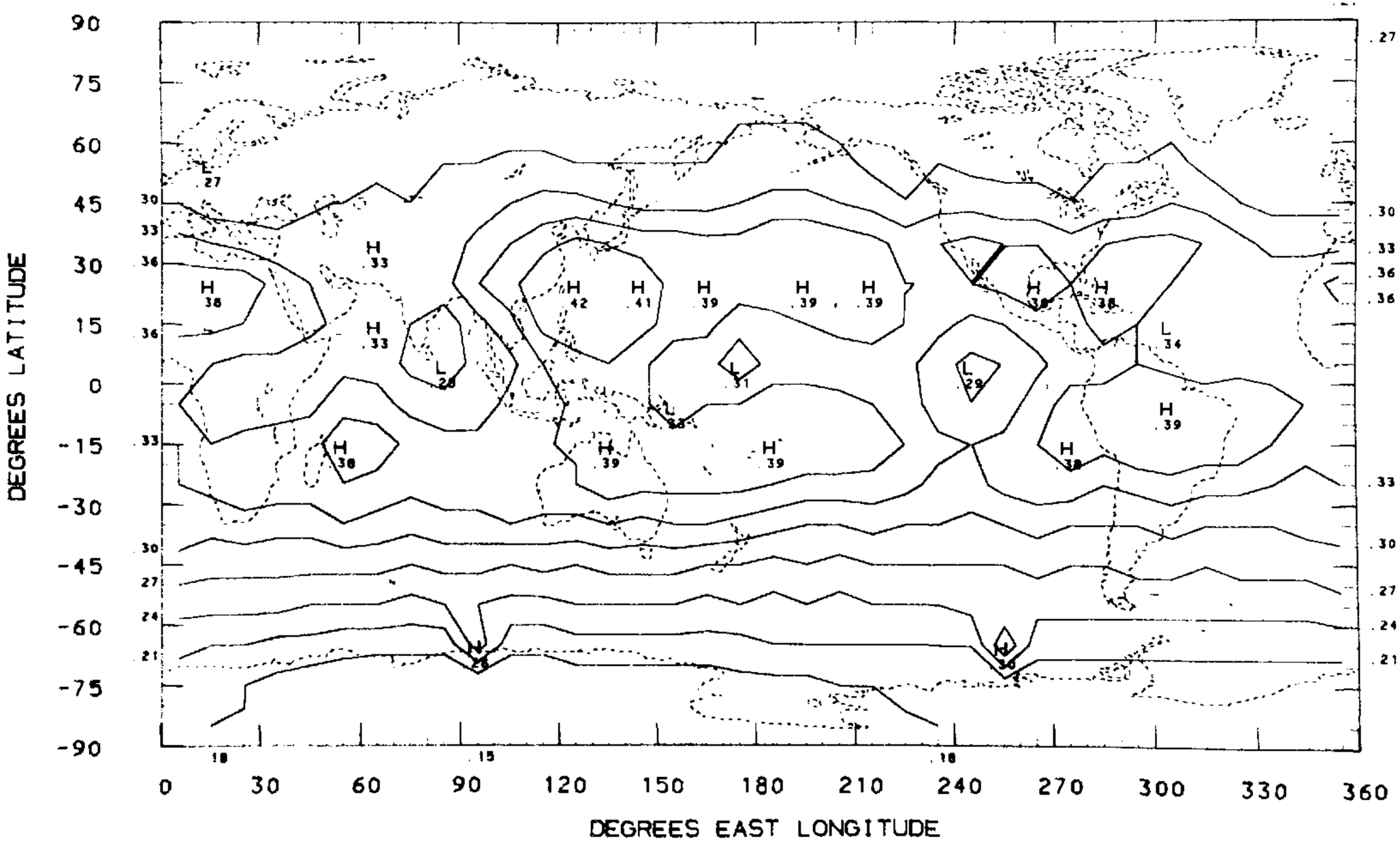
PLANETARY ALBEDO

MAY 1965



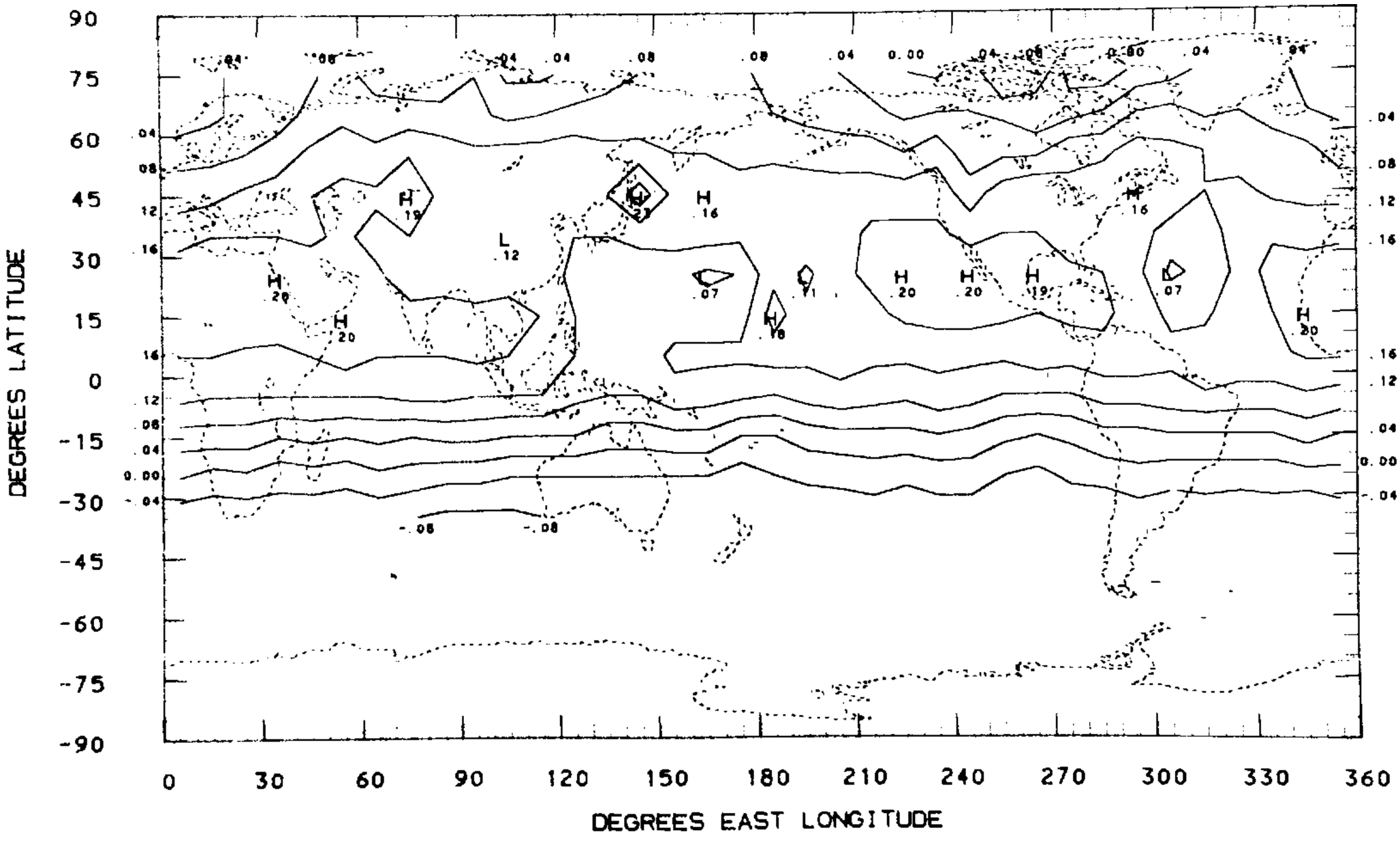
LONGWAVE RADIATION (LY/MIN)

MAY 1965



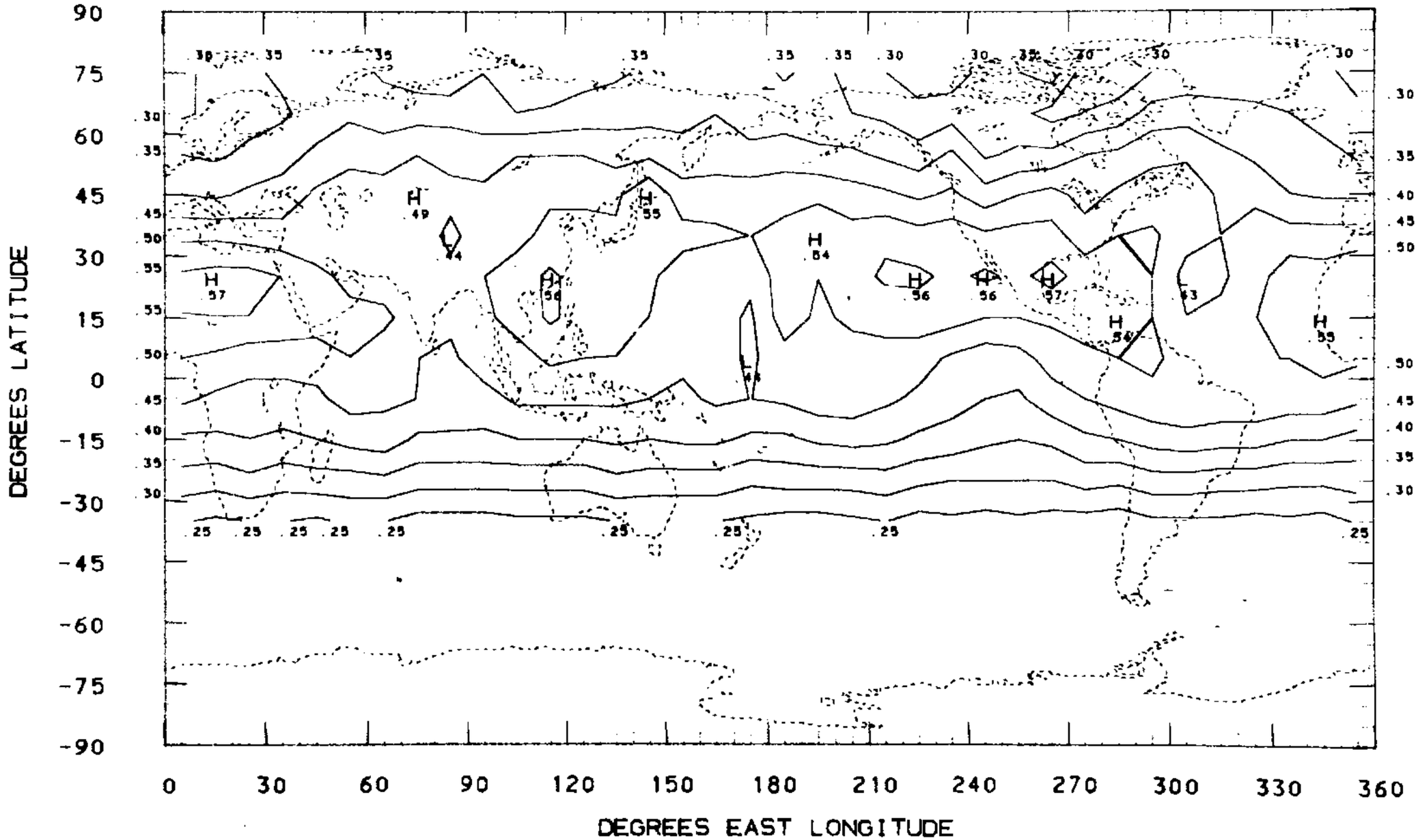
NET RADIATION (LY/MIN)

MAY 1965



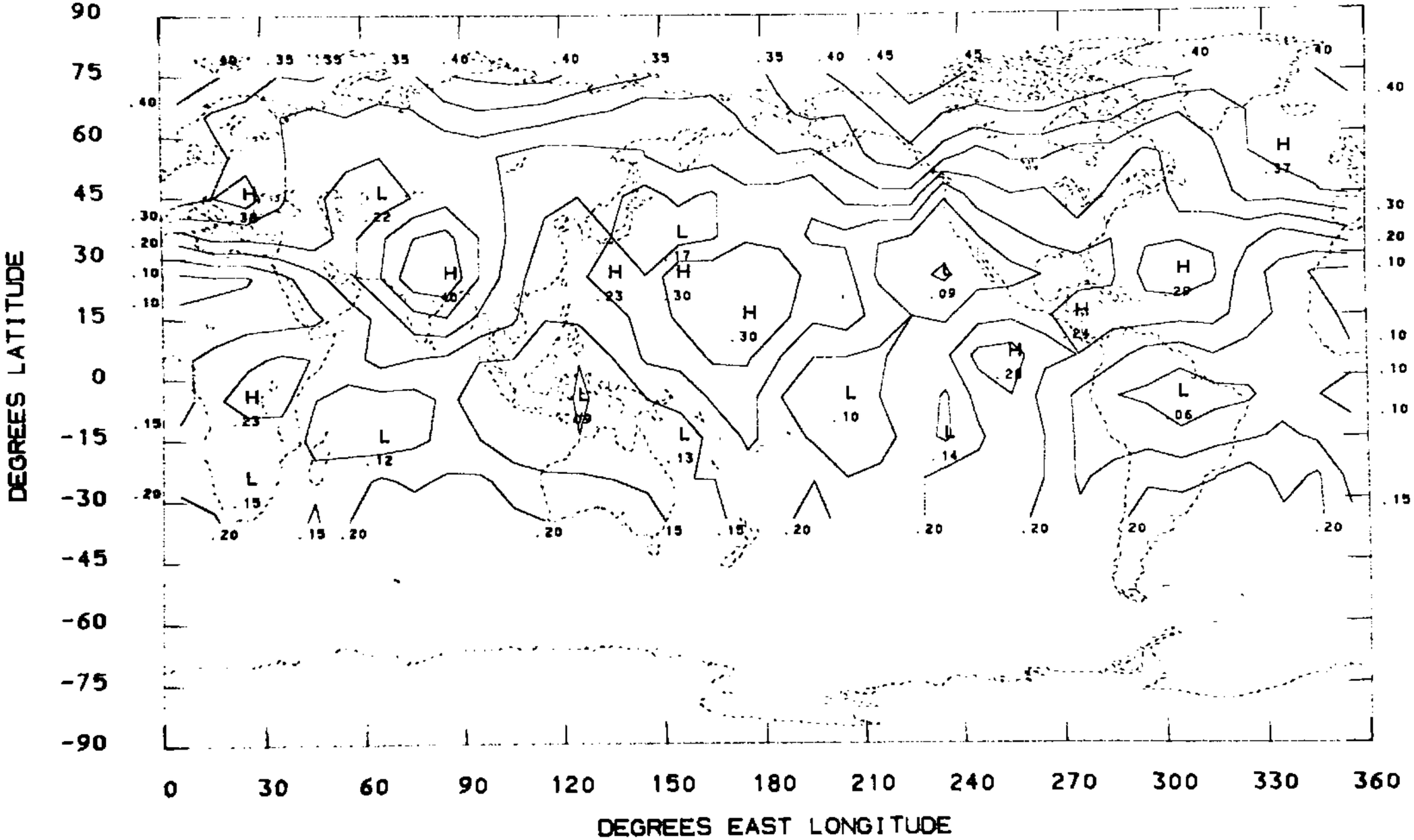
ABSORBED RADIATION (LY/MIN)

MAY 1965



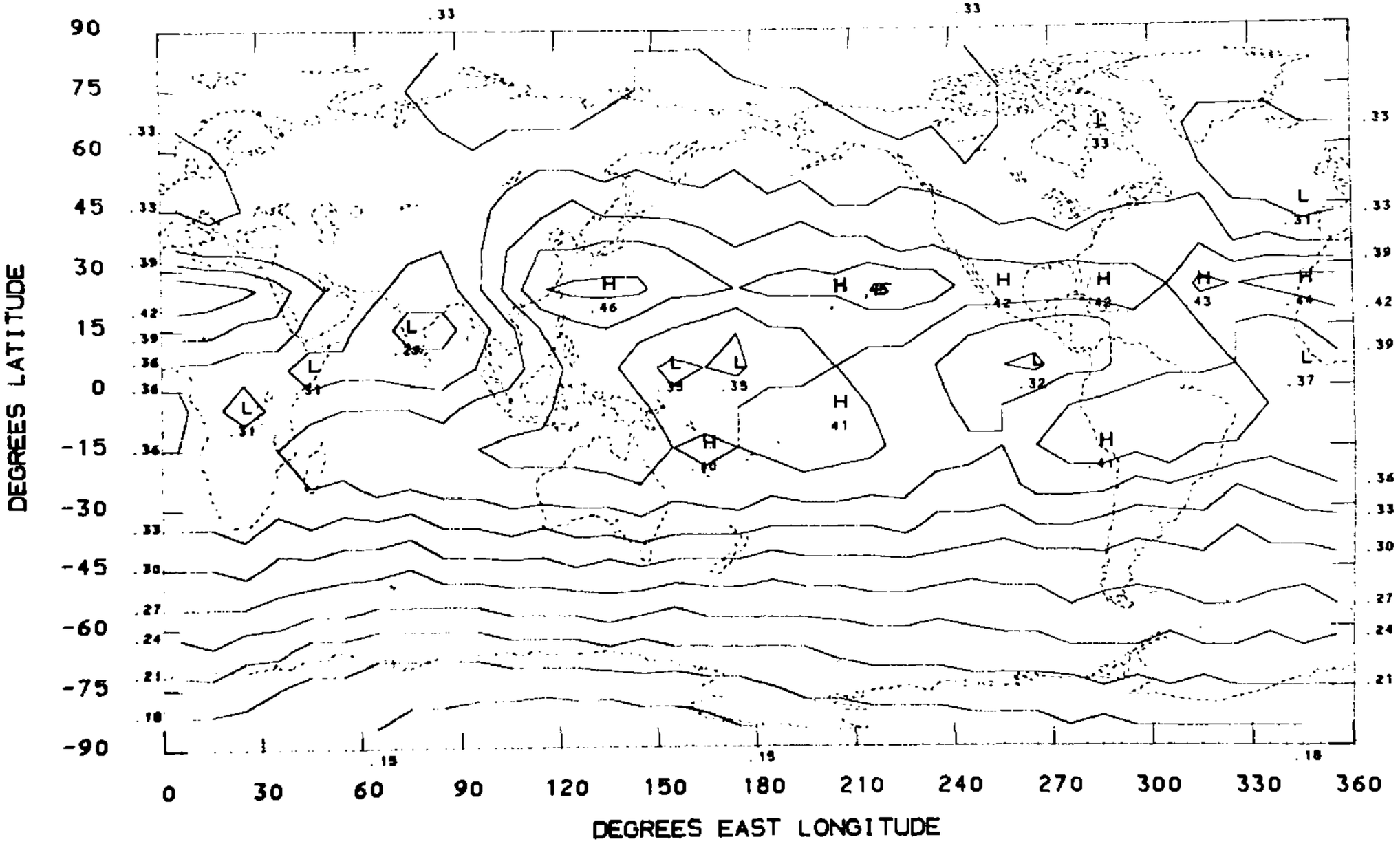
PLANETARY ALBEDO

JUNE 1965



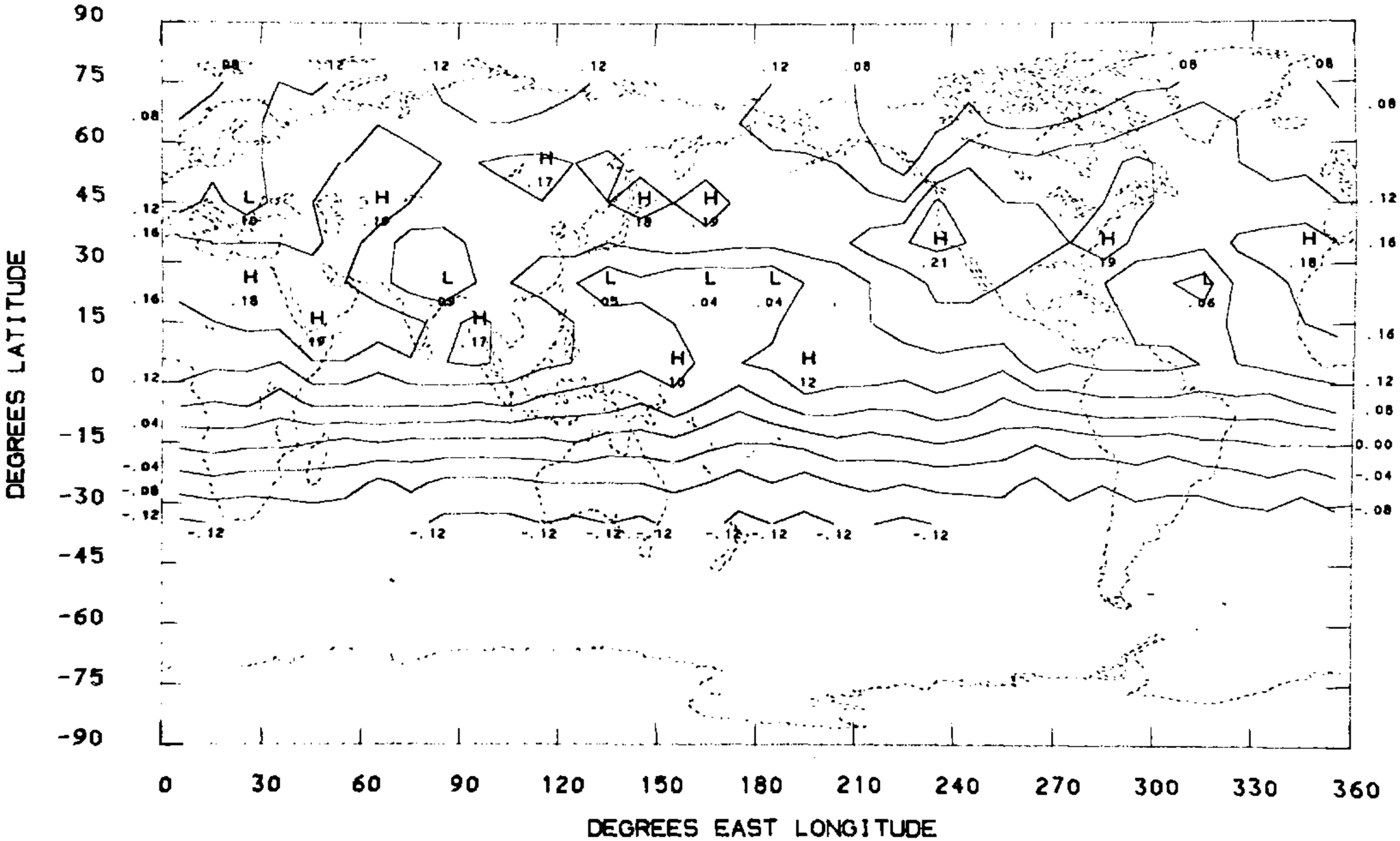
LONGWAVE RADIATION (LY/MIN)

JUNE 1965



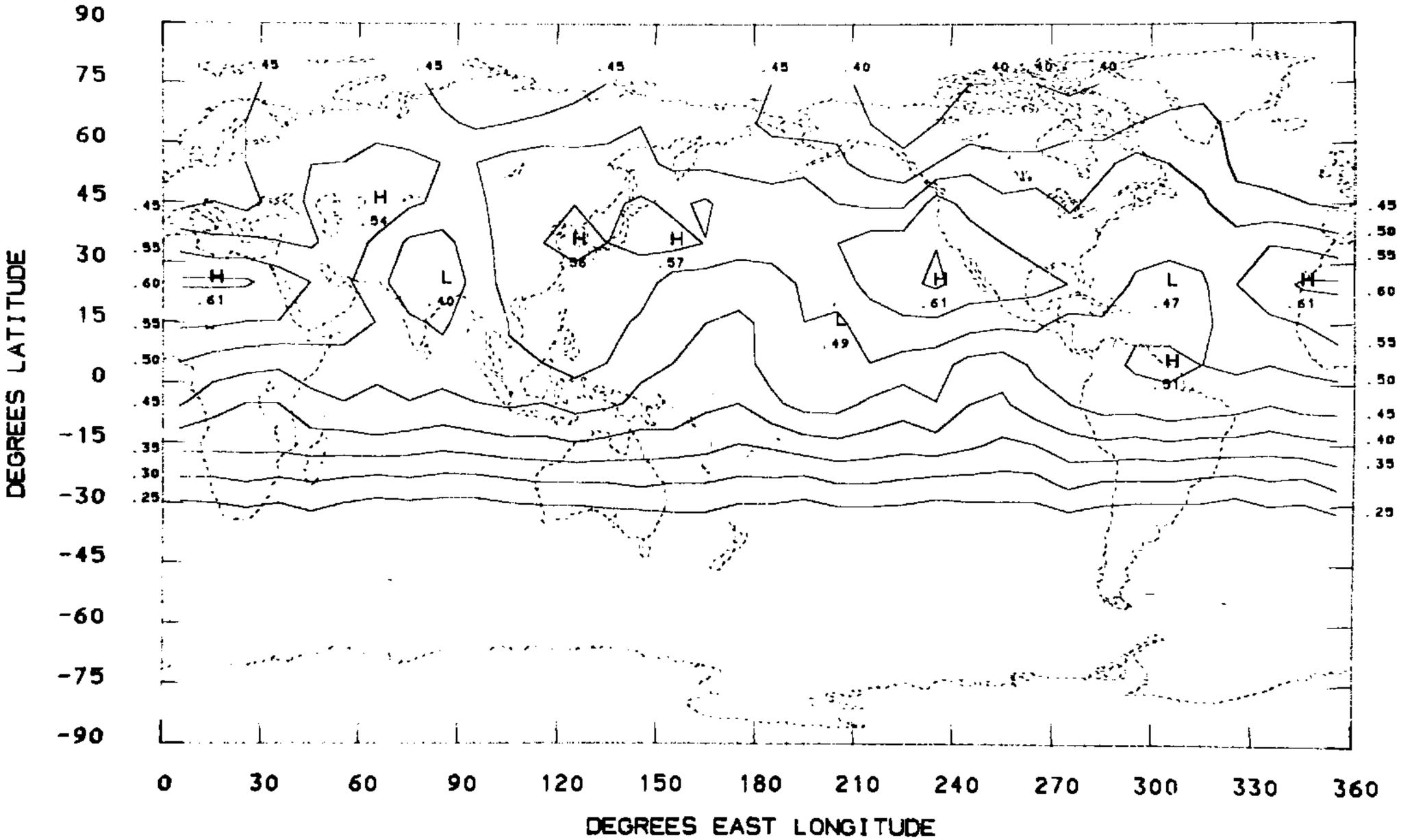
NET RADIATION (LY/MIN)

JUNE 1965



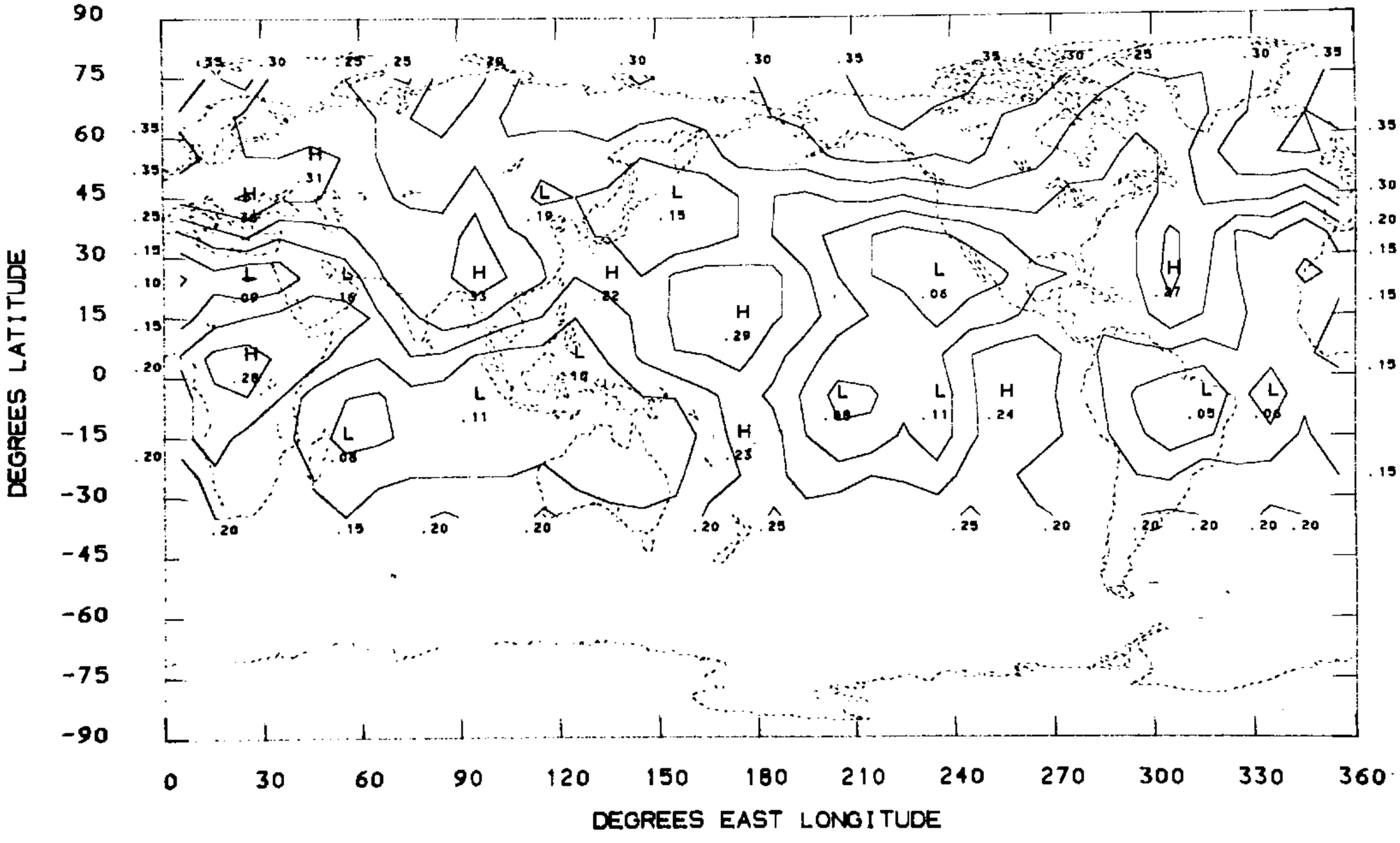
ABSORBED RADIATION (LY/MIN)

JUNE 1965



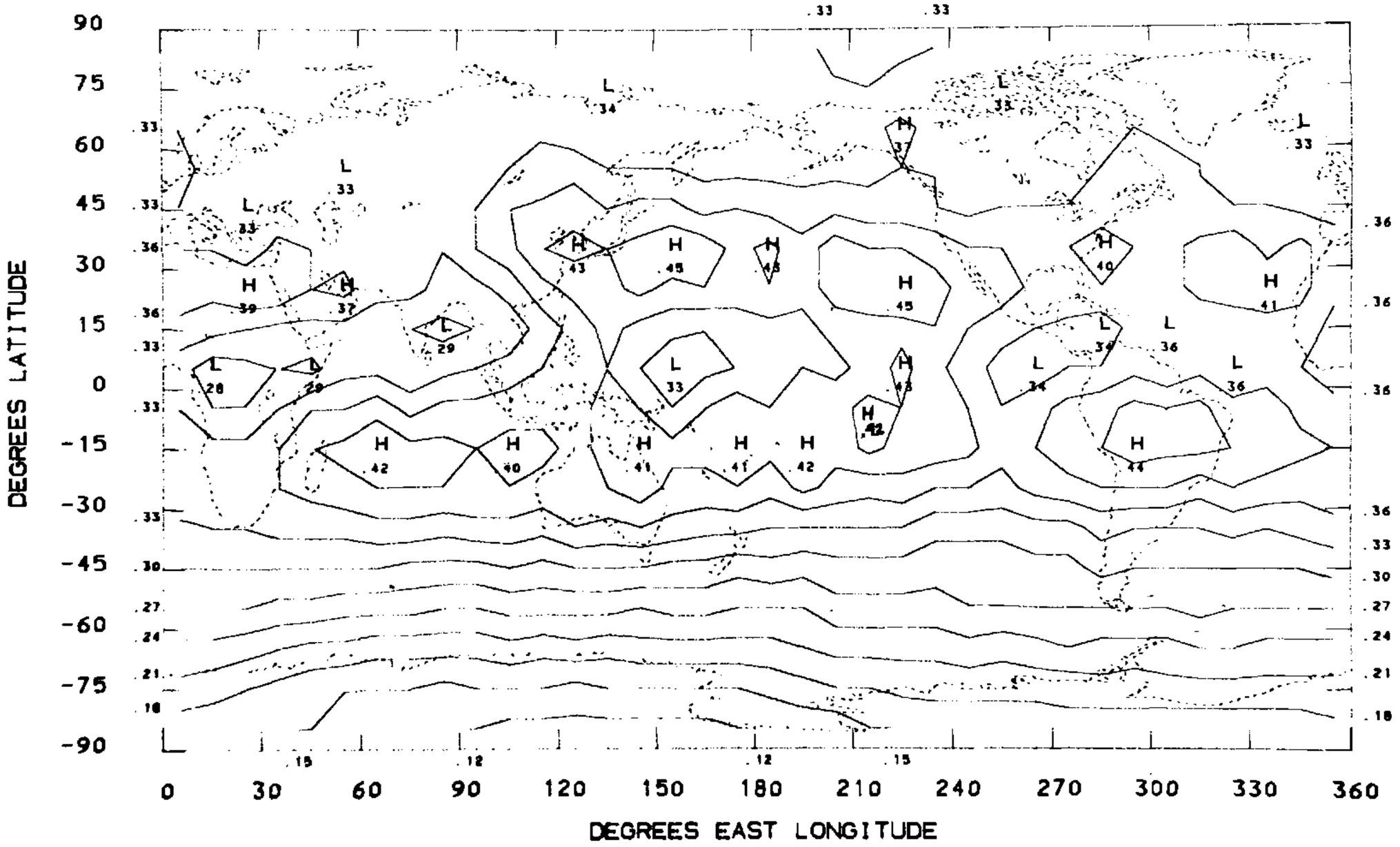
PLANETARY ALBEDO

JULY 1965



LONGWAVE RADIATION (LY/MIN)

JULY 1965



NET RADIATION (LY/MIN)

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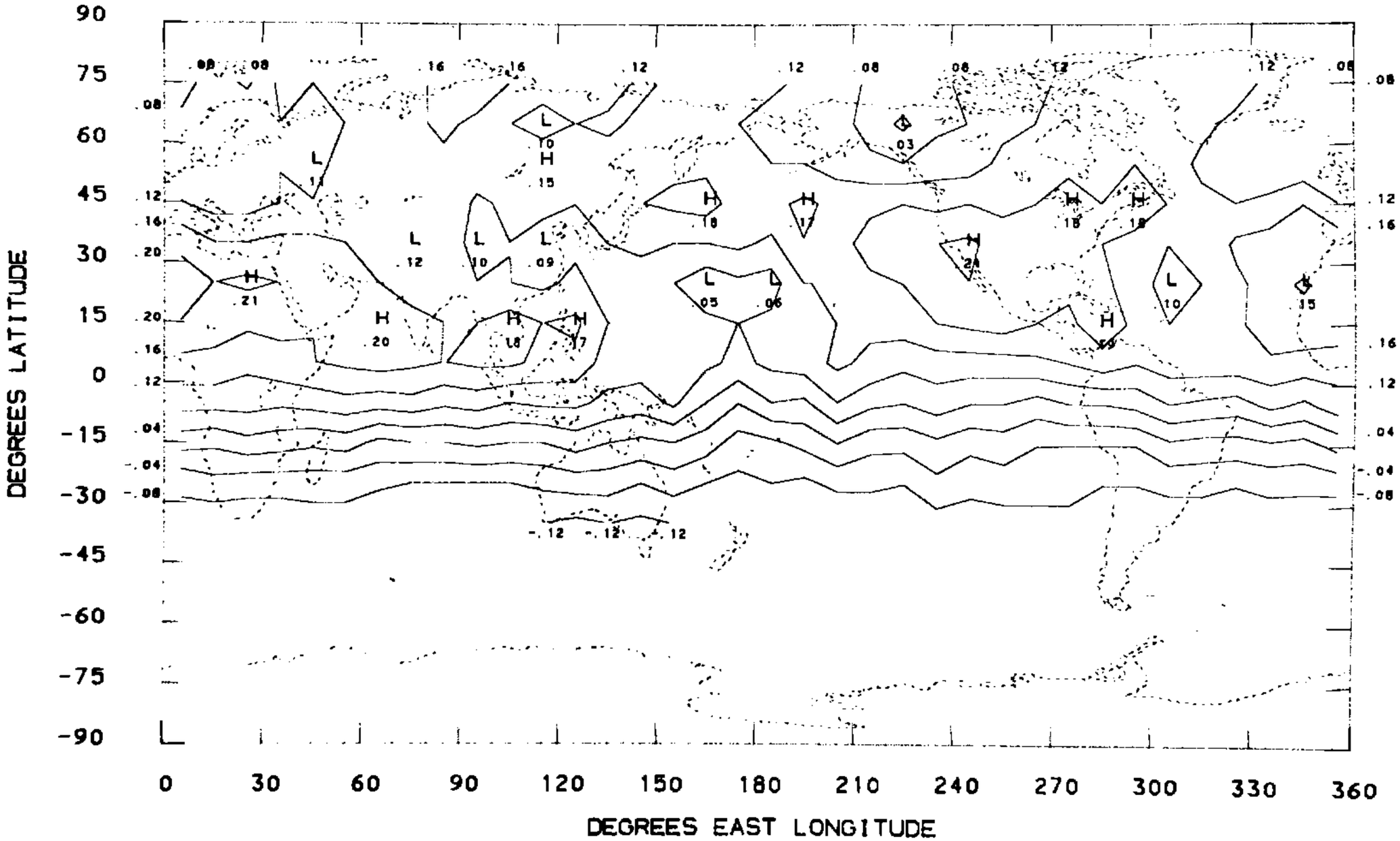

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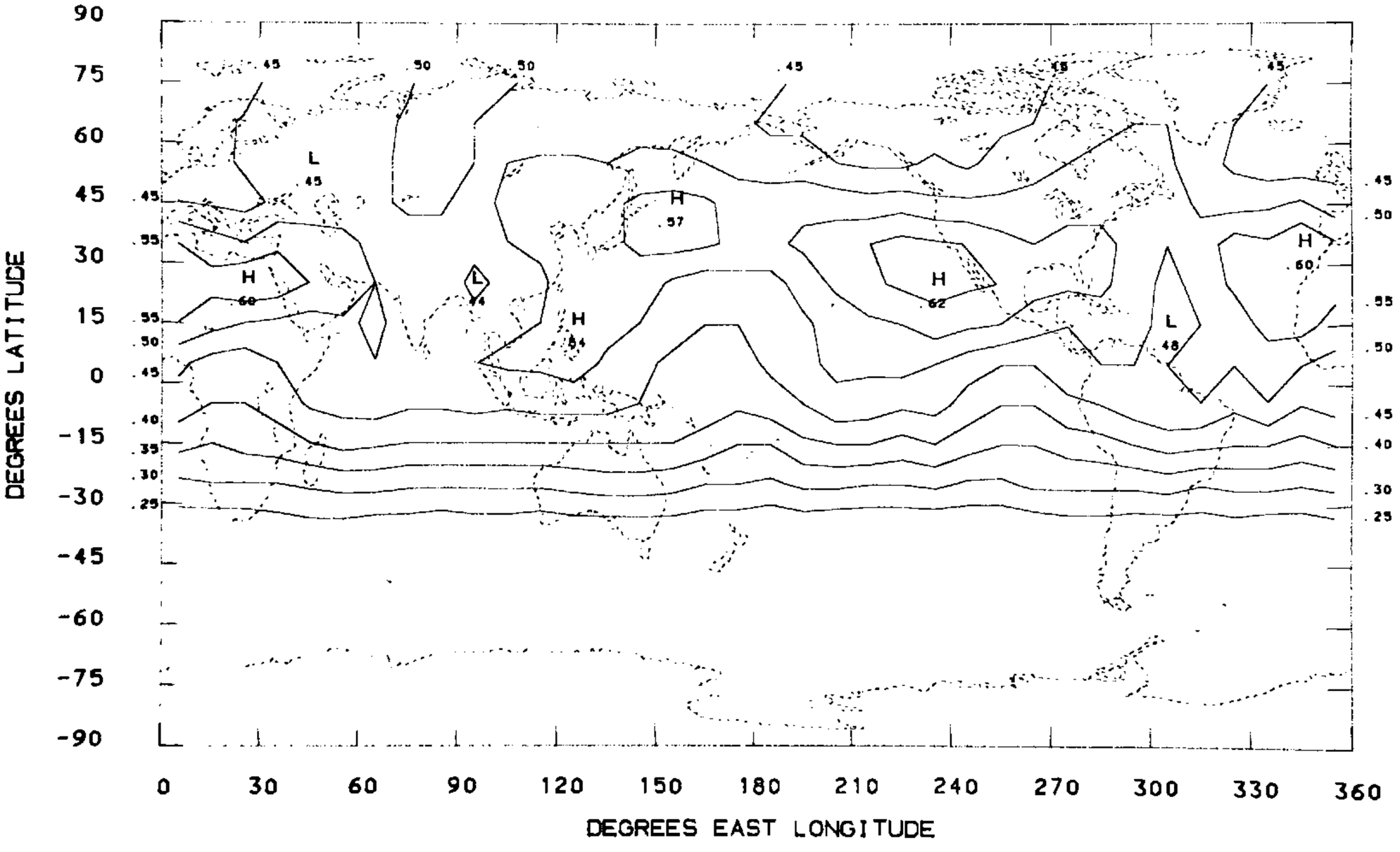
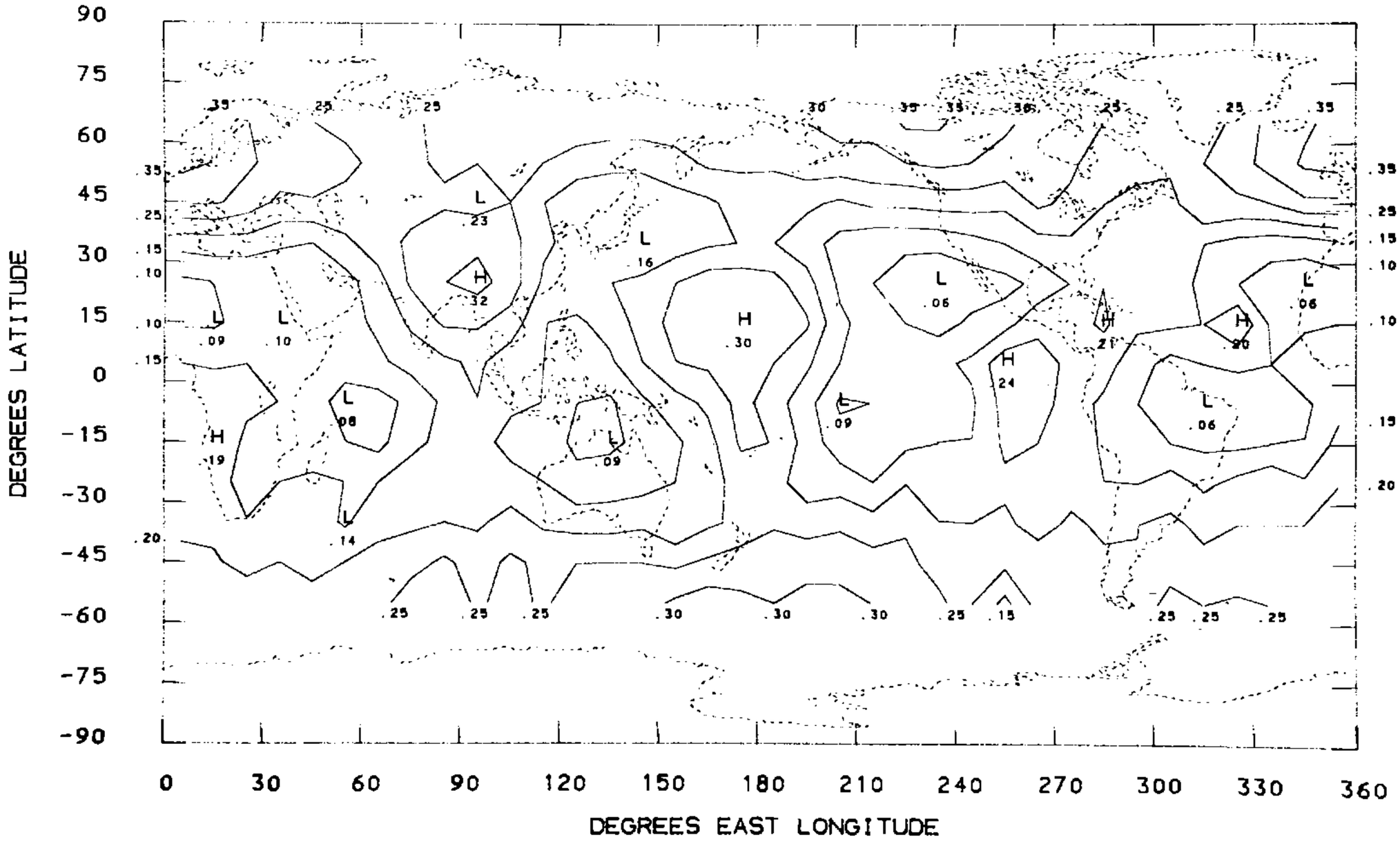


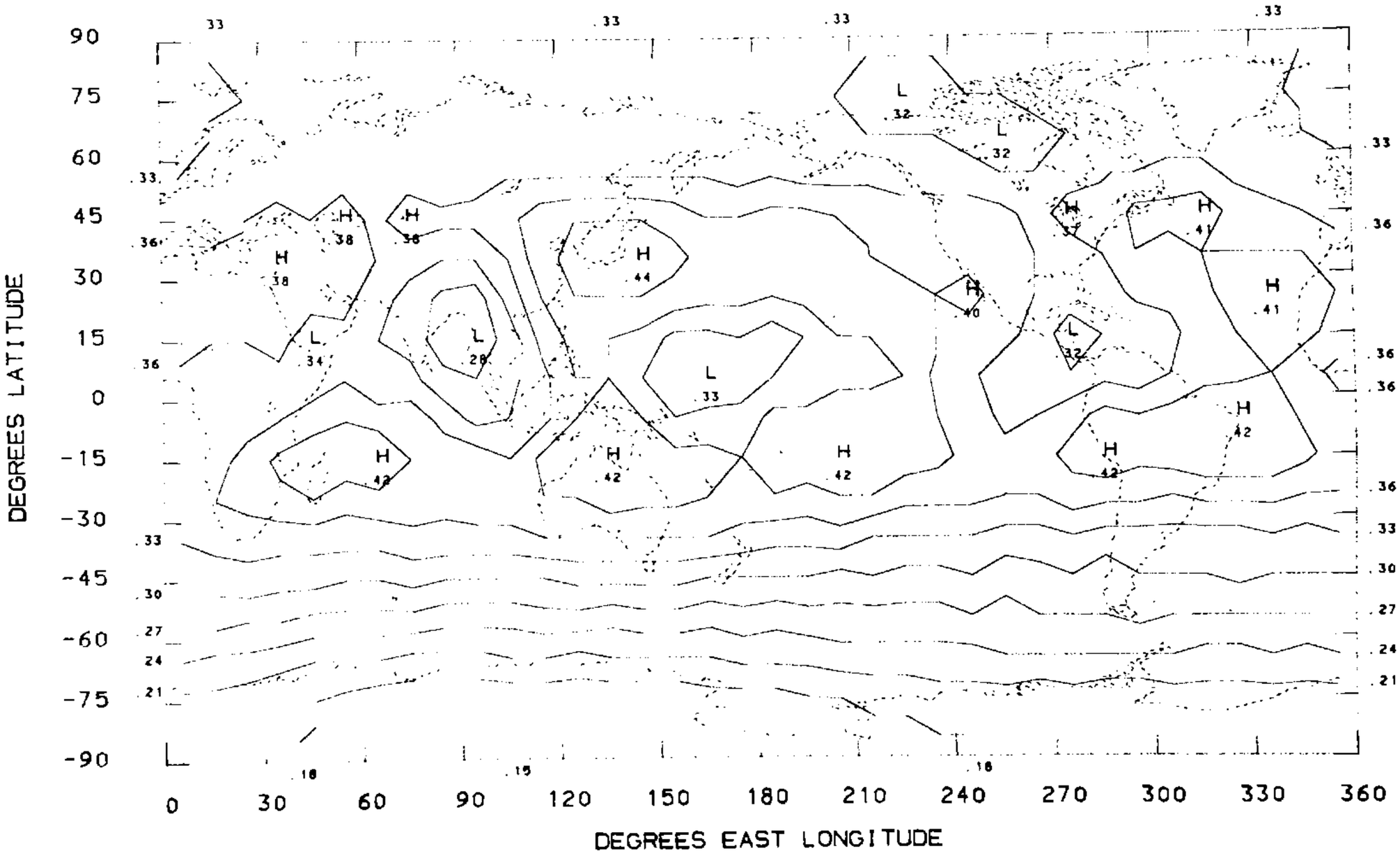
PLANETARY ALBEDO

AUGUST 1965



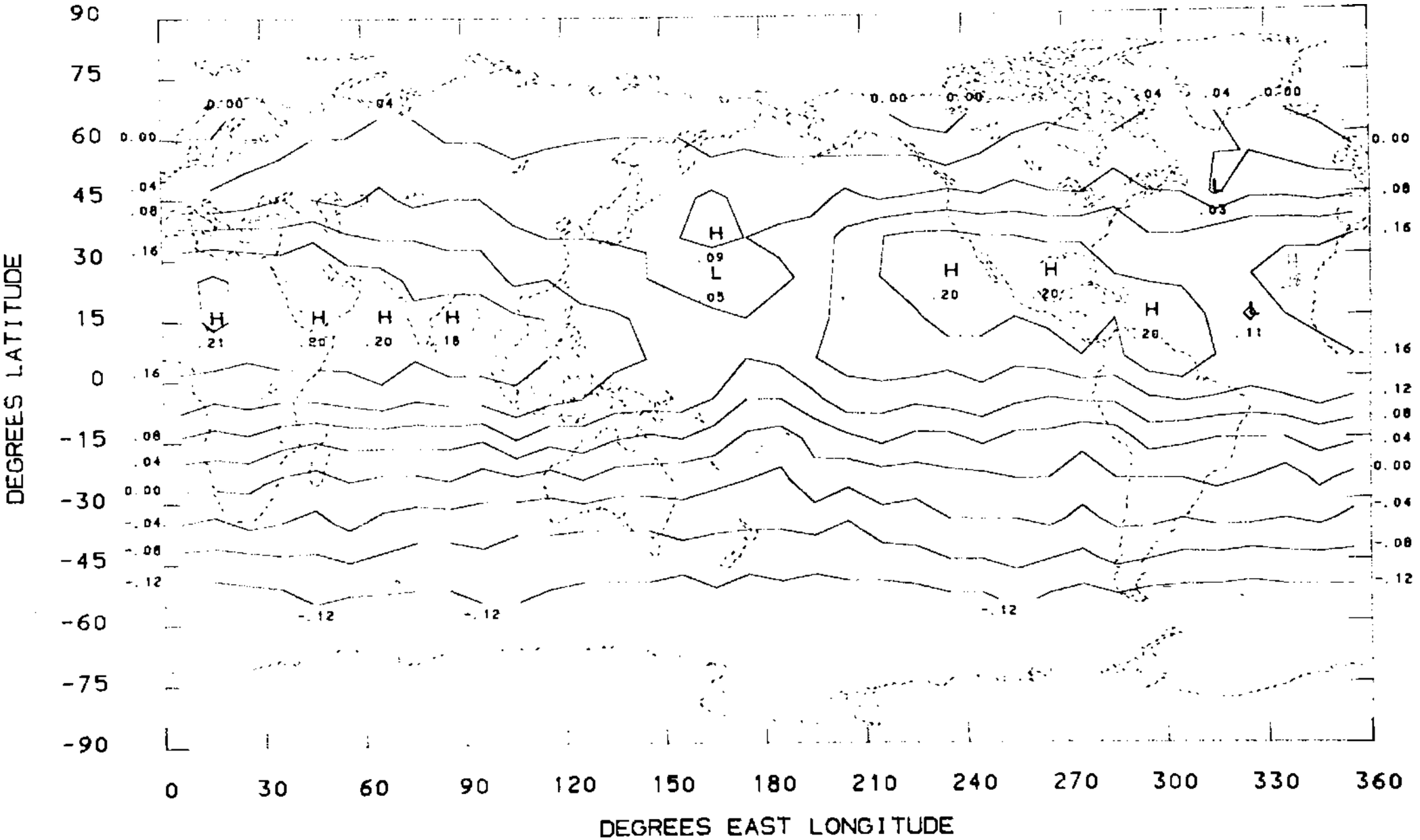
LONGWAVE RADIATION (LY/MIN)

AUGUST 1965



NET RADIATION (LY/MIN)

AUGUST 1965



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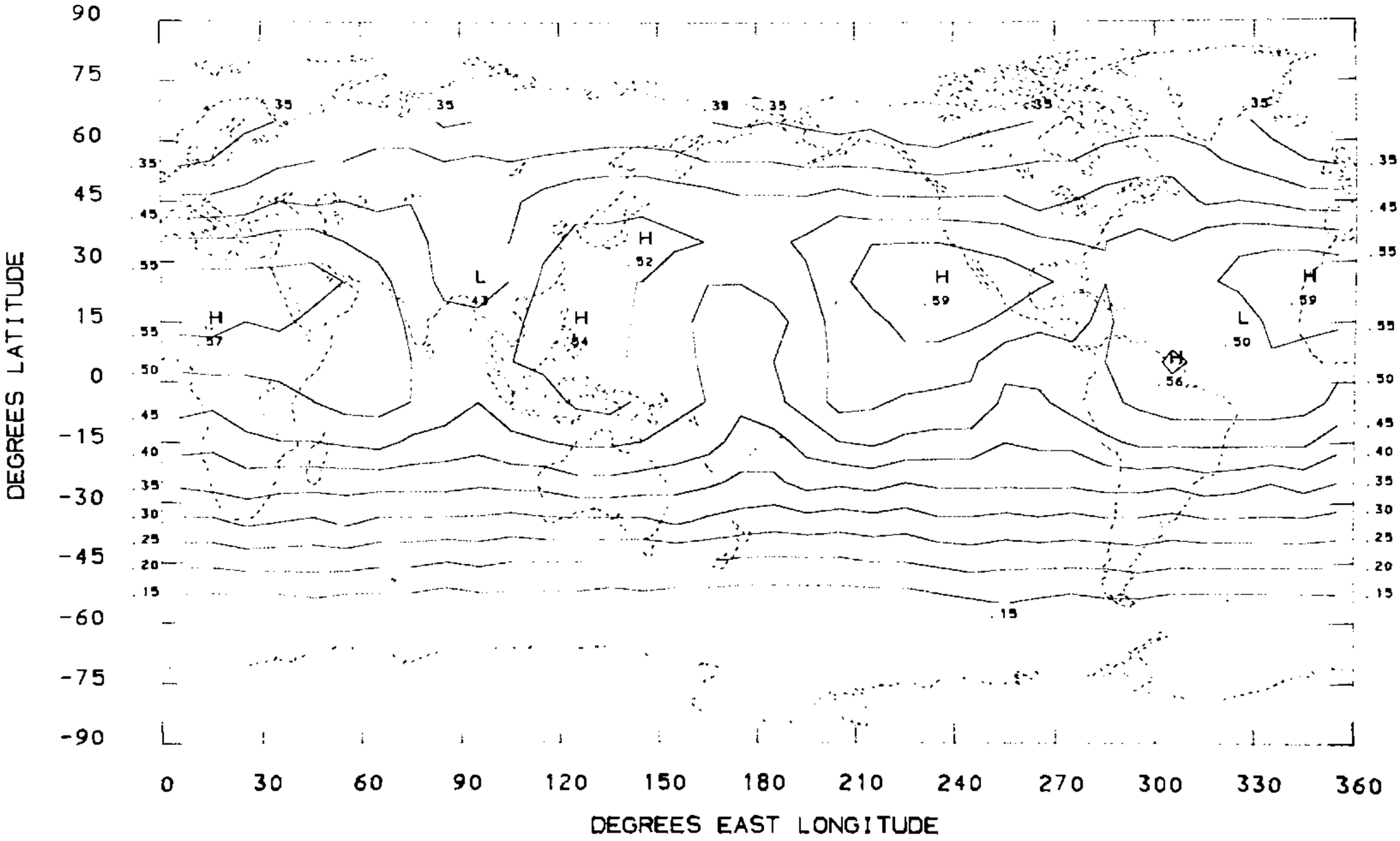
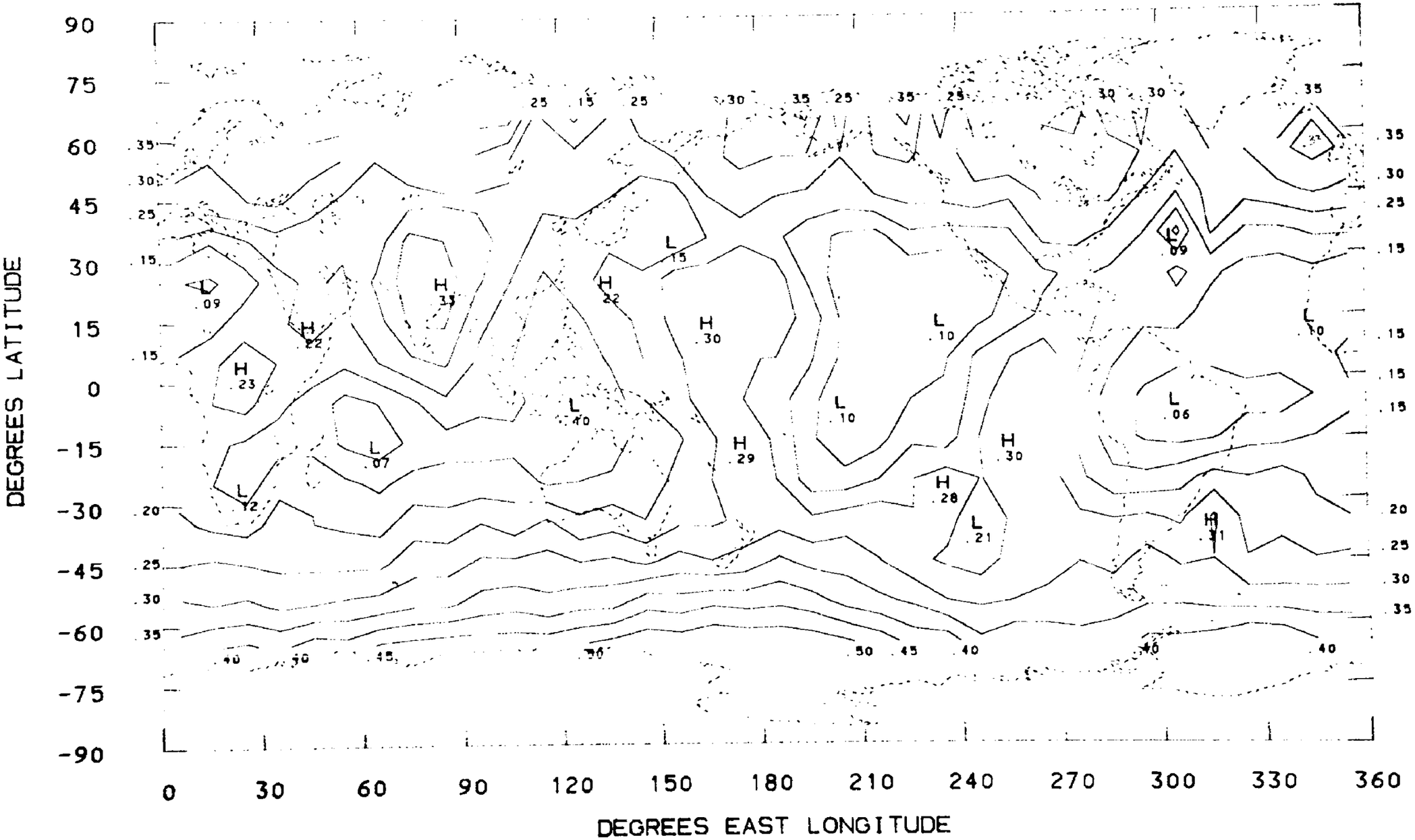


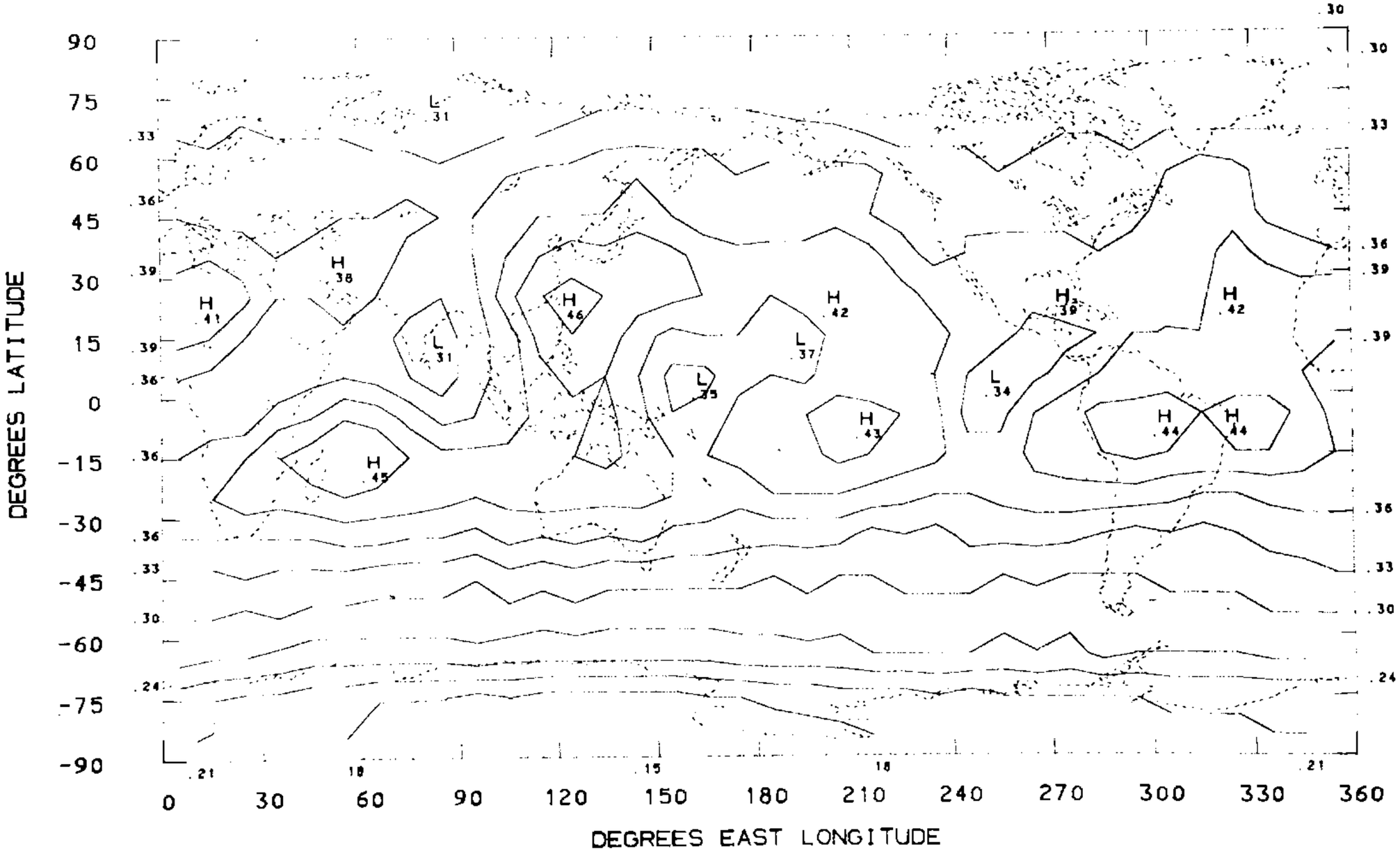
PLANETARY ALBEDO

SEPTEMBER 1965



LONGWAVE RADIATION (LY/MIN)

