APPENDIX

Tables for Computing Geopotential Distances between Isobaric Surfaces

Contents

Symbols and Definitions

$\alpha_{35,0,p}$: Specific volume of sea water of salinity 35 $^0/_{00}$ and temperature 0°C, and at pressure p.

δ: Anomaly of specific volume of sea water of salinity S and temperature ϑ and at pressure p (see p. 58):

$$\delta = \Delta_{s,\vartheta} + \delta_{s,p} + \delta_{\vartheta,p},$$

where

$$\Delta_{s,\vartheta} = 0.02736 - \frac{10^{-3}\sigma_t}{1 + 10^{-3}\sigma_t}.$$

$(D_1 - D_2)_s$: Standard geopotential distance between the isobaric surfaces p_1 and p_2 (equation XII, 6, p. 408):

$$(D_1 - D_2)_s = \int_{p_1}^{p_2} \alpha_{35,0,p} dp.$$

ΔD: Anomaly of the geopotential distance between the isobaric surfaces p_1 and p_2 (equation XII, 7, p. 409):

$$\Delta D = \int_{p_1}^{p_2} \delta dp.$$

Explanation

If σ_t has been computed by means of Knudsen's or other tables, the specific volume anomaly, δ, can be found from tables III, IV, and V. If numerous computations are to be made, special tables should be prepared with closer intervals of the arguments. In order to facilitate such preparation and in order to avoid accumulation of errors, the terms have been tabulated with one more decimal place than warranted by the accuracy of the temperature and salinity observations.

When the specific volume anomalies have been found, the geopotential anomalies can be computed by numerical integration (table 61, p. 411).

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TABLE I

SPECIFIC VOLUME OF SEA WATER OF SALINITY 35 ‰ AND TEMPERATURE 0°C, AND AT STATED PRESSURE, $\alpha_{35,0,p}$, EXPRESSED IN cm^3/g OR m^3/ton

(From Bjerknes and Sandström, 1910)

Pressure (decibars)	0	100	200	300	400	500	600	700	800	900
0	0.97264	0.97219	0.97174	0.97129	0.97084	0.97040	0.96995	0.96951	0.96907	0.96863
1000	0.96819	0.96775	0.96732	0.96688	0.96645	0.96602	0.96559	0.96516	0.96473	0.96430
2000	0.96388	0.96345	0.96303	0.96261	0.96219	0.96177	0.96136	0.96094	0.96053	0.96011
3000	0.95970	0.95929	0.95888	0.95848	0.95807	0.95766	0.95726	0.95686	0.95646	0.95606
4000	0.95566	0.95526	0.95486	0.95447	0.95407	0.95368	0.95329	0.95289	0.95251	0.95212
5000	0.95173	0.95134	0.95096	0.95057	0.95019	0.94981	0.94943	0.94905	0.94867	0.94829
6000	0.94791	0.94754	0.94717	0.94679	0.94642	0.94605	0.94568	0.94531	0.94494	0.94457
7000	0.94421	0.94384	0.94348	0.94312	0.94275	0.94239	0.94203	0.94167	0.94132	0.94096
8000	0.94060	0.94025	0.93989	0.93954	0.93919	0.93883	0.93848	0.93813	0.93778	0.93744
9000	0.93709	0.93674	0.93640	0.93605	0.93571	0.93537	0.93503	0.93469	0.93434	0.93401

TABLE II

GEOPOTENTIAL DISTANCES FROM THE SEA SURFACE TO STATED ISOBARIC SURFACES IN SEA WATER OF SALINITY 35 $^{0}/_{00}$ AND TEMPERATURE 0°C, $D_{35,0,p}$, EXPRESSED IN DYNAMIC METERS

