TIDAL DATABASE
ON SEAWATCH INDONESIA PROGRAM

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ABSTRACT

Tide is one of the important parameter in oceanography. SEAWATCH Indonesia as a project that concern in monitoring sea environment needs a complete tidal database to support its operational activities. For this reason, the tidal database was developed to collect all of available tidal data in Indonesia from many sources.

This software was designed very easy and user friendly under windows 95 platform using Visual C++ and called PASUT Version 1.002.

1. Background

Tide is one of the important parameter in oceanography. It is useful if the database of the tidal parameter can be completed in the SEAWATCH Indonesia database. In this activity, the tidal constituents of Indonesian waters are collected from several sources such as DISHIDROS TNI AL, P3O LIPI, Survey Reports, etc. and for analysis, the harmonic analysis with least square method is used. The software for this analysis developed using Visual C++ language and compatible for Windows 95. The software called PASUT Version 1.002.

The purpose of this database is to collect all of the Indonesia tidal data that available to anticipate needs from the users of SEAWATCH Indonesia and also for the internal needs (for survey, research, etc.).

Actually this software can be used for 53 tidal constituents, but because of the general tidal data in Indonesia maximum only have 9 constituents, so in this first version the ability of the software only limited for 9 constituents only.

2. Theory

Tides are shallow water waves, generated by gravitational forces exerted by the moon and sun upon the oceans.

The harmonic method is the most usual and satisfactory method for the prediction of tidal heights. It makes use of the knowledge that the observed tides is the sum of a number of components or partial tides, each of whose periods precisely corresponds with the period of one of the relative astronomical motions between earth, sun and moon. Each of the partial tides has an amplitude and phase which is unique to a given location. In this context, phase means the fraction of tidal cycle that has been completed at a given reference time. It depends upon the period of the tide-raising force concerned, and upon the lag of the partial tide for that particular location. The explanation above can be written as a function below

$$\eta(t) = S_0 + SS_0 + \sum_{i=1}^{N} A_i \cos(\omega_i t - \varphi_i) \qquad (2.1)$$

where :

$\eta(t)$: tidal elevation as a function of time
A_i : amplitude component number - i
ω_i : $2\pi/T_i$, T_i = period of the component number - i
φ_i : phase of the component number -i
S_0 : mean sea level
SS_0 : changes of seasonal mean sea level because of meteorological factor
t : time
N : number of component

Ignoring the parameter affected by meteorological factor, the equation (2.1) can be written as follows :

$$\eta(t) = S_0 + \sum_{i=1}^{K} A_i \cos(\omega_i t_n) + \sum_{i=1}^{K} B_i \cos(\omega_i t_n) \qquad (2.2)$$

where :

A_i dan B_i : the harmonic constituents number - i
K : number of the tidal constituents
t_n : time period (t_n = -n, ..,n; t = 0 is the middle time).

The solution of the equation above can be solved using linear equation system with least square method by computer.

3. The Computer Program Description

3.1. Main Routines Required

The PASUT Version 1.002 consist of some routines as follows :

WINMAIN	the main program which controls all routines program.
INPUT	reads the input file and makes a new input file
EDIT	edits first and last time of prediction and time reference
NDBD_NLY	calculates the long of the time prediction
MIDDAY	calculates the middle day of time prediction
VUF	reads and calculates the nodal informations and corrections
CALMTRX	solve the matrix problem
OUTPUT	print the prediction result to screen and printer

3.2. Data Input

The input file needed by this software should have format as follows :

Header	identification to check the validity of the input file
S_0	mean sea level
Lat-Long	latitude and longitude of the tidal station. (- for West and South)
Tidal Constituents	the value of amplitude and phase of tidal constituents

The units of mean sea level and amplitudes are in cm. and the phase in degree.

The input files can be created using facility in this software or Worpad Editor.

3.3. Output

The outputs of this software consist of four results as follows (on screen and printer) :

1. table of tidal constituents.
2. time series (graphic).
3. time series (table).
4. text file which can be downloaded by Excel.

3.4. Help Files

To help using this software, you can also execute the help files of this software. The help files are made in Indonesia version.

4. Bibliography

Brown, J. et. al, 1989, Waves, Tides and Shallow Water Processes, Butterworth Heinemann in Association with The Open University, Walton Hall, Milton Keynes, MK7 6AA, England, p. 43 - 65.

Foremann, M.G.G and R.F. Henry, 1979, Tidal Analysis Based on High and Low Water Observation, Pacific Marine Science Report 79-15, Institute of Ocean Science, Patricia Bay, Sidney, B.C., 36 p.

----------, 1997, Daftar Pasang Surut Kepulauan Indonesia, Dinas Hidro-Oseanografi TNI AL.

