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MEMORANDUM

THE SACLANTCEN SHALLOW-WATER TRANSMISSION-LOSS DATA-FILING SYSTEM

by

OLE F. HASTRUP, TUNCAY AKAL, ARTURO PARISOTTO

1 OCTOBER 1980

NORTH
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(6) THE SACLANTCEN SHALLOW-WATER TRANSMISSION-LOSS DATA-FILING SYSTEM,

by

(10) Ole F./Hastrup, Tuncay/Akal, Arturo/Parisotto

(11) 1 Oct[redacted]80

(12) 17

This memorandum has been prepared within the SACLANTCEN Underwater Research Division as part of Project 05.

O.F. Hastrup.

O.F. Hastrup
Acting Division Chief
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THE SACLANTCEN SHALLOW-WATER TRANSMISSION-LOSS DATA-FILING SYSTEM

by

Ole F. Hastrup, Tuncay Akal, Arturo Parisotto

ABSTRACT

A computerized data-filing system has been developed to store measured transmission losses in a matrix as functions of range and frequency, together with the information giving the basic characteristics of the environment. The main advantages of this system are its easy access and the possibilities for extracting the information in different formats, depending on the requirements.

INTRODUCTION

Since 1968 SACLANTCEN has been conducting a large number of broad-band acoustic propagation measurements in several shallow-water areas, covering zones from the Barents Sea to the Strait of Sicily <1, 2, 3, 4, 5>. During these experiments transmission losses were measured using explosive sources and were recorded as energy transmission losses averaged in 1/3 octave bands, expressed in decibels with reference to one metre. This large amount of data, together with that from some of the NATO nations that have been conducting experiments jointly with SACLANTCEN, has being collated in a standard filing format.

To describe this SACLANTCEN shallow-water transmission loss data filing system, the principle of the system is presented together with input and output data formats and some examples of the graphic display possibilities are shown.

1 DATA-ORGANIZATION

The measured transmission loss data <1, 2> are organized under the following identifiers: CRUISE, RUN, SOURCE DEPTH, RECEIVER (Hydrophone) DEPTH, as shown in Fig. 1.

The filing system basically consists of two parts. Part one, "DATA-LOG" which gives the general information concerning the RUN. Part two "DATA-FILE" gives the actual transmission losses as functions of range and frequency for each source and receiver combination.

1.1 Data-Log

The data-log contains all the information concerning the acoustic run such as the receiving ship's position, time, run geometry, water depth, and some environmental description.

The input formats for the data-log identifiers are given in Fig. 2. Figure 3 shows an example of data-log inputs, which creates a corresponding data-log page as seen in Fig. 4.

The four coefficients A, B, C, D, when shown; are obtained from the measured transmission-loss data and serve as a simple, fast method of calculating transmission losses as functions of range and frequency from the semi-empirical formula:

$$TL = 15 \log R + (A+B \log f + C (\log f)^2) R + D \quad (dB),$$

with R being the range in km and f the frequency in Hz <6>.

When the losses are measured at several depths for a given fixed source depth a depth-averaged transmission loss is also provided, identified as HYD AVR. <1>.

1.2 Data File

Apart from the CRUISE, RUN, HYDROPHONE and SOURCE identifiers, the data-file contains the number of ranges, a list of the ranges, and the matrix specifying the transmission loss for each range/frequency band. The input format and an example of input data are given in Figs. 5 and 6, with Fig. 7 showing the resulting data-file page.

2 OUTPUT OPTIONS

The standard outputs are the Data-Log and Data-File listings, of which examples were shown in Figs. 4 and 7. A set of display options are also available to suit different users' needs.

2.1 Transmission Loss versus Range

When the transmission loss is required only for a few selected frequency bands, the TL=TL (R) is available, as shown in Fig. 8 for seven selected frequencies.

2.2 Transmission Loss versus Range and Frequency

When the transmission losses are required as function of both range and frequency a TL = TL (R, f) display is available, the losses being given as isoloss contours in the range/frequency plane. To eliminate small-scale fluctuations, different degrees of two-dimensional smoothing procedures can be applied to the data, as shown as in Fig. 9.