(From Bjerknes and Sandström, 1910, expanded by ms data)

p (decibars)	$D_{35,0,p}$ (dynamic meters)	p (decibars)	$D_{35,0,p}$ (dynamic meters)
10	9.7262	1200	1163.9534
20	19.4520	1400	1357.3295
30	29.1773	1600	1550.5327
40	38.9021	1800	1743.5639
50	48.6265	2000	1936.4246
75	72.9356	2500	2417.8360
100	97.2417	3000	2898.2041
150	145.8457	3500	3377.5445
200	194.4382	4000	3855.8733
300	291.5898	4500	4333.2053
400	388.6965	5000	4809.5559
500	485.7584	6000	5759.3685
600	582.7759	8000	7647.8173
800	776.6777	10000	9522.0255
1000	970.4032		

TABLE III

$10^5\Delta_{s,\vartheta}$ AS FUNCTION OF σ_t

(From Sverdrup, 1933)

σ_t	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10
23.0	487.8	486.8	485.9	484.9	484.0	483.0	482.0	481.1	480.1	479.2	478.2
.1	478.2	477.2	476.3	475.4	474.4	473.4	472.5	471.6	470.6	469.6	468.7
.2	468.7	467.7	466.8	465.8	464.9	463.9	462.9	462.0	461.0	460.1	459.1
.3	459.1	458.1	457.2	456.3	455.3	454.3	453.4	452.5	451.5	450.5	449.6
.4	449.6	448.6	447.7	446.7	445.8	444.8	443.8	442.9	441.9	441.0	440.0
.5	440.0	439.0	438.1	437.2	436.2	435.2	434.3	433.4	432.4	431.4	430.5
.6	430.5	429.5	428.6	427.6	426.7	425.7	424.7	423.8	422.8	421.9	420.9
.7	420.9	419.9	419.0	418.1	417.1	416.1	415.2	414.3	413.3	412.3	411.4
.8	411.4	410.4	409.5	408.5	407.6	406.6	405.6	404.7	403.7	402.8	401.8
.9	401.8	400.8	399.9	398.9	398.0	397.0	396.0	395.1	394.1	393.2	392.2
24.0	392.2	391.2	390.3	389.4	388.4	387.4	386.5	385.6	384.6	383.6	382.7
.1	382.7	381.7	380.8	379.9	378.9	377.9	377.0	376.1	375.1	374.1	373.2
.2	373.2	372.2	371.3	370.3	369.4	368.4	367.4	366.5	365.5	364.6	363.6
.3	363.6	362.6	361.7	360.8	359.8	358.8	357.9	357.0	356.0	355.0	354.1
.4	354.1	353.1	352.2	351.3	350.3	349.3	348.4	347.5	346.5	345.5	344.6
.5	344.6	343.6	342.7	341.8	340.8	339.8	338.9	338.0	337.0	336.0	335.1
.6	335.1	334.1	333.2	332.2	331.3	330.3	329.3	328.4	327.4	326.5	325.5
.7	325.5	324.5	323.6	322.7	321.7	320.7	319.8	318.9	317.9	316.9	316.0
.8	316.0	315.0	314.1	313.2	312.2	311.2	310.3	309.4	308.4	307.4	306.5
.9	306.5	305.5	304.6	303.7	302.7	301.7	300.8	299.9	298.9	297.9	297.0