APPENDIX

APPENDIX A

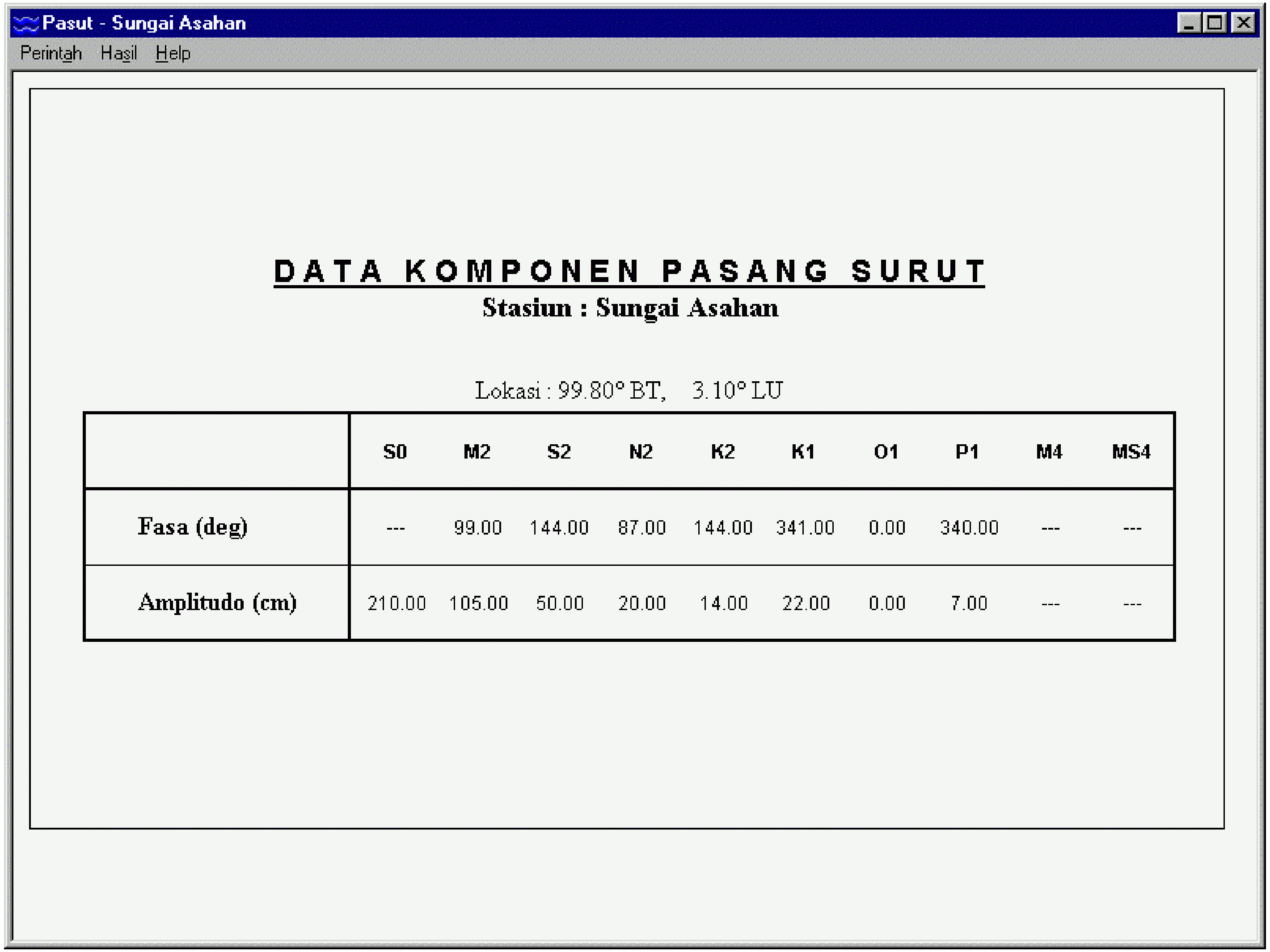
The Input File :

```
[kom]
Jombang
100.000000
-90.000000   80.000000
M2   28.984104200    30.000    80.000
S2   30.000000000    20.000     8.000
N2   28.439729500    20.000    89.000
K2   30.082137300     2.000    90.000
K1   15.041068600     2.000    80.000
O1   13.943035600    20.000    89.000
P1   14.958931400     2.000    98.000
M4   57.96821         2.000     9.000
MS4  58.9841          2.000     8.000
```

APPENDIX B

The Output File :