2.3 Transmission Loss versus Range and Depth

In the case of measurements when several hydrophone depths were used to sample the water column, a TL = TL (R, d) display is available, giving the losses as isoloss contours in the range/depth plane for selected frequency bands. An example for two frequencies is shown in Fig. 10.

CONCLUSIONS

With the standardized filing format for shallow-water transmission-loss data it is possible:

1. To examine and extract acoustic characteristics of selected areas of strategic importance.

2. To compare and test theoretical predictions with real data to improve the acoustic prediction models being developed.

3. To conduct parametric studies so as to understand the dependence of complex shallow-water propagation on environmental parameters.

4. Express measured transmission loss values by simple semi-empirical expressions.

5. To provide standardized format for exchanging data between different ASW laboratories.

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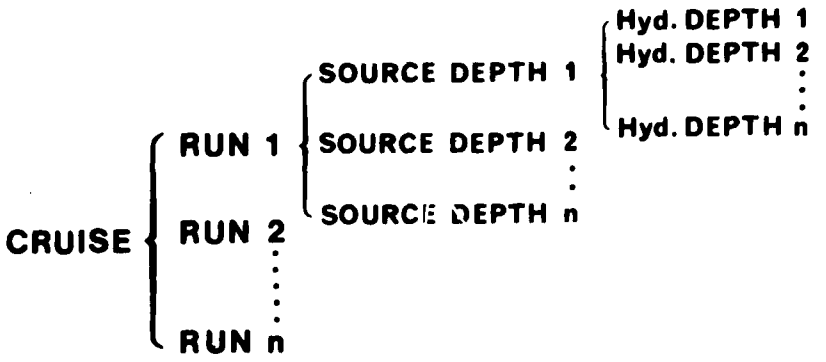

FIG. 1 ORGANIZATION OF DATA

1. Identification: Nation and laboratory which conducted the experiment. NAT (2), LAB (4).

2. Geographical position of the receiver:
LAT (6), LONG (7)

3. Date: YEAR (2), MONTH (2), DAY (2), HOUR (4)

4. Acoustic run geometry:
Direction (in degrees) and maximum distance (in km) of the run:
DIRECTION (3), RANGE (3)
Min and Max. water depth (in m) along the acoustic run track
DEPTHS (3), (3)
Source and hydrophone depth (in m)
SOURCE (4), HYD (4)

5. Frequency range of measurements (in Hz):
FMIN (5), MAX (5)

6. Wind speed (in kn), sea state (2)*, BT type (1)* (see <8>)

7. Cruise, run and hydrophone identifiers
CRUISE (12), RUN (12), HYD (12)

8. Data log number: consecutive number of each data unit (4)

9. Polynomial coefficients and standard deviation (in dB).
A(6), B(6), C(6), D(6), SDV(3)

10. Comments (80)

Note: *Numbers in brackets indicate maximum characters available*

See Appendix A.

FIG. 2 DATA-LOG INPUT FORMAT

1. NT, SACL
2. 74.05N, 21.14E
3. 75, 07, 22, 1400
4. 055, 066, 000, 340, 0050, 0050
5. 00020, 08064
6. 10, 03, 2
7. BEAR, AREA A IV, M4, 50
8. 0016
9. 0.343, -1.534, 1.81, 53.9, 3.50
10. This is an example to fill an event for DATA-LOG

FIG. 3 EXAMPLE OF DATA-LOG INPUT

D A T A L O G

CRUISE•AREA QUALIFIER•FILENAME
BEAR A IV BEAR•M4

						(DEG)	(KM)	(M)	(HZ)	(KTS)				
LAT	LONG	YR	MO	DY	HOUR	DIR	RANGE	DEPTHS	FMIN•MAX	WND	SS	BT	NAT	LAB
74.05N	21.14E	75	07	22	1400	55	66	340	20•8064	10	3	2	NT	SACL