25.0	297.0	296.0	295.1	294.1	293.2	292.2	291.2	290.3	289.3	288.4	287.4
.1	287.4	286.4	285.5	284.6	283.6	282.6	281.7	280.8	279.8	278.8	277.9
.2	277.9	276.9	276.0	275.1	274.1	273.1	272.2	271.3	270.3	269.3	268.4
.3	268.4	267.4	266.5	265.6	264.6	263.6	262.7	261.8	260.8	259.8	258.9
.4	258.9	257.9	257.0	256.1	255.1	254.1	253.2	252.3	251.3	250.3	249.4
.5	249.4	248.4	247.5	246.6	245.6	244.6	243.7	242.8	241.8	240.8	239.9
.6	239.9	238.9	238.0	237.1	236.1	235.1	234.2	233.3	232.3	231.3	230.4
.7	230.4	229.4	228.5	227.6	226.6	225.6	224.7	223.8	222.8	221.8	220.9
.8	220.9	219.9	219.0	218.1	217.1	216.1	215.2	214.3	213.3	212.3	211.4
.9	211.4	210.4	209.5	208.6	207.6	206.6	205.7	204.8	203.8	202.8	201.9
26.0	201.9	200.9	200.0	199.1	198.1	197.1	196.2	195.3	194.3	193.3	192.4
.1	192.4	191.4	190.5	189.6	188.6	187.6	186.7	185.8	184.8	183.8	182.9
.2	182.9	181.9	181.0	180.1	179.1	178.1	177.2	176.3	175.3	174.3	173.4
.3	173.4	172.4	171.5	170.6	169.6	168.6	167.7	166.8	165.8	164.8	163.9
.4	163.9	162.9	162.0	161.1	160.1	159.1	158.2	157.3	156.3	155.3	154.4
.5	154.4	153.5	152.5	151.6	150.6	149.7	148.7	147.8	146.8	145.9	144.9
.6	144.9	144.0	143.0	142.1	141.1	140.2	139.2	138.3	137.3	136.4	135.4
.7	135.4	134.5	133.5	132.6	131.6	130.7	129.7	128.8	127.8	126.9	125.9
.8	125.9	125.0	124.0	123.1	122.1	121.2	120.3	119.3	118.4	117.4	116.5
.9	116.5	115.5	114.6	113.6	112.7	111.7	110.8	109.8	108.9	107.9	107.0
27.0	107.0	106.0	105.1	104.1	103.2	102.2	101.3	100.3	99.4	98.4	97.5
.1	97.5	96.6	95.6	94.7	93.7	92.8	91.8	90.9	89.9	89.0	88.0
.2	88.0	87.1	86.1	85.2	84.2	83.3	82.3	81.4	80.4	79.5	78.5
.3	78.5	77.6	76.6	75.7	74.8	73.8	72.9	71.9	71.0	70.0	69.1
.4	69.1	68.1	67.2	66.2	65.3	64.3	63.4	62.4	61.5	60.5	59.6
.5	59.6	58.7	57.7	56.8	55.8	54.9	53.9	53.0	52.0	51.1	50.1
.6	50.1	49.2	48.2	47.3	46.3	45.4	44.5	43.5	42.6	41.6	40.7
.7	40.7	39.7	38.8	37.8	36.9	35.9	35.0	34.0	33.1	32.1	31.2
.8	31.2	30.2	29.3	28.3	27.4	26.4	25.5	24.6	23.6	22.7	21.7
.9	21.7	20.8	19.8	18.9	17.9	17.0	16.0	15.1	14.1	13.2	12.3
28.0	12.3	11.3	10.4	9.4	8.5	7.5	6.6	5.6	4.7	3.7	