SEPTEMBER 1965



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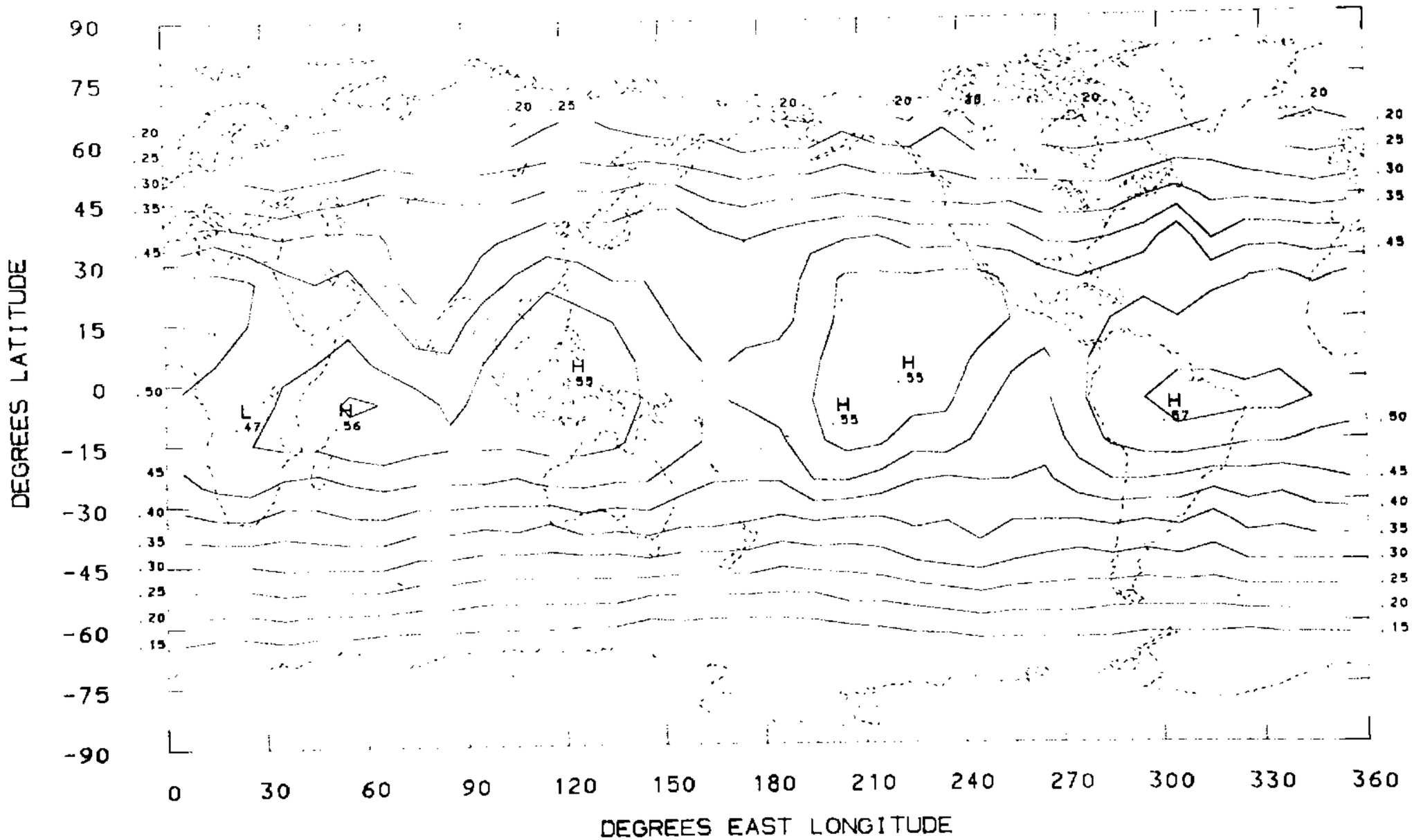
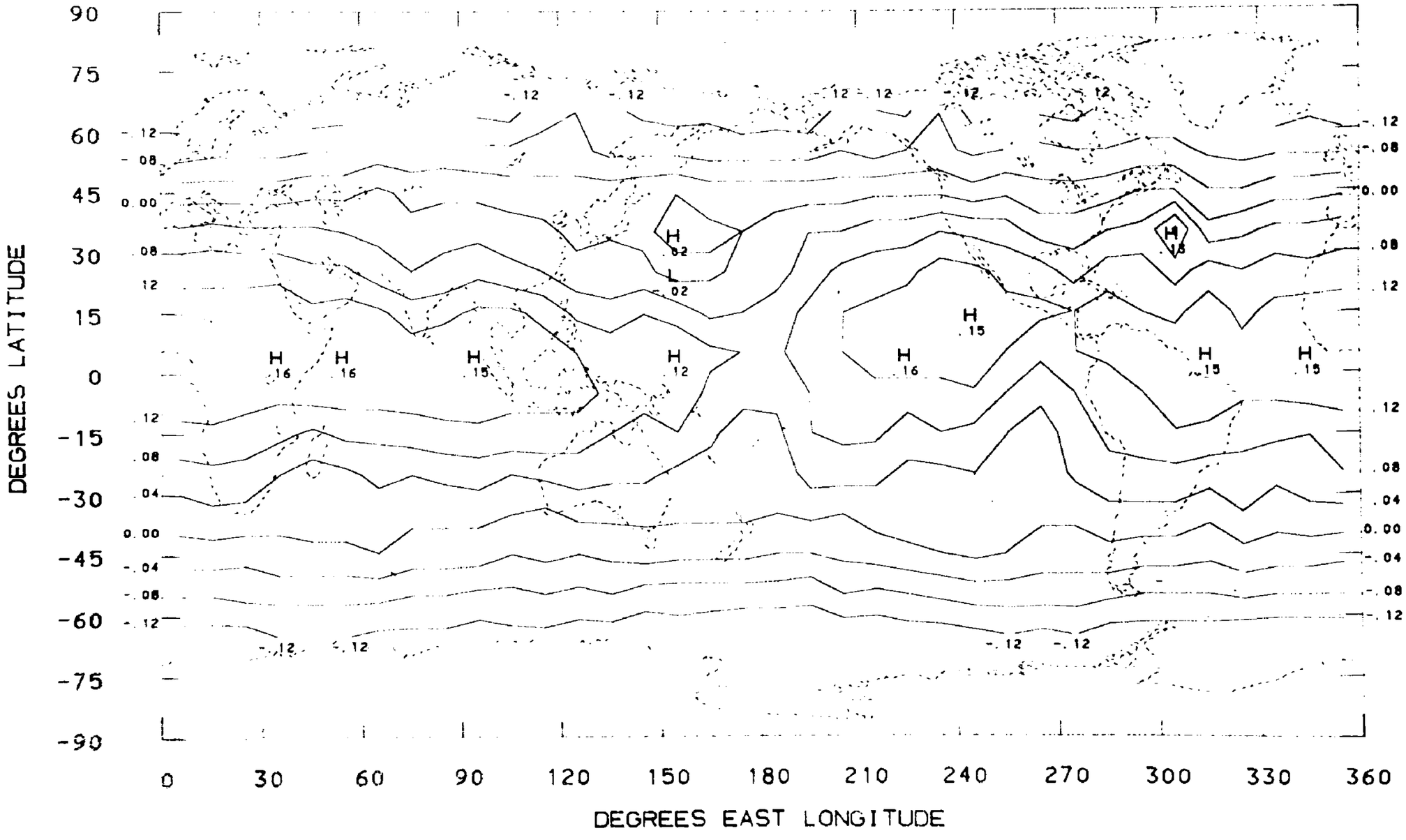


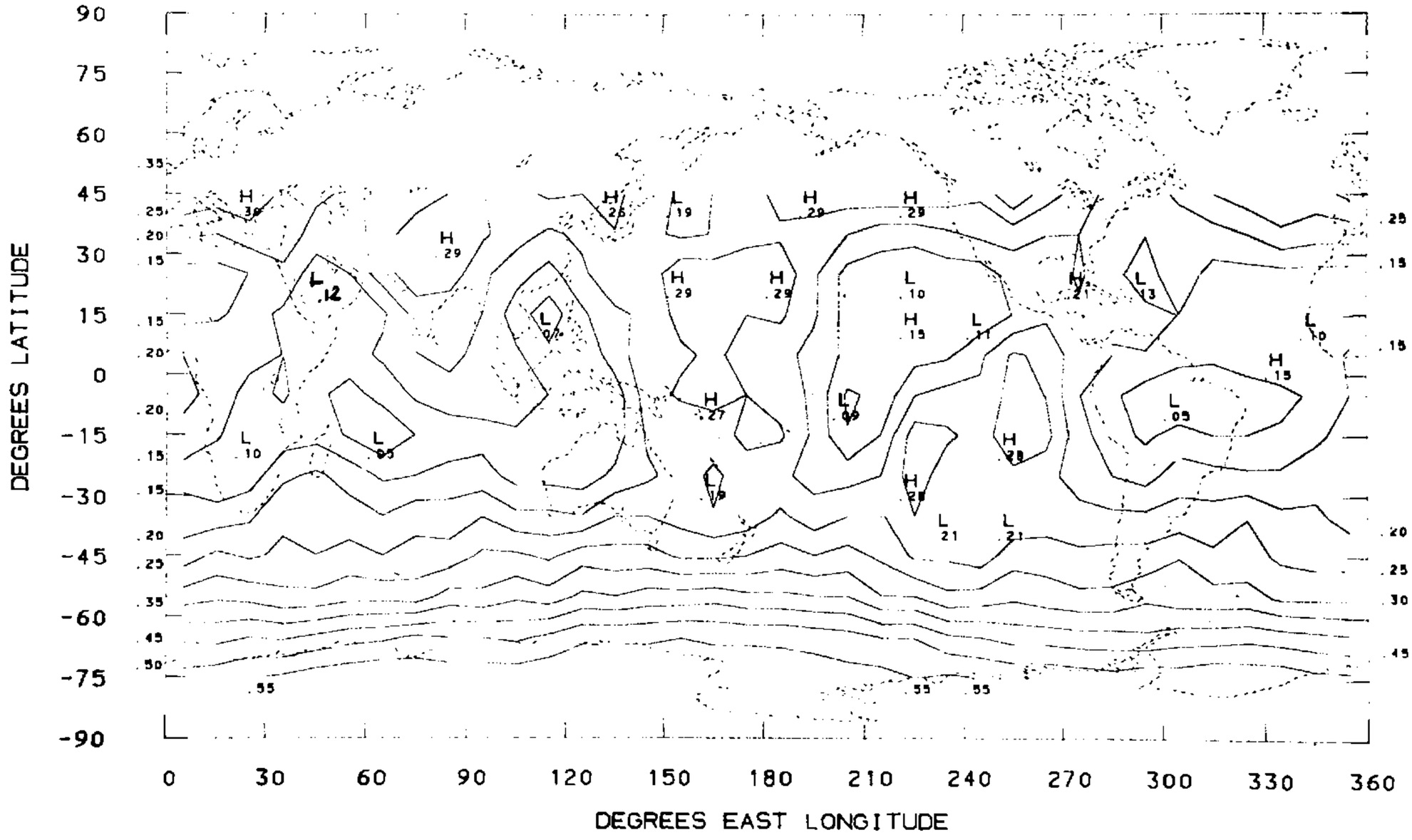
NET RADIATION (LY/MIN)

SEPTEMBER 1965



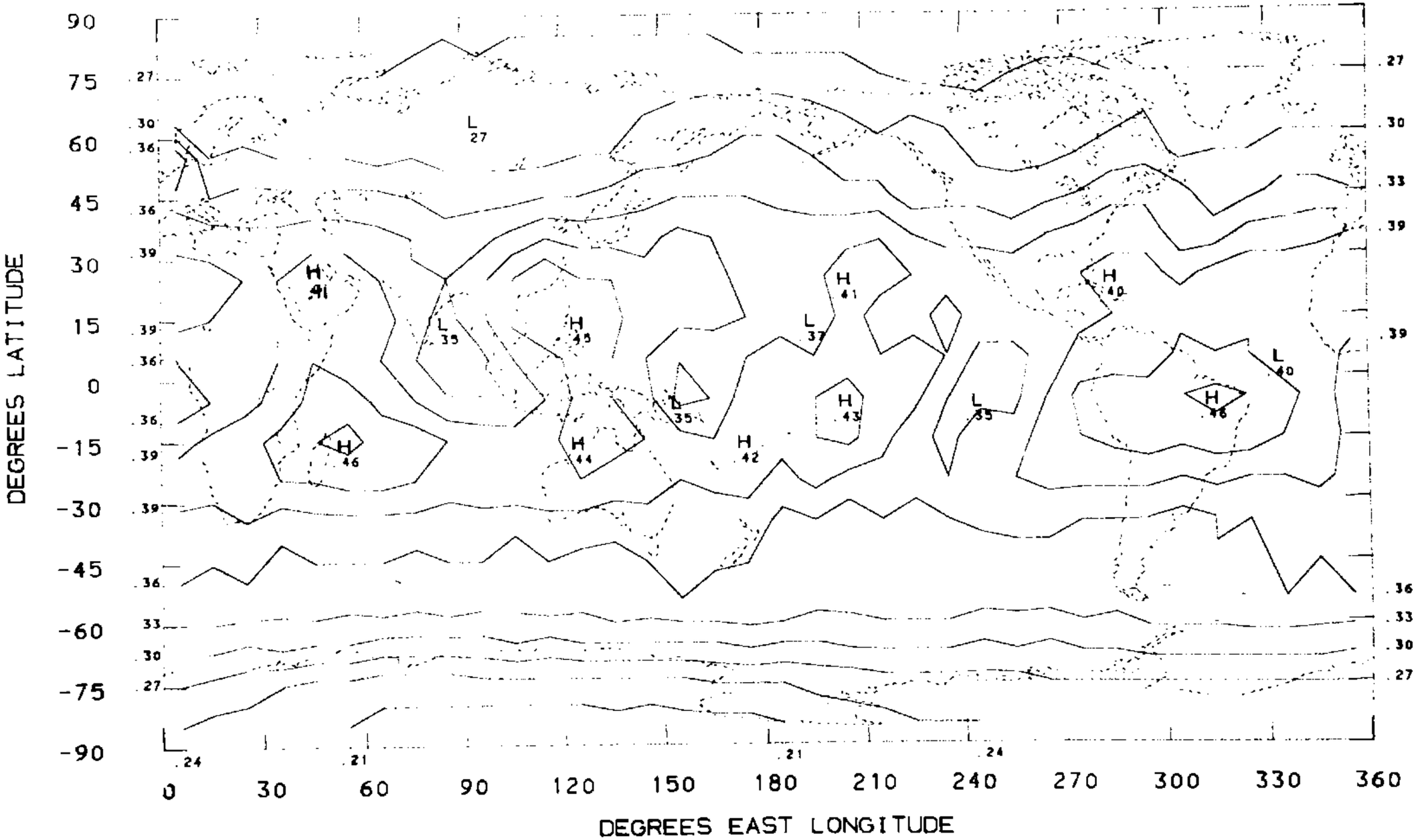
PLANETARY ALBEDO

OCTOBER 1965



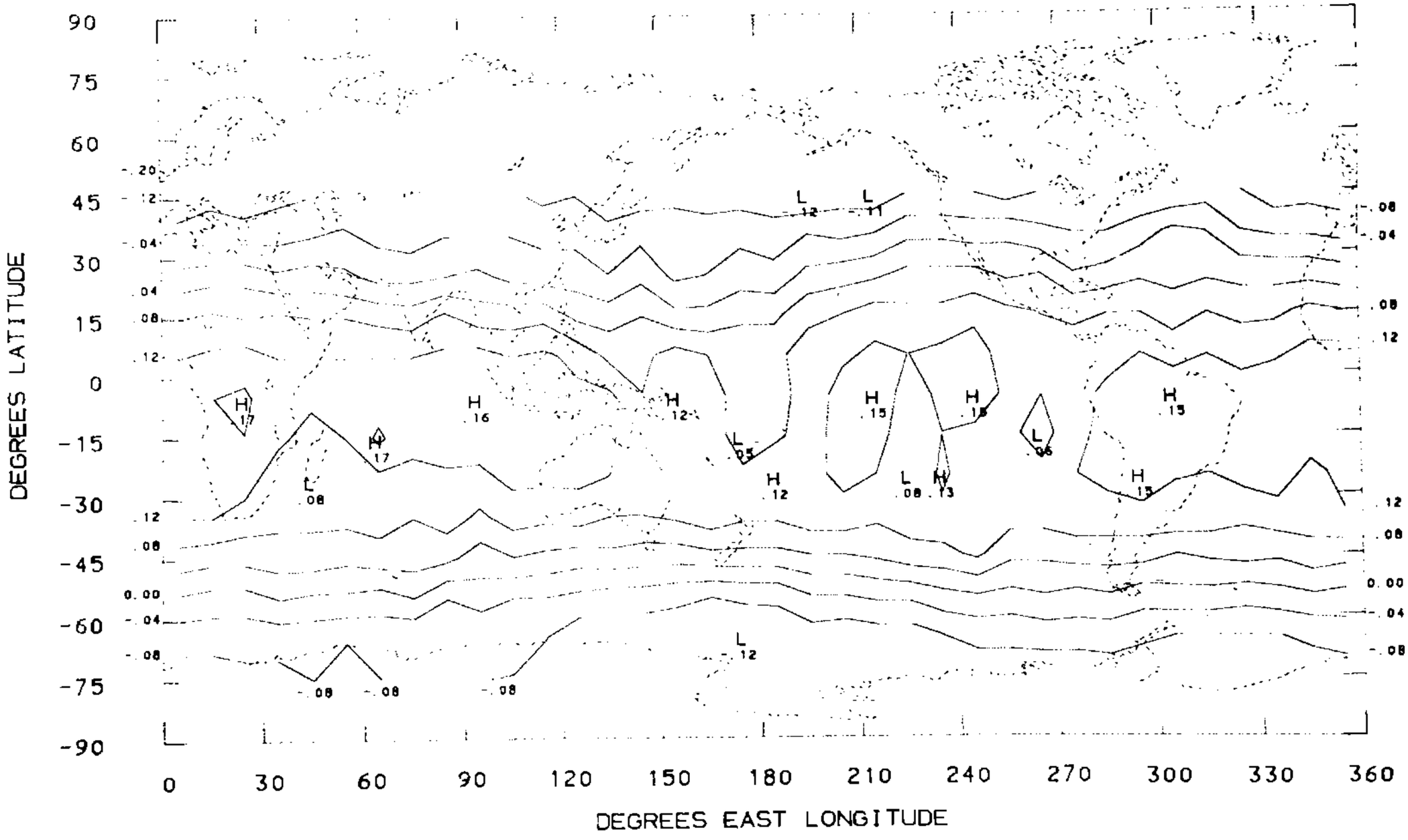
LONGWAVE RADIATION (LY/MIN)

OCTOBER 1965



NET RADIATION (LY/MIN)

OCTOBER 1965



ABSORBED RADIATION (LY/MIN)

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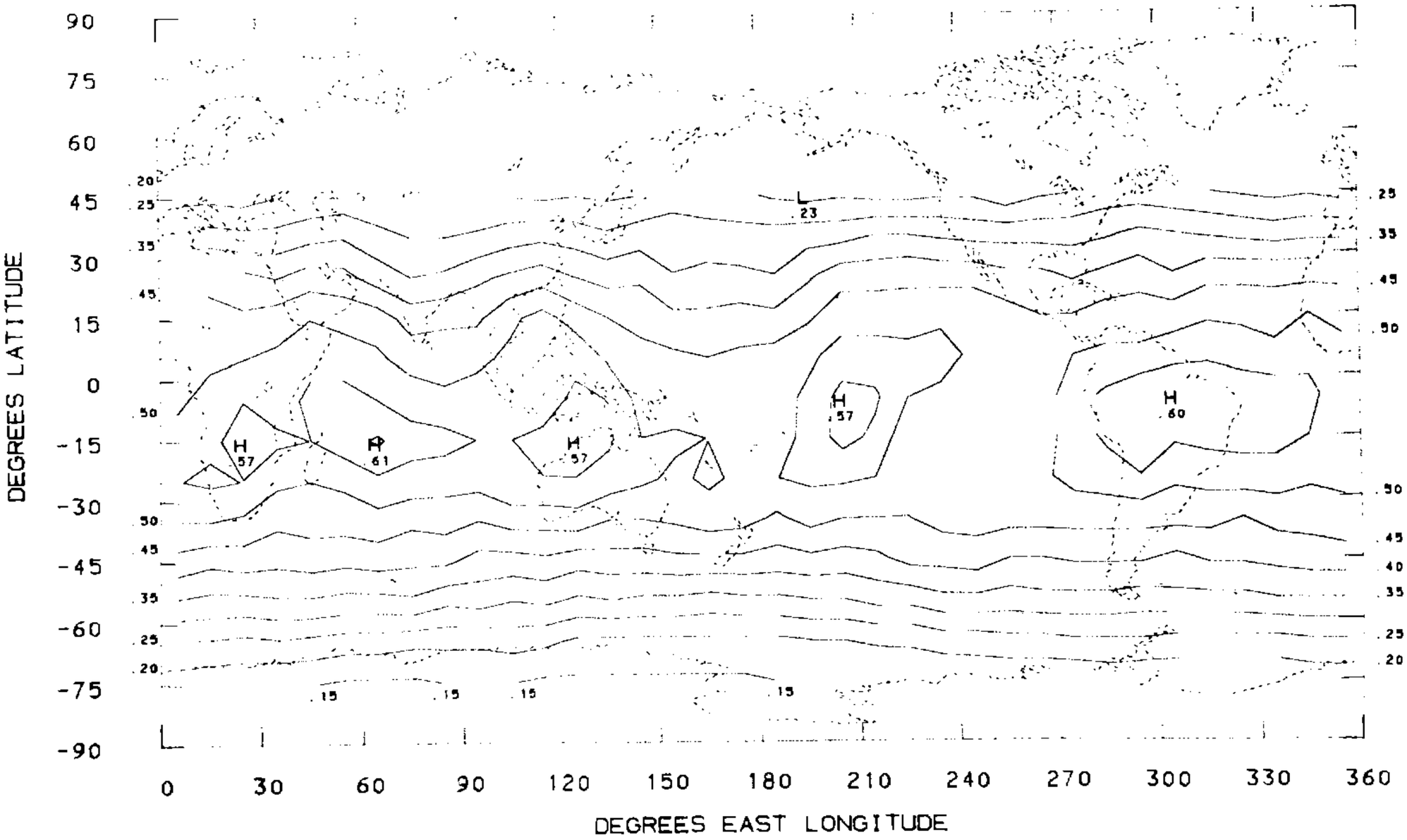
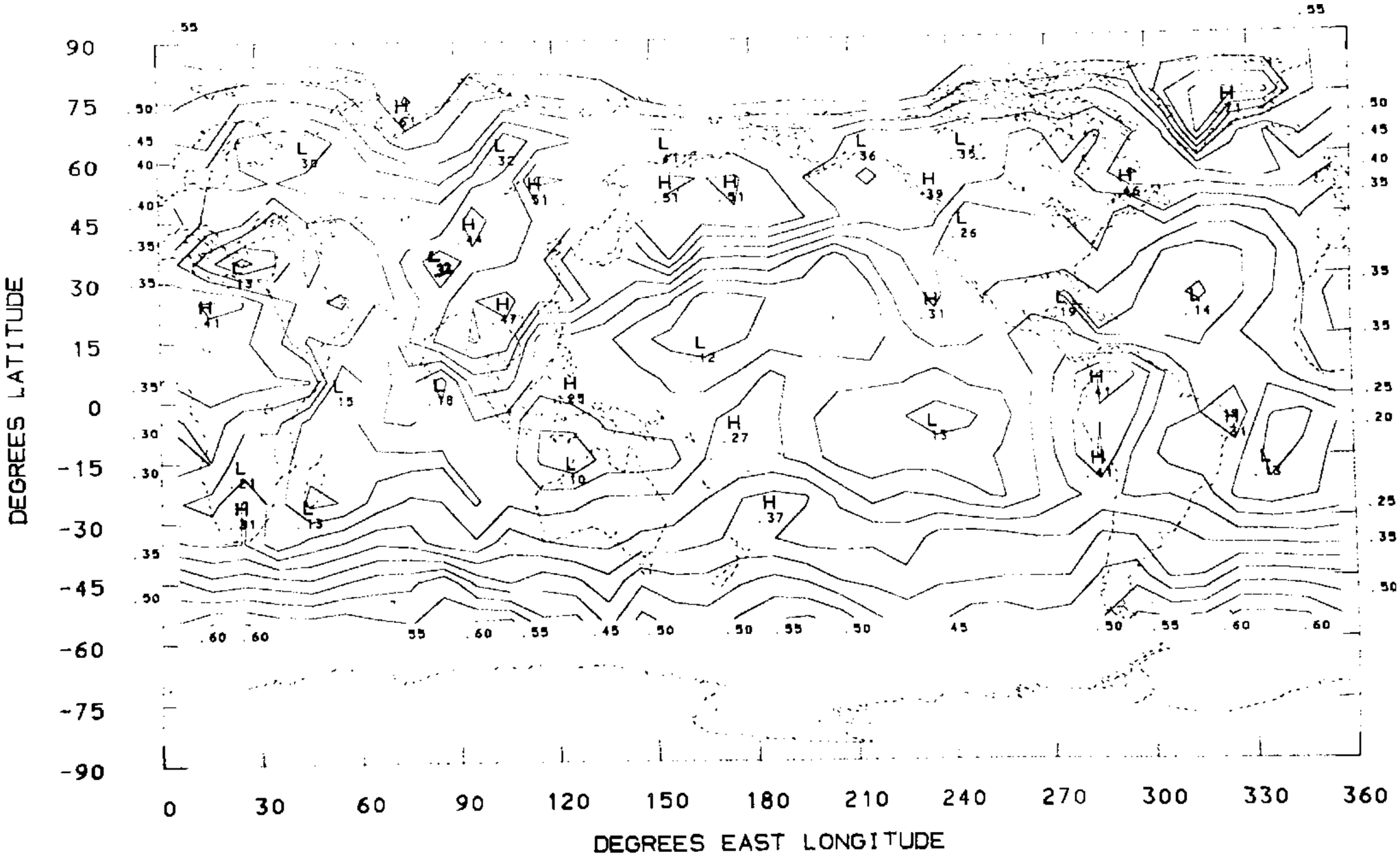


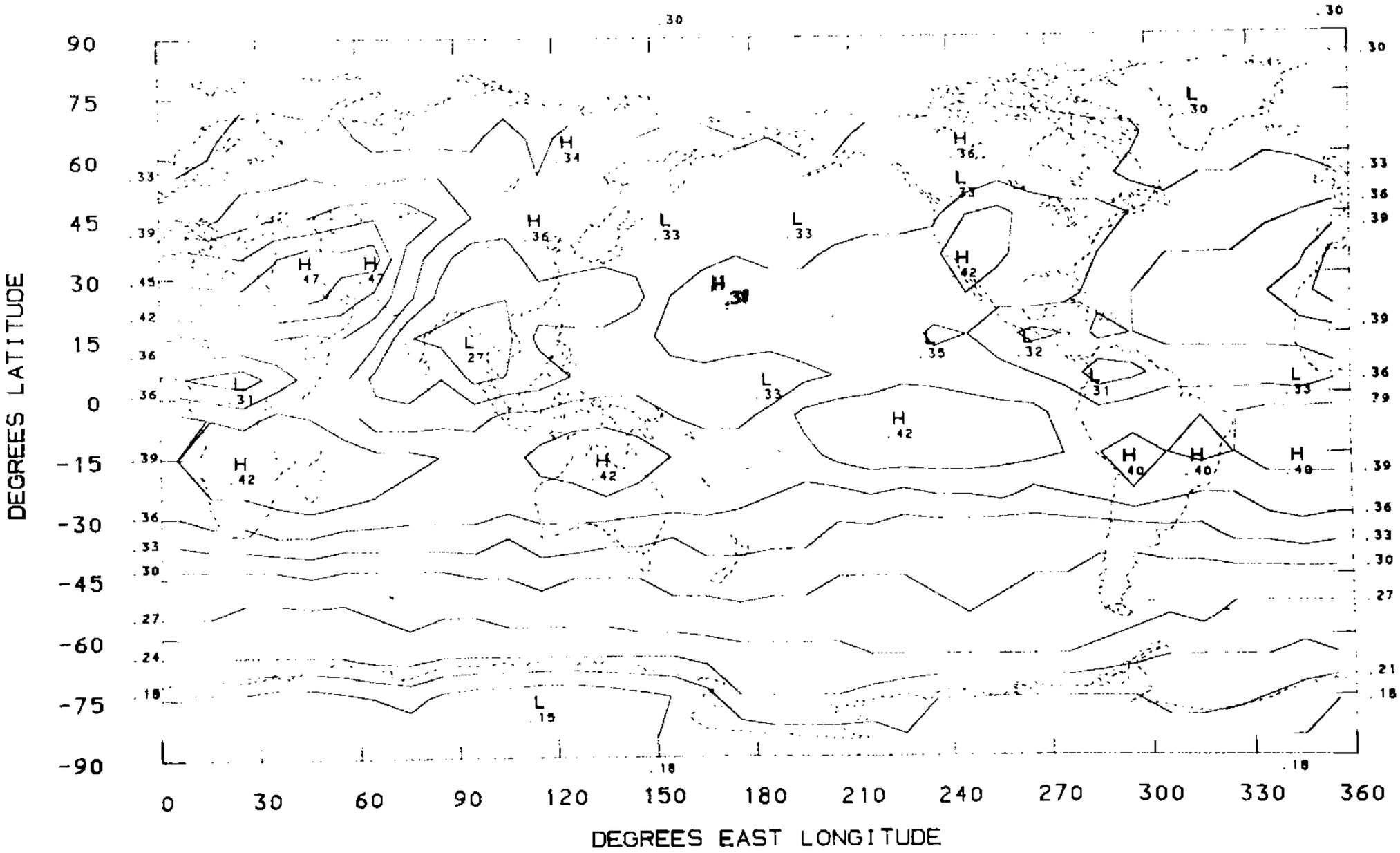
PLANETARY ALBEDO

JULY 1966



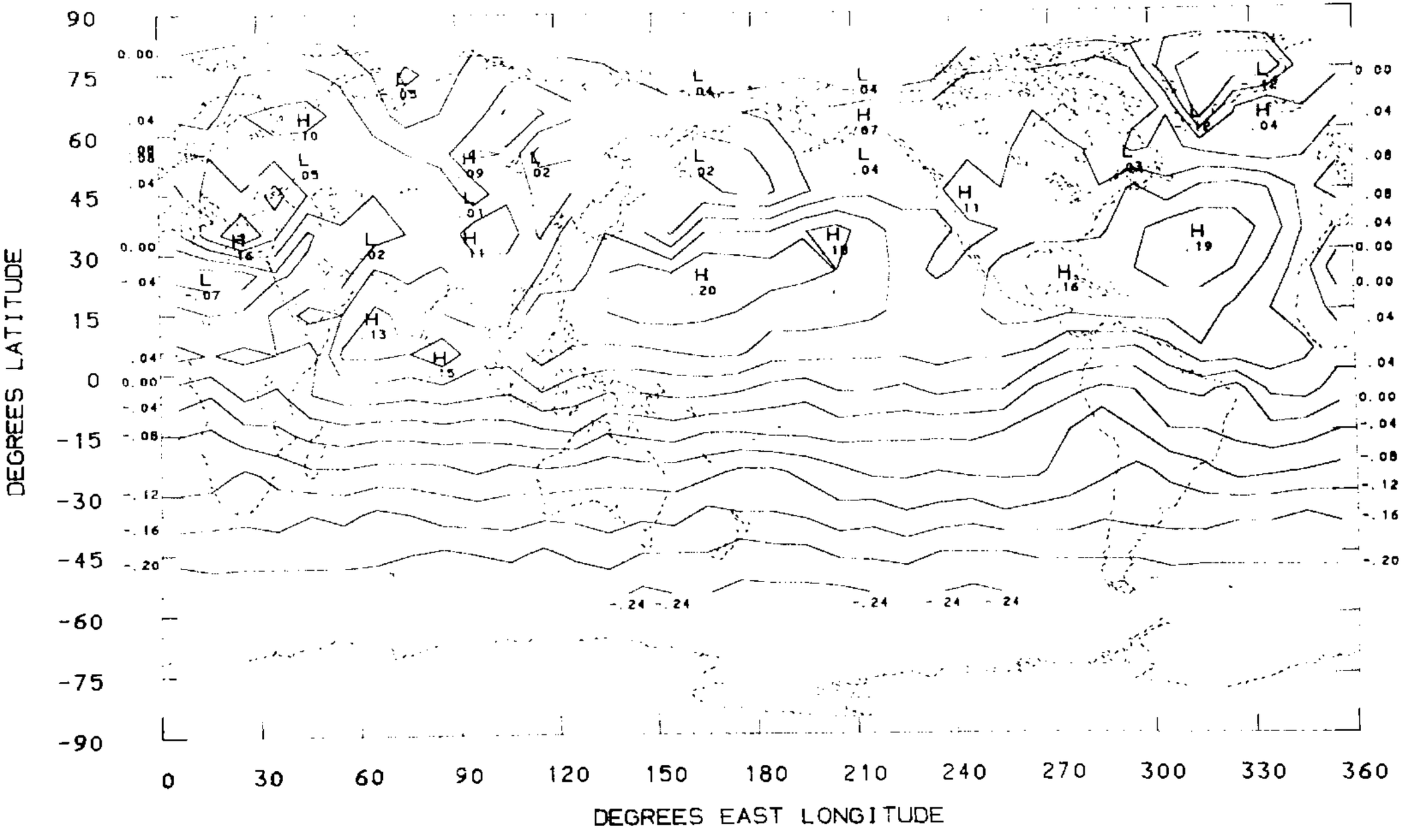
LONGWAVE RADIATION (LY/MIN)

JULY 1966



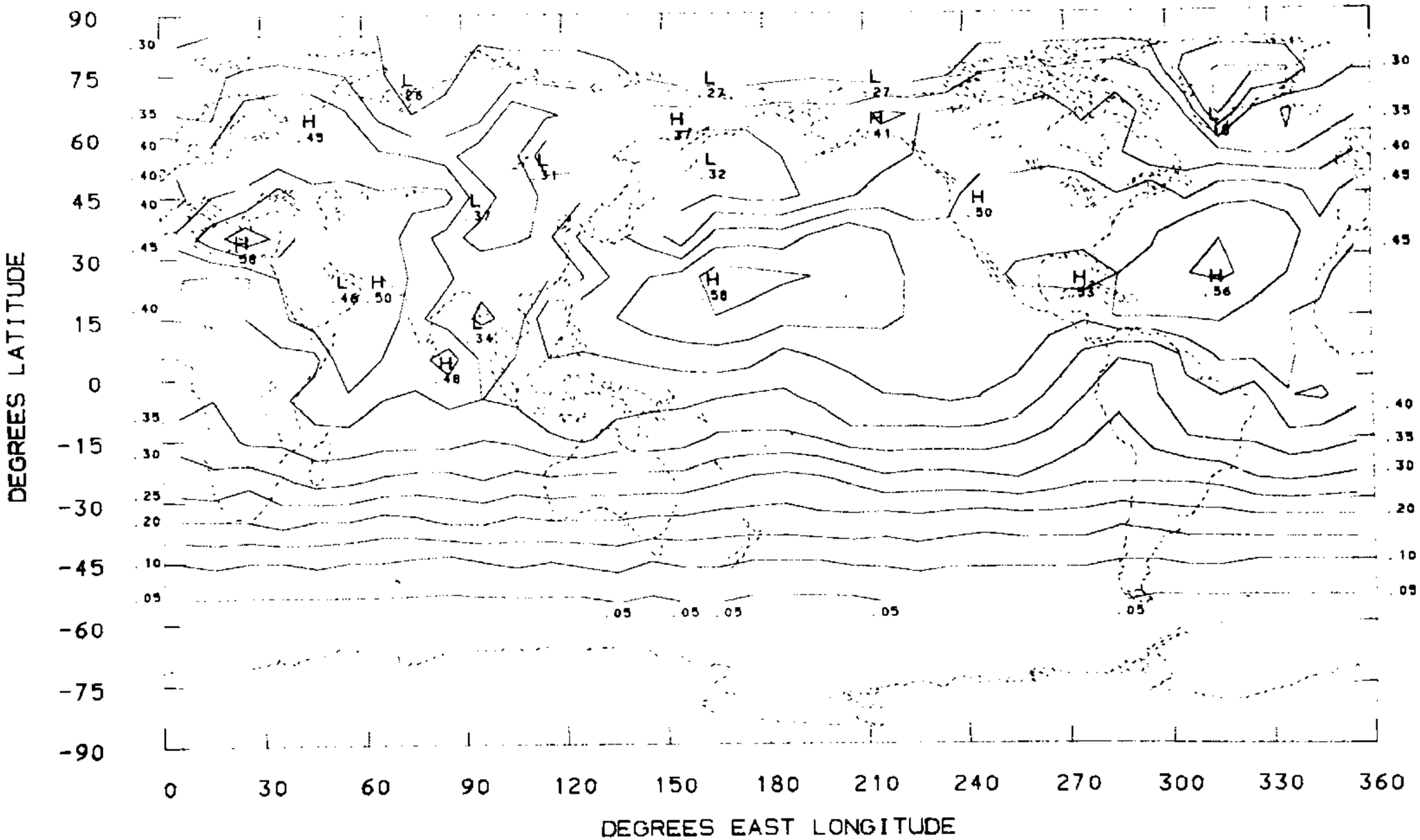
NET RADIATION (LY/MIN)

JULY 1966



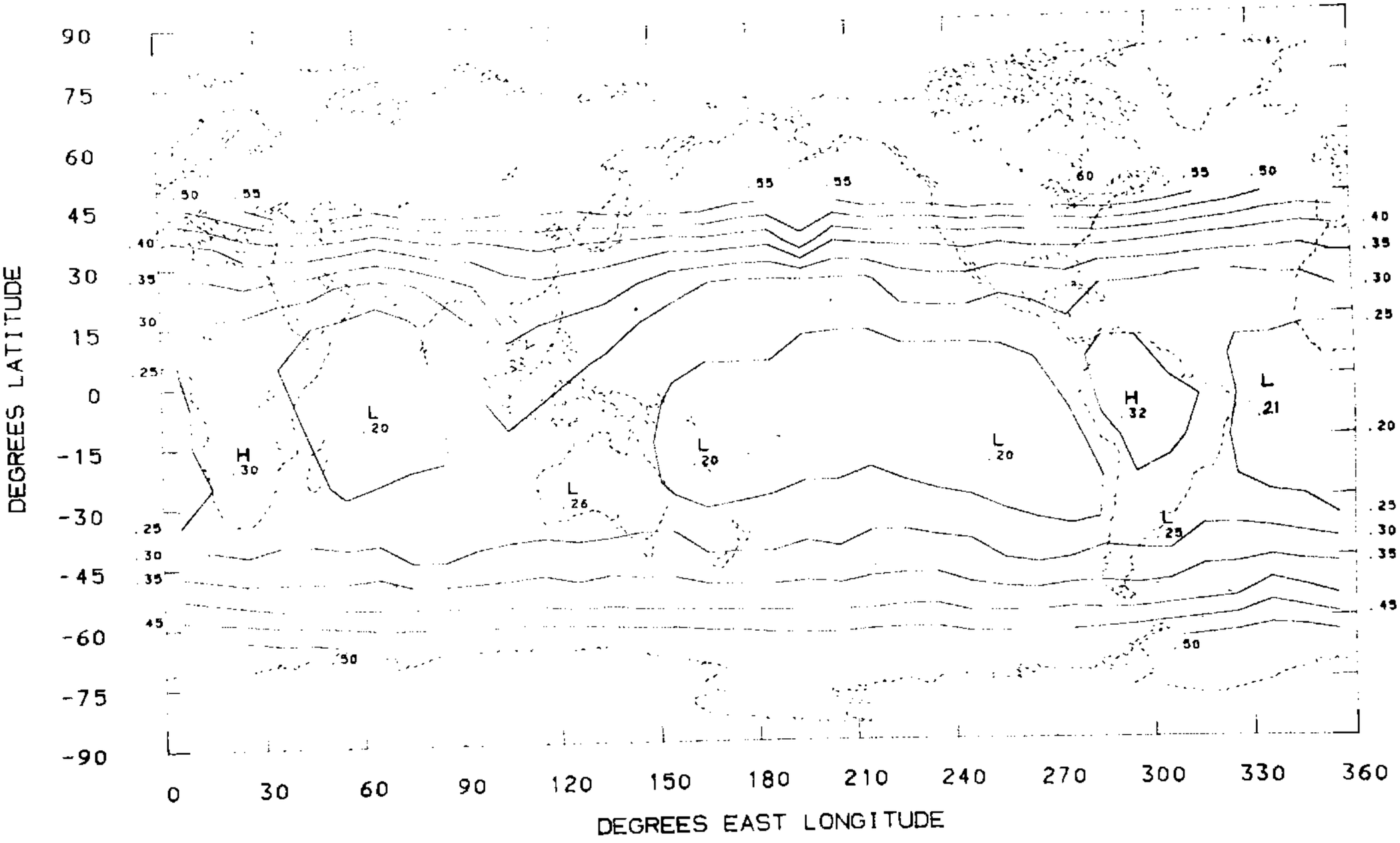
ABSORBED RADIATION (LY/MIN)

JULY 1966



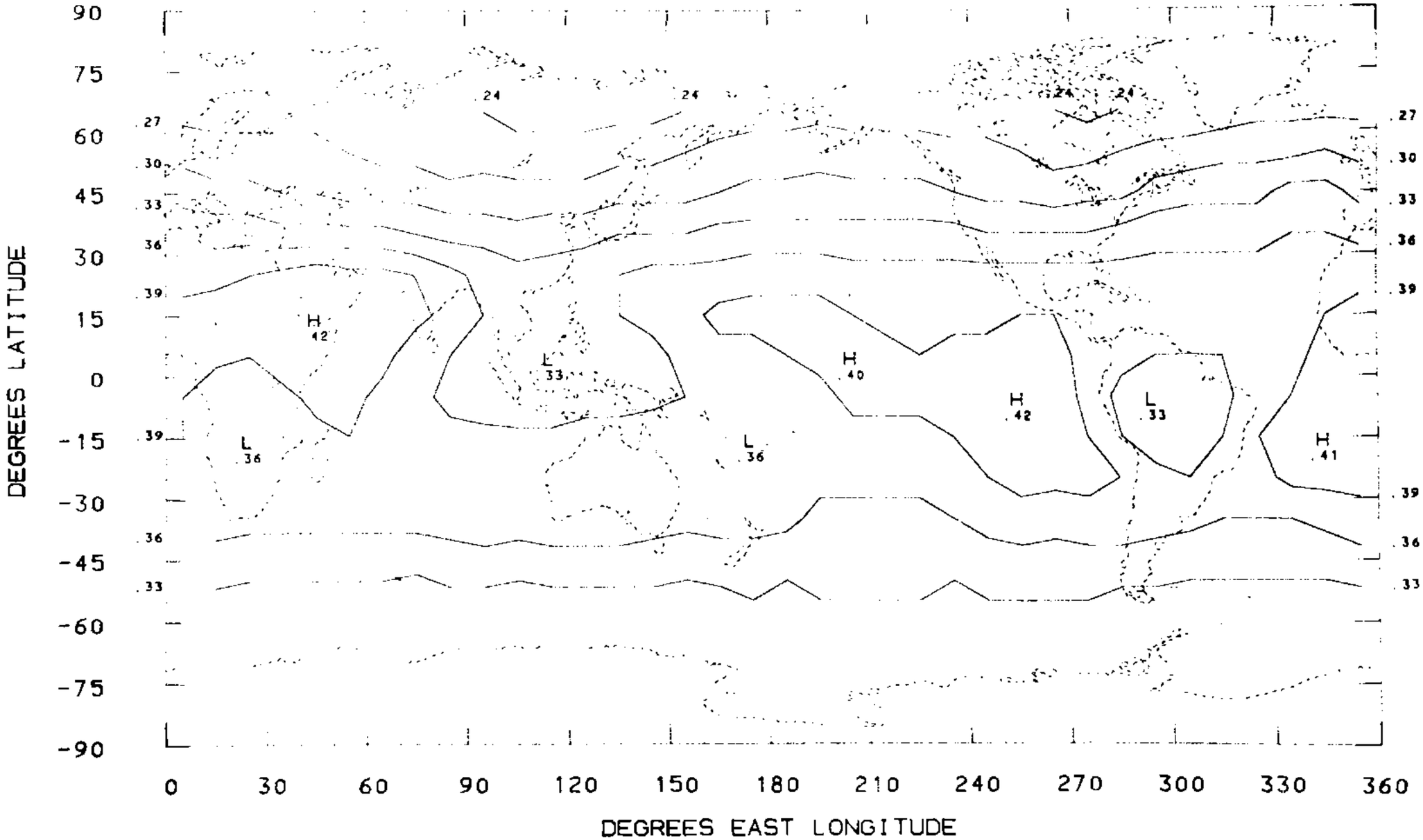
PLANETARY ALBEDO

DECEMBER 1966



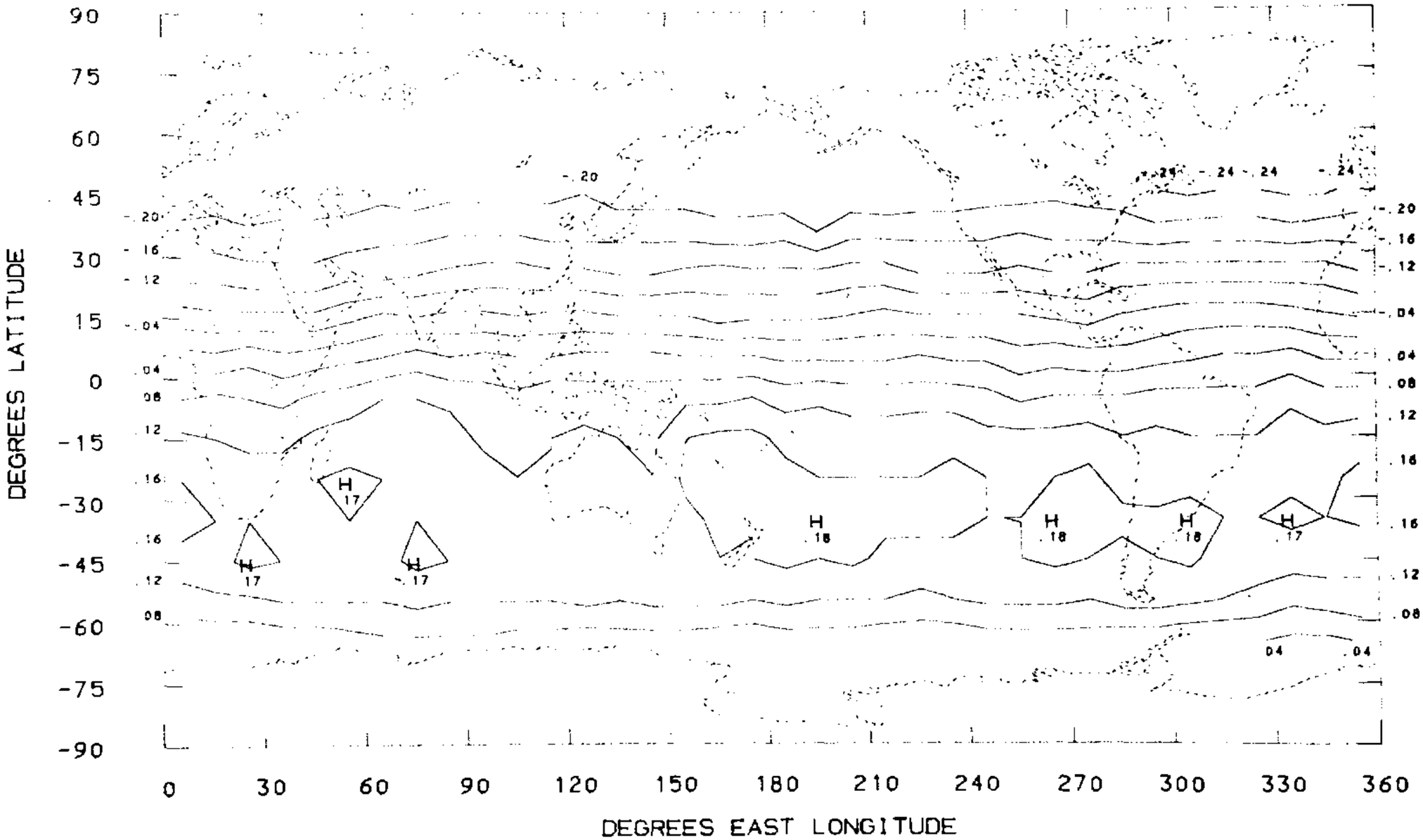
LONGWAVE RADIATION (LY/MIN)

DECEMBER 1966



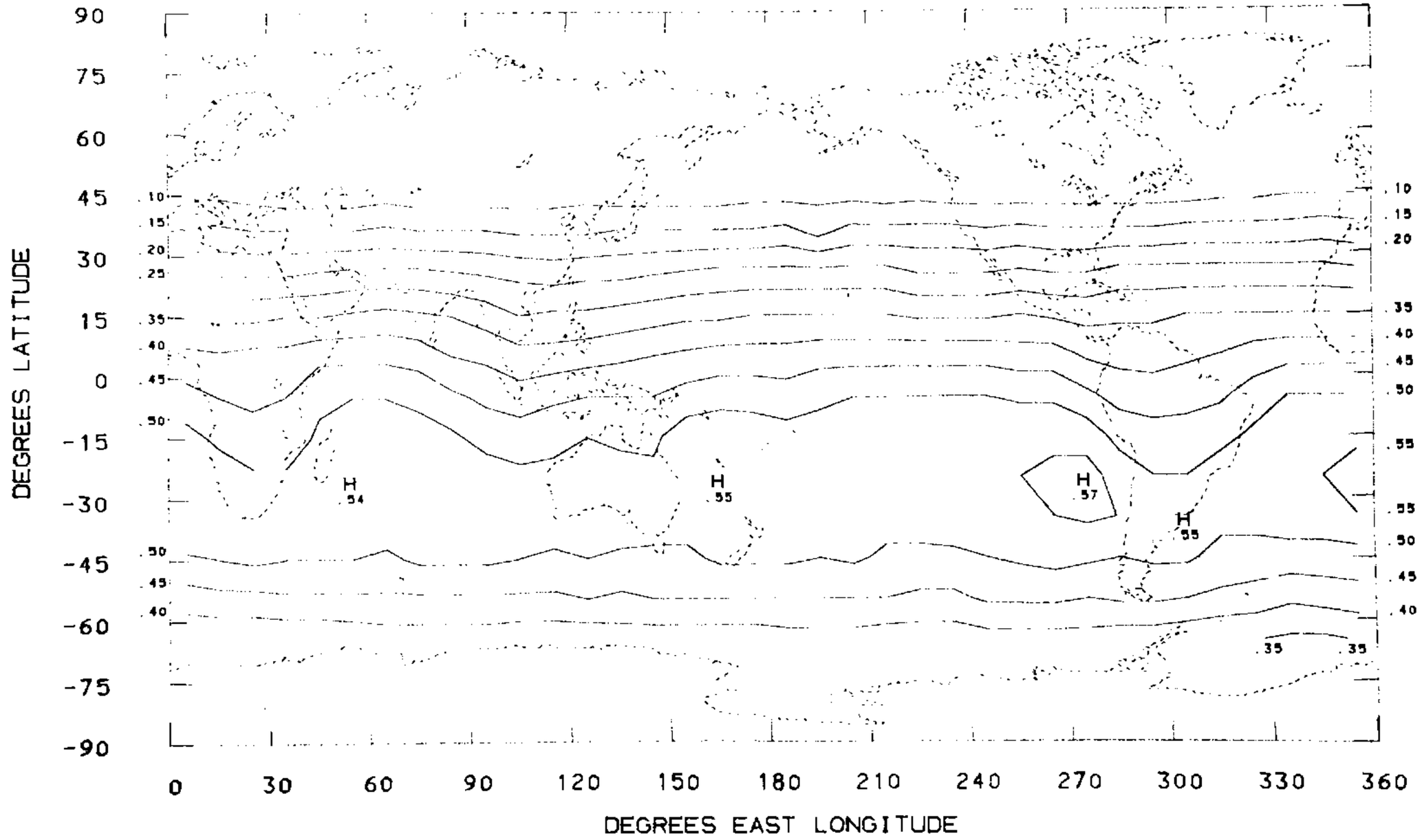
NET RADIATION (LY/MIN)

DECEMBER 1966



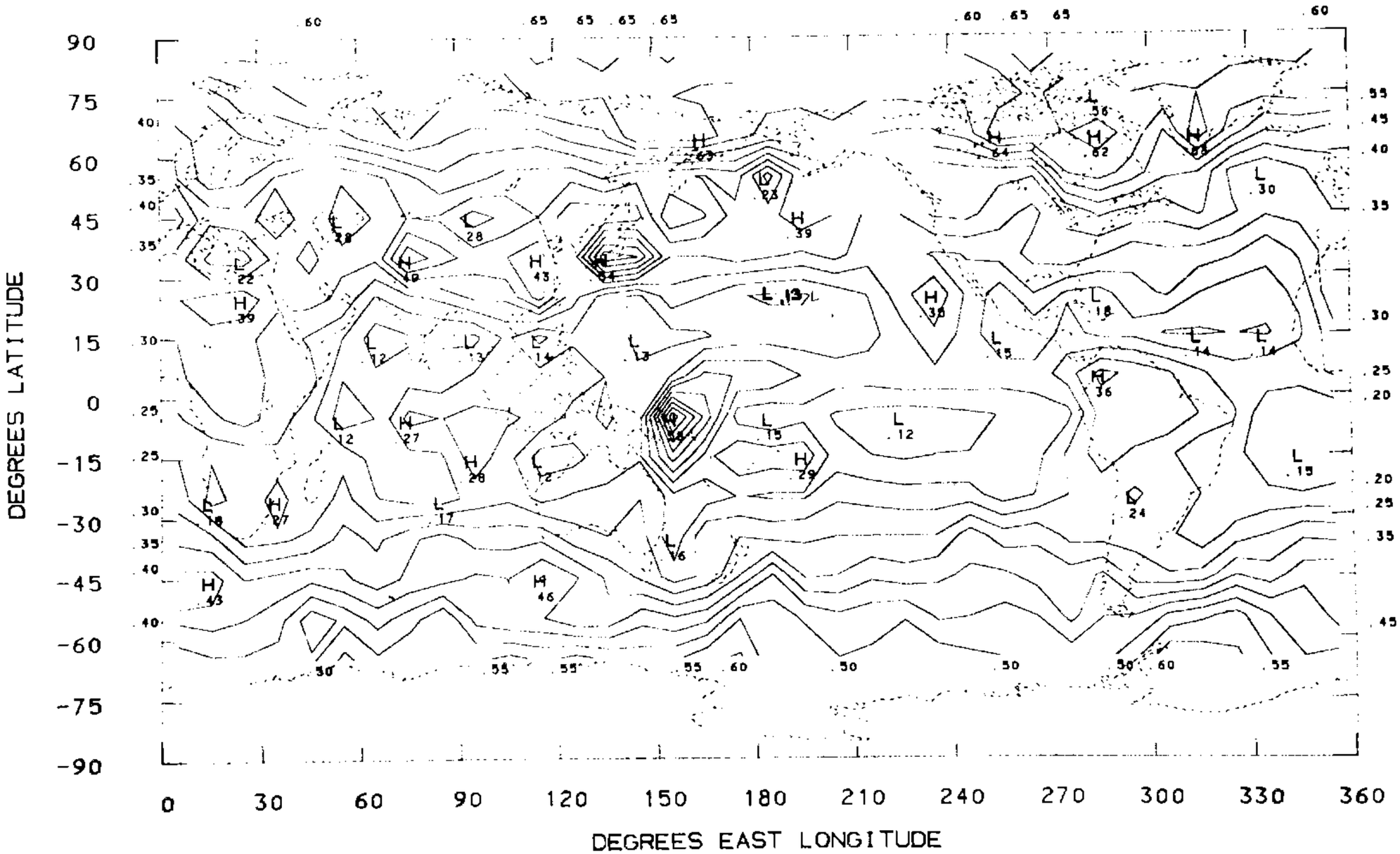
ABSORBED RADIATION (LY/MIN)

DECEMBER 1966



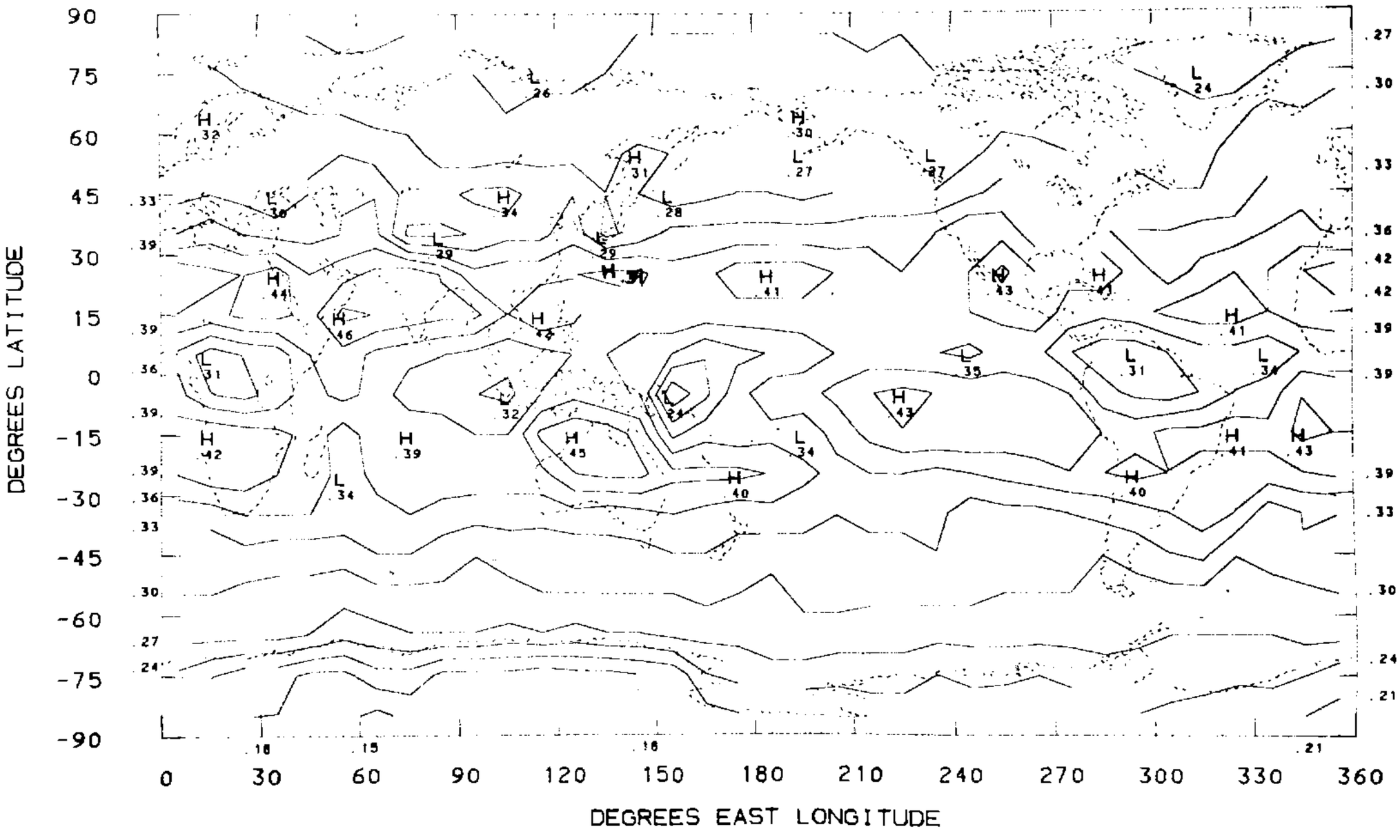
PLANETARY ALBEDO

APRIL 1969



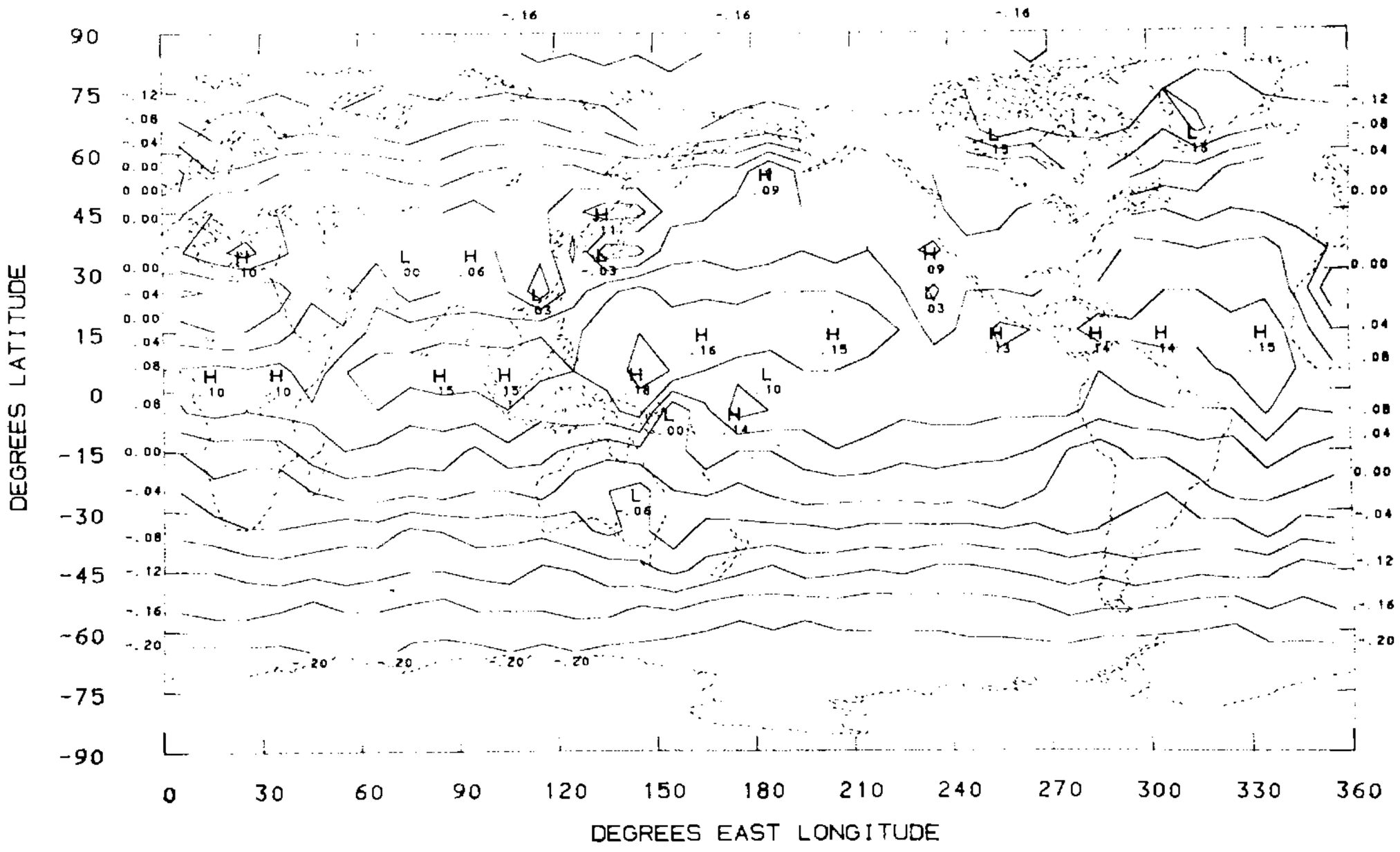
LONGWAVE RADIATION (LY/MIN)