DATA FILE NO	DEPTHS(M) SOURCE•HYD	A	B	C	D	ST•DEV•	ELTNAME/VERSION
0015	50•20						1/50
0016	50•50	.343	-1.534	1.181	53.9	3.50	3/50
0017	50•200						5/50
0018	50•AVR	1.905	-1.606	0.357	52.5	2.60	MEDIA/50
0019	200•20						1/200
0020	200•50						3/200
0021	200•200						5/200
0022	200•AVR	1.594	-1.398	0.317	52.7	2.18	MEDIA/200

FIG. 4 EXAMPLE OF DATA-LOG PAGE

1. Cruise, run, source, and hydrophone identifiers.
   CRUISE (12), RUN (12), SOURCE (12), HYD (12)

2. Number of ranges
   NR (3)

3. List of ranges (in m)
   R_1, R_2, ..., R_n (6)

4. For each 1/3 octave band frequency measured transmission losses (in dB)

   F_1 (5) - TL_1, TL_2, ... TL_n (3)
   F_2 (5) - TL_1, TL_2, ... TL_n (3)
   :
   F_n (5) - TL_1, TL_2, ... TL_n (3)

   where F_i is the center frequency and TL_j is the transmission loss at range R_j.

   Non-reliable TL values are entered as 327.

   Note: Numbers in brackets indicate maximum characters available.

FIG. 5 DATA-FILE INPUT FORMAT

1. BEAR, AREA A IV, M4, 50, 50
2. 045
3. 150, 1341, 2814, ..., 65370, 66861
4. 00020 - 044, 041, 047, ..., 097, 094
   00025 - 047, 052, 050, ..., 327, 327
   00031 - 044, 050, 050, ..., 327, 102
   .....
   .....
   .....
   .....
   06400 - 048, 062, 069, ..., 111, 118
   08064 - 080, 094, 102, ..., 327, 327

FIG. 6 EXAMPLE OF DATA-FILE INPUT

CRUISE REAR RUN R4 HYD 3 SD 50

DATA FILE NO= 16

CENTRE FREQ (HZ)