TABLE IVa

$10^5\delta_{s,p}$ AS FUNCTION OF SALINITY AND PRESSURE

(From Sverdrup, 1933)

Pressure (decibars)	Salinity ‰										
	30	31	32	33	34	35	36	37	38	39	40
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100	−0.8	−0.6	−0.5	−0.3	−0.2	0.0	0.2	0.3	0.4	0.6	0.7
200	−1.5	−1.2	−0.9	−0.6	−0.3	0.0	0.3	0.6	0.9	1.2	1.5
300	−2.3	−1.8	−1.4	−0.9	−0.5	0.0	0.5	0.9	1.3	1.8	2.2
400	−3.0	−2.4	−1.8	−1.2	−0.6	0.0	0.6	1.2	1.8	2.4	3.0
500	−3.8	−3.0	−2.3	−1.5	−0.8	0.0	0.8	1.5	2.2	3.0	3.7
600	−4.5	−3.6	−2.7	−1.8	−0.9	0.0	0.9	1.8	2.6	3.6	4.4
700	−5.3	−4.2	−3.2	−2.1	−1.1	0.0	1.1	2.1	3.1	4.2	5.1
800	−6.0	−4.8	−3.6	−2.4	−1.2	0.0	1.2	2.3	3.5	4.7	5.9
900	−6.8	−5.4	−4.1	−2.7	−1.4	0.0	1.4	2.6	4.0	5.3	6.6
1000	−7.5	−6.0	−4.5	−3.0	−1.5	0.0	1.5	2.9	4.4	5.9	7.3
1100				−3.3	−1.7	0.0	1.7	3.2	4.8	6.5	8.0
1200				−3.6	−1.8	0.0	1.8	3.5	5.2	7.0	8.7
1300				−3.9	−1.9	0.0	1.9	3.8	5.7	7.6	9.4
1400				−4.1	−2.1	0.0	2.1	4.1	6.1	8.1	10.1
1500				−4.4	−2.2	0.0	2.2	4.4	6.5	8.7	10.8
1600				−4.7	−2.3	0.0	2.3	4.7	6.9	9.3	11.5
1700				−4.9	−2.5	0.0	2.5	4.9	7.3	9.8	12.2
1800				−5.2	−2.6	0.0	2.6	5.2	7.8	10.4	12.9
1900				−5.5	−2.7	0.0	2.7	5.5	8.2	10.9	13.6
2000				−5.8	−2.9	0.0	2.9	5.8	8.6	11.5	14.3
2500				−7.2	−3.6	0.0	3.6	7.1	10.7	14.2	17.7
3000				−8.5	−4.3	0.0	4.2	8.5	12.7	16.8	21.0
3500				−9.9	−4.9	0.0	4.9	9.7	14.6	19.4	24.2
4000				−11.1	−5.6	0.0	5.5	11.0	16.5	22.0	27.4

TABLE IVb

$10^5\delta_{s,p}$ AS FUNCTION OF SALINITY AND PRESSURE

(From Sverdrup, 1933)

Pressure (decibars)	Salinity ‰				
	34.4	34.6	34.8	35.0	35.2
2000.....	−1.7	−1.2	−0.6	0.0	0.6
2500.....	−2.2	−1.4	−0.7	0.0	0.7
3000.....	−2.6	−1.7	−0.9	0.0	0.8
3500.....	−2.9	−2.0	−1.0	0.0	1.0
4000.....	−3.4	−2.2	−1.1	0.0	1.1
4500.....	−3.7	−2.5	−1.2	0.0	
5000.....	−4.1	−2.7	−1.4	0.0	
5500.....	−4.4	−3.0	−1.5	0.0	
6000.....	−4.8	−3.2	−1.6	0.0	
6500.....	−5.1	−3.4	−1.7	0.0	
7000.....	−5.5	−3.6	−1.8	0.0	
7500.....	−5.8	−3.8	−1.9	0.0	
8000.....	−6.1	−4.1	−2.0	0.0	
8500.....	−6.4	−4.3	−2.1	0.0	
9000.....	−6.7	−4.5	−2.2	0.0	
9500.....	−7.0	−4.6	−2.3	0.0	
10000.....	−7.3	−4.8	−2.4	0.0	

TABLE Va

$10^5\delta_{\vartheta,p}$ AS FUNCTION OF TEMPERATURE AND PRESSURE

(From Sverdrup, 1933)