APRIL 1969



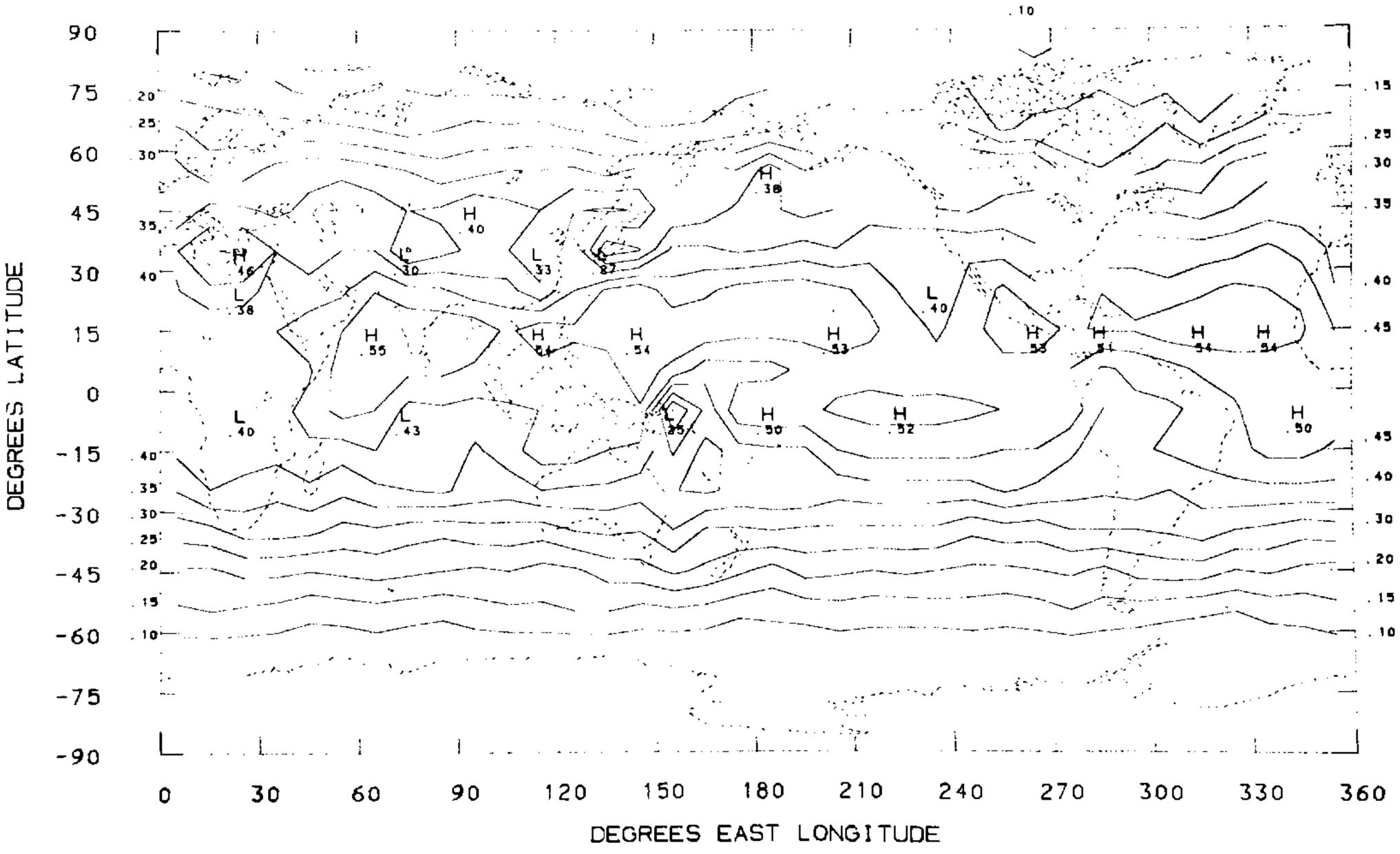
NET RADIATION (LY/MIN)

APRIL 1969



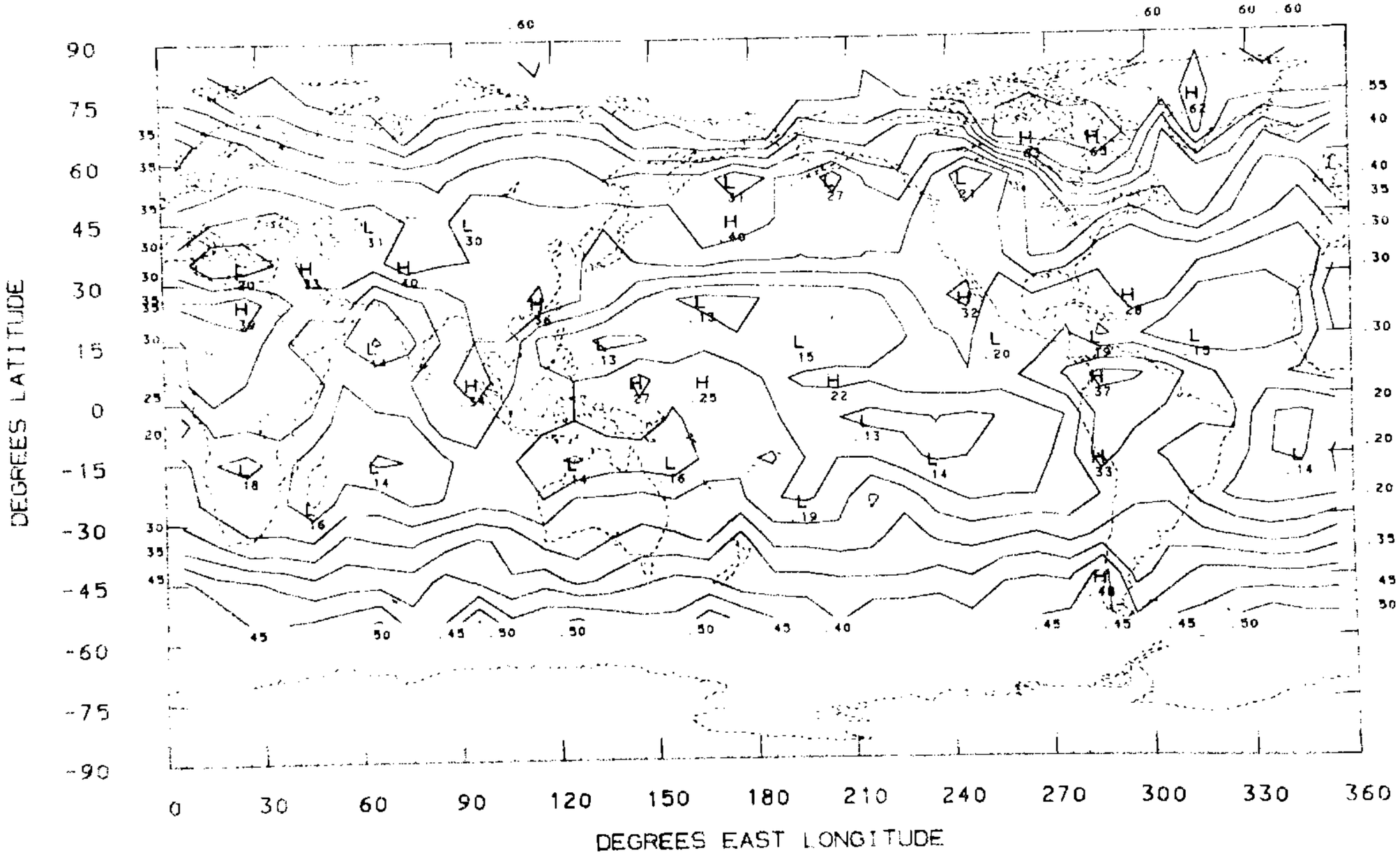
ABSORBED RADIATION (LY/MIN)

APRIL 1969



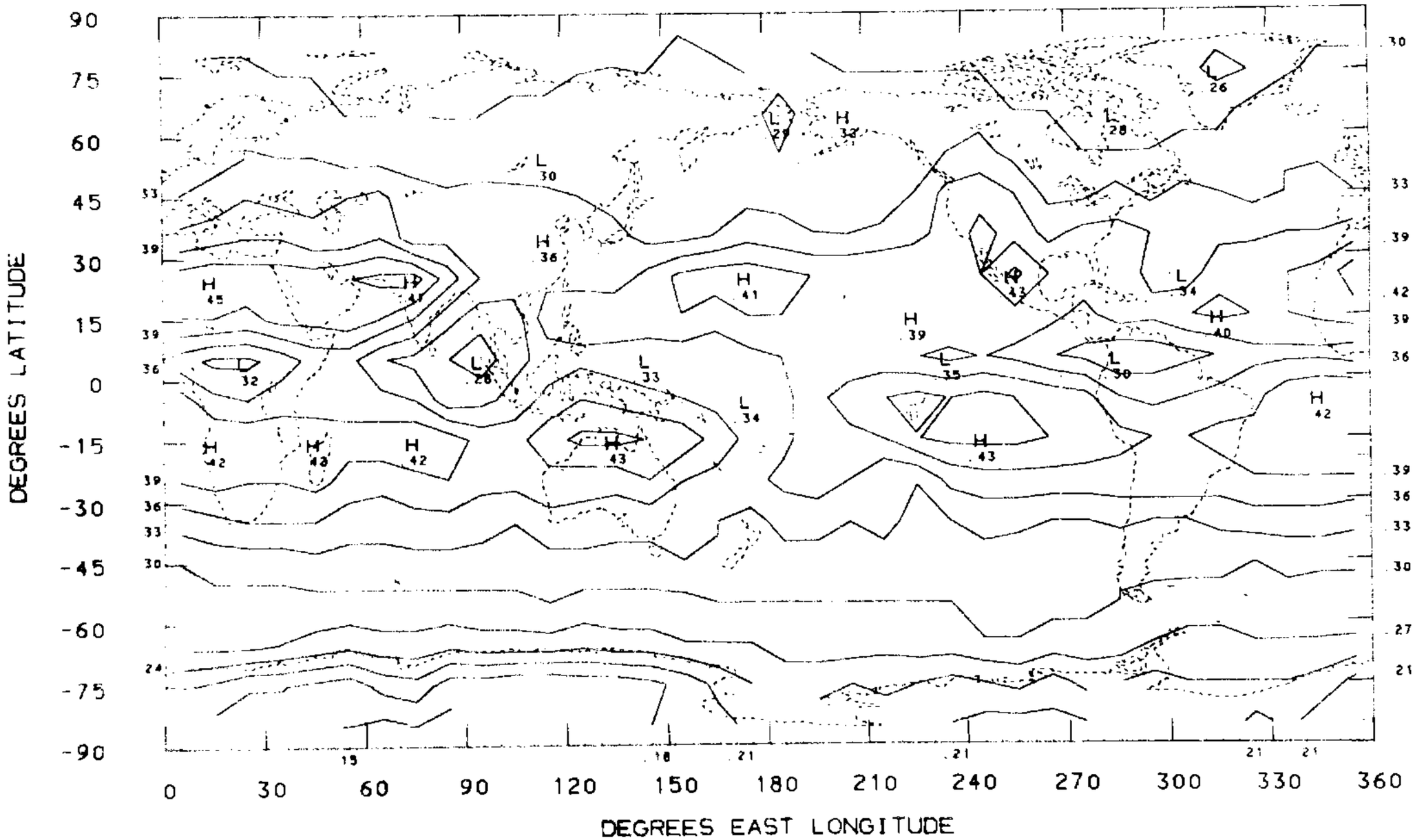
PLANETARY ALBEDO

MAY (1-15) 1969



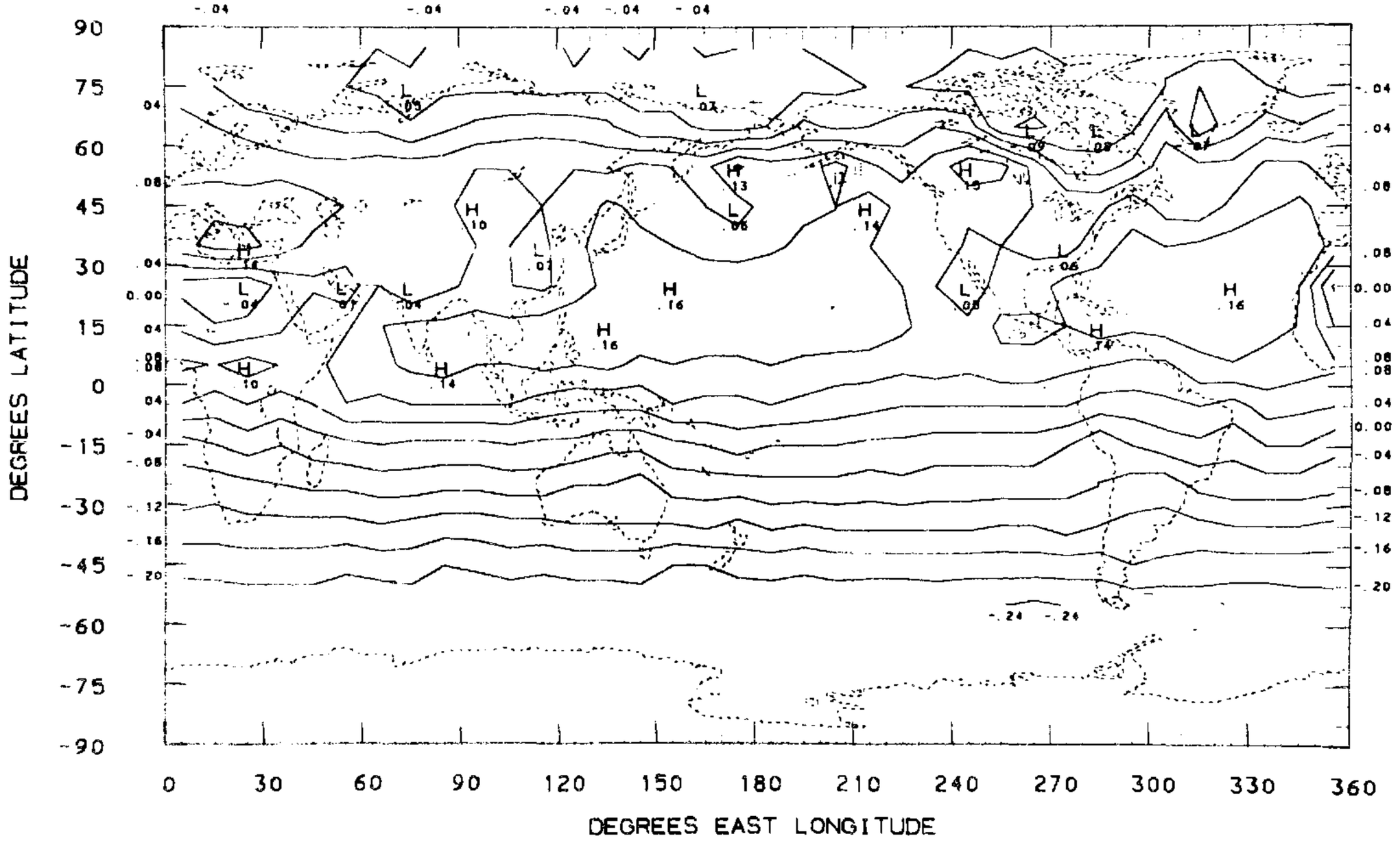
LONGWAVE RADIATION (LY/MIN)

MAY (1-15) 1969



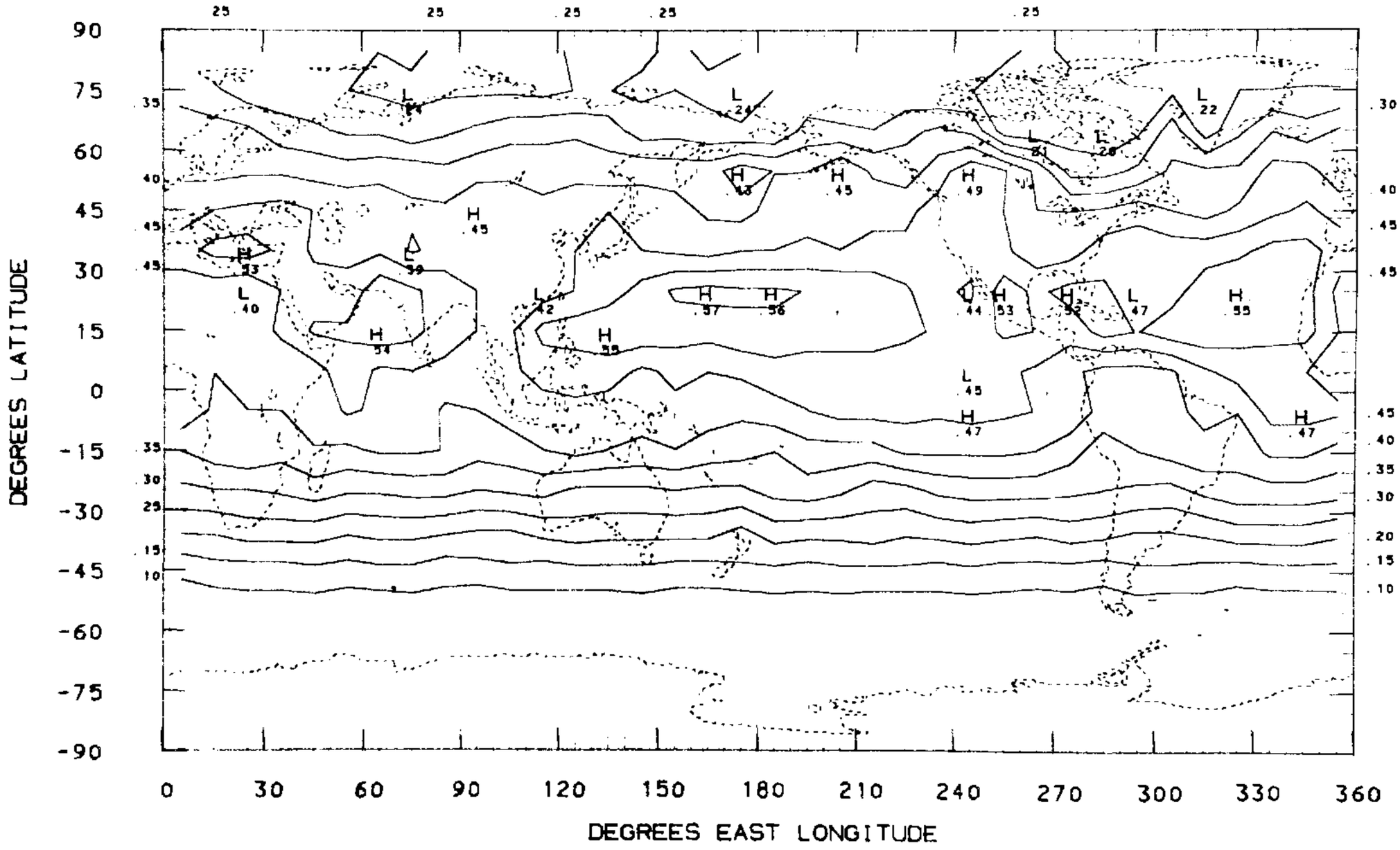
NET RADIATION (LY/MIN)

MAY (1-15) 1969



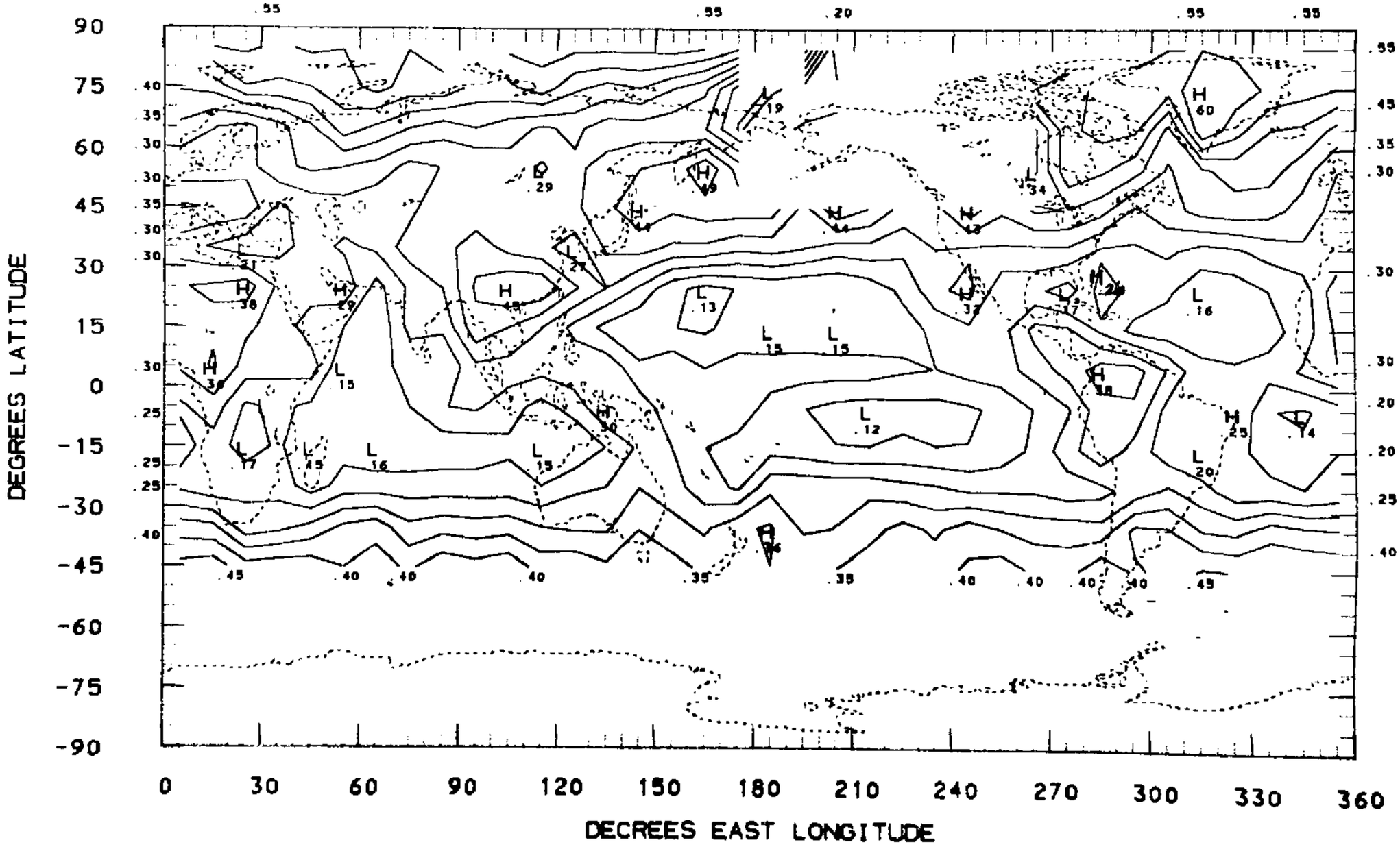
ABSORBED RADIATION (LY/MIN)

MAY (1-15) 1969



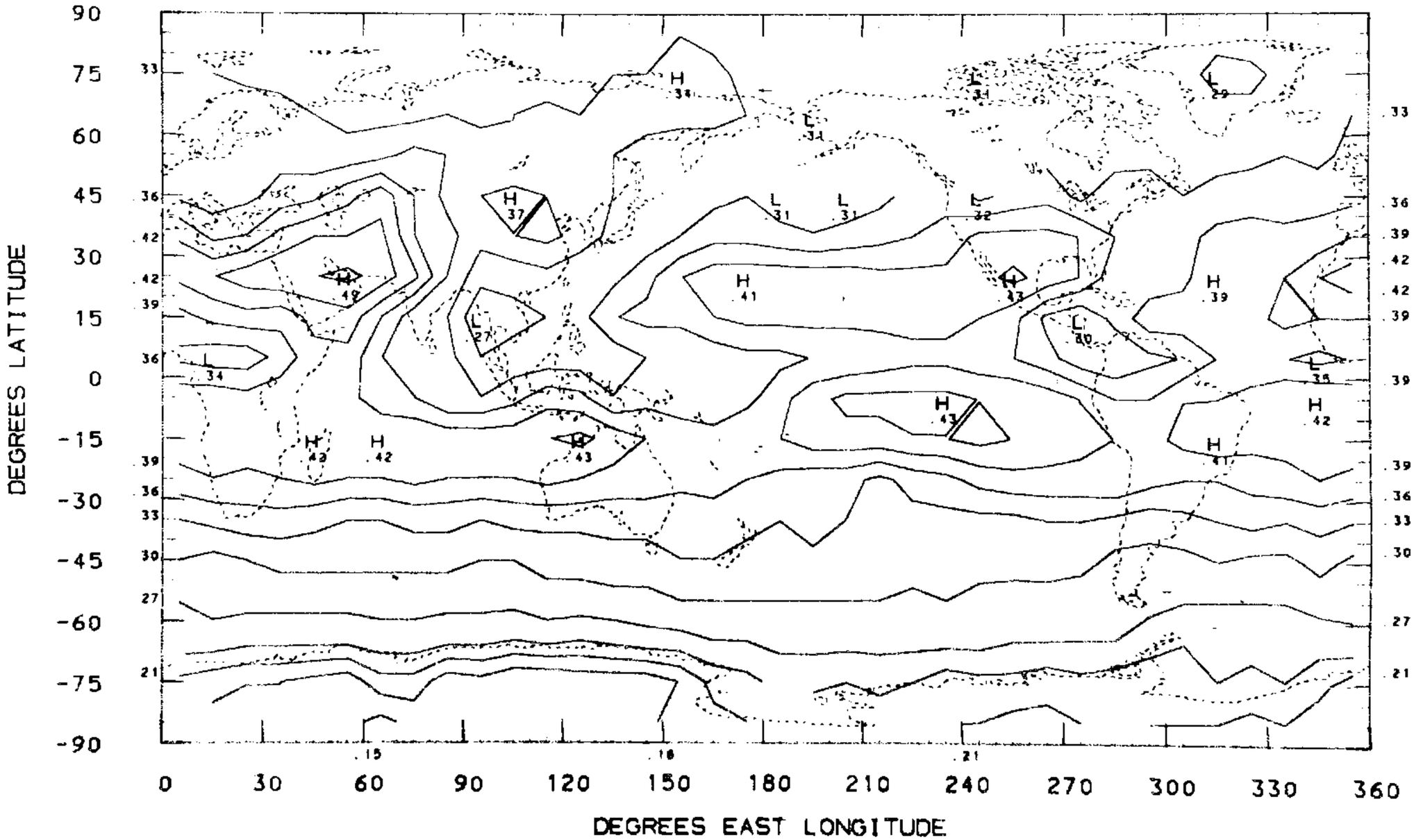
PLANETARY ALBEDO

JUNE 1969



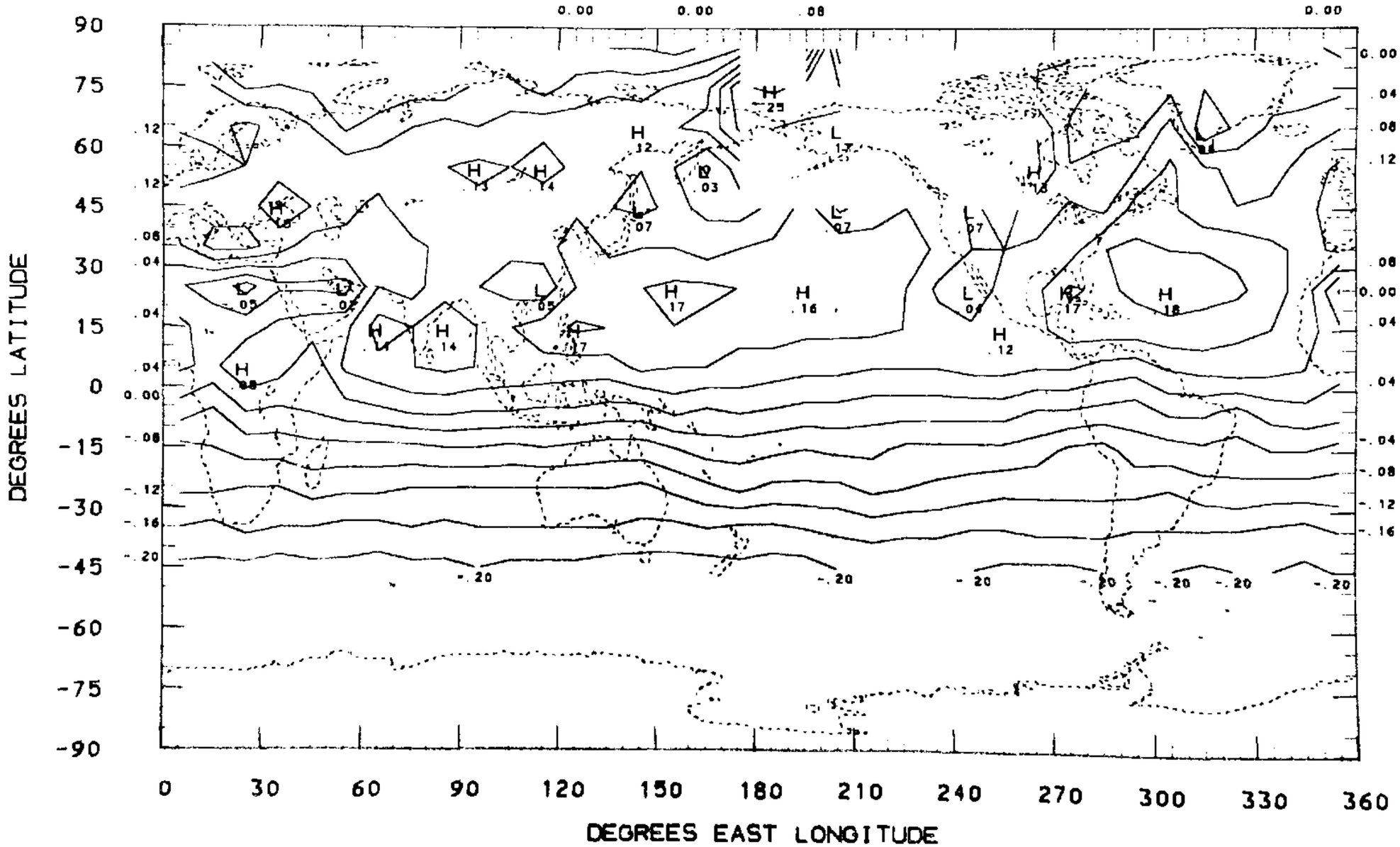
LONGWAVE RADIATION (LY/MIN)

JUNE 1969



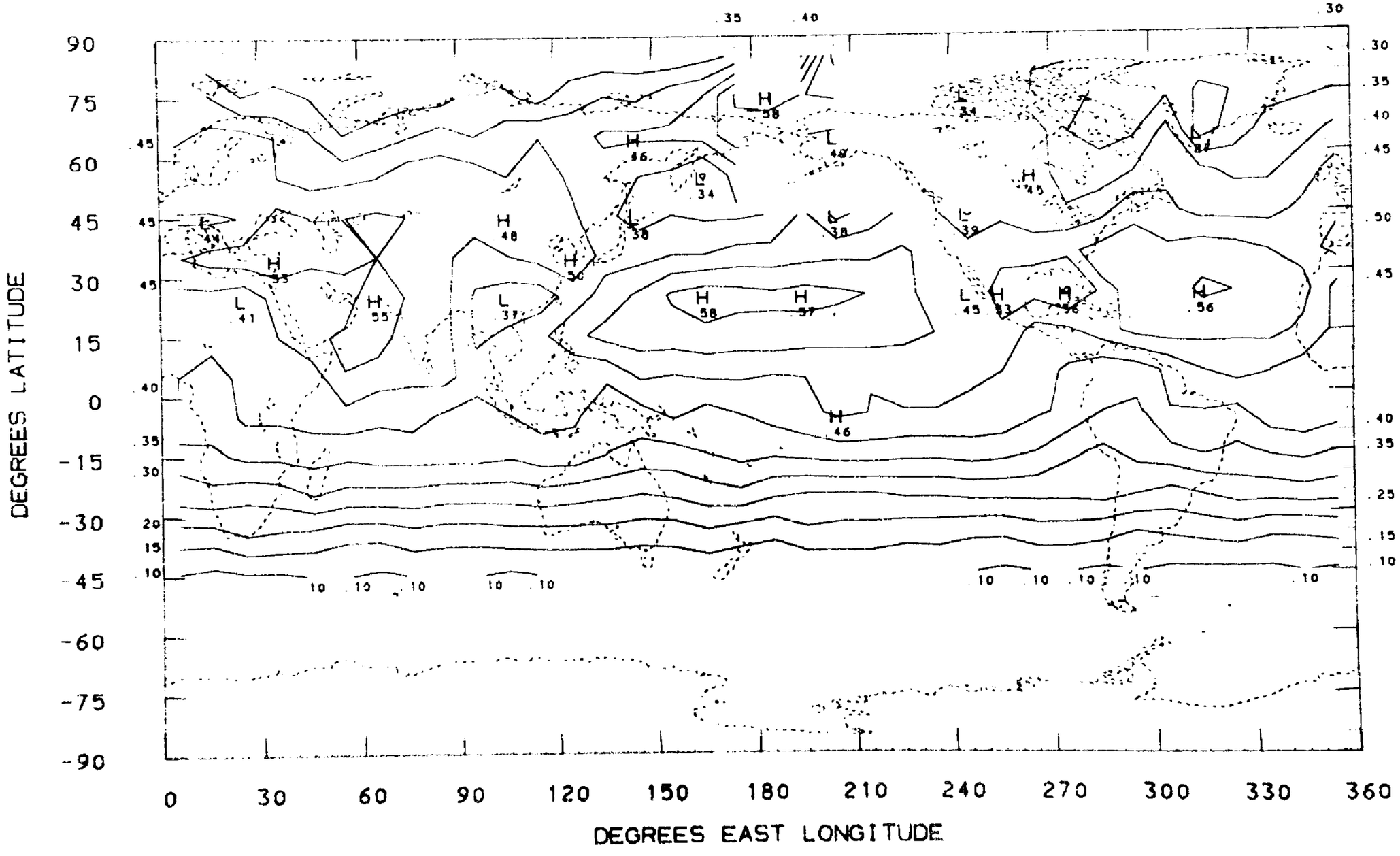
NET RADIATION (LY/MIN)

JUNE 1969



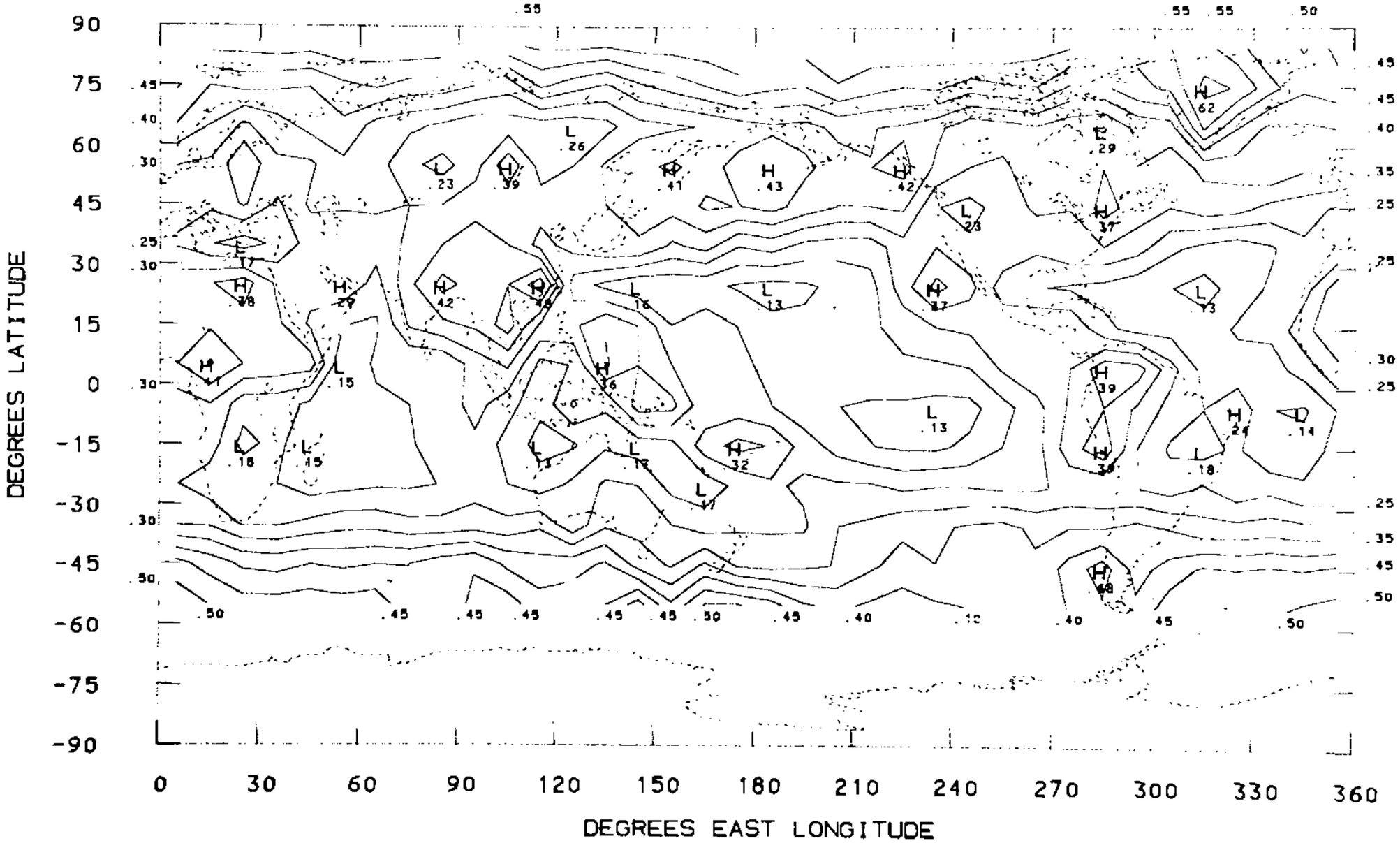
ABSORBED RADIATION (LY/MIN)

JUNE 1969



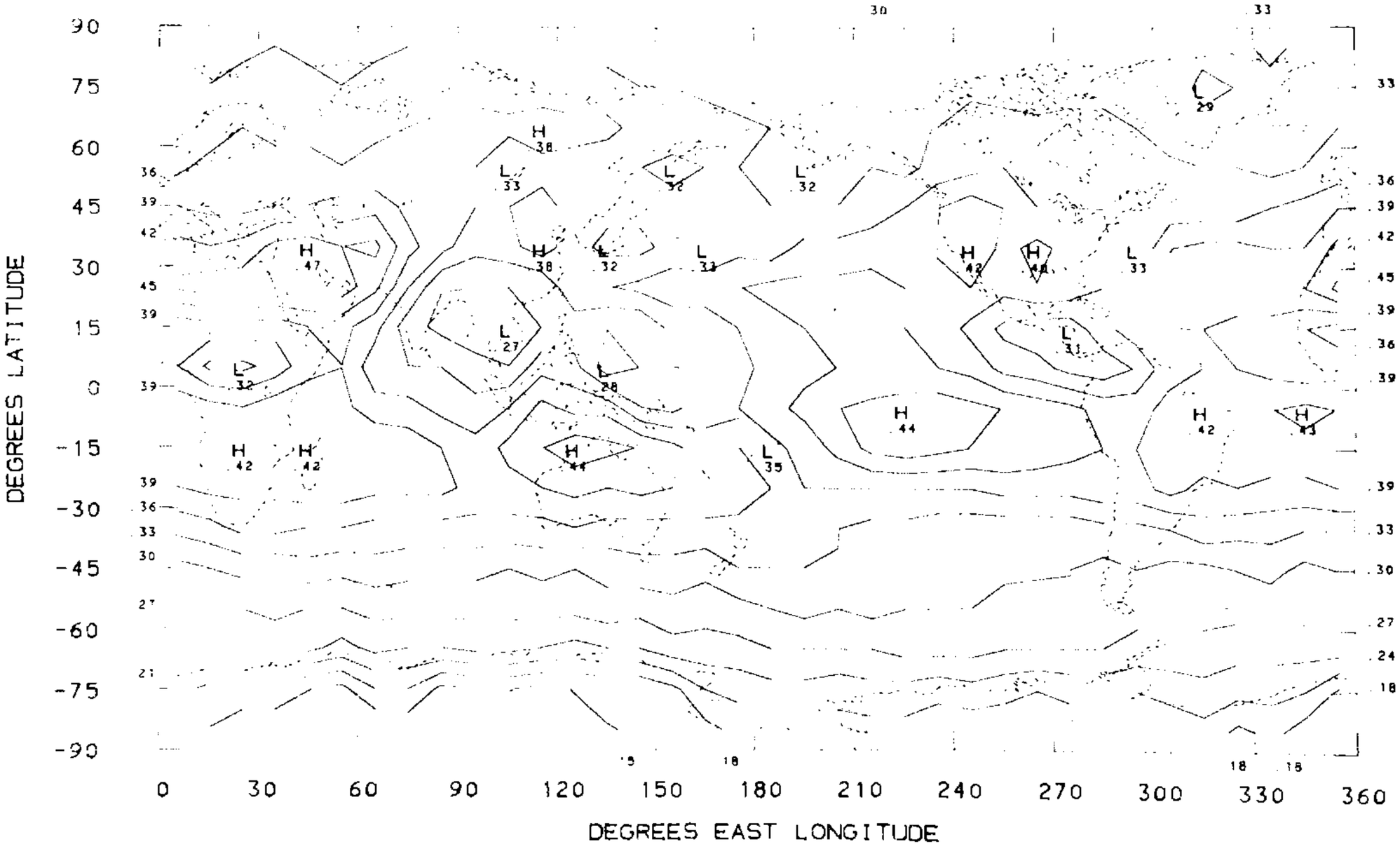
PLANETARY ALBEDO

JULY 1969



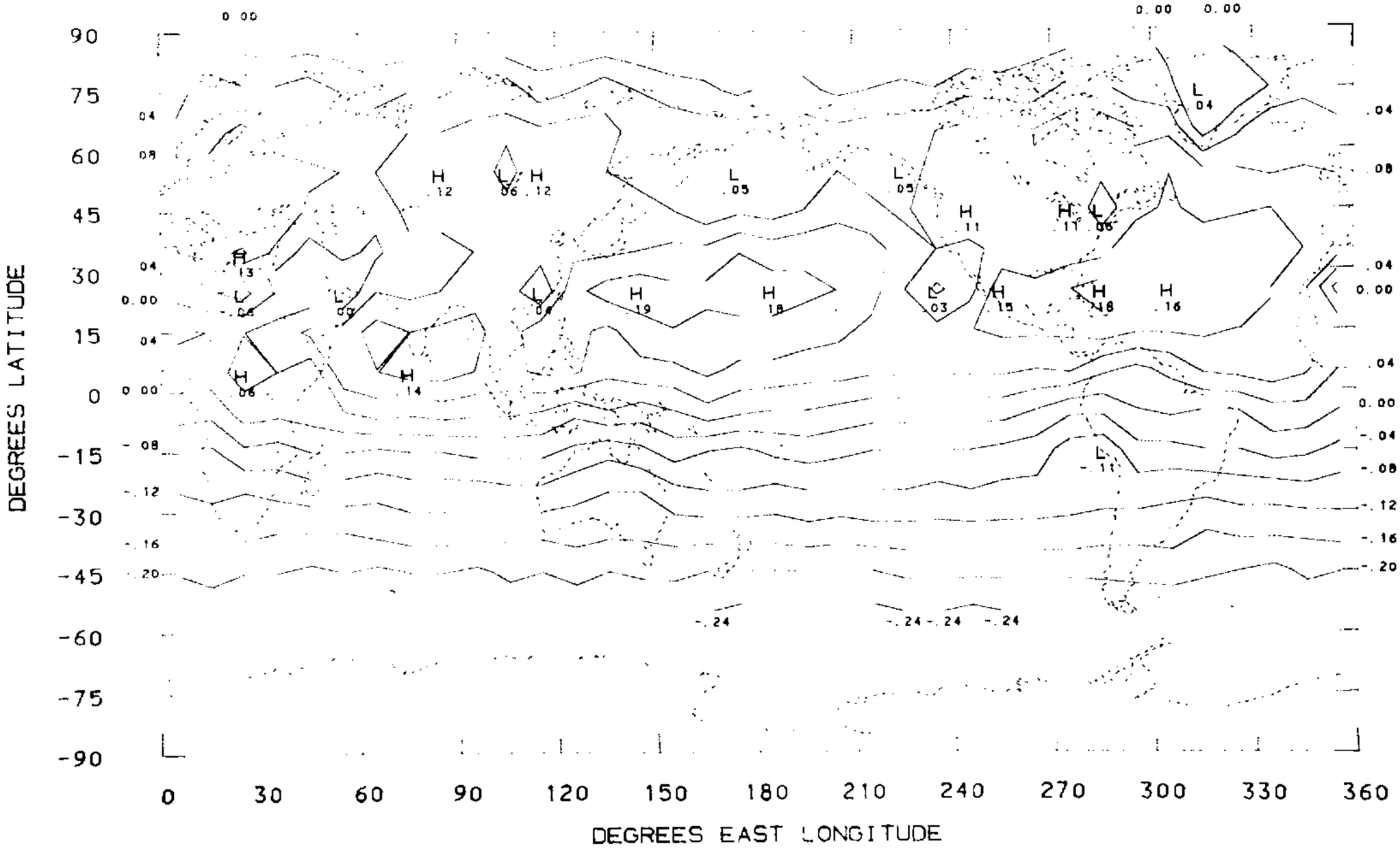
LONGWAVE RADIATION (LY/MIN)

JULY 1969



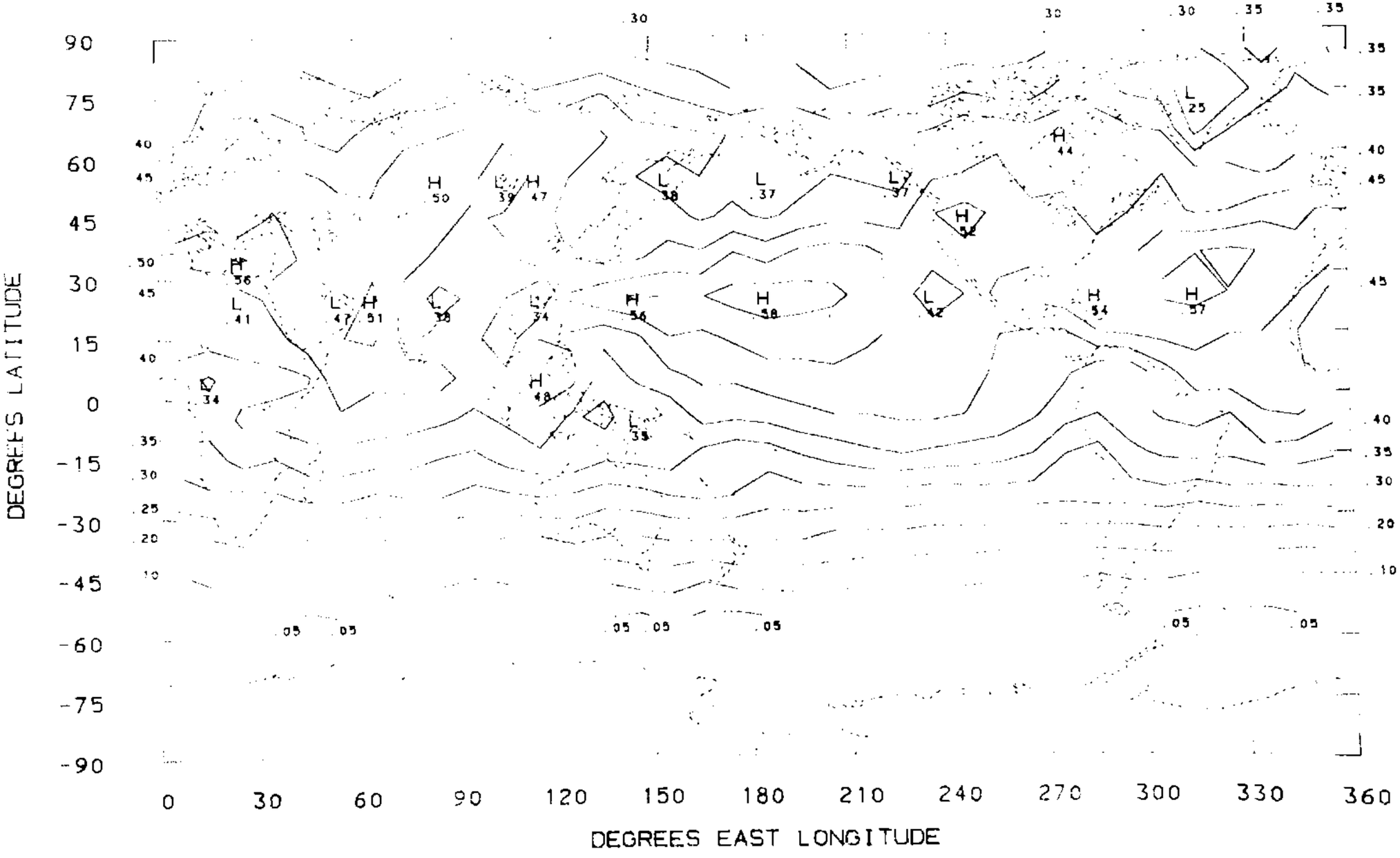
NET RADIATION (LY/MIN)

JULY 1969



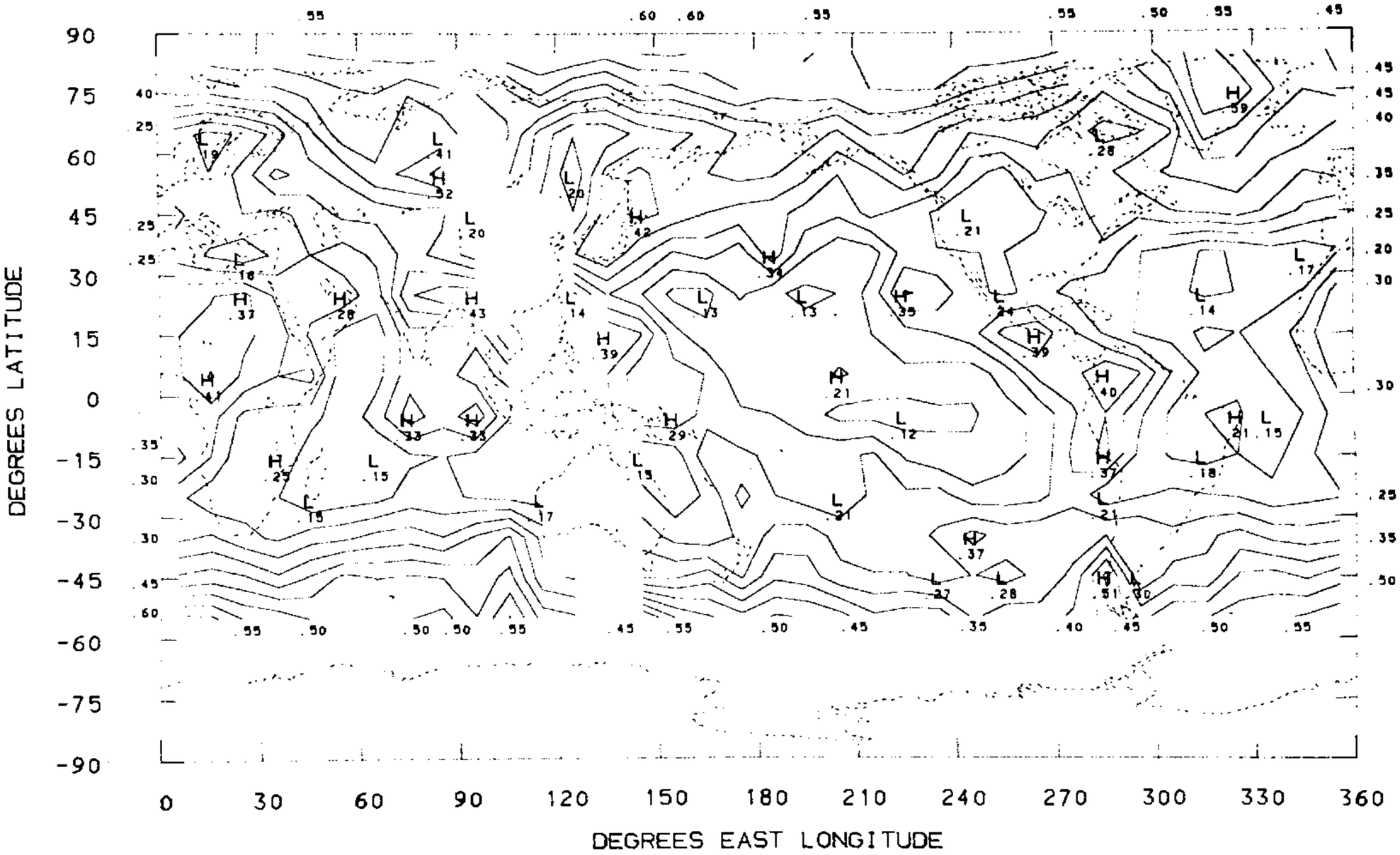
ABSORBED RADIATION (LY/MIN)

JULY 1969



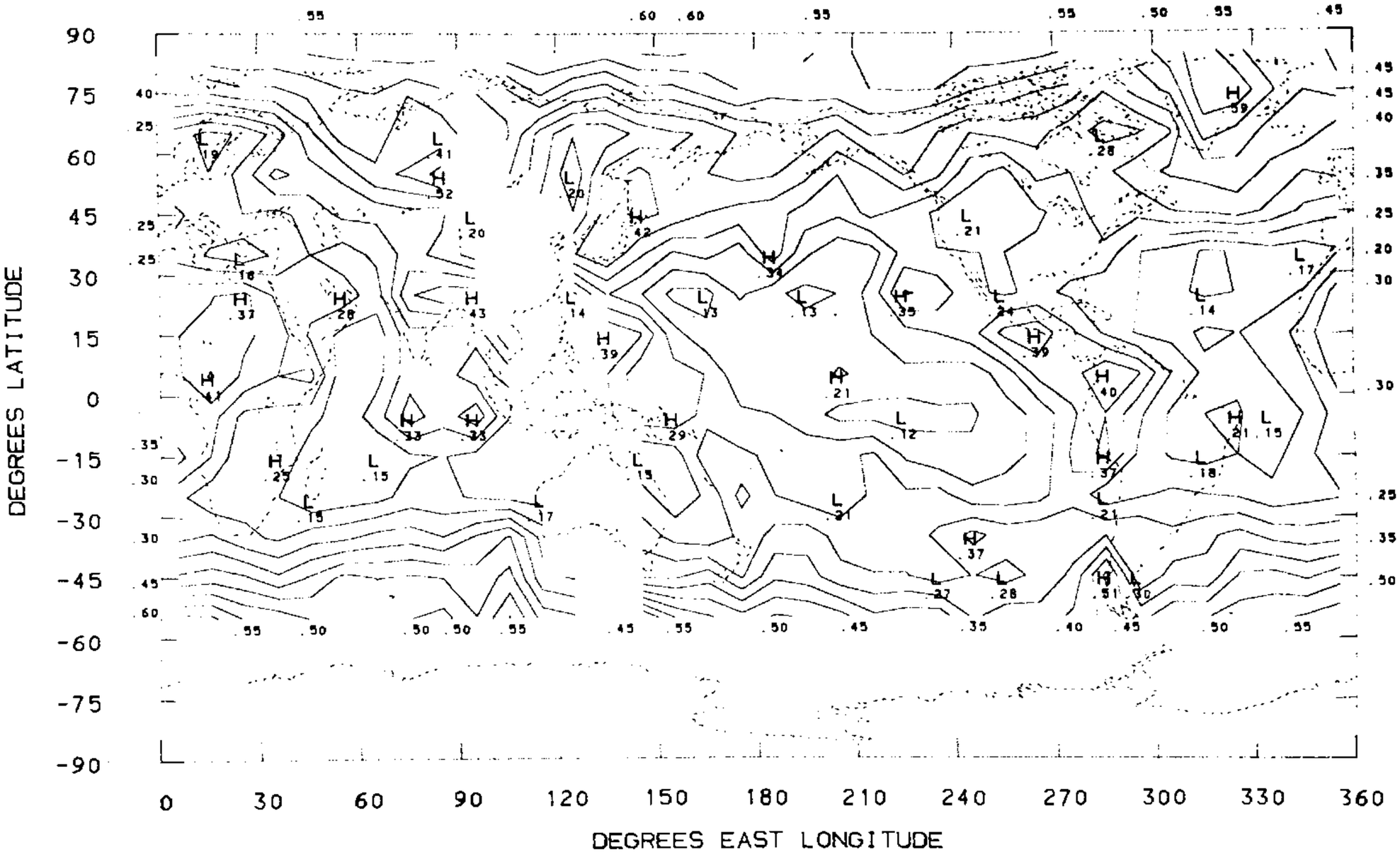
PLANETARY ALBEDO

AUGUST (1-15) 1969



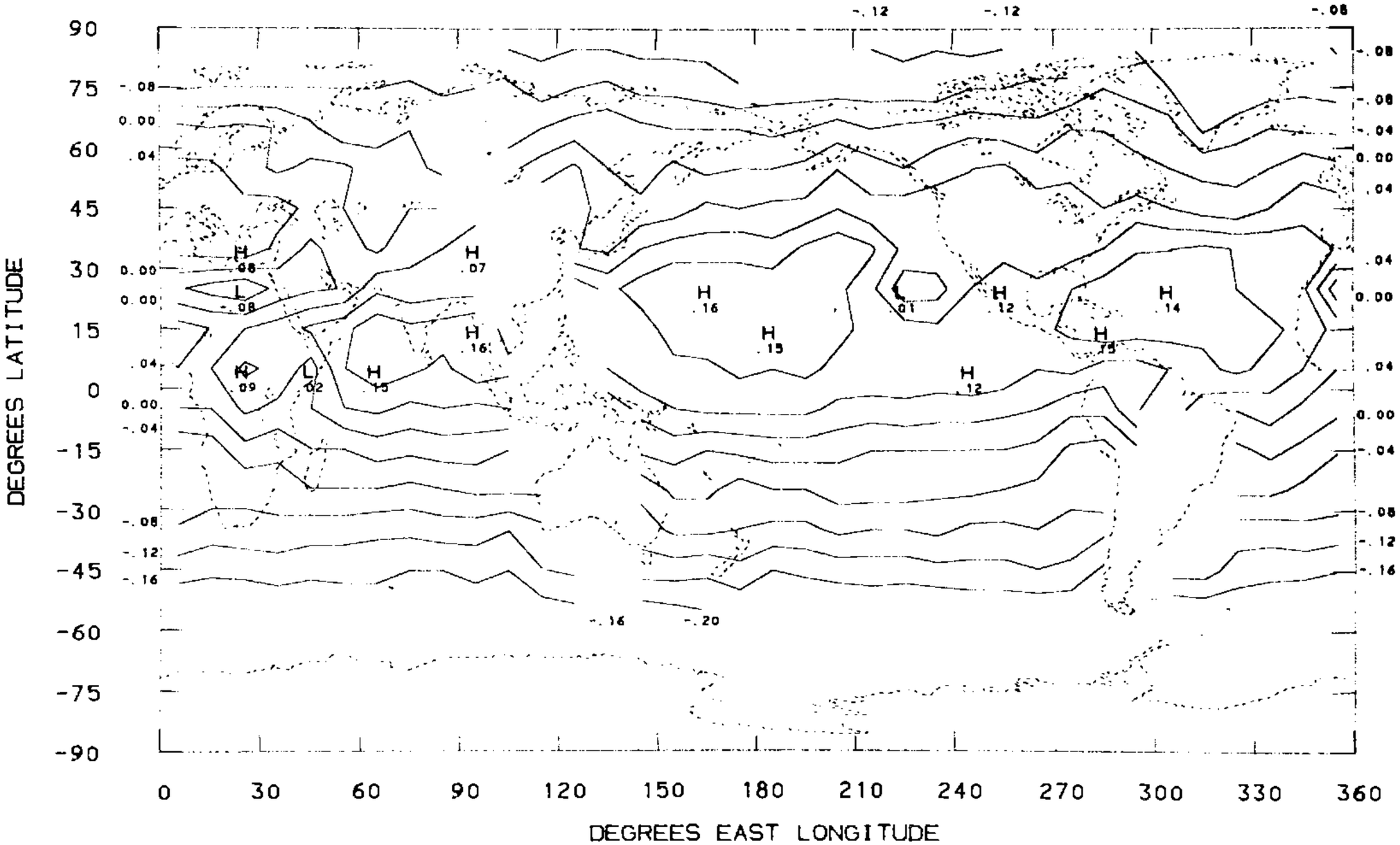
LONGWAVE RADIATION (LY/MIN)

AUGUST (1-15) 1969



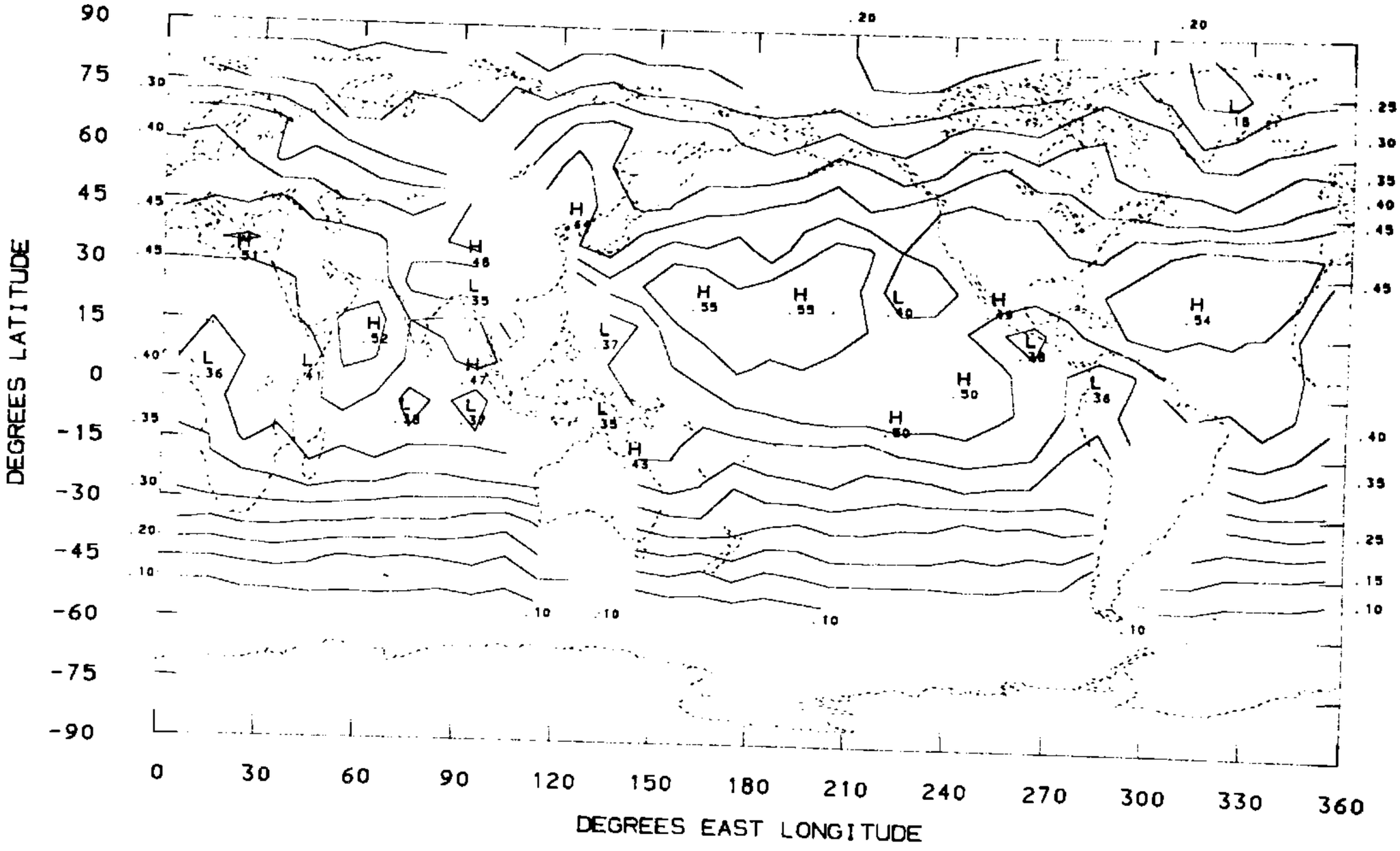
NET RADIATION (LY/MIN)