	20		31		50		79		126		200	317		504		800		1270		2016		3200		5080		8064	
RANGE												LOSS (DB)															
153	48	47	44	47	53	50	46	47	49	47	56	53	50	51	48	52	52	49	50	48	49	48	47	46	49	48	80
1381	41	50	50	54	62	57	58	59	58	60	60	57	59	57	58	59	60	58	61	60	61	62	61	60	61	62	94
2814	47	52	50	55	59	58	60	60	58	62	60	61	62	61	62	64	63	64	66	63	64	65	67	66	68	69	102
4329	50	55	57	53	60	60	56	61	64	65	63	63	61	62	62	63	63	65	68	66	69	69	71	73	73	74	107
5919	55	58	56	58	64	62	61	61	60	61	63	63	66	63	60	68	67	68	70	71	70	71	71	72	75	75	111
7489	63	71	60	60	67	66	62	67	65	61	64	64	65	63	66	65	67	68	67	69	72	75	78	75	76	80	114
8910	65	65	65	64	63	65	62	63	65	67	62	68	68	68	69	69	72	73	75	73	75	78	80	83	84	86	121
10731	75	70	64	68	67	66	69	64	64	64	67	68	68	68	68	73	73	72	74	76	76	81	83	85	84	88	121
11976	75	77	70	69	74	68	64	67	66	63	68	68	68	71	69	72	74	73	79	77	78	79	81	85	88	89	122
13491	79	72	68	66	69	67	67	66	69	69	67	68	73	71	72	74	74	75	78	79	81	84	84	87	87	91	125
15024	80	80	69	67	74	74	68	67	68	73	69	71	72	73	74	73	75	76	79	79	81	82	83	87	91	93	126
16581	80	76	72	66	71	71	68	70	68	69	68	74	71	71	74	74	77	79	79	83	83	86	88	92	93	96	126
18102	64	72	66	69	75	76	69	72	69	72	70	69	78	80	74	79	78	84	327	327	327	327	327	327	327	327	327
19587	81	81	74	69	73	74	67	71	72	73	73	74	73	76	75	77	76	76	80	82	85	85	87	90	93	96	128
21141	80	79	73	69	76	71	71	73	73	69	71	74	74	74	74	76	79	80	84	88	81	85	86	87	91	96	128
22734	93	85	78	72	71	75	70	71	71	72	74	75	73	74	74	77	74	81	84	84	84	86	87	90	94	97	129
24294	92	87	79	72	80	74	74	71	74	73	75	75	77	76	77	80	80	83	85	86	87	88	91	93	96	100	130
25716	87	84	78	72	73	78	69	76	74	75	75	76	76	78	77	81	83	83	85	85	86	88	91	93	96	100	132
27162	89	86	84	75	79	74	73	74	76	71	73	76	76	76	79	82	82	83	84	86	87	89	92	95	98	102	133
28656	92	91	81	74	77	78	71	73	74	73	75	74	80	77	78	79	81	82	85	87	89	89	90	95	97	102	133
30114	89	89	84	80	77	78	72	72	75	74	75	80	80	76	81	80	83	83	87	88	89	90	92	95	100	103	133
31596	91	90	82	83	78	79	75	75	78	74	76	75	80	78	83	82	83	86	87	89	91	93	93	98	103	105	135
33102	93	92	86	81	83	80	75	77	79	76	74	76	80	79	82	84	85	86	87	90	90	93	95	99	104	106	135
34620	101	97	88	89	83	82	77	77	80	84	76	80	76	81	82	82	85	88	90	92	93	94	98	103	108	107	137
36093	96	95	87	85	85	80	78	77	78	78	77	76	80	78	82	84	86	88	88	91	93	95	99	103	109	107	138
37602	102	96	88	87	85	82	79	77	79	79	78	77	77	82	84	83	86	90	92	93	93	96	99	102	108	107	138
39099	102	101	91	87	85	82	77	78	78	79	81	78	81	82	85	83	87	89	92	93	96	98	99	106	110	109	138
40593	109	101	91	86	86	82	81	79	81	78	79	81	82	82	85	87	88	89	94	96	98	99	102	109	111	110	140
42087	106	100	91	92	88	83	80	81	80	83	79	82	82	85	85	86	89	90	93	95	98	98	103	107	112	109	148
43674	108	102	97	92	91	86	84	84	84	82	84	85	84	86	88	89	91	94	97	98	99	103	106	112	116	114	144
45279	107	109	96	91	90	84	81	83	83	79	78	80	81	85	87	87	89	93	93	97	98	101	104	109	114	112	142
46854	95	98	96	90	94	87	82	81	81	79	82	82	82	86	86	89	90	94	96	98	101	103	106	111	116	116	143
48456	109	105	98	91	91	88	83	85	83	84	81	80	83	84	88	89	90	94	98	100	101	104	107	113	117	116	141
50093	99	103	100	95	92	90	84	85	86	84	79	85	87	88	88	91	93	95	97	101	104	107	110	114	120	110	144
51615	106	118	101	93	102	96	86	87	85	84	86	84	90	87	89	91	95	95	99	102	106	111	113	117	114	112	127
53193	114	108	103	97	99	98	88	88	87	87	88	86	87	88	89	93	95	98	102	106	111	120	117	119	127	110	127
54711	104	327	105	99	95	97	90	90	87	84	87	86	91	89	89	95	98	99	103	106	110	105	121	131	327	115	327
56268	327	327	104	102	99	96	90	90	86	88	84	88	90	89	90	93	97	98	102	106	109	327	119	120	327	112	327
57822	101	108	327	109	99	93	88	88	89	87	85	83	86	89	90	91	95	97	102	105	108	110	327	327	123	327	157
59373	96	117	100	99	106	96	87	92	88	89	88	88	88	89	92	91	97	99	102	106	110	113	118	116	327	115	327
60882	118	327	327	104	98	99	91	88	87	92	85	89	89	91	93	94	96	100	104	109	111	116	115	327	327	327	327
62373	113	113	327	107	101	96	93	88	87	87	89	90	90	92	93	95	99	103	106	111	113	327	112	126	128	115	151
63801	107	327	107	327	95	327	327	87	87	90	87	87	90	90	93	95	98	103	106	112	141	327	327	327	327	117	327
65370	97	327	327	327	100	95	94	89	88	87	90	89	90	92	94	97	98	103	106	114	115	117	327	113	120	111	327
66861	94	327	102	99	327	98	91	89	90	96	89	90	89	90	92	95	97	100	109	105	107	327	113	327	108	118	327