Pressure (decibars)	Temperature °C																
	−2	−1	0	1	2	3	4	5	6	7	8	9	10	15	20	25	30
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100	−0.6	−0.3	0.0	0.3	0.5	0.7	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.9	3.5	3.9	4.2
200	−1.1	−0.6	0.0	0.6	1.1	1.5	2.0	2.4	2.8	3.2	3.5	3.9	4.3	5.8	7.0	7.8	8.4
300	−1.7	−0.9	0.0	0.8	1.6	2.3	3.0	3.7	4.3	4.8	5.4	5.9	6.5	8.8	10.4	11.6	12.5
400	−2.2	−1.1	0.0	1.1	2.1	3.0	4.0	4.9	5.7	6.4	7.2	7.9	8.6	11.7	13.9	15.5	16.7
500	−2.8	−1.4	0.0	1.4	2.6	3.8	5.0	6.1	7.1	8.0	9.0	9.9	10.8	14.6	17.4	19.4	20.9
600	−3.3	−1.7	0.0	1.6	3.1	4.6	6.0	7.3	8.5	9.7	10.8	11.9	12.9	17.4	20.8	23.2	24.9
700	−3.9	−2.0	0.0	1.9	3.7	5.3	6.9	8.4	9.8	11.2	12.5	13.8	15.0	20.2	24.1	27.0	29.0
800	−4.4	−2.2	0.0	2.1	4.2	6.1	7.9	9.6	11.2	12.8	14.3	15.7	17.1	23.1	27.5	30.7	33.0
900	−5.0	−2.5	0.0	2.4	4.7	6.8	8.8	10.7	12.6	14.3	16.0	17.6	19.2	25.9	30.8	34.5	37.1
1000	−5.5	−2.8	0.0	2.7	5.3	7.6	9.8	11.9	14.0	15.9	17.7	19.5	21.3	28.7	34.2	38.3	41.1
1100	−6.0	−3.1	0.0	3.0	5.8	8.3	10.7	13.0	15.3	17.4	19.4	21.4	23.3	31.4	37.5		
1200	−6.5	−3.3	0.0	3.2	6.3	9.1	11.6	14.1	16.6	18.9	21.1	23.3	25.4	34.1	40.7		
1300	−7.1	−3.6	0.0	3.5	6.8	9.8	12.6	15.3	17.9	20.4	22.8	25.1	27.4	36.9	44.0		
1400	−7.6	−3.8	0.0	3.7	7.3	10.6	13.5	16.4	19.2	21.9	24.5	27.0	29.5	39.6	47.2		
1500	−8.1	−4.1	0.0	4.0	7.8	11.3	14.4	17.5	20.5	23.4	26.2	28.9	31.5	42.3	50.5		
1600	−8.6	−4.3	0.0	4.2	8.2	12.0	15.4	18.6	21.8	24.9	27.8	30.7	33.5	44.9	53.6		
1700	−9.1	−4.6	0.0	4.5	8.7	12.7	16.3	19.7	23.1	26.3	29.5	32.5	35.4	47.6	56.8		
1800	−9.6	−4.8	0.0	4.7	9.2	13.4	17.2	20.8	24.3	27.8	31.1	34.3	37.4	50.2	59.9		
1900	−10.1	−5.1	0.0	5.0	9.7	14.1	18.1	21.9	25.6	29.2	32.7	36.1	39.3	52.9	63.1		
2000	−10.6	−5.3	0.0	5.2	10.1	14.7	19.0	23.0	26.9	30.7	34.4	37.9	41.3	55.5	66.2		
2500	−13.1	−6.5	0.0	6.3	12.3	18.1	23.4	28.3	33.1	37.7	42.2	46.6	50.7	68.2			
3000	−15.4	−7.6	0.0	7.4	14.4	21.2	27.6	33.4	39.1	44.6	49.9	55.0	59.8	80.4			
3500	−17.7	−8.7	0.0	8.4	16.4	24.2	31.5	38.3	44.9	51.2	57.3	63.1	68.6	92.2			
4000	−19.9	−9.9	0.0	9.5	18.4	27.0	35.2	43.0	50.5	57.6	64.4	70.9	77.1				

TABLE I

SPECIFIC VOLUME OF SEA WATER OF SALINITY 35 ‰ AND TEMPERATURE 0°C, AND AT STATED PRESSURE, $\alpha_{35,0,p}$, EXPRESSED IN cm^3/g OR m^3/ton

(From Bjerknes and Sandström, 1910)