AUGUST (1-15) 1969



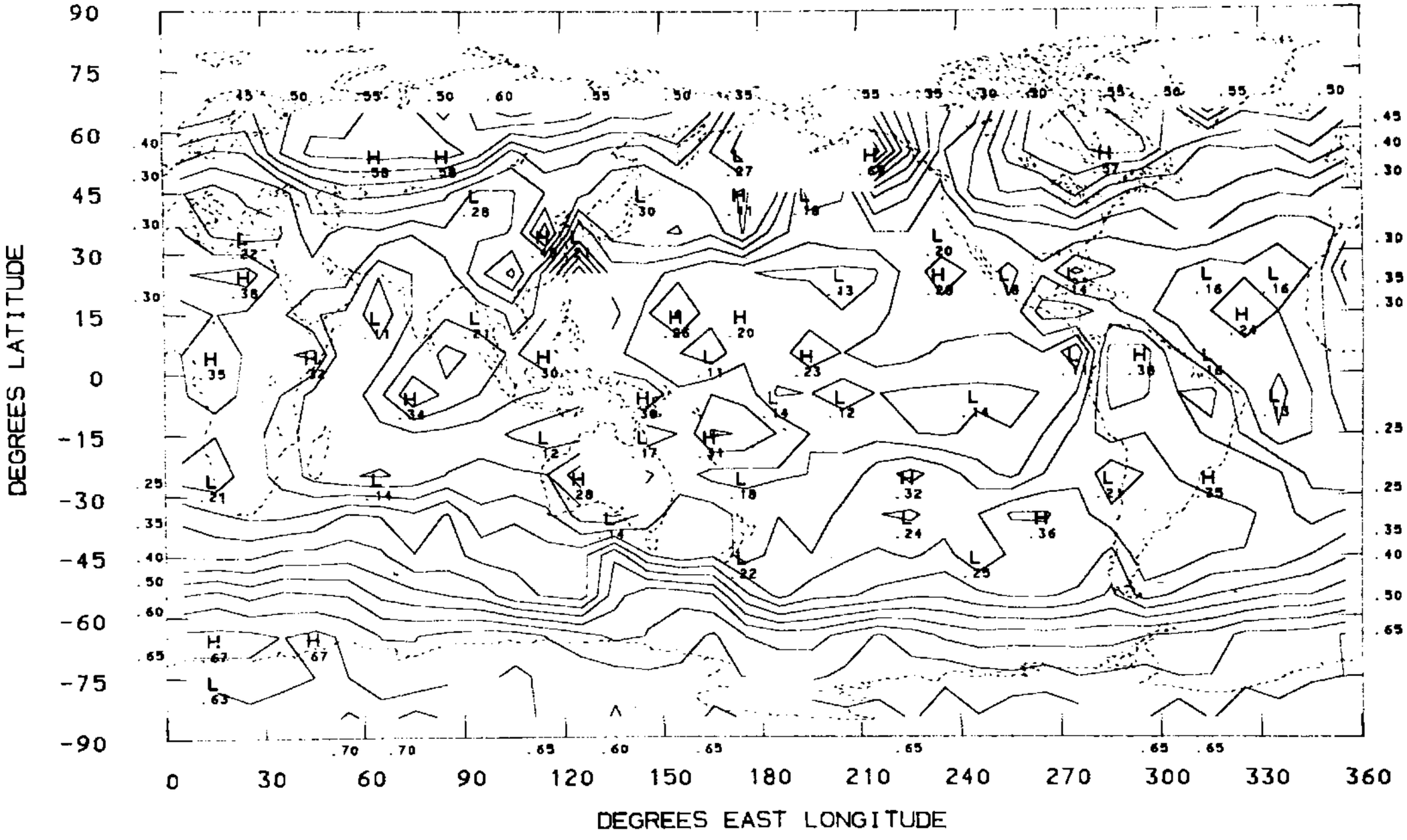
ABSORBED RADIATION (LY/MIN)

AUGUST (1-15) 1969



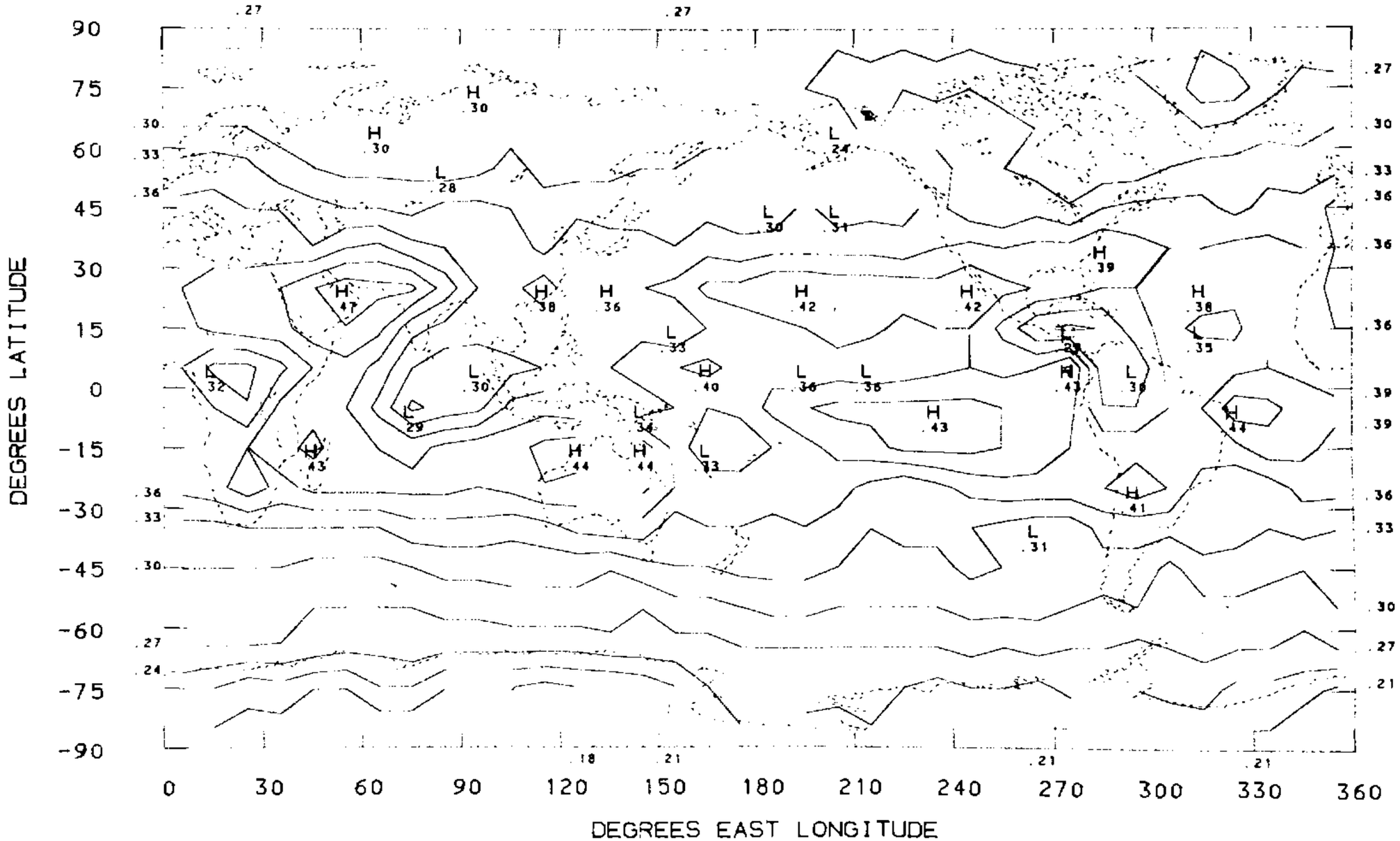
PLANETARY ALBEDO

OCTOBER (3-17) 1969



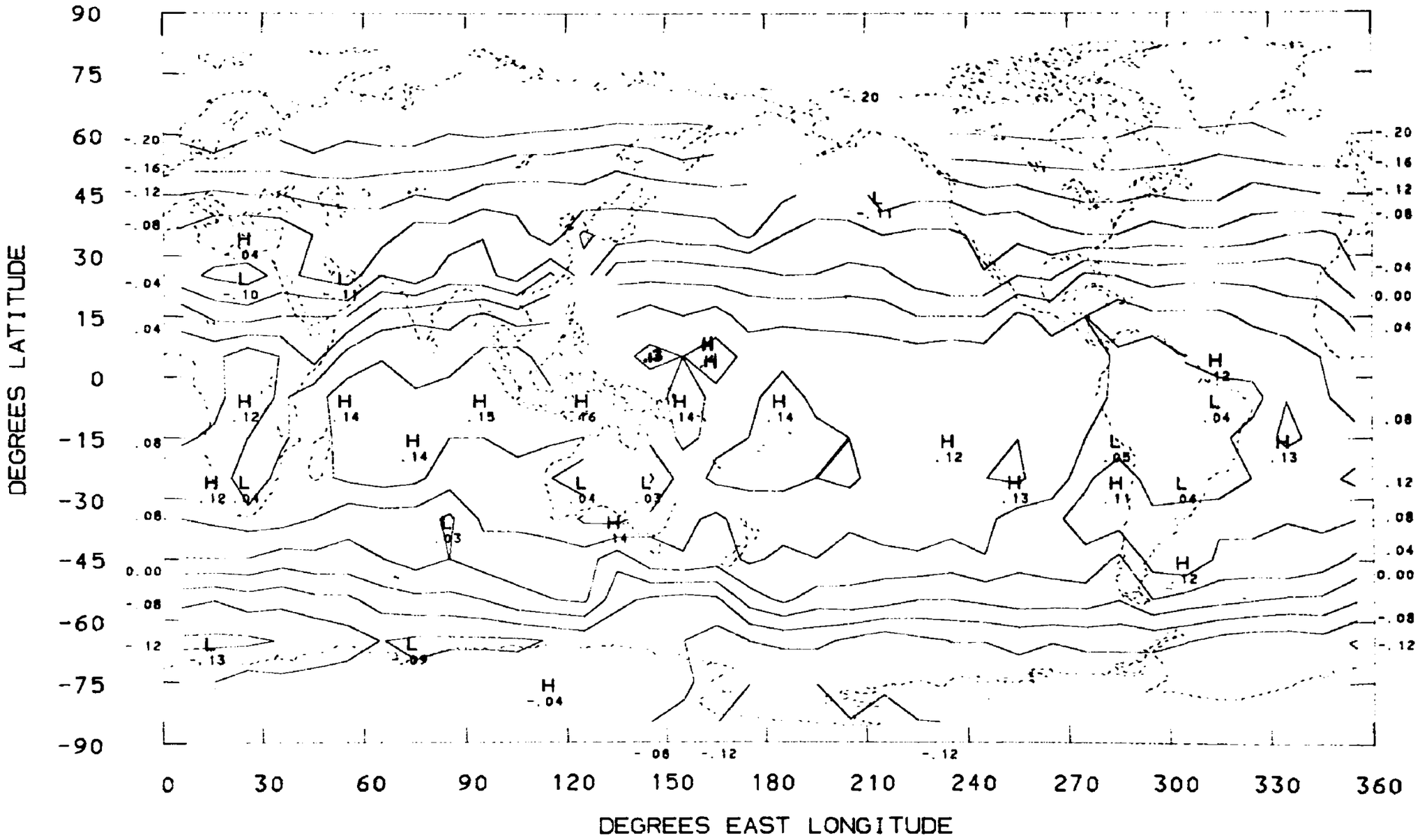
LONGWAVE RADIATION (LY/MIN)

OCTOBER (3- 17) 1969



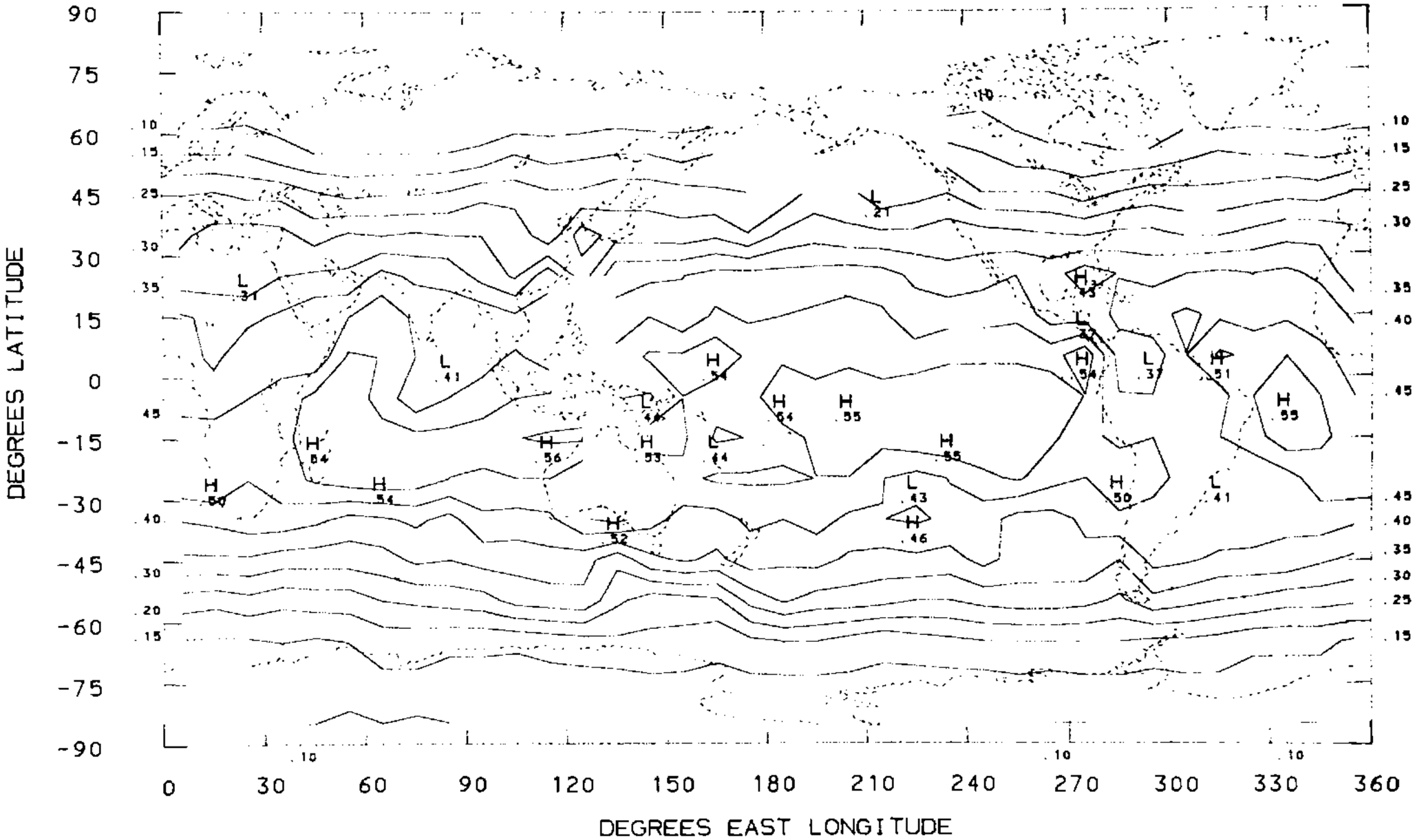
NET RADIATION (LY/MIN)

OCTOBER (3- 17) 1969



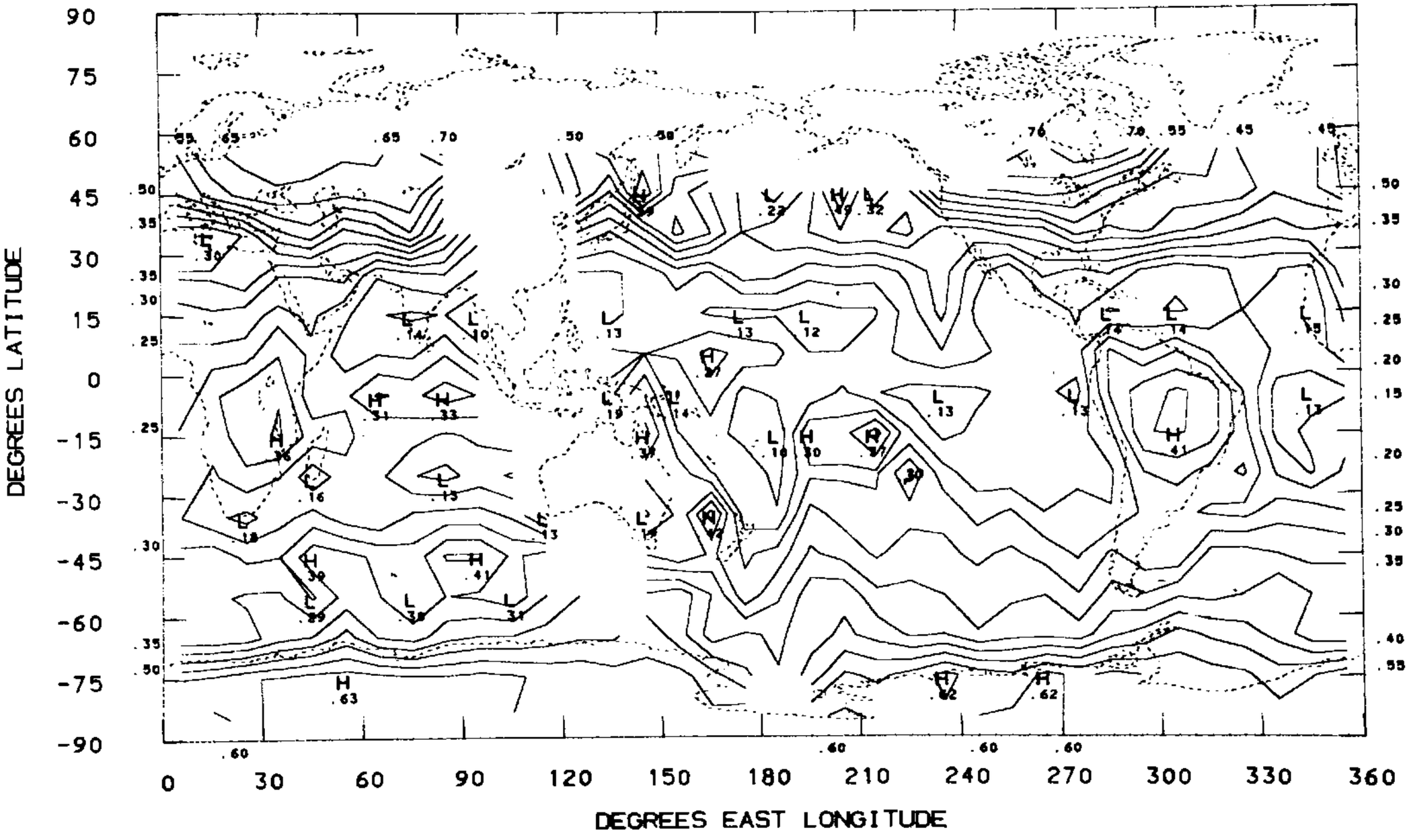
ABSORBED RADIATION (LY/MIN)

OCTOBER (3-17) 1969



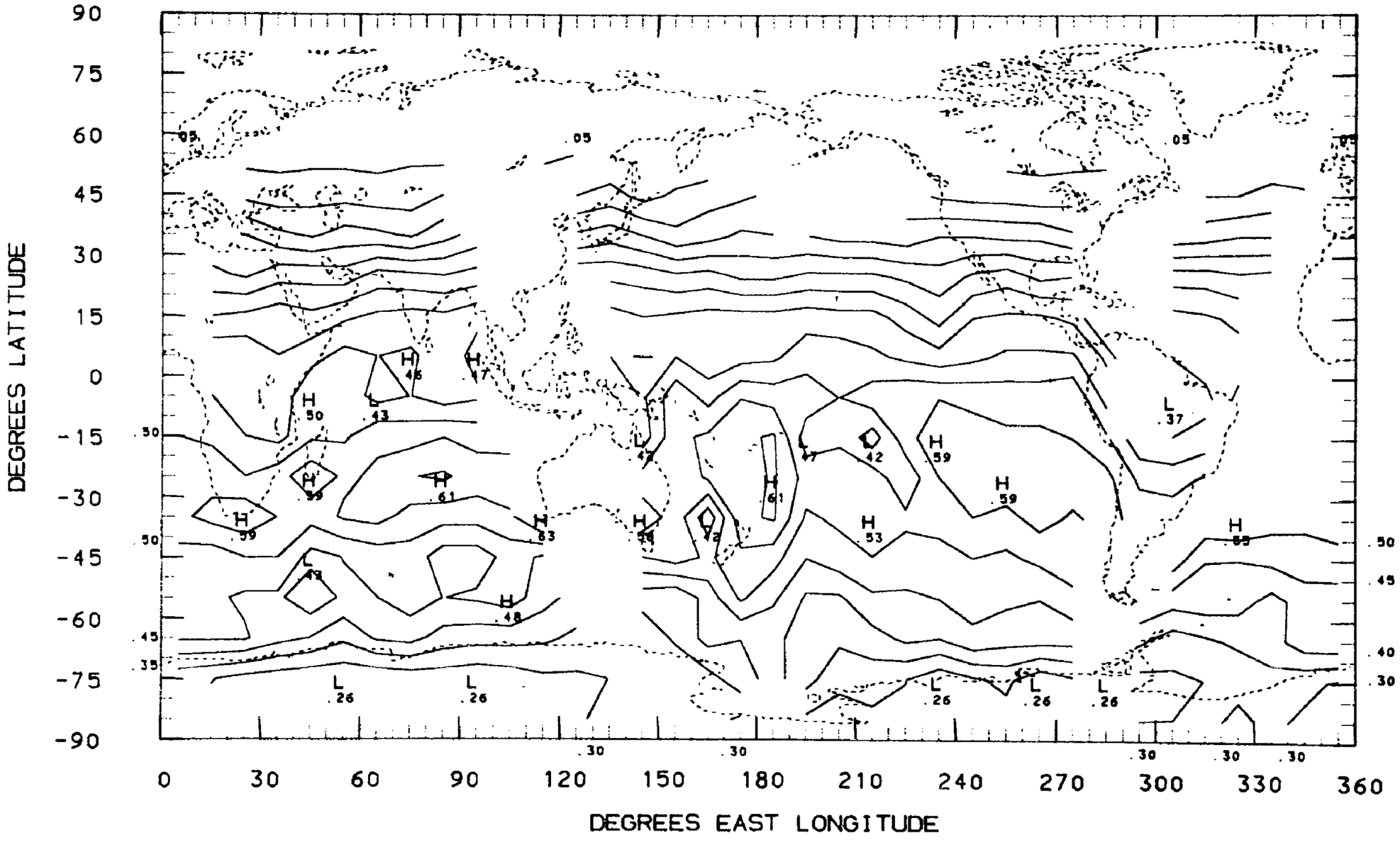
PLANETARY ALBEDO

JAN (21) - FEB (3) 1970



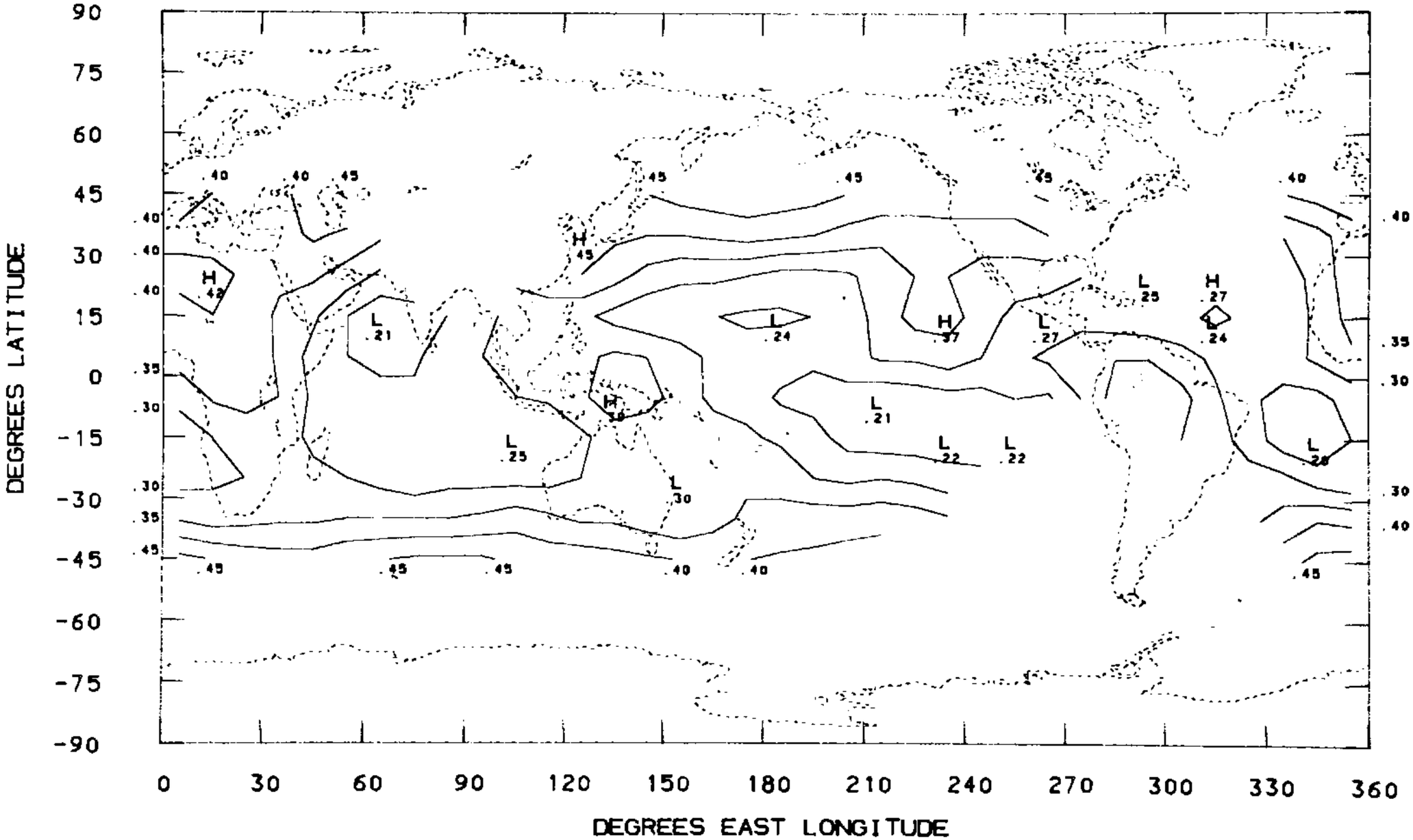
ABSORBED RADIATION (LY/MIN)

JAN (21) - FEB (3) 1970



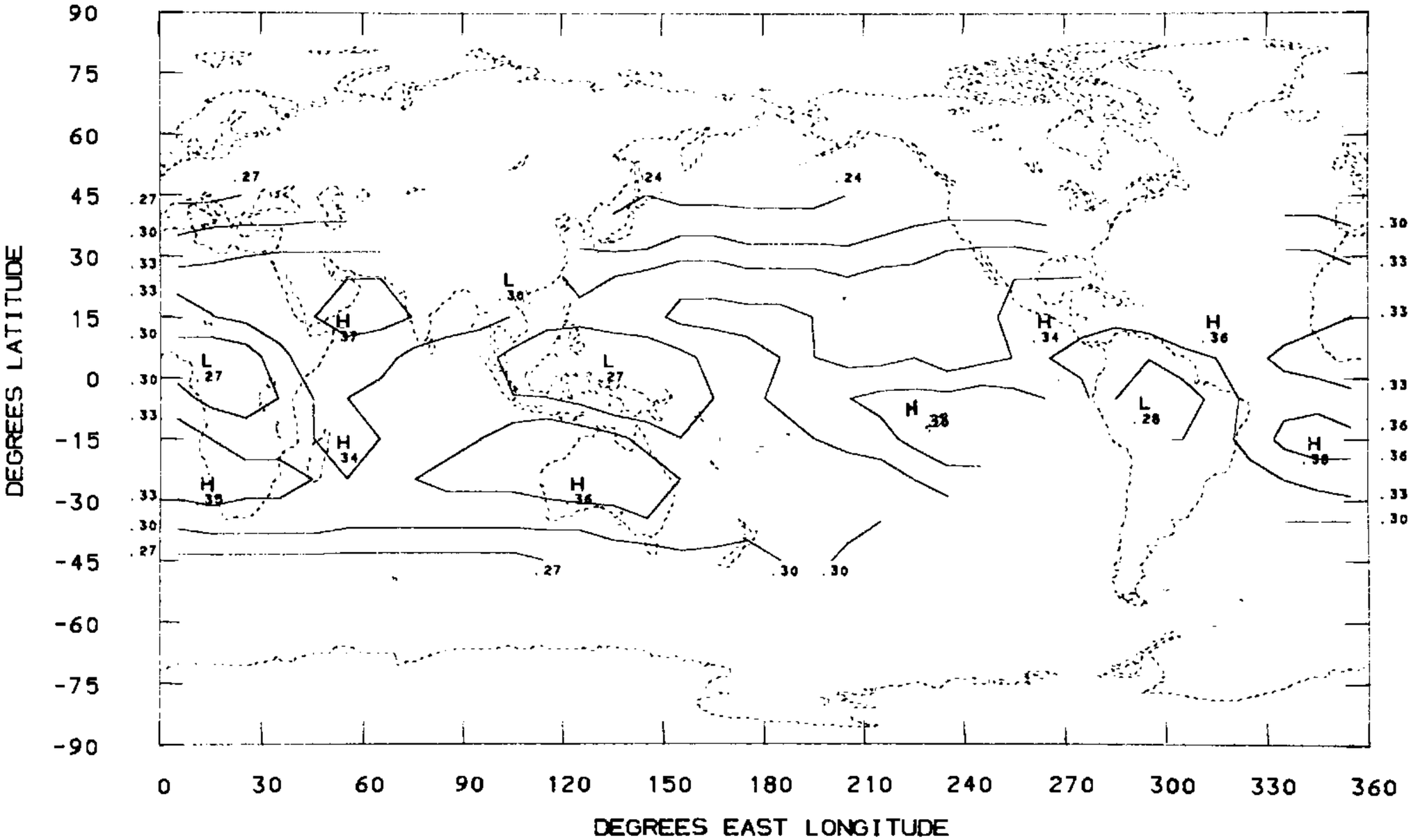
PLANETARY ALBEDO

MAR APR MAY 1962



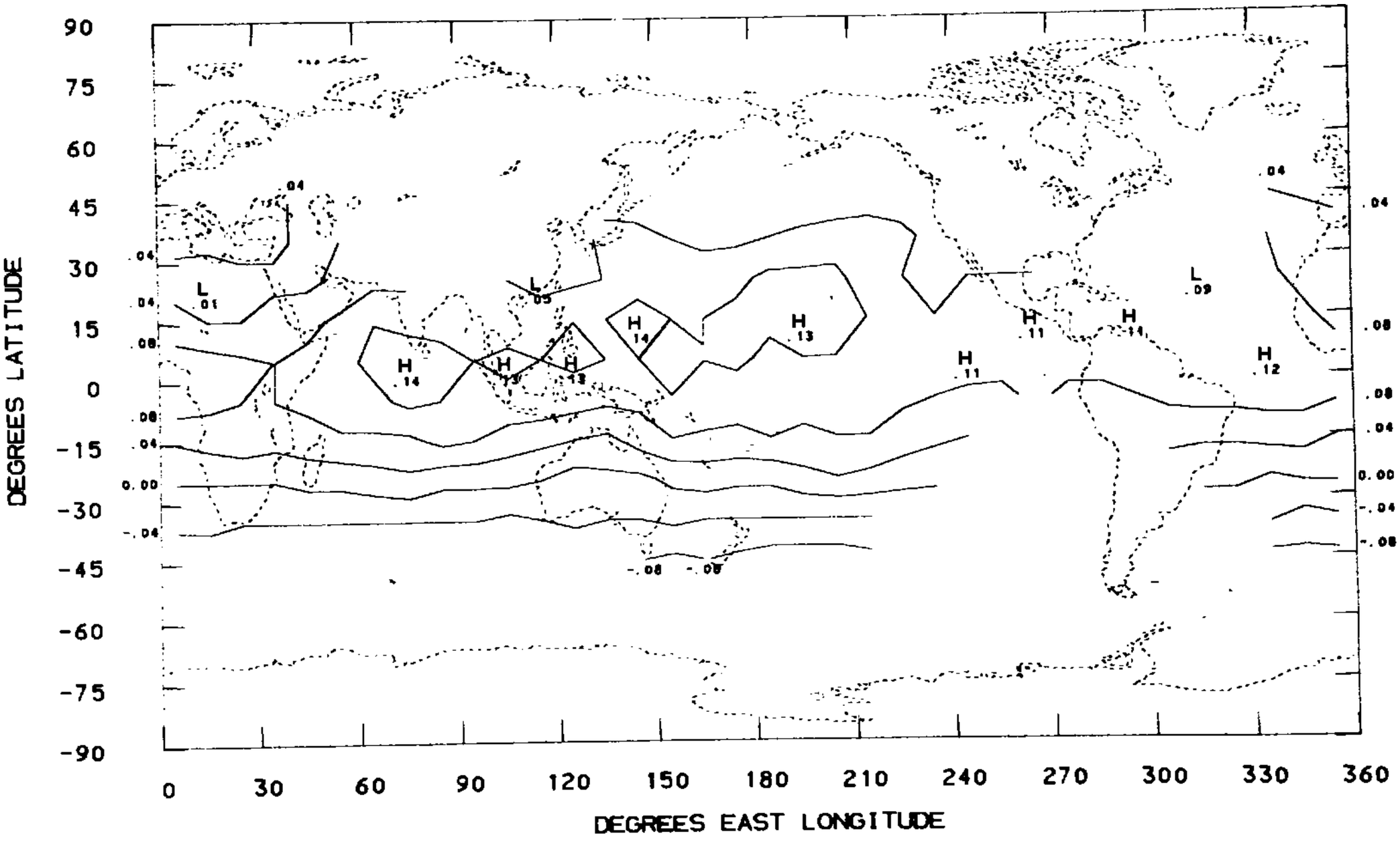
LONGWAVE RADIATION (LY/MIN)

MAR APR MAY 1962



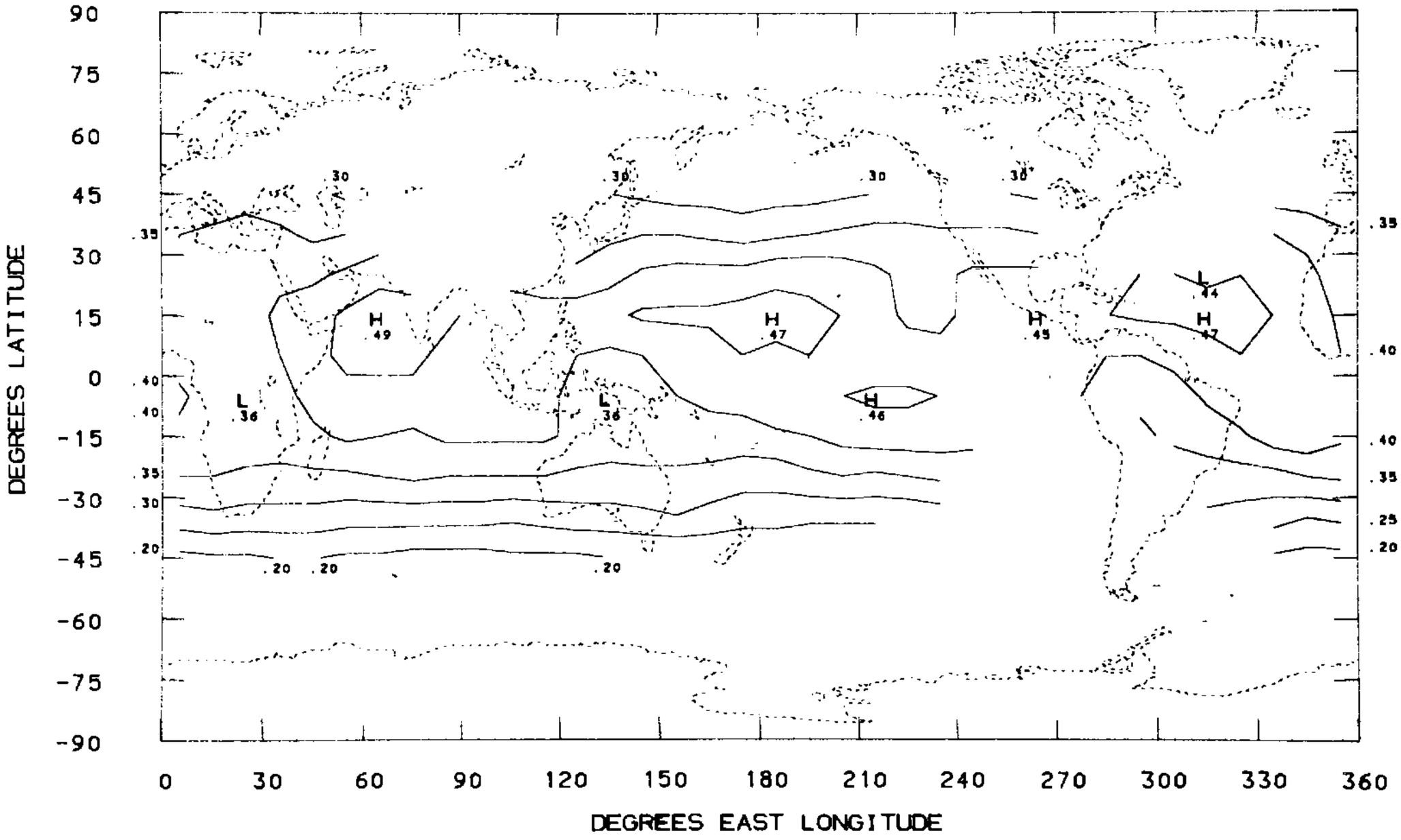
NET RADIATION (LY/MIN)

MAR APR MAY 1962



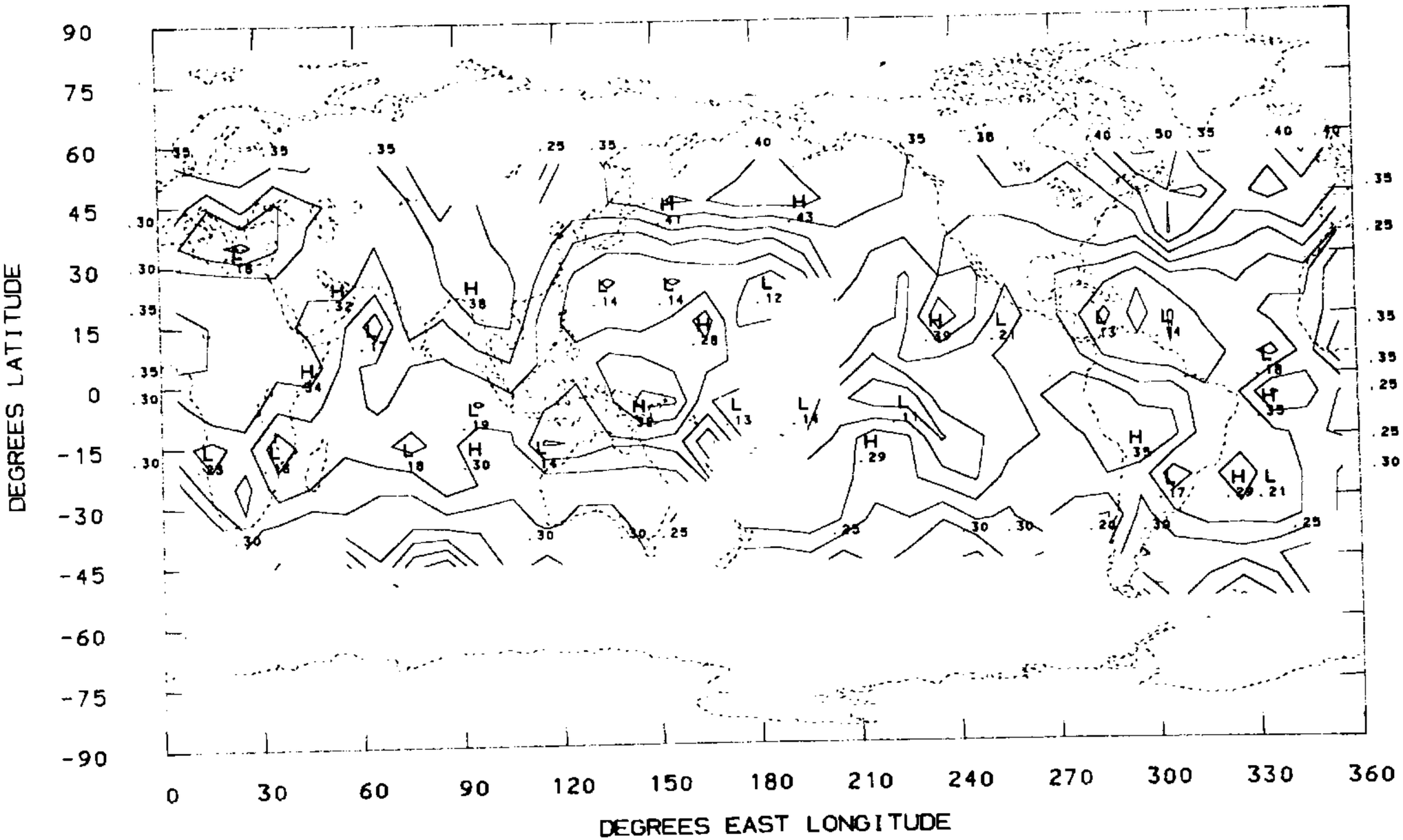
ABSORBED RADIATION (LY/MIN)

MAR APR MAY 1962



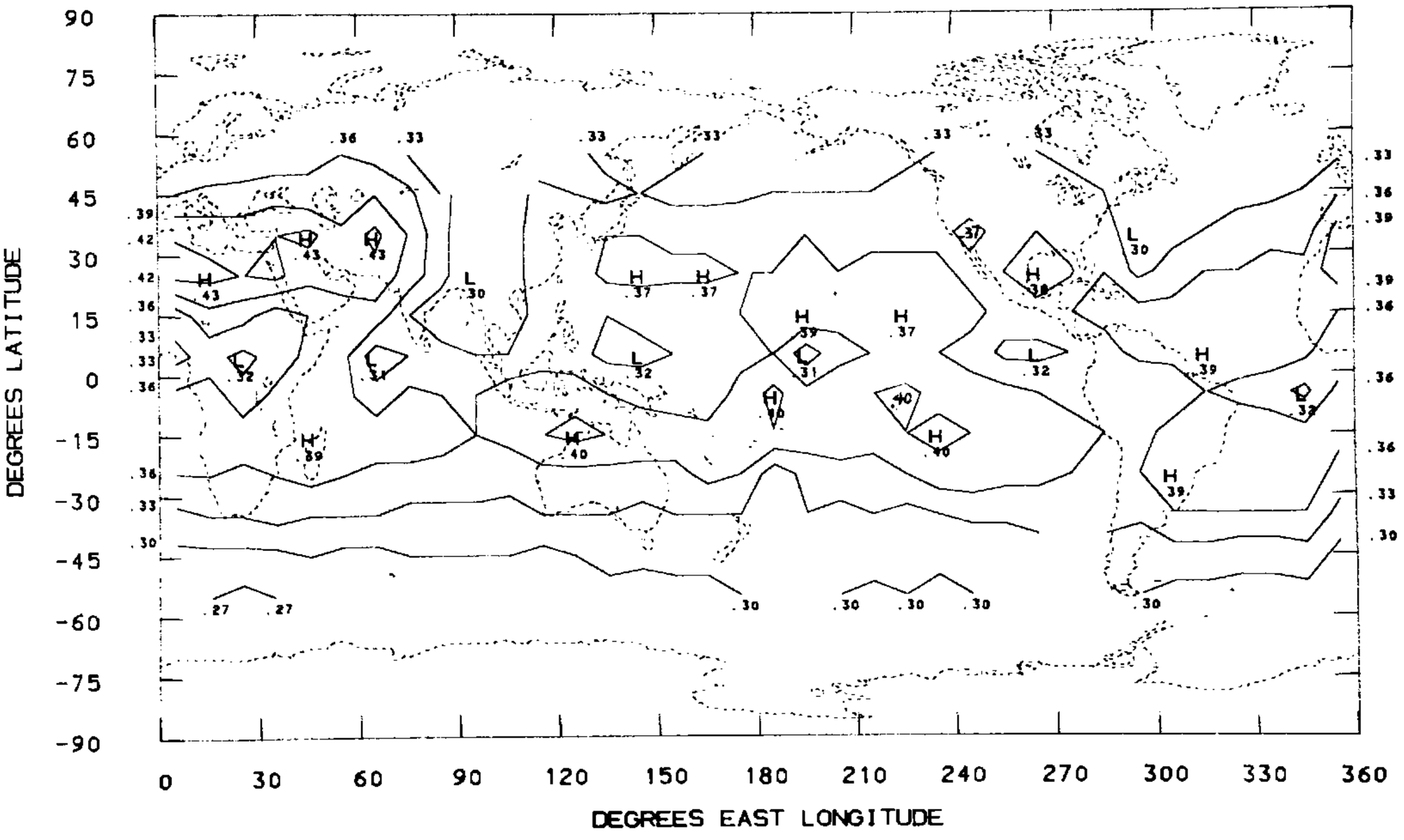
PLANETARY ALBEDO

JUN JUL AUG 1963



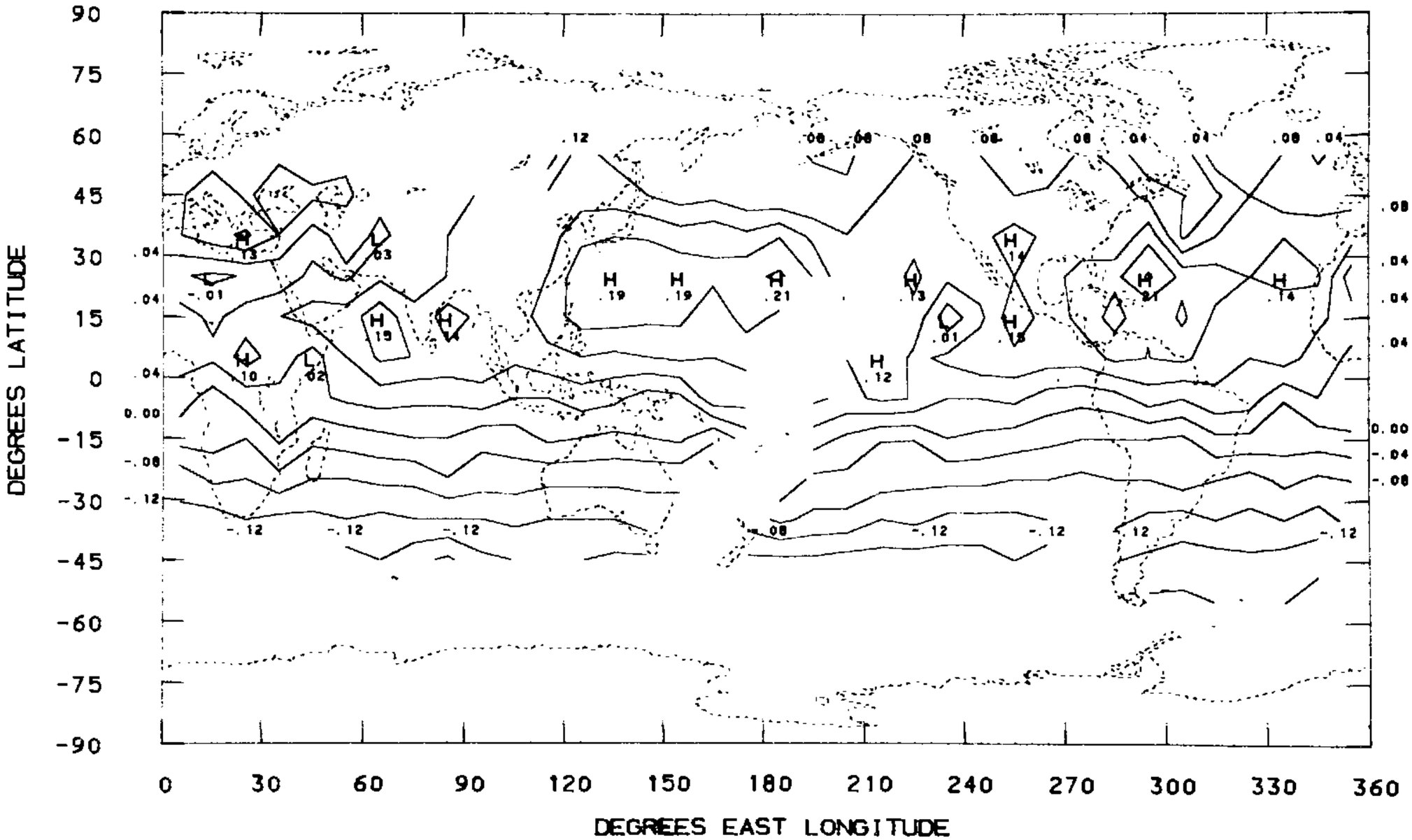
LONGWAVE RADIATION (LY/MIN)

JUN JUL AUG 1963



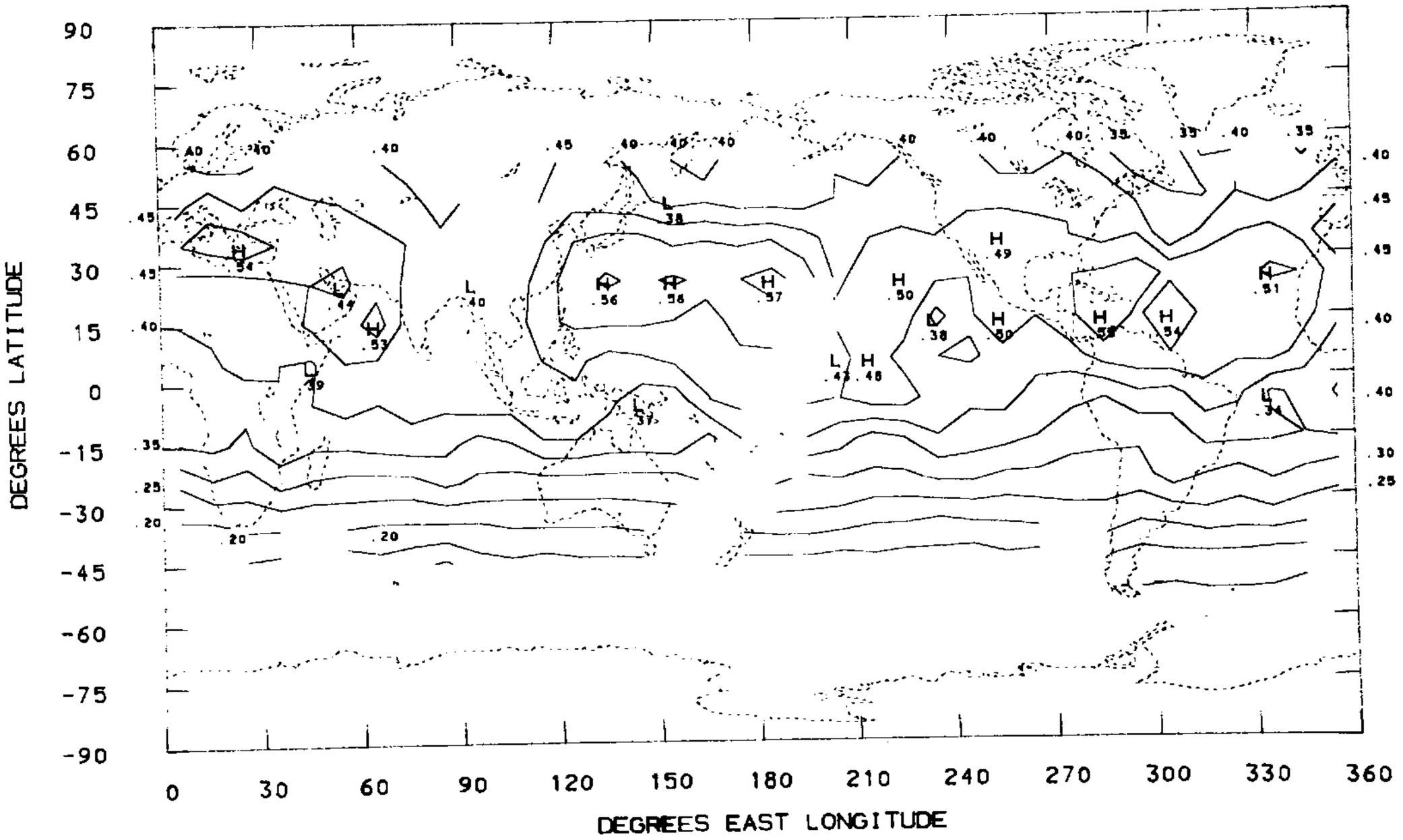
NET RADIATION (LY/MIN)

JUN JUL AUG 1963



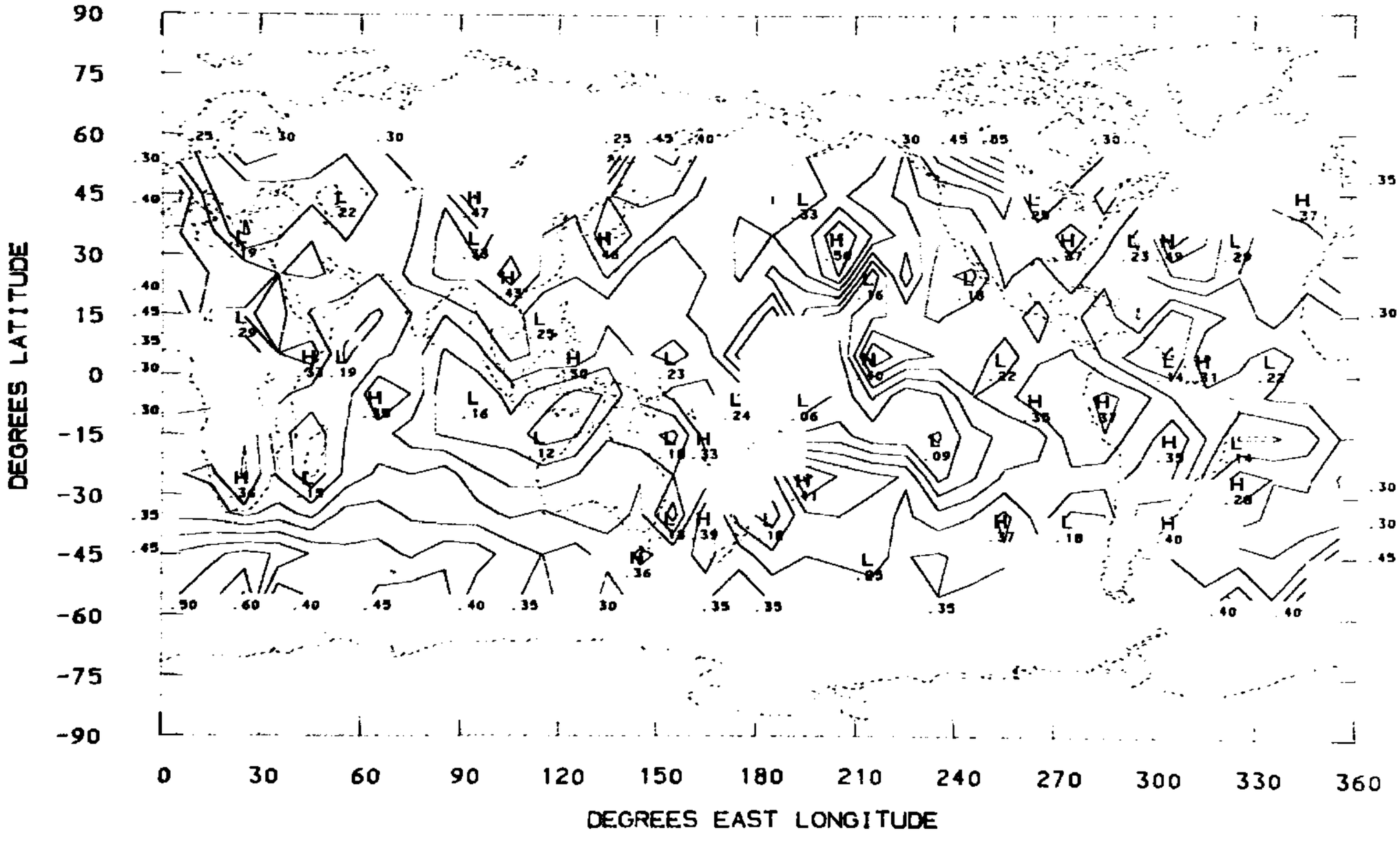
ABSORBED RADIATION (LY/MIN)

JUN JUL AUG 1963



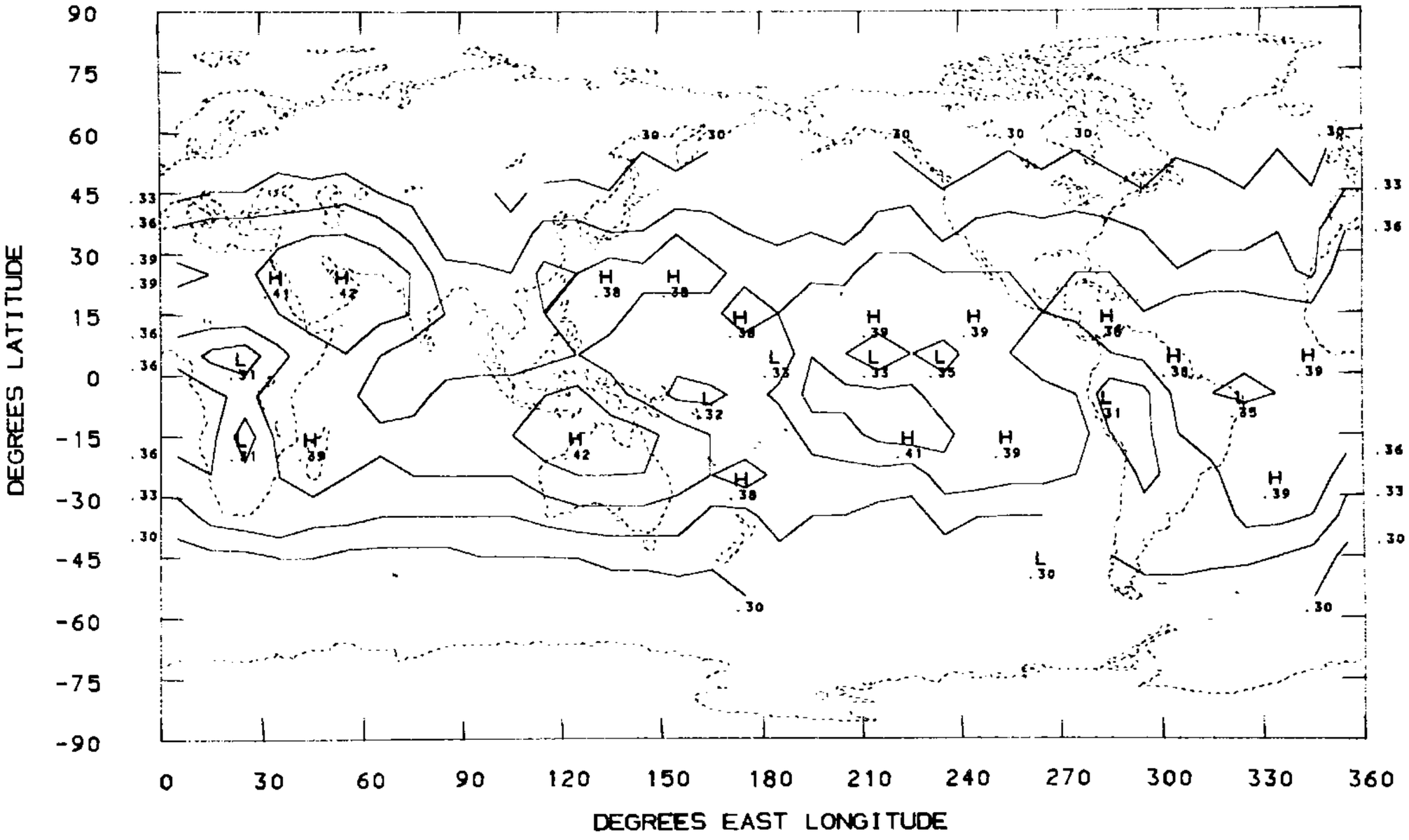
PLANETARY ALBEDO

SEP OCT NOV 1963



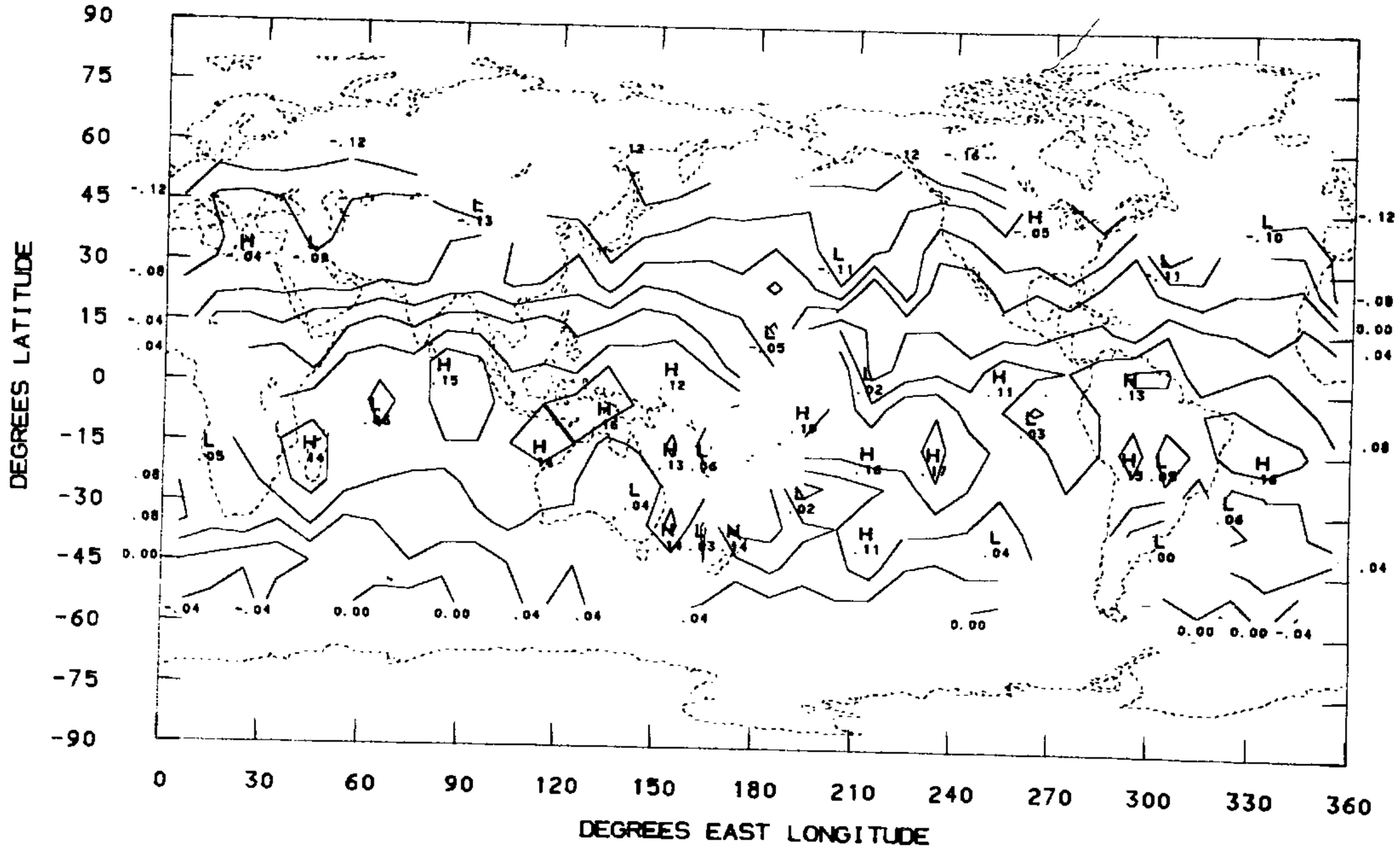
LONGWAVE RADIATION (LY/MIN)