FIG. 7 EXAMPLE OF DATA-FILE PAGE

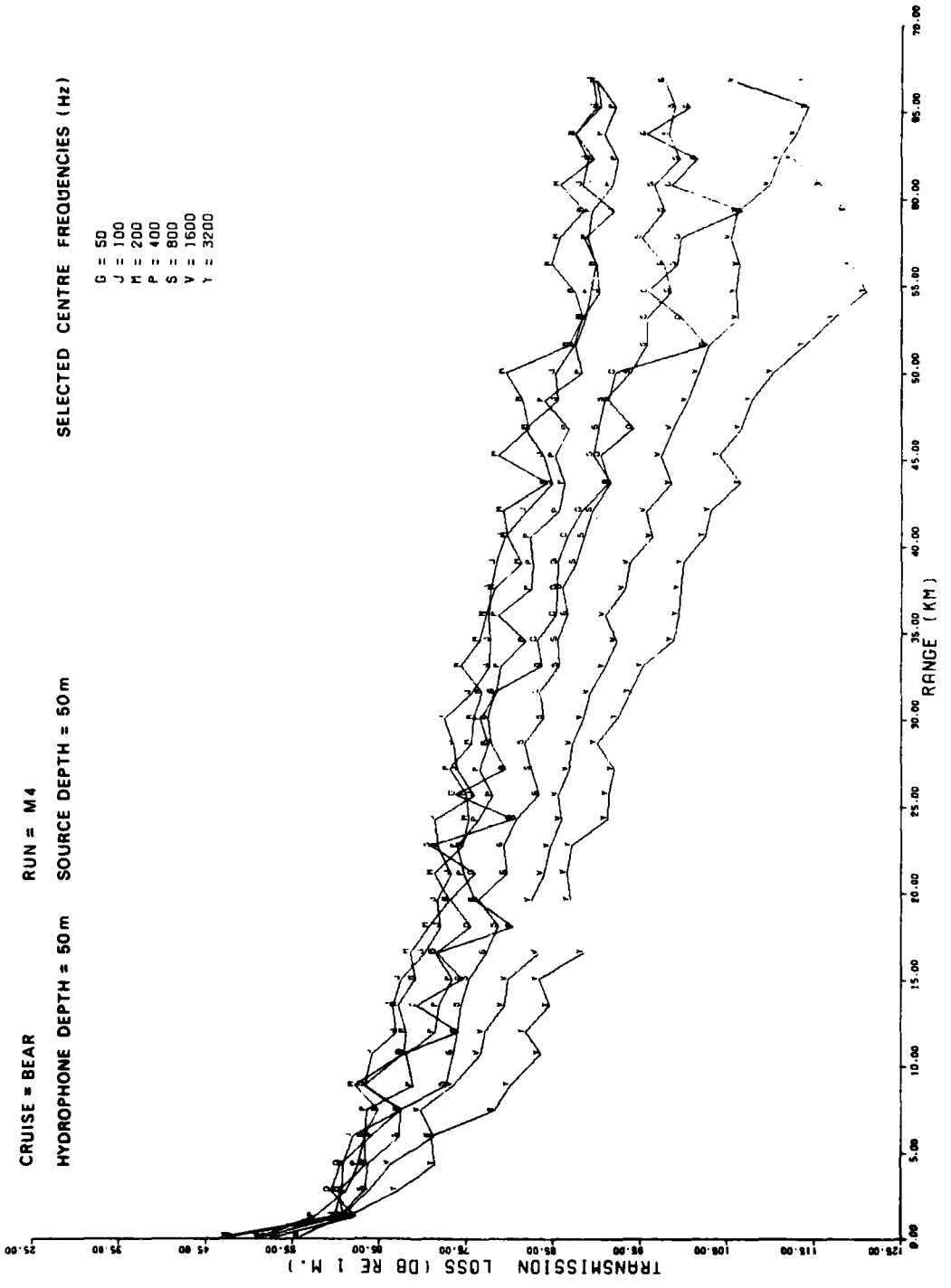

FIG. 8 TRANSMISSION LOSS VERSUS RANGE FOR SELECTED FREQUENCIES