1. Tidal Constituents.
2. Times Series of Tidal Elevation (Graphics).
3. Table of Tidal Elevation.



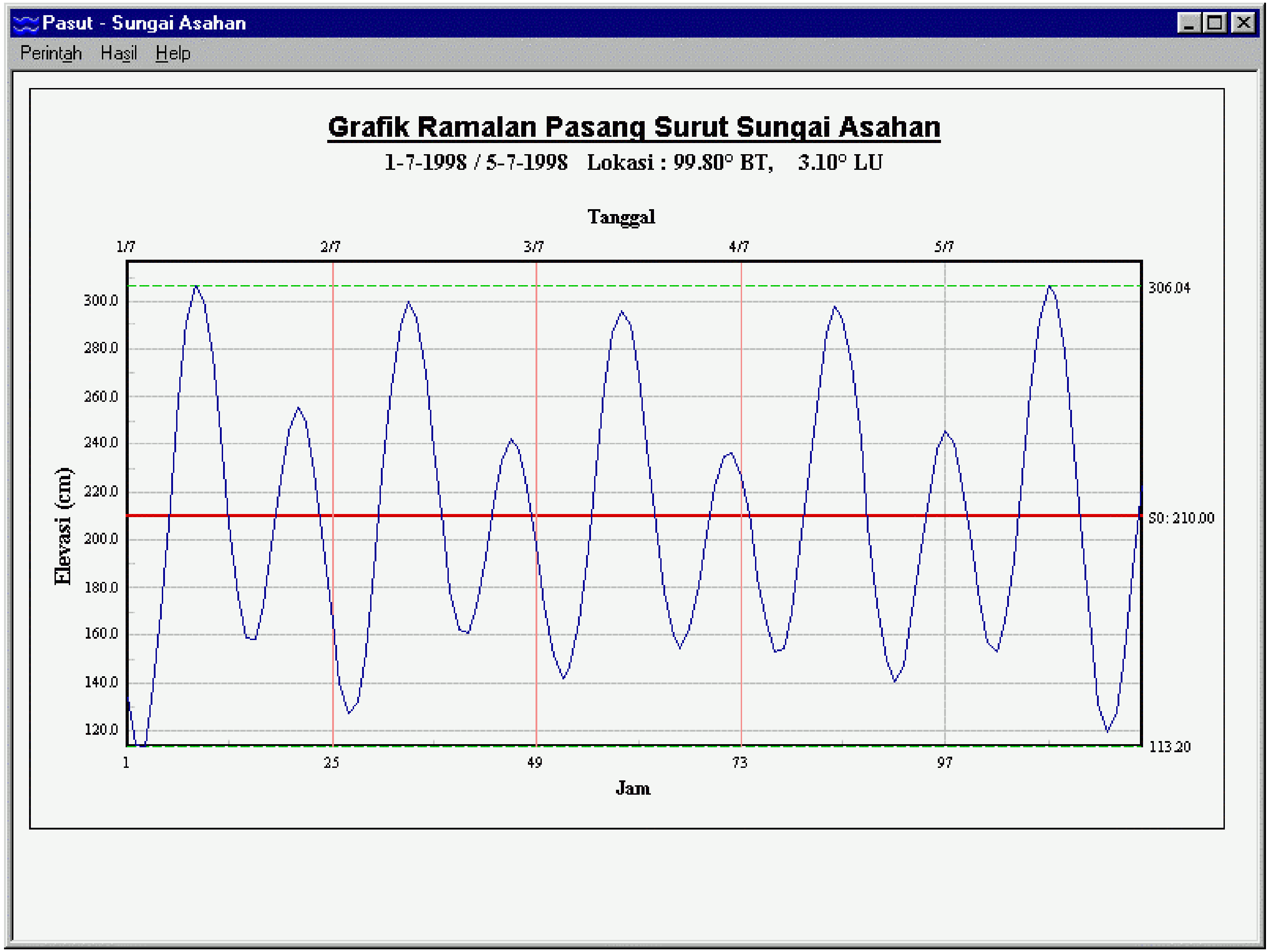
DATA KOMPONEN PASANG SURUT

Stasiun : Sungai Asahan

Lokasi : 99.80° BT, 3.10° LU

	S0	M2	S2	N2	K2	K1	O1	P1	M4	MS4
Fasa (deg)	---	99.00	144.00	87.00	144.00	341.00	0.00	340.00	---	---
Amplitudo (cm)	210.00	105.00	50.00	20.00	14.00	22.00	0.00	7.00	---	---

Appendix B.1. Tidal Constituents as the Input File



Appendix B.2. Time Series of Prediction Result

Pasut - Sungai Asahan

Perintah Hasil Help

TABEL RAMALAN PASANG SURUT

1-7-1998 / 5-7-1998 Stasiun : Sungai Asahan

Lokasi : 99.80° BT, 3.10° LU

TGL	JAM																							
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1 / 7	134.3	113.8	113.2	133.3	169.9	215.0	258.6	291.2	306.0	300.7	277.6	243.2	206.4	176.0	159.0	158.4	173.1	197.8	224.9	246.2	255.2	248.9	228.3	198.1
2 / 7	166.0	140.1	127.5	131.9	153.3	187.3	227.0	263.6	289.6	299.6	292.2	269.9	238.3	205.1	177.8	162.2	160.7	172.3	192.6	215.2	233.5	241.9	237.7	221.8
3 / 7	197.9	172.3	151.7	142.1	146.8	165.9	195.9	230.8	263.4	286.7	296.0	289.4	268.8	238.8	206.2	178.0	159.8	154.8	162.8	180.6	202.7	222.7	235.1	236.4
4 / 7	226.2	207.2	184.5	164.5	153.2	154.5	169.6	196.3	229.3	261.7	286.4	297.8	293.1	273.0	241.7	205.7	172.7	149.5	140.4	146.7	165.6	191.8	218.2	237.9
5 / 7	245.8	240.0	222.5	198.1	173.9	157.2	153.5	165.3	191.2	226.1	262.3	291.3	306.0	302.1	279.7	243.1	200.0	159.7	130.9	119.6	127.6	152.4	187.3	223.2

Appendix B.3. Table of Prediction Result