Pressure (decibars)	0	100	200	300	400	500	600	700	800	900
0	0.97264	0.97219	0.97174	0.97129	0.97084	0.97040	0.96995	0.96951	0.96907	0.96863
1000	0.96819	0.96775	0.96732	0.96688	0.96645	0.96602	0.96559	0.96516	0.96473	0.96430
2000	0.96388	0.96345	0.96303	0.96261	0.96219	0.96177	0.96136	0.96094	0.96053	0.96011
3000	0.95970	0.95929	0.95888	0.95848	0.95807	0.95766	0.95726	0.95686	0.95646	0.95606
4000	0.95566	0.95526	0.95486	0.95447	0.95407	0.95368	0.95329	0.95289	0.95251	0.95212
5000	0.95173	0.95134	0.95096	0.95057	0.95019	0.94981	0.94943	0.94905	0.94867	0.94829
6000	0.94791	0.94754	0.94717	0.94679	0.94642	0.94605	0.94568	0.94531	0.94494	0.94457
7000	0.94421	0.94384	0.94348	0.94312	0.94275	0.94239	0.94203	0.94167	0.94132	0.94096
8000	0.94060	0.94025	0.93989	0.93954	0.93919	0.93883	0.93848	0.93813	0.93778	0.93744
9000	0.93709	0.93674	0.93640	0.93605	0.93571	0.93537	0.93503	0.93469	0.93434	0.93401

CHART I.—MAJOR OCEAN BASINS WITH DEPTHS EXCEEDING 4000 METERS (I–XLV)

Features of Great Depth (A–Q)

(Based on Vaughan *et al*, 1940)

Indian Ocean

Western Indian	Eastern Indian	East Indian Archipelago
I. Arabian Basin II. Somali Basin III. Mascarenes Basin IV. Madagascar Basin(s) V. Atlantic-Indian Antarctic Basin	VI. India-Australia Basin A. Sunda Trench (7,455 m) B. Wharton Deep (6,460 m) VII. South Australia Basin VIII. Eastern Indian Antarctic Basin	IX. South China Basin X. Sulu Basin XI. Celebes Basin XII. Banda Basin

Pacific Ocean

Western Pacific	Central Pacific	South-Eastern Pacific
XIII. Philippines Basin C. Riu-Kiu Trench (7,480 m) D. Philippines Trench (Mindanao Trench) Emden Depth: 10,500 ± m XIV. Caroline Basin XV. Solomon Basin E. Bougainville-New Britain Trench Planet Depth: 9,410 m XVI. Coral Basin XVII. New Hebrides Basin XVIII. Fiji Basin XIX. East Australia Basin Marianna Trench: 10,863 m (See NATURE, vol. 169, no. 4302, 1952, pp 601–03)	XX. North Pacific Basin(s) F. Aleutian Trench (7,680 m) G. Kurile Trench Tuscarora Depth: 8,500 m H. Japan Trench Ramapo Depth: 10,550 m I. Bonin Trench (8,660 m) XXI. Mariana Basin J. Mariana Trench (9,810 m) XXII. Central Pacific Basin(s) XXIII. South Pacific Basin K. Tonga-Kermadec Trench Penguin Depth: 9,427 m L. Byrd Deep (8,590 m)	XXIV. Guatemala Basin XXV. Peru Basin M. Atacama Trench (7,635 m) XXVI. Pacific Antarctic Basin

Atlantic Ocean

Western Atlantic	Eastern Atlantic
XXVII. Labrador Basin XXVIII. Newfoundland Basin XXIX. North America Basin XXX. Western Caribbean Basin N. Cayman Trough S-21 Depth: 7,200 m XXXI. Eastern Caribbean Basin XXXII. Guiana Basin O. Puerto Rico Trough Milwaukee Depth: 8,750 m XXXIII. Brazil Basin XXXIV. Argentina Basin XXXV. South Antilles Basin	XXXVI. North Polar Basin XXXVII. West Europe Basin XXXVIII. Iberia Basin XXXIX. Canaries Basin XL. Cape Verde Basin XLI. Sierra Leone Basin P. Romanche Trench XLII. Guinea Basin XLIII. Angola Basin XLIV. Cape Basin XLV. Agulhas Basin V. Atlantic-Indian Antarctic Basin Q. South Sandwich Trench (8,264 m)