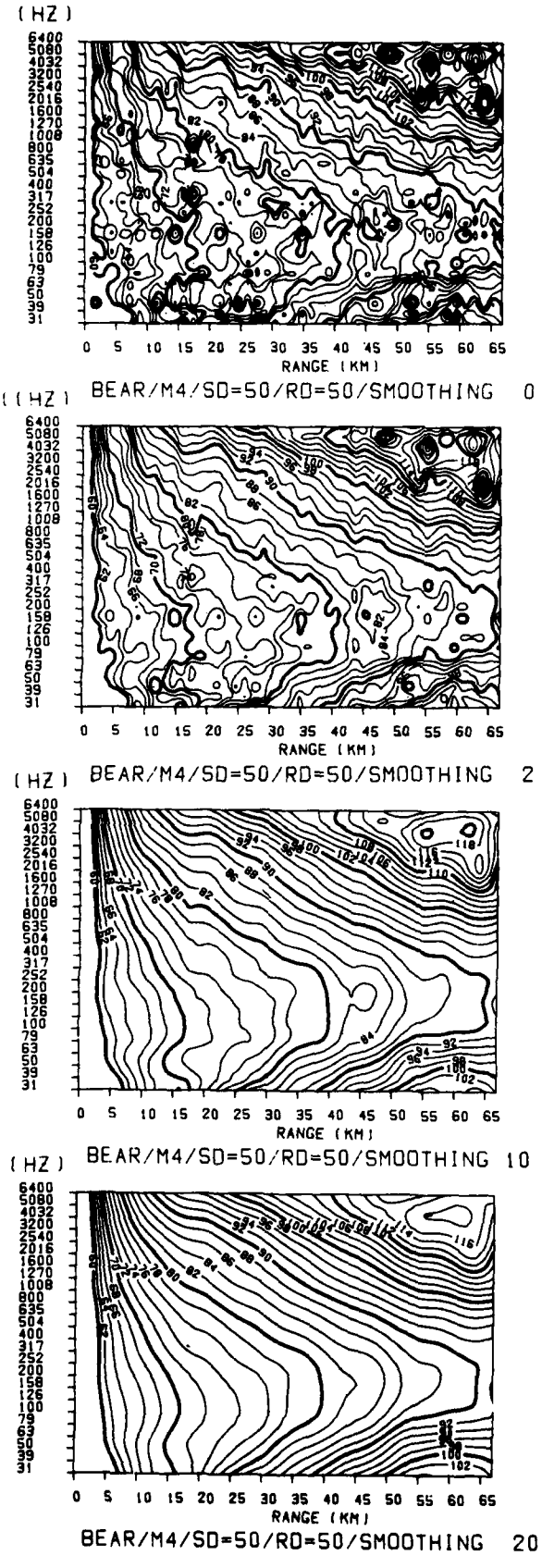

FIG. 9 TRANSMISSION LOSS CONTOURS AND THE EFFECT OF DIFFERENT DEGREES OF SMOOTHING