SEP OCT NOV 1963



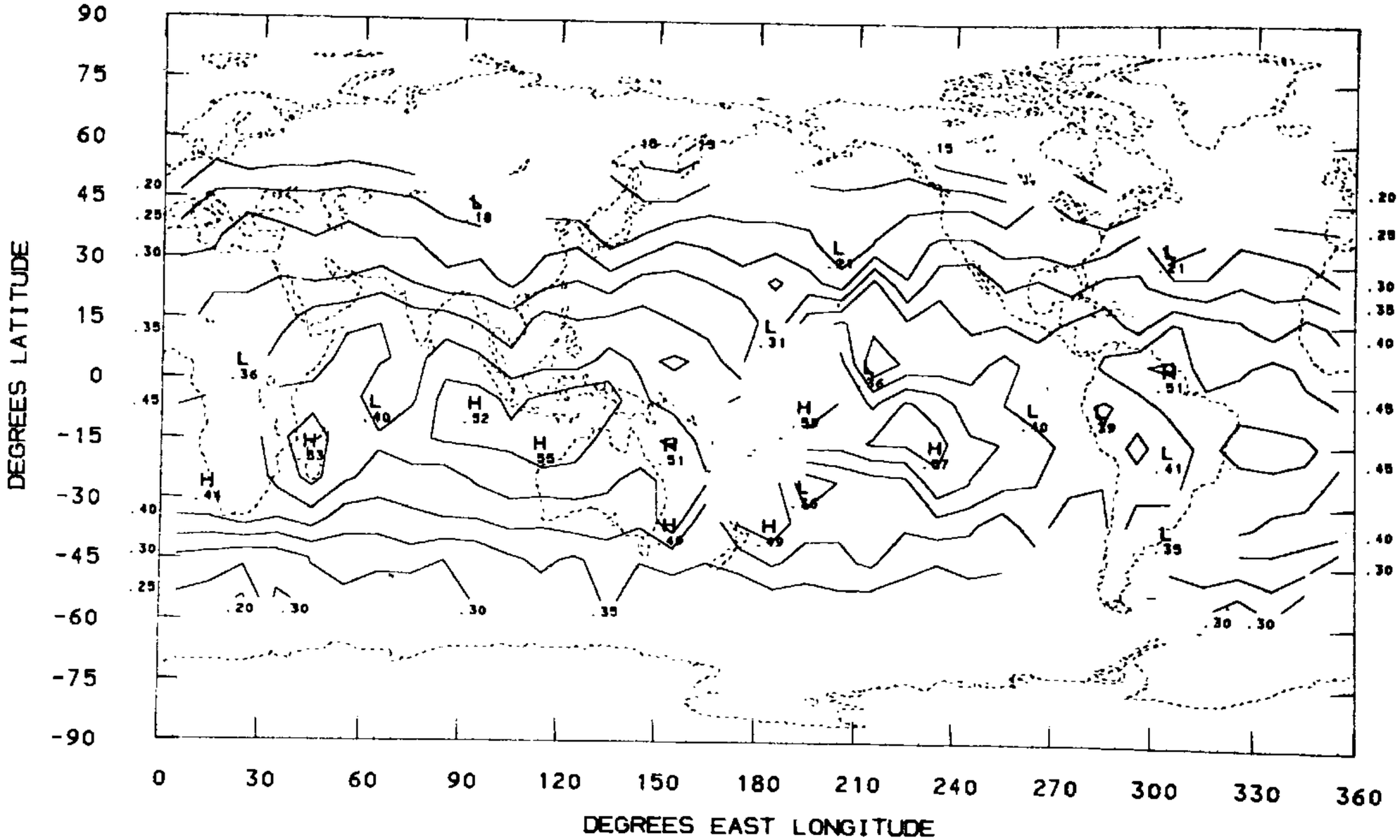
NET RADIATION (LY/MIN)

SEP OCT NOV 1963



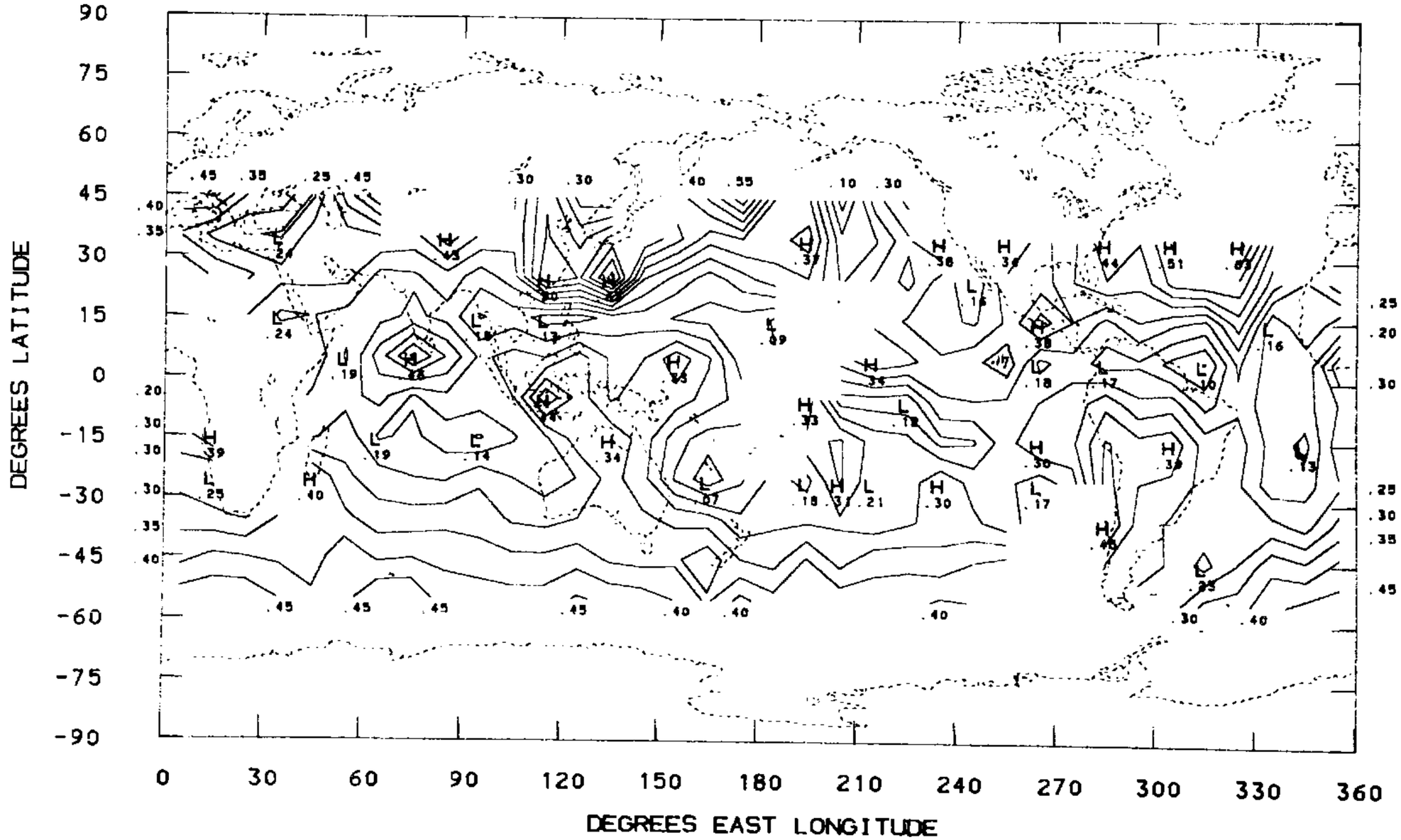
ABSORBED RADIATION (LY/MIN)

SEP OCT NOV 1963



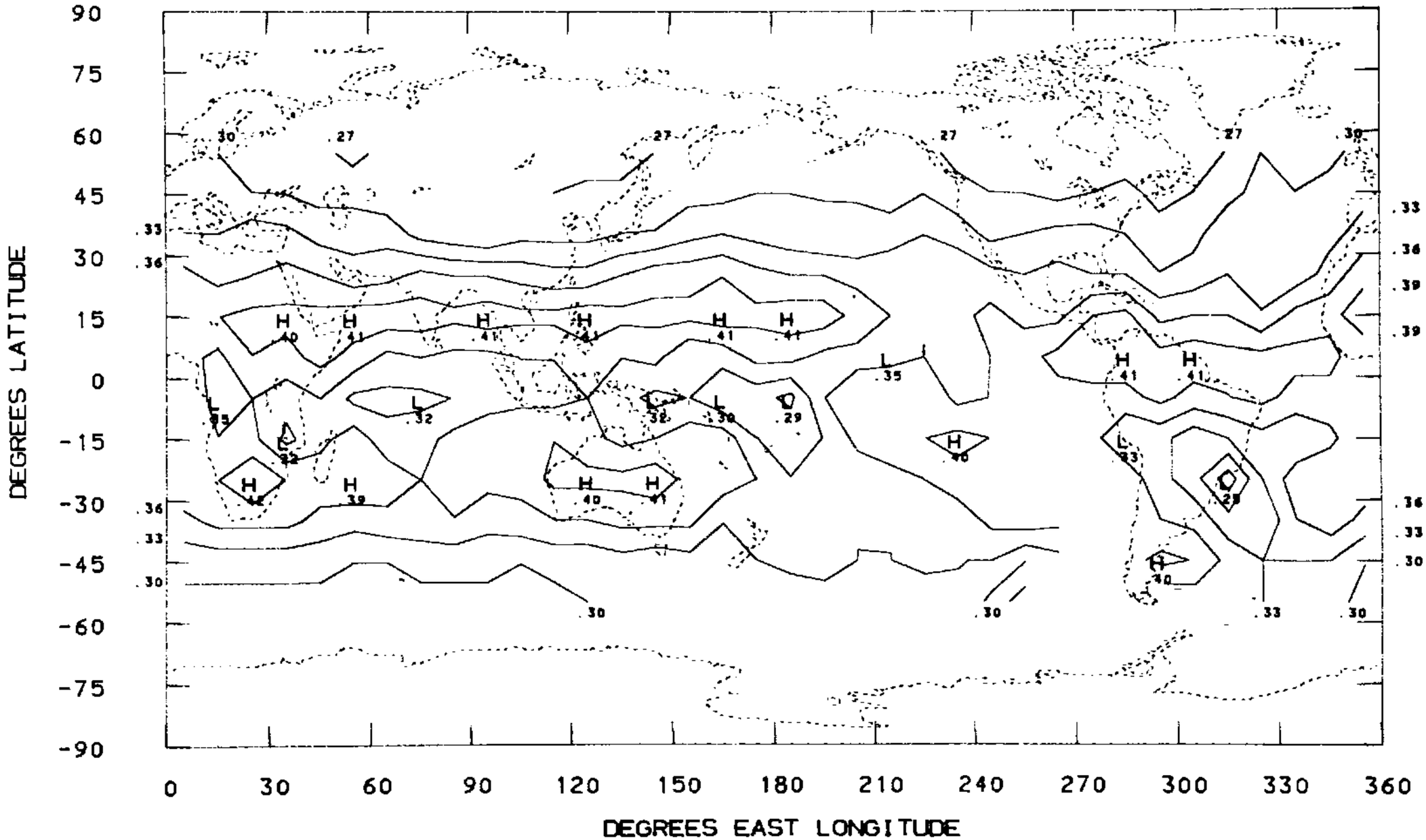
PLANETARY ALBEDO

DEC JAN FEB 1963/1964



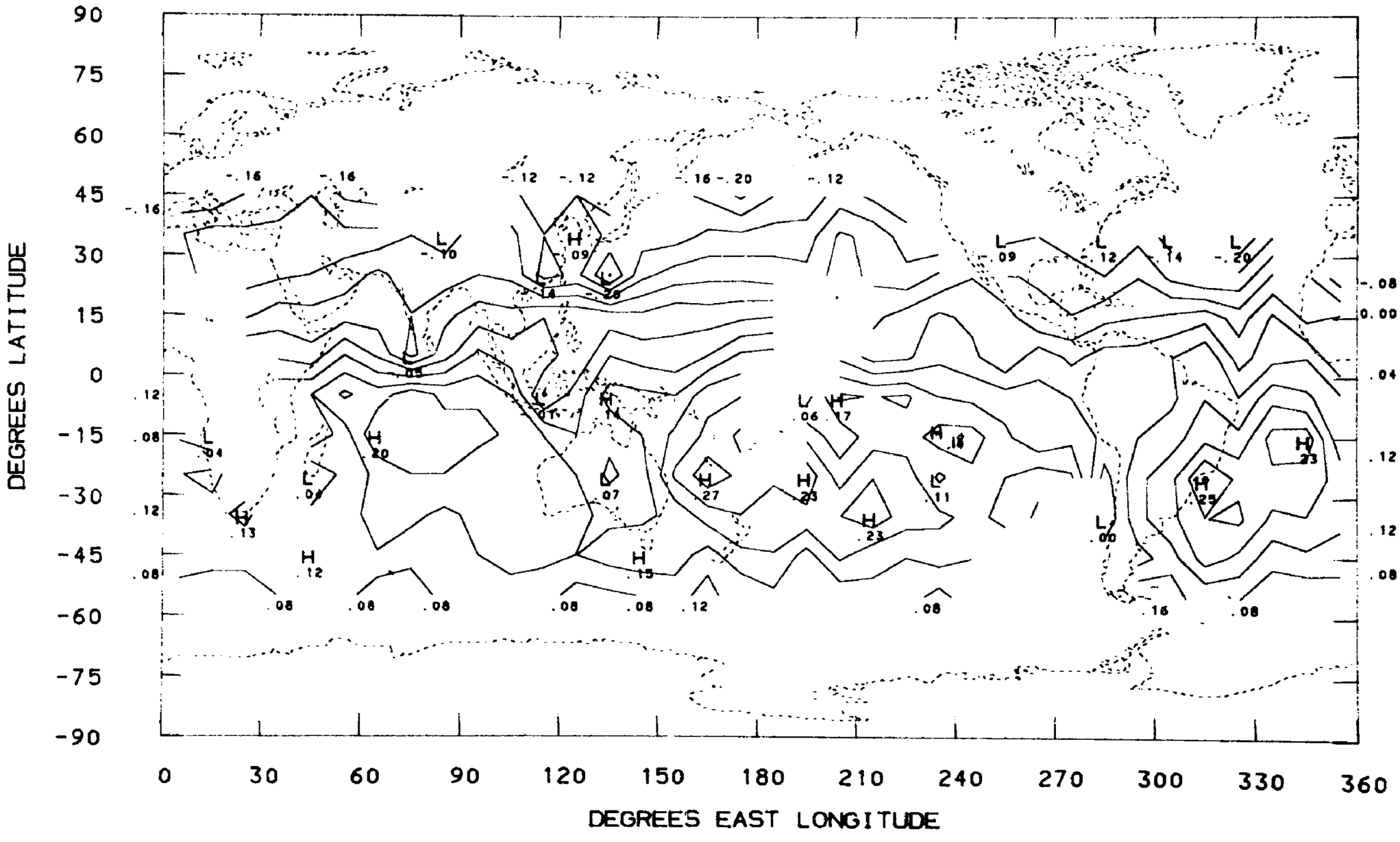
LONGWAVE RADIATION (LY/MIN)

DEC JAN FEB 1963/1964



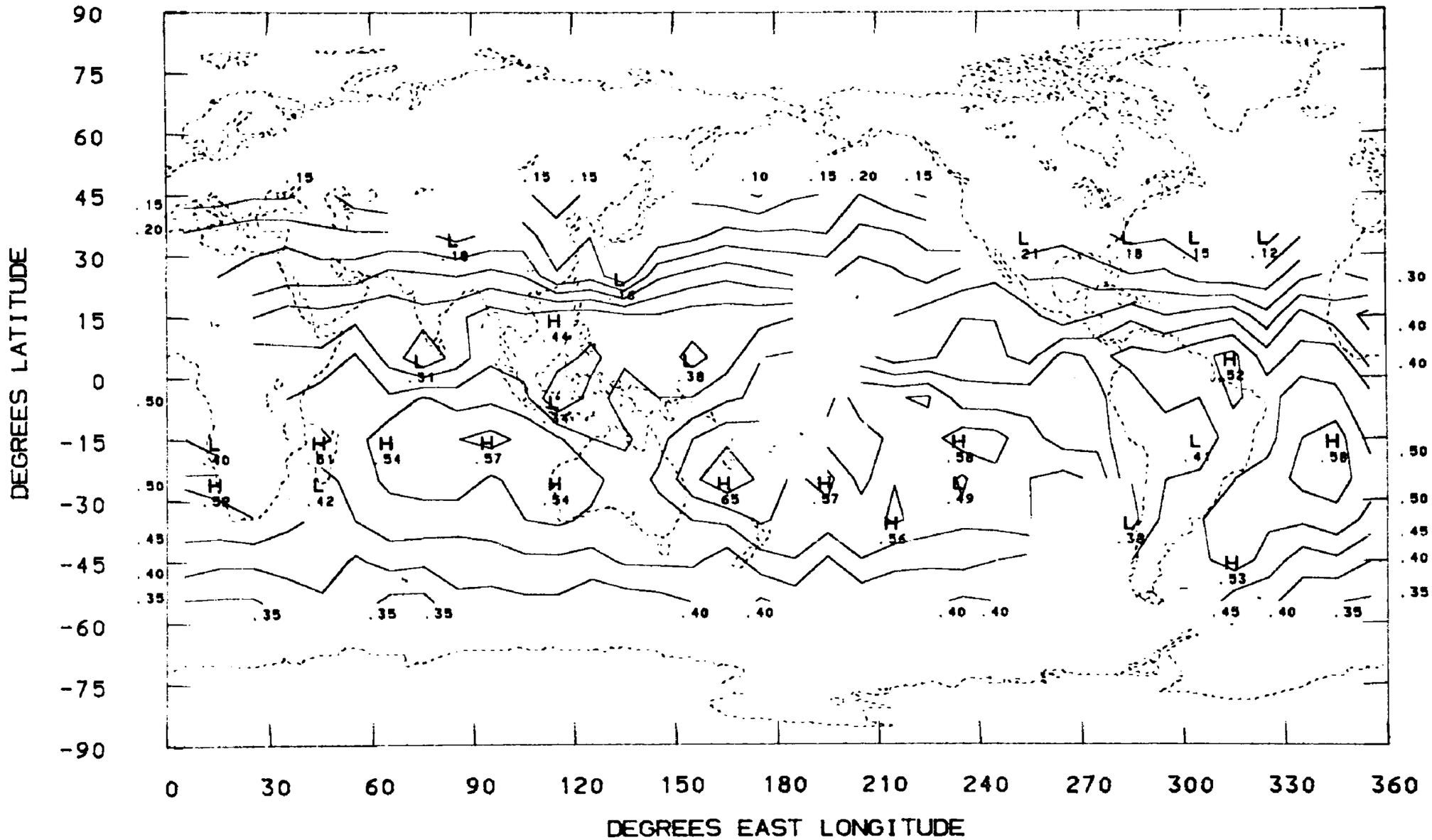
NET RADIATION (LY/MIN)

DEC JAN FEB 1963/1964



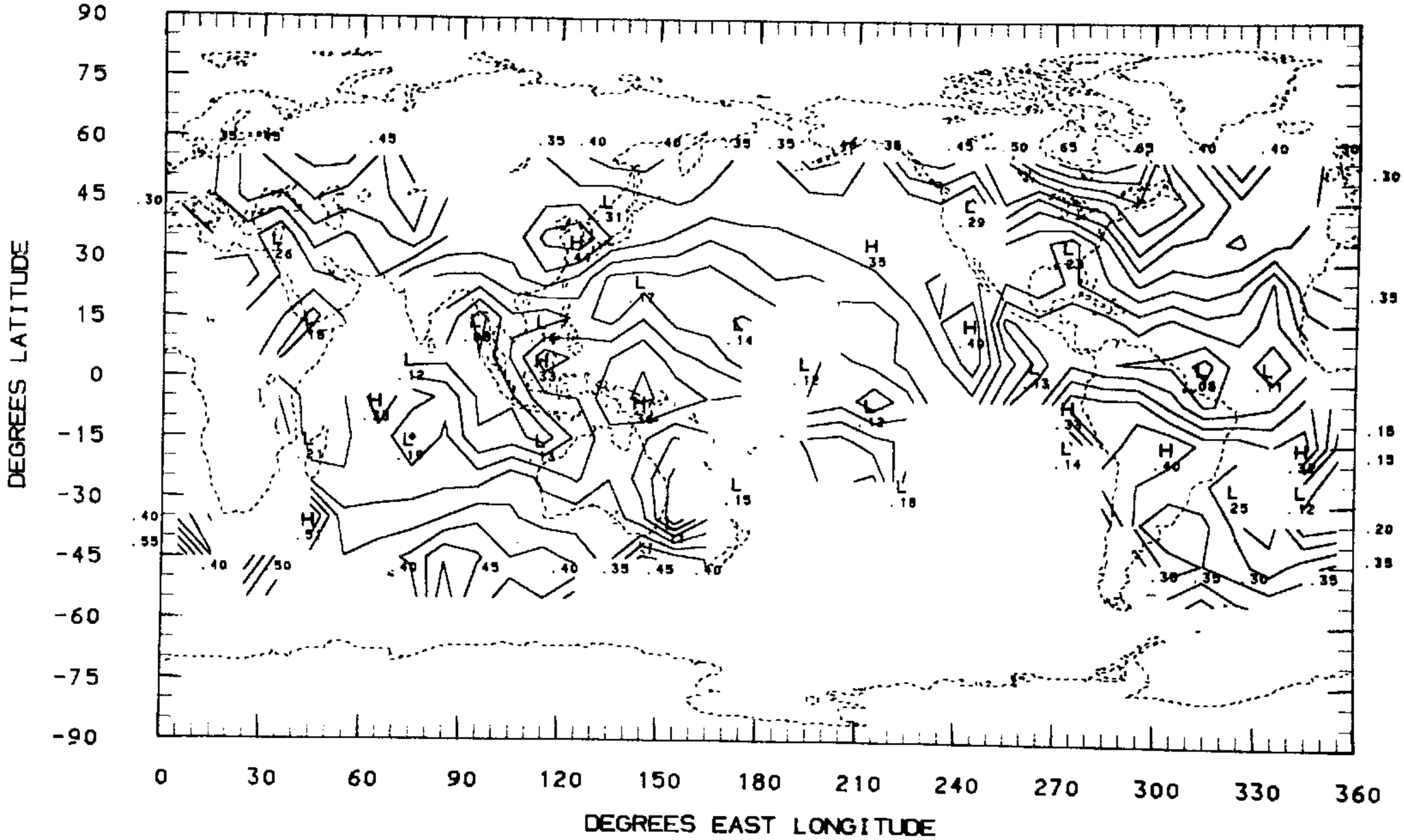
ABSORBED RADIATION (LY/MIN)

DEC JAN FEB 1963/1964



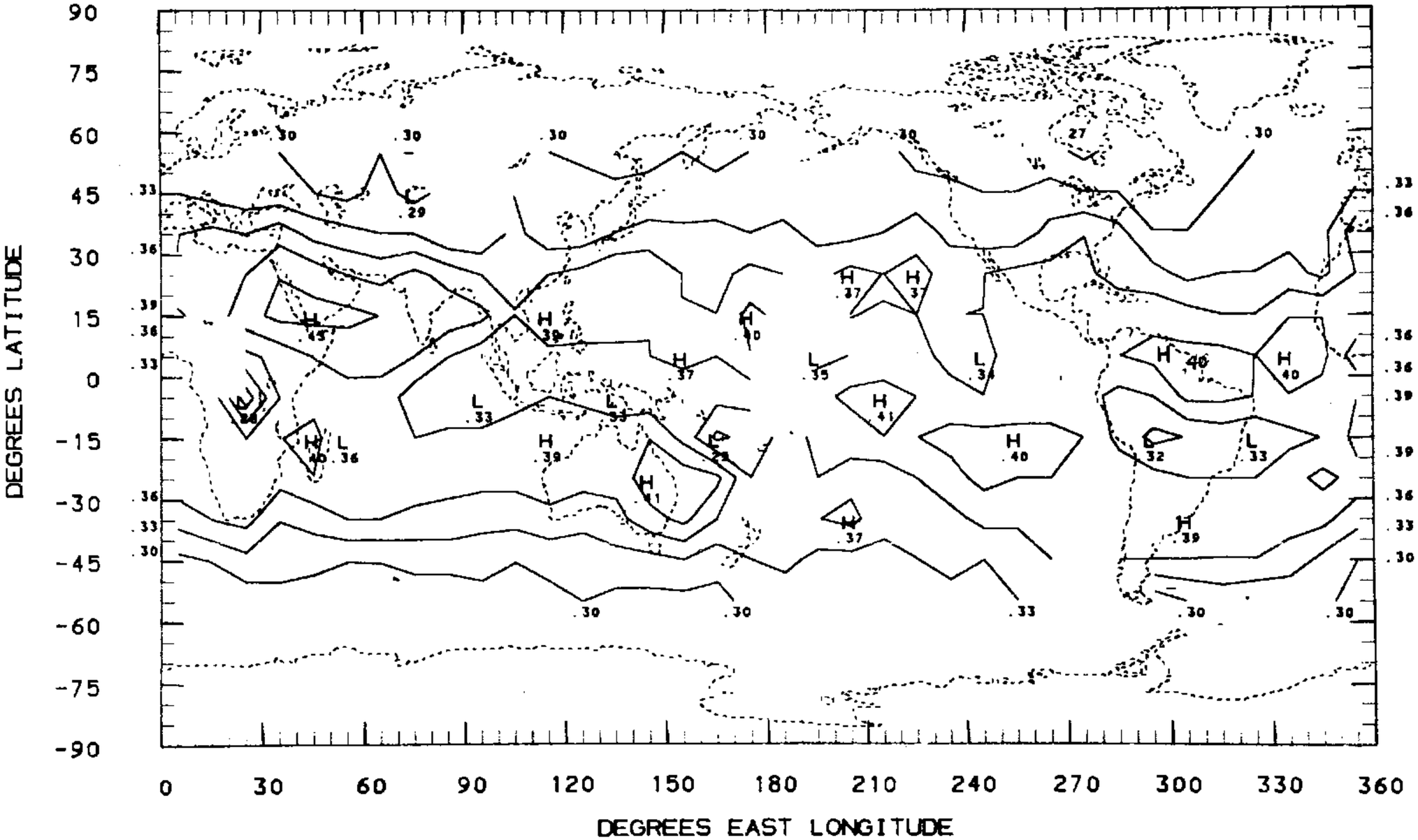
PLANETARY ALBEDO

MAR APR MAY 1964



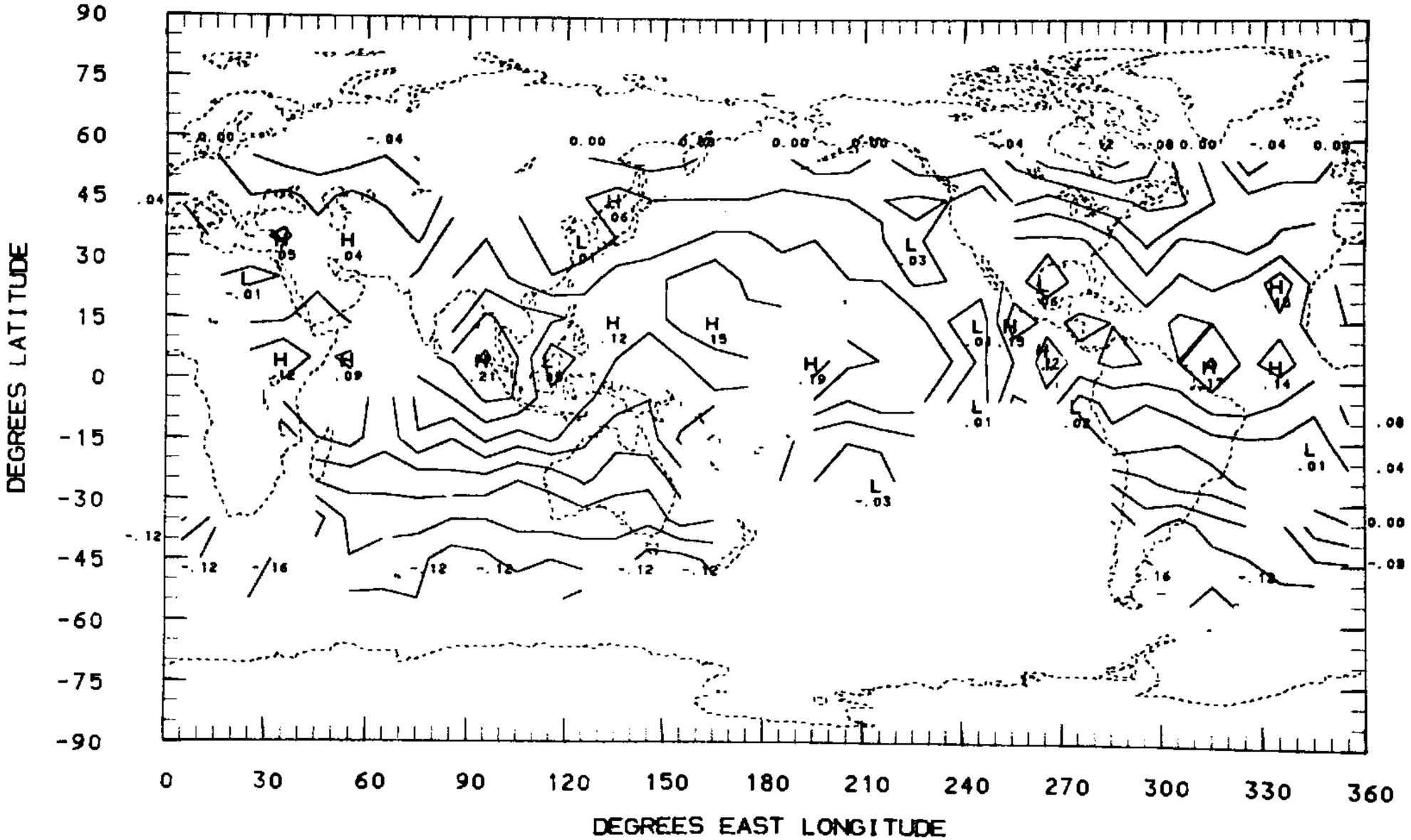
LONGWAVE RADIATION (LY/MIN)

MAR APR MAY 1964



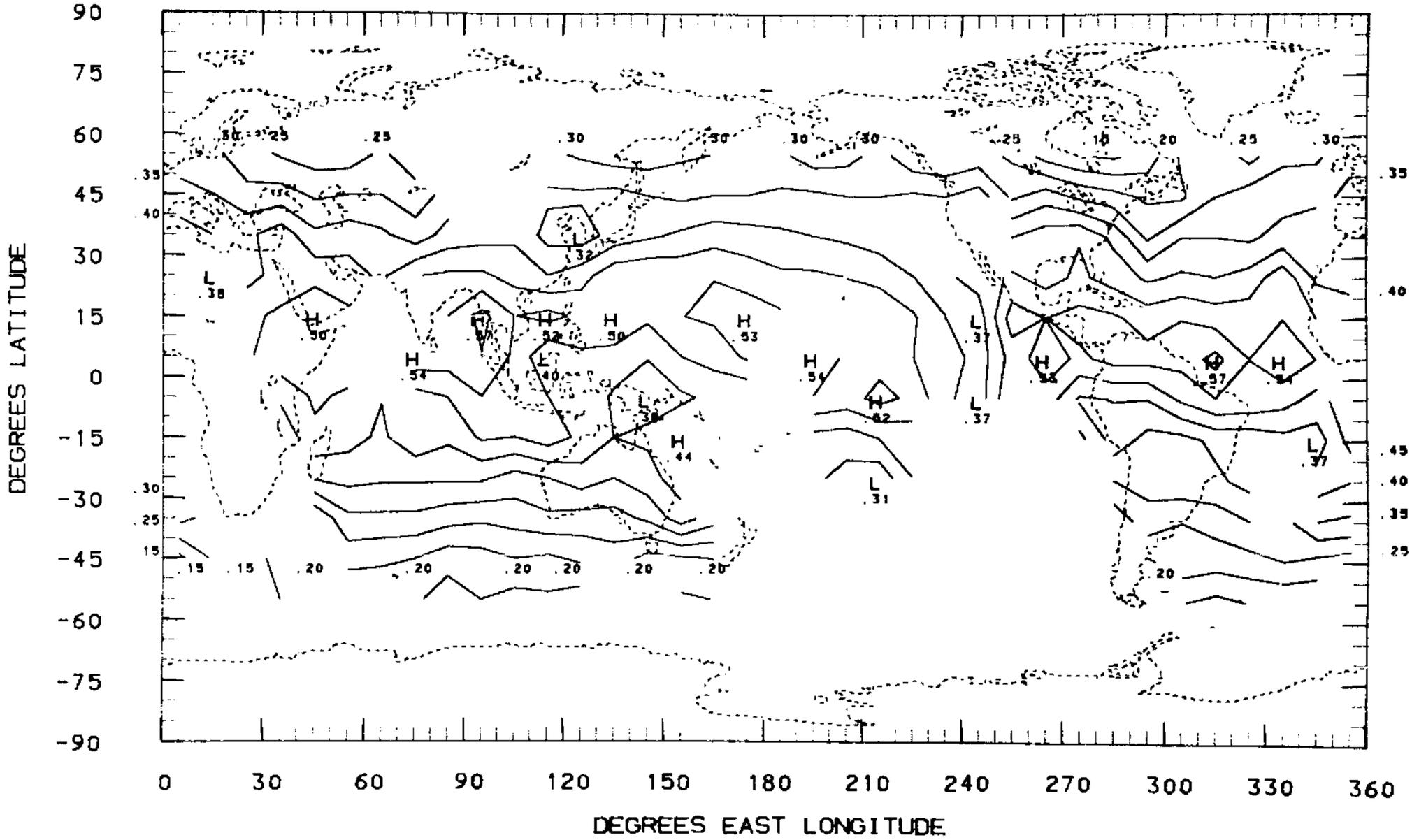
NET RADIATION (LY/MIN)

MAR APR MAY 1964



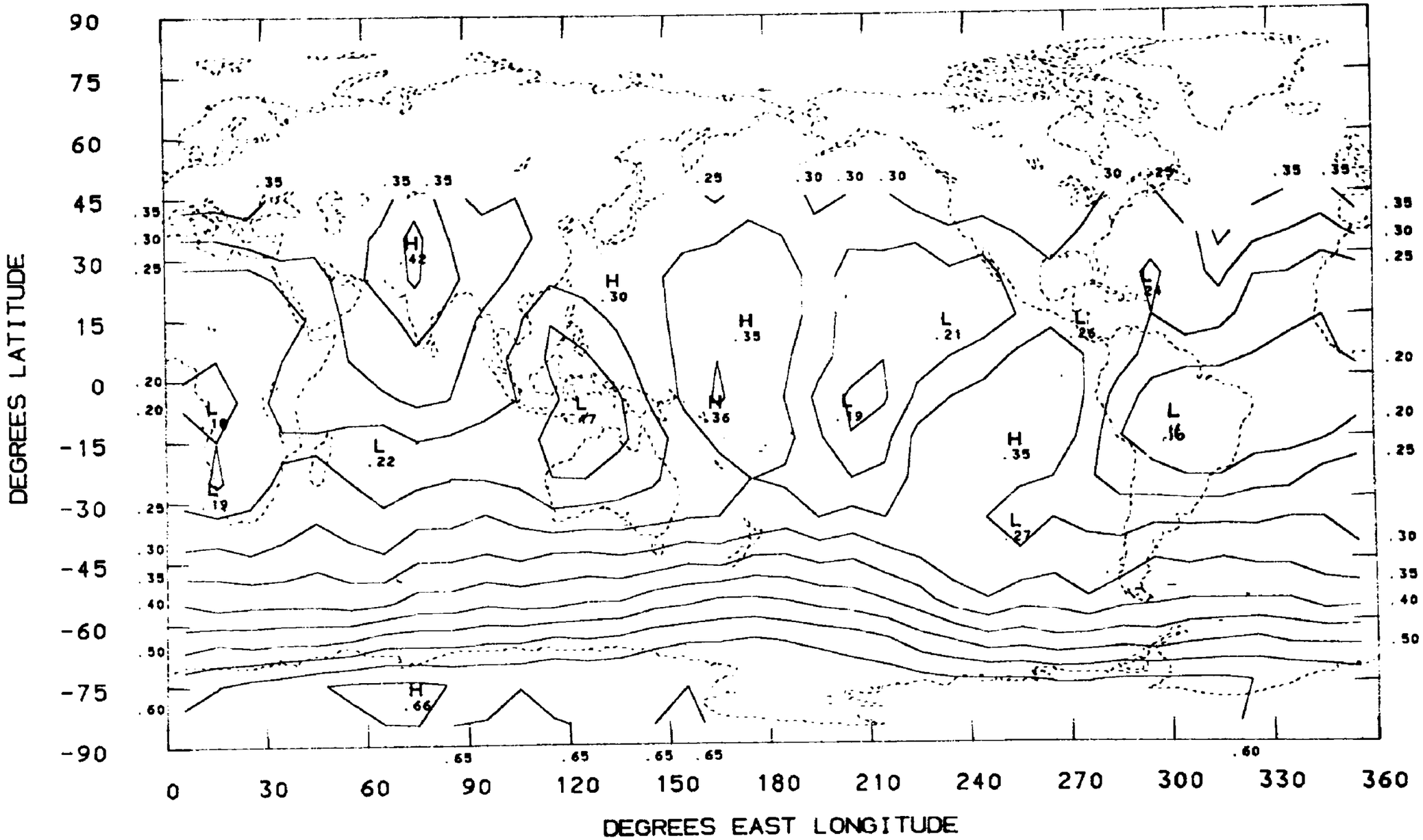
ABSORBED RADIATION (LY/MIN)

MAR APR MAY 1964



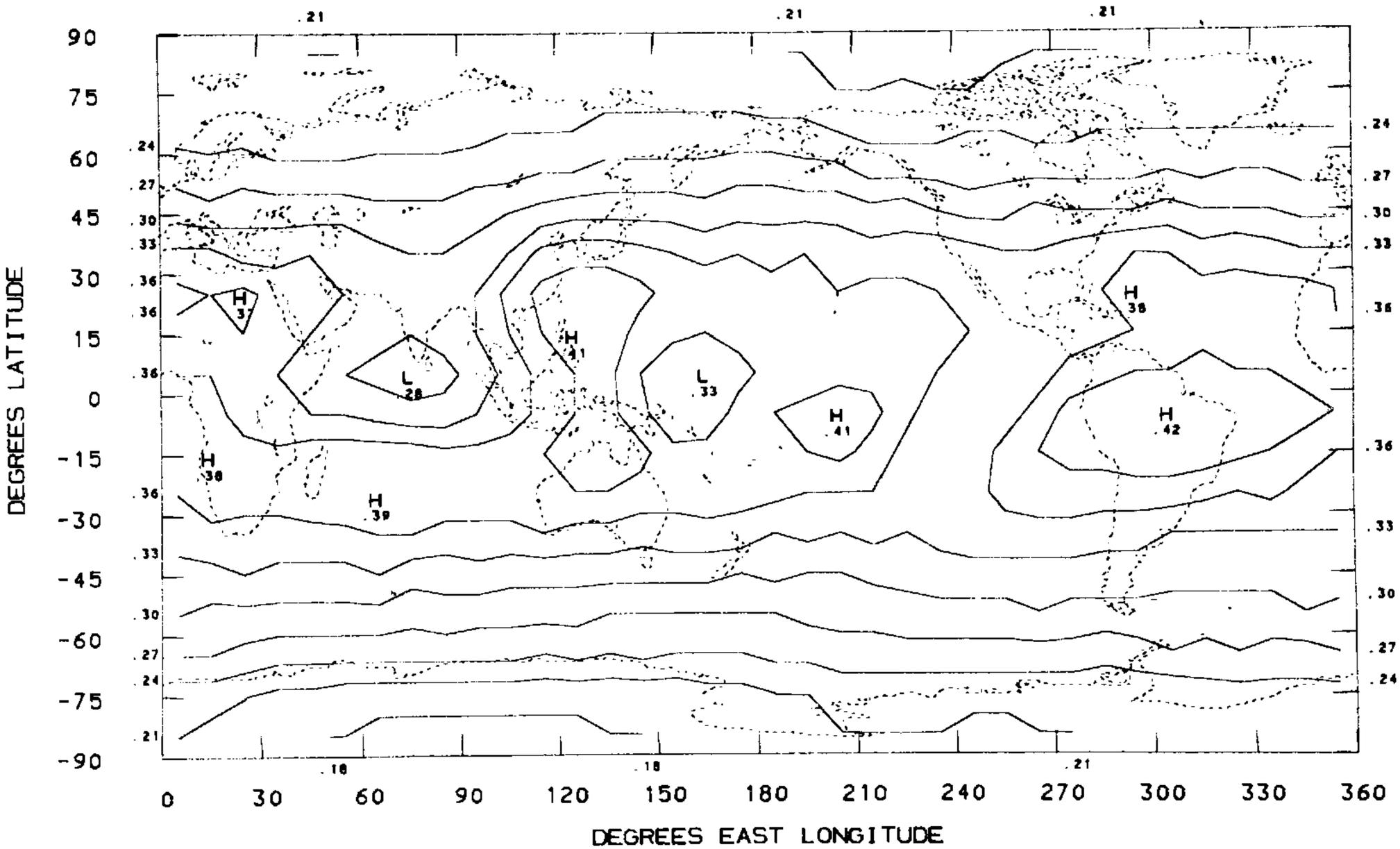
PLANETARY ALBEDO

SEP OCT NOV 1964



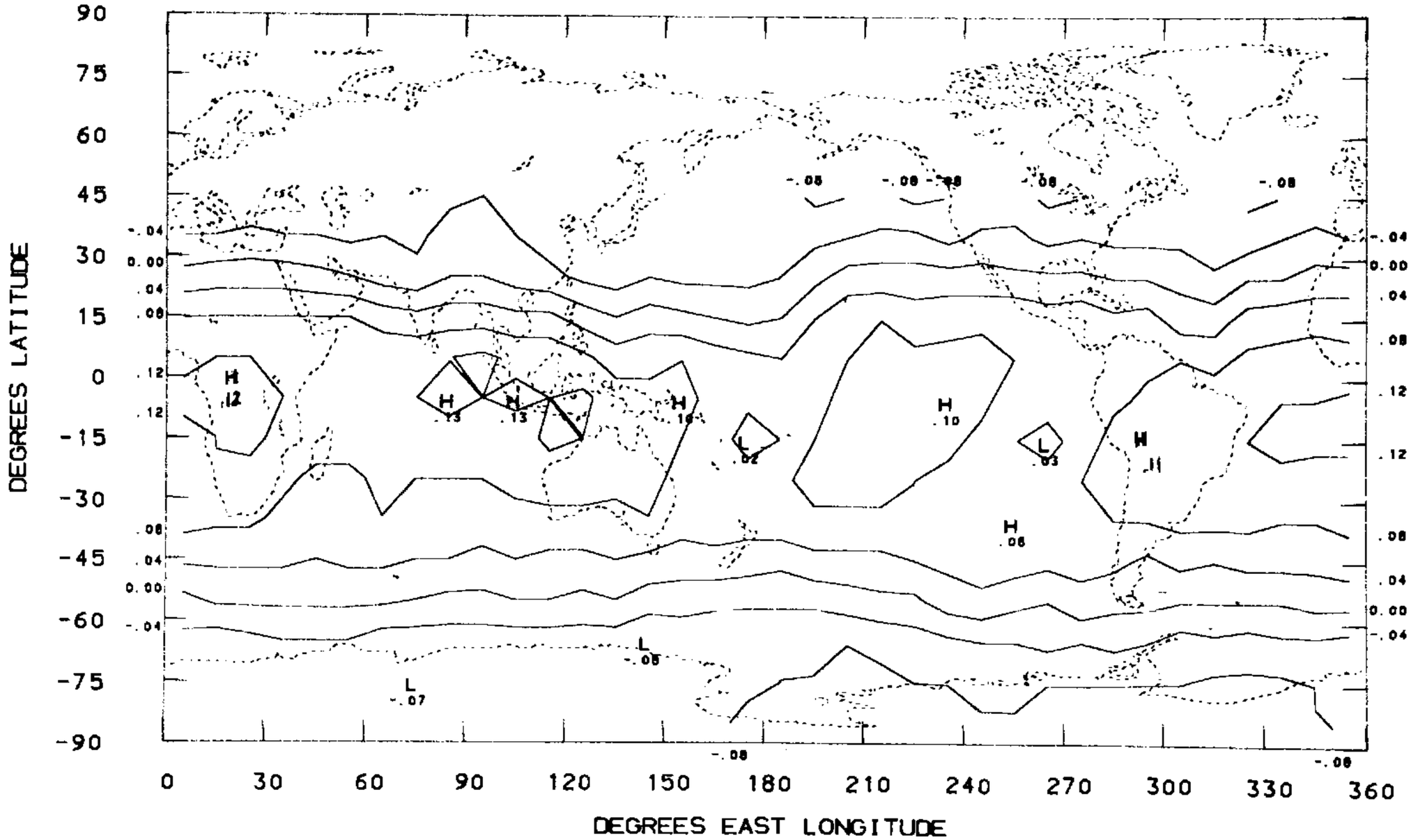
LONGWAVE RADIATION (LY/MIN)

SEP OCT NOV 1964



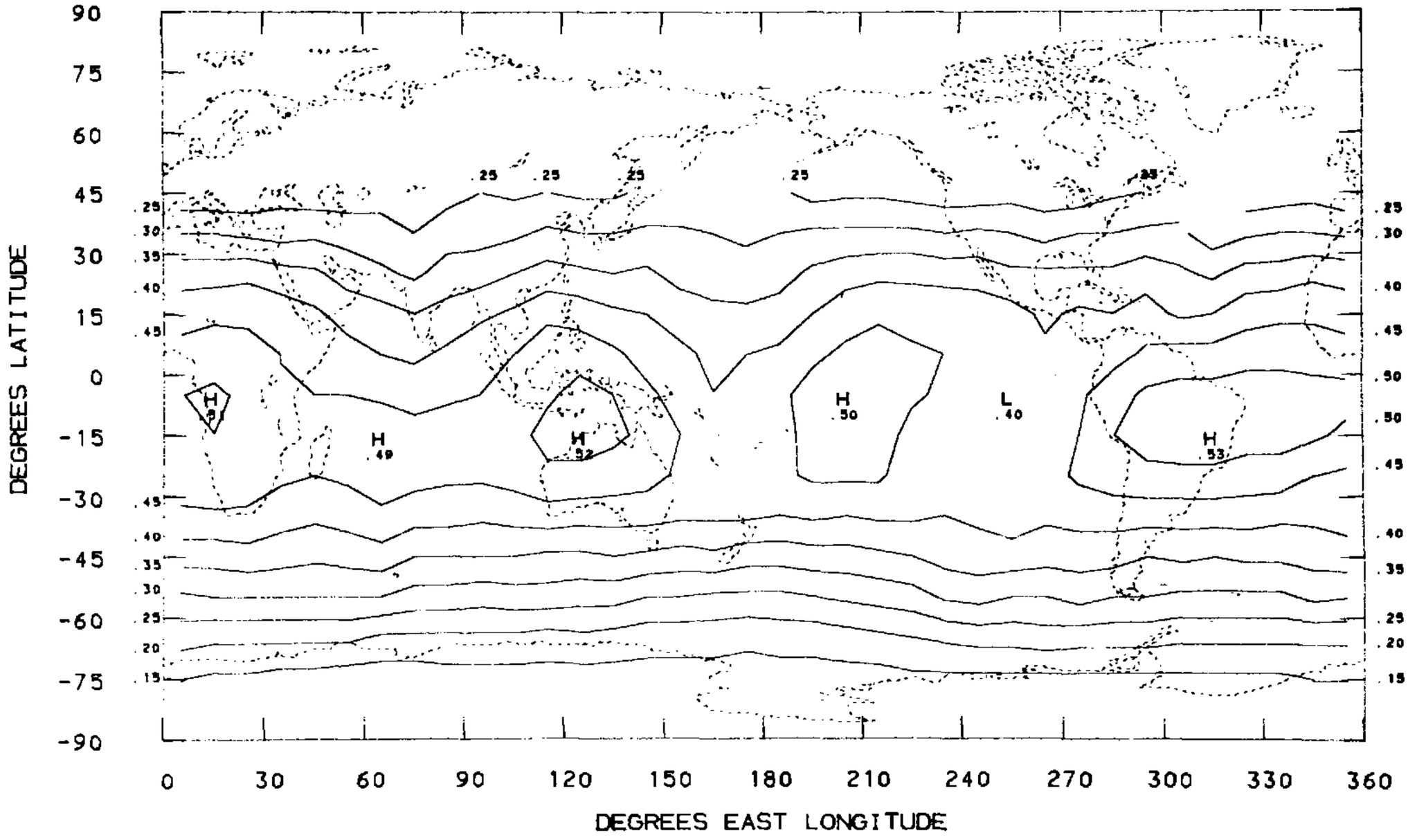
NET RADIATION (LY/MIN)

SEP OCT NOV 1964



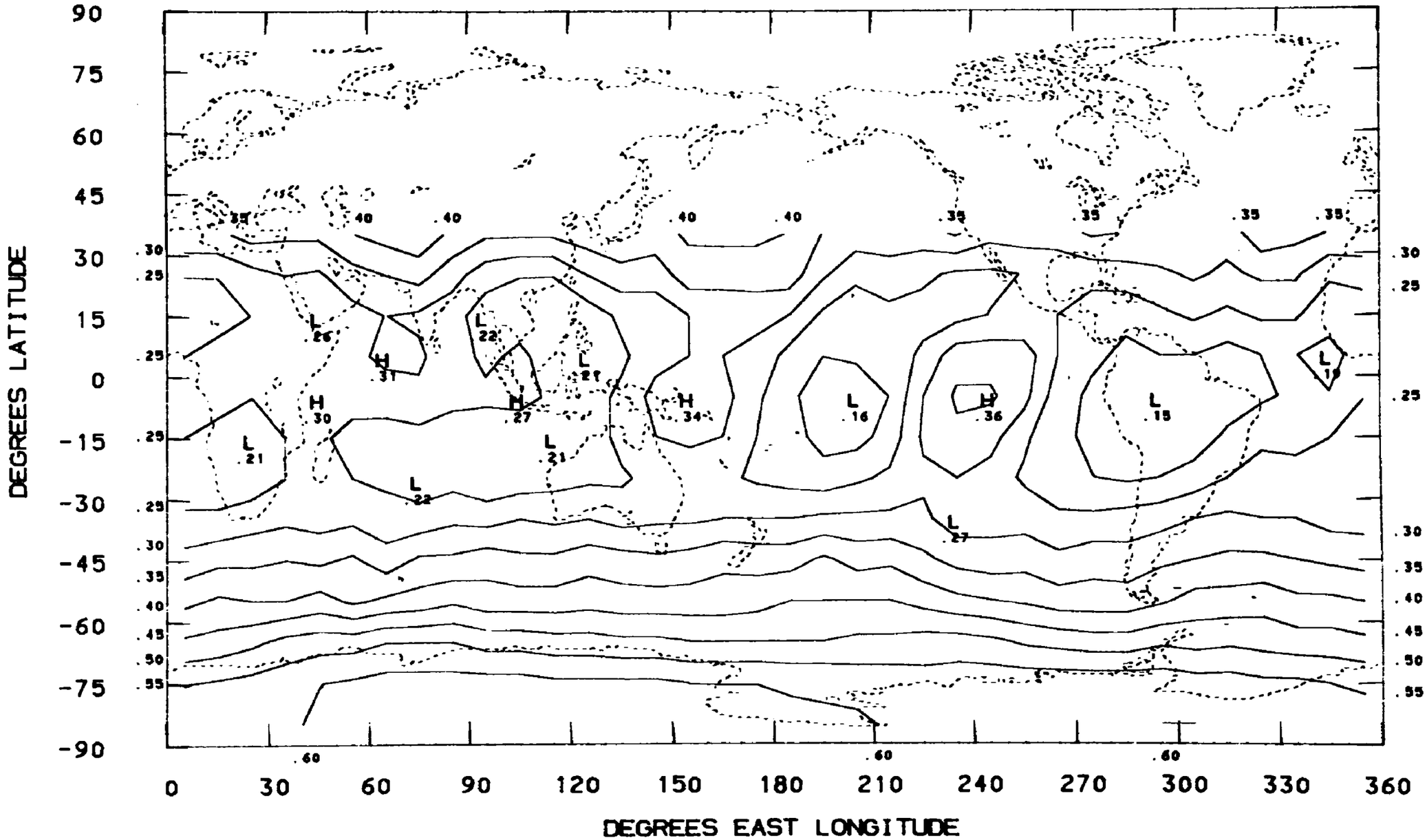
ABSORBED RADIATION (LY/MIN)

SEP OCT NOV 1964



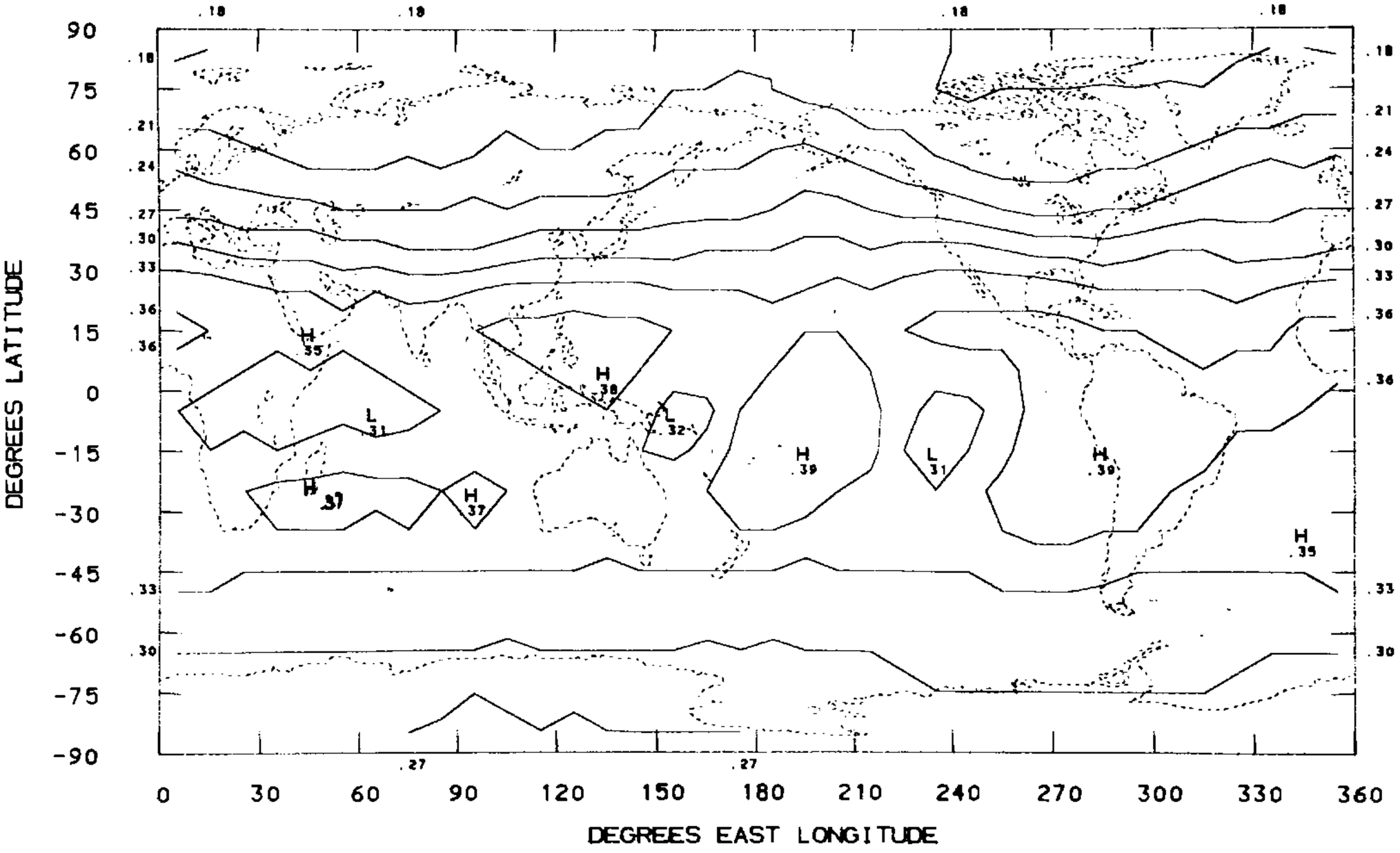
PLANETARY ALBEDO

DEC JAN FEB 1964/1965



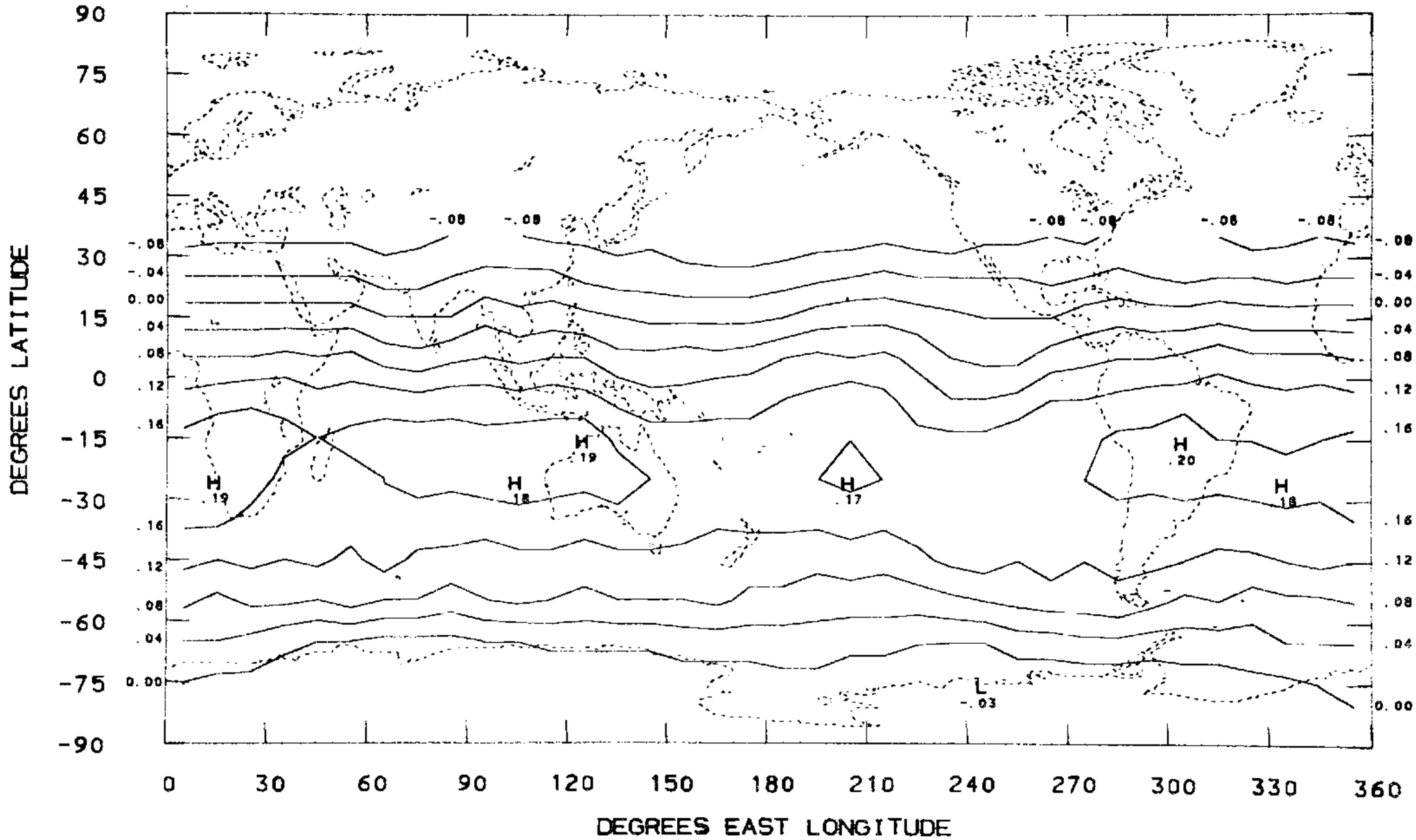
LONGWAVE RADIATION (LY/MIN)

DEC JAN FEB 1964/1965



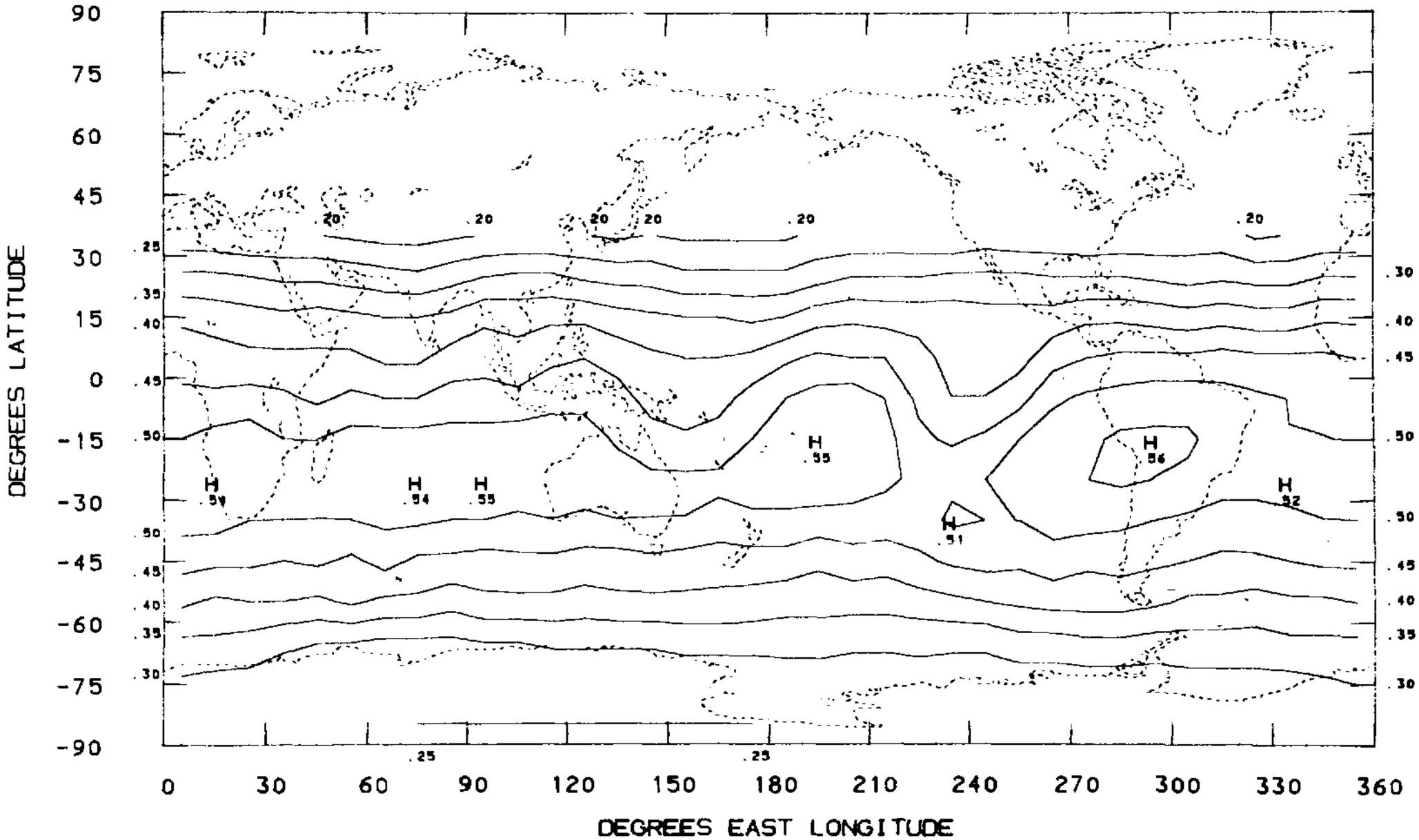
NET RADIATION (LY/MIN)