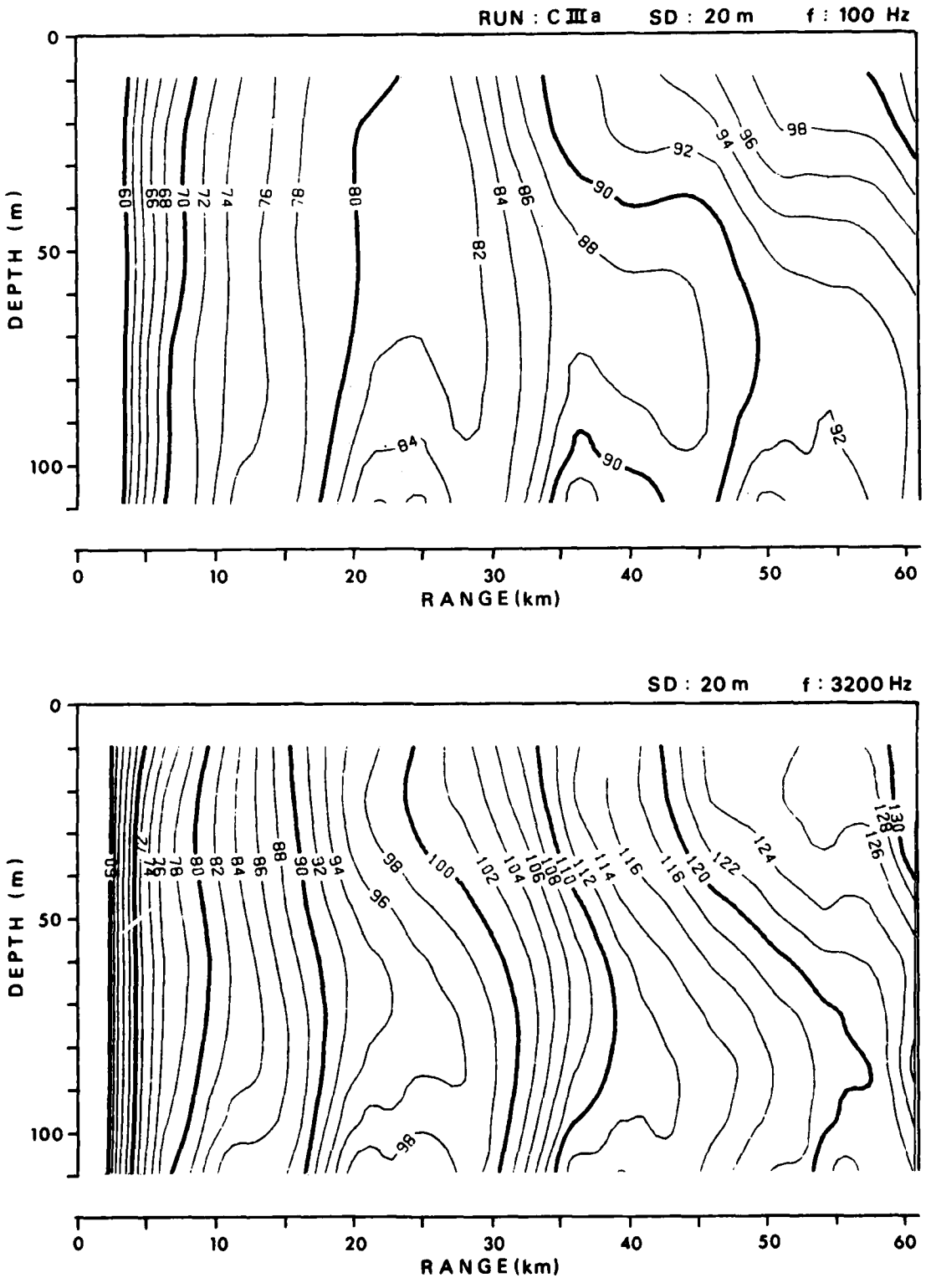

FIG. 10 TRANSMISSION LOSS CONTOURS IN RANGE AND DEPTH FOR SELECTED FREQUENCIES