DEC JAN FEB 1964/1965



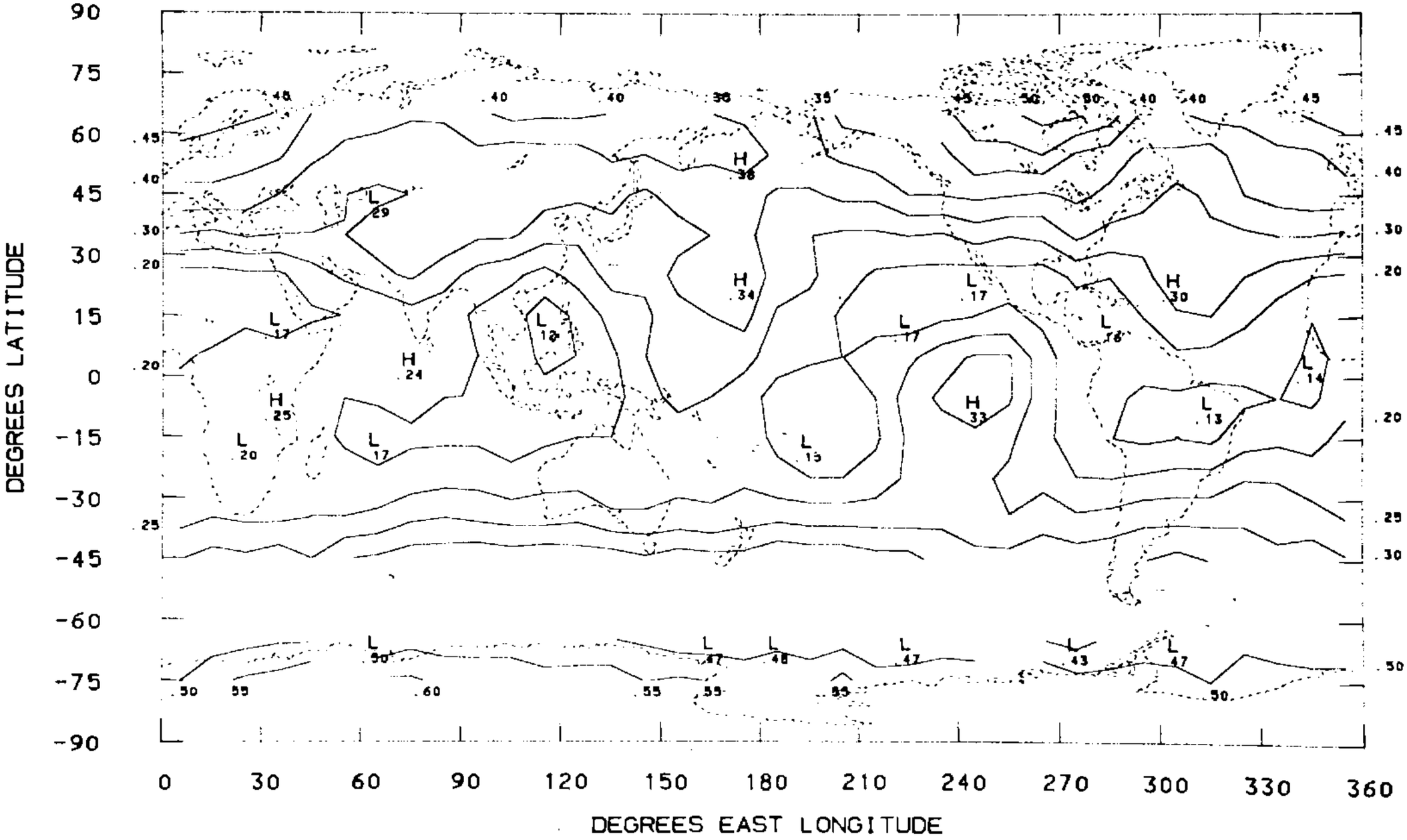
ABSORBED RADIATION (LY/MIN)

DEC JAN FEB 1964/1965



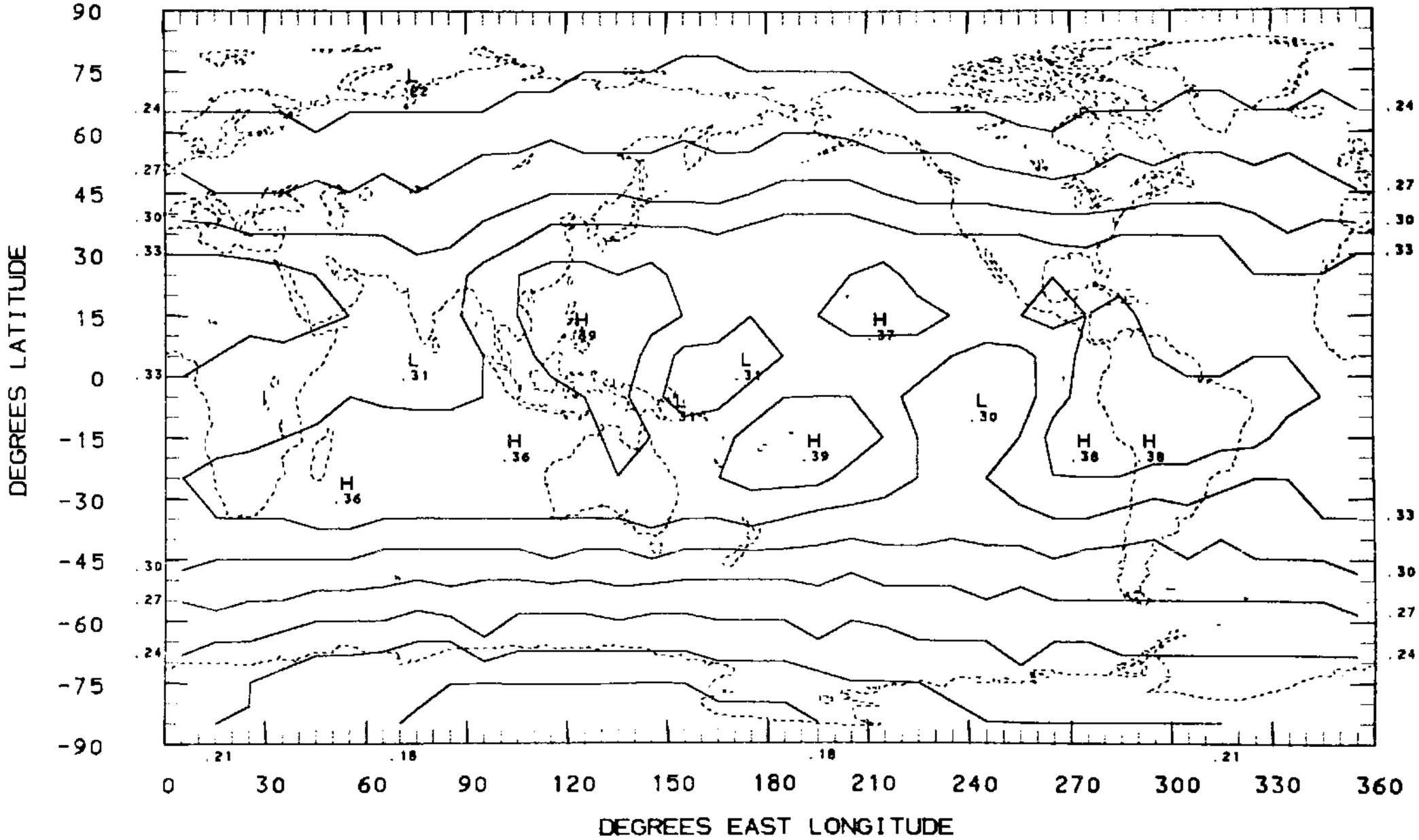
PLANETARY ALBEDO

MAR APR MAY 1965



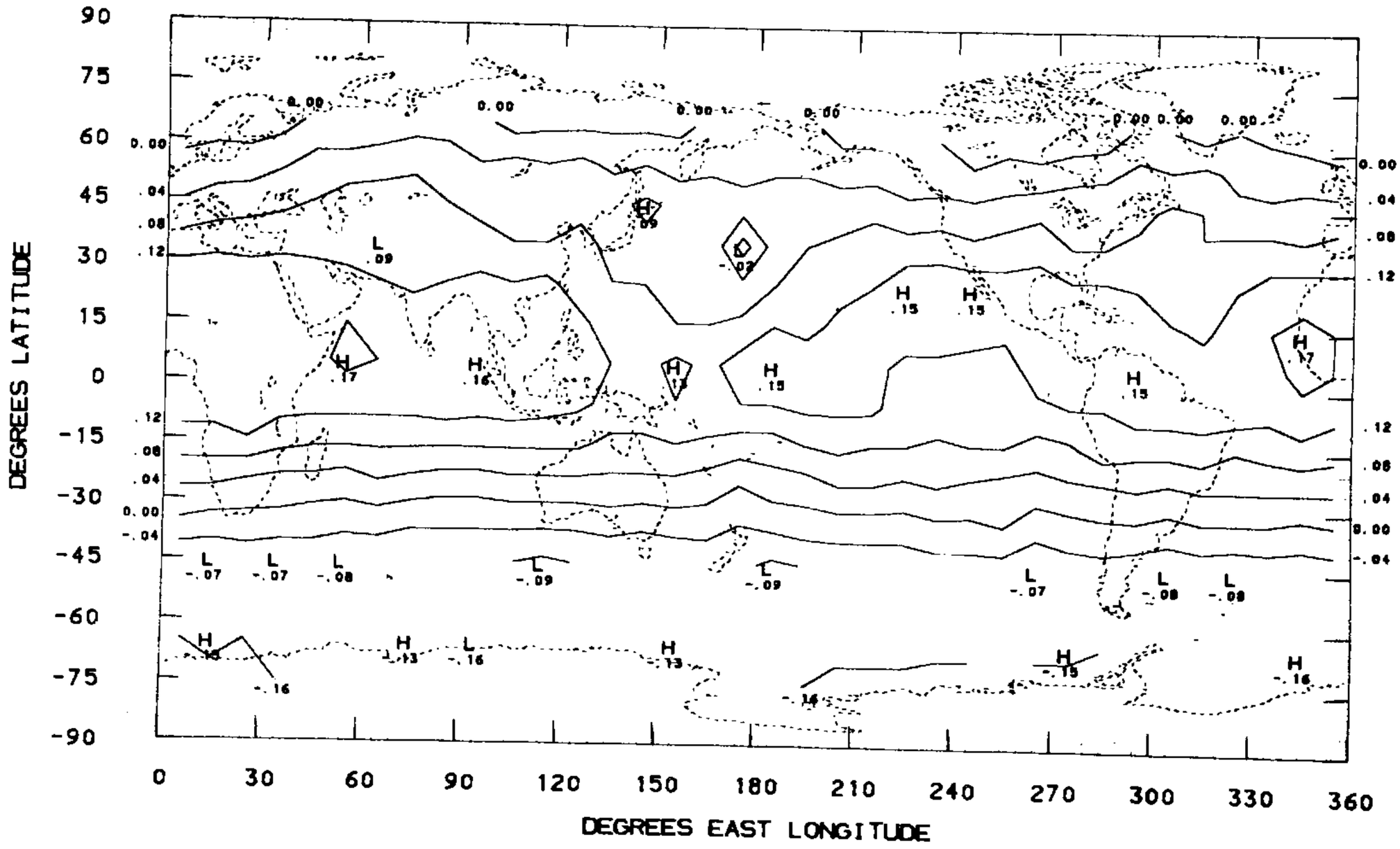
LONGWAVE RADIATION (LY/MIN)

MAR APR MAY 1965



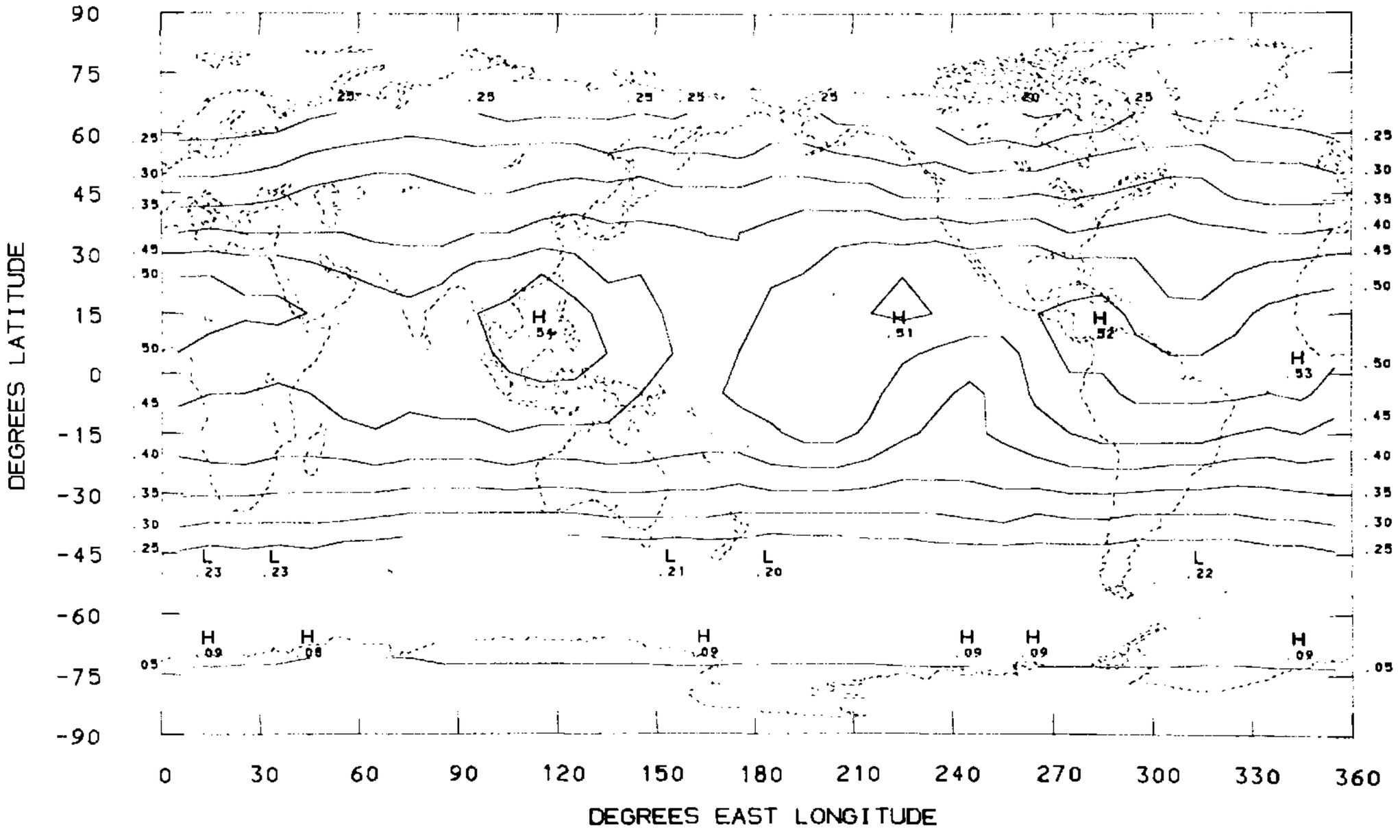
NET RADIATION (LY/MIN)

MAR APR MAY 1965



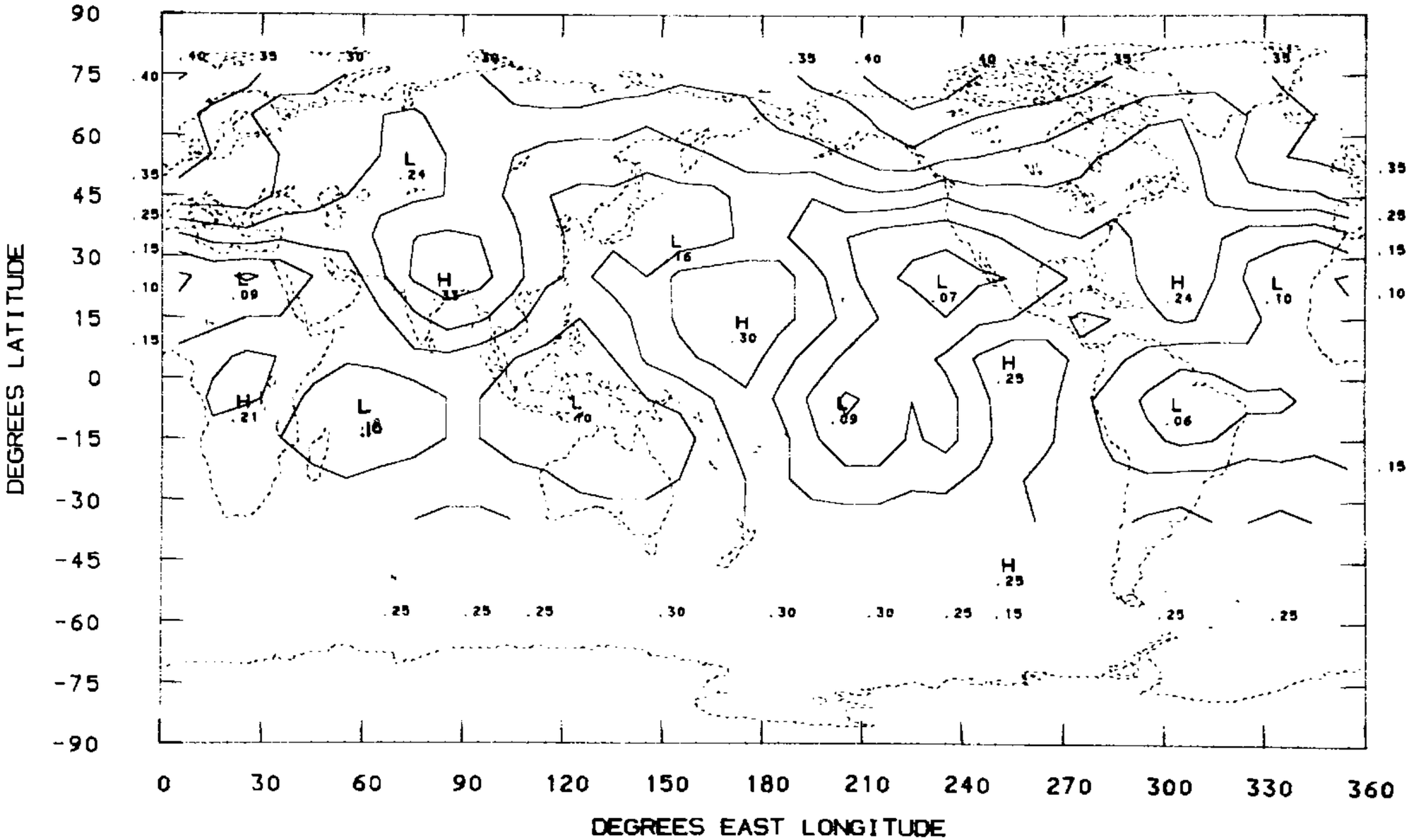
ABSORBED RADIATION (LY/MIN)

MAR APR MAY 1965



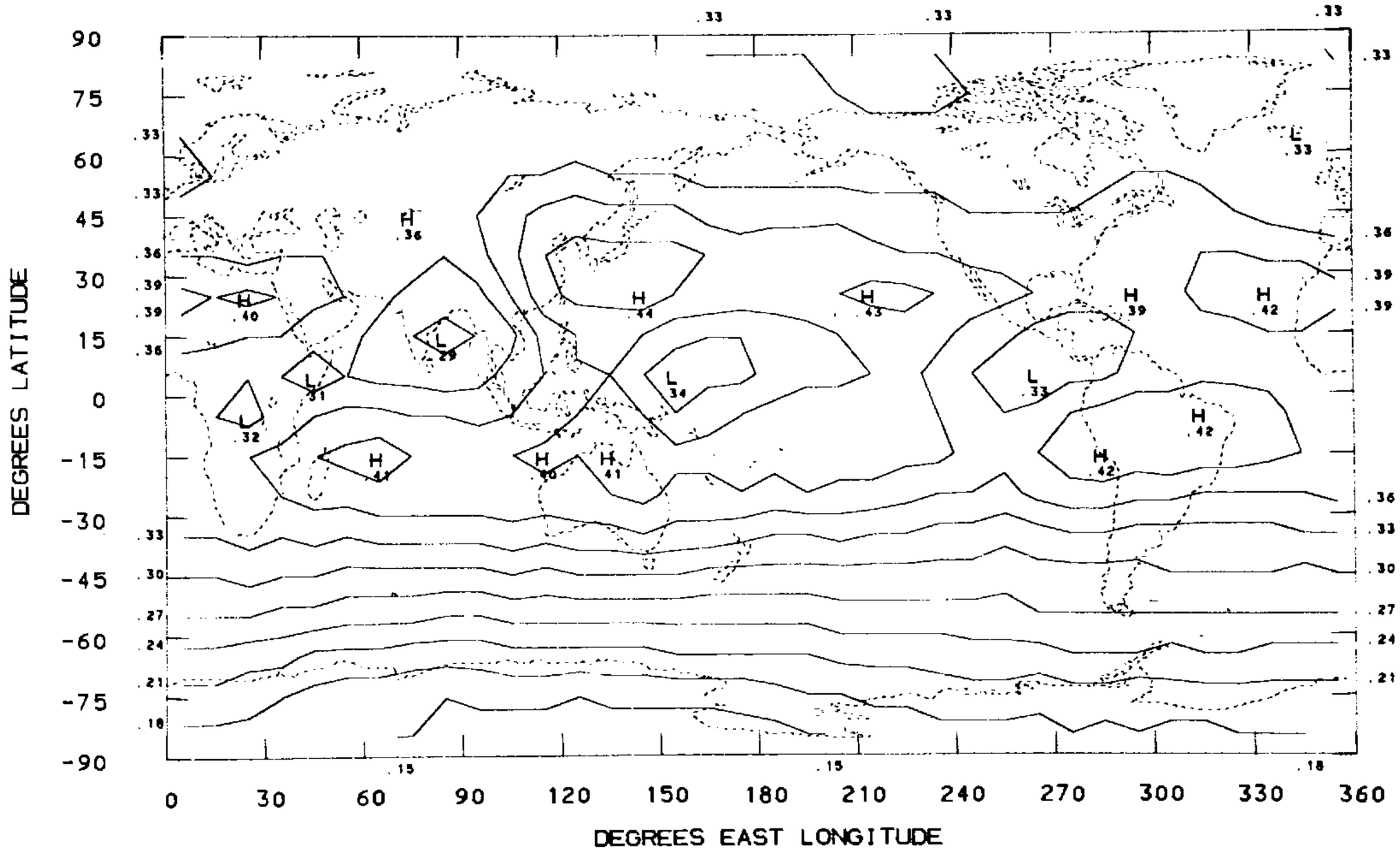
PLANETARY ALBEDO

JUN JUL AUG 1965



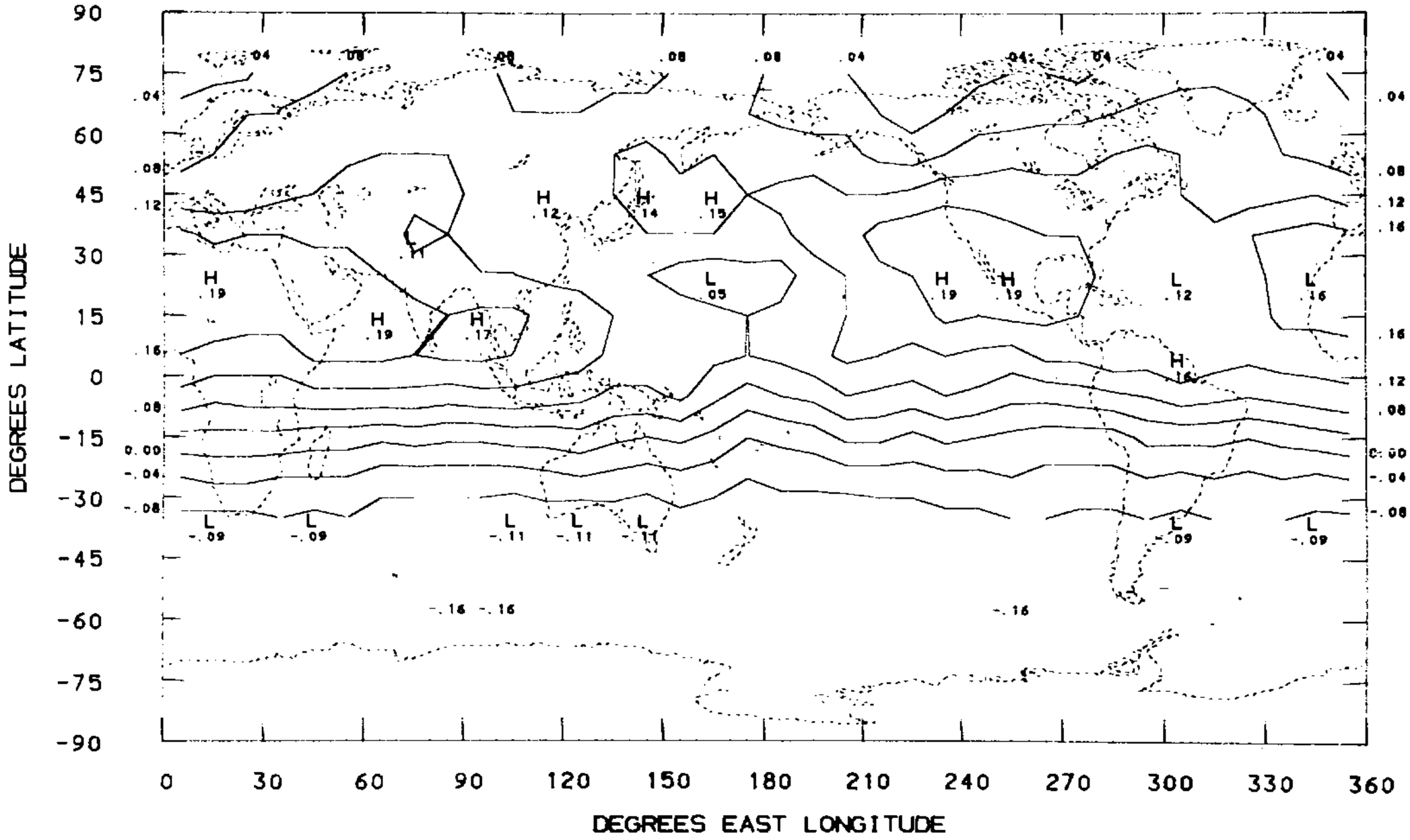
LONGWAVE RADIATION (LY/MIN)

JUN JUL AUG 1965



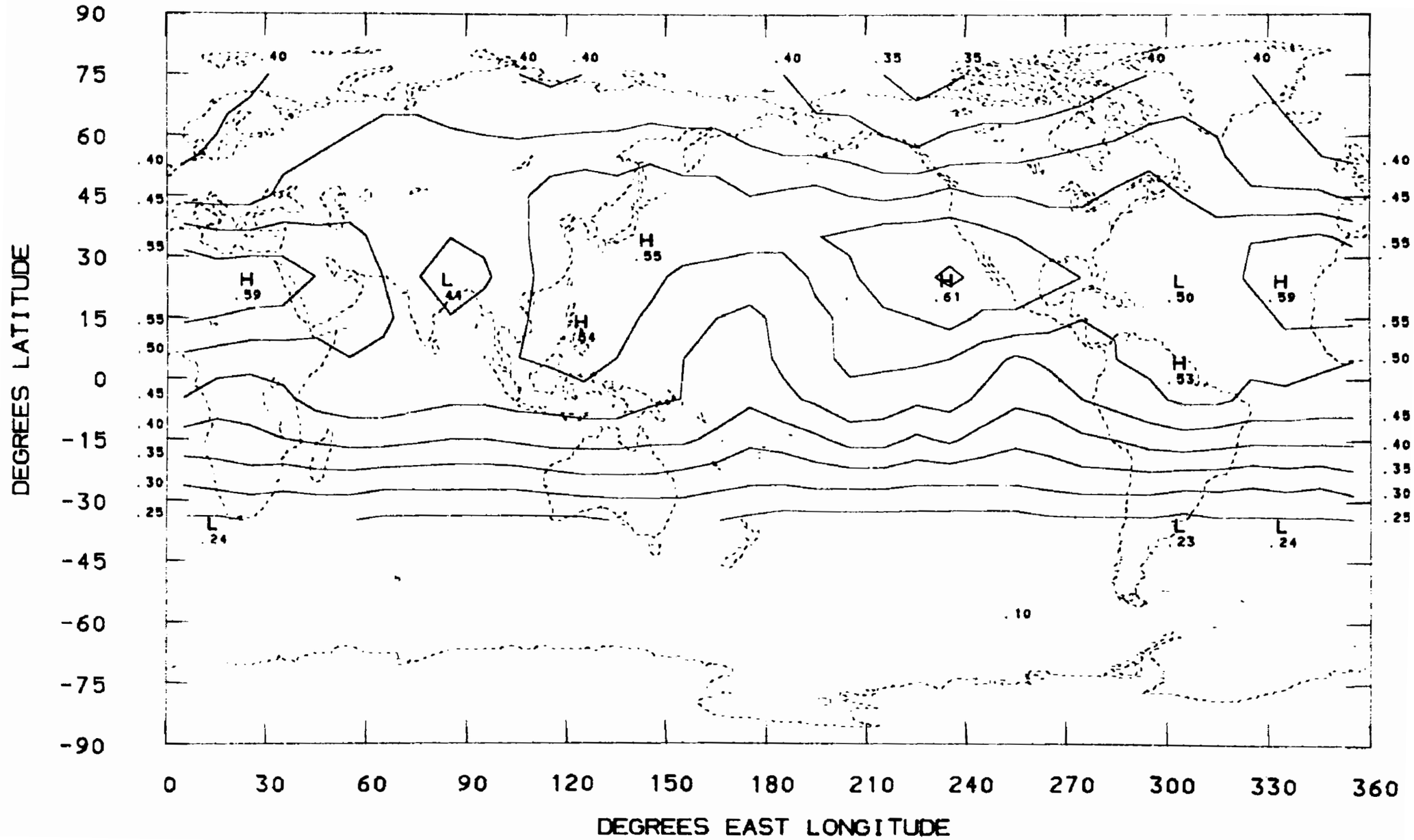
NET RADIATION (LY/MIN)

JUN JUL AUG 1965



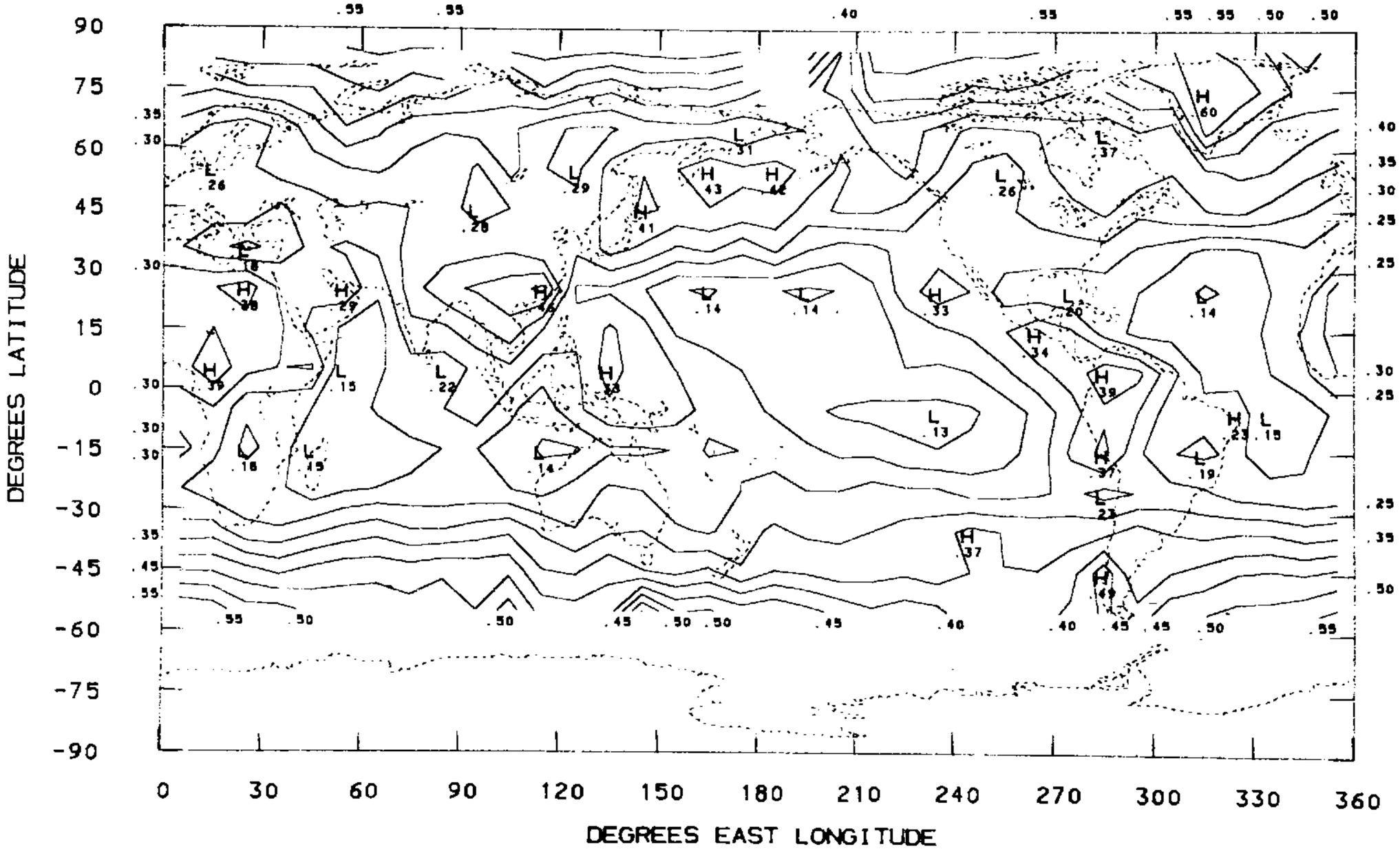
ABSORBED RADIATION (LY/MIN)

JUN JUL AUG 1965



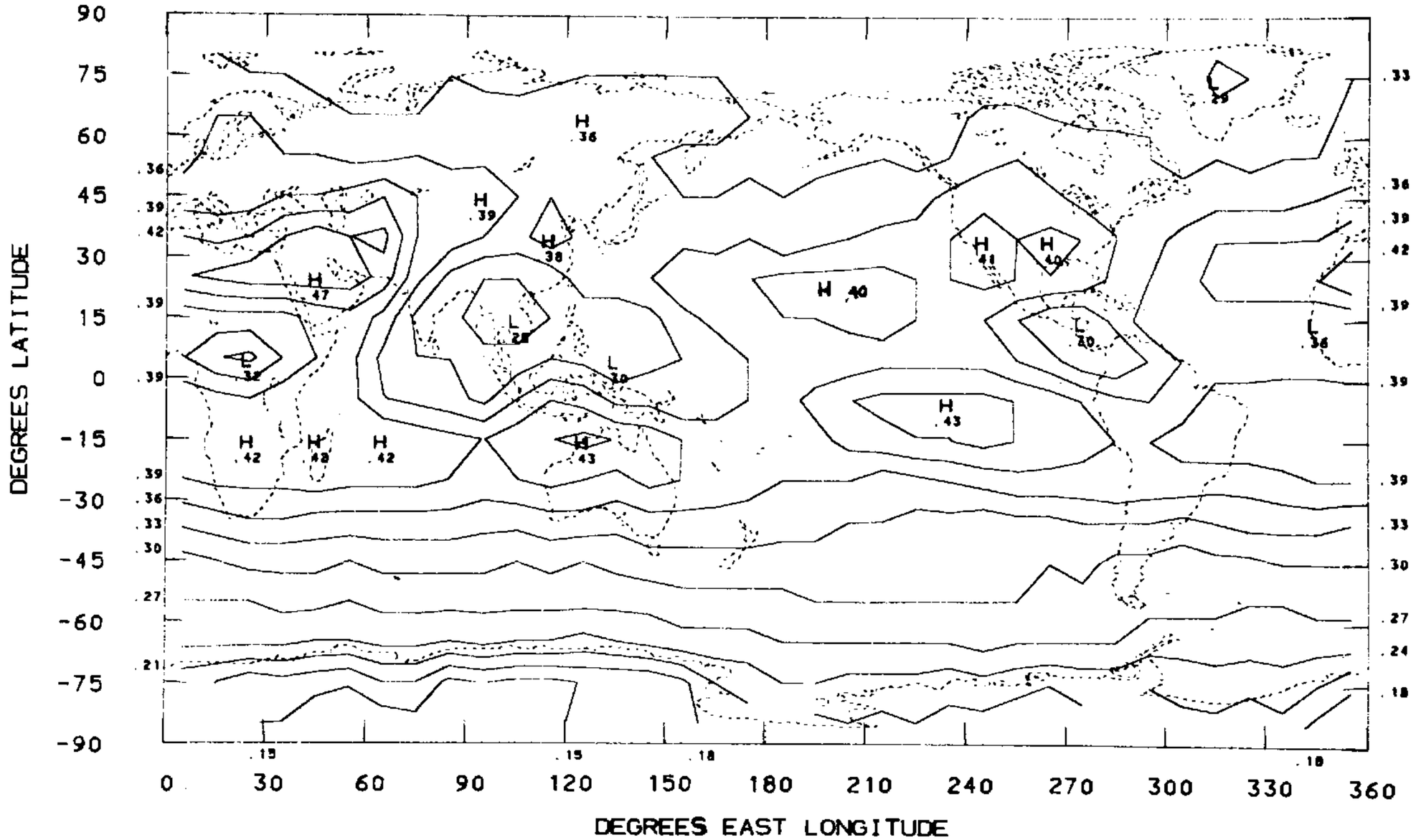
PLANETARY ALBEDO

JUN JUL AUG (1-15) 1969



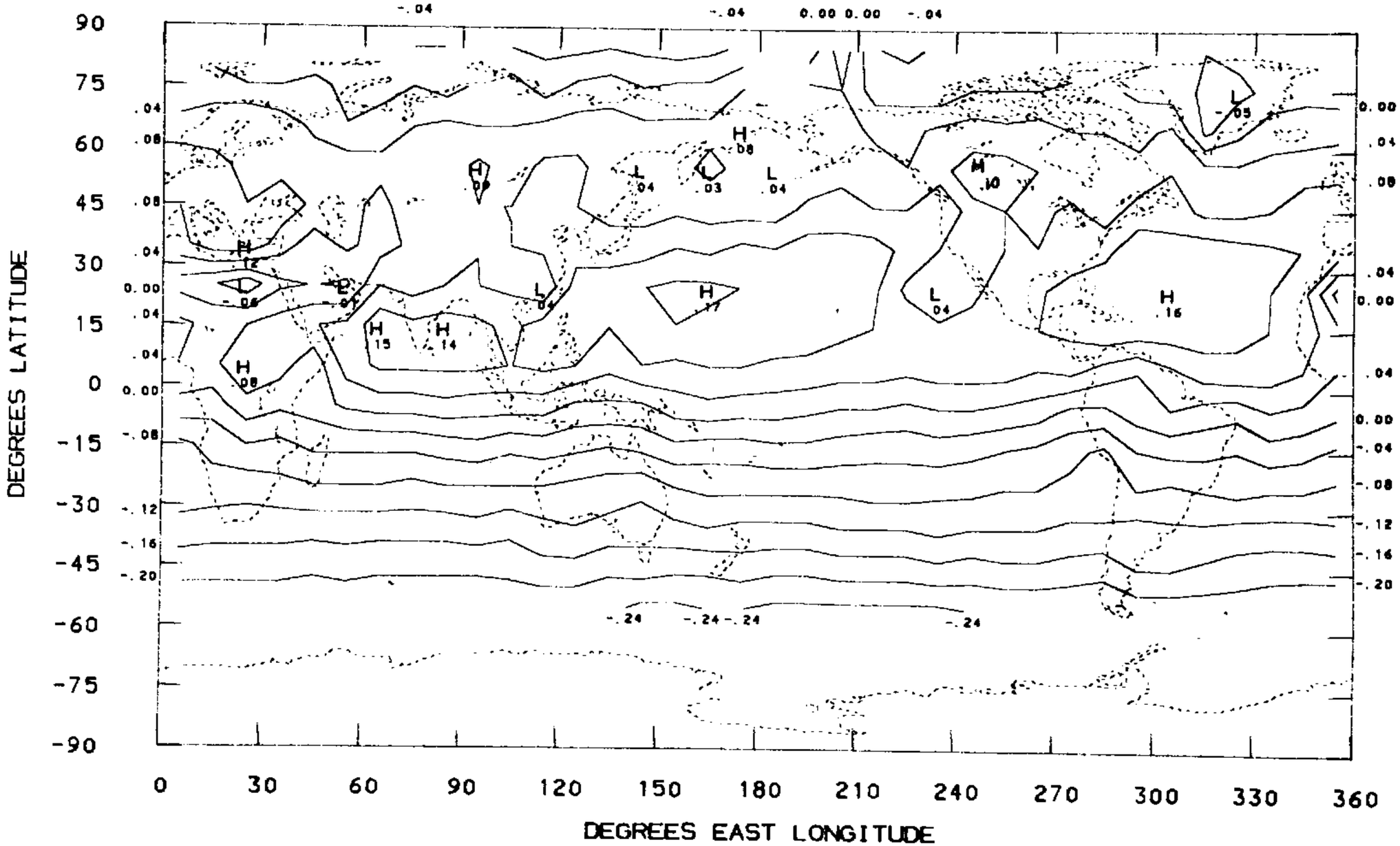
LONGWAVE RADIATION (LY/MIN)

JUN JUL AUG (1-15) 1969



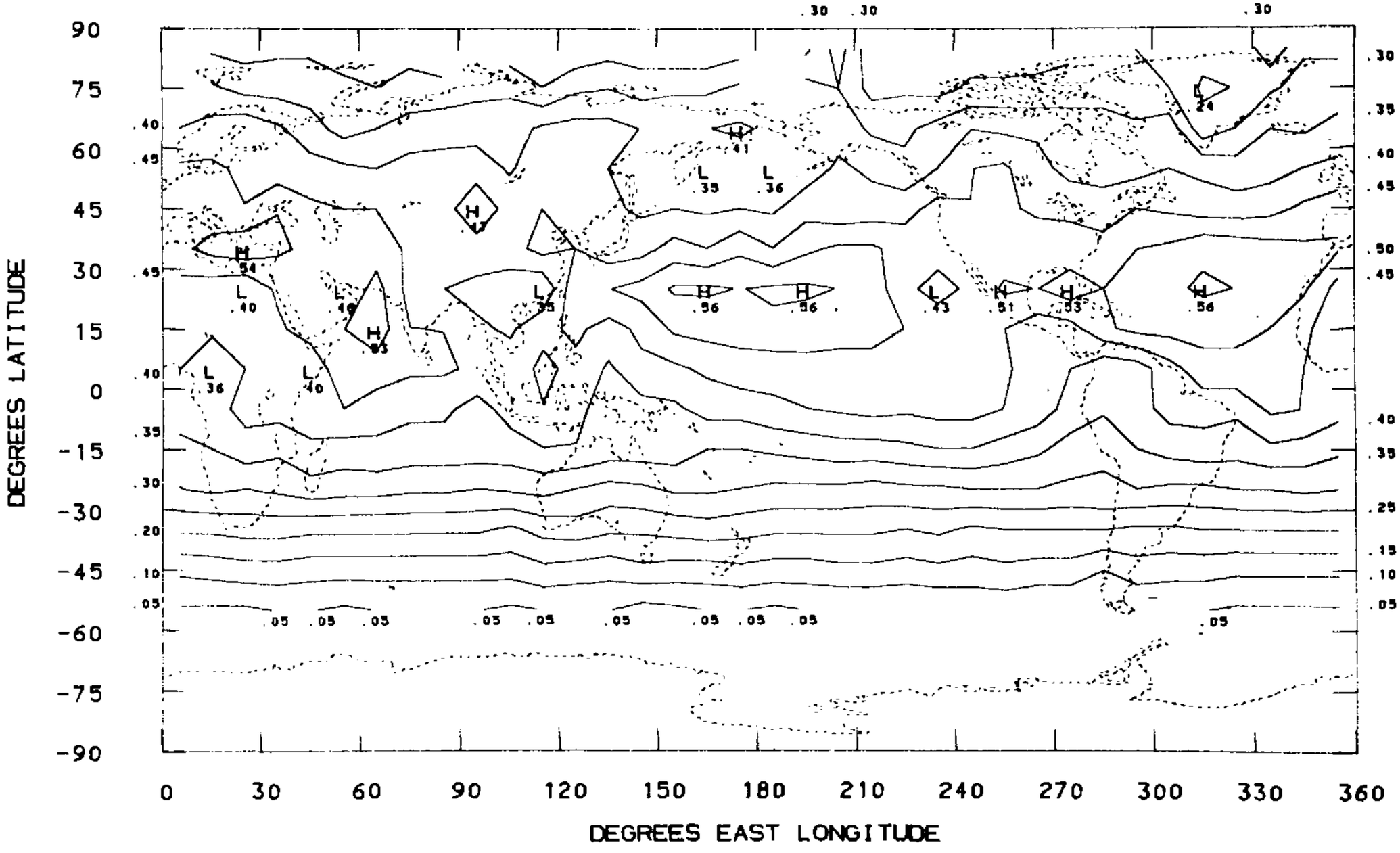
NET RADIATION (LY/MIN)

JUN JUL AUG (1-15) 1969



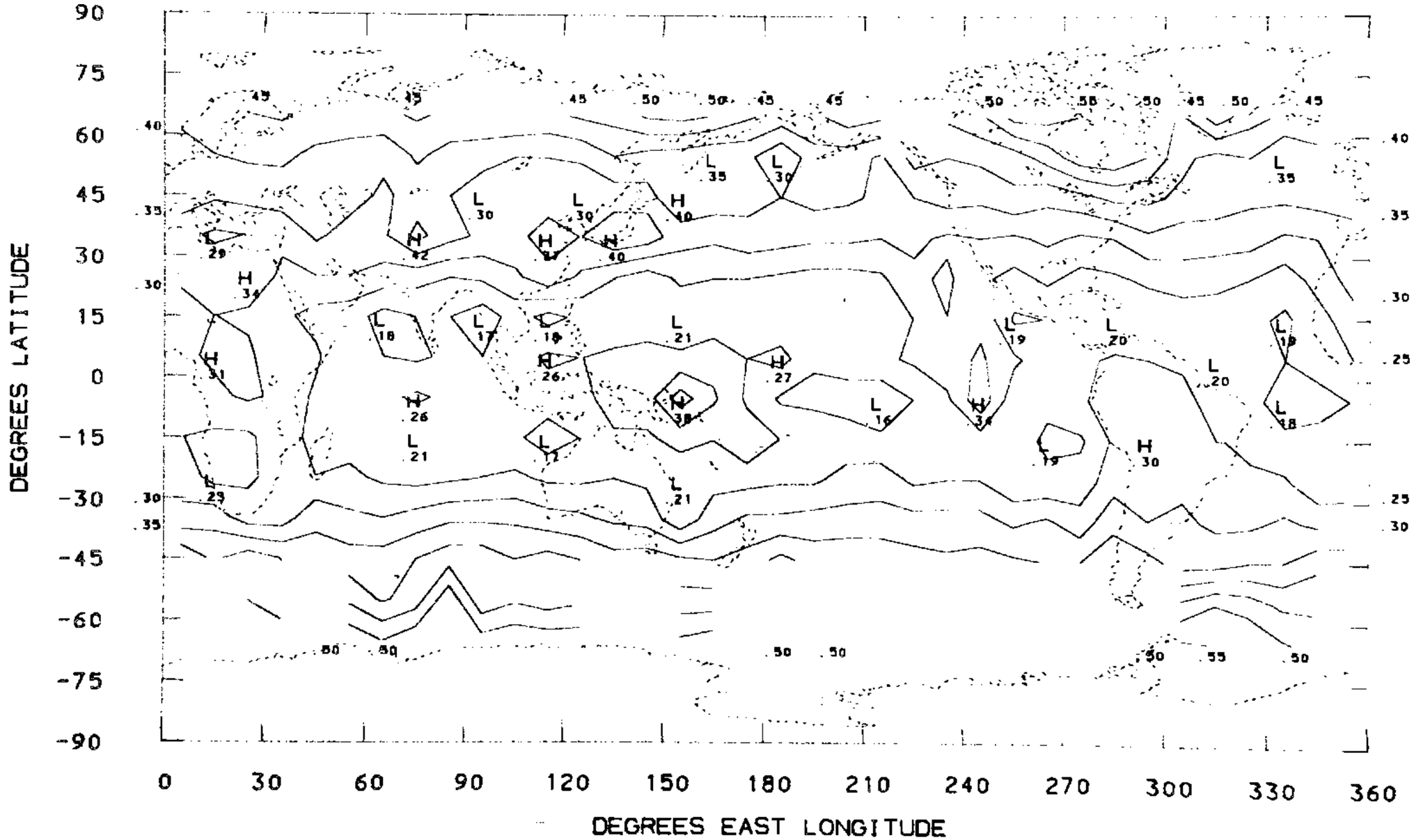
ABSORBED RADIATION (LY/MIN)

JUN JUL AUG (1-15) 1969



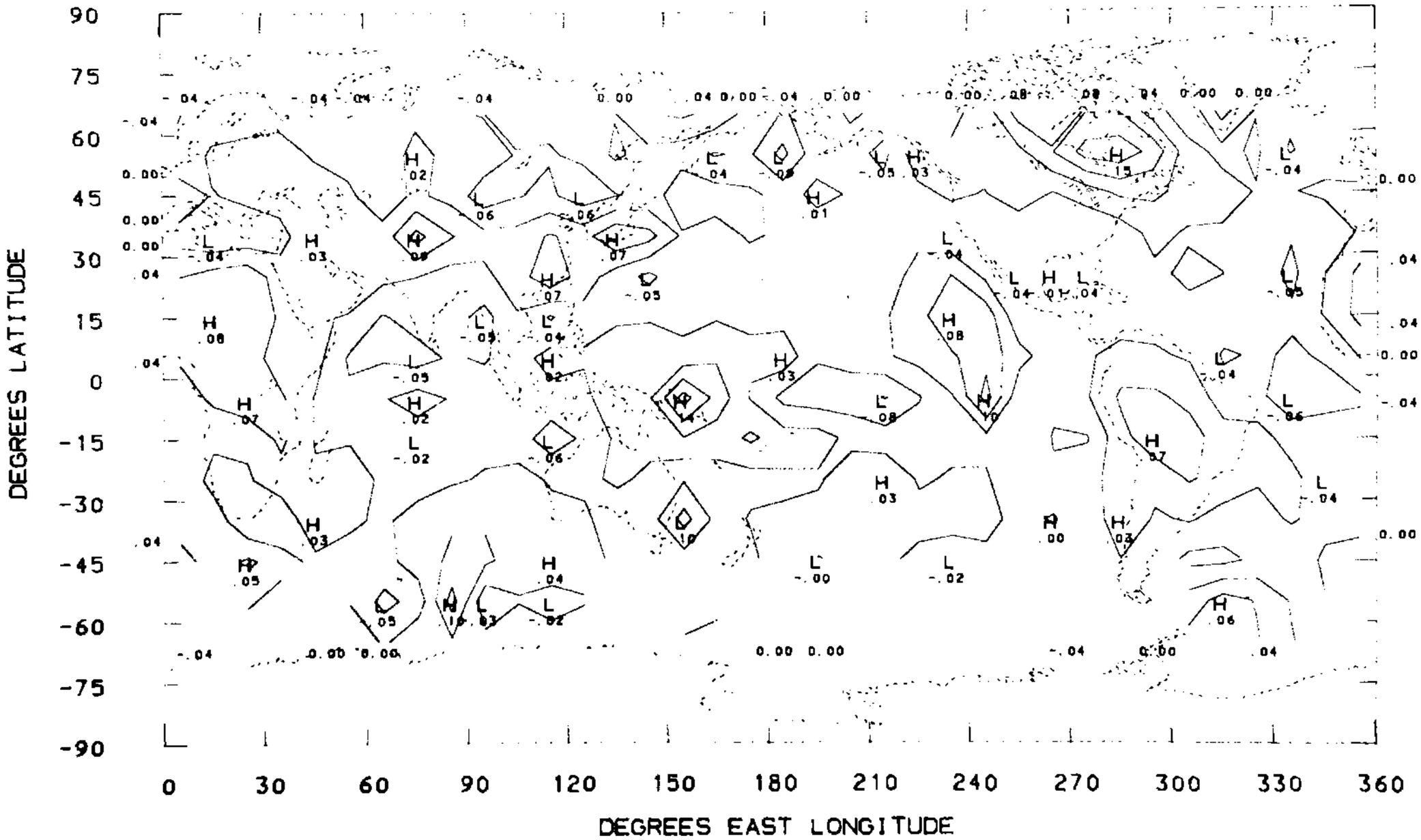
PLANETARY ALBEDO

MEAN MAR APR MAY



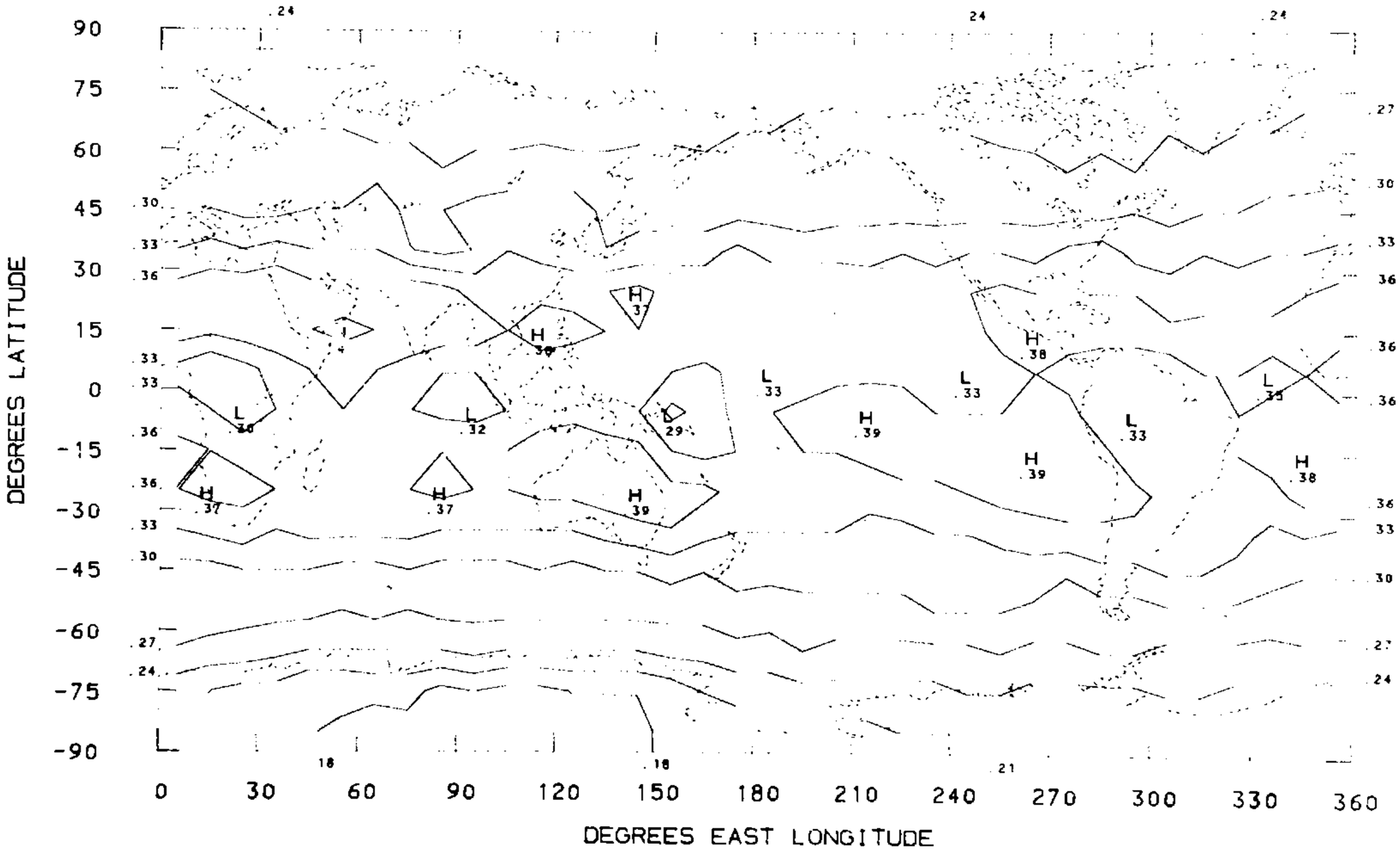
PLANETARY ALBEDO

DEVIATION FROM ZONAL AVG. MEAN MAR APR MAY



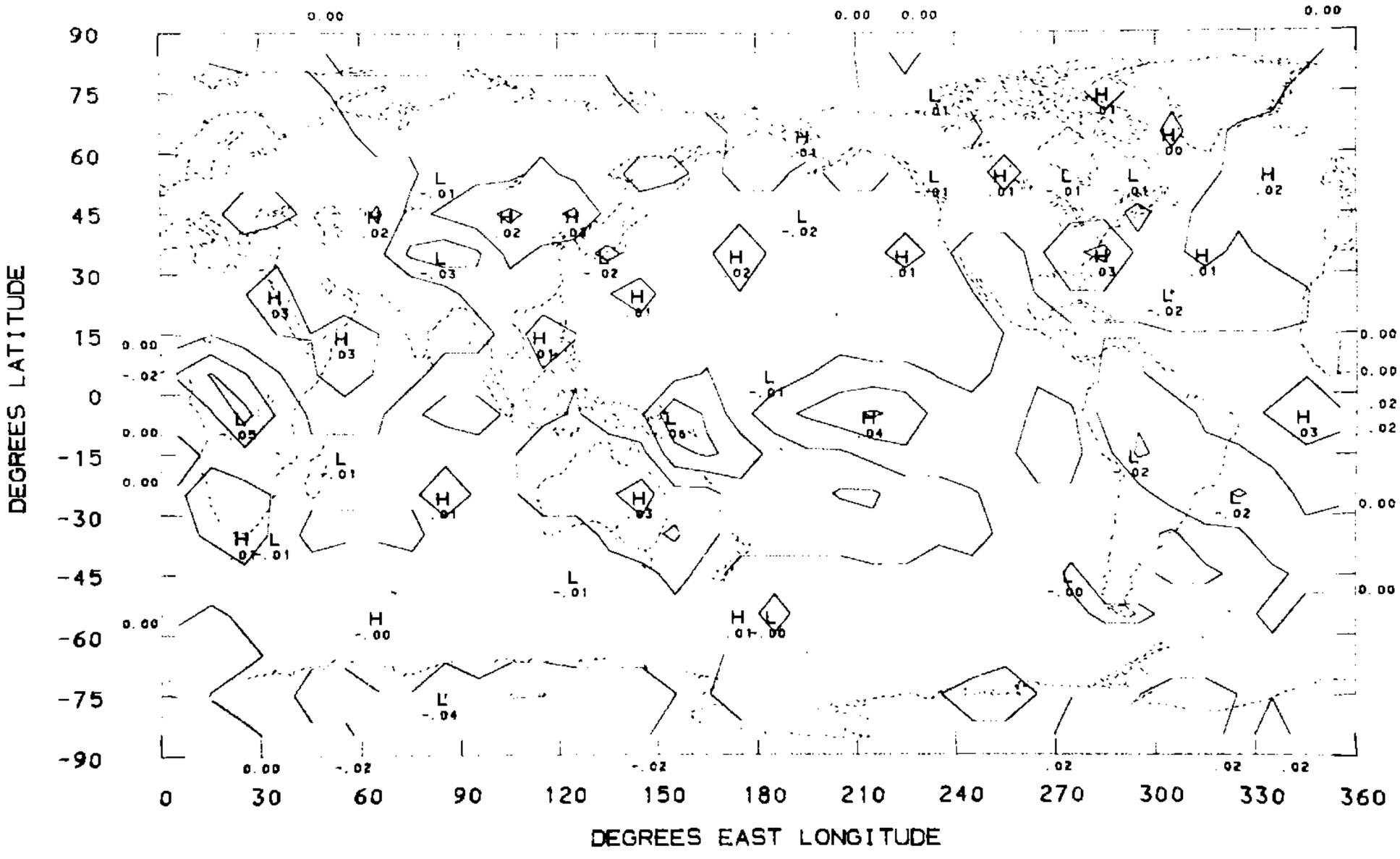
LONGWAVE RADIATION (LY/MIN)

MEAN MAR APR MAY



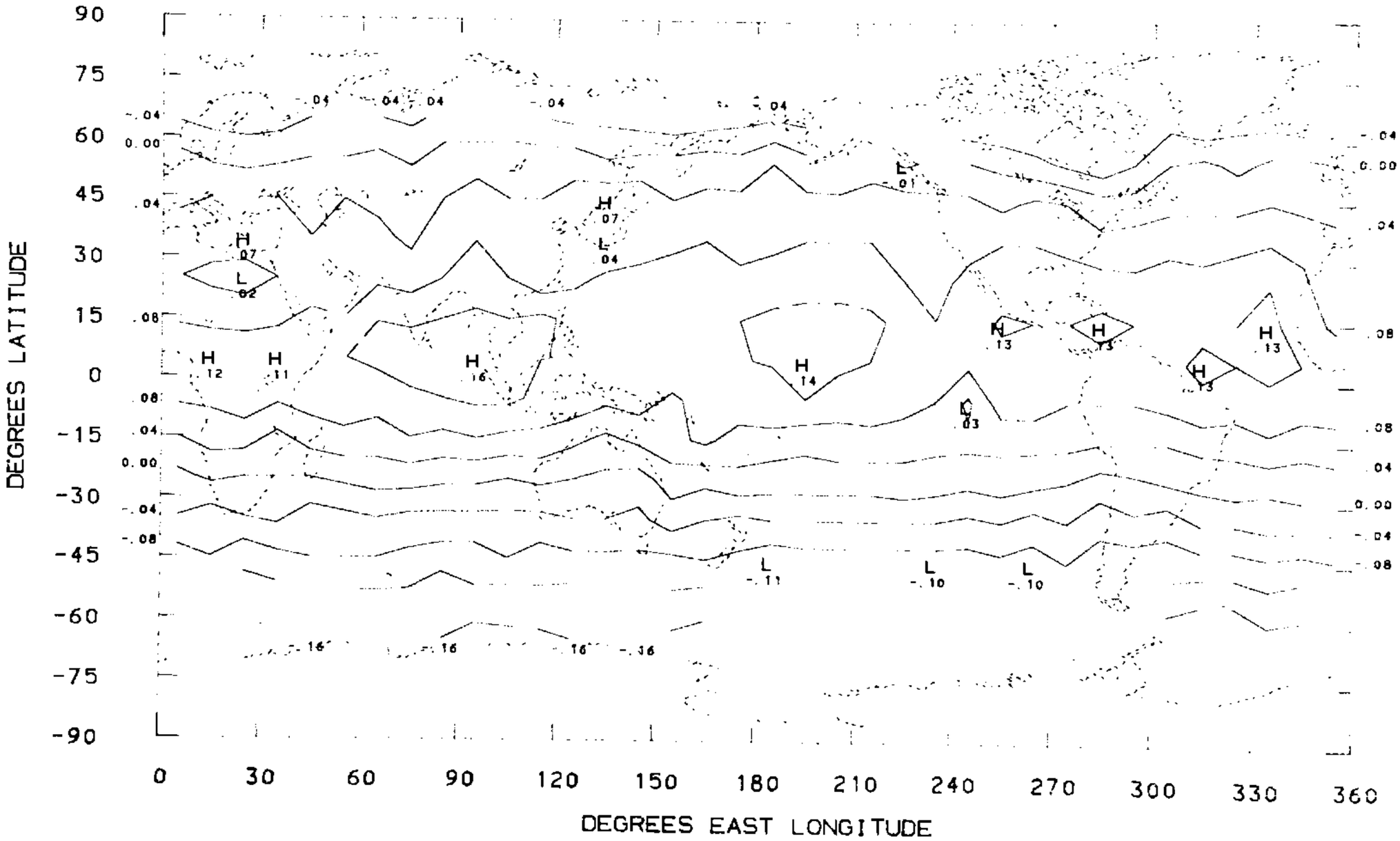
LONGWAVE RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN MAR APR MAY



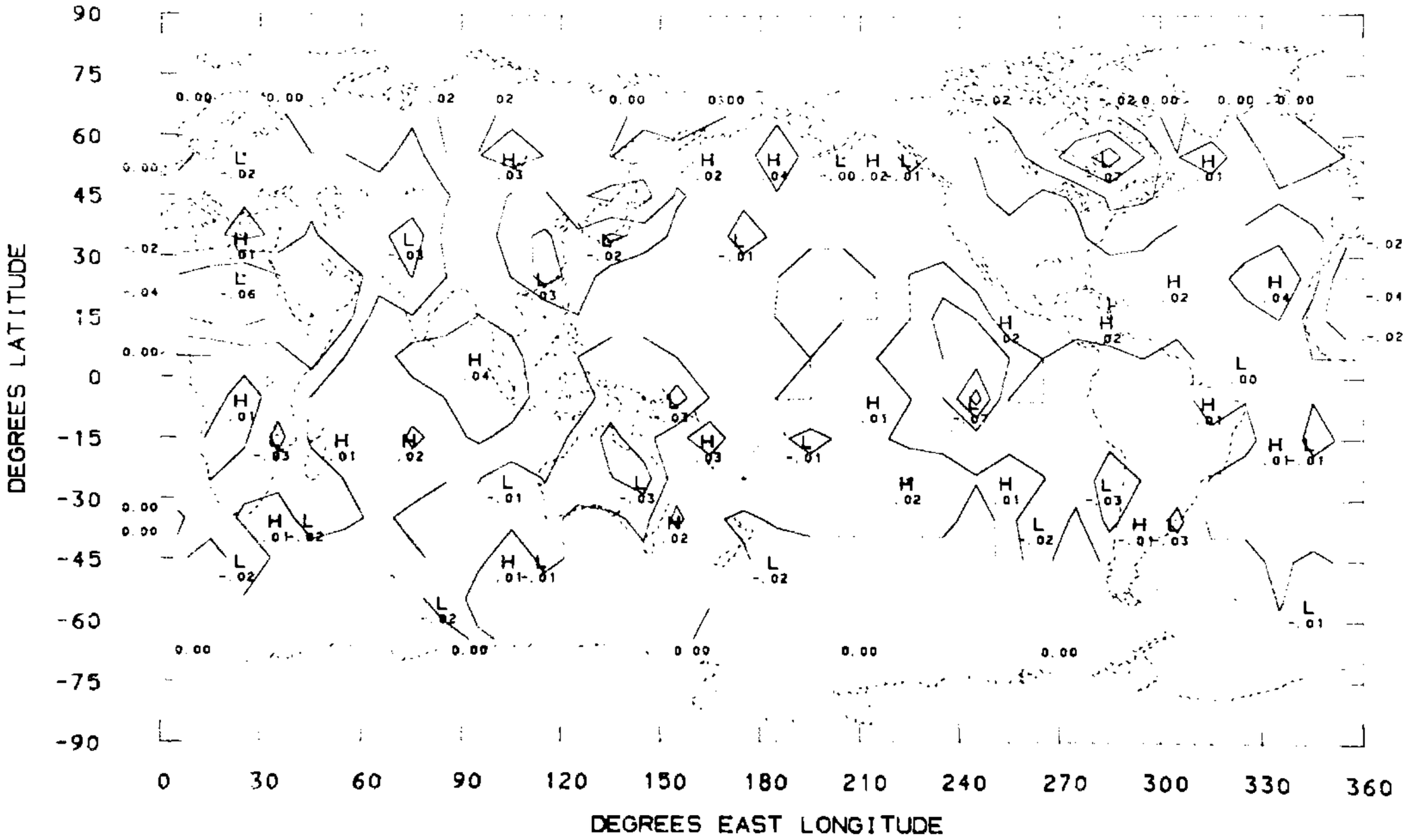
NET RADIATION (LY/MIN)

MEAN MAR APR MAY



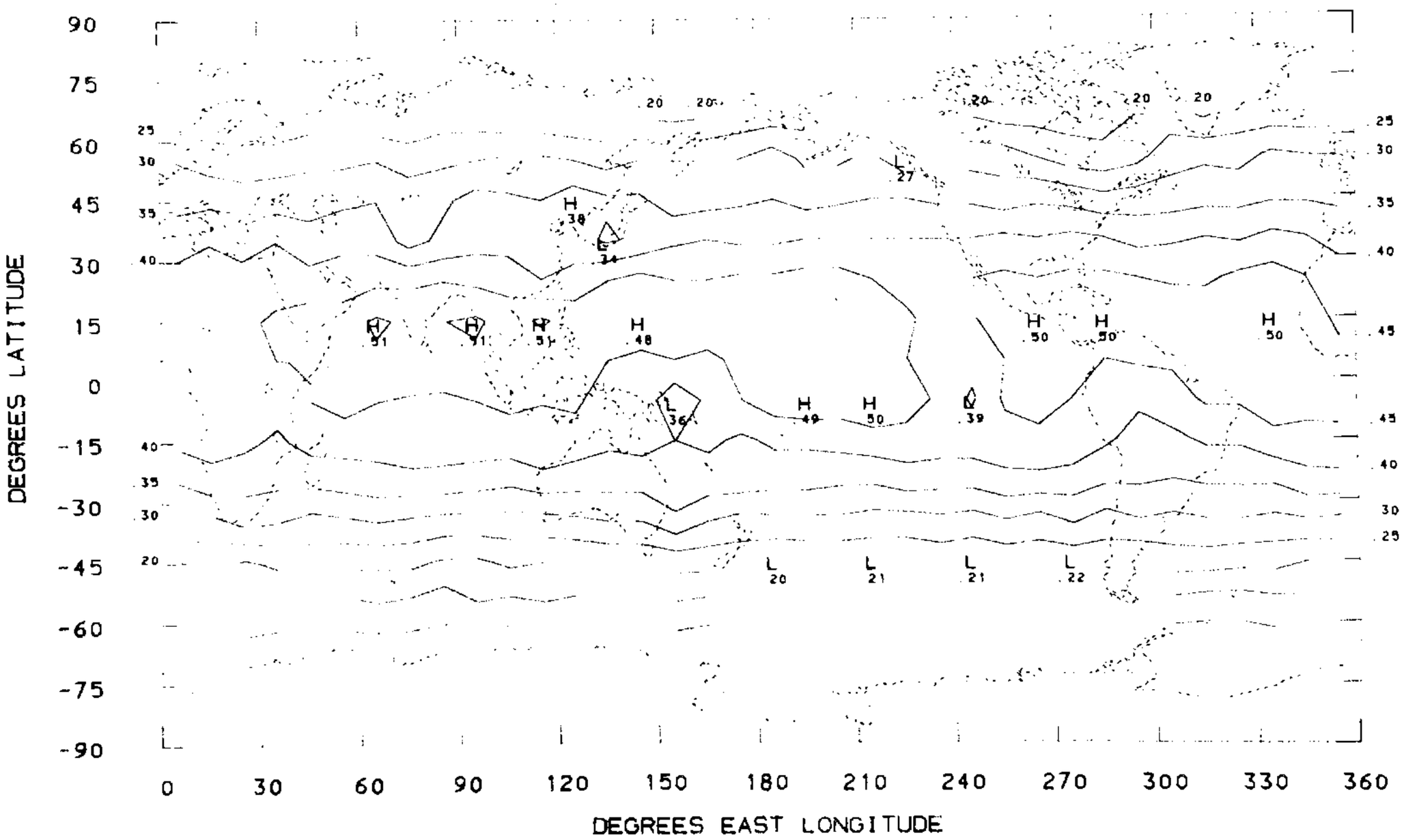
NET RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN MAR APR MAY



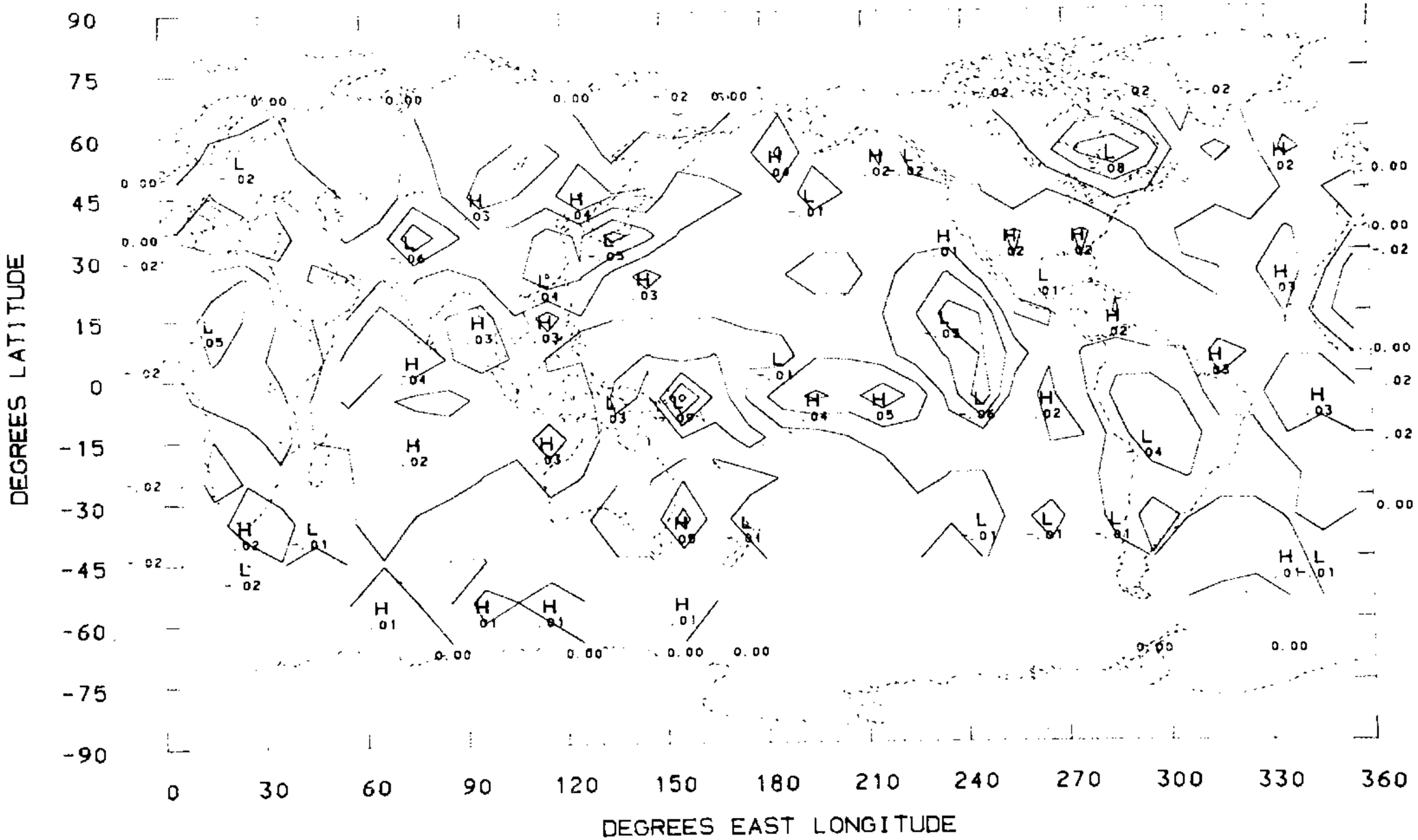
ABSORBED RADIATION (LY/MIN)

MEAN MAR APR MAY



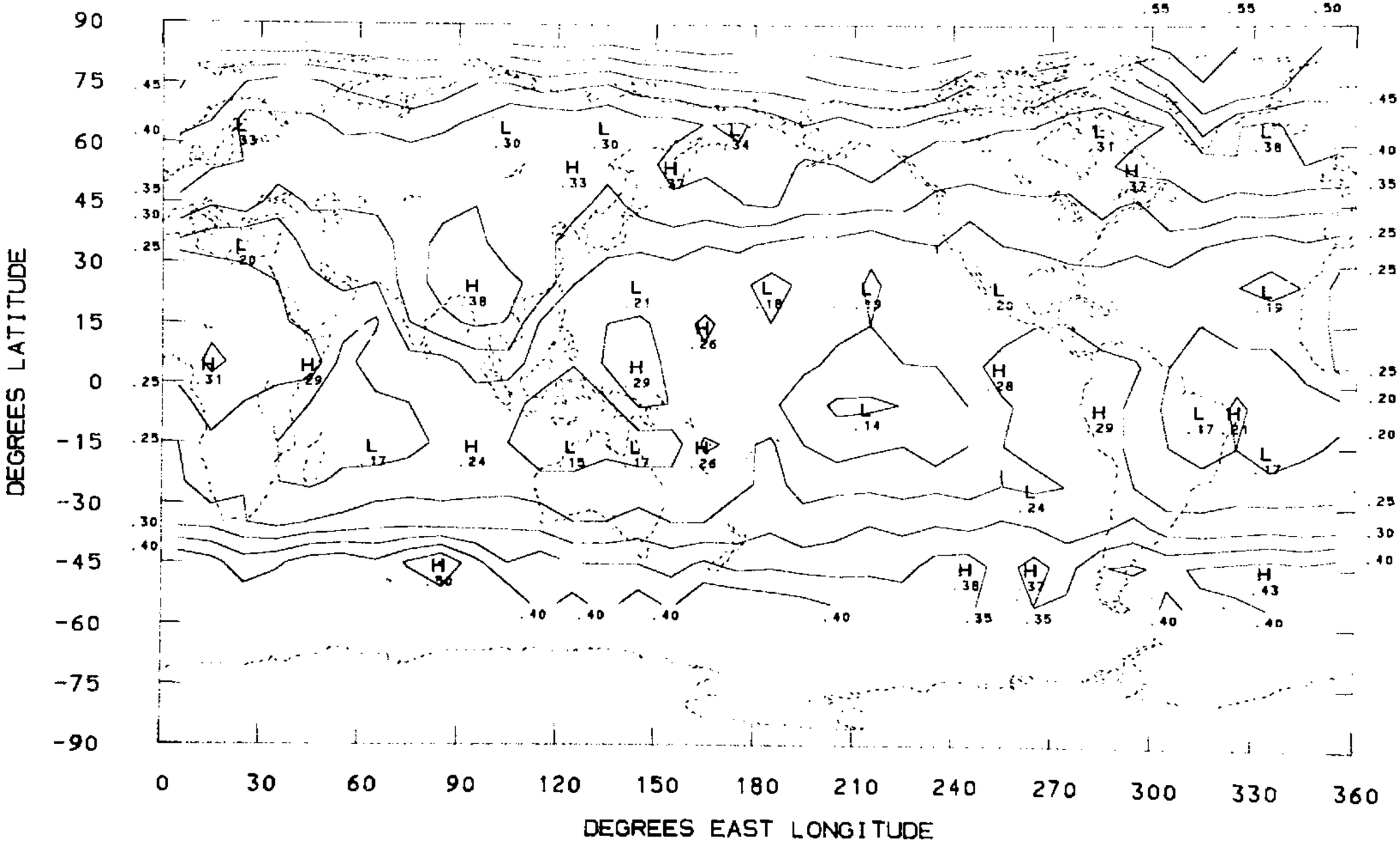
ABSORBED RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN MAR APR MAY



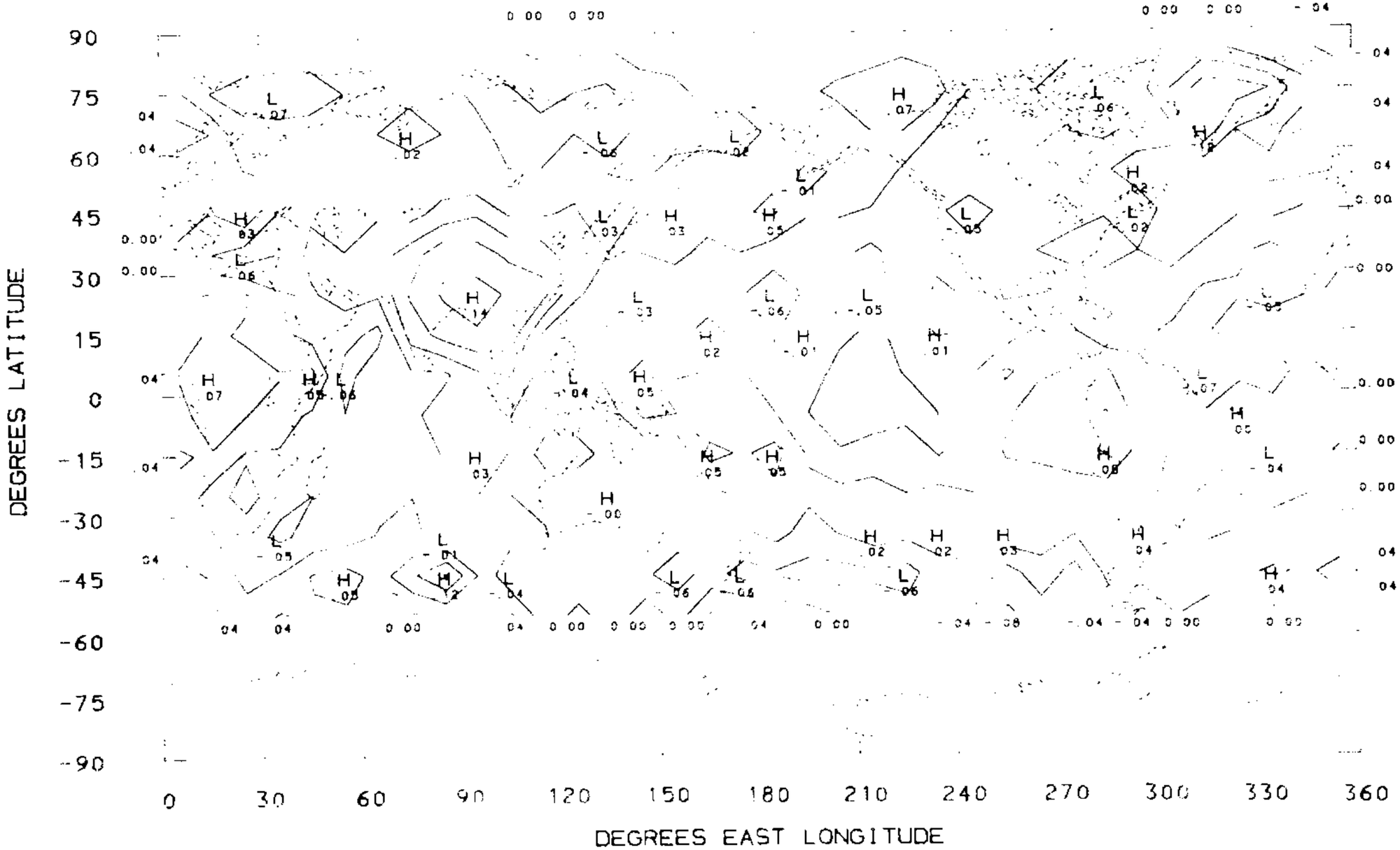
PLANETARY ALBEDO

MEAN JUN JUL AUG



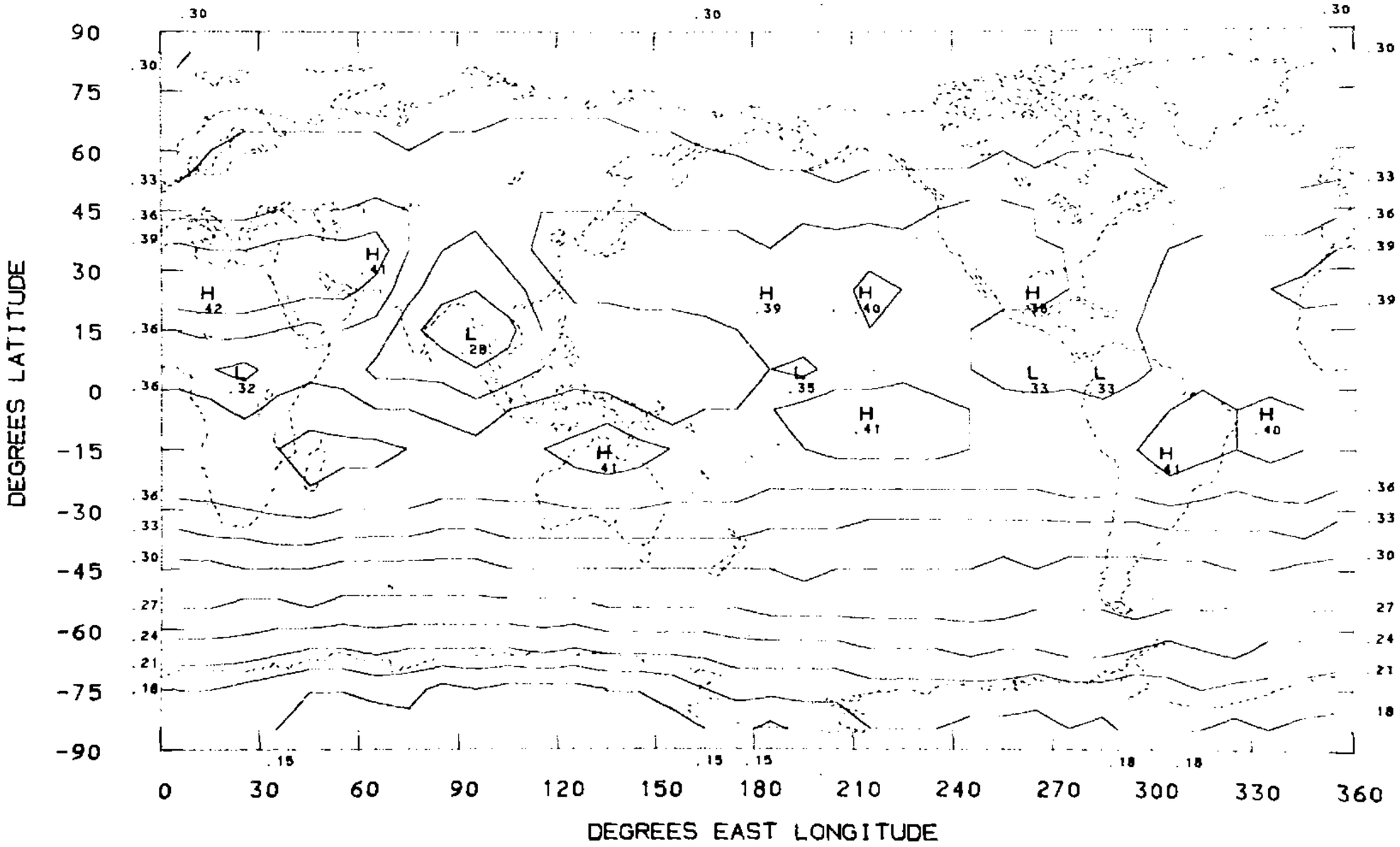
PLANETARY ALBEDO

DEVIATION FROM ZONAL AVG. MEAN JUN JUL AUG



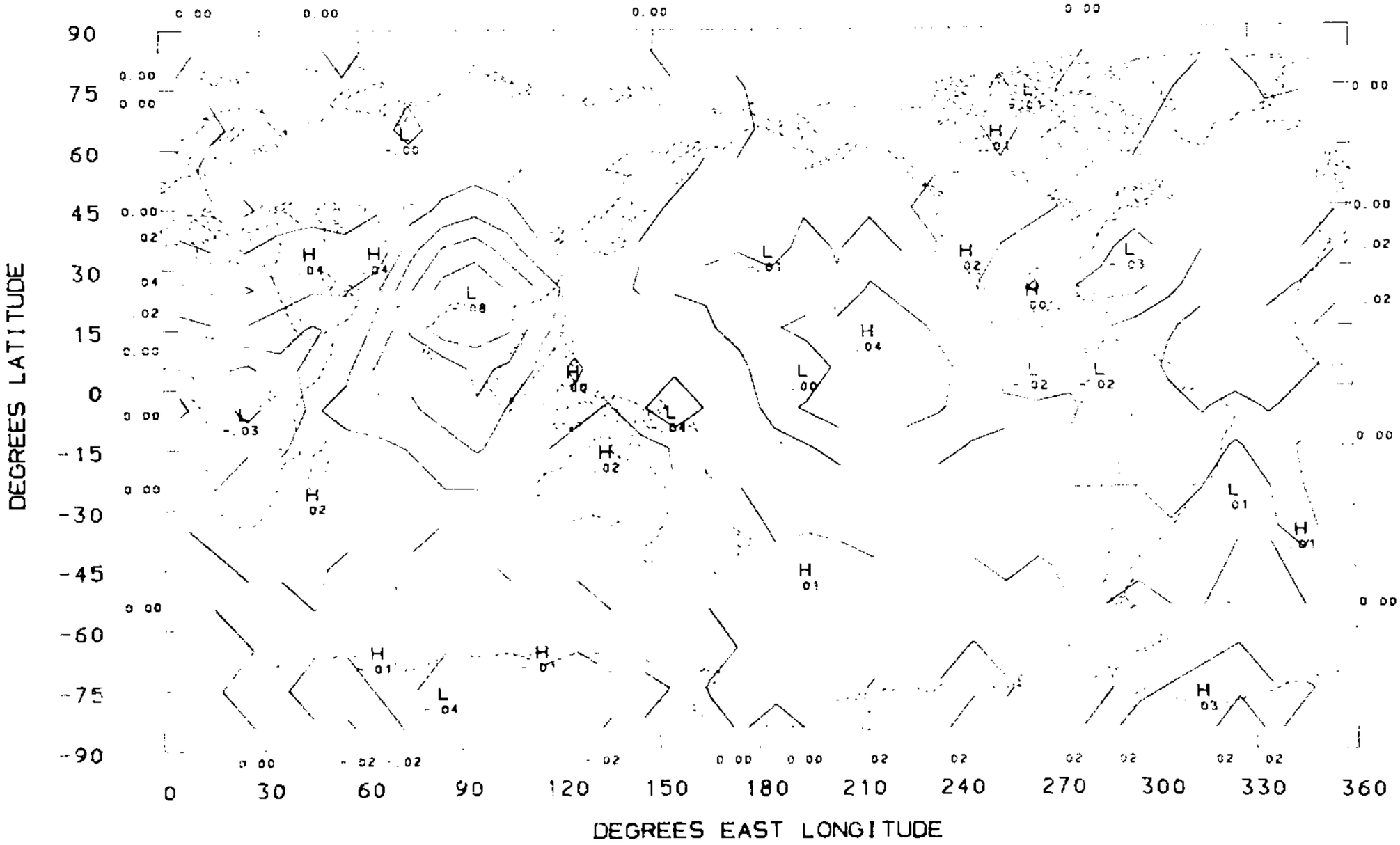
LONGWAVE RADIATION (LY/MIN)

MEAN JUN JUL AUG



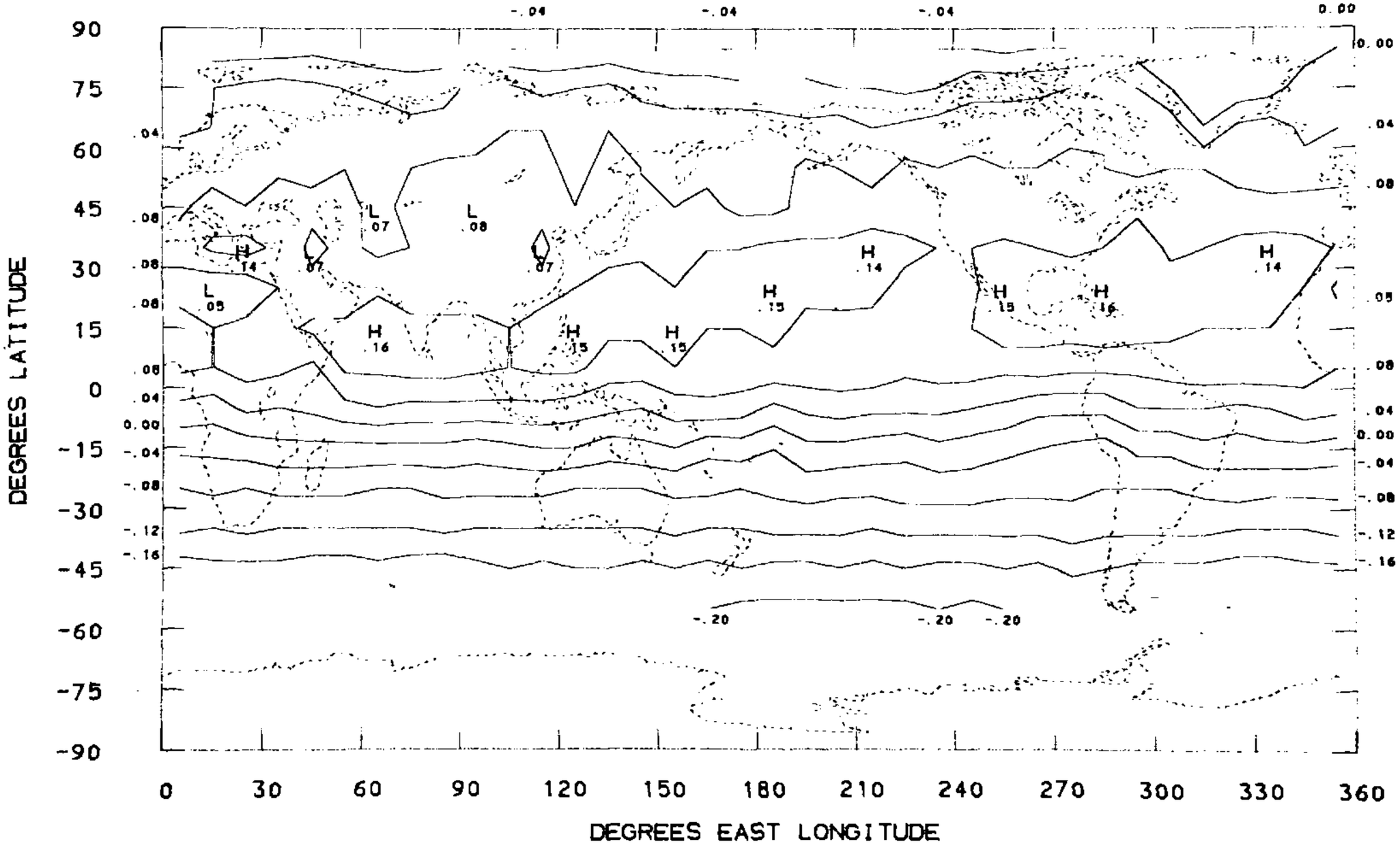
LONGWAVE RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN JUN JUL AUG



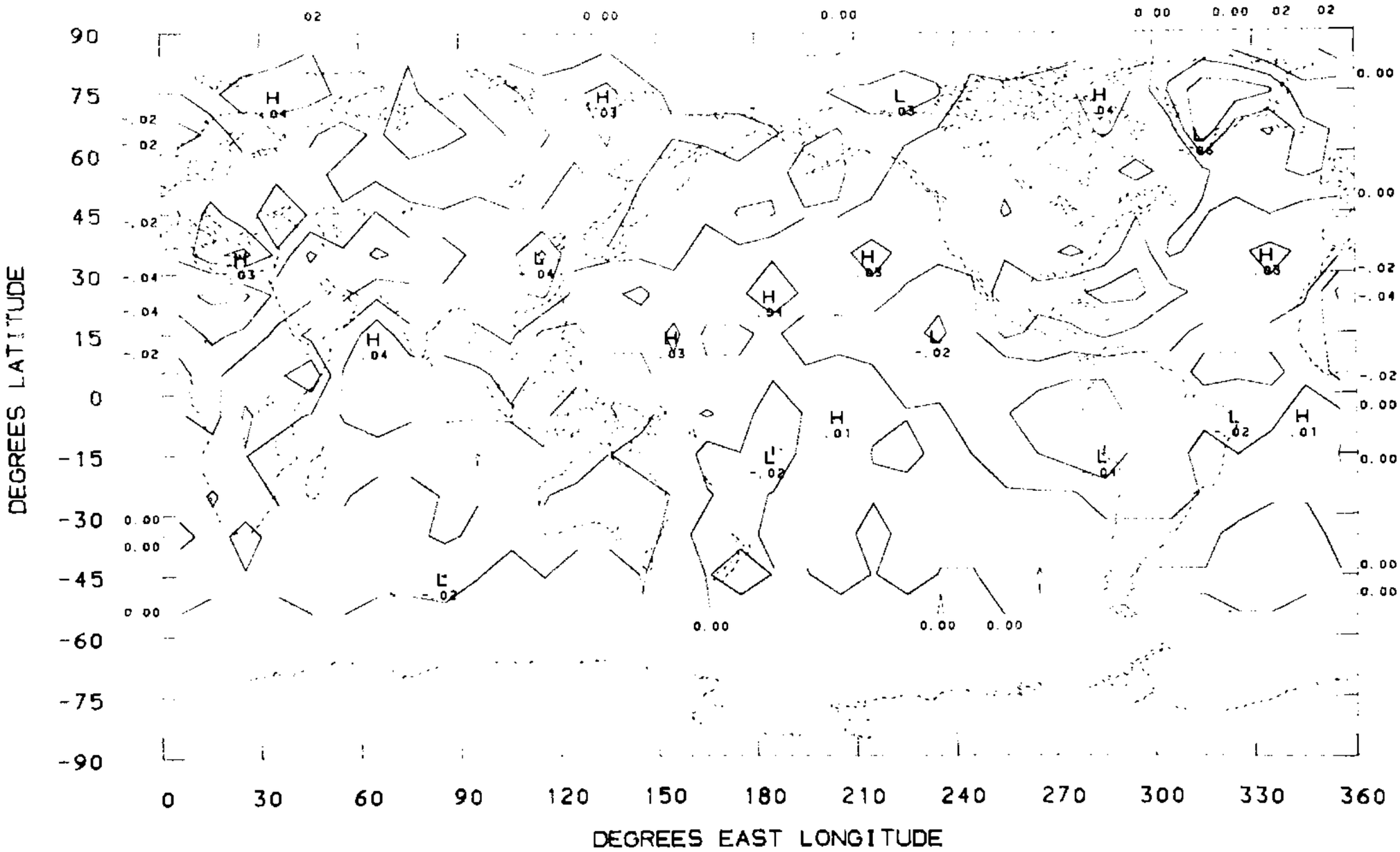
NET RADIATION (LY/MIN)

MEAN JUN JUL AUG



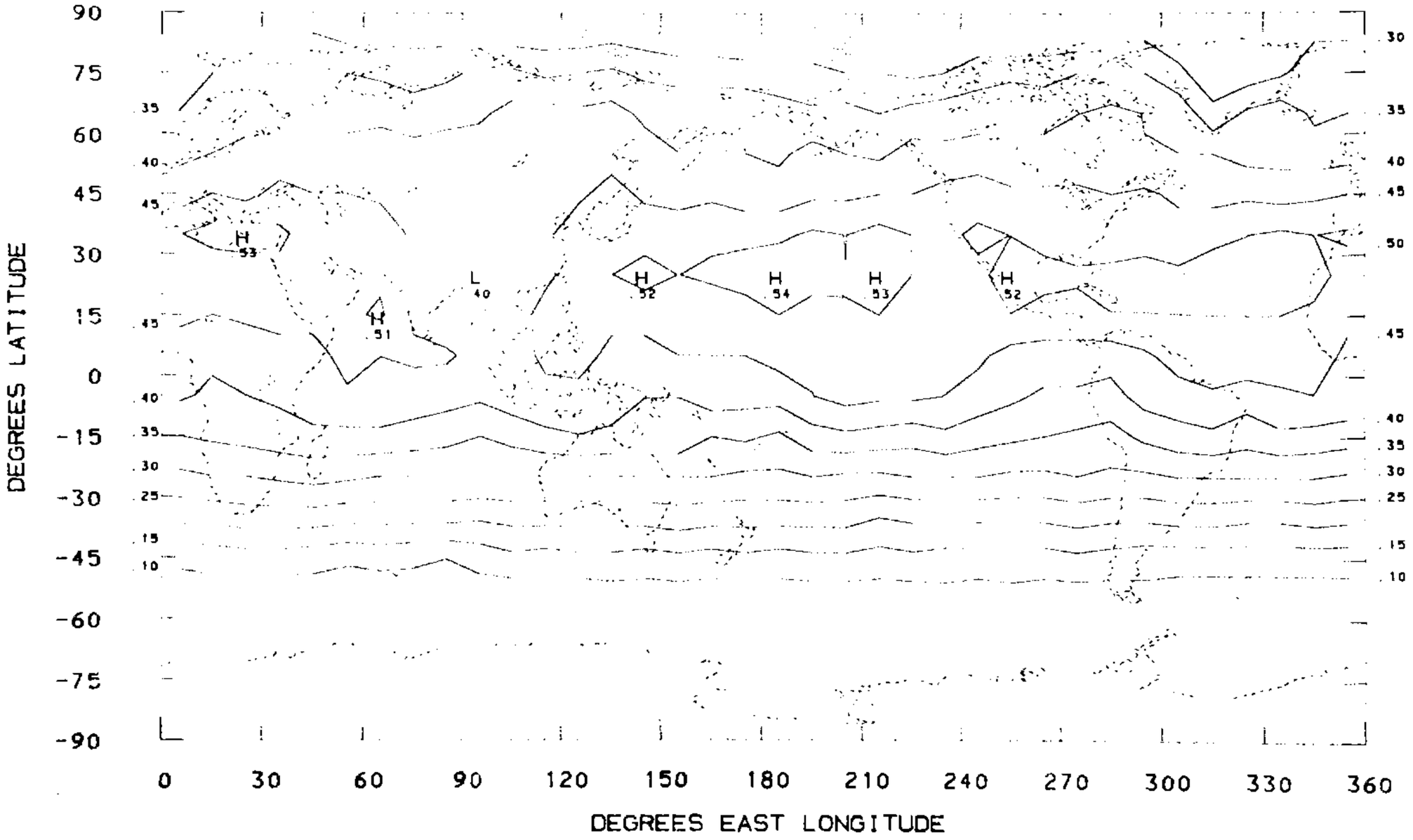
NET RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN JUN JUL AUG



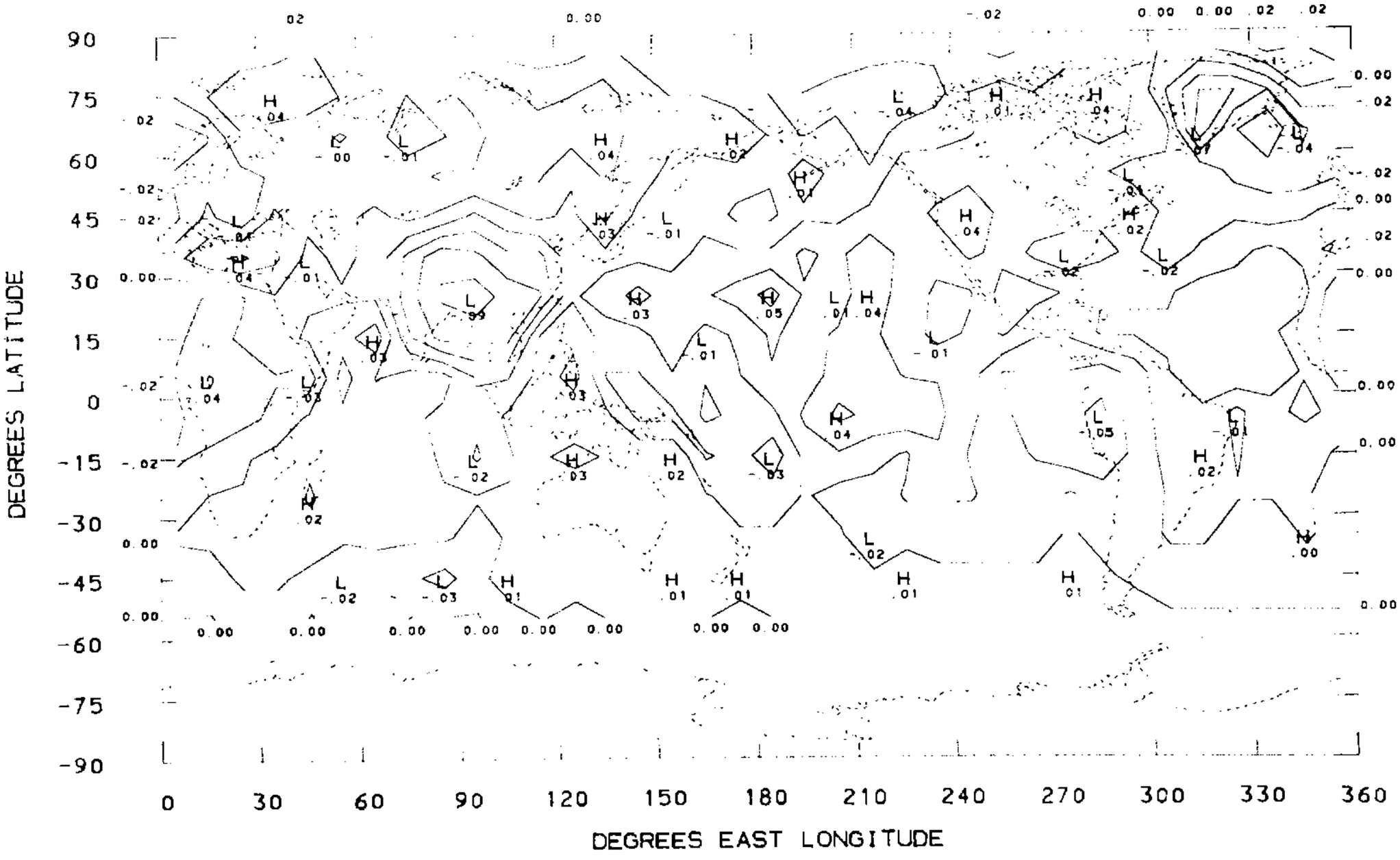
ABSORBED RADIATION (LY/MIN)

MEAN JUN JUL AUG



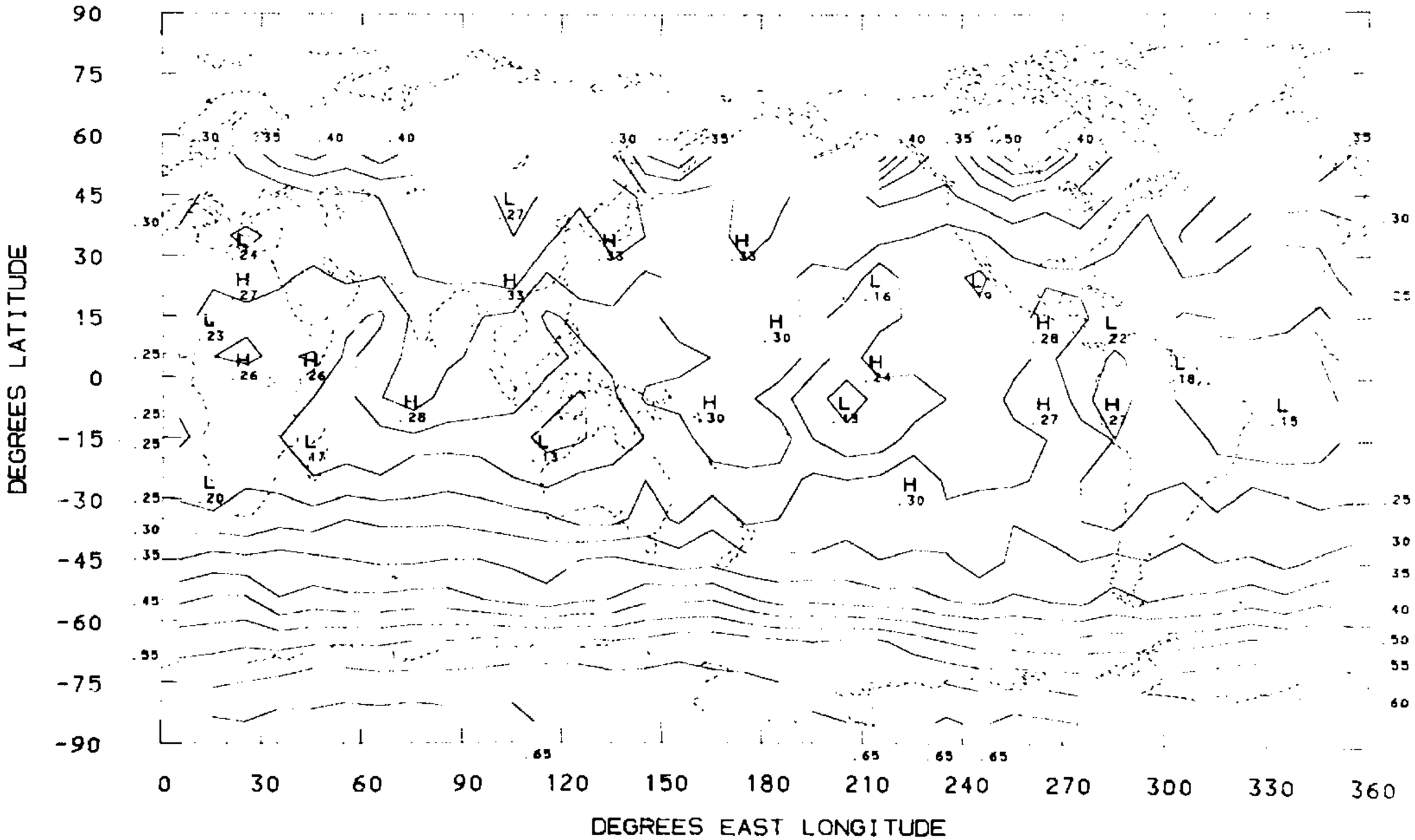
ABSORBED RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN JUN JUL AUG



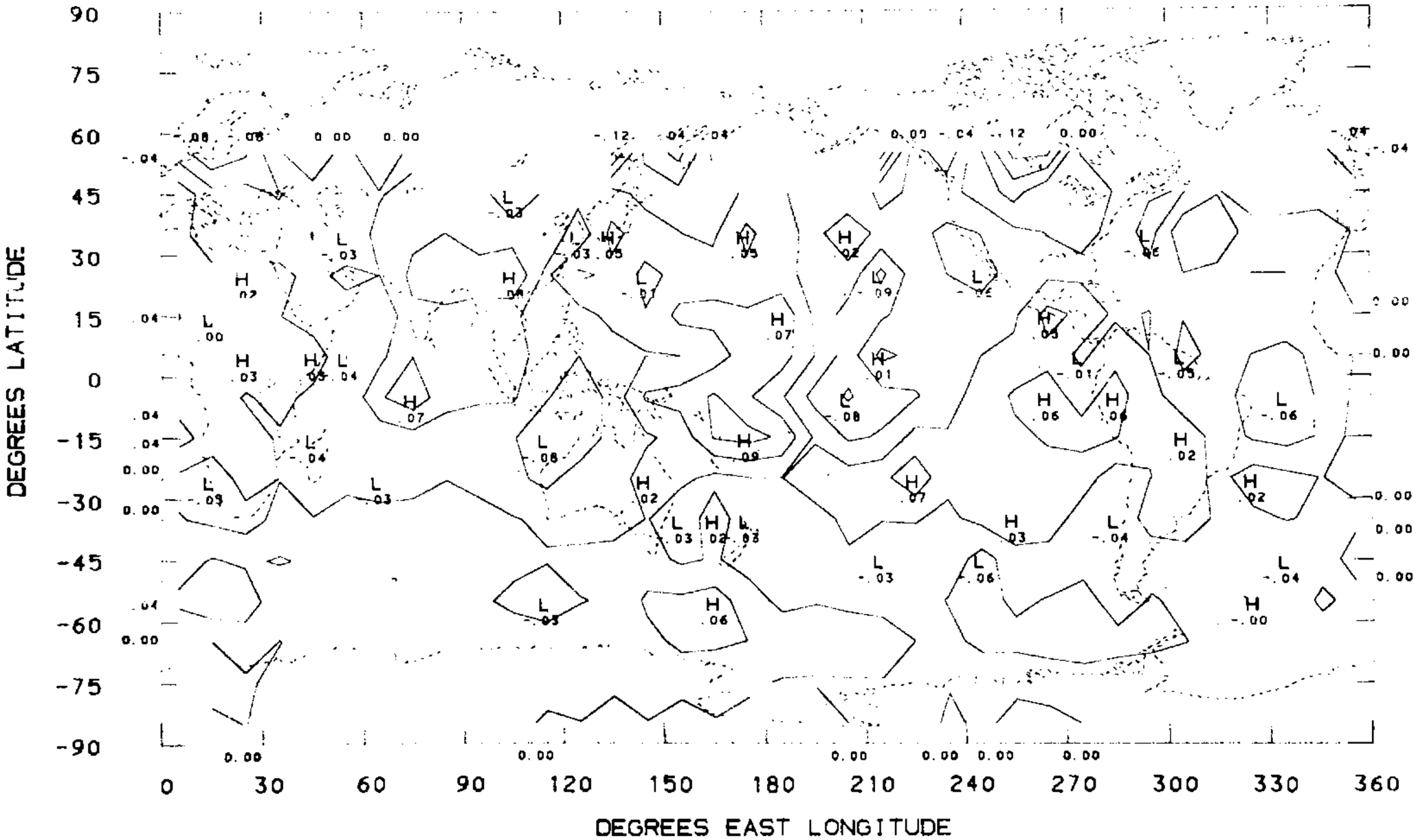
PLANETARY ALBEDO

MEAN SEP OCT NOV



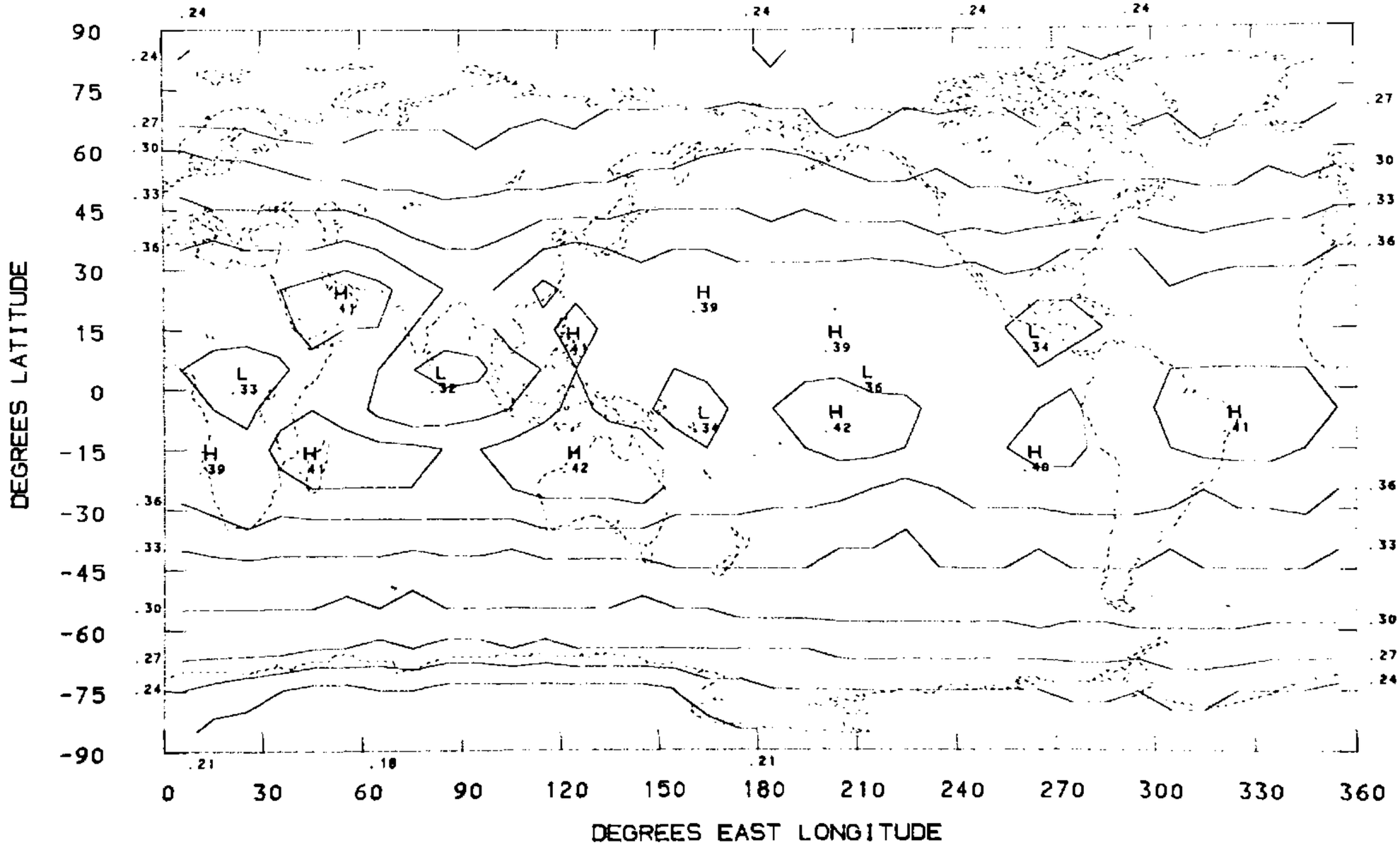
PLANETARY ALBEDO

DEVIATION FROM ZONAL AVG. MEAN SEP OCT NOV



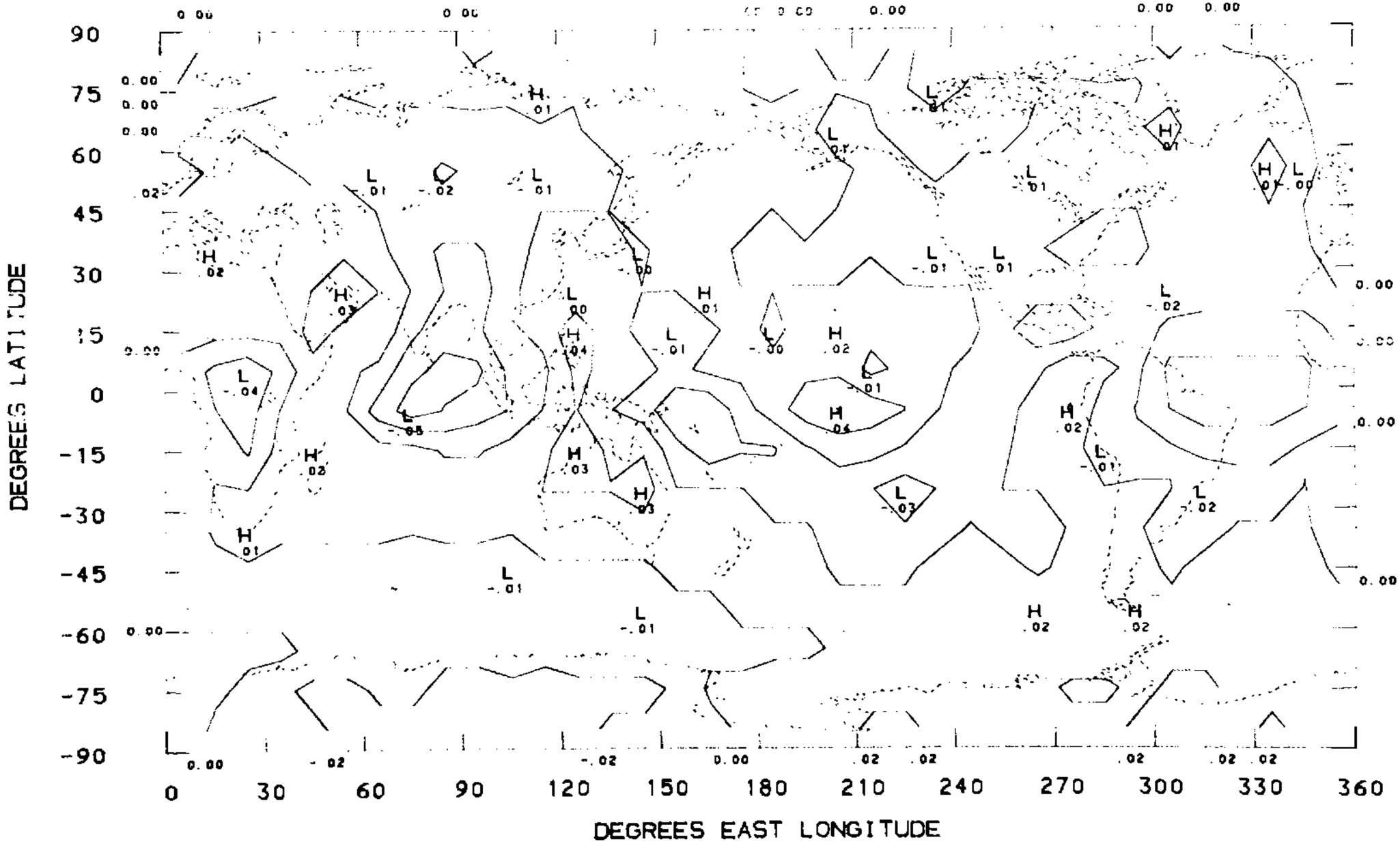
LONGWAVE RADIATION (LY/MIN)

MEAN SEP OCT NOV



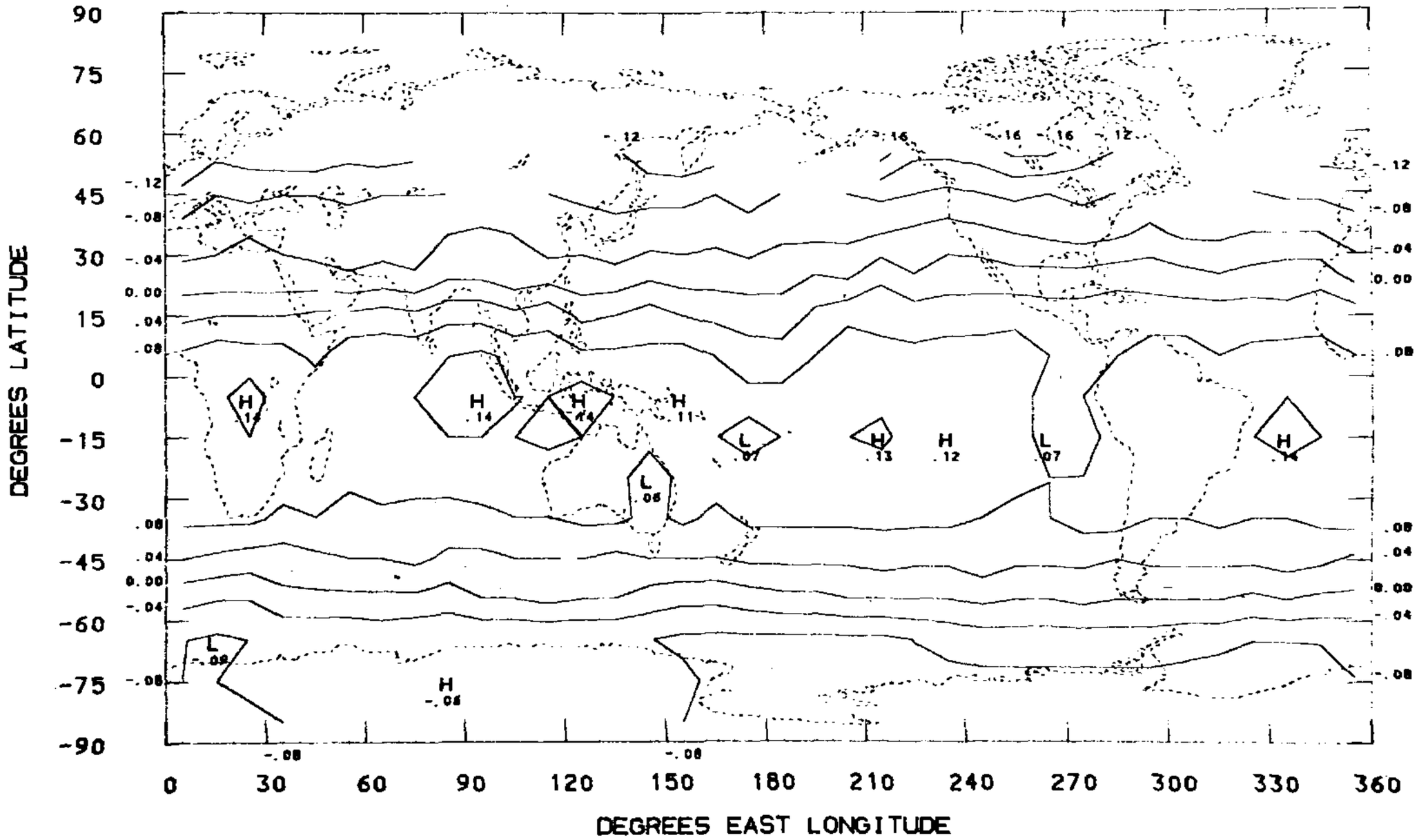
LONGWAVE RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN SEP OCT NOV



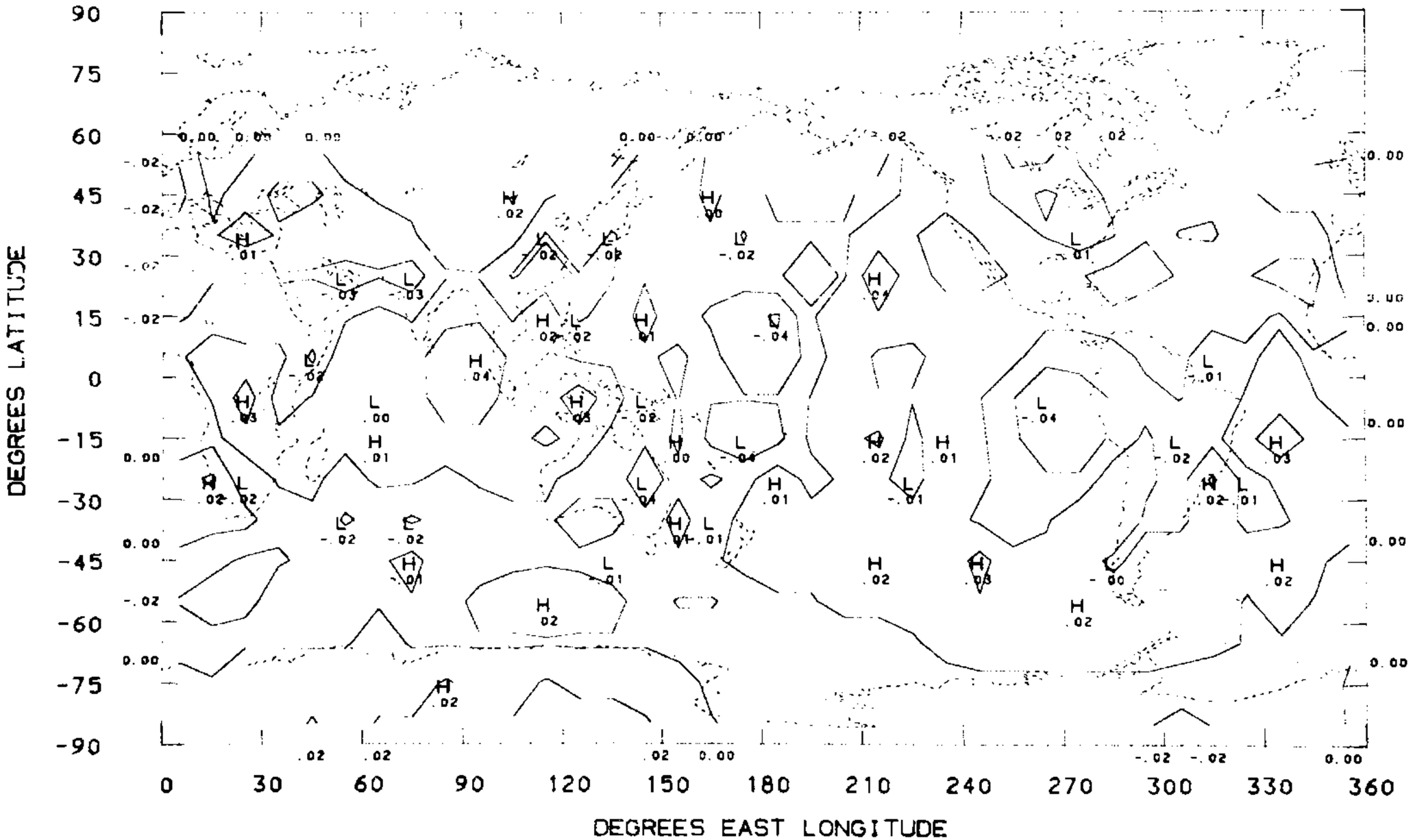
NET RADIATION (LY/MIN)

MEAN SEP OCT NOV



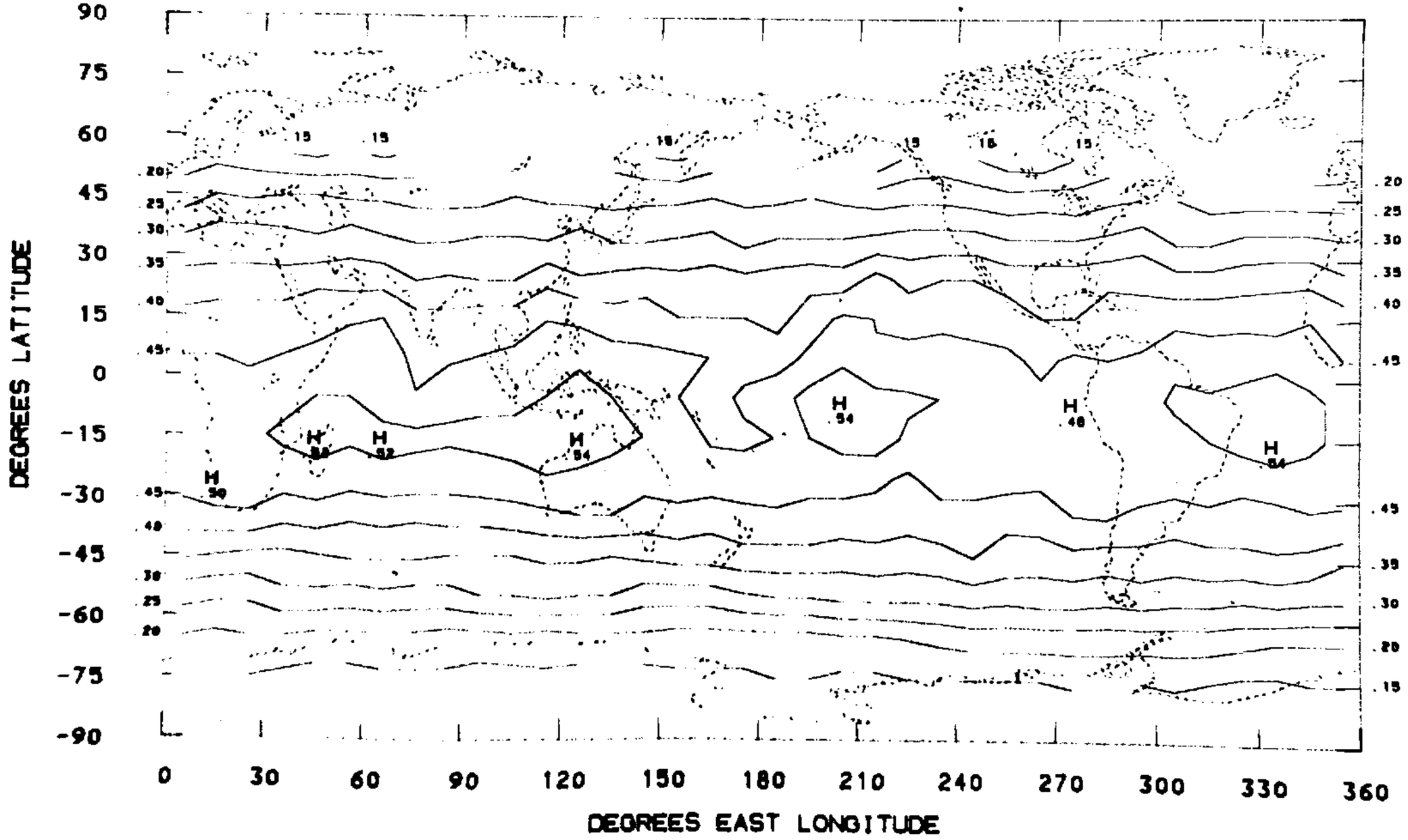
NET RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN SEP OCT NOV



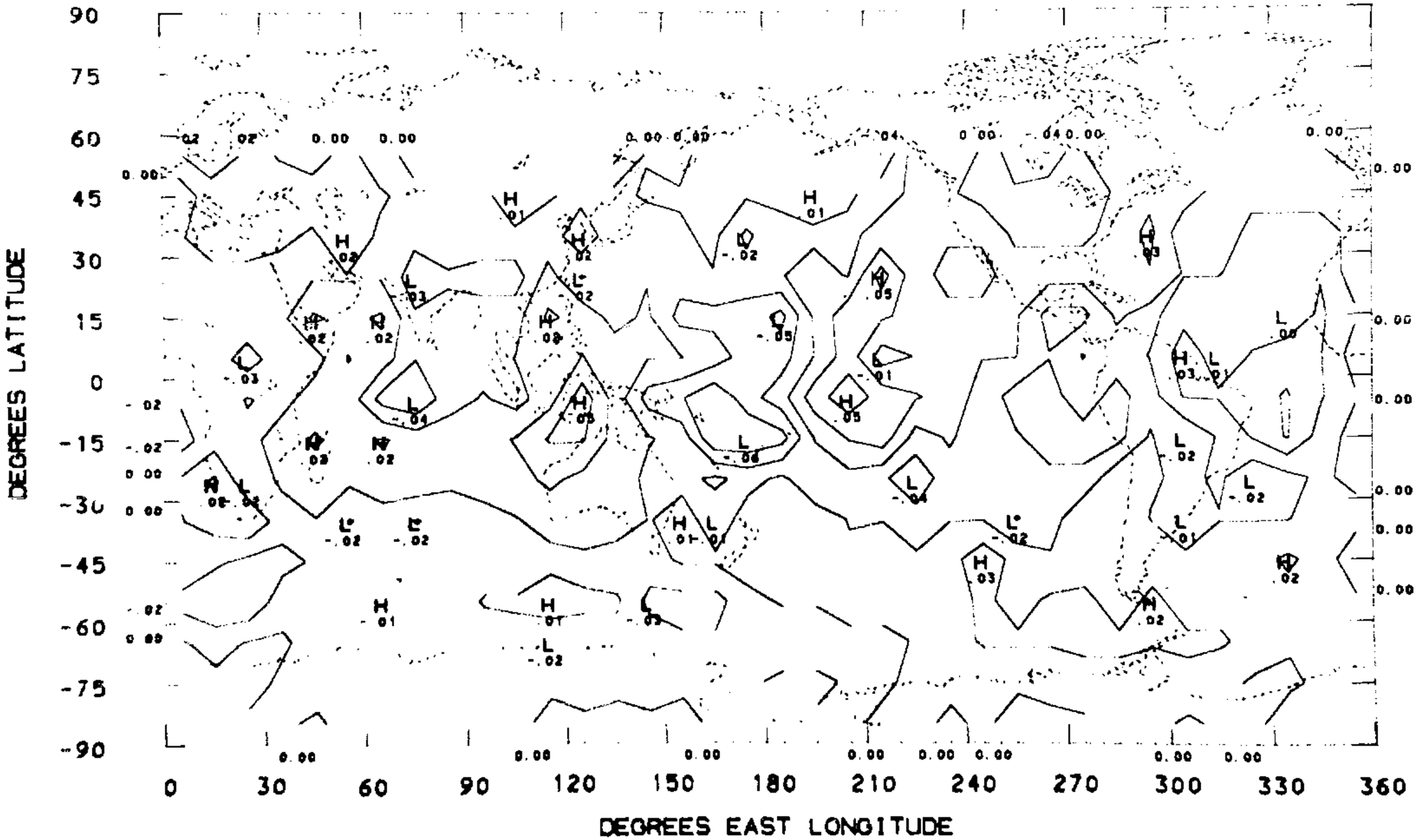
ABSORBED RADIATION (LY/MIN)

MEAN SEP OCT NOV



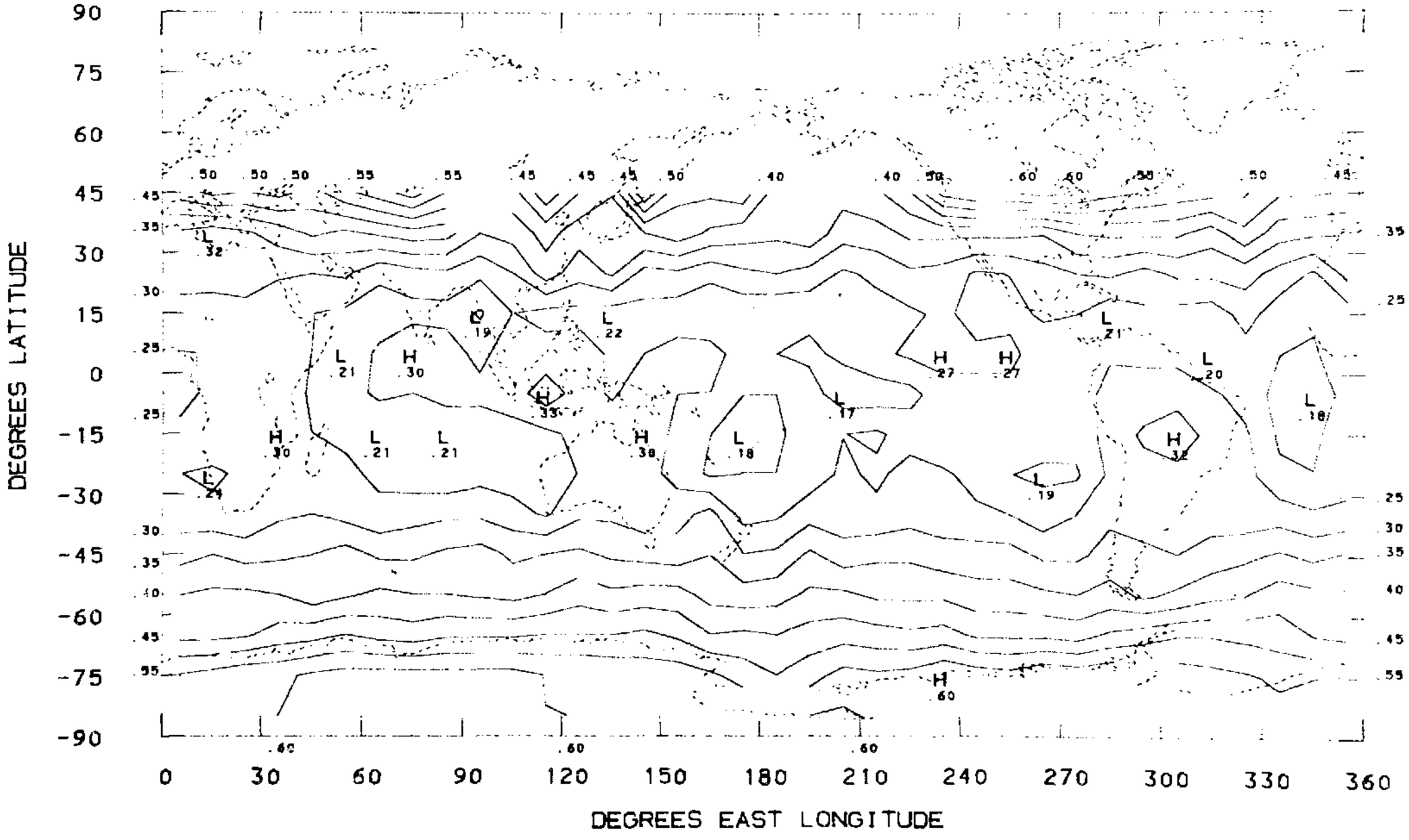
ABSORBED RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN SEP OCT NOV



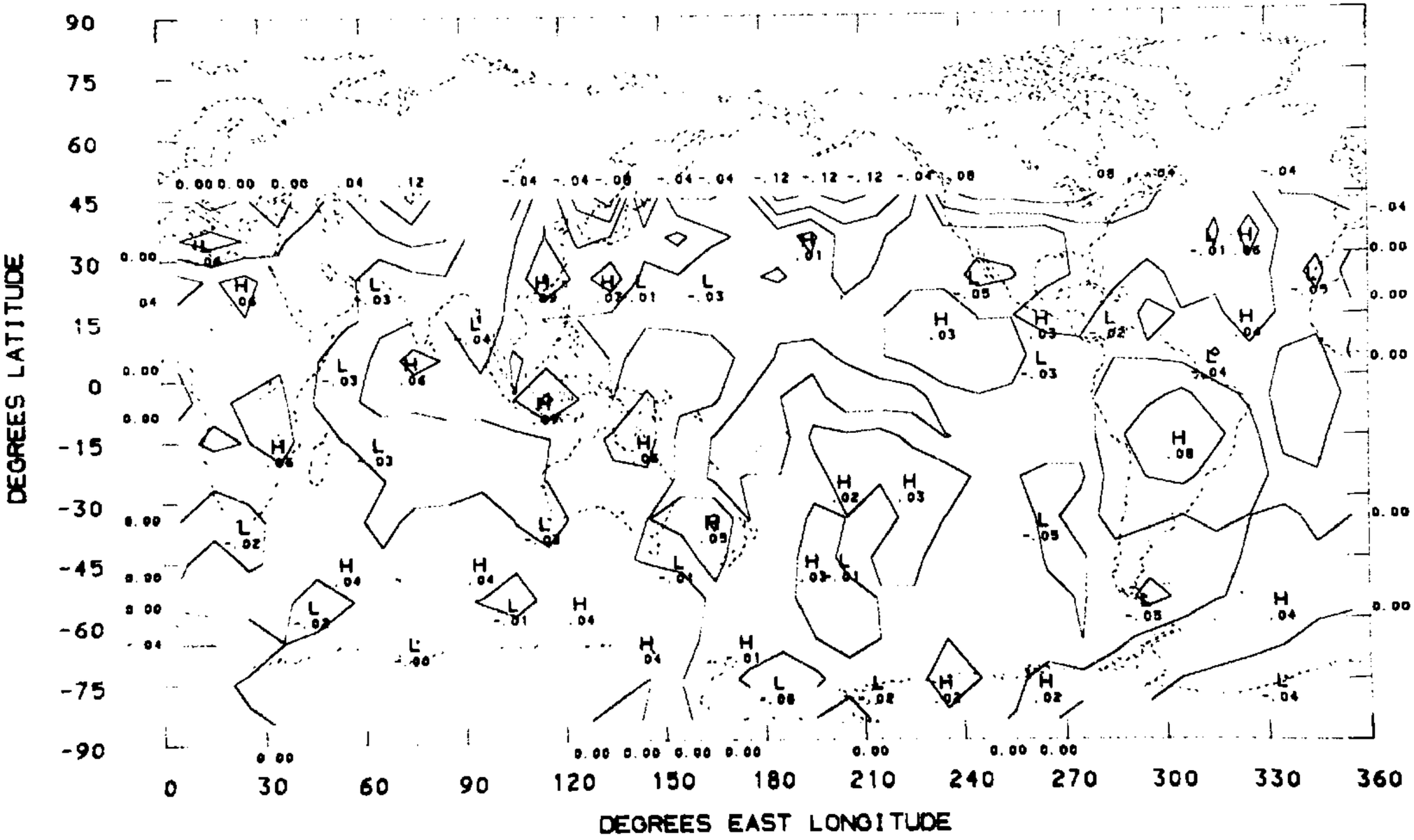
PLANETARY ALBEDO

MEAN DEC JAN FEB



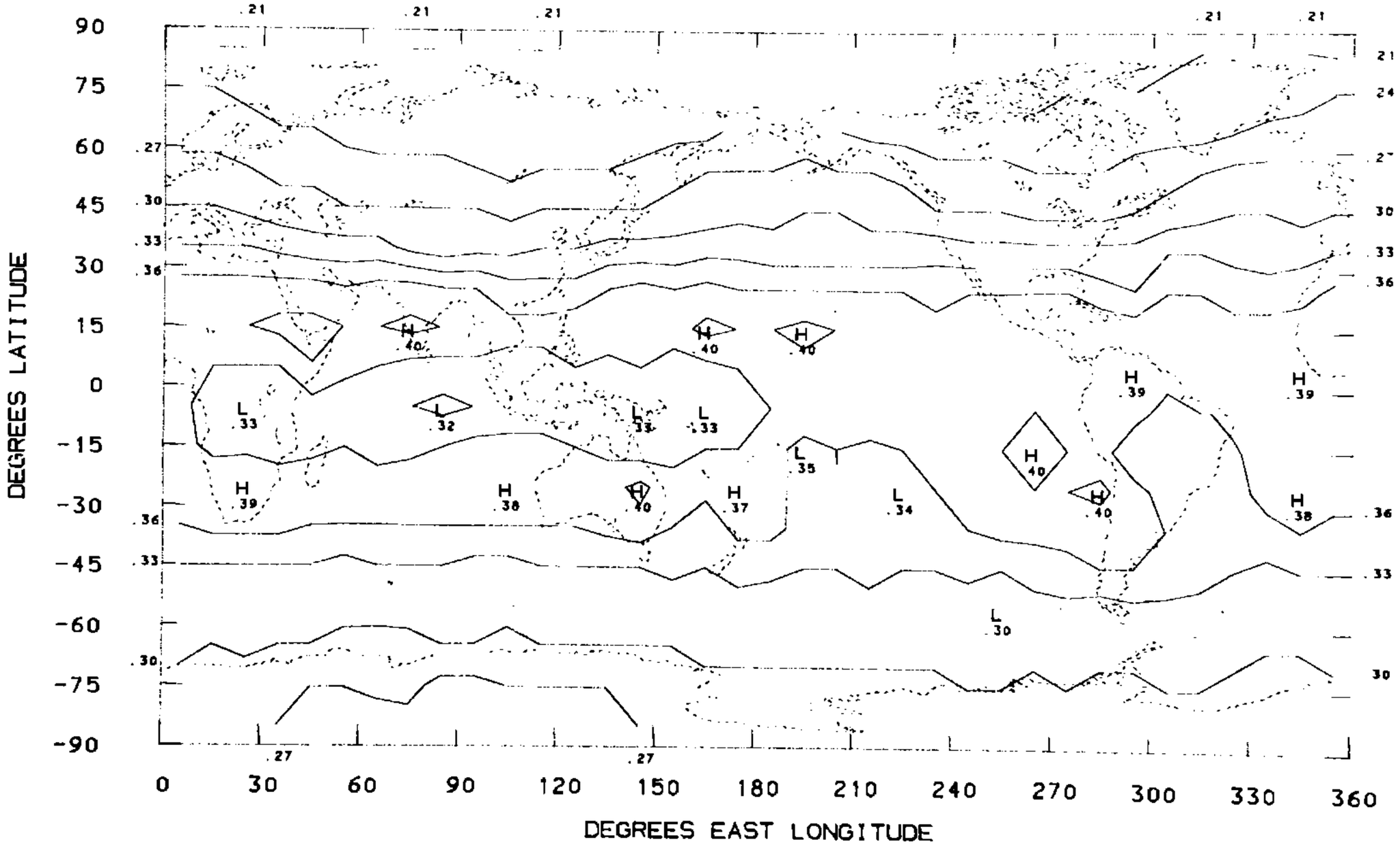
PLANETARY ALBEDO

DEVIATION FROM ZONAL AVG. MEAN DEC JAN FEB



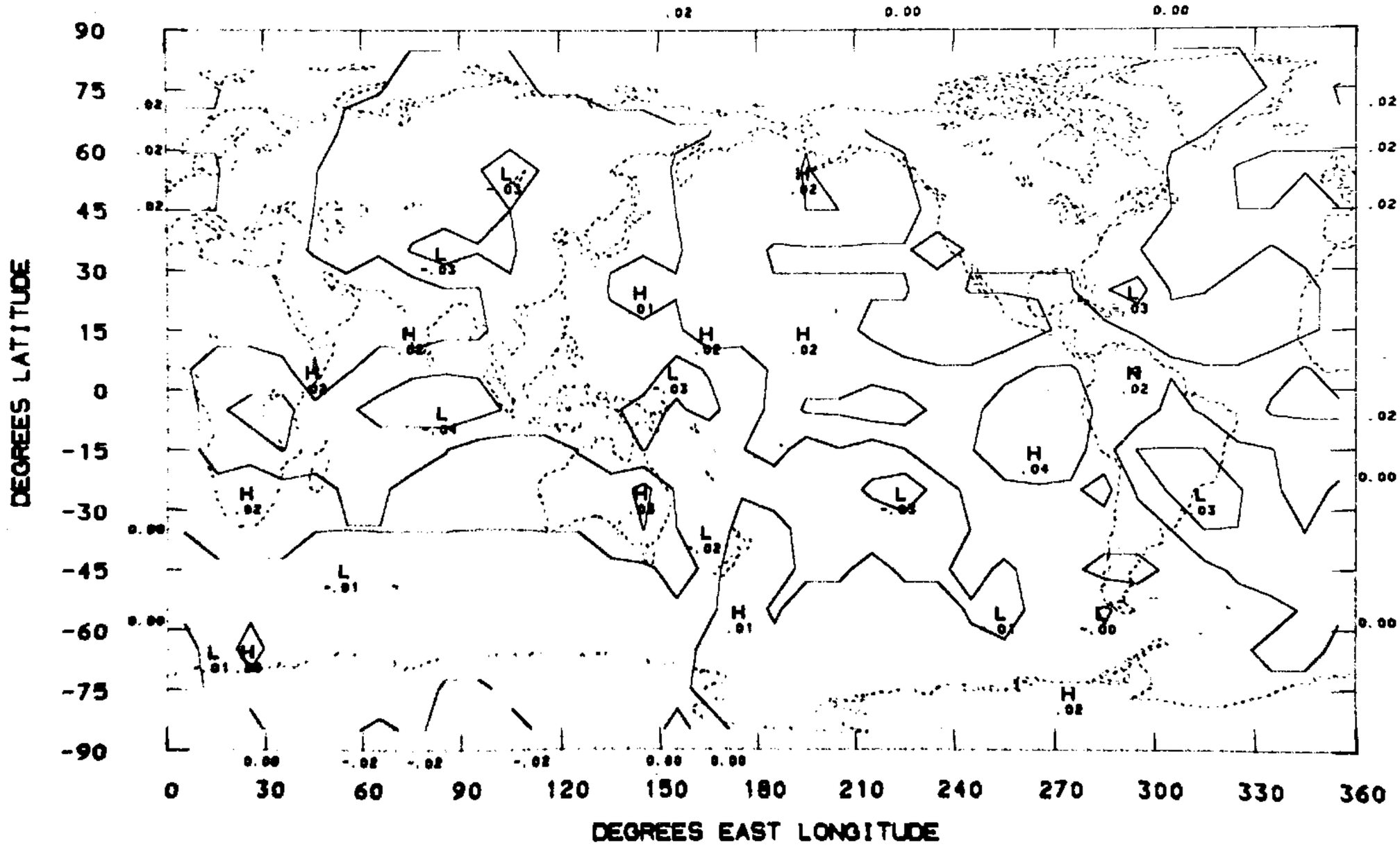
LONGWAVE RADIATION (LY/MIN)

MEAN DEC JAN FEB



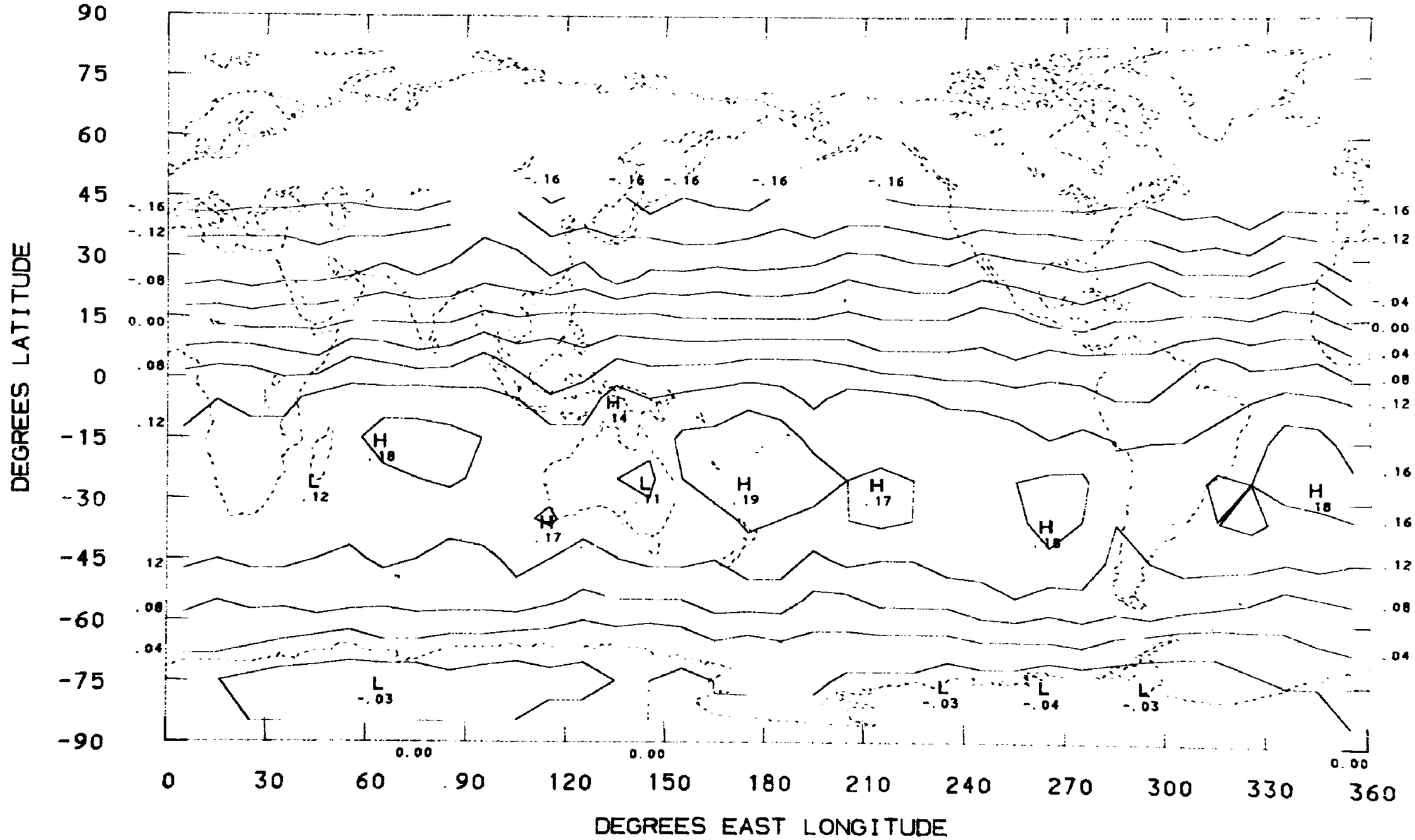
LONGWAVE RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN DEC JAN FEB



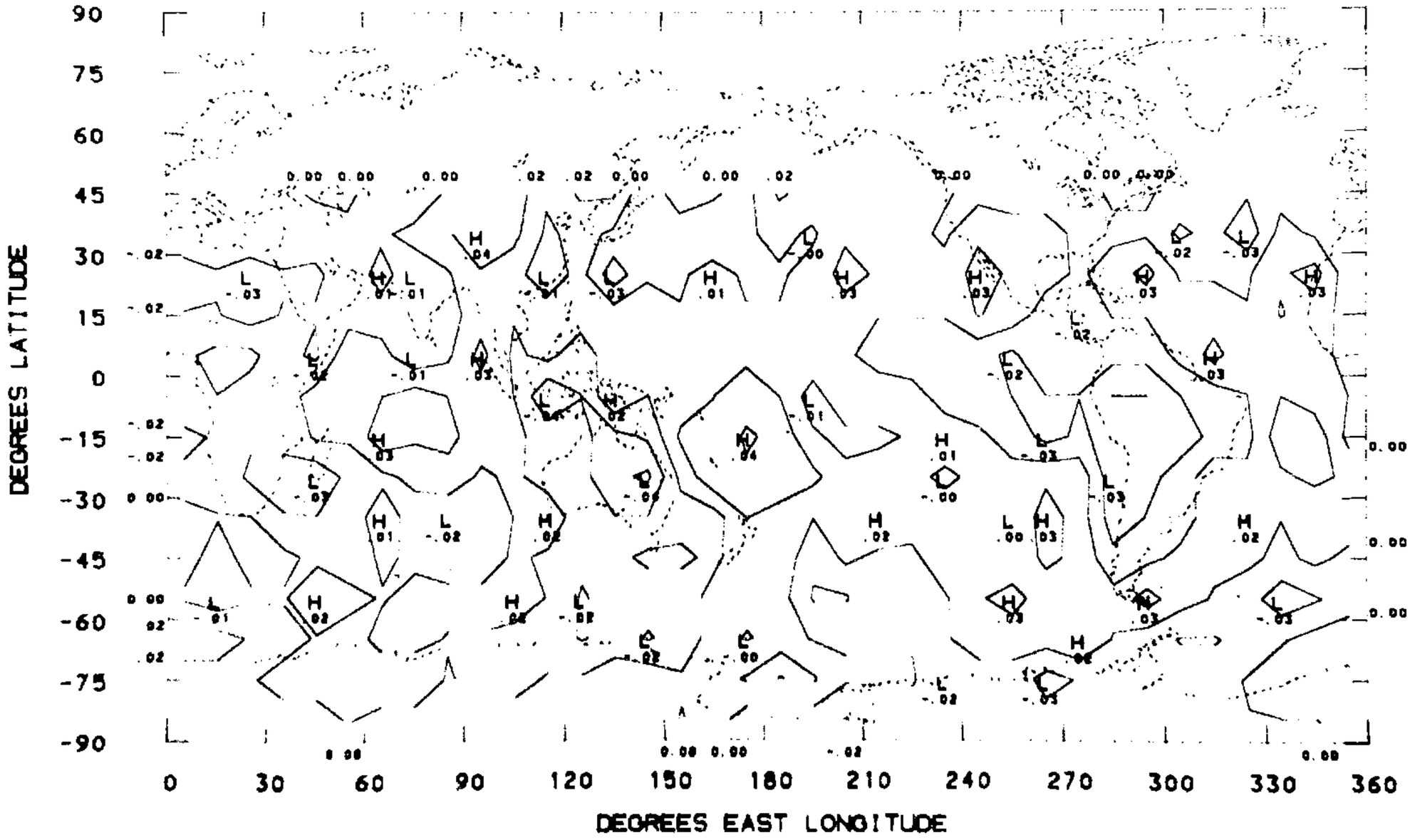
NET RADIATION (LY/MIN)

MEAN DEC JAN FEB



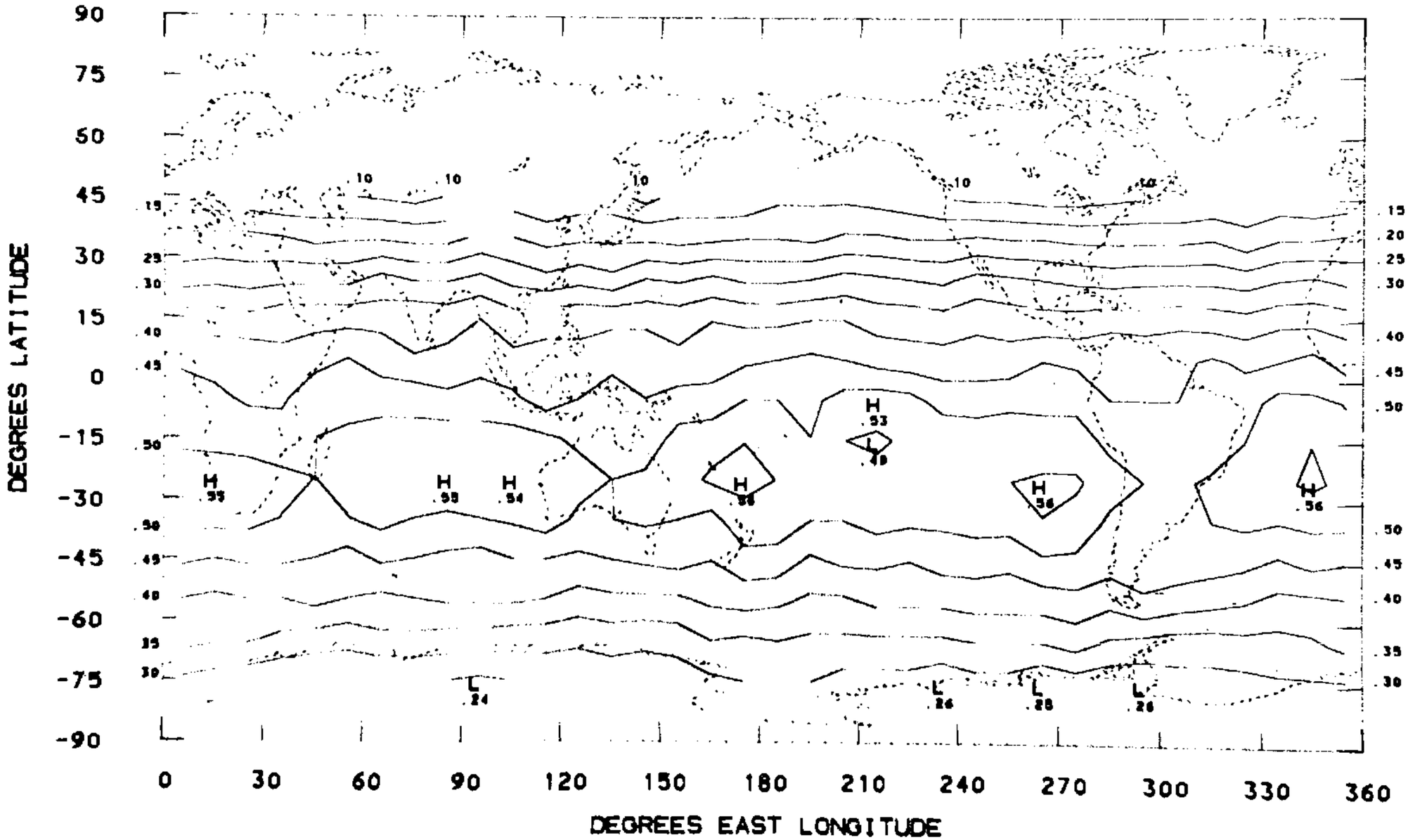
NET RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN DEC JAN FEB



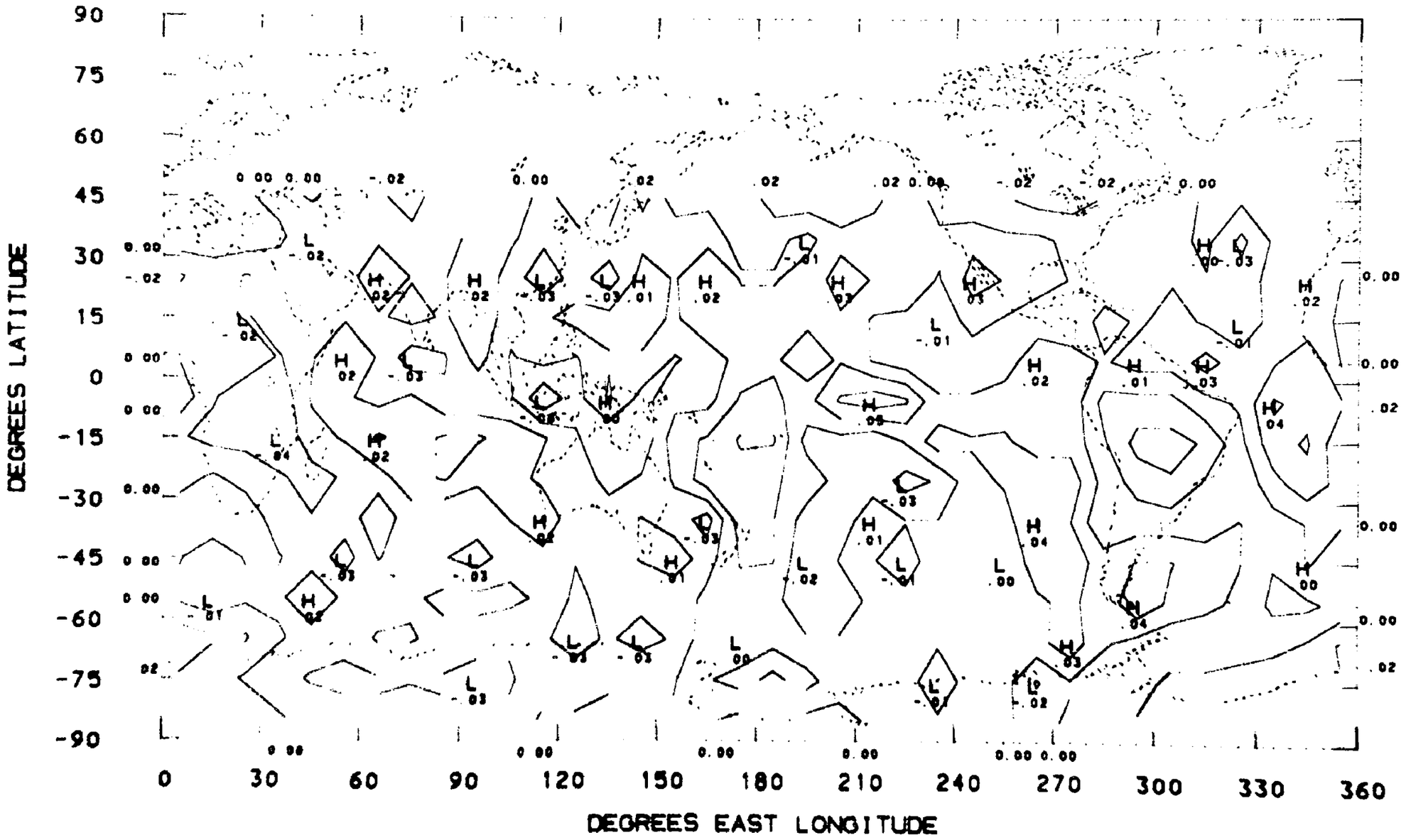
ABSORBED RADIATION (LY/MIN)

MEAN DEC JAN FEB



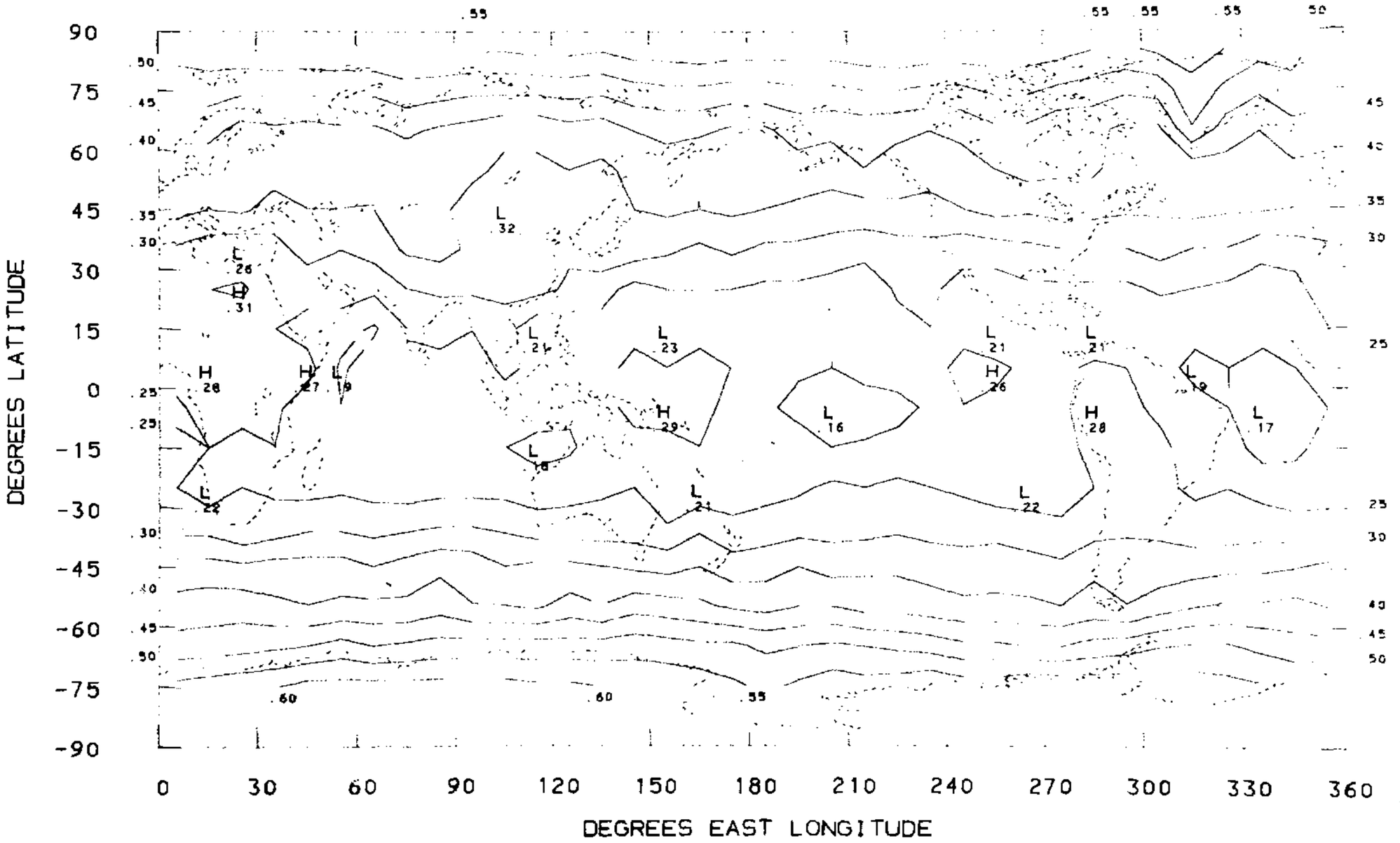
ABSORBED RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN DEC JAN FEB



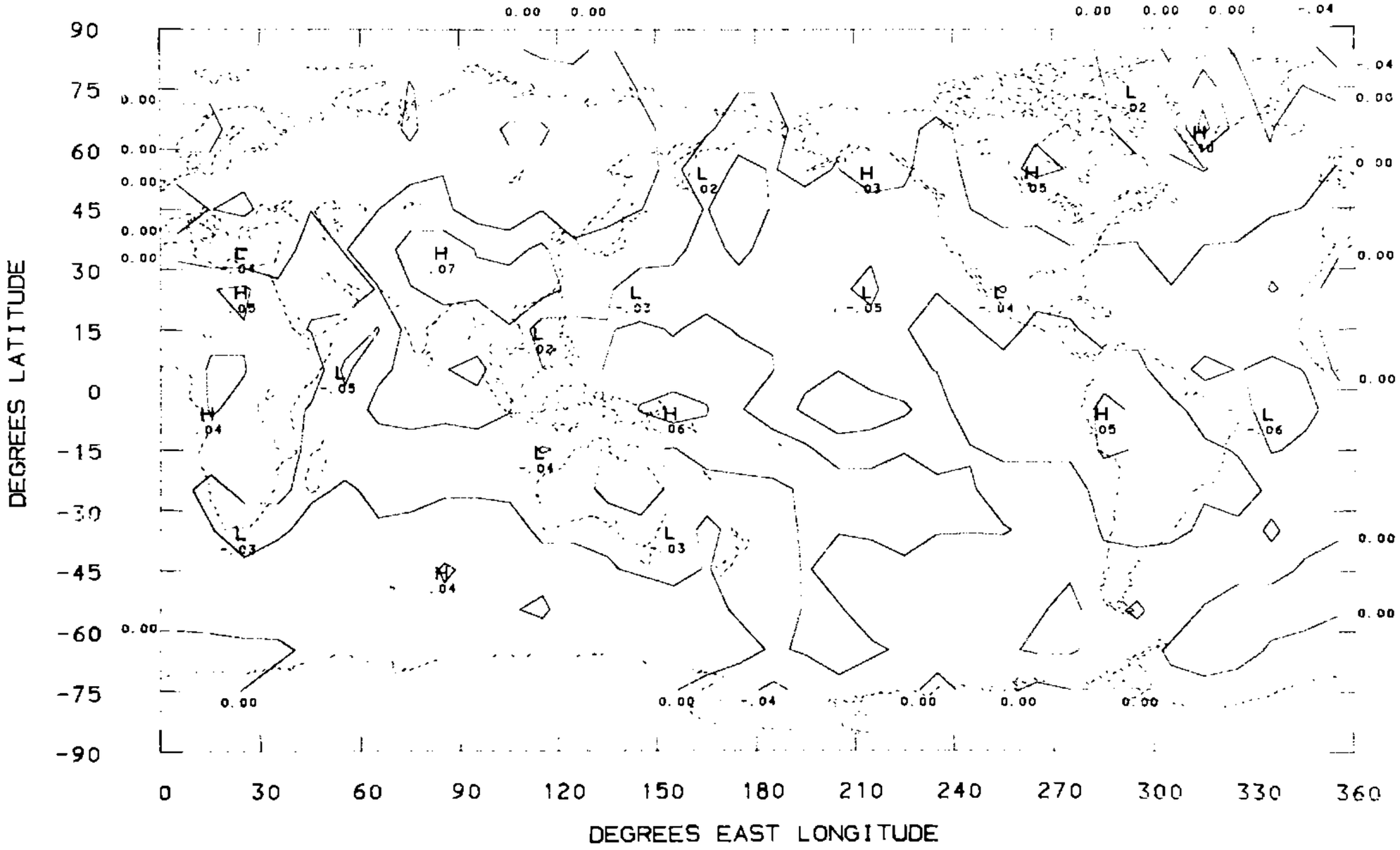
PLANETARY ALBEDO

MEAN ANNUAL 1962-70 17 SEASONS



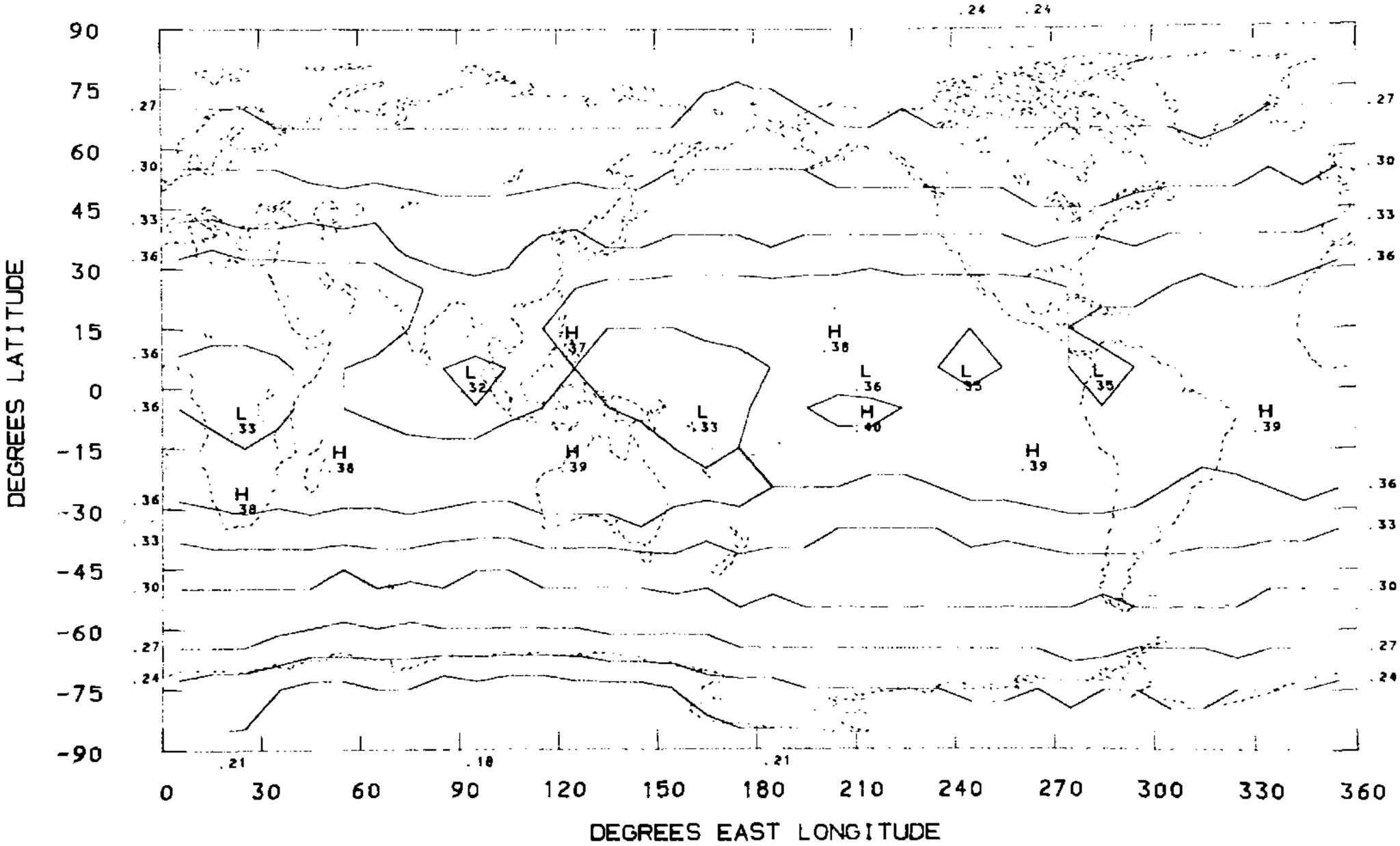
PLANETARY ALBEDO

DEVIATION FROM ZONAL AVG. MEAN ANNUAL 1962-70 17 SEASONS



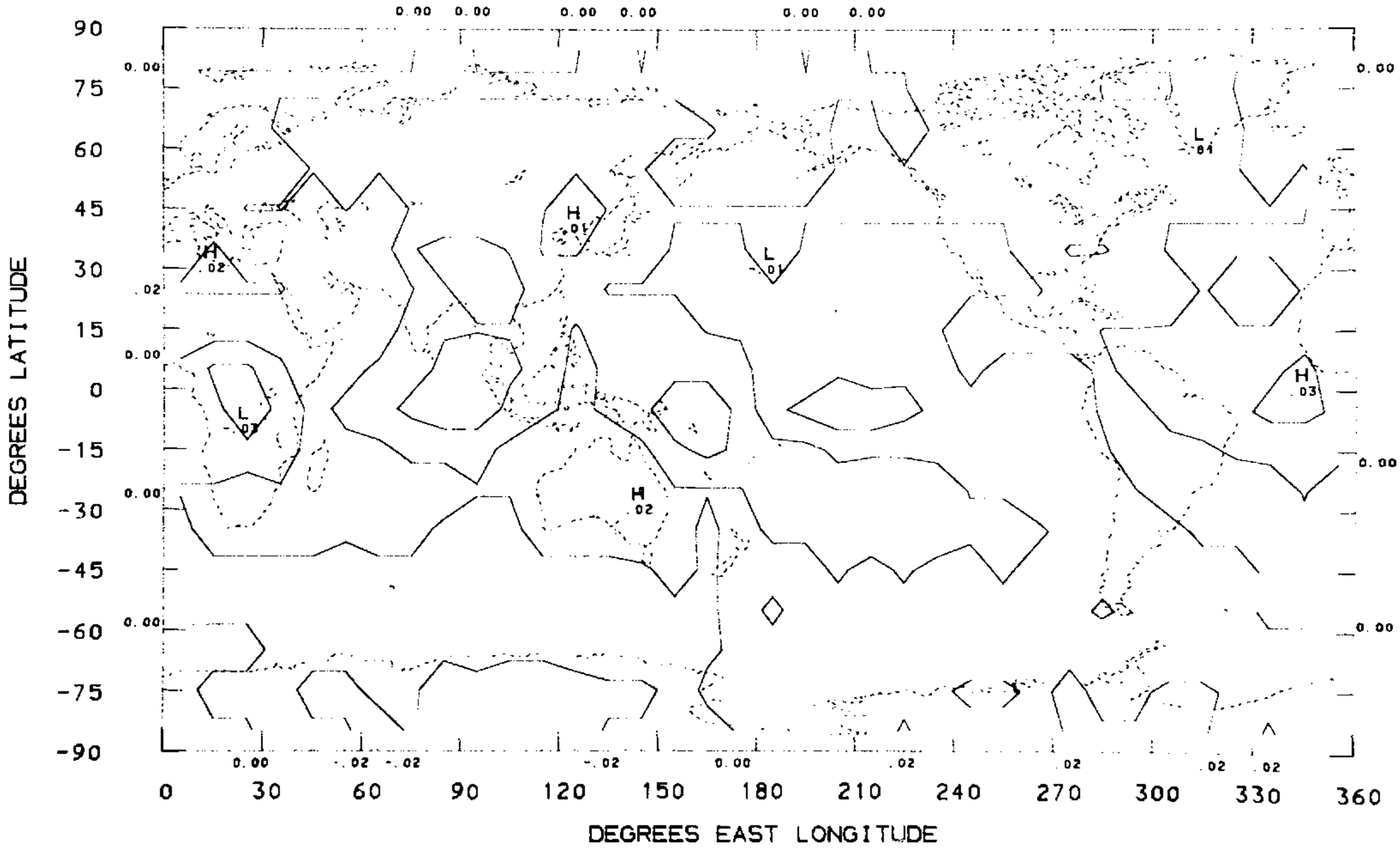
LONGWAVE RADIATION (LY/MIN)

MEAN ANNUAL 1962-70 17 SEASONS



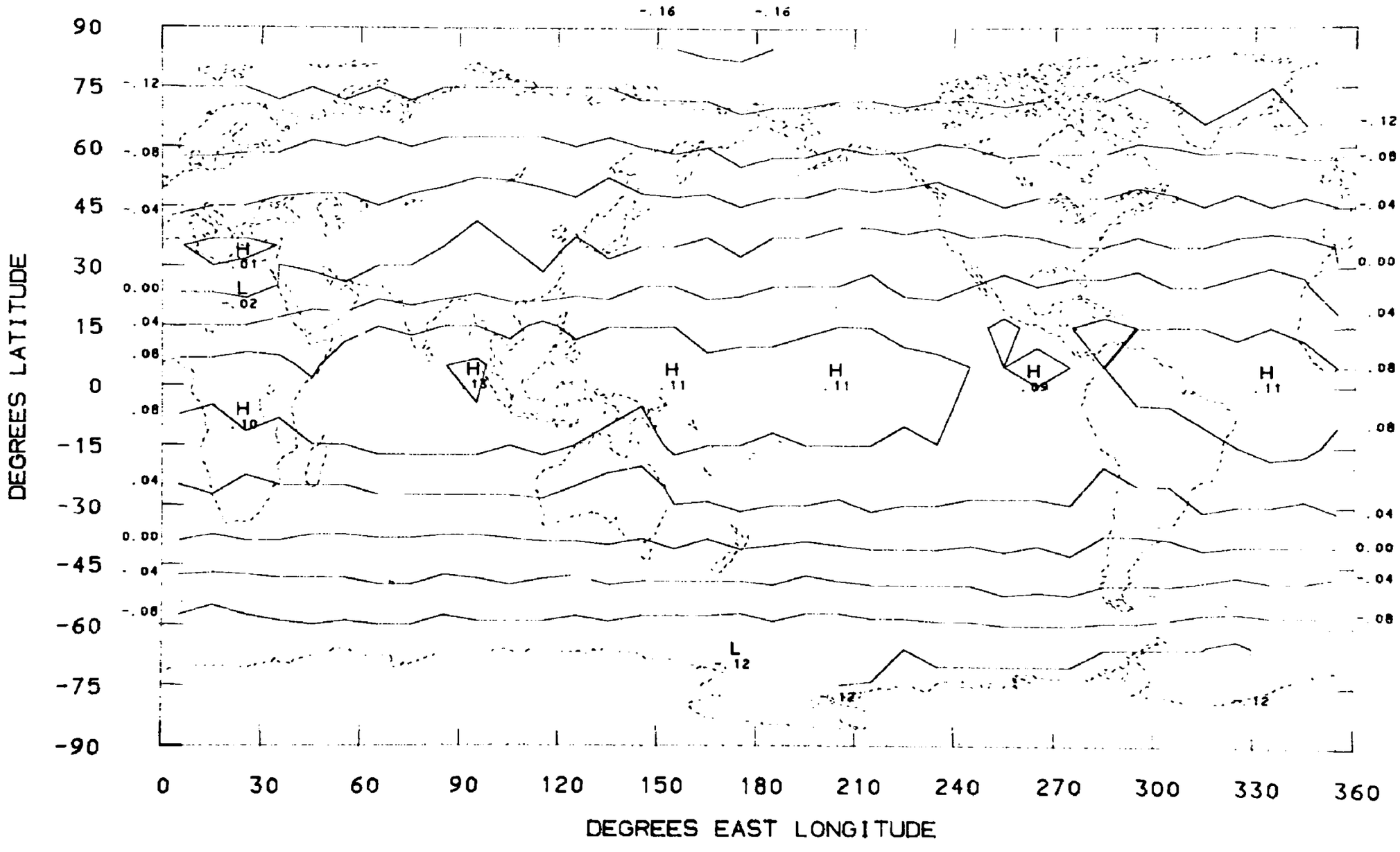
LONGWAVE RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN ANNUAL 1962-70 17 SEASONS



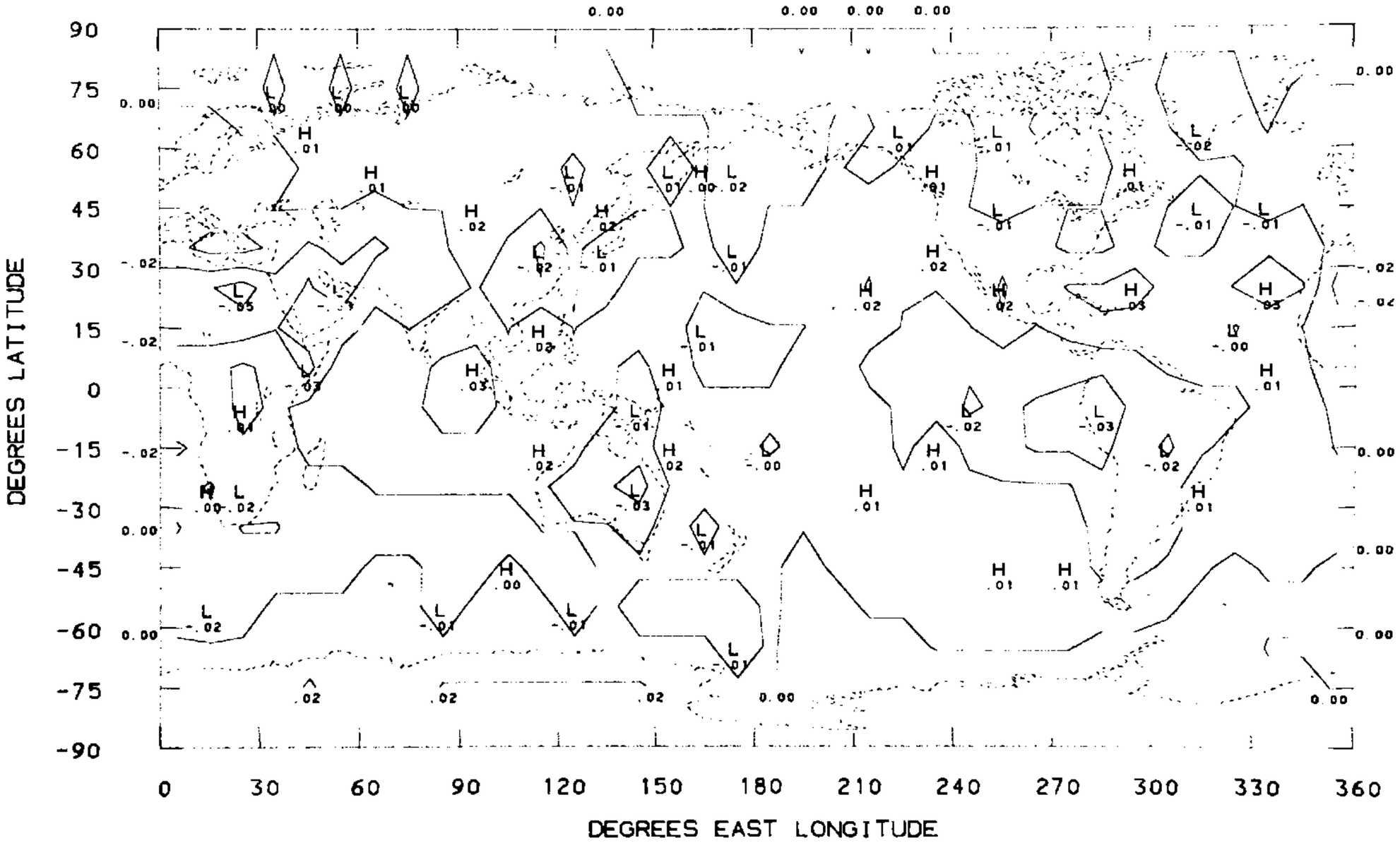
NET RADIATION (LY/MIN)

MEAN ANNUAL 1962-70 17 SEASONS



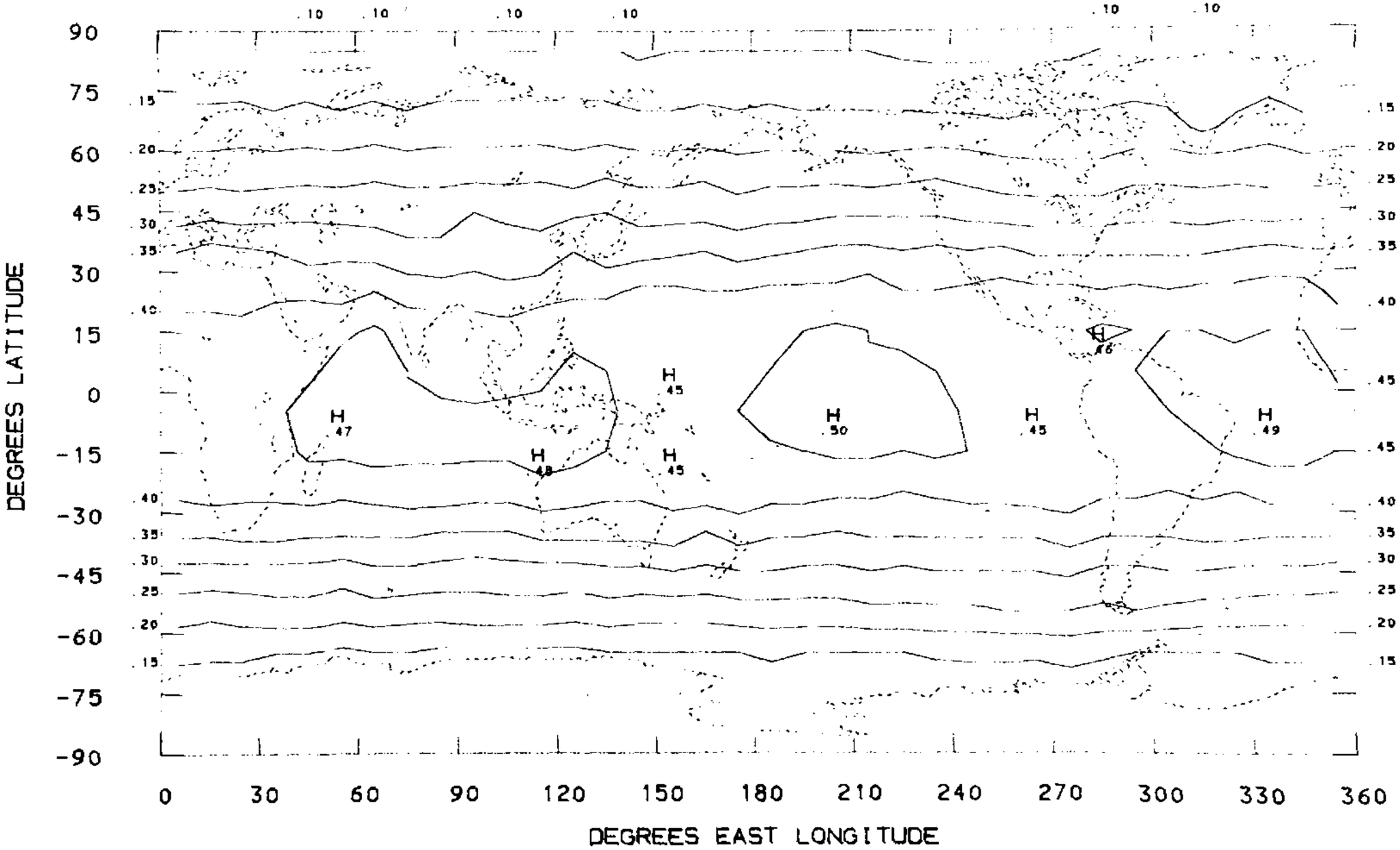
NET RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN ANNUAL 1962-70 17 SEASONS



ABSORBED RADIATION (LY/MIN)

MEAN ANNUAL 1962-70 17 SEASONS



ABSORBED RADIATION (LY/MIN)

DEVIATION FROM ZONAL AVG. MEAN ANNUAL 1962-70 17 SEASONS